Easy to build projects for everyone

Everyday ELECTRONICS

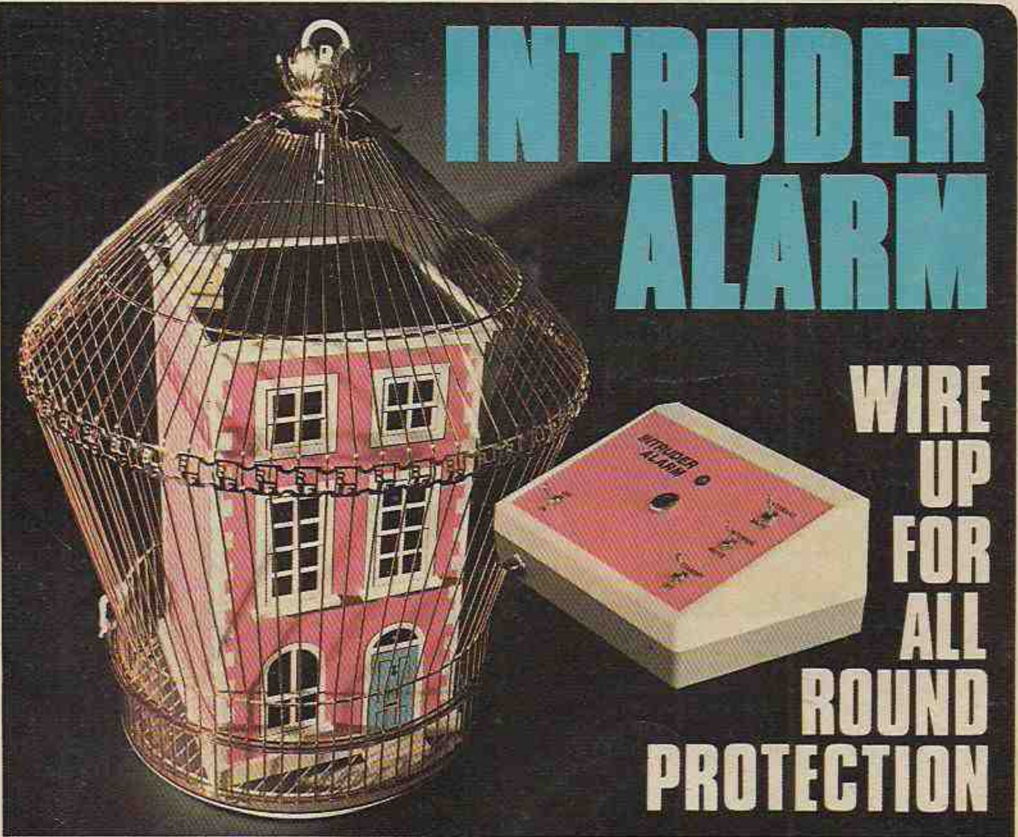
MAY 79
45p

KIOSKS KIOSKS
Mcloud

free
DUAL PURPOSE TOOL

FOR YOUR TOOL KIT

INTRUDER ALARM



WIRE UP FOR ALL ROUND PROTECTION

ELECTRONIC DICE

THERMOSTAT

FOR PHOTOGRAPHIC SOLUTIONS

S.W. CONVERTER

FOR USE WITH M.W. RECEIVERS

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

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

M4

QUARTZ LCD
ALARM 7 Function

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

£18.65

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

£24.65

M6

QUARTZ LCD Alarm Chrono with front alarm

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

£27.65

M7

QUARTZ LCD
Alarm Chrono

Ten 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

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.

£14.95

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.

£ 9.95

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).

£8.65

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

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

M16

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.

Metac
ELECTRONICS
& TIME CENTRES

North & Midlands
67 High Street, DAVENTRY
Northamptonshire
Telephone: 03272 76545

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

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. Send 50p (plus 25p p&p) for our catalogue.

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, 0·018 **9p**; 0·022, 0·033, **11p**; 0·047, 0·068 **14p**; 0·10 **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 **48p**.
DUBILIER: **1000V**: 0·01, 0·015 **20p**; 0·022 **22p**; 0·047 **26p**; 0·1 **38p**; 0·47 **48p**; 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 **12p**; 0-22, 0-33 **13p**; 0-47 **17p**; 0-68 **19p**; 1-0 **24p**; 1-5 **30p**; 2-2 **34p**.

FEED THROUGH CAPACITORS
100μF 350V **8p**

ELECTROLYTIC CAPACITORS: Axial lead type (Values are in SF) **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 **15p**; 63, 100 **27p** 50; 50, 100, 220 **25p**; 470 **32p**; 1000 **50p**; **40V**: 22, 33, **9p**; 100 **12p**; 2200 **68p**; 3300 **62p**; 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 **85p**; 3300, 4700 **70p**; 15,000 **450p**; **25V**: 4700 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, 220 **9p** each
250, 300, 330, 360, 390, 600, 820 **18p** each
1000, 1200, 1800, 2000 **28p** each

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

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

POTENTIOMETERS
(AB or EGEN)
Carbon Track. ¼W Log & ½W Linear values
500 Ω, 1K & 2K (lin only) Single **27p**
5KΩ—2MΩ single gang with D.P. Switch **65p**
5KΩ-2M Ω single gang **27p**
5K Ω-2MΩ dual gang stereo **78p**

SLIDER POTENTIOMETER
0·25W log and linear values 60mm
5K Ω-500K Ω single gang **76p**
10K Ω-500K Ω dual gang **80p**
Self Stick Graduated Bezels **22p**

PRESET POTENTIOMETERS
Vertical & Horizontal
0·1W 50 Ω—5MΩ Miniature **8p**
0·25W 100 Ω—3·3M Ω Horiz **10p**
0·25W 200 Ω—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 10 Ω-1MΩ		6p	4p
1% Metal Film 51 Ω-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
Spare Clips	2
ORP12	60
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"	190
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	Screened chrome	Plastic body	SOCKETS 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' **699p★**

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			
assorted colours	10p	6p single 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 **30p**
ROCKER: (black) on/off 10A 250V **23p**
ROCKER: Illuminated (white)
Lights when on: 3A 240V **52p**
ROTARY: (ADJUSTABLE STOP) 1 pole/ 2-12 way 2p/2-6W 3p/2-4W 4p/2-3W **41p**
ROTARY: Mains 250V AC, 4 Amp **45p**

DIL SOCKETS ★ (Low Profile – Texas)
8 pin **10p**; 14 pin **12p**; 16 pin **13p**; 18 pin **20p**; 20 pin **27p**; 24 pin **30p**; 28 pin **42p**; 40 pin **55p**.

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 **215p***
'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 (copper clad)	0·15 (copper clad)	0·15 (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	18
AA129	20
BA100	12
BY126	14
BY127	14
CRO33*	148
OA9	75
OA47	10
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★	15
3A/400V★	20
3A/600V★	24
3A/1000V★	30
6A/600V	60

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

1A50V	38
1A100V	42
1A200V	47
1A400V	52
1A600V	70
5A100V	32
5A300V	35
5A600V	43
8A300V	48
8A500V	58
8A600V	85
12A300V	59
12A500V	92
BT106	150
C106D	38
TIC44	25
TIC45	45

TRIACS★

3A100V	48
3A200V	49
3A400V	50
8A100V	54
8A400V	64
8A800V	108
12A100V	60
12A400V	70
16A100V	95
16A500V	150
25A800V	295
40659	120

DIAC★
ST2 **25**

TTL 74★

7400	13
7401	13
7402	14
7403	14
7404	14
7405	18
7406	38
7407	38
7408	17
7409	17
7410	15
7411	20
7412	17
7413	30
7414	51
7416	30
7417	30
7420	16
7421	29
7422	24
7423	27
7425	27
7426	36
7427	27
7428	35
7430	17
7432	25
7433	40
7437	30
7438	33
7440	17
7441	74
7442	68
7443	115
7444	112
7445	94
7446	94
7447	82
7448	56
7450	17
7451	17
7453	17
7454	17
7460	17
7470	28
7472	25
7473	32
7474	27
7475	38
7476	38
7480	48
7481	86
7482	69
7483	72
7484	95
7485	106
7486	31
7489	210
7490	33
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	73
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	108
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	80

CMOS★

4000	15
4001	15
4002	16
4006	92
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	335
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	128
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	198
4408	720
4409	720
4410	720
4411	958
4412F	1650
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★	45
733★	125
741C★ 8 pin	18
747C★	78
748C★	36
753	150
810	159
8038CC★	335
AY-1-0212	580
AY-1-1313	660
AY-1-1320	315
AY-1-5050	180
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★	70
CA3081	190
CA3805★	98
CA3089E	210
CA3090AQ	398
CA3123E	200
CA3130★	85
CA3140★	70
ICL7106E★	795
ICL8038	340
ICM7205★	1150
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★	100
M252AA★	750
M253AA★	795
MC1304P	260
MC724★	175
MC1310	149
MC1312P	195
MC1488★	85
MC1489★	90
MC1495★	350
MC1496	92
MC1710	79
MC3401	52
MC3403*	135
MC3340P★	120
MC3360P	120
MFC4000B	85
MFC6040★	97
MK50398★	635
MK50362★	650
MM2102-2★	170
MM2112★	105
MM2112-2N★	210
MM5303*	635
MM57160★	620
NE518A★	210
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★	595
SAD1024*	1450
SFF96364E★	1150
SG3402	295
SN76003N	170
SN76013N	140
SN6023N	140
SN76033N	175
SN76115N	215
SN76227	115
SN76477★	225
TAA621AX1	228
TAA960	300
TBA120S	70
TBA641BX11	250
TBA651	180
TBA800	90
TBA810S	95
TBA820	70
TBA920	260
TCA270	220
TDA1004★	290
TDA1008★	290
TDA1022★	575
TDA2020	320
TL061CP★	76
TL071CP★	76
TL081CP★	48
TL082CP★	96
TL084CP★	130
UAA170	198
ZN414	90
ZN424	130

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AC126★	20
AC127★	20
AC128★	20
AC141★	24
AC141K★	38
AC142★	24
AC142K★	38
AC176★	20
AC187★	20
AC188★	20
ACY17*	35
ACY18★	40
ACY19★	40
ACY20★	40
ACY21*	35
ACY22★	40
ACY28★	40
ACY39	78
ACY40★	48
ACY44	38
AD140★	70
AD149★	70
AD161★	42
AD162★	42
AF114★	40
AF115★	40
AF116★	40
AF117★	40
AF118★	55
AF121★	48
AF124★	55
AF125★	35
AF127★	35
AF139★	35
AF178★	70
AF180★	70
AF186★	50
AF239★	42
ASY26★	40
ASY27★	45
BC107★	9
BC107B★	10
BC108★	9
BC108B★	10
BC108C★	12
BC109★	9
BC109B★	12
BC109C★	12
BC113	20
BC114	20
BC115	20
BC116	20
BC117	20
BC118	20
BC119★	28
BC134	20
BC135	20
BC136	18
BC137	20
BC140★	35
BC142★	30
BC143★	30
BC147	8
BC148	8
BC149	8
BC153	27
BC154	27
BC157	10
BC158	11
BC159	11
BC160	42
BC167A	11
BC168C	12
BC169C	14
BC170	18
BC171	11
BC172	11
BC177★	18
BC178★	16
BC179★	18
BC182	9
BC182L	11
BC183	9
BC183L	11
BC184	9
BC184L	11
BC186	21
BC187★	28
BC212	10
BC212L	11
BC213	11
BC213L	12
BC214	12
BC214L	13
BC307B	20
BC308	13
BC328	15
BC338	12
BC441★	36
BC461★	36
BC477★	25
BC547	12
BC548	12
BC549	13
BC557	15
BC558	20
BCY30★	57
BCY34★	75
BCY39★	80
BCY40★	78
BCY43	85
BCY58★	90
BCY59★	90
BCY70★	15
BCY71★	20
BCY72★	20
BCY78★	25
BD115★	65
BD121★	95
BD123★	98
BD124★	115
BD131★	45
BD132★	45
BD133★	43
BD135★	38
BD136★	37
BD137★	38
BD138★	50
BD139★	40
BD140★	36
BD142★	59
BD145★	198
BD222★	75
BD659A★	65
BD696A★	65
BDY17★	195
BDY60★	110
BDY61★	165
BF115★	34
BF154★	25
BF156★	29
BF167	30
BF173★	25
BF177★	24
BF178★	25
BF179★	30
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BF181★	35
BF182★	35
BF183★	35
BF184★	38
BF194	12
BF195	12
BF196	12
BF197	14
BF198	18
BF200★	32
BF224A	18
BF244	29
BF256★	60
BF257★	30
BF258★	25
BF259★	30
BF394	27
BF594	40
BF595	38
BFR39	25
BFR40	28
BFR79	28
BFR80	28
BFX29★	28
BFX81★	45
BFX84★	26
BFX85★	28
BFX86★	28
BFX87★	28
BFX88★	28
BFY18★	50
BFY50★	20
BFY51★	20
BFY52★	20
BFY71★	20
BSX20★	18
BSY65★	30
BSY95★	25
BSY95A★	18
BU105	140
BU205★	190
BU208★	225
E5567	65
MD8001★	158
ME4102	10
ME6002	10
MJ400★	90
MJ491	160
MJ2955★	120
MJE340★	54
MJE370★	58
MJE371★	60
MJE520★	65
MJE521★	74
MJE2955★	99
MJE3055★	70
MPF102	44
MPF103	36
MPF104	36
MPF105	36
MPF106	36
MPF107	50
MPSA05★	25
MPSA06★	25
MPSA12	42
MPSA55	25
MPSA56	25
MPSA70	34
MPSU02★	58
MPSU05	50
MPSU06	56
MPSU52★	65
MPSU55★	55
MPSU56★	60
MPU131★	39
OC25★	170
OC26★	170
OC28★	150
OC29★	160
OC35★	130
OC36★	130
OC41★	75
OC42★	48
OC43★	55
OC44★	31
OC45★	28
OC46★	28
OC70★	28
OC71★	28
OC72★	30
OC76★	36
OC77★	66
OC79★	76
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OC82★	50
OC83★	48
OC84★	44
OC122★	75
OC123★	75
OC139★	110
OC140★	110
OC141★	110
OC170★	40
OC171★	40
OC201★	75
OC202★	95
OC203★	85
OC204★	85
TIP29	43
TIP29A	44
TIP29C	60
TIP30	47
TIP30A	50
TIP30B	64
TIP30C	65
TIP31★	50
TIP31A★	52
TIP31B★	58
TIP31C★	66
TIP32★	55
TIP32A★	58
TIP32B★	70
TIP32C★	75
TIP33★	80
TIP33A★	85
TIP33B★	100
TIP33C★	110
TIP34★	85
TIP34A★	85
TIP34B★	110
TIP34C★	110
TIP35★	179
TIP35A★	185
TIP35C★	220
TIP36A★	280
TIP36C★	325
TIP41A★	66
TIP41B★	73
TIP42A★	72
TIP42B★	82
TIP2955★	65
TIP3055★	52
TIS43	34
TIS44	45
TIS46	45
TIS50	47
TIS60	45
TIS62	52
TIS74	47
TIS90	20
TIS91	24
ZTX107	12
ZTX108	12
ZTX109	14
ZTX300	15
ZTX301	15
ZTX302	20
ZTX303	25
ZTX304	24
ZTX311	17
ZTX314	24
ZTX326	30
ZTX341	20
ZTX500	15
ZTX501	15
ZTX502	19
ZTX503	15
ZTX504	25
ZTX531	25
ZTX550	25
2N526★	58
2N696★	36
2N697★	25
2N698★	44
2N699★	44
2N706A★	19
2N707★	39
2N708★	19
2N914★	32
2N916★	27
2N918★	40
2N920★	51
2N930★	18
2N961★	61
2N1131★	22
2N1132★	22
2N1302★	35
2N1303★	50
2N1304★	50
2N1305★	28
2N1306★	35
2N1307★	50
2N1308★	46
2N1613★	23
2N1671★	190
2N1671B★	215
2N1893★	28
2N1986★	60
2N2160★	350
2N2217★	43
2N2218A★	34
2N2219A★	22
2N2220A★	23
2N2221★	23
2N2222★	20
2N2297	45
2N2303★	45
2N2368★	21
2N2369★	15
2N2476★	125
2N2483★	28
2N2484★	25
2N2646★	48
2N2784★	55
2N2846★	140
2N2894★	30
2N2904A★	22
2N2905A★	22
2N2906★	22
2N2907★	20
2N2907A★	22
2N2926G	10
2N2960	8
2N2926R	8
2N2926Y	8
2N3011★	24
2N3053★	20
2N3054★	55
2N3055★	48
2N3108	32
2N3121	40
2N3133	43
2N3135	33
2N3250	30
2N3252	38
2N3302	30
2N3442★	140
2N3563	20
2N3614★	169
2N3615★	135
2N3663	26
2N3702	11
2N3703	11
2N3704	11
2N3705	11
2N3706	11
2N3707	11
2N3708	11
2N3709	11
2N3710	16
2N3711	12
2N3715★	250
2N3772★	195
2N3773★	288
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2N3820	45
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2N3824★	70
2N3866★	90
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2N3904	18
2N3905	18
2N3906	17
2N4037★	52
2N4058	17
2N4061	17
2N4064★	120
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2N4289	20
2N4859	65
2N5135	42
2N5136	42
2N5138	20
2N5179★	60
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2N5191★	70
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2N5457	32
2N5458	32
2N5459	32
2N5485	35
2N5777★	45
2N6027	40
40311★	60
40313★	125
40316★	86
40317★	52
40324*	85
40326★	52
40327★	62
40348★	105
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40361★	45
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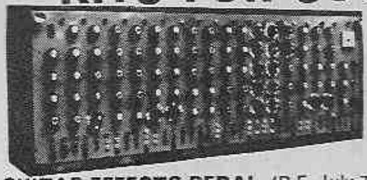

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Alternative component set with panel switches	£5·05
Printed circuit board	£1·43

GUITAR FREQUENCY DOUBLER
(P.E. Aug. 77)
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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.

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Printed circuit board	£1·62

GUITAR SUSTAIN (P.E. Oct. 77)
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VOICE OPERATED FADER (P.E. Dec. 73)
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A simple but effective manually controlled unit for introducing the phasing sound into live or recorded music.

Component set (incl. PCB)	£3·20

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For use with the above Phasing Unit to automatically control the rate of phasing.

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Based upon P.E. Sound Design circuit

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Gives a much shriller quality to audio signals fed through it. The depth of boost is manually adjustable.

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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	£7·67
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.

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Component set (incl. PCB)	£4·58

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

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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.

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Value	Price
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·015	0·07
·022	0·10
·033	0·10
·047	0·10
·068	0·10
·1	0·12

100V—100mm

·22	0·16
·33	0·22
·68	0·31
1·00	0·41

400—7mm

·001	0·07
·0015	0·07
·0022	0·07
·0033	0·07
·0047	0·07
·0068	0·07

400V—100mm

·022	0·07
·033	0·07
·047	0·08

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Value	Price
·001	0·08
·0015	0·08
·0022	0·08
·0033	0·08
·033	0·10
·047	0·10
·068	0·11
·1	0·14
·15	0·16
·22	0·18

100V—7mm

·18	0·18
·22	0·18
·27	0·23
·33	0·23
·39	0·30
·47	0·30
·56	0·36
·68	0·36

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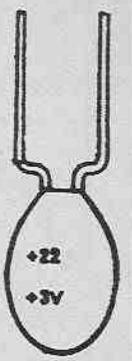
0·15						0·17
0·22						0·17
0·33						0·17
0·47						0·17
0·68						0·17
1·0						0·17
1·5						0·17
2·2				0·17		0·17
3·3					0·25	0·21
4·7				0·17		0·21
6·8					0·21	0·23
10		0·17		0·21		0·23
15		0·21	0·21	0·23	0·23	0·35
22		0·21		0·23		0·35
33			0·23			
47	0·21	0·23				0·75
68					0·75	
100	0·23			0·65		
150				0·91		
220				1·10		
330			1·10			
470		1·10				



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2 MHz	HC33/μ	2·00
2·097152 MHz	HC33/μ	
3·2766 MHz	HC25/μ	2·95
4 MHz	HC25/μ	2·95
4·194394 MHz	HC25/μ	2·95
4·433619 MHz	HC33/μ	1·10
5·00 MHz	HC25/μ	
8·00 MHz	HC25/μ	
10 MHz	HC25/μ	2·95
10·7 MHz	HC6/μ	2·95
18 MHz	HC25/μ	3·15
20 MHz	HC25/μ	3·15
48 MHz	HC25/μ	2·95
100 MHz	HC25/μ	3·95

Sockets	Price
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HC13/μ	0·15
HC25/μ	0·10

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100mA	TO92	0·30
500mA	TO202	0·56
1A	TO3	1·95
1A	TO220	0·88
1A	TO3	1·56
3A	TO3	5·75
5V NEGATIVE		
500mA	TO202	1·15
1A	TO220	1·86
3A	TO3	6·97

12V POSITIVE		Price
100mA	TO5	0·30
100mA	TO92	0·85
500mA	TO202	0·56
1A	TO220	0·88
1A	TO3	1·56
12V NEGATIVE		
500mA	TO202	1·15
1A	TO220	1·86
15V POSITIVE		
100mA	TO5	0·85
100mA	TO92	0·30

(See catalogue for full range)

PUNCHES from 'Q-MAX'

Easiest and quickest way of punching holes in sheet metal (up to 1·625mm mild steel).

Speciall designed to allow for a **continuous even load** during punching. A virtually **burr free hole** is produced. No jagged edges.

PUNCHES		**KEYS**	
3/8" (KEY T)	1·35	KEY T	0·16
1/2" (KEY A)	1·52	KEY A	0·20
5/8" (KEY A)	1·73		
3/4" (KEY A)	1·78		

CMOS (see catalogue for full range)

74C175N	0·90
74C192N	1·11
74C193N	1·11
74C195N	1·04
74C200N	6·70
74C221N	1·36
74C373N	1·87
74C374N	1·87
74C901N	0·54
74C902N	0·54
74C903N	0·54
74C904N	0·54
74C905N	7·28
74C906N	0·54
74C907N	0·54
74C908N	0·96
74C909N	1·63
74C910N	6·79
74C911N	7·70
74C112N	7·70
74C914N	1·41
74C915N	1·11
74C918N	1·15
74C922N	3·90
74C923N	3·74
74C925N	5·22
74C926N	5·22
74C927N	5·22
74C928N	5·22
74C932N	1·56
CD4099B	1·60
CD4503	0·58
CD4507	0·69
CD4510B	1·20
CD4511	1·75
CD4512	0·99
CD4514	2·54
CD4515	2·54
CD4516	1·20
CD4518B	1·20
CD4519	0·64
CD4520B	1·20
CD4522	1·19
CD4526	1·19
CD4527	1·20
CD4528	1·26
CD4529	1·41
CD4543	1·96
CD4723	1·60
CD4724	1·60

LINEAR (See catalogue for full list)

CA3000	3·30
CA3001	4·25
CA3002	3·30
CA3006	4·60
CA3007	4·15
CA3008	2·55
CA3012	1·65
CA3013	1·85
CA3014	2·20
CA3018	0·75
CA3018A	1·10
CA3020	2·20
CA3020A	2·50
CA3021	2·40
CA3022	2·20
CA3023	2·20
CA3026	0·70
CA3028A	0·90
CA3028B	1·25
CA3029	0·75
CA3029A	0·90
CA3030	1·50
CA3030A	2·20
CA3033	3·70
CA3034	2·75
CA3035	1·95
CA3036	1·21
CA3038	2·90
CA3038A	4·10
CA3039	0·77
CA3040	3·75
CA3041	1·65
CA3042	1·65
CA3043	2·20
CA3045	1·55
CA3046	0·77
CA3047	2·20
CA3047A	3·70
CA3048	2·45
CA3049	1·98
CA3050	2·66
CA3051	1·83
CA3052	1·78
CA3053	0·77
CA3054	1·10
CA3059	2·10
CA3060	2·50
CA3062	3·75
CA3064	1·10
CA3065	1·10
CA3068	3·80
CA3070	1·90
CA3071	1·90
CA3072	1·90
CA3075	1·70
CA3076	2·12
CA3080	0·85
CA3080A	2·10
CA3086	0·50
CA3088F	1·87
CA3089E	2·90
CA3090Q	4·40
CA3130	1·06
CA3140	1·04
TAA263	1·35
TAA300	3·70
TAA521	1·10
TAA522	1·65
TAA550	0·48
TAA611B	2·30
TAA621	2·50
TAA661A	1·65
TAA661B	1·45
TAA790	1·65
TAA700	3·50
TAA930A	1·45
TAA930B	1·45
TBA120	0·80
TBA331	0·90
TBA341	0·95
TBA395	1·80
TBA396	1·20
TBA400	2·20
TBA440	1·80
TBA510	1·76
TBA520	2·60
TBA520Q	2·70
TBA530	2·35
TBA530Q	2·45
TBA540	2·60
TBA540Q	2·70
TBA550	3·60
TBA550Q	3·80
TBA560C	2·95
TBA560Q	3·00
TBA570	2·10
TBA570Q	2·20
TBA641B	3·00
TBA651	2·50
TBA673	3·20
TBA700	2·20
TBA750	2·35
TBA750Q	2·45
TBA790A	1·75
TBA800	1·30
TBA810S	1·30
TBA820	0·80
TBA920	2·99
TBA920Q	3·09
TBA990	2·75
TBA990Q	3·00
TCA105	1·49
TCA150	1·80
TCA160C	2·66
TCA220	2·10
TCA270S	2·99
TCA440	1·65
TCA640	3·45
TCA650	3·45
TCA660B	3·45
TCA730	3·80
TCA740	3·80
TCA750	2·60
TCA800	3·75
TCA800Q	3·95
TCA830S	1·80
TCA900	1·05
TCA910	1·20
TCA940	1·90
TCA980	3·19
TDA1002	2·10
TDA1004A	3·33
TDA1005	3·58
TDA1022	7·50
TDA1024	1·24
TDA1034	4·75
TDA2020AD	4·50

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SAA 5010 Station selector/DICS	8·13
SAA 5012 Binary Input Tuners	P.O.A.

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SAA 5030 VIP (Video Input Processor)	11·61
SAA 5040 TAC (Teletext Data Acquisition and Control)	31·82
SAA 5050 TROM (Teletext Read—only Memory)	18·86

TIC, TAC & TROM are NMOS—VIP is linear bipolar. We recommend using DIL sockets with these chips

TTL (see catalogue for full list)

SN74H05N	0·60
SN74H10N	0·55
SN74H11N	0·55
SN74H20N	0·55
SN74H21N	0·55
SN74H30N	0·55
SN75H40N	0·55
SN74H51N	0·55
SN74H53N	0·55
SN74H54N	0·55
SN74H55N	0·55
SN74H60N	0·55
SN74H62N	0·55
SN74L00N	0·55
SN74L02N	0·55
SN74L04N	0·60
SN74L47N	3·10
SN74L74N	0·90
SN74L85N	2·62
SN74L93N	2·30
74LS00N	0·26
74LS01N	0·26
74LS02N	0·26
74LS03N	0·26
74LS04N	0·29
74LS05N	0·29
74LS08N	0·26
74LS09N	0·26
74LS10N	0·26
74LS11N	0·26
74LS12N	0·26
74LS13N	0·58
74LS14N	0·75
74LS15N	0·26
74LS20N	0·26
74LS21N	0·26
74LS22N	0·26
74LS26N	0·32
74LS27N	0·26
74LS28N	0·29
74LS30N	0·26
74LS32N	0·27
74LS33N	0·29
74LS37N	0·32
74LS38N	0·32
74LS40N	0·26
74LS42N	0·80
74LS47N	1·09
74LS48N	1·00
74LS49N	1·09
74LS51N	0·26
74LS54N	0·26
74LS55N	0·26
74LS63N	1·26
74LS73N	0·42
74LS74N	0·42
74LS75N	0·58
74LS76N	0·42
74LS78N	0·42
74LS583AN	0·90
74LS85N	0·95
74LS86N	0·44
74LS90N	0·64
74LS91N	1·20
74LS92N	0·70
74LS93N	0·64
74LS95AN	0·90
74LS56N	1·35
74LS107N	0·42
74LS109N	0·42
74LS112N	0·42
74LS113N	0·42
74LS114N	0·42
74LS122N	0·62
74LS123N	0·83
74LS124N	1·70
74LS125N	0·50
74LS126N	0·50
74LS132N	0·85
74LS136N	0·42
74LS138N	0·65
74LS139N	0·65
74LS145N	1·30
74LS147N	1·65
74LS148N	1·35
74LS151N	0·58
74LS153N	0·58
74LS154N	1·45
74LS155N	0·80
74LS156N	0·80
74LS157N	0·60
74LS158N	0·65
74LS160N	0·80
74LS161N	0·85
74LS162N	0·80
74LS163N	0·85
74LS164N	1·10
74LS165N	1·15
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74LS194N	0·70
74LS195N	0·70
74LS196N	0·80
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74LS221N	0·80
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74LS242N	1·25
74LS243N	1·25
74LS244N	1·50
74LS245N	1·65
74LS247N	1·09
74LS248N	1·09
74LS249N	1·09
74LS251N	1·00
74LS253N	1·00
74LS257N	1·00
74LS258N	1·00
74LS259N	1·55
74LS261N	3·25
74LS266N	0·44
74LS273N	1·30
74LS275N	3·20
74LS279N	0·58
74LS280N	1·65
74LS283N	1·20
74LS289N	3·74
74LS290N	1·00
74LS293N	1·00
74LS295N	1·35
74LS298N	1·35
74LS299N	2·95
74LS323N	3·50
74LS324N	1·65
74LS325N	2·40
74LS326N	2·70
74LS327N	2·55
74LS348N	1·10
74LS352N	1·07
74LS353N	1·07
74LS365N	0·55
74LS366N	0·55
74LS367N	0·55
74LS368N	0·55
74LS373N	0·85
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74LS386N	0·44
74LS390N	0·90
74LS393N	0·90
74LS395N	1·50
74LS398N	1·90
74LS399N	1·45
74LS490N	0·90
74LS670N	1·90
SN74S00N	0·77
SN74S03N	0·77
SN74S04N	0·94
SN74S10N	0·77
SN74S20N	0·77
SN74S40N	0·77
SN74S64N	0·77

TRANSISTORS (See catalogue for full range)

2N3738	1·35
2N3740	2·10
2N3741	2·20
2N3766	1·50
2N3771	2·15
2N3772	2·20
2N3773	3·15
2N3789	1·95
2N3790	2·05
2N3791	2·25
2N3792	2·40
2N3794	·21
2N3819	·36
2N3820	·39
2N3821	·95
2N3822	·85
2N3823	·85
2N3824	·80
2N3826	1·70
2N3827	·27
2N3831	2·30
2N3854A	·30
2N3855	·30
2N3855A	·30
2N3856A	·30
2N3858	·22
2N3858A	·22
2N3859	·22
2N3859A	·22
2N3860	·20
2N3866	1·98
2N3877	·28
2N3877A	·30
2N3879	2·20
2N3900	·28
2N3901	·30
2N3902	7·00
2N3903	·20
2N3904	·18
2N3905	·18
2N3906	·18
2N3945	·60
2N3962	·95
2N3993	3·65
2N4030	·53
2N4031	·55
2N4032	·65
2N4033	·65
2N4036	·72
2N4037	·60
2N4058	·22
2N4059	·17
2N4060	·22
2N4061	·19
2N4062	·20
2N4064	1·35
2N4074	2·65
2N4091	1·35
2N4092	·82
2N4093	1·10
2N4121	·27
2N4122	·27
2N4123	·19
2N4124	·19
2N4125	·19
2N4126	·19
2N4220	·87
2N4221	·80
2N4222	·78
2N4223	·78
2N4224	·78
2N4234	1·35
2N4235	1·65
2N4236	1·65
2N4237	·99
2N4238	1·28
2N4239	1·55
2N4240	1·70
2N4248	·22
2N4249	·20
2N4250	·28
2N4254	·83
2N4258	·50
2N4266	·22
2N4264	·27
2N4275	·33
2N4284	·38
2N4286	·22
2N4287	·22
2N4288	·22
2N4289	·22
2N4290	·22
2N4291	·22
2N4292	·27
2N4294	·22
2N4297	·33
2N4302	·31
2N4303	·33
2N4304	·28
2N4313	·60
2N4342	·50
2N4343	·77
2N4347	2·20
2N4348	2·65
2N4360	·36
2N4390	·45
2N4400	·16
2N4401	·20
2N4402	·20
2N4403	·20
2N4409	·20
2N4410	·20
2N4416	·88
2N4440	8·50
3N81	3·50
3N83	2·25
3N128	1·35
3N139	1·60
3N140	1·10
3N141	·95
3N142	·70
3N143	·88
3N152	1·10
3N153	1·89
3N154	·99
3N159	1·35
3N187	1·80
3N200	2·85
3N201	1·35
40050	1·70
40081	1·20
40232	·60
40233	·70
40235	·65
40237	·45
40242	·66
40251	1·15
40254	·66
40264	·95
40280	3·70
40309	·60
40310	·85
40311	·55
40312	·99
40313	1·38
40315	·60
40316	·95
40317	·60
40324	·95
40325	1·35
40326	·60
40327	·73
40348	1·10
40349	1·45
40360	·55
40361	·55
40362	·55
40363	1·45
40364	1·45
40372	1·15
40373	1·65
40374	1·65
40389	·70
40390	1·05
40391	·90
40392	·70
40394	·90
40395	1·45
40396	1·45
40406	·73
40407	·57
40408	·82
40409	·82
40410	·82
40411	3·10
40412	·68
40414	4·99
40422	2·20
40440	·70
40467A	1·05
4068A	·70
40513	1·60
40514	1·60
AC128	·48
AC151	·43
AC152	·54
AC153	·59
AC153K	·59
AC176K	·70
AC176	·54
AC187	·59
AC187K	·65
AC188	·54
AC188K	·65
AD135	2·75
AD142	1·45
AD143	1·45
AD149	2·85
AD150	3·10
AD161	1·00
AD162	1·00
AF106	·60
AF109	·82
AF114	·70
AF115	·70
AF116	·70
AF117	·70
AF118	·70
AF124	·70
AF125	·70
AF126	·70
AF139	·75
AF172	·70
AF178	1·30
AF186	·55
AF200	1·30
BC107/A/B	·16
BC108/A/B/C	·16
BC109/B/C	·16
BC113	·22
BC114	·22
BC115	·22
BC116	·21
BC116A	·22
BC117	·22
BC118	·22
BC119	·33
BC122	·61
BC123	·65
BC125	·22
BC132	·33
BC134	·22
BC135	·22
BC136	·21
BC137	·22
BC138	·44
BC140	·30
BC141	·32
BC142	·32
BC143	·32
BC147/A/B/C/	·13
BC148/A/B/C	·13
BC149/B/C	·15
BC152	·38
BC153	·30
BC154	·30
BC157/A/B	·15
BC158/A/B	·15
BC159/A/B/C	·17
BC160	·38
BC161	·38
BC167/A/B	·13
BF115	·39
BF119	1·10
BF121	·60
BF123	·60
BF134	·60
BF137	·60
BF152	·27
BF153	·27
BF154	·27
BF157	·48
BF159	·37
BF160	·33
BF161	·65
BF166	·44
BF167	·37
BF170	·76
BF173	·37
BF177	·27
FB178	·27
BF179	·33
BF180	·37
BF181	·37
BF182	·37
BF183	·44
BF184	·41
BF185	·37
BF194	·16
BF195	·16
BF196	·16
BF197	·18
BF198	·19
BF199	·19
BF200	·38
BF224J	·22
BF225J	·27
BF238	·55
TIP29A	·49
TIP29C	·65
TIP30A	·54
TIP30C	·70
TIP31A	·54
TIP31C	·72
TIP32A	·59
TIP32C	·82
TIP33A	·86
TIP33C	1·18
TIP34A	·97
TIP34C	1·31
TIP35A	2·20
TIP36A	3·00
TIP41A	·76
TIP41C	·97
TIP42A	·86
TIP42C	1·08
TIP50	·82
TIP54	1·83
TIP110	·77
TIP112	·93
TIP115	·83
TIP117	·99
TIP120	·87
TIP122	1·04
TIP125	·93
TIP127	1·11
TIP130	1·16
TIP132	1·33
TIP135	1·26

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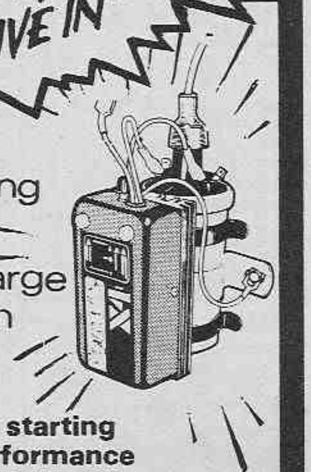

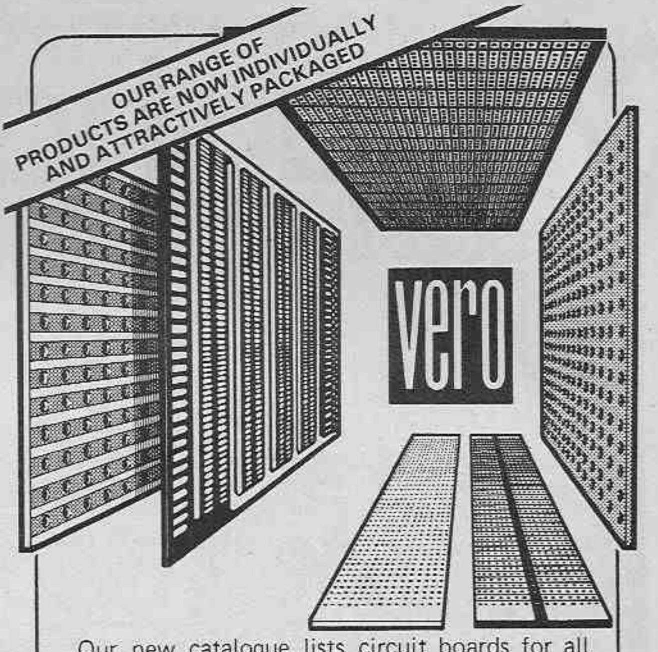
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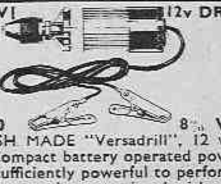

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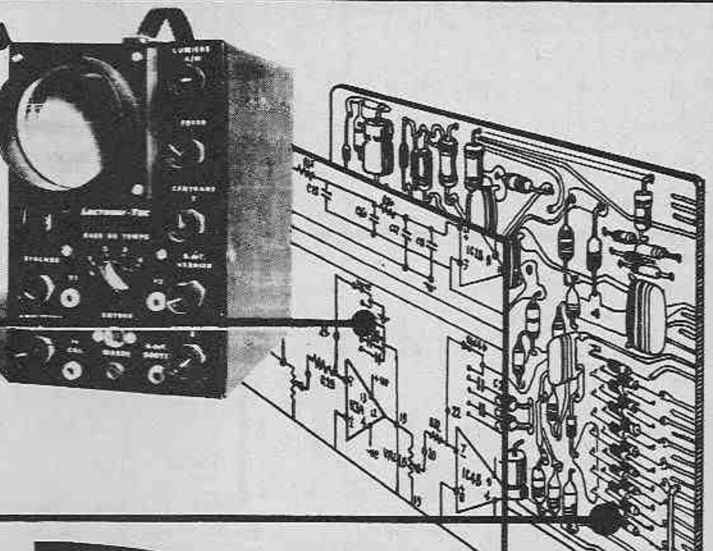

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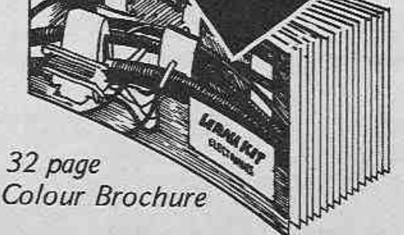

32 page Colour Brochure

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BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL
P.O. Box 156, Jersey, Channel Islands.

NAME ______________________________

ADDRESS ___________________________

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EEB5/79

___________________________ Block caps please

GMT
ELECTRONICS

(A DIVISION OF GOTHIC ELECTRONIC COMPONENTS LTD)

PO Box 290
8 Hampton Street
Birmingham B19 3JR

TELEPHONE:
021·233·2400

CALLERS BY APPOINTMENT

ALL PRICES IN PENCE EACH UNLESS OTHERWISE STATED

CAPACITORS

Electrolytic Axial Leads

−10% to +50% Tol

Order Code
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			

Tantalum Bead

±20% Tol.

Order Code
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	
27	11	14		16		
33		15	16	20		
47		16	20			
68	16	20				
100	20					

Electrolytic Can Type

High Ripple, IEC Grade 1, Low E.S.R.
Supplied complete with Vertical Fixing Clip

Order Code
Cap HR + µF + Volts

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	387
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

Electrolytic Radial Leads

−10% to +50% Tol.

Order Code
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							

Miniature Low Value

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

Order Code + Value

pF	424	632	630	629
1				
1.2				
1.5				
1.8		5		
2.2		5		
2.7		5		
3.3		5		
3.9		5		
4.7		5		
5.6		5		
6.8		5		
8.2		5		
10		5		
12		5		
15		5		
18		5		
22		5		
27		5		
33		5		
39		5		
47		5		
56		6		
68		6		
82		6		

pF	424	632	630	629
100	16	6		
120	18	8		
150	16	6		
180	16	6		
220	16	6		
270	18	8		
330	18	8		
390	18		5	
470	18		5	
560	16		5	
680	16		5	
820	18		5	
1000	16		5	5
1200	16		5	
1500	18		6	
1800	16		6	
2200	18		6	6
2700	18		6	
3300	18		6	
3900	18		6	
4700	23		7	6
5600	23			
6800	23			
8200	23			

nF	424	632	630	629
10	25			6
12	26			
15	26			
18	27			
22	28			8
27	38			
33	41			
39	43			

Polyester Radial Leads

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

Order Code + Value

µF	352	360	PHE280
.001		5	6
.0015		5	6
.0022	5	6	7
.0033	5	6	7
.0047	5	6	7
.0068	5	6	7
.01	5	6	7
.015	5	7	8
.022	5	7	8
.033	5	7	8
.047	5	7	8
.068	6	8	9

µF	352	360	PHE280
.1	6	8	9
.15	7	9	
.22	8	10	
.33	10		
.47	12		
.68	15		
1.0	19		
1.5	27		
2.2	32		

Trimmers

250V D.C. Wkg. Film Dielectric, Miniature

		Order Code
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

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

		Order Code
.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

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 D167.5 H 68.5 (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 BIM4006 OR

Diecast Boxes — Boss Industrial Mouldings

Diecast Box and Flanged Lid
Aluminium Box and Lid in Natural Finish

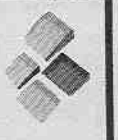
		Orrler Code
L113 W63 D31	104	Case BIM5003 NA
L152 W82 D50	181	Case BIM5005 NA
L192 W113 D61	280	Case BIM5006 NA

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)	191/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	VERD 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 D250 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

Carbon Film, Fixed

				Order Code
0.25W, E24 Values 1R0-10M, 5% Tol.	1.5 ea.	90p/100 (Mult 10/Value)	£7.90/1000 (Mult 100/Value)	Res RD¼
0.5W, E12 Values 1R0-4M7, 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, 5R1-1M, 2% Tol.	8 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, 1M-33M, 5% Tol.	10 ea.	5.40/100 (Mult 10/Value)		Res VR37 + Value

Skeleton Presets, Miniature

		Order Code
0.1W, E3 Values, 100R-1M, Lin. Vertical Mounting	7	Min Preset V
0.1W, E3 Values, 100R-1M, 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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DIGITAL INTEGRATED CIRCUITS

4000 Buffered C-MOS – High Speed

5–15V 'B' Series, Up to 20MHz

HEF4000	14
HEF4001	14
HEF4002	14
HEF4006	95
HEF4007	14
HEF4008	80
HEF4011	14
HEF4012	14
HEF4013	37
HEF4014	84
HEF4015	60
HEF4016	35
HEF4017	55
HEF4018	65
HEF4019	46
HEF4020	88
HEF4021	85
HEF4022	82
HEF4023	14
HEF4024	45
HEF4025	14
HEF4027	32
HEF4028	52
HEF4029	60
HEF4030	46
HEF4031	200
HEF4035	110
HEF4040	66
HEF4041	75
HEF4042	54
HEF4043	79
HEF4044	84
HEF4046	100
HEF4047	87
HEF4049	28
HEF4050	28
HEF4051	60
HEF4052	72
HEF4053	72
HEF4066	37
HEF4067	380
HEF4068	14
HEF4069	14
HEF4070	14
HEF4071	14
HEF4072	16
HEF4073	16
HEF4075	16
HEF4076	85
HEF4077	14
HEF4078	16
HEF4081	16
HEF4082	16
HEF4085	64
HEF4086	64
HEF4093	50
HEF4094	175
HEF4104	166
HEF4502	91
HEF4505	571
HEF4508	151
HEF4510	70
HEF4511	110
HEF4512	98
HEF4514	250
HEF4515	299
HEF4516	90
HEF4517	382
HEF4518	69
HEF4519	55
HEF4520	65
HEF4521	188
HEF4528	99
HEF4532	120
HEF4534	510
HEF4539	110
HEF4543	155
HEF4555	78
HEF4556	78
HEF4557	386
HEF4585	97
HEF4724	171
HEF40097	90
HEF40098	73
HEF40106	62
HEF40160	119
HEF40161	119
HEF40162	119
HEF40163	119
HEF40174	119
HEF40175	119
HEF40192	140
HEF40193	140
HEF40194	119
HEF40195	117

7400 T.T.L.

N7400N	9
N7401N	11
N7402N	11
N7403N	11
N7404N	12
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N74365N	150
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N74367N	120
N74368N	150

74LS

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N74LS196N	80
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N74LS243N	160
N74LS244N	160
N74LS251N	90
N74LS253N	105
N74LS257N	104
N74LS258N	107
N74LS260N	26
N74LS261N	300
N74LS266N	40
N74LS273N	130
N74LS283N	116
N74LS290N	90
N74LS293N	100
N74LS298N	100
N74LS324N	170
N74LS365N	105
N74LS366N	105
N74LS367N	105
N74LS368N	105
N74LS373N	150
N74LS374N	150
N74LS375N	100
N74LS378N	160
N74LS386N	35
N74LS390N	170
N74LS393N	170
N74LS395N	160
N74LS490N	130
N74LS670N	170

LINEAR INTEGRATED CIRCUITS

CA3011	92
CA3018	75
CA3020	191
CA3028A	86
CA3046	76
CA3048	245
CA3080E	70
CA3089E	253
CA3130E	90
CA3140E	38
CA3189E	266
LM301AN	30
LM308N	95
LM318N	200
LM319N	216
LM324N	70
LM339N	71
LM381N	110
LM381AN	180
LM382	120
MC1458N	35
MC1496N	97
NE531	119
NE536T	216
NE540	225
NE555N	25
NE556N	60
NE560N	351
NE561N	427
NE562N	461
NE565N	120
NE566N	155
NE567N	170
NE570N	405
NE571N	459
NE592K	162
RC4136	130
TBA120S	79
TCA580	346
TCA730	450
TCA740	450
TDA1008	326
TDA1022	648
TDA1028	338
TDA1029	338
TDA1034B	217
TDA2581	266
TDA2640	292
TL081CP	75
TL084CN	140
UA709CT	46
UA709CN	40
UA710CN	41
UA711CN	65
UA741CT	42
UA741CN	18
UA747CN	50
UA748CN	35

Voltage Regulators

LM309DA (K)	106
UA723CN	38
UA7805CU	65
UA7812CU	65
UA7815CU	65
UA7905CU	86
UA7912CU	86
UA7915CU	86
UA78L05CS	32
UA78L06CS	32
UA78L12CS	32
UA78L15CS	32

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. Anoda 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 8A1061
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
IN914	4
IN916	5
IN4001	4
IN4002	4
IN4003	6
IN4004	6
IN4005	7
IN4006	7
IN4007	8
IN4148	3
IN5402	15
IN5404	16
BAX13	5
BAY38	27
BB106(4)	122
BB110G	61
BY127	15
BY206	34
BYX10	19
OA47	10
OA90	7
OA91	7
OA200	9
OA202	9

Microwave

BAW95D	1091
CL8960	2592
CXY11C	1280

Zener Diodes

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

Transistors

2N929	37
2N1893	30
2N2218A	28
2N2222	21
2N2369	19
2N2369A	20
2N2646	42
2N2894	49
2N2895	28
2N2904	24
2N2904A	24
2N2905	22
2N2905A	24
2N2906	19
2N2907	22
2N2907A	25
2N2919	330
2N2926G	11
2N3053	17
2N3054	50
2N3055	50
2N3055 Full ISB Test	88
2N3340	30
2N3442	141
2N3702	8
2N3703	11
2N3704	8
2N3705	9
2N3706	9
2N3707	9
2N3708	9
2N3709	11
2N3773	270
2N3819	20
2N3820	39
2N3866	97
2N3903	20
2N3904	8
2N3905	12
2N3906	12
2N3962	95
2N4347	227
2N4401	20
2N4403	20
2N4416	86
2N4427	206
2N4856	158
2N4858	134
2N4860	122
2N5294	43
2N5416	108
2N5457	35
2N5458	30
2N5459	32
2N6258	432
40673	80
AC188	22
AD161	38
AD162	38
BC107	10
BC107B	14
BC108	10
BC108B	14
BC108C	16
BC109	10
BC109B	17
BC109C	18
BC147	7
BC148	9
BC149	8
BC157	10
BC158	9
BC159	11
BC177	15
BC178	15
BC179	18
BC182	10
BC182L	11
BC183	10
BC183L	11
BC184	10
BC184L	11
BC212	10
BC212L	11
BC213	10
BC213L	11
BC214	10
BC214L	11
BC327	17
BC328	15
BC337	16
BC338	14
BC478	24
BC547	12
BC548	10
BC548B	15
BC549	12
BC549B	20
BC557	14
BC558	14
BC559	17
BCY34	97
BCY70	14
BCY71	14
BCY72	15
BD131	35
BD132	35
BD135	38
BD136	37
BD137	38
BD138	39
BD139	35
BD140	35
BF115	28
BF180	37
BF181	37
BF257	35
BF258	32
BF259	36
BFR90	303
BFS21	428
BFX13	23
BFX84	26
BFX85	26
BFX86	30
BFX87	22
BFX88	26
BFY50	15
BFY51	15
BFY52	18
BFY90	97
BLX65	238
BLY35	1889
BLY93A	2706
BPX25	175
BPX29	175
BRY39	45
BSW69	33
BSX20	19
BSX66	18
MJE340	48
MPF102	32
OC28	107
OC35	95
OC45	82
OCP71	180
TIP29A	41
TIP29C	53
TIP30A	44
TIP30C	57
TIP31A	43
TIP31C	58
TIP32A	49
TIP32C	63
TIP41A	59
TIP41C	69
TIP42A	59
TIP42C	69
TIP2955	68
TIP3055	54
TIS43	32
ZTX109C	14

SEMICONDUCTORS

Rectifier Bridges

		Order Code
1A 400V S.I.L.	83	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

Order Code

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

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
SL362C	302
SL610	230
SL611C	230
SL612C	230
SL613C	394
SL620C	347
SL621C	347
SL622C	854
SL623C	629
SL624C	321
SL630C	218
SL640C	384
SL641C	384
SL650C	855
SL651C	786
SL652C	329
SL680C	230
SL701C	220
SL1610C	166
SL1611C	166
SL1612C	166
SL1613C	193
SL1620C	225
SL1621C	225
SL1623C	251
SL1625C	225
SL1626C	251
SL1630C	166
SL1640C	193
SL1641C	193
SL1680C	170
SL6600C	890
SL6640C	401
SL6650C	378
SP8629	446
SP8630B	1361
SP8655B	1058
SP8657B	1058
SP8659B	907
SP8660B	907
SP8690	907
SP8760B	680
SP8790B	454
SP8794B	454

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Projects... Theory... and Popular Features...

Remember the boy who cried "*Wolf*"? Burglar alarms ring continuously in the High Street and passers by go about their business without turning a head. Frequent false alarms due to malfunctioning of the equipment have conditioned people to disregard all alarms they hear. Despite this they serve a purpose since in the case of a genuine alarm the initial sounding-off must have caused the would-be intruders to beat a hasty retreat.

There are of course other more subtle and sometimes more effective ways of deploying electrics and electronics to safeguard premises and homes than through the triggering of a strident externally-sited bell or siren. The arrangements possible for detecting a break-in are pretty well unlimited. So anyone can have an intruder detection system tailored to suit his own needs and circumstances. The degree of complexity of design and/or of devices used can vary considerably: the whole gamut of the electronic armoury can be brought into play if money is no object.

On a more practical and reasonable level, very effective intruder alarm systems can be built and installed by any handyman, using standard components and without excessive cost. Such an example is presented in this issue. Most importantly, our *Intruder Alarm* is immune from power failures, and allows the alarm device (sound or visual as desired) to be situated wherever required.

It is a sad reflection upon the times, that this project could be the most important and urgent undertaking for today's householder.

An apology to disco fans and others. Unfortunately it has not proved possible to include the Xenon Strobe in this issue, as announced last month.

That most widely used of all tools, the humble screwdriver, is in its time applied to many a purpose entirely unconnected with screw heads. But there is no doubt about the *intended* dual purpose of our Free Gift to readers this month, for it is a useful pocket screwdriver with the bonus of a built-in wire stripper. This straight away gives it a head start on other screwdrivers for electronics constructors.

Fred Bennett.

Our June issue will be published on Friday, May 18. See page 275 for details.

Readers' Enquiries

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

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

Component Supplies

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

Everyday ELECTRONICS

VOL. 8 NO. 5

MAY 1979

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

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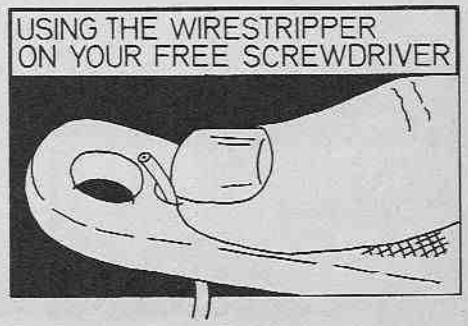

A RELIABLE SYSTEM FOR THE HOME — MAINS OPERATED WITH AUTOMATIC BATTERY BACK-UP

INTRUDER ALARM

By F. G. Rayer

ANYONE who has had the unfortunate experience of being burgled will certainly appreciate the usefulness of the Intruder Alarm described here.

When all entrances into the house e.g. doors, windows, fanlights etc, are connected via switches into one or both of the "loops" in this system, the alarm will be activated and alert you instantly if any of these entrances are opened. Closing the door or window afterwards will not cause the alarm to be turned off. This can only be done at the unit.

The Intruder Alarm is powered by a mains derived supply that automatically switches over to an internal battery should the mains supply fail or be interrupted. A remote alarm facility is included that can be muted by a switch on the front panel.

COMPONENTS approximate cost £13 excluding loop switches

CIRCUIT DESCRIPTION

The circuit diagram of the Intruder Alarm is shown in Fig. 1.

Mains voltage enters the unit via FS1 and S1 and is placed across the primary winding of T1; 12 volts a.c. is produced across the central-tapped secondary. Full-wave rectification is achieved by diodes D1 and D2 producing a d.c. level of approximately 7·8 volts across smoothing capacitor C1.

Under normal conditions, all the switches in the parallel loop are open, and all those in the series loop closed. The voltage on the gate of CSR1 is thus very low, being equal to the voltage drop across R4 (100 ohms) in series with D4, R2 and R1. Thus the gate voltage is insufficient to turn on CSR1.

If now any of the switches in the series loop are opened, the gate voltage rises and causes CSR1 to turn on bringing the anode down to almost 0V. With S3 and S4 closed, the full supply voltage is placed across WD1 and RLA operating both; also D4 is illuminated. If S3 is opened the internal alarm is muted; S4 takes the relay out of circuit, its contacts open and mute the external alarm, WD2 and/or LP2.

Consider all the series loop switches closed. If now a switch in the parallel loop is closed, the voltage at CSR1 gate is equal to about 1·2 volts $[V\text{supply} \times \text{R3}/(\text{R4}+\text{R30})]$ which is high enough for CSR1 to turn on and sound the alarms as before.

Once the thyristor has turned on, it cannot be turned off again by closing (or opening) the loop switches. It can only be turned off at the unit by setting both S1 and S2 to OFF.

POWER SUPPLIES

When operating on the mains derived power supply there is no drain on B1 with S2 in the STANDBY position since D3 is reverse biased (7·8 volts on cathode and 6 volts on anode).

Power for the external bell WD2 and/or lamp LP2 is obtained through relay contacts RLA1 when the relay coil is energised.

If a high power external alarm is required, the relay contacts should be disconnected from the circuit and taken to sockets on the back panel for connection to the external alarm and its own power

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Front Cover: Birdcage by courtesy of Harrods of Knightsbridge.

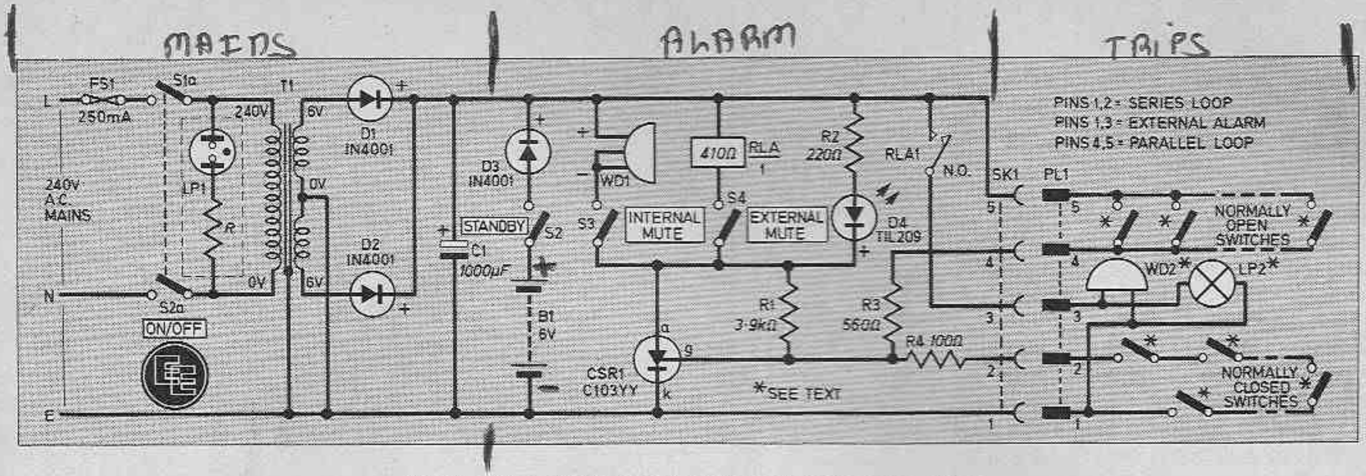


Fig. 1. The complete circuit diagram of the Intruder Alarm.

supply which may be mains or battery operated. With the relay specified, the contacts can handle mains voltages at currents up to 5A and d.c. power up to 150 watts.

Under "no alarm" conditions D4 will be off (completely dark) when S4 is closed. With S4 open, D4 will be lit very dimly, warning the user that the external alarm has been muted.

The inclusion of the MUTE switches allows the silent detection of an intruder by means of the l.e.d. and are useful when setting up.

Removal of PL1 from SK1, accidentally or deliberately will activate the internal alarm since the series loop will have been broken.

LOOP SWITCHES

The switches connected in the parallel loop must be normally open push-to-break, release-to-make types if used in the closed position and push-to-make, release-to break in the open position. Various types can be used such as push-button, microswitch, reed/magnet and pressure mats that close when stepped on. See Fig. 2.

The latter are preferred when "fitting" is to be kept to a minimum. These are to be placed at strategic points around the house such as below windows, close to external doors, foot of stairways. In all cases it is recommended they should be sited below carpets/rugs for security reasons.

OPERATING DEVICES

Home made switches can be devised from strips of metal with touch contact screws depressed by weight or by opening of windows of the sash variety.

Switches in the series loop must be of the normally closed type and could be push-button, microswitches, reed/magnet, foil conductors on a door or window which will be fractured if the glass is broken.

Fine gauge wire can also be used. This is most suitable and cheap for windows that are seldom opened and can be fitted across windows/frames so as to break the wire when the window is opened.

Pressure mats can also be obtained that have four leads. Here two form a continuous circuit which can be wired in the series loop and activate the alarm if cut.

Microswitches are particularly suitable due to their small size; most are of the changeover type allowing them to be fitted in the series or parallel loops.

If the alarm is required to "protect" an empty house (e.g. owners on holiday) a keyswitch wired in parallel with the series switch at door of exit is required. In the unlocked position the keyswitch should short-circuit the loop switch. The remote alarm should of course be sited outside the house.

CONSTRUCTION starts here

The prototype was constructed in a Verobox type 75-1798K which has a sloping top panel producing an attractive unit.

Some of the components are mounted on a piece of 0·1 inch

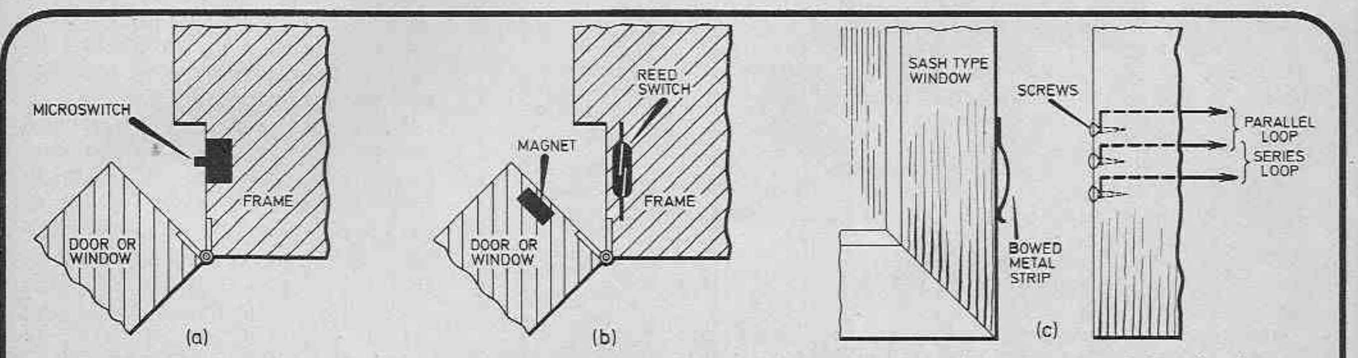


Fig. 2. Fitting of loop switches to doors and windows: (a) the microswitch is positioned so that it is operated when the door opens/closes; (b) using a reed switch and magnet. When the door closes the magnet causes the switch to close (suitable for series loop); (c) a home-made switch constructed from brass plate and screws. A dual type is shown for connection in both parallel and series loops.

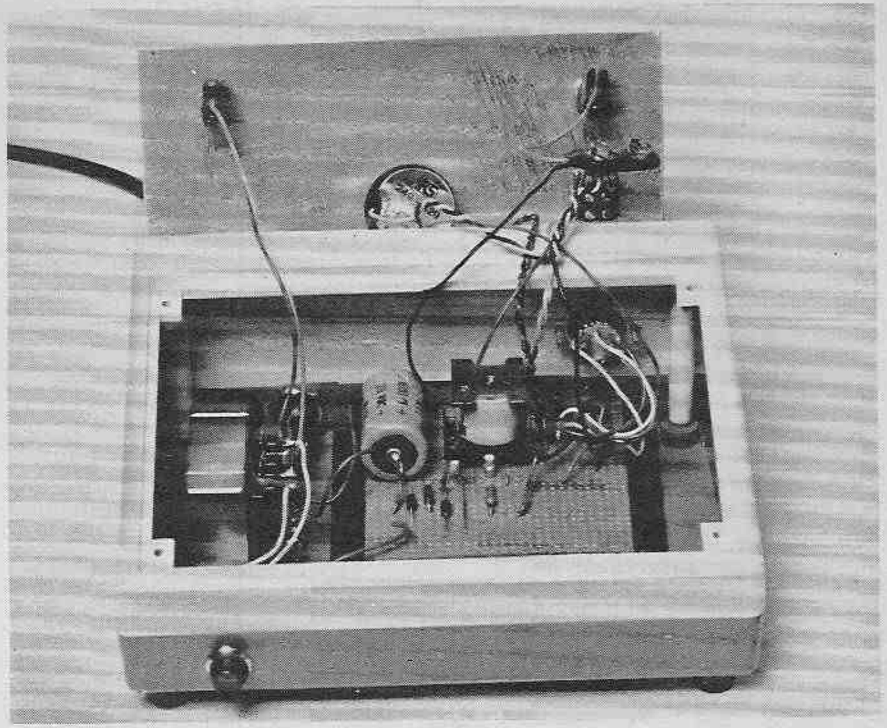
matrix stripboard size 27 strips x 32 holes. The layout of the components on the topside is shown in Fig. 3. There are only two breaks to be made on the underside at locations C13 and C18. If board fixings other than those specified are used, isolation breaks may be necessary around the fixing holes.

Assemble and solder all the components to the board paying attention to polarities of C1, D1, D2 and D3. Solder all flying leads to the board, of sufficient length to reach the other components in their final positions.

POWER SUPPLY

The transformer, neon, fuseholder and mains cable entry are accommodated in the lower section of the case. Drill and fix these components in position and wire up. Also connect S1 and check that the power supply is functioning; approximately 12 volts a.c. should be measured across T1 secondary. With one test probe connected to the earthing solder tag, 6 volts a.c. should be measured when the other probe is connected in turn to each "6V" tag of T1 secondary.

Fit the self adhesive board mounts, push the board in place and then wire up according to Fig. 3.



The complete prototype with lid removed.

Next the top panel and upper half of case should be prepared to accept the switches, socket etc. Fit SK1 and secure the top half of case to its other section and wire to SK1.

Connect the switches, WD1 and D4 to the appropriate flying leads, wire in the battery connector and finally secure to the top panel. The unit is now ready for testing.

A multi-way terminal block is a suitable connector for interconnecting unit to its loops and external alarm and allows other loops to be readily added. The DIN plug/socket arrangement allows instant removal of the unit from the system should this prove necessary.

Six-cored cable is required for PL1 to terminal block, see Fig. 4. The length of this cable is determined by the siting of the concealed terminal block.

TESTING

Thoroughly check out your wiring and when completely satisfied proceed as follows. Set S3 and S4 to MUTE and S2 to STANDBY. The l.e.d. should light brightly. Switch S4. The relay should be heard to pull in. Switch S3 and the internal buzzer should emit a tone. Set S2 to OFF. The buzzer should be quiet and the l.e.d. extinguish.

Now plug into the mains and switch on at S1. The internal buzzer should sound and the l.e.d. light along with LP1. Set S2 to STANDBY and switch off at S1. The only difference to be noticed is that LP1 goes out, WD1 pitch is slightly reduced and D4 is less bright. Set S2 to OFF.

Insert PL1 in SK1 and put a shorting link between 1 and 2 on terminal block and set S2 to STANDBY. The alarm should not

COMPONENTS

Resistors

R1	3·9kΩ
R2	220Ω
R3	560Ω
R4	100Ω

All ¼watt carbon ±10%

Capacitor

C1	1000μF 10V elect.

Semiconductors

D1 to D3	1N4001 or similar silicon diode (3 off)
D4	TIL209 red l.e.d. with bush
CSR1	C103YY or similar thyristor

Miscellaneous

T1	mains primary/6-0-6V 250mA secondary
S1 to S4	miniature on/off toggle switches (4 off)
FS1	250mA 20mm including panel fuseholder
LP1	mains panel mounting neon
LP2	6V 100mA lamp (optional)
SK1	5-pin DIN socket chassis mounting
PL1	5-pin DIN plug to suit SK1
RLA	miniature open relay, 410 ohm coil resistance with one set normally open contacts
WD1	miniature solid-state buzzer or similar
WD2	low voltage bell or other alarm (optional)
B1	9V type PP6

Stripboard: 0·1 inch matrix 27 strips × 32 holes; Verobox type 75-1798K self adhesive board mounts; sleeved grommet; mains cable; 4BA fixings; bell wire and switches for loops; PP6 battery connector; terminal block; six-cored cable.

See
Shop Talk
page 287

INTRUDER ALARM

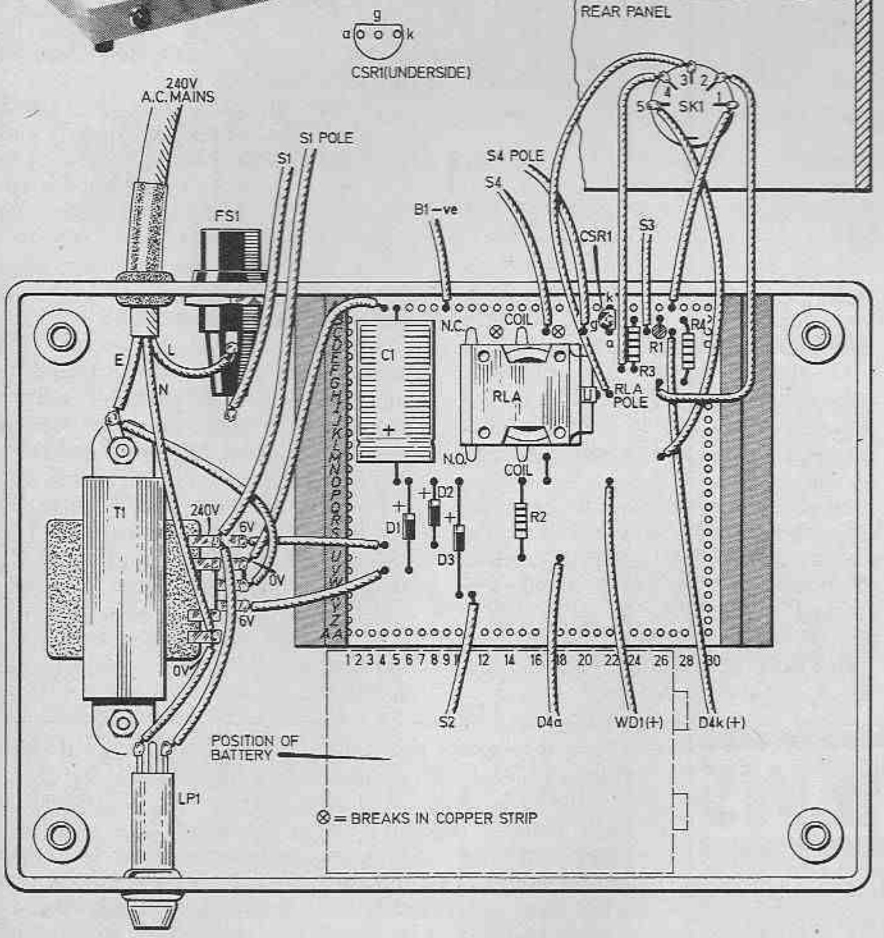
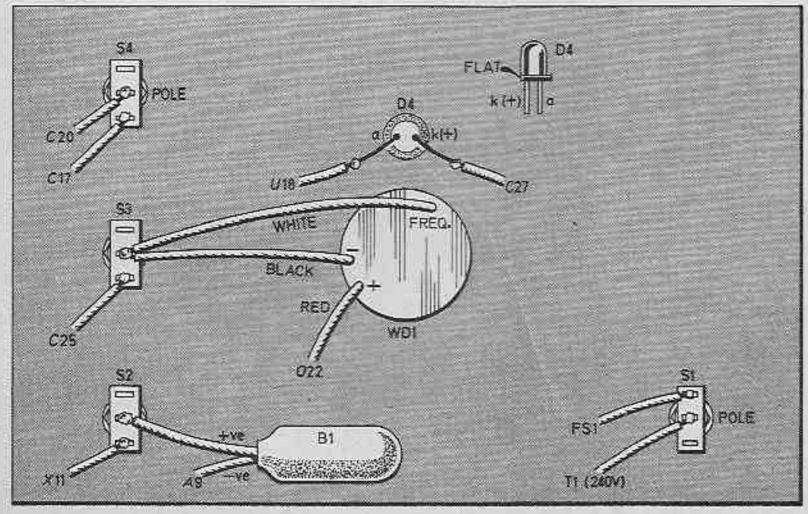


Fig. 3. Layout of the components on the stripboard and wiring-up details. Below shows positions of top-panel controls and wiring information. Note that the copper strip on the board underside is to be broken at two points, C13 and C18.



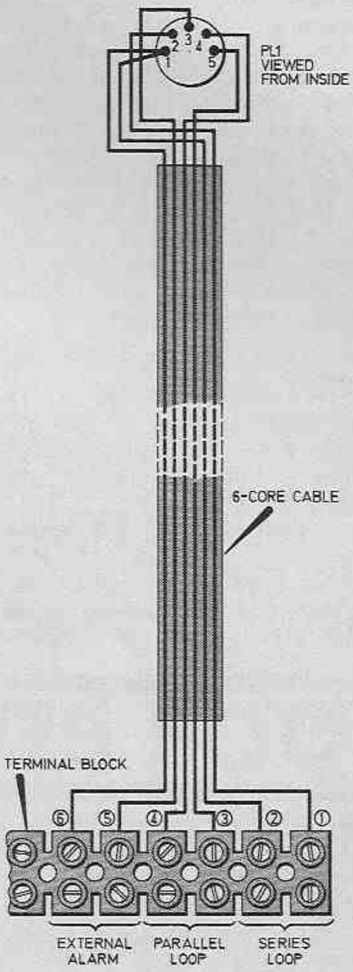
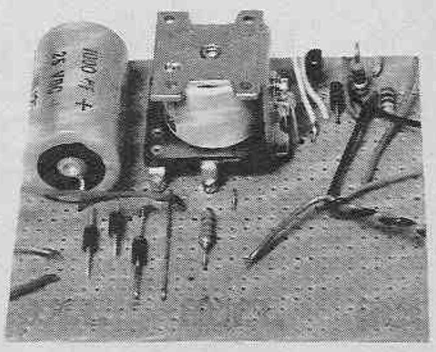


Fig. 4. Wiring up a terminal block to a 5-pin DIN socket.



The prototype component board shown in close-up.

sound. With S4 in the MUTE position the l.e.d. may glow dimly (not important). In its other position, the l.e.d. should be dark.

Connect the remote bell (or lamp) to positions 5 and 6 on the terminal block. Instantaneously short positions 3 and 4 on the terminal block. Both alarms should sound and the l.e.d. be on. Test EXTERNAL MUTE. Switch S2 to OFF and then return to STANDBY. The alarms and l.e.d. will turn off. Remove the shorting link between 1 and 2. Both alarms should sound and the l.e.d. light. Set S2 to OFF.

If all the above results have been obtained, the unit is complete and ready for use. It only remains to lay the two loops, remote alarm wiring and connect this to the terminal block.

IN USE

The final position of the unit will be a matter of individual preference but the bedside may be the favourite choice.

The application of the remote alarm will also vary. In some instances it would be used to alert everybody in the household including the intruder with the intention of scaring him away. Alternatively a local "soft" alarm may be employed so as to be inaudible to the intruder.

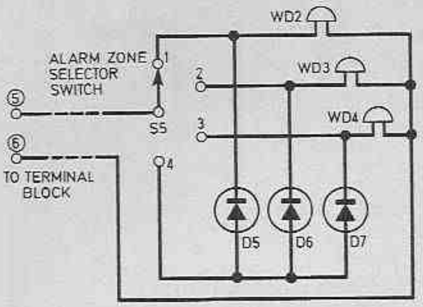


Fig. 5. Circuit for choice of remote alarm.

Also, the sounding of the external alarm can be left to the user by leaving S4 in the MUTE position and operating this if required after the internal buzzer has sounded. During daytime, S4 would be in the non-MUTE position so then the external alarm is the primary means of warning.

In larger premises, it may be advisable to fit several remote alarms in parallel (current output of power supply may need uprating) or be able to switch any one of several depending on the room occupied at the time e.g. TV room, bathroom, kitchen, Fig. 5.

The rotary switch and diode arrangement allows a choice of remote alarm, any one at a time or all three at once. Suitable diodes are 1N4001.

It is advisable for reasons of security and tidiness, that wires from and forming the loops be hidden e.g. below floorboards or under carpets. Twin bell wire is suitable for both loops.

If only the parallel loop is used, the terminal block position 3 and 4 must be shorted by means of a link wire. This can quickly be removed should a series loop be added at a later stage.

Double-pole type switches may be used to produce series and parallel loops protection at certain places around the house. This would help confuse the intruder if he was on the lookout for wiring to switches with the intention of cutting parallel loops and bridging series connected switches.

Finally, the Intruder Alarm is not intended to be a substitute for locks, bolts, catches etc., but to act as a back-up for these conventional fitments. If these do not prevent the intruder's entrance, the alarm will tell you of his presence. ⌑

BOOK REVIEWS

TELEVISION INTERFERENCE MANUAL

Author B. Priestley
Price £1·35
Size 210 × 150mm
Publisher Radio Society of Great Britain
ISBN 0 900612 45 2

This book, intended mainly for the radio amateur gives much valuable information on the often ticklish problem of TV interference.

It is a sad fact, that because the TV viewer might suffer from a brief burst of interference, the total blame is put upon the innocent local amateur down the road. But as the reader will discover after reading this book, this is not always the case. Indeed, it could well be, and nearly always is, due to a fault in the TV set, rather than the amateur station.

QUESTIONS & ANSWERS RADIO REPAIR

Author Les Lawry-Johns
Price £1·50
Size 165 × 110mm
Publisher The Butterworth Group
ISBN 0 408 003 677

There have been many books in the *Question and Answer* series, and no doubt there will be many more of these highly popular books. The essential aim is to present the reader with a question, and then follow this up with an answer of great detail.

The book is divided into a number of chapters, each leading logically on to the next. For example: power supplies, i.f. stages, audio amplifiers. Thus the reader is taken from first principles (it even tells you what tools are required!) to complex fault finding.

One chapter is devoted exclusively to car radios and gives much essential information on their repair. One aspect of repair which is often overlooked by the beginner is the trick of heating and/or cooling a component to find an intermittent fault.

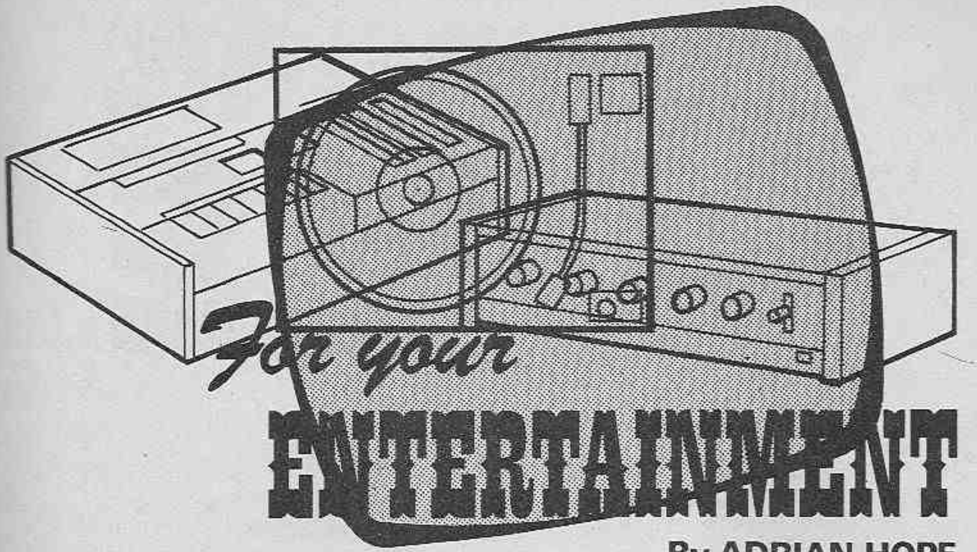
ELECTRONIC PROJECTS IN THE HOME

Author: Owen Bishop
Price £2·25 Paperback
Size 215 × 135mm 88pages
Publisher Newnes Technical Books
ISBN 0 408 00346 4

A recipe for yoghurt is an unexpected "find" in this book of useful electronic projects. The Yoghurt Maker, by the way, is quite ingenious and uses the heat produced by the control circuit components to maintain the interior of the container at the required 35 degrees C.

A Flashing Messenger and a Decorative Star for the Christmas Tree are two unusual and novel ideas that add further interest to this collection of simple circuits. The remaining ten projects have a more familiar ring about them: moisture detector, temperature-operated alarm, light-operated switch and so on.

Each project is well described, with a component list and stripboard layout. An excellent handy reference source for the constructor by the author of the highly acclaimed series "Doing It Digitally".



For your ENTERTAINMENT

By ADRIAN HOPE

Audio Reporting

The audio industry and press is currently engaged in publicly tearing itself apart in an effort to agree on who should review equipment and how. So the main bones of contention are now well known, even if there are as yet no answers.

Should sophisticated electronic equipment be reviewed by measurement or by ear—or by both? Is it reasonable for a lone reviewer to appraise the performance of a product developed and produced by a large company using money-no-object test techniques? Should reviewers test a carefully checked sample provided by the manufacturer and thus perhaps not representative of what appears in the shops? Or should the reviewer risk condemning a product on the strength of one faulty sample that has reached the open market and been bought for review unbeknown to the manufacturer?

Dubious Practice

And so it goes on, and on, and on. Meanwhile, these pages, being out of the mainstream of audio and hi fi, seem an ideal place to mention a couple of dubious practices that have crept into audio journalism over recent years.

Very reasonably reviewers have objected to the use of their review comments in advertising material produced by the manufacturer, either because it is lifted out of context in the manner of a film or theatre review "so funny it's pathetic" in a theatre critic's review becomes "so funny" in the theatre's advertising) or because lengthy reviews are reproduced in their entirety without the original writer's permission. Understandably reviewers have clamped down on this practice, attaching tight strings to permission to reproduce and asking an additional reproduction fee.

There is no evidence that anyone has deliberately praised a product simply to better their chances of selling a quote for subsequent reproduction, but some remarkably bland reviews have appeared. I even noticed excerpts of one review quoted in an advertisement that appeared in the *same* issue of the monthly hi fi magazine that carried the review. Doubtless there was nothing whatsoever dishonest about this coincidence, but it hardly engenders the confidence of thinking people in the independency of the reviewer.

Consult or Review

Although some reviewers somehow manage to finance a respectable laboratory almost entirely on the strength of reviews commissioned for magazine publication (usually by working very hard, very long hours) many find it necessary also to work on a consultancy basis for the manufacturers. Viewed from a distance, and in pure consumer terms, this may seem undesirable. But it is now, for better or for worse, an integral, and possibly essential part of audio reviewing.

The fee paid by the firms, either on a retainer or occasional consultancy basis, can be fat compared to those which magazines can afford to offer most contributors. Consultancy fees can thus go to subsidise the purchase of laboratory equipment which then enables the reviewer to conduct a more thorough appraisal of equipment for the magazines.

Unwritten rules over the years have emerged. First and foremost has been the tacit assumption that it is undesirable for one and the same person to both consult on a product and then review it in print.

Consultancy on a product can take many forms, from helping out a small manufacturer who is short on skill or equipment in one particular area to advising the importer of equipment from a vast Japanese company on the likely sales potential of a product, *vis à vis* the competition. But either way the reviewer is accepting hard cash from the manufacturer to advise.

Until recently no-one has suggested that it is ethically acceptable for anyone to act as a paid adviser on a product, then remove his consultant's hat, don his reviewers hat and appraise the same product for the benefit of the trade and consumer. *But this is now exactly what is happening, due largely to the move over recent years towards comparative reviewing.*

New Technology

There is also the additional problem that in some areas of technology the number of reviewers that are sufficiently skilled to appraise new products fairly is limited because to become skilled in any one area of fast moving technology may now be an almost full time job.

It is also argued that pure measurement consultancy will in no way prejudice a future review and that a volt is a volt, whether you measure it as a consultant or a reviewer. But the question then becomes, which volt to measure, how and when?

As hi fi technology becomes increasingly sophisticated, parameter compromises become essential and opinions diverge on the best and worse compromises to adopt. For instance product price may be no object or it may be taken into consideration.

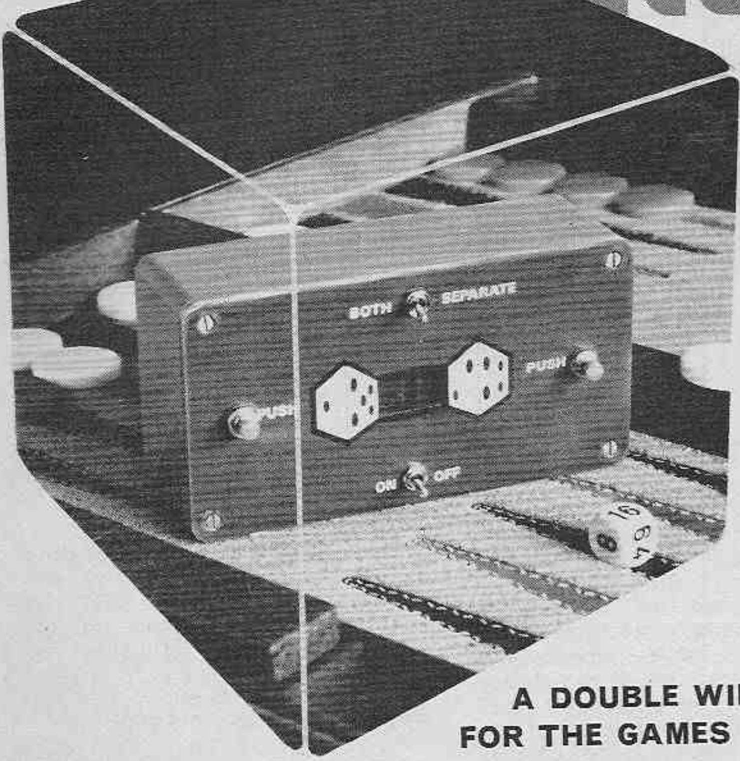
Conflict of Interest

The issue here is not so much whether the public is at risk. There is no evidence that anyone functioning both as a reviewer and consultant has ever knowingly misled anyone. But no mortal is infallible.

What matters most of all is that the trade and public should recognise the situation for what it is and form their own opinion on its desirability or otherwise. This necessitates a clear, bold and unambiguous declaration of interest on the part of any reviewer appraising a product on which he has also consulted.

Surely if a conflict of interest is innocuous there is nothing to be lost, and everything to be gained, from an open acknowledgement of the fact? You can't, as they say, have your cake and eat it.

ELECTRONIC DICE



By P. Leah

A DOUBLE WINNER FOR THE GAMES PERSON

The Electronic Dice to be described here has two independent counters and displays which can be operated separately or together. This makes it ideal for games such as Monopoly and Backgammon which require two dice as well as games that require only one dice such as Snakes and Ladders and Ludo.

This particular design is ingenious in so far as it uses only a single four-bit binary up-down counter to directly interface to a BCD/seven-segment display decoder/driver without the need for complex gating.

TRUTH TABLE

The truth table of the complete counting sequence of the binary counter, and the required sequence to drive a display decoder over the range of numbers 1 to 6 is shown in Table 1.

It can be seen that the counting sequence over the range 9 to 14 is identical to the range 1 to 6 if we ignore the most significant digit, and replace this logical 1 with a logical 0.

If we continually preset the counter to 9 after it has counted up to 14, the counter will count continuously over the range 9 to 14, which, when decoded, provides a display over the range 1 to 6.

CIRCUIT DESCRIPTION

The circuit diagram of the Electronic Dice is shown in Fig. 1.

The circuit can be split directly into the two identical circuits each comprising an oscillator made from two 2-input NOR gates (IC5), a 74C193 counter a 4511 decoder-driver and a seven-segment minitron display.

The Minitron display was chosen in preference to a l.e.d. display as each segment of the Minitron has a resistance of about 600 ohms and hence can be driven directly from the 4511 decoder-driver without the need for current limiting resistors.

Table 1: Truth table for four digit binary counter

	Binary outputs			
Decimal	D	C	B	A
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
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

The 74C193 binary counter provides a carry output which appears as a logical 1 as soon as the counter has reached 15. This carry output is used to preset the counters to 9. Hence the counter will continuously count over the range 9 to 14 when a clock pulse train is connected, without the need for additional gates.

OSCILLATORS

The oscillators are connected in a feedback loop as shown with the values of R1 (or R4) and C2 (or C3) controlling the frequency of the oscillators. The oscillators will oscillate when pin 13 or pin 5 is connected to ground (0V). This is achieved by depressing switches S3 or S4.

Switch S2 ensures that the earth from either S3 or S4 is connected to both oscillators when switched on so that the oscillators operate together (BOTH) or only one of the oscillators operate while S2 is switched off when the oscillators will operate by only S3 or S4 (SEPARATE).

The oscillator outputs are connected directly to the count-up inputs of the two binary counters (IC1 and IC4 pin 5) which count over the range 9 to 14 when the oscillators are enabled. The carry output, pin 11 of each counter is connected back to their respective "load" outputs to ensure that the counters are preset to 9 on every carry output pulse.

Two capacitors C1 and C4 are necessary to extend the duration of the preset pulse and hence ensure that the counters have sufficient time to preset correctly. The three

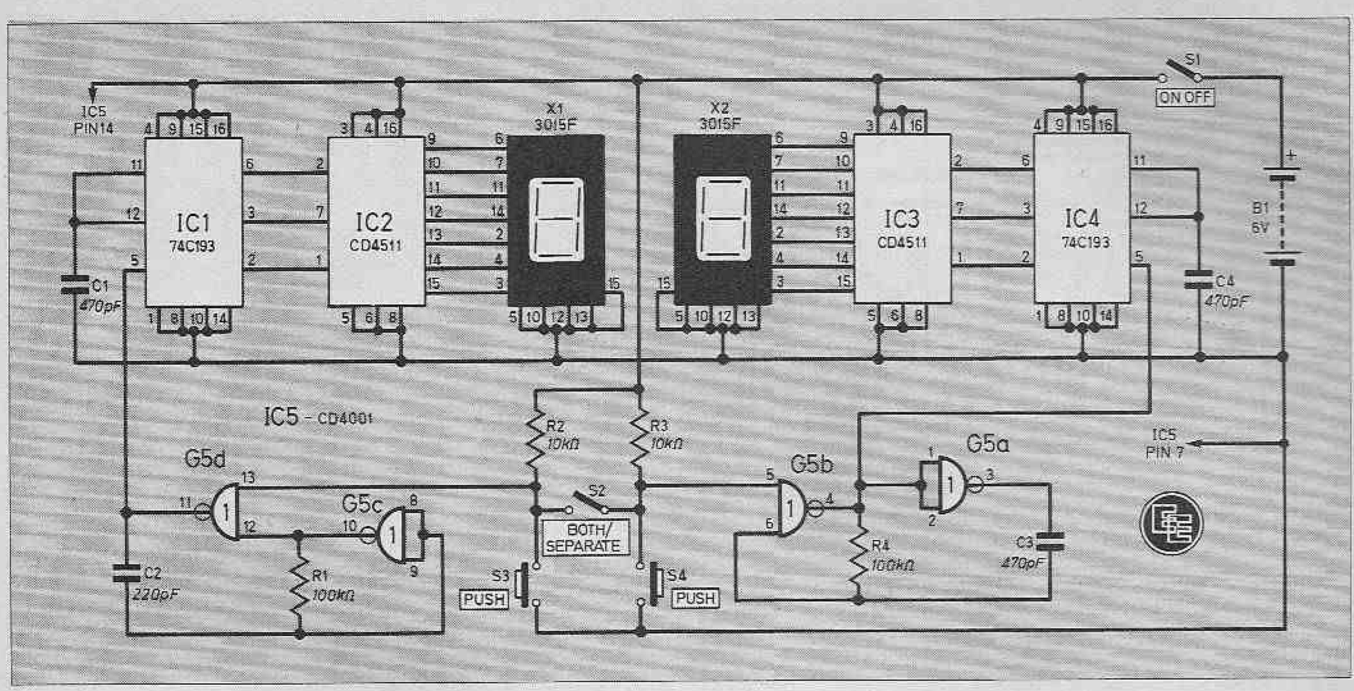


Fig. 1. The complete circuit diagram of the Electronic Dice.

least significant digits from the counters (pins 2, 3 and 6) are directly connected to the *A*, *B*, and *C* inputs of the decoder-drivers IC2 and IC3, while the *D* input (pin 6) is held at 0V. Hence the input to the decoder-drivers will be binary coded numbers 1 to 6. The decoder-driver outputs are directly connected to the Minitrons X1 and X2.

When the push buttons S3 and S4 are depressed, the display will appear to show number 8 because the display is changing so fast the eye cannot detect the changes. Only when the buttons are released will a number between 1 and 6 become clearly visible; S1 is the on-off switch which connects the battery to the circuit.

CLOCK SPEED

The random count is dependent on the length of time the push-button switches are depressed which connect the two clocks to the counters. The clocks count independently of each other at frequences of 10kHz and 20kHz, so there is no possibility of cheating by depressing the push-buttons for a set period of time, since no-one could depress the switches for a time within an accuracy of one ten thousandth of a second!

The power consumption is very low, the majority of the load being the display. When segments of both digits are operating, this is approximately 60mA, and therefore operated from four HP11 (1·5 volt) batteries. Hence the whole assembly is completely portable, enabling it to be mounted in a small plastic instrument case.

CONSTRUCTION starts here

The author's unit uses a printed circuit board. A full-size master of this is shown in Fig. 2. This is viewed from the copper side. The black regions are the areas of copper to remain after etching.

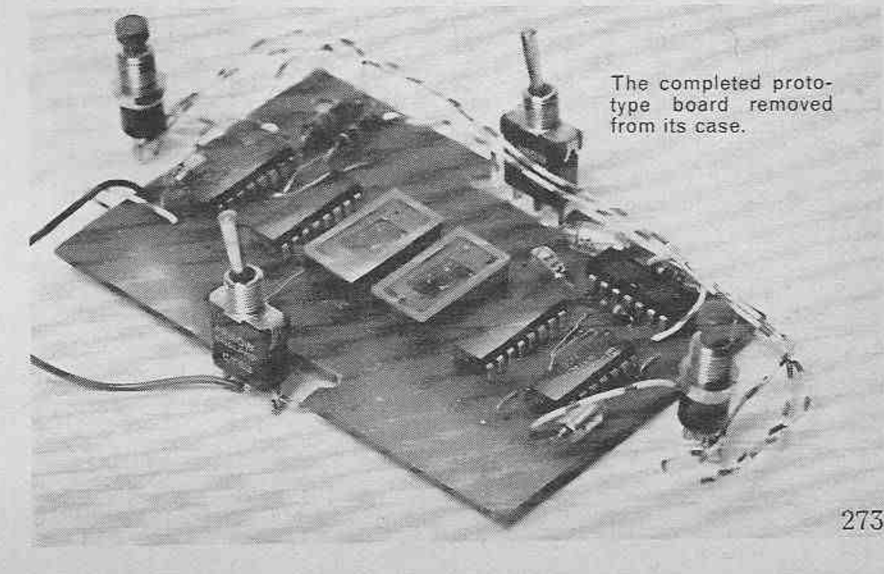
The layout is not critical and if desired can be constructed on stripboard.

The p.c.b. is specially shaped along its two longer sides to accommodate the switches and allow the unit to comfortably fit inside a small case. This arrangement at the same time provides space for the four batteries to sit below the board in the specified case.

Prepare the printed circuit board in the usual way. The design is not too complicated and can easily be laid out using transfers and ink resist pen.

The layout of the components on the topside of the board is also shown in Fig. 2.

Begin assembly by soldering the link wires in place followed by the resistors and capacitors. I.C. sockets



The completed prototype board removed from its case.

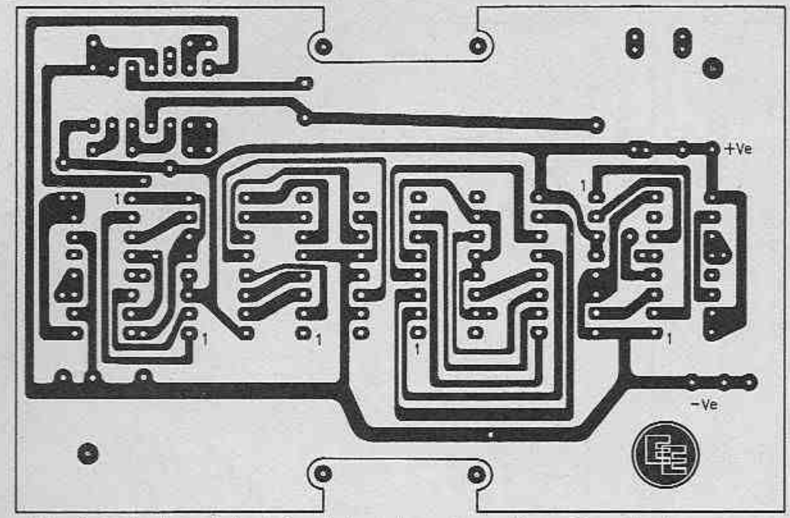


Fig. 2. Full size printed circuit board master pattern. The black areas are the regions of copper to remain after etching.

COMPONENTS

See **Shop Talk** page 287

Resistors
R1 100kΩ
R2, 3, 4 10kΩ (3 off)
All ¼W carbon ± 10%

Capacitors
C1,3,4 470pF polystyrene or ceramic (3 off)
C2 220pF polystyrene or ceramic

Semiconductors
IC1, 4 74193 TTL 4-bit binary up-down counter (2 off)
IC2, 3 CD4511 CMOS BCD to 7-segment latch decoder/driver (2 off)
IC5 CD4001 CMOS Quad 2-input NOR gate
X1, 2 Minitron 3015F filament 7-segment display (2 off)

Miscellaneous
S1, 2 miniature on/off toggle (2 off)
S3,S4 miniature push-to-make, release-to-break types (2 off)
B1 6 volt (HP11—4 off)
Printed circuit board, single sided 100mm × 66mm; Bimbox type BIM 5000/14; size approximately 145 × 75 × 50mm; battery holder; red Perspex 30 × 20mm; connecting wire.

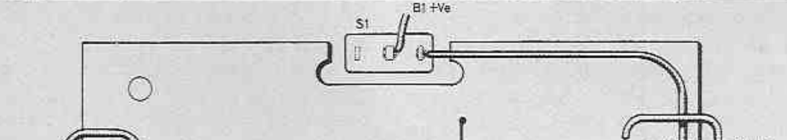


Fig. 3. Layout of the components on the topside of the board and wiring-up details.

COMPONENTS approximate cost £12

were not used in the prototype but room exists between the board and top panel for the low-profile type of socket. Position and solder the i.c. sockets and displays.

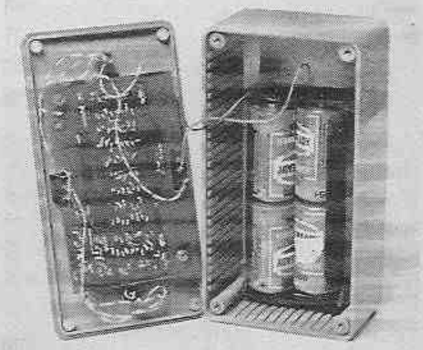
The switches in Fig. 2 are shown inverted for clarity. These should next be wired up to the board. Connect the leads to the battery connector and finally insert or solder the i.c.s. in position paying attention to polarity. An indented marker appears between the first and last pin numbers as shown in Fig. 2.

ASSEMBLY

The p.c.b. is secured to the lid of the plastic case by means of two countersunk bolts. This enables the whole assembly to be easily removed and provides easy access to the batteries. A facia glued to the lid will mask the board fixing screws.

The lid should next be prepared to accept the switches and a 25× 13mm rectangular slot cut in the centre to enable the displays to show through. The hole is backed with a small piece of red Perspex which helps to emphasise the digits. The Perspex is glued to the underside of the lid. Araldite is suitable.

The battery holder can either be glued or screwed to the base of the case to retain it. Fit the switches and board to the lid, attach the facia and the dice are ready to be rolled. ¤



Board mounted on the lid of the case and housing of the batteries.

BARGAIN HUNTERS...

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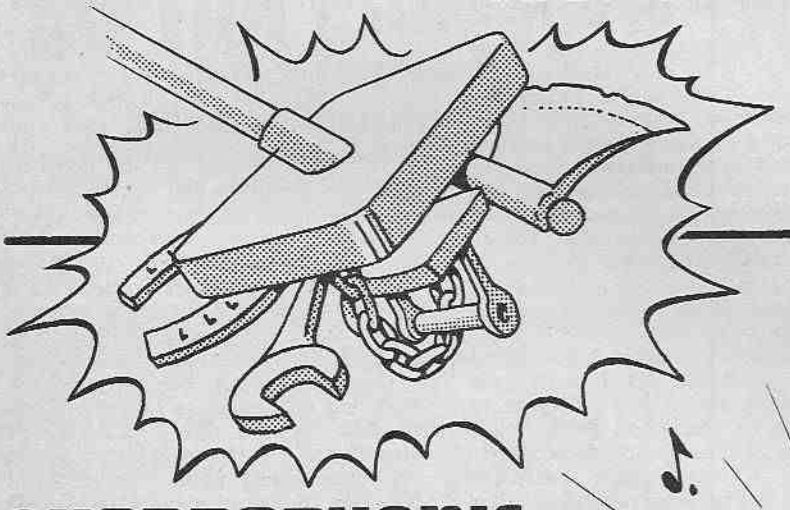

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DOING IT DIGITALLY

PART 8

By O. N. Bishop

A PULSE generator, sometimes called a clock, is at the heart of all timing systems. The TTL Electronic Test-Bed has its own built-in clock which can be very useful for simple timing projects and for designing and testing more elaborate projects being built up on the Test-Bed.

Unfortunately the built-in clock is not reliable enough for precision timing. Its frequency depends upon the supply voltage and, since the in-built voltage regulator is only a simple one, V_{CC} can vary by as much as 10 per cent, depending on the load connected to it. This gives a timing error of up to six minutes per hour, which is clearly unacceptable for many timing purposes.

If we need greater accuracy we can use the 555 timer i.c. This is not a TTL device, but it has a digital output that is fully compatible with TTL. It can be driven by any supply voltage between 3V and 15V, so we can run it from the V_{CC} supply of the Test-bed.

555 TIMER

The 555 timer i.c. can be used in many ways, one of which is shown in Fig. 8.1(a). Here it is being used as a *monostable multivibrator*. Its output is normally low, but goes high for a single period when the i.c. is triggered. This circuit is shown wired up on the Test-Bed in Fig. 8.1(b). Try various combinations of the timing capacitor C1 and the timing resistor R1.

With the values indicated the length of the high pulse is about 10 seconds.

Triggering is achieved by applying a negative-going pulse to the trigger input. This is obtained by grounding point *A*.

Another way is to connect a TTL gate output directly to pin 2; R2 will not then be needed. You could use the output of the NOT gate of IC3. Its input should be connected to ground; this applies a "high" to the trigger pin of the 555 i.c. If you next make the input of the NOT gate high, its output goes low, triggering the timer.

The input to the NOT gate need go high only for a fraction of a second, yet the timer output will go high for a considerably longer period, if we choose the appropriate values for C1 and R1. In this way the 555 can be used as a *pulse-stretcher*, giving out a long pulse whenever it is fed with a short one.

One way of delivering a short, low pulse is to touch pin 2 with your finger. Normally this is sufficient to trigger the i.c. This effect can be made use of in the construction of touch-switches, but can cause confusion when you are building or testing other circuits, for accidental touching can produce spurious triggering.

CHARGE/DISCHARGE

The action of the 555 i.c. depends upon the charging and discharging of C1. When the i.c. is in its quiescent state, C1 is charged to one-third of V_{CC} and the output of the i.c. is low. Although current flows through R2 it is diverted into the i.c. through pin 7 and the charge on C1 does not increase.

Upon triggering, the output goes high and current is no longer allowed to flow through pin 7; C1 charges steadily, at a rate depending upon its capacitance and upon the value of R1. The higher the capacitance and the higher the resistance, the more slowly the charge on C1 increases.

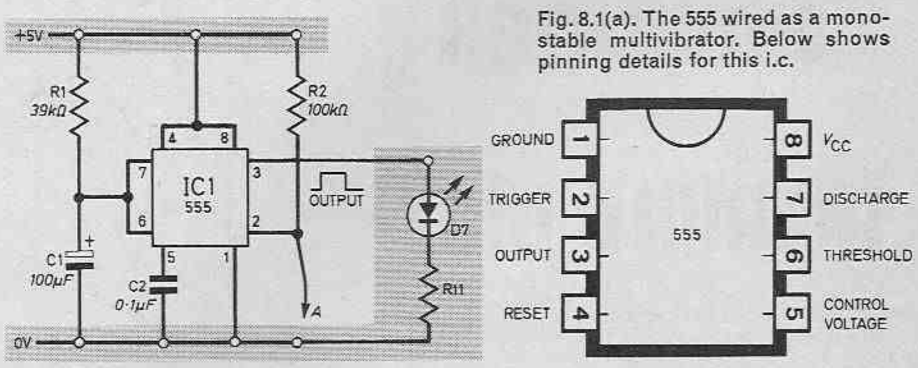


Fig. 8.1(a). The 555 wired as a monostable multivibrator. Below shows pinning details for this i.c.

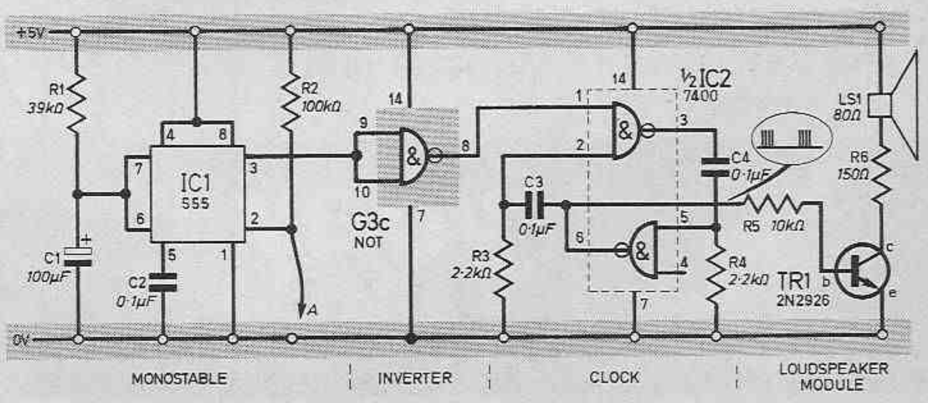


Fig. 8.2(a). An audible alarm is produced at a preset time after grounding point A.

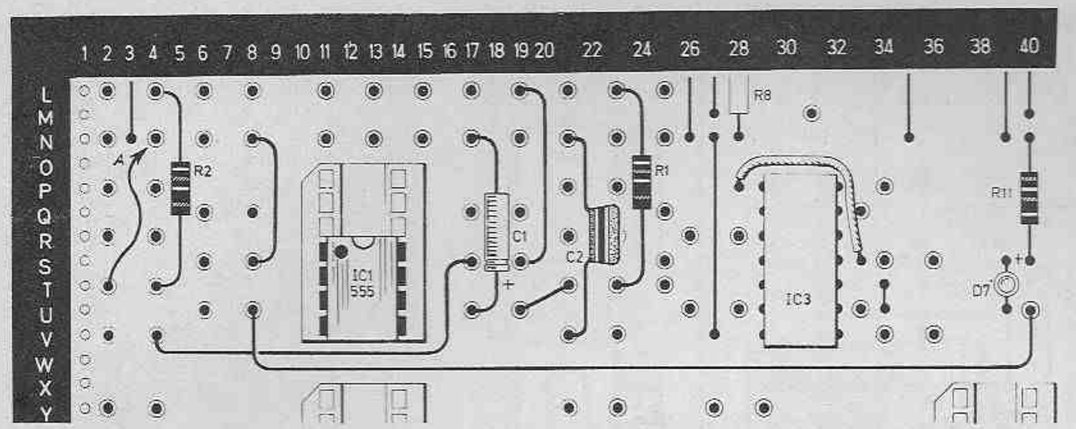


Fig. 8.1(b). The circuit of Fig. 8.1.(a) wired up on the Test-Bed. Try different combinations of values for C1 and R1 and observe the high pulse length.

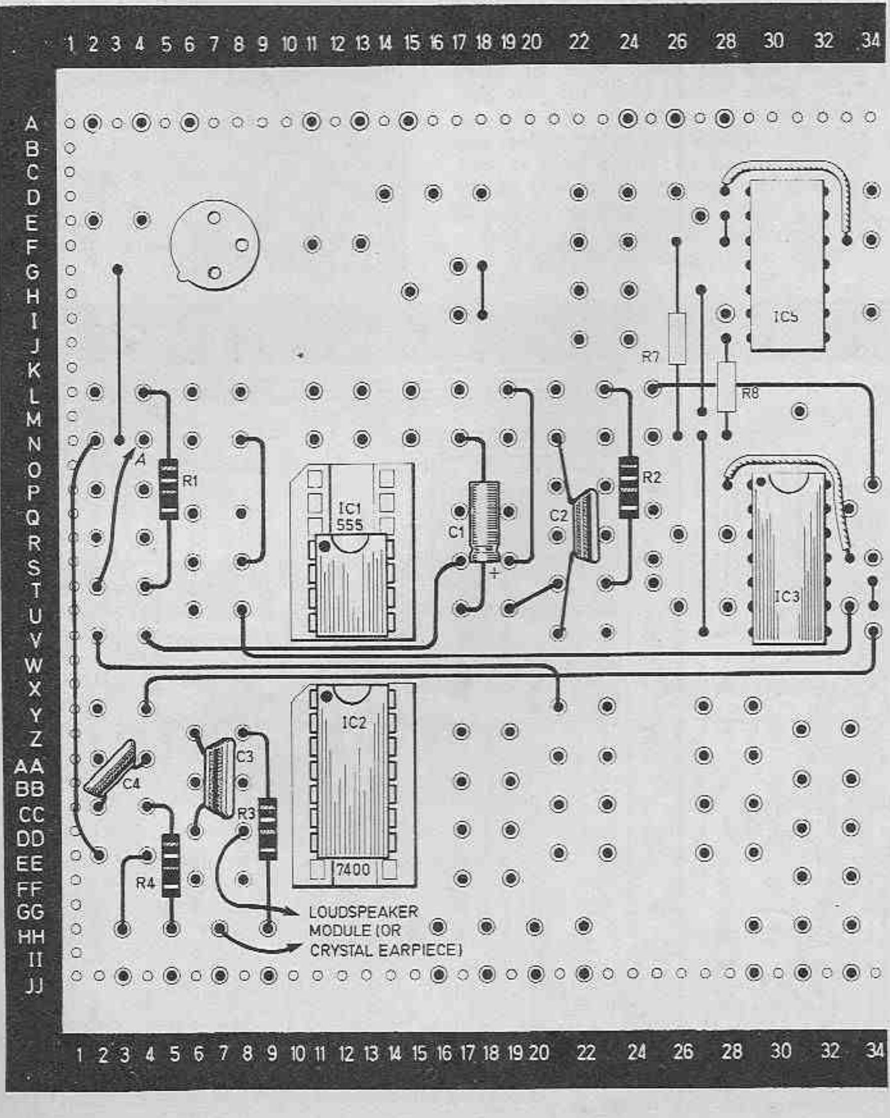
Eventually the charge reaches two thirds of V_{CC}; circuitry connected to pin 6 detects that the value $2/3V_{CC}$ has been reached, causes output to go low again, and begins the rapid discharge of C1 through pin 7.

When the voltage across C1 has once again fallen to $1/3V_{CC}$ discharge ceases and the i.c. is ready to be triggered again.

Because the action of the i.c. depends upon certain fractions of V_{CC}, but not upon the actual value of V_{CC}, the time intervals are independent of the value of V_{CC}.

Once the i.c. has been triggered, it goes through the sequence described above and is not affected if a second triggering pulse is applied during this time. If, while its output is high, a negative-going pulse is applied to the reset pin (pin 4), the output immediately goes low, and C1 is rapidly discharged to $1/3V_{CC}$.

Fig. 8.2(b). The circuit of Fig. 8.2(a) wired up on the Test-Bed.



EGG TIMER

The circuit of Fig. 8.1(a) is the basis of a simple egg-timer. If C1 is a 100μF capacitor and R1 has a resistance of 1 megohm, the high pulse lasts 4 or 5 minutes, depending upon the exact values of the timing components. Electrolytic capacitors have high tolerance (can be as high as -50 to $+100$ per cent) so you may need to select C1 from a number of capacitors having the same nominal value. Alternatively, a variable preset resistor in series with R1 will allow you to adjust the length of pulse to the correct time for cooking your egg to perfection.

So far, we have a timer that lights an l.e.d. for the prescribed period; when the lamp goes out the egg is ready for eating. This simple circuit can be improved upon to sound an alarm at the end of the time period. We need only use circuit elements that have already been described in this series, see Fig. 8.2(a). When the 555 is triggered, its high output pulse is inverted to a low pulse by the NOT gate. This low state inhibits the action of the astable multivibrator (this is the same circuit as the in-built clock, with capacitors chosen to give an audio-frequency output).

As soon as the timing period is over, the astable multivibrator begins to oscillate; since its output is connected to the loudspeaker module, an alarm note is heard. Thus the circuit emits a note as soon as it is switched on. This is silenced by pressing the trigger switch, and it remains silent until the set period has elapsed.

This circuit would be very suitable for building up into permanent form after you have worked out all the details on the Test-Bed. A single 7400

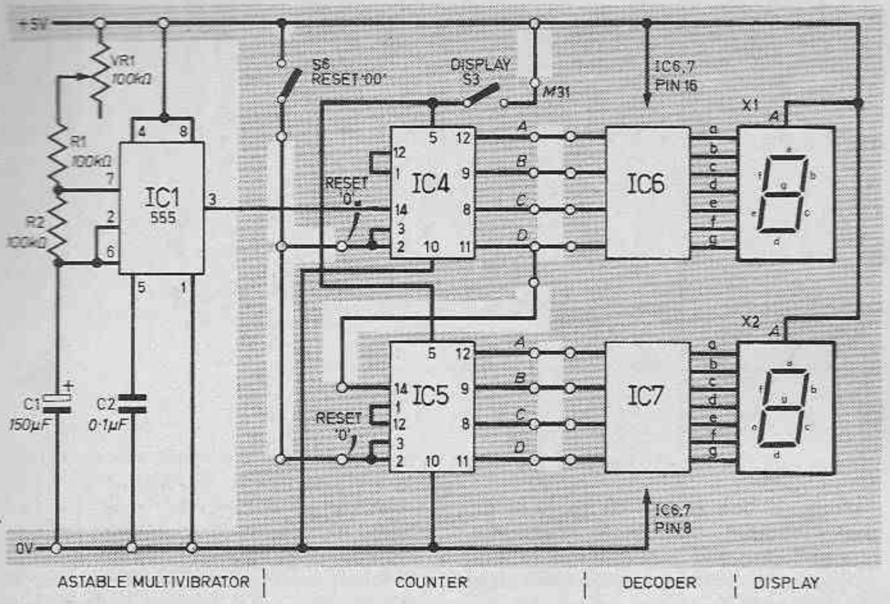


Fig. 8.3(a). The 555 wired as an astable multivibrator in an event timer up to 99 minutes in steps of one minute.

i.c. provides the necessary gates. See Fig. 8.2(b). As a refinement you could arrange a rotary switch to switch in a range of resistors, each in series with a preset resistor to allow fine adjustment. This would replace R1 and allow you to select one of a number of preset periods (say, 3, 4 and 5 minutes).

PARKING METER TIMER

The egg timer operates for a preset period, and is suitable for timing eggs or timing moves in games such as chess or Scrabble, but it does not tell you how much time has passed and how much remains before the period will be over. Now we shall build some timers that tell you how much time has elapsed since the circuit was triggered and so allow you to work out how much time is left. Circuits of this type make use of the 555 i.c. operating in another mode, as an *astable multivibrator*, Fig. 8.3(a).

Since the trigger pin (pin 2) is connected to pin 6, this circuit is self-triggering. Once started it produces a continuous train of pulses.

The timing capacitor, C1, charges through VR1, R1 and R2, but discharges only through R2, so the high pulses are longer than the low intervals between them.

The values shown in Fig. 8.3(a) cause the 555 to run at 1 cycle per minute (0·017Hz) when VR1 is suitably adjusted. If you next connect the output of the 555 to the built-in display system of the Test-Bed, the display changes once every minute, details in Fig. 8.3(b).

The RESET 00 button is used to set the display to zero at the beginning of a period that you wish to time. Thereafter the display counts from zero to 99. In short, this system can be used for timing events up to 99 minutes in length.

There is one small inaccuracy in this system. The operation of the 555 is not synchronised with your action in resetting the counter. This means that the first display change (from zero to "1") could occur *at any time* during the first minute.

This error (half a minute, on average) could be serious if you are timing relatively short periods, but is unimportant if you are using this circuit for purposes such as a parking meter reminder. Ingenious readers may like to discover a way of applying a low pulse to the reset of the 555 at the same time as the display reset button is pressed. The timer will then be fully accurate.

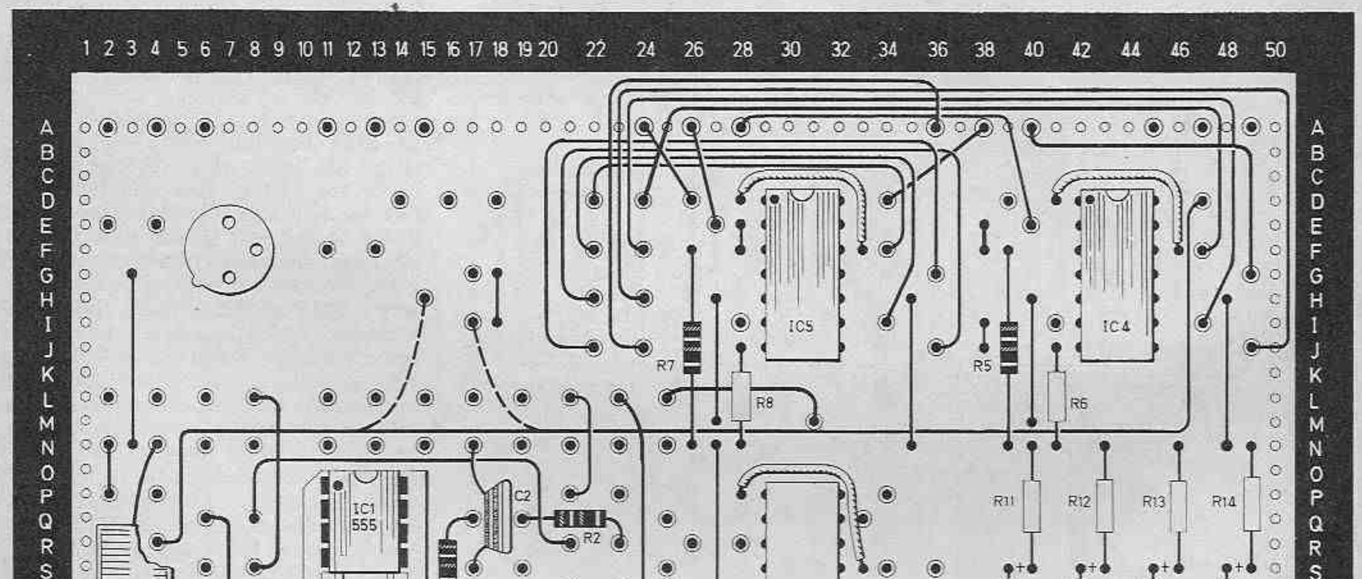


Fig. 8.3(b). The circuit of Fig. 8.3(a) wired up on the Test-Bed; S4 must be switched on.

STOP-CLOCK

Once again we can make use of units that we have already studied, but connect them together in a different way. To make a stop-clock we need only alter the values of the timing components of Fig. 8.3(a) to make the multivibrator run faster, and then interpose a latch between this and the counting/display system as indicated by dotted lines in Fig. 8.3(b). By suitable choice of values we can build stop-clocks of several ranges, see Table 8.1.

The way the stop-clock is turned on and off depends on the use to which it is to be put. For ordinary use we can simply use the in-built latch switch, resetting the display to zero at the beginning of each timing period.

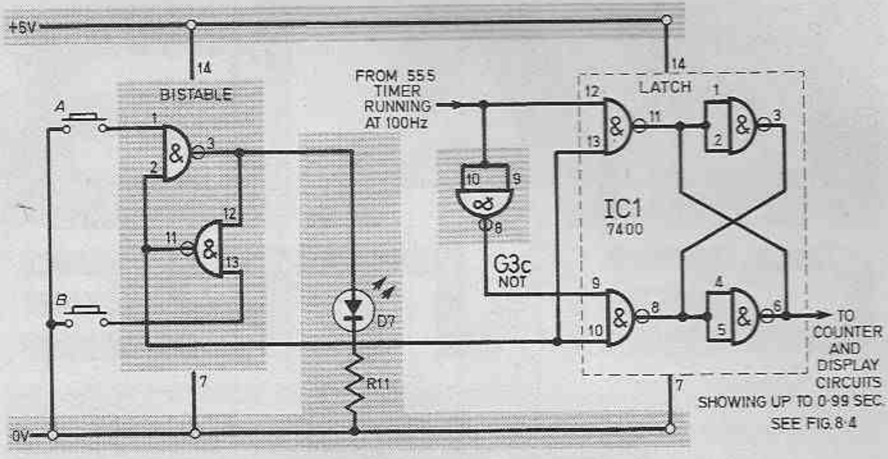


Fig. 8.4. Circuit diagram of a reaction timer.

Table 8·1 Timing Component changes for three stop-clock ranges

Timer Frequency (Hz)	Range (seconds)	Accuracy (seconds)	Timing Components C1	R1	R2	VR1
1	99	1	0·47μF	2·7MΩ	100kΩ	1MΩ
10	9·9	0·1	0·047μF	2·7MΩ	100kΩ	1MΩ
100	0·99	0·01	0·047μF	120KΩ	100kΩ	47KΩ

Instead of a push-button or toggle switch there are all kinds of ways of controlling the latch by linking it to the event that is to be timed.

In Fig. 8.4 a latch is controlled by a bistable. One person, unseen by the other presses button *A* without warning, causing the l.e.d. to light and the clock to start counting hundredths of a second. On seeing the lamp, the second person presses button *B*, so stopping the clock. The reading on the clock displays that person's reaction time.

In Fig. 8.5 the latch is controlled by a flip-flop, operated by the high-speed light sensor module (Fig. 7.10a last month). The first time the light beam is interrupted the output of the bistable goes low, causing the flip-flop to change state. This releases the latch and timing begins. The next time the beam is broken, the flip-flop changes back to its original state and timing ceases. Thus we have a lap-timer that can be used for timing the lap times of model slot-cars or other track events. **To be continued**

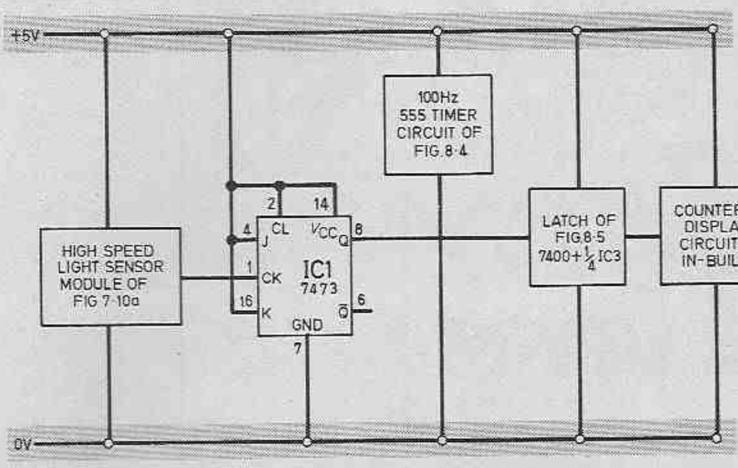
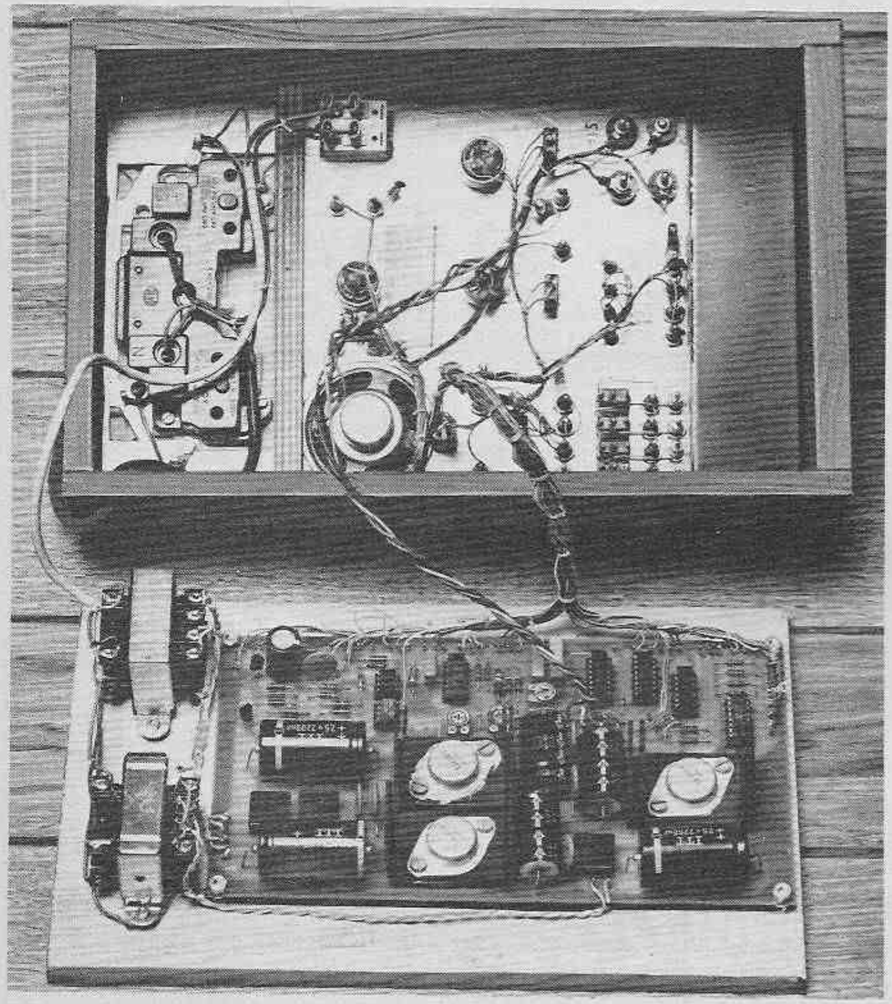


Fig. 8.5. Block diagram of a light triggered timer.

JACK PLUG & FAMILY...

BY DOUG BAKER

LAB CENTRE



PART 3

By R. W. Coles and B. Cullen

THIS month completes the construction of the Labcentre.

Dimensions and bending details of the component drawer incorporated in the console are shown in Fig. 3.1.

FRONT PANEL FINISH

On the prototype the front panel and the console frame were both finished using aerosol cellulose paints. At least three coats should be used, with sanding down between each coat, until a uniform and pleasing finish is obtained. Frame and front panel colours are of course the choice of the individual constructor but you are advised not to use a front panel colour which is too dark because black lettering and marking inks are easier to obtain than white!

To make Labcentre easy to use, its separate functions are clearly indicated on the front panel, using words, outline boxes, and where necessary, circuit schematics, see photographs. The lettering is applied using Letraset, and the symbols and outlines can be drawn using a dense drawing ink. It is of course this stage of the job which makes or breaks the finished unit as far as appearance is concerned, and we recommend a slow and careful approach to get the best results.

When lettering is complete, the front panel should be given several coats of clear polyurethane varnish to provide a lasting and durable, high gloss finish.

OVERALL ASSEMBLY

With the front panel completed, the controls and other front panel hardware can be fitted as shown in the underside view of the panel in Fig. 3.2. Note the fitting of larger solder tags under same socket fixing nuts.

Next carry out the interwiring between panel mounted components and soldertags. With the console base removed from the sides, mount the p.c.b. and the mains transformers with reference to the photographs and Fig. 3.3.

Nuts and bolts (4BA), rather than woodscrews, should be used to attach these components to the base, and this will necessitate drilling and countersinking to leave the bolt heads flush with the base lower face. The circuit board should be mounted after the transformers, and should be spaced above the base by means of a couple of nuts or spacers. Washers should be used wherever appropriate. Remember, a sturdy construction will pay dividends when you decide to take advantage of the portability of your Labcentre!

WIRING UP

The transformer wiring shown in Fig. 3.3 should be tackled next, using a solid or flexible p.v.c. wire rated at 2A or more. Next, with the base panel sited adjacent to the inverted frame fitted with the front panel, connect the wiring between the 13A sockets, the rocker switch, and the mains transformers with due regard to the lethal voltages which will be preset on these wires. Good quality well insulated flexible wire of 2A rating or greater is essential.

The wiring between the circuit board terminal pins 6, 7, 8 and 9 and the front panel power supply SK1, 2, 3 and 4 terminals can now be carried out using the same flexible p.v.c. insulated wire as was used for the transformer wiring. At this point it is a good idea to check that all is well with the mains wiring and the power supply circuitry. This can be done by applying the mains supply via a fused 13A plug, and checking that the required 5V, plus 15V and minus 15V

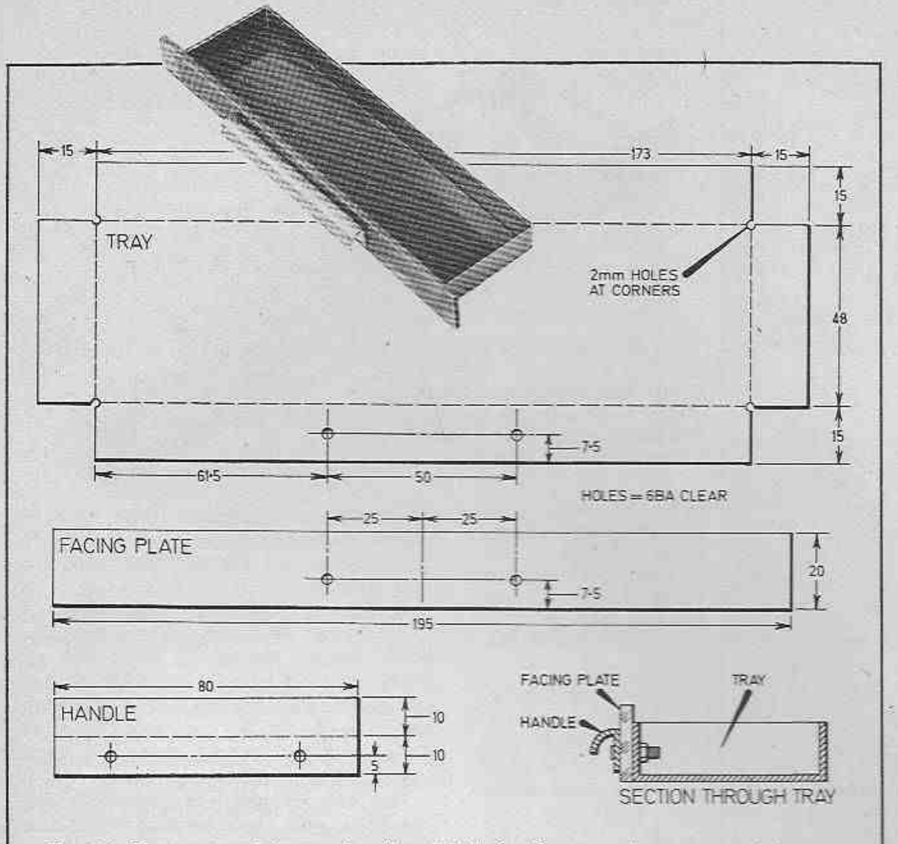


Fig. 3.1. Shows complete construction details for the console-component drawer.

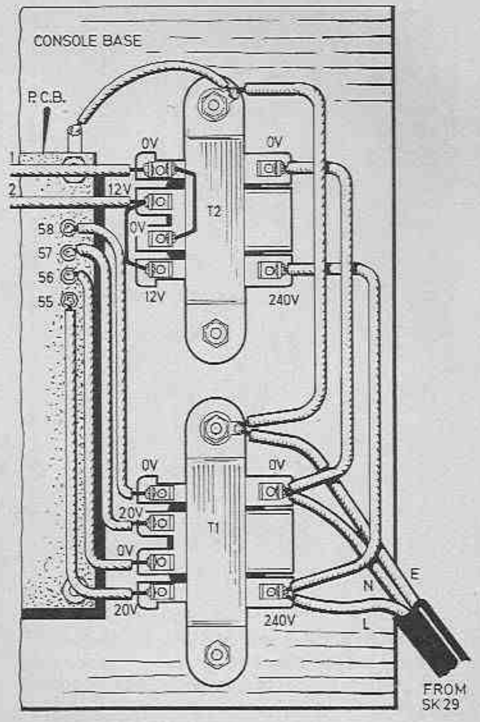
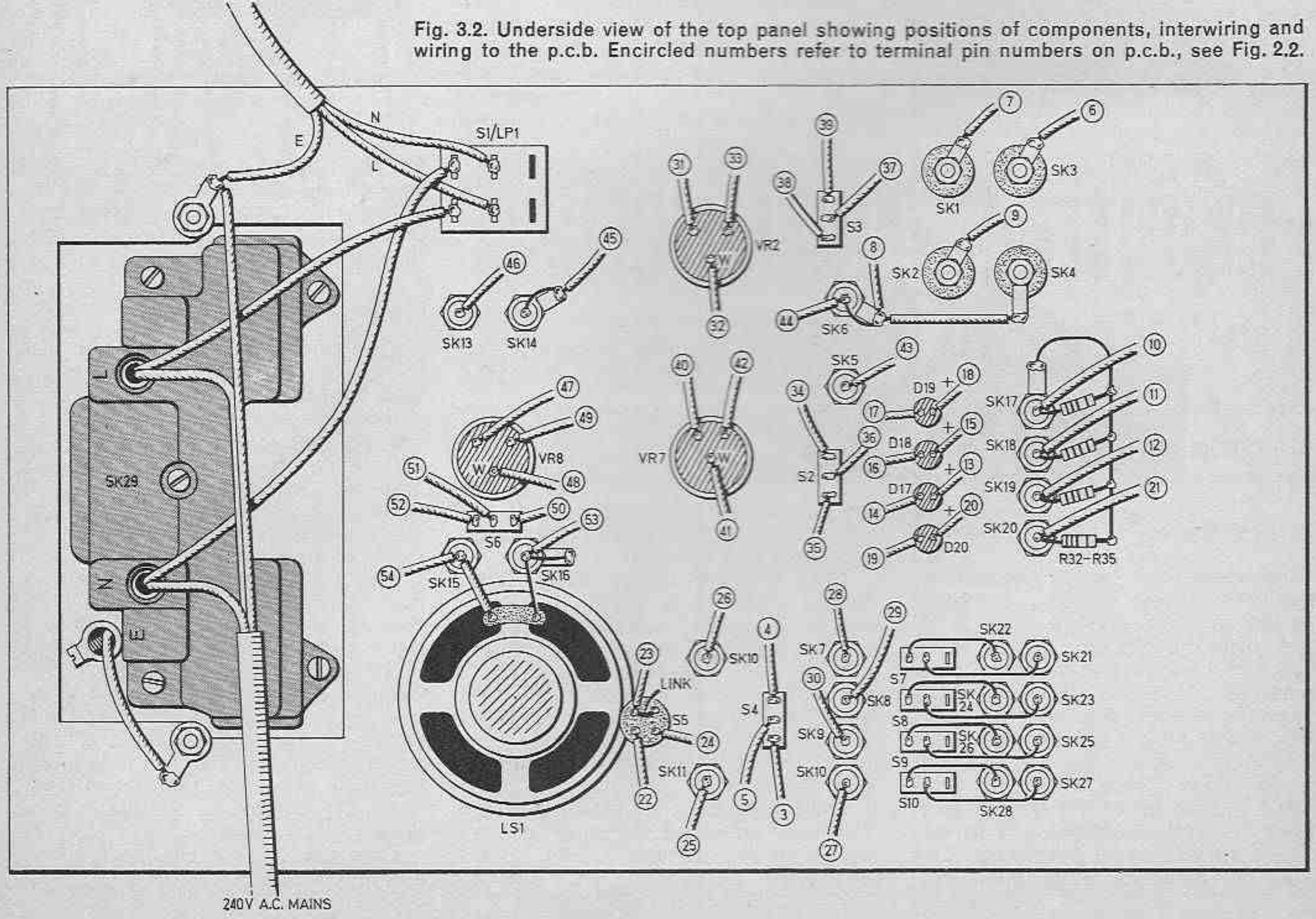
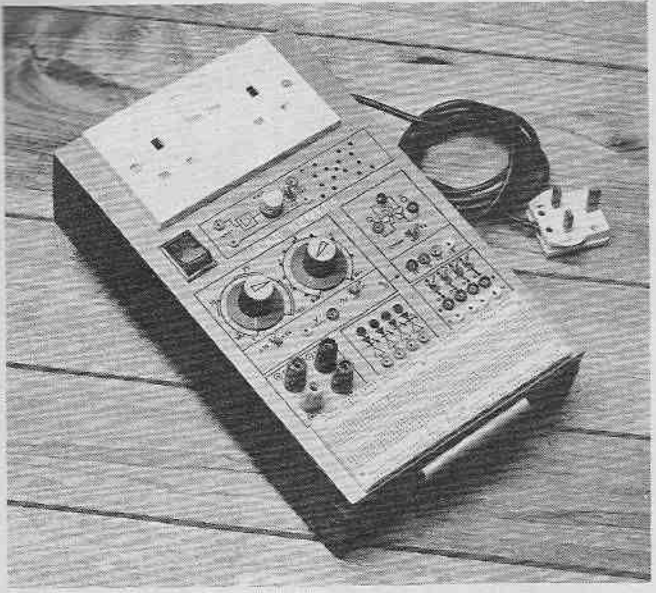


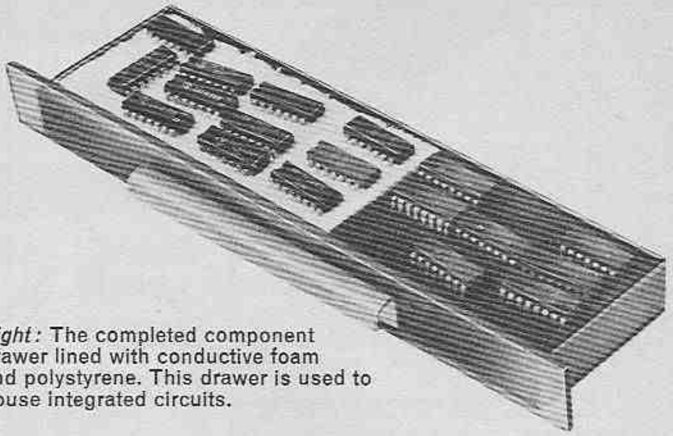
Fig. 3.3. Shows position of the transformer alongside the p.c.b. and wiring details. Note the use of solder tags for earthing purposes, particularly the one at the p.c.b. fixing. This must be in good contact with the earth plane on the board underside.

Fig. 3.2. Underside view of the top panel showing positions of components, interwiring and wiring to the p.c.b. Encircled numbers refer to terminal pin numbers on p.c.b., see Fig. 2.2.





Left: Completed console showing the front panel layout. The lettering is applied using Letraset, and symbols and outlines added with artists ink.



Right: The completed component drawer lined with conductive foam and polystyrene. This drawer is used to house integrated circuits.

supplies are all available on the front panel terminals.

Unplug from the mains before proceeding.

The next task is to wire the front panel controls etc, to the p.c.b. terminal pins.

There are 48 connections remaining to be made from components on the rear of the front panel to terminal pins 3 to 5 and 10 to 54 inclusive.

As can be seen from the photographs these wires are in four separate wiring looms (pins 3 to 5, 10 to 24, 25 to 30 and 31 to 54) which run into a single large loom. Deal with each sub-loom in turn and record the connections as they are made by crossing the appropriate terminal pin in Fig. 2.2.

All wiring should be kept as short as possible, consistent with accessibility and a tidy loom. Extra care is recommended during this phase to ensure that all connections are correctly made.

A flexible p.v.c. insulated wire of finer gauge than that used for the other wiring should be used for all loom connections to prevent undue strain on the soldered joints. Remember to make up the looms so that they do not impede front panel replacement or removal.

The unit is complete and ready for checking and then testing after the 48th connection has been made.

ERRATUM: In Fig. 2·2 diode D4 should be renumbered D13.

Next month: Testing and fitting out.

COUNTER INTELLIGENCE

By PAUL YOUNG

Burnt Offering

I suppose I am always advocating that if someone designs a better mousetrap let's change over to it and drop the old one; if not, let's keep what we have already got. For example consider the ordinary domestic toaster. Just after the War they were simple affairs but they produced nice evenly toasted bread. Then came the "pop up" which shot it up to the ceiling and gave you a choice of black or white. I have very recently purchased the latest in toasters. It is much the same, except it shoots the toast out sideways and hits you in the ear.

Here are the design faults. The timer, which is a simple bi-metal strip, is never constant. Surely today one might reasonably expect that it was replaced by a timing chip? The other fault is this. The toast is always burnt at the top. Don't toaster designers know that heat rises and they must compensate for this?

On the early post war toasters, this was achieved by spacing the wiring of the element further apart at the top. Looking at the element on my toaster I see it is equally spaced all the way up. It seems pathetic that a generation that can put men on the moon can not produce a satisfactory toaster.

Question Time

One of my greatest delights was the discovery that I have so many well informed readers. If I ask them a question in the electronic field I can be sure that a number of them will write to me with detailed answers. A question I have been pondering on lately is this. Has static electricity ever been made to perform any useful functions?

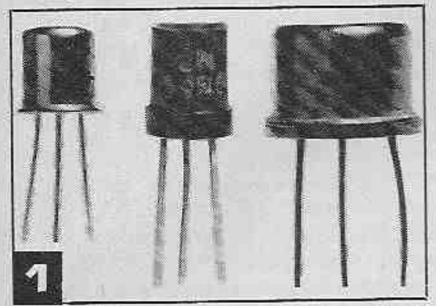
The first question to decide was how different is it from the type that is produced by a dynamo. I have put this question to one or two quite knowledgeable colleagues in a slightly different form, namely "What is the difference between static electricity and the ordinary sort and I do not mean just the way they are produced?" To date the question has only produced blank stares.

Can any of my brainy readers enlighten me?

SQUARE one FOR BEGINNERS

PRESENT day electronics owes everything to a three-legged device (in discrete form) called a *transistor*. The business part occupies only a tiny fraction of the volume, the remainder being protective encapsulation.

There are a huge number of different encapsulation and case geometries to suit particular mechanical and operating requirements. Three small-signal type transistors of different casings are shown in Fig. 1.

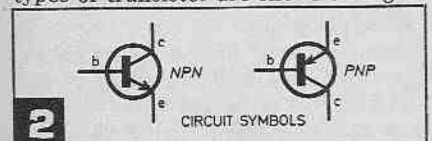


1

Transistors are made from "treated" wafers (or chips) of silicon or germanium—the latter being used less and less due to inferior performance compared to silicon devices.

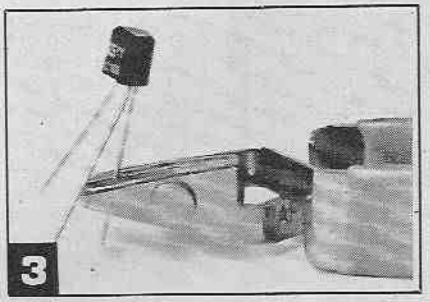
Depending on the "arrangement" of the treated sections a transistor is either a *pnp* or an *npn* device which determines its operating polarity. There are three distinct sections and these are called the *base, collector* and *emitter*. The three legs are connected to these sections.

The circuit symbols for these two types of transistor are shown in Fig. 2.



2

Transistors are sensitive to over-voltage and current and are easily destroyed. So extra care should be taken when positioning them on circuit boards. They are also sensitive to heat so swift soldering or the use of a heatshunt on the leads when soldering is recommended. Pliers can be used for this but a spring-loaded heatshunt is more convenient, Fig. 3.



3

Quite a selection of transistor types are used in constructional projects in EE, but in most cases each can be changed for other type numbers you may have in stock that have similar electrical characteristics, without affecting circuit operation. They may even have different pin-out arrangements and case styles, but the leads can easily be re-formed to suit.

TRANSISTOR CHARACTERISTICS

What characteristics are to be taken into account when deciding on a substitute is a question often asked.

The most important ones are voltage and current ratings. Manufacturers quote a parameter I_{Cmax} This is the maximum collector current that may pass before the transistor starts to suffer damage. A knowledge of currents flowing in the circuit would be useful in deciding on a replacement type, but if this is not known, select one with at least the maximum rating of the recommended type.

Transistor data sheets contain three voltage parameters: V_{CEmax} is the maximum voltage that is allowed across the collector/emitter under dynamic (operating) conditions before breakdown occurs; V_{CB} is the maximum voltage that can exist between collector and base before breakdown; V_{EB} is a much overlooked parameter, the maximum reverse voltage allowed across the emitter/base. In germanium transistors this can be quite high, but in silicon devices this is low being approximately 5 to 6 volts.

A transistor has two gains, h_{fe} and h_{FE}; h_{fe} is small signal current gain and h_{FE} large signal current gain. Due to production spreads you will find that a device gain is quoted either by its minimum and maximum gain (20-100) or by its minimum value only. The gain is defined as the ratio of collector current (I_c)/base current (I_b).

For low power devices, the base current is adjusted to obtain a collector current of 2mA when measuring gain.

A very important parameter is P_{TOT}, the maximum permissable power dissipation that can be tolerated before the internal "semiconductor junctions" overheat and destruct. This is equal to the product of the voltage between collector and emitter V_{ce} when collector current I_c flows.

This parameter is usually quoted for an ambient temperature of 25°C or, for power devices, case temperature maintained at 25°C.

Last but not least is f_T, the frequency at which the current gain drops to unity. This is particularly important for high frequency circuits when considering replacements.

Characteristics for some commonly used transistors, case styles and lead-outs are listed in Table 1.

TABLE: 1: Some common transistor types and their characteristics.

Type No.	Polarity	I_{Cmax} (mA)	V_{CE} (V)	V_{CB} (V)	V_{EB} (V)	h_{FE} *	P_{TOT} (mW)	f_T (MHz)	Case
BC107	*npn*	100	45	50	6	110	300	150	TO-18
BC108	*npn*	100	20	30	5	120	300	150	TO-18
BC109	*npn*	100	20	30	5	180	300	150	TO-18
BC182L	*npn*	200	50	60	5	240	300	120	TO-92
BC194L	*npn*	200	30	45	5	240	300	150	TO-92
BC212L	*pnp*	200	50	60	5	50	300	200	TO-92
BC214L	*pnp*	200	30	45	5	125	300	200	TO-92
BFY51	*npn*	1000	30	60	6	40	800	50	TO-5
2N2926/g	*npn*	100	25	25	5	235	200	100	TO-98
2N3702	*pnp*	200	25	40	5	60	360	100	TO-92
2N3704	*npn*	800	30	50	5	300	360	100	TO-92
ZTX300	*npn*	500	25	25	5	50/300	300	150	E-Line

All silicon devices
* Minimum values only with exception of ZTX300

MICROPROCESSOR BASICS

3

By R. W. Coles

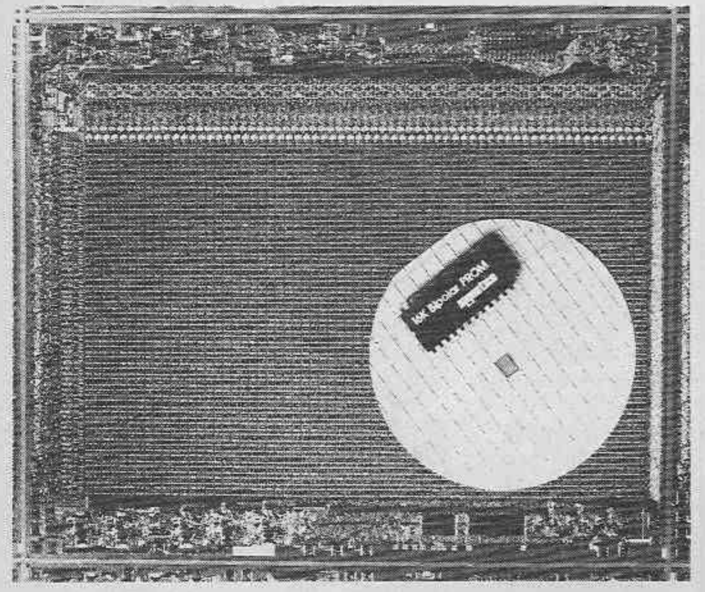


Photo micrograph of the Signetics (Mullard) 16K Programmable ROM (see Fig. 3.2) with inset photo's of one silicon slice which contains around 100 individual chips and an encapsulated chip—the final device.

Last month we had a look at microprocessor *systems*, and went on to consider the microprocessor chip itself. We saw how the microprocessor could send out an address from the program counter, and how this address was used to "point" to the next instruction word stored in program memory. The instruction word is "fetched" by the microprocessor and then "executed" by appropriate use of resources such as the Arithmetic and Logic Unit and the internal registers.

We also saw that other registers, apart from the program counter, could be gated on to the address bus to access not *instructions*, but *data* during the "execution" part of a cycle.

Program memory and data memory are usually external to the microprocessor chip itself, and other essential external components are the so-called input/output "ports" which allow the microprocessor to communicate with its environment. It is now time for us to consider these important elements of a microprocessor system in more detail.

NON-VOLATILE MEMORY

Many microprocessor systems perform "dedicated" functions. Control of a traffic light system or a washing machine, for example. Well, obviously for jobs like these we do not want to have the policeman or housewife loading a paper or magnetic tape based program into the system every time the power is turned on!

For controller jobs such as these we need the program to be an integral and unalterable part of the system, and so we put it in a Read Only Memory or ROM. Once the program is entombed in a ROM, it will stay there for as long as we like, whether the power is on or off. ROM storage is therefore "Non-Volatile" and ideal for fixed program storage.

Some *data* may also need the same treatment. Consider the washing machine controller. Its program may need access to data which describes the temperatures or washing times for different fabrics, and once again these must not be lost when power is removed and so a ROM is used.

READ/WRITE MEMORY

Data stored in a ROM must be *constant* data, but of course most systems also need to handle *variable* data also and these will need to be kept in *alterable* memory so that the current value of a variable can be stored and retrieved whenever necessary. An obvious variable for the traffic light system would be "time", but the system may also need to store data on the number of cars arriving in a particular direction, the current light status and so on. Washing machine variables could be the weight of the current load, actual temperature of the water in the drum, and also elapsed time.

Variable data is stored in Read/Write memory, and this is usually referred to as RAM. RAM actually stands for Random Access Memory, which is unfortunate because ROMS are also accessed in a random (rather than sequential) fashion. All you can do about this confusing situation is to mentally translate RAM into Read Write Memory, after that, it's easy!

Read/Write Memory can be thought of as a very large array of flip-flops or bistables, each of which can "remember" one binary bit. A microprocessor system needs to access the data on a word-by-word rather than a bit-by-bit basis, and so microprocessor Read/Write Memory is organised as an array of words, each word being separately addressable.

As anyone who has tinkered with TTL or CMOS flip-flops will know, when the power is turned off, the previous state of the flip-flop is lost. This "amnesia" also occurs with microprocessor RAM, making it unsuitable for the storage of system constants or fixed programs. Variable data on the other hand is generated anew when power is applied, and also has to be changed from time to time. For variables therefore, RAM is ideal.

PROGRAM R.A.M.

If RAM was only needed to store variables, most systems would not require very much of it, some would even be able to make do with only their internal registers, and yet some microprocessor systems are advertised as having "32K bytes of RAM" or more. Why is this?

Well, our traffic lights and washing machine can certainly make do with very little RAM, but some systems need to be able to change their programs, either for development purposes or because they are general purpose systems which need frequent program changes. In these systems RAM is used to hold programs as well as data, and so a lot of RAM is necessary.

To most microprocessors, RAM and ROM appear identical, so they can have any appropriate mixture depending on the job they have to perform. Only the programmer needs to know where in the address range of the microprocessor the two types of memory can be found.

To sum up then, programs can be stored in ROM (for dedicated applications) or RAM (for general purpose use). Data can be stored in ROM (for constants) or RAM (for variables).

READ ONLY MEMORIES

ROMS are an essential part of most microprocessor systems, and they are available in a wide variety of sizes and types. Like microprocessors, ROMS are complex integrated circuits and they are currently available in sizes of up to 64K bits each.

The 64K device is the largest ROM presently available, and you can see that a very large program can be stored in this chip when you consider that the 64K is organised as 8,192 eight-bit words. (Most microprocessor instructions consist of one, two or three eight-bit words.) All of this is packaged in a 28-pin dual-in-line package with thirteen address pins, eight data-out pins, three chip-select pin and two power supply pins. Fig. 3.1.)

The cheapest way to get your program into a ROM is to let the ROM manufacturer build it in when he makes the silicon chip. This is called "mask programming" because the final photographic mask used in the chip fabrication process is made up to your program's requirements. There is one small snag. It will be necessary to purchase over one thousand of the resulting ROMS to take advantage of this low cost method! For hobby use this isn't on of course, and so back to the drawing board!

P.R.O.M.S.

To overcome the need for mass production, the chip manufacturers have designed ROMS which arrive at your door unprogrammed. Using these chips, the final programming step can be carried out in the comfort of your own home or workshop. These ROMS are referred to as PROMS (the P stands for programmable) and there are many varieties available.

There's still a snag I'm afraid. To program these devices you will need a "PROM programmer" unit. This applies the correct voltages and timing pulses to the chip to persuade it to accept your program. Programmers are not cheap, although it *is* possible to build your own which can act as an accessory to a simple microprocessor system. This possibility is getting more practical as the semiconductor manufacturers make their PROMS easier to program.

One of the most common PROM technologies is called "Fusible link." In this case the PROM is manufactured with a logic one in each bit cell, the state being programmed by means of a shorting link made of metal alloy or silicon. To program the logic zeroes where you need them, the trick is to apply accurately timed high-current pulses which have the rather dramatic effect of destroying the appropriate links—just like fuses. (Fig. 3.2.) Another PROM family relies not on *blowing* links, but *growing* them by means of a technology called "Avalanche Induced Migration."

As you may have guessed, a big problem with PROMS is that if you

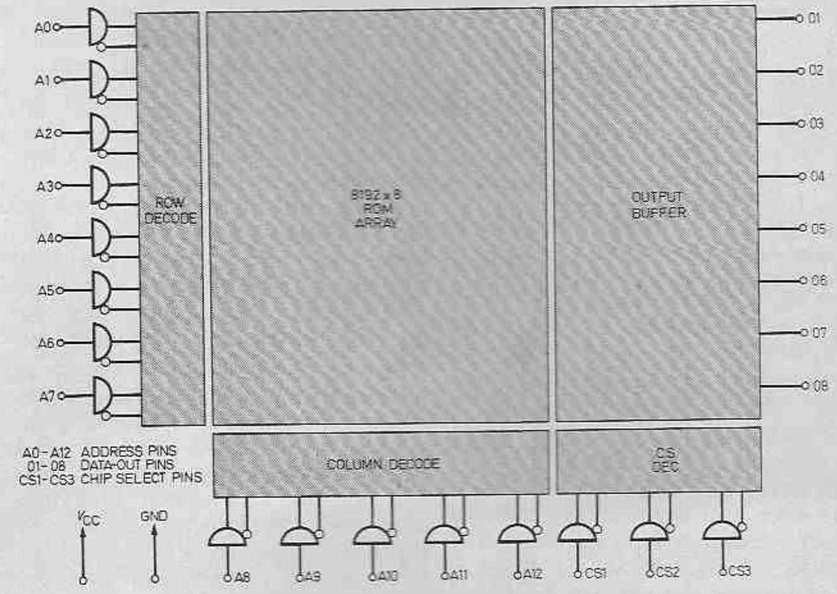


Fig. 3.1. The National Semiconductor MM5235 Read Only Memory. An example of the largest ROM currently available.

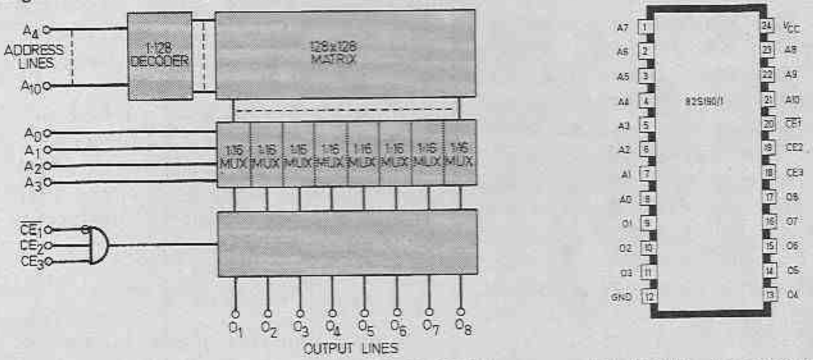
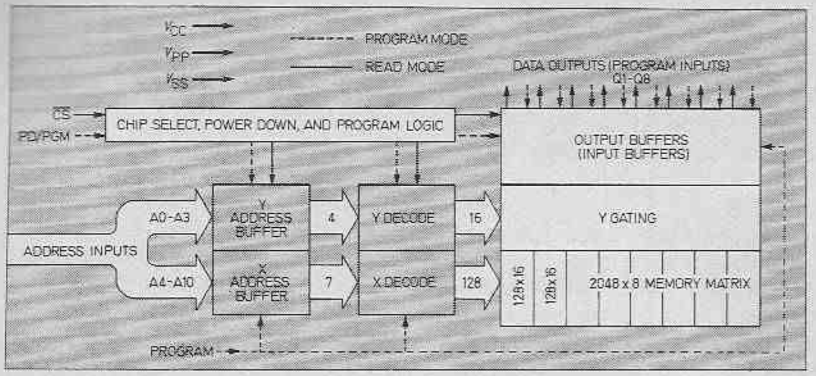


Fig. 3.2. The Signetics (Mullard) 82S190 16K Programmable ROM. An example of a fusible-link device, for field programming.



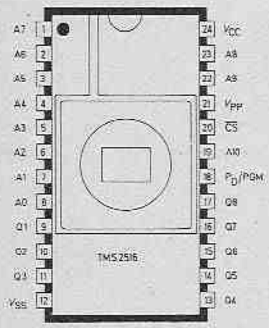
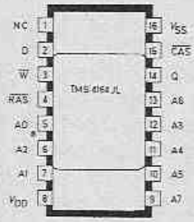


Fig. 3.3. (above and left). The Texas Instruments TMS 2516 16K EPROM. This ultraviolet light erasable electrically programmable read-only memory is ideal for use in microprocessor systems.

Fig. 3.4 (right). The Texas Instruments TMS 4164 65,536-bit Dynamic Random Access Memory. "Refreshing" is required to prevent data loss.



make mistakes during programming, you can't erase the mistake and start again—blowing fuses is for keeps! This disadvantage makes this type of ROM less than ideal for microprocessor work where a program will probably evolve through many stages before it can finally be called "finished."

E.P.R.O.M.s

To solve the problem of wasted PROMS, semiconductor manufacturers have developed a radically different technology which allows you to erase mistakes and old programs over and over again. These memory components are called Erasable, Programmable, Read Only Memories, or EPROMS, and it is this type of ROM chip which is best for hobby use.

You still need a programmer, but some of the new EPROMS such as the 2516 from Texas (Fig. 3.3) are so easy to program that your microprocessor can be used to do the job. The only other necessary facility is a 25 volt supply, and that's only needed during programming, the chip normally runs from a five volt supply.

But if these chips are erasable, you may wonder, how can we be sure our program will be safe? The answer is that the erasure operation requires the application of high intensity short-wave ultra violet light for some tens of minutes, a combination never likely to occur in normal operation, even in direct sunlight.

To use these devices you will need an erase light system to go with your programming facility, but once again these are easy to put together, and require only the purchase of a special UV lamp and some wood or metal bashing! A word of warning though, short wave UV light can be harmful to people, so the lamp must be used inside a light-tight box.

If all this talk about programmers and erasers is putting you off micro's, remember that you don't *have* to have these facilities because programs *can* be stored in RAM, an ideal form of storage while you are learning about hardware and software, and all you may ever need if programming becomes your source of enjoyment.

Finally, if you want to find out how a ROM or PROM actually works, and how address selection operates in both ROM *and* RAM read next month's panel feature "Build your own ROM."

R.A.M.

RAM if you remember, is synonymous with Read/Write memory, and like ROM, it comes in all sorts of varieties and sizes. There are two main types, Static and Dynamic, and a quick look at the differences will help to avoid costly purchasing mistakes!

Static RAM uses storage cells for each bit which are based on cross coupled latches, just like the TTL or CMOS flip-flops you may have used in the past.

Dynamic memory is quite different and relies on the storage of a voltage representing a logic one or zero by means of a small *capacitor* in each cell. The advantage of the dynamic design is that it needs fewer transistors per cell and is therefore smaller, faster and cheaper. In effect you get more memory for your money.

Before you rush out and buy any dynamic chips, though, let me tell you about a small problem! The dynamic memory cell *forgets*. In fact it can only remember things for 2 milliseconds or so! This rather unfortunate behaviour stems from the use of a leaky old capacitor for storage, and memory systems using this type of chip have to go round to each cell at least every 2 milliseconds to rewrite the data and hence prevent data loss.

This all sounds pretty horrible but in fact for large memories the dynamic devices are very cost effective because the extra hardware needed to carry out the "Refresh" operation as it is called, can be shared among all the chips in the system.

To see why dynamic memory is attractive despite its problems, have a look at the new Texas device which crams no less than 65,536 bits, all individually addressable, into a tiny 16-pin package! (Fig. 3.4.)

NOT RECOMMENDED

Having demonstrated that dynamic RAM is a good idea for some purposes, I think it only fair to say that I can't really recommend it for hobby use unless it comes as part of a fully designed memory board, for a home computer say.

For most hobby purposes memory sizes are small, and static RAM is therefore ideal, being easy to use and more tolerant in its power supply and timing requirements.

To be continued

By Dave Barrington

Catalogue

When Maplin Electronic Supplies first introduced their now famous components catalogue in 1973 it immediately jumped to the UK number one spot in popularity amongst readers, and also set the standards for other component suppliers to maintain. This position would seem to be strengthened with the introduction of their latest catalogue and must make them strong contenders for the number one spot in Europe, including the UK.

The new edition has been increased in size to 280 pages and includes 30 pages in full colour. We did not think it possible for Maplin to add many more products to their range but they have listed over 450 new items. This does not include new semiconductor devices and the expanding area of microprocessors which brings the grand total of new lines to well over 1000.

Over 50 pages are devoted to the Semiconductor/Microprocessor sections. For the constructor there are 14 pages of project kits, with circuit diagrams, ranging from a 150W power amplifier to a model train controller.

The 1979/80 Maplin components catalogue is a good investment for 75p (£1 overseas) and they also back up the catalogue with a bimonthly newsletter which contains the current prices and lists special offers. All prices quoted in the newsletter are guaranteed until a new issue is published.

The newsletter/price list is available on a subscription basis and cost 30p for six issues. For overseas customers the price is as follows: Europe 60p; non-European countries 60p surface mail and £1·20 airmail.

To help recover the cost of the catalogue and save on components vouchers are issued with most orders over £2. Also, each issue of the newsletter carries a 5p voucher.

Further details and copies of the 1979/80 catalogue can be obtained from Maplin Electronic Supplies Ltd, see back cover.

Power Supply

Further feedback from readers on the *General Purpose Power Supply* shows that readers are still having difficulty in obtaining the CA3085 voltage regulator.

We understand that Magenta Electronics are supplying a d.i.l. version together with an i.c. socket (with long connecting leads) for mounting on the Veroboard. The i.c. costs £1·15 and the socket 21p. A minimum order charge of 25p must be added.

The equivalent LM305H is also available from ACE Mailtronix Ltd, Dept EE, Tootal Street, Wakefield, Yorks WF1 5JR at an inclusive cost of £1.

Shaver Inverter

Please note that Davian Electronics, are NOT supplying parts for the *Shaver Inverter*. They were mentioned in last month's Shop Talk due to an editorial misunderstanding, and we apologise to Davian Electronics and to readers for any inconvenience this error may have caused.

Ace Mailtronix, Wakefield and other advertisers should be able to supply complete kits or individual parts for the *Shaver Inverter*.

Constructional Projects

Just a couple of pointers regarding the availability of components for this month's constructional projects need further comment.

Thermostat for Photographic Solutions

New to this magazine is the LM3911N temperature controller/thermometer i.c. called for in the *Thermostat for Photographic Solutions*. Being a rather unusual device this may prove difficult to obtain, but we have found that your local Tandy store, Maplin and Watford Electronics stock this item.

Electronic Dice

The Minitron displays specified for the *Electronic Dice* may be obtained from Electrovalue. Cost for both displays including VAT and postage is £5·13.

Intruder Alarm

When constructing the *Intruder Alarm* the space within the specified case is critical and it is adviseable to use the miniature toggle switches called for in the article. The audible warning device in the prototype was rather expensive and we suggest one of the many alternative buzzers be used.

EE CROSSWORD No 15

BY D. P. NEWTON

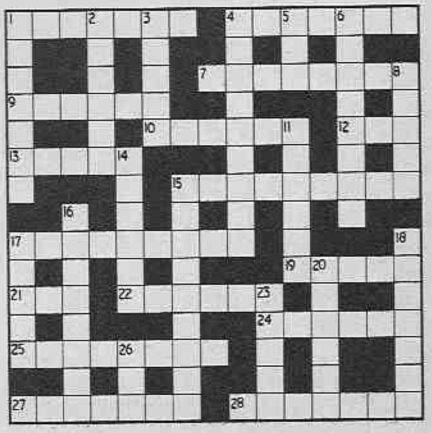
ACROSS

1 One who follows electrical paths, often through carbon deposits.
4 The flasher's aftermath?
7 Prejudiced towards a personal potential (4,4).
9 Loudspeaker screen.
10 Characters not to be trusted.
12 Drinking partner for tiffin.
13 Dodge.
15 Would such a circuit keep our feet under cover?
17 Fittings suitable for the attachment of components.
19 Switch to original state.
21 Nervous twitch.
22 Low person having a shared circuit.
24 Badge of sorts.
25 A hi fi fanatic must be one of these.
27 Leaving points.
28 A slow loss of charge.

DOWN

1 To start a horse's pulse?
2 Wired.
3 A soporific wave transporter.
4 Quavering.
5 Rapid vibrations in their initial state.
6 Charge carriers with nowhere to go.
8 Mischievous current?
11 Nearly a close relative in the transistor.
14 Core it for arousing display (Anag.).
15 Computers do it all in military style, like this (2,7).
16 Cement for emergency jobs (5,3).
17 Characteristically full of loosely bound electrons.
18 To render minute.
20 To begin a journey in an ark?
23 Circuit connector in body.
26 Electromotive force will shortly indicate the initial parts of this once-flighty animal.

Solution on page 305



Short Wave

CONVERTER

By R. A. Penfold

When most people become interested in short wave reception they choose to build their own receiver, this usually being of the t.r.f. variety.

While this type of receiver is capable of excellent performance and is relatively simple and inexpensive to construct, it does have disadvantages in terms of performance and convenience of use when compared to a superheterodyne receiver. Unfortunately, the complexities of a superhet make this type of set beyond the capability of most newcomers to electronics.

CONVERTER

There is another, and perhaps less common approach to commencing s.w. reception, and this is to use an ordinary medium wave superhet receiver in conjunction with a s.w. converter. Here an aerial is connected to a unit which can be tuned across the s.w. bands, with the received signals being converted to a frequency on the m.w. band. These signals are then picked up by a m.w. receiver which is tuned to the output frequency of the converter. Thus, in effect, a m.w. receiver is converted to a s.w. one.

This type of set up is not ideally suited to amateur bands reception due to the widespread use of s.s.b. and c.w. on these bands (an ordinary m.w. set cannot resolve these types of transmission without modification), but the author has obtained really excellent results on the s.w. broadcast bands using such a combination.

The subject of this article is a simple two transistor converter which covers a frequency range of approximately 4·5 to 15MHz, and has an output frequency of about 1·6MHz at the high frequency end of the m.w. band. Included in the converter's coverage are most of the popular s.w. broadcast bands, namely the 19, 25, 31, 41, and 49 metre bands.

Use of a long aerial is not essential and quite good results can be obtained using an indoor aerial. No direct connection is made to the m.w. receiver, and there is no need to modify the set in any way whatsoever.

OPERATING PRINCIPLE

Operation of the converter is based on the *heterodyne* principle and the unit is rather like the initial stages of a superhet receiver. Whereas in a normal receiver the output of the mixer would be fed to the i.f. stages of the set, here the output of the mixer is coupled to a m.w. receiver which provides the necessary amplification, detection, etc.

The block diagram in Fig.1 illustrates the operation of the device.

The aerial signal is fed to a tuned circuit which accepts signals at or close to the required reception frequency but rejects all others. The output from the tuned circuit is fed to one input of a mixer, and the output from an oscillator is fed to the other input.

In the mixer the two signals are "heterodyned" to produce two new frequencies at the output, in addition to the two original ones. The new signals are the *sum* and *difference* frequencies. In this case it is the difference signal that is of interest.

The oscillator frequency is always 1·6MHz above the input frequency, so that a difference signal of 1·6MHz is always produced at the output. In this way the s.w. input signal is converted to a frequency of 1·6MHz.

MIXING

A simple mathematical example is given in Fig.1. Here it is assumed that a 10MHz signal is being picked up.

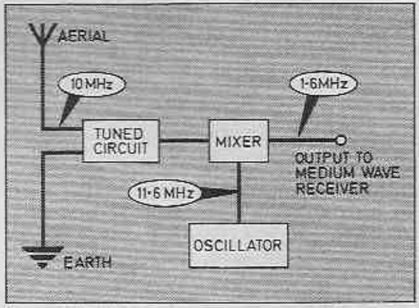


Fig. 1. Block diagram showing the various stages of the converter and the principle of operation.

The oscillator is at 11·6MHz and this produces output frequencies of 1·6MHz (11·6−10), 21·6 (11·6+10), 10MHz, and 11·6MHz. A m.w. receiver tuned to 1·6MHz will obviously only respond to the 1·6MHz signal and the other output signals are of no significance.

The oscillator could be adjusted so that it is always 1·6MHz *below* the input frequency (10−8·4=1·6), but it is conventional to have the oscillator frequency above the reception frequency. The input tuned circuit is an essential part of the design, as without it the unit would be simultaneously receiving

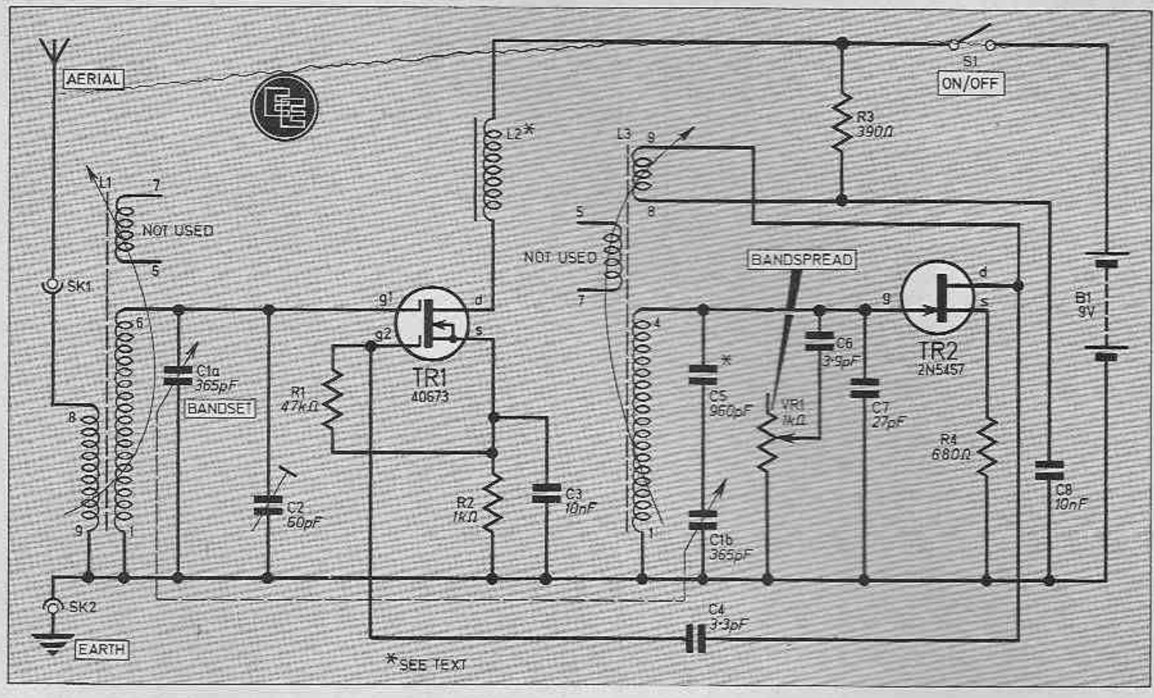


Fig. 2. Complete circuit diagram of the Short Wave Converter.

on two frequencies (11·6−10=1·6 and 13·2−11·6=1·6). The tuned circuit is required in order to reject the higher reception frequency, or "image signal" as it is termed.

CIRCUIT DESCRIPTION

The complete circuit diagram of the Short Wave Converter appears in Fig.2. Transistor, TR1 is the heart of the design and this is a dual gate mosfet which is used as a mixer.

The aerial signal is coupled to the tuned circuit via the primary winding of L1. The mosfet has a very high input impedance at its g1 terminal and the tuned circuit can be coupled direct to this. The coil normally has a base coupling winding, but as a f.e.t. is used this winding becomes redundant.

Resistor R2 is the usual source bias resistor and C3 is its bypass capacitor. Capacitor C1a is the tuning capacitor for the input tuned circuit and C2 is an alignment trimmer. The gain of TR1 at its g1 terminal can be varied by altering the voltage at its g2 terminal. The g2 terminal is biased about 1V positive of chassis by being connected to the source terminal by R1.

The oscillator output is connected to the g2 terminal of TR1, and so the gain of TR1 varies in sympathy with the oscillator signal. The oscillator thus modulates the aerial signal and produces the necessary mixing action.

The resultant output is developed across L2 which is a homemade choke. The output signal is radiated in the vicinity of L2 and if this is placed near the ferrite aerial of a m.w. receiver, this receiver will pick up the s.w. input signal. This provides about the simplest possible "interface" between the converter and the receiver.

OSCILLATOR

The oscillator is a simple design using a jugfet TR2. Positive feedback is provided between TR2 drain and gate by L3. The second half of the variable capacitor, C1b is the oscillator tuning capacitor. Capacitor C5 is a padder capacitor and is needed to ensure correct tracking between the oscillator and aerial tuned circuits. In order to obtain the correct frequency coverage a small amount of fixed capacitance must be added across the tuned winding of L3. This is provided by C7.

The variable control, VR1 and C6 form a bandspread "capacitor" and can be used to adjust the oscillator frequency slightly either side of its nominal frequency. It thus acts as a fine tuning capacitor, and this is a very useful feature as tuning over the very crowded s.w. bands can be very difficult using C1 alone. When a bandspread control is fitted to a receiver or converter, the tuning control is usually termed a "bandset" control.

Resistor R4 is the source bias resistor for TR2, and adequate gain is obtained without bypassing this component. In fact performance suffers if this resistor is bypassed, as this produces higher harmonic signal levels at the output of the oscillator, and this gives the converter increased spurious responses.

The small capacitor C4 couples the oscillator to the mixer and also provides d.c. blocking. Resistor R3 and C8 are a supply decoupling network, and S1 the on/off switch.

Note that L3 is not designed for use in this particular oscillator configuration, and has a third winding which is not used in this application. The coil manufacturer recommends a padder capacitor value of 960pF. As far as the author is aware, no such value is available to the amateur. It is therefore necessary to use two or more capacitors in parallel to make up the required value. The author used two 470pF components in parallel (940pF) and this seemed to be near enough.

The unit has a current consumption of only about 3mA from a 9V (PP3) battery, and is therefore very economical to run.

Short Wave CONVERTER

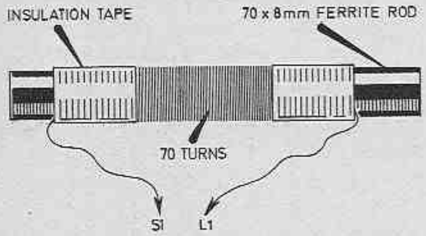
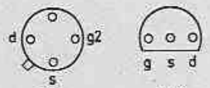
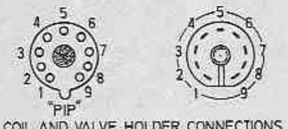


Fig. 3. Construction of the coupling coil L2. The coil is a single layer using 32 s.w.g. copper wire.



UNDERSIDE VIEW



COIL AND VALVE HOLDER CONNECTIONS (LOOKING AT PINS)

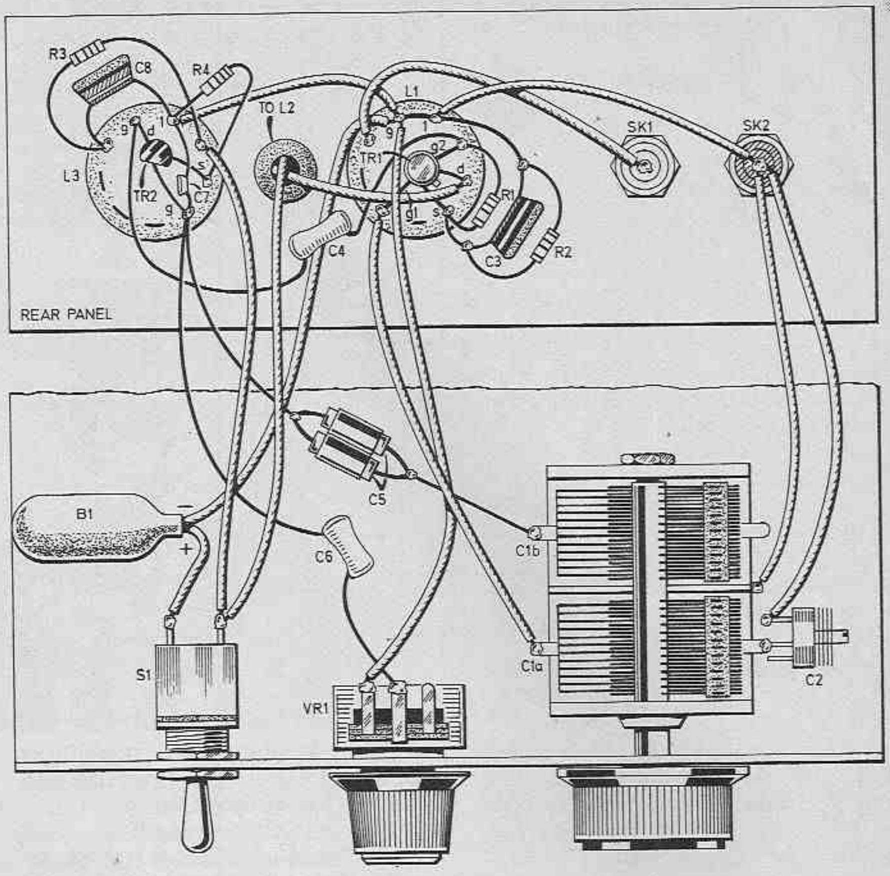
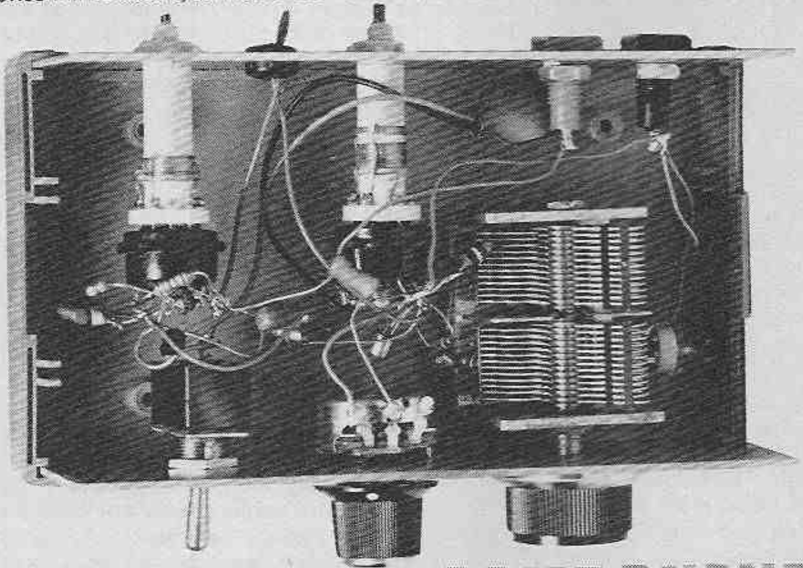


Fig. 4. Complete wiring details for the converter. Most of the components are mounted on the coils directly. When soldering TR1 be sure to leave the shorting clip in place, otherwise the device will be destroyed. Remember however, to remove it before switching on!



COMPONENTS

Resistors

R1 47kΩ
R2 1kΩ
R3 390Ω
R4 680Ω
All carbon ¼W ± 10%

Potentiometer

VR1 1kΩ lin. carbon

Capacitors

C1a,b 365 + 365pF air spaced variable (Jackson type 00)
C2 60pF plastic dielectric trimmer
C3 10nF plastic
C4 3·3pF miniature ceramic
C5 960pF (see text)
C6 3·9pF miniature ceramic
C7 27pF ceramic plate
C8 10nF plastic

Semiconductors

TR1 40673 *n*-type mosfet
TR2 2N5457 *n*-channel f.e.t.

Miscellaneous

L1 Denco Range 4T Yellow or Blue coil for transistor usage
L2 Coupling coil (choke—see text)
L3 Denco Range 4T White coil for transistor usage
SK1, 2 4mm sockets (two off)
S1 single pole toggle switch
B1 9V PP3 battery
Small plastic case 150 × 100 × 50mm or similar; two B9A valveholders; battery connector to suit B1; two small control knobs; ferrite rod, 70 × 8mm; 32 s.w.g. enamelled copper wire; small container for L2; connecting wire.

COMPONENTS approximate cost £7 excluding case

CONSTRUCTION starts here

CHOKE

The choke L2, is home-made and is wound on a 70×8mm length of ferrite rod. It has 70 turns in a single layer with the ends of the winding secured to the rod by bands of insulation tape. Either 32 s.w.g. enamelled or d.c.c. wire is used depending on what is already available, and details of the choke are given in Fig. 3.

This is not a tuned winding and is not critical with regard to size of rod, wire thickness, or even the precise number of turns. Many constructors will probably be able to make a suitable unit using items from their junk box.

CASE

The unit can be constructed in any case measuring about 150×100×50mm, but the case must not be much smaller than this. Components S1, VR1 and C1 are mounted in a line along the front panel. The bandset capacitor is not actually fastened to the front panel, but is secured to the base of the case by two 4BA bolts. These pass through holes drilled in the bottom of the case and into threaded holes in the bottom of C1.

Spacers or washers are used to hold the component at the right height, and to prevent the screws from penetrating too far into it and fouling one of the sets of plates.

The two coils and the aerial and earth sockets are mounted on the rear panel. This general arrangement can be seen from the accompanying photographs. A hole is drilled in the rear panel between the two coils and this takes the output leads to L2.

This is mounted in a small box by itself, and it is simply glued in position inside this.

WIRING

A point to point wiring system is used, and details of this are shown in Fig.4. It is not a good idea to solder direct to the pins of the coils as this will cause the plastic coil formers to melt. Instead, a B9A valveholder is pushed onto each coil base, and the connections are made to the holder.

Some components are mounted solely on one or other of the coil holders, and it is advisable to solder these into position prior to fitting the coil holders onto the coils. Then the other wiring is completed.

Tin with solder the ends of component leadout wires and tags, and good soldered joints should be obtained.

AERIAL AND EARTH

A suitable aerial for the converter is a length of wire which is as long as possible and placed as high as possible. Ideally an outdoor aerial 15 metres or more long should be used, but an indoor aerial consisting of say, 6 metres of wire in the loft, will provide good results.

An earth can consist of a metal pipe buried at any convenient spot with a lead connecting it to SK2. An earth is by no means essential though.

(A suitable installation was given on page 149 of the March issue.)

ALIGNMENT AND USE

The coupling coil L2, must be placed fairly close to the m.w. coil of the receiver if an efficient signal transfer is to be obtained. Usually the ferrite rod is situated towards the top of a receiver, and it is merely necessary to place the box containing L2 on top of the set at the appropriate point. If it should be necessary to place the coil at some other spot on the receiver, double sided tape can be used to hold it in place.

As supplied, the cores of L1 and L3 are screwed right into the former. Initially these are unscrewed so that about 10mm of metal screwthread protrudes from the top of each coil.

Turn the receiver on and tune it to the extreme high frequency end of the m.w. band. Try to find a tuning point that is free from stations, and remember that a ferrite aerial is directional, and the set can be turned to null a station if necessary.

Connect an aerial, and if required an earth to the converter and switch the unit on. Set the bandspread control at a central position and then try to tune a few stations using C1. When a station is picked up, adjust the core of L1 to peak this. It should then be possible to tune many stations.

Tune to one at the h.f. end of the band (C1 vanes unmeshed) and then adjust C2 to peak this signal. Tune to one at the other end of the tuning range and adjust the core of L1 to peak this station. Go back to the h.f. end of the range and repeat this whole cycle a few times until no further improvement in overall performance can be obtained.

NO SIGNAL

If no signals at all are received, then this is probably due to the oscillator not working. Slight adjustment of the core of L3, while tuning as normal with C1, should remedy this.

This completes the alignment and the unit is ready to use.

The m.w. receiver must always be tuned to the same frequency when it is used with the converter. If a significantly different one is used it will be necessary to realign the converter to suit the new output frequency.

Provided the m.w. receiver used has a reasonable performance, excellent results should be obtained and worldwide reception is possible. ⌑

How to use the Converter with a transistor radio. Note the position of the coupling coil. This is near the internal ferrite rod, and *in line* with it.

Everyday News

THE ALL-ELECTRONICS SHOW 1979

JAM-PACKED, that just about describes the three days of the "All-Electronics Show" this year at the Grosvenor House Hotel in London from February 27 to March 1. With attendances topping 19,000 this is 50 per cent up on last year according to show organisers, a physical impossibility it seemed at the time!

Exhibitors numbered around 215 with a heavy bias on component manufacture. It was good to be able to fiddle with many components that one can only normally see in catalogues. RS Components had over 400 new items on show, introduced since last year's show.

Gould Instruments decided to launch its new Alpha IV DMM at a press reception in the show. This 3½-digit meter has 25 ranges for just over £100, the l.c.d. readout giving long battery life. Gould's OS3300B scope might be a bit expensive but could prove invaluable to the TV service engineer, being able to analyse line-by-line as well as digital signals exemplified by the teletext services.

Old-established Wayne Kerr still produce a wide range of r.f. and a.f. bridges but featured this year was the B605 automatic component bridge for *L*, *C*, *R*, *D* and *Q* functions using, needless to say, a microprocessor. Meter makers Bach-Simpson highlighted its model 463 DMM with 3½-digit ½in high l.c.d. readout with 200 hour continuous operation capability from internal 9V alkaline battery. B-S's 710 Compact frequency counter covers 10Hz to 60MHz with 1Hz resolution from a 6-digit l.e.d. display, and weighs only 12oz. An ac adaptor is supplied and several optional extras are available.

Tools and suchlike were not neglected, with Tele-Production showing its mains-operated and low voltage soldering irons including thermostatically controlled versions adjustable to predetermined temperatures.

Lektrokit exhibited wire-wrapping tools and all the associated bits and pieces while OK Machine and Tool had a selection of pliers, cutters and the like which every DIY electronic enthusiast would love to have in his workshop.

Microprocessors were to be seen everywhere including the Fairchild 16-bit 9440 with a demo of its Spark 16 single board microcomputer. AMI Microsystems featured its S2000A single chip microcomputer designed to operate a vacuum fluorescent display. Silconix displayed the latest in VMOS power FET's including high voltage devices such as the 350V VN35JA and 450V VN45JA in TO3 packages, both rated at 4A.

ITT Meridian was all lit up with "the brightest devices available", in the form of the new range of Stanley l.e.d.s. Four colours are in production in various configurations. Germanium Power Devices Inc attracted a lot of attention now that it is producing germanium devices for replacement purposes, mainly by using plants that have already been written off by other manufacturers.

Potential visitors to next year's Show may like to note the later dates of April 29 to May 1.

MATTER OF DEGREE

The Institute of Electronic and Radio Engineers is resisting pressure from the Council of Engineering Institutions to make an honours degree mandatory for corporate membership as a chartered engineer.

The IERE would like to retain the ability to grant corporate membership to those with proven engineering aptitude and achievement, arguing that there is no invariable connection between academic qualifications and ultimate engineering achievment.

Getting the message

The UK's first computer-controlled telex gateway exchange is now in service handling autotelex calls between the UK and more than 100 other countries. The system is supplied by Plessey Controls.

The two earlier non-computerised telex gateways give users access to a million teleprinters in 205 countries. Telex usage is growing at 10 per cent per annum in Europe and 15 per cent beyond Europe.

. . . from the World of Electronics

—ANALYSIS

THE ELECTRONIC TELEPHONE

If asked which country is likely to have the first national all-electronic telephone system in the world most people would probably say the United States. Other choices might be Japan, W. Germany, France, even Britain. In fact the answer is Saudi-Arabia who will go all-electronic by 1981.

All very well, you might say, for an oil-rich Arab State to indulge in such luxuries. What other country with a population only that of Greater London could afford to spend £1,500 million on a technological up-date?

Well, money is an important factor, of course, but it is not the only one. Paradoxically, the most advanced nations are handicapped in implementing new innovations while the "backward" nations, because of their former backwardness, can start with almost a clean slate. Countries with well-developed and long established telephone systems like the United States and Britain have enormous problems of interfacing the most modern equipment into their existing networks.

The electronic exchange is now fully established as a reliable successor to the electro-mechanical system which has served so well for the past few decades. It is smaller, less costly, not so much in first cost but in maintenance costs over its service life, and can provide many more facilities for the user.

Up till now the BPO has been concentrating on electronics at their own telephone exchanges and only at the larger of the thousands of private automatic branch exchanges (PABXs). Now the small business will be able to have MPU-controlled PABX systems with the phased introduction of BPO's Customer Digital Switching System No. 1 (CDSS1). It is a modular system expandable to 20 exchange lines and 100 extensions now being manufactured by GEC and Plessey. It replaces the existing PABX systems first introduced in 1952 and of which 40,000 are in service.

The CDSS1 has a touch-sensitive panel instead of keys for the operator and includes a visual display unit. Because it is electronic all sorts of tricks can be played on it and users can program it to suit their own requirements. The equipment will come into service first in London and Scotland, then in other areas over a period of years.

On a smaller scale but important to every telephone user is the prospect of an electronic replacement for the present carbon granule microphone, unaltered in operational principle for over 100 years. Here again, there is the problem of compatibility, the new unit having to meet the requirement that it must be a direct replacement unit demanding no modification to the telephone handset. The electronic replacement will, however, give better quality speech over a considerably longer period.

But with well over 20 million private telephones in service in the UK it will be many years before you get your new electronic microphone. You can't expect to change everything overnight.

Brian G. Peck

Wakey—Wakey

Subscribers to Paris telephone exchange are now able to get early morning wake-up calls by computer. The service operates by dialling a special "wake-up" number and then dialing your own number and the time you need the call in standard 24-hour clock format (e.g. 0630 for 6.30 a.m.).

Heavy sleepers who don't respond are called a second time after an interval of 10 minutes. The computerised system guarantees the call within one minute of the requested time and can currently handle 10,000 wake-up calls daily.

* * *

Some 45,000 different integrated circuits are listed in the 1979 edition of "The IC Master" published in the USA.

TREASURE HUNTING BOOM

Amateur treasure hunting with the aid of metal detectors will continue to boom for the next seven years in Europe according to market researchers. Savo Electronics of Inverness, Scotland, a manufacturer in this specialised field is planning to treble workforce and turnover in the next three years to meet the demand.

* * *

Bubble memories are expected to have a market of some £250 million a year by 1985 according to a Rockwell International spokesman. Rockwell recently launched a 256k bubble memory in Europe and is expected to market a million-bit unit this year.

* * *

NEW MEMBER

Former US Secretary of State Henry Kissinger is acting as a consultant to the board of Britain's GEC group of companies. The appointment coincides with GEC's increased involvement in business in the USA through acquisition of US companies such as A. B. Dick and joint ventures such as GEC-Fairchild.

LINK-UP

What is thought to be the first-ever marriage by computerised data link is reported from Las Vegas. Bride and groom had met through a business network.

The happy couple stood before a VDU terminal with the presiding Minister some 2,000 miles away. Questions and responses were keyed in at each end of the networks.

The young couple are said to have conducted their courtship via terminals and became engaged before even seeing each other.

* * *

Food-chain Sainsbury is to try out computer-linked electronic checkout-systems at two branches this year. An IBM system is to be fitted at Crawley in June and an NCR system at Chippenham in September.

NEWS FROM SPACE

Solar power

A solar power panel with an output of over 1A at 14·4V has been developed by Ferranti Electronics Ltd. Designated the MST 300, it is said to be suitable for industrial, professional or domestic use and is competitive with imported units. It uses 36 silicon cells, each 3 inches in diameter connected in series.

On a larger scale Ferranti is building a 2kW output system under a contract awarded by the EEC. It will use 160 solar panels, the d.c. ouptut of which will be stored in a battery bank which, in turn, powers an inverter developing 240V 50Hz as a continuous mains supply. This is virtually a feasibility study to determine the effectiveness of solar power generation in northern latitudes.

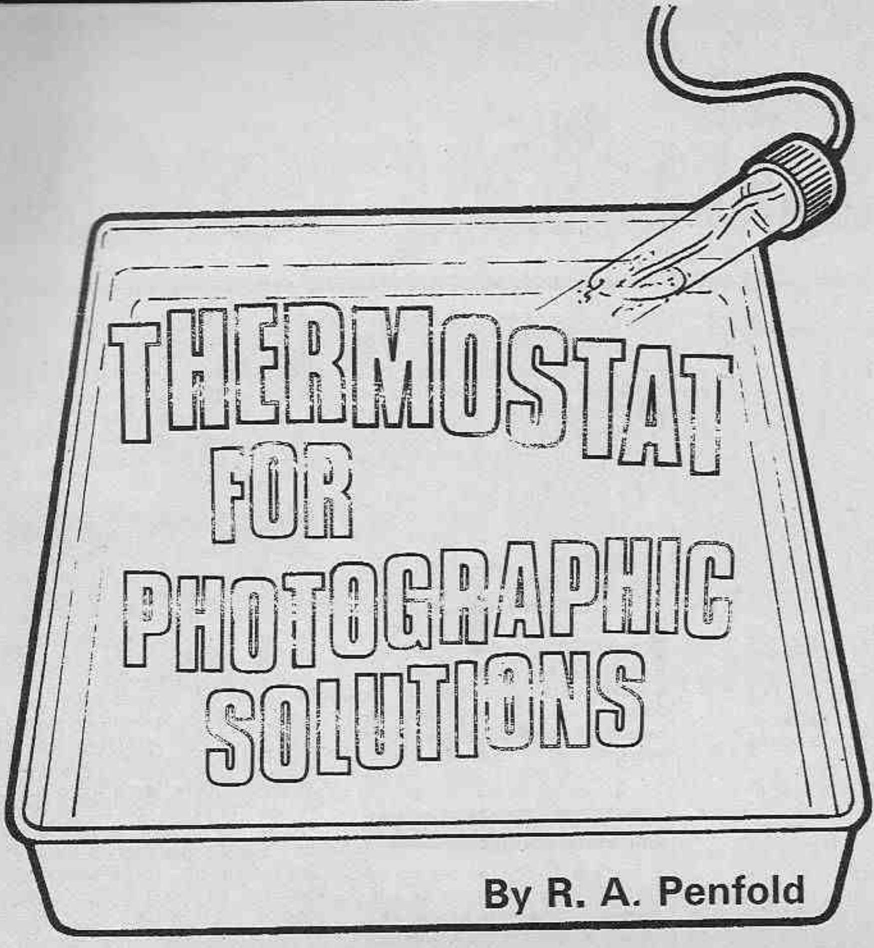
Amateur satellite

The UK's first amateur scientific satellite is to be built at the University of Surrey. It will be launched into polar orbit at a height of 900km in early 1981 if all goes well and will allow radio amateurs throughout the world to study propagation conditions.

Industry support for the £150,000 project is promised from British Aerospace, Ferranti, Marconi, MEL, Philips and Racal.

We have been informed that an Orbital Predications Calendar for Oscar 7 and 8 and both Russian Satellites, RS1 *and 2, are now available in a single book form, price £2·15 (including postage). Readers with a "Pet" computer can also obtain a Predications Programme Tape for any satellite for £2·15 including postage.*

Orders and other enquiries should be sent to: Honorary Secretary, AMSAT-UK, 94, Herongate Road, Wanstead Park, London E12 5EQ.



THERMOSTAT FOR PHOTOGRAPHIC SOLUTIONS

By R. A. Penfold

THIS DEVICE is primarily intended for precisely controlling and maintaining the temperature of photographic solutions.

It is important that the solutions should be maintained at a constant temperature during the printing process when dealing with colour or black and white, but colour printing is by far the more critical of the two. Thus a highly accurate thermostat of this type is of particular value when undertaking colour work.

The usual method of controlling the temperature of photographic solutions is to use a thermostatically controlled dish warmer. This system often lacks extreme accuracy as dish warmers are usually fitted with a mechanical thermostat of comparatively low sensitivity, and it is the temperature of the warmer rather than the solution that is actually controlled.

ACCURACY

A high degree of accuracy is obtained here by using an extremely sensitive integrated circuit temperature sensor which is fitted in a probe which is then immersed in the photographic solution. This enables small temperature changes to be quickly detected, and the warmer to be switched on or off, as appropriate, in order to compensate for this.

The unit will maintain the temperature of the solution to within a fraction of one degree centigrade, but the exact level of performance obtained will vary slightly from one unit to another, and is also affected by other parts of the overall set-up.

The circuit has four preset temperature settings which can be set to any desired levels from below zero to more than 60 degrees centigrade (32 to 140 degrees fahrenheit). Therefore, the unit can be used in many applications other than photography.

SENSOR

An LM3911N temperature controller/thermometer i.c. is employed as the basis of the project. This has an internal circuit arrangement as detailed in the block diagram of Fig.1a.

The temperature sensor relies on the fact that the voltage produced across a forward biased silicon diode varies with applied temperature. It actually varies by about 2 or 3mV per degree centigrade, with increased temperature causing decreased voltage, and *vice versa.*

The sensor is actually quite a sophisticated circuit which uses two transistor base/emitter junctions as sensing diodes, and these have different operating currents. A differential amplifier multiplies the difference in the output voltages of the two sensing transistor junctions, and produces an output voltage which varies by 10mV per degree centigrade. This gives a highly linear relationship between output voltage and applied temperature, which enables the device to be used as the basis of an accurate thermometer, but is admittedly of minor importance in the present application.

OUTPUT VOLTAGE

The voltage to the sensor circuit must be well stabilised, otherwise the sensor output voltage would vary considerably with changes in supply potential. A high quality 6·8V Zener diode is therefore incorporated in the device.

The output from the sensor is coupled to the non-inverting (+) input of an operational amplifier. The diode and the 50 kilohm resistor form the load for the *npn* output transistor of the amplifier,

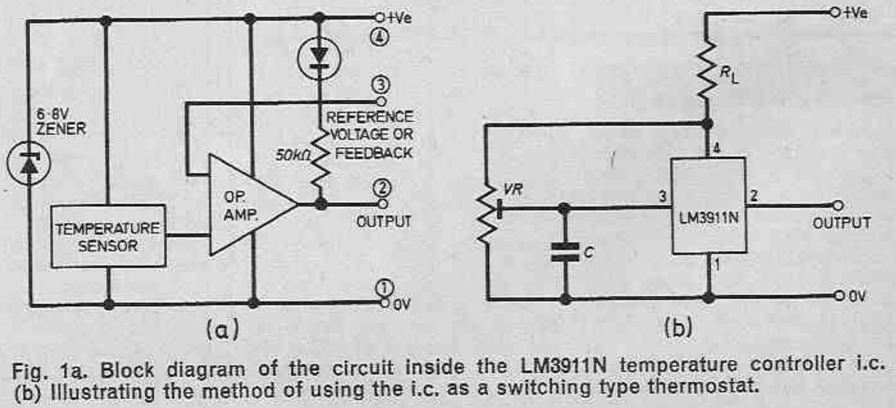


Fig. 1a. Block diagram of the circuit inside the LM3911N temperature controller i.c. (b) Illustrating the method of using the i.c. as a switching type thermostat.

COMPONENTS approximate cost £8.50 excluding case

but a higher output current drive can be obtained by connecting a discrete resistor between pin 2 and the unregulated positive supply line.

THERMOSTAT

When the i.c. is used as a temperature controller the inverting (−) input of the operational amplifier is connected to a reference voltage, and the amplifier is actually used as a comparator. The diagram of Fig.1b illustrates the basic method of using the LM3911N as a thermostat.

If the unit is required to produce a controlled temperature of, say, 25 degrees, then *VR* would be adjusted to provide a voltage at pin 3 of the i.c. which was identical to that generated by the sensor when at a temperature of 25 degrees. Capacitor *C* is merely required to decouple any hum or noise which would otherwise be picked up at pin 3 of the i.c.

The output potential depends on the capacitive levels of the two input voltages to the comparator. If the non-inverting input is at a higher voltage than the inverting one, the output voltage will be equal to the positive supply rail potential. If the states are reversed, the output voltage will fall to little more than zero. In practice the circuit is arranged so that the heating element is switched on when the output is high, and switched off when it is low.

OPERATING LIMITS

Thus, if the sensor is below 25 degrees it produces a voltage which is more than that at pin 3 of the i.c. and the heater is turned on. When the sensor rises above 25 degrees it produces a voltage which is lower than that at pin 3 of the i.c., and so the heater is turned off. The sensor voltage has to change by only an extremely small amount in order to change the output state of the comparator, and so the temperature of the sensor is only allowed to drift between extremely narrow limits.

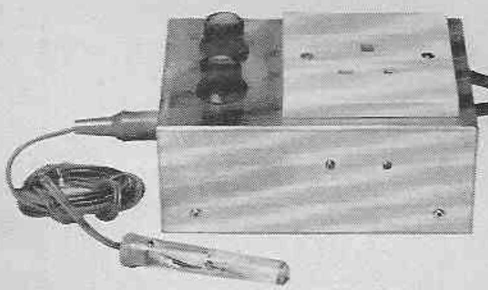
The operating temperature of the circuit can be adjusted over very wide limits by varying the setting of *VR*, and the LM3911N has an operating temperature range of at least −25 to +85 degrees centigrade.

Resistor R_L is the current limiting resistor for the Zener diode, and it is essential to include this to protect the Zener against an excessive current flow.

CIRCUIT DESCRIPTION

The complete circuit diagram of the Photographic Thermostat is given in Fig.2.

A nominal supply voltage of about 11 volts is provided by the simple mains power supply which is comprised of T1, D1, D2 and C1, S1 is the on/off switch.



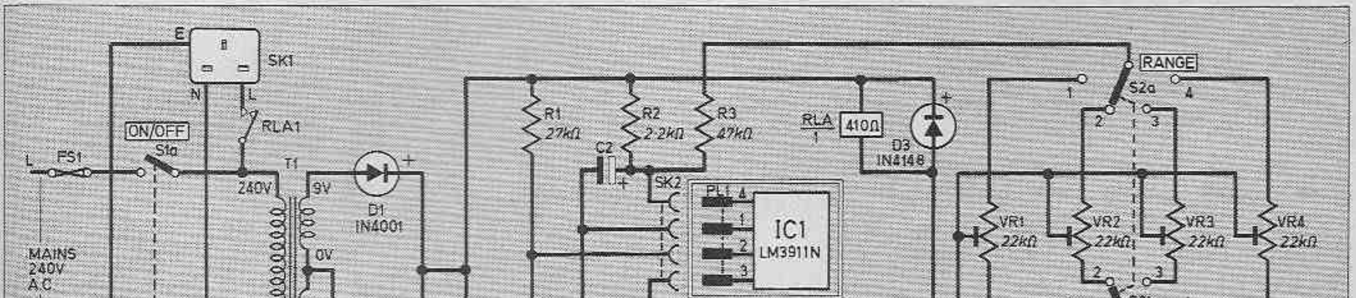
The reference voltage for the i.c. is produced by R3, R4, and whichever one of the four presets (VR1 to VR4) is switched into circuit by S2. The latter is the temperature selector, and the presets are adjusted to produce the four thermostat temperatures that are required, C3 is the decoupling capacitor.

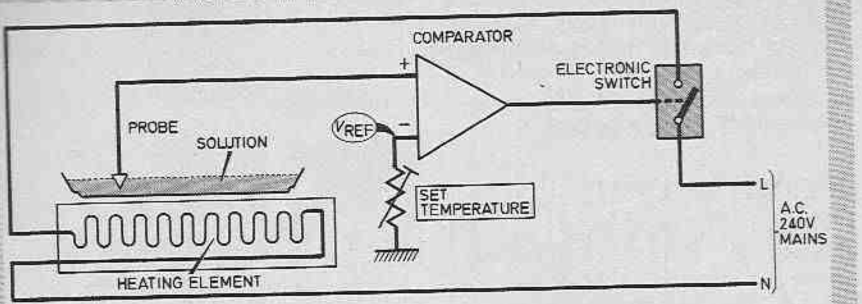
Resistor R2 is the current limiting resistor for the Zener diode and C2 provides additional smoothing of the stabilised supply.

Transistor TR1 is driven from the output of IC1 and will be switched on when the output is high, or cut off if it is low, R1 is used to increase the drive capability of IC1.

When TR1 is turned on, it activates the relay coil which forms its collector load. A pair of normally open relay contacts are connected in the mains supply to the heating element, and switch the element on when TR1 and the relay are activated. Diode, D3 is a protective diode which quenches the high reverse voltage which would otherwise be produced across the relay coil at it deactivated. Unless suppressed this voltage could easily damage TR1 and IC1.

Fig. 2. Complete circuit diagram of the Photographic Thermostat.





HOW IT WORKS

A special **PROBE** produces a voltage which decreases with an increase in temperature, (or *vice versa*). This voltage is fed to one input of a comparator, while a variable reference voltage is fed to the other input. If the probe produces a voltage which is higher than the reference voltage, the comparator switches on an **ELECTRONIC SWITCH**. This in turn switches on the heating element. This action causes the heating element to heat up the solution until such time the temperature causes the voltage from the probe to fall below that of the reference voltage. The comparator then switches off the **ELECTRONIC SWITCH** and thus the heating element. Because the heating is removed, the temperature of the solution starts to fall, the probe detects this drop, its voltage falls below that of the reference voltage, and the heating element is turned on once again. In this way the temperature of the solution is maintained within very fine limits.

CONSTRUCTION starts here

A suitable case for the unit can consist of a 152×102×64mm (6×4×2½inch) 18 s.w.g. aluminium chassis and baseplate. The base is fixed to the corner pieces of the chassis using four 6BA self-tapping screws, and four cabinet feet are fitted to the baseplate. A mains socket is mounted on top of the box on the right hand side, and this requires two 6BA mounting nuts and bolts. It also requires quite a large cut-out to be made in the case, and this can be achieved using a fretsaw or a needle file.

A solder tag is mounted on one of the fixing bolts for the mains socket to provide a chassis connection.

RELAY MOUNTING

Switches S1 and S2 are mounted to the left of the mains socket, and both these components require a 10mm diameter mounting hole. A five pin DIN socket is mounted on the left hand side panel of the case and the probe plugs into this, which is more convenient than wiring it direct to the rest of the unit. This socket requires a main 15mm diameter mounting hole as well as two 3·2mm diameter holes for the 6BA mounting bolts.

The relay is mounted on the front plate of the case, and it will probably be necessary to fabricate a mounting bracket of some kind. An Open P.C. relay having a 6 volt 410 ohm coil was used in the prototype, but any relay having a nominal 6 volt coil resistance of about 185 ohms or more should be equally suitable, but make sure the contacts are of the right type and of suitable current rating.

A piece of 0·1 inch plain matrix board having 14 by 16 holes is used as the mounting bracket for the relay on the prototype, and this has five of the holes enlarged slightly (to about 2mm dia.) to take the lugs on the relay. These are bent over at right angles on the underside of the panel to secure the relay to the panel. The panel is then bolted to the case, and spacers are used to hold the panel a little way clear of the case.

The mains transformer, T1 is mounted on the rear plate of the case, near to S1, using two short 4BA bolts and mounting nuts.

STRIPBOARD

All the other components are assembled on a 0·1 inch pitch stripboard which has 19 strips by 28 holes. Details of this panel are given in Fig.3 which also shows the remaining wiring.

First cut out a board of the correct size using a hacksaw and then make the six breaks in the copper

COMPONENTS

Resistors

R1	27kΩ
R2	2·2kΩ
R3	47kΩ
R4	68kΩ

All ⅛W carbon ± 5%

Capacitors

C1	1000µF 16V elect.
C2	10µF 16V elect.
C3	10µF 16V elect.

Miscellaneous

SK1	mains outlet socket (MK type)
SK2	5 pin DIN socket
PL1	5 pin DIN plug
S1	d.p.d.t. rotary mains switch
S2	2 pole 4 way rotary switch
RLA	6V 410 ohm coil with one set of mains rated normally open contacts
FS1	1A fuse, with panel mounting holder
T1	9-0-9V at 67mA mains transformer

Stripboard 0·1 inch matrix, 19 strips by 28 holes; plain matrix board, 0·1 inch 14 by 16 holes; aluminium chassis with baseplate 152 × 102 × 64mm; small glass tube or similar for probe (see text); silicon grease; twin screened cable or other four way cable; two round control knobs; length of three core mains lead; connecting wire; standard mains plug.

Potentiometers

VR1 to 4 22kΩ subminiature horizontal presets (4 off)

Semiconductors

TR1	BC108 silicon *npn*
IC1	LM3911N temperature controller
D1	1N4001 silicon
D2	1N4001 silicon
D3	1N4148 silicon

See **Shop Talk** page 287

SEMICONDUCTORS

TRANSISTORS

Type	Price
AC107	£0·22
AC113	£0·20
AC115	£0·20
AC117	£0·30
AC117K	£0·34
AC121	£0·20
AC122	£0·14
AC125	£0·18
AC126	£0·18
AC127	£0·18
AC128	£0·16
AC128K	£0·26
AC132	£0·20
AC134	£0·20
AC137	£0·20
AC141	£0·22
AC141K	£0·30
AC142	£0·20
AC142K	£0·30
AC151	£0·20
AC153	£0·22
AC153K	£0·30
AC154	£0·20
AC155	£0·20
AC156	£0·20
AC157	£0·25
AC165	£0·20
AC166	£0·20
AC167	£0·20
AC168	£0·25
AC169	£0·20
AC171	£0·25
AC176	£0·18
AC176K	£0·26
AC178	£0·25
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AC180	£0·20
AC180K	£0·28
AC181	£0·20
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AC187	£0·18
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AC188	£0·18
AC188K	£0·28
ACY17	£0·35
ACY18	£0·35
ACY19	£0·35
ACY20	£0·35
ACY21	£0·35
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ACY41	£0·35
ACY44	£0·35
AD130	£0·70
AD140	£0·60
AD142	£0·85
AD143	£0·75
AD149	£0·60
AD161	£0·35
AD162	£0·35
AD161/162	£0·70
ADT140	£0·55
AF114	£0·25
AF115	£0·25
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AF181	£0·58
AF186	£0·50
AF239	£0·38
AL102	£1·20
AL103	£1·18
ASY26	£0·38
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AU104	£1·40
AU110	£1·40
AU113	£1·40
BC107	£0·08
BC107A	£0·08
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BC107C	£0·10
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BU208	£1·90
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MAT100	£0·19
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OC205	£1·15
P346A	£0·35
P397	£0·45
R20008B	£2·50
R2010B	£2.60
ST140	£0·15
ST141	£0·20
TIC44	£0·29
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TIP42A	£0·44
TIP42B	£0·46
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TIP2955	£0·60
TIP3055	£0·50
TIS43	£0·22
TIS90	£0·18*
UT46	£0·20
ZTX107	£0·10*
ZTX108	£0·10*
ZTX109	£0·10*
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CD4011	£0·15	CD4023	£0·15	CD4040	£0·88	CD4055	£1·00	CD4518	£1·00
CD4012	£0·16	CD4024	£0·65	CD4041	£0·76	CD4056	£1·35	CD4520	£1·00
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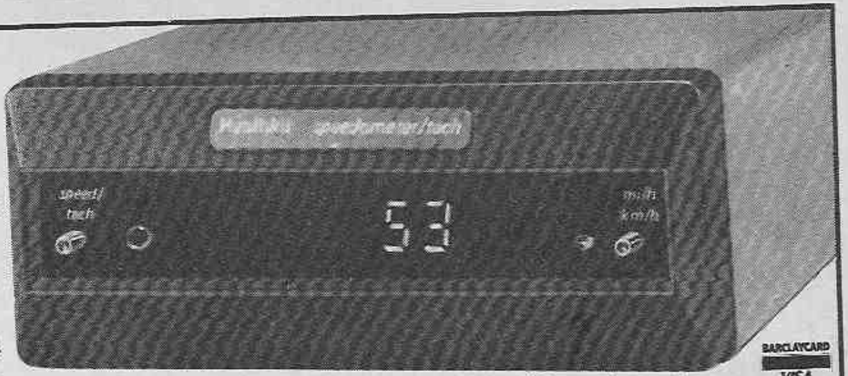

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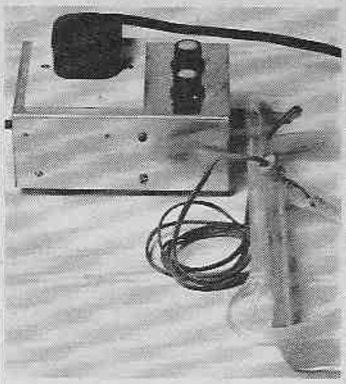
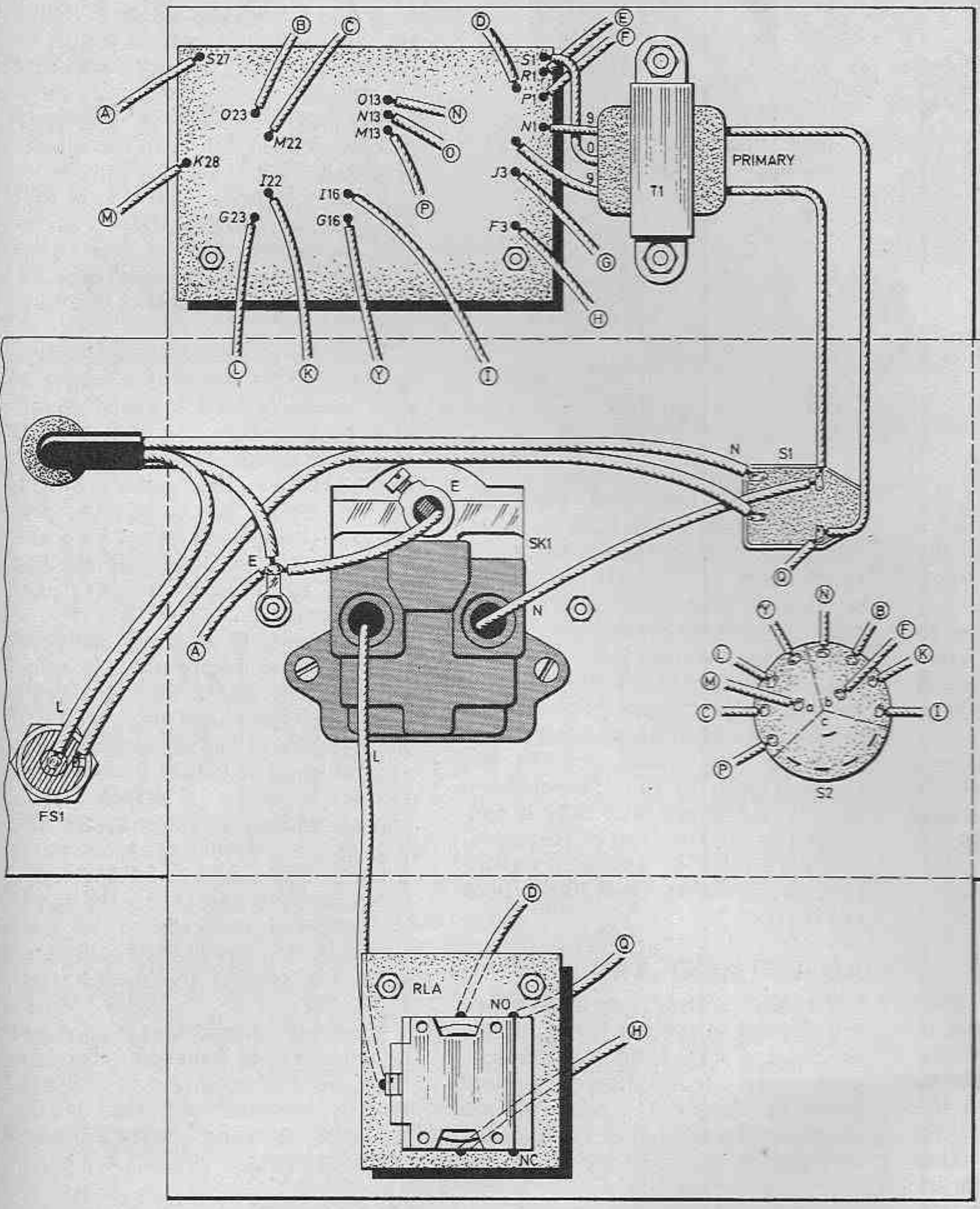
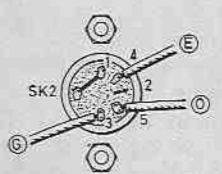






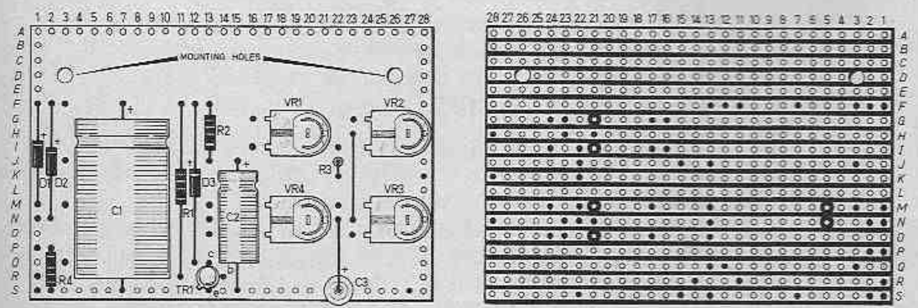


Fig. 3. Complete wiring details for the unit, showing the stripboard layout and other wiring. There is nothing critical about the layout and could be varied as required. When wiring up the mains socket, use mains rated connecting wire and insure that all connections are well insulated. The probe socket, SK2 needs particular care when wiring otherwise an incorrect connection will damage the i.c. The socket is shown looking at the tags. Note the earth tag connection.

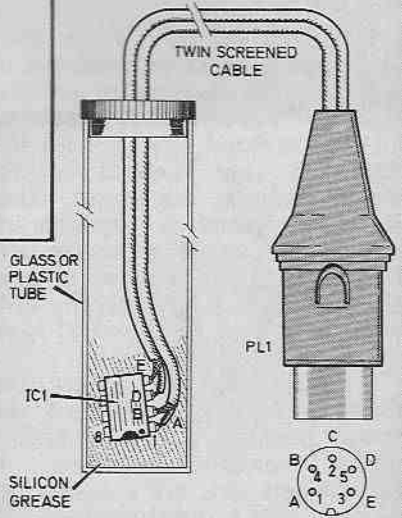
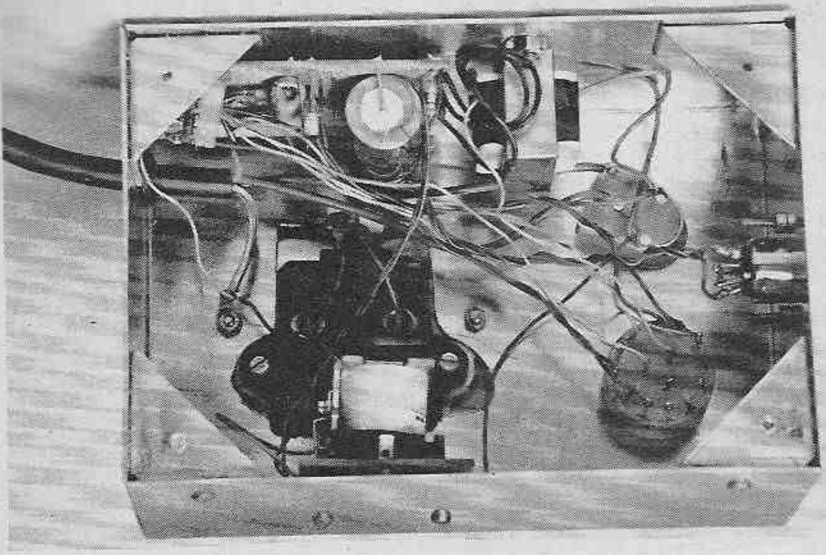


Fig. 4. Probe construction and wiring details. On no account use a socket for this i.c.—it would rather defeat the whole object of the unit. Providing you are quick when soldering, no damage should occur to the i.c. A convenient length for the lead would be about four feet.



strips. Next the various components and the single link wire are soldered into position on the board, and the two 3·2mm diameter mounting holes are drilled in the board. The point to point wiring must then be completed before the component panel is mounted next to T1 on the rear of the case.

The panel must be spaced well clear of the case so that there is no risk of any of the underside wiring of the board short circuiting through the metal casing.

PROBE

If the i.c. sensor is to be used in liquids it must be mounted in a waterproof housing to provide electrical insulation, but it must be in good thermal contact with the liquid. A poor thermal contact would result in the sensor being slow to respond to temperature changes and would reduce the performance of the set up. A poor thermal contact between the dish warmer and the solution will have the same effect.

A suggested form of construction for the probe is shown in Fig.4, and this is based on a small tube-like plastic container (such as that cake decorations are supplied in) or a test tube and cork stopper.

Begin by drilling a hole in the stopper to take the connecting cable. Twin individually screened cable was used by the author, but any four way cable not necessarily screened should be suitable. A short length of cable is threaded through the hole and then the cable is connected to IC1.

Some silicon grease is forced to the bottom of the tube and some of this is also spread over IC1. The i.c. is then pushed down into the bottom of the test tube, and the silicon grease will ensure a good thermal contact between the outside of the tube and pins 5 to 8 of the i.c. (which provide the thermal path to the silicon chip). Finally, a five pin DIN plug is connected to the free end of the cable, and care must be taken to ensure that all the connections to the plug are correct.

ADJUSTMENT AND USE

The dish warmer, or other heating device) is merely plugged into the mains socket on the thermostat, any temperature control fitted to the heater must be set to maximum so that it is rendered ineffective.

Probably the easiest way of adjusting the presets is to use the following procedure. Start with all four presets adjusted fully clockwise and S2 set to position 1. Allow the dish warmer to heat a dish of water to the lowest required thermostat temperature, and then slowly adjust VR1 in an anticlockwise direction until the heater is switched off.

It is essential that it is not adjusted any further than is necessary to switch off the heater, as this would cause a significant reduction in the thermostat temperature.

Next S2 is switched to position 2, the dish of water is allowed to rise to the second lowest thermostat temperature, and then VR2 is adjusted just far enough in an anti-clockwise direction to switch off the heater. The same basic procedure is then used to set VR3 and VR4 to the second highest and highest thermostat temperatures respectively.

Of course, if all four temperatures are not required, it is quite in order to use a switch having fewer positions and omit some of the presets. If more temperatures are required it would probably be better to wire a 22kΩ linear potentiometer in place of S2 and VR1 to VR4, rather than use more presets and a switch having more positions. The potentiometer would be mounted in place of S2, and would have a simple dial calibrated with the desired thermostat temperatures.

In some applications it might be necessary to have the relay contacts close when a rise in temperature is detected, and this can be achieved by using normally closed relay contacts. ⌑

RECORD REVIEW

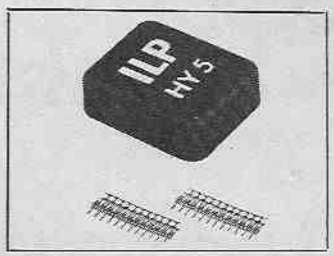
TITLE Long Live Short Wave!
LABEL Trans—Island Productions Ltd.
PRICE LP £3·50 Cassette £3·50 inc. p & p
PLAYING TIME Approx 55 minutes

THIS, our first-ever LP for review, is an attempt to introduce the listener to the fascinating hobby of DX'ing and short wave listening.

The first side contains an introduction as spoken by the BBC's World Service most respected and famous presenter, who also by chance happens to be a radio amateur of long standing; Henry Hatch. It continues with such interesting topics as; identifying different modes of transmissions, the aerial and how to operate a short wave receiver, the QSL card and reporting, and an explanation of the different frequency bands, etc. PO Box 24, Douglas, Isle of Man.

15—240 Watts!

HY5
Preamplifier



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

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

APPLICATIONS: Hi-Fi—Mixers—Disco—Guitar and Organ—Public address

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

Price £6·27 + 78p VAT P&P free.

HY30
15 Watts into 8Ω

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

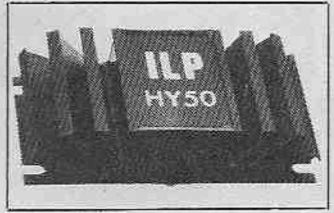
FEATURES: Complete Kit—Low Distortion—Short, Open and Thermal Protection—Easy to Build.

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

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

Price £6·27 + 78p VAT P&P free.

HY50
25 Watts into 8Ω



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

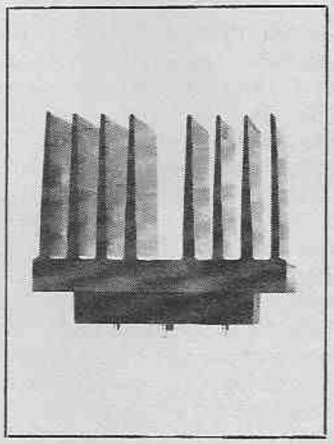
FEATURES: Low Distortion—Integral Heatsink—Only five connections—7 amp output transistors—No external components

APPLICATIONS: Medium Power Hi-Fi systems—Low power disco—Guitar amplifier

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

Price £8·18 + £1·02 VAT P&P free

HY120
60 Watts into 8Ω



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

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

APPLICATIONS: Hi-Fi—High quality disco—Public address—Monitor amplifier—Guitar and organ

SPECIFICATIONS
INPUT SENSITIVITY 500mV.
OUTPUT POWER 60W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·04% at 60W at 1kHz
SIGNAL/NOISE RATIO 90dB FREQUENCY RESPONSE 10Hz-45kHz– 3dB SUPPLY VOLTAGE ±25V
SIZE 114 50 85mm

Price £19·01 + £1·52 VAT P&P free.

HY200
120 Watts into 8Ω

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

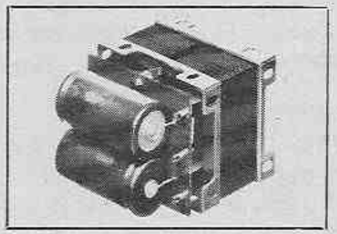
FEATURES: Thermal shutdown—Very low distortion—Load line protection—Integral heatsink—No external components

APPLICATIONS: Hi-Fi—Disco—Monitor—Power slave—Industrial—Public Address

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

Price £27·99 + £2·24 VAT P&P free.

HY400
240 Watts into 4Ω



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

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

APPLICATIONS: Public address—Disco—Power slave—Industrial

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

Price £38·61 + £3·09 VAT P&P free.

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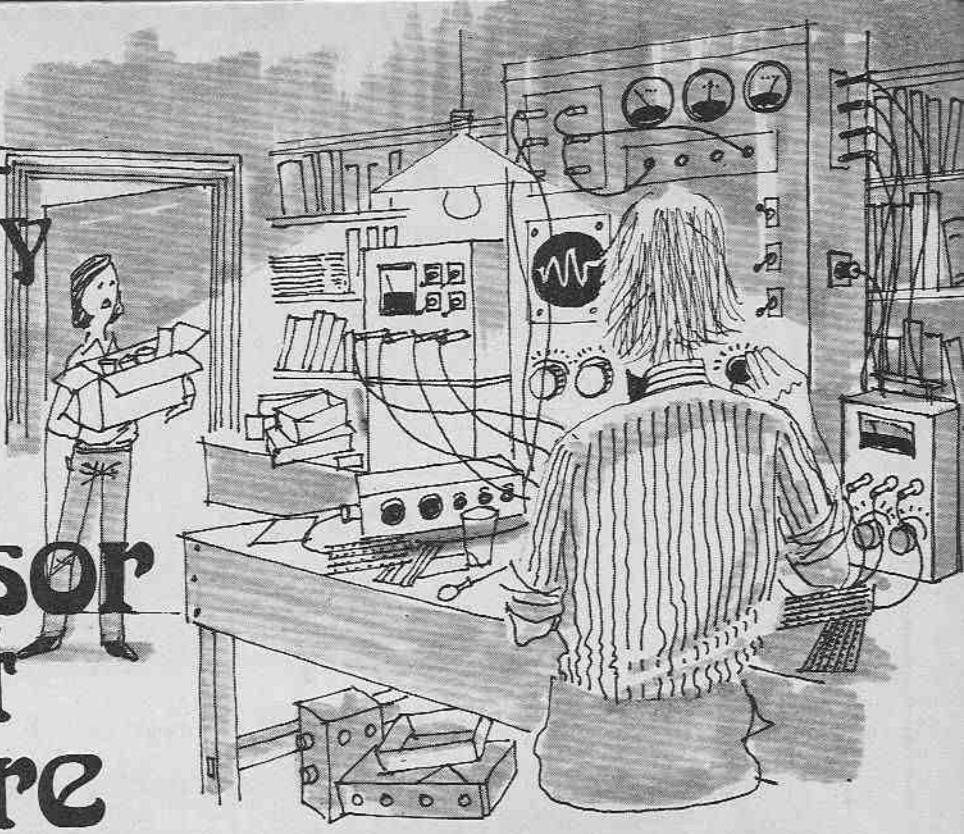

by Anthony John Bassett

A TEAM of the Prof.'s experimental robots have constructed an enormous vacuum chamber. It is so big that, by wearing special suits similar to spacesuits, Bob and the Prof. can go inside and carry out experiments in a simulated space environment.

From outside the capsule Bob watched as the robots used electronically controlled energy, laser and electron beams and other vacuum techniques to fabricate his space suit under vacuum conditions to avoid atmospheric contamination of the welded joints. He was eager to learn more about lasers and energy beams and could hardly wait to put on his space suit and enter the vacuum chamber.

AIR-LOCK

At last, after a series of careful tests, the suit was ready and the Prof. brought it out through the air-lock and instructed Bob on how to put it on, to check against leakage and other safety precautions such as a check on the oxygen reserves and power supply.

"An interesting technical point about these suits," the Prof. told Bob, "concerns the 'constructed volume joints'. Each of the joints is so constructed that movement does not result in change in the volume of the suit. This is a precaution which should be taken in construction of all suits where there is an appreciable pressure differential between the interior and the exterior, and naturally this applies even more to diving suits where the pressure differential can be much greater than for a space suit. At last, you're ready", The Prof. showed Bob how to operate the air-lock and conducted him into the vacuum chamber.

LIGHTER THAN AIR

"That's strange, Prof." Bob remarked once they were inside, "I feel lighter inside the vacuum chamber than outside it, and I was expecting the opposite. Lacking the natural buoyancy provided by normal air pressure I should seem to be a little heavier if anything, but even with the space suit, oxygen bottles, power supply unit, radio intercom, all these things I'm carrying, yet I still seem to be lighter than I was before I put the space suit on! How can this be so?"

"I wondered when you'd notice that, Bob. It is the result of my experimental weight-control device which is operating within the vacuum chamber to compensate for the extra weight of the space suit and life-support system."

NEGATIVE WEIGHT

He showed Bob a control knob set on one of the control panels of the internal control console of the vacuum chamber. As the Prof. turned the knob, Bob began to feel very heavy, then light again. He noticed that the calibrations on the weight control went all the way down to zero, then beyond that were some "negative" calibrations, but a small piece of metal set into the panel prevented the control from going into the "negative" region.

"Can the control be turned beyond the metal stop to give negative weight, Prof?"

The Prof. used a small key and the metal stop retracted inside the panel, but before Bob could indulge any thought of turning the control to give a negative weight, the stop popped up again as the Prof. took away the key.

"By using this key it can be done, whenever I wish to," the Prof. told Bob, "but the stop prevents the control from being set to a negative value by accident." Bob was fascinated by this new control. "Before you learn about

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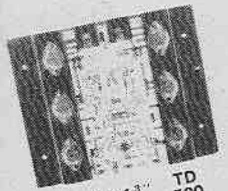
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T.D. 500 300W into 2 Ohms 220W into 4 Ohms 140W into 8 Ohms	£45.00
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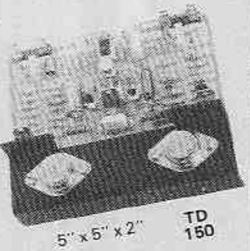
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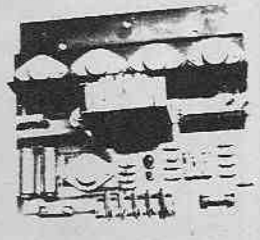

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SENSITIVITY 60 mV
for full output
Frequency response
20 Hz-20 KHz
HUM & NOISE–70dB

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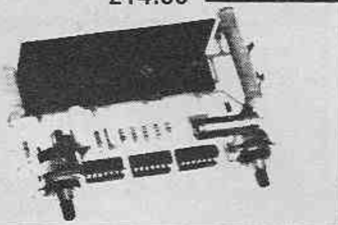

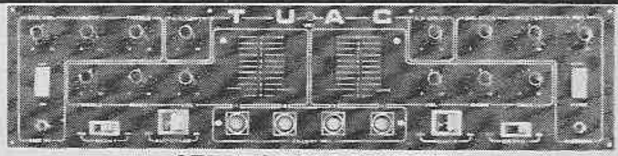

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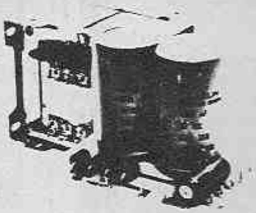

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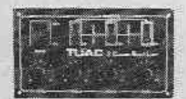
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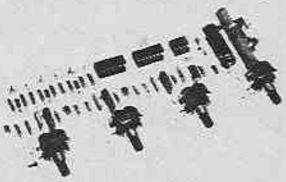

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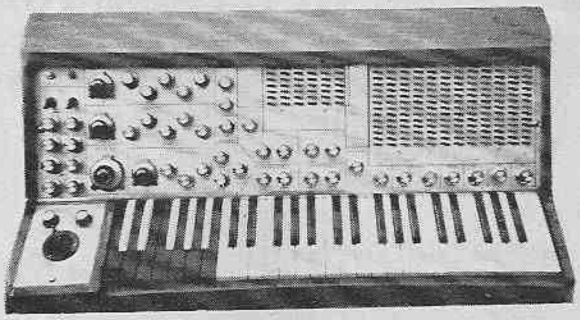

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7405	**14p**	7442	**54p**	7474	**23p**	7494	**66p**	74191	**94p**
7407	**22p**	7443	**60p**	7475	**45p**	7495	**57p**	74192	**94p**
7408	**18p**	7444	**60p**	7476	**32p**	7496	**63p**	74193	**94p**
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'anti-gravity', Bob, you need to learn more about normal gravitational properties. Be careful how you move, I'm setting it to $^{1}{}_{6}$ G which is approximately the same as the weight you would experience on the surface of the moon. Under these conditions a little effort can take you a long way.

DIELECTRIC HEATING

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"Prof., why did the robots use several different kinds of energy in fabrication of my space suit? I noticed that they used lasers, electron beams, dielectric heating and other equipment besides. Why not do all of the cutting and welding which is involved by just one of these methods, and save the complication of having the apparatus and power-supplies for each of them?"

"Each method has its own advantages and disadvantages, Bob. For instance, the electron beam can be used for both cutting and for welding."

ELECTRON GUN

The Prof. set a piece of thin sheet metal, and a piece of sheet plastic side by side in the bench vice, and scribed a line on each. Picking up the electron gun, he set it to give a high beam current suitable for cutting or welding, aimed it at the metal sheet and sliced it neatly along the marked line.

"Now don't you think the plastic should be easier to cut than the metal? Try it!" The Prof. handed the electron gun to Bob, who pointed it steadily towards the plastic and switched on. However, instead of the neat, easy cut which he had expected, Bob saw the plastic crumple and deform even in places at which he wasn't aiming the beam. Yet when Bob turned the electron-beam onto the remainder of the metal sheet, he found that he could cut it easily and neatly as the Prof. had shown him.

"This is because the plastic, being a good insulator, does not conduct away the electrons from the beam, and these tend to accumulate at the surface. The surface of the plastic quickly acquires a strong negative charge and deflects the beam, which is then forced to 'wobble' away from the point at which it is being aimed. This problem does not occur with the metal, as it is earthed and conducts away the charge instantly."

EARTH PROBLEM

"Prof, if this type of equipment were being used in space, where it could not be connected to earth, wouldn't there be a problem even with metal cutting? If the metal could not be earthed, wouldn't it become electrically charged like the plastic and repel the beam and wouldn't the electron-gun also become positively charged?"

"Yes, Bob, this could easily happen. The equipment operator would need to connect a wire from the workpiece to the electron-gun in order to provide a return path for the beam current. If he did not take care to do this properly, a number of problems could easily arise, and it might even be dangerous.

"By touching the apparatus, the operator could himself acquire an electric charge, and this could cause him to produce dangerous discharges upon touching other objects, or to pick up small unwanted objects by electrostatic attraction. Sharp objects such as nails and razor blades could easily be picked up under low-gravity conditions, and could do a lot of damage when the person moved around.

"An interesting way of demonstrating deflection of an electron-beam is to make the beam become visible, and this is something which we can easily do in this chamber."

EXCITING ELECTRONS

The Prof. unsealed a small container and held it near to the beam from the electron gun. The beam glowed a greenish-blue colour as it passed near the container.

"I am releasing a small amount of mercury vapour from the liquid mercury in this container. As the electron-beam passes through the mercury vapour, it excites the electrons which are orbiting around the mercury atoms in the vapour.

"These orbiting electrons absorb energy from the electrons of the beam, then re-emit this energy on wavelengths which are characteristic of the mercury atom, causing the characteristic spectral colours of mercury to appear along the path of the electron beam".

VAPOUR TRAIL

The Prof. released a number of different gases, and vapours of elements and volatile compounds, each of which caused the electron beam to show its path in brilliant colours.

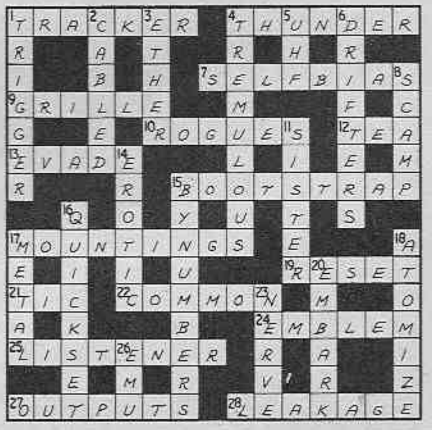
"It's amazing Prof., really great! But I would have thought that these vapours would have caused the electrons in the electron beam to scatter as they collided with the vapour molecules, and cause the beam to spread and diverge from its path. Yet I can see that the electron beam keeps to a narrow path all the way across the vacuum chamber. Why is this, Prof?"

"That is a very keen observation, Bob," The Prof. remarked, "It almost seems as if the presence of the vapour assists in keeping the electron beam to a narrow path, rather than scattering the beam as might be expected. This property has been made use of extensively in radar equipment, and the explanation is quite interesting."

Can readers find out the reason for this useful but unexpected behaviour of an electron-beam in the presence of a vapour, before the Prof. reveals all next month? One clue is the behaviour of the beam when Bob tried to use it for cutting plastic.

To be continued

Crossword No. 15–Solution



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

EE2020

BY E. A. RULE

TUNER AMPLIFIER

HI-FI SERIES

PART 6

WHEN all the work described in the previous article has been completed, the tuner amplifier must be thoroughly checked out in accordance with the detailed procedures given under **Initial Tests** and **Final Testing and Setting Up.** A voltmeter and milliammeter (multimeter) is the only test equipment required.

An additional (and optional) more advanced procedure is also given. This is for the benefit of those with the appropriate test equipment.

Comprehensive voltage tables are included, together with advice on Fault Finding.

This final article in the 2020 Series concludes with some notes concerning operation of the tuner amplifier and constructional details of a simple wooden case to house the chassis.

INITIAL TESTS

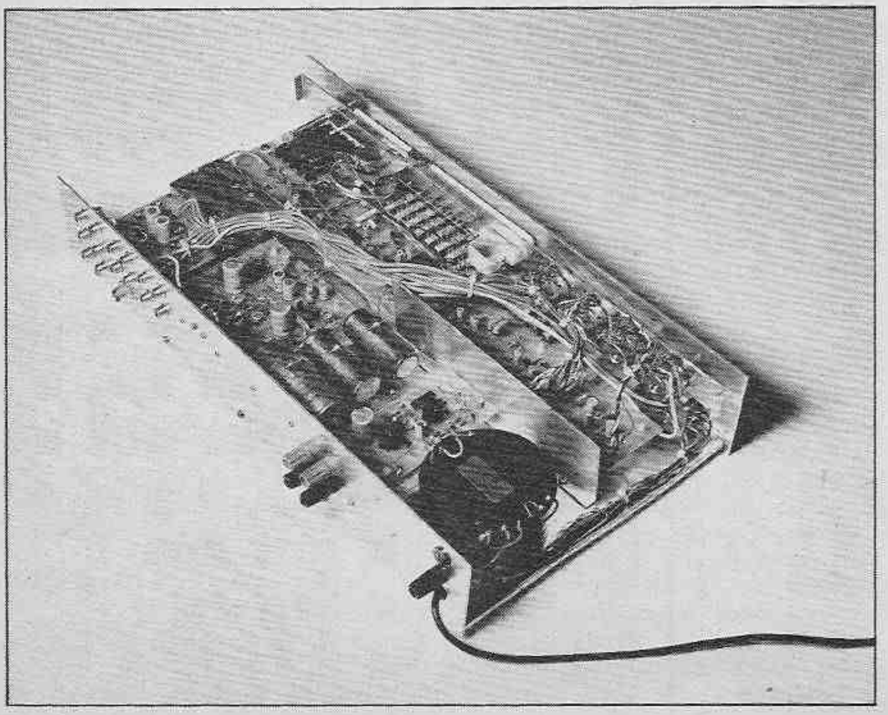
1. Mains switch off.
2. Remove 1 amp fuses from holders FS2, FS3.
3. Set all presets to the mid-way position.
4. Turn volume control to minimum. All other controls to mid-way.
5. Connect 8 ohm dummy loads (wirewound resistors 15W rating) across each loudspeaker output.
6. All pushbuttons out except AUX 1 and manual tuning.
7. Connect mains supply.
8. Switch on.
9. Connect a voltmeter −ve to chassis and +ve to TE3. The reading should be 52 volts.
10. Transfer meter to 25-volt line (pin TE5) and adjust VR17 for 25 volts on meter.
11. Transfer meter to pin TE9. This should read 14·5 volts.
12. Switch off. If all the above checks are correct proceed as follows; if not, recheck all wiring etc.
13. Connect a 30 ohm wirewound (5W) resistor across each fuseholder FS2, FS3. These are in place of the actual fuse while setting up.
14. Switch on and recheck voltage on TE3. This should still be the same as before. If correct measure the voltage on pins TD12a and TD12b. The voltage on these should be approximately 50 per cent of the voltages on pins TD10a and TD10b, which should be at almost the full supply voltage.

    NOTE. If either or both of the voltages on TD10a, b are very low it may be that VR16a or VR16b are set for a high quiescent current which would cause a voltage drop across the 30 ohm wirewound resistor fitted to the fuseholders. To check, carefully adjust each VR16 (one on each channel); the voltage on pins TD10 should rise and fall. Set VR16 for highest voltage reading. Recheck that TD12a, b voltages are still approx 50 per cent of respective TD10 voltage.

    The voltage on TD10a, b should be about 2 volts less than the full supply voltage. A larger drop in voltage may indicate a fault in the power amplifier, in which case the voltage to pin TD12 would also normally be wrong. This fault (if one exists) must be found and cleared before removing the 30 ohm wirewound resistor, otherwise the transistors could be damaged.

    The purpose of the 30 ohm resistors is to limit the current to a safe value in the event of a fault condition.

    Assuming the above check is correct proceed with the remaining tests.
15. Switch off.
16. Remove 30 ohm wirewound resistors and connect a milliammeter in place of the fuses −ve to TD10 and +ve to TE3 (set to highest range to start). Check each channel in turn and switch off when changing over meter from one channel to the other.
17. Switch on, adjust VR16 on metered channel for a reading of between 40mA and 50mA.
18. Switch off. Remove meter and fit 1 amp "quick blow" fuses.



19. Switch on. Measure voltages at each point shown in Table 6·2 and adjust presets where instructed.

TABLE 6·1

Terminal Pin	Voltage	Adjust
TE5	25	VR17
TE9	14·5	
TB2	25	
TC3	14·5	
TA7	14·5	
TA17	3·2	VR10
TD13 a, b (Loud-speaker Outputs)	ZERO*	

* VERY IMPORTANT NO VOLTAGE PRESENT

20. Switch off.

This completes the Initial Tests and it should now be safe to proceed with the Final Testing and Setting Up.

FINAL TESTING AND SETTING-UP

Radio

1. Remove 8 ohm dummy loads and connect loudspeakers.
2. Switch to FM and switch on. A "thump" may be heard from the speakers, but this should not be very loud. It is caused by capacitors in the loudspeaker circuit charging up.
3. Tune to 100MHz approximately on manual tuning. Advance volume control; a "hissing" should be heard from the loudspeakers.
4. Adjust L2 tuning slug carefully until meter reads centre-scale. Switch a.f.c. on (by pressing AFC button) and adjust VR1 until meter just reads to left-hand side of scale. Release AFC button.
5. Connect f.m. aerial and tune to approximately 89MHz. The BBC Radio 2 programme should be heard. Tune for centre-reading on meter. Adjust tuning cursor to the correct frequency for your Radio 2 programme.
6. Check Radio Times for actual frequency. At the same time check if a stereo transmission. If it is, adjust VR2 until stereo beacon lights up. Set final position of VR2 to mid-point of the two positions where the lamp comes on and goes out.
7. Check frequencies of other stations and also select preset stations and adjust preset tuning potentiometers as described in Part 1. (p. 875) (Anticlockwise for l.f.)
8. Switch back to manual tune and press MUTE button. Receiver should mute either with no signal and when de-tuning.
9. Release MUTE button. Tune to a spot around 100MHz where there is no signal. Listen to hiss while pressing H.F. or L.F. filters. A change in the general sound should be heard. The H.F. filter should cut the higher frequencies and the L.F. filter the lower. It may be difficult to detect the change on the L.F. filter, depending on how good the loudspeakers are.

Audio inputs

Connect a pick-up to the DISC input and a tape recorder to AUX 1, then AUX 2, and finally TAPE. Select the correct input and check that each input is working correctly. Test BASS and TREBLE controls.

That completes the Final Testing and Setting Up procedure.

MORE DETAILED PROCEDURE

Anyone who has access to test equipment would (normally) also know how to use it for checking a full specification, therefore only the f.m. i.f. alignment procedure will be given here. Once this has been carried out a full check of the performance can then be made against the Specification given in Part 1.

Radio I.F. Alignment

Having completed all the Initial Tests and the Final Testing and Setting Up satisfactorily, the next stage is to correctly align the f.m. i.f. section. This requires a f.m. signal generator with stereo modulation, an output meter, and a frequency counter.

1. Disable a.f.c. by shorting out switch S2c (front tags next to front panel —see Fig. 5·5 and *Erratum* below). Press AFC switch in. Inject f.m. generator to pins TA1 and earth at approximately 10·7MHz. Increase input until meter reads, then tune generator until meter shows maximum tuning point. The generator frequency is now set to the centre of the ceramic filter pass band.
2. Release AFC button and remove short from S2c. Do not alter generator. Adjust L2 for a centre reading. Discriminator is now correctly tuned to the ceramic filters.
3. Remove generator. Transfer to AERIAL input and inject a frequency of 88MHz. Tune receiver to the signal, adjust cursor to 88MHz on dial.
4. Check other frequencies. Very slight adjustment of VR10 may be needed, but this is normally set for 3·2 volts on TA17.
5. Connect frequency counter to pin TA8 and earth. Remove generator. Adjust VR2 for a frequency of 19kHz ±2Hz.

TABLE 6.2
CIRCUIT VOLTAGES

No signal applied. Volume control at minimum. AVO 8 meter used.

BOARD A

Terminal Pin	*Voltage*
TA1	0
TA2	0
TA3	14·5
TA4	0·3
TA5	7
TA6	5·6
TA7	14·6
TA8	1·7
TA9	0
TA10	0
TA11	0
TA12	3 or 12†
TA13	13·2
TA14	3·2–12*
TA15	12
TA16	10·5
TA17	3·2
TA18	5·7

† Depending on preset hi-lo l.e.d.s.
* Depending on tuning. 88-102MHZ.

BOARD B

Terminal Pin	*Voltage*
TB1	21·4
TB2	25
TB3a, b	0
TB4	0
TB5a, b	0
TB6a, b	0
TB7a, b	0
TB8a, b	0
TB9a, b	0
TB10a, b	0

BOARD C

Terminal Pin	*Voltage*
TC1a, b	0
TC2	0
TC3	14·5
TC4a, b	0

BOARD D

Terminal Pin	*Voltage*
TD1a, b	0
TD2	0
TD3	0
TD4a, b	0·5
TD5a, b	25·5
TD6a, b	0
TD7a, b	54·5
TD8a, b	25·5
TD9a, b	55·2
TD10a, b	55·2
TD11	0
TD12a, b	25·5

BOARD E

Terminal Pin	*Voltage*
TE1	55·4
TE2	0
TE3	55·4
TE4	0
TE5	25
TE6	Secondary of T1
TE7	
TE8	0
TE9	14·5

6. Disconnect frequency counter and reconnect signal generator. Switch to stereo and check separation using the output meter connected to the loudspeaker terminals together with 8 ohm dummy loads. Separation at 1kHz should be a minimum of 30dB. Slight readjustment of VR2 may be needed for optimum separation.
7. With oscilloscope connected to output, adjust VR15 for symmetrical clipping on full sine wave drive.

   NOTE: If oscilloscope not available, set VR15 to mid-way position.

Frequency Response

When testing for frequency response, some tone controls may not indicate a "flat" response when in their mid setting. If necessary small fixed resistors can be shunted across one half of each control to correct this. The actual value and section of control will have to be found by trial. Resistor values between 82k ohms and 180k ohms should prove satisfactory.

OPERATION OF THE 2020 TUNER AMPLIFIER

Most controls are self explanatory, but for completeness a few comments are in order.

Phones socket (SK9). This is wired directly to the power amplifier output and it may be necessary to use an attenuator to protect the headphones (and your ears) from excessive power at high volume levels.

An attenuator could not be fitted internally as a switched jack socket of suitable type was not readily available. In most cases a resistor of 100 to 270 ohms in series with each channel will prove satisfactory.

Tuning Meter (ME1). With AFC off, the meter shows the correct tuning point when set to the centre of its scale. With AFC on, it indicates the strength of the incoming signals over a range approximately 1 microvolt to 100 millivolts.

Pre-set tuning adjustment. This is fully described in Part 1 under *Varicap Tuning and L.E.D. Tuning Indicator.*

Mute. When detuning, the output is muted before the station goes out of tune and distorts. It stays muted until another station is correctly tuned in.

Mono. Not often used, but can be useful on weak stereo transmissions to give a mono reception with less background hiss. Sometimes also used for older records.

All other control functions are described in Part 1.

Preamp Out/Power Amplifier In. These sockets (SK7, SK8) are internally linked and are provided so that at a later date a quadraphonic decoder or other unit may be added simply by removing the internal link and plugging a suitable unit into these sockets.

Earth Terminal. Any ancillary equipment, such as a tape recorder or record player must be earthed to this terminal and NOT to the mains earth if hum loops are to be avoided. Note: on some record players the pick-up

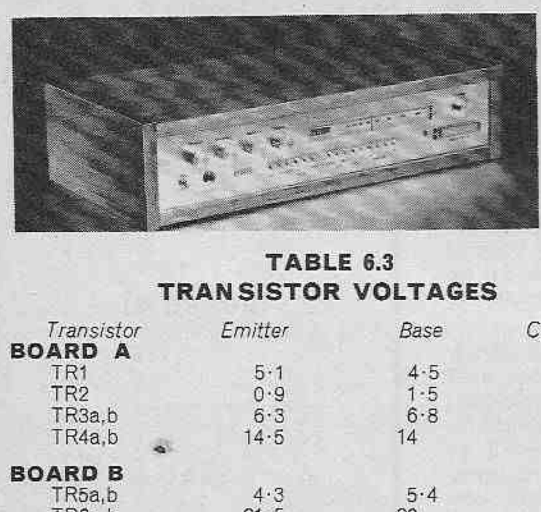


TABLE 6.3
TRANSISTOR VOLTAGES

Transistor	*Emitter*	*Base*	*Collector*
BOARD A			
TR1	5·1	4·5	1·5
TR2	0·9	1·5	12
TR3a,b	6·3	6·8	14
TR4a,b	14·5	14	12
BOARD B			
TR5a,b	4·3	5·4	20·7
TR6a,b	21·5	20	11
TR7a,b	9·6	10·2	20·7
TR8a,b	21·5	20·7	9·6
TR9a,b	0	0·6	12·7
TR10a,b	12	12·7	21·4
BOARD C			
TR11a,b	4·5	5·0	12·1
TR12a,b	4·5	5·0	6·5
TR13a,b	12·7	12·1	5·8
BOARD D			
TR14a,b	11·8	12·3	38·4
TR15a,b	11·8	12·5	18·9
TR16a,b	50·6	49·9	26·3
TR17a,b	25	25·7	26·3
TR18a,b	50·6	51·3	55·5
TR19a,b	25·8	25·0	0·6
TR20a,b	0	0·6	25·8
TR21a,b	25·6	26·3	54·8
TR22a,b	55·5	54·8	25·6
BOARD E			
TR23	12·8	13·3	25·7
TR24	25	25·7	35
TR25	14·9	15·4	25

TABLE 6.4
INTEGRATED CIRCUIT VOLTAGES

IC1, 2 and 3 are on Board A, see Fig. 2.2.
IC4 is on Board E, see Fig. 2.6.

Pin	*IC1*	*IC2*	*IC3*	*IC4*
1	2	14·7	*	0
2	1·9	3	*	14·9
3	1·9	5·2	—	14·7
4	0	10·8	0	7·3
5	0	10·8		7·3
6	5·6	13·2	*	7·3
7	5·5	0	*	0
8	5·6	2·3	—	0
9	5·6	2·3	—	8·9
10	5·6	1·7	*	15·4
11	10·7	2·3		25
12	2·8	2·3	3 or 12	25
13	0·4	2·3	14·5	0
14	0	3·3	—	0
15	7·9			
16	0·4			

* 3–12 volts (depends on tuning).

PRESET AND VARIABLE POTENTIOMETERS

Ref.	*Function*	*Board Location*	
VR1	—	A	Fig.2.2
VR2	—	A	
VR3	Manual Tune	—	Fig.5.3
VR4	Station 1	A	Fig.2.2
VR5	Station 2	A	
VR6	Station 3	A	
VR7	Station 4	A	
VR8	Station 5	A	
VR9	—	A	
VR10	—	A	
VR11a,b	Bass		Front Panel
VR12a,b	Treble		
VR13	Balance		
VR14a,b	Volume		
VR15a,b	—	D	Fig.3.2
VR16a,b	—	D	
VR17	—	E	Fig.2.6

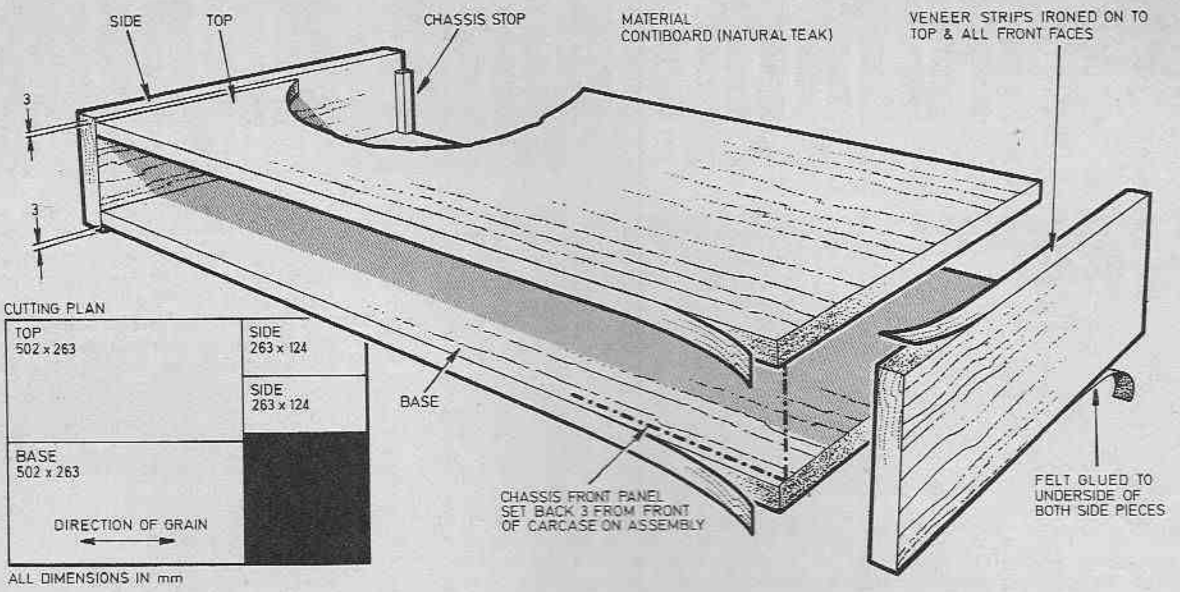


Fig. 6·1. A wooden case for housing the 2020 Tuner Amplifier.

earth return is also connected to the turntable metal chassis. These must be isolated and the turntable chassis connected directly to the tuner amplifier earth terminal; that is, the pick-up is earthed via the audio leads, but not the turntable chassis.

The tuner amplifier is earthed via its mains lead.

FAULT FINDING

All significant voltages are given in Tables 6·2, 6·3 and 6·4 and should prove helpful. Remember to check *both* channels were applicable.

When investigating suspected power amplifier faults, always fit the 30 ohm 5W resistors in place of the fuses (to limit the current) until the fault has been cleared. As the power amplifier is d.c. coupled a voltage check will not help as *all* voltages will be wrong. The best method is to switch the tuner amplifier off and check each transistor in turn.

If only one channel is faulty, compare the resistance reading from each part of the circuit when measured either to earth or H.T. line. (Remove fuses and 30 ohm resistors for this test.)

Most power amplifier faults (assuming the unit had been working) in the Author's experience have been due to faulty or blown transistors.

Erratum

In Fig. 5·5 the switch S2 is incorrectly marked. The "c" and the "d" should be transposed. (S2d is not used.)

WOODEN CASE

Details of a suitable case are given in Fig. 6·1. It is suggested that a wooden sleeve type of case as indicated be constructed, so that when the chassis is inserted into the sleeve from the front, the chassis front panel overlaps the front edges of the sleeve. The 2020 front panel has been made larger than the chassis so that it overlaps enough on all edges for mounting in a case of this type.

All parts were cut to the sizes stated, care being taken to ensure that the grain runs in the direction indicated on the cutting plan.

These parts were then assembled with the aid of panel pins and Resin W adhesive.

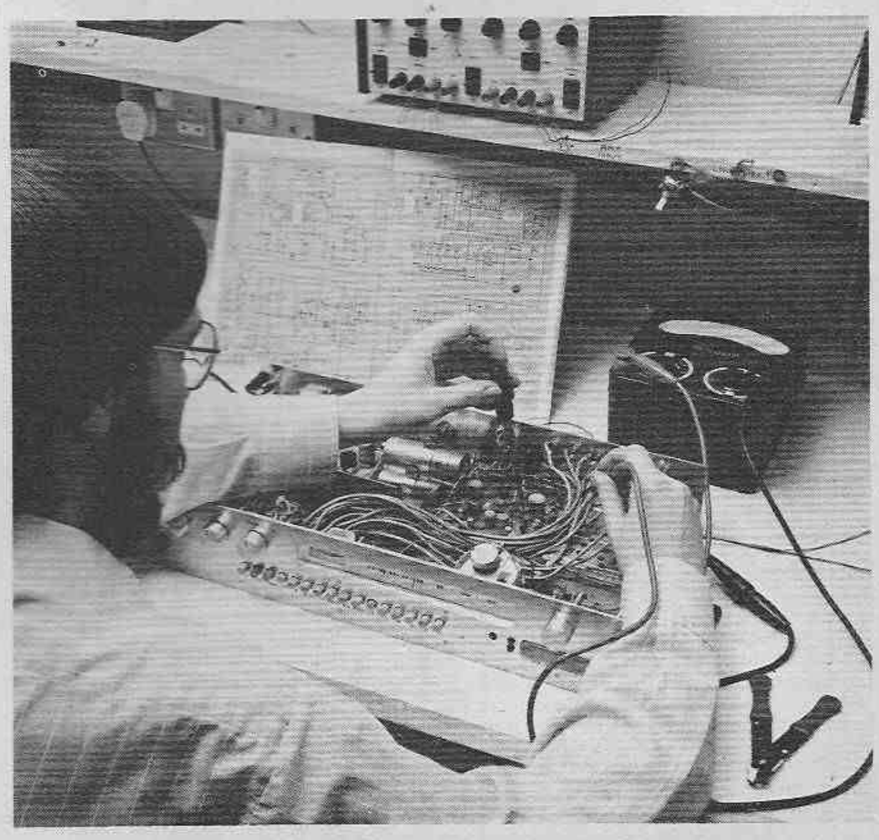
VENEER

Conti-strip veneer was ironed on to all top and front raw edges which were exposed during the cutting stage.

The carcase was given two coats of Contipol, and rubbed down with glasspaper between coats. ⌑

Stereo Decoder IC2

Please note that MC1310 (Motorola) is a pin-for-pin replacement for the type specified, and may be more readily available.



RUMMAGING AROUND

with Keith Cadbury

DEAR READER as you might well have guessed this column will be concerned with short-cuts and cheap ways of producing some projects, obtaining bargains in components and apparatus, and improvising in all constructional aspects of our hobby. The important consideration with all my ramblings will be that *of cost*. I cannot really be the only electronics afficionado who is unable to spend significant amounts on parts for projects, so I shall pass on as many tips for buying cheaply as I can.

HOW I GOT HOOKED

Before going further, it might be a good idea to tell how I got into electronics.

Less than two years ago I picked up a Philips cassette recorder in a junk shop for a fiver. Working away from home and with time on my hands, I determined to "dramatize" tapes for friends and relatives, by way of a change from my indecipherable letters.

Having long been an admirer of Kenny Everett's radio technique, I sat down after work one day to "do" a cassette for a friend in Canada, complete with background music, effects and lots of funny voices.

With no mixing facilities, no direct connection between record player and recorder, and next-door's howling dog complaining at being locked-out, the result of that first tape was poor, to say the least. I was going to need a mixer, sound-proofing, script, and rehearsals.

Sound-proofing proved unnecessary, when the mic was pointed away from the closed and curtained window; scripting meant learning to read my awful writing; taping "rehearsals" often resulted in successful "takes" first time.

It was because I needed a mixer that I took up electronics.

A visit to the local library revealed a number of books about elementary electronics that proved to be adequate introduction to transistors, capacitors, resistors and suchlike. A week later I went to the local shop to purchase components. I stayed up all night building the simplest of two-channel mixers from a 741 i.c., a couple of rotary pots and half-a-dozen other bits and pieces, and fitted the whole thing in a plastic box about 80mm by 70mm by 35mm that had housed an Ingersol wristwatch.

It worked!

I was hooked.

That first C60 tape for my old school-friend in Canada was enthusiastically received—he rang me at 5 a.m. my time to tell me he had just played it. So in the first week of taking up electronics as a hobby, I had lost-out on sleep three nights already (the other time was when I had stayed up very late, recording the cassette).

FAILURES

A lot of the ideas I tried didn't work—I have a two-litre ice-cream carton-full of failures, but I can't say that I learned from all of them. Some *should* have worked, and I still can't fathom out why they *don't* work. One of these days I'll go over them again and see if extra knowledge, gained since they were thrown in the box, enables me to work out what is wrong with them.

Still a "beginner," still an electronics hobbyist, still not understanding all of the basic rules, I continue to read everything I can get my hands on that has anything to do with your, and my, exciting pastime.

MICROPHONE WINDSHIELD

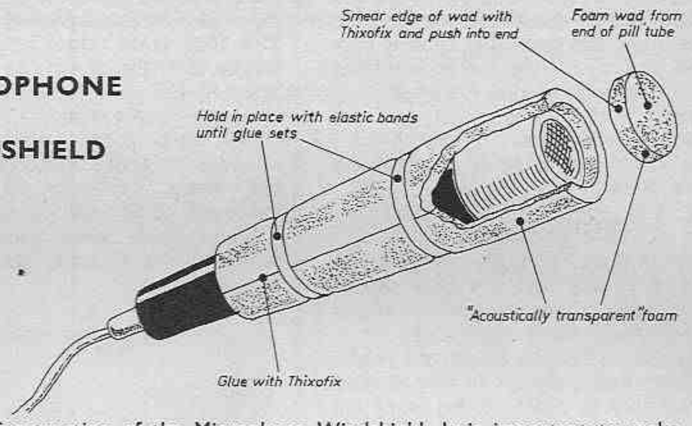


Fig. 1. Construction of the Microphone Windshield. It is important to make sure you use only a thin coating of glue to avoid sticking the foam to mic case.

Anyone who, like myself, has occasion to take a battery recorder outside, will have realised the importance of a microphone windshield. Most of those seen advertised cost from about £1·50p. A lot of money for a bit of plastic foam. I made my own.

"Acoustically Transparent," they call it in the ads—but don't be put-off by such esotericism. They simply mean that insertion of the foam in the path of sound waves from source to mic has no effect on the frequencies being recorded. As the average battery recorder does not record frequencies above about 10kHz, it has to be pretty thick, heavy, foam to cut signals below that level—and it is not thick stuff that is needed anyway.

What causes all the wind noises is *buffeting*—and I don't mean the effect caused by eating British Rail food standing-up (although the noises your stomach makes are similar). It is the *conducted* sound of wind bashing against the mic and its handle that makes all the noise, and this is easily got rid of by *cushioning* the microphone from the gusts.

A search through one of my non-electric junk boxes (I hate to throw anything away) produced several bits of foam of various sorts, and simple tests were made. A very flimsy piece that had been in the same wristwatch box used to house Mixer 1 was found to be not only "acoustically transparent," but also of exactly the right size to wrap round the simple stick mic I use on such occasions.

The end of the mic was covered with a small circle of foam from a tub of vitamin pills. The appropriate edges were smeared lightly with "Thixofix"glue (I should think that "Evostik" glue would work O.K. also). The foam was held in place on the mic with elastic bands while the glue set, see Fig. 1.

The result looks professional, and works perfectly—it takes pretty-near a gale to register on the recording, and no audible difference can be detected on the tapes.

THE NEW

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THE UNIQUE

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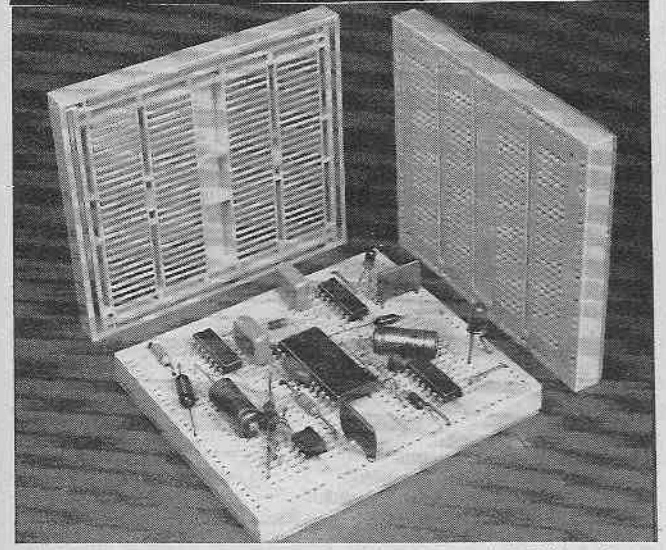

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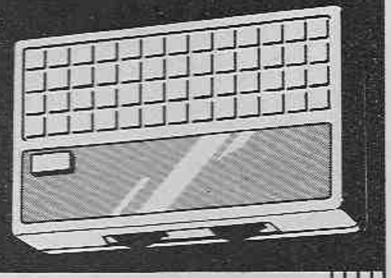

This easy to build kit includes:

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Signature________________________

CHROMATRONICS

RADIO WORLD

By Pat Hawker, G3VA

Losing the lead?

BRITISH television has a long-established tradition as a pioneer of new technology, stretching right back to the development of the original 405-line system by the EMI team in the mid-1930s and more recently to the setting up of a nationwide, "four-channel" u.h.f. transmitter network (seldom recognised as the technically audacious scheme that it was when planned over a decade ago).

Yet undoubtedly in some respects we are at the moment falling behind North America. One such area is the successful implementation there of satellite distribution systems, such as the Canadian *Anik* satellites that carry television to remote Arctic communities or those used by "Subscription TV" cable operators in the USA and the Public Broadcasting System (PBS).

Unlike so many technical innovations distribution satellites have really brought costs tumbling down and made coast-to-coast distribution relatively cheap. The smaller geographical area of the UK makes such systems less essential here, but there also seems to be less "get up and go" about the whole European approach to satellites.

Another, even more pertinent area in which the UK is treading water is the thorny subject of "electronic news gathering" (ENG). Almost everybody in television recognises that it must come here, as it has in America, yet for months the expensive experimental BBC unit (insured for some £90,000) has been figuratively in mothballs and the whole topic of "new technology" is almost as hairy in TV circles as it is in Fleet Street.

In 1976 I visited the CBS News Centre in Chicago just as it was being converted from film to electronic cameras and U-matic portable recorders. Since then one has waited for a similar revolution in the UK . . . waited and waited and waited.

Not so easy

There is a view of amateur radio h.f. operation that makes it look all too easy. If it really were just a matter of buying and installing a modern s.s.b./s.w. transceiver and then immediately being able to work at will all over the world, the hobby would in fact be altogether less challenging and less interesting than it is in practice, with the opportunity for gradual improvement as experience is gained.

It is true that with a transceiver and modest aerial, a newly licensed amateur *can* contact other amateurs in all parts of the world: but usually only when band conditions are just right, at the right time of the day, on the right band, in the right season. The urban amateur has to contend with high levels of electrical interference, may still encounter tricky problems of television or "audio" interference and, if he operates on s.s.b., has to get used to listening to amateurs who may be speaking with heavy accents under "frequency-shifted" conditions due to receiver or transmitter frequency drift or inexpert tuning.

If he uses simpler and more effective "cw" (Morse telegraphy) he finds there is a good deal of difference between scraping through a 12-words-per-minute Morse test and actual two-way working with weak, fading signals often under heavy interference. His aerial may often be at limited height, located near to power-absorbing objects such as trees, fences and metal drainpipes and guttering—or even slung up in a roof space.

Making contact

It thus remains true, as it always has been, that many amateurs, even when working on the long-distance (DX) bands such as 14, 21 and 28 MHz make contact most frequently with stations located a "single hop" away (under say 2000 miles). The really long-distance contacts thus come as a bonus, especially when using simple wire aerials.

At the moment, as we head towards the sunspot peak (expected late 1979 or early 1980 but possibly not until later) it is much easier to work long distances from poor locations. A high "maximum usable frequency" (muf) and low D-layer attenuation make even poor aerials suddenly seem as good as a beam, and logs are filling up with American, Japanese, Australian and other callsigns that are rare in sunspot minimum years.

Even so, it is still not possible just to switch on the rig at any time of the day or night and be sure of making contacts with stations many thousands of miles away. That is part of the attraction, and why the hobby is genuinely a form of "self training".

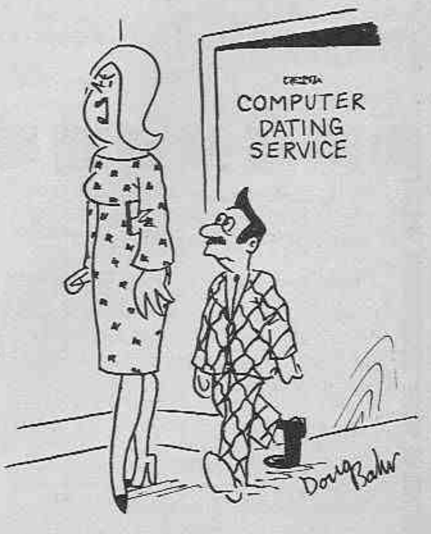
One of the high spots this year has been the reception in the UK of American amateurs working on the 50MHz band (not available to amateurs in the UK). Two-way contacts have been made with these stations by using the 28MHz band but there is the possibility of 50/70MHz cross-band contacts in the period October 1979 to March 1980.

If 70MHz signals can reach North America along an East/West path, there is an even greater possibility of their being heard in southern Africa or South America since the "muf" always tends to be higher for north/south than for east/west paths.

Working the stars

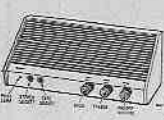
In the March 1979 issue, I reported the suggestion by Japanese scientists that we should listen on precisely 4829·659MHz for interstellar communications. Now a Russian, N. S. Kardashev of the Space Research Institute, Moscow, has come up with his favoured frequency for CETI (communication with extraterrestrial intelligence).

It is the very high frequency of 203·385GHz (wavelength about 1·5mm) which corresponds to splitting of the ground state of the lightest atom: positronium. Such a frequency corresponds roughly with minimum background radiation noise although not exactly a part of the radio spectrum covered by many existing sensitive receivers!



"Personally, I think it is a computer with a warped sense of humour!"

BUSH "PARTY AMP"



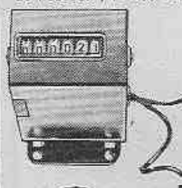
This very attractive unit is a complete mono amplifier originally designed as the second channel **BUSH** record players. All solid state, the case houses good quality speaker, power supply, pre-amp and controls. Standard DIN socket input accepts ceramic cartridge direct. 240v operation. Brand new and boxed complete and screened DIN to DIN connection lead and instruction leaflet. Many uses include baby alarm, guitar practice amp, booster amp for transistor radios, etc. etc.

Two types available:

Type 1 2-3 watts output with volume and tone control **£7·50**

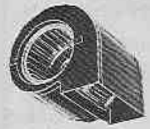
Type 2 2-5 watts output with separate bass, treble, volume controls and tape output **£8·50** + 56p, PP £1

*NOTE For use as baby alarm and guitar practice amp it may be necessary to use our phono preamplifier module (BMI).



6 DIGIT COUNTER

one pulse at mains voltage moves 1 digit—not resettable—real bargain @ **80p.**



MAINS BLOWER

The Torrin—quiet but powerful outlet size 2½ × 1¾ for cooling equipment etc. will extract of outlet is blowing outwards price **£5·50.**

Other models from £2·00.

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.**

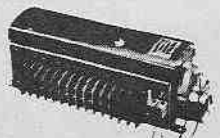
MICRO SWITCH BARGAINS

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.**

INDUCTION MOTORS

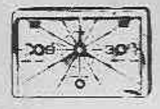
One illustrated is our reference MM11 made for ITT ¾ stack 1½ spindle **£2·25,** ½ stack model **£1·75.** 1 stack **£2·75.** 1½ stack **£3·25.**

MOTORISED DISCO SWITCH



With 10 amp change-over switches. Multi adjustable switches are rated at 10 amps. This would provide a magnificent display. For mains operating. 8 switch model **£5·25.** 10 switch model **£5·75.** 12 switch model **£6·75.**

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.**

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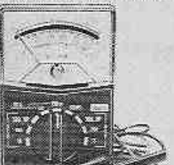

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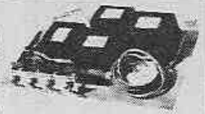
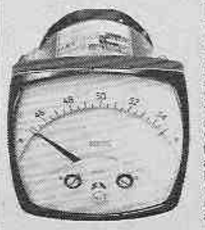
MULLARD UNILEX



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 Plessey 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.



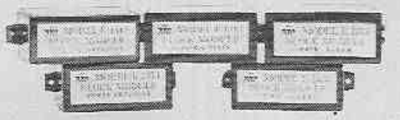
ELECTRONIC VOLTMETER/ SENSITIVE RELAY

Consists of a large, extremely readable, 4½" square drop through panel volt meter, 0/0-1 fsd. Built into the front of the meter are two screw adjusters which move two separate pointers, one red and one green, up and down the scale, the purpose being to set a minimum and maximum level so that when the needle falls below or rises above the preset levels a unique 'under' and 'over' circuit inside the meter operates one of two reed relays to bring an 'under' or 'over' circuit into action. The scale plate is detachable via two screws to be calibrated to your own individual requirements. The 10 transistor 'under' and 'over' circuit is completely separate from the meter movement so does not have to be connected to use this as a standard 0-1 meter. Many uses including level controls, light controls, auto battery chargers, alarm units, etc. etc. Manufacturers list price of over £120 each. An unbelievable snip at **£7·75** + 62p, p & p. 80p. (Less than value of the meter alone). Circuit diagram included.

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

In case measures 5¼ × 3½ × 1½ extremely high gain (70 DB) solid state amplifier designed for 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. etc. An absolute bargain at only **£2·25.** Suitable 80 ohm earpiece 60p + 5p.

PLUG IN MODULES



MODULES Neat 'plug-in' size approximately 2" long × ¾" wide × 1" high. Japanese made, 6v operation, solid state, eight different types to perform various functions as follows—all supplied with connection diagrams:—

FIRE-ALARM MODULE (BM 71) Used with thermostatic switch or switches and 6v battery this will drive a speaker and give audible alarm. Note: Ceiling type, white, fire operated thermal switches available **£2·50** + 12p ea.

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PHONO PREAMPLIFIER (BM1) Will amplify the output of a magnetic cartridge, tape head, timer etc., up to about 1 volt, and give a reasonably flat response curve, should suit most amplifiers.

DUAL LAMP FLASHER (BM100) An electronic switch designed to flash two miniature bulbs alternatively at ½ sec. intervals with any 6v, ·1 to ·3 amp bulb. Ideal for flasher of model car, model plant and boat, warning of railroad crossing of HO gauge; display attention getter, car emergency warning, etc.

MORSE CODE OSCILLATOR (BM42) Miniature transmitter, it transmits a modulated signal (400-30mhz) which can be picked up with normal AM radio receiver. Also ideal for a signal source on test bench for tracing troubles in AM radios.

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PRICES any module **£1·95,** bases optional 56p.

Terms: Prices include Post & VAT. But orders under £6·00 please add 50p to offset packing. Bulk enquiries—Please Phone for Generous Discounts 688 1833.

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MEMOREX 8" floppy disc drives, as new, **£180·56** + £14·44

TELETYPES ASR33 from **£295.** KSR33 from £175

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A range of TTL and other components is now stocked at the Shop.

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Scopes sell very fast we strongly advise a visit to the shop where personal callers can snap up bargains! Mail customers please telephone for availability.

Constant Voltage Auto-Transformers made for operating American made computer equipment off standard 230-240v mains. Input voltage can be plus or minus 20%, output voltage would be a steady 115v. They are beautifully made regardless of cost. We have two models, one 500w price **£49·50** or 750w price **£75.** Carriage depending on distance.

Telephone Headset and Mouthpiece As used by switchboard operators, made for the GPO so obviously best quality. Very lightweight so not uncomfortable to wear. **£3·75.**

Telephone Plug Short GPO 4 pole type, reference number 420, as currently used with plug-in telephones, ex equipment but unused. **92p.**

Telephone Socket Panel mounted, 4 pole, will take the 420 plug. **75p** + 6p.

Strong Metal Box Just the right size to hold in your hand approx. 5" × 3" × 1½", removable lid and top punched to take controls. This has dozens of uses, particularly suitable for making rugged portable test systems. **£1·38.**

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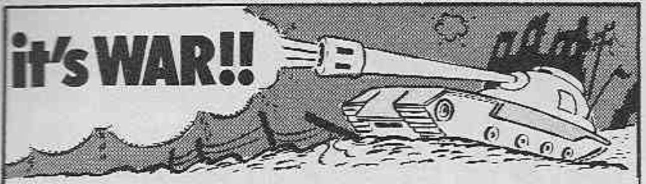

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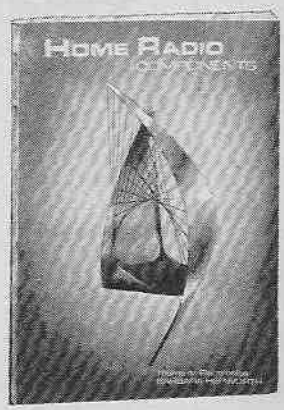

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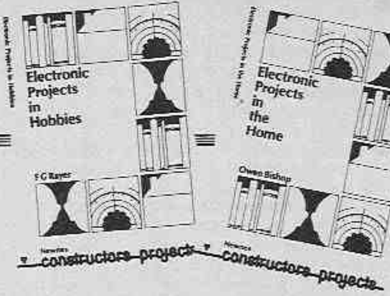
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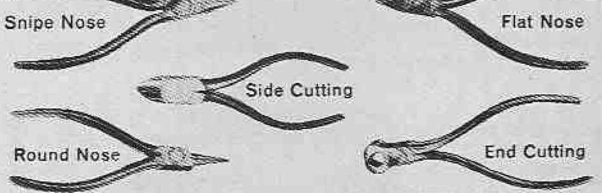
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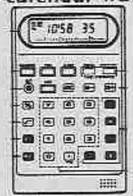

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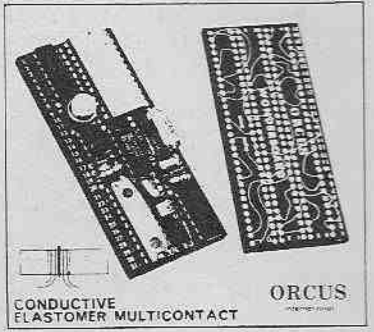

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1978 Jan	Audio Visual Metronome	E001	+ 65	5·50	B.E.H.L.
	Touch Switch	E002	+ 74	1·80	B.E.
	Rapid Diode Check	E004	+ 52	2·23	B.E.H.L.
Feb	Car Alarm	E005	+ 80	5·48	B.E.G.J.L
	Lead Tester	E006	51	4·17	B.E.H.L.
	Chaser Light Display	E007	1·75	20·32	B.E.H.L
	A.C. Meter Converter	E008	+ 60	5·37	B.E.H.L.
Mar	Audio Test (2 Pcb's)	E009	+1·74	14·96	B.F.G.J.
	C.R. Substitution Box	E010	—	8·45	E.H.L.
	Catch-a-Light	E011	+ 82	8·32	B.E.H.L.
	Weird Sound	E012	+ 62	5·29	B.E.H.L.
Apr	Roof Rack Alarm	E013	+ 60	—	
	Mains Delay Switch	E014	+ 94	12·48	B.E.J.L.
	Pocket Timer	E015	+ 60	3·46	B.E.H.L.
May	Flash Meter	E016	+ 75	11·09	B.E.H.L.
	Mains Tester	E017	+ 54	1·35	B.E.H.
	Teach In—Power Amp	E018	—	1·55	E.
	Power Pack	E019	+ 70	5·71	B.E.H.L.
Jun	Tele-Bell	E020	+1·00	10·69	B.E.H.L.
	Insitu—Transistor Tester	E021	+ 65	5·10	B.E.G.H.L.
	Teach In—S.W. Receiver	E022	—	2·61	E.
	Power Slave	E023	1·75	—	
	Visual Continuity Tester	E024	—	4·09	E.H.L.
Jul	Auto Night Light	E025	+ 85	9·39	B.E.G.H.L.
	Short Wave Radio	E026	—	7·86	E.J.
	Quagmire	E027	+1·40	7·39	B.E.G.H.
	Logic Probe	E028	+ 50	2·76	B.E.G.H.L.
Aug	Slave Flask	E029	+ 55	2·72	B.E.
	M.W. Mini Radio	E030	50	4·78	B.E.J.L.
	Audio Freq. Signal Generator	E031	+ 85	12·41	B.E.J.L.
	CHRONOSTOP	E032	+2·50	29·20	C.E.G.K.M.P.
Sep	R.F. Signal Generator	E033	—	15·82	E.H.
	Sound to Light Unit	E034	—	5·14	E.H.L.
	Guitar Tone Booster	E035	75	4·06	B.E.H.L.
	Car Battery State Indicator	E036	65	1·62	B.E.
Oct	C.M.O.S. Radio	E037	+1·45	10·76	B.E.G.H.L.
	Fuse Checker	E038	—	1·60	E.H.L.
	Treasure Hunter	E039	1·25	15·95	B.E.G.H.L.
	DOING-IT-DIGITALLY—TTL TEST BED	E040	—	20·65	N.
	DOING-IT-DIGITALLY—1st 6 PARTS	E041	—	3·60	N. (inc. add. comps.)
Nov	Audio Effects Oscillator	E042	—	2·40	E.H.L.
Dec	Water Level Alert	E043	+ 70	3·98	B.E.G.J.L.
Nov	SUBSCRIBERS TELE-TELL METER	E044	+2·80	19·90	C.E.G.K.M.P.
	Components to add 3rd digit to kit E044	E044A	—	3·00	E.
	Combination Lock (2 × PCB's)	E045	+2·55	19·90	B.E.H.L.
	Hotline Game	E046	+ 75	4·57	B.E.H.
Oct	Mini-Module—Passive Mixer	E047	—	2·47	B.E.H.
Dec	Audible Flasher	E048	—	1·21	E.H.
	Fuzz Box	E049	+ 75	5·20	B.E.H.L.
	Vehicle Immobiliser	E050	1·00	4·56	B.E.H.L.
	Mini-Module—Microphone Amp	E051	—	2·45	D.E.H.
1979 Jan	Mini Module—Continuity Tester	E052	+ 80	3·75	B.E.H.
	Lights Reminder	E053	+ 80	6·02	B.E.G.H.L.
	I'm First	E054	—	1·58	E.H.
	Roulette inc. colour printed wheel (2 × PCB's)	E055	+3·40	17·90	B.E.H.
	Headphone Enhancer	E056	—	2·06	E.H.L.
DEC TO FEB	EE 2020 Tuner Amp—Board A inc. RF unit	E057	3·65	54·44	B.E.G.H.
	EE 2020 Tuner Amp—Board B	E058	3·40	22·38	B.E.H.
	EE 2020 Tuner Amp—Board C	E059	1·45	4·30	B.E.H.
	EE 2020 Tuner Amp—Board D	E060	2·20	16·53	B.E.H.
	EE 2020 Tuner Amp—Board E Hardware & wire	E061	1·40	22·26	B.E.G.H.
	EE 2020	E062	—	11·95	K.
		E063	10·50	123·00	B.E.G.K.
Feb	Longwave Converter	E064	95p*	6·20	B.E.H.L.
	Mini Module Audio Modulator	E065	—	153	E.H.
	Power Supplies	E066	80p*	22·12	B.E.H.
	Thyristor Tester	E067	55p*	3·92	B.E.H.L.
	Sound Adaptor Treasure Hunter	E068	90p*	5·99	B.F.H.

\+ 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

Doing-it-Digitally
TTL ELECTRONIC TEST BED

Complete kit E040 **£20·65**

Components for first 6 parts E041 **£3·60** (including additional components)

BOTH KITS (special price) **£24·00**

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) £19·90
(3 digits) £22·90

BARGAIN CORNER

100 × ½w 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
4 × NE55 Timer	£1·00
Plug in mains PSU 3v/6v/9v/12v DC 300mA suitable for calculators & T.V. Games	£2·99

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 £29·20

SOLDERING IRONS & ACCESSORIES

SRB 18 watt Iron inc. No 20 Bit	£3·78
Stand	£3·25
Solder-Savbit 20 inch	52p

Bit sizes No. 90 (1·5mm)
" " " 20 (3mm)
" " " 21 (4·5mm)
" " " 22 (6mm)
Ideal for Home Constructor

Tamtronik Ltd. reserves the right to change kit content without notice, where necessary to incorporate current modifications or to make valid substitution for temporarily unavailable components. The majority of the kits we advertise can be supplied from stock or compiled at short notice from component stocks held, but when ordering you should be prepared to allow at least ten days, and up to one month, for us to complete your order. Upon receipt of your order, acknowledgement will be made by return post within 48 hours detailing our control number for that transaction. In case of any enquiry please quote this number.

Kits can be supplied excluding P.C.B's and/or case. Send SAE for details naming kit and kit reference and free catalogue.

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a digitizer adds another dimension

The Bit Pad computer digitizer converts graphic information into digital form for direct entry into a computer. By touching a pen like stylus or a cursor, to any position on a drawing, diagram, photograph, or other graphic presentation, the position co-ordinates are converted to digital equivalents.

- **Bit Pad interfaces with almost any micro computer.**
- **Bit Pad consists of a 15" sq. digitizer tablet (11" sq. active area), a stylus, and a controller cabinet.**
- **Bit Pad costs only £450 (excluding VAT).**

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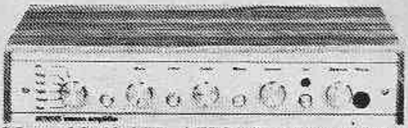
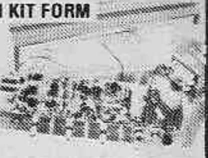


20 x 20 WATT STEREO AMPLIFIER

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.

£29.90 £2.50 p&p

30x30 WATT AMPLIFIER IN KIT FORM



For the experienced constructor complete in every detail, same facilities as Viscount IV, but with 30x30 output. 60x60 watts peak. For use with 4 15 ohms speakers.

£29.00 + p&p £2.50

SPECIAL OFFER

30x30 WATT AMPLIFIER IN KIT WITH SPEAKERS

2 GOODMAN compact 12" bass woofers with cropped size 14.000 Gauss magnet. 30 watts RMS handling, plus 2. 3" approx. tweeters and cross overs to suit.

£49.00 + p&p £4.00

BUILT AND READY TO PLAY

30x30 Viscount. Available fully built and tested.

39.00 + p&p £2.50

EMI SPEAKER BARGAIN

Stereo pair 350 kit. System consists of 13" x 8" approx. woofer with rolled surround; 2½" approx. Audax tweeter, crossover components and circuit diagram. Frequency response 20 Hz to 20 KHz. Power handling 15 watts RMS. 20 watts max. 8 ohm impedance.

£14.95

Per stereo pair + £3.40 p&p.

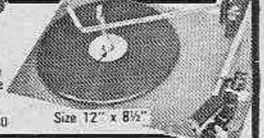
BSR P200

Belt drive chassis turntable unit semi automatic, cueing device. **£24.95** p&p £2.55

A.D.C. QLM 30 Mk III Magnetic Cartridge to suit. **£7.75**

BSR Manual single play record deck with auto return and cueing lever, fitted with stereo ceramic cartridge 2 speeds with 45 r.p.m spindle adaptor ideally suited from home or disco use OUR PRICE **£10.95** p&p £2.55

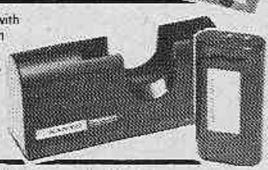
GARRARD DECK MODEL CC 10A



Record changer with cueing device fitted with stereo ceramic cartridge ready to fit into your own plinth.

£7.95 p&p £2.00 Size 12" x 8½"

SANYO Nic/cad. battery, with mains charger equivalent in size and replaces 4 SP11 type batts. Size 3¾"x1¼", x 2" approx.



£7.50 p+p £1.50p

AM/FM STEREO TUNER AMPLIFIER CHASSIS COMPLETE WITH DECODER

Ready built. Designed in a slim form for compact, modern installation.
Rotary Controls Vol On/Off, Bass, Treble, Balance
Push Buttons for Gram, Tape, VHF, MW, LW
Power Output 5 watts per channel Sine at 2% THD into 15 Ohm 7 watts speech and music.
Tape Sensitivity Playback 400mV/30K OHM for max output Record 200mV/50K output available from 25KHz. (150mV/100K) deviation FM signal **Frequency Range (Audio)** 50Hz to 17KHz within ± 1dB
Radio FM sensitivity for 3dB below limiting better than 10 uV AM sensitivity for 20dB S/N MW 350 uV/Metre LW 1mV/Metre
Size approx length 16" x height 2¾" x depth 4¼"
240 Volts AC Complete **with tuning dial**
Circuit diagram.

£19.95 p&p £2.25

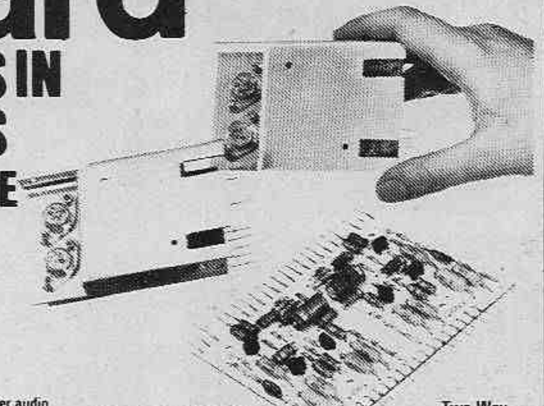
Mullard

AUDIO MODULES IN BARGAIN PACKS

CURRENT CATALOGUE PRICE £ AT OVER ~~25~~ PER PACK

SEE OUR PRICES

ACCESSORIES ARE ONLY AVAILABLE TO THOSE CUSTOMERS WHEN BUYING OUR BARGAIN PACKS.



1 PACK 1. 2 x LP1173 10w. RMS output power audio amp modules, + 1 LP1182/2 Stereo pre amp for ceramic and auxiliary input. OUR PRICE p+p £1.00 **£4.95**

2 PACK 2. 2 x LP1173 10w. RMS output power audio amp modules + 1 LP1184/2. Stereo pre amp for magnetic, ceramic and auxiliary inputs. **illus.** OUR PRICE p+p £1.00 **£7.45**

ACCESSORIES

Suitable mains power supply parts, consisting of mains transformer, bridge rectifier, smoothing capacitor and set of rotary stereo controls for treble, bass, volume and balance.

£2.90 plus £1.50 p & p

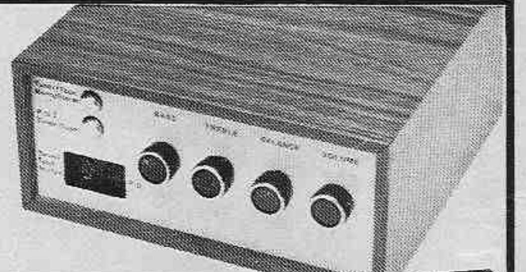
Two Way Speaker Kit

Comprising of two 8" x 5" approx. 4 ohm bass and two 3½" 15 ohm mid-range tweeter with two cross-over capacitors.

£3.95 per stereo pair plus £1.50 p & p

Available also to purchasers of the 10 + 10 Amplifier Kit.

10 + 10 AMPLIFIER KIT



An opportunity to buy a 10 watts per channel stereo amplifier kit which is suitable for use with a ceramic cartridge. The amplifier utilises proven Mullard modules and is available at a very competitive price. The amplifier kit comes complete with instructions and includes: a Mullard LP1183 stereo preamplifier module, two LP1173 power amplifiers with integral heatsinks, a power supply, Zobel networks, front and back mounting panels, a finished fascia panel, all control potentiometers (bass, treble, volume and balance), switches, input, output and headphone sockets, wire, and an easily assembled wrap around cabinet to house the finished unit.

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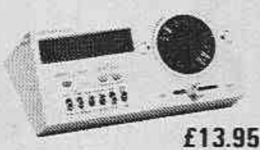
BARGAINS FOR PERSONAL SHOPPERS

LED 5 function men's digital watch stainless steel finish	£5.95
LCD 5 function men's digital watch stainless steel finish	£6.95
LCD 8 Function **CHRONOGRAPH** men's digital watch, stainless steel finish	£12.95
POCKET CALCULATOR. With LED display, memory and percentage key	£2.95
AM/FM DIGITAL CLOCK RADIO Accurate 4 Digit Electronic Clock with ½" LED display. Buzzer and snooze timer	£11.95
125 Watt Power Amp Module	£13.95
Mains power supply for above unit	£3.50
MULLARD Built power supply	£1.50
DECCA 20w Stereo speaker kit comprising 2 8" approx. bass units + 2 3½" approx tweeter inc. crossovers	£20.00
'VIDEOMASTER' Super Score TV Game with pistol mains operation	£14.95
PORTABLE RADIO/CASSETTE RECORDER, AM/FM with clock LW, MW, SW, VHF mains/battery operation	£41.95



VIDEOMASTER COLOUR SHOT TV GAME

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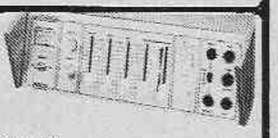
50 WATT MONO DISCO AMP

£29.95
P&P £2.50
Size approx. 13⅜" x 5¼" x 6¾"

50 watts rms. 100 watts peak output. Big features include two disc inputs, both for ceramic cartridges; tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.

70 & 100 WATT MONO DISCO AMP



Size approx. 14" x 4" x 10¼". Brushed aluminium fascia and rotary controls. Five vertical slide controls, master volume, tape level, mic level, deck level, PLUS INTER DECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level control (PFL) lets YOU hear next disc before fading it in. VU meter monitors output level. Output 100 watts RMS 200 watts peak.

70 watt 140 watt peak **£57**
p&p £4.00
100 watt **£65**

For personal shoppers only

DUO II SPEAKERS

Attractive teak finish modern design incorporating 2 speaker units — 6½" approx. woofer and 2½" approx. tweeter. 45 to 1800 Hz. Impedance 8 ohms. Power 15 watts RMS. 20 watts max. Per stereo pair

£17.00

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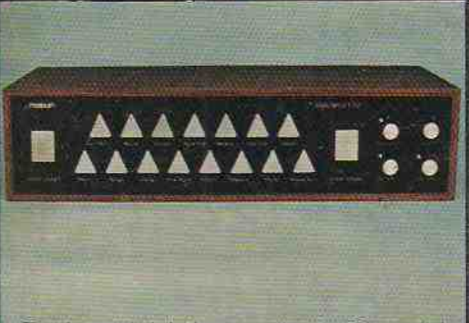

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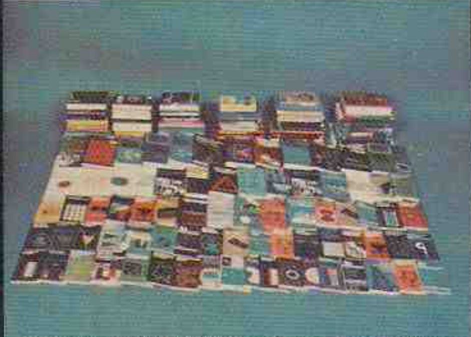

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