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TELEPHONE ANSWERING MACHINE
WITH REMOTE CALL-IN BLEEPER
This telephone answering machine is manufactured by Olympia Business Machines, one of the largest Office Equipment manufacturers in the U.K. It is fully BRIT. TELECOM APPROVED and will answer and record messages for 24 hours a day. With your remote call-in bleeper you can receive these-messages by telephone wherever you are in the world. The remote call-in-bleeper activates the Answer/Record Unit, which will at your command repeat messages, keep or erase them, and is activated from anywhere in the world, or on your return to your home or office. The machine can also be used for message referral, if you have an urgent appointment, but at expecting an important call, simply record the 'phone number' and location where you can be reached. With optional extra bleepers (£13 each) this facility can be extended to colleagues and members of the family. Using a C90 standard cassette you can record as many as 45 messages. The announcement can be up to 16 seconds long and the incoming message up to 30 seconds long.
The machine is easy to install and comes with full instructions. It is easily wired to your junction box with the spade connectors provided or alternatively a jack plug can be provided to plus into a jack socket. Most important of course, is the fact that it is fully BRITISH TELECOM APPROVED.
The price of £135 (inc. VAT) includes the machine, an extra-light remote call-in Bleeper, the microphone message tape A/C mains adaptor. The unit is 9¾" × 6" × 2¼" and is fully guaranteed for 12 months. The telephone can be placed directly on the unit—no additional desk space is required.
£135 inc VAT
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The ACE TELCOM VDX1000 Prestel View data adaptor simply plugs into the aerial socket of your television and enables you to receive the Prestel Viewdata service in colour or black & white
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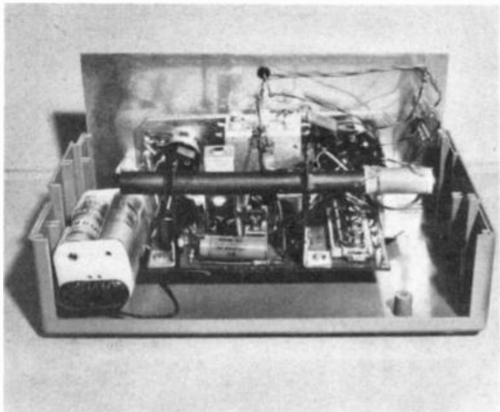
VOL. 11 NO. 2 FEBRUARY 1982

Everyday ELECTRONICS

PROJECTS . . . THEORY . . . NEWS . . .
COMMENT . . . POPULAR FEATURES . . .



SCHOOLS Electronic Design Award COMPETITION

To allow for the Christmas holiday period and seasonal postal delays, the SEDAC organisers have agreed that Registration Forms (Part A) returned by January 31, 1982 will be accepted.

The final date for submission of Papers is unaltered, i.e. February 16, 1982.

PROJECTS

SERIES

FEATURES

Our March issue will be published on Friday, February 19. See page 101 for details.

KITS, COMPONENTS, MICROS & PARTS

DISCO LIGHTING KITS

DL1000K. This value-for-money kit features a bi-directional sequence, speed of sequence and frequency of direction change, being variable by means of potentiometers and incorporates a master dimming control. . . . . Only £14.60

DLZ1000K. A lower cost version of the above, featuring undirectional channel sequence with speed variable by means of a pre-set pot. Outputs switched only at mains zero crossing points to reduce radio interference to a minimum. . . . . Only £8.00

Optional opto input DLA1 . . . . 60p
Allowing audio ("beat")—light response.

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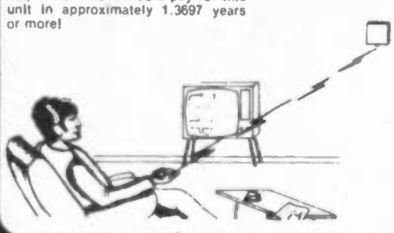
Published remote control systems tend to be quite complex, requiring difficult-to-get components and a well-equipped lab to get them to work. If this has put you off making your own system we have just the kits for you. Using infra-red, our KITS range from simple on/off controllers to coded transmitter/receivers with 16 on/off outputs or three analogue outputs for controlling, e.g., TV or Hi-Fi systems. The kits are easy to build and simple to set up—and they are extremely versatile, controlling anything from garage doors to room lighting just by adding the required output circuits, i.e. relays, triacs, etc. If you can design your own system we stock a wide range of remote control components at very competitive prices.

We have compiled a booklet on remote control, containing circuits, hints, data sheets and details of our remote control kits and components. So don't control yourself—SEND US 30p and a stamped addressed envelope for your copy TODAY!

THE PERFECT AID FOR "LAZYITIS"

Our Lamp Dimmer Kit with INFRA RED REMOTE CONTROL will enable you to switch the lights on or off, and set the brightness, at a push of a button without leaving your armchair, water-bed, etc. Not only will you save time but it has also been estimated that the savings in shoe leather and carpet wear alone would pay for this unit in approximately 1.3697 years or more!



This unit has considerable practical uses, especially for the old, infirm and disabled. It works like a conventional dimmer, enabling you to switch the lights on or off, or to dim them to whatever brightness you require, by touch or using the hand-held infra red transmitter. When assembled, it fits into a plaster depth box to replace your conventional switch or dimmer with no rewiring.

TDR300K Dimmer Kit £14.30
MK6 Transmitter Kit £4.20

We also still sell our highly popular TD300K Touch Dimmer Kit at £7.00 and the LD300K rotary controlled Dimmer Kit at . . . . only £3.50

All kits contain all necessary components and full instructions. You only need a soldering iron and cutters.

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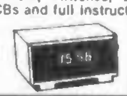
Switches any appliance up to 1kW on and off at present times once per day. Kit contains: AY-5-1230 IC, 0.5" LED display, mains supply, display drivers, switches, LEDs, triacs, PCBs and full instructions.



CT1000K Basic Kit £14.90
CT1000K with white box (56/131 x 71mm). £17.40
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Add 50p postage & packing + 15% VAT to total
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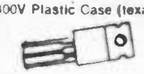
TRIACS



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Opto isolated triac MOC3020 0.6A/400V 110p

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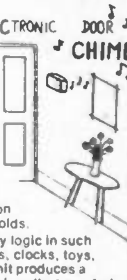

Our latest kit gives you a pleasing three-note harmonically related tone sequence (not a microprocessor controlled buzz or the same old ding dong) at a touch of a button. This kit, based on a new integrated circuit, is supplied complete with a printed circuit board, loudspeaker and drilled box and requires only 9V battery and push button common to most households.

It may also be switched by logic in such applications as car alarms, clocks, toys, P.A. systems, etc. The unit produces a 150mW output and draws less than one 1uA from a PP3 battery when the tone ceases. Supplied complete with circuit and assembly instructions.

IDEAL PROJECT FOR BEGINNERS—Only £5

DVM/ULTRA SENSITIVE THERMOMETER KIT

This new design is based on the ICL7126 (a lower power version of the ICL7106 chip) and a 3½ digit liquid crystal display. This kit will form the basis of a digital multimeter (only a few additional resistors and switches are required—details supplied), or a sensitive digital thermometer (—50°C to +150°C) reading to 0.1°C. The basic kit has a sensitivity of 200mV for a full scale reading, automatic polarity indication and an ultra low power requirement—giving a 2 year typical battery life from a standard 9V PP3 when used 8 hours a day, 7 days a week. . . . Price £15.50

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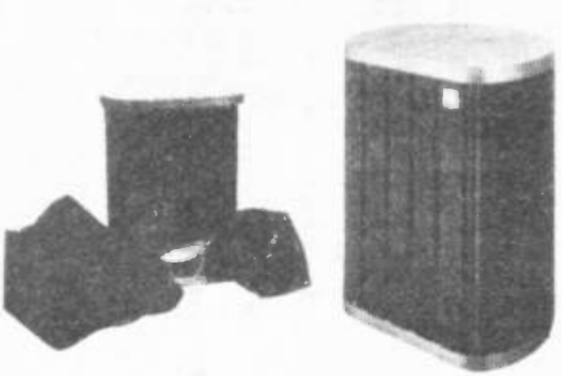

The kit includes complete and finished cabinets, grille foam, wadding, drive units, crossovers, etc. – everything, in fact, to make a pair of excellent compact loudspeakers.

Suitable for amplifiers of 20 – 70 watts

Size: 340×220×265mm. Finish: Walnut/black foam.

Price: **£69.95** VAT per pair plus carriage £3.95 inc.

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Oiscostrobe	SET57	39 78	Microphone Pre-amp	SET61	11 32

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TAG-END TYPE: 70V: 4700µ 245p. 64V: 3300 198p; 2200 139p. 50V: 3300 154p; 2200 110p. 40V: 4700µ 160p. 25V: 4000 92p; 3300 98p; 2500, 2200 90p. 15,000 345p

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500 Ω, 1K & 2K (Lin. only) Single 28p
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Range	Val.	1–99	100+
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		+ve		–ve	
1A	TO3				
5V	7805	145p	7905	220p
12V	7812	145p	7912	220p
15V	7815	145p	7915	220p
18V	7818	145p	—	
1A	TO220 Plastic Casing			
5V	7805	50p	7905	55p
12V	7812	50p	7912	55p
15V	7815	50p	7915	55p
18V	7818	50p	7918	55p
24V	7824	58p	7924	55p
100mA	TO92 Plastic Casing			
5V	78L05	30p	79L05	60p
6V	78L62	30p	—	
8V	78L82	30p	—	
12V	78L12	30p	79L12	60p
15V	78L15	30p	79L15	60p

CA3085 85 LM326N 240 78H05+5V/5A 550
LM300H 178 LM327N 270
LM305H 140 LM723 35 78HG 5A +5V
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LM317K 350 TBA625B 75 79HG 5A –2·25
LM323K 500 TDA1412 150 to –24V 850p

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,, ,, with slow motion drive 495p
Dial Drive 4103 6:1/36:1 775p
C804-5pF 10 15
25 50 pF 278p
Drum 54mm 59p
100, 150pF 352p
0·1-365pF 350p
'L' 3 x 310pF 725p
00 2 365pF 435p
00·3 x 25pF 575p

DENCO COILS 'DP' VALVE TYPE Range 1 to 5 Bl., Rd., Yl. Wht.122p
6–7 B.Y.R. 110p
1·5 Green 150p
'T' 1 to 5 Bl., Yl., Rd., Wht. 150p
B9A Valve Holder 42p
RDT2 145p
RFC 5 148p
RFC 7(19mH) 150p
IFT 13; 14; 15; 16; 17 128p
IFT 18/1·6 135p
IFT 18/465 152p
TOC 1 125p
MW5FR 122p
MW/LW 5FR 154p

VEROBOARDS ·1"

	clad	plain
2½ x 3¾"	73p	52p
2½ x 5"	83p	—
3¾ x 3¾"	83p	—
3¾ x 5"	95p	79p
3¾ x 17"	326p	211p
4¾ x 17"	426p	—

Pkt. of 100 pins 50p
Spot Face Cutter 118p
Pin Insertion Tool 182p

COPPER clad boards Fibreglass
6 x 6" 90p
6 x 12" 150p
S.R.B.P. 9·5 x 8 95p
Ferric Chloride 1 lb. Anhydr. 195p
Dalo Pen 90p

DIODES

AA129	22
BA100	18
BY126	12
BY127	12
CRO33	250
OA9	40
OA47	12
OA70	18
OA79	15
OA81	15
OA85	15
OA90	8
OA91	8
OA95	8
OA200	8
OA202	8
IN914	4
IN916	8
IN4001/2	5
IN4003	6
IN4004/5	6
IN4006/7	7
IN4148	4
IS44	8
3A/100V	18
3A/400V	16
3A/600V	17
3A/1000V	30
6A/400V	50p

We stock a wide selection of Electronic Books and Magazines

ZENERS
Range 2V7 to 39V 400mW 8p each
Range 3V3 to 33V. 1·3W 18p each

NOISE
Diode 195

BRIDGE RECTIFIERS (plastic case)

1A/50V	20
1A/100V	22
1A/200V	25
1A/400V	29
1A/600V	34
2A/50V	38
2A/200V	40
2A/400V	46
2A/600V	68
6A/100V	63
6A/400V	95
10A/200V	215
10A/600V	315
25A/200V	215
25A/600V	395
BY164	56
VM18 DIL	55

DIAC
ST2 25

SCRs Thyristors

1A/100V	42
5A/400V	48
8A/600V	40
8A/300V	60
8A/400V	75
8A/600V	96
12A/100V	78
12A/400V	85
12A/800V	188
15A/700V	180
2N4444	130
2N5062	32
2N5064	38
BT106	150
C106D	50
TIC44	24
TIC46	29
TIC47	35

TRIACS

3A/100V	48
3A/400V	56
8A/100V	60
8A/400V	60
8A/800V	115
12A/100V	78
12A/400V	82
12A/800V	135
16A/100V	103
16A/400V	105
25A/400V	185
25A/800V	295
25A/1000V	480
30A/400V	525
T 28000D	120

TTL 74 (TEXAS)

7400	11
7401	11
7402	11
7403	14
7404	14
7405	18
7406	28
7407	28
7408	16
7409	16
7410	14
7411	20
7412	20
7413	24
7414	32
7416	25
7417	25
7420	16
7421	20
7422	20
7423	22
7425	28
7426	30
7427	27
7428	28
7430	16
7432	26
7433	27
7437	27
7438	27
7440	17
7441	68
7442	38
7443	90
7444	90
7445	65
7446	55
7447	50
7448	50
7450	16
7451	16
7453	16
7454	16
7460	16
7470	35
7472	30
7473	30
7474	25
7475	40
7476	30
7480	48
7481	120
7482	70
7483	50
7484	80
7485	95
7486	28
7489	205
7490	28
7491	45
7492	30
7493	30
7494	34
7495	50
7496	45
7497	120
74100	95
74104	54
74105	55
74107	32
74109	35
74110	40
74111	55
74112	170
74116	88
74118	80
74119	90
74120	75
74121	30
74122	45
74123	50
74125	42
74126	40
74128	42
74132	48
74136	35
74141	70
74142	190
74143	250
74144	250
74145	70
74147	99
74148	75
74150	80
74151	45
74153	45
74154	75
74155	75
74156	75
74157	45
74159	99
74160	60
74161	60
74162	62
74163	64
74164	64
74165	62
74166	65
74167	185
74170	168
74172	290
74173	65
74174	72
74175	72
74176	55
74177	75
74178	95
74179	68
74180	65
74181	140
74182	75
74184	99
74185	99
74188	290
74190	70
74191	70
74192	70
74193	65
74194	75
74195	65
74196	65
74197	65

74LS

LS00	12
LS01	13
LS02	14
LS03	14
LS04	15
LS05	15
LS06	15
LS09	15
LS10	15
LS11	15
LS12	15
LS13	30
LS14	48
LS15	15
LS20	15
LS21	15
LS22	15
LS26	18
LS27	15
LS28	20
LS30	18
LS32	15
LS33	16
LS37	16
LS38	18
LS40	16
LS42	35
LS47	40
LS51	15
LS54	15
LS55	30
LS73	25
LS74	25
LS75	28
LS76	20
LS78	24
LS83	50
LS85	70
LS86	38
LS90	35
LS91	80
LS92	36
LS93	36
LS95	45
LS96	120
LS107	43
LS109	30
LS112	30
LS113	40
LS114	35
LS122	44
LS123	55
LS124	105
LS125	30
LS126	30
LS132	45
LS136	28
LS138	35
LS139	38
LS151	39
LS153	39
LS155	39
LS156	39
LS157	35
LS158	36
LS160	41
LS161	41
LS162	41
LS163	41
LS164	48
LS165	145
LS166	85
LS170	170
LS173	72
LS174	72
LS175	58
LS181	130
LS183	275
LS191	58
LS192	58
LS193	65
LS194	40
LS195	40
LS196	58
LS197	85
LS221	60
LS240	96
LS243	85
LS243	85
LS244	80
LS245	90
LS251	40
LS253	40
LS257	48
LS258	40
LS259	85
LS261	195
LS266	25
LS273	90
LS279	88
LS280	250
LS283	45
LS290	57
LS293	46
LS295	215
LS298	130
LS299	420
LS323	270
LS365	37
LS366	37
LS367	37
LS368	90
LS373	75
LS374	75
LS375	48
LS377	90
LS378	69
LS390	140
LS393	140
LS399	230
LS668	105

CMOS

4000	14
4001	14
4002	14
4006	66
4007	18
4008	62
4009	35
4010	40
4011	15
4012	18
4013	34
4014	75
4015	66
4016	32
4017	48
4018	88
4019	42
4020	61
4021	70
4022	86
4023	20
4024	45
4025	18
4026	130
4027	38
4028	58
4029	77
4030	50
4031	170
4032	125
4034	195
4035	95
4036	275
4037	115
4038	110
4039	290
4040	58
4041	78
4042	60
4043	70
4044	65
4046	75
4047	75
4048	55
4049	30
4050	30
4015	78
4052	78
4053	78
4054	125
4055	125
4056	120
4059	480
4060	90
4063	99
4066	36
4067	399
4068	22
4069	20
4070	26
4071	20
4072	20
4073	20
4075	20
4076	60
4081	26
4082	21
4085	65
4086	70
4089	140
4093	43
4094	168
4095	90
4096	90
4097	320
4098	88
4099	95
4161	99
4410	725
4411	895
4412	800
4433	770
4501	28
4502	90
4503	50
4507	40
4508	265
4510	68
4511	68
4512	75
4514	195
4515	195
4561	75
4518	42
4519	29
4520	78

LINEAR IC's

702	75
709C 8 pin	35
710	40
733	75
741 8 pin	14
747C 14 pin	78
748C 8 pin	38
753 8 pin	185
810	150
2114L-300N	95
2114L-200	130
2708	200
2716-5V	230
4116-200N	99
9400CJ	350
AY-1-1313A	660
AY-1-1320	225
AY-1-5051	160
AY-3-8500	390
AY-3-8910	620
AY-5-1224A	235
AY-5-1230	450
CA3011	110
CA3012	175
CA3014	157
CA3018	68
CA3019	70
CA3020	188
CA3023	191
CA3028A	120
CA3035	235
CA3036	115
CA3043	275
CA3045	365
CA3046	71
CA3048	70
CA3059	195
CA3075	213
CA3080E	85
CA3081	190
CA3089E	215
CA3090AQ	375
CA3123	150
CA3130	90
CA3140	48
CA3160	95
ICL7106	750
ICL7107	875
ICL8038CC	340
ICM7205	1150
ICM7207	475
ICM7215	1050
ICM7216A	1950
ICM7217A	785
ICM7224	785
ICM7555	80
LA4032	295
LC7120	385
LC7130	385
LF351	48
LF355	80
LF356	90
LM10	425
LM301A	28
LM308T	95
LM311H	70
LM318	200
LM324	45
LM339	54
LM348	64
LM349	115
LM358	415
LM379	75
LM380	75
LM381N	145
LM382	125
LM384	140
LM386	90
LM387	120
LM389	99
LM1458	40
LM2917	195
LM3900	44
LM3909N	70
LM3911	125
LM3914	210
LM3915	220
LM3916	240
LM13600	125
M252AA	825
M253AA	1150
MC1303	88
MC1304P	280
MC1310P	150
MC1488	62
MC1489	62
MC1494	894
MC1495	350
MC1496L	70
MC1596	228
MC1709	90
MC3302	150
MC3340	120
MC3360	120
MC3401	52
MC3403	110
MC3405	150
MCF6040	87
MK50398	835
MM5303	835
MM5387A	478
NE529	225
NE543	218
NE544	185
NE555	16
NE556	88
NE560	320
NE561	390
NE562	410
NE564	420
NE565	120
NE566	150
NE567	150
NE570	480
NE571	420
RC4136D	69
S566B	240
SAB3209	428
SAB3210	278
SG3402	288
SN76477	170
SP8629	200
TA7205A	225
TAA621	280
TAD100	150
TBA120	70
TBA550Q	330
TBA641	273
TBA651	190
TBA800	80
TBA810	95
TBA820	70
TDA1004	290
TDA1008	310
TDA1022	878
TDA1024	100
TDA2020	320
TDA2030	320
TL061CP	40
TL064	98
TL071CP	30
TL074CN	100
TL081CP	25
TL083CN	75
TL084CN	98
UAA170	170
UAA1003	835
XR2206	300
Z80CPU	360
ZN414	88
ZN423	195
ZN424	130
ZN425E	350
ZN426E	300
ZN1034	200

Transistors

AC125	35
AC126/7	25
AC128	25
AC141/2	30
AC176	28
ACY17/18	70
ACY19/20	75
ACY21/22	75
ACY28	75
ACY39	85
AD149	70
AD161/2	42
AF118	85
AF139	40
AF178	75
AF239	78
BC107	10
BC107B	12
BC108	10
BC108B	12
BC108C	12
BC109	10
BC109B	12
BC109C	12
BC140	30
BC142/3	30
BC147	9
BC147B	10
BC148	8
BC148B	10
BC148C	10
BC149	9
BC149C	10
BC153/4	27
BC157/8	10
BC159	11
BC160	45
BC167/8	10
BC169C	10
BC170	18
BC172/3	11
BC177/8	120
BC179/81	20
BC182/3	10
BC184	10
BC182L	10
BC183L	10
BC184L	10
BC187	28
BC212/3	10
BC212L	10
BC213L	10
BC214	10
BC214L	10
BC236	10
BC237	14
BC307B	15
BC308B	18
BC327/8	18
BC338	15
BC441	34
BC461	34
BC477	40
BC516/7	40
BC547/8	14
BC549C	14
BC557/8	15
BC559	15
BCY70/71	18
BCY72	20
BD131/2	48
BD133	80
BD135	45
BD136/7	40
BD138/9	40
BD140	40
BD144/5	108
BD205	118
BD214	115
BD245	108
BD378	78
BD434	55
BD517	75
BD695A	85
BD696A	85
BDY56	180
BF115	35
BF167	20
BF180	38
BF194/5	12
BF196/7	12
BF198/9	16
BF200	34
BF224	24
BF244/5	28
BF244B	30
BF256	35
BF257/8	32
BF259	35
BF274	42
BF336	48
BF451	35
BF594	30
BFR30/40	23
BFR41	23
BFR79	23
BFR80/81	24
BFR98	105
BFX29	28
BFX84	28
BFX85/86	28
BFX87/8	28
BFY50	23
BFY51/52	23
BFY56	32
BFY64	35
BFY81	120
BRY39	40
BSX20	20
BSY95A	25
BU105	170
BU205	190
BU208	200
E421	256
MD8001	250
MJ400	150
MJ491	175
MJ2955	90
MJE340	54
MJE370/71	100
MJE2955	90
MJE3055	70
MPF102	68
MPF103/104	34
MPF105	34
MPF106	40
MPSA05	25
MPSA06	25
MPSA12	32
MPSA55	30
MPSA56	30
MPSA70	25
MPSU06	55
OC23/26	170
OC28	130
OC35/36	125
OC41/42	120
OC43	55
OC44	120
OC45	40
OC70/71	40
OC72/74	50
OC75/76	50
OC81	50
OC82	130
OC83/84	40
OC140	118
OC170/1	85
OC200	85
TIP29	34
TIP29A	38
TIP29B	56
TIP29C	60
TIP30	48
TIP30C	58
TIP31A	45
TIP31C	55
TIP32A	48
TIP32C	60
TIP33A	95
TIP33C	78
TIP34A	74
TIP34C	88
TIP35A	108
TIP35C	185
TIP36A	170
TIP36C	198
TIP41A	60
TIP41B	66
TIP42A	60
TIP42B	75
TIP120	90
TIP121	99
TIP142/7	129
TIP2955	60
TIP3055	60
TIS43	32
TIS44/45	45
TIS88A	50
TIS90	30
TIS91	32
VK1010	80
VK10KM	53
VK46AF	75
VK66AF	96
VK88AF	105
ZTX107/8	11
ZTX109	11
ZTX300	13
ZTX301/2	18
ZTX303	28
ZTX304	17
ZTX314	25
ZTX326	30
ZTX341	30
ZTX500	14
ZTX501/502	15
ZTX503	18
ZTX504	28
ZTX531	25
ZTX550	28
2N697	23
2N698	40
2N699	35
2N706A	18
2N708	18
2N918	33
2N1131/2	24
2N1303	60
2N1304/5	85
2N1671B	215
2N2219A	28
2N2220A	28
2N2221A	25
2N2222A	25
2N2369A	17
2N2646	48
2N2904/5	28
2N2905A	28
2N2906/7	28
2N2926G	18
2N3053	28
2N3054	58
2N3055	48
2N3442	140
2N3663	15
2N3702/3	18
2N3704/5	10
2N3706/7	18
2N308/9	18
2N3710/1	10
2N3771	170
2N3772	195
2N3773	270
2N3819	22
2N3820	45
2N3822/3	65
2N3866	90
2N3903/4	18
2N3905	15
2N3906	17
2N4037	44
2N4058	18
2N4061/2	18
2N4427	88
2N3859	78
2N4871	58
2N5172	18
2N5179	48
2N5191	78
2N5305	24
2N547/8	38
2N5485	38
2N5642	750
2N5777	48
2N6027	32
2SA715	60
2SC495/6	79
2SC1096	88
2SC1173	120
2SC1306	150
2SC1307	220
2SC1449	88
2SC1678	140
2SC1923	58
2SC1945	225
2SC1953	90
2SC1957	90
2SC1969	198
2SC2028	85
2SC2029	200
2SC2078	175
2SC2091	85
2SC2314	85
2SC2166	185
2SC1679	100
2SD234	78
3N128	112
3N140	112
40311	80
40313	128
40315	88
40316	88
40361/2	58
40408	98
40411	288
40467	95
40468	88
40594/5	90
40603	90
40673	95

Rapid Electronics

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SOLDERING IRONS

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

CRYSTALS

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

PCB MATERIALS

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

SOCKETS

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

Soldercon pins 60p/100.

DIODES

BY127	12p	★IN4001	3p
OA47	10p	IN4002	5p
OA90	8p	IN4006	7p
OA91	7p	IN4007	7p
OA200	8p	IN5401	15p
OA202	8p	IN5404	18p
IN914	4p	IN5406	17p
★IN4148	2p	400mW zen.	6p

REGULATORS

Positive		Negative	
★78L05	25p	79L05	65p
78L12	30p	79L12	65p
78L15	30p	79L15	65p
★7805	45p	★7905	45p
★7812	45p	★7912	45p
7815	60p	7915	60p
LM309K	130p	★LM323K	350p
★LM317T	120p	LM723	40p

CABLES

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

PANEL METERS

Size 60 × 46 × 35mm.

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

450p each.

RESISTORS

¼W 5% Carbon film E12 series. 4·7Ω–10M. 1p each
½W 5% Carbon film E12 series 4·7Ω–4M7. 2p each
¼W 1% Metal film. E24 series 10Ω-1M 6p each

VERO

Verobloc 350p
Size 0·1 matrix

2·5 × 1"	22p
2·5 × 3·75"	75p
2·5 × 5"	85p
3·75 × 5"	95p
VQ board	160p

Veropins per 100
Single sided 50p
Double sided 60p
Spot face cutter 105p

BRIDGE RECTIFIERS

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

SWITCHES

Submin. Toggle
SPST 55p SPDT 60p ★DPDT 50p
Miniature toggle
SPDT 80p SPDT centre off 90p
DPDT 90p DPDT centre off 100p
Standard toggle
SPST 35p DPDT 48p
★Miniature DPDT slide 12p
★Push to make 12p Push to break 22p
Rotary stype adjustable stop
1P12W, 2P6W, 3P4W, 4P3W all 55p each
DIL switches
4 SPST 80p 6 SPST 80p 8 SPST 100p

OPTO

★3mm red	7p	★5mm red	8p
★3mm green	12p	★5mm green	12p
★3mm yellow	12p	★5mm yellow	12p

Clips to suit 3p each.

Rectangular			
★Red	12p	TIL32	40p
Green	17p	TIL78	40p
Yellow	17p	TIL111	60p
		ORP12	85p

Seven Segment Displays

Com. cathode			Com. anode		
DL704	0·3in	95p	DL707	0·3in	95p
★FND500	0·5in	65p	FND507	0·5in	90p
TIL313	0·3in	105p	TIL312	0·3in	105p
TIL322	0·5in	115p	TIL321	0·5in	115p

All seven segment displays are supplied with connection details.
2N5777 45p Dual colour LED 60p

TRANSFORMERS

Miniature mains.
606V, 909V, 12012V all @ 100mA — 100p each
High quality. Split bobbin construction.

6VA	0-6, 0-6V @ 0·5A; 0-9, 0-9V @ 0·4A; 0-12, 0-12V @ 0·3A	220p each
12VA	0-6, 0-6V @ 1A; 0-9, 0-9V @ 1·2A; 0-12, 0-12V @ 0·5A; 0-15, 0-15V @ 0·4A	275p each (plus 40p carriage)
24VA	0-6, 0-6V @ 1·5A; 0-9, 0-9V @ 1·2A; 0-12, 0-12V @ 1A; 0-15, 0-15V @ 0-8A	330p each (plus 60p carriage)
50VA	0-12, 0-12V @ 2A; 0-15, 0-15V @ 1·5A	400p each (plus 70p carriage)
100VA	0-30, 0-30V @ 1·6A	920p each (plus 80p carriage)

COMPONENT KITS

An ideal opportunity for the beginner or the more experienced constructor to obtain a wide range of components at reduced prices.
¼W 5% Resistor Kit. Contains 10 of each value from 4·7Ω to 1M (650 resistors) 480p.
Ceramic Capacitor Kit. Contains 5 of each value from 22p to 0·01 (135 caps.) 370p
Polyester Capacitor Kit. Contains 5 of each value from 0·01 to 1uF (65 caps.) 575p each
Preset Kit. Contains 5 of each hor. value from 100 to 1M (total 65 presets) 425p
Nut and Bolt Kit. Total 300 items 140p

25	6BA ½" bolts	25	4BA ½" bolts
25	6BA ¼" bolts	25	4BA ¼" bolts
50	6BA nuts	50	4BA nuts
50	6BA washers	50	4BA washers

CAPACITORS

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

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

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

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

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

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

ORDERING INFORMATION

All starred items are at Special Low Prices—just compare with other suppliers. All prices exclude VAT. Please add to total order. Please add 50p carriage on all orders under £10 in value. Send 42p for our catalogue (free with orders over £5). Official orders welcome from colleges, universities etc.

HARDWARE

PP3 Battery clips	6p
Red or black crocodile clips	6p
Black pointer control knob	15p
Pair Ultrasonics	350p
TO220 twisted vane heatsink	28p
20mm panel fuseholder	25p
4mm terminals (var. colours)	33p
TO18 transistor socket	15p
64mm 64 ohm speaker	70p
64mm 8 ohm speaker	70p

IT PAYS TO BUY FROM RAPID

TRANSISTORS

				BC549	10	BFX29	25	TIP29C	60	VN88AF	95	2N3053	20
AC125	35	BC157	10	BC558	10	BFX84	25	TIP30	45	★ZTX107	8	2N3054	55
AC126	25	BC158	10	BCY70	18	BFX85	25	TIP30A	40	★ZTX108	8	2N3055	50
AC127	25	★BC159	8	BCY71	18	BFX86	28	TIP30B	50	ZTX109	12	2N3442	120
★AC128	16	BC160	45	BCY72	18	BFX87	25	TIP30C	60	ZTX300	14	★2N3702	6
AC176	25	BC168C	10	BD115	80	BFX88	25	TIP31A	45	ZTX301	16	2N3703	9
AC187	22	BC169C	10	BD131	35	BFY50	23	TIP31B	45	ZTX302	15	★2N3704	6
AC188	22	BC170	8	BD132	35	BFY51	23	TIP31C	55	ZTX304	17	2N3705	9
AD142	120	BC171	10	BD133	50	BFY52	23	TIP32A	45	ZTX341	30	2N3706	9
AD149	80	BC172	8	BD135	30	BFY53	32	TIP32B	55	ZTX500	15	2N3707	10
AD161	40	BC177	18	BD136	30	BFY55	32	TIP32C	60	ZTX501	15	2N3708	10
AD162	40	BC178	18	BD137	30	BFY56	32	TIP33A	50	ZTX502	15	2N3709	10
		BC179	18	BD138	30	BRY39	40	TIP33C	75	ZTX503	18	2N3772	190
AF124	60	BC182	10	BD139	35	BSX20	20	TIP34A	60	ZTX504	25	2N3773	210
AF126	50	★BC182L	8	BD140	35	BSX29	23	TIP34C	85	2N697	20	★2N3819	15
AF139	40	BC183	10	BD204	110	BSY95A	25	TIP35A	160	2N698	40	2N3820	40
AF186	70	BC183L	10	BD206	110	BU205	160	TIP35C	180	2N706A	20	2N3823	65
AF239	75	BC184	10	BD222	85	BY206	200	TIP36A	170	2N708	20	2N3866	90
BC107	10	★BC184L	7	BF180	35	BU208	170	TIP36C	195	2N918	35	2N3903	10
BC107B	10	BC212	10	BF182	35	MJ2955	99	TIP41A	60	2N1132	22	2N3904	10
★BC108	8	BC212L	10	BF184	25	MJE340	50	TIP42A	60	2N1613	30	★2N3905	6
BC108B	12	BC213	10	BF185	25	MJE520	65	TIP120	90	2N2218A	45	2N3906	10
BC108C	12	BC213L	10	BF194	12	MJE521	95	TIP121	90	2N2219A	25	2N4037	45
★BC109	8	BC214	10	BF195	12	MJE3055	70	TIP122	90	2N2221A	25	2N4058	10
BC109C	12	★BC214L	8	BF196	12	MPF102	40	TIP141	120	2N2222A	20	2N4060	10
BC114	22	BC237	8	BF197	12	MPF104	40	TIP142	120	2N2368	25	2N4061	10
BC115	22	BC238	14	BF198	10	MPSA05	22	TIP147	120	2N2369	11	2N4062	10
BC117	22	BC308	15	BF199	18	MPSA06	25	TIP2955	60	2N2484	25	2N5457	36
BC119	35	BC327	14	BF200	30	MPSA12	30	TIP3055	55	2N2646	45	2N5458	36
BC137	40	BC328	14	★BF244B	18	MPSA55	30	TIS43	40	2N2904	20	2N5459	30
BC139	40	BC337	14	BF245	30	MPSA56	30	TIS44	45	2N2904A	20	2N5485	36
BC140	30	BC338	14	BF256B	45	MPSU05	55	TIS45	45	2N2905	22	2N5777	45
BC141	30	BC477	30	BF257	32	MPSU06	55	TIS90	30	2N2905A	22	2N6027	30
BC142	25	BC478	30	BF258	25	MPSU55	60	TIS91	30	2N2906	25	40360	40
BC143	25	BC479	30	BF259	25	MPSU56	60	★VN10KM		2N2906A	25	40361	50
BC147	8	BC517	40	BF337	40	TIP29	35		45	2N2907	25	40362	50
BC148	8	★BC547	7	BFR40	23	TIP29A	40	VN46AF	75	2N2907A	25	40408	70
BC149	9	BC548	10	BFR80	25	TIP29B	55	VN66AF	85	2N2926	9	40594	100

LINEAR

★709	25	CA3161E	140	LM377	150	LM3900	50	NE566	150	★TDA1022	560
★741	14	CA3162E	450	★LM380	65	LM3909	70	★NE567	100	TDA1024	125
748	35	CA3189E	290	★LM381	100	LM3911	120	NE571	425	TLO71	45
AY-3-1270	840	ICL7106	790	LM382	120	★LM3914	200	RC4136	90	TLO72	75
AY-3-8910	700	ICL8038	320	★LM386	65	★LM3915	200	SN76013	170	★TLO81	30
★AY-3-8912	625	ICM7555	80	LM387	120	LM13600	120	SN76018	150	TLO82	70
CA3046	60	★LF351	40	LM393	100	MC1310	150	★SN76477	150	★TLO84	90
★CA3080	55	LF353	85	★LM709	25	MC3302	150	TBA641B11	250	★XR2206	300
CA3089	215	LF356	90	LM710	50	MC3340	135	TBA800	80	ZN414	100
CA3090AQ	375	LM10	395	LM725	350	NE515	270	TBA810	95	ZN423	195
CA3130E	90	★LM301A	25	LM733	75	NE529	225	TBA820	80	ZN424	135
CA3140E	45	LM311	70	★LM741	14	NE531	150	TBA953	290	ZN425E	390
CA3160E	100	LM318	85	LM747	75	NE544	185	TCA940	170	ZN426E	330
		★LM324	40	LM748	35	★NE555	16	TDA1004	300	ZN427E	650
		LM339	50	LM1458	40	★NE556	45	TDA1008	320	ZN428E	480
		LM348	90	LM2917	200	NE565	120	TDA1010	225	ZN1034E	200
		LM358	50								

CMOS

4000	14	★4017	43	4036	285	4055	115	4082	20	4502	70	4529	150
★4001	12	4018	60	4039	295	4059	480	4085	65	4503	50	4532	95
4002	14	4019	35	4040	55	4060	85	4086	65	4507	38	4534	495
4006	65	★4020	55	4041	75	4063	90	4089	140	4508	200	4538	110
4007	17	4021	65	4042	55	4066	35	★4093	33	4510	65	4543	110
4008	58	4022	70	4043	60	4067	395	4094	14	★4511	50	4549	380
4009	30	4023	18	4044	65	★4068	15	4095	90	4512	70	4553	295
4010	35	4024	40	4046	70	4069	18	4097	340	4514	180	4555	45
★4011	13	4025	18	4047	70	4070	18	4098	85	4515	180	4556	48
4012	17	★4026	96	4048	55	4071	18	4099	95	4516	75	4559	390
★4013	22	4027	30	★4049	28	4072	18	40106	50	★4518	45	4560	180
4014	60	4028	55	4050	18	4073	20	40109	100	4520	70	4584	45
4015	60	4029	75	4051	60	4075	20	40163	100	4521	200	4585	99
★4016	22	4030	35	4052	70	4076	60	40173	100	4526	80	4724	140
		4031	170	4053	60	4077	25	40175	100	4527	90		
		4034	170	4054	110	4081	18	40193	120	★4528	65		

TTL

7400	11	7413	24	7442	40	7480	45	74107	30	74155	60	74177	75
7401	11	7414	35	7444	85	7482	70	74109	28	74156	60	74179	85
7402	12	7416	25	7446	60	7483	50	74121	28	74157	43	74180	65
7403	14	7417	25	7447	48	7485	75	74122	45	74160	60	74181	135
7404	14	7420	15	7448	50	7486	25	74123	48	74161	60	74182	75
7405	17	7421	20	7450	16	7489	180	74125	40	74162	60	74190	70
7406	26	7422	20	7451	16	7490	28	74126	40	74163	60	74191	70
7407	26	7427	28	7453	16	7491	45	74132	40	74164	60	74192	70
7408	15	7428	24	7454	16	7492	40	74141	65	74165	60	74193	65
7409	16	7430	15	7460	16	7493	30	74145	65	74167	180	74194	70
7410	14	7432	25	7472	25	7494	25	74147	100	74170	165	74195	63
7411	20	7433	27	7473	28	7495	50	74148	75	74173	60	74196	63
7412	20	7437	27	7474	25	7496	45	74150	75	74174	65	74197	63
		7438	27	7475	38	7497	120	74153	45	74175	70	74198	95
		7440	17	7476	30	74100	80	74154	75	74176	55	74199	95

LS TTL

		LS21	15	LS76	20	LS125	30	LS161	42	LS221	60	LS365	38
		LS22	18	LS78	24	LS126	30	LS162	42	LS240	90	LS366	38
LS00	13	LS26	18	LS83	50	LS132	45	LS163	42	LS241	80	LS367	38
LS01	14	LS27	15	LS85	70	LS136	30	LS164	50	LS242	80	LS368	50
LS02	14	LS30	16	LS86	25	LS138	35	LS165	120	LS243	85	LS373	80
LS03	14	LS32	16	LS90	35	LS139	35	LS166	85	LS244	80	LS374	80
LS04	15	LS37	16	LS92	38	LS145	75	LS170	170	LS245	120	LS375	50
LS05	15	LS38	16	LS93	35	LS147	160	LS173	70	LS247	75	LS377	90
LS08	16	LS40	16	LS95	45	LS148	95	LS174	60	LS251	40	LS378	70
LS09	18	LS42	38	LS96	110	LS151	40	LS175	60	LS257	48	LS390	75
LS10	16	LS47	40	LS107	45	LS153	40	LS190	55	LS258	45	LS393	75
LS11	16	LS48	80	LS109	30	LS154	120	LS191	55	LS259	95	LS399	220
LS12	16	LS51	16	LS113	30	LS155	45	LS192	55	LS266	25	LS541	135
LS13	25	LS55	30	LS114	30	LS156	45	LS193	60	LS279	50	LS670	175
LS14	48	LS73	25	LS122	42	LS157	35	LS195	50	LS283	45		
LS15	15	LS74	25	LS123	55	LS158	36	LS196	60	LS353	100		
LS20	15	LS75	27			LS160	42	LS197	68				

BOXES

Dimensions in inches. Aluminium.

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

TRIACS + SCRS

SCRS		TRIACs	
★C106D	30p	400V 4A	60p
400V 8A	70p	400V 8A	70p
400V 12A	99p	400V 16A	105p

POTENTIOMETERS

Rotary. Carbon track Log or Lin 5K-1M.
Single 32p. Stereo 85p each.
Slide. 60mm travel single Log or Lin 5K-500K. 63p.
Preset. Submin horiz. 100Ω-1M. 7p

The Rapid Guarantee ★ Same day despatch ★ Top quality components ★ Competitive prices ★ In-depth stock

BI-PAK BARGAINS

"IRRESISTABLE RESISTOR BARGAINS"

Pak No.	Qty*	Description	Price
SX10	400	Mixed "All Type" Resistors	£1
SX11	400	Pre-formed ¼-½ watt Carbon Resistors	£1
SX12	200	⅓ watt Carbon Resistors	£1
SX13	200	½ watt Carbon Resistors	£1
SX14	150	½ watt Resistors 22 ohm-2m2 Mixed	£1
SX15	100	1 and 2 watt Resistors 22 ohm-2m2 Mixed	£1

Paks SX12-15 contain a range of Carbon Film Resistors of assorted values from 22 ohms to 2.2 meg. Save pounds on these resistor paks and have a full range to cover your projects.

*Quantities approximate, count by weight.

"CAPABLE CAPACITOR PAKS"

Pak No.	Qty*	Description	Price
SX16	250	Capacitors Mixed Types	£1
SX17	200	Ceramic Capacitors Miniature Mixed	£1
SX18	100	Mixed Ceramics 1pf-56pf	£1
SX19	100	Mixed Ceramics 68pf-0.5mf	£1
SX20	100	Assorted Polyester/Polystyrene Capacitors	£1
SX21	60	Mixed C280 type capacitors metal foil	£1
SX22	100	Electrolytics, all sorts	£1
SX23	50	Quality Electrolytics 50-1000mf	£1
SX24	20	Tantalum Beads, mixed	£1

*Quantities approximate, count by weight.

AUDIO PLUGS, SOCKETS AND ACCESSORIES

25 pieces of Audio Plugs, Sockets and Connectors to include DIN 180°-240°, Inline 3-6 Pin, Speakers, Phono, Jack, Stereo and Mono, etc. etc. Valued at well over £3 normal. Order No. SX25. Our Price £1.50 per pak. Guaranteed to save you money.

SX26	3 Prs. of 6 pin 240° DIN Plugs and Chassis Sockets	50p
SX27	1 x Right Angle Stereo Jack Plug 6.3mm plus matching metal chassis mounting socket	30p
SX28	4 Phono plugs and 2 dual phono connectors	30p
SX29	1 x 2.5mm Plug to 3.5mm Socket adaptor	20p
SX30	1 x 3.5mm Plug to 2.5mm Socket adaptor	20p
SX31	1 x 3.5mm Plug to Phono Socket adaptor	20p

SX32	1 x Standard Jack Plug to Phono Socket adaptor	25p
SX33	1 x Toggle Switch SPST Miniature, 125v 10A	40p
SX34	1 x Toggle Switch SPDT Miniature, 125v 10A	40p
SX35	1 x Rocker Switch SPDT Miniature, 240v 5A	40p
SX36	1 x Right Angle Mono Jack Plug	15p
SX37	20 pieces, 1, 2 & 4mm plugs and sockets (Banana). Matching colours and sizes	£1
SX50	10 Assorted Switches, Toggle, Slide, Rocker, Push button	£1
SX77	25 mixed cable clips and ties round grommets & plastic feet. Always sought by the project builder	50p

TRIACS — PLASTIC

4 AMP — 400v — T0202 — TAG 136G

1 OFF	10 OFF	50 OFF	100 OFF
40p	£3.75	£17.50	£30.00

8 AMP 400v — T0220 — TAG 425

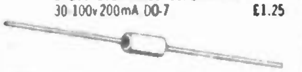
60p	£5.75	£27.50	£50.00

Everyday Electronics

Teach-in '81
Kit 1 £15.65 (Kits 1 & 2 combined
Kit 2 £ 8.94 price £23.00)

All prices include V.A.T. & postage.

SX40	250 Silicon Diodes—Switching like IN4148 DO-35. All good—uncoded. Worth double our price. 45v 75mA	£1.25
SX41	250 Silicon Diodes—General Purpose, like OA200/202, BAX13/16. Uncoded. 30-100v 200mA DO-7	£1.25



SX44	10 5A SCR's T064. 3 x 50v, 3 x 100v, 2 x 200v, 2 x 400v. Super value less than ½ price	£1
SX45	10 5A SCR's T066. 2 x 50v, 2 x 100v, 4 x 200v, 2 x 400v. All coded. Brand new, a give away at	£1

SEMICONDUCTORS FROM AROUND THE WORLD

100 A Collection of Transistors, Diodes, Rectifiers, Bridges, SCR's, Triacs, IC's both Logic and Linear plus Opto's all of which are current everyday usable devices **100**

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yours for only **£4·00** Data etc. in every pak. Order No. SX56

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This offer only applies to this advertisement

Guarantee

Satisfaction or your money back has always been BI-PAK's GUARANTEE and it still is. All these Sale items are in stock in quantity and we will despatch the same day as your order is received.

BI-PAK'S OPTO BARGAIN OF THE YEAR!

Valued at over £10—Normal Retail—we offer you a pack of 25 Opto devices to include LED's Large and Small in Red, Green, Yellow and Clear. 7 Segment Displays both Common Cathode and Common Anode PLUS bubble type displays—like DL-33. Photo Transistors—similar to OCP71 Photo Detectors—like MEL11-12. This whole pack of 25 devices will cost you just

25 £4·00 25

AND we guarantee your money back if you are not completely satisfied. FULL data etc included.

Order No. SX57.

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The lowest price ever.

The more you buy the cheaper they come!

Pin	10 off	50 off	100 off
8	75p	£3.00	£5
14	80p	£3.25	£5.50
16	80p	£3.25	£5.50

VOLTAGE REGULATORS

T0220

Positive +	Negative +
7805 — 50p	7905 — 55p
7812 — 50p	7912 — 55p
7815 — 50p	7915 — 55p
7824 — 50p	7924 — 55p

(please state voltage required)

Other types: LM340K — 5 volt — 18 volt — 24 volt. T03 — 40p. UA723 — 14 pin DIL — 40p

BARGAINS

SX42	20 small .125 Red LED's	£1
SX43	10 Rectangular Green LED's .2	£1
SX46	30 Assorted Zener Diodes 250mw-2 watt mixed voltages, all coded. New	£1
SX47	4 Black Instrument Knobs—winged with pointer ¼" Standard screw. Fit size 29 x 20mm	50p
SX49	20 Assorted Slider Knobs Black/Chrome, etc	£1
SX80	12 Neons and Filament Lamps. Low voltage and mains — various types and colours — some panel mounting	£1

MORE BARGAINS!

SX51	60 metres PVC covered Hook-up wire single and stranded. Mixed colours	£1
SX58	25 Assorted TTL Gates 7400 Series, 7401-7460	£1
SX59	10 Assorted flip Flops and MSI TTL	£1
SX60	20 Assorted Slider Potentiometers	£1
SX61	25 Assorted Potentiometers, Rotary, Dual, etc.	£1
SX62	40 Assorted Pre-Sets Hor/Vert etc.	£1
SX79	10 Reed Switches — glass type 3 Micro Switches — with lever	£1

STILL MORE!

SLIDER POTENTIOMETERS

Plastic 40mm Travel Mono

SX63 5 x 470 ohms Lin	SX67 5 x 47k Lin
SX64 5 x 1k Lin	SX68 5 x 47k Log
SX65 5 x 22k Lin	SX69 5 x 100k Lin
SX66 5 x 22k Log	SX70 5 x 1 meg Lin

All at 50p per pack.

SX71	50 BC108 "Fallouts". Manufacturers out of spec on volts or gain. You test.	£1
SX72	A mixed bundle of Copper clad Board, Fibre glass and paper. Single and double sided. A fantastic bargain	£1
SX78	Genuine MULLARD OC71 Germanium PNP Transistors. Brand New 10 for	£1

SX52	6 Black Heatsink will fit TO-3 and TO-220. Ready drilled. Half price value.	£1
SX53	1 Power finned Heatsink. This heatsink gives the greatest possible heat dissipation in the smallest space owing to its unique staggered fin design, pre drilled. TO-3 Size 45mm squarex 20mm high	40p
SX54	TO-66 size. 35mm x 30mm x 12mm	35p
SX55	1 Heat Efficiency Power Finned Heatsink, 90mm x 80mm x 35mm High. Drilled to take up to 4 x TO-3 devices	£1.50 each

5 watt (RMS) Audio Amp

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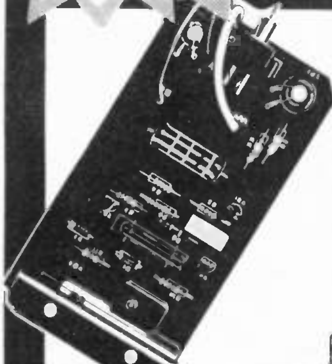

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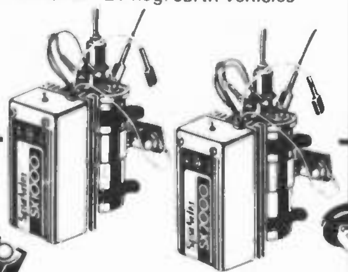

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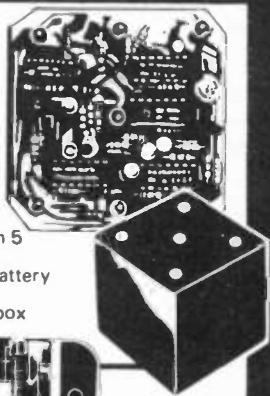

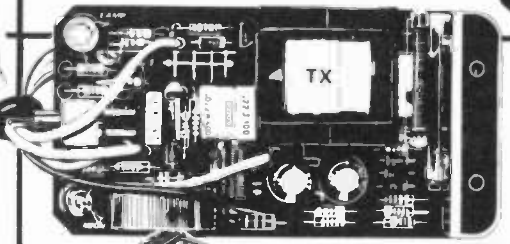

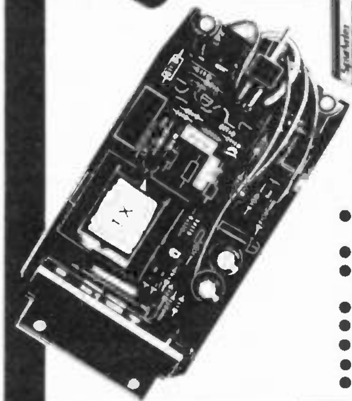

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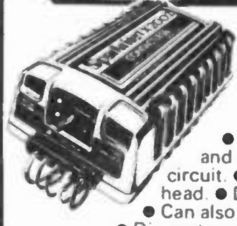

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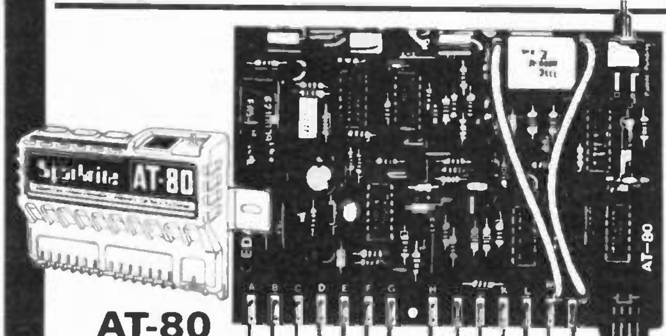

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Everyday ELECTRONICS

VOL. 11 NO. 2 FEBRUARY 1982

NOT IN ISOLATION

A stranger to electronics flipping through the pages of this month's EVERYDAY ELECTRONICS might be forgiven for imagining that carpentry and mechanical engineering are essential parts of this hobby. Yet upon reflection, our browser might be nearer the truth than we perhaps realise.

Evidence of the intrusion of "foreign technology" is to be found in two of this month's projects. The second and final part of the *Automatic Garage Door* article includes details of the electro-mechanical arrangements. No avoiding this—all the electronic wizardry comes to nought if the mechanics are not properly organised.

Carpentry? The *Stereo Record Player* entails the construction of a wooden cabinet and a pair of loudspeaker enclosures. Although the latter are purely acoustic devices they are integral parts of any sound reproducing system and their design and construction is reckoned to come fairly within the jurisdiction of electronics.

These two projects are different in that most of our designs begin and end with the electronics. In practical terms this usually means simply a circuit board assembly neatly stowed in a readily available plastic case. Rarely are tools other than screwdriver, pliers and soldering iron required. This is fine, generally speaking, and it makes the building of useful electronic gadgets and equipments a beautifully uncomplicated occupation.

Yet the appearance of projects such as the Automatic Garage Doors and the Stereo Record Player is rather important for—apart from their intrinsic functional value—they illustrate the fact that electronics does not have to be separate, self-contained and isolated. Quite the opposite in reality. The interface of electronic circuitry with non-electronic devices and mechanisms is important and upon this progress in technology is largely dependent.

No true enthusiast of electronics should be put out or disturbed by the appearance of any supposedly alien art, craft or technology in our pages, if it makes for overall completeness of the project in question. Obviously there are limits to how far we can or should go in these non-electronic areas; but it is important to recognise that in its everyday usage, electronc technology has no real bounds. We cannot therefore logically draw lines around our favourite subject and ignore what lies beyond.

To paraphrase John Donne, "No technology is an Island, entire of itself . . ." . Most certainly not electronics.

Stereo Record Player

BY V. TERRELL

GOING back about 15 years or so "record players" were commonplace in many homes, but since the arrival of the music centre and portable cassette player, the availability and choice one has for this type of separate unit is now limited.

This was highlighted recently when the author was looking for a suitable unit for his son to use at home. The unit needed to be compact and portable so that it could be easily moved from one room to another and on occasions carried to a friend's house.

It was therefore decided to design and build a stereo record player which was inexpensive, simple to construct and yet robust enough to be carried around.

The unit was designed around a dual amplifier i.c. which requires few external components, a simple power supply, and when fed directly from a high output ceramic cartridge produces about 2 watts per channel into 8 ohm speakers.

RECORD DECK

There are many types of "deck" on the market that could be used for this project. The use of a top quality deck is not really justified. In fact a deck from an older type of "mono player" could be used providing a stereo ceramic cartridge could be fitted. Obviously the base board "cut-out" for another deck must be made to suit.

The unit described here uses the inexpensive BSRP207 record deck fitted with a SC12H high output ceramic cartridge. It is a single play semi-automatic deck, that is, the arm is placed manually onto the record and after playing returns automatically and switches off. Use is also made of this on/off switch to switch the amplifier on and off, thus saving the need for an extra mains switch.

THE CIRCUIT

The complete circuit diagram of the Stereo Record Player amplifier is shown in Fig. 1. Right channel components have component references of corresponding left channel references preceded by 100.

IC1 is a dual 2 watt amplifier for 8 ohm loads. It has internal current limiting short circuit protection and internal thermal shutdown, thus making it a very robust device.

The ceramic cartridge used in the prototype produced an average output when measured on an oscilloscope of approximately 1 volt peak-to-peak.

The cartridge outputs are fed directly across the left- and right-channel volume controls VR1, VR101.

As both channels operate identically only the left channel will be described.

Capacitor C2 couples signals from VR1 to pin 6 of IC1, the input to the amplifier which here is being used in the non-inverting mode. Resistor R1 sets pin 6 at half the supply voltage via pin 1 the internal bias pin. Any mains ripple on this pin is decoupled to earth via C3.

The resulting amplified output signal at pin 2 varies about half supply rail voltage. Part of this output voltage is fed back (via a resistor-capacitor network) to the inverting input, pin 7, to affect the gain of the amplifier as required.

GAIN

The gain of an LM377 operating in the non-inverting mode may be set by two external resistors *R1*, *R2* as shown in Fig. 2, where part of the output is fed back to the inverting input.

This (purely resistive) arrangement should theoretically produce equal gain at all frequencies within the amplifier bandwidth.

In Fig. 1, you will see that the feedback circuitry is much more complex than the simple resistor circuit, but this can be reduced to just two "impedance" elements *Z1* and *Z2* to replace *R1* and *R2* in Fig. 2.

To make the gain frequency dependent, capacitors are introduced into the feedback network.

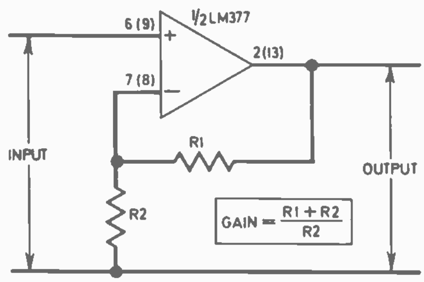


Fig. 2. Calculating the gain of the LM377 wired in the non-inverting mode.

Capacitors have reactance (resistance to a.c., where this resistance is inversely proportional to frequency). By incorporating these in the feedback circuitry, increase or decrease in the gain of the amplifier will occur within a specified frequency range.

In the prototype this method of varying the gain for particular frequencies is provided for by the adjustment of a single potentiometer, VR2. Together with its associated capacitors and resistors it has been designed to provide bass boost and bass cut.

BASS TONE CONTROL

The components R2 to R5, C4, C5 in the feedback network were chosen to give the amplifier a gain of about 23dB (×14) at all frequencies when the TONE control VR2 is set mid-way.

Potentiometer VR2 is a log. type and so when set to the mid-way position, the slider splits the resistive element into two portions equal to 90kΩ and 10kΩ with C4 and C5 respectively across each section.

Full bass boost occurs when the wiper is set at the C4 end of its travel, and full cut occurs when the wiper is set at the C5 end of its travel. Varying degrees of cut and boost occur between these two extremes.

OUTPUT

The two components R6 and C6 form what is known as a Zobel network. This has been included for reasons of stability when feeding reactive loads. Capacitor C8 couples the output signal to the speaker via the headphone socket internal contacts.

When the headphone plug is inserted contacts 2 and 3 open and are themselves isolated from the plug. Contact 4 meets with the tip of the plug while the body connects to earth. Resistor R7 (100 ohms) is thereby placed in series with the headphones (8 ohms) reducing the speaker output level by a factor of about 1/13.

COMPONENTS

Resistors

R1, R101	1MΩ (2 off)	R4, R104	10kΩ (2 off)	R7, R107	100Ω ½W (2 off)
R2, R102	47kΩ (2 off)	R5, R105	10kΩ (2 off)	R8	2·2kΩ
R3, R103	1kΩ (2 off)	R6, R106	2·7Ω (2 off)		

All ¼W carbon ± 5% except where stated otherwise

Potentiometers

VR1, VR101 1MΩ carbon log. law (2 off)
VR2 100k carbon log. law dual ganged

Capacitors

C1, C101 47µF 16V elect. radial leads (2 off)
C2, C102 0·1µF polyester (2 off)
C3 47µF elect. 16V radial leads
C4, C104 0·33µF polyester (2 off)
C5, C105 0·033µF polyester (2 off)
C6, C106 0·1µF polyester (2 off)
C7, C107 470µF 25V elect. (2 off)
C8 2200µF 25V elect.

COMPONENTS approximate cost £30 excluding speakers

Semiconductors

IC1 LM377 dual 2 watt audio amplifier i.c.
D1 TIL220 l.e.d. panel mounting bezel type
D2-D5 1N4001 1A 50V silicon rectifier diodes (4 off)

See Shop Talk page 95

Miscellaneous

T1 mains primary/15V 1A secondary transformer
FS1 1A 20mm
FS2 315mA 20mm
SK1 enclosed 6·3mm stereo switched jack socket (Tandy 274-277)
SK2, SK102 DIN chassis mounted loudspeaker sockets (and plugs) (2 off)
Stripboard: 0·1 inch matrix size 24 strips × 37 holes; Veropins, single-sided (16 off); control knobs (3 off); 7-way 1A screw terminal block; self-adhesive rubber feet (16 off); 3-core mains cable, length to suit; screened cable, approx. 50cm; speaker cable, length to suit; 14-pin d.i.l. socket for IC1; cable sleeving; 4BA fixings for T1; 20mm chassis mounting fuseholders for FS1 and FS2 (2 off); heatsink for 14-pin d.i.l. i.c. (Tandy 276-9180)
case: cabinet catches (2 off), attache case type hinges (2 off), chrome screw cups, see cutting list for wood sizes; **speaker cabinets**: speaker grille cloth; metallized self-adhesive angle, see cutting list for wood sizes.

Record Deck BSR P207
Cartridge SC12H stereo ceramic
Loudspeakers 8 ohm 8 × 5 inch elliptical type rated at 2 watts or greater (2 off)

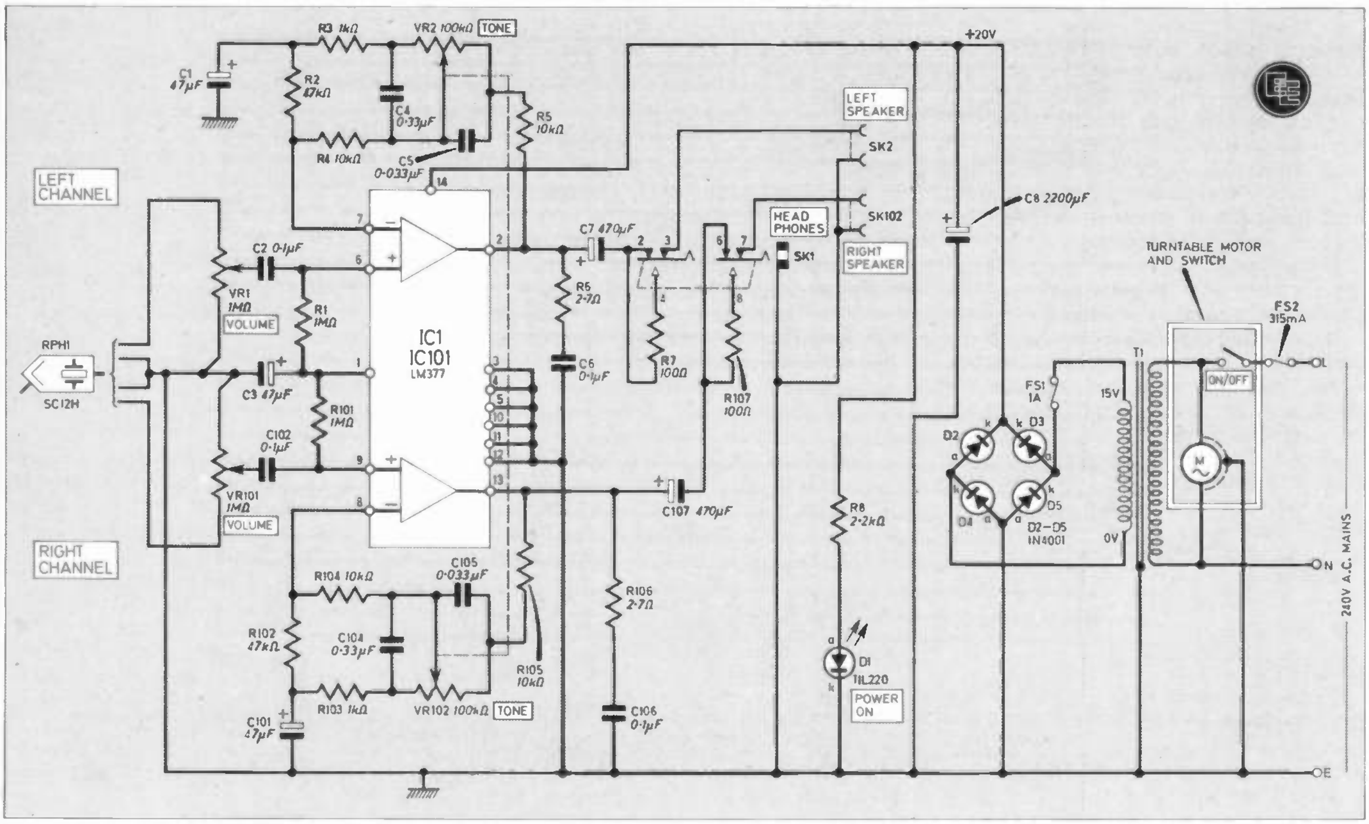


Fig. 1. The complete circuit diagram of the Stereo Record Player.

Stereo Record Player

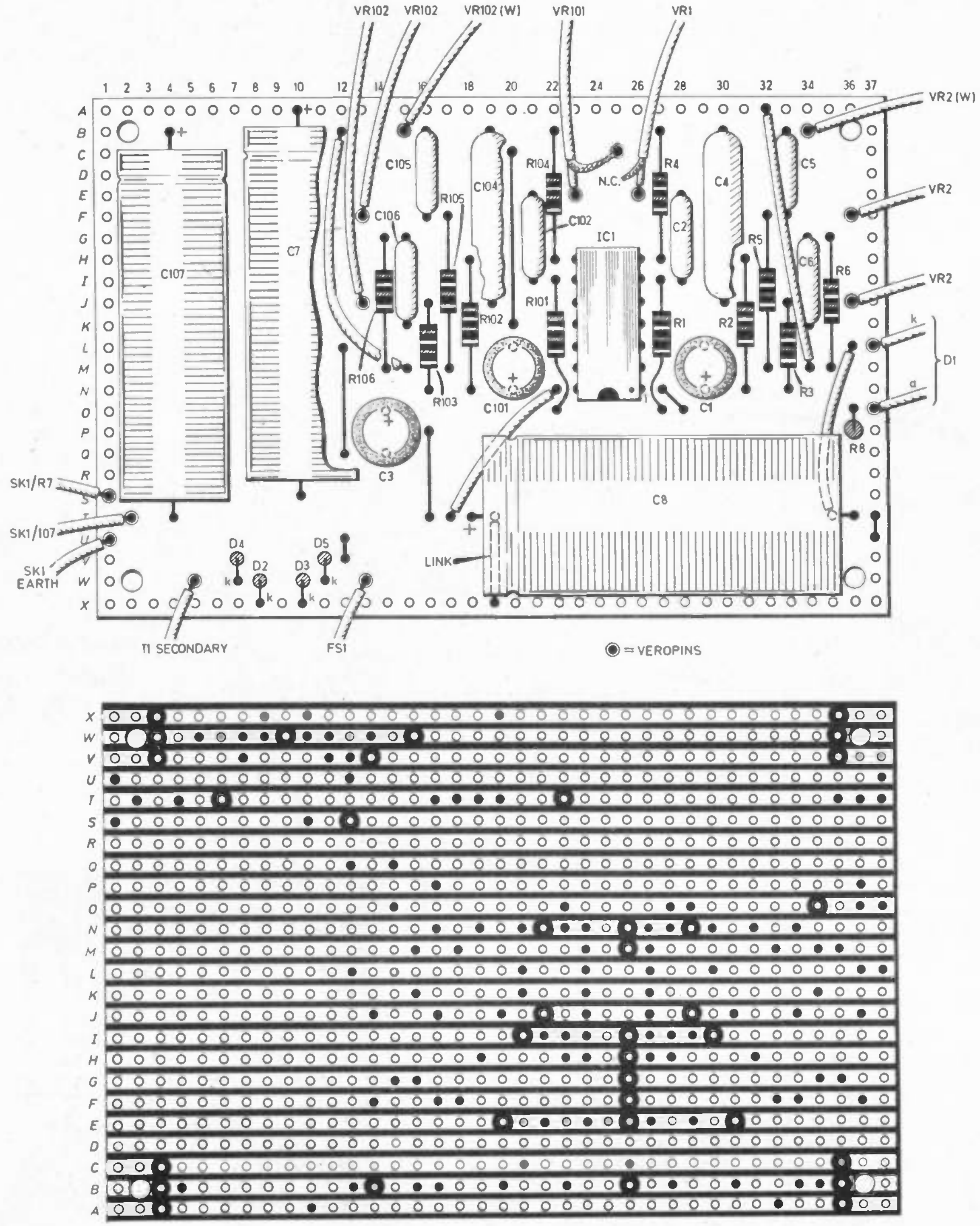


Fig. 3. The layout of the components on the topside of the stripboard and the breaks to be made on the underside (trackside) of the board. Note that all flying leads from this board are via Veropins. The screen on the cable from VR1 is not connected at the board end.

POWER SUPPLY

The power supply and amplifier are switched "on" and "off" as mentioned previously by the on-board motor switch.

T1 secondary provides 15 volt a.c. at 1 amp. Full-wave rectification is accomplished by diode bridge D2-D5. Its output is smoothed by reservoir capacitor C8 producing a d.c. supply voltage of 20 volts.

Resistor R8 limits the current through l.e.d. D1 which functions as a POWER ON indicator and is located on the control panel.

CONSTRUCTION starts here

AMPLIFIER BOARD

The layout of the components on the stripboard (24 strips × 37 holes × 0·1 inch matrix) is shown in Fig. 3. All flying leads are soldered on the board topside via Veropins.

Start by drilling the four fixing holes and cut the strips where shown. Next fit and solder the Veropins and link wires into position. After locating and soldering the i.c. socket into position, the rest of the components can then be soldered in place, starting with the smallest components first.

Glue the heatsink to the i.c. using "Araldite" and mark the position of pin 1 on the sink for future reference, and then leave to one side to set. All lead-out wires are to be connected when the board is in position. The next stage recommended is to prepare the deck baseboard.

DECK BASEBOARD

The baseboard was made from 8mm thick plywood. A scaled template for this is shown in Fig. 4. The cut-out was made using a Stanley trimming knife fitted with a type 1275B saw blade. If using a deck other than the BSRP207, a different cut-out contour will need to be originated.

Simply drill a hole to clear the blade and saw around the line finishing off with a woodfile and sandpaper. Next drill all holes, cut the three slots with a small chisel and fit the two wooden blocks that support the control panel. Now press into place the deck "spring cups", and check that the deck sits in these correctly.

SECURING TRANSFORMER

With the deck fitted to the baseboard unscrew the transit screws to tighten the deck against the base.

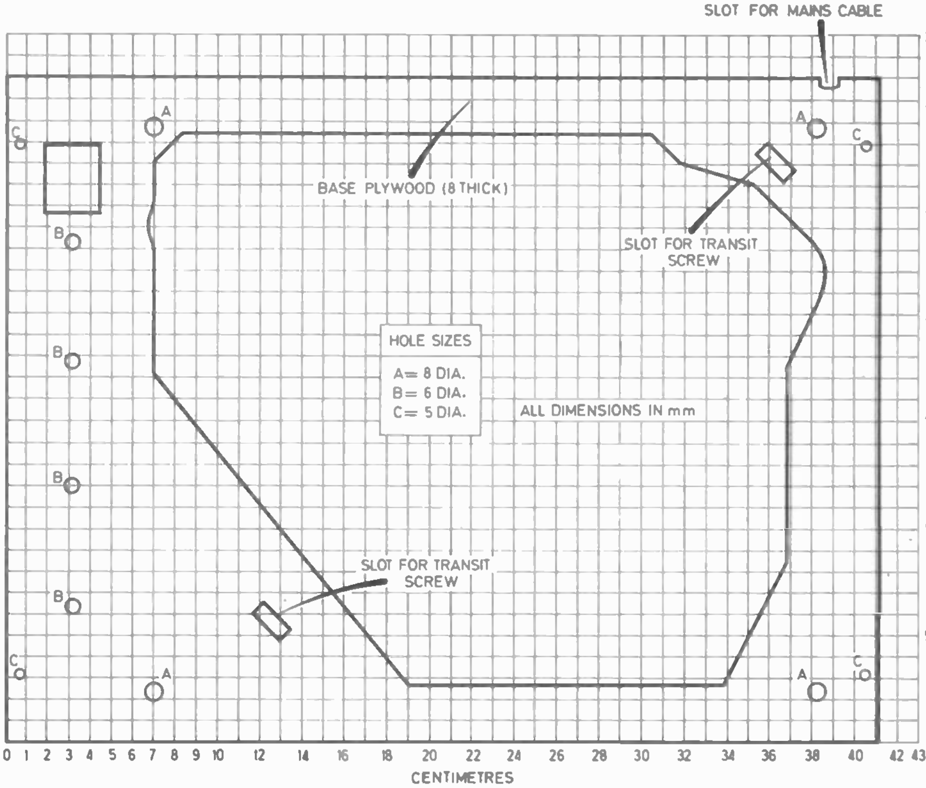
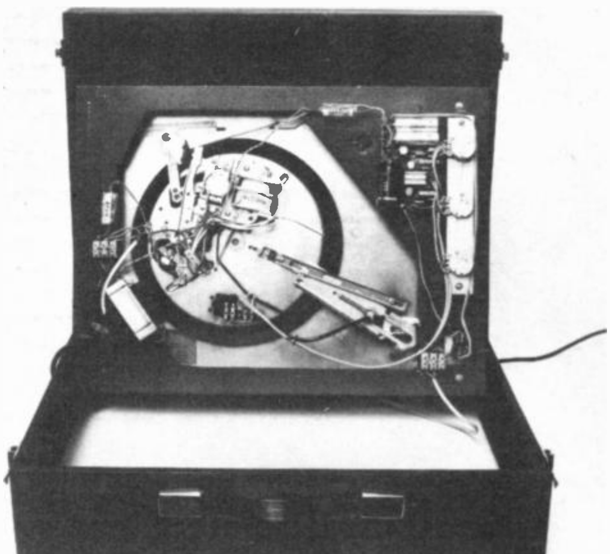
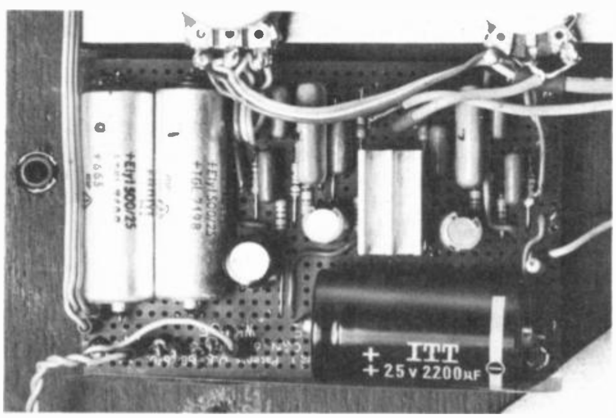


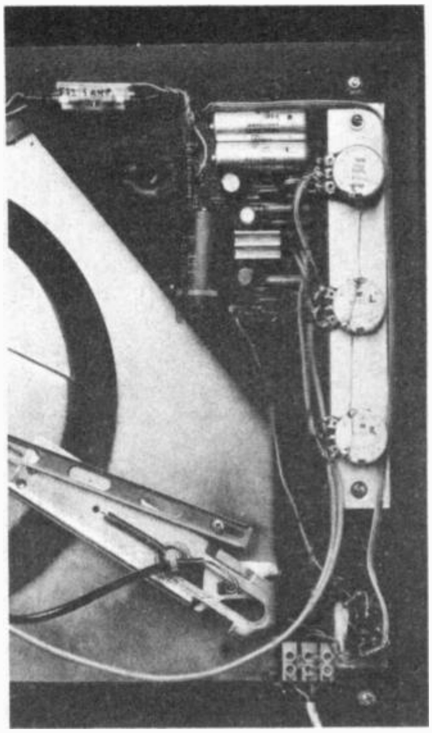
Fig. 4. Scaled template for the cut-out in the deck baseboard to suit the BSRP207 and chassis mounted transformer. Viewed from underside.



The fully wired prototype with deck baseboard raised to show component assembly on underside.

Lower left: Close up view of the prototype component board.



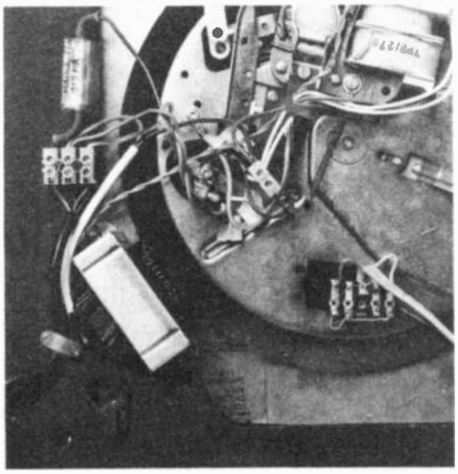


Shows the fully wired up component board and control panel. You can also see the headphone socket and speaker terminal block.

Then position the transformer so that its fixing bolts (when fitted) will be hidden by the turntable. Remove the turntable by easing out the spring clip attached to the centre spindle and lift off. Drill 4BA clearance holes, secure the transformer and replace the turntable.

The deck support spring nearest the transformer may have to be stretched a little to compensate for the extra weight, thereby keeping the deck level. The baseboard is now ready for covering or painting as required.

The mains and motor wiring of the prototype unit. The pick-up tag strip can be seen lower right.



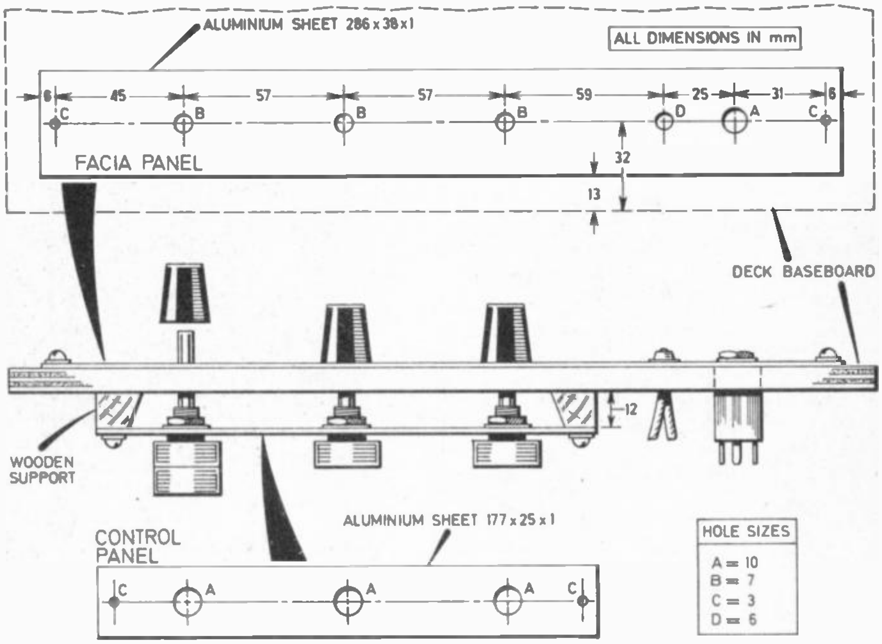


Fig. 5. Drilling and mounting details for the control and facia panels.

Before proceeding to the wiring stage the control and facia panels are cut and drilled as shown in Fig. 5.

WIRING UP

The complete wiring-up details are shown in Fig. 6. Unscrew the transit screws and support the upturned baseboard with two wooden bearers. Locate the mains wire that goes from the microswitch to the motor (lead "X"). Cut this wire and insert the single terminal block into position. Now fit the mains and speaker terminal blocks in place followed by the two fuseholders.

Fix the three potentiometers to the control panel and then screw this assembly into the small wooden supports. Fix the bezelled l.e.d. and headphone socket to the facia panel feeding the l.e.d. wires through the baseboard.

The amplifier board can next be screwed down to the baseboard on spacers. Small lengths (5mm) of plastic sleeving make suitable spacers.

In the prototype there were two additional (white) leads from the motor. These are not required and should be adequately insulated after cutting back close to the fitted motor wiring clamp. Wiring between pick-up and 5-way tag-strip is carried out by the deck manufacturers.

With reference to Fig. 6, carry out the wiring up, keeping all leads as short as possible. Note that the contact numbers for SK1 are printed on the socket body. Use screened lead where appropriate.

INITIAL TESTING

The first test is to make sure the deck functions correctly. Insert the mains fuse FS2 leaving FS1 out for the moment.

Now with the deck and baseboard supported by the wooden bearers, release the transit screws and switch on. Put a record on and check that the deck works satisfactorily.

Next test the power supply. Lock the arm and tighten the transit screws and turn the deck upside down. In this position the motor must be disconnected from the supply otherwise its bearings may be damaged. Unscrew the motor lead from the single terminal block and insulate it with tape. At this stage do not have the i.c. in its socket. Insert FS1 and switch on. Measure the voltage at pin 14 of the i.c. socket, this should read 20 volts or be close to this. Check also that D1 lights up.

Once this has been confirmed, switch off and insert the i.c. in its socket making sure it is the correct way round, otherwise it will certainly be destroyed. Turn both volume controls fully down and without speakers or headphone connected, switch on and measure the voltage at pins 2 and 13. Both should read 10 volts (or half the measured pin 14 voltage). If any of these tests fail, thoroughly check all the wiring around each stage to locate the fault before proceeding.

FINAL TESTING

Assuming all voltages are correct, solder a short length of cable to each

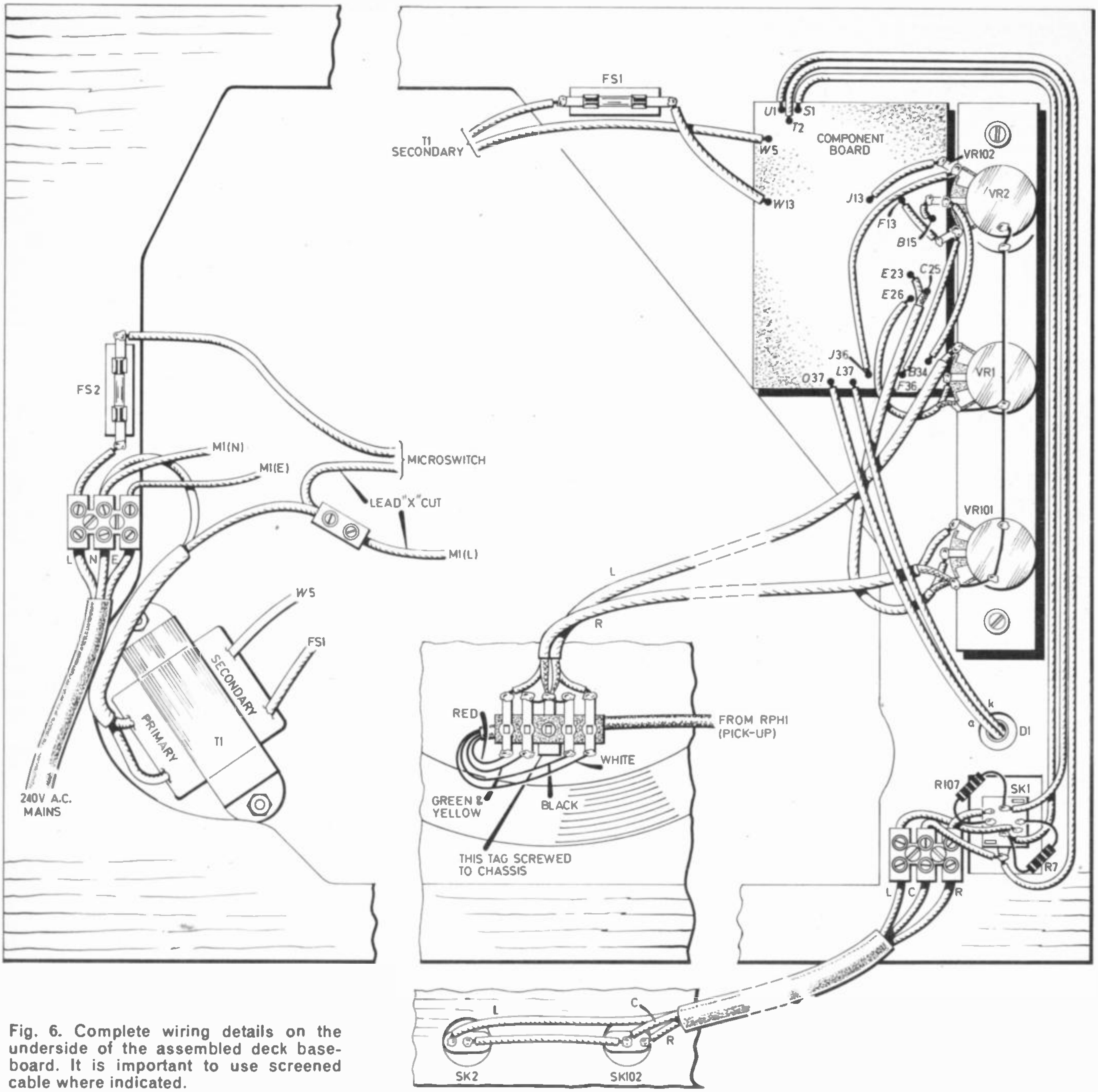


Fig. 6. Complete wiring details on the underside of the assembled deck baseboard. It is important to use screened cable where indicated.

speaker and connect up to the speaker terminal block. With both volume controls fully down and the deck still upside down, switch on. A faint hiss should be heard in both speakers, move each volume control about a quarter of a turn, hold a screwdriver by the blade and touch each amplifier input at the small tag strip on the deck. A loud buzz should be heard. Leave the unit switched on for a while and check that the heatsink stays cool.

Once satisfied switch off and reconnect the motor lead and set the deck up to play a record. Make sure both channels give equal volume without distortion and that the tone control functions satisfactorily: anticlockwise for cut, clockwise for boost, from centre position. Carry out the same check with the headphones connected.

Once again if problems arise check all wiring for possible mistakes and bad joints. If mains hum is present check that there is a good earth to the deck, and the two screened cables to the board. Only one of the screens should go to the board earth pin.

If the unit so far built gives satisfactory performance, the case and speaker enclosures may now be prepared.

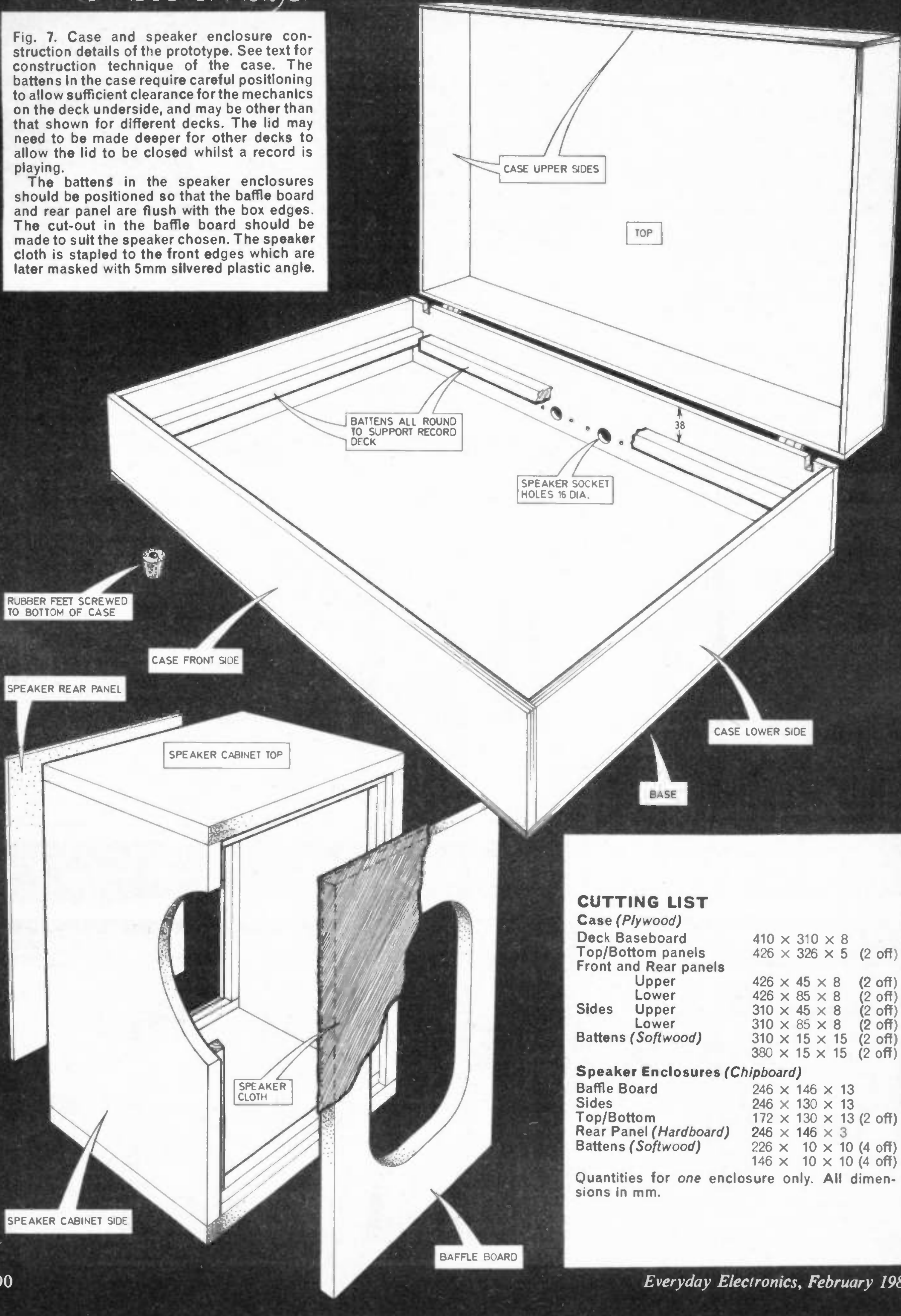
THE CASE

Plywood was chosen for making the cabinet, the main structure being 8mm thick with the base and lid 5mm thick. For details see Fig. 7.

The cabinet was first made as a complete box all joints being glued and pinned. Then using a woodworkers marking gauge set to the

Fig. 7. Case and speaker enclosure construction details of the prototype. See text for construction technique of the case. The battens in the case require careful positioning to allow sufficient clearance for the mechanics on the deck underside, and may be other than that shown for different decks. The lid may need to be made deeper for other decks to allow the lid to be closed whilst a record is playing.

The battens in the speaker enclosures should be positioned so that the baffle board and rear panel are flush with the box edges. The cut-out in the baffle board should be made to suit the speaker chosen. The speaker cloth is stapled to the front edges which are later masked with 5mm silvered plastic angle.



CUTTING LIST

Case ***(Plywood)***		
Deck Baseboard	410 × 310 × 8	
Top/Bottom panels	426 × 326 × 5	(2 off)
Front and Rear panels		
Upper	426 × 45 × 8	(2 off)
Lower	426 × 85 × 8	(2 off)
Sides Upper	310 × 45 × 8	(2 off)
Lower	310 × 85 × 8	(2 off)
Battens *(Softwood)*	310 × 15 × 15	(2 off)
	380 × 15 × 15	(2 off)
Speaker Enclosures ***(Chipboard)***		
Baffle Board	246 × 146 × 13	
Sides	246 × 130 × 13	
Top/Bottom	172 × 130 × 13	(2 off)
Rear Panel *(Hardboard)*	246 × 146 × 3	
Battens *(Softwood)*	226 × 10 × 10	(4 off)
	146 × 10 × 10	(4 off)

Quantities for *one* enclosure only. All dimensions in mm.

correct lid depth mark around the box and cut with a small tenon saw. This method ensures the lid fits the base perfectly.

Next glue and pin the baseboard supporting battens and cut the slots at the rear of the cabinet to accommodate the mains and headphone cables. Drill 15mm holes for the speaker sockets and temporarily screw them into place.

The hinges and catches are fitted with 9mm No. 6 round head screws. Drill the two holes and fit the carrying handle which comes complete with fixing nuts and bolts. These bolts need to be cut flush with the nuts to allow the deck baseboard to slot into place.

All these items must be removed before the final finish is applied to the cabinet.

Finally, the self-adhesive rubber feet are stuck into position on rear and underside. The rear feet are necessary to protect the hinges and speaker sockets should the unit be put down whilst it is being carried around.

SPEAKER CABINETS

The speaker cabinets are made from 13mm chipboard the rear panel being hardboard, see Fig. 7 for details.

The speaker cut-outs accept 8×5in elliptical speakers and are made using the same technique as described for the deck baseboard. All joints are glued and pinned, the rear panel being pinned only, to allow access. Once the baffle has been fixed, countersink and fill-in all holes.

Because some grille cloth is an open weave its a good idea to paint the front of the enclosure with a similar matt colour as the cloth.

At this stage the outer finish can be applied to the cabinets; the prototype was given several coats of matt black paint.

The grille cloth should be cut about 25mm or so larger than the front of the enclosure, then stretched across and temporarily held down at the edges with drawing pins. The cloth can be permanently fixed down using a small staple gun. To mask the staples and edges of the cloth a length of right angled metallised self-adhesive edging was fitted all round, mitreing the corners to give a neat appearance.

The speaker is fixed into place with 4×15mm long No. 8 round head wood screws. Solder the speaker leads on, and fit a cable staple to prevent any stress being applied to the speaker terminals. Cut a small slot at the bottom of the rear panel to allow the cable to come through, and secure the panel with short panel pins.

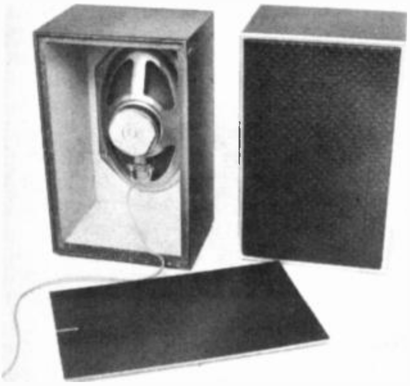
The enclosures may now be completed by fitting self-adhesive rubber feet.

FINISHING OFF

Prior to cleaning and lettering, the facia panel is removed by unsoldering the panel indicator wires and removing the headphone fixing nut and washer. Once off it can be rubbed down lightly with steel wool to give a brushed aluminium effect, then thoroughly washed with hot soapy water before lettering.

"Magic letters" sold by W. H. Smith were used on the prototype. They are simply rubbed down onto the aluminium, then the whole panel sprayed with clear lacquer for protection.

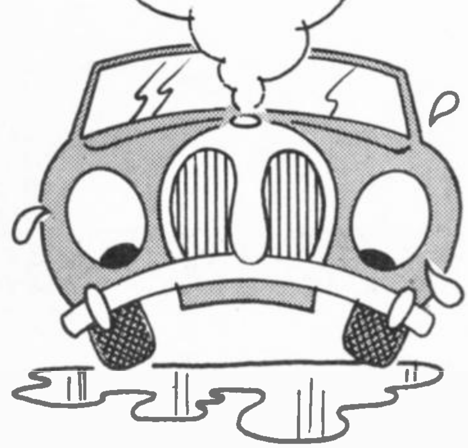
Finally, the deck baseboard is secured down with chrome finished screws and cups. ⌘



JACK PLUG & FAMILY... BY DOUG BAKER

Car Over-heating Alarm

by
T. R. de Vaux-Balbirnie



THIS circuit has been designed to give an audible warning when a car engine reaches a predetermined temperature. It was originally intended for use as an overheating alarm when towing a caravan but has proven equally useful in a number of other situations where overheating could occur. Trips at high speed, touring in hot countries and high altitude driving can also cause overheating in cars normally quite free from this problem.

If warned in time, the driver may simply ease off a little, or stop for a short while to allow the engine to cool. Without such warning, water will be lost and the situation can become more serious.

Although most cars are fitted with a water temperature gauge, they do not give a positive signal in the event of overheating, so it is quite possible to miss the pointer creeping slowly into the red. An audible warning provides the answer; being high pitched rather than loud, it easily "carries" above engine noise.

The driver must always check that there is no actual reason for overheating such as a blocked radiator, leak or broken pump. This project has not been designed to cover-up poor maintenance!

POSITIVE OR NEGATIVE EARTH

The circuit is suitable for both positive and negative earth cars without modification.

The overheating alert is simple to construct, being designed around two cheap and readily available integrated circuits, IC1, a 741 Operational Amplifier and IC2, a 555 Timer. An engine-mounted thermistor RTH1, "senses" the temperature.

The circuit is connected to the car's electrical system such that it will only operate with the ignition switched on so there is no drain from the battery when the car is at rest. Sounding or not, the current requirement is very low, around 5mA.

CIRCUIT DESCRIPTION

The circuit works in the following way (see Fig. 1). As the temperature of the engine rises, the resistance of the RTH1 falls. This component, together with R1, from a potential divider across the supply resulting in a voltage appearing at Pin 2 of the op-amp IC1. This voltage will therefore fall as the temperature rises. VR1 forms a second potential divider which gives a reference voltage at Pin 3 of the IC1, this voltage dependant upon the setting of VR1. When the voltage at Pin 2 falls below that at Pin 3, IC1 switches 'on' and the supply voltage appears at the output, Pin 6. This enables IC2, the 555 timer, wired as an astable multivibrator, which results in an audible tone from the loudspeaker LS1. The temperature at which this happens is preset by suitable adjustment of VR1. The frequency of the alarm note is determined by the setting of VR2 and this may be adjusted for best effect at the end.

If the thermistor is not as specified, that is with a room temperature (20°C) resistance of about 1MΩ and about 50kΩ at 100°C, then R1 may need changing and the value should be approximately the thermistor resistance at 100°C.

Slight variations in battery voltage will occur but these have no effect on the operation of the circuit. Rapid fluctuations from the charging circuit may result in a "warbling" note from the loudspeaker but this is of no consequence.

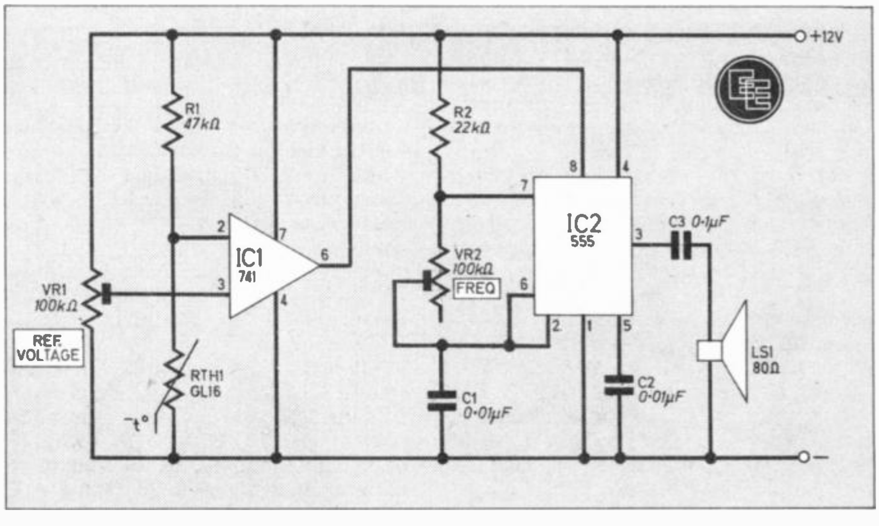
CIRCUIT BOARD

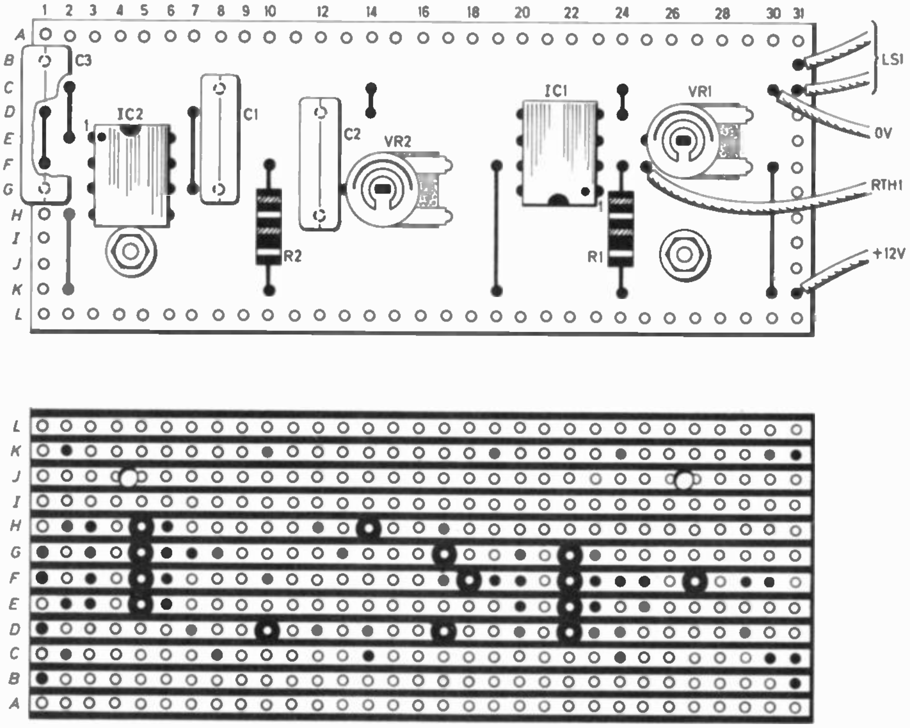
The circuit panel is built on a small piece of 0·1 inch matrix stripboard, 12 strips by 31 holes (see Fig. 2). In the prototype, the i.c.s. were soldered direct to the panel. This is acceptable where the constructor has confidence in the quality and speed of his soldering, but if there is some doubt 8 pin d.i.l. sockets should be used. Note that IC1 is upside down with respect to IC2. This made for simpler construction in the prototype.

There are several places where the copper strips have to be cut and it is important not to miss the track breaks between the pins of the i.c.s. The best tool to use is a proper stripboard cutter but a small hand held twist drill makes a good substitute. Several wire links are required and these should be on the component side of the panel as shown.

Add the resistors, capacitors and potentiometers and finally wire the loudspeaker in with two flexible wires approximately 100mm long.

Fig. 1. Circuit diagram of the Car Overheating Alarm.





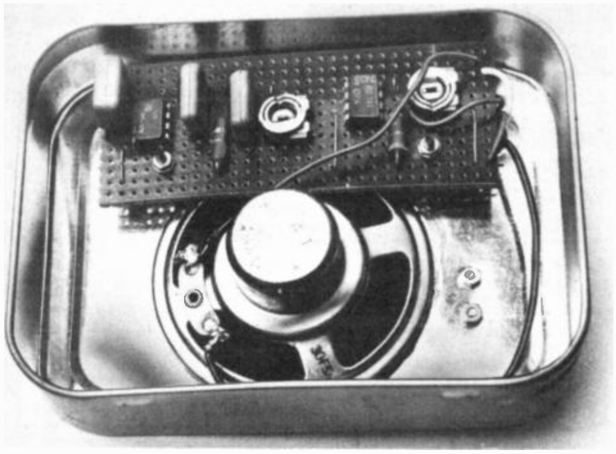


Fig. 2. Layout of components on the stripboard and positions of track breaks on the underside view. Note that the thermistor is connected remotely across RTH1 and 0V wires.

View inside case showing the board assembly and speaker positions.

COMPONENTS

See **Shop Talk** page 95

Resistors
R1 47kΩ
R2 22kΩ
All ¼W carbon ±5%

Capacitors
C1, 2 0·01µF polyester (2 off)
C3 0·1µF polyester

Semiconductors
IC1 741 operational amplifier
IC2 555 timer

Miscellaneous
RTH1 GL16 bead thermistor, negative temperature coefficient, 1MΩ @ 20°C and 50kΩ @ 100°C
VR1, 2 100k miniature horizontal preset (2 off)
LS1 70-80Ω minature speaker, 57mm dia.
0·1 inch matrix stripboard, 12 strips by 31 holes; case to suit; 3 way 5 A terminal block; 2 way 5 A terminal block; 8 pin d.i.l. i.c. holder (2 off); grommet; 7/0·2 connecting wire; thin copper sheet approx 20 × 60mm; epoxy resin adhesive; automotive type spade connectors; mounting hardware; 8BA screws, nuts and insulating stand-offs (2 off); p.t.f.e. sleeving for thermistor leads (approx 100mm)

Approx cost Guidance only £7 excluding case

Two holes should be drilled very carefully in the circuit board and corresponding holes drilled in the case. These are to secure the panel using short stand-off insulators and 8BA nuts and screws. The three wires from the circuit board should be passed through the grommet and connected to the terminal block and labelled +12V, 0V and "RTH1" as shown in Fig. 3.

BENCH TESTING

When the circuit is complete and has been checked visually, it may be tested using a 9 volt battery. To do this, VR1 should be set fully anticlockwise and VR2 to approximately the mid-position. The thermistor and a 9V battery should then be temporarily connected. A note may be heard from the loudspeaker, and if not, VR2 should be adjusted to the position where a shrill note is emitted. VR1 is then backed off to the point where the note is just silenced.

If the thermistor is now warmed slightly by holding it between the fingers or dipping the end in warm water, the tone should be heard once again. When the temperature falls it should switch off. These tests will confirm that all is well with the circuit and the panel may now be built into a suitable box.

CASE

Although a tobacco tin was used for the prototype, care must be taken when using a metal box to prevent short circuits. However, any suitably sized case of any material can be used.

A series of small holes, drilled in the base, form a "grill" for the loudspeaker which may then be secured in place using epoxy resin adhesive applied thinly around the rim. A hole should be drilled for a grommet through which the connections to the circuit board will pass. A 3-way terminal block should be secured to the underside for these wires (see Fig. 3).

THERMISTOR

Next, the thermistor unit should be prepared. Thermistors are extremely delicate components and could not possibly be used in an unprotected state. Although some form of protection is essential, heat must readily pass to the thermistor.

The method shown in Fig. 4 proved effective in the prototype. A piece of thin copper sheet was cut and bent into the form of a "P" clip, the cavity for the thermistor was formed by rolling the sheet around a thick nail. The thermistor leads must then be sleeved with p.t.f.e. insulation and the thermistor encapsulated in epoxy resin adhesive in the cavity. A 2-way terminal block should be glued on top of the clip and the thermistor connections made to it.

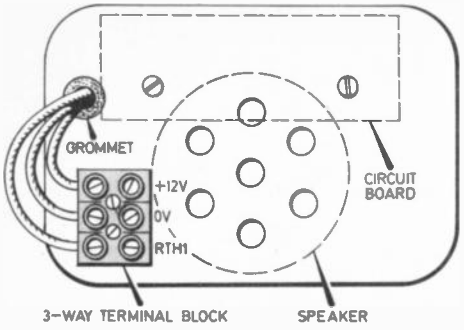


Fig. 3. Underside view of case showing speaker "grill" and terminal block.

The prototype thermistor assembly unit was secured to the engine using epoxy resin adhesive. A flat, horizontal surface is ideal and very thorough cleaning of the contact area is essential and slight roughening of the surfaces helps.

The clip must make good contact with the engine for efficient transfer of heat and it must be situated away from direct sources of heat like the exhaust manifold and also away from cool, moving air. It may require several experiments to find the best position. (A clip attached with adhesive may be removed by careful use of a penknife blade.) Obstinate cases will demand a thermistor unit which is "boxed in" over the top surface with fibreglass insulation. It is also necessary to keep the thermistor unit dry.

INSTALLATION

With the thermistor in position, temporarily at least, two lengths of stranded wire should be run from it to the main unit inside the car. For the time being, the main unit should be placed in a temporary position so that a *passenger* can adjust VR1 and VR2 whilst driving along. The positive (+12V) connection on the main unit should be taken to a fuse which is "live" only when the ignition is switched on. For cars having a positive earth system this will be the negative (0V) connection.

A 12V test lamp with one side to chassis will locate a suitable fuse. Ensure that the light goes "off" when the fuse is removed thus confirming that the correct side of the fuse is being used. The negative connection on the unit should be run to an "earth" point (the positive connection on positive earth cars). The leads from the thermistor unit will be connected across RTH1 and the negative (0V) connection regardless of the polarity of the cars electrical system.

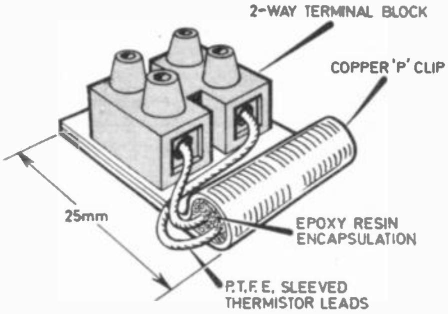


Fig. 4. Thermistor mounting assembly.

IN-CAR TESTING

To test the circuit, the ignition should be switched on and VR1 set fully anticlockwise. A tone should be heard and VR2 adjusted as necessary to give a high-pitched whistle. VR1 should now be adjusted clockwise to silence the alarm and the car driven to bring the engine up to full operating temperature.. VR1 should be advanced at intervals to keep the alarm just "off".

If the sound has a tendency to cut out when the engine is revved up this is usually cured by raising the pitch of the note by means of VR2. If the operation of the circuit is erratic and seems to depend on the speed of the car rather than the temperature this indicates that the siting of the thermistor unit is not good enough and more attention must be given to prevent the unit from being cooled by the car slipstream.

The final settings for VR1 and VR2 can only be found after a proper trial run. VR1 should then be adjusted so that the tone is just "off". Remember, **DO NOT** attempt to adjust VR1 and VR2 whilst driving along. Get a passenger to assist you.

COUNTER INTELLIGENCE

By PAUL YOUNG

Electroneer

Here we are again at the start of a new year and with our eternal optimism expecting it to be better than the last. I go along with that sentiment, as Robert Louis Stevenson said, "It is better to travel hopefully than to arrive", and although he was talking about a journey, I don't see why it should not equally apply to time.

I would like to thank all those kind readers who wrote to me suggesting a word for an Electronic Engineer. The consensus seems to be "Electroneer" but while it seems a logical conclusion, to my rather whimsical way of viewing things it conjures up a vision of a man with ears made of electrons!—They probably are anyway.

I do agree it is difficult to think of something that rolls off the tongue and I haven't come up with anything better. Here are some of the suggested words:

From Mrs. Doreen Tomlin of Bracknell, Berks., "Dynamician", Mr. Stephen J. Parker of Glossop, Derbyshire, "Electronist", Mr. W. C. Hobson of Humberside and Mr. Albert H. Scott of Jersey, "Electroneer".

Anxious to Please

"He who pays the Piper calls the tune", and never has that been so true as today. I think the day of the vast Electronic store, run by a Tycoon who changes his Rolls everytime the ashtrays are full, is disappearing, and this has been replaced by a larger number of smaller outfits.

From the customers point of view this may be a step in the right direction. In case of complaints it is easier to get to the man at the top and be certain of getting some speedy action.

Most of us are enthusiasts and anxious to please, but we would ask that you help us to help you, by being clear in your requests. Remember that unless you are ordering a specific item from a catalogue, where it has an identifying number, there are certain data we must know, such as voltage, current, wattage, capacity, inductance, impedance, according to what the item is you are ordering.

You may also required the item not to exceed a certain physical size. If that is the case, please tell us. Only today I had a letter from a customer asking me to send him a mains transformer, without telling me what output current he required, an electrolytic capacitor, without stating the voltage, and would I also send him two general purpose transistors with a medium gain. It must also be said that when a customer sends in a long list of miscellaneous items which he wants us to work out and price, there is always the sneaking suspicion that he is giving us half an hours work, when we are already overloaded, in order to save himself the cost of a catalogue.

Match This

My last little grumble, is an error of which I am sure the true electronic constructor is not guilty. It is the chap who walks in with some odd part of a foreign set, which is broken and asks us if we have one like it. It is almost like going into an ironmongers when you want some spare part for your car. Having said that, I must redress the balance by saying (and I know all my colleagues would agree with me) that our customers are among the very best and always appreciative of any help we are able to give them.

In Brief

Citizen Band Radio is officially with us, and although I haven't dabbled in it yet, I think it will do much good, particularly in bringing companionship and comfort to the old, the sick and the lonely, and more important still, help if they are in trouble.

I was very sorry to have missed the *Breadboard Exhibition* this year, but I don't think I was entirely to blame. I expected to see some publicity for it a few weeks before it was scheduled, but none appeared.

By Dave Barrington

Circuit Board Holder

We are always on the look out for any "gadgets" or items that help to make the task of construction that much easier.

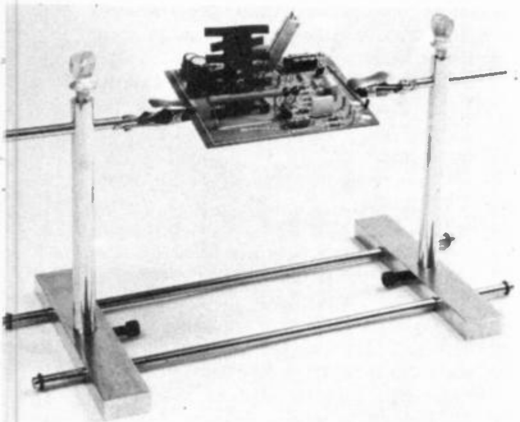
In this respect, we have already drawn readers attention to the excellent Mini-bench work holder with flexible arms from Absonglen. This is now joined by another form of circuit board holder manufactured by Carlton Nichol.

Two models are available. The CNC6, which is probably more suited to our kind of work, and the CNC9, able to accept Euroboard size boards. Both are constructed in aluminium and plated steel and allow rotation of circuit boards through 360 degrees, with locking in any position.

The CNC6 will take boards up to 254mm × 178mm (10 × 7in). The boards are held by spring loaded "jaws" and width adjustment is by lockable metal rods. The CNC9 will take boards up to 203mm × 203mm (8in × 8in) and are held in position by sliding Vee clamps.

An anti-static foam pad is also available as an optional extra to allow the insertion of a number of components before rotating the p.c.b. for soldering. The pad, which is on a backing plate, clips onto the rotating arms of the board holder.

The CNC6 costs £13·80 and the CNC9 £15·95. Whilst the anti-static foam pad costs £9·20. For more details contact Carlton Nichol & Co. Ltd., Dept EE, Goldkey Industrial Estate, Kelvedon, Essex.



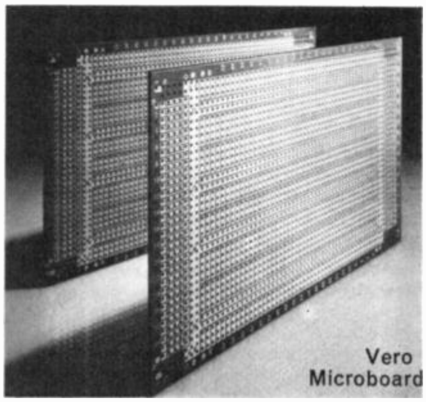
The CNC6 Circuit board holder from Carlton Nichol

Microboard

We are sure that no one doubts the versatility of stripboard, but there are times when another form of component mounting board would be most welcome. This is particularly evident when dealing with multi-pin i.c. devices.

Recognising this possible gap, Vero Electronics have taken a leaf out of the industrial market and decided to launch their first Euroboard size Microboard onto the retail and amateur constructor markets.

Made from s.r.b.p. material, the Microboards are available in two sizes, 160mm × 100mm and 160mm × 233mm; priced £3·47 and £5·47 respectively. The boards are also compatible with indirect connectors and international card frame systems.



Vero Microboard

It is claimed that the boards will accept any integrated circuit package, and allow high component packing density. On the component side, each board is printed with an "island" pattern for ease of wiring and is suitable for both solder and wire wrap applications.

According to Mike Humphrey, Vero's Retail Sales Manager, "the development of a board specifically for the hobby market is an important step for the company. More and more, industry has been moving towards the use of Eurocard sized microboards."

"For the hobbyist, the availability of this microboard pattern in Eurocard format increases still further access to our wide range of industrial quality products."

The Microboards are available from Vero's usual retail outlets, or direct from Vero Electronics Ltd., Dept EE, Industrial Estate, Chandler's Ford, Hants, SO5 3ZR.

CONSTRUCTIONAL PROJECTS

Stereo Record Player

The record deck chosen for the *Stereo Record Player* is the BSR P207 with a SC12H ceramic cartridge. This was selected because of its high output, typically 1V peak-to-peak in the authors model.

The system has been designed around this cartridge and to obtain similar performance readers are advised to keep to the components specified. To date, the only source we have been able to locate for the deck and cartridge is from Radio Components Specialists. We understand that some local hi fi shops may be able to help.

The stereo jack socket for the headphone input is a multi-contact type, with internal switch, and may be difficult to locate. The one used in our unit was obtained from a Tandy store and is listed as order number 274-277.

Practically any general purpose 8 ohm speakers will suffice for the enclosures. The cut-out for the speaker used will have to be tailored to suit. Of course, one of the better quality speaker kits and ready-made enclosures, from such advertisers as RT-VC and B.K. Electronics would enhance the final result.

For those constructing their own enclosures, the speaker grille cloth may be obtained from Home Radio. The plastic angled edging for the cabinet should be available from the local hardware or DIY shop.

Cine Interval Timer & Frame Counter

Only a couple of items need further comment when purchasing components for the *Cine Interval Timer and Frame Counter*.

The prototype unit uses 500mA general purpose plastic encapsulated transistors. However, we feel the BFY50's would be better suited here.

The designation "E" in the type number for the integrated circuits refers to a "buffered" output and this type should be used. It is quite possible that other equivalent i.c.s will work in this circuit, but we have not tested them in the prototype and cannot vouch that they will work.

Provision for a relay option has been included for a remote single-frame operation. Almost any 9V relay with a coil resistance from approximately 185 ohms and a set of normal open contacts will be suitable. The author used a 9V 410ohm type.

Medium Wave Radio

The coils called for in the *Medium Wave Radio* are Denco types and these are available direct from Denco Ltd, Dept EE, 355 Old Road, Clacton-on-Sea, Essex CO15 3RH.

The Jackson 00 gang 208/176pF tuning capacitor is available from Home Radio for the sum of £4·40 plus VAT. They also supply suitable trimmer capacitors and the MT31A/3 or the MT31A/12 can be used.

We understand that Watford Electronics are able to supply all the Denco coils, compression trimmers and the Jackson tuning capacitor.

Automatic Garage Door

The final article for the *Automatic Garage Door* deals with the mechanical arrangements and setting-up.

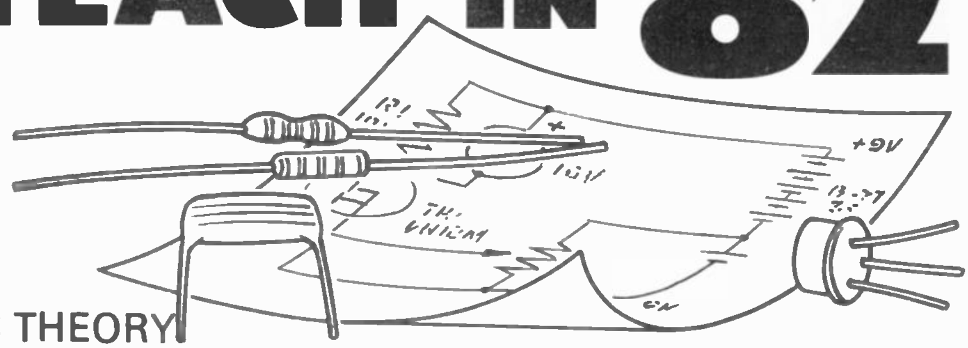
The motor used in the designer's set-up was a Fracmo type, currently stocked by Service Trading Co, (Dept EE, 57, Bridgman Road, Chiswick, London W4 5BB), with an output shaft running at approximately 56 r.p.m. and a more than adequate torque of 50lbs/in. We have been informed that they have only a limited supply, but are able to supply a near equivalent type in their Parvalux range with 42 or 30 r.p.m. at 50lbs/in. torque.

Most of the hardware for the door gear should be available from local builders merchants or hardware stores.

EE TEACH-IN 82

PART 5

BY O.N. BISHOP



BASIC ELECTRONIC THEORY WITH EXPERIMENTS

BIPOLAR TRANSISTORS

When people speak of "a transistor", the bipolar junction transistor is the sort they usually mean. This is the kind which is used in most circuits, except in integrated circuits where the MOSFET is the dominant type.

It is easy to understand how f.e.t.s work, which is why we began this course by studying them. **Bipolar transistors** are harder to understand, but they are much easier to manufacture, so they have been the most widely used type until recently.

Field effect transistors belong to the group of transistors known as **unipolar transistors.** This name means that only one kind of charge carrier occurs in it. We have *n*-channel f.e.t.s in which charge is carried by electrons. In *p*-channel f.e.t.s charge is carried by holes.

Bipolar transistors use both holes and electrons in the same transistor. The action of a f.e.t. depends on the effect of an electrical field. The bipolar junction transistor depends on the action of a *pn*-junction. The *pn*-junction was described in Part 3.

From now on we will use the word "transistor" to mean "bipolar junction transistor", so saving a lot of space. You will already have noticed the symbol for the transistor appearing in circuit diagrams on the pages of this magazine. You may have noticed that there are two types, *npn* and *pnp*, see Fig. 5.1.

Transistors can be made from silicon or germanium, though the silicon ones are far more popular today.

A transistor is a three-layered device. An *npn* silicon transistor consists of a layer of *p*-type silicon sandwiched between two layers of *n*-type silicon. The layers are named as shown in Fig. 5.2.

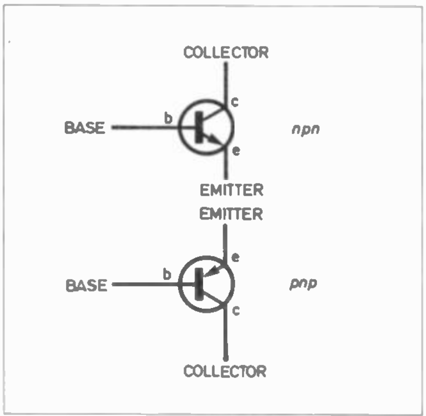


Fig. 5.1. Circuit symbols for the two types of bipolar transistors.

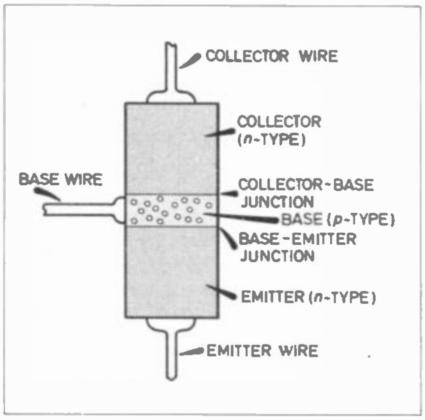


Fig. 5.2. Structure of an npn transistor (diagrammatic and not to scale).

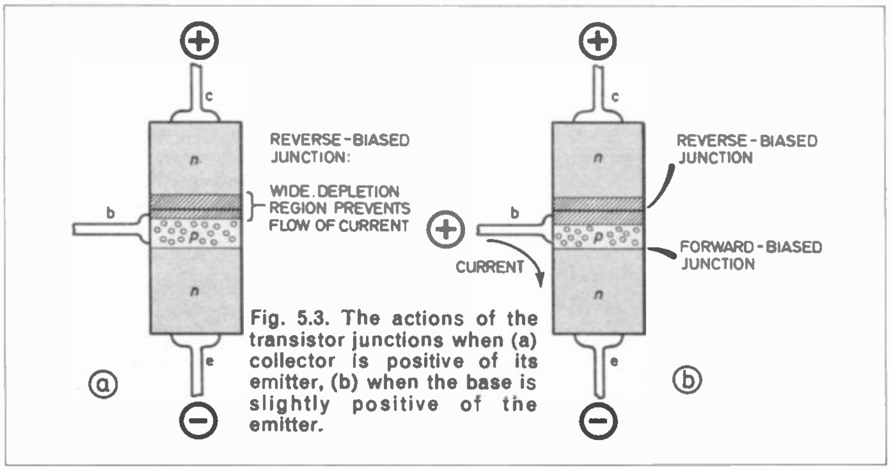


Fig. 5.3. The actions of the transistor junctions when (a) collector is positive of its emitter, (b) when the base is slightly positive of the emitter.

HOW AN NPN TRANSISTOR WORKS

The transistor has two *pn*-junctions. If the transistor is connected as in Fig. 5.3a, the collector-base (c/b) junction is reverse-biased, so we would expect that it is impossible for a current to flow from collector to base and on to the emitter. If we apply a slight positive potential to the base, the base-emitter junction (b/e) becomes forward-biased (Fig. 5.3b). If the potential is greater than the forward voltage drop (0·6V), a current flows from base to emitter.

Let us look at this current more closely, for it is the b/e junction which is the important one. In Fig. 5.4 we see that the current consists of:

(1) electrons flowing out of the base, creating . . .

(2) holes which flow to the b/e junction, where they are filled by . . .

(3) electrons arriving from the external circuit and flowing through the emitter to the b/e junction.

Now we can see the reason for the calling them bipolar transistors.

The second important point is that the base layer is exceedingly thin (much thinner than shown in the diagrams. As electrons flow through the emitter to the base they come *very close* to the collector.

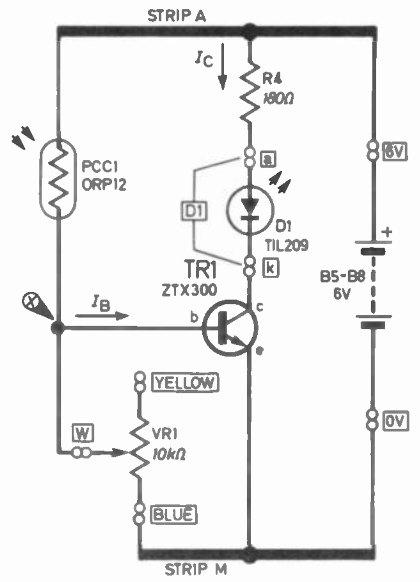


Fig. 5.5. Circuit for demonstrating a light operated transistor switch.

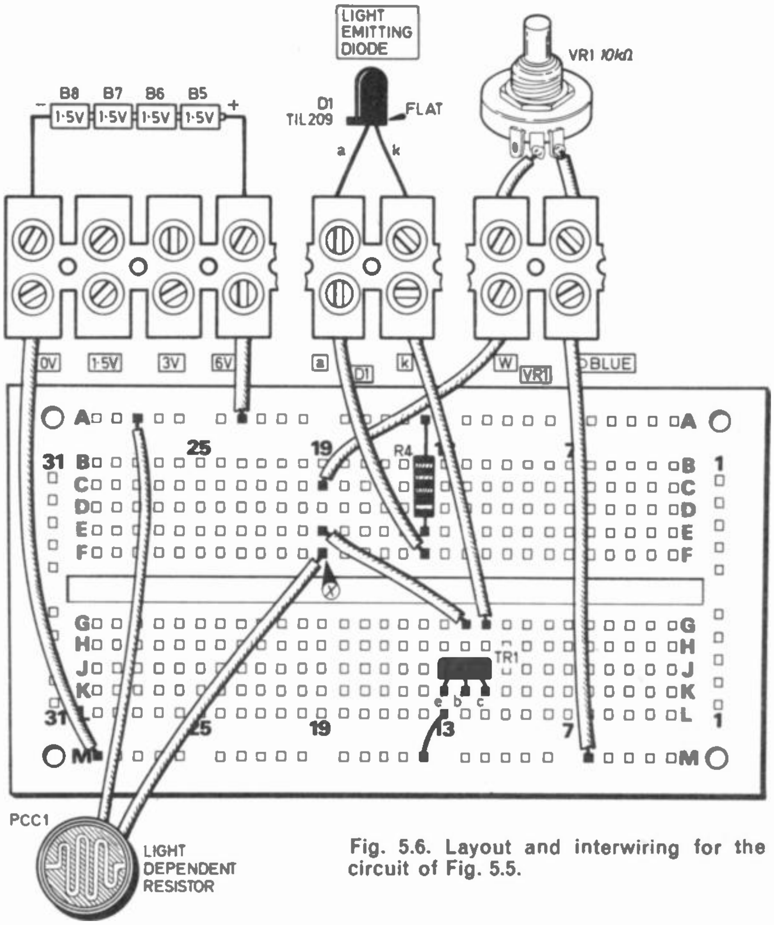


Fig. 5.6. Layout and interwiring for the circuit of Fig. 5.5.

The potential of the collector region is more strongly positive than that of the base. It attracts electrons so strongly that they are pulled across the depletion region at the c/b junction, in spite of the fact that it is reverse-biased.

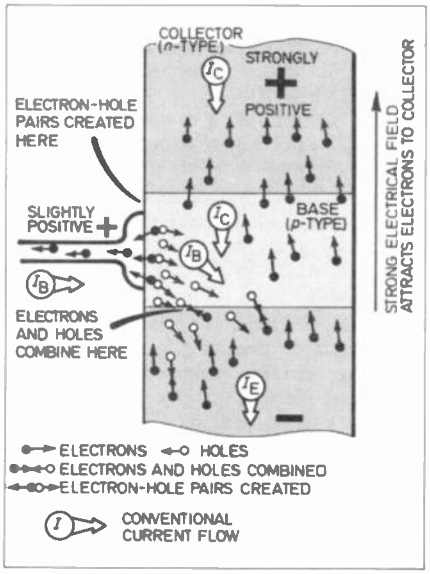


Fig. 5.4. The happenings in the base region of a transistor.

Only about 1 per cent of the electrons are used to combine with holes in the base. The remaining 99 per cent pass into the collector and then flow out of the transistor. In other words, the collector current (I_C) is around 99 times greater than the base current (I_B)

I_C depends on I_B bringing electrons to the base layer, so I_C flows only when I_B is flowing. By turning the small I_B on or off we can control the much larger I_C. The transistor can be used as a switch.

Secondly, by varying the amount of the small I_B we can vary the amount of the large I_C. The transistor can be used as an amplifier.

A *pnp* transistor works in a similar way except that polarities are reversed.

EXPERIMENT 5.1
A transistor switch

In Fig. 5.5, PCC1 is a **light-dependent resistor** (l.d.r.). This is a piece of semiconducting material such as cadmium sulphide. When light falls on it, electrons in the atoms become excited and some escape from their orbits. They become charge carriers, allowing current to flow more easily through the material. The resistance of PCC1 decreases when the amount of light falling on it is increased.

Here, PCC1 and VR1 act as a potential divider. In the dark, the resistance of PCC1 is high, so the potential at *X* (and at the base of TR1) is very low. In the light, the resistance of PCC1 is reduced so the potential at *X* rises. We can adjust VR1 so that the potential at *X* is *just* less than 0·6V. This is just not enough to switch TR1 on.

Set up the components on the Verobloc as shown in Fig. 5.6. Make sure that PCC1 is not shaded. Turn VR1 until D1 goes out; then turn VR1 slowly back until D1 just comes on again. The potential at *X* is now a little over 0·6V. Place your hand or a thick cloth over the l.d.r. What happens to D1? TR1 switches D1 on or off according to the potential applied to its base.

EXPERIMENT 5.2
A current amplifier

This experiment illustrates the action of the transistor as a current amplifier, see the circuit in Fig. 5.7. I_B flows through the high-value resistor, R4. We use a meter to measure the corresponding I_C.

The meter belonging to *Minilab* has a f.s.d. of 100μA. To let it measure larger currents we put a resistor in parallel with

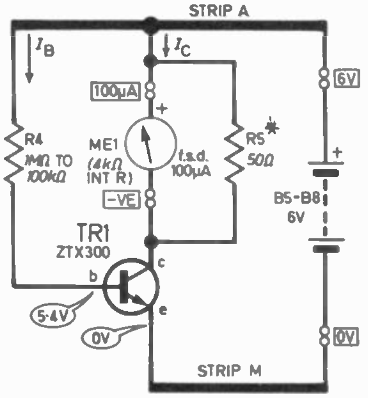


Fig. 5.7. The circuit for investigating the action of a current amplifier.

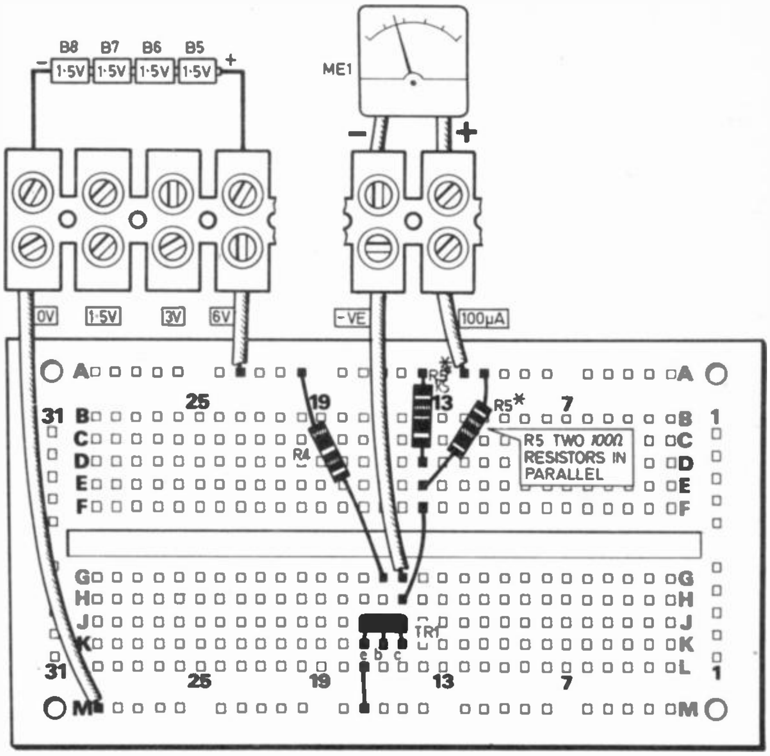


Fig. 5.8. Layout and interwiring details for the circuit in Fig. 5.7.

it (R5 in Fig. 5.7). The majority of the current by-passes the meter. If the resistance of the coil of the meter is 4kΩ (as in the recommended meter), the p.d. across the coil is $(4 \times 10\Omega^3) \times (100 \times 10^{-6}\ \mu A) =$ 0·4V, when the current is 100μA.

When a 50Ω resistor has a p.d. of 0·4V put across it, the current through it is $0{\cdot}4V/50\Omega = 8 \times 10^{-3}A = 8000\mu A$. So the current flowing through both meter and resistor is 8000 + 100 = 8100μA. (To round it down to 8000μA is near enough.)

This means that a reading of 100μA on the meter indicates a total current of 8000μA. To measure the total current, take the scale reading and multiply it by 80.

For those readers having a meter other than the 4kΩ type, a suitable value needs to be derived for R5.

To give approximately the same multiplication factor as above, divide the internal resistance of your meter by 80. Choose the nearest preferred value to this. Next divide the meter internal resistance by the preferred value to give the required factor.

For example, if the internal resistance is 1100 ohms, dividing by 80 gives 13·75. Nearest preferred value is 15. Divide 1100 by 15 to give the factor which here is 73·3. Thus all meter readings must be multiplied by 73·3 to give I_C.

In the experimental layout shown in Fig. 5.8 we use two 100Ω resistors in parallel to give the equivalent of 50Ω. Start with a 1MΩ resistor for R4.

The base of TR1 is at 0·6V (= forward voltage drop), so there is a p.d. of 5·4V across R4. We can calculate I_B as $5{\cdot}4V/(1 \times 10^6\Omega) = 5{\cdot}4\mu A$. What is the collector current? Maybe it is too small to read.

Try various resistor values for R4, calculate I_B and measure I_C. To help you, Table 5.1 has two sets of figures filled in, though yours may be different depending on the transistor used.

Table 5.1: Results of Experiment 5.2

R4 (ohms)	I_B/(ΩA)	I_C/(ΩA)	I_C/I_B
1M			
470k			
270k			
220k	25	3500	140
150k			
100k	54	7700	143

We work out the figures in the last column to tell us how many times I_C is greater than I_B. This is called the **d.c. current gain** of the transistor, symbol h_{FE}.

$$\text{d.c. current gain, } h_{FE} = \frac{I_C}{I_B}$$

The d.c. current gain of the author's transistor was about 140. What is the gain of yours?

Gain can be measured in another way which is slightly different. As I_B is increased from 25μA to 54μA, I_C increases from 3500μA to 7700μA. Increasing I_B by 29μA brings about an increase of 4200μA in I_C. We calculate:

$$\textbf{Small signal current gain, } h_{fe} = \frac{\text{change in } I_C}{\text{change in } I_B}$$

For the author's transistor, $h_{fe} = 4200/29 = 145$. What was h_{fe} for your transistor.

Transistors of the same type may vary in gain. Transistors of different types vary even more widely (from 15 to 1000 or more), depending on their design.

EXPERIMENT 5.3
A simple audio amplifier

In Fig. 5.9, I_C flows through R5. As I_C varies, the p.d. across R5 varies in proportion. Variations in I_B result in large variation of voltage at point X.

A steady base current of 20μA flows through R4. This is the **bias current.** If h_{FE} is 100, I_C is 2000μA. The potential across R5 is $1500\Omega \times 2000\mu A = 3000000\mu V =$ 3V. The potential at X is exactly midway between 0V and 6V, allowing it to swing by equal amounts in either direction.

The crystal microphone generates varying small voltages when energised by sound. This causes a varying potential to appear at capacitor C2 (more about capacitors next month).

A small additional base current flows to or from C2. It varies in size and direction according to the waveform of sound received by the microphone. It adds to or subtracts varying amounts from the bias current.

The resulting I_B models the waveform of the original sound. Consequently, the changes of voltage at X also model the original sound, but the changes are large enough to power the loudspeaker, making it emit a sound loud enough to be heard.

EXPERIMENT 5.3

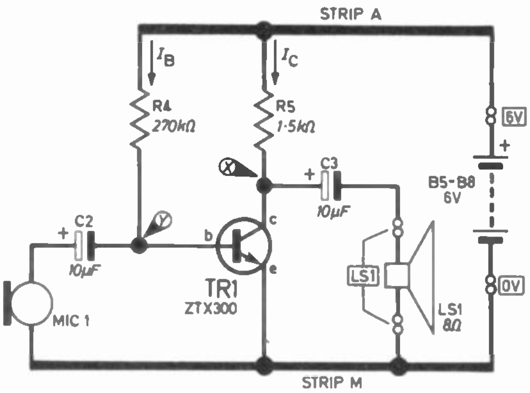


Fig. 5.9. A simple audio amplifier.

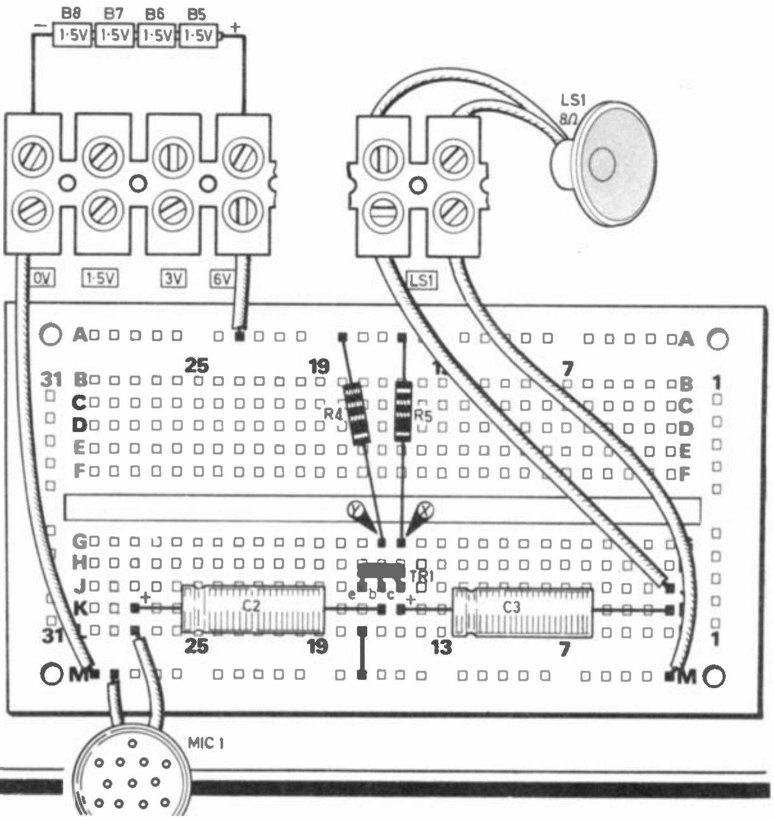


Fig. 5.10. Layout and interwiring for the circuit in Fig. 5.9.

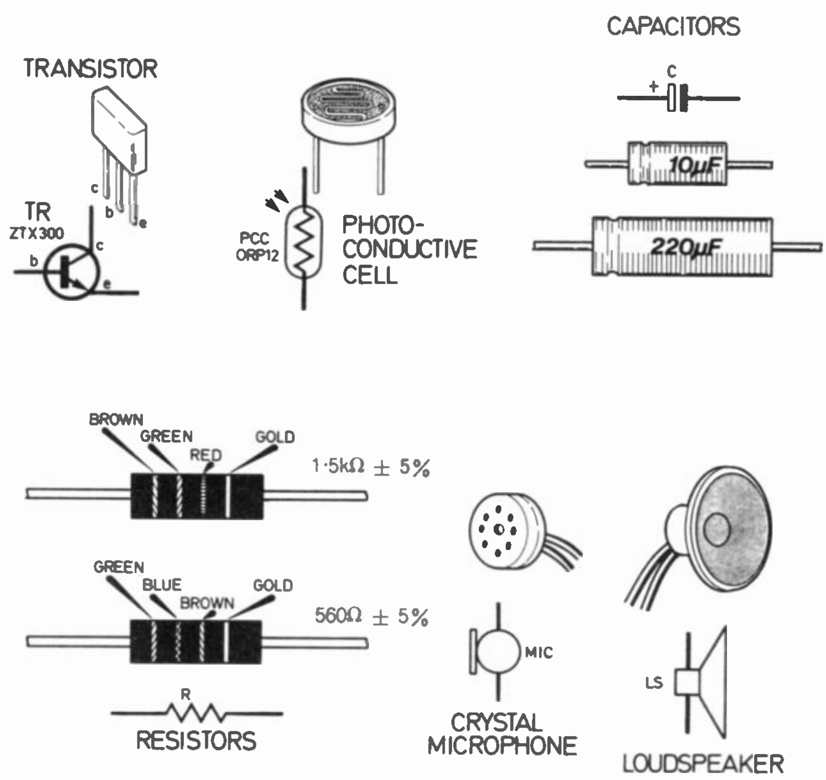
Set up the circuit on the Verobloc as in Fig. 5.10, but do not put in the capacitors yet. Use the meter to measure the voltage at X (location $L15$). If necessary change R4 for a resistor of lower or higher value to make the voltage as close as possible to 3V, for if the voltage is too high or too low, it will not be able to swing equally in either direction and the resulting waveform will be distorted.

Now insert the capacitors to couple the microphone, MIC1 and loudspeaker, LS1 to the amplifier. Put your ear close to LS1 and tap the microphone with a pencil. You should be able to hear the sound distinctly.

To get a better effect, you can use a pair of long wires (ordinary lighting flex will do) and place the microphone in another room. Ask a friend to speak into the microphone while you listen at the loudspeaker. The amount of sound energy actually striking the microphone is not large so, even with a gain of 100, we would not expect a large output. A more powerful amplifier will be described later in the series.

The amplification of this circuit depends entirely on the value of h_{fe}, which varies a lot from transistor to transistor. If h_{fe} is very high, I_C will be high, making the voltage at X swing far too close to 0V, causing great distortion. A way around this is to connect the bias resistor between point X and point Y. Since X should normally be at 3V, we reduce R4 to half its normal value. Alter your circuit to bias the amplifier in this way. (Remove the 270kΩ resistor and place 150kΩ between X and Y $G\underline{16}$ to $L\underline{15}$.)

TEACH-IN 82
COMPONENTS IDENTIFIED



EXPERIMENT 5.4

Fig. 5.11. A stabilised audio amplifier.

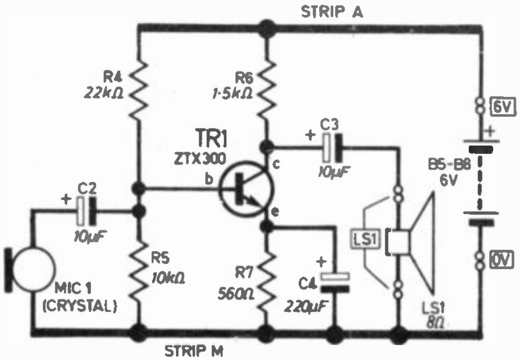
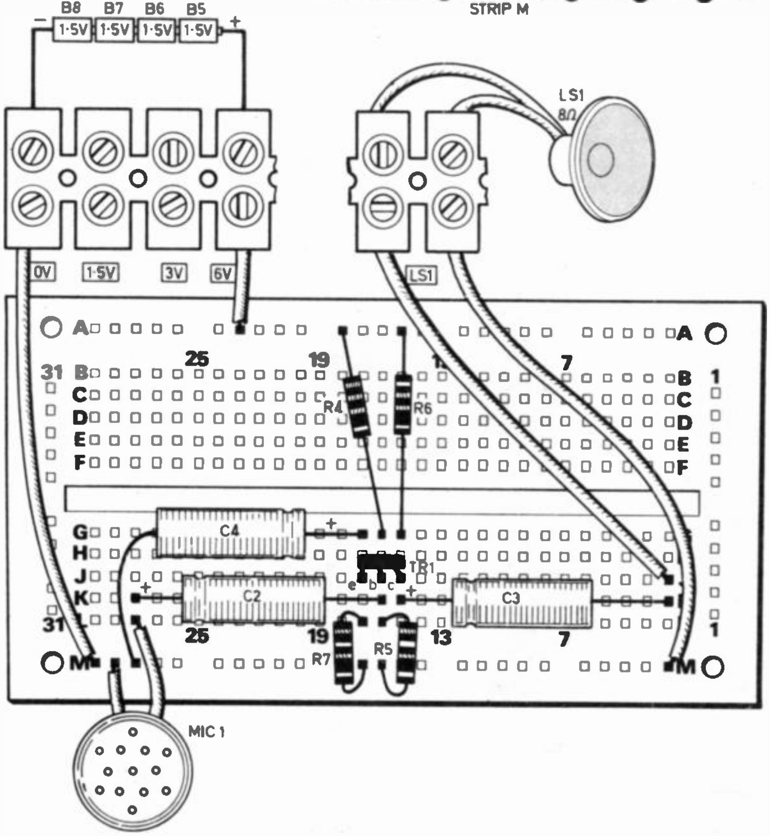


Fig. 5.12. The layout and interwiring for the circuit in Fig. 5.11.



QUESTION TIME

5.1. What do we mean by a bipolar transistor?

5.2. What do we mean by a junction transistor?

5.3. How would the circuit of Fig. 5.5 act if you interchanged PCC1 with VR1?

5.4. If a transistor is receiving base current of 30μA and its d.c. current gain is 150, what is its collector current?

5.5. h_{FE} and h_{fe} measure different things. What is the essential difference between them?

5.6. Fig. 5.13 shows a single stage amplifier. If the base potential is increased by 0·1V, what is the change in emitter potential?

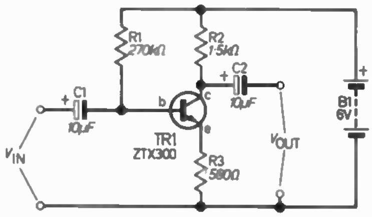


Fig. 5.13

5.7. Can you think how the circuit above could be useful? (Hint: remember f.e.t.s?)

5.8. A transistor in the circuit of Fig. 5.7 has h_{fe} = 50. When I_B = 20μA, I_C = 1mA. If I_B is increased to 24μA, what does I_C become?

5.9. Fig. 5.14 shows a circuit using transistors as switches. Wire *X* can be touched to points *Y* or *Z*. Can you work out what happens if *X* is touched to *Y*, to *Z*, to *Y*, to *Z*, and so on, alternately? (Hint: you could try setting it out on *Minilab* to see what it does.)

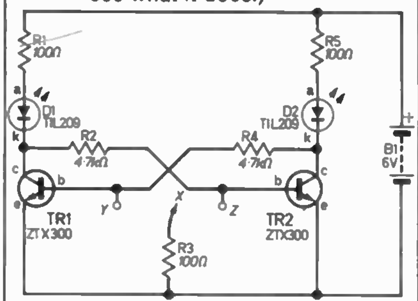


Fig. 5.14

5.10. What is the circuit in Fig. 5.13 called? (Hint: see Part 4.)

EXPERIMENT 5.4
A stabilised amplifier

Fig. 5.11 shows another way of biasing the transistor. R4 and R5 form a potential divider, providing a fixed potential of 1·875V at the base of TR1. The emitter must therefore be at (1·875 − 0·6)V = 1·275V. The emitter current (I_E) through R7 must therefore be 1·275V/560Ω = 0·0023A = 2300μA.

Since I_B is so small compared with I_C we can say that $I_C = I_E$ = 2300μA. This makes the voltage drop across R5 equal to 3·45V, which is much the same as in the previous amplifier. We could make it 3V by varying the ratio between R4 and R5.

Note that we have calculated I_C *without using* h_{FE}. Gain does not depend on h_{FE} in this circuit. It depends only on R4, R5 and R7. Amplification is independent of variations between transistors, or the effects of changes of temperature which also affect h_{FE} considerably.

Build this amplifier up on the Verobloc as shown in Fig. 5.12. Measure the voltages at the three terminals of TR1.

This amplifier has a capacitor (C4) which was not present in the previous one. Remove C4; does the amplifier work now?

Obviously C4 is very important. It is known as the **by-pass capacitor**. As the voltage from the microphone rises, base potential rises and I_B is increased. Increasing I_B means increasing I_C and I_E. If I_E increases, this increases the p.d. across R7. The emitter potential rises.

If a rise in base potential causes a rise in emitter potential, the two rises tend to cancel out. There is less increase in I_B than might be expected. The change in I_C is correspondingly reduced, so little sound comes from the speaker.

C4 prevents rapid changes of potential at the emitter. As emitter potential tries to rise or fall, a large amount of current is required to alter the charge on the capacitor, so the change of potential is much less than it might have been without the capacitor. To put it another way, C4 holds the emitter potential steady. The alternating potentials due to the audio signals are filtered out, or "by-passed" to the 0V line. You could try the effect of using capacitors of other values for C4.

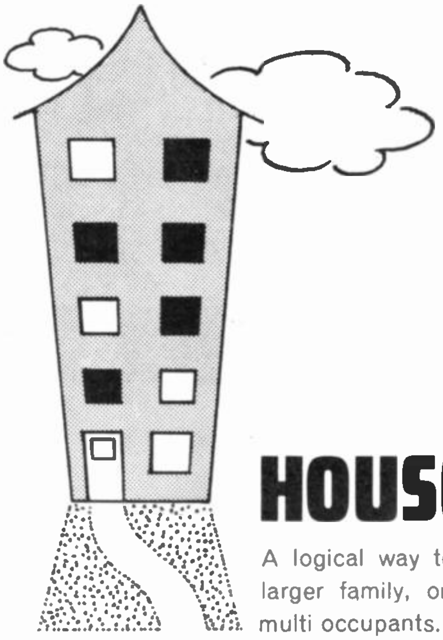
To be continued

FREE STRIPBOARD IN NEXT MONTHS ISSUE

AND FULL DETAILS OF TWO USEFUL INSTRUMENTS TAILOR-MADE FOR THIS BOARD

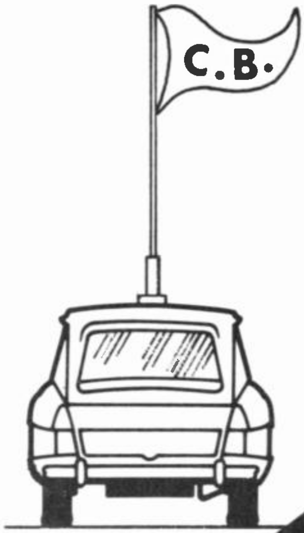
CAMERA OR FLASHGUN TRIGGER

Infra-red operated device. Invaluable for in-flight shots of insects or birds and the like.



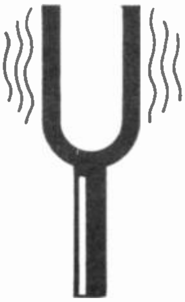
HOUSE REGISTER

A logical way to keep tabs on people. For the larger family, or any residential premises with multi occupants.



CITIZENS' BAND RADIO

A special feature including a survey of equipment on the U.K. market.



GUITAR TUNER

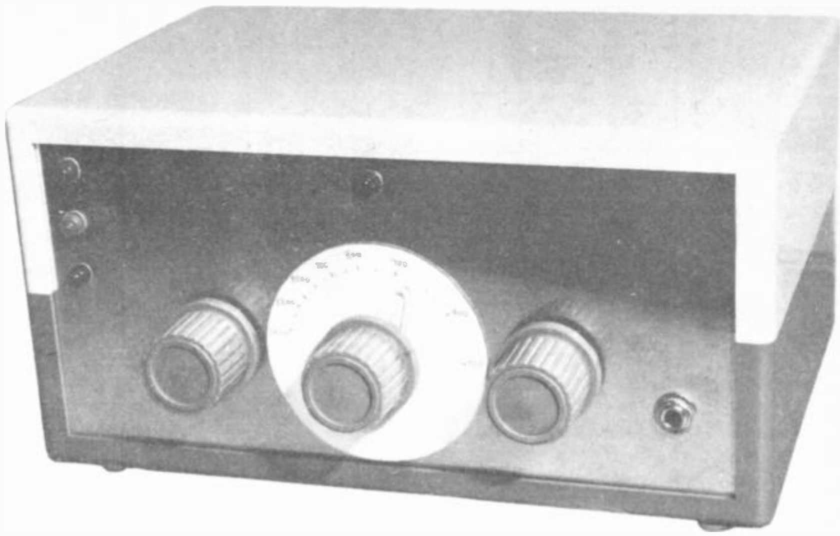
This handy self-contained unit reproduces the six notes of guitar strings.

Everyday ELECTRONICS

MARCH 1982 ISSUE
ON SALE
FRIDAY, FEBRUARY 19

MEDIUM WAVE RADIO

WITH PRESET TUNING FOR THREE STATIONS



BY F. G. RAYER

This unit provides pre-set tuning for three stations, plus manual tuning of the MW band, and is for personal headphone reception when used alone, or will feed an audio amplifier for loudspeaker listening. A simplified superhet circuit is employed, and this gives greater selectivity and sensitivity than t.r.f. type circuits. Illuminated l.e.d.s indicate selection of pre-set or manual tuning.

TUNING ARRANGEMENTS

Signals are picked up by the ferrite rod aerial. This has a coil L1 which is tuned by the selected capacitor.

Switch S1b selects the required means of tuning the ferrite rod winding L1. With manual tuning, C1 is in use. Position 2 of S1b selects the combination C3 and C4. Position 3 selects C5 and C6, while position 4 brings into use C7 and C8.

Mounted over L1 is a smaller coil L2. This is the base coupling winding for TR1, the mixer-oscillator.

L3 is the oscillator coil. Associated with it are two smaller coils which couple L3 to the emitter and collector circuits of TR1, respectively.

Switch S1c selects the required tuning capacitors for L3 as follows: manual tuning: C12 (ganged with C1); Position 2: C14, C15; Position 3: C16, C17; Position 4: C18, C19. Fine tuning or circuit alignment is provided by the trimmer capacitors connected across each main tuning capacitor.

The capacitor values used provide for normal MW coverage with manual tuning, and three pre-set stations: Radio 2 693kHz; Radio 3 1215kHz; and Radio 4 200kHz programmes.

If C1, C12 is left tuned to Radio 1, this allows instant selection of Radio 1, 2, 3 or 4 at the turn of the switch S1. An l.e.d. above the tuning control indicates manual tuning, with red, yellow and green l.e.d.s for 2, 3 and 4. These l.e.d.s are selected by S1a.

Other frequencies can be provided for as described later.

I.F. AMPLIFIER

The intermediate frequency (i.f.) amplifier uses the double-tuned transformer IFT1, and integrated circuit IC1. The latter incorporates amplifier, automatic volume control and detec-

COMPONENTS

Resistors
R1 680Ω
R2 18kΩ
R3 15kΩ
R4 2·7kΩ
R5 100kΩ
R6 470Ω
R7 680Ω
R8 1·8kΩ
R9 1·8MΩ
R10 5·6kΩ
All ¼W carbon ±5%

See **Shop Talk** page 95

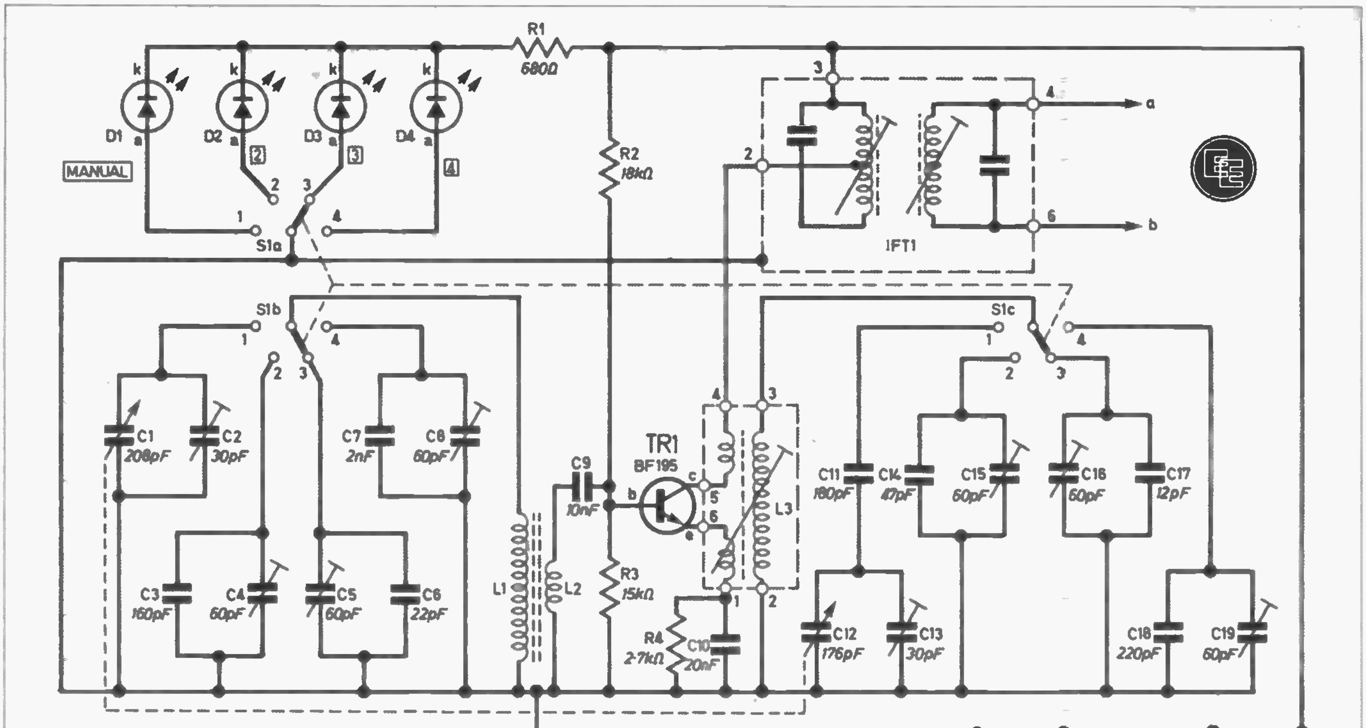
Potentiometers
VR1 22kΩ log. with switch (S2)
VR2 1kΩ miniature vertical pre-set

Capacitors
C1 208pF air spaced variable
C12 176pF air spaced variable
C2 30pF trimmer
C13 30pF trimmer
Jackson 00 gang., 208/176 slow motion with trimmers
C3 160pF silvered micro
C4 60pF trimmer*
C5 60pF trimmer*
C6 22pF silvered micro
C7 2nF silvered micro
C8 60pF trimmer*
C9 10μF ceramic or polyester
C10 20μF ceramic or polyester
C11 180pF polystyrene
C14 47pF polystyrene
C15 60pF trimmer*
C16 60pF trimmer*
C17 12pF polystyrene
C18 220pF polystyrene
C19 60pF trimmer*
C20 10μF ceramic or polyester
C21 0·1μF polyester
C22 0·47μF polyester
C23 0·47μF polyester
C24 10μF 10V elect.
C25 1μF 10V elect.
C26 100μF 10V elect.
* compression type; 30pF, 40pF, or 50pF (max.) will suit.

Inductors
L1, L2 5in medium wave ferrite rod (Denco MW5 FR)
L3 M.W. oscillator coil (Denco TOC1)
1FT1 i.f. transformer (Denco IFT18/465)

Semiconductors
TR1 BF195 silicon *n.p.n.*
TR2 BC147 silicon *n.p.n.*
IC1 ZN414 i.f. amplifier and detector
D1-4 l.e.d. 5mm dia. (4 off-red, green, yellow)

Miscellaneous
B1-4 1·5V cell HP7 (4 off)
S1 3 pole 4 way rotary switch
S2 single pole on/off switch (part of VR1)
SK1 jack socket, 3·5mm
Verobon 75-3009D or similar case, aluminium 5 × 3¾in. Perforated s.r.p.b. 13 × 26 holes 0·15in matrix. 3 knobs. Battery holder (for 4 × HP7) and connector.



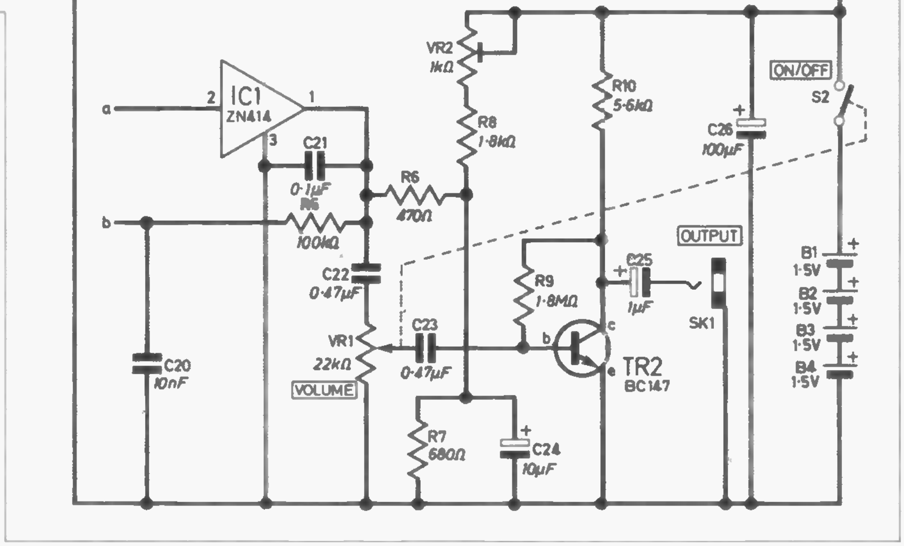


Fig. 1. Circuit diagram of the medium wave radio. The four-position switch S1 provides MW coverage and three preset tuning positions; the last of these is tuned to 200 kHz (long waves).

tor stages, and the audio signal is available at pin 1 of this device.

For a 6V supply it is usually in order to fit 2·2kilohms from the positive line, with R7 being 680 ohm, as shown. The pre-set VR2 would then be omitted and R8 would be 2·2kilohm. However it has been found with such circuits, due to component tolerances (and possibly slight variations in IC1), that a means of adjustment is often worthwhile. For this reason R8 is reduced in value, and VR2 added.

Though this i.f. amplifier needs few discrete components, it provides very good results.

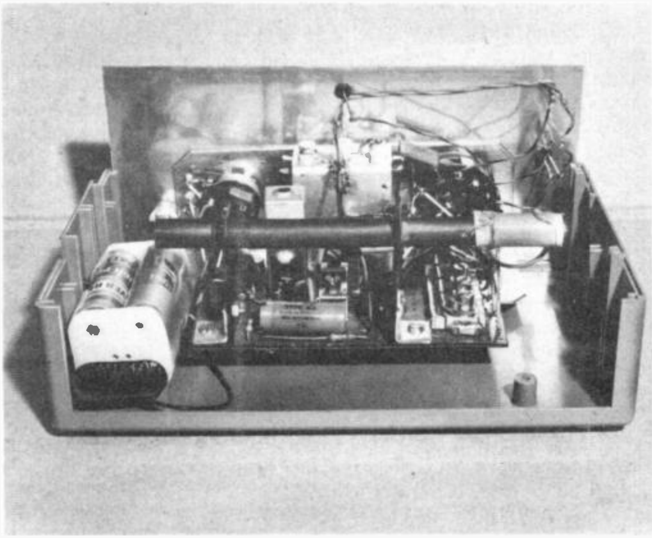
A.F. SECTION

Audio signals are fed via C22 to the audio gain control VR1, and so to the single transistor amplifier TR2. The collector of TR2 is coupled via C25 to an output socket SK1. This stage provides more than adequate volume for headphones. Alternatively the output may be fed to an external audio amplifier via a screened lead.

POWER SUPPLY

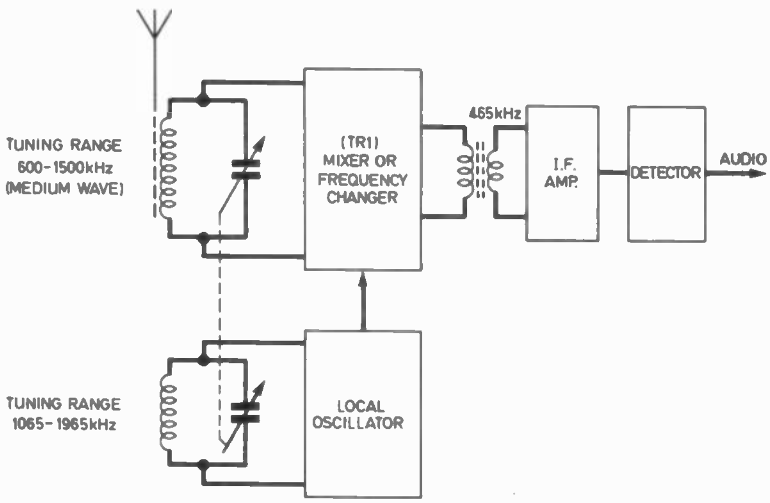
Total current drain of the receiver is about 7mA from a 6V supply. This is readily provided by four HP7 type cells series connected in a holder. These will have a very long life.

If the receiver is always going to be used as a tuner, the supply may if wished be drawn from the amplifier. It is then necessary to connect a



6·1V Zener diode across C26 and to place a series resistor in the positive supply line. With a 400mW Zener, this resistor may be 150 ohm for 9V, 270 ohm for 12V, and 390 ohm for 15V to 16V. A negative power connection must also be provided of course.

HOW IT WORKS



The principle of superhet reception is explained here in simple terms. Reference should be made to the block diagram above, and also to the main circuit diagram given in Fig. 1.

Transistor TR1 is a self-oscillating mixer, or frequency changer. Its purpose is to change the carrier frequency of any station selected by the aerial circuit, to a fixed frequency. The latter frequency can then pass to the section of the receiver having fixed tuning, which is called the intermediate frequency (i.f.) amplifier.

When two different frequencies are present at a mixer or frequency changer, other frequencies are produced. Here, one frequency is that of the wanted signal, obtained from the ferrite aerial L1. The other frequency is produced by the oscillator coil L3, coupled to TR1 emitter and collector by windings provided for this purpose. In the present receiver, the important new frequency obtained from TR1 collector corresponds to the difference in frequency between aerial and oscillator. Examples will make this clear.

Suppose the aerial circuit is tuned to 200kHz, and the oscillator circuit to 665kHz. The difference is 465kHz. So output at 465kHz is obtained from TR1 collector. If now the aerial circuit were tuned to, say, 1,000kHz, and the oscillator circuit tuned to 1,465kHz, the difference is still 465kHz, and the output from TR1 is still at 465kHz. In the same way, the aerial circuit can be tuned to any wanted frequency, and provided the oscillator is always tuned 465kHz higher, the output of TR1 will always be at 465kHz.

With manual tuning, using a two-gang variable capacitor, if the aerial circuit tunes 1,500kHz to 600kHz, then the oscillator circuit needs to tune 1,965kHz to 1,065kHz. That is, 465kHz higher, through the band. This is arranged as accurately as possible by a suitable choice of inductance and capacitor values.

So when all signals tuned in are changed to 465kHz, they can pass to the intermediate frequency amplifier. This does not need to have variable tuning, as it is permanently adjusted to operate at 465kHz. This allows additional tuned circuits, for better selectivity, without the difficulties which would be present if several variably tuned circuits were to be used instead.

All stations received are amplified at 465kHz, and the detector or demodulator follows, to make available the audio signal or programme.

CONSTRUCTION starts here

CIRCUIT BOARD

Components are assembled on a piece of perforated s.r.p.b. On the prototype this has 13×26 holes, 0·15in matrix, see Fig. 2. Make sure the board is large enough for the trimmers and other parts actually used.

Drill holes for L3 and IFT1. Note that pins 1-2 and 5-6 are slightly closer to each other. This arrangement identifies the connections. Also drill holes for the can tags, and under the middle of IFT1, to give access to the bottom core.

Fig. 3 shows point to point wiring under the board. Two tags MC are fitted with $\frac{1}{2}$in 6BA bolts at the corners of the board. These bolts eventually secure the board to the flange of the panel bracket.

Earth the metal cans, top plate tags of trimmers, and other components as shown, to a wire run between the tags. In most places the wire ends of components will be long enough to reach the various points. Elsewhere, use thin wire, with sleeving where needed.

The ferrite rod fits about $1\frac{1}{2}$in above the board. It passes through holes in Paxolin (s.r.b.p.) strips, which are bolted to small angle brackets, see Fig. 2.

Position VR2 so that it can be adjusted from the back.

BEHIND THE PANEL

The front panel is metal, $6\frac{3}{4} \times 3\frac{1}{8}$in (172×80mm) for the case used.

A bracket has to be made from a piece of aluminium about $5 \times 3\frac{3}{4}$in. This is bent at $1\frac{3}{4}$in along one long edge, to take VR1, C1, C12 and S1, as in Fig. 4. The bush nuts and screws for C1, C12 hold the front panel and bracket together, and the circuit board is mounted on the horizontal flange, as previously described, clear of C1, C12.

The remaining wiring can then be carried out. Take a lead from C1, C12 frame tag down to the board MC line wire. This lead supports C14, C17 and C18, see Fig. 4. The aerial section of the switch S1A can be wired, and then the oscillator section S1B, followed by the l.e.d. section S1C. C1 is the variable section nearer the panel, with most plates.

COMPONENTS approximate cost £25

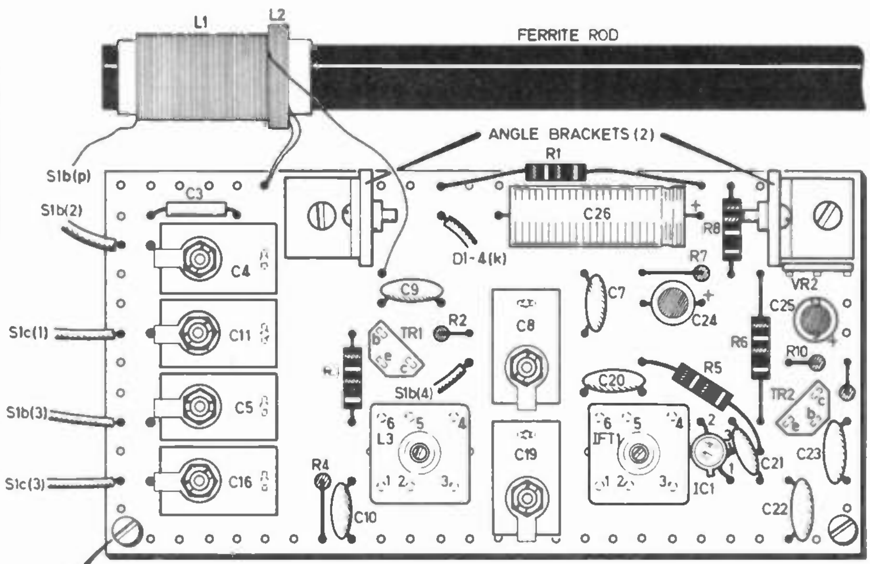


Fig. 2. Top view of the circuit board and the ferrite rod aerial.

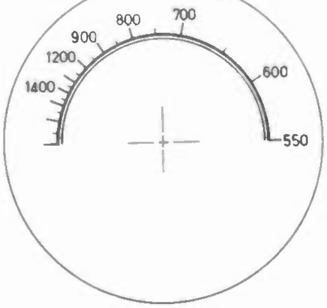


Fig. 5. The calibrated dial of the prototype receiver. Slight differences in the position of these frequency points are to be expected with individual receivers.

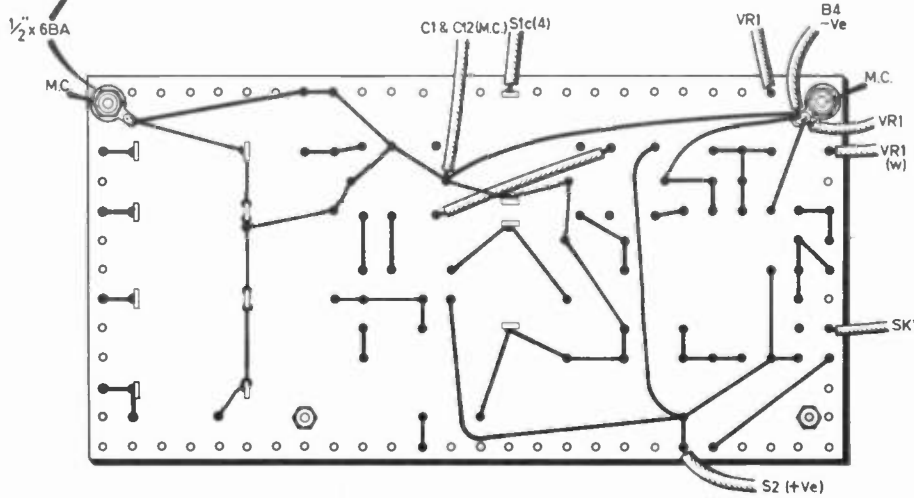


Fig. 3. Underside of the circuit board. Bare wire may be used for the links, except where wires cross, then insulated wire must be used as illustrated.

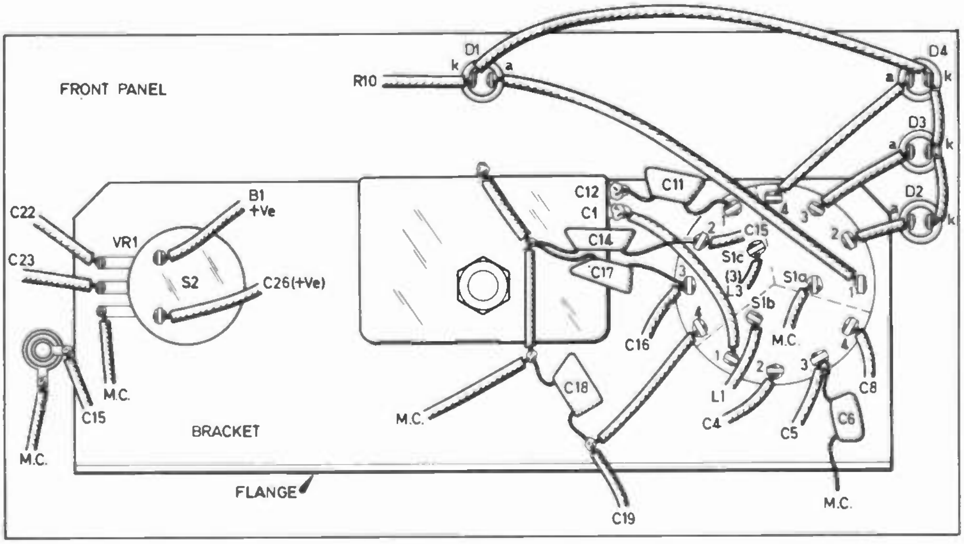
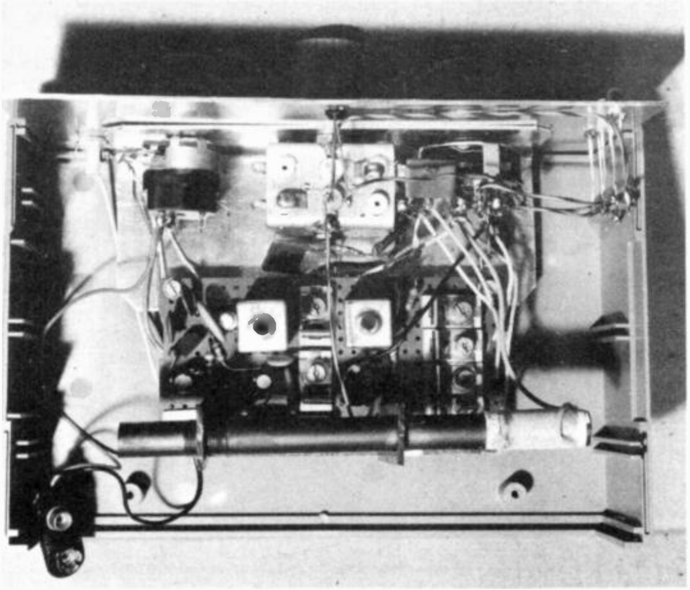


Fig. 4. Rear view of the front panel. The circuit board is secured to the flange of the bracket by two 6BA bolts (these are shown in Fig. 2 and Fig. 3).



The specified ganged tuning capacitor is provided with trimmers. These are designated C2 and C13. If a ganged tuning capacitor without trimmers is used, separate trimmers should be fitted.

Connections to VR1 and the output socket are made as shown. Check the socket is not wired so that output is shorted.

VR2 ADJUSTMENT

Initially, VR2 can be set so that a high resistance meter shows about 1·3V at the side of positive C24. Subsequently, set VR2 for best results. Too low a voltage will reduce sensitivity, while too high a voltage will cause whistles or oscillation. The setting is not very critical.

I.F. ALIGNMENT

IFT1 cores are pre-aligned, and should not be touched until a station has been correctly tuned in. Choose a weak signal, *correctly tuned in*, or rotate the unit for minimum signal pick-up, and adjust top and bottom cores of IFT1, very slightly, for maximum volume.

MANUAL TUNING

Initially position the coil L1 about level with the end of the rod, with C2 and C13 about half closed. Tune in a weak signal correctly with the ganged capacitor C1, C12 nearly open, and adjust trimmers C2 and C13 for best volume.

Now tune in a weak signal with C1, C12 nearly closed, and modify the position of L1 on the rod, for best volume.

Repeat these adjustments a few times, to obtain full sensitivity over the whole manual tuning range.

If it is necessary to change frequency coverage by altering the core of the oscillator coil L3, rotate this *only slightly*. Use a properly shaped tool here and for IFT1, to avoid breaking the cores.

PRE-SET TUNING

After correct operation and alignment for manual tuning, the pre-set tuning adjustments can be made. Proceed as follows: adjust C4 for aerial tuning and C15 for oscillator tuning, at switch position 2, to receive Radio 2. At position 3, adjust C5 and C16 for Radio 3. At position 4, set C8 and C19 for 200kHz long wave, Radio 4.

In some parts of the country LW is not required for Radio 4. The large values at C7 and C18 are then unnecessary, and values up to about 200pF may be used in the aerial position, and up to 100pF in the oscillator circuit, a further MW station.

With the capacitor values given, coverage is around the frequencies listed earlier. There is considerable latitude in both trimmer values and fixed capacitor values. Small values move tuning towards the high frequency end of the band, and larger values allow tuning towards lower frequencies.

For personal listening, medium or high impedance phones (say 500 ohm to 2 kilohm) will allow excellent results.

LETTERS

Something for Everyone

Looking back in previous issues of EVERYDAY ELECTRONICS, I happened to read *Letters* on page 130 of February 1981 issue.

The first two letters were from fellow Aussies. I am ashamed for them and hope you "Poms" don't think we are all as helpless as those two. They will be wanting printed circuit boards for crystal sets next.

The trouble is they are "spoon fed" over here by some Australian electronic journals and, of course, the trade, both of which seems to cater for the lowest common denominator in intellect. I must assure you that there are many over here who can construct without p.c. boards, matrix boards or Veroboard. All of which are pretty useless at h.f. or v.h.f. anyway.

Also interesting was the letter from F. W. Blakeley of Wrexham. I am not quite as old as your Mr. Blakeley, being a mere 73 years of age, and my experience only goes back, in radio, to 1923. I am probably a "Johnny come lately" to him.

I consider EVERYDAY ELECTRONICS an excellent paper for the electronic enthusiast, and although it does dwell a little too much on "gadgets" sometimes; on the whole there seems to be something for everyone. Your "Home Sentinel Unit" in Volume 1 No. 1 was constructed and worked first time. Happily however, apart from testing when first installed, it was never called upon to deter burglars, we did not have any of these light fingered gentlemen around at the time.

On my retirement from the "hassle" of a working life some years ago, the business, and of course all the instruments, was sold, however as is usually the case, a need was found for a few items of test gear.

The first item to be constructed was Mr. Rayner's "Signal Generator" as featured in your September '78 issue. As usual, with most of your projects, it worked first time off.

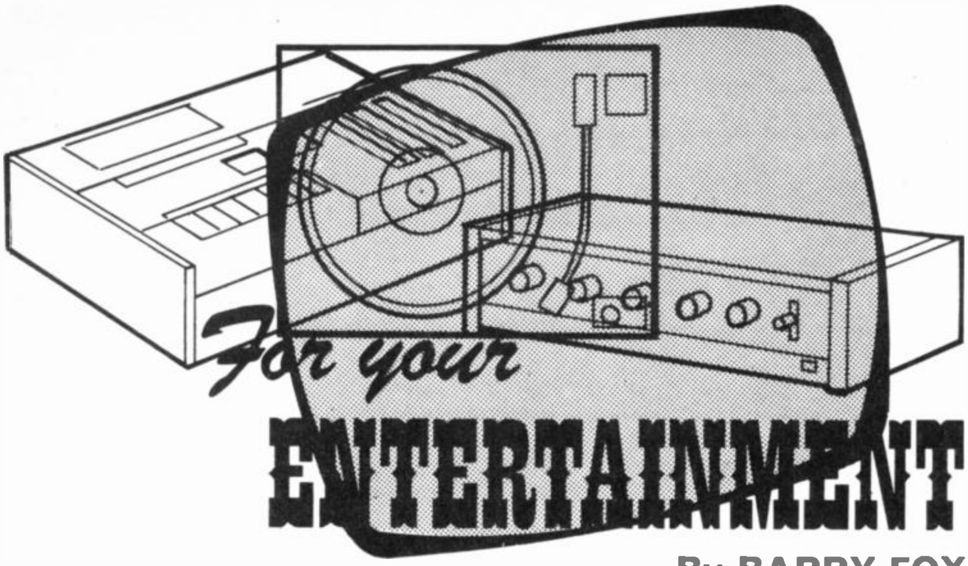
However, due to small wiring differences the calibrated scale was out, and the only way to correct this fault was by fitting trimmers to the coils. Adjusting the coil slugs at the l.f. ends of each band, and the trimmers at the h.f. ends, brought the readings somewhere near. A crystal calibrator was used, together with an all-band radio for setting up. A switch was also fitted to cut out the a.f. modulator when not needed.

Many "old timers" seem to complain about over sophistication of some articles which are published in electronic journals. They are right in this opinion in some respects, as many modern projects are updated versions of previously featured projects. They don't work any better, have more parts which can develop faults, and, their only advantage seems to be in reduced physical dimensions.

A typical example being your "Continuity Tester" featured in your June '78 issue. A better continuity tester was constructed 9 years ago, the components being two surplus transistors and one 6·3V, 0·04 amp flashlight bulb. There are 3 ranges and useful indications can be obtained up to 2MΩ. Four of these were installed at a local transformer factory and have been in constant use for years.

Presumably careful selection of the transistors would result in a performance equal to the unit described in the June 78 issue.

J. Ratcliffe,
Australia.



For your ENTERTAINMENT

By BARRY FOX

This month Barry Fox continues his saga of the "commercialisation" of the Post Office and calls for an amnesty for illicit telephones.

The Beginning

For the Post Office the end of an era, and for the British public the beginning of an era, came on September 12, 1979 when Sir Keith Joseph, Secretary of State for Industry, announced the government's intention of splitting the Post Office into separate sections for posts and telecommunications. He promised consultations "with a view to early relaxation of the Post Office's telecommunications monopoly".

On July 21, 1980 Sir Keith Joseph carried through his promise and told Parliament that legislation was being enacted to let private firms to compete with the Post Office Telecommunication Division (to be called British Telecom) for the supply of telephone equipment. After a transitional period of about three years the Post Office, he said, would retain a monopoly only on the main telephone network and the installation and maintenance of the first telephone in each home and business. "I am sure that one of the reasons for America's greater success has been the freedom available there to entrepreneurs to develop new services and a wide range of equipment associated with tele-communications" Sir Keith told Parliament.

This was the water-shed speech. But even by then the Post Office had been forced to liberalise its attitudes on answering machines. A certification scheme was inaugurated on April 2, 1980. Any person wanting to sell an answering machine on the British market has since that date been able to submit it to the Post Office for official approval. In what some would call a face saving operation the Post Office claimed that this liberalisation followed "in the light of advances in the functioning of the public switched telephone network itself and with improved manufacturing standards"!

Announcement of the answering machine certification scheme was one of the last statements made by the Post Office, because British Telecom was born on May 21, 1980.

The Telecommunications Bill is likely to become law any moment now, a year after it was first introduced in Parliament (November 1980). When this happens British Telecom will hand over responsibility for certifying all telephone equipment (including the answering machines which it currently certifies) to a neutral third party, almost certainly The British Standards Institution. In the meantime it's rewarding to catalogue some of the statements made by BT since its May 1980 birth.

On the very same day as the name change was announced, Peter Benton, then Managing Director, said that the new name was being adopted to "re-inforce staff pride and make clear to our customers that this is a rejuvenated business". This followed a promise made by Mr Benton of what three weeks earlier was still the Post Office that "we are attacking our problems at the roots; we intend to improve the service permanently".

Accepting the Challenge

On July 21, the day Sir Keith Joseph committed the British government to the break-up of the Post Office, Sir William Barlow, Chairman of the PO proclaimed "We are not afraid of the new challenge". Nevertheless on July 31, British Telecom announced they would have to put up the prices of local calls.

This is one area in which we are certainly *not* being brought in line with the North American Continent. Over there local calls are either free or very cheap. Most long distance calls are also far cheaper than in Britain. Even stripped of their monopoly, the Bell company are still able to offer far cheaper call rates than the British Post Office.

In November 1980 publication of the Telecommunications Bill caused the Post Office to say it "accepted the challenge" of free competition. But within just six days there was the tell tale sign of an escape route being prepared. "Neglect of investment and determination in previous years will inevitably leave us with difficulties in some places for a while yet" said Mr. George Jefferson, then Chairman of British Telecom.

In February 1981 British Telecom was forced, by an article in *The Daily Mail*, to acknowledge that Telecom engineers had been taking cash back-handers to install business telephones ahead of others in the queue. BT asked for information "which could help us stamp out these activities". There was, of course, one very simple answer; speed up legitimate installation to eliminate the queue!

Time Wasting

In April 1981 British Telecom finally acknowledged what everyone who made international calls already knew—it is absurdly time-wasting for anyone making an international directory enquiry to have to go through the international operator. So separate directory service was promised for May 1982.

In May 1981 British Telecom again pledged "to improve service" and claimed that the waiting list for telephones had been halved by speedier connection. In June 1981 the Chairman Sir George Jefferson again acknowledged past errors. "We must be more market responsive than we have been in the past" he said. A few days later he announced the creation of a sales force to do something wholly novel for the British Post Office—*sell* telephones. "Until now we have sometimes been hard to find" he admitted.

The signs for the future are good. This year British Telecom will extend its in-house certification scheme from answering machines to other attachments such as facsimile machines and intruder alarms. Within the three years promised by Sir Keith Joseph, the scheme moves on to privately supplied telephones. The only tragedy is that it has taken government pressure to convert our complacent Post Office into something approaching a business enterprise.

Call for Amnesty

One problem remains. This is the plethora of illicit telephones already in use, many of them incorrectly connected by subscribers who have had no where to go for engineering advice.

British Telecom is now sending out a leaflet with all quarterly telephone bills which warn of the dangers to the network, to the service and to individuals. This leaflet repeats the previous threat that British Telecom "will disconnect the telephone service of customers who breach the conditions under which telephone service is provided".

So anyone with an illicit telephone will still not dare ask for help from a British Telecom engineer. When a fault develops on the line they will have to rip out all their illicit phones before calling for service. As often as not this will waste the engineer's time because the fault will usually be on the equipment which has been disconnected.

By the time the certification scheme extends to privately supplied telephones, there could be a million unauthorised connections in Britain. Now, more than ever before, we need an amnesty.

"We must be market responsive" said Sir George Jefferson when addressing the annual conference of the Post Office Engineering Union on June 2, 1981. "Competition will provide many opportunities for us but we must adapt the way we work to make the most of these opportunities".

If Sir George is serious about adaptation, British Telecom must offer an amnesty of technical aid to anyone with an illicit phone connected to the British network.

INTRODUCTION TO LOGIC

PART 10 BY J. CROWTHER

USE OF TRUTH TABLES

Truth Tables are the easiest method of conveying information, or the whole truth, about a gate, or Logic Circuit requirement. Suppose we were told to design a Logic Module which would give a "1" output if:

"*A*, *B*, and *C* were 0, or if *C* was 1, or if *A* was 1, or if *A* and *C* were 1 or if *A* and B were 1, or if *A*, *B* and *C* were 1."

This statement tends to be confusing and could be easily misunderstood. It would be less liable to be misunderstood if it were written in the form of a truth table, Table 10.1;

Table 10.1

Inputs			*Output*
A	*B*	*C*	*S*
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

Table 10.1 shows at a glance what combinations of the inputs are required to give an output at *S*. A Boolean Equation can be derived from the information given in the truth table, this equation can then be simplified and converted into gates as shown previously.

Note

When writing Boolean Equations from truth tables, where $A=0$ in the Truth Table, this is written as *A* in the equation, and if $A=1$ in the Truth Table it is written as *A* in the equation.

example

$\bar{A}\bar{B}\bar{C}$ means *A* AND *B* AND $C=0$

$\bar{A}\bar{B}C$ means A AND $B=0$ AND $C=1$.

Two methods can be used:

Deriving a logic module circuit from a truth table—method 1

Taking the condition when an output is present, that is when $S=1$. The Boolean Equation for Table 9.1 then becomes:

$$\bar{A}\bar{B}\bar{C}+\bar{A}\bar{B}C+A\bar{B}\bar{C}+A\bar{B}C+AB\bar{C}+ABC=S$$

Simplifying we get:

$$\bar{A}\bar{B}(\bar{C}+C)+A\bar{B}(\bar{C}+C)+AB(\bar{C}+C)=S$$
$$\bar{A}\bar{B}1+A\bar{B}1+AB1=S$$
$$\bar{A}\bar{B}+A\bar{B}+AB=S$$
$$\bar{A}\bar{B}+A(\bar{B}+B)=S$$
$$\bar{A}\bar{B}+A1=S$$
$$\bar{A}\bar{B}+A=S$$
$$\bar{B}+A=S$$

This represents an OR gate fed with *A* and *B*, *B* being obtained by passing *B* through a NOT gate.

Therefore the final module is as seen in Fig. 10.1.

This shows that *C* is not needed to obtain the required result, and that the original requirement was unnecessarily complicated.

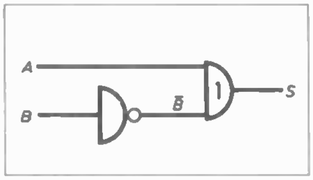


Fig. 10.1. Logic module to realise the truth table above. Shows that *C* is not required to obtain the required result.

Method 2

Taking the condition when there is no output, that is when $S=0$, or the output is $\bar{S}$.

$$\bar{A}B\bar{C}+\bar{A}BC=\bar{S}$$
$$\bar{A}B(\bar{C}+C)=\bar{S}$$
$$\bar{A}B1=\bar{S}$$
$$\bar{A}B=\bar{S}$$

In order to make the equation so that the output is S, add a bar to both sides (see Rule 5 in Part 5).

$$\overline{\bar{A}B}=\bar{\bar{S}}$$
$$\bar{\bar{A}}+\bar{B}=S$$
$$A+\bar{B}=S$$

This gives the same result as Method 1 as would be expected.

In practice the easiest method would be used, that is the second method in this case, as it involves the least number of terms.

APPLICATION OF LOGIC TECHNIQUES

(1) The Equivalent Module, or Exclusive NOR

Symbol

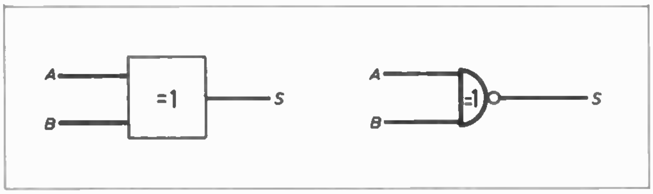


Fig. 10.2. Two common symbols for the EXCLUSIVE NOR gate.

Result

There is an output if *A* and *B* are the same.

Truth Table

Inputs		Output
A	*B*	*S*
0	0	1
0	1	0
1	0	0
1	1	1

Boolean Equation

Take the case when S = 1.

$\overline{A}\,\overline{B} + AB = S.$

This equation represents the logic circuit, shown in Fig. 10.3, containing five gates.

By applying Demorgan's Law we can reduce the number of gates to three:

$\overline{A}\,\overline{B} + AB = \overline{(A + B)} + AB = S.$

This represents the logic circuit shown in Fig. 10.4.

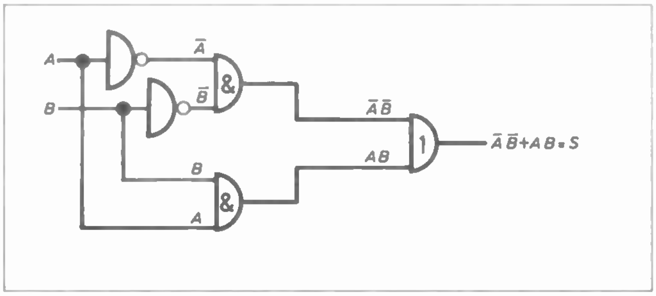


Fig. 10.3. The logic circuit for the above Boolean expression.

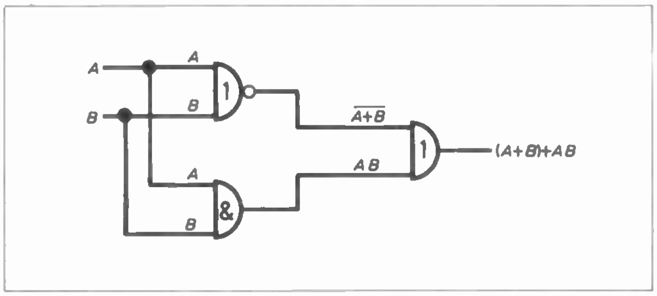


Fig. 10.4. Logic circuit of Fig. 10.3 after applying Demorgan's laws.

(2) The NOT Equivalent Module, or Exclusive OR

Symbol

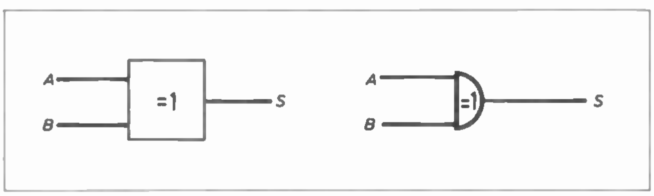


Fig. 10.5. Two common symbols for the OR gate.

Result

There is an output if A and B are not the same.

Truth Table

Inputs		Output
A	B	S
0	0	0
0	1	1
1	0	1
1	1	0

Boolean Equation

Taking the case where S = 0

$\overline{A}\,\overline{B} + AB = \overline{S}$

$\overline{\overline{A}\,\overline{B} + AB} = S$

This represents the logic circuit in Fig. 10.6 which contains five gates.

By applying Demorgan's theorem we can reduce the number of gates to three:

$\overline{\overline{A}\,\overline{B} + AB} = \overline{\overline{A}\,\overline{B}}\,(\overline{AB}) = (\overline{\overline{A}} + \overline{\overline{B}})\,\overline{AB} = (A + B)\,\overline{AB}$

This represents the logic circuit in Fig. 10.7.

An alternative arrangement of logic gates to give the NOT Equivalent Module could be obtained as follows:

Boolean Equation

$\overline{A}\,\overline{B} + AB = \overline{S}$

$\overline{\overline{A}\,\overline{B} + AB} = S$

$\overline{\overline{(A + B)} + AB} = S$

This represents the logic circuit in Fig. 10.8.

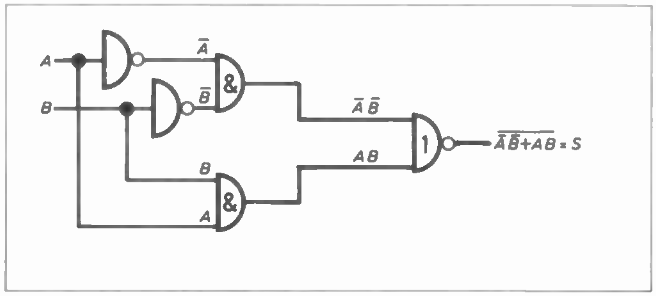


Fig. 10.6. The logic circuit for the above equation and truth table.

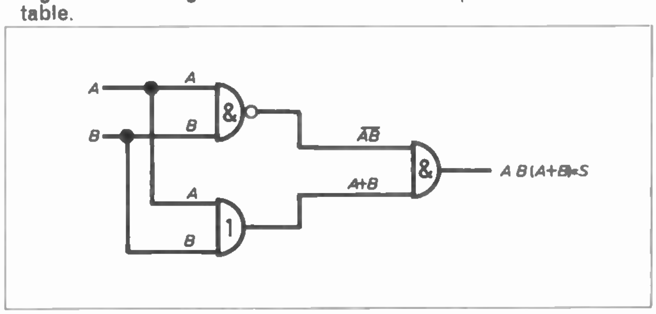


Fig. 10.7. The reduced logic circuit after applying Demorgan's laws.

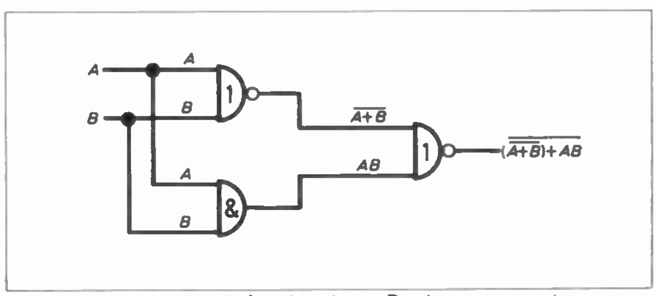


Fig. 10.8. Logic circuit for the above Boolean expression.

It can be seen that this circuit is the same as the Equivalent Module followed by a NOT gate, showing that the NOT Equivalent Module is the inverse of the Equivalent Module.

Because of this there is no need for manufacturers to make both EXCLUSIVE OR and EXCLUSIVE NOR modules. In practice manufacturers rarely made EXCLUSIVE NOR modules, but tend to make EXCLUSIVE OR and follow it by a NOT gate if an EXCLUSIVE NOR is required.

TO BE CONTINUED

Everyday News

Electronic post - a Royal Mail Service

To underline its position as a world leader in postal communications, The Royal Mail has started "field" trials on a computer-based service which can send mass mailings by wire, to be printed and enveloped in a distant centre for delivery through the mail the next morning.

Anyone who has read some of those old postcards found in Antique shops will have admired the postal service of that era. It was quite common to see comments like "I will be around *this* afternoon at 4 o'clock."—Such was the confidence in the local delivery service.

The sole reason for mentioning the above is to highlight the latest technological development that brings the 80's system that much nearer the 20's and 30's "same day" delivery.

Called Electronic Post, this latest advance for Britain's postal service is the first system of its kind to use a combination of computer transmission, laser printing and postal delivery to transmit, print and prepare items for delivery to many thousands of addresses. The service is potentially capable of handling any kind of multiple items, such as statements, bills and invoices.

At London's Electronic Post Centre at Mount Pleasant, postmen oversee printing, folding and enveloping of letters transmitted from the Manchester computer centre.

A London operator keys in customer's identification to be transmitted to the computer in Manchester. Meanwhile, magnetic tape containing the customer's mailing list is loaded into the computer prior to transmission

London and Manchester are the two centres chosen for the first trial service and will cover about seven million addresses. This represents about a third of all the 22 million delivery points in the UK.

Mr. Kenneth Baker, Minister of State for Industry and Information Technology, joined with Mr. Ron Dearing, Post Office Chairman, to watch the first transmission of a letter from a major commercial mailer being reproduced in bulk, enveloped and addressed ready for delivery the following morning to addresses in London and Manchester.

The System

The system was developed by the Post Office and GEC Mechanical Handling with help from GEC-Marconi Electronic.

A company produces letters, statements or invoices on a magnetic tape, complete with address and postcode. A computer processes the information and transmits it to the appropriate distant centre.

At the receiving end the items are printed by a laser printer. The letters are then automatically addressed, enveloped and delivered using the normal delivery service.

To counter violence and vandalism the whole fleet of London's 5,500 buses are to be equipped with two-way radio in the driver's cab.

CLASSIC

Covert Local Area Sensor Systems for Intruder Classification (CLASSIC) is a new intruder alarm system for front line use by the British Army. Detection is by seismic or other sensors radio-linked to a monitoring point.

Developed as a private venture by Racal-SES Ltd, CLASSIC is already the subject of negotiations with overseas customers as well as having been purchased by the British Ministry of Defence.

COAL RADAR

A novel application of radar is determination of the level of coal in underground vertical storage bunkers. The radar system only suitcase-sized will measure the level of coal within five per cent.

The system has been developed by Marconi Avionics in conjunction with the National Coal Board's Mining Research and Development Establishment.

UK Computers for USA

The United States Air Force and Navy have standardised on a British range of air data computers for re-equipping 27 variants of 10 types of aircraft from jet fighters to large military transports.

Marconi Avionics won the design and prototype contract, worth five million dollars, against fierce competition from US suppliers.

ATE Winner

The newest COMPACT automatic test equipment (ATE) from Marconi Avionics had clocked up over £1 million of orders before its first public demonstration just before Christmas.

It is just half the size of the original COMPACT system developed in 1973.

Government funding of £77 million is promised as the British share in the European Space Agency's Large Satellite due for launch in 1986.

Prime contractor is British Aerospace with Marconi as one of the British subcontractors.

—ANALYSIS

NOTHING NEW

Technological advance means better, cheaper or easier ways of doing things, often all three. In the process it is inevitable that some people experience damage to their interests but the majority benefit. This has been true throughout history. It is still true today.

The invention of the power loom put the cottage weavers out of business. Transatlantic flight killed the passenger steamship. Mass-produced cars injured the classical craft of coach building. The home washing machine led to the disappearance of the steam laundry. Radio and TV shut down the music halls. These are just a few of hundreds of examples.

Man is distinguished in his power of reason and invention and every invention has led to change but never more so than in this age of the electronics revolution. In principle this is no different, say, than the innovation of steam power in the last century. What is different, however, is the speed of change. Whereas in the past we have more or less successfully adapted to change over a period of years, today we seem to have been overtaken by it.

Speaking only of the United Kingdom this is partly our own fault. We have been inventive enough but slow to exploit technological advances in general industry. We preferred old work practices and resisted the new.

An exception is the electronics industry itself, the cradle of invention and unafraid in exploiting every means of improving its own performance. The result is that leading companies like GEC-Marconi, Plessey, Ferranti and Racal have all done well in world markets throughout the recession and have full order books.

The industrial robot, the electronic office, computer-aided-design, automatic draughting machines are all aids to efficiency and economy in the supply of goods and services. They may not always be welcome but to fail to embrace these and other innovations is to eventually put ourselves out of business altogether.

Brian G. Peck

X-Stream

Preliminary orders worth £750,000 a year in rental have already been received for advanced new digital communication services which British Telecom is to launch during the year, as part of its contribution to promoting information technology in the UK.

The new services, to be marketed under the general title "X-Stream", are made possible by the steady spread of digital transmission through Britain's cable, microwave and optical fibre network.

Digital techniques are now being increasingly used instead of traditional analogue transmission as part of Telecom's £2 billion a year modernisation programme.

BBC Radio Birmingham is now to be known as BBC Radio WM, the local radio service for the West Midlands.

WORLD FIRST

Britain achieved a world first recently when the Duke of Kent inaugurated a fully computerised cargo system at Harmondsworth near Heathrow.

Called ACP80, air cargo processing in the 80s, it serves Heathrow and Gatwick airports and is claimed to be the world's most sophisticated airport system handling both exports and imports.

Robots Make Robots

The Department of Industry is reported as examining a £20 million project for a robot factory with robots building robots.

Participation by private industry is anticipated and the factory, if it comes to fruition, will be a working demonstration of the changing nature of production engineering as well as producing urgently needed robots.

BASICally Sinclair

Coinciding with ICL's announcement of major new developments employing Sinclair technology and Sinclair BASIC, Sinclair Research reports that worldwide sales of the ZX81 computer now exceeds 250,000.

With ZX81 monthly production running at 50,000 units, over 60 per cent for export, Sinclair claims to have more units installed than any other personal computer manufacturer worldwide, firmly establishing Sinclair BASIC as the most widely used microcomputer programming language.

Commented Clive Sinclair, "With so many units in the field, supported by a large number of new projects using Sinclair BASIC, we believe our language now merits serious consideration by the industry as the 'standard', if confusion, particularly in the educational field, is to be avoided in the future."

ICL has announced a new range of ZX81 software with orders for more than 100,000 packages already received from W. H. Smith's, the only licensed ZX81 retailer, and is to develop further software in support of both the ZX81 and future products using Sinclair BASIC.

ICL is also in advanced discussion with Sinclair to develop an ultra low cost integrated terminal/digital phone work-station employing Sinclairs' flat tube technology and Sinclair BASIC.

Prestel Delivers the Goods

A new information service for freight forwarders and exporters, entitled "Mini Cargo Tariff", has been launched by British Airways Cargo on Prestel, British Telecom's viewdata service. Radio Rentals Contracts are supplying approximately 150 colour viewdata terminals for the system.

British Airways have invested substantial sums in producing a 2,000 page database which provides freight forwarders with up-to-the-minute details of rates, dates, loads, restrictions and class for the shipment of goods. The information is available to BA agents on a "Closed User Group" basis to ensure system security.

Agreement in principle has been reached between Gould Advance Ltd, and Ashcroft Electronics Ltd, for the acquisition of Gould Components Ltd by Ashcroft.

All-Digital Desk

The BBC is to order an all-digital 48-channel sounds mixing desk from Neve Electronics International of Royston. A prototype desk has been installed at the BBC in Broadcasting House.

When the production version of the desk is delivered it is believed that it will become the world's first comprehensive all-digital sound mixing desk to enter operational service in broadcasting.

STICKY BREAKERS

Watch out for illegal CB rigs carrying stickers claiming immunity from prosecution.

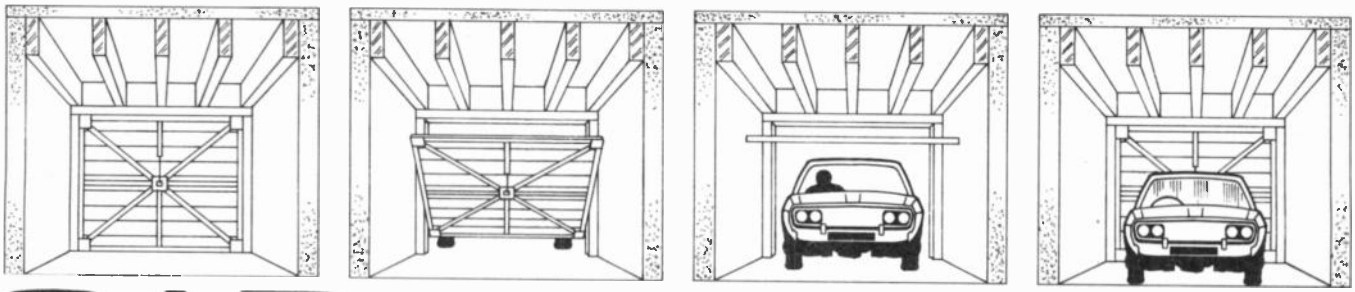
The Home Office have just issued this advice to the CB trade and prospective buyers.

"Don't be misled by unfounded rumours claiming that the use of illicit 27MHz AM sets will be legalised; the Government has no intention of making any changes to the new legal 27MHz FM CB service".

The warning to traders and CB users follows a large number of inquiries to the Home Office concerning rumours of AM legalisation, and reports of AM sets carrying labels stating that the apparatus cannot be used "until April 1982" or similar wording.

Any such stickers or labels which imply pending changes in the UK CB service are quite simply hoaxes.

AUTOMATIC



GARAGE DOOR

PART TWO

BY P. HORSEY

LAST month having discussed the suitability of converting an up-and-over type garage door and described the Ultrasonic Remote Control system (Transmitter and Receiver), we now move on to the Control Logic/Power Supply unit and installing the mechanics.

POWER SUPPLY

The Control Logic and Receiver units are powered from the same p.s.u., a rectified and smoothed 12V supply, built into the Control Logic case. For the circuit diagram see Fig. 7. The mains supply is connected via switch S1 and fuse F1 to the transformer, T1. The live line is supplied via switch S2 to the relay contacts RLA1 and RLB1 (shown in Fig. 8), the neutral line also being connected to TB2/5, then to the appropriate point on the motor. A neon indicator with integral resistor, LP1, is connected across the transformer primary.

TRANSFORMER

The transformer used in the prototype was a 6VA type, with two 4·5 volt secondary windings wired in series to provide 9 volts. The 600mA output was more than required and 300mA would be sufficient.

The nominal 9V a.c. output from the transformer is rectified by bridge rectifier D1 to D4. The voltage developed across smoothing capacitor C1 is about 12·7 volts, but in practice may be higher according to the regulation of the transformer. The exact working voltage of the circuit is unimportant, hence no regulating components are employed. Capacitor C2 provides high frequency de-coupling, and switches S3 and S4 form the safety cut-out elements, S3 being the microswitch at the base of the door and S4 the tension cut-out switch, discussed later.

CONTROL LOGIC CIRCUIT DESCRIPTION

The logic circuit is based on a CMOS integrated circuit type 4081, a quad 2 input AND gate, see circuit diagram Fig. 8.

The input from the receiver circuit is connected via diode D5 to the input of gate IC1a, capacitor C3 suppressing unwanted noise. As the voltage at the input of IC1a rises, the output will go high, with feedback occurring via R3. Thus a Schmitt trigger is formed, the output from IC1a rising very quickly to full potential. R2 will reduce the input to zero, when no signal from the Ultrasonic Receiver is present. IC1a may also be triggered by push-button switches S5 and S6. These switches are the MANUAL DOOR OPEN/CLOSE controls.

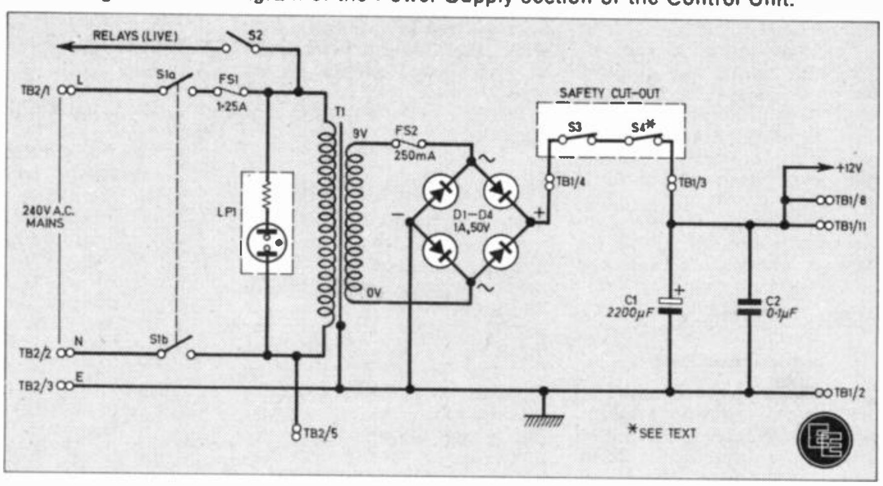
The output from gate IC1a is coupled by C4 to the next stage. This capacitor along with R4 forms an integrator to reduce the output to a single pulse, otherwise a confused state of re-triggering would occur in the next stage of the circuit.

The finished electronic control units. The Power Supply is built into the Control Logic case.

OPEN DOOR

Assuming the garage door is at present closed, the normally closed contacts of S7 are now open, and S8 is closed. Hence pin 6 of gate IC1b is at logic 1 (high) and pin 12 of gate IC1d is low. Thus gate IC1d cannot switch on, and we will not consider its associated circuit at this point.

Fig. 7. Circuit diagram of the Power Supply section of the Control Unit.



IC1b produces a high output upon receiving the pulse from D6. Feedback occurs via R9, and gate IC1b stays on. This will turn transistor TR1 on thus illuminating the SYSTEM ON indicator, an l.e.d., D14.

Current also passes through R15 to C7. This charges in about two to three seconds, turning on TR3. As will be apparent later, the circuit is arranged so that the motor may be instantly reversed when closing the door. The delay provided by C7 charging prevents any damage to the motor by allowing a "pausing time" before reversing.

Transistor TR3 activates the relay RLA with D12 providing protection against the back e.m.f. Relay RLA switches on the "open door" connection to the motor.

When the door is fully open, it operates microswitch S8, which now opens. Thus gate IC1b is turned off and diode D10 ensures that the base of TR3 is rapidly returned to zero volts, thus quickly stopping the motor.

CLOSE DOOR

Microswitch S7 is now closed, and S8 open. A pulse from C4 will now trigger gate IC1d and this channel operates exactly as described above.

The delay provided by C8 may not seem necessary, but there are certain circumstances where the motor may be required to suddenly change from "open door" to "close door", and C8 provides a suitable margin of safety.

When the door is fully closed, microswitch S7 opens, and gate IC1d is turned off thus stopping the motor.

PRIORITY OPEN

It can be seen that whilst the door is in motion, both microswitches are closed and thus both gates IC1b and IC1d are able to trigger if another pulse is received from C4. Thus both relays could operate together, causing problems (to say the least!) for the motor.

This arrangement is deliberate, since it offers the opportunity to instantly reverse the door whilst closing, and also enables the door to be set in motion from a mid way position, if it has stopped for some reason.

In order to prevent TR3 and TR4 switching on together, IC1c has each input connected to the output of IC1b and IC1d respectively. If both these gates turn on together, IC1c goes high, turning on TR2. This reduces the feedback voltage via R13 to zero, thus switching off IC1d. Resistor R12 limits the flow of current from IC1a into TR2, without affecting the rest of the circuit.

All this happens so quickly that the relay RLB does not operate, leaving relay RLA to safely open the door.

If the door is already closing, and a pulse is received from C4, the same action will follow, with IC1d turning off, whilst IC1b switches on. Diode D11 will ensure that the motor switches off rapidly, whilst C7 will delay the switching-on process. Thus the closing door stops, pauses, then re-opens.

It will be apparent that a pulse received whilst the door is opening will have no effect on the operation of the door.

Capacitors C5 and C6 suppress noise picked up from the microswitches.

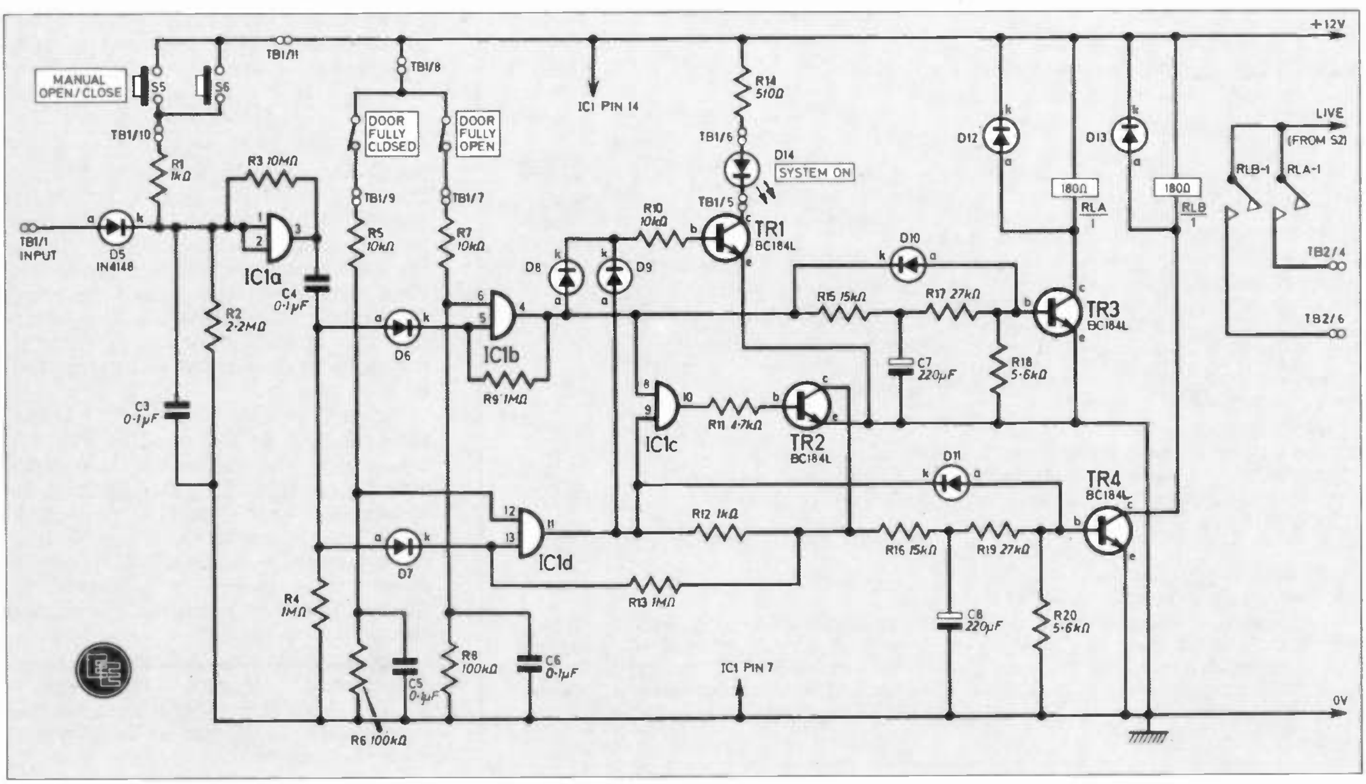
TRIGGERING THE CIRCUIT

The logic circuit may be triggered from the car, with the ultrasonic link as previously described, or alternatively a positive triggering pulse may be generated by S5 or S6 and any number of push button switches may be wired in parallel to these for additional control.

One push switch, S5, should be mounted near the door, inside the garage, and is used to close the door after parking the car inside. Another push switch, S6, may be mounted inside the house to open the door, or if too inconvenient regarding the necessary wiring, it could be mounted outside the garage. However, this may be considered an unacceptable security risk, whereby a key switch or electronic combination switch could be used.

Note that both these switches will open *or* close the door as will the ultrasonic remote control system.

Fig. 8. Circuit diagram of the Control Logic Unit (Power supply shown in Fig. 7).



CONSTRUCTION starts here

CONSTRUCTING THE POWER UNIT AND CONTROL LOGIC

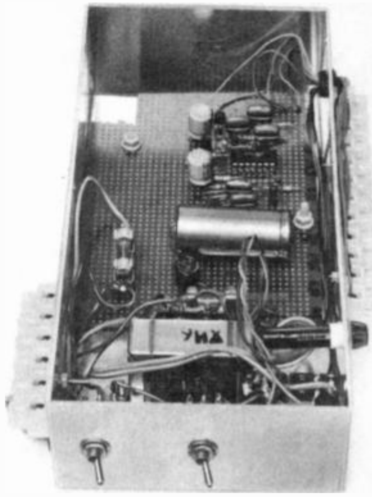
The circuit requires a piece of stripboard measuring a minimum of 46 holes by 22 strips, however a larger piece measuring 50 holes by 34 strips was found to be more convenient in the prototype. It must be securely mounted bearing in mind the various mains connections in close proximity.

A rebate in the stripboard is cut out as shown in Fig. 9 to provide access to one of the case mounting screws. Drill the three stripboard mounting holes where shown, and break the tracks (20 in all) as indicated in the second part of Fig. 9.

Mount the i.c. holder, wire links, resistors and fuse clips where indicated, followed by the non electrolytic capacitors. Take care to fit the diodes, transistors, bridge rectifier and electrolytic capacitors the correct way round. Finally, connect the flexible leads and fit the CMOS i.c. taking great care not to touch the pins during fitting, as it is static sensitive.

THE CASE

An aluminium case measuring 205 × 100 × 50mm was chosen, and this provided sufficient space for the stripboard, transformer, relays, neon mains indicator LP1 and switches S1 and S2. Carefully arrange these items before drilling, to ensure that adequate space is left especially in the region of the neon and switches.



View inside the Control Logic case.

The relays need to be securely fixed in position and it may be necessary to fabricate a small bracket to do this.

Mark the hole positions for the stripboard (3 off), case mounting holes (2 off), transformer (2 off), neon, switches (2 off), leads (at least 4 holes), and terminal blocks. Drill the holes and fit rubber grommets to all holes requiring leads to pass through.

The positions shown for the main components given in Fig. 10 are intended as a guide, in practice great care must be taken in ensuring that there is no danger of any components breaking loose and shorting out. **REMEMBER THAT THERE IS LIVE MAINS PRESENT IN THIS ENCLOSURE.**

Mount the transformer, switches, neon, terminal blocks and circuit board, passing the appropriate leads neatly through a grommet. Note that the mains fuse is mounted on an insulated 20mm board mounted fuse holder, secured with a fixing screw. On the prototype, rubber grommets were fitted over the screws securing the circuit board, between the board and the aluminium case, to prevent the circuit board being short circuited by the case.

Fit the relays, and wire up the mains circuit as indicated in Fig. 10. The mains and motor terminal strip may be mounted outside the case as shown, in which case a protective cover should be fitted, or inside for extra security against an electric shock. It is extremely advisable to sleeve *all* solder joints on the mains side of the circuit.

Finally, complete the low voltage connections. Ensure the mains EARTH lead is securely fixed to the case, using a tag on a transformer mounting screw.

COMPONENTS

COMPONENTS approximate cost £28·70

Resistors

R1, 12	1kΩ (2 off)
R2	2·2MΩ
R3	10MΩ
R4, 9, 13	1MΩ (3 off)
R5, 7, 10	10kΩ (3 off)
R6, 8	100kΩ (2 off)
R11	4·7kΩ
R14	510Ω ½W
R15, 16	15kΩ (2 off)
R17, 19	27kΩ (2 off)
R18, 20	5·6Ω (2 off)

All ¼W carbon ± 5% except where stated

Capacitors

C1	2200μF 25V elect
C2-C6	0·1μF polyester (5 off)
C7, 8	220μF 25V elect (2 off)

Semiconductors

D1-D4	1A, 50V bridge rectifier
D5-D13	1N4148 small signal silicon (9 off)
D14	0·2 inch red l.e.d. high brightness, wide angle
IC1	4081 CMOS quad 2 input AND gate
TR1-TR4	BC184L silicon *npn* (4 off)

See Shop Talk page 95

Switches

S1	d.p.d.t. miniature toggle
S2	s.p.d.t. miniature toggle
S3, 7, 8	s.p.d.t. lever actuated heavy duty microswitch (3 off)
S4	See text
S5, 6	Push-to-make, non-latching (2 off)

Miscellaneous

T1	Mains transformer, 9V, 0·6A secondary
LP1	Mains neon indicator with integral series resistor
F1	20mm anti-surge, 1·25A (for the motor specified)
F2	20mm 250mA
RLA, RLB	Relay, 180Ω 12V coil, 2 normally open contracts rated at 240V, chassis mounting (2 off)
TB1	Terminal block, 12 way, 2A
TB2	Terminal block, 6 way, 2A

Stripboard, 0·1 inch matrix, 50 holes by 34 strips; aluminium case size 201 × 100 × 50mm; case size 72 × 50 × 25mm (2 off, for S5, 6); fuse holder, 20mm chassis mounting (for F1); fuse clips, p.c.b. mounting (2 off, for F2); 14 pin d.i.l. i.c. holder; small grommets (5 off); equipment wire; rubber sleeving; solder tags; board mounting hardware (M3 or 6BA); heavy duty wire, 16/0·2 (for mains wiring).

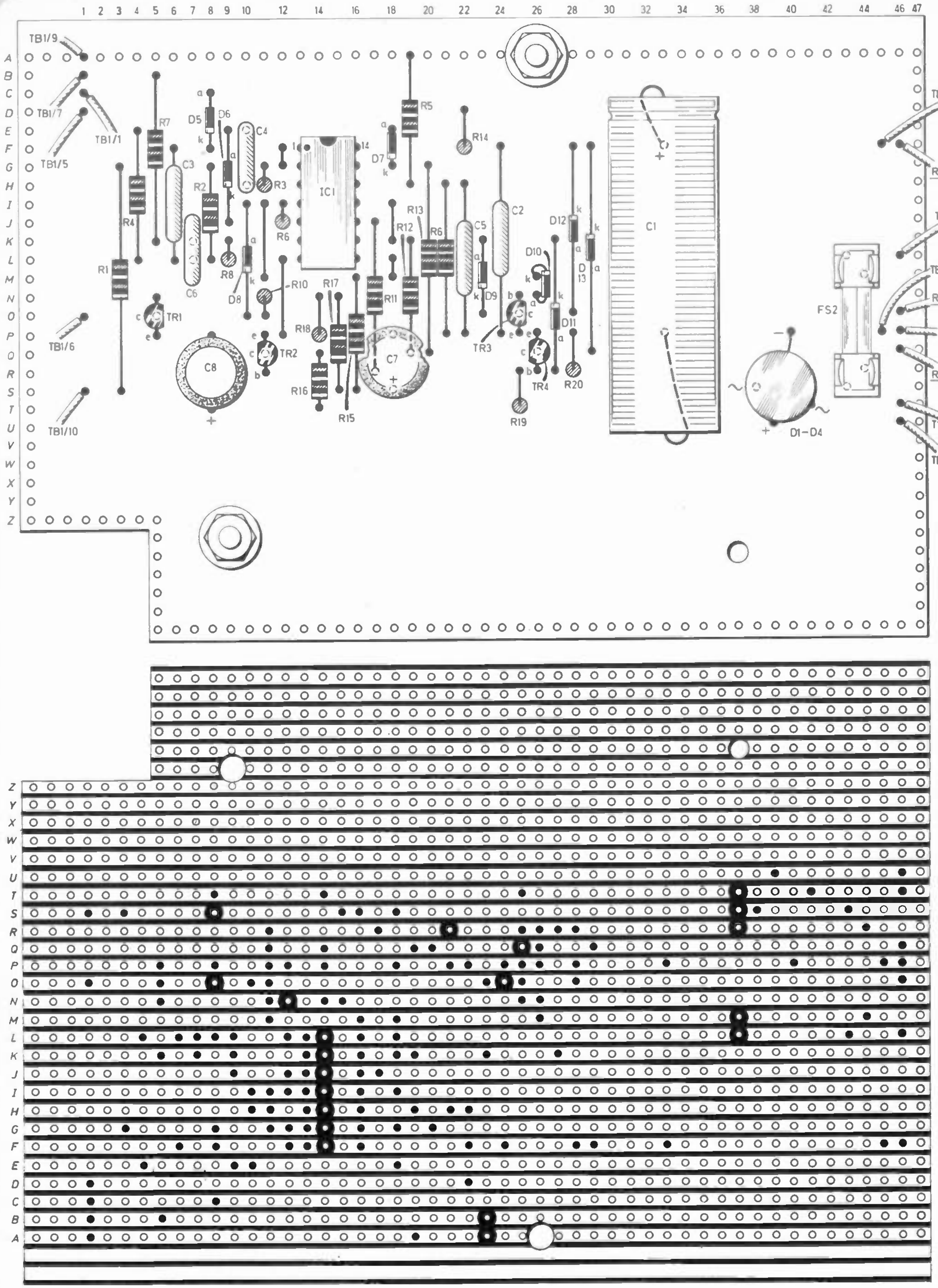


Fig. 9. Component board layout and track breaks for the Control Logic Unit.

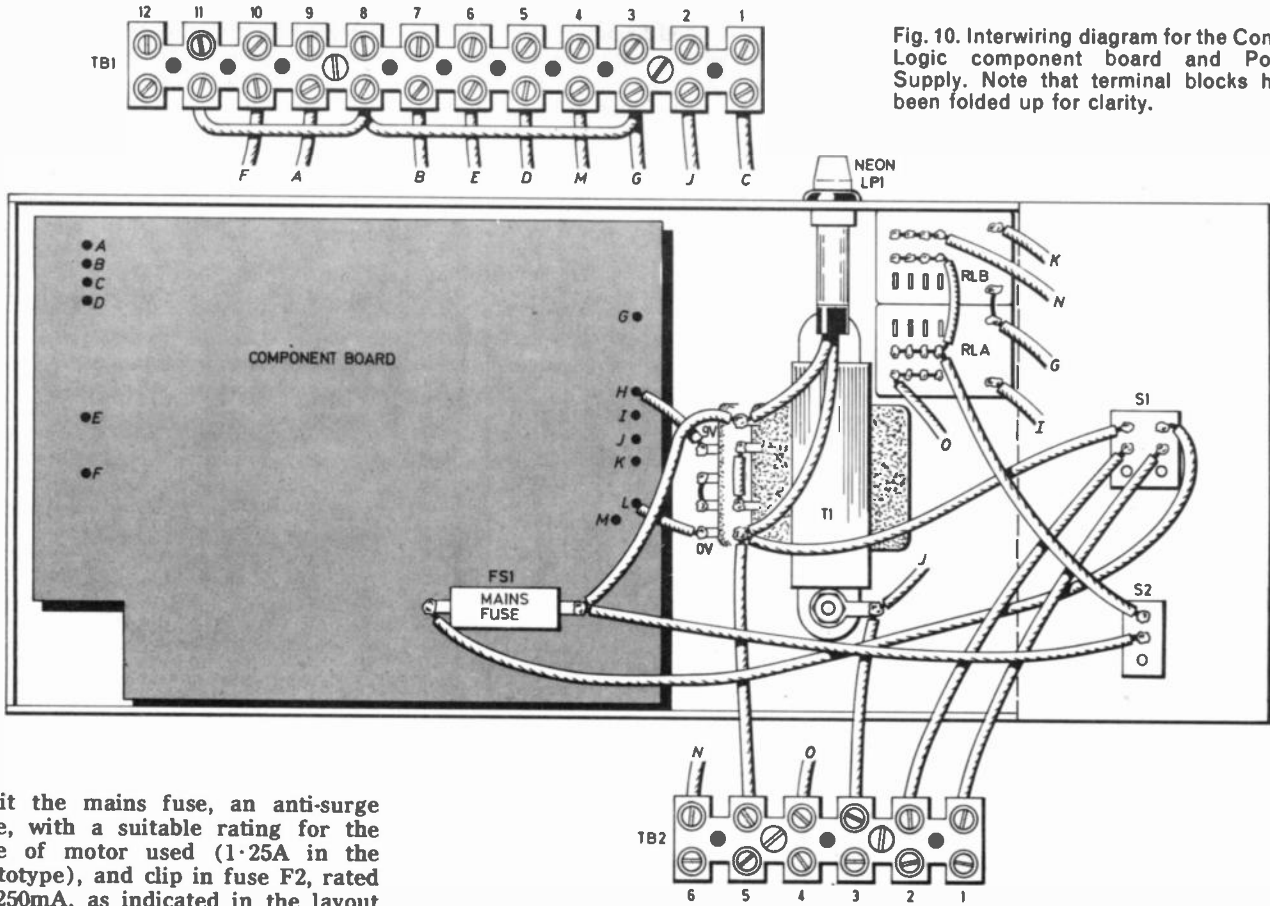


Fig. 10. Interwiring diagram for the Control Logic component board and Power Supply. Note that terminal blocks have been folded up for clarity.

Fit the mains fuse, an anti-surge type, with a suitable rating for the type of motor used (1·25A in the prototype), and clip in fuse F2, rated at 250mA, as indicated in the layout diagram, Fig. 10.

TESTING THE LOGIC

Connect a voltmeter set to the 20V d.c. range across TB1/4, the positive output from the rectifier and TB1/2, 0V. Connect the mains, and switch on. The meter should read 12 to 16 volts.

Now wire D14, an l.e.d. across TB1/5 and TB1/6 ensuring correct polarity, the cathode, k, to TB1/5. Connect a short wire to joint TB1/3 and TB1/4 and then join TB1/7 with TB1/8 (to represent the DOOR FULLY CLOSED switch, S7).

Using a piece of flexible wire, join TB1/10 to TB1/11 for a moment. This represents the MANUAL OPEN push-button switch, S5, being activated and the l.e.d. should light. About two to three seconds later, the OPEN DOOR relay, RLA, should activate

Remove the link from TB1/7. The l.e.d. and relay should instantly switch off. Join block TB1/8 to TB1/9 and re-join TB1/10 to TB1/11 for a moment. The l.e.d. should again light and three seconds later the 'CLOSE DOOR' relay, RLB, should activate.

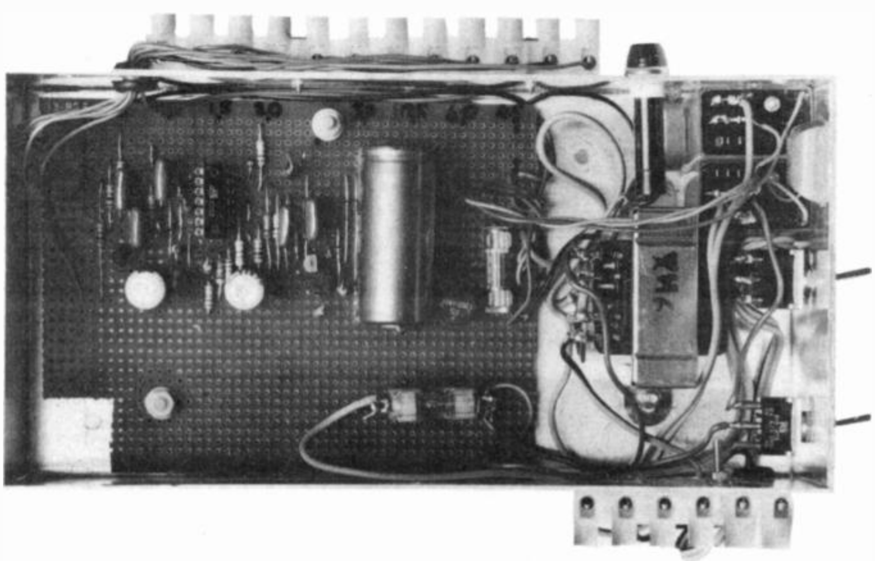
Remove the link from TB1/7 and the l.e.d. and relay RLB should switch off. Now join TB1/8 with both TB1/7 and TB1/9 (representing the door *half* open). Again join TB1/10 with TB1/11 for an instant. The l.e.d. should light, but only relay RLA should activate, NOT both relays.

Repeat one or more of these tests, activating the circuit by connecting TB1/11 to TB1/1, input instead of TB1/10 (this will represent the Ultrasonic Control system activating the Control Logic).

If the circuit does not perform correctly, take voltage measurements throughout the circuit, using the circuit description as a guide. Note that a logic one (high) should produce a voltage nearly equal to the supply, and a logic 0 (low) should read nearly zero volts. Check that the components are fitted the correct way where applicable, and that the BC184L transistors are not confused with BC184 types, which have a different lead arrangement.

Assuming all is well, connect the ultrasonic receiver positive power lead, 0 volts and output wire to TB1/3, TB1/2 and TB1/1 respectively. It should now be possible to trigger the circuit with the Ultrasonic Transmitter.

Control Logic Unit with lid removed to show component board, power supply and relays. Note that this prototype has the non-preferred mounting of TB2 on the outside of the case.



MECHANICAL ASSEMBLY

The system works as follows: (note that all *item* numbers referred to are given in Fig. 11). With the door closed, the electronic control system receives the command to open from either the Ultrasonic Remote Control (*item 4*) or the push-button switches (*item 9*). The solenoid (*item 8*) will then activate to release the lock mechanism and the motor (*item 1*) will unwind the cord thus raising the door since it is counterbalanced towards opening.

To achieve this bias towards opening, a system of pulleys and weights (*item 10*, see also Fig. 2(d) last month) is attached to the door and to overcome the initial inertia (that is, reluctance to move) when raising the door, a cord secured to the roof joists by springs (*item 5*) "catapults" the door backwards by means of a bracket (*item 9*) fixed at the top of the door. This is providing a force in direction *A* shown in Fig. 2(a), discussed last month.

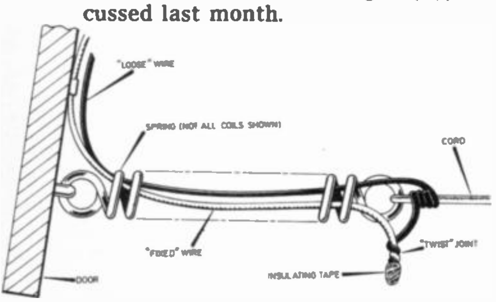


Fig. 12. Method of constructing tension cut-out switch, S4 *(item 11, Fig. 11)*.

A microswitch, S8, not shown in Fig. 11 but mounted outside so as to activate when the door is fully raised, signals for the motor to stop.

CLOSING

Upon receipt of the command to close the door, the motor will reverse, hence winding up the cord and lowering the door.

Microswitch S7 (*item 7*) will stop the motor when the door is fully shut.

FAIL-SAFE SWITCHES

A large microswitch, S3 (*item 12*), is fixed in position at the base of the door, such that it activates if it touches any object during the descent of the door. A piece of rubber or plastic sleeving may be slipped over the lever to protect the car, and the switch should be carefully positioned to ensure that it operates correctly.

Should any other fault occur which would prevent the motor switching off when the door is closing or fully closed, the tension cut-out switch, S4 (*item 11*), comes into being. This is made with a pair of thin insulated wires pushed through the spring which connects the main driving cord with the door. One wire is "loose" (that is, not fixed firmly at the garage door end) with its other end fixed to the cord. The other wire is secured to the door, allowing enough slack in the wires to enable the spring to expand in normal use. The other end of the secured wire is twisted around the wire attached to the cord, with the two ends stripped, twisted, and then insulated with tape. See Fig. 12.

As the spring stretches in normal use, the join should hold. Under fault conditions the spring will stretch well beyond its normal limit, and the fixed wire will disconnect at the twisted join, thus disabling the system.

MICROSWITCHES

A small lever microswitch, S7, must be fixed to signal the logic control circuit when the door is fully closed. It should be screwed to the wooden frame about 500mm from floor level such that when the door is fully closed, it is activated.

A similar microswitch, S8, is also used to signal the fully open position. It must be mounted outside the garage, near the top of the frame, and be activated when the door reaches the end of its travel. A small piece of plastic may be used to protect the switch from direct rain, or preferably it should be encased with only the lever protruding.

A certain amount of experimentation will be required to find the ideal locations of these switches so this is largely left up to the constructor.

OPENING MECHANISMS

To initially open the door, arrange two large nails or screws in the garage roof joists sufficiently high to clear the door. Fit two springs and a piece of cord tightly between the nails as shown in Fig. 11. Attach a metal bracket to the inside of the door, so that as it closes, it presses against the cord. The tension in the cord should initially open the door sufficiently to allow it to slowly rise. The nails should be fixed at about 250mm back from the door frame, but the exact position must again be located by trial and error.

WEIGHT AND PULLEYS

To raise the door to the fully open position, a system of pulleys are employed whereby the point on the door which runs vertically in a "track" up the side of the frame is linked, via a cord, to a weight. This is illustrated in Fig. 2(d) and Fig. 11.

It is possible that the door may already be fitted with a counterweight or powerful spring in which case no further weights need be added. If not then fix the two pulleys to a roof joist as shown at one edge of the door, feed the cord through and attach a weight (we found 4kg to be sufficient) to one end, the other end fixed to the door at the aforementioned point, as shown.

The length of cord, optimum weight and best suited mounting positions are ideally established by experimentation.

ELECTRIC MOTOR

At the heart of the system is the electric motor, and this will probably be the most expensive item. The motor used in the prototype was a reversible mains motor, complete with gearbox.

COMPONENTS

Mechanical Components

Springs	Type 1—Extension, approx. 300mm long, 15mm dia. with looped ends to attach cords (used for closing the door).
	Type 2—Extension, approx. 100mm long, of the type used in spring balance scales (for the counter balance weights).
	Type 3—Extension, approx. 100mm long, about half the strength of type 2 (two required, for the initial opening mechanism).
Weight	4kg counterwight (8 to 9lbs) however this may vary and in practise will need to be adjusted to suit.
Pulleys	2 required, of the type available at most builders yards.
Brackets	Type 1—mild steel strip approx. 200 × 20 × 1·6mm (for initial opening mechanism.
	Type 2—approx. 100 × 100 × 1·6mm (2 off required for mounting baseboard to garage wall).
Base	400 × 300 × 25mm chipboard or plywood sheet.

Electro-mechanical Components

Motor	Fracmo 240Va.c. reversible motor and gearbox, output speed 56r.p.m., output torque 50lbs/in.
Solenoid	240Va.c. type, optional if lock is required.

Miscellaneous

Nylon cord, approx. 10kg minimum breaking strain, about 10m required; metal disc to prevent cord slipping off gearbox spindle; 2 large nails or screws; assorted nuts, bolts, washers and screws for installation.

This list is intended primarily as a guide and due to the nature of the system and the enormous variation in design of garage doors, it is quite likely that the project will have to be tailored to suit individual needs.

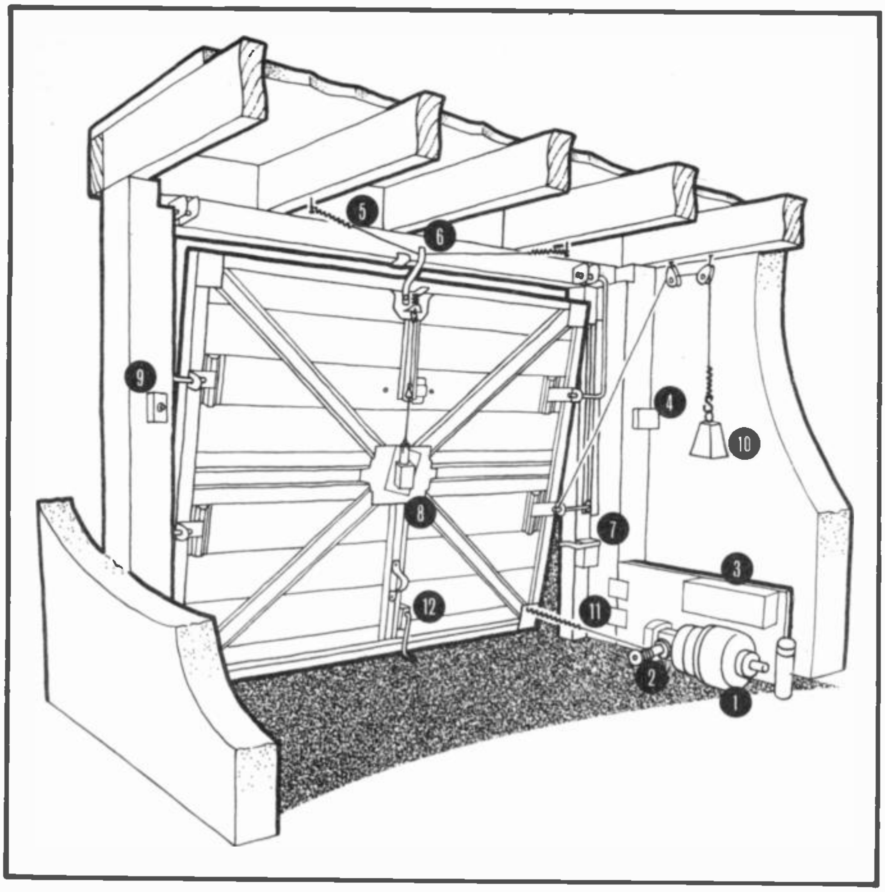


Fig. 11. Cut-away drawing of the garage showing the locations of the major mechanical components and electronic units.

ITEMS LIST FOR FIG. 11

1 240V mains reversible electric motor
2 Gearbox and winch
3 Control Logic unit
4 Ultrasonic Receiver unit (transducer is mounted in the door frame)
5 Initial opening mechanism
6 Top bracket
7 Door fully closed switch, S7 (the door fully open switch, S8 is mounted outside the garage at the top of the frame)
8 Lock solenoid
9 Manual open/close push-button switch, S5
10 Pulley/weight counterbalance system
11 Wind-up cord/spring incorporating the safety cut-out switch, S4
12 Obstruction safety cut-out switch, S3

The motor employed was a Fracmo type, with an output shaft running at 56 rpm and a more than adequate torque of 50lb/in.

A piece of wood measuring 400×300mm may be used to mount the motor and the Control Logic circuit. The motor is bolted to this wooden base, which can then be fixed vertically to the wall at the correct angle. See photograph for layout.

Ensure that the motor winding shaft has no rough edges to cut the cord and drill a small hole in the end of the shaft to take a self-tapping screw to secure a circular disc of metal. This will prevent the cord slipping off the end of the shaft.

Drill and de-burr a hole in the metal disc, so that the cord may be pushed through and fastened. The other end of the cord should be fixed to the door via a spring to even the tension. Leave the cord slightly slack, in the fully open position to enable a few turns to be wound on the shaft.

Fix the wooden base vertically to the garage wall near floor level, and at the correct angle so as to allow the cord to wind neatly onto the shaft.

SOLENOID DOOR LOCK

Lock designs vary even more than garage doors, and again it is impossible to give exact details. A 240V mains solenoid is used to unlock the door, and ideally it is to be linked to the existing lock, so that the door may still be unlocked by key in the event of a mains or system failure.

The solenoid used in the prototype was wired across the "door open" motor connections. It was bolted to the garage door in the centre below the lock release plunger. A piece of strong, heavy gauge steel wire linked the solenoid plunger with the lock release mechanism, so that the lock was released as the solenoid energised.

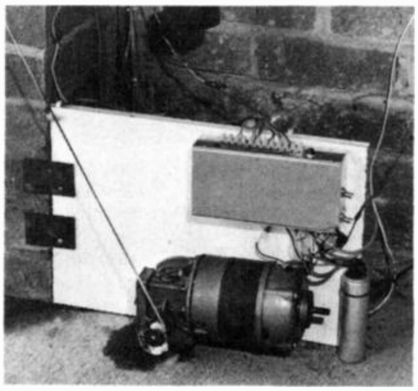
HIGH BRIGHTNESS L.E.D.

A hole should be drilled right through the door frame just below the microswitch, S8, to house the high brightness l.e.d., D14. Insulate the long wires joining the l.e.d. to the Control Logic, before pushing the device fully into the hole, with the wires emerging inside the garage.

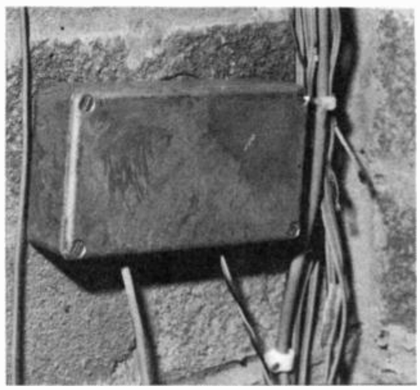
A piece of red transparent gel glued in front of the l.e.d. will greatly improve visibility in strong light, or alternatively a complete l.e.d. indicator with lens etc may be purchased.

RECEIVING TRANSDUCER

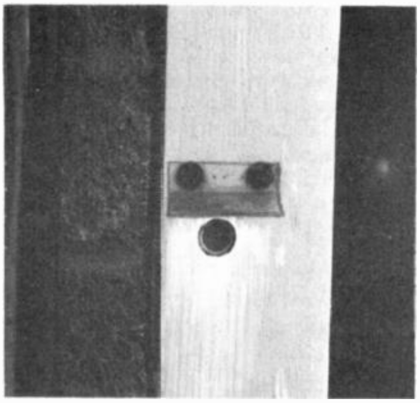
Park the car in front of the garage, and drill a hole into the garage door frame for the receiving transducer,



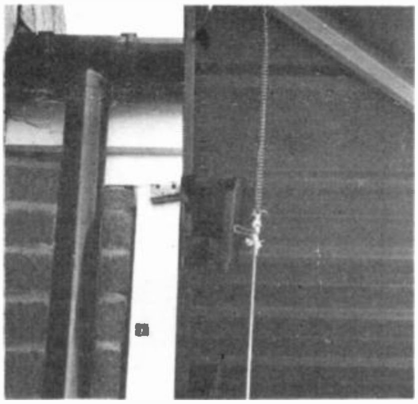
Motor, gearbox and Logic unit (*items 1, 2 and 3*) on baseboard.



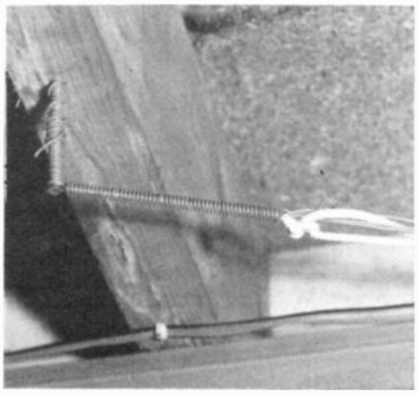
Ultrasonic Receiver (*item 4*) mounted on inside wall.



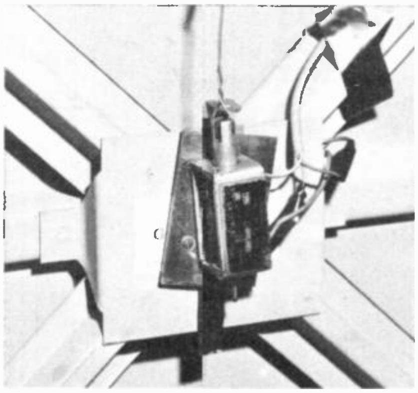
Receiving transducer (*part of item 4*) mounted outside in the door frame.



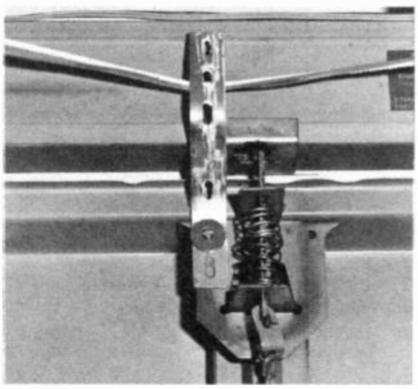
Door fully open switch, S8 (*not shown in Fig. 11*).



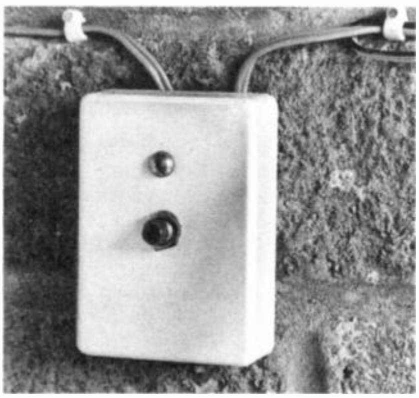
Part of the initial opening mechanism (*item 5*).



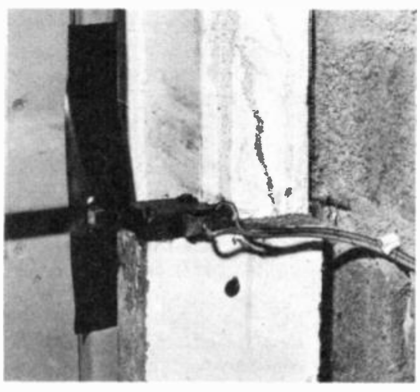
Solenoid unlocking mechanism (*item 8*).



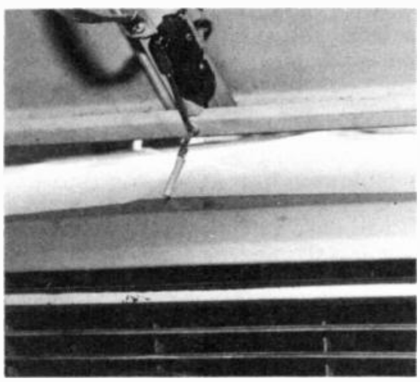
Top bracket (*item 6*).



Manual open/close switch, S5 (*item 9*) mounted on inside wall.



Door fully closed switch, S7 (*item 7*).



Obstruction safety cut-out switch, S3 (*item 12*) shown actuating on bonnet.

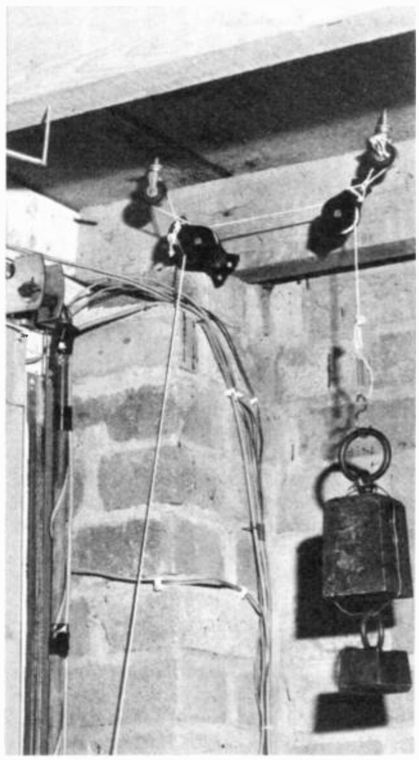
X1, so that it will line up with the transmitter. This hole should be wide and deep enough to flush mount the transducer, and a small hole should be continued into the garage for its lead. A small piece of stiff plastic may be fixed just above the transducer as a rain shield.

Mount the receiver unit on the garage wall near the transducer, and wire it in with the screened cable.

TRANSMITTING TRANSDUCER

The transmitter unit and transducer must be securely mounted inside the engine compartment of the car, such that the transducer has a direct line of sight through the front grille. Note that ultrasonic transducers are fairly directional, and mount the unit at a suitable angle to align with the receiving transducer embedded in the door frame.

A piece of very thin plastic (for example Cling Film) may be used to protect the transmitting transducer from dirt and water. It will reduce the output slightly, but is virtually essential bearing in mind the adverse conditions with which it must contend.



Pulley and weight system (*item 10*). Note that the front most pulley is mounted in the roof as close as possible to the door frame without fouling the hinge struts, the rear pulley clearing the moving weights away from the corner support.

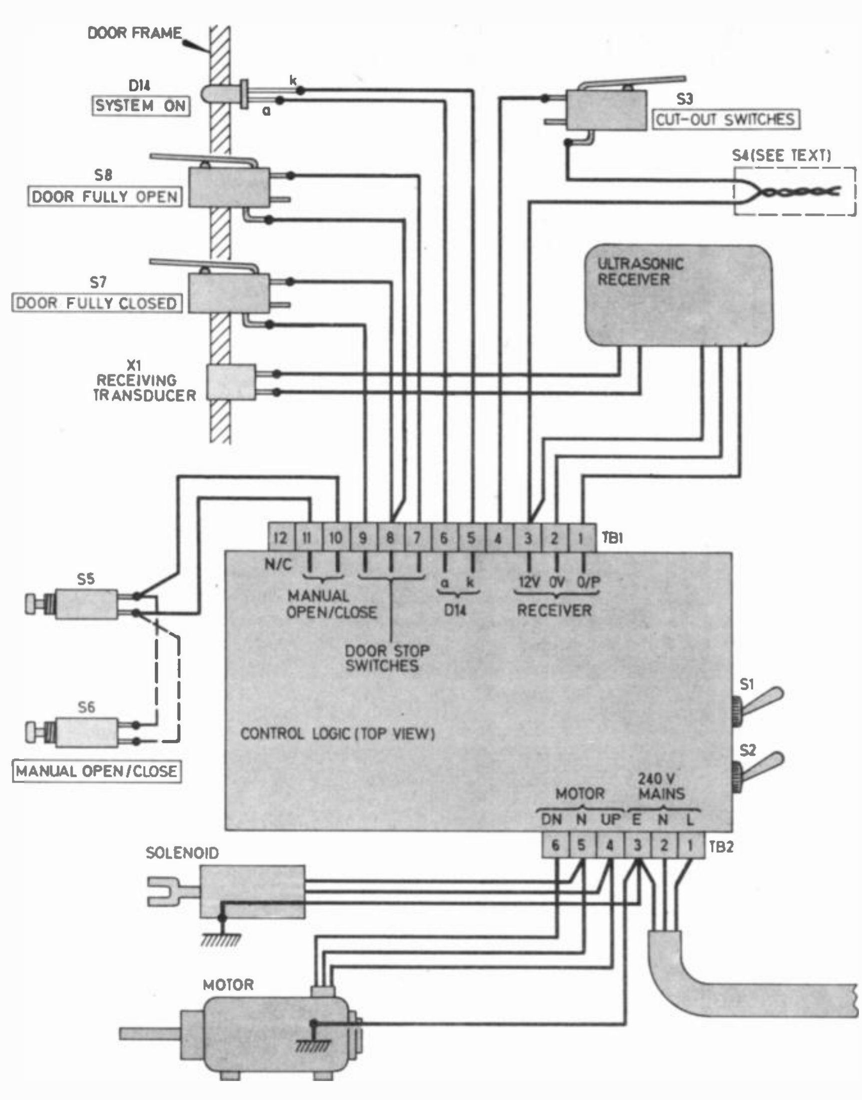


Fig. 13. System wiring diagram giving all interconnections for installing the Automatic Garage Door. Note that it is not to scale (see Fig. 11 for layout).

Having fixed the transducer and transmitter unit, mount the push button inside the car, and connect it with the transmitter.

Alternatively, the transmitter can be built as a hand held unit with the transducer and switch mounted into the same case as the circuit board and therefore can be used from any vehicle.

POWER CUTS

Unless the garage is accessible through a rear door, some provision should be made in case of a mains power failure, which would, to say the least, be inconvenient! Depending upon the type of spring used, it may be possible to simply inch the door open just enough to allow the spring to be unhooked. Alternatively the spring could be fixed to the door by means of a bolt which may be unscrewed, if necessary, from the outside.

WIRING

Having fitted all the various components, the wiring can commence. The wiring diagram, Fig. 13, used in conjunction with Fig. 11, shows all connections.

Start with the Ultrasonic Receiver, the output, 0V and 12V rails going to terminals 1, 2 and 3 respectively, on TB1, Control Logic.

Continue by wiring the microswitches S7 and S8, the l.e.d. D14 and the manual open/close pushbutton switches S5 and S6. As these connections are all in pairs, twin cored cable of the type used for doorbell installation is ideal.

Where possible, run all wires along the same route to assist in lacing them together when completed. All joints to be sleeved after soldering.

Now we move on to the emergency cut-out switches S3 and S4, wired from terminals TB1/3 and 4. As both these switches are mounted on the moving door, the wires must be carefully routed via the hinge struts and great care taken to prevent the wires being severed by any moving parts.

MAINS WIRING

When wiring the mains side of the circuit, exercise extreme caution when dealing with the potentially lethal voltages involved. **Remember that a garage is a damp environment with a large amount of exposed metal, so on no account at all should any mains terminations be exposed to the elements or enquiring young fingers!** The importance of this cannot be overstressed.

For these reasons, TB2 must either be a completely insulated type or mounted inside the Control Logic case with all wires fed through *grommeted* holes. Also all metalwork, the door, solenoid frame and the motor housing *must* be properly earthed (by a firmly bolted connection).

For the solenoid wiring, the same precautions must be taken when routing the leads as for the fail-safe switches, as this too is mounted onto the door.

When it comes to the motor connections, follow the manufacturers instructions supplied, remembering that the neutral connection is common, the UP (or "open") will be forward and the DOWN (or "close") will be reverse.

When all wiring is complete, form the wires into a neat bundle and secure them to the door frame or masonry where necessary. Then vigorously check all wires and terminals both visually and with the aid of a continuity tester before applying any power to the circuit. If all is well, the system is ready for a trial run.

IN CONCLUSION

As may have become evident in the description of the automatic garage door, it is extremely difficult to give exact details and dimensions due to the enormous variety of door types and hinge design. However, we hope to have given you enough inspiration to develop the idea to suit your own particular needs, having shown how it can be done.

The system illustrated is very much a prototype and has room for improvement, but it does work and very well too. So come on all you budding Heath-Robinsons, armed with the necessary electronics, I am sure even a shuttered type door could be adapted! ⌑

RADIO WORLD

By Pat Hawker, G3VA

News Gathering

In television broadcasting one of the continuing problems is that of providing "links" back to the studios for pictures of news events from places to which there are no permanent broadband circuits. This can be accomplished today by means of transportable satellite terminals, such as the one built by the IBA in 1978 or the more recent BBC unit.

But, at least in Europe, these are still experimental systems, although used from time to time for operational broadcasts from the Channel Islands, a North Sea oil rig and as a temporary link between Madeira and Portugal. There is still no European "domestic" satellite system that includes transponders dedicated to this type of work, and even when this does happen the equipment and satellite costs seem likely to remain quite high.

One of the unanticipated "hazards" of electronic news gathering (ENG) stems directly from the compact size and light weight of the expensive equipment. In the turmoil of news gathering it is sometimes difficult to keep an eye on equipment costing many thousands of pounds. One team recently lost its small colour camera and portable tape recorder and is beginning to believe that ENG stands for "easily nicked gear".

Slow-Scan

It has always seemed surprising to me that more use has not been made by the broadcasters of high-quality "slow-scan" television systems capable of providing a succession of still pictures over narrow-band radio links or even the public switched telephone system. In the 1950s, various "cable TV" systems were developed both by the BBC and ITV for sending rather jerky black-and-white film across the atlantic, but with the coming of *Intelsat 1 ("Early Bird")* these were thankfully abandoned. But even today, with the worldwide satellite system, quite a lot of news reports, for example, consist of a telephone voice set against a "library" photograph of the correspondent or the city concerned.

Yet the development of digital frame stores and digital synchronisers during the past few years could result in much improved slow-scan systems, and this type of approach is now being used in Germany. Brunswick Technical University has developed a process for transmitting colour photographs via the public switched telephone network to allow weather maps to be sent to the Frankfurt television production centre.

The picture is viewed with an ordinary television camera and is displayed on a domestic receiver. The colour image from the camera is stored in a digital memory and then transmitted slowly over the telephone network. Each picture takes 20-100 seconds, depending on the quality required, although only 5 seconds are needed for a less clear picture for recognition purposes.

British Telecom at their Martlesham research centre are also developing various forms of "narrow-band" television. Radio amateurs have used both black-and-white and colour slow-scan television for a considerable time, but are satisfied with results rather different from the high-quality pictures sought by broadcasters.

Military ingenuity

The very first contact entered in my post-war log was with SV1EC in Athens on February 27, 1946. In the current issue of *Mercury* the journal of the Royal Signals Amateur Radio Society, vice-president Major General (retd) Eric Cole, CB, CBE, former Director of Telecommunications, War Office, SU1EC and G2EC, tells the story of how SV1EC came on the air.

As Chief Signals Officer, Land Forces, Greece in 1945-46 he arranged, after the German evacuation of Crete, for a large consignment of their signals equipment to be sent to Athens. But while looking it over a 30lb generator fell on his foot, resulting in a stay in Hassani Military Hospital.

To while away the time he had an HRO communications receiver installed beside his bed and found to his surprise that, although the amateur bands were still nominally closed, a lot of stations were already jumping the gun on 7MHz. The Corps transmitters, some miles from the hospital, included a number of much-prized American BC610 transmitters (the military version of a Hallicrafters pre-war amateur transmitter). An "order-wire" and keying line were soon installed.

In his capacity as a national telecommunication authority he allotted himself the call SV1EC and was soon working stations all over the world. British amateurs were re-licensed for 1·8 and 28MHz only from January 1, 1946 and soon afterwards British Service personnel in the Mediterranean area were permitted to use four letter callsigns, beginning XA, on the amateur bands.

On the Beam

A few years later, General Cole, while living in a black of flats in Mayfair showed similar ingenuity and determination when objection was taken to his roof-top aerials. He devised a system of three aerials, including a 28MHz rotary beam, that could all be erected and dismantled at short notice, during darkness or when they were unlikely to be observed by censorous eyes.

At other times all poles and wires were dismantled and could not be seen from the ground 80ft below.

New Emissions

For many years the various types of radio emissions have been classified internationally as part of ITU's Radio Regulations: A1 for CW, A3 for a.m telephony; A3J for s.s.b. with fully suppressed carrier; A5 for television, and so on. But now the old order changeth and is giving place to new.

As a result of the 1979 World Administrative Radio Conference a revised list officially came into operation on January 1. What was A1 now becomes A1A; A3 becomes A3E; F1 for r.t.t.y. becomes F1B. In a rather more radical change s.s.b. becomes J3E; f.m. telephony becomes F3A; vestigial-sideband, amplitude-modulated television is C3F.

In front of these basic classifications a further set of hieroglyphics can, when required, be used to indicate the bandwidth of the emission. This is now written according to a code in which the frequency designation is used as a "decimal point": thus 0·1Hz becomes H100; 400Hz is written 400H; 2·4kHz becomes 2K4; 1·25MHz is 1M25; while 5·5GHz would be written 5G5.

Satellite TV

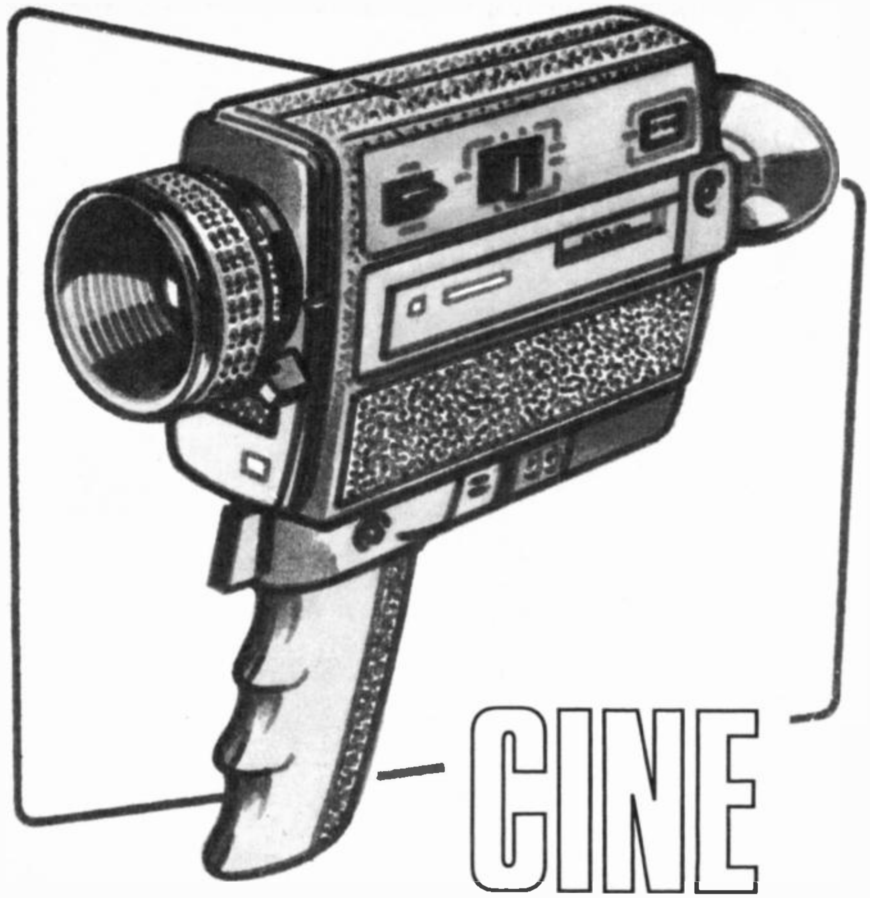
Despite much talk, the outlook for UK direct-broadcast satellites (DBS) is still confused. Britain is to pay a one-third share (£77 million) towards the £230 million cost of the European Space Agency's *L-Sat* project which plans to put a large satellite capable of carrying a high-power DBS transponder into geostationary orbit in 1986. But this will be at 19 degrees West, and not the allotted position for a fully operational UK DBS satellite at 31 degrees West.

The *L-Sat* transponder may in fact be used for a Pan-European system under the aegis of the European Broadcasting Union which has been offered experimental use of a DBS transponder on *L-Sat* free of charge.

With the support of broadcasters in the UK, Austria, Belgium, Greece, Ireland, Israel, Italy, Malta, The Netherlands, Spain, Switzerland, Turkey and Yugoslavia, EBU are to make feasibility studies this year (1982) using lower-power distribution satellites. But although these will include transmission of many TV programmes it is not intended that these should be available to the public.

In the meantime there is a growing feeling that before DBS can flourish some way must be found of overcoming at least some of the barriers that make it difficult to provide television programmes across frontiers. This applies particularly to the vital differences in transmission standards and particularly those between the PAL and SECAM colour systems.

One proposal for overcoming this problem has come from IBA engineers, an ingenious system called MAC (Multiplexed Analogue Component). This system, if used for satellite transmission, would provide high-quality pictures, in a universal form more suited to the characteristics of satellite transmission.



CINE Interval Timer & Frame Counter

BY L. A. PRIVETT

PRODUCING special effects with a cine camera can be aided by using one or both of the circuits in this article. These are not normally found on medium priced cine cameras.

The obvious use for the Interval Timer would be in time lapse cine, for example, the opening of flowers, fast moving clouds or simulation of early black and white comedy films.

The Frame Counter has rather a different use in as much as mode of operation is shorter but it is still very useful, for example, the inclusion of a Matte, such as a laser shot from a spaceship could be fired on the film where you want it. Using the Frame Counter at the beginning of the first exposure it will tell you the number of frames that have been taken. A backwinder may then be used to rewind the film to the precise position where the second exposure is to take place.

CINE SOCKETS

It should be noted now that not all cine cameras will have the facility to use both circuits. For using the Frame Counter the camera must be equipped with a flash or sync. socket. This will have a pair of internal contacts that make as each frame is taken.

The Interval Timer can only be used with a cine that has a single frame switch, that is for taking one frame at a time. It must also be of the type which uses an electro mechanical solenoid as the trigger and be connected to an output socket for remote control. This will normally be a 2·5mm or 3·5mm jack socket. If in any doubt about either of these sockets, contact your local photographic dealer who should be able to help.

CIRCUIT DESCRIPTION

The complete circuit diagram is shown in Fig. 1. There are two distinct sections, the Interval Timer and the Frame Counter, and could if required be built separately. It must be remembered, however, that IC2 is shared by both sections and so if only building one section, the gates not used should have their inputs connected to the positive supply rail.

IC1 forms the basis of the Interval Timer, the 555 device being wired in the astable mode, to provide a very low frequency square wave oscillator. The speed of this is controlled by VR1.

The pulse from the output, pin 3, is inverted by IC2a and fed to the base of TR1 via R5. Pulses from IC1 cause TR1 collector/emitter resistance to rise and fall in sympathy; when low it acts like a switch being closed across SK1 to reach the REMOTE socket on the camera.

The frequency of the output pulses ranges from approximately 1 a second to 1 a minute. To indicate that the timer is working, for setting up purposes, an l.e.d. is connected across IC1 output. The l.e.d. in fact is the d.p. pin on X1.

RELAY OPTION

TR1 can be connected to the camera using the collector and emitter as described above, or alternatively if this method is not favourable then a relay could be incorporated as shown in Fig. 2. This would of course consume more current so a larger battery or a small 9 volt power pack would be advisable for prolonged use. Each pulse is fed to transistor TR1 which activates the relay and closes its contacts to complete the circuit to the solenoid and so take one frame of film.

IC3 and IC4 are decade counters with 7-segment display outputs. These are wired together to form a counter from 0 to 99.

The pulses to the clock input to IC4 are derived from the SYNC. contacts on the cine camera via SK2, switching positive to pin one IC3. So the number of pulses received at SK2 are counted by IC3 and IC4 and displayed on X1 and X2.

R6 and C2 eliminate contact bounce from camera sync. output. R7 holds pin 15 on both IC3 and IC4 to ground (count condition) until S1 is depressed when pin 15 is taken "high" and resets both i.c.s to 00.

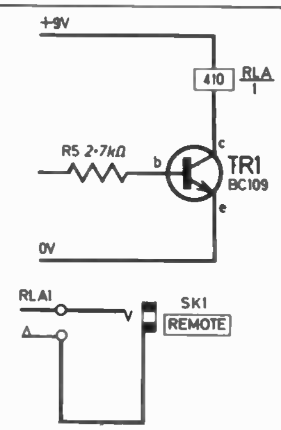


Fig. 2. Circuit arrangement for including a relay for remote operation.

DISPLAYS

The outputs from IC3 and IC4 directly feed displays X1 and X2 whose cathodes are connected to the collectors on TR2 and TR3. Gates IC2a and IC2b and their surrounding components form a square wave oscillator whose output is fed via R11 to the base of TR3 and also to the input of gate IC2d wired as an inverter feeding the base of TR2 via R10. This circuit grounds each display alternately to function as a simple multiplexer. This keeps the current consumption down, as does the use of CMOS i.c.s.

Once the counter reaches 99 the next pulse will reset the display to zero and continue counting.

COMPONENTS

Resistors

R1	470Ω	R4	680Ω	R7	10kΩ	R10	6·8kΩ
R2	18kΩ	R5	2·7kΩ	R8	16kΩ	R11	6·8kΩ
R3	1kΩ	R6	470kΩ	R9	16kΩ		

All ¼W carbon ± 5%

Capacitors

C1 47μF 10V tantalum bead
C2, C3 0·047μF miniature sleeved polyester (2 off)

Semiconductors

TC1 555 timer i.c.
IC2 CD4011 CMOS Quad 2-input NAND gates
IC3, 4 CD4033 CMOS decade counter/7-segment outputs
TR1 BC109 silicon *npn*
TR2, 3 BFY50 silicon *npn* (2 off)
X1, X2 DL704 common cathode 7-segment displays

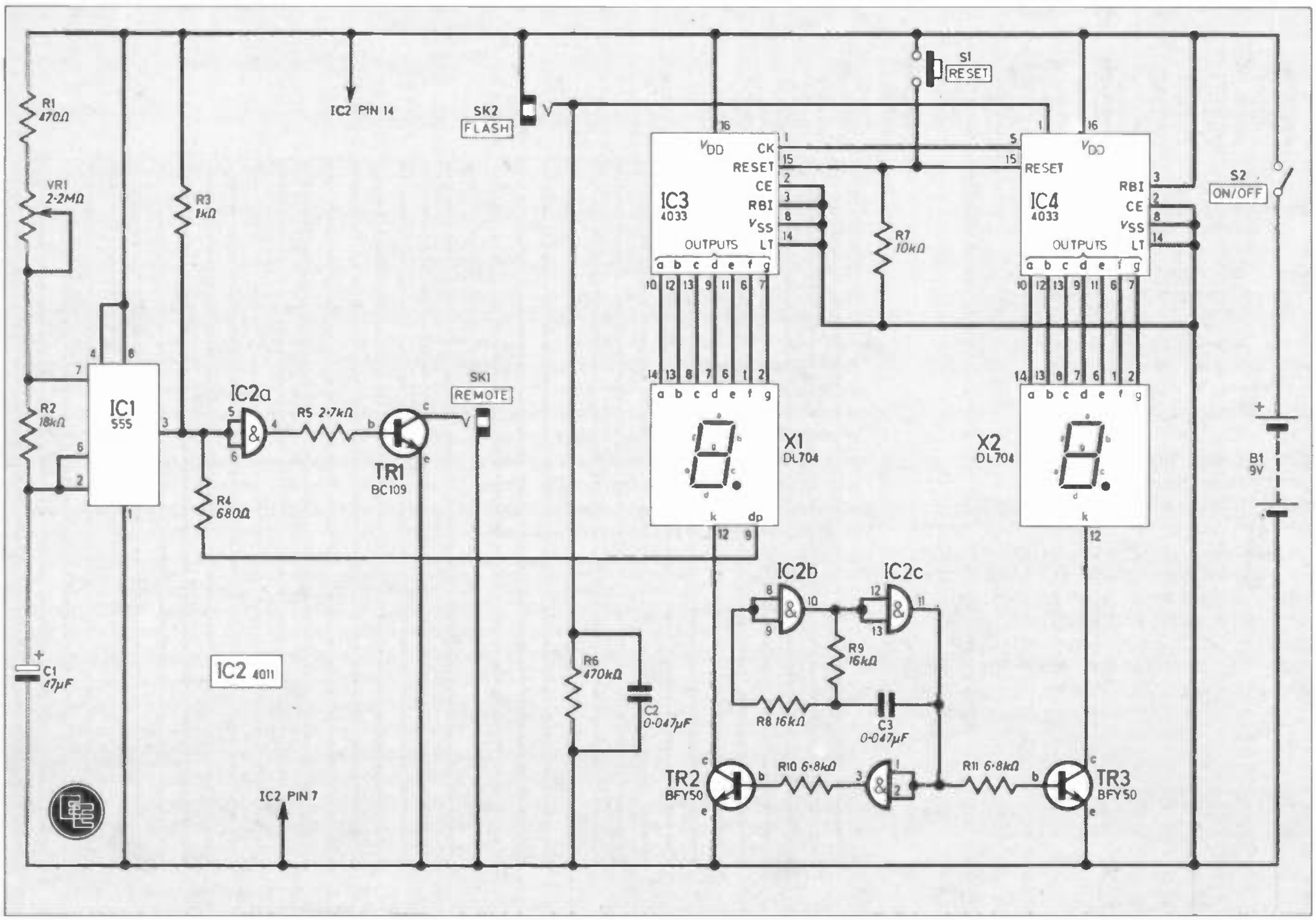
See Shop Talk page 95

Miscellaneous

VR1 2·2MΩ log. law carbon potentiometer
S1 momentary action push-to-make switch
S2 miniature single pole on/off switch
SK1 2·5mm jack socket
SK2 3·5mm jack socket
B1 9V type PP3 battery

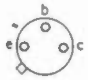
Stripboard: 0·1 inch matrix size 34 strips × 29 holes; d.i.l. i.c. sockets: 16-pin (2 off), 14-pin (1 off), 8-pin (1 off); PP3 battery clip; 22 s.w.g. tinned copper wire (for links); general purpose miniature stranded connecting wire (or ribbon cable—see text); control knob; case, sloping front panel size 160 × 100 × 60mm approx., West Hyde TEK362 or similar.
REMOTE Option—see text, Fig. 2.
RLA 9V 410 ohm coil with 1 set of normally open contacts.

Fig. 1. Complete circuit diagram for the Cine Interval Timer and Frame Counter.



CINE
Interval Timer & Frame Counter

BY L A PRIVETT



TR1 2 & 3
PIN VIEW

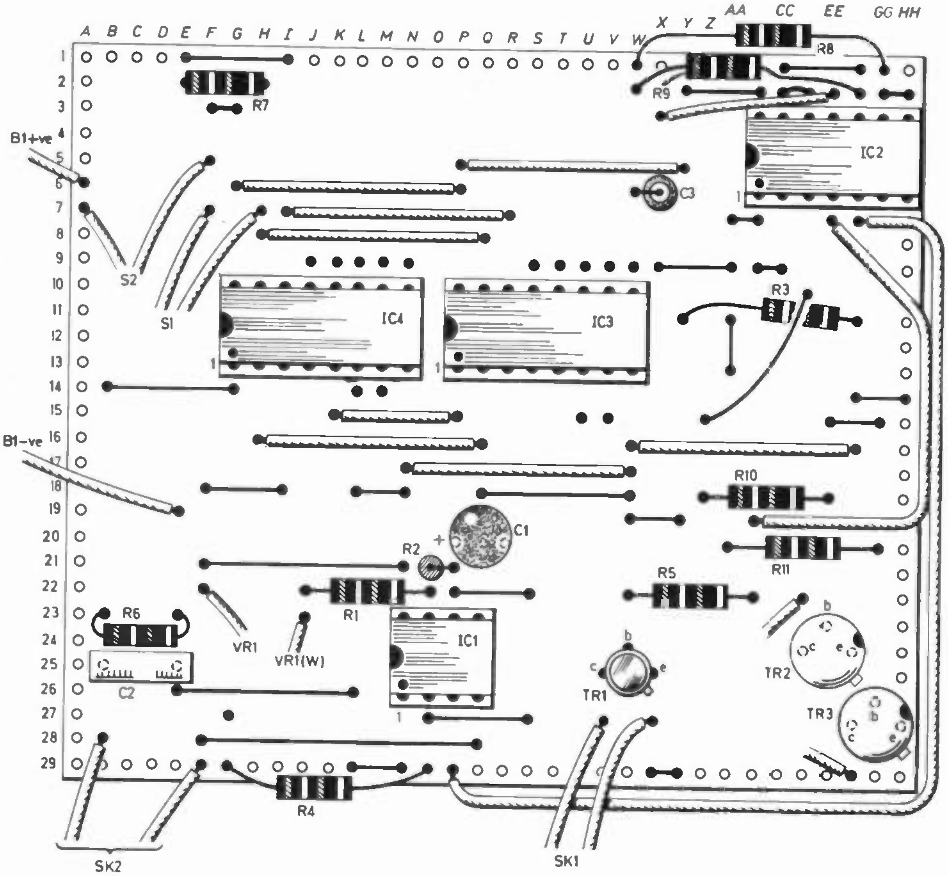


Fig. 3. Component layout on the topside of the stripboard.

COMPONENTS
approximate
cost £14·50

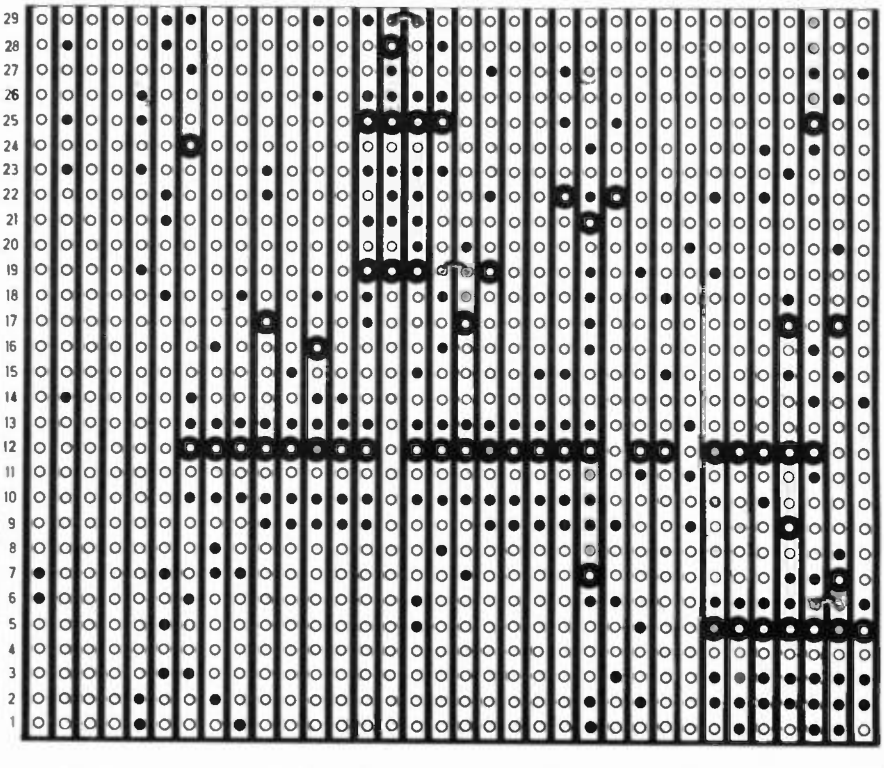


Fig. 4. Underside details for the circuit board showing breaks in the copper strips. Also note the small links across strips.

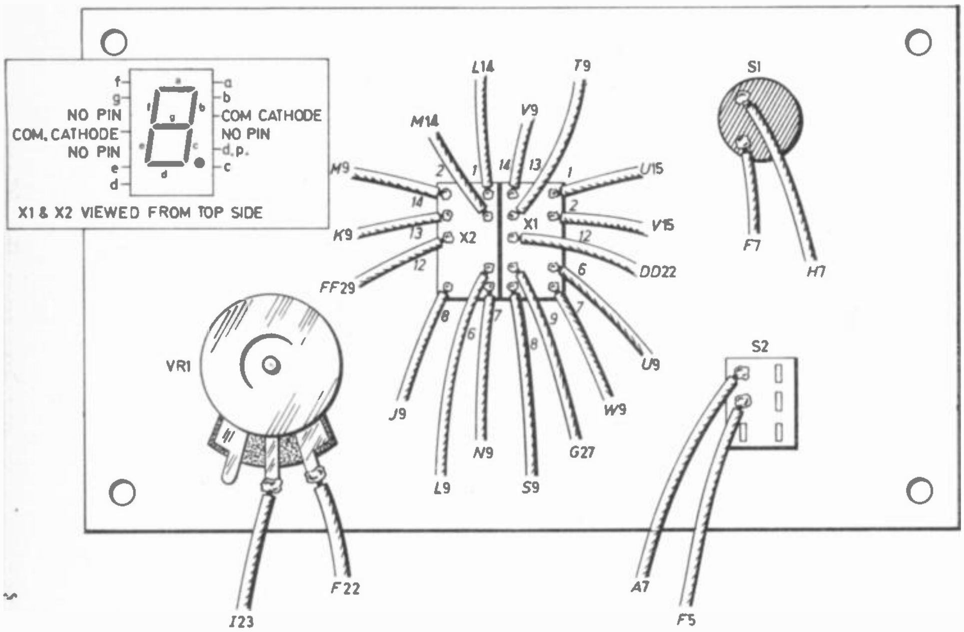


Fig. 5. Wiring to the rear of the front panel. The letters and numbers at the ends of the wires refer to locations on the topside of the circuit board.

CONSTRUCTION starts here

ASSEMBLY

The prototype was constructed on a single piece of stripboard, size 87 x 75mm as shown in Fig. 3. First, make all the breaks required on the underside and then mount the i.c. sockets followed by the resistors, link wires, capacitors and transistors. Do not insert the i.c.s. at this stage. Note that these are CMOS devices and the usual precautions should be taken.

In the prototype the flying leads from the board to other case mounted components used ribbon cable for this to keep wiring together and neat. General purpose "separate" hook-up wire can be used here if preferred.

The two displays were glued to a red diffuser (Perspex) using Araldite and this assembly when set glued to the underside of the front panel behind a previously made rectangular cut-out.

If preferred a separate l.e.d. (TIL 209 for example) could be used in place of the d.p. l.e.d. on X1 as was used on the prototype. The power supply is a 9V PP3 battery, but if desired, a socket could be wired in place of the battery clip to allow an external power source to be used.

Finally check all wiring, especially to the CMOS i.c. power lines and the displays. If satisfied, insert the i.c.s into their sockets paying special attention to their orientation.

TESTING

Connect up to your camera using suitable leads. With the interval timer first check the polarity of the REMOTE socket and connect SK1 so that the more positive lead goes to the collector of TR1. Operate the single frame switch on the cine camera, turn VR1 to minimum resistance (fully anticlockwise), switch on and the "monitor" l.e.d. (d.p. or X1) should flash on and off at approximately one second intervals and if connected correctly to your cine camera, the camera should take 1 frame per second.

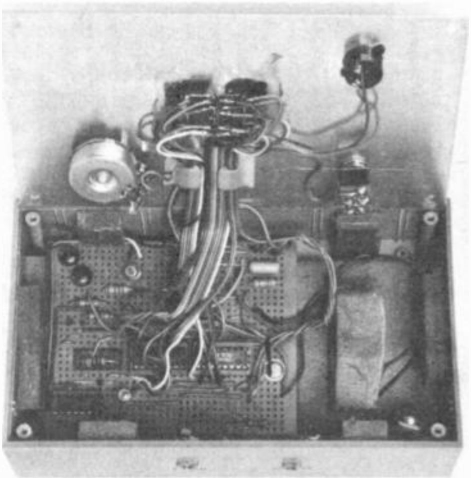
A stop-watch or other means will be needed to calibrate the scale around VR1.

Connect the Frame Counter to the SYNC. or flash socket, press RESET and manually take 1 frame at a time to check that the counter is counting properly and not jumping. If contact bounce is affecting counting then some experimenting with the values R6 and C2 will be necessary to cure this.

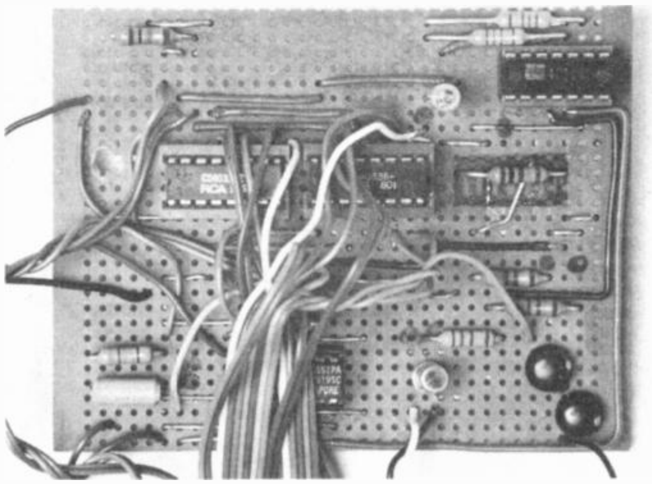
Using both facilities of this unit will be advantageous in time lapse cine as the Frame Counter will show the number of shots taken by the Interval Timer and also allow the "run time" of the film to be calculated.

For example: 96 frames at 24 frame per second = 4 seconds. 90 frames at 18 frames per second = 5 seconds. ⌘

Components mounted inside the case and interwired with ribbon cable.



Completed prototype board. The two transistors in the bottom right have been replaced with more common types.



SQUARE one FOR BEGINNERS

THE transformer is often regarded in awe as a seemingly complicated and confusing device but in reality, it is a very useful and efficient component.

The first encounter newcomers to electronics are likely to have with transformers will probably be in power supply circuits, but in fact they have applications in many aspects of electronics, including radio, high frequency work and audio circuits. However, here we shall concern ourselves only with the mains power supply.

STEP-UP AND STEP-DOWN

Basically, a transformer is a device for converting one a.c. voltage to another a.c. voltage (note that they will *not* work with d.c. voltages) and and it can be either converting a low voltage to a high voltage (step-up) or converting a high voltage to a lower one (step-down). It is this latter type which feature mainly in EVERYDAY ELECTRONICS as it includes transformers used for stepping down the mains to low voltages.

PRIMARY AND SECONDARY

The input of the transformer is known as the *primary winding* and the output as the *secondary winding* ("winding" because the transformer consists of coils of wire wound onto a bobbin).

It is not uncommon for a transformer to have two or more primary or secondary windings and this is best illustrated on mains transformers with two 120V primary windings. The reason for this being that the transformer can be used on 120V mains (in Europe for example) or by connecting the two primaries in series, the transformer will work on 240V (the UK standard).

It is also permissible to join secondary windings together in series, so for example, two 4·5V secondaries in series will result in a 9V output.

It is *not* correct, however, to connect the primary to the secondary, except under exceptional circumstances.

PARALLEL WINDINGS

When considering connecting primary or secondary windings in parallel, you have to look at the current rating of the transformer and this is usually governed by the size of the component and the gauge (thickness) of the wire used.

So for example, if a circuit requiries 12V at 2A and the available transformer has two 12V secondaries rated at 1A each, these can be wired in parallel to supply the 2A.

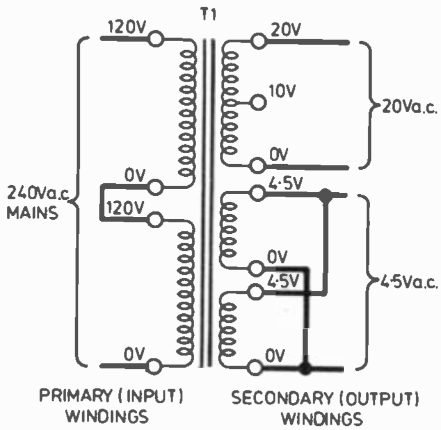


Fig. 1. Circuit diagram of a step-down transformer with two 120V primary windings connected in series for 240V mains operation, a centre-tapped 20V secondary and two 4·5V secondaries wired in parallel.

Note the two lines down the centre of the symbol representing the metalwork or "laminations" of the transformer. It is also customary to draw fewer "coils" on the low voltage windings.

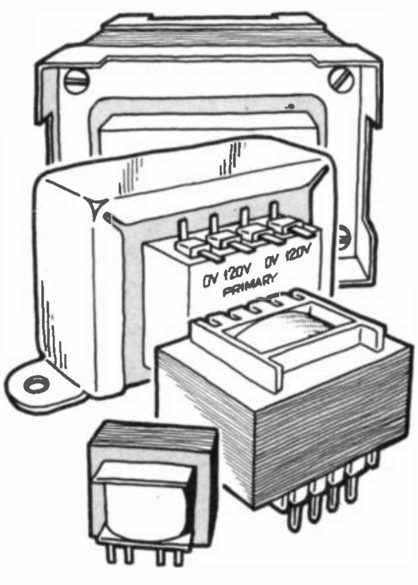


Fig. 2. Various types of mains transformer. From the front: a 1·2VA sub-miniature with p.c.b. mounting pins; 12VA p.c.b. mounting; 20VA chassis mounting with solder tag connections; 100VA chassis mounting with screw terminals.

Two very important points *must* be remembered when connecting windings in parallel: (1) they *must* be of the same voltage, that is, you cannot wire a 9V winding in parallel with a 12V winding, and; (2) the starts of the windings must be joined together and likewise the two finishes must be connected. If this rule is not observed and the windings are reversed, there will be no output, as the voltages cancel each other, and one very hot transformer!

The same applies to primary windings in parallel.

CENTRE TAPPING

Another form of winding is the centre tapped winding, and this simply means that an extra output voltage can be achieved by literally "tapping" off from a winding without breaking the continuity of the coils. For instance, if a tapping is made half-way up a 20V winding, 10V will result at this point.

VA RATING

The power capacity of a transformer is often quoted as a VA rating. This is the total output voltage multiplied by the maximum output current. For example, a transformer with a single 12V secondary rated at 0·5A is a 6VA transformer.

$$12V \times 0{\cdot}5A = 6VA$$

Equally, by knowing the VA rating of a transformer, the maximum current can be calculated by dividing the VA rating by the output voltage. For example, a 20VA transformer with a single 10V secondary can supply 2A.

$$20VA \div 10V = 2A$$

Incidentally, the VA rating is also true of the primary windings, so to calculate the current drawn from the supply on maximum load, simply divide the VA rating for the transformer by the primary (input) voltage. For example, a 12A, 240V mains transformer will draw 50mA from the supply.

$$12VA \div 240V = 0{\cdot}05A \text{ or } 50mA$$

TERMINATIONS

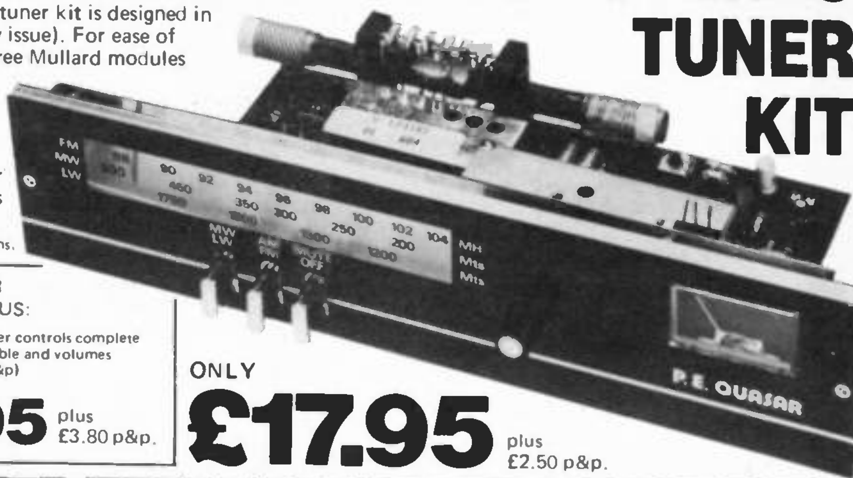
To a large extent, the VA rating will determine the physical size of a transformer, the higher the rating, the bigger the component.

A variety of shapes and methods are available, some of which are illustrated in Fig. 2. Transformers up to about 12VA can be supplied with solder tags or p.c.b. mounting, from 20VA to 100VA will almost certainly be too heavy for p.c.b. mounting so therefore they are only available with solder tags and integral fixing bracket. Greater than 100VA will be quite a substantial assembly with mounting frame and terminal block connections.

NEW

PRACTICAL ELECTRONICS - STEREO TUNER KIT

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



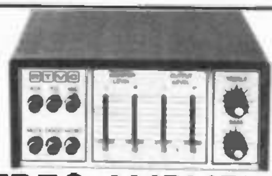
FEATURES: VHF, MW, LW Bands, interstation muting and AFC on VHF. Tuning meter. Two back printed PCB's. Ready made chassis and scale. Aerial: AM - ferrite rod, FM - 75 or 300 ohms. Stabilised power supply with 'C' core mains transformer. All components supplied are to P.E. strict specification. Front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

SPECIAL OFFER! TUNER KIT PLUS:

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

£21.95 plus £3.80 p&p.

ONLY **£17.95** plus £2.50 p&p.



STEREO AMPLIFIER KIT

- Featuring latest SGS/ATES TDA 2006 10 watt output IC's with in-built thermal and short circuit protection.
- Mullard Stereo Preamplifier Module.
- Attractive black vinyl finish cabinet, 9"x8¼"x3¾" (approx)
- 10+10 Stereo converts to a 20 watt Disco amplifier.

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

£14.95 Plus £2.90 p&p.

SPECIFICATIONS: Suitable for 4 to 8 ohm speakers.

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

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

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

PRACTICAL ELECTRONICS CAR RADIO KIT SERIES II

2 WAVE BAND MW — LW

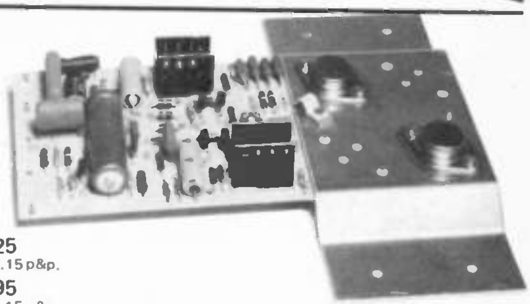
- Easy to build
- 5 push button tuning
- Modern design
- 6 watt output
- Ready etched and punched PCB
- Incorporates suppression circuits.

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

£10.50 Plus £2.00 p&p.

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

HIGH POWER AMPLIFIER MODULES



READY BUILT OR IN KIT FORM

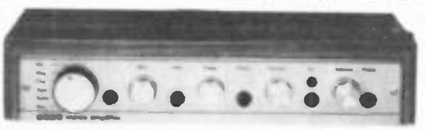
	KIT	BUILT
125 WATT MODEL	£10.50 Plus £1.15 p&p	£14.25 Plus £1.15 p&p.
200 WATT MODEL	£14.95 Plus £1.15 p&p	£18.95 Plus £1.15 p&p.

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

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

ACCESSORIES:

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



30+30 WATT STEREO AMPLIFIER

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

£32.90 Plus £3.80 p&p.

TV SOUND TUNER KIT

as featured in E.T.I. December '81 issue. Kit of parts including PCB, UHF tuner, I.C.'s, all components excluding case, and selector switch. £11.45 + £1.50 p&p.

- Transformer £1.50 + £1.50 p&p (p&p free on transformer if ordered with kit).
- Ready built LP1183 Module for simulated stereo operation £1.95 + 75p p&p.

MONO MIXER AMPLIFIERS

50 WATT Six individually mixed inputs for two pick ups (Cer. or Mag.), two moving coil microphones and two auxiliary for tape, tuner, organs, etc. Eight slider controls - six for level and two for master bass and treble, four extra treble controls for mic and aux inputs. Size: 13¼"x6½"x3¾" app. Power output 50 watts R.M.S. (continuous) for use with 4 to 8 ohm speakers. Attractive black vinyl case with matching fascia and knobs. Ready to use.

£39.95 Plus £3.70 p&p.

100 WATT Brushed Aluminium fascia and rotary controls. Size: approx. 14"x4"x10¼". Five vertical slider controls, master volume, tape level, mic level, deck level, PLUS INTERDECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level controls (PFL) lets YOU hear the next disc before fading it in. VU meter monitors output. 100w RMS output (200w peak).

£76.00 Plus £4.60 p&p.

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NEW PRODUCTS

ZX PRINTER

Sinclair Research has introduced a new Printer to complement its existing ZX range of personal computers and software. The ZX Printer is only available direct from Sinclair, mail order, for the sum of £49·95 including VAT.

Designed by Sinclair exclusively for use with the ZX81 personal computer, and the ZX80 with retrofit 8K ROM, the new printer features full alphanumerics and high resolution graphics. A special feature is a Copy command, which prints out exactly what is on the TV screen without further instructions.

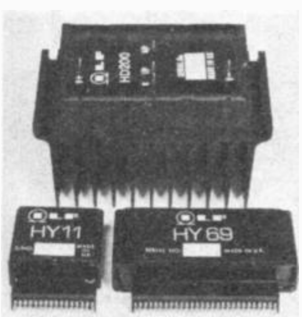
Sinclair Research Ltd, Dept EE, 6 King's Parade, Cambridge CB2 1SN.

POWER MODULES

One of the leading British designers and manufacturers of encapsulated audio amplifiers, pre-amplifiers and power supplies, ILP Electronics of Canterbury, is in the process of launching a major range of new modular products for home hi-fi and disco constructors. The new audio modules, like the existing range, are all totally compatible with each other and can be combined to create a "tailored" system.

The HD Power Amp modules are a new range of heavy duty Bipolar power amplifiers, specially designed to withstand the heavy usage and potential misuse of disco and guitar amplifier work. Available in a choice of three outputs; 60W, 120W or 240W per channel (each with or without heatsink), the prices range from just under £20 plus VAT to approximately £39 plus VAT.

The HY7 mono mixer is an encapsulated unit capable of mixing up to eight signals into one. The HY7 cost £5·15 plus VAT.



Other new mixer modules are the HY11 mono mixer, which mixes five signals into one and has provision for bass and treble controls, and the HY69 mono preamplifier with two input channels for magnetic cartridge or microphone with mixing volume, treble and bass control facilities. Price £10·45 plus VAT.

ILP Electronics Ltd, Dept EE, Graham Bell House, Roper Close, Canterbury, Kent CT2 7EP.

DIGITAL MULTIMETERS

Two new liquid crystal display (LCD) multimeters just introduced onto the market by Lascar Electronics are claimed to be nearly half the price of competing instruments.

The six function, including a diode check facility, instruments have 21 ranges and can resolve voltages to 1mV, current to 1μA and resistance to 1 ohm. Auto-polarity and auto-zero are standard. The 4mm input terminals are protected against overloads and transients.

Housed in identical moulded cases, the DP200 model claims a 0·5 per cent accuracy and is available at £27·95 plus VAT, while the DP2010 model costs £23·95 plus VAT and claims an accuracy of 1 per cent.

Both types feature a 0·5in LCD readout with a 200 hour battery life and an indication on the display when the battery needs replacing.

Lascar Electronics Ltd., Dept EE, Unit 1, Thomasin Road, Burnt Mills, Basildon, Essex SS13 1LH.

CHARGE IT

Appearing in the shops now, under the brand name of X-Cell, is a new rechargeable battery designed to replace the existing, fairly expensive 6V, type 996, lantern battery.

Developed by NiTech Ltd., a British Company, the battery features a "built-in" charging unit, which means that you need no other adaptor or recharging device; you simply plug into the nearest power supply with the leads provided. The units can be directly recharged from almost any mains supply worldwide, or from vehicle, boat or aircraft batteries.

The manufacturers claim that tests have proved that the X-Cell will give a minimum of 300 and as many as 3,000 charge/discharge cycles at a cost of less than 1/10 of a penny per charge. It is claimed that they cannot be overcharged and connection polarity makes no difference.

Two versions are available, the X-Cell Plus with continuous operation times between charges of 3½ hours and a retail price of £19·95, and the X-Cell Regular, a light duty household version, at 1½ hours and a retail price of £14·95. The X-Cell is guaranteed for three years.

NiTech Ltd, Dept EE, 4 Castle Street, Hastings, East Sussex TN34 3DY.

CALCULATOR WITH PUNCH

A novel design pocket calculator, type BG15, combining the extra functions of a quartz clock with alarm and a realistic electronic boxing game is the latest offering from Casio and available through Tempus.

When switched to the boxing game, the display shows a couple of pugilists in action, throwing and blocking punches to the head and body, swaying to avoid blows, reeling when struck, retreating to the ropes, and so on in imitation of a real bout.

One boxer is under control of the player, the other a programmed hitter and defender. As the player's skill progresses, successive opponents become more robust and competent, as "weight" divisions and handicaps increase.

The calculator automatically keeps score of rounds, points and verdicts.

The Casio BG15 is available from Tempus and costs £16·95.

Tempus, Dept EE, 164/167 East Road, Cambridge CB1 1DB.

CIRCUIT EXCHANGE

MICROPROCESSOR-CONTROLLED MUSIC BOXES

This is a modification that can be applied to the *Microchime* (February 1979) and the *Micro Music Box* (February 1980).

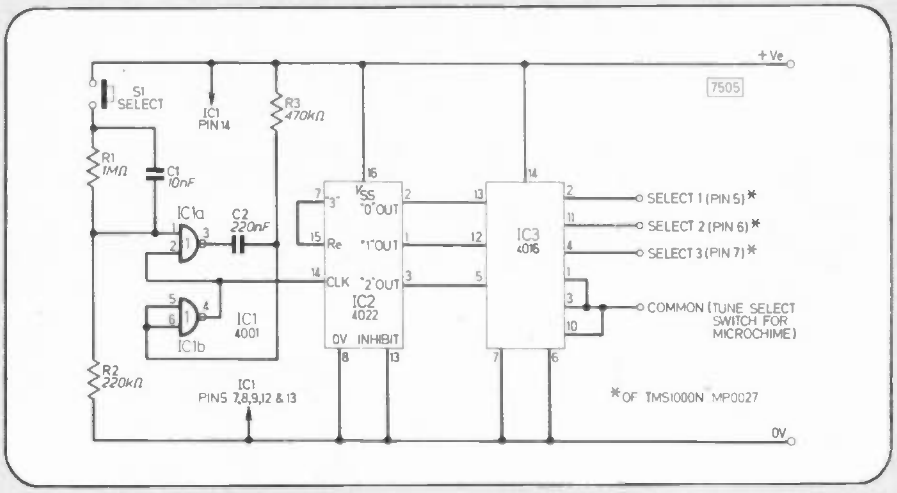
The TM1000N, MP0027A musical integrated circuit has two switching functions: one to select the tune and the other to select the bank of tunes to be played. Instead of using a three-position switch for the former I designed a push button unit which gives the project a little more style!

The operation of the circuit can be considered as follows:

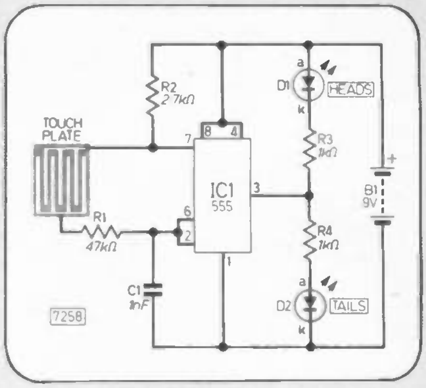
IC1 is used to "clean up" the pulses made available from S1 to feed IC2. IC2 is a decade counter wired to count from 0 to 2 giving three outputs which are used to control IC3. The bilateral switches in this integrated circuit are operated by these outputs to cause either select 1, 2 or 3 lines to be activated. Therefore, together with the common line this part of the circuit functions as a three-way switch.

The unit can be fitted into the existing case taking its power from one or both batteries.

D. Butler,
Lexden, Colchester,
Essex.

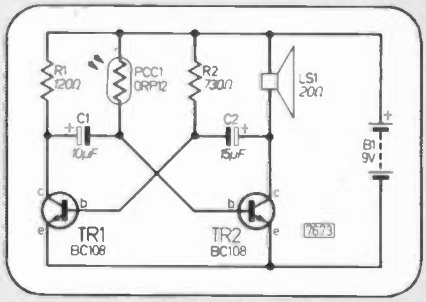


COIN FLIP



This is a cheap and novel way of producing an electronic "heads and tails". Not only does it use only one i.c., it is touch sensitive as well. The resistance of one's finger forms the timing resistance and, in fact, if only a very light touch is applied the l.e.d.s can be seen to flip between states. Taking the finger of the touch plate (which can be Veroboard with alternate stips joined) will end the "throw". One l.e.d. has to be labelled "Heads" and the other "Tails"

A. J. Boulton,
Stoney Stanton,
Leics.



ELECTRONIC CHICKENS

Now I know there are kits on the market for electronic chickens, but this one is different! The circuit is a simple multivibrator using common components, is simple to build, and is unique! It is light controlled. So what, you say. The ORP12 used has *black tape* over the window, the circuit is that sensitive!

How to use it: Put it in a box with the PCC1 on the outside of the lid, and black tape on the window. Carry the box about in the room to obtain *random clucking* as it goes in and out of the shadows. It also does the *long baaachackle* in brightish daylight, near a window. It clucks slowly in the dark, faster in medium dark.

Brian S. Craigie,
Edinburgh,
Scotland

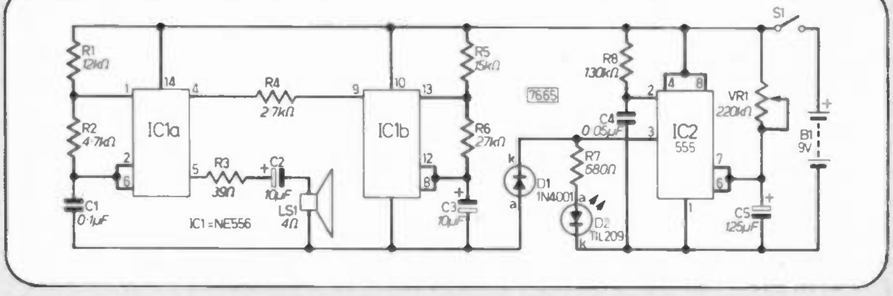
DARKROOM TIMER

This circuit was designed around two timer i.c.s. The 555 is wired as a monostable and the 556 is wired as two astables. The timing period is determined by adjusting VR1. The 556 forms the audio alarm section of the timer, and the 555 does all the timing.

On closing S1, the output (pin 3) of IC2 goes high, thus preventing the 556 from turning on. The l.e.d. will be on, indicating that timing has begun.

When the timing period is over, the l.e.d. will go off as pin 3 (IC2) goes low. At the same time that the l.e.d. goes off, IC1a, b switch on and the alarm sounds. The alarm will be short bleeps caused by the switching on and off high frequency oscillator IC1a. This is achieved by connecting the output of IC1b to the reset pin (4) of IC1a. IC1b is oscillating at about 1Hz. VR1 is 220 kilohm linear.

R. T. Nkambule,
Mbabane,
Swaziland



Sinclair ZX81 Personal Comp the heart of a system that grows with you.

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. Not surprisingly, over 50,000 were sold.

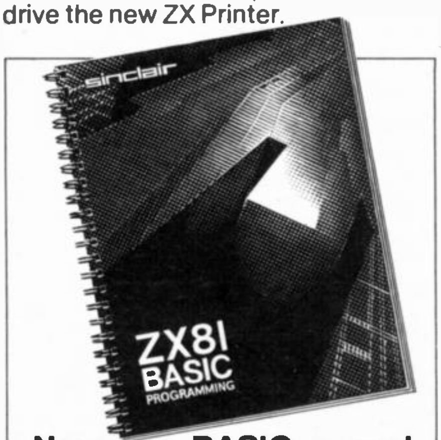
In March 1981, the Sinclair lead increased dramatically. For just £69.95 the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

Today, the Sinclair ZX81 is the heart of a computer system. You can add 16-times more memory with the ZX RAM pack. The ZX Printer offers an unbeatable combination of performance and price. And the ZX Software library is growing every day.

Lower price: higher capability
With the ZX81, it's still very simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, *and* to drive the new ZX Printer.



New BASIC manual

Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs.

Kit: £49.95

Higher specification, lower price – how's it done?
Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

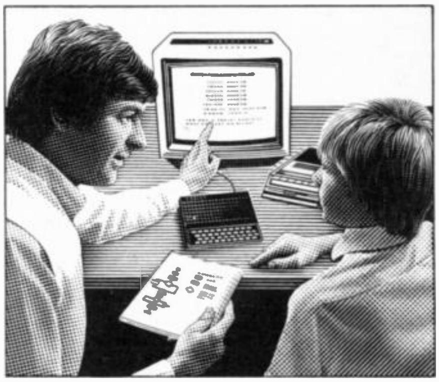
New, improved specification

- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function – useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer.
- Advanced 4-chip design: micro-processor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.

Built: £69.95

Kit or built – it's up to you!
You'll be surprised how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.



uter-

Available now-the ZX Printer for only £49.95

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alphanumerics *and* highly sophisticated graphics.

A special feature is COPY, which prints out exactly what is on the whole TV screen without the need for further intructions.

At last you can have a hard copy of your program listings – particularly useful when writing or editing programs.

And of course you can print out your results for permanent records or sending to a friend.

Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your computer – using a stackable connector so you *can* plug in a RAM pack as well. A roll of paper (65 ft long x 4 in wide) is supplied, along with full instructions.

16K-byte RAM pack for massive add-on memory.

Designed as a complete module to fit your Sinclair ZX80 or ZX81, the RAM pack simply plugs into the existing expansion port at the rear of the computer to multiply your data/program storage by 16!

Use it for long and complex programs or as a personal database. Yet it costs as little as half the price of competitive additional memory.

With the RAM pack, you can also run some of the more sophisticated ZX Software – the Business & Household management systems for example.

How to order your ZX81

BY PHONE – Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day.

BY FREEPOST – use the no-stamp-needed coupon below. You can pay by cheque, postal order, Access, Barclaycard or Trustcard.

EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

To: Sinclair Research Ltd, FREEPOST, Camberley, Surrey, GU15 3BR. **Order**

Qty	Item	Code	Item price £	Total £
	Sinclair ZX81 Personal Computer kit(s). Price includes ZX81 BASIC manual, excludes mains adaptor.	12	49.95	
	Ready-assembled Sinclair ZX81 Personal Computer(s). Price includes ZX81 BASIC manual and mains adaptor.	11	69.95	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	10	8.95	
	16K-BYTE RAM pack.	18	49.95	
	Sinclair ZX Printer.	27	49.95	
	8K BASIC ROM to fit ZX80.	17	19.95	
	Post and Packing.			2.95

☐ Please tick if you require a VAT receipt TOTAL £______

*I enclose a cheque/postal order payable to Sinclair Research Ltd, for £______

*Please charge to my Access/Barclaycard/Trustcard account no.

*Please delete/complete as applicable

Please print.

Name: Mr/Mrs/Miss

Address:

FREEPOST – no stamp needed. Offer applies to UK only. EVE 02

sinclair ZX81

6 Kings Parade, Cambridge, Cambs., CB2 1SN. Tel: (0276) 66104 & 21282.

THIS MONTH'S NEW KITS

For the musically inclined	
Drum Synthesiser	£29.50
Mixer/Pre Amp	£16.00
Stylus Organ	£4.95
For the Service Engineer	
Micro Volt Multiplier	£3.95
Sign Wave Generator	£5.75
Linear Power Output Meter	£11.50
For the Ham or CB Enthusiast	
Aerial Rotator	£24.50
Aerial Direction Indicator	£5.90
For the Motorist	
Electronic Ignition Kit	£19.50
For all of you	
Electric Jigsaw Puzzle	£5.30
Blow Heater Kit	£6.45
And if you are having TV Interference Problems	
High-Pass Filter	£1.95
Low-Pass Filter	£3.45

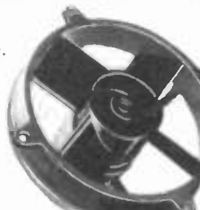
UNIVAC KEYBOARD BARGAIN

Ideal for use with ZX80/81. Has 50 keys and many other parts for your spares box. Probably cost in excess of £100. In very good used condition — £13.50 + £2.00 post. Diagram showing how to connect to ZX80/81 — £2.00 extra.

COMPUTER DESK

Size approx. 4'x 2' x 2'6" high. These were made for hard work, the top being formica covered. Suitable for housing instruments or for use as office desks. Beautifully made, these cost over £100 each, our price only £11.50 each, however, you must arrange to collect.

EXTRACTOR FANS



Mains operated — ex. Computer.
5" Woods extractor £5.75 Post £1.00.
6" Woods extractor £6.90 Post £1.25
6" Plannair extractor £7.50 Post £1.00
4" x 4" Muffin 115v. £4.50 Post 50p.
4" x 4" Muffin 230v. £5.75 Post 50p.

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

INSTRUMENT BOX WITH KEY

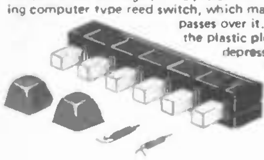
Very strongly made (ply-wood sides with hard board top and bottom). This is black grained effect, vinyl covered, very pleasing appearance. Internal dimensions 12½" long, 4¾" wide, 6" deep. Ideal for carrying your multi range meter and small tools and for keeping them in a safe place. £2.30. Post paid if ordered with other goods, otherwise £1.00.

ROPE LIGHT

4 sets of coloured lamps in translucent plastic tube arranged to give the appearance of a running or travelling light. With variable speed control box, ideal for disco or shop window display. Complete, made up, ready to plug into mains. £36.00 + £2 post.

COMPUTER KEY SWITCHES (make your own keyboard)

These are for making up on a p.c.b. and consist of a vertical mounting computer type reed switch, which makes circuit when a magnet passes over it. The magnet is located in the plastic plunger which in turn is depressed by a push rod, to which the legended top is fixed. These are made up in banks of 6, price £2.30 per bank of 6 (including tops)

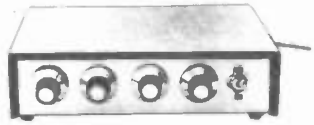


OUR CAR STARTER AND CHARGER KIT has no doubt saved many motorists from embarrassment in an emergency you can start car off mains or bring your battery up to full charge in a couple of hours. The kit comprises: 250w mains transformer, two 10 amp bridge rectifiers, start/charge switch and full instructions. You can assemble this in the evening, box it up or leave it on the shelf in the garage, whichever suits you best. Price £11.50 + £2.50 post.

GPO HIGH GAIN AMP/SIGNAL TRACER. In case measuring only 5½in x 3½in x 1¾in is an extremely high gain (70dB) solid state amplifier designed for use as a signal tracer on GPO cables, etc. With a radio it functions very well as a signal tracer. By connecting a simple coil to the input socket a useful mains cable tracer can be made. Runs on standard 4½v battery and has input, output sockets and on-off volume control, mounted flush on the top. Many other uses include general purpose amp, cueing amp, etc. An absolute bargain at only £1.85. Suitable 80ohm earpiece 69p.

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

3 CHANNEL SOUND TO LIGHT KIT



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

MULLARD UNILEX

A mains operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost anyone. In easy to assemble modular form this should sell at about £30 — but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only £16.75 including VAT and post.
FREE GIFT — buy this month and you will receive a pair of Goodman's elliptical 8"x5" speakers to match this amplifier.

THIS MONTH'S SNIP

POCKET AUDIO COMPONENT TESTER

With it you can quickly test diodes, rectifiers, transistors, capacitors, check wiring and p.c. boards for open circuits, find the anode and cathode of a diode or rectifier and whether a transistor is PNP or NPN, which are the base collector and emitter connections. Condensers, if bad, give a continuous signal, but if good, give intermittent signals of varying length depending on their value. The test current is very low (2uA) and the voltage only 1.4v, so it is also possible to check MOS devices, as well as sensitive transistors without fear of damaging them. The unit is supplied complete with internal battery, which should last many months.
Price £3.45p

THERMOSTAT ASSORTMENT

10 different thermostats. 7 bi-metal types and 3 liquid types. There are the current stats which will open the switch to protect devices against overload, short circuits, etc., or when fitted say in front of the element of a blow heater, the heat would trip the stat if the blower fuses; appliance stats, one for high temperatures, others adjustable over a range of temperatures which could include 0 — 100°C. There is also a thermostatic pod which can be immersed, an oven stat, a calibrated boiler stat, finally an ice stat which, fitted to our waterproof heater element, up in the loft could protect your pipes from freezing. Separately, these thermostats could cost around £15.00 - however, you can have the parcel for £2.50.

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

MEDIUM & 2 SHORT WAVE CRYSTAL RADIO
All the parts to make up the beginner's model. Price £2.30. Crystal earpiece 65p. High resistance headphones (gives best results) £3.75. Kit includes chassis and front but not case.

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

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

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

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

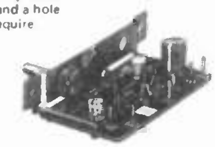
POPULAR SNIP — STILL AVAILABLE

And it still carries a free gift of a desoldering pump, which we are currently selling at £6.35p. The snip is perhaps the most useful breakdown parcel we have ever offered. It is a parcel of 50 nearly all different computer panels containing parts which must have cost at least £500. On these boards you will find over 300 IC's. Over 300 diodes, over 200 transistors and several thousand other parts, resistors, condensors, multi-turn pots, recifiers, SCR, etc. etc. If you act promptly, you can have this parcel for only £8.50, which when you deduct the value of the desoldering pump, works out to just a little over 4p per panel. Surely this is a bargain you should not miss!
When ordering please add £2.50 post and £1.27 VAT.

BURGLAR ALARM CONTROL PANEL

Contains labelled connection block, latching relay, test switch and removable key control switch. Simplifies the whole installation, all you have to do is to take wires to pressure pads and to alarm bell. Price £7.95, with complete diagram.

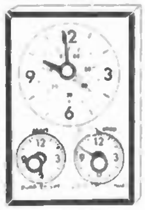
MINI MONO AMP on p.c.b., size 4"x 2"



approx. Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amplifier. Brand new, perfect condition, offered at the very low price of £1.15 each, or 10 for £10.00.

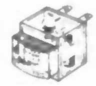
DELAY SWITCH

Mains operated — delay can be accurately set with pointers knob for periods of up to 2½hrs. 2 contacts suitable to switch 10 amps — second contact opens a few minutes after 1st contact. £1.95.



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

LEVEL METER



Size approximately ¾" square, scaled signal and power but cover easily removable for rescaling. Sensitivity 200 uA. 75p.

WATERPROOF HEATING WIRE
60 ohms per yard, this is a heating element wound on a fibre glass coil and then covered with p.v.c. Dozens of uses — around water pipes, under grow boxes in gloves and socks.

TANGENTIAL BLOW HEATER

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

12V SUBMERSIBLE PUMP

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

VENNER TIME SWITCH

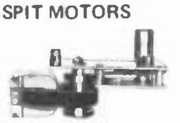
Mains operated with 20 amp switch, one on and one off per 24 hrs. repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only £2.95. These are without case, but we can supply metal case with window £2.95.
Also available is adaptor kit to convert this into a normal 24hr time switch but with the added advantage of up to 12 on/offs per 24hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is £2.30. Post any or all items £1.

12V FLUORESCENT LIGHTING

For camping — car repairing — emergeny lighting from a 12v battery you can't beat fluorescent lighting. It will offer plenty of well distributed light and is economical. We offer an inverter for 21" 13 watt miniature fluorescent tube. £3.45. (tube not supplied).

FIVE UNUSUAL SWITCHES
For inventors, experimenters, service engineers, students or in fact anyone interested in making electrical gadgets. The parcel contains: — delay switch — motor driven switch — two-way and off switch — polarity changing switch — and humidity switch. Our regular price for these switches bought separately is over £10, but this month you can have the 5 for £2.50.

SPIT MOTORS



These are powerful mains operated induction motors with gear box attached. The final shaft is a ¼" rod with square hole, so you have alternative couplingmethods — final speed is approx. 5 revs/min, price £5.50. — Similar motors with final speeds of 80, 100, 160 & 200r.p.m. same price.

COMPONENT BOARD Ref. WO998

This is a modern fibreglass board which contains a multitude of very useful parts, most important of which are: 35 assorted diodes and rectifiers including 4 3amp 400v types (made up in a bridge) 8 transistors type BC 107 and 2 type BFY 51 electrolytic condensers. SCR ref 2N 5062, 25 0uf 100v DC and 100uf 25v DC and over 100 other parts including variable, fixed and wire wound resistors, electrolytic and other condensers. A real snip at £1.15.

J. BULL (Electrical) Ltd.

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

MAIL ORDER TERMS: Cash, P.O. or cheque with order. Orders under £10.00, add 60p service charge. Monthly account orders accepted from schools and public companies. Access & Barclaycard orders phone Haywards Heath (0444) 54563. CALLERS: to Haywards Heath (closed Sat.), or 2, Bentham Road, Off Elm Grove, Brighton (closed Wed.). BULK ORDERS: Write for special quotation. Normally delivery is by return.

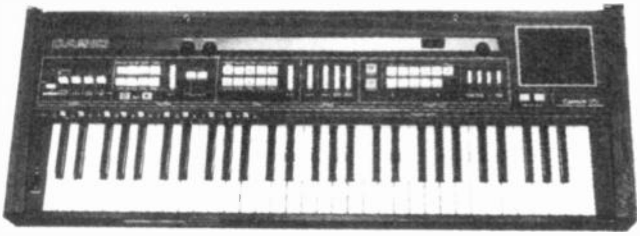
THE NEW 1982 CASIO WORLD BEATERS

WE WILL BEAT ANY LOWER ADVERTISED PRICE BY 5% providing the advertiser has stocks

AVAILABLE SOON — THE SENSATION OF THE JAPANESE MUSIC SHOW

Designed by a genius, controlled by computer, programmed by a laser. Played by amateurs professionally and by professionals superbly.

THE NEW CASIOTONE 701



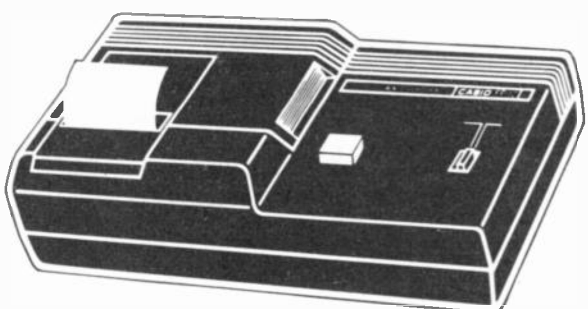
The complete programmable polyphonic keyboard for around £500
Price and delivery on application. (Available very early 1982)

Provisional specification

* Input an entire piece of music, specially scored in bar code and read by a light pen attached to the instrument.
* Alternatively, program your own melodies, chords and timing into the extensive memory, (up to 5 minutes or more) with full editing.
* 3-WAY PLAYBACK
  1/Auto playback of the entire piece; melody, chord, bass and rhythm with arpeggio; following the music via lamps above the keys.
  2/Auto accompaniment only, with manual melody playing guided by the keyboard lamps which light up to indicate the next note to be played.
  3/ONE KEY PLAY facility; allows the melody line to be played, simply by stroking one key to produce the next note.
* The 5 octave polyphonic keyboard can be split into 2 and 3 octaves and a different voice can be used for the accompaniment.
* 20 breathtaking, clear and bright pre-set instruments and voices.
* Easy play Casio Auto Chord with chords and auto bass. Major, minor, 7th or minor 7th chords — fingered or auto memory facility.
* 16 superb rhythm accompaniments with fill-in variation by touch sensitive strip and 2 different percussion effect buttons.

NEW MT-31. 3 octaves, 22 instruments and voices. (RRP £79) .... **ONLY £69**
NEW MT-40. As MT-31 plus rhythms and auto chords/bass. (£125) **£99**
Other Casiotones: CT-101 £225. CT-202 £275. CT-403 £275. VL-1 £35.95.

NEW CASIO FP-10 PRINTER



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AN INCREDIBLE £44.95

Compatible with the FX-501P, FX-502P, FX-601P, FX-602P and FX-702P
Manual and program results printout. Memory and program listing.

FP-10 electric discharge mini printer. A remarkably clear 5 × 7 dot matrix printout of 20 characters per line. Up to 30 characters store/printout over 1½ lines, with overload symbol. Fast 2 lines/second print speed. Aluminised paper rolls are approx 2,500 lines/30 feet long. Connects directly to the calculator, or via FA-2 cassette interface. Four AA batteries will print approx. 6,000-9,600 lines. Rechargeable pack NP-4M, 13,000 lines. (£6.90) AC adaptor AD-4150 will recharge NP-4M, in situ. (£5). Printer rolls £2.50 per pack of five. Dims: 43.5H × 157.5W × 82.5D (1¾" × 6¼" × 3¼") weight 372g (13.1oz).

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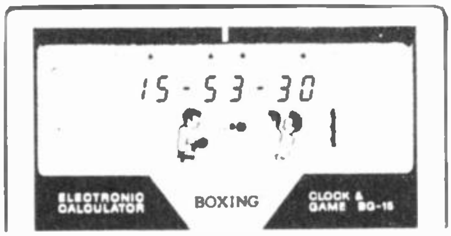
BG-15 Calculating Alarm Clock **ONLY £16.95**

Display.



Fight up to 100 challengers of 10 different weights and increasing speed and technique. All the realism of the ring with eight 30-second rounds per bout, with points scoring. You must win every bout on points or by KO to continue the game — scores are incremental. Raise or lower your guard in defence and attack, sway back to avoid a blow, or forward for maximum power. Throw stamina sapping combination punches (with digital display of stamina rating), high scoring counterpunches, knock-down and knock-out blows and lucky punches. You can even be saved by the bell! Digital display of hours, minutes and seconds. 24 hour alarm function. 8 digit calculator with full memory, % and sign change. Two silver oxide batteries last approximately 18 months. 7.3 × 68.5 × 113.7mm (5/16 × 2 5/8 × 4 3/2"). 66g (2.3oz). With wallet.

NEW SPACE INTERCEPTOR WATCH

GM-10 Alarm Chronograph (RRP £22.95) **£19.95**

LCD readout of hours, minutes and seconds, with continuous display of Space Interceptor graphics. Automatic day, date and month calendar function. Daily alarm mode, with hourly time signal option. 1/100 second stopwatch measuring net, lap and 1st and 2nd place times to 1 hour.

INTERCEPTOR GAME

The UFO beams, travelling from left to right, have to be intercepted by changing the altitude of your defences and firing an interceptor along the beam. A number will light up in the zone of the hit and when 4 zones are lit up a high bonus game starts. Shoot down 16 UFOs without losing 3 missiles and the next, speeded up, round starts. Sound effects are incorporated.
One lithium battery lasts approx 15 months. Black resin case/strap. Metal bezel. Mineral glass face.

World's Most Versatile Alarm Chronograph Watch AX-210

10 Alternative displays: over 60 functions. LCD ANALOG display of time, plus: DIGITAL display of: Time (12 or 24 hour); Calendar; Full month calendar (this month and next month); Dual time (12 or 24 hour); Alarm time; Professional 1/100 second stopwatch with laps, etc. Hourly time signal. Alarm — electronic buzzer or 3 selectable melodies. Rapid forward/backward setting. 9.4 × 35.4 × 36mm.

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Sets the pace for 1982

Displays hours, minutes and seconds (12 or 24 hours system), day and date. Auto calendar; calculator; professional 1/100 second stopwatch measuring net, laps and 1st and 2nd place times; Pacer mode. Can be used as a metronome to pace your running, or any other event.
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(RRP £22.95) **ONLY £19.95**

OTHER CASIO WATCHES

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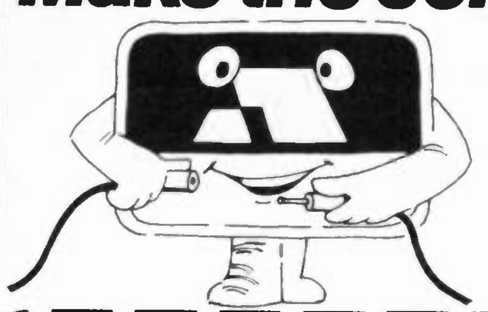

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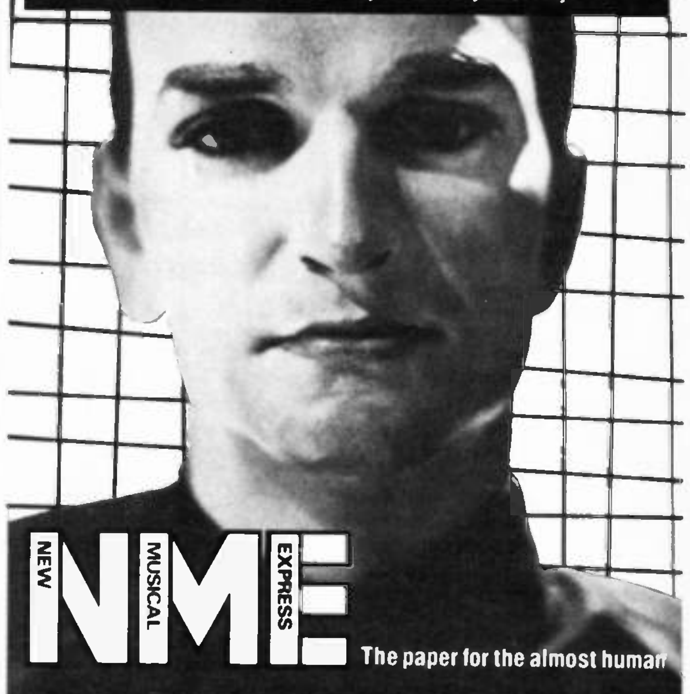
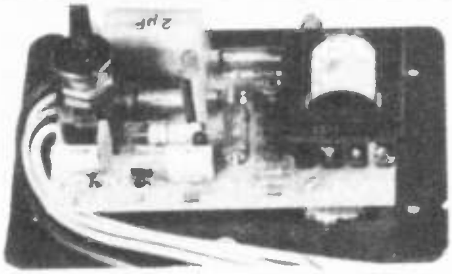


Pic of Kraftwerk dummy by Anton Corbijn.

ELECTRONIC IGNITION KIT



TOTAL ENERGY DISCHARGE

electronic ignition gives all the well known advantages of the best capacitive discharge systems.

PEAK PERFORMANCE ——— higher output voltage under all conditions.

IMPROVED ECONOMY ——— no loss of ignition performance between services.

FIRES FOULED SPARK PLUGS no other system can better the capacitive discharge system's ability to fire fouled plugs.

ACCURATE TIMING ——— prevents contact wear and arcing by reducing load to a few volts and a fraction of an amp.

SMOOTH PERFORMANCE —— immune to contact bounce and similar effects which can cause loss of power and roughness.

PLUS

SUPER POWER SPARK ——— 3½ times the energy of ordinary capacitive systems — 3½ times the power of inductive systems.

OPTIMUM SPARK DURATION 3 times the duration of ordinary capacitive systems — essential for use on modern cars with weak fuel mixtures.

BETTER STARTING ——— full spark power even with low battery.

CORRECT SPARK POLARITY unlike most ordinary C.D. systems the correct output polarity is maintained to avoid increased stress on the H.T. system and operate all voltage triggered tachometers.

L.E.D. STATIC TIMING LIGHT for accurate setting of the engine's most important adjustment.

LOW RADIO INTERFERENCE fully suppressed supply and absence of inverter 'spikes' on the output reduces interference to a minimal level.

DESIGNED IN RELIABILITY an inherently more reliable circuit combined with top quality components — plus the 'ultimate insurance' of a changeover switch to revert instantly back to standard ignition.

IN KIT FORM

it provides a top performance electronic ignition system at less than half the price of competing ready-built systems. The kit includes everything needed, even a length of solder and a tiny tube of heatsink compound. Detailed easy-to-follow instructions, complete with circuit diagram, are provided — all you need is a small soldering iron and a few basic tools.

AS REVIEWED IN ELECTRONICS TODAY MAGAZINE

JUNE '81 ISSUE
Quote "the kit is very impressive"
"well written instructions and a good performance".
"Exellent value for money. Highly recommended".

FITS ALL VEHICLES, 6 or 12 volt, with or without ballast
NEGATIVE EARTH ONLY

OPERATES ALL VOLTAGE IMPULSE TACHOMETERS
Some older current impulse types (Smiths pre '74) require an adaptor — PRICE £2.95

STANDARD CAR KIT £14.85 PLUS £1
TWIN OUTPUT KIT £22.94 U.K. P.&P.

For MOTOR CYCLES and CARS with twin ignition systems

Prices include V.A.T.

BARCLAYCARD VISA

ELECTRONIZE DESIGN
Magnus Road, Wilnecote,
Tamworth. B77 5BY
Phone 0827-281000

DIMENSIONS:

Length	12.5 cm
Width	8.9 cm
Height	4.3 cm
Lead length	100.0 cm

TECHNICAL DETAILS

The basic function of a spark ignition system is often lost among claims for longer 'burn times' and other marketing fantasies. It is only necessary to consider that, even in a small engine, the burning fuel releases over 5000 times the energy of the spark, to realise that the spark is only a trigger for the combustion. Once the fuel is ignited the spark is insignificant and has no effect on the rate of combustion. The essential function of the spark is to start that combustion as quickly as possible and that requires a high power spark.

The traditional capacitive discharge system has this high power spark but, due to it's very short spark duration and consequential low spark energy, is incompatible with the weak air/fuel mixtures used in modern cars. Because of this most manufacturers have abandoned capacitive discharge in favour of the cheaper inductive system with it's low power but very long duration spark which guarantees that sooner or later the fuel will ignite. However, a spark lasting 2000μS at 2000 rev/min. spans 24 degrees and 'later' could mean the actual fuel ignition point is retarded by this amount.

The solution is a very high power, medium duration, spark generated by the TOTAL ENERGY DISCHARGE system. This gives ignition of the weakest mixtures with the minimum of timing delay and variation for a smooth efficient engine.

SUPER POWER DISCHARGE CIRCUIT A brand new technique prevents energy being reflected back to the storage capacitor, giving 3½ times the spark energy and 3 times the spark duration of ordinary C.D. systems, generating a spark powerful enough to cause rapid ignition of even the weakest fuel mixtures without the ignition delay associated with lower power 'long burn' inductive systems.

HIGH EFFICIENCY INVERTER A high power, regulated inverter provides a 370 volt energy source — powerful enough to store twice the energy of other designs and regulated to provide sufficient output even with a battery down to 4 volts.

PRECISION SPARK TIMING CIRCUIT This circuit removes all unwanted signals caused by contact volt drop, contact shuffle, contact bounce, and external transients which, in many designs, can cause timing errors or damaging un-timed sparks. Only at the correct and precise contact opening is a spark produced. Contact wear is almost eliminated by reducing the contact breaker current to a low level – just sufficient to keep the contacts clean.

TYPICAL SPECIFICATION

	TOTAL ENERGY DISCHARGE	ORDINARY CAPACITIVE DISCHARGE
SPARK POWER (PEAK)	140 W	90 W
SPARK ENERGY (STORED ENERGY)	36 mJ 135 mJ	10 mJ 65 mJ
SPARK DURATION	500 μS	160 μS
OUTPUT VOLTAGE (LOAD 50pF EQUIVALENT TO CLEAN PLUGS)	38 KV	26 KV
OUTPUT VOLTAGE (LOAD 50pF + 500 KΩ EQUIVALENT TO DIRTY PLUGS)	26 KV	17 KV
VOLTAGE RISE TIME TO 20 KV (Load 50pF)	25 μS	30 μS

TOTAL ENERGY DISCHARGE should not be confused with low power inductive systems or hybrid so called reactive systems.

Goods normally despatched within 7 days

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