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DECEMBER 1978
VOLUME 54
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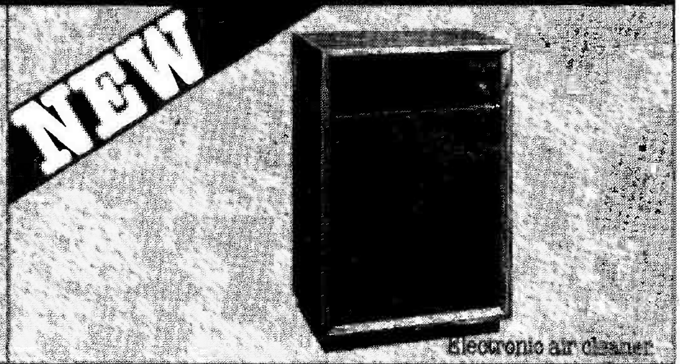

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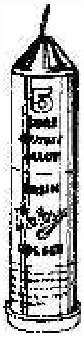

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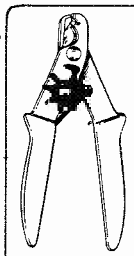

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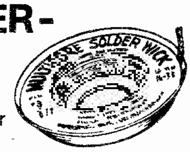

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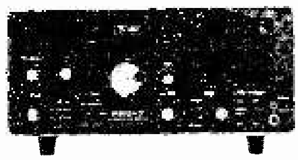

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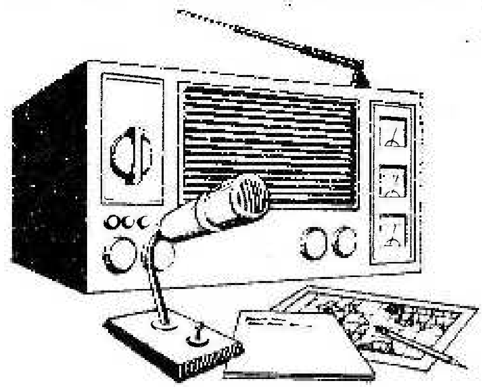

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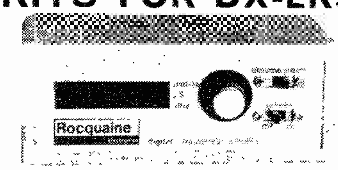

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BC109	0·13
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BC237	0·09*
BC238	0·12*
BC301	0·25
BC303	0·24
BC307	0·10*
BC308	0·10*
BC327	0·20*
BC328	0·18*
BC337	0·18*
BC338	0·17*
BCY30	1·00
BCY31	1·00
BCY32	1·00
BCY33	0·90
BCY34	0·90
BCY39	3·00
BCY40	1·00
BCY42	0·25
BCY43	0·25
BCY58	0·16
BCY70	0·15
BCY71	0·17
BCY72	0·13
BCZ11	1·50
BD115	0·45
BD121	1·20
BD123	1·20
BD124	1·30
BD131	0·35
BD132	0·38
BD135	0·34*
BD136	0·34*
BD137	0·35*
BD138	0·40*
BD139	0·43*
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BD182	1·18
BD237	0·40
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BDX32	2·00
BDY20	1·25
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BF115	0·25
BF152	0·18
BF153	0·20
BF154	0·17
BF159	0·23
BF160	0·16
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BF197	0·12*
BF200	0·27*
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BF244	0·28*
BF257	0·24
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BFX85	0·23
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BFY50	0·26
BFY51	0·26
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OC140	2·75
OC141	3·25
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OC201	1·75
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OC203	1·75
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T1P33A	1·69
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T1P42A	0·70
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T1P3055	0·56
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ZS271	0·23*
ZS278	0·57*
ZTX107	0·11*
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ZTX109	0·12*
ZTX300	0·12*
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1N916	0·07
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1N4006	0·08
1N4007	0·09
1N4009	0·06
1N4148	0·06
1N5400	0·13
1N5401	0·13
1S44	0·04
1S920	0·07
1S921	0·07
2G301	1·00
2G302	1·00
2G306	1·10
2N404	1·00
2N696	0·25
2N697	0·25
2N698	0·30
2N705	1·20
2N706	0·15
2N708	0·20
2N930	0·20
2N1131	0·26
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2N1613	0·25
2N1671	1·50
2N1893	0·25
2N2147	1·75
2N2148	1·65
2N2218	0·25
2N2219	0·24
2N2220	0·18
2N2221	0·18
2N2222	0·18
2N2223	2·75
2N2368	0·17
2N2369A	0·21
2N2484	0·20
2N2646	0·55
2N2904	0·25
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2N2906	0·21
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2N2924	0·21*
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2N2926	0·14*
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2N3054	0·50
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2N3440	0·60
2N3441	0·80
2N3442	1·10
2N3525	0·80
2N3614	1·50
2N3702	0·11*
2N3703	0·13*
2N3704	0·13*
2N3705	0·13*
2N3706	0·13*
2N3707	0·13*
2N3708	0·10*
2N3709	0·13*
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2N3711	0·10*
2N3771	1·75
2N3772	2·00
2N3773	3·80
2N3819	0·36*
2N3820	0·45*
2N3823	0·55*
2N3866	0·72
2N3904	0·13*
2N3905	0·13*
2N3906	0·13*
2N4058	0·14*
2N4059	0·10*
2N4060	0·12*
2N4061	0·12*
2N4062	0·13*
2N4124	0·15*
2N4126	0·15*
2N4286	0·20*
2N4288	0·22*
2N4289	0·24*
2N5457	0·35*
2N5458	0·35*
2N5459	0·35*

VALVES

AZ31	1·10*
CBL31	1·50
CL33	2·00*
CY31	1·00*
DAF91†	0·40*
DAF96	1·00*
DF91†	0·40*
DF96	1·00*
DK91†	0·55*
DK92	1·25*
DK96	1·10*
DL92	0·75*
DL94	1·20*
DL96	1·10*
DY86/7†	0·55*
DY802	0·80*
E88CC†	1·00
EABC80	0·55*
EAC91	0·50
EAF42	1·25*
EAF801	1·75*
EB41	2·00*
EB91†	0·40*
EBC33	1·75*
EBC41	1·25*
EBC81	1·10*
EBC90	0·75*
EBF80	0·50*
EBF83	1·25*
EBF89†	0·45*
EBL31	2·50*
EC40	1·25*
ECC81†	0·50*
ECC82†	0·47*
ECC83†	0·55*
ECC84†	0·60*
ECC85†	0·55*
ECC88†	0·75*
ECC91†	0·55*
ECC189	1·66*
ECF80†	0·60*
ECF82†	0·70*
ECH35	2·00*
ECH42	1·15*
ECH81†	0·55*
ECH83	0·85*
ECH84†	0·85*
ECL80†	0·60*
ECL82†	0·60*
ECL83	1·50*
ECL86†	0·85*
ECLL800	7·00*
EF37A†	2·50*
EF39†	1·60*
EF40	1·15*
EF41	1·20*
EF42	2·00*
EF50†	0·60*
EF80†	0·50*
EF83	1·75*
EF85†	0·50*
EF86†	0·60*
EF89	0·60*
EF91†	0·70*
EF92†	0·75*
EF98	1·25*
EF183†	0·70*
EF184†	0·70*
EH90	1·28*
EL32	1·50*
EL33	3·50*
EL41	1·25*
EL42	1·75*
EL81	1·10*
EL84†	0·45*
EL86†	0·75*
EL91	4·35*
EL95†	0·80*
EL360	2·75*
EM80	1·10*
EM81	1·00*
EM84	1·00*
EM85	1·25*
EM87	1·50*
EN91†	2·24*
EY51†	0·75*
EY86†	0·50*
EZ40	1·25*
EZ41	1·25*
EZ80†	0·50*
EZ81†	0·50*
EZ90†	0·60*
GZ32	0·75*
GZ33	4·00*
GZ34†	1·52*
KT61	3·50*
KT66	5·00*
KT88	6·25*
KTW61	1·75*
KTW62	1·75*
KTW63	1·75*
MU14	1·00*
N78	9·00*
OA2†	0·55
OB2†	0·60
OC3†	0·75
OD3†	0·75
OZ4	0·75*
PC86†	0·85*
PC88†	0·85*
PC97	1·08*
PC900†	1·00*
PCC84†	0·50*
PCC88	0·65*
PCC89†	1·05*
PCC189†	1·00*
PCF80	0·96*
PCF82†	0·50*
PCF86†	0·75*
PCF87†	1·10*
PCF200†	1·15*
PCF201†	1·10*
PCF801†	0·60*
PCF802†	0·88*
PCF805	1·44*
PCF806	1·44*
PCF808	1·44*
PCL82†	0·80*
PCL83†	0·92*
PCL84†	0·75*
PCL85†	0·96*
PCL86†	0·85*
PCL805/85†	0·96*
PD500	3·60*
PFL200	1·12*
PL36†	1·12*
PL81	1·12*
PL81A†	1·12*
PL82	0·60*
PL83†	0·55*
PL84†	0·75*
PL504/500†	1·20*
PL508†	1·60*
PL509†	2·72*
PL519†	3·60*
PL801	1·10*
PL802†	3·00
PY33	0·68*
PY81†	0·72*
PY82	0·55*
PY83	0·70*
PY88†	1·16*
PY500A†	1·60*
PY800/81†	0·92*
PY801	0·92*
QQV02-6	9·90
QQV03-10†	2·00
QQV03-20A†	10·50*
QQV06-40A†	13·00*
R17	1·65
R19	1·00
R20	1·44
U18-20	2·50*
U25	1·16*
U26	1·44*
UABC80†	0·58*
UAF42	0·75*
UB41	1·25*
UBC41†	1·00*
UBF89	0·60
UCC84	0·75*
UCC85†	0·55*
UCF80	0·75*
UCH42	1·20*
UCH81†	0·65*
UCL82†	0·75*
UCL83	1·44*
UF41	1·00*
UF80†	0·50*
UF85†	0·65*
UF89†	0·55*
UL41	1·00*
UL84†	0·85*
UM80	1·00*
UY41†	0·75*
UY85†	0·65*
1B3GT†	0·65*
1R5†	0·55*
1S5†	0·40*
1T4†	0·40*
2AS15	10·00
2D21†	0·80
3A5	1·35
3CX100A5	20·00
3S4†	0·75*
3V4†	1·00*
4CX250B	17·50
5R4GY†	1·10*
5U4G	1·52*
5U4GB	2·26*
5V4G†	0·65*
5Y3GT	0·65*
5Z3	1·50*
5Z4G	1·12*
5Z4GT	1·00*
6-30L2	1·56*
6AB7	0·75*
6AC7	0·75*
6AF4A†	0·70*
6AG7	0·75*
6AH6†	0·95*
6AK5†	0·50*
6AK6	0·95*
6AL5†	0·40*
6AM4	2·30*
6AM5	3·85*
6AM6†	0·70*
6AN5	2·50*
6AN8A†	0·70*
6AQ5†	0·85*
6AR5	0·70*
6AS6†	0·80*
6AS7G†	1·50*
6AT6†	0·75*
6AU5GT	4·26*
6AU6†	0·55*
6AV5GT	3·74*
6AV6†	0·75*
6AW8A†	1·00
6AX5GT	3·10*
6B7	0·75
6B8	0·75
6BA6†	0·50*
6BA7	5·12*
6BA8A	3·75
6BC4	3·71
6BE6†	0·48*
6BH6†	1·20*
6BJ6†	1·20*
GBK4	4·21*
6BL6	85·00
6BL7GT	3·86*
6BN6	0·80*
6BQ7A	1·55*
6BR7	4·00*
6BR8†	1·20*
6BS7	4·00*
6BW6	3·75*
6BW7	1·40*
6BX7GT	4·96*
6BZ6	1·78*
6C4†	0·55*
6CB6A†	0·55*
6CD6GA	4·90*
6CG7	1·72*
6CH6	4·42*
6CL6†	0·75*
6CW4	7·24*
6D2†	0·40*
6DK6	2·49*
6DQ6B	3·90*
6EA8	2·21*
6EB8	2·12*
6EW6	0·30*
6F6	0·75
6F23	1·60*
6F28	1·16*
6H2N	0·75*
6H3N	0·75*
6H6	0·75*
6J4†	·20*
6J6†	0·55*
6J7	0·80*
6K4N	0·75*
6K6GT	0·75*
6K7	0·75*
6K8	0·75*
6KD6	4·79*
6L6G	2·50*
6L6GA	1·50*
6L6GT	0·85*
6L6GC	1·95*
6L7	0·75
6N2P	0·75
6N3P	0·75
6N7	0·75*
6P25	3·60*
6Q7	0·80*
6R7	0·80*
6SA7	0·80*
6SC7	0·80*
6SF7	0·80*
6SH7	0·80*
6SJ7	0·80*
6SK7	0·80*
6SL7GT†	0·70*
6SN7GT†	0·70*
6SQ7	0·75*
6SR7	0·75*
6SS7	0·75*
6U5G	2·00*
6U8†	0·55*
6U8A†	0·55*
6V6GT†	0·65*
6X4†	0·60*
6X5GT†	0·60*
7B7	1·00*
7C5	1·75*
7C6	1·25*
7H7	1·00*
7R7	1·50*
7S7	2·25*
7Y4	0·75*
7Z4	0·75*
12AT6	0·45*
12AT7†	0·50*
12AU6	0·65*
12AU7†	0·47*
12AV6	0·85*
12AV7	3·46*
12AX7†	0·55*
12AY7†	0·85*
12B4A†	1·00*
12BA6	0·65*
12BE6	1·60*
12BH7†	0·65*
12BY7†	0·80*
12E1	7·10
30C15	1·56*
30C17	1·56*
30C18	1·44*
30F5	1·60*
30FL1/2	1·12*
30FL12	1·72*
30FL14	1·44*
30L1	0·84*
30L15	1·72*
30L17	1·72*
30P4	0·92*
30P19	1·12*
30PL1	1·32*
30PL13	1·72*
30PL14	1·68*
30PL15	1·72*
35W4	0·60*
50C5	0·70*
85A2	1·50
90AG	7·26
90AV	7·16
90C1	1·50
90CG	13·78
90CV	13·30
92AG	7·26
92AV	7·16
150B2	1·80
150C2	1·50
150C4	2·30
211	5·00
723AB†	8·00
807†	1·20
811A†	3·80
812A	8·35
813†	10·00
833A	30·00
866A	8·85
872A	13·75
931A	12·24
2050	2·50
5642	5·26*
5654	3·81*
5651	1·80*
5670	2·85*
5814A	2·60*
6080†	6·85*
6146A	5·58*
6146B	4·65*
6159	6·00
6442	15·00
6973	3·52*
7586	11·38*
7587	19·60*
7868	3·94*
8068	5·50
8136	2·44*

INTEGRATED CIRCUITS

7400	0·16
7401	0·16
7402	0·16
7403	0·16
7404	0·17
7405	0·16
7406	0·40
7407	0·40
7408	0·20
7409	0·20
7410	0·16
7412	0·26
7413	0·32
7416	0·32
7417	0·32
7420	0·17
7422	0·20
7423	0·32
7425	0·30
7427	0·30
7428	0·43
7430	0·17
7432	0·30
7433	0·36
7437	0·32
7438	0·32
7440	0·18
7441AN	0·85
7442	0·72
7447AN	1·90
7450	0·18
7451	0·18
7453	0·18
7454	0·18
7460	0·18
7470	0·35
7472	0·33
7473	0·36
7474	0·40
7475	0·54
7476	0·40
7480	0·55
7482	0·75
7483	0·90
7484	1·00
7486	0·35
7490	0·52
7491	0·80
7492	0·60
7493	0·60
7494	0·80
7495	0·72
7496	0·80
7497	3·00
74100	1·50
74107	0·45
74109	0·70
74110	0·50
74111	0·86
74116	1·75
74118	1·00
74119	1·50
74120	0·83
74121	0·40
74122	0·80
74123	1·00
74125	0·55
74126	0·55
74128	0·60
74132	0·70
74136	0·55
74141	0·80
74142	2·30
74143	2·50
74144	2·50
74145	0·90
74147	2·00
74148	1·75
74150	1·60
74151	0·85
74154	1·75
74155	0·85
74156	0·85
74157	0·75
74159	2·10
74170	2·30
74172	4·40
74173	1·40
74174	1·50
74175	0·90
74176	1·20
74178	1·25
74179	1·25
74180	1·15
74190	1·50
74191	1·50
74192	1·35
74193	1·35
74194	1·25
74195	1·00
74196	1·20
74197	1·10
74198	2·25
74199	2·25
76013N	1·75*
LM309K	1·50
TAA570	2·30*
TAA630S	3·50*
TBA480Q	1·84*
TBA520Q	2·30*
TBA530	1·98*
TBA540Q	2·30*
TBA550Q	3·22*
TBA560CQ	3·22*
TBA673	2·19*
TBA700	1·52*
TBA720Q	2·30*
TBA750Q	2·07*
TBA800	1·20
TBA920	2·90
TBA990Q	2·99*
TCA270Q	2·99*
TCA760A	1·38*

DIL Sockets

8 PIN	0·15
14 PIN	0·15
16 PIN	0·17

BASES

B7G unskirted	0·15
B7G skirted	0·30
B9A unskirted	0·15
B9A skirted	0·30
Int Octal	0·20
Loctal	0·55
8 pin DIL	0·15
14 pin DIL	0·15
16 pin DIL	0·17
Valve screening cans all sizes	0·30

CRT'S

1CP31	31·00
2AP1*	8·50
2BP1*	9·00
3BP1	8·00
3DP1*	5·00
3EG1*	7·00
3FP7*	3·00
3GP1	6·00
3JP1*	8·00
3JP2*	8·00
3JP7*	10·00
3KP1*	15·00
3RP1*	35·00
4EP1	25·00
4EP7	25·00
4EP11	25·00
5ADP1	35·00
5BP1*	10·00
5CP1*	5·00
5CP1A	40·00
5FP15A	5·00
5UP7*	5·00
DG7-5	25·00
DG7-32	36·00
DH3-91	31·00
DH7-11	68·00
VCR97*	5·00
VCR138*	10·00
VCR138A*	12·50
VCR139A*	8·00
VCR517A*	10·00
VCR517B*	6·00
VCR517C*	6·00
Tube Bases	0·75

* = Surplus
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NUTS AND BOLTS

BA BOLTS – packs of BA threaded cadmium plated screws slotted cheese head.
Supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
1in 0BA	839	£1·20	½in 4BA	846	£0·32
½in 0BA	840	£0·75	¼in 4BA	847	£0·25
1in 2BA	842	£0·65	1in 6BA	848	£0·40
½in 2BA	843	£0·45	½in 6BA	849	£0·21
¼in 2BA	844	£0·52	¼in 6BA	850	£0·25
1in 4BA	845	£0·44			

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

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

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

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

SOLDER TAGS – hot tinned supplied in multiples of 50.

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

SWITCHES

Description	No.	Price
DPDT miniature slide	1973	£0·11*
DPDT standard slide	1974	£0·14*
Toggle switch SPST 1½ amp 250V a.c.	1975	£0·33*
Toggle switch DPDT 1 amp 250V a.c.	1976	£0·42*
Rotary on-off mains switch	1977	£0·50*
Push switch – Push to make	1978	£0·13*
Push switch Push to break	1979	£0·18*

ROCKER SWITCH

A range of rocker switches SPST – moulded in high insulation. Material available in a choice of colours ideal for small apparatus.

Colour	No.	Price
RED	1980	£0·30*
BLACK	1981	£0·30*
WHITE	1982	£0·30*
BLUE	1983	£0·30*
YELLOW	1984	£0·30*
LUMINOUS	1985	£0·30*

Description	No.	Price
Miniature SPST toggle, 2 amp 250V a.c.	1958	£0·50*
Miniature SPDT toggle, 2 amp 250V a.c.	1959	£0·55*
Miniature DPDT toggle, 2 amp 250V a.c.	1960	£0·70*
Miniature DPDT toggle, centre off, 2 amp 250V a.c.	1961	£0·85*
Push button SPST, 2 amp 250V a.c.	1962	£0·78*
Push button SPDT, 2 amp 250V a.c.	1963	£0·83*
Push button DPDT, 2 amp 250V a.c.	1964	£0·98*

MIDGET WAFER SWITCHES

Single-bank wafer type – suitable for switching at 250V a.c. 100mA or 150V d.c. in non-reactiver loads make-before-break contacts. These switches have a spindle 0·25in dia. and 30° indexing.

Description	Order No.	Price
1 pole 12 way	1965	£0·48*
2 pole 6 way	1966	£0·48*
3 pole 4 way	1967	£0·48*
4 pole 3 way	1968	£0·48*

MICRO SWITCHES

Description	Order No.	Price
Button gives 1 pole change over action. Rating 10 amp 250V a.c.	1970	£0·25

FUSE HOLDERS AND FUSES

Description	Order No.	Price
20mm x 5mm chassis mounting	506	£0·07*
1¼in x ¼in chassis mounting	507	£0·12*
1¼in car inline type	508	£0·15*
Panel mounting 20mm	509	£0·20
Panel mounting 1¼in	510	£0·30

QUICK BLOW 20mm

Type	No	Price	Type	No	Price	Type	No	Price
150mA	611	6p	1A	615	5p	3A	619	5p
250mA	612	5p	1·5A	616	6p	4A	620	6p
500mA	613	5p	2A	617	5p	5A	621	5p
800mA	614	7p	2·5A	618	6p			

All 5p each excepting 616 which is 7p.

ANTI-SURGE 20mm

Type	No.	Type	No.	Type	No.
100mA	622	1A	625	2·5A	628
250mA	623	2A	626	3·15A	629
500mA	624	1·6A	627	5A	630

All 7p each

QUICK BLOW 1¼in

Type	No.	Type	No.	Type	No.
250mA	631	500mA	632	800mA	634

All 7p each

Type	No.	Type	No.	Type	No.
1A	636	2·5A	638	4A	641
		3A	639	5A	642
2A	637				

All 6p each

CASES AND BOXES

INSTRUMENT CASES. In two sections vinyl covered top and sides, aluminium bottom, front and back.

No.	Length	Width	Height	Price
155	8in	5¼in	2in	£1·52*
156	11in	6in	3in	£2·12*
157	6in	4¾in	1¾in	£1·30*
158	9in	5¼in	2½in	£1·76*

ALUMINIUM BOXES. Made from bright ali., folded construction each box complete with half inch deep lid and screws.

No.	Length	Width	Height	Price
159	5¼in	2¼in	1½in	62p
160	4in	4in	1½in	62p
161	4in	2¼in	1½in	62p
162	5¼in	4in	1½in	70p
163	4in	2½in	2in	64p
164	3in	2in	1in	44p
165	7in	5in	2½in	£1·04
166	8in	6in	3in	£1·32
167	6in	4in	2in	86p

METAL FOIL CAPACITOR PAK

Containing 50 metal foil Capacitor—like Mullard C280 series. Mixed values ranging from ·01uf—2·2uf. Complete with identification sheet O/N 16204 **£1·20***

TRANSFORMERS

MINIATURE MAINS Primary 240V

No.	Secondary	Price
2021	6V-0-6V 100mA	90p*
2022	9V-0-9V 100mA	90p*
2023	12V-0-12V 100mA	95p*

MINIATURE MAINS Primary 240V with two indebendent secondary windings

No.	Type	Price
2024	MT280-0-6V, 0-6V RMS	£1·50*
2025	MT150-0-12V, 0-12V RMS	£1·50*

1 AMP MAINS Primary 240V

No.	Secondary	Price	
2026	6V 0 6V 1 amp	£2·50*	P. & P. 45p
2027	9V 0 9V 1 amp	£2·00*	P. & P. 45p
2028	12V 0 12V 1 amp	£2·60*	P. & P. 55p
2029	15V 0-15V 1 amp	£2·75*	P. & P. 66p
2030	30V 0 30V 1 amp	£3·45*	P. & P. 86p

STANDARD MAINS Primary 240V
Multi tapped secondary mains transformers available in ½ amp, 1 amp and 2 amp current rating. Secondary taps are 0-19 25 33 40-50V.
Voltages available by use of taps:
4, 7, 8, 10, 14, 15, 17, 19, 25, 31, 33, 40, 25-0-25V

No.	Rating	Price	
2031	½ amp	£5·50*	P. & P. 86p
2032	1 amp	£6·60*	P. & P. 86p
2033	2 amp	£8·40*	P. & P. £1·10

AUDIO LEADS

107	FM Indoor Ribbon Aerial	£0·60*
113	3.5mm Jack plug to 3.5mm jack plug. Length 1.5m	£0·75*
114	5 pin DIN plug to 3.5mm. Jack connected to pins 3&5. Length 1.5m	£0·85*
115	5 pin DIN plug to 3.5mm. Jack connected to pins 1&4. Length 1.5m	£0·85*
116	Car aerial extension. Screened insulated lead. Fitted plug & skt.	£1·10*
117	AC mains connecting lead for cassette recorders & radios. 2 metres	£0·68*
118	5 pin DIN phono plug to stereo headphone jack socket	£1·05*
119	2+2 pin DIN plugs to stereo jack socket with attenuation network for stereo headphones. Length 0.2m	£0·90*
120	Car stereo connector. Variable geometry plug to fit most car cassette, 8 track cartridge & combination units. Supplied with inline fused power lead and instructions.	£0·60*
123	6.6m Coiled Guitar Lead Mono Jack Plug to Mono Jack Plug BLACK	£1·50*
124	3 pin DIN plug to 3 pin DIN plug. Length 1.5m	£0·75*
125	5 pin DIN plug to 5 pin DIN plug. Length 1.5m	£0·75*
126	5 pin DIN plug to Tinned open end. Length 1.5m	£0·75*
127	5 pin Din plug to 4 Phono Plugs. All colour coded. Length 1.5m	£1·30*
128	5 pin DIN plug to 5 pin DIN socket. Length 1.5m	£0·80*
129	5 pin DIN plug to 5 pin DIN plug mirror image. Length 1.5m	£1·05*
130	2 pin DIN plug to 2 pin DIN inline socket Length 5m	£0·68*
131	5 pin DIN plug to 3 pin DIN plug, 1&4 and 3&5. Length 1.5m	£0·83*
132	2 pin DIN plug to 2 pin DIN socket. Length 10m	£0·98*
133	5 pin DIN plug to 2 phono plugs. Connected pins 3&5. Length 1.5m	£0·75*
134	5 pin DIN plug to 2 phono sockets. Connected pins 3&5. Length 23cm	£0·68*
135	5 pin DIN socket to 2 phono plugs. Connected pins 3&5. Length 23cm	£0·68*
136	Coiled stereo headphone extension lead. Black. Length 6m	£1·75*
178	AC mains lead for calculators etc.	£0·68*

ELECTROLYTIC PAKS

A range of paks each containing 18 first quality, mixed value miniature electrolytics.

16201—values from ·47mFD—10mFD	60p*
16202—values from 10mFD—100mFD	60p*
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V.A.T. Add 12½% to prices marked*, 8% to those unmarked. Items marked are zero rated.
P&P. 35p unless otherwise shown.

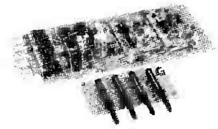
BI-PAK

DEPT. PW12, P.O. Box 6, Ware, Herts
COMPONENTS SHOP: 18 BALDOCK STREET, WARE, HERTS.

High quality audio modules for Stereo and mono

S450

STEREO FM TUNER Fitted with phase lock-loop



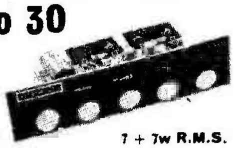
£22·30 + 40p p&p + 12½% VAT

FREQUENCY RANGE	88–108 Mhz
SENSITIVITY	3·0 μV
BANDWIDTH	250 kHz
SPURIOUS REJECTION	50 dB
SELECTIVITY ± 400 kHz	55 dB
AUDIO OUTPUT (±2 kHz deviation)	100 mV
STEREO SEPARATION	30 dB
SUPPLY REQUIREMENTS	20 to 30V (90mA max)
AERIAL IMPEDANCE	75 ohms
DIMENSIONS	240mm × 110mm × 32mm

The 450 Tuner provides instant programme selection at the touch of a button ensuring accurate tuning of 4 pre-selected stations, any of which may be altered as often as you choose, simply by changing the settings of the pre-set controls. Features include FET input stage. Vari-Cap diode tuning. Switched AFC LED Stereo Indicator.

Stereo 30

COMPLETE AUDIO CHASSIS



£18·95 + 40 p&p + 12½% VAT

7 + 7w R.M.S.

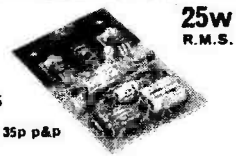
OUTPUT POWER	7 Watts RMS
LOAD IMPEDANCE	8 ohms
TOTAL HARMONIC DISTORTION	Less than ·5% (Typically ·3%)
FREQUENCY RESPONSE	50 Hz to 20 kHz ± 3dBs
TONE CONTROL RANGE	± 12 dBs at 100Hz and 10kHz
SENSITIVITY	190 mV for full output
INPUT IMPEDANCE	1 M ohms
TRANSFORMER REQUIREMENTS	22 V.A.C. rated at 1A
DIMENSIONS (Less controls and panel)	200mm × 130mm × 33mm

The Stereo 30 comprises a complete stereo pre-amplifier, power amplifiers and power supply. This, with only the addition of a transformer or overwind will produce a high quality audio unit suitable for use with a wide range of inputs i.e. high quality ceramic pick-up, stereo tuner, stereo tape deck etc. Simple to install, capable of producing really first class results, this unit is supplied with full instructions, black front panel, knobs, main switch, fuse and fuse holder and universal mounting brackets.

AL60

AUDIO AMPLIFIER MODULE 25 Watts RMS

25w R.M.S.



£4·55 + 35p p&p + 12½% VAT

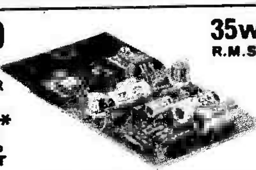
OUTPUT POWER	25 Watts RMS
SUPPLY	30–50 V
LOAD IMPEDANCE	8–16 ohms
TOTAL HARMONIC DISTORTION	Less than ·1% (Typically ·06%)
FREQUENCY RESPONSE	20 Hz to 30 kHz × 2 dBs
SENSITIVITY	280 mV for full output
MAX. HEAT SINK TEMPERATURE	90°C
DIMENSIONS	103mm × 64mm × 15mm

This high quality audio amplifier module is for use in audio equipment and stereo amplifiers and provides output powers up to 25 RMS with distortion levels below 0·1%.

AL80

AUDIO AMPLIFIER MODULE

35w R.M.S.



£7·15* + 35p p&p + 8% VAT

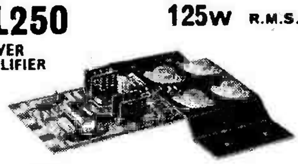
OUTPUT POWER	35 Watts RMS
SUPPLY	40–60 V
LOAD IMPEDANCE	8–16 ohms
TOTAL HARMONIC DISTORTION	Less than ·1% (Typically ·06%)
FREQUENCY RESPONSE	20 Hz to 30 kHz × 2 dBs
SENSITIVITY	280 mV for full output
MAX. HEAT SINK TEMPERATURE	90°C
DIMENSIONS	103mm × 64mm × 15mm

The AL80 is similar in design to the AL60 above and is of the same high quality but provides output powers up to 35W with distortion levels below 0·1%.

AL250

POWER AMPLIFIER

125w R.M.S.



£17·25* + 40p p&p + 8% VAT

OUTPUT POWER	125 Watts RMS continuous
OPERATING VOLTAGE	50–80 V
LOADS	4–16 ohms
FREQUENCY RESPONSE	25 Hz 20 kHz measured at 100 Watts
SENSITIVITY FOR 100 WATTS O/P AT 1 kHz	450 mV
INPUT IMPEDANCE	33 K ohms
TOTAL HARMONIC DISTORTION 50 WATTS into 4 ohms	0·1%
50 WATTS into 8 ohms	0·06%

This unit, designated AL250, is a power amplifier providing an output of up to 125W RMS, into a 4 ohm load.

AL30A

AUDIO AMPLIFIER MODULES

10w R.M.S.

£3·75 + 35p p&p + 12½% VAT

MAXIMUM SUPPLY VOLTAGE	30 V
POWER OUTPUT for 2% THD	10 Watts RMS
TOTAL HARMONIC DISTORTION	Less than ·25%
LOAD IMPEDANCE	8–16 ohms
INPUT IMPEDANCE	100 K ohms
FREQUENCY RESPONSE	50 Hz–25 kHz ± 3 dBs
SENSITIVITY	75 mV for full output
DIMENSIONS	74mm × 63mm × 28mm

These low cost 5 and 10 watt modules offer the utmost in reliability and performance, whilst being compact in size.

SPM80

STABILISED POWER SUPPLY

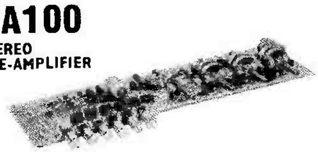
£4·25 + 35p p&p + 12½% VAT

INPUT A.C. VOLTAGE	33–40V
OUTPUT D.C. VOLTAGE	33 V nominal
OUTPUT CURRENT	10 mA–1·5 amps
OVERLOAD CURRENT	1·7 amps approx.
DIMENSIONS	105mm × 63mm × 30mm

Designed to power two AL60s at 15 Watts per channel simultaneously. Circuit Techniques include full short circuit protection.

PA100

STEREO PRE-AMPLIFIER



£15·80 + 40p p&p + 12½% VAT

FREQUENCY RESPONSE	20 Hz to 20 kHz × 1 dB	
TOTAL HARMONIC DISTORTION	Less than ·1% (Typically ·07%)	
SENSITIVITY INPUTS 1. TAPE	100 mV/100 K ohms	For an output 250 mV
2. RADIO TUNER	100 mV/100 K ohms	
3. MAGNETIC P.U.	3·5 mV/50 K ohms	
EQUALISATION	Within ± 1 dB from 20 Hz to 20 kHz	
BASS CONTROL RANGE	± 15 dBs at 75 Hz	
TREBLE CONTROL RANGE	+ 10–20 dBs at 15 kHz	
SIGNAL/NOISE RATIO	Better than 65 dBs (All inputs)	
INPUT OVERLOAD	Better than 26 dBs (All inputs)	
SUPPLY	20 to 40 V	
DIMENSIONS	300 × 90 × 33mm (less controls)	

A top quality stereo pre-amplifier and tone control unit, the PA100 provides a comprehensive solution to the front end requirements of stereo amplifiers or audio units. The six push button selector switch gives a choice of inputs together with two filters for high and low frequencies.

MPA30

MAGNETIC CARTRIDGE PRE-AMPLIFIER

£2·95 + 35p p&p + 12½% VAT

Enjoy the quality of a magnetic cartridge with your existing ceramic equipment using the MPA 30 which is a high quality pre-amplifier enabling magnetic cartridges to be used where facilities exist for the use of ceramic cartridges only.

SENSITIVITY	3·5 mV for 100 mV output
EQUALISATION	Within ± 1 dB from 20 Hz to 20 kHz
INPUT IMPEDANCE	50 K ohms
SUPPLY	18 to 30 V—re earth
DIMENSIONS	110 × 50 × 25mm (inc DIN socket)

PA12

STEREO PRE-AMPLIFIER

£7·10 + 30p p&p + 12½% VAT

The PA12 Stereo Pre-Amplifier chassis is designed and recommended for use with the AL 20/30 Audio Amplifier Modules, the PS12 power supply and the T538 Transformer. Features include on/off volume, Balance, Bass and Treble controls. Complete with tape output.

FREQUENCY RESPONSE	20 Hz–20 kHz (—3dB)
BASS CONTROL	± 12 dB at 60 Hz
TREBLE CONTROL	± 14 dB at 10 kHz
INPUT IMPEDANCE	1 Meg. ohm
INPUT SENSITIVITY	300 mV
CROSSTALK	—60 dB
SIGNAL/NOISE RATIO	—65 dB
OVERLOAD FACTOR	± 20 dB
TAPE OUTPUT IMPEDANCE	25 K ohms
DIMENSIONS	152mm × 84mm × 25mm

PS12 POWER SUPPLY

Designed for use with the AL30A S.450 and MPA30 in conjunction with transformer T538.

INPUT VOLTAGE	17–20v AC
OUTPUT VOLTAGE	27–30v DC
OUTPUT CURRENT	800mA
SIZE	60mm × 43mm × 26mm

£1·30 + 35p p&p + 12½% VAT

GE 100 NINE CHANNEL MONO-GRAPHIC EQUALIZER

The GE100 has nine 1 octave adjustments using integrated circuit active filters. Boost and Cut limits are ± 12dB. Max. Voltage handling 2 V RMS, T.H.O., 0·05%, input impedence 100K. Output impedence less than 10 K. Frequency response 20 Hz -20 KHz (3dB). The nine gain controls are centred at 50, 100, 200, 400, 800, 1,600, 3,200, 6,400 and 12,800 Hz. The suggested gain controls are 10 K LIN sliders (not supplied with the module) See Paks S31 and 16192.

£22·00 + 35p p&p + 12½% VAT

SG30 POWER SUPPLY BOARD for GE100 15-0-15 VOLT **£5·50 + 12½% VAT + 35p p&p**

SIREN ALARM MODULE

American Police screamer powered from any 12 volt supply into 4 or 8 ohm speaker. Ideal for car burglar alarm, freezer breakdown and other security purposes. Order No. S15. No. BP124.
Only £3·50 + 8% VAT + 35p p&p

MA60 HI-FI AMPLIFIER KIT

Build you own top quality amplifier, save yourself pounds. The MA60 kit comprises the following BI-kits modules, 2 × AL60 amps, 1 × PA100 pre-amp, 1 × SPM80 stab. power supply, 1 × BMT80 transf. giving 17 watts RMS per channel STEREO. All modules covered by the BI-PAK satisfaction or money back guarantee. Details of the above modules are in this ad.
Price £32·00 + 12½% VAT + 62p p&p.

TC60 KIT

A beautifully designed genuine TEAK WOOD veneered cabinet to put the professional touches to your home built amplifier. Full set of parts incl. Front & Back Panels, Knobs, Chassis, Fuses, Sockets, Noen, etc. Ideal for the MA60. Size: 425mm × 280mm × 95mm.
Price £19·95 + 12½% VAT + 86p p&p

TRANSFORMERS

T538 For use with S.450 AL30A MPA30
Order No. **2036** Price: **£3·20** + 55p p&p + 12½% VAT
T2050 For use with Stereo 30
Order No. **2050** Price: **£3·25** + 55p p&p + 12½% VAT
BMT80 For use with AL60 SPM80
Order No. **2034** Price: **£5·40** + 86p p&p + 12½% VAT
BMT250 For use with AL250
Order No. **2035** Price: **£6·35** + £1·10 p&p + 12½% VAT

BI-PAK

DEPT.PW12, P.O.Box6, Ware, Herts

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Happenings

THE month of November 1978 sees two unusual events in the United Kingdom. One, and that with the most widespread effect on the population both here and abroad, is the major reshuffle of frequencies in the medium and long wave broadcast bands effective on 23rd November. Since the first provisional plans were published earlier in the year, there have been a number of revisions, and the additional long-wave channel on 227kHz will not now be used by BBC Radio 4. Full details of the changes as they affect UK programmes are given elsewhere in this issue. The BBC has spent £3 million on new m.f. and l.f. transmitters in an effort to improve reception of its services after the changeover date. Let's hope it proves to have been worthwhile!

Undoubtedly the shift of Radio 4 to the long waveband will inconvenience many listeners whose receiver does not cover that band. Already, several designs have appeared for converters, which transpose the signals received on 200kHz to a channel in the medium waveband. In this issue we feature a unit suitable for use with a car radio, and we hope to publish one for portable radios in the very near future. The loss of 647kHz to the Overseas Services is a great pity.

If you're thinking of buying a new receiver, make sure it includes medium, long and v.h.f. bands for the best choice of programmes. If you want a new tuner for your hi-fi system, why not build the *PW* Dorchester?

The other event is the first staging of a new exhibition intended specifically for the amateur electronics constructor and experimenter. It's called "Breadboard 78" and it's on at the Seymour Hall, Seymour Place, London W1 from 21—25th November, daily from 10 am to 7 pm. Some sixty manufacturers and retailers, many of them regular advertisers in *PW*, will be exhibiting and there should be lots of interesting things to see.

Practical Wireless will be there showing a selection of projects, past, present and future, and we hope we'll see you there too.

PW PERSONALITY

Sylvia M. Barrett—Secretary

On leaving secretarial college, Sylvia, an Essex girl, got her first job with the British India shipping company in their London dock office. When her parents and brother Ray moved to Dorset, she and her husband Richard soon followed, a change they never regretted.

Before joining Practical Wireless last year, Sylvia worked for two large local electronic/engineering companies and for several years had her own small business which included long-distance chauffeuring. She also assists in running a local taxi firm with her husband, a qualified Company Secretary.

An avid sun worshipper, Sylvia loves to travel abroad to countries where the sun is hottest. Besides her secretarial work, she enjoys dressmaking, driving and motor-cycling, but her favourite pastime is Latin & Ballroom dancing, in which she and Richard have won many competition and examination awards.

NEWS... NEWS... NEWS...

Goonhilly 4

On 5th September 1978, Marconi Communication Systems Limited, formally handed over the new Goonhilly 4 earth terminal to the Post Office.

Designed for use with the next generation of communication satellites operating in the 11/14GHz frequency bands the new terminal was built as a joint-venture project with the Department of Industry, the Post Office and Marconi.

The equipment includes a 19-metre diameter antenna with a four reflector beam feed for frequency re-use, 2kW power amplifiers, up and down converters and high speed (120Mbit/s) digital modems.

Goonhilly 4 will be initially used with Europe's Orbital Test Satellite, OTS2, (forerunner to the European Communications Satellite, ECS) which was launched on 11th May, 1978 to prove the technology for digital satellite communications in the 11/14GHz frequency bands. The results of the OTS test programme will be particularly relevant to the 1980's when 11/14GHz operation will be used for the European and other regional satellite communication systems and for international services via Intelsat V.

Club news

The following clubs inform me that they would like to increase their membership and would like to extend a welcome to anyone caring to attend their meetings.

First, the North Bristol Amateur Radio Club—G4GCT, who meet at the Lockeaze Community Association, Romney Avenue, Bristol, every Friday at 1900hrs.

The club has a Trio FT.200 transceiver, feeding into a trap dipole and recently installed an 8-element 2m beam, they also hold an RAE class during the winter.

Further details from *W. G. R. Wilby G2BSU, 10 Wolseley Road, Bristol BS7 8EN.*

Next, the Wisbech Radio Club—G8NED, who meet fortnightly in the private bar, of The Five Bells public house, Parson Drove (which is 5 miles west of Wisbech).

Further details from *J. Arnold G8NPH, 5 Princes Road, Wisbech, Cambs PE13 2PG.*

Finally, the Scottish v.h.f. and s.w. DXers Club, who specialise in v.h.f., (bands 1, 2 and 3) and u.h.f. DXing. They meet every second Saturday of the month at 1430hrs in members' homes.

The club operates a 'net' to alert members to 'openings', be they tropospheric or sporadic-E and would be interested in hearing from other enthusiasts in Scotland, Cumbria, Northumbria and Northern Ireland. In fact, anyone actively interested in anything above 30MHz is more than welcome.

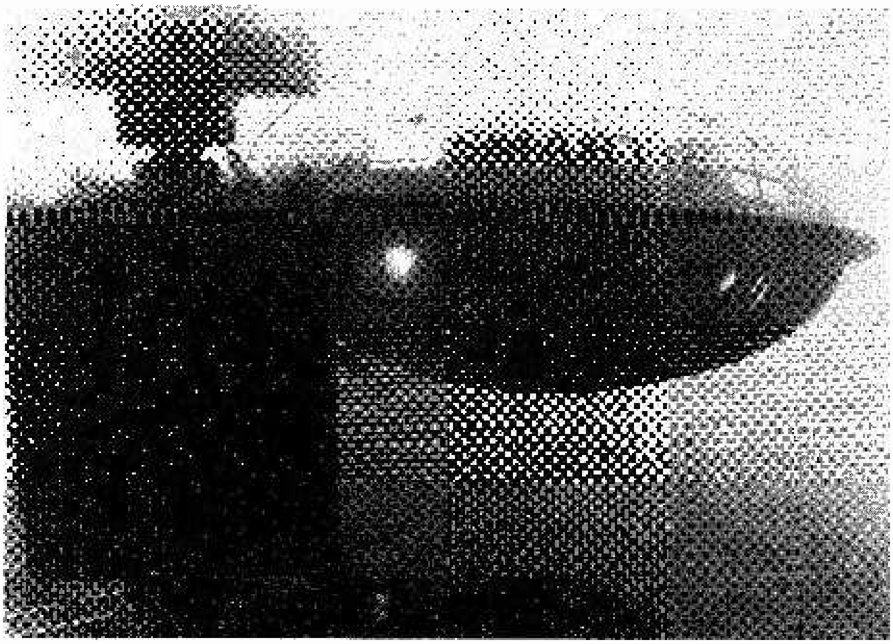
Further details from *Frank Luman, 2 Ormonde Drive, Glasgow G44 3SJ. Tel: 041-637 5958.*

SMARTIE

A completely new type of microcomputer-controlled unmanned inspection system, built to operate in the poor visibility and hostile operating conditions of the North Sea, has been launched by Richmond-based Marine Unit Technology Limited.

The new system is code-named SMARTIE (Submarine Automatic Remote Television Inspection Equipment). It is elliptical in cross-section and is basically a highly mobile underwater vehicle equipped with a battery of underwater t.v. cameras. These will consist of at least one low-light silicon intensified target (SIT) camera and a high resolution vidicon camera. The vehicle is driven by an elctrically-powered submersible pump and is therefore propellerless.

Apart from the relatively straightforward procedures of interpreting manually, input control signals from the operator's console, and controlling vehicle speed and direction. For low visibility work, the microcomputer can accept input from the submersible's magnetic compass and gyro, and project an artificial navigation 'target' which the operator can follow on his video screen even though the craft may be passing through an area of zero visibility.



The vehicle will be supplied with power and control signals by a single umbilical cable under 0·5cm in diameter. The video signal will be continuously transmitted back to the surface via the same cable, unlike most unmanned submersibles that are supplied by very bulky multicore cables which can present very real problems of signal interaction and physical drag by the cable on the vehicle.

SMARTIE will not be sold to the offshore industry for the time being. Instead, a complete underwater inspection will be offered.

Marine Technology Ltd., 3 Friars Lane, Richmond, Surrey TN9 1NL.

ADD-ON RECEIVER ACCESSORIES

ERIC DOWDESWELL G4AR

The short-wave listener with his first communications receiver cannot be expected to get the best from it until a fair amount of time has been spent listening and getting the feel of the set, and of s.w. propagation conditions. There will be a tendency to cast an eye on the ads in various radio magazines for add-on accessories which claim to give improved reception.

Whether they will or not much depends upon the receiver. If it is from the highest price bracket it is very unlikely that much can be done externally to improve it. Indeed, any additions would be an insult to the designer! If, however, the set is really basic, without an r.f. stage and only simple ceramic filters in the i.f. stage/s and a conventional audio output stage, then it is going to need all the help it can get.

This article sums up the pros and cons of add-on units because they make excellent DIY projects and most can be bought in kit form or ready-built. But, remember, all of them, except a passive audio filter, will add some noise to the normal noise of the set. What we want is less noise and more signal and the simplest way of achieving that is probably cheapest. A better aerial system! Add-on units fit the bill because they restrict the bandwidth being amplified, at the r.f. input, at the i.f. stage or in the audio circuits.

Preselectors

A common tendency, where a listener considers that signals ought to be stronger, is to add a preselector (sometimes referred to as a pre-amplifier, wrongly in my opinion, as this term is usually reserved for audio work). If the receiver already has one or more r.f. stages then the preselector may prove to be worse than useless, causing increased cross-modulation, especially where strong signals are concerned. If the set has no r.f. stage at all then a preselector will be very worthwhile.

When obtaining a preselector make sure that it is a tuneable one and not aperiodic (wideband) and that it covers the s.w. bands on the receiver with which it is to be used. It must be connected to the receiver with proper coaxial cable, such as that used on TV installations, using proper coaxial fittings as it is essential that the signals reach the receiver via the preselector and not through any unscreened wire connected to the aerial terminal of the set.

The band switch should include a position where the aerial is switched directly to the receiver, eliminating the preselector and, generally, turning off the power supply to the preselector. Not an essential feature but highly desirable. An r.f. gain control is essential but if one is not fitted it is an easy matter to modify the preselector.

When using the preselector, first switch it to the straight-through position and tune the set to a steady but not too strong signal in, say, the 19m band, with the set's r.f. gain about half way. Switch in the preselector on the appropriate range and tune it for an increase in signal strength, which should be very marked. Note if there are any spurious signals that were not on the original signal. If there are this is a sign of internally generated cross-modulation and the r.f. gain on the preselector should be reduced until the spurious signals disappear.

Always ensure that the preselector is tuned "on the nose" to any signal being received and **never** detune it to act as a volume control. If a calibrated dial is fitted check that the frequency at which it peaks corresponds, more or less, to the signal frequency. At the higher frequencies it is very easy to tune the preselector to the second channel frequency which produces a marked increase in noise but no increase in wanted signal strength.

If, for example, the wanted signal is on 15050kHz then the second channel frequency is 15050kHz plus twice the set's i.f., usually around 470kHz, making 15990kHz which is not so far removed, as far as the tuned circuit is concerned, from 15050kHz. Many a preselector has been condemned because it has been tuned wrongly.

A preselector is sometimes chosen because it is thought that it will improve the "selectivity" of a receiver. This refers to the problem of adjacent channel selectivity where the preselector cannot help to any marked degree, but it does greatly reduce the second channel interference, previously referred to, by introducing more tuned circuits at the signal frequency.

Preselectors tend to be of more use at the higher frequencies especially if the main receiver is an older one lacking in sensitivity at the h.f. end. Do not be afraid to switch the preselector in and out of circuit to see if it is really effective. Sometimes it will be found to be an improvement and sometimes not, much depending upon the frequency involved.

Q-Multipliers

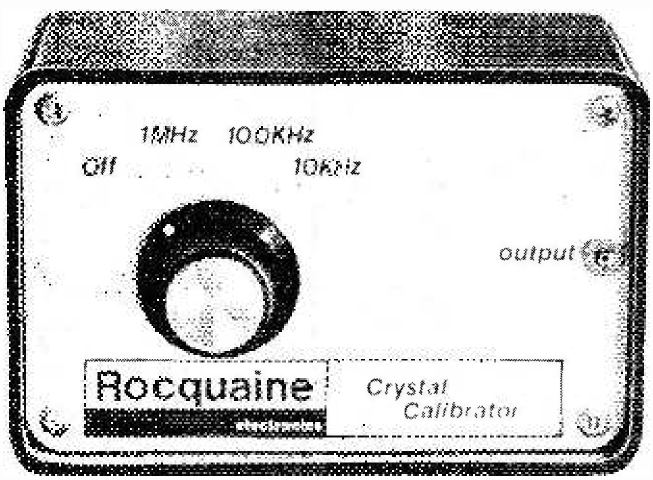
Adjacent channel selectivity is the main failing of most communication receivers, especially the cheaper variety, and, come to think of it, the not-so-cheap ones now available. Selectivity is governed entirely by the quality of the i.f. filters, generally the one immediately following the mixer stage. Ceramic filters are frequently extolled today as being the best, but only because they are cheaper for the set manufacturer and eliminate expensive alignment time. The three usual modes of reception in which we are interested, a.m., a.m.(s.s.b.) and c.w. all require different i.f. bandwidths for optimum reception and a single bandwidth i.f. filter can only be a compromise. Unfortunately, separate filters can make a receiver rather expensive.

The only external aid to improved i.f. selectivity is some form of "Q-multiplier" which can be wired into the set with a couple of screened leads and virtually no modification to the set itself. In effect it extracts some of the i.f. signal and passes it through the external i.f. stage and back into the set. The external stage, or Q-multiplier, has a feedback control which allows the bandwidth to be sharpened up thus improving the selectivity, often to the point where the multiplier goes into oscillation. It only peaks signals over a comparatively narrow band of frequencies, rather than producing the ideal square-topped bandwidth characteristic, but it can be very effective for c.w. reception.

When buying or making a Q-multiplier ensure that its operating frequency is the same as that of the set to which it is going to be fitted. There is usually some form of adjustment to peak it to the i.f. after installation. Like the preselector there should be an "off" position that effectively by-passes the Q-multiplier.

Calibrators

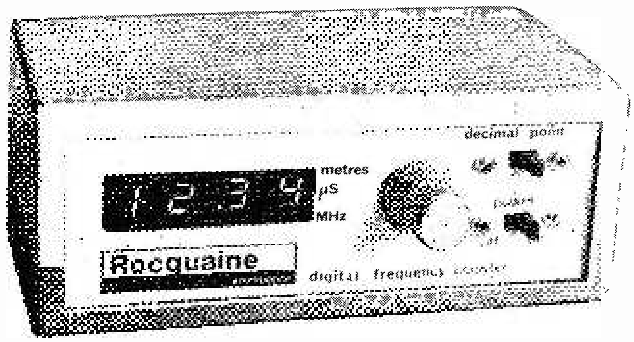
No receiver should be used without some means of checking its calibration instantly. The better sets will have an internal crystal oscillator operating on 100kHz producing markers at that interval throughout the s.w. bands. Sets intended for the US market may have this broken down to 25kHz for checking the limits of the mandatory sub-bands in that country.



Rocquaine Electronics produce this crystal calibrator, an important accessory for a communications receiver

My own preference is for an external 1MHz crystal oscillator divided down to provide outputs at 100kHz and 10kHz, in addition to the fundamental 1MHz. After that it is not difficult to interpolate down to 1kHz especially if there is a decent bandspread dial on the receiver, which is quite sufficient to pinpoint an amateur or broadcast station for reference purposes.

The output of the calibrator is inserted into the set at the aerial terminal, again using coaxial cable. If possible fit a three-way wafer switch to provide "aerial only", "aerial plus calibrator" and "calibrator only". If the aerial is permanently connected then marker signals can often be lost or difficult to locate among other signals.



DFM from Roquaine Electronics operates up to 40MHz. It can be coupled to the receiver to provide direct readout of frequency. Unusually, wavelength can also be displayed

It is desirable for the receiver to have some means of either moving the dial cursor line or the frequency of the local oscillator in order to bring the set's calibration into line on any range. A small value tuning capacitor is often used in parallel with the oscillator section of the ganged tuning capacitor or an additional potentiometer if the oscillator is varicap tuned. Then the nearest calibration point on the dial can be made to agree with a marker signal from the calibrator, around the frequency of the station being checked.

My own method of measuring a station's frequency is to first note the approximate frequency and then check the 100kHz points on the set's dial against the calibrator, either side of the station, adjusting the vernier control if necessary to make the dial and calibrator agree. Then the 10kHz markers are switched on and counted down or up from one of the 100kHz markers. The station finishes up between two 10kHz points after which the frequency can be estimated to about a kilohertz. Sounds longwinded but, in fact, can be done in seconds, with some practice.

Note that all the usual causes of frequency drift in a set such as mains variations, temperature changes, vibration, etc., are eliminated by checking against a crystal standard over a very short period of some seconds only. Some experts recommend the preparation of calibration charts for every range of a receiver, checking every 100kHz point against the standard and noting the difference. This is an extremely tedious and entirely unnecessary procedure and certainly unreliable. A heavy knock or an enforced repair to the set and all the work done in preparing the graphs has gone down the drain, apart from the uncertainty of all the other factors previously noted.

One more point to watch. Ensure that the signal is tuned in for maximum strength, preferably using the S-meter if one is fitted, rather than relying upon the ear. The beat frequency oscillator should be used when making these frequency measurements and must be correctly adjusted and checked again from time to time.

To set the b.f.o., turn it off, tune in a reasonably strong signal, on the m.w. band if possible, where it is more likely to be steady in strength, again using the S-meter, then switch on the b.f.o. and adjust the beat frequency to zero. This point should coincide with the datum point on the b.f.o. knob or dial. Now, if it doesn't, either mark the zero-beat point on the panel or set the knob to the datum point and adjust the frequency of the b.f.o. internally until the zero-beat agrees with the datum. Either way, it is essential to know when the b.f.o. is zero-beat and it must be set at that point whenever a frequency measurement is to be made. A marker from the crystal calibrator can be used, in lieu of a station, in making this adjustment.

Audio Filters

Audio filters are a common way of increasing the adjacent selectivity of a receiver but the importance of obtaining adequate selectivity as early as possible in the receiver cannot be overemphasised, thus giving subsequent filters a better chance of doing their job and avoiding the overloading of stages by strong signals.

The average audio stage is pretty flat in response compared to what is really required, especially on the amateur bands. The vast majority of amateurs use s.s.b. with commercial equipment where the audio bandwidth is deliberately restricted to about 300 to 3000Hz, considered the minimum necessary for adequate intelligibility on speech. So it is pointless for the audio stages to be any better than this, unless the SWL is particularly interested in the broadcast bands where better quality audio may be desirable.

On c.w. the bandwidth should be very sharp indeed and bandwidths down to a few tens of hertz are common although a couple of less selective positions are advisable. A simple way to restrict audio bandwidth is to fit an external filter between the set and the headphones. Commercial filters available may offer switchable bandwidths of, say, 80, 110 and 180Hz which are a joy to use on c.w. However, given the choice, such a filter should be fitted immediately after the detector stage and before the first audio stage, where signal levels are low, if it is to give of its best.

Some audio filters are passive, that is they do not contain any amplifying device, but consist of inductors and capacitors to resonate at, say, 750Hz or so. These will not provide such narrow bandwidths as previously quoted without "ringing", an effect that causes notes from c.w. signals to be sustained so that at high speeds the dots and dashes merge making the signal unreadable.

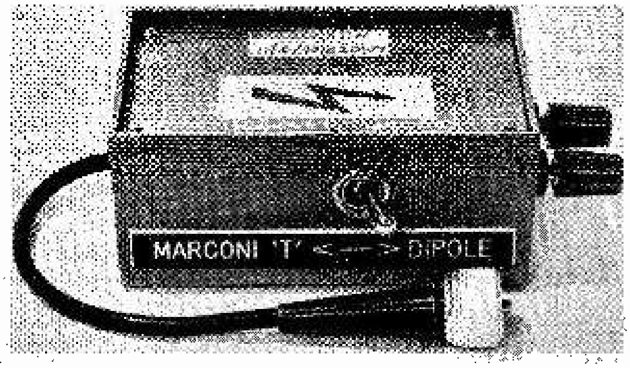
Although I have mentioned headphones before in other articles I am not going to miss the opportunity to do so again! They are an extremely important part of the receiving set-up. Not a luxury, but an absolute necessity for the serious DXer, to be preferred to a speaker at all times, unless listening to Capital Radio while doing some other work in the shack!

To go back a bit in time, the old magnetic diaphragm type of headset had a high resistance of 2 to 4kΩ, was extremely sensitive and frequently formed the anode load of the detector or first audio stage. No further amplification was necessary, hence the popularity and great sensitivity of the old t.r.f. receivers. These headsets had a very peaky response, frequently with a peak around 1000Hz, thus forming an excellent mechanical filter in themselves. When the c.w. beat note was adjusted to the same frequency the result was quite startling!

These old headphones had little response at low frequencies so any hum on the power supply was completely attenuated. In all, every desirable feature for the DXer. But along came hi-fi and stereo and low impedance headsets with every undesirable characteristic as far as DXing is concerned! If you can find a pair of high impedance headphones try connecting them to the receiver's low impedance output with a transistor type step-up audio transformer. An old valve-type output transformer is ideal.

Aerial Tuners

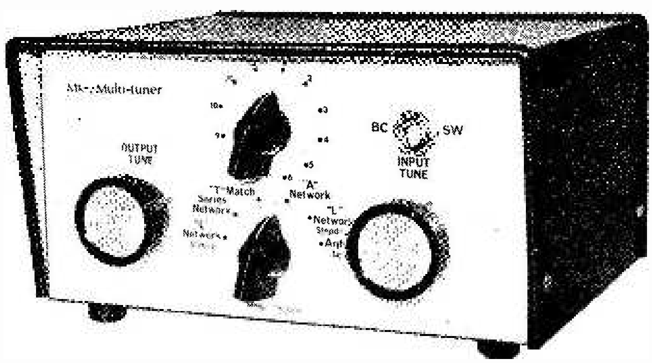
The best receiver going will do even better if it is allowed to, by providing it with a good aerial system suitable for the frequency band in use, as distinct from an odd length of wire. Any aerial can be likened to a tuned circuit where the voltage developed across the circuit is at a maximum when it has the same resonant frequency as the incoming signal. An odd length of wire will be resonant at some frequency or other but an aerial tuning unit (a.t.u.) will ensure that it is resonant at the desired frequency at all times.



A ferrite-cored transformer is used in this wideband aerial matching unit by G2DYM Aerials and Projects

An a.t.u. can be bought or it makes an ideal home project, because a simple a.t.u. need only consist of a tapped coil and a tuning capacitor initially. A more comprehensive one would have another capacitor and calibrated knobs plus a wafer switch to select the appropriate tap on the coil. An a.t.u. is simply an r.f. transformer changing the impedance at the end of the aerial wire to that of the input impedance of the receiver.

When using an a.t.u. the aerial is connected to the input terminal or socket and the output goes, via a short length of coaxial cable, to the aerial and earth terminals of the receiver. Most receivers today have a low impedance input, 50 to 75Ω, so the a.t.u. will take care of the mismatch between aerial and set.

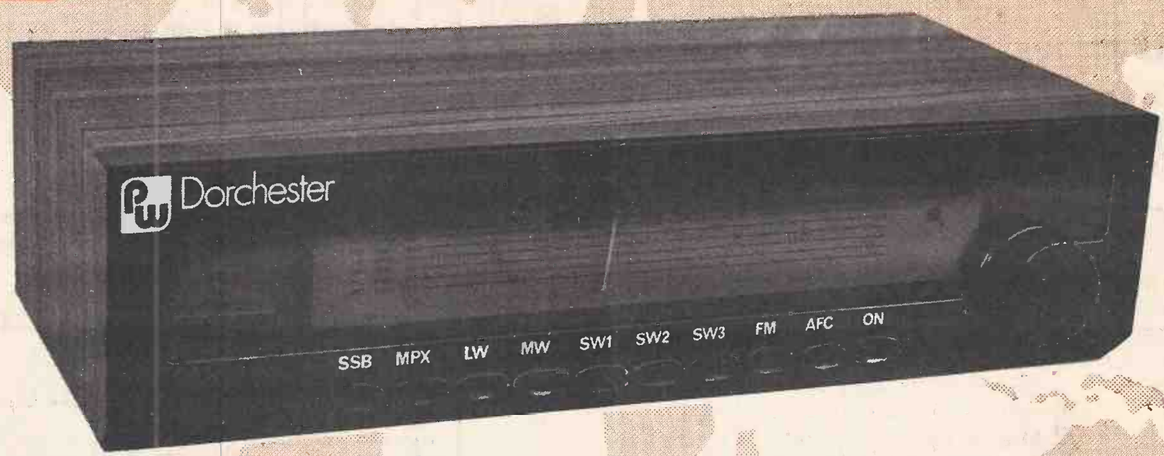


This a.t.u. from Stephen-James allows any length of aerial to be resonated on the h.f. amateur bands. It also covers the m.w. broadcast band

Continued on page 59

PW Dorchester

PART 1



ALL-BAND TUNER

W. S. POEL

The past few months have seen the introduction of several new i.c.s which greatly simplify the design of quality radio receivers. However, the term "simplification" refers specifically to the basic circuit complexity and not functional capability. In the process of integration, various techniques have been evolved, substantially advancing the art of mass production to a level where it closely approaches the performance achieved by some of the more revered communication-grade devices.

The i.c. employed in this project is a characteristic example of low cost/high technology components that are no longer merely an integrated version of an age-old discrete configuration but combinations of some very useful communications-type building blocks which provide an entire radio tuner on one speck of silicon. This is not to be confused with the ZN414 approach, which is strictly t.r.f.—a technique little better than a high input-impedance h.f. audio amplifier and peak detector.

The TDA1090 from Sprague is typical of state-of-the-art i.c. technology in low-cost a.m./f.m. receiver systems. It includes not only a very sensitive a.m. circuit (with an exceptionally-linear two-terminal local oscillator and balanced peak detector) but also all the features of the widely used CA3089E in its f.m. configuration.

Sprague may be a relatively new name to many readers but they have been market leaders in the USA for many years and were amongst the first to successfully integrate such consumer functions cost-effectively. The TDA 1090 is spearheading an attack on the world market for radio manufacturing—and from the performance of the tuner described in this article, it will be readily apparent that they have a potential industry standard to offer in the TDA1090.

Though not intended as a portable radio device, some may consider the current consumption figure of 16-23mA (a.m./f.m.) to be within the bounds of acceptability for this application.

The TDA1083 would probably be a better choice for portable receivers, offering basically similar features, though without the f.m. tuner options—such as a.g.c., tuning meter drive, mute etc; it includes an 800mW audio stage.

The TDA1090 therefore is best suited to mains or automobile applications. It is very much aimed at the hi-fi market, with a basic specification that offers the same degree of performance as the CA3089E for f.m. and a 20dB S/N figure for an a.m. signal of just 6μV. The application considered here takes full advantage of the fact that the a.m. section is provided with a fully balanced input mixer stage and an excellent local oscillator system that produces a waveform of exceptional purity, minimising the chance of h.f. imaging whistles.

Circuit Description

The basic block diagram of the TDA1090 and its functions is shown in Fig. 1. Here the device can be seen to use the same i.f. for processing both a.m. and f.m. signals. In the a.m. mode however, the local oscillator and mixer are employed with substantial a.g.c. to keep the operation linear. The a.g.c. also controls these stages, helping to maintain the excellent signal capabilities of this type of system. The a.m. overload point is at 50mV—a dynamic range of some 80dB.

Use of a.g.c. on the local oscillator leads to a drawback if the device is to be used for s.s.b. reception however, since it will inevitably cause a degree of

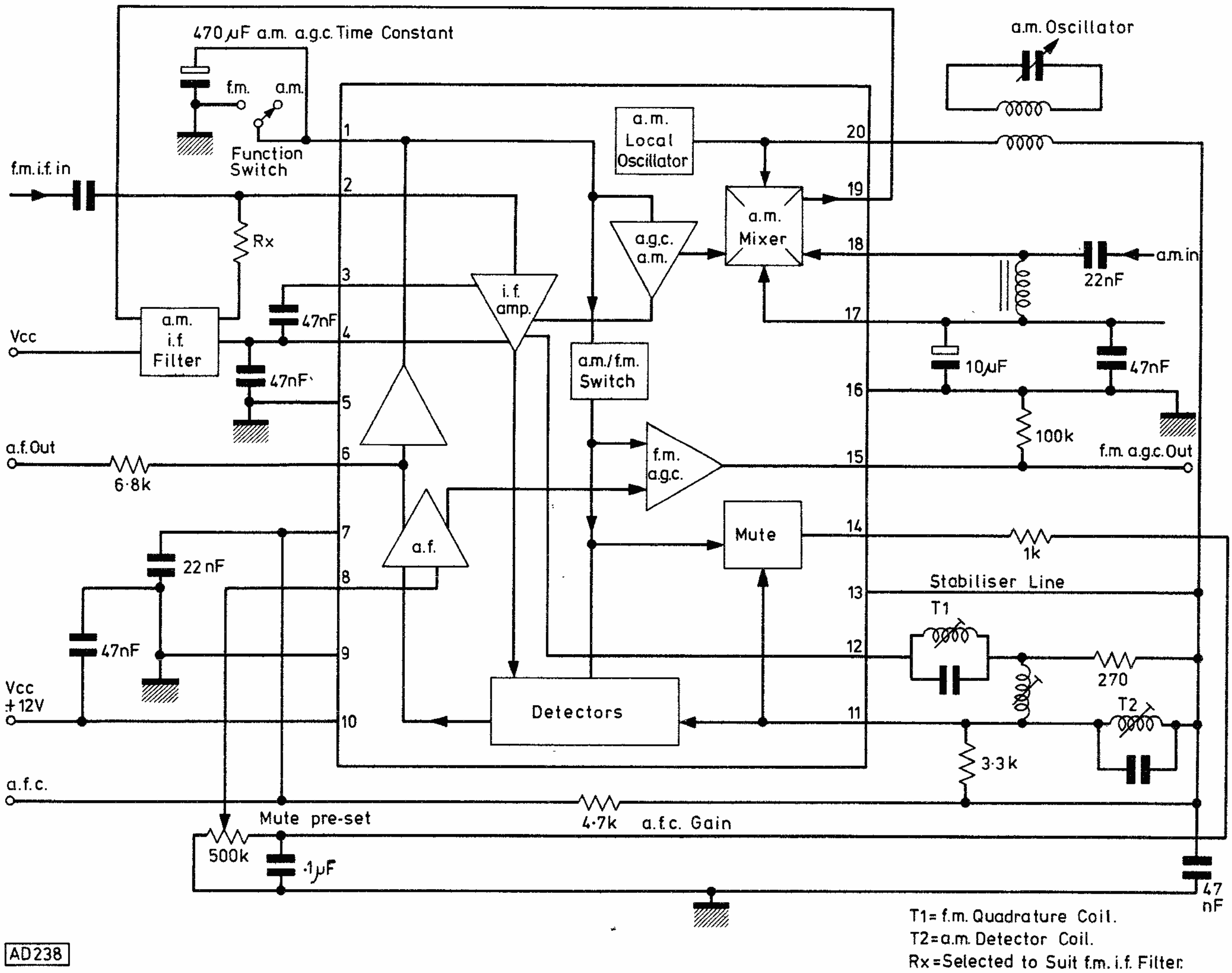


Fig. 1: Basic block diagram of the TDA1090 a.m./f.m. receiver chip with external circuitry required

oscillator-pulling at high frequencies. Although a very minor problem, this effect is sufficient to become annoying on s.s.b., even though completely unnoticeable on a.m.

The i.f. system is a four stage differential amplifier used at a gain of 82dB in the f.m. mode, and 26dB for a.m., the mixer stage making up for lost gain in the latter case. These figures represent the practical limits before instability and noise become problematical—although doubtless they will be improved at some time in the future.

The a.m. detector (Fig. 2) deserves special attention, since it is one of the fundamental features contributing to the success of this design.

The a.m. envelope is taken from the detector i.f. at pin 12 and then processed in a balanced arrangement at relatively low levels of i.f. voltage. Instability from feedback attributed to higher voltages—a problem inherent in such devices as the CA3123E/µA720 series—is virtually overcome.

The f.m. detector (Fig. 3) is the familiar four-quadrant mixer, found in the CA3089E series. It is driven differentially from the i.f., the quadrature signal being provided by the usual tuned circuit between pins 11 and 13.

Basically, its operation relies on the fact that perfectly symmetrical transitions of the f.m. carrier will create an output voltage which is proportional to the phase/frequency response of the tuned circuit. The distortion will depend almost exclusively on the linear characteristics of the detector coil across the bandwidth of the incoming signal.

As with the CA3089E, the total harmonic distortion may be reduced by the use of secondary (and even tertiary) tuned circuits critically coupled to the primary quadrature coil. This enables greater bandwidths to be achieved whilst maintaining good linearity. For a perfectly-tuned signal there will be no basic offset (Fig. 4), but should the signal be to one side of its centre point, the d.c. offset generated in the detector can be used to provide the a.f.c. voltage for tuning correction. The f.m. and a.m. audio is arranged to appear at the same pin, obviating the need for switching.

In the case of f.m., the functions of muting, a.g.c. and meter drive are all basically related to signal amplitude and are simply peak detected and routed to the appropriate pin for external adjustment. The mute level will thus be dependent on i.f. noise levels, as well as basic signal headroom and is going to be

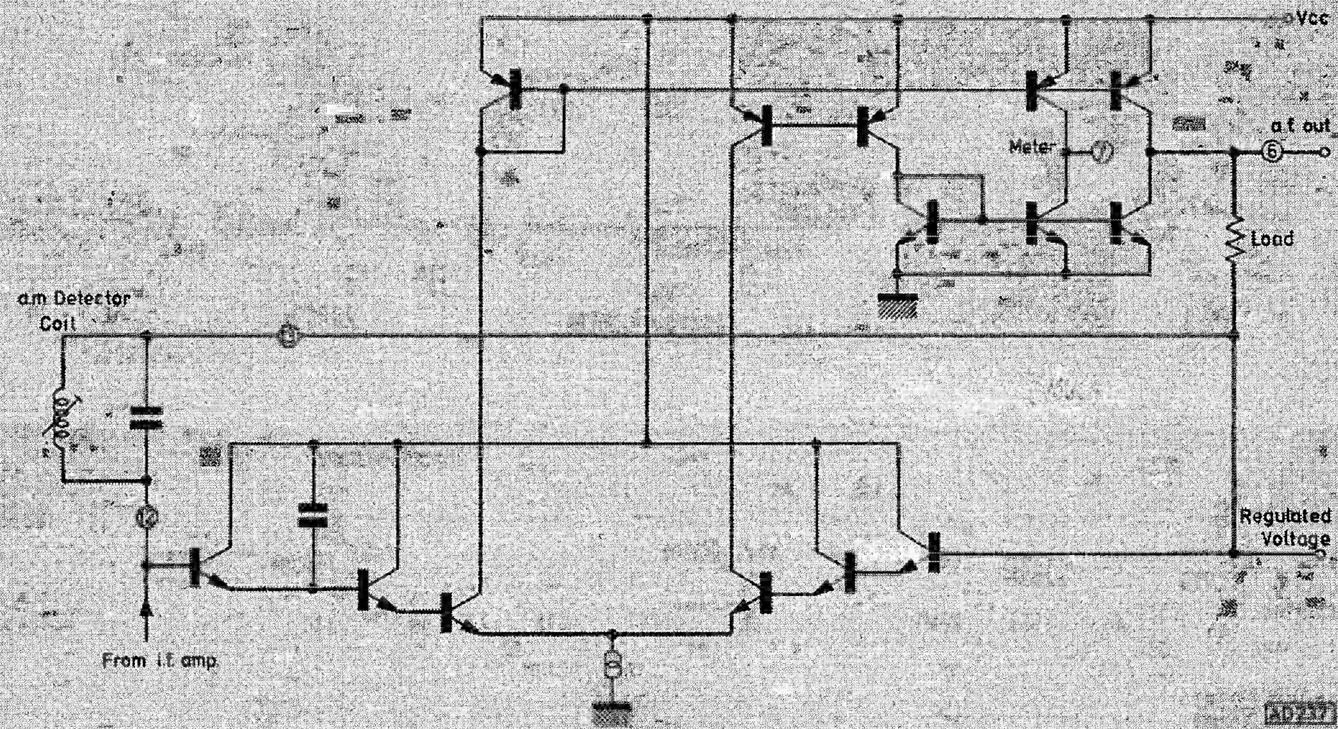


Fig. 2: Equivalent circuit of the a.m. detector section of the TDA1090 plus necessary externa components

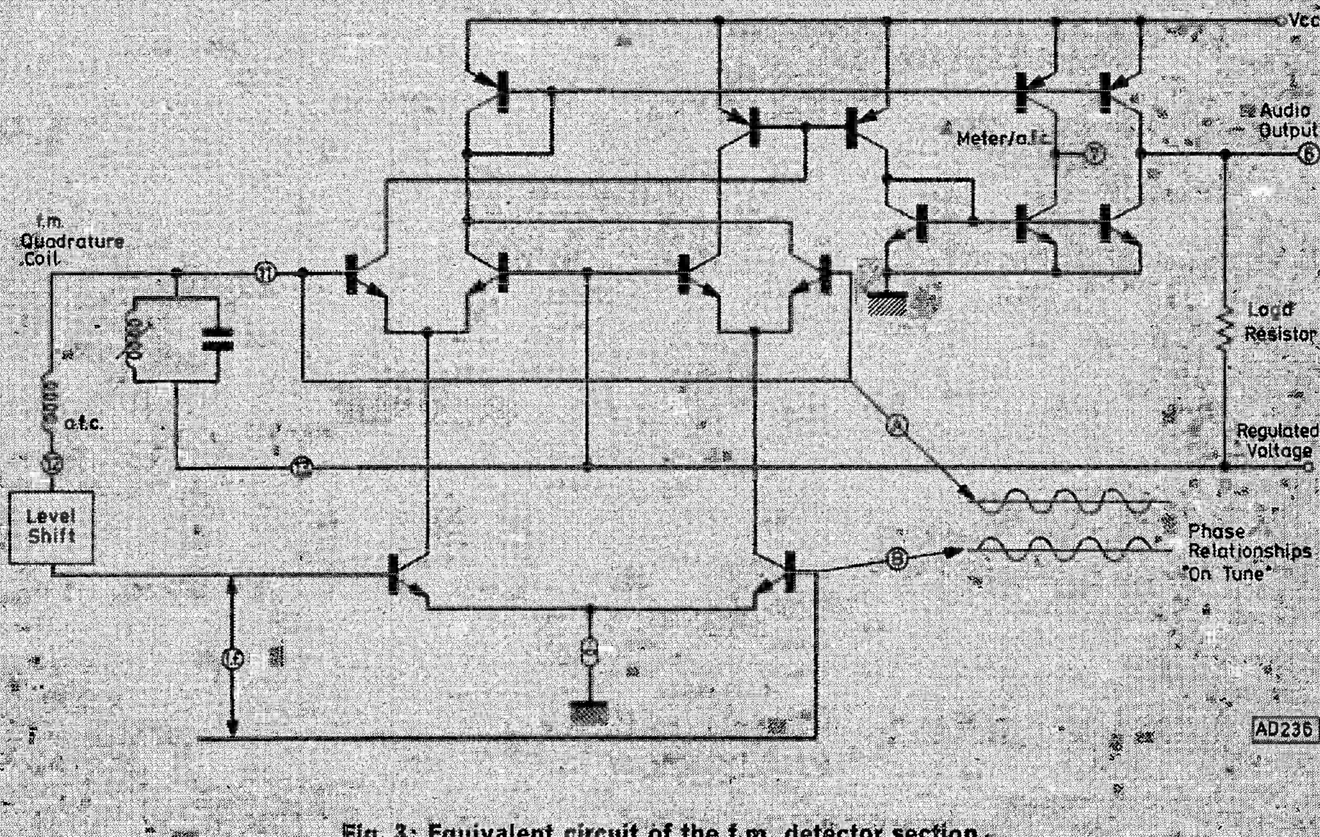


Fig. 3: Equivalent circuit of the f.m. detector section of the TDA1090 plus necessary external components

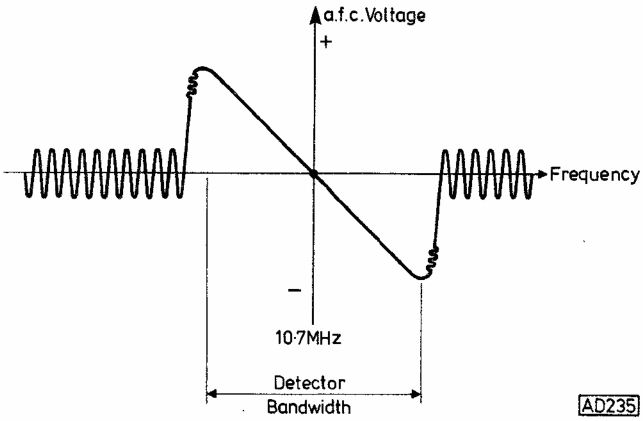


Fig. 4: Voltage/frequency characteristic of the f.m. detector

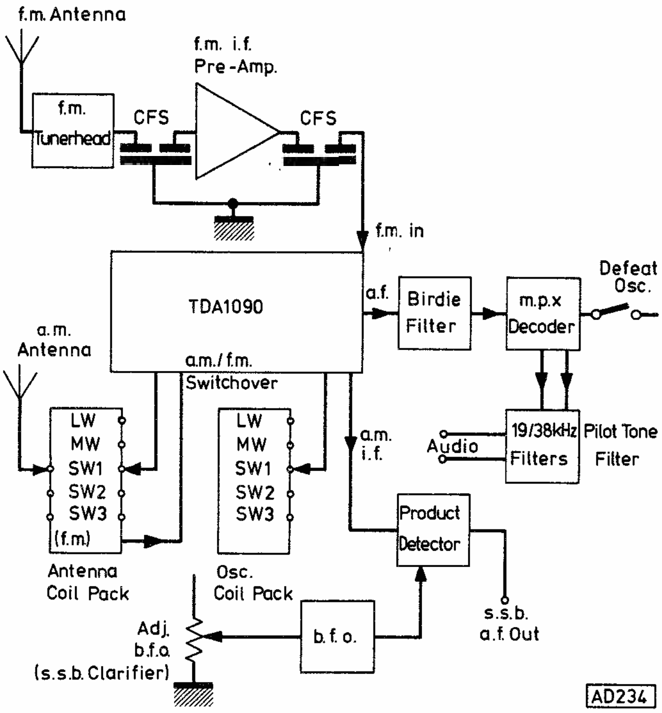


Fig. 5: Complete block diagram of the PW "Dorchester" all-band a.m./f.m. tuner

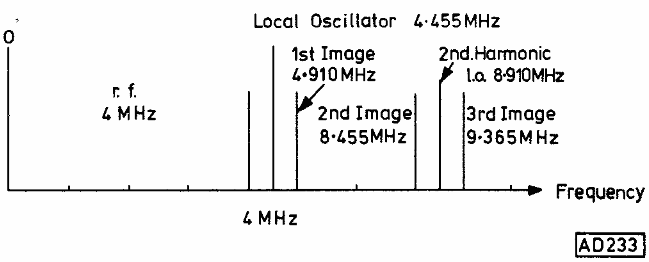


Fig. 6: Local oscillator output spectrum and image responses due to oscillator impurity

critical when used in conjunction with external gain at 10·7MHz.

The CA3089E illustrated this shortcoming very clearly until developments of the KB4420A from Toko and HA1137W from Hitachi built in a degree of offset to accommodate high gain front end and i.f. pre-amp systems. In this configuration, an f.m. antenna sensitivity of 1μV is achieved with functional mute—and this represents the optimum attainable without an external muting circuit. It is nevertheless quite acceptable, and in many instances superior to some expensive hi-fi tuners.

The Complete Tuner

A block diagram of the complete tuner is shown in Fig. 5. The application of the TDA1090 uses a Toko type AT3302UG tunerhead, which combines a high quality a.m. tuning capacitor, with an f.m. tuner whose performance complements the overall design concept.

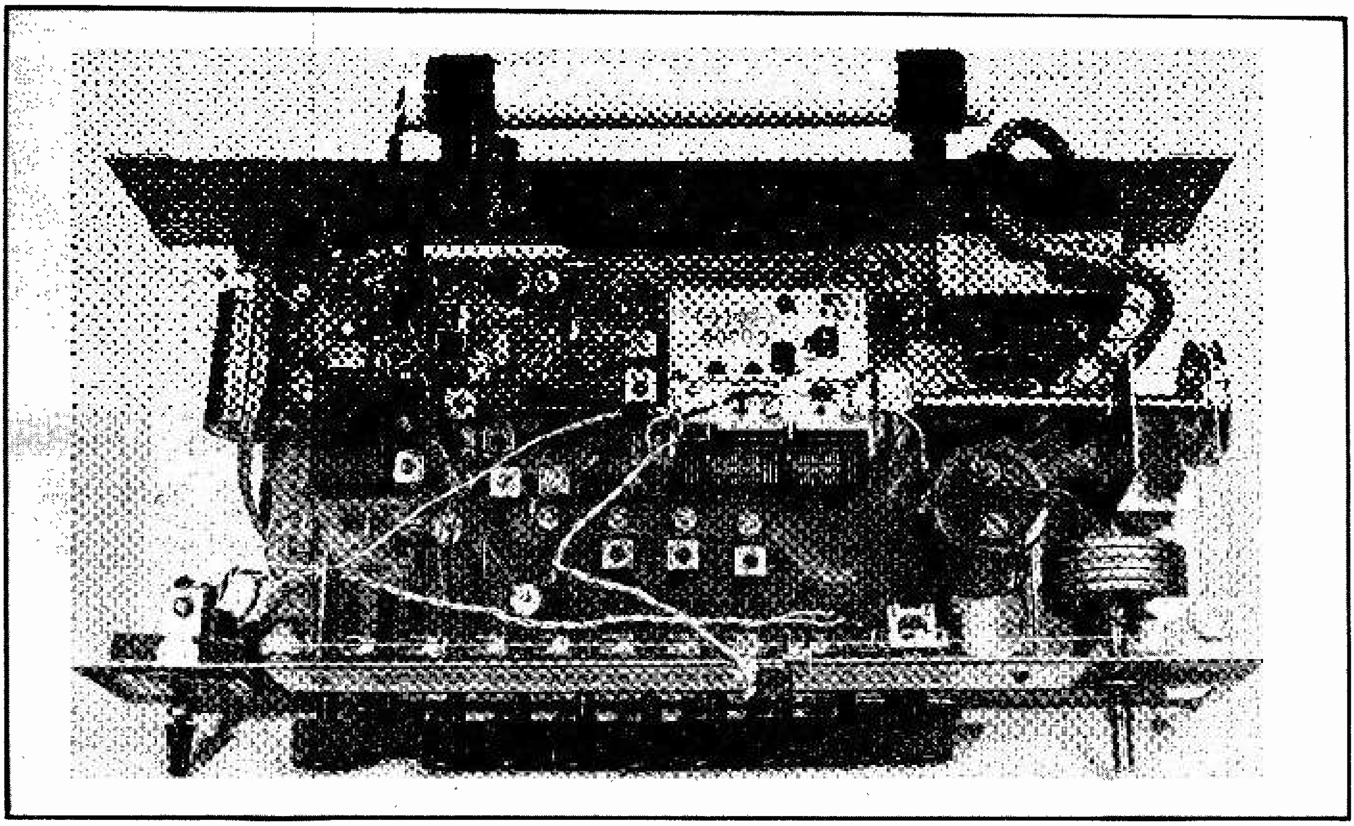
This is a really comprehensive radio tuner—covering all known radio broadcast bands (with the exception of the more unusual f.m. bands used in some parts of the world.) As well as short-wave broadcasts, it is also possible to receive amateur and commercial transmissions, though not to the stability necessary for communications-standard s.s.b. beyond SW2. This is due to a.g.c. action on the local oscillator (mentioned earlier), and the simple mechanics of stable tuning where such a large number of channels are covered within a single range. For instance, SW3 covers from 12 to 30MHz: 180,000 segments of 100Hz, generally considered to be the necessary resolution for s.s.b. By comparison, an amateur-bands-only tuner would typically cover 500 kHz, representing 5000 channels.

An electronic bandspread may be added by means of a single varicap across the local oscillator section of the variable capacitor. This will assist tuning at h.f. but will not entirely ameliorate basic mechanical shock and thermal problems. On a.m. broadcasts, a surprising degree of stability is achieved once the signal is tuned: generally rather better than can be expected from a discrete tuner of this type. In fact, there is no real reason—apart from the stability aspects—why varicap tuning could not be employed for the whole unit—but the additional care and techniques required are outside the scope of this article.

Two-stage tuning of s.w. is generally frowned upon as being inadequate and it is certainly true that many discrete s.w. designs do suffer from a variety of heterodynes brought about by image reactions. If the r.f. stage is tuned to, say 10MHz, and the local oscillator (high) at 10·455MHz, the basic image problem will be due to signal at 10·455 MHz+0·455MHz (i.e. where the local oscillator is 455kHz l.f. of the image) frequency. This problem can only be rectified by good r.f. selectivity, and is frequently blamed for heterodyne interference of another sort, namely that

TABLE ONE - BAND COVERAGE (AD239)

	LF	HF
LW	175kHz	250kHz
MW	525kHz	1605kHz
SW1	1·5MHz	4·2MHz
SW2	4MHz	13MHz
SW3	12MHz	30MHz
FM	88	108MHz



Internal view of the prototype tuner

brought on by harmonics of the local oscillator, rather than the fundamental. In this case, a further diagram Fig. 6 serves to illustrate the nature of the effect.

The local oscillator second harmonic may be as little as 3-6dB down in some discrete circuits, where linearity is compromised to keep costs low by omitting the necessary impedance matching in order to avoid coil loading. So the mixer stage is then also presented with the out-of-band results of two-times the local oscillator frequency, plus and minus the i.f. All of which leads to an unruly cacophony of whistles in the short-wave bands!

The TDA1090 employs a type of oscillator that is far more linear than most discrete types—and furthermore, requires only a single switched connection for the necessary feedback winding, as opposed to the more usual configuration of less-elegant oscillator designs. The second harmonic of the oscillator is kept to below −50dB at most frequencies, substantially reducing the requirements of r.f. stage selectivity.

The net result is a tuner that can just about equal the performance of many lesser three-stage designs. There is no reason why a further r.f. stage should not be used in the form of a preselector—but with the high sensitivity of the basic circuit, it is important to use some form of gain control.

Pin 17 of the i.c. is an a.g.c. function on a.m., falling from 1·8V at maximum gain, to around 0·5 volt with an input to the i.c. of 1mV or so. This may either be used directly, or amplified to provide greater effect. Apart from additional gain, a large antenna may make an input attenuator a more useful extra and the unique *pin* diode network—the TDA1061—makes a good choice.

The f.m. side of the design includes all the usual functions, including a low pass filter, and stereo decoder. From the tunerhead the i.f. is fed through a 10·7MHz filter placed as close to the output as possible since even an inch or two of track would permit sufficient h.f. pickup to cause a swamping effect in the limiting amplifier of the i.c. A single transistor i.f. pre-amp provides an extra 10dB or so gain (over and above filter losses), and is a useful means of matching both ceramic filters. The decoder is nothing too esoteric. Whilst the Author is only too aware of the vast array of very high spec. devices, the HA1197, HA11223, TCA4500 and so forth, the long-established 1310 type of decoder has been used here.

The basic tuner is intended to be hi-fi, low-cost. More recent versions of the 1310 from Toko and Hitachi have provided superior separation and distortion to fill this particular requirement. A more pedantic approach to the whole project would be to use double detector coil arrangements, and the like, but then the unit could not have been readily copied by the enthusiast, unless sophisticated test equipment was to hand.

A pre-aligned pilot tone filter block is used to take out obtrusive 19/38kHz whistles when recording but this may simply be linked out if not required.

Finally, the block diagram shows a MOSFET product detector, fed from a high-stability f.e.t. b.f.o. As mentioned, s.s.b. reception is not up to the best communications standards, but this arrangement will make the most of the unit's capability up to about 14MHz.

Next month we move on to consider the practical circuitry and construction methods.

Introduction to LOGIC ~ 5

S. A. MONEY

A group of devices related to the flip-flops is that of the monostable circuits. Unlike the flip-flop, with its two stable states, a monostable device, as its name implies, has only one stable condition, which is usually its reset state where the Q output is at *0*.

If a clock pulse is applied at its input a monostable will be triggered into the Set state, with Q at *1*, in much the same way as a normal flip-flop. After some time delay, governed by a resistor-capacitor network, the circuit will return automatically to its normal reset state with Q at *0*. Thus the Q output consists of a pulse at the *1* level whose length is determined by the time constant of the R-C network.

Practical Monostable Circuits

A monostable circuit can readily be produced by using a CMOS D-type flip-flop connected as shown in Fig. 58. In the stable state of the circuit the flip-flop will sit with its Q output at *0*. Capacitor C will be discharged so that the Reset input will also be at *0* and therefore is inactive. Now, assuming that the D input is held at *1*, if a clock pulse is applied the flip-flop will switch to the Set state and the Q output will rise to the *1* level.

When Q is at *1* the capacitor will charge towards the *1* level through the resistor R. After a period of time the voltage across the capacitor will have risen to the level where the Reset input is activated. For a CMOS flip-flop this threshold level will be about half the supply voltage. When the capacitor voltage rises above the threshold level it will activate the Reset input and force the flip-flop to return to its reset state with Q at *0*.

As the Q output falls to *0* the capacitor will start to discharge through the resistor R. When its voltage falls below the threshold level again the Reset input will be disabled which in turn will allow the flip-flop to respond to input clock pulses once more. After some period of time the capacitor will have discharged back to the *0* level again and the circuit will be ready to start a new cycle of operations. The various waveforms that will appear in the circuit as it operates are shown in Fig. 59.

The time period for which Q is at the *1* level will be governed mainly by the values of the resistor and capacitor although the voltage level of the Q output, when it is at *1*, and the threshold level of the Reset input will also have some influence. For this circuit the time delay can be calculated from the formula:

$$t = -CR \log_e \frac{V_t}{V_q} \text{ seconds}$$

where C is capacitance in farads, R is resistance in ohms, V_t is the threshold voltage for the Reset input and V_q is the *1* level voltage at the Q output.

For a CMOS flip-flop where V_t is roughly equal to half V_q the equation simplifies to:

$$t = 0{\cdot}69\ CR$$

and this equation will be found to be common to most of the monostable circuits in both CMOS and TTL type devices.

Because monostables are often used in logic systems they are available as logic elements in most of the types of digital logic. As an example, in the 74 series

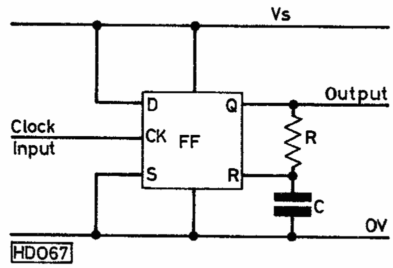


Fig. 58: Monostable circuit using a CMOS D-type flip-flop

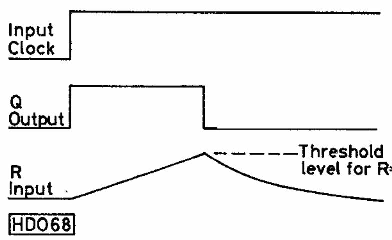


Fig. 59: Waveforms for the monostable circuit of Fig. 58

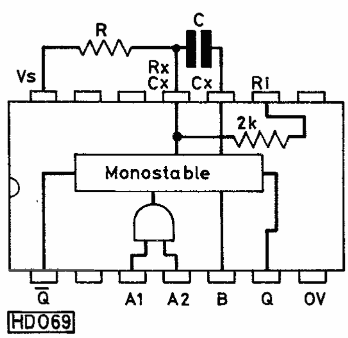


Fig. 60: The 74121 monostable and its external timing components

TTL types, the 74121 is a single monostable circuit and its internal arrangement and pin connections are shown in Fig. 60.

To make the 74121 reasonably versatile it has three clock inputs, A1, A2 and B. The B input is designed to be triggered by a pulse or logic level transition which goes from *0* to *1*, whilst the A inputs are clocked by pulses going from *1* to *0*. When either of the A inputs is fed by a clock pulse the monostable will be triggered, which is convenient if the circuit is required to respond to clock pulses from two separate sources.

The A and B inputs can be used to inhibit one another thus giving a simple means of gating the incoming clock pulses. The B input is only effective if at least one of the A inputs is at *0*. Similarly the A inputs will respond to clock pulses only when the B input is held at *1*.

To allow flexibility in the choice of values the R and C timing components are connected external to the package with the capacitor between pins 10 and 11 and the resistor from pin 11 to the +5V supply as shown in Fig. 60. There is a timing resistor with a nominal value of 2kΩ built into the chip and this can be used by simply joining pin 9 to the +5V supply. This is useful for some circuits, where timing is not critical, since the only external component needed is a single capacitor. For accurate time periods however the external resistor should be used and it is possible by suitable choice of values for R and C, to produce time delays from 100ns up to about 0·1 second.

Two separate monostable circuits in a single package are provided in the 74123 whilst in the CMOS logic there is also a dual monostable device with the type number 4528.

Retriggerable Monostables

One problem with a simple monostable, such as that shown in Fig. 58, is that once it has been triggered it will not respond to any further clock pulses until it has completed its timing cycle. These later clock pulses would simply try to switch the monostable into the set condition when it is already there. The clock pulses will usually have no effect upon the state of the R-C timing network.

At the end of the timing cycle, when the Reset input is active, any applied clock pulses will be ineffective since they will be overridden by the reset action itself. In fact there will be a short period after the end of the timing cycle when the monostable cannot be triggered by an input clock pulse because the Reset input is still active.

For some applications of monostables it would be an advantage if each new clock pulse would make the circuit start a new timing cycle even if the monostable is already in the middle of a timing cycle. Such a monostable circuit is called a Retriggerable monostable and a typical example is the 74122 in the TTL range. In CMOS the two monostables in a 4528 are of the retriggerable type.

In a retriggerable monostable the clock pulse not only sets the monostable but also discharges the timing capacitor to its original state so that a new timing cycle starts. If the circuit is already set the result is that the timing cycle is extended so that a complete timing period occurs after the last clock pulse before the circuit resets. This type of monostable often has a direct reset input as well which will override any timing cycle that is in progress and force the monostable to return immediately to its reset condition.

In the simple monostable circuit of Fig. 58 if the flip-flop is triggered again immediately after a cycle has completed the capacitor may not have had enough time to discharge completely. Now the new timing cycle starts with the capacitor already partly charged. As a result the reset input voltage will reach the threshold level earlier and the length of the new timing period will have been reduced from normal. This problem has been overcome in most of the monostable elements available in TTL and CMOS by incorporating a rapid discharge circuit for the timing capacitor so that it recovers rapidly after the end of a timing cycle. In the circuit of Fig. 58 this could be achieved by connecting a diode across the resistor R so that the diode conducts and discharges the capacitor when Q goes to *0*.

Using Monostables

How can a monostable be used in a practical logic system? One obvious application is to use it as a simple pulse generator. Here the monostable is triggered each time a pulse is required and the output from Q or $\bar{Q}$ will provide the desired pulse output. The width of the pulse will be controlled by the timing components of the monostable and its polarity by whether it is taken from Q or $\bar{Q}$. The input required to produce a pulse is simply a logic transition either from *0* to *1* or *1* to *0* depending upon which input of the monostable is used.

A second application of the monostable is that of producing a time delay. Here the trailing edge of the pulse produced at the output of the monostable is used to trigger a flip-flop or another monostable as shown in Fig. 61. If the monostable is triggered it

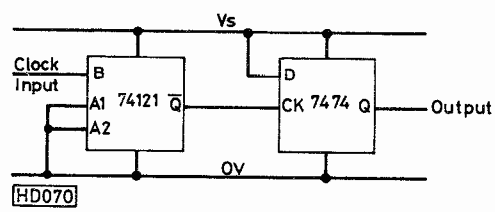


Fig. 61: Using a monostable as a delay circuit

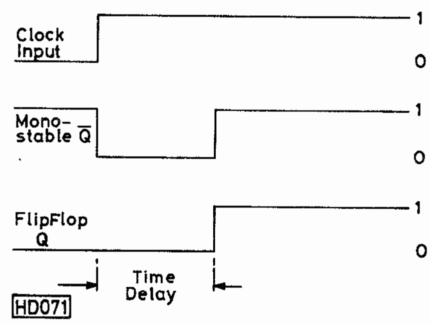


Fig. 62: Time delay produced by a monostable

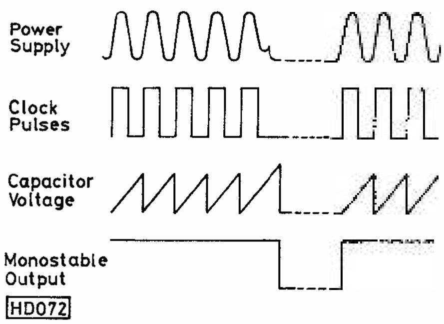


Fig. 63: Use of a retriggerable monostable as a missing pulse or power failure detector

will go through its timing cycle and then trigger the following stage thus producing a delayed action as shown in Fig. 62. The length of the time delay produced will be determined by the timing components used with the monostable circuit.

The retriggerable type of monostable can be used as a missing pulse detector. Here the monostable is clocked by a regular stream of pulses and its timing cycle is set to be about 50 per cent longer than the period between successive pulses. All the while the input pulses are present the monostable will remain set because a new pulse will retrigger it before it can complete a timing cycle. If however one of the input pulses is missing from the stream the monostable will have enough time to complete its cycle and will reset for a time, thus producing an output pulse. This action is shown in Fig. 63.

A retriggerable monostable might be used as the basis for a rapid-acting power failure detector. In this case the clock would be derived from the a.c. power supply, at say 50Hz, and the monostable would have its timing period set at 30ms. Now the monostable will remain set whilst the supply is on. If the supply fails for just one cycle the monostable will time out and may be used to trigger a circuit which switches in a standby power supply.

Similar missing pulse detectors are often used in data systems to detect the gaps between individual data records or between blocks of data which have been recorded onto a magnetic tape or disc.

Astable Circuits

If two monostable circuits are connected back to back as shown in Fig. 64 the system will oscillate continuously. As one monostable times out at the end of its cycle it will trigger the other monostable and vice versa. Such a circuit has no stable condition and is referred to as an Astable. In a logic system astable circuits are generally used for the clock and timing oscillators. In most cases they will be built up from either logic gates, monostables or from simple discrete component circuits. In CMOS however the 4047 is a special device designed to operate as an astable.

The 555 timer is a linear integrated circuit which is frequently used as an astable oscillator in logic systems. Fig. 65 shows the internal arrangement of the 555 and the way it would be connected to operate as an astable. Here an input voltage is compared with a pair of internal reference voltages V_1 and V_2 by two voltage comparator circuits which in turn set or reset a flip-flop to control the output.

In the astable arrangement of the 555 when the voltage across the capacitor is zero the flip-flop will be set and the output level will go to *1*. Now the capacitor will charge through R1 and R2. As the capacitor voltage rises above level V_1, usually about $\frac{2}{3}$ of the supply voltage, the comparator Comp.1 operates and resets the flip-flop. Now the output falls to *0*. When the flip-flop is reset it turns on a discharge transistor which effectively shorts the junction of R1 and R2 to 0V so that the capacitor now discharges through R2. When the capacitor voltage falls below level V_2, nominally $\frac{1}{3}$ of the supply voltage, the second comparator Comp.2 is activated and this sets the flip-flop again. Now the discharge transistor turns off and the capacitor starts to charge again. This cycle of operations will continue indefinitely so that the capacitor voltage rises and falls between the limits V_1 and V_2 whilst the output alternately switches between the *0* and *1* states. Frequency of operation is determined by the values of R1, R2 and C.

Logic Inputs

So far in this series we have looked at the logical operation of the various types of logic element but now it is time to examine in more detail the input and output characteristics of the logic devices. We shall start by looking at the input characteristics.

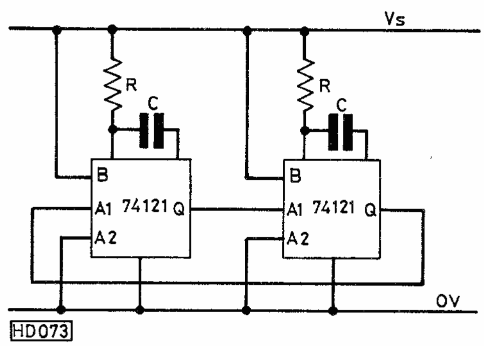


Fig. 64: Two monostables connected to form an Astable oscillator

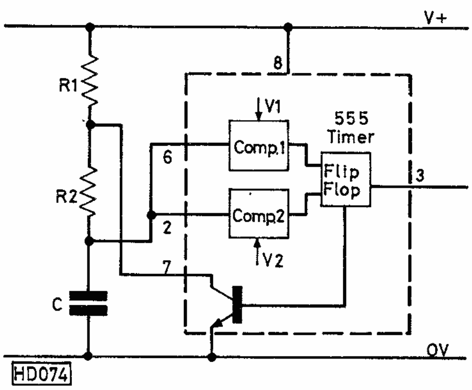


Fig. 65: The 555 timer and its connection for use as an Astable

It will be remembered that in a TTL device the input signal is fed to one of the emitters of a multi-emitter *npn* transistor. The base of this transistor is usually held at a bias voltage of some +1·2 volts.

Suppose the input were connected directly to 0V to produce a logic *0* input. The input emitter will now become forward biased and the transistor will conduct passing a current of some 1·6mA from its emitter through the external circuit to the 0V line. In practice the input will not be shorted to the 0V line but will be driven by an external circuit which may have some resistance. The emitter current will now produce a voltage drop across the external circuit so that the actual input voltage is no longer zero but some small positive voltage.

For a typical TTL device any input voltage between 0V and about +0·8V will be treated as a *0* level logic input. This means that the circuit driving the input must be able to "sink" the 1·6mA flowing from the input emitter without producing a voltage drop of more than 0·8V when it is at a *0* logic level. If a simple resistor were connected to 0V to produce a *0* level input the resistor would need to be less than 500 ohms in value.

When the logic input is taken to say +5V to produce a logic *1* input the emitter of the input transistor will be reverse biased and therefore cut off. In fact a small level of leakage current of perhaps 50μA will flow into the logic input. Normally TTL circuits are designed to accept any input voltage from +2V to +5V as a *1* level logic input. In this case the driving circuit need not have a particularly low resistance and a typical value resistor for tying an input to +5V for a *1* level might be about 4·7kΩ.

Input voltages between +0·8V and +2V may be treated as either a *0* or a *1* state by the logic device. Usually if a TTL input is left open circuit it will assume a voltage level of about +1·2V and generally acts as a *1* level input. For reliability however it is advisable to connect up any unused inputs either by tying them directly to 0V or +5V or by joining them in parallel with another input if the device is a gate.

With its MOSFET input stages the CMOS type logic unit presents a rather different input characteristic. Here the input impedance is extremely high, perhaps tens of megohms, and virtually no current flows in either the *0* or *1* state.

Because of the very high input impedance of a CMOS device it is very easy for a charge of static electricity to build up at the inputs of a circuit. Static potentials of hundreds of volts may easily occur and if these were allowed to discharge through the device itself it is likely that the internal circuits would be at least partially destroyed. In the early days of MOS and CMOS devices great care was needed when handling the i.c.s to avoid damage due to static charges. A careless operator could easily destroy hundreds of i.c.s just by touching them. Fortunately today nearly all of the CMOS devices incorporate protection diodes at each input. These diodes which may be arranged as shown in Fig. 66 are designed to allow static charges to leak away before they reach dangerous levels which might damage the chip. Although protection diodes are fitted however it is wise to take some precautions when handling CMOS devices.

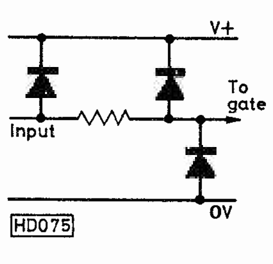


Fig. 66: Gate input showing protection diodes

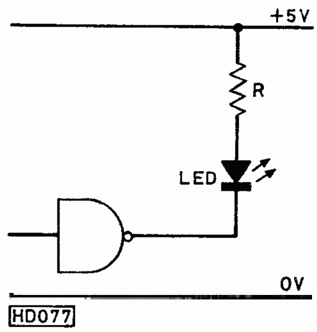


Fig. 67: Preferred method of driving an LED from a TTL type gate

Normally CMOS circuits should be stored and handled with all of the pins of the device shorted together. This may be achieved quite easily by pushing the pins through a sheet of aluminium foil or conductive plastic foam. If the device is to be soldered into a circuit board make sure that the soldering iron is properly earthed. It is preferable to mount CMOS i.c.s in sockets so that they can be inserted after all of the construction and wiring is complete.

Any unused inputs of a CMOS device should be tied, either directly or through a resistor, to one of the supply rails. An open circuit input will tend to float as static charges build up on it and the input voltage level may vary continuously with time. Because of its high impedance the input will also tend to pick up stray signals, such as 50Hz power frequency components, and as a result logic operation is likely to be erratic to say the least.

Where a CMOS input is driven from outside the unit or from another circuit card it is as well to treat it in the same way as an unused input by tying it to one of the power rails through a resistor of perhaps 22kΩ to 100kΩ.

Logic Outputs

The totem pole type output stage of a TTL device is specifically designed to drive the inputs of other TTL type circuits. When the output is at logic *0* the output stage is capable of sinking a current of some 16mA to ground whilst still maintaining the output voltage below +0·5V to ensure a proper *0* level signal. Thus a standard TTL output will drive ten TTL input circuits reliably. In fact it will be able to drive more than ten circuits most of the time but the load on a device should be limited to ten TTL inputs for reliable logic operation. Some devices, such as the 7440, have a higher output capability and can drive up to 40 TTL inputs.

In the *1* state the TTL output can drive a current of about 0·5mA whilst maintaining a minimum voltage level of +2·5V. This must be borne in mind if the logic device is to be used to drive discrete circuits. If an LED indicator is to be driven by a TTL output it should be arranged as shown in Fig. 67 so that the TTL circuit sinks the current from the lamp rather than trying to drive current into it.

Outputs in CMOS are normally capable of driving or sinking currents of the order 0·5mA and the output voltage levels are likely to switch from about +0·5V up to about 0·5V less than the positive supply rail.

Open Collector Outputs

There are occasions in logic system design where a number of outputs are required to feed into a single line. This can, of course, be achieved by combining the signals in an OR gate to produce a single output. Another approach which comes to mind is the possibility of connecting all of the outputs directly in parallel to a common output line. If this were done using conventional totem pole output stages the results would be disastrous. If one output is at *1* and another at *0* the two output stages will conflict in an attempt to drive the output to both *1* and *0* at the same time resulting in excessive currents in the output transistors. As a result one or both of the output circuits would be destroyed or at least damaged.

By using a modified form of output stage, known as an Open Collector output, it is possible to connect a number of outputs directly in parallel with no damage. In an open collector output the upper transistor of the totem pole is omitted so that the output will only draw current in the *0* state and is effectively open circuit for a *1* output. Open collector outputs are fed to a common load resistor as in Fig. 68. This arrangement works effectively as an AND gate and the configuration is usually known as WIRED AND.

Tri-State Logic

A further development in output stages is the Tri-State output circuit. Here an extra control line allows the output stage to be switched off so that it presents an open circuit to the output terminal. Thus the output can have three states (tri-state) namely *0*, *1* and open circuit. In a multi-gate package a single enable line may be used to switch on all of the output stages simultaneously or separate enable lines may be provided for each section of the device.

It is important in a system using paralleled tri-state devices that only one circuit is enabled at any time, otherwise the results would be the same as if normal output stages were connected in parallel.

Both CMOS and TTL type devices are available with tri-state output stages. In some cases tri-state input circuits may also be provided. Here when the circuit is disabled the input will present an open circuit impedance. Sometimes a circuit, especially in the case of memory devices, may use the same pin for both input and output the function being selected by a control line which enables the appropriate part of the device.

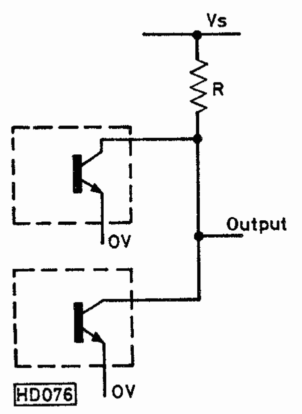


Fig. 68: WIRED AND system using open collector devices

Power Supplies

One aspect of logic systems which is often overlooked is the power supply. In a TTL system the supply voltage must be held within ±0·25V of a nominal +5V level for proper logic operation. Gates will often work at lower supply levels than +4·75V but flip-flops, counters and shift registers are likely to behave erratically under these conditions.

The TTL circuits tend to draw quite a bit of current and it is quite easy to reach a supply current of an ampere or so with relatively few i.c.s, especially if they are of the more complex type. To maintain proper supply conditions some form of regulated or stabilised supply will be needed.

In a TTL system where the devices switch at up to 30MHz quite large pulses of current may flow as devices switch. It is important that adequate decoupling of the supply leads is provided to avoid interaction between logic devices. A good rule is to fit a 0·1μF ceramic capacitor across the supply rail for every three TTL chips in the system. These decoupling capacitors should be distributed around the circuit board to confine circulating currents to local areas of the board.

The CMOS devices are much more tolerant of supply variations and will work with any supply voltage between +3V and about +15V. Current requirements are generally very small since the CMOS stages often take most current as a pulse whilst they are switching from one state to another. These current pulses charge and discharge stray circuit capacitances and usually the supply current will increase as the frequency of logic operation increases. Supply decoupling is required in a CMOS system but need not be as heavy as in a TTL circuit.

Because of their low current demand, CMOS circuits are ideally suited to battery operated systems. A CMOS digital watch chip will run for a year or two from a tiny cell.

Frequency of switching of a CMOS circuit is affected by the supply voltage and will be higher with the higher supply voltages. Typically a CMOS counter may operate at 10MHz on a 15V supply but this rate would fall to perhaps 3MHz at 10V and only 1MHz at +5V.

Next month we shall look at the way in which a logic system might be designed.

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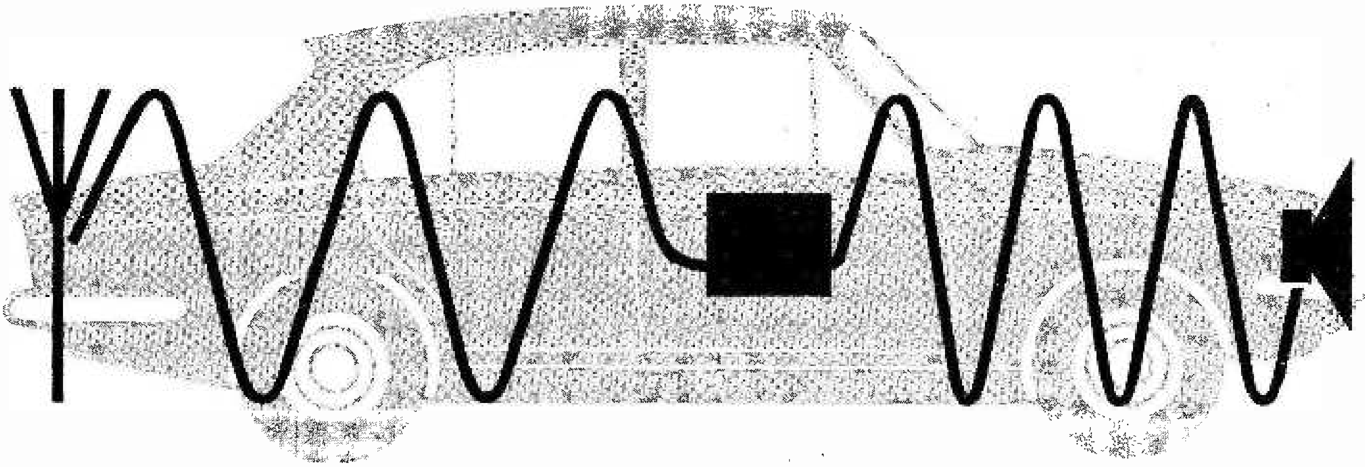
Car Radio



LONG WAVE CONVERTER

M. J. HUTCHINSON

The shift in BBC frequencies at the end of 1978 creates a problem for many car radio owners. From November 23rd, Radio 4 programmes will be transmitted on 200kHz, at present used by Radio 2. This will mean that thousands of listeners without long wave facilities will lose the only national alternative to the essentially music stations Radio 1, Radio 2, and Radio 3. These radios fall into two categories:-

(1) Standard units fitted to Japanese cars
(2) Units which incorporate an f.m. band and/or cassette playing facilities. Examples are to be found in the Pye, Amstrad, Sony, Pioneer, Sharp and Philips ranges, amongst others.

The provision of an f.m. band does not entirely solve the problem. Reception can be erratic in some areas, and in any case almost four hours is daily used for educational broadcasts.

The need was therefore to find a less expensive alternative to the problem than the purchase of a new receiver. The unit described offers a considerable saving on the £60+ needed to replace a set in the secondary category. Fig. 1 illustrates the operation of the unit in block diagram form. The aerial cable is tapped within the screened box to provide the signal for the fixed frequency long wave tuner (B). A simple r.f. amplifier stage (A) is used to interface the tuner with the aerial for two reasons. It improves the sensitivity of the tuner and ensures that the additional load does not degrade the signal to the car radio. This solution proved to be better than using an electronic splitting circuit. The aerial cable remains unbroken, so no wide bandwidth amplifier is required for a.m./f.m. sets.

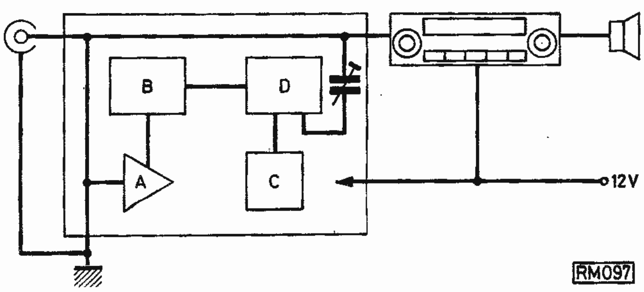


Fig. 1: Block diagram of the Car Radio Long-Wave Converter

The Circuit Technique

A 1600kHz oscillator (C) provides a signal which is modulated (D) by the audio output of the tuner. The resulting r.f. signal is fed into the aerial system via a trimmer capacitor. The radio will now receive the original 200kHz signal at around 1600kHz on the medium wave band.

Fig. 2 shows in detail the r.f. buffer amplifier. Like all stages of the unit it is powered by the car's 12 Volt supply. Using the f.e.t. means that no undue load is placed on the aerial line.

The l.w. tuner is varicap tuned and designed around the HA1197 i.c. Although it is unaffected by the fluctuations in the car's supply it is essential that the tuning voltage be derived from a stable source, and in this case the 10V required is obtained from the oscillator circuit. Capacitor C32 is required to smooth out any peaks from the electrical system which would cause interference, although in practice the value need not be as high as 1500μF; the 4·7kΩ pot on the tuner board sets the audio output level.

The oscillator in Fig 3 is a conventional Colpitts circuit, and the coil is wound on an Ambit 13K series former with a single tuning slug. This, together

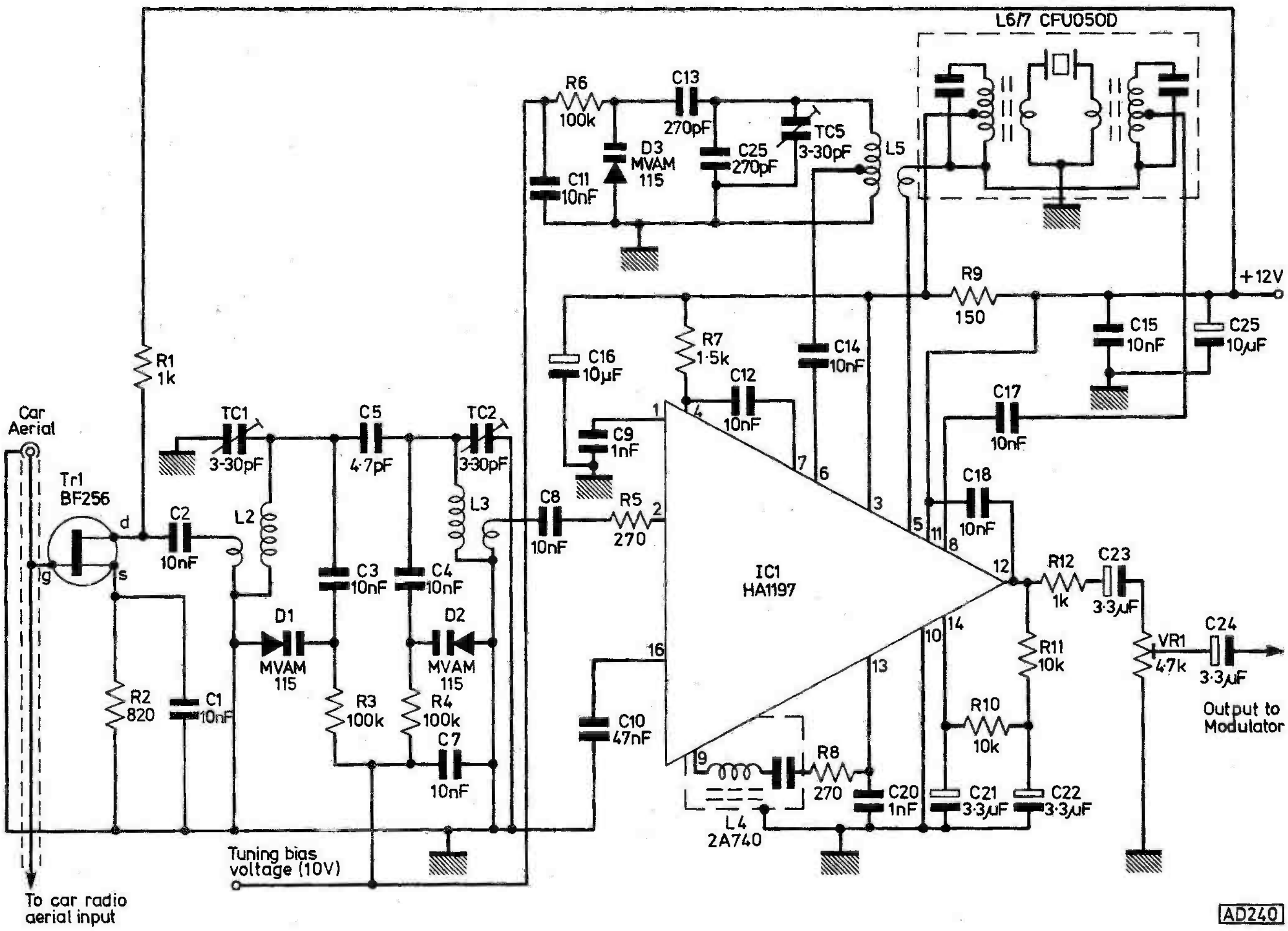
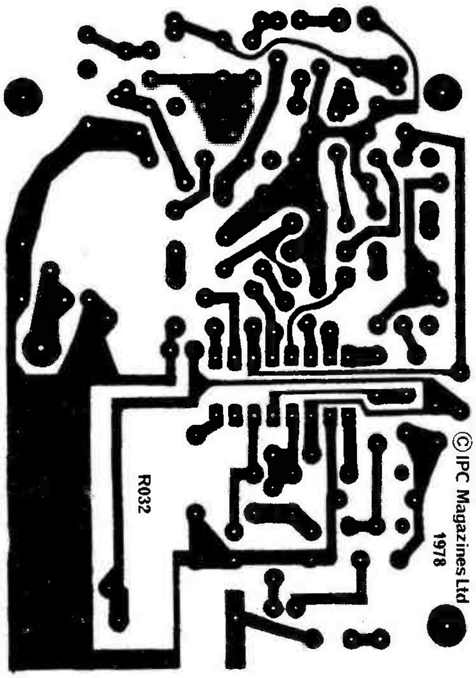
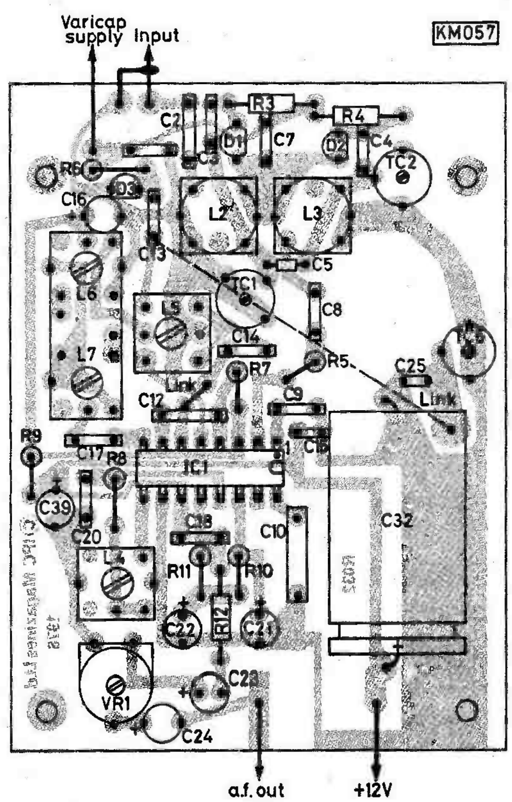


Fig. 2: Circuit diagram of the r.f. amplifier and l.w. tuner (C25 near + 12V terminal should be C39). Below we show the full-size p.c.b. pattern of the above circuit and the component layout—capacitor near C2 is C11





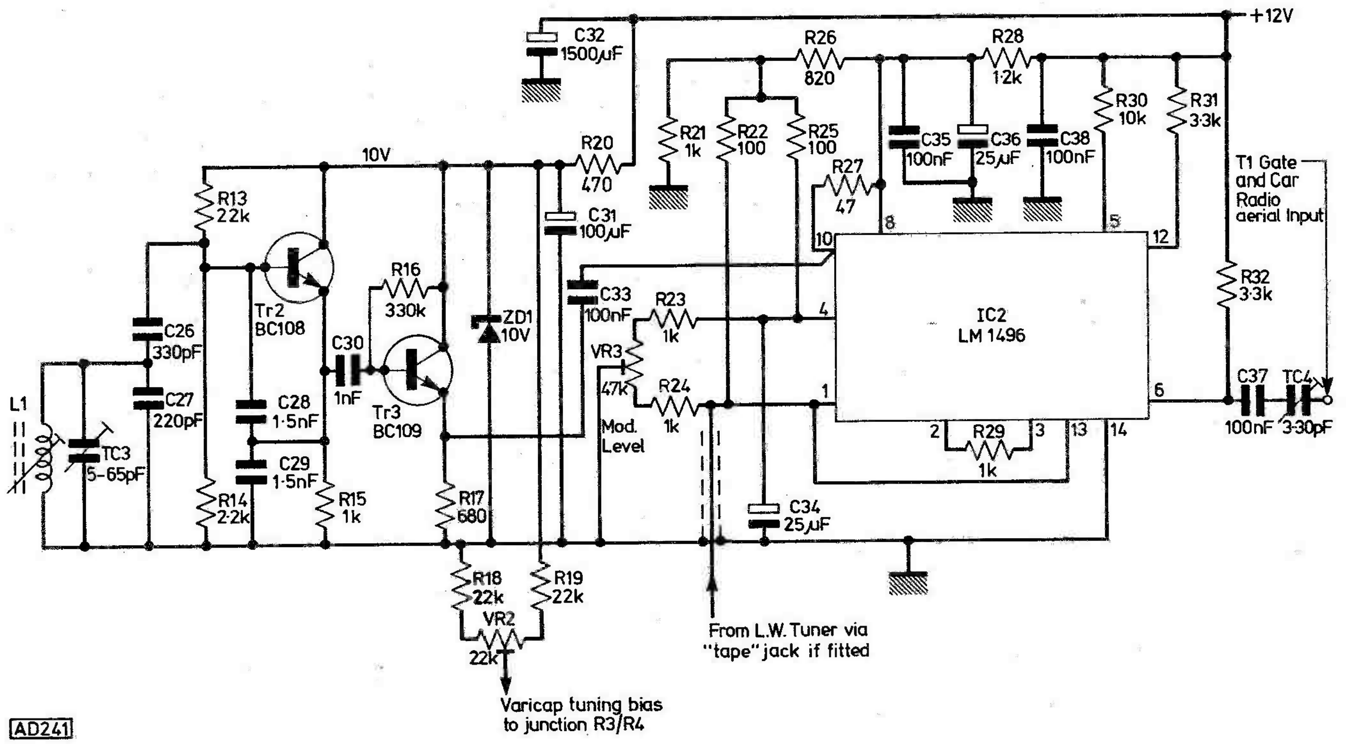
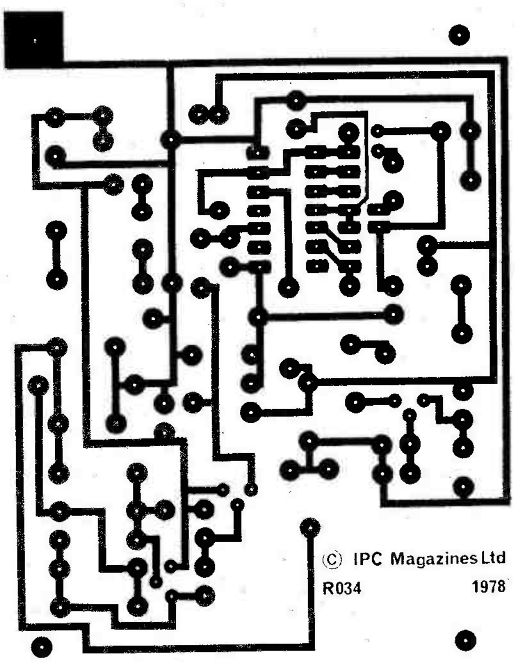
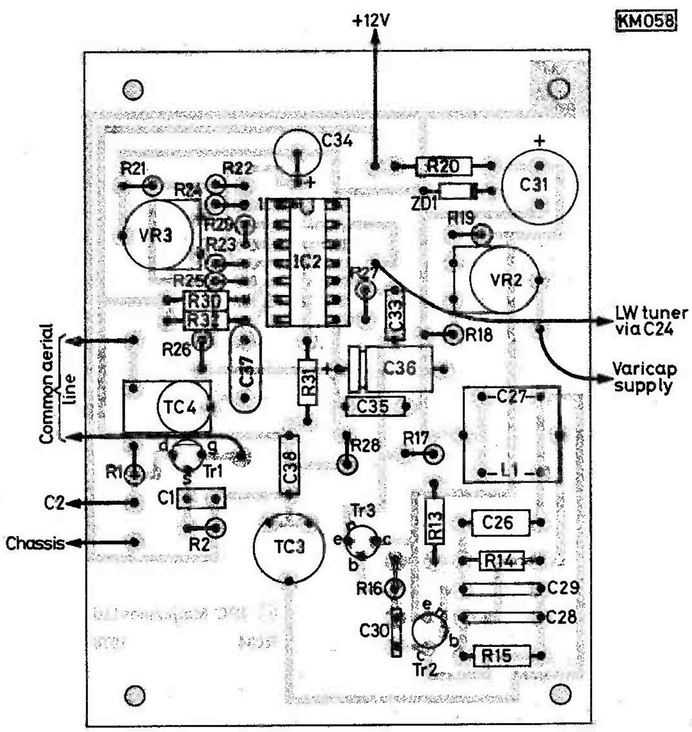


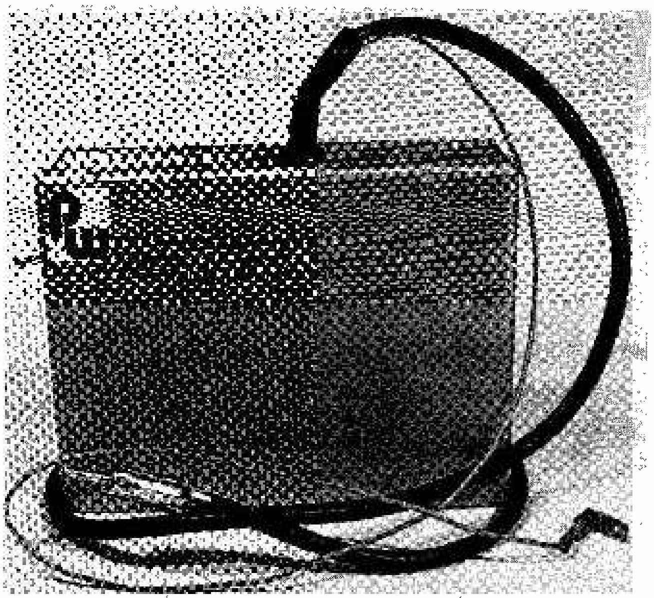
Fig. 3: Circuit diagram of the Oscillator and Modulator. Below we show the full-size p.c.b. pattern of the above circuit and the corresponding component layout





with the trimmer, sets the frequency of the oscillator and in practice a fairly wide frequency range can be obtained.

Fig. 3 also shows the modulator circuit which is designed around the LM1496 i.c. VR1 is used to balance the level of modulation of the carrier and the outgoing signal is then fed to the aerial via the trimmer capacitor. N.B. The unit described is for a car with a NEGATIVE earth. Older models may have a POSITIVE earth and the unit must be wired accordingly.



Constructional Notes

The circuit should be built in an aluminium box to screen out interference from the car. The screened lead from the unit to the radio should be the low loss type designed for car radio aerials and this can be obtained as an 'aerial extension lead' from car accessory shops. Ideally the unit should be connected to the car radio on/off switch but if this is a problem then it can be connected to a spare 12V terminal. An independent on/off switch may be included if required.

The car aerial plug is connected to the unit, and the outgoing lead is plugged into the car radio aerial socket.

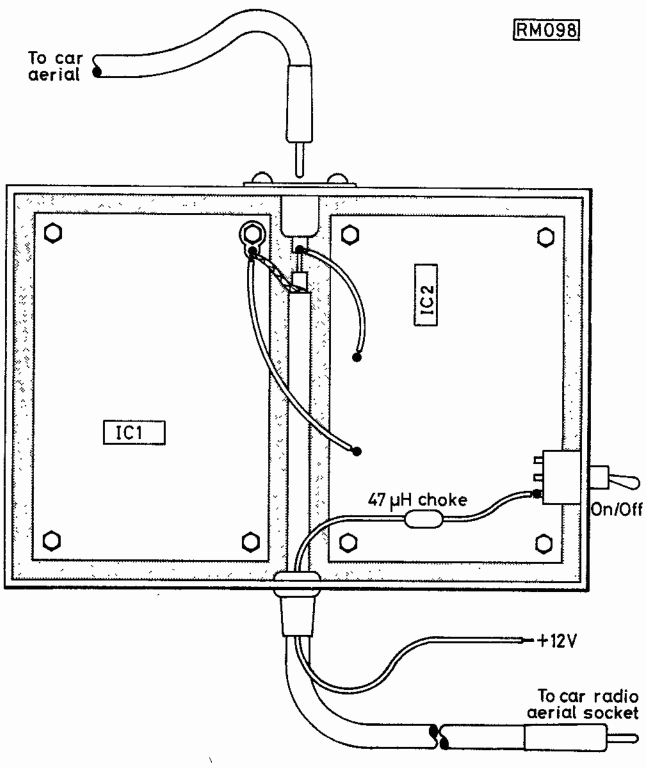


Fig. 4: Connecting up the completed unit

★ components

Resistors *(⅛ or ¼ W carbon)*

47Ω	1	R27
100Ω	2	R22, 25
150Ω	1	R9
270Ω	2	R5, R8
470Ω	1	R20
680Ω	1	R17
820Ω	2	R2, 26
1kΩ	7	R1, 12, 15, 21, 23, 24, 29
1·2kΩ	1	R28
1·5kΩ	1	R7
2·2kΩ	1	R14
3·3kΩ	2	R31, 32
10kΩ	3	R10, 11, 30
22kΩ	3	R13, 18, 19
100kΩ	3	R3, 4, 6
330kΩ	1	R16

Potentiometers

all miniature pre-set

4·7kΩ	1	VR1
22kΩ	1	VR2
47kΩ	1	VR3

Capacitors

s/mica

4·7pF	1	C5
220pF	1	C27
270pF	1	C25
330pF	1	C26

Ceramic Disc

1nF	3	C9, 20, 30
1·5nF	2	C28, 29
10nf	12	C1, 2, 3, 4, 7, 8, 11, 12, 14, 15, 17, 18
47nF	1	C10
10nF	4	C1, C33, 37, 38

Electrolytic (p.c.b. mounting) 16V

3·3µF	4	C21, 22, 23, 24
10µF	2	C16, 39
25µF	2	C36
100µF	1	C31

Tubular 25V

1500µF	1	C32

Note: C6 and 19 not fitted

Trimmers (foil or compression types)

3-30pF	4	TC1, 2, 4, 5
5-65pF	1	TC3

Integrated Circuits

HA1197	1	IC1
LM1496	1	IC2

Transistors

BF256	1	Tr1
BC109	2	Tr2, 3

Zener Diode

10V 100mW ZD1

Inductors

L1—50 turns of 34 s.w.g. enamelled on Ambit 13k former
L2/L3—1A350 (Toko), L4-2A740 (Toko), L5-16726 (Toko), L6/7 CFU050 (Toko)

Miscellaneous

Car coaxial plug and socket, tape jack (optional), case approx. 105 × 135 × 40mm, on/off toggle switch (optional)

Although the unit is connected to the car earth supply by the outer screen of the aerial cable, it is advisable to make an additional link to the car's metalwork direct from the aluminium box in order to ensure good bonding to chassis.

In some cases prominent "spikes" from the generator or ignition system may cause interference. This can be reduced by including a 47μH choke, (or higher) in the 12V supply line.

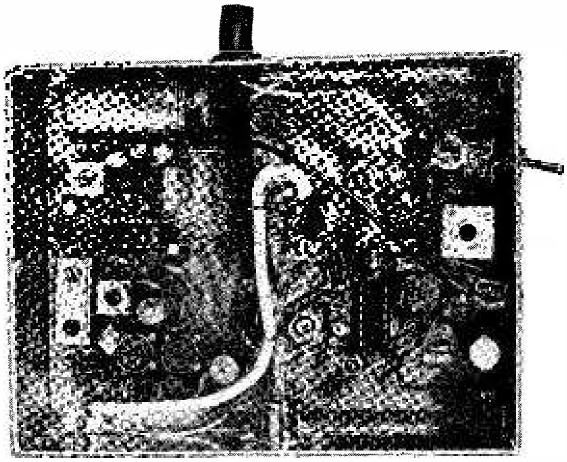
Alignment and Testing

The long wave module can be aligned by ear using the 200kHz transmission if no signal generator is available, or a complete aligned module may be obtained from Ambit International.

The tuning pot should be set to receive 200kHz. The technique is to use a generator or the BBC 200kHz transmission, and a meter connected to the test point on the board. The unit should now be wired into the car system.

Tune the car radio around the 1600kHz area until the long wave signal is heard. Now set the pot on the modulator circuit to achieve the best signal. It may be necessary to adjust the audio output level on the tuner board in order to obtain a distortion free signal. Once this has been obtained then the oscillator should be adjusted so that the signal generated by the unit is obtained on a quiet part of the band.

Bear in mind that the band becomes more crowded after dark, and check the full length of the medium wave band to see that any harmonic signals from the unit do not clash with stations you may require. Some harmonics are inevitable but by trimming the capacitor in the unit's output line they may be reduced. The aerial trimmer in the car radio may need some adjustment in order to obtain the best results. Finally, if the radio has push button tuning, lock on to the position of the long wave signal.



View inside the completed l.w. converter

Additional use of the Unit

The unit may be used in conjunction with a hi-fi system tuner, provided that the tuner has a medium wave facility. In this case a stabilised 12 Volt supply will be required. The plug will almost certainly need to be a different type in order to connect to the a.m. socket of the hi-fi tuner unit. A short length of wire will serve as an aerial. ●

letters

The Editor,
PRACTICAL WIRELESS,
Westover House,
West Quay Road, Poole,
Dorset BH15 1JG

Citizen's band

Sir: In the last few years we have heard a lot of talk about a citizen's band for the UK. There are people in this country who can't wait to get their hands on a transmitter and push out a few watts. But have they ever stopped to think what a citizen's band would mean. A citizen's band is what it says; it is a CITIZEN'S BAND i.e. every Tom, Dick and Harry can pick up a transmitter and get on the air. From the trucker to the school boy—and they will come in their millions.

You can be sure that the true citizen's band campaigner will try to use the band as an extra amateur band to make regular local contacts and pass on information and news to other people—impossible because the band will be overcrowded by the Toms, Dicks and Harrys of this world.

Has it never occurred to the citizen's band campaigner to stop campaigning for such a band and start campaigning for a novice amateur band. Here are my ideas for such a band:—

1. A simpler version of the R.A.E. to be taken at home with the help of text books. Most of the questions would be on licensing conditions and transmitter interference.
2. A successful applicant will be given a call sign. Possibly GN then a number.
3. A log to be kept of all contacts.
4. Power output to be limited to about 10 watts with no repeaters. All emissions to be f.m. only, no s.s.b.
5. The band allocated to be from 144·5 to 145·0MHz (a dead part of 2m in my opinion), and to be split up into 20 simplex channels, 25kHz apart.
6. An emergency channel for climbers and hikers, i.e. channel 1. A licence would be available for a few pounds.
7. Licence to be paid yearly of about £7.

The above ideas are the rough foundations of a novices' amateur band and should be treated as such. If such a band is ever introduced it should never be called a citizen's band or advertised as such.

J. S. Goodier
Stockport

Pen-Pal

Sir: I am seeking a pen-pal, my work is in automation-research and development. My hobby is digital electronics and I would like to correspond and perhaps exchange technical literature and periodicals with anyone who has similar interests.

Mr. Z. Kalab
79804, Urice 369, Okr, Prostejov
Czechoslovakia

Ideas

Sir: I think the recently introduced "Blob Board" series of circuit boards are even better than sliced bread and much more easily solderable! I use mainly the ZB1C range, which accommodate various different combinations of (up to) 16-pin DIL devices, for various logic applications.

In this usage, I've found that lots of the pins have to be connected to positive or negative supply rails, and, frequently, to each other. It greatly simplifies wiring, and leaves much more room for other components, if such connections are made using conductive paint rather than wire jumpers. Crossovers are *not* possible, of course, but a bit of forethought can minimise the need for these.

I doubt if the same technique is possible using Veroboard—but, then, the Blob Boards are much more convenient anyway!

R. T. Third
Fraserburgh

Sir: I was interested in your Audio Filter described in the May 1978 issue. However there is a simpler way of getting a similar effect if you have on hand an old fashioned a.f. transformer as used in valve sets of the 1920s and '30s. These had a primary inductance that tuned to around 1kHz with a capacitor of about 0·001μF. By connecting this capacitor across the primary and also parallel feeding with a similar series value, and tuning the secondary with a pre-set of suitable value a very efficient narrow-band filter is produced. I used this with valves very satisfactorily and an added feature is that if a volume control of some 1 megohm is also connected across the secondary, this gives a variable bandwidth according to the signal being handled. A similar effect could probably be obtained using an f.e.t.

The only problem likely to be encountered, is that if connected too early in the amplifier there may be hum pick-up.

K. A. Smith
Ross-on-Wye

Data

Sir: I have recently obtained an "Audio Frequency Response Curve Tracer, Model 1900" manufactured by Industrial Electronics of London WC1. The serial number is 544.

If any other of your readers have any information concerning the maintenance and use of this equipment, that I could photocopy and return. I would be grateful if they could send it to me.

G. H. Honigman
34 Silverdale Road
Gatley, Cheadle
Cheshire SK8 4QS

Sir: I would like to get in touch with any reader who has built the 'Seekit' metal locator, published in the May and June 1977 issues of *Practical Wireless.*

J. Hinde
12A Station Road
East Horsley
Leatherhead
Surrey

PRODUCTION LINES

alan martin

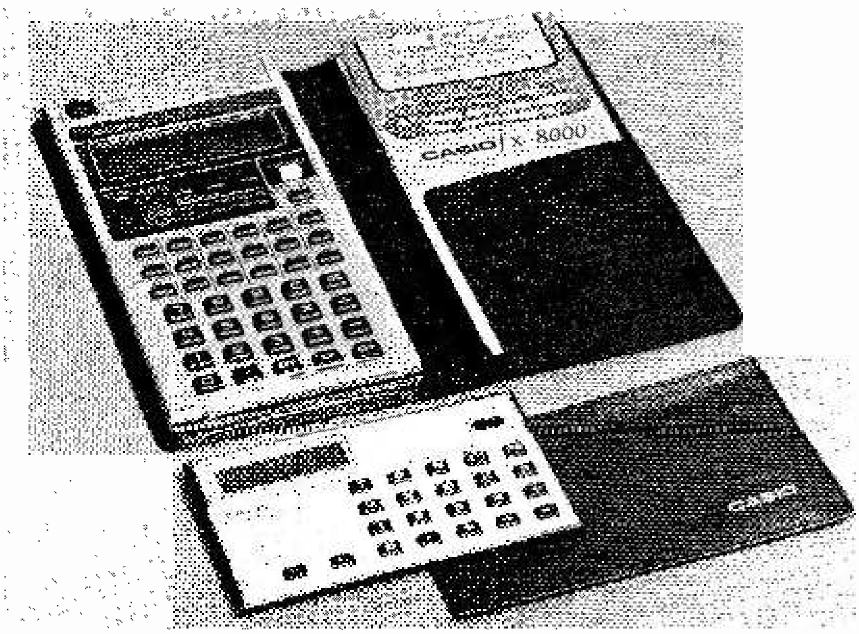
Nice pair

Just received from Casio, two scientific calculators which live up to the Casio reputation for quality.

First, the fx-8000 a pocket calculator measuring 145 × 70 × 8mm. The fx-8000 boasts 28 separate functions which include all the normal scientific requirements, plus two stopwatch and two timer facilities.

Second, the Mini card fx-48 which possesses most of the advantages of the fx-8000 less the stopwatch and timer features. This truly biscuit-sized calculator measures only 90 × 55 × 4mm with a well spaced easy-to-operate keyboard.

Both the calculators are presented in smart wallets with full operating instructions, and are available from Tempus at discount prices, which include VAT and p&p, (the RRP is shown in parentheses) the fx-8000 £29·95 (£35·95) and the Mini card fx-48 £19·95 (£24·95). *Tempus, Dept. P.W., 19/21 Fitzroy Street, Cambridge CB1 1EH. Tel: 0223 312866.*



Stick with it

Two new products from Loctite (UK) Ltd will be of interest to the home constructor and handyman. Loctite Handy Strip is a plastic, putty-like substance based on epoxy resin, and can be used to fill, bond or seal almost all materials. Handy Strip comes in a 10 inch strip, part blue, part white. Just tear off the amount required, knead it until it becomes a uniform white in colour. Once mixed it remains workable for 2 hours and sets hard within 24 hours. Ideal for use on items such as aerial arrays.

Loctite Glass Bond is a clear one-part adhesive for bonding glass to glass or glass to metal. It is cured by by the ultraviolet radiation which is present in natural daylight—within 10 seconds in strong sunlight, about 1—2 minutes on a cloudy day.

Both products have been used with success by *PW* staff members, and are available from hardware and DIY stores.

Airlite 62 Headset

This headset has been adopted as standard equipment by over 50 international airlines and many of the world's leading aircraft manufacturers. It is also used extensively by British and overseas armed forces for airborne and ground communications, in addition to satisfying requirements in the hovercraft, air traffic control, flight simulator, broadcast, oil and gas industries.

A variety of noise-cancelling microphone capsules and earpieces to cater for all applications can be supplied and the headset may be terminated with many different types of connector. Rugged in construction, it is fully type-approved by the F.A.A. and A.R.B. to WR603.

Price varies according to type and quantity, but for a single unit would be typically £50-60. The headset is designed and distributed by *Clement-Clarke International Ltd., Airmed House, Edinburgh Way, Harlow, Essex. Tel: 0279 24331, Telex 81338.*

Frequency Shift

Those worried by the problem of losing their favourite programmes on Radio 4 when it moves to the long waves in November can draw comfort from a small unit called the Ambitune. This takes the BBC's 200kHz (1500m) long wave channel and converts it to around 900kHz on the medium wave band, reradiating it so that it can be picked up on your medium wave receiver's ferrite rod aerial. It is **not** suitable for use with car radios. Tests we have made around the Bournemouth area have proved very satisfactory.

Measuring just 85mm square by 25mm thick, the Ambitune is powered by a single PP3 or similar type of 9 volt battery. Using the MN1604 manganese alkaline equivalent, a battery life of some 700 to 900 hours is claimed.

The Ambitune costs £6 including post, packing and VAT, and is available from *Ambit International 2 Gresham Road, Brentwood, Essex CM14 4HN.*

Ideas DEPARTMENT

Some original circuit ideas provided by our readers. These designs have not been proved by us, and we cannot therefore guarantee their effectiveness. They should at least provide a basis for experimentation.

Why not send us your idea? If it is published, you will receive payment according to its merits. Articles submitted should follow the usual style of PW in circuit diagrams and the use of abbreviations. Diagrams should be clearly drawn on separate sheets, not included in the text.

Each idea should be accompanied by a declaration that it is the original work of the person submitting it, and that it has not been accepted for publication elsewhere.

SHORT-PULSE GATE

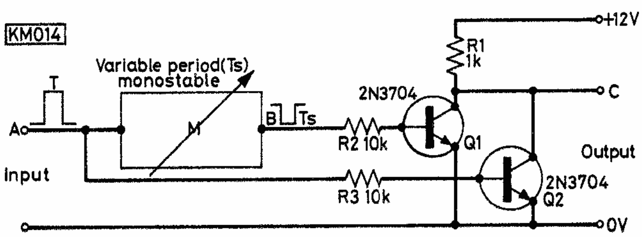


Fig. 1: The circuit diagram

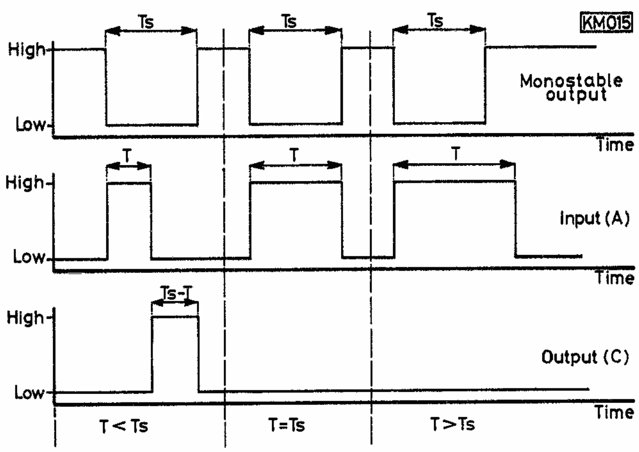


Fig. 2: Input and output waveforms

Considering the circuit of Fig. 1, with the input (A) at ground potential (low), and the output of monostable (M) at +12V (high), Q1 is turned on, and output (C) will be low. Since Q2 is turned off by the low applied to its base, it will not have any effect on the output as the "on" state of Q1 over-rides it. If a positive-going pulse of period T is applied to the input, Q2 will turn on, and the variable period (Ts) monostable will trigger from high to low—this state being applied to the base of Q1, turning it off. As Q1 is off and Q2 is on, the output remains low.

In the case when T is equal to Ts, after a period of T has elapsed, A will return to ground potential turning Q2 off and C will then go high as both Q1 and Q2 are off. After a further period of Ts=T has elapsed, the monostable will revert to its original condition; Q1 will turn on and C will go low. In this way, an output pulse of Ts-T is realised.

This circuit was developed to enable a system to react to pulses of 0·5s and ignore pulses of a greater length. The monostable type is not specified as it will be related to the minimum length of pulse to be registered.

T. Austin,
Southampton, Hants.

micro-power PILOT LIGHT

R.A.PENFOLD

Small battery-operated items of equipment rarely incorporate a pilot light, due to the increased demand for power this involves. Modern l.e.d. indicators have changed the situation, as these will give a bright display from a current of only about 20mA, and will give a visible glow under normal lighting conditions. An even lower current consumption can be achieved by storing a small electrical charge and using it to briefly illuminate an l.e.d. In this way the l.e.d. can be fully illuminated for brief periods, at about one second intervals and at currents in the µA range.

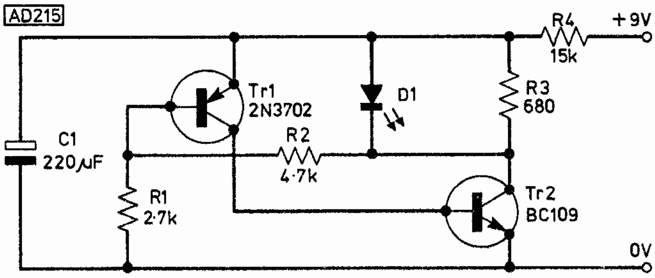


Fig. 1: Circuit diagram of the Micro-Power Pilot Light

A device of this type can be built very cheaply, and is easily miniaturised. Fig. 1. shows the circuit diagram. Here, when the supply is connected, C1 will charge exponentially via R4. When the charge across C1 reaches about 2V, a sufficiently large potential will be produced across the base-emitter junction of Tr1 by the divider action of R1, R2 and R3, for Tr1 to begin to turn on. This will cause a current to flow via its collector into the base circuit of Tr2, causing Tr2 to begin to turn on.

A regenerative action will then take place as Tr1 receives further base current via R2 from Tr2 collector. Tr2 will then receive an increased base current via the collector of Tr1. This will result in Tr2 rapidly turning hard on, causing C1 to be largely discharged through the l.e.d. resulting in it producing a brief flash. When C1 has partially discharged, insufficient circuit potentials will be available to hold Tr2 on, and a regenerative action will again occur. This time it will be the exact opposite of the original action, and will end with both Tr1 and Tr2 turned off. C1 will then begin to charge again, and this process will continue for as long as the supply is connected. With the circuit values shown a flash from the l.e.d. occurs every second or so, the period between flashes depending on the exact value of C1. The average current consumption of the prototype unit is about 450µA.

★ components

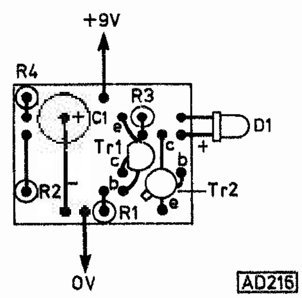
Resistors
All miniature ¼ or ⅛W, 5%
R1 27kΩ
R2 4·7kΩ
R3 680Ω
R4 15kΩ

Capacitor
C1 220µF 10V electrolytic

Semiconductors
Tr1 2N3702
Tr2 BC109
LED1 TIL209

Miscellaneous
0·1in Veroboard (9 holes by 7 strips)

Fig. 2: Component layout on a small piece of Veroboard



The unit is constructed on a 0·1in Veroboard panel having 9 holes by 7 copper strips, and this gives the finished article dimensions of only about 23 × 18 × 23mm. The component layout of the device is shown in Fig. 2. There are no breaks in any of the copper strips.

The leadout wires of LED1 are not taken through the holes in the Veroboard, but are conveniently soldered direct to the copper strips on the underside of the panel, as shown in Fig. 2. This is advisable as many l.e.d.s have thick leadouts which will not go through the holes in the Veroboard. In fact, it is an advantage to use an l.e.d. having heavy gauge leadouts, as when the finished unit is mounted in the main equipment, LED1 is fitted into its panel clip, and the component panel is then rigidly mounted on its leadout wires.

As the unit is so small, it should be possible to find enough space to fix it into almost any existing equipment.

PW WIMBORNE

N.B.MATTEY

Music Centre

PART 4 Cassette & A.M. Units + Full System Wiring

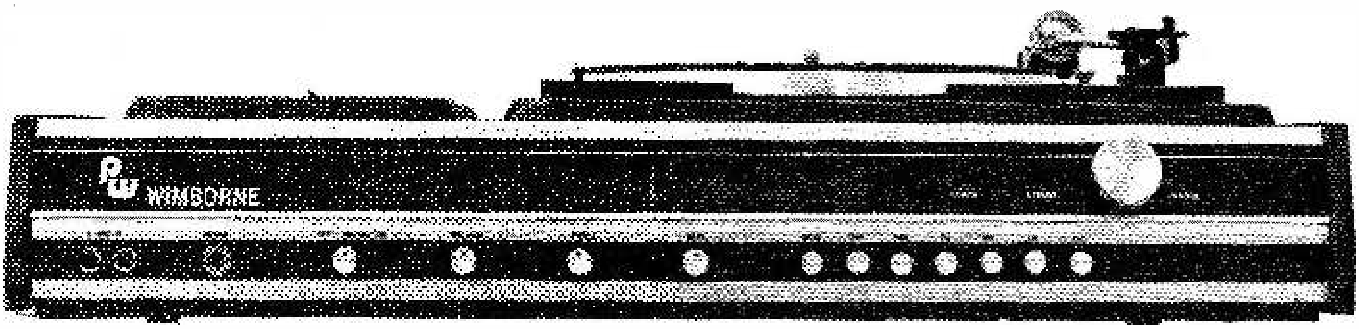


Table 1

Performance Details, A.M. Receiver	
Typical Ratings:	
S/N Ratio	55dB
Sensitivity	200μV (worst case)
THD	0·8%
Output	200mV approx
AGC FOM	75dB

A.M. Receiver Unit

While the limited dynamic range of the a.m. broadcast bands relegates the system to second place behind f.m. stereo, the extension of local radio and the move to medium wave of several national stations in November makes an a.m. receiver somewhat more attractive.

A central problem involved in designing an effective medium and long wave receiver is to achieve the sensitivity to resolve distant signals, and the selectivity needed to make evening listening (when a good deal of station overlap and fading occurs) a practical possibility. This paradoxical situation, that of wider range, but a more crowded band, can to some extent be overcome by increasing the sensitivity of the "front end" to the level where only a very short aerial is needed to maintain a good s/noise ratio. By coupling this to an oscillator and i.f. amplifier circuit of "tight" selectivity and superior a.g.c. performance, it is possible to achieve a well defined result, as shown by the table of performance figures.

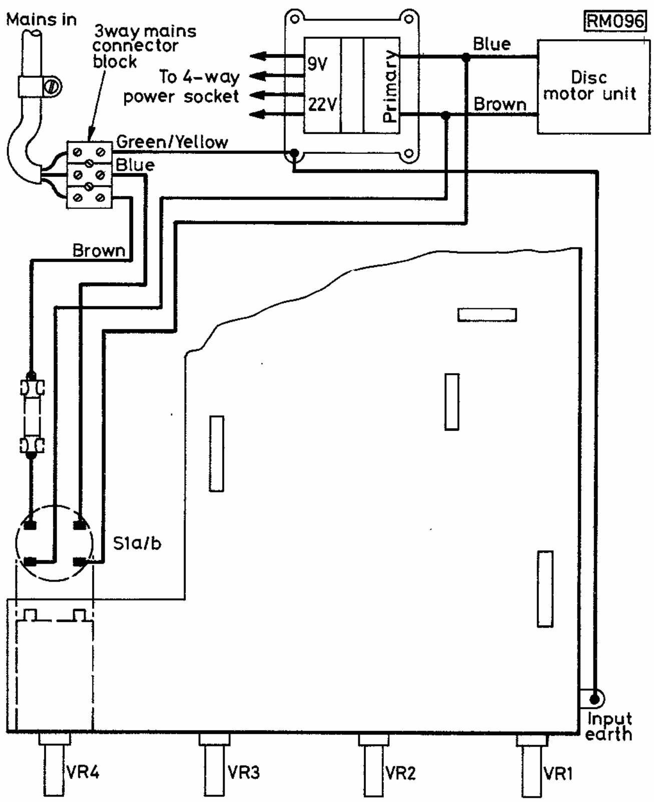


Fig. 1: Mains input cable and transformer details, plus general system wiring

The Basic Circuit

With the above aims in view, the excellent qualities of the HA1197 a.m. "chip" were utilised. The circuit is fairly conventional except that aerial (r.f.) transformers were chosen for the input stage, rather than the usual m.w./l.w. ferrite rod which necessitates some method of "swinging" the rod for maximum signal due to its directional properties. Further, direct coupling to an aerial means that a signal can be "brought in" easily when the unit is being used in say, a building of ferro-concrete where reception is likely to be impaired.

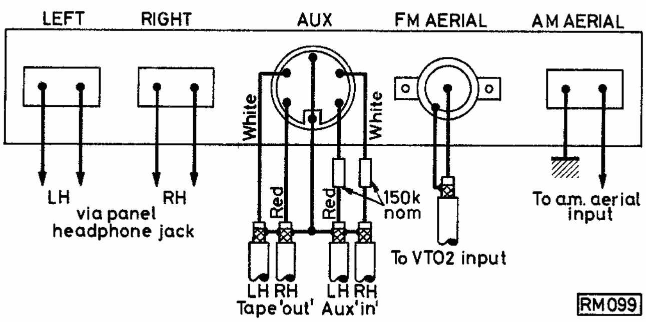


Fig. 2: Connections to the rear panel accessory sockets

Both the r.f. stage, in which the active element is the BF256, and the oscillator circuitry (L12 and associated components) are varicap tuned, in line with the f.m. receiver. Sensitivity is controlled by VR6, and the HA1197 amplifies and delivers the demodulated audio signal through the correction network R51, C81, L13 and R52.

Table 2

Circuit reference points: to be read in conjunction with all circuits	
1. R/H output	16. Signal Strength Meter point
2. L/H Output	17. Gram l.e.d. point
3. R/H Tape Input	18. AC Input to turntable
4. L/H Tape Input	19. Tape l.e.d. point
5. L/H Gram Input	20. FM l.e.d. point
6. R/H Gram Input	21. LW l.e.d. point
7. 18V (regulated)	22. MW l.e.d. point
8. Earth (chassis)	23. AM aerial input
9. 2·5 Bias point	24. Tuner head a.f.c.
10. 15V Bias point	25. Tuner head i.f. output
11. 19kHz Measurement point	
12. Stereo Beacon Output	
13. Tuner Head +V	
14. Tuner Head −V	
15. Tuner Head AGC	

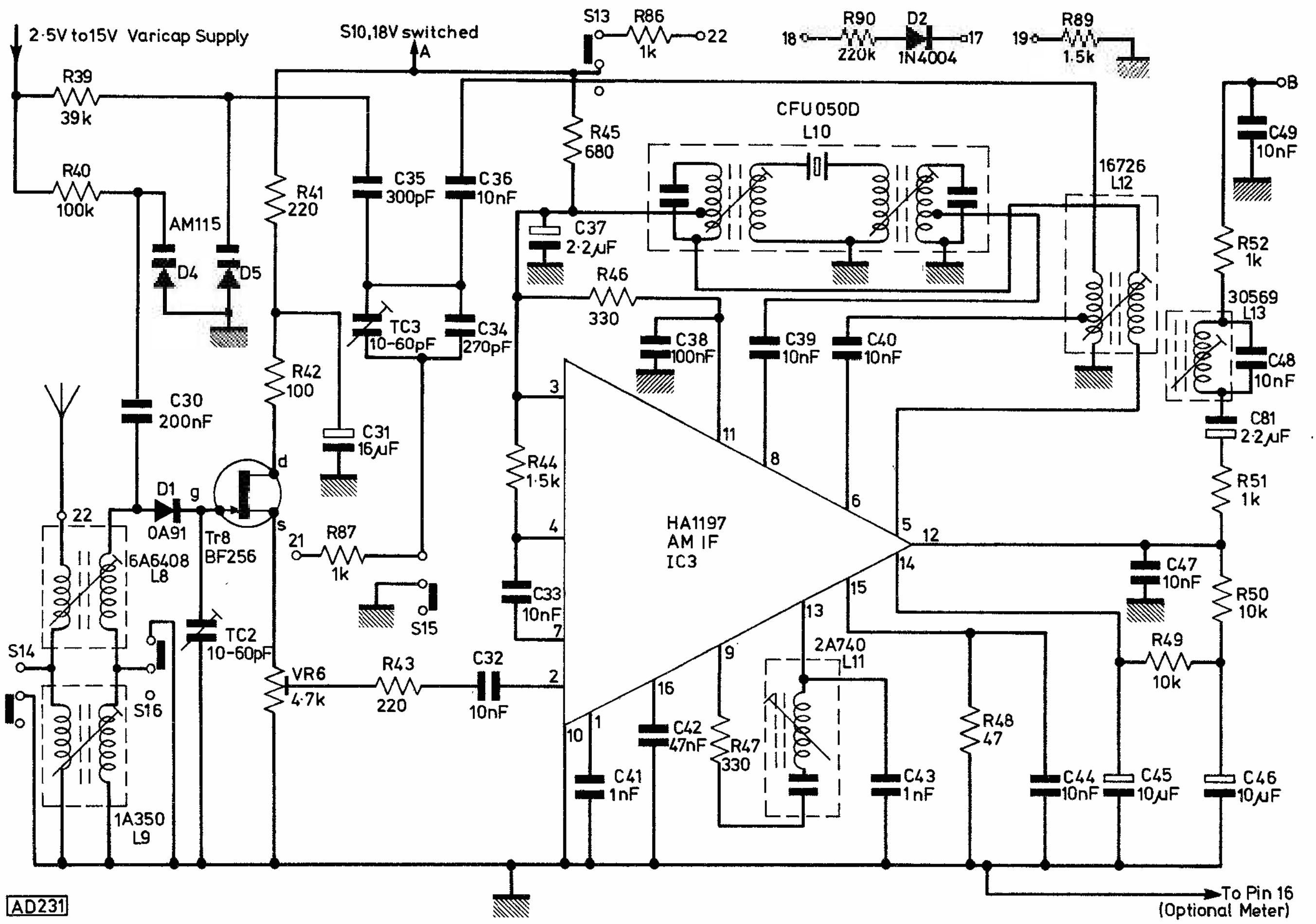


Fig. 3: Circuit diagram of the complete a.m. receiver; Tr8 is shown as Tr12 on the layout diagram shown in part 3 (Nov.)

★ components

Resistors
¼W carbon film 5%

47Ω	3	R7, 37, 48
100Ω	2	R42, 67
150Ω	1	R8
220Ω	2	R41, 43
330Ω	8	R4, 11, 14, 15, 16, 29
470Ω	4	R19, 72, 77, 83
680Ω	2	R38, 45
1kΩ	11	R1, 2, 9, 10, 25, 51, 52, 68, 73, 86, 87
1·5kΩ	2	R35, 44
2·2kΩ	2	R6, 34
2·7kΩ	1	R22
3·3kΩ	3	R36, 75, 81
4·7kΩ	4	R23, 33, 69, 70
8·2kΩ	1	R24
10kΩ	9	R12, 13, 17, 49, 50, 76, 79, 82, 85
15kΩ	8	R3, 5, 18, 21, 28, 30, 31, 32
18kΩ	1	R71
22kΩ	1	R20
39kΩ	1	R39
47kΩ	2	R78, 84
100kΩ	3	R40, 74, 80
470kΩ	2	R26, 27

Potentiometers

4·7Ω	3	VR1, 5, 6 (miniature pre-set)
100kΩ	1	VR3 (miniature pre-set)
100kΩ	1	VR4 (linear pot)
470kΩ	1	VR2 (miniature pre-set)

Capacitors

Silvered mica		
56pF	1	C25
100pF	4	C22, 23, 24, 80
270pF	1	C34
300pF	1	C35
470pF	1	C65
Ceramic Disc		
1nF	2	C41, 43
10nF	21	C1, 2, 4, 5, 6, 7, 8, 11, 12, 13, 18, 21, 32, 33, 36, 39, 40, 44, 47, 48, 49
Polycarbonate 160V		
22nF	3	C9, 10, 61
47nF	1	C42
100nF	4	C3, 14, 29, 38
200nF	1	C30
220nF	2	C64, 67
470nF	2	C19, 66
Polystyrene		
1nF	1	C4
2·2nF	3	C70, 71, 72
3·3nF	2	C63, 73
Polyester		
2·2nF	1	C62
Electrolytic		
16V		
10μF	4	C17, 20, 45, 46
16μF	1	C31
25V		
100μF	2	C31, 76
1000μF	1	C27
63V		
2·2μF	5	C26, 37, 60, 79, 81
100μF	1	C28
Tantalum Bead 35V		
0·47μF	1	C15
2·2μF	3	C16, 74, 75
10μF	2	C77, 78
Trimmers		
10-60pF	3	TC1, 2, 3

Integrated Circuits

CA3189	1	IC1
MC1310	1	IC2
HA1197	1	IC3

Transistors

BC148	1	Tr5
BC238c	3	Tr3, 6, 7
BC327	1	Tr4
BF254	2	Tr1, 2
BF256	1	Tr8

Diodes

OA91	1	D1
13V 100mW Zener	1	ZD2
AM115	2	D4, 5

Inductors

L1	22μH	
L2	TKAC34342	(Toko)
L3	TKAC34343	(Toko)
L4, L6	CLNS30569Z	(Toko)
L5, L7	CLNS30568Z	(Toko)
L8	6A6408	(Toko)
L9	1A350	(Toko)
L10	CFU050D	(Toko)
L11	2A740	(Toko)
L12	16726	(Toko)
L13	30569	(Toko)

Miscellaneous
F.M. Tuner Module VTO2 (Reed Hampton). S1-S18 7-button interlocked switch-bank (15mm pitch) (Reed Hampton or Armon Products, Wembley, Middx). F1, F2 Ceramic Filters CFS10·7 MHz (Toko or Murata). 14-pin d.i.l. socket. 16-pin d.i.l. socket (2 off). Six-way connectors (2 off). 4-way connectors (2 off). Cassette unit (from Reed-Hampton).

Construction and Setting Up

The component layout, shown complete with the f.m. section in our November issue, should be adhered to if problems of instability are to be avoided. Simi-

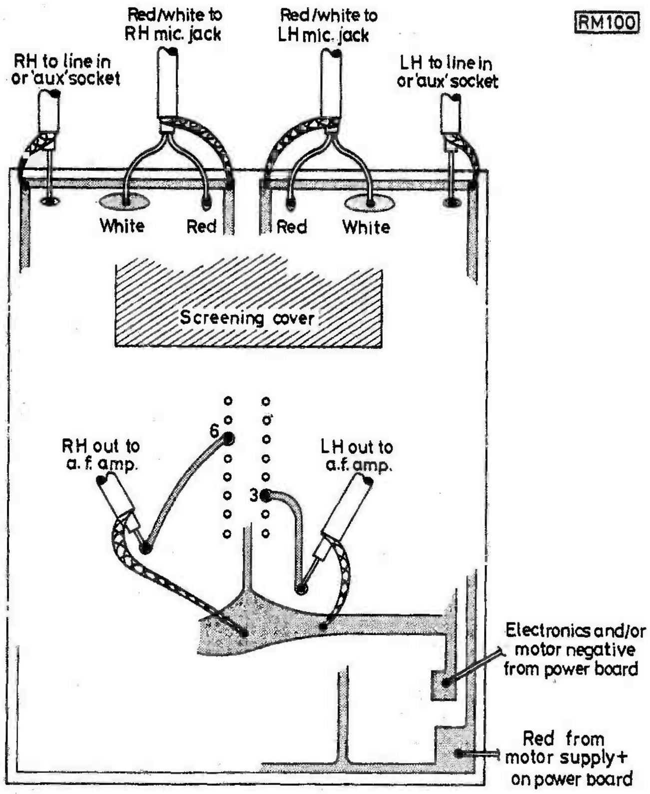


Fig. 4: Cassette unit underside showing "in" and "out" points on each p.c.b.

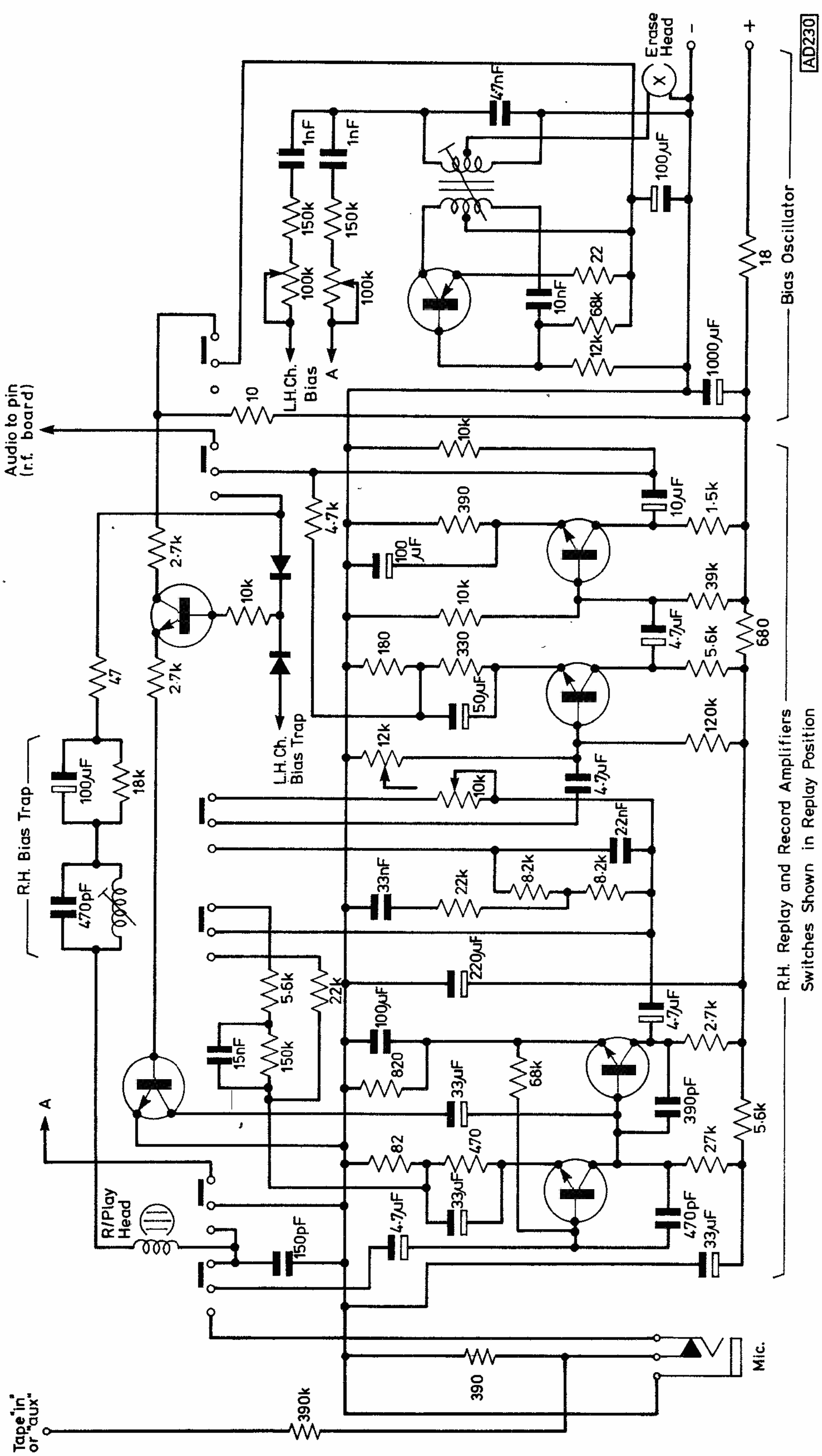


Fig. 5: The circuit diagram of one complete cassette record/play amplifier. Some oddities have crept in: two electrolytic capacitors are shown unpolarised, a 100μF (which should have − to chassis) and a 4·7μF (+ connection to base of appropriate transistor), a 12kΩ fixed resistor is shown with an unnecessary arrow, and the audio signal "out" (top right) should go to pin 3, r.f. board. This circuit is intended only as a rough guide for connection and servicing purposes

larly, the sensitivity control (VR6) should not be advanced too far for similar reasons. When setting up, TC2 is used to peak the high frequency end of the m.w. band (194 metres or about 1600kHz), and the cores of L8 and L9 set for maximum output at the low frequency end of each band (530m on m.w. and 150m on l.w.). If no signal generator is available for this operation, it can be carried out by ear, or in conjunction with an output meter.

Trimmer TC3 is set to produce accurate oscillator tracking across the m.w. band. An additional feature (optional) is the inclusion of l.e.d. points for the display of medium or long wave function in the "on" state.

Aerial Length

In view of the high sensitivity of the r.f. stage, only a short aerial should be used (except in areas of low signal strength), and the prototype performed very well on a 4 metre length of mains cable. Very long aerials may, in some areas, induce i.f. breakthrough, with consequent c.w. (Morse code) interference. However, there is unfortunately no way of eliminating the timebase "whine" from 405 line tv receivers, so the shorter the aerial the better.

Cassette Unit Electronics

It will be noted that no component references are given for the amplifier, and this is due to the fact that the unit is supplied complete, and with input/output leads wired in. It is not really recommended that the constructor wires up an individual unit since the connecting points on the cassette p.c.b. are minute, but a plan view is shown for those who wish to attempt this. Similarly, a line mains fuse may be fitted in series with the "live" input lead to S1.

General Notes

Cassette Unit: check that the supply rail does not exceed 12V for the motor unit, and 10-12V for the electronics. Where both are fed from the 12V supply, start-up motor "plop" can be eliminated by isolating via a 47Ω (nominal) resistor fitted in series with + connection junction with C301 (1500μF). The tag on the component side of the board is then removed and directly linked to +12V on power panel.

The slide switch for CrO2 can be removed if not required (Reed-Hampton supplied unit only).

Safety Hints: all chassis and metal parts must be bonded to "earth" line at some point. Before switching on, check with a multimeter that resistance ("Ω×100" range) is virtually infinite, so as to avoid possibly lethal wiring errors. The 150kΩ resistors shown in series with the "Aux in" connections are nominal only, and should be increased where high signal inputs are considered.

Loudspeakers

Although this is technically the final instalment of the "Wimborne", details will appear in the new year of a suitable design for loudspeakers. ●

KINDLY NOTE!

"Gillingham" SW Receiver Frequency Readout, October

IC1 should be type SN7404. (Hex Inverter.)

ZL SPECIAL 2m Beam (November (1978)

We very much regret that on the drawing Fig. 2 (p 23) the dimensions of the rear and front driven elements were omitted. These should be 965mm (rear) and 927mm (front). We apologise to our readers and the Author for this unfortunate oversight.

STD Charge Timer November 1978

R15, 1·2MΩ was omitted from the p.c.b. layout Fig. 3. It should be connected to the next S1 contact to that carrying R14 and its other end connected to the common point of the other timing resistors.

NEW BOOKS

A PRACTICAL INTRODUCTION TO ELECTRONIC CIRCUITS by Martin Hartley Jones. Cambridge University Press, September 1977. Hard-back £9·50, Paper-back £3·95.

The straightforward presentation of technical information at any level is a technique which the initiated finds a simple task, but to make this information at once dynamic and attractive is the preserve of the sensitive writer or engineer. Martin Hartley Jones proves that he is both of these with the publication of this book.

As an example of the originality of approach, the author begins with the vital process of amplification, and unlike many who forget or ignore the value of analogy, provides the excellent example of the original Morse relay, demonstrating how a large output can be controlled by a small input. This leads into considerations of gain, and while some may consider this to be "cart before horse", it seems rational to me to look at Darlington pairs and other circuits designed to achieve gain, before a consideration of the physical processes begins. After all, gain is a vital factor in amplification, to state the obvious.

This is not to say that the general succession of basic approaches is ignored. From voltage amplifiers, the course of the instruction pursues a productive line based upon essentials of theory and practice, from comparisons of f.e.t. and valve techniques, through feedback and impedance matching, to the inevitable final chapters on truth tables and binary counting. The difference lies in some of the intervening material. At long last the differential amplifier is included, along with sections on pulse clipping, thyristors and triacs, inverting amplifiers, and active filters. The work is sound, and the layout of text and diagrams tends to lead the eye and brain rather than push it unwillingly onward.

One point of criticism—how practical is "Practical"? Although many pin-out details, and valve base connection details are shown, there is little consideration of actual physical layout—what should we do about "earth" loops? Nevertheless, the information is there, and very attractively presented. This book must be good value.

Ted Parratt

HOTLINES

A REVIEW OF RECENT DEVELOPMENTS

In general, the author does not have any more information on products than appears in the article.

Soft Errors

One of the areas in electronics where smaller and smaller has been the key word is memories. News from researchers has brought the startling realisation that packing things into tiny areas can breed problems not previously considered. In the case of dynamic random access memories, a problem occurred called "soft errors". These are errors which can be corrected by simply repeating the operation, but they are a problem.

The 4096 RAM had these worries and now the newer 16K RAMS are causing researchers to examine the problems of soft errors quite carefully. And they've come up with some startling conclusions. One is that these soft errors are caused by alpha particle radiation generated from within the i.c. or, more specifically, from the materials which are used in the packaging. Apparently it's the teeny-weeniest amount of radioactivity which is the source of the troubles—they think. According to the eggheads amongst them, researchers argue that when the alpha particle whizzes through the chip atoms it finally comes to rest. Its energy is absorbed (which is why it stops) and the result is the production of 1·4 million electron hole pairs in a tiny 25μm length. (I wonder whose calculator they used to work that out with?) It's this which is apparently causing all the problems. The answers are not simple and work is currently proceeding in many different directions but all with the same end objective. I'll report more on this fascinating battle as and when news comes in. Meanwhile, if you do happen to wake up one morning with 1·4 million electron hole pairs on your pillow and that old "soft error feeling" at least you'll know what caused them!

CMOS 555

Those who really like to be with-it in terms of the latest i.c.s will be pleased to hear that a c.m.o.s. version of the 555 timer looks like being a reality. Magic numbers to look for are ICM 7555. Some technical buffs are mumbling about currents of only 85μA (160μA for the 7556) plus advantages in timing applications because higher resistance elements will be possible. Batteries should last for a very long time with these chips. Writers of books with such titles as "Five Hundred Million Circuits Using the 555" are doubtless busy rewording and rewriting current circuitry to take commercial advantage of these devices.

Plastic Keys

Burglars in hotels are going to be in for a very hard time if a new electronic lock manages to get off the ground. While there are already many locks of a kind on the market, they usually have signals going to and/or from them via wiring of some sort. In the case of hotels this is often the telephone wiring or mains etc. It's now thought that todays' sophisticated thief might be able to 'tap' into this wiring and open doors, hence the need for a different kind of lock. The new one, not yet on the market commercially, has a really unique feature—no wires. The whole thing is built into the door and runs off its own batteries.

The key looks like taking the form of a kind of credit card which has a coding put on it at the reception desk. It's a 28-bit code, too, and that means an awful lot of possibilities before you might guess the right one. The door mechanism has a microprocessor and memory so it's virtually a miniature computer built into the door. The guest inserts the card or "key" and the computer will check the number on the card against the number held in its memory; if they tally the door will open.

Then someone thought of a weakness. Perhaps the cards and their codes might be duplicated. So, a "guest" might use a room, copy the key, then return some days later when it was occupied by someone else, and commit a burglary.

To avoid this, the key carries two 28-bit code capabilities. When a guest checks in, his key carries the old or previous code. But the main desk has put another "new" code into the other 28-bit capability. This new code is generated completely randomly. When the new guest puts his key into the lock the new code does not tally (because the old code is still in the door lock's memory). Immediately, the door will generate a recheck of the other 28-bit code. This, of course, it recognises. Upon receipt of this, the door will erase the old code from its memory, and reprogram itself with the new code—and open the door. Thus each new guest effectively reprograms his/her door to a new secure code. Wonder what they'll think up for bicycles?

Longer Video

Video recorders seem to be catching on; even the TV rental showrooms have them. Because of the enormous potential market seen in video recording, many companies are competing and nowhere more keenly than in the video cassette field. The early cassettes for this purpose did not last very long and this was a marketing difficulty. However, the latest broadside in the cassette war is from a German manufacturer who is launching a 4-hour video cassette. Not so long ago a Dutch company launched a 3-hour cassette. Better to come (for the consumer), a 5-hour version is on the way later this year, while an 8-hour video cassette is in development. If this goes on you'll soon be able to have the whole of Wimbledon in a single package. Then heaven help any visitor who shouts, "Anyone for tennis".

Ginsberg

LW/MW Frequency Changes

On 23 November, 1978, a new international frequency agreement comes into force. This provides for a considerable increase in the number and power of transmitters in Europe. The BBC is reorganising its arrangements for broadcasting Radios 1, 2, 3 and 4 on medium wave (m.f.) and long wave (l.f.) from that date.

The main object of making the changes has been to make the most effective use of the frequencies which are available, and to alleviate so far as possible the increased interference which is expected to affect many of them. A number of additional transmitters are being installed and listeners should not assume that their present reception of a particular frequency is necessarily any indication of the reception it will provide under the new plan. Full details of the new channels are given in the tables, but the changes and their expected effect are summarised below.

Radio 1 will be transmitted on **1053** and **1089**kHz (285 and 275 metres) instead of 1214kHz (247m). By using two medium frequencies instead of one, Radio 1 will have much better coverage, both by day and night. The low-power transmission on 1485kHz (202m) at Bournemouth will be retained.

Radio 2 will be transmitted on **693** and **909**kHz (433 and 330m) m.f. instead of 200kHz (1500m) l.f. and 1484kHz (202m) m.f. (Scotland). With two medium frequencies instead of the present l.f. service, Radio 2 will be easier to receive in many areas where the present long-wave service is poor. On the other hand, some areas will suffer increased interference after dark, and here listeners should use v.h.f. whenever possible.

Radio 3 will be transmitted on **1215**kHz (247m) instead of 647kHz (464m). There will also be a low-power transmission on **1197**kHz (251m) at Cambridge. Radio 3 should be available on medium wave in all the most populous parts of the country, with about the same coverage as for Radio 1 at present. Listeners who cannot receive Radio 3 on m.f. are advised to use v.h.f.

Radio 4 will be transmitted on **200**kHz (1500m) l.f. instead of 692, 908 and 1052kHz (434, 330 and 285m) m.f. There will, in addition, be medium-wave transmissions on **603**kHz (498m) for Tyneside; **720**kHz (417m) for Northern Ireland; **1449**kHz (207m) for Aberdeen; and **1485**kHz (202m) for Carlisle.

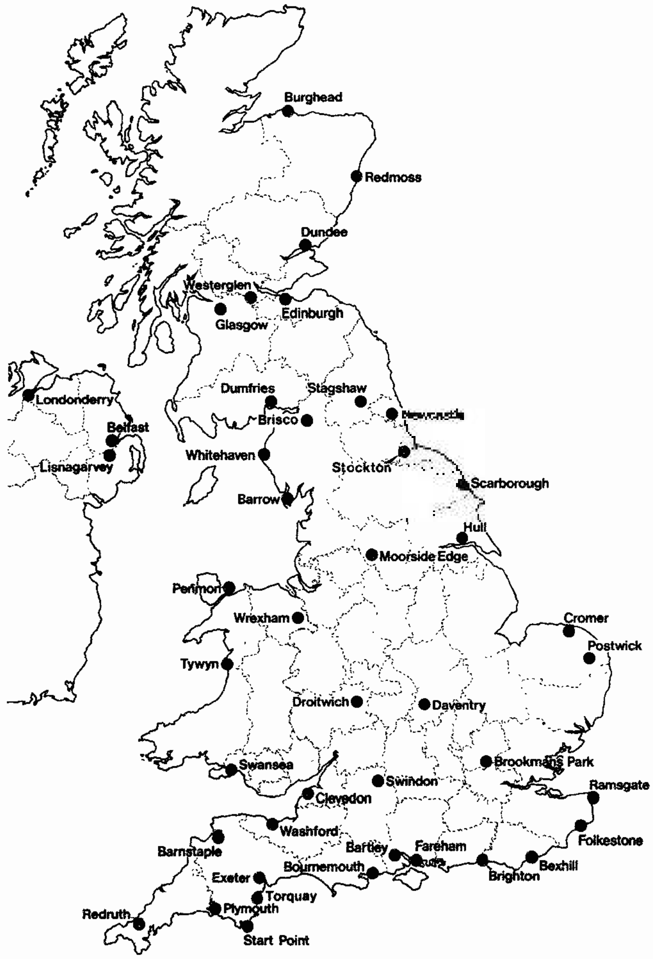
Using l.f. and a number of m.f. channels for local coverage, Radio 4 should be receivable almost anywhere in the UK. In Scotland, Wales and Northern Ireland it will provide an alternative to Radio Scotland, Radio Wales and Radio Ulster. In England, existing Radio 4 services on v.h.f. will continue, providing local news and weather forecasts as at present.

Radio 4 in Northern Ireland will continue to be transmitted on 720kHz/417m. This service will be transferred to a new site with higher power, and should be available throughout most of the province. In some areas an alternative service will be available on l.f.

Radio 4 South West. From 23 November the frequencies of three Radio 4 South West m.f. transmitters will change. Barnstaple will change from 683kHz/439m to **801**kHz/375m; Plymouth from 1457kHz/206m to **855**kHz/351m; and Torquay from 854kHz/351m to **1458**kHz/206m.

With the exception of brief local news and weather reports and the early morning magazine programme Morning Sou'West, the five Radio 4 South West m.f. transmitters—Barnstaple, Exeter (990kHz/303m), Plymouth, Redruth (756kHz/397m), and Torquay—will carry the same programmes as the Radio 4 l.f. service.

Shipping forecasts. From 23 November both the main shipping forecasts and the forecast for inshore waters will be broadcast on Radio 4's long- and medium-wave



LONG AND MEDIUM-WAVE RADIO

	Frequency kHz	Wavelength Metres	Power kW
Radio 1			
Barnstaple	1053	285	1
Barrow	1053	285	1
Bexhill	1053	285	2
Bournemouth	1485	202	2
Brighton	1053	285	2
Brookmans Park	1089	275	150
Burghead	1053	285	20
Droitwich	1053	285	150
Dundee	1053	285	1
Fareham	1089	275	1
Folkestone	1053	285	1
Hull	1053	285	1
Lisnagarvey	1089	275	10
Londonderry	1053	285	1
Moorside Edge	1089	275	150
Postwick	1053	285	10
Redmoss	1089	275	2
Redruth	1089	275	2
Stagshaw	1053	285	50
Start Point	1053	285	100
Tywyn	1089	275	1
Washford	1089	275	50
Westerglen	1089	275	50
Whitehaven	1089	275	1
Radio 2			
Barrow	693	433	1
Bexhill	693	433	1
Bournemouth	909	330	1
Brighton	693	433	1
Brookmans Park	909	330	140
Burghead	693	433	50
Clevedon	909	330	20
Droitwich	693	433	150
Exeter	693	433	1
Fareham	909	330	1
Folkestone	693	433	1
Guernsey	909	330	0·5
Jersey	909	330	1
Lisnagarvey	909	330	10
Londonderry	909	330	1
Moorside Edge	909	330	100
Plymouth	693	433	1
Postwick	693	433	10
Redmoss	693	433	1
Redruth	909	330	2
Stagshaw	693	433	50
Torquay	909	330	1
Westerglen	909	330	50
Whitehaven	909	330	1
Radio 3			
Brighton	1215	247	1
Brookmans Park	1215	247	50
Burghead	1215	247	20
Cambridge	1197	251	0·2
Droitwich	1215	247	30
Fareham	1215	247	1
Hull	1215	247	0·15
Lisnagarvey	1215	247	10
Londonderry	1215	247	0·25
Moorside Edge	1215	247	50
Newcastle	1215	247	2
Plymouth	1215	247	1
Postwick	1215	247	1
Redmoss	1215	247	2
Redruth	1215	247	2
Tywyn	1215	247	0·5
Washford	1215	247	60
Westerglen	1215	247	40

LONG AND MEDIUM-WAVE RADIO

	Frequency kHz	Wavelength Metres	Power kW
Radio 4			
UK Service			
Burghead	200	1500	50
Carlisle	1485	202	1
Droitwich	200	1500	400
Lisnagarvey	720	417	10
Londonderry	720	417	0·25
Newcastle	603	498	2
Redmoss	1449	207	2
Westerglen	200	1500	50
South West			
Barnstaple	801	375	2
Exeter	990	303	1
Plymouth	855	351	1
Redruth	756	397	2
Torquay	1458	206	1
Radio Ulster			
Lisnagarvey	1341	224	100
Londonderry	1341	224	0·25
Radio Scotland			
Burghead	810	370	100
Dumfries	810	370	2
Redmoss	810	370	5
Westerglen	810	370	100
Radio Wales			
Penmon	882	340	10
Tywyn	882	340	5
Washford	882	340	70
Wrexham	882	340	2

BBC LOCAL RADIO

	MEDIUM WAVE			VHF	Max. erp	
	Metres	kHz	kW	MHz	kW	Pol'n
Birmingham	206	1458	10	95·6	5·5	H
Blackburn	351	855	0·5	96·4	1·6	S
Brighton	202	1485	1	95·3	0·5	H
Bristol	194	1548	5	95·5	5	H
Carlisle (Main)	397	756	1	95·6	5	H
(relay)	206	1458	0·5			
Cleveland	194	1548	1	96·6	5	H
Derby (Main)	269	1116	0·5	96·5	5·5	S
(relay)				94·2	0·01	V
Humberside	202	1485	2	96·9	4·5	H
Leeds	388	774	0·5	92·4	5·2	S
Leicester	189	1584	0·5	95·1	0·3	S
London	206	1458	50	94·9	16·5	H
Manchester	206	1458	5	95·1	4·2	S
Medway	290	1035	0·5	96·7	5·6	H
Merseyside	202	1485	2	95·8	7·5	S
Newcastle	206	1458	2	95·4	3·5	H
Nottingham	197	1521	0·25	95·4	0·3	S
Oxford	202	1485	0·5	95·2	4·5	H
Sheffield (Main)	290	1035	1	97·4	5·2	S
(relay)				88·6	0·03	H
Solent (Main)	300	999	1	96·1	5	H
(relay)	221	1359	0·25			
Stoke-on-Trent	200	1503	0·5	96·1	2·5	H

H—Horizontal S—Slant V—Vertical

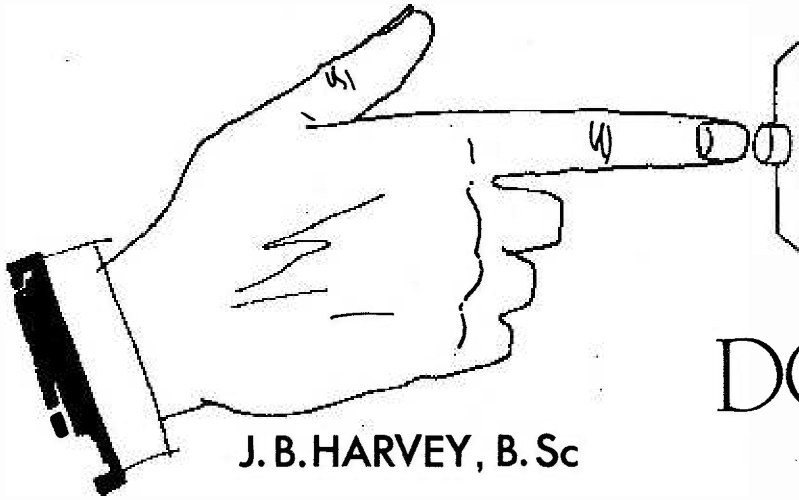
transmitters. The late-night forecasts will be broadcast on v.h.f. also.

Local Radio. The majority of Local Radio stations will be unaffected by the changes. The exceptions are Radio Leeds, which will change from 1106kHz/271m to 774kHz/388m; Radio Leicester from 1594kHz/188m to 1584kHz/189m; and Radio Solent's service in Bournemouth which will change from 1594kHz/188m to 1359kHz/221m.

Receivers with pre-set station selection. In addition to the changes which have been described, all of the BBC's medium frequencies, both for the National services and for Local Radio, will be increased by a very small amount. These increases will be too small to be noticed on radios having continuous tuning (the great majority) but receivers with preset (pushbutton) station selection in the m.f. band may require adjustment of the preset controls. This will apply to many car receivers.

VHF services. There are no changes to the BBC's v.h.f. transmissions except in Northern Ireland, where the present Radio 4 v.h.f. network will be transferred to Radio Ulster. Radio Ulster v.h.f. will, however, continue to carry all Schools, Open University and Further Education programmes and some Radio 4 programmes.

We are grateful to the BBC Engineering Information Department for their assistance in providing the information given here. If you require further advice or information, please write to: Radio Changes, BBC, Broadcasting House, London W1A 4WW. ●



Digital DOOR CHIMES

J. B. HARVEY, B. Sc

Introduction

Being unimpressed with a simple door bell or chime the author decided to design a circuit that would generate the "Big Ben" sequence when a visitor called. Realising that one might grow tired of "Big Ben" a programmable version was developed, variations in diode linkages producing different tunes; the one in the author's home, which is described here, is currently programmed to generate the opening bars of "Colonel Bogey"!

The component cost is around £5, and the circuit is suitable for battery operation, drawing negligible current in the "standby" mode.

Circuit Description

The circuit can be considered in three sections: the sequence generator and the audio oscillators, designed around c.m.o.s. devices and linked by diodes to produce the tune required, and a simple power amplifier to drive one or more loudspeakers.

Oscillator Operation

Basic to the circuit is a two stage c.m.o.s. oscillator (see Fig. 2). This simple circuit requires only two gates, two resistors and a capacitor and operates as follows. When the waveform (1) at the output of inverter B is in a high or "1" state, capacitor C becomes positively charged. As a result the input to inverter A is high and its output is low or "0". Resistor R2 is returned to the output of inverter A to provide a path to ground for the capacitor to discharge. As long as the output of A is low, the output of B is high. As capacitor C discharges, however, the voltage at the junction of C and R2 approaches and passes through the switching point of inverter A. The output of A goes high, that of B goes low, and capacitor C charges negatively. R2 then provides a discharge path to the supply voltage, and C begins to charge to this voltage. Again the voltage at the junction of C and R2 passes through the transfer point of inverter A; at that instant the circuit again changes state, the output of A going low and of B high, and the cycle repeats.

The time to repeat one cycle is approximately 1·4CR2; the frequency can be made nearly independent of supply voltage and switching point variations by including a large resistor in series with the input to inverter A: hence R1. The oscillator may be gated on and off by using one of the inputs to gate A as a control line, taking the line high to run, low to inhibit, and this is done in the chime circuit. Since the c.m.o.s. gates used cost around 5p each, the circuit is very economical; indeed it was cheaper to use five separate oscillators in the chime circuit than one oscillator with switchable frequency.

Chime Circuit Operation

When switch S1 is closed, the RS flip-flop comprising gates A3 and A4 is set, the Q output going high and $\bar{Q}$ low (see Figs. 1 and 3). The reset line to the decade counters B & C is cleared, and the clock generator (E1 & E2) is enabled. Now the enable lines to each counter are taken to a second RS flip-flop (RS2); since one output is always high when the other is low, both counters cannot sequence at once, even though they are both clocked simultaneously. Initially, B is enabled and commences counting. On the 9th clock pulse RS2 is set, counter B is frozen and counter C takes up the count.

On the 17th clock pulse both RS flip-flops and counters are reset, and the clock is disabled.

For the sequence to repeat correctly the next time S1 is pressed it is necessary for RS2 to reset before RS1, since the reset drive pulse is taken from counter C, and this disappears when RS1, and hence the counters, are reset. Since both flip-flops are reset by the same drive pulse a race hazard situation exists; this is resolved by including a resistor R3 in the reset line to RS1. R3 in conjunction with the input capacitance of gate A3 gives rise to a small time constant, sufficient to delay the reset of RS1 by the required number of nanoseconds. Should the delay prove insufficient a small capacitor (10-100pF.) can be fitted (C2).

This reset pulse, and consequently the 17th clock pulse, are of short duration, comparable with the propagation delay of a c.m.o.s. gate (typically 25 nS), since in resetting everything in sight the reset pulse is itself eliminated.

Inspection of Fig. 3 shows that a sequence of sixteen discrete pulse outputs is available, each output being one clock pulse in duration; the other outputs of the decade counters are of longer or shorter duration, and so are unsuitable for the present purpose. These sixteen pulses are connected by programming diodes to the enable lines of five audio oscillators, and it is the positioning of these diodes that determines the note sequence that will be generated. These oscillators are set to operate at suitable audio frequencies, adjustment being provided by VR1-5. The five outputs are isolated from each other by D1-5, and are taken to the input of a simple power amplifier.

Power Amplifier

This amplifier operates in the class D mode, the output being switched between supply and ground at a rate determined by the incoming signal. This has several advantages: there is no quiescent current, the load may be driven directly without the need for a large coupling capacitor, and large amounts of power may be switched into the load with little dissipation in the output transistors Tr2 and Tr3, limited only by the maximum collector current of these transistors (for BC140/BC160 $I_c$max is 1A); consequently no heatsinking is required and therefore the amplifier is very economical.

Other transistors may be used if BC140/BC160 are not readily available, provided that they have reasonable gain and current handling capability. The astute reader will realise that with the load coupled to the amplifier as shown, Tr3 does most of the work; Tr2 would be unnecessary for a purely resistive load, but for an inductive load such as a loudspeaker Tr2 provides an active pull-up and serves to square off the output waveform. D7 and D8 are included to restrict the possibility of breakdown in the output transistors when driving an inductive load.

Construction

The digital door chime may be assembled on veroboard, no special care in layout being necessary; however, a purpose-made printed circuit board is undoubtedly neater, and a suitable layout is shown in Fig. 4; Fig. 5 gives the component locations. If S1 were connected to the circuit via a very long length of wire, spurious pick-up could set off the chimes (although this has not happened on any of the units

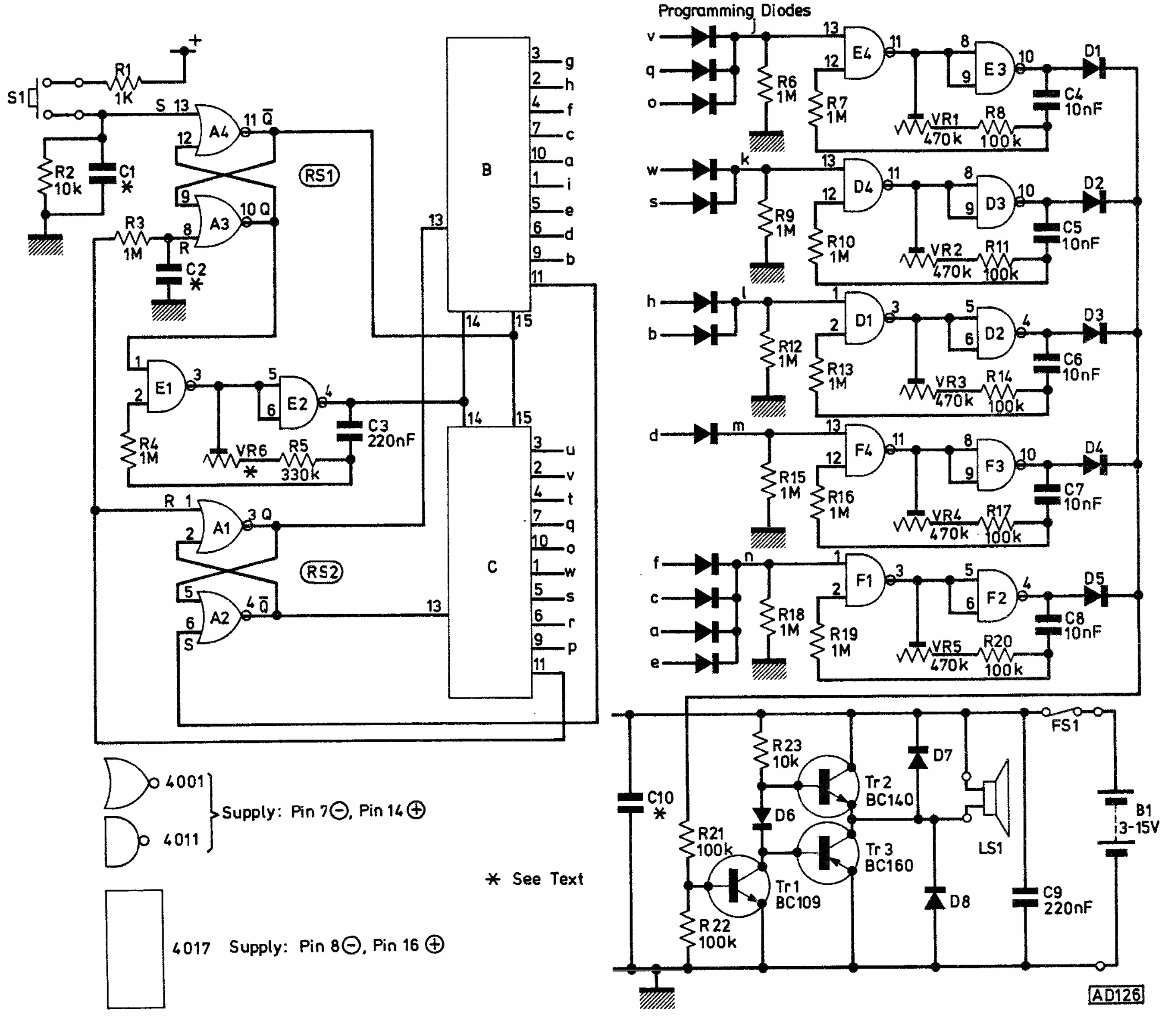


Fig. 1: The circuit diagram is easily divided into three separate sections, the sequence generator on the left, the audio oscillators and the audio amplifier

so far built); a 10nF capacitor (C1) across R2 will eliminate this hazard. C10 may be added for extra supply decoupling, although no problems have been experienced with the prototypes. VR6 may be added to vary the clock rate, and hence the speed at which the tune is played; if this facility is not required then the VR6 position should be linked across on the p.c.b. Finally a fuse has been included in the supply line to protect the power source in the event of a component failure.

Handling C.M.O.S.

Whatever method of construction is used it is necessary to handle the c.m.o.s. devices with care, to avoid damage by static discharge. Unless the constructor is experienced in the handling and soldering of these devices it is advisable to assemble the circuits using i.c. sockets, leaving the fitting of the devices until last. The chips are supplied either in a metal tube or mounted on conductive foam to prevent damage during transit, and they should be left there until they are transferred to the circuit. When handling the i.c.s, avoid working in a very dry atmosphere, wearing a nylon shirt or doing anything else likely to produce a build-up of static. It is a good idea to cover the working surface with a sheet of earthed aluminium foil and keep everything on that. Once in circuit, of course, the i.c.s are safe from further damage by static.

Operation

Unlike t.t.l., c.m.o.s. will operate from any supply in the range 3-15V; in addition the current drawn by c.m.o.s. when powered up but not switching is negligible. Since the power amplifier draws no quiescent current either, the digital door chime may be run off a small dry battery (e.g. PP9), the life of the battery approaching its shelf life, since current is only drawn when the chime is operating. (If you find this difficult to believe, connect a 50μA meter in the supply lead—there is no deflection on "stand-by").

The current drawn when the unit is running depends almost entirely on the load, the circuit itself drawing around 1mA. The only limitation on load impedance is that the $I_c$max of the output transistors is not exceeded; e.g. if a 15V supply and a 15 ohm load is used, the peak load current will be 1A, and the r.m.s. power delivered to the load will be 3·75W, assuming a 1:1 mark-space ratio. Being driven by a square wave the loudspeaker signal is rich in harmonics, the note produced having a penetrating quality that is well suited to its application.

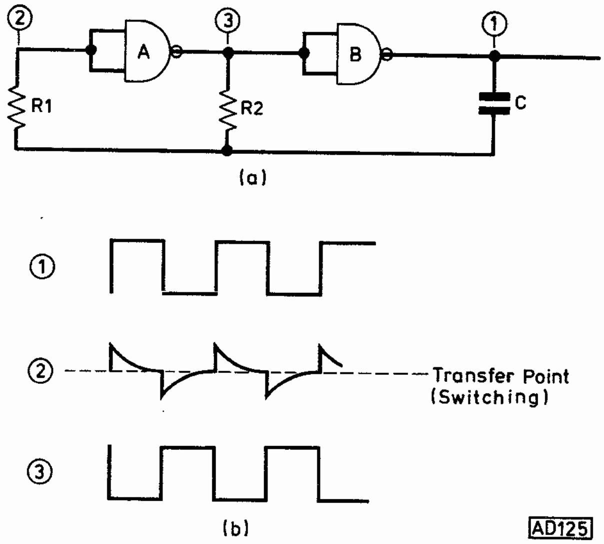


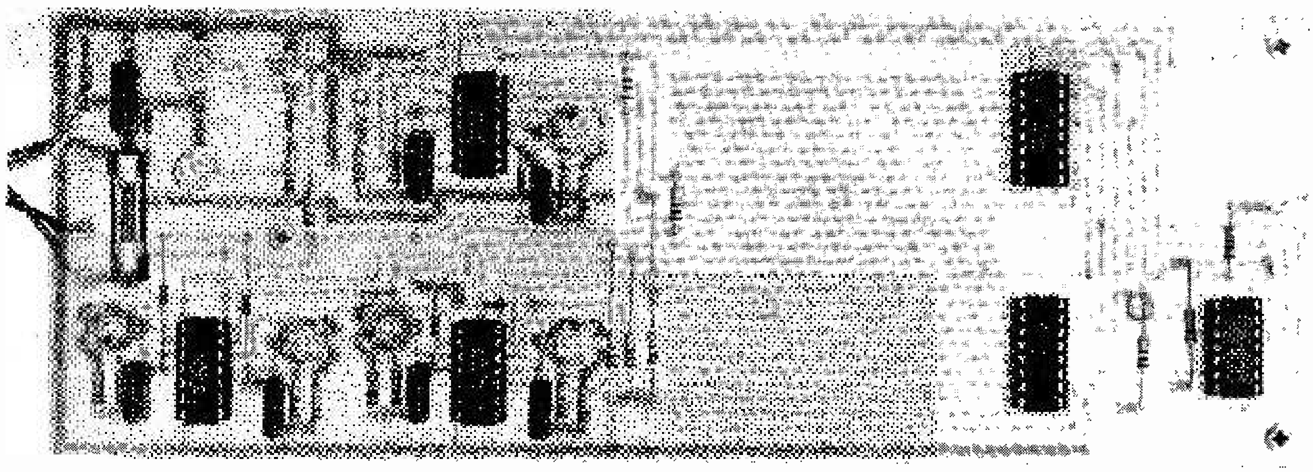
Fig. 2: The basic two stage c.m.o.s. oscillator

Setting Up

Plug in all the i.c.s and connect the unit to a power supply, with a current meter in the positive lead. There should be negligible current drawn when the circuit is not operating: any permanent quiescent current should be investigated. The five notes may be set up easily by pulling up each enable line (j-n) in turn to give a continuous tone and adjusting the associated preset.

To adjust	Link positive rail to
VR1	I.C.E Pin 13
VR2	I.C.D Pin 13
VR3	I.C.D Pin 1
VR4	I.C.F Pin 13
VR5	I.C.F Pin 1

Finally, close S1 to verify the operation of the entire circuit. The speed at which the tune is played may be adjusted by altering the value of R5 (or tweaking VR6 if fitted).



The prototype p.c.b. seen from the component side

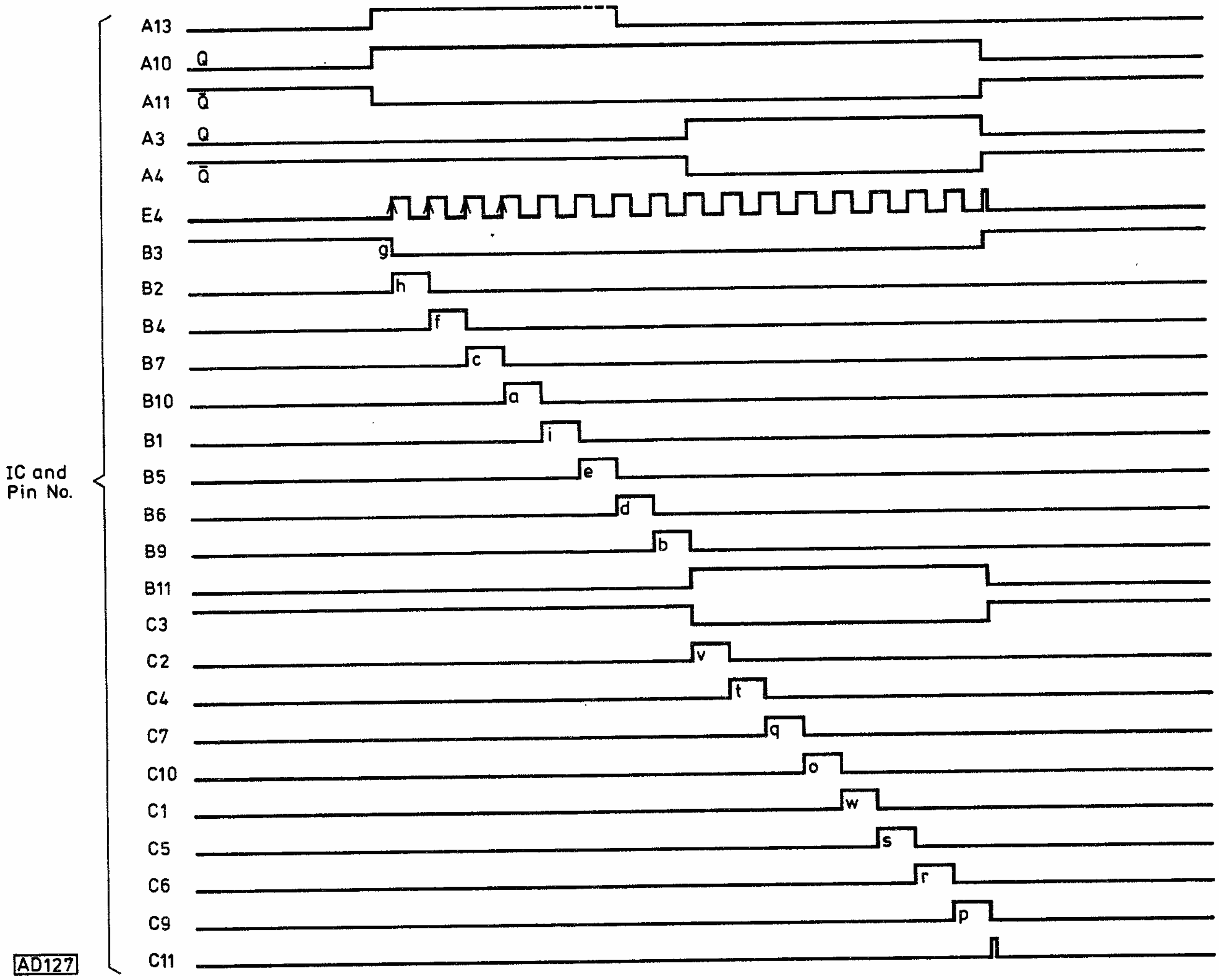
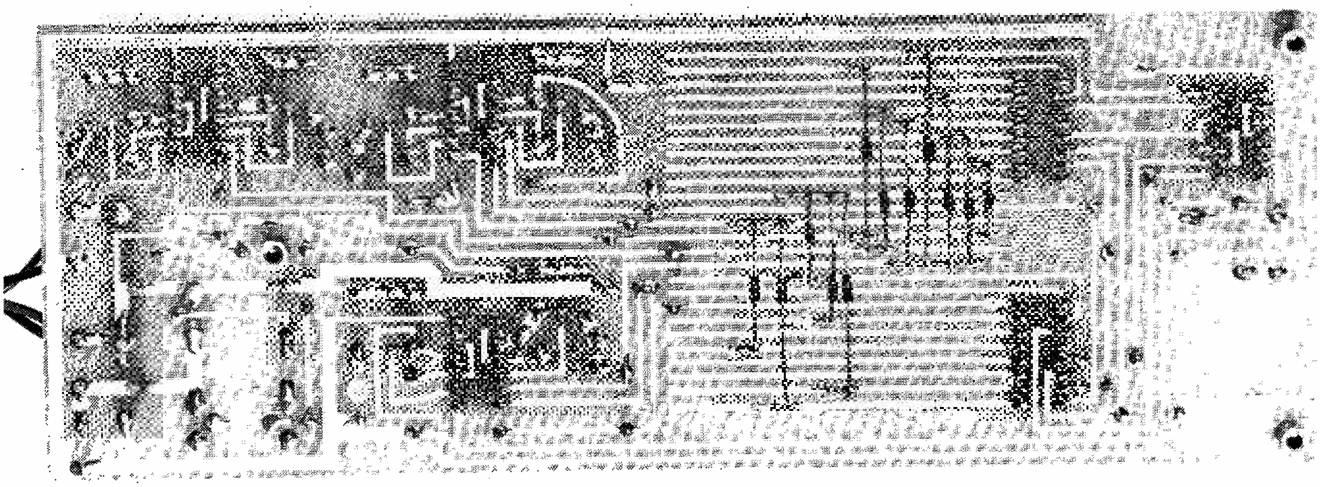


Fig. 3: Timing diagram showing the relationships of the various pulses

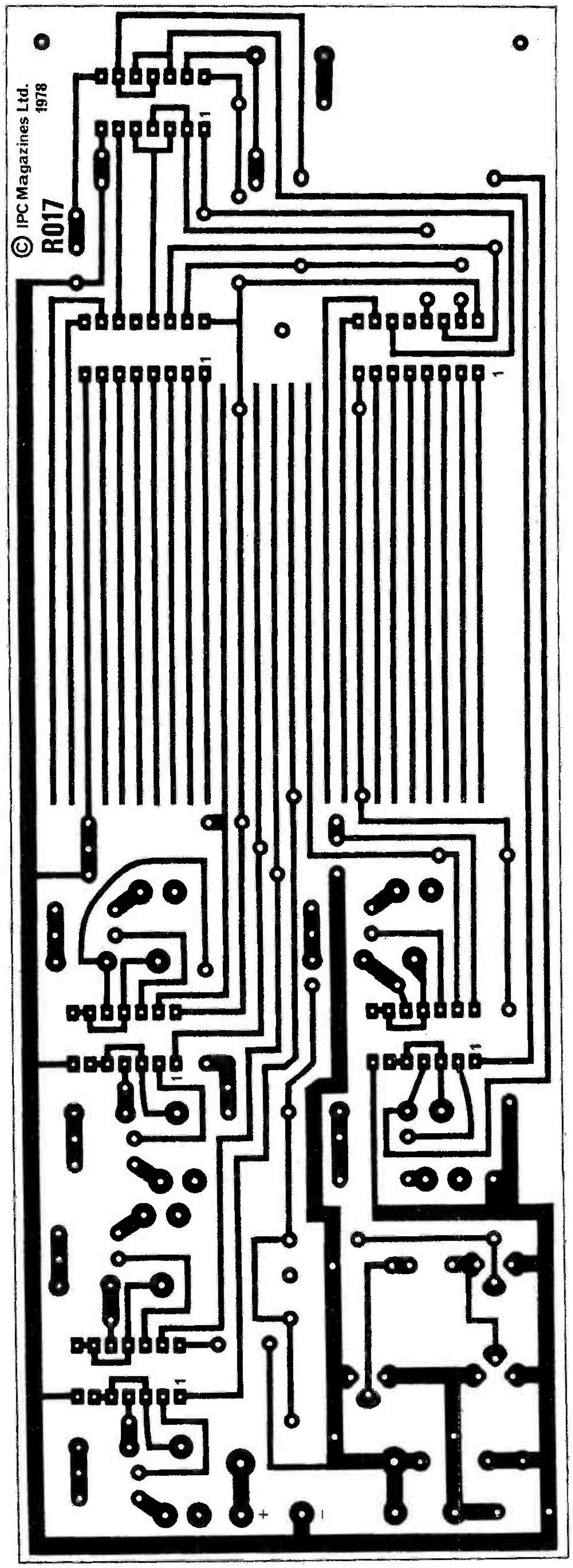
Faultfinding (e.g. decoding errors, wrong or missing notes) may be simplified by bridging C3 with a 2·2μF capacitor; this will slow down the clock to 1Hz and allow the circuit operation to be checked at leisure against the timing diagram (Fig. 3) with a meter.

Touch Control

Advantage may be taken of the very high input impedance of c.m.o.s. devices to operate the chimes by touch control instead of a switch. Simply increase R1 to 100k and R2 to 10M, and replace S1 with a pair of touch contacts.



Copper track side of the p.c.b. showing positioning of the diodes



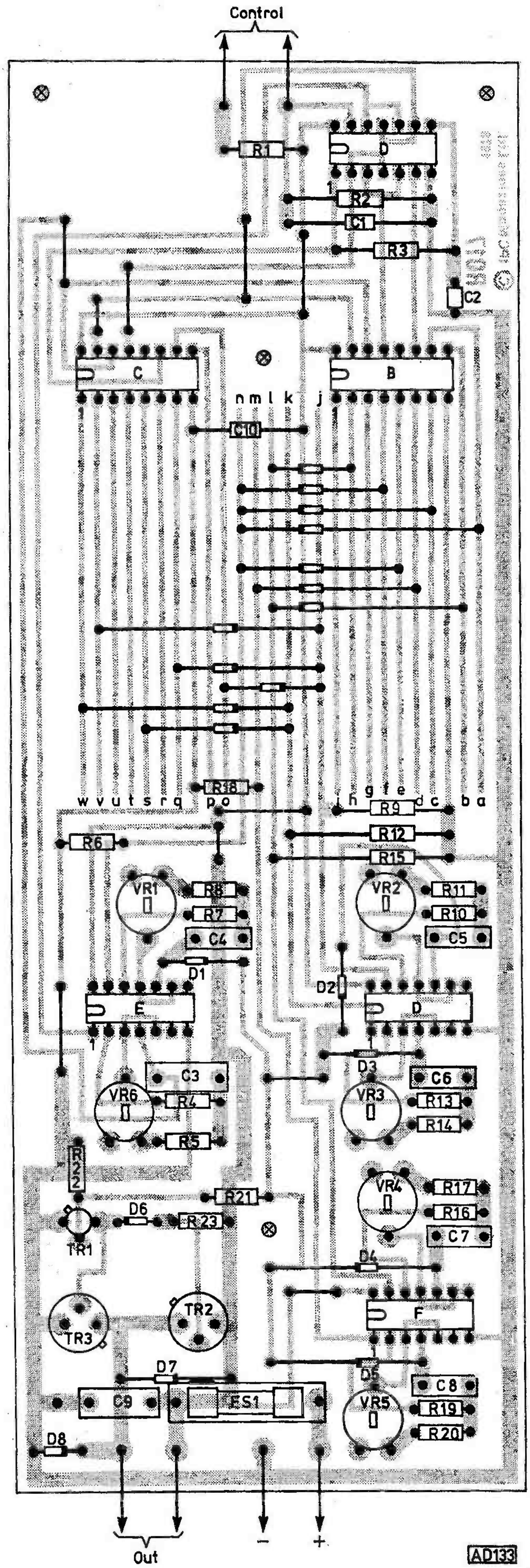


Fig. 4: Above, copper track layout of the p.c.b. (shown full size)
Fig. 5: Right, component layout

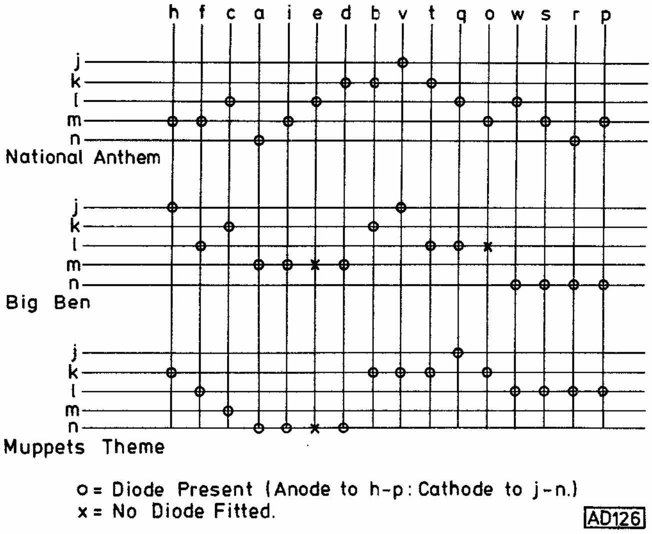


Fig. 6: Programming for three sample tunes. This shows the positioning of the diodes on the matrix part of the p.c.b.

★ components

Resistors

All ¼ watt 5%

R1	1k	R10	1M	R19	1M
R2	10k	R11	100k	R20	100k
R3	1M	R12	1M	R21	100k
R4	1M	R13	1M	R22	100k
R5	330k	R14	100k		
R6	1M	R15	1M		
R7	1M	R16	1M		
R8	100k	R17	100k		
R9	1M	R18	1M		

VR1-5 all 470k lin. preset

Capacitors

C1	see text	C6	10nF 100V polyester
C2	see text	C7	10nF 100V polyester
C3	220nf 100V polyester	C8	10nF 100V polyester
C4	10nF 100V polyester	C9	220nF 100V polyester
C5	10nF 100V polyester	C10	see text

Semiconductors

Tr1	BC109	IC A	4001	IC D	4011
Tr2	BC140	IC B	4017	IC E	4011
Tr3	BC160	IC C	4017	IC F	4011

All diodes 1N4148

Miscellaneous

Fuseholder, 1A fuse, loudspeaker, battery and connector, 14 way i.c. sockets (4 off), 16 way i.c. sockets (2 off), door bell switch or touch contacts.

Alternative tunes

The circuit as it stands provides sixteen time intervals and five notes, conveniently enabling the first four bars of any number of tunes to be programmed; several examples are shown in Fig. 6. Extra notes may be provided by adding further audio oscillators to the circuit (most economically added in pairs, since there are four Nand gates in each i.c.) and programming them as required; the outputs would be taken via isolating diodes to R21. Finally, really keen constructors can work out for themselves how to add further decade counters to extend the length of the chimes. ●

RECEIVER ADD-ON ACCESSORIES

Continued from page 25

In use, the object is to find the right amount of inductance, by changing the tapping point on the coil, and the correct amount of capacitance, the point of resonance being indicated by a sharp increase in signal strength. There will be many points at which the signal will peak but there will be a particular ratio of inductance and capacitance giving the maximum signal. Make a note of the tapping point on the coil and the tuning capacitor/s settings for future reference. Do this at the centre of each band of interest. It is worth while taking a little time to find the correct settings, so do not settle for the first peak found.

Stephen-James Ltd, 47 Warrington Road, Leigh, Lancs.
Multi Tuners, Mkl 1·8 to 30MHz, five aerial configurations. Mk2, similar plus m.w. band. **Crystal Calibrator**, 1MHz, 500kHz, 100kHz, 50kHz, 10kHz, 5kHz and 1kHz. **Audio Bandpass Filter**, eight switched bandwidths 80Hz to 2·5kHz. Peak and Notch Filter, between receiver and speaker/phones. Preselectors.

Amtest, 55 Vauxhall Street, Rainbow Hill, Worcester WR3 8PA.
Aerial Tuner AT2, 1·5 to 30MHz for end-fed aerials. **RF Preselector** PRS1, same range, up to 30dB gain. **PRM** for m.w. coverage to 1·6MHz. **PRM Adaptor Unit**, for coupling external aerials to internal ferrite rod aerial of receiver.

Cambridge Kits, 45(P) Old School Lane, Milton, Cambridge CB4 4BS.
LF Converter, 100/600kHz converted to 80m band. **Tunable Audio Notch Filter**, between speaker and receiver, 350 to 6000Hz. **Crystal Calibrator** 1MHz, 100kHz, 25kHz. All are kits.

G2DYM Aerials and Projects, Whiteball, Wellington, Somerset.
Aerial Matching Unit, designed to combat TV timebase QRM, untuned, wideband for 50Ω to balanced feeder from multi- or single-band dipole. Switch for Marconi T operation on 160m and broadcast band.

Partridge Electronics Ltd, Broadstairs, Kent.
ATU's 111B and LO-Z500 for use with Joystick aerial. **Joymatch Triple purpose ATU**, s.w. and m.w. coverage, in kit form.

Lowe Electronics Ltd, 119 Cavendish Road, Matlock, Derbyshire.
ATU, Daiwa CL22 1·8 to 30MHz for SWL. **Converters** by Microwave Modules, various for 4m, 2m, 70cm and 23cm to h.f. receiver.

Rocquaine Electronics, Aldebaran, Le Coudre, St. Pierre-du-Bois, Guernsey, Channel Isles.
Crystal Calibrator RQ1, 1MHz, 100kHz and 10kHz, c.w. or modulated output, kit form. **Frequency Counter** RQ3, up to 40MHz, 4-digit l.e.d. display of frequency or period or wavelength, kit form.

Datong Electronics Ltd, Spence Mills, Mill Lane, Bramley, Leeds LS13 3HE.
Active Antenna AD170, indoor aerial system 60kHz to 70MHz, 3m long dipole plus amplifier, output 50Ω. **Up-Converter UC/1**, synthesised receiving adapter plus 2m converter for receivers tuning 28-29MHz or 144-145MHz, range 90kHz to 30MHz. **Audio Filter FL1**, automatic suppression of heterodynes in range 280-3000Hz, variable width notch 25-1000Hz. ●

CALCULATOR JARGON

John A.C. BEATTIE M Sc M Inst P

Before you rush off to spend your hard earned money, why not stop, think a little, and decide exactly what you need. Don't let the salesman talk you into buying something you will never use; try to get value-for-money.

Buy the best that circumstances allow, for you can then expand your use of it as time progresses. A machine only meeting an immediate requirement could be a serious limitation later, so take a few moments to ponder the following points, and put them in order of importance, then find the cheapest machine offering the majority of your choices.

The overall dimensions will depend on whether a truly "pocket-sized" machine is required or not, and the size of the buttons is also often a determining factor. There are those who are not very keen on the closely-spaced buttons usually associated with small calculators, so it may be wise to try one or two in the shop. Some have a kind of "feel": that is, they click when pressed. Others just travel down to a stop with no feel when contact has been made. Again, it will be necessary to look at various types and determine your preferences.

Batteries

A tip on calculators that give key trouble from time to time: if they have not been used for a little while, a thin oxide film builds up on the contacts. This can easily be removed by one or two firm presses on the offending button.

There are three types of battery commonly employed: the ordinary carbon-zinc (torch type) dry battery, the alkaline cell and the rechargeable cell. The alkaline battery will cost about three times as much as the carbon-zinc but lasts approximately three times as long; its characteristics are such that it runs down much more quickly however, giving less warning that replacement is due. If the machine you choose has a suitable socket, a mains unit can be used to conserve battery life. However, it is a good idea in this case to take the batteries out, as under certain circumstances they can be damaged if you do not. The rechargeable type of battery is more expensive still, but can be used again and again. (That is not to say that they do not wear out; they do, and can only be recycled for a limited number of times). When they are low, plugging in the charger will top them up, and on most machines this is achieved whilst the calculator is in use.

If you cannot afford rechargeable cells, or if there are none available to fit the calculator you are using, there are various ways of prolonging battery life. The easiest is to cultivate the habit of switching off between each sum. It will often be necessary to write down an answer and gather other figures before the next sum is performed, so it is an idea to switch off and on each time.

Another point to watch when buying your calculator is how the machine responds when the battery is low. Some machines flash the display or give similar indications: other give no sign at all other than the display getting dimmer. A frequent check should be kept on battery condition, as the calculator may give wrong answers when the battery voltage falls.

Before we go further, a few words about some possible uses: points which should influence the type of machine that you finally choose. Most people only use calculators for adding up bank statements, checking the family budget and metric conversions—indeed, some are pre-programmed to do these calculations specifically, and for these purposes a standard four-function machine is quite adequate.

Four-function refers to a multiplication, division, addition and subtraction capability: limited facilities, but ideal for many applications such as homework! A scientific calculator, with logarithmic and trigonometric functions, will be much more versatile for the student however, and probably have exponential notation, but it is advisable to check whether it is aceptable at the school or college, as some will allow only certain kinds of machine. A good compromise would have at least two extra and very useful functions: the reciprocal (1/the number) and the square root. Various other buttons are provided on different types of machine and it may be of interest to consider a few examples in the ensuing paragraphs.

Constant function

The constant function allows one to operate repetitively on a whole string of numbers. For example, should you wish to divide several numbers by 2·54, initially enter the first on the list, press "Divide" and then "2·54" followed by "=". It is now only necessary to enter those remaining one-by-one, pressing the "=" sign after each, thus saving several additional operations.

If, instead of 2·54, the constant had been 3·1415926 (pi) then ten button pressings are saved. Machines will differ in this respect, so care is needed; some will have the constant facility initiated by a switch, which

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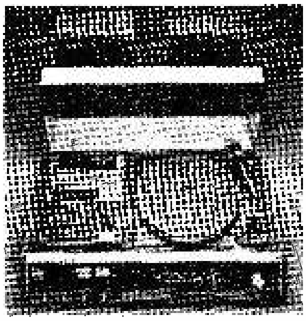

MC020

AN ADVANCED MUSIC CENTRE for the experienced constructor. This unit is available as a fully wired chassis, in modular form or as a kit. It can be built in easy stages or as a complete unit. A variety of cassette decks are suitable.

SPECIFICATIONS

AMPLIFIER	Nominal
Power Output:	2 × 25 watts RMS.
Distortion:	THD @ 2 × 20 watts 0·7%
Frequency Range:	@—1·5dB 30Hz-15KHz
Tone Control Range:	
VC-20dB	18dB
Basic Electrical centre	@ 100Hz-14dB
Treble Electrical centre	@ 10KHz+8dB —14dB
Loudness Control:	
VC30dB	@ 100Hz+14dB @ 10KHz+11dB
Filters:	
VC30dB	@ 10KHz—6dB
Controls:	5 rotary: volume, balance, bass, treble tuning.
Switches:	9 push button: phono, tape, radio, aux. input, mono/stereo, loudness, filter, speaker switching, separate mains switch.
Meters:	2 signal strength: FM tuning
Sockets:	Headphones: 5 pin DIN Aux: AM aerial (ext) FM aerial (co-axial): 4 × 2 pin DIN L/S

Intermediate Frequency:	
AM	475KHz
FM	10·7KHz
Aerial input:	
AM (internal)	Ferrite Rod
AM (external)	2 pin DIN
FM (external)	Co-axial 75 ohm unbalancedl
AGC:	
For 6dB audio change	46dB
IF Bandwidth	
@ max sensitivity	± 1·5KHz @ 6dB
RF Sensitivity:	
@ 20dB S/N Ratio	
200KHz	1500µV/m
600KHz	500µV/m
1400KHz	200µV/m
FM:	
RF Sensitivity	
@ 26dB S/N (mono)	2·5µV
88MHz	
100MHz	
@ 46dB S/N (mono)	16µV
@ 46dB S/N (stereo)	125µV
Distortion:	
@ Decoder O/P	0·9%
Frequency Response:	
@ ± 1·5dB	30Hz-15KHz
Stereo Separation:	40dB
Audio Filter	Flat to 55KHz 50dB @ 130KHz

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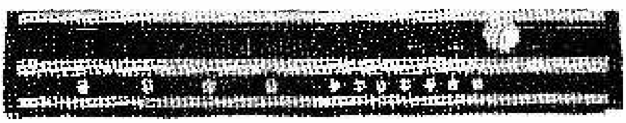
Stereo power amp 25w rms P/channel	£7·50
Low noise pre amp. Full freq correction	£5·99
RF Bald MW/LM/MPX Fet. 3 × IC	£9·99
P.S.U. £3·50 Transformer £5·50	
Selector Board 8 way	£3·99
Complete chassis massive 22 inches	£8·50



TU020

A Hi Fi tuner amplifier

This unit can be built from our modules or as a complete kit. Input for mag cartridge, tape record/playback, MW/LW/VHF stereo, tuner. Uses the same R F Board as does the Wimborne with birdie filters, multiplex filter, varicap tuning on MW and LW.

Items from the Wimborne numbers 2 and 3 can be used for different performance specifications.

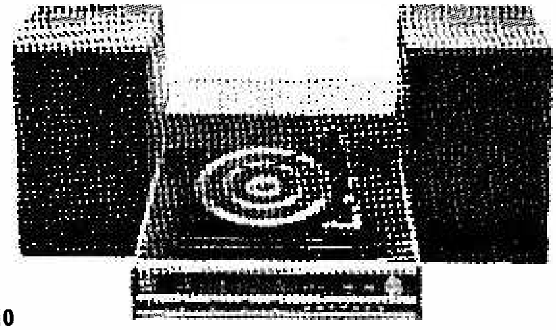
SPECIFICATIONS

Power output 25 Watts RMS per channel (both channels driven)
Total harmonic distortion 0·05%
Bass 100 Hz ± 12 dB
Treble 10 KHz ± 12 dB
Frequency response ± 1·5 dB 30 Hz—20 KHz

FM sensitivity 1·0µV for 26 dB S/N ratio
IF rejection 60 dB image rejection 60 dB
Stereo separation 40 dB
AM sensitivity 200µV at 1600 KHz 20 dB S/N ratio.

Fully wired modules, Preamplifier,	£6·99
Power amplifier	£9·50
RF Board	£33·95
Power supply unit	£3·99
Transfomer	£4·50
Magnetic PU amp	£2·99
Hardware kit	£7·99

PLEASE ADD £1 for postage and packaging for each item except the mag PU amp which is 30p.



AU10

A Radio Record Player Kit which has everything you need to make a first class three band STEREO unit. Can be assembled in modular form or from scratch. A professional finish is guaranteed.

SPECIFICATIONS

Amplifier	
Output	2 × 10W RMS, both channels driven
Distortion:	1% ± 2 × 5 watts
Controls:	Four rotary 1. OFF/ON/VOLUME 2. Balance 3. Treble 4. Bass
Tone Control Range:	Bass @ 100 Hz ±9dB Treble @ 10 kHz ±9dB
Outputs:	2 × 2-pin DIN for 8 ohm loudspeakers; 1 switched stereo headphone socket; 1 5-pin DIN Aux. Tape in/out socket
Stereo Performance:	Frequency response @ ± 1·5dB 30 Hz—15kHz; Separation 40dB; Audio Filter—flat to 55 kHz—50dB @ 130 kHz
Controls:	7 Push Button: Phono, Tape, Mono, FM, MW, LW, AFC; 1 Rotary: Tuning
Radio Tuner	
Waveband Coverage:	Medium Wave 525—1620 kHz; Long Wave 155—280 kHz; FM VHF 88—108 kHz

Price Hardware Kit	8·90	RF Board	21·95
Amplifier & Pots	8·75	Record Deck	13·95
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The most versatile music centre ever.
Complete kit price approximately £110 comparable price £180.

1. Hardware Kit, for a professional finish, trim, knobs, extrusions, sockets, top moulding 50 plus parts. **£9·95.**
2. Amplifier Module (11-14) watts RMS per channel, wired and tested, **£19·95**, kit price **£13·95.**
3. Mechanically tuned RF Board, absolutely complete and tested 1·5µV sensitivity FET front end 7 way switch, MW, LW, stereo VHF, only requires 13 VDC. **£21·95.**
4. Stereo cassette module, with CRO2 switching, low noise devices, ALC tape counter, excellent specification, incredible price **£24·95.**
5. Varicap tuned RF Board, the ultimate AM/FM Receiver kit, MOSFET front end, Deviation mute, interstation mute, fantastic performance 1·0µV sensitivity, Hitachi, AM receiver ic, excellent MW/LW performance, complete with 7 way switch, The basis of the finest Hi Fi system, fully wired and tested. **£33·95.** Kit **£26·95.**
6. Magnetic PU Amp with LM387 or discrete (BC 149). Both **£2·99** each.
7. Wooden Plinth plus base board **£9·95.**
8. Perspex dust cover plus hinges **£6·50.**
9. Mains transformer **£2·99.**

All items include VAT. Please add £1 per item for postage and packaging, item 6 30p. For further details please send 15p.

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can be useful when working on complex problems, as it can be brought in and out during the course of the sum and used as a pseudo-memory. Other machines have the constant operating all the time, and this can be something of a nuisance if it is overlooked. The number of constant functions will vary from one calculator to another, and on some machines it will operate on multiply and divide only, whereas, in the case of others, it will operate on add and subtract as well.

Most calculators have displays of eight digits, so, if your solution should happen to exceed this, various responses will be elicited from the machine. The most common is for a symbol of some sort to appear on the right-hand side of the answer, and the electronics then prevent any further operations until the "clear" button is pressed; the calculation then has to be attempted in some other way. There are also machines which show a symbol to the left of the display. Pressing the "CE" button will allow you to continue, remembering that the decimal point will be moved eight places to the left; that is to say, the number appears a hundred-million times smaller than it actually is.

Significant

Another type operates in such a way that it is calculating with numbers over a very wide range but only displays the eight most significant digits. In order to find out where the decimal point is, should it not appear, one has to multiply or divide by ten repeatedly, depending on whether noughts or figures are shown. Count the number of times the operation is performed and when the decimal point appears on the display the true answer is the number shown multiplied by ten to the power of plus-or-minus the number of operations carried out. i.e. If 12345678 is displayed, divide by 10 until the decimal point appears. Let us suppose that after three attempts 1234567·8 is shown. Then the *true* answer is 1,234,567,800 or: $1234567{\cdot}8 \times 10 \times 10 \times 10$ i.e. $1234567{\cdot}8 \times 10^3$.

The exponential display shows an expression in two distinct parts; the number (or "mantissa") and the power of ten (or "exponent") by which it should be multiplied to give the correct magnitude.

For example $1536 = 1{\cdot}536 \times 10^3$ and could be displayed as 1·536 3. Similarly $0{\cdot}003724 = 3{\cdot}724 \times 10^{-3}$ and would be displayed as 3·724−3.

Maximum range

Unless there is some other reason for limiting the numbers that can be displayed by this method, the maximum range is 10^{100} to 10^{-104}. To make the electronics simpler, some machines restrict the style of entry so that the decimal point is assumed and fixed after the first digit. Other calculators will allow the number to be entered in any form and adjust the display accordingly.

The floating point is a similar function to the exponential and is available on all but the cheapest machines. It is the ability to give an answer with all the digits available in the display, cutting off only those after the decimal point for which there is no room. If this facility is not available, the machine is said to have a *fixed decimal point*. The remainder of the number is bunched to the right and hence the machine shows less than it is capable of. When searching for the point, try to establish what happens when the calculator cuts off: some machines just truncate; that is, they ignore the remainder, whilst others will round up.

If the calculator has a floating point facility it could work against you if zero-suppression is not included. For example, the answer to a calculation is given as "1" and the display appears as 1·0000000. With zero-suppression this would be shifted to the right and appear as "1"—an obvious saving in battery power as the display takes the higher proportion of the total current.

Changing sign

Some machines have two buttons fitted both having the minus sign, or alternatively a single button is provided which acts in either or two ways, depending on the state of the calculation. Others are not fitted with this facility and here difficulties may be encountered. The problem is that the minus sign carries out two functions: sometimes it is an "operator": that is, it says something *about* a number ("this number is negative"). On other occasions it instructs the calculator to make a subtraction. Without a two-button capability—or a double-acting one—you may only be able to make a subtraction, whilst in fact you may wish to change a sign. The solution is to multiply the number by −1, because when the "1" is entered, the minus sign acts as an operator.

The Algebraic and the Reverse Polish are two calculators having these characteristics available. In the case of the Algebraic machine, data is entered as it is spoken—i.e. "one times two equals . . ." etc. Care must be taken however if the expression becomes complex, such as when brackets occur in an equation. These may have to be expanded unless the machine has a "bracket" facility, (usually limited to only two layers).

Reverse Polish

With the Reverse Polish machine a slightly different way of solving the problem is adopted. Each time the number is entered you should ask yourself "can I perform an operation?" if the answer is "yes" then this is exactly what you do; if it is "no" then press the "enter" key which will record the number at the bottom of a small column of registers.

This may at first seem unnecessarily complicated, but is very quick indeed when you become familiar with the technique. As with any piece of technical apparatus, best results will only be achieved when the operations are fully understood. Even the cheapest machine will have modes, perhaps with a constant facility, which can be used to save several key operations and perhaps even a certain amount of rearrangement to the equation.

Example:

> 7 + (3 × 9), would normally be resolved by re-writing as 3 × 9 + 7. If the constant is used however the entry becomes 7 + 9 = = =

This is only a simple example but shows the difference between the two methods.

The conclusion is, when buying your calculator, reflect at first on its application. Study the manufacturer's specifications and, most important of all, ask about its capabilities, endeavouring where possible to try them out.

Happy calcuating! ●

IC OF THE MONTH 72

Brian DANCE M.Sc

NATIONAL SEMICONDUCTOR LM3909N

The device we are considering this month has been developed by National Semiconductor mainly for use in simple "flasher" circuits using light-emitting diodes. It is economical in use, and is ideal for applications involving the beginner.

The LM3909N

The device itself is encapsulated in a small 8 pin dual-in-line package which can be used in the simple circuit of Fig. 1. Supplies are connected between pins 4 and 5, with pin 5 positive. Initially, the voltage across the l.e.d. (D1) is too small for it to pass an appreciable current; however, C1 charges through internal resistors R2, R3, and R4 and when the potential at pin 8 falls below a certain level, the electronic switch closes and effectively connects pin 2 to pin 4. The voltage across D1 is now equal to the power supply voltage plus the potential across the charged capacitor. D1 then emits a pulse of light of about 5ms duration, and the electronic switch re-opens.

The value of C1 may be 300µF, 3V, in which case the flashing rate will be about one per second, and the current consumption about 0·7 to 0·8 mA.

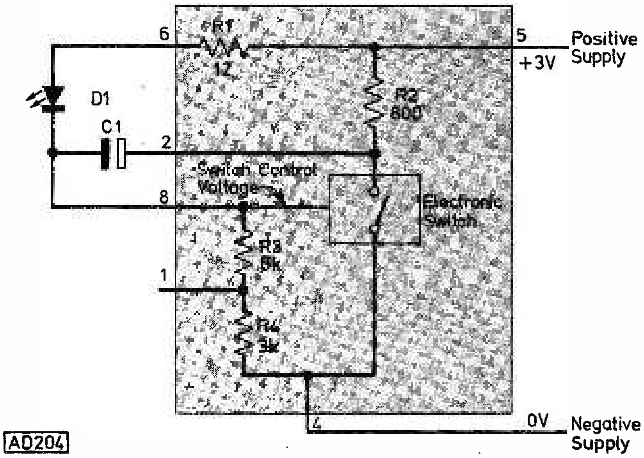


Fig. 1: A flasher circuit, showing the operation of the internal circuitry of the LM3909N

Supply Levels

An l.e.d. requires at least 1·7V applied before it will conduct and emit light. However, the voltage boost obtained in the Fig. 1 circuit by the switching of the charged capacitor enables flashes to be obtained with supply voltages down to 1·2V. The flash frequency decreases as the applied voltage is reduced; if a rate of one per second is required, pins 1 and 8 should be linked and 1·5V supplied. The maximum permissible voltage before damage occurs in the LM3909N is 6V.

To reduce the current consumption from a 1·5V supply to the absolute minimum, C1 in Fig. 2 is reduced to 100µF 3V, with pin 1 unconnected. The rate is then little more than one per second and the mean current taken from the battery is about 0·3mA, with a consequent reduction in flashing intensity.

The exact flashing rates stated may not be obtained since electrolytic capacitors have very wide tolerances —up to 100 per cent over their marked value. An increase in capacitance will reduce the flashing rate, but will increase the brilliance of the flash, although it will not have much effect on the current consumption.

Fig. 2 shows a circuit which provides a greater flashing rate (about 2·6Hz) for a current drain of about 1·2mA.

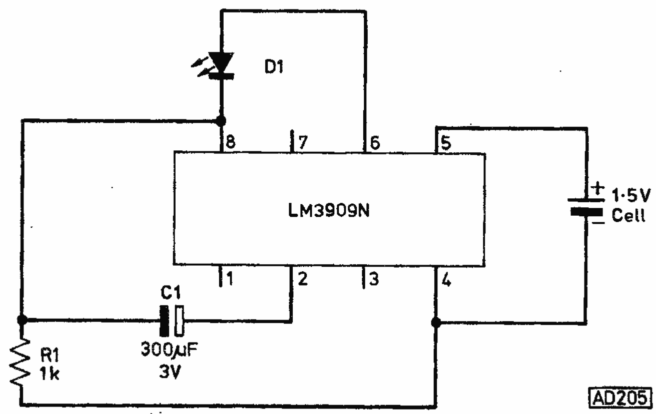


Fig. 2: A 2·6Hz flasher using a 1·5V supply

Torch Finder

One of the most useful LM3909N applications involves its use in the base of a torch with an l.e.d. The latter emits weak flashes of light continuously when the torch is switched off; this enables the torch to be found very easily even in complete darkness. The quiescent current consumption is so small that the normal battery life is almost unaffected. A torch finder of this type is shown in Fig. 3. The LM3909N circuit and the l.e.d. may be fitted into a transparent cap on the base of the torch.

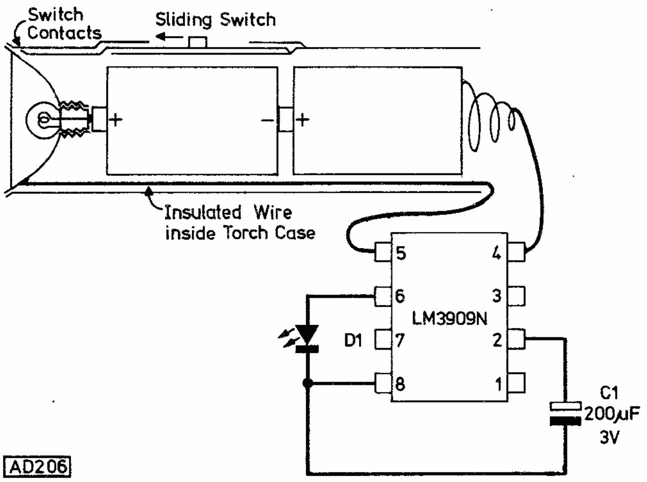


Fig. 3: A simple torch finder

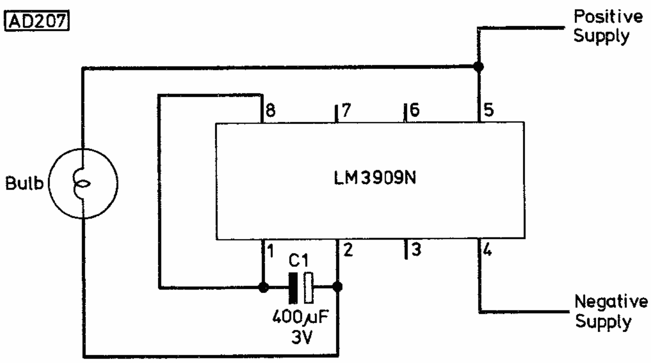


Fig. 4: A flasher using an incandescent bulb

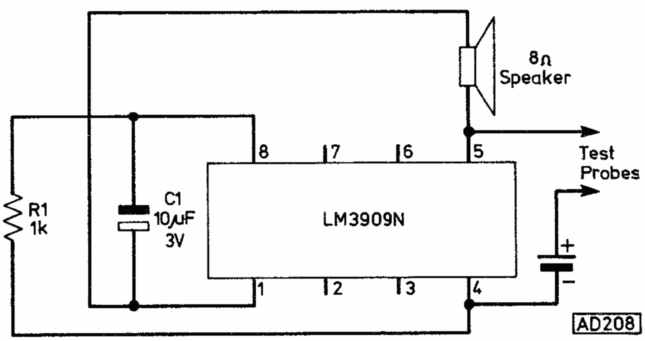


Fig. 5: A simple continuity tester based on the LM3909N

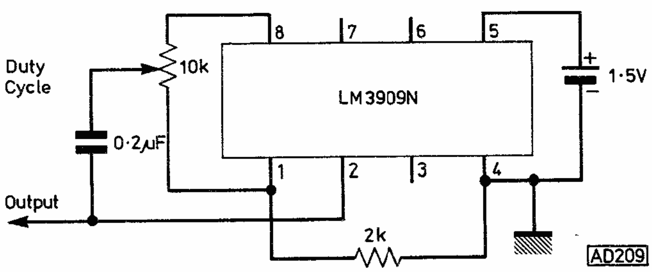


Fig. 6: A square wave generator circuit

Incandescent Bulb Flasher

The circuit of Fig. 4 shows how the LM3909N can cause a small tungsten filament lamp to flash at about 3 flashes in each 2 seconds. In this circuit a small current flows from the positive supply through the bulb and charges the capacitor via the internal resistor connected between pins 1 and 4. This current is much too small to illuminate the bulb and when the potential at pin 8 has fallen by an adequate amount, the electronic switch closes. A larger current can now flow from the supply line through the bulb to pin 2, and ceases when the potential of pin 8 rises and the electronic switch opens. Thus the bulb emits a flash of light.

The mean current required by the circuit of Fig. 4 is much greater than that required by the circuits using l.e.d. indicators.

Continuity Tester

A simple continuity tester is shown in Fig. 5. When the test probes are shorted together, the circuit oscillates and a note is emitted from the loudspeaker. This note is distinguishable from that emitted when the test probes are joined by a resistance of only a few ohms.

Another simple circuit using the LM3909N is shown in Fig. 6 where it is used as an oscillator. This circuit will produce a square wave output with a frequency of about 1kHz.

The LM3909N is available from Arrow Electronics Ltd., Coptfold Road, Brentwood CM14 4EN. At the time of writing the price is 95p inclusive of V.A.T., but 25p must be included for packing and postage on orders under £5. ●

by Eric Dowdeswell G4AR

Another fledgling takes to the air as **Michael Walker** passes his RAE and becomes G8PRX, but he intends to get the code test over pretty soon. Michael is looking for a cheap, simple transceiver for 2m so any offers to 100 Langdale Road, Woodlesford, Leeds LS20 8XF. As a PS "15-soon 16" year-old Michael blames me for pushing him into getting a licence "but I don't regret it a bit".

Conditions generally on the h.f. bands have not been too good as confirmed by **Brian Smith** BRS40307 of 15 Courtenay Road, Barry, Glam, so Brian has been busy organising a contest for the FRG-7 Owners Club, formed recently. Write to Brian for details if you sport an FRG-7. A candidate for the club is **Joe Porter,** a newcomer to the column, living in Belfast. Joe started on the broadcast bands but says that the amateur bands have added a new interest to his life since getting the FRG-7.

John Bell BRS40279 of Melksham, Wiltshire, started SWL'ing only last April with his 1943 AR88 and 120ft of wire which is "more of a ham-string than an aerial". John would like to beg, borrow or steal a handbook for the set so if you can help drop a preliminary line to 12 Windsor Avenue, Melksham, Wilts.

Regular *PW* reader **Bruce Norval** G3VHT of 203 Surrenden Road, Brighton BN1 6NN has an old Cossor 3339 'scope but feels he could get more out of it if he had a manual. Anyone oblige? Any expenses gladly refunded, naturally. A quick note from our **Simon Robinson** reveals that his new call is G8POO with which he is not at all pleased, so he is after his G4 call as soon as possible! **Len Adlard** of Leigh-on-Sea, Essex, wrote a few words of appreciation for the replies he had concerning info on his R1392 receiver and hopes *PW* "may long foster the friendship between those interested in radio", which sums up our hobby very well!

Newcomers to the Column

I. D. Calvert residing at 16 Nabwood Drive, Shipley, West Yorks, has progressed from the s.w. broadcast bands to the amateur bands now that he has a Yaesu FR50B but would be happier if he had a manual. College studies permitting "I.D." intends to swot for the RAE in due course. He reckons the column is far too short so a copy of the letter will be passed to the Editor very soon! **W. Sides** hailing from Swinton, near Mexborough, has also found the amateur bands, on a Lafayette HA800, which has given him "a new interest in a life that seemed destined to be boring", having retired early due to ill-health. I hope both the above will let me have their Christian names next time round!

In Darlington, Co. Durham, **Rod Hunt** had fun on the s.w. BC bands with his two-transistor regen' set but couldn't find the amateur bands, until he fitted a super-slow-motion dial. Rod says "If I could starve the kids and divorce the missus I could afford a better set". A bit drastic OM and hope it won't come to that! So, carry on building! An ex-master mariner, Rod was hot on visual code and is now building up his c.w. copying ability and comments on lack of c.w. logs. I'd certainly like to see more, so what about it?

Around the Bands

Martin Leizers (Newport) took his radio on holiday but found little other than a couple of openings on 10m. An FRG-7 plus converter and quarter-wave vertical helped **J. S. Goodier** (Marple, Cheshire) get on 2m but has not heard much of note. I think a good beam aerial, preferably rotatable, would make a world of difference here, OM. "J.S." commends the Pacific DX Net on 14265kHz s.s.b. on Tuesdays around 0600, for info on activity in that part of the world.

All bands from 10 to 80m have been visited by **Ian Marquis** of Leigh-on-Sea, Essex, finding OE5CA/YK on the Golan Heights on 80m, VP8NX on 40m, new country CE0AE on Easter Island on 20m plus two really rare ones in ZL2BJU/K on Kermadec Island and VK2AGT/LH on Lord Howe Island, all s.s.b. 15m revealed KC4AAD plus KG6JJY on Guam and KM6FC on Midway, while 10m came up with KZ5RO. A late note from Brian Smith BRS40307 reports J3AH from

Reports on the various bands are welcome and should be sent direct, by the 15th of the month, to:-

AMATEUR BANDS Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashtead, Surrey KT21 2TW. Logs by bands, each in alphabetical order.

MEDIUM and SW BANDS Charles Molloy G8BUS, 132 Segars Lane, Southport, PR8 3JG. Reports for both bands **must** be kept separate.

VHF BANDS Ron Ham BRS15744, Faraday, Greyfriars, Storrington, Sussex RH20 4HE.

Grenada on 80m. Is this the start of the winter activity on the l.f. bands? P29NKV on Papua was also a first for Brian. **Steve Turner** BRS37620 (Wilmslow, Cheshire) recorded D4CBS of the Cape Verde Islands for a rare one, as did several other listeners. Summer time brought OH0 to life with several OH's there on holiday. Remember that OH0 is a separate country.

CE9AT in Antarctica is also a different country from the mainland CEs, reported by **John Whiting** BRS40086 of Fareham, Hants. QSL manager is CE2BIO. This was on 15m. A listen at the c.w. end of 20m brought FB8XS, with ZD9GI on 10m for **Dave Greenhalgh** (Poynton, Ches).

Bill Rendell (Truro, Cornwall) injured his knob-twiddling finger but that didn't stop him finding some VK7s on 20m s.s.b. plus VP2LDB on St. Lucia and ZL4KI, while 15m yielded CT3AF, YB0ABO and ZB2BU.

Club News

The **Wessex AR Group** had 20 up for the May RAE and 15 made it! Which speaks well for the club's organisation. Needless to say RAE courses are under way again with, incidentally, a reduction in course fees of 50% for OAPs. A nice thought. Sec. is Geoff Cole G4EMN, 6 St. Anthony's Road, Bournemouth. Forthcoming talks are on Fast Scan amateur TV on Nov 3 by G3PYB, G8ADM and G8GYS and the Intruder Watch by Watch organiser G5XB on Nov 17.

The **White Rose RS** meets at 83 Town Street, Arnley, near Leeds, every Wednesday evening at the White Horse Hotel. Further info, ring Sec. Dick Hughes on 680937. Excellent monthly magazine *White Rose Clippings* has something for everyone, including constructional articles. The **Wigston RC** flourishes in Leicester with the previously sole licensee G3YOO being augmented by six passes at the May RAE. All welcome at the United Reformed Church, Long Street, Wigston Magna at 1930 first Friday of the month. This is a brand new club and much deserving of support.

J. M. Coates G4GYU tells me of the radio club of the **1st Rainworth Scout Group** which now boasts of two G8s following the May RAE. Scouts interested in the club contact G4GYU, 30 Abbott Road, Mansfield, Notts.

The Hon. Sec. of the **Radio Amateur Invalid and Bedfast Club** Harry, G2CLP, has been able to unload his heavy burden of running the club on to the capable shoulders of Francis Woolley G3LWY, a previous holder of the job. Thought you'd finished eh, Francis? If interested, as a supporter or an invalid, contact her at 9 Rannoch Court, Adelaide Road, Surbiton, Surrey KT6 4TE.

It was with deep regret that we heard of the death of Tom Darn, G3FGY at the age of 56. A member of the Derby club since 1950, Tom was active in many aspects of Amateur radio, and did much for the handicapped. He will be sadly missed.

Log Extracts

W. Rendell:—20m A7WL VK7AE VP2LDB ZL4KI 8P9JH **15m** CT3AF FG7AX P29JS VP9HS YB0ABO ZB2BU

D. Greenhalgh:—20m FB8XS 10m ZD9GI 5B4CY

J. Whiting:—20m OY5J **15m** CE9AT P29NYL 6W8FZ **10m** 5H3KS

S. Turner:—20m C31MK DA1GR/OH0 D4CBS CP6HI

B. Smith:—80m J3AH **20m** CP5ADE **15m** P29NKV **10m** HK3AXT S79MC 3D6BP

I. Marquis:—80m C31DM OE5CA/YK **40m** C31IP OY5J TU2HG VP8NX YN2DX ZB2BL 7X5AB (QSL W2KF) **ZD7WT 20m** CE0AE ZL2BJU/K VK2AGT/LH VK9ZM VR1AF VR3AK VS5CW YI1BGD 6O1FG **15m** H44LW (?) (Solomon Is.) KC4AAD KG6JJY KM6FC VR3AR VS5XU YB0GF 5W1BN (QSL KH6JEB) **10m** C31OC KZ5RO 9V1SW.

M. Leizers:—80m VO1FG 40m CE3RR C31IP **20m** VP2VPK YB0ONQ HZ1BS/8Z4 **15m** KZ5AS YB3AE **10m** CE3BZB CX7UM C31NX FM7BB

B. Hughes:—20m VP2EEN **15m** VE7IG TA1MB FB8XS

J. Bell:—20m C31NM EA8QU PJ4CR TA1ZB VP2VBK

All s.s.b. except those in bold which are c.w.

MEDIUM WAVE DX

by Charles Molloy G8BUS

On November 23rd, 1978, the Geneva Plan for the medium waves comes into being. It covers Europe, Asia, Africa and Australasia (ITU Regions 1 and 3) and in Europe it replaces the Copenhagen Plan which has been in operation since 1948.

The total number of channels will be 120 starting at 531kHz and ending on 1602kHz. The spacing between channels will be 9kHz and each frequency will also be an exact multiple of 9kHz which it is claimed will help to reduce heterodynes. In practice this means that in Europe, where the spacing is already 9kHz, the majority of channels will simply move up by 1kHz, a change that will hardly be noticed, except perhaps on receivers with push-button tuning. The long-wave frequencies are unchanged with 15 channels being allocated for broadcasting in Region 1 only as at present. There are some alterations, with the UK being awarded 227kHz as well as 200kHz though both frequencies will have to be shared with other countries.

Many European stations will only move by 1kHz and it is probable that the average listener would not even notice the introduction of the new plan but for the decision of the BBC to reorganise its radio programmes on the same date. The changes in Radios 1, 2, 3 and 4 listed elsewhere in this issue have really very little to do with the Geneva plan.

Station Listings

So far as I know, the only published list is the one attached to the Geneva Plan itself which is very expensive and beyond the reach of the majority of us. Parts of this list have been reproduced in some radio club bulletins. In any case this list is of limited value as it refers to authorised frequencies and occupants. How many of these will actually be on the air on November 23rd is another matter altogether. Several countries have published a list of their intentions and no doubt the 1979 edition of the *World Radio and TV*

Handbook, when it appears early in the new year, will only mention those stations actually in service. In the meantime there may be a lot of uncertainty.

The New Plan and DXing

What effect will the new plan have on medium wave DXing in the UK? Asiatic DX will certainly become more difficult as stations in that continent will, or should now be on European channels. A loop will not be of great help as a lot of the European QRM will be roughly in the same direction as the DX. African DX should not be affected so badly as a loop will be of value in this case. The interesting area will be Region 2 which covers North, Central and South America and the Caribbean. Stations in Region 2 are not affected by the Geneva Plan but QRM from other parts of the world will change.

Region 2

The majority of broadcasters in Region 2 are on frequencies which are multiples of 10kHz. This means that there are some frequencies which are in use in all three regions. These are 540, 630, 720, 810, 900, 990, 1080, 1170, 1260, 1350, 1440 and 1530. This is not very different from the current position but the change may be sufficient in marginal cases to make difficult DX either impossible or alternatively a little easier. Stations such as CBT Grand Falls in Newfoundland on 540, WTIC Hartford on 1080 and WCKY Cincinatti on 1520 may become rarities. Some stations that are easy to log at the moment will become difficult and even WINS on 1010 may be harder to hear as it will be only 2kHz away from European QRM.

As a result of the different channel spacing in Region 2 there are a number of places in the band where maximum separation from Geneva Plan channels occurs. The frequencies come in pairs and start with 580 and 590kHz where the "nearest" European is 4kHz away, then to 670kHz and 680kHz, 760 and 770, 850 and 860 and so on up the band. In Europe these are the DX slots in the band. Finally, there is a major change at the h.f. end of the band above 1540kHz where the spacing in Europe at the moment is 8kHz. 1570kHz will be 4kHz away from QRM instead of sharing a European channel and 1580kHz should become reasonably clear of QRM.

The Geneva Plan will add a new dimension to m.w. DXing not only in the UK but throughout the world though it may be some time before its effects are fully apparent. One can be certain of one thing; the medium waves, the oldest DX band, will remain as attractive and as challenging as ever.

Loops and Portable Receivers

From Liskeard in Cornwall comes a long letter from **K. Lewis** who uses a 36in loop with a Grundig 305 Transistor receiver, following the method outlined in this column in May 1978. "The receiver is placed on a shelf inside the loop and orientated so that the null of the ferrite rod aerial coincides with the null of the loop. The whole system is mounted so as to enable simultaneous rotation of receiver and loop in one simple operation." Mr Lewis goes on to say that the loop does not have a coupling winding or feeder cable as there is no direct metallic connection of any sort between the loop and receiver. The portable's own ferrite rod aerial picks up signals from the loop as well as from the station and a considerable improvement in signal strength is the result. Stations logged with this rig between 0230 and 0330 during July and August included CKVO Clarenville on 710kHz and CJYQ St John's on 930 both in Newfoundland, WINS 1010 in New York and CFRB in Toronto also on 1010, Radio Margarita Venezuela 1020 and WQXR in New York on 1560. An unidentified US broadcast on 1020 would almost certainly be the famous KDKA in Pittsburgh.

A number of readers have written to me about problems they encounter when trying to use a loop with a portable and nearly all of these problems arise from a misunderstanding of the principles involved, probably the result of the terminology used. The "null" of a loop is really a shorthand way of saying that there are two directions from which a loop does not pick up any signal. If the loop is positioned so that a "null" points towards an unwanted station it will no longer be heard. Very useful provided that the receiver is not picking up this unwanted station from a second aerial such as the internal ferrite rod aerial that is standard with portable receivers. A loop should only be connected to a receiver that does not have its own aerial. You can easily check this. Disconnect the loop and if the receiver still picks up stations then it must have its own internal aerial. In answer to **Martin Liezers**—remove the ferrite rod aerial from the back of your DX160, it is not part of the receiver.

A large number of portable type receivers are in use today. Some are quite complicated and expensive and they perform very well indeed on the short waves but to quote **F. R. C. Fowle** of Somerset West in Cape Province. "I have a Barlow Wadley which seems to be remarkably immune to any add-on aid to reception" and this certainly applies to the loop aerial. A ferrite rod aerial is of course equivalent to a mini-loop, but unfortunately the pick-up is not great enough for DXing. If the receiver is mounted at the centre of a loop in such a way that the ferrite rod and loop nulls coincide then the two can be rotated together and an unwanted station will then be capable of being nulled out. No need for a direct connection between the two. The wanted signal picked up the loop is re-radiated and picked up by the receiver's aerial, the whole system operating like an amplifier without power supplies. One of the few examples of getting something for nothing! Although having a touch of the Heath Robinson about it this procedure does enable useful DX to be heard on a portable receiver. The alternative is to purchase a communications receiver or to become discouraged before even sampling the thrills of m.w. DXing.

DX Clubs

David Pristupa writes from Saskatoon in Canada to say that he can receive only North American m.w. stations from his QTH and he invites any DXer who might be in his area to look him up at 3437 Ortona Street, Saskatoon, Canada 57M 3R9. I suggest David that you join one of the two North American DX Clubs that specialise in m.w. DXing. These are the International Radio Club of America (IRCA), PO Box 26254, San Francisco, CA 94126 and the National Radio Club (NRC), Box 99, Cambridge, Massachusetts 02138 USA.

The domestic log published by the NRC is referred to by **S. Donnelly** of Adlington. This booklet lists all medium wave stations in Canada and the United

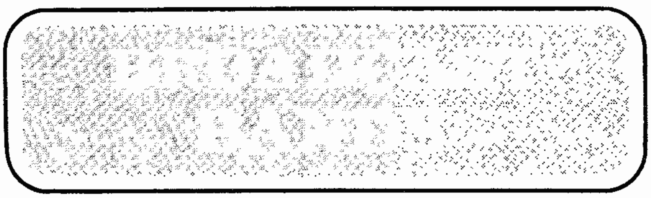
States in frequency order and gives the callsign, power, address and other information about them. This listing is for the North American specialist and it can be obtained by non-members of the NRC from the address given above.

DX

Reception conditions during the summer were very good this year and several readers had a go at Middle East DXing during Ramadan, which incidentally is an annual event occurring approximately 10 days earlier each year, by our calendar. **David Sidebottom** of Fleetwood has a Realistic DX160 and a 33ft long wire and he logged 10 North Americans between 0100 and 0400 with this rig, including WLAM Lewiston Maine on 1470 and WITS Boston on 1510. David would like to know how the new Yaesu Musen FRG-7 compares with the Realistic DX160 on the medium waves. Can anyone help? Replies should go direct to David at 7 Bristol Avenue, Larkholme Estate, Fleetwood FY7 8JQ. **Bob Bell** of Blyth (FRG-7 and loop) reports hearing two stations on 737 which would be Israel and Iran, Qatar on 952 and two Arab stations on 820. Iran is on 820 and Egypt and Morocco are on 818kHz.

Some really excellent North American DX comes from **Derek Taylor** of Preston who used his FRG-7 and loop during the month of August to pull in WBBM Chicago on 780, CJVA Caraquet NB on 810, WOAI San Antonio Texas on 1200, CKIM Baie Vert Newfoundland on 1240, WEVD New York on 1330, WDEA Ellsworth Maine on 1370 and WEGP Presque Isle Maine on 1390. Derek gives a word of warning about WEVD which is multilingual and can be heard in Hebrew at times though the identification on the hour is in English.

A log of long-wave DX comes from **Andrew Rogers** of Bristol who used a Vega Spidola with internal aerial to log Minsk on 281kHz at 1958, Algeria in French and Arabic on 251 at 2300 and Brasov Romania on 155 at 2150. Are there any more long-wave DXers around?



SHORT WAVE BROADCASTS
by Charles Molloy G8BUS

Loops on the Short Waves

DXers who have a medium wave loop often wonder if it is possible to use one on the short waves. The answer unfortunately is no. Ionospheric scattering becomes significant as frequency increases and as a result the directional properties of the loop gradually disappear as one tunes above 2MHz. The question is raised again by **K. Lewis** of Cambourne who asks if it is possible to use any kind of loop on the 120m tropical band. A difficult question to answer as there is so little DX to be heard on this band but at a guess I would think that a loop would still give some results even if it is only to reduce local static.

Several years ago I built a 3-turn 28in box loop to investigate this problem and I was able to tune the loop between 2MHz and 6MHz using a variable capacitor of about 300pF. During the daytime I could null out MSF (Standard Frequency station at Teddington) on 2·5MHz and 5MHz and the directional effect was still apparent on some stations on the 49m band. After dark MSF could still be nulled out on both frequencies but DX on the 90m band could not. I interpreted the above to mean that the loop would work on the ground wave and short-range sky wave but was no use on long-range signals above 2MHz. There is no sharp dividing line as the null just broadens out as frequency increases.

There is incidentally, a ferrite material called F16 which is effective up to 12MHz. Rods made of this material are available such as item FRD in the Ambit catalogue, which is a rod 8in long and $^3/_8$in in diameter, and it could be a useful item for the experimenter. Some receivers use a ferrite rod aerial instead of a whip for short wave reception and it would be interesting to hear from any DXer who has one. Try rotating the receiver to see if the aerial has directional properties.

120 Metre Band

120 metres (2300 to 2499kHz) is one of three bands reserved for local broadcasting in the tropics where the noise level due to thunderstorms makes reception difficult on the medium waves. The other two tropical bands are 90 metres (3200 to 3400) and 60 metres (4750 to 5060kHz). Of the three, 120m is by far the most difficult for DXing and there are probably only a few DXers around who have heard anything on it. At first sight this may seem surprising as propagation should be similar to that on the medium waves i.e. a path of darkness between transmitter and receiver before reception is possible. Unfortunately, 120m is used by commercial stations outside the tropics and the consequent high level of telegraph QRM makes reception rather difficult. Harmonics from m.w. stations are another problem and it is not unknown for BBC Radio 1 to be heard on 2428kHz which is twice 1214 (247m).

What are the chances of hearing the 500 watt Falkland Island broadcasting station on 2385kHz asks **Martin Liezers.** This station is on the air until 0200 on weekdays, but the chances of hearing it are not very good as a combination of low power and high QRM is not encouraging; but it is possible. If Argentina is coming in well on the medium waves then it might be worthwhile trying 2385. As far as I know it has never been heard in the UK. Stations that have been logged on 120m are Gwelo Rhodesia on 2336 and 2425, Galei Zahal (Israeli Army) on 2442 and in the winter Fuzhou in China on 2430kHz.

Commercial Stations

A number of readers including **Andrew Belsey** and **M. A. Carter** have enquired about transmissions that mention circuit or receiver adjustment. These are not broadcasting stations. They are commercial radio links which often transmit recordings with this sort of announcement while their engineers set up the circuit. It is illegal in the UK to listen to these transmissions without a licence and details of them cannot be included in this column.

Readers' Letters

Ian McLean (Port Glasgow) wants to know how many International Reply Coupons he should send to each different country to cover the cost of a reply to a reception report. A single IRC is exchangeable in any country that is a member of the UPU for stamps sufficient for a reply by sea mail. DXers usually send two IRCs for a reply by air mail. IRCs do not seem to be acceptable in some countries, mainly in Latin America.

Joseph Pritchard (Nottingham) has made a crystal set using Denco coils, a diode and an old tuning capacitor from a scrap receiver. When connected to a 50ft outdoor aerial it produced earphone signals from the 49m, 41m, 31m and 25m bands. Reception was improved by the addition of a length of wire from the earth terminal of the crystal set to the bed frame! When the output for the earphones was put through a 3-transistor audio amplifier it gave loudspeaker reception of a number of stations including Radio Canada International on the 25m band.

A home-made receiver made out of two integrated circuits, a ZN414 and LM780N pulled in Radio Canada International for **Derwyn Williams** who lives in Maesteg in Glamorgan. The frequency announced over the air was 6195kHz and he is puzzled by this as RCI is not listed on that channel. The station Derwyn heard is the CBC relay at Daventry in the UK. The trend these days among international broadcasters is to use relay stations near to their target area rather than rely on the uncertainties of propagation over long distances. Radio Japan, for example, has recently been doing tests from the Mediterranean area and if they do open a relay station there it will enable them to be heard well in Europe during the peak listening period in the evening. Direct reception from Japan is best in the morning.

DX

An old Pye receiver, a PR40 preselector and a 100ft wire in the loft brought some interesting DX to Ian McLean (Port Glasgow) who reports hearing Radio Nigeria on 4950kHz at 2300; Voice of Greece on 9565 at 1928, Radio Havana on 17865 at 2112. **S. I. Fass** (Edgware) has a Yaesu transreceiver type FT901D with an up-converter for short-wave listening. With this rig he managed to pull in Radio New Zealand on 15130kHz at 0645 through heavy QRM. Martin Liezers (Newport) has picked up the English transmission from Radio Uganda on 15325 at 0330 which is intended for North America. Also logged were TWR Guam on 17855 at midnight in English and Radio Reloj Continente (Venezuela) on 5030 at 0400.

Harmonics are in the news again with a report from **Harold Brodribb** of St. Leonards-on-Sea of the BBC Arabic Service on 29475kHz in the 10m amateur band which is three times 9825, the latter also coming in with a good signal. The receiver is an AR88 with a loft dipole. **Goff Curtis** reports again from South Harrow with reception of the BBC Eastern Relay (Masirah Island) on 15130 which is on this frequency from 0700 to 0800 and again from 0900 to 1500. Gear in use is an Eddystone 740 and a 20ft Windom aerial. Other DX heard was the BBC Caribbean relay on 17745 at 2000, Tanzania 15435 at 1845, BBC Ascension Island 15260 at 2000, KTWR Guam on 17855 in Chinese at 2300 and Cameroons on 4850kHz at 2200.

by Ron Ham BRS15744

I've said it before and I will say it again, the v.h.f.s are full of surprises. This one occurred on August 28th when a severe ionospheric disturbance, lasting most of the day, closed parts of the h.f. bands. The afternoon aurora, which upset the 2m band, caught us all on the hop because there was no previous solar radio noise to warn us. In fact, we observers of the radio sun had nothing at all to report during August.

Henry Hatch, G2CBB, reported on BBC World Radio Club, that the disturbance began around 0400 and **Cliff Ranft**, Guildford, Surrey, told me that he recorded two SCNAs (Sudden Cosmic Noise Absorbtion) at 30MHz during the morning of the 25th, and one at 1623 on the 27th. Despite overcast skies, **Cmdr Henry Hatfield**, Sevenoaks, observed the sun with his spectrohelioscope on the 27th. He saw three sunspots with an "active" plage coming around the east limb and thinks that this caused the event.

Aurora

Although **Barry Ainsworth**, G4GPW, Lancing, Sussex heard a French station calling GM via aurora at 0815, **Charlie Newton**, G2FKZ, London reports that the main auroral activity began around 1300 and lasted for about three hours. The Oxford University Radio Club, GM3OUR/P worked 14 countries on 2m during the event. Much of the following day's repeater conversations were about the aurora and the strong signals heard and worked from Germany, Scandinavia and all of the UK.

At 1345, **Roy Bannister**, G4GPX, Lancing, Sussex worked GI. He phoned **Alan Baker**, G4GNX, Newhaven, Sussex who rapidly devoured his dinner, raced to his shack, and made c.w. contacts with GM3OUR/P, whose auroral signal was very strong in the south, PA0SGL, and, after three years of trying, worked GD, his 17th country on 2m. Alan found that c.w. was the best mode and although signals were on a general beam heading between 350 and 70 degrees, the best direction was 30 degrees. He also heard a GW working EA and another calling a station in the USSR.

Dave Cox, G8OPR, Andover, Hants worked GM5MJI/P at 58A and **John Branegan**, GM8OXQ, Saline, Fife, who missed the August event, took part in another aurora during the afternoon of September 9th when he heard tone-A signals from the 2m beacons, GB3GI, GB3LER, GB3GM, and GB3VHF among a host of amateur stations from LA, a few from G and an EI.

Solar Activity

This later aurora was not unexpected because **John Smith**, Rudgwick, Sussex, Henry Hatfield and myself recorded solar radio noise between September 3rd and 10th, the strongest on 5th and 6th, and, on the 5th, Henry saw plenty of plages and filaments on the sun's disc and counted 22 sunspots, mainly in two large groups.

10m Band

Harold Goble, G4FDQ, Lancing, Sussex worked VK0A5 in Mawson, Antartica at 1310 on September 5th and noticed the very high noise level, which often happens on 10m when the sun is "active". On the 3rd, Harold worked two stations in the Channel Islands and commented about the short skip conditions. At 1747 on the 4th he had a 59 contact with ST2SA in Khartoum. **Harold Brodribb**, St. Leonards-on-Sea, Sussex, using a loft-mounted inverted V aerial into his AR88 is delighted with the aerial's performance on 10m. Between the 7th and 10th he heard strong signals from stations in Europe, Russia, South America and South Africa. At 0948 on the 16th very strong signals from Japan pounded in and G4GNX worked one for the first time on 10m.

Sporadic-E

The 1978 sporadic-E season, which really began on May 1st, ended with a big opening around noon on August 26th when, between 0715 and 1140, Ian Rennison, Horsham, Sussex received Band I television pictures from Austria, Hungary, Italy, Portugal, Scandinavia and the USSR. Like myself, Ian received pictures from Norway and Spain during sporadic-E disturbances on August 22nd and 23rd.

Clive Atlowe, Blofield, Norwich heard several Polish f.m. stations on the 23rd and on the 26th he received signals for about 1½ hours on Ch. E2 from Rhodesia. Up in Glasgow, **Frank Luman** watched pictures from Dublin, Hungary and Spain on the 25th and 26th. From Pretoria, South Africa, our reader **Ian Roberts** writes "I have been DXing on the v.h.f. bands for about one year now, using a 4-element horizontally polarised Yagi (40-70MHz) and a wide band TV pre-amplifier." During August, Ian, whose main interest is DXTV, received various weak video signals around 45MHz and both BBC and French TV sound on 41·5 and 41·25MHz respectively. On September 1st (spring day in the Southern hemisphere), the MUF on the North/South transequatorial path went up to 55MHz and Ian heard signals from the Cyprus beacon, 5B4CY, on 50·5MHz, which may be a "first" for South Africa. His main receiver is a National Panasonic RF8000, and he is delighted with its f.m./a.m./s.s.b./c.w. capability on the v.h.f. bands between 20-230MHz, plus the normal short-wave coverage up to 30MHz.

Tropospheric

The atmospheric pressure between August 20th and September 4th was above 30·0in in southern England and conditions were right for some v.h.f. DX. While holidaying in north Wales, **Roy Patrick**, whose home is in Mackworth, Derby, took his National receiver 678 feet up on the Great Arms and heard f.m. signals from Manx Radio, RTE, Down Town Radio, Belfast, and Radios Blackburn, Merseyside, Manchester, Sheffeld and Stoke-on-Trent, between 88 and 97MHz. During the evenings of August 21st Alan Baker heard signals on all 2m repeaters from R1 to R7 and 9 and worked F2PI, F6DWG and F9LT on c.w. and **Graham Kent**, G8HVD, St. Leonards-on-Sea, worked a German station on 2m s.s.b.

John Branegan was listening on 2m in Lancashire and heard West Country stations on August 24th and GMs on the 25th. Back in Saline on the 28th he observed a sudden lift on 70cm. Around this time, Dave Cox, using a Trio TR-7010 into a QQV06-40, 80 watts to a 6-element quad worked all G prefixes in 6 hours and 20 minutes, G, GB, GD, GJ, GM, GW and GU by tropo, and GI at 1404 via aurora.

During the RSGB 2m portable contest on September 3rd, Alan Baker worked DB6KH, 8 French stations, 4 GWs, 3 HB9s, 4 ONs and a PA0, and up north, John Branegan heard several GW stations. The pressure went high again on the 8th, and, as it fluctuated between 30·0in and 30·4in over several days, v.h.f. conditions were good. On the 9th, G4GNX assisted **Eric Arnold**, G8OUK, Hove, Sussex, to erect his new 2m X10 aerial and rotor on a 30ft pole atop a roof 20ft a.g.l. Imagine their delight when they switched on at 1930 and heard signals through both French and UK repeaters R3 to 7 and worked G8PNA in Buckinghamshire via the Hampshire repeater GB3SN. During the evening of the 13th, I heard GW stations working through GB3LO, Belgian stations through GB3PO and GB3SN, and I am told that EA1TA worked G.

At 1400 on the 17th, Alan Baker heard a G station on holiday in Torquay and using 1 watt from a hand-held transceiver, working through the French repeater, FZ3VHB on R7, which was very strong in Brighton, as was the Paris repeater on R6. Alan was alerted to this particular opening by **John Cooper**, G8NGO, Cowfold, Sussex, when he heard HB9 stations calling G.

Microwaves

The two Erns, **Downer**, G8GKV and **Hoare**, G8BDJ, were on Chanctonbury Ring, Sussex as usual for the fourth leg of the RSGB's 10GHz Cumulative contest on August 27th. Although conditions were poor in the morning they both worked F6DLA/P and in the afternoon, when conditions improved, they both worked F1BQ/P, F3LP/P, G3JVL and G8DIC.

Readers' Specials

Congratulations to **David Wakefield**, Worthing, who has been promoted to Corporal in 45F Squadron of the ATC, passed his RAE and is now polishing his Morse ready for that G4 call. Congratulations also to **Roy Hills**, of the Brighton Club, who now sports the call G4HLH.

The Scottish VHF and Short Wave DXers club is going well, members, **Don Bassnett**, **John Cowan** and **Frank Luman** have received v.h.f. signals from almost every country in Europe and TV pictures, in good colour, from Finland, Iceland, Italy, Ireland, Norway and Sweden. The Club hopes to expand its membership into Cumbria, Northumbria and N. Ireland. Readers in those areas who are interested, drop me a line, and I will pass it on.

OSCAR

Although John Branegan spent half of August on a working holiday in Lancashire he took his portable OSCAR rig with him and writes "I had a great time as a G8 particularly on 8J, despite very small simple aerials fixed on my camera tripod". Back in Saline he worked W4AXR, Florida on September 2nd and VE3BNA, Ottawa on the 3rd via OSCAR mode 7B and 8J respectively.

ELECTROVALUE Buying Guide

Section 3

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SECTION FOUR
Resistors, Pots, Knobs, etc.
SECTION FIVE
Pot Core selection, Solder Tools, Transformers, etc.

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7413	22p
7414	60p
7420	14p
7430	14p
7440	14p
7442	54p
7443	60p
7444	60p
7447	70p
7450	14p
7451	14p
7453	14p
7454	14p
7460	14p
7470	24p
7472	24p
7473	23p
7474	23p
7475	45p
7476	32p
7480	41p
7482	61p
7483	58p
7485	74p
7486	27p
7490	40p
7491	71p
7492	46p
7493	40p
7494	66p
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74104	40p
74107	27p
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4013	40p
4014	96p
4015	1·14
4016	40p
4017	80p
4018	88p
4019	64p
4020	96p
4021	88p
4022	83p
4023	19p
4024	90p
4025	19p
4026	1·75
4027	58p
4028	95p
4029	1·23
4030	54p
4041	84p
4042	80p
4043	93p
4044	93p
4046	1·28
4049	48p
4050	48p
4060	1·33
4069	19p
4070	19p
4071	19p
4072	19p
4081	19p
4082	19p
4510	1·28
4511	1·36
4514	3·30
4516	1·37
4518	1·25
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SAJ410	1·05
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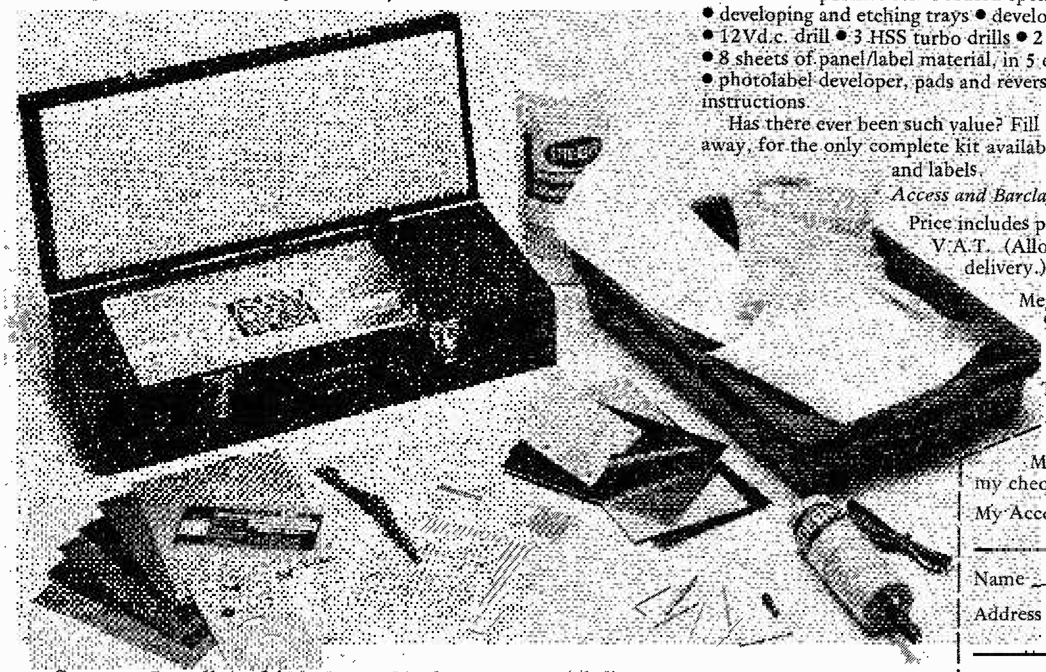

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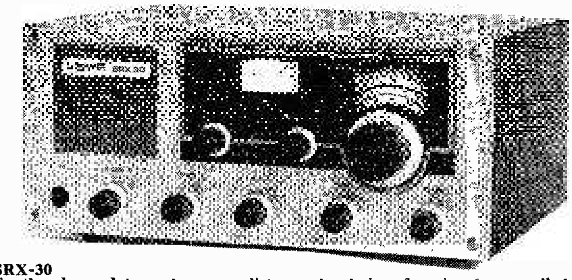

SRX-30

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The SRX-30 provides AM, CW, USB and LSB reception on all frequencies from 500 kHz to 30MHz. All right, so does your Sooper Blooper Mk. 3 but you can't set the Sooper Blooper dial to the frequency you want and be sure that it's correct! **The SRX-30 tuning system** is so simple to operate. You have a dial reading in MHz from 0-29 and a main tuning dial reading 0-1000 kHz. So—if you know that Radio Slobovia is broadcasting on 10.295 MHz, you set the MHz dial to 10, the kHz dial to 295 and there you are. The MHz dial setting is not critical, as stability is guaranteed by a triple mixing drift cancelling system, thereby overcoming another problem in your Sooper Blooper Mk. 3; drift.

A further drawback to cheap receivers is massive image interference on the higher frequencies due to the use of a low IF, typically 455 kHz. The cure for this problem is the use of a high IF and the SRX-30 employs a first IF of around 40 MHz—so goodbye to first IF images. You could of course find the same system as this in the Racal RA17 series receivers; after all, the SRX-30 has copied the basic idea from this very receiver. The big drawback to the RA17 (apart from the price !!) is that unless you have the muscles of a prize fighter, lifting the RA17 may send you for a holiday at Hernia Bay (staying at the Truss House?).

To summarize, the SRX-30 covers 500 kHz to 30 MHz with excellent dial readout and reset accuracy; it has all mode (AM, CW, SSB) reception and is equally at home in broadcast or amateur bands: it has all the facilities of a top class communications receiver, RF gain, fine tuning, selectable sidebands, built in loudspeaker, operation from ac mains or 12v. Dc, rugged construction and super styling and all at an attractive price—£175 inc. VAT. Carr £3.

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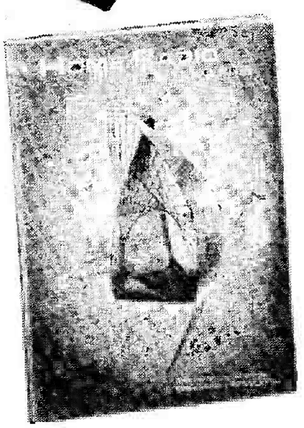

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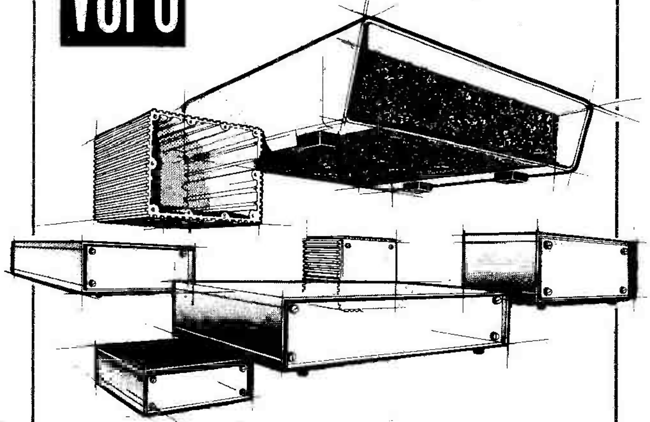

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LM1351N	1·30
LM1458N	0·45
LM1496N	1·97
LM1800N	1·94
LM1812N	6·20
LM1820N	1·16
LM1828N	1·90
LM1830N	1·90
LM1841N	1·90
LM1845N	1·50
LM1848N	1·98
LM1850N	1·90
LM1889N	4·90
LM2907N-8	1·80
LM2987N-8	1·80
LM3301N	0·60
LM3302N	0·55
LM3401N	0·55
LM3900N	0·68
LM3905N	1·15
LM3909N	0·78
LM3911N	1·10
LM4250CN	1·30
LM78L05CH	0·85
LM78L12CH	0·85
LM78L15CH	0·85
LM78L24CH	0·85
LM7805KC	1·75
LM7812KC	1·75
LM7815KC	1·75
LM7824KC	1·75

LM78L05CZ	0·30
LM78L12CZ	0·30
LM78L15CZ	0·30
LM78224CZ	0·30
MC1035P	1·90
MC1327P	1·70
MC1330P	1·10
MC1352P	1·20
MC1433G	3·65
MC1435G	2·20
MC1439G	1·75
MC1440G	1·65
MC1456G	2·15
MC1463R	3·90
MC1468L	3·85
MC1469R	3·10
MC1488L	4·25
MC1495L	5·50
MC1529G	7·10
MC4024P	2·20
MM5314	4·60
MM5316	4·60
MM5320	4·20
NE555	0·33
NE556	0·65
NE560	4·50
NE561	4·50
NE562	4·50
NE565	1·39
NE566	1·75
NE567	1·90
NE558N	1·98
NE571N	4·95
SAS560	2·70
SAS570	2·70
SAS580	2·40
SAS590	2·40
SN76001N	1·30
SN76003N	2·38
SN76008KE	1·60
SN76013N	1·50
SN76012ND	1·30

SN76018KE	1·60
SN76023N	1·50
SN76023ND	1·30
SN76033N	2·35
SN76110N	1·30
SN76115N	1·65
SN76116N	1·80
SN76131N	1·30
SN76226N	1·68
SN76227N	1·30
SN76228N	1·55
SN76531N	0·82
SN70532N	1·55
SN76533N	1·30
SN76544N	1·60
SN76545N	1·80
SN76546N	1·58
SN76550-2	0·38
SN76552-2	0·57
SN76570N	1·80
SN76620AN	0·99
SN76650N	1·20
SN76660N	0·66
SN76666N	0·99
SL610C	2·75
SL611C	2·75
SL612C	2·75
SL620C	3·85
SL621C	3·75
SL623C	6·25
SL640C	4·40
SL641C	4·40
SL701C	2·50
TAA263	1·35
TAA300	3·70
TAA320A	1·15
TAA350A	3·00
TAA521	1·10
TAA522	2·10
TAA550	0·48
TAA560	2·10
TAA570	2·20

Prices correct at 9 Oct. 1978. All prices include VAT, p & p 40p.

NEW! BUILD-IT-YOURSELF TEST GEAR KIT

BASIC SERVICING INSTRUMENTS WITH EASY STAGE BY STAGE BUILDING INSTRUCTIONS—IDEAL FOR THE AMATEUR

MULTI RANGE TEST METER

A general purpose meter covering all usual ranges of A.C. and D.C. volts current and resistance measurements

AUDIO SIGNAL GENERATOR

New design covering 10Hz to 10KHz and variable output. Distortion less than 0·01% Ideal for HIFI Testing.

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A basic 3″ general purpose cathode ray oscilloscope for simple testing and servicing work. Sensitivity 0·3 volts/cm

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PROGRESSIVE RADIO

31 CHEAPSIDE, LIVERPOOL L2 2DY. Tel: 051-236-0982.

SEMICONDUCTORS ALL FULL SPEC. TBA800 I.C.'s 10 for **£5·00.** LM380 **80p,** LM381 **95p,** NE555 **33p,** 741 8 PIN **23p,** 741S (wide bandwidth) 8 pin **35p.** TIL305 Alpha numerical display (with data) **£2·50p.** BX504 opto isolators infra red led to photo cell, 4 lead **25p,** BFY50 plastic **14p,** 723 REGS I.C.'s 14 pin **35p,** BD533 **33p,** MRD3051 photo transistors **35p,** FETS similar to 2N3819 **18p,** MOSFET similar 40673 **35p.** Intel C1103 1024 bit mos rams **95p,** CD4051 **45p.** Special Offer 6v speed regulated cassette motor ex equip as new **55p.** New 8 track 12v cartridge motor **£1·25p.**

DIODES, BY127 **9p,** IN4002 **4p,** IN4005 **7p,** 600v 3 amp **17p,** ORP61, Mullard new boxed **30p.**

MAN3A 3mm led displays **50p,** Min. Nixie 587 OST **75p.**

Pot core unit, has six pot cores including one FX2243 (45mm) and two FX2242 (35mm) 3 TO3 sil. power transistors on heat sink 3-20m/m panel fuseholders and panel with various transistors, diodes and a 5 amp plastic SCR, **£1·75p** plus 75p postage.

MOTORS, Model type 1·5-6 volts **20p,** 'BIG INCH' sub min motor 115 vac, 3 r.p.m. **25p.** 24 OVAC SYNCH. MOTORS WITH GEARBOX, 1/5 r.p.m. **75p,** 1/24th r.p.m. **75p,** Crouzet 115 VAC 4 r.p.m. **85p.** 12v D.C. 5. Pole **35p.**

HI-SPEED MORSE KEY, ALL METAL **£2·25p.** PLASTIC VERSION **95p.**

PLESSEY WINKLER SWITCHES, 1 Pole, 30 way, 2 Bank Adj. Stop, **75p.**

Crystal microphone inserts 37mm **45p,** Grundig electret condenser inserts with built in FET preamp **£1·50p,** ELECTRET PENCIL HAND MICROPHONES 1K IMP WITH STANDARD JACK PLUG **£2·85p,** TIE CLIP CONDENSER MIKES OMNI, 1K IMP, (uses deaf aid battery, supplied) **£4·95p.**

SOLDER SUCKER, high suction, eye protection shield **£4·95p.**

PROJECT BOXES, BLACK ABS PLASTIC WITH BRASS INSERTS AND LID, 75 × 56 × 35 **44p,** 95 × 71 × 35 **52p,** 115 × 95 × 36 **60p.**

BUZZERS, GPO open type 3-6v **30p.** Large plastic domed type loud note 6 or 12 volts **30p,** Solid State buzzers, miniature, 6-9-12-24 volt 15ma **75p** each.

TAPE HEADS, Mono Cassette **£1·30p.** Stereo cassette **£3·00,** BSR MNI330 half track dual imped. heads **£1·75p,** TD10 Dual head assemblies 2 heads both ½ track R/P with built in erase, mounted on bracket, **£1·20p.** SRP90 ½ track R/P **£1·95p.**

Relays. Min 24v dc 2 pole c/o 3 amp contacts **55p,** Min sealed 220v ac 2 pole c/o **40p,** Open type 12v dc 4 pole c/o **50p,** 4 pole reed relays N/O **20p.**

CRYSTALS, 300khz **40p,** 50V AC cam units, motor switching ten c/o micro switches, supplied with capacitor for 240V AC use **£1·95p** plus 35p postage.

MAINS TRANSFORMERS, all 240V AC primary, postage shown in brackets per transformer. 6-0-6 100ma, 9-0-9 75ma, 12-0-12 50ma **75p** each (15p). 0-4-6-9 150ma no mounting bracket, **65p** (20p). 12-0-12 100ma **95p** (15p). 12V 500ma **95p** (22p). 12V 2 amp **£2·25** (45p). 12V 4 amp **£2·75** (54p). 15-0-15V 1 amp **£2·10** (45p). 30-0-30V 1 amp **£2·75** (54p). 0-12-15-20-24-30V tapped at 2 amp **£4·50** (54p). 20-0-20V 2 amp **£3·50** (54p). 25V 1·5 amp **£1·45** (45p). 18V 1·5 amp rectified **£2·00** (45p). 35V 2 amp, 2·5V 2 amp Toroid **£2·95** (54p). 20V 2·5 amp, **£2·20** (54p). Murata MA401L 40KHZ rec/send transducers **£3·25** pair.

Large mains solenoid 25lb pull 2″ travel. £3·95p + 54p Post

U.H.F. TV Tuners, push button (not varicap) new and boxed **£2·50p.** Miniature toggle switches, SPST 8 × 5 × 7 **45p,** DPDT 8 × 7 × 7 **50p,** DPDT c/o 12 × 11 × 9 **75p,** Min. push to make or push to break 16 × 16mm **15p** each type. Slider switches, DPDT standard **15p,** Min **12p,** Std. c/o **20p.** Roller action micro switches **15p.**

TOOLS Small side cutters 5″ insulated handles **£1·35p.** Snub nosed pliers 5″ insulated handles **£1·35p.** Large mains tester screwdrivers, fully insulated 8″ **44p.** Test lead jumper sets, 10 leads with insulated croc clips each end, different colours **80p.** Telephone pick up coil, suction type with 3·5mm jack plug **50p.** 9 volt battery eliminators, 240v ac input 9v dc out at 120mA stabilised replaces PP3, PP6, PP7, PP9 **£2·45p.** Edge connectors, 0·1 64 way **65p,** 34 way **40p,** 0·2 18 way **15p.** 13 amp rubber trailer extension sockets **38p.** LA1(3) adj. core 15mm diam. 14mH-18mH. HI Q 6 for **50p.** Tape head demagnetisers 240v ac with on/off switch, straight probe **£2·00,** curved probe (cassette) **£2·35p.**

TERMS: cash with order, (or official orders from colleges etc). Postage 30p unless otherwise shown, overseas post at cost. VAT inclusive prices. New Illustrated Catalogue now ready. S.A.E. please.

Progressive Radio, 31 Cheapside, Liverpool L2 2DY. Tel: 051 236 0982.

ROOM THERMOSTAT

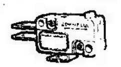
Famous Satchwell, elegant design. Intended for wall mounting. Will switch up to 20 amps at mains voltage, covers the range 0.30 C. Special snip this month **£3·25.**

ROD THERMOSTAT—£3·00.

WINDSCREEN WIPER CONTROL

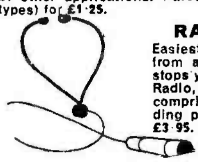
Vary speed of your wiper to suit conditions. All parts and instructions to make **£3·75.**

MICRO SWITCH BARGAINS



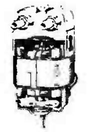
Rated at 5 amps 250V. Ideal to make a switch panel for a calculator and for dozens of other applications. Parcel of 10 (two types) for **£1·25.**

RADIO STETHOSCOPE



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

MULTISPEED MOTORS

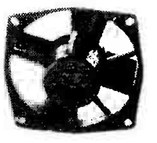


Six speeds are available 500, 800 and 1,000 r.p.m. and 7,000, 9,000 and 11,000 r.p.m. Shaft is ¼ in. diameter and approximately 1 in. long. 230/240V. Its speed may be further controlled with the use of our Thyristor controller. Very powerful and useful motor size approx. 2 in. dia. × 5 in. long. Price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

12V MINIATURE RELAY

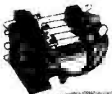
dc operated with two sets of change-over contacts. The unique feature of this relay is its heavy lead out wires; these provide adequate support and therefore the relay needs no fixing; on the other hand there is a fixing bolt protruding through one side so if you wish you can fix the relay and use its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

EXTRACTOR FAN



Ex computers—made by Woods of Colchester. Ideal for fixing through panel—reasonably quiet running—very powerful 2500 rpm. Choice of two sizes 5" or 6½" dia. **£5, £6.**

MAINS RELAYS



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

MICRO AMPLIFIER

Ex behind the ear hearing aid complete with volume control. **£2·16.** Case not supplied

MERCURY BATTERIES

Bank of 7 Mercury cells type 625 which are approx. ⅝in. diameter by ⅛in. thick in plastic tube giving a total of 10·7V. Being in a plastic tube it is very easy to break up the battery into separate cells and use these for radio control and similar equipment. Carton of 25 batteries **£1·60.**

PP3/PP9 REPLACEMENT

Japanese made in plastic container with leads size 2in. × 1¾in. × 1½in., this is ideal to power a calculator or radio. It has a full wave rectifier and smoothed output of 9V suitable for loading of up to 100mA. **£2·53.**

SWITCH TRIGGER MATS

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

MAINS TRANSISTOR PACK

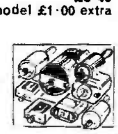
Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: mains transformer, rectifier, smoothing and load resistor, condensers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

DRILL CONTROLLER

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

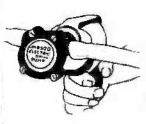
Made up model £1·00 extra

8 POWERFUL BATTERY MOTORS



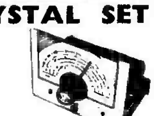
For models, Meccanos, drills, remote control planes, boats, etc. **£2.**

ROTARY PUMP



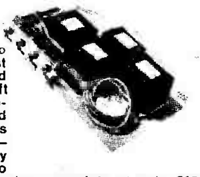
Self priming, portable, fits drill or electric motor, pumps up to 200 gallons per hour depending upon revs. Virtually uncorrodable, use to suck water, oil, petrol, fertiliser, chemicals, anything liquid. Hose connectors each end. **£2.**

SHORTWAVE CRYSTAL SET



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

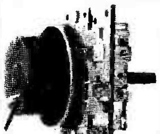
MULLARD UNILEX



A mains operated 4+4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost anyone in easy-to-assemble modular form and complete with a pair of speakers this should sell at about £30—but due to a special bulk-buy and as an incentive for you to buy this month we offer the system complete at only **£15** including VAT and postage.

HUMIDITY SWITCH

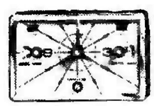
American made by Ranco, their type No. J11. The action of this device depends upon the dampness causing a membrane to stretch and trigger a sensitive micro-switch adjustable by a screw, quite sensitive—breathing on it for instance will switch it on. Micro 3 amp. at 250V a.c. Overall size of the device approx. 3¾ in. long, 1 in. wide and 1¾ in. deep **75p.**



DELAY SWITCH

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

25A ELECTRIC PROGRAMMER



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

MULLARD AUDIO AMPLIFIERS

All in module form, each ready built complete with heat sinks and connection tags, data supplied Model 1153 500mW, power, output **£1·69**

Model 1172—10 watts power output **£3·94**

Model 1172 1W. power output **£2·25**

Model EP9000 4 watt power output **£2·90**

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

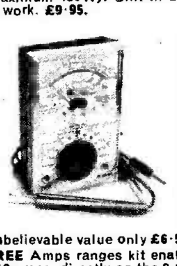
WAFER SWITCHES

6 pole 2 way	12 pole 2 way	18 pole 2 way
5 pole 3 way	10 pole 3 way	15 pole 3 way
4 pole 4 way	8 pole 4 way	12 pole 4 way
3 pole 5 way	6 pole 5 way	9 pole 5 way
2 pole 6 way	4 pole 6 way	6 pole 6 way
2 pole 8 way	4 pole 8 way	6 pole 8 way
1 pole 10 way	4 pole 9 way	6 pole 9 way
1 pole 12 way	2 pole 10 way	3 pole 10 way
all £1·32 each	all £2·41 each	all £3·12 each

Multi bank switches up to 72 pole 2 way—to 12 pole 12 way quickly made to special order.

SOUND TO LIGHT UNIT

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



MINI-MULTI TESTER

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

11 instant ranges measure:—

DC volts 10, 50, 250, 1000

AC volts 10, 50, 250, 1000

DC amps 0-1 mA and 0-100 mA

Continuity and resistance 0-150K ohms.

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

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

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

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

BULK ENQUIRIES INVITED. PHONE: 01-688 1833.

J. BULL (ELECTRICAL) LTD

(Dept. P.W.), 103 TAMWORTH RD., CROYDON CR9 1SG

IT'S FREE

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

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

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

Quantity Discounts apply.

Component Panel Ref. 3055. Taken from unused P.S.U.'s, these contain 4 × 2N 3055 power transistors with mica insulators all on heat sink and 4 × 3W type variable pots, preset type with spindle locks. Real bargain at **£1·08.**

Component Board 421. Again from unused equipment, major items on these are two power silicon transistors, Motor Rola ref. SJ 5433 mounted on a heat sink with mica insulators, also behind the panel are two power rectifiers ST NS 1008. Price **96p.**

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

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

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

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

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

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

Power Packs for the Telephone Answering Machines have just arrived, these isolate the machine from the mains and provide the correct voltages for driving the record and playback motors, etc. On metal chassis with voltage selector and fuse, these have a plastic cover to make them safe. Not new of course but fully guaranteed. Price **£5·86.**

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

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

10 r.p.m. Motor with 230v mains coil, not like the usual of these geared motors, this has a good length of ¼" shaft price. **£3·00 + 20p.**

Can Anyone Help US? We are looking for fairly large quantities of the items listed below. If you have any stock yourself or can put us on to a reasonably priced supplier we would be obliged.

7-Segment displays common anode red or green.

BZY88C5V6 Zener.

TIL209 red l.e.d.s.

Soldercon pins.

0·1 inch matrix Veroboard 52 holes × 46 strips.

0·1 inch matrix Veroboard size 34 holes × 34 strips.

CA3130 1C. Operational amplifier 1C.

MPF102. Transistor.

We are also looking for VDU's, oscilloscopes, computers and most instruments. If you know of any surplus please send details or 'phone Mr. J. Bull, 01-688 1833.

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

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

Disc Motor, mains operated. This is very thin in fact less than ¾" thick and only approx. 2" dia. Spindle revolves at 250 rpm and the spindle which is approx. 1/32" dia. pushes through so motor could be used to drive clockwise or anti-clockwise. The spindle being a friction fit can be pushed completely out and replaced by your own spindle, a knitting needle for instance. Price only **38p.**

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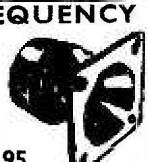

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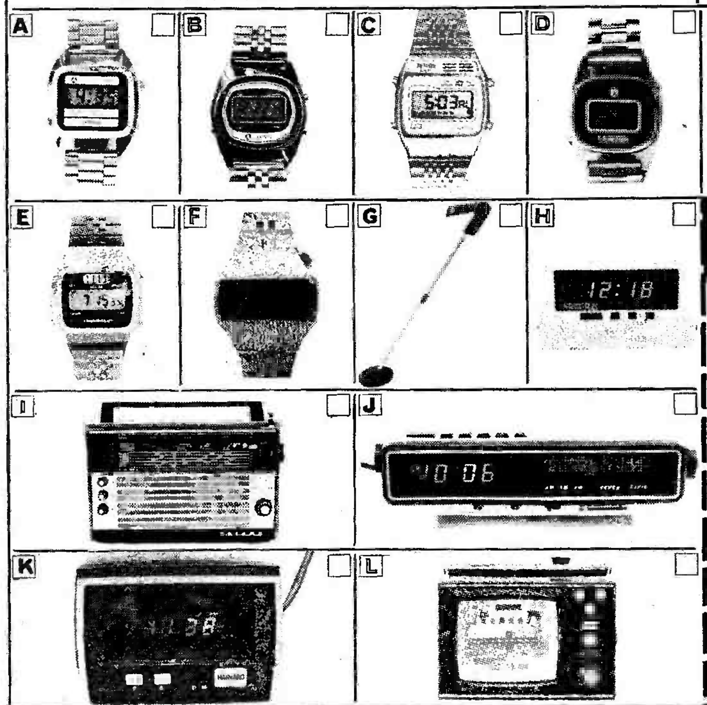

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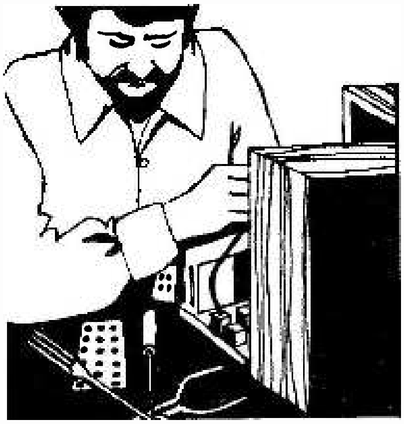

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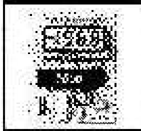

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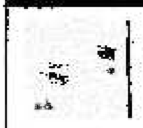

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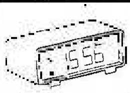

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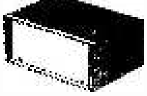

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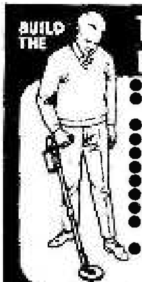

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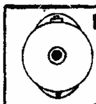

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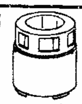

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PW12

PULL OUT SUPPLEMENT AND FOLD BACK

THE PW EXPERIMENTER

The usefulness of any universal plug-in breadboard system can be greatly improved if the boards are mounted onto a box containing a set of stabilised power supplies of the most commonly used voltage levels. Several commercial models are available which provide the constructor with these facilities but they all tend to be rather expensive.

The philosophy behind the PW Experimenter is to provide a reasonably priced, easy to use universal system which is complete with power supplies suitable for both TTL logic and standard op. amps. A small loudspeaker is also contained within the case as it was felt that any self respecting 'Wireless' breadboard system should have a speaker readily available.

Power Supplies

Three stabilised power supplies are contained in the Experimenter and these have been selected to provide the most useful voltages. A stabilised 5 volt supply capable of providing 1A is useful for any work using TTL logic chips, while a positive and negative pair of 15V supplies, with a common 0V terminal, provide the necessary balanced voltage rails for use with i.c. op. amps. To make these two supplies more versatile they are switched to give either $\pm$12V or $\pm$15V at 100mA each.

The power supplies are all similar and use i.c. regulators, fed from a simple full wave bridge rectifier circuit Fig. 1. These i.c. stabilisers give adequate regulation with full overload protection, are very simple to use and cost very little to buy.

Construction

The stabilised supplies are built on a piece of Veroboard as shown in Fig. 2. The actual layout of the components is not critical in any way and could be altered to suit available components.

The 1A 5V positive regulator is mounted on a suitable small heatsink which is screwed to the bottom of the case. The two transformers are also screwed to the case bottom and the regulator board and smoothing capacitors C2 and C3 held in position by double-sided adhesive foam rubber pads.

Suitable size holes in the back of the case take a mains fuse holder and the mains cable which is held securely by a suitable cable entry clamp. All soldered joints on the mains side should be sleeved with small rubber tubing and the fuse holder should be fitted with a suitable rubber boot.

The position of the speaker is marked on the case bottom, towards the front, and extra holes drilled to allow the sound to be heard. The speaker is fastened in place with epoxy adhesive.

The case chosen is the largest in the Bimconsole range

THE PW EXPERIMENTER

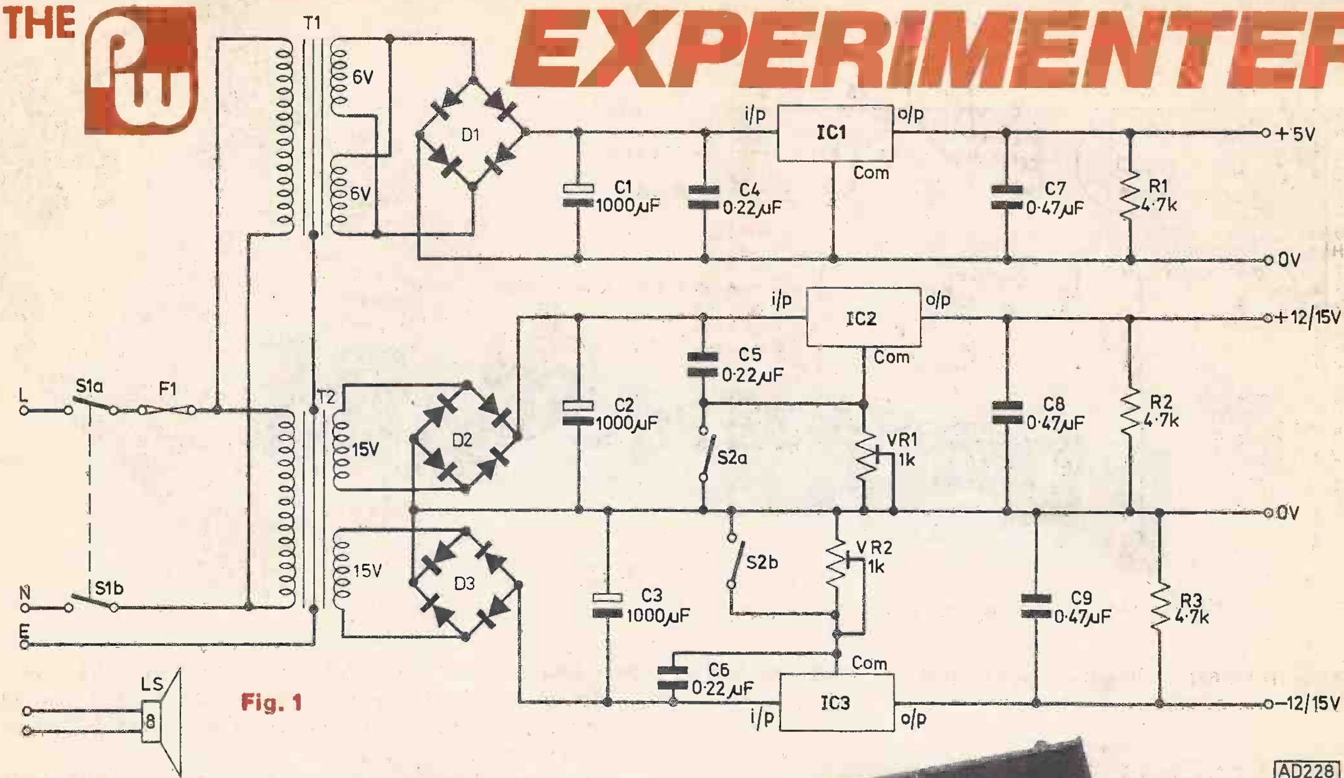
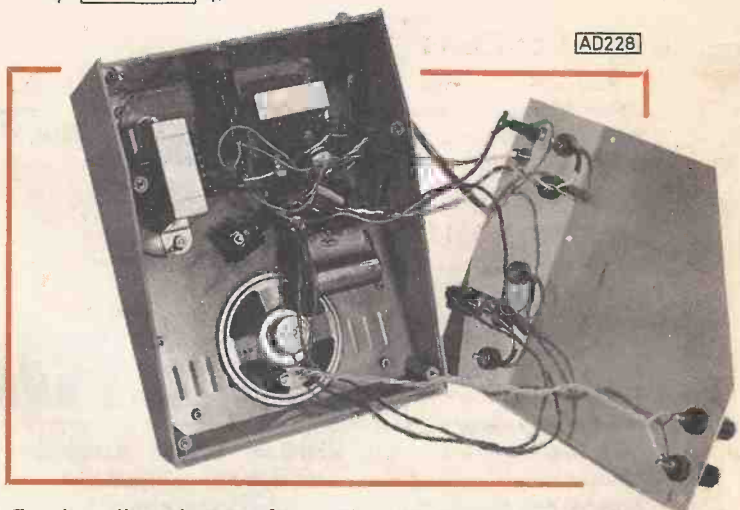


Fig. 1

and has the advantage of a sloping front on which the universal breadboards can be mounted. The area available will allow almost any of the commercial systems to be fitted and although the prototype Experimenter used the new



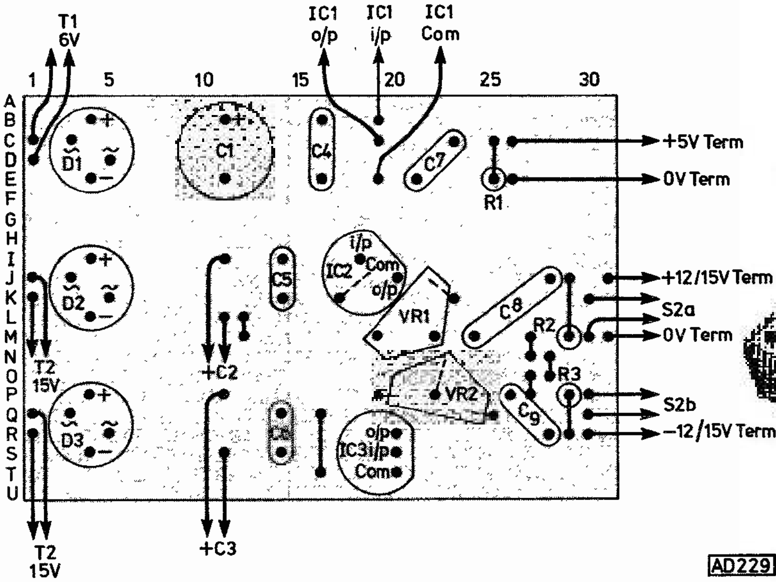
Eurobreadboards any of the other systems reviewed elsewhere in this supplement could be used.

Suitable holes are drilled to take the terminals and the two switches, together with the mains indicator.

The final stage is to complete the wiring to the terminals

Company Addresses

Bandridge Ltd., 80a Battersea Rise, London SW11 1EH. **Boss Industrial Mouldings Ltd.**, 2 Herne Hill Road, London SE24 0AU. **Charcroft Electronics**, Charcroft House, Sturmer, Haverhill, Suffolk. **Continental Specialities Corporation UK Ltd.**, Spur Road, North Feltham Trading Estate, Feltham, Middx. TW1 40JW. **David George Sales**, r/o 74 Crayford High Street, Crayford, Kent DA1 4EF. **E & L Instrument UK**, 62 Queen Anne Street, London W1M 9LA. **Lascar Electronics Ltd.**, PO Box 12, Module House, Billericay, Essex CM12 9QA. **Lektrokit Ltd.**, Sutton Industrial Park, Earley, Reading, Berks RG6 1AZ. **Michael Williams Electronics**, 47 Vicarage Ave., Cheadle Hulme, Cheshire SK8 7JP. **OK Machine & Tool UK Ltd.**, 48a The Avenue, Southampton SO1 2SY. **Rhopoint Ltd.**, Eastman House, 98-102 Station Road East, Oxted, Surrey RH8 0AY.



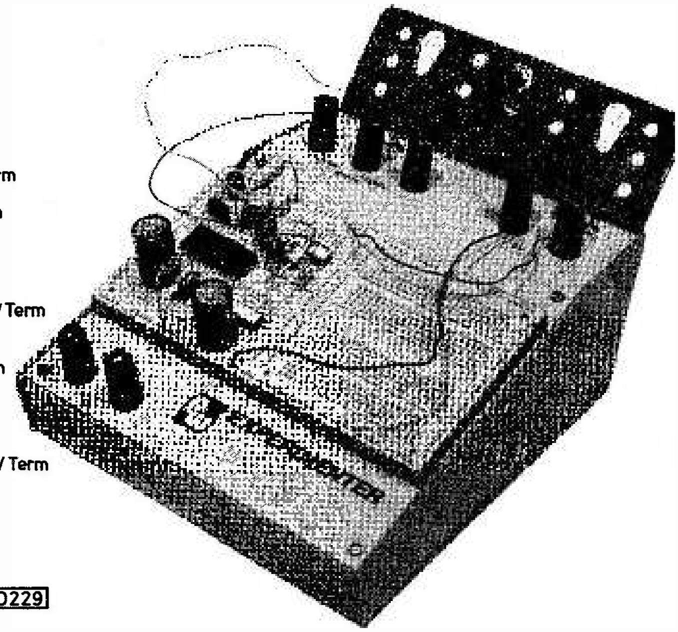


Fig. 2: Veroboard layout of regulated supplies.

and switches, fit the front panel onto the case and test the power supplies.

Applications

You will find your PW Experimenter an invaluable aid when trying out new ideas. Almost any component can be easily plugged into the various rows of contacts to make up circuits quickly and easily. However you should only use components which have clean leads free from solder blobs otherwise difficulty will be experienced in inserting the leads into the contacts and damage may be caused to the breadboard.

When inserting or removing integrated circuits from the board care must be taken to ensure that the leads are not bent or broken off. Follow the makers instructions supplied with the breadboard and you should find it simple to plug-up any circuit configuration. ●

★ components

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¼W 5%		
4·7kΩ	3	R1, 2, 3
Potentiometers		
Vert. Skeleton preset		
1kΩ	2	VR1, 2
Capacitors		
Polyester		
0·22μF	3	C4, 5 6
0·47μF	3	C7, 8, 9
Electrolytic		
1000μF 25V	3	C1, 2, 3
Semiconductors		
Silicon Bridge rectifier		
1A 50V	3	D1, 2, 3
Regulators		
78L12	1	IC2
79L12	1	IC3
7805	1	IC1

Miscellaneous

8Ω 76mm dia. loudspeaker (1); Case 214 × 170 × 82mm (Bim6007); Eurobreadboard (2); d.p.d.t. min. toggle switch (2); 20mm panel mounting fuse holder and 1A fuse (1); Insulating boot for fuseholder (1); Cable entry clamp to fit mains cable (1); Insulated terminals red (2), blue (3), black (2) Transformer 15V + 15V 8VA (Watford Electronics) (1); Transformer 6V + 6V 12VA (Watford Electronics) (1); Heat sink (1); Indicator 28V Red (1). 3 Core mains cable.

Survey of AVAILABLE BREADBOARD SYSTEMS

The use of some form of breadboarding system is as old as the art of wireless itself. However the modern system of specially designed pluggable socket systems is far removed from the panel pins in a wooden board of bygone days.

Although the modern systems will accept components having widely varying lead diameters it is essential that the leads are straight at the ends and free from solder. If possible it pays to use new components with full length leads rather than try to force short leads, covered with solder, into the contacts.

Integrated circuits often prove a stumbling block as it takes quite a force to insert or extract 16 pins simultaneously. Most socket manufacturers suggest a method of insertion and withdrawal and it is advisable to follow their recommendations to avoid damaging the i.c. leads.

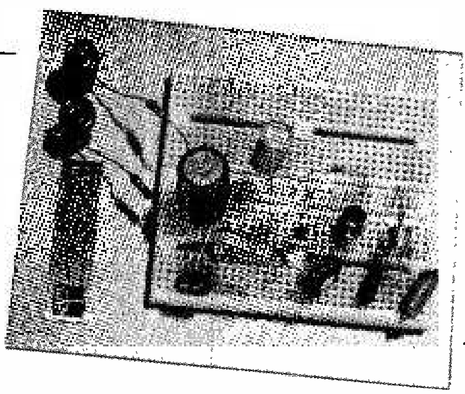
In the following review of available breadboard systems, we have, wherever possible, tried actual samples to see just how easy it is to insert component leads into the contacts. The technical information given, such as contact resistance, etc has been taken from the manufacturer's own published literature. Prices quoted include VAT.

ACE

O K Machine & Tool

There are three models in the ACE series of breadboards, the differences being mainly in size and flexibility. ACE stands for All Circuit Evaluators, and all three models use combinations of plug-in terminal strips and distribution buses all on a 0·1 inch matrix. The various matrix boards are attached to a back plate which also carries two screw terminals for easy supply connection.

The smallest model the ACE 200-K has 728 sockets arranged in a conventional double row of five sockets tied together each side of a central strip. There are two such boards together with a two rail bus. The two larger models have 1,224 and 1,760 socket positions, utilising the same matrix boards as the smaller version.



The matrix boards are also available separately in a wide range of configurations. Moulded in acetal copolymer with nickel-silver contact strips the boards have a removable backing or can be mounted onto a board with screws which are supplied. With suitable combinations of the bus strips and matrix boards almost any component can be used as long as its leads conform to a 0·1 inch matrix. Leads of up to 0·8mm diameter can be used.

The ACE 200-K is supplied in kit form which is simple to assemble, our sample took about 10 minutes. The retail price of the 200-K is around £13·20 while the largest model, the 218 costs around £32·65.

The ACE 200-K provides the amateur with a reasonably priced easy to use breadboard system which will cope with fairly complex circuits, and components were easily inserted into the sockets. The separate matrix boards and bus strips could be used to make up one's own design of universal breadboarding unit.

Lektrokit are also marketing these boards.

Bimboards

Boss Industrial Mouldings

This is a useful sized board which accepts most d.i.l. i.c. packages as well as any other component with leads spaced on a 0·1 inch grid.

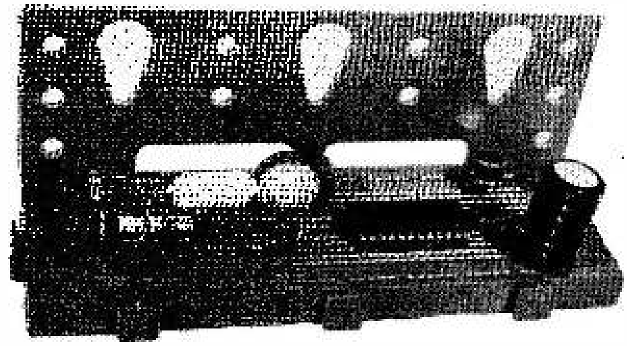
The body is moulded in a blue plastics material with 47 rows of 5 interconnected contacts each side of a central strip across which i.c. packages can be fitted. Two rows of contacts are fitted along the edges of the board for power supply rails.

A simple plastics bracket is provided ready punched with various sized holes and slots to take switches, pots and other items which require a mechanical support.

Any number of these boards can be slotted together to make a larger working area for more complex projects.

Contact material is nickel-silver with a contact resistance of better than 10mΩ and a current rating of 1A per strip.

The maximum working voltage between rows of contacts is 240 a.c. and inter-row capacitance is 0·5pF max. Each



contact takes wires of between 0·25 and 0·85mm diameter and wirewrap sockets may be used to carry i.c.s if desired.

The Bimboard is a reasonably priced unit which is versatile and easy to use. Component leads can be inserted fairly easily without too much risk of bending and the vertical mounting bracket for switches and pots is a useful adjunct.

Bimboards also go under two other names; MW Breadboard from Michael Williams Electronics and Professional Prototype Board from RS Components.

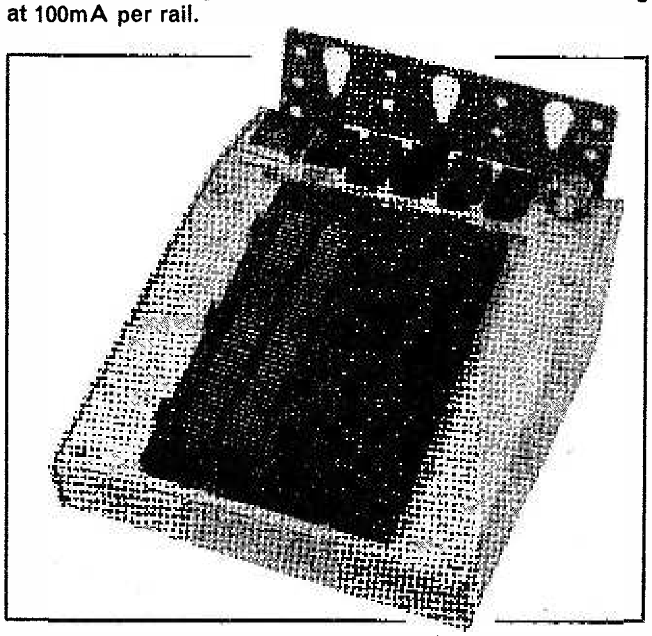
Typical retail price is around £9·70 including VAT. Bimboards are also available mounted on back panels with terminals fitted. Prices range from £22·68 to £42·12 for the 4 board version.

Breadbloc

Lascar Electronics

This unit uses one or two Bimboards mounted onto a sloping front panel of a Bimconsole into which is built two independent stabilised power supplies.

These supplies give 5V at 1A and ±5 to 15V dual tracking at 100mA per rail.



A mains switch, indicator and fuse are incorporated and connections to the power supplies are by means of 4mm sockets or push-button terminals.

The remarks made under the Bimboard review obviously apply to the Breadbloc unit while the power supplies make it virtually self-contained and increase its versatility.

The two Bimboard version retails for around £51·80 and the single Bimboard model for £43·16.

Bug System

E & L Instruments

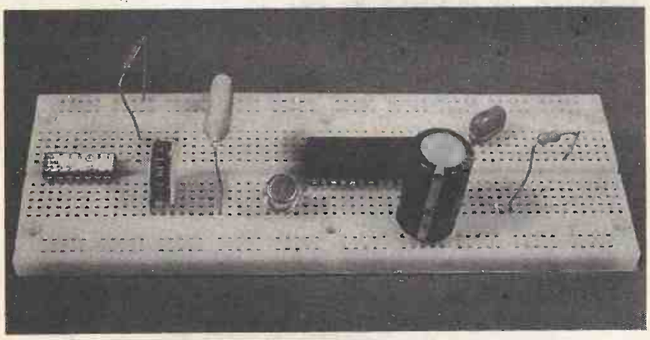
The three sizes of basic breadboard in this range both take any component with leads on a 0·1 inch matrix.

The largest, the SK10 takes up to eight 14 pin d.i.l. integrated circuits of the standard 0·3 inch width across pins. The contact strips are arranged in 63 rows of five linked contacts each side of the central strip. Two continuous rows of linked contacts are placed along each long edge of the base which is moulded in acetal copolymer. Contact resistance is 5mΩ average.

The smaller SK50 unit has 33 rows of five linked contacts and correspondingly shorter continuous linked contacts for power rails. SK20 is a miniature socket.

Versions are available for permanent connection to p.c.b.s and these have tabs protruding from the contact strips downwards to allow soldered connections to be made through the p.c.b.

The basic boards are used in a very wide range of universal breadboarding aids including versions with the basic breadboard unit mounted onto a metal back panel with terminal posts fitted. Other types have built-in power supplies to suit many varied applications. Even more complex systems are available fitted with all sorts of extra equipment such as multimeters, potentiometers, switches and speakers. A version is also made especially for use with microprocessors.



All of these units are based around the three basic breadboard units, and, as a further aid to constructors, a p.c.b. version of the SK-10 unit is available as well as a double SK-10 pattern board with edge connector contacts.

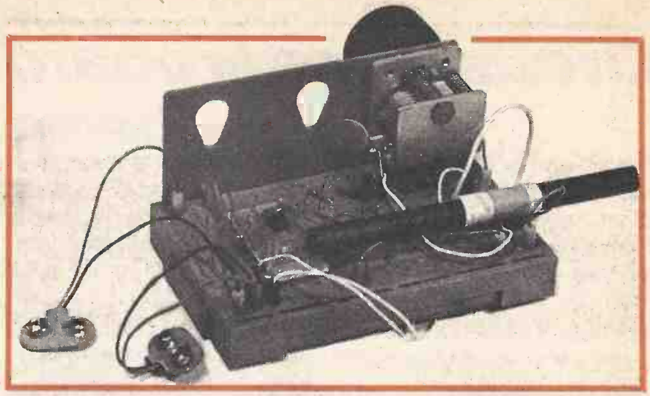
Prices range from £6·95 for the SK50 to £12·07 for the SK10. The universal design aids range from £15·55 for the smallest to £24·72 for the largest and the complete units with power supplies cost from £79·00 upwards with the top-of-the-range Elite 2 which has almost everything built-in costing a mere £1081·00.

DeCs

At the time of writing it has been announced that the manufacturers have gone into liquidation and the future of the DeC series is therefore in doubt. However stocks are held by a number of retailers and we feel that the following review is still valid, although no prices have been given for obvious reasons. Bandridge supply DeCs under their own name.

The S-DeC is intended for use with discrete components and has two sets of seven parallel rows of five interconnected contact strips mounted in a plastics box.

The μ-DeC and T-Dec are both intended for use with i.c.s as well as discretes. The T-DeC has provision for accepting one i.c. held in a special carrier while the μ-DeC takes two i.c.s.



The DeC range of pluggable boards should be familiar to readers of Practical Wireless as the simplest version, the S-DeC was used in a series of articles published during 1977 and the μ-DeC in the more recent μ-DeCnology series.

Eurobreadboards

David George Sales

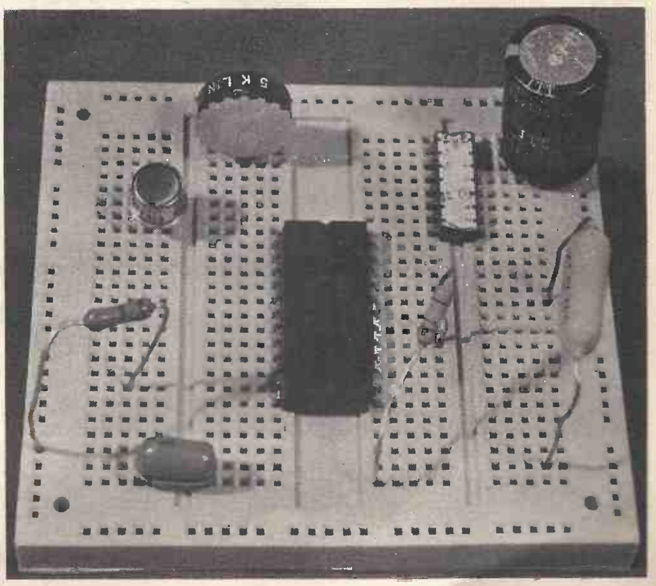
One of the newcomers to the breadboarding scene, the Eurobreadboard has 500 individual contacts in the main area with four power rail strips arranged around the outside. The contacts are arranged in four lines of 25 rows of five interconnected sockets. The basic module pitch is 0·1 inch with the spacing of the lines of contacts at either 0·3 inch or 0·6 inch pitch to accommodate all sizes of d.i.l. i.c.s

The body is moulded in a yellow plastics material with a non-slip rubber backing which is removable to allow access to the contact strips if necessary. Four fixing holes are provided if the unit is to be fastened onto a back panel but no slots are moulded into the edges to allow several boards to be linked together.

The contacts material is nickel silver with a contact resistance better than 10mΩ.

The Eurobreadboard offers versatility at a reasonable price. A wide variety of components including l.s.i. packages can be accommodated and the sockets will take leads of up to 0·85mm diameter without excessive force being needed.

Typical retail prices are £5·80 for one board.

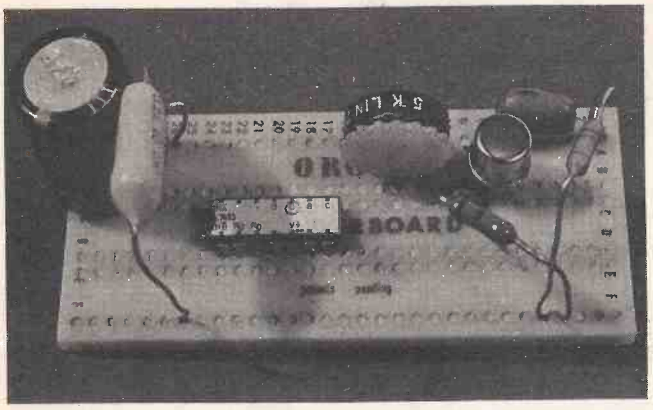


Orcus Wonderboard

Charcroft Electronics

Unlike the usual type of breadboarding system the Wonderboard uses elastomeric multicontacts instead of metal contact strips. The elastomeric contacts, made from a conducting foam rubber material, are moulded into a pattern of holes in a hard plastics material. Two different sizes of Wonderboard are available, the 12 i.c. "Small Wonder" and the 48 i.c. "Big Wonder".

Each hole containing an elastomeric contact is electrically



isolated from its neighbours and to use the board the component leads are inserted into the contact holes and the circuit wired up using a length of thin tinned copper wire threaded through the contact material.

Contact resistance is better than 10mΩ with a current capacity of 7A. Breakdown voltage is 9kV with an insulation resistance of 10,000MΩ. The contacts will accept wires of 0·2 to 0·8mm diameter with up to six wires in each hole.

The Orcus Wonderboards offer an easy to use breadboarding system which, the makers suggest, could be used to make up a circuit which could then be potted in a clear potting compound to make a permanent unit. All sizes of d.i.l. i.c.s can be used together with any component with leads on a 0·1 inch matrix.

Typical retail prices are £2·80 for the "Little Wonder".

Proto-Boards

Continental Specialities Corp.

This is a large and versatile system. The basic units are the socket matrix boards and bus strips which are available in two different ranges.

The 'Quick Test Sockets' are available in ten different sizes, three double bus strips and seven socket matrix boards. The bases are moulded in a plastics material with a snap together joining system which allows boards to be connected together to produce any size of system as required. The contact strips are made from a prestressed, non-corrosive alloy with sockets on a 0·1 inch matrix. The socket matrix boards have rows of five linked sockets each side of a central strip which allows standard d.i.l. i.c.s to be used.

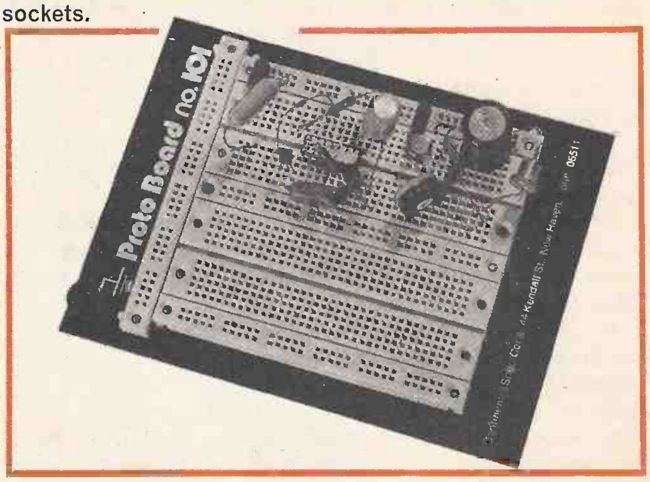
The Experimentor system is similar to the QT sockets but the method of joining boards together is more robust and there are two sizes of board which will accept 0·6 inch centre d.i.l. chips.

The QT boards are used on the Proto-board range of breadboards. There are six different sizes in the range to cater for most needs. Screw terminals are provided on the metal back panel.

At the top of the range are two units which incorporate stabilised power supplies to provide a self contained breadboard system.

A variation on this theme is the Design Mate 1 which has a QT socket matrix board and bus strips mounted on the front panel with a power supply of 5 to 15V variable at 600mA and a 0-15V meter built in.

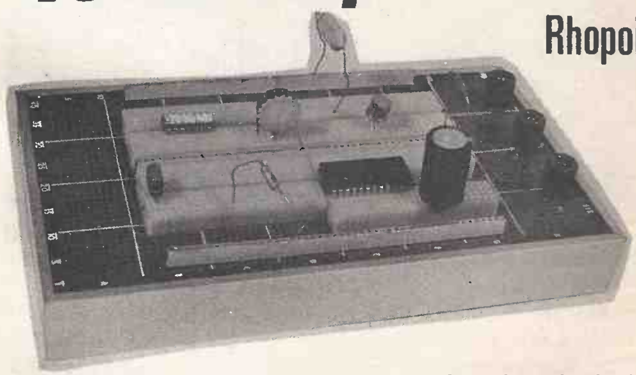
The various systems accept most components with leads on a 0·1 inch matrix and leads are easily inserted into the sockets.



Retail prices range from £9·94 for the small Proto-board 6 to £80·68 for the top-of-the-range Proto-board 203A. The QT range retails from £1·89 to £7·20 and the Experimentor range from £2·48 to £5·75.

Vector Klip-Block

Rhopoint



The Klip-Blok system uses an epoxy glass board which has a matrix of holes punched in it, mounted in an aluminium frame as the base on which a wide variety of insulating blocks containing metal contacts can be assembled.

A wide range of contact blocks are available which give this system enormous flexibility and the capability of taking any shape and size of component.

Individual baseboards can be linked together to expand the working area and boards are available either with or without terminals.

Wire diameters of 0·38 to 0·9mm diameter can be accepted by the beryllium copper, tin-lead coated, contacts which give a contact resistance of about 1mΩ and have a current rating of 5A.

The Vector Klip-Blok system is probably one of the most versatile breadboarding systems available but the cost of the various system components must, to a large extent, reduce its appeal to the amateur user.

Typical prices are difficult to give since the ultimate price is governed by the number of blocks and strips purchased. The system shown would cost around £24·00. Starter kits for three d.i.l. i.c.s cost around £5·00.