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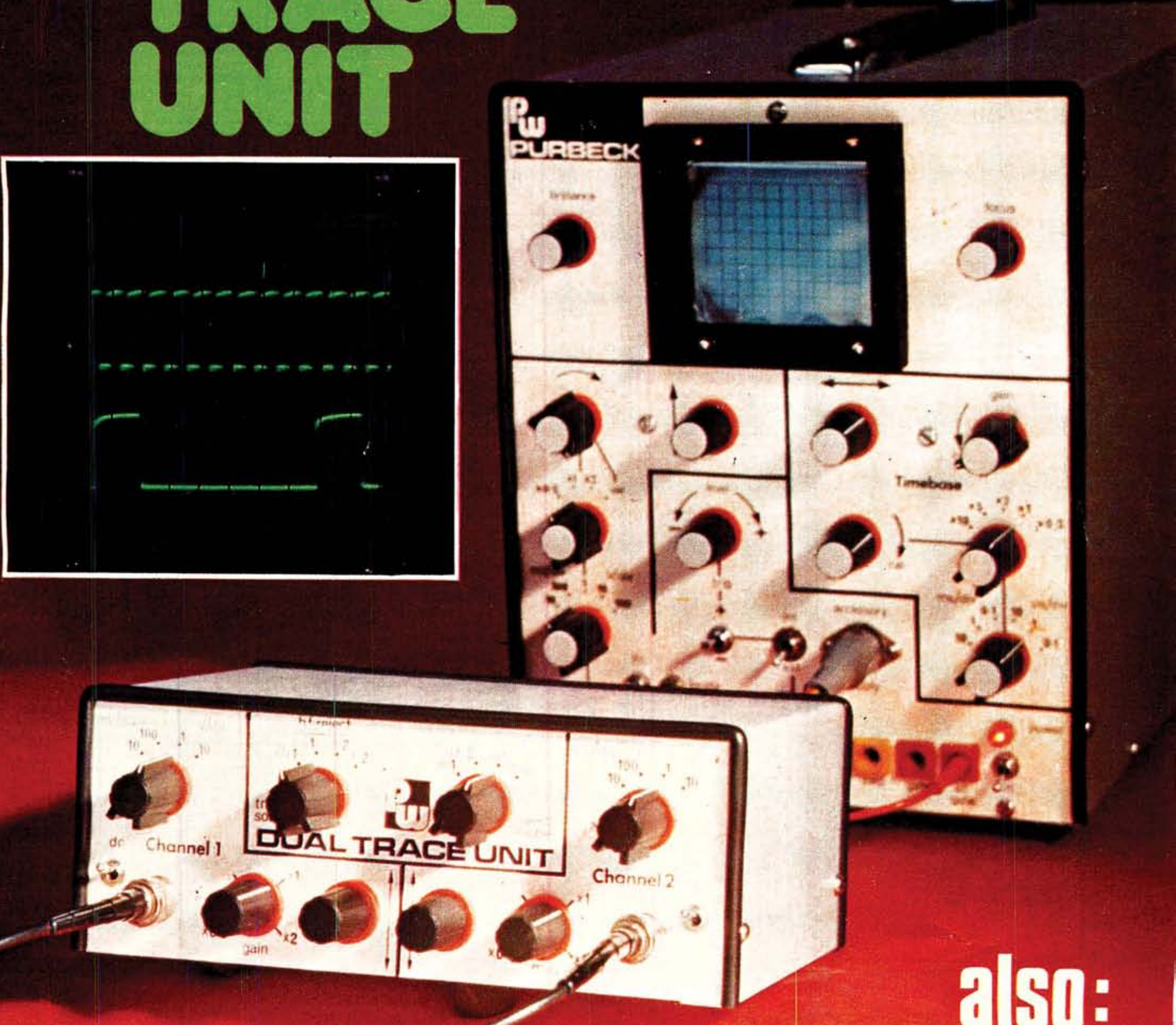

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M1

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M2

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M4

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M5

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M6

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M7

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- Stop-watch to 12 hours 59.9 secs. in 1/10 sec. steps.
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- Alarm.
- 9 mm thick.
- Back-light.
- Fully adjustable bracelet.

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M8

SOLAR QUARTZ LCD Chronograph

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M9

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List Price £130.00

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M10

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M11

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M12

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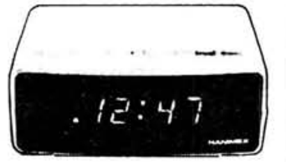

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M13

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M14

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M15

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practical WIRELESS

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☐ FOR OUR CONSTRUCTORS

☐ GENERAL INTEREST

Our March issue will be published on 1 February
(for details see page 43)

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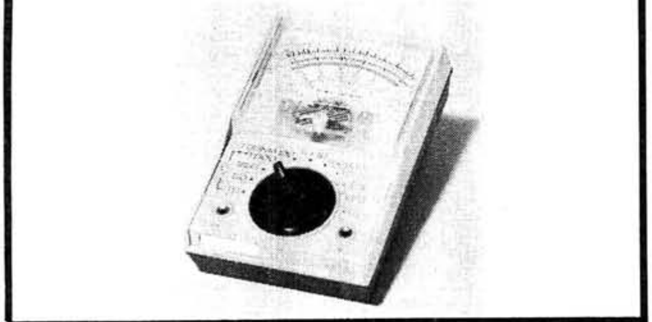

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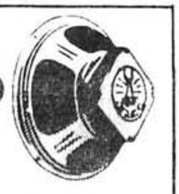

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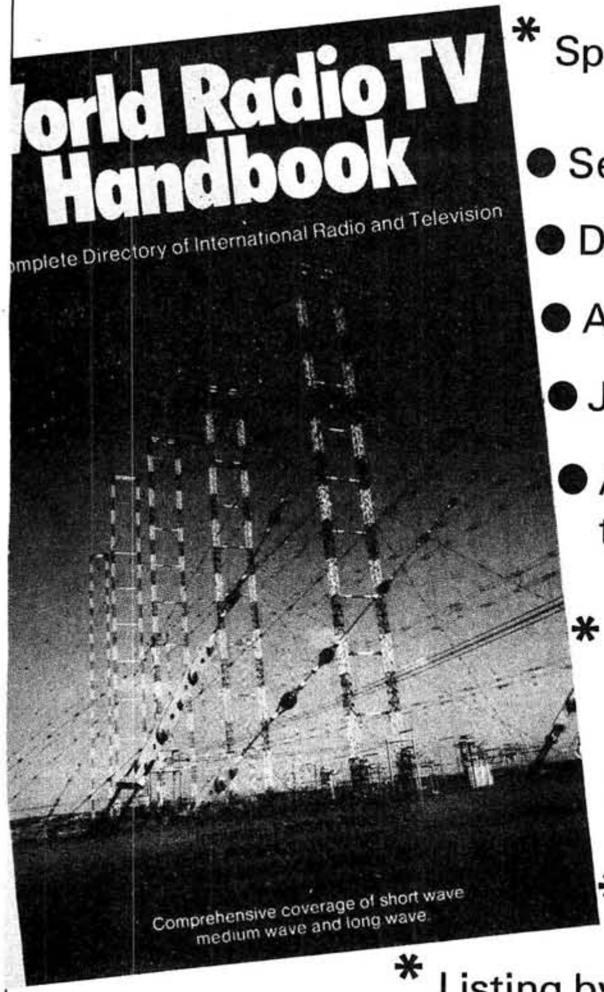
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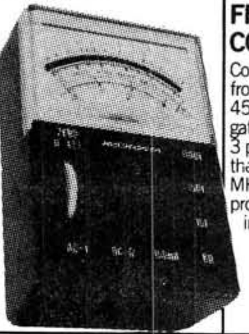

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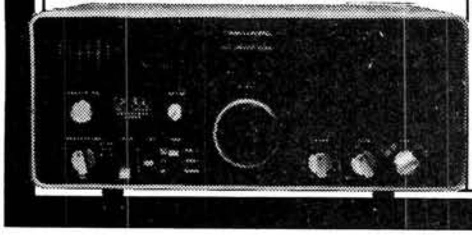

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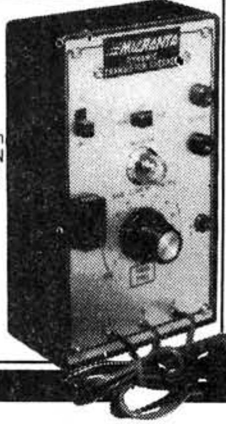

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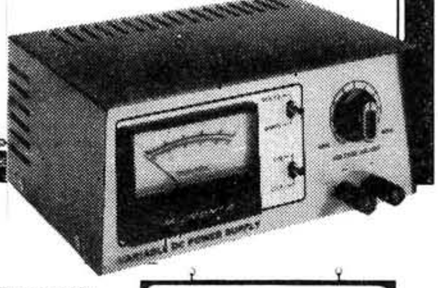

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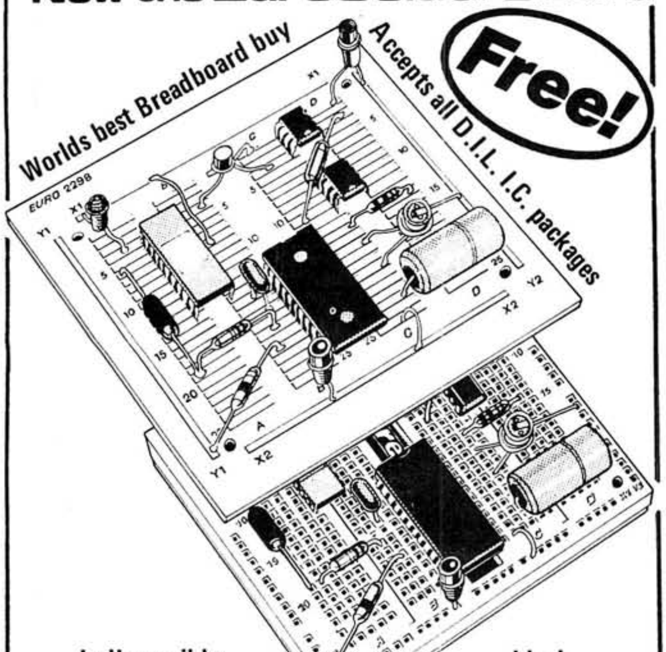

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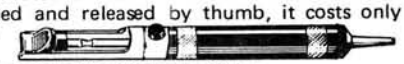

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QQV06/40A	16.10
QV03-12	2.80
SCL/400	4.50
SCL/600	4.50
SP61	0.95
TT21	11.80
TY2-125	52.80
U25	1.15
U26	1.00
U27	1.15
U191	0.85
U281	0.65
U301	0.65
U600	11.50
U801	0.90
UBC41	1.20
UABC80	0.90
UAF42	0.85
UBF80	0.70
UFB89	0.60
UBL1	1.15
UBL21	2.50
UCC84	0.75
UCC85	0.80
UCF80	0.90
UCH81	0.70
UCL82	0.85
UF41	0.90
1R5	0.65
1S4	0.45
1S5	0.45
1T4	0.45
1U4	0.80
1X2B	1.30
2D21	0.80
2K25	12.40
2X2	0.90
3A4	0.70
3D6	0.50
3D21	23.00
3E29	6.60
3S4	0.60
4PR60B	106.80
5B/254M	8.80
5B/255M	8.80
5B/258M	8.80
5R4GY	1.30
5U4G	1.10
UF80	0.60
UF85	0.70
UL41	1.20
UL84	0.85
UM80	0.70
UM84	0.70
UY82	0.65
UY85	0.60
VR105/30	2.15
VR150/30	1.45
X66	1.05
X61M	1.70
XR1-6400A	82.90
Z759	9.00
Z800U	3.45
Z801U	4.00
Z803V	3.90
Z900T	2.55
1A3	0.70
1L4	0.50
5V4G	0.80
5Y3GT	0.80
5Z3	1.15
5Z4G	0.85
5Z4GT	0.90
6AB4	see EC92
6AB7	0.70
6AC7	0.70
6AH6	1.15
6AK5	0.95
6AK8	0.60
6AL5	0.50
6AL5W	0.80
6AM5	3.25
6AM6	1.30
6AN8	3.60
6AQ4	6.20
6AQ5	0.90
6AQ5W	1.45
6AS6	0.90
6AT6	0.85
6AU6	0.65
6AV6	0.60
6AX4GT	0.95
6AX5GT	1.15
6B7	0.85
6BA6	0.50
6BE6	0.60
6BG6G	1.15
6BH6	0.95
6BJ6	1.25
6BQ7A	0.70
6BR7	2.70
6BW6	5.18
6BW7	1.15
6C4	0.70
6C6	0.70
6CH6	7.50
6CL6	1.70
6CY5	1.15
6D6	0.85
6EA8	3.20
6F6GB	0.85
6F8G	0.85
6F12	0.90
6F14	0.90
6F15	1.30
6F17	1.15
6F24	4.75
6F33	4.75
6H6	1.90
6J4	1.60
6J4WA	2.00
6J5GT	1.35
6J6	0.85
6J7	0.90
6J7G	0.60
6K7	0.80
6K7G	0.50
6K8GT	0.65
6L6M	2.15
6L6GT	1.75
6L7GT	0.75
6L18	0.70
6LD20	
6Q7G	0.95
6SA7	0.65
6SG7	0.90
6SJ7	0.80
6SJ7GT	0.60
6SK7	1.05
6SL7GT	0.85
6SN7GT	0.85
6SQ7	0.85
6V6GT	0.95
6X4	0.70
6X5GT	0.65
6Y6G	1.10
6Z4	0.75
6-30L2	2.05
7B7	0.90
7V4	0.90
9D2	0.70
9D6	0.85
10C2	0.70
10F18	0.70
10P13	1.20
11E2	12.40
12A6	0.70
12AT6	0.55
12AT7	0.65
12AU7	0.60
12AV6	0.80
12AX7	0.65
12BA6	0.60
12BE6	1.25
12BH7	1.10
12C8	0.65
12E1	4.95
12J5GT	0.55
12K7GT	*0.70*
12K8GT	0.80
12Q7GT	0.65
12SC7	*0.65*
12SH7	0.85
12SJ7	0.65
12SQ7	0.85
12Y4	0.55
13D6	0.70
14S7	1.15
19AQ5	0.90
19G3	11.50
19G6	6.90
19H5	19.55
20D1	0.75
20F2	0.75
20E1	1.30
20P1	0.65
20P3	0.80
20P4	1.30
20P5	1.30
25L6GT	0.95
25Z4G	0.85
30C15	1.15
30C17	1.35
30C18	2.10
(see PCF805)	
30F5	1.15
30FL2	1.70
30FL12	1.45
30FL14	2.05
30L15	1.15
30L17	1.15
30P12	1.15
30PL1	1.15
30PL13	1.25
30PL14	1.25
35L6GT	1.15
35W4	0.80
35Z4GT	0.85
50C5	1.35
50CD6G	1.45
75	1.25
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78	0.95
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723A/B	12.80
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866A	3.20
931A	12.00
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955	0.70
956	0.60
957	1.05
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1629	0.85
2051	1.20
5763	4.40
5842	7.50
5933	3.50
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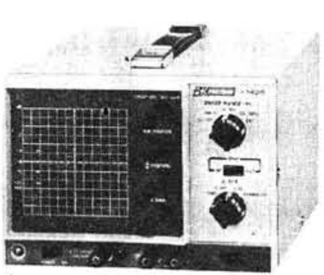

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1505	.2	LED Diffused	GREEN	£0.11
1503	.125	LED Diffused	YELLOW	£0.11
1506	.2	LED Diffused	YELLOW	£0.11
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AC171K	£0.24
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AC187K	£0.26
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AC188K	£0.26
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AD149	£0.53
AF239	£0.35
BC107	£0.06
BC107A	£0.06
BC107B	£0.07
BC107C	£0.09
BC108	£0.06
BC108A	£0.06
BC108B	£0.07
BC108C	£0.09
BC109	£0.06
BC109B	£0.07
BC109C	£0.09
BC113	£0.10
BC114	£0.12
BC116	£0.16
BC118	£0.10
BC140	£0.20
BC141	£0.20
BC142	£0.18
BC147	£0.07
BC148	£0.07
BC149	£0.07
BC157	£0.09
BC158	£0.09
BC159	£0.09
BC169C	£0.09
BC170	£0.06
BC171	£0.07
BC172	£0.07
BC173	£0.08
BC177	£0.13
BC178	£0.13
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BC184L	£0.07
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BC208	£0.08
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BC213L	£0.07
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BC261	£0.14
BC327	£0.12
BC328	£0.12
BC337	£0.12
BC338	£0.12
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BC479	£0.15
BC547	£0.08
BC548	£0.08
BC549	£0.08
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BC558	£0.09
BC559	£0.10
BCY70	£0.13
BCY71	£0.13
BCY72	£0.13
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BD131	£0.30
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TIP31A	£0.30
TIP31B	£0.32
TIP31C	£0.34
TIP32	£0.30
TIP32A	£0.30
TIP32B	£0.32
TIP32C	£0.34
TIP41	£0.34
TIP41A	£0.34
TIP41B	£0.36
TIP41C	£0.38
TIP42	£0.34
TIP42A	£0.34
TIP42B	£0.36
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ZTX301	£0.10
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Type	Price
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OA202	£0.07
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BY127	£0.14
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OA79	£0.08
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OA90	£0.08
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OA95	£0.08
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IN60	£0.07
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IN5408	£0.28
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SJ18	20 Tantalum bead capacitors mixed	0.50
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SJ59	6 5K lin 40mm slider pots	0.50
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SJ66	100K lin	0.25 each
SJ67	Chrome slider knobs to fit	0.10 each
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Ref	*Amps*	Price	P & P
112	0·5	**2·90**	0·90
79	1·0	**3.93**	1·10
3	2·0	**6·35**	1·10
20	3·0	**6·82**	1·31
21	4·0	**8·79**	1·31
51	5·0	**10·86**	1·52
117	6·0	**12·29**	1·67
88	8·0	**16·45**	1·89
89	10·0	**18·98**	1·89
90	12·0	**21·09**	2·24
91	15·0	**24·18**	2·39
92	2·0	**32·40**	O.A.

50 VOLT RANGE

Pri 220/240V Sec 0-20-25-33-40-50V Voltages available 5, 7, 8, 10, 13, 15, 17, 20, 33, 40 or 20V-0-20V and 25V-0-25V.

Ref	*Amps*	Price	P & P
102	0·5	**3·75**	0·90
103	1·0	**4·57**	1·10
104	2·0	**7·88**	1·31
105	3·0	**9·42**	1·52
106	4·0	**12·82**	1·73
107	6·0	**16·37**	1·89
118	8·0	**22·29**	2·39
119	10·0	**27·48**	O.A.
109	12·0	**31.89**	O.A.

MAINS ISOLATORS (SCREENED)

PM 120/240 Sec 120/240V CT

Ref	*VA*	Price	P & P
•07	20	**4·84**	0·91
149	60	**7·37**	1·10
150	100	**8·38**	1·31
151	200	**12·28**	1·31
152	250	**14·61**	1·73
153	350	**18·07**	2·12
154	500	**22·52**	2·47
155	750	**32·03**	O.A.
156	1000	**40·92**	O.A.
157	1500	**56·52**	O.A.
158	2000	**67·99**	O.A.
159	3000	**95·33**	O.A.

•Pri 0-220-240V Sec 115 or 240V. State sec. volts required.

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240V cable in 115V USA flat pin outlet

VA	Price	P & P	*Ref*
20	**6·55**	1·03	56W
75	**8·50**	1·31	64W
150	**11·00**	1·31	4W
200	**12·02**	1·67	65W
250	**12·55**	1·67	69W
500	**20·13**	1·89	67W
1K	**30·67**	2·65	84W
1·5K	**42.82**	O.A.	93W
2K	**54·97**	O.A.	95W

60 VOLT RANGE

Pri 220/240V sec 0-24-30-40-48-60V. Voltages available 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 or 24V-0-24V or 30V-0-30V.

Ref	Amps	Price	P & P
124	0·5	**4·27**	1·10
126	1·0	**6·50**	1·10
127	2·0	**8·36**	1·31
125	3·0	**12·10**	1·31
123	4·0	**13·77**	2·12
40	5·0	**17·42**	1·89
120	6·0	**19·87**	2·12
121	8·0	**27·92**	O.A.
122	10·0	**32·51**	O.A.

END OF LINE OFFERS

Ref				P · P
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Pri 220-240 volts

	Amps			
Ref	*12V*	*24V*	Price	P&P
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213	1·0	0·5	**2·90**	0·90
71	2	1	**3·86**	0·90
18	4	2	**4·46**	1·10
85	0·5	2·5	**6·16**	1·10
70	6	3	**6·99**	1·10
108	8	4	**8·16**	1·31
72	10	5	**8·93**	1·31
116	12	6	**9·89**	1·52
17	16	8	**11·79**	1·52
115	20	10	**15·38**	2·39
187	30	15	**19·72**	2·39
226	60	30	**40·41**	O.A.

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212	1A, 1A	0-6, 0-6	**3·14**	0·90
13	100	9-0-9	**2·35**	0·44
235	330, 330	0-9, 0-9	**2·19**	0·44
207	500, 500	0-8-9, 0-8-9	**3·05**	0·85
208	1A, 1A	0-8-9, 0-8-9	**3·88**	0·90
236	200, 200	0-15, 0-15	**2·19**	0·44
214	300, 300	0-20, 0-20	**3·08**	0·90
221	700 (DC)	20-12-0-12-20	**3·75**	0·90
206	1A, 1A	0-15-20-0-15-20	**5·09**	1·10
203	500, 500	0-15-27-0-15-27	**4·39**	1·10
204	1A, 1A	0-15-27-0-15-27	**6·64**	1·10
239	50	12-0-12	**2·88**	0·37

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1·0	431	**8·12**	0·99
2·0	432	**13·35**	1·31
3·0	433	**16·17**	1·40
4·0	434	**20·65**	2·11
5·0	435	**29·30**	2·47
6·0	436	**36·69**	O.A.
8·0	437	**40·03**	O.A.

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64	75	0-115-210-240	**4·41**	1·10
4	150	0-115-200-220-240	**5·70**	1·10
67	500	0-115-200-220-240	**12·09**	1·91
84	1000	0-115-200-220-240	**20·64**	2·39
93	1500	0-115-200-220-240	**25·61**	OA
95	2000	0-115-200-220-240	**38·31**	OA
73	3000	0-115-200-220-240	**65·13**	OA
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Tel. 061-428-4497.
Please state type number and enclose cheque or postal order.

RECEIVER UNIT. Small high performance receiver uses 7 miniature plug-in valves covers 2·5 to 20Mc/s in 3 bands as RF stage, BFO, Volt Stab. with O/P for H.R or crystal phones, direct freq cal with geared drive size $5\times3\frac{3}{4}\times3\frac{1}{2}$" these req ext supplies of 180v DC at 40mA & 6·3v AC at 1 amp. Supplied tested with circ & notes, no ext case **£25.**

TRANSMITTER ASS. Small low power 15/25w 2·5 to 20Mc/s Tx unit crystal controlled sold for breakdown contains 2× 175pf tuning conds, miniature 500Ua meter, morse key, coils, swts, RF chokes, knobs etc. Supplied less valves with circ, contains most parts for TX or RX ATU **£8.50.**

POWER UNIT INVERTOR special purpose unit 115v 50c/s I/P gives high & low O/Ps at 25Kc contains 6 pots cores FX2240/42/43,2× HV T0·3 pwr transis, 4× 400v 3 amps diodes, 8× BC107,2 BFY52, (types may vary) 2× Thyristors inc 4 amp type, 3× 20mm panel fuse holders, elec conds, zener & swt diodes etc all in screened case size $9\times3\frac{1}{2}\times4$" with circ **£4.50** or two for **£8.**

MONITOR UNIT. Standard mains I/P 6" green trace CRT as Y amp 10Mill/V to 1v per cm in 5 ranges, calibrated Y shift with meter readout, T.B. as one free running range 60c/s to 1Kc, plus trigg mode, controls focus, brill. × shift etc. EHT 3Kv. Large units about 45Kg, 26 valves plus rect no circ, tube tested **£45.**

RECEIVER UNIT. Small 5 valve battery superhet covers 2 to 8Mc/s in two bands, as BFO O/P for low or high res phones in case size 8×5×4" reqs 135v & 1·5v DC with circ **£13.**

TX UNIT. 2/8 Mc/s battery operated contains small 500Ua meter, tun cond, coils, rot swts, in case 8 × 5 × 4" with circ less valves **£5.50.**

RECORDING TAPE. By Ampex 3600ft $10\frac{1}{2}$" plastic spools $\frac{1}{4}$" audio tape new unused **£7.50.**

ARMY RECT UNIT. 200/250v I/P gives 12v DC at 3 amps twice i.e. 12v 6 amp or 24v 3 amp in case with circ okay for HD battery charger **£13.** The following for callers, American military tape recorders 115v 50c/s valve units 19" rack mounting 3 heads 3 motors heavy duty units about 25Kg **£30.**

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BSR DE LUXE AUTOCHANGER

Plays 12", 10" or 7" records, Auto or Manual. A high quality unit backed by BSR reliability. Stereo Ceramic Cartridge. AC 200/250V. Size 13½-11¼in. 3 speeds. Above motor board 3¾in. Below motor board 2½in. with Ceramic Stereo cartridge.

£20 Post £1.60

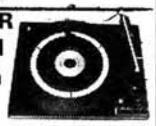
TURNTABLE PLINTHS

Cut out for most BSR or Garrard decks. Silver grey finish. Post £1.60

Model "B" Size 16 x 13¾ x 3in. **£4.50**

TINTED PLASTIC COVERS ONLY
Sizes 14½ ×12½ × 4¼in, 14½ × 12½ × 3in **£3.50.**
18 × 13¾ × 3½in **£6.**
15¼ × 13½ × 4in. **£4.** 18 × 13¼ × 4in. **£6.**
17¼ × 9½ × 3½in. **£3.** 18 × 12½ × 3in. **£6.**
14½ × 14¾ × 2½in. Rosewood sides **£4.** Post £1.60
Ideal for record decks, tape decks, etc.

BSR SINGLE PLAYER

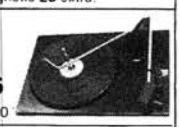


Ideal replacement or disco deck with cueing device and stereo ceramic cartridge. 3 speeds. Large turntable, modern design **£21** Post £1.60

TWO-SPEED BUDGET MODEL £15.

BSR P182 3 speeds flared aluminium turntable "S" shape arm, cueing device, ceramic cartridge **£24.** Post £1.60
BSR MP60/P128 Stereo Ceramic, balanced arm, cueing device. Bias compensator **£26.** Magnetic **£5** extra.

GARRARD HI-FI MINI CHANGER



3-speed stereo cartridge
Cueing devices
£8.95 Post £1.60

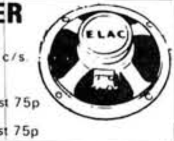
B.S.R. P163 BELT DRIVE QUALITY DECK

Manual or automatic play. Two speeds. Precision balanced arm. Slide in head, cueing device. Bargain price

£30 Post £1.60

Suitable magnetic cartridge **£6.50.**

ELAC HI-FI SPEAKER 8in. TWIN CONE



Large ceramic magnet. 50-16,000 c/s.
Bass resonance 40 c/s.
8 ohm impedance
10 watts. RMS **£5.95** Post 75p
20 watt woofer bass unit only **£7.95** Post 75p

LOW VOLTAGE POWER PACK for MODELS

Ready made. Famous make. Will supply 10 volts D.C. at 400mA. With terminals and mains lead. **£2.75** Post 50p

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5kΩ to 2MΩ. LOG or LIN.
L/S **35p.** DP **60p.**
Stereo L/S **85p.** DP **£1**
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80 Ohm Coax

FRINGE LOW LOSS **15p** yd.
PLUGS **10p.** SOCKETS **10p.**
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OUTLET BOXES **80p**
300 ohm FEEDER **5p** yd

EMI 13½ x 8in. LOUDSPEAKERS

With tweeter and crossover. 10 watt. 3 or 8 ohm.
£9.95 Post 75p

Bass woofer only 8 ohm. 15 watt.
£10.95 Post 75p

Bass woofer only 15 ohm. 20 watt. **£11.95** Post 75p

Suitable Bookshelf Cabinet
Teak finish. For EMI 13 x 8 speakers.
Size 16 x 11 x 8 inches approximately **£9.50** Post £1.60

THE "INSTANT" BULK TAPE ERASER

Suitable for cassettes, and all sizes of tape reels. A.C. mains 200/250V. Leaflet S.A.E. Will also demagnetise small tools **£7.50** Post 50p
Head Demagnetiser only £5.00

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BLANK ALUMINIUM CHASSIS. 6 x 4—**95p;** 8 x 6—**£1.40;** 10 x 7—**£1.55;** 12 x 8—**£1.70;** 14 x 9—**£1.90;** 16 x 6—**£1.85;** 16 x 10—**£2.20.** **ANGLE ALI.** 6 x ¾ x ¾in—**20p.**
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PLASTIC AND ALI BOXES IN STOCK. MANY SIZES
VARICAP FM TUNER HEAD with circuit & connections. Some technical knowledge required **£4.95.**
TAG STRIP 28-way **12p.**
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MANY OTHER TOGGLES IN STOCK. Please enquire.
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SONOTONE 9TAHC Diamond **£3.75.** V100 Magnetic **£6.50.**
WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt **15p.**
CASSETTE MOTOR. 6 volt **£1.00.**
CASSETTE MECHANISM. Mono heads, no motor **£3.00.**

MAINS OPERATED SOLID STATE AM/FM STEREO TUNER

200/240V AC Mains. F.M./A.M. Stereo Tuner. Covering M.W., A.M. 540-1605KHz. V.H.F., F.M. 88-108MHz. Ferrite rod aerial for M.W. Full AFC and AGC on A.M. and F.M. Stereo Beacon Indicator. Built-in Pre-amps with variable output adjustable by pre-set control. Max. o/p Voltage 600mV R.M.S. into 20K. Simulated Teak finish cabinet. Will match almost any amplifier. Size 8¼in wide, 4in. high x 9½in. deep approx.

£28 Post £1.60

RCS SOUND TO LIGHT KIT Mk. 2 £18

Post 50p

Kit of parts to build a 3 channel sound to light unit 1,000 watts per channel. Suitable for home or disco. Easy to build. Full instructions supplied. Cabinet **£4.50** extra. Will operate from 200MV to 100 watt signal.

RCS "MINOR" 10 watt AMPLIFIER KIT

This kit is suitable for record players, guitars, tape playback, electronic instruments or small PA systems. Two versions available: Mono, **£12.50;** Stereo, **£20.** Post 45p. Specification 10W per channel; input 100mV; size 9½ x 3 x 2in. approx. SAE details. Full instructions supplied. AC mains powered. Input can be modified to suit guitar.

R.C.S. STEREO PRE-AMP KIT. All parts to build this pre-amp. Inputs for high, medium or low imp per channel. With volume control and P.C. Board. Can be ganged to make multi-way stereo mixers **£2.95** Post 35p

MAINS TRANSFORMERS	ALL POST 75p
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300-0-300V 120mA. 2×6.3V 2A C.T. 5V 2A	£8.50
220V 45mA. 6.3V 2A	£2.50
HEATER TRANSFORMER. 6.3V ½ amp **£2.00** 3 amp	£2.20
GENERAL PURPOSE LOW VOLTAGE. Tapped outputs available	
·2 amp 3 4 5 6 8 9 10 12 15 18 25 and 30V	£6.00
1 amp 6 8 10 12 16 18 20 24 30 36 40 48 60	£6.00
2 amp 6 8 10 12 16 18 20 24 30 36 40 48 60	£9.50
3 amp 6 8 10 12 16 18 20 24 30 36 40 48 60	£12.50
5 amp 6 8 10 12 16 18 20 24 30 36 40 48 60	£16.00

12V. 100mA	£1.30	20V, 40V, 60V, 1 amp	£4.00
12V. 750mA	£1.75	12V, 3 amp	£3.50
10-0-10V 2amp	£3.00	10V, 30V, 40V, 2 amp	£3.50
30V. 5 amp and 17V-0-17V 2 amp	£4.00	40V, 2 amp	£3.50
		20V, 1 amp	£3.00
0.5.8.10.16V. ½ amp	£2.50	20V-0-20V, 1 amp	£3.50
9V. 3 amp	£3.50	30V-0-30V, 2 amp	£8.00
25-0-25V 2 amp	£3.50	2 of 18V, 6 amp, each	£11.00
30V. 2 amp	£3.50	12-0-12V, 2 amp	£3.50
30V. 1½ amp	£3.30	9V, ¼ amp	£1.50

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FULL WAVE BRIDGE CHARGER RECTIFIERS
6 or 12V outputs. 2 amp **75p.** 4 amp **£1.60**
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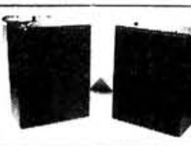
12V. 1½ amp Half Wave Selenium Rectifier **25p**

COMPACT SPEAKERS



Teak 4 or 8 ohm
White 4 ohm only
13 × 10 × 6in. approx
50 to 14,000 cps.
10 watts.
£19 pair Post £1.60

STEREO SPEAKERS £8 pair

Globe shaped cases in high gloss mouldings of red or green, are finished with chrome frontal trim. In addition, 2½ metres of twin lead already fitted with phono plug is supplied.

Full Range Quality
Frequency Response
Impedance: 8 ohms
Power Peak: 5 watts

LOW VOLTAGE ELECTROLYTICS
1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V **10p.**
500mF 12V **15p;** 25V **20p;** 50V **30p;** 420mF/500V **£1.30.**
1000mF 12V **17p;** 25V **35p;** 50V **47p;** 100V **70p.**
2000mF 6V **25p;** 25V **42p;** 40V **60p;** 1200mF 76V **80p.**
2500mF 50V **62p;** 3000mF 25V **47p;** 50V **65p.**
4500mF 64V **£2;** 4700mF 63V **£1.20.** 2700mF/76V **£1.**
5000mF 35V **85p.** 5600mF/76V **£1.75.**

HIGH VOLTAGE ELECTROLYTICS

8/350V	22p	8+8/450V	50p	50+50/300V	50p
16/350V	30p	8+16/450V	50p	32+32/450V	75p
32/500V	75p	16+16/450V	50p	100+100/275V	65p
50/350V	80p	32+32/350V	50p	150+200/275V	70p

MANY OTHER ELECTROLYTICS IN STOCK

SHORT WAVE 100pf air spaced gangable tuner, **95p.**
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MICRO SWITCH SINGLE POLE CHANGEOVER 20p.
SUB-MIN MICRO SWITCH, 25p. Single pole change over
TWIN GANG, 385 + 385pF **80p;** 500pF slow motion **75p.** 365 + 365 + 25 + 25pF. Slow motion drive **85p.** 120pF **50p.**
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NEON PANEL INDICATORS 250V. Amber or red **30p.**
ILLUMINATED ROCKER SWITCH. single pole. Red **65p.**
RESISTORS. 10Ω to 10M. ¼W, ½W, 1W. 20% **2p;** 2W. **10p.**
HIGH stability. ½W 2% 10 ohms to 1 meg., **12p.**
Ditto 5%. Preferred values 10 ohms to 10 meg., **5p.**
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12K7GT, 35L6GT, 954, 30PLI, 35Z4GT, PCC84, PCC89
PCF82, PCF86, PCL82, PCL84, PL81, PL82, PL83
PL84, PY33, PY80, PY82, PY83, EB91, EBC81
EBF80, ECC83, ECC84, ECF80, ECL80, ECL82, EF41
EF80, EM84, EM85, EM87, EY51, EY86, EZ40

BAKER SUPERB 12in 25 watt £24

Post £1.60

Quality loudspeaker, low cone resonance ensures clear reproduction of the deepest bass. Special copper drive and concentric tweeter cone. Full range reproduction with remarkable efficiency in the upper register.

Bass resonance	25 c/s
Useful response	20-17,000 c/s

8 or 16 ohms models

BAKER "BIG-SOUND" SPEAKERS. Post £1.60

'Group 100'	'Disco 100'	'Disco 100/15'
12 inch	12 inch	15 inch
100 watt **£29**	100 watt **£29**	100 watt **£35**
8 or 16 ohm	8 or 16 ohm	8 or 16 ohm

BAKER LOUDSPEAKER, 12 INCH. 60 WATT.
GROUP 50/12, 4 OR 8 OR 16 OHM HIGH POWER
FULL RANGE PROFESSIONAL QUALITY
RESPONSE 30-16,000 CPS
MASSIVE CERAMIC MAGNET
WITH ALUMINIUM PRESENCE CENTRE DOME
£20 Post £1.60

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For 13x8in. or 8in. speaker **£9.50** Post £1.60
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Many other cabinets in stock. Phone your requirements
SPEAKER COVERING MATERIALS. Samples Large S.A.E.
LOUDSPEAKER CABINET WADDING 18in wide **20p** ft

R.C.S. 100 watt VALVE AMPLIFIER CHASSIS

Four inputs. Four way mixing, master volume, treble and bass controls. Suits all speakers. This professional quality amplifier chassis is suitable for all groups, disco, PA, where high quality power is required. 5 speaker outputs. AC mains operated. Slave output socket. Produced by demand for a quality valve amplifier. 100V line output to order £10 extra. Send for leaflet. Suitable carrying cab **£21** Price **£105** carr. £6.00

GOODMANS TWIN AXIOM 8 inch dual cone loudspeaker. 8 ohm, 15 watt hi-fi unit **£10.50.**
CROSSOVERS. TWO-WAY 3000 c/s 3 or 8 or 15 ohm **£1.90.** 3-way 950 cps/3000 cps. **£2.20.**
LOUDSPEAKERS PM 3 OHM 7x4in. **£1.50;** 6½in., **£1.95;** 8x5in., **£1.90;** 8in., **£2.50.**
SPECIAL OFFER: 80 ohm, 2¼in., 2¾in. **35 ohm,** 3in. **25 ohm,** 2½in., 3in., 5x3in., 7x4in. **8 ohm,** 2½in., 3in., 3½in., 5in. **15 ohm,** 3½in. dia., 6x4in., 7x4in., 5x3in. **3 ohm,** 2½in., 2⅝in., 3½in., 5in. dia. **£1.50 each.**
PHILIPS LOUDSPEAKER, 8in., 4 ohms, 4 watts **£2.50.**
RICHARD ALLAN TWIN CONE LOUDSPEAKERS
8in. diameter 4W **£2.50.** 10in. diameter 5W **£3.50;** 12in. diameter 6W **£4.50.** 3/8/15 ohms, please state
MOTOROLA PIEZO ELECTRIC HORN TWEETER. £6.50
Handles up to 100 watts. No crossover required
BLACK PLASTIC CONSTRUCTION BOX with brushed aluminium facia. Sturdy job. Size 6¼ x 4¾ x 2in. **£1.50**

BAKER 150 WATT PROFESSIONAL MIXER AMPLIFIER

All purpose transistorised. Ideal for Groups, Disco and P.A. 4 inputs speech and music. 4 way mixing. Output 4. 8/16 ohms. A.C. Mains. Separate treble and bass controls. Master volume control.
100 volt line model **£99** **£85** £1.60 carr

BAKER 50 WATT AMPLIFIER

£65 Post £1.60

Superior quality ideal for Halls/PA systems. Disco's and Groups. Two inputs with Mixer Volume Controls. Master Bass, Treble and Gain Controls. 50 watts RMS. Three loudspeaker outlets 4. 8. 16 ohm. AC 240V (120V available). Blue wording on black cabinet.

GOODMANS RUBBER SURROUND BASS WOOFER

Standard 12in. diameter fixing with cut sides 12 x 10. 14 000 Gauss magnet. 20 watts R.M.S. 4 ohm imp. Bass resonance = 30 c.p.s. Frequency response 30-8000 c.p.s.
£9.95 each Post £1.60

ALUMINIUM HEAT SINKS. FINNED TYPE.
Sizes 5" x 4" x 1" **95p.** 6½" x 2" x 2¼" **45p**
JACK PLUGS Mono Plastic 25p; Metal 30p.
JACK PLUGS Stereo Plastic 30p; Metal 35p.
JACK SOCKETS Mono Open 20p; Closed 25p.
JACK SOCKETS Stereo Open 25p; Closed 30p.
FREE SOCKETS — Cable end 30p.
2.5mm and 3.5mm JACK SOCKETS 15p.
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DIN TYPE CONNECTORS
Sockets 3-pin, 5-pin 10p. Free Sockets 3-pin, 5-pin 25p.
Plugs 3-pin 20p; 5-pin 25p.
PHONO PLUGS and SOCKETS ea. 10p.
Free Socket for cable end ea. 15p.
Screened Phono Plugs ea. 15p.
TV CONVERGENCE POTS 15p each.
Values = 5, 7, 10, 20, 50, 100, 200, 250, 470, 2000 ohms

MONO PRE-AMPLIFIER. Mains operated solid state pre-amplifier unit designed to complement amplifiers without low level phono and tape input stages. This free-standing cabinet incorporates circuitry for automatic R.I.A.A. equalisation on magnetic phono input and N.A.B. equalisation for tape heads. Phono sockets for input and output.

£5 Post 50p

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NEW LOW PRICES ALL EX-STOCK

REAL-STATE-OF-THE-ART

NEW AC/DC/BATTERY PORTABLE FREQUENCY COUNTER FROM OPTOELECTRONICS USA

Model©OPTO 7000

7 DIGITS 10Hz to 600MHz

ONLY £141.45 inc. (was £168)
(£120 + £3 p&p + VAT £18.45)

Complete with built-in NiCads, charging circuits & rear panel switch for 1Hz resolution.

Size only 1¼"H × 4¼"W × 5¼"D.
The miniature go anywhere counter that gives you more range, visibility accuracy and versatility than any comparable unit at anywhere near as low price.

★ TCXO time base 0·8PPM/°C (0·0001% accuracy) less than 2PPM per year aging ★ Deluxe gold and black anodised aluminium case ★ H1Z and 50 ohm imputs ★ 1 sec and 1/10 sec gate times ★ Built in prescaler and preamps standard ★ Auto decimal ★ BNC connectors ★ No direct connect required for RF pick up ★ State of the art LS1 circuitry ★ Sensitivity 10mV to 60MHz 25mV to 150MHz 50mV to 450MHz (less than 75mV guaranteed) ★ Power requirement 7·5V AC/DC - less than 250mA.

ELENCO PRECISION DMM 1200B

ONLY £66.70 inc.
(£55 + £3 p&p + VAT £8.70)
(for a limited period only)

The most versatile DMM we have ever offered at lowest ever price!

★ 3½ digit jumbo LED (0·56") display ★ 0·05% basic accuracy ★ Measures AC/DC voltages from 100 microvolt to 1000 volts, AC/DC current from 1 microamp to 2 amp and resistance from 0·01 ohm to 20 Megohm ★ Fully overload protected to 1000 volts.

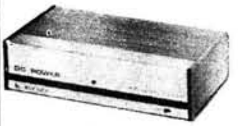
★ High input impedance to 10 Megohm ★ Mains (with adaptors not supplied) or battery (both disposable and Nicads) operation ★ Uses 1% precision resistors not unstable trimpots ★ Hi Lo power ohms, Hi for diodes, Lo for resistors in circuit (on how many DMM's costing less than £100 do you find this feature!)

ELENCO POWER SUPPLY MODEL XP–90

13·8V - 8 amps Regulated only £63.25 inc.

Elenco Precision Power Supplies let you operate your mobile or marine or mobile two way radio, CB, tape player AM/FM car radio, or other mobile equipment right in your own home. Elenco provides the exact output voltage no matter what current you use. No loss of power when you transmit due to dropping voltage. Fool proof current protection minimizes surge current that may damage your expensive equipment, works 1000 times faster than any fuse, automatic self resetting. Special circuit protects equipment, user and itself!

SPECIFICATIONS:-



Input Voltage	240V AC
Output Voltage	13·8V DC
Output Current	8 amps
Load Regulation	·15V
Line Regulation	·15V
Ripple Max. RMS	·01V
Current Protection	8A Limit
Short Protection	1A Fold back
Crowbar Protection	Yes
Output Impedance	·025 ohms

BE THE HIT AT PARTIES!

YAP BOX – 3 Discreet Sounds
ONLY £9.95 inc.

- Laser Gun
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Plus many others

Use on car PA system, bicycle horn, or protection against would be attackers.

Invent your own sound effects, make believe you're the police or fireman.
GREAT FOR KIDS OF ALL AGES.

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£35·95
PER PAIR
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The modern way of instant 2-way communications. Just plug into power socket. Ready to use. Crystal clear communications from room to room. Range ¼-mile on the same mains phase. On/off switch. Volume control, with 'buzzer' call and light indicator. Useful as inter-office intercom, between office and warehouse, in surgery and in homes. P. & P. £1·25.

4-STATION INTERCOM

£31·95
+VAT £4·80

Solve your communication problems with this 4-Station Transistor Intercom system (1 master and 3 Subs) in robust plastic cabinets for desk or wall mounting. Call/talk/listen from Master to Subs to Master. Ideally suitable for Business, Surgery, Schools, Hospitals and Office. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 66ft. A Battery and other accessories. P. & P. £1·25.

NEW AMERICAN TYPE CRADLE

TELEPHONE AMPLIFIER

£17·95
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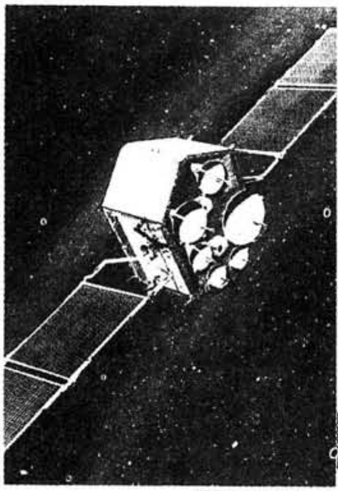

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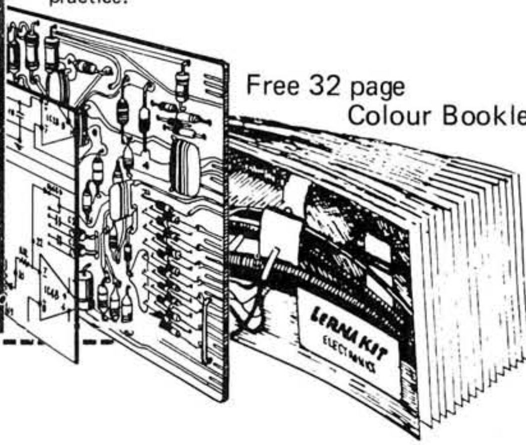

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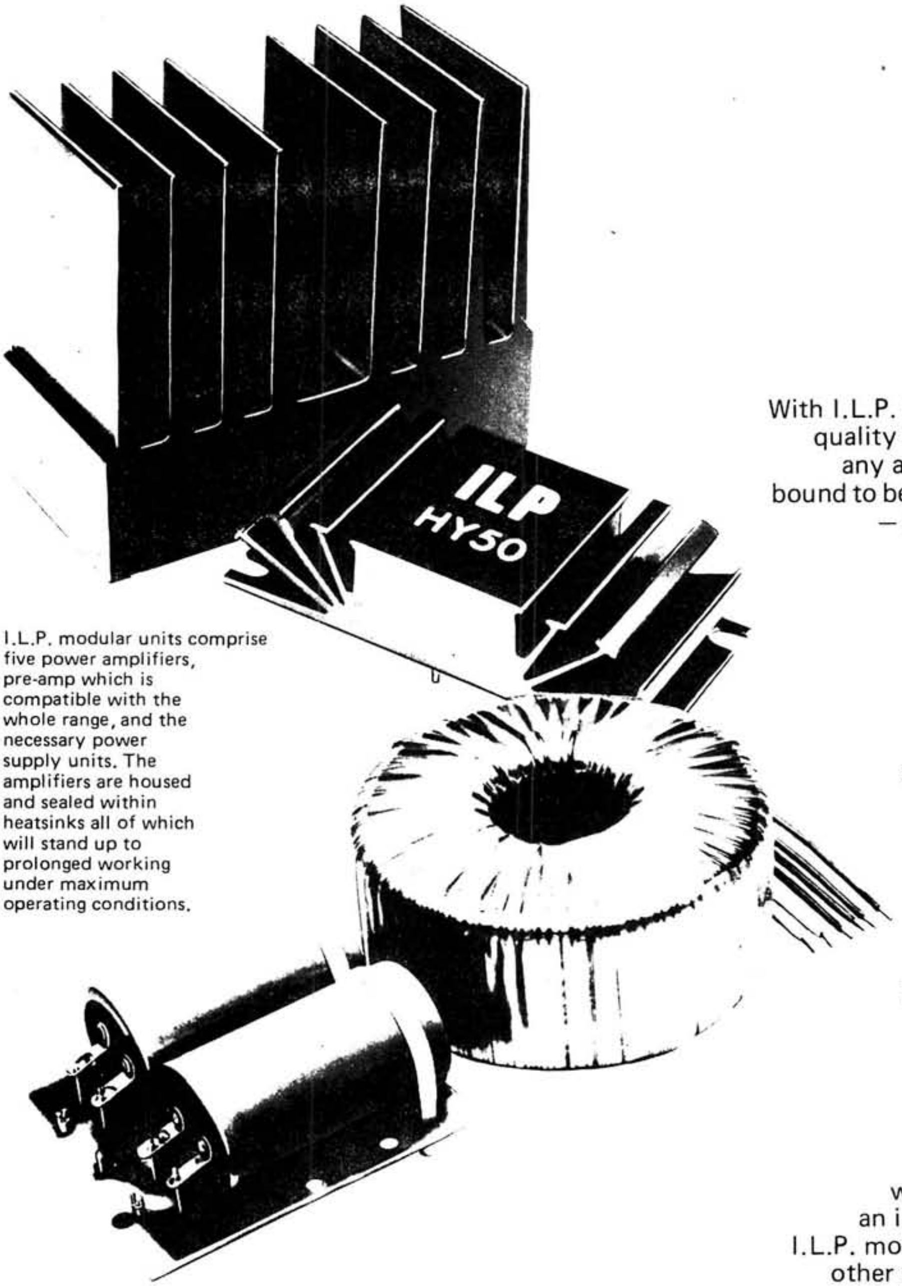

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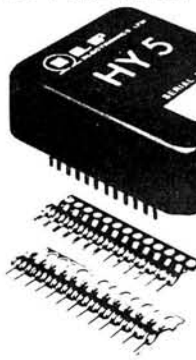

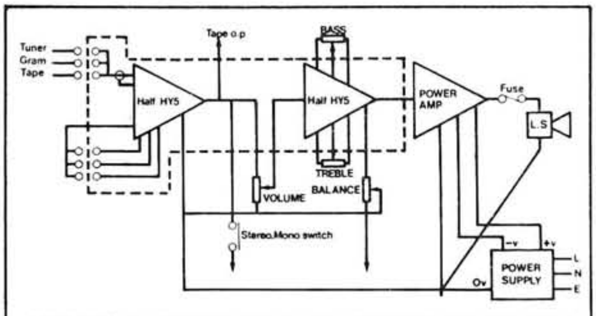

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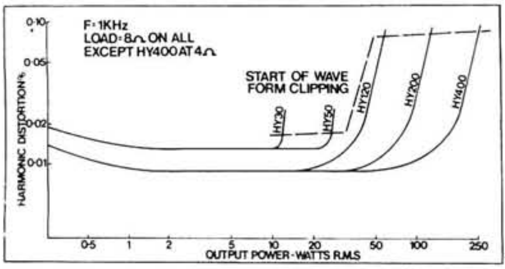

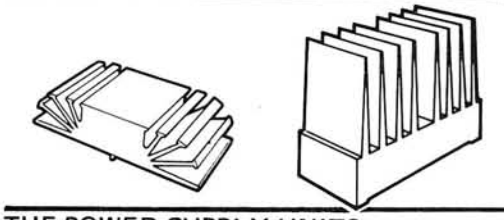

Model	Output Power R.M.S.	Distortion Typical at 1KHz	Minimum Signal/Noise Ratio	Power Supply Voltage	Size in mm	Weight in gms	Price + V.A.T.
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HY50	30 W into 8 Ω	0.02%	90dB	-25 -0- +25	105x50x25	155	£7.24 + £1.09
HY120	60 W into 8 Ω	0.01%	100dB	-35 -0- +35	114x50x85	575	£15.20 + £2.28
HY200	120 W into 8 Ω	0.01%	100dB	-45 -0- +45	114x50x85	575	£18.44 + £2.77
HY400	240 W into 4 Ω	0.01%	100dB	-45 -0- +45	114x100x85	1.15Kg	£27.68 + £4.15

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Input sensitivity – all models 500 mV
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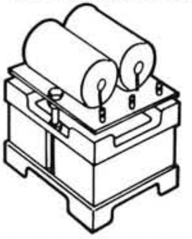

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Broadcasting

THE announcement in late October 1979, by the Independent Broadcasting Authority, of their firm plans for the launch of ITV2, brings to an end the years of argument, delay and speculation which have surrounded the question of a fourth TV channel in the United Kingdom. We are fortunate in that our broadcasting authorities reached agreement when planning the original u.h.f. TV network, that each station should be erected and used jointly by the BBC and IBA, reducing the number of masts and buildings required and easing aerial directivity problems for the viewer. Such an agreement is, so far as I am aware, unique in the Western World, and is the envy of many other broadcasting authorities.

In some parts of the UK it has, of course, been possible for many years to receive (I will not say enjoy—that is perhaps debatable) more than three programmes. Here in east Dorset we have a choice of BBC1 with West and South variations, and ITV from HTV or Southern. In parts of Essex it is quite easy to view no less than four of the ITV regions' programmes, though aerial requirements do start to get rather more complex. One of the problems now is that we are fast running out of push-button positions on conventional TV receivers. Perhaps this will provide a boost for the sale of new sets, economic conditions allowing.

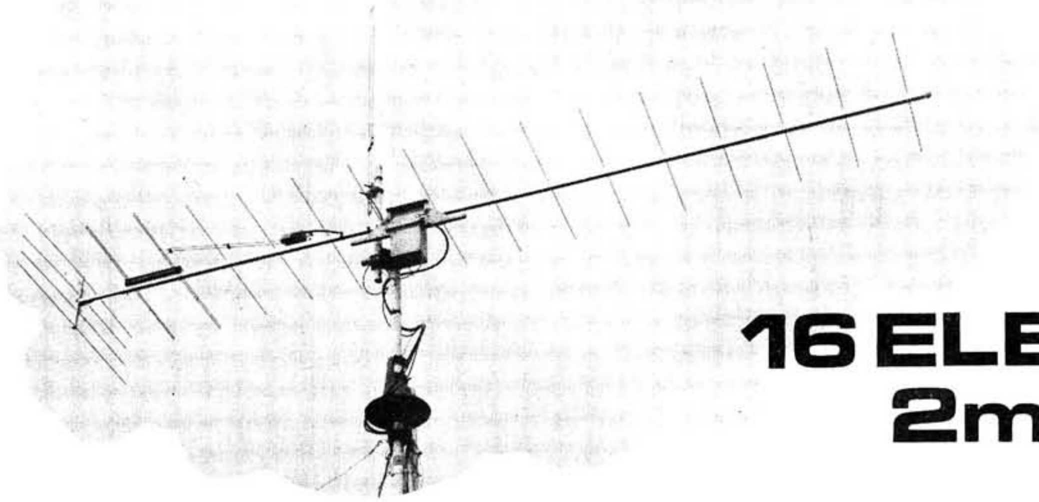
Because provisions for the fourth channel were made in planning the transmitting stations, it will not take long to get it on the air. Contracts for the transmitters have been placed, and deliveries should start in just over a year's time. The first batch of 30 main stations should be operational in November 1982, and a further 18 during 1983 and 1984. The installation of the necessary relay stations to complete coverage will presumably, in part at least, proceed hand-in-hand with the extension of ITV1.

Whether this large network of relay stations is the best way to strive for complete coverage is arguable. Alternative means of reaching topographically isolated communities are cable or satellite, though each has its problems. There are a number of MATV (master antenna TV) systems already in use in this country, though on nothing like the scale of, for example, the Federal Republic of Germany, where some 8 million of the estimated 20 million television households no longer have aerials of their own, but obtain their radio and TV signals relayed via cable from a local receiving station, sited for best reception from a central aerial array. There is obviously scope for such a system to be extended to receive its programmes by cable all the way from the studios, rather than off-air.

Although a cable distribution system is attractive for, say, a village on a hillside, screened from the adjacent TV transmitter, it is hopelessly uneconomic for isolated homes, spread over a large area. It is here that satellite broadcasting could come into its own. There have already been a number of studies and trials to assess the viability of bringing TV to vast areas of the developing continents via satellite. It is attractive to consider adding sound broadcast channels to the satellite service, even to provide TV sound channels in different languages for the same pictures, of great benefit in multilingual countries.

In some recent American radio and electronics magazines, news has been given of work by amateurs in the US in developing equipment capable of "eavesdropping" on international satellite links carrying broadcast programmes, so increasing still further the choice of entertainment. This raises an interesting legal aspect, for though it is permitted to listen to a radio transmission intended for general reception, it is not permitted to listen to one intended for reception by a particular individual or group. Satellite point-to-point links come into the latter category, but in the US, some of the programmes they carry have been obtained by off-air reception of public broadcasting stations. Is it then legal to listen to a programme on one frequency, but illegal to listen to that same programme on another?

Any changes in the way in which sound and TV programmes are distributed will, of course, have profound effects on industry, the public, and the skyline. They could also change completely the hobby of DXing.



'2BCX 16 ELEMENT 2m BEAM

F. C. JUDD G2BCX

High-gain beam aerials of the conventional Yagi type for 2-metre operation are of necessity rather long, the average being 5 to 6 metres to achieve a gain of more than about 14dBd (dB relative to a dipole). The alternative way of obtaining high gain would be a pair of beams of smaller dimensions which, suitably phased, should (in theory) provide an increase in gain of 3dB over that of one by itself. Unfortunately this rarely works out in practice, and the extra gain is usually somewhat less than 3dB.

In fact, the possibility of using a suitably matched and phased pair of 12-element ZL beams (designed by the writer and published in *PW* November 1978) was considered, since this aerial is physically smaller (3·2m) than a normal Yagi type having the same gain of 13dB. However, this would have involved double the amount of material required for a single aerial (and thus twice the cost) and a spacing between the pair of at least 0·75λ (almost 2m) in order to achieve anything approaching the extra 3dB gain. Such an array would present a rather large total area to the wind. Neither did the 12-element ZL lend itself to achieving higher gain by simply adding more directors, at least not without extensive modification and increasing the length considerably.

A gain of 3dB over the existing gain of an aerial may not seem worth while, but it does in fact mean twice the original radiated power. For example, with an aerial such as the 12-element ZL having a gain of 13dB and radiating all of, say, 10 watts applied to it, the effective radiated power (e.r.p.) would be almost 200 watts. Another 3dB would mean an e.r.p. of nearly 400 watts!

Taking into account all of the foregoing observations, it was decided to investigate the possibilities of a beam aerial that would provide at least 16dBd total gain, be not unduly long, not too expensive to construct, be of reasonably light weight and not present too much area to the wind.

The '2BCX 16-Element Beam

The basis of this aerial is a double driven element and plane reflector system, designed to provide the highest possible initial gain. The driven elements are a pair of folded dipoles, coupled by a short crossed transmission line so as to obtain current in one element in phase opposition to that in the other, i.e., they are driven with 180° phase difference. Such a system is commonly called an end-fire array (Ref. 1) which with close spacing between the elements (approx. $\frac{1}{8}\lambda$) provides the highest gain possible (nearly 4dB) with any driven linear pair (Ref. 2). The configuration of such an array and its radiation pattern compared with that from a dipole are shown in Fig. 1.

We now have a driven element system with a relatively broad bandwidth, by virtue of the folded dipoles, and a large amount of radiation in two directions which allows the use of a reflector as well as a series of directors. The self impedance of this type of array is, however, only a few ohms and this becomes even less when parasitic elements are in close proximity. Hence the use of a half-wave line section to secure a direct match to 50 ohm coaxial cable.

Details of the whole aerial are given in Fig. 2, which includes all radiator lengths, etc., but not those of the plane reflector elements, the phasing line and the matching line sections. Details for these are included in other diagrams. The total length of the aerial is 4·26m and it has a measured gain of 16dBd. Three prototypes were constructed and tested, and the final version as described here has been in use for almost a year at a height of about 25 feet above ground and 70 feet a.s.l. Distances of 100 miles and over have been worked consistently on 2 metres f.m. regardless of conditions, and large numbers of continental stations (in France, Belgium, Holland and Germany) have been worked direct with average signal reports of well over S9 during only medium "lift" conditions.

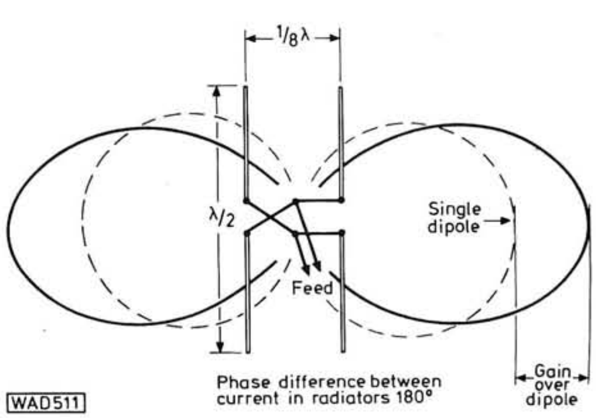


Fig. 1: Function of the two half-wave driven radiators with currents 180 degrees out of phase

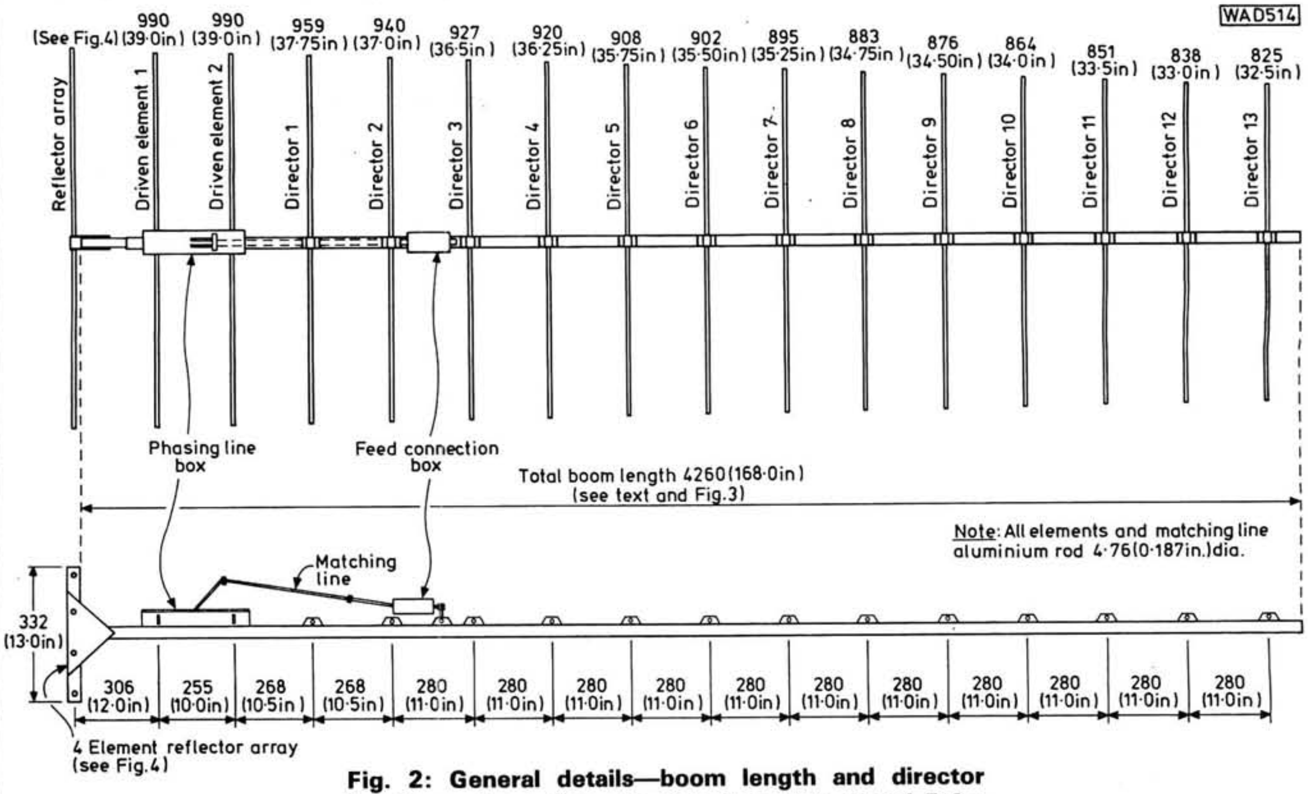


Fig. 2: General details—boom length and director lengths and spacing, etc. See also Figs. 4 and 5 for assembly of reflector and matching line

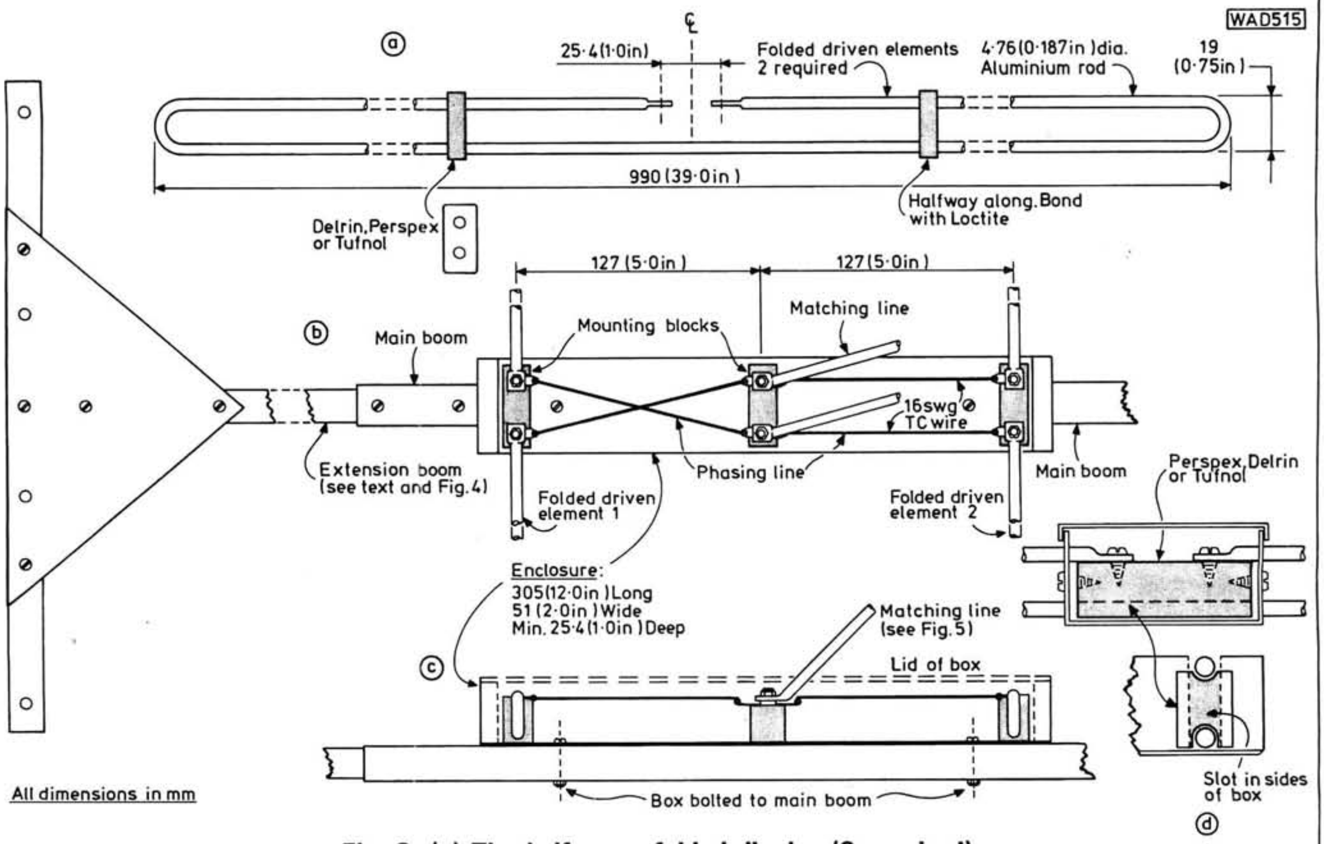


Fig. 3: (a) The half-wave folded dipoles (2 required). (b) Phasing line and dipole connections—top view. (c) Side view—box bolted directly to boom. (d) Suggested method of securing dipoles within box

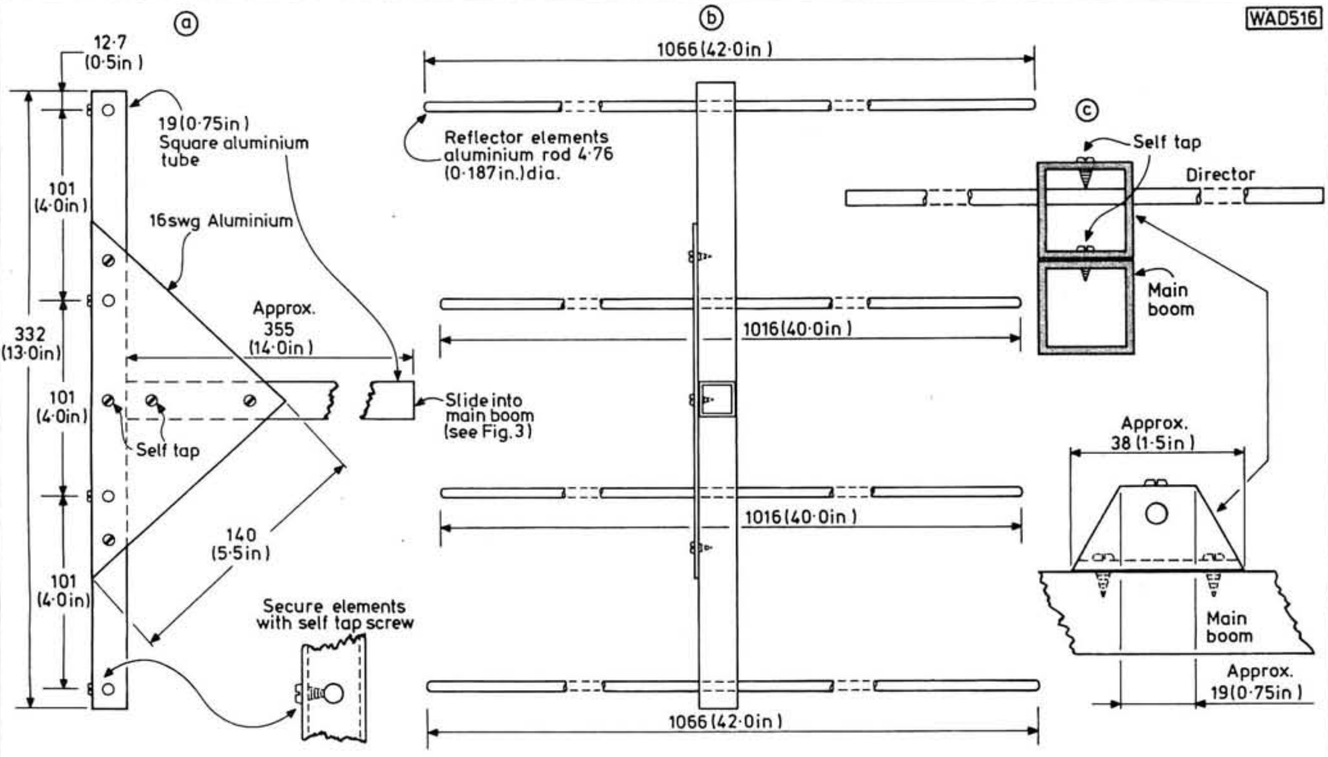


Fig. 4: (a) Side view—assembly of plane reflector. (b) Reflector details. (c) Method of securing directors to main boom

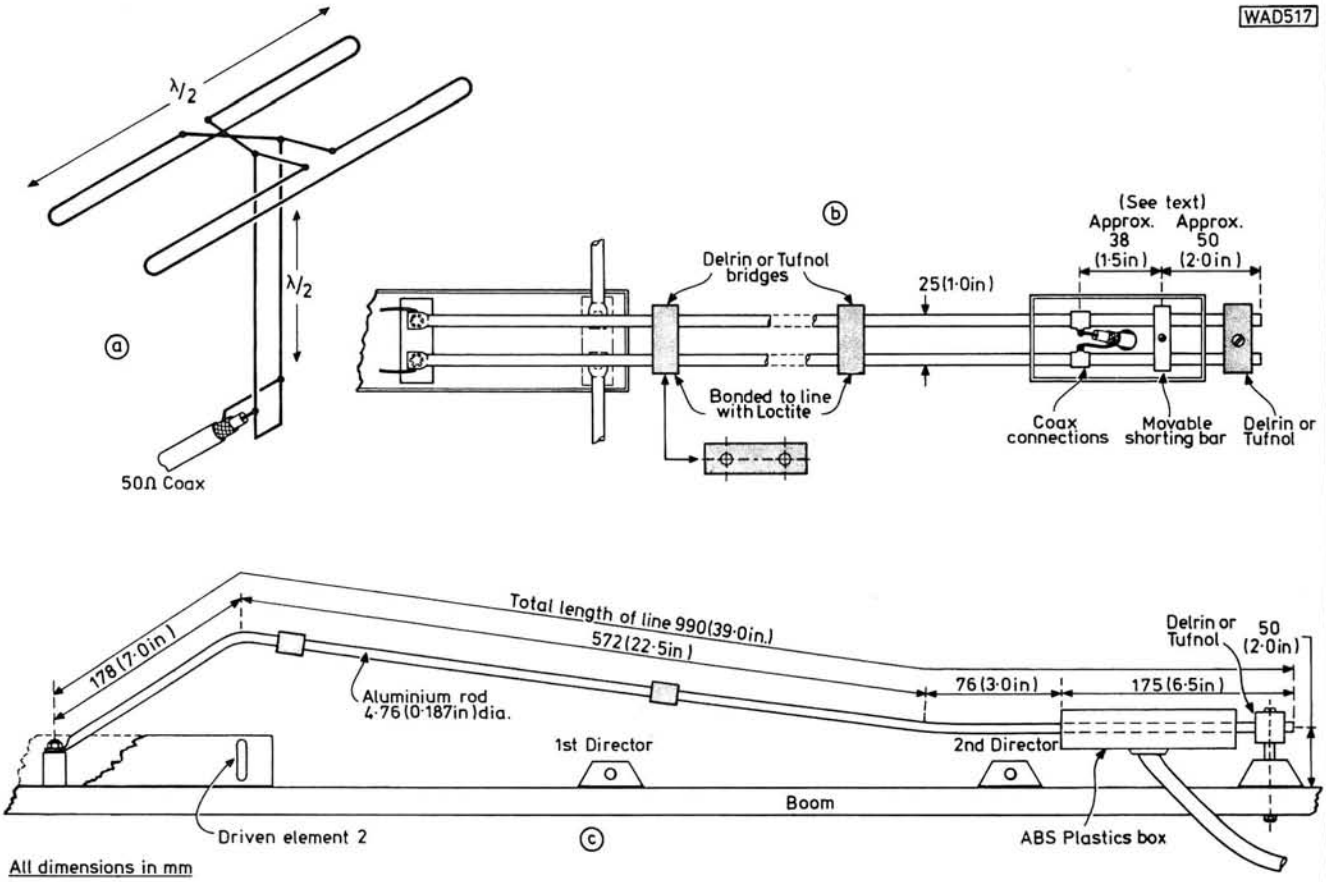


Fig. 5: (a) Method of half-wave line match to primary radiators. (b) Top view of matching line assembly. (c) Side view

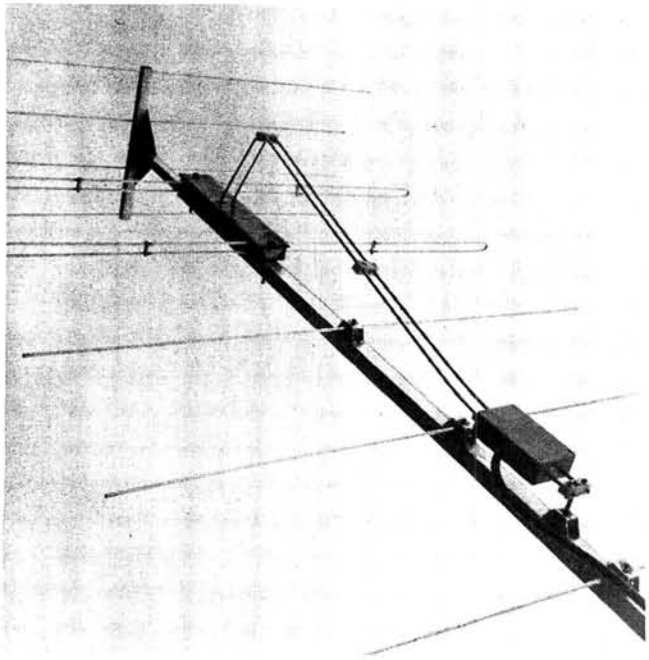


Fig. 6: Photo of phasing line box, matching line and coaxial connecting box

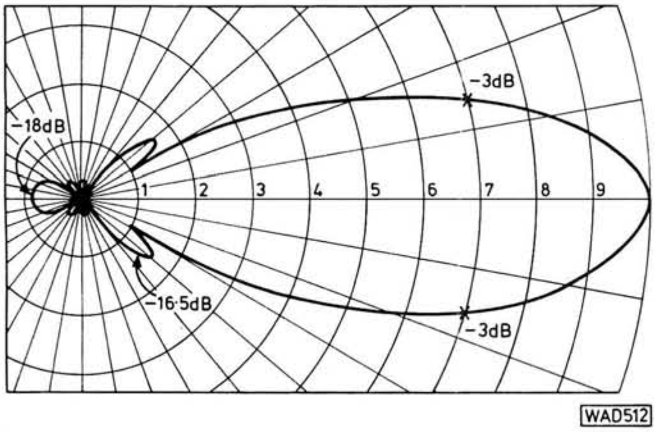


Fig. 7: Radiation pattern in horizontal mode under ideal test conditions

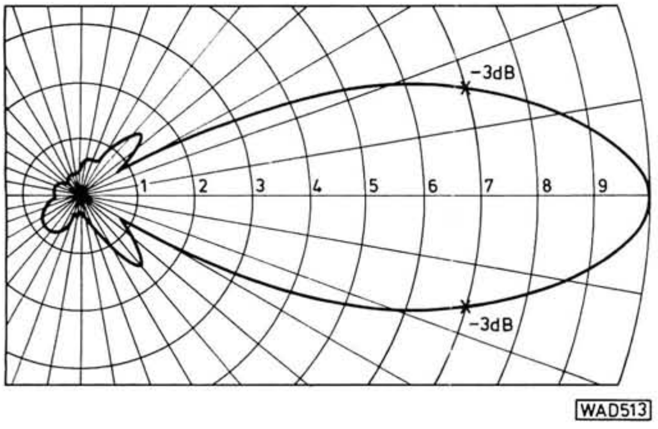


Fig. 8: Radiation pattern in horizontal mode with aerial in normal environment (see text)

Construction

All details for construction as for the prototype shown in the photo, are included in the various diagrams. It is important to maintain good insulation at the driven element and phasing line junctions, and along the matching line and at its feed point, and also to ensure that water cannot enter the phasing line and coaxial cable connection boxes.

The main boom is of 1in (25·4mm) square-section aluminium tube and this is usually sold in standard lengths of 4m. The plane reflector is therefore mounted on a short length of 0·75in (19mm) square section tube that will fit into the end of the main boom as in Figs. 3 and 4.

Construction of the two driven dipoles and assembly with the phasing line box is shown in Fig. 3. This box can be made from plastics electrical trunking, blocked at each end with Perspex or plywood about 10mm thick. The mounting blocks for the elements and phasing line may be Delrin, Tufnol, Perspex or PTFE. Note how the matching line is connected to the centre of the phasing line, so make entry holes for this in the lid of the box. The two driven elements can be "U" formed at each end by means of a round piece of metal or wood clamped in a vice. Heat the point where the "U" bend is to be made but bend slowly and gradually and don't overheat the aluminium. A trial on a scrap length is recommended. Remember however to put the element spacers on before the bends are made and thread these to the appropriate points before the connecting flats are hammered out and drilled.

Construction and assembly of the plane reflector is shown in Fig. 4. It consists of four elements to form the required plane area and the lengths of these are set to take velocity factor into account. Note also the method of securing the self-tapping screws (zinc plated) through the vertical boom, which is attached to the horizontal boom section by the triangular aluminium plate. Lengths and spacings for the 13 directors are given in Fig. 2 and these are mounted on the main boom by supports cut from 1in (25·4mm) square section tube as in Fig. 4(c).

The final part of construction is the half-wave matching line and coaxial line feed box as in Fig. 5, in which (a) shows the theoretical arrangement, (b) a view of the line from above and (c) from the side. The photo, Fig. 6, shows a close view of this assembly. Make the holes for the line just large enough for the coaxial feed box to move backward or forward to facilitate the setting of the shorting bar and the points of connection for the cable. When these have been established the box can be secured to the lines by Araldite.

Adjustment and performance

Setting the feed point and shorting bar positions are the only adjustments necessary, but must be carried out with the full length of coaxial cable to be used, preferably low-loss cable such as UR67. Set the aerial up at least 6 feet above ground and in a clear space. This will most likely be in the garden, and if the transmitter can be taken out near the aerial it will be much easier to watch the power or v.s.w.r. meter whilst adjustments are being made. Set the shorting bar and coaxial feed points as shown in Fig. 5(b). Adjust both one way or the other to obtain lowest v.s.w.r. or maximum power into the aerial at mid-band, i.e., 145MHz. It should be possible to get the v.s.w.r. down to 1·1 to 1·2 to 1 at mid-band, and this should rise only slightly at each end of the band.

continued on page 78 ▶▶▶

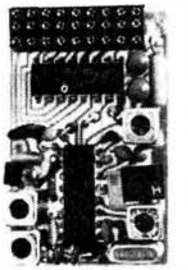
ambit
INTERNATIONAL

IT'S HAPPENNED* AGAIN !

THE PART THREE CATALOGUE IS PUBLISHED & WE HAVE MOVED TO BIGGER PREMISES.

Yes, it's here at last - the all new Part Three Catalogue. Fun for all the family, and the usual update on all that is new, worthwhile and exciting in the world of Radio and Communications. A big section on frequency synthesis techniques covering broadcast tuners, to communication quality transmitter systems. More new products than ever - RADIO CONTROL parts, crystal filters, ceramic filters for 455kHz and the new range of TOKO CFSH low temperature coefficient types for 10.7MHz. Details on new radio ICs, including the new HA11225, the CA3189E lookalike with 84dB signal to noise, and adjustable muting threshold. Radio control ICs - and an updated version of the RCM&E 8 channel FM receiver - now with an Ambit designed screened front end, with 27MHz ceramic bandpass filter. LCD panel clock/timer modules - the neatest and best LCD panel DVM yet (only £19.45 each + VAT), the new 5 decade resolution DFM3 for LW/HF/VHF with LCD readout. The DFM6 with fluorescent display to 10kHz resolution on VHF, 1kHz on SW. A 1kHz HF synthe siser with five ICs - the list is endless. Get your copy of the catalogue now. Post publication price is 60p (inc PP etc). The previous two sections are also required for a complete picture: Parts 1 & 2 £1 the pair. All 3 £1.50. And don't miss our spot the gibbon contest, together with a quiz to see if you can spot the differences between a neolithic cave drawing and a circuit diagram of one of our competitor's tuners. (* Yes, we still haven't learnt how to spell.)

Updated RCME FM radio control RX kit

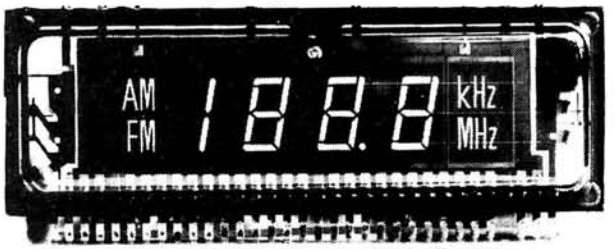


8 Channel RC receiver (FM)
- Single IC RF/IF/Detector
- Single IC decoder
- 27MHz ceramic filter input
- FET RF stage with double tuned bandpass filter
- Dual ceramic filter IF
- Based on RCM&E FM system
- Best quality SLM servo connector block
- ONLY £16.10 inc VAT (kit)

(includes new SLM case)

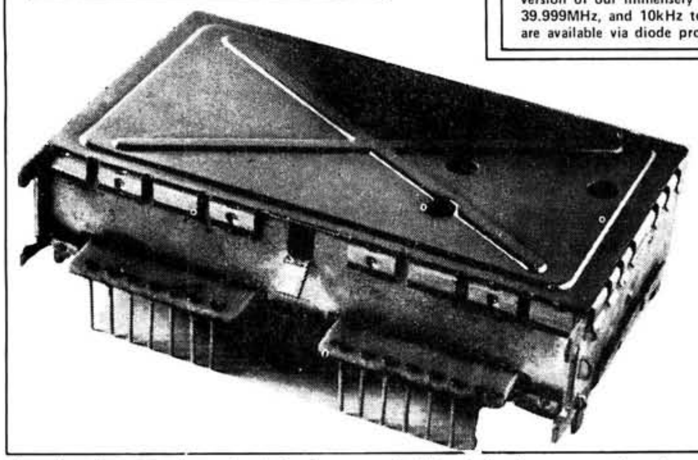
DOES YOUR ONE GLOW GREEN IN THE DARK ??

Our DFM4 does, since it uses a vacuum fluorescent display for direct readout of MW/LW/FM. Basically the same as the DFM2, (LCD Version). £24.45 kit (inc VAT) Transformer with all necessary windings for DFM4 - £2.50 inc VAT.



Not illustrated here - but also now available is the DFM6. This is a vacuum fluorescent display version of our immensely popular DFM3 (LCD). Resolution is 100Hz to 3.9999MHz, 1kHz to 39.999MHz, and 10kHz to 200.00MHz+; all standard IF offsets (inc. 10.7MHz on shortwave) are available via diode programming.

New series of radio modules in fully screened cans:



UM1181 VHF band 2 VARICAP TUNERHEAD

5 tuned circuit, with image/spurii better than −80dB, buffered LO output, MOSFET RF stage, FET IF preamp, tunes with only 1½ to 8v, −9dBm 3rd order intercept. 1off price £12.00 inc VAT. (100off/ OA)

911225 FM IF strip with all mod cons for the HiFi tuner:

All types use 80+dB S/N Hitachi IC, with muting, AFC, AGC, meter outputs for signal level and centre zero. IF preamp stage.

'A' Dual linear phase ceramic filters, with MOSFET (AGC'd) IF preamp and a 3rd narrow filter with DC filter selection. Dual tuned FM detector stage. £23.95 inc VAT (built)

'B' Dual ceramic filters, single tuned detector stage £14.95 inc VAT

(All 'A' series units are set up with a spectrum analyzer for best THD)

91072 AM RADIO TUNER MODULES - DC TUNED and DC SWITCHED Available February '80

All include buffered LO output, mechanical IF filter (TOKO CFMQ)
1-10v tuning bias, switching by a single pole to earth
A MW/LW (150 to 350kHz LW range) with ferrite rod antenna
B As 'A' but also including SW1 or SW2 (specify.)
SW1 = 1.8 to 4MHz SW2 = 5 to 10MHz
C With both SW ranges

Prices -one off INC VAT
'A' £14.43 'B' £15.90 'C' £17.50 (Custom types OA)

There is a danger - when advertizing in some magazines - that because we do not find space to list everything we sell in every ad., that some readers forget about half the ranges we stock. So to summarize the general ranges:

TOKO	Chokes, coils for AM/FM/SW/MPX, Audio filters etc Filters: Ceramic for AM/FM, LC for FM, MPX etc. Polyvaricons ICs for radio, clock LSI, radio control, MPX decoders etc
Micrometals	Dust iron cores for toroids for resonant and EMI filters Toroid mounts
Hitachi	Radio/audio/mpx linear ICs 100W MOSFETs, small signal FETs, MOSFETs and bipolar

And the following groups of products from a broad range of sources:

Semiconductors –specializing in radio devices, Plessey SL1600, EUROPE's best selection of AM/FM and communications devices. Power MOSFETs, WORLD's LOWEST NOISE AUDIO small signal transistors, BAR graph LED drivers for linear and log.
CD4000 series CMOS, TTL/LPSNTTL, standard linears (741, 301, 3080 etc). MPUs, memories.
Small signal transistors from AEG BC237/8/9 families etc. (1000 off BC239C : 5.2p ea)
LEDs: AEG 3mm/5mm round, 2.5x5mm flat, red, greem, orange, yellow. The best prices you will find for quality products.
MOSFETs for RF signal processing, including the BF960 UHF device, and 3SK51 for VHF.
Varicap diodes for 17:1 capacity ratio tuning

FREQUENCY READOUT LSI from OKI, with a one-chip answer to most digital frequency display needs (and various modules).
Crystal and ceramic ladder filters from leading manufacturers, ferrite rods, various ferrite beads and a range of crystals for 'standard' frequencies and both AM and FM radio control at 27MHz.
Trimmer capacitors.
METERS - a new range of linear movement types, plus many 'indicator' types for VU, all types of tuning indicators etc.
SOCKETS - a new range that are better quality than Texas low profile, yet better priced.
Modules for AM/FM/STEREO, complete kits for tuners, audio amplifiers from Larsholt.
SWITCHES - complete low cost DIY systems for push button arrays, keyboard switches.
DOUBLE BALANCED MIXERS - MCL SBL1, replacement for MD108 etc. And cheaper.

OUR LATEST MOVING EXPERIENCE :: At last, we have moved to the address below. There is car parking for customers approaching via North Service Road (an extension of North Road Avenue, entrance opposite the Brentwood Fire Station.) Pedestrian access from the High Street (alongside 117 High Street). The new building is six times bigger than our Gresham Road offices, and we will be installing a much expanded sales counter in the fullness of time. NEW TELEPHONE NUMBER (0277) 230909, TELEX NUMBER (as before) 995194 AMBIT G. See you there !

200 North Service Road, Brentwood, Essex.

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

Find the Retailer

Lektrokit are pleased to announce the appointment of Damon Electronics as a new retailer for their bread-boarding and testing devices in the Nottingham area.

Damon Electronics was recommended as a stockist by a local electronics enthusiast who will be receiving a free Super Strip breadboard for his efforts.

This follows Lektrokit's policy of promoting sales through local retailers and the offer of a free Super Strip is open to any other enthusiasts who successfully recommend new retailers.

Further information from: *Lektrokit Ltd., Sutton Industrial Park, London Road, Earley, Reading, Berks. RG6 1AZ. Tel: (0734) 669116/7.*

New Catalogue

A new 14pp. full-colour catalogue is available from Hamlin Electronics covering the company's wide range of large-area liquid-crystal display devices. The catalogue includes several recently introduced products, and emphasises the versatility of the Hamlin range in both standard and custom products.

The Hamlin catalogue covers three grades of field-effect liquid-crystal displays designed to meet the performance requirements of standard commercial grade, special-purpose instrument grade or high-temperature applications. Displays are offered in a variety of reflective and transflective viewing modes, with both commercial-grade and high-stability polariser options available. A broad line of standard display formats, package sizes and connector types is included, as well as a section on flexible formats for custom displays.

Further details from: *Hamlin Electronics Europe Ltd., Diss, Norfolk IP22 3AY. Tel: (0379) 4411.*

Free Literature

Publications issued recently by the IBA include an extended edition of "ITV & ILR TRANSMITTING STATIONS—A Pocket Guide" (16pp) and a new four-page illustrated leaflet "500—the IBA's 500th Transmitter on Air Autumn 1979".

The pocket guide includes brief details of some 500 u.h.f. transmitters (representing 2000 IBA (ITV), IBA ('Fourth Channel'), BBC1 and BBC2 channels), the 47 ITV/v.h.f. (405-line) transmitters, and 28 different ILR radio services (m.f. and v.h.f./f.m.). Information provided includes channel numbers (or frequencies), polarisation of signals, power, aerial height, and service date (or target service date) and national grid reference of location.

The '500' leaflet marks the recent taking into service in a West Yorkshire valley of the 500th IBA transmitting installation.

Either or both publications are available on request from: *IBA Engineering Information Service, Crawley Court, Winchester, Hants. SO21 2QA.*

Business News

Sinclair Radionics Limited (Sinclair) is to sell its existing miniature TV and calculators to Binatone International Limited (Binatone), the London-based consumer electronics group.

Binatone intend continuing production of the miniature TV sets, based on the existing models. The current Microvision TV and the Enterprise Programmable calculator are now available from Binatone.

The Sinclair instrument division (trading under the name of Sinclair Electronics) is continuing, based in St. Ives, Huntingdon. The new arrangements will ensure that more resources can be applied to the development of this part of the business.

The flat screen TV project is continuing and discussions are being held with third parties, with a view to its long-term development being taken forward in partnership with an existing company in the industry. This development work is supported by NRDC.

Latest EPI

The second edition of the "Electronic Projects Index", compiled by M. L. Scaife, Principal Librarian (Technical) of North Tyneside Libraries and Art Department, is now available.

The index provides a guide to projects published during 1978 in 16 technical magazines, which includes *Practical Wireless, Practical Electronics, Television, Wireless World and Practical Hi-Fi.*

The price of EPI number 2 is £1.30 which includes P&P, is available from: *M. L. Scaife, Central Library, Northumberland Square, North Shields, Tyne and Wear NE30 1QU. Tel: (08945) 82811.*

Club Diary

The "Cheshunt & District Radio Club" meets every Monday, January 1980 topics as follows: **9 Jan**—Rig Clinic; **16 Jan**—10 metres f.m., John G3YPZ; **23 Jan**—Film "Tour of The West Indies", Richard G3RWL; **30 Jan**—Natter Nite/RAE/CW.

An invitation is extended to visitors, who can obtain further details from: *The Chairman, Jim Sleight G30JI, 18 Coltsfoot Road, Ware, Herts. SG12 7NW. Tel: (0920) 4316.*

ME Centre

The National Microprocessor and Electronics Centre, will hold three mini-exhibitions during January 1980, they are as follows: **8th to 10th**—Logic Analysis; **15th to 17th**—Soldering, Desoldering and Interconnection; **22nd to 24th**—Plotters and Chart Recorders.

The centre's mini-exhibitions last for three days and are deliberately restricted to a single product area, so that visitors have a chance to see a comprehensive selection of similar products in one place at one time.

The ME Centre is situated in the London World Trade Centre, close to the Tower of London. It is open from Monday to Friday between 10.00 and 16.00 hours.

Further details from: *ME Centre, London World Trade Centre, Europe House, London E1 9AA. Tel: 01-488 2400.*

On the move

With effect from 19 October 1979, *Invader Components Ltd.,* started trading from new premises. The new address is: *Westmeads Road, Whitstable, Kent CT5 1LW. Tel: (0227) 264444. Telex: 965313.*

Can I Help You!

Are you the secretary, organiser or general dog's body of your local radio club or any other group whose functions may interest readers of *PW*. If so, let me know and I will endeavour to publicise your rally, get-together whatever, through this column. Remember though, we compile the magazine some time ahead of publication day (e.g. this note was written in November), so, the earlier I can have details, the better.

Alan Martin

NEWS...

Club News

A new AR club has been formed, The Louth & District Amateur Radio Club. The first meeting was held on Friday, 19 October, and the attendance was very promising.

For further information regarding the club, please contact: *The Secretary, Ron Padbury, at "Fermaen", 8 Osborne Drive, Holton Le Clay, South Humberside.*

New M.Eng Degree Course

A new $4\frac{1}{2}$-year degree course in Electronic/Electrical Engineering has been devised jointly by Bath University and GEC-Marconi Electronics Limited, one of the world's largest electronics groups.

The course is intended to provide an engineering education at a level equivalent to that of the French Grandes Écoles and the German Technische Hoch Schulen. The course covers a broad spectrum of electronic/electrical engineering and yet allows for specialised study to a greater than normal depth. It is intended for students of high calibre and will lead to a Master of Engineering Degree (M.Eng).

The need for such a course became evident when GEC-Marconi Electronics found that many of the incoming graduates needed a long period of further training before they could even start to "pull their weight". This arose in part from having no knowledge of the industrial process, but also no experience of how people were motivated, nor, therefore, how to motivate them.

Bath University already has an excellent reputation for its electronic and electrical degree courses and always draws a very high level of candidates for them. The University has entered enthusiastically into the joint study which also has the support of the Engineering Industries Training Board in the form of a grant. Much of the course is devoted to participation by the student in the combination of supportive and technical subjects in case studies, simulations, seminars, role playing activities and so on.

The course is an integrated one in that each year is divided between academic and industrial periods, but it will not be a "sandwich" course in the usual sense. Too often there is little correlation in the content or time phasing in the majority of sandwich courses today. The new course will be fully linked between the University and whichever one of the companies in the GEC-Marconi Electronics group is sponsoring a particular student. To emphasise the wholeness of the course there are two themes running through both the academic and industrial periods—the system approach to problems and the design activity. It is felt that upon these disciplines can be built a sound course coming close to "real life" engineering and providing a recognition of the commercial significance at work in industry, including the principles of quality and reliability engineering, the science of measurement and many other supporting subjects.

The course will start in September 1980. Full details and applications to enter the course should be made to: *The School of Electrical Engineering, Bath University, Claverton Down, Bath.*

Marshall's New Credit Card Scheme

Marshall's, the UK distributors and retailers of electronic components, announce in their 1979/1980 product range catalogue, that they are launching a new "budget" credit card scheme, in conjunction with RETRA. The scheme will enable customers to purchase goods on credit from any of the four Marshall's retail branches. Minimum monthly repayment is £5.00 and goods up to 20 times this amount may be purchased.

With the publishing of this catalogue, Marshall's have reduced prices on 100's of their top line products. All prices quoted in the catalogue are for one-off, VAT excluded.

Twin reply paid order forms are supplied in each catalogue to facilitate easy ordering and faster turn round. The catalogue costs 50p from any Marshall's branch or 65p post paid from: *Marshall's (Head Office), Kingsgate House, Kingsgate Place, London NW6 4TA. Tel: 01-624 8570.*

Breakthrough

After a 21-year campaign aimed at breaking the Post Office telecommunications monopoly in the UK, Air Call chairman John Stanley—head of the country's largest private communications services organisation—reacted swiftly to the recently announced new initiative, by Industry Secretary, Sir Keith Joseph.

Mr Stanley, after hearing the proposed Parliamentary moves to broaden the scope for the provision of communications services from the private sector, commented: "This provides an eleventh hour initiative not only for the Post Office by enabling it to concentrate on creating telecommunications networks more appropriate to the high-speed communications age in which we live.

"But equally importantly it begins to remove the straightjacket that companies such as ours have been forced to wear for the last two decades with the result that many contemporary services have either been neglected or deliberately underdeveloped". He went on to say: "I cannot help but consider the progress that might have been made if we, and other companies such as Air Call, had been allowed to operate more freely and in a more enterprising environment of the kind the Government has now indicated. That it is happening now suggests that decision-making may be back at long last to where it belongs."

Mr Stanley, whose company operates through 33 centres throughout the UK and additionally runs the principal medical deputising services in Great Britain in conjunction with the British Medical Association, added: "The private communications sector is far more ready, and far more prepared, to respond to these new opportunities than may be realised. This move could mark a revolution for the telephone user in this country and, despite the restrictions that are now to be removed, we are more than ready for it". The ability of the private organisations to respond to the new opportunities would depend on the speed with which legislation could be brought into effect.

He said: "This is a magnificent first step but even so there is now much to be done. There is the need for efficient national and international facsimile services. There is a requirement for a totally liberalised policy of interconnection so as to ensure that any equipment that meets the minimum CCIT standards can be connected to any telephone line.

If the network characteristics are sub-standard, then the Post Office should bring them up to the relevant standard because at the moment there is a vast amount of equipment that could be interconnected with the telephone network for the quite considerable benefit to both users and the telephone companies."

Air Call Ltd., Air Call House, 105/111 High Street, Houghton Regis, Dunstable, Bedfordshire LU5 5EL.

RADIO SPECIAL PRODUCT REPORT

SONY

ICF-6800W FM/AM MULTI-BAND RECEIVER

The ICF-6800W is a receiver which will appeal to the short wave listener and to the medium wave DX enthusiast, having proved itself capable of good performance on a.m., c.w. and s.s.b., and also on v.h.f. f.m. It incorporates a number of novel features which will either be dismissed as gimmicks or enthused over, according to personal requirements and likes.

The ICF-6800W is one of a new generation of receivers using a phase-locked loop controlled, synthesised local oscillator for its frequency control. This system is fairly easily engineered using modern digital techniques, and provides in an h.f. bands receiver many of the advantages of the Wadley Loop "triple-mix" system (good frequency stability, constant tuning rate, high first i.f. for good image rejection) without the need for such sophisticated filters. It does, however, still suffer from problems of spurious, internally generated signals.

The f.m. and a.m. sections of the receiver are separate until the late i.f. stages are reached, having separate tuning controls and scales. We will deal with the f.m. section first.

A single f.e.t. r.f. stage is used, feeding a discrete bipolar l.o. and mixer set-up, followed by three stages of i.f. amplification incorporating cascaded ceramic filters at 10·7MHz. Further processing is performed by an a.m./f.m. i.f. amplifier chip incorporating a.g.c. and meter amplifiers, and f.m. demodulation is by a conventional ratio detector. Tuning on f.m. is by a ganged capacitor, with switchable a.f.c. control by a varicap diode across the local oscillator section.

On medium waves, a single f.e.t. r.f. stage takes the signal from the internal ferrite rod aerial. The external aerial input is applied to a winding on the ferrite rod—a disadvantage so far as the m.w. DXer is concerned, as it makes it very much more difficult to use a loop aerial with the receiver. Manual and automatic r.f. gain control is applied to a diode attenuator across the r.f. stage input.

Further f.e.t.s are used as the main v.f.o. and a MW mixer, with a bipolar buffer interposed. The output of the mixer at 455kHz is fed to the second i.f. stages of the SW receiver, described below.

Synthesised

The SW bands are divided into 29 bands 1MHz wide, with overlap at each end. A Preselector, based on a dual-gate f.e.t., provides r.f. selectivity. This preselector is separately tuned, with its own knob and scale, covering the range 1·6 to 30MHz in one band. It is this circuit which limits performance at the low end of the 1–2MHz band.

Manual and automatic control of r.f. gain is by means of a diode attenuator similar to that in the MW r.f. amplifier, but an additional transistor attenuator, operated by the manual r.f. gain control only, is connected across the external SW aerial input. This is designed to reduce cross-modulation problems when tuning to a weak signal adjacent to a stronger interfering signal, and seems to do this most effectively. A double superhet system is used, the first i.f. being 19·055MHz. The first oscillator signal is derived from a phase-locked loop synthesiser using a 10MHz crystal as its reference, and applied to a balanced mixer. Continuous tuning across each 1MHz band is controlled by the v.f.o. described in the MW section above.

An 18·6MHz crystal is used in the second oscillator, the output being applied to an f.e.t. mixer stage to produce the second i.f. at 455kHz. A combination of top-coupled i.f. transformers and ceramic filters provide the selectivity, an extra filter being switched in when the Mode switch is set to Narrow, USB or LSB/CW. The output of the a.m. i.f. strip is muted whenever the synthesiser is out of lock, thus preventing spurious outputs during retuning.

Separate detectors are provided for d.s.b. and s.s.b/c.w. services. The output from these, or from the f.m. demodulator, is selected by the Mode switch and passed to a discrete complementary audio amplifier incorporating Bass and Treble tone controls.

On the MW and SW bands, dual indication of tuned frequency is provided: analogue by means of a drum scale some 130mm in diameter with cursor adjustment, and digital by means of an 8mm high l.e.d. display. When USB or LSB/CW modes are selected on the SW band, the digital readout is offset by 2kHz, so that it still reads the carrier fre-

YAESU MUSEN
U.K. MAIN DISTRIBUTOR FOR ALL YOUR RADIO NEEDS

This month we list a few of the popular accessories that compliment our extensive range of communications equipment.
Whatever your interest or requirements in radio we can probably help.

POWER SUPPLY
12 Volts DC regulated supply
240V 50/60Hz input
3 Amps Cont. 5 Amp peak
3″×4½″×6″. 3½lbs
ODR123C (Post free) **£15.40**

DIP OSCILLATOR
1.5-250MHz on fundamental.
c/w earphone, battery, 6 plug in coils
1-15MHz crystal test. 2KHz modulation
LDM815 (P&P free of charge) **£51.75**

UHF COAX PLUGS
Post and Packing £0.25 any quantity

PL259	**£0.55**	S0239	**£0.48**
UG175/U	**£0.14**	PL258	**£0.90**
S0239F	**£0.48**	M359	**£1.07**

VHF MONITOR RECEIVERS
12 Chan. FM Monitor, 2½×1½×4½″ 8ozs.
12KHz BW. 130-170MHz

HF12	c/w Accessories	**£57.50**
HF12A12	c/w S(20,23),R(0-7)	**£80.50**
HF12M9	c/w 16,6,8,10,67,M,12,14	**£77.00**

COAX SLIDE SWITCHES
50 ohms impedance S0239 sockets

TWS120 1 in 2 out	(p&p £0.20)	**£6.60**
TWS150 1 in 5 out	(p&p £0.30)	**£12.10**
TWS220 2 in 4 out	(p&p £0.30)	**£12.50**

QUARTZ/CERAMIC FILTERS
(p&p £0.30)
QUARTZ – 3.18, 9, 10.7MHz Centre frequencies – 350Hz, 600Hz, 2.4KHz, 6KHz, 12KHz, – 20KHz
CERAMIC – 455KHz (9 and 11 elements) – 2KHz, 6KHz, 12KHz
Prices; Ceramic **£5-£11** Crystal **£18-£25**

QUARTZ CRYSTALS (p&p £0.30)
2m FM Tx; 6, 12, 18MHz Range
2m FM Rx; (10.7MHz), 14.44, 52MHz Range
Convertors: (28MHz), 22(6m), 38.66(2m), 50.5 (70cm) **£2.50** each, **£4.60** pair.
Phone for details
Spares – Standard units for Yaesu etc P.O.A.

MULTIMETERS (p&p free of charge)
20K ohms per volt. 1000X overload on ohms
Plug in range selection.

80	Microtest	40 Ranges	**£19.00**
680G	Supertest	48 Ranges	**£28.15**
680R	Supertest	80 Ranges	**£36.80**

HF/VHF SWR METER
Twin Meter. 3.5 to 170MHz
Calibrated to 3:1 SWR. 50 ohms
Relative Power. S0239 sockets
T3-170L (p&p £0.60) **£12.90**

DIGITAL FREQUENCY COUNTER
100KHz to 30MHz. 12V DC operation
5,7 segment displays resolves to 10Hz
only 6¼×2¼×5½″
RT75D (p&p free) New Low Price **£44.00**

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Callers to any agent or branch.
30p stamps brings 24 page stock/price list, catalogues, brochures etc.

FM BOOSTER
88-108MHz. (FM BAND 11) pre-amp.
Low noise Typ 4.5dB. up to 20dB gain
Fitted flying leads (car plugs)
12 volts. LED indicator. 1¼″×3½″×2¼″
T203 (p&p free of charge) **£8.90**

HF BALUN TRANSFORMER
1:1 Ratio. 3-40MHz. S0239 (UHF) Socket
5½″×1¾″ D. 7½ozs. "Hang up type"
High power handling
H1Q (Post free of charge) **£10.00**

BNC COAX PLUGS
Post and Packing £0.25 any quantity

UG88	**£0.62**	UG916	**£1.07**
UG291	**£0.64**	UG274	**£1.66**
UG914	**£1.07**	UG306	**£1.86**

VHF AND UHF CONVERTORS
50ohm. 9-12V. BNC (p&p free)

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quency of an s.s.b. emission, rather than its assigned frequency. The digital display is multiplexed, but Sony are to be congratulated that there is no perceptible interference to reception. The display is rather dim, presumably in the interests of battery economy, and the receiver needs to be kept away from windows or bright lights. To further conserve battery power, the digital readout can be switched off, though it is arranged to come on automatically at switch-on, or when MW or SW are first selected. The 29 SW bands are selected by concentric switches for units and tens of MHz.

Special Features

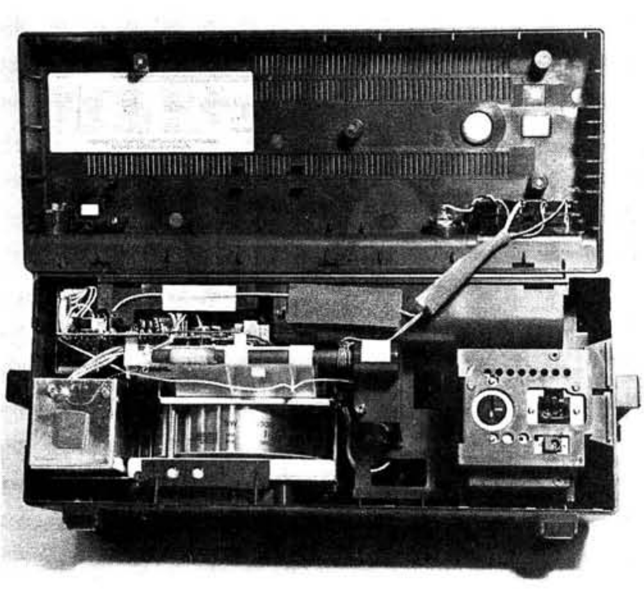
Several of the unusual features have been mentioned already. Another one aimed at battery conservation is a special circuit controlling the dial and meter scale illumination. When operating from mains, this is on continuously, but on batteries, the lights can be brought on by pressing a button which doubles as a battery check facility, using the tuning meter. So you don't need to remember to switch them off again (they draw about 90mA), they are arranged to fade gently out after some 20 seconds. A very luxurious touch! Another special feature, and the only one which, to my mind, could really be dismissed as a gimmick, is a "Memo-lite", which you can switch on for note-taking or reading at night. No doubt it will prove useful to some people.

The front feet on the cabinet are adjustable, allowing the receiver fascia to be tilted to a more convenient angle. The hinged lid over the battery compartment will lock in the open position and carries useful operating information including a frequency spectrum scale showing the limits of the shortwave broadcast bands, and a world map with Great Circle bearings and distances based on London plus international time zones.

There are carrying handles at each end of the receiver, and these incorporate lugs apparently intended to take a carrying strap, though this is not referred to anywhere in the accompanying literature.

Results

Extensive listening tests on all bands have given generally very satisfactory results. No sensitivity or selectivity specifications are published by the manufacturer, but apart from the inevitable compromise resulting from the use of the same filter for s.s.b. and c.w. they would appear adequate. In fact, very good results are produced using only the integral ferrite rod and whip aerials. It is a pity that there is no provision for disconnecting the ferrite rod, nor for connecting an external v.h.f. aerial.



★ specification

Frequency ranges:	MW: 530–1605kHz SW: 1·6–30MHz
Circuit system:	SW: Double superhet with p.l.l. synthesiser
Aerials:	FM: Telescopic whip MW: Internal ferrite rod, plus terminals for external aerial/earth SW: Telescopic whip, or terminals and "UHF" (SO–239) connector for external aerial/earth
Outputs:	Internal loudspeaker: 900mW min. at 10% t.h.d. Headphones: 8Ω via ¼in jack Earphone: 8Ω via 3·5mm jack Recorder: 0·8mV 1kΩ via 3·5mm jack
Input:	Timer: For external control by time-switch via 3·5mm jack
Power Supplies:	Mains: 110/120/220/240V 50/60Hz 9W Internal batteries: 9V (6 off HP2 etc) External battery: 9V Quiescent consumption on battery: FM: 35mA MW: 140mA (50mA) SW: 180mA (80mA) Figures in brackets are with digital frequency display switched off
Dimensions:	453 × 184 × 227mm overall
Weight:	5·9kg approx. including batteries

The main MW/SW tuning knob is about 50mm in diameter, well-placed, and clear of other controls, and has a slight flywheel action. The tuning rate is approximately 100kHz per revolution, which makes it quite easy to resolve an s.s.b. signal without need for a clarifier or fine tuning control.

The internally generated spurii are quite strong at 18·6MHz and at 10, 20 and 30MHz, and weaker at the intermediate 1MHz points. The operating instructions acknowledge the existence of such signals and recommend the use of an external aerial, which does indeed help considerably.

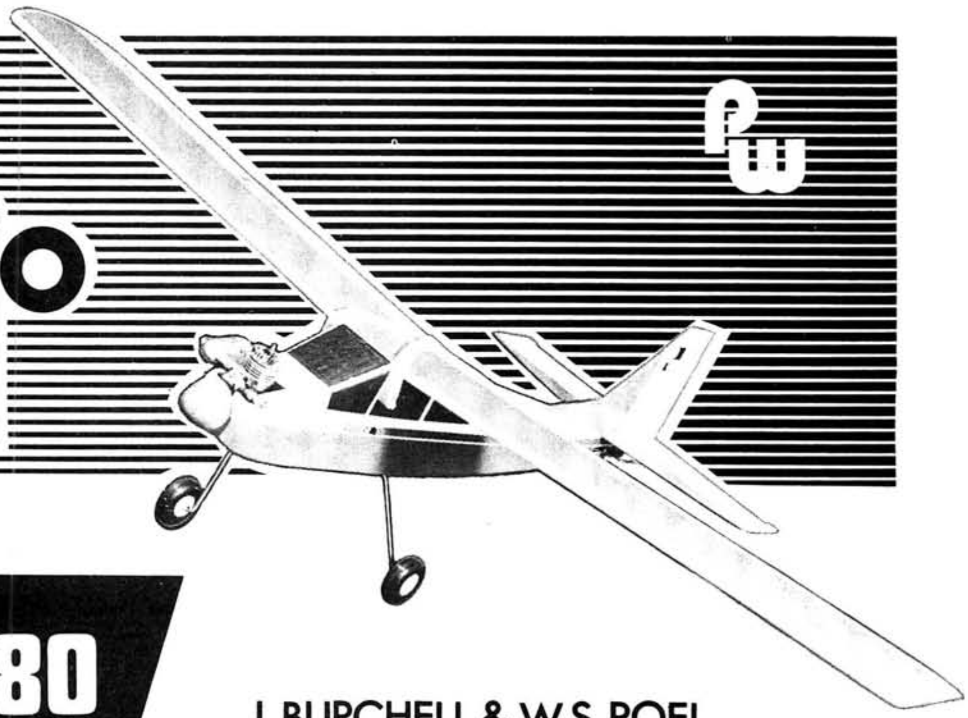
The set is obviously not intended for use in conjunction with a transmitter, as the case is made of plastics, and therefore provides no screening, nor is there any provision for muting. The construction and finish of the receiver might be described as equivalent to better quality domestic hi-fi and TV equipment. The sound quality produced by its internal 100mm loudspeaker is quite pleasant to listen to for entertainment purposes. The provision of a completely separate tuning dial for v.h.f. f.m. gives a bonus of being able

continued on page 78 ▶▶▶

Model Radio Control

Part 3

THE PW FM~80 SYSTEM



J. BURCHELL & W.S.POEL

The series so far has described a control system capable of producing at a remote site, five pulse trains in which the pulse width is representative of the current position of the transmitter control sticks.

To control the flight of a model aircraft, or the speed and direction of a model car or boat, the appropriate controls on the model have to be constantly varied. The most common means of achieving this is with a unit capable of adjusting the control positions by means of a small electric motor controlled by the pulses from the decoder output. This unit is known as a servo and comprises a small motor and gearbox assembly housed in a plastics box. The position of the output shaft is controlled by the servo amplifier and a feedback potentiometer coupled to the output shaft. Later in this series we will be describing an electronic speed controller.

Both of these devices are compatible with most commercial radio control systems, the only requirements being positive-going channel pulses of between 1–2ms duration and a repetition rate of 30 to 60Hz.

The servo-amp. and the speed controller are based on a readily available servo amplifier i.c. There are several manufacturers offering suitable products, and the circuits described use the Signetics NE544.

This i.c. offers good performance, is cheap and readily available. It has also been found from experience to be an extremely hardy device and capable of withstanding severe abuse.

Basic Servo Operation

Figure 1 is a much simplified block diagram of the typical servo system used by most radio control modellers.

The principle of operation is very simple. The input pulse width, representing the desired position of the output arm, is compared with an internally generated pulse controlled by the actual position of the output arm. Any difference in width between these two pulses is detected and an error signal of appropriate width and sense produced. This is processed by the rest of the i.c. and used to drive the motor in the direction required to minimise the error signal, and consequently causing the output arm to take up the desired position.

This cycle of operations is repeated each time the input pulse changes in width, so causing the output arm to track the movement of the control stick on the transmitter.

In the typical model servo the output arm consists of a disc or arm attached to a rotating shaft which moves through 90° for a change in input pulse of 1ms. The output shaft is driven from a small geared down electric motor. The output shaft also drives the wiper of a miniature cermet potentiometer which acts as the feedback device.

The functions enclosed within the dotted area of Fig. 1 are all contained within the NE554, a diagram of which is shown in Fig. 2. All that is necessary to produce a working servo is the addition of a few external timing components.

Circuit

The complete circuit is shown in Fig. 3. VR1 is the feedback potentiometer and is driven from the reference voltage available on pin 3 of IC1. The potentiometer works as a potential divider and the actual value is not critical, any value from 1·5kΩ to 15kΩ should work. Most servo mechanisms seem to have 5kΩ potentiometers built into them as standard along with 11Ω motors.

The capacitor C6 must have a low internal resistance and a tantalum should be used. To produce the miniaturisation required to allow the electronics to fit inside the servo case all the capacitors should be miniature tantalum or monolithic ceramic types.

The 544 can drive 11Ω motors directly but also has drive outputs for external *pnp* bypass transistors; it is recommended that these be employed in all cases, as the drive capability is raised to well over 1 amp. Also some

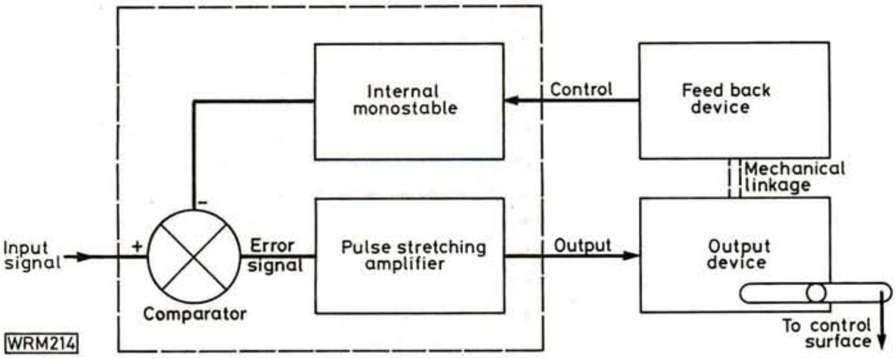


Fig. 1. Block diagram of a servo

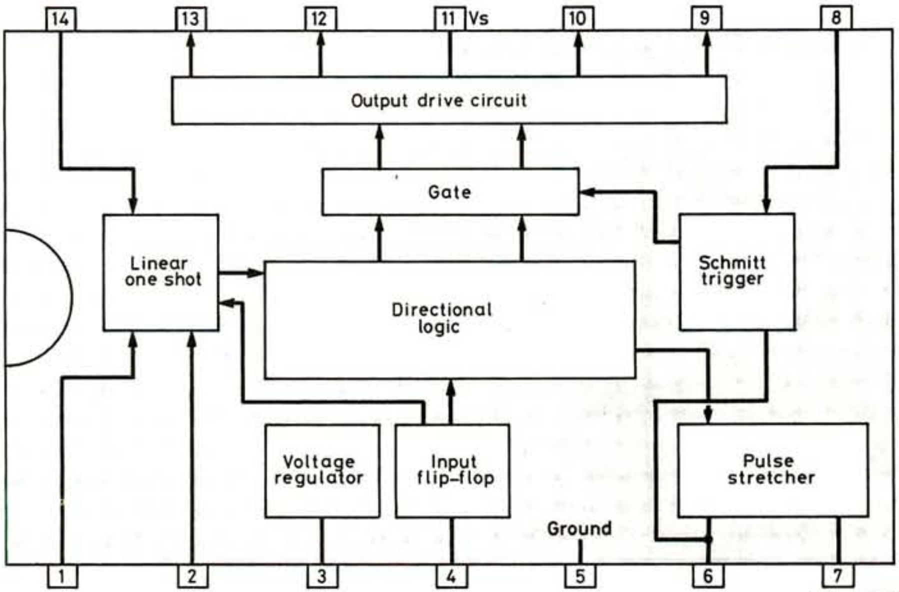


Fig. 2. The Signetics NE544

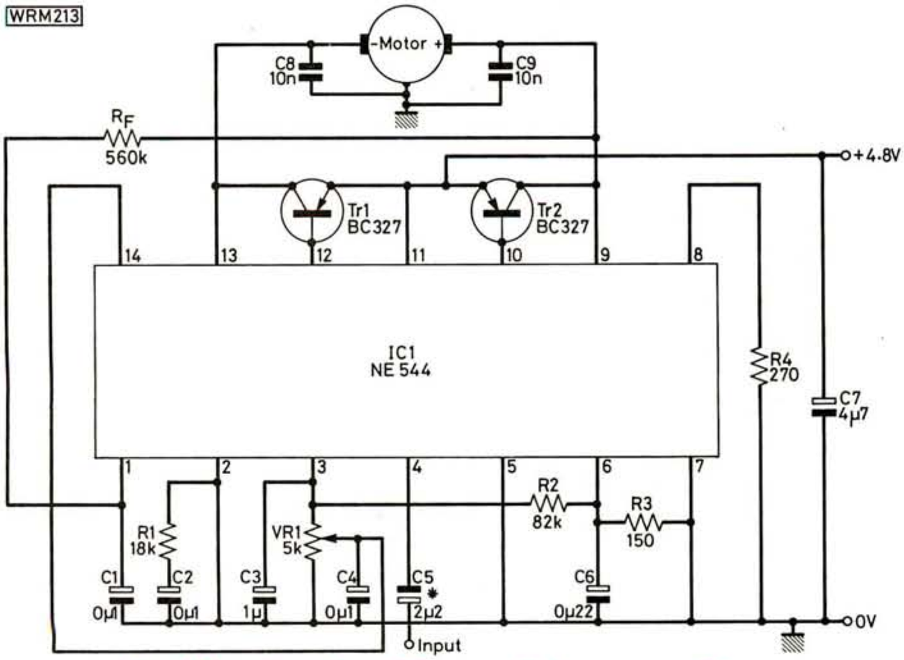


Fig. 3. Complete circuit diagram of the servo amplifier

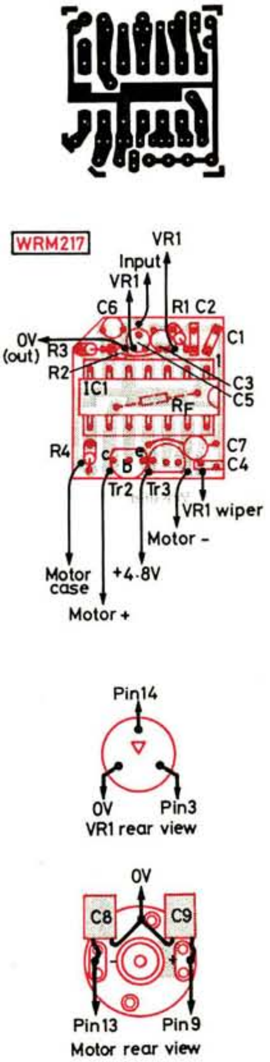
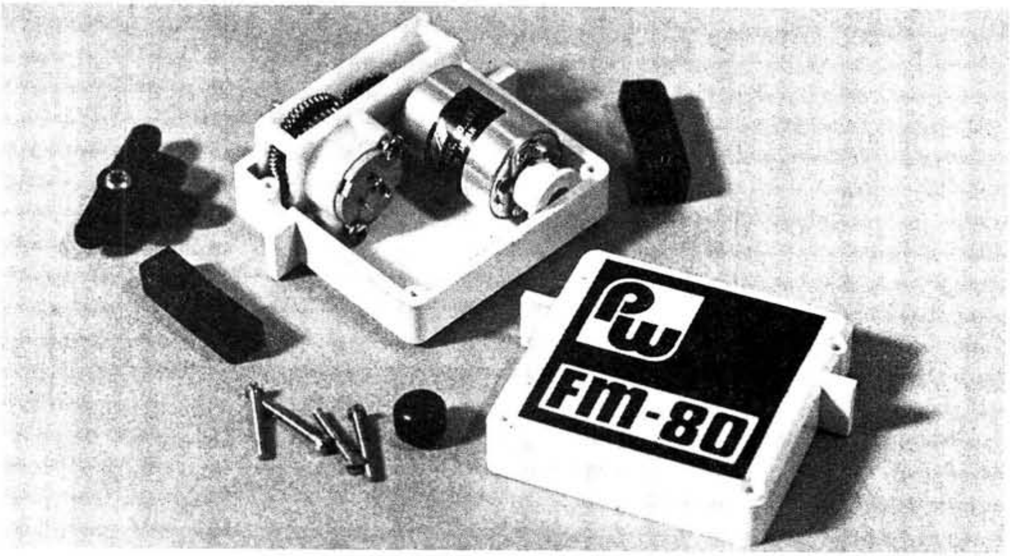
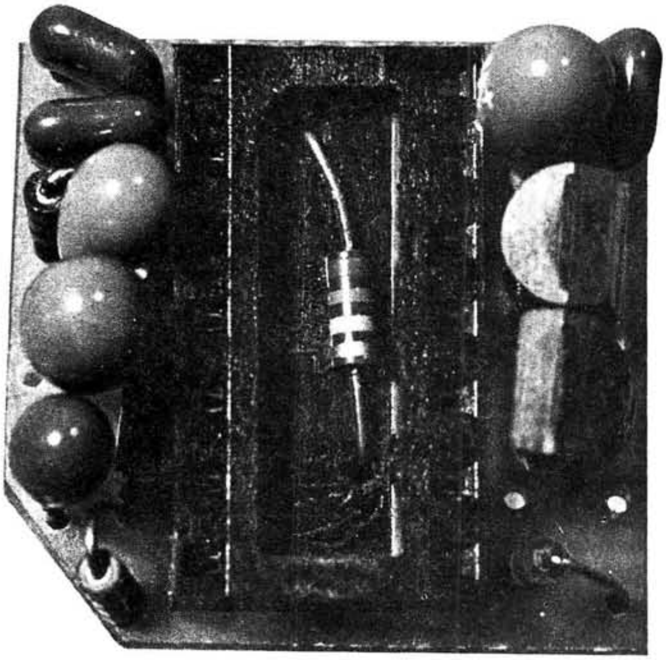
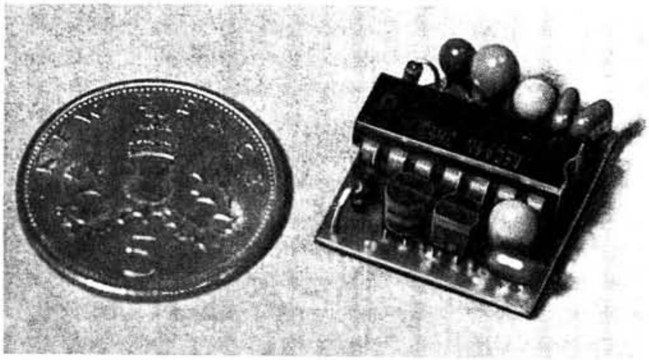


Fig. 4. (Top) the copper track pattern of the servo amp. p.c.b. shown full size. (Centre) the component placement drawing again full size. (Bottom) the wiring of the motor and potentiometer

The picture on the right shows the various component parts of the Micron servo mechanics chosen for the *PW* FM–80 servo ▶

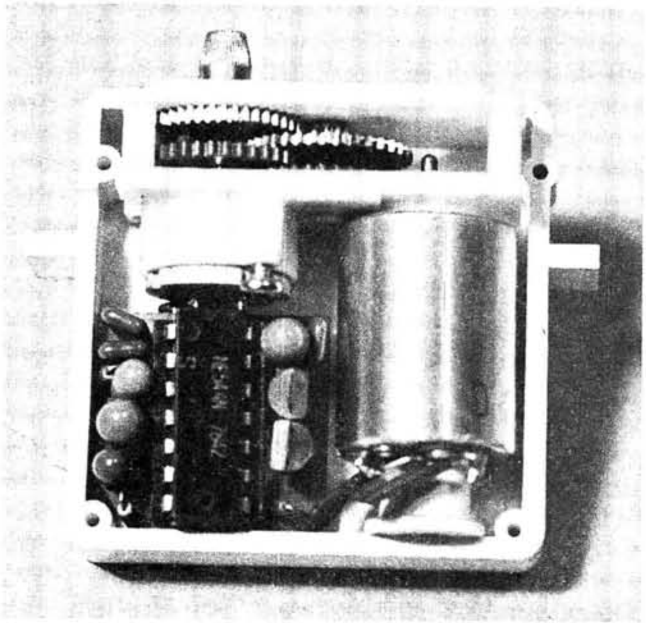


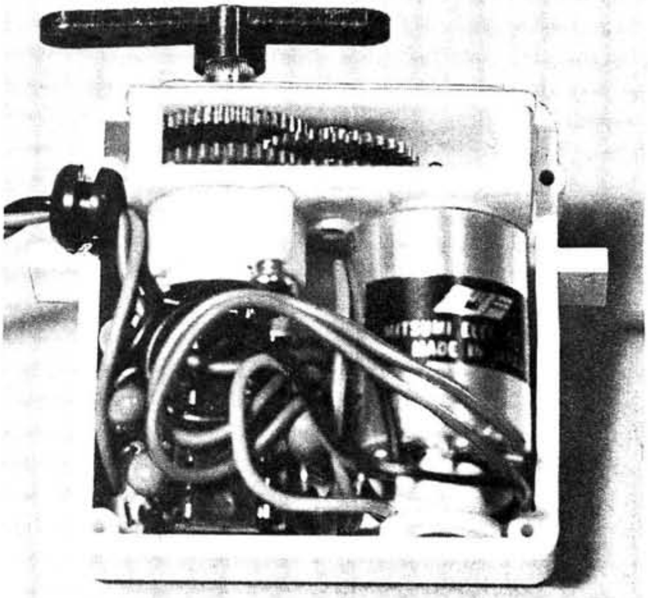




▲ The p.c.b. with the components inserted but no external wiring

◀ This shows the method of placing the feedback resistor in the i.c. socket





▲ The completed servo showing how the internal wiring is carried out

◀ The p.c.b. is fitted into the case and held in position with a self-adhesive foam rubber pad

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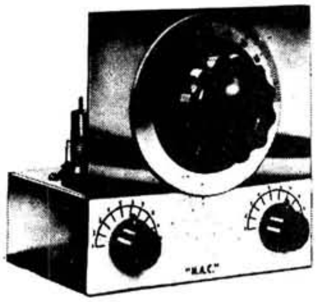

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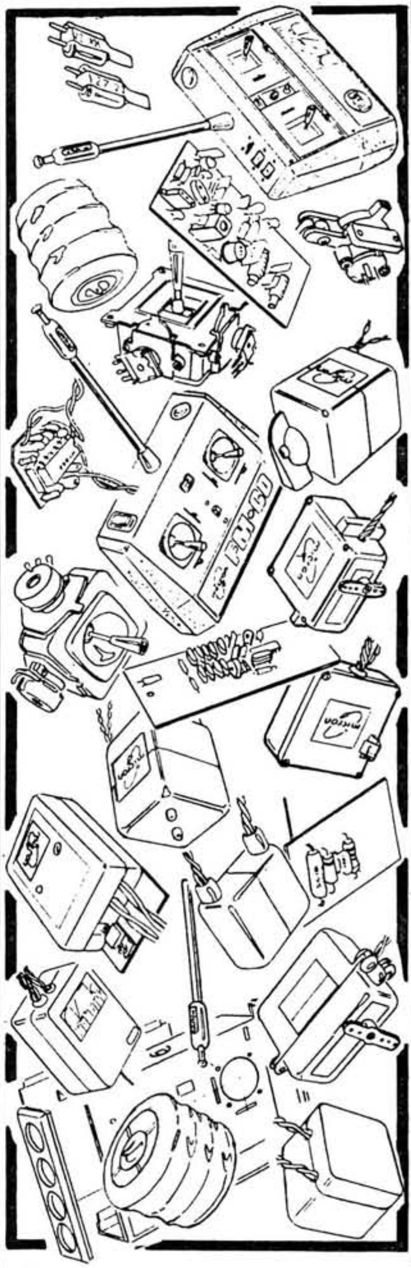

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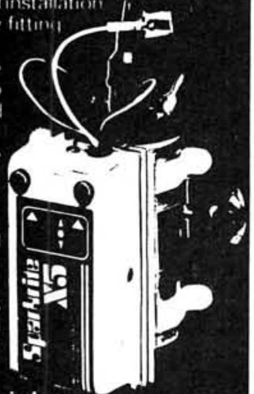

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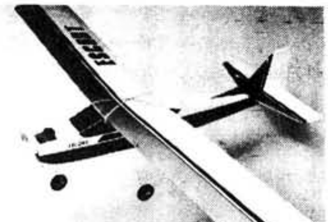

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protection is offered to the i.c. against shorted-out motors.

Damping of the amplifier is provided by resistor R_F. Mechanisms with high mechanical gain may require a reduction in the value of this resistor together with an additional feedback resistor between pins 13 and 14. The input signal is fed to the amplifier through a 2·2µF tantalum capacitor C5. This capacitor can be replaced by a 10kΩ resistor for use with the *PW* FM-80 or most other systems.

The 544 is, at least in part, utilizing a high gain width-band amp. and it must be properly decoupled to prevent its taking off; this is the function of C7 which must be placed close to the i.c.

The values shown have been found to work with all the servo mechanisms tried, ranging from expensive metal geared types to ones made out of the steering mechanisms of cheap radio controlled plastic cars. The 544 is a very versatile device and anyone wishing to design their own mechanisms should consult the manufacturer's data sheet. It is possible for instance to increase servo travel up to the whole active area of the feedback potentiometer and Figs. 5a and 5b show how to do this.

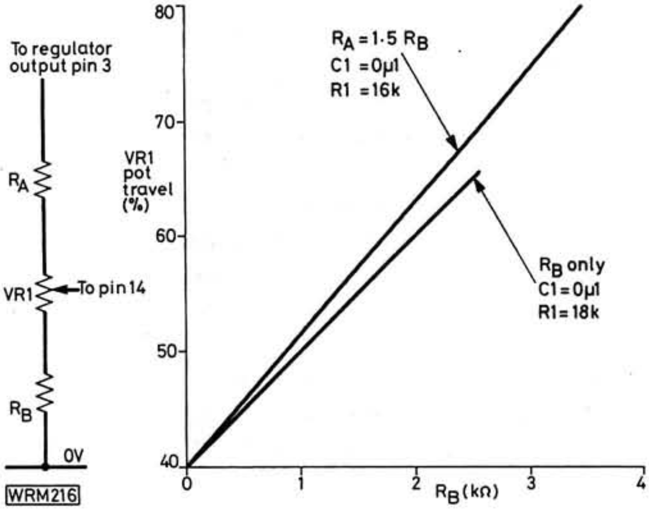


Fig. 5a. (Left) the addition of resistors R_A and R_B to alter the output shaft throw of the servo. Fig. 5b. (Right) the effect of adding the extra resistors

Construction

The p.c.b. layout is shown in Fig. 4. As can be seen the board is small, allowing it to fit inside most of the commercially available servo mechanisms. The board should be $\frac{1}{32}$ inch thick.

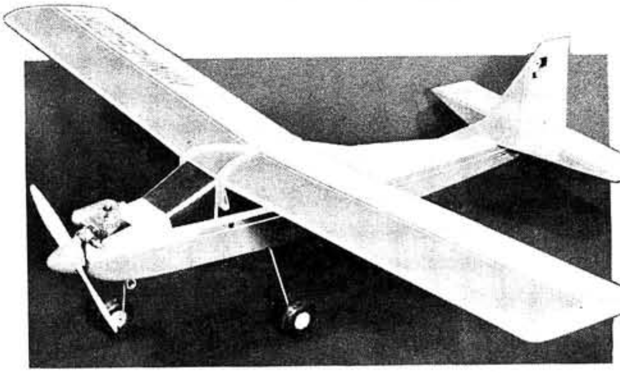
Construction must be carried out carefully and methodically using a clean small soldering iron and 22 s.w.g. resin cored solder.

The capacitors used must be miniature tantalum or monolithic ceramic types and the resistors should be $\frac{1}{8}$ watt types.

First fit the i.c. socket followed by resistor R_F. This fits inside the i.c. socket, passing through small holes drilled in the socket base.

Now fit the remaining capacitors and resistors. The resistors are mounted vertically as shown in the photograph. The bypass transistors can now be fitted, again making sure that they are the correct way round.

The servo mechanics chosen for the *PW* FM-80 system are Micron's metal geared type. These are of good quality and small enough for most applications. However, any other type of servo mechanics could be used and the photographs show several others.



The servos described in this article fit easily into Galaxy Models Mini-Escort trainer

Connect up the feedback potentiometer, after trimming the terminals back to about 2mm long, and the motor, as shown in Fig. 4. Each motor lead should be decoupled at its entry to the motor-case by 10nF ceramic plate capacitors to help suppress any r.f. interference.

For those constructors who feel that the servo amplifier is just a bit too miniature for their soldering capabilities, any commercial servo can be used as long as it accepts positive going pulses with a nominal centre length of 1·5ms and a shift of 1 to 2ms.

Testing

As is good practice with all newly constructed circuits, the servo should be powered up from a current limited supply set to 4·8V. If this is not available then use a 4·5V stack of ordinary dry cells. If the only power source

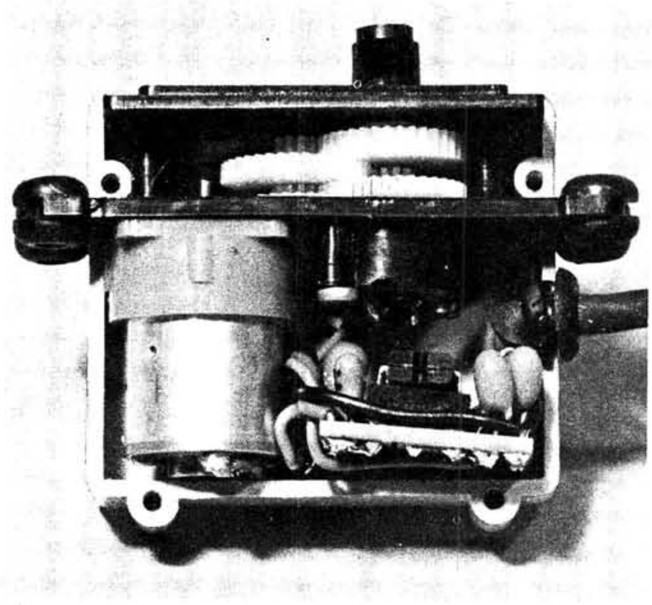
★ components

Resistors		
$\frac{1}{8}$W 5%		
150Ω	1	R3
270Ω	1	R4
18kΩ	1	R1
82kΩ	1	R2
560kΩ	1	R_F
Capacitors		
Ceramic disc		
10nF	2	C8,9
Tantalum		
0·1µF 35V	3	C1*,2*,4*
0·22µF 35V	1	C6
1µF 35V	1	C3
2·2µF 35V	1	C5*
4·7µF 16V	1	C7
(*See text)		
Semiconductors		
Transistors		
BC327 or MPS3638	2	Tr1, 2
Integrated Circuits		
NE544N	1	IC1
Miscellaneous		
Printed circuit board; Servo mechanics, Micron MRC 05 fitted with 5kΩ pot and 11Ω motor; 14 pin d.i.l. low profile i.c. socket.		

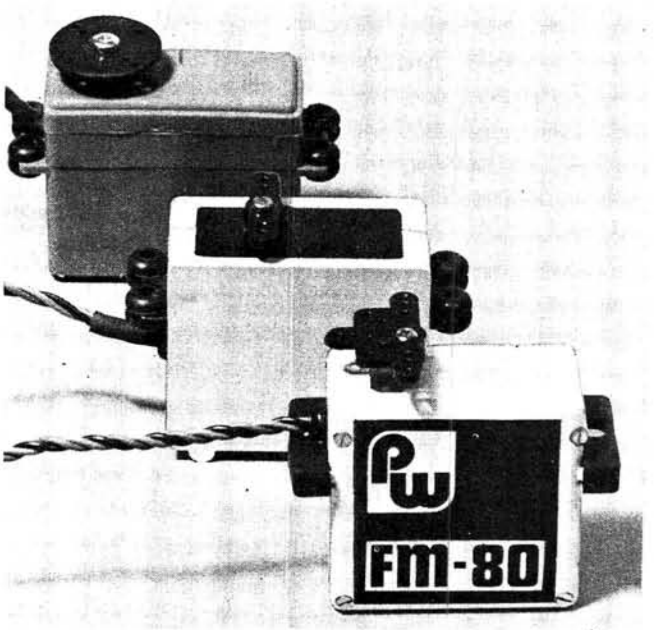
available is a stack of NiCads then extra care must be taken. As freshly charged NiCads can provide a current of several amperes, a series current limiting resistor would be a good idea in this case.

On powering up, the current drawn with no input signal should be less than 10mA providing the motor is still. If all is well an input signal should now be connected, if not, double check everything.

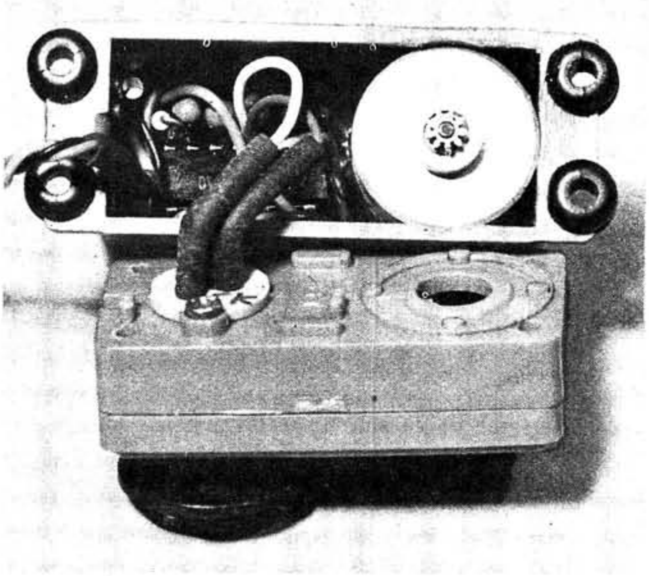
The input signal can either be the output of the rest of the control system or a pulse generator set to provide positive going pulses of 4·8V amplitude of between 1–2ms width at a rate of 50Hz. On applying the input signal the motor should take up a position and remain still. Altering the width of the input signal (e.g., by moving the relevant control stick) should cause the output arm to follow.



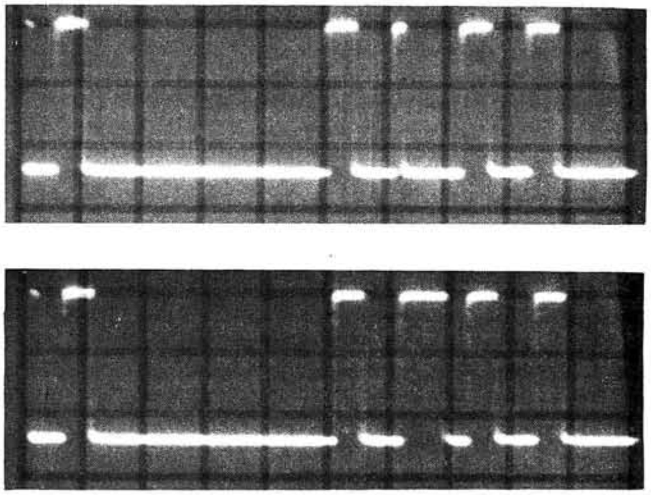
The amplifier fits easily into other servo mechanics as shown here. This unit is a low-cost unit fitted with an 11Ω motor and 5kΩ potentiometer



Three different servos. Front is the *PW* FM–80 unit, centre is a low-cost model with an SLM FB3-B at the back



The internal volume of the FB3–B servo is large but awkwardly arranged compared with the side opening type used for the *PW* FM–80 servo



These waveforms, taken directly from the tube of the *PW* Purbeck oscilloscope shows the output of the *PW* FM–80 encoder unit. The top trace shows the second channel set to a minimum (1·0ms) while the lower one shows the opposite state (2·0ms)

If the output arm continuously rotates, and the input signal is known to be in the range 1–2ms, then the sense of the motor connections is incorrect and must be reversed.

Note that only the motor connections are changed—leave the potentiometer connections alone.

Later in this series a servo test unit will be described which will enable the modeller to check the operation of his servos and set them up without needing to use the transmitter and receiver.

The next part will deal with the electronic speed controller, designed with the car and boat enthusiast in mind.

A licence is required to operate radio control equipment. This costs £2.80 for five years. Application forms are available from: The Home Office, Radio Regulatory Dept., Waterloo Bridge House, Waterloo Road, London SE1 8UA

HOTLINES

A REVIEW OF RECENT DEVELOPMENTS

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

Liquid crystal needle

For many years there has been a difference of opinion concerning analogue versus digital meters. The analogue addicts argued that their approach allowed both rates of change and absolute values to be seen at a glance. But the market was slowly being educated into thinking that it was a "Digital World".

It now seems that the boffins at a British Research establishment have come up with the answer—an analogue-digital meter! The idea employs a liquid crystal approach which has 120 "pointers" with a conventionally marked scale. The relevant pointer when switched on, becomes a blue line on a grey background. The display can be driven directly via suitable logic circuitry and has two very important features.

Firstly, because of the clever design, the number of display connections has been reduced to a very small number—only 23 pin connections are required. Secondly, the researchers appear to have got round the temperature sensitivity problem. Liquid crystal displays are very sensitive to temperature variations at their turn-on threshold. Although a few wrist watches use a "digital pointer" approach, these are normally worn on the wrist which keeps the entire unit at a reasonably constant temperature. The new approach could be important since it might prove useful in automative applications and, of course, electronic instrumentation.

Wafers

The second important item (could there be a connection?) is that of reports of a thing called Wafer Scale Integration. The idea is that when i.c.s are "printed" down on their big substrate, instead of cutting them up into little individual i.c.s and packaging them, to leave them just where they are and connect them up on the one big slice.

Complete data processors could be built on one wafer. As it stands, the present technique of using various i.c.s on a Mother board spreads out the connections and brings time propagation delay problems. By connecting the i.c.s up on a 4 inch wafer, propagation times would become picoseconds instead of microseconds.

Apart from the technical advantages, the savings in packaging, size, cost, plus increased density could become quite staggering. Why use an external memory at all? Just build it in on the wafer.

The researchers are also talking about built-in fault diagnosis, built-in self-repair, and error detection. With literally hundreds of i.c.s on the wafer, duplication back-up makes sense. One idea, for example, is that should a memory circuit fail, the wafer would immediately switch to another duplicate i.c. Because the propagation times would be so very fast, the user probably would not even notice the event.

Although in its infancy, I predict that this approach will have great impact later in the 1980's. One company has been busily working on it for nearly eight years. While details are as yet sparse, the very feasible possibilities are already being talked of. One example is that WSI could be used as a solid state "disc" memory in computers. No moving parts and about 10 times the speed of magnetic bubbles.

Mods

Meet the monolithic optoelectronic detector. They're very new and, as far as I know, not available in Europe as yet. The brain-child of a Japanese company, these interesting devices are optoelectronic, analogue sensors. They are able to provide two-dimensional, positional information on any spot of illumination that happens to pass across their surfaces. Usefully, almost "any old light" will do, from ultra violet to infra red. External circuitry required is claimed to be simple and, by using a.c. coupling, the effects of ambient light interference are avoided.

The surface area of one of these sensors is only 13 × 13mm, however, light could easily be focussed to a small spot. I cannot think of an immediate application, certainly in amateur constructor circles. Perhaps readers might like to have thoughts ready for when they become available "surplus" at 50p each down Lisle Street.

Mais oui

I hear from spies in gay "Paree" that a French company is to market computer systems to give you the perfect home! The control panels are pictorial and so could make sense in any country. Among the many things these electronic environment robots will control are humidity, temperature, communications, ionisation of the air and security. The first one is to be installed in Belgium and is reckoned to be costing over £200,000. I think that the ageing Ginsberg seaweed will have to suffice for just a little longer.

Tape searching

For tape recorder and hi-fi buffs—great news. Bet you're fed up with trying to find the beginning of a particular recording. First you go past it and come in halfway through. Then you fast-rewind and come in part way through the previous item. Not any more. A certain large Dutch company (guesses on a postcard please) has brought out a tape recorder that puts a special marker on the tape (electronically) at the start of each recording. It also employs a separate read head which looks for the coded marker, when you ask it to, via the front panel. When the head finds the marker it immediately slows the tape speed to normal and plays.

The only other type of electronic system I've heard of that did this was one which looked for the pause or non-recorded section between recordings. The Dutch Company (definitely only postcards!) claim that this type of system can be unreliable since it may not accurately differentiate between no recording and legitimate pauses in required recorded pieces.

The recorder is designated the N2554, and offers all sorts of goodies in recording, and all sorts of baddies for wallets—like around £450. Ah, where's my trusty old Lane tape deck?

Ginsberg

ELECTRONICS IN SCHOOLS

M.H.S.HIGLEY T ENG (CEI) MITE

In this age of mass technology it is becoming increasingly important for everybody to have something of a basic understanding of electricity and electronics and the ways in which the ubiquitous electron can be made to work to our advantage. I am sure no one could fail to appreciate that electronics, in one form or another, now affects every single person in his daily life.

With this approach in mind, my school, the Queensbury School in Dunstable, Bedfordshire, has taken the initiative by including electronic project work in their curriculum for fourth and fifth year pupils who wish to study either Technology or Electronics. Projects which have been undertaken include simple radio receivers, photocell applications and moisture detectors for the less able pupils, with the more advanced pupils constructing such projects as the Mullard 10W audio amplifier, a manual telephone exchange with 5 lines, a Logic Tutor box utilising AND, OR and NOT gates with l.e.d.s as indicators, a power controller with inertia for a model train, a *PW* rev. counter, a logic half-adder using TTL and the RS Components digital clock. One pupil, for his O Level Technology examination project, is developing a system to control street lights so that their light output is automatically adjusted for local fog and smog conditions. Two devices which have been constructed and have performed exceptionally well are the Electrocardigraph and the Logic Tutor box, both of which are described in detail in this article.

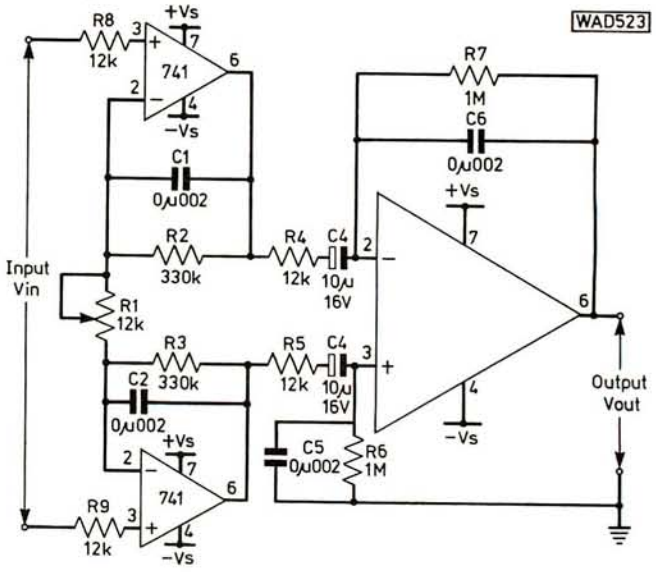


Fig. 1: Detector circuit of Electrocardiograph

Electrocardiograph

This project concerns the construction of a "Life Monitoring Unit" which a fifth year pupil is attempting. He is endeavouring to produce a unit which can be used to monitor pulse rate and body temperature. So far a prototype Electrocardiograph system has been developed employing two copper electrodes, a differential amplifier and a chart recorder.

Perhaps I should explain that Electrocardiography simply means the recording of the heart's electrical activity and this is achieved by taking electrical measurements on the surface of the body. Due to the chemical changes that take place, electricity can be found in the heart within the membrane of the myocardial cells. These are the heart muscle cells and provide the mechanical pumping action of the heart. The electrical signals picked up by the electrodes may be displayed either on an oscilloscope or chart recorder. This is a very important aid to a doctor and gives an indication of any abnormalities in the rhythm, rate and conduction of the heart. It was decided, unlike the practice in hospital e.c.g. units where several electrodes are used, to have only two electrodes in the school system. The electrodes are placed one on each wrist and the other ends of the leads are plugged into the two inputs of a high gain differential amplifier. The output of the differential amplifier is monitored either with an oscilloscope or a chart recorder. Ideally the electrodes would be silver discs but we used copper discs suitably cleaned. When attaching the electrodes the dead surface skin, which is non-conductive, is removed with fine glass-paper and the wrist wiped with a brine solution to aid conduction. Having connected the subject, the differential amplifier and the recorder, the pulse rate is then plotted. It helps if the subject is calm and keeps absolutely still while the measurements are taken.

The Head of Physics occasionally manages to find time for a 25 minute training run across the Dunstable Downs and it was decided that he would make an ideal subject for the e.c.g. "machine". His pulse rate was plotted immediately before and after the training run. The first plot showed he had a pulse rate of 84 which we thought was

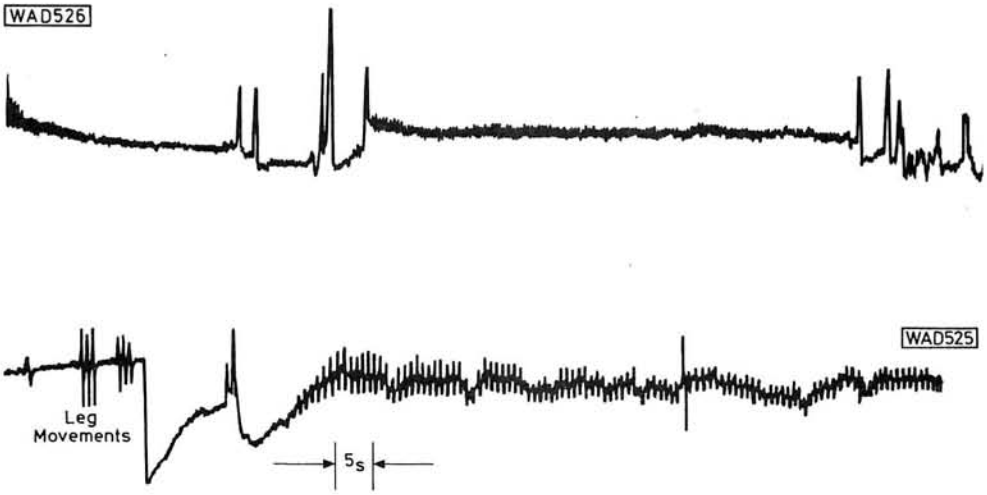
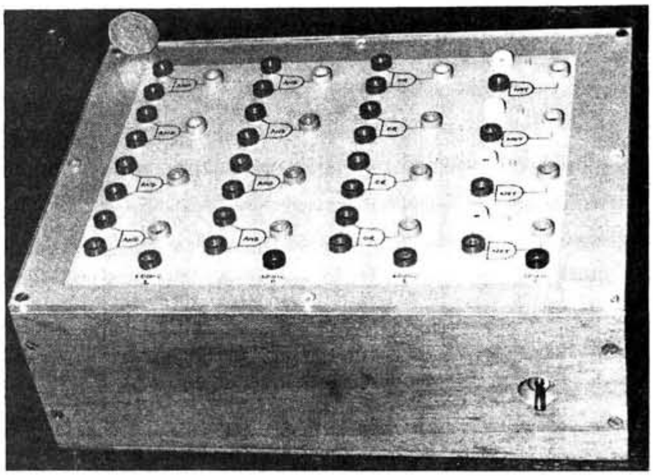


Fig. 2: Typical traces obtained on the e.c.g. pen recorder

slightly high but it was decided that this was probably due to a stress factor while undergoing the test. After the training run the plot showed he had a pulse rate of 120. This was confirmed by an independent measurement taken by our laboratory technician who held his wrist and counted the pulses.

To ensure the e.c.g. system worked we obtained large deviations on the graph paper whenever we requested our subject to move a leg or stamp his feet! This was done at the start of the recording and once towards the end, just to prove the system was working. Comparing the two traces it is noticeable that the 120 pulse rate recording has a smaller amplitude and this, we feel, is probably due to the frequency response of the recorder. Having completed this section of the project the next stage is to construct a unit to measure body temperature. It has been decided to build an electronic thermometer using a bead thermistor and a 741 op. amp.



The logic tutor box

Logic Tutor

Many pupils who opt for Technology also take Computer Studies. In Technology classes they have the opportunity to build the logic circuits which they encounter. The TTL integrated circuits are ideal for school use because they are inexpensive and several gates are available on one chip.

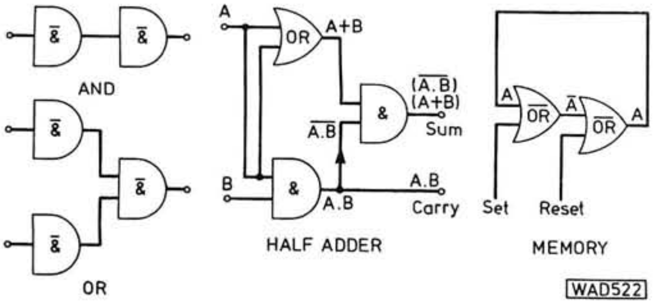
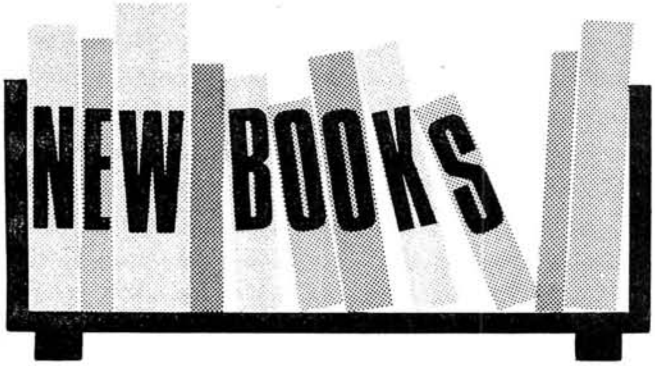


Fig. 3: Construction of other types of gate

A fifth year pupil has used the 7400 integrated circuit in his construction of a Logic Tutor. The Tutor consists of eight 7400 (NAND) integrated circuits and from these he has produced a box with eight AND gates, four OR gates and four NOT gates. The tutor also has two logic 1's, two logic 0's and four l.e.d.s. It was decided not to have manual switches, giving either logic 1 or logic 0 outputs, fitted to the box.

Because the Computer Studies syllabus contains only the AND, OR and NOT gates, the NAND gates in the 7400 integrated circuits were connected to form the gates required, using 4mm sockets which, although large, are compatible with technology and science equipment throughout the School.

The Tutor can be used to demonstrate how other gates, such as NAND and NOR, may be produced. "Truth tables" for all the gates may be obtained using the logic 1 and 0 facilities together with the l.e.d.s. In addition more advanced logic circuits can be constructed such as the "half-adder" and "memory" circuits. ●



PRACTICAL CONSTRUCTION OF PRE-AMPS, TONE CONTROLS, FILTERS AND ATTENUATORS

by A. D. M. Smith
Published by Bernard Babani (publishing) Ltd.
111 pages, 181 × 109mm. Price £1.45

This book presents some 16 circuits complete with p.c.b. patterns and component layouts, plus a host of other circuits. Subjects covered include: Magnetic tape recording pre-amplifiers; Microphone Pre-amplifiers; Disc Pre-amplifiers; Tone Controls; Filters; Attenuators and Pads. A final section gives a brief introduction to the manufacture and assembly of printed circuit boards.

AMATEUR RADIO OPERATING MANUAL

by R. J. Eckersley
Published by Radio Society of Great Britain
190 pages, 246 × 181mm. Price £4.20

A new publication from the RSGB, which draws together an amazing collection of operating information and reference data for radio amateurs and short wave listeners.

Chapter titles are: The Amateur Service; Setting up a Station; Operating Practices and Procedures; DX; Contests; Mobile, Portable and Repeater Operation; Amateur Satellites; RTTY; SSTV; Special Event Stations. Appendices cover Continental and Regional Maps, International Callsign Series Holders, Callsign List, Country List and Worldwide Legal Time. All sections are illustrated by a wealth of drawings, maps and tables.

ELEMENTS OF ELECTRONICS

by F. A. Wilson
Published by Bernard Babani (publishing) Ltd.
Book 1—The Simple Electronic Circuit and Components
209 pages, 181 × 109mm. Price £2.25
Book 2—Alternating Current Theory
216 pages, 181 × 109mm. Price £2.25

These are the first two volumes in a new series intended to introduce the beginner to the hobby or career of electronics by imparting a thorough understanding of the fundamental principles involved.

Book 1 covers the nature and sources of electricity, the simple electrical circuit, electrostatics and electromagnetism, with appendices on abbreviations, decimals, logarithms, mathematics, geometry, units, symbols, work and power, and component values and marking systems.

Book 2 moves on to alternating currents, time constants, reactance, impedance, resonance and transformers. The appendices deal with abbreviations, graphs, trigonometry, more mathematics and more geometry. There is obviously a lot more maths in this second book, but it is treated in a straightforward way.

Book 3, which deals with semiconductor technology, will be available shortly, and it is anticipated that there will be further volumes in due course.

ELECTRONIC SECURITY DEVICES

by R. A. Penfold
Published by Bernard Babani (publishing) Ltd.
102 pages, 181 × 109mm. Price £1.45

Readers of *PW* will need no introduction to R. A. Penfold. In this book he covers switch-activated alarms; infra-red, ultrasonic and Doppler shift alarms; light detectors; smoke/gas detectors; high and low temperature alarms, even a baby alarm!

The circuits are simple, based on discrete transistors, CMOS and 555 timers, with strip-board layouts given for the constructor.

YOUR ELECTRONIC CALCULATOR AND YOUR MONEY

by F. A. Wilson
Published by Bernard Babani (publishing) Ltd.
174 pages, 181 × 109mm. Price £1.35

Whilst not in any way a book about electronic calculators, this little volume will nevertheless be of interest to anyone wishing to keep better track of their money: income, outgoings, interest, mortgages, VAT. Calculations cover the home, the car and the small business.

PRACTICAL ELECTRONICS CALCULATIONS AND FORMULAE

by F. A. Wilson
Published by Bernard Babani (publishing) Ltd.
248 pages, 181 × 109mm. Price £2.25

The Preface to this useful book says that it has been written to try to "bridge the gap between complicated technical theory which sometimes seems to have little relevance to practical work, and 'cut and try' methods which may bring success in design but leave the experimenter unfulfilled." It certainly lives up to its avowed intention of avoiding tedious higher mathematics, yet it manages to put across many of the more difficult topics of electronics, such as filter design, in a way which will give reassurance to the struggling student, plus the confidence to tackle and understand more abstruse treatments.

Chapter headings are: Units and Constants; DC Circuits; Passive Components; Alternating Current Circuits; Networks and Theorems; Measurements. Besides the calculations and formulae there is much useful reference data on associated topics.

50 CIRCUITS USING 7400 SERIES ICs

by R. N. Soar
Published by Bernard Babani (publishing) Ltd.
76 pages, 181 × 109mm. Price £1.35

These circuits form a practical series of exercises of use to anyone wishing to learn about digital techniques from the beginning.

BEGINNERS GUIDE TO DIGITAL TECHNIQUES

by G. T. Rubaroe
Published by Bernard Babani (publishing) Ltd.
62 pages, 181 × 109mm. Price 95p

For anyone reared on analogue systems and equipment, this book would form an ideal introduction to the world where everything is strictly black and white, true or false. Subjects include: Number Systems; Codes; Combinational and Sequential Logic; Analogue-to-Digital and Digital-to-Analogue Conversion, plus a very brief look at some of the applications of digital techniques, such as computers, digital voltmeters and digital frequency meters.

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★

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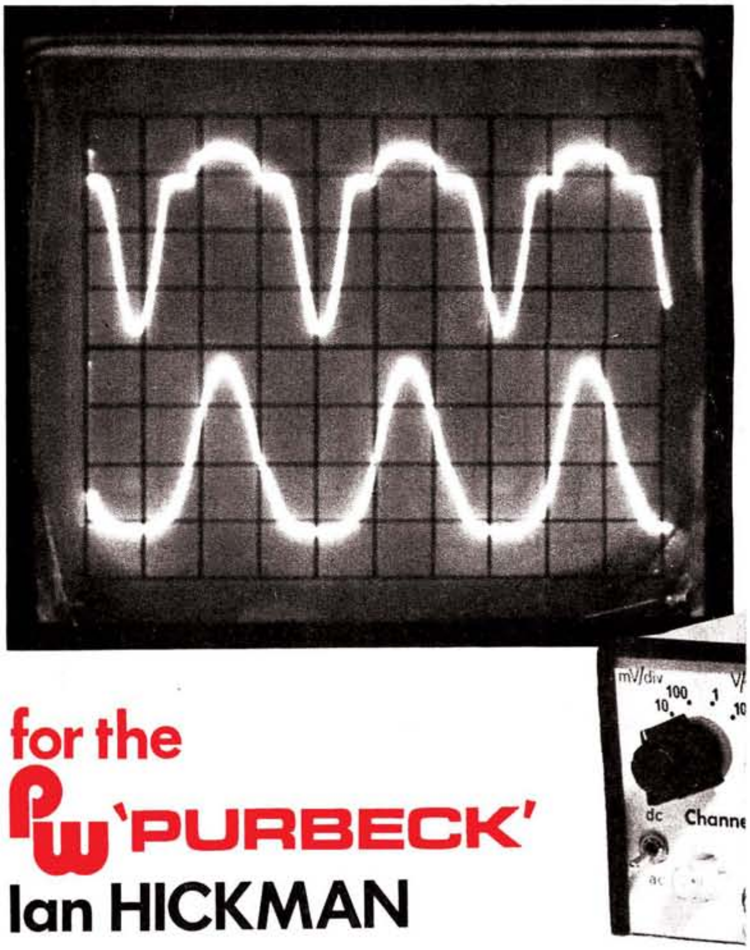
We start with a 4-channel, crystal-controlled hand-held with 500mW output. Later articles will describe a range of "add-on" modules including: speech processor/modulators, 10W power amplifier, mains power unit, battery charger, repeater tone burst with time-out facility and a synthesiser

THE VINTAGE YEARS OF RADIO

A nostalgic backwards look at the pre-war days of "steam" radio, when a fiver would buy you a reasonable set and "Practical Wireless" was a brand new title on the bookstalls



for the PW 'PURBECK'

Ian HICKMAN

Hundreds of readers have built or are building the *PW* Purbeck oscilloscope, and as a result now possess what is undoubtedly the most useful single instrument in the home electronics laboratory. The author's Purbeck is in almost daily use and examples of the problem-solving power of a 'scope occur frequently.

When the original Purbeck was developed, a single channel design was chosen in the interests of simplicity and lowest cost. It was felt that a single trace instrument would meet many constructors' requirements, and certainly the project has proved very popular.

However, there are circumstances in which two trace working is not only highly desirable, but virtually essential. The most obvious example is when checking out logic circuitry, where it is helpful to be able to display the clock waveform on one trace whilst using the other to display the output of, for example, a decade counter.

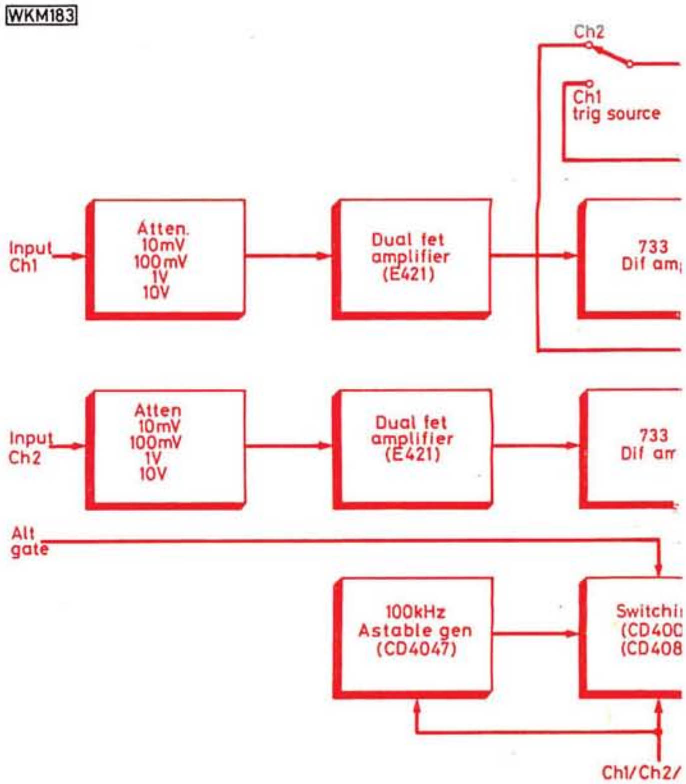
A single trace 'scope can provide useful information to some extent by using the external trigger facility fed from the output of the counter in question, and this is why some 'scopes are fitted with a TRIG VIEW button, which when pressed displays the signal from which the scope is being triggered. However, if the counter or whatever under investigation is triggering erratically, it is much more useful to have two traces displaying simultaneously, a point to which I shall return later.

The accessory described adds to the Purbeck most of the facilities found on a good two channel oscilloscope. The unit is powered from the front panel auxiliary power socket of the Purbeck with which it is used.

Circuit

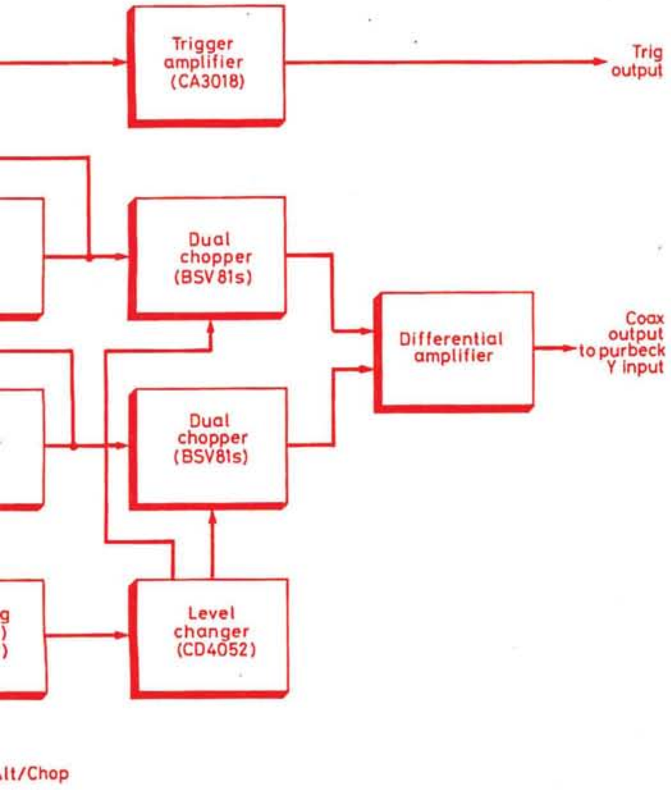
Fig. 1 shows a block diagram of the Dual Trace Unit, from which it can be seen that each of the two input channels is basically the same as the first two stages of the Purbeck amplifier. The output of first one, and then the other, amplifier is switched through to the output amplifier, either on alternate traces ("ALTERNATE" mode), or at a fixed switching rate of around 100kHz ("CHOPPED" mode); alternatively either the Y1 or Y2 channel can be selected, ("Y1" or "Y2" mode). Triggering can be derived from either channel and in addition to the normal triggering mode, an "HF REJECT" facility is provided, the use of which is explained later. Fig. 2 is the circuit diagram of the Y1 attenuator and input stage, that for Y2 is identical. It is virtually the same as that of the Purbeck itself except in two important respects. Firstly, in the Dual Trace Unit, a variable capacitor C503 is used in parallel with the 1MΩ resistor of the 10mV range, at position 1 of the Y mV/division switch S503. This means that the input capacitance of the Dual Trace Unit can be adjusted to equal that of the Purbeck so that it is not necessary to readjust a ×10 probe which has been set up for use with the Purbeck when using the probe with the Dual Trace Unit. Secondly, a variable resistor R517 connected in the source circuit of dual f.e.t. Tr601 provides a continuously variable gain control. This

Fig. 1: Block diagram of the Dual Trace Unit



dual trace unit

Part 1



front panel mounted control is marked to indicate gain settings of ×0·5, ×1, and ×2 and of course also covers the variable gain function thus combining the functions of two knobs on the Purbeck front panel. This arrangement was adopted to enable all the facilities of the Dual Trace Unit to be fitted onto a relatively small front panel, and the finished unit fits neatly in front of the Purbeck as in the photograph on the front cover.

The output of the dual f.e.t. Tr601 is applied to IC601, a 733 video amplifier (see Fig. 3). The maximum gain of the Y channel is set to 5mV/div by preset potentiometer R621, which is connected in the emitter circuit of the input stage of the 733, and the Y1 shift voltage is injected into this emitter circuit also. The balanced output of the Y1 channel amplifier is applied to a pair of BSV81 switching f.e.t.s Tr603, 604, which connect it to the output amplifier when appropriate. The switching f.e.t.s Tr603, 604 are 'on' when +5V is applied to their gates, at which time approximately −4V is applied to the gates of Tr605 and Tr606, keeping them switched off. Thus either the Y1 amplifier output or that of the Y2 amplifier (but never both) is connected to the output amplifier shown in Fig. 4.

Output Amplifier

The output amplifier actually has a gain of less than unity, its purpose being to convert the 733 outputs from a balanced to a single ended circuit and to provide a low impedance to drive the short length of miniature coaxial cable which delivers the output signal from the Dual Trace Unit to the Purbeck Y input. The selection of channel Y1 only, Y2 only, ALTERNATE, or CHOPPED is made by the mode switch S506 (see Fig. 6). This controls gating which via a level shifter CD4052 (IC607) applies +5V to the gates of f.e.t.s Tr603 and Tr604 and −4V (approx) to the gates of the f.e.t.s Tr605 and Tr606—this being in the Y1 only state, or vice versa for Y2 only. On CHOPPED, +5V and −4V are applied to each pair of f.e.t.s alternately at a 100kHz rate, while on ALTERNATE, +5V and −4V are applied for the duration of alternate sweeps of the Purbeck timebase. Being basically an interconnection diagram, Fig. 6 does not make the functioning very clear, so this has been shown in a more functional form in Fig. 7.

Trigger Pick-off Amplifier

Fig. 5 is the triggering pick-off amplifier. The four transistors in the CA3018, IC603, are connected in an amplifier configuration which provides, typically, 49dB of gain with a 30MHz −3dB bandwidth. The gain is greatly in excess of that required, but good use is made of this, as it permits simple mismatch pads to be used to pick off a sample of the signals at the outputs of the Y amplifiers with high isolation and without appreciably loading the amplifiers. The trigger amplifier, which has a low output impedance, drives the external trigger input of the Purbeck oscilloscope.

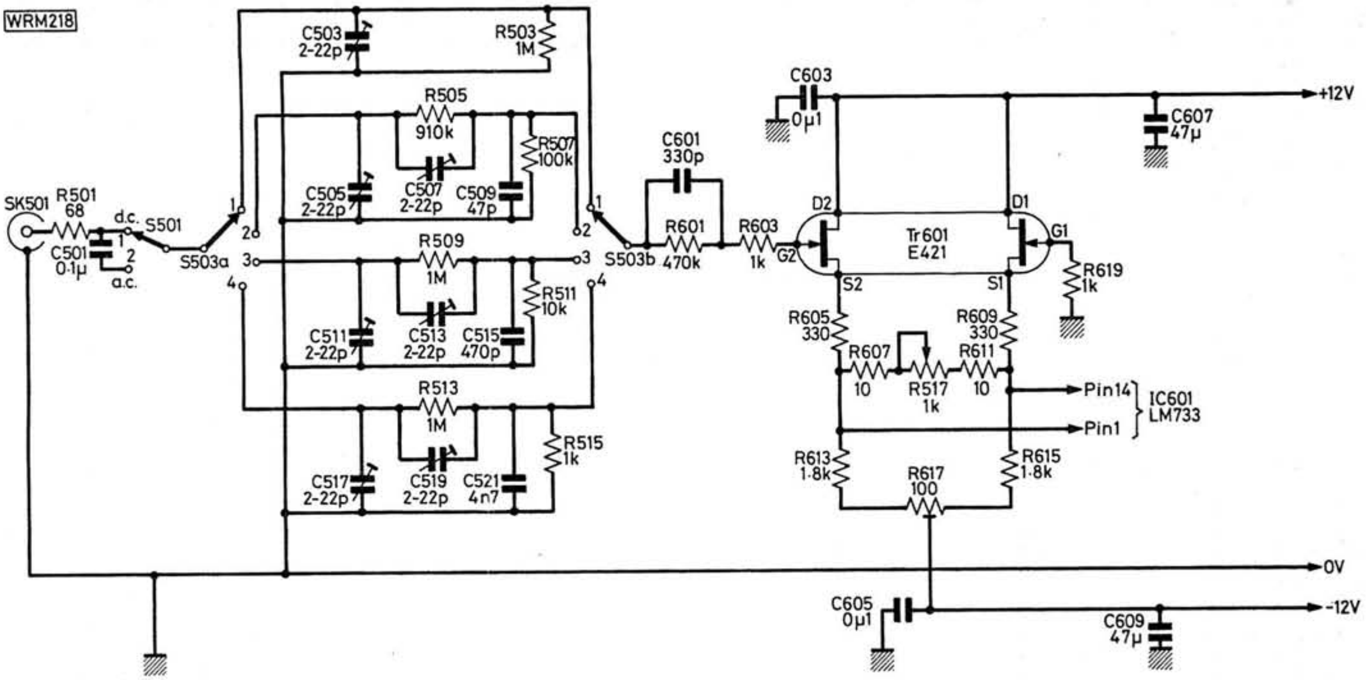
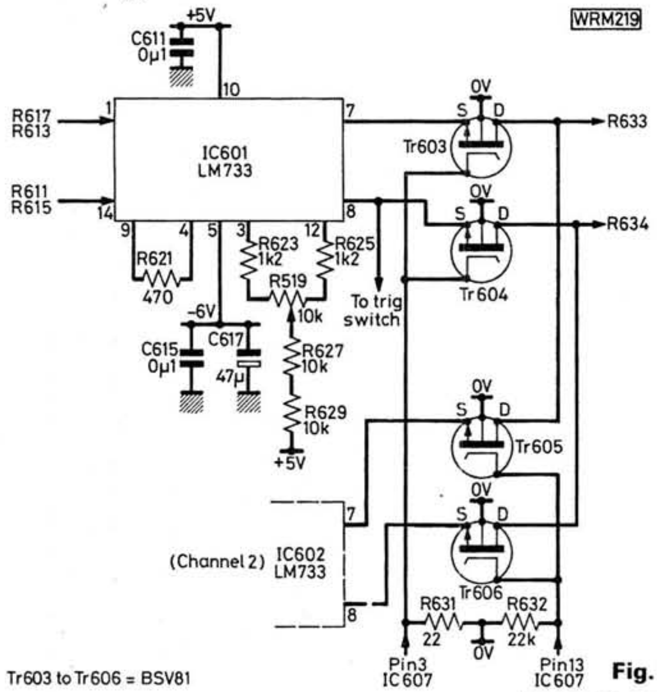


Fig. 2



Tr603 to Tr606 = BSV81

Fig. 3

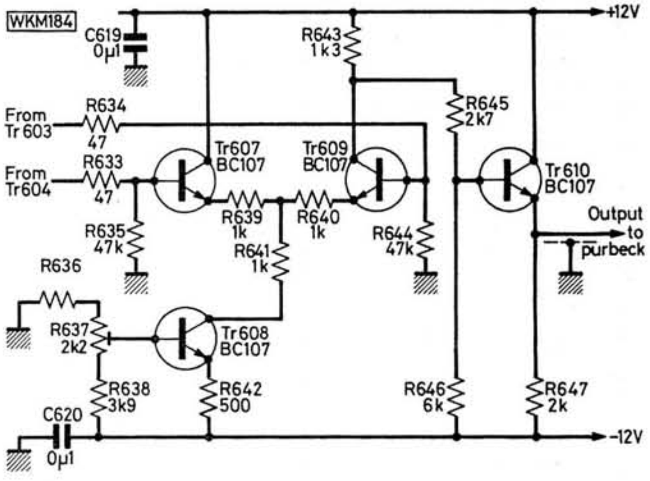
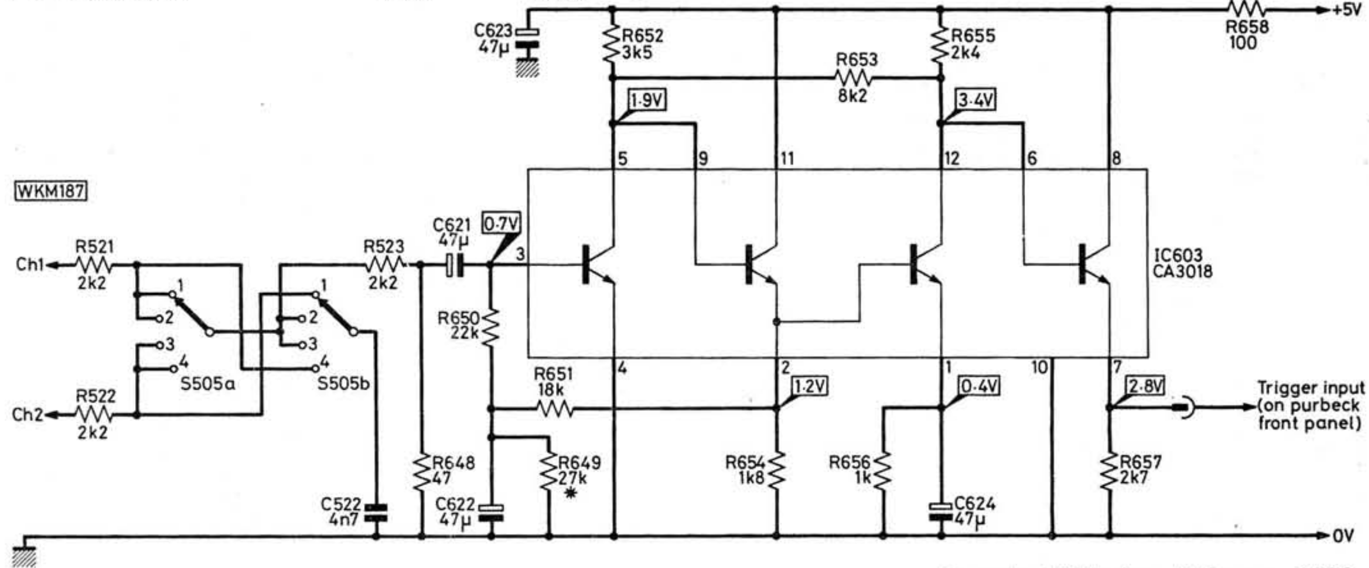


Fig. 4



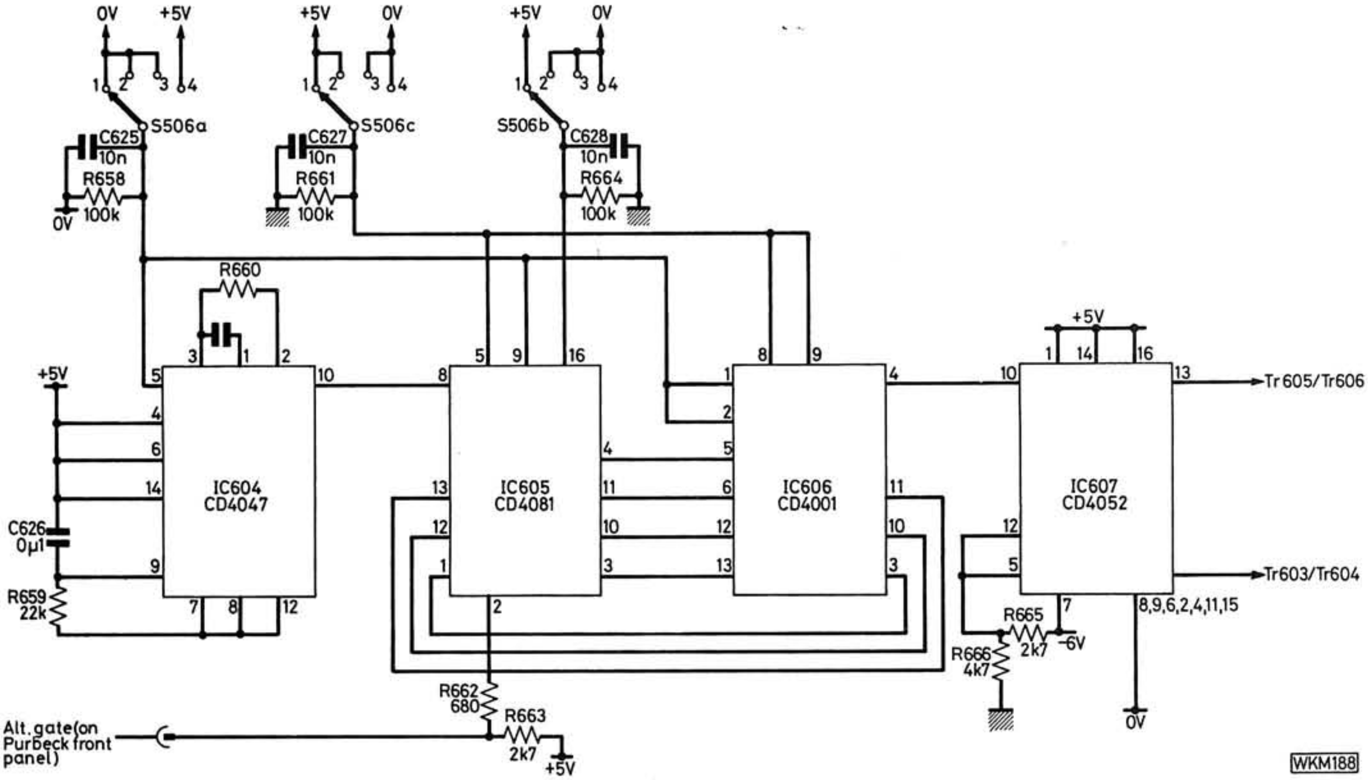


Fig. 6: R660 has a value of 1·5kΩ and the unmarked capacitor is C630 and has a value of 1nF

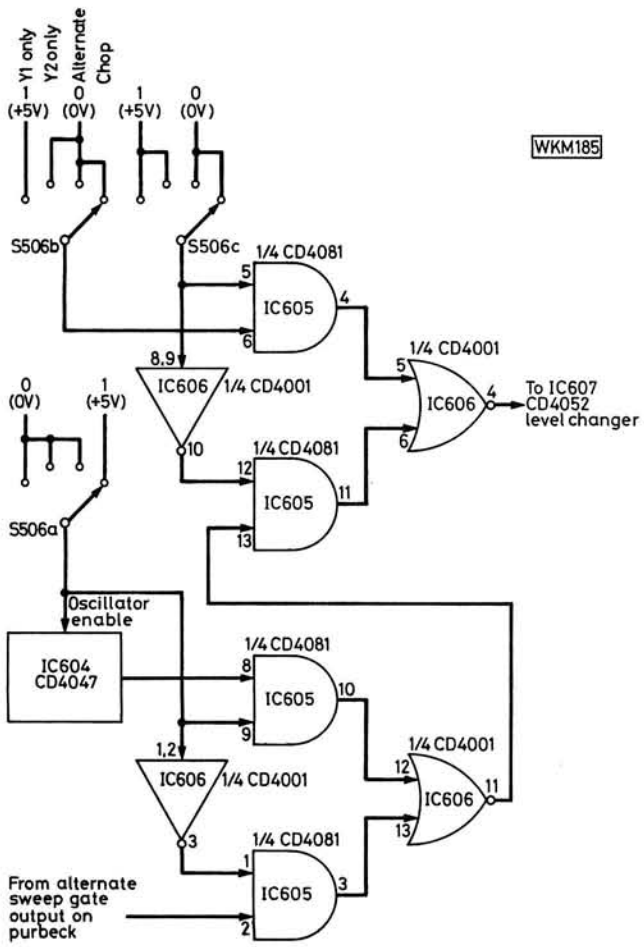
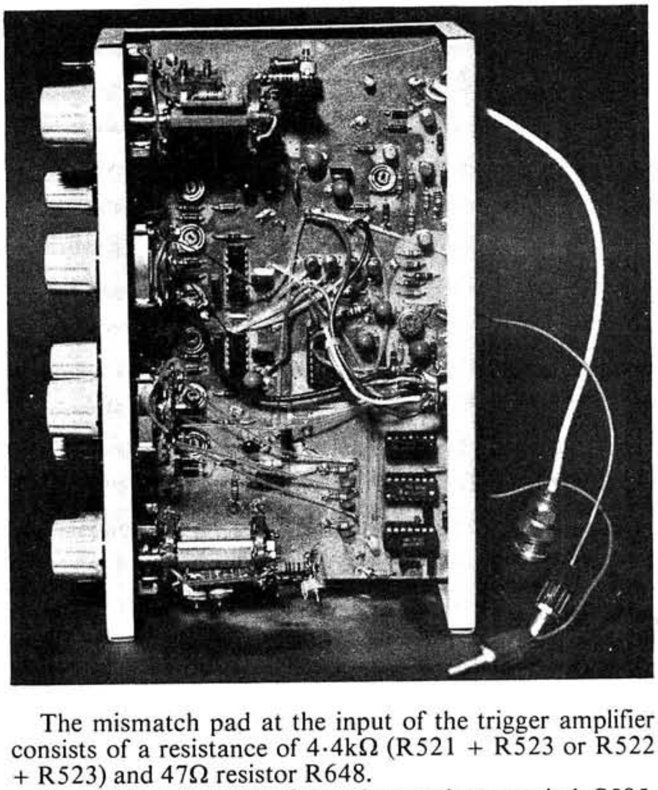


Fig. 7



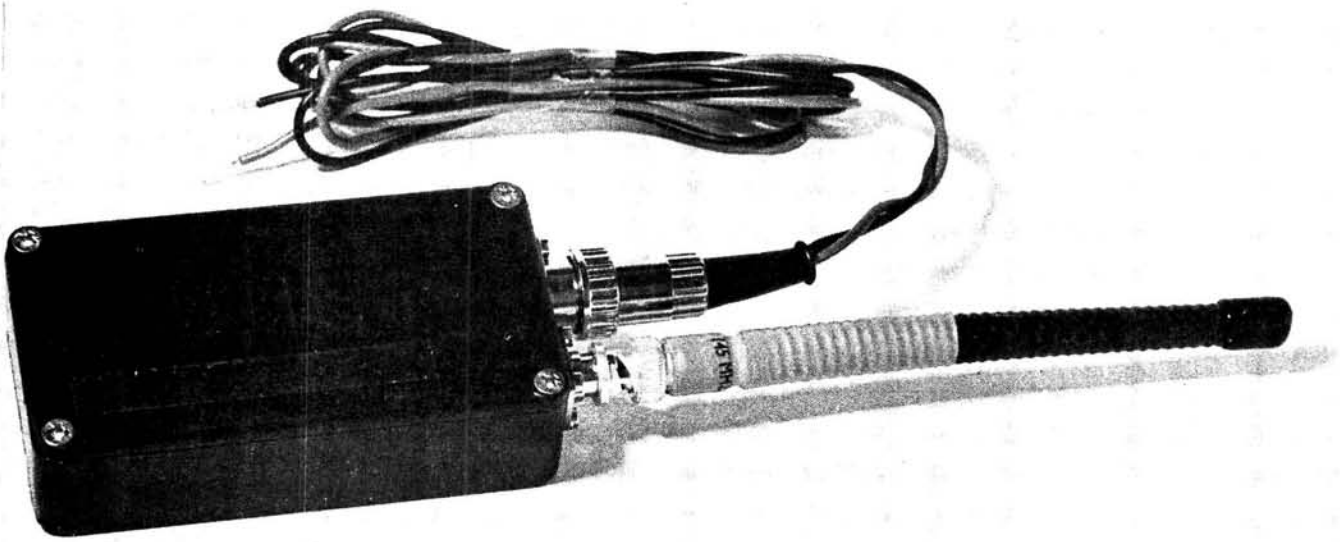
The mismatch pad at the input of the trigger amplifier consists of a resistance of 4·4kΩ (R521 + R523 or R522 + R523) and 47Ω resistor R648.

In positions 2 and 3 of the trigger selector switch S505, the junction of the two 2·2kΩ resistors has a 4700pF capacitor connected to ground. This rolls off the gain of the trigger channel above 40kHz, providing a useful h.f. reject facility, explained further in the last section. In positions 1 and 4, the 4700pF capacitor is used to prevent crosstalk into the trigger channel via S505 stray capacitance, form whichever channel is *not* being used as the trigger source.

In the second part we will cover the construction of the Dual Trace Unit.

SPECIAL PRODUCT REPORT

MICROWAVE MODULES LTD



DIGITAL FREQUENCY METER

The instrument under the *PW* spotlight this month is particularly appropriate as it can be used to monitor the frequency of the *PW* FM-80 radio control transmitter described last month.

The 500MHz digital Frequency Meter MMD050/500 made by Microwave Modules Ltd. is a robustly built unit which can be powered from a 12V d.c. supply or, for use in the field a standard 12V car battery.

To give the frequency counter the necessary strength to resist knocks and bangs when used outside the laboratory the case is a black painted diecast aluminium box. This obviously imposes limitations on the outward appearance and positioning of the display and input leads.

The six-digit l.e.d. display is fitted in the lid of the box while the power lead and input sockets are fitted in one end. No switches or controls are provided, range changes being performed by internal diode switching selected by applying the 12V supply to the appropriate pins of the power socket.

A 145MHz helical whip aerial which mounts onto the 50Ω b.n.c input socket was supplied with the instrument and this is used when checking the output frequency of a transmitter.

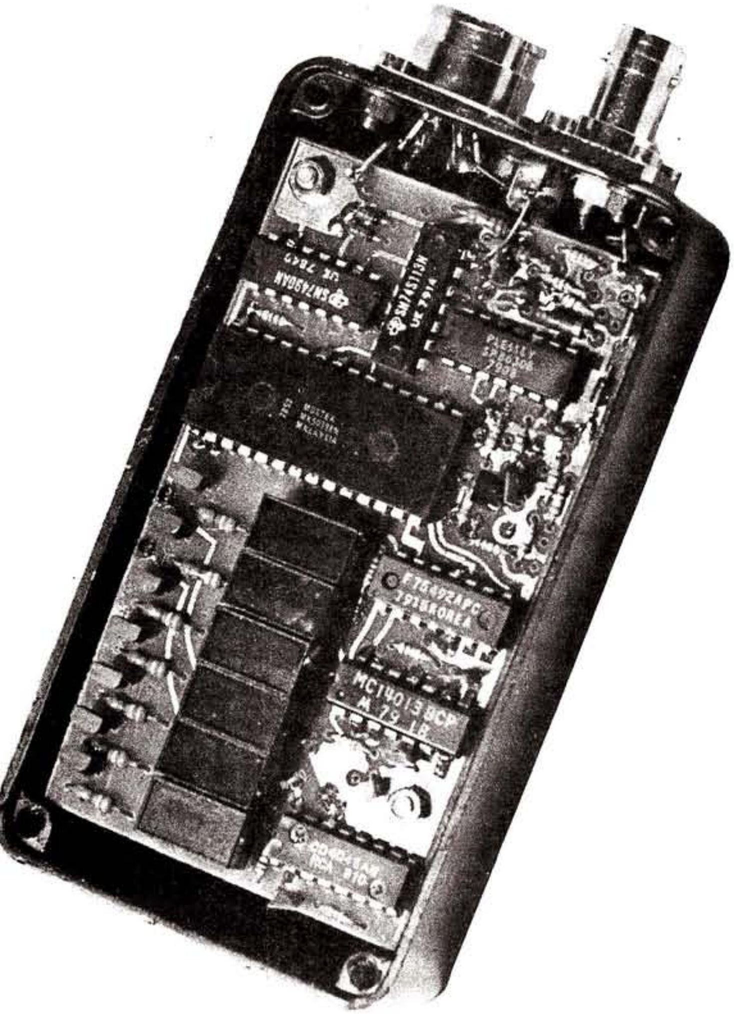
The internal construction of the counter was of good quality and should prove to be reliable even with rough use. The display was bright, too bright, in fact when run from a 12V supply and this tended to make the digits rather difficult to read. No cover glass is fitted over the display and this could be one way in which the brilliance of the digits could be toned down. With the unit being held in the hand and the aerial in the most convenient attitude to check a transmitter, the power lead is awkward and the display reads upwards, needing a twist of the head to read the frequency.

When used to check the frequency of the *PW* FM-80 transmitter the counter showed the correct frequency for the crystal in use and the counter could also be used to set up the deviation. To do this the encoder is disconnected from the r.f. board and the modulation input to the transmitter connected to 0V. The transmitter frequency is noted and the shorting link removed. With the input to the trimmer pot. connected to +4·8V the pot. is adjusted to give a frequency reading different from the first one by the required deviation.

By substituting a lead fitted with suitable probes for the aerial, it is possible to use the counter to check frequencies in a more conventional manner.

★ specification

Digit Height:	10mm
Display Width:	45mm
Case Size:	111 × 60 × 27mm
Frequency Ranges:	0·45–50MHz 50–500MHz
Sensitivity:	Better than 50mV r.m.s. over 0·45–50MHz Better than 200mV r.m.s. over 50–500MHz
Input Connector:	50 Ω b.n.c.
Input Impedance:	50 Ω
Power Connector:	5 pin 270° locking DIN socket
Power Requirements:	11 to 15V d.c. at 300mA approximately



This instrument is obviously intended for field checking of transmitters and should prove very useful as an addition to the radio control enthusiast's toolbox. Like all sophisticated tools it needs to be used properly if false readings are not to be obtained. For instance, when checking old-fashioned a.m. systems the encoder must be disabled if low frequency readings are not to be obtained.

Dick Ganderton

Price

£69·00 including VAT.

The Digital Frequency Meter was supplied by Microwave Modules Ltd., Brookfield Drive, Aintree, Liverpool L9 7AN. Tel: 051-523 4011.

KINDLY NOTE!

VHF DF Loop Aerial, October 1979

A few readers have queried my statment in this article which said: "For bearings related to grid North add 10° to compass bearings". (Fig. 6.) This should have said *subtract* 10° from compass bearings, an error for which I apologise, having fallen into a trap which I unwittingly set up in the first place. How this occurred is not important but an explanation about the reason for this 10° difference may be of help.

A radio direction finding loop indicates a *true* direction relative to *true* North whereas a compass indicates a direction relative to *magnetic* North. The difference, including a further small variation for grid reference maps as explained in the article, is approximately 10° and this is accurate enough for practical purposes in radio direction finding. So, if we take grid (true) as 360° on a protractor aligned with the map grid lines then a compass bearing of an object lying in this direction would be 10° *magnetic.* Subtracting this therefore gives 0/360° grid *(true).*

The text on page 52 (second column) said that the compass can be fitted and aligned so that the 0/360° mark points to one side of the loop, i.e., in line with the sighting bar which is at 90° to the loop itself or on axis with a null. This means that when looking through the loop, along the line of a null and with the compass reading 0/360° *magnetic,* then the loop is also in alignment with *magnetic* North.

Again, subtract 10° to obtain the grid *(true)* bearing of 350°. A further example: You have a null from a transmission which although unknown to you, happens to be in a grid *(true)* direction of say 40°. The compass will be reading 50°. Since you will have to get the grid *(true)* bearing from the compass anyway then subtract the requisite 10° to obtain 40°. Further apologies for not having explained this more fully in the article.

F. C. Judd G2BCX

IC of the month, February 1979

In Fig. 2, the inverting and non-inverting inputs of the LM391N-60 were shown reversed. Pin 1 is the non-inverting input and pin 2 is the inverting input, as shown in Fig. 1.

VMOS Top Band Transmitter, July 1979

One or two readers have experienced problems due to Tr3 not switching properly, with the result that R11 overheats, apparently due to the logic "low" output from IC1 not being low enough to turn Tr3 off.

This can be overcome by reducing R10, 470Ω being a suitable value.

Aerial Data Chart. Insert in November 1979 issue

We were guilty of the sin of over-simplification in the section on Yagi aerials. Adding a parasitic reflector to a dipole cannot produce a true cardioid response pattern, because of the losses inherent in energising the reflector from the field radiated from the dipole.

The response pattern is of the same general form as a cardioid, varying in shape according to element spacing. A true cardioid is produced by having two driven elements, appropriately phased, as in the ZL Special.

Aerials for 160 Metres, Part 2. December 1979

The third paragraph on page 25 should read:

The vertically-polarised radiation could be *increased* by top loading in a non-radiating way. This will reduce . . .

SUPPLY REVERSAL PROTECTION

I. H. CROWTHER G3KLF

Nowadays, most medium-power transceivers, whether h.f., v.h.f. or u.h.f., tend to be entirely solid-state, including the final r.f. amplifier. Present trends indicate that at power levels up to about 100 watts, the days of valves are numbered.

The purchaser of a modern rig expects to be able to run it from:

1. A free-standing car battery.
2. An electronically regulated mains power unit.
3. A car electrical system in a mobile installation.

Most amateurs realise the wisdom of ensuring that reverse polarity protection circuits are included in the basic equipment design, but many can be lulled into a false sense of security by the sight of a line fuse in the positive supply lead, and a description of a diode across the supply somewhere inside the set.

The purpose of this article is to draw attention to the dangers of failing to check just what protection is provided, and to highlight the risks for different types of installation. The sad tale of the owner of a very expensive h.f. transceiver which was written off completely the first time it was connected (with reverse polarity), to a free-standing car battery, plus the author's own experience of destroying the invertor transistors due to careless connection of his FT-100 some years ago, should serve as further emphasis to the point.

Shunt Diode Protection

Assuming that the rig might be connected to the three power sources mentioned earlier, first check from the circuit diagram exactly what protection has been provided by the manufacturer.

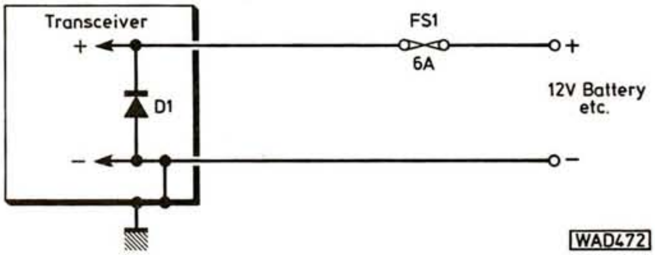


Fig. 1: The most common protection arrangement, with shunt diode inside the set, and a fuse in the positive supply line

In the author's experience, the most common circuit is a diode across the d.c. input inside the set, and a series line fuse rated at about double the normal running current required by the rig in the transmit mode. Typically, the author's FT-7 draws 3 amps on transmit, and a 6A line fuse is fitted in the positive supply lead (Fig. 1). The effectiveness of this circuit depends on the power source and the way the set is installed.

Consider Option 1, connection to a free-standing car battery. With correct connection, the diode D1 will be reverse biased and will not conduct, but connecting the supply leads to the battery in reverse will bring D1 into conduction. Provided that the diode can conduct about twice the rated fuse current, the line fuse will then certainly

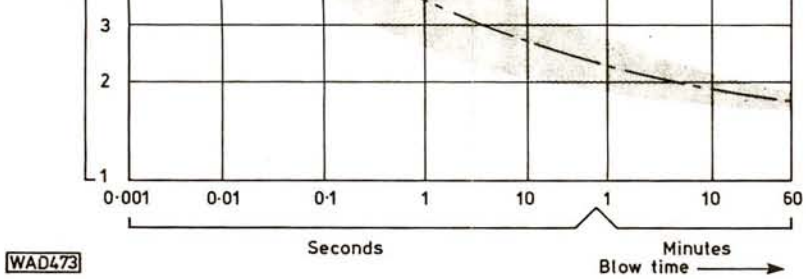


Fig. 2: Blowing characteristic curve of a 1A "quick-blow" cartridge fuse. The curve for other values is generally similar, except for very low values. It will be seen from the width of the shaded area, that there is a wide tolerance in blowing time within the specified characteristic

blow. A narrow 12V negative pulse will enter the set, however, its width being proportional to the blowing time of FS1. Normally, this pulse will be decoupled by the first resistor/capacitor network it sees on the 12V rail, and would cause no damage to the set.

If the diode is rated only slightly above the fuse current, there is a risk that it could blow, rather than the fuse, so that protection would be lost. Even if this state were not reached, the high forward voltage drop (typically 1·1V) of a power diode run at near its maximum current, could put the whole circuit into a state where voltage drops in wiring and diode could be so large as to limit the current to a value which would prevent the fuse blowing. Remember that a standard "quick-blow" cartridge fuse can withstand twice its rated current for between 10 seconds and about 20 minutes, and needs to pass up to 9 times its rated current to be certain of blowing within 0·1s! The graph of Fig. 2 shows the blowing time characteristic for a 1A "quick blow" fuse.

The first eventuality would definitely be fatal for the semiconductors in the transceiver, and the second possibly so. Therefore, check the current rating of the protection diode and make sure that it will carry at least twice the line fuse current. If necessary, remove it and test it on the bench to be certain. Remember, your transceiver could be worth £300–£900!

Next, we will consider the second option, the electronically regulated mains power unit. This will usually employ a series regulator or special regulator module, possibly with short-circuit protection or current foldback, see Fig. 3.

The power unit feeding the author's FT-7 has a 5A regulator package with thermal fold-back protection built in. It can withstand a short-circuit for a brief time, although the current is limited under these conditions to 7 amps.

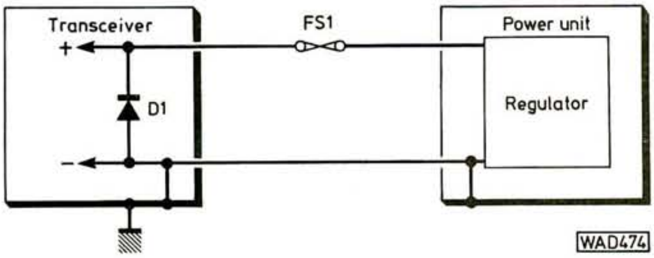


Fig. 3: The equipment of Fig. 1 connected to a regulated mains power unit. The power unit case is not earthed, *not* a normal situation; more usually the case would be earthed but isolated from the output lines

Assume now that the transceiver positive lead is accidentally plugged into the power unit negative socket first; no damage will result, but if the negative lead is then plugged into the positive socket of the power unit, D1 will conduct and try to blow the line fuse. In the author's case, the power unit cannot supply fusing current to the FT-7, so a stable condition would exist with a steady 5 to 7 amps flowing through the fuse and diode continuously. Note that this applies only if there is **no** actual earth connection between the transceiver and the power unit. As mentioned above, if the fuse goes first, fine; but if the diode fails open-circuit first, then reverse voltage will reach the transceiver and destroy it.

Next assume that the transceiver negative lead is accidentally connected to the power unit positive socket, but this time there is a solid connection between the chassis of the two units, either a wire or possibly a mains earth to both cabinets, see Fig. 4. The error will apply a short-circuit across the power unit; current will flow from the power unit negative and chassis, via the earth connection and back to the power unit positive terminal through the transceiver negative lead just wrongly connected. There will be no fuse in circuit, and the power unit will go into over-current protection if the facility is fitted, or will probably blow up the series regulator if not.

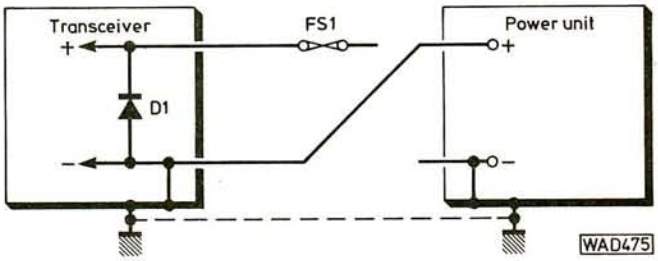


Fig. 4: A potentially dangerous fault situation produced by a single connection error

Finally, consider Option 3, the mobile installation. The conditions just described apply, but with a serious complication. You will probably have followed good practice by wiring direct to your earthed battery negative terminal using the heavy-duty lead supplied with your set, and consider the line fuse in the positive lead to be excellent protection against reverse connection at the car battery. Remember, though, that the common earth wire this time is your car chassis, to which your transceiver is certainly connected via its mounting tray or bracket, the aerial braid, and probably a separate wire from its earth terminal to a convenient car chassis screw.

All this is fine if you connect the supply lead to the car battery correctly, but if you accidentally connect the negative lead to the battery positive terminal, you will again have a direct short-circuit through the car chassis, your transceiver power plug, and back through the negative lead (unfused) to the battery positive terminal. This will probably weld the negative wire to the battery terminal if you are unlucky, and could cause a fire, as you will probably have tucked the transceiver supply leads neatly under the carpets, etc!

Series Diode Protection

An alternative form of protection is to place a diode in the positive lead of the transceiver, so that correct

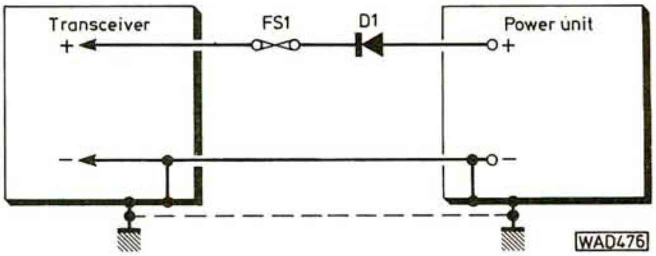


Fig. 5: The series diode protection arrangement, which suffers from the major drawback of the loss of power due to the voltage drop across the diode

connection to the battery or power unit will forward bias it, and reverse connection will reverse bias it, so protecting the set, see Fig. 5.

This arrangement is satisfactory for connection to a free-standing battery, but not to a mains power unit which might have an earth connection between the units, nor for installation in a car where the common chassis would lead to the dangerous short-circuit state just described. Also, the diode will introduce a voltage drop of at least 0·5V across its junction, which could be a nuisance.

Relay Protection

Another form of protection is the use of a relay, fed via a diode, connected so that it is energised only if the supply polarity is correct, see Fig. 6. Unfortunately, although this method does eliminate the voltage drop across the diode, the relay contacts are invariably in the positive line, thus giving no protection to the power unit if the transceiver negative lead is connected to the power unit positive terminal. Again, a short-circuit would exist via the common chassis or earth wire.

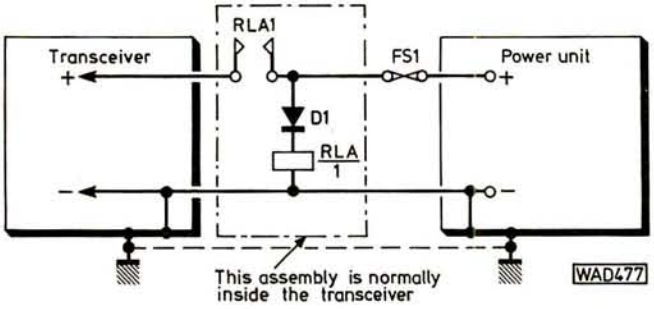


Fig. 6: A relay protection system—a better arrangement but still not foolproof

This would apply even if a double-pole relay was used, as the short-circuit would exist before the relay contacts unless the relay was separately housed outside the set, in the supply lead.

Bridge Rectifier Protection

Finally, some manufacturers use a bridge rectifier to ensure that whichever way the power supply is connected, the correct polarity is always presented to the transceiver, see Fig. 7.

This method poses some problems with regard to common chassis connections, especially in a mobile installation. For instance, if the lower terminal of the power unit in Fig. 7 was connected to chassis and earth, D3 would be shorted out. If that same terminal was the positive one, D4 would be forward biased and connected directly across the power supply, conducting heavily. Even if the power supply is completely isolated from earth, there is still the disadvantage of having more than 1 volt lost across the two conducting diode junctions in the bridge.

A Comprehensive System

The author uses a form of polarity reversal protection which overcomes all the above defects and is extremely simple, see Fig. 8. This circuit is especially safe in a mobile installation.

If the transceiver negative lead is accidentally connected to the positive terminal of the power unit or car battery, the diode D1 will be reverse biased and will not conduct. There will be no short-circuit fault current. If the connections are made correctly, the common chassis will bypass the diode D1 and cancel the 0·5V dropped across its junction.

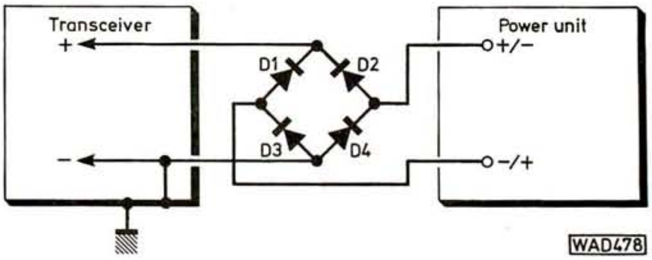


Fig. 7: The bridge rectifier allows the supply to be connected with either polarity, but cannot be used where one side of the supply is earthed, as in a car, unless the transceiver circuitry and the aerial can be d.c.-isolated from the car chassis

The fuse FS1 should be chosen to have a value virtually the same as the normal transmit current of the transceiver. Its function is to protect the transceiver and power unit in the event of a fault developing in the transceiver. For example, the author's FT-7 draws 3 amps on transmit, and FS1 is rated at 3A and is of the Delay (Slow-blow) type.

The diode D1 should be rated to carry the full transmit current of the transceiver, although in the mobile installation the current will divide between the negative supply lead and the car chassis according to their relative resistances. It could be argued that the negative lead is superfluous in the mobile installation and might be dispensed with, but this is contrary to good practice, as the route of all the transmit current drawn by the transceiver becomes an unknown factor and could give rise to noise generation and resistance variations.

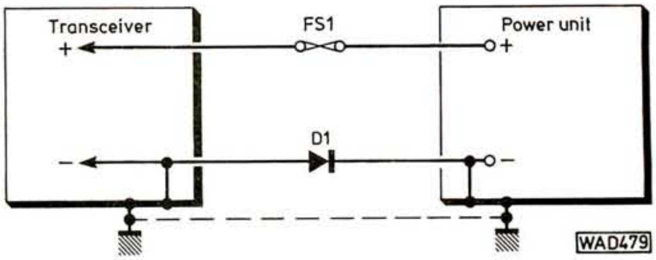


Fig. 8: The author's suggested system of protection, which overcomes all the disadvantages of the more commonly used systems

Conclusions

The foregoing is intended for guidance only, and the author appreciates that there are probably better methods of protection than the one just described. It does, however, work and has the advantage of being very simple. ●

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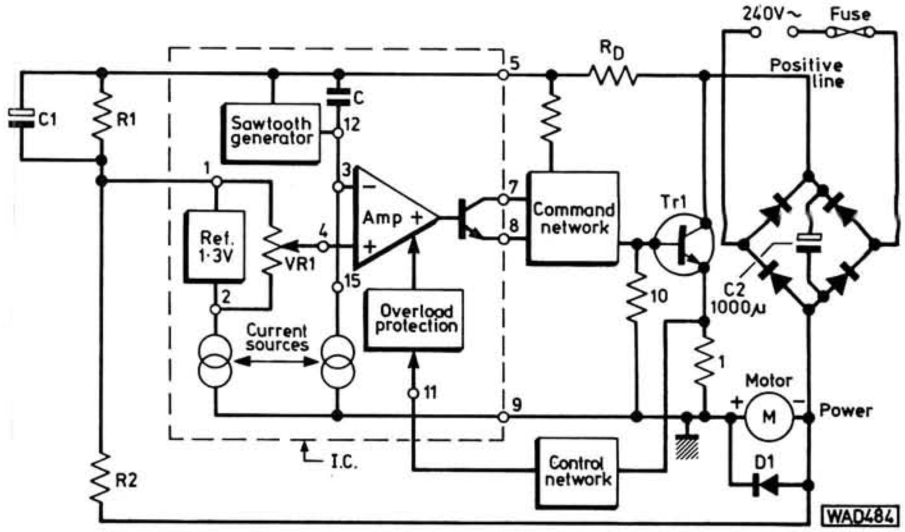
OF THE MONTH

Brian DANCE M.Sc

THOMSON-CSF TDA1067 POWER CONTROLLER

WARNING

Circuit points shown in this article as connected to chassis CANNOT BE EARTHED unless the mains power input is fed via an appropriately rated double-wound isolating transformer



The TDA1067 is a 16-pin dual-in-line device, manufactured by the French Company Thomson-CSF, for the control of power to various types of load, including a heater, motor speed control, etc. Unlike most types of dual-in-line devices, the TDA1067 has a small bar of metal embedded along the back of the device so that it can be clamped to a suitable heatsink when this is necessary to keep it cool.

The TDA1067 is intended for the driving of power transistors or the firing of thyristors or triacs which are fed from the emitter or collector of the internal power transistor. It can operate from any supply voltage from 3V to 18V and is able to provide output currents of up to 2·5A from the collector (pin 7) or the emitter (pin 8) of the internal output transistor. If necessary, the power output stage of the device may be effectively protected by means of an overload detection circuit. An internal thermal overload circuit protects the device against the overheating of its internal control stage.

The internal circuit of the TDA1067 is quite complex, containing some 37 transistors and many other components. We will therefore confine our attention to its practical applications which include (i) the speed control of electric motors using transistors or thyristors (ii) proportional power control with transistors, thyristors or triacs (iii) thermal regulation or thermostatic control and (iv) the regulation or control of power switching systems.

DC Motor Control

The basic circuit of Fig. 1 shows how the TDA1067 may be used for controlling the speed of a d.c. motor using an alternating mains power supply. The numbers shown in this circuit are the pin connections of the TDA1067.

The speed control is obtained by switching the external transistor Tr1 on and off. The alternating mains voltage is rectified in the diode bridge and when the transistor Tr1 conducts, a current flows through this component and the 1Ω emitter resistor to the motor. When the transistor is switched off, the high voltage transient which may appear across the inductive motor is by-passed by the silicon diode D1 so that it cannot cause any damage; this transient is known as the "back e.m.f."

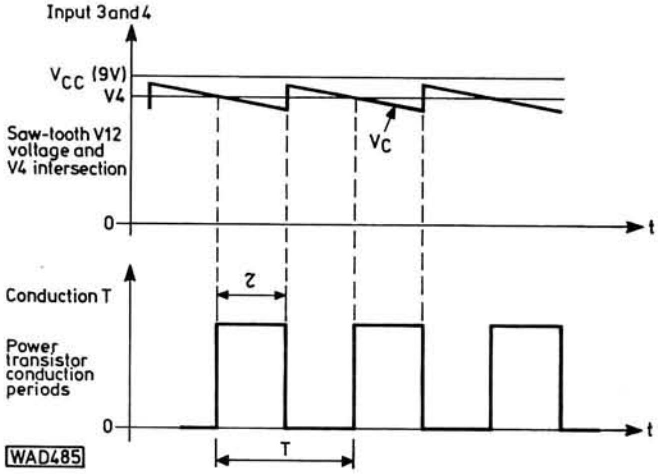


Fig. 1: A basic circuit for a motor speed controller with timing waveforms

The transistor Tr1 is switched to conduction by the output from the TDA1067 device. The motor is fed with a rectangular waveform at a fixed frequency, but the duty cycle is variable; that is, there are a constant number of pulses of current per second, but the time for which each pulse passes can be varied by means of a potentiometer.

An internal sawtooth-wave generator causes the voltage across the internal capacitor C to rise very rapidly and then to fall more slowly as indicated in Fig. 1 (b). This voltage is applied to the inverting input of the internal operational amplifier.

The internal reference voltage generator produces a constant voltage of about 1·3V between pins 1 and 2 and this potential is applied across an external potentiometer VR1. The setting of this potentiometer determines the voltage applied to the non-inverting input of the internal op. amp. and hence the power fed to the motor. As indicated in Fig. 1 (b), no power is fed to the motor until the voltage across the capacitor C falls below that of the non-inverting input of the operational amplifier. Thus the length of each current pulse (and therefore the motor speed) decreases as the voltage at pin 4 decreases.

In the circuit shown, the value of the dropping resistor marked R_D must be chosen so that the voltage supply to the integrated circuit is within the recommended range.

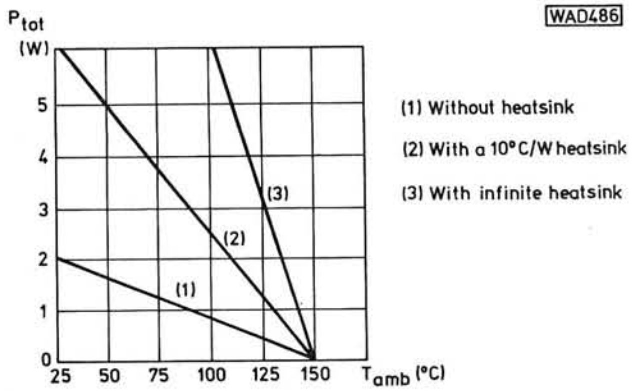


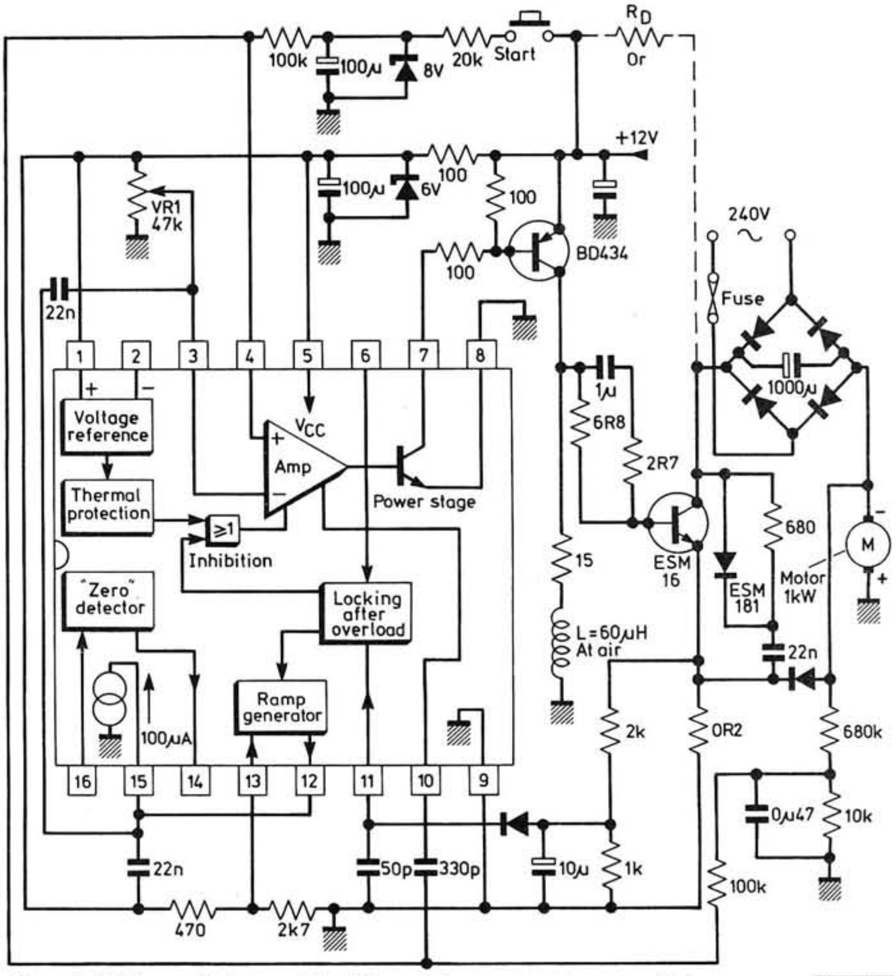
Fig. 2: Maximum power dissipation data for the TDA1067

Heat Sinking

The maximum power dissipation in the TDA1067 must not be allowed to exceed 5W, whilst the junction temperatures on the silicon chip must not exceed 150°C. The junction-to-case thermal resistance is 6°C/W, but without any heatsink the junction-to-ambient thermal resistance has the much higher value of 60°C/W.

The graphs of Fig. 2 translate these figures into practical terms. If no heatsink is employed, the power dissipated in the device can be allowed to rise up to a maximum of 2W provided that the ambient temperature does not exceed 25°C, but the maximum is about 1W for temperatures of up to 90°C. Graph 2 of Fig. 2 applies when a heatsink of thermal resistance 10°C/W is fitted to the device using a suitable thermal coupling grease; it can be seen that a dissipation of 5W can be permitted at temperatures of up to 50°C. The graph marked 3 is for a so-called "infinite" heatsink which keeps the temperature of the metal insert along the back of the TDA1067 at not more than 25°C.

One can only decide whether a heatsink is required and, if so, the size of the heatsink when one has calculated the thermal dissipation in the device in the particular application concerned. However, one may try to estimate experimentally whether the device is becoming too hot when the circuit has been used for a short time; a heatsink can then be fitted if there is any doubt whatsoever about the matter.



Chopped at 5kHz Typical regulation 1% Delay over current surge protection

Fig. 3: A speed control circuit for direct current motors of up to 1kW power

A practical circuit for the control of a 1kW direct current motor using the TDA1067 is shown in Fig. 3. The potentiometer VR1 controls the duty cycle of the output voltage at the collector of the internal transistor (pin 7) which drives an external BD434 transistor; the latter in turn is used to drive the ESM16 triple-diffused, high-power transistor which controls the current flowing to ground through the 0·2Ω resistor and hence to the positive side of the motor. Very high output currents can be controlled in this way.

A +12V supply may be used for the TDA1067 as indicated, or the supply may be obtained from the rectified mains supply by the use of the connection shown dashed using the dropping resistor marked R_D. The current pulses to the motor occur at a frequency of about 5kHz.

Thyristor control

Another motor speed control circuit is shown in Fig. 4, but in this case a bridge circuit is employed which consists of two diodes and two thyristors. The power output stage inside the TDA1067 feeds a small 1:1 iron-cored transformer which in turn feeds the gates of the thyristors in the mixed thyristor-diode bridge with pulses at the correct times. The current carrying capacity of the thyristors employed in this circuit must, of course, be adequate for the particular type of motor being used.

A re-start switch is incorporated in the pin 11 circuit. When the overload circuit has been actuated, this re-start switch must be operated to render the circuit operative again.

Thermostat circuit

The circuit of Fig. 5 shows how the TDA1067 may be employed to switch a triac which keeps the temperature in an enclosure constant. The triac controls the power in the load which determines the temperature of the enclosure; one to three silicon diodes in this enclosure are used to sense the temperature and are connected in the pin 1 circuit of the TDA1067. The temperature of the enclosure can be selected by means of the potentiometer VR1.

If radio frequency interference is experienced, a suitable inductor L may be connected in series with the load. This inductor must be made from wire which can carry the full load current and is best made experimentally, the number of turns being changed until a suitable amount of radio interference rejection is obtained.

A thermistor of 200 to 400Ω may be employed in the pin 1 circuit instead of the diodes shown in Fig. 5. Naturally the resistor must be placed in the enclosure whose temperature is to be maintained constant.

Protection

In Fig. 5 the 0·1Ω resistor in series with the triac provides overload protection. If the current flowing through this resistor to the load exceeds about 6A, the

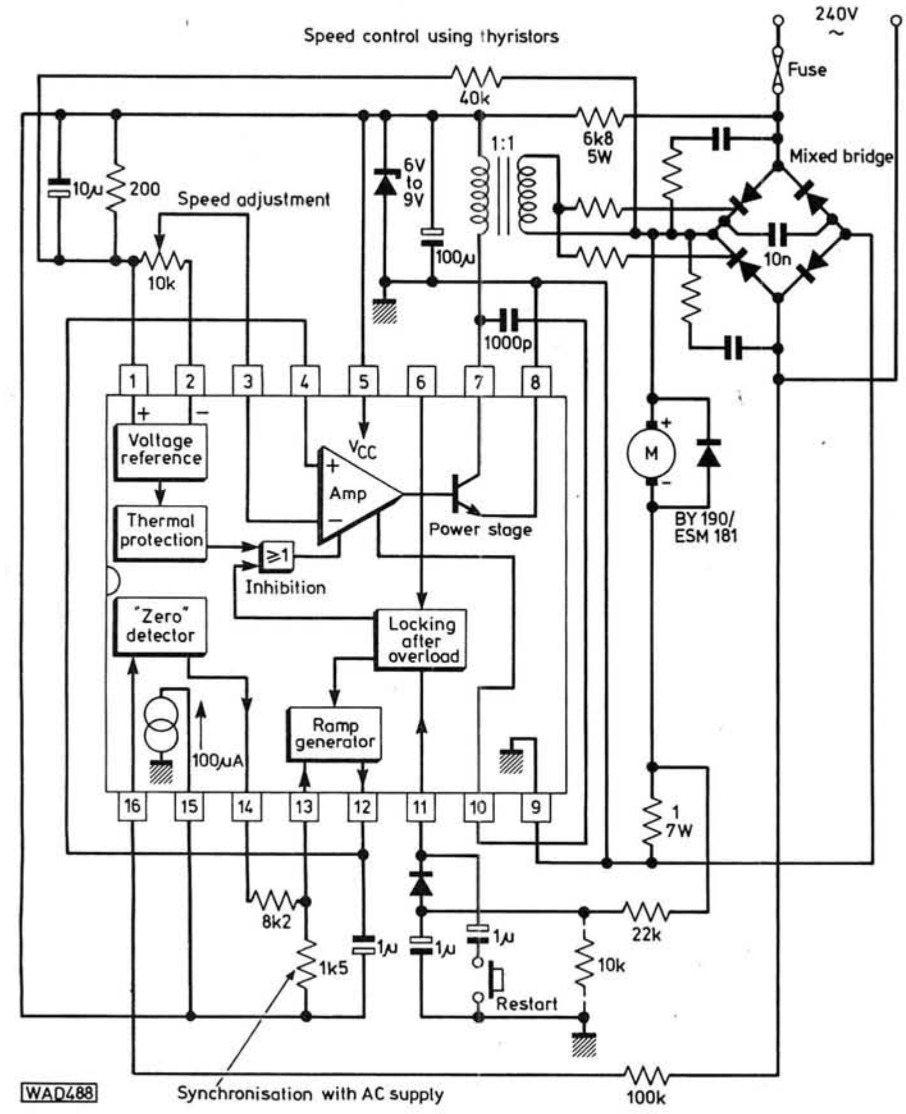


Fig. 4: A motor speed control circuit using a thyristor-diode mixed bridge circuit

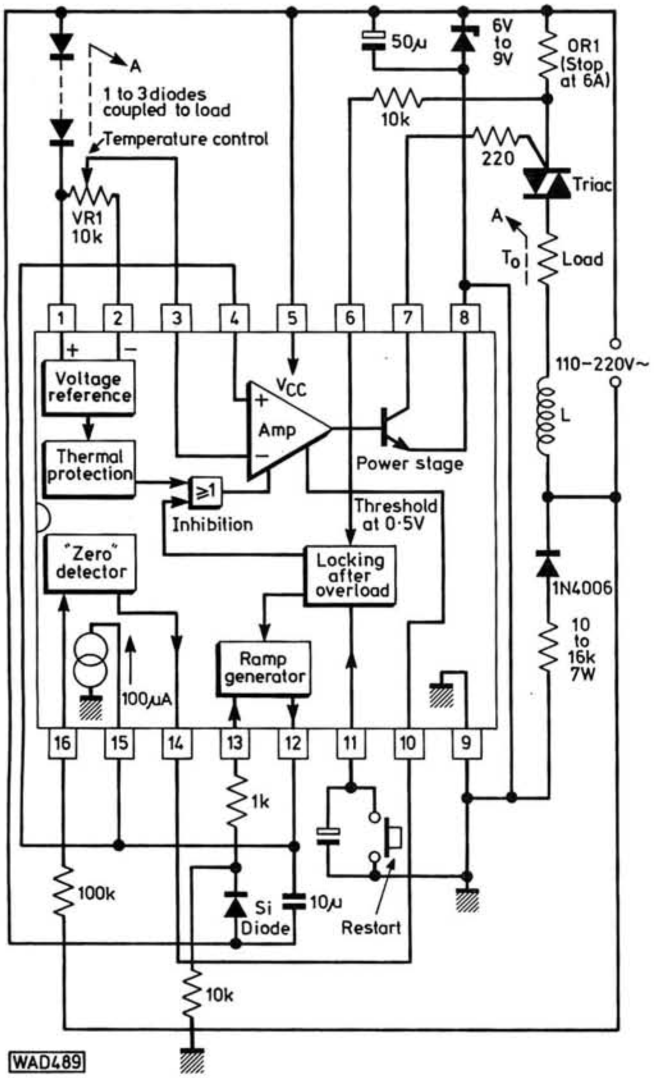


Fig. 5: A thermometer control circuit using the TDA1067; the diodes in the pin 1 circuit are placed in the temperature-controlled enclosure

voltage developed across this resistor is about 0·6V which is great enough to cause an internal transistor whose base is connected to the pin 6 circuit to conduct and divert the base current away from the output transistor. The power to the load is then removed.

The value of this overload sensing resistor in series with the triac can be chosen so that the overload switching-off process occurs at any reasonable value of the load current.

Similar overload protection is provided by means of the 1Ω resistor in the emitter circuit of Tr1 in Fig. 1, using the pin 11 facility. In Fig. 3, the 0·2Ω resistor in the ESM16 emitter circuit provides protection, whilst in Fig. 4 the 1Ω, 7W resistor in series with the motor provides the same facility.

In high-power circuits, overload protection is very valuable to prevent serious damage if a fault occurs, such as if the motor armature becomes jammed and the current through the motor therefore increases rapidly.

Availability

The TDA1067 is available at £2.99 (including VAT) plus 30 pence for packing and postage from Phoenix Electronics Ltd., 139–141 Havant Road, Drayton, Portsmouth, Hants PO6 2AA. ●

letters

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

CB

Sir: Following on from recent correspondence on Citizens' Band Radio, I have noticed a rapid increase in the unauthorised use of such equipment in the main city areas of Eire, principally Dublin and Cork. Thinly veiled advertising of 27MHz equipment, even linears, is appearing in national newspapers, and many legal 27MHz paging systems are experiencing interference.

At this stage it is estimated that there are between 200 and 300 unauthorised 27MHz units in operation and increasing rapidly in number. Unless some action is taken we will find ourselves in the same situation as Australia, where the sheer volume of illegal 27MHz operators forced the facility.

The Eire authorities must now act swiftly, or we will have 27MHz Citizens' Band by default.

Des Walsh
Carrick on Suir
Co Tipperary

Pen-Pal

Sir: I am seeking a pen-pal. I am at the moment studying for my MSc exams (electronics special paper) and would like to correspond and perhaps exchange technical literature and periodicals with anyone who has similar interests.

Kapil Warikoo
c/o Tara Chand Bhatta Wala
Petti Mehar
Baraut (Meerut)
Pin 250 611
India

Where are you now?

Sir: Visiting Johannesburg recently, I came across a silver cup, somewhat tarnished, being used as a commercial ashtray. In its side, an inscription read:

"PRESENTED TO MIKE KRUGER—JOHANNESBURG, SOUTH AFRICA.
WORLD CHAMPION RADIO TROPHY.
WINNER OF THE 6000 TO 12 500 MILE INTERNATIONAL BROADCAST CONTEST.
EMPLOYING A PILOT 'DRAGON' RECEIVER.
AWARDED BY THE 6000 TO 12 500 MILE ALLWAVE RADIO CLUB—PHILADELPHIA, U.S.A.
PRESIDENT—OLIVER AMLIE (MASTER OF WIRELESS)".

As it certainly smacks of the romantic era of radio of the '20's and '30's—perhaps the owner of the cup, or his descendants, would like to reclaim it. I should be pleased to advise them of its location should they care to contact me.

Nev Kirk G3JDK
54 Allendale Road
Rotherham
Yorks S65 3BY

More Readers' Letters on page 64 ▶▶▶

Car INTERMITTENT Wiper Unit

A.R.Ward

If you drive a car regularly on British and European roads (and the chances are that you do), then you will almost certainly have experienced the irritation and fatigue induced when driving a car not fitted with an intermittent-wipe facility.

Light rain, or a thin veil of motorway spray are just two examples of miserable conditions where to have the wipers on continuously involves juddering blades and undue strain on the mechanism and to have them off . . . Well, most of us go for a compromise solution and switch the wretched things on two or three times per minute!

Mystery

Quite why, in these days of mass-produced electronics, so many vehicles are manufactured minus a delayed-wipe unit when these are easily installed and comparatively inexpensive, is a mystery. But the fact is that, despite the undoubted contribution to road safety made by these devices, most cars are not equipped with them. On a typical February morning in Britain, it's wipers on, off, on, off for most motorists.

The solution, obviously, is to instal a suitable intermittent-wipe unit and there are plenty of commercial designs available. The *PW* unit differs from these, however, in that the driver has closer control over what the unit actually does; the infinite range of weather and road conditions can be better catered for as a result. This has been achieved by incorporating two worthwhile and important features which were born out of practical experience. The circuit is more complicated than that of most commercial designs, but it is nevertheless quite simple to build and instal.

Extra Features

The first of these is that, when first switched on, the unit provides several extra wipes. The driver decides to use his wipers owing to an accumulation of water and muck which has made it difficult for him to see—the extra wipes clear this accumulation before the selected "wipe pattern" is established.

The second extra feature is the ability to select a "wipe pattern" appropriate to the prevailing conditions. The delay between the wipes is continuously adjustable, and the *PW* design even allows you to select the number of wipes given during each burst of activity. A single wipe usually serves only to smear the windscreen—two or more are generally necessary to fully restore the driver's vision.

Circuit

When the unit is first switched on, the sequence of events is as follows: Capacitor C1 is fully discharged and Tr1 will thus be "off", as its base is at 0V. Transistor Tr2 will therefore also be "off" and Tr3 will be held "on" by the base-emitter bias applied via R5 and R7. The emitters of Tr2 and Tr3 will be at about 3V, and Tr3's collector at just above 3V—this potential causes Tr4 and Tr5 to conduct, operating relay RLA. Contact sets RLA1 and RLA2 change over: RLA1 enables C1 to begin charging via R2 and VR2 and RLA2 switches on the wipers. These continue to function as C1 charges, completing approximately five wipes (the initial screen-clean referred to above), plus the number of wipes selected by switch S2.

When the voltage on C1 has climbed to around 4V, Tr2 turns "on" and, due to the feedback via R7 and R8, Tr3

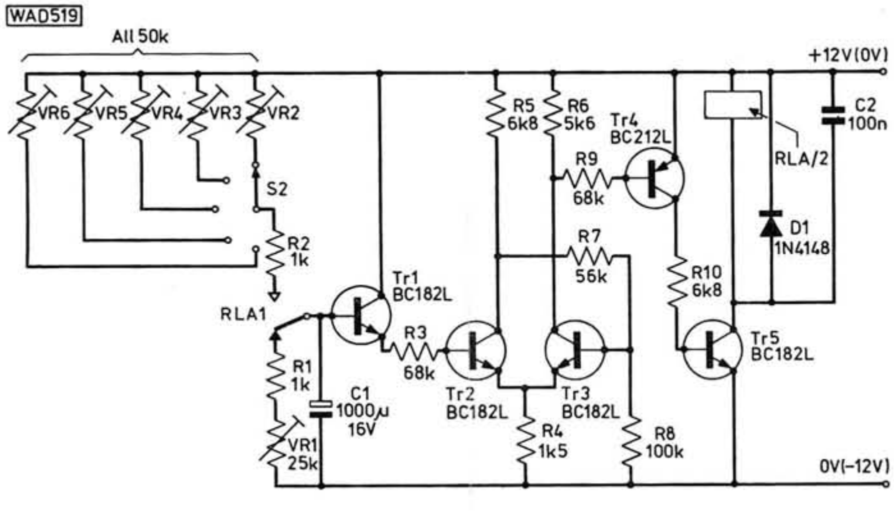


Fig. 1: Circuit diagram

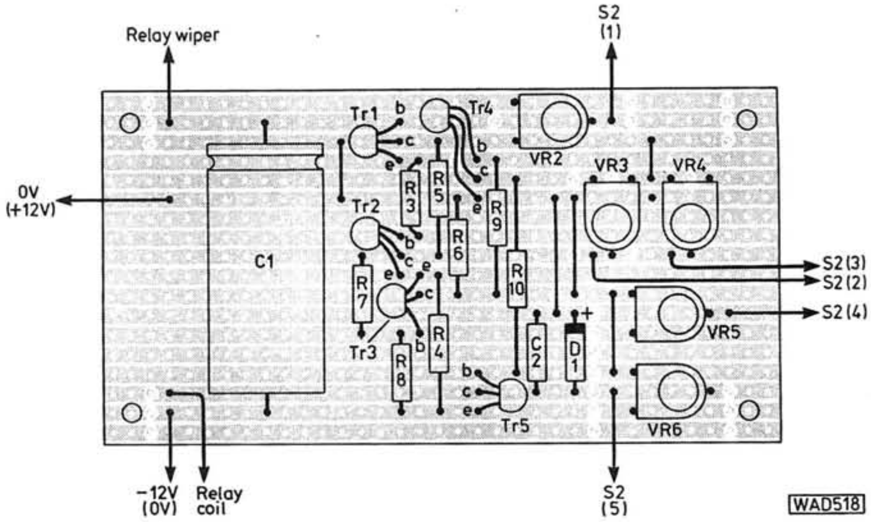


Fig. 2: Suggested Veroboard layout

will be turned "off" very sharply. Transistors Tr4 and Tr5 are turned "off" as a consequence, de-energising the relay. The wipers stop and C1 starts to discharge via R1 and VR1. The emitter of Tr2 will now be at about 2V and thus the voltage across C1 will have to fall to approximately 3V before Tr2 turns "off", restarting the cycle.

★ components

Resistors
½W 10%

1kΩ	2	R1,2
1·5kΩ	1	R4
5·6kΩ	1	R6
6·8kΩ	2	R5,10
56kΩ	1	R7
68kΩ	2	R3,9
100kΩ	1	R8

Capacitors
Polyester

100nF	1	C2

16V electrolytic

1000µF	1	C1

Potentiometers
Linear track

25kΩ	1	VR1

Miniature pre-set (horizontal mounting)

50kΩ	5	VR2—6

Semiconductors
Diode

1N4148	1	D1

Transistors

BC182L	4	Tr1,2,3,5
BC212L	1	Tr4

Miscellaneous
0·1in Veroboard (50 × 90mm); Veropins; 12V 2-pole changeover relay (contacts must be capable of switching 5A); s.p.s.t. toggle switch (S1); single-pole 5-way switch (S2); 5-way connector block; aluminium box.

Controls

Potentiometer VR1 controls the delay time (the interval between the wipe periods) and, with the value shown, gives a range of adjustment of 1–15 seconds. Increasing the value of VR1 will result in a greater range if this is desired. Continuous operation is selected by setting VR1 to a minimum (this reduces the delay to a point where it becomes less than the time the wipers take to traverse the windscreen and therefore they do not switch off).

The pre-set potentiometers VR2–VR6, selected by S2, are adjusted to give a "wipe time" of one to five wipes respectively. An alternative and simpler arrangement is to use a 50kΩ potentiometer which can be continuously adjusted as required.

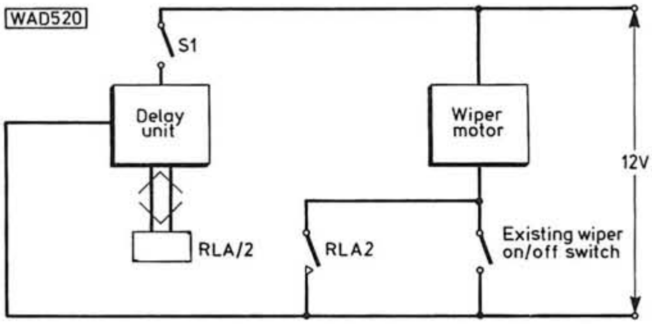


Fig. 3: Wiring diagram with single-pole wiper switch

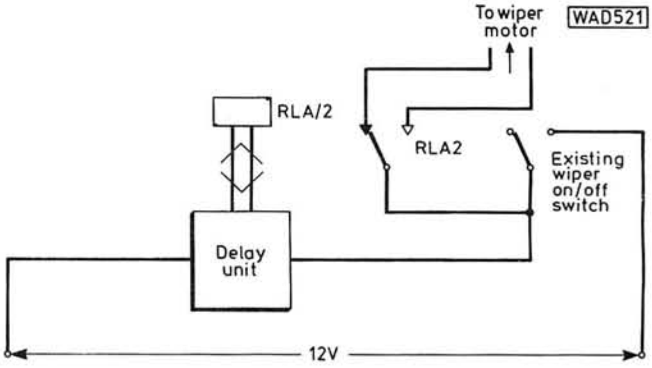


Fig. 4: Arrangement with changeover switch

continued on page 64 ▶▶▶

HI-FI GLOSSARY

4

Gordon J KING

I

IHF

This stands for the *Institute of High Fidelity,* an American "standards" authority concerned essentially with matters of hi-fi. The Institute publishes references, standards and methods of testing and expressing hi-fi amplifiers and tuners, and is extensively quoted in the literature. The Institute has fairly recently published a revised set of measurements for amplifiers known as IHF-A-202, which embodies more meaningful tests than set out earlier in IHF-A-201. The address is: Institute of High Fidelity, 125 East 23rd Street, New York 10, N.Y., USA.

INDUCED-MAGNET PICKUP CARTRIDGE

This is a type of magnetic *pickup cartridge* in which the magnetic field is provided by a small but powerful magnet contained within the body moulding. The field from this magnet is "induced" into the ferrous metal vibrating armature, so that this then behaves like a moving-magnet pickup cartridge but without the extra mass of the magnet. By this technique it is possible to secure a very small effective stylus *tip mass*, which enhances the high acceleration *tracking ability* of the cartridge. A number of magnetic cartridges are made like this, including the British Goldring species.

INFINITE BAFFLE

This term applies to a speaker system where the air distance between the front and rear of the cone is "infinite". When a sound wave from the rear of the cone reaches a sound wave at the front of the cone, a degree of sound "cancellation" obtains. To avoid this happening at bass frequencies, where the sound wavelengths are long, a baffle is interposed to separate the front and rear halves of the speaker unit.

Ideally, of course, the baffle should be an infinitely large plane surface of solid, "non-resonant" (e.g., acoustically damped) material. Because such a large baffle to "isolate" very low frequencies would barely be domestically viable, the trend nowadays is to isolate the front and rear cone surfaces by mounting the unit in a closed box. To some extent, however, this is self-defeating, because the enclosed air reduces the intrinsic *compliance* (makes it more stiff) of the cone suspension, thereby increasing the low-frequency resonance of the unit, below which the bass falls off, anyway. To obtain a low bass, therefore, this type of system requires a speaker unit whose unloaded resonance is at a very low frequency.

Moreover, to retain a "flat" pressure response output from the system, it is necessary to reduce the output relative to the lower frequencies, which results in a reduction in the effective efficiency (electrical input power to acoustical output power) of the system. Hence this type of speaker system needs a driving amplifier of greater power than its size might indicate. The correct term for this type of speaker system is *acoustical suspension,* owing to the cone's suspension being provided mostly by the air trapped in the sealed enclosure.

INTEGRATED AMPLIFIER

This refers to a hi-fi amplifier which contains both the control amplifier (*pre-amplifier*) and power amplifier departments, both usually working from a common power supply section, an example of which is given in Fig. 16. The opposite is a hi-fi amplifier composed of two separate units, the *control amplifier* and the power amplifier, each often having its own power supply section. The Quad amplifiers are so composed.

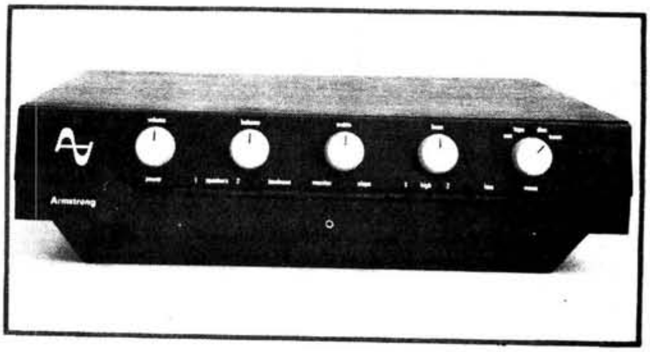


Fig. 16: Example of integrated amplifier. This is by the British Armstrong Company, and includes a control amplifier (with pre-amplifiers for a magnetic pickup, etc.) and a power amplifier switchable to drive either or both of two speaker pairs

IONOPHONE

This is a rather special kind of treble speaker unit in which the sound pressure is generated by means of an electrical discharge being "modulated" by the audio signal.

L

LABYRINTH SPEAKER SYSTEM

This refers to another type of speaker loading arrangement whereby an extended convoluted path is created by ducting within the cabinet and into which the rear of the speaker unit drives. The front of the unit radiates directly

HI-FI GLOSSARY

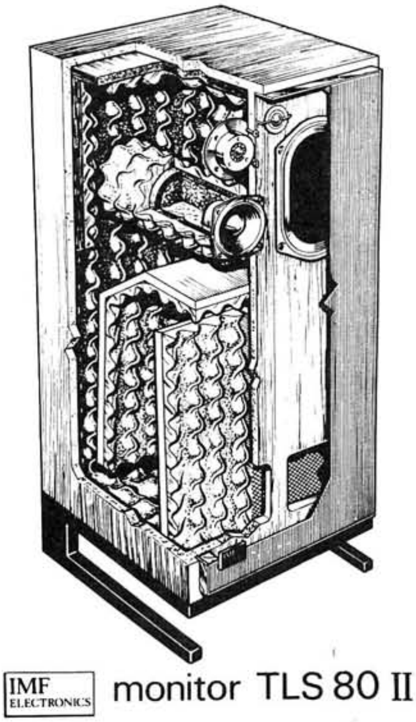


Fig. 17: This acclaimed speaker system by British IMF (the TLS80/II) uses ducting within the enclosure to load the rear of the bass unit diaphragm, this then exhausting at the bottom of the front panel as can be seen. The "labyrinth" is lined with acoustical damping material to tame undesirable resonances right down to the lowest frequencies

from the front panel, while the ducting or labyrinth exhausts from underneath or lower down the front panel, this enhancing the bass frequencies. An example is given in Fig. 17.

LIMITING

This generally refers to a circuit arrangement which prevents the output from exceeding a determined level regardless of how large an input signal is fed in. A primary application is in a frequency modulated (f.m.) receiver to ensure that the *intermediate-frequency* (i.f.) signal amplitude applied to the f.m. detector remains constant from very low to very high signal levels. Distortion resulting from the non-linearity of *transfer characteristic* does not occur in this case because the audio information is carried by the changing frequency rather than by the changing amplitude of the signal.

It is also sometimes used in the microphone and recording circuits of tape recorders to avoid over-modulation, but in this application some distortion is inevitable.

LINE OUTPUT

In terms of domestic hi-fi this is commonly the replay output from a tape machine, which is of a reasonable level and not too high an impedance for coupling with minimum losses to the appropriate input of the hi-fi amplifier.

An alternative output is sometimes from a *DIN socket* (see Part 3), but as this emanates from a high source impedance to yield a "constant current" signal for recording (and to satisfy the DIN requirements), it can impair the upper-frequency response and the signal-to-noise (S/N) ratio. Where possible, it is always best to use the line output, which is usually a *"phono" type socket* or a pair of them for the left and right channels of stereo, for tape recording.

LOUDNESS

This is a subjective term referring to how loud a sound appears to a listener. It must thus refer to the sensitivity of hearing (see below), and a logarithmic scale has been drawn up embracing loudness from the threshold of hearing to the threshold of pain. The unit is the *phon*.

LOUDNESS CONTROL

Sensitivity of hearing is greatest over the middle range of audio frequencies. For the sensation of equal loudness, therefore, the lower and to a lesser degree the higher frequencies need to be boosted relative to the middle frequencies. However, the sensitivity of hearing changes over the spectrum with changes in sound level, the low- and high-frequency differences relative to the middle frequencies being more marked as the sound level is reduced.

In an endeavour to flatten out this natural effect, some amplifiers are equipped with a so-called loudness control linked in some way to the volume control, so that as the control is retarded the middle frequencies are attenuated more than the lower frequencies and sometimes a little more than the higher frequencies. The net result is a bass and sometimes treble boost to the reproduction as the control is turned down for low-level listening! This mode of control is deprecated by the true hi-fi devotee as it is removed from the natural order of listening.

M

MICROPHONY

If you place the pickup stylus on a stationary gramophone record and, with the amplifier switched to pickup, moderately advance the volume control, you will find on tapping the record or, indeed, motor board, that the taps will be heard from the speakers. This is microphony in but one guise. Anything which is sensitive to mechanical or acoustical stimuli is said to be microphonic. The pre-amplifier valves of early amplifiers often suffered from microphony and had to be mounted on soft-suspension valve holders.

In more modern vein, the problem has been re-discovered and re-established with respect to record decks. Hence the illustration given above. It is obvious, of course, that if the speakers are reproducing a loud signal, the sound waves will impinge upon the record deck and cause the pickup (even when it is playing a record) to yield a grossly distorted image of the speaker sound. This finds its way back to the speakers by the conventional amplifier route and, owing to delay, produces a spurious though low-level signal directly following the original sound.

It is held by a number of people (myself included) that this can, in fact, detract from the absolute quality of disc record replay and cause different record decks to audition differently depending on their microphonic tendencies and acoustical characteristics. For example, the sharpness of a transient can be blurred, or the low-level "framing" ambience of a sound scene can be disturbed by these low-level signals getting back again into the system.

A record deck which is likely to be troublesome in this way can be exposed by resting the pickup stylus on a stationary record and then progressively increasing the setting of the volume control, taking care not to disturb the deck. A particularly microphonic deck will show up by the system going into a state of instability (turn the volume control back again quickly when this happens) such that a howl builds up from the speakers. This is referred to colloquially as *"howl round"*—a term originating in America I think! The more microphonic the deck, the less the volume control setting required to instigate the *acoustical feedback,* which is really what it is.

With a particularly good deck it will be possible to advance the volume control fully before it happens; or it may not happen at all even at full setting. The howl-round frequency is related to the natural resonances of the deck enclosure, pickup system, speakers and listening room. An idea of the frequency spectrum delivered by a cartridge when its stylus is resting on a stationary record and when the deck is subjected to a weighted noise signal of 96dBA sound pressure level (SPL) from a nearby speaker is shown in Fig. 18.

If the 0dB datum refers to 1cm/s recorded velocity and the cartridge has a sensitivity of 1mV per cm/s, then it will be seen that at just below 50Hz, corresponding to one of the resonance peaks, the output is 16dB below 1mV, which is about 158μV, a quite substantial signal. Signals of lesser strength will also be produced at all the other frequencies over the spectrum. Clearly, then, a record deck should be as clear as possible of microphony for the most accurate reproduction.

It is also highly desirable to keep the deck well away from the "firing" line of the speakers, to mount it on a thick, compliant mat if necessary and on a small, non-resonant solid shelf secured to a wall. If you have a tape recorder, a good test is to make a recording from a record while the speakers are being driven fairly loud, followed by a recording of the same music but this time with the speakers turned right off. Comparing the two sections on tape replay will reveal coloration of the first section with respect to the second if the deck is affecting the reproduction seriously.

MONAURAL

This is ***not*** the same as *monophonic* (commonly shortened to mono), which is a single-channel sound system, since it refers more accurately to "one-eared", which is a different thing altogether!

MULTIPATH RECEPTION

In the hi-fi realm this refers to a v.h.f. f.m. receiver responding first to the direct signal emanating from the transmitter and then, a small fraction of a second later, to a second signal (and possibly subsequent signals) which is reflected by a hill or large building, for example. Owing to their longer journey, these subsequent signals arrive at the receiving aerial a shade after the direct signal. The principle is shown in Fig. 19.

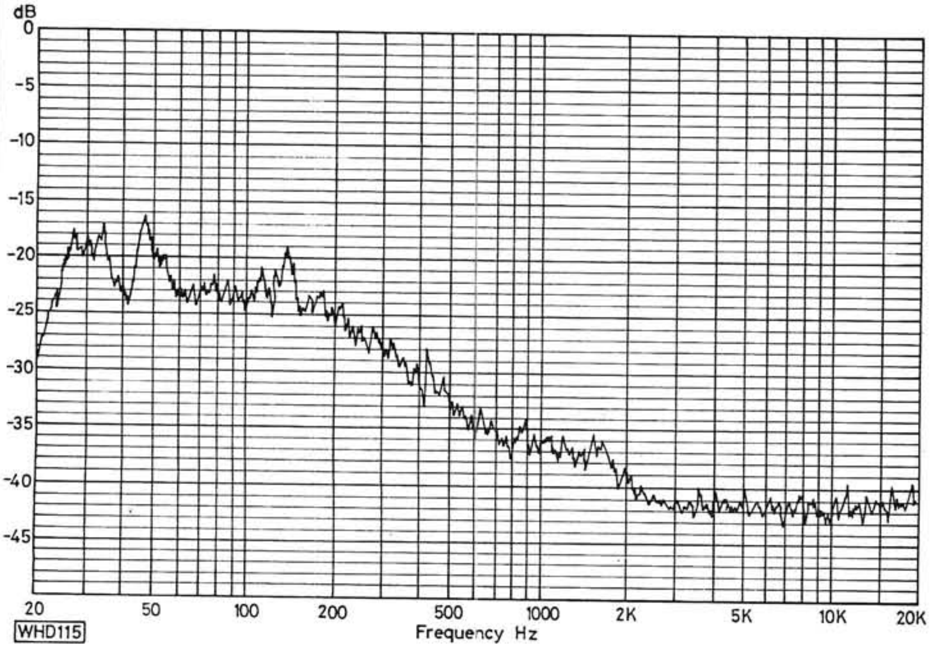


Fig. 18: Output from pickup whose stylus is resting on a stationary gramophone record when the deck is subjected to 96dBA of weighted noise signal from nearby speaker

HI-FI GLOSSARY

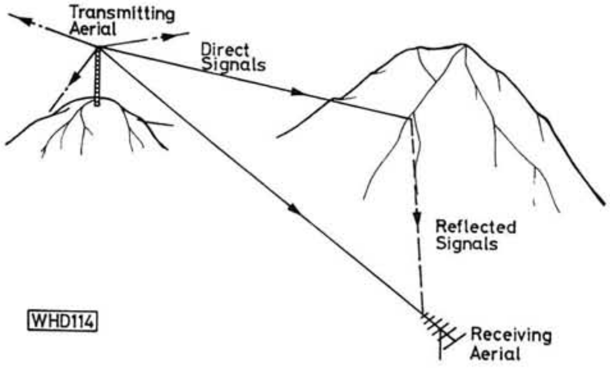


Fig. 19: Illustration of multipath reception (see text)

Propagation velocity of a radio wave, the same as light, is close to 300m/µs. If the additional path traversed by the signal *via* the reflection is, say, 1·6km (about 1 mile), then the reflected signal will arrive at the receiving aerial about 5·3µs after the direct signal. Signals arriving from other reflections will, of course, have different delays with respect to the direct signal. That is multipath reception.

MULTIPATH DISTORTION

Such small delays may seem inconsequential. This is certainly not the case, however. For example, 312·5 lines (one field of an interlaced frame) of a TV picture are traced out on the screen of the picture tube every one-fiftieth of a second (it is true that a few are suppressed as they carry sync and blanking information). This corresponds to 20ms, which means that each line takes 64µs. When there is multipath reception, therefore, the slightly delayed signals will produce "ghost pictures" slightly to the right of the real picture, and only a few microseconds of signal delay is needed for this to become apparent.

That is one aspect of multipath "distortion". More accurately, though, the "distortion" is that produced by a v.h.f. f.m. receiver when it receives reflected signals following the direct signal. To some extent, the f.m. detector interprets the signals arriving a little late as some sort of "phase modulation" (which is a brand of f.m.) and tries to detect them accordingly. The result is an audio distortion which, in severe cases, is not unlike that caused by an out-of-centre moving-coil speaker. The stereo decoder, too, is phase-sensitive, so the stereo performance is also affected by the multipath signals, which is apparent more on signals containing large amounts of high-frequency energy, such as piano music.

Receivers with a good *capture ratio* (see Part 2) are less prone to the distortion, as the reflected signals are handled as though they were unwanted co-channel signals. Some f.m. receivers and tuners are equipped with a switch which enables multipath reception to be revealed on the signal strength meter. Others are endowed with rear phono sockets allowing the connection of an oscilloscope for detection and analysis. Multipath reception can only be reduced by using a directional aerial which provides the maximum discrimination against the reflected signals under the best orientation.

MULTIPLEX

In hi-fi parlance, this refers to the encoding of the stereo information on a v.h.f. f.m. carrier-wave without detracting from the mono compatibility of the transmission. It is sometimes shortened to *MPX*.

MULTIPLEX (MPX) DECODER

This is the part of a v.h.f. f.m. stereo receiver which "unscrambles" the multiplex so that the output consists of the audio signals comprising the separate left- and right-hand stereo channels. At the transmitter, matrixed L–R and L+R information is amplitude modulated on a 38kHz subcarrier but the subcarrier is suppressed before transmission so that only the sidebands of the matrixed information are frequency modulated on the v.h.f. carrier. The L+R mono information also frequency modulates the v.h.f. carrier in the normal way, so that the signal will be accommodated by non-stereo f.m. receivers.

For the stereo decoder to yield the separate left and right channels, the matrixed information itself needs to be "detected" after the signal has passed through the normal f.m. detector, and this can only be achieved by reinserting the suppressed 38kHz subcarrier. Proper operation of the decoder demands that the phasing of the subcarrier be very accurately correlated to that of the original subcarrier, and to satisfy this requirement a 19kHz *pilot tone* derived by division from the suppressed subcarrier is also frequency modulated on the v.h.f. carrier. This signal complex after normal f.m. detection is the multiplex signal.

In the stereo decoder at the receiver the subcarrier is obtained merely by a 2 : 1 frequency step-up of the pilot tone or by using the pilot tone to phase-lock a separately generated 38kHz signal. The deviation occupied by the pilot tone and residual subcarrier is about 10 per cent of the total deviation. For full modulation this is ±75kHz, 10 per cent of which is ±7·5kHz. Non-stereo f.m. receivers reject the multiplex and respond only to the L+R mono information, but at a slightly poorer signal/noise ratio than a non-stereo-encoded transmission owing to the 10 per cent cut in audio deviation.

The decoder in stereo receivers processes the multiplex so that the left channel signal is obtained from $(L+R)+(L-R)=2L$ and the right channel signal from $(L+R)-(L-R)=2R$, which is a reversal of the matrixing used at the transmitter.

MUSIC POWER

The *average power* of an amplifier (often very incorrectly stated as "r.m.s. power') can be found by dividing the square of the voltage obtained across a resistive load by the value of the load in ohms (e.g., $W=V^2/R$). Because the voltage is that of continuous sinewave signal at a specified frequency, the full title of the power should be *average continuous sinewave power*.

Now, because music is not continuous like this, the power of an amplifier could be greater on music, depending on the power supply and output transistor heatsink capabilities. Music power, therefore, can be measured with repetitively-pulsed sinewave bursts. One burst of this kind is shown by Fig. 20 oscillogram which conforms to the *IHF-A-202* requirement (IHF is defined in Part 3). The

HI-FI GLOSSARY

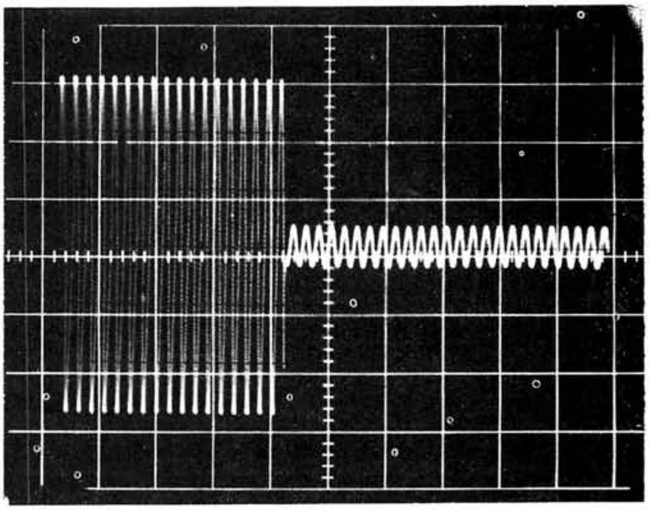


Fig. 20: Oscillogram of IHF-type pulsed sinewave ▶

burst at full output lasts 20ms, it then falls by 20dB for 480ms, increases to full output for 20ms, and so on.

By increasing the output of the amplifier to a point just before the peaks of the burst start to clip, the average power of the burst can be calculated as described by dividing the peak-to-peak amplitude by two and then multiplying by 0·707 to obtain the *root mean square* (r.m.s.) value of the burst voltage. The *peak music power* is twice the average power, and the peak power of the two channels of a stereo amplifier are sometimes added together to give the total peak music power of the amplifier. Be on the look-out for specifications which tend to inflate the power of an amplifier in this way!

TO BE CONTINUED

Index of Partly Defined Jargon

Acoustical feedback
Acoustical suspension
Average continuous sinewave power
Average power
Capture ratio (see also Part 2)
Compliance (see also Part 2)
Control amplifier
DIN socket
Howl round
IHF-A-202
Intermediate-frequency (i.f)
Monophonic (mono)
MPX
Peak music power
Phon
Phono socket
Pickup cartridge
Pilot tune
Pre-amplifier
Root mean square (r.m.s.)
Tip mass
Tracking ability
Transfer characteristic

Letters

Protest

Sir: I was very interested in your Holiday Guide for Radio and TV in Britain. I do hope, as your readers travel and find that many BBC programmes are unobtainable in a car in large areas of Britain, that they will write to the BBC and protest in no uncertain terms.

I refer especially to Radio 3 music on medium waves, and also to Test Match Special which appeals to a considerable audience.

H. S. Brodribb
St. Leonards-on-Sea

Information Please

Sir: I have recently acquired a 5-band valved receiver and need some help in identifying it. The metal case measures 450 × 230 × 230mm (16 × 9 × 9in), with a perforated top. Tuning is via a reducing drive fitted behind the tuning knob. The eight valves are Types CV1100, CV1101, CV1193, 6V6, KTW62 (2-off) and a Y61 magic eye. The bands covered are 75–200kHz, 200–500kHz, 600–1500kHz, 3·0–7·5MHz and 7·5–18MHz.

The front panel layout has the volume control on the left-hand side, with the waveband selector below, the tuning knob is in the centre of the panel and the magic eye above and to the right, the on/off switch is at the bottom right-hand side.

The receiver which has no internal speaker, performs quite well with just a throwout wire aerial.

R. Ankers,
82 Motherwell Road,
Hartlepool,
Cleveland

Car Intermittent Wiper Unit

▶▶▶ *continued from page 59*

Fitting

The circuit can be used with a positive or negative earth system; obviously, you should ascertain the system used in your car before wiring in the unit, and then connect it accordingly (see circuit diagram).

The wiring arrangements are as shown in Fig. 3 and Fig. 4. If the wiper on/off switch in your car is a simple single-pole "make" switch, then the arrangement should be as shown in Fig. 3. The normally-open and the moving contact of one changeover set (RLA2) should be connected to the two wires going to the wiper switch—the contact set will then act as a switch in parallel with it. The wiper switch thus controls the wipers as before and overrides the intermittent-wipe unit—when intermittent wiping is required, the wiper switch must obviously be returned to the "off" position.

On some cars, the wipers are controlled by a changeover switch when the arrangement shown in Fig. 4 should be followed. Remove all three wires from the wiper switch and connect these to the changeover set RLA2. The car on/off switch is now purposeless and can therefore be used to activate the unit, becoming S1 in Fig. 3. Continuous operation is selected by setting the delay time to a minimum as previously described.

The prototype was successfully built onto Veroboard (a suggested arrangement is shown in Fig. 2) and was housed in a small aluminium box, mounted under the fascia. Connections in and out of the box were taken via a 5-way connector mounted on the outside of the box.

Happy motoring! ●

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PRODUCTION LINES

alan martin

Sugiyama F850

A new transceiver giving coverage of all amateur bands from 160m to 2m (including 4 metres), with all modes (s.s.b., c.w., a.m. and f.m.) is available from Zycomm Electronics Ltd.

The F850 has a power output of 10 watts minimum on s.s.b., c.w. and f.m. modes (5 watts a.m.), with the output on c.w. and f.m. variable from the front panel.

Included in the specification is VOX with variable return times, a speech processor, a 25kHz marker unit and for 2m f.m. repeater operation, a repeater shift and automatic tone burst.

A 2·4kHz i.f. filter is fitted as standard, but additional filters with widths of 0·4, 1·2 and 1·8kHz are available which when fitted are readily selected by front panel push switches.

This compact, all purpose transceiver with the ability to operate from mains or battery, make it an ideal choice for base station, portable and/or mobile service.

The F850 costs in the region of £1000 and further information is available from: *Zycomm Electronics Ltd., 47, 49 & 51 Pentrich Road, Ripley, Derbyshire DE5 3DS. Tel: (0773) 44281.*

New l.c.d. Watch

Barrie Electronics introduce a new l.c.d. digital quartz watch to their product range. The "Stempo Alarm Chronograph" features 11 functions which include continuous display of hours, minutes, seconds, day, date and month with optional 12/24 hour clock display actuated by push button. The chronograph runs at 1/10 second increments with lap time or total event time facilities. The watch also incorporates an alarm and back light.

Priced at £16.00, which includes VAT and 50p P&P, the watch is available from: *Barrie Electronics Ltd., 3 The Minories, London EC3N 1BJ. Tel: 01-488 3316/7/8.*

If you please

Would readers kindly mention "Production Lines", when applying to manufacturers or suppliers featured on this page.

Mini l.c.d. clock module

Ambit are now stocking a miniature panel clock that provides all usual timekeeping functions in both UK and US formats for time, day, date.

The unit is quartz controlled (with access to the trimmer for fine adjustment), and includes an incandescent backlight feature. An alarm function is available to drive a bleeper or some other external means of indication.

With a running consumption of only 6μA, the PCIM161A is suited to a variety of applications—ranging from all types of consumer electronic equipment, to instrumentation, telephones, communications equipment, etc.

The cost of the unit is £9.50 plus VAT and 25p P&P. It requires only three momentary contact switches for setting, etc. The accuracy of the unit as supplied is within ±2·5 minutes per year.

Other units in the range include character heights of up to 0·5 inches.

The units require a power supply of 1·5V and with the very low running consumption of only 6μA, it is claimed that a cell-life of 5 years could be expected, if a manganese-alkaline type is used.

Ambit International, the suppliers, will be running a competition in their latest catalogue (available in early December), with a prize of £50 for the person who can suggest the most novel method of powering the module.

Further details from: *Ambit International, 2 Gresham Road, Brentwood, Essex. Tel: (0277) 227050.*

Micro TV

JVC have launched probably the world's smallest black and white TV/radio, the P100, measuring only 53 × 148 × 187mm with a 50mm (diagonal) tube and an a.m./f.m. radio tuner. Emphasis has been placed on complete portability in the design of the model, and a variety of power sources can be used—mains, batteries, rechargeable battery pack and 12V d.c. mobile power. An a.c. adaptor is supplied with the P100 and a "Car Cord" (for d.c. mobile power from a boat or car), a rechargeable battery pack and an a.c. power adaptor/charger are available as optional extras. An external antenna connector and a TV magnifying lens are also available.

The P100 features a novel 38mm 16 ohm speaker built into the tuning dial for compactness.

Supplied complete with carrying case, TV hood, dynamic earphone and a.c. adaptor, the P100 retails at around £165.00 (including VAT).

JVC (U.K.) Ltd., Eldonwall Trading Estate, Staples Corner, 6-8 Priestley Way, London NW2 7AF. Tel: 01-450 2621.

Lead Bender

Eraser International Limited would like to announce the availability of a new hand tool for bending leads of axial electronic components prior to insertion into printed circuit boards.

This new lead forming tool, Model PR2, is designed for bending at 90° the leads of electronic components such as resistors, diodes, capacitors, etc.

The Model PR2 Component Lead Bender is a fully adjustable tool and the legs of components may be bent with pitch centres between 12mm and 45mm. The adjustment on the PR2 is extremely simple and effective, by the turn of the knob on the side of the tool, two pointers are lined up with the holes on the printed circuit board, thus setting the bending dies to the correct dimensions. Then it is merely a matter of inserting the components into the tool and pushing the handles to give the desired bend.

The bending jaws on the PR2 incorporate a spring system which automatically compensates for different diameter lead legs on components thus eliminating any nicking or damaging of the components.

The PR2 costs £15.97 plus VAT and 65p P&P. Available from: *Eraser International Ltd., Unit M, Portway Industrial Estate, Andover, Hants SP10 3LU. Tel: (0264) 51347/8.*

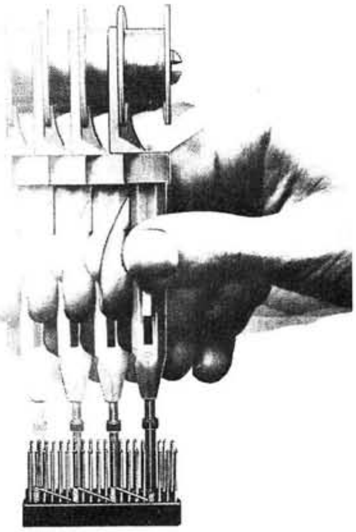
Speed Wiring Tool

OK Machine & Tool (UK) Ltd's new "Just Wrap" produces wire wrapped terminal connections without the need to pre-strip or slit the wire insulation. Hand-operated, the compact tool wraps on 0·025in (0·63mm) square terminal posts. Each tool has an integral refillable reel carrying 50ft (15m) of 30 a.w.g. (0·25mm) wire and will wire continuously through any number of pins in a "daisy chain". Also, it can be used for point-to-point working and for this purpose has a built-in cutter.

Wire refills are available with four insulation colours for colour coding—blue, white, red and yellow.

Price of this "pocket" tool, part of a wide range of OK's electronic production aids, is £11.18 plus VAT and P&P.

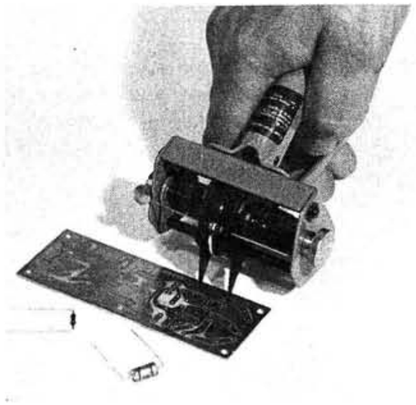
Further details from: *OK Machine & Tool (UK) Ltd., 48a The Avenue, Southampton, Hants SO1 2SY. Tel: (0703) 38966/7.*

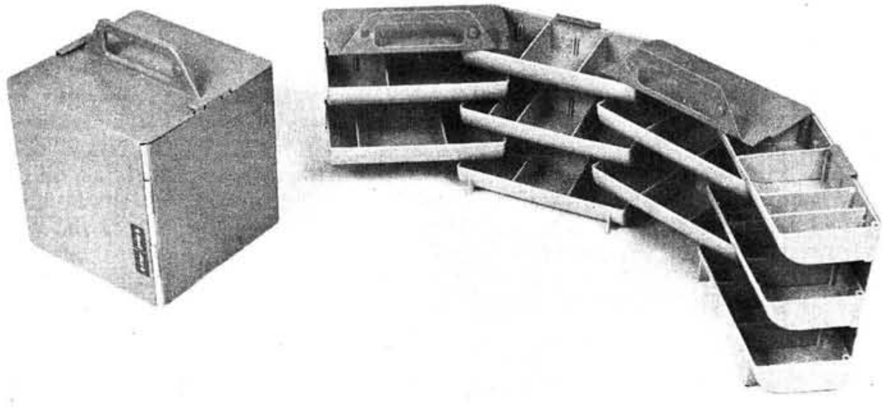


Handy Bin

The model 200 Partfolio is a unique folding production bin system which offers up to 30 separate compartments over a width of 800mm, but when closed occupies only a 200mm cube. Each system is supplied complete with compartment dividers and labels. Each individual tray measures 195 × 95 × 40mm.

The unit is light and robust and can be folded, stacked and locked with all the compartments held securely in place. The Partfolio 200 costs £17.50 plus VAT and is available from: *Toolrange Ltd., Upton Road, Reading RG3 4JA. Tel: (0734) 29446 or 22245.*





ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

A very long and newsy letter from the Reverend Nigel Eva of SE London takes me to task, in the nicest possible way, for my comments in the December issue on the sad lack of experience so prevalent today among newly-licensed amateurs, adding "how the heck can they be experienced if they are newly-licensed?" A good point but in the distant past we amateurs had to get some experience of handling transmitting equipment before getting a radiating licence, so there is nothing revolutionary in my suggestion, at least implied, that something ought to be done about it.

Now our friend is, I suspect, a likely candidate for the RAE in due course, having friends in the Cray Valley club which meets only a few hundred yards from his QTH, and a desire to buy a communications receiver, but he may not know that before the last war it was necessary to hold an Artificial Aerial licence for a while before going on the air. The AA licence enabled one to play around and make experiments, using a dummy load in place of an aerial, with a low power transmitter. Transceivers were unheard of then so one could listen to the transmissions and monitor them on a separate receiver, a sad failing in modern transceivers.

To get a radiating licence it was necessary to show why one wanted to radiate and the only answer was "experiments with aerials", what else?! So whatever one really wanted to do the stupid regulations invited one to lie! I must have been an honest lad at the time because aerials have been my main interest ever since.

With the problems of TVI and the preponderance of commercial equipment today for v.h.f. and h.f. bands it is impossible to resurrect the old AA ticket. The answer would seem to lie in obtaining the necessary experience in operating by using club radio gear under supervision of a licensed amateur, either before or after passing the RAE although, obviously it would be better if obtained before, thus increasing the chances of passing the exam. The club would issue a letter or certificate listing the experience obtained, and this would accompany the full licence application form.

This idea would help clubs immensely in attracting new members and raise the standard of activity. Too many clubs do not have much in the way of organised programmes, preferring just to meet and sit around asking each other: "What shall we do tonight?" Part of the potential licensee's initiation would be in other activities such as learning the code for the "A" licence, building and testing equipment for subsequent use at home, and taking part in field days where making up and using different aerial systems would be invaluable experience.

At the moment I feel that far too many people automatically go for the G8 ticket without having tasted the delights of h.f. working, which they could do at a club station. The problem is the would-be licensee unable to get to a club, and the handicapped or disabled, although the latter are well taken care of by the supporters of the RAIBC. The isolated person might be visited by a licensed amateur prepared to demonstrate transmitting techniques and the ways to avoid interference being generated. This point needs some more thought. Naturally if evidence of previous experience with transmitters can be provided then this experience qualification is not required. Without some such experience it is rather like allowing anyone to drive a car after passing a written exam on the Highway Code! But perhaps not so deadly!

Readers' News

A round of applause for **Ian Calvert** (Shipley, W. Yorks) for passing the RAE and becoming G8TVR, plus passing his City and Guilds T3 maths exam. After taking a course on radar, Ian managed to get a shipboard job after many difficulties but chucked it in and returned to land where he finds living conditions much more amenable! **Alan Taylor** of Stanford-le-Hope, Essex was delighted when, following a mention of his name in the column, fellow reader John Allen eventually contacted him and both have now joined the Thurrock AR club. Alan has a Trio 9R59DS and hopes to get a ground-plane up soon. Alan thinks he and I may have had a QSO some years ago when I was flying around the Med and he was on the Tripoli h.f. DF station at Idris. That was on 333kHz, I would add!

Arthur White (Grantham, Lincs) wonders if the length of the coaxial cable feeding a dipole is at all important. Provided the cable matches the impedance at the centre of the dipole the answer is "no", and it would be of less importance on receiving than on transmitting. However, the length should be kept to a minimum to reduce losses, to reduce the weight at the centre of the aerial and to keep down costs! The feeder should be allowed to drop vertically for a distance, rather than straining it at an angle from the centre. The impedance at the centre is likely to be around 70Ω in practice, but if only 50Ω cable is available then use that. If the dipole can be turned into the folded version then 300Ω flat twin feeder is an ideal match.

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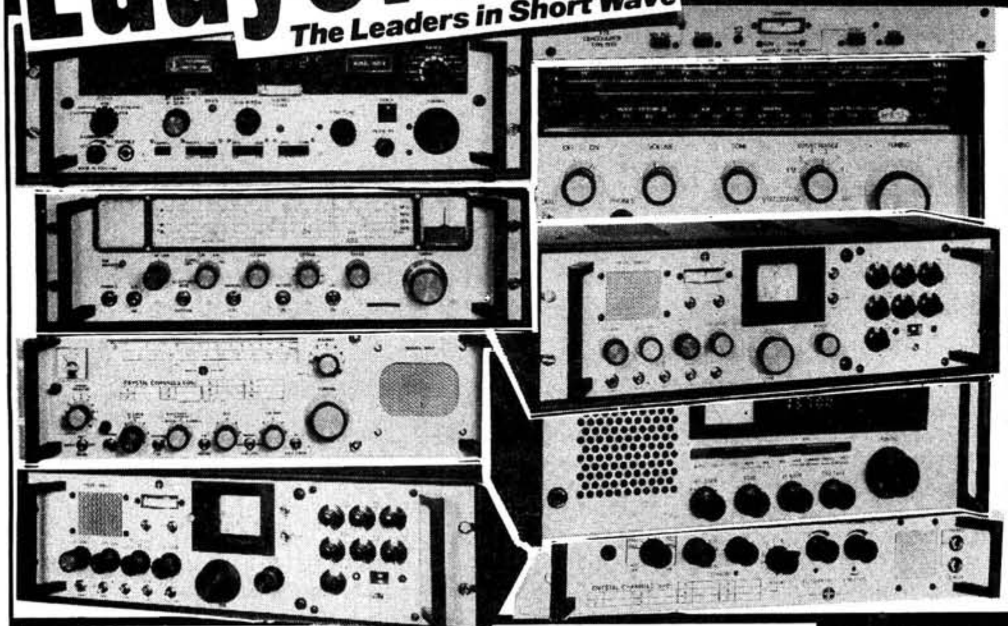

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Lee Humphries in Maidenhead, Berks wanted info on the best bands to use at different times of the day so I have referred him to the article in the October issue of *Short Wave Magazine* where all is revealed. The material was obtained from the very extensive logs of the late G2DC, an old DXing friend of mine and a very fine operator.

In Tetbury, Glos, **Jim Rowland,** who admits to being an OAP plus a bit, has been playing with aerials but found that two long wires starting from the same pole were interacting, proved by noting the reduction in signal strength when the unused aerial was earthed. Presumably the unused aerial was acting as a reflector or director, so possibly by earthing one aerial via an a.t.u. it could be tuned to act as a bi-directional beam. This was all on 80m. More fun for Jim who suffered, or his receiver did, from ear-shattering bursts of noise which he traced, with the aid of a "tranny" radio, to a chlorinator on a heated swimming pool 400 yards away! The owner was only too happy to get it fixed as his own radio has also been rendered almost useless by the QRM.

Around the Bands

Mike Stolov G4HWB still finds time to write in since he has not got himself on the air yet. He's now acquired an AR88 from G3JIJ who is off to aurora land, namely Scotland, where he can use the reflecting telescope that formed part of the deal! Mike heard his best stuff on 10m with FY7BF, VP5WJR, YS9RVE, ZB7BW and 6W8FZ with A5CV, SV0AE and ZL1AWS on 15m, all s.s.b. On 40m the only catch of interest was CM1RH.

In Knutsford, Cheshire, **Dave Coggins** got his DX160 on to the DX on top band during the CQ world-wide contest and logged VP2KC twice, once with his ordinary aerial and again with a m.w. loop tuned down to 160m. At times, the signal was better on the loop. Dave also mentions the reduction in QRM from TV timebases, so those of you having this problem on 160m might like to try a loop. Other goodies logged at the same time were DL7RT/HB0 and OH2PB/OH0 on Aaland Island, plus plenty of the UA fraternity, new to the band. On 80m Dave found CO2F, HS1ABD and VS6DO. On 40m FM7WS, FY7BC and JA2BAY came through with KX6PP and 9Q5DH on 10m completing this all-band journeying.

Regular **Dennis Sheppard** (Sheerness, Kent) stuck to RTTY logging, but I am surprised that no other reader has been interested enough to enquire about this fascinating mode of reception. A ZL Special aerial is now being used on 28MHz bringing in stuff like JA1BPQ, lots of Yanks, TI2CAH, VE1TX, 3B8RS, 9G1JX and 9H79ET. Best on 15m was ZS6AKO with 20m revealing JH1HWN, KH6SP, KL7JHD, VK2BGL, YO7BI and ZS6JR.

Peter Hawkes of Stourbridge, W. Midlands, also listened to 160m, but TVI QRM caused UW9AF to get away. However, 20m came up with 8Z4A in the so-called Saudi/Iraqi neutral zone, who seems to have annoyed many people by just wanting to work W1s! Guess he must come from them there parts! Others on the band were 3C1AA, HP6KY and FB8XY. I'm hoping to hear soon from **Allan Stevens,** of Crowthorne, Berks, as to how he fared in the last RAE and I'm glad to learn he is swotting the code to get his G4 from the word go. A slight correction to the DX performance figures of **Bernard Hughes** (Worcester) who has heard a total of 325 different countries with no less than 308 confirmed! Of these 306 have been for 14MHz.

Reporting for the first time to the column, **R. Guest** of Braintree, Essex, has an FRG-7 with a.t.u. and logs VP2MPB of Montserrat, YA1AWZ and 9K2FX on 28MHz, DU1KW, OY9R, SV0AM, VP2MS for his 21MHz catch and 3C1AA and 9H79EU among others on 14MHz. Lastly, regular reporter **Bill Rendell** of Truro has now added an eighteenth knob to his trusty AR3! This is a fine tuning capacitor on the preselector to take out the slight alignment errors of the tuning gang. First DX logged after mod was KX6PJ in the Marshall Is. Bill, I'm sorry to say, has defected somewhat, by building a m.w. loop aerial a la Charles Molloy. He's well acquainted with loops from his RAF days, but Bill has never got round to making one before. However, the XYL objects to the loop in the bedroom so Bill is talking of putting it in the loft with a hole through the ceiling. He'll be lucky! New ones for Bill include ZS2MI on Marion Is. The daily logging of VK/ZL has now been called off after a stretch of 161 days. With constant kicking from me, Bill may get his RAE 'ere long and then he can try working them for 161 days!

Clubs Agogo

West Kent ARS at the Adult Education Centre, Monson Road, Tunbridge Wells, Jan 18 sees G6TQ chatting on The Secret Listeners and, if it is what I think it is, it will be absorbing. Feb 1 is discussion night for HF/VHF Field Days. Alternate Tuesdays see informal meetings throughout the year at the Drill Hall, Victoria Road, so no complaints here of inactivity. Further info from: Sec Brian Castle G4DYF, 6 Pinewood Avenue, Sevenoaks, Kent or ring 0732 56708.

The **Stevenage and District ARS,** first and third Thursdays in the Senior Staff Canteen, British Aerospace Site B, Gunnels Wood Road, Stevenage at 8.15 with visitors advised to make it a bit earlier to get intros over before fun commences. Jan 17 has G3OZF on RTTY and Feb 7 will give G8KMG a chance to talk and lecture on a visit to Skye. Hope it includes some bird shots! Sec Ted Godfrey brings up the age-old moan on lack of material for the club newsletter and no suggestions for meetings. "Even adverse comments give the committee an indication of the way to go (like out the door!) for future activities." So help Ted out by joining or at least writing him at: 94 Common View, Letchworth or make his earpiece warm on Letchworth 72184.

The **Liverpool and District ARS** would like chaps and chapesses in the area to know that it meets every Tuesday at 8pm at the Conservative Rooms, Church Road, Wavertree with goodies in the pipeline like a Club Quiz run by G8CFM on Jan 8 and Microprocessor Software from G4EST on the 15th while Jan 22 is Surplus Sale night. Contact: Al Neilson G4CVZ, 78 Ackers Hall Avenue, Liverpool L14 2EA or ring (051) 220 5470. Forgot to mention that RSGB's Region 1 rep Bill Furness G3SMM will be visiting the club on Jan 29. Sorry, Sir!

The **ARC of Nottingham** (that's a nice permutation on the usual format!) meets Thursdays at the Sherwood Community Centre, with Jan 10 seeing G8FWH discourse on an MSF clock, the 17th being a club activity night. DXers ought to find the saga of a DXpedition to the IOM interesting as related by G3TVY–G4AFJ and G3YUT, on the 24th, with a Junk Sale on Jan 31st. If you've never been to a junk sale, you've never lived! Try reaching Sec Mike Shaw G4EKW at 50 White Road, Nottingham NG5 1JR. Young Men of Dover ought not to ignore the **Dover RC,** call G3**YMD,** meeting Wednesdays at the Dover YMCA (where else!) Godwin Road. Call G4EGQ on 203000 for latest info on meetings. On the other hand if you live around **Maidenhead** or district you will want to know about the local club activity from John Patrick G3TWG, Bedford Lodge, Camden Place, Bourne End, Bucks. Meetings first and third Tuesdays at Red Cross

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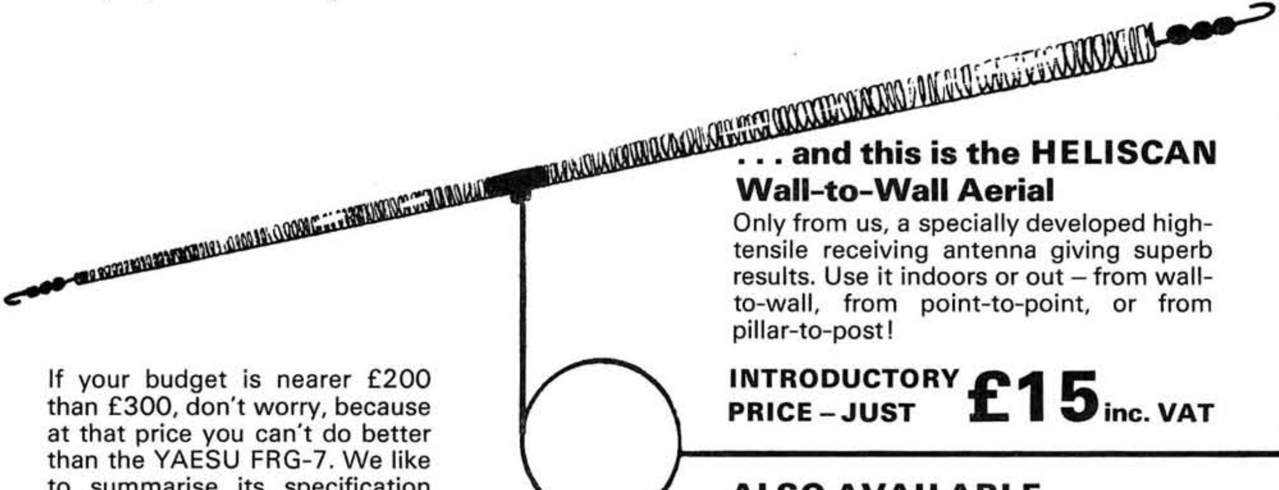

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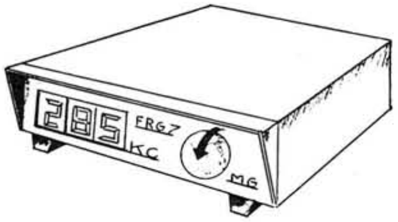

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Centre, The Crescent, Maidenhead. You can ring John on Bourne End 25275 if you so wish.

Visitors are always welcome at the **St Helens and District ARC,** Wednesday evenings 7.45 or get there earlier for the code practice sessions at YWCA, 107 Corporation Street, St Helens or drop a line to: Paul Gaskell G8PQD, 131 Greenfield Road, St Helens or ring him on 25472.

Culled from the Torbay ARS Newsletter *TARS Talk*—four out of five of the Davies family took last May's RAE and all passed! Calls G8SXA to SXD! As they say, it's just got to be a record of some kind!

Odd items

My daughter Susan has drawn my attention to a piece in her Open University newspaper *Sesame* entitled "Self-help on the Short Waves" with pictures of Steve McGee G4HDC in Wigan and Rod Beavon G3PPR of Sherborne, Dorset, who have regular skeds on 3750kHz to discuss mutual problems with their OU course.

BROADCAST BANDS

MEDIUM WAVE DX

by Charles Molloy G8BUS

Selectivity is probably the most important and least understood feature of a receiver intended for DXing on the crowded medium waves. From letters received, it appears that the reasons for and the consequences of using narrow selectivity, are not fully appreciated. The problem lies partly in the nature of the signal we are trying to pick up so perhaps it is best to start there.

Double-Sideband Transmissions

A carrier is simply a single frequency which, as the name suggests, carries the programme (modulation). Suppose we want to transmit an audio tone (note) of 4500Hz (4·5kHz) using a carrier of 900kHz, which is channel 42 under the Geneva Plan. Fig. 1 shows what is actually transmitted. It is the 900kHz carrier together with 895·5kHz which is 4·5kHz below the carrier, and 904·5kHz which is 4·5kHz higher. If we now modulate the carrier with audio which has a range up to 4500Hz, the results will be as Fig. 2. The programme is actually transmitted twice, once in the hatched area above the carrier and again below the carrier. These are called the upper and lower sidebands respectively and their width depends on the highest audio frequency. If you want to transmit sounds up to 6000Hz then the station will spread out over the spectrum from 894kHz (6kHz below) to 906 (6kHz above). This is the type of signal we are trying to pick up.

As a matter of interest, only one sideband is required for reception. If one is suppressed then we have single sideband transmission, and if the carrier is removed as well we have suppressed carrier s.s.b. which is the type used by radio amateurs. The carrier has to be replaced within the receiver before the audio can be extracted, which adds complications at that end, and this is the main reason that s.s.b. is not used for broadcasting.

Receiving Problems

Look at Fig. 3 which shows two adjacent m.w. channels spaced 9kHz apart. The upper and lower sidebands are 4·5kHz wide and if you are using a receiver with a passband of 9kHz and you tune it to 900kHz you should, it would appear, pick up the programme without interference from the station on 891kHz.

In an ideal world you would. Unfortunately the sidebands do not end abruptly 4·5kHz from the carrier. They spread out and taper off in strength gradually as audio higher than 4500Hz manages to get through. The receiver passband too is more like an archway than a window; it spreads out as well.

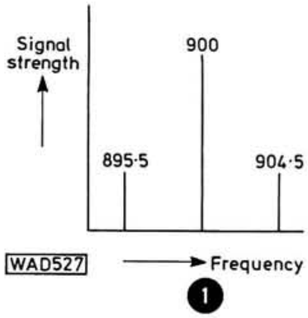
A real-life problem is shown in Fig. 4 where the DX signal is weak and the QRM strong. Narrow receiver bandwidth is required to reduce the QRM, but if it is made too narrow then audio quality will suffer due to sideband clipping. What you do now is to tune away from the QRM (Fig. 4). Audio quality will immediately improve as you have re-tuned to the upper sideband in place of the low (audio) frequency portion of both sidebands, which are nearest to the carrier. The strength of the QRM will diminish too, since you are now farther away from it. It is always worthwhile tuning away from QRM even with a

Fig. 1: Spectrum of a double-sideband signal, comprised of carrier at 900kHz plus sidebands due to modulation by a single 4500Hz tone

Fig. 2: Idealised spectrum of a speech-modulated d.s.b. signal

Fig. 3: Two d.s.b. signals on adjacent channels

Fig. 4: Receiving a weak DX station in the presence of a strong interfering signal on an adjacent channel



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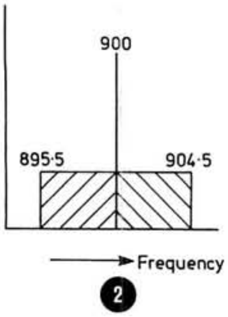

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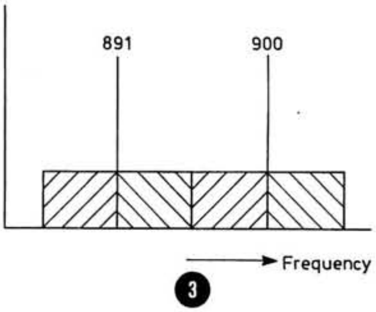

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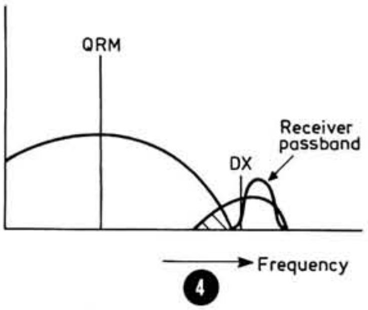

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Reports on the various bands are welcome and should be sent direct, by the 15th of the month, to:

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.

receiver with moderate selectivity. Peak up the station on the "S" meter and then de-tune away from the QRM.

When I use my BRT400 on the medium waves I switch the selectivity to 2kHz which brings in the crystal filter and phasing control. This position is really intended for c.w. and is a shade too narrow for clear speech. If I tune spot-on the carrier as shown on the "S" meter then speech is slightly muffled. So I normally de-tune to one of the sidebands unless of course, QRM is slight and static is low, when I open up to a wider passband.

From the above it will be obvious that a receiver with fixed bandwidth will have to compromise between the needs of the DXer (narrow) and the s.w.l. (moderate selectivity). A reader wrote to me recently saying his new Rx gave better quality audio than his old set which is an indication that the new one may have inferior selectivity and therefore be less effective for DXing! On the other hand it was clearly more pleasing to use for general listening.

Beginners' Corner

Hilversum I, the Dutch station on 1008kHz, signs off nightly at approximately 2300 to leave the channel clear for Radio Las Palmas (EAF50) in the Canary Islands. This station is usually a conspicuous signal and is on the air until 0100 with programming in Spanish.

Now tune up slightly to 1010kHz where, if the path to North America is open, you may pick up WINS in New York City. Don't be disappointed if it isn't heard first time as reception can vary a lot from night to night. Remember too that slow fading is normal with DX signals on the medium waves so stay on the channel for a minute or two to see if WINS comes up out of the noise.

When conditions are good you may hear a second North American on 1010kHz. This will be CFRB in Toronto which, if it is audible, will be as strong as WINS. If you are lucky you will hear each station reach the peak of the fading cycle in turn and it is interesting to compare the style of these two broadcasting neighbours in the USA and Canada.

Reader's Letter

"Can you suggest any good maps that are available for DX work—one with UK as an aerial centre for world wide direction information", enquires **G. S. Maynard** from Newtownabbey in Northern Ireland. What you are looking for is a Great Circle map centred on the UK. Its official name is "The World on the Azimuthal Equidistant Projection" which is published by the Admiralty and can be ordered through bookshops.

A Great Circle map can be centred on any location, this one being on the UK. Bearings are marked round the sides and if you take a straight line from the UK through the country concerned you can read off the bearing along the side. This type of map is very useful for use with a loop and a compass, for if you know the bearing of a station it may help with identification. Mr Maynard is constructing a five-sided 12ft diameter garden loop which should pull in the DX. DXers will be interested to learn how it performs.

DX Heard

In spite of the sunspot maximum, some good North American DX has been reported, which is rather surprising. **Sandy Mountain** (Lytham) picked up six Canadian and six US stations between 0100 and 0400 with his National Panasonic DR28 with Joymatch and Joystick. CJYQ was heard as early as 2104 and at 0700, WITS 1510, WKBW 1520 and XEDM Hermosillo Mexico on 1580.

A home-brew receiver and loop are in use in Hartlepool by **Fred Ainsley,** who reports hearing eight Canadian and four US stations from 2300 onward including CKEC New Glasgow, Nova Scotia on 1320 and WCAU Philadelphia on 1210. The CBC station on 750kHz is CBGY at Bonavista Bay, Newfoundland which comes in well at my QTH. Yes Fred, WMEX is no more, the callsign having been changed to WITS. The location is Boston as before.

BROADCAST BANDS

SHORT-WAVE BROADCASTS

by Charles Molloy G8BUS

Following on from last month when receiving aerials were discussed, we will now have a look at the more popular aerials used by DXers. These are illustrated in the Aerial Data Chart presented with the November 1979 issue of *PW* and we will start this month with the long wire. The name is something of a misnomer as it is really an end-fed aerial. The "long" is related to the wavelength of the signal as well as to the length of the wire. An aerial 20m long would be a long wire on 11m but not on the medium and long waves. The term long wire though is well established so we had better stick to it.

The Long Wire

This is the simplest and easiest aerial to erect. It consists of a length of wire led from the receiver to a mast at the bottom of the garden or to a nearby building. For best results it should be as high as possible above the ground and clear of surrounding buildings. If the receiver is in a downstairs room then the aerial becomes an inverted "L" type with the horizontal portion fixed to the chimney or eaves and a downlead dropping to the window and receiver.

Matching

The long wire is a non-resonant aerial whose impedance changes as we tune across the bands from 11m to 120m. For maximum transfer of energy from aerial to receiver the two must have the same impedance, otherwise a mismatch will occur and some of the energy from the aerial will be reflected from the point of mismatch, and be reradiated.

It is possible to lengthen an aerial electrically by means of a series inductor, or to shorten it with a series capacitor, and thus bring it to resonance at any frequency. More conveniently, we can place a matching network between aerial and receiver and adjust it for maximum signal every time we change bands. The usual type is the pi network, consisting of a variable inductor and two variable capacitors. It is called pi because it is supposed to look like the Greek letter π. The Aerial Tuning Unit (a.t.u.) shown in the Aerial Data Chart is a pi network. It is easy to make one but they can be obtained commercially.

To get the best from a long wire, erect it as high as possible and join it to the receiver via an a.t.u. It really is worthwhile using an a.t.u. and a good earth often helps as well.

Tropical Bands DX

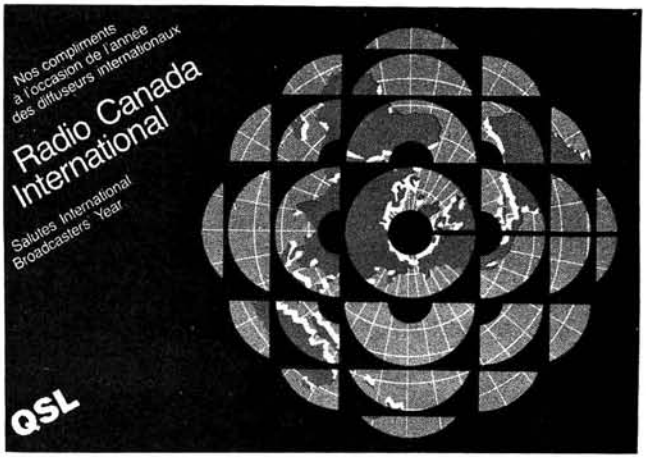
An FRG-7 and 10m vertical are in use at Newcastle-on-Tyne by **Ron Proudfoot,** who reports hearing a number of interesting stations on the 90, 60 and 49m bands. Faro del Caribe (Lighthouse of the Caribbean) was heard with American-style religious programming from 0310 to 0400 on 5055kHz. Salisbury in Zimbabwe/Rhodesia was logged on 3396kHz, in English from 2106 to 2151 and a verification was received in 16 days. Blantyre, Malawi was heard in English from 2115 to 2210 on 3380kHz. "DXers, like fishermen, have their own favourite catch, my own being a recent logging from 0501 to 0611 on 5954kHz," writes Ron. The station was Radio Casino, Limon in Costa Rica with an English programme, and a pennant and QSL came in 28 days. Although the 49m band is not officially one of the Tropical Bands, it is used for local broadcasting in some tropical areas.

Other DX includes La Cruz de Sur in Bolivia on 4875kHz with identification in English at 0102, Radio America in Peru on 3240kHz at 0518 and La Voz de Guatemala on 6180kHz in the 49m band at 0411. Ron will be delighted if his log encourages others to have a go.

Harmonics

The area above the 10m amateur band (beyond 29·7MHz) is in the news again with an interesting report of harmonics from **Harold Brodribb** of St Leonards-on-Sea. With his AR88LF he pulled in the BBC World Service on 30·16MHz at 1501, Tashkent in English on 30·44 at 1400, Moscow on 30·32 and 30·44 and an unidentified, perhaps Alma Ata on 29·81. In addition the IBA broadcast on 29·705MHz was logged at 1500.

Andrew Howlett G8DWR, from Caversham Park, reports that Jerusalem is on the air daily on 29 705 at 0530, 1000 and from 1400 to 1700, the transmission being intended for reception by Russian amateurs.



K. Smith (Ross-on-Wye) mentions that at least one commercially available receiver employs harmonics of its local oscillator to tune to the 11m band! When the receiver is tuned to 22MHz, stations on the 11MHz (25m) band can be picked up, presumably from the fundamental of the local oscillator. This should add a new dimension to harmonic hunting.

Jamming

Reader **Piers Rothschild** of Bagillt in Wales is puzzled by jamming heard on the 31m band. In one case he could not hear even a trace of the station being jammed. Jammers sometimes come on the air early, in anticipation of the transmission they are trying to blot out. There is another possibility. If the jammer and its quarry are in locations widely separated from one another then the path from each location to the DXer may be different. For example, one could be in daylight and the other in darkness, so it is possible to hear the jammer on its own.

The technical problems involved in jamming are interesting when one considers the effects of skip and the restricted range of the ground wave on the short waves. The higher the frequency the more difficult the problem, with more and more jammers needed to drown out a single transmission.

DX Programmes

DX Digest is the name of the weekly programme for DXers which comes from Radio Canada International in two parts every Sunday evening. The first is during the half hour programme beginning at 1900 and the second part is an hour later. At the time of writing the 1900 transmission comes in well on 15 325kHz in the 19m band and the second one on 11 905kHz in the 25m band. Frequencies are always changing on the short waves so it is better to write for an up-to-date schedule to Radio Canada International, PO Box 6000, Montreal, Canada, H3C 3A8. Along with the schedule will come a do-it-yourself QSL card which you fill in and return for verification.

DX Digest is one of the better programmes for DXers, for as well as the usual "tips" there are interesting talks on a variety of subjects relating to DXing. The majority of s.w. broadcasters change their schedule four times a year so it is advisable to write for a schedule if you are interested in any particular transmission.

Syria

According to the *WRTVH* November Newsletter, Syria is back on the short waves again on 7145kHz. It has been heard carrying the Western/Turkish programme from Damascus and also programmes of the Arabic service.

Reader's Letter

Receivers without an r.f. stage are referred to by reader **A. White** who lives in Aisby, Lincs. He wonders if the performance of this type of set would be improved by using a preselector. Yes it would, both sensitivity and second channel (image) rejection will be improved, but any effect on selectivity would be minimal as it is the i.f. stages rather than the r.f. that provide the selectivity in a receiver.

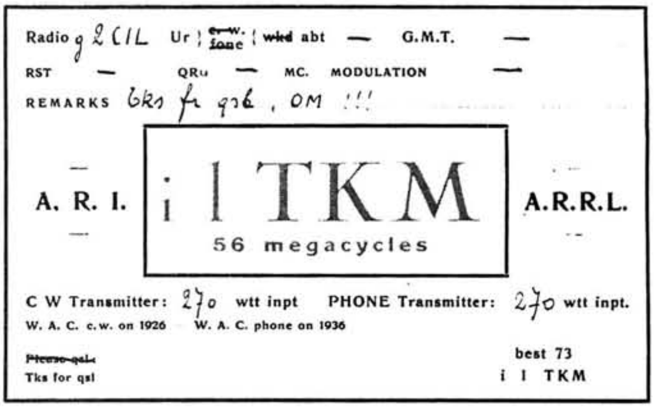
I use a Codar PR30 preselector which is no longer available, new at any rate, but other models are on the market. It is used only occasionally as I find the sensitivity of the BRT400 to be adequate for most purposes. If you use a preselector with a sensitive receiver on a crowded band you may overload the r.f. stage and mixer, producing undesirable effects such as cross-modulation. It is really with the simpler type of receiver that a preselector comes into its own.

B40 Receiver

My request in the August issue for information about the cross-modulation control on the B40 receiver brought a reply from **Max Gill** of Gordon, NSW. These receivers were in use by the Australian Broadcasting Commission after the last war, as part of an emergency programme link to transmitters in case of landline failure. Max mentions the problems of using a receiver in close proximity to a 50kW transmitter where literally volts of r.f. are flying around. Under those circumstances "with the magic crossmodulation control one adjusts the bias of the first r.f. stage and the unwanted signal disappears completely, when the linear portion of the transfer curve is in operation". The B40 was a naval receiver and similar problems may have been encountered with ships' transmitters.

by Ron Ham BRS15744

While listening, with delight, to the strong s.s.b. signals from north American stations just above 50MHz, I remembered that my QSL collection contained a card, Fig. 5, confirming that signals from Italy were received here in Sussex, on 56MHz, more than 40 years ago, with far less sophisticated equipment and, just like today, the Novosti of the opening soon travelled among the DXers.



Radio g 2CIL Ur } ~~c-w.~~ fone } ~~wkd~~ abt — G.M.T. —

RST — QRu — MC. MODULATION —

REMARKS tks fr qsl, OM !!!

A. R. I.

i 1 TKM

56 megacycles

A.R.R.L.

C W Transmitter: 270 wtt inpt PHONE Transmitter: 270 wtt inpt.

W. A. C. c.w. on 1926 W. A. C. phone on 1936

~~Please qsl~~

Tks for qsl

best 73

i 1 TKM

Fig. 5: QSL Card received in Sussex by George Hook, 2CIL, in 1939

Solar

Both **Cmdr Henry Hatfield,** Sevenoaks, and I recorded individual bursts of solar noise, at 136 and 146MHz respectively, on October 24, 27, 29 and November 5, 7 and 8 (Fig. 6). Solar noise storms were recorded on October 27, 29 and November 8, 9 and 10. On November 5, Henry, using his spectrohelioscope, saw a large and very active area coming around the east limb of the sun and on the 9th, he saw many sunspots spread across the disc. Some were in large groups accompanied by several flares and active areas.

Ted Waring, Bristol, counted 44 sunspots on October 18, 23 on the 24th, 54 on the 31st, 85 on November 10 and 77 on the 12th. Some of the solar noise and about one minute of the four-minute burst, which occurred at 1122 on November 8, were also recorded by Henry at 1296MHz. With all these sunspots it was not surprising that the BBC World Service reported an ionospheric disturbance during the small hours of November 14 and frequently the m.u.f. was rising above 50MHz.

The 10 Metre Band

"This is where the action has been," wrote **N. Clarke** BRS 34306, Knottingley, West Yorkshire, on November 13, who noted 10m openings to the USA on almost every day during the preceding month.

On most days from October 22 to November 18, the band was wide open. Although the best DX came during working hours, it was good to hear the predominantly strong signals from Japan, Scandinavia and the USSR before 1000 and Canada, USA and the USSR at midday. My advice to all DXers is to make hay while the sun shines because super conditions do not last for ever. It is difficult to select one day, but around 0930 on November 3, I heard a very strong JA work A9, OH and SM, who

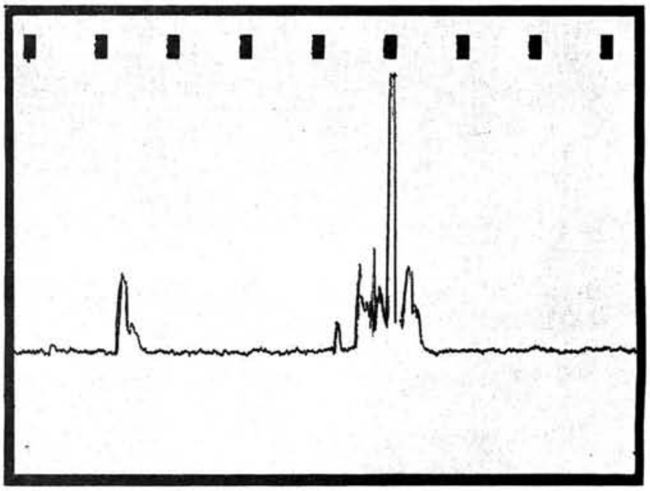


Fig. 6: Typical solar burst recorded by the author at 146MHz at midday on November 7

were equally strong with me. At the same time there was an echo on the signals from the German beacon DL0IGI.

Russian signals were extra strong on November 6, when, around 0930, I heard a QSO between a UA and a VK4 and about the same time on the 8th an RB5 was very strong with G5OD. The Russian stations were good keys to the DX, because, by listening on the frequency after their CQs, replies from many parts of the world were heard. This could be a good tip for **Arthur White,** Grantham, Lincs, a newcomer to listening on the amateur bands. Welcome Arthur, I am sure you will enjoy it like the rest of us do, especially when, like **Sam Faulkner,** Burton-on-Trent, you hear a special interest station such as W6RO, working /A from aboard the Queen Mary, in Long Beach, California.

International Beacon Project

Throughout the period October 21 to November 18, I received consistent signals, averaging 539, from the IBP stations in Bahrain A9XC, Cyprus 5B4CY, Germany DL0IGI; almost every midday, Bermuda VP9BA; and less frequently, Florida N4RD and Germany DK0TE. At 0920 on November 5, I heard a 559, peaking 589 signal from the Norwegian beacon, LA5TEN, 28·237MHz. Like me, N. Clarke heard A9XC, DL0IGI and 5B4CY almost daily, and periodically the Canadian beacon VE3TEN. Although Ted Waring received signals from VE3TEN on most days between October 17 and November 12, they were irregular and hard to find during early November.

Harmonics

When h.f. conditions are good, harmonics of lower frequency broadcast stations are frequently heard between 28 and 31MHz and **Harold Brodribb,** St Leonards-On-Sea, Sussex, is making a special study of these. "They must be irritating the amateurs", writes Harold, "there was chaos around 28·5MHz during a CQ contest and many moved up around 29MHz to get away from the din." Between 1500 and 1715 on October 28, Harold heard a variety of languages and music, from about eleven stations between 28·200 and 30·300MHz. One, a programme of music, around 29·81MHz fascinated him, because it was interrupted by a curious identity signal of gongs or bells, followed by a male announcer using the word "ALMATYDAN" (any ideas?), possibly Russian from Alma Ata Kazakstan, thinks Harold.

Novosti

In our November issue I asked for ideas about the word "HOBOCTON" which **Mark Stephens,** Haslingden, Lancs, and I, saw on a Band I TV caption flashing around a tower. Well, as always your replies came in; "The word "HOBOCTON" would seem to be the Russian word for NEWS, which is pronounced Novosti", writes **N. G. Davis,** Welling, Kent, who also enclosed a clipping from a Soviet magazine, with a picture of a tower, and suggests that the tower we saw was the gigantic tower in the Ostankino district in the northern sector of Moscow. Similar letters saying "News, Novosti" came from **Eric Blake** G4HWQ, Scarborough and **Ignor Hajek,** Lancaster and phone calls with the gen from **John Cooper** G8NGO, Cowfold, Sussex and **Guy Stanbury.** Many thanks for your interest. I am always pleased to hear from my readers.

DXTV

At 0900 on November 2, all seemed quiet on Band I and then I saw several long bursts of test card YLE-HLK-1, from Finland. Then came a general mix-up of pictures, due to the prevailing F2 conditions, which faded away and from 0947 until I left home at 1000, I received a strong test card, TV1 Sverige, from Sweden. Many of us have been frustrated by the strong, yet smeary and mixed up pictures which have been coming up during the mornings on Band I, via F2, between October 16 and November 18.

"A typical F2 day starts at sunrise with USSR communications and short-wave harmonics up to about 45MHz followed by USSR TV on Channel R1, 49·75MHz", writes **Mike Allmark,** Leeds, who has identified test cards from the USSR and possibly China and Malaysia from the mixture of pictures. "The only caption seen was, as near as I can translate, DUSHWABE, on Afghan border", writes **John Branegan** GM4IHJ, Saline, Fife. At 0949 on November 6, I saw a hospital film with nurses walking along a corridor, which became predominant from the muddle for a short while. On November 7, Mike Allmark received TV pictures from the USA on Channel A2, 55·25MHz. The 60Hz field timebase presented a problem, and when it locked, he had a black band at the top and bottom of the screen. From 0745 to 1100, on October 21, Sam Faulkner monitored Channel R1 and writes; "The video was distorted, blurred and suffering co-channel interference which seemed to be pictures of oriental origin". He identified some Russian pictures and between 1140 and 1200 he watched a programme of ballet on R1. At 1130 on the 22nd, Sam received a strong test card on R1 from CST, Czechoslovakia.

Sporadic-E

Both John Branegan and Sam Faulkner were in on the sporadic-E disturbance which occurred between 1300 and 1500 on October 14. While John was receiving the PM5544 test card from ORF-FSI, Austria, on Channel

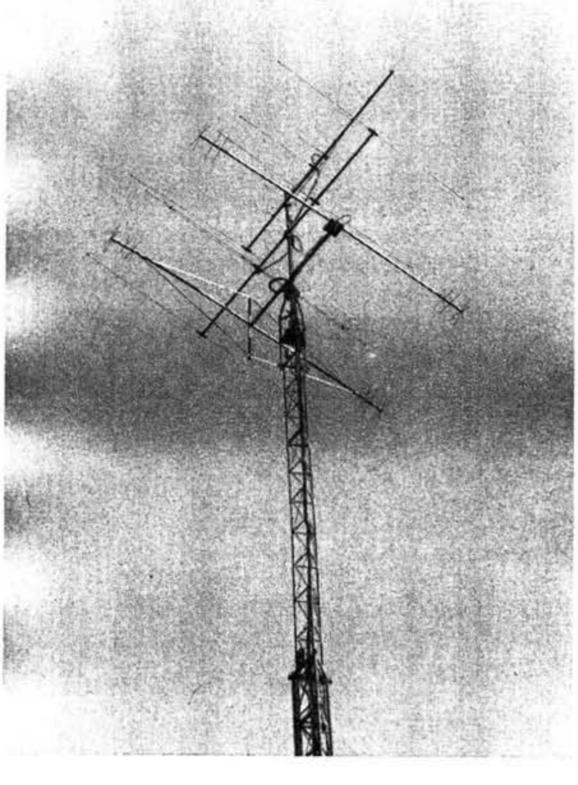


Fig. 7: The array of beams on top of Sam Faulkner's aerial mast

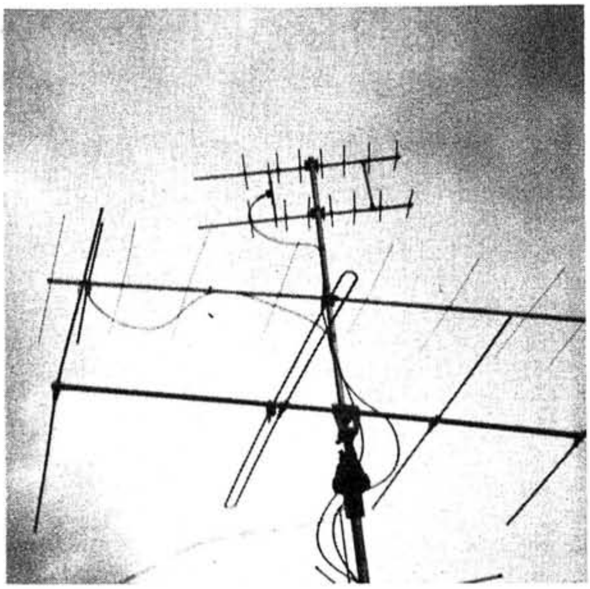


Fig. 8: The 4m, 2m and 70cm beams used by George Grzebieniak at his home in London

E2, 48·25MHz and a "super picture on programme, unidentified", on E4, 62·25MHz, Sam watched a sports programme, with male announcer introducing horse racing and motor racing from CST, Czechoslovakia and had excellent signals from 1315 to 1430. John also heard plenty of East European f.m. broadcast signals between 68 and 72MHz during the event.

DX in Bangladesh

A welcome letter from **W. Kruse,** Hirten, West Germany, who used a JVC 3050EU and a home-brew aerial at 30ft a.g.l. while in Dacca/Bangladesh, during the summer months. On several occasions he received a Chinese educational programme, around noon GMT, with Chinese characters appearing and a lecturer at a blackboard.

Slow Scan Television

Between 1500 and 1700 on October 20, Sam Faulkner received SSTV from two Jamboree On The Air stations, GB3LA and GB3RSS, as well as pictures from Finland and the USA on 28·680MHz. Another Jamboree station LA4LN/W3 and four from the USA were received on the 21st. Sam watched pictures from several north American stations between October 25 and 30, and at 0830 on November 11 he received signals from JA3CF and JA3EP and, from 1500, five more from the USA.

Meteor Scatter

From 0720 on November 2, Sam Faulkner received bits of a television test card from Sweden and, on the 3rd, bits from Norway, Gamlem, both in band I via meteor trail reflection. Pictures were also received, via this mode of propagation, from Scandinavia during the early mornings of November 10 and 11.

10 Metre Repeater

Barry Ainsworth G4GPW, Lancing, Sussex, has taken advantage of the good conditions on 10m to use f.m. on 29·600MHz. In 17 minutes, around 1700 on November 5, he worked four stations in the USA. Both Barry and N. Clarke told me about a 10m to 2m repeater, possibly in the New York area, with an input on 2m and 29·540MHz and an output on 2m and 29·640MHz. At 1343 on November 10, Barry worked WA2ORT, New York, who was on 2m, via this repeater and N. Clarke has heard stations in New York, New Jersey, California, Winnipeg and Cape Town working through it. More information will be welcome.

Satellites

John Branegan is delighted with the QSL card from K0RZ, Boulder, Colorado, confirming their long range QSO via OSCAR-7B and from his latest observations he reports "terrific Scintillations" on satellite signals on October 6 to 8 and 14, 19, 21 and 27. **Flemming Jul-Christensen** G8RMA/OZ7EVA, Eastbourne, Sussex, is setting up equipment to work through OSCARs 7 and 8, Mode A, so I will look forward to hearing more about this in the future.

Cross Band, 10m to 6m

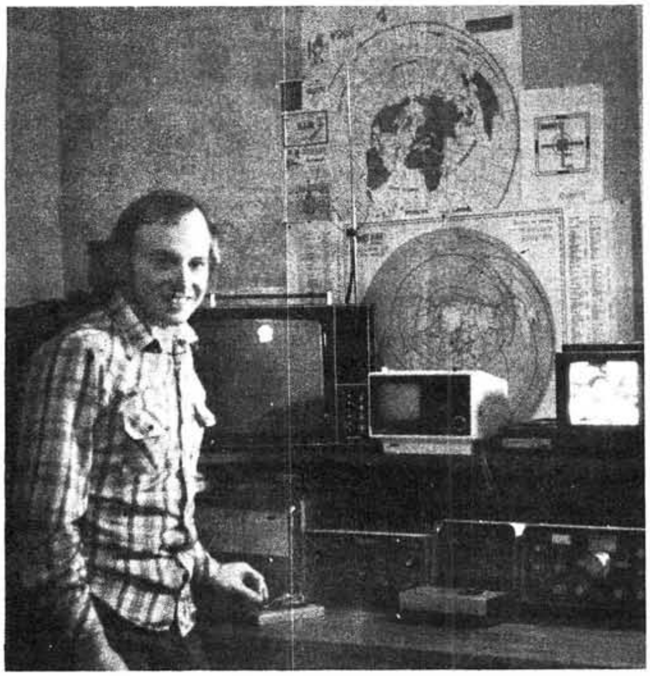
Between 1520 and 1745 on October 21, John Branegan, using his Eddystone 770R and a home-brew 3-element beam, heard K1BXC on 6m in cross-band QSO with G3VQT on 10m. During the period, John also heard VE1AVX, VE2CRA, W1XEN, W1XM, W2UTH and some north American stations talking among themselves, not realising that the 6m band was so wide open. At 1707 John heard K2CBA in QSO with W2UTH, saying that they could hear E2 and BBC video up to 51MHz, and by 1734, the strong s.s.b. signal of K2CBA was in deep QSB, as the event neared its end. The c.w. signals from the USA were between 50·010 and 50·080MHz and s.s.b. from 50·080 to 50·120MHz while the cross-band replies were between 28·880 and 28·890MHz. "I did not get to work anyone but I thoroughly enjoyed myself," said John. In the 1950s he used an ex-RAF converter in front of a Hallicrafters receiver for 50MHz and heard nothing, but now, some 20 years later, he has been rewarded, because on October 31, he worked VE1AVX; on November 3 WA1DZJ; 4th, W1RJA and K8MMM; 5th, VE1BX, WA1EKV and again VE1AVX who told him that he had worked Guam, 6m both ways, on the 4th.

"Lots of activity around 50MHz and upwards from 1418 on November 7", writes Mike Allmark, who by 1621 had heard 59-plus s.s.b. signals from two Ks, five Ws and VE1AVX. Sam Faulkner heard many G stations on 28·880MHz, especially G3BA and G3ZQW working crossband to 6m. For my part, using an R216 and vertical dipole, I heard N3AHI at 1402 on November 15 working into DJ and SM, and at midday on the 16th, I heard W2CAP/P1 on 6m saying that these openings were exciting and praised the European stations for their efforts in working crossband. I also received strong signals on 6m from WA1EXN, WB1FUB, W2UTH and VE1AVX.

Tropospheric

Although the atmospheric pressure was generally below 30·0in from October 24 to November 18, which is not good for v.h.f. DX, it did rise to 30·4in during the period November 2 and 3. Early in the evening of the 3rd, I received strong signals from the Bristol Channel repeater GB3BC, R6, and pictures from the IBA transmitter at Lichfield on channel 8, 189MHz. **George Grzebieniak** RS 41733, London, has been busy mounting his 4m, 2m and 70cm beams on a single mast (Fig. 8), and turning them with an AR40 rotator. George also noticed an improvement to signals when he used the UR67 coaxial cable for his aerial feeders.

VHF PERSONALITY



Sam Faulkner ISWL G14929

by Ron HAM

"Radio has been a popular interest and hobby in our family for as long as I can remember", said 25-year-old Sam Faulkner of Burton-on-Trent. It was the exciting sounds from his Father's Eddystone 640 and ex-USAAF BC348 that inspired young Sam to take up radio and, at the age of 14 he began listening to broadcast stations, enjoying the news and comment from around the world. Very soon he learned about the amateur bands and developed a special interest in s.s.b. signals on 20, 15 and 10m. Sam became aware of the v.h.f. bands through listening to amateur stations on 2m and a few years ago he read a DX-TV log in the ISWL's Magazine *Monitor*, and began experimenting himself, first looking for fringe area stations at u.h.f. and later looking farther afield in Bands I and III.

Sam's current h.f. receivers, installed in his upstairs bedroom shack, are Eddystone 840 and 640 and KW202 with EZEE MATCH and pre-selector. For slow scan TV he uses a Venus SS2 monitor, Robot 400 scan converter, Hitachi 9in CCTV monitor and audio cassette recorder, and for DX-TV in bands I, III, IV and V, he has a Skantic 1746 and a JVC 3040 UKC. His QTH is 400ft a.s.l. and his aerials, a HQ-1 mini quad for the h.f. bands and Yagis for the TV bands, are turned by a CDE rotator and mounted on a 60ft telescopic lattice mast. Sam, a regular contributor to my v.h.f. column, is planning a more high gain TV aerial system for the future, as well as pursuing his interest in photography, vintage vehicles and machinery and meeting and corresponding with fellow enthusiasts.

'2BCX 16 ELEMENT 2m BEAM

▸▸▸ *continued from page 24*

Before the aerial is finally hoisted to the mast, make sure that the phasing line and coaxial connection boxes are sealed everywhere against the ingress of water, e.g., around the entry of the driven elements and matching line, etc. Suitable sealants are Scotchkote, Araldite or Evostik. Give the phasing line and its bridge spacers one or two coats of polyurethane varnish. This is important for the prevention of r.f. leakage that could occur with rain or frost.

Finally, the radiation pattern of the aerial which is shown in Fig. 7 was obtained under ideal conditions and is the true pattern with a main lobe beam width of 30° at 3dB down. The radiation pattern in the vertical mode is almost identical except that the main lobe is a degree or so wider at 3dB down. The second pattern, Fig. 8, was taken from signals arriving from a fairly long distance and with the aerial operating in a normal environment, i.e., at the top of its mast at the writer's home QTH. As will be seen, there is no distortion of the main lobe, and the minimal differences in the small side and rear lobes are due to random reflection likely to occur in normal conditions. Finally, it may be worth mentioning that the overall performance of this aerial in terms of gain and radiation pattern is virtually identical with that of a well-known commercial 16-element beam with a total length of 6m.

References

1. *Antennas*. Kraus. McGraw-Hill
2. *Antenna Arrays with closely spaced elements*. Proc. IRE. Feb. 1940

ICF-6800W REVIEW

▸▸▸ *continued from page 31*

to switch quickly back to a Band II broadcast station to catch a news bulletin or whatever, when listening on another band.

The data provided with the set comprises an *Operating Instructions* book, giving fairly comprehensive information on installing and operating the receiver, in English, French, German and Spanish. Another book, entitled *Sony Short Wave Guide*, provides a wealth of information on frequency allocations, propagation, reporting cards and codes, standard frequency stations and aerial systems.

No service information is included with the receiver, but a service manual is available from Sony UK Ltd., Spare Parts Department, 219 Bath Road, Slough, Berks, price 84p + 53p postage and packing. This gives a fairly detailed theoretical description of all the more unusual circuit features; synthesiser, frequency counter, etc., together with a block diagram and full circuit diagram with voltage readings and waveforms. The most important section deals with dismantling the receiver for access to the various circuit boards—quite an involved business. Alignment details, p.c.b. component layouts and mechanical and electrical parts details complete the service manual.

Price

The ICF-6800W receiver has a recommended price of just over £400, but is available below this price in some places.

The receiver reviewed was kindly loaned by Park Electric, 211 Streatham Road, Mitcham, Surrey, telephone 01-648 6201, and we would like to thank them for their invaluable assistance in this respect.

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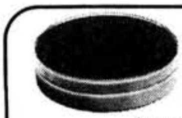

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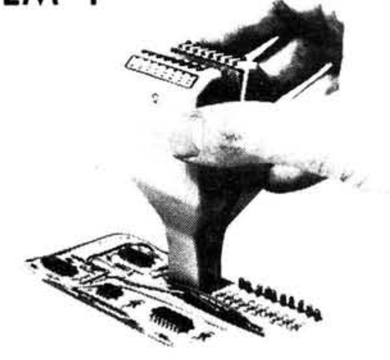

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PC etching kits:- economy £2.32, standard £4.36. 40 sq ins pcb 66p. 1 lb FeC1 £1.30. etch resist pens:- economy 50p, dalo 84p. drill bits 1/32" or 1mm 27p. etching dish 89p. laminate cutter 82p.

S-DECS AND T-DECS
S-Dec £3.79. T-Dec £4.59. u-DecA £4.69. u-DecB £7.16. 16 dil adaptor £2.31.

BATTERY ELIMINATORS
3-way types with switched output and 4 way multi-jack:- 3/4½/6v 100ma £2.39, 6/7½/9v 300ma £3.14. 100ma radio types with press stud connectors 9v £3.57, 6v £3.57, 4½v £3.57, 9 + 9v £4.79, 6 + 6v £4.79, 4½ + 4½v £4.79. cassette recorder mains unit 7½v 100ma with 5 pin din plug £3.57. fully stabilized type 3/6/7½/9v 400ma £5.76. car convertors 12v dc input, output 9v 300ma £1.19, output 7½v 300ma £1.19, output 3/4½/6/7½/9/12v 800ma £2.66.

BATTERY ELIMINATOR KITS
100ma radio types with press-stud connectors 4½v £1.49, 6v £1.49, 9v £1.49, 4½ + 4½v £1.92, 6 + 6v £1.92, 9 + 9v £1.92. cassette type 7½v 100ma with din plug £1.49. heavy duty 13 way types 4½/6/7/8½/11/13/14/17/21/25/28/34/42v 1A £4.95, 2A £7.72. car convertor input 12v dc, output 6/7½/9v 1A stabilized £1.35.

STABILIZED POWER KITS
The first price is for kit without transformer, the bracketed price includes transformer. 8-way types 3/4½/6/7½/9/12/15/18v 100ma £1.74 (£2.50), 1A £2.98 (£5.10), 2A £4.10 (£6.87). variable voltage models 2-18v 100ma £2.12 (£2.98), 1-30v 1A £2.98 (£5.95), 1-30v 2A £4.98 (£11.24).

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AL30A £4.08. PA12 £8.38. PS12 £1.58. T538 £2.70. S450 £25.06. AL60 £5.06. PA100 £17.33. SPM80 £4.74. BMT80 £6.08. Stereo 30 £21.57. MA60 £38.27.

COMPONENTS
1N4148 0.9p. 1N4002 3.1p. 741 8 dil 18p. 723 14 dil 31p. NE555 8 dil 25p. bc183, bc213, bc547, bc549 4.2p. bc182, bc184, bc212, bc214, bc548 5p. tip31c, tip32c 30p. tip41c 39p. bd131, bd132 27p. plastic equiv bc107 5p. fuses 20mm × 5mm cartridge .15, .25, .5, 1, 2, 3, 5 Amp quickblow 1p, anti-surge 3.6p. resistors 5% ¼W E12 10R to 10M 1p, 0.8p for 50 + of one value. polyester capacitors 250v .015, .068, 1mf 1.5p, .01, .033, .33 2.8p, .022, .047mf 3.3p, .22, .47mf 4.9p. polystyrene capacitors E12 63v 10 to 1000pf 3p, 1n2 to 10n 4p. ceramic capacitors 50V E6 22pf to 47n 2p. electrolytic capacitors 50v .5, 1, 2mf 5p, 25v 5, 10mf 5p, 16v 22, 33mf 5p, 47, 68mf 3.5p, 100mf 6p, 330, 470mf 9p, 1000mf 10p. zeners 400mW E24 2v7 to 33v 7p. preset pots subminiature 0.1W horiz or vert 100 to 4M7 6p. potentiometers ¼W 4K7 to 2M2 log or lin single 27p, dual 67p. ⅕" red LEDs 9.7p. ic sockets 8 dil 8.7p, 14 dil 10.1p, 16 dil 12p.

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AC188	0·23
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ACY18	0·92
ACY19	086
ACY20	0·80
ACY21	0·86
ACY39	1·72
AD149	0·80
AD161	0·52
AD162	0·52
AF106	0·52
AF114	0·86
AF115	0·86
AF116	0·86
AF117	0·86
AF139	0·46
AF186	1·38
AF239	0·52
AFZ11	3·16
AFZ12	3·16
ASY26	0·46
ASY27	0·46
ASZ15	1·44
ASZ16	1·44
ASZ17	1·44
ASZ20	1·72
ASZ21	2·30
AU110	1·96
AU113	1·96
AUY10	2·30
BA145	0·15
BA148	0·15
BA154	0·10
BA155	0·12
BA156	0·10
BAW62	0·06
BAX13	0·07
BAX16	0·10
BC107	0·14
BC108	0·14
BC109	0·15
BA113	0·14
BC114	0·15
BC115	0·16
BC116	0·17
BC117	0·20
BC118	0·12
BC125	0·18
BC126	0·23
BC135	0·16
BC136	0·17
BC137	0·17
BC147	0·10
BC148	0·09
BC149	0·10
BC157	0·10
BC158	0·09
BC159	0·12
BC167	0·14
BC170	0·13
BC171	0·12
BC172	0·12
BC173	0·14
BC177	0·17
BC178	0·16
BC179	0·18
BC182	0·13
BC183	0·12
BC184	0·13
BC212	0·15
BC213	0·14
BC214	0·17
BC237	0·10
BC238	0·14
BC301	0·38
BC303	0·38
BC307	0·12
BC308	0·12
BC327	0·23
BC328	0·21
BC337	0·21
BC338	0·20
BCY30	1·15
BCY31	1·15
BCY32	1·15
BCY33	1·04
BCY34	1·04
BCY39	3·45
BCY40	1·15
BCY42	0·29
BCY43	0·29
BCY58	0·18
BCY70	0·17
BCY71	0·20
BCY72	0·15
BCZ11	1·72
BD115	0·52
BD121	1.50
BD123	1.50
BD124	1·50
BD131	0·40
BD132	0·44
BD135	0·39
BD136	0·39
BD137	0·40
BD138	0·46
BD139	0·49
BD140	0·51
BD144	2·30
BD181	1·26
BD182	1·36
BD237	0·46
BD238	0·63
BDX10	1·05
BDX32	2·30
BDY20	1·44
BDY60	1·72
BF115	0·29
BF152	0·21
BF153	0·23
BF154	0·20
BF159	0·26
BF160	0·18
BF167	0·23
BF173	0·23
BF177	0·28
BF178	0·28
BF179	0·29
BF180	0·35
BF181	0·35
BF182	0·35
BF183	0·29
BF184	0·29
BF185	0·29
BF194	0·10
BF195	0·10
BF196	0·12
BF197	0·14
BF200	0·31
BF224	0·23
BF244	0·32
BF257	0·28
BF258	0·30
BF259	0·37
BF336	0·35
BF337	0·35
BF338	0·36
BFS21	4·55
BFS28	2·56
BFS61	0·23
BFS98	0·23
BFW10	0·74
BFW11	0·74
BFX84	0·25
BFX85	0·26
BFX87	0·24
BFX88	0·24
BFY50	0·30
BFY51	0·30
BFY52	0·30
BFY64	0·30
BFY90	1·44
BSX19	0·24
BSX20	0·23
BSX21	0·23
BT106	1·44
BTY79/400R	3·67
BU205	2·02
BU206	2·59
BU208	2·30
BY100	0·52
BY126	0·16
BY127	0·17
BZX61	0·21
Series	
BZY88	0·15
Series	
CRS1/40	0·69
CRS3/40	0·86
CRS3/60	1·04
GEX66	1·73
GEX541	4·60
GJ3M	0·86
GJ5M	0·86
GM0378A	2·02
KS100A	0·52
MJE340	0·92
MJE370	1·35
MJE371	0·71
MJE520	0·60
MJE521	0·63
MJE2955	1·44
MJE3055	0·86
MPF102	0·35
MPF103	0·35
MPF104	0·35
MPF105	0·35
MPSA06	0·28
MPSA56	0·30
MPSU01	0·41
MPSU06	0·53
MPSU56	0·56
NE555	0·52
NKT401	2·30
NKT403	1·99
NKT404	1·99
OA5	1·09
OA7	0·63
OA10	0·74
OA47	0·16
OA70	0·35
OA79	0·35
OA81	0·35
OA85	0·35
OA90	0·09
OA91	0·09
OA95	0·09
OA200	0·10
OA202	0·10
OA211	1·15
OAZ200	1·15
OAZ201	1·15
OAZ206	1·15
OAZ207	1·15
OC16	2·30
OC20	2·88
OC22	2·88
OC23	3·16
OC24	3·45
OC25	1·05
OC26	1·04
OC28	2·30
OC29	2·30
OC35	1·73
OC36	1·73
OC41	0·92
OC42	0·86
OC43	2·59
OC44	0·69
OC45	0·63
OC71	0·63
OC72	0·63
OC73	1·15
OC74	0·74
OC75	0·74
OC76	0·63
OC77	1·38
OC81	0·74
OC81Z	1·38
OC82	0·74
OC83	0·74
OC84	0·74
OC122	1·73
OC123	2·02
OC139	2·59
OC140	3·16
OC141	3·74
OC170	1·15
OC171	1·15
OC200	1·73
OC201	2·02
OC202	2·02
OC203	2·02
OC204	2·88
OC205	2·88
OC206	2·88
OC207	2·02
OCP71	1·44
ORP12	1·15
R2008B	2·02
R2009	2·59
R2010B	2·02
T1C44	0·35
T1C226D	1·38
T1L209	0·23
T1P29A	0·47
T1P30A	0·48
T1P31A	0·51
T1P32A	0·55
T1P33A	0·79
T1P34A	0·84
T1P41A	0·72
T1P42A	0·81
T1P2955	0·77
T1P3055	0·64
T1S43	0·52
ZS140	0·29
ZS170	0·24
ZS178	0·62
ZS271	0·26
ZS278	0·65
ZTX107	0·13
ZTX108	0·12
ZTX109	0·14
ZTX300	0·14
ZTX301	0·15
ZTX302	0·17
ZTX303	0·20
ZTX304	0·22
ZTX311	0·14
ZTX314	0·23
ZTX500	0·15
ZTX501	0·16
ZTX502	0·18
ZTX503	0·20
ZTX504	0·23
ZTX531	0·23
ZTX550	0·18
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1N916	0·08
1N4001	0·07
1N4002	0·07
1N4003	0·08
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1N4005	0·09
1N4006	0·09
1N4007	0·10
1N4009	0·07
1N4148	0·07
1N5400	0·15
1N5401	0·15
1S44	0·05
1S920	0·08
1S921	0·08
2G301	1·15
2G302	1·15
2G306	1·27
2N404	1·15
2N696	0·29
2N697	0·29
2N698	0·35
2N705	1·38
2N706	0·17
2N708	0·23
2N930	0·30
2N1131	0·30
2N1132	0·30
2N1302	0·40
2N1303	0·40
2N1304	0·52
2N1305	0·52
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2N1309	0·63
2N1613	0·29
2N1671	1·73
2N1893	0·29
2N2147	2·02
2N2148	1·89
2N2218	0·29
2N2219	0·28
2N2220	0·21
2N2221	0·21
2N2222	0·21
2N2223	3·16
2N2368	0·20
2N2369A	0·24
2N2484	0·23
2N2646	0·63
2N2904	0·29
2N2905	0·29
2N2906	0·24
2N2907	0·24
2N2924	0·24
2N2925	0·25
2N2926	0·16
2N3053	0·29
2N3054	0·58
2N3055	0·81
2N3440	0·69
2N3441	0·92
2N3442	1·26
2N3614	1·73
2N3702	0·13
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2N3707	0·15
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2N3772	2·30
2N3773	3·45
2N3819	0·41
2N3820	0·52
2N3823	0·63
2N3866	0·83
2N3904	0·15
2N3905	0·15
2N3906	0·15
2N4058	0·16
2N4059	0·12
2N4060	0·14
2N4061	0·14
2N4062	0·15
2N4124	0·17
2N4126	0·17
2N4286	0·23
2N4288	0·25
2N4289	0·28
2N5457	0·40
2N5458	0·40
2N5459	0·40

VALVES

AZ31	1·26
CBL31	2·30
CL33	2·30
CY31	1·15
DAF91	0·46
DAF96	1·15
DF91	0·46
DF96	1·15
DK91	1·21
DK92	1·44
DK96	1·26
DL92	1·26
DL94	1·38
DL96	1·26
DY86/7	0·73
DY802	0·96
E80CC	9·27
EABC80	1·38
EAF42	1·44
EAF801	2·02
EB41	2·30
EB91	1·01
EBC33	2·02
EBC41	1·44
EBC81	1·26
EBC90	0·97
EBF80	0·58
EBF83	1·44
EBF89	0·97
EBL31	2·88
ECC40	1·44
ECC81	1·01
ECC82	0·82
ECC83	1·01
ECC84	1·36
ECC85	1·38
ECC88	2·07
ECC91	8·72
ECC189	1·90
ECF80	1·24
ECF82	1·38
ECH35	2·30
ECH42	1·32
ECH81	1·38
ECH83	1·44
ECH84	1·47
ECL82	1·15
ECL83	1·73
ECL86	1·38
EF37A	4·02
EF39	3·16
EF40	1·32
EF41	1·38
EF42	2·30
EF50	1·73
EF80	0·92
EF83	2·02
EF85	0·92
EF86	1·74
EF89	1·84
EF91	2·07
EF92	6·03
EF98	1·44
EF183	0·92
EF184	0·96
EH90	1·61
EL32	1·73
EL33	4·02
EL34 (Thorn)	2·53
EL34 (Mullard)	2·57
EL41	1·44
EL42	2·02
EL81	1·26
EL84	1·15
EL86	2·48
EL91	7·44
EL95	1·51
EL360	6·32
EM34	5·75
EM80	1·26
EM81	1·15
EM84	1·15
EM85	1·44
EM87	1·73
EN91	2·94
EY51	2·02
EY86	0·96
EZ40	1·44
EZ41	1·44
EZ80	0·96
EZ81	0·96
EZ90	1·38
GZ32	1·44
GZ33	4·60
GZ34	2·18
KT61	4·02
KT66	11·50
KT88	13·80
KTW61	2·02
KTW62	2·02
KTW63	2·02
MU14	1·73
N78	10·35
OA2	1·78
OB2	1·44
OC3	2·20
OD3	2·20
OZ4	1·84
PC86	1·61
PC88	1·61
PC97	1·38
PC900	1·38
PCC84	1·15
PCC88	1·38
PCC89	1·58
PCC189	1·61
PCF80	1·15
PCF82	1·15
PCF86	1·84
PCF87	1·84
PCF200	2·82
PCF201	2·45
PCF801	1·84
PCF802	1·82
PCF805	1·84
PCF806	1·84
PCF808	1·84
PCL82	1·15
PCL83	1·82
PCL84	1·15
PCL85	1·24
PCL86	1·24
PCL805/85	1·24
PD500	4·24
PFL200	2·07
PL36	1·38
PL81	1·38
PL81A	1·38
PL82	1·38
PL83	2·55
PL84	1·24
PL504/500	1·61
PL508	2·07
PL509	3·45
PL519	3·73
PL801	1·27
PL802	3·40
PY33	0·92
PY81	0·81
PY82	1·01
PY83	2·07
PY88	1·01
PY500A	2·07
PY800	0·97
PY801	0·97
QQV02-6	13·16
QQV03-10	5·44
QQV03-20A	20·13
QQV06-40A	40·25
R17	1·89
R19	1·38
R20	1·66
U18-20	2·88
U25	1·33
U26	1·66
UABC80	1·44
UAF42	1·44
UB41	1·44
UBC41	1·73
UBF89	1·38
UCC84	1·26
UCC85	1·38
UCF80	1·32
UCH42	1·38
UCH81	2·67
UCL82	1·20
UCL83	1·66
UF41	1·15
UF80	1·66
UF85	1·66
UF89	1·66
UL41	2·88
UL84	1·38
UM80	1·15
UY41	1·44
UY85	1·20
Z803U	9·09
1B3GT	2·58
1R5	1·21
1S5	0·46
1T4	0·46
2AS15	11·50
2D21	2·94
3A5	1·55
3CX100A5	23·00
3S4	1·26
4CX250B	28·53
5R4GY	2·30
5U4G	4·35
5U4GB	2·60
5V4G	1·75
5Y3GT	0·98
5Z3	1·73
5Z4G	1·75
5Z4GT	1·75
6-30L2	1·79
6AB7	1·73
6AC7	1·61
6AF4A	1·84
6AG7	2·30
6AH6	5·52
6AK5	3·98
6AK6	2·81
6AL5	1·01
6AM4	2·65
6AM5	4·43
6AM6	2·07
6AN5	6·12
6AN8A	3·80
6AQ5	1·10
6AR5	1·84
6AS6	6·42
6ASTGA	7·76
6AT6	0·98
6AU5G7	4·81
6AU6	1·24
6AV5GA	4·35
6AV6	0·98
6AX5GT	3·57
6B7	1·73
6B8	2·02
6BA6	1·15
6BA7	5·89
6BA8A	4·31
6BC4	4·27
6BE6	1·24
6BH6	1·75
6BJ6	1·24
6BK4	4·84
6BL6	97·25
6BL7GT	4·44
6BN6	1·89
6BQ7A	4·14
6BR7	4·60
6BR8	2·02
6BS7	4·60
6BW6	4·60
6BW7	1·75
6BX7GT	5·70
6BZ6	2·62
6C4	1·01
6CB6A	2.86
6CD6GA	5·64
6CG7	2·55
6CH6	7·48
6CL6	4·12
6CW4	8·33
6D2	1·01
6DK6	2·59
6DQ6B	4·49
6EA8	3·31
6EB8	2·44
6EW6	1·73
6F6	2·02
6F23	1·84
6F28	1·33
6H2N	1·21
6H3N	1·21
6H6	1·73
6J4	6·10
6J6	6·21
6J7	9·04
6K4N	1·44
6K6GT	1·50
6K7	1·73
6K8	2·02
6KD6	7·08
6L6G	2·88
6L6GA	1·73
6L6GT	2·24
6L6GC	2·24
6L7	2·30
6N2P	1·21
6N3P	1·21
6N7	1·73
6P25	4·14
6Q7	2·53
6R7	2·07
6SA7	1·67
6SC7	1·73
6SF7	1·84
6SH7	1·73
6SJ7	1·84
6SK7	1·50
6SL7QT	3·08
6SN7GT	1·84
6SQ7	1·50
6SR7	1·73
6SS7	2·07
6U5G	2·30
6U8	0·92
6U8A	3·24
6V6GT	1·84
6X4	1·38
6X5GT	0·97
7B7	1·96
7C5	2·02
7C6	1·44
7H7	2·30
7R7	1·73
7S7	2·59
7Y4	1·84
7Z4	2·13
12AT6	1·38
12At7	1·01
12AU6	2·83
12AU7	0·83
12AV6	2·30
12AV7	3·98
12AX7	1·01
12AY7	5·24
12B4A	3·50
12BA6	2·42
12BE6	2·55
12BH7	1·29
12BY7	3·01
12E1	8·17
19H4	28·75
30C15	1·84
30C17	1·84
30C18	1·84
30F5	1·93
30FL1/2	1·28
30FL12	2·07
30FL14	1·84
30L1	1·15
30L15	2·07
30L17	2·07
30P4	1·06
30P19	1·38
30PL13	2·07
30PL14	1·93
30PL15	2·07
35W4	0·69
50C5	0·81
85A2	2·19
90AG	9·15
90AV	9·15
90C1	2·24
90CG	15·73
90CV	15·30
92AG	9·15
92AV	9·15
95A1	5·98
150B2	2·76
150B3	5·06
150C2	1·73
150C4	2·19
211	6·90
723AB	40·25
807	2·30
811A	9·78
812A	9·60
813	36·80
833A	86·25
866A	6·61
872A	15·81
931A	14·08
2050	8·00
5642	6·05
5654	4·05
5651	2·07
5670	5·29
5814A	4·81
6080	7·88
6146A	5·89
6146B	6·42
6159	9·18
6973	4·05
7586	13·09
7587	22·54
7868	4·53
8068	6·33
8136	2·81
4CX 250B	5·75

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7400	0·18
7401	0·18
7402	0·18
7403	0·18
7404	0·20
7405	0·18
7406	0·46
7407	0·46
7408	0·23
7409	0·23
7410	0·18
7412	0·30
7413	0·37
7416	0·37
7417	0·37
7420	0·20
7422	0·23
7423	0·37
7425	0·35
7427	0·35
7428	0·49
7430	0·20
7432	0·35
7433	0·41
7437	0·37
7438	0·37
7440	0·21
7441AN	0·97
7442	0·83
7447AN	1·04
7450	0·21
7451	0·21
7453	0·21
7454	0·21
7460	0·21
7470	0·40
7472	0·38
7473	0·41
7474	0·46
7475	0·62
7476	0·46
7480	0·63
7482	0·86
7483	1·04
7484	1·15
7486	0·40
7490	0·60
7491	0·92
7492	0·69
7493	0·69
7494	0·92
7495	0·83
7496	0·92
7497	3·45
74100	1·73
74107	0·52
74109	0·81
74110	0·58
74111	0·81
74116	2·02
74118	1·15
74119	1·73
74120	0·95
74121	0·46
74122	0·69
74123	1·15
74125	0·63
74126	0·63
74128	0·69
74132	0·81
74136	0·63
74141	0·92
74142	2·65
74143	2·88
74144	2·88
74145	1·04
74147	2·30
74148	2·02
74150	1·84
74151	0·97
74154	2·02
74155	0·97
74156	0·97
74157	0·86
74159	2·42
74170	2·65
74172	5·06
74173	1·61
74174	1·73
74175	1·04
74176	1·26
74178	1·44
74179	1·44
74180	1·32
74190	1·73
74191	1·73
74192	1·55
74193	1·55
74194	1·44
74195	1·15
74196	1·38
74197	1·26
74198	2·59
74199	2·59
76013N	2·02
LM309K	1·73
TAA570	2·65
TAA630S	4·02
TAA700	4·50
TBA480Q	2·12
TBA520Q	2·65
TBA530	2·28
TBA540Q	2·65
TBA550Q	3·70
TBA560CQ	3·70
TBA673	2·52
TBA700	1·75
TBA720Q	2·65
TBA750Q	2·38
TBA800	1·38
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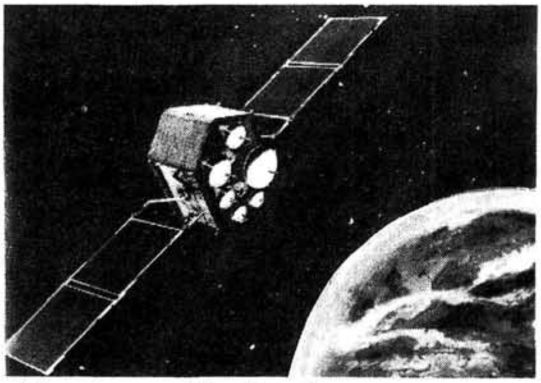

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1W	2Ω2-10M	E12	**5p**	**3p**
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3¾"×3¾"	**55p**	**50p**	—	—
3¾×5"	**62p**	**67p**	**50p**	**43p**
3¾×17"	**218p**	**180p**	**141p**	**120**
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14 pin	**12p**	**35p**
16 pin	**13p**	**46p**
18 pin	**16p**	**52p**
20 pin	**22p**	**65p**
22 pin	**25p**	**70p**
24 pin	**36p**	**78p**
28 pin	**39p**	**85p**
36 pin	—	**105p**
40 pin	**50p**	**109p**

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	·1	·156
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2×18 way	**115p**	**120p**
2×22 way	**130p**	**135p**
2×25 way	**149p**	**160p**
2×30 way	**170p**	—
2×36 way	**194p**	—
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DENCO COILS
Dual Purpose 'DP'
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00-2-500pF	**525p**

0 2 365pF with slow motion Drive	**345p**
00 208/176	**285p**
„ „ with slow motion drive	**345p**
C804: 5pF; 10; 15; 25pF	**175p**
50pF	**195p**
100;150pF	**235p**
'L' 3×310pF	**595p**
00-3×25pF	**430p**

TRANSISTORS

	p
AC125	20
AC126	20
AC127	20
AC128	20
AC141	24
AC142	24
AC176	24
ACY17	40
ACY18	40
ACY19	40
ACY20	40
ACY21	35
ACY22	40
ACY28	40
ACY39	78
AD149	70
AD161	42
AD162	42
AF114	50
AF115	50
AF116	50
AF117	50
AF118	65
AF139	35
AF178	70
BC107	10
BC107B	12
BC108	10
BC108B	12
BC108C	12
BC109	10
BC109B	12
BC109C	12
BC140	35
BC142	30
BC143	30
BC147	8
BC147B	10
BC148	8
BC148B	10
BC148C	10
BC149	8
BC149C	10
BC153	27
BC154	27
BC157	10
BC158	11
BC159	11
BC160	42
BC167A	11
BC168C	12
BC169C	14
BC170	18
BC172	11
BC173	12
BC177	18
BC178	16
BC179	18
BC181	20
BC182	9
BC183	9
BC184	9
BC182L	11
BC183L	10
BC184L	11
BC187	28
BC212	10
BC212L	11
BC213	10
BC213L	12
BC214	10
BC214L	13
BC307B	20
BC308B	20
BC327	15
BC328	15
BC338	12

	p
BC441	36
BC461	36
BC477	25
BC547	12
BC548	12
BC549C	13
BC557	15
BC558	20
BC559	20
BCY70	18
BCY71	20
BCY72	20
BD131	45
BD132	45
BD133	43
BD135	38
BD136	36
BD137	36
BD138	50
BD139	40
BD140	36
BD144	198
BD145	198
BD205	110
BD378	65
BD434	42
BD517	65
BD695A	65
BD696A	65
BDY56	156
BF115	34
BF167	30
BF180	35
BF194	12
BF195	12
BF196	12
BF197	14
BF198	18
BF199	18
BF200	32
BF244	29
BF244B	30
BF256	60
BF257	30
BF258	30
BF259	30
BF274	18
BF336	35
BF594	40
BF595	38
BFR39	25
BFR40	25
BFR41	28
BFR79	28
BFR80	28
BFR81	28
BFR98	105
BFX29	28
BFX84	26
BFX85	28
BFX86	28
BFX87	28
BFX88	28
BFY50	20
BFY51	20
BFY52	20
BFY56	45
BFY64	40
BFY71	20
BFY81	90
BSX20	18
BSY95A	18
BSZ26	75
BU105	140
BU205	190
BU208	225
MD8001	158

	p
MJ491	160
MJ2955	105
MJE340	54
MJE370	58
MJE371	60
MJE2955	105
MJE3055	70
MPF102	66
MPF103	36
MPF104	36
MPF105	36
MPF106	40
MPSA05	25
MPSA06	25
MPSA12	42
MPSA55	25
MPSA56	25
MPSU06	56
MPSU56	60
OC26	170
OC28	150
OC35	130
OC36	130
OC41	48
OC42	48
OC43	55
OC44	31
OC45	28
OC70	28
OC71	28
OC72	45
OC74	55
OC76	36
OC81	50
OC82	50
OC83	48
OC84	44
OC140	110
OC170	85
OC171	75
OC200	85
TIP29	43
TIP29B	56
TIP29C	60
TIP30	47
TIP30B	64
TIP30C	65
TIP31A	52
TIP31C	65
TIP32A	58
TIP32C	75
TIP33A	85
TIP33C	105
TIP34A	85
TIP34C	110
TIP35A	185
TIP35C	220
TIP36A	220
TIP36C	255
TIP41A	66
TIP41B	73
TIP42B	82
TIP120	70
TIP121	90
TIP142	190
TIP147	195
TIP2955	65
TIP3055	65
TIS43	34
TIS44	45
TIS45	45
TIS88A	00
TIS90	20
TIS91	24
ZTX107	12
ZTX108	12
ZTX109	14

	p
ZTX300	13
ZTX301	15
ZTX302	20
ZTX303	25
ZTX304	24
ZTX314	24
ZTX326	40
ZTX341	20
ZTX500	15
ZTX501	15
ZTX502	19
ZTX503	15
ZTX504	25
ZTX531	25
ZTX550	25
40311	60
40313	125
40315	55
40316	85
40362	48
40408	70
40411	295
40467	95
40594	90
40595	98
40603	65
40594	90
40595	98
40603	65
40673	68
2N697	25
2N698	44
2N699	54
2N706A	18
2N708	19
2N918	40
2N1131	22
2N1132	22
2N1303	50
2N1304	50
2N1305	28
2N1670	150
2N1671B	215
2N2219A	22
2N2220A	26
2N2221A	23
2N2222A	20
2N2369A	15
2N2646	48
2N2784	55
2N2904	22
2N2905A	22
2N2906	22
2N2907A	22
2N2926G	10
2N3053	20
2N3054	55
2N3055	48
2N3442	146
2N3663	26
2N3702	11
2N3703	11
2N3704	11
2N3705	11
2N3706	11
2N3707	11
2N3708	11
2N3709	11
2N3710.	16
2N3711	12
2N3822	130
2N3771	233
2N3772	195
2N3773	288
2N3819	22
2N3820	45
2N3823	95

	p
2N3866	90
2N3903	20
2N3904	18
2N3905	18
2N3906	17
2N4037	52
2N4058	17
2N4061	17
2N4062	17
2N4427	75
2N5172	25
2N5179	60
2N5191	70
2N5305	40
2N5457	32
2N5458	32
2N5459	32
2N5485	35
2N5642	750
2N5777	45
2N6027	40
3N128	112
3N140	112

Matched Pair 20p extra

74LS

LS00	**11**
LS01	**11**
LS02	**12**
LS03	**12**
LS04	**12**
LS05	**23**
LS08	**22**
LS09	**22**
LS10	**20**
LS11	**22**
LS12	**23**
LS13	**38**
LS14	**75**
LS15	**30**
LS20	**20**
LS21	**22**
LS22	**22**
LS26	**48**
LS27	**28**
LS28	**48**
LS30	**22**
LS32	**27**
LS33	**39**
LS37	**39**
LS38	**39**
LS40	**28**
LS42	**98**
LS47	**63**
LS51	**24**
LS54	**28**
LS55	**30**
LS73	**46**
LS74	**41**
LS75	**48**
LS76	**40**
LS78	**40**
LS83	**115**
LS85	**118**
LS86	**43**
LS90	**38**
LS91	**104**
LS92	**89**
LS93	**89**
LS95	**116**
LS96	**116**
LS107	**44**
LS109	**55**
LS112	**55**
LS113	**50**
LS114	**50**
LS122	**70**
LS123	**70**
LS124	**180**
LS125	**60**
LS126	**60**
LS132	**95**
LS136	**55**
LS138	**85**
LS139	**85**
LS151	**96**
LS153	**76**
LS155	**96**
LS157	**76**
LS158	**96**
LS160	**128**
LS161	**98**
LS162	**138**
LS163	**102**
LS164	**114**
LS165	**75**
LS166	**226**
LS168	**155**
LS169	**150**
LS170	**288**
LS173	**105**
LS174	**106**
LS175	**110**
LS181	**398**
LS183	**298**
LS189	**430.**
LS191	**140**
LS192	**132**
LS193	**130**
LS194	**166**
LS195	**136**
LS196	**100**
LS197	**140**
LS200	**348**
LS221	**96**
LS240	**236**
LS243	**232**
LS244	**155**
LS245	**270**
LS251	**134**
LS253	**142**
LS257	**110**
LS258	**110**
LS259	**160**
LS261	**450**
LS266	**52**
LS273	**244**
LS279	**66**
LS280	**250**
LS283	**192**
LS290	**128**
LS293	**128**
LS295	**185**
LS298	**68**
LS299	**468**
LS323	**468**
LS365	**65**
LS366	**65**
LS367	**65**
LS368	**66**
LS373	**180**
LS375	**160**
LS374	**155**
LS377	**212**
LS378	**184**
LS379	**215**
LS384	**86**
LS390	**230**
LS393	**230**
LS395	**218**
74LS398	**276**
74LS399	**230**
74LS447	**144**
74LS490	**180**
74LS668	**182**
74LS670	**248**
74LS673	**1050**
74LS674	**1450**

VOLTAGE REGULATORS

1A +ve 5V, 12V, 15, 18, 24V	**65p**
1A –ve	**85p**
100mA +ve 5V, 6, 8, 12, 15V	**30p**
100mA –ve	**65p**
LM309K	**135p**
LM317K	**350p**
LM323K	**635p**
LM723	**38p**

BRIDGE RECTIFIERS

1A/50V	**20**
1A/100V	**22**
1A/400V	**29**
1A/600V	**34**
2A/50V	**35**
2A/100V	**44**
2A/200V	**48**
2A/400V	**53**
2A/600V	**65**
4A/100V	**72**
4A/400V	**79**
4A/600V	**105**
4A/800V	**120**
6A/100V	**73**
6A/400V	**90**
BY164	**58**
VM18 DIL	**48**

SCRs THYRISTORS

0.8/200V	**35**
5A/100V	**32**
5A/400V	**39**
5A/600V	**43**
8A/300V	**48**
8A/600V	**85**
12A/300V	**59**
12A/800V	**150**
15/700V	**195**
BT106	**150**
C106D	**38**
TIC44	**22**
2N4444	**140**

TRIACS

3A/100V	**48**
3A/400V	**50**
8A/100V	**54**
8A/400V	**64**
8A/800V	**108**
12A/100V	**60**
12A/400V	**70**
12A/800V	**130**
16A/100V	**95**
16A/400V	**105**
25A/400V	**180**
25A/800V	**250**
T2800D	**120**

DIAC
ST2 **25p**

LINEAR IC's

702	**75**
709C 8 pin	**35**
710•	**67**
723 14 pin	**39**
741 8 pin	**17**
747C 14 pin	**78**
748C 8 pin	**36**
753 8 pin	**150**
810	**159**
AY-1-0212	**580**
AY-1-1313A	**660**
AY-1-1320	**315**
AY-1-5050	**190**
AY-1-5051	**145**
AY-1-6721/6	**195**
AY-3-1270	**840**
AY-3-8500	**390**
AY-5-1224A	**260**
AY-5-1230	**450**
AY-5-1315	**560**
AY-5-1317A	**630**
AY-5-3500	**510**
AY-5-3507A	**450**
AY-5-4007D	**638**
AY-5-8100	**735**
CA3011	**100**
CA3014	**137**
CA3018	**68**
CA3020	**170**
CA3023	**170**
CA3028A	**80**
CA3035	**240**
CA3036	**110**
CA3043	**190**
CA3045	**350**
CA3046	**71**
CA3048	**210**
CA3075	**175**
CA3080E	**70**
CA3081	**190**
CA3089E	**210**
CA3090AQ	**398**
CA3123	**200**
CA3130	**85**
CA3140	**70**
ICL7106	**795**
ICL7107	**975**
ICL8038CC	**340**
ICM7205	**1150**
ICM7215	**1025**
ICM7216A	**1950**
ICM7216B	**1950**
ICM7216C	**1950**
ICM7217A	**790**
ICM7555	**89**
LD130	**452**
LF365	**98**
LM10	**350**
LM301A	**30**
LM308T	**110**
LM311H	**120**
LM318H	**205**
LM324A	**68**
LM339	**70**
LM348	**90**
LM349	**125**
LM379	**375**
LM380	**80**
LM381N	**145**
LM381AN	**248**
LM382	**125**
LM386	**99**
LM387	**150**
LM389	**93**
LM733	**125**
LM1458	**50**
LM3900	**60**
LM3909N	**70**
LM3911	**125**
LM3914	**258**
LM13600	**125**
M252AA	**750**
M253AA	**795**
MC1303	**88**
MC1304P	**260**
MC1310P	**150**
MC1312PQ	**195**
MC1495	**350**
MC1496L	**92**
MC1596	
MC1710	**79**
MC3302	
MC3340P	**120**
MC3360P	**120**
MC3401	**52**
MC3403	**135**
MFC6040	**97**
MK50398	**635**
MM5303	**635**
MM5307	**1275**
MM57160	**620**
MSM5526	**850**
NE518	**210**
NE543K	**210**
NE544	**185**
NE555	**20**
NE556DB	**60**
NE560	**325**
NE561	**395**
NE562B	**410**
NE564	**425**
NE565A	**120**
NE566	**160**
NE567V	**170**
NE570	**395**
NE571	**420**
RC4136D	**120**
SAD1024	**1350**
SG3402	**295**
SN76003N	**170**
SN76013N	**170**
SN76013ND	**130**
SN76018	**148**
SN76023N	**170**
SN76023ND	**130**
SN76033N	**175**
SN76115N	**215**
SN76131	**110**
SN76227N	**115**
SN76477	**225**
SN76660	**90**
SP8629	**299**
TAA621AX1	**250**
TAA661A	**155**
TAA960	**320**
TAD100	**159**
TBA120S	**70**
TBA540	**220**
TBA550Q	**330**
TBA990Q	**270**
TBA641-A12/ BX1 or BX11	**250**
TBA651	**180**
TBA800	**90**
TBA810S	**95**
TBA820	**70**
TBA920Q	**260**
TCA965	**120**
TDA1004	**290**
TDA1008	**310**
TDA1022	**575**
TDA1024	**105**
TDA2020	**320**
TL061C	**76**
TLO62CP	**125**
TLO64CN	**199**
TL071	**75**
TLO72CP	**125**
TLO74CN	**199**
TLO81CP	**48**
TLO82CP	**96**
TLO83CP	**105**
TLO84CP	**130**
TMS2716	**1750**
UAA170	**198**
UAA180	**198**
ZN414	**90**
ZN424E	**130**
ZN425E	**415**
ZN1034	**200**
ZN1040E	**685**

COMPUTER IC'S

2102-2	**225**
2111	**195**
2112	**110**
2112-2N	**250**
2114	**435**
2513	**650**
2708	**675**
2716	**2550**
4116 16K	**1025**
4027	**325**
4047	**750**
6502	**995**
745288	**210**
74S00	**60**
74S04	**73**
74S132	**00**
74S138	**250**
74S158	**00**
74S188	**185**
74S189	**158**
74S194	**00**
74S195	**00**
74S241	**195**
74S262	**895**
74S287	**325**
74S470	**325**
74S472	**1150**
74S475	**825**
81LS95	**125**
81LS96	**125**
81LS97	**137**
AY-5-2376	**980**
CP1610	**920**
MC1488	**85**
MC1489	**90**
MK4027 4K	**325**
MK4118	**2099**
Z80 CPU2 5	**990**
Z80 4M	**1099**
Z80 P10	**660**
Z80 CTC	**595**

VDU IC'S

AY-3-1015	**550**
AY-5-1013	**450**
RO-3-2513	**650**
SFF96364E	**1050**
SFC71301	**820**
SFS80102	**205**
SN74265	**63**
SN74LS163	**118**
SN74S262	**895**
SN75450	**120**
SN75451	**70**
SN75452	**70**
SN75454	**225**
TMS6011	**355**

TTL 74
(TEXAS)

7400	**11**
7401	**11**
7402	**11**
03	**12**
04	**12**
05	**18**
06	**28**
07	**38**
08	**17**
09	**17**
10	**11**
11	**20**
12	**17**
13	**30**
14	**45**
16	**30**
17	**30**
20	**16**
21	**29**
22	**17**
23	**27**
25	**27**
26	**36**
27	**27**
28	**35**
30	**17**
32	**25**
33	**40**
37	**30**
38	**33**
40	**15**
41	**74**
42	**68**
43	**115**
44	**112**
45	**94**
46	**94**
47	**57**
48	**56**
50	**17**
51	**17**
53	**17**
54	**17**
60	**17**
70	**28**
72	**25**
73	**32**
74	**25**
75	**38**
76	**36**
80	**48**
81	**86**
82	**69**
83	**72**
84	**95**
85	**75**
86	**31**
89	**140**
90	**30**
91	**75**
92	**38**
93	**32**
94	**78**
95	**65**
96	**57**
97	**189**
100	**119**
104	**62**
105	**62**
107	**29**
109	**54**
110	**54**
111	**68**
112	**125**
116	**198**
118	**83**
119	**149**
120	**115**
121	**25**
122	**46**
123	**48**
125	**38**
126	**57**
128	**74**
132	**73**
136	**65**
141	**56**
142	**209**
143	**314**
144	**314**
145	**65**
147	**175**
148	**109**
150	**99**
151	**64**
153	**64**
154	**96**
155	**53**
156	**80**
157	**65**
159	**185**
160	**82**
161	**92**
162	**92**
163	**92**
164	**105**
165	**105**
166	**140**
167	**200**
170	**185**
172	**625**
173	**120**
174	**87**
175	**87**
176	**75**
177	**78**
178	**153**
180	**85**
181	**165**
182	**88**
184	**135**
185	**135**
188	**275**
190	**95**
191	**95**
192	**98**
193	**98**
194	**98**
195	**98**
196	**93**
197	**80**
198	**150**
199	**150**
221	**132**
246	**204**
247	**204**
248	**240**
249	**204**
251	**125**
265	**63**
273	**320**
278	**220**
279	**119**
298	**185**
75108	**00**
75150	**175**
75491	**92**
75492	**92**
75450	**120**
75451	**50**
75454	**225**

CMOS*

4000	**13**
4001	**13**
4002	**15**
4006	**87**
4007	**18**
4008	**82**
4009	**38**
4010	**38**
4011	**18**
4012	**18**
4013	**42**
4014	**80**
4015	**82**
4016	**45**
4017	**82**
4018	**87**
4019	**48**
4020	**99**
4021	**95**
4022	**85**
4023	**22**
4024	**66**
4025	**19**
4026	**180**
4027	**45**
4028	**81**
4029	**99**
4030	**58**
4031	**205**
4032	**100**
4033	**145**
4034	**116**
4035	**111**
4036	**335**
4037	**100**
4038	**108**
4039	**320**
4040	**105**
4041	**80**
4042	**75**
4043	**94**
4044	**95**
4045	**145**
4046	**128**
4047	**87**
4048	**58**
4049	**48**
4050	**48**
4051	**72**
4052	**73**
4053	**72**
4054	**110**
4055	**128**
4056	**135**
4057	**1950**
4059	**480**
4060	**115**
4061	**1425**
4062	**995**
4063	**110**
4066	**58**
4067	**380**
4068	**22**
4069	**20**
4070	**32**
4071	**21**
4072	**21**
4073	**21**
4075	**23**
4076	**85**
4077	**40**
4078	**21**
4081	**20**
4082	**21**
4085	**74**
4086	**73**
4089	**150**
4093	**78**
4094	**190**
4095	**105**
4096	**105**
4097	**372**
4098	**110**
4099	**145**
4160	**109**
4161	**109**
4162	**109**
4163	**109**
4174	**110**
4175	**99**
4194	**108**
4408	**720**
4409	**720**
4410	**720**
4411	**958**
4412V	**1380**
4415F	**795**
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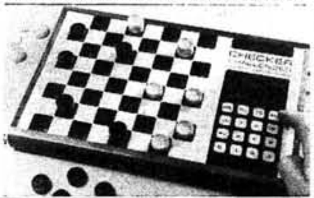

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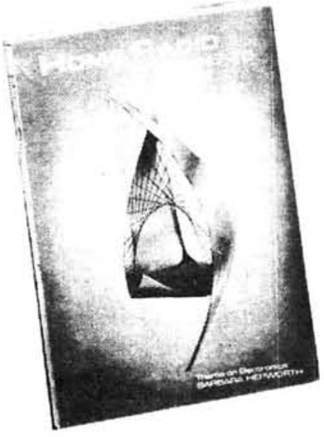

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We've been producing our Electronics Components Catalogue for *over 20 years.* During that time we've learned a lot, not only in the art of catalogue production but in building a business that serves the needs of constructors. Little wonder that we have a reputation *second to none* for our catalogue – *and* for the service that backs it up. Experience both for yourself. Just send £1.30 with the coupon and a catalogue will come by return of post.

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POST THIS COUPON
with cheque or P.O. for £1.30

Please write your Name and Address in block capitals

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MAIL ORDER PROTECTION SCHEME

INTRODUCTION

The Office of Fair Trading have agreed that the notice of the Mail Order Protection Scheme to appear in periodicals carrying mail order advertising should appear as follows:-

"MAIL ORDER ADVERTISING

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Advertisements in this publication are required to conform to the British Code of Advertising Practice. In respect of mail order advertisements where money is paid in advance, the code requires advertisers to fulfill orders within 28 days, unless a longer delivery period is stated. Where goods are returned undamaged within seven days, the purchaser's money must be refunded. Please retain proof of postage/despatch, as this may be needed.

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This guarantee covers only advance payment sent in direct response to an advertisement in this magazine not, for example, payment made in response to catalogues etc, received as a result of answering such advertisements. Classified advertisements are excluded."

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ANTEX TCSU1 with CTC

...its the perfect kit

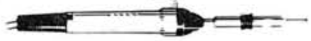
Model TCSU1 Micro-Soldering Station

Accurate pin point temperature control between 65° and 400°C. Heating element and sensor built in tip of the iron for fast response. Interchangeable slide-on bits from 4.7 mm (3/16") down to 0.5mm. Zero voltage switching, no spikes. No magnetic field, no leakage. Supplied with miniature CTC (35-40watt) iron or XTC (50watt). TCSU1 soldering station with XTC or CTC iron **£36** (6.44). Nett to industry.

Model CTC - 24 volts Priced at **£9.75** (1.87)

Model XTC - 24 volts Priced at **£9.75** (1.87)

Model CX 17watts - 230 volts



A miniature iron with the element enclosed first in a ceramic shaft, then in stainless steel. Virtually leak-free. Only 7½" long Fitted with a 3/32" bit **£4.20** (.98)
Range of 5 other bits available from ¼" down to 3/64"
Also available for 24volts

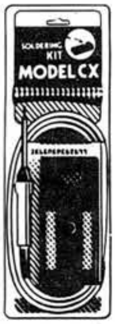
Spare element Model CX230E

Model X25 25watts - 230 volts

A general purpose iron also with a ceramic and steel shaft to give you toughness combined with near-perfect insulation Fitted with 1/8" bit and priced at **£4.20** (.98)
Range of 4 other bits available
Also available in 24volts.

Spare element Model X25 240E

Model SK3 Kit



Contains both the model CX230 soldering iron and the stand ST3. Priced at **£5.70** (1.49)
It makes an excellent present for the radio amateur or hobbyist.

Model SK4 Kit

With the model X25/240 general purpose iron and the ST3 stand, this kit is a must for every toolkit in the home. Priced at **£5.70** (1.49)

Model SK1

This kit contains a 15watt miniature soldering iron, complete with 2 spare bits, a coil of solder, a heat sink and a booklet 'How to Solder'. Priced at **£5.95** (1.53)

Model MLX 12volts

The soldering iron in this kit can be operated from any ordinary car battery. It is fitted with 15 feet flexible cable and battery clips Packed in a strong plastic envelope it can be left in a car, a boat or a caravan ready for soldering in the field Price **£4.55** (1.14)

ST3 Stand.

A strong chromium plated steel spring screwed into a plastic base of high grade insulating material provides a safe and handy receptacle for all ANTEX models soldering irons Priced at **£1.50** (.57)

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ANTEX

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PW18D

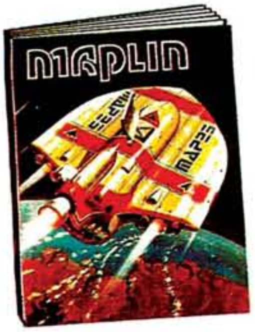
MAPLIN

This superb organ – build the first working section for just over £100. Full specification in our catalogue.

Touch operated rhythm generator, the 'Drumsette'. Construction details 25p. (Leaflet MES49). Specification in our catalogue.

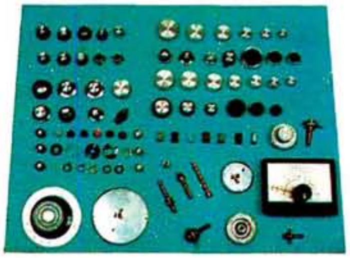
Multimeters, analogue and digital, frequency counter, oscilloscopes, and lots, lots more at excellent prices. See cat. pages 106 and 183 to 188 for details.

61-note touch-sensitive piano to build yourself. Full specification in our catalogue.

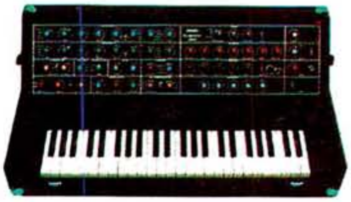


A massive new catalogue from Maplin that's even bigger and better than before. If you ever buy electronic components, this is the one catalogue you must not be without. Over 280 pages – some in full colour – it's a comprehensive guide to electronic components with hundreds of photographs and illustrations and page after page of invaluable data.

Our bi-monthly newsletter contains guaranteed prices, special offers and all the latest news from Maplin.



A range of highly attractive knobs is described in our catalogue. Our prices are very attractive too!



The 3800 synthesiser build it yourself at a fraction of the cost of one ready-made with this specification. Full details in our catalogue.

A pulse width train controller for smooth slow running plus inertia braking and acceleration. Full construction details in our catalogue.

Speakers from 1½ inch to 15 inch; megaphone. PA horns, crossovers etc. They're all in our catalogue. Send the coupon now!

Post this coupon now for your copy of our 1979-80 catalogue price 70p.

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