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Amateur RADIO

For all two-way radio enthusiasts

Build a base station microphone

A look at the new G4ZPY paddle keys

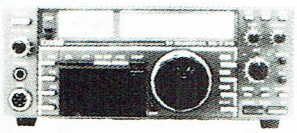
HF antennas for small gardens

On test: SSB Products LT2S 28/144MHz transverter

MORSE REPORT

For Tomorrow's Radio Technology TODAY

BASE STATIONS



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FT767GX MK2/RWC

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NEW

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YAESU FT209R/FNB3 3.7W 2MTRS C/W CHRGR/CASE	**£199.00**
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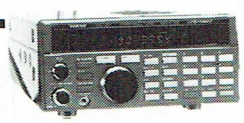

YAESU FRG9600/RWC

FRG 9600

We supply the Yaesu FRG 9600 modified receiver to Government departments and professional users. We offer more options and facilities than any other company. We transform the basic unit by improving sensitivity and adding extra bands. No other scanner has this many options and modes available. Call now for much more information. Overseas dealer required for our kit.

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NEW

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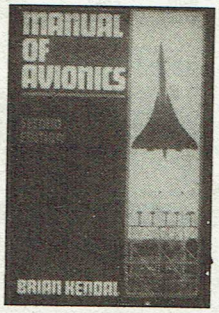

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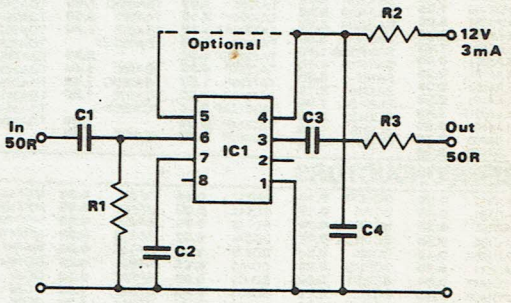

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R20	1.20
R1169	55.00
R5559	9.50
RG1-125	4.95
RG1-240A	14.50
RG3-250A	6.50
RG3-1250A	35.00
RK2K25	62.50
RPY18	2.50
RPY43	2.50
RPY82	2.50
RR3-250	15.00
RR3-1250	35.00
S6F17	5.95
S6F33	28.95
S11E12	38.00
S30/2K	8.50
S104/1K	10.00
S109/1K	15.00
S130P	5.95
SC1/800	5.00
SC1/1100	6.00
SC1/1200	5.00
SC1/1300	6.00
SC1/1400	6.00
SP41	5.00
SP61	3.50
ST11	5.00
STV280/40	11.95
SU42	4.95
TB2-5/300	85.00
TB2-300	195.00
TB3-750	95.00
TB3-2000	450.00
TBL2-300	395.00
TBL2-500	495.00
TC04/10-02	45.00
TD03-10E	35.00
TD03-10F	35.00
TDD2A	4.95
TH328	850.00
TH2321	4.95
TP2620	5.50
TT11	1.50
TT15	45.00
TT21	45.00
TT22	45.00
TT100	69.00
TTR-31MR	65.00
TY2-125A	85.00
TY4.400	85.00
TY7-6000A	600.00
TY8-600W	365.00
TYS2/250	375.00
U18-20	2.75
U19	11.95
U24	2.00
U25	0.90
U26	0.90
U35	3.50
U37	9.00
U41	6.95
U50	2.00
U82	3.00
U191	0.70
U192	1.00
U193	1.00
U251	2.50
U801	3.50
UABC80	0.65
UAF42	1.00
UBF80	0.60
UBC41	2.25
UBC81	1.50
UBF89	1.00
UBL21	1.75
UC92	1.20
UCC84	0.70
UCC85	0.60
UCF80	1.00
UCH21	1.20
UCH41	2.50
UCH42	2.50
UCH81	1.00
UCL82	1.75
UCL83	2.50
UF41	1.15
UF42	1.15
UF80	1.75
UF85	1.20
UF89	2.00
UL41	5.50
UL44	3.50
UL84	1.50
UL85	0.85
UU5	3.50
UU6	6.00
UU7	8.00
UU8	9.00
UY41	3.50
UY85	0.70
V235A/1K	250.00
V238A/1K	295.00
V246A/2K	315.00
V2406/1K	225.00
V241C/1K	195.00
V453	12.00
VLS631	10.95
VP4B	4.50
VP41	4.95
VR7-30	3.00
VR101	2.50

VR105/30	2.50
VR150/30	2.50
VU29	4.50
VU39	1.50
W21	4.50
W61	4.50
W77	5.00
W81M	4.50
W729	1.00
W739	1.50
X24	4.50
X41	4.50
X66/X65	4.95
X76M	1.95
XC24	1.50
XC25	0.50
XFW47	1.50
XFW50	1.50
XG1-2500	75.00
XG5-500	22.50
XL628FT	7.50
XNP12	2.50
XR1-1600A	49.50
XR1-3200A	79.50
XR1-6400A	149.50
Y65	6.95
YD1100	75.00
YJ1020	42.50
YJ1060	265.00
YL1060	195.00
YL1070	195.00
YL1071	195.00
YL1290	65.00
YL1440	450.00
Z77	1.20
Z300T	6.00
Z302C	12.00
Z359	9.00
Z520M	4.00
Z700U	9.50
Z759	19.85
Z803U	18.95
ZA1000	12.50
ZA1001	1.50
ZM1001	12.00
ZM1005	8.00
ZM1020	6.00
ZM1021	8.00
ZM1023	7.95
ZM1041	14.00
ZM1082	9.00
ZM1084	10.00
ZM1175	6.50
ZM1177	9.00
ZM1202	55.00
ZM1263	4.00
1A3	4.50
1AE4	3.50
1AX2	3.50
1B22	10.00
1B27	55.00
1B35A	45.00
1B63A	75.00
1K3	2.50
1N5GT	2.50
1P28	25.00
1R5	0.90
1S5	1.50
1T4	1.00
1U4	1.75
1U5	1.00
1X2B	2.50
2A3	16.50
2AS15A	11.50
2B7	2.50
2B22	69.50
2C36	70.00
2C39A	32.50
2C39BA	39.50
2C40	37.00
2C42	29.50
2C43	60.00
2C51	2.50
2CY5	1.50
2D21	1.95
2D21W	3.15
2E22	49.00
2E26	7.95
2J55	295.00
2K25	35.00
2K25 Raytheon	75.00
2K26	95.00
2K29	250.00
2K48	140.00
2K56	250.00
2X2A	5.00
3A/107B	12.00
3A/108A	9.00
3A/109B	11.00
3A/110K	12.00
3A/141K	11.50
3A/146J	7.50
3A/147J	7.50
3A167M	10.00
3A3A	3.95
3A4	1.10
3A5	4.50
3AT2	3.35
3B22	25.00
3B24	12.00
3B26	24.00
3B28	15.00
3BZ6	1.50
3C45	24.00
3CX3000A7	650.00
3CY5	1.50
3D21A	29.50
3E22	49.50
3E29	39.50
3EJ7	1.95
3H	0.40
3J.170E	1450.00
3J.187E	1450.00
3L	0.40
3Q4	2.50
3V4	1.75
4-65A	65.00

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4-400A	87.50
1000A	425.00
4B32	35.00
4B/551B	125.00
4BQ7A	1.75
4BZ6	1.95
4C28	25.00
4C35	145.00
4CX125C Eimac	150.00
4CX250B	49.00
4CX250B Eimac	59.50
4CX250BM	65.00
4CX250K	115.00
4C250R	125.00
4CX350A	100.00
4CX350F	95.00
4CX1000A	425.00
4CX1500B	398.50
4CX5000A	1000.00
4D21/4-125A	85.00
4D32	125.00
4GS7	2.25
4GV7	2.25
4JC6A	2.95
4KT6	1.50
4X150A	35.00
4X500A	350.00
5A/102D	9.50
5A152M	9.00
5A163K	10.00
5A170K	6.25
5A-180M	9.00
5A-206K	10.00
5AM8	2.15
5AN8	1.20
5B-110M	10.00
5B-254M	14.50
5B-255M	19.50
5B-256M	15.00
5B-257M	15.00
5B-258M	14.50
5C22	125.00
5CL8A	2.50
5J180E	2950.00
5LJ8	2.95
5R4GB	5.50
5R4GY	4.95
5TA	5.95
5T8A	1.95
5U4G	2.95
5U4GB	4.50
5V4G	1.50
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5Y3GT	1.95
5Z3	4.50
5Z4GT	2.50
6/30L2	0.70
6A203K	9.00
6A7	4.95
6A8	1.50
6AB4	3.50
6AC7WA	2.00
6AG5	2.50
6AG7	1.95
6AH6	3.50
6AJ4	3.50
6AJ7	2.00
6AK5	1.95
6AK6	2.50
6AL5	0.60
6AM4	3.25
6AM5	6.00
6AM6	1.95
6AN5	4.50
6AN8A	4.50
6AQ5	1.75
6AQ8	0.85
6AR5	5.95
6AS5	1.50
6AS6	2.50
6AS7G	4.50
6AT6	0.90
6AT8	1.75
6AU4GT	2.00
6AU5GT	4.50
6AU6	0.95
6AV6	0.90
6AW8A	3.50
6AX4GT	1.95
6AY3B	1.95
6AZ8	4.50
6B4G	7.50
6B8G	1.50
6B10	1.95
6BA6	1.50
6BA7	4.50
6BA8A	3.50
6BC8	0.85
6BE6	1.50
6BG6G	3.00
6BH6	1.95
6BH8	1.50
6BJ6	1.50
6BK4	4.00
6BL6	85.00
6BL8	1.15
6BM6	115.00
6BN6	1.65
6BN8	3.95
6BQ5	0.95
6BQ7A	1.50
6BR7	4.95
6BS7	5.50
6BW6	5.35
6BW7	1.50
6BZ6	2.50
6BZ7	2.95
6C4	1.50
6C5	1.95
6C6	3.50
6C8G	1.50
6C9	4.95
6CA4	4.95

6CA7	3.50
6CB5	3.95
6CB6	1.95
6CD6GA	4.50
6CF6	1.95
6CG7	3.50
6CH6	6.95
6CL6	3.25
6CL8A	1.50
6CM7	2.95
6CS6	0.75
6CS7	0.95
6CW4	8.00
6DC6	2.35
6DJ8	0.95
6DK6	1.50
6DQ5	8.50
6DQ6B	2.50
6DT6A	1.50
6DW4B	2.15
6E5	3.95
6EA7	2.50
6EA8	2.50
6EB8	1.75
6EJ7	0.65
6EM5	2.50
6EM7	2.50
6EV8	1.75
6EV7	2.95
6EW6	1.50
6EW7	4.50
6F1	2.00
6F5	5.50
6F6G	2.50
6F7	5.50
6F13	3.00
6F14	1.00
6F17	2.75
6F23	0.60
6F24	1.25
6F25	1.25
6F28	1.25
6F32	1.25
6F33	17.00
6FH5	6.50
6FH8	5.95
6FL2	4.50
6FQ7	3.50
6GE5	3.95
6GH8A	2.50
6GJ7	0.85
6GK6	1.95
6GM6	2.65
6GS7	2.15
6GV8	0.95
6GW8	2.50
6GY5	3.95
6GY6	2.50
6H1	9.50
6H6	2.50
6H6GT	1.95
6HB7	1.95
6HF5	5.50
6HF8	2.50
6HM5	2.50
6HQ5	3.50
6HS6	4.95
6HS8	2.95
6HZ6	3.50
6J4	2.15
6JAWA	3.15
6J5GT	2.50
6J6	2.00
6J7	4.15
6J7G	4.15
6JB6A	4.50
6JE6C	6.50
6JM6	3.95
6JU8A	2.50
6JS6C	6.50
6K7G	2.00
6K8G	3.00
6KD6	6.50
6KG6A	6.95
6KM8	2.50
6L1	2.50
6L6GC	2.95
6L6GC (GE)	5.75
6L6GC Philips	6.50
6L6GAY	5.50
6L6GT	2.50
6L6WGC	5.50
6L7	3.50
6L15	3.15
6L19	3.95
6LJ8	2.50
6LD20	1.15
6LF6	7.50
6LQ6	6.50
6P28	2.00
6Q7GT	1.20
6R7	3.15
6RHH8	10.00
6S4A	1.50
6SA7	1.35
6SC7	1.50
6SG7	2.50
6SH7	1.35
6SJ7GT	1.20
6SK7	1.35
6SL7GT	1.50
6SN7GT	1.50
6SQ7GT	1.35
6SS7	1.95
6T8	2.00
6U6GT	3.50
6U7G	3.50
6U8A	1.50
6V6G	1.25
6V6GT	1.95
6W4GT	1.95
6Y6G	3.95
6X2N	1.00
6X4	1.50
6X5GT	1.00
6X5GTY	1.00
6X8A	2.25
7A6	4.50
7AU7	1.50
7B6	3.50
7B7	2.50
7D8	4.50
7J7	5.50

7K7	7.50
7L	1.50
7Q7	4.50
7Y4	2.50
8B8	2.50
8B10	2.50
8BQ5	1.95
8CW5	1.50
8EB8	1.50
8FQ7	1.97
10CW5	1.50
10D2	1.25
10DE7	2.50
10DX8	2.50
10EB8	1.95
10EW7	2.95
10F1	0.75
10GK6	1.95
10P14	2.50
11E3	55.00
11R3	5.50
12A6	3.95
12AD6	1.50
12AE6	5.50
12AH7GT	4.95
12AL5	1.00
12AT6	1.25
12AT7	1.15
12AT7WA	2.50
12AU6	1.50
12AU7	0.65
12AV6	1.95
12AV7	2.50
12AX4GTB	1.50
12AX7	0.85
12AX7WA	2.50
12AX7S	7.95
12AY7	3.95
12B4A	4.50
12BA6	1.50
12BE6	1.95
12BH7A	2.95
12BL6	1.75
12BR3	1.95
12BY7A	2.75
12C8	2.50
12CA5	1.95
12CX6	1.20
12DQ6B	3.50
12DW4A	3.50
12DZ6	3.95
12E1	19.50
12E14	38.00
12FX5	1.95
12GN7	3.95
12HG7	3.95
12J5GT	3.95
12J7GT	3.50
12JZ8	2.95
12K7GT	1.50
12K8Y	1.95
12KU7	1.95
12PE13A	53.00
12S7GT	1.50
12SA7GT	1.95
12SG7	4.75
12SK7	1.95
12SJ7	1.50
12SN7GT	1.85
12SW7	3.50
12SY7	4.50
12X4	1.95
13D3	3.20
13D7	3.20
13D9	3.20
13DE7	2.50
13DR7	2.95
13E1	145.00
13EM7	3.50
14B6	4.50
14R7	3.50
15E	5.50
16AQ3	1.95
16GY5	2.95
16H	0.40
16L	0.40
17A8	3.50
17AX4GTA	1.95
17BE3	2.50
17DW4A	2.95
17EW8	0.95
17JZ8	4.50
18D3	6.00
18GB5	3.50
19AQ5	3.50
19AU4GT	2.50
19BG6	3.50
19G3	19.50
19G6	9.00
19H4	35.00
19H5	33.50
20CV	9.50
20D1	0.70
20LF6	7.95
20L1	0.95
20P1	0.55
20P4	1.95
20P5	1.15
21JZ6	4.95
21KQ6	4.95
21LU8	3.75
24B1	39.50
24B9	39.50
25BQ6	1.75
25DQ6B	2.95
25L6GT	1.75
29C1	19.50
29KQ6	6.50
30C15	0.50
30C17	0.40
30C18	1.48
30FL2	1.35
30FL12	0.95
30FL13	1.10
30FL14	1.25
30L1	0.45
30L15	0.60
30L17	0.60
30P4MR	1.00
30P12	1.00
30P18	0.60
30P19	1.00
30PI 1	2.50

30PL13	0.60
30PL14	1.75
31JS6C	5.50
33A/158M	19.50
35A3	3.95
35A5	4.50
35C5	4.50
35L6GT	2.00
35Z3	1.95
35Z5GT	3.50
38HE7	4.50
40KD6	5.50
42	6.95
47	6.00
50A5	1.50
50B5	1.95
50C5	0.95
50CD6G	1.95
50EH5	1.50
50JY6	2.95
53KU	4.50
75B1	3.50
75C1	4.50
80	4.50
83	8.50
83A1	7.50
85A1	6.50
85A2	2.95
90AV	15.00
90C1	3.50
90CG	13.50
90CV	12.50
91AG	9.00
92AG	19.50
92AV	15.00
95A1	6.50
100E1	10.00
108C1	2.50
150B2	6.50
150C1K	9.00
150C2	2.50
150C4	2.50
185BT	1.50
211	33.50
230D	15.00
231D	15.00
250TH	150.00
307	5.00
328A	15.00
404A-10	0.95
425A5	8.00
436A	35.00
572B	59.50
705A	8.00
708A	8.00
723A/B	75.00
724A	275.00
725A	275.00
726A	75.00
801A	15.00
802	25.00
803	14.95
805	59.00
807	2.50
808	5.95
810	85.00
811	15.00
812A	35.00
813	27.50
813 Philips	35.00
829B	14.50
833A	95.00
843	7.50
866A	6.50
872A	20.00
873	60.00
954	1.00
955	1.00
958A	1.00
1299A	0.60
1626	3.00
1768	95.00
1849	315.00
1927	25.00
2040	25.00
2050	5.95
2050W	6.95
4004A	11.50
4212E	250.00
4212H	250.00
4313C	4.00
4328D	9.00
4471	35.00
4687A	9.50
5544	79.50
5636	5.50
5642	9.50
5651	2.50
5654	1.95
5670	3.25
5672	4.50
5675	28.00
5678	7.50

5687	4.50
5696	4.50
5702	3.50
5704	3.50
5718	6.15
5725	2.50
5726	2.50
5727	2.50
5749	2.50
5750	1.85
5751	2.95
5762	550.00
5763	5.75
5814A	3.25
5823	9.50
5829WA	6.50
5840	3.50
5842	11.00
5863	95.00
5886	13.95
5894	39.50
5899	4.50
5963	1.75
5965	2.15
6005	1.85
6021	3.65
6057	3.75
6058	3.95
6059	3.75
6060	2.25
6062	4.50
6063	2.00
6064	3.25
6067	7.00
6072	6.95
6080	8.50
6080WA	9.50
6132	10.50
6136	2.50
6146B	9.00
6155	72.00
6156	72.00
6157	2.50
6158	3.20
6201	6.45
6205	6.95
6211	2.50
6267	4.50
6299	250.00
6350	3.50
6360	4.50
6386	14.50
6443	7.00
6463	7.50
6550 RCA	15.00
6550 GE	10.95
6688	6.50
6761	12.50
6870	11.50
6883B	9.95
6973	7.95
7025	2.50
7025S	6.95
7027	6.50
7032	2.00
7036	4.95
7044	6.95
7054	3.95
7059	2.50
7119	9.00
7167	3.95
7189	5.50
7193	7.50
7199	7.50
7247	4.95
7360	15.00
7475	5.00
7486	155.00
7527	85.00
7551	8.50
7558	9.45
7581A	9.95
7586	15.00
7587	19.50
7591A	5.95
7609	47.00
7698	75.00
7699	25.00
7788	25.00
7815	59.50
7868	7.50
7963	7.95
8005	95.00
8020	45.00
8136	2.15
8156	7.95
8417	6.95
8844	25.00
8874	215.00
8950	10.50
9001	1.50
18042	10.50
18045	10.00
18046	11.50

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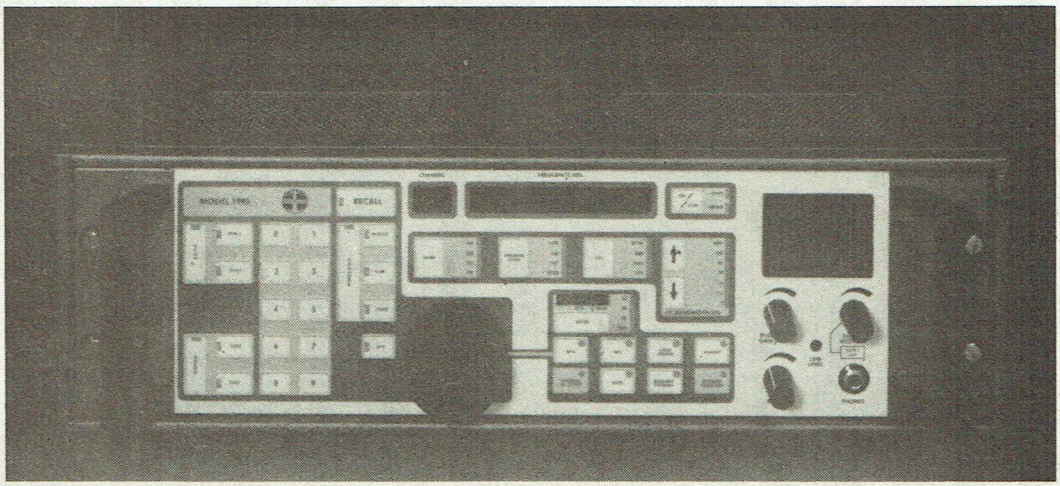


VHF/UHF RECEIVER

The 1995 series VHF/UHF receivers have been introduced to compliment the HF range already available from Eddystone Radio, and as a companion to the renowned 1650 HF receiver. It offers the user a combination of high performance with moderate cost and provides versatile and reliable service in surveillance, monitoring, laboratory and general point-to-point radio communication roles.

Effective use of surface-mounted components and modular construction has resulted in a highly sophisticated yet compact receiver featuring a comprehensive BITE system, and a versatile remote control system which offers the user a wide selection of remote control methods.

Further information is available from: *Eddystone Radio Ltd, Alverchurch Road, Birmingham BS1 3PP. Tel: (0241) 475 2231.*

2 to 6m TRANSVERTER

C M Howes Communications are pleased to announce the addition of a ready-made 2 to 6 metre Transverter to their product range.

Designated the Howes HC266, this neatly styled unit features 10W RF output power, controlled by an ALC (Automatic Level Control) system that automatically maintains the rated output over a range of 2 metre input levels. The transverter will accept 1 to 5W of drive as standard, or 5 to 10W as an option.

Features include SWR and reverse polarity protection circuits, PTT and RF VOX change-over and very low harmonic and local oscillator radiation levels. An operator's handbook is supplied complete with block and circuit diagrams in addition to the operating and installation instructions. A service manual is to be available at extra cost.

The HC266 costs £179.90, including postage and VAT, and is available direct from the manufacturers by mail order, or from selected retail shops.

For further information contact: *C M Howes Communications, Eydon, Daventry, Northants NN11 6PT. Tel: (0327) 60178.*

KWIKKALK

Methodia Design of Norway have just released KwikKalk, the latest software in their Technical Series.

This comprehensive program is designed to take the hard work out of radio calculations. You just enter the circuit values you already have and it instantly provides the component value that you need. The current value of all components is held in the program so that you don't have to keep entering them every time when performing a series of related calculations.

The program is menu-driven, very easy to use and contains useful explanations and hints for its operation. It is the perfect addition to every constructor's shack and also comes in handy when preparing for the Radio Amateurs Exam.

There are versions for Spectrum, CBM64 and BBC-B/Master computers at £12 on tape or £14 on CBM or BBC disc or Spectrum microdrive cartridge. BBC disc users should state if they want 40 or 80 tracks.

For further information contact: *Technical Software, Fron, Upper Llandwrog, Caernarfon LL54 7RF. Tel: (0286) 881886.*

CONNECTOR H100

Telecomms have announced that they can now offer a Greenpar N type, silver plated connector to fit the popular Pope H100 cable. At their request, Greenpar have specially manufactured this item and Telecomms are holding large stocks for both Trade and Retail users.

In recent years Pope H100 has become very popular with both radio amateurs and commercial users, since it offers extremely low loss at an economical price. However, the outer diameter of 9.1mm for this cable meant that many connectors would not fit correctly; Greenpar's new plug now solves this problem.

The new Greenpar N type

All the latest news, views, comment and developments on the amateur radio scene

sells at £3.36.

For further information contact: *Telecomms Ltd, 189 London Road, North End, Portsmouth, Hants PO2 9AE. Tel: (0705) 698113.*

WORK HOLDER

The Octopus universal work holder was developed to provide a solution to an industrial production problem. So good was the result that it has been further developed into an efficient general-purpose professional and DIY tool.

Available from Freetrade TEP Ltd, the Octopus was designed initially to hold solder tags in the repair of small electrical portable pump motor units. Prior to its invention, the tags were soldered to terminal leads using two operators, one holding the tags with pliers and the other performing the soldering.

This method had a number of disadvantages, aside from the labour intensiveness. In particular, the pliers acted as a heatsink, reducing the effectiveness of the soldering. The application required a well-insulated holding device and an insulated crocodile clip was employed, fitted to a short length of heavy cable, giving a positive and flexible support arm.

In the original application, holes were drilled in the bench to take the arm but this was replaced by a small aluminium block which had retaining screws for the arms and a g-clamp for bench fitting.

This simple device proved to be a very convenient and flexible tool for all kinds of work, including model making, for which a magnifying glass was added to allow close work. The success of the design led to the holder becoming a separate project and was first used in the craft department of a local school.

The Octopus has now been developed into an attractive and refined general purpose holder, retaining the original concept but with a number of useful additions. It incorporates a number of design and manufacturing additions that enhance its convenience and range of applications. For example, The Super Octopus now incorporates a large 2½ inch diameter high quality lens that allows fine work to be carried out with reduced eye strain. All metal parts are now black anodised for maximum durability and it is supplied in a neat wallet for easy transportation.

The versatility and excellent ergonomics of the Octopus universal work holder is a testimony to its beginnings as a solution developed for a real industrial work holding problem.

For further information please contact: *Freetrade TEP Ltd, Moor Lane, Witton, Birmingham B6 7HH. Tel: (021) 356 2582.*

DUAL-CHANNEL SCOPE

The Grundig MO20 dual-channel oscilloscope, a cost-effective 20MHz instrument which combines the performance and reliability associated with the Grundig name with an ergonomic front-panel layout leading to ease of use in many applications, is now available exclusively in the UK from Electronic Brokers.

Offering a sensitivity of 2mV/cm over the full bandwidth, the MO20 incorporates a wide range of measuring and trace-manipulation features, including addition and subtraction capabilities, inversion on both channels, dual-channel Y-deflection in the X/Y mode, and ac/dc/LF/HF coupling modes.

Both TV field and line trigger functions are included, and an automatic peak-value trigger ensures that triggering always occurs in the correct range, even where amplitude changes occur.

The CRT features an internal graticule, leading to unambiguous, parallax-free results. The new instrument measures 365 x 155 x 425mm, and weighs 8kg.

Full service and support for the Grundig instrument range is provided in the UK by Electronic Brokers.

For further information contact: *Electronic Brokers Limited, 140-146 Camden Street, London NW1 9PB.*

25MHz DUAL-TRACE SCOPE

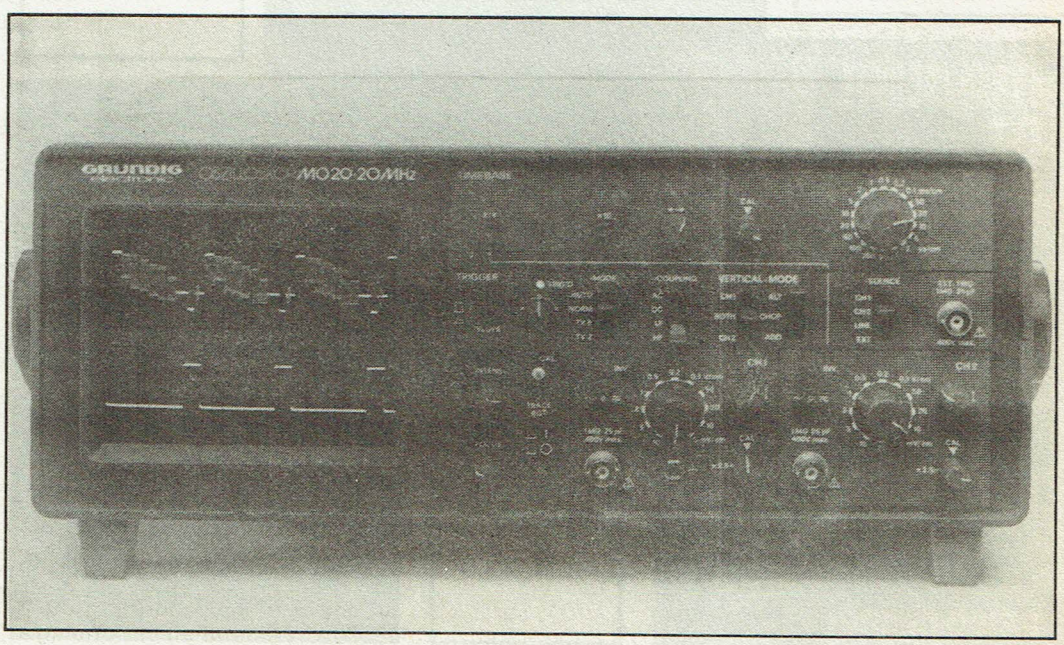
Offering an excellent price/performance ratio, the new Crotech Model 3133 25MHz dual trace oscilloscope is offered at a competitive £319. A range of additional and useful benefits make its price particularly good value for money, especially when combined with Crotech's new two-year warranty.

A useful facility in this price bracket is a variable, 10:1 hold-off for the time base to facilitate reliable triggering on aperiodic and complex waveforms. The time base range is from 40nS/div to 0.2S/div, and maximum vertical sensitivity of 2mV/div. The 5 inch flat faced CRT has a 10 × 8 division graticule which has effective 0 and 100% markings to simplify rise time measurements.

The 3133 has a rise time of 14nS and can be operated in X-Y modes, and has add/subtract channel options. Triggering is reliable up to 40MHz and there is an active TV trigger circuit. Z modulation is provided.

Two other facilities make the Crotech 3133 particularly unique. The first is a front-panel triple output dc source, giving +5V, 1A and ±12V, 200mA, or 24V. A built-in dual component comparator allows both active and passive component evaluation or circuit signature comparison for go/no-go tests.

For further information please contact: *Crotech Instruments Limited, 2 Stephenson Road, St Ives, Huntingdon, Cambridgeshire PE17 4WJ. Tel: (0480) 301818.*



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TRANSMITTER HUNTING: RADIO DIRECTION FINDING SIMPLIFIED

by JD Moell and T Curlee

Transmitter hunting is not a new aspect of amateur radio, but it has been largely ignored by ham radio publications. Nevertheless, DFing is a flourishing hobby, and this American publication seeks to rectify the current situation in this chatty and informative book.

A short and fascinating history of 'foxhunting' is given, and handy hints on which rig to buy – although it must be stressed that this book was clearly intended primarily for the US market; some material may be irrelevant and some items unavailable in this country.

The section on antenna construction for mobile use is most handy and contains plenty of detailed ideas for home construction enthusiasts.

Hunting techniques are discussed, and different support units are shown, with circuit diagrams and construction details, all of which should make this book very popular with enthusiasts.

John Wiley and Sons Ltd, £14.50. ISBN 0-8306-2701-4

MANUAL OF AVIONICS

by B Kendal

In this new and fully updated edition, the knowledgeable Mr Kendal unravels the mysteries of civil aviation electronics. An essential reference text for the professional, this book is also an enjoyable read for the layman, with fascinating sections on the development of radio and radar and a totally new section on space systems.

As those who regularly read this magazine will know, the author is an expert in this field, with the ability to communicate highly technical information accurately and straightforwardly, with the minimum fuss.

Recommended for all enthusiasts.

Blackwell Scientific Publications, £17.50. ISBN 0-632-01863-1

THE SECRET OF LEARNING MORSE CODE

by M Francis

Written from first-hand experience, this book provides hope for Class A aspirants who previously believed that Morse was beyond them. If the subject seems intimidating to those who have tried and failed, the text is not. Mr Francis constantly encourages and amuses with this anecdotal voyage through the learning process.

Numerous exercises and sample tests are provided, and some of the myths surrounding the code are exploded. The author's tips on easy ways to learn really do help the uninitiated – in fact, the temptation is to exclaim: 'Now why didn't I think of that?' It should be remembered that the ability to produce this response is the hallmark of a good teacher.

A useful and inexpensive book, this should be on every beginner's list of invaluable texts.

SPA Publishing Ltd, £4.95. ISBN 0-9512729-0-X

GOOD MORSE

Geefor Enterprises are pleased to announce the launch of a new book. *Your Key to Good Morse* is a 28 page A5 sized book by Trevor Berry G4SON, and is aimed at taking a novice through the Morse test and onto his first QSO.

Also included are abbreviations, the Q code and RST tables. The price of this book is £3 including postage and packing.

For further information contact: *Geefor Enterprises, 112 Leeds Road, Mirfield, W Yorkshire WF14 0JE.*

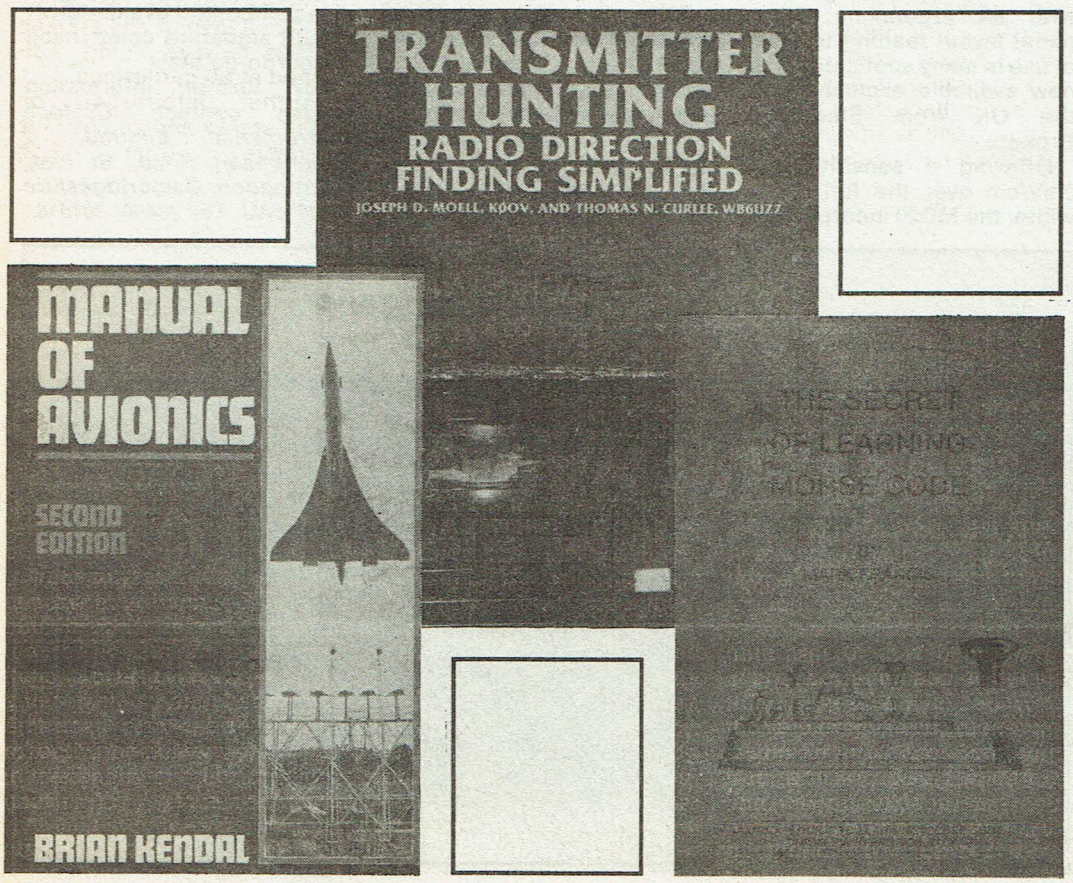
MAPLIN MAGAZINE

Security is one of the major themes of the *Electronics – The Maplin Magazine* , for September to November 1987, highlighting the Maplin Radiation Monitor. With environmental monitoring, particularly nuclear radiation, being a matter of national concern, the need for an independent, portable and easy to use monitor unit is undoubted. But such radiation monitoring equipment is not commonly available through domestic retail outlets, while professional scientific instruments are very costly.

The Maplin Geiger Counter Kit, priced at £99.95, is sensitive to Alpha, Beta, Gamma and X-rays. A remote detector, which if required can be connected to home computers to record the collected data, and costs £79.95. To enhance the environmental benefits, the system can be powered by solar energy.

Likely to be of major interest to an increasing number of households, is the new Maplin Video Recorder Alarm. This is a portable, self-contained alarm system disguised as a video cassette which detects movement from any pre-determined position. The cassette can be inserted into VHS video players and will give an audible warning if the machine is moved, or cassette ejected. In addition, the cassette can be placed on top of the video machine, TV or hi-fi system – in fact in any natural position. When in action, batteries drive two powerful electronic buzzers. The complete kit costs £11.95.

An external horn has now been added to the Maplin Home Security System. When triggered, the horn or siren will sound for a pre-deter-



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mined period, ranging from 30 seconds to over two hours. The basic Burglar System is now one of Maplin's best selling kits.

Other features included in the magazine, now available from Maplin warehouse stores and branches of WH Smith, include a further episode of *The Story of Radio*; a VHF band pre-amplifier primarily designed for use with the Mapsat weather satellite receiving system; Machine Code programming; and part six of a series on Test Gear and Measurement.

With subscriptions continuing to show a very healthy increase, the latest issue of *Electronics – The Maplin Magazine* at just 85p looks set to be a sellout.

For further information, please contact: *Maplin Electronic Supplies Ltd, PO Box 3, Rayleigh, Essex SS6 8LR. Tel: (0702) 554155.*

RF POWER FETs

Anglia Microwaves extensive range of Polycore PolyFET gold-metallised RF power FETs is shown in a new shortform catalogue.

The shortform contains all of the necessary data to select a device. It has detailed facts and figures on each type and illustrates the wide choice of package styles offered. Among the series covered are the PolyFET F1000, operating from HF to GHz frequencies, the F1200 Mobile series, F2000 - HF to 2GHz and F3000 Superpower range for operation from HF and VHF bands.

The impressive performance figures illustrate the advantages of gold metallisation, including the highest reliability and mean time between failure (MTBF) figures of any FET. It provides low capacitance, high Gm (typically 10-13) and high Ft specifications, for use in VHF, UHF and microwave circuits.

Enthusiasts now have access to a range of devices covering frequency ranges from 1MHz to 2GHz with power levels from 1W to 300W in Class A, B and C.

For further information please contact: *Anglia Microwaves Limited, Radford Business Centre, Radford Way, Billericay, Essex CM12 0BZ.*

CLUB NEWS

DTI information sheet

The Department of Trade and Industry have published a new information sheet on the subject of entering the amateur radio hobby and the Radio Amateurs' Examination.

This information sheet has been produced in consultation and cooperation with the City and Guilds of London Institute. The City and Guilds have agreed to distribute some 40,000 copies of this information sheet via their mailshots to educational centres and libraries around the UK, and certain places abroad. In addition, City and Guilds will be distributing these information sheets throughout the year when they attend conventions and other public events related to leisure, education, science and technology.

The DTI's intention in producing the sheet in the terms in which it is couched is to try to gain access to (and encourage interest in) as many people as possible who would not normally come across amateur radio as a potential hobby. Perhaps this time next year they will be able to gauge just how successful (or otherwise) this joint initiative has been.

To obtain a copy of the Amateur Radio Information Sheet No 6 contact the DTI, Room 613 Waterloo Bridge House, Waterloo Road, London SE1 8UA.

Rathlin Island

Ballymena Amateur Radio Club recently went on their annual expedition to Rathlin Island, under the callsign GB3MKB. This expedition is undertaken to commemorate the work done by Marconi for Lloyds of London 89 years ago.

The station was sited in square IO65VH and WAB square D15. There are two other WAB squares on the island, D14 and D05. These were worked under the club's own callsign GI3FFF/P. Both HF and VHF were active, with ATV on 70cm.

TARS

The Torbay Amateur Radio Society meet on Friday evenings for 7.30pm at the English China Clay Social Club, Highweek, near Newton Abbot. Facilities include a licensed bar and access to club stations operating on both HF and VHF.

Activities outside weekly meetings for November include a visit from Eric G3GC of Yeovil, new members and visitors always being welcomed at all gatherings.

Further information on membership and activities is available from Bob

Members of the Ballymena Amateur Radio Club GI3FFF on Rathlin Island with the special event station GB2MRI

McCreadie G0FGX on Haytor (03646) 233.

All change

The Banbury Amateur Radio Society has been undergoing several changes recently. Now that the metamorphosis has completed, the club meets at two week intervals at 'The Mill', Spice Ball Park, Banbury.

These meetings are on Wednesday evenings from 7.30pm onwards, and most will include talks on radio subjects. DF hunts are also arranged for Sunday afternoons, at which all amateurs and SWLs are welcome.

The meetings for November are on the 4th and 18th, the first being a talk and video by Geoff Todd, the assistant County Emergency Planning officer.

The second talk is by Dave Howes G4KQH on building kits from CM Howes Communications.

Further details may be obtained from the secretary, Bryan G1IIO, QTHR or on Banbury 51774.

In the dark

Edgware and District Radio Society will be in the dark this month – a film evening is planned for November 12th, by G4RMD.

On November 26th the club will be discussing any SWR topics, so members who want to chat about these can come along and do just that.

Club meetings are on the second and fourth Thursdays of each month at 8pm at the Watling Community Centre, 145 Orange Hill Road, Burnt Oak, Edgware. To find out more, contact the club secretary, Ian G4IUZ, on Hatfield 65707.

MARS move

MARS – the Midland Amateur Radio Society – are holding a construction competition on November 17th, so members are invited to bring their projects along – you never know, you might win a prize!

MARS is currently searching for a new HQ, as the old one is due to be demolished. Though club HQs seem to have this problem regularly, the club strenuously deny that they are a blight on property, pointing to large sections of the Midlands which are still intact despite their presence . . .

Roy Seabridge G4SEA QTHR would be delighted to hear of a suitable city centre site, preferably a very solid one.

SAnDRA

SAnDRA stands for Sudbury and District Radio Amateurs, who are a new group on the scene, and would like to advertise their presence to anyone who might be interested in joining.

Attendance figures have been most promising, and SAnDRA would like to thank all those who have dropped in so far – keep on coming!

Meetings are at 8pm on the first Tuesday of the month, at the Saracen's Head, Newton Green, Sudbury. For further details please contact Colin G1GPO on (0787) 77004.

Mess code

The Mid-Lanark Amateur Radio Society tried to fool us by sending their club news for the month in Morse – it's no good, we worked out that ZORZ NLLP is doing something . . . um . . .

Actually, George Allan GM3HYF has the floor to himself, or so it is rumoured, and a positively dotty evening will ensue . . . must dash.

When the club is not trying to confuse us lesser mortals, it meets at Wrangholm Hall, in the Community Centre, Jerviston Street, New Stevenson, Motherwell. We hope we got the message right, folks. If we didn't, the secretary, David Williams GM1SSA might be able to help, please phone Holytown 732403 – and don't forget to say it in Morse.

Verulam ARC

The Verulam Amateur Radio Club meets at the RAF Association Headquarters, New Kent Road, St Albans on the second and fourth Tuesdays in each month.

On Tuesday 10th November the club is holding an activity evening, and on November 24th Mr Robin Hewes G3TDR will give a talk entitled 'Advanced Receiver Technology'.

Further information can be obtained from Hilary G4JKS, on St Albans 59318.

RSGB at MARS

Mansfield Amateur Radio Society has three major events scheduled for the month, an RSGB video on Friday 6th November, a talk by Keith G4AAH on the grid dip oscillator on Tuesday 17th November, and a home construction competition – bring along your latest homebrew, you never know, it might win a prize. This is also scheduled for the 17th. Whether the two events are to run concurrently or whether one has been cancelled, we do not know . . .

Meetings are held in the Victoria Social club, Mansfield, at 7.30pm on the first Friday and third Tuesday of the month. For more details please contact Keith Lawson G4AAM, QTHR.

Chesham AGM

Chesham and District Amateur Radio Society meets every Wednesday at 8pm at 'The Stable Loft', The Bury Farm, Pednor Road, Chesham.

Club members are asked to put the AGM on November 18th in their diaries. Other meetings this month include a talk and demonstration of high power linear amps on November 11th, while on November 25th Tony G4BPC will be talking about the history of stereo.

For more information about any of the above please contact the club secretary, Liz G0ETU QTHR on (092) 78 3911.

Construction competition

Southgate ARC is holding a construction competition on November 12th, so any ingenious gadgets can be brought from the shack and admired by all. An informal evening is scheduled later in the month on November 26th.

The club meets on Thursdays at 7.45pm at Holy Trinity Church Hall (Upper), Green Lanes, Winchmore Hill, London N21.

For those wanting to enter the competition or to find out more about club activities, contact DC Elson G4YLL on (0992) 30051.

Seeing STARS

Or rather, hearing them, as Stourbridge Amateur Radio Society is going to have an 'on air' night on November 2nd. Reaching even further afield, members are holding a DX contest on November 7th and 8th and, for anyone who feels like improving their equipment, the annual surplus sale is on November 16th.

To find out more about venues and dates, contact the hon secretary, Derek Pearson G3ZOM on Kingswinford 288900.

Radio Races

The Irish Radio Transmitters Society has a long cherished ambition to set up a permanent HQ for meetings and archives, in which a station could be set up.

With this in mind, the building fund is getting under way with a race night. All club members have to do is obtain sponsors for the race card – or, if any member cannot find a sponsor, he or she may sponsor a space themselves. A good opportunity to see your name in print!

The big night will be Thursday November 19th, at the Grand Hotel, Malahide, and for further information about the event Tony EI6EW should be contacted.

Stolen goods

Tony G3JHR would like readers to be on the lookout for equipment stolen by thieves from his shack.

Tony lives in Morecambe, Lancashire, and his Yaesu – FT290R Mk1 S/N 020527 – plus mike went missing on August 18th. Both are postcode marked, which can be read by using a UV lamp.

If anyone has bought or knows about the sale of a rig like the above in suspicious circumstances, please call the police or G3JHR (QTHR).

If your club has an event that could do with a little publicity, just send in the details to the editorial address on the contents page, and we will indlude it in this column. Make sure that you include all the essential info, ie time, place, admission and access etc.

DX DIARY

News for HF operators compiled by Don Field G3XTT

The HF Convention is now history, but if you were not there you missed a great weekend. I was privileged to have Einar LA1EE, staying at my house during the convention and it was fascinating to hear a first hand account of the Peter 1st Island expedition. What I found particularly interesting was the way in which HF amateur radio took on a wider significance than the DXpedition itself. The DXpeditioners and the research team from the Norwegian Polar Research Institute were using the ship Aurora while it was waiting for a young Norwegian explorer – Monica Christensen, who was following in Amundsen's footsteps – to make her way to the South Pole and back.

Out of touch

The ship, which was supposed to act as the radio link between the polar expedition and Norway, had been out of touch for over two weeks due to QRN right across the spectrum. It took the radio amateurs to trace the problem to the switched-mode power supply in the satellite terminal on the ship. When contact was finally made, the low power being used by the polar explorers necessitated the use of CW, which the official radio operator on the ship was unable to copy. Radio amateurs to the rescue again!

Later both the satellite link to Norway and the ship's HF radio equipment failed, but the two amateurs on board were able to maintain daily contact with Norway on twenty metres. Again, a coup for amateur radio. These various events brought the two amateurs LA1EE and LA2GV much acclaim in the Norwegian press when they finally returned. This kind of publicity must be good for the image of amateur radio generally – and is one in the eye for anyone who regards DXpeditions of this sort as frivolous activities. All in all, a fascinating story.

Einar had also been kind enough to go through the logs to find all the UK contacts made by the DXpedition. Of almost 16000 QSOs in total, about 240 were with the UK. Given that some UK amateurs contacted Peter 1st on two, three or even four bands, this number suggests that probably only about 150 UK amateurs in total actually made it.

We will never know how many more had been there in the pile-ups but failed to make a QSO. The remoteness of Peter 1st, plus the inhospitable terrain and climate, make it very unlikely that there will be another expedition for many years to come. However, the true-blue DXer always lives in hope! What does seem surprising is that relatively few of the UK amateurs who worked the group on 80 metres (a real coup) actually bothered to QSL.

CQWW CW contest

Last month I gave you details of DXpeditions geared to the CQWW SSB contest. This month it is the turn of the CW leg of the contest, which takes place over the weekend of 28/29th November. This is always the one I most look forward to, because it is easier to work LF DX during the CW leg of the contest than it is during the SSB leg.

N3JT was planning to operate from San Andres (HK0), although this has not been confirmed at the time of writing. K4BAI will operate as 8P9HT from Barbados using the same site as the group who were due to operate in October.

Turks & Caicos Is

A large team of Californian amateurs will be operating as VP5W from the Turks and Caicos Islands. Meanwhile, the Southwestern Ohio DX Association will once again operate as J6DX from St Lucia. Their activity will commence on 23rd November and run through until 6th December. W2GD will be active yet again as P40GD from Aruba. And the Kansas City DX Club will be operational from Belize (V3).

Returning for a moment to the SSB leg of the contest, if you took part you might like to compare your scores with those of UK stations who took part last year (see table). Congratulations are due especially to GW4VEQ who was world 6th on 80 metres.

Top Band

This winter looks like being another good one for Top Band enthusiasts. YB0JH and TR8JLD were both worked in the UK early in the season, and the first of these is regularly active on 1834kHz from about 2230GMT. PA0GAM/ST2 told me in a QSO on 20 that he expects to be active on Top Band by about the time you read this. A4XJZ kept appearing over the summer, so we can reasonably expect to hear some more of him, and A92BE also promises some activity. Along with those I mentioned last month it's looking very good.

While on the subject of 160, I was very interested to read an article by KL7Y in the American *Radiosporting* magazine about his activities on LF last winter from north of the Arctic Circle. Dan was able to work many Europeans with ease on both Top Band and 80, signals often being stronger on Top Band. Dan postulates that this may be because at his latitude the MUF actually dropped below 3.5MHz quite frequently.

Signal comparison

Dan was able to compare signal strengths at his Arctic QTH with those from his home station in Wasilla which was being operated by WL7E. The Wasilla QTH had better antennas, but was located right under the auroral belt and signals from there were always at least 20dB down in Europe compared with signals from the Arctic QTH, and the difference was often more like 30 to 40dB. The biggest problem Dan faced was in erecting antennas and keeping them in the air. The low temperatures and the chill factor of the high winds took temperatures as low as −73C and most plastic materials went completely brittle at these temperatures.

Over the course of just one month's operation from his

Arctic QTH, Dan was able to make over 600 Top Band QSOs (about 350 of which were with Europe) in 45 states and 46 countries. He compares this with the 49 states and 44 countries he was able to work in 4 years from his home QTH in Wasilla. Dan was hoping to be active from his Arctic location yet again this winter, but as he is hoping to catch some missing zones on 80, he will probably be less active on 160 compared with last season.

DX achievements

When I mentioned the *DX News Sheet* Jubilee Award last month, I said that I thought it represented a very demanding challenge. I was amazed then to note that Hazel G4YLO had worked 210 countries in the first three weeks of the qualifying period, 170 of these being worked in just 10 days!

Hazel also worked 115 zones on 5 bands during the same period. Congratulations to Hazel who can obviously teach the men among us a thing or two! Hazel was also lucky enough to win the draw at the HF Convention for a piece of rock, brought back from Peter 1st Island by the two DXpeditioners.

Forthcoming DX

As well as the contest operations which I mentioned earlier, there is the usual crop of DX news to report. G3AAG is reported to be going to Cocos-Keeling Island from November 25th to December 7th, where he will operate as VK9YV on all bands, mainly on SSB. He will be accompanied by F6GVD and they may also operate from KH2 and KH6 on the way home.

It looks as though Heard Island may slide down the wanted lists this winter, as VK3DHF should be active by now as VK0HI and expects to be on the island until May of next year, being active on all bands. From what I have seen of slides from earlier operations, Heard Island is hardly the place to spend several months, but I suppose amateur radio at least helps to pass the time. Some CW activity is promised and on SSB look out for him from 1600-1800GMT around 14150kHz.

Now one for the prefix hunters. The XO7 prefix will be aired from Terrance Bay in British Columbia during December, and a range of special prefixes will be used in Canada from 1st January to 29th February 1988 to mark the 15th Winter Olympics, to be held in Calgary during that period. The Canadians have always been great ones for activating special prefixes; VE1ASJ was very active earlier this autumn for example as VF1ASJ, generating some large pile-ups into the bargain.

Apparently Gary VE3XN, who himself has activated many Canadian prefixes over the years, has now worked something like 150 Canadian prefixes. There can't be many other countries with so many prefixes on offer with the exception, I suppose, of the USA. Some rare prefixes will also be on offer from the French Antarctic Territories over the winter period. Listen out for FT2, FT3, FT4 and FT5 from Kerguelen and Amsterdam Islands and from Adelie Land.

Falkland activity

Reg, GW8VHI, was due to start a 4 month tour of duty in the Falklands in mid October and hopes to make at least a brief trip to South Georgia for some amateur radio operation. Remember that Class B licensees who take out licences in VP8, ZD8, etc get full HF privileges, so look for Reg on 40, 20 and 15, though presumably only on SSB.

XU1SS in Kampuchea is reported in *DX News Sheet* to be very active again. Check 14165 from 1200-1400GMT daily. TA2/N4EXR will be in Turkey for 2 years. 9M6AE is GM4DGS and will be in Saba for an extended period. He uses an FT757 to a vertical and looks especially for UK stations. Check 14165kHz from 1500GMT on weekdays.

1A0KM turned up again at short notice during the last weekend of September, and about 4000 QSOs were made. Unfortunately, it is never possible to give advance warning of this one, as operations are usually notified only a few days in advance.

Build your own country

Some years ago Okino-Torishima was on the DXCC list, but was eventually removed. The only surprise about this was that it had ever counted in the first place, because Okino-Torishima is a tiny speck of land which is all but covered by the sea at high tide. Photographs from the few DXpeditions that operated from there show that the DXpeditioners had to construct a platform for the station, to avoid it becoming swamped by the sea.

Anyway, now it seems the island is fast disappearing altogether below the waves, which has prompted the Japanese to plan a survey to

UK SCORES IN 1986 CQWW SSB CONTEST

Callsign	Category	Score	QSOs	Zones	Countries
G3SJX	All-band	669,908	1004	80	236
GM4GPN	All-band	319,676	778	59	174
GB6AR	All-band	296,100	522	63	172
GM3BCL	All-band	276,740	602	53	149
GM4WEW	All-band	233,120	625	42	146
G3SNN	All-band	217,588	405	76	190
G4IUF	All-band	208,803	471	58	105
G4UDU	All-band	184,110	525	41	149
G3ICG	All-band	85,120	414	29	83
G6QQ	All-band	64,827	249	39	108
G4BWP	All-band	52,731	205	37	56
GD4GWQ	All-band	41,008	261	26	62
G4GIR	All-band	13,230	74	30	40
G6NK	All-band	13,164	109	15	48
G4JQL	All-band	2,395	23	12	23
GM8SQ	All-band	1,122	24	9	8
G0AEV	28MHz	19,158	171	16	46
GM4CHX	28MHz	1,300	29	8	17
GI4MWA	28MHz	817	21	8	11
G4RKK	21MHz	166,026	559	34	84
G3RTE	21MHz	137,706	510	31	87
G4PCI/P	21MHz	40,950	259	22	53
GM0AXY	21MHz	4,756	66	11	18
GM3MOR	21MHz	1,104	24	10	14
GW4RHW	14MHz	155,958	798	25	77
GI3KDR	14MHz	45,375	321	22	53
GM4JFS	14MHz	27,786	252	15	51
GB2RIP	14MHz	8,668	81	13	31
G3JKY	14MHz	8,442	123	13	29
G4CNY	7MHz	80,200	447	21	79
GI4BBY	7MHz	22,357	180	17	62
GW4VEQ	3.5MHz	123,670	906	17	63
G3XTT	1.8MHz	10,974	142	10	52
G3XWZ	1.8MHz	8,272	94	8	36
G3NAS	Multi-single	2,775,216	2585	107	349
GM0BRS	Multi-single	1,390,095	2020	73	242
GB6AA	Multi-Multi	997,150	1396	93	277
G4MTC	QRPp, All-band	41,195	271	26	81
G3KDB	QRPp, All-band	35,640	160	31	77
GM4ELV	QRPp, 14MHz	32,560	320	16	64

see whether the island can be saved. This is because international law requires land to be above sea level at all times for it to be claimed as sovereign territory, and if Okino-Torishima disappears it will mean the loss to Japan of some 170,000 square miles of fishing waters. Maybe we will yet see this tiny spot reappear on our country lists.

Mt Athos

Much to everyone's surprise, in view of the controversy that there has been in recent years, a group of Greek amateurs appeared on the air from Mt Athos in late September signing their own callsigns /SY.

They were very active on all bands, although very slow in their operating. Nevertheless, UK amateurs were able to work them on 160 through to 15 metres.

We will have to wait and see whether this operation is accepted by the DXCC desk at ARRL, although the fact that it was put on by Greek nationals must make this reasonably likely.

Books

I came away from the HF Convention with several books which would be of interest to the HF DXer. One is ON4UN's excellent book *Low-Band DXing* which deals in depth with a wide range of topics of interest to LF band enthusiasts. John was at the convention to promote his book and also to demonstrate the software which goes with it.

This software includes programs for antenna design, propagation predictions and feedline calculations and is available to run on a wide range of computers though not, unfortunately, on the BBC machines. I have yet to run the programs on my own machine, but look forward to giving them a whirl.

Yagi design

The other book which I can heartily recommend is *Yagi Antenna Design* by the late Jim Lawson, W2PV. Jim's excellent series of articles on yagi design were first published in the American *Ham Radio* magazine in 1980 and since then I have always kept that series of articles near to hand. This book brings them together for the first time and includes some additional material. Both the above books are published by the ARRL, but are available from various sources in the UK.

Contests

Apart from the CQWW CW contest, look out during November for the RSGB Top Band contest on 14/15th and the DARC RTTY event the same weekend. The TOPS 80 metre CW contest takes place over 5/6th December and the ARRL 10 metre contest (both CW and SSB) on 12/13th December.

Countries wanted

Finally, *The DX Bulletin* has recently published the results of its 1987 'countries wanted' survey. The world ranking shows Albania top of the list, followed by Burma, Bouvet Island, South Yemen, Vietnam, Afghanistan, North Yemen, Laos, Bangladesh and Spratly Island. For European DXers the list is slightly different, with Vietnam topping the list, followed by Burma and Albania. China continues to fall down the list, having ranked top when the first survey was conducted in 1980, but now going down to 96th position.

Libya, Minami Torishima, Cocos Keeling, Christmas Island and Revilla Gigedo have also dropped down the table this year, while Jan Mayen, the Maldives, Tuvalu and Sudan are on the way up. Others which have climbed rapidly over the last five years include Bhutan, Niger and Spratly Island.

Good DXing, and do please let me know all your DX news. 73 de Don.

Don't miss the next issue of *Amateur Radio* on sale Thursday 28 November

Build a Base Station Microphone

by Steven and John Goodier

A base station microphone is an added advantage to any operator; apart from looking nice and hopefully sounding pleasant over the air, it can be left keyed while the operator fills in the log etc whilst still carrying on with the QSO. The price of a commercial desk microphone is a little on the expensive side for most people, so we decided to have a go at building such a unit.

The whole project came about when experimenting with an external microphone for use with a Yaesu FT209 hand-held, which was to be used as a base station unit. Two mic amps were tried, one a two transistor amplifier and the other used the 6270 VOGAD IC. Excellent results were obtained from both amplifiers and we finally used the two transistor version in the base unit, for reasons which will be explained later. There are very few main components needed to build a desk microphone, the main items being: metal box; microphone insert; microphone amplifier; goose neck; PTT switches; connectors and screened cable.

The real aim of this article is to describe the construction of two microphone amplifiers, and the way they can be used in the construction of a good quality desk microphone. We will also have a quick look at the Yaesu MD1 microphone and look at using electret inserts with hand-helds and other types of rigs.

Dynamic microphones

In a dynamic microphone a diaphragm is fixed to a set of coils suspended between the poles of a magnet, the sound causes the diaphragm to move and current is induced into the coils by the magnet. To ensure a wide frequency response the coil and diaphragm must be very light to allow the microphone to respond quickly to sound.

We had the opportunity to study a Yaesu MD1 desk microphone and, although looking very nice, its make-up is relatively simple. The main component is a high quality 600 ohm hand-held dynamic microphone which is held to the base unit by a microphone holder. The base unit contains the PTT switches and scan buttons and the microphone is plugged into the back via an 8 pin mic plug. The output to the rig is then taken via another 8 pin mic socket and screened lead. The MD1 has the facility to switch the output impedance between 600 ohms and 50k, which is achieved via a microphone transformer.

For anybody wishing to construct this type of microphone, all the components are readily available and the circuit diagram of the impedance switching is shown in *Figure 1a*. As already stated, the main component is the hand-held microphone, and this can range in price from about £14 to £40 upwards, depending on the quality. Maplin Electronics sell two types of impedance matching transformers. Type 1 has an input impedance of 600 ohms and an output impedance of 20k, and type 2 has an input impedance of 200-600 ohms and an output impedance of 50k. Either type should work well with most 500-600 ohm dynamic microphones.

If you have a look at the microphone section in the current Maplin Electronics catalogue, you will see most of the bits needed, including microphone holders, and we would recommend the YN75S vocal mic at £14.95, although better quality microphones are available from other suppliers (try the local music shop). The MD1 has a custom-made box, and we have looked through many suppliers for a suitable box and have failed to find one, so it is up to the constructor to find a suitable type. The

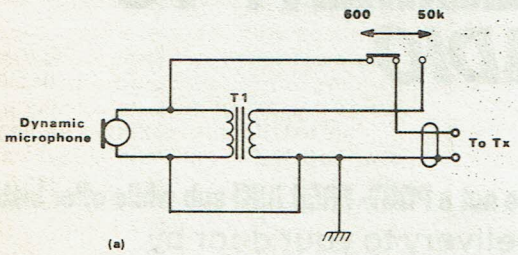


Fig 1a *Showing how a microphone transformer is used to switch between an output of 600Ω and 50k*

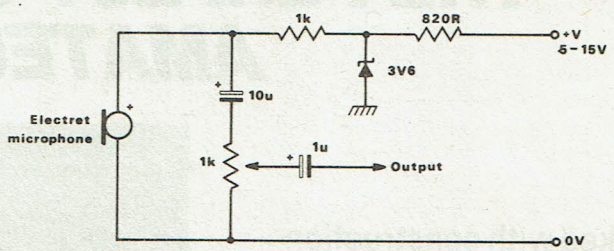


Fig 1b *Showing a basic electret microphone set-up including power supply and output level control*

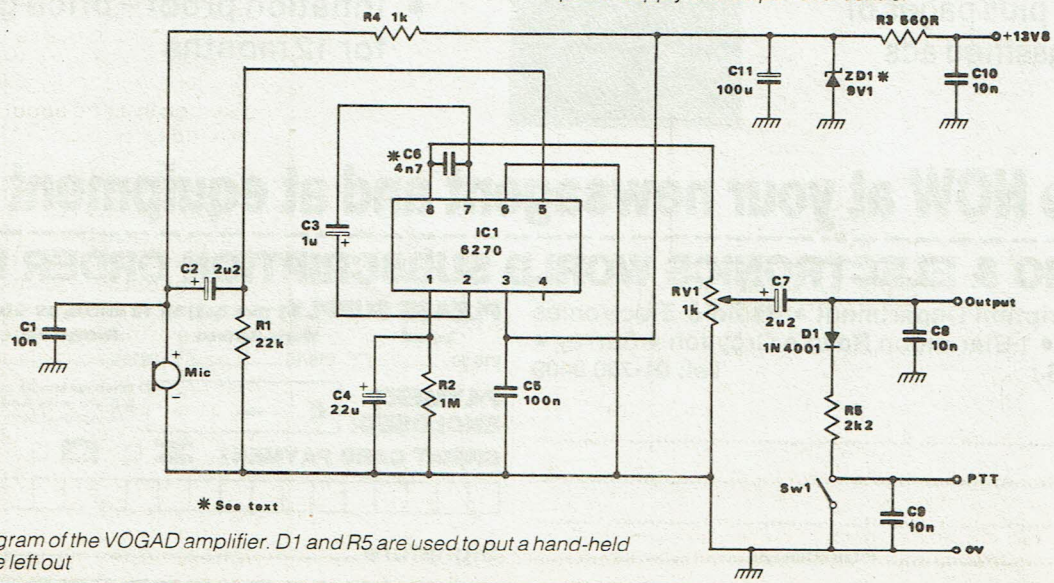


Fig 2 *Circuit diagram of the VOGAD amplifier. D1 and R5 are used to put a hand-held on air and may be left out*

microphone to be described later was housed in a small die-cast box and if you study the construction this should give you some ideas about the box and PTT switching etc. The main advantage of this type of circuit is that it requires no power supply and gives good quality audio on all modes.

Electret microphones

In an electret microphone one of the plates is charged at the time of manufacture, and because the output is very low it has a built-in FET amplifier. This type of microphone requires a power supply of about 1.5 volts, but in practice the supply can be anything between 1.5-10 volts, but it is always worth checking the manufacturer's data first.

If you are going to use an electret microphone with a hand-held, such as the Yaésu FT209 etc, then it is possible to wire it directly to the mic socket on the top of the rig. The FT209 and similar hand-helds have a small dc voltage running up the audio line and this is used to power the electret insert. The rig is put 'on air' by shorting the inner of the audio lead to ground via a 2k2 resistor. If you wish to use an electret with other rigs, then *Figure 1b* may be of some help. The supply voltage can be anything between about 5-15 volts, and is dropped to around 3.5 volts via the Zener diode. The output from the electret can be adjusted by the 1k resistor. None of the capacitor values shown are critical and can range from about 1μF to 100μF. It was found that when using an electret insert the audio quality on FM was very good, but it was the general opinion of most stations that the quality on SSB was not as good as that of the dynamic insert.

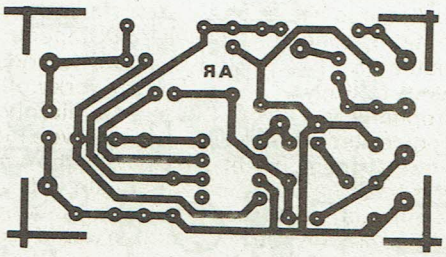


Fig 3a *PCB pattern for the VOGAD amplifier*

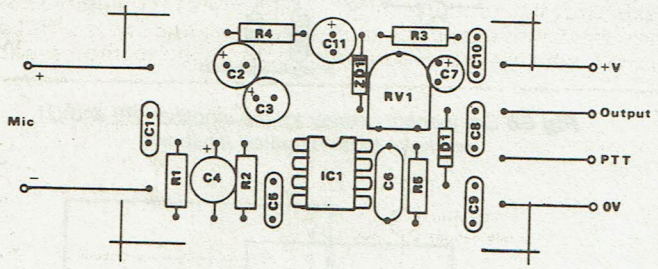


Fig 3b *Component overlay for the VOGAD amplifier. Use miniature electrolytic capacitors as space is tight*

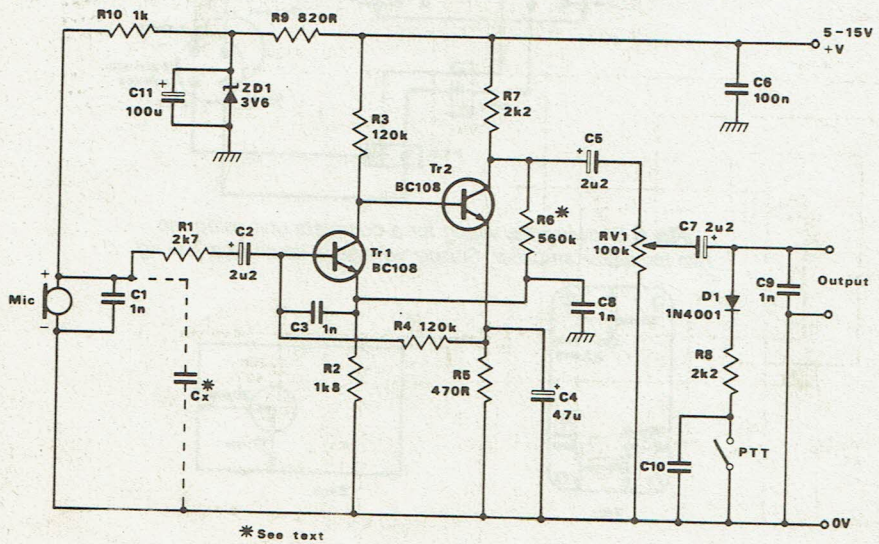


Fig 4 *Circuit diagram of the two transistor amplifier. ZD1 is used to supply an electret insert with about 3.5 volts*

VOGAD mic amp

The first microphone amplifier we will deal with is the VOGAD type. VOGAD stands for Voice Operated Gain Adjusting Device, and the type used in this design is the popular 6270. Most people will have seen this type of circuit before, and we can't really claim any originality for this design. For those people who are not familiar with the workings of the VOGAD circuit I will explain what it will do.

The IC has been designed to keep a constant output of about 90mV regardless of the input from the microphone. This enables the operator to talk up to 5m away from the mic and still remain at good audio level to the received station. When experimenting with the prototype we were astounded by its sensitivity; it could easily pick up background conversations and sounds from outside the room. This was probably due to the omni-directional insert used and background noise should be greatly reduced by using a uni-directional type.

Figure 2 shows the circuit diagram of the VOGAD amplifier and it has been designed to operate with an electret insert. The IC contains two amplifiers and an AGC detector, the main amplifier's gain is set by an internal 10k resistor and the microphone is fed to the pre-amp input at pin 5. The output of the pre-amp is at pin 2, and this is coupled to the main amplifier and AGC detector at pin 7 via C3. Pin 1 is the AGC time constant and this is controlled by C4 and R2. The main output is at pin 8 and this is fed to the level control VR1.

The capacitor C6 sets the high frequency roll-off and it was found that changing this value would dramatically change the tone of the output, making it possible to tailor the response. Values between 0.0047μF (4n7) and 0.022μF can be tried. As already stated, most hand-held rigs are put 'on air' by shorting the audio line to earth via a 2k2 resistor and this is the job of D1, R5 and SW1. If you are not planning to use the circuit with a hand-held rig then they can be left off the board if wished. The 6270 IC will operate satisfactorily with a supply voltage of between 4.5-10 volts dc and this is taken care of by ZD1. The rating of ZD1 can be between 9V1 and about 5 volts. Power is also fed to the electret insert via R4.

Construction and testing

Figure 3a and *Figure 3b* show the printed circuit board layout and component overlay. The PCB size is round about 58 × 35mm. Construction is very simple and we would recommend the use of miniature electrolytic capacitors as space is a little tight. As already stated you can leave out D1 and R5 if you have no plans to use the circuit with a hand-held rig. If you plan to supply the circuit with less than 10 volts then it is possible to leave out ZD1 and replace R3 with a wire link. It is worth a mention that most modern day rigs carry a small voltage on one of the mic pins. For example, my HF rig carries +8 volts on

pin 5 and this was used to power the prototype.

When completed, give the board a quick check and connect up as shown. The electret insert has a positive and negative side, so make sure you wire the screen cable the correct way round. All cables to the rig should be screened, and after wiring the mic, plug in and switch on. Start by setting VR1 to its centre position and get another station to monitor your transmission. Speak between one or two feet from the microphone and with the help of the other station set the output to the correct level; too much gain will result in a processed sound. Once set up try walking some distance from the mic – the output should remain about the same level to the receiving station. If you get reports that there is too much 'bass' or 'treble', then you can change the value of C6.

General purpose mic amp

Figure 4 shows the circuit diagram of a general purpose low noise microphone amplifier. This circuit is suited to both dynamic and electret type inserts. The amplifier is based around two BC108/109 transistors; feedback is applied via R6 and using the value shown will produce about 1 volt peak to peak output for a 10mV input. The circuit will happily run with a supply voltage of between 5 and 15 volts and there is an on-board power supply based around R9, R10 and ZD1, which powers an electret insert if used. Again D1 and R8 are used to put 'on air' any hand-held connected to the amplifier and may be omitted if wished.

Mic amp construction and testing

Figure 5a and *Figure 5b* show the printed circuit board layout and component overlay. The PCB size is approximately 60 × 41mm. There are a lot more components packed onto this board, but construction is still very simple. Again we would recommend the use of miniature electrolytic capacitors. If you plan to use a dynamic microphone with this circuit then leave out R10 and ZD1. D1 was added at the last moment, so you will have to arrange it as shown in *Figure 5b.*

When completed give the board a quick check and connect up as shown. Just to remind you; if you are using an electret insert make sure it is connected the right way round. Setting up is simple and it is just a matter of setting VR1 for the best output. If you find that the amplifier has too much gain, try reducing the value of R6; if you halve the value you will approximately halve the gain of the amplifier. It is also possible to change the tone by placing Cx across the input as shown – try values between 0.22μF and 1μF – but this was not needed on the prototype.

Notes about both amplifiers

Both amplifiers were tried on a Yaesu FT209 hand-held and a Trio/Kenwood TS440S. It was found that the VOGAD amplifier and electret insert were not suited to SSB operation; its poor performance on SSB was probably due to the way this simple VOGAD amplifier

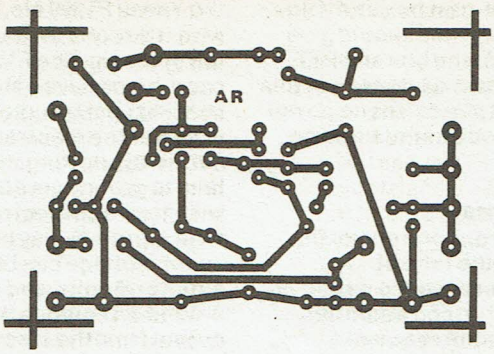


Fig 5a *The PCB pattern for the transistor amplifier*

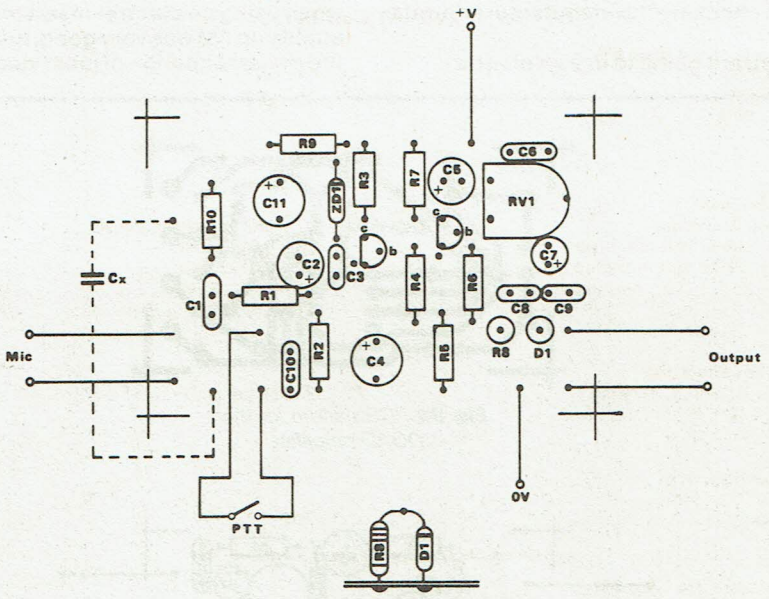


Fig 5b *Component overlay for the amplifier. R8 and D1 will have to be mounted as shown*

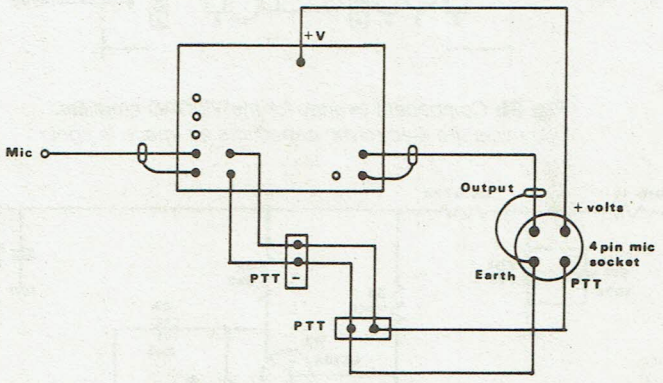


Fig 6 *Showing the wiring for a complete unit using the two transistor amplifier. Supply voltage is taken from the rig*

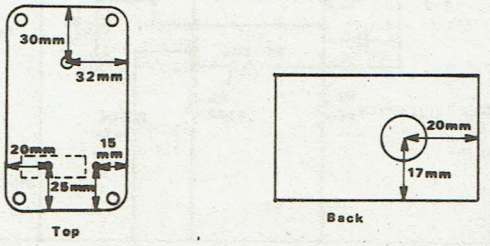


Fig 7 *Showing drilling details of the top and back of the box used. The dotted line on top represents the keytop of the PTT switch*

works. The best combination for SSB seemed to be the two transistor amplifier and a dynamic insert.

Both amplifiers worked very well on FM with the VOGAD set-up giving total freedom to walk around the shack–handy for ATV work. We found the best combination for our FT209 was the electret insert and the transistor amplifier, but it must be said that the dynamic insert gave a very smooth and rounded audio. We were still able to speak some 3 to 4 feet away from the microphone with very good audio reports. For all mode operation a dynamic insert is recommended.

Current consumption for both amplifiers is very low. For the VOGAD design it was about 10mA from a 9 volt supply. The two transistor design drew about 13mA from 13.8 volts but this dropped to only 6mA when running from 8 volts. Battery operation is possible for both circuits and we would advise you to switch the power to the circuit ON and OFF along with the PTT switch.

A desk microphone

We shall now make use of one of the above amplifiers in a desk microphone. As we found that the VOGAD amplifier was not suited for SSB use, we decided to use the transistor version and a dynamic insert. You may wish to use a professional microphone and holder but this decision is left up to the constructor.

A small die-cast metal box was used to hold the goose neck, PTT switches and PCB. First solder a length of screened lead to the insert and feed it down the centre of the goose neck. The dynamic insert used was glued to the goose neck with Evo-Stik impact adhesive, and a piece of self-amalgamating tape was wrapped around the join to secure the bond. Finally, a wind shield was placed over the microphone and this gave the goose neck and mic a professional look.

Figure 6 shows the wiring diagram for the complete unit with the power supply taken from the rig. It is, of course, possible to dispense with the amplifier and use a 600 ohm/50K microphone transformer, and the wiring for this is shown in *Figure 1a.* We used two PTT switches on our unit, the first being a push to make and the second a single pole changeover known as a 'waffle switch'. The push to make was a keyboard switch and was fitted with a keyboard keytop. This gave a very smooth PTT action. If you are unable to power the unit from the rig you will have to use a battery and arrange the PTT switches to switch the power on/off. This may not be possible with the keyboard switch as they are single pole only.

Metalwork

If you were able to build one of the mic amps then the wiring of the unit should be no problem; the hard part is the metal work. *Figure 7* shows the drilling details for the box I used. The bottom two holes are for the PTT switches and the top hole is for the goose neck; the size of these holes will depend on the type of components used. The type of keyboard switch I used is designed to be pushed into place from the top, but this made the PTT keytop stand up too much, so what we did was to stick the switch in with Evo-Stik impact adhesive from the underside of the lid. The hole on the back of the box is to take a 4 pin mic socket. This takes the audio and PTT lines out and power in if available. You may wish to use a multi-pin socket and then it is possible to incorporate any scanning feature your rig may have, onto the desk microphone. You will, of course, have to add extra switches for this feature.

Conclusion

Without doubt both amplifiers worked very well and if you only wish to use FM then the electret insert should be first choice. For all mode operation we preferred the dynamic insert which produced a much rounder sound on SSB. Audio reports on both types of mic were complimentary. The total cost for the desk mic was less than £20 and this is a considerable saving when compared with a commercial unit which could cost as much as £80. Most people should be able to construct this type of unit and it should make an excellent and worthwhile first project.

COMPONENTS LIST

VOGAD Amplifier

Resistors 1/4 watt 5%
R1 – 22k
R2 – 1M
R3 – 560R
R4 – 1k
R5 – 2k2

VR1 – 1k min horz

Capacitors
C1 – 0.01μF disc
C2 – 2μ2 16 volt min elec
C3 – 1μF 16 volt min elec
C4 – 22μF 16 volt min elec
C5 – 0.01μF disc
C6 – 4n7, see text
C7 – 2μ2 16 volt min elec
C8 – 0.01μF disc
C9 – 0.01μF disc
C10 – 0.01μF disc
C11 – 100μF 16 volt min elec

Semiconductors
IC1 – 6270 VOGAD amp — RS302-132 or Cirkit 61-06270
ZD1 – 9V1 400mW, see text
D1 – 1N40001

Miscellaneous
8 pin IC holder
Electric insert — Maplin QY62S

Components List Transistor Amplifier

Resistors 1/4 watt 5%
R1 – 3k7
R2 – 1k8
R3 – 120k
R4 – 120k
R5 – 470R
R6 – 560k, see text
R7 – 2k2
R8 – 2k2
R9 – 820R
R10 – 1k

VR1 – 100k

Capacitors
C1 – 1nF
C2 – 2μ2 16 volt min elec
C3 – 1nF
C4 – 47μF 16 volt min elec
C5 – 2μ2 16 volt min elec
C6 – 1nF
C7 – 2μ2 16 volt min elec
C8 – 1nF
C9 – 1nF
C10 – 1nF
C11 – 100μF 16 volt min elec
Cx – see text

Semiconductors
Tr1/2 – BC108 or equivalent
D1 – 1N4001
ZD1 – 3V6 400mW

Miscellaneous
Electric insert — Maplin QY62S
Dynamic insert — Maplin FK44X

Components List Desk Microphone

Die-cast box 120mm × 65mm × 40mm — Maplin LH71N
Gooseneck 8in — Maplin YW72P
Microphone windshield — Maplin LB35Q

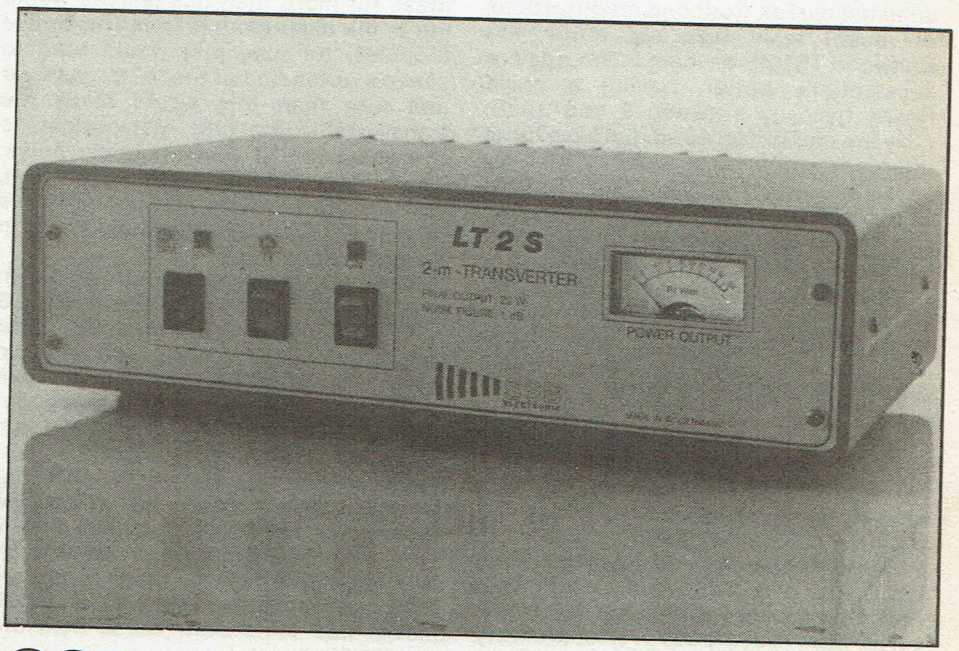
PTT switch single pole changeover
PTT keyboard switch — Maplin FF61R
Keyboard switch keytop — Maplin FF63T

Mic socket to suit
Screen lead etc

Optional

Microphone transformer
Type-1 600 ohm – 20k — Maplin FD23A
Type-2 600 ohm – 50k — Maplin LR06G

ANGUS McKENZIE TESTS



SSB PRODUCTS LT2S

28/144MHz transverter

In the October 1985 issue of *Amateur Radio* I gave one of the best product reviews that I have ever given to the muTek TVVF144E transverter. Virtually every product that muTek made was technically a winner, so it was extremely tragic that Chris Bartram decided to cease manufacture of all his major items in the summer of 1986. His 50 and 144MHz transverters are now changing hands at above their original normal selling price and I suggest that Chris marketed these products at a price far below their real worth.

Perhaps if they had been around £350 ($550), amateurs the world over would have believed more readily how good the products actually were and there would have been more, rather than fewer, sales. This may appear strange to some readers, but this type of situation has occurred many times before in marketing.

I did not think that I was going to find too easily a new transverter to replace the now unavailable muTek, but let me say straight away that this SSB Products model does come up to, and even surpasses, the muTek in several areas.

Facilities

The styling is very similar to that of the LT23 1296MHz transverter that I reviewed quite a time ago. On the front panel there are rocker switches for 13V dc on/off, simplex/duplex and Tx/Rx override. Indicators light up to remind you of the mode of operation at any particular time. There is an RF output meter, scaled every 2W from 0 to 20W. On the back of the transverter are two huge heatsinks and the interface sockets.

As supplied, the LT2S has an N socket for the 144MHz antenna connection, with another N socket, normally spare, if you wish to change the system so that there could be an independent Rx input socket, thus omitting the changeover relay. You would use this configuration if you wanted to place a large linear in the Tx output line, having a coaxial changeover antenna relay on its output for minimum Rx signal loss.

Separate BNC sockets are provided for 28MHz input drive and Rx output feed, this configuration being ideal for use with most transceivers such as the Trio/Kenwood TS940S, or Icom IC751A. A phono socket is provided for the PTT line. The dc power input has to be connected to black and red terminal banana sockets. I personally find the interfacing much easier to deal with than usual and it should be far simpler to adapt the system to various forms of interfacing in a hurry, eg for contest use.

In between the 28MHz BNC sockets there is a hole behind which is the 28MHz Tx drive preset gain control. This allows a very wide range of RF drive levels to be accommodated, although full Tx output of 20W nominal could not quite be obtained without being extremely near to clipping if used with some recent Icom rigs with low transverter drive level capability. Kenwood rigs, however, can supply ample drive level.

Transverter philosophy

Since I have not reviewed any stand-alone transverters for two years or more, I felt that it might be useful to outline the basic differences between HF transceivers with totally separate transverters as against integrated 144MHz rigs. If you are an 'A' licensee, then you will want an HF transceiver and a rig for, say, 144MHz. If you buy a transverter, the maximum you need pay is £400, but there are of course cheaper models than the one under review.

However, if you want a separate dedicated 144MHz rig with a similar output capability to the transverter reviewed here, then you would have to consider rigs such as the Kenwood TS711E or Icom IC275. Both these rigs cost in the region of £1000 and in several ways their performance is poorer than you would get using a first class HF transceiver with the LT2S.

As I will show later, the LT2S is so good that its performance depends almost entirely on the quality of HF transceiver used with it. All the facilities available for use in the band 28 to 30MHz on the main rig will immediately become available on the band 144 to 146MHz. The process is to mix a low power 28MHz output (between a few hundred microwatts up to 500mW) with the local oscillator frequency of 116MHz within the transverter. The sum frequency on the 144MHz band is amplified up to the VHF PA, and thence to the antenna. The frequency on the 2m band is always either 116MHz above the dialled frequency on the 28MHz band, or 600kHz below that frequency if the duplex position is chosen.

In the latter case, the local oscillator crystal controlled frequency in the transverter is of course different, at 115.4MHz. When the main rig is switched to Rx, the transverter also changes to the Rx mode and frequencies in the band 144 to 146MHz are converted down to 28 to 30MHz, which thus allows them to be tuned in on a normal HF receiver. Since the 116MHz local oscillator is an extremely stable one, also having very low noise, the drift and reciprocal mixing noise characteristics are virtually dependent on the quality of the main transceiver.

The better quality HF transceivers normally have far more facilities available than are fitted to 144MHz rigs. Most HF transceivers have various switchable filters, or even variable selectivity. Most of them now have multimode capability and many interfacing possibilities are provided for. An HF transceiver's synthesizer should normally be much quieter than a VHF one and so the combined

reciprocal mixing noise should be better.

Whilst average 144MHz black boxes have sensitivities in the range 0.14 to 0.2μV (EMF/2) on SSB, only perfectly adjusted muTek front end modifications of recent Icom rigs and either the Kenwood TS751E or Icom IC275 rigs are substantially better, having a noise figure typically between 2 and 3.5dB. Only the muTek front end rigs have input intercept points near 0dBm. The very best transverters all have noise figures of around 2dB or better and the muTek and SSB Products models both have RF intercept points better than 0dBm.

The transmit two-tone intermodulation performance of even the best modern black boxes is not good enough for use with the best valve linears on today's crowded bands and I suggest that only a class A solid-state output stage is good enough, if the output is going to be amplified up to the legal limit and then let loose on the band from a large antenna array at the top of a high hill during a 144MHz contest.

You can thus see that I am favouring the choice of a transverter, if you want first class results and if the HF transceiver used with the transverter is of very high calibre. This latter point is extremely important, for whilst the HF transceiver does not have to be sensitive, as the front end gain is in the transverter, its dynamic range capability has to be enormous. The system may have to receive as well as possible a signal entering the transverter at only 0.03μV and give R5 copy on it, whilst coping with a signal as high as 3mV perhaps only 10kHz off channel. The difference between these signals is 100dB; try coping with this on an FT290, let alone a Belcom Liner 2!

Even with a superb front end, you still have to consider the skirt selectivity at the intermediate frequency, and whilst most HF transceivers are good enough, some VHF models, eg the Icom 271 range, have filters that open out badly below −60dB. The HF transceiver should have an attenuator in the front end so that the system intercept point, including that of the transverter, is limited by the transverter's front end only, without the attenuation being too much for the system noise figure to be affected.

Around 20dB gain in the transverter is ideal, for more than this (as you would get in the older models from Microwave Modules, for example) would tend to cause overloading of the HF transceiver and less than this would allow the transverter's Rx gain completely to overcome the HF input receiver noise. The LT2S has around 24dB overall gain, but this can be easily attenuated as the receive 28MHz output is separate from the drive line.

Ideal HF transceivers for use with transverters are the Kenwood TS930S and 940S models, which have 10dB attenuation steps up to −30dB, and the Icom transceivers, on which you can switch the front end pre-amp in and out and put in 20dB additional attenuation if you need it. Many other rigs have just 20dB antenna attenuators and this may be too much attenuation, unless the transverter has itself much too high a gain. Almost inevitably, a transverter with excessive gain will also have a very poor intercept point and one old British model was some 24dB worse than the one under review.

As most black boxes are a lot less sensitive than the LT2S, you would probably need an external pre-amp with them, preferably at masthead, to obtain a satisfactory system sensitivity. Combined with such a pre-amp, the average rig will not have an acceptable dynamic range, especially for contest working. Only two or three black boxes are good enough for reasonably good DX working under contest conditions, but the LT2S transverter will outperform almost everything when used with quite a wide range of suitable HF transceivers. Once you are used to the concept of interfacing the transceiver with a transverter, you will realise that you are better off.

There is no ALC

When I reviewed the various muTek transverters, I strongly praised the inclusion of not only an internal ALC loop but, more importantly, an external ALC feed which could interface with an ALC input on an HF transceiver. An input preset pot was provided for setting the maximum ALC voltage and up to −8V dc was available.

This meant that it was virtually impossible to overdrive the transverter and that the transverter itself fed back a voltage to the HF transceiver, which would stop the latter from clipping at its 28MHz output drive socket or pin. This allowed the exciter to peak at several dB below clipping and thus provide an extremely clean RF signal at all times. This is particularly important in contest operation, so someone with a voice like a foghorn would not cause severe overload!

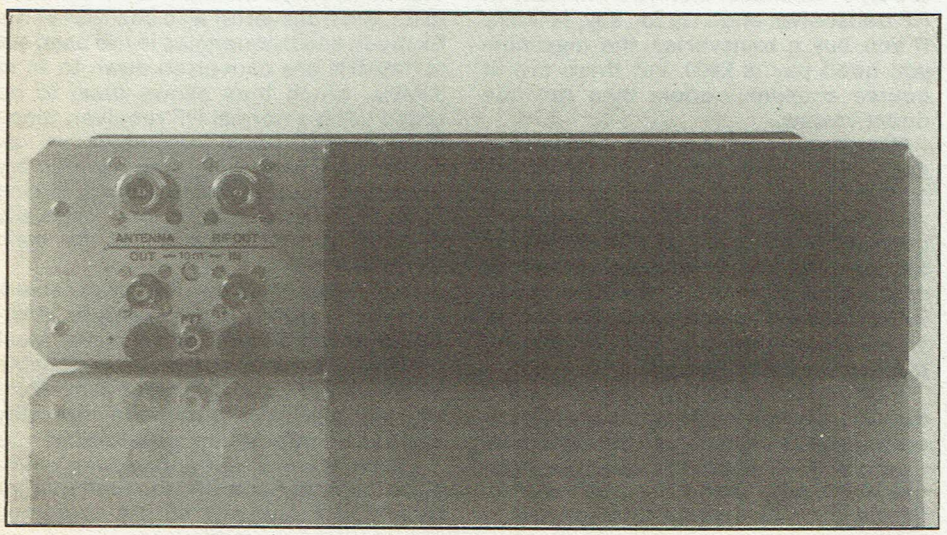
Alas – the LT2S has no ALC feedback to the exciter, although there is a drive pot for setting the input RF drive gain. This will mean that the transverter can be very easily overdriven and that you have to be extremely careful to avoid clipping the output drive of the main exciter. There is barely enough gain for the transverter to work with many Icom and Yaesu rigs, and Kenwood rigs are far more satisfactory for use with the LT2S as they have a much higher output drive level potential.

Drive levels up to 500mW can be accommodated by backing off the drive level control, so earlier Yaesu rigs such as the FT101 series can be perfectly compatible. The problem with fitting an ALC drive circuit is that a negative voltage has to be obtained from equipment that normally only requires an earth and a +13V connection. In the muTek transverter, Bartram designed a neat little oscillator which, when rectified, gave positive and negative volts, which were then used to drive an amplifier from which was derived a negative going ALC voltage. It is a great pity that SSB Products have not included such a circuit in their transverter and this is, in my opinion, a serious omission.

Getting round the ALC problem

Purchasers of this magnificent transverter can get round the problem of the lack of ALC in one of at least three ways. The first way is to use the main exciter, with modifications if necessary, in such a way that the RF drive is already subject to ALC. One or two rigs are very suitable here, for the TS820S and 830S are both supplied with a PA screen disable switch, which cuts off PA current whilst leaving the heaters on. The switch disconnects the screens from their HT supply and puts them down to earth. This was specifically engineered to allow ALC to be present even when the PA is disabled.

The TS530 can be modified to have the same facility. It would not be difficult to modify other rigs with valve PAs to provide the same facility, but the problem comes with solid-state PA rigs. If no external ALC voltage can be derived, then you will have to consider sinking the main PA RF output into a large dummy load and also you should alter the internal ALC preset or user



drive control, so that the ALC threshold occurs at only a fraction of the full normal rig output.

This is a rather nasty way of coping with the problem, but even so, the drive at least will be subject to ALC, so the 144MHz output should be cleaner and thus there would be much less chance of disqualification in a contest!

The second way of coping with the problem is to rectify a sniff of the output RF in a voltage doubler circuit and pass this back as negative going ALC. This is a rather crude technique and you will have to be careful that you do not degrade the intermodulation performance of the transverter PA.

The third way of getting round the problem is to derive an ALC voltage from the linear and, as there is so much more RF level to play with, the loading effect of a sniffer and rectify circuit will be far less marked on the output RF. If this technique is used, the setting up of the entire system becomes quite critical and much care will have to be taken. If you are using a large valve linear PA, you should be careful to tune up and load before you start applying ALC feedback. If you do not tune and load first, you may become confused between poor matching and ALC action when you note that the RF output level is dropping.

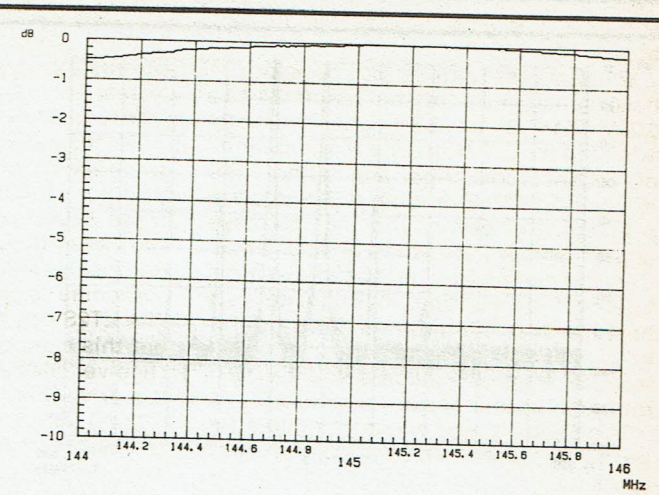
It is far better to derive ALC from a valve PA by monitoring the grid circuits, for in this way the entire equipment can be set up so that it would be impossible for it to go into substantial grid current. However, it is not quite so easy to control the maximum output to be at a much lower level.

Blowing it up

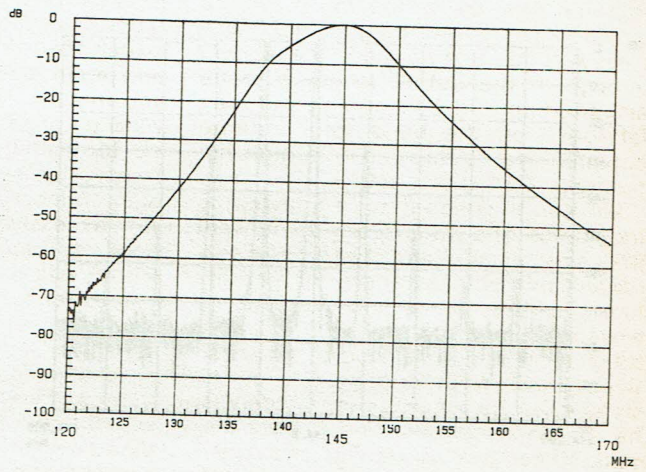
Chris Bartram told me that several purchasers of his transverters sent them back as faulty on more than one occasion and a brief examination showed incredibly charred or demolished components and circuitry, especially in the Rx 28MHz output section. It did not take Chris very long to realise that certain purchasers had not read the instruction book properly and were, in fact, transmitting up to 100W of RF into the transverter's 28MHz output socket, at the same time as applying a low drive level to the normal RF drive socket.

Sad letters would state that the transverter worked so well initially on Rx, but seemed to go dead after a brief spell of Tx! I am dead serious about this and so is many a transverter! The reason is quite simple – the amateurs concerned had forgotten to disable the PA on the exciter. They should have either applied 8V to a pin on the accessory socket (Icom rigs require this), or altered the connections on some Yaesu rigs to stop dc getting through to the PA section. As if this wasn't bad enough, these amateurs also connected the Rx 28MHz output to the main SO239 on the rig, even when there was an independent Rx input which would normally be jumpered to the Rx out socket from the HF relay.

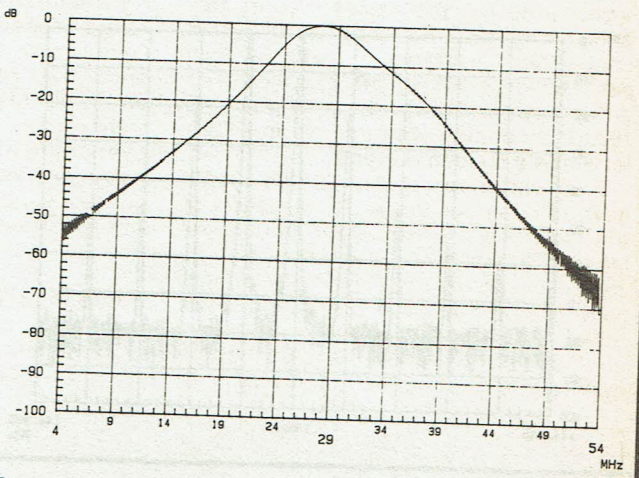
The moral of this is that you should



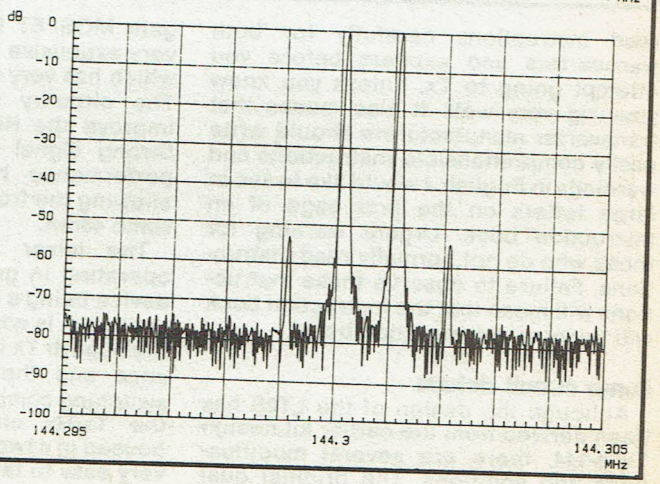
Plot 1
SSB Products LT2S Rx response 144MHz to 146MHz



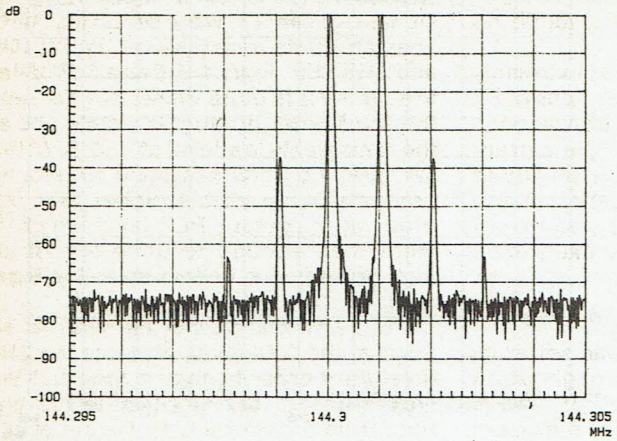
Plot 2
SSB Products LT2S Rx response. Input to output showing filtering



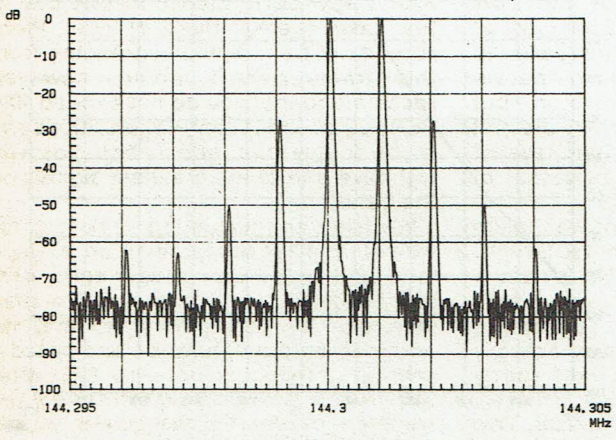
Plot 3
SSB Products LT25S Tx overall frequency response. Input to output ref input F



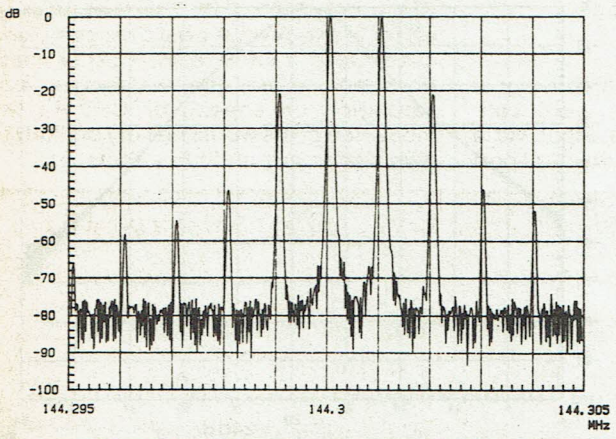
Plot 4
SSB Products LT2S Tx two-tone test. 1W PEP



Plot 5
SSB Products LT2S Tx two-tone test. 5W PEP



Plot 6
SSB Pruducts LT2S Tx two-tone test. 10W PEP



Plot 7
SSB Products LT2S Tx two-tone test 21W PEP, 3dB compression

read instructions carefully for both transverters and exciters before you attempt going to Tx, unless you know your rig very well. It also means that transverter manufacturers should write easily comprehensible instructions and warnings in English. I would like to see in large letters on the first page of an instruction book 'Urgent warning for those who do not normally read instructions. Failure to observe these instructions will mean that the instruction book will become a destruction book'.

Some circuit details

Although the design of the LT2S has been derived from the earlier kit design TV28-144, there are several modifications and additions. The original dual gate MOSFET has been changed to a very expensive GaAsFET type MGF1302, which has very low noise and high gain. The circuitry has been modified to improve the RF input intercept point. Strong signal and transient handling performance has been improved by allowing the front end GaAsFET to draw some 45mA.

The mixer post amp is a P8002 operating in grounded gate mode, the device being a power FET. A PA working in class A is added to the design to give the superb Tx intermodulation performance and the entire transverter has switching components added to operate the Tx/Rx changeover. The unit is housed in a two-tone green case and it is very easy to take the top lid off.

Subjective tests

I interfaced the LT2S directly with my TS940S and found that there was plenty of system gain to drive the transverter to full output. I had to use the processor in and out controls, in order to get automatic self-limiting of the RF drive; this is yet another way of getting over the absence of ALC from the transverter. Stations told me that the transmissions were extremely clean and at least as good as my normal signal from the muTek.

The transverter was capable of driving my Dressler 4CX3-50 A linear with stacks to spare; thus even with the linear on, the transmitted RF was exceptionally clean. The only problem was that I could not use drive without processing, for otherwise I could easily have gone over the top. I did very carefully transmit some unprocessed RF with gains wound down, and I was told that the quality was superb.

There was no trace of any pulling of the transmitted frequency, either on SSB or on CW. The rig could give full output on FM without trouble for quite long overs.

The receiver seemed virtually identical in performance to that of the muTek, using the TS940S as the IF. The LT2S's internal crystal oscillator was extremely stable, drifting only a few tens of Hz from switch on to the final stable end frequency.

I could not hear any intermodulation products from signals outside the band anywhere within it, even when turning the antenna to almost every possible direction, and I did not note any spurii anywhere. I usually found that I used 10dB attenuation in the TS940S, so the overall transverter gain was just slightly too high.

However, I think I did get a very slight improvement in system noise when I took out the attenuation, when I was picking up extremely weak DX very late at night. It was obvious that the system sensitivity was quite exceptionally good and that I did not require any masthead pre-amp at all. Switching in my muTek masthead (1dB noise figure) made no audible signal to noise improvement on even the weakest signals, but just increased the system background noise and signal levels simultaneously.

Simple to interface

The LT2S was extremely simple to interface and was very reliable in operation. In particular, I very much liked the N type sockets at 144MHz and the BNC sockets for the 28MHz inputs and outputs are far better than various alternatives. The little power meter on the front panel was much better than a row of LEDs and it was very useful to be able to switch the transverter to Tx with the front panel switch, thus overriding the PTT socket. The simplex/duplex switch allows one to access repeaters even if the main HF transceiver only has one VFO, provided of course that it includes FM mode. You may, however, have to learn to whistle 1750Hz fairly accurately.

Laboratory tests

It was very obvious from the subjective tests that this transverter has an amazingly good sensitivity. As noise figure measurements in the region of 1dB are exceptionally difficult to carry out accurately, I felt it better to actually measure the sensitivity on SSB and on FM with the LT2S connected into my Kenwood TS940S. The SSB 12dB sinad sensitivity was incredible, just 0.07μV (EMF/2) being required on the input, the FM 12dB sinad being 0.1μV – again amazingly good.

Calculations based upon the known noise bandwidth of the 940S and losses in the leads etc, come out with an estimated noise figure of 1dB or better and this becomes by far the finest transverter or rig front end that I have yet measured on 144MHz.

The first attempt to measure the input intercept point gave a figure of +1dBm based on the 60dB intermodulation ratio point. This was rather a long way below the manufacturer's specification of +6dBm and so Fiona (my wife) and I took measurements at various other ratios, these giving input intercept points between +3 and +4dBm, the best figure being noted from the calculations taken from the 46dB ratio point. Great care was taken to ensure that the test signals were very clean. The overall result represents yet again the best 144MHz figure that I have checked on any transverter or rig.

The average input to output gain was 24dB and *Plot 1* shows that the gain is very uniform across the band from 144 to 146MHz. Please note that the vertical scaling is 1dB per division, rather than my usual 10dB, in order to show the remarkably flat curve properly.

Plot 2 shows the input to output response over a much wider band from 120 to 170MHz. Although the skirts are quite steep, the bandpass characteristic is a little wider than ideal, but you should not have any problems at all with it, unless you are almost next door to a very powerful transmitter up to ±5MHz of the 144MHz band.

Breakthrough of 144MHz to the output, or of the IF frequency through the transverter, is at a very low level, averaging about –64dB at both frequencies checked. Since the transverter has 24dB gain, the breakthrough levels would actually be around 88dB below equivalent levels actually on the band.

The image response from signals in the 86 to 88MHz band was some 89dB below the main channel and we had to spend a very considerable time delving down into noise in order to get this figure out of the machinery! It involved much video filtering, extremely narrow bandwidths and video averaging in order to see a clear pimple in the grass at the bottom of the screen. 116MHz local oscillator breakthrough on the 28MHz output was at the very low level of 2mV EMF/2 and this is not likely to cause any problems to HF transceivers.

The second harmonic of the local oscillator was at a much lower level still and thus insignificant. We had a thorough look for other spurious products including those relating to harmonics of the local oscillator ± IF and found no measurable products.

The local oscillator was extremely stable, for it only drifted a few tens of Hz in the first hour. The typical transversion frequency error was 120Hz. The current drawn from the power supply was quite low at 230mA on Rx. The local oscillator, incidentally, was extremely clean and I suggest cleaner than any rig likely to be used with the transverter.

Transmitting section

The input drive control was set at its maximum gain position throughout all the tests. An input level of 300μW (–5dBm) was required to give maximum output on a single tone, but this output was just 16.5W instead of the 20W claimed, 13V dc being used for most of the tests. At 14V, the output increased to around 18W. At this maximum output we noted around 3dB compression, but sending in another 5dB (1mW) did not give any more output. Note that a level of 10μW (–20dBm) produced an output of 1W.

A frequency response plot was taken with the input sweeping from 4 to 54MHz, from which you will see in *Plot 3* that the overall response showed very rapid falloff either side of the main bandpass. However, maximum gain was actually just below the bottom of the band and by the top of the band (30MHz or 146MHz), the gain had fallen by around 2dB. This gain drop is slightly annoying, especially because of the lack of ALC.

Two-tone tests

We then set up two 2019 Marconi signal generators whose outputs were connected to the 28MHz drive input via a hybrid transformer having excellent port isolation. As usual, everything possible was locked to the 60kHz Rugby transmissions. Two carriers were set up just 1kHz apart and plots were taken at 1W, 5W, 10W and 21W PEP, *Plots 4, 5, 6* and *7. Plot 4* at the 1W level is quite incredible, for only the third order product is visible and at the remarkably low level of –54dB. At the 5W level the LT2S was again superb, no products being visible higher than 5th order at an output PEP level which is more than enough to drive almost all high power valve linears up to the legal limit.

The performance can be seen to be good at the 10W level, whilst at the 21W level third order becomes poor, but the higher orders again fall quite rapidly. Poor third order products are not of any real concern, but often they go along with a poor performance further out. In this case, even at the 21W level, there should not be too much spreading from this transverter. I would, however, recommend that you do not exceed 10W PEP output under contest conditions and if you follow this recommendation you will have one of the cleanest signals on the band.

We tried an interesting soak test, for we set up a 1W output level on a single tone and noted only a very small drift indeed over a few minutes. We then increased the drive level so that we obtained output saturation and noted a change of frequency of only 11Hz after several minutes. Holding the drive level, we then decreased the power supply voltage by 1V and after quite a while noted only 30Hz drift. This was all in an effort to check what would happen if one used rather thin wire for PSU connections and drove the transverter into saturation on speech or CW. All the measured drifts would be very unlikely to give rise to any audible effects.

Laboratory Measurements on LT2S Transverter

Rx noise figure	approx 1dB
RF input intercept point from 60dB IM ratio	+1dBm
RF input intercept point from 45dB IM ratio	+4dBm
RF input intercept point from 32dB IM ratio	+3dBm
Typical Rx overall gain	24dB
Rx conversion frequency error when cool	120Hz
Image ratio	89dB
Local oscillator frequencies 116 or 115.4MHz – switchable on Tx	
Rx standing current	230mA
28MHz drive requirement for full Tx output	–5 to +27dBm
Max single tone output from 13V dc supply	16.5W, 18W from 14V dc
Maximum two tone output	approx 21W PEP
Tx standing current	2.8A
Maximum Tx current	3.8A

The Tx standing current was very high at 2.8A, quite clearly because of the PA running in class A, and this rose to 3.8A at saturation. You would thus need a power supply capable of giving a very healthy clean 4A virtually continuously for operating this transverter.

Spurii and harmonics?

We checked the second harmonic output when the rig was giving a full output and noted with surprise that the harmonic was as low as −75dBc, which is excellent. We did not note any third harmonic. 116MHz breakthrough on the output was some 68dB below full output and is therefore insignificant. The image response on the output between 86 and 88MHz could not be detected and was thus below −80dB, which is excellent. No other spurii could be detected, until we tried the nasty one – 5th harmonic of the drive frequency with output on the 144MHz band.

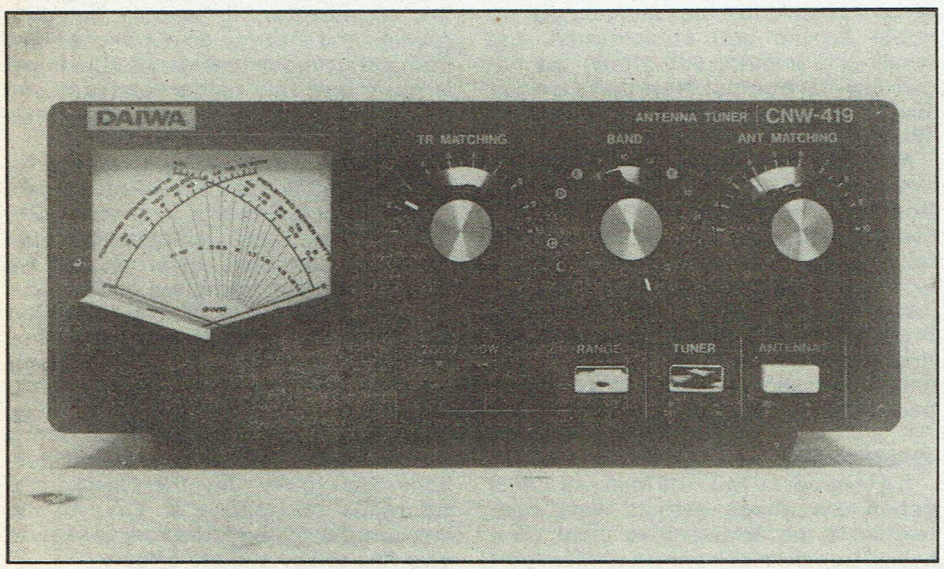
This cruel test gave the very low breakthrough figure of −70dB when the transverter was driven fully. This again is an excellent result.

Conclusions

What a very remarkable 144MHz transverter this is, for I cannot remember many products that I have been equally enthusiastic about. This has to be the finest available transverter for the band and also, when used properly, is clearly going to produce the cleanest signal available from any commercial rig or system on 144MHz. The measurements clearly demonstrate how much better a transverter can be than a dedicated 144MHz rig and both the transmit and receive performances clearly outclass even £1000 Japanese black boxes. How much better the Kenwood TS711 and Icom IC275 could be if their PAs could be worked in class A!

The LT2S thus receives my highest possible recommendation, although it is expensive at around £400, unfortunately a lot more than the under-priced muTek and the Microwave Modules model. The rig is so easy to use and is extremely well constructed, but no instruction book was supplied, although Dave Aram of Piper Communications, SSB Products' UK agents, kindly supplied circuits and much information which was most helpful.

Very many thanks to Fiona for the hours of help required to take all the measurements, representing many days work!



DAIWA CNW-419

HF ATU with power meter

Daiwa's crossed double needle metering system is by now well-known, and allows the simultaneous reading of forward power, reverse power and SWR, the last being read below the intersection of the two needles.

The Daiwa CNW-419 ATU and power meter covers all frequencies from 1.8 to 32MHz. On the front panel are the knobs controlling the two variable capacitors and the switched inductance. A row of three push-buttons selects tuner in or bypass, 20W or 200W forward (4/40W reflected) and antenna 1 or 2. On the back panel is an SO239 socket for connection to the transceiver and two additional SO239s for antennas 1 and 2, the former also having by its side a large screw terminal for the connection of a long wire antenna. There is also a wing nut grounding terminal.

The unit is very robustly made, measuring 225mm W × 90mm H × 245mm D, and weighs 3.1kg. It has four fairly large rubber feet, but no bail stand. There are two LEDs mounted on the front panel which light up when more than half power is transmitted on the 20 or 200W range.

The ATU's matching circuitry is a T network with series capacitor tuning for the input and output of the T, whilst an inductance with 17 tapping points on it is connected from the centre of the T to ground.

I tried out the ATU on various antennas and into a high power dummy load, using the TS940S as the exciter. A Bird 'Thruline' wattmeter type 4410 was used with its various power ranges for measuring SWR and power loss, as well as the Marconi spectrum analyser type 2382, which was used for plotting SWR and through responses using the internal tracking generator.

We had a look at the power loss when the tuner was switched in and very carefully matched, and we measured 1dB loss on 1.9MHz, 0.75dB on 3.75MHz, 0.5dB on 7.06MHz and 0.4dB or less on all the higher frequency bands. The power measurement accuracy was checked at the 100W level and was never more than 5W out, which was excellent. When the tuner was switched out of circuit to bypass mode there was virtually no power loss, and no mismatch was noted.

I was at first rather perplexed at some of the lettered positions on the switch selecting the inductance tap, for on the B and C positions, in between the 1.8 and 3.5 taps, I could not get any match on 1.93MHz, although I could on the A position. My Kenwood TS940S was modified some time ago to give general coverage transmit, an extremely simple mod, and this was put in specifically for testing ATUs and similar components in the lab. I found that the B position coped with frequencies from around 2.2MHz up to 3MHz, whilst the C position coped well from 2.5 to just over 3.5MHz. It was thus obvious that the ATU would also be very suitable for marine and other short wave matching, in addition to coping well with all the LF and HF amateur bands.

The two variable capacitors were very smooth to turn and I did not detect any backlash, while the coil switch was also very smooth, clicking into position positively but not requiring too much effort – just about right. The dual needle meter system was a delight to use, and so much more convenient than having two completely separate meters.

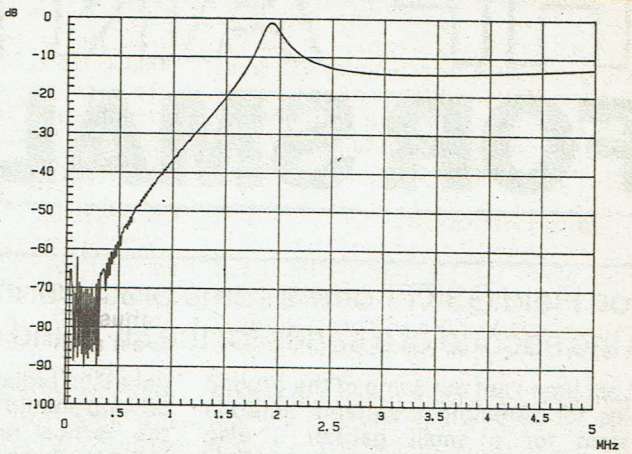
The long wire terminal is not suitable for use with a long wire antenna, having a multiple of half waves as its length, which would require a very high impedance feed. So, Daiwa recommend just over quarter wave long wires for the band in use, which can be accommodated with this ATU very well, as well as normal coax fed antennas or baluns.

We took one plot with the Marconi spectrum analyser of the swept response of the tuner from 0 to 5MHz when the tuner was itself tuned to match 1.93MHz/50 ohms. Note the very steep

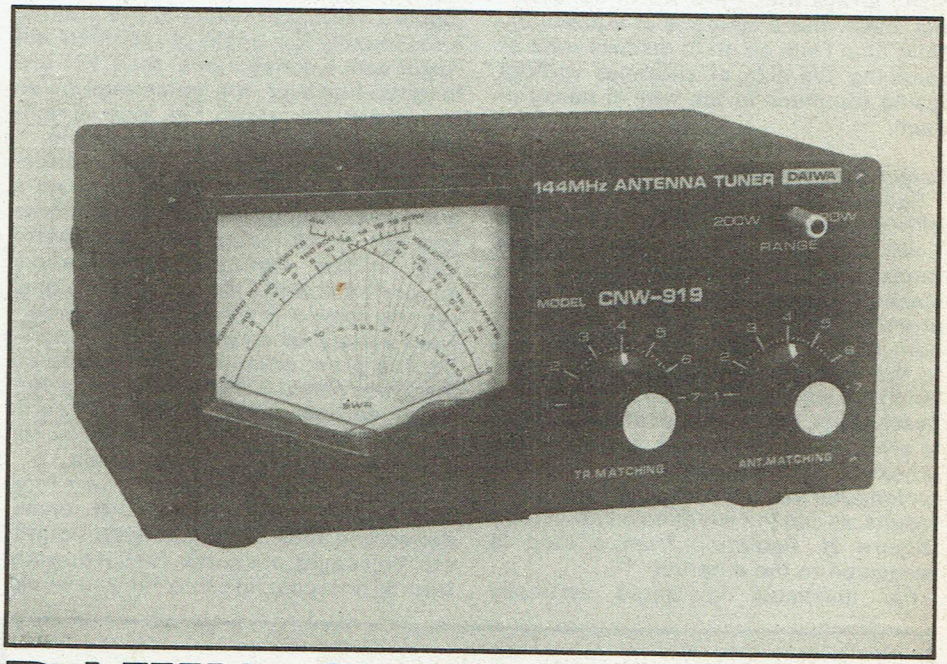
high pass filter action below the bottom of the 1.8MHz band, which is just what is needed with many modern rigs if you want to remove much of the energy from strong local medium wave stations. The 'T' matching circuit, however, does not give any significant low pass filtering action, so it is always a good idea to use a very high quality low pass filter on the transmitter side of the ATU to remove harmonics above 30MHz from the antenna feedline.

Conclusions

This very nice ATU copes with barefoot exciters, with quite a wide range of matching possibilities. It is highly recommended, particularly because of its built-in power meter. The cost is £206 inc VAT.



Daiwa CNW-419 ATU Rx response. Tx tuned 1.93MHz into 50 ohms 1:1. NB: HP filtering



DAIWA CNW-919

VHF antenna tuning unit

There are many occasions when you have set up a 144MHz antenna on its own and have obtained some good SWR readings, but things then go to rack and ruin when other antennas for various bands are positioned in fairly close proximity. This is usually completely unavoidable because of space problems and so it can be useful to have a 144MHz ATU for correcting the SWR, especially when you are using a high power solid-state PA, perhaps delivering 100W to the co-ax.

Smaller unit

The Daiwa CNW-919 is much smaller than the HF band model, but includes a similar dual cross needle power meter, again reading forward and reverse power, with the intersection point calibrated to show SWR. Two knobs on the front panel control input and output variable capacitors, the inductance element being fixed.

The unit is stated to cope with impedances from 15 to 250 ohms on the output, and is intended for matching these to 50 ohms. A power switch on the front panel selects either 20 or 200W forward power ranges, the equivalent reverse power ranges than being 4 and 40W respectively.

On the back panel is a single SO239 socket for interconnection to the transceiver or linear, and two SO239s for feeding separate antennas or a single one and a 50 ohm dummy load. There are two switches on the back panel, one for selecting the required antenna or load and the other one to switch the tuning section in or to the bypass mode. A wing nut on the back is provided for ground connections. The unit measures 165mm W × 75mm H × 97mm D and weighs 1.1kg.

Brief tests

This useful little ATU had an extremely small through loss when carefully set to match into 50 ohms, 0.13dB being noted throughout the band which is an insignificant loss. The frequency response showed a very wide bandpass characteristic with a roll-off above 200MHz or so.

There was some harmonic filtering action, which could be useful if you have a fourth or fifth harmonic problem in your area. You will need to tune up very rapidly to avoid damaging the PA, and this should always be done with the lowest power possible. If you are using an extra amplifier, then I would normally recommend you to switch the transceiver to low power, with the linear on, and use the 20W position to get the SWR down. Then high power can be used for quickly touching up for optimum results. The use of an ATU such as this could actually improve the quality of SSB transmissions from your station if your amplifier is affected by mismatches. It is useful also to have the power meter, which can show you immediately if anything has gone wrong with the system.

A very solidly built unit, which can be safely recommended, provided you really do need a 144MHz ATU as well as a very good power meter. Unfortunately, SO239s are used rather than N type sockets, but perhaps I am being pedantic again! The cost is £147 inc VAT.

Many thanks to Lowe Electronics for the loan of both the Daiwa meters.

NEXT MONTH

Angus McKenzie G3OSS reviews the new Icom IC900 multiband mobile FM transceiver

HF ANTENNAS FOR SMALL GARDENS

Don Field G3XTT offers some practical information on antenna design and construction in the second of a series for the HF band operator whose aerial space is at a premium

Last time I set out some of the ground rules for selecting a suitable antenna system for a small garden. I also discussed dipoles and wire beams. This time I want to turn to some other full-sized arrays which are worth considering, even where space is at a premium. Next time I will go on to discuss ways of reducing the size of antennas without losing too much in the way of performance.

Loops and quads

Full-wave loops can be extremely effective antennas, offering up to about 1.4dB of gain over a dipole. In simple terms they can be considered as two stacked dipoles, but with some compromise in gain due to the ends being bent. Gain is more or less in relationship to the area enclosed by the wire. This being the case, a circular loop would give best results, but would be rather difficult to erect (to say the least!). A square loop is next best but, where height is limited, a rectangular loop *(Figure 1)* can give good results, as can the well-known delta loop *(Figure 2)*. Radiation from a loop is broadside to the antenna.

For maximum low-angle vertically polarised radiation, a square or horizontal loop should be fed half-way up one of the vertical legs, a delta loop in the bottom corner. These rules are not important when the loop is electrically well above ground. In this case, as with a dipole a half wave or more above ground, a reasonably low angle of radiation will result with a conventional feed. For low heights, however, the guidelines given above are important. For loop dimensions, see the table in my last article.

The minimum support height for effective results should be something over a quarter wavelength, say 75ft on 80 metres and 35ft on 40 metres. With a 40 metre loop in the *Figure 2* configuration, supported at 35ft, I have received signal reports some 3 'S' units up on a quarter-wave vertical when working into Australia. The great advantage of the loop on the lower bands is that, unlike a quarter-wave vertical, it requires no earth system. Often it can be concealed by, for example, supporting it from a tree.

The feed impedance of a full-wave loop will be of the order of 100 ohms, depending upon the exact shape, height, etc. You could, of course, feed it directly from 50 ohm coaxial cable, but you would end up with an SWR of 2:1. A better approach is to use a length of 75 ohm cable as an impedance transformer (see *Figure 3*). To calculate the length, work out the free space length of a quarter wave on the frequency of interest (or use the table from last time), and multiply by the velocity factor of the cable (see *Table 1* for typical figures). If, for example, you were using a 40 metre loop and the 75 ohm co-ax had a velocity factor of 0.66, then the length of the transformer section should be 22ft 2in. As always, cut slightly longer than the calculation suggests, and trim for best SWR.

A logical step

The next logical step from a loop is to go to a quad. Adding the reflector gives a very substantial increase in gain, so that a full size two element quad will usually out-perform a tribander and is likely to be on a par with a full size three element monoband yagi. Now I accept that a 20 metre quad is something of a monster, although of course its turning circle is only half that of a yagi, but a 10 metre quad is a different matter altogether. It can be made very cheaply from garden canes, is light and easy to get into the air and, as I said, will out-perform many much more expensive antennas. It is also much easier to homebrew a multiband quad than a multiband yagi. Ideally use separate feeds for each band, though feeding the separate loops via single co-ax (or, better still, 75 ohm twin, see *Figure 4*) will not degrade performance significantly. *Table 2* shows dimensions for a four band quad which can be made very easily from 12ft garden canes (I recently bought some for just 20p each). The dimensions are for a quad in which the reflector is a closed loop slightly larger than the driven element. The alternative, which you will find in some of the handbooks, is to make the reflector the same dimensions as the driven element and then to use a stub which is trimmed for best front-to-back ratio.

Using a 'spider' support for the canes will ensure optimum spacing on all bands, but the spacing of elements in a quad is by no means critical, so almost equally good results will be obtained by constructing the quad with equal spacing on all bands (about 5ft would be suitable for a 15-6 metre quad). The feed impedance of a two element quad will be around 50 ohms, as the presence of the reflector will pull the impedance down

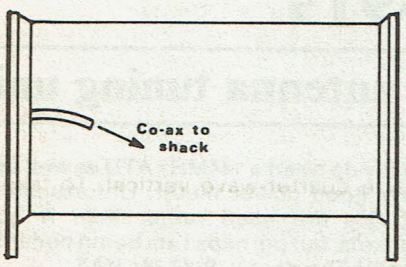


Fig 1 *Rectangular loop*

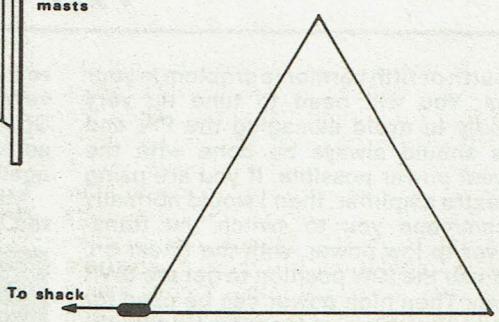


Fig 2 *Delta loop*

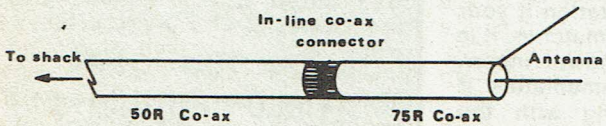


Fig 3 *Impedance transformer*

from the 100 ohms or so of a single loop.

If you do make a quad out of garden cane, try to weatherproof it with varnish or, better still, a wrapping of fibreglass. Mind you, even if you have to build a new antenna each season, this won't break you at £2 a time!

Verticals

Many people who are short of space turn to vertical antennas when they first come to the HF bands. The commercial trapped verticals in particular tend to be especially popular with their promise of multiband performance from a fairly inconspicuous antenna. However, disappointment can set in very quickly when you start to use the antenna.

Quarter-wave verticals can be regarded as one half of a dipole, and an earth system is required to act as a 'mirror' to introduce the other half of the dipole. If the vertical can be mounted well above the ground at, say, roof level, then a fairly efficient system is possible by using at least four resonant radials on each band. For the best match to 50 ohm co-ax these should be angled down slightly rather than being horizontal. Even when mounted well in the clear, don't expect wonders from a vertical antenna. If it is working perfectly efficiently it will, of course, radiate equally in all directions, and will be about 1.4dB down on a dipole's best direction.

Now this statement doesn't take into account the angle of radiation, and verticals inherently produce low angle radiation, which is what you need for DX working. So matters might not be too bad and, again, 1.4dB is barely discernible in practice. What is more of a concern is that most multiband verticals use traps which can be fairly lossy. The pity also is that the use of traps, as with traditional trapped beams or dipoles, means that only a part of the antenna is radiating on the higher bands, so some of that precious hardware is wasted.

Getting around the problem

Some of the better multiband verticals get round these problems. The Butternut verticals, for example, have high quality, low loss coils, but are also designed so that the whole of the antenna is in use on every band. Unfortunately, these antennas are not readily available in the UK.

The other area of concern with vertical antennas is that, when they are ground-mounted, achieving a low-loss earth system is by no means a trivial matter. The radials will come out horizontally from the feed-point, producing a feed impedance of about 30 ohms. If, as can easily be the case, the earth impedance is of the same order, then half your output power will be wasted. Getting the earth impedance down to less than ten ohms requires a very extensive system of radials. Much has been written about how many and how long. To an extent the answer to this will depend upon the conductivity of the soil at your QTH; however, for the lower bands you should be aiming for 20 or more radials, with an average length of 50ft or more. For the higher bands, (20, 15, 10) I wouldn't recommend ground mounting at all if you can possibly avoid it, because the surrounding buildings, trees, etc will seriously affect performance.

You may regard all the above as rather negative, but I wanted to put verticals in perspective compared with other types of antenna. Amateurs turn to them very readily because of their simplicity, without always understanding the compromise they are making. However, there is certainly a positive side. For, say, forty metres, a full-size monoband vertical antenna against a good earth system will give excellent DX results, whereas a dipole would have to be a half-wave high (66ft) before it really started to shine. The effect of earth losses can also be reduced.

One way is to fold the vertical. This will increase its feed impedance by a factor of four (to around 100 ohms), while the earth resistance will remain constant. So, as a proportion of total power, earth losses will be reduced considerably. However, the antenna will be slightly harder to match, though the quarter-wave transformer of *Figure 3* can again be used. A vertical rather longer than a quarter wave will also have a higher feed impedance. However, it will be necessary to tune out the reactance using a series capacitor. The advantage of this approach is that it can be used as the basis for a multiband system (see below), whereas a folded vertical is essentially a monoband antenna.

The inverted-L configuration can be used where there are limitations on the height available. The maximum radiation will, in any case, be from near the feedpoint of the antenna. The horizontal top simply makes up the electrical length to resonance. The alternative would be to use a loading coil (potentially lossy) or a capacity hat (physically more difficult to construct). The top of an inverted-L doesn't even have to be horizontal, but can slope back towards the ground (see *Figure 5*) without a serious effect on performance.

Straightforward maths

Table 3 (based on some reasonably straightforward maths, integrating the current distribution along each leg of the antenna) shows the relative amounts of vertically polarised radiation from different configurations compared with a full size quarter-wave vertical. To take the practical example of, say, an 80 metre antenna 35ft high (0.15 wavelengths), where the far end is only 18ft high (representing an angle of about 45 degrees), you will see that the antenna will be about 67% as efficient as a full size quarter-wave vertical in terms of its vertically-polarised radiation, or in other words less than 2dB down. This approach is very much an approximation, but gives you some idea of the level of compromise involved. Vertical antennas also lend themselves to phasing to achieve both gain and discrimination against unwanted signals. The gain is fairly modest (perhaps 2dB in the case of two verticals), but when carefully phased and with proper attention paid to the power distribution, the front-to-back ratio can

▶ **Table 1**

Velocity factors of typical cables (rough guide only)	
Co-ax (solid dielectric)	0.67
Co-ax(semi-airspaced)	0.86
300 ohm flat twin	0.85

▼ **Table 2**

Dimensions for quad antenna			
Band	Side dimension (Driven element) $L = \frac{250}{f(MHz)}$	Side dimension (Reflector) $L = \frac{258}{f(MHz)}$	Spacing $S = \frac{118}{f(MHz)}$
15	11ft 8in	12ft 3in	5ft 7in
12	10ft 0in	10ft 4in	4ft 9in
10	8ft 8in	9ft 1in	4ft 2in
6	5ft 0in	5ft 2in	2ft 4in

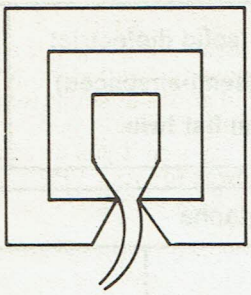


Fig 4 *One way of feeding a multiband quad*

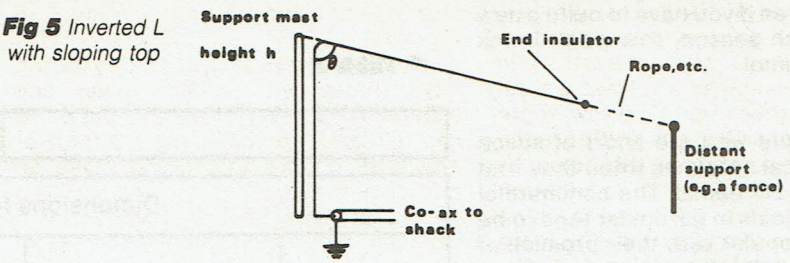


Fig 5 *Inverted L with sloping top*

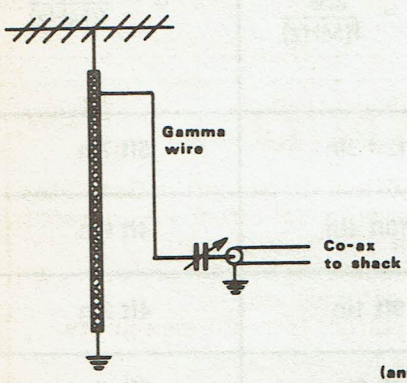


Fig 7 *Wilkinson power divider*

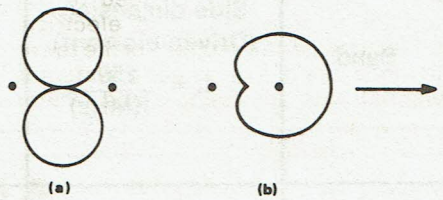


Fig 6 *Radiation patterns of phased verticals*

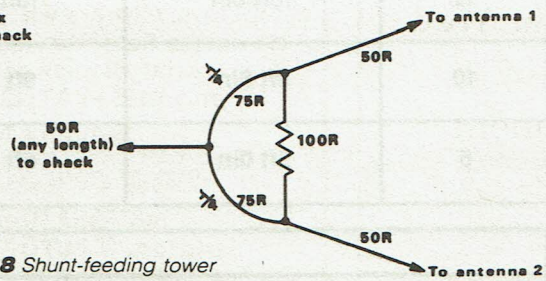


Fig 8 *Shunt-feeding tower*

Comparison of vertically polarised radiation between quarter wave vertical and *Figure 5* inverted-L

Mast height (h)	Efficiency (%) compared with quarter wave			Loss in dB compared with quarter wave vertical		
	θ + 90%	θ = 60%	θ =45%	θ = 90%	θ = 60%	θ = 45%
0.25λ	100%			0		
0.2λ	95	93	92	0.2	0.3	0.3
0.15λ	81	71	67	0.9	1.5	1.7
0.1λ	59	38	30	2.3	4.2	5.2
0.05λ	31	—	—	5.1	—	—

be up to 20dB. When trying to winkle out Caribbean DX on 40 metres in the face of Radio Albania et al this can be extremely valuable.

Up to a point the spacing of phased verticals is unimportant, because the radiation pattern you end up with depends not only on the spacing but also on the phasing of the RF which you put into each vertical. All this is well documented in the various handbooks. However, let's take what is probably the most popular case which is to space two verticals by a quarter wavelength. When they are fed in phase the pattern will be broadside (*Figure 6a*). When they are fed 90 degrees out of phase the pattern is the well-known cardioid pattern (*Figure 6b*).

To feed out of phase by 90 degrees means that the feeder to one vertical must be an electrical (as against a physical) quarter wave longer than the feeder to the other (use *Table 1* again). It is possible to connect these feeders in parallel and run them back to the transmitter; however, this will present an impedance mismatch. It is worth considering some sort of power divider such as the Wilkinson Power Divider (*Figure 7*). There will be a small power loss in the resistors (theoretically zero, but in practice not due to both mismatches and mutual coupling between the antennas), but paying attention to correct power distribution in this way will maximise the performance of the array. The Wilkinson Power Divider was first brought to the attention of the amateur world by W1CF in the April 1976 issue of *QST*.

Finally

Finally, while on the subject of vertical antennas, remember that they do not have to be resonant, but can be fed via a suitable tuning unit. I have in the past obtained very satisfactory results from a 40ft vertical (army surplus, purchased at one of the rallies) fed via a loading coil on 80, via a series capacitor on 40, and via a slightly more complex tuning arrangement on the higher bands. Such an antenna has the advantage over the commercial trapped verticals that the whole antenna is working for you on every band and, of course, that it is nice and cheap.

If you want to be sophisticated, you can build a relay box to switch in the appropriate tuning circuit for the band in use. If, like me, you can't be bothered, then, at worst, it requires a trip out into

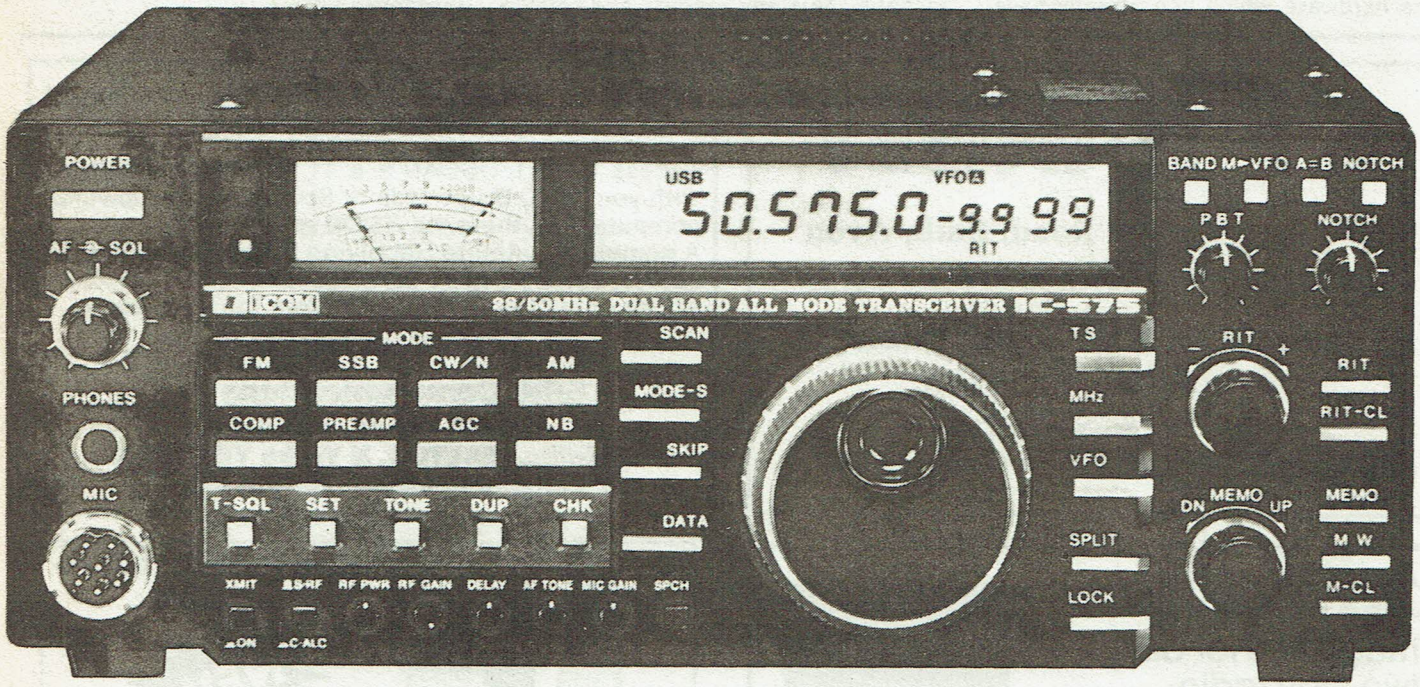
the rain to change bands. As with any vertical, it's the earth system which will make or break its performance at the end of the day. Remember also that a 5/8th wave vertical gives optimum low angle radiation, but once it starts getting much longer than this more of the power is radiated in high angle lobes. So although that 40ft antenna will work well to DX on 80, 40 and 20, on 15 and 10 it will be more suitable for European working.

Another non-resonant vertical radiator you might want to consider is your mast or tower. Shunt feeding a tower can be an excellent way of getting the most out of the hardware which you already have. The basic arrangement is shown in *Figure 8*.

Usually this approach is used by the big boys (those with a 60ft tower and tribander) as a way of getting out on 80 and 160. But if you have, say, a 30ft tower plus VHF beams, this would make an effective radiator for 80 and 40. The beams on top of the mast will act as a capacity hat making the tower look, electrically speaking, somewhat higher than it really is. You will need to pay attention to ensuring good electrical contact between all sections of the tower and, once again, a good earth system is essential. Run any feeders and rotator cables down to ground level before running them away from the tower. I don't propose to dwell at length here on the dos and don'ts of shunt feeding as it really merits an article in its own right. Suffice to say that if you already have a mast or tower for your VHF antennas it might well be worth considering as an approach.

I have covered a lot of ground this time, so much of the material has had to be relatively superficial. However, I hope it has got you thinking. Next time, as I said earlier, we'll turn our attention to ways of squeezing the most out of reduced size antennas.

ICOM Communications



IC-575, 28/50Mhz Dual band multimode base station.

The ICOM IC-575 base station was developed to meet the demand for advanced communications for the recently acquired 6m band. Similar in appearance to the IC-275/475 2m and 70cm base stations, the beauty of this new transceiver from ICOM is that it gives you the best of both worlds, 6 & 10m in one compact unit. The IC-575 covers 28-30Mhz and 50-54Mhz. Operating modes are SSB, CW, AM & FM. Power output is 10 watts (AM 4 watts) with a front panel control to reduce output for QRP operations. A pass band tuning circuit narrows the I.F. passband width, eliminating signal in the passband. A built-in notch filter eliminates beat signals with sharp attenuation characteristics.

Some PLL systems have difficulty meeting the lockup time demands placed on them by new data communications. This is why ICOM developed the DDS (Direct Digital Synthesizer) method. With a lockup time of just 5msec the DDS method allows the IC-575 to handle data communicatons such as packet or AMTOR. 99 programmable memories can store frequency, mode, offset frequency and direction. A total of four scanning functions for easy access to a wide range of frequencies, memory scan, programmed scan, selected mode memory scan and lock out scan. The IC-575 has an internal A.C. power supply, but can also be used on 13.8v DC for mobile or portable operation.

Optional accessories available are the UT36 voice synthesizer, the IC-FL83 CW narrow filter, SM7 external loudspeaker, HP2 communication headphones and SM8/SM10 desk microphones. Other transceivers available in this range are: IC-275E 2m multimode 25w, IC-275H 2m multimode 100w, IC-475E 70cm multimode 25w, IC-475H 70cm multimode 75w.

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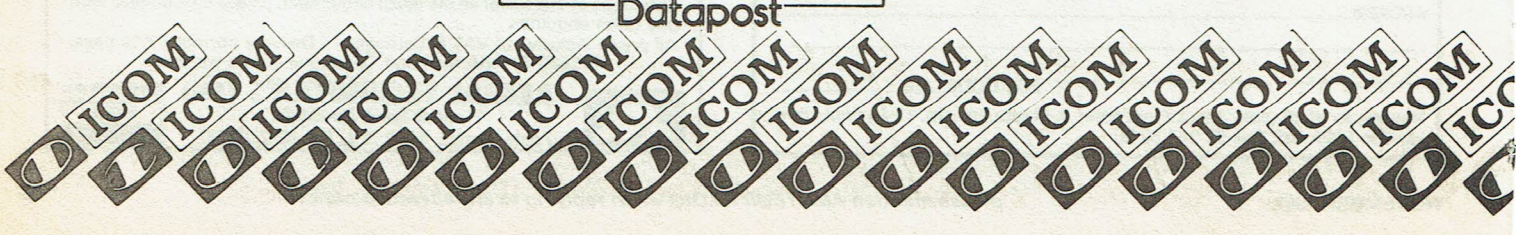
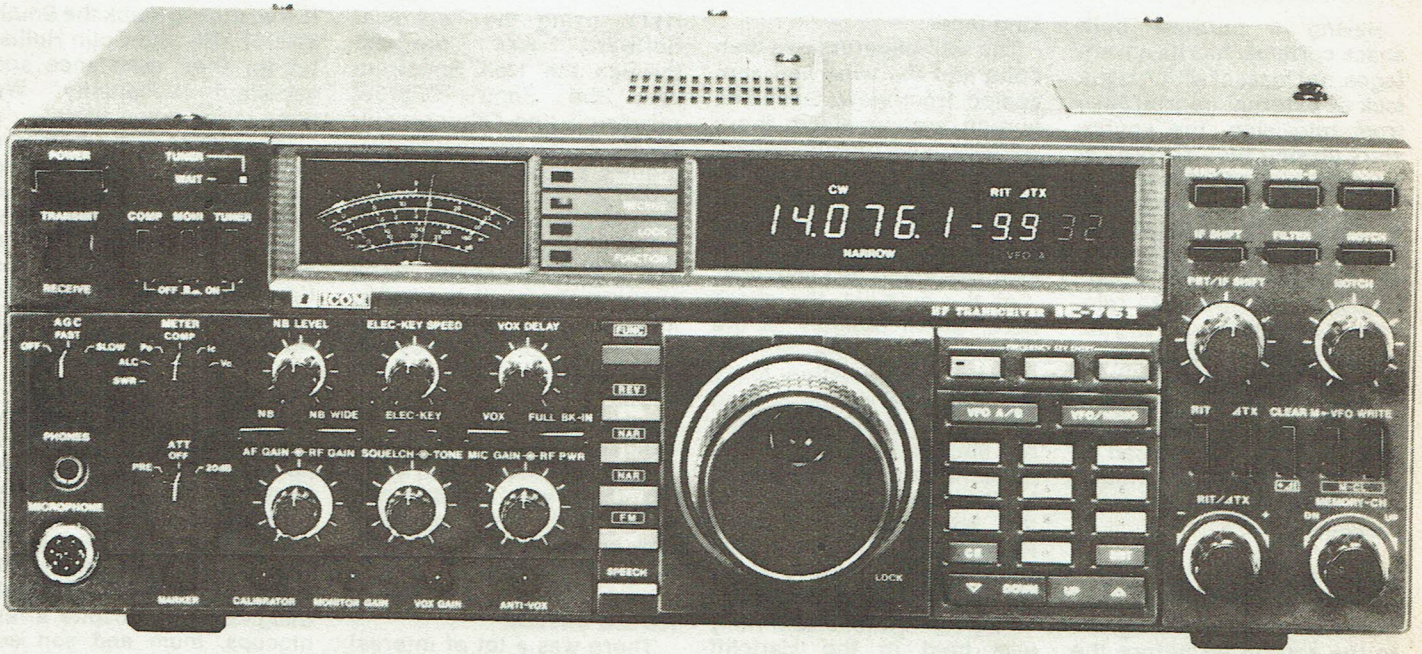


TOP HF



IC-761, HF Transceiver with general coverage receiver

The new ICOM IC-761 H.F. Tranceiver has many features making it probably the best top of the line Amateur transceiver available today. This all mode tranceiver features an internal aerial tuning unit and A.C. power supply. The A.T.U. boasts a 3 second band selection and tune up with a VSWR matching of less than 1.3:1. For the serious operator the 100kHz-30MHz general coverage receiver and 105dB dynamic range make it ideal for DX chasing. Frequency selection is by the main VFO or via the front panel direct access keypad.

And for when reception is difficult, pass band tuning, I.F. shift, notch filter, noise blanker, pre-amp and attenuator should enable you to copy even those weak DX stations whether amateur or broadcast.

The C.W. operator will appreciate the electronic keyer, 500Hz filter and full break in (40wpm) other filter options are available. The IC-CR64 high stability crystal is standard as is the CI-V communications interface for computer control. Twin VFO's and split mode for cross band contacts the IC-761 features program scanning, memory scan and mode select scan and the 32 memories can store frequency and mode.

The tranceivers operating system is held permanently in ROM and is not dependant upon the lithium battery. The cell is used for memory back up only. A new style meter gives P.O., A.L.C., IC, VC, COMP and SWR readings. Optional accessories include the IC-SP20 external loudspeaker with audio filter selections, FL101 250Hz CW filter, FL102 6kHz A.M. filter and the EX 310 voice synthesizer. The SM8 & SM10 desk microphones are also suitable for this equipment.

Telephone us free-of-charge on:

HELPLINE 0800-521145.

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SHORT WAVE LISTENER

TREVOR MORGAN GW4OXB

Having a purpose built shack certainly has its advantages, not least of which is the lack of external interference from television, the youngsters playing their records at 500 decibels and the doorbell! There is also the point that others do not have to listen to the chatter of ethereal voices or the sounds of Morse, teletype and slow scan television emanating from your set-up. However, many listeners have to be content with having the receiving station set up in the lounge or bedroom and this fact can be the cause of endless friction with other members of the household.

A little thought

This does not have to be the case if a little thought is given to the setting up before the equipment is installed. One of the most commonly used ploys is the domestic bureau/drinks cabinet which, if it blends with the normal household furniture, is generally quite acceptable to 'she who must be obeyed'. The problems arise when aerials are mentioned, with visions of scaffold poles and 'plumbers' nightmares' of aluminium tubing cluttering up the garden springing to mind.

I had this sort of problem early on in my listening days and it took me a while to solve it. However, the lounge was due for decorating at the time so the thinking cap went on. The result was the purchase of an old transformer, wound with fine copper wire. This was carefully unwound and stored until we were ready to do the paper hanging. Deciding on the best location for the bureau, a small terminal block was fixed to the skirting board. The end of the copper wire was fixed in place and the wire taken along the upper surface of the skirting board to a corner, vertically up in the corner to ceiling level and then twice around the room, finishing at the adjacent corner and back to the terminal block. It was secured in place using masking tape.

The wall-papering was then done and the wire well concealed from view. Once the bureau was in place, there were no signs that the station even existed and the aerial, operated through an aerial tuning unit, gave excellent service for many years. The cost was about two shillings!

At the moment, the shack here, which doubles as the office for the International Listeners' Association, looks like the local postal sorting office! On Sunday, September 6th, the ILA held its first convention in Bristol, thanks to the kind co-operation of the South Bristol Amateur Radio Club and the invaluable assistance of Colin Hollister G4SQQ.

The 3rd Bristol Radio Rally was held in the Hartcliff Community and Youth Centres and the Bristol group kindly offered the ILA the use of a room in the community centre.

When Vernon Bird GW0DST and myself arrived, we were shown into the room by the club's secretary and Ron Harvey ILA027, who had come from Weston Super Mare, and we noticed that the club had signposted the way to the room with big notices for 'International Listeners' so there would be no lost visitors wandering about!

A fair display

Our display was quickly set up using the tables kindly provided. We had prepared a display of the QSL cards received from our 'Anniversary Station', GB2ILA, a description and display of the many awards available from the association, a description and sample of pages and information sheets from the ILA newsletter and a display of pennants, stickers, gifts and information from some of the many broadcast stations.

The active displays included a continuous demonstration of the G1FTU slow scan television program using the 48K Spectrum and a continuous demonstration of RTTY, using the Technical Software RX4 program through the 128K Spectrum with the Sony ICF670W receiver in line. Other receivers were also set up monitoring two metres, seventy centimetres and the marine and aircraft bands on VHF/UHF.

The rally opened at 1000hrs and, despite some early showers, the weather was dry, although there was a high wind which gave the boys on the TAR Aerials stand nightmares as they had set up their display outside and it was in danger of taking off at times! The crowds were soon picking their way through the usual stalls and inevitable junk boxes and the ILA members started arriving.

Award interest

There was a lot of interest amongst visitors in the *Amateur Radio* prefix awards and the displays attracted a lot of favourable comment from licensed amateurs and listeners alike, some of whom had not seen RTTY and SSTV set up in a listening station situation.

Fortunately, the catering facilities were excellent...and the tea bar opened up into our room...so the dry throats were kept lubricated as members explained the various systems to interested parties.

During the day, we all had the opportunity of visiting the rally itself. Once again we noticed the lack of receivers on offer as we had in other rallies. Perhaps, as one stallholder commented, 'they're just not about, and those that are are overpriced'. This comment was reinforced by the sight of a 9R59DS at £70 and an RA17 at over £150! Despite this, there was plenty to see and money was changing hands, so there was obviously plenty to buy...even my wallet moths had an airing!

The rally was split by being in the two areas, but it gave visitors a chance to get fresh air into their lungs and it was only a short walk between the sections anyway. All said, it was a very good rally and the ILA wishes to thank the South Bristol ARC and Colin Hollister for their assistance and excellent hospitality. We hope to meet you again!

Thanks also to the members for turning out and making the day a success, gaining us new friends and members, and special thanks to Vernon Bird and Alf Williams for the transport arrangements. As Ron Harvey put it, '... well worth the time and trouble!'

The mailbag

So to this month's mailbag and our congratulations to our regular award winner Mick Hudson of Canterbury, who has been presented with a special award of merit by his wife. The happy couple now have a brother for their daughter and, despite a few hiccups, mum and son are now well! Mind you, Mick is complaining that the nappies drip on his copies of *Amateur Radio* and his listening is suffering a bit due to wails from the nursery, but he's managing to run the ISWL contests so it can't be all bad.

Mike Turner of London sent me the instruction manual for his new receiver. It's a Sangean ATS803 which I had never heard of. However, seeing the manual makes me think it's a clone of the recently introduced Matsui receiver marketed by Curry's. Funny that, because the Matsui reminded me of the Uniden and Realistic receivers of a couple of years ago which, in turn, seemed similar to the Sony ICF2001D. Now, I could be wrong, but what did the orginators of the design do with the leftovers when they stopped production to bring out a new receiver . . .? It's happened before, too!

Tales of woe

Huw Greenhough ILA064, of Norfolk, sent tales of woe when his village was cut off by the local spark manufacturers and the only batteries he had were for a very deaf airband receiver. Seems I forgot to sign his bronze award for him – soppy date – so one auto-

graph is on the way! Huw, now G1YEI, has dug up an ancient R107 receiver and it's in good nick, so when he gets his volts back he's going prefix hunting again.

Patricia Bates of Norfolk wrote to say that she had received QSLs from the Somerset station she logged with the MBR7 (thanks G4JBH/P!), and she now has the use of a Kenwood TS180S. Having now received G1XYD via two credits (well done Pat!), she is chasing Angela Sitton to get her Morse tucked away.

Wrong again

And, having mentioned Angie, we have her reports from the wilds of Stevenage during which she ticked me off for misreading her last letter! Her effort to get the Bronze certificate for CW was intentional to prove she'd got most of the prefixes *before* she was licensed. Sorry, Angie! Angie enjoys being 'one of the crowd' on the CW bands and is now looking to join the High Speed Club so those boys had better watch out! Although nothing exotic has been worked, Angela noticed a number of lifts on 15m when good stuff was being heard from JA, PY, HZ and the States, especially late evenings, and she did manage a QSO with K1SHR using the key on QRP through a vertical.

Talking about verticals, Vernon Bird GW0DST had an idea regarding his HF5 which didn't seem to be getting the places he wanted. Removing the groundplane wires he had put up, he tacked on his half G5RV with the centre at the base of the HF5V and was amazed to hear stations from areas he'd not heard before. Which just goes to show that however daft an idea sounds – try it!

UBA Competition

Colin Tait BRS88825 of Lisburn thinks it's a shame that only three stations in the UK entered the UBA Competition in 1987 (he was one of them!), and hopes that more listeners will make an attempt next time. Colin noted some nice ones around during the contest, including 3C1, C37, YV4, J6, K8MN/OH0, BY4, JX9 and, notably, C30BVA and SV0FE on ten.

Philip le Brun G0HHN, of Cheltenham, is now writing a listeners' column for the G/QRP Club and is operating QRP himself. He recently had a windfall of bits and bobs, including an MLX board and VFO kit, and he's hoping to build a Tx/Rx for VHF. Considering that he only started listening a couple of years ago as part of his Duke of Edinburgh Award programme, he's really got hooked on the radio lark.

Preserve QSLs

I had an interesting letter from Jerry Berg of the Committee to Preserve Radio Verifications, which is based in Massachusetts. The idea of this group is to preserve QSL cards of listeners who have closed down their stations. Basically, it's an effort to locate QSLs belonging to DXers who are no longer active and protect them from wet basements, scrap heaps etc. It seems a nice idea as a memorial to those who have left the hobby.

Contact

Incidentally, the QSLs are kept individually filed at the Boston Headquarters of the Christian Science Monitor and this scheme has received massive support in the USA. If you would like more information, you can contact Jerry at 38 Eastern Avenue, Lexington, MA 02173, USA.

And so to the award winners this month, and the first in line is Barrie Musselwhite ILA186 of Warminster who claims the Gold award for 1000 prefixes logged. Well done Barrie! Amongst the fine catches were AP1, AL5, AA4, BV2, CS7, WB8YUC/CP2/M, CQ8, C53, CX6, CO7, HV3, HP1, HK5, HH5, J37, J3AH, KQ5, KT3, KZ2, KV8, PS7, T77T, T32, VK7, VQ9, XQ5, YC0, ZP45, ZF6, 5T5, 5N6, 9Y4 and many others. Barrie has also teamed up with Scott Marshall ILA058, and they've been helping a white stick operator to get on 2m. That's the spirit, lads!

Martyn Whyte of Edinburgh sent in his first claim, which had been delayed due to a burglary which robbed him of his entire shack while he was enjoying an evening out. Thankfully, his insurance company paid up and he's back into the swing of things and is taking the RAE in December. Good luck, Martyn! So to his claim for Bronze which included AP2, HH2, A24, BY5, CE8, CN5, DP7/KH8, VP9, 3A2, T30, TZ1, HZ4/MM, 4N0, 4S7, 5Z4 and 9K2.

20m reception

On to Darrell Jacobs of Grasse in France, who is still in the hunt and claimed the Silver award for 500 prefixes logged on SSB only. Darrell specifically mentions the excellent reception on twenty metres in the early (0200) hours and lists HZ1, A92, A4X, YI2, 9N1, AH2F, 6W1, AP2, SU1, J28, VK8 and VK9 as being amongst the early birds. Immediately following this award, Darrel claimed a Bronze for forty metres, stating 'forty was my dullest band before I updated my shack!' He now uses the FRG7700 set-up with a 71ft inverted-L, a 36ft sloper and an 18ft vertical and has logged PY3, LU1, ZP4, HR1, CE2 and ZF1LC, who passed the information that the Cayman Islands Club operates ZF10PW from October 25th to October 31st on all bands using SSB and CW, so keep your ears open!

As well as holding our event in Bristol, the listeners were represented at Woburn during the RSGB Rally this year. Unfortunately, I could not get there, but Ken Burnell ILA097, of Milton Keynes, was there and sent us this report.

As usual . . .

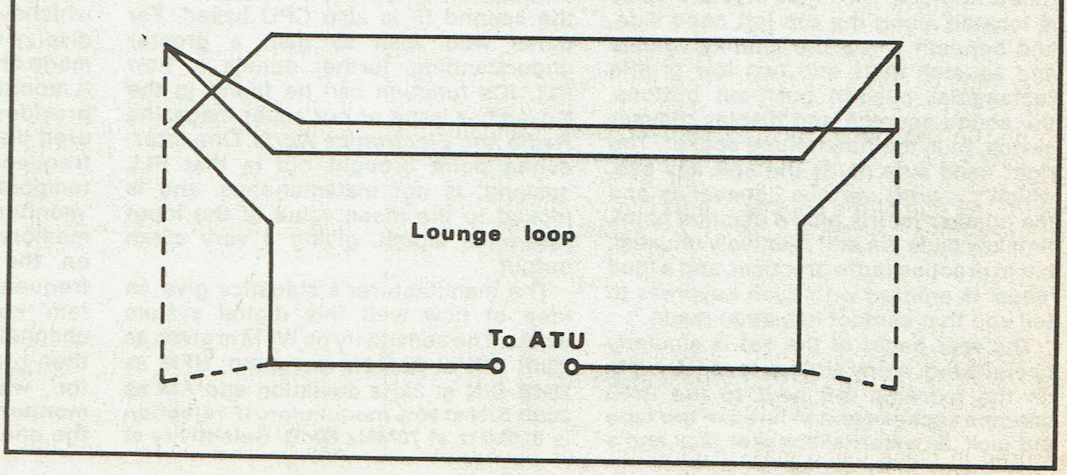
'It was the usual Woburn weather, wet, windy and muddy, when G4VXY and I arrived on site. We had set up the display well before 1000hrs so had the chance to look around the rest of the rally. The doors opened on schedule and things soon got very busy, and we spent the next couple of hours chatting about the listening scene. We were pleased to receive visits from G8MWR of *On the Beam* fame and G4KSQ and G4HPV of the WAB Group. Our thanks to all the listeners who came over for a chat. It was a most enjoyable day and we closed at 1730, leaving the monkeys to chatter on.

Geoff Watts, of *Prefix List* fame, has brought out the *DXNS Countries Guide* which has alphabetical lists with present and past prefixes back to 1945, plus a reference list of previous names of countries and other notes, such as a list of countries deleted from the awards. It has eleven packed pages of information for only £1.00 including postage and packing. Send to: 62 Belmore Road, Norwich NR7 0PU.

That's it

Well, that's it for this month. Next month I hope to have a couple of reviews for you. Until then, keep listening and good DXing!

Wire plan for a concealed living room aerial



USER REVIEW

REALISTIC PRO-2004 AM/FM SCANNING RECEIVER

This receiver, recently introduced by Tandy, has a wide range, covering frequencies from 25-520MHz and 760-1300MHz, which consequently made it most interesting to review.

The coverage is not the only unusual feature of this set (more details on major features are given below), in addition it also has a massive 300 channel memory . . . presumably to help the SWL who is faced with the vast frequency coverage.

Helpful manual

The 2004 has a considerable number of resources which are carefully detailed in the owner's manual. This, fortunately, is extremely clear and well laid out, so that even the bemused beginner can get under way with the minimum of fuss. For those who hanker after the unusual and almost poetic version of English so often served up in Japanese translated manuals – sorry, this one's different.

To look at the 2004 is extremely solid, if futuristic (did Tandy beam it down from the USS Enterprise?), the slanted front panel being remarkably devoid of buttons and knobs. The liquid crystal display is located along the top left hand side, and beneath it are the chunky volume and squelch dials and two low profile rectangular push-in push-out buttons, the sound squelch and display dimmer switch, plus the headphone socket. The right hand side holds the soft key pad, which includes various commands and the number matrix plus a decimal point. Soft key pads are still relatively unusual, but in practice quite practical, and a loud 'beep' is emitted with each keypress to tell you that contact has been made.

The rear panel of the set is similarly uncluttered. A tiny attenuator switch sits on the extreme left next to the BNC antenna socket. Next in line are the tape out jack, an external speaker jack and a dc jack which enables the unit to be run, with a connector, from a car cigarette lighter. The set is intended for both base and mobile use, although its size (75mm x 275mm x 230mm) and lack of securing points would suggest that it is primarily a base station unit.

The ac cable is located directly beneath the dc jack, and on the far right is the battery compartment for the 9V memory back-up battery. It is stressed that the ac supply should be left connected when changing the battery, to enable the memory to hold up for a few minutes. Losing 300 stored frequencies would be quite a catastrophe!

Versatility

The Pro-2004 owes it versatility to the fact that it contains a central processing unit – the heart of every computer. The block diagram at the back of the manual shows the way in which the CPU accepts input from the keyboard and initiates the various commands. Band data is fed to the bandpass filter from the CPU. Phase locked loop (PLL) control data is also fed from the CPU to the voltage controlled oscillators (VCOs). Mode select data for the second IF is also CPU based. For those who wish to gain a greater understanding, further details of how PLL ICs function can be found in the November issue of our sister magazine *Radio and Electronics World.* One interesting point brought out is that PLL 'locking' is not instantaneous, and is locked to the mean value of the input reference signal, giving a very clean output.

The manufacturer's statistics give an idea of how well this digital system works. The sensitivity on WFM is given as 30dB S/N at 22.5kHz deviation; NFM as 20dB S/N at 3kHz deviation and AM as 20dB S/N at 60% modulation. IF rejection is 610MHz at 70MHz 60dB. Selectivity at NFM and AM is ±9kHz, −6dB; ±15kHz, −50dB; at WFM it is ±150kHz, −6dB; ±300kHz, −50dB. Squelch sensitivity at NFM and AM has a threshold at 25−520MHz of 0.5μV, at 760-1100MHz 0.5μV and at 1100-1300MHz at 3μV. Tight S/N is quoted at 25dB, antenna impedance at 50 ohms, and the audio power at 1.8 watts nominal. The built-in speaker is a 3in 8 ohm dynamic type.

Facilities

Before using the receiver, it seemed like a good idea to look carefully at the facilities of the 2004. The one disappointment was that the set does not have the ability to copy CW or SSB, which would mean that it could not be compared with a dedicated receiver like the Icom ICR7000, but then the Icom costs nearly three times as much. However, features which are included are interesting: the priority memory is 1 by default, but any memory can be made priority and priority channel sampling is every 2 seconds; frequency ranges can be programmed in and searched at a rate of 8 or 16 channels per second; up to ten search ranges can be memorised and recalled at the touch of a button.

The delay function, which is optional, allows a two second delay between transmissions in order to prevent further scanning. The lockout function can be used to prevent scanning of individual channels or blocks of channels (the memory is arranged into ten banks of 30 channels), but when individual channels are locked out, one must be left active in the block. This is used to bypass continuous weather reports and similar constantly used channels; the block lockout makes scanning quicker when not all of the memories have been programmed.

Automatic mode and search

The mode and search step are chosen automatically: depending on the frequency NFM, WFM or AM that is chosen, with steps of 5kHz, 12.5kHz or 50kHz. These can all be changed by repeated pressing of the 'mode' or 'step' key to whichever range is preferred, but the display will flash to remind you that the mode or step has been manually altered. A monitor bank of ten extra memories is provided to store frequencies discovered during a search. Search stops: the frequency is automatically placed in the temporary memory, simply by pressing 'monitor'. Transferral to the permanent memory is also simple, and is a variation on the normal method of entering frequencies into memories. The 'program' key is pressed, followed by the channel number to be used. 'Program' is then pressed again, followed by 'monitor', which causes the last frequency monitored to be displayed. If this is not the one which is to be stored, repeated

pressing of the 'monitor' key will bring it up. Pressing 'enter' stores the frequency. To store frequencies normally this procedure is followed almost exactly, but instead of recalling 'monitor', the frequency is keyed in manually and entered.

Simple procedures

As can be seen from this, procedures are fairly simple, and the manual is so helpful that very few problems arise. It was clearly time to turn on. At power on, the display contrast and illuminaton proved good, even on the lower setting and the various indicators are easily read. The channel number and frequency are shown in large print in the centre of the display. Above these lie the monitor channel or scan bank number indicator, the scan bank being searched appearing as a flashing line beneath the channel number. Various function statuses are shown; mode and step indicator beneath the frequency display, delay indicator and lockout to their left. The operation mode indicators lie to the left of the channel number, beside the small 'p' that indicates that the priority memory function is being used.

In use the 2004's simple layout proved to be a boon, minimising the amount of user error. The internal aerial proved to be quite efficient, especially on 2m and 70cm bands, with scanning being rapid and silent and little interference showing. The aircraft bands were just about audible, but many signals were drowned by interference. The 2m repeaters R5 and R7 came over clearly; on one occasion a QSO with Holland was heard, and on another occasion with France. The range seemed to be about 30-40 miles on average, with Chatham in Kent (from mid-Essex) being the furthest catch out of the repeaters. None of the other amateur bands were in evidence, although the given range suggested that it should be possible to listen to the 50MHz and 28MHz amateur bands.

Naturally, I was curious to see what results could be obtained from an external aerial, and tried the 2004 with both an end-fed wire and an Icom AH7000 discone aerial. The improvement in pick-up was impressive, especially with the discone which excelled on airband. The interference largely disappeared, and airports heard included Gatwick, Heathrow, Stansted, Southend and Leavesden. At one point an extremely loud and clear communication coincided with an aeroplane passing overhead!

Unexpected bonus

One unexpected bonus was a QSO on the marine band – unexpected, as our distance from the sea had been thought to make the chances of hearing ship-to-shore slim. On every band the 2004 behaved well, and with the sound squelch on, scan and search were virtually noiseless. It wasn't long before a respectable number of memories had good frequencies tucked away in them.

The broadcast bands were an interesting test of the set's ability to cope with strong signals only a few kilohertz apart. Once again, interference was minimal, as was intermodulation, although I get the impression that the lower frequencies were a little lacking. Local stations in Kent and Sussex were easily audible, as was Medway's Invicta radio.

Regrettably, nothing was heard at either the top or the bottom end of the set's range, a situation which could doubtless be changed with some diligent listening ... it could become habit forming ...

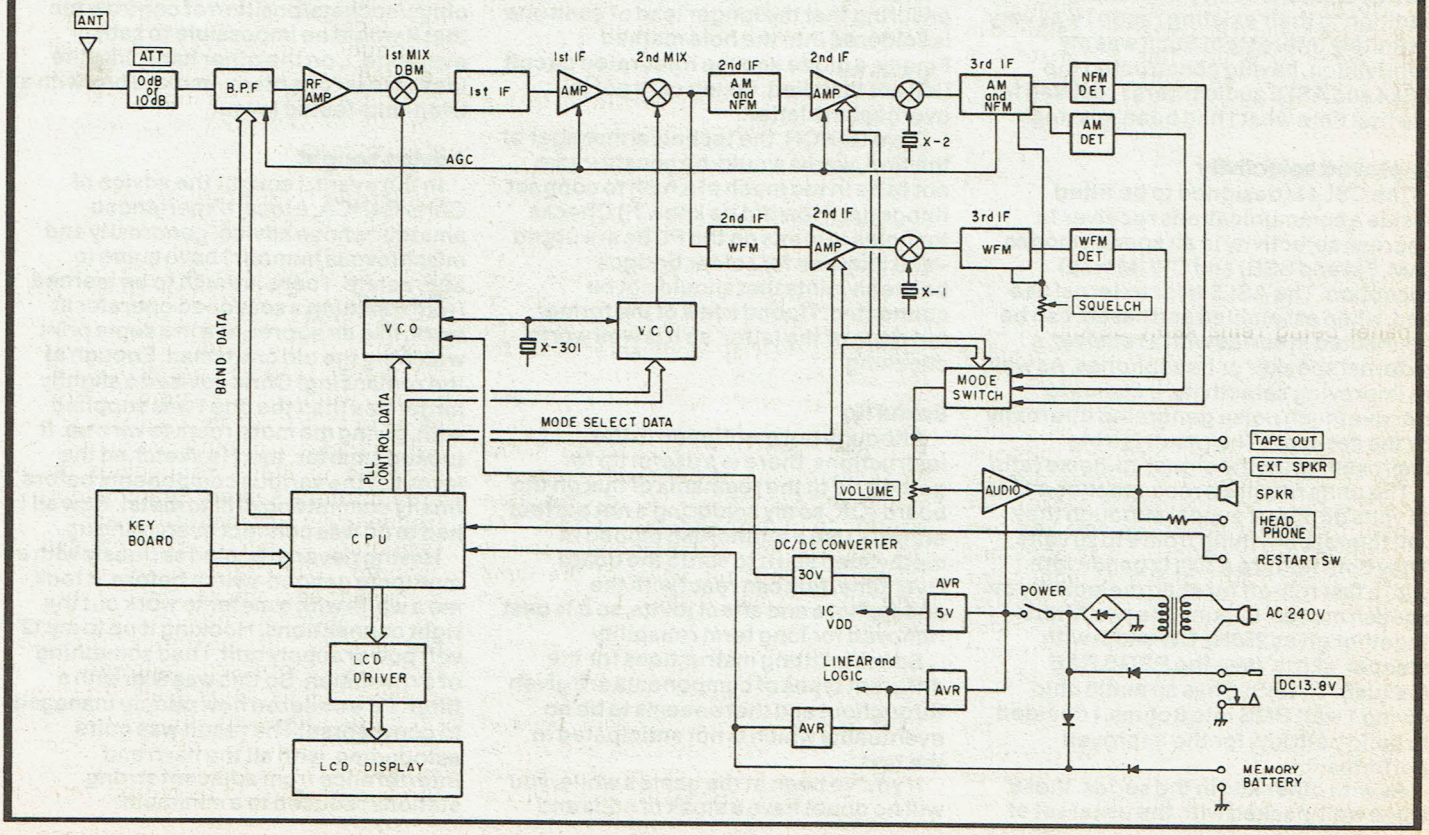
Good reputation

Realistic have a reputation for being reliable and the 2004 lives up to this, with tough, easy to use controls, clearly marked and sensibly laid out. It performed well, especially on two metres, though the addition of the external aerial improved both range and quality of reception, so it is worth investing in one.

Having no computer interface or BFO will make this set less attractive to the dedicated ham, but for those with no interest in CW or RTTY it is more than adequate. With the option of an external speaker available, the quality of the audio is a strong recommendation. For anyone interested in the airband, the 2004 would be a good choice, with the benefits of an extra range beyond most other scanners in its price range. A good investment for the interested beginner, or anyone wanting to try out the VHF and UHF bands. Easy to operate, with an uncommonly wide range, the Pro-2004 is a very nice receiver indeed.

The Pro-2004 costs £349.95 and is available from Selectronics Ltd, 203 High Street, Canvey Island, Essex. Tél: (0268) 691481.

Block diagram of the Realistic Pro-2004 scanning receiver



CLEANING UP THE ACT

My liking for the C M Howes Communications' range of kits stems only in part from the fact that they tend to work when put together by a greenhorn. Just as importantly, they have been accompanying me throughout my discovery of the delights of amateur radio.

Searching in vain for a cheap HF receiver in the very early days, I bought and built an 80m direct conversion receiver in the range which I wrote about in an earlier issue of this magazine. Later, when I was beginning to appreciate the significance of a good aerial (as opposed to a big one) I built the mark 1 antenna tuning unit. (This has since been superseded by the CTU30 antenna tuning or matching unit with a balun). Having obtained my 'B' licence in July 1986, my thoughts turned in the autumn to learning Morse, so I bought the side tone oscillator (ST2) for practice purposes.

Listening to Morse on the 80m band at night frequently comes under the heading of hair-shirt activity. When C M Howes announced two filters as an addition to their existing range I was very definitely interested! Such was my deprivation, having constructed the CSL4 and ASL5 audio filters I realised for the first time what I had been missing!

Improved selectivity

The CSL4 is designed to be fitted inside a communications receiver to improve selectivity in all speech modes (AM, FM and SSB) and CW (Morse) reception. The ASL5 is for external use and, when assembled and cased, can be connected in series with a receiver's external speaker or headphones. As well as improving selectivity, it claims to remove much noise generated internally by the set itself. The result is a big improvement in the signal-to-noise ratio.

The units require a recommended 12 to 14 volts dc power supply although they will tolerate anything from 9 to 20 volts. They both feature a 300Hz bandwidth with a fast roll-off for sharp selectivity on speech modes. Linking the two filters together gives 250Hz CW width with steeper 'skirts' (see the RSGB RAE Manual). The ASL5 has an audio chip giving 1 watt RMS into 8 ohms. I decided to build both kits for the improved performance.

As with other kits in the series, these came well-packed with the usual set of clear step-by-step instructions, with plenty of helpful tips on soldering and construction. Each kit is complete with a printed circuit board (PCB), and all board-mounted components needed. The parts list indicates each item by colour and marking, which is useful for double-checking. The instructions are best read through at least once beforehand. Only a very basic tool kit like mine is required, but a soldering iron with a fine tip is essential.

Assembly process

The assembly process is similar for both kits, starting with the fitting of terminal pins to the PCB. These are helpful in the final wiring up of the finished PCBs and are a nicely detailed improvement on earlier kits. Next come the resistors, with tips for fitting on the clearly-marked PCBs, followed by one variable resistor which enables you to adjust the output level of the CW filter. This gives equal subjective volume to the other selectivity positions.

Fitting the capacitors follows, keeping the leads as short as possible and ensuring that the longer lead of each one is soldered into the hole marked '+'. Finally, a diode and the integrated circuit (IC) are installed, taking care not to overheat the latter.

Dave G4KQH, the technical manager of the firm, warns would-be constructors not to be in too much of a rush to connect things up. (How did he know?!) Checks for holes in joints on the PCBs are urged – and likewise for solder bridges between joints that should not be connected. I found a few of the former, but none of the latter, so it is well worth checking.

Useful tip

Although not mentioned in the instructions, there is a useful tip for getting rid of the remnants of flux on the board (OK, so my soldering's not perfect either!). Use a toothbrush dipped in methylated spirit to scrub the board. Over time, flux can react with the atmosphere and affect joints, so it is best removed for long term reliability.

Specific fitting instructions for the different types of components are given throughout and there seems to be no eventuality which is not anticipated in the text.

If you've been at the game a while, you will no doubt have a stock of odds and ends to fit the kits into the box which you bought at the last junk sale! I have no such collection, being at a relatively early stage in the hobby, so I rang Dave. He supplied me with all the necessary parts to box both kits in the same case. To fit comfortably, a screened box of approximately 150mm × 125mm × 75mm deep will suit. The alternative to the recommended screened box is to use screened wire.

Confession time

Now it's confession time. Putting the whole bangshoot in a case felt more difficult for me in prospect than constructing the PCBs, both of which I built at separate times in under an hour for each one. What I would have liked was a ready-drilled box with instructions for fitting. This may sound very elementary, but as I can spend hours with tape measures and spirit levels and still end up with a sloping shelf, it is important! The argument against supplying a case and instructions is, of course, obvious. There are so many differing and individual requirements for plugs/sockets/position of controls etc that it would be impossible to satisfy everyone. I, on the other hand, like the idea at least of a ready-marked box with a tried-and-tested layout.

Advice sought

In the event, I sought the advice of Chris G4HCA, a local experienced amateur whose advice, generosity and mischievous humour I have come to appreciate. There is much to be learned from watching a seasoned operator at work, like an apprentice in a sepia print watching the old craftsman. Enough of the romancing! Chris advised a slightly larger box than the one I was supplied with, giving me more room to wire up. It looked smarter, too. He sketched the layout of the various components before finally committing drill to metal. Now all I had to do was connect everything up.

Having never grappled seriously with a multipole ganged switch before, it took me a while with a meter to work out the right connections. Hooking it up to my 12 volt power supply unit, I had something of a revelation. So this was 80m with a filter. I'd wondered how people managed to copy Morse! The result was quite astounding, with all the hash and interference from adjacent strong stations reduced to a minimum.

Peter Wood G1UTH looks at a couple of C M Howes kits suitable for the 'Greenhorn' to tackle with ease

The filters are operated from a three-way switch for wideband SSB, narrow-band SSB and CW (very narrow!). There is a second single pole 2-way switch which selects the ASL5 filter alone or both filters in series, giving six possible settings. I've no test equipment for checking the claimed performance figures for the filters, but I have no reason to doubt them. A very worthwhile addition to the shack.

Operation

They can be operated from a reasonably well smoothed PSU or from a battery. If used with the latter, a switch and indicator light are recommended, with the addition of a fuse in the positive line. The CSL4 for internal fitting has a PCB which is 85mm × 51mm, which gives an idea of the space needed. We are thoughtfully reminded to switch off at the mains if we are delving inside a rig and that such delving may invalidate any warranty. Sets that have poor frequency stability would not be suitable for these filters, as the wanted signal is likely to do a vanishing act as it drifts outside the filter passband!

Price

The cost of the CSL4 is £9.90 or £15.90 ready-assembled, whilst the ASL5 is £14.90 or £22.50 made up. Add 90p postage and packing with every order. In the unlikely event that you are not able to get a kit to work, there is a fault-tracing and rectification service for a fee. Most faults are due to poor soldering, so be warned! The cost of the hardware will vary according to source and the specification of the bits concerned. By way of an example, C M Howes Communications charged £13.40p for all that was needed, including four jack plugs.

Thanks

My thanks are due to C M Howes Communications for the CSL4 and to my colleagues at work who gave me the ASL5 as a farewell present, and of course to Chris G4HCA for his invaluable advice and help.

Having cleaned up my act, so to speak, I await the results of my Morse exam and the arrival of my next kit with interest!

C M Howes Communications is based at Eydon, Daventry, Northants NN11 6PT. Tel: (0327) 60178.

FIRST IMPRESSIONS

'And the Brass will crash,
And the trumpets bray,
and they'll cut a dash . . .'
(W S Gilbert)

G and S were certainly not referring to sending Morse code, but in amateur radio culture 'brass pounding' has become the slang term for CW operating. Then came the 'cruder metals' and Morse keys seemed to lose the golden sheen of brass in favour of the coldness of steel or the brashness of chromium plate. Recently companies have appeared on the amateur radio scene offering brass Morse keys. I have one. These are 'straight' telegraph keys (up and downers), and very fine they are in use and appearance.

These days many radio amateurs, including me, prefer to use an electronic keyer with a sideways action Paddle Key. Alas, most of these paddles are chromium plated . . . so we pound the chromium.

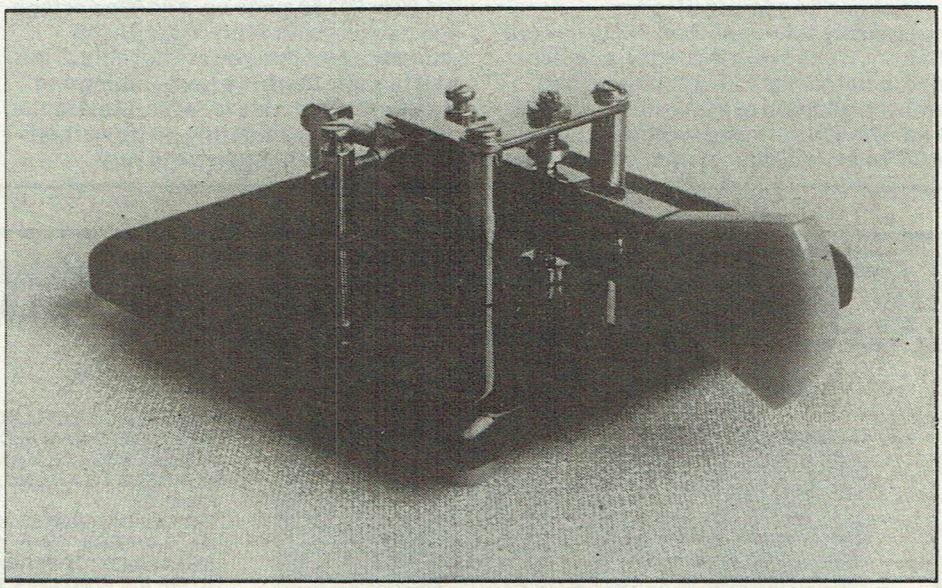
There are many choices, the main two being the Bencher Paddle and the Vibroplex Paddle, the latter not be to confused with the Vibroplex Bug Key which is a mechanical semi-automatic key. For many years I have used the Vibroplex Paddle to drive my Electronic Keyer. I may be wrong, but to me the Bencher Paddle looks as if it could spring apart at any moment and scatter to the four corners of the shack.

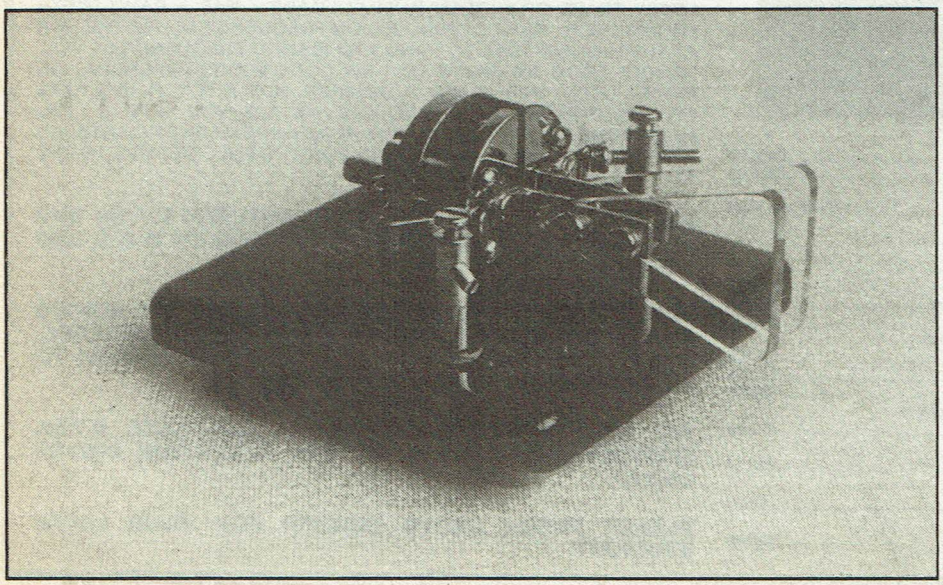
I like Morse keys and have a small collection of old keys and take an interest whenever new keys appear on the market. So when I heard that a new Morse key maker had appeared on the scene, naturally I wanted to see, and, if possible, sample his wares.

Gordon Crowhurst G4ZPY first made Morse keys for his own amusement and use. A product of that fine tradition of British precision engineering, G4ZPY spent many hours trying to produce keys which satisfied his engineering standards and looked pleasing to the eye. Other radio amateurs saw his keys and began to ask him to make them for sale. Soon he began to produce a small number of handmade keys for local amateurs. The response was so good that he decided to offer them for general sale, so the G4ZPY Keys have now become generally available. At present G4ZPY produces a range of two paddle keys for electronic keyers and a straight key.

I managed to divert a couple of the paddle keys, which were on their way to buyers, and had a chance to try them out on the air for a few days. What follows are my impressions of the two paddle keys. The two keys used were the Single Paddle and the Twin Paddle.

The first impression is the appearance





of the paddles, they are finished in highly polished brass and are things of beauty. They would improve the aesthetics of any operating table. I can do nothing less than give G4ZPY full marks for the workmanship and finish. Each key is handmade and shows the touch of the craftsman.

The Single Paddle is of simple sturdy construction and drove my electronic keyer well. The springing arrangement is unusual but easily adjusted. My keying action is very heavy – I thump the paddle – but I was able to adjust the spring to suit that action and the contact gaps to my taste. The base is heavy enough even for my heavy handed ministrations and held position firmly on the table throughout its use.

Most amateurs who use an electronic keyer seem to buy a twin paddle key, but probably only need a single paddle. The twin paddle (or squeeze keyer) is only

George Dobbs G3RJV takes a look at two new paddles from a manufacturer who prides himself in producing quality wares

really required for iambic keying. This is a method of keying which gives the option of the two paddles making the dot or dash or when squeezed at the same time producing alternative dots and dashes until the paddles are released. This facility coupled with dot and dash memories in the electronics results in far fewer manipulations to send the characters. Iambic Keyers are a bit difficult to drive at first, but when mastered they make sending Morse much easier. But – when I have watched many operators using a twin paddle on their electronic keyer, they do not use the iambic features and merely use it like a single paddle.

The Twin Paddle is designed to drive an iambic keyer and does so very well. In the north west of England we are proud of our old steam engines which once powered the local mills, and many of them have been lovingly preserved and stand magnificent in gleaming brass. In some ways the structure of the Twin Paddle Key reminded me of some parts of these engines. The Twin Paddle is a real thing of beauty. The 'split ring' type of construction makes the front of it look rather like a Bencher Paddle, but the spring arrangement is firmly built into the brass rings. The mechanics appear much firmer than the Bencher.

Once it was set to my taste, the Twin Paddle performed very well. I like the width of the paddle blades – the feel was just about right. I used this paddle with my keyer for about a week on the air and was very sorry to see it go. It had already been ordered for another amateur and was personalised with his callsign.

Overall I was most impressed by the G4ZPY Paddle Keys. They handle well in use and look very nice indeed. My only personal quibble is that I would like a double blade on the single paddle perhaps mounted either side of the bar. This is only my own taste, I converted my Vibroplex single paddle to give me that wider feel, but most single paddles do come with one blade and the G4ZPY blades are wider than most.

The current range sold by G4ZPY is:
Single Paddle: Standard at £40, Deluxe at £42.
Twin Paddle: Standard at £45, Deluxe at £47

Keys can be personalised with a callsign in gilt lettering at £2 extra and the postage on any key, in the UK, is £2.50. G4ZPY now makes a straight key (seen but not tried) for £25.

Enquiries and orders to: Gordon Crowhurst G4ZPY, 41 Mill Dam Lane, Burscough, Ormskirk, Lancs L40 7TG. Tel: (0704) 894299.

50MHz

Welsh AR Convention 1987

50MHz was featured this year at the Welsh Amateur Radio Convention at Oakdale College Blackwood Gwent on 4th October with a long interesting illustrated talk by Ray Cracknell G2AHU, co-ordinator of the RSGB 50MHz Reporting Club.

The main intention was to introduce newcomers to 50MHz, and topics discussed included achievements since the general release of the band to all holders of amateur licences in June 1987; modes of propagation usable at 50MHz in relation to methods employed; the new band plan and licence restrictions concerning power and antennas; some essential elementary propagation theory; and setting up a station for 50MHz.

Achievements

Newcomers to 50MHz since 1st June 1987 have shown themselves primarily interested in working DX. Summer is the sporadic E season and SSB has been almost universally employed. The following DX was available: (a) two-way on 50MHz: Norway, Portugal, Malta, Gibraltar, Cyprus (Asia), Greece (1 stn), Holland (1 stn), Spain (2 locally authorised), Iceland. And (b) crossband 50/28MHz: Sweden, Denmark, Finland, France, Germany, Yugoslavia, Italy, Austria, Czechoslovakia, Switzerland and 4U1ITU.

Transatlantic openings included: (a) Eastern USA and Canada on June 7th, 13th, 14th, 17th (very extensive), 18th, 19th (very extensive), and July 14th, 17th (major opening), 21st and 23rd. (b) Greenland (OX3VHF) on June 18th, 19th and July 9th and 10th. (c) French Guiana (FY7THF) on May 28th, June 5th, 6th, 11th, 12th, 13th, 14th, 18th, 19th and July 15th (West Indies, (W6JKV/V2A and /YV0) expedition), Antigua on 14th and 15th June and Avis Island on 24th June.

Modes of propagation usable at 50MHz include: (1) 'Groundwave', which provides consistent propagation up to 200km (125 miles); (2) Tropospheric enhancement up to at least 1000km; (3) Meteor Scatter by showers and sporadic meteors (50MHz is the best band for MS); (4) Aurora provided by reflections from 'curtains' of ionisation during magnetic storms (50MHz is the best band for working from auroral reflections); (5) Sporadic E using dense 'clouds' of ionizations in the E region, which has a pronounced maximum during May to September (28 and 50MHz are the best bands for working by Es); (6) F layer propagation, which is normally confined to years of high solar activity at 50MHz, except in tropical regions and in the run-up to major ionosphere storms; (7) Mixed modes, for example F plus E, TEP plus MS are possibilities. Backscatter frequently occurs during E openings.

50MHz band plan

The following band plan was formulated by the RSGB VHF Committee. Experience during the June and July 1987 transatlantic openings had shown that a more detailed plan was necessary and that account had to be taken of the fact that solar flux was rising again and long-distance F layer openings must be expected in a few years time.

In view of the rapidly increasing popularity of the band it was realised that long-distance signals needed to be protected from interference by local and one-hop sporadic E signals if the DX possibilities of the band were to be fully realised. Further, facilities had to be made for all modes of operating and the 2MHz now available had to be used as economically as possible. The resultant plan is:

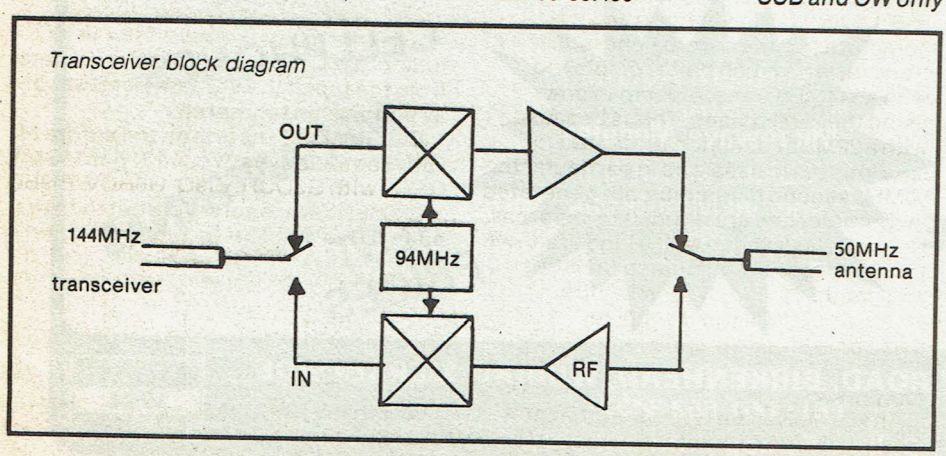
50.000-50.020	Intercontinental DX CW only
50.020-50.080	Beacons
50.080-50.100	CW only
50.100-50.400	SSB and CW only
50.100-50.125	Intercontinental DX window (see note 1)
50.110	Intercontinental DX calling frequency (see note 2)
50.200	(see note 3)
50.300	MS calling frequency for CW only
50.350	MS calling frequency for SSB only
50.400-50.600	All modes
50.600-50.700	Packet mail boxes
50.700-51.000	All modes
51.000-51.100	Pacific DX window (see note 1)
51.100-51.400	All modes
51.400-51.600	20kHz channelised FM with 10kHz offsets
50.510	FM telephony calling channel
51.600-52.000	All modes

Notes

1. It is most important that all local and continental QSOs be kept out of the intercontinental DX windows. This applies in particular to crossband work.
2. 50.110 is the internationally recognised calling frequency and should never be used for QSOs. It is of special value for those who leave a receiver running while doing other things. Stations are urged to try calling back off the frequency and to completely ignore CQs on 50.110 from stations in the same continent as themselves.
3. The designation of 50.200 as a 'centre of activity' has been deleted. It is considered that the present degree of band occupation makes it imperative to call CQ on any vacant frequency in the appropriate section of the band, and to make full use of the available frequencies. This does not preclude the use of 50.200, and it may still be of advantage to use it when calling into a 'dead' band.
4. Efforts need to be made to prevent pile-ups becoming unmanageable. Techniques such as the careful timing of a short call and calling off the DX station's frequency should be employed. Patience is often rewarded and DX stations are invariably more easy to work towards the end of an opening.

Licence restrictions

(These were detailed in this magazine earlier, but we make no apology for repeating Ray's comments.) On 50MHz, power is defined as effective radiated power (ERP) in dB above 1 watt (dBW), and is currently fixed at 14dBW carrier or 20dBW SSB. In round figures this is a maximum of 25 watts on CW or 100 watts on SSB into a dipole, but if a beam is used its gain has to be subtracted. For example, with a beam having a 6dB gain over a dipole and a feeder loss of 1dB, a power output of 9dBW (8 watt) CW or 15dBW (31.6 watt) PEP SSB is permissible at the Tx output. AM and FM are subject



to the same power limits as CW.

The antenna must be horizontally polarized and not more than 20 metres above 'ground' level, although we have been assured liberally interpreted exceptions will be made in cases such as those of amateurs living in high rise buildings.

No mobile operation or repeaters are permitted on the band. 50-51MHz is a primary allocation and 51-52MHz is on a secondary basis, but both are subject to not causing interference to other services, and this applies in particular to European TV services still operating across the 50MHz band.

Certificates and awards

Certificates and additional stickers for the number of locater squares, and for the number of countries worked both two-way on 50MHz and for all QSOs provided transmission was made on 50MHz. Jack Hum G5UM is the VHF awards manager, and full details of how to apply will be published shortly (watch this column).

Setting up a station for 50MHz

ANTENNAS

Surprisingly good results have been achieved with only 10 watts to a dipole, but few are likely to be satisfied unless they can raise their ERP to the permitted limits. The cheapest, easiest and most significant improvement, since it affects both transmission and reception, is to add a second element, either as a director or reflector, and to arrange a means of rotating it.

Erection of the antenna, be it a dipole or beam, should be high and clear of all obstruction, but going above 2 wavelengths (12 metres) in the clear is only likely to be of advantage in working extended groundwave signals, and may be a disadvantage in being too selective in the vertical angle of radiation for some modes you may wish to work. Stacked beams are even more selective, and before erecting one you would be well advised to heed the experience of well known amateurs like G6DH and EI2W who, during the 1947 transatlantic F-layer openings, found that tilting their beams up at an angle of 40 degrees significantly improved their results (there are possibly other reasons than angle of arrival, eg signal/noise ratio, but the warning is there and G2AHU has worked North America successfully even though there is a 1200ft line of hills at a distance of 2 miles in direct line on the great circle route north-west, making the lowest possible angle of elevation 5 degrees).

For those not permitted to erect an outside antenna, surprisingly good results have been obtained with antennas in the roof space. Rotary antennas may be limited by the rafters, but two or more two element beams may be made up out of thick wire, and with separate co-ax switched in the shack to each of them, are usually a possibility. The VHF Committee hopes to obtain removal of the ban on portable operation and vertically polarised antennas as the next priority, so that flat dwellers unable to transmit from home may get on the air from their car. At present, fixed portable (/A) operation is permitted, and one of the advantages of 50MHz is that a two or three element yagi is very simply constructed so that it will fold or screw together for easy transportation.

Crossband working is facilitated by the very strong 28MHz signals received from the continent, and a dipole or rod antenna is usually sufficient for this purpose. Those interested in weak signal reception on 28MHz may, however, favour a dual beam turned on the same mast. Normally separate feed lines are desired so that duplex and break-in is facilitated.

Interlacing 6 and 10 metre beams is not usually successful if all-metal construction is used, but they can be mounted on the same boom with the six metre beam in front of the ten metre. Otherwise the six metre beam should be mounted above the ten and spaced at least three metres from it.

TRANSCEIVERS

For two-way 6 metre QSOs, a transceiver is accepted as the norm although, if frequent crossband work is undertaken, a separate Tx and Rx still has much to commend it. Newcomers, other than those who build their own, will use either: (a) a purpose-built 50MHz or 50/28MHz rig; or (b) a transverter. Those with a good quality all mode 144MHz transceiver may well opt for a transverter. The basic arrangement is shown in *Figure 1*, and many commercial variations are available with a price that is considerably lower than that of a complete transceiver. In general, a transverter is much better employed with a 144MHz transceiver than one using the 28MHz band. This is because with a 22MHz oscillator, unwanted spurious responses, and in particular the 56MHz second harmonics, are generated in the mixer and are difficult to suppress. Nevertheless, those with a high grade HF transceiver with split tuning facilities and good SSB and CW crystal filters would find it well worthwhile to overcome these difficulties.

Commercial gear

Angus McKenzie G3OSS, author of *A Buyer's Guide to Amateur Radio* supplied the following information:

(a) Gear designed for 50MHz in the 10 watt class includes: TS660 – good but only a few were imported; TS670 – an updated version; IC551 – good provided the VOX is removed as it distorts speech even when switched off; IC575 – a 28/50MHz transceiver, which should be on the market in about a month;

(b) Several HF transceivers have facilities for built-in transverters, eg FT767, but the quality of the transverters may be questionable especially as regards the cleanliness of the signal and freedom from harmonics and spurious emissions.

(c) Transverters: The Mutek transverter was good, but unfortunately has been discontinued.

A German SSB Products transverter should be available shortly. Other products (and there are several smaller producers) may vary widely in quality and need to be checked carefully before being put on the air.

From the mailbag

Before starting this month's mailbag, I must confirm that I have moved to Folkestone, and thanks to Jim G1GCA and his son Ken, who helped to erect my aerials, I am again on the air on two, six and ten metres. It is too early yet to make an appreciation, but first impressions are favourable. Of course, I am no stranger to this area, as I have operated portable here for over 50 years and am fully aware of the potential.

Ted G4UPS reports on his liaison trip to Scotland, mainly to encourage tests on the tropo mode of propagation from the SW to GM. As a result Bill GM4DGT now appears daily on 3718 and 50195. Ted was very surprised at the number of openings up there on ten metres, but disappointed at the lack of activity on six metres. Alan GW3LDH, Secretary of the UK Six Metre Group, is home from Malta after installing the Malta beacon, mainly for TEP.

He and Maureen were delighted that the beacon was heard by ZS4TX at its temporary QTH. It is planned to operate from the top of the Verdala Hotel as soon as permission is granted.

Bill GM4DGT reports on the aurora of 25th September between 1547-1614GMT. QSOs with G3CCH, EI9Q, G6HCV, EI9BG and G3ENY were achieved, but then the band faded out. The 2nd phase opened at 1633, with EI6AS, G4GLT, G6NB, G3CUN, G4ASR, G4ENA, G3USF, G2BSJ, G4CMT, GI4GPC, G3BRA and finally G3CCH at 1929 as the aurora faded out. That sums it up for now, 73 and good DX on 50MHz de Ken Ellis G5KW, 18 Joyes Road, Folkestone, Kent CT19 6NX. Tel: (0303) 53276.

HINTS AND TIPS

A H Cain offers some comments and observations on the Marconi CR100

The Marconi CR100 communications receiver has never really been held in high esteem by the licensed amateur or the SWL. However, as a general coverage receiver (60kHz to 30MHz in 6 bands) it is still useful as a test bench receiver for checking xtal oscillator frequencies, local oscillator functioning on other receivers and similar tests where a wide range of frequencies are required.

The circuit diagram showing 2 RF stages, mixer, separate HF oscillator, and 3 stages of IF amplification followed by 2 audio stages should by all reasonable assumptions give a good account of itself, but all the various CR100s used at different times by the writer have been mediocre in performance, especially on Band VI (11 to 30MHz).

Basically a Naval receiver, but also used by Air Ministry and Civil Aviation departments, it is unlikely that in the design stage much consideration was given to operation on Band VI. The valves used were not of high amplification factor and the poor LC ratio of the RF tuned circuits at the bottom end of the band are only some of the possible reasons for the inferior performance experienced with this admittedly ageing receiver.

Specific fault CR100/2

Whilst investigating a CR100/2 that had been used intermittently over a period of about a year some findings were made that may be of interest to CR100 owners.

The fault symptoms were (a) instability at high RF gain positions and (b) a very definite increase in valve noise when the function switch was placed in the AVC position. The AVC circuitry is not complicated, being basically grounded when the function switch is placed in the 'man' position.

With the RF gain at maximum and no aerial input there should be little, if any, change in background valve noise. If anything it should decrease when going to AVC, due to valve noise operating the AVC system and applying negative voltage to the grids (control) of the AVC controlled valves (V1, V2, V5 and V6).

Instability was first thought to be the result of faulty decoupling capacitors, but substitution proved ineffective. A check on the cathode voltage of the AVC controlled valves showed 3.5+ in the 'man' position going up to 4.5+ when switching to AVC, the RF gain being kept at maximum during the test.

Both these readings are too high and indicate excessive current being passed by the valves. The 4.5+ voltage in the AVC position indicated why the noise level went up, with extra current being passed by the valves under test.

With the aid of a high impedance electronic voltmeter, the AVC voltage was checked at C74 (main AVC decoupling capacitor). A positive voltage of 12 volts was recorded! Obviously, here was the cause of the excessive current with positive voltage being applied to a circuit which should have zero or negative voltage. AVC coupling capacitor C85 was at first suspected (between IF anode and AVC diode), but this proved to be perfectly sound.

Fortunately the AVC bus line in the CR100 is easy to get at and all the AVC connections to tag boards and the function switch were disconnected. It was with some surprise that the tags of the decoupling resistors, R1, R2, R4 and R5 showed positive voltages ranging from 4V to 12V, whilst the flying leads from the function switch indicated 36 volts positive. It became fairly obvious that leakage from the HT+ line was being impressed upon the AVC line, and a quick look at the tab boards showed HT+ dropper resistors alongside the AVC decoupling resistors, with their securing tags only a few millimetres apart.

The function switch is a single wafer carring HT+ for the BFO and also for the OFF function (in addition to AVC switching). No amount of cleaning or blowing warm, dry air made very much difference; in fact, over a period of about 30 minutes the HT leakage figures actually increased!

Whilst the AVC decoupling resistors R1, R2, R4 and R5 could be replaced away from the tab board, the function switch presented a more difficult problem. A separate toggle switch could have been fitted to ground the AVC line in the CW position, but in CW AVC an extra capacitor is switched across the AVC line, making life complicated. Furthermore, the function switch would not operate in the manner indicated by the legend.

Alternative

The alternative was to replace the existing wafer or add another wafer to the existing Yaxley type switch and use that wafer solely for AVC switching. This latter course was selected. However, it did require the removal of the control knobs and then the front panel. Even then the funciton switch could not be removed unless the HF oscillator screening box was moved out of the way; a major undertaking.

After some consideration a junior hacksaw with a new blade was used to make 2 sawcuts up the front of the chassis to the funciton switch hole. The switch could then be dropped down complete with any wiring attached. This operation, which sounds fairly drastic, was in fact much easier than envisaged, but it was necessary to be careful of swarf getting into dangerous corners.

The existing switch spindle in the CR100 is not very long, and if another wafer is to be added (as in my case) some juggling with spacers will be required. Having rewired the AVC leads to the new wafer, a check revealed zero volts on this line (no leakage). The switch was then refitted by sliding up the slot and locking it into place. New AVC resistors were soldered into the circuit, avoiding the tags originally used and still showing 12 volts or more.

After switch-on, a quick check showed no difference in valve noise when going from man to AVC, and all signs of instability had disappeared with RF gain at maximum. A signal from a small aerial produced a nice negative going voltage on the AVC line when tuning across one or two stations and all seemed well.

However, as a final check with no signal input it was disconcerting to find 0.5 volts + appearing on the AVC capacitor C74. A quick look at the circuit and the inside of the receiver showed that HT+ tags and control grid tags were close to each other on the paxolin type bases of the IF transformers. Either the HT wiring or the grid wiring on each IFT would really need to be removed, but at the time of writing this has not been done. The receiver is vastly improved and backing off the RF gain slightly should hopefully compensate for the unwanted 0.5 volts + appearing on the grid.

Without giving too much thought to the circuitry, the grounding of the AVC line should remove the 0.5V+, giving normal operation. However, another look at the circuit clearly indicates that, with leakage across the IFT tags and also the ungrounded end of the decoupling resistors, this is not the case and with values of R1, R2, R4 and R5 in the region of 50,000 ohms by about 0.3 volts + is still being applied to the grids of both AVC controlled IF amplifying valves.

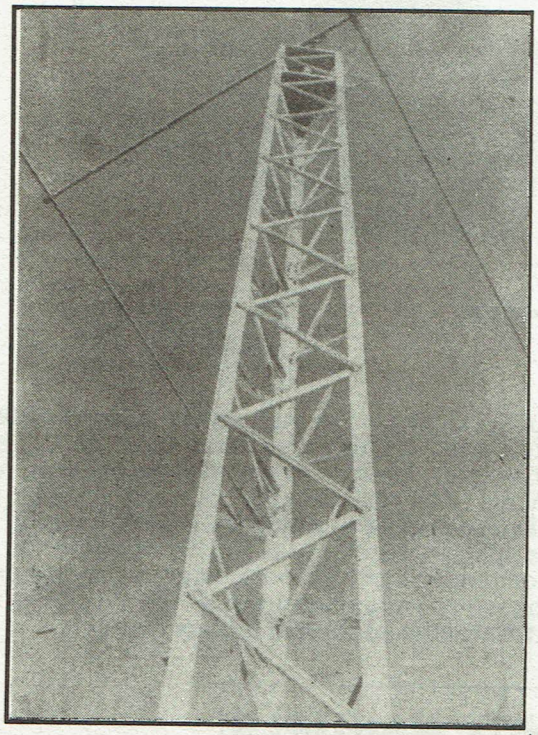
Conclusion

The problem does not appear to be surface leakage across the paxolin type board or switch wafer. A great deal of time was taken to make certain of this. Rather, it would seem that the leakage is taking place between the rivets holding the tags, and through the material sandwiched between the outside glazed surfaces of the material.

If this is the case, then all switch wafers, valve holders and coil formers must be suspect, giving rise to HT and RF leakage, and may well account for the inferior performance encountered with many of these receivers. Whether moisture is penetrating the core of the paxolin type material or there is some chemical decomposition it is not clear, and exactly what action to take will depend upon material available and just how much each individual treasures his particular receiver!

Western

ALUMAST



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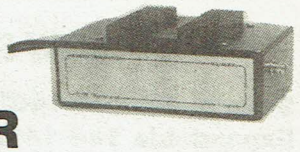

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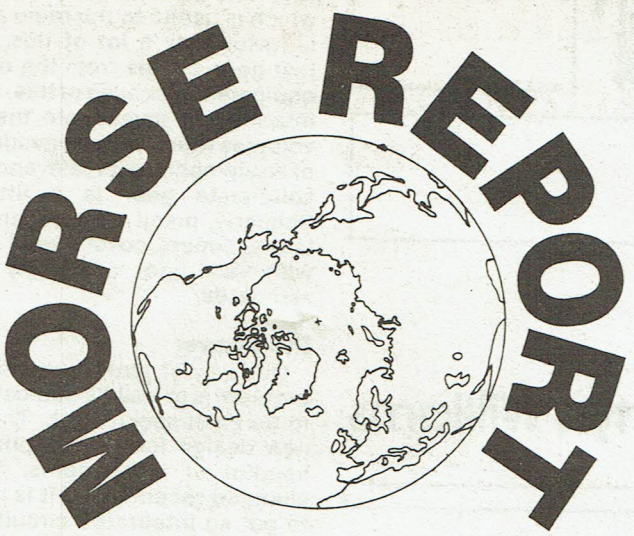


Tony Smith G4FAI takes his bimonthly look at the world of dots and dashes

EUCW is an association of over a dozen European CW clubs dedicated to encouraging the use of CW on the amateur bands. This year, its annual fraternising CW QSO party is over the weekend 14-15th November and is open to all, including SWLs.

There is usually plenty of activity and it can be most enjoyable. Although basically a contest, it is less impersonal than some other events. Exchanges are fuller than normal and include name, QTH, club and club number (NM if not a member). Certificates are issued to the first three stations of four classes.

It's all very civilised. It doesn't take the whole weekend, and the frequencies are deliberately limited to allow non-participants QRM-free QSOs! The schedule is as follows: Nov 14: 1500-1700GMT 7.010-7.030 and 14.020-14.050MHz; 1800-2000GMT 7.010-7.030 and 3.520-3.550MHz; Nov 15: 0700-0900GMT 7.010-7.030 and 3.520-3.550MHz; 1000-1200GMT 7.010-7.030 and 14.020-14.050MHz. Call CQ EUCW, and work (or SWL log) stations once per band per day.

This is an occasion when CW operators of all persuasions, beginner or veteran, QRO or QRP, low-speed or high-speed, all come together to demonstrate that amateur CW is alive and well. So come to the party, fraternise, and have a good time! There's not enough space to provide all details here, but if you would like more information just send me a stamped addressed envelope, QTHR, and I'll send you your invitation!

New book

Two years ago Mark Francis G0GBY could not read a single letter in Morse. In August this year his book, *The Secret of Learning Morse Code,* was published. It would be easy to say, 'How can a newcomer write such a book?' But if you think about it, when is there a better time to write about learning Morse than shortly after you have been through the whole process yourself?

In his introduction, Mark says 'I have received so much help and advice from fellow amateurs that I felt this should be recorded and passed on to others, so they may also benefit from all the suggestions and advice given to me.' He also says, quite rightly, 'there are many conflicting ideas and views on the best approach to Morse code'.

Having said that, he goes on to describe in considerable detail the methods which worked for him in learning the code and passing the test. He tells prospective candidates what to expect when they take the test and describes his own experience as an encouragement for others. To help candidates he provides a number of sample tests to practice with in advance of the big day.

My only reservation, if it can be called that, concerns his suggestion that as the test only requires a knowledge of letters and figures, there is no need to learn anything else at this stage. I have to admit that when I learned the code I took the same view. It's just that I have changed my mind since!

It seems to me now that students should acquire a little punctuation, the basic procedure signals and a few abbreviations, as part of the learning process. Perhaps more would then be inclined to try Morse on the air after passing the test instead of shying away and being lost to the mode without ever having tried it.

The book does, however, have a number of appendices containing the punctuation symbols, a good selection of Q codes, and nearly 150 abbreviations to use in CW work.

It also recommends other publications to help the beginner get on the air and offers some help itself – in the form of a sample QSO, together with details of the G-QRP Club's Novice Award intended to encourage newcomers to use the key during their first year of operation.

If you want to learn Morse, or if you are in the process of learning, I recommend this book. Published by Spa Publishing Ltd, it costs £4.95 from most amateur radio outlets. It is also available by post from Waters & Stanton, 18-20 Main Road, Hockley, Essex, for £5.85 post paid. I congratulate Mark Francis on a fine publication. It could well become a 'standard' book for learners in the years ahead.

You don't forget it!

Jack Pemberton, G3DOZ, wrote to me, 'Having just retired, I thought I might dust off my key – silent for 40 years! If it's any consolation to those of your readers who are struggling to learn old Samuel's code; you don't forget it. I was pleased to find that I can still read at 20wpm (give or take an oblique stroke!).'

Jack was delighted to find that under the new arrangement announced recently he could get his old call back without re-examination. So if you hear him on the bands give him a warm welcome-back to the mode and let him demonstrate to you the permanency of Morse once you have mastered it!

Vintage Field Day

The Norwegian Historical Radio Society (Norsk Radiohistorik Forening) held a rather special field day on 30th May. They took WW2 clandestine communications equipment into an open-air location of the kind it was originally used in, and invited a number of war-time operators to join them for the event.

A number of different sets were used, including the Type B3 MkII, the 19 set, illegally produced Norwegian sets and a few from Germany and the USA. The main intention, however, was to get CW signals through to Britain with Type B3 MkII, the set most used by the Norwegian Resistance groups.

Unfortunately, although a good number of contacts were made, under the call LA1D, none were with the UK. This was partly due to heavy QRM, partly to antenna problems, and partly to the fact that there was insufficient publicity in advance to alert potential UK participants.

The Norwegians would like to try again to establish a vintage radio-link between the two countries. I will publicise anything arranged, but if any readers owning vintage equipment care to send me an SAE I will ensure that they are notified individually.

In the meantime, NRF have established a permanent 'antique' net on approximately 3.575MHz every Saturday morning from 0730GMT. They call CQ ANT to begin with, and would be delighted to receive calls from British stations running vintage equipment. Let me know if you make contact!

Why not?

A note from G3MCK says, 'The other day I came across two UK stations having a fine CW QSO on about 3.700MHz. Quite within the bandplan, but most unusual. I wonder why?'

Would anyone care to comment?

PROJECT BOOK

by Martyn Williams

There is a lot of equipment on the surplus market at very realistic prices, which is useful to the radio amateur, but unfortunately a lot of this, particularly test gear, comes from the days of valve equipment. Because of this, the gear was intended to investigate the fairly high voltages which were common in that type of equipment, so its relevance to modern solid-state gear is a little suspect. Similarly, many early receivers, especially scanners, cover useful airspace but with very poor sensitivity by modern standards.

The answer

One way of getting round this type of problem is to build a dedicated amplifier to do each specific job. This involves a new design for each application and a handful of components. Things have changed recently and it is now possible to get an integrated circuit which, with only a slight change in existing component values, can be arranged to do more or less what you require in a specific application.

The IC is available from Plessey, type SL560 or from RS Components as the RS560 (these type numbers may be followed by a single letter suffix, usually 'C'). They can be set up to give high gain, wide bandwidth or low noise operation – or indeed, any combination of these parameters. Two other bits of good news are that they will work up to around 300MHz and they are cheap!

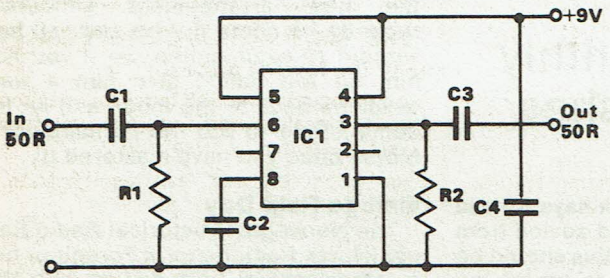


Fig 1 *Components*
R1 22k ¼W
R2 330Ω ¼W
C1, 2 10nF disc ceramic
C3 100nF disc ceramic
IC1 SL560C

Broadband amp

The circuit for this is shown in *Figure 1*. The supply requirements are 9 volts at 35 milliamps, to provide a gain of 10dB which is sensibly flat between 3 and 300MHz.

The maximum input level is 300 millivolts, peak to peak, so you will have a hard time trying to overload it. The output impedance is matched for 50 ohms and the maximum output into this load is 1.7 volts. You could even use this as a QRP output stage.

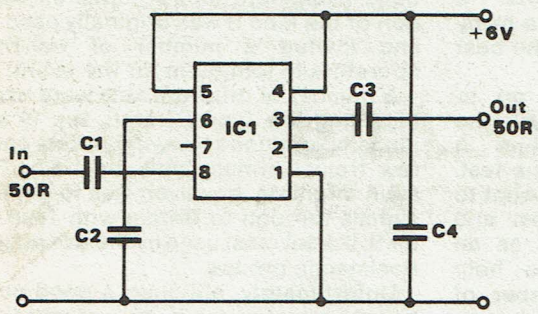


Fig 2 *Components*
IC1 SL560C
C1, 2, 3 10nF disc ceramic
C4 100nF disc ceramic

50 in, 50 out

Figure 2 shows a broadband amp with both the input and output impedances matched to 50 ohms. Note that the supply voltage for this circuit is 6 volts. The unit provides 15dB of gain falling to about 10dB at 200MHz and is capable of providing up to 5 milliwatts at the upper frequency.

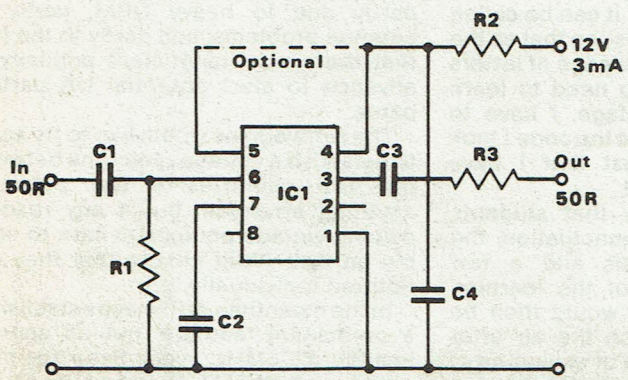


Fig 3 *Components*
C1, 2, 3 10nF disc ceramic
C4 100nF disc ceramic
R1 2k2 ¼W
R2 390Ω ¼W
R3 33Ω ¼W
IC1 SL560C

Low noise

Figure 3 shows the circuit for a low noise pre-amp, which is just the thing for an older scanner. It provides a noise figure of only 2.5dB right up to 150MHz with a virtually flat frequency response up to this frequency. The gain is set by the linking between pins 4 and 5; the gain will be 13dB with the link in place or 23dB without it.

The supply voltage for this circuit is 12 volts. The input and output circuits are matched for 50 ohms and this matching is dependent on both the supply voltage and the value of R1; these must be as specified, give or take the usual component tolerances.

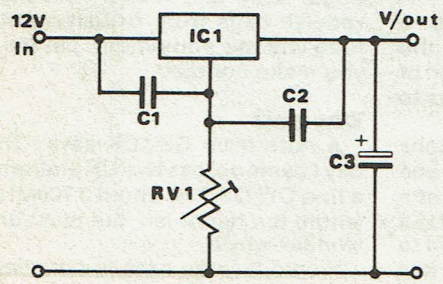


Fig 4 *Components*
IC1 7805
VR1 1kΩ preset
C1, 2 .47μF polyester
C3 10μF 25V electrolytic

Open door

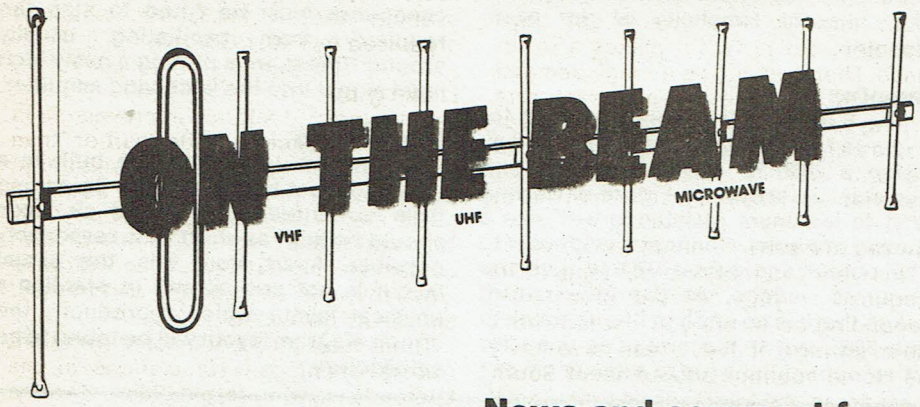
It must be remembered that these units give a lot of gain over a very wide bandwidth and are, in the jargon, wide open. This is essential for many applications, but where the frequency range can be restricted, say for use as a 50MHz preamp, some filtering should be included. Possibly the simplest way to do this is to include a suitable series tuned circuit, placed in series with the output from the amplifier. This could be resistively loaded to obtain the required bandwidth. Normal tuned circuits can be fitted across the input but, due to the low impedance at this point, they do require careful matching and this tends to defeat the inherent simplicity of the basic designs.

Supplies

The 6 and 9 volt supplies needed for *Figures 1* and *2* can be easily obtained by using a 7805 IC with a small jack-up resistor, as shown in *Figure 4*. Setting VR1 to minimum resistance will give a supply of 5 volts. Connect a voltmeter to the output and adjust VR1 to give the required voltage. At the low current taken there is no need to fit a heatsink to the 7805, but if the circuit is used for other applications (up to a maximum of 1 amp) then one should be used. The .47μF capacitors *must* be fitted to stop the regulator from oscillating, usually around 10MHz, thus putting a nasty high level signal into the wideband amplifier.

Construction

The whole unit should be built in a small die-cast box to provide screening from unwanted pick-up and all leads should be kept as short as is reasonably possible. Apart from this, the actual layout is not critical and in practice a physical layout which reproduces the circuit diagram layout will be found to be satisfactory.



News and comment from Glen Ross G8MWR

Moan and groan dept

Several letters have been received this month, all of which have been complaining about what can be loosely described as operating standards. The favourite moan seems to be about the person who you think can clearly hear your CQ call, but promptly follows up with one of his own, without giving you time to hear any reply which may be coming your way.

The problem is not always as straightforward as it seems and the assumption that the other station heard your call may not be correct. It all depends on the relative powers of the stations concerned and the beam headings that are being used.

If you are only running a couple of watts output and the other guy is running legal limits then, if your beams are broadside on, he may not even hear you, although you could still be getting a good signal from him off the side of your beam. Of course, if the other station is fairly local to you then – just put it down to a case of electronic yobo-ism or the 'alligator' effect; all mouth and no ears.

What now?

The sporadic E season is past, some people think it never really arrived this year – the next thing to look forward to is the big tropo openings, which usually occur round about this time of the year.

The signs are, usually, a large high pressure system that is starting to move away from us and also the possibility of temperature inversions where a nice warm day is followed by a very quick drop of temperature in the early evening and perhaps, with a hint of fog around.

Remember . . .

A point to bear in mind is that if there have been excellent conditions in the evening, they are often followed by similar conditions first thing next morning; it is always worth getting up an hour earlier than usual and having a scout round the bands before you head for work or back to bed. Also do not forget that, contrary to popular belief, openings do not always start on two metres and work up, as many operators seem to believe.

In fact, you will frequently find that seventy centimetres or even twenty three centimetres opens first and then the lower bands follow on. It is not at all uncommon for twenty three centimetres to be open into the continent when two metres is as dead as the Dodo. This is one of the reasons why I am not heard very often on two.

The problem

Another common moan is that although you have called the DX station for hours non-stop, you have not had a reply and yet your mate up the road, who runs less power than you, made it first call. Well, this is partly the luck of the draw, of course, but are you really sure that you are giving yourself the best chance of making the contact?

Tricks of the trade

Like most other activities, there are tricks of the trade to be learnt. Nearly all newcomers call the DX station by netting on to the frequency he is transmitting on, the problem being that he is unlikely to be listening on the same spot on the dial. This may sound odd but a moment's thought will sort it out.

The answer

Not all rigs Tx and Rx on exactly the same frequency, so he will have had to use his RIT to clarify the incoming signals and, because he will not have reset it to zero offset between each call, he may well be receiving two or three kilohertz away from his sending frequency. If you call him on his Tx frequency, you will just be monkey chatter in his receiver.

So what do you do to get round this problem? The answer is to tune to a signal that you can hear, of someone who is already in contact with the DX station and then use your RIT to clarify the DX station. Now when you call the rare man you will be on the receive frequency that he used only a moment or so before and he has a far better chance of hearing you.

Serious stuff

Do you fancy losing some of our VHF and higher parts of the spectrum? Listen carefully. In March 1985 the DTI commissioned a report entitled *Deregulation of the radio spectrum in the UK*. This report, running to two hundred pages, was published in March 1987. The June 1987 issue of *Radcom* casually wrote it off in two paragraphs and nothing has been heard from the RSGB on the matter since. You may feel that this is because it was of no interest to the amateur radio world, but let me quote from page 147 of the document:

Conclusion

'It is our opinion that the quantity of spectrum set aside for amateur use is larger than economic considerations would dictate . . . We recommend that the UK government apply pressure in international discussions to avoid further increases or even to *reduce existing allocations.*'

The response

The RSGB, who should represent all radio amateurs in Great Britain, were asked to comment on the report not later than 30th June 1987, but apparently *failed to do so,* saying, in effect: 'The Society cannot react quickly since a number of committees and volunteers are involved'.

Let us be kind, they did only have four months from March to June to get a reply together and it was only a trifling matter of the possibility of losing some of our bands that they had to respond to. Now, some six months after the report was published, the RSGB, have still not submitted a formal response.

Complacency

Remember, you are paying the best part of twenty pounds a year for this representation. I suggest that you put pen to paper and ask them when they are going to sort this one out. If you don't, they will simply assume that 'nobody complained, so we thought nobody was interested'.

While you are at it, you might ask them how they are progressing on the problem of the Pave Paws type radar installation which is being erected up North and, if American experience is anything to go by, could mean the effective loss of seventy centimetres. You may remember when I reported this some months ago, the RSGB responded by saying that it wasn't coming and even if it did arrive it didn't matter – well there are an awful lot of bricks and equipment being assembled up there! After taking all that stick I think they deserve a free plug . . . Join the RSGB they do, after all, represent all UK amateurs, and although they may have lapsed in the above they put in an awful lot of work on your behalf.

Extra digits

For those of you into the Packet scene the following will be of interest. Another batch of digipeaters has been licensed

by the DTI and if they are not already active, they should be on in the next few weeks. They are all on two metres and share the common digipeater frequency of 144.65MHz.

Callsigns and locations are GB3EA in Bury St Edmunds, GB3GP at St Peter Port in Guernsey, GB3LP at Llandudno, GB3NP located in Norwich, GB3POX down the road in Cambridge, GB3TA which is in Swindon and further up the A4 in Reading is GB3RA which also boasts a mailbox facility. Down in Gloucester there is a new seventy centimetre repeater (not digital), with the callsign GB3GH.

This one is located just outside the town at Ullenwood and does its stuff on RB5. Reports would be welcomed by Nick G6AWT (QTHR) who is taking time off from his 10GHz activities to do the job.

50MHz FM

The RSGB VHF committee has come up with proposals for FM use on 50MHz. The recommendation is that FM channels will be from 51.41 to 51.59MHz with the calling channel on 51.51MHz. The channel spacing will be 20kHz to conform with the USA standard and will also adopt the 10kHz offset from the more normal round figure frequencies that we are used to on two metres. The deviation however will be the usual 5kHz.

This may seem to be doing a bit of an about turn on what we might have expected, but in fact it makes a lot of sense. There will not be enough demand in the UK to warrant the manufacturers turning out special European versions of the rigs, and so using the USA standard is the only way in which equipment at reasonable prices will be available here.

The microwaves

This year's cumulative contests have produced varying degrees of activity. Depending on where you operate from the main high activity areas have been the Home counties and adjacent South coast areas, the Midlands and the South Yorkshire to East coast area.

In these areas there has been a noticable increase in the use of 10GHz SSB and in the Midlands a surprisingly large increase in 24GHz activity. The 240km path from Scotland to Snowdon was worked by several people and a new, previously unknown 170km path was found between Scotland and Northern Ireland, where there is a busy 10GHz group. In the Midlands it is now practically impossible to find a Sunday when there is not some activity.

If you live in the service area of the GB3AM repeater, keep an ear open for Dave G0DJA who can keep you up to date with what is happening. In the Sheffield area, look out for the Wednesday evening net on 144.33MHz, which is organised by Peter G3PHO.

Looking up

The expected Autumn improvement in conditions came a little earlier than expected with a very nice opening into Europe over the Bank holiday weekend at the end of August. Conditions on 144, 432 and 1296 were excellent, with contacts being made into Scandinavia, Germany, eastern Europe, Switzerland and Czechoslovakia.

There have also been some excellent Aurora openings with stations in the Midlands working into Norway, Sweden and the Faroes. Many reports have been received of stations working SM1BSA on the island of Gotland off the East coast of Sweden. There are also reports of contacts into the UP2 and UQ2 areas of Russia.

Close down

Nearly 2000 words, more than enough, time to say farewell for this month. Thinks; this morning I was given a report of S zero/Q five; how can an inaudible signal be fully readable? All comments to me at 81 Ringwood Highway, Coventry CV2 2GT. Or you could use Prestel on 203616941. Now where did I put that nurses uniform, Anita? Cheers.

SECONDHAND EQUIPMENT GUIDE

by Hugh Allison G3XSE

In the August issue I touched briefly upon the subject of sexing transistors, and had a bit of a moan about people who 'repair' equipment by putting npn transistors into pnp circuits. Accompanying my contributor's copy (at the end of July! How do people get their copy of this magazine so early?) were several readers letters asking how to differentiate between npn and pnp transistors, and how to then select a replacement?

Sexing the transistor

The first move has got to be the sexing of the transistor. You will need an AVO, or similar, switched to its mid ohms range. If you can, practice on a known good transistor first, preferably an npn one that you know the connections of. If you refer to *Figures 1* and *2* you will see that, with an npn transistor, the black lead to the base should cause the meter to read when the red one goes to either the collector or emitter. Remember, if you can, 'black base npn reads'. I find this so much easier than the people who stand there trying to remember what polarity of the internal battery goes to what terminal of the meter and how this will then bias the transistor. 'Black base npn reads' means that, with the black lead of the meter to the base of an npn transistor, the needle should read to either of the other transistor legs.

Done that? Now put the red lead to the base and connect the black to the collector, then emitter as per *Figures 3* and *4*. There should be no reading.

pnp transistors are the opposite, so we need to remember 'Red base pnp reads' ie, the red lead to the base of our pnp transistor should give a reading when the black goes to collector or emitter, and will not read when the black goes to base and the red goes to either collector or emitter.

In all of the above it is pairs we are looking for. The reading you get with the emitter to the red lead, black to base must roughly equal the red to collector, black to base. One reading and one not means the transistor is NBG (No Bloody Good). Similarly, if you cannot find a pair that will conduct somehow with the AVO leads one way round, the transistor is open circuit (think about it) or, alternatively, if it conducts in all directions it's a dead short.

So far the above is all you will find in any good practical servicing guide. What a lot of them fail to tell you to try is that you should now check collector to emitter *both ways*. Regardless of the sex of the transistor (npn or pnp), the AVO should not read. If it does, and it never ceases to amaze me that a transistor can look good base/collector and base/emitter but 'grow' another diode emitter/collector, then it too is NBG.

Punched through

Very often a transistor duff emitter/collector, which, incidentally, is referred to as 'punched through', may have failed through over volts, ie its emitter collector voltage (VCE) may have been exceeded. If I find a failed transistor like this in equipment in which highish voltage lurks, I check carefully for other faults. This is very common in electronically controlled washing machines, for example, when the module 'on board' power supply goes high.

Before leaving the testing of transistors it is only fair to warn about early transistors, such as the OC, XA and AF series. These will appear a little leaky in all directions, ie when doing your AVO checks as above, where you would expect no meter movement (normally with the black to base since they were nearly all pnp) you will see some movement. I normally start to suspect one of these transistors if the 'off' resistance is lower than about 5000 ohms. This also applies to all the transistors in Russian portable radios.

Finding a replacement

Let us assume that your fault finding was correct and the transistor you have hauled out and checked has proved to be duff. You obviously want to repair the equipment, thus a replacement is required. One approach is to buy the correct part, which is great. However, the transistor may not now be obtainable, the repair is required immediately, or the duff transistor may be unidentifiable. Having learnt how to check the transistor as above, you can often use the converse to sex the remains of the dead transistor. For example, if the only reading you can get on the AVO is with the red on the base, black to collector, everything else giving no reading it's a fairly reasonable bet that the transistor was pnp.

Should your luck be really out, ie open or short circuit in all directions (or a great big hole in the transistor case!) then all you can do, assuming a lack of circuit diagram, is fire the circuit up and sort out which pin has what volts on it.

To an extent some transistor lead-outs are fairly common. Regardless of case size, *Figure 5* is about the most standard you will get. If the can is also connected to a three wire transistor then the can is invariably the collector. On a four wire transistor the case is the screen. Incidentally, it's well worth checking that the screen wire has not made contact with

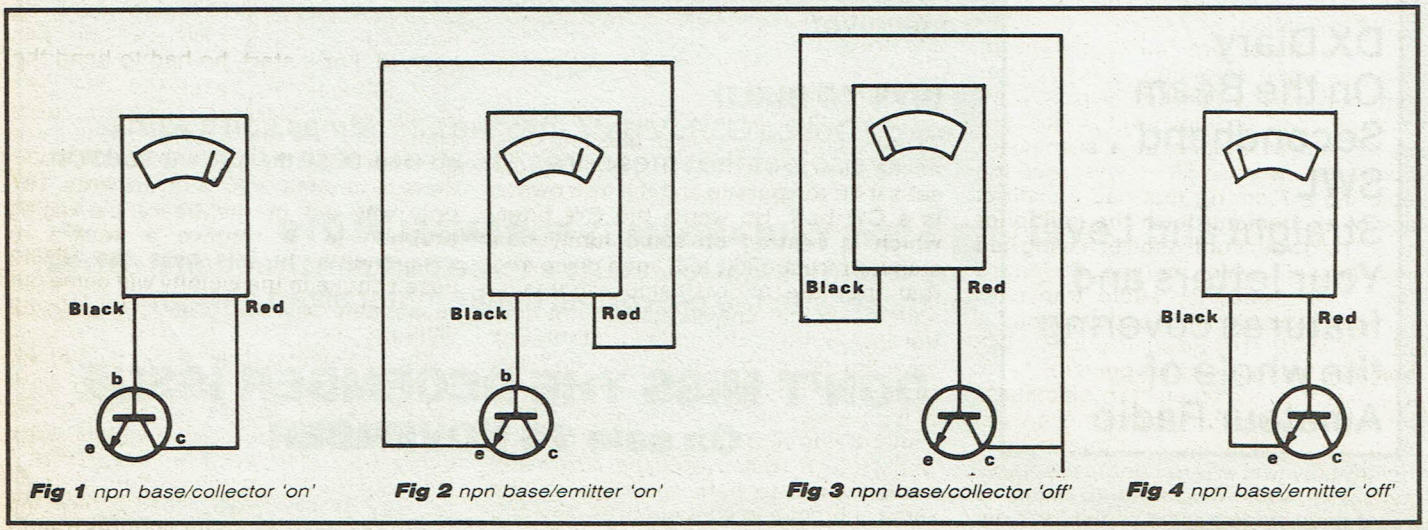


Fig 1 *npn base/collector 'on'*

Fig 2 *npn base/emitter 'on'*

Fig 3 *npn base/collector 'off'*

Fig 4 *npn base/emitter 'off'*

the other wires somehow, which is very common on AF series transistors and a few OC types.

I once remember repairing a 'scope where a small signal, plastic encapsulated transistor was a dead short in all directions. It was fairly obvious, although I had no circuit diagram, that the transistor was in the trigger circuit and needed to be a npn VHF type. I'd selected a suitable replacement from the usual dross littering the bench, but was unsure as to the lead-out configuration the scope required. As I wrestled with AVO leads trying to work it out, a smarty pants apprentice pointed out that the old transistor had BCE marked on it!

A dot or line adjacent to one pin is indicative of collector, and, since your AVO will tell you what is the base, the other lead has got to be the emitter.

Selecting an alternative

So you now know if you require npn or pnp, and you should have an idea of how to identify the lead-out. All you have to do now is select a replacement. The best clue is – what was the dead one doing? If it was, say, an audio output transistor then we are mainly interested in the dissipation of the replacement. There is no point in fitting a 100 milliwatt dissipation VHF transistor in the audio output stage of a car radio which will be shifting watts, for example, yet a fairly hefty RF transistor could be used here if you were desperate. With power supply transistors you are mainly interested in the volts across it and the power it is dissipating. As a rough rule the more volts and watts the replacement the better. Don't forget that a dead power supply transistor is often due to problems elsewhere.

For small signal transistors – we are talking of IF mixers, VFO's RF stages etc – the first consideration should be frequency capability. A 50MHz IF transistor is of no use in a two metre front end, but conversely there isn't a lot against a 1GHz device in an IF strip at 455kHz.

RF power devices feature the equal considerations of frequency and power. If dealing with an AM set on 12 volts it's also worth a quick glance at the voltage capability of your selected replacement – there could well be 36 volts or so at 100% modulation.

I know there are other things to consider when selecting your replacement, particularly gain, but the rough and ready guide given above will at least put you in with a chance of a successful repair. As an example I was recently repairing a 70cm rig that had a distinct lack of excitement down the multiplier strip. The owner confessed to having had a go himself, which helped me find a 1MHz max frequency audio transistor trying to triple to 140MHz. His reason for fitting it was that it had come out of a UHF Westminster and was thus good for 70cm. What a pity he had taken his replacement out of the modulator. If he had taken one out of the Westminster multiplier (which, incidentally was where I got his replacement from, since it was still to hand) he would have made a good repair. So near and yet so far!

Fig 5 *Standard pin out bottom view*

Fig 6 *Round an IC as bought*

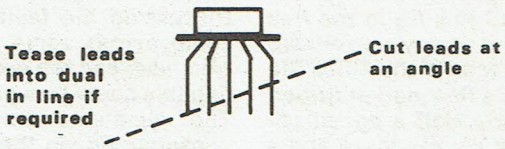


Fig 7 *Leads arranged for dual in line and cut for easy insertion*

I know I've said this before in these hallowed columns, but the number of letters I get asking 'Where can I get a B123 transistor' every month proves that it needs repeating. Japanese transistors often leave off the 2S from the start of the number, so a device coded B123 is really a 2SB123, which makes it much easier to find in transistor data books! The same goes for all Japanese transistors starting with an A, C or D, they are, obviously 2SA, 2SC or 2SD respectively.

In finishing this article on selecting replacement transistors I would like to return to the subject of line output transistors in televisions. These transistors are a very special breed, mainly due to their ability to withstand a thousand volts or so across them. Your average, 2N3055 will not take this, it normally limits at a couple of hundred volts or so, which can result in a very dull picture, probably with naff focusing. You would be amazed at the number of Heathkit Kit TVs (the ones in the wooden box) that come my way with a 2N3055 lurking in the line output stage. Pop in a BU208 or some such and they are away.

Filing

At a flea market I picked up a cross-pointer type SWR bridge. Ten pence seemed reasonable for it, even though the movement didn't look at all well. The seller told me it had stopped working after he drilled a hole in the case to fit a bulb to illuminate the meter. Guess where the swarf went? Don't let this happen to you, remove all meters prior to any drilling!

TS520 IF filters

The scenario is that the first owner of a TS520 is only interested in SSB and thus never buys the optional CW filter. He sells it off to upgrade and the new owner is a CW buff. He wants the CW filter, which is centred on some funny non standard frequency, and soon discovers that they are unobtainable. Unobtainable means not only in the UK, not only the USA but also Japan (a lot of telexes have flowed on this one!). I can be fairly certain that I am correct in saying there is only one way out of the problem since, whilst trying to help one of the readers who wrote in, I discovered that Arrow had endeavoured to help someone on the same subject and come up with only the one, same, solution. The Fox Tango Corporation in America sell filters in a variety of bandwidths for most of the TS series. I am given to understand that these are not Trio/Kenwood filters but of their own origin. I have no experience of their CW filters in Trio gear, but had one in an Atlas rig wherein it was superb. They certainly are not cheap though, so lever the price down if you are purchasing a 520 without filter and are a serious brass pounder. Beware, incidentally, any TS10/Kenwood rig with AM. Fitting a CW filter can be a problem.

As an aside I've met up with a few amateurs who have bought bits and pieces (as distinct from whole rigs) from America. Those that have gone through a bank in any way – dollar cheques etc – have been upset at being about 7% worse off when the transaction was all over due to various bank charges, commissions etc. A couple of amateurs just used their credit card/charge card over the phone and were quite impressed at the very favourable exchange rates they received when the bill came in. I have no experience of this myself and would welcome the comments of readers on the subject of offshore purchases made from the UK.

Circular ICs

Last month I mentioned the 747 problem in Palm handportables. Coincidentally I have just received a letter from an amateur who was going mad with frustration trying to fit a 747 IC into one. He had removed the faulty IC without any problems and bought a replacement. His problem in fitting the new one was twofold. For a start, he had to bend the lead-outs from circular (as they come out of the IC) to dual inline, as the board expects to see them. Secondly, there is no room to get the new one in, due to the density of components in the area. The only way out of the board packaging problem is to remove a couple of components. In this case the ferrite based choke in the vicinity will come out reasonably easily, greatly improving visibility.

The actual insertion of the IC into the board can be greatly helped by both reforming the leads into dual in line before starting to fit (this can be done using the *underside* of the board, where there are no other components to get in the way, as a template), then cutting the leads across at an angle, *Figures 6* and *7*

give the idea. The advantage of cutting like this is that you only have to persuade one pair of leads at a time to go down their respective rat holes rather than all 8 or 10 in one go, which really is an improvement.

FDK multi 800

Your scribe bought a 'sold as not working' example of this rig in the flea market at Woburn at a very reasonable price. Incidentally, what a shambles the advertised member's flea market turned out to be at Woburn. Half a dozen car boot sellers here, a couple there and a handful of tables in a tent, divorced from the main attractions, and all of it liberally covered in the usual Woburn muddy slime – however, I digress.

The seller of the rig told me the PA module had gone, then said something very rude indeed about the price of spares for this rig. Having repaired several of the PA modules I decided to take a gamble and bought it. On the workbench the fault turned out to be a short circuited variable capacitor. This is the only variable on the PA module board, and appeared to have melted. Discussing the fault on the air I have come across some other FDK owners who have had the same fault, so it looks like this could be worth bearing in mind. The symptoms are: variable current consumption via the power-out control on the front panel, from 1 to 5.5 amps but no RF out, with the front panel meter hardly moving. I was quite pleased to have acquired an otherwise good rig at a cheap price.

Icom spares

Remember my ravings about the disgusting price of a dedicated micro for an Azden rig? At Woburn I bought a dead IC255 Icom rig. The fault turned out to be a dead dedicated micro. In fear and trepidation I rang up the Icom spares department to timidly enquire about the price of a replacement. The man explained that the chip very rarely gives trouble and suggested several checks I should carry out to confirm its health. He also went and checked that their stock was the same as their computer readout to save mucking me about. The cost? Less than a third of the price of the Azden one, and good service to boot – they went out of their way *not* to sell me one, and gave good technical advice freely over the 'phone. I am most impressed.

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■ Cobra 148GTL suitable for conversion to 10m, £100 ono. HyGain AM, FM, USB, LSB, £75 ono. WKS515 AM, FM, LSB, USB frequency readout, £100 ono. Colt Excaliber home base, down on power, hence £110 ono. Search 9, Daiwa 2m FM Rx, £40 ono. Zetagi BV131 linears 200W SSB, £175 ono. Zetagi TM1000, £30. Bremi BRS35 10A PSU, £30. CTE 767 linears 160W SSB, £25. All in vgc, good working. Contact Mr Patrick, Meadow View, Pound Green, Shipdham, Norfolk IP25 1LJ

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■ Racal RA117E Rx. RA218 SSB converter. MA1978 preselector, all fitted Imhoff cabinets. In new mint condition, £350. Smobuo slow scan monitor, superbly built, £40. Buyer collects. Wanted Trio T599, transmitter, Trio TS700S, TS770E multimode 2mtr transceiver. L Huntley, G4LW, 118 Bradford Road, Trowbridge, Wilts. Tel: Trowbridge 3166, any time

■ Realistic DX200 communications receiver, good condition, £65 ono. Partridge Joystick variable frequency antenna with Joymatch ATU, £25. Tel: (0925) 72 5402

■ FT23 latest model Yaesu 2m handheld with two FNB10 NiCads, NC28C charger, soft case, with h/b, PTT switch box, dc/dc convertor, MMB21 mobile mount, super rod ⅝ telescopic whip, YH1 headset mike, £275 the lot, still under warranty with all packaging. Also Minolta AFE quartz 35mm compact camera with data back and case, £80, only 8 weeks old, still under warranty. Paul Godolphin G4XTA. Tel: (09313) 359

■ Yaesu FT7 HF transceiver, plus tri-band vertical antenna, £250. Trio TR2300, NiCads, charger, helical, 10W linear, brackets etc, £150. Audioline 10FM (Spectrum conversion) with BRL210 100W mains linear, £85. Tandy 40 chnl handheld CB, £30. Tel: Tamworth 250038

■ Sait professional receiver MR1411, AM/CW/USB/LSB/FM, digital VLF-30MHz, full handbook, beautiful late example, £335. Woodson trawler receiver 150kHz-4.5MHz BFO and provision for switched crystal controlled 8 settings, handbook, £50. Army 'green' BC30 with headset/mike, no handbook, £45. Cameras Reid III with Ross telephoto, Leitz 50mm lenses, Mamiya Super Press 23 with back movement, £285 each. Wanted, 6 metre TRx/convertor. Tel: 01-660 1326 (Purley)

■ Trio 9130 multimode, boxed, new condition, £335. FT230 2 metre 25 watt mobile, £145. FRG7 receiver, £110. Trio 9R59DS, £45. 209RH 5 watt handheld spk/mic VOX headset, mobile bracket, £175. AR22 2 metre pocket Rx, £55. G4EMG. Tel: 01-584 3460 evenings, 01-553 7308 days

■ FT290R 2m multimode, NiCads, rubber duck, case. Good condition. CB power supply, Sun mobile KG208SEZ antenna + gutter mount, 2m collinear ⅝/⅝ 6.4dB, £300 ono. Sanyo MBC555 computer 256W twin disk drive, green screen Juki daisy wheel printer (6100). Software, Data Star, Report Star, Word Star, Calc Star + all users guides + spare 5¼ diskettes, £300 ono. Helen, Leeds. Tel: (0532) 588453

■ AOR2001 scanner, 25 to 550MHz (boxed). Revcone antenna plus leads. Also mobile car mounting and brand new car antenna, with all fixings. All for £280, bargain. Mr Terry Phillips, 2 Cyril Crescent, Roath, Cardiff, S Wales CF2 1DQ. Tel: (0222) 471366

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■ Sommerkamp FT290R case, NiCads, charger, boxed vgc, £260, or swap for 2m SSB or h-held + cash. Tel: (0226) 716477, after 5.30

■ ARA30 Dressler active antenna, mint cond, little used bought in Feb '87, excellent SWL ant. Will consider swap for ATU or scanner + or – cash adjust, price £90.00. All letters will be replied to, or write with phone no and time and I will phone you. S P Martin. 24 Collingwood Close, Worle, W S Mare, Avon BS22 9PQ

■ Deceased effects. Trio R2000 receiver with VC10 VHF converter, new and boxed, £450. Crotech 3131 15MHz dual trace scope, new, £150. Trio JR500S receiver, amateur bands 80 to 10 metres, £50. AR88LF receiver, £50. Jap HE40 Rx 500kHz to 30MHz, £20. Trophy 8 Rx 500kHz to 48MHz, £18. Technical handbooks copies, AR77, SX28, R216, SP600, R107, R206, £4 each. Others, list available. Tel: 01-554 6631

■ FT290R multimode with pre-amp, NiCads, charger, carrying case and mobile mount. All boxed and in immaculate condition, £265 ono. Paul. Tel: Wellingborough (0933) 224526

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■ Icom IC735 all mode tcvr, with superb genral coverage, condition, as new, £700. Purchaser to air test/collect. Gregg, 2 Park Road, Granborough, near Aylesbury, Bucks. MK18 3NS

■ Microwave Modules MMT432/285 transverter + Jaybeam MMB48/70 antenna, £100 ono. Jaybeam Q6/2M antenna, £20. Realistic DX160 receiver, £40 or will exchange for 10m SSB transceiver, general coverage receiver, FRG7 or WHY? Tel: (03635) 471 (Devon) evenings

■ Bought new but not compatible with present equipment. Mitsubishi MF353A D/S, D/B, D/TD, 3.5in disk drive, chassis and info. Tandon TM8480X compact 8in D/S 48TPI disk drive, chassis and info. two variable 12 volt 10 amp PSUs, half chassis insert fit. All boxed, unused, same with Jobo CPE2 amatuer photo colour/b/w processor, with instructions, complete, might consider exchange lot (cost £427.50+), Eddystone 830/4 WHY? Hounslow, 46 Garrick Road, Abington, Northampton NN1 5ND. Tel: (0604) 24486 evenings

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■ Uniden Bearcat model 100XL hand-held scanning Rx, exl cond, bought Sept this year, 16 channel, 9 band, coverage 66-88, 118-1369, 144-512MHz. ac power supply/battery charger, earphone carrying case, rubber duck antenna, NiCads, £165. G4EJH. Tel: Bristol (0272) 843897

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■ ARA30 Dressler active antenna, 0-40MHz brought Feb 87, hardly used, £90.00, includes PSU co-ax. Also Zenith audio speech processor, any reasonable offer considered. Also Plessey type 72 switches, 30-way, 3 pole, 3 bank, all silver contact, 7 to clear, offers? All letters answered. G P Martin, 24 Collingwood Close, Worle, W S Mare, Avon BS22 9PQ

■ WWII original USA manuals, sae list. 1940s domestic radios, approx 12, list sae. Pye base station as new, T401, R401, R/C. High band AM, offers. MM 100W VHF linear, £70. Single channel VHF mobiles, offers. Wanted R1116 manual, R1147 manual. RAF type multi pin plugs, sockets, grey metal with locking ring. Eddystone 740 finger plate, or complete Rx. Marine VHF R/T. Anything considered. Cain, 18 Oaky Balks, Alnwick, Northumberland NE66 2QE. Tel: (0665) 602487

■ Hand-portable, 68-88, 108-136, 138-174, 380-512MHz, AM/FM, search and scan, 16 memories, with rechargeable batteries and charger, rubber aerial included, vgc, box and instructions, little used bargain, £145 ono. S Wilden, 15 Poyntell Road, Staplehurst, Kent. Tel: (0580) 892764

■ Pye Cambridge AM10B six channel, with two control cables, two control boxes, mic and speaker. Working order, but no crystals, comes with manual, circuit diag, mounting cradle and all brackets. Ideal for 4 metres, £30 ono. G1RLA, Oxon. Tel: (0608) 3558 after 6pm

■ Octal valves, unused, boxed. Low prices, 6K7GT, 6SK7GT, 6K7H, 6SK7GT, 6Q7GT, 6SQ7GT, 6J7GT, at 75p each. 12V octals also, same types. 25V octals, 35V octals, 50L6GT, £1.50. All others 75p each. 6A7, 6F7, 6L7 at £2 each. Post free over £5, £1 post under £5. Some UX types available, sae for lists. A E Jeffrey, 42 Dennis Road, Padstow, Cornwall PL28 8DF

■ Icom 720A gen cov trans ICP515, SM5 desk mic, £700 ono. Mr A Herbert, 98 Blithdale Rd, Abbey Wood SE2. Tel: 01-311 0332

■ Ham International Concord 2, suitable for conversion to 10MHz, offers. ATU, make Amtech 300, CB Rotel 230 in good condition, £35 ovno. Video Betamax, buyer to inspect and seen working, £75. Tel: (0283) 221870

■ KW Vespa mark 2 Tx, good cond, new PA valve, £70 ono. Racal RA17L Rx, very good cond, £160 ono, price for both £200 ono. Alan G1EBH, QTHR. Tel: Basildon (0268) 45573 after 6pm

■ Yaesu FT690R MkI, new condition, £235. MET 3-ele yagi unused, £20. Both for £250. G2AIH, Epsom Downs, Surrey. Tel: (0737) 350995

■ 934MHz Uniace 400, immac cond, still boxed plus 10 element beam, £195. Tel: (0752) 345784

■ FDK Multi 112 metre FM transceiver, c/w mobile bracket, ⅝ whip and gutter mount. 10W/1W. Owner's handbook. Repeater channels R0/R7 and inputs, simplex 19/23, auto scanning, £110. G3RDG QTHR. Tel: 01-455 8831

■ Eddystone 770R Rx excellent condition, £100 or swap for HF Rx, cash adjustment if required. Wanted Eddystone 940 Rx, Drake R4C Rx. Mr Wright, 54 Queen Mary Avenue, Basingstoke, Hants RG21 2PG. Tel: (0256) 468649

■ Kenpro KT200EE, similar to IC2E, vgc, 1 year old with accessories, microphone, soft case, spare aerial etc, £120. KW Vespa HF Tx and matching KW201 HF Rx both in good working order, £140. (G0BES). Tel: Winchester (0962) 883066

■ Tristar 747 multimode, plus extras. CTE Speedy 26 to 30MHz 120 watts max (needs new valve). Both in gwo. Phone for more info. Wanted: manual for Taylor 45C valve tester. The above are Tristar, £70 ono, CTE Speedy, £40. G1YPM (Ricky) evenings, Tel: Exeter 31941

■ Commodore 64 monitor new, never used, £50. Or will exchange for Trio R1000, Trio R600, Yaesu FRG7, Heathkit RA1 or HR10B. Apply to Brian, 55 Torquay Gds, Redbridge, Ilford, Essex IG4 5PU

■ FT690R all mode transceiver with NiCads, charger and carrying case, two months old, £265 ono. Consider part exchange for 2mtr equipment. Contact GW1ATK. Tel: (049528) 661 anytime

■ Trio JR310 Rx 80-10m Xtal control front end, manual, mint, buyer collects, £80. HRO spares: 4 gang cap, dial, S meter, 21MHz coil box, mint, buyer collects, £10. H V Rayment, 5 Oakwood Drive, Bletchley, MK Bucks MK2 2JG. Tel: (0908) 643 929

■ FRG9600 100kHz to 950MHz scanner, fitted with video unit, £500 ono. AMT 2 and BBC ROM, £180. Wanted: FT77 or FT707 or similar. Tel: (04312) 242 and ask for Derek

■ ZX Spectrum and computer, including data recorder, interface and joystick, manual and instruction tape. As new, boxed, £75. Tel: (0925) 725402 (Warrington)

■ Yaesu FT207, NC1A chger, Yaesu FT208, NC8 chger, Yaesu FT202 6 chnl, Belcom chgr LS20XE, communications receiver Eddystone 640, TCS12

FREE CLASSIFIED ADS

station Tx/Rx, R209 receiver. Tel: 01-949 2317

■ Trio TS120V HF solid-state trans, 10 watts output, c/w PS20 power supply, VFO120 external VFO, and SP120 speaker. All in mint cond, £450 ono. Also Yaesu FT221R, £325, and Kenwood TR9500 UHF set, £250. Datong audio filter, £30 or WHY? I am prepared to haggle, so ring for a chat. Andy GU1WDT. Tel: (0481) 49112 after 5.30pm

■ Trio 2500 hand-held with case, spk mike, mobile stand, dc charger and ac charger. All mint cond, £175 ono. Tel: Peter (0246) 415784

WANTED

■ RA7 recording amplifeir and PSU. Swap 813s for 211s. G3BIE, 49 Westbourne, Terrace, Reading RG3 2RP, Tel: (0734) 53046

■ Belcom LS102L. Must be gwo, good price paid for mint condition. John. Tel: (038) 787660

■ HRO Rxs, dead or alive, BS coils p/p, spkr etc, no mods or bashed about too much. Also want a good BRT400 or valve gen cov Rx. Have Diawa CNW419 ATU, £160, as new. Trio MC60 desk mike, £50. Swaps etc considered. Tel: (0908) 313507

■ Serious collector requires T1154, R1155 and accessories, including loop aerial, static PSUs, cables etc. Also PSU for WS C12 plus ATU, 52 set parts, coils for 358X, coils for National 1-10,HRO coils, Admiralty B13, B21, B21A, B29, B50 receivers together with any information. Also require literally any wartime radio and radar equipment in good original condition. Tony Burke, Bridge Far, House, Tumby Woodside, Boston, Lincs PE227SR. Tel: (0526) 42173

■ 250 to 500 watt power amp, also power supply 15-20 amp. Tel: (061) 927 7325

■ ITC 12V TV camera with lens, also Sinclair microvision 12V monitor or other small 12V monitor. Tel: (0235) 33030

■ Icom ICR70 Rx, or Sony CRF330K Rx. Also interested in Pan-International Crusader X 12 band receiver. Cash paid for pristine sensibly priced example. Tel: (061) 7431570

■ Exchange Yaesu FRG9600 scanner, fitted video unit, with PSU, 6 mths old, boxed as new, for FT707 plus FC707 ATU. Tel: Stalham (0692) 82075 daytime only,ask for Ian

■ Cobra 148, Superstar, Nato 2000, best M/M rig offered or best scanner offered. Tel: Grimsby 827717

■ Panasonic RF9000, Sony CRF330K, RF6300. Grundig radios, cash offered. Non-working considered. Tel: (0462) 33690

■ Cobra 148 for conversion. Tel: (0283) 221870

■ External VFO for KW2000B. Dave G3UHU. Tel: Maldon (0621) 56286

■ Carrier level meter 100μA FSD for Eddystone EC10 mark II receiver. Please write stating price and condition. K Dean, 2 Bayard Road, Weymouth, Dorset DT3 6AJ

■ Hokushin HF mobile aerials for 20 and 40 metres (for some reason no longer imported). Name your price. Bernie Coles G0EHW QTHR. Tel: Preston (0772) 39702

■ Have Realistic Pro32 200 channel hand-held scanner, complete with NiCads, charger, brand new condition. Also Fluke model 77 digital multimeter with bargraph and shockproof case, excellent condition. Exchange both for SX400 or AR2001 scanner. Tel: (0207) 544342 after 6pm

■ Information on Asden PCS2800 10m FM transceiver brochures, circuit diagram operating manual, all postage refunded. Contact Steve GW0HNS QTHR. 46 Y Berllan, Dunvant, Swansea, W Glam SA2 8RE. Tel: (0792) 299566 any evening between 6-8pm

■ WW2 German ex-service radio/radar equipment, parts, literature. Any condition OK – museum purposes only, will collect. Cash or swap. Wanted for Norwegian museum: WS11, T-1190, WS65 + 66. AD67, 52ERT, RG37, YQ. Remote control units C, D, F, H. HS2 or SCR720 parts. Available: WS38, 58, 19, 22, Siemens GC comm receiver 12kHz-32MHz. OZ8RO Rag Otterstad, Vejdammen 5, DK-2840 Holte, Denmark. Tel: 010-452-801875

■ KW Ten-Tec Century 22 or Yaesu FT77S. Details to G0EWC QTHR. Tel: Bristol 776891

■ Spectrum Plus with Wafa drive, good cond, will exchange for a good sideband radio, Cobra etc, or any good receiver. Will sell for £175. Buyer to collect or pay postage. Mr Bourne, 72 Cornish Way, Royton, Lancs. Tel: (0706) 846815

■ Valve holders for 6HF5 valves, also 811 or 811A valves, cash waiting. G3HXQ. Tel: Dursley 3180

■ Atlas 210X mobile mounting bracket with IF, possible power leads and fitting instructions. Lionel G0GZS. Tel: (04022) 28896

■ Swap Philips video recorder for Sony ICF2001D radio receiver. Video includes nine VHS tapes, seven Scotch and two cheap ones. All been used, but only once for concerts and documentaries etc. Also wanted Realistic Pro30 hand-held scanner, money waiting. Richard Keary, 18 Cardew Avenue, XAcres, Wythenshawe, MI22 7XX. Tel: (061) 436 7224

■ Japan Radio NFG505 preselector, Stephens James Mark 2 multi tuner. MS7 speaker, Aux7 auxiliary programme board and RRM7 modules for Drake R7 receiver. Non working Hammarlund HQ180 for spare parts. Tel: (0875) 52317 evenings and weekends

■ National company HRO Senior Junior, MX, M, 5, W, 5TA, 5RA, 7, 50, or 60 series, any of these considered. Must be in gwo and complete with PSU and coils etc. Good price paid. Hammarlund also considered, valves for R390 receiver, particularly 6082 voltage regulator. K Hindle. Tel: (061) 962 7577

■ FRG7 Rx wanted (or sim), swap for Polaroid Polavision instant movie outfit, c/w zoom lens camera. Replay monitor, as new, or offers WHY? Tel: 01-906 4206

■ Icom R7000 scanning receiver, or Icom R71 general coverage receiver. Also Yaesu FT-2100Z linear. All must be in first class condition. Tel: (0206) 394336 Essex, after 7pm

■ Radio paging equipment wanted. Receivers, encoders etc. Preferably multitone equip, but interested in anything. Tel: Bristol (0272) 515596 after 6pm, ask for Mark

■ Mobile HF transceiver in gwo, also G whip or similar HF antenna. Tel: Les (work) 01-858 8675, QTH 01-462 6740 Bromley, Kent

FREE CLASSIFIED ADS

Send to: Amateur Radio Classified Ads · Sovereign House · Brentwood · Essex CM14 4SE

Classification: (tick appropriate box) If you want to insert ads under more than one classification use separate sheets for second and subsequent ads

For Sale ..... ☐ Wanted ..... ☐

USE BLOCK CAPITALS (One word per box)

To avoid mistakes please write clearly and punctuate your ad

Name/Address Postcode/Telephone							

USE SEPARATE SHEET FOR MORE WORDS

Ensure that you have included your name and address, and/or telephone number

CONDITIONS: Ads will be published in the first available issue on a first come first served basis. We reserve the right to edit or exclude any ad. Trade advertisements are not accepted

Amateur RADIO SMALL ADS

JAYCEE ELECTRONICS LTD
JOHN GM30PW
20 Woodside Way, Glenrothes, Fife KY7 5DP
Tel: 0592 756962
Open: Tues-Sat 9-5
Quality secondhand equipment in stock. Full range of TRIO goodies. Jaybeam – Microwave Modules – LAR.

D.P. HOBBS (Norwich) Ltd
13 St Benedicts Street, Norwich Tel: 615786
Open Mon-Sat 9-5.30
Closed Thurs 1.00pm
Stockists of:
YAESU, FDK, ICOM, JAYBEAM
& Electronic Component Specialists

USED AMATEUR EQUIPMENT BOUGHT SOLD EXCHANGE. SAE FOR LATEST LIST.
SECONDHAND PRICE GUIDE UPDATED MONTHLY
USEFULL GUIDE FOR BUYING/SELLING £2.00
ATU MODS ADD TOP BAND TO SEM KW ETC. £6.50
CALL **MARTYN G4SUI.**
GEEFOR ENTERPRISES.
112 LEEDS ROAD, MIRFIELD,
WEST YORKS. WF14 0JE.
TEL: 0924 495916
PERSONAL CALLERS BY ARRANGEMENT.

Selectronic
The UK's leading suppliers of 934MHz personal radio equipment
203 High Street
Canvey Island, Essex,
Tel: 0268 691481
(Open Mon-Sat 9-5.30)
Amateur radio equipment also in stock

CIRCUIT DIAGRAMS
Any Make, Model, Type, Audio Music Systems, Television, Video Recorders, Amateur Radio, Test Equipment, Vintage Wireless etc.
£3.00 plus LSAE. State Make/Model/Type with order
Full Workshop Manual prices on request with LSAE.
MAURITRON (AR), 8 CHERRY TREE ROAD, CHINNOR, OXON OX9 4QY

MRZ
COMMUNICATIONS LTD
STOKE-ON-TRENT
DESK DC SUPPLY AND BASE FOR ICOM PORTABLES
ICOM-AMATEUR/PMR/MARINE/AIR
YAESU – AMATEUR UK AND EXPORT
ICOM
TEL: (0782) 619658
7 DAY SERVICE

JAPANESE Ic's (PART OF OUR RANGE)
AN301 £3.50, AN7140 £2.20, AN7145 £1.95, AN7146 £2.20, BA532 £1.60, BA536 £2.40, HA1377 £2.20, HA1398 £2.75, HA13001 £2.95, LA4460 £1.80, LA4461 £1.80, LA4507 £4.25, LC7137 £2.75, M51515 £2.50, M51517 £2.80, MB3705 £1.80, MB3712 £1.50, MB3722 £3.50, MB3730 £2.50, MB3731 £3.50, MB3756 £2.60, MB8719 £3.85, STK461 £7.50, STK463 £8.40, TA7205AP £1.00, TA7222AP £1.30, TA7229 £3.25, TA7240 £2.95, TA7607 £2.95, TA7614 £2.75, TA7628 £2.95, TA7640 £1.75, UPC575 £1.00, UPC1001 £2.20, UPC1031 £1.95, UPC1158 95p, UPC1181 £1.10, UPC1182 £1.10, UPC1185 £2.50, UPC1188 £2.75, UPC1230 £2.50, UPC1277 £2.75, UPC1365 £3.60.
ADD 60p POST AND PACKING AND THEN ADD 15% VAT TO TOTAL
T POWELL 16 PADDINGTON GREEN LONDON W2 1LG
OPEN MON-FRI 10AM-5PM, SAT 9AM-12 NOON.
TELEPHONE: 01 723 9246
ACCESS/VISA. TELEPHONE ORDERS ACCEPTED OVER £5.00

VALVES WANTED
Especially large audio types
PX4, PX25, PP3/250, KT66, KT88 complete collections or shop clearance etc welcome.
AMAZING BARGAIN PACKS
20lbs of transistors, resistors, potentiometers, electrolytics, etc, etc. Amazing value – a few items would cost £10, but we haven't time to sort out. Grocery box 11" cube, crammed to the brim, 20lbs £10 + VAT. 50lbs £20 + VAT. Delivered.
PLEASE STATE PRICE REQUIRED, CASH WAITING.
MARTIN BILLINGTON
39 Highlands Rd, Horsham, West Sussex RH13 5LS
Tel: 0403 864086

PSSS....
ALL THE SUPER BARGAINS ARE ON THE INSIDE-FRONT COVER OF THIS MAGAZINE!!

Amateur RADIO **SMALL ADS**

This method of advertising is available in multiples of a single column centimetres — (minimum 2cms). Copy can be changed every month.

RATES
per single column centimetre:
1 insertion £7.00, 3 — £6.60, 6 — £6.30, 12 — £5.60.

AMATEUR RADIO SMALL AD ORDER FORM

TO: **Amateur Radio · Sovereign House**
Brentwood · Essex CM14 4SE · England · (0277) 219876

PLEASE RESERVE.....centimetres by.....columns
FOR A PERIOD OF 1 issue.....☐ 3 issues.....☐ 6 issues.....☐ 12 issues.....☐
COPY enclosed.....☐ to follow.....☐
PAYMENT ENCLOSED: (Add 15%VAT).... £ — Cheques should be made payable to Amateur Radio. Overseas payments by International Money Order and Credit Card
CHARGE TO MY ACCOUNT.....☐ CREDIT CARD EXPIRY DATE ☐☐ / ☐☐
COMPANY .....
ADDRESS .....
SIGNATURE .....TELEPHONE.....
.....
C P I

AGRIMOTORS
MERTON CB AND RADIO CENTRE
MERTON GARAGE AND POST OFFICE, MERTON.
Nr OAKHAMPTON, DEVON EX20 3DZ
OPEN 6 DAYS 9-6 LUNCH 1-2pm THURSDAY 9-1
(SUNDAYS BY APPOINTMENT)
SPECIALIST IN 934 MHz
SUPPLIERS OF ALL 27MHz AND 934 MHz EQUIPMENT
AMATEUR EQUIPMENT CATERED FOR
08053 200

ADVERTISING RATES & INFORMATION

DISPLAY AD RATES

depth mm x width mm	ad space	1 issue	series rates for consecutive insertions: 3 issues	6 issues	12 issues
61 x 90	1/8 page	£66.00	£62.00	£59.00	£53.00
128 x 90 or 61 x 186	1/4 page	£115.00	£110.00	£105.00	£92.00
128 x 186 or 263 x 90	1/2 page	£225.00	£210.00	£200.00	£180.00
263 x 186	1 page	£430.00	£405.00	£385.00	£345.00
263 x 394	double page	£830.00	£780.00	£740.00	£660.00

COLOUR AD RATES

colour rates exclude cost of separations

depth mm x width mm	ad space	1 issue	series rates for consecutive insertions: 3 issues	6 issues	12 issues
128 x 186 or 263 x 90	1/2 page	£305.00	£290.00	£275.00	£245.00
263 x 186	1 page	£590.00	£550.00	£530.00	£470.00
263 x 394	double page	£1,130.00	£1,070.00	£1,010.00	£900.00

SPECIAL POSITIONS

Covers: Outside back cover 20% extra, inside covers 10% extra
Bleed: 10% extra [Bleed area = 307 x 220]
Facing Matter: 15% extra

DEADLINES

*Dates affected by public holidays

issue	colour & mono proof ad	mono no proof & small ad	mono artwork	on sale thurs
Dec 87	29 Oct 87	4 Nov 87	6 Nov 87	26 Nov 87
Jan 88	26 Nov 87	2 Dec 87	4 Dec 87	24 Dec 87
Feb 88	24 Dec 87	6 Jan 88	8 Jan 88	28 Jan 88
Mar 88	28 Jan 88	3 Feb 88	5 Feb 88	25 Feb 88

CONDITIONS & INFORMATION

SERIES RATES
Series rates also apply when larger or additional space to that initially booked is taken.
An ad of at least the minimum space must appear in consecutive issues to qualify for series rates.
Previous copy will automatically be repeated if no further copy is received.
A 'hold ad' is acceptable for maintaining your series rate contract. This will automatically be inserted if no further copy is received.
Display Ad and Small Ad series rate contracts are not interchangeable.

If series rate contract is cancelled, the advertiser will be liable to pay the unearned series discount already taken.

COPY
Except for County Guides copy may be changed monthly.
No additional charges for typesetting or illustrations (except for colour separations).
For illustrations just send photograph or artwork.
Colour Ad rates do not include the cost of separations. Printed – webb-offset.

PAYMENT
Above rates exclude VAT.
All single insertion ads are accepted on a pre-payment basis only, unless an account is held.
Accounts will be opened for series rate advertisers subject to satisfactory credit references.
Accounts are strictly net and must be settled by the publication date.
Overseas payments by International Money Order or credit card.

FOR FURTHER INFORMATION CONTACT
Amateur Radio, Sovereign House, Brentwood, Essex CM14 4SE.
(0277) 219876

Commission to approved advertising agencies is 10%.

CONDITIONS
10% discount if advertising in both Amateur Radio and Radio & Electronics World.
A voucher copy will be sent to Display and Colour advertisers only.
Ads accepted subject to our standard conditions, available on request.

AMATEUR RADIO
BACK ISSUES SERVICE

TO: Back Issues Department • Amateur Radio • Sovereign House • Brentwood • Essex • CM14 4SE

NAME .....

ADDRESS .....

.....

.....

.....

POSTCODE .....

PLEASE SUPPLY: (state month and year of issue/s required) NOTE: Only issues from August 1986 are available

.....

..... at £1.40 each

PAYMENT ENCLOSED: £ –

Cheques should be made payable to ***Amateur Radio*** Overseas payment by International Money Order or credit card

CREDIT CARD PAYMENT: ☐ ☐ EXPIRY DATE

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ ☐☐/☐☐

SIGNATURE .....

C P I

ADVERTISERS INDEX

£1 BAKERS DOZEN PACKS

Price per pack is £1.00.* Order 12 you may choose another free. Items marked (sh) are not new but guaranteed ok.

1 – 5 13 amp ring main junction boxes
2 – 5 13 amp ring main spur boxes
3 – 5 flush electrical switches
4 – 5 4in flex line switches with neons
5 – 2 80 watt brass cased elements
6 – 2 mains transformers with 6V 1A secondaries
7 – 2 mains transformers with 12V ½A secondaries
8 – 1 extension speaker cabinet for 6½" speaker
9 – 5 octal bases for relays or valves
10 – 12 glass reed switches
11 – 4 OCP 70 photo transistors
12 – 4 tape heads, 2 record, 2 erase
13 – 1 ultrasonic transmitter and 1 ditto receiver
14 – 2 15000 mfd computer grade electrolytics
15 – 2 light dependent resistors
16 – 5 different micro switches
17 – 2 mains interference suppressors
18 – 2 25 watt crossover units 2 way
19 – 1 40 watt 3 way crossover unit
20 – 1 6 digit counter mains voltage
21 – 2 Nicad battery chargers
22 – 1 key switch with key
23 – 2 humidity switches
24 – 96 × 1 metre lengths colour-coded connecting wires
25 – 2 air spaced 2 gang tuning condensors
26 – 2 solid diaelectric 2 gang tuning condensors
27 – 10 compression trimmers
28 – 6 Rocker Switches 10 amp mains SPST
29 – 5 Rocker Switches 10 amp SPDT Centre Off
30 – 4 Rocker Switches 10 amp DPDT
31 – 1 24 hour time switch mains operated (s.h.)
32 – 1 6 hour clock timeswitch
33 – 2 6V operated reed switch relays
34 – 10 neon valves – make good night lights
35 – 2 × 12V DC or 24V AC, 4 CO relays
36 – 1 × 12V 2C O very sensitive relay
37 – 1 12V 4C relay
38 – 1 locking mechanism with 2 keys
39 – Miniature Uniselector with circuit for electric jigsaw
40 – 5 Dolls' House switches
41 – 5 ferrite rods 4" × 5/16" diameter aerials
42 – 4 ferrite slab aerials with L & M wave coils
43 – 4 200 ohm earpieces
44 – 1 Mullard thyristor trigger module
45 – 10 assorted knobs ¼ spindles
46 – 5 different themostats, mainly bi metal
47 – Magnetic brake – stops rotation instantly
48 – Low pressure 3 level switch
49 – 2 25 watt pots 8 ohm
50 – 2 25 watt pots 1000 ohm
51 – 4 wire wound pots – 18, 33, 50 and 100 ohm
52 – 4 3 watt wire wound pots 50 ohm
53 – 1 time reminder adjustable 1-60 mins
54 – 5.5 amp stud rectifiers 400V
55 – 1 mains shaded pole motor ¾" stack – ¼ shaft
56 – 2 5" ali fan blades fit ¼" shaft
57 – 2 3" plastic fan blades fit ¼" shaft
58 – Mains motor suitable for above blades
59 – 1 mains motor with gearbox 1 rev per 24 hours
60 – 2 mains motors with gearbox 16 rpm
61 – 4 11 pin moulded bases for relays
62 – 5 B7G valve bases
63 – 4 skirted B9A valve bases
64 – 1 thermostat for fridge
65 – 1 motorised stud switch (s.h.)
66 – 1 2½ hours delay switch
67 – 1 6v mains power supply unit
68 – 1 4½ V mains power supply unit
69 – 1 5 pin flex plug and panel socket
70 – 1 5" speaker size radio cabinet with handle
71 – 10¼" spindle type volume controls
72 – 10 slider type volume controls
73 – 1 heating pad 200 watts mains
74 – 1 1W amplifier Mullard 1172
75 – 1 Wall mounting thermostat 24V
76 – 1 Teak effect extension 5" speaker cabinet
77 – 2 p.c.b. with 2 amp full wave and 17 other recs
78 – 10 mtrs twin screened flex white p.v.c. outer
79 – 2 plastic boxes with windows, ideal for interrupted beam switch etc
80 – 3 varicap push button tuners with knobs
81 – 1 plastic box, sloping metal front, 16 × 95mm, average depth 45mm
82 – 1 car door speaker (very flat) 6½" 15 ohm made for Radiomobile
83 – 2 speakers' 6" × 4" 15 ohm 5 watt made for Radiomobile
84 – 2 mains transformer 9V ½A secondary split primary so OK also for 115V
85 – 1 mains transformers 15V 1A secondary p.c.b. mounting
86 – 2 6V 0.6V mains transformer .3a p.c.b. mounting
87 – 40 double pole leaf switches
88 – 1 7uf 660V 50hz metal cased condenser
89 – 2 2¼in 60 ohm loudspeakers
90 – 2 2¼in 8 ohm loudspeakers
91 – 1 mains operated relay with 2 sets c/o contacts
92 – 2 packets resin filler/sealer with cures
93 – 3 5A round 3 pin plugs will fit item 193
94 – 4 7 segment l.e.d. displays
95 – 4 pc boards for stripping, lots of valuable parts
96 – 1 3A double pole magnetic trip, saves repairing fuses
97 – 4 1000uf 25V axial electrolytic capacitors
98 – 1 Audax PM 8" speaker 15 ohm 5 watt rating
99 – 100 4BA 1½" cheesehead plated screws and 100 4BA nuts
100 – 1 pair stereo tape head as in cassette recorder/players
101 – 1 bridge rectifier 600V international rectifier ref 3SB100
102 – 2 battery operated relays (3-6v) each with 5A c/o contacts 2 pairs
103 – 2 lithium 3V batteries (everlasting shelf life)

TELEPHONE BITS

Master socket (has surge arrestor – ringing condenser etc) and takes B.T. plug..... £3.95
Extension socket..... £2.95
Dual adaptors (2 from one socket)..... £3.95
Cord terminating with B.T. plug 3 metres..... £1
Kit for converting old entry terminal box to new B.T. master socket, complete with 4 core cable, cable clips and 2 B.T. extension sockets..... £11.50
100 mtrs 4 core telephone cable..... £8.50

COMPACT FLOPPY DISC DRIVE EME-101

The EME-101 drives a 3" disc of the new standard which despite its small size provides a capacity of 500k per disc, which is equivalent to the 3½" and 5¼" discs. We supply the Operators Manual and other information showing how to use this with popular computers: BBC, Spectrum, Amstrad etc. All at a special snip price of £27.50 including post and VAT. Data available separately £2, refundable if you purchase the drive.

MULLARD UNILEX AMPLIFIERS

We are probably the only firm in the country with these now in stock. Although only four watts per channel, these give superb reproduction. We now offer the 4 Mullard modules – i.e. Mains power unit (EP9002) Pre amp module (EP9001) and two amplifier modules (EP9000) all for £6.00 plus £2 postage. For prices of modules bought separately see TWO POUNDERS.

CAR STARTER/CHARGER KIT

Flat Battery! Don't worry you will start your car in a few minutes with this unit – 250 watt transformer 20 amp rectifiers, case and all parts with data and case £17.50 post £2.

THIS MONTH'S SNIP

is a 2½ kW tangential heater, metal box to contain it and 3 level switch to control it. Special price £7.50 post paid.

VENNER TIME SWITCH

Mains operated with 20 amp switch, one on and one off per 24 hrs. repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only £2.95 without case, metal case – £2.95, adaptor kit to convert this into a normal 24hr time switch but with the added advantage of up to 12 on/offs per 24hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is £2.30

Ex-Electricity Board.
Guaranteed 12 months.

12 volt MOTORS BY SMITHS

Made for use in cars, etc. these are very powerful and easily reversible.
Size 3½" long by 3" dia.
They have a good length of ¼" spindle – 1/10 hp £3.45
1/8 hp £5.75. 1/6 hp £7.50

SOUND TO LIGHT UNIT

Complete kit of parts for a three channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two tone metal case and has controls for each channel, and a master on/off. The audio input and output are by ¼" sockets and three panel mounting fuse holders provide thyristor protection. A four pin plug and socket facilitate ease of connecting lamps. Special price is £14.95 in kit form.

9" MONITOR

Ideal to work with computer or video camera uses Philips black and white tube ref M24/306W. Which tube is implosion and X-Ray radiation protected. VDU is brand new and has a time base and EHT circuitry. Requires only a 16V dc supply to set it going. It's made up in a lacquered metal framework but has open sides so should be cased. The VDU comes complete with circuit diagram and has been line tested and has our six months guarantee. Offered at a lot less than some firms are asking for the tube alone, only £16 plus £3 post.

LIGHT BOX

This when completed measures approximately 15" × 14". The light source is the Philips fluorescent 'W' tube. Above the light a sheet of fibreglass and through this should be sufficient light to enable you to follow the circuit on fibreglass PCBs. Price for the complete kit, that is the box, choke, starter, tube and switch, and fibreglass is £5 plus £2 post, order ref 5P69.

TANGENTIAL HEATERS

We again have very good stocks of these quiet runnng instant heat units. They require only a simple case, or could easily be fitted into the bottom of a kitchen unit or book case etc. At present we have stocks of 1.2kw, 2kw, 2.5kw, and 3kw. Prices are £5 each for the first 3, and £6.95 for the 3k. Add post £1.50 per heater if not collecting.
CONTROL SWITCH enabling full heat, half heat or cold blow, with connection diagram, 50p for 2kw, 75p for 3kw.

FANS & BLOWERS

5" £5 + £1.25 post. 6" £6 + £1.50 post
4" × 4" Muffin equipment cooling fan 115V £2.00
4" × 4" Muffin equipment cooling fan 230/240V £5.00
9" Extractor or blower 115V supplied with 230 to 115V adaptor £9.50 + £2 post.
All above are ex computers but guaranteed 12 months.
10" × 3" Tangential Blower. New. Very quiet – supplied with 230 to 115V adaptor on use two in series to give long blow £2.00 + £1.50 post or £4.00 + £2.00 post for two

TELEPHONE LEAD

3 mtrs long terminating one end with new BT, flat plug and the other end with 4 correctly coloured coded wires to fit to phone or appliance. Replaces the lead on old phone making it suitable for new BT socket. Price £1 ref BD552 or 3 for £2 ref 2P164.

POWERFUL IONISER

Generates approx. 10 times more IONS than the ETI and similar circuits. Will refresh your home, office, shop, work room etc. Makes you feel better and work harder – a complete mains operated kit, case included. £9.50 + £2 P&P.

J & N BULL ELECTRICAL

Dept. A.R., 250 PORTLAND ROAD, HOVE, BRIGHTON, SUSSEX BN3 5QT

MAIL ORDER TERMS: Cash, P.O. or cheque with order. Orders under £20 add £1 service charge. Monthly account orders accepted from schools and public companies. Access & B/card orders accepted. Brighton (0273) 734648 or 203500.

NEW ITEMS

Some of the many described in our current list which you will receive with your parcel.

£2 POUNDERS*

2P120 – 1 combined clockwork switch and thermostat for boiler control
2P122 – 1 30a rotary switch, surface mounting with pointer knob
2P123 – 1 25a rotary switch, surface mounting, cover engraved, high, medium low and off
2P124 – 1 28kv .001 mfd block condensor
2P127 – 1 30a bridge rectifier assembly on heat sinks
2P129 – 1 10rpm motor 115V so supplied with adaptor for 230V
2P131 – 1 Crouzet motor 230V fits the Crouzet gearbox
2P132 – 1 ceiling heat-stat for fire warning or protection
2P133 – 1 Circuit breaker 20a, Crabtree ref C50
2P134 – 1 9V 500mA psu, plugs into 13a socket
2P135 – 10m 10 conductor intercom cable
2P136 – 1 2½ kw element made for tangential blowers
2P137 – 1 Thermo couple, stainless steel tipped for measuring internal heat
2P138 – 1 Mains transformer 20V-0-20V 1a upright mounting
2P141 – 1 rechargeable battery D size (4 AH) solder tag ended
2P142 – 10m 4 pair intercom cable White PVC outer
2P144 – 1 mains operated relay with 4 × 8a c/o contacts
2P145 – 1 10,000 uf 70V d.c. smoothing capacitor
2P146 – 1 7,800 uf 150C d.c. smoothing capacitor
2P148 – 1 Technical information on 3" FDD refundable if you buy fdd
2P149 – 5 diff battery operated model motors
2P150 – 1 PSU chassis with all components for 24V 2A d.c. unwired
2P151 – 1 Metal box 14½ × 14 × 4 with lid add £2.00 post
2P152 – 1 Motor start capacitor 80uf 250V
2P153 – 1 Two station intercom unused but line reject
2P154a – 1 Nicad charger – plug into 13a socket 5.2V .7UA output
2P154b – 1 Nicad charger – plug into 13a socket 6V .9VA output
2P155 – 1 Mains transformer giving 16, 17, 18 & 20V 60W
2P158 – 1 Oven thermostat with temp calibrated knob
2P159 – 1 9V 500ma cased with mains lead and output lead
2P160 – 1 13a plug adaptor fused takes 3 × 3a plugs
2P161 – 1 6" diagonal side cutters
2P162 – 1 Stereo Matrix PCB mounting deemphasis K35
2P163 – 1 AC Working capacitor 12uf 660V AC or 1500V dc
2P164 – 3 Phone leads 3 mtrs long tags one end B.T. plug other end

£3 POUNDERS*

3P7 – 1 DC voltage, doubler or halver for 12V to 24V, 12 to 6V 24 to 12V
3P8 – 1 24hr time switch Sangamo, new condition Guaranteed 1 year
3P9 – 12V 500mA psu plugs in 13a socket regulated
3P10 – 1 Mains transformer 50V 2A with 6.3 pilot light winding, upright mounting, fully shrouded plus £1 post
3P13 – 1 Noise filter to fit in mains lead of appliance up to 25a
3P15 – 1 waterproof case will take 150 watt transformer
3P16 – 1 signal box, 3 lamps on face plate of metal box size 5½ × 3½
3P17 – 1 choke and starter to work 8" fluorescent tube at 125W
3P18 – 1 22V 3a mains transformer with bridge rect fitted on top panel
3P20 – 1 0-5a ammeter 3½ ac/dc ex equipment
3P21 – 1 power factor correction condenser 35uf 350ac
3P22 – 1 200va – auto transformer 230 to 115V torroidal encapsulated £1.50 post
3P23 – 1 36V-0-36V tapped 20V-0-20V 100va
3P24 – 1 3" floppy disc for Amstrad etc
3P25 – 1 7" Electricians pliers

£4 POUNDERS*

4P12 – 50m low loss co-ax 75ohm + £1 post
4P13 – 3 Horstmann time and set switches 15amp
4P14 – 1 150w mains transformer "c" core 43V 3.5A secondary
4P15 – 1 powerful motor 2" stack fitted with gearbox final speed 60rpm mains operated, could operate door opener etc.
4P17 – 1 Uniselector 3 pole 25W, 50V coil standard size
4P18 – 1 Volt meter with digital display (DIGIVISOR)
4P19 – 1 12V dc motor will fit to gearbox 4P20
4P20 – 1 Gear train giving speed reduction

£5 POUNDERS*

5P86 – 1 Transformer upright mounting 230/240V primary 2 × 100 1a secondary
5P88 – 1 Transformer in waterproof metal box 24V 5A add £2 post
5P89 – 1 4 bank heating element each 2kw ideal convector heater
5P90 – 1 18" long tangential blower with motor at one end
5P91 – 1 14" blower, motor in middle
5P92 – 10m Audio co-ax double screened 75ohm super low loss for TV
5P93 – 1 6" Alarm bell 24V dc or ac
5P94 – 1 Current transformer 14V out with 1a dc input
5P95 – 1 Vintage photo cell
5P97 – 1 Impedance matching transformer 0-4-5-8-160 ohm 100 add £1.50 post
5P98a – 1 0-90a ammeter for mounting outside control panel
5P98b – 1 0-180a ammeter for mounting outside control panel
5P99 – 1 Mains operated blower centrifugal output size app. 5" × 1½"
5P100 – 1 Mains splitter 45a switch 3 × 15a fused circuits
5P101 – 1 Model motor 1 rpm from 6V reversible

£7 POUNDERS*

7P1 – 1 Instant heat solder gun – mains with renewable tip and job light

£8 POUNDERS*

8P1 – 1 Charger transformer 10a upright mounting 230/240 primary 16v 10a secondary
8P2 – 1 6" underdome alarmbell suitable for a fire alarm or burglar alarm mains operated.
8P3 – 1 heat sink big powerful so ideal for power transmitter
8P5 – 1 ½ hp motor 900 rpm capacitor run
8P6 – 1 24hr time switch – 2 on offs 16a c/o contacts 3" × 3" × 1½"
8P7 – 1 Silent sentinel invisible ray kit
8P8 – 1 Papst fan 3½ × 3½ × 1½ 230V metal bodied

£10 POUNDERS*

10P13 – 1 reversible motor with gearbox 104 rpm Parvalux
10P14 – 1 100a time switch 1 on/off per 24hr extra triggers £1 per pair
10P15 – 1 Max demand meter 230 ac mains
10P16 – 1 powerful air mover 2 small type blowers with motor in middle
10P18 – 1 mains operated klaxon
10P19 – 1 12V alarm bell really loud, mains operated, in iron case + £5 post
10P22 – 1 sensitive volt meter relay
10P23 – 1 fruit machine heart 3 fruit wheels each stepper motor operated add £3 post
10P24 – 1 big panel meter face size 4¾ × 2½ 200uA movement scaled 1-10
10P26 – 1 "Secretary" phone auto-dialer complete untested sold as such
10P29 – 1 12V engine cooling fan
10P30 – 1 instrument psu on pcb has 4 outputs .12V/.5V 6A/12V .5A/5V .5A
10P31 – 1 7 day time switch 16a c/o contacts sep switches for each day
10P32 – 1 68 rpm 1/6th hp motor reversible

£15 POUNDERS*

15P1 – 1 kit for 115W hi fi amp
15P2 – 1 kit for psu to supply one or two 15P1 amps
15P3 – 1 time switch battery or mains operated – 16a c/o contacts, 7 day programmable has 36hr reserve

£25 POUNDERS*

25P1 – 1 1500 PSI hydraulic pump 24V dc motor, made for operating aircraft undercarriage etc.

LIGHT CHASER KIT motor driven switch bank with connection diagram, used in connection with 4 sets of xmas lights makes a very eye catching display for home, shop or disco, only £5 ref 5P56.

JUST ARRIVED!!

A major electronic distributor's discontinued lines all being sold off at LESS THAN HALF PRICE!! – Boxes, cases, connectors, LED's, switches, DIP boards, cable ties etc. All goods detailed in a 16 page supplement, available now, **FREE!!**

Examples:
Briefcase type combination locks **£4.71** per pair
Sloping front cases: 161x96x57/39mm **92p**
215x130x73/47mm **£1.49**
Plastic box with PCB slots 190x110x60mm **£1.40**
Large steel case 336x269x148mm **£15.45**

'Tidyman' Kits: Contain a wide variety of support pillars, stand offs, cable straps and clamps etc (46 diff) all in attractive plastic case.
Small: (201 total) **£7.80;** Large (708 total) **£13.00.**

Full details in Supplement.
(Post £2 on all above).

CREAM DISPENSER

Z801 Coin operated machine for dispensing hand cream. Cabinet 620 x 365 x 200mm, wt 10kg, contains coin mech, PCB, counter, pump mech consisting of high torque geared 6V motor driving cam that pumps cream, & sensing components, all powered by internal 6V 2.6A rechargeable battery **£15** + £5 carr. Parts available separately. See list 30.

SPEECH CHIP

Z733 SPO256A + index chip + ULA chip as used in Currah microspeech. Cct and info for using SPO256 with Spectrum, ZX81, BBC, VIC & C64. No info on other 2 chips. All 3 for..... **£3.00**

AUTO DIALLER

Sloping front case 240 x 145 x 90/50 contains 2 PCB's: One has 4 keypads (total 54 switches) + 14 digit LED display. 2 x ULN2004, ULN2033 & 4067; the other has 12 chips + 4 power devices etc. Case contains speaker, 8 core cable 2m long with plug. For use with PABX..... **£9.00**

SWITCHED MODE PSU

Astec type AA7271. PCB 50x50mm has 6 transistor cct providing current overload protection, thermal cut-out and excellent filtering. Input 8-24V DC. Output 5V 2A. Regulation 0.2%..... **£5.00**

PROCESSOR PANELS

Z620 68000 Panel, PCB 190 x 45 believed to be from ICL's 'One per Desk' computer containing MC68008P8 (8MHz 16/8 bit microprocessor + 4 ROM's, all in skts; TMP5220CNL, 74HCT245, 138, LS08, 38 etc **£5.00**

Z625 32k Memory Board, PCB 170 x 170 with 16 2kx8 6116 static RAM's. Also 3.6V 100mA memopack nicad, 13 other HC/LS devices, 96W edge plug, 8 way DIL switch, R's, C's etc..... **£4.80**

sinclair

MICROVISION

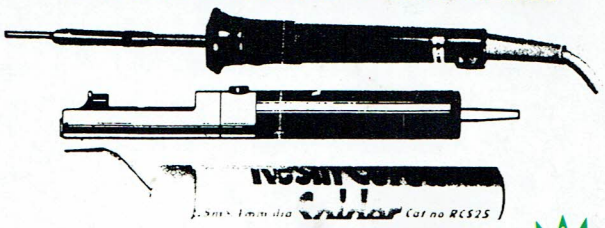
CASES!!!

We now have a supply of cases, complete with aerial at the special low price of **£5.00.** We have a quantity of these units in varying states. From labels attached to some of the PCB's it seems after assembly on the production line they did not function correctly. No attempt has been made to repair them, though – instead the following parts were removed:

a) RF Tuner
b) Vol control & switch
c) ZN401E chip

Z666 2 x PCB in good condition with 2 x CRT that have been removed, but maybe repairable. Conductive paint (15ml bottle £3.45) will probably be needed to remake contacts. With diagram & notes..... **£6.95**
RF Tuner **£6.95;** ZN401 chip **£9.95;** Vol control + switch with knob..... **£1.00**

SOLDER SPECIAL!!!



★ 15W 240Vac soldering iron
★ High power desolder pump
★ Large tube solder

ALL FOR £7.95

AUDIO/RADIO PANELS

Z914 Audio amp panel 95x65mm with TBA820 chip. Gives 1W output with 9V supply. Switch and vol control. Just connect batt and speaker. Full details supplied.

Only **£1.50**:10 for **£12;** 25 for **£25**:100 for **£75**

AM RADIO PANEL

Z916 For use with mono amp above. Neat panel. 60x45mm... **Only £1.50; 10 for £12.00**

Z974 Mixer Amp Panel

115x115mm and gives 1W O/P from a TBA820M chip. There are two inputs, one via a pre-amp, from phono sockets and separate volume controls. A third pot is used to fade from one input to the other. There are also 2 4p 3w rotary switches. Attached to the PCB by flying leads is a panel on which are mounted the 2 input skts, 2x5 pin DIN skts and a 2 pin DIN speaker skt. A data sheet is supplied. All this for just **£2.50**

DIODE BARGAINS

Minimum 10 of any one type: 20 for £1; 50 for £2; 250 for £8; 1000 for £25. Types available: BAX12 BAX12A BAX16 BY206 BYX55-300 BY207 CV8308 LR75C MR817 MV1404 VSK140 1N659 1N4933

Z912 RF panel 103x39mm with a TDA1200 EM/IF chip & UPC1176C noise canceller + R's & C's inc tants. Chips worth around £8 **£1.50**

Z910 139x39mm, this panel has soldered in components – TCA4500A and TBA651R, AM radio with IF amp. Probably complete RF section of radio, as IF's and trimmers are on board. + R's, C's etc..... **£1.50**

LOGIC PROBE

For TTL, CMOS etc. LED and sound indication. Pulse enlargement capability allows pulse direction down to 25nsec.

Max f = 20MHz 4-16V. I/P Z: 1M..... **£9.99**

1988 CATALOGUE

The new 88 page GREENWELD catalogue will be available in mid-October, featuring lots of new goodies. Virtually
NO PRICE INCREASES!!
Incorporates Bargain List 32, Order Form and Discount Vouchers.
Reserve your copy now – still only **£1.00!!**

Z996 QAS Tape Selector. Satin finish aluminium case 130x70x45mm with three push buttons on front wired to three 5 pin DIN sockets on back, enabling either of two tape recorders to be connected to an amplifier, or to each other. Comes complete with leaflet in presentation box..... **£2.50**

Z997 QAS Tape Selector. Three way version, enables one amplifier and three tape recorders to be connected in many combinations. Satin finish aluminium case 180x70x45mm contains 8 push buttons and four 5 pin DIN skts, all mounted on a PCB. Very neat, leaflet explains all possible switching premitations. Supplied in presentation box. Special low price ... **£4.95**

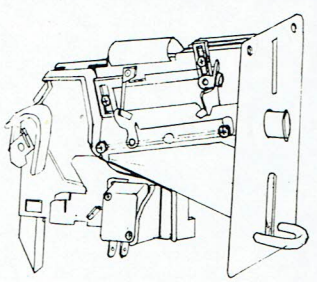
RELAY 1/3 TRIAC PANELS

Z925 DPCO 12V 185R relay, 12V DPCO relay with heavy duty contacts, SC146D 400V 12A triac, 555 timer, 11x1N4001, 2N5061 SCR, 3x2N3704, R's, C's etc..... **£1.90**
Z926 Similar to above, but instead of heavy duty relay, a T2800D 400V 12A triac and C122D 400V 12A SCR. Both boards 100x75mm..... **£1.85**
Z927 2x6V reed relays by Alma, 6x2S3230, R's and diodes..... **Only 60p**

MOTOR/SOLENOID

Z659 Motor, high torque 6V operation with integral brass gearbox giving 60RPM. Shaft 18mm long x 6mm dia with flat. Overall length exc spindle 80mm. Dia 33mm. Ideal for robotics applications, being extremely high torque..... **£2.75**

Z738 6V solenoid single hole fixing. 46x16x18mm. Slug is 45mm long x 6.5mm dia with tapped cross hole and slot. 25mm pull **£1.75**



Z652
Coin acceptor mechanism. Made by Coin Controls, this will accept various size coins by simple adjustment of 4 screws. Incorporates various security features – magnet, bent coin rejector etc. Microswitch rated 5A 240V. Front panel 115x64. Depth 130mm. Cost £10.85. Our price **£4.00.**

COUNTER

Z654 6V 6 digit counter by Veeder Root. Size 60x48x34mm..... **£1.50**

RIBBON CABLE

100ft reel 20 way rainbow ribbon cable.. **£25**

Z663
50 way rainbow cable 2m long, terminated one end with IDC 2 row skt & other end with transition connector..... **£3.50**

Z664
As above but cable is 'twisted and flat' **£3.00**

VIDEO FANS!!

Here's your chance to never be without power again!!
We're offering a set of 10 6V 3A sealed lead acid rechargeable batteries, together with a mains powered charger that takes all 10 batts at an unbeatable price! They can be wired up in parallel/series combination to provide 6V 30A or 12V 15A, thus giving over 20hrs recording time on most camcorders. Limited stocks, so order now! **Z802 £99** + **£5** carr.
Price includes 10 charging leads and mains lead.

Z805 Phillips 'Copy 80' printer. Sold for spare parts only, although they may well be functional. Unit is 380x270x120mm and houses a processor/memory PCB 235x235mm with 3x2716 & 8085A processor in skts, 8251, 8253, 8255, 6x2114 + 23 other chips, also 3x8W DIP switches, 25W D plug etc. There is a switched mode power supply (mains input), large smoothing cap and high quality stepper motor with useful gears and drive belts etc (robotics?). The whole unit for the bargain price of..... **£14** + £4 carr.

SPEAKERS

Z578 Sub-min speaker 30 x 30 x 3mm thick by Fuji. 16R 0.4W. **60p** ea; 10 **£3.70;** 25 **£7;** 100 **£22;** 1000 **£180.**
Z575 70 x 45mm 45R 0.5W **55p** ea; 10 **£3.30;** 25 **£6;** 100 **£20**

SOLDER

500g reels resin cored 18g..... **£5.95**
500g reels resin cored 22g..... **£7.95**

NewBrain

Z494 Motherboard microprocessor panel 265 x 155mm. Complete PCB for computer. Z80, char EPROM, etc. 68 chips altogether + other associated components, plugs, skts, etc..... **£5.50**
Z495 RAM panel. PCB 230 x 78mm with 14 x MM5290-2 (4116) (2 missing) giving 28k of memory. Also 8 LS chips. These panels have not been soldered, so chips can easily be removed if required..... **£5.00**

'NEWBRAIN' PSU

BRAND NEW Stabilized Supply in heavy duty ABS case with rubber feet. Input 220/240V ac to heavy duty transformer via suppressor filter. Regulated DC outputs: 6.5V @ 1.2A; 13.5V @ 0.3A: 12V @ 0.05A. All components readily accessible for mods etc. Chunky heatsink has 2 x TIP31A. Mains lead (fitted with 2 pin continental plug) is 2m long. 4 core output lead 1.5m long fitted with 6 pole skt on 0.1" pitch. Overall size 165 x 75 x 72mm..... **£5.95;** 10 for **£40**
Z679 Keyboard. 62 keys on ally chassis 260x90mm. No PCB..... **£6.50**
Z670 Handbook. 204pp. Useful appendix (about ½the book) gives some tech info **£5.00**
Z674 Data Pack. Interfaces & connector pin-out, i/p, o/p, port map, cct diagram + data on COP420C..... **£2.00**
Z672 Motherboards, complete but probably faulty..... **£3.50**

GREENWELD
ELECTRONIC COMPONENTS

443K Millbrook Road, Southampton SO1 0HX.
Tel. (0703) 772501/783740

All prices include VAT;
just add 60p P&P
Min Access order
£5. Official orders
from schools etc welcome –
min invoice charge £10.

Access

Our shop has enormous stock of components and is open 9-5.30 Mon-Sat. Come and see us!!!