

## Processing Gain Test for HZB-S24-08 (Model 31350)

### Test Setup:

The processing gain was measured using the CW jamming margin method as described in 15.247(e)(2). The specific test diagram is illustrated below.

All test equipment and the EUT were allowed to warm up for four hours prior to start of test to minimize drift over time. All test equipment had valid calibration. Calibration of carrier and interferer levels was performed several times during testing with no observed changes.

The measurements were performed on the frequency channel centered at 2426 MHz, over a range of  $\pm 7.0$  MHz. The measurements made across the center  $\pm 6$  MHz should be used for calculation of  $G_p$  since that bandwidth represents the receiver passband.

For the carrier signal, a level approximately 40 dB above threshold was chosen so that thermal noise would not effect the processing gain measurements. The measured threshold of the receive radio was  $\sim -91$  dBm at  $BER = 1 \times 10^{-6}$ , the signal level of the transmit radio was  $-53.0$  dBm measured at the input of the receive radio, ( $P_s$ ). For the jammer signal,  $-35$  dBm at the generator ( $P_g$ ) corresponds to  $-53.5$  dBm ( $P_j$ ) at the receiver input. It is these numbers that were used for calculating C/I and  $G_p$ .

### Test Equipment:

Signal Generator	Hewlett Packard 83731A
Power Meter	HP437B/8484A
BER Test Set	Fireberd 6000

### Explanation of Results:

The following notations are used on the spreadsheet data:

**$P_g$ :** Power at Generator in dBm (as indicated by generator display).

**$P_j$ :** Power of interferer at the receiver input.(calculated in spreadsheet)

**$P_s$ :** Power of carrier at receiver input (initial calibration).

**J/S:** Jammer to Signal ratio,  $P_j - P_s$  (dB) (calculated in spreadsheet)

**$G_p$ :** Processing Gain:  $(S/N)_o + J/S + L_{sys}$  where:

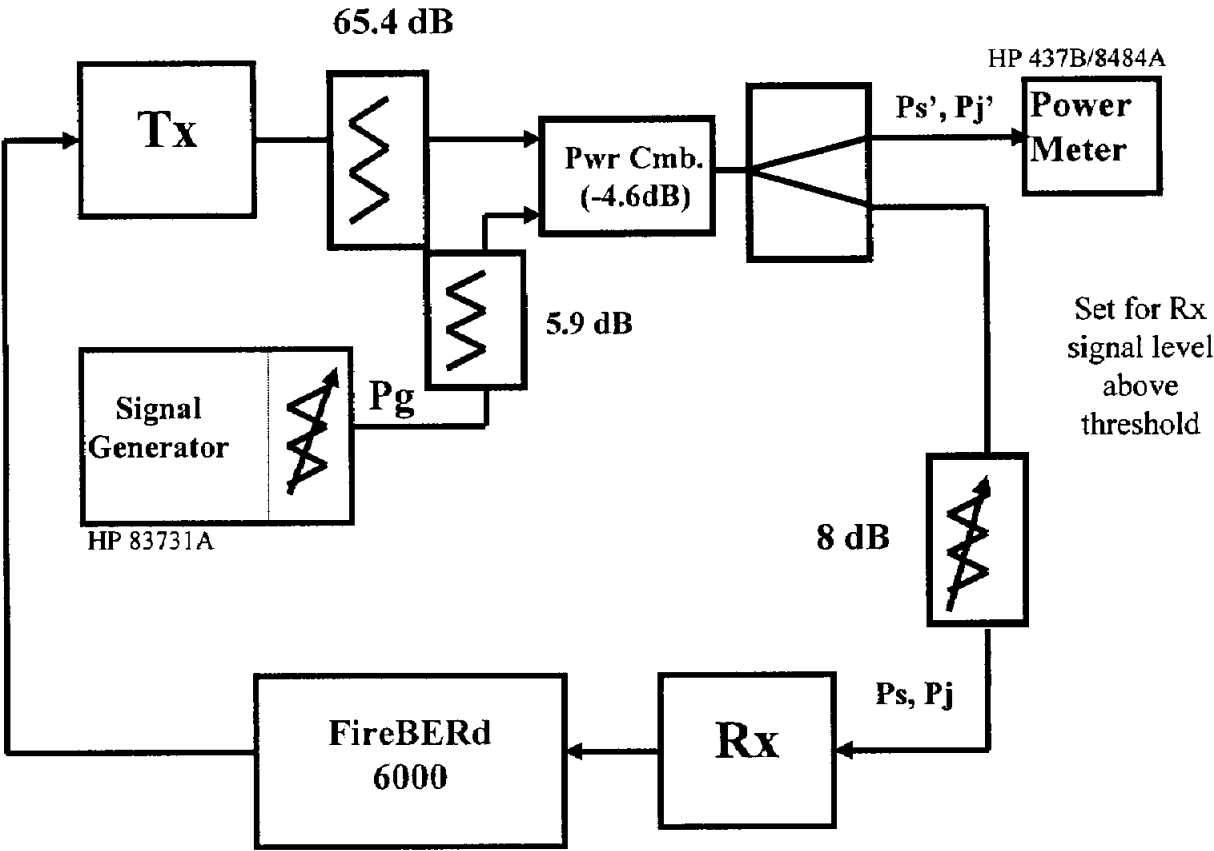
$$L_{sys} = 2 \text{ dB}$$

$$(S/N)_o = 13.5 \text{ dB for QPSK and } BER = 10^{-6} \text{ (see curve provided)}$$

therefore:  $G_p = 13.5 + 2 + J/S = 15.5 + J/S$  (calculated in spreadsheet)

100% of measurements meet the minimum processing gain of 10 dB.

# Processing Gain Test Equipment Setup



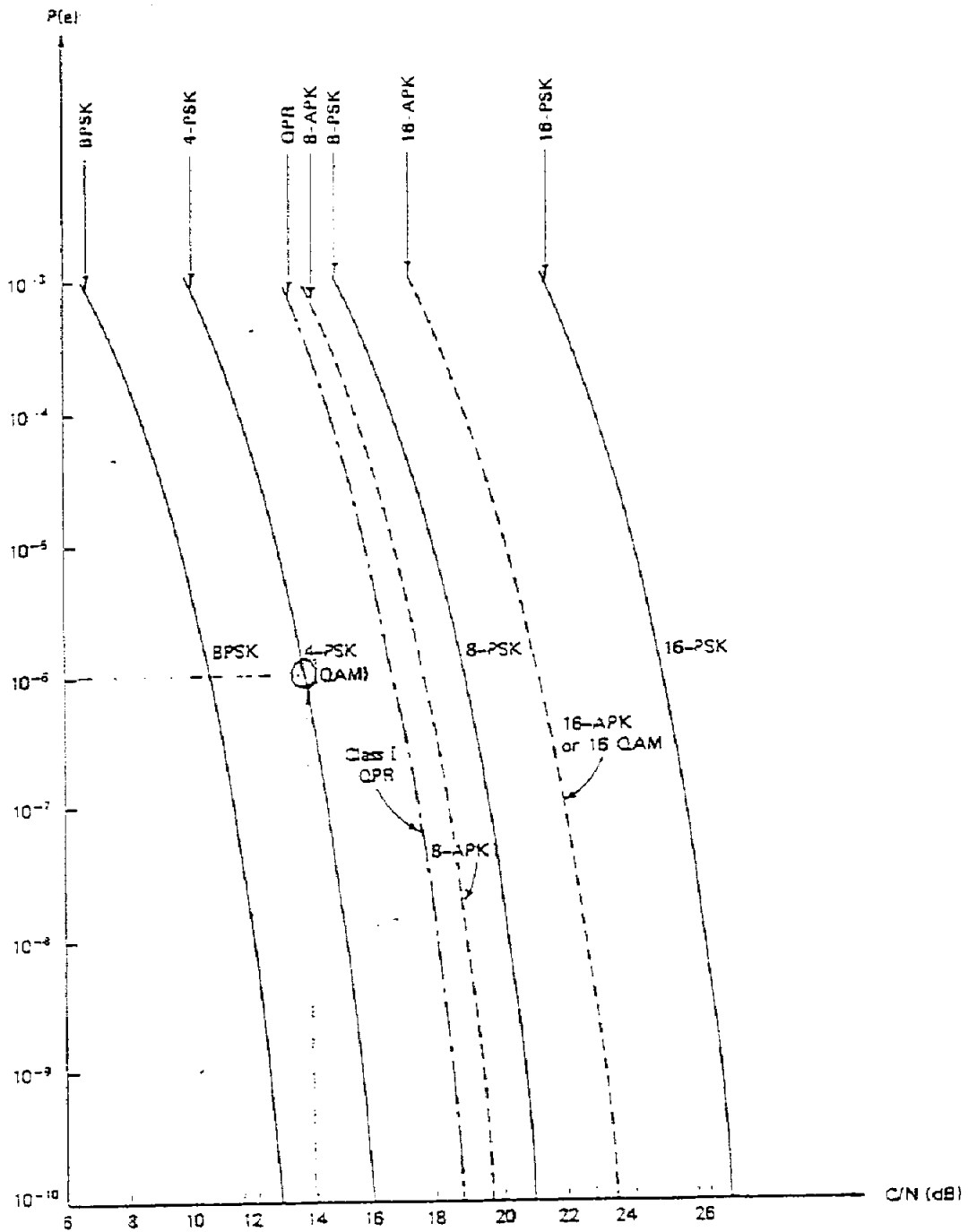
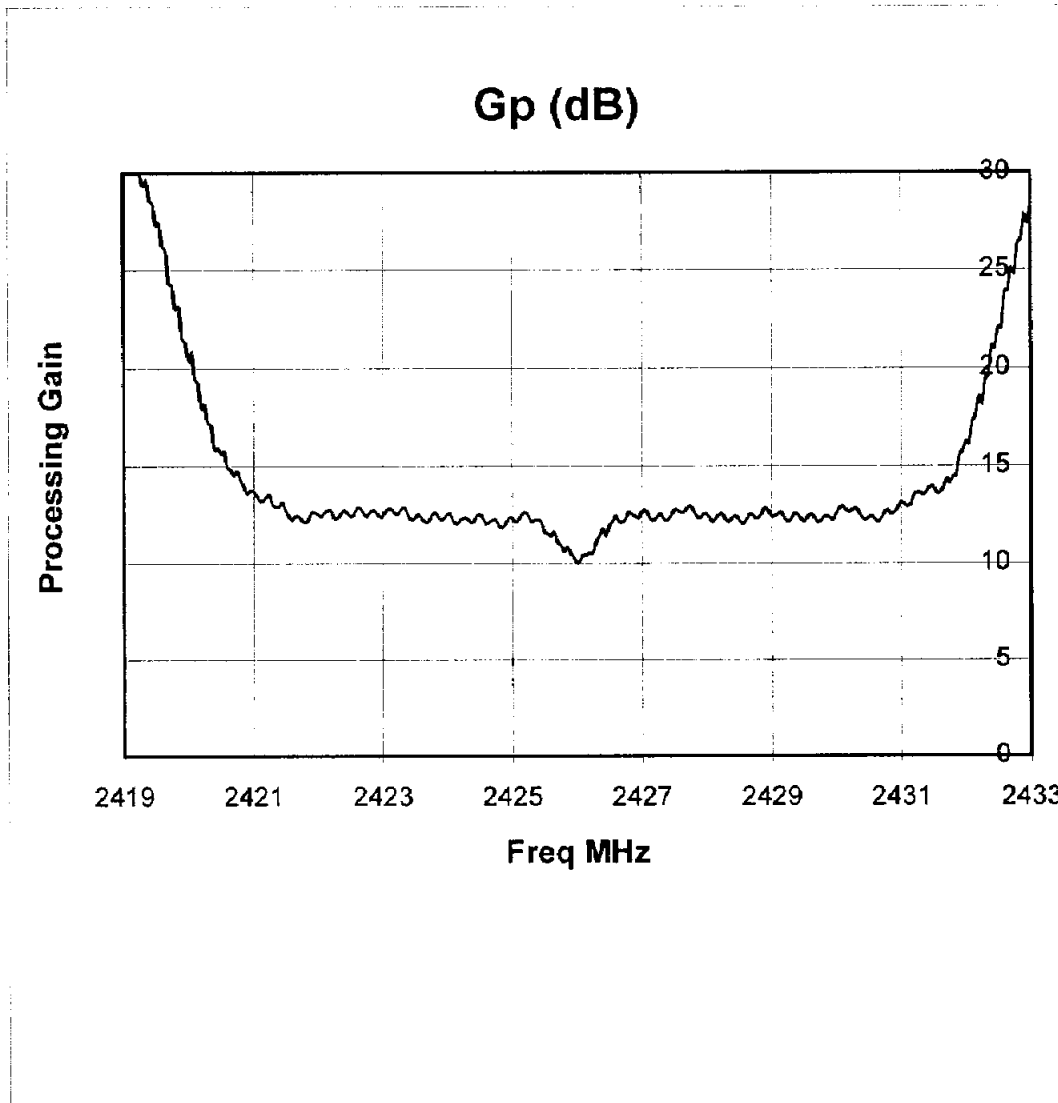


Fig. 3.21.  $P(e)$  performance of  $M$ -ary PSK, QAM, QPR, and  $M$ -ary APK coherent systems. The rms  $C/N$  is specified in the double-sided Nyquist bandwidth.

Figure showing offset for QPSK (4-PSK) modulation  $C/N$  offset (1.4 dB).  
 (Obtained from DIGITAL COMMUNICATIONS: Microwave Applications, by  
 Kamilo Feher, Prentice-Hall Inc., 1981)



Processing Gain vs Frequency (Carrier at 2.426 GHz) Model 31350 Radio (1/6/2000)

meas #	f MHz	Gp dBm	Pj dBm	Pg dBm	Ps dBm	J/S dB
1	2419	30.83	-37.7	-19.2	-53.03	15.33
2	2419.05	30.83	-37.7	-19.2	-53.03	15.33
3	2419.1	30.73	-37.8	-19.3	-53.03	15.23
4	2419.15	30.83	-37.7	-19.2	-53.03	15.33
5	2419.2	30.03	-38.5	-20	-53.03	14.53
6	2419.25	29.93	-38.6	-20.1	-53.03	14.43
7	2419.3	29.33	-39.2	-20.7	-53.03	13.83
8	2419.35	29.63	-38.9	-20.4	-53.03	14.13
9	2419.4	28.63	-39.9	-21.4	-53.03	13.13
10	2419.45	28.43	-40.1	-21.6	-53.03	12.93
11	2419.5	27.33	-41.2	-22.7	-53.03	11.83
12	2419.55	27.43	-41.1	-22.6	-53.03	11.93
13	2419.6	26.23	-42.3	-23.8	-53.03	10.73
14	2419.65	26.03	-42.5	-24	-53.03	10.53
15	2419.7	24.33	-44.2	-25.7	-53.03	8.83
16	2419.75	24.23	-44.3	-25.8	-53.03	8.73
17	2419.8	23.03	-45.5	-27	-53.03	7.53
18	2419.85	23.13	-45.4	-26.9	-53.03	7.63
19	2419.9	21.53	-47	-28.5	-53.03	6.03
20	2419.95	21.33	-47.2	-28.7	-53.03	5.83
21	2420	20.43	-48.1	-29.6	-53.03	4.93
22	2420.05	20.73	-47.8	-29.3	-53.03	5.23
23	2420.1	19.43	-49.1	-30.6	-53.03	3.93
24	2420.15	19.23	-49.3	-30.8	-53.03	3.73
25	2420.2	17.93	-50.6	-32.1	-53.03	2.43
26	2420.25	18.13	-50.4	-31.9	-53.03	2.63
27	2420.3	17.23	-51.3	-32.8	-53.03	1.73
28	2420.35	17.03	-51.5	-33	-53.03	1.53
29	2420.4	15.83	-52.7	-34.2	-53.03	0.33
30	2420.45	15.93	-52.6	-34.1	-53.03	0.43
31	2420.5	15.63	-52.9	-34.4	-53.03	0.13
32	2420.55	15.73	-52.8	-34.3	-53.03	0.23
33	2420.6	14.93	-53.6	-35.1	-53.03	-0.57
34	2420.65	14.83	-53.7	-35.2	-53.03	-0.67
35	2420.7	14.53	-54	-35.5	-53.03	-0.97
36	2420.75	14.73	-53.8	-35.3	-53.03	-0.77
37	2420.8	14.33	-54.2	-35.7	-53.03	-1.17
38	2420.85	14.03	-54.5	-36	-53.03	-1.47
39	2420.9	13.63	-54.9	-36.4	-53.03	-1.87
40	2420.95	13.73	-54.8	-36.3	-53.03	-1.77
41	2421	13.73	-54.8	-36.3	-53.03	-1.77
42	2421.05	13.53	-55	-36.5	-53.03	-1.97
43	2421.1	13.23	-55.3	-36.8	-53.03	-2.27

meas #	f MHz	Gp dBm	Pj dBm	Pg dBm	Ps dBm	J/S dB
44	2421.15	13.23	-55.3	-36.8	-53.03	-2.27
45	2421.2	13.43	-55.1	-36.6	-53.03	-2.07
46	2421.25	13.53	-55	-36.5	-53.03	-1.97
47	2421.3	13.03	-55.5	-37	-53.03	-2.47
48	2421.35	12.93	-55.6	-37.1	-53.03	-2.57
49	2421.4	12.93	-55.6	-37.1	-53.03	-2.57
50	2421.45	13.13	-55.4	-36.9	-53.03	-2.37
51	2421.5	12.73	-55.8	-37.3	-53.03	-2.77
52	2421.55	12.43	-56.1	-37.6	-53.03	-3.07
53	2421.6	12.23	-56.3	-37.8	-53.03	-3.27
54	2421.65	12.43	-56.1	-37.6	-53.03	-3.07
55	2421.7	12.43	-56.1	-37.6	-53.03	-3.07
56	2421.75	12.23	-56.3	-37.8	-53.03	-3.27
57	2421.8	12.13	-56.4	-37.9	-53.03	-3.37
58	2421.85	12.23	-56.3	-37.8	-53.03	-3.27
59	2421.9	12.63	-55.9	-37.4	-53.03	-2.87
60	2421.95	12.63	-55.9	-37.4	-53.03	-2.87
61	2422	12.53	-56	-37.5	-53.03	-2.97
62	2422.05	12.43	-56.1	-37.6	-53.03	-3.07
63	2422.1	12.63	-55.9	-37.4	-53.03	-2.87
64	2422.15	12.73	-55.8	-37.3	-53.03	-2.77
65	2422.2	12.73	-55.8	-37.3	-53.03	-2.77
66	2422.25	12.33	-56.2	-37.7	-53.03	-3.17
67	2422.3	12.33	-56.2	-37.7	-53.03	-3.17
68	2422.35	12.53	-56	-37.5	-53.03	-2.97
69	2422.4	12.73	-55.8	-37.3	-53.03	-2.77
70	2422.45	12.63	-55.9	-37.4	-53.03	-2.87
71	2422.5	12.43	-56.1	-37.6	-53.03	-3.07
72	2422.55	12.53	-56	-37.5	-53.03	-2.97
73	2422.6	12.83	-55.7	-37.2	-53.03	-2.67
74	2422.65	12.83	-55.7	-37.2	-53.03	-2.67
75	2422.7	12.63	-55.9	-37.4	-53.03	-2.87
76	2422.75	12.43	-56.1	-37.6	-53.03	-3.07
77	2422.8	12.63	-55.9	-37.4	-53.03	-2.87
78	2422.85	12.73	-55.8	-37.3	-53.03	-2.77
79	2422.9	12.63	-55.9	-37.4	-53.03	-2.87
80	2422.95	12.43	-56.1	-37.6	-53.03	-3.07
81	2423	12.43	-56.1	-37.6	-53.03	-3.07
82	2423.05	12.73	-55.8	-37.3	-53.03	-2.77
83	2423.1	12.83	-55.7	-37.2	-53.03	-2.67
84	2423.15	12.73	-55.8	-37.3	-53.03	-2.77
85	2423.2	12.53	-56	-37.5	-53.03	-2.97
86	2423.25	12.63	-55.9	-37.4	-53.03	-2.87
87	2423.3	12.83	-55.7	-37.2	-53.03	-2.67

meas #	f MHz	Gp dBm	Pj dBm	Pg dBm	Ps dBm	J/S dB
88	2423.35	12.83	-55.7	-37.2	-53.03	-2.67
89	2423.4	12.43	-56.1	-37.6	-53.03	-3.07
90	2423.45	12.23	-56.3	-37.8	-53.03	-3.27
91	2423.5	12.33	-56.2	-37.7	-53.03	-3.17
92	2423.55	12.53	-56	-37.5	-53.03	-2.97
93	2423.6	12.33	-56.2	-37.7	-53.03	-3.17
94	2423.65	12.13	-56.4	-37.9	-53.03	-3.37
95	2423.7	12.13	-56.4	-37.9	-53.03	-3.37
96	2423.75	12.43	-56.1	-37.6	-53.03	-3.07
97	2423.8	12.63	-55.9	-37.4	-53.03	-2.87
98	2423.85	12.43	-56.1	-37.6	-53.03	-3.07
99	2423.9	12.23	-56.3	-37.8	-53.03	-3.27
100	2423.95	12.33	-56.2	-37.7	-53.03	-3.17
101	2424	12.53	-56	-37.5	-53.03	-2.97
102	2424.05	12.53	-56	-37.5	-53.03	-2.97
103	2424.1	12.13	-56.4	-37.9	-53.03	-3.37
104	2424.15	12.03	-56.5	-38	-53.03	-3.47
105	2424.2	12.23	-56.3	-37.8	-53.03	-3.27
106	2424.25	12.33	-56.2	-37.7	-53.03	-3.17
107	2424.3	12.33	-56.2	-37.7	-53.03	-3.17
108	2424.35	12.13	-56.4	-37.9	-53.03	-3.37
109	2424.4	12.13	-56.4	-37.9	-53.03	-3.37
110	2424.45	12.43	-56.1	-37.6	-53.03	-3.07
111	2424.5	12.53	-56	-37.5	-53.03	-2.97
112	2424.55	12.33	-56.2	-37.7	-53.03	-3.17
113	2424.6	12.03	-56.5	-38	-53.03	-3.47
114	2424.65	12.13	-56.4	-37.9	-53.03	-3.37
115	2424.7	12.23	-56.3	-37.8	-53.03	-3.27
116	2424.75	12.23	-56.3	-37.8	-53.03	-3.27
117	2424.8	11.93	-56.6	-38.1	-53.03	-3.57
118	2424.85	11.83	-56.7	-38.2	-53.03	-3.67
119	2424.9	12.03	-56.5	-38	-53.03	-3.47
120	2424.95	12.33	-56.2	-37.7	-53.03	-3.17
121	2425	12.33	-56.2	-37.7	-53.03	-3.17
122	2425.05	12.13	-56.4	-37.9	-53.03	-3.37
123	2425.1	12.23	-56.3	-37.8	-53.03	-3.27
124	2425.15	12.53	-56	-37.5	-53.03	-2.97
125	2425.2	12.63	-55.9	-37.4	-53.03	-2.87
126	2425.25	12.43	-56.1	-37.6	-53.03	-3.07
127	2425.3	12.13	-56.4	-37.9	-53.03	-3.37
128	2425.35	12.23	-56.3	-37.8	-53.03	-3.27
129	2425.4	12.23	-56.3	-37.8	-53.03	-3.27
130	2425.45	12.13	-56.4	-37.9	-53.03	-3.37
131	2425.5	11.63	-56.9	-38.4	-53.03	-3.87

meas #	f MHz	Gp dBm	Pj dBm	Pg dBm	Ps dBm	J/S dB
132	2425.55	11.53	-57	-38.5	-53.03	-3.97
133	2425.6	11.43	-57.1	-38.6	-53.03	-4.07
134	2425.65	11.63	-56.9	-38.4	-53.03	-3.87
135	2425.7	11.13	-57.4	-38.9	-53.03	-4.37
136	2425.75	10.93	-57.6	-39.1	-53.03	-4.57
137	2425.8	10.63	-57.9	-39.4	-53.03	-4.87
138	2425.85	10.83	-57.7	-39.2	-53.03	-4.67
139	2425.9	10.53	-58	-39.5	-53.03	-4.97
140	2425.95	10.33	-58.2	-39.7	-53.03	-5.17
141	2426	10.03	-58.5	-40	-53.03	-5.47
142	2426.05	10.13	-58.4	-39.9	-53.03	-5.37
143	2426.1	10.43	-58.1	-39.6	-53.03	-5.07
144	2426.15	10.43	-58.1	-39.6	-53.03	-5.07
145	2426.2	10.53	-58	-39.5	-53.03	-4.97
146	2426.25	10.53	-58	-39.5	-53.03	-4.97
147	2426.3	11.13	-57.4	-38.9	-53.03	-4.37
148	2426.35	11.43	-57.1	-38.6	-53.03	-4.07
149	2426.4	11.73	-56.8	-38.3	-53.03	-3.77
150	2426.45	11.43	-57.1	-38.6	-53.03	-4.07
151	2426.5	11.93	-56.6	-38.1	-53.03	-3.57
152	2426.55	12.13	-56.4	-37.9	-53.03	-3.37
153	2426.6	12.43	-56.1	-37.6	-53.03	-3.07
154	2426.65	12.13	-56.4	-37.9	-53.03	-3.37
155	2426.7	12.13	-56.4	-37.9	-53.03	-3.37
156	2426.75	12.23	-56.3	-37.8	-53.03	-3.27
157	2426.8	12.63	-55.9	-37.4	-53.03	-2.87
158	2426.85	12.53	-56	-37.5	-53.03	-2.97
159	2426.9	12.43	-56.1	-37.6	-53.03	-3.07
160	2426.95	12.33	-56.2	-37.7	-53.03	-3.17
161	2427	12.63	-55.9	-37.4	-53.03	-2.87
162	2427.05	12.73	-55.8	-37.3	-53.03	-2.77
163	2427.1	12.53	-56	-37.5	-53.03	-2.97
164	2427.15	12.23	-56.3	-37.8	-53.03	-3.27
165	2427.2	12.23	-56.3	-37.8	-53.03	-3.27
166	2427.25	12.43	-56.1	-37.6	-53.03	-3.07
167	2427.3	12.53	-56	-37.5	-53.03	-2.97
168	2427.35	12.23	-56.3	-37.8	-53.03	-3.27
169	2427.4	12.23	-56.3	-37.8	-53.03	-3.27
170	2427.45	12.43	-56.1	-37.6	-53.03	-3.07
171	2427.5	12.73	-55.8	-37.3	-53.03	-2.77
172	2427.55	12.73	-55.8	-37.3	-53.03	-2.77
173	2427.6	12.63	-55.9	-37.4	-53.03	-2.87
174	2427.65	12.63	-55.9	-37.4	-53.03	-2.87
175	2427.7	12.83	-55.7	-37.2	-53.03	-2.67



meas #	f MHz	Gp dBm	Pj dBm	Pg dBm	Ps dBm	J/S dB
176	2427.75	12.93	-55.6	-37.1	-53.03	-2.57
177	2427.8	12.73	-55.8	-37.3	-53.03	-2.77
178	2427.85	12.43	-56.1	-37.6	-53.03	-3.07
179	2427.9	12.33	-56.2	-37.7	-53.03	-3.17
180	2427.95	12.53	-56	-37.5	-53.03	-2.97
181	2428	12.53	-56	-37.5	-53.03	-2.97
182	2428.05	12.33	-56.2	-37.7	-53.03	-3.17
183	2428.1	12.13	-56.4	-37.9	-53.03	-3.37
184	2428.15	12.33	-56.2	-37.7	-53.03	-3.17
185	2428.2	12.53	-56	-37.5	-53.03	-2.97
186	2428.25	12.53	-56	-37.5	-53.03	-2.97
187	2428.3	12.23	-56.3	-37.8	-53.03	-3.27
188	2428.35	12.13	-56.4	-37.9	-53.03	-3.37
189	2428.4	12.33	-56.2	-37.7	-53.03	-3.17
190	2428.45	12.43	-56.1	-37.6	-53.03	-3.07
191	2428.5	12.23	-56.3	-37.8	-53.03	-3.27
192	2428.55	12.03	-56.5	-38	-53.03	-3.47
193	2428.6	12.13	-56.4	-37.9	-53.03	-3.37
194	2428.65	12.43	-56.1	-37.6	-53.03	-3.07
195	2428.7	12.53	-56	-37.5	-53.03	-2.97
196	2428.75	12.33	-56.2	-37.7	-53.03	-3.17
197	2428.8	12.33	-56.2	-37.7	-53.03	-3.17
198	2428.85	12.53	-56	-37.5	-53.03	-2.97
199	2428.9	12.83	-55.7	-37.2	-53.03	-2.67
200	2428.95	12.73	-55.8	-37.3	-53.03	-2.77
201	2429	12.43	-56.1	-37.6	-53.03	-3.07
202	2429.05	12.43	-56.1	-37.6	-53.03	-3.07
203	2429.1	12.53	-56	-37.5	-53.03	-2.97
204	2429.15	12.63	-55.9	-37.4	-53.03	-2.87
205	2429.2	12.33	-56.2	-37.7	-53.03	-3.17
206	2429.25	12.13	-56.4	-37.9	-53.03	-3.37
207	2429.3	12.23	-56.3	-37.8	-53.03	-3.27
208	2429.35	12.53	-56	-37.5	-53.03	-2.97
209	2429.4	12.53	-56	-37.5	-53.03	-2.97
210	2429.45	12.33	-56.2	-37.7	-53.03	-3.17
211	2429.5	12.13	-56.4	-37.9	-53.03	-3.37
212	2429.55	12.33	-56.2	-37.7	-53.03	-3.17
213	2429.6	12.53	-56	-37.5	-53.03	-2.97
214	2429.65	12.43	-56.1	-37.6	-53.03	-3.07
215	2429.7	12.13	-56.4	-37.9	-53.03	-3.37
216	2429.75	12.13	-56.4	-37.9	-53.03	-3.37
217	2429.8	12.33	-56.2	-37.7	-53.03	-3.17
218	2429.85	12.43	-56.1	-37.6	-53.03	-3.07
219	2429.9	12.33	-56.2	-37.7	-53.03	-3.17

meas #	f MHz	Gp dBm	Pj dBm	Pg dBm	Ps dBm	J/S dB
220	2429.95	12.23	-56.3	-37.8	-53.03	-3.27
221	2430	12.53	-56	-37.5	-53.03	-2.97
222	2430.05	12.83	-55.7	-37.2	-53.03	-2.67
223	2430.1	12.93	-55.6	-37.1	-53.03	-2.57
224	2430.15	12.73	-55.8	-37.3	-53.03	-2.77
225	2430.2	12.63	-55.9	-37.4	-53.03	-2.87
226	2430.25	12.73	-55.8	-37.3	-53.03	-2.77
227	2430.3	12.83	-55.7	-37.2	-53.03	-2.67
228	2430.35	12.63	-55.9	-37.4	-53.03	-2.87
229	2430.4	12.33	-56.2	-37.7	-53.03	-3.17
230	2430.45	12.23	-56.3	-37.8	-53.03	-3.27
231	2430.5	12.33	-56.2	-37.7	-53.03	-3.17
232	2430.55	12.43	-56.1	-37.6	-53.03	-3.07
233	2430.6	12.23	-56.3	-37.8	-53.03	-3.27
234	2430.65	12.13	-56.4	-37.9	-53.03	-3.37
235	2430.7	12.33	-56.2	-37.7	-53.03	-3.17
236	2430.75	12.63	-55.9	-37.4	-53.03	-2.87
237	2430.8	12.73	-55.8	-37.3	-53.03	-2.77
238	2430.85	12.53	-56	-37.5	-53.03	-2.97
239	2430.9	12.63	-55.9	-37.4	-53.03	-2.87
240	2430.95	12.83	-55.7	-37.2	-53.03	-2.67
241	2431	13.13	-55.4	-36.9	-53.03	-2.37
242	2431.05	13.03	-55.5	-37	-53.03	-2.47
243	2431.1	12.93	-55.6	-37.1	-53.03	-2.57
244	2431.15	13.03	-55.5	-37	-53.03	-2.47
245	2431.2	13.53	-55	-36.5	-53.03	-1.97
246	2431.25	13.63	-54.9	-36.4	-53.03	-1.87
247	2431.3	13.63	-54.9	-36.4	-53.03	-1.87
248	2431.35	13.53	-55	-36.5	-53.03	-1.97
249	2431.4	13.73	-54.8	-36.3	-53.03	-1.77
250	2431.45	13.93	-54.6	-36.1	-53.03	-1.57
251	2431.5	13.93	-54.6	-36.1	-53.03	-1.57
252	2431.55	13.63	-54.9	-36.4	-53.03	-1.87
253	2431.6	13.63	-54.9	-36.4	-53.03	-1.87
254	2431.65	13.83	-54.7	-36.2	-53.03	-1.67
255	2431.7	14.33	-54.2	-35.7	-53.03	-1.17
256	2431.75	14.13	-54.4	-35.9	-53.03	-1.37
257	2431.8	14.43	-54.1	-35.6	-53.03	-1.07
258	2431.85	14.53	-54	-35.5	-53.03	-0.97
259	2431.9	15.53	-53	-34.5	-53.03	0.03
260	2431.95	15.73	-52.8	-34.3	-53.03	0.23
261	2432	16.23	-52.3	-33.8	-53.03	0.73
262	2432.05	16.13	-52.4	-33.9	-53.03	0.63
263	2432.1	17.23	-51.3	-32.8	-53.03	1.73

meas #	f MHz	Gp dBm	Pj dBm	Pg dBm	Ps dBm	J/S dB
264	2432.15	17.53	-51	-32.5	-53.03	2.03
265	2432.2	18.53	-50	-31.5	-53.03	3.03
266	2432.25	18.23	-50.3	-31.8	-53.03	2.73
267	2432.3	19.43	-49.1	-30.6	-53.03	3.93
268	2432.35	19.63	-48.9	-30.4	-53.03	4.13
269	2432.4	21.13	-47.4	-28.9	-53.03	5.63
270	2432.45	21.03	-47.5	-29	-53.03	5.53
271	2432.5	22.03	-46.5	-28	-53.03	6.53
272	2432.55	22.03	-46.5	-28	-53.03	6.53
273	2432.6	23.83	-44.7	-26.2	-53.03	8.33
274	2432.65	23.93	-44.6	-26.1	-53.03	8.43
275	2432.7	25.03	-43.5	-25	-53.03	9.53
276	2432.75	24.83	-43.7	-25.2	-53.03	9.33
277	2432.8	26.33	-42.2	-23.7	-53.03	10.83
278	2432.85	26.53	-42	-23.5	-53.03	11.03
279	2432.9	27.73	-40.8	-22.3	-53.03	12.23
280	2432.95	27.43	-41.1	-22.6	-53.03	11.93
281	2433	28.43	-40.1	-21.6	-53.03	12.93