1/6/2000

Processing Gain Test for HZB-S24-04 (Model 31360)

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 2419.0 MHz, over a range of ±4.0 MHz. The measurements made across the center ± 3.0 MHz should be used for calculation of Gp 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 ~-94 dBm at BER = 1×10^{-6}, the signal level of the transmit radio was –52.85 dBm measured at the input of the receive radio, (Ps). For the jammer signal, -35 dBm at the generator (Pg) corresponds to – 53.85 dBm (Pj) at the receiver input. It is these numbers that were used for calculating C/I and Gp.

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:

Pg: Power at Generator in dBm (as indicated by generator display).

Pj: Power of interferer at the receiver input.(calculated in spreadsheet)

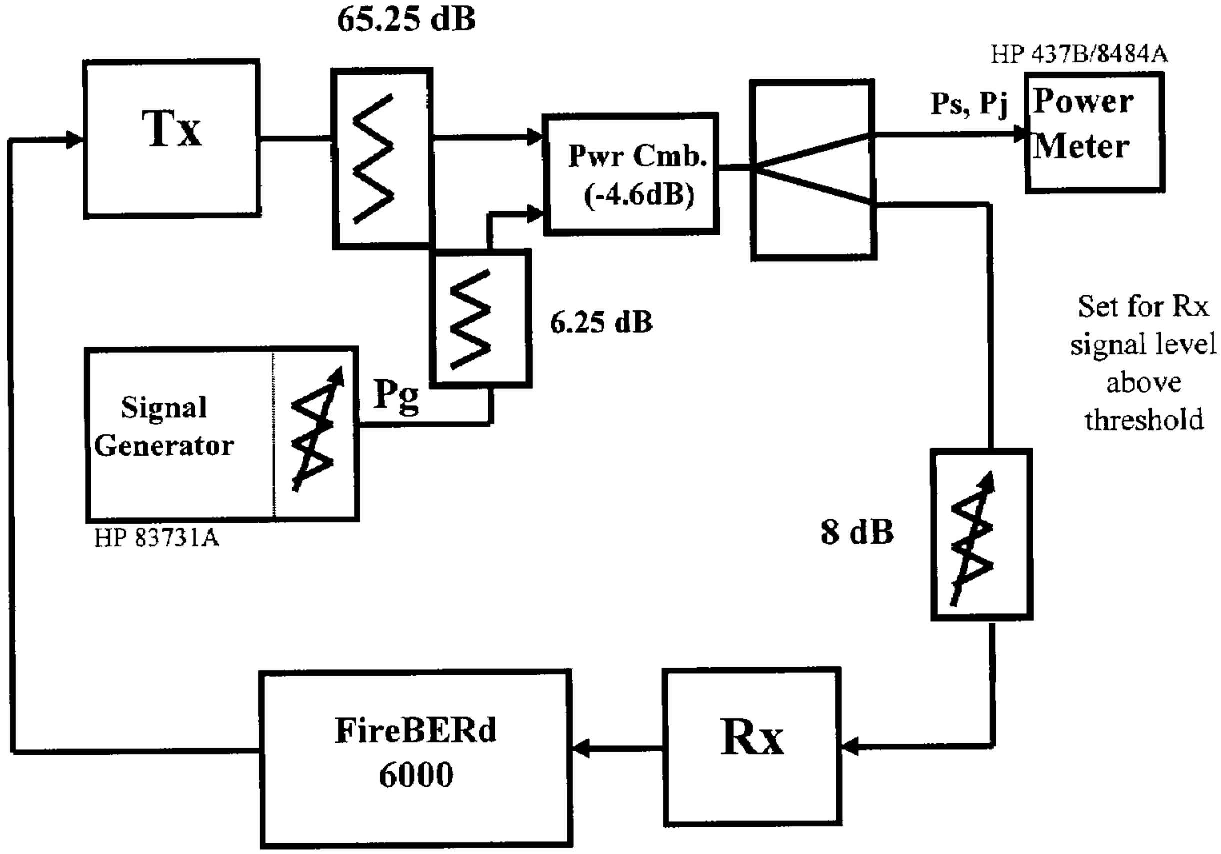
Ps: Power of carrier at receiver input (initial calibration).

J/S: Jammer to Signal ratio, Pj-Ps (dB) (calculated in spreadsheet)

Gp: Processing Gain: (S/N)o + J/S + Lsys where:
Lsys = 2 dB
(S/N)o = 13.5 dB for QPSK and BER = 10^{-6} (see curve provided)
therefore: Gp = 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



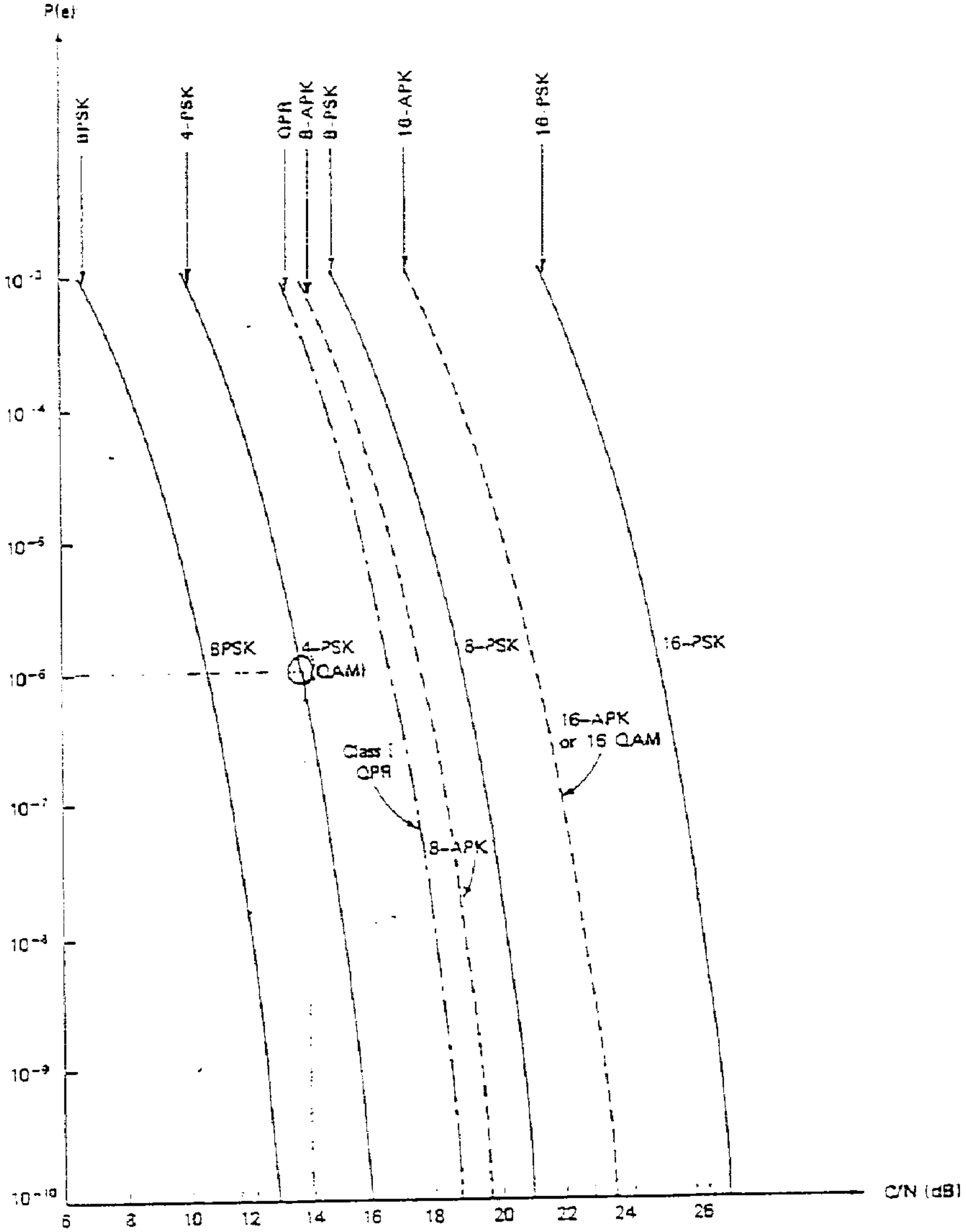
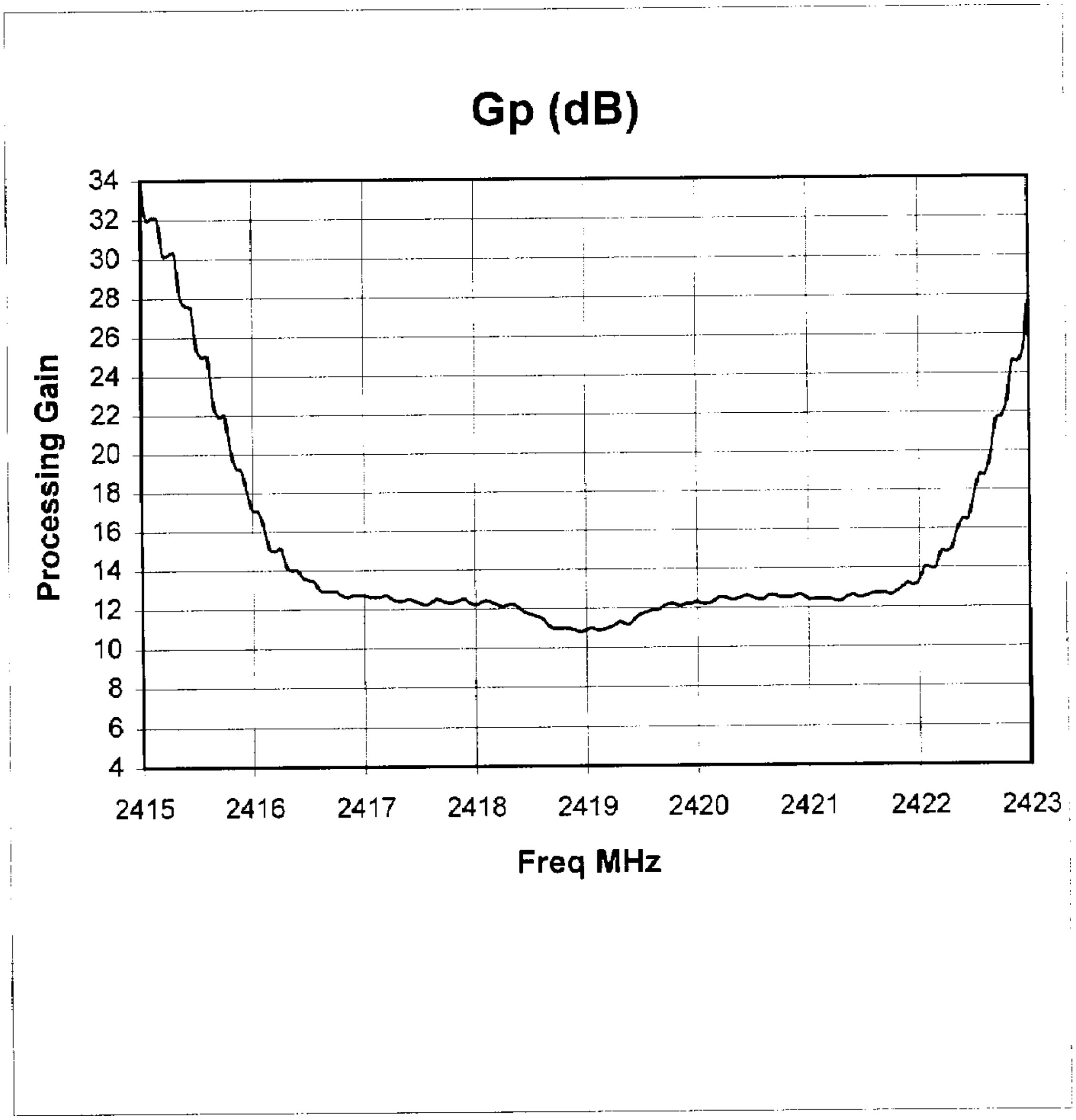


Fig. 3.21. $P(e)$ performance of M-ary PSK, QAM, QPR, and M-ary APK coherent systems. The rms C/N is specified in the double-sided Nyquist bandwidth.

Figure showing offset for QPSK (4-PSK) modulation C/N offset (14 dB).
(Obtained from DIGITAL COMMUNICATIONS: Microwave Applications, by Kamilo Feher, Prentice-Hall Inc., 1981)



Plot of Processing Gain vs Frequency (Carrier at 2.419 GHz) 2E1 Rate.
(January 6, 2000) Model: 31360 Radio.

meas #	f MHz	Gp dBm	Pj dBm	Pg dBm	Ps dBm	J/S dB
1	2415	33.8	-34.55	-15.7	-52.85	18.3
2	2415.05	32	-36.35	-17.5	-52.85	16.5
3	2415.1	32.1	-36.25	-17.4	-52.85	16.6
4	2415.15	32	-36.35	-17.5	-52.85	16.5
5	2415.2	30.2	-38.15	-19.3	-52.85	14.7
6	2415.25	30.2	-38.15	-19.3	-52.85	14.7
7	2415.3	30.3	-38.05	-19.2	-52.85	14.8
8	2415.35	28.1	-40.25	-21.4	-52.85	12.6
9	2415.4	27.6	-40.75	-21.9	-52.85	12.1
10	2415.45	27.5	-40.85	-22	-52.85	12
11	2415.5	25.4	-42.95	-24.1	-52.85	9.9
12	2415.55	25	-43.35	-24.5	-52.85	9.5
13	2415.6	25	-43.35	-24.5	-52.85	9.5
14	2415.65	22.6	-45.75	-26.9	-52.85	7.1
15	2415.7	21.9	-46.45	-27.6	-52.85	6.4
16	2415.75	22	-46.35	-27.5	-52.85	6.5
17	2415.8	20.3	-48.05	-29.2	-52.85	4.8
18	2415.85	19.3	-49.05	-30.2	-52.85	3.8
19	2415.9	19.1	-49.25	-30.4	-52.85	3.6
20	2415.95	18	-50.35	-31.5	-52.85	2.5
21	2416	17.1	-51.25	-32.4	-52.85	1.6
22	2416.05	17	-51.35	-32.5	-52.85	1.5
23	2416.1	16.2	-52.15	-33.3	-52.85	0.7
24	2416.15	15.1	-53.25	-34.4	-52.85	-0.4
25	2416.2	15	-53.35	-34.5	-52.85	-0.5
26	2416.25	15.1	-53.25	-34.4	-52.85	-0.4
27	2416.3	14.2	-54.15	-35.3	-52.85	-1.3
28	2416.35	14	-54.35	-35.5	-52.85	-1.5
29	2416.4	14	-54.35	-35.5	-52.85	-1.5
30	2416.45	13.6	-54.75	-35.9	-52.85	-1.9
31	2416.5	13.5	-54.85	-36	-52.85	-2
32	2416.55	13.4	-54.95	-36.1	-52.85	-2.1
33	2416.6	13	-55.35	-36.5	-52.85	-2.5
34	2416.65	12.9	-55.45	-36.6	-52.85	-2.6
35	2416.7	12.9	-55.45	-36.6	-52.85	-2.6
36	2416.75	12.9	-55.45	-36.6	-52.85	-2.6
37	2416.8	12.7	-55.65	-36.8	-52.85	-2.8
38	2416.85	12.6	-55.75	-36.9	-52.85	-2.9
39	2416.9	12.7	-55.65	-36.8	-52.85	-2.8
40	2416.95	12.7	-55.65	-36.8	-52.85	-2.8
41	2417	12.7	-55.65	-36.8	-52.85	-2.8
42	2417.05	12.6	-55.75	-36.9	-52.85	-2.9
43	2417.1	12.6	-55.75	-36.9	-52.85	-2.9

meas #	f MHz	Gp dBm	Pj dBm	Pg dBm	Ps dBm	J/S dB
44	2417.15	12.6	-55.75	-36.9	-52.85	-2.9
45	2417.2	12.7	-55.65	-36.8	-52.85	-2.8
46	2417.25	12.5	-55.85	-37	-52.85	-3
47	2417.3	12.4	-55.95	-37.1	-52.85	-3.1
48	2417.35	12.4	-55.95	-37.1	-52.85	-3.1
49	2417.4	12.5	-55.85	-37	-52.85	-3
50	2417.45	12.4	-55.95	-37.1	-52.85	-3.1
51	2417.5	12.3	-56.05	-37.2	-52.85	-3.2
52	2417.55	12.2	-56.15	-37.3	-52.85	-3.3
53	2417.6	12.3	-56.05	-37.2	-52.85	-3.2
54	2417.65	12.5	-55.85	-37	-52.85	-3
55	2417.7	12.4	-55.95	-37.1	-52.85	-3.1
56	2417.75	12.3	-56.05	-37.2	-52.85	-3.2
57	2417.8	12.3	-56.05	-37.2	-52.85	-3.2
58	2417.85	12.4	-55.95	-37.1	-52.85	-3.1
59	2417.9	12.5	-55.85	-37	-52.85	-3
60	2417.95	12.3	-56.05	-37.2	-52.85	-3.2
61	2418	12.2	-56.15	-37.3	-52.85	-3.3
62	2418.05	12.3	-56.05	-37.2	-52.85	-3.2
63	2418.1	12.4	-55.95	-37.1	-52.85	-3.1
64	2418.15	12.3	-56.05	-37.2	-52.85	-3.2
65	2418.2	12.2	-56.15	-37.3	-52.85	-3.3
66	2418.25	12.1	-56.25	-37.4	-52.85	-3.4
67	2418.3	12.2	-56.15	-37.3	-52.85	-3.3
68	2418.35	12.2	-56.15	-37.3	-52.85	-3.3
69	2418.4	12	-56.35	-37.5	-52.85	-3.5
70	2418.45	11.8	-56.55	-37.7	-52.85	-3.7
71	2418.5	11.7	-56.65	-37.8	-52.85	-3.8
72	2418.55	11.6	-56.75	-37.9	-52.85	-3.9
73	2418.6	11.5	-56.85	-38	-52.85	-4
74	2418.65	11.2	-57.15	-38.3	-52.85	-4.3
75	2418.7	11	-57.35	-38.5	-52.85	-4.5
76	2418.75	11	-57.35	-38.5	-52.85	-4.5
77	2418.8	11	-57.35	-38.5	-52.85	-4.5
78	2418.85	11	-57.35	-38.5	-52.85	-4.5
79	2418.9	10.9	-57.45	-38.6	-52.85	-4.6
80	2418.95	10.8	-57.55	-38.7	-52.85	-4.7
81	2419	10.9	-57.45	-38.6	-52.85	-4.6
82	2419.05	11	-57.35	-38.5	-52.85	-4.5
83	2419.1	10.9	-57.45	-38.6	-52.85	-4.6
84	2419.15	10.9	-57.45	-38.6	-52.85	-4.6
85	2419.2	11	-57.35	-38.5	-52.85	-4.5
86	2419.25	11.1	-57.25	-38.4	-52.85	-4.4
87	2419.3	11.3	-57.05	-38.2	-52.85	-4.2

meas #	f MHz	Gp dBm	Pj dBm	Pg dBm	Ps dBm	J/S dB
88	2419.35	11.2	-57.15	-38.3	-52.85	-4.3
89	2419.4	11.2	-57.15	-38.3	-52.85	-4.3
90	2419.45	11.5	-56.85	-38	-52.85	-4
91	2419.5	11.7	-56.65	-37.8	-52.85	-3.8
92	2419.55	11.8	-56.55	-37.7	-52.85	-3.7
93	2419.6	11.9	-56.45	-37.6	-52.85	-3.6
94	2419.65	11.9	-56.45	-37.6	-52.85	-3.6
95	2419.7	12.1	-56.25	-37.4	-52.85	-3.4
96	2419.75	12.2	-56.15	-37.3	-52.85	-3.3
97	2419.8	12.2	-56.15	-37.3	-52.85	-3.3
98	2419.85	12.1	-56.25	-37.4	-52.85	-3.4
99	2419.9	12.2	-56.15	-37.3	-52.85	-3.3
100	2419.95	12.2	-56.15	-37.3	-52.85	-3.3
101	2420	12.3	-56.05	-37.2	-52.85	-3.2
102	2420.05	12.2	-56.15	-37.3	-52.85	-3.3
103	2420.1	12.2	-56.15	-37.3	-52.85	-3.3
104	2420.15	12.3	-56.05	-37.2	-52.85	-3.2
105	2420.2	12.5	-55.85	-37	-52.85	-3
106	2420.25	12.5	-55.85	-37	-52.85	-3
107	2420.3	12.4	-55.95	-37.1	-52.85	-3.1
108	2420.35	12.4	-55.95	-37.1	-52.85	-3.1
109	2420.4	12.5	-55.85	-37	-52.85	-3
110	2420.45	12.6	-55.75	-36.9	-52.85	-2.9
111	2420.5	12.5	-55.85	-37	-52.85	-3
112	2420.55	12.4	-55.95	-37.1	-52.85	-3.1
113	2420.6	12.4	-55.95	-37.1	-52.85	-3.1
114	2420.65	12.6	-55.75	-36.9	-52.85	-2.9
115	2420.7	12.6	-55.75	-36.9	-52.85	-2.9
116	2420.75	12.5	-55.85	-37	-52.85	-3
117	2420.8	12.5	-55.85	-37	-52.85	-3
118	2420.85	12.5	-55.85	-37	-52.85	-3
119	2420.9	12.6	-55.75	-36.9	-52.85	-2.9
120	2420.95	12.6	-55.75	-36.9	-52.85	-2.9
121	2421	12.4	-55.95	-37.1	-52.85	-3.1
122	2421.05	12.4	-55.95	-37.1	-52.85	-3.1
123	2421.1	12.4	-55.95	-37.1	-52.85	-3.1
124	2421.15	12.4	-55.95	-37.1	-52.85	-3.1
125	2421.2	12.4	-55.95	-37.1	-52.85	-3.1
126	2421.25	12.3	-56.05	-37.2	-52.85	-3.2
127	2421.3	12.3	-56.05	-37.2	-52.85	-3.2
128	2421.35	12.5	-55.85	-37	-52.85	-3
129	2421.4	12.6	-55.75	-36.9	-52.85	-2.9
130	2421.45	12.5	-55.85	-37	-52.85	-3
131	2421.5	12.5	-55.85	-37	-52.85	-3

meas #	f MHz	Gp dBm	Pj dBm	Pg dBm	Ps dBm	J/S dB
132	2421.55	12.6	-55.75	-36.9	-52.85	-2.9
133	2421.6	12.7	-55.65	-36.8	-52.85	-2.8
134	2421.65	12.7	-55.65	-36.8	-52.85	-2.8
135	2421.7	12.7	-55.65	-36.8	-52.85	-2.8
136	2421.75	12.6	-55.75	-36.9	-52.85	-2.9
137	2421.8	12.8	-55.55	-36.7	-52.85	-2.7
138	2421.85	13	-55.35	-36.5	-52.85	-2.5
139	2421.9	13.2	-55.15	-36.3	-52.85	-2.3
140	2421.95	13.1	-55.25	-36.4	-52.85	-2.4
141	2422	13.3	-55.05	-36.2	-52.85	-2.2
142	2422.05	14	-54.35	-35.5	-52.85	-1.5
143	2422.1	14	-54.35	-35.5	-52.85	-1.5
144	2422.15	14	-54.35	-35.5	-52.85	-1.5
145	2422.2	14.8	-53.55	-34.7	-52.85	-0.7
146	2422.25	14.8	-53.55	-34.7	-52.85	-0.7
147	2422.3	15	-53.35	-34.5	-52.85	-0.5
148	2422.35	16	-52.35	-33.5	-52.85	0.5
149	2422.4	16.5	-51.85	-33	-52.85	1
150	2422.45	16.5	-51.85	-33	-52.85	1
151	2422.5	17.7	-50.65	-31.8	-52.85	2.2
152	2422.55	18.8	-49.55	-30.7	-52.85	3.3
153	2422.6	18.8	-49.55	-30.7	-52.85	3.3
154	2422.65	19.8	-48.55	-29.7	-52.85	4.3
155	2422.7	21.6	-46.75	-27.9	-52.85	6.1
156	2422.75	21.8	-46.55	-27.7	-52.85	6.3
157	2422.8	22.6	-45.75	-26.9	-52.85	7.1
158	2422.85	24.6	-43.75	-24.9	-52.85	9.1
159	2422.9	24.6	-43.75	-24.9	-52.85	9.1
160	2422.95	25.2	-43.15	-24.3	-52.85	9.7
161	2423	27.4	-40.95	-22.1	-52.85	11.9