WESTERN Multiplex

1196 Borregas Ave., Sunnyvale, CA 94089-1302, USA
Tel: +1 (408) 542-5200, Fax: +1 (408) 542-5300

Federal Communications Commission
Authorization and Evaluation Division
7435 Oakland Mills Road
Columbia, MD 21046

May 4, 2000

RE: Response to FCC Requests
Correspondence Reference Numbers: 12812
FCC IDs: HZB-S24-04
Form 731 Confirmation Numbers: EA96697

Attn: Joe Dichoso

Dear Mr. Dichoso:

This is in response to your request 12812 regarding the application of HZB-S24-04 product.

1, 4 Please see attachment 1, which I will upload separately, for our previous responses to the Commission's request for processing gain. Please also find the test report of the process gain document as attached at the end of this letter. The processing gain compliance is demonstrated using the method as described in part 15.247 (e) (2). All measurements are above 10dB; therefore, there was no requirement to delete worst case 20% data points.

It is difficult to determine the theoretical processing gain when multiple coding technologies are implemented in combination with spreading, all of which contribute to the improvement to the received signal to noise ratio. We believe the processing gain definition given by many textbooks where spread spectrum technology is discussed alone is over simplified for our technology and can not accurately describe the improvement to the received signal to noise ratio of our system. As we have expressed in our previous letters to the Commission, and have been accepted numerous times by the Commission in our previous applications, we believe the demonstration of the specification by means of Commission-approved test procedures should acknowledge the compliance of any device. We are interested in research on the theoretical processing gain in a complex system where spread spectrum technology is implemented in combination with other technologies, and are willing to discuss and research with the Commission on this issue in the future independent of the equipment approval.

2 Please find herewith a list of antennas as examples of the type and models of antennas can be used with the HZB-S24-04 product. Since there are so many antenna vendors in the market, it is impossible to provide a full list of all antennas that could possibly be used with our product. That is why we recommend in our manual by antenna sizes and gains, rather than model names.

Antenna Type and Size	Range of Mid Band Gain for Antennas by Various Vendors (dBi)
2' parabolic	20.6-21.6
4' parabolic	26.6-27.6
6' parabolic	30.1-31.1
8' parabolic	31.8-33.6

Please refer to page 3-38 and 3-39 as attached for information we provide in our manual in regards to antenna gains, cable losses, and maximum output power. This information is provided so that the EIRP limit for the 2.4GHz band is met.

3 Please find in Page 1-1 of the manual language indicating that the radio is exclusively for fixed point-to-point operation. A copy of the manual page is attached to this letter.

I hope I have addressed questions in your request. Please contact the undersigned should there be any further questions.

Yours

Caroline Yu
International Product Manager
Western Multiplex Corporation

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 x 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)

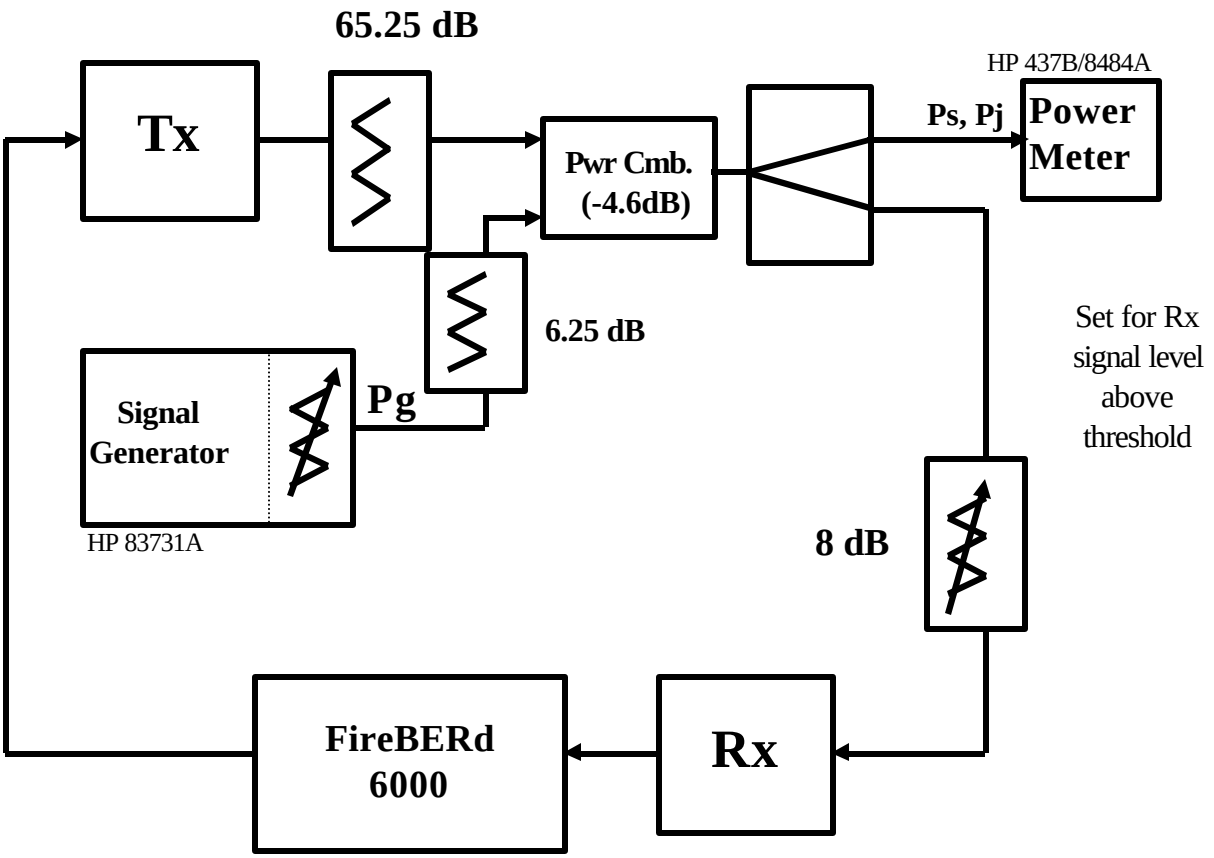
Ps: Power of carrier at receiver input (initial calibration).

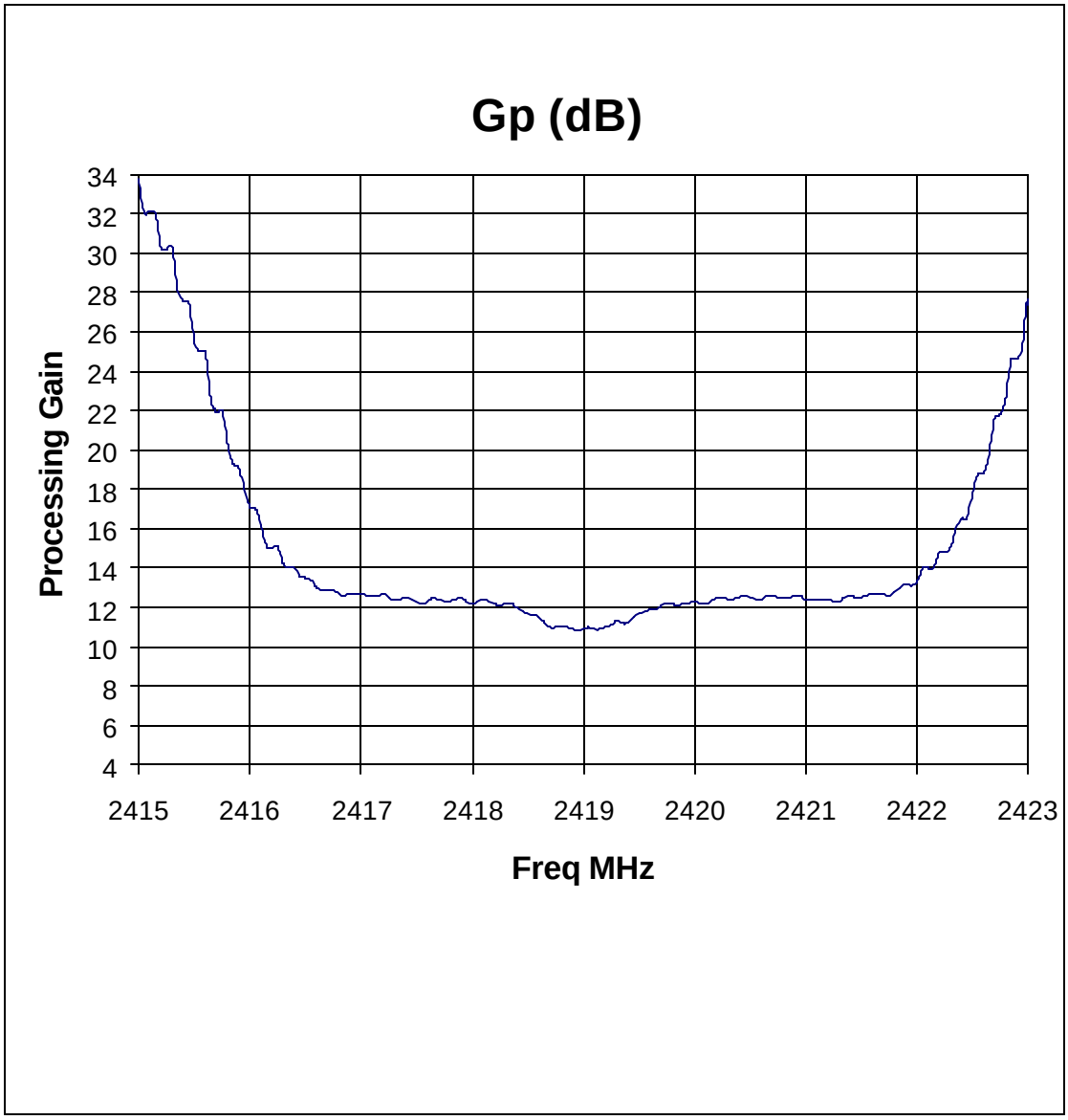
J/S: Jammer to Signal ratio, Pj-Ps (dB) (calculated in spreadsheet)

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





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

Feeder Length Meters	Feeder Length Feet	TRANSMITTER POWER (dBm)					
		2.4 GHz, 1/2" Coax			2.4 GHz, 7/8" Coax		
		4' Dish	6' Dish	8' Dish	4' Dish	6' Dish	8' Dish
3.0	10	23.4	22.0	21.2	23.2	21.9	21.1
6.1	20	23.8	22.4	21.6	23.5	22.1	21.3
9.1	30	24.1	22.8	22.0	23.7	22.4	21.5
12.2	40	24.5	23.2	22.4	23.9	22.6	21.8
15.2	50	24.9	23.6	22.7	24.2	22.8	22.0
18.3	60	25.3	23.9	23.1	24.4	23.0	22.2
21.3	70	25.7	24.3	23.5	24.6	23.3	22.4
24.4	80	26.0	24.7	23.9	24.8	23.5	22.7
27.4	90	26.4	25.1	24.3	25.1	23.7	22.9
30.5	100	26.8	25.5	24.6	25.3	24.0	23.1
33.5	110	27.2	25.8	25.0	25.5	24.2	23.4
36.6	120	27.6	26.2	25.4	25.8	24.4	23.6
39.6	130	27.9	26.6	25.8	26.0	24.7	23.8
42.7	140	28.3	27.0	26.2	26.2	24.9	24.1
45.7	150	28.7	27.4	26.5	26.5	25.1	24.3
48.8	160	29.1	27.7	26.9	26.7	25.3	24.5
51.8	170	29.5	28.1	27.3	26.9	25.6	24.7
54.9	180	29.8	28.5	27.7	27.1	25.8	25.0
57.9	190	MAX	28.9	28.1	27.4	26.0	25.2
61.0	200	MAX	29.3	28.4	27.6	26.3	25.4
64.0	210	MAX	29.6	28.8	27.8	26.5	25.7
67.1	220	MAX	MAX	29.2	28.1	26.7	25.9
70.1	230	MAX	MAX	29.6	28.3	27.0	26.1
73.2	240	MAX	MAX	MAX	28.5	27.2	26.4
76.2	250	MAX	MAX	MAX	28.8	27.4	26.6
79.2	260	MAX	MAX	MAX	29.0	27.6	26.8
82.3	270	MAX	MAX	MAX	29.2	27.9	27.0
85.3	280	MAX	MAX	MAX	29.4	28.1	27.3
88.4	290	MAX	MAX	MAX	29.7	28.3	27.5
91.4	300	MAX	MAX	MAX	29.9	28.6	27.7
94.5	310	MAX	MAX	MAX	MAX	28.8	28.0
97.5	320	MAX	MAX	MAX	MAX	29.0	28.2
100.6	330	MAX	MAX	MAX	MAX	29.3	28.4
103.6	340	MAX	MAX	MAX	MAX	29.5	28.7
106.7	350	MAX	MAX	MAX	MAX	29.7	28.9
109.7	360	MAX	MAX	MAX	MAX	29.9	29.1
112.8	370	MAX	MAX	MAX	MAX	MAX	29.3
115.8	380	MAX	MAX	MAX	MAX	MAX	29.6
118.9	390	MAX	MAX	MAX	MAX	MAX	29.8
121.9	400	MAX	MAX	MAX	MAX	MAX	30.0

Table 3-D: Transmitter Output Power Adjustment for 2.4 GHz, USA Installations

3.13.1 Output Power Adjustment

The *LYNX.sc* radio requires professional installation. In certain cases, it is necessary to adjust the output power from the factory setting, for example:

- to meet EIRP (effective isotropic radiated power) limits, such as +6 dBW in Canada.
- to meet transmitter output limits in the 2.4 GHz band for USA installations.
- to avoid exceeding the maximum far-end RSL of 0 dBm.
- to coordinate a hub or repeater location.

To ensure maximum protection of the radio circuits, always ensure the antenna connector is terminated when power is applied.

For precise measurement of transmitter power, a calibrated RF power meter (such as the HP 435B with Power Sensor HP8481) is recommended. This power sensor can be connected directly to the output of the radio without exceeding the power rating. With some power meters, it may be necessary to place a calibrated in-line fixed attenuator between the radio antenna port and the power meter so as to not exceed the power meter's maximum input level. Thruline power meters do not operate at *LYNX.sc* RF frequencies.

If adjusting the output power to meet an EIRP limit, it will be first necessary to calculate the overall system gains and losses, including feeder losses for the type of transmission line installed and the antenna gain. Also refer to Table 3-C or 3-D for transmitter output power settings where installed with various transmission line lengths and antenna sizes. You may determine the radio transmit power for EIRP limited installations by the following equation:

Tx Power (dBm) = EIRP Limit(dBm) + Feeder Loss(dB) - Antenna Gain(dB)

In the USA, 2.4 GHz models have an output limit which is determined by:

Tx Power (dBm) = 30 - [(Antenna Gain - 6)/ 3] + Feeder Loss

Output power may be adjusted using a small screwdriver and rotating the potentiometer which is recessed behind the front panel. Clockwise rotation increases output power while counter-clockwise rotation decreases output power.

In lieu of a calibrated RF power meter, the PWR test port voltage can be used to estimate the output power. Figures 3-16 & 3-17 illustrate the voltage reading for various output power levels. The factory test data sheet should be used to establish a more precise setting of this adjustment.

After setting the correct output power, place the cover cap found in the installation accessory kit over the front panel receptacle.

1. How to Use This Manual

1.1 Manual Organization

The Installation and Maintenance Manual provides information required to install and maintain the *LYNX.sc* and to use its many features to the fullest advantage. This manual is divided into the following sections:

Section 1 Provides instructions on how to most effectively utilize the information in this manual.

Section 2 Provides a brief description and specifications of the *LYNX.sc*.

Section 3 Explains the *LYNX.sc* installation and adjustments in detail.

Section 4 Provides maintenance, repair and troubleshooting information for the *LYNX.sc Spread Spectrum radios*.

Appendices Charts and diagrams are provided for radio connections and DIP switch settings along with other general information.

This device must be professionally installed. Instructions on setting the transmitter RF output power are contained in Section 3 of this Manual.

This device is to be used exclusively for fixed point-to-point operation that employs directional antennas.