

# **CC-Antenna-DK2 and Antenna Measurements Summary**

Richard Wallace

## **ABSTRACT**

The purpose of the antenna development kit (CC-Antenna-DK2) is to ease the decision of which type of low-cost antenna can be implemented as well as give an estimation of the performance that can be achieved.

### **Contents**

1	Introduction.....	13
2	CC-Antenna-DK2.....	13
3	Conclusion .....	51
4	References .....	52
Appendix A CTIA Measurement Reports .....		53

### **List of Figures**

1	CC-Antenna-DK2 Panel .....	14
2	CC-Antenna-DK2 Board Showing Metal Layers, Solder Paste, Silkscreen and v-Cut.....	14
3	Top Metal Layer and Contour .....	15
4	Bottom Metal Layer and Contour .....	15
5	JSC-JS Cable (MXJA01JA1200) Provided With the CC-Antenna-DK2.....	15
6	JSC-SMA Low-Cost Cable Provided With the CC-Antenna-DK2 .....	16
7	Insertion Loss of MXFR01JA3000 Low-Cost Cable .....	16
8	CC-Antenna-DK2 Board #9 Connected to a CC1350 SensorTag Rev 1.3.x.....	16
9	Connecting to a Launchpad .....	16
10	Board #1 – CR2032 Dual-Band 868 MHz and 2.4 GHz PCB Antenna .....	17
11	Impedance Measurement With No Matching Components.....	18
12	SWR Measurements of Board #1 - Single-Band Configuration 2.4 GHz .....	19
13	SWR Measurements of Board #1 - Dual-Band Configuration 868 MHz and 2.4 GHz .....	20
14	Board #2 – Compact 2.4 GHz PCB Antenna.....	21
15	Impedance and SWR Measurement With No Matching Components .....	21
16	Board #3 - Fractus Dual-Band 868 MHz and 2.4 GHz Chip Antenna.....	22
17	SWR Measurements of Board #3.....	23
18	Board #4: 433-510 MHz PCB Antenna.....	24
19	Impedance Measurement With No Matching Components.....	24
20	SWR Measurements of Board #4 - Single-Band Configuration 433 MHz .....	25
21	SWR Measurements of Board #4 - Single-Band Configuration 470-510 MHz.....	26
22	Board #5: 2.4 GHz Antenna Diversity .....	27
23	Impedance Measurement With No Matching Components.....	27
24	5A - SWR Measurements .....	27
25	Impedance Measurement With No Matching Components.....	28
26	5B - SWR Measurements .....	28
27	Board #6: Compact PCB Antenna .....	29

All trademarks are the property of their respective owners.

28	Impedance Measurement With No Matching Components.....	29
29	SWR Measurements of Board #6.....	29
30	ProANT 169 MHz Metal Stanced Antenna .....	30
31	SWR Measurements of Board #7.....	31
32	Board #8: 868/915/920 MHz Antenna Diversity.....	31
33	Impedance Measurement With No Matching Components.....	32
34	8A - SWR Measurements .....	32
35	8B - SWR Measurements With Z32 at 12 nH .....	33
36	Board #9: 868/915/920 MHz and 2.4 GHz Dual-Band PCB Antenna.....	33
37	Impedance Measurement With No Matching Components.....	34
38	SWR Measurements of Board #9.....	34
39	Board #10: Dual-Band 433 MHz/868 MHz PCB Antenna .....	35
40	SWR Measurements of Board #10 With 433 MHz BOM.....	35
41	Impedance Measurement With No Matching Components and Z42: DNM .....	36
42	SWR Measurements of Board #10 With 868 MHz BOM.....	36
43	Board #11: 2.4 GHz PCB Antenna .....	37
44	Impedance and SWR Measurement With No Matching Components .....	37
45	Board #12: Compact PCB Antenna.....	38
46	Impedance Measurement With No Matching Components.....	39
47	SWR Measurements of Board #12 .....	39
48	Boards #13, #14, and #15: Calibration Boards.....	39
49	Board #13, SHORT Impedance Measurement.....	40
50	Board #14, LOAD Impedance Measurement.....	40
51	Board #14, LOAD SWR Measurement.....	40
52	Board #15, OPEN Impedance Measurement.....	40
53	Board #14: Helical Wire Antenna – 169/315 MHz .....	41
54	Impedance Measurement With No Matching Components.....	41
55	SWR Measurements of Board #16 - Configuration 169 MHz .....	41
56	Standard Format of CTIA OTA Measurement Report.....	43
57	Antenna Board XYZ Coordinate Orientation.....	44
58	Board #1 (Single Band 2.40 GHz): Theta = 0, Phi = 0.....	57
59	Board #1 (Single Band 2.40 GHz): Theta = 180, Phi = 0.....	57
60	Board #1 (Single Band 2.40 GHz): Theta = 90, Phi = 0 .....	57
61	Board #1 (Single Band 2.40 GHz): Theta = 90, Phi = 180 .....	57
62	Board #1 (Single Band 2.40 GHz): Theta = 90, Phi = 270 .....	57
63	Board #1 (Single Band 2.40 GHz): Theta = 90, Phi = 90.....	57
64	Board #1 (Single Band 2.44 GHz): Theta = 0, Phi = 0.....	62
65	Board #1 (Single Band 2.44 GHz): Theta = 180, Phi = 0.....	62
66	Board #1 (Single Band 2.44 GHz): Theta = 90, Phi = 0 .....	62
67	Board #1 (Single Band 2.44 GHz): Theta = 90, Phi = 180 .....	62
68	Board #1 (Single Band 2.44 GHz): Theta = 90, Phi = 270 .....	62
69	Board #1 (Single Band 2.44 GHz): Theta = 90, Phi = 90.....	62
70	Board #1 (Single Band 2.48 GHz): Theta = 0, Phi = 0.....	67
71	Board #1 (Single Band 2.48 GHz): Theta = 180, Phi = 0.....	67
72	Board #1 (Single Band 2.48 GHz): Theta = 90, Phi = 0 .....	67
73	Board #1 (Single Band 2.48 GHz): Theta = 90, Phi = 180 .....	67
74	Board #1 (Single Band 2.48 GHz): Theta = 90, Phi = 270 .....	67
75	Board #1 (Single Band 2.48 GHz): Theta = 90, Phi = 90.....	67

76	Board #1 (Dual Band 868 MHz): Theta = 0, Phi = 0 .....	72
77	Board #1 (Dual Band 868 MHz): Theta = 180, Phi = 0 .....	72
78	Board #1 (Dual Band 868 MHz): Theta = 90, Phi = 0 .....	72
79	Board #1 (Dual Band 868 MHz): Theta = 90, Phi = 180 .....	72
80	Board #1 (Dual Band 868 MHz): Theta = 90, Phi = 270 .....	72
81	Board #1 (Dual Band 868 MHz): Theta = 90, Phi = 90 .....	72
82	Board #1 (Dual Band 2.40 GHz): Theta = 0, Phi = 0 .....	77
83	Board #1 (Dual Band 2.40 GHz): Theta = 180, Phi = 0 .....	77
84	Board #1 (Dual Band 2.40 GHz): Theta = 90, Phi = 0 .....	77
85	Board #1 (Dual Band 2.40 GHz): Theta = 90, Phi = 180 .....	77
86	Board #1 (Dual Band 2.40 GHz): Theta = 90, Phi = 270 .....	77
87	Board #1 (Dual Band 2.40 GHz): Theta = 90, Phi = 90 .....	77
88	Board #1 (Dual Band 2.44 GHz): Theta = 0, Phi = 0 .....	82
89	Board #1 (Dual Band 2.44 GHz): Theta = 180, Phi = 0 .....	82
90	Board #1 (Dual Band 2.44 GHz): Theta = 90, Phi = 0 .....	82
91	Board #1 (Dual Band 2.44 GHz): Theta = 90, Phi = 180 .....	82
92	Board #1 (Dual Band 2.44 GHz): Theta = 90, Phi = 270 .....	82
93	Board #1 (Dual Band 2.44 GHz): Theta = 90, Phi = 90 .....	82
94	Board #1 (Dual Band 2.48 GHz): Theta = 0, Phi = 0 .....	87
95	Board #1 (Dual Band 2.48 GHz): Theta = 180, Phi = 0 .....	87
96	Board #1 (Dual Band 2.48 GHz): Theta = 90, Phi = 0 .....	87
97	Board #1 (Dual Band 2.48 GHz): Theta = 90, Phi = 180 .....	87
98	Board #1 (Dual Band 2.48 GHz): Theta = 90, Phi = 270 .....	87
99	5Board #1 (Dual Band 2.48 GHz): Theta = 90, Phi = 90 .....	87
100	Board #2 (2.40 GHz): Theta = 0, Phi = 0 .....	92
101	Board #2 (2.40 GHz): Theta = 180, Phi = 0 .....	92
102	Board #2 (2.40 GHz): Theta = 90, Phi = 0 .....	92
103	Board #2 (2.40 GHz): Theta = 90, Phi = 180 .....	92
104	Board #2 (2.40 GHz): Theta = 90, Phi = 270 .....	92
105	Board #2 (2.40 GHz): Theta = 90, Phi = 90 .....	92
106	Board #2 (2.44 GHz): Theta = 0, Phi = 0 .....	97
107	Board #2 (2.44 GHz): Theta = 180, Phi = 0 .....	97
108	Board #2 (2.44 GHz): Theta = 90, Phi = 0 .....	97
109	Board #2 (2.44 GHz): Theta = 90, Phi = 180 .....	97
110	Board #2 (2.44 GHz): Theta = 90, Phi = 270 .....	97
111	Board #2 (2.44 GHz): Theta = 90, Phi = 90 .....	97
112	Board #2 (2.48 GHz): Theta = 0, Phi = 0 .....	102
113	Board #2 (2.48 GHz): Theta = 180, Phi = 0 .....	102
114	Board #2 (2.48 GHz): Theta = 90, Phi = 0 .....	102
115	Board #2 (2.48 GHz): Theta = 90, Phi = 180 .....	102
116	Board #2 (2.48 GHz): Theta = 90, Phi = 270 .....	102
117	Board #2 (2.48 GHz): Theta = 90, Phi = 90 .....	102
118	Board #3 (868 MHz): Theta = 0, Phi = 0 .....	107
119	Board #3 (868 MHz): Theta = 180, Phi = 0 .....	107
120	Board #3 (868 MHz): Theta = 90, Phi = 0 .....	107
121	Board #3 (868 MHz): Theta = 90, Phi = 180 .....	107
122	Board #3 (868 MHz): Theta = 90, Phi = 270 .....	107
123	Board #3 (868 MHz): Theta = 90, Phi = 90 .....	107
124	Board #3 (2.40 GHz): Theta = 0, Phi = 0 .....	112

125	Board #3 (2.40 GHz): Theta = 90, Phi = 0 .....	112
126	Board #3 (2.40 GHz): Theta = 90, Phi = 180 .....	112
127	Board #3 (2.40 GHz): Theta = 90, Phi = 270 .....	112
128	Board #3 (2.40 GHz): Theta = 90, Phi = 90 .....	112
129	Board #3 (2.44 GHz): Theta = 0, Phi = 0 .....	117
130	Board #3 (2.44 GHz): Theta = 180, Phi = 0 .....	117
131	Board #3 (2.44 GHz): Theta = 90, Phi = 0 .....	117
132	Board #3 (2.44 GHz): Theta = 90, Phi = 180 .....	117
133	Board #3 (2.44 GHz): Theta = 90, Phi = 270 .....	117
134	Board #3 (2.44 GHz): Theta = 90, Phi = 90 .....	117
135	Board #3 (2.48 GHz): Theta = 0, Phi = 0 .....	122
136	Board #3 (2.48 GHz): Theta = 180, Phi = 0 .....	122
137	Board #3 (2.48 GHz): Theta = 90, Phi = 0 .....	122
138	Board #3 (2.48 GHz): Theta = 90, Phi = 180 .....	122
139	Board #3 (2.48 GHz): Theta = 90, Phi = 270 .....	122
140	Board #3 (2.48 GHz): Theta = 90, Phi = 90 .....	122
141	Board #4 (433 MHz): Theta = 0, Phi = 0 .....	127
142	Board #4 (433 MHz): Theta = 180, Phi = 0 .....	127
143	Board #4 (433 MHz): Theta = 90, Phi = 0 .....	127
144	Board #4 (433 MHz): Theta = 90, Phi = 180 .....	127
145	Board #4 (433 MHz): Theta = 90, Phi = 270 .....	127
146	Board #4 (433 MHz): Theta = 90, Phi = 90 .....	127
147	Board #4 (470 MHz): Theta = 0, Phi = 0 .....	132
148	Board #4 (470 MHz): Theta = 180, Phi = 0 .....	132
149	Board #4 (470 MHz): Theta = 90, Phi = 0 .....	132
150	Board #4 (470 MHz): Theta = 90, Phi = 180 .....	132
151	Board #4 (470 MHz): Theta = 90, Phi = 270 .....	132
152	Board #4 (470 MHz): Theta = 90, Phi = 90 .....	132
153	Board #4 (490 MHz): Theta = 0, Phi = 0 .....	137
154	Board #4 (490 MHz): Theta = 180, Phi = 0 .....	137
155	Board #4 (490 MHz): Theta = 90, Phi = 0 .....	137
156	Board #4 (490 MHz): Theta = 90, Phi = 180 .....	137
157	Board #4 (490 MHz): Theta = 90, Phi = 270 .....	137
158	Board #4 (490 MHz): Theta = 90, Phi = 90 .....	137
159	Board #4 (510 MHz): Theta = 0, Phi = 0 .....	142
160	Board #4 (510 MHz): Theta = 180, Phi = 0 .....	142
161	Board #4 (510 MHz): Theta = 90, Phi = 0 .....	142
162	Board #4 (510 MHz): Theta = 90, Phi = 180 .....	142
163	Board #4 (510 MHz): Theta = 90, Phi = 270 .....	142
164	Board #4 (510 MHz): Theta = 90, Phi = 90 .....	142
165	Board #5A: Theta = 0, Phi = 0 .....	147
166	Board #5A: Theta = 180, Phi = 0 .....	147
167	Board #5A: Theta = 90, Phi = 0 .....	147
168	Board #5A: Theta = 90, Phi = 180 .....	147
169	Board #5A: Theta = 90, Phi = 270 .....	147
170	Board #5A: Theta = 90, Phi = 90 .....	147
171	Board #5B: Theta = 0, Phi = 0 .....	152
172	Board #5B: Theta = 180, Phi = 0 .....	152



173	Board #5B: Theta = 90, Phi = 0.....	152
174	Board #5B: Theta = 90, Phi = 180.....	152
175	Board #5B: Theta = 90, Phi = 270.....	152
176	Board #5B: Theta = 90, Phi = 90 .....	152
177	Board #6 (868 MHz): Theta = 0, Phi = 0 .....	157
178	Board #6 (868 MHz): Theta = 180, Phi = 0 .....	157
179	Board #6 (868 MHz): Theta = 90, Phi = 0 .....	157
180	Board #6 (868 MHz): Theta = 90, Phi = 180 .....	157
181	Board #6 (868 MHz): Theta = 90, Phi = 270 .....	157
182	Board #6 (868 MHz): Theta = 90, Phi = 90 .....	157
183	Board #6 (915 MHz): Theta = 0, Phi = 0 .....	162
184	Board #6 (915 MHz): Theta = 180, Phi = 0 .....	162
185	Board #6 (915 MHz): Theta = 90, Phi = 0 .....	162
186	Board #6 (915 MHz): Theta = 90, Phi = 180 .....	162
187	Board #6 (915 MHz): Theta = 90, Phi = 270 .....	162
188	Board #6 (915 MHz): Theta = 90, Phi = 90 .....	162
189	Efficiency of OnBoard SMD 169-MHZ Antenna .....	163
190	Gain of OnBoard SMD 169-MHZ Antenna .....	163
191	Radiation Pattern at 169.5 MHz .....	163
192	Board #8A: Theta = 0, Phi = 0 .....	168
193	Board #8A: Theta = 180, Phi = 0 .....	168
194	Board #8A: Theta = 90, Phi = 0.....	168
195	Board #8A: Theta = 90, Phi = 180.....	168
196	Board #8A: Theta = 90, Phi = 270.....	168
197	Board #8A: Theta = 90, Phi = 90 .....	168
198	Board #8B: Theta = 0, Phi = 0 .....	173
199	Board #8B: Theta = 180, Phi = 0 .....	173
200	Board #8B: Theta = 90, Phi = 0.....	173
201	Board #8B: Theta = 90, Phi = 180.....	173
202	Board #8B: Theta = 90, Phi = 270.....	173
203	Board #8B: Theta = 90, Phi = 90 .....	173
204	Board #9 (868 MHz): Theta = 0, Phi = 0 .....	178
205	Board #9 (868 MHz): Theta = 180, Phi = 0 .....	178
206	Board #9 (868 MHz): Theta = 90, Phi = 0 .....	178
207	Board #9 (868 MHz): Theta = 90, Phi = 180 .....	178
208	Board #9 (868 MHz): Theta = 90, Phi = 270 .....	178
209	Board #9 (868 MHz): Theta = 90, Phi = 90 .....	178
210	Board #9 (915 MHz): Theta = 0, Phi = 0 .....	183
211	Board #9 (915 MHz): Theta = 180, Phi = 0 .....	183
212	Board #9 (915 MHz): Theta = 90, Phi = 0 .....	183
213	Board #9 (915 MHz): Theta = 90, Phi = 180 .....	183
214	Board #9 (915 MHz): Theta = 90, Phi = 270 .....	183
215	Board #9 (915 MHz): Theta = 90, Phi = 90 .....	183
216	Board #9 (2.40 GHz): Theta = 0, Phi = 0.....	188
217	Board #9 (2.40 GHz): Theta = 180, Phi = 0 .....	188
218	Board #9 (2.40 GHz): Theta = 90, Phi = 0 .....	188
219	Board #9 (2.40 GHz): Theta = 90, Phi = 180 .....	188
220	Board #9 (2.40 GHz): Theta = 90, Phi = 270 .....	188
221	Board #9 (2.40 GHz): Theta = 90, Phi = 90.....	188

222	Board #9 (2.44 GHz): Theta = 0, Phi = 0 .....	193
223	Board #9 (2.44 GHz): Theta = 180, Phi = 0 .....	193
224	Board #9 (2.44 GHz): Theta = 90, Phi = 0 .....	193
225	Board #9 (2.44 GHz): Theta = 90, Phi = 180 .....	193
226	Board #9 (2.44 GHz): Theta = 90, Phi = 270 .....	193
227	Board #9 (2.44 GHz): Theta = 90, Phi = 90 .....	193
228	Board #9 (2.48 GHz): Theta = 0, Phi = 0 .....	198
229	Board #9 (2.48 GHz): Theta = 180, Phi = 0 .....	198
230	Board #9 (2.48 GHz): Theta = 90, Phi = 0 .....	198
231	Board #9 (2.48 GHz): Theta = 90, Phi = 180 .....	198
232	Board #9 (2.48 GHz): Theta = 90, Phi = 270 .....	198
233	Board #9 (2.48 GHz): Theta = 90, Phi = 90 .....	198
234	Board #10 (433 MHz): Theta = 0, Phi = 0 .....	203
235	Board #10 (433 MHz): Theta = 180, Phi = 0 .....	203
236	Board #10 (433 MHz): Theta = 90, Phi = 0 .....	203
237	Board #10 (433 MHz): Theta = 90, Phi = 180 .....	203
238	Board #10 (433 MHz): Theta = 90, Phi = 270 .....	203
239	Board #10 (433 MHz): Theta = 90, Phi = 90 .....	203
240	Board #10 (868 MHz): Theta = 0, Phi = 0 .....	208
241	Board #10 (868 MHz): Theta = 180, Phi = 0 .....	208
242	Board #10 (868 MHz): Theta = 90, Phi = 0 .....	208
243	Board #10 (868 MHz): Theta = 90, Phi = 180 .....	208
244	Board #10 (868 MHz): Theta = 90, Phi = 270 .....	208
245	Board #10 (868 MHz): Theta = 90, Phi = 90 .....	208
246	Board #11 (2.40 GHz): Theta = 0, Phi = 0 .....	213
247	Board #11 (2.40 GHz): Theta = 180, Phi = 0 .....	213
248	Board #11 (2.40 GHz): Theta = 90, Phi = 0 .....	213
249	Board #11 (2.40 GHz): Theta = 90, Phi = 180 .....	213
250	Board #11 (2.40 GHz): Theta = 90, Phi = 270 .....	213
251	Board #11 (2.40 GHz): Theta = 90, Phi = 90 .....	213
252	Board #11 (2.44 GHz): Theta = 0, Phi = 0 .....	218
253	Board #11 (2.44 GHz): Theta = 180, Phi = 0 .....	218
254	Board #11 (2.44 GHz): Theta = 90, Phi = 0 .....	218
255	Board #11 (2.44 GHz): Theta = 90, Phi = 180 .....	218
256	Board #11 (2.44 GHz): Theta = 90, Phi = 270 .....	218
257	Board #11 (2.44 GHz): Theta = 90, Phi = 90 .....	218
258	Board #11 (2.48 GHz): Theta = 0, Phi = 0 .....	223
259	Board #11 (2.48 GHz): Theta = 180, Phi = 0 .....	223
260	Board #11 (2.48 GHz): Theta = 90, Phi = 0 .....	223
261	Board #11 (2.48 GHz): Theta = 90, Phi = 180 .....	223
262	Board #11 (2.48 GHz): Theta = 90, Phi = 270 .....	223
263	Board #11 (2.48 GHz): Theta = 90, Phi = 90 .....	223
264	Board #12 (868 MHz): Theta = 0, Phi = 0 .....	228
265	Board #12 (868 MHz): Theta = 180, Phi = 0 .....	228
266	Board #12 (868 MHz): Theta = 90, Phi = 0 .....	228
267	Board #12 (868 MHz): Theta = 90, Phi = 180 .....	228
268	Board #12 (868 MHz): Theta = 90, Phi = 270 .....	228
269	Board #12 (868 MHz): Theta = 90, Phi = 90 .....	228

270	Board #12 (915 MHz): Theta = 0, Phi = 0 .....	233
271	Board #12 (915 MHz): Theta = 180, Phi = 0 .....	233
272	Board #12 (915 MHz): Theta = 90, Phi = 0 .....	233
273	Board #12 (915 MHz): Theta = 90, Phi = 180 .....	233
274	Board #12 (915 MHz): Theta = 90, Phi = 270 .....	233
275	Board #12 (915 MHz): Theta = 90, Phi = 90 .....	233
276	433-MHz Kit Antenna: Theta = 0, Phi = 0 .....	237
277	433-MHz Kit Antenna: Theta = 180, Phi = 0 .....	237
278	433-MHz Kit Antenna: Theta = 90, Phi = 0.....	237
279	433-MHz Kit Antenna: Theta = 90, Phi = 180.....	237
280	433-MHz Kit Antenna: Theta = 90, Phi = 270.....	237
281	433-MHz Kit Antenna: Theta = 90, Phi = 90 .....	237
282	Impedance of 490-MHz Kit Antenna .....	238
283	SWR of 490-MHz Kit Antenna .....	238
284	470-MHz Kit Antenna: Theta = 0, Phi = 0 .....	243
285	470-MHz Kit Antenna: Theta = 180, Phi = 0 .....	243
286	470-MHz Kit Antenna: Theta = 90, Phi = 0.....	243
287	470-MHz Kit Antenna: Theta = 90, Phi = 180.....	243
288	470-MHz Kit Antenna: Theta = 90, Phi = 270.....	243
289	470-MHz Kit Antenna: Theta = 90, Phi = 90 .....	243
290	490-MHz Kit Antenna: Theta = 0, Phi = 0 .....	248
291	490-MHz Kit Antenna: Theta = 180, Phi = 0 .....	248
292	490-MHz Kit Antenna: Theta = 90, Phi = 0.....	248
293	490-MHz Kit Antenna: Theta = 90, Phi = 180.....	248
294	490-MHz Kit Antenna: Theta = 90, Phi = 270.....	248
295	490-MHz Kit Antenna: Theta = 90, Phi = 90 .....	248
296	510-MHz Kit Antenna: Theta = 0, Phi = 0 .....	253
297	510-MHz Kit Antenna: Theta = 180, Phi = 0 .....	253
298	510-MHz Kit Antenna: Theta = 90, Phi = 0.....	253
299	510-MHz Kit Antenna: Theta = 90, Phi = 180.....	253
300	510-MHz Kit Antenna: Theta = 90, Phi = 270.....	253
301	510-MHz Kit Antenna: Theta = 90, Phi = 90 .....	253
302	Impedance of 868/915-MHz Kit Antenna .....	254
303	SWR of 868/915-MHz Kit Antenna .....	254
304	868-MHz Kit Antenna: Theta = 0, Phi = 0 .....	259
305	868-MHz Kit Antenna: Theta = 180, Phi = 0 .....	259
306	868-MHz Kit Antenna: Theta = 90, Phi = 0.....	259
307	868-MHz Kit Antenna: Theta = 90, Phi = 180.....	259
308	868-MHz Kit Antenna: Theta = 90, Phi = 270.....	259
309	868-MHz Kit Antenna: Theta = 90, Phi = 90 .....	259
310	915-MHz Kit Antenna: Theta = 0, Phi = 0 .....	264
311	915-MHz Kit Antenna: Theta = 180, Phi = 0 .....	264
312	915-MHz Kit Antenna: Theta = 90, Phi = 0.....	264
313	915-MHz Kit Antenna: Theta = 90, Phi = 180.....	264
314	915-MHz Kit Antenna: Theta = 90, Phi = 270.....	264
315	915-MHz Kit Antenna: Theta = 90, Phi = 90 .....	264
316	2.40-GHz Kit Antenna: Theta = 0, Phi = 0.....	269
317	2.40-GHz Kit Antenna: Theta = 180, Phi = 0.....	269
318	2.40-GHz Kit Antenna: Theta = 90, Phi = 0 .....	269

319	2.40-GHz Kit Antenna: Theta = 90, Phi = 180 .....	269
320	2.40-GHz Kit Antenna: Theta = 90, Phi = 270 .....	269
321	2.40-GHz Kit Antenna: Theta = 90, Phi = 90.....	269
322	2.44-GHz Kit Antenna: Theta = 0, Phi = 0.....	274
323	2.44-GHz Kit Antenna: Theta = 180, Phi = 0.....	274
324	2.44-GHz Kit Antenna: Theta = 90, Phi = 0 .....	274
325	2.44-GHz Kit Antenna: Theta = 90, Phi = 180 .....	274
326	2.44-GHz Kit Antenna: Theta = 90, Phi = 270 .....	274
327	2.44-GHz Kit Antenna: Theta = 90, Phi = 90.....	274
328	2.48-GHz Kit Antenna: Theta = 0, Phi = 0.....	279
329	2.48-GHz Kit Antenna: Theta = 180, Phi = 0.....	279
330	2.48-GHz Kit Antenna: Theta = 90, Phi = 0 .....	279
331	2.48-GHz Kit Antenna: Theta = 90, Phi = 180 .....	279
332	2.48-GHz Kit Antenna: Theta = 90, Phi = 270 .....	279
333	2.48-GHz Kit Antenna: Theta = 90, Phi = 90.....	279

### List of Tables

1	Acronyms and Descriptions.....	13
2	Low-Cost Cable Compensation in dB for Each Frequency.....	16
3	PCB Size of Board #1 .....	18
4	BOM for Board #1 – Single Band of 2.4 GHz .....	18
5	BOM for Board #1 – Single Band of 2.4 GHz .....	20
6	PCB Size and BOM for Board #2 .....	21
7	PCB Size and BOM for Board #3 .....	22
8	PCB Size for Board #4 .....	24
9	BOM for 433 MHz .....	25
10	BOM China (470-510 MHz).....	26
11	PCB Size and BOM for Board #5 .....	27
12	PCB Size and BOM for Board #6: Compact PCB Antenna .....	29
13	PCB Size and BOM for Board #7 .....	30
14	PCB Size and BOM for Board #8 .....	32
15	PCB Size and BOM for Board #9 .....	34
16	PCB Size and BOM for Board #10 (433 MHz) .....	35
17	BOM for Board #10 (868 MHz).....	36
18	PCB Size and BOM for Board #11.....	37
19	PCB Size and BOM for Board #12.....	38
20	PCB Size and BOM for Calibration Boards.....	39
21	PCB Size and BOM for Board #14: Helical Wire Antenna – 169/315 MHz .....	41
22	169-MHz Wire Antennas .....	45
23	Total Radiated Power (TRP) (169 MHz) .....	45
24	433-MHz Wire Antennas .....	46
25	433-MHz Wire Antennas .....	46
26	Total Radiated Power (TRP) (433 MHz) .....	47
27	868-MHz PCB Antennas .....	47
28	868-MHz Chip Antennas .....	47
29	868-MHz Wire Antennas .....	48
30	Total Radiated Power (TRP) (868 MHz) .....	48
31	2.4-GHz PCB Antennas .....	49
32	2.4-GHz Chip Antennas .....	49

33	2.4-GHz PCB Antennas .....	50
34	Total Radiated Power (TRP) (2.4 GHz) .....	50
35	Highest Recorded TRP Efficiencies [%] .....	51
36	Board #1: OTA Evaluation Results (Single Band 2.40 GHz) .....	53
37	Board #1: RP_2400.000_tot .....	54
38	Board #1: RP_2400.000_hor .....	55
39	Board #1: RP_2400.000_ver .....	56
40	Board #1: OTA Evaluation Results (Single Band 2.44 GHz) .....	58
41	Board #1: RP_2440.000_tot .....	59
42	Board #1: RP_2440.000_hor .....	60
43	Board #1: RP_2440.000_ver .....	61
44	Board #1: OTA Evaluation Results (Single Band 2.48 GHz) .....	63
45	Board #1: RP_2480.000_tot .....	64
46	Board #1: RP_2480.000_hor .....	65
47	Board #1: RP_2480.000_ver .....	66
48	Board #1: OTA Evaluation Results (Dual Band 868 MHz) .....	68
49	Board #1: RP_868.000_tot .....	69
50	Board #1: RP_868.000_hor .....	70
51	Board #1: RP_868.000_ver .....	71
52	Board #1: OTA Evaluation Results (Dual Band 2.40 GHz) .....	73
53	Board #1: RP_2400.000_tot .....	74
54	Board #1: RP_2400.000_hor .....	75
55	Board #1: RP_2400.000_ver .....	76
56	Board #1: OTA Evaluation Results (Dual Band 2.44 GHz) .....	78
57	Board #1: RP_2440.000_tot .....	79
58	Board #1: RP_2440.000_hor .....	80
59	Board #1: RP_2440.000_Vertical .....	81
60	Board #1: OTA Evaluation Results (Dual Band 2.48 GHz) .....	83
61	Board #1: RP_2480.000_tot .....	84
62	Board #1: RP_2480.000_hor .....	85
63	Board #1: RP_2480.000_Vertical .....	86
64	Board #2: OTA Evaluation Results (2.40 GHz) .....	88
65	Board #2: RP_2400.000_tot .....	89
66	Board #2: RP_2400.000_hor .....	90
67	Board #2: RP_2400.000_ver .....	91
68	Board #2: OTA Evaluation Results (2.44 GHz) .....	93
69	Board #2: RP_2440.000_tot .....	94
70	Board #2: RP_2440.000_hor .....	95
71	Board #2: RP_2440.000_ver .....	96
72	Board #2: OTA Evaluation Results (2.48 GHz) .....	98
73	Board #2: RP_2480.000_tot .....	99
74	Board #2: RP_2480.000_hor .....	100
75	Board #2: RP_2480.000_ver .....	101
76	Board #3: OTA Evaluation Results (868 MHz) .....	103
77	Board #3: RP_868.000_tot .....	104
78	Board #3: RP_868.000_hor .....	105
79	Board #3: RP_868.000_ver .....	106
80	Board #3: OTA Evaluation Results (2.40 GHz) .....	108

81	Board #3: RP_2400.000_tot.....	109
82	Board #3: RP_2400.000_hor.....	110
83	Board #3: RP_2400.000_ver.....	111
84	Board #3: OTA Evaluation Results (2.44 GHz).....	113
85	Board #3: RP_2440.000_tot.....	114
86	Board #3: RP_2440.000_hor.....	115
87	Board #3: RP_2440.000_ver.....	116
88	Board #3: OTA Evaluation Results (2.48 GHz).....	118
89	Board #3: RP_2480.000_tot.....	119
90	Board #3: RP_2480.000_hor.....	120
91	Board #3: RP_2480.000_ver.....	121
92	Board #4: OTA Evaluation Results (433 MHz).....	123
93	Board #4: RP_433.000_tot.....	124
94	Board #4: RP_433.000_hor.....	125
95	Board #4: RP_433.000_ver.....	126
96	Board #4: OTA Evaluation Results (470 MHz).....	128
97	Board #4: RP_470.000_tot.....	129
98	Board #4: RP_470.000_hor.....	130
99	Board #4: RP_470.000_ver.....	131
100	Board #4: OTA Evaluation Results (490 MHz).....	133
101	Board #4: RP_490.000_tot.....	134
102	Board #4: RP_490.000_hor.....	135
103	Board #4: RP_490.000_ver.....	136
104	Board #4: OTA Evaluation Results (510 MHz).....	138
105	Board #4: RP_510.000_tot.....	139
106	Board #4: RP_510.000_hor.....	140
107	Board #4: RP_510.000_ver.....	141
108	Board #5A: OTA Evaluation Results.....	143
109	Board #5A: RP_2440.000_tot.....	144
110	Board #5A: RP_2440.000_hor.....	145
111	Board #5A: RP_2440.000_ver.....	146
112	Board #5B: OTA Evaluation Results.....	148
113	Board #5B: RP_2440.000_tot.....	149
114	Board #5B: RP_2440.000_hor.....	150
115	Board #5B: RP_2440.000_ver.....	151
116	Board #6: OTA Evaluation Results (868 MHz).....	153
117	Board #6: RP_868.000_tot.....	154
118	Board #6: RP_868.000_hor.....	155
119	Board #6: RP_868.000_ver.....	156
120	Board #6: OTA Evaluation Results (915 MHz).....	158
121	Board #6: RP_915.000_tot.....	159
122	Board #6: RP_915.000_hor.....	160
123	Board #6: RP_915.000_ver.....	161
124	Board #8A: OTA Evaluation Results.....	164
125	Board #8A: RP_868.000_tot.....	165
126	Board #8A: RP_868.000_hor.....	166
127	Board #8A: RP_868.000_ver.....	167
128	Board #8B: OTA Evaluation Results.....	169
129	Board #8B: RP_915.000_tot.....	170



130	Board #8B: RP_915.000_hor .....	171
131	Board #8B: RP_915.000_ver.....	172
132	Board #9: OTA Evaluation Results (868 MHz) .....	174
133	Board #9: RP_868.000_tot .....	175
134	Board #9: RP_868.000_hor .....	176
135	Board #9: RP_868.000_ver .....	177
136	Board #9: OTA Evaluation Results (915 MHz) .....	179
137	Board #9: RP_915.000_tot .....	180
138	Board #9: RP_915.000_hor .....	181
139	Board #9: RP_915.000_ver .....	182
140	Board #9: OTA Evaluation Results (2.40 GHz).....	184
141	Board #9: RP_2400.000_tot.....	185
142	Board #9: RP_2400.000_hor.....	186
143	Board #9: RP_2400.000_ver .....	187
144	Board #9: OTA Evaluation Results (2.44 GHz).....	189
145	Board #9: RP_2440.000_tot.....	190
146	Board #9: RP_2440.000_hor.....	191
147	Board #9: RP_2440.000_ver .....	192
148	Board #9: OTA Evaluation Results (2.48 GHz).....	194
149	Board #9: RP_2480.000_tot.....	195
150	Board #9: RP_2480.000_hor.....	196
151	Board #9: RP_2480.000_ver .....	197
152	Board #10: OTA Evaluation Results (433 MHz) .....	199
153	Board #10: RP_433.000_tot.....	200
154	Board #10: RP_433.000_hor.....	201
155	Board #10: RP_433.000_ver .....	202
156	Board #10: OTA Evaluation Results (868 MHz) .....	204
157	Board #10: RP_868.000_tot.....	205
158	Board #10: RP_868.000_hor.....	206
159	Board #10: RP_868.000_ver .....	207
160	Board #11: OTA Evaluation Results (2.40 GHz) .....	209
161	Board #11: RP_2400.000_tot .....	210
162	Board #11: RP_2400.000_hor .....	211
163	Board #11: RP_2400.000_ver .....	212
164	Board #11: OTA Evaluation Results (2.44 GHz) .....	214
165	Board #11: RP_2440.000_tot .....	215
166	Board #11: RP_2440.000_hor .....	216
167	Board #11: RP_2440.000_ver .....	217
168	Board #11: OTA Evaluation Results (2.48 GHz) .....	219
169	Board #11: RP_2480.000_tot .....	220
170	Board #11: RP_2480.000_hor .....	221
171	Board #11: RP_2480.000_ver .....	222
172	Board #12: OTA Evaluation Results (868 MHz) .....	224
173	Board #12: RP_868.000_tot.....	225
174	Board #12: RP_868.000_hor.....	226
175	Board #12: RP_868.000_ver .....	227
176	Board #12: OTA Evaluation Results (915 MHz) .....	229
177	Board #12: RP_915.000_tot.....	230

178	Board #12: RP_915.000_hor.....	231
179	Board #12: RP_915.000_ver.....	232
180	433-MHz Kit Antenna: OTA Evaluation Results .....	234
181	433-MHz Kit Antenna: RP_433.000_tot .....	235
182	433-MHz Kit Antenna: RP_433.000_hor .....	236
183	470-MHz Kit Antenna: OTA Evaluation Results .....	239
184	470-MHz Kit Antenna: RP_470.000_tot .....	240
185	470-MHz Kit Antenna: RP_470.000_hor .....	241
186	470-MHz Kit Antenna: RP_470.000_ver.....	242
187	490-MHz Kit Antenna: OTA Evaluation Results .....	244
188	490-MHz Kit Antenna: RP_490.000_tot .....	245
189	490-MHz Kit Antenna: RP_490.000_hor .....	246
190	490-MHz Kit Antenna: RP_490.000_ver.....	247
191	510-MHz Kit Antenna: OTA Evaluation Results .....	249
192	510-MHz Kit Antenna: RP_510.000_tot .....	250
193	510-MHz Kit Antenna: RP_510.000_hor .....	251
194	510-MHz Kit Antenna: RP_510.000_ver.....	252
195	868-MHz Kit Antenna: OTA Evaluation Results .....	255
196	868-MHz Kit Antenna: RP_868.000_tot .....	256
197	868-MHz Kit Antenna: RP_868.000_hor .....	257
198	868-MHz Kit Antenna: RP_868.000_ver.....	258
199	915-MHz Kit Antenna: OTA Evaluation Results .....	260
200	915-MHz Kit Antenna: RP_915.000_tot .....	261
201	915-MHz Kit Antenna: RP_915.000_hor .....	262
202	915-MHz Kit Antenna: RP_915.000_ver.....	263
203	2.40-GHz Kit Antenna: OTA Evaluation Results .....	265
204	2.40-GHz Kit Antenna: RP_2400.000_tot .....	266
205	2.40-GHz Kit Antenna: RP_2400.000_hor .....	267
206	2.40-GHz Kit Antenna: RP_2400.000_ver.....	268
207	2.44-GHz Kit Antenna: OTA Evaluation Results .....	270
208	2.44-GHz Kit Antenna: RP_2440.000_tot .....	271
209	2.44-GHz Kit Antenna: RP_2440.000_hor .....	272
210	2.44-GHz Kit Antenna: RP_2440.000_ver.....	273
211	2.48-GHz Kit Antenna: OTA Evaluation Results .....	275
212	2.48-GHz Kit Antenna: RP_2480.000_tot .....	276
213	2.48-GHz Kit Antenna: RP_2480.000_hor .....	277
214	2.48-GHz Kit Antenna: RP_2480.000_ver.....	278

## 1 Introduction

The frequency range of the antennas will cover all international ISM frequency band spectrums from 169 MHz to 2.48 GHz. The A4-sized PCB panel contains 16 different boards; 13 antenna designs and 3 boards for calibration purposes. Each board has been v-cut and can be snapped out of the PCB panel.

All antennas are individually tuned. A matching network is used on each antenna board to provide flexibility for matching to other frequencies. This document compares various antenna measurements in an overview format. For each antenna, a complete OTA CTIA measurement report is included in this report.

Choosing the correct antenna for the application is crucial if the optimum range is to be achieved. Similarly, for a given distance, the power can be reduced on the transmitter side if the optimum antenna is chosen.

Antennas are categorized under the operating frequency (169 MHz, 433 MHz, 868 MHz or 2.44 GHz) and then the type of antenna (PCB Antennas, Chip Antennas, and Wire Antennas). The main focus is on PCB antennas since these are mainly used in high volume products.

CC-Antenna-DK2 [1] is a part of the antenna support provided by Texas Instruments Wireless Connectivity. For further antenna support documentation, see the *Antenna Selection Quick Guide* [2] and the *Comprehensive Antenna Selection Guide* [3]. The previous version of the antenna kit documentation is still available for reference purposes, see [4] and [5].

### 1.1 Acronyms and Descriptions

**Table 1. Acronyms and Descriptions**

Acronym	Description
AUT	Antenna Under Test
BOM	Bill Of Materials
BW	Bandwidth
CTIA	Cellular Telecommunications Industry Association
DK	Development Kit
DNM	Do Not Mount
EB	Evaluation Board
EIRP	Effective Isotropic Radiated Power
EM	Evaluation Module
ISM	Industrial, Scientific, Medical
NHPRP	Near Horizon Partial Radiated Power
NHPRP45	Near Horizon Partial Radiated Power within a 45° angle
OTA	Over The Air
PCB	Printed Circuit Board
RF	Radio Frequency
SWR	Standing Wave Ratio
TRP	Total Radiated Power

## 2 CC-Antenna-DK2

### 2.1 Board Description

The CC-Antenna-DK2 PCB panel contains 12 different boards; 13 antenna designs and 3 boards for calibration purposes (see [Figure 1](#) and [Figure 2](#)). The schematic, layout, PCB stack-up are provided in the CC-Antenna-DK2 documentation [1].

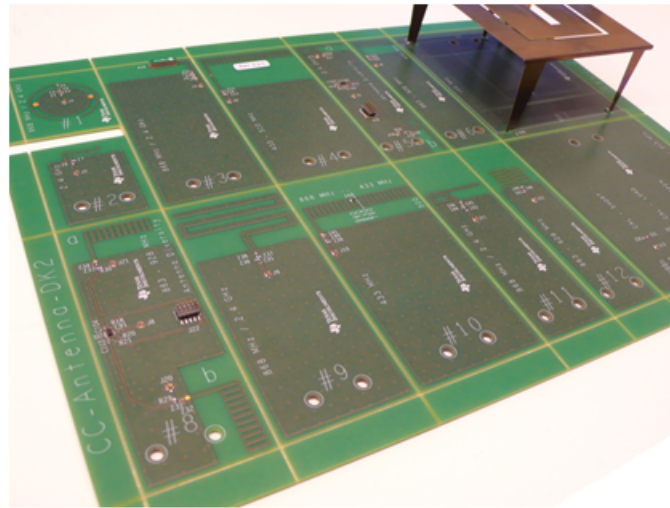


Figure 1. CC-Antenna-DK2 Panel

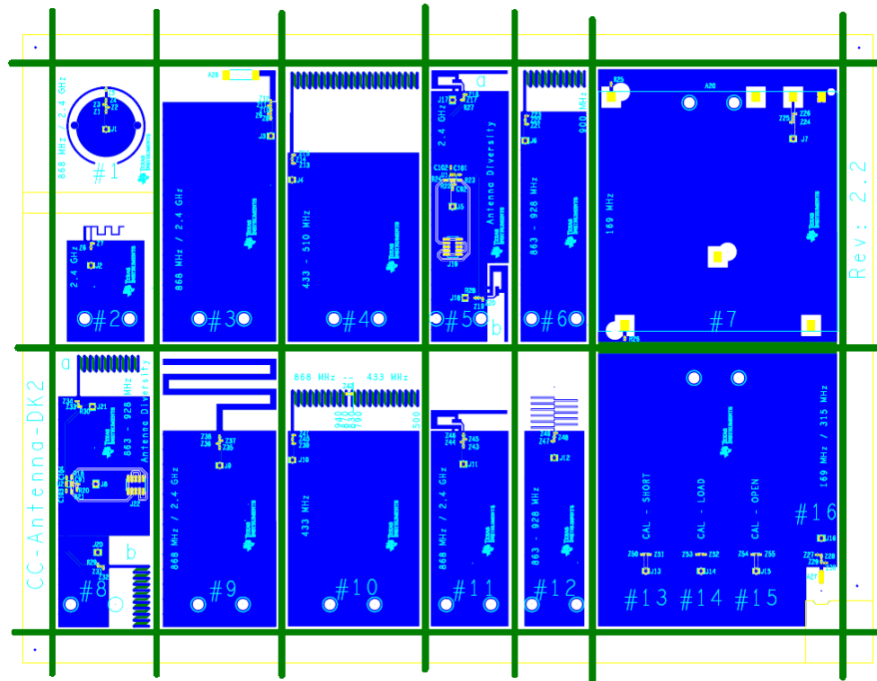
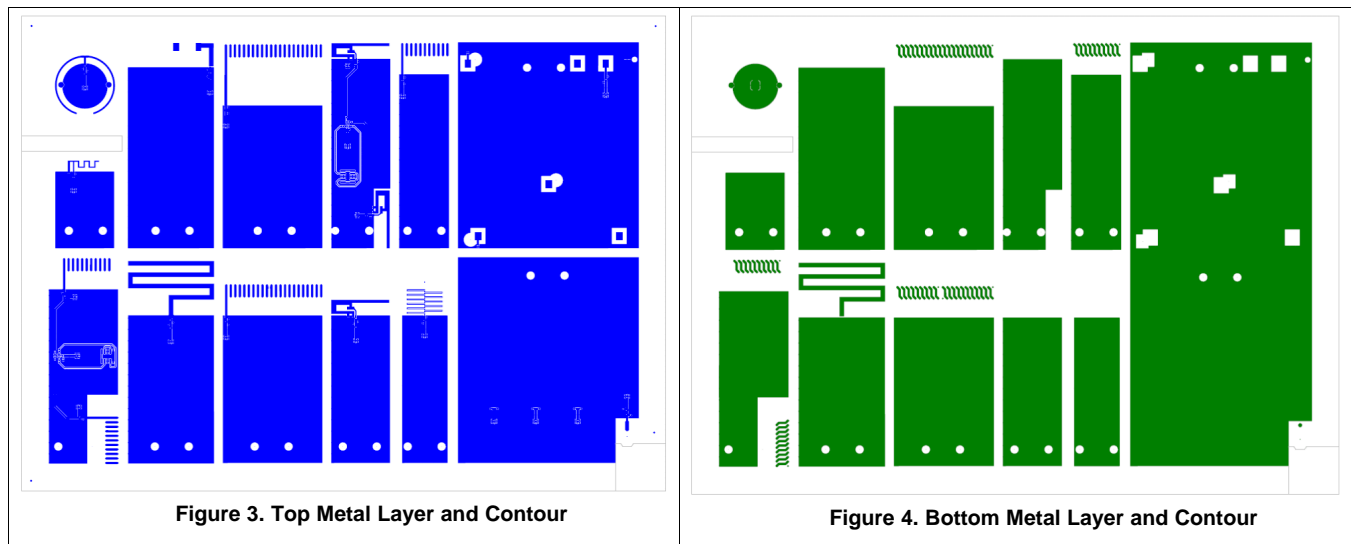


Figure 2. CC-Antenna-DK2 Board Showing Metal Layers, Solder Paste, Silkscreen and v-Cut

The frequencies covered by the antennas designs will cover all international ISM frequency spectrums from 169 MHz to 2.48 GHz. 169 MHz band is common in France, Spain, and Italy. 315 MHz and 915 MHz are common frequency bands in the United States. 433 MHz and 868 MHz frequency bands are mainly in Europe and Africa. 490 MHz and 790 MHz frequency bands are mostly used in China. 920 MHz frequency band is common in Japan. 433 MHz and 2.4 GHz frequency bands are quite global frequency bands for the majority of countries.

The top metal layer is shown in [Figure 3](#) and the bottom metal layer is shown in [Figure 4](#). Antenna board #1 has a diameter of 27 mm and a GND size to represent a CR2032 coin cell. The width of antenna board #2 is 26 mm and the height is 40 mm. Antenna boards #3, #4, #5, #6, #8, #9, #10, #11 and #12 have a height of 95 mm and a width of 20 mm to 45 mm. The antenna boards on the far right, #7 and #16 have a width of 80 mm and a height of 190 mm (see [Figure 4](#)) with the option to reduce the board / GND size (height) in half (see [Figure 3](#)). The PCB is 2-layer, 1.6 mm thick and has a dielectric of 4.2. The v-cut depth is 1.2 mm from the top side which allows each antenna board to be easily snapped out of the A4 sized panel.

A matching network is used on each antenna design so the antenna boards can be matched to other frequencies or other GND sizes. [Figure 3](#) and [Figure 4](#) show the top metal layer in blue and the bottom layer in green. All antennas have been measured and tuned in free space with the uSMA to SMA cable provided in the kit.



Connection to each antenna board is via a micro SMA (uSMA) coax connector. The uSMA (JSC series) coaxial connector is from Murata and the manufacturing part number is MM5829-2700RJ4. There are two coaxial cables provided with the CC-Antenna-DK2:

- uSMA connector to uSMA connector cable – connectivity to SensorTag or LaunchPad, part number: MXJA01JA1200 (see [Figure 5](#)).
- Low-cost uSMA connector to SMA connector cable, part number: MXFR01JA3000 (see [Figure 6](#))

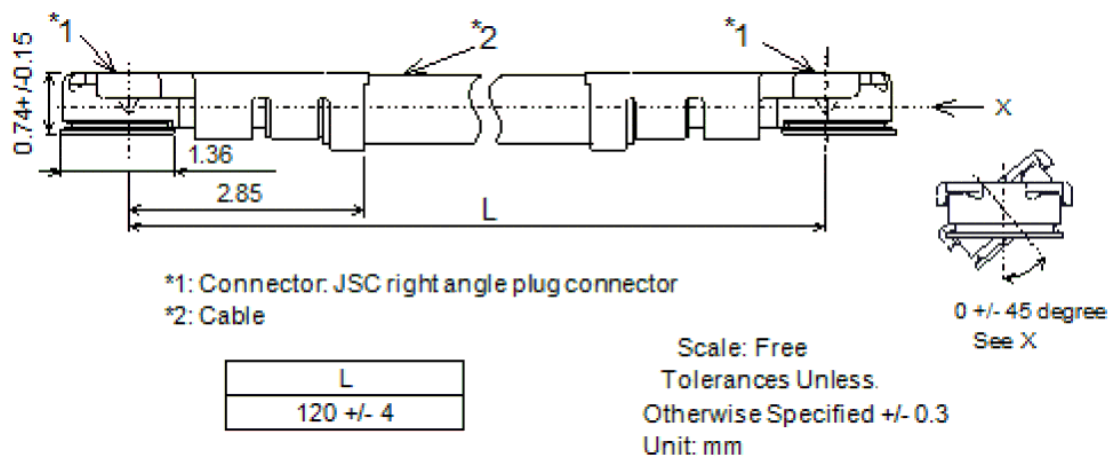


Figure 5. JSC-JS Cable (MXJA01JA1200) Provided With the CC-Antenna-DK2



**Figure 6. JSC-SMA Low-Cost Cable Provided With the CC-Antenna-DK2**

The MXFR01JA3000 low-cost cable has a significant insertion loss that has been compensated for in the measurement reports. For the insertion loss measurement, see [Figure 7](#); for the actual values used, see [Table 2](#). The loss is small at low frequencies and increases with frequency.

**Table 2. Low-Cost Cable Compensation in dB for Each Frequency**

169 MHz	315 MHz	433 MHz	490 MHz	790 MHz	868 MHz	915 MHz	2440 MHz
0.38	0.54	0.64	0.68	0.88	0.94	0.98	1.91



**Figure 7. Insertion Loss of MXFR01JA3000 Low-Cost Cable**

Connecting to the CC1350 SensorTag is possible by using the  $\mu$ SMA to  $\mu$ SMA cable (MXJA01JA1200), as shown in [Figure 8](#). The  $0\ \Omega$  resistor on the CC1350 SensorTag must be assembled towards the  $\mu$ SMA connector instead of the integrated PCB antenna. This allows connecting a higher efficiency antenna to the CC1350 SensorTag. Connectivity to the LaunchPad platform is also possible with the CC-Antenna-DK2 (see [Figure 9](#)).



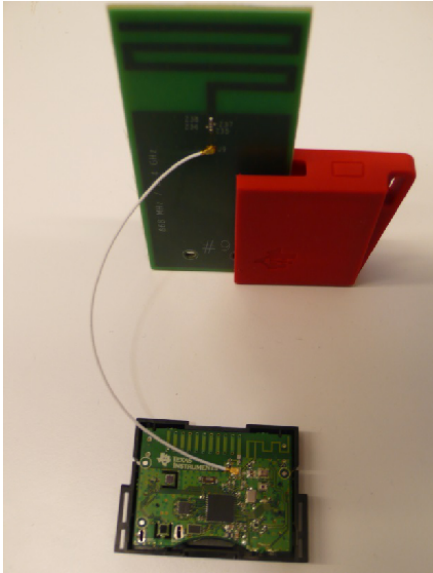


Figure 8. CC-Antenna-DK2 Board #9 Connected to a CC1350 SensorTag Rev 1.3.x

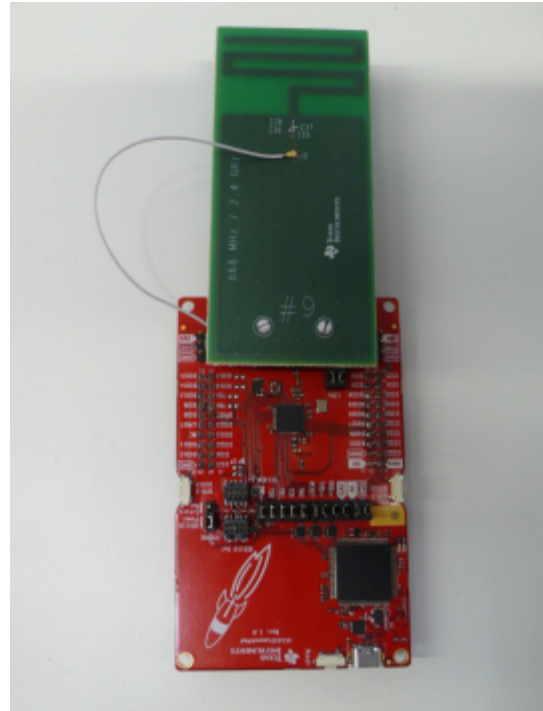


Figure 9. Connecting to a Launchpad

2.1.1 Board #1: CR2032 Dual-Band 868 MHz and 2.4 GHz PCB Antenna

This design can be configured as a single frequency of 2.4 GHz or as a dual-band design with 868 MHz and 2.4 GHz.

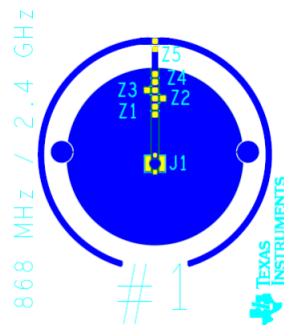


Figure 10. Board #1 – CR2032 Dual-Band 868 MHz and 2.4 GHz PCB Antenna

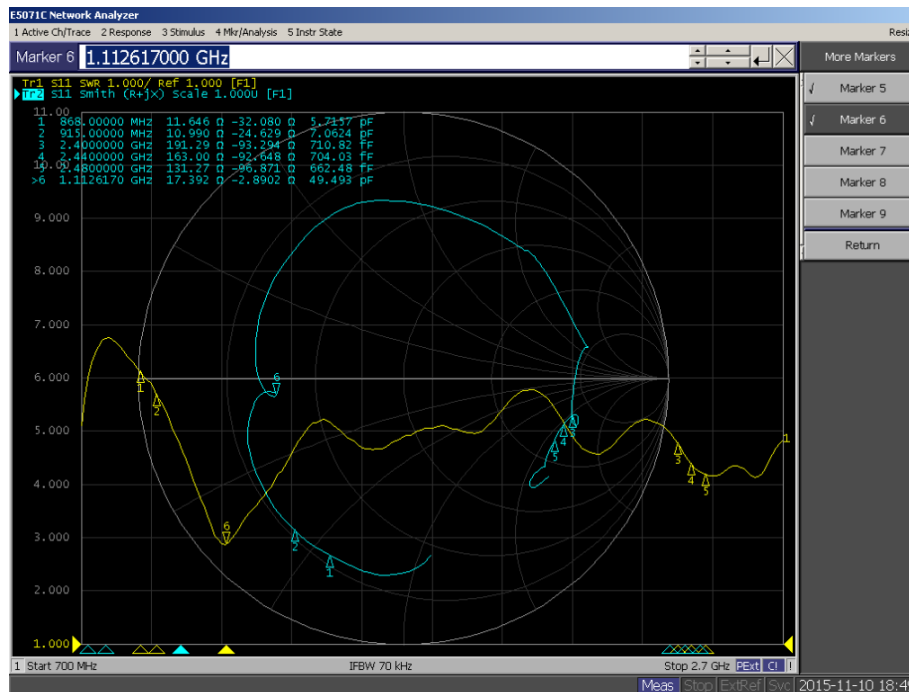


Figure 11. Impedance Measurement With No Matching Components

Table 3. PCB Size of Board #1

Size	Width (mm)	Height (mm)
PCB Board	26.5 dia	26.5 dia
GND	20 dia	20 dia

### 2.1.1.1 Single Band of 2.4 GHz

Table 4. BOM for Board #1 – Single Band of 2.4 GHz

Reference Designator	Part Number	Value
Z1, Z4	RK73Z1ETTP	0 ohm
Z2, Z3	DNM	-
Z5	LQW15AN4N7C00D	4.7nH

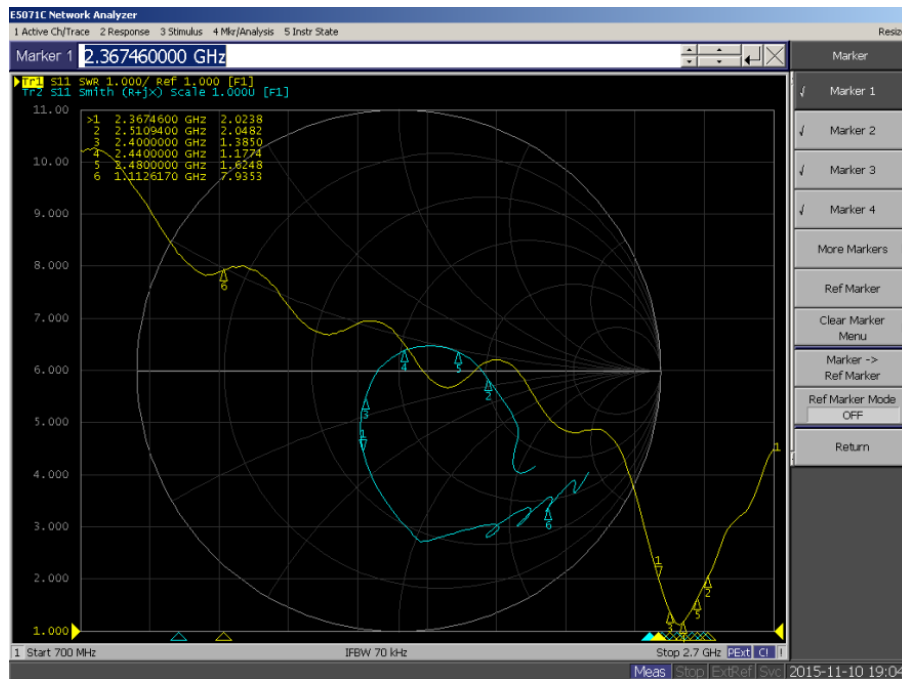


Figure 12. SWR Measurements of Board #1 - Single-Band Configuration 2.4 GHz

Figure 12 shows that the bandwidth (SWR: 2) is 143 MHz.

- Pros: Compact antenna for CR2032 coin cell design with good efficiency average of 47% across the 2.4 GHz ISM band and good bandwidth of 143 MHz.
- Cons: The design can be optimized furthermore for 2.4 GHz by reducing the length of the antenna arms. The match is dependent of the external discrete components and the PCB thickness. Tight tolerances are recommended for the antenna match network.

2.1.1.2 Dual-Band 868 MHz and 2.4 GHz

Table 5. BOM for Board #1 – Single Band of 2.4 GHz

Reference Designator	Part Number	Value
Z1	LQW15AN9N1G00D	9.1 nH
Z2	GRM1555C1HR60BA01D	0.6 pF
Z3	LQW15AN5N1C00D	5.1 nH
Z4	GRM1555C1H5R6CA01D	5.6 pF
Z5	LQW15AN10NJ00D	10 nH

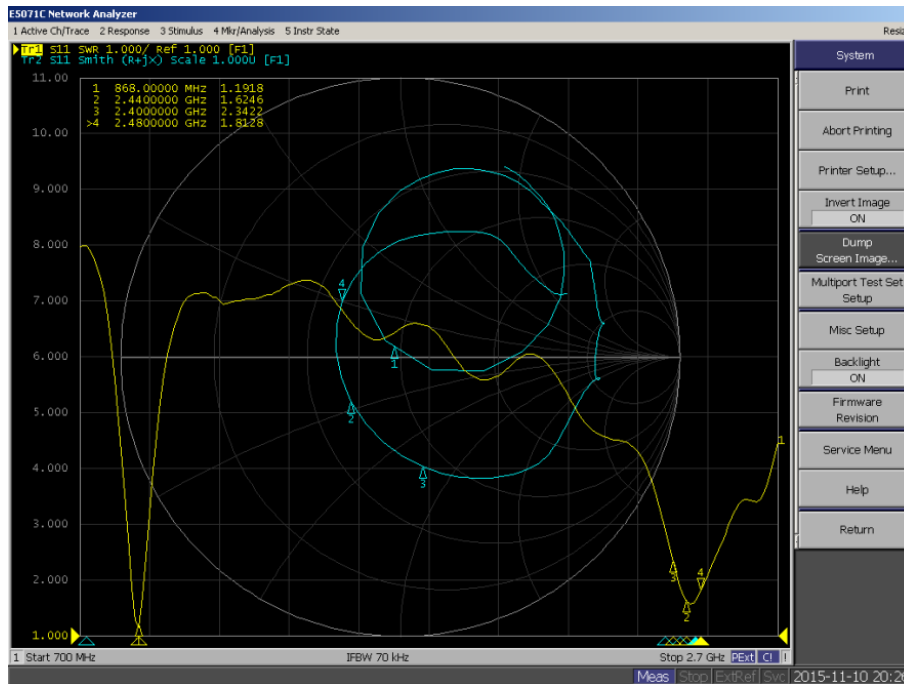


Figure 13. SWR Measurements of Board #1 - Dual-Band Configuration 868 MHz and 2.4 GHz

Figure 13 shows that the 2.4 GHz bandwidth (SWR: 2) is approximately 80 MHz and the 868 MHz bandwidth (SWR: 2) is approximately 40 MHz.

- Pros: Compact dual-band antenna for CR2032 coin cell design with reasonable efficiency average of 21% across the 2.4 GHz ISM band and good efficiency of 51% at 868 MHz. Reasonable bandwidth coverage for both bands. Can also be tuned for 915/920 MHz and 2.4 GHz with a new matching network.
- Cons: The optimum efficiency of the antenna is for sub 1 GHz with the long antenna which sacrifices the performance at 2.4 GHz. If 2.4 GHz performance is more critical than the sub 1 GHz performance then the antenna lengths can be reduced. The dual-band match is dependent of the match components. Sub 1 GHz bandwidth needs to be tuned for 868 MHz or 915/920 MHz.

2.1.2 Board #2: Compact 2.4 GHz PCB Antenna

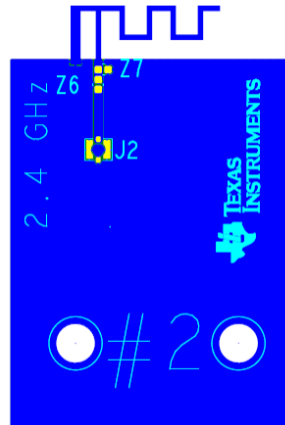


Figure 14. Board #2 – Compact 2.4 GHz PCB Antenna

Table 6. PCB Size and BOM for Board #2

Size	Width (mm)	Height (mm)
PCB Board	35	44
GND	26	34
Reference Designator	Part Number	Value
Z6	RK73Z1ETTP	0 $\Omega$
Z7	DNM	—

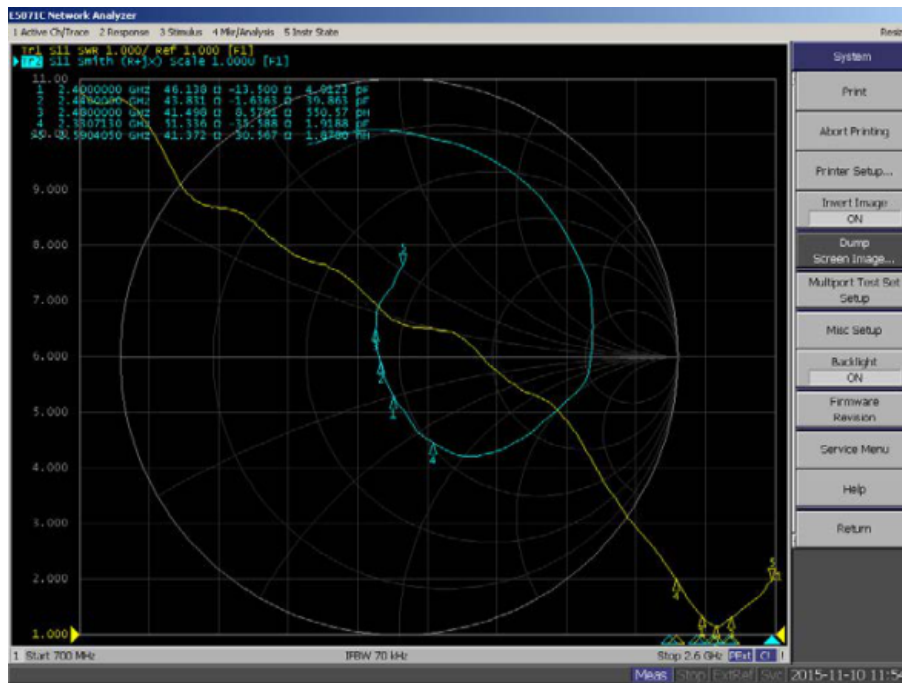


Figure 15. Impedance and SWR Measurement With No Matching Components

Figure 15 shows that the 2.4 GHz bandwidth (SWR: 2) is 260 MHz.

- Pros: Compact antenna design with excellent efficiency average of 66% across the 2.4 GHz ISM band and excellent bandwidth of 260 MHz. No matching components used but still recommend to use with matching components to account for variations in resonance caused by different sizes of GND plane or physical surroundings.
- Cons: This is the second general recommended antenna for 2.4 GHz. If space is available for the antenna design then use board # 11 instead (3.1.12) since this has greater efficiency (average of 71%) and even better bandwidth (369 MHz).

### 2.1.3 Board #3: Fractus Antennas Dual-Band 868 MHz and 2.4 GHz Chip Antenna



Figure 16. Board #3 - Fractus Dual-Band 868 MHz and 2.4 GHz Chip Antenna

Table 7. PCB Size and BOM for Board #3

Size	Width (mm)	Height (mm)
PCB Board	42	95
GND	38	80
Reference Designator	Part Number	Value
Z8	LQW15AN2N9C00D	2.9 nH
Z9	GRM1555C1HR80BA01D	0.8 pF
Z10	GRM1555C1HR70BA01D	0.7 pF
Z11	LQW15AN15NJ00D	15 nH
Z12	RK73Z1ETTP	0 ohm
A28	FR01-S4-224	FR01-S4-224



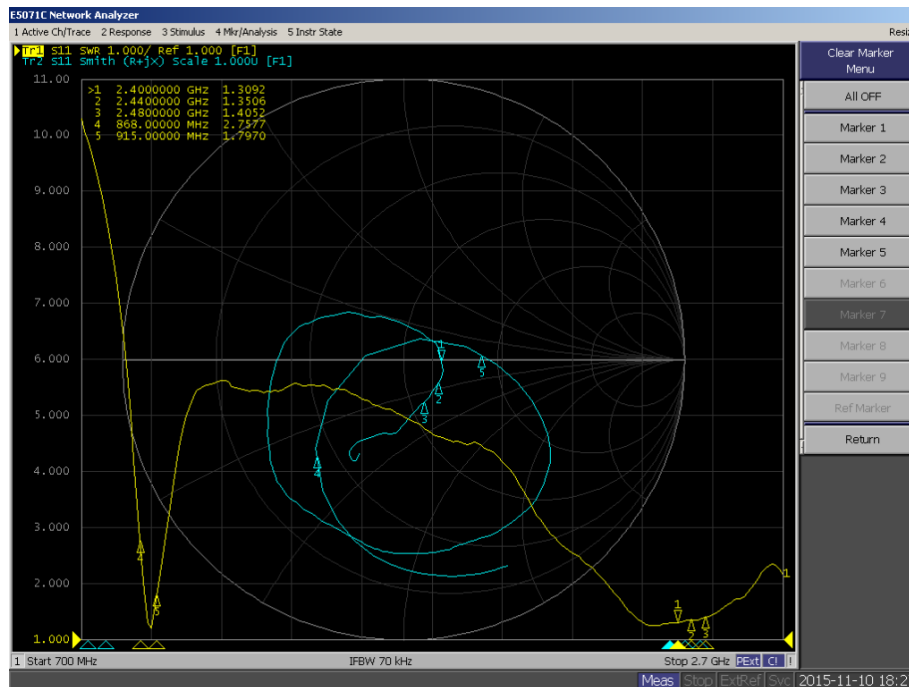


Figure 17. SWR Measurements of Board #3

For tuning of this particular antenna, contact Fractus Antennas for direct support with their antenna ([www.fractusantennas.com](http://www.fractusantennas.com)).

Figure 17 shows that the 2.4 GHz bandwidth (SWR: 2) is approximately 410 MHz and the 868/915 MHz bandwidth (SWR: 2) is approximately 43 MHz.

- Pros: Compact dual-band antenna with good efficiency average of 54% across the 2.4 GHz ISM band and good efficiency of 47% at 868 MHz. Excellent bandwidth coverage for 2.4 GHz and good bandwidth for 868 MHz or 915/920 MHz. Can also be tuned for 915/920 MHz and 2.4 GHz with a new matching network. Excellent antenna tuning support is available from Fractus.
- Cons: Small component cost of a chip antenna. The dual-band match is dependent of the match components. Sub 1 GHz bandwidth needs to be tuned for 868 MHz or 915/920 MHz.

2.1.4 Board #4: 433-510 MHz PCB Antenna

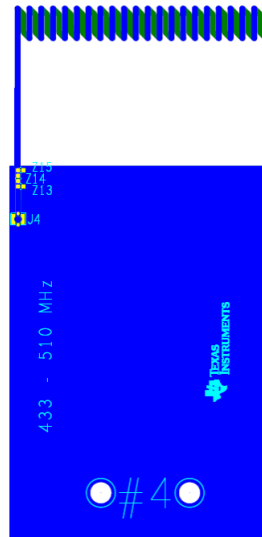


Figure 18. Board #4: 433-510 MHz PCB Antenna

Table 8. PCB Size for Board #4

Size	Width (mm)	Height (mm)
PCB Board	48	95
GND	44	63

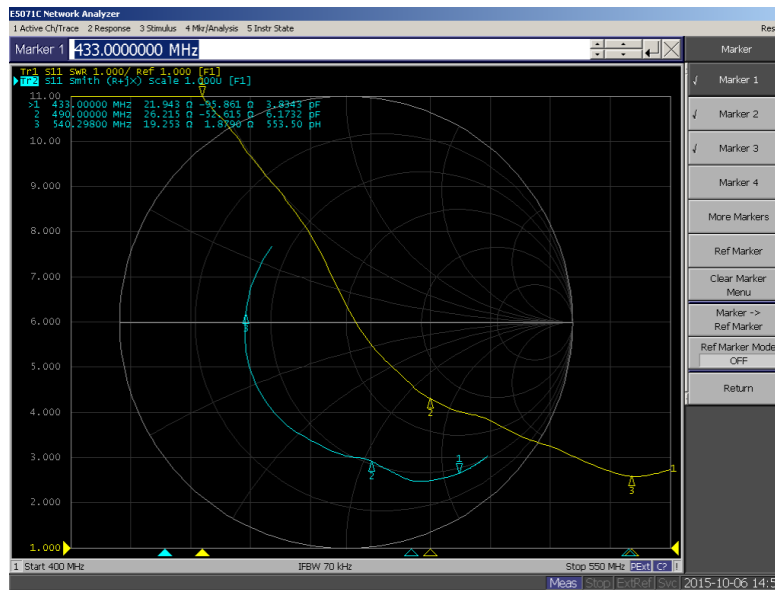


Figure 19. Impedance Measurement With No Matching Components

2.1.4.1 433 MHz

Table 9. BOM for 433 MHz

Reference Designator	Part Number	Value
Z13	GRM1555C1H5R1CA01D	5.1 pF
Z14	GRM1555C1H2R5CA01D	2.5 pF
Z15	LQG15HS27NJ02D	27 nH

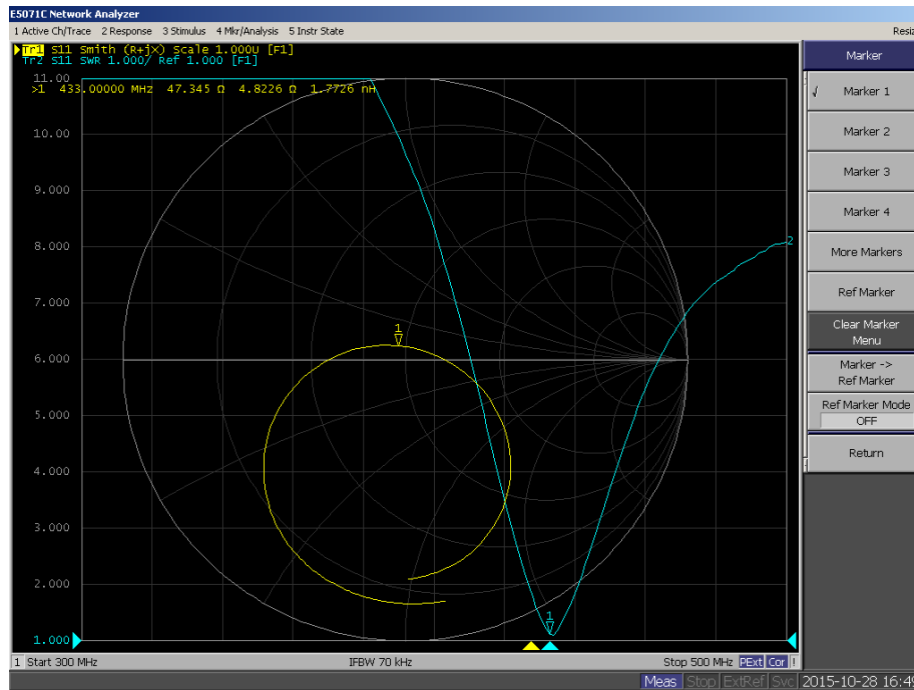


Figure 20. SWR Measurements of Board #4 - Single-Band Configuration 433 MHz

Figure 20 shows that the bandwidth (SWR: 2) is approximately 15 MHz.

- Pros: Antenna with good efficiency (for a small board size) of 35% at 433 MHz and good bandwidth of 15 MHz (for a small board size).
- Cons: The match is dependent of the external discrete components and the PCB thickness. Tight tolerances are recommended for the antenna match network. Larger distance/size to GND plane but this also gives an advantage of greater efficiency and bandwidth. Compare with results of same antenna (see Section 2.1.10) placed closer to GND plane; efficiency drops to 26% to and bandwidth drops to 9 MHz.

2.1.4.2 470-510 MHz

Table 10. BOM China (470-510 MHz)

Reference Designator	Part Number	Value
Z13	DNM	—
Z14	GRM1555C1H5R1CA01D	5.1 pF
Z15	LQW15AN13NJ00D	13 nH

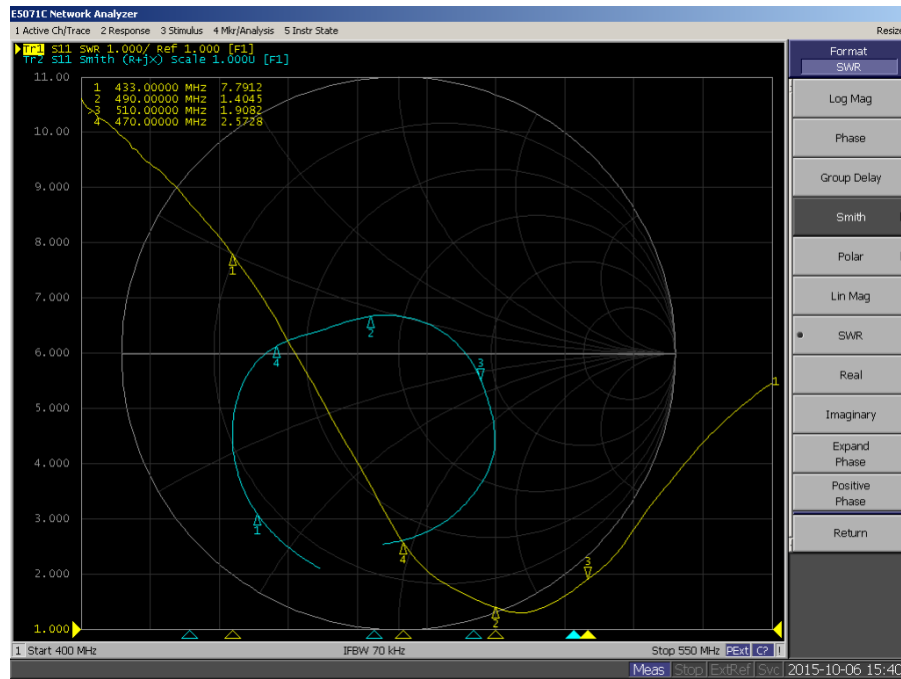
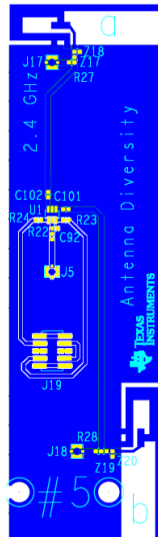


Figure 21. SWR Measurements of Board #4 - Single-Band Configuration 470-510 MHz

Figure 21 shows that the bandwidth (SWR: 2) is approximately 36 MHz.

- Pros: Antenna with excellent efficiency (for a small board size) of 35% average across the Chinese frequency band of 470-510 MHz. The PCB helical antenna has excellent performance especially when comparing to the kit antenna. The 470-510 MHz kit whip antenna has a similar average efficiency of 35% (see Section A.14) but a slightly higher bandwidth of 48 MHz (see Section A.14.2).
- Cons: The match is dependent of the external discrete components and the PCB thickness. Tight tolerances are recommended for the antenna match network. The bandwidth does not fully cover the complete 470-510 MHz band with VSWR:2 but this is also difficult to cover even with the kit antenna (see Section A.14.2).

**2.1.5 Board #5: 2.4 GHz PCB Antenna Diversity**



**Figure 22. Board #5: 2.4 GHz Antenna Diversity**

**Table 11. PCB Size and BOM for Board #5**

Size	Width (mm)	Height (mm)
PCB Board	30	95
GND	26	83
Reference Designator	Part Number	Value
Z17	GJM1555C1H1R8BB01D	1.8 pF
Z18, Z20	DNM	-
R27, R28	RK73Z1ETTP	0 ohm
C92, C101, C102	GRM1555C1H101JA01D	100 pF
R22	CRCW04028K20JNED	8.2 kohm
R23, R24	CRCW04021K00JNED	1 kohm
U1	PE4259SCBECT-Z	PE4259SCBECT-Z
Z19	GRM1555C1H3R3CA01D	3.3 pF
J17, J19	MM5829-2700	—

The average of the total power measured with antenna 5A is -3.3 dBm. Average power measured with antenna 5B is -3.4 dBm. By switching to the maximum power for each angular position between the two antennas, the average power would be increased to -2.2 dBm. Therefore, there is only a slight increase (1.1 dB to 1.2 dB) in transmitted radiated power by using antenna diversity.

The main advantage of using antenna diversity is when receiving the electromagnetic signal through a multi-path environment where there can be up to 15 dB of nulls within a square meter area. The sensitivity limit specified in the datasheet will be reduced by an amount determined by the size of the multi-path propagation null. In the event of the receiving unit being present in a null, then the antenna can be switched and the amplitude of the null will be reduced. When calculating range distances without antenna diversity, a guard band of 20 dB is typically used so the multi-path propagation null will never affect the link budget. When using antenna diversity, the guard band can be reduced to 10-15 dB.

Antenna diversity will not improve the absolute level of sensitivity of the radio but will improve the sensitivity when positioned in a multi-path propagation null area.

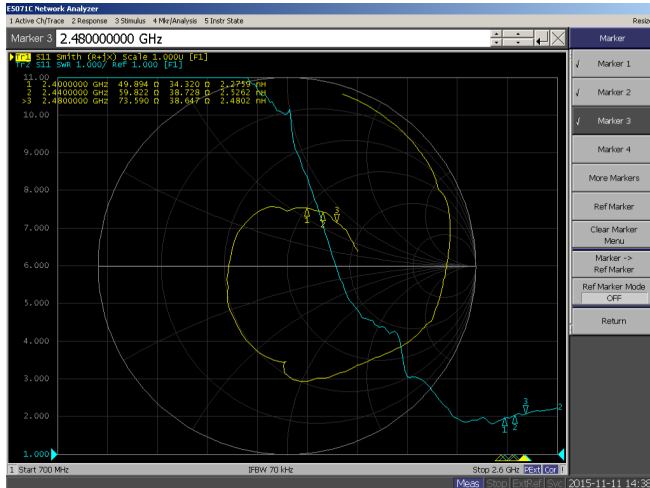


Figure 23. Impedance Measurement With No Matching Components

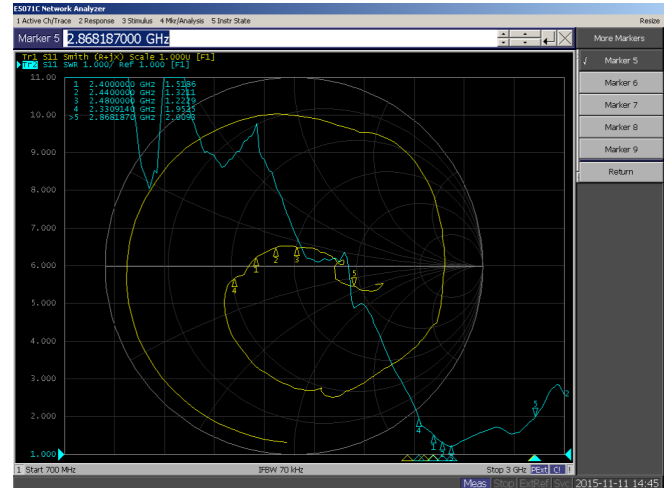


Figure 24. 5A - SWR Measurements

Figure 24 shows that the bandwidth (SWR: 2) is 538 MHz.

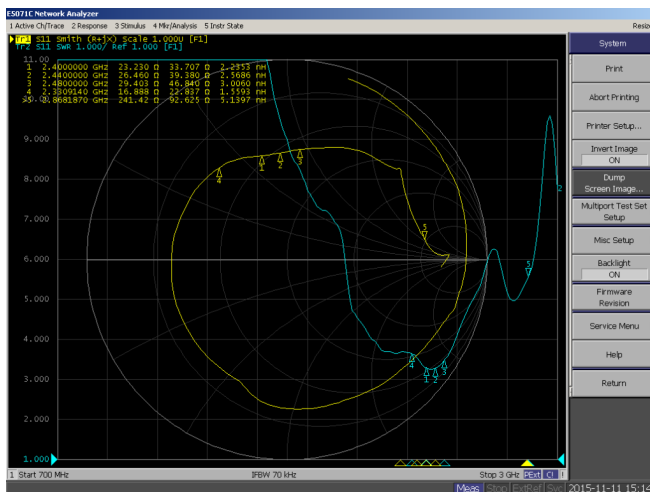


Figure 25. Impedance Measurement With No Matching Components

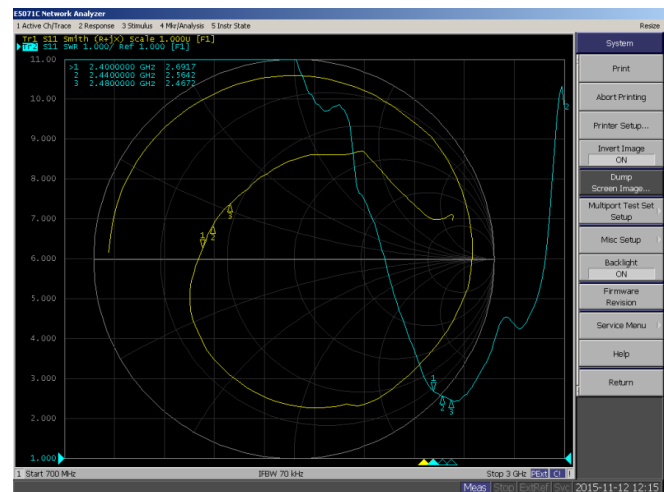


Figure 26. 5B - SWR Measurements

Figure 26 shows that the bandwidth (SWR: 3) is approximately 270 MHz. A good match (SWR:2) was not achieved unless the GND plane width was extended slightly.

The efficiency of antenna 5A is 54% (see Section A.5.1) and antenna 5B is 45% (see Section A.5.2). The isolation between the two 2.4 GHz antennas is 20 dB at 2.4 GHz. Isolation at frequencies outside the tuned band of 2.4 GHz were also recorded: 433 MHz: 80 dB and 868 MHz: 37 dB.

The IL between J5 and J17 or J18 is approximately -6.0 dB when measuring with two uSMA to SMA cables (see Figure 6); one cable connected to J5 and the other to J17 or J18. Taking into account the cable loss from Table 2 of  $2 \times 1.9 \text{ dB} = 3.8 \text{ dB}$ , then the IL through the switch and PCB is 2.2 dB.



2.1.6 Board #6: 868 MHz or 915/920 MHz Compact PCB Helical Antenna



Figure 27. Board #6: Compact PCB Antenna

Table 12. PCB Size and BOM for Board #6: Compact PCB Antenna

Size	Width (mm)	Height (mm)
PCB Board	45	95
GND	43	63
Reference Designator	Part Number	Value
Z21	LQG15HS5N6S02D	5.6 nH
Z22	RK73Z1ETTP	0 $\Omega$
Z23	DNM	—

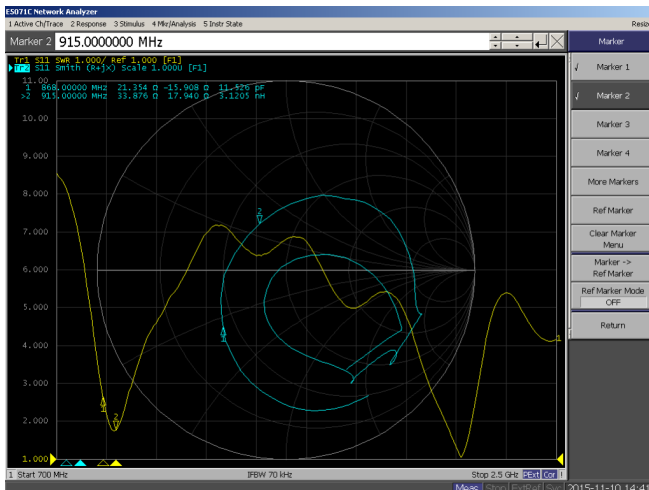


Figure 28. Impedance Measurement With No Matching Components

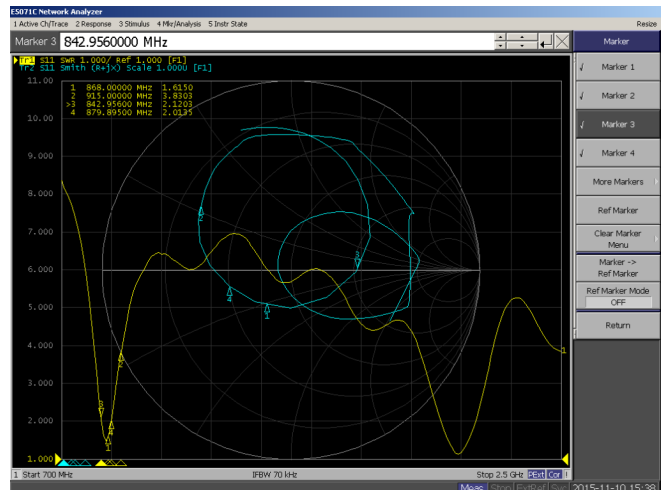


Figure 29. SWR Measurements of Board #6

Figure 29 shows that the bandwidth (SWR: 2) is 37 MHz.

- Pros: Compact antenna design with a good efficiency average of 63% at 868 MHz and a good bandwidth of 37 MHz. This is the second general recommended antenna for 868 MHz or 915 MHz or 920 MHz. The kit antenna has similar efficiency performance (see Section A.15.3).
- Cons: The match is dependent of the external discrete components and the PCB thickness. Tight tolerances are recommended for the antenna match network. The bandwidth (VSWR: 2) is not sufficient to cover both 868 MHz and 915/920 MHz with one match. If space is available for the antenna design then use board # 9 instead (see Section 2.1.9), since this has a greater efficiency (average of 80%) and even better bandwidth (122 MHz).

### 2.1.7 Board #7: ProANT 169 MHz Metal Stanced Antenna

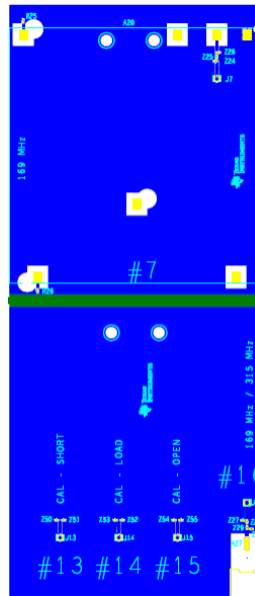


Figure 30. ProANT 169 MHz Metal Stanced Antenna

Table 13. PCB Size and BOM for Board #7

Size	Width (mm)	Height (mm)
PCB Board	84	190
GND	80	186
Reference Designator	Part Number	Value
R25	GRM1555C1H1R0BA01D	1.0 pF
R26	GRM1555C1H2R7CA01D	2.7 pF
Z24	DNM	—
Z25	GRM1555C1H220JA01D	22 pF
Z26	GRM1555C1H100JA01D	10 pF
A20	PROANT 169 MHz	PROANT 169 MHz

For antenna tuning of this particular antenna, contact ProANT for direct support with their antenna ([www.proant.se](http://www.proant.se)).

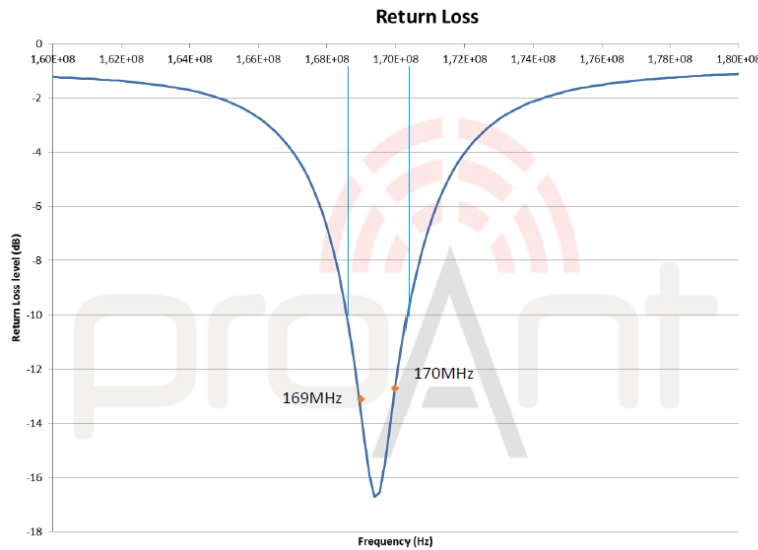


Figure 31. SWR Measurements of Board #7

Figure 31 shows that the bandwidth (SWR: 2) is approximately 2 MHz.

- Pros: Excellent antenna efficiency of 25% that is difficult to achieve at 169 MHz. This is the recommended antenna for 169 MHz for automatic meter reading (AMR) products. Strongly recommend to contact ProANT for antenna tuning with this antenna.
- Cons: The antenna is very large (approximately W:8 x L:8 x H:3 cm). The match is dependent of the external discrete components and the PCB thickness. Tight tolerances are recommended for the antenna match network. The bandwidth (VSWR: 2) is very small and it is easy to detune. Cost of antenna component.

2.1.8 Board #8: 868/915/920 MHz PCB Antenna Diversity

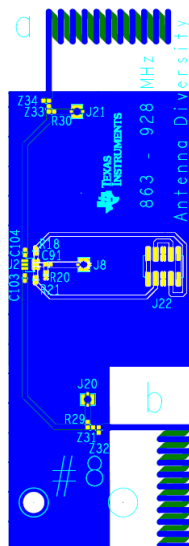


Figure 32. Board #8: 868/915/920 MHz Antenna Diversity

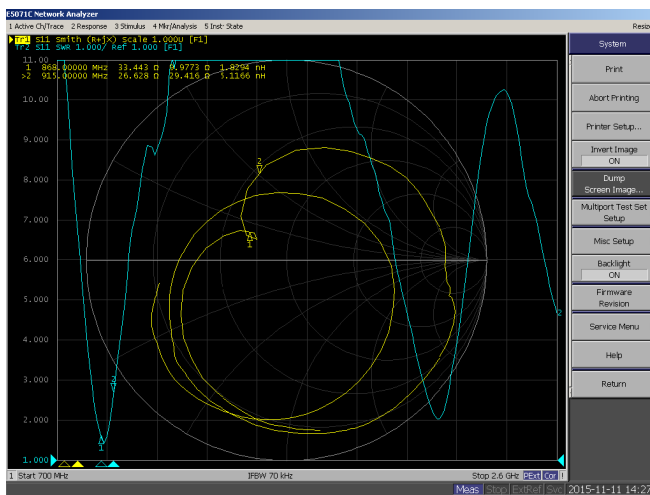
**Table 14. PCB Size and BOM for Board #8**

Size	Width (mm)	Height (mm)
PCB Board	35	95
GND	31	77
Reference Designator	Part Number	Value
R29, R30, Z31, Z33	RK73Z1ETTP	0 Ω
Z34	DNM	—
R18, R21	CRCW04021K00JNED	1kΩ
R20	CRCW04028K20JNED	8.2 Ω
C91, C103, C104	GRM1555C1H101JA01D	100 pF
Z32	LQG15HS12NJ02D	12 nH
J20, J21	MM5829-2700	—

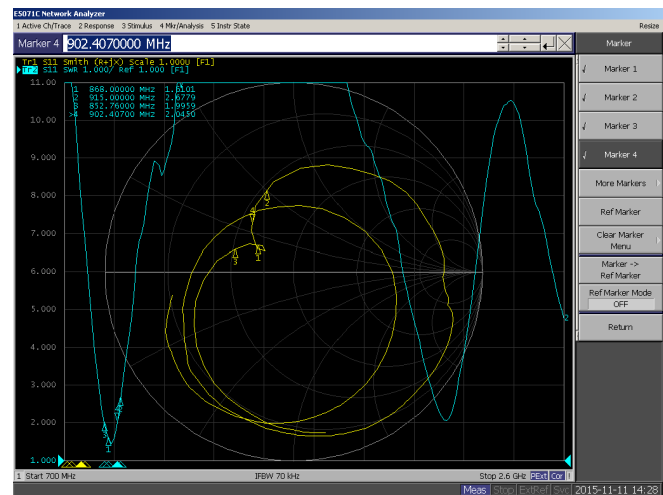
The average of the total power measured with antenna 8A is -2.8 dBm. Average power measured with antenna 8B is -4.9 dBm. By switching to the maximum power for each angular position between the two antennas, the average power would be increased to -2.4 dBm. Therefore, there is only a slight increase (0.4 dB to 2.5 dB) in transmitted radiated power by using antenna diversity.

The main advantage of using antenna diversity is when receiving the electromagnetic signal through a multi-path environment where there can be up to 15 dB of nulls within a square meter area. The sensitivity limit specified in the datasheet will be reduced by an amount determined by the size of the multi-path propagation null. In the event of the receiving unit being present in a null, then the antenna can be switched and the amplitude of the null will be reduced. When calculating range distances without antenna diversity, a guard band of 20 dB is typically used so the multi-path propagation null will never affect the link budget. When using antenna diversity, the guard band can be reduced to 10-15 dB.

Antenna diversity will not improve the absolute level of sensitivity of the radio but will improve the sensitivity when positioned in a multi-path propagation null area.



**Figure 33. Impedance Measurement With No Matching Components**



**Figure 34. 8A - SWR Measurements**

Figure 34 shows that the bandwidth (SWR: 2) is 50 MHz.

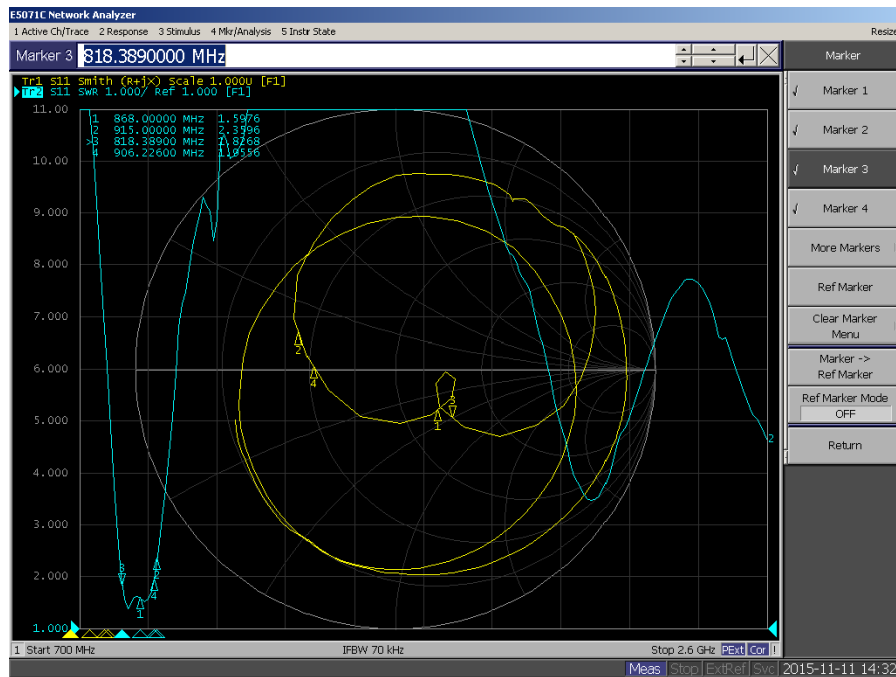


Figure 35. 8B - SWR Measurements With Z32 at 12 nH

Figure 35 shows that the bandwidth (SWR: 2) is 88 MHz.

The efficiency of antenna 8A is 50% (see Section A.8.1) and antenna 8B is 31% (see Section A.8.2). The isolation between the two 868 MHz antennas is 10 dB at 868 MHz. Isolation at frequencies outside the tuned band of 868 MHz were also recorded: 433 MHz: 40 dB and 2.4 GHz: 32 dB.

The IL between J8 and J20 or J21 is approximately -3.5 dB when measuring with two uSMA to SMA cables (see Figure 6); one cable connected to J5 and the other to J20 or J21. Taking into account the cable loss from Figure 2 of  $2 \times 0.9 \text{ dB} = 1.8 \text{ dB}$ , then the IL through the switch and PCB is 1.7 dB.

### 2.1.9 Board #9: 868/915/920 MHz and 2.4 GHz Dual-Band PCB Antenna

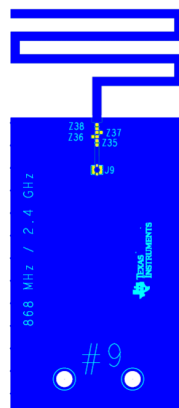
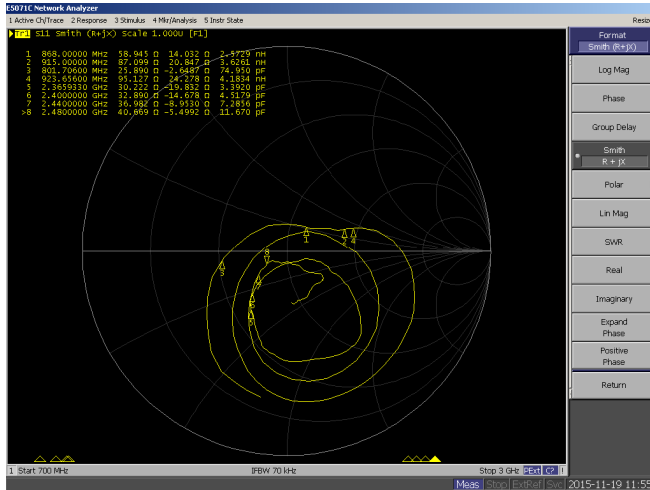


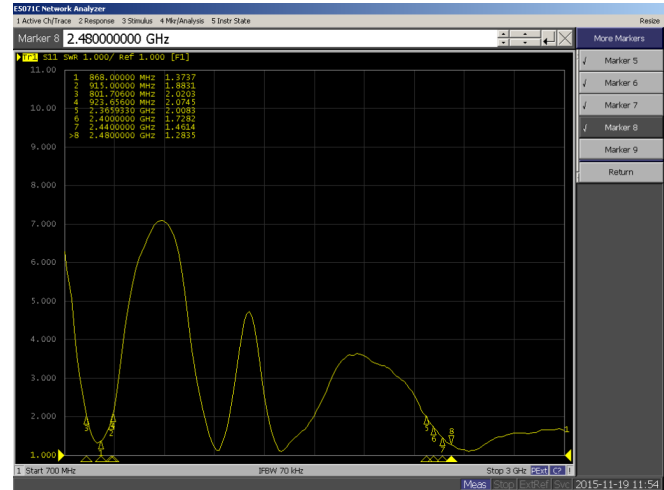
Figure 36. Board #9: 868/915/920 MHz and 2.4 GHz Dual-Band PCB Antenna

**Table 15. PCB Size and BOM for Board #9**

Size	Width (mm)	Height (mm)
PCB Board	42	95
GND	38	66
Reference Designator	Part Number	Value
Z35, Z38	RK73Z1ETTP	0 Ω
Z36, Z37	DNM	—



**Figure 37. Impedance Measurement With No Matching Components**



**Figure 38. SWR Measurements of Board #9**

Figure 38 shows that the 868 MHz bandwidth (SWR: 2) is 122 MHz and the 2.4 GHz bandwidth (SWR: 2) is approximately 600 MHz.

- Pros: This is the recommended antenna for 868 MHz and for dual-band 868 MHz/2.4 GHz. The antenna design has an excellent efficiency of 80% at 868 MHz and excellent bandwidth of 122 MHz. No matching components used but still recommend to use with matching components to account for variations in resonance caused by different sizes of GND plane or physical surroundings.
- Cons: Size.

2.1.10 Board #10: Dual-Band 433 MHz/868 MHz PCB Antenna

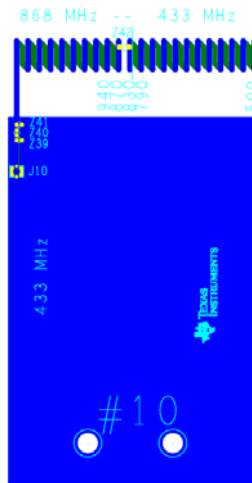


Figure 39. Board #10: Dual-Band 433 MHz/868 MHz PCB Antenna

Table 16. PCB Size and BOM for Board #10 (433 MHz)

Size	Width (mm)	Height (mm)
PCB Board	48	95
GND	44	65
Reference Designator	Part Number	Value
Z39	GRM1555C1H120JA01D	12 pF
Z40	RK73Z1ETTP	0 $\Omega$
Z41	DNM	—
Z42	LQW15AN56NJ00D	56 nH

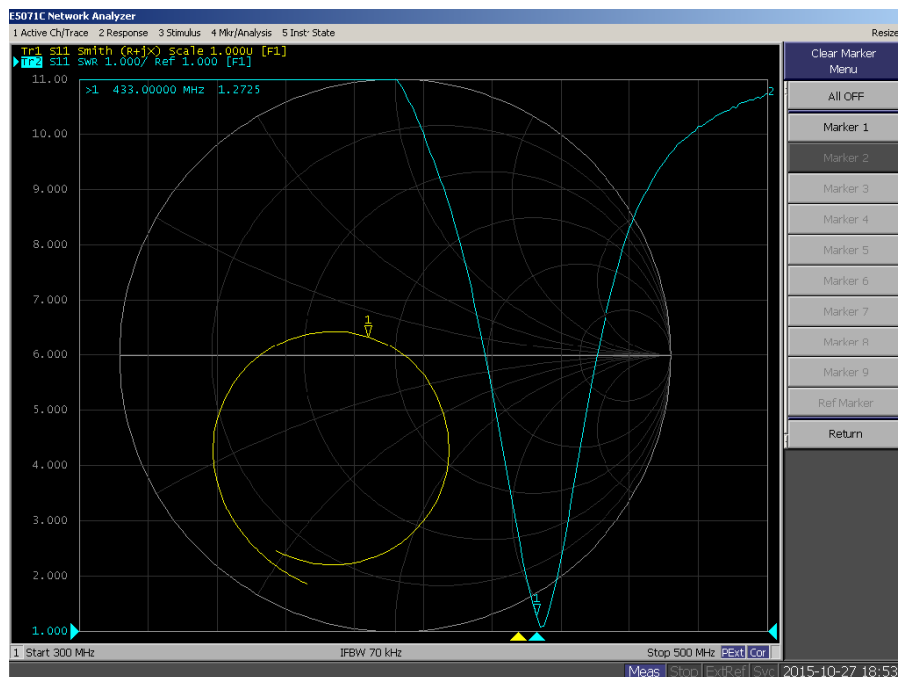


Figure 40. SWR Measurements of Board #10 With 433 MHz BOM

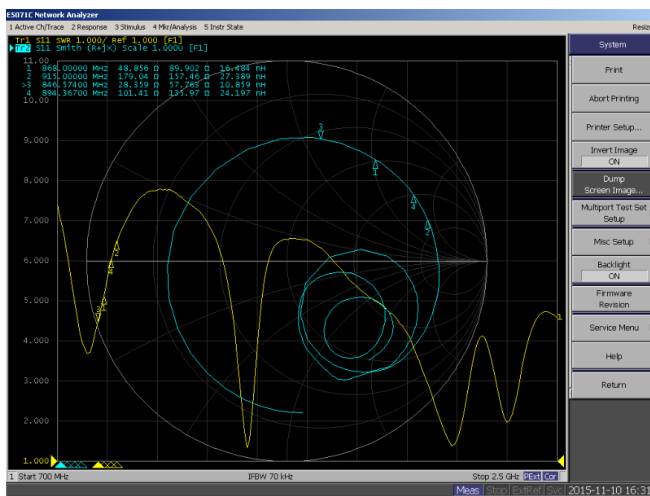


Figure 40 shows that the 433 MHz bandwidth (SWR: 2) is approximately 9 MHz.

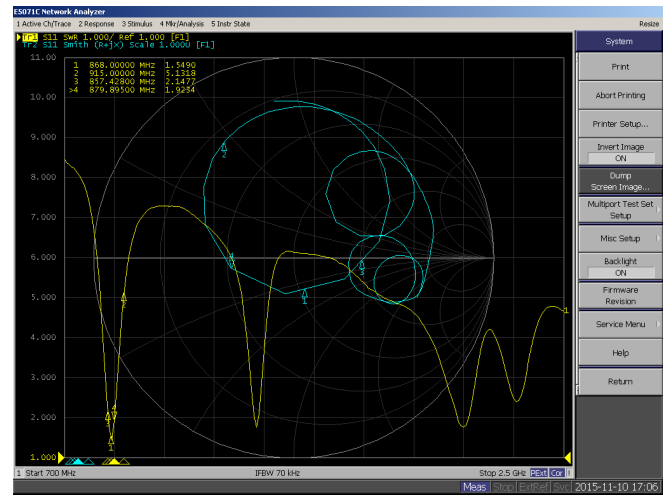
- Pros: Antenna with good efficiency (for a small board size) of 26% at 433 MHz. Small distance/size to GND plane, but this also gives a disadvantage of lower efficiency and smaller bandwidth.
- Cons: The bandwidth is 9 MHz, but this is related to the short distance to GND and the compact size. The match is dependent of the external discrete components and the PCB thickness. Tight tolerances are recommended for the antenna match network. Compare with results of the same antenna (see Section 2.1.4.1) placed at a greater distance from the GND plane; efficiency increases to 35% to and bandwidth increases to 15 MHz.

**Table 17. BOM for Board #10 (868 MHz)**

Reference Designator	Part Number	Value
Z39	LQW15AN7N5G00D	7.5 nH
Z40	GJM1555C1H1R8BB01D	1.8 pF
Z41	DNM	—
Z42	DNM	—



**Figure 41. Impedance Measurement With No Matching Components and Z42: DNM**



**Figure 42. SWR Measurements of Board #10 With 868 MHz BOM**

Figure 42 shows that the 868 MHz bandwidth (SWR: 2) is approximately 23 MHz.

- Pros: Compact antenna design with a good efficiency average of 47% at 868 MHz and a reasonable bandwidth of 23 MHz. Ideal antenna for applications with one PCB to cover 433 MHz and 868 MHz with two different BOM.
- Cons: The match is dependent of the external discrete components and the PCB thickness. Tight tolerances are recommended for the antenna match network. The bandwidth (VSWR: 2) is not sufficient to cover both 868 MHz and 915/920 MHz with one match.

2.1.11 Board #11: 2.4 GHz PCB Antenna



Figure 43. Board #11: 2.4 GHz PCB Antenna

Table 18. PCB Size and BOM for Board #11

Size	Width (mm)	Height (mm)
PCB Board	30	95
GND	26	65
Reference Designator	Part Number	Value
Z43, Z46	RK73Z1ETTP	0 $\Omega$
Z44, Z45	DNM	-

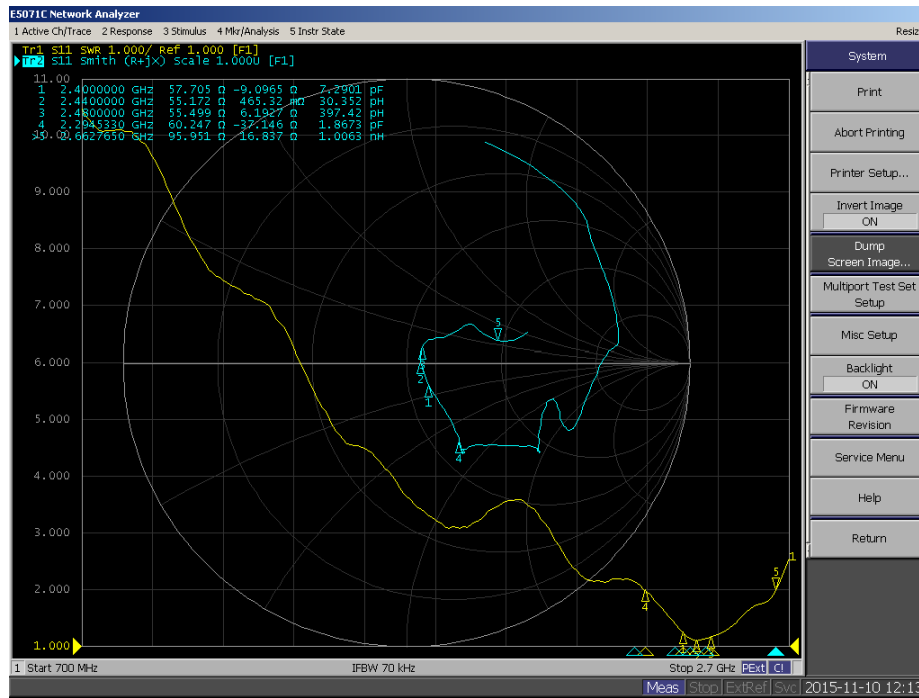


Figure 44. Impedance and SWR Measurement With No Matching Components

Figure 44 shows that the bandwidth (SWR: 2) is 369 MHz.

- Pros: Antenna design with excellent efficiency average of 71% across the 2.4 GHz ISM band and excellent bandwidth of 369 MHz. No matching components used but still recommend to use with matching components to account for variations in resonance caused by different sizes of GND plane or physical surroundings. This is the general recommended antenna for 2.4 GHz.
- Cons: None

**2.1.12 Board #12: 868 MHz or 915/920 MHz Single-Sided Compact PCB Antenna**



**Figure 45. Board #12: Compact PCB Antenna**

**Table 19. PCB Size and BOM for Board #12**

Size	Width (mm)	Height (mm)
PCB Board	26	95
GND	20	65
Reference Designator	Murata Part Number	Value
Z47	LQG15HS5N6S02D	5.6 nH
Z48	LQG15HS1N2S02D	1.2 nH
Z49	DNM	—

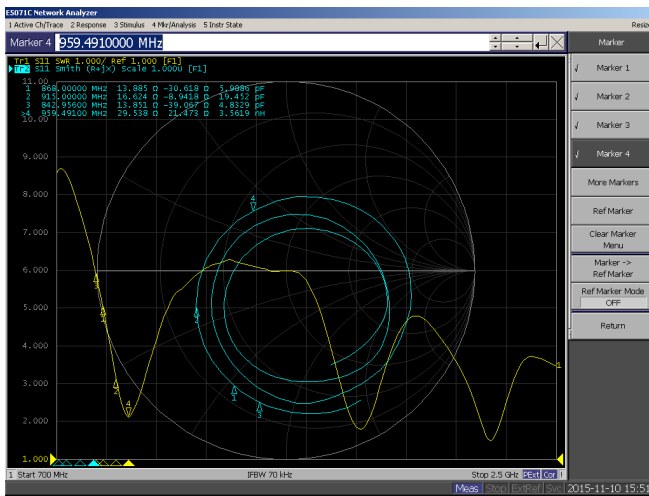


Figure 46. Impedance Measurement With No Matching Components

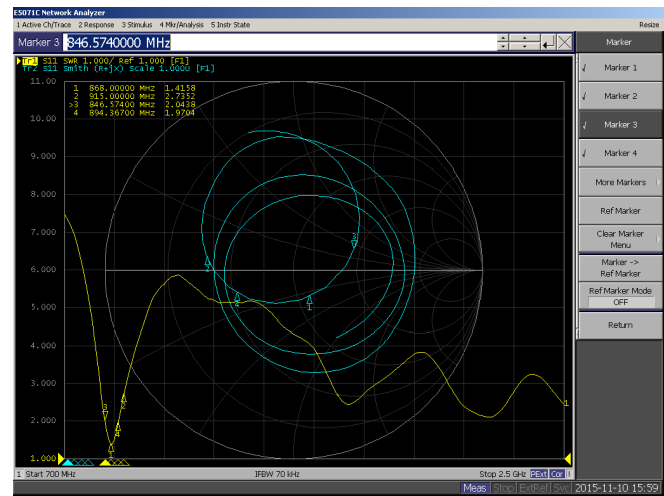


Figure 47. SWR Measurements of Board #12

Figure 47 that the bandwidth (SWR: 2) is 48 MHz.

- Pros: Compact antenna design with a good efficiency average of 63% at 868 MHz and a good bandwidth of 48 MHz.
- Cons: The match is dependent of the external discrete components. The bandwidth (VSWR: 2) is not sufficient to cover both 868 MHz and 915/920 MHz with one match. Line traces are quite thin so more susceptible for over or under etching in PCB production. If space is available for the antenna design then use board # 9 instead (see Section 2.1.9), since this has a greater efficiency (average of 80%) and even better bandwidth (122 MHz).

2.1.13 Boards #13 (SHORT), #14 (LOAD), and #15 (OPEN): Calibration Boards

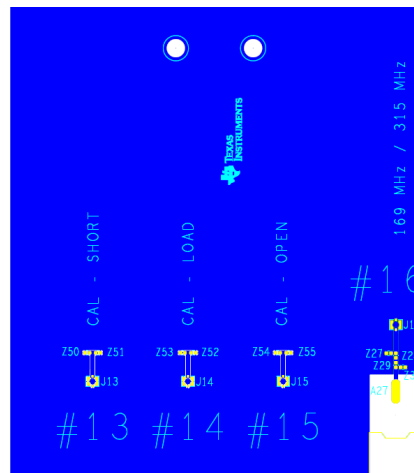


Figure 48. Boards #13, #14, and #15: Calibration Boards

Table 20. PCB Size and BOM for Calibration Boards

Size	Width (mm)	Height (mm)
PCB Board	84	95
GND	80	91
Reference Designator	Part Number	Value

Table 20. PCB Size and BOM for Calibration Boards (continued)

Size	Width (mm)	Height (mm)
Z47	RK73Z1ETTP	0 Ω
Z48	RK73H1ETTP1000F	100 Ω
Z49	DNM	—

Three boards have been provided for calibration purposes; SHORT (#13), LOAD (#14), and OPEN (#15). These boards are mainly used when working with a network analyzer so a complete calibration can be performed. By using the calibration boards, the cable provided and a 50-ohm feed can be taken into account when measuring the antenna.

The #16 antenna is positioned on the calibration board since this space was available on the CC-Antenna-DK2. Antenna #16 is explained in more detail in [Section 2.1.14](#).

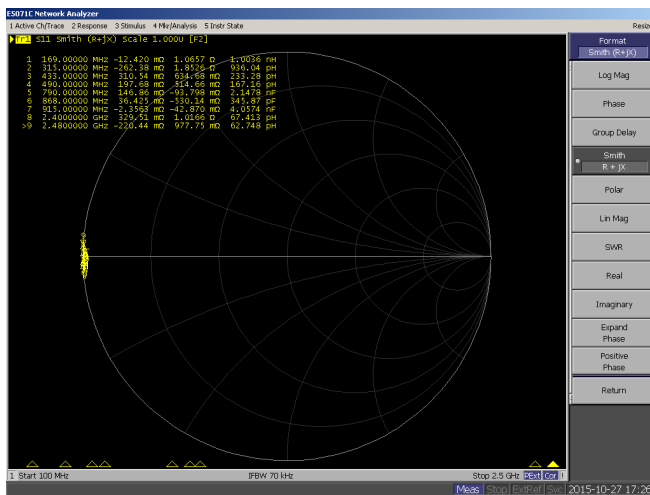


Figure 49. Board #13, SHORT Impedance Measurement

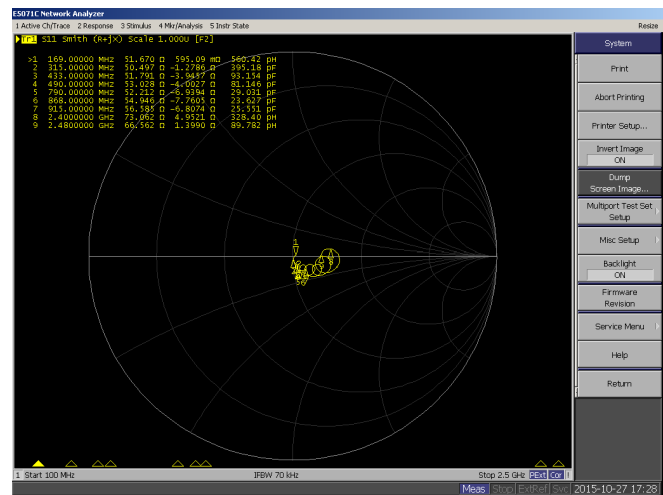


Figure 50. Board #14, LOAD Impedance Measurement

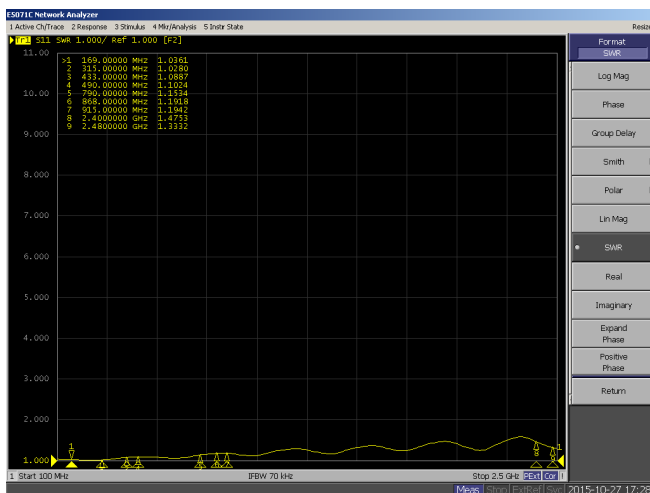


Figure 51. Board #14, LOAD SWR Measurement

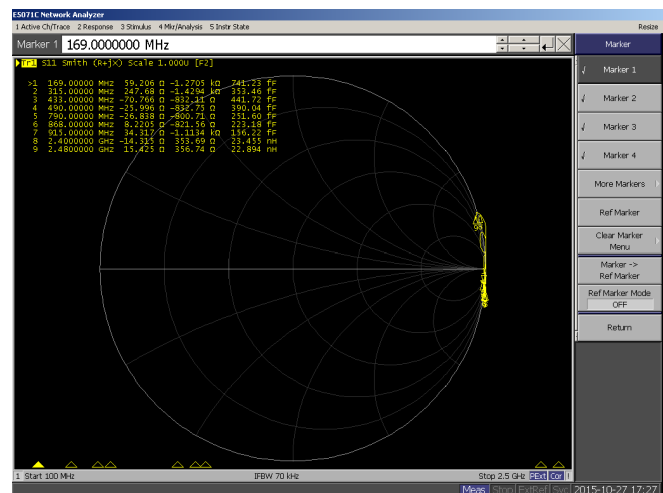


Figure 52. Board #15, OPEN Impedance Measurement

2.1.14 Board #16: Pulse Helical Wire Antenna – 169/315 MHz

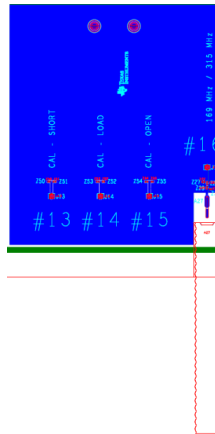


Figure 53. Board #14: Helical Wire Antenna – 169/315 MHz

Table 21. PCB Size and BOM for Board #14: Helical Wire Antenna – 169/315 MHz

Size	Width (mm)	Height (mm)
PCB Board	45	95
GND	43	63
Reference Designator	Part Number	Value
Z27	LQW15AN47NJ00B	47 nH
Z28	LQW15AN82NJ00D	82 nH
Z29	LQW15AN9N1G00D	9.1 nH
Z30	DNM	—
A27	W3100 (not supplied)	—

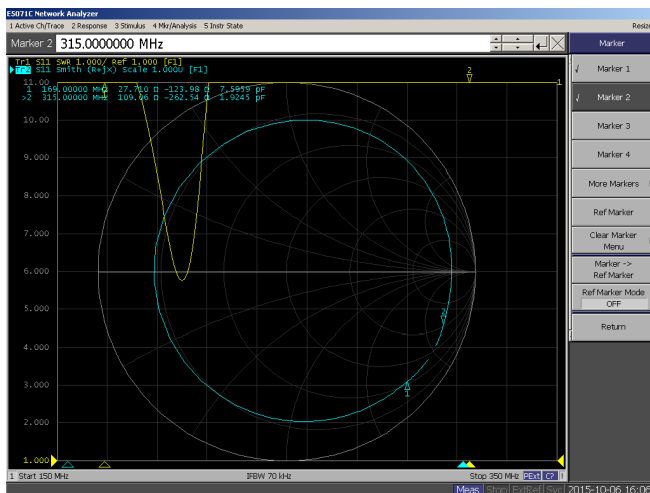


Figure 54. Impedance Measurement With No Matching Components

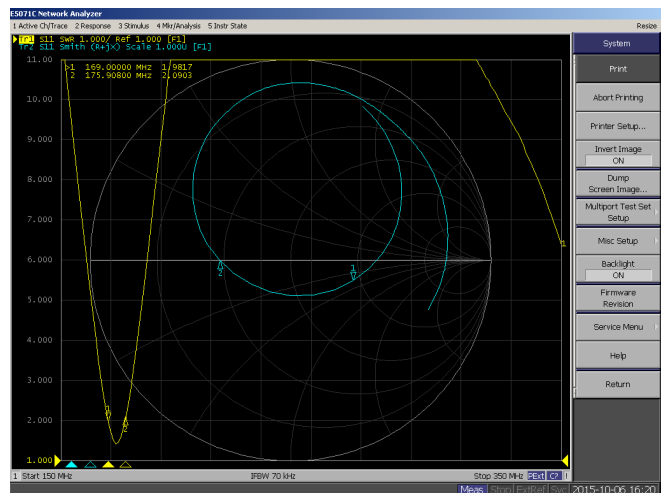


Figure 55. SWR Measurements of Board #16 - Configuration 169 MHz

Figure 55 shows that the bandwidth (SWR: 2) is approximately 6 MHz.

The #16 antenna is positioned on the calibration board since this space was available on the CC-Antenna-DK2. The W3100 antenna is not supplied with the kit but can be purchased from Pulse.

- Pros: Expected antenna efficiency of around 20% at 169 MHz and good bandwidth of 6 MHz. This is a common approach for 169 MHz antennas and 315 MHz antennas.
- Cons: The match is dependent of the external discrete components. Cost of helical wire antenna. The bandwidth (VSWR: 2) is small and it is easy to detune.

## 2.2 Antenna Measurement Summary

### 2.2.1 Over-The-Air (OTA) Testing

OTA testing provides a more accurate testing for wireless devices in order to be able to determine the antenna characteristics of the final product. Traditionally, the antenna radiation patterns were stated as horizontal and vertical polarizations in XY, XZ, and YZ planes. This information is still useful, but for the majority of wireless devices, the polarization and positioning is usually unknown and makes comparing antennas difficult.

The testing is performed in an anechoic chamber and the transmitted power is recorded in a dual polarized antenna. The AUT is fixed onto the turn arm that is on the turn table. The turn table rotates from 0° to 180° and the turn arm is rotated 360° so a 3D radiation diagram can illustrate the spatial distributions.

The hardware part of the test system is based on the R&S TS8991 and the software is EMC32. Within the EMC32 program, a standard CTIA OTA report is generated from the test suite that is performed and the main results obtained are:

- Total Radiated Power, TRP (dBm)
- Peak EIRP (dBm)
- Directivity (dBi)
- Efficiency (%)
- Gain (dBi)

Figure 56 shows the typical format and the parameters specified in the CTIA OTA measurement report. Advantages of having a standard measurement suite are that two antennas can be compared and documented in an easier manner.



<b>Antenna Kit</b> board 7 - 2400-2480 MHz - Stand Alone	<b>Texas Instruments</b>	<b>DN615</b> 5 / 12
<b>OTA Test Results for Frequency 2440.000 MHz</b>		
OTA Evaluation Results:		
Total Radiated Power	-0.26 dBm	
Peak EIRP	5.89 dBm	
Directivity	6.15 dBi	
Efficiency	-0.26 dB	
Efficiency	94.17 %	
Gain	5.89 dBi	
NHPRP 45°	-2.07 dBm	
NHPRP 45° / TRP	-1.81 dB	
NHPRP 45° / TRP	65.90 %	
NHPRP 30°	-3.93 dBm	
NHPRP 30° / TRP	-3.67 dB	
NHPRP 30° / TRP	42.95 %	
NHPRP 22.5°	-5.07 dBm	
NHPRP 22.5° / TRP	-4.81 dB	
NHPRP 22.5° / TRP	33.05 %	
UHRP	-3.65 dBm	
UHRP / TRP	-3.39 dB	
UHRP / TRP	45.81 %	
LHRP	-2.92 dBm	
LHRP / TRP	-2.66 dB	
LHRP / TRP	54.19 %	
Front/Back Ratio	16.57	
PhiBW	118.1 deg	
PhiBW Up	87.9 deg	
PhiBW Down	30.2 deg	
ThetaBW	32.0 deg	
ThetaBW Up	11.1 deg	
ThetaBW Down	20.8 deg	
Boresight Phi	30 deg	
Boresight Theta	150 deg	
Maximum Power	5.89 dBm	
Minimum Power	-12.15 dBm	
Average Power	0.72 dBm	
Max/Min Ratio	18.04 dB	
Max/Avg Ratio	5.17 dB	
Min/Avg Ratio	-12.87 dB	
Best Single Value	5.34 dBm	
Best Position	Phi = 270 deg, Theta = 180 deg, Pol = Hor	

**Figure 56. Standard Format of CTIA OTA Measurement Report**

Total Radiated Power (TRP) is calculated by integrating the power measured for the complete rotation of the AUT.

Effective Isotropic Radiated Power (EIRP) is the amount of power that a theoretical isotropic antenna would emit to produce the peak power density observed in the direction of maximum antenna gain and this stated in dBm.

Gain is usually referred to an isotropic antenna and with the designation dBi. Directivity and Gain are angular dependent functions. [Figure 56](#) shows that the Directivity is the difference from the Peak EIRP and TRP; Gain is the sum of Efficiency and Directivity, refer to [Equation 2](#).

Ohmic losses in the antenna element and reflections at the feed point of the antenna determine the efficiency. It is important to state that the antenna gain is not similar to amplifier gain where there is more power generated. Antenna gain is just a measure of the antenna directivity and an antenna can only radiated the power that is delivered to the antenna.

Efficiency ( $\eta$ ) is the relation between the TRP ( $P_{rad}$ ) and the input power ( $P_{in}$ ) delivered to the AUT, see [Equation 1](#). This data is presented in both dB and in percentage. Efficiency can also be expressed with the relation between Gain ( $Gain_{max}$ ) and Directivity ( $D_{max}$ ), see [Equation 2](#). Gain takes into account VSWR mismatch and energy losses.

$$\eta = \frac{P_{rad}}{P_{in}} \times 100\%$$

Efficiency Definition with Relation to Power (1)

$$Gain_{max} = \eta D_{max}$$

Definition with Relation to Gain and Directivity (2)

### 2.2.2 XYZ Co-ordinates for Antenna Diagrams

Figure 57 shows the XYZ coordinates for all the measurements performed in the antenna chamber. Board #9 is shown in Figure 57. The antenna board is switched between the various antennas on the CC-Antenna-DK2 but positioning is kept in the same position.

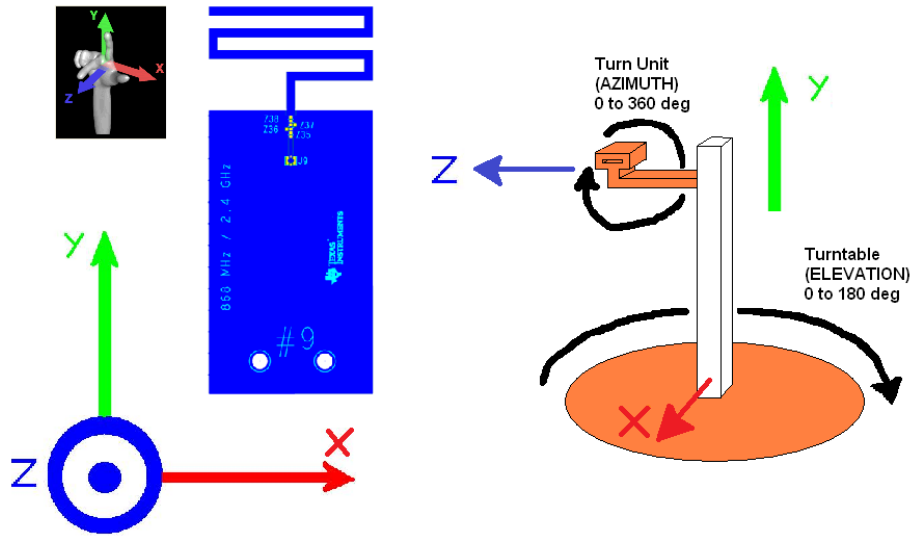


Figure 57. Antenna Board XYZ Coordinate Orientation

### 2.3 169-MHz Band Measurement Summary

These antennas can be used in the frequency band of 136 MHz to 240 MHz. The 169 MHz was chosen so the characteristics of the antenna can be compared.

#### 2.3.1 PCB Antennas (169 MHz)

Not recommended due to physical size.

#### 2.3.2 Chip Antennas (169 MHz)

Not recommended due to poor performance for compact designs.

#### 2.3.3 Wire/Stanced Antennas (169 MHz)

**Table 22. 169-MHz Wire Antennas**

	Board #7 (Section 2.1.7) (169 MHz)	Board #15 (169 MHz)
	ProANT Report (Section A.7)	Simulation Report
Test Description	Test Result	Test Result
Total Radiated Power	-6.5 dBm	-7.0 dBm *1

#### 2.3.4 Antenna Efficiency Summary (169 MHz)

Recommend to use the ProANT Onboard 169 antenna since ProANT provides excellent support and has on-site chamber to measure at 169 MHz.

**Table 23. Total Radiated Power (TRP) (169 MHz)**

Ranking	Description	TRP Efficiency [%]	Comments
1	Ex-it BS 169	81%	1m dipole antenna
2	Ex-it 169	32%	ProANT 169 MHz kit antenna
3 (RECOMMENDED)	CC-Antenna-DK2 #7 (Section 2.1.7)	22%	ProANT Onboard 169
4	W3100	20% *1	Pulse *1: simulated
5	CC-Antenna-DK1 #14	14%	Previous antenna kit

## 2.4 433-MHz Band Measurement Summary

These antennas can be used in the frequency band of 387 MHz to 510 MHz. The 433 MHz was chosen so the characteristics of the antenna can be compared.

### 2.4.1 PCB Antennas (433 MHz)

Requires a separation distance from the GND plane to the antenna element for improved efficiency; refer to difference between CC-Antenna-DK2 #4 and CC-Antenna-DK2 #10. Ideally, the antenna should be placed perpendicular to the GND plane, if area is available. PCB antenna size is reduced by using stub antenna design concepts and meandering techniques then good performances can be achieved in a small size.

**Table 24. 433-MHz Wire Antennas**

	CC-Antenna-DK2 #4	CC-Antenna-DK2 #10
Full CTIA Report	<a href="#">Section A.4.1</a>	<a href="#">Section A.10.1</a>
Test Description	Test Result	Test Result
Total Radiated Power	-4.58 dBm	-5.89 dBm
Peak EIRP	0.21 dBm	-0.68 dBm
Directivity	4.79 dBi	5.21 dBi
Efficiency	-4.58 dB	-5.89 dB
Efficiency	34.87%	25.76%
Gain	0.21 dBi	-0.68 dBi

### 2.4.2 Chip Antennas (433 MHz)

Not strongly recommended due to poorer performance for compact designs.

### 2.4.3 Wire Antennas (433 MHz)

**Table 25. 433-MHz Wire Antennas**

	CC-Antenna-DK1 #8	CC-Antenna-DK1 #13
Full CTIA Report	DN605 - board 8 ( <a href="#">SWRA334</a> )	DN609 - board 13 ( <a href="#">SWRA338</a> )
Test Description	Test Result	Test Result
Total Radiated Power	-7.07 dBm	-5.93 dBm
Peak EIRP	-2.51 dBm	-1.15 dBm
Directivity	4.56 dBi	4.78 dBi
Efficiency	-7.07 dB	-5.93 dB
Efficiency	19.62%	25.53%
Gain	-2.51 dBi	-1.15 dBi

## 2.4.4 Antenna Efficiency Summary (433 MHz)

**Table 26. Total Radiated Power (TRP) (433 MHz)**

Ranking	Description	TRP Efficiency [%]	Comments
1	Kit Antenna	83%	SPWH24433TI
2 (RECOMMENDED)	CC-Antenna-DK2 #4	35%	
3	CC-Antenna-DK2 #10	26%	
4	CC-Antenna-DK1 #13	26%	Previous antenna kit
5	CC-Antenna-DK1 #8	20%	Previous antenna kit
6	CC-Antenna-DK1 #12	15%	Previous antenna kit

## 2.5 868-MHz Band Measurement Summary

These antennas can be used in the frequency band of 779 MHz to 920 MHz. The 868 MHz was chosen so the characteristics of the antenna can be compared.

### 2.5.1 PCB Antennas (868 MHz)

**Table 27. 868-MHz PCB Antennas**

	CC-Antenna-DK1 #5	CC-Antenna-DK1 #10	CC-Antenna-DK2 #1	CC-Antenna-DK2 #6	CC-Antenna-DK2 #9	CC-Antenna-DK2 #10	CC-Antenna-DK2 #12
Full CTIA Report	DN602 - board 5 (SWRA331)	DN606 - board 10 (SWRA335)	<a href="#">Section A.1.2.1</a>	<a href="#">Section A.6.1</a>	<a href="#">Section A.9.1</a>	<a href="#">Section A.10.2</a>	<a href="#">Section A.12.1</a>
Test Description	Test Result	Test Result	Test Result	Test Result	Test Result	Test Result	Test Result
Total Radiated Power	-1.95 dBm	-2.82 dBm	-2.87 dBm	-2.00 dBm	-0.95 dBm	-3.30 dBm	-3.38 dBm
Peak EIRP	3.46 dBm	1.38 dBm	1.39 dBm	2.12 dBm	3.52 dBm	0.87 dBm	1.02 dBm
Directivity	5.41 dBi	4.20 dBi	4.25 dBi	4.13 dBi	4.47 dBi	4.16 dBi	4.40 dBi
Efficiency	-1.95 dB	-2.82 dB	-2.87 dB	-2.00 dB	-0.95 dB	-3.30 dB	-3.38 dB
Efficiency	63.78%	52.29%	51.69%	63.05%	80.38%	46.83%	45.94%
Gain	3.46 dBi	1.38 dBi	1.39 dBi	2.12 dBi	3.52 dBi	0.87 dBi	1.02 dBi

### 2.5.2 Chip Antennas (868 MHz)

**Table 28. 868-MHz Chip Antennas**

	CC-Antenna-DK1 #3	CC-Antenna-DK1 #4	CC-Antenna-DK2 #3
Full CTIA Report	DN600 - board 3 (SWRA329)	DN601 - board 4 (SWRA330)	<a href="#">Section A.3.1</a>
Test Description	Test Result	Test Result	Test Result
Total Radiated Power	-3.25 dBm	-2.09 dBm	-2.87 dBm
Peak EIRP	1.73 dBm	2.88 dBm	1.39 dBm
Directivity	4.98 dBi	4.98 dBi	4.25 dBi
Efficiency	-3.25 dB	-2.09 dB	-2.87 dB
Efficiency	47.34%	61.74%	51.69%
Gain	1.73 dBi	2.88 dBi	1.39 dBi

### 2.5.3 Wire Antennas (868 MHz)

**Table 29. 868-MHz Wire Antennas**

	Nearson Whip Dipole	Pulse Whip Dipole
Full CTIA Report	DN613 ( <a href="#">SWRA342</a> )	<a href="#">Section A.15.3</a>
Test Description	Test Result	Test Result
Total Radiated Power	-1.52 dBm	-2.07 dBm
Peak EIRP	1.42 dBm	1.38 dBm
Directivity	2.94 dBi	3.45 dBi
Efficiency	-1.52 dB	-2.07 dB
Efficiency	70.49%	62.07%
Gain	1.42 dBi	1.38 dBi

### 2.5.4 Antenna Efficiency Summary (868 MHz)

First recommended choice of PCB antenna is the CC-Antenna-DK2 #9 (DN024) and second choice is CC-Antenna-DK2 #6 (DN038). Even though these antennas are specified at 868 MHz, they can also be used for 915/920 MHz. Changing the frequency will require a new match or shortening of the antenna structure.

**Table 30. Total Radiated Power (TRP) (868 MHz)**

Ranking	Description	TRP Efficiency [%]	Comments
1 (RECOMMENDED)	CC-Antenna-DK2 #9	80%	Dual-band, DN024, (868/2440 MHz)
2	Nearson Kit Antenna	70%	DN613 ( <a href="#">SWRA342</a> )
3	CC-Antenna-DK1 #5	64%	Previous antenna kit
4	CC-Antenna-DK2 #6	63%	Compact helical antenna. DN038
5	Pulse Kit Antenna	62%	<a href="#">Section A.15.3</a>
6	CC-Antenna-DK1 #4	62%	Previous antenna kit
7	CC-Antenna-DK2 #1	54%	Dual-band, CR2032, (868/2440 MHz)
8	CC-Antenna-DK2 #3	52%	Dual-band, Fractus, (868/2440 MHz)
9	CC-Antenna-DK1 #10	52%	Previous antenna kit
10	CC-Antenna-DK2 #10	47%	Dual-band, (433/868 MHz)
11	CC-Antenna-DK1 #3	47%	Previous antenna kit
12	CC-Antenna-DK2 #12	46%	Compact single sided 868 MHz

## 2.6 2.40-GHz Band Measurement Summary

This antenna can be used in the frequency band of 2400 MHz to 2480 MHz. The 2400 MHz was chosen so the characteristics of the antenna can be compared.

### 2.6.1 PCB Antennas (2.40 GHz)

**Table 31. 2.4-GHz PCB Antennas**

	CC-Antenna-DK2 #1	CC-Antenna-DK2 #1	CC-Antenna-DK2 #2	CC-Antenna-DK2 #9	CC-Antenna-DK2 #11
Full CTIA Report	<a href="#">Section A.1.1.1</a>	<a href="#">Section A.1.2.2</a>	<a href="#">Section A.2.1</a>	<a href="#">Section A.9.3</a>	<a href="#">Section A.11.1</a>
	Single band	Dual band			
Test Description	Test Result	Test Result	Test Result	Test Result	Test Result
Total Radiated Power	-2.64 dBm	-7.85 dBm	-1.96 dBm	-1.93 dBm	-1.47 dBm
Peak EIRP	2.58 dBm	-2.61 dBm	2.67 dBm	2.94 dBm	3.94 dBm
Directivity	5.22 dBi	5.24 dBi	4.63 dBi	4.88 dBi	5.41 dBi
Efficiency	-2.64 dB	-7.85 dB	-1.96 dB	-1.93 dB	-1.47 dB
Efficiency	54.50%	16.41%	63.62%	64.07%	71.30%
Gain	-2.64 dBm	-7.85 dBm	2.67 dBi	2.94 dBi	3.94 dBi

### 2.6.2 Chip Antennas (2.40 GHz)

There is a large range of chip antennas available at 2.4 GHz that have reasonable performance. The drawback with ceramic chip antennas at this frequency is the performance of PCB antennas is also very good and compact. If board space for a PCB antenna is not available, then a ceramic antenna is a good option.

**Table 32. 2.4-GHz Chip Antennas**

	CC-Antenna-DK2 #3
Full CTIA Report	<a href="#">Section A.3.2</a>
Test Description	Test Result
Total Radiated Power	-2.53 dBm
Peak EIRP	1.84 dBm
Directivity	4.38 dBi
Efficiency	-2.53 dB
Efficiency	55.79%
Gain	1.84 dBi



### 2.6.3 Wire Antennas (2.40 GHz)

**Table 33. 2.4-GHz PCB Antennas**

	2.4 GHz Kit Antenna
Full CTIA Report	<a href="#">Section A.16.1</a>
Test Description	Test Result
Total Radiated Power	-1.66 dBm
Peak EIRP	2.11 dBm
Directivity	3.77 dBi
Efficiency	-1.66 dB
Efficiency	68.20%
Gain	2.11 dBi

### 2.6.4 Antenna Efficiency Summary (2.40 GHz)

First recommended choice of PCB antenna is the CC-Antenna-DK2 #11 (DN007) and second choice is CC-Antenna-DK2 #2 (AN043).

**Table 34. Total Radiated Power (TRP) (2.4 GHz)**

Ranking	Description	TRP Efficiency [%]	Comments
1 (RECOMMENDED)	CC-Antenna-DK2 #11	71%	DN007
2	Kit Antenna	68%	Pulse
3	CC-Antenna-DK2 #2	64%	AN043
4	CC-Antenna-DK2 #9	64%	Dual-band, DN024
5	CC-Antenna-DK2 #3	56%	Dual-band, Fractus
6	CC-Antenna-DK2 #2	55%	Single band, CR2032
7	CC-Antenna-DK2 #1	16%	Dual-band, CR2032

### 3 Conclusion

CC-Antenna-DK2 transmitted radiated power (TRP) efficiencies have been presented from >70% at 2.4 GHz to >20% at 169 MHz. The TRP efficiencies  $\leq$ 490 MHz are not in the region of the efficiencies presented at  $\geq$ 868 MHz. This is mainly due to the wavelength at the lower frequencies is much larger, see [Table 35](#). The height and width of a CC-Antenna-DK2 board is limited as in any normal hand-held device. The limitation of the board/GND size affects the efficiency especially at low frequencies.

**Table 35. Highest Recorded TRP Efficiencies [%]**

Frequency (MHz)	$\lambda / 4$ (cm)	Highest Recorded TRP Efficiency (%)
2440 MHz	3.1 cm	>70%
868 MHz	8.6 cm	>70%
490 MHz	15.3 cm	>35%
433 MHz	17.3 cm	>30%
169 MHz	44.4 cm	>20%

An antenna basically consists of two quarter-wave elements to form a dipole. A monopole antenna utilizes the GND plane for the field reflection of one quarter-wave element. All the antennas on the CC-Antenna-DK2 are monopole. Changing the size of the GND plane will affect the antenna since the field characteristics will also change. This applies for all monopole antennas regardless of type (for example, PCB, chip, wire stanced metal). To copy an antenna design, it is always recommended incorporating an antenna matching network as well that can be used if there is a resonance shift. This still applies even if 0 ohm resistors have been used on the reference design. The antenna match allows the mismatch to be minimized at the desired frequency even though the resonance frequency of the antenna structure will be similar.

All the antennas in the CC-Antenna-DK2 have been measured in free space. Positioning the antenna on/near an object (body, metal, certain plastic mixtures with high carbon content) will always load the antenna and will shift the frequency down. Using an antenna with a large bandwidth will help minimize the mismatch loss when the antenna is being loaded by an external object. If the bandwidth of the antenna is not sufficient, then the load seen by the radio will be outside the wanted VSWR: 2, which may cause degradation in the link budget and increase the current consumption.

Measuring the absolute efficiency of antennas in an EMC chamber is quite difficult. Specifying an absolute efficiency number is difficult when the sum of the tolerances in the chamber can be as large as  $\pm 3$  dB; this corresponds to 50% to 150% antenna efficiency. The EMC chamber is regularly calibrated and the absolute calibration level can therefore change. This can make it difficult to compare measurements taken with different calibration factors; that is, direct comparison of CC-Antenna-DK1 and CC-Antenna-DK2 results. Previously with CC-Antenna-DK1, the efficiencies presented at 2.4 GHz were in the >80% region but now are in the >70% region. 10% difference can sound significant at 2.4 GHz but this corresponds to 0.5 dB difference. All the antennas in the CC-Antenna-DK2 have been measured with the same configuration and at the same time so the relative efficiency comparison is correct even though the absolute level can be discussed.

When calculating an expected range in the excel sheet [\[6\]](#) or a link budget, the antenna performance is related to the board size so a realistic antenna efficiency has to be used in the calculation, that is, using a board size that is significantly smaller than a quarter-wave of the antenna frequency will have significantly reduced performance.

All antenna documentation can be selected via the *Antenna Selection Quick Guide* [\[2\]](#), which is one A4 sheet that contains a summarized overview of all the antenna with hyperlinks for additional documentation such as the *Comprehensive Antenna Selection Guide* [\[3\]](#). There is no one antenna that fits all applications but hopefully the CC-Antenna-DK2 will help in determining which antenna type should be the best solution for your application.

#### 4 References

1. *CC-Antenna-DK2 Reference Design* (SWRC314)
2. *Antenna Selection Quick Guide* ([SWRA351](#))
3. *Comprehensive Antenna Selection Guide* ([SWRA161](#))
4. *CC-Antenna-DK and Antenna Measurements Summary* ([SWRA328](#))
5. *CC-Antenna-DK Reference Design* ([SWRR070](#))
6. Excel sheet to estimate range for Indoor and Outdoor  
([https://e2e.ti.com/support/wireless\\_connectivity/proprietary\\_sub\\_1\\_ghz\\_simplici/f/156/t/375556](https://e2e.ti.com/support/wireless_connectivity/proprietary_sub_1_ghz_simplici/f/156/t/375556))

## **CTIA Measurement Reports**

The Near Horizon Partial Radiated Power (NHPRP) is specified for 45° (NHPRP45), 30° (NHPRP30), or 22.5° (NHPRP22.5).

### **A.1 Board #1: CR2032 Dual-Band 868 MHz and 2.4 GHz PCB Antenna**

#### **A.1.1 Single Band of 2.4 GHz**

##### **A.1.1.1 2.40 GHz**

**Table 36. Board #1: OTA Evaluation Results (Single Band 2.40 GHz)**

<b>Test Description</b>	<b>Test Result</b>
Total Radiated Power	-2.64 dBm
Peak EIRP	2.58 dBm
Directivity	5.22 dBi
Efficiency	-2.64 dB
Efficiency	54.50%
Peak Gain	2.58 dBi
NHPRP 45°	-5.06 dBm
NHPRP 45° / TRP	-2.43 dB
NHPRP 45° / TRP	57.18%
NHPRP 30°	-7.04 dBm
NHPRP 30° / TRP	-4.40 dB
NHPRP 30° / TRP	36.28%
NHPRP 22.5°	-8.27 dBm
NHPRP 22.5° / TRP	-5.64 dB
NHPRP 22.5° / TRP	27.32%
UHRP	-5.77 dBm
UHRP / TRP	-3.13 dB
UHRP / TRP	48.62%
LHRP	-5.53 dBm
LHRP / TRP	-2.89 dB
LHRP / TRP	51.38%
PGRP (0-120°)	-4.41 dBm
PGRP / TRP	-1.77 dB
PGRP / TRP	66.49%
Front/Back Ratio	4.95
PhiBW	360.0°
PhiBW Up	360.0°
PhiBW Down	360.0°
ThetaBW	32.9°
ThetaBW Up	22.7°

**Table 36. Board #1: OTA Evaluation Results (Single Band 2.40 GHz) (continued)**

Test Description	Test Result
ThetaBW Down	10.2°
Boresight Phi	150°
Boresight Theta	180°
Maximum Power	2.58 dBm
Minimum Power	-16.67 dBm
Average Power	-1.82 dBm
Max/Min Ratio	19.25 dB
Max/Avg Ratio	4.40 dB
Min/Avg Ratio	-14.85 dB
Worst Single Value	-22.76 dBm
Worst Position	Azi = 15°; Elev = 75°; Pol = Horizontal
Best Single Value	2.23 dBm
Best Position	Azi = 165°; Elev = 180°; Pol = Vertical

**Table 37. Board #1: RP\_2400.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-2.29	-1.19	1.18	-0.49	0.29	-0.93	-0.39	-0.42	0.29	1.24	2.03	-2.21	0.85
15	-2.58	-1.7	0.56	0.1	-0.68	-0.61	0.17	-0.07	-0.4	0.28	2	-3.51	1.11
30	-2.52	-1.61	-0.86	-0.89	-3.02	-3.3	-2	-2.79	-5.07	-0.42	1	-3.59	0.97
45	-2.49	-1.37	-1.15	-3.08	-4.36	-9.37	-8.39	-6.01	-4.35	-2.22	1.26	-3.87	0.72
60	-2.69	-1.5	-0.96	-3.01	-5.73	-7.49	-8.42	-6.8	-4.53	-0.93	2.19	-4.81	0.59
75	-2.82	-1.62	-1.37	-2.55	-7.22	-10.23	-9.49	-4.86	-5.39	-0.54	2.16	-4.89	0.35
90	-2.74	-2.32	-1.79	-2.74	-7.38	-15.05	-10.53	-6.35	-4.53	-1.41	1.51	-3.98	0.85
105	-3.37	-3.49	-2.08	-3.09	-7.6	-16.67	-10.48	-8.78	-3.09	-2.66	1.24	-3.5	1.83
120	-3.93	-3.68	-1.47	-2.88	-8.83	-15.3	-9.36	-11.19	-1.74	-2.99	1.33	-2.66	2.06
135	-3.88	-2.66	-1.4	-1.27	-5.25	-6.5	-3.78	-6.22	-1.07	-1.99	0.95	-2.12	2.4
150	-3.88	-2.27	-2.68	-0.44	-4.02	-2.62	-2.19	-1.97	-4.06	-2.04	0.18	-1.83	2.58
165	-4.42	-3.11	-3.35	-1.75	-7.2	-3.54	-5.04	-3.74	-8.3	-5.62	-0.18	-2.05	2.53
180	-4.88	-4.34	-0.82	-3.8	-1.44	-5.84	-1.05	-5.32	-4.04	-5.83	-0.11	-2.6	2.03
195	-4.87	-4.43	1.46	-0.16	1.45	-0.7	1.49	-0.23	-4.24	-0.57	1.13	-4.56	0.88
210	-4.61	-3.13	1.83	1.47	-0.71	-0.33	-1.71	-2.26	-3.46	-0.07	1.94	-6.55	-0.31
225	-4.77	-1.86	1.08	-0.58	-2.55	-5.56	-4.33	-5.18	-4.98	-2.65	0.82	-5.23	-0.36
240	-4.62	-1.81	0.33	-4.46	-3.58	-6.43	-3.64	-6.29	-5.66	-3.5	-1.6	-2.85	0.24
255	-4.14	-2.76	-0.59	-5.08	-5.04	-3.96	-6.48	-8.38	-3.23	-3.53	-3.31	-1.5	0.62
270	-3.33	-3.02	-1.27	-4.58	-5.28	-5.18	-9.42	-10.07	-2.91	-5.2	-2.77	-0.23	1.21
285	-3.09	-3.36	-1.26	-4.1	-3.94	-8.41	-8.84	-12.28	-4.84	-5.86	-2.32	0.81	1.5
300	-3.28	-3.75	-1.22	-3.7	-2.52	-7.11	-6.06	-10.34	-5.47	-4.54	-1.79	0.93	1.42
315	-2.66	-2.97	-0.55	-3.27	-2.61	-4.36	-4.39	-6.34	-5.71	-2.57	-1.09	0.59	1.39
330	-2.36	-2.62	0.12	-2.42	-4.41	-3.28	-5.07	-5.59	-4.58	-0.2	-0.79	-0.03	1.06
345	-2.31	-1.95	0.36	-1.01	-2.9	-4.38	-3.75	-6.45	-2.44	1.55	-0.38	-0.75	0.76
360	-2.29	-1.19	1.18	-0.49	0.29	-0.93	-0.39	-0.42	0.29	1.24	2.03	-2.21	0.85

**Table 38. Board #1: RP\_2400.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-15.2	-15.07	-18.08	-21.3	-18.08	-15.13	-21.18	-20.03	-20.32	-16.42	-18.97	-11.54	-20.91
15	-20.52	-13.25	-12.75	-18.94	-17.65	-22.76	-16.89	-12.61	-21.04	-9.46	-13.01	-8.15	-12.82
30	-13.61	-6.83	-7.18	-12.22	-13.55	-17.06	-21.77	-11.24	-9.12	-5.34	-4	-6.01	-6.2
45	-8.78	-3.99	-4.12	-7.68	-11.81	-16.95	-17.16	-15.32	-5.22	-2.73	0.63	-4.98	-2.36
60	-6.78	-2.91	-2.55	-5.44	-10.26	-18.51	-17.47	-16.59	-5.6	-1.37	2.16	-5.15	-0.55
75	-5	-2.04	-1.98	-4.7	-9.04	-22.33	-21.04	-13.28	-6.66	-1.65	1.97	-5.24	0.14
90	-3.71	-2.38	-2.22	-3.91	-8.73	-21.8	-15.66	-10.81	-6.03	-3.12	0.73	-5.65	0.72
105	-3.79	-4.15	-3.16	-3.66	-9.06	-21.74	-12.26	-10.89	-4.89	-5.66	-1.53	-8.91	0.77
120	-4.64	-6.9	-4.45	-4.7	-10.24	-19.86	-11.8	-12.61	-5.1	-10.67	-4.66	-12.33	-0.38
135	-5.66	-9.25	-8.98	-8.21	-13.6	-16.35	-12.03	-17.4	-7.92	-13.58	-6.91	-16.24	-1.98
150	-7	-8.84	-20.74	-15.6	-21.94	-13.8	-12.37	-18	-17	-9.76	-4	-16.24	-4.43
165	-9.05	-9.17	-10.39	-10.7	-12.18	-14.25	-16.53	-11.55	-11.25	-10.39	-2.45	-12.22	-9.31
180	-11.74	-12.57	-8.97	-9.57	-9.87	-14.08	-18.65	-12.99	-10.04	-15.43	-5.28	-11.45	-18.9
195	-13.37	-19.28	-15.46	-9.77	-11.13	-12.12	-13.45	-21.92	-22.51	-18.72	-12.4	-15.35	-12.44
210	-11.84	-13.29	-12.32	-6.73	-8.24	-11.99	-18	-11.02	-11.2	-8.24	-5.35	-19.52	-6.14
225	-9.91	-7.87	-3.84	-5.6	-4.81	-21.76	-12.82	-10.71	-9.33	-4.74	-2.58	-8.08	-2.58
240	-7.41	-5.9	-1.06	-6.13	-6.13	-15.21	-8.6	-12.09	-6.93	-4.01	-2.79	-4.01	-0.59
255	-5.18	-5.2	-0.8	-5.58	-7.22	-9.83	-8.72	-12.49	-4.49	-4.4	-3.72	-2.02	0.46
270	-3.62	-4.08	-1.35	-4.87	-5.63	-9.24	-9.79	-12.84	-4.16	-5.89	-4.7	-0.43	1.11
285	-3.23	-3.74	-1.75	-5	-5.08	-8.75	-11.29	-13.59	-5.21	-6.87	-6.57	0.13	0.83
300	-3.96	-4.4	-2.57	-6.29	-6	-10.36	-12.46	-14.97	-5.76	-8.18	-9.02	-0.67	-0.19
315	-4.66	-5.25	-2.84	-8.04	-9.87	-13.85	-12.16	-16.14	-6.82	-8.61	-10.68	-2.55	-1.88
330	-6.01	-7.08	-3.99	-10.97	-17.78	-18.36	-11.95	-15.32	-7.63	-8.63	-11.2	-5.66	-4.44
345	-8.64	-8.86	-6.74	-12.61	-13.69	-19.88	-13.85	-18.15	-10.25	-10.81	-11.41	-8.16	-8.66
360	-15.2	-15.07	-18.08	-21.3	-18.08	-15.13	-21.18	-20.03	-20.32	-16.42	-18.97	-11.54	-20.91

**Table 39. Board #1: RP\_2400.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-2.52	-1.37	1.13	-0.53	0.23	-1.1	-0.42	-0.47	0.25	1.16	2	-2.74	0.82
15	-2.65	-2.02	0.35	0.04	-0.77	-0.64	0.08	-0.32	-0.44	-0.21	1.86	-5.33	0.93
30	-2.87	-3.17	-2.02	-1.22	-3.43	-3.49	-2.04	-3.46	-7.24	-2.1	-0.66	-7.28	0.04
45	-3.65	-4.82	-4.19	-4.92	-5.23	-10.2	-9.01	-6.55	-11.75	-11.79	-7.4	-10.33	-2.22
60	-4.83	-7.08	-6.09	-6.68	-7.61	-7.85	-8.99	-7.29	-11.11	-11.15	-20.05	-16.13	-5.76
75	-6.86	-11.91	-10.24	-6.64	-11.87	-10.51	-9.8	-5.54	-11.35	-7	-11.6	-16.03	-12.97
90	-9.74	-20.54	-11.99	-9.01	-13.13	-16.08	-12.12	-8.27	-9.86	-6.28	-6.33	-8.95	-14.33
105	-13.74	-12.03	-8.64	-12.2	-13.05	-18.28	-15.22	-12.93	-7.77	-5.67	-2.02	-4.98	-4.8
120	-12.17	-6.49	-4.5	-7.54	-14.4	-17.17	-13.02	-16.74	-4.43	-3.81	0.07	-3.16	-1.6
135	-8.61	-3.74	-2.23	-2.25	-5.94	-6.98	-4.48	-6.56	-2.08	-2.3	0.17	-2.29	0.43
150	-6.78	-3.35	-2.75	-0.58	-4.09	-2.97	-2.62	-2.08	-4.29	-2.85	-1.9	-1.99	1.62
165	-6.25	-4.35	-4.31	-2.35	-8.85	-3.92	-5.36	-4.53	-11.38	-7.38	-4.08	-2.49	2.23
180	-5.88	-5.04	-1.54	-5.13	-2.11	-6.54	-1.12	-6.13	-5.3	-6.33	-1.69	-3.21	1.99
195	-5.53	-4.57	1.37	-0.66	1.21	-1.03	1.35	-0.26	-4.31	-0.64	0.93	-4.94	0.67
210	-5.51	-3.58	1.65	0.76	-1.56	-0.63	-1.81	-2.88	-4.26	-0.79	1.04	-6.78	-1.62
225	-6.35	-3.12	-0.6	-2.22	-6.47	-5.67	-4.99	-6.61	-6.97	-6.82	-1.84	-8.4	-4.33
240	-7.87	-3.96	-5.3	-9.41	-7.11	-7.04	-5.3	-7.62	-11.62	-13.07	-7.78	-9.17	-7.36
255	-10.83	-6.43	-13.81	-14.74	-9.09	-5.26	-10.41	-10.51	-9.22	-10.95	-13.76	-10.97	-13.75
270	-15.24	-9.68	-18.59	-16.44	-16.49	-7.34	-20.19	-13.33	-8.95	-13.52	-7.23	-13.72	-15.15
285	-18.07	-14.19	-10.95	-11.37	-10.33	-19.68	-12.5	-18.1	-15.79	-12.68	-4.37	-7.56	-6.96
300	-11.66	-12.32	-6.94	-7.18	-5.1	-9.9	-7.19	-12.17	-17.31	-7.01	-2.7	-4.2	-3.65
315	-6.99	-6.86	-4.43	-5.03	-3.51	-4.88	-5.19	-6.82	-12.17	-3.81	-1.6	-2.29	-1.37
330	-4.82	-4.55	-2.01	-3.07	-4.62	-3.41	-6.07	-6.08	-7.55	-0.87	-1.21	-1.42	-0.37
345	-3.46	-2.94	-0.58	-1.32	-3.28	-4.5	-4.19	-6.75	-3.23	1.29	-0.74	-1.63	0.24
360	-2.52	-1.37	1.13	-0.53	0.23	-1.1	-0.42	-0.47	0.25	1.16	2	-2.74	0.82



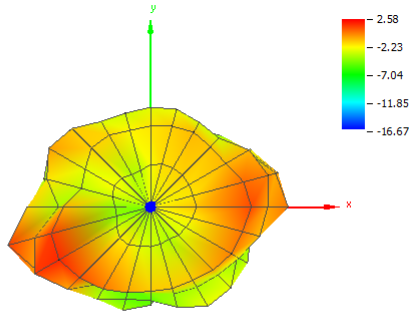


Figure 58. Board #1 (Single Band 2.40 GHz): Theta = 0, Phi = 0

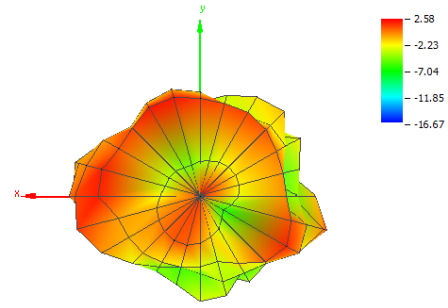


Figure 59. Board #1 (Single Band 2.40 GHz): Theta = 180, Phi = 0

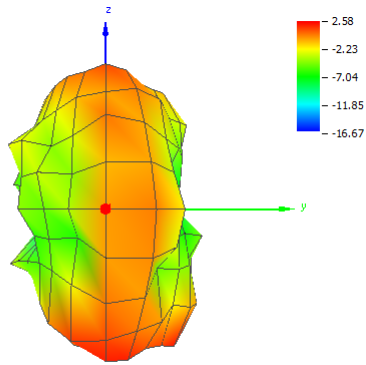


Figure 60. Board #1 (Single Band 2.40 GHz): Theta = 90, Phi = 0

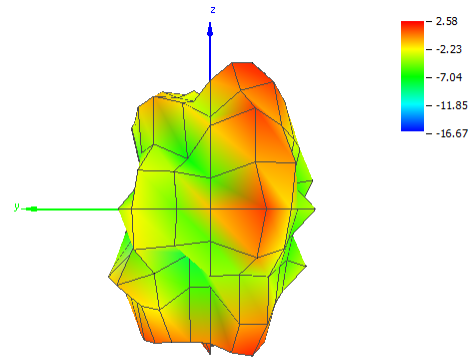


Figure 61. Board #1 (Single Band 2.40 GHz): Theta = 90, Phi = 180

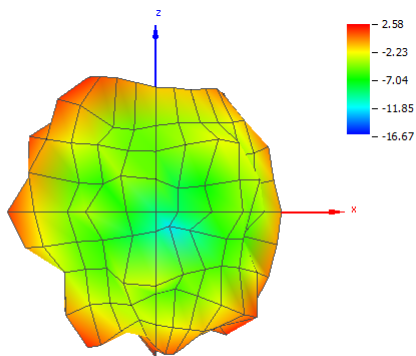


Figure 62. Board #1 (Single Band 2.40 GHz): Theta = 90, Phi = 270

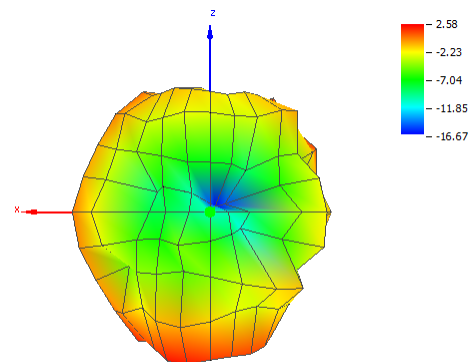


Figure 63. Board #1 (Single Band 2.40 GHz): Theta = 90, Phi = 90

**A.1.1.2 2.44 GHz**
**Table 40. Board #1: OTA Evaluation Results (Single Band 2.44 GHz)**

Test Description	Test Result
Total Radiated Power	-3.35 dBm
Peak EIRP	2.63 dBm
Directivity	5.97 dBi
Efficiency	-3.35 dB
Efficiency	46.28%
Peak Gain	2.63 dBi
NHPRP 45°	-5.83 dBm
NHPRP 45° / TRP	-2.48 dB
NHPRP 45° / TRP	56.45%
NHPRP 30°	-7.74 dBm
NHPRP 30° / TRP	-4.39 dB
NHPRP 30° / TRP	36.38%
NHPRP 22.5°	-9.00 dBm
NHPRP 22.5° / TRP	-5.65 dB
NHPRP 22.5° / TRP	27.21%
UHRP	-6.96 dBm
UHRP / TRP	-3.61 dB
UHRP / TRP	43.54%
LHRP	-5.83 dBm
LHRP / TRP	-2.48 dB
LHRP / TRP	56.46%
PGRP (0-120°)	-5.36 dBm
PGRP / TRP	-2.01 dB
PGRP / TRP	62.94%
Front/Back Ratio	5.33
PhiBW	171.9°
PhiBW Up	127.3°
PhiBW Down	44.7°
ThetaBW	22.0°
ThetaBW Up	7.6°
ThetaBW Down	14.4°
Boresight Phi	15°
Boresight Theta	150°
Maximum Power	2.63 dBm
Minimum Power	-13.00 dBm
Average Power	-2.24 dBm
Max/Min Ratio	15.62 dB
Max/Avg Ratio	4.87 dB
Min/Avg Ratio	-10.76 dB
Worst Single Value	-21.95 dBm
Worst Position	Azi = 150°; Elev = 105 deg; Pol = Horizontal
Best Single Value	2.49 dBm
Best Position	Azi = 0°; Elev = 150°; Pol = Vertical

**Table 41. Board #1: RP\_2440.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-1.34	-4.03	-2.51	-2.25	-2.41	-3.99	-1.84	0.03	0.21	-0.17	2.54	-2.51	0.76
15	-0.74	-3.11	-2.06	-1.65	-3.48	-2.8	-3.23	-0.37	-0.05	-0.5	2.63	-3.26	0.48
30	-0.49	-1.29	-1.04	-0.9	-3.78	-3.47	-3.92	-4.33	-5.8	-1.47	1.7	-3.56	0.46
45	-0.88	-0.59	-0.52	-1.58	-3	-6.73	-8.81	-5.25	-6.14	-2.42	1.29	-4.16	1.22
60	-1.67	-0.88	-1.01	-2.47	-3.96	-7.22	-9.84	-7.62	-5.08	-2.8	1.51	-4.57	1.34
75	-2.17	-1.15	-1.67	-2.54	-5.5	-8.45	-8.47	-7.09	-6.72	-2.01	0.95	-5.23	0.91
90	-1.97	-1.04	-1.74	-2.45	-5.4	-9.91	-9.13	-5.64	-6.67	-2.41	0.7	-6.04	1.41
105	-2.1	-0.94	-0.97	-2.95	-5.32	-12.46	-12.94	-6.26	-5.6	-3.8	0.95	-5.49	1.69
120	-2.02	-0.82	-0.65	-2.48	-4.96	-12.06	-12.61	-9.6	-3.6	-3.65	1.11	-4.25	1.28
135	-1.86	-1.35	-1.24	-1.95	-4.22	-6.75	-6.23	-6.95	-2.12	-2.2	0.26	-3.01	1.36
150	-1.69	-1.93	-3.21	-1.25	-5.78	-3.22	-3.97	-3.76	-4.67	-2.01	-1.04	-1.94	1.78
165	-1.08	-2.56	-4.18	-2.92	-7.91	-3.96	-7.59	-5.25	-8.33	-5.73	-1.6	-1.6	1.68
180	-1.04	-3.98	-2.84	-5.56	-2	-6.92	-3.1	-6.02	-3.78	-5.57	-0.72	-2.67	1.07
195	-1.46	-4.58	-2.7	-0.9	-0.79	-1.27	0.85	0.41	-2.98	-1.08	1.11	-4.57	0.57
210	-1.78	-3.34	-2.26	-0.27	-1.66	-0.89	-1.89	-0.56	-2.66	-0.91	2.17	-5.46	0.67
225	-1.83	-2.68	-2.36	-4.2	-4.2	-6.37	-3.16	-2.47	-5.09	-2.37	1.52	-3.39	0.43
240	-2.01	-2.91	-3.63	-9.26	-5.81	-5.51	-2.82	-3.9	-4.82	-2.1	-0.46	-1.51	0.44
255	-2.5	-3.58	-4.96	-7	-7.43	-5.3	-6.54	-5.51	-4.85	-2.93	-1.26	-0.54	0.32
270	-2.68	-4.78	-5.72	-6.94	-7.69	-8.11	-11.88	-8.2	-6.15	-4.88	-0.78	0.02	0.48
285	-1.97	-4.79	-5.21	-8.06	-6.01	-12.59	-12.59	-13	-6.97	-5.73	-0.51	0.41	1.29
300	-1.07	-4.46	-4.33	-7.7	-4.53	-10.41	-7.19	-9.33	-7.61	-4.06	-1.16	0.7	1.23
315	-1.34	-5.17	-3.66	-6.04	-3.82	-7.1	-5.19	-5.69	-6.58	-2.47	-1.36	0.34	1.22
330	-1.22	-4.9	-3.18	-4.58	-4.63	-6.15	-7.37	-5.52	-6.19	-1.17	-0.39	-0.22	1.09
345	-1.5	-4.23	-2.92	-2.89	-5.11	-4.52	-5.92	-6.09	-4.62	0.31	0.58	-0.45	0.73
360	-1.34	-4.03	-2.51	-2.25	-2.41	-3.99	-1.84	0.03	0.21	-0.17	2.54	-2.51	0.76

**Table 42. Board #1: RP\_2440.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-18.76	-21.82	-21.76	-15.66	-21.03	-16.62	-18.08	-19.52	-20.4	-13.69	-17.1	-12.42	-16.8
15	-18.45	-13.38	-14.89	-12.32	-18.43	-20.07	-19.9	-14.38	-20.5	-10.85	-11.75	-9.31	-9.78
30	-9.88	-7.2	-7.42	-9.08	-12.01	-17.62	-17.18	-14.46	-12.38	-6.86	-3.28	-6.74	-4.58
45	-6.23	-3.79	-3.51	-5.4	-10.07	-13.3	-18.05	-11.62	-7.97	-4.41	0.38	-5.66	-1.53
60	-4.29	-2.06	-2.17	-3.9	-8.44	-14.01	-17.09	-15.08	-6.74	-2.91	1.38	-5.16	-0.1
75	-2.82	-1.3	-2.05	-3.4	-7.87	-17.15	-18.88	-14.16	-8.26	-3.11	0.83	-5.41	0.55
90	-2.06	-1.3	-2.28	-3.13	-7.58	-17.37	-18.25	-13.17	-8.45	-4.14	-0.17	-7.16	1.24
105	-2.79	-2.51	-2.6	-3.53	-8.07	-16.08	-18.39	-13.11	-7.32	-6.38	-1.74	-9.27	1
120	-4.14	-4.67	-4.66	-4	-8.64	-17.33	-15.74	-12.97	-6.71	-10.05	-4.87	-12.14	-0.19
135	-4.93	-7.69	-8.31	-7.85	-10.52	-20.96	-12.01	-15.25	-8.46	-15.33	-9.34	-17.92	-2.06
150	-6.44	-9.31	-12.38	-16.15	-20.63	-13.33	-11.21	-21.95	-16.82	-10.28	-5.83	-13.06	-4.88
165	-9.38	-10.73	-9.93	-11.91	-12.36	-11.29	-13.99	-14.12	-11.07	-9.47	-3.63	-10.4	-9.56
180	-14.43	-15.73	-9.7	-12.87	-8.83	-14.5	-21.68	-13.88	-10.75	-14.11	-6.14	-10.78	-18.75
195	-17.29	-17.23	-18.03	-9.14	-9.93	-11.35	-14.79	-21.05	-21.42	-19.78	-14.21	-15.48	-13.17
210	-12.26	-9.36	-11.01	-7.9	-6.48	-15.69	-20.2	-11.57	-10.51	-7.35	-5.46	-16.5	-6.59
225	-7.86	-6.03	-6.11	-9.75	-6.76	-20.95	-13.55	-11.42	-7.8	-3.27	-2.04	-7.22	-2.87
240	-4.97	-4.59	-5.08	-12.13	-9.05	-12.85	-11.92	-13.07	-5.88	-2.73	-1.42	-2.77	-0.77
255	-3.61	-4.24	-5.35	-11.17	-11.31	-12.58	-13.67	-13.37	-6.13	-3.96	-1.6	-0.85	-0.05
270	-3.01	-5.4	-6.53	-10.33	-8.86	-14.36	-15.79	-14.59	-7.53	-5.54	-2.03	-0.12	0.29
285	-2.07	-5.93	-7.31	-10.06	-7.35	-16.22	-15.5	-15.41	-7.91	-7.36	-3.12	-0.02	0.76
300	-1.47	-6.05	-8.64	-10.16	-8.31	-16.87	-16.71	-16.59	-8.52	-8.1	-4.98	-0.54	-0.01
315	-2.47	-7.52	-9.58	-11.43	-11.13	-18.87	-17.54	-19.25	-9.32	-8.63	-7.08	-2.17	-1.57
330	-4.58	-9.37	-9.87	-13.98	-17.65	-18.66	-18.7	-21.56	-11.15	-9.47	-8.75	-5.02	-3.92
345	-8.41	-12.41	-13.2	-18.05	-17.65	-17.53	-19.49	-21.23	-13.95	-9.92	-10.4	-7.87	-7.91
360	-18.76	-21.82	-21.76	-15.66	-21.03	-16.62	-18.08	-19.52	-20.4	-13.69	-17.1	-12.42	-16.8

**Table 43. Board #1: RP\_2440.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-1.42	-4.1	-2.57	-2.45	-2.47	-4.24	-1.95	-0.02	0.17	-0.37	2.49	-2.97	0.69
15	-0.82	-3.54	-2.3	-2.04	-3.62	-2.89	-3.32	-0.55	-0.09	-0.92	2.47	-4.5	0.06
30	-1.02	-2.58	-2.18	-1.61	-4.49	-3.65	-4.13	-4.78	-6.88	-2.95	0.04	-6.41	-1.18
45	-2.38	-3.42	-3.55	-3.91	-3.95	-7.81	-9.36	-6.4	-10.76	-6.77	-5.94	-9.5	-2.08
60	-5.1	-7.1	-7.32	-7.97	-5.87	-8.24	-10.75	-8.48	-10.05	-18.57	-14.07	-13.58	-4.16
75	-10.74	-15.83	-12.37	-9.99	-9.26	-9.07	-8.88	-8.04	-11.98	-8.5	-14.59	-19.23	-10.12
90	-19.08	-13.39	-11.01	-10.85	-9.43	-10.77	-9.7	-6.49	-11.4	-7.24	-6.72	-12.5	-12.65
105	-10.46	-6.12	-6.01	-12.02	-8.62	-14.93	-14.4	-7.26	-10.46	-7.3	-2.4	-7.84	-6.63
120	-6.15	-3.12	-2.85	-7.75	-7.39	-13.59	-15.49	-12.27	-6.52	-4.78	-0.16	-5.03	-4.16
135	-4.82	-2.5	-2.19	-3.24	-5.38	-6.92	-7.56	-7.64	-3.27	-2.42	-0.24	-3.15	-1.29
150	-3.46	-2.8	-3.77	-1.4	-5.93	-3.67	-4.88	-3.83	-4.94	-2.71	-2.8	-2.29	0.73
165	-1.78	-3.28	-5.53	-3.51	-9.84	-4.85	-8.72	-5.86	-11.62	-8.11	-5.88	-2.21	1.34
180	-1.25	-4.28	-3.85	-6.45	-3.01	-7.76	-3.16	-6.79	-4.76	-6.23	-2.19	-3.4	1.02
195	-1.57	-4.82	-2.83	-1.6	-1.35	-1.72	0.73	0.38	-3.05	-1.14	0.98	-4.94	0.38
210	-2.18	-4.59	-2.88	-1.09	-3.4	-1.03	-1.96	-0.92	-3.44	-2.03	1.34	-5.81	-0.24
225	-3.08	-5.38	-4.75	-5.62	-7.7	-6.52	-3.57	-3.06	-8.42	-9.63	-1	-5.71	-2.31
240	-5.06	-7.84	-9.1	-12.41	-8.59	-6.39	-3.38	-4.46	-11.47	-10.8	-7.48	-7.51	-5.68
255	-8.96	-12.08	-15.65	-9.09	-9.72	-6.21	-7.47	-6.28	-10.77	-9.72	-12.46	-12.18	-10.51
270	-14.07	-13.53	-13.43	-9.61	-13.95	-9.28	-14.14	-9.33	-11.82	-13.39	-6.81	-15.19	-13.09
285	-18.13	-11.18	-9.38	-12.38	-11.76	-15.06	-15.7	-16.7	-14.05	-10.78	-3.95	-9.84	-8.16
300	-11.72	-9.59	-6.34	-11.35	-6.89	-11.53	-7.71	-10.23	-14.84	-6.24	-3.5	-5.36	-4.83
315	-7.72	-8.97	-4.94	-7.53	-4.71	-7.4	-5.45	-5.89	-9.87	-3.67	-2.71	-3.24	-2.02
330	-3.9	-6.82	-4.23	-5.11	-4.86	-6.4	-7.7	-5.63	-7.86	-1.87	-1.08	-1.97	-0.56
345	-2.49	-4.95	-3.35	-3.03	-5.36	-4.74	-6.12	-6.23	-5.16	-0.12	0.22	-1.32	0.09
360	-1.42	-4.1	-2.57	-2.45	-2.47	-4.24	-1.95	-0.02	0.17	-0.37	2.49	-2.97	0.69

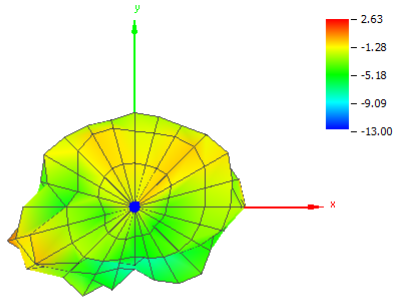


Figure 64. Board #1 (Single Band 2.44 GHz): Theta = 0, Phi = 0

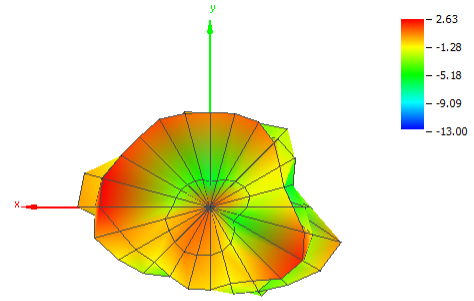


Figure 65. Board #1 (Single Band 2.44 GHz): Theta = 180, Phi = 0

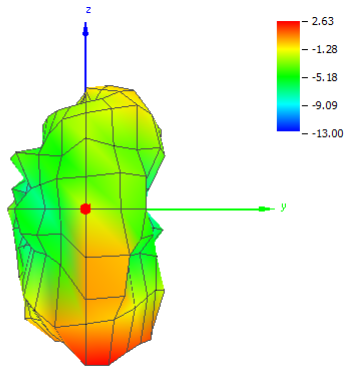


Figure 66. Board #1 (Single Band 2.44 GHz): Theta = 90, Phi = 0

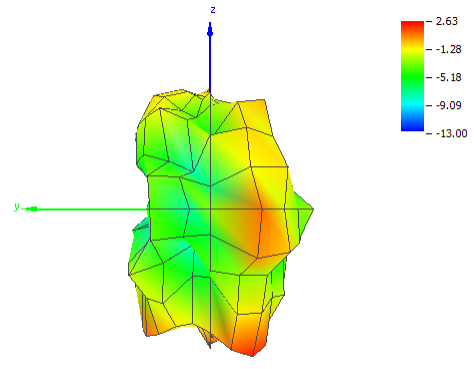


Figure 67. Board #1 (Single Band 2.44 GHz): Theta = 90, Phi = 180

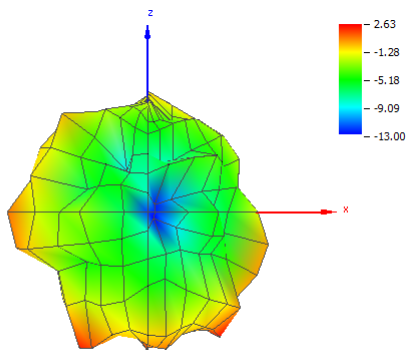


Figure 68. Board #1 (Single Band 2.44 GHz): Theta = 90, Phi = 270

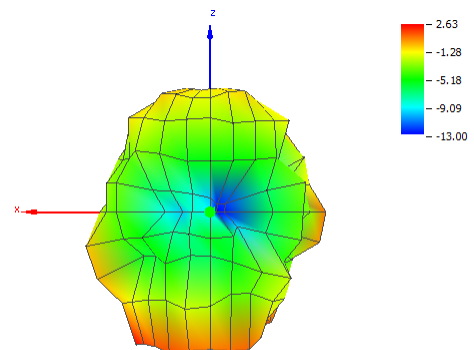


Figure 69. Board #1 (Single Band 2.44 GHz): Theta = 90, Phi = 90

**A.1.1.3 2.48 GHz**
**Table 44. Board #1: OTA Evaluation Results (Single Band 2.48 GHz)**

Test Description	Test Result
Total Radiated Power	-3.81 dBm
Peak EIRP	1.80 dBm
Directivity	5.61 dBi
Efficiency	-3.81 dB
Efficiency	41.55%
Peak Gain	1.80 dBi
NHPRP 45°	-6.34 dBm
NHPRP 45° / TRP	-2.52 dB
NHPRP 45° / TRP	55.92%
NHPRP 30°	-8.34 dBm
NHPRP 30° / TRP	-4.53 dB
NHPRP 30° / TRP	35.26%
NHPRP 22.5°	-9.56 dBm
NHPRP 22.5° / TRP	-5.74 dB
NHPRP 22.5° / TRP	26.66%
UHRP	-6.71 dBm
UHRP / TRP	-2.89 dB
UHRP / TRP	51.37%
LHRP	-6.95 dBm
LHRP / TRP	-3.13 dB
LHRP / TRP	48.63%
PGRP (0-120°)	-5.48 dBm
PGRP / TRP	-1.66 dB
PGRP / TRP	68.17%
Front/Back Ratio	2.58
PhiBW	121.2°
PhiBW Up	77.5°
PhiBW Down	43.7°
ThetaBW	17.2°
ThetaBW Up	6.9°
ThetaBW Down	10.4°
Boresight Phi	15°
Boresight Theta	150°
Maximum Power	1.80 dBm
Minimum Power	-14.95 dBm
Average Power	-2.77 dBm
Max/Min Ratio	16.75 dB
Max/Avg Ratio	4.57 dB
Min/Avg Ratio	-12.18 dB
Worst Single Value	-22.06 dBm
Worst Position	Azi = 300°; Elev = 90 deg; Pol = Horizontal
Best Single Value	1.72 dBm
Best Position	Azi = 0°; Elev = 150°; Pol = Vertical

**Table 45. Board #1: RP\_2480.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-1.4	-1.37	-0.52	-0.01	-2.09	-4.07	-3.16	-3.67	-2.49	-1.5	1.77	-3.09	0.72
15	-1.29	-0.84	-0.12	0.28	-0.34	-2.41	-2.25	-2.92	-2	-2.54	1.8	-4.76	0.29
30	-1.74	-1.18	-0.99	-0.14	-2.38	-0.58	-1.74	-4.51	-4.57	-1.86	0.53	-6.72	0.12
45	-2.84	-2.35	-1.97	-0.74	-2.91	-3.8	-3.87	-5.95	-5.86	-1.51	-0.39	-7.74	0.14
60	-3.79	-3.03	-2.38	-2.94	-4.27	-7.34	-7.5	-9.27	-6.06	-2.43	-0.64	-8.68	-0.71
75	-3.54	-2.79	-2.5	-4.22	-7.79	-8.49	-7.6	-7.63	-8.51	-1.44	-0.85	-10.13	-1.21
90	-3.04	-2.59	-1.96	-4.47	-9.31	-12.47	-8.92	-6.75	-7.09	-1.51	-1.18	-10.13	-0.98
105	-2.46	-2.44	-1.24	-4.26	-8.36	-14.26	-12.09	-9.96	-5.01	-2.37	-1.32	-7.9	-1.24
120	-1.39	-2.21	-0.44	-3.65	-5.96	-13.19	-12.76	-9.82	-3.34	-2.51	-1.49	-6.71	-1.04
135	-0.72	-1.96	-0.4	-2.94	-3.54	-7.83	-5.41	-4.16	-3.5	-2.25	-2.06	-5.05	-0.77
150	-0.12	-1.7	-1.69	-1.86	-4.19	-3.41	-3.49	-2.12	-8.32	-3.55	-2.94	-3.73	-0.57
165	0.25	-2.07	-3.63	-2.45	-5.84	-4.43	-6.95	-5.82	-10.1	-8.48	-3.35	-3.8	-0.76
180	0.32	-2.63	-2.55	-3.82	-1.84	-6.79	-1.04	-3.57	-4.99	-4.51	-1.08	-5.16	-0.97
195	0.39	-1.5	-0.78	0.55	-1.21	-0.83	0.2	-1	-4.01	-0.49	1.21	-7.39	-0.96
210	0.22	0.19	-1.49	1.06	-3.59	-2.8	-5.31	-3.92	-4.24	-1.39	1.73	-6.68	-1.02
225	-0.53	0.2	-2.45	-2.12	-6.58	-11.32	-5.82	-5.02	-7.96	-4.06	0.37	-4.14	-1.42
240	-1.28	-1.04	-3.18	-4.72	-8.47	-6.42	-5.13	-5.61	-6.25	-3.67	-2.22	-2.44	-1.57
255	-1.83	-2.31	-3.51	-4.28	-7.55	-6.26	-8.09	-5.92	-6.18	-4.28	-3.26	-1.1	-1.45
270	-2.9	-3.25	-3.39	-4.72	-7.34	-10.34	-13.96	-7.97	-9.55	-6.38	-3.07	-0.78	-1.22
285	-3.17	-3.67	-3.04	-6.48	-7.87	-10.13	-14.95	-11.92	-10	-7.84	-3.12	-0.32	-0.59
300	-2.44	-3.4	-3.18	-7.3	-6.9	-9.77	-11.53	-14.17	-9.84	-7.52	-2.63	-0.46	0.21
315	-1.91	-2.86	-2.96	-6.29	-4.74	-8.27	-7.89	-10.8	-8.83	-5.66	-2.21	-0.32	0.61
330	-1.64	-2.56	-3.17	-4.86	-3.9	-6.24	-6.28	-9.32	-7.62	-3.38	-1.29	-0.65	0.82
345	-1.62	-2.29	-2.7	-3.04	-4.35	-4.53	-7.22	-9.15	-5.76	-1.31	-0.22	-0.78	0.78
360	-1.4	-1.37	-0.52	-0.01	-2.09	-4.07	-3.16	-3.67	-2.49	-1.5	1.77	-3.09	0.72



**Table 46. Board #1: RP\_2480.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-21.9	-20.4	-20.34	-15.46	-21.98	-19.21	-17.21	-16.37	-21.78	-16.76	-17.7	-17.27	-21.28
15	-14.76	-11.95	-14.52	-10.31	-18.63	-21.41	-19.71	-16.36	-21.24	-12.05	-12.51	-12.67	-12.43
30	-9.13	-7.6	-7.69	-7.87	-13.2	-15.5	-18.64	-16.03	-13.75	-7.34	-4.77	-10.43	-6.68
45	-6.84	-5.69	-5.08	-6.67	-11.2	-12.18	-14.56	-15.97	-7.46	-4.12	-1.89	-10.21	-4.09
60	-5.03	-3.99	-4.13	-6.66	-11.14	-14.13	-15.19	-18.82	-7.13	-2.58	-0.85	-10.35	-2.78
75	-3.72	-2.97	-3.41	-6.12	-11.78	-16.61	-18.11	-17.66	-9.04	-2.43	-0.95	-11.78	-1.64
90	-3.78	-3.2	-2.54	-5.96	-13.81	-17.25	-17.73	-17.13	-8.75	-3.12	-1.8	-13.28	-1.13
105	-4.21	-4.44	-2.65	-5.4	-15.14	-16.85	-16.98	-18.69	-7.83	-5.43	-3.61	-12.9	-1.57
120	-4.08	-6.73	-3.57	-5.61	-12.82	-16.64	-17.19	-19.43	-7.25	-9.63	-7.64	-16.77	-2.55
135	-5.39	-11.09	-6.06	-9.12	-12.62	-19.63	-17.71	-19.57	-8.38	-15.72	-10.98	-17.38	-4.27
150	-8.24	-13.1	-12.43	-19.38	-20.47	-16.28	-15.04	-17.2	-12.97	-13.17	-7.23	-13.11	-7.06
165	-11.85	-12.64	-15.74	-11.85	-13.51	-13.29	-15.71	-17.51	-17.73	-11.36	-5.9	-11.65	-12.36
180	-15.6	-15.96	-13.66	-15.57	-10.89	-14.97	-20.57	-19.38	-14.35	-13.51	-9.16	-13.01	-21.95
195	-13.85	-17.6	-21.43	-12.18	-11.38	-12.38	-19.82	-20.76	-20.29	-18.41	-13.08	-19.72	-13.28
210	-10.23	-8.66	-9.41	-6.38	-7.3	-16.15	-18.6	-14.81	-13.95	-8.9	-6.9	-14.32	-7.84
225	-7.54	-5.25	-4.59	-6.8	-8.3	-17.15	-15.7	-12.83	-10.18	-5.39	-4.03	-7.75	-4.87
240	-5.21	-3.69	-3.52	-8.1	-15.18	-12.2	-14.14	-13.17	-8.42	-5.08	-3.43	-3.84	-2.8
255	-3.93	-3.23	-3.73	-7.52	-14.06	-11.45	-15.58	-14.04	-9.03	-6.07	-4.07	-1.45	-1.77
270	-3.44	-3.49	-4.14	-6.58	-9.69	-12.54	-19.16	-15	-10.57	-7.83	-5.33	-0.86	-1.58
285	-3.54	-4.27	-5	-6.96	-8.55	-13.22	-22.03	-16.33	-13.23	-9.83	-5.86	-0.65	-1.7
300	-4.13	-5.39	-6.91	-8.57	-9	-13.1	-22.06	-17.83	-14.11	-10.92	-6.32	-1.79	-2.09
315	-5.45	-7.18	-9.07	-11.68	-11.18	-12.42	-21.97	-18.64	-14.05	-11.37	-8.26	-3.27	-3.45
330	-7.79	-10.19	-12.41	-15.79	-15.65	-13.16	-21.86	-20.61	-14.96	-10.28	-10.31	-5.95	-5.8
345	-11.3	-12.75	-13.71	-18.95	-17.94	-13.38	-21.81	-18.24	-15.37	-10.29	-11.34	-9.04	-9.34
360	-21.9	-20.4	-20.34	-15.46	-21.98	-19.21	-17.21	-16.37	-21.78	-16.76	-17.7	-17.27	-21.28

**Table 47. Board #1: RP\_2480.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-1.44	-1.43	-0.56	-0.13	-2.14	-4.21	-3.33	-3.91	-2.54	-1.64	1.72	-3.26	0.7
15	-1.49	-1.19	-0.28	-0.11	-0.4	-2.47	-2.33	-3.12	-2.05	-3.05	1.64	-5.53	0.05
30	-2.61	-2.3	-2.04	-0.95	-2.76	-0.72	-1.83	-4.83	-5.13	-3.31	-0.99	-9.13	-0.89
45	-5.04	-5.06	-4.88	-2.01	-3.61	-4.49	-4.26	-6.4	-10.98	-4.96	-5.74	-11.37	-1.92
60	-9.82	-10.06	-7.18	-5.34	-5.27	-8.36	-8.31	-9.78	-12.68	-17.33	-13.8	-13.64	-4.93
75	-17.64	-16.82	-9.72	-8.72	-10.01	-9.22	-8.01	-8.08	-17.89	-8.35	-17.69	-15.13	-11.39
90	-11.1	-11.41	-10.98	-9.84	-11.22	-14.22	-9.53	-7.17	-12.07	-6.62	-9.92	-12.99	-15.71
105	-7.25	-6.76	-6.82	-10.63	-9.38	-17.75	-13.8	-10.59	-8.23	-5.33	-5.2	-9.55	-12.62
120	-4.76	-4.11	-3.33	-8.04	-6.96	-15.79	-14.71	-10.33	-5.61	-3.44	-2.7	-7.16	-6.37
135	-2.53	-2.53	-1.77	-4.14	-4.11	-8.12	-5.67	-4.28	-5.21	-2.45	-2.66	-5.31	-3.34
150	-0.84	-2.03	-2.07	-1.93	-4.29	-3.64	-3.81	-2.26	-10.14	-4.05	-4.96	-4.27	-1.67
165	-0.02	-2.47	-3.91	-2.98	-6.66	-5.04	-7.57	-6.12	-10.93	-11.62	-6.87	-4.58	-1.07
180	0.21	-2.84	-2.9	-4.12	-2.42	-7.51	-1.09	-3.69	-5.53	-5.1	-1.82	-5.94	-1.01
195	0.22	-1.61	-0.82	0.31	-1.64	-1.14	0.16	-1.05	-4.11	-0.56	1.04	-7.65	-1.22
210	-0.19	-0.41	-2.26	0.19	-5.99	-3	-5.52	-4.29	-4.73	-2.23	1.08	-7.5	-2.04
225	-1.49	-1.27	-6.54	-3.92	-11.43	-12.63	-6.29	-5.8	-11.93	-9.83	-1.59	-6.63	-4.02
240	-3.53	-4.43	-14.41	-7.39	-9.51	-7.75	-5.72	-6.45	-10.3	-9.22	-8.36	-8.04	-7.64
255	-5.99	-9.49	-16.57	-7.06	-8.64	-7.83	-8.94	-6.65	-9.35	-8.99	-10.97	-12.2	-12.93
270	-12.25	-16.01	-11.39	-9.29	-11.12	-14.35	-15.53	-8.92	-16.33	-11.83	-7	-18.25	-12.17
285	-14.13	-12.56	-7.43	-16.31	-16.23	-13.07	-15.9	-13.87	-12.8	-12.19	-6.41	-11.67	-7.06
300	-7.36	-7.73	-5.57	-13.24	-11.07	-12.47	-11.94	-16.62	-11.88	-10.17	-5.05	-6.25	-3.65
315	-4.46	-4.86	-4.18	-7.77	-5.86	-10.38	-8.06	-11.58	-10.38	-7.02	-3.45	-3.39	-1.56
330	-2.84	-3.39	-3.72	-5.23	-4.21	-7.22	-6.4	-9.66	-8.51	-4.37	-1.87	-2.17	-0.24
345	-2.11	-2.7	-3.06	-3.16	-4.55	-5.13	-7.38	-9.72	-6.27	-1.89	-0.56	-1.48	0.34
360	-1.44	-1.43	-0.56	-0.13	-2.14	-4.21	-3.33	-3.91	-2.54	-1.64	1.72	-3.26	0.7

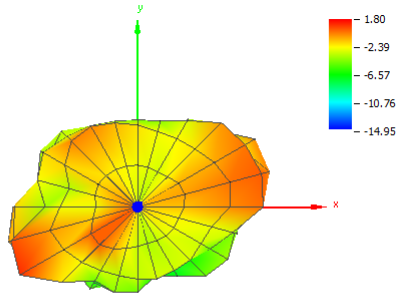


Figure 70. Board #1 (Single Band 2.48 GHz): Theta = 0, Phi = 0

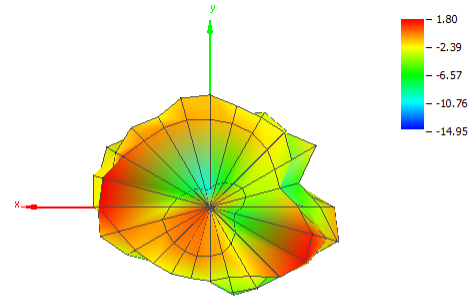


Figure 71. Board #1 (Single Band 2.48 GHz): Theta = 180, Phi = 0

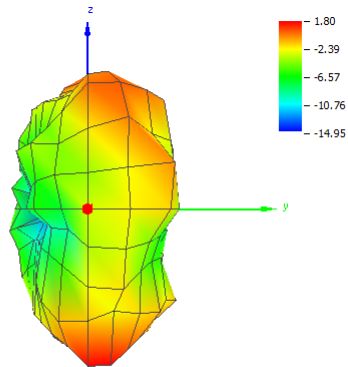


Figure 72. Board #1 (Single Band 2.48 GHz): Theta = 90, Phi = 0

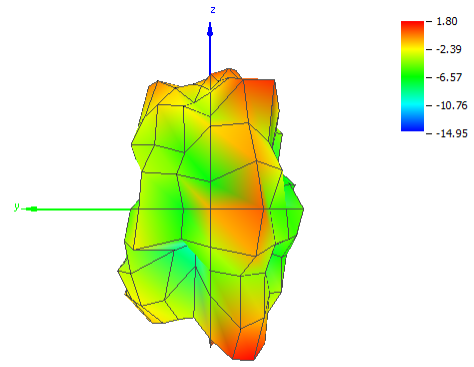


Figure 73. Board #1 (Single Band 2.48 GHz): Theta = 90, Phi = 180

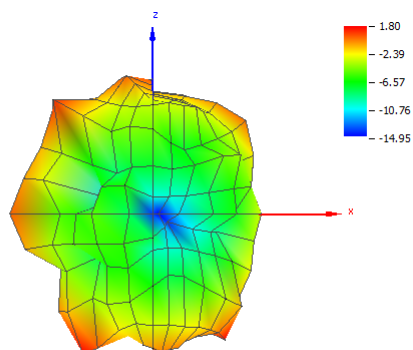


Figure 74. Board #1 (Single Band 2.48 GHz): Theta = 90, Phi = 270

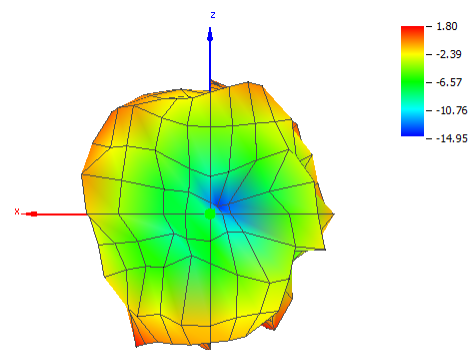


Figure 75. Board #1 (Single Band 2.48 GHz): Theta = 90, Phi = 90

**A.1.2 7.1.1.2 Dual Band 868 MHz and 2.4 GHz**
**A.1.2.1 868 MHz**
**Table 48. Board #1: OTA Evaluation Results (Dual Band 868 MHz)**

Test Description	Test Result
Total Radiated Power	-2.87 dBm
Peak EIRP	1.39 dBm
Directivity	4.25 dBi
Efficiency	-2.87 dB
Efficiency	51.69%
Peak Gain	1.39 dBi
NHPRP 45°	-5.04 dBm
NHPRP 45° / TRP	-2.17 dB
NHPRP 45° / TRP	60.63%
NHPRP 30°	-7.13 dBm
NHPRP 30° / TRP	-4.26 dB
NHPRP 30° / TRP	37.45%
NHPRP 22.5°	-8.54 dBm
NHPRP 22.5° / TRP	-5.68 dB
NHPRP 22.5° / TRP	27.06%
UHRP	-6.53 dBm
UHRP / TRP	-3.67 dB
UHRP / TRP	42.99%
LHRP	-5.31 dBm
LHRP / TRP	-2.44 dB
LHRP / TRP	57.01%
PGRP (0-120°)	-4.83 dBm
PGRP / TRP	-1.97 dB
PGRP / TRP	63.56%
Front/Back Ratio	1.24
PhiBW	99.8°
PhiBW Up	43.8°
PhiBW Down	56.1°
ThetaBW	44.3°
ThetaBW Up	24.2°
ThetaBW Down	20.1°
Boresight Phi	225°
Boresight Theta	135°
Maximum Power	1.39 dBm
Minimum Power	-13.81 dBm
Average Power	-2.69 dBm
Max/Min Ratio	15.19 dB
Max/Avg Ratio	4.07 dB
Min/Avg Ratio	-11.12 dB
Worst Single Value	-29.15 dBm
Worst Position	Azi = 285°; Elev = 90 deg; Pol = Horizontal
Best Single Value	0.66 dBm
Best Position	Azi = 45°; Elev = 30°; Pol = Vertical

**Table 49. Board #1: RP\_868.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-3.9	-3.18	-2.42	-1.94	-0.35	-1.08	-11.19	-4.51	-0.01	0.45	-1.96	-5.35	-5.48
15	-2.57	-2.32	-0.83	-0.76	-0.06	-1.57	-9.78	-2.66	0.23	-0.6	-3.64	-5.67	-5.73
30	-1.74	-1.12	0.32	0.16	-0.97	-2.44	-5.4	-0.42	-0.75	-2.25	-3.05	-6.32	-6.33
45	-1.03	-0.06	1.04	0.14	-2.83	-2.19	-2.08	0.61	-3.23	-3.96	-2.47	-6.26	-7.04
60	-0.54	0.57	1.18	-0.7	-4.38	-1.57	-0.47	0.38	-5.32	-4.43	-1.45	-5.4	-7.51
75	-0.13	0.9	0.92	-2	-5.8	-1.24	-0.11	-0.54	-4.97	-3.87	-0.41	-4.14	-7.71
90	0.08	0.88	0.5	-3.12	-7.4	-1.51	-0.78	-1.38	-3.46	-3.33	0.34	-3.04	-7.46
105	-0.09	0.38	-0.22	-4.27	-9.91	-2.82	-2.63	-2.25	-2.22	-3.16	0.84	-1.85	-6.77
120	-0.63	-0.54	-1.09	-5.28	-12.38	-5.22	-5.92	-3.56	-1.88	-3.1	1.03	-1.07	-6.05
135	-1.47	-1.82	-2.04	-5.81	-13.14	-8.98	-13.65	-6.25	-2.65	-2.7	0.99	-0.66	-5.6
150	-2.4	-2.98	-2.73	-5.14	-10.77	-11.65	-13.81	-8.59	-4.54	-2.22	0.85	-0.7	-5.5
165	-3.35	-4.3	-3.46	-3.8	-6.87	-12.51	-8.15	-7.04	-7.01	-1.79	0.65	-1.11	-5.67
180	-3.95	-5.4	-4.03	-2.67	-3.62	-11.98	-6.28	-5.7	-5.55	-1.11	0.49	-1.66	-6.01
195	-4.13	-6.08	-4.15	-1.87	-1.4	-9.41	-5.64	-6.66	-2.65	0.18	0.45	-2.28	-6.32
210	-3.96	-5.99	-3.58	-1.46	-0.95	-6.53	-6.66	-6.24	-1.14	1.2	0.42	-2.58	-6.14
225	-3.66	-5.38	-2.96	-1.05	-1.68	-5.26	-9.51	-4.18	-0.3	1.39	0.16	-2.72	-5.38
240	-3.45	-4.77	-2.76	-0.96	-2.9	-6.31	-11.18	-3.49	-0.3	0.57	-0.36	-2.75	-4.58
255	-3.33	-4.25	-3.08	-1.67	-4.76	-9.31	-11.73	-3.65	-1.18	-0.91	-0.8	-2.65	-3.94
270	-3.24	-3.75	-3.86	-3.32	-7.96	-13.34	-12.16	-4.23	-2.56	-1.67	-0.69	-2.35	-3.71
285	-3.08	-3.45	-5.1	-5.94	-10.73	-13.07	-11.41	-5.47	-3.64	-1.25	-0.14	-2.12	-3.73
300	-3.22	-3.72	-6.13	-7.77	-8.04	-8.22	-9.78	-7.27	-3.57	-0.4	0.18	-2.25	-3.98
315	-4.02	-4.7	-6.36	-7.24	-5.2	-4.7	-7.95	-10.06	-2.71	0.38	-0.07	-2.84	-4.52
330	-4.94	-5.45	-5.48	-5.89	-3.58	-2.83	-7.15	-12.54	-1.79	0.83	-0.59	-3.62	-4.94
345	-5.42	-5.01	-4.36	-4.4	-2.09	-1.29	-8.01	-11.85	-0.9	1.2	-1.22	-4.33	-4.97
360	-3.9	-3.18	-2.42	-1.94	-0.35	-1.08	-11.19	-4.51	-0.01	0.45	-1.96	-5.35	-5.48

**Table 50. Board #1: RP\_868.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-9.56	-8.31	-7.55	-8.29	-5.42	-6.43	-13.41	-21.16	-3.49	-2.37	-7.03	-12.76	-8.18
15	-10.88	-9.87	-8.56	-7.95	-4.4	-5.43	-13.25	-27.23	-4.6	-3.5	-8.78	-10.39	-7.78
30	-12.82	-11.54	-9.69	-7.29	-4.07	-5.02	-12.61	-14.1	-7	-4.62	-5.44	-9.4	-8.2
45	-14.91	-12.53	-9.7	-6.68	-4.64	-5.39	-13.29	-9.02	-11.13	-5.59	-4.46	-8.68	-9.21
60	-14.97	-11.3	-8.2	-6.5	-5.66	-6.73	-13.77	-6.99	-11.39	-5.9	-3.5	-7.82	-10.45
75	-12	-8.6	-6.09	-6.54	-7.19	-9.01	-13.39	-5.89	-7.61	-5.46	-2.47	-6.38	-12.12
90	-8.78	-6.45	-4.53	-6.62	-9.26	-11.52	-12.69	-5.27	-5.12	-4.77	-1.49	-4.9	-13.43
105	-6.33	-5.24	-3.54	-6.87	-12.85	-14.45	-12.29	-5.11	-3.8	-4.06	-0.57	-3.27	-13.38
120	-5.07	-5.01	-3.3	-6.98	-17.08	-18.3	-13.12	-5.89	-3.6	-3.56	0	-2.22	-11.62
135	-4.41	-5.2	-3.51	-6.63	-20.81	-25.71	-16.93	-8.26	-4.33	-2.96	0.32	-1.52	-9.32
150	-4.36	-5.58	-4.05	-6.14	-19.4	-22.07	-27.73	-12.2	-5.57	-2.36	0.48	-1.26	-7.63
165	-4.65	-6.3	-5.21	-6.21	-14.76	-17	-18.97	-19.45	-7.37	-1.81	0.56	-1.36	-6.47
180	-5.17	-7.21	-6.85	-7.42	-11.73	-14.24	-13.28	-22.9	-8.24	-1.4	0.48	-1.7	-6.17
195	-5.97	-8.47	-9.37	-10.66	-10.75	-11.71	-10.44	-18.69	-7.2	-0.95	0.24	-2.36	-6.6
210	-6.93	-9.8	-12.46	-16.71	-11.82	-10.31	-9.55	-15.54	-6.06	-0.61	-0.09	-3.08	-7.56
225	-8.21	-11.36	-16.23	-24.75	-13.98	-10.25	-10.07	-14.07	-5.63	-0.58	-0.51	-3.99	-9.08
240	-9.31	-12.35	-17.5	-16.83	-14.15	-11.4	-11.56	-14.04	-5.78	-1.12	-0.93	-4.74	-10.72
255	-9.65	-11.49	-14.81	-12.63	-12.9	-13.43	-14.61	-14.2	-5.97	-2.06	-1.31	-5.14	-12.62
270	-8.12	-8.93	-11.95	-10.79	-12.53	-15.99	-19.42	-14.62	-5.76	-2.32	-1.5	-5.3	-13.46
285	-5.76	-6.66	-9.71	-9.81	-12.92	-18.51	-29.15	-16.03	-5.07	-1.72	-1.52	-6.02	-13.39
300	-4.57	-5.75	-8.54	-9.38	-12.46	-16.63	-25.59	-18.05	-4.29	-1.14	-1.85	-8.03	-13.23
315	-4.67	-5.89	-7.68	-8.8	-10.64	-13.11	-20.77	-18.39	-3.6	-0.95	-3.01	-12.51	-11.78
330	-5.75	-6.4	-7.01	-8.34	-8.82	-10.62	-17.99	-17.58	-3.19	-1.08	-4.72	-20.31	-9.88
345	-7.32	-6.9	-6.72	-8.17	-7.32	-8.31	-15.64	-19.31	-3.02	-1.14	-6.72	-20.68	-8.56
360	-9.56	-8.31	-7.55	-8.29	-5.42	-6.43	-13.41	-21.16	-3.49	-2.37	-7.03	-12.76	-8.18

**Table 51. Board #1: RP\_868.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-5.28	-4.77	-4.02	-3.08	-1.97	-2.58	-15.17	-4.61	-2.59	-2.75	-3.59	-6.22	-8.81
15	-3.26	-3.16	-1.63	-1.68	-2.05	-3.87	-12.37	-2.67	-1.51	-3.73	-5.23	-7.45	-9.98
30	-2.09	-1.54	-0.14	-0.7	-3.89	-5.92	-6.31	-0.61	-1.92	-6.02	-6.78	-9.27	-10.88
45	-1.21	-0.31	0.66	-0.87	-7.5	-5.02	-2.42	0.11	-4	-9.02	-6.83	-9.95	-11.09
60	-0.7	0.28	0.64	-2.02	-10.31	-3.15	-0.68	-0.5	-6.55	-9.85	-5.7	-9.08	-10.6
75	-0.42	0.38	-0.04	-3.89	-11.41	-2.04	-0.32	-2.04	-8.39	-9	-4.63	-8.08	-9.65
90	-0.52	-0.01	-1.14	-5.68	-11.97	-1.97	-1.07	-3.66	-8.43	-8.84	-4.3	-7.62	-8.73
105	-1.27	-1.02	-2.93	-7.74	-12.99	-3.13	-3.13	-5.41	-7.37	-10.42	-4.74	-7.42	-7.83
120	-2.57	-2.46	-5.07	-10.17	-14.18	-5.44	-6.83	-7.37	-6.74	-13.11	-5.71	-7.4	-7.46
135	-4.54	-4.49	-7.47	-13.44	-13.95	-9.08	-16.41	-10.56	-7.6	-15.05	-7.43	-8.14	-7.99
150	-6.81	-6.46	-8.57	-11.98	-11.41	-12.06	-13.98	-11.08	-11.3	-16.99	-10.02	-9.8	-9.63
165	-9.23	-8.64	-8.26	-7.51	-7.65	-14.42	-8.53	-7.3	-18.07	-26.48	-15.87	-13.66	-13.4
180	-10.05	-10.07	-7.25	-4.44	-4.35	-15.91	-7.24	-5.78	-8.9	-13.06	-24.72	-22.42	-20.39
195	-8.77	-9.82	-5.7	-2.49	-1.94	-13.27	-7.38	-6.94	-4.52	-6.22	-12.94	-19.8	-18.32
210	-7	-8.32	-4.19	-1.59	-1.32	-8.89	-9.79	-6.78	-2.82	-3.48	-9.18	-12.23	-11.69
225	-5.53	-6.65	-3.17	-1.07	-1.94	-6.91	-18.66	-4.65	-1.81	-2.99	-8.3	-8.67	-7.8
240	-4.75	-5.61	-2.91	-1.08	-3.24	-7.92	-21.95	-3.89	-1.75	-4.35	-9.48	-7.1	-5.78
255	-4.49	-5.16	-3.38	-2.04	-5.48	-11.43	-14.86	-4.05	-2.94	-7.23	-10.35	-6.24	-4.57
270	-4.95	-5.32	-4.59	-4.18	-9.82	-16.75	-13.06	-4.65	-5.39	-10.25	-8.36	-5.41	-4.19
285	-6.44	-6.28	-6.94	-8.24	-14.74	-14.53	-11.48	-5.87	-9.16	-11.17	-5.76	-4.39	-4.23
300	-8.96	-7.99	-9.84	-12.87	-9.98	-8.9	-9.89	-7.65	-11.72	-8.43	-4.12	-3.58	-4.53
315	-12.57	-10.92	-12.2	-12.46	-6.66	-5.37	-8.19	-10.75	-10.05	-5.4	-3.15	-3.34	-5.42
330	-12.66	-12.49	-10.75	-9.55	-5.12	-3.62	-7.52	-14.18	-7.38	-3.66	-2.71	-3.71	-6.61
345	-9.92	-9.54	-8.13	-6.75	-3.64	-2.26	-8.84	-12.7	-5.03	-2.6	-2.66	-4.43	-7.47
360	-5.28	-4.77	-4.02	-3.08	-1.97	-2.58	-15.17	-4.61	-2.59	-2.75	-3.59	-6.22	-8.81

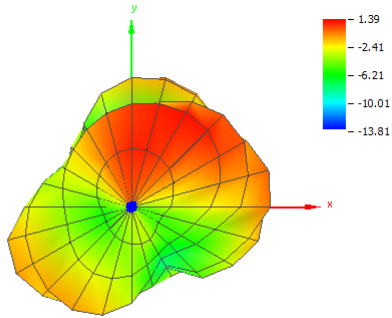


Figure 76. Board #1 (Dual Band 868 MHz): Theta = 0, Phi = 0

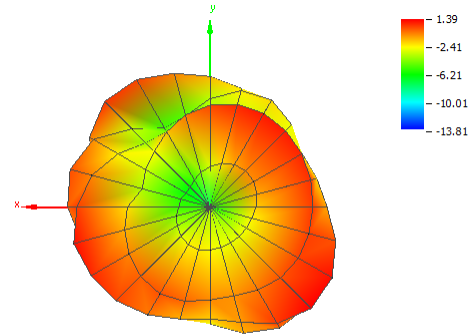


Figure 77. Board #1 (Dual Band 868 MHz): Theta = 180, Phi = 0

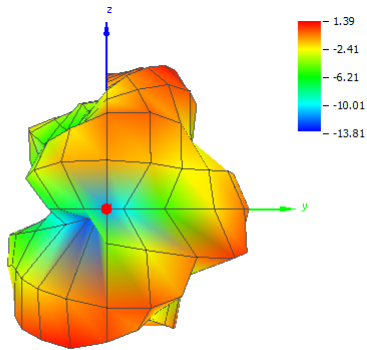


Figure 78. Board #1 (Dual Band 868 MHz): Theta = 90, Phi = 0

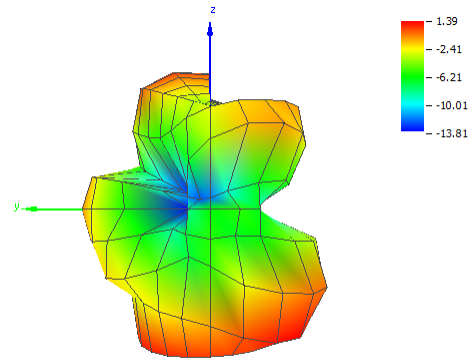


Figure 79. Board #1 (Dual Band 868 MHz): Theta = 90, Phi = 180

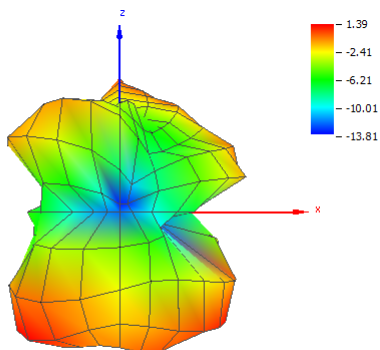


Figure 80. Board #1 (Dual Band 868 MHz): Theta = 90, Phi = 270

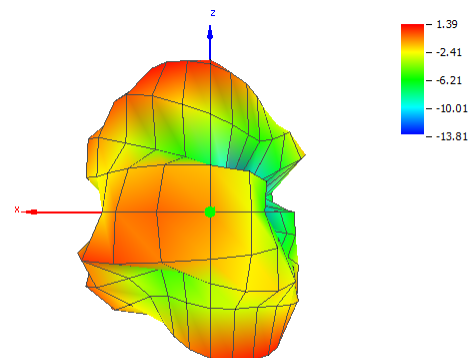


Figure 81. Board #1 (Dual Band 868 MHz): Theta = 90, Phi = 90



**A.1.2.2 2.40 GHz**
**Table 52. Board #1: OTA Evaluation Results (Dual Band 2.40 GHz)**

Test Description	Test Result
Total Radiated Power	-7.85 dBm
Peak EIRP	-2.61 dBm
Directivity	5.24 dBi
Efficiency	-7.85 dB
Efficiency	16.41%
Peak Gain	-2.61 dBi
NHPRP 45°	-10.14 dBm
NHPRP 45° / TRP	-2.29 dB
NHPRP 45° / TRP	59.03%
NHPRP 30°	-12.13 dBm
NHPRP 30° / TRP	-4.28 dB
NHPRP 30° / TRP	37.29%
NHPRP 22.5°	-13.37 dBm
NHPRP 22.5° / TRP	-5.52 dB
NHPRP 22.5° / TRP	28.05%
UHRP	-10.82 dBm
UHRP / TRP	-2.97 dB
UHRP / TRP	50.42%
LHRP	-10.90 dBm
LHRP / TRP	-3.05 dB
LHRP / TRP	49.58%
PGRP (0-120°)	-9.50 dBm
PGRP / TRP	-1.65 dB
PGRP / TRP	68.38%
Front/Back Ratio	1.51
PhiBW	142.4°
PhiBW Up	53.3°
PhiBW Down	89.0°
ThetaBW	44.5°
ThetaBW Up	34.4°
ThetaBW Down	10.1°
Boresight Phi	135°
Boresight Theta	150°
Maximum Power	-2.61 dBm
Minimum Power	-16.41 dBm
Average Power	-7.26 dBm
Max/Min Ratio	13.79 dB
Max/Avg Ratio	4.65 dB
Min/Avg Ratio	-9.14 dB
Worst Single Value	-22.63 dBm
Worst Position	Azi = 15°; Elev = 135 deg; Pol = Horizontal
Best Single Value	-2.89 dBm
Best Position	Azi = 165°; Elev = 180 deg; Pol = Vertical

**Table 53. Board #1: RP\_2400.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-7.89	-6.18	-5.29	-5.33	-6.38	-7.45	-6.04	-5.93	-6.46	-7.03	-6.36	-10.73	-5.46
15	-7.92	-7.09	-6.43	-6.45	-7.89	-7.52	-6.88	-7.1	-7.79	-8.72	-6.23	-9.81	-6.14
30	-8.18	-8.12	-7.6	-7.62	-8.3	-8.71	-7.25	-8.57	-11.07	-8.07	-8	-8.38	-6.64
45	-8.11	-8.66	-8.81	-8.74	-10.7	-10.98	-11.17	-9.68	-9.84	-8.52	-5.75	-7.26	-6.69
60	-7.83	-8.78	-10.26	-9.65	-13.87	-13.73	-13.82	-14.06	-10.79	-8.13	-3.56	-7.03	-6.41
75	-8.01	-8.39	-9.63	-8.88	-12.05	-14.5	-13.04	-15.55	-12.26	-7.52	-2.81	-7.06	-5.87
90	-8.83	-8.44	-8.39	-7.82	-10.62	-15.43	-13.55	-12.88	-11.69	-8.26	-2.72	-6.88	-4.7
105	-9.87	-9.3	-7.72	-7.61	-10.46	-16.08	-13.9	-13.14	-11.7	-9.22	-2.67	-6.22	-3.94
120	-9.76	-10.15	-6.77	-7	-10.53	-16.41	-13.64	-13.72	-11.02	-8.77	-2.74	-5.1	-3.71
135	-9.79	-10.36	-6.14	-5.45	-9.93	-15.4	-14.98	-14.11	-10.55	-7.08	-2.61	-4.59	-2.99
150	-10.16	-10.81	-5.44	-4.27	-8.02	-11.6	-11.64	-11.75	-10.88	-6.2	-2.78	-4.54	-2.64
165	-10.15	-10.93	-5.26	-3.75	-5.61	-7.2	-6.38	-9.02	-7.71	-5.97	-3.73	-4.71	-2.84
180	-10.29	-11.25	-5.96	-4.86	-4.63	-5.3	-4.89	-6.17	-6.38	-4.54	-5.61	-5.46	-3.56
195	-10.34	-12.43	-7.47	-7.77	-6.87	-6.51	-6.17	-5.67	-7.13	-4.24	-5.61	-7.29	-4.09
210	-10.4	-12.3	-8.18	-9.72	-9.64	-9.85	-8.81	-9.86	-8.4	-6.98	-4.79	-9.6	-4.36
225	-10.48	-10.6	-7.16	-7.92	-6.61	-9.13	-7.11	-9.69	-12.06	-13.82	-5.85	-11.67	-4.26
240	-10.29	-9.07	-6.26	-6.88	-7.07	-8.58	-8.55	-9.63	-12.59	-10.57	-9.3	-13.27	-4.22
255	-9.83	-8.52	-5.31	-7.32	-10.06	-11.52	-15.15	-12.14	-10.93	-8.56	-11.91	-12.65	-4.35
270	-9.71	-8.26	-4.59	-7.58	-10.23	-15.59	-12.83	-13.34	-10.46	-9.41	-10.85	-10.51	-3.9
285	-9.31	-7.95	-4.2	-7.55	-8.4	-12.65	-10.3	-10.95	-9.62	-8.89	-8.9	-8.88	-3.95
300	-9.2	-7.7	-4.23	-6.44	-7.17	-10.5	-9.69	-9.37	-8.3	-7.55	-7.09	-8.24	-4.15
315	-9.22	-7.1	-4.12	-5.29	-6.51	-8.67	-10.24	-8.56	-7.92	-6.1	-5.15	-8.34	-4.47
330	-8.97	-6.67	-4.25	-4.4	-6.29	-6.67	-8.83	-8.46	-7.17	-4.46	-4.7	-9.21	-4.74
345	-8.83	-5.91	-4.48	-3.85	-6.06	-6.18	-6.51	-8.24	-6.84	-3.62	-5.08	-10.01	-4.86
360	-7.89	-6.18	-5.29	-5.33	-6.38	-7.45	-6.04	-5.93	-6.46	-7.03	-6.36	-10.73	-5.46

**Table 54. Board #1: RP\_2400.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-17.91	-14.36	-16.49	-16.74	-22.58	-21.14	-18.51	-16.56	-15.26	-17.91	-16.39	-13.74	-14.85
15	-20.12	-17.28	-18.29	-17.61	-21.2	-21.74	-21.76	-19.15	-16.33	-22.63	-12.11	-12.37	-11.95
30	-19.62	-19.87	-19.55	-21.75	-20.32	-18.54	-21.1	-21.42	-19.31	-17.78	-12.33	-10.5	-9.61
45	-16.2	-16.51	-19.48	-14.34	-19.55	-19.15	-19.08	-21.91	-13.75	-12	-6.55	-8.84	-7.93
60	-13.13	-12.5	-14.21	-11.09	-15.88	-21.86	-18.45	-21	-13.18	-8.56	-3.8	-8	-6.75
75	-11.67	-10.52	-10.73	-9.26	-13.32	-22.31	-19.77	-20.43	-15.32	-7.84	-2.93	-7.58	-6.14
90	-11.21	-10.2	-9.29	-8.09	-11.63	-19.97	-20.98	-20.17	-16.52	-8.82	-3.07	-7.47	-5.88
105	-11.14	-11.05	-9.29	-8.03	-11.72	-18.95	-22.1	-21.44	-15.69	-10.16	-3.86	-7.72	-6.37
120	-10.58	-12.29	-9.88	-8.26	-11.56	-18.68	-21.37	-21.06	-14.64	-10.43	-5.5	-8.02	-8.14
135	-10.94	-13.97	-12.19	-8.28	-11.3	-17.88	-20.73	-20.19	-14.78	-9.73	-7.66	-9.67	-10.21
150	-12.37	-17.55	-16.8	-9.89	-11.93	-16.7	-19.44	-20.61	-18.3	-11.03	-9.8	-13.64	-14.61
165	-13.47	-18.69	-22.53	-13.53	-14.9	-16.43	-19.64	-20.83	-21.06	-13.23	-12.99	-17.72	-21.74
180	-15.02	-17.51	-16.79	-18.96	-19.78	-16.87	-19.39	-15.79	-16.8	-10.93	-18.71	-19.91	-16.71
195	-17.9	-18.66	-14.59	-17.2	-18.57	-15.66	-17.13	-12.78	-10	-10.33	-10.74	-17.1	-11.65
210	-21.54	-22.26	-16.54	-19.04	-16.74	-17.82	-15.28	-12.62	-9.5	-11.69	-7.26	-14.75	-8.25
225	-20.53	-19.4	-16.06	-17.72	-12.84	-20.82	-14.14	-17.2	-14.98	-15.14	-7.56	-13.75	-6.01
240	-16.19	-13.98	-9.98	-11.13	-10.65	-19	-14.18	-18.3	-21.11	-15.09	-11.58	-14.25	-4.82
255	-13.93	-11.77	-6.35	-8.61	-10.82	-17.72	-18.6	-15.21	-14.54	-11.62	-14.42	-13.81	-4.53
270	-12.28	-10.12	-4.99	-8.49	-12.68	-19.93	-22.02	-14.94	-12.15	-11.02	-11.68	-11.42	-4.41
285	-10.64	-9.4	-5.09	-10.23	-15.05	-21.72	-20.42	-15.8	-11.46	-11.67	-10.33	-9.28	-5.23
300	-10.06	-9.47	-6.7	-12.46	-16.23	-21.61	-20.21	-17.44	-11.19	-12.71	-11.13	-8.51	-6.88
315	-10.44	-10.01	-8.03	-15.72	-18.39	-20.91	-19.44	-18.54	-12.1	-12.94	-12.63	-8.88	-9.51
330	-11.61	-11.47	-10.06	-21.64	-21.79	-19.19	-18.63	-20.11	-14.01	-12.41	-13.96	-10.55	-14.08
345	-13.85	-12.59	-12.27	-21.74	-21.38	-18.72	-16.85	-18.74	-15.42	-12.74	-13.73	-12.25	-21.58
360	-17.91	-14.36	-16.49	-16.74	-22.58	-21.14	-18.51	-16.56	-15.26	-17.91	-16.39	-13.74	-14.85

**Table 55. Board #1: RP\_2400.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-8.35	-6.89	-5.63	-5.66	-6.49	-7.64	-6.3	-6.32	-7.08	-7.4	-6.82	-13.75	-5.99
15	-8.19	-7.53	-6.73	-6.8	-8.1	-7.69	-7.03	-7.38	-8.45	-8.9	-7.52	-13.33	-7.46
30	-8.5	-8.42	-7.88	-7.79	-8.58	-9.19	-7.44	-8.8	-11.78	-8.56	-10	-12.52	-9.7
45	-8.85	-9.44	-9.2	-10.15	-11.3	-11.7	-11.94	-9.95	-12.1	-11.11	-13.52	-12.43	-12.72
60	-9.35	-11.18	-12.5	-15.15	-18.17	-14.46	-15.65	-15.04	-14.52	-18.36	-16.29	-14.05	-17.58
75	-10.46	-12.49	-16.14	-19.6	-17.99	-15.29	-14.08	-17.26	-15.21	-19.01	-18.5	-16.6	-17.97
90	-12.58	-13.2	-15.66	-19.94	-17.47	-17.31	-14.42	-13.77	-13.43	-17.45	-13.89	-15.82	-10.92
105	-15.84	-14.1	-12.9	-18.03	-16.44	-19.24	-14.62	-13.83	-13.91	-16.33	-8.87	-11.57	-7.62
120	-17.4	-14.25	-9.68	-13.01	-17.28	-20.31	-14.44	-14.6	-13.5	-13.75	-6.02	-8.2	-5.66
135	-16.15	-12.84	-7.38	-8.66	-15.6	-19.01	-16.32	-15.34	-12.6	-10.48	-4.24	-6.2	-3.91
150	-14.17	-11.84	-5.77	-5.66	-10.28	-13.21	-12.43	-12.36	-11.75	-7.93	-3.74	-5.11	-2.92
165	-12.87	-11.73	-5.34	-4.24	-6.16	-7.75	-6.59	-9.31	-7.91	-6.87	-4.28	-4.93	-2.89
180	-12.08	-12.42	-6.33	-5.03	-4.76	-5.62	-5.04	-6.68	-6.8	-5.67	-5.83	-5.62	-3.78
195	-11.18	-13.61	-8.41	-8.3	-7.17	-7.07	-6.54	-6.61	-10.29	-5.47	-7.21	-7.77	-4.93
210	-10.75	-12.76	-8.87	-10.26	-10.58	-10.6	-9.92	-13.15	-14.89	-8.77	-8.41	-11.18	-6.64
225	-10.93	-11.22	-7.76	-8.4	-7.79	-9.43	-8.07	-10.53	-15.16	-19.64	-10.74	-15.85	-9.06
240	-11.57	-10.76	-8.67	-8.93	-9.59	-8.99	-9.93	-10.26	-13.25	-12.47	-13.18	-20.22	-13.14
255	-11.97	-11.3	-12.03	-13.23	-17.97	-12.71	-17.76	-15.09	-13.42	-11.52	-15.5	-18.95	-18.23
270	-13.21	-12.83	-15.16	-14.81	-13.87	-17.59	-13.38	-18.45	-15.36	-14.49	-18.47	-17.75	-13.48
285	-15.12	-13.41	-11.51	-10.91	-9.46	-13.23	-10.74	-12.67	-14.22	-12.16	-14.43	-19.5	-9.87
300	-16.66	-12.47	-7.84	-7.69	-7.74	-10.85	-10.09	-10.11	-11.44	-9.13	-9.26	-20.32	-7.46
315	-15.34	-10.22	-6.39	-5.71	-6.8	-8.93	-10.79	-9.02	-10.01	-7.11	-6.01	-17.67	-6.1
330	-12.39	-8.42	-5.58	-4.49	-6.41	-6.92	-9.31	-8.77	-8.17	-5.22	-5.24	-14.96	-5.28
345	-10.48	-6.96	-5.28	-3.92	-6.19	-6.43	-6.94	-8.65	-7.49	-4.19	-5.71	-13.96	-4.96
360	-8.35	-6.89	-5.63	-5.66	-6.49	-7.64	-6.3	-6.32	-7.08	-7.4	-6.82	-13.75	-5.99

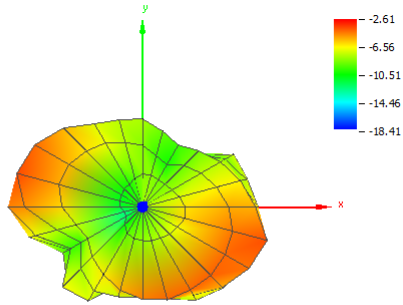


Figure 82. Board #1 (Dual Band 2.40 GHz): Theta = 0, Phi = 0

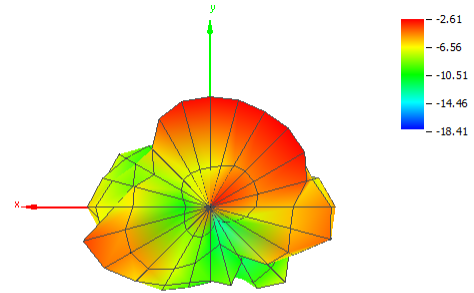


Figure 83. Board #1 (Dual Band 2.40 GHz): Theta = 180, Phi = 0

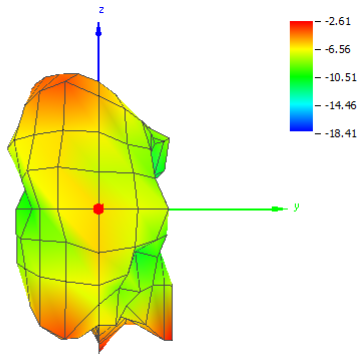


Figure 84. Board #1 (Dual Band 2.40 GHz): Theta = 90, Phi = 0

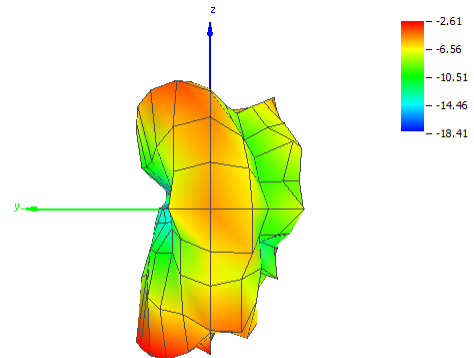


Figure 85. Board #1 (Dual Band 2.40 GHz): Theta = 90, Phi = 180

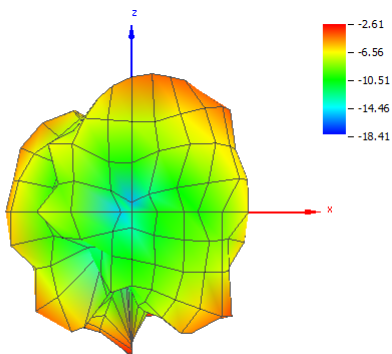


Figure 86. Board #1 (Dual Band 2.40 GHz): Theta = 90, Phi = 270

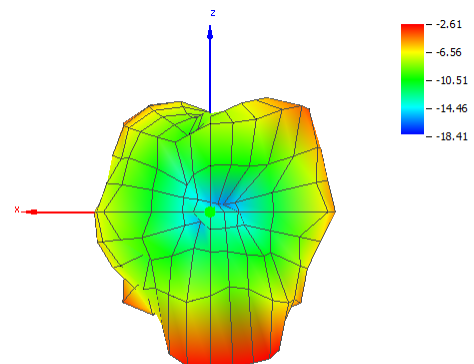


Figure 87. Board #1 (Dual Band 2.40 GHz): Theta = 90, Phi = 90

**A.1.2.3 2.44 GHz**
**Table 56. Board #1: OTA Evaluation Results (Dual Band 2.44 GHz)**

Test Description	Test Result
Total Radiated Power	-6.73 dBm
Peak EIRP	-1.73 dBm
Directivity	4.99 dBi
Efficiency	-6.73 dB
Efficiency	21.25%
Peak Gain	-1.73 dBi
NHPRP 45°	-9.00 dBm
NHPRP 45° / TRP	-2.27 dB
NHPRP 45° / TRP	59.23%
NHPRP 30°	-10.95 dBm
NHPRP 30° / TRP	-4.22 dB
NHPRP 30° / TRP	37.84%
NHPRP 22.5°	-12.21 dBm
NHPRP 22.5° / TRP	-5.49 dB
NHPRP 22.5° / TRP	28.27%
UHRP	-10.26 dBm
UHRP / TRP	-3.53 dB
UHRP / TRP	44.35%
LHRP	-9.27 dBm
LHRP / TRP	-2.55 dB
LHRP / TRP	55.65%
PGRP (0-120°)	-8.61 dBm
PGRP / TRP	-1.88 dB
PGRP / TRP	64.87%
Front/Back Ratio	2.05
PhiBW	286.7°
PhiBW Up	67.6°
PhiBW Down	219.1°
ThetaBW	48.7°
ThetaBW Up	34.9°
ThetaBW Down	13.7°
Boresight Phi	150°
Boresight Theta	150°
Maximum Power	-1.73 dBm
Minimum Power	-14.89 dBm
Average Power	-6.00 dBm
Max/Min Ratio	13.16 dB
Max/Avg Ratio	4.26 dB
Min/Avg Ratio	-8.90 dB
Worst Single Value	-21.95 dBm
Worst Position	Azi = 15°; Elev = 0°; Pol = Horizontal
Best Single Value	-2.09 dBm
Best Position	Azi = 75°; Elev = 150°; Pol = Horizontal

**Table 57. Board #1: RP\_2440.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-5.21	-4.47	-4.64	-4.74	-6.97	-8.87	-6.41	-4.53	-4.62	-4.85	-3.35	-10.49	-4.63
15	-4.74	-5.06	-5.5	-5.22	-8.15	-7.6	-7.51	-5.03	-4.58	-6.17	-2.7	-10.63	-5.02
30	-4.56	-6.03	-6.8	-7.17	-9.34	-8.49	-7.89	-6.7	-7.14	-5.64	-3.34	-8.28	-5.01
45	-4.74	-6.8	-7.64	-9.05	-9.17	-12.06	-12.08	-9.37	-7.9	-5.79	-2.94	-6.68	-4.49
60	-5.17	-6.87	-7.73	-7.31	-7.58	-10.38	-11.8	-14.27	-9.96	-6.68	-2.15	-5.54	-4.19
75	-5.93	-7.4	-7.95	-5.93	-7.59	-10.3	-10.94	-13.05	-9.65	-6.28	-1.99	-5.12	-3.72
90	-7.02	-9.09	-7.78	-5.62	-7.87	-13.16	-11.8	-12.36	-10.35	-6.78	-2.22	-5.02	-3.2
105	-6.76	-9.82	-6.29	-5.48	-8.78	-14.56	-11.64	-12.84	-10.25	-8.06	-2.66	-4.34	-3.6
120	-5.7	-9.72	-5.36	-4.39	-8.4	-14.07	-12.71	-13.1	-9.73	-6.81	-2.48	-3.92	-3.73
135	-5.07	-10.06	-4.74	-4.06	-6.48	-12.19	-14.06	-14.89	-10.57	-5.33	-2.07	-3.29	-3.4
150	-4.94	-9.89	-4.84	-3.96	-4.36	-8.24	-9.94	-13.68	-10.92	-5.02	-1.73	-2.6	-3.58
165	-5.12	-10.58	-6.27	-4.71	-3.22	-5.13	-5.34	-8.75	-6.04	-5.49	-2.63	-2.82	-3.74
180	-5.16	-11.98	-9.15	-6.57	-4.13	-4.35	-3.93	-3.51	-4.57	-3.99	-3.85	-4.1	-3.62
195	-5.33	-10.73	-12.66	-9	-8.61	-6.56	-4.41	-2.55	-6.75	-3.48	-3.92	-5.68	-3.33
210	-5.88	-8.58	-11.74	-10.55	-10.76	-9.92	-7.74	-7.12	-8.07	-7.34	-4.02	-8.14	-3.27
225	-6.45	-7.17	-8.33	-7.8	-6.54	-9.99	-5.12	-5.96	-10.65	-12.65	-5.43	-9.87	-3.84
240	-6.95	-6.01	-6.26	-6.01	-6.81	-7.45	-6.14	-5.18	-10.84	-7.82	-7.66	-9.17	-4.16
255	-7.22	-5.26	-6.09	-7.02	-10.01	-10.1	-12.79	-8.62	-11.06	-6.9	-8.13	-7.01	-4.06
270	-7.2	-4.97	-6.37	-8.58	-11.2	-14.45	-12.17	-14.06	-9.15	-7.2	-6.88	-5.91	-3.35
285	-6.92	-4.36	-5.94	-7.78	-9.14	-12.59	-9.99	-10.55	-7.74	-6.21	-5.28	-5.74	-2.8
300	-6.13	-3.77	-5.4	-6.66	-7.67	-11.76	-9.94	-7.87	-6.7	-4.64	-3.89	-5.67	-2.82
315	-5.96	-3.44	-4.49	-5.86	-7.02	-10.91	-9.4	-6.64	-5.65	-3.45	-3.53	-5.94	-2.98
330	-5.96	-3.13	-3.79	-5.09	-6.71	-8.11	-8.23	-5.57	-4.95	-3.12	-3.54	-6.88	-3.68
345	-6.27	-3.44	-3.73	-4.38	-7.17	-6.29	-6.43	-5.38	-4.85	-2.89	-3.76	-7.84	-4.41
360	-5.21	-4.47	-4.64	-4.74	-6.97	-8.87	-6.41	-4.53	-4.62	-4.85	-3.35	-10.49	-4.63

**Table 58. Board #1: RP\_2440.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-18.67	-14.82	-16.66	-14.19	-19.69	-17.01	-17.45	-18.32	-17.4	-20.19	-19.99	-13.51	-4.49
15	-21.95	-15.74	-17.29	-13.1	-17.4	-19.24	-18.58	-18.78	-18.7	-20.55	-11.1	-14.2	-10.97
30	-15.94	-15.98	-16.61	-16.28	-14.98	-15.49	-19.97	-18.49	-17.16	-14.64	-8.68	-11.39	-8.07
45	-12.23	-14.51	-14.68	-13.56	-15.68	-16.39	-16.77	-19.05	-12.48	-10.08	-4.56	-9.2	-6.2
60	-9.22	-12.15	-11.9	-8.9	-12.63	-17.86	-16.33	-18.23	-12.23	-7.5	-2.61	-7.27	-4.79
75	-7.94	-11.02	-9.62	-6.49	-9.65	-17.5	-16.44	-16.87	-13.11	-6.58	-2.09	-6.15	-3.93
90	-7.98	-10.6	-8.16	-5.86	-9.08	-16.69	-18.82	-18.83	-13.71	-7.04	-2.46	-6.04	-3.62
105	-7.47	-10.49	-7.5	-5.89	-9.87	-17.01	-19.29	-19.69	-13.62	-8.59	-3.61	-6.2	-4.6
120	-7.33	-11.4	-7.9	-5.22	-9.56	-15.68	-17.78	-20.98	-13.57	-8.35	-5.08	-7.78	-6.14
135	-8.46	-14.63	-8.94	-6.1	-8.7	-13.5	-15.75	-20.72	-13.7	-7.6	-6.43	-11.29	-8.43
150	-10.51	-18.49	-11.7	-9.36	-9.26	-12.63	-15.41	-18.44	-14.16	-8.19	-7.55	-15.31	-12.56
165	-12.84	-17.21	-18.18	-16.53	-11.42	-13.03	-16.12	-17.64	-15.52	-12.02	-9.87	-18.77	-19.24
180	-15.81	-16.21	-20.39	-17.23	-15.77	-15.07	-17.39	-15.91	-15.53	-13.78	-14.25	-18.39	-19.33
195	-19.87	-18.65	-16.94	-15.1	-19.96	-16.26	-16.03	-12.35	-11.14	-11.38	-10.46	-15.76	-12.75
210	-19.9	-19.43	-18.51	-18.44	-16.05	-19.22	-13.58	-12.54	-9.97	-12	-7.3	-13.18	-8.86
225	-15.4	-13.15	-15.36	-14.48	-14.22	-19.58	-13.53	-20.22	-15.31	-14.36	-8.1	-11.8	-6.48
240	-12.19	-8.51	-10.64	-10.2	-12.67	-20.16	-16.56	-14.51	-18.62	-13.11	-11.16	-10.23	-4.87
255	-9.87	-6.15	-8.47	-8.8	-11.98	-20.45	-16.46	-13.03	-13.43	-9.47	-10.2	-8.29	-4.26
270	-8.32	-5.42	-8.09	-9.25	-12.81	-18.91	-17.21	-16.08	-12.88	-8.08	-7.19	-6.84	-3.98
285	-7.27	-5.32	-8.53	-11.9	-14.52	-18.86	-19.42	-19.17	-12.45	-8.76	-6.21	-6.16	-4.08
300	-6.81	-6.36	-9.98	-15.13	-17.97	-20.23	-20.39	-19.99	-11.9	-9.46	-6.83	-5.9	-5.32
315	-7.29	-8.26	-12.09	-17.36	-20.7	-19.52	-20.65	-20.84	-11.7	-10.4	-9.29	-6.45	-7.31
330	-8.59	-10.1	-13.2	-20.38	-19.62	-18.83	-21.47	-21.11	-12.95	-11.78	-12.69	-7.83	-10.61
345	-11.14	-12.17	-15.18	-21.32	-17.04	-16.53	-19.7	-20.68	-15.5	-13.34	-15.69	-9.43	-15.9
360	-18.67	-14.82	-16.66	-14.19	-19.69	-17.01	-17.45	-18.32	-17.4	-20.19	-19.99	-13.51	-14.49



**Table 59. Board #1: RP\_2440.000\_Verical**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-5.41	-4.89	-4.92	-5.27	-7.21	-9.59	-6.76	-4.71	-4.86	-4.98	-3.45	-13.48	-5.11
15	-4.82	-5.44	-5.79	-6	-8.69	-7.91	-7.87	-5.22	-4.75	-6.33	-3.37	-13.14	-6.29
30	-4.89	-6.49	-7.28	-7.74	-10.73	-9.46	-8.16	-7	-7.59	-6.23	-4.84	-11.19	-7.97
45	-5.59	-7.61	-8.6	-10.95	-10.26	-14.07	-13.88	-9.86	-9.76	-7.82	-7.99	-10.23	-9.36
60	-7.34	-8.39	-9.82	-12.46	-9.21	-11.24	-13.69	-16.49	-13.86	-14.32	-12.15	-10.37	-13.05
75	-10.22	-9.89	-12.92	-15.13	-11.82	-11.21	-12.37	-15.38	-12.26	-18.04	-18.1	-11.9	-16.99
90	-14.02	-14.41	-18.59	-18.28	-14.03	-15.72	-12.76	-13.47	-13.04	-19.21	-14.91	-11.83	-13.58
105	-14.98	-18.25	-12.43	-15.94	-15.31	-18.22	-12.46	-13.85	-12.93	-17.44	-9.73	-8.93	-10.47
120	-10.75	-14.66	-8.91	-11.96	-14.7	-19.16	-14.32	-13.87	-12.05	-12.04	-5.95	-6.22	-7.43
135	-7.72	-11.92	-6.81	-8.33	-10.47	-18.04	-18.98	-16.21	-13.47	-9.23	-4.05	-4.03	-5.04
150	-6.35	-10.54	-5.85	-5.44	-6.06	-10.2	-11.39	-15.44	-13.72	-7.87	-3.05	-2.84	-4.17
165	-5.92	-11.64	-6.56	-5.01	-3.93	-5.9	-5.72	-9.35	-6.56	-6.58	-3.54	-2.93	-3.86
180	-5.56	-14.04	-9.49	-6.96	-4.44	-4.73	-4.13	-3.77	-4.93	-4.47	-4.26	-4.27	-3.73
195	-5.48	-11.5	-14.69	-10.23	-8.94	-7.05	-4.72	-3.03	-8.72	-4.24	-5.01	-6.12	-3.86
210	-6.06	-8.95	-12.76	-11.31	-12.29	-10.47	-9.05	-8.59	-12.58	-9.17	-6.77	-9.77	-4.67
225	-7.04	-8.44	-9.28	-8.85	-7.35	-10.49	-5.79	-6.12	-12.47	-17.52	-8.81	-14.34	-7.26
240	-8.49	-9.61	-8.23	-8.09	-8.12	-7.69	-6.55	-5.72	-11.64	-9.35	-10.24	-15.83	-12.38
255	-10.62	-12.57	-9.82	-11.75	-14.4	-10.52	-15.22	-10.58	-14.83	-10.41	-12.34	-12.91	-17.56
270	-13.61	-15.03	-11.24	-17.05	-16.3	-16.38	-13.8	-18.36	-11.55	-14.6	-18.54	-13.03	-12.07
285	-17.93	-11.39	-9.42	-9.91	-10.62	-13.76	-10.52	-11.19	-9.53	-9.72	-12.42	-16.07	-8.72
300	-14.52	-7.25	-7.26	-7.33	-8.1	-12.42	-10.35	-8.14	-8.26	-6.38	-6.97	-18.44	-6.41
315	-11.75	-5.18	-5.32	-6.18	-7.21	-11.55	-9.74	-6.81	-6.89	-4.43	-4.87	-15.49	-4.97
330	-9.38	-4.1	-4.31	-5.22	-6.93	-8.49	-8.44	-5.69	-5.7	-3.76	-4.1	-13.94	-4.66
345	-7.98	-4.06	-4.05	-4.47	-7.64	-6.73	-6.64	-5.51	-5.24	-3.3	-4.05	-12.96	-4.73
360	-5.41	-4.89	-4.92	-5.27	-7.21	-9.59	-6.76	-4.71	-4.86	-4.98	-3.45	-13.48	-5.11

Theta = 0, Phi = 0

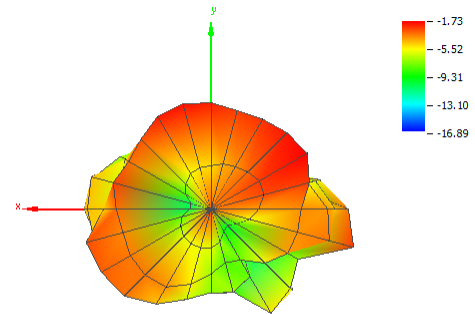
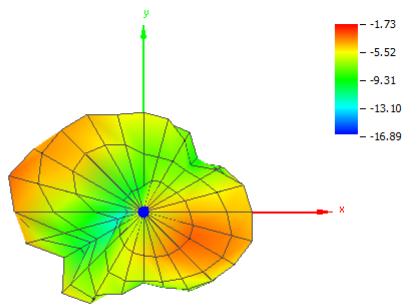


Figure 88. Board #1 (Dual Band 2.44 GHz): Theta = 0, Phi = 0

Figure 89. Board #1 (Dual Band 2.44 GHz): Theta = 180, Phi = 0

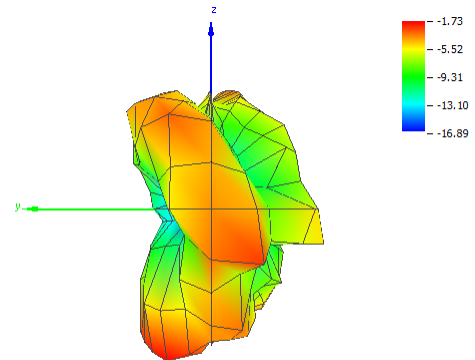
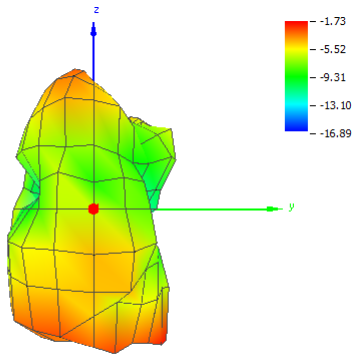


Figure 90. Board #1 (Dual Band 2.44 GHz): Theta = 90, Phi = 0

Figure 91. Board #1 (Dual Band 2.44 GHz): Theta = 90, Phi = 180

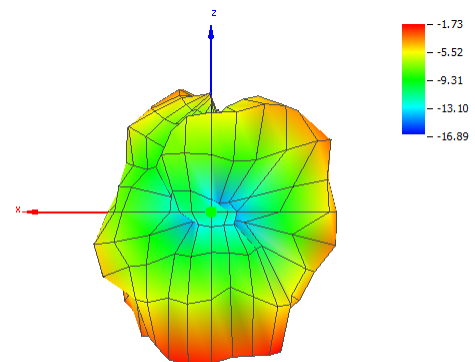
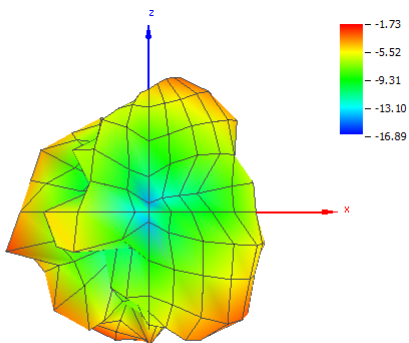


Figure 92. Board #1 (Dual Band 2.44 GHz): Theta = 90, Phi = 270

Figure 93. Board #1 (Dual Band 2.44 GHz): Theta = 90, Phi = 90

**A.1.2.4 2.48 GHz**
**Table 60. Board #1: OTA Evaluation Results (Dual Band 2.48 GHz)**

Test Description	Test Result
Total Radiated Power	-6.18 dBm
Peak EIRP	-1.95 dBm
Directivity	4.23 dBi
Efficiency	-6.18 dB
Efficiency	24.10%
Peak Gain	-1.95 dBi
NHPRP 45°	-8.62 dBm
NHPRP 45° / TRP	-2.44 dB
NHPRP 45° / TRP	57.03%
NHPRP 30°	-10.74 dBm
NHPRP 30° / TRP	-4.56 dB
NHPRP 30° / TRP	35.02%
NHPRP 22.5°	-12.01 dBm
NHPRP 22.5° / TRP	-5.83 dB
NHPRP 22.5° / TRP	26.11%
UHRP	-9.17 dBm
UHRP / TRP	-2.99 dB
UHRP / TRP	50.21%
LHRP	-9.21 dBm
LHRP / TRP	-3.03 dB
LHRP / TRP	49.79%
PGRP (0-120°)	-7.86 dBm
PGRP / TRP	-1.68 dB
PGRP / TRP	67.94%
Front/Back Ratio	3.32
PhiBW	40.7°
PhiBW Up	18.8°
PhiBW Down	21.8°
ThetaBW	74.2°
ThetaBW Up	40.8°
ThetaBW Down	33.4°
Boresight Phi	165°
Boresight Theta	60°
Maximum Power	-1.95 dBm
Minimum Power	-15.14 dBm
Average Power	-5.33 dBm
Max/Min Ratio	13.19 dB
Max/Avg Ratio	3.38 dB
Min/Avg Ratio	-9.81 dB
Worst Single Value	-22.12 dBm
Worst Position	Azi = 330°; Elev = 90 deg; Pol = Horizontal
Best Single Value	-2.40 dBm
Best Position	Azi = 345°; Elev = 30°; Pol = Ver

**Table 61. Board #1: RP\_2480.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-3.13	-2.33	-2.35	-2.82	-5.47	-7.32	-6.61	-5.4	-4.47	-3.6	-2.39	-7.94	-4.03
15	-3.21	-2.71	-3.45	-3.76	-6.06	-7.4	-7.31	-5.48	-4.54	-5.22	-2.83	-9	-4.85
30	-3.43	-3.67	-4.95	-4.93	-7.53	-6.06	-6.38	-7.87	-8.15	-5.48	-4.46	-8.38	-5.14
45	-3.9	-4.55	-5.69	-5.12	-5.99	-6.95	-6.62	-8.12	-7.73	-5.51	-4.36	-7.34	-4.87
60	-4.99	-6.36	-6.13	-6.67	-6.41	-8.26	-9.24	-9.56	-6.43	-4.58	-2.91	-7.18	-4.59
75	-6.71	-8.46	-6.57	-7.43	-8.56	-11.39	-11.56	-11.68	-7.99	-4.29	-2.56	-7.45	-4.15
90	-6.95	-9.59	-5.59	-7.71	-11.38	-15.14	-10.87	-14.72	-8.79	-5.67	-3.08	-7.16	-4.01
105	-5.93	-8.95	-4.58	-6.78	-11.74	-14.61	-10.93	-15.03	-8.6	-6.29	-3.39	-6.65	-4.12
120	-4.95	-8.78	-3.3	-5.5	-9.28	-13.39	-12.07	-13.39	-9.77	-5.32	-2.86	-6.05	-3.73
135	-4.74	-8.31	-2.5	-4.2	-6.65	-12.05	-11.5	-11.3	-11.3	-4.58	-2.36	-4.61	-3.49
150	-4.57	-8.57	-2.54	-3.11	-3.53	-7.58	-6.31	-7.67	-8.29	-4.43	-2.46	-3.81	-3.26
165	-3.91	-8.83	-3.8	-2.76	-1.95	-4.05	-3.77	-5.4	-4.39	-4.67	-3	-3.94	-2.88
180	-3.21	-7.08	-7.08	-3.29	-3.42	-3.2	-3.01	-2.92	-4.89	-3.67	-3.71	-4.41	-2.36
195	-3.03	-5.2	-8.52	-4.85	-9.4	-5.33	-4.94	-3.74	-7.98	-2.95	-3.69	-4.91	-2.14
210	-3.3	-3.75	-5.87	-6.07	-7.59	-8.97	-9.09	-9.56	-8.72	-5.72	-4.18	-6.51	-2.4
225	-3.6	-2.89	-4.71	-3.76	-5.9	-7.92	-5.15	-7.89	-9.39	-11.36	-5.37	-8.66	-3.21
240	-4.14	-2.69	-4.61	-2.97	-7.71	-6.99	-6.55	-6.21	-8.72	-6.1	-7.33	-9.2	-4.11
255	-4.82	-3.07	-4.42	-4.63	-9.73	-9.85	-13.5	-7.77	-9.3	-5.14	-8.43	-7.46	-4.22
270	-5.84	-3.55	-4.19	-7.82	-11.35	-13.07	-14.53	-12.09	-8.75	-5.84	-8.16	-6.41	-4.14
285	-6.37	-3.51	-3.89	-8.69	-12.15	-11.54	-12.81	-12.43	-6.75	-5.42	-6.45	-6.25	-3.81
300	-5.98	-2.71	-3.15	-8.17	-10.76	-11.14	-11.72	-10.55	-6.47	-4.61	-4.42	-6.12	-2.95
315	-4.76	-2.2	-2.72	-7.15	-8.98	-10.89	-10.55	-9.43	-6.04	-4.63	-3.39	-5.87	-2.45
330	-3.74	-2.19	-2.39	-5.09	-7.33	-10.08	-11.19	-8.19	-5.45	-3.8	-2.83	-6.22	-2.45
345	-3.6	-2.1	-2.27	-3.44	-6.53	-7.75	-10.72	-8.21	-5.27	-2.66	-2.54	-6.39	-2.95
360	-3.13	-2.33	-2.35	-2.82	-5.47	-7.32	-6.61	-5.4	-4.47	-3.6	-2.39	-7.94	-4.03

**Table 62. Board #1: RP\_2480.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-19.42	-17.73	-18.9	-16.01	-18.8	-19.16	-18.26	-18.33	-15.19	-16	-15.75	-14.52	-18.48
15	-21.67	-17.02	-18.1	-14.7	-18.56	-19.35	-17.97	-18.1	-16.13	-21.32	-13.97	-16.65	-14.2
30	-14.89	-15.39	-14.95	-16.65	-16.08	-15.23	-18.93	-17.24	-21.92	-14.8	-10.59	-13.67	-9.89
45	-10.95	-13.95	-11.68	-13.16	-14.07	-13.63	-16.73	-16.62	-12.81	-9.8	-5.93	-10.97	-7.22
60	-9.19	-12.32	-8.75	-9.07	-10.43	-15.28	-14.08	-16.36	-9.56	-5.74	-3.47	-9.57	-5.41
75	-9.02	-11.22	-7.17	-8.04	-9.73	-17.91	-16.98	-17.08	-10.17	-4.81	-2.79	-8.73	-4.54
90	-7.61	-10.68	-6.29	-8.23	-12.77	-20.24	-20.51	-18.5	-10.83	-6.14	-3.21	-7.89	-4.5
105	-6.37	-10.09	-5.9	-7.44	-13.59	-19.7	-19.65	-19.43	-12.05	-7.49	-4.06	-7.93	-5.22
120	-6.66	-11.46	-5.79	-7.17	-11.33	-16.76	-17.25	-20.58	-13.17	-7.39	-5.14	-9.73	-6.53
135	-8.2	-15.04	-6.98	-8.14	-10.47	-14.33	-15.34	-21.66	-13.31	-7.23	-5.95	-11.2	-8.58
150	-9.44	-19.66	-10.3	-11.03	-10.26	-13.1	-14.82	-20.87	-13.12	-8.64	-7.38	-13.52	-12.13
165	-10.9	-17.23	-15.71	-16.39	-11.36	-14.24	-16.43	-18.69	-12.88	-12.69	-9.92	-16.43	-17.89
180	-15.07	-16.09	-21.6	-14.77	-15.75	-17.72	-19.7	-16.54	-14.28	-16.98	-15.11	-15.57	-19.66
195	-21.76	-16.79	-17.45	-12.95	-17.76	-17.2	-20.35	-13.28	-12.27	-12.39	-11.61	-12.82	-13.07
210	-16.57	-14.74	-15.97	-14.56	-13.34	-15.43	-14.79	-11.93	-11	-10.84	-8.42	-11.51	-9.17
225	-12.61	-10.11	-13.1	-10.2	-12.19	-13.45	-10.47	-17.21	-13.66	-12.87	-9.34	-11.23	-6.99
240	-9.76	-6.49	-7.72	-6.43	-12.4	-12.63	-12.5	-17.41	-17.77	-12.67	-13.37	-10.27	-5.47
255	-7.89	-4.57	-5.34	-6.27	-11.77	-16.12	-19.16	-13.22	-13.29	-8.89	-12.69	-8.6	-4.55
270	-6.71	-3.75	-4.79	-8.35	-12.58	-18.87	-20.88	-13.74	-11.62	-6.83	-8.84	-7.2	-4.41
285	-6.68	-4.15	-5.99	-10.81	-14.87	-16.6	-19.04	-15.33	-12.34	-6.97	-7.22	-6.6	-4.96
300	-7.34	-5.55	-8.01	-13.09	-16.24	-15.75	-18.92	-16.67	-12.12	-8.38	-7.27	-6.46	-5.42
315	-7.84	-7.68	-11.59	-15.7	-17.09	-15.31	-20.2	-18.01	-11.75	-9.72	-8.92	-6.63	-6.7
330	-9.05	-10.69	-15.34	-18.07	-18.43	-15.66	-22.12	-19.02	-12.29	-10.35	-11.66	-7.82	-9.47
345	-11.46	-12.87	-17.73	-20.55	-18.68	-15.73	-20.53	-19.91	-13.8	-11.04	-13.52	-9.41	-13.61
360	-19.42	-17.73	-18.9	-16.01	-18.8	-19.16	-18.26	-18.33	-15.19	-16	-15.75	-14.52	-18.48

**Table 63. Board #1: RP\_2480.000\_Vertical**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-3.23	-2.46	-2.45	-3.03	-5.67	-7.61	-6.92	-5.63	-4.86	-3.86	-2.6	-9.02	-4.18
15	-3.27	-2.88	-3.61	-4.12	-6.31	-7.69	-7.69	-5.72	-4.85	-5.33	-3.17	-9.81	-5.39
30	-3.75	-3.98	-5.41	-5.24	-8.18	-6.62	-6.63	-8.4	-8.34	-6.02	-5.68	-9.9	-6.91
45	-4.85	-5.07	-6.95	-5.86	-6.72	-8	-7.06	-8.78	-9.35	-7.53	-9.54	-9.8	-8.65
60	-7.06	-7.63	-9.56	-10.39	-8.6	-9.22	-10.97	-10.57	-9.32	-10.88	-12.04	-10.91	-12.26
75	-10.55	-11.75	-15.46	-16.25	-14.82	-12.49	-13.03	-13.15	-12.03	-13.81	-15.38	-13.39	-14.84
90	-15.52	-16.13	-13.86	-17.21	-17.01	-16.74	-11.37	-17.07	-13.06	-15.49	-18.45	-15.3	-13.75
105	-16.04	-15.3	-10.41	-15.28	-16.35	-16.22	-11.55	-16.98	-11.21	-12.47	-11.86	-12.58	-10.61
120	-9.83	-12.16	-6.89	-10.44	-13.52	-16.07	-13.64	-14.31	-12.42	-9.53	-6.74	-8.47	-6.96
135	-7.34	-9.35	-4.41	-6.45	-8.98	-15.94	-13.81	-11.71	-15.62	-7.98	-4.87	-5.68	-5.11
150	-6.28	-8.92	-3.34	-3.87	-4.56	-9.01	-6.96	-7.88	-10.02	-6.5	-4.15	-4.3	-3.86
165	-4.88	-9.51	-4.09	-2.95	-2.48	-4.48	-4.02	-5.61	-5.05	-5.42	-3.99	-4.19	-3.02
180	-3.5	-7.66	-7.23	-3.62	-3.69	-3.36	-3.11	-3.11	-5.43	-3.88	-4.04	-4.75	-2.44
195	-3.09	-5.52	-9.12	-5.58	-10.08	-5.62	-5.07	-4.25	-10	-3.47	-4.45	-5.68	-2.5
210	-3.5	-4.11	-6.32	-6.74	-8.93	-10.08	-10.45	-13.32	-12.61	-7.31	-6.24	-8.16	-3.42
225	-4.19	-3.8	-5.39	-4.88	-7.07	-9.35	-6.67	-8.43	-11.42	-16.69	-7.6	-12.17	-5.56
240	-5.53	-5.03	-7.52	-5.58	-9.52	-8.38	-7.82	-6.55	-9.29	-7.19	-8.57	-15.81	-9.84
255	-7.78	-8.43	-11.61	-9.63	-14	-11.02	-14.88	-9.23	-11.51	-7.51	-10.47	-13.82	-15.69
270	-13.25	-16.97	-13.06	-17.21	-17.4	-14.4	-15.68	-17.11	-11.91	-12.73	-16.59	-14.19	-16.3
285	-17.92	-12.13	-8.05	-12.82	-15.47	-13.16	-13.99	-15.55	-8.15	-10.64	-14.33	-17.45	-10.15
300	-11.67	-5.88	-4.87	-9.86	-12.2	-12.98	-12.63	-11.77	-7.85	-6.97	-7.59	-17.45	-6.57
315	-7.71	-3.64	-3.32	-7.8	-9.71	-12.84	-11.05	-10.07	-7.39	-6.24	-4.82	-13.78	-4.49
330	-5.26	-2.85	-2.61	-5.31	-7.68	-11.48	-11.56	-8.56	-6.45	-4.88	-3.44	-11.33	-3.41
345	-4.38	-2.48	-2.4	-3.53	-6.8	-8.5	-11.2	-8.52	-5.92	-3.34	-2.9	-9.39	-3.34
360	-3.23	-2.46	-2.45	-3.03	-5.67	-7.61	-6.92	-5.63	-4.86	-3.86	-2.6	-9.02	-4.18

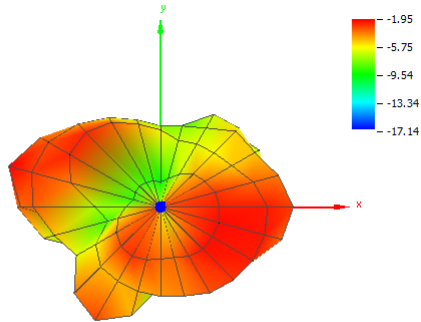


Figure 94. Board #1 (Dual Band 2.48 GHz): Theta = 0, Phi = 0

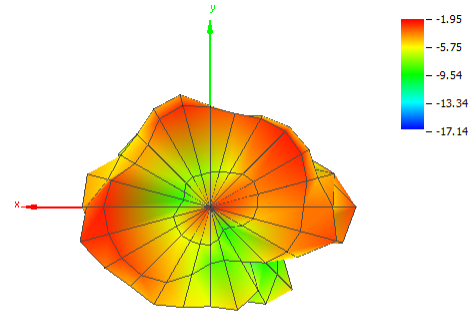


Figure 95. Board #1 (Dual Band 2.48 GHz): Theta = 180, Phi = 0

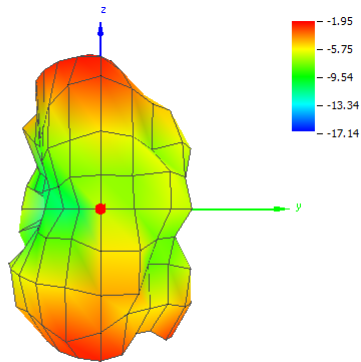


Figure 96. Board #1 (Dual Band 2.48 GHz): Theta = 90, Phi = 0

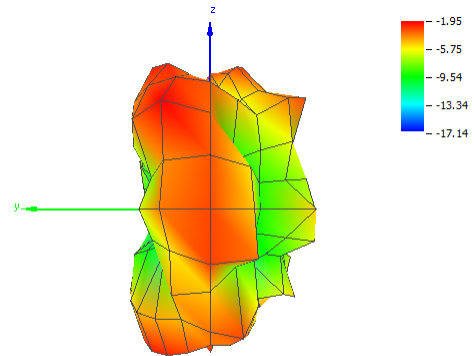


Figure 97. Board #1 (Dual Band 2.48 GHz): Theta = 90, Phi = 180

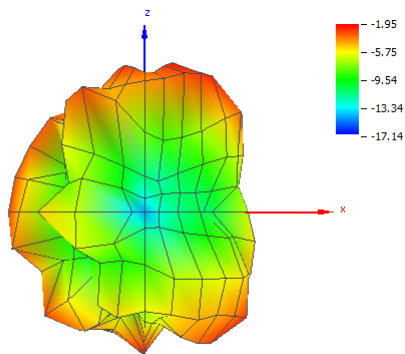


Figure 98. Board #1 (Dual Band 2.48 GHz): Theta = 90, Phi = 270

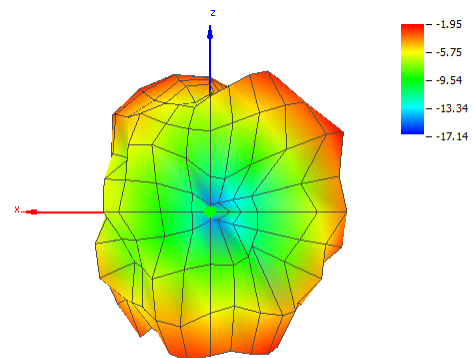


Figure 99. Board #1 (Dual Band 2.48 GHz): Theta = 90, Phi = 90

**A.2 Board #2: Compact 2.4 GHz PCB Antenna**
**A.2.1 2.40 GHz**
**Table 64. Board #2: OTA Evaluation Results (2.40 GHz)**

Test Description	Test Result
Total Radiated Power	-1.96 dBm
Peak EIRP	2.67 dBm
Directivity	4.63 dBi
Efficiency	-1.96 dB
Efficiency	63.62 %
Peak Gain	2.67 dBi
NHPRP 45°	-3.81 dBm
NHPRP 45°/TRP	-1.85 dB
NHPRP 45°/TRP	65.30%
NHPRP 30°	-5.64 dBm
NHPRP 30°/TRP	-3.68 dB
NHPRP 30°/TRP	42.89%
NHPRP 22.5°	-6.91 dBm
NHPRP 22.5°/TRP	-4.95 dB
NHPRP 22.5°/TRP	32.00%
UHRP	-5.36 dBm
UHRP/TRP	-3.40 dB
UHRP/TRP	45.75%
LHRP	-4.62 dBm
LHRP/TRP	-2.66 dB
LHRP /TRP	54.25%
PGRP (0-120°)	-3.63 dBm
PGRP/TRP	-1.67 dB
PGRP/TRP	68.15%
Front/Back Ratio	4.81
PhiBW	91.1°
PhiBW Up	40.6°
PhiBW Down	50.6°
ThetaBW	30.3°
ThetaBW Up	13.8°
ThetaBW Down	16.5°
Boresight Phi	105°
Boresight Theta	150°
Maximum Power	2.67 dBm
Minimum Power	-12.21 dBm
Average Power	-1.78 dBm
Max/Min Ratio	14.88 dB
Max/Avg Ratio	4.44 dB
Min/Avg Ratio	-10.43 dB
Worst Single Value	-21.64 dBm
Worst Position	Azi = 255°; Elev = 105°; Pol = Horizontal
Best Single Value	2.23 dBm
Best Position	Azi = 0°; Elev = 135°; Pol = Vertical



**Table 65. Board #2: RP\_2400.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-2.5	-0.68	-0.38	1.07	-0.99	-0.34	-0.22	-0.4	0.48	2.56	-1.49	-3.14	-1.66
15	-2.55	-0.78	0.25	0.38	-0.84	-2.53	-0.75	0.26	1.51	0.27	-1.64	-4	-2.28
30	-2.19	-0.99	0.08	-2.92	-1.64	-2	-2.55	-1	0.85	-2.25	-0.41	-4.67	-2.79
45	-1.89	-1.32	-2.06	-5.25	-5.92	-1.14	-0.15	-2.27	-4.67	1.22	-0.87	-3.81	-3.05
60	-1.99	-1.95	-4.15	-4.6	-4.77	-3.27	-1.14	-0.9	-2.2	1.6	-0.02	-2.48	-2.25
75	-2.05	-2.26	-4.2	-3.84	-1.9	-2.25	-4.79	-3.83	-0.83	0.28	1.55	-0.89	-1.7
90	-1.59	-2.37	-3.1	-3.37	-1.13	-1.98	-6.72	-10.4	-3.47	0.09	2.34	-0.29	-1.9
105	-1.57	-2.75	-2.13	-2.23	-1.44	-3.71	-7.59	-6.77	-5.35	0.21	2.67	-0.59	-1.78
120	-1.84	-3.35	-1.85	-1.68	-2.06	-4.25	-4.72	-3.15	-3.19	-0.19	2.36	-0.92	-1.16
135	-1.85	-3.23	-1.37	-1.32	-2.55	-3.47	-1.25	-0.55	-1.73	-1.11	1.04	-1.54	-1.1
150	-1.65	-2.82	-0.76	-0.81	-3.24	-3.58	-0.05	1.12	-1.4	-0.86	-0.91	-2.73	-1.27
165	-1.3	-2.12	-0.25	-0.4	-2.42	-5.47	-1.98	0.92	-3.48	0.41	-0.69	-4.1	-1.56
180	-1.36	-1.84	0.05	0.03	-0.21	-4.32	-4.97	-3.04	-4.11	-1.23	0.29	-4.61	-1.64
195	-1.98	-2.41	-0.7	-0.02	0.13	-2.6	-1.62	-3.47	-7.52	-8.79	-1.98	-4.17	-1.81
210	-2.29	-3.57	-2.15	-1.8	-1.31	-1.94	-1.2	-2.95	-7.6	-5.16	-7.24	-3.48	-2.37
225	-2.28	-4.34	-3.46	-6.77	-3.45	-4.22	-6.28	-6.83	-4.15	-2.95	-4.24	-3.82	-2.76
240	-2.35	-3.72	-3.81	-10.56	-5.55	-9.93	-8.66	-9.89	-6.3	-3.67	-1.41	-4.81	-2.22
255	-2.47	-3.06	-3.62	-9.29	-10.87	-7.9	-6.08	-8.95	-7.68	-4.53	-0.57	-5.35	-1.2
270	-2.89	-3.12	-3.26	-7.16	-12.21	-7.97	-8.29	-4.86	-2.51	-3.63	-0.64	-6.39	-0.71
285	-2.9	-2.97	-2.15	-4.74	-6.66	-9.42	-10.24	-4.57	-0.13	-1.36	-0.29	-6.3	-0.35
300	-2.26	-2.23	-0.83	-3.02	-3.19	-5.64	-6.22	-4.43	0.51	-0.15	0.54	-5.69	-0.28
315	-2.64	-1.47	0.26	-1.24	-0.66	-2.24	-2	-4.15	0.54	0.4	1.49	-5.31	-0.53
330	-2.59	-0.67	0.46	-0.82	1.08	-1.63	-0.4	-3.03	0.23	0.16	1.92	-4.43	-1.02
345	-2.64	-0.59	-0.17	-0.66	1.52	-1	-0.87	-1.99	0.67	0.87	1.18	-4.25	-1.39
360	-2.5	-0.68	-0.38	1.07	-0.99	-0.34	-0.22	-0.4	0.48	2.56	-1.49	-3.14	-1.66

**Table 66. Board #2: RP\_2400.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-11.9	-12.18	-11.87	-14.98	-11.88	-15.6	-9.79	-9.21	-9.63	-8.75	-12.13	-15.08	-12.39
15	-7.9	-7.5	-10.68	-12.87	-14.55	-20.21	-14.17	-10.14	-7.36	-12.59	-9.27	-17.29	-8.81
30	-4.97	-5.24	-9.21	-14.34	-21.06	-14.65	-17.64	-15.47	-8.91	-10.17	-8.3	-8.5	-6.13
45	-3.2	-4.03	-7.4	-13.26	-13.73	-10.45	-10.76	-15.34	-12.3	-7.82	-4.39	-4.44	-3.93
60	-2.41	-3.63	-5.99	-8.23	-7.72	-9.42	-6.68	-13.49	-7.76	-4.51	-0.51	-2.57	-2.52
75	-2.18	-3.03	-4.47	-4.94	-3.42	-7.28	-11.15	-18.53	-6.27	-1.3	1.49	-1.38	-2.06
90	-2.19	-2.84	-3.41	-3.96	-2.37	-5.99	-13.97	-15.35	-6.82	0.01	1.88	-1.65	-2.6
105	-3.24	-3.7	-3.71	-4	-3.22	-6.95	-13.28	-17.4	-8.33	-0.43	1.25	-3.54	-3.73
120	-5.71	-5.68	-4.8	-5.23	-5.08	-9.64	-11.82	-14.26	-12.47	-2.37	-0.35	-6.35	-5.07
135	-8.92	-9.87	-6.3	-6.82	-8.25	-15.24	-9.39	-13.65	-20.01	-7.31	-3.74	-11.38	-7.14
150	-12.48	-17.16	-8.64	-8.25	-10.35	-14.99	-9.27	-13.78	-9.8	-13.87	-9.05	-17.63	-10.04
165	-19.23	-14.18	-13.95	-11.89	-9.85	-11.23	-11.51	-12.85	-9.45	-12.97	-10.7	-13.56	-13.8
180	-13.53	-8.92	-10.99	-9.61	-12.85	-10.05	-9.79	-13.04	-11.45	-17.7	-8.6	-10.28	-11.13
195	-9.01	-6.46	-5.2	-5.57	-10.58	-10.63	-11.9	-8.75	-13.39	-13.06	-9.48	-8.66	-6.93
210	-6.23	-6.02	-3.39	-5.29	-4.42	-8.11	-17.14	-9.7	-13.08	-7.64	-11.71	-7.69	-4.85
225	-4.19	-5.9	-3.9	-7.61	-3.76	-8.11	-13.2	-12.62	-7.71	-6.59	-6.81	-7.35	-3.7
240	-3.15	-4.96	-5.46	-11.92	-7.12	-11.08	-10.36	-13.93	-7.34	-5.82	-2.87	-7.05	-2.87
255	-2.67	-3.91	-5.66	-12.86	-16.41	-12.98	-10.6	-21.64	-14.7	-5.34	-0.97	-6.59	-2.26
270	-3.37	-3.66	-4.31	-9.71	-16.49	-14.9	-12.05	-12.98	-15.71	-5.75	-0.73	-7.09	-2.51
285	-4.41	-3.6	-3.24	-8.39	-13.16	-15.51	-12.65	-10.25	-10.06	-7.81	-1.51	-6.79	-3.31
300	-5.02	-3.68	-3.1	-9.44	-13.7	-16.45	-11.39	-9.26	-7.7	-11.05	-3.15	-6.69	-4.38
315	-7.33	-5.54	-5.09	-13.94	-14.88	-15.46	-10.78	-9.86	-6.87	-15.35	-5.35	-7.07	-6.76
330	-10.94	-9.08	-8.58	-20.15	-16.44	-11.66	-9.53	-10.4	-6.86	-14.51	-8.64	-6.37	-10.67
345	-18.91	-13.78	-14.44	-19.62	-16.03	-11.53	-6.68	-10.26	-7.98	-10.79	-17.66	-7.33	-16.81
360	-11.9	-12.18	-11.87	-14.98	-11.88	-15.6	-9.79	-9.21	-9.63	-8.75	-12.13	-15.08	-12.39

**Table 67. Board #2: RP\_2400.000\_ver**

Azimuth (deg)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-3.03	-1	-0.7	0.96	-1.36	-0.47	-0.73	-1.02	0.04	2.23	-1.88	-3.43	-2.04
15	-4.05	-1.82	-0.11	0.17	-1.03	-2.6	-0.96	-0.16	0.91	0.03	-2.46	-4.2	-3.37
30	-5.44	-3.03	-0.46	-3.24	-1.69	-2.24	-2.69	-1.16	0.36	-3.02	-1.19	-6.99	-5.5
45	-7.76	-4.65	-3.56	-6	-6.7	-1.68	-0.55	-2.49	-5.49	0.65	-3.43	-12.48	-10.4
60	-12.34	-6.88	-8.76	-7.07	-7.83	-4.48	-2.56	-1.14	-3.61	0.38	-9.71	-19.31	-14.45
75	-17.44	-10.14	-16.4	-10.32	-7.21	-3.89	-5.94	-3.98	-2.29	-4.89	-17.19	-10.63	-12.68
90	-10.47	-12.34	-14.75	-12.33	-7.21	-4.18	-7.63	-12.07	-6.16	-17.23	-7.67	-5.97	-10.13
105	-6.53	-9.81	-7.27	-6.96	-6.17	-6.5	-8.95	-7.16	-8.4	-8.4	-2.88	-3.65	-6.19
120	-4.13	-7.16	-4.92	-4.21	-5.06	-5.73	-5.67	-3.5	-3.74	-4.22	-0.96	-2.39	-3.42
135	-2.8	-4.29	-3.06	-2.75	-3.92	-3.76	-1.97	-0.77	-1.79	-2.3	-0.72	-2.01	-2.34
150	-2.02	-2.98	-1.53	-1.67	-4.18	-3.9	-0.61	0.98	-2.07	-1.08	-1.64	-2.88	-1.89
165	-1.37	-2.4	-0.44	-0.72	-3.29	-6.81	-2.49	0.74	-4.75	0.2	-1.14	-4.62	-1.83
180	-1.63	-2.79	-0.3	-0.47	-0.45	-5.67	-6.7	-3.5	-5	-1.33	-0.31	-5.98	-2.16
195	-2.94	-4.59	-2.61	-1.44	-0.25	-3.34	-2.05	-5	-8.82	-10.82	-2.83	-6.07	-3.41
210	-4.53	-7.23	-8.2	-4.37	-4.22	-3.13	-1.31	-3.99	-9.04	-8.78	-9.16	-5.56	-5.98
225	-6.77	-9.54	-13.55	-14.33	-15.07	-6.51	-7.27	-8.16	-6.68	-5.41	-7.74	-6.37	-9.85
240	-10.12	-9.78	-8.82	-16.27	-10.73	-16.26	-13.57	-12.07	-13.01	-7.75	-6.87	-8.76	-10.83
255	-15.86	-10.56	-7.89	-11.81	-12.29	-9.51	-7.98	-9.19	-8.64	-12.22	-11.2	-11.39	-7.86
270	-12.65	-12.4	-9.96	-10.69	-14.24	-8.96	-10.66	-5.59	-2.73	-7.76	-17.34	-14.63	-5.42
285	-8.22	-11.69	-8.68	-7.19	-7.77	-10.64	-13.95	-5.93	-0.6	-2.48	-6.42	-15.99	-3.4
300	-5.54	-7.72	-4.75	-4.14	-3.59	-6.02	-7.79	-6.16	-0.2	-0.51	-1.88	-12.54	-2.41
315	-4.45	-3.63	-1.24	-1.48	-0.83	-2.46	-2.61	-5.51	-0.33	0.28	0.48	-10.09	-1.72
330	-3.27	-1.35	-0.12	-0.87	1	-2.08	-0.96	-3.9	-0.72	0.01	1.53	-8.87	-1.52
345	-2.75	-0.8	-0.34	-0.72	1.44	-1.4	-2.19	-2.69	0.04	0.56	1.12	-7.19	-1.52
360	-3.03	-1	-0.7	0.96	-1.36	-0.47	-0.73	-1.02	0.04	2.23	-1.88	-3.43	-2.04

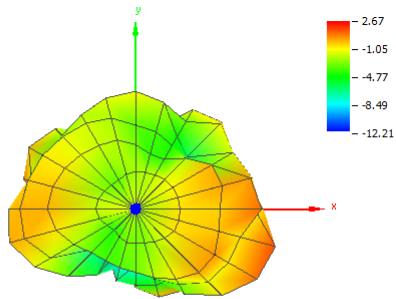


Figure 100. Board #2 (2.40 GHz): Theta = 0, Phi = 0

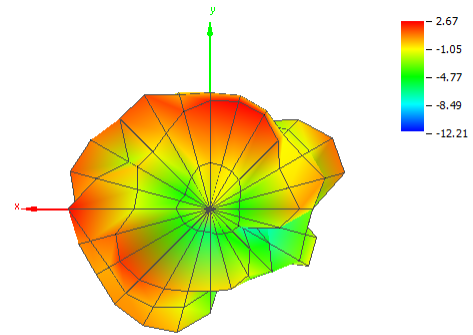


Figure 101. Board #2 (2.40 GHz): Theta = 180, Phi = 0

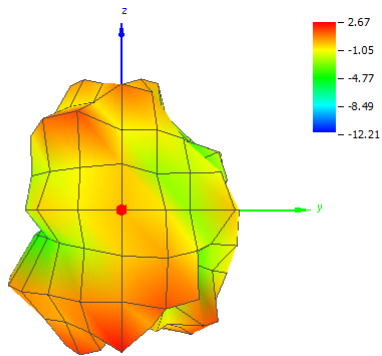


Figure 102. Board #2 (2.40 GHz): Theta = 90, Phi = 0

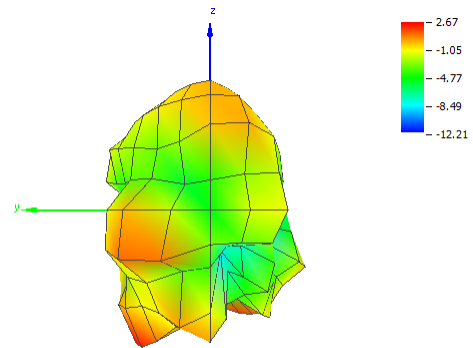


Figure 103. Board #2 (2.40 GHz): Theta = 90, Phi = 180

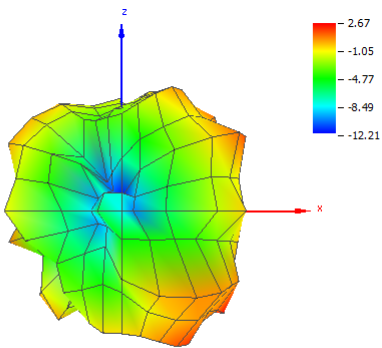


Figure 104. Board #2 (2.40 GHz): Theta = 90, Phi = 270

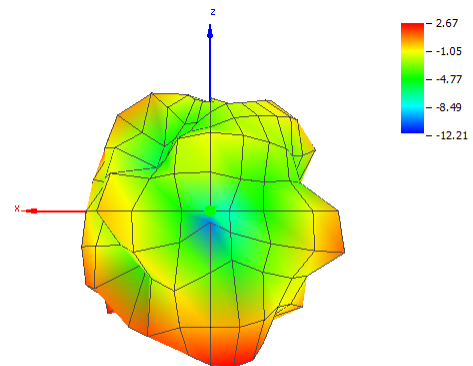


Figure 105. Board #2 (2.40 GHz): Theta = 90, Phi = 90

**A.2.2 2.44 GHz****Table 68. Board #2: OTA Evaluation Results (2.44 GHz)**

Test Description	Test Result
Total Radiated Power	-2.06 dBm
Peak EIRP	2.78 dBm
Directivity	4.84 dBi
Efficiency	-2.06 dB
Efficiency	62.30 %
Peak Gain	2.78 dBi
NHPRP 45°	-4.02 dBm
NHPRP 45° / TRP	-1.96 dB
NHPRP 45° / TRP	63.68 %
NHPRP 30°	-5.85 dBm
NHPRP 30° / TRP	-3.80 dB
NHPRP 30° / TRP	41.71 %
NHPRP 22.5°	-7.15 dBm
NHPRP 22.5° / TRP	-5.09 dB
NHPRP 22.5° / TRP	30.97 %
UHRP	-5.52 dBm
UHRP / TRP	-3.47 dB
UHRP / TRP	45.03 %
LHRP	-4.65 dBm
LHRP / TRP	-2.60 dB
LHRP / TRP	54.97 %
PGRP (0-120°)	-3.80 dBm
PGRP / TRP	-1.74 dB
PGRP / TRP	66.93 %
Front/Back Ratio	7.63
PhiBW	121.5°
PhiBW Up	44.7°
PhiBW Down	76.8°
ThetaBW	43.3°
ThetaBW Up	29.8°
ThetaBW Down	13.6°
Boresight Phi	105°
Boresight Theta	150°
Maximum Power	2.78 dBm
Minimum Power	-14.52 dBm
Average Power	-1.66 dBm
Max/Min Ratio	17.30 dB
Max/Avg Ratio	4.44 dB
Min/Avg Ratio	-12.86 dB
Worst Single Value	-21.71 dBm
Worst Position	Azi = 270°; Elev = 60°; Pol = Horizontal
Best Single Value	2.13 dBm
Best Position	Azi = 90°; Elev = 150°; Pol = Horizontal

**Table 69. Board #2: RP\_2440.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-1.86	-0.49	0.34	-0.59	-1.22	-0.73	-1.31	-2.79	-0.13	0.74	-1.68	-3.42	-1.74
15	-1.1	-0.49	-0.36	-0.85	-2.32	-3.69	-1.83	-1.46	-0.26	-1.59	-2.78	-2.69	-0.86
30	-0.57	-1.11	-0.43	-2.28	-1.8	-5.6	-4.21	-2.28	0.86	-5.91	0.14	-1.54	0
45	-0.61	-2.06	-0.64	-3.95	-2.39	-1.79	0.47	-2.79	-3.02	-0.5	1.35	-0.95	0.33
60	-1.16	-2.58	-1.52	-3.96	-3.36	-4	-1.47	0.66	-2.76	1.93	1.18	-0.79	0.69
75	-1.36	-3.04	-2.75	-3.19	-1.89	-3.6	-5.66	-1.29	-1.1	1.36	1.65	-0.58	0.13
90	-1.32	-3.67	-3.04	-2.24	-0.82	-3.28	-6.19	-7.42	-3.86	0.29	2.46	0	-0.51
105	-1.32	-4.1	-2.19	-1.72	-0.3	-3.89	-6.39	-10.85	-7.06	-0.54	2.78	0.26	-0.23
120	-0.74	-2.74	-1.22	-1.37	-0.21	-3.87	-4.48	-6.48	-5.73	-1.59	2.17	-0.21	-0.12
135	0.14	-1.68	-0.48	-0.48	-1.38	-3.37	-2.1	-1.5	-2.08	-1.78	0.78	-1.34	-0.45
150	0.35	-1.49	0.17	0.01	-2.34	-4.5	-1.8	0.63	-1.14	0.26	-0.24	-2.3	-0.66
165	-0.14	-1.37	0.01	0.65	-0.56	-5.51	-4.88	0.31	-2.82	1.04	0.41	-2.63	-0.29
180	-1.1	-1.9	-1.21	0.95	0.78	-3.34	-7	-5.56	-3.74	-2.36	0.02	-2.79	0.27
195	-2.02	-3.3	-2.92	-0.31	-0.65	-1.78	-1.37	-3.92	-8.37	-12.15	-3.74	-2.74	-0.36
210	-2.39	-3.95	-4.67	-3.64	-4.49	-3.12	-2.49	-2.26	-5.1	-4.04	-6.3	-2.98	-1.41
225	-2.79	-3.59	-5.41	-8.52	-5.87	-6.14	-9.92	-6.2	-2.75	-4.43	-1.99	-4.23	-1.38
240	-2.8	-3.28	-5.83	-6.47	-8.17	-5.48	-9.58	-11.13	-7.22	-4.5	0.04	-4.85	-1.07
255	-2.45	-2.79	-6.18	-5.83	-13.59	-6.61	-7.86	-10.24	-4.63	-2.7	0.39	-5.58	-0.67
270	-2.16	-2.05	-5.75	-6.76	-14.52	-7.6	-8.54	-4	-0.82	-1.89	0.51	-6.38	-0.46
285	-2.17	-2.07	-4.85	-5.59	-7.4	-8.09	-7.41	-2.32	0.49	-1.35	0.71	-7.15	-0.31
300	-2.55	-1.82	-2.58	-2.59	-4.68	-4.05	-4.34	-2.6	0.59	-0.94	1.22	-6.03	-0.01
315	-2.19	-1.18	-0.87	-1.49	-3.16	-0.83	-1.53	-2.52	0.28	-0.86	1.9	-4.55	0.02
330	-2.33	-1.03	0.18	-1.47	-1.43	-0.23	0.38	-2.78	0.19	-0.29	2.5	-3.58	-0.1
345	-2.66	-0.6	0.49	-1.71	0.01	-1.4	0.07	-1.85	0.8	0.15	2.21	-3.62	-0.73
360	-1.86	-0.49	0.34	-0.59	-1.22	-0.73	-1.31	-2.79	-0.13	0.74	-1.68	-3.42	-1.74

**Table 70. Board #2: RP\_2440.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-10.99	-10.89	-10.33	-13.56	-10.94	-21.57	-10.78	-10.06	-10.04	-9.92	-13.64	-15.08	-12.31
15	-6.62	-6.88	-8.61	-11.39	-11.02	-18.3	-14.62	-9.8	-9.11	-13.17	-11.27	-16.67	-8.14
30	-3.57	-5.36	-8.03	-9.43	-17.2	-16.17	-15.26	-11.56	-9.72	-10.99	-8.84	-7.65	-3.92
45	-2.36	-4.86	-7	-9.41	-12.06	-13.79	-9.06	-9.56	-13.61	-7.56	-4.24	-3.48	-1.43
60	-1.88	-4.22	-5.07	-6.74	-6.75	-11.77	-10.06	-12.64	-8.77	-4.2	-0.29	-1.48	-0.35
75	-1.46	-3.73	-3.59	-3.8	-3.41	-8.41	-11.43	-17.22	-6.23	-1.06	1.59	-0.67	-0.5
90	-1.66	-4.2	-3.25	-2.91	-2.14	-7.16	-10.67	-12.26	-6.53	0.08	2.13	-0.93	-0.97
105	-2.7	-5.81	-3.32	-3.56	-2.44	-8.69	-12.83	-12.23	-8.35	-0.75	1.65	-2.07	-1.14
120	-4.2	-7.69	-3.97	-5.6	-4.41	-13.64	-16.13	-13.57	-14.02	-3.08	0.1	-4.14	-2.02
135	-6.36	-11.14	-5.92	-7	-9.57	-17.43	-13.96	-14.12	-14.09	-9.02	-3.21	-7.52	-3.82
150	-10.17	-19.52	-9.21	-8.51	-11.43	-12.17	-9.71	-12.97	-7.6	-20.12	-8.57	-14.51	-6.82
165	-15.82	-14.63	-11.12	-9.24	-9.27	-10.96	-10.09	-11.25	-7.16	-13.55	-11.97	-16.95	-10.38
180	-15.56	-9.46	-8.4	-6.73	-9.55	-11.08	-13.77	-12.29	-12.58	-16.59	-9.06	-10.7	-10.47
195	-11.32	-7.81	-5.66	-4.4	-7.78	-9.71	-10.95	-8.42	-15.01	-13.45	-9.2	-7.92	-7.96
210	-7.88	-6.96	-5.47	-4.99	-6.03	-7.75	-11.51	-10.02	-13.3	-7.88	-9.24	-6.97	-5.36
225	-5.39	-5.87	-7.85	-9.16	-6.21	-7.4	-17.22	-13.53	-8.45	-7.45	-4.94	-7.34	-3.14
240	-3.68	-4.57	-9.97	-15.24	-10.09	-9.52	-10.81	-16.23	-8.52	-5.83	-1.63	-7.71	-2
255	-2.64	-3.21	-7.99	-11.35	-17.36	-11.97	-8.98	-19.49	-12.12	-4.18	0.03	-7.49	-1.35
270	-2.45	-2.2	-6.06	-8.9	-21.71	-10.27	-9.21	-10.54	-12.47	-4.27	0.27	-6.87	-1.33
285	-3.15	-2.77	-6.09	-8.94	-20.44	-10.27	-8.42	-6.57	-8.93	-6.09	-0.37	-7.61	-2.38
300	-5.31	-4.2	-6.81	-9.86	-19.35	-9.41	-7.55	-5.4	-6.54	-9.23	-1.28	-7.48	-4.09
315	-7.15	-5.78	-7.79	-12.39	-19.96	-9.11	-6.69	-5.29	-6.09	-13.25	-3.31	-8	-6.61
330	-10.58	-10.47	-13.88	-17.17	-20.62	-9.59	-6.13	-7.66	-7.02	-15.15	-6.67	-8.45	-9.25
345	-17.38	-18.14	-19.73	-17.48	-17.95	-11.28	-6.3	-9.28	-8.29	-11.52	-14.78	-8.63	-12.73
360	-10.99	-10.89	-10.33	-13.56	-10.94	-21.57	-10.78	-10.06	-10.04	-9.92	-13.64	-15.08	-12.31

**Table 71. Board #2: RP\_2440.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-2.43	-0.9	-0.04	-0.81	-1.71	-0.76	-1.83	-3.69	-0.59	0.35	-1.97	-3.72	-2.14
15	-2.53	-1.62	-1.06	-1.25	-2.95	-3.84	-2.07	-2.15	-0.87	-1.9	-3.44	-2.87	-1.77
30	-3.6	-3.15	-1.26	-3.21	-1.92	-5.99	-4.56	-2.82	0.46	-7.52	-0.45	-2.76	-2.25
45	-5.41	-5.28	-1.78	-5.41	-2.88	-2.08	-0.05	-3.82	-3.42	-1.45	-0.06	-4.51	-4.43
60	-9.31	-7.6	-4.04	-7.21	-6.01	-4.79	-2.11	0.45	-4.01	0.71	-4.22	-9.16	-6.02
75	-17.76	-11.36	-10.34	-12.02	-7.21	-5.35	-7	-1.4	-2.69	-2.34	-16.77	-17.63	-8.54
90	-12.6	-13.12	-16.32	-10.74	-6.63	-5.56	-8.1	-9.16	-7.24	-12.91	-8.89	-7.12	-10.53
105	-6.99	-8.98	-8.6	-6.34	-4.4	-5.64	-7.51	-16.49	-12.95	-13.87	-3.62	-3.56	-7.43
120	-3.34	-4.41	-4.5	-3.43	-2.29	-4.35	-4.79	-7.42	-6.42	-6.96	-2.03	-2.45	-4.61
135	-0.96	-2.2	-1.95	-1.57	-2.09	-3.54	-2.39	-1.74	-2.36	-2.68	-1.42	-2.54	-3.14
150	-0.06	-1.56	-0.37	-0.65	-2.92	-5.32	-2.57	0.44	-2.25	0.22	-0.93	-2.57	-1.87
165	-0.26	-1.58	-0.34	0.18	-1.19	-6.96	-6.43	-0.01	-4.81	0.89	0.15	-2.8	-0.73
180	-1.26	-2.74	-2.13	0.14	0.35	-4.14	-8.03	-6.6	-4.35	-2.52	-0.55	-3.56	-0.12
195	-2.57	-5.2	-6.23	-2.45	-1.59	-2.55	-1.88	-5.82	-9.44	-18.05	-5.19	-4.3	-1.19
210	-3.83	-6.95	-12.44	-9.36	-9.76	-4.96	-3.07	-3.06	-5.81	-6.36	-9.38	-5.19	-3.64
225	-6.26	-7.5	-9.08	-17.16	-17.11	-12.13	-10.82	-7.09	-4.11	-7.43	-5.07	-7.14	-6.17
240	-10.13	-9.19	-7.95	-7.09	-12.64	-7.65	-15.64	-12.74	-13.09	-10.3	-4.92	-8.01	-8.22
255	-16.09	-13.15	-10.86	-7.27	-15.96	-8.1	-14.28	-10.78	-5.48	-8.09	-10.57	-10.07	-9.04
270	-14.02	-16.99	-17.25	-10.85	-15.44	-10.97	-16.98	-5.08	-1.13	-5.64	-12.04	-16.06	-7.89
285	-9.11	-10.31	-10.89	-8.28	-7.62	-12.14	-14.24	-4.36	-0.04	-3.13	-5.86	-17.17	-4.53
300	-5.83	-5.56	-4.64	-3.49	-4.83	-5.54	-7.16	-5.83	-0.34	-1.64	-2.38	-11.5	-2.16
315	-3.87	-3.03	-1.86	-1.86	-3.25	-1.53	-3.11	-5.79	-0.86	-1.12	0.34	-7.16	-1.04
330	-3.03	-1.55	0	-1.59	-1.48	-0.77	-0.72	-4.49	-0.73	-0.43	1.94	-5.3	-0.67
345	-2.81	-0.67	0.45	-1.83	-0.06	-1.87	-1.07	-2.71	0.23	-0.16	2.12	-5.26	-1.01
360	-2.43	-0.9	-0.04	-0.81	-1.71	-0.76	-1.83	-3.69	-0.59	0.35	-1.97	-3.72	-2.14



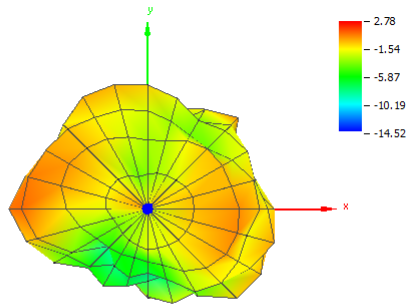


Figure 106. Board #2 (2.44 GHz): Theta = 0, Phi = 0

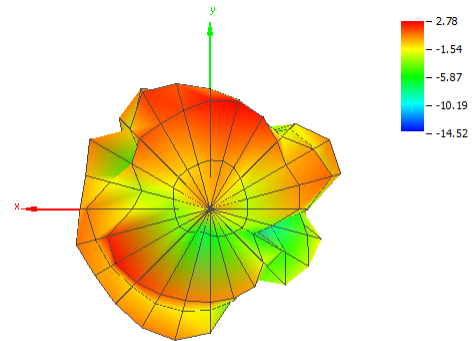


Figure 107. Board #2 (2.44 GHz): Theta = 180, Phi = 0

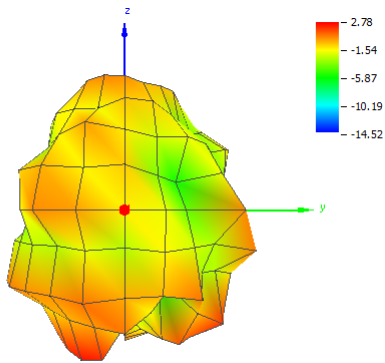


Figure 108. Board #2 (2.44 GHz): Theta = 90, Phi = 0

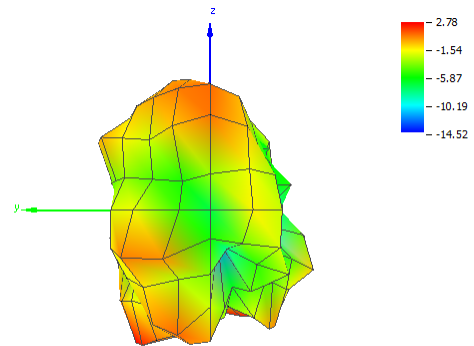


Figure 109. Board #2 (2.44 GHz): Theta = 90, Phi = 180

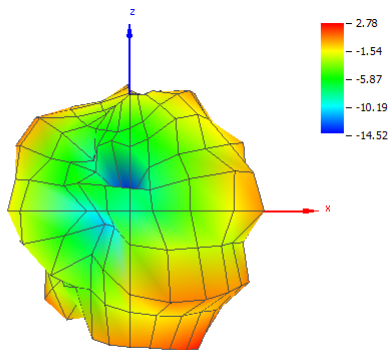


Figure 110. Board #2 (2.44 GHz): Theta = 90, Phi = 270

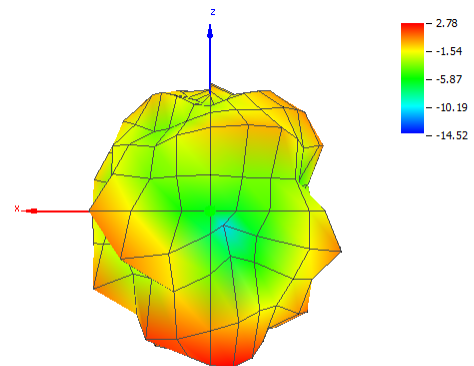


Figure 111. Board #2 (2.44 GHz): Theta = 90, Phi = 90

**A.2.3 2.48 GHz**
**Table 72. Board #2: OTA Evaluation Results (2.48 GHz)**

Test Description	Test Result
Total Radiated Power	-1.46 dBm
Peak EIRP	3.14 dBm
Directivity	4.61 dBi
Efficiency	-1.46 dB
Efficiency	71.40 %
Peak Gain	3.14 dBi
NHPRP 45°	-3.25 dBm
NHPRP 45° / TRP	-1.79 dB
NHPRP 45° / TRP	66.24 %
NHPRP 30°	-4.94 dBm
NHPRP 30° / TRP	-3.48 dB
NHPRP 30° / TRP	44.88 %
NHPRP 22.5°	-6.14 dBm
NHPRP 22.5° / TRP	-4.68 dB
NHPRP 22.5° / TRP	34.06 %
UHRP	-4.17 dBm
UHRP / TRP	-2.71 dB
UHRP / TRP	53.56 %
LHRP	-4.79 dBm
LHRP / TRP	-3.33 dB
LHRP / TRP	46.44 %
PGRP (0-120°)	-2.75 dBm
PGRP / TRP	-1.29 dB
PGRP / TRP	74.30 %
Front/Back Ratio	3.40
PhiBW	80.0°
PhiBW Up	38.5°
PhiBW Down	41.4°
ThetaBW	90.4°
ThetaBW Up	60.4°
ThetaBW Down	30.0°
Boresight Phi	345°
Boresight Theta	30°
Maximum Power	3.14 dBm
Minimum Power	-13.65 dBm
Average Power	-1.21 dBm
Max/Min Ratio	16.79 dB
Max/Avg Ratio	4.35 dB
Min/Avg Ratio	-12.44 dB
Worst Single Value	-21.69 dBm
Worst Position	Azi = 345°; Elev = 60°; Pol = Horizontal
Best Single Value	3.12 dBm
Best Position	Azi = 345°; Elev = 30°; Pol = Vertical

**Table 73. Board #2: RP\_2480.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	0.94	0.87	1.77	0.5	1.3	0.72	-2.49	-6.52	-2.66	0.16	-1.39	-2.06	-0.56
15	0.31	0.5	0.41	1.89	-0.44	0.93	0.3	-3.91	-2.35	0.43	-2.71	-1.17	-0.37
30	-0.53	-0.58	-0.06	2.31	1.06	-3.39	-1.6	0.83	1.16	-3.61	0.09	-1.18	-0.45
45	-1.44	-1.57	-0.58	-0.16	-0.75	-1.22	0.47	-0.3	-1.64	-0.6	1.07	-2.26	-0.19
60	-2.08	-2.57	-2.75	-2.29	-4.46	-2.92	-0.11	1.62	-4.16	2.12	0.1	-2.52	-0.65
75	-1.82	-3.5	-3.77	-3.1	-3.16	-3.64	-1.91	0.66	-0.85	1.33	0.19	-2.07	-1.64
90	-2.03	-4.06	-3.66	-3.38	-0.97	-1.43	-2.57	-2.63	-1.59	0.05	1.32	-1.19	-1.06
105	-2.02	-3.37	-3.12	-2.65	0.21	-1.12	-2.12	-3.92	-3.45	-0.89	1.94	-1.03	-0.66
120	-0.79	-3.06	-1.24	-0.66	0.24	-1.43	-0.57	-0.97	-3.03	-1.03	1.52	-1.41	-0.45
135	0.42	-2.6	0.01	0.27	-0.67	-1.76	0.41	0.98	-1.47	-0.66	0.2	-2.03	-0.08
150	0.65	-1.13	0.54	1.15	-1.68	-1.99	0.33	1.08	-2.22	0.29	-0.84	-2.83	0.76
165	0.02	-0.83	0.76	2.07	0.09	-1.9	-1.72	-1.66	-3.79	-0.16	-0.26	-3.29	1.27
180	-0.36	-1.55	0.09	2.56	1.65	-1	-2.73	-8.12	-4.47	-7.38	-0.47	-4.54	0.69
195	-0.44	-2.15	-1.84	1.86	0.56	0.44	0.49	-2.69	-10.46	-8.05	-4.02	-4.7	-0.23
210	-1.19	-2.57	-3.12	-1.34	-2.7	-0.39	-2.68	-4.85	-3.47	-2.95	-6.22	-4.88	-0.88
225	-1.65	-2.93	-3.19	-5.76	-5.85	-5.56	-10.96	-8.92	-3.32	-4.7	-1.65	-5.23	-1.31
240	-1.83	-3.03	-3.42	-4.74	-10.8	-4.79	-6.28	-13.26	-7.18	-4.19	-0.18	-6.04	-1.26
255	-1.84	-3.43	-3.77	-3.14	-13.65	-4.87	-9.47	-9.24	-3.99	-2.43	-0.53	-7.23	-1.37
270	-1.79	-3.44	-2.82	-3.68	-9.11	-8.95	-10.88	-5.89	-0.97	-2.11	-0.39	-7.28	-0.8
285	-1.15	-2.59	-1.54	-3.24	-5.42	-7.49	-6.36	-4.62	-0.11	-2.74	0.27	-6.41	-0.5
300	-0.43	-2.2	-0.18	-1.61	-3.97	-3.29	-3.96	-4.74	-0.25	-2.71	1.03	-5.68	-0.26
315	0.03	-0.97	1.2	0.08	-2.72	-0.73	-2.53	-4.95	-0.54	-2.54	1.49	-5.29	-0.4
330	0.93	0.34	2.66	1.4	-1.36	1.33	-0.25	-6.21	-1.65	-2.79	1.68	-4.74	-1.02
345	1.35	1.18	3.14	1.09	0.33	1.02	0.35	-6.65	-2.42	-2.86	1.31	-3.77	-1.13
360	0.94	0.87	1.77	0.5	1.3	0.72	-2.49	-6.52	-2.66	0.16	-1.39	-2.06	-0.56

**Table 74. Board #2: RP\_2480.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-10.89	-12.83	-10.51	-13.66	-9.52	-13.86	-10.31	-10.16	-12.09	-6.57	-12.85	-11.29	-17.12
15	-8.29	-8.35	-8.05	-11	-8.49	-14.74	-13.75	-7.35	-9.65	-7.11	-9.99	-19.9	-10.72
30	-6.26	-5.83	-6.11	-8.58	-13.28	-20.37	-15.62	-8.47	-6.45	-7.01	-9.9	-11.26	-5.78
45	-4.55	-4.28	-5.36	-8.28	-10.27	-12.66	-12.69	-9.59	-8.83	-6.36	-7.13	-6.29	-3.64
60	-2.88	-3.42	-4.73	-6.34	-7.22	-7.22	-9.69	-16.47	-8.34	-5.11	-2.62	-3.34	-2.7
75	-2	-3.69	-4.13	-4.39	-4.5	-5.67	-7.05	-15.62	-6.69	-2.61	-0.12	-2.21	-2.5
90	-2.47	-4.77	-3.99	-3.64	-2.09	-4.27	-8.43	-10.7	-7.15	-1.1	1.12	-2.16	-1.76
105	-3.73	-5.9	-4.93	-4.85	-2.15	-4.83	-10.33	-11.4	-8.13	-1.41	1.05	-2.91	-1.38
120	-4.23	-8.58	-6.22	-5.88	-4.84	-8.08	-13.09	-15.62	-13.62	-4.19	-0.93	-4.56	-2.06
135	-5.12	-13.96	-7.62	-7.34	-8.11	-18.45	-15.73	-16.49	-14.51	-10.31	-5.25	-7.24	-3.88
150	-8.44	-21.41	-10.59	-11.08	-10.55	-11.47	-12.78	-13.08	-8.6	-18.04	-12.29	-11.46	-7.06
165	-15.31	-12.71	-12.28	-9.63	-11.46	-8.76	-10.03	-8.87	-8.66	-14.21	-13.27	-14.62	-10.93
180	-19.91	-8.65	-6.87	-4.65	-10.54	-14.75	-14.09	-11.7	-13.08	-21.08	-10.1	-12.4	-15.77
195	-11.54	-7.27	-4.49	-2.67	-5.34	-7.68	-19.06	-11.96	-17.25	-12.61	-10.73	-9.61	-11.24
210	-6.82	-6.39	-4.62	-3.28	-3.8	-5.35	-11.17	-9.47	-11.55	-8.92	-11.1	-8.17	-6.33
225	-4.14	-5.41	-6.21	-6.53	-6.78	-6.26	-12.33	-11.64	-8.06	-7.87	-5.79	-7.72	-3.67
240	-2.66	-4.26	-6.39	-8.81	-16.08	-10.58	-16.05	-14.86	-10.88	-5.61	-2.29	-8.26	-1.97
255	-2.01	-3.88	-4.79	-5.79	-16.65	-17.76	-15.71	-20.65	-14.51	-4.56	-1.07	-9.17	-1.56
270	-2.03	-3.58	-3.24	-3.98	-11.99	-10.94	-14.78	-12.48	-12.7	-4.71	-0.94	-8.18	-1.2
285	-2.21	-3.25	-2.42	-4.12	-10.02	-8.83	-11.56	-7.19	-9.24	-5.74	-1.69	-7.02	-1.76
300	-3.16	-4.84	-3.71	-5.5	-11.34	-8.88	-9.6	-5.61	-6.65	-8.43	-2.7	-7.78	-3.25
315	-5.47	-6.76	-5.82	-8.94	-13.69	-10.26	-8.98	-6.13	-5.98	-11.79	-4.2	-8.32	-5.28
330	-9.09	-10.37	-9.47	-16.66	-18.1	-12.57	-7.56	-8.9	-7.71	-13.33	-7.34	-9.78	-9.26
345	-15.06	-16.35	-20.36	-20.65	-21.69	-12.06	-8.03	-12.82	-10.16	-10.77	-14.4	-9.29	-13.91
360	-10.89	-12.83	-10.51	-13.66	-9.52	-13.86	-10.31	-10.16	-12.09	-6.57	-12.85	-11.29	-17.12

**Table 75. Board #2: RP\_2480.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	0.65	0.68	1.51	0.33	0.93	0.57	-3.28	-8.99	-3.19	-0.88	-1.72	-2.61	-0.65
15	-0.34	-0.11	-0.26	1.66	-1.18	0.81	0.13	-6.53	-3.25	-0.41	-3.61	-1.23	-0.79
30	-1.89	-2.12	-1.3	1.94	0.9	-3.48	-1.78	0.28	0.33	-6.26	-0.37	-1.63	-1.96
45	-4.34	-4.9	-2.34	-0.88	-1.26	-1.54	0.26	-0.84	-2.56	-1.94	0.36	-4.44	-2.8
60	-9.84	-10.08	-7.09	-4.46	-7.73	-4.94	-0.62	1.55	-6.26	1.21	-3.21	-10.14	-4.9
75	-15.69	-17.31	-14.83	-9	-8.93	-7.92	-3.49	0.56	-2.16	-0.92	-11.44	-17.05	-9.12
90	-12.21	-12.28	-14.93	-15.78	-7.41	-4.63	-3.87	-3.36	-3.01	-6.3	-12.26	-8.16	-9.36
105	-6.9	-6.91	-7.8	-6.65	-3.57	-3.53	-2.83	-4.77	-5.26	-10.34	-5.4	-5.57	-8.81
120	-3.41	-4.49	-2.9	-2.22	-1.37	-2.49	-0.82	-1.12	-3.43	-3.89	-2.13	-4.29	-5.53
135	-1	-2.93	-0.82	-0.56	-1.54	-1.85	0.31	0.9	-1.69	-1.15	-1.26	-3.58	-2.42
150	0.08	-1.17	0.19	0.88	-2.29	-2.51	0.12	0.91	-3.35	0.23	-1.16	-3.47	-0.02
165	-0.11	-1.12	0.54	1.76	-0.23	-2.9	-2.42	-2.58	-5.5	-0.34	-0.48	-3.63	1
180	-0.4	-2.49	-0.88	1.65	1.37	-1.18	-3.06	-10.64	-5.11	-7.57	-0.97	-5.32	0.59
195	-0.79	-3.74	-5.24	-0.02	-0.73	-0.29	0.44	-3.24	-11.49	-9.93	-5.07	-6.38	-0.59
210	-2.58	-4.9	-8.45	-5.76	-9.21	-2.07	-3.34	-6.69	-4.21	-4.22	-7.93	-7.63	-2.34
225	-5.25	-6.55	-6.2	-13.63	-13.01	-13.85	-16.62	-12.25	-5.1	-7.55	-3.76	-8.84	-5.08
240	-9.42	-9.11	-6.47	-6.9	-12.33	-6.12	-6.76	-18.36	-9.6	-9.75	-4.32	-10.02	-9.47
255	-16.02	-13.55	-10.57	-6.54	-16.67	-5.1	-10.65	-9.56	-4.39	-6.55	-9.86	-11.65	-15.01
270	-14.41	-18.41	-13.19	-15.41	-12.25	-13.31	-13.15	-6.96	-1.27	-5.56	-9.67	-14.57	-11.42
285	-7.78	-11.12	-8.91	-10.59	-7.27	-13.24	-7.92	-8.11	-0.67	-5.75	-4.14	-15.19	-6.48
300	-3.73	-5.62	-2.73	-3.9	-4.84	-4.7	-5.34	-12.18	-1.37	-4.06	-1.36	-9.84	-3.3
315	-1.41	-2.3	0.24	-0.5	-3.08	-1.24	-3.64	-11.18	-2.01	-3.09	0.12	-8.28	-2.1
330	0.47	-0.05	2.38	1.33	-1.45	1.15	-1.15	-9.57	-2.89	-3.19	1.1	-6.37	-1.72
345	1.25	1.1	3.12	1.06	0.3	0.8	-0.33	-7.85	-3.22	-3.62	1.2	-5.2	-1.36
360	0.65	0.68	1.51	0.33	0.93	0.57	-3.28	-8.99	-3.19	-0.88	-1.72	-2.61	-0.65

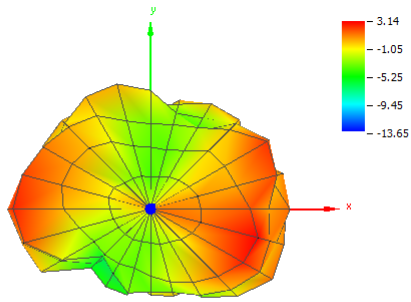


Figure 112. Board #2 (2.48 GHz): Theta = 0, Phi = 0

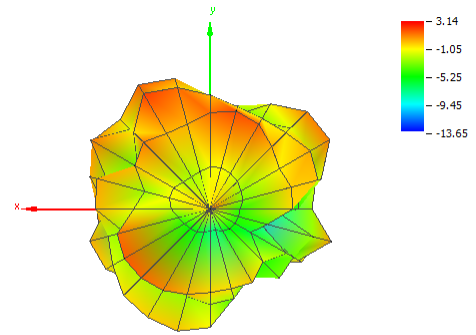


Figure 113. Board #2 (2.48 GHz): Theta = 180, Phi = 0

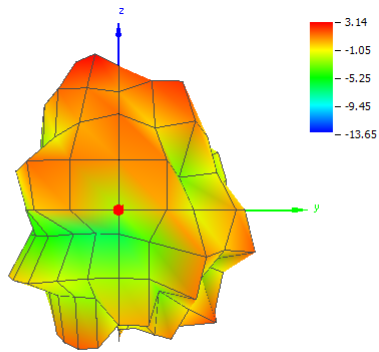


Figure 114. Board #2 (2.48 GHz): Theta = 90, Phi = 0

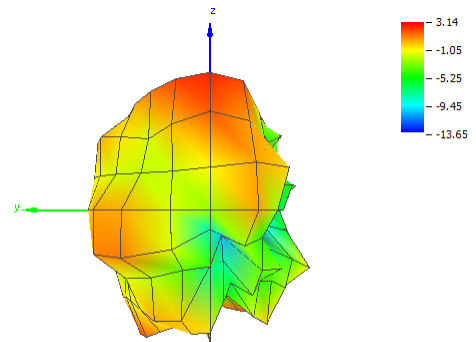


Figure 115. Board #2 (2.48 GHz): Theta = 90, Phi = 180

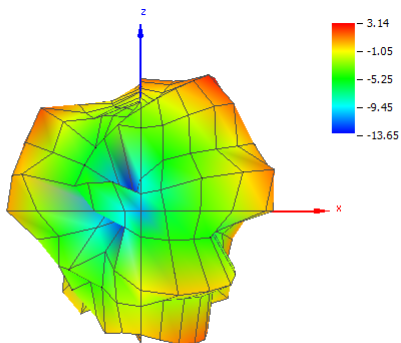


Figure 116. Board #2 (2.48 GHz): Theta = 90, Phi = 270

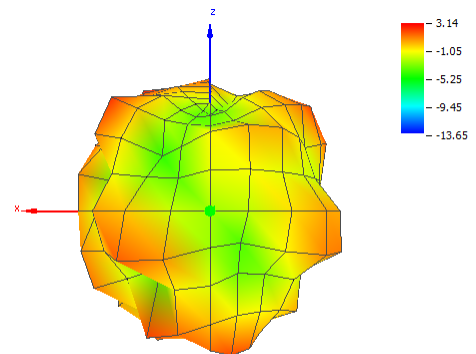


Figure 117. Board #2 (2.48 GHz): Theta = 90, Phi = 90

### A.3 Board #3: Fractus Dual-Band 868 MHz and 2.4 GHz Chip Antenna

#### A.3.1 868 MHz

**Table 76. Board #3: OTA Evaluation Results (868 MHz)**

Test Description	Test Result
Total Radiated Power	-3.32 dBm
Peak EIRP	0.60 dBm
Directivity	3.92 dBi
Efficiency	-3.32 dB
Efficiency	46.61%
Peak Gain	0.60 dBi
NHPRP 45°	-5.15 dBm
NHPRP 45° / TRP	-1.84 dB
NHPRP 45° / TRP	65.53%
NHPRP 30°	-6.70 dBm
NHPRP 30° / TRP	-3.39 dB
NHPRP 30° / TRP	45.84%
NHPRP 22.5°	-8.04 dBm
NHPRP 22.5° / TRP	-4.72 dB
NHPRP 22.5° / TRP	33.72%
UHRP	-6.27 dBm
UHRP / TRP	-2.95 dB
UHRP / TRP	50.68%
LHRP	-6.39 dBm
LHRP / TRP	-3.07 dB
LHRP / TRP	49.32%
PGRP (0-120°)	-4.68 dBm
PGRP / TRP	-1.36 dB
PGRP / TRP	73.08%
Front/Back Ratio	0.93
PhiBW	87.9°
PhiBW Up	60.5°
PhiBW Down	27.4°
ThetaBW	37.0°
ThetaBW Up	28.3°
ThetaBW Down	8.7°
Boresight Phi	165°
Boresight Theta	105°
Maximum Power	0.60 dBm
Minimum Power	-20.45 dBm
Average Power	-2.60 dBm
Max/Min Ratio	21.05 dB
Max/Avg Ratio	3.20 dB
Min/Avg Ratio	-17.85 dB
Worst Single Value	-31.55 dBm
Worst Position	Azi = 15°; Elev = 180°; Pol = Horizontal
Best Single Value	0.55 dBm
Best Position	Azi = 165°; Elev = 105°; Pol = Vertical

**Table 77. Board #3: RP\_868.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-0.74	-0.88	-1.37	-2.54	-1.37	-0.04	-1.06	-1.13	-2.73	-2.14	-0.33	-0.19	-0.53
15	-1.08	-0.36	-1.18	-1.59	-1.47	0.22	-1.4	-1.12	-2.58	-1.43	-0.17	-0.24	0.33
30	-1.1	-0.01	-1.22	-1.05	-1.95	0.14	-1.93	-1.22	-2.29	-1.07	-0.31	-0.51	-0.4
45	-0.82	-0.24	-1.37	-1.31	-2.82	-1.17	-3.26	-1.97	-2.47	-2.38	-1.18	-1.16	-0.85
60	-0.55	-0.6	-1.99	-1.96	-3.94	-2.93	-4.55	-3.33	-3.38	-4.38	-2.45	-1.75	-1.32
75	-0.46	-0.99	-2.44	-3.68	-5.57	-5.45	-8.31	-6.28	-5.47	-7.75	-4.25	-2.63	-1.9
90	-0.51	-1.53	-2.8	-4.83	-7.54	-8.12	-15.82	-10.46	-7.45	-10.9	-6.02	-3.51	-2.1
105	-0.81	-2.23	-3.25	-6.5	-8	-10.78	-17.95	-12.97	-8.45	-12	-7.79	-4.45	-1.98
120	-0.96	-2.71	-3.47	-7.33	-6.85	-9.36	-9.42	-7.31	-6.49	-10.08	-8.16	-4.89	-1.54
135	-1.27	-2.72	-3.28	-6.02	-4.45	-6.42	-5.94	-2.8	-3.88	-7.22	-7.01	-4.7	-1.27
150	-1.26	-2.92	-2.77	-4.3	-2.35	-4.91	-3.96	-0.47	-1.54	-4.72	-5.29	-4.57	-1.04
165	-0.85	-2.41	-2.01	-2.63	-0.5	-3.15	-4.55	0.6	-0.33	-2.67	-3.53	-3.38	-0.87
180	-0.2	-1.91	-1.37	-2	0.36	-1.46	-4.35	0.34	-0.18	-1.55	-2.48	-2.78	-1.08
195	0.44	-1.81	-0.51	-3.56	0.53	0.34	-3.41	-1.62	-0.68	-1.42	-2.17	-2.68	-1.82
210	-0.02	-0.11	-0.84	-2.63	-0.96	0.1	-4.67	-2.1	-1.77	-1.67	-2.42	-2.29	-3.63
225	0.19	0.48	-1.31	-3.66	-1.91	-0.86	-6.87	-2.39	-4.01	-1.95	-2.95	-2.75	-4.17
240	-0.22	0.54	-2.28	-3.66	-4.21	-3.38	-8.75	-2.55	-6.33	-2.34	-3.3	-3.79	-4.12
255	-0.76	-0.02	-3.12	-4.66	-7.72	-7.42	-12.08	-5.44	-7.58	-3.25	-3.75	-4.26	-3.28
270	-1.18	-1.15	-4.12	-6.68	-12.33	-12.91	-17.17	-9.41	-7.43	-3.74	-3.77	-4.29	-2.72
285	-2.01	-2.55	-4.71	-9.52	-16.28	-20.45	-16.78	-12.21	-7.51	-3.84	-3.07	-3.76	-2.85
300	-1.82	-3.12	-4.98	-11.4	-13.33	-11.42	-11.19	-11.03	-7.41	-3.53	-1.92	-3.21	-2.55
315	-1.55	-2.93	-3.99	-9.45	-8.51	-5.72	-6.96	-8	-6.31	-2.62	-0.88	-2.67	-2.16
330	-0.94	-2.24	-2.82	-7.39	-4.79	-2.77	-4.3	-5.35	-4.92	-1.63	-0.19	-1.96	-1.82
345	-0.63	-0.94	-2.1	-4.74	-2.54	-0.33	-3.15	-3.16	-3.52	-0.41	0.07	-1.22	-1.95
360	-0.74	-0.88	-1.37	-2.54	-1.37	-0.04	-1.06	-1.13	-2.73	-2.14	-0.33	-0.19	-0.53



**Table 78. Board #3: RP\_868.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-22.78	-19.64	-19.62	-22.04	-12.93	-15.65	-19.73	-15.4	-24.33	-17.38	-14.9	-15.36	-17.01
15	-17.61	-20.76	-29.71	-19.53	-11.89	-14.24	-18.47	-17.95	-18.6	-16.06	-24.1	-26.61	-31.55
30	-9.52	-11.16	-15.21	-15.39	-12.22	-12.28	-13.23	-20.09	-13.38	-15.35	-15.13	-17.43	-14.14
45	-5.08	-6.6	-9.27	-11.97	-10.56	-10.94	-21.77	-19.26	-10.14	-15.03	-11.73	-10.81	-8.32
60	-2.73	-4.29	-7.01	-9.46	-9.76	-10.93	-15.49	-16.88	-8.59	-14.23	-9.58	-7.57	-5.53
75	-1.41	-2.74	-4.86	-7.75	-8.98	-10.76	-30.29	-14.39	-8.32	-12.74	-8.32	-5.71	-3.73
90	-0.77	-2.38	-3.65	-7.34	-8.66	-10.82	-27.51	-14.05	-8.07	-11.96	-7.79	-4.92	-2.63
105	-0.81	-2.38	-3.43	-6.99	-8.08	-11.36	-27.02	-15.29	-8.74	-12.59	-8.26	-4.72	-1.99
120	-1.12	-2.93	-3.82	-7.53	-8.51	-12.16	-23.98	-18.1	-9.38	-13.99	-8.9	-4.94	-1.87
135	-2.2	-3.71	-5.11	-8.53	-8.8	-11.99	-20.17	-18.79	-11.48	-15.87	-10.09	-5.69	-2.7
150	-3.8	-5.6	-6.98	-11.45	-9.66	-13.68	-13.1	-20.39	-12.74	-16.57	-12.23	-7.44	-4.17
165	-6.68	-8.57	-10.36	-15.59	-11.47	-14.89	-16.06	-18.9	-14.15	-18.19	-15.8	-9.88	-6.49
180	-11.21	-16.57	-15.14	-24.61	-12.8	-18.85	-16.39	-21.78	-14.72	-20.72	-16.57	-15.56	-10.19
195	-29.07	-17.24	-22.75	-20.94	-11.33	-14.55	-14.82	-27.28	-15.65	-20.07	-12.05	-22.56	-19.58
210	-14.31	-9.55	-14.77	-8.39	-13.57	-13.54	-18.45	-23.12	-17.62	-15	-8.54	-13.9	-18.43
225	-7.34	-6.15	-9.57	-10.18	-16.83	-12.84	-26.24	-18.95	-18.31	-6.75	-6.02	-9.8	-10.01
240	-4.53	-4.43	-6.25	-9.05	-15.45	-15.3	-22.62	-16.29	-14.13	-4.93	-4.76	-7.47	-6.05
255	-2.92	-3.27	-4.88	-9.16	-15.84	-20.73	-26.91	-14.43	-10.37	-4.59	-4.24	-5.45	-3.74
270	-1.9	-2.85	-4.61	-9.37	-16.5	-21.6	-22.51	-13.3	-8.67	-4.18	-3.8	-4.44	-2.83
285	-2.05	-2.8	-4.74	-10.05	-18.51	-21.46	-22.84	-12.46	-8.81	-4.21	-3.42	-3.93	-3.23
300	-2.21	-3.27	-5.53	-11.98	-30.33	-19.68	-20.2	-12.28	-9.67	-4.85	-3.16	-4.08	-3.72
315	-3.59	-4.56	-6.36	-13.54	-24.22	-17.26	-19.21	-12.78	-10.69	-5.48	-3.65	-5.1	-4.82
330	-5.73	-6.72	-7.83	-14.91	-17.92	-15.17	-18.12	-13.45	-12.28	-6.83	-4.82	-6.7	-6.27
345	-9.72	-9.26	-10.66	-16.78	-14.26	-13.13	-18.14	-13.81	-14.83	-7.71	-7.27	-8.83	-9.58
360	-22.78	-19.64	-19.62	-22.04	-12.93	-15.65	-19.73	-15.4	-24.33	-17.38	-14.9	-15.36	-17.01

**Table 79. Board #3: RP\_868.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-0.77	-0.94	-1.44	-2.59	-1.69	-0.16	-1.12	-1.3	-2.76	-2.27	-0.48	-0.32	-0.62
15	-1.18	-0.4	-1.19	-1.66	-1.89	0.06	-1.49	-1.21	-2.69	-1.58	-0.18	-0.25	0.32
30	-1.77	-0.36	-1.4	-1.21	-2.38	-0.12	-2.26	-1.27	-2.64	-1.23	-0.45	-0.6	-0.59
45	-2.86	-1.38	-2.14	-1.7	-3.62	-1.65	-3.32	-2.05	-3.28	-2.62	-1.59	-1.65	-1.71
60	-4.59	-3.02	-3.64	-2.82	-5.26	-3.68	-4.91	-3.53	-4.94	-4.85	-3.38	-3.07	-3.39
75	-7.53	-5.79	-6.14	-5.84	-8.22	-6.97	-8.34	-7.01	-8.64	-9.41	-6.4	-5.57	-6.53
90	-12.8	-9.02	-10.31	-8.41	-13.96	-11.46	-16.12	-12.96	-16.19	-17.52	-10.78	-9.07	-11.49
105	-30.54	-17.2	-17.19	-16.19	-25.32	-19.85	-18.52	-16.81	-20.31	-20.94	-17.63	-16.68	-25.87
120	-15.45	-15.75	-14.54	-20.83	-11.82	-12.59	-9.57	-7.68	-9.62	-12.34	-16.19	-23.73	-12.91
135	-8.4	-9.62	-7.91	-9.61	-6.45	-7.83	-6.1	-2.91	-4.71	-7.85	-9.94	-11.6	-6.79
150	-4.8	-6.29	-4.84	-5.23	-3.25	-5.53	-4.53	-0.52	-1.88	-5.01	-6.27	-7.72	-3.94
165	-2.16	-3.61	-2.69	-2.85	-0.86	-3.46	-4.87	0.55	-0.51	-2.79	-3.79	-4.48	-2.26
180	-0.56	-2.06	-1.56	-2.03	0.14	-1.53	-4.63	0.31	-0.33	-1.6	-2.65	-3.01	-1.65
195	0.43	-1.93	-0.54	-3.63	0.23	0.19	-3.74	-1.63	-0.82	-1.48	-2.64	-2.73	-1.89
210	-0.18	-0.64	-1.01	-3.98	-1.2	-0.09	-4.85	-2.13	-1.89	-1.88	-3.64	-2.6	-3.77
225	-0.66	-0.59	-2.01	-4.76	-2.06	-1.15	-6.92	-2.49	-4.17	-3.7	-5.9	-3.7	-5.48
240	-2.23	-1.13	-4.51	-5.14	-4.55	-3.67	-8.93	-2.74	-7.12	-5.82	-8.75	-6.22	-8.58
255	-4.82	-2.8	-7.89	-6.57	-8.45	-7.63	-12.22	-6.02	-10.81	-9.01	-13.5	-10.47	-13.23
270	-9.37	-6.06	-13.86	-10.04	-14.42	-13.54	-18.67	-11.69	-13.51	-13.91	-25.54	-19.02	-18.86
285	-22.23	-15.09	-25.99	-18.88	-20.23	-27.26	-18.02	-24.69	-13.4	-14.78	-14.22	-18.04	-13.58
300	-12.45	-17.89	-14.28	-20.41	-13.42	-12.12	-11.77	-17.05	-11.33	-9.34	-7.98	-10.63	-8.83
315	-5.79	-7.99	-7.77	-11.6	-8.63	-6.03	-7.22	-9.76	-8.28	-5.78	-4.14	-6.34	-5.54
330	-2.69	-4.16	-4.47	-8.24	-5.01	-3.03	-4.49	-6.08	-5.8	-3.19	-2.01	-3.74	-3.75
345	-1.21	-1.63	-2.76	-5.02	-2.85	-0.56	-3.29	-3.55	-3.85	-1.31	-0.82	-2.04	-2.77
360	-0.77	-0.94	-1.44	-2.59	-1.69	-0.16	-1.12	-1.3	-2.76	-2.27	-0.48	-0.32	-0.62

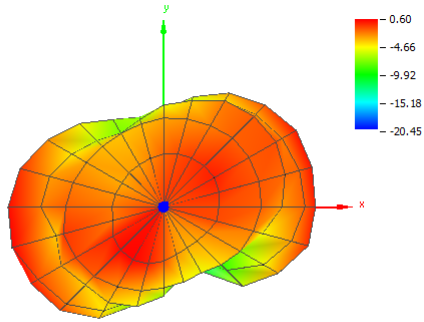


Figure 118. Board #3 (868 MHz): Theta = 0, Phi = 0

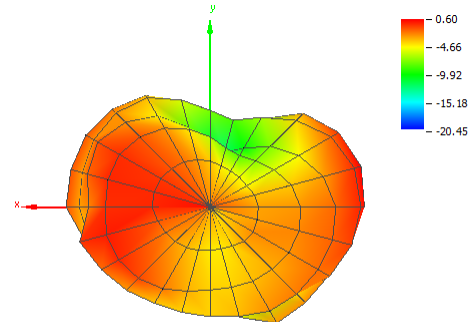


Figure 119. Board #3 (868 MHz): Theta = 180, Phi = 0

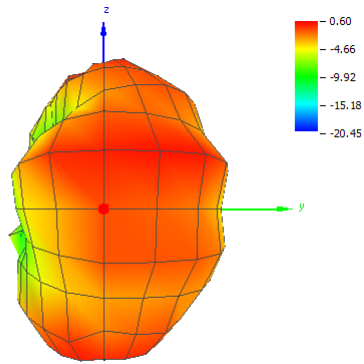


Figure 120. Board #3 (868 MHz): Theta = 90, Phi = 0

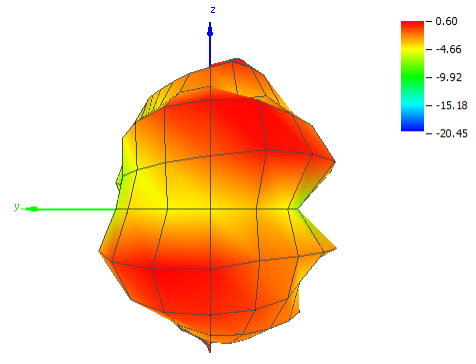


Figure 121. Board #3 (868 MHz): Theta = 90, Phi = 180

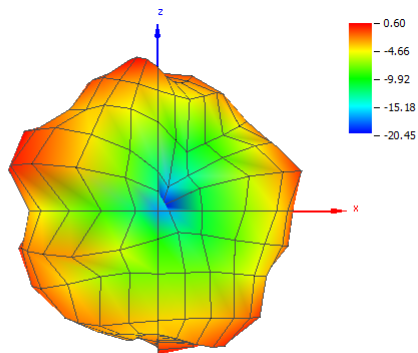


Figure 122. Board #3 (868 MHz): Theta = 90, Phi = 270

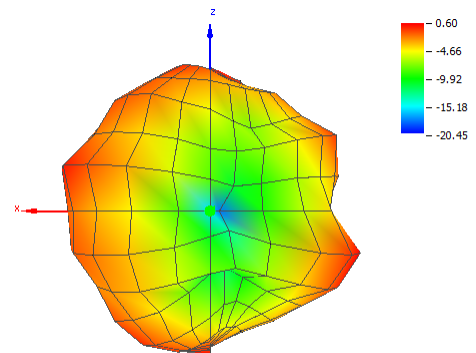


Figure 123. Board #3 (868 MHz): Theta = 90, Phi = 90

**A.3.2 2.40 GHz**
**Table 80. Board #3: OTA Evaluation Results (2.40 GHz)**

Test Description	Test Result
Total Radiated Power	-2.53 dBm
Peak EIRP	1.84 dBm
Directivity	4.38 dBi
Efficiency	-2.53 dB
Efficiency	0.5579
Peak Gain	1.84 dBi
NHPRP 45°	-4.06 dBm
NHPRP 45° / TRP	-1.53 dB
NHPRP 45° / TRP	0.7033
NHPRP 30°	-5.68 dBm
NHPRP 30° / TRP	-3.15 dB
NHPRP 30° / TRP	0.4842
NHPRP 22.5°	-6.92 dBm
NHPRP 22.5° / TRP	-4.39 dB
NHPRP 22.5° / TRP	0.364
UHRP	-5.10 dBm
UHRP / TRP	-2.56 dB
UHRP / TRP	0.5542
LHRP	-6.04 dBm
LHRP / TRP	-3.51 dB
LHRP / TRP	0.4458
PGRP (0-120°)	-3.61 dBm
PGRP / TRP	-1.08 dB
PGRP / TRP	0.7798
Front/Back Ratio	6.51
PhiBW	109.2°
PhiBW Up	47.4°
PhiBW Down	61.8°
ThetaBW	39.9°
ThetaBW Up	27.6°
ThetaBW Down	12.3°
Boresight Phi	90°
Boresight Theta	15°
Maximum Power	1.84 dBm
Minimum Power	-11.69 dBm
Average Power	-2.92 dBm
Max/Min Ratio	13.53 dB
Max/Avg Ratio	4.76 dB
Min/Avg Ratio	-8.77 dB
Worst Single Value	-22.07 dBm
Worst Position	Azi = 225°; Elev = 15°; Pol = Horizontal
Best Single Value	1.18 dBm
Best Position	Azi = 60°; Elev = 15°; Pol = Vertical

**Table 81. Board #3: RP\_2400.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-2.03	-3.07	-6.05	-3.91	-7.23	-6.63	-5.76	-11.01	-9.24	-8.97	-2.96	-5.91	-6.59
15	-2.41	-2.62	-7.5	-4.57	-7.74	-10.97	-11.69	-11.18	-10.07	-9.53	-4.64	-7.07	-7.62
30	-0.99	-0.96	-4.95	-4.65	-8.93	-9.05	-7.79	-8.4	-6.14	-7.03	-5.47	-7.26	-6.71
45	-0.63	0.05	-1.44	-4.26	-2.65	-5.49	-5.39	-5.01	-2.23	-6.34	-6.44	-6.94	-6.85
60	-1.12	1.32	1.08	-2.91	-1.02	-3.16	-1.48	-7.73	-1.71	-3.85	-0.53	-5.72	-4.92
75	-0.92	1.49	0.7	-2.61	0.03	-2.47	-1.62	-6.45	-1.65	0.6	-2.58	-4.8	-4.88
90	-1.81	1.84	0.12	-1.41	-0.88	-2.37	-2.59	-2.25	-2.23	0.52	-0.37	-3.31	-5.87
105	-3.1	1.64	-0.72	-1.86	-0.91	-4.82	-4.97	-7.58	-3	-0.75	-1.33	-2.39	-5.64
120	-2.17	-0.58	-0.29	-0.77	-0.96	-3.52	-4.58	-8.3	-1.91	-2.24	-0.97	-4.06	-6.16
135	-3.78	-0.86	-0.01	-0.48	0.05	-2.39	-1.72	-3.38	-1.13	-1.85	-1.25	-3.13	-6.18
150	-4.2	-2.75	0.42	-0.09	1.15	-0.82	-1.1	-1.91	-0.62	-1.03	-1.68	-2.54	-6.1
165	-4.5	-2.42	0.74	-0.29	1.28	-0.13	-0.25	0.26	-0.42	-0.28	-3.09	-4.41	-7.38
180	-3.82	-2.65	-0.08	-0.91	0.11	0.59	-0.89	-1.16	0.29	-2.43	-6.56	-6.4	-7.94
195	-4.8	-5.09	-1.14	-2.08	-2.02	-1.71	-3.03	-1.27	-4.66	-3.93	-10.03	-9.1	-9.78
210	-2.94	-4.51	-3.76	-4.51	-4.9	-4.56	-3.94	-3.73	-7.22	-6.35	-6.9	-9.77	-3.89
225	-5.57	-6.23	-4.54	-2.95	-2.33	-1.33	-1.84	-1.23	-2.37	-4.45	-6.56	-7.41	-6.98
240	-5.98	-6.89	-2.76	-1.34	-0.78	-0.8	-0.28	-0.21	-1.99	-1.63	-5.51	-5.7	-6.36
255	-6.97	-8.33	-1.76	-1.15	-1.43	-0.56	-0.49	-0.54	-2.4	-2.04	-4.58	-5.15	-8.64
270	-6.39	-8.1	-1.25	-0.9	-2.75	-0.58	-2.42	-1.5	-3.03	-2.9	-2.78	-4.67	-8.27
285	-7.05	-9.08	-1.31	-1.08	-2.74	-1.7	-2.87	-2.2	-4.39	-4.17	-1.81	-3.3	-8.86
300	-7.46	-7.83	-1.22	-1.51	-2.6	-5.34	-3.05	-3.23	-3.46	-3.59	-1.46	-5.34	-7.57
315	-5.96	-5.28	-2.13	-1.67	-3.59	-2.31	-4.21	-4.78	-4.02	-2.79	-2.04	-5.31	-8.97
330	-5.43	-6.59	-1.75	-4.68	-2.44	-4.28	-4.1	-5.46	-3.2	-4.12	-3.05	-7.9	-6.7
345	-3.69	-5.85	-3.88	-2.62	-5.06	-1.78	-2.81	-4.13	-1.57	-3.67	-3.76	-4.9	-5.87
360	-2.03	-3.07	-6.05	-3.91	-7.23	-6.63	-5.76	-11.01	-9.24	-8.97	-2.96	-5.91	-6.59

**Table 82. Board #3: RP\_2400.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-7.67	-5.71	-13.94	-6.74	-11.58	-16.16	-15.43	-13.8	-14.5	-13.69	-5.63	-8.11	-8.64
15	-12.98	-6.02	-10.34	-5.04	-12.12	-16.72	-15.24	-13.66	-12.94	-12.73	-6.14	-8.39	-9.34
30	-13.88	-6.58	-9.39	-5.37	-19.64	-16.96	-17.84	-9.5	-12.15	-8.8	-6.26	-10.52	-10.83
45	-15.92	-9.18	-12	-10	-20.56	-12.63	-20.39	-7.58	-9.51	-10.66	-7.67	-14.13	-12.8
60	-14.43	-13.85	-10.72	-17.19	-12.3	-10.54	-15.12	-11.58	-9.21	-9.1	-8.33	-19.35	-15.86
75	-12.51	-7.78	-7.75	-10.21	-7.31	-12.62	-14.64	-8.91	-7.35	-4.56	-7.56	-19.25	-20.48
90	-9.44	-5.38	-4.08	-5.27	-4.12	-10.09	-9.24	-11.51	-6.82	-4.08	-3.08	-6.17	-18.23
105	-7.37	-3.11	-3.18	-2.71	-3.06	-8.74	-11.77	-10.58	-5.68	-2.77	-4.45	-4.21	-18.44
120	-6.15	-3.57	-1.55	-1.51	-2.78	-7.09	-11.46	-12	-4.81	-3.1	-1.98	-5.41	-14.95
135	-5.01	-1.91	-1.27	-2.22	-2.82	-7.26	-8.35	-14.46	-6.47	-2.53	-2.89	-3.92	-11.62
150	-4.76	-3.01	-1.51	-3.28	-2.9	-9.3	-11.25	-17.35	-5.44	-4.03	-5.54	-6.34	-10.71
165	-4.8	-3.47	-2.5	-5.99	-4.81	-10.93	-13.76	-9.61	-6.59	-6.38	-11.6	-8.71	-9.85
180	-5.59	-6.18	-5.74	-9.97	-7.8	-15.28	-11.41	-11.18	-7.1	-13.02	-15.33	-16.19	-9.3
195	-7.41	-10.17	-7.91	-13.16	-10.6	-12.08	-8.46	-15.9	-11.6	-18.96	-14.68	-14.97	-11.26
210	-9.86	-14.71	-9.57	-10.74	-9.12	-9.4	-10.09	-9.58	-18.98	-16.83	-15.71	-11.65	-11.53
225	-12.9	-22.07	-9.04	-4.3	-8.62	-7.87	-15.58	-10.21	-11.66	-7.21	-12.69	-9.06	-12.66
240	-17.37	-10.95	-7.45	-5.04	-13.48	-10.6	-9.31	-9.4	-10.28	-5.34	-11.13	-10.1	-15.28
255	-20.6	-11.74	-6.56	-11.29	-18.58	-19.44	-16.29	-6.63	-9.17	-6.04	-7.23	-11.51	-18.85
270	-14.7	-11.4	-6.04	-15.26	-16.43	-21.72	-20.13	-10.04	-7.63	-5.47	-5.01	-10.41	-20.44
285	-9.79	-13.24	-5.78	-8.49	-11.79	-19.19	-16.46	-10.17	-9.42	-5.38	-4.69	-6.78	-15.99
300	-9.04	-12.26	-6.25	-8.15	-9.66	-11.6	-10.02	-7.94	-6.49	-5	-4.02	-9.1	-12
315	-8.76	-10.32	-5.58	-8.75	-15.79	-11.96	-11.04	-8.8	-6.41	-5.83	-4.3	-8.41	-11.81
330	-6.74	-7.94	-5.9	-11.34	-14.67	-13.63	-8.87	-8.09	-6.71	-8.39	-4.68	-10.22	-10.9
345	-6.72	-6.9	-8.58	-10.64	-17.97	-14.03	-9.36	-10.85	-8.04	-10.15	-5.27	-7.37	-7.99
360	-7.67	-5.71	-13.94	-6.74	-11.58	-16.16	-15.43	-13.8	-14.5	-13.69	-5.63	-8.11	-8.64

**Table 83. Board #3: RP\_2400.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-3.41	-6.48	-6.82	-7.11	-9.22	-7.14	-6.26	-14.25	-10.78	-10.76	-6.35	-9.91	-10.83
15	-2.81	-5.27	-10.69	-14.46	-9.71	-12.31	-14.22	-14.79	-13.22	-12.36	-9.99	-12.89	-12.48
30	-1.22	-2.35	-6.88	-12.79	-9.32	-9.82	-8.24	-14.9	-7.39	-11.79	-13.27	-10.04	-8.84
45	-0.76	-0.51	-1.84	-5.61	-2.72	-6.42	-5.53	-8.51	-3.12	-8.35	-12.49	-7.86	-8.12
60	-1.32	1.18	0.79	-3.07	-1.36	-4.03	-1.68	-10.04	-2.56	-5.39	-1.32	-5.91	-5.28
75	-1.24	0.95	0.04	-3.44	-0.85	-2.91	-1.85	-10.1	-3.01	-0.98	-4.24	-4.96	-5.01
90	-2.64	0.93	-1.95	-3.71	-3.68	-3.17	-3.64	-2.79	-4.08	-1.34	-3.71	-6.47	-6.13
105	-5.14	-0.13	-4.36	-9.33	-5.01	-7.09	-5.98	-10.61	-6.37	-5.05	-4.24	-7.04	-5.87
120	-4.39	-3.61	-6.26	-8.84	-5.61	-6.03	-5.57	-10.72	-5.03	-9.68	-7.78	-9.81	-6.77
135	-9.84	-7.53	-5.99	-5.3	-3.09	-4.1	-2.79	-3.73	-2.63	-10.25	-6.25	-10.87	-7.65
150	-13.39	-15.16	-4.04	-2.93	-1.02	-1.49	-1.54	-2.04	-2.36	-4.05	-3.97	-4.88	-7.94
165	-16.28	-9.09	-2.05	-1.66	0.05	-0.51	-0.45	-0.21	-1.62	-1.51	-3.75	-6.42	-11
180	-8.58	-5.21	-1.45	-1.48	-0.65	0.48	-1.29	-1.61	-0.59	-2.82	-7.18	-6.88	-13.65
195	-8.25	-6.71	-2.16	-2.43	-2.67	-2.13	-4.5	-1.42	-5.64	-4.07	-11.85	-10.4	-15.16
210	-3.93	-4.94	-5.08	-5.69	-6.96	-6.28	-5.15	-5.05	-7.51	-6.76	-7.51	-14.32	-4.71
225	-6.45	-6.34	-6.44	-8.7	-3.5	-2.42	-2.03	-1.82	-2.92	-7.74	-7.78	-12.41	-8.34
240	-6.31	-9.05	-4.56	-3.76	-1.02	-1.28	-0.86	-0.76	-2.69	-4.04	-6.9	-7.65	-6.96
255	-7.16	-10.97	-3.5	-1.59	-1.52	-0.62	-0.6	-1.77	-3.42	-4.25	-7.98	-6.29	-9.07
270	-7.09	-10.85	-3.01	-1.06	-2.94	-0.62	-2.5	-2.15	-4.89	-6.42	-6.73	-6.01	-8.54
285	-10.36	-11.18	-3.22	-1.95	-3.32	-1.78	-3.06	-2.95	-6.03	-10.3	-4.95	-5.89	-9.79
300	-12.63	-9.77	-2.85	-2.57	-3.56	-6.51	-4.03	-5.03	-6.45	-9.16	-4.97	-7.72	-9.51
315	-9.18	-6.91	-4.75	-2.62	-3.86	-2.81	-5.22	-6.97	-7.76	-5.78	-5.97	-8.24	-12.17
330	-11.25	-12.31	-3.85	-5.74	-2.71	-4.82	-5.87	-8.88	-5.76	-6.15	-8.1	-11.73	-8.77
345	-6.68	-12.52	-5.67	-3.36	-5.29	-2.04	-3.89	-5.17	-2.69	-4.78	-9.07	-8.52	-10.01
360	-3.41	-6.48	-6.82	-7.11	-9.22	-7.14	-6.26	-14.25	-10.78	-10.76	-6.35	-9.91	-10.83

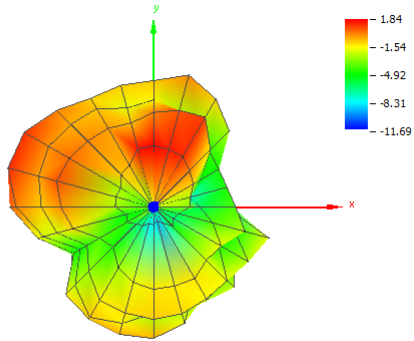


Figure 124. Board #3 (2.40 GHz): Theta = 0, Phi = 0

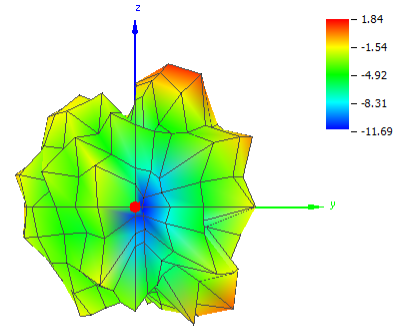


Figure 125. Board #3 (2.40 GHz): Theta = 90, Phi = 0

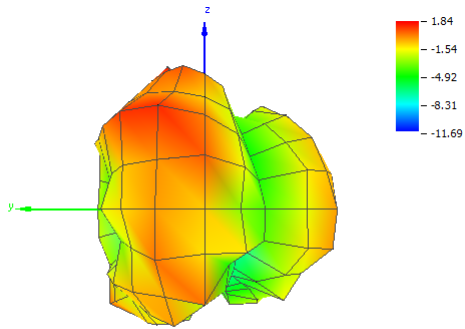


Figure 126. Board #3 (2.40 GHz): Theta = 90, Phi = 180

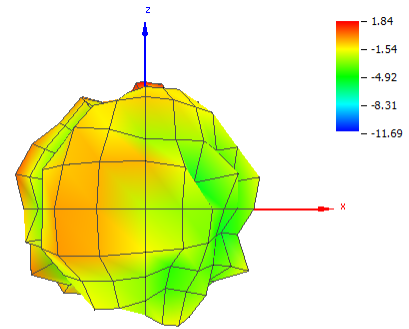


Figure 127. Board #3 (2.40 GHz): Theta = 90, Phi = 270

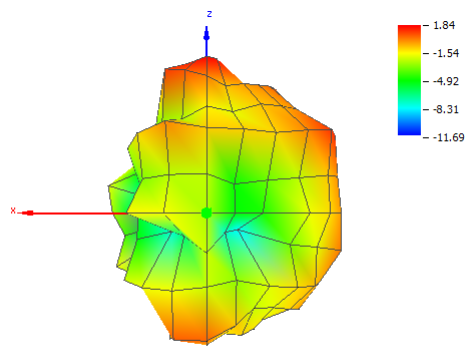


Figure 128. Board #3 (2.40 GHz): Theta = 90, Phi = 90



**A.3.3 2.44 GHz**
**Table 84. Board #3: OTA Evaluation Results (2.44 GHz)**

Test Description	Test Result
Total Radiated Power	-2.64 dBm
Peak EIRP	2.14 dBm
Directivity	4.78 dBi
Efficiency	-2.64 dB
Efficiency	0.5441
Peak Gain	2.14 dBi
NHPRP 45°	-4.12 dBm
NHPRP 45° / TRP	-1.48 dB
NHPRP 45° / TRP	0.7116
NHPRP 30°	-5.84 dBm
NHPRP 30° / TRP	-3.19 dB
NHPRP 30° / TRP	0.4796
NHPRP 22.5°	-7.14 dBm
NHPRP 22.5° / TRP	-4.50 dB
NHPRP 22.5° / TRP	0.3552
UHRP	-5.39 dBm
UHRP / TRP	-2.75 dB
UHRP / TRP	0.5309
LHRP	-5.93 dBm
LHRP / TRP	-3.29 dB
LHRP / TRP	0.4691
PGRP (0-120°)	-3.88 dBm
PGRP / TRP	-1.23 dB
PGRP / TRP	0.753
Front/Back Ratio	5.44
PhiBW	65.6°
PhiBW Up	19.3°
PhiBW Down	46.3°
ThetaBW	115.6°
ThetaBW Up	91.5°
ThetaBW Down	24.1°
Boresight Phi	165°
Boresight Theta	60°
Maximum Power	2.14 dBm
Minimum Power	-15.45 dBm
Average Power	-3.00 dBm
Max/Min Ratio	17.59 dB
Max/Avg Ratio	5.14 dB
Min/Avg Ratio	-12.45 dB
Worst Single Value	-21.93 dBm
Worst Position	Azi = 285°; Elev = 75°; Pol = Horizontal
Best Single Value	0.78 dBm
Best Position	Azi = 180°; Elev = 75°; Pol = Vertical

**Table 85. Board #3: RP\_2440.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-4.19	-2.72	-3.13	-4.07	-1.89	-4.08	-5.48	-11.95	-6.89	-8.48	-4.21	-3.74	-4.83
15	-5.05	-2.98	-14.79	-4.68	-4.05	-6.93	-15.45	-14.76	-7.82	-7.02	-6.07	-4.51	-5.13
30	-4.56	-3.38	-9.9	-3.13	-10.67	-10.44	-6.23	-5.86	-5.21	-5.36	-13.73	-3.99	-4.34
45	-3.37	-3.01	-6.62	-4.1	-5.54	-5.71	-4.92	-2.52	-3	-4.3	-9.99	-2.79	-3.51
60	-3.99	-2.72	-1.2	-2.17	-3.25	-3.37	-1.01	-2.47	-2.44	-1.88	-0.04	-1.57	-2.84
75	-3.85	-2.81	-1.64	-1.35	-1.62	-3.26	-0.59	-0.87	-1.53	1.54	-2.75	-1.03	-2.65
90	-2.78	-1.25	-0.76	-4.04	-2.95	-7.1	-2.86	-0.82	-1.91	1.43	-0.69	-1.16	-2.76
105	-2.65	-0.8	-1.77	-5.98	-2.12	-4.6	-9.29	-4.08	-1.25	0	0.48	-0.62	-3.1
120	-1.76	-2.65	-1.05	-3.01	-0.74	-3.61	-8.02	-8.4	-1.05	-0.12	0.77	-3.23	-2.85
135	-2.78	-2.14	-1.22	-1.98	1.58	-2.29	-3.14	-4.18	0.03	-0.74	0.58	-6.42	-3.79
150	-3.06	-3.19	-1.43	-0.31	1.85	-0.17	-2.84	-1.02	-0.46	0.9	0.44	-4.08	-4.13
165	-3.93	-3.39	-1.21	-0.32	2.14	0.34	-0.3	-0.41	0.28	0.47	-0.46	-4.5	-4.05
180	-4.84	-3.09	-1.62	-0.82	0.04	0.85	-0.83	-2.45	0.9	-1.94	-2.96	-5.91	-3.43
195	-5.73	-5.17	-4.17	-2.56	-3.13	-0.82	-3.69	-3.15	-4.6	-3.11	-5.92	-11.06	-4.38
210	-5.26	-3.95	-5.2	-5.28	-4.7	-4.93	-6.32	-7.6	-3.32	-5.97	-4.13	-10.74	-4.91
225	-6.44	-4.54	-4.8	-4.74	-2.57	-2.85	-3.07	-3.73	-1.56	-5.44	-5.14	-13.67	-7.35
240	-5.7	-4.58	-2.67	-2.5	-1.76	-1.51	-0.89	-2.01	-2.41	-2.24	-4.72	-9.6	-5.02
255	-7.04	-5.3	-1.57	-1.84	-2	-0.68	-1.96	-1.68	-4.45	-2.44	-5.33	-4.54	-6.63
270	-5.93	-4.61	-1.28	-1.37	-2.32	-1.3	-2.9	-2.09	-3.1	-4.1	-4.27	-3.93	-9.3
285	-7.59	-5.97	-0.97	-0.31	-2	-2.86	-2.7	-2.21	-5.58	-6.45	-3.34	-3.3	-6.54
300	-9.46	-6.07	-3.04	-0.72	-1.68	-4.41	-2.39	-3.36	-6.26	-7.31	-2.75	-3.42	-8.12
315	-8.16	-5.16	-1.32	-0.8	-0.9	-2.9	-6.35	-3.79	-7.99	-7.74	-2.93	-3.36	-6.84
330	-6.44	-3.84	-1.16	-3.23	-0.97	-3.5	-5.01	-9.93	-4.46	-6.2	-5.72	-6.03	-7.21
345	-6.3	-4.04	-2.62	-1.35	-1.42	-2.56	-3.38	-6.57	-3.3	-5.2	-5.91	-4.91	-4.92
360	-4.19	-2.72	-3.13	-4.07	-1.89	-4.08	-5.48	-11.95	-6.89	-8.48	-4.21	-3.74	-4.83

**Table 86. Board #3: RP\_2440.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-6.17	-5.54	-14.99	-6	-6.31	-11.86	-16.36	-13.16	-13.48	-13.41	-9.91	-4.73	-5.26
15	-8.59	-4.67	-17.42	-5.18	-6.77	-10.89	-19.31	-16.61	-14.68	-14.07	-12.18	-4.87	-5.72
30	-7.66	-4.98	-19.38	-4.61	-12.84	-15.7	-14.4	-11.31	-11.7	-11.56	-17.51	-6.53	-7.02
45	-8.4	-5.81	-17.69	-8.9	-20.52	-10.69	-16.96	-9.03	-14.91	-9.1	-13.04	-9.33	-7.79
60	-11.13	-7.36	-8	-16.15	-17.02	-8.16	-15.78	-9.58	-8.87	-8.74	-8.89	-11.17	-9.58
75	-14.95	-10.77	-6.21	-14.81	-9.61	-12.58	-10.68	-8	-7.59	-4.27	-5.21	-10.49	-12.05
90	-15.18	-8.54	-2.22	-6.61	-5.97	-11.51	-10.8	-7.81	-5.9	-1.59	-2.65	-12.26	-14.44
105	-11.12	-5.38	-2.16	-7.13	-4	-10.31	-13.68	-7.61	-4.46	-1.93	-1.1	-5.14	-19.3
120	-6.55	-5.36	-2.12	-4.86	-3.37	-7.92	-12.67	-9.97	-4.41	-0.86	0.29	-8.11	-13.03
135	-4.79	-3.58	-2.18	-5.48	-1.74	-9.05	-12.9	-15.36	-3.97	-1.61	-0.16	-7.06	-8.2
150	-4.47	-4	-2.81	-4.57	-1.98	-13.64	-19.13	-7.65	-4.74	-1.92	-1.56	-5.63	-7.08
165	-4.86	-4.76	-3.37	-8.08	-3.19	-13.88	-17.29	-9.86	-7.39	-4.61	-3.54	-7.13	-6.12
180	-5.74	-7.94	-5.2	-14.23	-9.69	-16.97	-13.48	-15.99	-6.84	-12.47	-4.96	-13.25	-6.35
195	-7.48	-12.23	-9.32	-17.43	-9.15	-14.3	-12.92	-11.59	-16.93	-10.87	-7.38	-18.48	-8.61
210	-9.31	-16.59	-10.3	-12.65	-7.84	-13.46	-17.69	-15.4	-7.41	-11.15	-7.56	-13.05	-8.81
225	-14.46	-20.3	-9.91	-6.79	-14.16	-10.19	-12.31	-18.08	-7.38	-7.73	-9.91	-15.23	-10.79
240	-19.19	-11.73	-11.33	-11.03	-13.89	-10.85	-15.01	-8.94	-12.6	-7.31	-12.86	-18.75	-13.43
255	-19.59	-11.85	-10.23	-19.8	-13.98	-12.87	-16.71	-7.62	-20.54	-9.14	-12.68	-8.72	-14.41
270	-13.72	-8.25	-7.73	-9.16	-14.81	-20.23	-19.22	-12.89	-13.6	-10.31	-10.15	-7	-12.43
285	-10.86	-9.68	-4.84	-3.32	-9.78	-21.93	-16.26	-13.97	-16.74	-10.42	-9.75	-5.77	-11.55
300	-9.98	-10.27	-7.67	-3.46	-15.36	-13.93	-10.86	-12.6	-12.38	-11.2	-11.14	-5.24	-9.14
315	-9.01	-10.6	-3.91	-5.18	-11.49	-20.02	-13.54	-12.23	-15.92	-12.41	-9.12	-5.46	-8.75
330	-7.16	-9.55	-5.75	-6.85	-11.06	-12.12	-8.76	-16.95	-9.33	-17.73	-16.67	-6.44	-7.51
345	-6.93	-7.87	-11.68	-6.5	-11.54	-17.65	-9.65	-13.08	-9.19	-14.44	-10.14	-5.53	-5.26
360	-6.17	-5.54	-14.99	-6	-6.31	-11.86	-16.36	-13.16	-13.48	-13.41	-9.91	-4.73	-5.26

**Table 87. Board #3: RP\_2440.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-8.57	-5.94	-3.42	-8.52	-3.83	-4.87	-5.85	-18.09	-7.97	-10.17	-5.57	-10.64	-15.07
15	-7.59	-7.89	-18.22	-14.33	-7.37	-9.17	-17.75	-19.35	-8.82	-7.97	-7.29	-15.59	-14.1
30	-7.48	-8.48	-10.42	-8.53	-14.71	-11.98	-6.95	-7.32	-6.31	-6.55	-16.08	-7.53	-7.7
45	-5	-6.24	-6.97	-5.85	-5.68	-7.37	-5.21	-3.61	-3.29	-6.05	-12.95	-3.88	-5.54
60	-4.92	-4.55	-2.22	-2.34	-3.43	-5.12	-1.16	-3.42	-3.56	-2.88	-0.65	-2.08	-3.87
75	-4.2	-3.57	-3.5	-1.55	-2.38	-3.81	-1.04	-1.81	-2.76	0.21	-6.38	-1.55	-3.18
90	-3.04	-2.15	-6.22	-7.54	-5.96	-9.06	-3.62	-1.79	-4.13	-1.57	-5.07	-1.51	-3.07
105	-3.32	-2.66	-12.47	-12.34	-6.67	-5.96	-11.26	-6.62	-4.08	-4.45	-4.7	-2.5	-3.2
120	-3.51	-5.98	-7.65	-7.6	-4.16	-5.62	-9.84	-13.58	-3.74	-8.18	-8.98	-4.93	-3.28
135	-7.09	-7.64	-8.27	-4.54	-1.15	-3.31	-3.62	-4.53	-2.18	-8.15	-7.5	-15.05	-5.74
150	-8.6	-10.87	-7.1	-2.35	-0.46	-0.37	-2.94	-2.08	-2.48	-2.31	-3.9	-9.32	-7.2
165	-11.07	-9.06	-5.28	-1.12	0.63	0.18	-0.39	-0.94	-0.53	-1.14	-3.41	-7.94	-8.26
180	-12.11	-4.82	-4.13	-1.03	-0.45	0.78	-1.07	-2.64	0.09	-2.34	-7.28	-6.8	-6.54
195	-10.53	-6.12	-5.75	-2.71	-4.38	-1.02	-4.25	-3.82	-4.86	-3.91	-11.36	-11.93	-6.43
210	-7.43	-4.19	-6.81	-6.16	-7.6	-5.58	-6.64	-8.39	-5.47	-7.53	-6.76	-14.59	-7.19
225	-7.18	-4.66	-6.39	-8.98	-2.88	-3.74	-3.62	-3.89	-2.88	-9.31	-6.89	-18.89	-9.97
240	-5.9	-5.51	-3.3	-3.16	-2.04	-2.05	-1.06	-2.99	-2.84	-3.86	-5.45	-10.17	-5.7
255	-7.28	-6.39	-2.2	-1.91	-2.29	-0.95	-2.11	-2.96	-4.56	-3.48	-6.22	-6.63	-7.43
270	-6.73	-7.08	-2.4	-2.16	-2.57	-1.36	-3	-2.47	-3.51	-5.29	-5.57	-6.88	-12.19
285	-10.35	-8.37	-3.27	-3.32	-2.79	-2.91	-2.89	-2.51	-5.93	-8.68	-4.47	-6.92	-8.18
300	-18.95	-8.15	-4.87	-4.01	-1.87	-4.92	-3.06	-3.92	-7.47	-9.58	-3.43	-8.08	-14.93
315	-15.67	-6.62	-4.79	-2.77	-1.3	-2.98	-7.27	-4.46	-8.75	-9.55	-4.13	-7.54	-11.33
330	-14.61	-5.19	-3.02	-5.71	-1.42	-4.14	-7.39	-10.9	-6.17	-6.52	-6.08	-16.43	-19.01
345	-15.01	-6.36	-3.2	-2.93	-1.87	-2.7	-4.54	-7.67	-4.59	-5.76	-7.97	-13.63	-16.26
360	-8.57	-5.94	-3.42	-8.52	-3.83	-4.87	-5.85	-18.09	-7.97	-10.17	-5.57	-10.64	-15.07

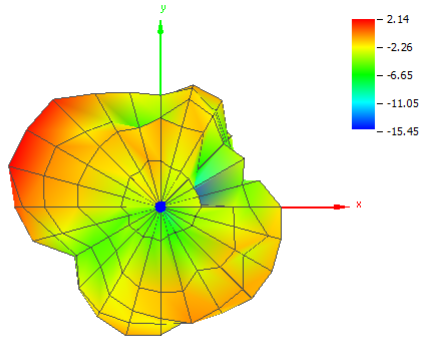


Figure 129. Board #3 (2.44 GHz): Theta = 0, Phi = 0

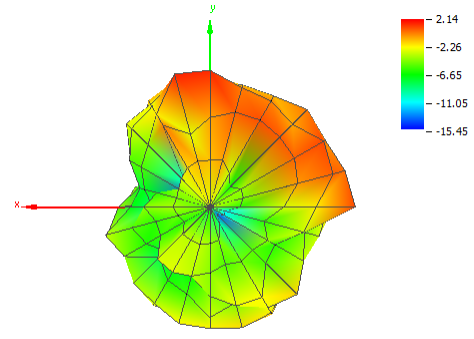


Figure 130. Board #3 (2.44 GHz): Theta = 180, Phi = 0

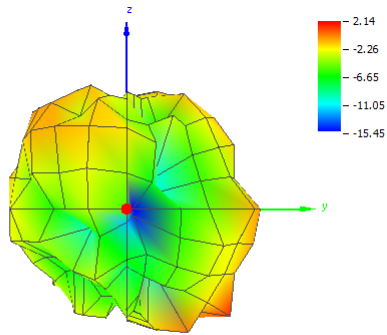


Figure 131. Board #3 (2.44 GHz): Theta = 90, Phi = 0

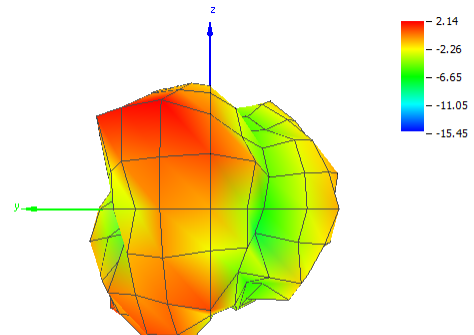


Figure 132. Board #3 (2.44 GHz): Theta = 90, Phi = 180

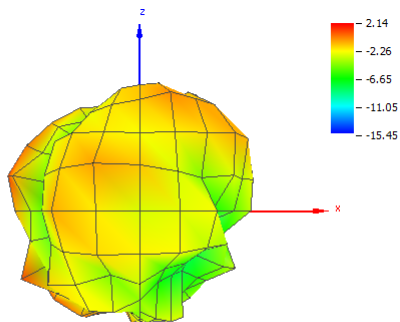


Figure 133. Board #3 (2.44 GHz): Theta = 90, Phi = 270

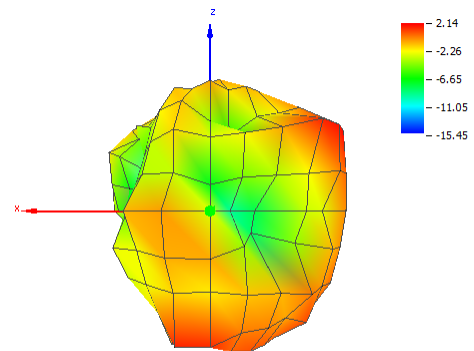


Figure 134. Board #3 (2.44 GHz): Theta = 90, Phi = 90

**A.3.4 2.48 GHz**
**Table 88. Board #3: OTA Evaluation Results (2.48 GHz)**

Test Description	Test Result
Total Radiated Power	-2.91 dBm
Peak EIRP	2.02 dBm
Directivity	4.93 dBi
Efficiency	-2.91 dB
Efficiency	0.5115
Peak Gain	2.02 dBi
NHPRP 45°	-4.38 dBm
NHPRP 45° / TRP	-1.47 dB
NHPRP 45° / TRP	0.7129
NHPRP 30°	-6.11 dBm
NHPRP 30° / TRP	-3.19 dB
NHPRP 30° / TRP	0.4792
NHPRP 22.5°	-7.46 dBm
NHPRP 22.5° / TRP	-4.55 dB
NHPRP 22.5° / TRP	0.3511
UHRP	-5.28 dBm
UHRP / TRP	-2.36 dB
UHRP / TRP	0.5802
LHRP	-6.68 dBm
LHRP / TRP	-3.77 dB
LHRP / TRP	0.4198
PGRP (0-120°)	-3.91 dBm
PGRP / TRP	-0.99 dB
PGRP / TRP	0.7954
Front/Back Ratio	7.49
PhiBW	74.8°
PhiBW Up	27.7°
PhiBW Down	47.1°
ThetaBW	28.3°
ThetaBW Up	13.3°
ThetaBW Down	15.0°
Boresight Phi	105°
Boresight Theta	15°
Maximum Power	2.02 dBm
Minimum Power	-13.21 dBm
Average Power	-3.13 dBm
Max/Min Ratio	15.24 dB
Max/Avg Ratio	5.15 dB
Min/Avg Ratio	-10.08 dB
Worst Single Value	-21.96 dBm
Worst Position	Azi = 30°; Elev = 90°; Pol = Horizontal
Best Single Value	0.72 dBm
Best Position	Azi = 240°; Elev = 75°; Pol = Vertical

**Table 89. Board #3: RP\_2480.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-2.17	-1.76	-2.11	-4.47	0.16	-5.04	-9.53	-5.5	-3.81	-4.36	-3.3	-6.36	-5.8
15	-1.07	-2.92	-10.3	-4.88	-3.13	-8.58	-13.21	-9.41	-3.08	-6.3	-3.72	-9.15	-6.65
30	-1.32	-2.72	-9.18	-3.34	-8.8	-9.97	-5.42	-9.07	-4.55	-6.66	-7.35	-11.5	-7.68
45	-0.79	-1.87	-10.83	-3.53	-2.91	-6.94	-3.53	-4.23	-4.64	-8.54	-12.24	-8.41	-7.52
60	-2.07	-0.84	-1.24	-0.02	-3.82	-6.43	-2.56	-6.22	-7.82	-5.28	-2.46	-5.06	-8.21
75	-2.18	-0.25	-1.35	0.26	-2.94	-3.3	-1.41	-1.79	-3.59	-1.84	-6.46	-2.26	-9.9
90	-0.43	1.61	-1.02	-1.7	-4.15	-7.16	-5.89	-3.29	-2.7	-3.14	-3.68	-1.63	-7.64
105	0.38	2.02	-1.36	-6.65	-2.4	-3.32	-9.09	-7.62	-3.41	-6.11	-1.08	-0.86	-7.94
120	0.49	-0.32	-0.57	-2.67	0.37	-3.15	-8.72	-8.34	-1.23	-4.95	-1.77	-2.14	-7.67
135	-4.55	-1.1	-0.63	-5.37	0.56	-2.43	-3.99	-4.25	0.57	-4.03	-1.84	-3.62	-7.23
150	-4.65	-2.08	-1.05	-0.92	0.23	-1.54	-3.55	-2.05	-0.53	-1.22	-1.44	-4.44	-8.45
165	-5.67	-3.47	-1.61	-1.04	0.51	-1.73	-2.13	-1.92	0.35	-2.05	-1.44	-3.36	-7.34
180	-5.71	-2.19	-0.72	-1.79	-1.7	-2.4	-3	-3.32	0.16	-5.73	-4.12	-3.96	-5.45
195	-5.22	-3.5	-3.39	-2.76	-4.62	-2	-5.76	-4.79	-7.48	-7.7	-3.49	-7.23	-5.36
210	-7.12	-3.67	-4.29	-4.73	-3.39	-4.86	-6.74	-7.98	-3.61	-11	-4.93	-9.9	-4.17
225	-6.25	-4.94	-3.16	-2.91	-0.52	-1.28	-1.37	-2.01	-4.21	-5.4	-5.3	-11.41	-3.97
240	-9.07	-6.85	-0.39	-0.1	0.66	0.75	0.29	-0.63	-6.11	-2.73	-6.21	-7.39	-4.45
255	-6.52	-7.59	-1.13	0.71	0.67	0.46	-1.9	-1.19	-4.57	-3.05	-5.15	-5.37	-4.43
270	-4.89	-5.79	-1.51	0.61	0.47	-0.28	-1.04	-0.82	-3.86	-2.76	-2.89	-4.45	-3.95
285	-6.78	-6.92	-1.55	-0.26	-0.62	-1.51	-2.25	-5.78	-5.23	-3.88	-2.84	-5.47	-4.29
300	-6.39	-6.28	-4.7	-1.41	-1.74	-3.2	-3.9	-3.76	-6.49	-3.71	-3.97	-3.33	-4.97
315	-5.37	-7.38	-3.14	-1.47	-0.88	-3.46	-11.89	-2.43	-5.06	-4.58	-3.07	-3.6	-4.91
330	-4.32	-2.6	-3.01	-2.72	-1.46	-5.8	-8.94	-6.32	-2.7	-4.16	-5.31	-4.3	-5.09
345	-4.47	-6.66	-3.87	-1.43	-2.38	-2.62	-5.1	-1.8	-2.66	-1.38	-6.35	-4.14	-5.16
360	-2.17	-1.76	-2.11	-4.47	0.16	-5.04	-9.53	-5.5	-3.81	-4.36	-3.3	-6.36	-5.8

**Table 90. Board #3: RP\_2480.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-7.03	-9.12	-9.57	-6.16	-4.8	-20.47	-14.5	-10.33	-8.43	-7.54	-7.39	-12.43	-7.33
15	-7.64	-7.38	-12.42	-5.63	-6.73	-16.43	-17.99	-13.22	-6.26	-8.3	-6.2	-12.58	-7.38
30	-8.89	-7.41	-18.61	-5.03	-10.38	-17.15	-21.96	-15.89	-7.07	-8.73	-8.8	-13.75	-8.28
45	-10.66	-9.18	-16.69	-8.84	-12.64	-18.61	-20.73	-9.96	-13.08	-13.27	-16.89	-14.14	-8.36
60	-14.7	-11.16	-6.48	-11.01	-16.8	-17.29	-19.94	-20.09	-13.7	-16.99	-13.19	-11.57	-9.33
75	-19.13	-9.17	-4.81	-11.87	-15.51	-16.74	-11.45	-13.32	-10.92	-18.64	-8.49	-7.71	-12.16
90	-15.12	-5.63	-1.91	-4.98	-9.86	-14.68	-18.98	-8.16	-9.14	-5.2	-5.46	-5.9	-16.34
105	-9.97	-3.44	-1.65	-15.35	-6.13	-11.03	-20.48	-11.97	-8.11	-7.25	-2.52	-2.79	-21.14
120	-7.48	-3.19	-1.63	-5.51	-5.08	-9.3	-14.11	-9.15	-7.37	-5.41	-2.02	-3.49	-15.33
135	-6.75	-3.07	-0.99	-9.07	-2.26	-8.61	-9.18	-8.28	-4.64	-4.99	-2.78	-4.18	-12.32
150	-6.28	-3.74	-2.03	-3.05	-2.9	-11.24	-19.09	-8.51	-7.41	-4.9	-4.75	-6.01	-11.08
165	-6.31	-5.3	-4.12	-4.82	-3.81	-14.48	-16.41	-12.48	-9.36	-7.81	-4.07	-9.81	-9.15
180	-6.82	-7.76	-4.34	-7.91	-9.17	-14.22	-12.64	-17.26	-7.84	-18.26	-5.37	-13.65	-8.57
195	-7.97	-10.07	-8.17	-12.1	-8.14	-13.53	-12.25	-13.88	-15.86	-15.58	-4.37	-14.93	-9.78
210	-9.35	-12.09	-8.03	-15.22	-9.31	-16.45	-18.64	-15.23	-8.1	-12.65	-9.61	-13.7	-8.83
225	-12.43	-13.94	-7.14	-8.41	-18.23	-19.44	-17.08	-10.12	-11.41	-9.84	-11.8	-12.86	-8.66
240	-16.42	-18.21	-11.23	-11.63	-10.2	-20.81	-16.95	-6.1	-15.55	-11.79	-18.15	-8.69	-10.57
255	-20.68	-15.52	-14.38	-7.77	-8.95	-18.2	-15.9	-12.2	-13.32	-13.6	-15.05	-8.14	-12.46
270	-17.37	-9.89	-13.97	-5.42	-9.82	-12.69	-19.98	-15.48	-11.41	-8.68	-9.64	-8.11	-14.21
285	-11.32	-12.69	-8	-4.57	-10.14	-13.19	-20.33	-17.21	-12.65	-10.07	-9.09	-8.42	-14.91
300	-10.21	-8.54	-16.42	-4.61	-10.75	-12.42	-17.57	-14.03	-15.23	-11.16	-14.3	-7.51	-14.42
315	-9.46	-11.13	-5.01	-5.14	-6.88	-12.69	-19.3	-12.07	-13.92	-17.75	-10.1	-8.97	-12.48
330	-8.07	-10.53	-7.77	-4.58	-7.86	-18.1	-11.72	-12.9	-10.17	-12.9	-12.7	-9.9	-11.07
345	-7.05	-10.25	-11.04	-5.74	-8.63	-14.37	-10.59	-13.92	-12.73	-8.79	-11.97	-11.52	-8.65
360	-7.03	-9.12	-9.57	-6.16	-4.8	-20.47	-14.5	-10.33	-8.43	-7.54	-7.39	-12.43	-7.33



**Table 91. Board #3: RP\_2480.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-3.88	-2.64	-2.96	-9.38	-1.51	-5.17	-11.2	-7.23	-5.64	-7.2	-5.44	-7.6	-11.07
15	-2.15	-4.84	-14.43	-12.93	-5.62	-9.36	-14.97	-11.74	-5.93	-10.64	-7.34	-11.78	-14.73
30	-2.16	-4.53	-9.71	-8.26	-13.95	-10.9	-5.52	-10.09	-8.12	-10.89	-12.8	-15.44	-16.57
45	-1.26	-2.76	-12.14	-5.04	-3.4	-7.25	-3.62	-5.58	-5.31	-10.32	-14.06	-9.77	-15.11
60	-2.31	-1.26	-2.79	-0.38	-4.05	-6.8	-2.64	-6.4	-9.12	-5.58	-2.84	-6.16	-14.64
75	-2.27	-0.85	-3.95	-0.02	-3.18	-3.5	-1.86	-2.11	-4.48	-1.94	-10.75	-3.72	-13.81
90	-0.58	0.7	-8.35	-4.47	-5.51	-8.01	-6.11	-5	-3.82	-7.37	-8.42	-3.66	-8.27
105	-0.04	0.57	-13.27	-7.28	-4.8	-4.12	-9.41	-9.61	-5.21	-12.5	-6.55	-5.3	-8.16
120	-0.27	-3.48	-7.21	-5.87	-1.09	-4.36	-10.21	-16.03	-2.45	-14.9	-14.22	-7.88	-8.48
135	-8.56	-5.47	-11.62	-7.79	-2.64	-3.63	-5.56	-6.44	-0.98	-11.04	-8.95	-12.86	-8.84
150	-9.67	-7.07	-8.01	-5.03	-2.66	-2.04	-3.67	-3.16	-1.53	-3.65	-4.17	-9.63	-11.88
165	-14.25	-8.11	-5.19	-3.41	-1.49	-1.97	-2.29	-2.32	-0.14	-3.39	-4.85	-4.47	-12.01
180	-12.16	-3.6	-3.19	-3.01	-2.55	-2.7	-3.5	-3.5	-0.59	-5.98	-10.11	-4.46	-8.35
195	-8.51	-4.58	-5.14	-3.29	-7.17	-2.31	-6.86	-5.36	-8.17	-8.48	-10.88	-8.04	-7.31
210	-11.09	-4.35	-6.68	-5.14	-4.67	-5.18	-7.03	-8.89	-5.52	-16.01	-6.74	-12.24	-5.99
225	-7.44	-5.53	-5.39	-4.35	-0.6	-1.34	-1.49	-2.74	-5.13	-7.33	-6.4	-16.88	-5.77
240	-9.95	-7.18	-0.76	-0.42	0.29	0.72	0.21	-2.08	-6.63	-3.3	-6.5	-13.27	-5.67
255	-6.69	-8.36	-1.34	0.05	0.16	0.4	-2.08	-1.55	-5.19	-3.45	-5.61	-8.63	-5.17
270	-5.14	-7.93	-1.77	-0.63	0.04	-0.53	-1.1	-0.97	-4.7	-4.05	-3.93	-6.9	-4.38
285	-8.66	-8.25	-2.67	-2.27	-1.14	-1.82	-2.32	-6.11	-6.09	-5.08	-4.01	-8.53	-4.69
300	-8.72	-10.19	-5	-4.25	-2.32	-3.75	-4.09	-4.19	-7.12	-4.57	-4.39	-5.42	-5.5
315	-7.51	-9.76	-7.71	-3.91	-2.14	-4.01	-12.76	-2.93	-5.67	-4.79	-4.03	-5.08	-5.75
330	-6.71	-3.37	-4.77	-7.3	-2.59	-6.06	-12.18	-7.4	-3.56	-4.78	-6.19	-5.7	-6.35
345	-7.96	-9.16	-4.79	-3.44	-3.55	-2.92	-6.54	-2.08	-3.11	-2.25	-7.75	-5.02	-7.74
360	-3.88	-2.64	-2.96	-9.38	-1.51	-5.17	-11.2	-7.23	-5.64	-7.2	-5.44	-7.6	-11.07

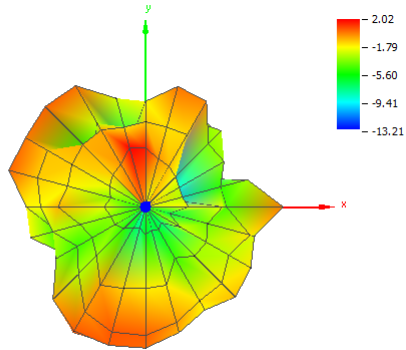


Figure 135. Board #3 (2.48 GHz): Theta = 0, Phi = 0

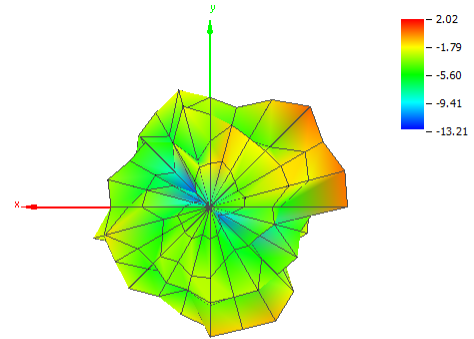


Figure 136. Board #3 (2.48 GHz): Theta = 180, Phi = 0

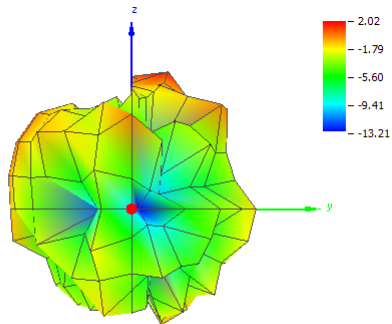


Figure 137. Board #3 (2.48 GHz): Theta = 90, Phi = 0

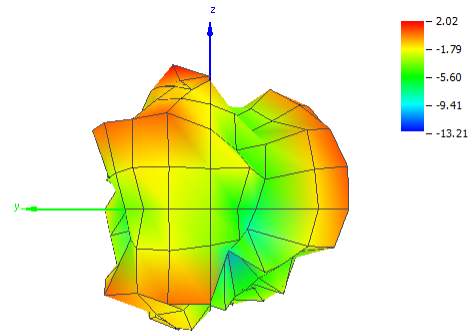


Figure 138. Board #3 (2.48 GHz): Theta = 90, Phi = 180

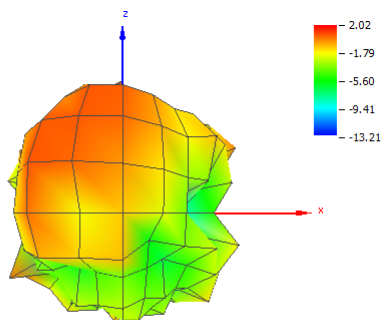


Figure 139. Board #3 (2.48 GHz): Theta = 90, Phi = 270

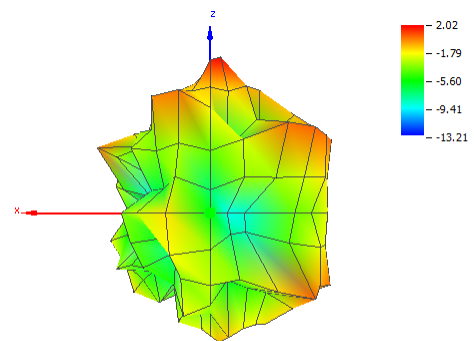


Figure 140. Board #3 (2.48 GHz): Theta = 90, Phi = 90

## A.4 Board #4: 433-510 MHz PCB Antenna

### A.4.1 433 MHz

**Table 92. Board #4: OTA Evaluation Results (433 MHz)**

Test Description	Test Result
Total Radiated Power	-4.58 dBm
Peak EIRP	0.21 dBm
Directivity	4.79 dBi
Efficiency	-4.58 dB
Efficiency	34.87%
Peak Gain	0.21 dBi
NHPRP 45°	-5.91 dBm
NHPRP 45° / TRP	-1.33 dB
NHPRP 45° / TRP	73.62%
NHPRP 30°	-7.21 dBm
NHPRP 30° / TRP	-2.63 dB
NHPRP 30° / TRP	54.54%
NHPRP 22.5°	-8.33 dBm
NHPRP 22.5° / TRP	-3.75 dB
NHPRP 22.5° / TRP	42.12%
UHRP	-6.31 dBm
UHRP / TRP	-1.74 dB
UHRP / TRP	67.01%
LHRP	-9.39 dBm
LHRP / TRP	-4.82 dB
LHRP / TRP	32.99%
PGRP (0-120°)	-5.14 dBm
PGRP / TRP	-0.57 dB
PGRP / TRP	87.75%
Front/Back Ratio	13.09
PhiBW	95.7°
PhiBW Up	46.2°
PhiBW Down	49.5°
ThetaBW	65.9°
ThetaBW Up	26.7°
ThetaBW Down	39.2°
Boresight Phi	15°
Boresight Theta	75°
Maximum Power	0.21 dBm
Minimum Power	-19.85 dBm
Average Power	-4.62 dBm
Max/Min Ratio	20.06 dB
Max/Avg Ratio	4.83 dB
Min/Avg Ratio	-15.24 dB
Worst Single Value	-38.13 dBm
Worst Position	Azi = 30°; Elev = 0°; Pol = Horizontal
Best Single Value	0.01 dBm
Best Position	Azi = 15°; Elev = 75°; Pol = Vertical

**Table 93. Board #4: RP\_433.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-4.19	-4.21	-4.2	-2.9	-1.15	0.1	-0.3	-3.14	-8.42	-9.47	-6.18	-4.55	-4.08
15	-4.46	-4.17	-3.34	-1.91	-0.63	0.21	-0.53	-3.42	-8.48	-8.87	-5.52	-4.05	-3.84
30	-5.37	-4.02	-2.92	-1.28	-0.8	-0.12	-1.16	-3.77	-7.93	-7.91	-5.15	-3.67	-3.95
45	-6.36	-4.13	-2.82	-1.33	-1.66	-1.1	-2.04	-4.14	-7.33	-7.49	-5.24	-3.71	-4.59
60	-7.23	-4.23	-2.92	-1.87	-3.17	-2.64	-3.12	-4.55	-7.12	-7.75	-5.76	-4.03	-5.58
75	-7.27	-4.27	-3.05	-2.8	-4.91	-4.44	-4.37	-5.06	-7.01	-8.18	-6.45	-4.6	-6.66
90	-6.9	-4.39	-3.26	-3.71	-6.11	-5.92	-5.62	-5.62	-6.64	-8.12	-7	-5.22	-7.6
105	-6.27	-4.54	-3.31	-4.12	-5.71	-6.31	-6.62	-5.97	-5.85	-7.34	-7.34	-5.96	-8.57
120	-5.44	-4.55	-3.02	-3.64	-4.22	-5.58	-7.07	-6.05	-4.98	-6.33	-7.46	-6.63	-9.41
135	-4.37	-4.12	-2.51	-2.63	-2.77	-4.45	-7.17	-6.18	-4.49	-5.67	-7.55	-7.29	-10.01
150	-3.18	-3.36	-1.8	-1.62	-1.56	-3.52	-7.15	-6.76	-4.7	-5.69	-7.97	-8.02	-10.53
165	-2.16	-2.43	-1.37	-0.88	-0.91	-2.85	-7.13	-8.01	-5.85	-6.6	-9	-8.96	-11.16
180	-1.35	-1.73	-1.23	-0.58	-0.73	-2.49	-7.07	-10.27	-8.25	-8.52	-10.52	-10.02	-11.87
195	-0.9	-1.33	-1.48	-0.77	-1.09	-2.43	-6.85	-12.88	-12.74	-11.31	-12.38	-11.25	-12.68
210	-0.75	-1.28	-2.07	-1.49	-1.88	-2.72	-6.59	-13.44	-19.85	-13.06	-13.25	-12.35	-13.25
225	-0.87	-1.56	-2.97	-2.71	-3.23	-3.4	-6.49	-11.82	-17.4	-11.81	-12.74	-13.26	-13.49
240	-1.19	-2.02	-4.09	-4.43	-5.02	-4.41	-6.52	-9.99	-12.42	-9.93	-11.54	-13.65	-12.98
255	-1.68	-2.56	-5.3	-6.65	-7.53	-5.66	-6.46	-8.45	-9.62	-8.49	-10.35	-13.1	-11.78
270	-2.19	-3.21	-6.5	-9.53	-10.56	-6.7	-5.81	-6.97	-7.93	-7.76	-9.38	-11.74	-10.24
285	-2.67	-3.83	-7.43	-12.68	-12.4	-6.74	-4.63	-5.55	-6.87	-7.5	-8.66	-9.99	-8.56
300	-3.04	-4.43	-7.79	-13.98	-10.26	-5.55	-3.31	-4.4	-6.24	-7.65	-8.14	-8.48	-7.17
315	-3.3	-4.87	-7.43	-11.44	-7.11	-3.91	-2.08	-3.58	-6.14	-8.18	-7.73	-7.28	-6.01
330	-3.48	-5.03	-6.53	-8.29	-4.54	-2.31	-1.14	-3.09	-6.54	-8.92	-7.37	-6.41	-5.29
345	-3.8	-4.69	-5.71	-5.5	-2.8	-0.95	-0.48	-2.91	-7.18	-9.45	-7.04	-5.78	-4.95
360	-4.19	-4.21	-4.2	-2.9	-1.15	0.1	-0.3	-3.14	-8.42	-9.47	-6.18	-4.55	-4.08

**Table 94. Board #4: RP\_433.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-10.96	-12.58	-19.73	-17.02	-13.23	-12.29	-8.93	-7.65	-9.21	-11.73	-11.36	-13.66	-16.27
15	-15.8	-20.59	-21.07	-12.72	-13.05	-13.17	-8.97	-6.97	-8.75	-12.25	-11.1	-12.81	-18.61
30	-38.13	-19.1	-13.22	-8.79	-11.12	-14	-9.24	-6.37	-8.05	-12.47	-10.94	-11.47	-18.31
45	-17.65	-12.26	-8.68	-6.4	-9.19	-14.88	-9.78	-6.19	-7.46	-12.78	-10.84	-10.12	-15.54
60	-11.99	-8.52	-6.13	-4.79	-7.93	-15.45	-10.63	-6.28	-7.28	-13.66	-10.86	-9.18	-13.46
75	-9.11	-6.4	-4.55	-4.04	-7.43	-16.78	-11.69	-6.57	-7.31	-14.54	-11.18	-8.73	-12.42
90	-7.56	-5.38	-3.85	-3.94	-7.54	-19.51	-12.37	-6.82	-7.32	-14.73	-11.95	-8.82	-12.3
105	-6.82	-5.12	-3.71	-4.24	-8.13	-23.36	-12.26	-6.77	-7.08	-13.98	-13.28	-9.53	-12.98
120	-6.88	-5.59	-4.09	-4.83	-8.96	-27.04	-11.64	-6.57	-6.74	-12.89	-15.1	-10.75	-14.43
135	-7.72	-6.72	-5.05	-5.76	-9.93	-26.93	-11.28	-6.63	-6.6	-12.28	-17.17	-12.5	-16.51
150	-9.23	-8.73	-6.46	-6.95	-10.71	-24.58	-11.65	-7.27	-6.98	-12.54	-19.4	-14.73	-19.1
165	-11.68	-11.44	-8.34	-8.4	-11.36	-22.42	-13.19	-8.68	-8.18	-14.17	-22.21	-17.68	-21.98
180	-14.65	-15.03	-10.8	-10.15	-11.96	-19.73	-16.58	-11.51	-10.69	-17.85	-26.68	-21.47	-23.32
195	-16.74	-17.51	-13.63	-12.24	-12.72	-17.27	-23.88	-16.44	-15.98	-25.24	-29.36	-26.86	-21.02
210	-14.26	-15.28	-15.74	-14.55	-13.86	-15.19	-22.11	-21.29	-29.38	-20.11	-23.59	-29.76	-18.15
225	-10.69	-12.1	-15.72	-17.62	-15.53	-13.89	-15.67	-16.41	-18.06	-14.3	-19	-26.93	-15.77
240	-7.98	-9.49	-14.26	-22.02	-17.91	-13.2	-12.61	-12.48	-12.56	-11.34	-16.45	-24.81	-13.94
255	-5.93	-7.55	-12.37	-24.15	-20.74	-12.97	-10.98	-10.34	-9.78	-9.48	-14.84	-24	-12.57
270	-4.5	-6.14	-10.67	-19.68	-20.83	-12.79	-10.07	-9.02	-8.25	-8.51	-13.92	-23.4	-11.64
285	-3.59	-5.28	-9.35	-16.05	-17.81	-12.53	-9.52	-8.27	-7.46	-8.05	-13.42	-21.59	-10.97
300	-3.24	-4.97	-8.59	-14.01	-15.05	-12	-9.13	-7.93	-7.14	-8.06	-13.04	-18.97	-10.65
315	-3.49	-5.29	-8.54	-13.35	-13.4	-11.55	-8.91	-7.9	-7.34	-8.54	-12.62	-16.83	-10.71
330	-4.39	-6.34	-9.45	-14.08	-12.65	-11.39	-8.82	-8.11	-7.95	-9.34	-12.06	-15.28	-11.36
345	-6.05	-7.76	-11.82	-15.44	-12.73	-11.23	-8.77	-8.22	-8.83	-10.11	-11.51	-14.48	-12.71
360	-10.96	-12.58	-19.73	-17.02	-13.23	-12.29	-8.93	-7.65	-9.21	-11.73	-11.36	-13.66	-16.27

**Table 95. Board #4: RP\_433.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-5.22	-4.89	-4.32	-3.08	-1.42	-0.15	-0.94	-5.04	-16.19	-13.38	-7.75	-5.12	-4.36
15	-4.79	-4.27	-3.41	-2.29	-0.89	0.01	-1.21	-5.96	-20.67	-11.55	-6.93	-4.67	-3.98
30	-5.38	-4.16	-3.35	-2.12	-1.22	-0.3	-1.89	-7.23	-23.85	-9.77	-6.48	-4.46	-4.11
45	-6.69	-4.86	-4.12	-2.95	-2.51	-1.28	-2.84	-8.4	-22.81	-9.02	-6.64	-4.83	-4.95
60	-8.99	-6.25	-5.73	-4.97	-4.93	-2.88	-3.96	-9.39	-21.44	-9.03	-7.37	-5.62	-6.36
75	-11.88	-8.38	-8.38	-8.83	-8.47	-4.7	-5.26	-10.41	-18.74	-9.32	-8.23	-6.73	-8.01
90	-15.4	-11.26	-12.25	-16.67	-11.64	-6.11	-6.65	-11.78	-15.05	-9.19	-8.67	-7.71	-9.4
105	-15.48	-13.56	-13.87	-19.98	-9.4	-6.39	-8	-13.73	-11.91	-8.41	-8.62	-8.47	-10.52
120	-10.93	-11.26	-9.63	-9.86	-6	-5.61	-8.94	-15.56	-9.78	-7.41	-8.27	-8.76	-11.05
135	-7.06	-7.58	-6.05	-5.52	-3.7	-4.48	-9.3	-16.29	-8.63	-6.73	-8.05	-8.85	-11.1
150	-4.42	-4.85	-3.62	-3.12	-2.12	-3.55	-9.05	-16.34	-8.58	-6.69	-8.29	-9.06	-11.18
165	-2.68	-3.02	-2.34	-1.73	-1.32	-2.9	-8.36	-16.45	-9.67	-7.44	-9.22	-9.58	-11.54
180	-1.56	-1.94	-1.73	-1.09	-1.08	-2.57	-7.58	-16.33	-11.92	-9.06	-10.63	-10.34	-12.19
195	-1.01	-1.43	-1.76	-1.09	-1.4	-2.57	-6.94	-15.4	-15.54	-11.49	-12.46	-11.37	-13.37
210	-0.95	-1.46	-2.26	-1.71	-2.17	-2.98	-6.72	-14.22	-20.36	-14.02	-13.68	-12.43	-14.94
225	-1.34	-1.96	-3.21	-2.85	-3.49	-3.81	-7.05	-13.68	-25.92	-15.43	-13.91	-13.45	-17.38
240	-2.2	-2.88	-4.52	-4.5	-5.25	-5.03	-7.74	-13.59	-27.63	-15.5	-13.24	-14	-20.02
255	-3.72	-4.22	-6.25	-6.73	-7.75	-6.56	-8.36	-12.97	-23.99	-15.4	-12.26	-13.46	-19.58
270	-6.03	-6.3	-8.6	-9.97	-10.99	-7.93	-7.85	-11.21	-19.39	-15.77	-11.26	-12.04	-15.84
285	-9.85	-9.31	-11.9	-15.35	-13.87	-8.07	-6.33	-8.88	-15.86	-16.68	-10.43	-10.3	-12.25
300	-16.54	-13.79	-15.51	-34.71	-12.01	-6.67	-4.63	-6.95	-13.55	-18.04	-9.84	-8.88	-9.77
315	-17.11	-15.24	-13.92	-15.94	-8.27	-4.73	-3.09	-5.58	-12.33	-19.07	-9.43	-7.79	-7.8
330	-10.72	-10.85	-9.63	-9.62	-5.26	-2.89	-1.95	-4.73	-12.11	-19.19	-9.17	-7.01	-6.53
345	-7.73	-7.64	-6.93	-5.96	-3.26	-1.38	-1.18	-4.42	-12.16	-18	-8.95	-6.41	-5.74
360	-5.22	-4.89	-4.32	-3.08	-1.42	-0.15	-0.94	-5.04	-16.19	-13.38	-7.75	-5.12	-4.36

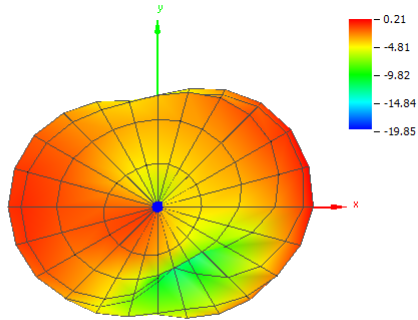


Figure 141. Board #4 (433 MHz): Theta = 0, Phi = 0

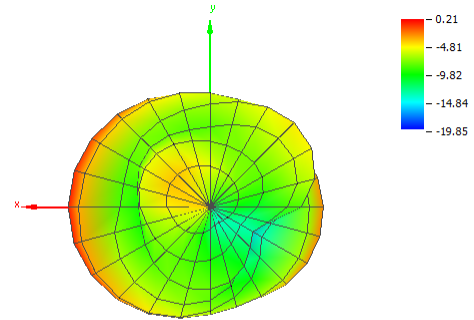


Figure 142. Board #4 (433 MHz): Theta = 180, Phi = 0

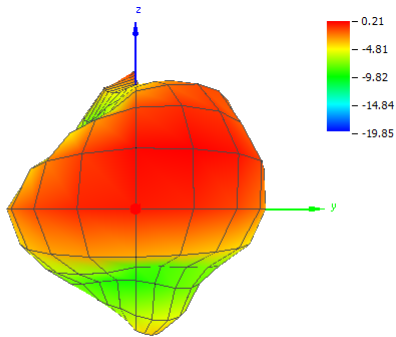


Figure 143. Board #4 (433 MHz): Theta = 90, Phi = 0

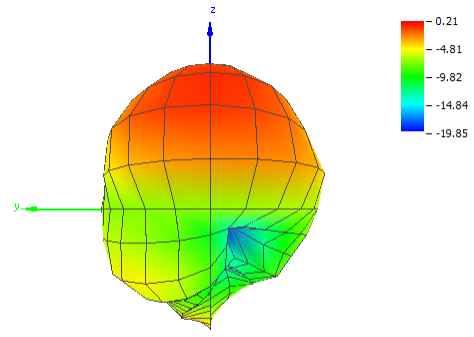


Figure 144. Board #4 (433 MHz): Theta = 90, Phi = 180

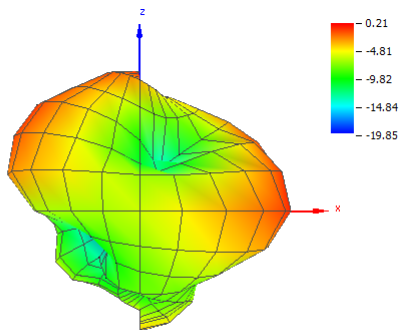


Figure 145. Board #4 (433 MHz): Theta = 90, Phi = 270

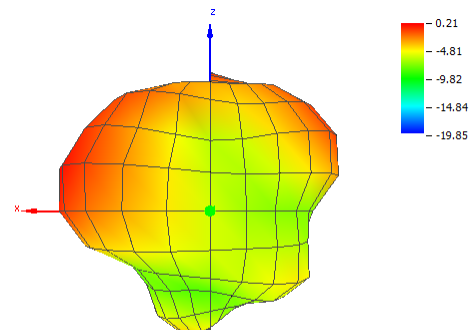


Figure 146. Board #4 (433 MHz): Theta = 90, Phi = 90

**A.4.2 470 MHz**
**Table 96. Board #4: OTA Evaluation Results (470 MHz)**

Test Description	Test Result
Total Radiated Power	-8.12 dBm
Peak EIRP	-3.70 dBm
Directivity	4.42 dBi
Efficiency	-8.12 dB
Efficiency	0.154
Peak Gain	-3.70 dBi
NHPRP 45°	-9.07 dBm
NHPRP 45° / TRP	-0.95 dB
NHPRP 45° / TRP	0.8042
NHPRP 30°	-10.38 dBm
NHPRP 30° / TRP	-2.25 dB
NHPRP 30° / TRP	0.5956
NHPRP 22.5°	-11.54 dBm
NHPRP 22.5° / TRP	-3.42 dB
NHPRP 22.5° / TRP	0.4553
UHRP	-11.15 dBm
UHRP / TRP	-3.02 dB
UHRP / TRP	0.4986
LHRP	-11.12 dBm
LHRP / TRP	-3.00 dB
LHRP / TRP	0.5014
PGRP (0-120°)	-9.02 dBm
PGRP / TRP	-0.90 dB
PGRP / TRP	0.8136
Front/Back Ratio	8.14
PhiBW	151.6°
PhiBW Up	41.1°
PhiBW Down	110.5°
ThetaBW	104.7°
ThetaBW Up	19.7°
ThetaBW Down	85.0°
Boresight Phi	165°
Boresight Theta	120°
Maximum Power	-3.70 dBm
Minimum Power	-22.29 dBm
Average Power	-8.86 dBm
Max/Min Ratio	18.59 dB
Max/Avg Ratio	5.16 dB
Min/Avg Ratio	-13.43 dB
Worst Single Value	-39.77 dBm
Worst Position	Azi = 270°; Elev = 135°; Pol = Vertical
Best Single Value	-3.89 dBm
Best Position	Azi = 180°; Elev = 60°; Pol = Vertical



**Table 97. Board #4: RP\_470.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-9.56	-10.49	-10.27	-10.1	-9.44	-7.23	-6.77	-7.4	-9.79	-11.48	-11.12	-9.27	-9.25
15	-8.88	-9.73	-8.64	-8.87	-8.52	-7.11	-6.93	-6.96	-9.21	-9.96	-10.63	-9.72	-9.88
30	-8.5	-8.71	-7.81	-8.04	-8.54	-7.49	-7.56	-6.82	-8.06	-8.71	-10.53	-10.28	-10.82
45	-8.4	-8.26	-7.61	-8.1	-9.65	-8.74	-8.52	-6.79	-7.06	-7.93	-10.95	-11.34	-12.04
60	-8.62	-8.37	-8.04	-8.93	-11.36	-10.49	-9.36	-6.74	-6.5	-7.6	-11.93	-12.82	-13.21
75	-9.47	-9.08	-9.18	-10.52	-12.66	-12.47	-9.73	-6.66	-6.09	-7.56	-13.65	-15.02	-14.42
90	-10.99	-10.45	-10.83	-11.96	-11.77	-12.54	-9.35	-6.45	-5.78	-7.57	-15.37	-17.62	-14.8
105	-13.45	-12.71	-12.48	-12.13	-9.57	-10.68	-8.38	-5.96	-5.28	-7.37	-15.58	-18.97	-13.96
120	-16.04	-14.94	-12.32	-10.62	-7.66	-8.69	-7.24	-5.34	-4.7	-6.88	-13.74	-17.22	-12.67
135	-16.99	-15.01	-10.48	-8.57	-6.07	-6.93	-6.08	-4.6	-4.09	-6.26	-11.65	-14.74	-11.54
150	-14.73	-12.87	-8.63	-6.94	-4.98	-5.76	-5.24	-4.15	-3.72	-5.8	-10.14	-13.05	-10.87
165	-12.12	-10.6	-7.23	-5.64	-4.21	-4.91	-4.68	-4.08	-3.7	-5.58	-9.16	-11.82	-10.54
180	-10.4	-9.22	-6.53	-4.94	-3.87	-4.47	-4.5	-4.5	-4.18	-5.83	-8.78	-11.17	-10.7
195	-9.32	-8.38	-6.34	-4.71	-3.96	-4.38	-4.68	-5.45	-5.39	-6.74	-8.98	-10.85	-11.25
210	-8.9	-8.18	-6.6	-5	-4.49	-4.68	-5.14	-6.63	-7.16	-8.25	-9.72	-10.89	-12.01
225	-8.95	-8.43	-7.28	-5.88	-5.62	-5.52	-6.01	-8.1	-9.82	-10.72	-11.13	-11.15	-12.93
240	-9.33	-8.97	-8.17	-7.1	-7.17	-6.83	-7.13	-9.5	-12.87	-13.81	-12.83	-11.56	-13.39
255	-9.97	-9.77	-9.28	-8.8	-9.42	-8.86	-8.7	-11.09	-16.72	-18.21	-14.84	-11.84	-13.1
270	-10.63	-10.58	-10.42	-10.54	-12.2	-11.13	-10.16	-12.45	-19.53	-21.99	-16.16	-11.88	-12.2
285	-11.32	-11.54	-11.8	-12.46	-15.62	-13.23	-11.04	-13	-19.03	-22.29	-16.45	-11.63	-10.99
300	-11.76	-12.47	-13.14	-14.09	-17.77	-13.23	-10.65	-12.23	-16.67	-20	-15.8	-11.17	-10.07
315	-11.85	-13.47	-14.39	-15.37	-16.25	-11.54	-9.37	-10.73	-14.33	-17.75	-14.67	-10.63	-9.38
330	-11.3	-13.78	-14.31	-15.34	-13.83	-9.85	-8.15	-9.27	-12.82	-15.87	-13.48	-10.07	-8.99
345	-10.68	-12.87	-13.03	-13.35	-11.84	-8.49	-7.33	-8.09	-11.62	-14.21	-12.13	-9.43	-8.98
360	-9.56	-10.49	-10.27	-10.1	-9.44	-7.23	-6.77	-7.4	-9.79	-11.48	-11.12	-9.27	-9.25

**Table 98. Board #4: RP\_470.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-18.5	-19.57	-16.81	-17.72	-25.31	-16.28	-10.83	-9.92	-11.81	-14.49	-16.14	-15.55	-17
15	-20.05	-20.89	-16.46	-17.2	-26.44	-17.52	-10.49	-8.84	-10.48	-12.02	-15.91	-17.41	-21.23
30	-23.24	-22.85	-16.59	-16.4	-20.21	-16.49	-10.23	-7.98	-8.85	-10.41	-15.57	-20.12	-28.43
45	-29.86	-23.62	-16.67	-15.45	-16.38	-14.52	-9.92	-7.39	-7.61	-9.35	-15.58	-24.17	-32.8
60	-36.04	-21.58	-16.24	-14.63	-14.4	-13.23	-9.88	-7.07	-6.89	-8.66	-15.91	-27.56	-23.26
75	-27.65	-19.1	-15.52	-14.17	-13.39	-12.77	-10.1	-6.87	-6.32	-8.17	-16.28	-25.14	-18.84
90	-24.24	-17.68	-15.12	-14.19	-13.32	-13.15	-10.41	-6.65	-5.91	-7.85	-16.54	-21.85	-16.46
105	-22.51	-17.35	-15.25	-14.9	-14.08	-14.27	-10.53	-6.26	-5.47	-7.55	-16.51	-19.66	-14.86
120	-22.1	-17.95	-16.01	-16.38	-15.56	-15.49	-10.18	-5.8	-5.09	-7.28	-16.22	-18.82	-14.09
135	-22.35	-19.44	-17.53	-19.13	-18.28	-16.04	-9.38	-5.28	-4.76	-7.12	-15.86	-19.28	-13.96
150	-23.11	-21.54	-19.5	-23.31	-22.41	-15.62	-8.57	-5	-4.61	-7.12	-15.5	-21.2	-14.53
165	-24.87	-24.41	-21.58	-26.25	-31.02	-14.93	-8	-5.06	-4.74	-7.37	-15.14	-25.63	-15.95
180	-27.51	-25.36	-21.56	-22.26	-28.73	-14.52	-7.88	-5.56	-5.27	-7.98	-14.97	-29.48	-18.76
195	-30.35	-23.4	-19.78	-18.81	-21.98	-14.31	-8.23	-6.62	-6.46	-9.21	-15.07	-23.07	-24.57
210	-28.16	-21.62	-18.43	-17.39	-19.3	-14.35	-8.88	-7.96	-8.14	-10.89	-15.38	-18.74	-29.92
225	-25.02	-20.68	-17.97	-17.11	-18.23	-14.58	-9.81	-9.7	-10.61	-13.4	-15.76	-15.71	-21.36
240	-23.59	-20.87	-18.55	-18.02	-18.47	-14.96	-10.7	-11.29	-13.41	-16.13	-16.02	-13.98	-16.77
255	-23.97	-22.63	-20.53	-20.27	-19.73	-15.48	-11.6	-12.84	-16.97	-19.44	-16.21	-12.71	-13.89
270	-26.33	-26.2	-24.02	-22.68	-20.88	-15.59	-12.2	-13.92	-20.21	-22.06	-16.37	-12.03	-12.29
285	-29.85	-36.82	-29.44	-22.54	-20.23	-15.04	-12.45	-14.44	-22.88	-24.16	-16.66	-11.79	-11.34
300	-26.24	-30.89	-27.06	-20.24	-18.38	-14.15	-12.29	-14.28	-23.2	-25.45	-17.04	-11.89	-11.13
315	-21.46	-23.76	-22.07	-18.36	-17.08	-13.43	-11.83	-13.62	-21.64	-25.84	-17.51	-12.38	-11.54
330	-18.97	-20.86	-19.28	-17.75	-17.2	-13.45	-11.37	-12.56	-19.08	-22.86	-17.69	-12.99	-12.45
345	-17.86	-19.78	-17.41	-17.43	-19.44	-14.44	-10.94	-11.33	-15.69	-19.29	-17.09	-13.66	-14
360	-18.5	-19.57	-16.81	-17.72	-25.31	-16.28	-10.83	-9.92	-11.81	-14.49	-16.14	-15.55	-17

**Table 99. Board #4: RP\_470.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-10.16	-11.06	-11.36	-10.92	-9.55	-7.81	-8.93	-10.96	-14.09	-14.5	-12.76	-10.44	-10.05
15	-9.22	-10.08	-9.42	-9.56	-8.59	-7.53	-9.45	-11.5	-15.15	-14.2	-12.16	-10.53	-10.21
30	-8.65	-8.88	-8.43	-8.73	-8.84	-8.08	-10.93	-13.13	-15.87	-13.6	-12.15	-10.75	-10.89
45	-8.43	-8.39	-8.19	-8.98	-10.69	-10.07	-14.12	-15.68	-16.37	-13.47	-12.79	-11.57	-12.07
60	-8.62	-8.58	-8.76	-10.29	-14.34	-13.8	-18.82	-18.08	-17.14	-14.26	-14.15	-12.97	-13.66
75	-9.54	-9.54	-10.33	-12.97	-20.76	-24.19	-20.51	-19.75	-19.06	-16.34	-17.09	-15.47	-16.37
90	-11.2	-11.36	-12.84	-15.93	-17.01	-21.36	-16	-19.72	-20.98	-19.62	-21.63	-19.69	-19.76
105	-14.03	-14.55	-15.76	-15.4	-11.47	-13.18	-12.46	-17.81	-18.98	-21.23	-22.72	-27.32	-21.24
120	-17.27	-17.94	-14.74	-11.96	-8.43	-9.7	-10.31	-15.34	-15.38	-17.41	-17.36	-22.33	-18.21
135	-18.49	-16.95	-11.43	-8.97	-6.34	-7.5	-8.81	-13.03	-12.55	-13.75	-13.72	-16.62	-15.23
150	-15.41	-13.5	-9.01	-7.04	-5.06	-6.24	-7.94	-11.66	-11.03	-11.63	-11.64	-13.77	-13.32
165	-12.35	-10.78	-7.39	-5.68	-4.22	-5.36	-7.39	-11.04	-10.43	-10.29	-10.42	-12.01	-12.01
180	-10.48	-9.33	-6.67	-5.02	-3.89	-4.93	-7.17	-11.13	-10.71	-9.92	-9.98	-11.23	-11.44
195	-9.36	-8.52	-6.54	-4.88	-4.03	-4.84	-7.2	-11.72	-12.04	-10.38	-10.21	-11.12	-11.46
210	-8.96	-8.38	-6.9	-5.26	-4.64	-5.17	-7.53	-12.42	-14.14	-11.65	-11.09	-11.67	-12.08
225	-9.05	-8.7	-7.66	-6.22	-5.86	-6.1	-8.36	-13.2	-17.59	-14.08	-12.96	-13.02	-13.61
240	-9.49	-9.26	-8.59	-7.46	-7.5	-7.56	-9.64	-14.23	-22.24	-17.65	-15.67	-15.25	-16.06
255	-10.15	-10	-9.62	-9.12	-9.85	-9.93	-11.83	-15.88	-29.35	-24.3	-20.53	-19.29	-20.93
270	-10.75	-10.7	-10.61	-10.82	-12.83	-13.05	-14.42	-17.87	-27.91	-39.77	-29.4	-26.47	-29.16
285	-11.38	-11.55	-11.87	-12.9	-17.47	-17.9	-16.62	-18.49	-21.34	-26.86	-29.79	-25.9	-22.01
300	-11.92	-12.54	-13.32	-15.3	-26.57	-20.44	-15.67	-16.49	-17.76	-21.46	-21.83	-19.34	-16.72
315	-12.35	-13.9	-15.2	-18.4	-23.83	-16.06	-13	-13.86	-15.23	-18.49	-17.87	-15.43	-13.45
330	-12.11	-14.72	-15.97	-19.05	-16.5	-12.35	-10.96	-12.02	-14	-16.84	-15.55	-13.17	-11.59
345	-11.6	-13.86	-15	-15.51	-12.68	-9.76	-9.82	-10.87	-13.79	-15.82	-13.8	-11.49	-10.62
360	-10.16	-11.06	-11.36	-10.92	-9.55	-7.81	-8.93	-10.96	-14.09	-14.5	-12.76	-10.44	-10.05

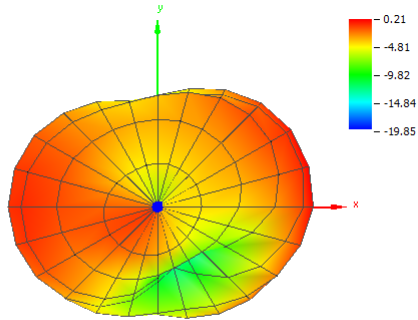


Figure 147. Board #4 (470 MHz): Theta = 0, Phi = 0

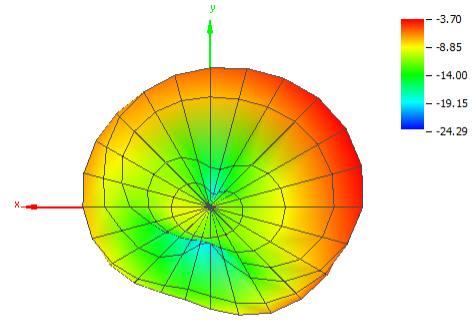


Figure 148. Board #4 (470 MHz): Theta = 180, Phi = 0

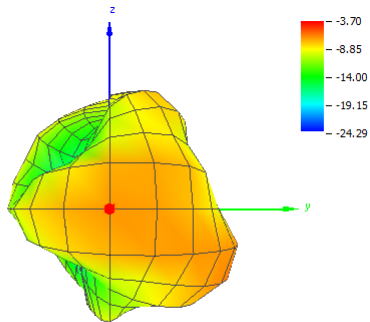


Figure 149. Board #4 (470 MHz): Theta = 90, Phi = 0

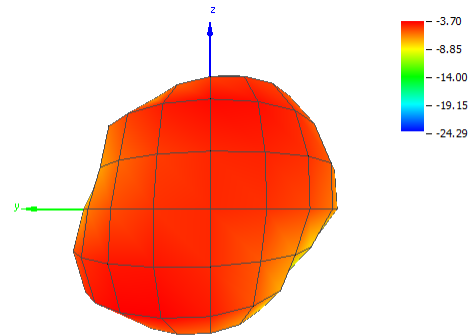


Figure 150. Board #4 (470 MHz): Theta = 90, Phi = 180

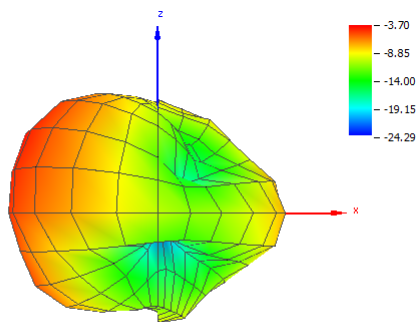


Figure 151. Board #4 (470 MHz): Theta = 90, Phi = 270

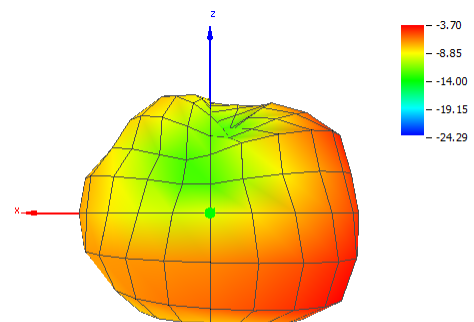


Figure 152. Board #4 (470 MHz): Theta = 90, Phi = 90

**A.4.3 490 MHz**
**Table 100. Board #4: OTA Evaluation Results (490 MHz)**

Test Description	Test Result
Total Radiated Power	-4.37 dBm
Peak EIRP	0.13 dBm
Directivity	4.50 dBi
Efficiency	-4.37 dB
Efficiency	0.3654
Peak Gain	0.13 dBi
NHPRP 45°	-5.37 dBm
NHPRP 45° / TRP	-1.00 dB
NHPRP 45° / TRP	0.7948
NHPRP 30°	-6.80 dBm
NHPRP 30° / TRP	-2.43 dB
NHPRP 30° / TRP	0.5718
NHPRP 22.5°	-8.03 dBm
NHPRP 22.5° / TRP	-3.66 dB
NHPRP 22.5° / TRP	0.4307
UHRP	-8.03 dBm
UHRP / TRP	-3.66 dB
UHRP / TRP	0.4306
LHRP	-6.82 dBm
LHRP / TRP	-2.45 dB
LHRP / TRP	0.5694
PGRP (0-120°)	-5.59 dBm
PGRP / TRP	-1.22 dB
PGRP / TRP	0.7553
Front/Back Ratio	10.54
PhiBW	187.9°
PhiBW Up	49.8°
PhiBW Down	138.1°
ThetaBW	83.2°
ThetaBW Up	21.0°
ThetaBW Down	62.1°
Boresight Phi	165°
Boresight Theta	120°
Maximum Power	0.13 dBm
Minimum Power	-16.07 dBm
Average Power	-5.08 dBm
Max/Min Ratio	16.20 dB
Max/Avg Ratio	5.21 dB
Min/Avg Ratio	-10.99 dB
Worst Single Value	-33.43 dBm
Worst Position	Azi = 195°; Elev = 15°; Pol = Horizontal
Best Single Value	-0.37 dBm
Best Position	Azi = 150°; Elev = 120°; Pol = Horizontal

**Table 101. Board #4: RP\_490.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-4.8	-4.83	-4.1	-4.88	-5.88	-5.83	-3.09	-2.77	-4.25	-5.3	-5.83	-5.65	-6.18
15	-4.07	-3.97	-2.9	-3.69	-4.31	-5.07	-3.31	-2.81	-3.62	-3.93	-5.08	-5.63	-6.62
30	-3.61	-3.22	-2.24	-2.8	-3.62	-4.56	-4.12	-3.17	-2.67	-2.91	-4.59	-5.77	-7.43
45	-3.42	-2.87	-2.15	-2.57	-3.65	-4.81	-5.6	-3.63	-1.98	-2.31	-4.59	-6.2	-8.53
60	-3.52	-2.91	-2.58	-2.87	-4.08	-5.73	-7.51	-4	-1.54	-2.13	-5.04	-6.93	-9.81
75	-4.04	-3.44	-3.6	-3.66	-4.64	-6.84	-9.2	-4.09	-1.28	-2.16	-5.81	-8	-10.57
90	-5	-4.48	-5.13	-4.65	-5.14	-7.29	-9.25	-3.81	-1.1	-2.21	-6.63	-9.15	-10.52
105	-6.4	-6.13	-7.29	-5.74	-5.15	-6.71	-7.9	-3.31	-0.86	-2.24	-7.19	-10.11	-9.62
120	-8.17	-8.3	-9.3	-6.62	-4.7	-5.39	-6.05	-2.63	-0.57	-2.14	-7.06	-10.29	-8.48
135	-10.12	-10.87	-10.4	-6.78	-4	-3.94	-4.37	-1.83	-0.18	-1.84	-6.37	-9.69	-7.51
150	-11.78	-13.19	-10.03	-6.33	-3.12	-2.81	-3.07	-1.18	0.09	-1.59	-5.54	-8.77	-6.87
165	-12.94	-13.92	-9.2	-5.36	-2.45	-1.92	-2.13	-0.86	0.13	-1.49	-4.91	-7.76	-6.46
180	-13.59	-13.26	-8.47	-4.6	-2.05	-1.36	-1.56	-0.96	-0.19	-1.69	-4.6	-7.02	-6.41
195	-14.17	-12.31	-8.02	-4.15	-1.98	-1.13	-1.34	-1.48	-1.02	-2.36	-4.71	-6.54	-6.62
210	-14.65	-11.66	-7.93	-4.22	-2.34	-1.31	-1.49	-2.28	-2.31	-3.54	-5.25	-6.36	-7.05
225	-14.86	-11.31	-8.11	-4.8	-3.19	-1.94	-2.01	-3.24	-4.07	-5.33	-6.27	-6.37	-7.62
240	-14.35	-11.12	-8.46	-5.81	-4.47	-3.05	-2.87	-4.22	-6.07	-7.61	-7.67	-6.65	-8.06
255	-13.28	-10.94	-8.87	-7.12	-6.25	-4.61	-3.98	-5.17	-7.94	-10.36	-9.42	-6.95	-8.23
270	-12.05	-10.83	-9.4	-8.56	-8.46	-6.47	-5.02	-5.91	-9.09	-12.9	-10.98	-7.25	-7.9
285	-10.93	-10.75	-10.11	-10.16	-11.04	-8.24	-5.63	-6.11	-9.2	-13.98	-11.81	-7.34	-7.16
300	-9.92	-10.6	-10.75	-11.87	-14.03	-9.5	-5.54	-5.65	-8.53	-13.14	-11.54	-7.16	-6.43
315	-8.73	-9.95	-10.5	-13.06	-16.07	-9.77	-4.87	-4.82	-7.55	-11.36	-10.41	-6.81	-5.86
330	-7.38	-8.58	-8.73	-11.57	-13.48	-9.23	-4.08	-3.91	-6.55	-9.41	-8.98	-6.43	-5.68
345	-6.31	-6.92	-6.77	-8.51	-10.41	-7.88	-3.64	-3.23	-5.59	-7.84	-7.8	-6.06	-5.92
360	-4.8	-4.83	-4.1	-4.88	-5.88	-5.83	-3.09	-2.77	-4.25	-5.3	-5.83	-5.65	-6.18

**Table 102. Board #4: RP\_490.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-17.35	-13.57	-10.95	-13.35	-20.02	-13.41	-6.33	-5.12	-5.53	-6.43	-8.31	-9.83	-12.4
15	-16.83	-13.69	-11.22	-13.5	-17.95	-12.87	-6.64	-4.81	-4.58	-5.01	-7.76	-10.58	-14.41
30	-17.18	-15.47	-12.84	-14.83	-14.76	-10.56	-6.94	-4.63	-3.43	-4.01	-7.25	-11.34	-16.71
45	-17.99	-19.39	-16.85	-15.62	-11.88	-8.6	-7.32	-4.61	-2.63	-3.37	-7.08	-11.88	-17.22
60	-18.54	-26	-24.59	-13.51	-9.6	-7.67	-8.02	-4.75	-2.05	-3.02	-7.1	-11.92	-15.08
75	-17.85	-21.36	-20.38	-10.88	-8.1	-7.61	-9.32	-4.75	-1.62	-2.77	-7.2	-11.43	-12.62
90	-16.27	-16.49	-14.84	-8.96	-7.48	-8.36	-10.82	-4.39	-1.28	-2.52	-7.29	-10.84	-10.9
105	-14.45	-13.83	-12.17	-8.18	-7.59	-9.84	-11.9	-3.83	-0.96	-2.37	-7.39	-10.49	-9.72
120	-13.06	-12.6	-11.23	-8.46	-8.37	-11.64	-11.39	-3.16	-0.71	-2.34	-7.53	-10.6	-9.18
135	-12.24	-12.61	-11.75	-9.78	-9.84	-12.75	-9.53	-2.44	-0.48	-2.34	-7.75	-11.36	-9.26
150	-12.22	-13.87	-13.75	-12.65	-12.05	-12.73	-7.7	-1.86	-0.37	-2.49	-8.04	-12.83	-9.99
165	-13.14	-16.59	-18.1	-17.99	-15.48	-12.16	-6.22	-1.58	-0.43	-2.82	-8.42	-15.04	-11.51
180	-15.17	-21.79	-28.1	-32.08	-20.98	-11.69	-5.36	-1.68	-0.76	-3.39	-8.87	-17.44	-14.24
195	-19.25	-33.43	-23	-21.28	-22.9	-11.41	-4.99	-2.21	-1.51	-4.33	-9.47	-17.92	-19.27
210	-26.97	-23.13	-17.06	-16.74	-18.66	-11.26	-5.01	-3.05	-2.66	-5.65	-10.12	-15.43	-26.18
225	-24.03	-17.87	-14.56	-14.99	-16.49	-11.17	-5.21	-4.09	-4.26	-7.43	-10.79	-12.48	-18.46
240	-18.32	-15.65	-13.64	-15.02	-16.29	-11.14	-5.48	-5.05	-6.12	-9.47	-11.46	-10.41	-13.32
255	-15.79	-14.74	-13.71	-16.36	-17.62	-11.14	-5.74	-5.8	-7.95	-11.79	-12	-8.93	-10.37
270	-15.15	-14.96	-14.58	-18.8	-20.23	-10.95	-5.92	-6.31	-9.39	-13.76	-12.42	-8.12	-8.63
285	-16.08	-16.35	-16.12	-22.4	-22.62	-10.52	-5.97	-6.55	-10.22	-14.81	-12.65	-7.76	-7.63
300	-18.85	-18.8	-17.94	-25.01	-21.83	-10.02	-5.91	-6.52	-10.39	-14.44	-12.61	-7.74	-7.3
315	-23.96	-20.41	-17.95	-22.13	-20.59	-9.84	-5.79	-6.32	-10	-12.88	-12.09	-7.98	-7.53
330	-25.27	-18.16	-15.22	-17.93	-20.88	-10.39	-5.74	-5.96	-9	-10.78	-11.12	-8.44	-8.36
345	-20.57	-15.75	-12.57	-15.21	-21.84	-11.3	-5.93	-5.65	-7.64	-9.04	-9.97	-8.88	-9.77
360	-17.35	-13.57	-10.95	-13.35	-20.02	-13.41	-6.33	-5.12	-5.53	-6.43	-8.31	-9.83	-12.4

**Table 103. Board #4: RP\_490.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-5.05	-5.46	-5.11	-5.55	-6.05	-6.66	-5.88	-6.56	-10.2	-11.71	-9.46	-7.74	-7.36
15	-4.31	-4.45	-3.59	-4.17	-4.5	-5.85	-6.02	-7.15	-10.61	-10.52	-8.46	-7.31	-7.41
30	-3.81	-3.49	-2.63	-3.08	-3.97	-5.82	-7.34	-8.64	-10.6	-9.39	-7.97	-7.18	-7.97
45	-3.57	-2.97	-2.3	-2.79	-4.36	-7.16	-10.45	-10.56	-10.56	-8.94	-8.19	-7.57	-9.16
60	-3.66	-2.93	-2.61	-3.27	-5.51	-10.18	-17.12	-11.97	-11.03	-9.41	-9.26	-8.58	-11.34
75	-4.23	-3.51	-3.7	-4.57	-7.24	-14.72	-24.77	-12.57	-12.45	-10.99	-11.44	-10.62	-14.83
90	-5.33	-4.76	-5.63	-6.66	-8.93	-13.91	-14.45	-12.85	-15.06	-13.83	-15.19	-14.08	-21.31
105	-7.14	-6.94	-9	-9.41	-8.82	-9.6	-10.1	-12.81	-17.42	-17.53	-20.69	-20.84	-25.95
120	-9.87	-10.32	-13.76	-11.23	-7.14	-6.57	-7.55	-12.04	-15.33	-15.66	-16.96	-21.84	-16.76
135	-14.26	-15.67	-16.12	-9.81	-5.31	-4.55	-5.94	-10.68	-11.97	-11.54	-12.03	-14.63	-12.3
150	-21.97	-21.6	-12.44	-7.49	-3.71	-3.27	-4.91	-9.56	-9.86	-8.9	-9.14	-10.94	-9.78
165	-26.44	-17.31	-9.8	-5.6	-2.68	-2.35	-4.28	-9.03	-9	-7.28	-7.46	-8.66	-8.09
180	-18.76	-13.91	-8.52	-4.6	-2.11	-1.78	-3.9	-9.12	-9.25	-6.6	-6.64	-7.43	-7.2
195	-15.79	-12.34	-8.16	-4.23	-2.02	-1.56	-3.79	-9.62	-10.71	-6.74	-6.48	-6.87	-6.86
210	-14.92	-11.98	-8.49	-4.48	-2.44	-1.77	-4.04	-10.18	-13.34	-7.69	-6.96	-6.94	-7.1
225	-15.42	-12.39	-9.23	-5.24	-3.4	-2.49	-4.84	-10.74	-17.76	-9.49	-8.16	-7.59	-8
240	-16.57	-13.01	-10.03	-6.37	-4.77	-3.78	-6.31	-11.81	-26.18	-12.18	-10.02	-9.02	-9.6
255	-16.86	-13.28	-10.6	-7.67	-6.57	-5.7	-8.74	-13.8	-31.93	-15.88	-12.9	-11.31	-12.33
270	-14.98	-12.95	-10.98	-8.99	-8.76	-8.39	-12.28	-16.42	-20.88	-20.33	-16.46	-14.67	-15.99
285	-12.51	-12.15	-11.37	-10.42	-11.36	-12.14	-16.85	-16.33	-16	-21.54	-19.34	-17.64	-17.06
300	-10.51	-11.31	-11.68	-12.08	-14.81	-18.93	-16.43	-13.04	-13.11	-19	-18.17	-16.18	-13.84
315	-8.87	-10.36	-11.36	-13.64	-17.96	-27.69	-12.08	-10.17	-11.2	-16.67	-15.36	-13.05	-10.84
330	-7.45	-9.09	-9.83	-12.71	-14.35	-15.52	-9.04	-8.14	-10.2	-15.11	-13.08	-10.74	-9.05
345	-6.48	-7.53	-8.1	-9.56	-10.73	-10.52	-7.52	-6.93	-9.84	-13.99	-11.85	-9.27	-8.23
360	-5.05	-5.46	-5.11	-5.55	-6.05	-6.66	-5.88	-6.56	-10.2	-11.71	-9.46	-7.74	-7.36



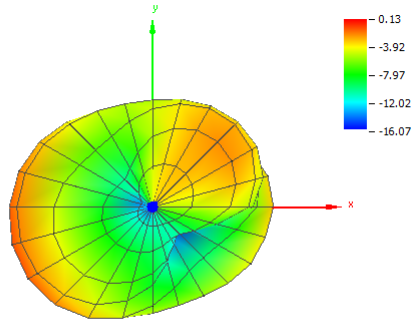


Figure 153. Board #4 (490 MHz): Theta = 0, Phi = 0

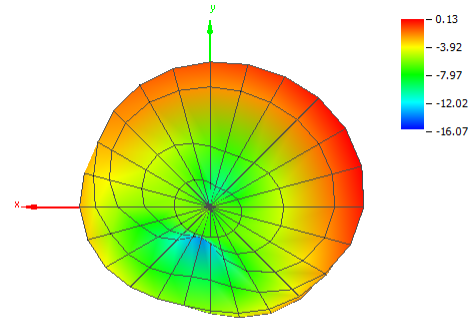


Figure 154. Board #4 (490 MHz): Theta = 180, Phi = 0

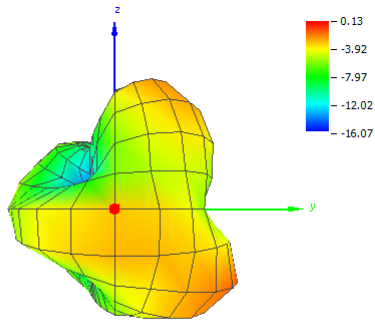


Figure 155. Board #4 (490 MHz): Theta = 90, Phi = 0

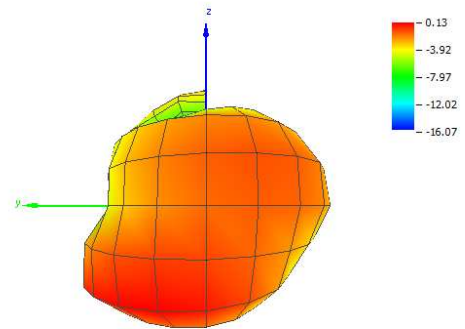


Figure 156. Board #4 (490 MHz): Theta = 90, Phi = 180

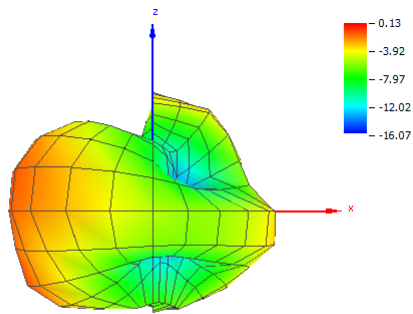


Figure 157. Board #4 (490 MHz): Theta = 90, Phi = 270

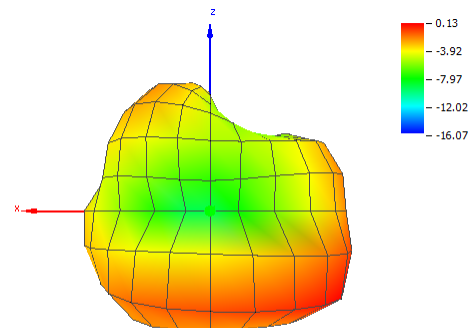


Figure 158. Board #4 (490 MHz): Theta = 90, Phi = 90

**A.4.4 510 MHz**
**Table 104. Board #4: OTA Evaluation Results (510 MHz)**

Test Description	Test Result
Total Radiated Power	-3.23 dBm
Peak EIRP	0.53 dBm
Directivity	3.76 dBi
Efficiency	-3.23 dB
Efficiency	0.4749
Peak Gain	0.53 dBi
NHPRP 45°	-4.19 dBm
NHPRP 45° / TRP	-0.96 dB
NHPRP 45° / TRP	0.8016
NHPRP 30°	-5.60 dBm
NHPRP 30° / TRP	-2.36 dB
NHPRP 30° / TRP	0.5805
NHPRP 22.5°	-6.82 dBm
NHPRP 22.5° / TRP	-3.58 dB
NHPRP 22.5° / TRP	0.4382
UHRP	-6.57 dBm
UHRP / TRP	-3.33 dB
UHRP / TRP	0.4643
LHRP	-5.94 dBm
LHRP / TRP	-2.71 dB
LHRP / TRP	0.5357
PGRP (0-120°)	-4.35 dBm
PGRP / TRP	-1.11 dB
PGRP / TRP	0.7742
Front/Back Ratio	3.21
PhiBW	93.6°
PhiBW Up	46.9°
PhiBW Down	46.7°
ThetaBW	65.4°
ThetaBW Up	23.1°
ThetaBW Down	42.3°
Boresight Phi	45°
Boresight Theta	60°
Maximum Power	0.53 dBm
Minimum Power	-16.63 dBm
Average Power	-4.00 dBm
Max/Min Ratio	17.16 dB
Max/Avg Ratio	4.52 dB
Min/Avg Ratio	-12.64 dB
Worst Single Value	-31.81 dBm
Worst Position	Azi = 210°; Elev = 30°; Pol = Horizontal
Best Single Value	0.09 dBm
Best Position	Azi = 30°; Elev = 60°; Pol = Vertical

**Table 105. Board #4: RP\_510.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-7.6	-5.87	-4.49	-2.75	-2.02	-1.9	-1.3	-2.06	-3.98	-5.82	-5.7	-4.13	-3.98
15	-6.6	-4.69	-2.81	-1.52	-0.48	-0.75	-1.32	-2.83	-3.97	-4.41	-4.7	-3.92	-4.12
30	-5.59	-3.54	-1.71	-0.4	0.39	-0.01	-2.33	-4.5	-3.3	-2.94	-3.81	-3.74	-4.54
45	-4.88	-2.75	-1.23	0.1	0.53	-0.25	-4.4	-6.18	-2.43	-1.98	-3.5	-3.84	-5.11
60	-4.46	-2.36	-1.22	0.17	0.03	-1.42	-8.26	-6.99	-1.63	-1.42	-3.62	-4.36	-6
75	-4.41	-2.42	-1.65	-0.22	-0.88	-3.36	-13.38	-6.16	-1.03	-1.18	-4.06	-5.13	-6.75
90	-4.62	-2.81	-2.33	-1.05	-2.29	-5.74	-12.56	-4.68	-0.6	-1.08	-4.56	-6.25	-7.28
105	-4.96	-3.49	-3.17	-2.19	-3.73	-7.11	-8.17	-3.37	-0.25	-1.05	-4.89	-7.26	-7.45
120	-5.46	-4.4	-4.14	-3.81	-4.88	-6.3	-5.09	-2.23	0.06	-0.98	-4.79	-7.9	-7.35
135	-5.94	-5.53	-5.11	-5.43	-4.95	-4.55	-3.24	-1.39	0.32	-0.84	-4.44	-7.8	-7.01
150	-6.68	-7.17	-6.18	-6.71	-4.06	-2.81	-1.82	-0.68	0.43	-0.8	-4.03	-7.33	-6.69
165	-7.7	-9.05	-7.3	-6.76	-3.04	-1.48	-0.86	-0.29	0.31	-0.97	-3.84	-6.76	-6.45
180	-9.25	-11.45	-8.67	-6.17	-2.33	-0.44	-0.12	-0.16	-0.13	-1.5	-3.94	-6.36	-6.46
195	-11.23	-14.11	-10.15	-5.72	-2.14	0.06	0.26	-0.25	-0.79	-2.39	-4.37	-6.22	-6.84
210	-13.33	-16.63	-11.94	-5.83	-2.48	0.01	0.2	-0.51	-1.72	-3.77	-5.19	-6.36	-7.61
225	-13.8	-16.24	-13.38	-6.42	-3.33	-0.64	-0.33	-0.89	-2.68	-5.35	-6.32	-6.66	-8.6
240	-12.11	-13.66	-13.73	-7.27	-4.66	-1.97	-1.44	-1.52	-3.71	-7.16	-7.84	-7.06	-9.48
255	-9.99	-11.37	-13.02	-7.9	-6.3	-3.85	-2.82	-2.28	-4.44	-8.58	-9.44	-7.33	-9.67
270	-8.23	-9.91	-12.23	-8.41	-8.33	-6.51	-4.41	-3.02	-4.75	-9.28	-10.84	-7.47	-8.66
285	-7.39	-9.45	-12.09	-8.81	-10.26	-9.7	-5.26	-3.31	-4.6	-9.21	-11.41	-7.27	-7.08
300	-7.29	-9.79	-12.76	-9.6	-11.9	-13.04	-5.11	-3.02	-4.17	-8.68	-10.95	-6.64	-5.59
315	-7.78	-10.37	-13.03	-10.24	-11.91	-12.94	-4.13	-2.49	-3.79	-8.2	-9.97	-5.84	-4.6
330	-8.45	-10.11	-10.95	-9.19	-8.92	-9.2	-3.03	-1.91	-3.63	-7.7	-8.76	-5.21	-4.03
345	-8.75	-8.65	-8.4	-6.48	-6.07	-5.67	-2.39	-1.68	-3.63	-7.32	-7.71	-4.74	-4.06
360	-7.6	-5.87	-4.49	-2.75	-2.02	-1.9	-1.3	-2.06	-3.98	-5.82	-5.7	-4.13	-3.98

**Table 106. Board #4: RP\_510.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-23.69	-14.91	-12.81	-11.43	-13.52	-15.88	-7.8	-5.67	-5.61	-7.21	-9.29	-10.79	-15.72
15	-22.31	-14.35	-12.92	-12.17	-12.69	-11.69	-8.02	-6.15	-4.82	-5.53	-8.34	-11.07	-17.03
30	-19.03	-15.05	-15.47	-15.15	-11.31	-8.48	-8.37	-6.79	-3.75	-4.09	-7.31	-11.02	-16.15
45	-16.67	-15.81	-20.47	-15.8	-9.33	-6.83	-8.93	-7.26	-2.84	-3.16	-6.73	-10.63	-13.86
60	-14.56	-14.59	-16.05	-10.74	-7.19	-6.35	-10.69	-7.34	-2.1	-2.49	-6.29	-9.95	-11.47
75	-12.67	-12.04	-10.63	-7.36	-5.81	-6.92	-13.76	-6.72	-1.5	-2.04	-6	-9.2	-9.64
90	-10.83	-9.46	-7.25	-5.27	-5.23	-8.34	-20.16	-5.71	-1.01	-1.66	-5.73	-8.53	-8.35
105	-9.25	-7.8	-5.55	-4.45	-5.32	-10.48	-22.06	-4.75	-0.67	-1.47	-5.57	-8.18	-7.64
120	-8.03	-6.85	-4.86	-4.57	-6.04	-12.86	-15.65	-3.95	-0.48	-1.47	-5.55	-8.31	-7.5
135	-7.4	-6.89	-5.19	-5.62	-7.23	-14.22	-12.12	-3.36	-0.41	-1.6	-5.78	-8.92	-7.82
150	-7.43	-7.96	-6.54	-7.99	-9.29	-14.68	-9.62	-2.76	-0.46	-1.94	-6.22	-10.21	-8.7
165	-8.18	-9.92	-8.98	-11.83	-12.41	-14.61	-7.96	-2.31	-0.62	-2.43	-6.81	-11.97	-10.02
180	-9.78	-13.3	-13.25	-20.45	-18.52	-14.53	-6.85	-2.02	-0.93	-3.2	-7.56	-14.58	-12.18
195	-12.15	-18.16	-20.31	-26.97	-28.87	-14.5	-6.32	-2.02	-1.37	-4.19	-8.44	-16.8	-15.55
210	-15.11	-22.14	-31.81	-17.06	-19.32	-14.53	-6.18	-2.28	-2.05	-5.52	-9.55	-16.61	-21.68
225	-15.79	-17.73	-20.8	-14.02	-15.97	-14.83	-6.15	-2.66	-2.84	-6.97	-10.86	-14.09	-21.86
240	-13.21	-13.81	-16.65	-12.84	-15.12	-15.54	-6.14	-3.09	-3.77	-8.56	-12.54	-11.56	-15.18
255	-10.62	-11.44	-14.77	-12.55	-15.91	-16.4	-6.04	-3.39	-4.54	-9.81	-14.14	-9.76	-11.53
270	-8.78	-10.17	-13.78	-12.6	-17.85	-16.77	-5.87	-3.64	-5.15	-10.66	-15.45	-8.63	-9.27
285	-8.09	-10	-13.74	-12.94	-19.84	-16.07	-5.65	-3.83	-5.62	-11.2	-16.08	-8.19	-8.09
300	-8.44	-10.92	-14.85	-13.8	-21.12	-15.19	-5.55	-4.02	-6.08	-11.6	-15.96	-8.16	-7.78
315	-9.84	-12.83	-16.66	-14.57	-21.88	-15.33	-5.53	-4.26	-6.43	-11.66	-15.07	-8.49	-8.28
330	-12.68	-15.45	-17.46	-14.14	-20.68	-16.88	-6.03	-4.61	-6.66	-10.96	-13.5	-9.22	-9.64
345	-16.74	-16.46	-15.5	-12.89	-17.19	-19.18	-6.87	-5.06	-6.6	-9.94	-11.78	-9.78	-11.63
360	-23.69	-14.91	-12.81	-11.43	-13.52	-15.88	-7.8	-5.67	-5.61	-7.21	-9.29	-10.79	-15.72

**Table 107. Board #4: RP\_510.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-7.71	-6.45	-5.18	-3.38	-2.33	-2.08	-2.4	-4.55	-9.01	-11.42	-8.2	-5.18	-4.28
15	-6.72	-5.18	-3.25	-1.91	-0.75	-1.11	-2.36	-5.55	-11.46	-10.85	-7.17	-4.85	-4.34
30	-5.79	-3.85	-1.9	-0.55	0.09	-0.68	-3.57	-8.38	-13.4	-9.3	-6.38	-4.64	-4.85
45	-5.18	-2.97	-1.28	-0.01	0.05	-1.32	-6.28	-12.79	-12.81	-8.23	-6.31	-4.86	-5.73
60	-4.91	-2.62	-1.37	-0.2	-0.88	-3.1	-11.95	-18.15	-11.52	-8.03	-7	-5.76	-7.45
75	-5.11	-2.92	-2.23	-1.15	-2.57	-5.88	-24.05	-15.33	-10.97	-8.68	-8.48	-7.28	-9.89
90	-5.8	-3.86	-4.02	-3.11	-5.38	-9.21	-13.39	-11.42	-11.08	-10.18	-10.83	-10.15	-13.88
105	-6.99	-5.5	-6.92	-6.11	-8.87	-9.8	-8.35	-9.03	-10.68	-11.4	-13.28	-14.42	-21.18
120	-8.97	-8.05	-12.29	-11.7	-11.18	-7.38	-5.49	-7.09	-9.26	-10.69	-12.76	-18.34	-21.95
135	-11.41	-11.24	-22.3	-19.05	-8.84	-5.04	-3.84	-5.77	-7.81	-8.78	-10.22	-14.24	-14.73
150	-14.69	-14.95	-17.19	-12.64	-5.61	-3.1	-2.61	-4.88	-6.88	-7.18	-8.06	-10.48	-11
165	-17.44	-16.44	-12.24	-8.38	-3.58	-1.7	-1.8	-4.58	-6.85	-6.4	-6.88	-8.32	-8.96
180	-18.69	-16.05	-10.53	-6.33	-2.44	-0.62	-1.15	-4.73	-7.89	-6.38	-6.41	-7.07	-7.82
195	-18.42	-16.28	-10.59	-5.76	-2.15	-0.09	-0.81	-5.02	-9.84	-7.09	-6.53	-6.62	-7.46
210	-18.05	-18.07	-11.98	-6.18	-2.57	-0.14	-0.93	-5.25	-13.1	-8.56	-7.17	-6.79	-7.78
225	-18.15	-21.6	-14.24	-7.25	-3.58	-0.81	-1.65	-5.63	-17.18	-10.42	-8.2	-7.53	-8.81
240	-18.6	-28.48	-16.84	-8.68	-5.07	-2.16	-3.23	-6.71	-22.47	-12.74	-9.64	-8.96	-10.84
255	-18.66	-29.16	-17.81	-9.73	-6.8	-4.09	-5.64	-8.75	-20.83	-14.68	-11.24	-11.02	-14.26
270	-17.46	-22.28	-17.48	-10.49	-8.84	-6.94	-9.85	-11.81	-15.23	-14.95	-12.69	-13.75	-17.48
285	-15.63	-18.73	-17.09	-10.94	-10.77	-10.84	-15.95	-12.84	-11.38	-13.54	-13.22	-14.49	-13.9
300	-13.64	-16.19	-16.93	-11.67	-12.46	-17.13	-15.3	-9.88	-8.67	-11.78	-12.6	-11.93	-9.62
315	-12.01	-14.01	-15.51	-12.24	-12.37	-16.68	-9.72	-7.24	-7.2	-10.8	-11.58	-9.25	-7.04
330	-10.51	-11.62	-12.05	-10.86	-9.22	-10.02	-6.06	-5.27	-6.62	-10.46	-10.54	-7.41	-5.43
345	-9.5	-9.43	-9.35	-7.61	-6.42	-5.87	-4.3	-4.35	-6.69	-10.76	-9.88	-6.37	-4.89
360	-7.71	-6.45	-5.18	-3.38	-2.33	-2.08	-2.4	-4.55	-9.01	-11.42	-8.2	-5.18	-4.28

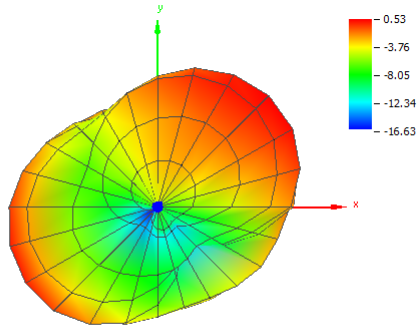


Figure 159. Board #4 (510 MHz): Theta = 0, Phi = 0

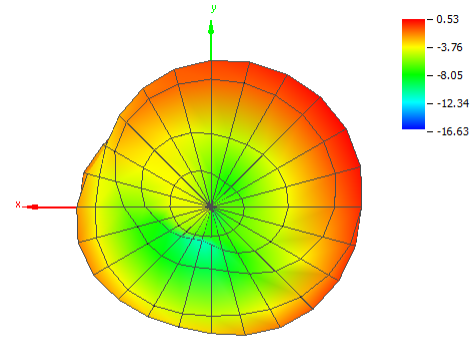


Figure 160. Board #4 (510 MHz): Theta = 180, Phi = 0

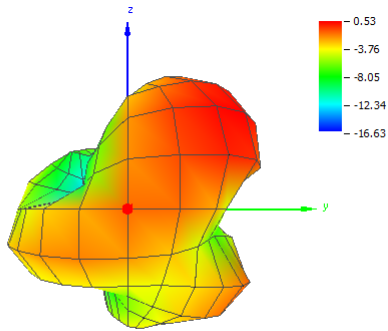


Figure 161. Board #4 (510 MHz): Theta = 90, Phi = 0

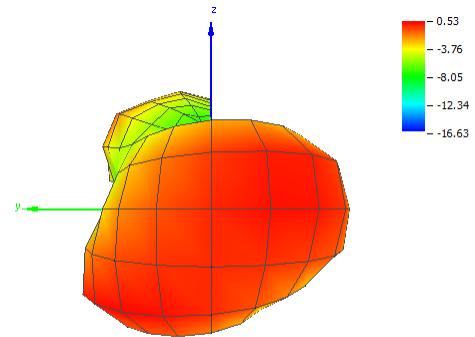


Figure 162. Board #4 (510 MHz): Theta = 90, Phi = 180

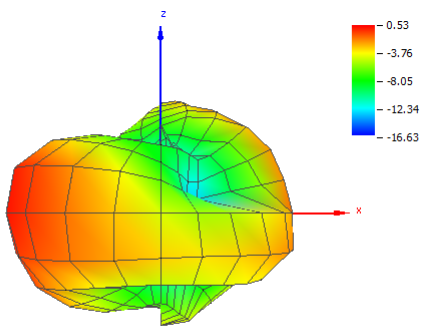


Figure 163. Board #4 (510 MHz): Theta = 90, Phi = 270

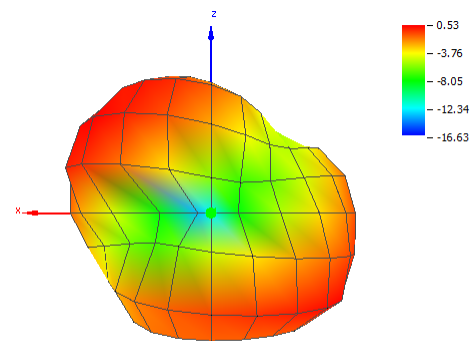


Figure 164. Board #4 (510 MHz): Theta = 90, Phi = 90

## A.5 Board #5: 2.4 GHz PCB Antenna Diversity

### A.5.1 Board #5A

**Table 108. Board #5A: OTA Evaluation Results**

Test Description	Test Result
Total Radiated Power	-2.65 dBm
Peak EIRP	2.55 dBm
Directivity	5.20 dBi
Efficiency	-2.65 dB
Efficiency	0.5426
Peak Gain	2.55 dBi
NHPRP 45°	-3.88 dBm
NHPRP 45° / TRP	-1.23 dB
NHPRP 45° / TRP	0.7539
NHPRP 30°	-5.33 dBm
NHPRP 30° / TRP	-2.67 dB
NHPRP 30° / TRP	0.5405
NHPRP 22.5°	-6.53 dBm
NHPRP 22.5° / TRP	-3.87 dB
NHPRP 22.5° / TRP	0.4099
UHRP	-6.37 dBm
UHRP / TRP	-3.72 dB
UHRP / TRP	0.4247
LHRP	-5.06 dBm
LHRP / TRP	-2.40 dB
LHRP / TRP	0.5753
PGRP (0-120°)	-4.09 dBm
PGRP / TRP	-1.43 dB
PGRP / TRP	0.7191
Front/Back Ratio	6.08
PhiBW	49.8°
PhiBW Up	26.6°
PhiBW Down	23.3°
ThetaBW	103.9°
ThetaBW Up	70.6°
ThetaBW Down	33.4°
Boresight Phi	45°
Boresight Theta	90°
Maximum Power	2.55 dBm
Minimum Power	-14.04 dBm
Average Power	-3.26 dBm
Max/Min Ratio	16.59 dB
Max/Avg Ratio	5.81 dB
Min/Avg Ratio	-10.78 dB
Worst Single Value	-22.21 dBm
Worst Position	Azi = 210°; Elev = 120°; Pol = Horizontal
Best Single Value	2.47 dBm
Best Position	Azi = 45°; Elev = 90°; Pol = Vertical

**Table 109. Board #5A: RP\_2440.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-8.8	-9.77	-8.37	-9.45	-7.73	-6.66	-4.4	-6.75	-4.41	-4.27	-7.16	-4.87	-3.71
15	-9.48	-10.14	-8.05	-8.61	-3.26	-4.88	-1.32	-3.61	-1.95	-4.21	-5.27	-3.08	-3.3
30	-10.05	-9.66	-6.55	-4.9	-0.88	-1.99	0.61	0.42	-0.03	-1.68	-0.73	-1.79	-2.56
45	-10.39	-7.91	-4.84	-2.18	0.05	0.37	2.55	2.24	1.2	0.62	1.44	-1.25	-2
60	-9.15	-5.91	-3.33	-1.29	0.43	1.32	2.2	2.47	0.67	1.65	1.76	-1.28	-2.1
75	-8.18	-5.51	-2.8	-1.2	-0.51	0.57	-1.24	0.47	-0.8	1.25	1.48	-1.51	-2.22
90	-7.68	-5.39	-2.75	-1.22	-1.71	-1.77	-7.64	-5.99	-1.86	-0.28	1	-2.12	-2.06
105	-7.97	-5.94	-2.7	-1.27	-1.77	-4.44	-9.45	-6.95	-2.26	-2	0.08	-2.61	-2.4
120	-9.59	-6.99	-3.42	-1.44	-1.41	-3.61	-4.68	-2.49	-1.8	-3.33	-1.37	-3.29	-2.13
135	-10.4	-7.93	-4.98	-1.6	-1.76	-2.16	-1.84	-1.14	-1.47	-4.6	-3.93	-3.89	-2.66
150	-10.39	-8.56	-7.58	-2.97	-4.11	-2	-1.73	-1.99	-2.36	-5.24	-5.48	-4.52	-3.3
165	-9.72	-9.15	-11.28	-5.86	-9.36	-4.87	-6.63	-3.74	-6.93	-6.3	-4.77	-5.35	-3.68
180	-9.14	-10.13	-12.78	-9.8	-11.22	-14.04	-8.49	-10.18	-7.08	-9.69	-4.38	-6.31	-3.72
195	-8.57	-10.31	-8.28	-6.4	-5.52	-3.26	-4.09	-6.41	-6.3	-8.98	-4.24	-6.72	-3.29
210	-9.08	-9.01	-5.11	-4.05	-3.31	-2.59	-1.34	-1.38	-3.72	-6.36	-3.69	-7.12	-2.63
225	-10.07	-7.06	-3.53	-2.82	-4.67	-3.54	-3.53	-0.83	-2.06	-4.15	-3.61	-6.76	-2.16
240	-10.68	-6.09	-2.81	-3.05	-4.98	-8.09	-7.19	-0.85	-2.69	-1.4	-3.14	-5.33	-2.12
255	-10.59	-5.81	-2.48	-4.05	-5.16	-9.13	-8.77	-4.3	-2.91	-0.44	-2.45	-4.38	-1.86
270	-10.54	-5.79	-2.56	-4.2	-3.88	-3.63	-6.86	-5.78	-2.07	-0.8	-2.22	-3.72	-1.51
285	-10.56	-7.43	-3.14	-4.3	-3	-2.06	-2.46	-2.98	-0.94	-0.79	-2.54	-4.28	-1.15
300	-9.27	-7.95	-3.82	-4.72	-2.98	-1.56	-1	-1.61	0.39	-0.62	-3.06	-5.86	-1.25
315	-8.26	-6.89	-4.93	-5.43	-3.87	-1.79	-1.05	-0.75	0.38	-0.74	-3.32	-7.28	-1.96
330	-7.76	-6.23	-5.79	-5.69	-4.81	-2.71	-2.56	-0.86	-0.82	-1.61	-3.21	-8.11	-3.52
345	-7.64	-6.88	-5.86	-5.94	-6.67	-5.32	-4.28	-2.8	-3.14	-2.99	-3.91	-8.21	-4.04
360	-8.8	-9.77	-8.37	-9.45	-7.73	-6.66	-4.4	-6.75	-4.41	-4.27	-7.16	-4.87	-3.71



**Table 110. Board #5A: RP\_2440.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-11.01	-11.98	-10.74	-12.14	-11.12	-13.4	-11.41	-9.99	-7.24	-6.17	-10.03	-6.46	-4.81
15	-10.8	-11.35	-10.52	-10.73	-11.15	-12.45	-12.49	-10.6	-6.88	-7.88	-8.54	-4.87	-3.61
30	-10.83	-11.74	-10.55	-9.34	-10.72	-14.73	-14.26	-10.44	-6.57	-6	-4.64	-3.43	-2.75
45	-11.51	-11.19	-9.31	-7.22	-10.55	-17.57	-15.12	-8.68	-5.08	-2.8	-1.65	-2.54	-2.69
60	-11.3	-9.5	-6.84	-5.47	-8.57	-13.43	-17.8	-8.28	-3.75	-0.77	-0.14	-2.22	-3.58
75	-10.89	-8.78	-4.69	-4.1	-5.64	-9.17	-20.98	-8.63	-2.85	-0.29	0.19	-2.07	-5.47
90	-10.87	-8.52	-3.75	-3.03	-3.72	-6.99	-21.9	-9.59	-3.28	-1.35	-0.44	-2.61	-8.27
105	-12.02	-8.49	-3.88	-2.83	-2.88	-6.53	-21.01	-12.2	-5.57	-4.13	-2.01	-3.56	-13.18
120	-16.19	-10.08	-5.37	-3.73	-3.43	-7.74	-17.49	-15.65	-10.11	-7.94	-4.23	-5.41	-17.88
135	-21.57	-11.04	-8.18	-5.45	-5.54	-10.54	-12.66	-16.09	-21.25	-10.44	-6.59	-8.47	-19.48
150	-17.19	-11.15	-12.08	-8.05	-9.45	-11.91	-11.42	-11.02	-12.92	-9.05	-6.7	-12.01	-13.94
165	-13.51	-11.44	-14.86	-10.13	-13.68	-12.12	-13.53	-9.58	-10.22	-9.52	-5.93	-12.19	-9.24
180	-12.24	-12.18	-14.06	-11.28	-14.37	-17.82	-10.36	-15.78	-8.02	-11.02	-6.06	-9.29	-5.97
195	-11.61	-12.64	-12.64	-9.91	-16.44	-13.91	-10.72	-16.98	-10.43	-12.11	-7.84	-7.39	-3.99
210	-11.58	-12.54	-11.47	-8.77	-12.19	-18	-17.5	-14.56	-22.21	-14.72	-9.14	-7.9	-2.96
225	-11.79	-10.7	-8.8	-7.15	-8.74	-20.33	-21.09	-8.13	-13.85	-12.75	-7.33	-10.53	-2.77
240	-11.84	-9.05	-6.53	-6.01	-9.56	-16.46	-13.82	-7.09	-8.54	-7.56	-5.45	-13.97	-3.65
255	-11.67	-7.49	-5.05	-6.33	-10.69	-14.8	-11.71	-7.26	-6.18	-4.04	-5.27	-11.78	-5.05
270	-12.49	-6.82	-4.29	-7.55	-10.68	-19.63	-13.06	-7.12	-3.28	-2.32	-6.02	-8.7	-7.72
285	-16.73	-7.84	-4.89	-7.9	-13.56	-21.24	-13.91	-7.05	-1.75	-2.08	-6.2	-8.24	-11.38
300	-20.59	-10.45	-7.11	-8.57	-15.77	-17.49	-12.96	-6.9	-1.37	-2.49	-6.14	-8.41	-12.73
315	-15.37	-12.06	-10.36	-10.41	-15.97	-14.61	-11.7	-6.49	-2.39	-2.68	-6.81	-8.54	-14.21
330	-12.53	-12.4	-11.98	-11.28	-14.73	-14.44	-11.07	-6.51	-4.17	-2.89	-8.37	-8.76	-13.47
345	-11.5	-11.92	-10.88	-11.24	-16.08	-13.2	-10.71	-7.66	-6.33	-3.62	-10.6	-8.77	-9.51
360	-11.01	-11.98	-10.74	-12.14	-11.12	-13.4	-11.41	-9.99	-7.24	-6.17	-10.03	-6.46	-4.81

**Table 111. Board #5A: RP\_2440.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-12.8	-13.76	-12.12	-12.82	-10.38	-7.7	-5.36	-9.53	-7.61	-8.79	-10.32	-10.02	-10.22
15	-15.3	-16.26	-11.67	-12.73	-4.03	-5.71	-1.66	-4.58	-3.63	-6.65	-8.03	-7.79	-14.87
30	-17.87	-13.86	-8.76	-6.84	-1.35	-2.22	0.46	0.05	-1.12	-3.68	-3	-6.81	-16.19
45	-16.8	-10.65	-6.76	-3.81	-0.35	0.3	2.47	1.88	0.03	-2.01	-1.5	-7.13	-10.32
60	-13.22	-8.41	-5.9	-3.38	-0.15	1.17	2.16	2.09	-1.27	-2.05	-2.74	-8.37	-7.5
75	-11.51	-8.27	-7.31	-4.33	-2.09	0.09	-1.29	-0.1	-5.05	-4	-4.42	-10.72	-5.01
90	-10.51	-8.28	-9.62	-5.91	-6.01	-3.33	-7.8	-8.49	-7.41	-6.9	-4.47	-11.84	-3.24
105	-10.14	-9.46	-8.94	-6.45	-8.22	-8.61	-9.77	-8.5	-4.99	-6.11	-4.1	-9.64	-2.77
120	-10.67	-9.92	-7.85	-5.31	-5.71	-5.73	-4.91	-2.7	-2.49	-5.18	-4.54	-7.42	-2.24
135	-10.75	-10.84	-7.81	-3.9	-4.11	-2.84	-2.22	-1.28	-1.51	-5.91	-7.33	-5.75	-2.75
150	-11.41	-12.04	-9.48	-4.58	-5.62	-2.47	-2.22	-2.57	-2.76	-7.57	-11.59	-5.37	-3.69
165	-12.07	-13.01	-13.78	-7.9	-11.37	-5.78	-7.62	-5.05	-9.67	-9.12	-11.09	-6.35	-5.09
180	-12.06	-14.38	-18.71	-15.2	-14.1	-16.4	-13.05	-11.58	-14.18	-15.46	-9.31	-9.35	-7.65
195	-11.55	-14.13	-10.27	-8.96	-5.89	-3.65	-5.16	-6.81	-8.42	-11.88	-6.74	-15.17	-11.59
210	-12.67	-11.56	-6.25	-5.83	-3.91	-2.72	-1.44	-1.6	-3.78	-7.04	-5.15	-14.92	-13.93
225	-14.93	-9.52	-5.07	-4.82	-6.82	-3.63	-3.61	-1.73	-2.36	-4.8	-6.01	-9.12	-11.05
240	-16.99	-9.14	-5.21	-6.11	-6.84	-8.78	-8.25	-2.03	-4	-2.6	-6.99	-5.97	-7.41
255	-17.18	-10.75	-5.99	-7.96	-6.58	-10.5	-11.86	-7.37	-5.68	-2.93	-5.66	-5.25	-4.7
270	-14.96	-12.56	-7.39	-6.9	-4.9	-3.74	-8.06	-11.56	-8.21	-6.08	-4.56	-5.38	-2.7
285	-11.76	-17.89	-7.92	-6.79	-3.4	-2.11	-2.79	-5.15	-8.62	-6.69	-4.99	-6.52	-1.58
300	-9.61	-11.54	-6.58	-7.02	-3.21	-1.67	-1.29	-3.13	-4.36	-5.18	-6.01	-9.38	-1.57
315	-9.19	-8.46	-6.4	-7.09	-4.15	-2.02	-1.44	-2.1	-2.88	-5.18	-5.91	-13.26	-2.23
330	-9.53	-7.43	-6.99	-7.09	-5.28	-3.01	-3.22	-2.24	-3.53	-7.55	-4.79	-16.67	-3.99
345	-9.93	-8.51	-7.51	-7.46	-7.2	-6.09	-5.4	-4.52	-5.99	-11.68	-4.96	-17.4	-5.49
360	-12.8	-13.76	-12.12	-12.82	-10.38	-7.7	-5.36	-9.53	-7.61	-8.79	-10.32	-10.02	-10.22

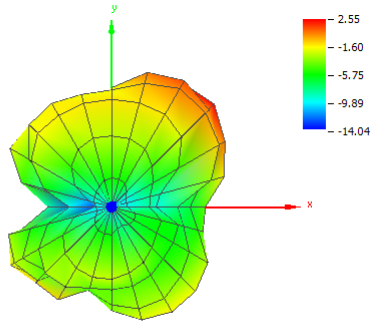


Figure 165. Board #5A: Theta = 0, Phi = 0

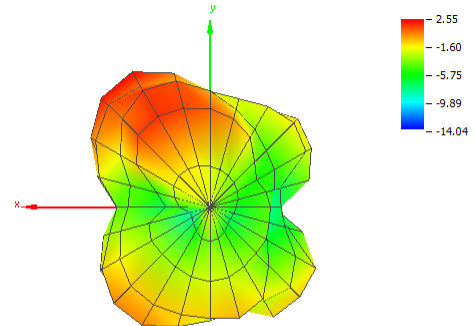


Figure 166. Board #5A: Theta = 180, Phi = 0

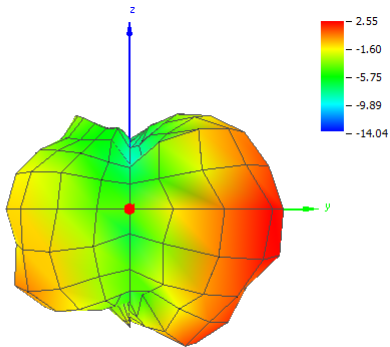


Figure 167. Board #5A: Theta = 90, Phi = 0

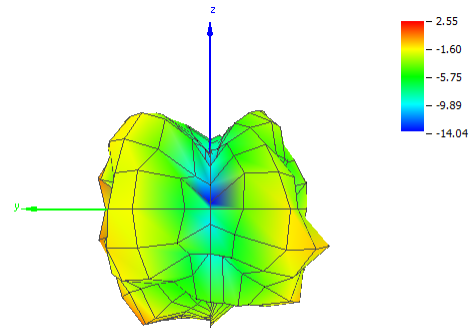


Figure 168. Board #5A: Theta = 90, Phi = 180

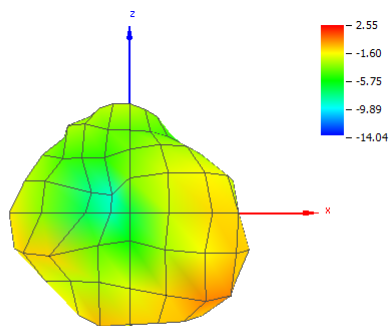


Figure 169. Board #5A: Theta = 90, Phi = 270

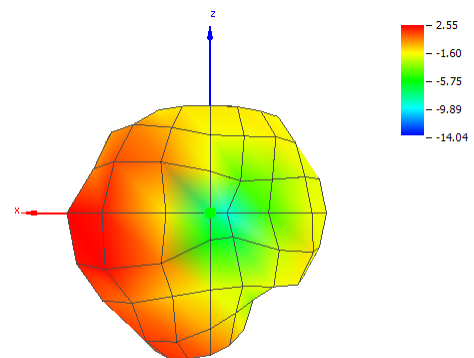


Figure 170. Board #5A: Theta = 90, Phi = 90

**A.5.2 Board #5B**
**Table 112. Board #5B: OTA Evaluation Results**

Test Description	Test Result
Total Radiated Power	-3.47 dBm
Peak EIRP	1.42 dBm
Directivity	4.89 dBi
Efficiency	-3.47 dB
Efficiency	0.45
Peak Gain	1.42 dBi
NHPRP 45°	-5.15 dBm
NHPRP 45° / TRP	-1.68 dB
NHPRP 45° / TRP	0.6785
NHPRP 30°	-6.85 dBm
NHPRP 30° / TRP	-3.38 dB
NHPRP 30° / TRP	0.4592
NHPRP 22.5°	-8.13 dBm
NHPRP 22.5° / TRP	-4.66 dB
NHPRP 22.5° / TRP	0.3416
UHRP	-6.61 dBm
UHRP / TRP	-3.14 dB
UHRP / TRP	0.4849
LHRP	-6.35 dBm
LHRP / TRP	-2.88 dB
LHRP / TRP	0.5151
PGRP (0-120°)	-4.89 dBm
PGRP / TRP	-1.42 dB
PGRP / TRP	0.7207
Front/Back Ratio	2.74
PhiBW	83.5°
PhiBW Up	27.6°
PhiBW Down	56.0°
ThetaBW	51.7°
ThetaBW Up	6.8°
ThetaBW Down	44.9°
Boresight Phi	90°
Boresight Theta	150°
Maximum Power	1.42 dBm
Minimum Power	-13.74 dBm
Average Power	-3.37 dBm
Max/Min Ratio	15.16 dB
Max/Avg Ratio	4.79 dB
Min/Avg Ratio	-10.37 dB
Worst Single Value	-22.01 dBm
Worst Position	Azi = 60°; Elev = 75°; Pol = Horizontal
Best Single Value	1.28 dBm
Best Position	Azi = 90°; Elev = 150°; Pol = Vertical

**Table 113. Board #5B: RP\_2440.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-3.68	-4.59	-5.06	-7.52	-7.29	-8.12	-6.89	-9.2	-4.13	-6.13	-3.39	-6.55	-3.95
15	-2.75	-4.52	-5	-6.11	-5.43	-6.59	-5.76	-8.5	-5.23	-5.56	-2.79	-7.11	-3.4
30	-1.95	-4.43	-5.3	-4.34	-6.34	-5.45	-8.83	-5.59	-3.83	-4.11	-1.81	-6.95	-3.1
45	-1.86	-3.99	-5.29	-4.07	-6.05	-7.1	-7.85	-6.25	-4.42	-3.05	-0.96	-5.73	-2.51
60	-2.01	-3.03	-4.18	-2.58	-2.39	-2.01	-1.89	-3.5	-5.46	-2.6	0.34	-5.56	-1.44
75	-1.67	-1.66	-2.82	-1.29	-1.44	-0.39	-1.31	-1.57	-2.67	-2.03	1.29	-5	-1.79
90	-1.59	-1.69	-2.66	-1.5	-3.18	-1.11	-3.02	-1.58	-0.07	-1.06	1.42	-5.22	-2.31
105	-2.11	-1.88	-3.28	-2.45	-4.42	-2.06	-3.64	-2.55	-0.6	-0.8	0.15	-5.7	-2.19
120	-2.77	-2.03	-3.46	-2.99	-4.25	-3.15	-4.01	-2.44	-2.2	-1.6	-1.91	-6.33	-2.44
135	-3.51	-2.27	-3.09	-2.84	-3.58	-3.57	-4.05	-2.26	-3.7	-3.36	-3.39	-7.14	-3.06
150	-3.49	-2.87	-3.41	-3.08	-3.69	-3.39	-4.21	-3.98	-4.34	-5.01	-3.8	-7.12	-3.79
165	-3.02	-3.33	-2.91	-2.88	-3.56	-3.75	-4.01	-5.75	-3.54	-5.66	-3.81	-6.56	-4.13
180	-2.32	-3.01	-2.25	-2.3	-2.02	-1.7	-2.31	-4.72	-2.61	-5.35	-4.24	-6.05	-3.82
195	-2.56	-3.22	-1.99	-1.4	-0.29	-0.31	-2.52	-1.99	-2.93	-2.51	-4.64	-5.3	-3.36
210	-2.6	-3.4	-1.44	-0.84	1.02	-1.27	-1.24	-0.22	-3.37	-1.27	-3.48	-4.52	-2.37
225	-3.02	-3.21	-1.11	-0.65	-1.02	-3.02	-3.99	-2.64	-3.74	-2.22	-2	-4.76	-1.5
240	-2.77	-2.96	-1.23	-1.28	-5.69	-5.9	-10.88	-5.88	-3.61	-3.4	-2.38	-3.94	-1.12
255	-2.59	-3.39	-1.47	-2.87	-7.01	-5.58	-5.9	-4.23	-1.75	-1.99	-4.48	-3.5	-1.48
270	-2.65	-4.54	-1.32	-3.9	-5.07	-3.08	-4.67	-2.18	-1.74	-0.96	-6.55	-3.23	-2.12
285	-3.42	-4.41	-1.43	-4.25	-5.01	-5.02	-3.96	-1.96	-1.74	-0.23	-6.25	-2.31	-2.58
300	-3.9	-4.58	-2.37	-5.19	-6.66	-8.35	-5.47	-4.25	-1.85	-1.2	-5.23	-1.57	-3
315	-3.74	-4.72	-3.64	-6.58	-9.34	-9.77	-9.76	-6.32	-3.24	-3.48	-5.6	-1.97	-3.26
330	-3.72	-4.56	-5.05	-7.24	-12.37	-10.53	-11.41	-6.71	-5.64	-6.14	-5.88	-3.55	-3.88
345	-4.16	-4.56	-5.37	-8.86	-13.74	-12.36	-10.42	-7.99	-6.41	-6.31	-4.68	-5.6	-3.93
360	-3.68	-4.59	-5.06	-7.52	-7.29	-8.12	-6.89	-9.2	-4.13	-6.13	-3.39	-6.55	-3.95

**Table 114. Board #5B: RP\_2440.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-4.71	-5.09	-5.91	-8.29	-11.07	-14.07	-14.7	-10.58	-6.73	-7.06	-3.93	-9.23	-6.18
15	-4.98	-5.54	-6.58	-8.06	-10.15	-13.74	-12.65	-11.19	-6.08	-5.79	-4.09	-10.17	-7.68
30	-5.83	-7.06	-8.98	-8.41	-9.13	-13.09	-15.66	-10.93	-5.25	-4.32	-4.02	-10.63	-9.43
45	-8.05	-10.57	-11.44	-9.77	-10.18	-16.94	-18.04	-10.15	-6.53	-3.71	-4.62	-12.08	-11.68
60	-12.3	-15.79	-12.3	-12.12	-14.37	-22.01	-19.55	-14.03	-9.13	-4.78	-6.27	-17.23	-14.93
75	-14.73	-18.77	-14.74	-16.36	-18.13	-20.1	-18.55	-20.48	-9.17	-7.38	-9.21	-17.67	-18.78
90	-12.27	-20.81	-18.42	-16.16	-14.67	-17.85	-20.06	-17.88	-8.54	-10.71	-13.55	-13.64	-12.25
105	-10.51	-13.05	-15.57	-13.23	-11.71	-15.15	-19.11	-17.03	-9.23	-13.2	-12.57	-10.49	-7.09
120	-8.27	-7.41	-10.81	-10.56	-10.46	-13.08	-16.75	-17.07	-9.97	-10.53	-8.6	-8.93	-4.64
135	-5.91	-5.16	-7.43	-9.09	-9.47	-12.77	-14.34	-13.96	-8.76	-7.16	-6.38	-7.77	-4.14
150	-4.21	-4.16	-6.1	-7.31	-9.33	-13.82	-13.78	-12.1	-7.26	-5.98	-5.43	-7.54	-4.12
165	-3.48	-3.96	-5.41	-5.06	-9.58	-14.6	-16.77	-10.67	-8.63	-6.25	-5.65	-8.11	-4.28
180	-3.35	-4.28	-5.67	-6.32	-11.28	-16.5	-20.71	-11.18	-10.69	-7.08	-6.45	-8.98	-4.54
195	-4.64	-5.83	-6.91	-7.01	-9.63	-12.65	-16.91	-12.7	-9.11	-7.26	-7.56	-10.33	-5.45
210	-5.83	-7.92	-7.04	-6.1	-6.37	-17.15	-12.55	-13.31	-7.03	-8.42	-9.15	-11.82	-6.95
225	-9.36	-10.54	-5.14	-4.63	-6.97	-14.3	-15.01	-7.88	-6.55	-8.56	-8.12	-13.35	-9.78
240	-12.76	-9.74	-4.49	-4.6	-10.72	-12.83	-16.8	-7.04	-7.12	-6.7	-6.83	-13.22	-14.14
255	-15.9	-9.2	-5.09	-7.43	-11.59	-15.46	-13.74	-9.39	-8.76	-5.43	-7.62	-12.88	-21.43
270	-15.99	-11.89	-6.55	-15.53	-12.13	-21.51	-14.83	-12.57	-9.37	-6.87	-9.67	-14.26	-15.28
285	-13.27	-11.82	-8.86	-19.21	-16.7	-16.13	-15.64	-14.35	-9.34	-9.04	-11.48	-12.42	-9.47
300	-8.28	-8.49	-8.2	-17.99	-20.84	-16.72	-15.79	-12.62	-9.28	-9.1	-10.65	-8.66	-6.31
315	-5.28	-6.22	-7.25	-15.25	-19.99	-20.43	-13.98	-10.75	-8.02	-8.67	-8.44	-6.45	-4.43
330	-4.36	-5.03	-6.66	-12.93	-19.79	-19.53	-13.35	-9.14	-6.7	-7.83	-6.35	-5.87	-4.13
345	-4.63	-4.83	-5.77	-10.38	-16.19	-16.45	-13.24	-9.13	-6.65	-6.97	-4.85	-6.86	-4.33
360	-4.71	-5.09	-5.91	-8.29	-11.07	-14.07	-14.7	-10.58	-6.73	-7.06	-3.93	-9.23	-6.18

**Table 115. Board #5B: RP\_2440.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-10.42	-14.22	-12.6	-15.43	-9.65	-9.39	-7.68	-14.84	-7.59	-13.24	-12.64	-9.92	-7.92
15	-6.71	-11.31	-10.14	-10.54	-7.22	-7.52	-6.75	-11.86	-12.75	-18.32	-8.66	-10.08	-5.42
30	-4.23	-7.86	-7.73	-6.49	-9.59	-6.27	-9.84	-7.09	-9.36	-17.23	-5.79	-9.38	-4.26
45	-3.05	-5.07	-6.49	-5.43	-8.17	-7.57	-8.29	-8.52	-8.58	-11.6	-3.41	-6.87	-3.07
60	-2.44	-3.27	-4.91	-3.09	-2.67	-2.05	-1.96	-3.9	-7.9	-6.63	-0.73	-5.86	-1.64
75	-1.89	-1.75	-3.11	-1.43	-1.54	-0.44	-1.4	-1.63	-3.77	-3.53	0.89	-5.24	-1.88
90	-1.97	-1.75	-2.78	-1.65	-3.5	-1.2	-3.11	-1.69	-0.74	-1.55	1.28	-5.89	-2.77
105	-2.79	-2.22	-3.55	-2.83	-5.31	-2.28	-3.77	-2.71	-1.24	-1.05	-0.09	-7.44	-3.89
120	-4.21	-3.52	-4.34	-3.82	-5.44	-3.62	-4.24	-2.59	-3	-2.2	-2.96	-9.8	-6.46
135	-7.24	-5.4	-5.08	-4.01	-4.88	-4.13	-4.47	-2.57	-5.33	-5.7	-6.42	-15.83	-9.65
150	-11.66	-8.77	-6.77	-5.14	-5.07	-3.81	-4.72	-4.7	-7.44	-12.01	-8.86	-17.42	-15.09
165	-13.03	-12.02	-6.49	-6.9	-4.81	-4.13	-4.25	-7.44	-5.15	-14.62	-8.43	-11.79	-18.81
180	-9.08	-8.97	-4.89	-4.49	-2.57	-1.84	-2.37	-5.83	-3.35	-10.17	-8.23	-9.14	-11.99
195	-6.77	-6.68	-3.68	-2.8	-0.82	-0.57	-2.68	-2.38	-4.12	-4.28	-7.74	-6.93	-7.55
210	-5.39	-5.3	-2.85	-2.38	0.15	-1.38	-1.57	-0.44	-5.81	-2.21	-4.86	-5.42	-4.23
225	-4.17	-4.1	-3.29	-2.87	-2.29	-3.36	-4.35	-4.18	-6.96	-3.37	-3.21	-5.4	-2.2
240	-3.23	-3.98	-3.99	-4.01	-7.33	-6.89	-12.17	-12.19	-6.17	-6.14	-4.31	-4.49	-1.34
255	-2.8	-4.71	-3.95	-4.73	-8.87	-6.05	-6.68	-5.81	-2.72	-4.62	-7.37	-4.03	-1.52
270	-2.86	-5.42	-2.86	-4.21	-6.02	-3.15	-5.11	-2.6	-2.56	-2.24	-9.45	-3.58	-2.33
285	-3.9	-5.28	-2.3	-4.39	-5.31	-5.38	-4.27	-2.22	-2.56	-0.84	-7.8	-2.76	-3.57
300	-5.86	-6.85	-3.68	-5.42	-6.83	-9.03	-5.89	-4.94	-2.72	-1.96	-6.7	-2.51	-5.73
315	-9.01	-10.06	-6.13	-7.22	-9.73	-10.15	-11.82	-8.27	-5	-5.04	-8.79	-3.88	-9.52
330	-12.4	-14.45	-10.15	-8.61	-13.24	-11.12	-15.85	-10.39	-12.31	-11.04	-15.72	-7.39	-16.5
345	-14.02	-16.85	-15.92	-14.14	-17.39	-14.51	-13.64	-14.36	-19.1	-14.82	-18.71	-11.59	-14.47
360	-10.42	-14.22	-12.6	-15.43	-9.65	-9.39	-7.68	-14.84	-7.59	-13.24	-12.64	-9.92	-7.92

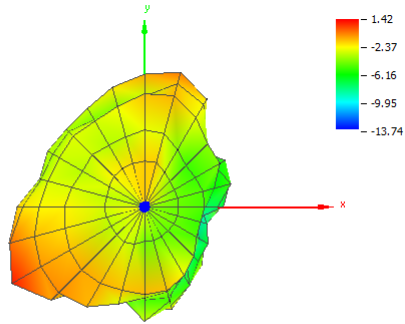


Figure 171. Board #5B: Theta = 0, Phi = 0

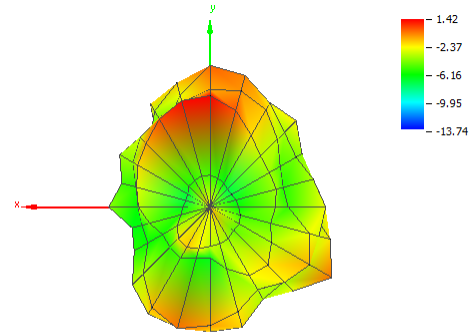


Figure 172. Board #5B: Theta = 180, Phi = 0

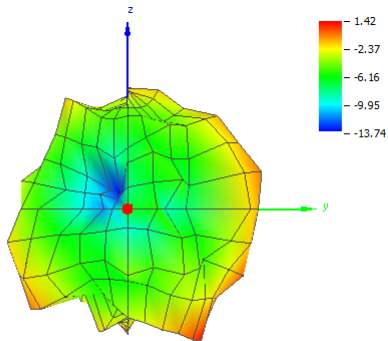


Figure 173. Board #5B: Theta = 90, Phi = 0

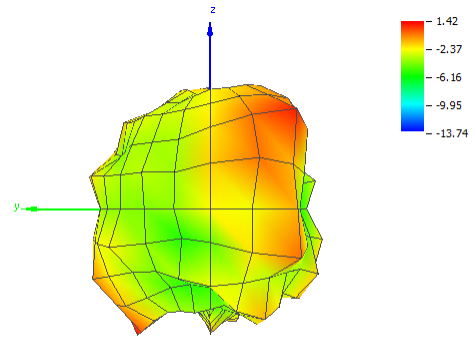


Figure 174. Board #5B: Theta = 90, Phi = 180

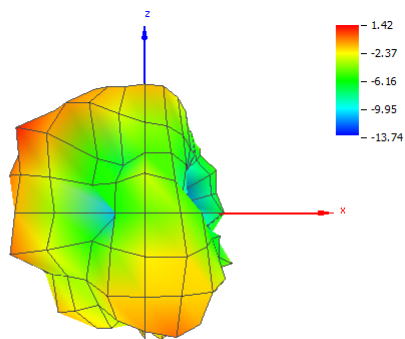


Figure 175. Board #5B: Theta = 90, Phi = 270

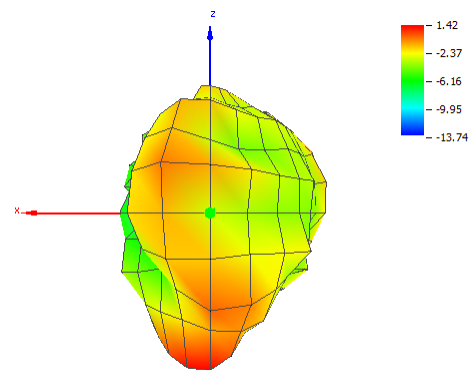


Figure 176. Board #5B: Theta = 90, Phi = 90



## A.6 Board #6: 868/915/920 MHz Compact PCB Helical Antenna

### A.6.1 868 MHz

**Table 116. Board #6: OTA Evaluation Results (868 MHz)**

Test Description	Test Result
Total Radiated Power	-2.00 dBm
Peak EIRP	2.12 dBm
Directivity	4.13 dBi
Efficiency	-2.00 dB
Efficiency	0.6305
Peak Gain	2.12 dBi
NHPRP 45°	-3.91 dBm
NHPRP 45° / TRP	-1.91 dB
NHPRP 45° / TRP	0.6446
NHPRP 30°	-5.39 dBm
NHPRP 30° / TRP	-3.38 dB
NHPRP 30° / TRP	0.4587
NHPRP 22.5°	-6.65 dBm
NHPRP 22.5° / TRP	-4.65 dB
NHPRP 22.5° / TRP	0.343
UHRP	-4.97 dBm
UHRP / TRP	-2.97 dB
UHRP / TRP	0.5049
LHRP	-5.06 dBm
LHRP / TRP	-3.05 dB
LHRP / TRP	0.4951
PGRP (0-120°)	-3.30 dBm
PGRP / TRP	-1.30 dB
PGRP / TRP	0.7416
Front/Back Ratio	3.14
PhiBW	135.6°
PhiBW Up	60.5°
PhiBW Down	75.0°
ThetaBW	69.3°
ThetaBW Up	29.6°
ThetaBW Down	39.7°
Boresight Phi	225°
Boresight Theta	15°
Maximum Power	2.12 dBm
Minimum Power	-17.06 dBm
Average Power	-1.31 dBm
Max/Min Ratio	19.19 dB
Max/Avg Ratio	3.43 dB
Min/Avg Ratio	-15.75 dB
Worst Single Value	-30.47 dBm
Worst Position	Azi = 90°; Elev = 60°; Pol = Vertical
Best Single Value	1.75 dBm
Best Position	Azi = 165°; Elev = 105°; Pol = Vertical

**Table 117. Board #6: RP\_868.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	0.47	0.5	0	-1.46	-0.61	0.33	-0.29	-1.56	-1.22	-0.93	-0.45	0.53	0.49
15	0.62	0.58	-0.45	-1.51	-0.5	0.11	-1.8	-2.01	-0.13	-0.76	-0.81	0.2	0.08
30	0.65	0.47	-0.99	-1.48	-0.92	-1	-3.44	-1.36	0.36	-0.98	-1.77	-0.28	-0.53
45	0.66	0.09	-1.41	-1.43	-2.15	-3.2	-3.44	-0.59	-0.31	-2.05	-3.16	-1.02	-1.23
60	0.43	-0.35	-1.77	-1.71	-4.11	-5.62	-3.13	-1.25	-2.12	-3.65	-4.32	-1.64	-1.72
75	0.12	-1	-2.19	-2.54	-6.33	-6.76	-4.25	-3.96	-4.93	-5.27	-4.5	-2.11	-1.9
90	-0.33	-1.61	-2.55	-3.77	-7.22	-6.53	-6.96	-9.12	-6.77	-5.44	-3.85	-2.33	-1.6
105	-0.54	-2.08	-2.65	-5.1	-6.19	-5.43	-8.74	-10.96	-5.62	-4.39	-2.97	-2.38	-1.1
120	-0.4	-2.07	-2.34	-5.55	-4.42	-3.55	-6.04	-5.13	-3.54	-3.25	-2.23	-2.21	-0.67
135	0.09	-1.59	-1.68	-4.75	-2.61	-1.65	-3.3	-1.23	-1.48	-2.32	-1.63	-1.82	-0.42
150	0.65	-0.87	-0.93	-3.57	-1.39	-0.52	-2.11	0.92	-0.01	-1.54	-1.21	-1.43	-0.38
165	1.15	-0.01	-0.25	-2.49	-0.6	0.23	-2.3	1.83	0.76	-0.77	-0.83	-1.11	-0.63
180	1.42	0.84	0.31	-1.87	-0.32	0.79	-2.82	1.48	0.6	-0.17	-0.5	-0.89	-1.08
195	1.54	1.55	0.85	-1.57	-0.64	1.15	-2.35	0.1	-0.72	-0.02	-0.21	-0.76	-1.68
210	1.48	1.98	1.26	-1.32	-1.58	0.9	-1.85	-0.96	-2.77	-0.54	-0.1	-0.73	-2.2
225	1.24	2.12	1.4	-0.94	-3.07	-0.36	-2.45	-1	-4.31	-1.84	-0.26	-0.76	-2.64
240	0.83	1.89	1.1	-0.79	-4.68	-2.8	-4.63	-1.32	-5.03	-3.64	-0.48	-0.74	-2.52
255	0.23	1.25	0.34	-1.27	-6.27	-7.17	-8.74	-3.05	-6.06	-5.67	-0.82	-0.53	-1.92
270	-0.45	0.31	-0.79	-2.31	-7.3	-15.15	-13.6	-6.18	-7.39	-7.38	-1.08	-0.26	-1.08
285	-0.97	-0.86	-1.56	-3.41	-6.53	-17.06	-10.08	-9.52	-7.09	-7.85	-1.06	0.1	-0.19
300	-0.97	-1.46	-1.42	-3.68	-4.71	-8.86	-5.55	-6.76	-5.2	-6.53	-0.74	0.37	0.4
315	-0.52	-1.2	-0.65	-2.99	-2.87	-4.55	-2.34	-3.02	-3.56	-4.75	-0.42	0.56	0.74
330	-0.04	-0.55	-0.04	-2.17	-1.59	-2.01	-0.57	-1.09	-2.61	-3.43	-0.29	0.61	0.87
345	0.07	0.25	0	-1.4	-0.96	-0.52	0.08	-0.51	-2.37	-2.42	-0.31	0.83	0.71
360	0.47	0.5	0	-1.46	-0.61	0.33	-0.29	-1.56	-1.22	-0.93	-0.45	0.53	0.49

**Table 118. Board #6: RP\_868.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-24.11	-25.72	-22.2	-19.87	-19.71	-22.93	-22.77	-14.87	-10.26	-9.27	-11.04	-16.93	-26.37
15	-16.17	-13.59	-20.65	-25.14	-23.8	-28.05	-25.78	-15.12	-8.85	-10.68	-17.5	-17.86	-16.8
30	-7.88	-7.42	-11.56	-16.42	-21.69	-20.77	-26.5	-15.66	-8.39	-11.74	-23.32	-10.04	-9.17
45	-3.93	-4.28	-7.7	-11.21	-13.83	-15.62	-21.93	-16.81	-8.5	-10.47	-11.94	-6.2	-5.46
60	-1.92	-2.66	-5.48	-7.98	-9.73	-13.38	-18.56	-18.76	-8.35	-8.1	-7.66	-4.04	-3.41
75	-0.8	-1.89	-4.04	-5.96	-7.8	-12.1	-16.29	-21.51	-7.63	-6.28	-5.31	-2.83	-2.19
90	-0.52	-1.78	-3.3	-5.14	-7.24	-11.44	-15.03	-22.99	-6.94	-5.48	-4.33	-2.46	-1.63
105	-0.79	-2.24	-3.29	-5.34	-7.88	-11.57	-14.89	-23.88	-6.74	-5.54	-4.37	-2.86	-1.69
120	-1.46	-3.17	-4.11	-6.65	-9.55	-12.92	-15.67	-23.73	-7.34	-6.43	-5.33	-3.95	-2.4
135	-2.63	-4.77	-5.88	-9.15	-12.46	-16.15	-17.64	-20.3	-8.78	-8.44	-7.28	-5.92	-4.02
150	-4.57	-7.22	-8.67	-13.78	-16.94	-20.67	-19.16	-17.28	-10.98	-11.97	-10.6	-8.93	-6.55
165	-8.08	-12.06	-13.61	-24.13	-23.23	-23.96	-18	-15.84	-13.56	-18.02	-17.07	-13.58	-11.24
180	-14.9	-20.9	-25.07	-21.98	-18.52	-23.88	-16.81	-16.42	-15.38	-16.04	-15.63	-13.84	-19.85
195	-16.06	-13.31	-17.97	-14.09	-13.94	-22.89	-17.2	-19.82	-16.54	-10.82	-9.14	-8.85	-15.39
210	-8.55	-7.74	-10.85	-10.42	-11.38	-21.53	-18.18	-24.07	-18.69	-8.05	-5.51	-5.58	-8.9
225	-4.67	-4.37	-6.92	-7.8	-9.77	-21.35	-18.6	-17.97	-24.53	-6.73	-3.3	-3.25	-5.45
240	-2.52	-2.43	-4.46	-5.88	-8.78	-22.32	-17.43	-13.7	-22.41	-6.43	-2.03	-1.81	-3.35
255	-1.28	-1.26	-2.81	-4.58	-8.09	-23.77	-15.7	-11.21	-14.81	-6.84	-1.41	-0.8	-1.98
270	-0.85	-0.84	-1.92	-3.83	-7.61	-24.21	-14.61	-10.06	-11.53	-7.7	-1.26	-0.36	-1.28
285	-1	-0.99	-1.61	-3.66	-7.38	-23.2	-14.17	-9.76	-10.31	-8.72	-1.39	-0.4	-1.13
300	-1.58	-1.68	-1.85	-4.1	-7.55	-23.23	-14.63	-10.13	-10.99	-9.16	-1.69	-1.06	-1.63
315	-2.63	-2.98	-2.76	-5.3	-8.59	-25.73	-15.23	-11.27	-14.01	-9.14	-2.43	-2.43	-3.01
330	-4.41	-5.08	-4.59	-7.44	-10.67	-26.05	-16.44	-12.84	-17.97	-8.88	-3.67	-4.6	-5.2
345	-7.89	-7.9	-7.91	-9.88	-13.7	-23.14	-18.42	-14.05	-15.32	-9.08	-5.68	-6.82	-9.08
360	-24.11	-25.72	-22.2	-19.87	-19.71	-22.93	-22.77	-14.87	-10.26	-9.27	-11.04	-16.93	-26.37

**Table 119. Board #6: RP\_868.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	0.45	0.49	-0.03	-1.53	-0.66	0.31	-0.31	-1.76	-1.8	-1.62	-0.85	0.45	0.48
15	0.53	0.41	-0.49	-1.53	-0.52	0.11	-1.82	-2.23	-0.76	-1.22	-0.91	0.13	-0.01
30	-0.01	-0.3	-1.38	-1.62	-0.95	-1.05	-3.47	-1.53	-0.26	-1.36	-1.8	-0.77	-1.17
45	-1.2	-1.89	-2.57	-1.92	-2.46	-3.45	-3.5	-0.69	-1.02	-2.72	-3.78	-2.59	-3.29
60	-3.36	-4.2	-4.18	-2.87	-5.5	-6.42	-3.25	-1.32	-3.3	-5.59	-7.03	-5.36	-6.64
75	-7.07	-8.33	-6.78	-5.18	-11.75	-8.26	-4.53	-4.03	-8.28	-12.11	-12.19	-10.32	-13.72
90	-13.96	-15.93	-10.59	-9.47	-30.47	-8.23	-7.7	-9.3	-21.07	-25.66	-13.64	-17.61	-23.69
105	-13.09	-16.42	-11.29	-17.78	-11.13	-6.64	-9.94	-11.19	-12.03	-10.74	-8.55	-12.17	-10.03
120	-7.04	-8.59	-7.11	-12.04	-6.01	-4.09	-6.55	-5.19	-5.89	-6.11	-5.14	-7.03	-5.49
135	-3.23	-4.45	-3.75	-6.7	-3.08	-1.81	-3.46	-1.28	-2.38	-3.54	-3.01	-3.96	-2.91
150	-0.9	-2.02	-1.73	-4	-1.51	-0.56	-2.19	0.85	-0.37	-1.95	-1.74	-2.29	-1.58
165	0.6	-0.29	-0.46	-2.52	-0.62	0.22	-2.42	1.75	0.6	-0.85	-0.94	-1.37	-1.03
180	1.31	0.81	0.29	-1.91	-0.39	0.78	-3	1.41	0.49	-0.28	-0.63	-1.11	-1.14
195	1.46	1.4	0.79	-1.82	-0.84	1.13	-2.49	0.06	-0.84	-0.39	-0.81	-1.49	-1.87
210	1.03	1.49	0.98	-1.89	-2.06	0.87	-1.95	-0.98	-2.88	-1.39	-1.57	-2.45	-3.25
225	-0.05	1.02	0.71	-1.94	-4.11	-0.39	-2.55	-1.09	-4.35	-3.54	-3.24	-4.36	-5.86
240	-1.86	-0.11	-0.32	-2.4	-6.82	-2.85	-4.87	-1.58	-5.11	-6.88	-5.7	-7.34	-10.16
255	-5.07	-2.32	-2.54	-4.01	-10.94	-7.26	-9.71	-3.78	-6.68	-11.92	-9.78	-12.79	-20.72
270	-11	-6.02	-7.2	-7.59	-18.9	-15.73	-20.4	-8.46	-9.5	-18.94	-15	-16.62	-14.41
285	-23.04	-15.93	-21.09	-15.95	-14.03	-18.27	-12.23	-22.12	-9.9	-15.27	-12.4	-9.52	-7.3
300	-9.79	-14.55	-11.72	-14	-7.91	-9.03	-6.12	-9.43	-6.53	-9.94	-7.78	-5.16	-3.88
315	-4.67	-5.94	-4.8	-6.85	-4.23	-4.59	-2.57	-3.73	-3.97	-6.72	-4.73	-2.46	-1.63
330	-2.02	-2.43	-1.92	-3.71	-2.16	-2.03	-0.68	-1.39	-2.73	-4.89	-2.96	-0.95	-0.36
345	-0.68	-0.47	-0.77	-2.06	-1.2	-0.55	0.02	-0.71	-2.6	-3.47	-1.8	0.01	0.23
360	0.45	0.49	-0.03	-1.53	-0.66	0.31	-0.31	-1.76	-1.8	-1.62	-0.85	0.45	0.48

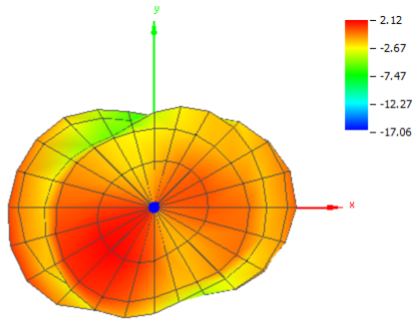


Figure 177. Board #6 (868 MHz): Theta = 0, Phi = 0

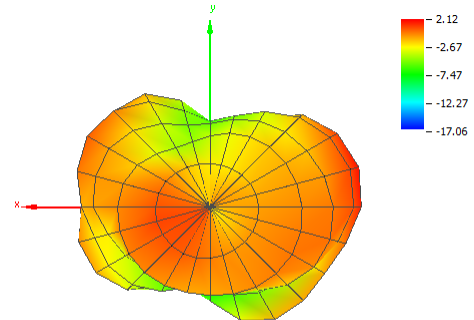


Figure 178. Board #6 (868 MHz): Theta = 180, Phi = 0

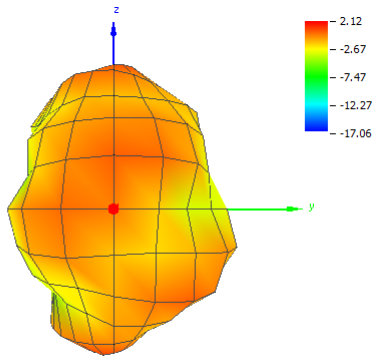


Figure 179. Board #6 (868 MHz): Theta = 90, Phi = 0

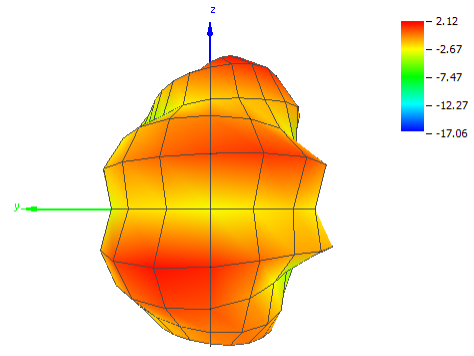


Figure 180. Board #6 (868 MHz): Theta = 90, Phi = 180

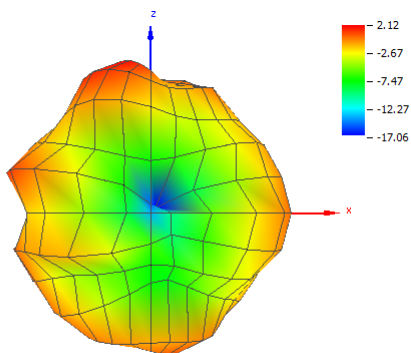


Figure 181. Board #6 (868 MHz): Theta = 90, Phi = 270

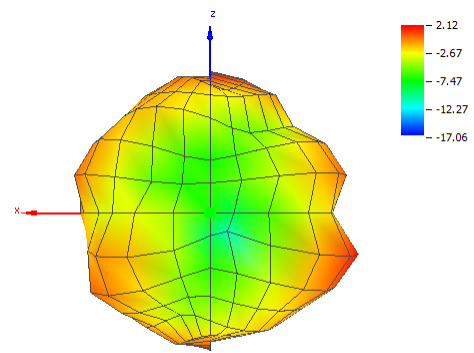


Figure 182. Board #6 (868 MHz): Theta = 90, Phi = 90

**A.6.2 915 MHz**
**Table 120. Board #6: OTA Evaluation Results (915 MHz)**

Test Description	Test Result
Total Radiated Power	-5.45 dBm
Peak EIRP	-1.73 dBm
Directivity	3.72 dBi
Efficiency	-5.45 dB
Efficiency	0.285
Peak Gain	-1.73 dBi
NHPRP 45°	-7.50 dBm
NHPRP 45° / TRP	-2.05 dB
NHPRP 45° / TRP	0.6244
NHPRP 30°	-9.15 dBm
NHPRP 30° / TRP	-3.70 dB
NHPRP 30° / TRP	0.4266
NHPRP 22.5°	-10.44 dBm
NHPRP 22.5° / TRP	-4.98 dB
NHPRP 22.5° / TRP	0.3173
UHRP	-9.05 dBm
UHRP / TRP	-3.59 dB
UHRP / TRP	0.4371
LHRP	-7.95 dBm
LHRP / TRP	-2.50 dB
LHRP / TRP	0.5629
PGRP (0-120°)	-7.16 dBm
PGRP / TRP	-1.71 dB
PGRP / TRP	0.6743
Front/Back Ratio	2.32
PhiBW	360.0°
PhiBW Up	360.0°
PhiBW Down	360.0°
ThetaBW	322.4°
ThetaBW Up	99.9°
ThetaBW Down	222.5°
Boresight Phi	0°
Boresight Theta	165°
Maximum Power	-1.73 dBm
Minimum Power	-16.18 dBm
Average Power	-4.79 dBm
Max/Min Ratio	14.44 dB
Max/Avg Ratio	3.06 dB
Min/Avg Ratio	-11.39 dB
Worst Single Value	-33.40 dBm
Worst Position	Azi = 180°; Elev = 165°; Pol = Horizontal
Best Single Value	-1.82 dBm
Best Position	Azi = 0°; Elev = 165°; Pol = Vertical

**Table 121. Board #6: RP\_915.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-4.51	-3.78	-3.47	-4.45	-4.33	-3.38	-3.58	-2.21	-2.53	-2.24	-1.79	-1.73	-1.85
15	-4.48	-3.72	-3.74	-4.4	-4.11	-3.34	-3.98	-2.37	-2.34	-2.23	-2.04	-1.85	-2.12
30	-4.71	-3.86	-4.28	-4.52	-4.41	-3.95	-4.99	-2.8	-2.61	-2.63	-2.78	-2.08	-2.66
45	-5.1	-4.33	-4.83	-4.89	-5.34	-5.42	-6.3	-3.66	-3.52	-3.62	-3.85	-2.55	-3.27
60	-5.82	-4.95	-5.36	-5.48	-7.2	-7.89	-8.2	-5.37	-5.31	-5.21	-5.21	-3.1	-3.87
75	-6.48	-5.69	-5.6	-6.27	-9.88	-11.51	-10.76	-8.39	-7.82	-7.32	-6.29	-3.8	-4.28
90	-7.12	-6.28	-5.45	-6.9	-12.8	-14.62	-14.59	-13.59	-10.38	-9.06	-6.79	-4.42	-4.19
105	-7.31	-6.57	-5.01	-6.95	-12.45	-12.67	-14.5	-16.18	-10.08	-8.97	-6.17	-4.71	-3.7
120	-6.97	-6.4	-4.34	-6.28	-9.84	-9.14	-10.62	-10.4	-7.75	-7.31	-4.96	-4.56	-3.09
135	-6.27	-5.83	-3.73	-5.3	-7.49	-6.64	-7.83	-6.44	-5.49	-5.71	-3.83	-4.1	-2.61
150	-5.52	-5.12	-3.34	-4.52	-5.72	-5.01	-6.41	-4.1	-3.76	-4.3	-2.99	-3.57	-2.19
165	-4.94	-4.5	-3.26	-4.12	-4.82	-3.93	-5.89	-2.97	-2.87	-3.31	-2.52	-3.06	-2.03
180	-4.67	-4.05	-3.34	-4.18	-4.84	-3.23	-5.64	-2.97	-2.86	-2.77	-2.36	-2.69	-2.1
195	-4.63	-3.89	-3.56	-4.54	-5.74	-3.18	-5.45	-3.78	-3.76	-2.89	-2.5	-2.47	-2.43
210	-4.86	-4.04	-4	-4.87	-7.26	-4.09	-5.8	-4.84	-5.41	-3.81	-2.92	-2.49	-2.91
225	-5.28	-4.48	-4.66	-5.27	-8.67	-6.07	-7.22	-5.96	-7.27	-5.51	-3.63	-2.64	-3.44
240	-5.92	-5.22	-5.6	-5.9	-9.94	-9.06	-10.25	-7.75	-9.27	-8.04	-4.43	-2.94	-3.92
255	-6.66	-6.15	-6.47	-6.83	-11.05	-12.37	-14.41	-10.97	-10.86	-10.82	-4.98	-3.22	-4.11
270	-7.35	-7.07	-7	-7.76	-11.88	-15.38	-15.57	-15.55	-11.26	-12.31	-5.14	-3.43	-3.94
285	-7.57	-7.65	-6.73	-8.19	-11.1	-14.22	-12.17	-13.51	-9.5	-10.65	-4.65	-3.34	-3.43
300	-7.09	-7.43	-5.87	-7.69	-9.11	-10.85	-8.97	-8.6	-6.97	-8.01	-3.8	-3.02	-2.76
315	-6.32	-6.45	-4.9	-6.67	-7.26	-8.16	-6.68	-5.5	-5.19	-5.78	-2.91	-2.68	-2.19
330	-5.51	-5.31	-4.07	-5.62	-5.99	-6.17	-4.95	-3.55	-3.89	-4.17	-2.22	-2.32	-1.84
345	-5.16	-4.36	-3.77	-4.82	-5.28	-4.62	-4.06	-2.56	-3.28	-3.07	-1.99	-1.86	-1.87
360	-4.51	-3.78	-3.47	-4.45	-4.33	-3.38	-3.58	-2.21	-2.53	-2.24	-1.79	-1.73	-1.85

**Table 122. Board #6: RP\_915.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-28.34	-25.67	-24.59	-27.94	-27.5	-24.48	-24.42	-22.35	-26.5	-21.87	-17.99	-18.84	-21.92
15	-18.95	-15.9	-16.63	-18.27	-23.99	-21.86	-25.17	-25.35	-23.19	-22.09	-27.79	-24.35	-26.11
30	-13.35	-11.37	-11.44	-13.25	-20.35	-18.7	-25.01	-27.34	-17.62	-17.95	-20.19	-13.51	-13.75
45	-10.38	-8.88	-8.62	-10.79	-17.89	-16.52	-25.7	-24.73	-14.69	-14.71	-13.21	-9.23	-9.14
60	-8.65	-7.3	-6.89	-9.19	-15.85	-15.5	-27.83	-22.44	-13.12	-12.22	-9.76	-6.66	-6.52
75	-7.66	-6.51	-5.97	-8.23	-14.48	-15.44	-31.29	-21.19	-12.2	-10.61	-7.82	-5.27	-5
90	-7.3	-6.35	-5.63	-7.77	-13.86	-16.09	-32.8	-19.88	-11.7	-9.61	-6.9	-4.69	-4.2
105	-7.58	-6.87	-5.89	-7.86	-13.73	-17.23	-30.73	-18.54	-11.65	-9.22	-6.72	-4.78	-4.06
120	-8.53	-8.12	-6.75	-8.58	-14.18	-18.8	-28.29	-17.38	-12.14	-9.46	-7.22	-5.58	-4.53
135	-10.26	-10.19	-8.26	-9.85	-15.29	-21.1	-26.09	-16.53	-13.27	-10.55	-8.51	-7.2	-5.73
150	-13.08	-13.61	-10.68	-12.34	-17.2	-24.43	-24.56	-15.94	-14.99	-12.51	-11.13	-10.18	-7.85
165	-17.62	-19.72	-14.9	-16.43	-20.86	-28.13	-24.16	-16.2	-16.89	-14.86	-15.84	-15.84	-11.52
180	-30.3	-26.81	-22.69	-24.77	-27.85	-27.48	-25.18	-18	-19.55	-16.75	-22.95	-33.4	-18.74
195	-21.48	-17.6	-21.12	-24.14	-28.75	-24.37	-27.23	-21.71	-25.2	-17.6	-16.13	-15.37	-24.56
210	-14.61	-12.8	-14.59	-16.72	-22.05	-22.3	-29.63	-27.32	-27.88	-17.58	-11.24	-9.81	-13.22
225	-11.18	-10.18	-11.12	-12.9	-18.39	-21.51	-30.45	-26.81	-19.91	-16.48	-8.61	-6.8	-8.84
240	-9.17	-8.54	-8.97	-10.53	-16.02	-20.78	-27.28	-22.57	-15.96	-14.87	-6.84	-5.01	-6.24
255	-8.03	-7.69	-7.77	-9.17	-14.43	-20.3	-24.33	-19.76	-13.83	-13.53	-5.74	-4	-4.73
270	-7.57	-7.44	-7.19	-8.58	-13.71	-20.35	-22.05	-17.86	-12.59	-12.58	-5.23	-3.55	-3.97
285	-7.67	-7.75	-7.18	-8.63	-13.71	-21.09	-20.8	-17.13	-12.17	-12.19	-5.13	-3.54	-3.74
300	-8.35	-8.81	-7.8	-9.25	-14.36	-22.33	-20.39	-16.58	-12.59	-12.43	-5.51	-4.03	-4.07
315	-9.9	-10.74	-9.2	-10.61	-15.43	-23.64	-20.53	-17.05	-13.76	-13.1	-6.3	-5.2	-5.04
330	-12.59	-13.88	-11.78	-12.98	-17.31	-25.98	-20.82	-18.02	-15.96	-14.4	-7.83	-7.21	-6.88
345	-17.29	-17.87	-16.37	-15.99	-20.87	-27.01	-21.73	-19.18	-19.3	-15.99	-10.31	-9.49	-10.05
360	-28.34	-25.67	-24.59	-27.94	-27.5	-24.48	-24.42	-22.35	-26.5	-21.87	-17.99	-18.84	-21.92



**Table 123. Board #6: RP\_915.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-4.53	-3.81	-3.5	-4.47	-4.36	-3.42	-3.61	-2.25	-2.54	-2.29	-1.9	-1.82	-1.89
15	-4.64	-3.99	-3.97	-4.59	-4.15	-3.4	-4.02	-2.39	-2.37	-2.27	-2.05	-1.87	-2.14
30	-5.35	-4.71	-5.21	-5.14	-4.52	-4.1	-5.03	-2.82	-2.75	-2.76	-2.86	-2.41	-3.01
45	-6.62	-6.2	-7.18	-6.19	-5.59	-5.77	-6.35	-3.7	-3.87	-3.97	-4.38	-3.6	-4.57
60	-9.02	-8.73	-10.65	-7.89	-7.84	-8.72	-8.25	-5.45	-6.09	-6.17	-7.09	-5.62	-7.27
75	-12.72	-13.31	-16.45	-10.68	-11.73	-13.77	-10.8	-8.63	-9.79	-10.07	-11.55	-9.23	-12.44
90	-21.16	-23.8	-19.33	-14.32	-19.44	-20.03	-14.65	-14.76	-16.2	-18.31	-22.82	-16.65	-28.59
105	-19.5	-18.25	-12.38	-14.18	-18.36	-14.53	-14.6	-19.95	-15.27	-21.48	-15.44	-22.53	-14.71
120	-12.17	-11.25	-8.05	-10.16	-11.84	-9.63	-10.7	-11.37	-9.71	-11.4	-8.87	-11.36	-8.58
135	-8.48	-7.81	-5.61	-7.17	-8.28	-6.8	-7.89	-6.89	-6.28	-7.43	-5.63	-7.03	-5.51
150	-6.36	-5.79	-4.23	-5.31	-6.04	-5.06	-6.48	-4.39	-4.1	-5	-3.71	-4.64	-3.56
165	-5.18	-4.63	-3.57	-4.38	-4.93	-3.95	-5.96	-3.18	-3.04	-3.63	-2.73	-3.3	-2.55
180	-4.68	-4.08	-3.39	-4.22	-4.87	-3.25	-5.69	-3.11	-2.96	-2.95	-2.4	-2.7	-2.2
195	-4.72	-4.08	-3.64	-4.59	-5.76	-3.21	-5.48	-3.85	-3.79	-3.04	-2.69	-2.7	-2.46
210	-5.35	-4.66	-4.4	-5.16	-7.41	-4.16	-5.82	-4.86	-5.44	-4	-3.61	-3.37	-3.33
225	-6.57	-5.84	-5.77	-6.09	-9.16	-6.19	-7.24	-6	-7.52	-5.87	-5.29	-4.75	-4.91
240	-8.71	-7.95	-8.28	-7.74	-11.16	-9.37	-10.34	-7.9	-10.32	-9.05	-8.13	-7.15	-7.75
255	-12.33	-11.38	-12.35	-10.62	-13.73	-13.13	-14.88	-11.59	-13.9	-14.14	-12.93	-11.1	-12.9
270	-20.5	-18.01	-20.78	-15.43	-16.51	-17.04	-16.68	-19.39	-17.02	-24.56	-22.26	-19.25	-27.07
285	-23.97	-23.77	-16.81	-18.43	-14.56	-15.22	-12.81	-15.98	-12.87	-15.88	-14.47	-16.96	-15.08
300	-13.07	-13.09	-10.33	-12.89	-10.65	-11.17	-9.29	-9.35	-8.37	-9.96	-8.69	-9.83	-8.61
315	-8.83	-8.47	-6.92	-8.92	-7.98	-8.28	-6.86	-5.82	-5.84	-6.67	-5.58	-6.25	-5.37
330	-6.46	-5.97	-4.88	-6.5	-6.33	-6.22	-5.06	-3.71	-4.17	-4.6	-3.61	-4.02	-3.47
345	-5.43	-4.55	-4.02	-5.16	-5.4	-4.64	-4.13	-2.65	-3.39	-3.3	-2.68	-2.68	-2.58
360	-4.53	-3.81	-3.5	-4.47	-4.36	-3.42	-3.61	-2.25	-2.54	-2.29	-1.9	-1.82	-1.89

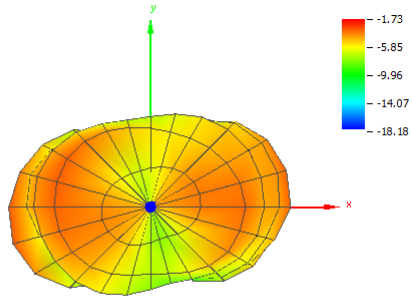


Figure 183. Board #6 (915 MHz): Theta = 0, Phi = 0

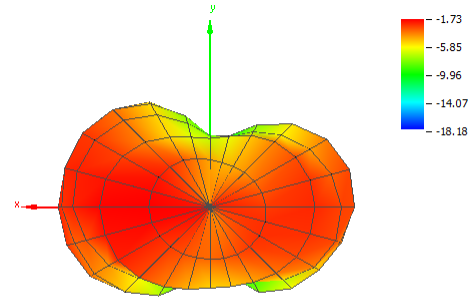


Figure 184. Board #6 (915 MHz): Theta = 180, Phi = 0

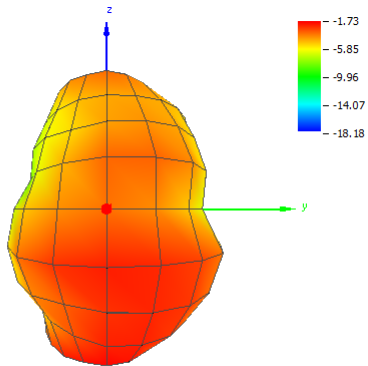


Figure 185. Board #6 (915 MHz): Theta = 90, Phi = 0

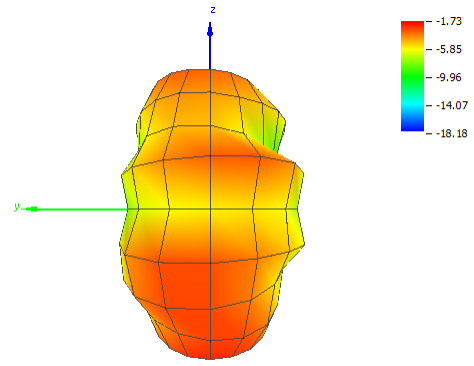


Figure 186. Board #6 (915 MHz): Theta = 90, Phi = 180

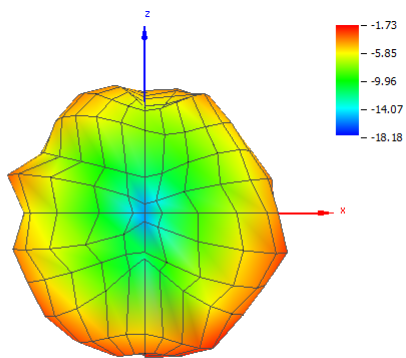


Figure 187. Board #6 (915 MHz): Theta = 90, Phi = 270

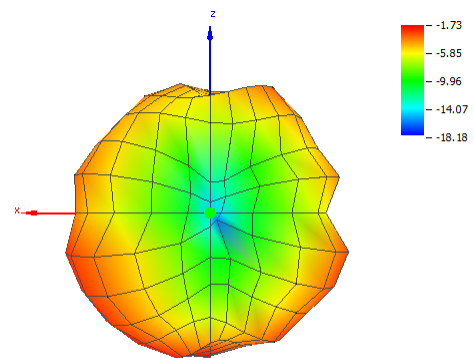
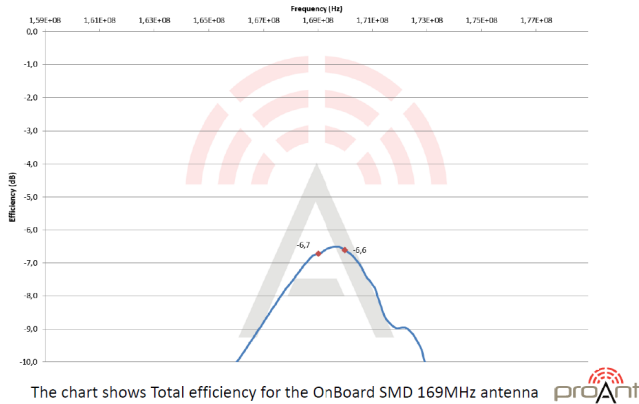
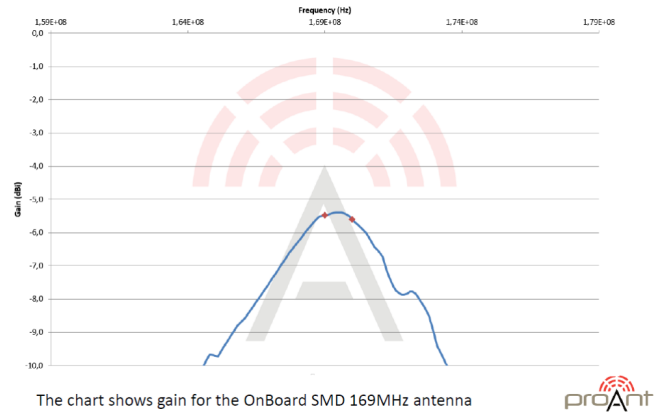


Figure 188. Board #6 (915 MHz): Theta = 90, Phi = 90

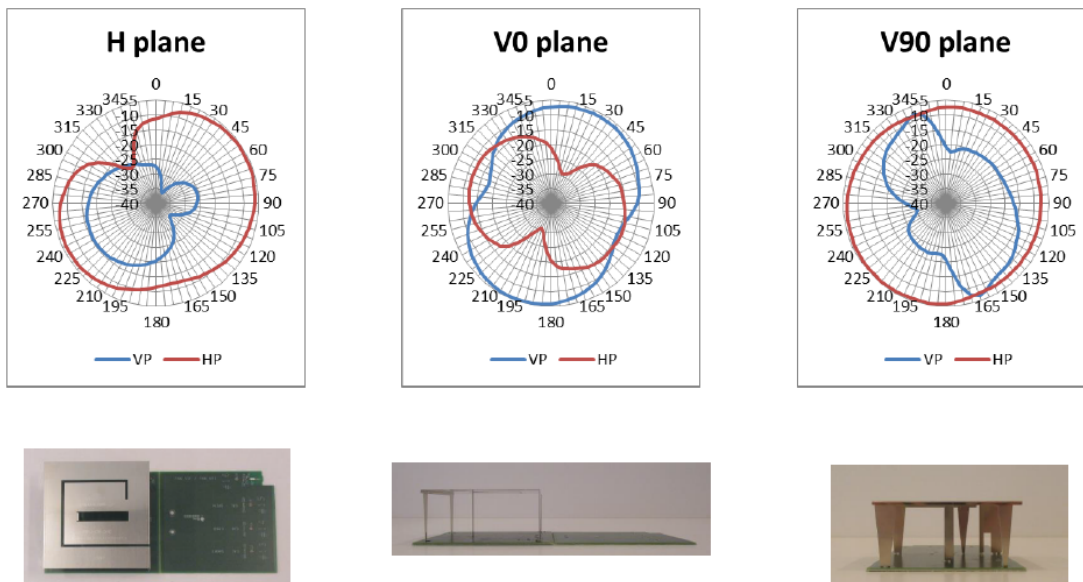
**A.7 Board #7: ProANT 169-MHz Metal Stanced Antenna**



**Figure 189. Efficiency of OnBoard SMD 169-MHZ Antenna**



**Figure 190. Gain of OnBoard SMD 169-MHZ Antenna**



VP = Vertical polarization  
HP = Horizontal polarization



**Figure 191. Radiation Pattern at 169.5 MHz**

**A.8 Board #8: 868/915/920 MHz PCB Antenna Diversity**
**A.8.1 Board #8A**
**Table 124. Board #8A: OTA Evaluation Results**

Test Description	Test Result
Total Radiated Power	-3.04 dBm
Peak EIRP	3.31 dBm
Directivity	6.35 dBi
Efficiency	-3.04 dB
Efficiency	0.4967
Peak Gain	3.31 dBi
NHPRP 45°	-5.07 dBm
NHPRP 45° / TRP	-2.03 dB
NHPRP 45° / TRP	0.6262
NHPRP 30°	-6.96 dBm
NHPRP 30° / TRP	-3.92 dB
NHPRP 30° / TRP	0.4056
NHPRP 22.5°	-8.22 dBm
NHPRP 22.5° / TRP	-5.18 dB
NHPRP 22.5° / TRP	0.303
UHRP	-6.17 dBm
UHRP / TRP	-3.13 dB
UHRP / TRP	0.4861
LHRP	-5.93 dBm
LHRP / TRP	-2.89 dB
LHRP / TRP	0.5139
PGRP (0-120°)	-4.63 dBm
PGRP / TRP	-1.59 dB
PGRP / TRP	0.6936
Front/Back Ratio	8.39
PhiBW	73.3°
PhiBW Up	37.1°
PhiBW Down	36.2°
ThetaBW	29.0°
ThetaBW Up	15.8°
ThetaBW Down	13.1°
Boresight Phi	30°
Boresight Theta	135°
Maximum Power	3.31 dBm
Minimum Power	-15.08 dBm
Average Power	-2.79 dBm
Max/Min Ratio	18.39 dB
Max/Avg Ratio	6.10 dB
Min/Avg Ratio	-12.29 dB
Worst Single Value	-28.49 dBm
Worst Position	Azi = 315°; Elev = 75°; Pol = Vertical
Best Single Value	2.85 dBm
Best Position	Azi = 15°; Elev = 60°; Pol = Vertical

**Table 125. Board #8A: RP\_868.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-4.48	-6.43	-5.49	0.45	2.49	0.24	-1.62	-4.07	-4.44	2.31	0.54	-3.69	-6.28
15	-3.3	-5.3	-2.86	0.77	3.1	0.43	-5.67	-4.88	-1.36	2.95	0.69	-3.18	-5.87
30	-2.19	-2.97	-1.01	1.5	2.4	-0.77	-6.06	-4.17	-0.12	3.31	0.51	-3.22	-5.01
45	-1.92	-1	-0.42	1.51	0.5	-3.34	-2.46	-2.27	-0.81	2.65	0.17	-3.98	-3.75
60	-1.42	0.36	-0.05	0.96	-2.36	-4.88	-1.27	-2.34	-2.86	1.14	-0.16	-5.23	-2.56
75	-0.91	1.08	0.08	-0.3	-6.09	-4.21	-1.65	-4.25	-4.06	-0.63	-0.58	-4.97	-1.64
90	-0.84	1.24	0.09	-1.7	-10.43	-3.61	-3.17	-6.84	-4.15	-1.84	-1.05	-4.48	-1.07
105	-0.92	0.94	-0.17	-2.83	-15.08	-3.66	-5.2	-7.38	-3.27	-2.68	-1.83	-4.27	-0.94
120	-1.18	0.54	-0.38	-3.15	-14.99	-4.12	-6.46	-5.41	-2.33	-3.33	-2.45	-4.46	-1.48
135	-1.75	-0.07	-0.4	-2.63	-11.89	-4.83	-6.41	-3.26	-1.77	-3.89	-2.96	-4.91	-2.33
150	-2.28	-0.94	-0.41	-1.99	-9.68	-5.83	-6.56	-1.92	-1.58	-4.21	-3.12	-5.17	-3.33
165	-3.03	-1.73	-0.84	-2.2	-8.69	-6.6	-7.31	-1.81	-1.72	-4.53	-2.62	-4.91	-4.65
180	-3.9	-2.54	-1.38	-2.82	-8.34	-7.03	-7.14	-2.01	-1.92	-4.75	-2.12	-4.59	-6.08
195	-4.59	-2.93	-2.03	-3.99	-8.37	-6.69	-7.01	-2.42	-1.82	-5.23	-1.64	-4.46	-7.58
210	-4.74	-3	-2.51	-5.09	-8.91	-6.5	-7.76	-2.92	-1.69	-5.13	-1.44	-4.27	-8.26
225	-4.15	-2.7	-2.87	-5.43	-10.22	-6.42	-8.73	-3.73	-2.07	-5.09	-1.23	-4.03	-8.05
240	-3.31	-2.5	-3.08	-5.5	-11.12	-6.49	-8.87	-4.47	-3.06	-5.2	-1.18	-3.69	-7.39
255	-2.62	-2.55	-3.36	-6.02	-11.26	-6.41	-8.73	-4.91	-4.62	-5.79	-1.33	-3.46	-6.68
270	-2.38	-2.82	-3.85	-6.88	-11.14	-6.05	-7.82	-5.2	-6.36	-6.4	-1.51	-3.34	-6.02
285	-2.38	-3.34	-4.32	-7.47	-10.05	-5.72	-6.53	-5.78	-8.22	-6.9	-1.64	-3.49	-5.7
300	-2.36	-3.81	-4.75	-7.35	-8.61	-5.56	-4.99	-6.32	-10.4	-6.52	-1.56	-3.98	-5.82
315	-2.45	-4.13	-5.06	-6.82	-6.69	-5.25	-2.66	-5.78	-12.17	-5.34	-1.67	-4.81	-6.46
330	-2.89	-4.73	-5.48	-6.01	-4.3	-4.28	-0.85	-4.17	-12.51	-3.92	-1.81	-5.63	-7.02
345	-3.83	-5.35	-6.21	-4.78	-2.6	-2.56	-0.01	-2.98	-10.91	-2.52	-2.23	-5.27	-7.36
360	-4.48	-6.43	-5.49	0.45	2.49	0.24	-1.62	-4.07	-4.44	2.31	0.54	-3.69	-6.28

**Table 126. Board #8A: RP\_868.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-10.54	-9.53	-11.02	-11.55	-9.99	-9.63	-18.59	-7.21	-8.87	-9.86	-5.64	-8.69	-16.75
15	-13.7	-11.11	-12.65	-10.41	-9.39	-11.81	-16.47	-6.19	-10.48	-8.07	-4.58	-6.37	-10.69
30	-12.93	-8.64	-10.36	-8.38	-9.47	-10.13	-11.65	-7.47	-12.36	-4.18	-2.52	-4.81	-6.92
45	-8.7	-5.04	-6.88	-6.12	-9.66	-7.43	-8.88	-9.73	-10.01	-2.2	-1	-4.56	-4.48
60	-5.57	-2.25	-3.83	-4.02	-10.15	-5.35	-7.68	-10.46	-6.66	-1.66	-0.43	-5.46	-2.85
75	-3.27	-0.48	-1.75	-3.29	-11.13	-4.36	-6.98	-9.44	-4.78	-1.73	-0.68	-5.87	-1.88
90	-1.99	0.44	-0.5	-2.78	-13.11	-3.97	-6.81	-8.37	-4.19	-2.25	-1.41	-6.65	-1.5
105	-1.38	0.64	-0.27	-2.93	-17.16	-4	-7.05	-8.03	-4.16	-3.12	-2.65	-7.91	-1.69
120	-1.28	0.37	-0.66	-3.44	-23.67	-4.49	-7.54	-8.45	-4.51	-4.14	-3.7	-10.12	-2.76
135	-1.79	-0.48	-1.46	-4.01	-23.76	-5.61	-7.96	-9.16	-5.25	-5.01	-4.61	-13.87	-4.37
150	-2.7	-1.93	-2.53	-4.63	-19.31	-7.39	-8.8	-9.81	-6.29	-5.31	-5.04	-16.6	-6.18
165	-4.48	-4.16	-4.46	-5.72	-15.96	-9.52	-10.11	-10.19	-7.14	-5.42	-4.27	-12.34	-8.33
180	-7.44	-7.97	-7.13	-7.28	-12.03	-12.47	-11.29	-10.42	-7.88	-5.5	-3.33	-9.1	-10.05
195	-12.88	-14.6	-12.03	-9.92	-9.89	-11.97	-12.4	-10.36	-8.33	-6.08	-2.52	-7.3	-10.8
210	-26.76	-24.04	-21.25	-14.11	-9.8	-10.12	-11.85	-10.19	-8.63	-6.31	-2.23	-6.03	-10.13
225	-14.57	-12.4	-15.94	-15.9	-11.26	-9.06	-10.51	-9.46	-8.85	-6.88	-2	-5.13	-8.83
240	-8.78	-8.86	-10.48	-13.34	-12.68	-8.47	-9.35	-8.58	-8.95	-7.39	-1.94	-4.4	-7.64
255	-5.77	-7.22	-8.12	-11.31	-12.57	-7.61	-8.91	-8.07	-9.19	-8.04	-2.01	-3.91	-6.84
270	-4.24	-6.36	-7.08	-10.05	-11.85	-6.8	-8.37	-8.04	-9.61	-8.41	-2.06	-3.64	-6.35
285	-3.43	-5.9	-6.2	-9.05	-10.56	-6.22	-8.02	-8.49	-10.4	-8.68	-2.09	-3.81	-6.4
300	-2.99	-5.57	-5.74	-7.93	-9.44	-5.77	-8.42	-9.57	-11.96	-8.53	-2.06	-4.57	-7.13
315	-3.02	-5.52	-5.55	-7.25	-8.53	-5.27	-8.78	-11.63	-13.43	-7.83	-2.5	-6.18	-8.94
330	-3.82	-6.14	-5.81	-7.15	-7.85	-5	-9.2	-14.21	-13.45	-7.48	-3.4	-8.69	-11.5
345	-5.62	-7.09	-6.84	-7.64	-7.58	-5.1	-10.64	-14.83	-11.33	-8.22	-4.79	-9.54	-14.05
360	-10.54	-9.53	-11.02	-11.55	-9.99	-9.63	-18.59	-7.21	-8.87	-9.86	-5.64	-8.69	-16.75

**Table 127. Board #8A: RP\_868.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-5.71	-9.36	-6.92	0.17	2.24	-0.23	-1.71	-6.94	-6.38	2.03	-0.66	-5.33	-6.68
15	-3.72	-6.62	-3.35	0.43	2.85	0.17	-6.04	-10.74	-1.93	2.59	-0.84	-6.03	-7.62
30	-2.57	-4.34	-1.54	1.03	2.11	-1.3	-7.47	-6.91	-0.38	2.45	-2.48	-8.34	-9.49
45	-2.95	-3.17	-1.53	0.69	0.06	-5.5	-3.58	-3.13	-1.37	0.93	-6.13	-12.99	-11.85
60	-3.53	-3.1	-2.41	-0.7	-3.15	-14.79	-2.4	-3.07	-5.2	-2.08	-12.34	-18.03	-14.45
75	-4.68	-4.13	-4.55	-3.33	-7.72	-18.79	-3.16	-5.82	-12.24	-7.11	-17.36	-12.23	-14.37
90	-7.19	-6.49	-8.88	-8.27	-13.79	-14.69	-5.64	-12.11	-24.53	-12.31	-12.06	-8.52	-11.39
105	-10.86	-10.82	-16.9	-19.19	-19.27	-14.85	-9.81	-15.94	-10.6	-12.86	-9.45	-6.72	-8.94
120	-17.6	-13.55	-12.37	-15.09	-15.62	-15.03	-13.05	-8.39	-6.36	-11	-8.45	-5.84	-7.44
135	-22.22	-10.54	-7.05	-8.29	-12.19	-12.65	-11.63	-4.55	-4.36	-10.35	-7.98	-5.5	-6.59
150	-12.63	-7.85	-4.54	-5.4	-10.18	-11.02	-10.51	-2.69	-3.38	-10.71	-7.6	-5.49	-6.51
165	-8.5	-5.41	-3.31	-4.75	-9.6	-9.71	-10.54	-2.49	-3.19	-11.88	-7.62	-5.78	-7.08
180	-6.43	-4.01	-2.72	-4.74	-10.76	-8.49	-9.25	-2.69	-3.19	-12.77	-8.26	-6.48	-8.31
195	-5.28	-3.24	-2.49	-5.27	-13.68	-8.21	-8.49	-3.17	-2.92	-12.73	-8.97	-7.64	-10.38
210	-4.77	-3.03	-2.57	-5.67	-16.26	-8.97	-9.91	-3.82	-2.67	-11.39	-9.25	-9.04	-12.81
225	-4.56	-3.2	-3.09	-5.84	-16.94	-9.84	-13.44	-5.08	-3.09	-9.82	-9.08	-10.54	-15.9
240	-4.75	-3.64	-3.95	-6.28	-16.32	-10.87	-18.72	-6.61	-4.36	-9.22	-9.12	-11.87	-20.01
255	-5.5	-4.36	-5.12	-7.54	-17.08	-12.59	-22.72	-7.78	-6.49	-9.71	-9.72	-13.57	-21.3
270	-6.95	-5.35	-6.65	-9.74	-19.33	-14.02	-17.08	-8.39	-9.14	-10.71	-10.77	-15.16	-17.35
285	-9.07	-6.85	-8.87	-12.64	-19.64	-15.33	-11.89	-9.12	-12.26	-11.62	-11.74	-15.03	-13.99
300	-11.08	-8.58	-11.64	-16.39	-16.23	-18.78	-7.61	-9.1	-15.61	-10.83	-11.24	-12.96	-11.67
315	-11.56	-9.75	-14.86	-17.09	-11.29	-28.49	-3.88	-7.08	-18.18	-8.94	-9.28	-10.51	-10.07
330	-10.08	-10.31	-16.86	-12.37	-6.84	-12.48	-1.54	-4.62	-19.63	-6.45	-6.95	-8.6	-8.93
345	-8.53	-10.16	-14.87	-7.94	-4.27	-6.1	-0.4	-3.28	-21.2	-3.88	-5.74	-7.31	-8.41
360	-5.71	-9.36	-6.92	0.17	2.24	-0.23	-1.71	-6.94	-6.38	2.03	-0.66	-5.33	-6.68

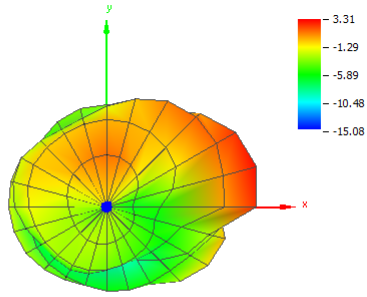


Figure 192. Board #8A: Theta = 0, Phi = 0

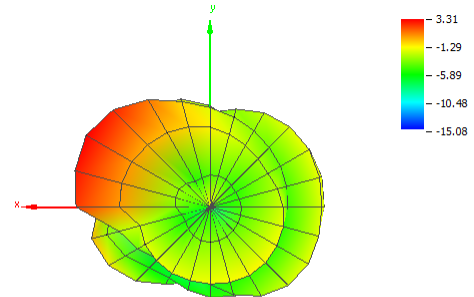


Figure 193. Board #8A: Theta = 180, Phi = 0

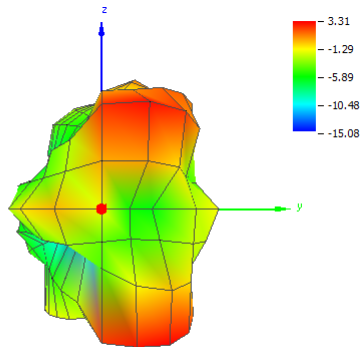


Figure 194. Board #8A: Theta = 90, Phi = 0

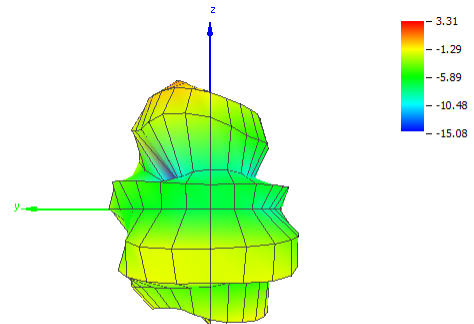


Figure 195. Board #8A: Theta = 90, Phi = 180

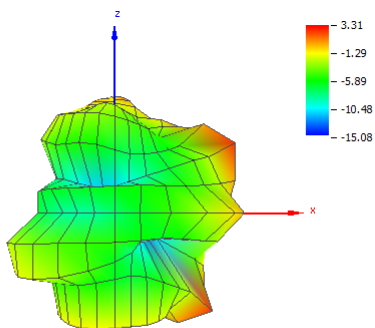


Figure 196. Board #8A: Theta = 90, Phi = 270

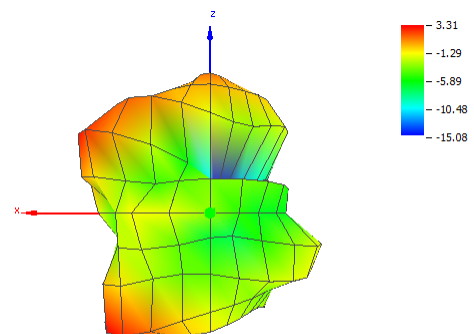


Figure 197. Board #8A: Theta = 90, Phi = 90



**A.8.2 Board #8B**
**Table 128. Board #8B: OTA Evaluation Results**

Test Description	Test Result
Total Radiated Power	-5.04 dBm
Peak EIRP	-0.65 dBm
Directivity	4.39 dBi
Efficiency	-5.04 dB
Efficiency	0.3133
Peak Gain	-0.65 dBi
NHPRP 45°	-7.00 dBm
NHPRP 45° / TRP	-1.96 dB
NHPRP 45° / TRP	0.6372
NHPRP 30°	-8.72 dBm
NHPRP 30° / TRP	-3.68 dB
NHPRP 30° / TRP	0.4289
NHPRP 22.5°	-10.03 dBm
NHPRP 22.5° / TRP	-4.99 dB
NHPRP 22.5° / TRP	0.3173
UHRP	-8.74 dBm
UHRP / TRP	-3.70 dB
UHRP / TRP	0.4264
LHRP	-7.45 dBm
LHRP / TRP	-2.41 dB
LHRP / TRP	0.5736
PGRP (0-120°)	-6.93 dBm
PGRP / TRP	-1.89 dB
PGRP / TRP	0.6479
Front/Back Ratio	5.56
PhiBW	141.4°
PhiBW Up	56.7°
PhiBW Down	84.7°
ThetaBW	25.9°
ThetaBW Up	12.9°
ThetaBW Down	13.0°
Boresight Phi	315°
Boresight Theta	150°
Maximum Power	-0.65 dBm
Minimum Power	-16.57 dBm
Average Power	-4.86 dBm
Max/Min Ratio	15.93 dB
Max/Avg Ratio	4.22 dB
Min/Avg Ratio	-11.71 dB
Worst Single Value	-30.96 dBm
Worst Position	Azi = 345°; Elev = 90°; Pol = Horizontal
Best Single Value	-1.31 dBm
Best Position	Azi = 30°; Elev = 120°; Pol = Vertical

**Table 129. Board #8B: RP\_915.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-4.27	-2.63	-2.25	-3.12	-5.58	-6.63	-12.56	-1.58	-1.28	-2.47	-2.96	-4.07	-8.84
15	-4.96	-3.02	-3.01	-3.45	-6.97	-8.5	-9.7	-2.58	-0.75	-1.52	-3.84	-3.76	-9.2
30	-5.3	-3.62	-4.47	-4.85	-8.94	-7.23	-5.36	-3.29	-0.79	-0.76	-3.86	-3.53	-8.53
45	-5.11	-4.31	-6.37	-7.32	-9.82	-4.84	-3.26	-4.37	-2.19	-0.86	-3.4	-3.9	-8.3
60	-4.48	-4.22	-7.42	-9.59	-9.57	-3.67	-3.33	-6.54	-4.42	-1.8	-2.82	-3.88	-7.47
75	-3.76	-3.77	-7.44	-9.18	-9.3	-3.58	-4.3	-9.48	-5.59	-2.82	-2.28	-3.52	-7.1
90	-2.95	-3.39	-7.58	-8.45	-8.64	-4.06	-5.73	-10.67	-5.98	-3.23	-1.99	-3.45	-7.22
105	-2.46	-2.87	-7.13	-8.14	-7.93	-4.14	-6.59	-10.38	-5.54	-3.01	-2.16	-3.87	-8.02
120	-2.01	-2.14	-6.76	-8.13	-6.96	-3.9	-6.3	-8.65	-5.11	-2.45	-2.39	-4.66	-9.66
135	-1.79	-1.47	-6.2	-8.37	-6.57	-3.44	-5.14	-6.76	-5.25	-2.11	-3.06	-5.85	-10.98
150	-1.69	-1.64	-5.55	-8.68	-7.3	-3.56	-4.41	-4.8	-5.88	-2.88	-3.86	-7.98	-11.83
165	-1.82	-1.62	-4.9	-8.8	-8.68	-4.4	-4.83	-3.64	-5.9	-3.64	-5.06	-10.05	-12.53
180	-2.09	-1.91	-4.82	-7.85	-9.41	-5.83	-6.8	-4.14	-6.05	-4.03	-5.64	-11.82	-13.51
195	-2.37	-2.53	-5.54	-6.93	-7.85	-6.68	-9.47	-6.07	-6.61	-3.94	-5.38	-11.98	-14.18
210	-2.82	-3.48	-6.51	-7.09	-6.78	-6.5	-12.43	-8.19	-6.99	-3.94	-4.72	-10.44	-14.54
225	-3.28	-4.43	-7.15	-7.67	-7.24	-6.33	-12.63	-7.7	-6.77	-4.15	-3.91	-8.6	-14.8
240	-3.91	-5.25	-6.94	-7.55	-8.01	-6.88	-11.36	-6.03	-6.52	-4.46	-3.16	-7.15	-15.25
255	-4.72	-5.53	-5.98	-7.15	-8.21	-8.23	-11.44	-4.73	-6.79	-4.79	-2.44	-6.18	-16.02
270	-5.2	-5.52	-5.05	-7.1	-8.03	-9.21	-13.5	-4.22	-6.7	-4.95	-1.76	-5.45	-16.49
285	-5.39	-5.31	-4.42	-6.69	-6.74	-8.33	-14.8	-4.39	-6.38	-4.75	-1.2	-4.87	-16.57
300	-5.51	-5.29	-4.12	-5.73	-4.88	-6.06	-11.14	-5.2	-5.93	-4.33	-0.83	-4.41	-16.11
315	-5.76	-5.11	-3.87	-4.42	-3.43	-3.88	-7.65	-6.3	-5.32	-4.12	-0.65	-4.14	-15.55
330	-6.21	-4.81	-3.84	-3.7	-2.76	-2.75	-6.15	-6.92	-4.79	-2.65	-0.92	-4.11	-14.6
345	-6.54	-4.73	-3.89	-3.63	-2.55	-2.36	-6.97	-6.43	-4.62	-5.01	-1.59	-3.91	-13.04
360	-4.27	-2.63	-2.25	-3.12	-5.58	-6.63	-12.56	-1.58	-1.28	-2.47	-2.96	-4.07	-8.84

**Table 130. Board #8B: RP\_915.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-8.86	-8.67	-10.87	-13.69	-10.87	-10.05	-19.76	-8.02	-8.51	-8.52	-4.11	-4.6	-9.72
15	-7.63	-6.96	-9.99	-13.8	-11.15	-9.62	-14.54	-7.83	-9.1	-9.89	-4.5	-4.18	-11.28
30	-6.43	-6.01	-9.3	-15.71	-11.8	-7.28	-12.17	-8.71	-10.3	-9.45	-4.21	-3.8	-12.04
45	-5.65	-5.67	-9.24	-17.44	-12.06	-5.1	-9.82	-11.37	-12.01	-7.58	-3.53	-4.22	-13.72
60	-5.06	-5.06	-9.21	-24.2	-11.84	-3.93	-8.26	-14.24	-12.19	-6.14	-2.84	-4.45	-15.72
75	-4.59	-4.79	-9.1	-21.93	-11.78	-3.77	-7.67	-16.1	-10.68	-5.24	-2.38	-4.55	-15.99
90	-4.71	-5.2	-9.76	-17.17	-11.62	-4.12	-7.99	-15.74	-9.04	-5.02	-2.23	-5.03	-14.51
105	-5.96	-6.2	-11.05	-13.86	-12.04	-4.51	-8.54	-14.18	-7.59	-4.95	-2.61	-5.89	-13.84
120	-7.36	-7.36	-12.77	-11.84	-12.28	-5.23	-9.02	-12.18	-6.56	-4.93	-3.06	-7.26	-13.69
135	-8.34	-8.06	-12.56	-10.87	-12.91	-6.59	-9.73	-10.71	-5.89	-5.11	-3.88	-9.21	-12.72
150	-8.06	-8.18	-11.2	-10.69	-16.29	-8.66	-12	-9.97	-6.04	-5.4	-4.64	-10.92	-12.46
165	-7.43	-7.86	-9.27	-10.66	-23.82	-10.71	-15.03	-9.78	-5.94	-5.68	-5.45	-12.34	-12.73
180	-6.8	-7.28	-8.29	-10.08	-23.81	-10.8	-18.92	-10.35	-6.18	-5.73	-5.7	-12.77	-13.77
195	-6.07	-6.75	-7.59	-9.32	-15.19	-9.25	-19.13	-10.97	-6.64	-5.49	-5.44	-12.09	-14.7
210	-5.83	-6.34	-7.28	-8.77	-12.19	-8.22	-16.78	-11.41	-7.23	-5.3	-4.82	-10.6	-15.39
225	-5.63	-6.39	-7.25	-8.51	-10.98	-8.35	-15.18	-11.16	-7.85	-5.14	-3.98	-8.94	-16.1
240	-5.78	-6.62	-7.46	-8.57	-10.11	-8.74	-15.08	-10.57	-8.4	-5.06	-3.27	-7.53	-17.35
255	-6.43	-7.14	-7.74	-8.67	-9.3	-9.19	-15.01	-9.98	-9.38	-5.1	-2.73	-6.55	-19.75
270	-7.12	-8.1	-8.53	-9.41	-9.09	-9.3	-15.11	-9.68	-10.18	-5.17	-2.35	-5.88	-22.49
285	-8.21	-9.86	-10.2	-11.23	-9.43	-9.22	-15.78	-9.96	-11.03	-5.06	-2.13	-5.48	-26.16
300	-9.97	-13.18	-13.43	-13.32	-9.84	-8.89	-16.59	-10.75	-11.66	-4.89	-2.03	-5.28	-29.35
315	-13.12	-21.57	-18.34	-13.8	-9.61	-8.31	-18.48	-11.61	-11.27	-5.05	-2.14	-5.29	-25.46
330	-18.28	-22.33	-16.85	-12.19	-8.75	-7.92	-21.75	-11.41	-10.55	-3.52	-2.69	-5.56	-19.72
345	-18.27	-15.86	-13.14	-11.33	-7.97	-7.41	-30.96	-10.45	-9.77	-7.04	-3.61	-5.37	-16.36
360	-8.86	-8.67	-10.87	-13.69	-10.87	-10.05	-19.76	-8.02	-8.51	-8.52	-4.11	-4.6	-9.72

**Table 131. Board #8B: RP\_915.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-6.12	-3.88	-2.89	-3.52	-7.1	-9.27	-13.48	-2.7	-2.19	-3.71	-9.3	-13.51	-16.18
15	-8.35	-5.26	-3.99	-3.87	-9.06	-14.95	-11.43	-4.11	-1.43	-2.2	-12.35	-14.11	-13.4
30	-11.69	-7.36	-6.2	-5.23	-12.11	-26.79	-6.37	-4.76	-1.31	-1.39	-14.96	-15.68	-11.08
45	-14.44	-10.01	-9.53	-7.77	-13.76	-17.33	-4.34	-5.33	-2.67	-1.9	-18.64	-15.45	-9.77
60	-13.53	-11.77	-12.12	-9.74	-13.46	-15.94	-5.01	-7.35	-5.21	-3.8	-25.04	-13	-8.18
75	-11.34	-10.57	-12.4	-9.42	-12.92	-17.42	-6.98	-10.55	-7.19	-6.51	-18.81	-10.26	-7.7
90	-7.73	-8.05	-11.61	-9.07	-11.68	-22.48	-9.65	-12.28	-8.93	-7.94	-14.75	-8.61	-8.12
105	-5.03	-5.58	-9.4	-9.5	-10.06	-15	-10.99	-12.72	-9.79	-7.46	-12.23	-8.16	-9.33
120	-3.51	-3.69	-8.02	-10.53	-8.47	-9.69	-9.62	-11.2	-10.57	-6.05	-10.82	-8.11	-11.84
135	-2.87	-2.54	-7.34	-11.97	-7.72	-6.32	-6.99	-9.01	-13.86	-5.14	-10.71	-8.54	-15.78
150	-2.83	-2.73	-6.93	-12.98	-7.88	-5.16	-5.24	-6.38	-20.22	-6.45	-11.74	-11.05	-20.52
165	-3.21	-2.8	-6.88	-13.4	-8.82	-5.56	-5.27	-4.85	-26.16	-7.89	-15.72	-13.94	-26.12
180	-3.88	-3.4	-7.42	-11.81	-9.57	-7.49	-7.08	-5.33	-21.24	-8.92	-24.74	-18.86	-25.81
195	-4.78	-4.6	-9.79	-10.66	-8.74	-10.19	-9.97	-7.77	-28.02	-9.17	-23.6	-28.24	-23.68
210	-5.84	-6.65	-14.37	-12.01	-8.25	-11.37	-14.41	-11.01	-19.73	-9.63	-21.26	-24.7	-22.06
225	-7.08	-8.81	-23.56	-15.23	-9.63	-10.63	-16.16	-10.31	-13.36	-11.04	-21.85	-19.86	-20.68
240	-8.48	-10.94	-16.41	-14.36	-12.17	-11.45	-13.76	-7.91	-11.05	-13.29	-19.28	-17.84	-19.43
255	-9.59	-10.61	-10.75	-12.42	-14.75	-15.25	-13.95	-6.27	-10.28	-16.49	-14.23	-16.98	-18.42
270	-9.65	-9.01	-7.63	-10.95	-14.66	-26.08	-18.6	-5.68	-9.3	-18.07	-10.69	-15.7	-17.75
285	-8.61	-7.18	-5.76	-8.57	-10.1	-15.66	-21.78	-5.79	-8.2	-16.45	-8.37	-13.69	-17.08
300	-7.44	-6.06	-4.66	-6.56	-6.54	-9.26	-12.6	-6.63	-7.28	-13.49	-6.97	-11.83	-16.32
315	-6.64	-5.21	-4.02	-4.95	-4.62	-5.83	-8.03	-7.81	-6.59	-11.25	-6	-10.46	-16.01
330	-6.49	-4.89	-4.06	-4.37	-4.02	-4.32	-6.27	-8.82	-6.13	-10.06	-5.69	-9.6	-16.2
345	-6.84	-5.08	-4.44	-4.44	-4.02	-4	-6.98	-8.63	-6.21	-9.29	-5.88	-9.38	-15.76
360	-6.12	-3.88	-2.89	-3.52	-7.1	-9.27	-13.48	-2.7	-2.19	-3.71	-9.3	-13.51	-16.18

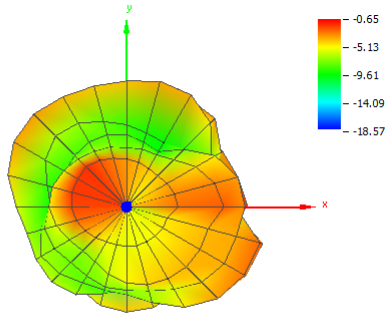


Figure 198. Board #8B: Theta = 0, Phi = 0

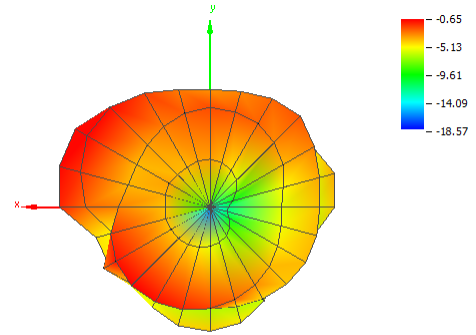


Figure 199. Board #8B: Theta = 180, Phi = 0

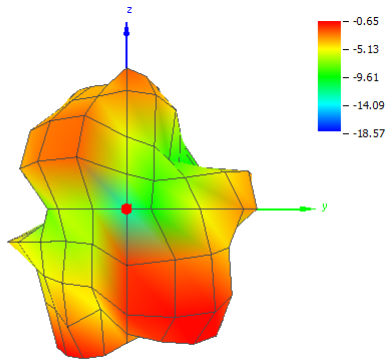


Figure 200. Board #8B: Theta = 90, Phi = 0

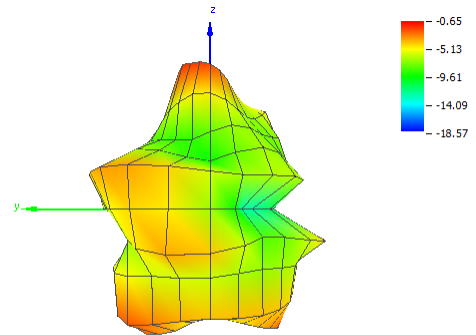


Figure 201. Board #8B: Theta = 90, Phi = 180

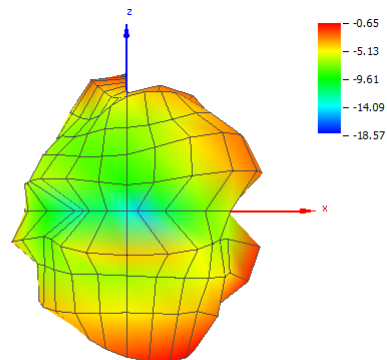


Figure 202. Board #8B: Theta = 90, Phi = 270

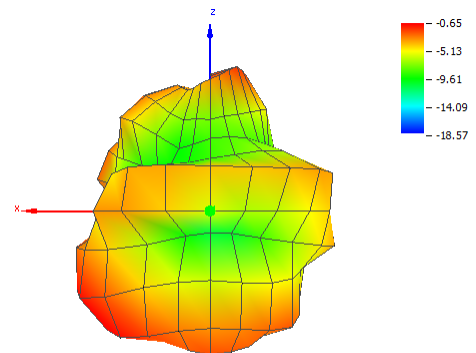


Figure 203. Board #8B: Theta = 90, Phi = 90

**A.9 Board #9: 868/915/920 MHz and 2.4 GHz Dual-Band PCB Antenna**
**A.9.1 868 MHz**
**Table 132. Board #9: OTA Evaluation Results (868 MHz)**

Test Description	Test Result
Total Radiated Power	-0.95 dBm
Peak EIRP	3.52 dBm
Directivity	4.47 dBi
Efficiency	-0.95 dB
Efficiency	0.8038
Peak Gain	3.52 dBi
NHPRP 45°	-2.87 dBm
NHPRP 45° / TRP	-1.92 dB
NHPRP 45° / TRP	0.6421
NHPRP 30°	-4.35 dBm
NHPRP 30° / TRP	-3.40 dB
NHPRP 30° / TRP	0.4571
NHPRP 22.5°	-5.64 dBm
NHPRP 22.5° / TRP	-4.69 dB
NHPRP 22.5° / TRP	0.3394
UHRP	-4.13 dBm
UHRP / TRP	-3.18 dB
UHRP / TRP	0.4803
LHRP	-3.79 dBm
LHRP / TRP	-2.84 dB
LHRP / TRP	0.5197
PGRP (0-120°)	-2.37 dBm
PGRP / TRP	-1.42 dB
PGRP / TRP	0.7206
Front/Back Ratio	4.45
PhiBW	80.4°
PhiBW Up	47.9°
PhiBW Down	32.6°
ThetaBW	115.7°
ThetaBW Up	104.1°
ThetaBW Down	11.6°
Boresight Phi	165°
Boresight Theta	105°
Maximum Power	3.52 dBm
Minimum Power	-15.99 dBm
Average Power	-0.06 dBm
Max/Min Ratio	19.52 dB
Max/Avg Ratio	3.58 dB
Min/Avg Ratio	-15.94 dB
Worst Single Value	-30.83 dBm
Worst Position	Azi = 150°; Elev = 150°; Pol = Horizontal
Best Single Value	3.33 dBm
Best Position	Azi = 165°; Elev = 105°; Pol = Vertical

**Table 133. Board #9: RP\_868.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	2.25	1.75	0.51	-1.48	-0.3	0.27	0.68	0.58	0.94	0.97	0.73	2.12	2.37
15	2.09	1.93	0.05	-1.57	0.04	0.48	-0.18	0.05	1.44	1.3	0.34	1.72	1.86
30	1.85	1.75	-0.5	-1.55	-0.13	-0.1	-2.01	-0.42	1.53	0.98	-0.76	1.08	1.31
45	1.5	1.28	-0.98	-1.45	-1.35	-2.4	-3.74	-0.77	0.54	-0.41	-2.74	0.12	0.74
60	1.18	0.78	-1.32	-1.67	-3.58	-6.06	-4.34	-2.01	-1.58	-2.53	-4.65	-0.71	0.47
75	0.82	0.16	-1.57	-2.56	-6.44	-9.09	-5.3	-5.4	-5.18	-5.11	-5.12	-1.29	0.6
90	0.53	-0.34	-1.59	-3.75	-6.99	-6.8	-6.48	-9.27	-7.69	-5.78	-3.93	-1.32	1.08
105	0.52	-0.52	-1.1	-4.73	-4.87	-3.58	-5.95	-6.21	-5.81	-4.41	-2.22	-0.9	1.71
120	0.82	-0.12	-0.34	-4.19	-2.6	-1.27	-3.78	-1.97	-2.86	-2.84	-0.87	-0.18	2.2
135	1.47	0.6	0.71	-2.58	-0.44	0.57	-1.57	1.04	-0.17	-1.26	0.41	0.69	2.48
150	2.05	1.43	1.43	-1.04	0.93	1.71	-0.52	2.72	1.42	0.08	1.24	1.33	2.45
165	2.53	2.23	1.9	0.11	1.81	2.53	-0.36	3.52	2.26	1.25	1.91	1.83	2.16
180	2.75	2.79	2.02	0.41	1.91	2.95	-0.64	3.25	2.01	1.81	2.25	2.09	1.72
195	2.72	3.13	1.96	-0.04	1.05	2.74	-0.9	1.98	0.47	1.61	2.28	2.17	1.13
210	2.48	3.09	1.83	-0.71	-0.69	1.62	-1.6	0.72	-1.84	0.51	1.95	2.02	0.58
225	2	2.73	1.36	-1.2	-3.21	-1.15	-3.77	-0.31	-4.36	-1.86	1.34	1.7	0.19
240	1.41	2.07	0.64	-1.6	-5.27	-5.33	-7.16	-1.78	-6.11	-4.62	0.63	1.49	0.3
255	0.65	1.01	-0.45	-2.41	-6.44	-12.98	-10.53	-4.77	-7.88	-7.68	-0.13	1.4	0.8
270	0.12	-0.14	-1.59	-3.54	-6.51	-15.99	-9.2	-9.04	-8.36	-8.93	-0.6	1.47	1.49
285	-0.09	-1.2	-2.18	-4.51	-5.29	-9.69	-6.44	-9.98	-5.96	-7.52	-0.78	1.65	2.17
300	0.3	-1.31	-1.75	-4.32	-3.75	-6.21	-4.37	-5.75	-3.47	-5.29	-0.5	1.87	2.61
315	1.06	-0.47	-0.8	-3.27	-2.23	-3.75	-2.36	-2.22	-1.47	-3.12	-0.09	2.04	2.83
330	1.69	0.46	-0.03	-2.26	-1.18	-2.12	-0.87	-0.24	-0.35	-1.59	0.19	2.11	2.83
345	1.91	1.35	0.18	-1.4	-0.62	-0.93	0.16	0.82	0.21	-0.37	0.42	2.24	2.57
360	2.25	1.75	0.51	-1.48	-0.3	0.27	0.68	0.58	0.94	0.97	0.73	2.12	2.37

**Table 134. Board #9: RP\_868.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-14.8	-15.48	-19.15	-30.56	-15.65	-15.16	-14.97	-10.63	-5.44	-5.49	-10.15	-22.55	-18.56
15	-7.93	-7.29	-12.07	-20.33	-16.53	-17.4	-16.19	-9.13	-4	-4.77	-12.14	-12.76	-9.86
30	-3.81	-3.81	-7.82	-15.81	-22.04	-18.43	-17.19	-8.21	-3.43	-4.69	-10.81	-7.04	-4.99
45	-1.29	-1.7	-5.39	-11.44	-17.3	-14.96	-16.41	-8.14	-3.83	-4.92	-8.12	-3.87	-2.03
60	0.04	-0.66	-3.99	-8.16	-10.93	-13.15	-14.98	-9.1	-4.91	-5.24	-6.3	-2.29	-0.43
75	0.61	-0.26	-2.97	-5.83	-7.99	-12.24	-13.4	-11.16	-6.45	-5.68	-5.34	-1.52	0.53
90	0.45	-0.5	-2.5	-4.9	-7.2	-11.65	-12	-13	-7.77	-6.38	-5.46	-1.61	0.86
105	-0.36	-1.41	-2.72	-5.15	-7.82	-11.5	-11.1	-13.18	-9.39	-7.57	-6.83	-2.6	0.56
120	-1.54	-2.81	-3.8	-6.56	-9.46	-12.17	-11.2	-12.13	-11.23	-9.15	-9.19	-4.36	-0.43
135	-3.57	-5.52	-6.13	-9.93	-12.17	-13.78	-12.13	-10.95	-13.36	-11.65	-14.2	-7.72	-2.53
150	-6.66	-10.03	-10.01	-14.61	-14.55	-15.19	-13.27	-10.26	-13.96	-13.03	-30.83	-13.11	-5.78
165	-13.89	-24.43	-17.48	-13.78	-12.62	-15.34	-13.91	-10.16	-12.33	-10.68	-14.2	-15.65	-12.72
180	-20.55	-13.93	-14.31	-9.34	-9.08	-13.96	-14.45	-11.24	-10.89	-8.11	-7.91	-8.78	-20.27
195	-8.9	-6.9	-8.38	-6.43	-6.4	-12.14	-15.99	-14.68	-10.85	-6.35	-4.16	-4.19	-8.82
210	-4.53	-3.82	-5.45	-5.11	-5.25	-11.45	-17.3	-19.59	-12.74	-5.8	-2.08	-1.73	-4.34
225	-1.93	-1.83	-3.65	-4.48	-5.22	-12.38	-17.71	-17.89	-18.21	-6.35	-0.78	-0.1	-1.66
240	-0.53	-0.77	-2.56	-4.19	-5.78	-15.3	-16.95	-14.35	-20.36	-6.94	-0.32	0.85	-0.13
255	0.13	-0.31	-1.98	-4.15	-6.7	-20.15	-15.2	-12.15	-14.52	-8	-0.32	1.34	0.78
270	0.11	-0.46	-1.9	-4.33	-7.57	-24.08	-13.58	-11.19	-11.61	-9.44	-0.63	1.36	1.08
285	-0.62	-1.28	-2.28	-4.96	-8.51	-24.63	-12.47	-11.12	-10.49	-11.39	-1.26	0.86	0.81
300	-1.8	-2.57	-3.1	-6.05	-9.54	-23.99	-12.18	-11.56	-10.94	-12.6	-1.95	-0.15	-0.04
315	-3.8	-4.68	-4.67	-8	-11.31	-22.02	-12.31	-12.14	-12.56	-11.96	-3.14	-2.04	-1.95
330	-6.73	-8.03	-7.15	-11	-13.43	-19.22	-12.64	-12.48	-12.67	-10.08	-4.82	-4.74	-4.72
345	-13.5	-13.23	-12.67	-14.82	-15.25	-16.94	-13.1	-12.44	-9.62	-8.15	-7.13	-7.76	-10.19
360	-14.8	-15.48	-19.15	-30.56	-15.65	-15.16	-14.97	-10.63	-5.44	-5.49	-10.15	-22.55	-18.56



**Table 135. Board #9: RP\_868.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	2.17	1.67	0.46	-1.48	-0.43	0.14	0.56	0.24	-0.2	-0.14	0.36	2.11	2.34
15	1.63	1.38	-0.22	-1.63	-0.06	0.41	-0.29	-0.51	-0.03	0.07	0.09	1.57	1.56
30	0.47	0.34	-1.4	-1.71	-0.16	-0.17	-2.14	-1.21	-0.14	-0.39	-1.21	0.35	0.15
45	-1.74	-1.76	-2.94	-1.9	-1.46	-2.65	-3.98	-1.65	-1.43	-2.3	-4.22	-2.09	-2.53
60	-5.19	-4.7	-4.7	-2.77	-4.46	-7	-4.74	-2.96	-4.3	-5.85	-9.67	-5.87	-6.8
75	-12.5	-10.23	-7.14	-5.32	-11.66	-11.96	-6.03	-6.74	-11.17	-14.22	-18.18	-14.03	-17.34
90	-16.79	-14.84	-8.84	-10.06	-20.17	-8.53	-7.92	-11.66	-24.89	-14.65	-9.21	-13.32	-11.9
105	-6.84	-7.88	-6.16	-15.1	-7.94	-4.35	-7.53	-7.19	-8.31	-7.29	-4.07	-5.82	-4.6
120	-2.96	-3.48	-2.94	-7.96	-3.6	-1.64	-4.65	-2.41	-3.55	-4	-1.56	-2.28	-1.23
135	-0.17	-0.62	-0.3	-3.47	-0.74	0.41	-1.97	0.76	-0.38	-1.68	0.25	0.01	0.84
150	1.42	1.11	1.11	-1.23	0.8	1.62	-0.75	2.5	1.29	-0.14	1.24	1.17	1.74
165	2.43	2.22	1.85	-0.07	1.65	2.46	-0.55	3.33	2.1	0.96	1.8	1.76	2.02
180	2.73	2.69	1.92	-0.08	1.55	2.86	-0.83	3.09	1.79	1.34	1.81	1.71	1.69
195	2.41	2.67	1.53	-1.17	0.19	2.6	-1.03	1.88	0.14	0.85	1.16	1.02	0.66
210	1.52	2.11	0.93	-2.67	-2.56	1.4	-1.72	0.68	-2.21	-0.65	-0.24	-0.35	-1.11
225	-0.25	0.86	-0.29	-3.96	-7.53	-1.49	-3.95	-0.39	-4.55	-3.77	-2.8	-2.99	-4.43
240	-3.02	-1.12	-2.18	-5.07	-14.82	-5.79	-7.64	-2.03	-6.28	-8.45	-6.42	-7.11	-10.04
255	-8.76	-4.81	-5.75	-7.23	-18.86	-13.91	-12.35	-5.65	-8.95	-19.11	-13.72	-16.9	-20.95
270	-26.88	-11.61	-13.29	-11.37	-13.17	-16.73	-11.17	-13.12	-11.15	-18.52	-22.22	-14.36	-9.05
285	-9.48	-18.46	-18.44	-14.58	-8.1	-9.83	-7.69	-16.34	-7.86	-9.82	-10.53	-6.11	-3.54
300	-3.86	-7.28	-7.49	-9.15	-5.08	-6.29	-5.16	-7.07	-4.32	-6.18	-5.99	-2.42	-0.78
315	-0.65	-2.53	-3.09	-5.05	-2.8	-3.81	-2.82	-2.69	-1.82	-3.73	-3.06	-0.12	1.07
330	1.02	-0.21	-0.96	-2.88	-1.45	-2.2	-1.17	-0.51	-0.62	-2.25	-1.46	1.1	1.99
345	1.78	1.2	-0.06	-1.6	-0.77	-1.04	-0.05	0.61	-0.26	-1.16	-0.42	1.78	2.34
360	2.17	1.67	0.46	-1.48	-0.43	0.14	0.56	0.24	-0.2	-0.14	0.36	2.11	2.34

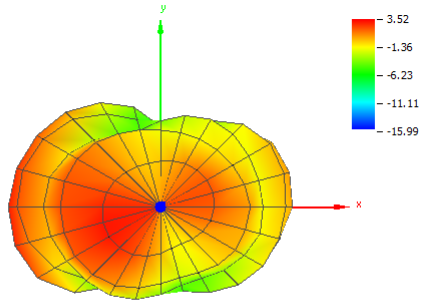


Figure 204. Board #9 (868 MHz): Theta = 0, Phi = 0

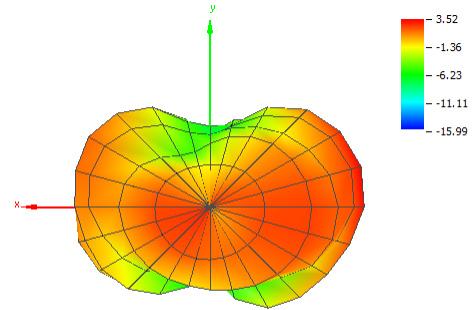


Figure 205. Board #9 (868 MHz): Theta = 180, Phi = 0

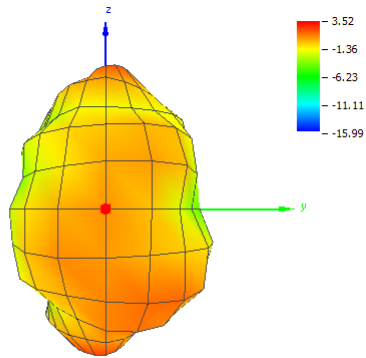


Figure 206. Board #9 (868 MHz): Theta = 90, Phi = 0

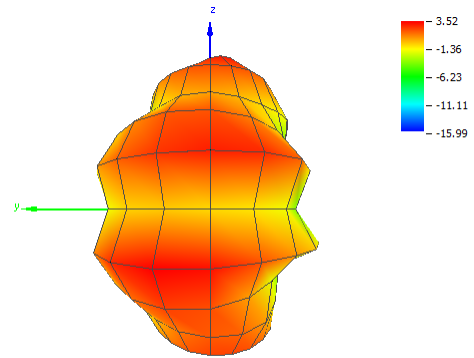


Figure 207. Board #9 (868 MHz): Theta = 90, Phi = 180

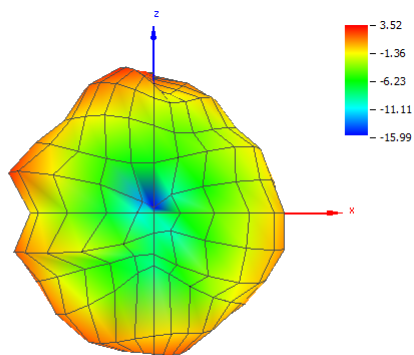


Figure 208. Board #9 (868 MHz): Theta = 90, Phi = 270

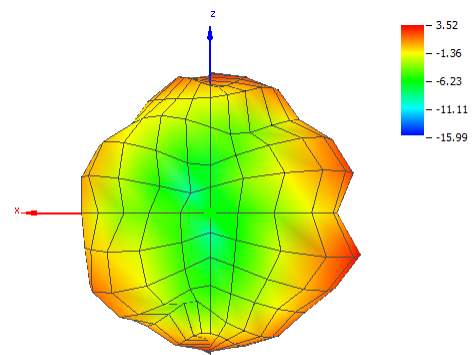


Figure 209. Board #9 (868 MHz): Theta = 90, Phi = 90

**A.9.2 915 MHz**
**Table 136. Board #9: OTA Evaluation Results (915 MHz)**

Test Description	Test Result
Total Radiated Power	-3.64 dBm
Peak EIRP	0.97 dBm
Directivity	4.61 dBi
Efficiency	-3.64 dB
Efficiency	0.4327
Peak Gain	0.97 dBi
NHPRP 45°	-5.72 dBm
NHPRP 45° / TRP	-2.09 dB
NHPRP 45° / TRP	0.6184
NHPRP 30°	-7.36 dBm
NHPRP 30° / TRP	-3.72 dB
NHPRP 30° / TRP	0.4245
NHPRP 22.5°	-8.67 dBm
NHPRP 22.5° / TRP	-5.03 dB
NHPRP 22.5° / TRP	0.3141
UHRP	-7.45 dBm
UHRP / TRP	-3.81 dB
UHRP / TRP	0.4159
LHRP	-5.97 dBm
LHRP / TRP	-2.34 dB
LHRP / TRP	0.5841
PGRP (0-120°)	-5.47 dBm
PGRP / TRP	-1.83 dB
PGRP / TRP	0.6565
Front/Back Ratio	2.69
PhiBW	289.1°
PhiBW Up	74.5°
PhiBW Down	214.6°
ThetaBW	167.4°
ThetaBW Up	100.7°
ThetaBW Down	66.7°
Boresight Phi	345°
Boresight Theta	165°
Maximum Power	0.97 dBm
Minimum Power	-17.25 dBm
Average Power	-2.83 dBm
Max/Min Ratio	18.22 dB
Max/Avg Ratio	3.80 dB
Min/Avg Ratio	-14.42 dB
Worst Single Value	-31.53 dBm
Worst Position	Azi = 90°; Elev = 60°; Pol = Vertical
Best Single Value	0.82 dBm
Best Position	Azi = 0°; Elev = 180°; Pol = Vertical

**Table 137. Board #9: RP\_915.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-2.72	-2.44	-2.91	-4.94	-4.7	-3.73	-2.41	-0.89	-1.41	-0.36	0.24	0.79	0.83
15	-2.98	-2.52	-3.46	-5.05	-3.71	-3.01	-3.03	-1.42	-0.95	-0.23	-0.36	0.39	0.41
30	-3.49	-2.96	-4.25	-5.09	-3.16	-3.14	-4.89	-2.06	-0.88	-0.69	-1.64	-0.2	-0.15
45	-4.17	-3.76	-5.01	-4.94	-3.57	-5.02	-7.28	-2.74	-1.79	-2.15	-3.55	-1.1	-0.86
60	-4.86	-4.68	-5.28	-4.84	-5.33	-8.39	-9.09	-4.14	-3.98	-4.32	-5.65	-2.06	-1.43
75	-5.42	-5.33	-4.75	-5.07	-8.48	-11.81	-10.64	-7.54	-8.02	-7.27	-7.04	-3.07	-1.53
90	-5.58	-5.31	-3.73	-5.12	-10.71	-9.89	-11.31	-13.17	-11.6	-8.85	-6.6	-3.5	-1.15
105	-5.14	-4.68	-2.48	-4.48	-8.71	-6.43	-8.96	-11.95	-8.73	-7.63	-4.79	-3.27	-0.52
120	-4.44	-3.72	-1.58	-3.25	-5.92	-3.97	-6.01	-6.12	-5	-5.41	-3.12	-2.62	0.02
135	-3.53	-2.76	-0.83	-2.15	-3.6	-2.24	-3.78	-2.3	-1.88	-3.3	-1.53	-1.77	0.47
150	-2.96	-2.06	-0.64	-1.47	-2.24	-1.18	-3	-0.34	-0.1	-1.55	-0.47	-0.91	0.65
165	-2.67	-1.72	-0.82	-1.46	-1.76	-0.33	-2.94	0.26	0.7	-0.19	0.32	-0.14	0.72
180	-2.7	-1.7	-1.2	-2.07	-2.5	0.08	-2.9	-0.48	0.16	0.3	0.65	0.35	0.51
195	-2.95	-1.98	-1.75	-2.95	-4.67	-0.4	-2.87	-1.98	-1.75	-0.26	0.54	0.59	0.03
210	-3.41	-2.5	-2.44	-3.53	-7.13	-2.19	-3.73	-3.15	-4.33	-2	0.01	0.56	-0.58
225	-3.9	-3.3	-3.37	-3.93	-8.23	-5.98	-6.52	-4.11	-6.77	-5.3	-0.91	0.28	-1.17
240	-4.51	-4.13	-4.25	-4.62	-8.61	-10.42	-11.39	-5.86	-8.32	-10.11	-2.11	0	-1.44
255	-5.28	-5.03	-5.07	-5.38	-9.17	-14.5	-17.25	-9.72	-9.89	-17.16	-3.07	-0.29	-1.38
270	-5.75	-5.56	-5.43	-6.32	-9.81	-15.35	-14.62	-16.62	-10.41	-15.23	-3.4	-0.42	-1.01
285	-5.67	-5.57	-5.11	-6.92	-9.53	-13.58	-10.95	-13.45	-8.16	-9.93	-2.98	-0.31	-0.4
300	-5.05	-5.06	-4.29	-6.64	-8.17	-10.91	-8.65	-7.45	-5.49	-6.7	-2.13	0.05	0.16
315	-4.12	-4.1	-3.39	-5.86	-6.61	-8.94	-6.72	-3.9	-3.39	-4.47	-1.16	0.42	0.66
330	-3.38	-3.16	-2.87	-5.16	-5.89	-7.77	-4.94	-1.79	-2.4	-2.92	-0.33	0.72	0.9
345	-2.99	-2.52	-2.77	-4.77	-5.57	-6.24	-3.64	-0.73	-1.94	-1.62	0.12	0.97	0.84
360	-2.72	-2.44	-2.91	-4.94	-4.7	-3.73	-2.41	-0.89	-1.41	-0.36	0.24	0.79	0.83

**Table 138. Board #9: RP\_915.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-18.25	-20.07	-19.62	-18.25	-23.76	-27.49	-24.83	-19.98	-11.59	-9.95	-12.59	-19.5	-24.71
15	-13.27	-12.57	-13.76	-14.84	-29.94	-19.86	-29.95	-17.35	-10.52	-9.21	-15.59	-19.05	-13.17
30	-9.59	-9.02	-9.53	-12.38	-24.91	-15.08	-30.42	-15.03	-9.7	-9.12	-15.27	-10.47	-7.61
45	-7.36	-6.93	-7.12	-10.42	-15.99	-12.83	-28.43	-13.87	-9.78	-9.33	-11.47	-6.66	-4.55
60	-6.21	-5.89	-5.8	-8.64	-12.64	-11.98	-24.52	-14.09	-10.57	-9.29	-8.86	-4.74	-2.81
75	-5.69	-5.45	-4.99	-7.07	-11.08	-11.86	-20.1	-14.83	-11.76	-9	-7.39	-3.77	-1.71
90	-5.78	-5.72	-4.72	-6.13	-10.75	-12.28	-17.09	-15.23	-12.72	-8.91	-7.05	-3.61	-1.31
105	-6.67	-6.98	-5.13	-5.88	-10.99	-13.16	-15.27	-14.97	-14.13	-9.44	-7.65	-4.23	-1.5
120	-8.5	-9.21	-6.32	-6.43	-11.46	-14.22	-14.44	-13.73	-16.44	-10.78	-9.3	-5.64	-2.33
135	-11.78	-13.24	-8.58	-8.3	-12.55	-15.56	-14.12	-11.77	-17.43	-13.19	-13.04	-8.72	-4.07
150	-16.76	-19.78	-12.26	-11.73	-14.37	-16.62	-14.78	-10.41	-14	-13.31	-21.11	-14.4	-6.91
165	-30.61	-24.6	-18.51	-19.05	-18.5	-16.45	-17.23	-10.51	-11.22	-10.39	-15.8	-25.94	-12.18
180	-20.67	-15.88	-17.02	-17.7	-19.86	-15.08	-21.16	-12.35	-10.96	-8.47	-9.45	-12.15	-27.28
195	-13.42	-11.21	-11.96	-12.09	-13.93	-13.32	-25.21	-15.92	-13.32	-8.01	-6.02	-6.58	-13.82
210	-9.82	-8.62	-9.01	-9.57	-10.8	-12.31	-25.78	-20.56	-17.74	-8.8	-4.21	-3.73	-7.6
225	-7.61	-6.97	-7.15	-7.86	-9.63	-12.1	-23.17	-26.25	-19.04	-10.97	-3.28	-1.98	-4.33
240	-6.42	-6.09	-6.02	-7.04	-9.65	-12.84	-20.01	-25.31	-15.31	-13.56	-3.14	-0.98	-2.5
255	-5.94	-5.67	-5.53	-6.49	-10.14	-14.67	-17.94	-21.59	-13.06	-17.36	-3.19	-0.49	-1.49
270	-5.88	-5.67	-5.45	-6.63	-10.97	-17.32	-16.69	-19.32	-11.98	-21.92	-3.52	-0.45	-1.13
285	-6.28	-6.13	-5.79	-7.19	-12.13	-20.7	-15.34	-17.4	-11.41	-26.5	-4.06	-0.85	-1.34
300	-7.28	-7.33	-6.64	-8.07	-13.6	-22.87	-14.63	-16.44	-11.53	-27.3	-4.69	-1.57	-2.06
315	-9.49	-9.6	-8.35	-9.64	-15.07	-22.48	-14.67	-16.45	-12.07	-20.53	-5.51	-2.89	-3.57
330	-13.02	-13.06	-11.07	-11.88	-16.74	-22.34	-15.46	-17.43	-13	-15.42	-6.57	-5.1	-6.14
345	-19.06	-17.61	-16.12	-14.67	-19.48	-23.14	-17.45	-18.73	-13.53	-12.56	-8.26	-7.78	-11.3
360	-18.25	-20.07	-19.62	-18.25	-23.76	-27.49	-24.83	-19.98	-11.59	-9.95	-12.59	-19.5	-24.71

**Table 139. Board #9: RP\_915.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-2.85	-2.52	-3.01	-5.15	-4.75	-3.75	-2.43	-0.95	-1.85	-0.87	0.01	0.75	0.82
15	-3.41	-2.97	-3.89	-5.53	-3.72	-3.1	-3.03	-1.53	-1.46	-0.81	-0.49	0.34	0.22
30	-4.71	-4.19	-5.78	-5.99	-3.19	-3.43	-4.9	-2.28	-1.49	-1.37	-1.83	-0.62	-1.01
45	-7	-6.62	-9.17	-6.38	-3.83	-5.81	-7.31	-3.09	-2.54	-3.07	-4.31	-2.52	-3.28
60	-10.58	-10.82	-14.78	-7.18	-6.22	-10.89	-9.22	-4.61	-5.06	-5.99	-8.47	-5.42	-7.08
75	-17.59	-20.83	-17.49	-9.38	-11.94	-31.22	-11.16	-8.43	-10.41	-12.09	-18.2	-11.34	-15.43
90	-19.03	-15.7	-10.61	-11.95	-31.53	-13.63	-12.64	-17.41	-18.02	-27.43	-16.64	-19.57	-15.68
105	-10.41	-8.54	-5.88	-10.07	-12.61	-7.47	-10.11	-14.95	-10.2	-12.3	-7.96	-10.32	-7.44
120	-6.61	-5.17	-3.36	-6.1	-7.34	-4.4	-6.68	-6.94	-5.32	-6.9	-4.32	-5.62	-3.76
135	-4.23	-3.17	-1.63	-3.35	-4.19	-2.45	-4.2	-2.82	-2	-3.77	-1.85	-2.75	-1.41
150	-3.14	-2.13	-0.95	-1.9	-2.51	-1.3	-3.3	-0.79	-0.28	-1.85	-0.51	-1.11	-0.19
165	-2.68	-1.74	-0.89	-1.54	-1.85	-0.44	-3.11	-0.12	0.41	-0.62	0.22	-0.16	0.49
180	-2.77	-1.87	-1.31	-2.19	-2.58	-0.05	-2.97	-0.77	-0.19	-0.32	0.2	0.1	0.5
195	-3.36	-2.54	-2.19	-3.52	-5.22	-0.63	-2.89	-2.16	-2.07	-1.05	-0.54	-0.33	-0.15
210	-4.53	-3.72	-3.52	-4.77	-9.56	-2.63	-3.76	-3.23	-4.54	-3.02	-2.06	-1.46	-1.54
225	-6.31	-5.73	-5.73	-6.17	-13.81	-7.2	-6.62	-4.14	-7.04	-6.67	-4.66	-3.64	-4.04
240	-9.01	-8.52	-8.99	-8.3	-15.32	-14.13	-12.04	-5.91	-9.28	-12.72	-8.86	-6.91	-8.1
255	-13.83	-13.65	-15.11	-11.85	-16.14	-28.53	-25.62	-10.01	-12.74	-30.75	-18.74	-13.85	-17.56
270	-21.16	-21.76	-28.42	-17.88	-16.14	-19.73	-18.84	-19.97	-15.59	-16.28	-18.95	-21.91	-16.63
285	-14.54	-14.69	-13.48	-19.13	-12.98	-14.52	-12.91	-15.69	-10.94	-10.02	-9.56	-9.65	-7.49
300	-9.02	-8.96	-8.08	-12.17	-9.64	-11.19	-9.92	-8.04	-6.73	-6.74	-5.64	-5.02	-3.83
315	-5.61	-5.53	-5.06	-8.22	-7.28	-9.14	-7.47	-4.14	-4.03	-4.58	-3.16	-2.3	-1.4
330	-3.88	-3.63	-3.58	-6.2	-6.26	-7.92	-5.34	-1.91	-2.79	-3.17	-1.5	-0.6	-0.05
345	-3.1	-2.66	-2.98	-5.24	-5.75	-6.33	-3.82	-0.8	-2.26	-1.98	-0.56	0.35	0.56
360	-2.85	-2.52	-3.01	-5.15	-4.75	-3.75	-2.43	-0.95	-1.85	-0.87	0.01	0.75	0.82

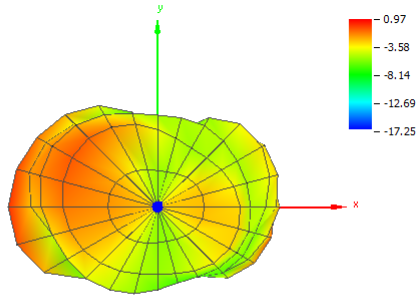


Figure 210. Board #9 (915 MHz): Theta = 0, Phi = 0

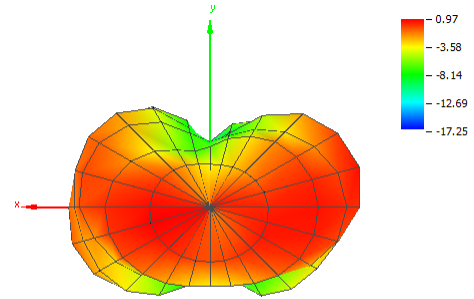


Figure 211. Board #9 (915 MHz): Theta = 180, Phi = 0

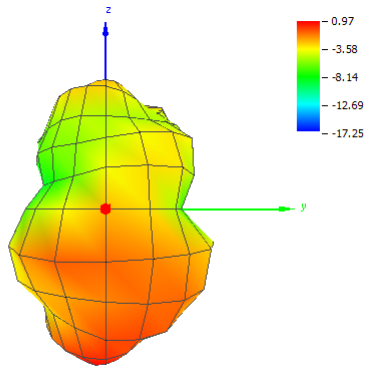


Figure 212. Board #9 (915 MHz): Theta = 90, Phi = 0

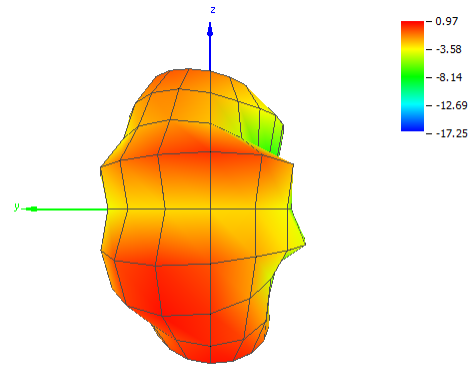


Figure 213. Board #9 (915 MHz): Theta = 90, Phi = 180

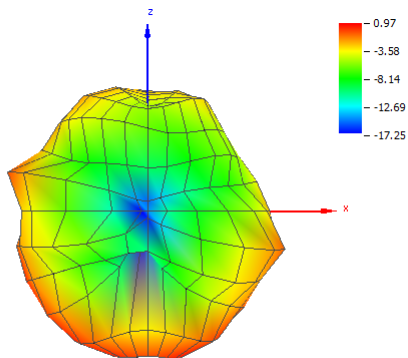


Figure 214. Board #9 (915 MHz): Theta = 90, Phi = 270

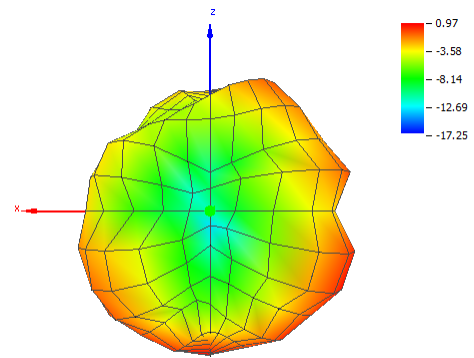


Figure 215. Board #9 (915 MHz): Theta = 90, Phi = 90

**A.9.3 2.40 GHz**
**Table 140. Board #9: OTA Evaluation Results (2.40 GHz)**

Test Description	Test Result
Total Radiated Power	-1.93 dBm
Peak EIRP	2.94 dBm
Directivity	4.88 dBi
Efficiency	-1.93 dB
Efficiency	0.6407
Peak Gain	2.94 dBi
NHPRP 45°	-3.14 dBm
NHPRP 45° / TRP	-1.21 dB
NHPRP 45° / TRP	0.7574
NHPRP 30°	-4.67 dBm
NHPRP 30° / TRP	-2.73 dB
NHPRP 30° / TRP	0.5327
NHPRP 22.5°	-5.92 dBm
NHPRP 22.5° / TRP	-3.99 dB
NHPRP 22.5° / TRP	0.3995
UHRP	-5.13 dBm
UHRP / TRP	-3.20 dB
UHRP / TRP	0.4785
LHRP	-4.76 dBm
LHRP / TRP	-2.83 dB
LHRP / TRP	0.5215
PGRP (0-120°)	-3.08 dBm
PGRP / TRP	-1.14 dB
PGRP / TRP	0.7684
Front/Back Ratio	3.01
PhiBW	53.2°
PhiBW Up	24.8°
PhiBW Down	28.4°
ThetaBW	97.8°
ThetaBW Up	19.9°
ThetaBW Down	77.9°
Boresight Phi	90°
Boresight Theta	120°
Maximum Power	2.94 dBm
Minimum Power	-13.56 dBm
Average Power	-2.60 dBm
Max/Min Ratio	16.50 dB
Max/Avg Ratio	5.55 dB
Min/Avg Ratio	-10.95 dB
Worst Single Value	-22.73 dBm
Worst Position	Azi = 30°; Elev = 135°; Pol = Horizontal
Best Single Value	2.50 dBm
Best Position	Azi = 90°; Elev = 120°; Pol = Vertical



**Table 141. Board #9: RP\_2400.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-7.53	-9.15	-5.53	-3.77	-4.66	-3.57	-2.67	-1.26	-0.99	-2.88	-3.07	-9.62	-4.38
15	-8.13	-9.1	-4.63	-2.57	-3.17	-2.05	-0.21	-0.51	-0.71	-2.54	-4.48	-10	-5.69
30	-7.8	-7.83	-2.68	-1.42	-0.39	-0.94	0.07	0.37	-0.94	-3.77	-5.63	-9.42	-5.79
45	-7.49	-6.41	-1.16	-0.64	0.38	0.63	-0.03	-0.94	-1.47	-4.54	-4.97	-7.98	-4.5
60	-7.73	-5.21	-0.63	0.31	0.5	0.6	0.34	0.34	-0.34	-0.8	-4.1	-7	-3.43
75	-8.16	-4.65	-0.79	0.64	1.17	0.85	0.93	2.29	2.28	1.35	-3.7	-6.83	-3.35
90	-8.22	-4.84	-1.71	0.34	1.12	1.62	1.55	2.55	2.94	1.82	-3.9	-6.82	-3.76
105	-8.36	-5.93	-3.42	-0.69	0.18	1.13	0.5	1.72	1.79	1.12	-4.76	-7.33	-3.91
120	-8.22	-7.72	-5.78	-2.77	-1.87	-1.07	-2.72	-0.54	-1.04	-1.08	-5.67	-8.09	-3.86
135	-8.28	-9.16	-7.61	-6.52	-5.68	-5.26	-8.37	-4.58	-4.63	-5.29	-6.84	-8.79	-3.82
150	-7.63	-7.79	-6.99	-10.94	-10.43	-10.81	-12.63	-9.4	-5.28	-9.12	-7.15	-8.85	-3.78
165	-6.51	-5.55	-5.27	-8.38	-12.11	-11.04	-10.17	-8.54	-6.4	-7.25	-6.21	-7.42	-3.48
180	-6.18	-4.22	-4.21	-5.81	-9.95	-9.92	-11.55	-8.1	-7.4	-6.86	-4.9	-6.35	-3.14
195	-6.26	-4.04	-3.83	-4.77	-8.45	-10.89	-13.56	-7.34	-4.16	-6.34	-3.6	-6.01	-2.86
210	-6.43	-4.24	-3	-3.69	-5.57	-8.35	-8.09	-4.1	-2.44	-3.79	-2.09	-5.8	-2.71
225	-6.24	-4.05	-1.58	-1.82	-2.72	-4.18	-3.16	-2.67	-2.1	-1.8	-1.2	-5.31	-2.7
240	-5.6	-3.35	-0.39	0.11	-0.86	-1.18	-1.21	-1.46	-1.11	-0.91	-0.73	-4.54	-2.76
255	-4.63	-2.66	0.21	0.88	0.01	-0.66	-0.32	0.09	-0.51	-0.92	-0.41	-3.98	-2.69
270	-4.22	-2.19	0.44	0.76	-0.06	-1.02	-0.5	0.35	-0.52	-0.86	-0.19	-3.71	-2.62
285	-3.95	-2.23	0.22	0.3	-0.62	-1.71	-1.57	-0.03	-0.7	-0.58	-0.23	-3.62	-2.38
300	-3.99	-2.76	-0.45	-0.49	-1.36	-2.62	-2.84	-0.73	-1.01	-0.5	-0.47	-3.95	-2.14
315	-4.81	-3.7	-1.35	-1.3	-2.34	-3.43	-3.98	-1.28	-1.48	-1.25	-0.85	-4.64	-2.1
330	-5.6	-5.22	-2.75	-2.3	-3.32	-4.49	-4.42	-1.81	-1.68	-2.35	-1.53	-6.01	-2.43
345	-6.55	-7.4	-3.99	-3.2	-4.15	-4.98	-4.28	-1.83	-1.81	-3.02	-2.06	-7.63	-2.84
360	-7.53	-9.15	-5.53	-3.77	-4.66	-3.57	-2.67	-1.26	-0.99	-2.88	-3.07	-9.62	-4.38

**Table 142. Board #9: RP\_2400.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-12.94	-16.32	-11.02	-16.71	-15.56	-17.27	-13.49	-10.8	-11.89	-14.29	-8.75	-12.75	-8.39
15	-10.97	-16.73	-14.04	-19.04	-16.97	-18.07	-12.87	-15.26	-17.12	-18.29	-10.04	-13.34	-7.23
30	-9.24	-16.2	-19.3	-14.15	-12.54	-14.27	-14.18	-18.55	-21.41	-22.73	-11.25	-13.65	-6.19
45	-8.25	-14.91	-22.37	-12.2	-12.19	-12.92	-16.63	-18.67	-18.95	-17.97	-10.51	-13.33	-5.65
60	-8.18	-12.59	-20.1	-12.85	-15.62	-14.52	-16.18	-14.98	-13.78	-11.97	-8.37	-12.13	-5.93
75	-8.84	-10.08	-14	-13.03	-16.78	-18.05	-14.19	-11.5	-9.93	-7.92	-6.49	-10.22	-7.67
90	-10.23	-8.48	-10.19	-10.59	-13.21	-19.22	-14.15	-9.63	-7.17	-5.21	-5.17	-8.88	-11.27
105	-13.22	-8.06	-8.23	-8.26	-10.76	-15.85	-15.66	-8.85	-5.49	-3.88	-5.02	-8.68	-15.88
120	-18.6	-8.87	-7.81	-7.52	-9.33	-14.25	-16.82	-8.53	-5.03	-4.14	-6.14	-10.01	-14.59
135	-20.32	-11.59	-8.52	-8.81	-9.3	-15.11	-17.26	-9.16	-6.25	-6.72	-10.16	-13.68	-10.01
150	-14.61	-16	-10.74	-12.69	-11.89	-16.57	-15.44	-11.21	-8.93	-12.04	-13.99	-18.06	-7.32
165	-11.02	-12.59	-11.73	-17.21	-18.7	-15.59	-15.31	-14.9	-13.58	-21.74	-8.74	-12.1	-5.11
180	-9.04	-8	-8.69	-10.33	-17.79	-17.45	-18.35	-17.27	-16.98	-14.59	-5.35	-8.21	-3.8
195	-7.79	-5.48	-5.45	-6.53	-11.94	-18.77	-21.28	-12.25	-9.24	-9.4	-3.88	-6.54	-3.14
210	-7.11	-4.49	-3.74	-5.36	-9.06	-12.84	-17.26	-11.22	-7.54	-6.79	-3.45	-6.23	-3.02
225	-7.05	-4.62	-3.66	-6.24	-8.32	-12.68	-13.75	-13.9	-9.5	-7.49	-3.94	-6.66	-3.34
240	-7.4	-5.8	-5	-9.09	-10.57	-14.21	-12.23	-14.21	-14.27	-11.46	-5.79	-7.75	-4.04
255	-8.1	-8.06	-7.95	-13.6	-16.22	-14.85	-12.69	-11.71	-14.47	-15.4	-9.69	-9.62	-5.09
270	-9.13	-11.63	-12.79	-18.44	-18.15	-14.99	-14.31	-10.97	-11.08	-11.84	-17.89	-12.83	-6.84
285	-9.97	-16.55	-18.61	-14	-13.37	-14.02	-16.07	-10.3	-8.39	-8.27	-16.71	-16.99	-9.43
300	-11.03	-20.04	-15.18	-10.52	-10.8	-12.95	-17.03	-9.46	-7.11	-6.76	-10.87	-21.69	-12.88
315	-12.66	-17.44	-11.41	-8.7	-9.25	-12.16	-15.73	-8.47	-6.63	-6.68	-9.28	-17.06	-15.53
330	-14.35	-14.92	-8.95	-7.9	-9.02	-11.51	-14.38	-7.99	-6.23	-7.73	-8.5	-14.14	-14.35
345	-15.33	-15.02	-8.77	-8.78	-10.72	-11.79	-13.92	-7.67	-6.98	-9.74	-8.22	-12.95	-11.14
360	-12.94	-16.32	-11.02	-16.71	-15.56	-17.27	-13.49	-10.8	-11.89	-14.29	-8.75	-12.75	-8.39

**Table 143. Board #9: RP\_2400.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-9.01	-10.07	-6.98	-3.99	-5.03	-3.76	-3.04	-1.77	-1.36	-3.21	-4.44	-12.5	-6.58
15	-11.31	-9.93	-5.16	-2.67	-3.36	-2.16	-0.45	-0.66	-0.81	-2.66	-5.89	-12.69	-10.93
30	-13.28	-8.51	-2.77	-1.65	-0.66	-1.15	-0.1	0.31	-0.98	-3.83	-7.02	-11.49	-16.4
45	-15.43	-7.07	-1.19	-0.95	0.13	0.44	-0.12	-1.01	-1.55	-4.74	-6.4	-9.48	-10.85
60	-17.85	-6.08	-0.68	0.1	0.4	0.46	0.24	0.21	-0.54	-1.14	-6.13	-8.59	-7
75	-16.55	-6.11	-1.01	0.44	1.1	0.79	0.79	2.11	2.01	0.81	-6.94	-9.48	-5.36
90	-12.54	-7.31	-2.38	-0.02	0.96	1.59	1.43	2.28	2.5	0.85	-9.86	-11.03	-4.61
105	-10.08	-10.05	-5.16	-1.52	-0.18	1.04	0.39	1.32	0.89	-0.53	-17.08	-13.04	-4.2
120	-8.64	-14.06	-10.07	-4.55	-2.73	-1.28	-2.89	-1.29	-3.25	-4.04	-15.57	-12.57	-4.24
135	-8.56	-12.84	-14.85	-10.41	-8.15	-5.74	-8.97	-6.44	-9.69	-10.82	-9.56	-10.5	-5.02
150	-8.6	-8.5	-9.36	-15.72	-15.88	-12.15	-15.85	-14.08	-7.73	-12.23	-8.15	-9.4	-6.32
165	-8.41	-6.51	-6.38	-8.98	-13.19	-12.92	-11.76	-9.69	-7.32	-7.41	-9.76	-9.23	-8.52
180	-9.36	-6.58	-6.13	-7.7	-10.73	-10.77	-12.57	-8.66	-7.9	-7.67	-15.01	-10.94	-11.65
195	-11.55	-9.54	-8.91	-9.53	-11.02	-11.66	-14.36	-9.03	-5.78	-9.3	-15.67	-15.38	-14.86
210	-14.82	-16.84	-11.06	-8.63	-8.16	-10.26	-8.65	-5.04	-4.04	-6.8	-7.78	-16.01	-14.22
225	-13.93	-13.14	-5.79	-3.77	-4.12	-4.84	-3.55	-3.01	-2.97	-3.17	-4.5	-11.06	-11.32
240	-10.29	-7	-2.23	-0.45	-1.36	-1.4	-1.57	-1.7	-1.32	-1.31	-2.36	-7.35	-8.68
255	-7.23	-4.14	-0.52	0.73	-0.09	-0.83	-0.58	-0.21	-0.69	-1.08	-0.95	-5.37	-6.41
270	-5.91	-2.72	0.23	0.7	-0.13	-1.2	-0.69	0.01	-0.92	-1.22	-0.26	-4.27	-4.69
285	-5.2	-2.39	0.16	0.13	-0.86	-1.97	-1.73	-0.46	-1.51	-1.39	-0.33	-3.83	-3.34
300	-4.94	-2.84	-0.59	-0.95	-1.89	-3.04	-3.01	-1.35	-2.23	-1.68	-0.88	-4.02	-2.53
315	-5.59	-3.89	-1.8	-2.17	-3.32	-4.05	-4.28	-2.2	-3.07	-2.72	-1.53	-4.89	-2.31
330	-6.22	-5.72	-3.95	-3.7	-4.68	-5.45	-4.88	-3.01	-3.55	-3.83	-2.5	-6.74	-2.72
345	-7.17	-8.23	-5.74	-4.61	-5.23	-5.99	-4.78	-3.14	-3.39	-4.06	-3.27	-9.14	-3.54
360	-9.01	-10.07	-6.98	-3.99	-5.03	-3.76	-3.04	-1.77	-1.36	-3.21	-4.44	-12.5	-6.58

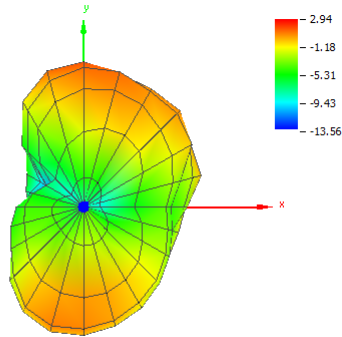


Figure 216. Board #9 (2.40 GHz): Theta = 0, Phi = 0

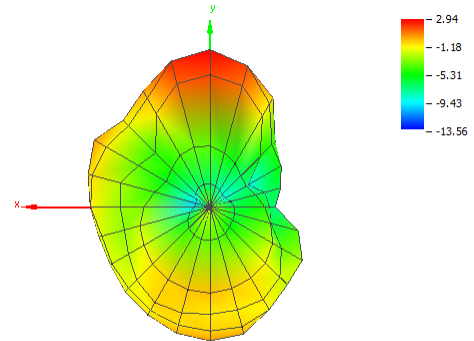


Figure 217. Board #9 (2.40 GHz): Theta = 180, Phi = 0

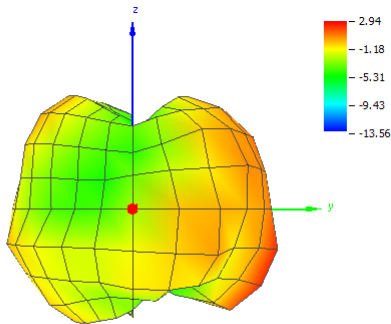


Figure 218. Board #9 (2.40 GHz): Theta = 90, Phi = 0

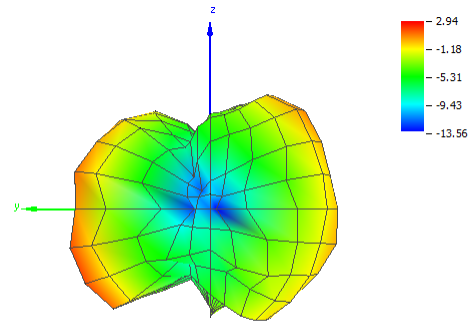


Figure 219. Board #9 (2.40 GHz): Theta = 90, Phi = 180

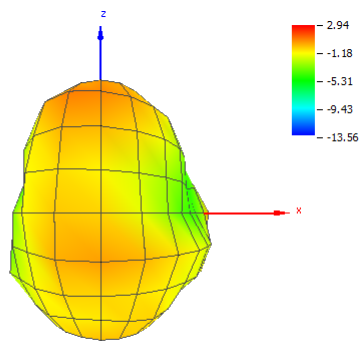


Figure 220. Board #9 (2.40 GHz): Theta = 90, Phi = 270

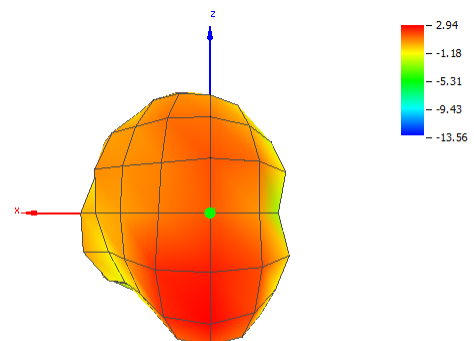


Figure 221. Board #9 (2.40 GHz): Theta = 90, Phi = 90

**A.9.4 2.44 GHz**
**Table 144. Board #9: OTA Evaluation Results (2.44 GHz)**

Test Description	Test Result
Total Radiated Power	-1.77 dBm
Peak EIRP	2.73 dBm
Directivity	4.50 dBi
Efficiency	-1.77 dB
Efficiency	0.6649
Peak Gain	2.73 dBi
NHPRP 45°	-2.96 dBm
NHPRP 45° / TRP	-1.19 dB
NHPRP 45° / TRP	0.7612
NHPRP 30°	-4.48 dBm
NHPRP 30° / TRP	-2.71 dB
NHPRP 30° / TRP	0.5357
NHPRP 22.5°	-5.71 dBm
NHPRP 22.5° / TRP	-3.94 dB
NHPRP 22.5° / TRP	0.4036
UHRP	-4.74 dBm
UHRP / TRP	-2.97 dB
UHRP / TRP	0.5044
LHRP	-4.82 dBm
LHRP / TRP	-3.05 dB
LHRP / TRP	0.4956
PGRP (0-120°)	-2.92 dBm
PGRP / TRP	-1.15 dB
PGRP / TRP	0.7675
Front/Back Ratio	2.48
PhiBW	52.9°
PhiBW Up	26.7°
PhiBW Down	26.2°
ThetaBW	103.7°
ThetaBW Up	22.2°
ThetaBW Down	81.5°
Boresight Phi	90°
Boresight Theta	120°
Maximum Power	2.73 dBm
Minimum Power	-12.25 dBm
Average Power	-2.28 dBm
Max/Min Ratio	14.98 dB
Max/Avg Ratio	5.01 dB
Min/Avg Ratio	-9.97 dB
Worst Single Value	-22.09 dBm
Worst Position	Azi = 165°; Elev = 135°; Pol = Horizontal
Best Single Value	2.32 dBm
Best Position	Azi = 75°; Elev = 60°; Pol = Vertical

**Table 145. Board #9: RP\_2440.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-4.67	-2.83	-3.77	-5.45	-6.19	-4.87	-3.66	-4.6	-0.93	-2.76	-2.97	-6.26	-4.62
15	-4.47	-3.31	-3.57	-4.11	-3.63	-2.2	-0.73	-2.75	-0.18	-1.78	-3.56	-6.19	-4.04
30	-4.27	-3.98	-2.26	-1.73	0.21	-0.54	0.94	-0.14	-0.13	-2.1	-4.75	-5.74	-2.75
45	-4.5	-4.87	-0.73	-0.89	2.09	1	0.79	-0.43	-0.93	-3.77	-4.25	-5.19	-1.55
60	-4.96	-5.41	-0.35	0.63	2.12	1.71	1.34	0.45	-0.92	-0.61	-3.43	-4.84	-1.08
75	-5.15	-5.66	-0.81	1.44	2.43	1.49	1.52	2.33	1.64	1.85	-3.05	-4.65	-1.13
90	-5.32	-6.02	-1.82	0.91	2.32	2.18	1.93	2.41	2.73	2.44	-3.2	-4.09	-1.06
105	-5.21	-6.4	-3.37	-0.37	1.26	1.87	0.86	1.42	1.89	1.78	-3.53	-3.81	-1.11
120	-4.84	-6.58	-4.74	-2.49	-1.3	-0.12	-2.32	-1.19	-0.87	-0.53	-4.36	-3.68	-1.16
135	-4.4	-6.52	-5.69	-5.82	-5.94	-4.43	-8.27	-6.17	-4.52	-4.96	-4.95	-4.32	-1.38
150	-3.85	-5.98	-5.42	-10.02	-12.14	-11.31	-11.28	-12.25	-5.22	-10.58	-5.29	-4.45	-1.46
165	-3.98	-5.55	-4.95	-8.99	-10.83	-10.55	-7.47	-9.04	-6.56	-8.05	-4.82	-4.38	-1.15
180	-4.46	-5.39	-4.95	-7.2	-7.6	-8.11	-8.26	-10.02	-8.05	-6.75	-4.55	-5.16	-1.13
195	-4.98	-5.49	-4.89	-6.03	-6.79	-9.7	-11.25	-7.95	-4.34	-5.75	-3.46	-6.17	-1.37
210	-5.23	-5.48	-4.1	-4.54	-3.87	-7.12	-6.75	-6.22	-2.5	-3.28	-1.72	-6.64	-1.73
225	-5.17	-5.02	-2.7	-2.28	-1.72	-2.28	-2.84	-4.77	-2.98	-1.43	-0.98	-6.07	-2.01
240	-4.84	-4.01	-1.6	-0.2	-0.1	0.11	-0.69	-2.6	-1.94	-0.73	-0.83	-5.12	-2.2
255	-4.46	-3.1	-0.89	0.65	0.63	0.34	0.5	-0.35	-1.24	-1.16	-0.67	-4.34	-2.05
270	-3.93	-2.54	-0.77	0.69	0.25	0.32	0.28	0.21	-0.91	-1.11	-0.61	-3.97	-1.71
285	-3.84	-2.4	-1.13	0.46	-0.71	-0.25	-0.71	-0.26	-1.04	-0.79	-0.88	-4	-1.44
300	-4.12	-2.89	-1.95	-0.14	-2.03	-1.5	-2.34	-1.22	-1.36	-0.75	-1.5	-4.35	-1.53
315	-4.95	-3.48	-2.77	-1.11	-3.55	-2.83	-4.17	-2.2	-1.44	-1.16	-1.91	-4.95	-2.03
330	-5.54	-3.42	-3.3	-2.36	-5.56	-3.95	-5.48	-3.4	-1.48	-2.49	-2.38	-5.49	-2.96
345	-5.18	-3.07	-3.38	-3.76	-7.3	-5.24	-6.01	-4.21	-1.43	-3.65	-2.47	-6.29	-3.67
360	-4.67	-2.83	-3.77	-5.45	-6.19	-4.87	-3.66	-4.6	-0.93	-2.76	-2.97	-6.26	-4.62

**Table 146. Board #9: RP\_2440.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-6.52	-6.1	-8.04	-12.59	-21.72	-17.15	-15.69	-16.39	-14.74	-14.66	-8.67	-7.96	-5.52
15	-5.21	-6.63	-10.39	-18.13	-16.24	-19.71	-15.74	-21.87	-21.64	-16.53	-9.18	-8.17	-4.51
30	-4.61	-7.45	-13.57	-13.24	-10.02	-15.12	-16.66	-19.44	-20.01	-21.76	-9.94	-9.02	-3.87
45	-4.98	-8.16	-12.23	-10.65	-9.07	-13.33	-18.22	-18.33	-19.4	-17.71	-9.21	-9.53	-3.85
60	-6.1	-8.33	-10.09	-10.34	-11.14	-15.04	-15.37	-16.41	-13.35	-10.81	-7.55	-9.64	-4.76
75	-7.64	-7.71	-8.66	-10.47	-13.5	-17.63	-14.56	-12.65	-9.41	-6.85	-5.67	-8.81	-6.78
90	-9.75	-7.02	-7.39	-9.44	-12.54	-15.01	-17.07	-10.79	-6.48	-4.45	-4.29	-7.31	-9.14
105	-11.31	-6.81	-6.18	-7.91	-9.8	-12.34	-20.25	-9.89	-4.93	-3.45	-3.79	-6.69	-11.48
120	-11.44	-7.34	-5.46	-6.9	-8.4	-10.93	-21.88	-10.45	-4.62	-4.12	-5.24	-7.12	-11.36
135	-10.24	-9.04	-6.2	-7.52	-9.04	-11.49	-21.3	-11.73	-5.89	-6.57	-9.64	-9.64	-9.2
150	-8.72	-11.1	-8.21	-12.04	-13.4	-14.05	-19.52	-13.45	-8.54	-12.47	-21.68	-13.79	-6.28
165	-7.59	-11.41	-10.34	-19.18	-21.97	-16.79	-16.19	-15.94	-12.98	-22.09	-9.6	-12.27	-4.1
180	-6.65	-8.89	-9.76	-10.22	-12.89	-18.23	-14.64	-11.91	-16.63	-11.92	-5.62	-9.58	-2.88
195	-6.18	-6.78	-7.29	-6.81	-9.92	-21.61	-16.35	-8.44	-7.55	-7.3	-3.62	-8.22	-2.24
210	-6.07	-5.96	-5.97	-6.47	-8.15	-15.22	-18.44	-9.89	-5.88	-5.16	-2.69	-7.4	-2.08
225	-6.22	-6.39	-6.22	-8.53	-8.21	-14.19	-19.01	-18.41	-8.5	-6.13	-3.31	-7.58	-2.31
240	-6.58	-7.85	-8.44	-13.71	-11.71	-16.13	-14.8	-17.05	-14.39	-10.45	-5.32	-8.45	-3.1
255	-7.23	-10.39	-11.98	-19.32	-16.62	-13.73	-12.52	-12.68	-17.42	-16.04	-8.79	-10.28	-4.14
270	-8.22	-14.09	-14.34	-13.45	-14.09	-10.2	-12.01	-10.64	-12.09	-12.68	-15.02	-13.57	-5.69
285	-10.1	-20.05	-11.59	-10.03	-11.13	-8.24	-11.68	-9.88	-9.14	-9.31	-21.23	-19.05	-8.2
300	-13.63	-15.37	-9.15	-8.24	-9.22	-7.6	-11.8	-9.55	-7.61	-7.5	-15.33	-20.32	-12.63
315	-20.18	-11.44	-7.73	-7.47	-8.61	-7.62	-11.96	-8.83	-6.59	-7.37	-11.03	-13.71	-16.32
330	-16.64	-8.34	-6.71	-7	-9.06	-8.54	-12.21	-9.11	-6.57	-8.87	-9.68	-9.97	-11.95
345	-10.71	-6.8	-6.15	-7.36	-11.19	-9.66	-13.77	-9.45	-7.45	-10.94	-8.52	-8.93	-8.41
360	-6.52	-6.1	-8.04	-12.59	-21.72	-17.15	-15.69	-16.39	-14.74	-14.66	-8.67	-7.96	-5.52

**Table 147. Board #9: RP\_2440.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-9.27	-5.61	-5.81	-6.39	-6.31	-5.13	-3.94	-4.9	-1.11	-3.05	-4.33	-11.16	-11.89
15	-12.53	-6.04	-4.58	-4.29	-3.88	-2.28	-0.87	-2.8	-0.21	-1.93	-4.95	-10.55	-13.91
30	-15.5	-6.58	-2.59	-2.04	-0.22	-0.69	0.86	-0.2	-0.17	-2.15	-6.32	-8.49	-9.17
45	-14.36	-7.62	-1.05	-1.37	1.75	0.84	0.74	-0.5	-1	-3.95	-5.92	-7.18	-5.4
60	-11.33	-8.51	-0.84	0.27	1.91	1.62	1.24	0.36	-1.18	-1.05	-5.55	-6.59	-3.51
75	-8.76	-9.91	-1.59	1.15	2.32	1.44	1.41	2.19	1.28	1.22	-6.49	-6.75	-2.52
90	-7.26	-12.86	-3.23	0.49	2.17	2.09	1.87	2.2	2.17	1.45	-9.74	-6.9	-1.79
105	-6.44	-16.81	-6.6	-1.21	0.9	1.7	0.83	1.09	0.88	0.23	-15.8	-6.95	-1.52
120	-5.91	-14.51	-12.92	-4.45	-2.24	-0.49	-2.37	-1.74	-3.25	-3.03	-11.7	-6.3	-1.6
135	-5.71	-10.08	-15.23	-10.73	-8.85	-5.38	-8.49	-7.58	-10.18	-10.04	-6.75	-5.84	-2.17
150	-5.57	-7.58	-8.66	-14.32	-18.15	-14.61	-11.99	-18.41	-7.95	-15.11	-5.39	-4.99	-3.19
165	-6.47	-6.85	-6.44	-9.43	-11.18	-11.73	-8.1	-10.03	-7.69	-8.23	-6.57	-5.15	-4.23
180	-8.49	-7.97	-6.69	-10.2	-9.13	-8.55	-9.4	-14.53	-8.69	-8.32	-11.16	-7.1	-5.93
195	-11.14	-11.39	-8.62	-13.85	-9.69	-9.99	-12.85	-17.69	-7.15	-10.96	-18.07	-10.42	-8.81
210	-12.76	-15.31	-8.65	-8.97	-5.9	-7.85	-7.06	-8.66	-5.17	-7.82	-8.7	-14.62	-12.81
225	-11.82	-10.7	-5.25	-3.45	-2.82	-2.57	-2.95	-4.97	-4.41	-3.23	-4.81	-11.38	-13.81
240	-9.65	-6.32	-2.6	-0.39	-0.41	0.01	-0.86	-2.76	-2.2	-1.22	-2.74	-7.83	-9.45
255	-7.74	-4	-1.24	0.61	0.55	0.17	0.28	-0.62	-1.34	-1.3	-1.39	-5.62	-6.24
270	-5.95	-2.85	-0.96	0.52	0.09	-0.08	0.01	-0.16	-1.26	-1.43	-0.77	-4.47	-3.92
285	-5.01	-2.48	-1.54	0.05	-1.13	-1	-1.08	-0.76	-1.78	-1.45	-0.92	-4.14	-2.47
300	-4.64	-3.14	-2.87	-0.87	-2.96	-2.72	-2.86	-1.91	-2.54	-1.79	-1.69	-4.46	-1.88
315	-5.09	-4.24	-4.43	-2.25	-5.18	-4.58	-4.96	-3.27	-3.02	-2.35	-2.47	-5.57	-2.2
330	-5.9	-5.1	-5.95	-4.18	-8.13	-5.8	-6.52	-4.76	-3.09	-3.63	-3.28	-7.41	-3.55
345	-6.6	-5.46	-6.64	-6.25	-9.57	-7.19	-6.81	-5.75	-2.68	-4.55	-3.71	-9.71	-5.44
360	-9.27	-5.61	-5.81	-6.39	-6.31	-5.13	-3.94	-4.9	-1.11	-3.05	-4.33	-11.16	-11.89



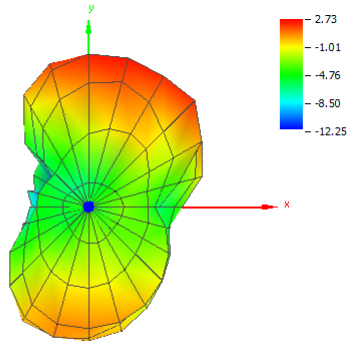


Figure 222. Board #9 (2.44 GHz): Theta = 0, Phi = 0

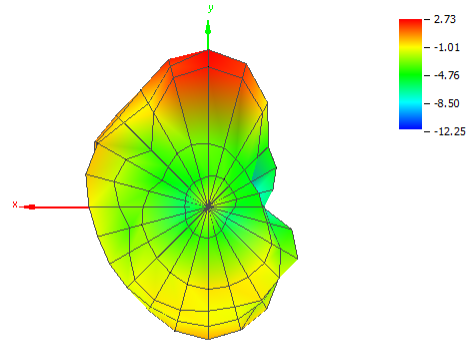


Figure 223. Board #9 (2.44 GHz): Theta = 180, Phi = 0

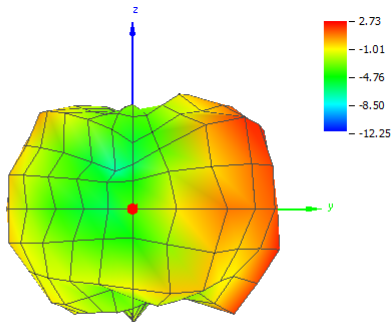


Figure 224. Board #9 (2.44 GHz): Theta = 90, Phi = 0

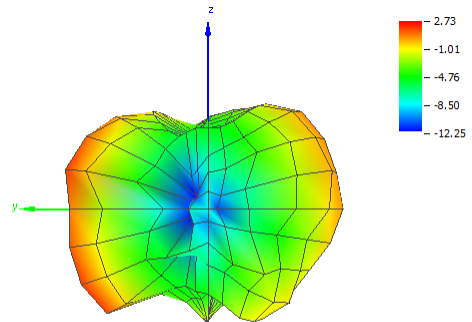


Figure 225. Board #9 (2.44 GHz): Theta = 90, Phi = 180

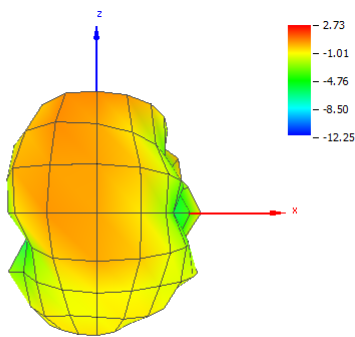


Figure 226. Board #9 (2.44 GHz): Theta = 90, Phi = 270

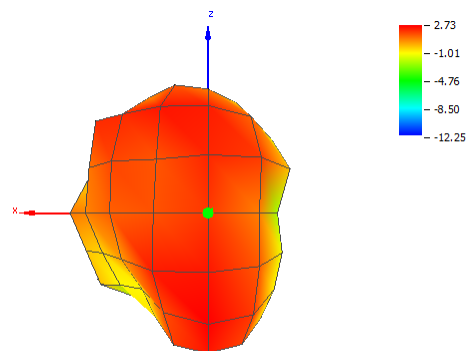


Figure 227. Board #9 (2.44 GHz): Theta = 90, Phi = 90

**A.9.5 2.48 GHz**
**Table 148. Board #9: OTA Evaluation Results (2.48 GHz)**

Test Description	Test Result
Total Radiated Power	-1.47 dBm
Peak EIRP	4.00 dBm
Directivity	5.47 dBi
Efficiency	-1.47 dB
Efficiency	0.7134
Peak Gain	4.00 dBi
NHPRP 45°	-2.55 dBm
NHPRP 45° / TRP	-1.09 dB
NHPRP 45° / TRP	0.7785
NHPRP 30°	-3.93 dBm
NHPRP 30° / TRP	-2.46 dB
NHPRP 30° / TRP	0.5669
NHPRP 22.5°	-5.11 dBm
NHPRP 22.5° / TRP	-3.64 dB
NHPRP 22.5° / TRP	0.4325
UHRP	-4.96 dBm
UHRP / TRP	-3.49 dB
UHRP / TRP	0.4479
LHRP	-4.05 dBm
LHRP / TRP	-2.58 dB
LHRP / TRP	0.5521
PGRP (0-120°)	-2.68 dBm
PGRP / TRP	-1.21 dB
PGRP / TRP	0.7563
Front/Back Ratio	6.62
PhiBW	89.6°
PhiBW Up	22.7°
PhiBW Down	66.9°
ThetaBW	81.8°
ThetaBW Up	19.5°
ThetaBW Down	62.3°
Boresight Phi	90°
Boresight Theta	120°
Maximum Power	4.00 dBm
Minimum Power	-13.95 dBm
Average Power	-2.01 dBm
Max/Min Ratio	17.95 dB
Max/Avg Ratio	6.01 dB
Min/Avg Ratio	-11.94 dB
Worst Single Value	-21.77 dBm
Worst Position	Azi = 75°; Elev = 75°; Pol = Horizontal
Best Single Value	3.67 dBm
Best Position	Azi = 90°; Elev = 120°; Pol = Vertical

**Table 149. Board #9: RP\_2480.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-2.07	-2.99	-2.63	-2.76	-2.08	-1.97	-0.94	-1.2	-1.56	-1.83	-2.26	-6.39	-3.97
15	-2.34	-3.7	-2.69	-2.23	-0.89	0.28	1.52	0.74	0.63	0.13	-2.29	-6.75	-3.6
30	-2.62	-4.54	-2.89	-0.91	0.63	1.39	2.62	2.75	1.31	0.2	-3.67	-6.87	-2.97
45	-2.66	-4.68	-2.55	-0.74	1.64	2.06	1.69	1.9	1.07	-1.85	-4.02	-6.34	-2.41
60	-2.1	-4.45	-2.07	-0.7	0.88	2.2	1.78	1.05	1.03	-0.18	-2.88	-4.65	-1.81
75	-1.73	-4.21	-2.19	-0.34	0.97	1.44	1.93	2.96	3.06	1.95	-2.33	-2.9	-1.13
90	-1.67	-3.92	-2.89	-0.75	1.31	1.86	2.43	3.55	4	2.43	-2.32	-1.97	-0.82
105	-1.93	-3.98	-3.71	-2.17	0.48	1.66	1.85	2.71	2.87	1.4	-2.91	-2.16	-1.12
120	-2.51	-4.6	-5.12	-4.94	-2.52	-0.72	-1.28	-0.25	-0.78	-1.57	-4.29	-3.18	-1.55
135	-2.82	-5.24	-5.48	-7.86	-8.25	-5.49	-6.54	-6.5	-5.94	-6.89	-5.38	-4.45	-2.13
150	-3.77	-5.62	-5.14	-5.93	-10.64	-13.95	-10.81	-11.47	-7.15	-9.05	-5.21	-4.92	-2.28
165	-4.71	-5.8	-4.83	-3.54	-6.6	-10.65	-7.53	-5.02	-7.67	-5	-4.75	-4.81	-2.14
180	-5.16	-5.91	-5.35	-3.08	-4.87	-7.99	-8	-5.34	-5.84	-4	-4.39	-5.25	-2.28
195	-5.22	-6.03	-5.65	-4.22	-6.13	-9.01	-8.7	-4.51	-2	-3.22	-2.96	-5.7	-2.38
210	-5.36	-6.1	-3.84	-6.18	-4.88	-6.98	-3.85	-2.83	-0.65	-1.32	-1.24	-6.25	-2.8
225	-5.54	-6.02	-2.21	-4.77	-2.6	-2.26	-0.86	-2.52	-0.45	0.09	-0.6	-6.98	-3.13
240	-5.62	-5.79	-1.35	-2.23	-1.28	0	0.54	-0.61	0.72	0.39	-0.27	-7.19	-3.17
255	-5.75	-5.17	-1.44	-1.7	-1.27	-0.3	1.11	0.83	0.87	-0.04	0.08	-6.99	-3.07
270	-5.82	-4	-1.44	-1.76	-2.62	-1.31	0.32	0.26	0.67	-0.37	-0.06	-6.72	-2.56
285	-5.18	-2.75	-1.62	-1.98	-4.28	-2.1	-1.33	-1.26	0.1	-1.12	-0.73	-6.39	-2.38
300	-4.1	-1.72	-1.6	-2.32	-5.55	-3.35	-3.31	-3.65	-1.34	-2.25	-1.57	-6.06	-2.63
315	-2.93	-1.43	-1.71	-2.45	-5.98	-4.76	-5.04	-6.35	-2.48	-3.8	-2.23	-6.12	-3.02
330	-2.36	-1.44	-2.08	-2.61	-5.71	-5.48	-5.69	-8.16	-3.76	-5.84	-2.73	-5.92	-3.73
345	-1.93	-1.74	-2	-2.89	-4.85	-4.53	-4.48	-6.64	-4.41	-6.12	-2.69	-6.19	-3.88
360	-2.07	-2.99	-2.63	-2.76	-2.08	-1.97	-0.94	-1.2	-1.56	-1.83	-2.26	-6.39	-3.97

**Table 150. Board #9: RP\_2480.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-3.18	-4.89	-6.9	-8.2	-13.42	-20.8	-17.97	-16.13	-19.89	-20.52	-11.56	-7.1	-4.31
15	-2.98	-5.67	-8.34	-12.86	-13.71	-18.97	-15.97	-14.28	-18.56	-18.16	-12.16	-8.02	-3.81
30	-3.56	-6.84	-11.62	-18.23	-13.79	-16.14	-15.54	-12.91	-15.84	-15.94	-12.6	-9.46	-3.75
45	-4.62	-7.62	-13.31	-17.16	-12.56	-14.99	-18.53	-13.4	-15.13	-14.84	-10.73	-10.86	-4.33
60	-5.82	-7.33	-11.53	-13.96	-13.52	-18.16	-19.21	-15.05	-11.93	-11.29	-8.07	-10.27	-5.71
75	-6.81	-6.54	-8.94	-11.62	-14.6	-21.77	-18.28	-13.81	-9.89	-8.05	-5.87	-8.05	-7.51
90	-7.76	-5.8	-6.86	-9.2	-12.79	-17.22	-17.41	-12.1	-7.39	-5.68	-4.04	-6.02	-9.29
105	-8.77	-5.65	-5.72	-7.79	-10.74	-14.82	-16.8	-11.2	-5.86	-4.78	-3.46	-5.11	-11.41
120	-10.08	-6.62	-5.67	-7.17	-9.8	-13.84	-15.96	-11.43	-5.73	-5.24	-4.8	-5.75	-12.98
135	-10.31	-8.32	-6.42	-8.3	-10.75	-15.45	-15.61	-12.81	-7.17	-8.2	-9.49	-8.31	-12.14
150	-10.68	-11.9	-8.96	-12.29	-16.01	-17.83	-15.68	-18.48	-10.97	-16.12	-20.41	-14.21	-8.36
165	-10.37	-14.4	-12.22	-19.76	-17.49	-18.63	-19.95	-19.8	-17.58	-15.87	-9.93	-21.38	-6.09
180	-9.23	-10.46	-10.35	-10.63	-12.4	-17.19	-18.76	-10.54	-12.26	-8.13	-5.41	-13.55	-4.53
195	-8.14	-7.72	-6.7	-7.31	-10.75	-12.88	-15.29	-6.26	-5.22	-4.93	-3.21	-10.08	-3.65
210	-7.44	-6.45	-4.96	-6.96	-9.08	-11.87	-13.14	-6.48	-4.01	-3.37	-2.31	-8.8	-3.37
225	-7.24	-6.8	-5.12	-9.17	-9.25	-13.32	-13.1	-11.2	-6.22	-4.35	-2.83	-9.26	-3.56
240	-7.66	-8.68	-6.99	-13.87	-13.81	-16.68	-17.59	-21.31	-11.9	-9.3	-5.17	-11.3	-4.3
255	-8.95	-12.9	-10.98	-20.15	-21.65	-21.09	-20.41	-17.7	-21.51	-19.74	-8.96	-14.39	-5.78
270	-11.78	-20.38	-16.38	-16.07	-17.54	-14.59	-18.33	-13.97	-14.63	-14.53	-16.74	-19.39	-8.19
285	-16.17	-15.38	-15.35	-11.91	-15.05	-11.54	-17.18	-13.69	-10.86	-10.79	-18.28	-19.84	-11.97
300	-17.44	-9.92	-9.87	-9.09	-13.29	-10.55	-16.2	-14.16	-9.02	-9.19	-12.79	-13.97	-19.35
315	-12.27	-7.58	-7.35	-7.49	-11.99	-10.44	-16.62	-15.21	-8.35	-8.96	-10.85	-10.27	-14.46
330	-7.74	-5.91	-6.4	-6.24	-10.36	-11.69	-18.78	-16.14	-8.79	-11.47	-9.66	-7.53	-8.93
345	-5.03	-5.07	-5.78	-5.79	-10.28	-13.07	-21.1	-16.6	-10.62	-15.85	-9.51	-6.81	-6.37
360	-3.18	-4.89	-6.9	-8.2	-13.42	-20.8	-17.97	-16.13	-19.89	-20.52	-11.56	-7.1	-4.31

**Table 151. Board #9: RP\_2480.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-8.52	-7.5	-4.66	-4.23	-2.41	-2.02	-1.03	-1.34	-1.62	-1.89	-2.8	-14.64	-15.21
15	-10.95	-8.08	-4.07	-2.62	-1.13	0.22	1.44	0.6	0.58	0.07	-2.76	-12.74	-16.97
30	-9.71	-8.4	-3.52	-0.99	0.47	1.31	2.55	2.63	1.23	0.09	-4.26	-10.34	-10.82
45	-7.06	-7.77	-2.93	-0.84	1.48	1.97	1.65	1.77	0.97	-2.07	-5.06	-8.23	-6.9
60	-4.49	-7.61	-2.59	-0.91	0.72	2.16	1.74	0.95	0.81	-0.53	-4.44	-6.04	-4.08
75	-3.35	-8.03	-3.22	-0.68	0.84	1.42	1.89	2.87	2.83	1.5	-4.86	-4.49	-2.27
90	-2.89	-8.45	-5.12	-1.42	1.14	1.8	2.38	3.43	3.67	1.7	-7.18	-4.14	-1.49
105	-2.93	-8.95	-8.02	-3.56	0.13	1.56	1.79	2.53	2.24	0.2	-12.2	-5.22	-1.55
120	-3.35	-8.9	-14.39	-8.9	-3.42	-0.94	-1.43	-0.6	-2.46	-4.01	-13.83	-6.68	-1.87
135	-3.67	-8.19	-12.58	-18.03	-11.85	-5.95	-7.12	-7.66	-12.04	-12.73	-7.52	-6.74	-2.59
150	-4.76	-6.79	-7.47	-7.07	-12.14	-16.23	-12.53	-12.44	-9.48	-9.99	-5.34	-5.46	-3.51
165	-6.08	-6.45	-5.7	-3.65	-6.97	-11.4	-7.79	-5.16	-8.13	-5.37	-6.32	-4.91	-4.38
180	-7.32	-7.78	-7.01	-3.92	-5.72	-8.55	-8.38	-6.91	-6.97	-6.12	-11.18	-5.94	-6.2
195	-8.33	-10.94	-12.31	-7.16	-7.97	-11.3	-9.78	-9.31	-4.81	-8.1	-15.6	-7.67	-8.35
210	-9.55	-17.18	-10.27	-14.03	-6.95	-8.69	-4.39	-5.28	-3.34	-5.55	-7.87	-9.78	-11.92
225	-10.46	-13.89	-5.33	-6.73	-3.66	-2.61	-1.13	-3.16	-1.79	-1.85	-4.57	-10.87	-13.37
240	-9.89	-8.91	-2.73	-2.54	-1.53	-0.1	0.47	-0.65	0.48	-0.11	-1.97	-9.33	-9.59
255	-8.59	-5.97	-1.96	-1.76	-1.31	-0.34	1.08	0.76	0.84	-0.08	-0.5	-7.86	-6.41
270	-7.09	-4.1	-1.58	-1.92	-2.76	-1.52	0.26	0.1	0.54	-0.54	-0.15	-6.96	-3.95
285	-5.54	-3	-1.81	-2.45	-4.66	-2.62	-1.45	-1.51	-0.26	-1.62	-0.8	-6.59	-2.89
300	-4.3	-2.43	-2.3	-3.34	-6.35	-4.26	-3.54	-4.05	-2.16	-3.24	-1.91	-6.83	-2.72
315	-3.46	-2.64	-3.09	-4.09	-7.23	-6.13	-5.35	-6.96	-3.78	-5.38	-2.88	-8.23	-3.34
330	-3.84	-3.35	-4.08	-5.08	-7.53	-6.67	-5.91	-8.92	-5.4	-7.23	-3.71	-11.01	-5.3
345	-4.85	-4.45	-4.36	-6.02	-6.32	-5.18	-4.57	-7.11	-5.6	-6.6	-3.7	-14.97	-7.49
360	-8.52	-7.5	-4.66	-4.23	-2.41	-2.02	-1.03	-1.34	-1.62	-1.89	-2.8	-14.64	-15.21

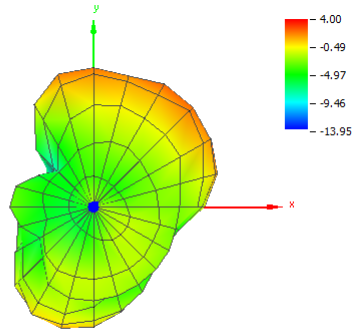


Figure 228. Board #9 (2.48 GHz): Theta = 0, Phi = 0

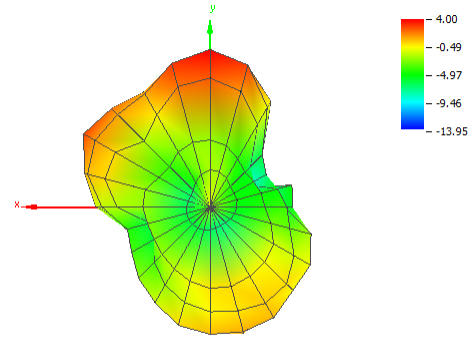


Figure 229. Board #9 (2.48 GHz): Theta = 180, Phi = 0

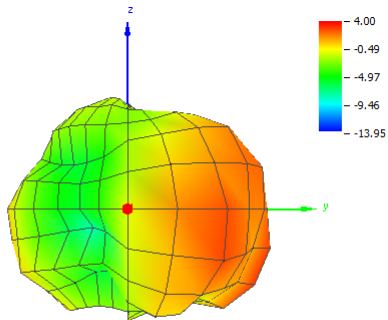


Figure 230. Board #9 (2.48 GHz): Theta = 90, Phi = 0

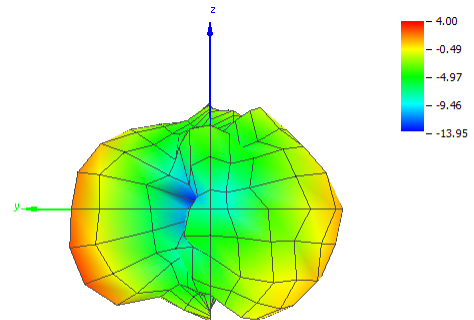


Figure 231. Board #9 (2.48 GHz): Theta = 90, Phi = 180

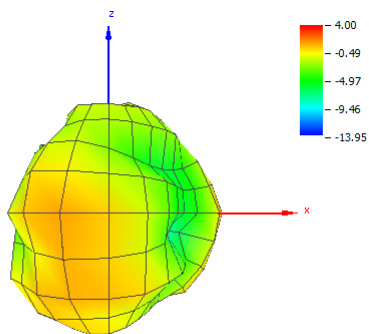


Figure 232. Board #9 (2.48 GHz): Theta = 90, Phi = 270

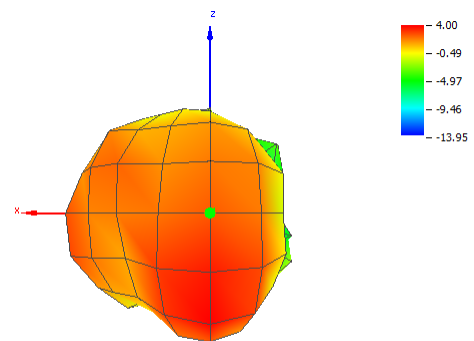


Figure 233. Board #9 (2.48 GHz): Theta = 90, Phi = 90

**A.10 Board #10: Dual-Band 433 MHz/868 MHz PCB Antenna**
**A.10.1 433 MHz**
**Table 152. Board #10: OTA Evaluation Results (433 MHz)**

Test Description	Test Result
Total Radiated Power	-5.89 dBm
Peak EIRP	-0.68 dBm
Directivity	5.21 dBi
Efficiency	-5.89 dB
Efficiency	0.2576
Peak Gain	-0.68 dBi
NHPRP 45°	-7.58 dBm
NHPRP 45° / TRP	-1.69 dB
NHPRP 45° / TRP	0.6776
NHPRP 30°	-9.22 dBm
NHPRP 30° / TRP	-3.33 dB
NHPRP 30° / TRP	0.4642
NHPRP 22.5°	-10.46 dBm
NHPRP 22.5° / TRP	-4.57 dB
NHPRP 22.5° / TRP	0.349
UHRP	-9.20 dBm
UHRP / TRP	-3.30 dB
UHRP / TRP	0.4672
LHRP	-8.63 dBm
LHRP / TRP	-2.73 dB
LHRP / TRP	0.5328
PGRP (0-120°)	-7.43 dBm
PGRP / TRP	-1.54 dB
PGRP / TRP	0.7012
Front/Back Ratio	8.7
PhiBW	112.0°
PhiBW Up	50.4°
PhiBW Down	61.6°
ThetaBW	76.9°
ThetaBW Up	45.0°
ThetaBW Down	31.9°
Boresight Phi	165°
Boresight Theta	135°
Maximum Power	-0.68 dBm
Minimum Power	-17.14 dBm
Average Power	-5.73 dBm
Max/Min Ratio	16.46 dB
Max/Avg Ratio	5.06 dB
Min/Avg Ratio	-11.41 dB
Worst Single Value	-37.39 dBm
Worst Position	Azi = 315°; Elev = 120°; Pol = Horizontal
Best Single Value	-0.97 dBm
Best Position	Azi = 150°; Elev = 135°; Pol = Vertical

**Table 153. Board #10: RP\_433.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-7.17	-5.56	-8.1	-10.98	-10.1	-5.94	-4.21	-5.02	-8.42	-8.51	-5.62	-4.86	-4.88
15	-9.36	-6.36	-8.3	-10.62	-6.99	-4.84	-2.95	-4.4	-8.38	-8.81	-5.32	-4.34	-4.42
30	-11.16	-7.3	-7.63	-8.21	-4.82	-3.16	-2.23	-4.11	-9.1	-9.26	-5.42	-4.08	-4.16
45	-10.64	-7.59	-6.74	-6.03	-3.56	-2.27	-2.19	-4.57	-10.9	-10.3	-5.73	-4.01	-4.06
60	-9.11	-7.3	-6	-4.61	-3.08	-2.14	-2.94	-5.89	-12.62	-10.59	-5.87	-3.82	-3.9
75	-7.75	-6.79	-5.48	-3.97	-3.41	-2.93	-4.75	-7.93	-10.46	-8.43	-5.31	-3.4	-3.53
90	-6.96	-6.26	-5.19	-3.99	-4.7	-4.84	-7.8	-8.99	-6.7	-5.64	-4.15	-2.84	-3.11
105	-6.75	-5.83	-5.09	-4.59	-6.67	-8.55	-11.71	-7.48	-3.92	-3.44	-2.96	-2.35	-2.8
120	-6.88	-5.69	-5.18	-5.41	-8.82	-14.91	-11.73	-5.35	-2.16	-1.97	-2.09	-2.08	-2.73
135	-7.25	-5.91	-5.41	-6.18	-9.68	-15.85	-8.97	-3.92	-1.16	-1.11	-1.57	-2.01	-2.79
150	-7.87	-6.55	-5.85	-6.62	-8.86	-11.21	-7.33	-3.22	-0.73	-0.72	-1.41	-2.16	-3.07
165	-8.71	-7.68	-6.47	-6.75	-7.99	-9.15	-7.09	-3.18	-0.86	-0.68	-1.67	-2.52	-3.61
180	-9.7	-9.04	-7.14	-6.83	-7.45	-8.63	-8.21	-3.89	-1.51	-0.93	-2.31	-3.11	-4.46
195	-9.99	-10.19	-7.62	-6.81	-7.01	-8.67	-10.68	-5.58	-2.76	-1.71	-3.36	-3.95	-5.57
210	-8.95	-9.99	-7.56	-6.62	-6.34	-8.25	-13.04	-8.36	-4.71	-3.01	-4.86	-5.16	-6.8
225	-7.2	-8.62	-6.92	-6.15	-5.43	-7.1	-11.71	-12.72	-7.67	-4.88	-6.75	-6.6	-8.16
240	-5.54	-7.08	-6.1	-5.63	-4.66	-5.9	-8.94	-16.33	-11.88	-7.46	-9.07	-8.44	-9.4
255	-4.23	-5.69	-5.37	-5.29	-4.28	-5.11	-7.11	-13.66	-16.32	-11.02	-11.73	-10.49	-10.28
270	-3.36	-4.62	-4.89	-5.11	-4.47	-4.99	-6.52	-10.73	-15.41	-15.32	-13.19	-12.24	-10.56
285	-2.92	-3.93	-4.71	-5.19	-5.38	-5.59	-7.02	-9.18	-13.1	-17.14	-12.64	-12.54	-10.31
300	-2.91	-3.59	-4.91	-5.52	-6.98	-6.94	-8.19	-8.51	-11.81	-14.86	-11.05	-11.18	-9.57
315	-3.24	-3.6	-5.47	-6.19	-9.2	-8.77	-8.87	-8.11	-10.94	-12.35	-9.26	-9.31	-8.46
330	-3.57	-3.85	-6.27	-7.45	-11.43	-10.63	-8.02	-7.53	-10.1	-10.69	-7.8	-7.55	-7.27
345	-3.63	-4.36	-6.77	-9.38	-11.86	-10.04	-6.33	-6.47	-9.55	-9.63	-6.91	-6.17	-6.5
360	-7.17	-5.56	-8.1	-10.98	-10.1	-5.94	-4.21	-5.02	-8.42	-8.51	-5.62	-4.86	-4.88



**Table 154. Board #10: RP\_433.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-8.12	-6.32	-8.81	-11.65	-13.45	-13.64	-14.93	-15.43	-19.85	-24.31	-17.05	-14.26	-13.7
15	-9.45	-6.74	-9.56	-13.42	-14.35	-14.38	-15.36	-14.54	-18.17	-19.57	-14.23	-12.04	-12.35
30	-12.05	-8.08	-11.53	-17.69	-18.18	-16.09	-16.21	-14.15	-15.73	-16.67	-12.29	-10.29	-10.58
45	-16.22	-10.49	-15.76	-24.39	-23.72	-17.95	-18.4	-14.14	-14.08	-15.38	-11.22	-9.25	-9.38
60	-24.53	-15.02	-29.04	-16.85	-17.27	-17.37	-22.32	-14.35	-13.08	-15.08	-10.99	-8.76	-8.68
75	-32.62	-26.58	-19.7	-11.82	-12.48	-15.13	-28.4	-14.47	-12.57	-15.69	-11.54	-8.79	-8.45
90	-20.9	-19.65	-12.8	-9.03	-10.16	-13.81	-31.64	-14.14	-12.23	-16.62	-12.73	-9.24	-8.63
105	-15.67	-12.8	-9.35	-7.54	-9.2	-14.16	-27.36	-13.03	-11.67	-17.18	-14.59	-10.02	-9.25
120	-12.54	-9.77	-7.55	-6.91	-9.33	-16.44	-20.75	-11.4	-10.76	-16.53	-17	-11.24	-10.39
135	-10.76	-8.39	-6.74	-6.92	-10.34	-21.18	-16.25	-9.9	-9.64	-14.91	-20.77	-13.01	-12.23
150	-9.77	-8.02	-6.6	-7.32	-11.75	-31.51	-13.61	-8.87	-8.73	-13.27	-27.73	-15.59	-14.87
165	-9.44	-8.39	-6.94	-7.85	-13.05	-28.65	-12.37	-8.53	-8.28	-12.03	-34.74	-19.26	-18.86
180	-9.74	-9.35	-7.63	-8.46	-13.46	-22.61	-12.3	-8.97	-8.36	-11.37	-23.08	-22.36	-22.58
195	-10.52	-10.75	-8.6	-9.05	-13.12	-19.35	-13.22	-10.33	-9.12	-11.31	-18.58	-20.36	-19.75
210	-11.6	-12.24	-9.72	-9.72	-12.63	-17.12	-14.75	-12.52	-10.72	-11.75	-15.9	-17.26	-16.15
225	-12.95	-13.84	-10.95	-10.52	-12.35	-15.58	-16.02	-15.65	-13.31	-12.6	-14.15	-14.95	-13.67
240	-14.24	-15.59	-12.37	-11.67	-12.55	-14.9	-16.43	-18.32	-17.5	-13.74	-13.21	-13.57	-12.16
255	-15.03	-17	-14.53	-13.88	-13.61	-15.44	-16.4	-19.14	-24.15	-15	-12.89	-12.79	-11.19
270	-14.5	-16.73	-18.2	-18.09	-16.19	-17.81	-17.08	-19.33	-30.29	-16.33	-13.21	-12.58	-10.71
285	-12.7	-14.46	-21.81	-28.68	-22.66	-24.03	-19.34	-20.58	-28.25	-17.97	-14.21	-12.87	-10.67
300	-10.6	-11.74	-17.92	-21.69	-29.18	-28.84	-23.39	-22.56	-29.24	-20.37	-16.01	-13.59	-11.04
315	-8.6	-9.53	-13.5	-15.51	-17.87	-19.58	-23.08	-22.48	-37.39	-23.92	-18.83	-14.8	-11.98
330	-6.93	-7.89	-10.88	-12.77	-13.96	-15.7	-18.78	-19.74	-32.07	-29.93	-22.48	-16.13	-13.42
345	-5.77	-6.86	-9.37	-11.77	-12.26	-14.13	-15.99	-17.2	-25.47	-36.4	-24.62	-16.82	-14.93
360	-8.12	-6.32	-8.81	-11.65	-13.45	-13.64	-14.93	-15.43	-19.85	-24.31	-17.05	-14.26	-13.7

**Table 155. Board #10: RP\_433.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-14.23	-13.53	-16.33	-19.45	-12.8	-6.74	-4.59	-5.44	-8.74	-8.62	-5.95	-5.39	-5.49
15	-25.93	-17.08	-14.3	-13.87	-7.88	-5.35	-3.21	-4.85	-8.86	-9.2	-5.92	-5.15	-5.18
30	-18.47	-15.14	-9.91	-8.72	-5.02	-3.39	-2.41	-4.56	-10.16	-10.13	-6.42	-5.26	-5.28
45	-12.05	-10.72	-7.32	-6.09	-3.6	-2.39	-2.3	-5.08	-13.75	-11.91	-7.17	-5.56	-5.56
60	-9.23	-8.1	-6.02	-4.88	-3.25	-2.27	-2.99	-6.56	-22.63	-12.49	-7.47	-5.49	-5.65
75	-7.76	-6.84	-5.65	-4.75	-3.98	-3.2	-4.77	-9.02	-14.61	-9.34	-6.49	-4.88	-5.22
90	-7.14	-6.47	-6.02	-5.63	-6.15	-5.43	-7.82	-10.58	-8.13	-6	-4.8	-3.97	-4.53
105	-7.35	-6.81	-7.14	-7.66	-10.22	-9.94	-11.83	-8.9	-4.71	-3.63	-3.27	-3.17	-3.92
120	-8.26	-7.85	-8.94	-10.77	-18.41	-20.18	-12.31	-6.6	-2.81	-2.12	-2.23	-2.64	-3.55
135	-9.81	-9.53	-11.21	-14.23	-18.21	-17.35	-9.87	-5.18	-1.82	-1.3	-1.62	-2.37	-3.31
150	-12.39	-11.96	-13.84	-14.92	-11.99	-11.25	-8.5	-4.6	-1.48	-0.97	-1.42	-2.36	-3.36
165	-16.83	-15.85	-16.3	-13.23	-9.61	-9.2	-8.62	-4.67	-1.73	-1.01	-1.67	-2.62	-3.74
180	-29.82	-20.75	-16.84	-11.87	-8.71	-8.8	-10.37	-5.5	-2.51	-1.34	-2.34	-3.16	-4.52
195	-19.38	-19.38	-14.53	-10.75	-8.23	-9.05	-14.22	-7.36	-3.9	-2.22	-3.49	-4.06	-5.74
210	-12.37	-13.93	-11.62	-9.55	-7.51	-8.85	-17.92	-10.47	-5.97	-3.63	-5.22	-5.43	-7.33
225	-8.54	-10.17	-9.1	-8.13	-6.42	-7.77	-13.72	-15.8	-9.05	-5.68	-7.62	-7.29	-9.6
240	-6.17	-7.74	-7.27	-6.87	-5.44	-6.48	-9.79	-20.69	-13.27	-8.62	-11.18	-10.04	-12.67
255	-4.61	-6.02	-5.93	-5.94	-4.82	-5.54	-7.66	-15.1	-17.1	-13.24	-18.04	-14.35	-17.53
270	-3.71	-4.9	-5.1	-5.34	-4.77	-5.22	-6.92	-11.37	-15.55	-22.14	-35.69	-23.54	-25.26
285	-3.4	-4.34	-4.8	-5.21	-5.46	-5.65	-7.28	-9.51	-13.24	-24.73	-17.81	-23.92	-21.38
300	-3.72	-4.31	-5.14	-5.62	-7.01	-6.97	-8.32	-8.68	-11.89	-16.29	-12.71	-14.9	-14.99
315	-4.74	-4.88	-6.21	-6.73	-9.84	-9.15	-9.03	-8.27	-10.95	-12.66	-9.77	-10.75	-11.02
330	-6.25	-6.03	-8.12	-8.95	-14.98	-12.25	-8.4	-7.8	-10.13	-10.74	-7.95	-8.2	-8.48
345	-7.74	-7.95	-10.24	-13.1	-22.39	-12.18	-6.83	-6.85	-9.67	-9.64	-6.99	-6.57	-7.18
360	-14.23	-13.53	-16.33	-19.45	-12.8	-6.74	-4.59	-5.44	-8.74	-8.62	-5.95	-5.39	-5.49

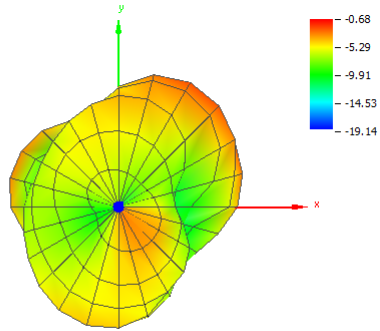


Figure 234. Board #10 (433 MHz): Theta = 0, Phi = 0

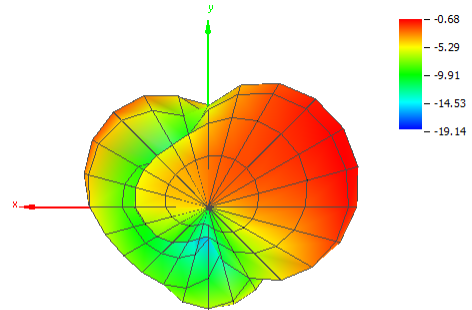


Figure 235. Board #10 (433 MHz): Theta = 180, Phi = 0

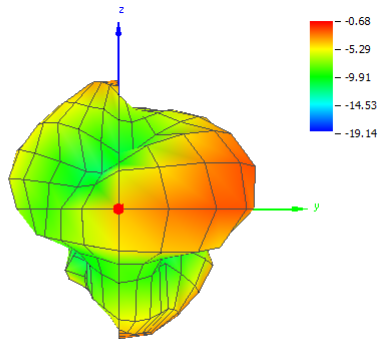


Figure 236. Board #10 (433 MHz): Theta = 90, Phi = 0

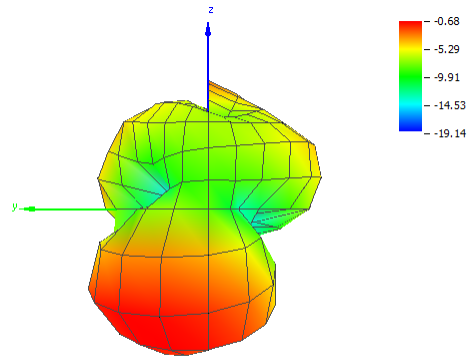


Figure 237. Board #10 (433 MHz): Theta = 90, Phi = 180

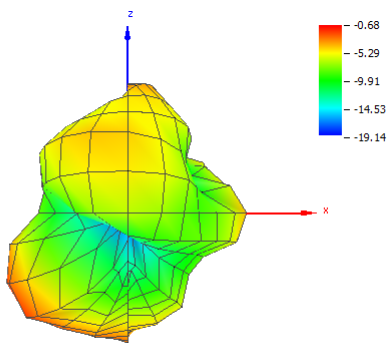


Figure 238. Board #10 (433 MHz): Theta = 90, Phi = 270

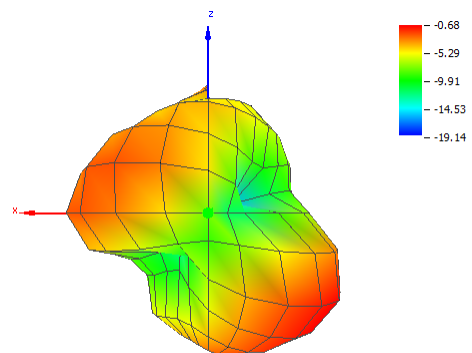


Figure 239. Board #10 (433 MHz): Theta = 90, Phi = 90

**A.10.2 868 MHz**
**Table 156. Board #10: OTA Evaluation Results (868 MHz)**

Test Description	Test Result
Total Radiated Power	-3.30 dBm
Peak EIRP	0.87 dBm
Directivity	4.16 dBi
Efficiency	-3.30 dB
Efficiency	0.4683
Peak Gain	0.87 dBi
NHPRP 45°	-5.20 dBm
NHPRP 45° / TRP	-1.90 dB
NHPRP 45° / TRP	0.6456
NHPRP 30°	-6.59 dBm
NHPRP 30° / TRP	-3.29 dB
NHPRP 30° / TRP	0.4687
NHPRP 22.5°	-7.77 dBm
NHPRP 22.5° / TRP	-4.47 dB
NHPRP 22.5° / TRP	0.357
UHRP	-6.78 dBm
UHRP / TRP	-3.49 dB
UHRP / TRP	0.4479
LHRP	-5.88 dBm
LHRP / TRP	-2.58 dB
LHRP / TRP	0.5521
PGRP (0-120°)	-4.91 dBm
PGRP / TRP	-1.62 dB
PGRP / TRP	0.6891
Front/Back Ratio	3.19
PhiBW	219.7°
PhiBW Up	53.7°
PhiBW Down	165.9°
ThetaBW	45.0°
ThetaBW Up	15.0°
ThetaBW Down	30.0°
Boresight Phi	345°
Boresight Theta	165°
Maximum Power	0.87 dBm
Minimum Power	-15.84 dBm
Average Power	-2.94 dBm
Max/Min Ratio	16.70 dB
Max/Avg Ratio	3.81 dB
Min/Avg Ratio	-12.90 dB
Worst Single Value	-32.07 dBm
Worst Position	Azi = 195°; Elev = 105°; Pol = Horizontal
Best Single Value	0.28 dBm
Best Position	Azi = 165°; Elev = 105°; Pol = Vertical

**Table 157. Board #10: RP\_868.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-4.95	-4.8	-5.21	-5.47	-3.05	-0.82	-1.33	-5.96	-4.11	-1.12	-0.04	0.14	-0.56
15	-5.13	-4.25	-4.82	-4.37	-1.44	-0.59	-2.65	-5.77	-1.82	-1.78	-0.95	-0.42	-0.96
30	-4.96	-3.89	-3.71	-2.45	-0.88	-1.1	-3.61	-2.77	-1.11	-3.03	-2.66	-1.39	-1.56
45	-4.32	-3.58	-2.55	-1.13	-1.32	-2.61	-2.38	-0.62	-1.92	-5.63	-4.97	-2.67	-2.37
60	-3.65	-3.28	-1.87	-0.85	-2.7	-4.33	-1.02	-0.53	-3.76	-8.72	-6.39	-3.93	-3.1
75	-3.12	-3.05	-1.61	-1.4	-4.78	-4.8	-1.19	-2.2	-5.46	-8.93	-5.66	-4.84	-3.49
90	-2.84	-2.97	-1.6	-2.42	-6.78	-4.51	-2.77	-5.06	-5.4	-6.49	-4	-5.08	-3.43
105	-2.6	-2.95	-1.6	-3.59	-7.24	-4.18	-5.27	-6.97	-4.31	-4.68	-2.83	-5.09	-3.1
120	-2.36	-2.82	-1.67	-4.31	-5.74	-3.42	-6.45	-4.99	-3.33	-4.02	-2.31	-4.84	-2.75
135	-2.05	-2.75	-1.82	-4.35	-3.94	-2.3	-5.45	-2.11	-2.51	-3.86	-2.09	-4.12	-2.44
150	-1.7	-2.56	-2.2	-4.31	-2.92	-1.51	-4.87	-0.28	-1.85	-3.45	-1.83	-3.31	-2.34
165	-1.48	-2.32	-2.92	-4.7	-2.83	-1.19	-6.05	0.29	-1.73	-2.49	-1.37	-2.59	-2.52
180	-1.45	-2.12	-3.72	-6.02	-3.55	-1.07	-7.26	-0.71	-2.44	-1.37	-0.76	-2.1	-2.9
195	-1.57	-1.99	-4.05	-8.62	-5.24	-1.07	-4.96	-3.47	-4.39	-0.56	-0.09	-1.72	-3.52
210	-1.83	-2.09	-3.42	-9.58	-8.49	-1.53	-3.24	-4.11	-6.28	-0.42	0.41	-1.43	-4.1
225	-2.2	-2.44	-2.61	-6.02	-11.49	-2.83	-3.17	-1.81	-5.5	-1.01	0.73	-1.12	-4.46
240	-2.63	-2.98	-2.41	-3.52	-9.26	-5.19	-4.53	-0.81	-4.34	-2.17	0.78	-0.72	-4.11
255	-3.43	-3.84	-2.96	-2.64	-7.31	-8.45	-7.71	-1.66	-4.86	-3.8	0.6	-0.29	-3.24
270	-4.5	-5.12	-4.14	-3.15	-6.8	-10.82	-13.81	-4.24	-6.95	-5.46	0.37	0.15	-2.28
285	-5.53	-6.87	-5.59	-4.32	-6.53	-10.95	-15.84	-8.89	-9.51	-6.2	0.3	0.51	-1.43
300	-5.78	-7.68	-6.16	-5.27	-6.11	-9.57	-8.82	-10.43	-9.77	-5.42	0.48	0.73	-0.88
315	-5.31	-7.16	-5.83	-5.8	-5.71	-7.4	-4.59	-6.44	-8.35	-4.05	0.63	0.75	-0.6
330	-4.95	-6.3	-5.47	-6.06	-5.46	-5.3	-2.29	-4.3	-7.45	-2.92	0.67	0.71	-0.5
345	-5	-5.48	-5.71	-6.13	-5.17	-3.2	-1.4	-3.96	-6.86	-2.14	0.61	0.87	-0.56
360	-4.95	-4.8	-5.21	-5.47	-3.05	-0.82	-1.33	-5.96	-4.11	-1.12	-0.04	0.14	-0.56

**Table 158. Board #10: RP\_868.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-21.69	-15.85	-13.46	-12.6	-10.41	-9.31	-11.63	-13.57	-10.49	-4.6	-5.08	-9.58	-20.53
15	-13.83	-9.69	-10.83	-12.82	-10.41	-8.03	-10.66	-14.45	-10.15	-7.01	-6.9	-10.64	-14.12
30	-8.8	-6.36	-8.21	-11.96	-9.91	-6.87	-10.69	-16.22	-13.04	-11.83	-8.92	-9.31	-9.36
45	-5.83	-4.43	-6.5	-9.81	-8.5	-6.82	-12.69	-17.22	-17.19	-23.47	-9.36	-7.36	-6.48
60	-4.32	-3.5	-5.29	-7.59	-7.24	-8.06	-15.87	-16.4	-12.14	-13.93	-8.01	-6.02	-4.83
75	-3.86	-3.3	-4.27	-5.81	-6.82	-10.56	-19.23	-14.44	-7.73	-9.03	-6.41	-5.28	-3.83
90	-4.42	-3.78	-3.74	-5.03	-7.33	-13.59	-22.08	-13.01	-5.76	-7.36	-5.42	-5.19	-3.45
105	-5.88	-5	-3.81	-5.22	-8.66	-17.95	-25.06	-13.11	-5.26	-7.44	-5.26	-5.93	-3.7
120	-7.49	-6.6	-4.72	-6.34	-10.4	-22.83	-28.67	-15.24	-6.15	-8.79	-5.85	-7.42	-4.79
135	-9.13	-9.27	-6.65	-8.55	-12.42	-22.74	-26.32	-19.97	-8.5	-11.39	-6.74	-9.29	-7.06
150	-11.21	-13.29	-9.74	-12.07	-15.06	-19.19	-20.46	-28.61	-12.69	-12.6	-7.18	-10.81	-10.84
165	-14.54	-20.67	-15.25	-16.45	-19.75	-16.55	-16.45	-26.2	-18.75	-9.81	-6.55	-10.46	-18.54
180	-15.09	-18.9	-22.25	-19.38	-22.71	-14.58	-13.54	-25.91	-15.84	-6.55	-5.12	-8.57	-25.02
195	-10.75	-12.6	-18.34	-18.68	-19.38	-12.98	-11.67	-32.07	-11.77	-4.19	-3.43	-6.24	-13.48
210	-7.49	-9.46	-14	-16.51	-16.4	-12.08	-11.26	-22.77	-10.56	-2.93	-1.98	-4.24	-9.09
225	-5.27	-7.51	-11.62	-13.69	-14.21	-11.9	-12.26	-18.13	-11.57	-2.57	-0.83	-2.62	-6.39
240	-4.14	-6.42	-9.85	-10.7	-11.94	-12.12	-14	-16.57	-14.6	-3.06	-0.19	-1.41	-4.65
255	-3.91	-6.04	-8.14	-7.99	-9.8	-12.38	-15.8	-15.84	-21.51	-4.29	0.04	-0.58	-3.57
270	-4.53	-6.34	-7	-6.49	-8.19	-12.18	-17.21	-15.31	-29.62	-5.87	-0.03	-0.13	-3.08
285	-5.89	-7.26	-6.51	-5.79	-7.15	-11.54	-17.46	-14.63	-21.94	-6.59	-0.19	-0.17	-3.21
300	-7.48	-8.48	-6.69	-5.92	-6.83	-10.96	-16.58	-14.12	-20.74	-5.84	-0.38	-0.75	-4
315	-9.14	-10.3	-7.59	-6.89	-7.24	-10.5	-15.76	-14.25	-18.84	-4.61	-0.82	-2.08	-5.86
330	-11.34	-13.24	-9.51	-8.63	-8.19	-10.26	-15.27	-14.5	-14.7	-3.77	-1.56	-3.82	-8.66
345	-15.83	-17.62	-13.02	-10.4	-9.33	-9.81	-14.31	-13.78	-11.45	-3.68	-2.63	-4.95	-13.49
360	-21.69	-15.85	-13.46	-12.6	-10.41	-9.31	-11.63	-13.57	-10.49	-4.6	-5.08	-9.58	-20.53

**Table 159. Board #10: RP\_868.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-5.04	-5.15	-5.91	-6.41	-3.93	-1.48	-1.75	-6.78	-5.25	-3.71	-1.67	-0.34	-0.61
15	-5.76	-5.72	-6.07	-5.05	-2.03	-1.46	-3.4	-6.4	-2.52	-3.33	-2.23	-0.85	-1.18
30	-7.28	-7.52	-5.61	-2.97	-1.46	-2.43	-4.56	-2.97	-1.4	-3.64	-3.83	-2.15	-2.34
45	-9.66	-11.1	-4.79	-1.77	-2.24	-4.68	-2.81	-0.72	-2.05	-5.7	-6.93	-4.47	-4.5
60	-12.07	-16.25	-4.51	-1.88	-4.59	-6.72	-1.16	-0.64	-4.44	-10.28	-11.44	-8.1	-7.94
75	-11.15	-15.51	-5	-3.34	-9.05	-6.14	-1.26	-2.47	-9.36	-25.42	-13.63	-15	-14.74
90	-8	-10.64	-5.7	-5.86	-15.98	-5.08	-2.82	-5.82	-16.38	-13.88	-9.53	-21.11	-26.38
105	-5.36	-7.21	-5.59	-8.64	-12.78	-4.36	-5.32	-8.19	-11.35	-7.95	-6.5	-12.61	-11.98
120	-3.96	-5.17	-4.64	-8.59	-7.56	-3.47	-6.48	-5.42	-6.54	-5.78	-4.86	-8.33	-7.01
135	-2.99	-3.84	-3.55	-6.43	-4.61	-2.34	-5.49	-2.18	-3.76	-4.7	-3.91	-5.69	-4.27
150	-2.21	-2.95	-3.04	-5.1	-3.2	-1.58	-5	-0.29	-2.22	-4.02	-3.32	-4.16	-3
165	-1.71	-2.39	-3.18	-5	-2.92	-1.32	-6.46	0.28	-1.82	-3.38	-2.95	-3.37	-2.63
180	-1.65	-2.21	-3.79	-6.22	-3.6	-1.27	-8.42	-0.72	-2.64	-2.93	-2.73	-3.21	-2.93
195	-2.13	-2.38	-4.22	-9.07	-5.41	-1.36	-6	-3.48	-5.26	-3.03	-2.79	-3.62	-3.98
210	-3.21	-2.97	-3.81	-10.57	-9.26	-1.93	-3.99	-4.17	-8.3	-4.01	-3.32	-4.64	-5.75
225	-5.15	-4.06	-3.19	-6.84	-14.81	-3.41	-3.75	-1.92	-6.74	-6.22	-4.49	-6.49	-8.91
240	-7.94	-5.6	-3.27	-4.44	-12.62	-6.17	-5.05	-0.93	-4.77	-9.49	-6.19	-9.05	-13.35
255	-13.17	-7.85	-4.53	-4.14	-10.92	-10.71	-8.45	-1.83	-4.95	-13.51	-8.57	-12.16	-14.56
270	-26.28	-11.23	-7.29	-5.85	-12.44	-16.53	-16.46	-4.59	-6.97	-15.9	-10.27	-11.8	-10.02
285	-16.49	-17.46	-12.77	-9.76	-15.27	-19.89	-20.89	-10.23	-9.77	-16.81	-9.4	-7.9	-6.18
300	-10.69	-15.42	-15.55	-13.83	-14.32	-15.2	-9.61	-12.85	-10.14	-15.79	-6.98	-4.66	-3.79
315	-7.63	-10.04	-10.59	-12.33	-11.01	-10.31	-4.94	-7.23	-8.76	-13.2	-4.81	-2.45	-2.14
330	-6.08	-7.28	-7.65	-9.56	-8.77	-6.96	-2.51	-4.74	-8.36	-10.41	-3.31	-1.18	-1.22
345	-5.37	-5.75	-6.61	-8.16	-7.27	-4.27	-1.63	-4.44	-8.72	-7.38	-2.18	-0.45	-0.79
360	-5.04	-5.15	-5.91	-6.41	-3.93	-1.48	-1.75	-6.78	-5.25	-3.71	-1.67	-0.34	-0.61

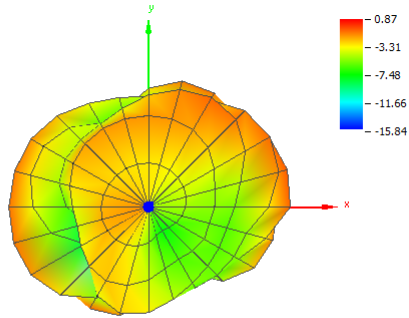


Figure 240. Board #10 (868 MHz): Theta = 0, Phi = 0

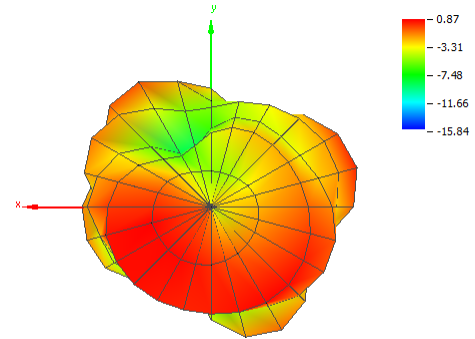


Figure 241. Board #10 (868 MHz): Theta = 180, Phi = 0

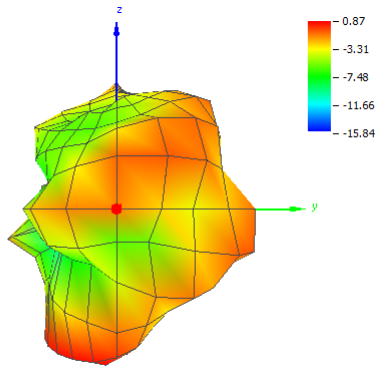


Figure 242. Board #10 (868 MHz): Theta = 90, Phi = 0

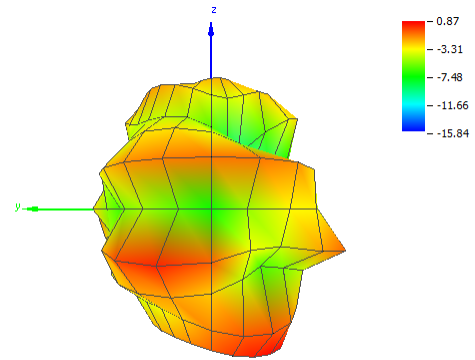


Figure 243. Board #10 (868 MHz): Theta = 90, Phi = 180

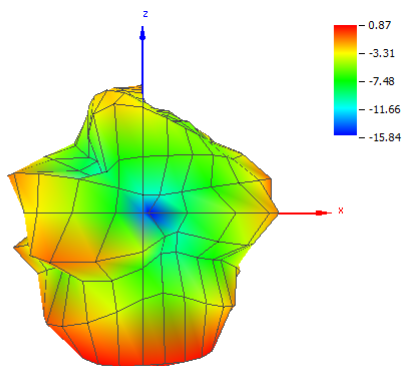


Figure 244. Board #10 (868 MHz): Theta = 90, Phi = 270

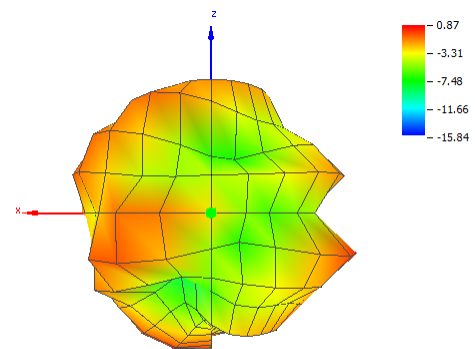


Figure 245. Board #10 (868 MHz): Theta = 90, Phi = 90



## A.11 Board #11: CC-Antenna-DK2

### A.11.1 2.40 GHz

**Table 160. Board #11: OTA Evaluation Results (2.40 GHz)**

Test Description	Test Result
Total Radiated Power	-1.47 dBm
Peak EIRP	3.94 dBm
Directivity	5.41 dBi
Efficiency	-1.47 dB
Efficiency	0.713
Peak Gain	3.94 dBi
NHPRP 45°	-3.14 dBm
NHPRP 45° / TRP	-1.67 dB
NHPRP 45° / TRP	0.6813
NHPRP 30°	-4.65 dBm
NHPRP 30° / TRP	-3.18 dB
NHPRP 30° / TRP	0.4805
NHPRP 22.5°	-5.85 dBm
NHPRP 22.5° / TRP	-4.38 dB
NHPRP 22.5° / TRP	0.3651
UHRP	-4.55 dBm
UHRP / TRP	-3.08 dB
UHRP / TRP	0.4922
LHRP	-4.41 dBm
LHRP / TRP	-2.94 dB
LHRP / TRP	0.5078
PGRP (0-120°)	-2.89 dBm
PGRP / TRP	-1.42 dB
PGRP / TRP	0.7204
Front/Back Ratio	7.39
PhiBW	159.2°
PhiBW Up	98.0°
PhiBW Down	61.2°
ThetaBW	90.5°
ThetaBW Up	34.8°
ThetaBW Down	55.7°
Boresight Phi	60°
Boresight Theta	150°
Maximum Power	3.94 dBm
Minimum Power	-13.92 dBm
Average Power	-1.01 dBm
Max/Min Ratio	17.86 dB
Max/Avg Ratio	4.95 dB
Min/Avg Ratio	-12.91 dB
Worst Single Value	-22.82 dBm
Worst Position	Azi = 270°; Elev = 150°; Pol = Horizontal
Best Single Value	3.11 dBm
Best Position	Azi = 45°; Elev = 150°; Pol = Vertical

**Table 161. Board #11: RP\_2400.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-2.31	-3.93	-2.74	-4.96	-1.63	-2.1	-0.63	-4.45	-1.71	2.3	1.09	0.78	2.45
15	-2.02	-2.7	-1.82	-1.97	0.67	-0.66	1.03	-1.8	-0.5	1.44	1.61	0.76	2.66
30	-1.95	-1.14	-0.52	0.92	1.72	1.81	2.07	1.51	0.63	0.06	2.64	1.19	2.59
45	-2.06	0.09	0.49	2.21	1.22	3.03	2.79	2.46	1.97	-0.3	3.77	1.12	2.16
60	-1.97	0.38	0.33	1.41	-0.94	1.62	0.86	1.14	2.11	0.97	3.94	1.08	1.88
75	-2.54	-0.01	0.07	-0.26	-1.4	-1.4	-2.74	-1.08	0.7	0.97	3.18	1.1	1.98
90	-3.17	-0.7	0.43	-1.36	-1.36	-5.01	-8.17	-2.42	0.06	0.41	2.11	0.9	2.04
105	-3.56	-1.06	0.22	-1.68	-2.8	-7.15	-8.79	-3.87	-1.23	-0.79	1.58	0.5	1.97
120	-3.59	-1.18	-0.1	-1.07	-3.1	-4.55	-5.41	-4.99	-4.03	-3.19	1.36	-0.08	2.03
135	-3.54	-1.52	0.14	0.15	-1	-2.11	-2.96	-6.71	-3.92	-5.53	1.23	-0.47	2.14
150	-3.16	-1.87	0.42	0.99	1.99	0.81	1.47	-3.85	-0.78	-2.59	1.26	-0.53	2.42
165	-2.8	-2.6	-0.27	1.03	2.18	3.22	2.42	1.64	-0.44	-0.09	0.65	-0.75	2.66
180	-2.57	-3.76	-1.63	-0.14	-0.04	2.44	0.14	1.44	-2.02	-0.69	-0.75	-1.06	2.76
195	-2.69	-5.82	-3.44	-2.43	-4.21	-2.35	-4.91	-5.04	-5.88	-3	-2.9	-1.49	2.64
210	-3.33	-8.12	-4.57	-4.78	-8.25	-5.67	-6.52	-10.71	-5.8	-5.11	-4.14	-1.73	2.49
225	-4.12	-8.48	-4.44	-6.7	-5.82	-5.25	-6.55	-6.14	-5.89	-5.91	-4.63	-2.05	2.4
240	-4.51	-7.42	-3.45	-6.55	-3.41	-5.04	-3.9	-4.71	-4.57	-5.69	-6.82	-2.02	2.35
255	-4.41	-7.2	-2.81	-4.6	-3.8	-2.53	-4.09	-3.22	-3.82	-6.52	-12.96	-1.06	2.18
270	-4.25	-8.03	-2.35	-3.1	-3.75	-2.31	-3.71	-1.77	-4.43	-6.38	-13.92	-0.3	2.32
285	-4.08	-8.47	-2.43	-2.92	-2.67	-4.2	-3.17	-2.52	-4.1	-5.48	-11.41	-0.16	2.93
300	-4.08	-8	-2.75	-2.8	-2.2	-5.74	-3.35	-3.59	-3.52	-5.04	-10.21	-0.45	3.41
315	-3.74	-7.03	-3.58	-3.18	-3.29	-6.28	-3.57	-3.99	-4.77	-4.32	-6.19	-0.65	3.29
330	-3.43	-6.63	-3.98	-4.04	-5.53	-6.49	-4.03	-4.66	-5.88	-3.46	-2.14	-0.78	2.82
345	-3.3	-5.49	-3.25	-4.76	-6.25	-4.25	-5.32	-6.09	-3.98	-1.14	-0.69	-0.43	2.37
360	-2.31	-3.93	-2.74	-4.96	-1.63	-2.1	-0.63	-4.45	-1.71	2.3	1.09	0.78	2.45

**Table 162. Board #11: RP\_2400.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-8.01	-9.07	-16.92	-17.43	-20.31	-13.56	-15.16	-16.27	-13.82	-8.22	-6.63	-16.15	-7.12
15	-8.25	-10.42	-15.83	-15.03	-14.02	-10.85	-13.44	-15.02	-15.02	-9.14	-10.06	-13.45	-4.42
30	-7.59	-10.28	-11.38	-11.66	-13.35	-13.53	-17.77	-17.88	-9.77	-10.27	-12.37	-9.17	-2.03
45	-6.2	-7.84	-7.01	-7.77	-17.57	-20.3	-20.34	-11.52	-5.24	-5.91	-4.74	-6.12	-0.42
60	-5.2	-5.47	-4.1	-4.46	-10.25	-9.73	-19.25	-5.83	-2.71	-2.56	-1.48	-4.36	0.53
75	-5.27	-4.01	-2.12	-2.5	-4.07	-6.66	-15.95	-3.9	-1.2	-1.04	0.18	-2.44	1.27
90	-6.03	-3.08	-0.62	-2.06	-2.34	-6.94	-12.56	-3.72	-0.15	-0.46	1.06	-0.89	1.38
105	-6.4	-1.99	0.03	-1.82	-2.89	-8.32	-10.57	-4.15	-1.3	-1.23	1.47	-0.15	0.86
120	-6.15	-1.66	-0.2	-1.7	-4	-7.44	-9.43	-5.76	-4.72	-3.32	0.92	-0.55	-0.16
135	-7.19	-2.66	-1.01	-1.31	-3.18	-3.94	-9.43	-9.4	-9.54	-7.22	-1.35	-2.09	-2.07
150	-8.64	-5	-2.86	-3.07	-2.64	-3.88	-10.39	-17.43	-11.38	-10.77	-5.12	-4.29	-4.1
165	-10.72	-9.36	-7.78	-9.67	-6.53	-9.59	-16.35	-13.26	-12.15	-13.07	-10.42	-7.65	-5.55
180	-12.44	-14.43	-13.21	-10.11	-8.72	-10.74	-14.98	-11.65	-14.85	-16.18	-9.49	-9.13	-5.41
195	-13.53	-14.29	-9.76	-9.11	-8.47	-15.98	-11.31	-12.03	-15.63	-12.66	-7.99	-6.5	-4.04
210	-11.41	-11.54	-9.24	-12.46	-13.73	-17.01	-10.27	-15.89	-12.24	-12.27	-7.87	-4.26	-2.5
225	-8.43	-10.43	-10.69	-19.03	-18.76	-15.88	-12.39	-19.17	-14.13	-15.68	-7.86	-3.44	-0.64
240	-7.19	-11.55	-11.52	-20.73	-20.23	-15.06	-15.17	-17.74	-22.58	-14.1	-8.64	-3.24	0.73
255	-6.7	-13.78	-11.32	-18.61	-18.76	-15.86	-21.14	-19.13	-11.91	-9.37	-13.88	-2.85	1.57
270	-6.05	-15.45	-11.41	-16.54	-18.82	-22.19	-21.87	-15.68	-8.53	-7.07	-22.82	-2.67	1.77
285	-5.61	-14.69	-11.07	-14.61	-16.26	-17.9	-22.5	-14.59	-7.01	-5.75	-16.15	-3.01	1.71
300	-5.83	-11.86	-10.85	-15.02	-14.56	-16.27	-18.22	-11.87	-5.94	-5.37	-16.04	-3.96	1.28
315	-5.76	-9.15	-11.49	-15.77	-14.64	-14.66	-13.21	-9.2	-5.71	-5.35	-16.03	-5.26	-0.11
330	-6.03	-8.54	-13.01	-15.83	-17.1	-15.34	-13.45	-9.76	-6.14	-6.48	-11.07	-7.07	-2.26
345	-6.92	-7.88	-14.44	-15.88	-21.21	-18.27	-19.45	-12.13	-7.49	-8.34	-7.05	-10.04	-5.64
360	-8.01	-9.07	-16.92	-17.43	-20.31	-13.56	-15.16	-16.27	-13.82	-8.22	-6.63	-16.15	-7.12

**Table 163. Board #11: RP\_2400.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-3.67	-5.51	-2.91	-5.21	-1.69	-2.42	-0.79	-4.75	-1.99	1.9	0.28	0.69	1.95
15	-3.21	-3.5	-2	-2.19	0.52	-1.1	0.87	-2.01	-0.65	1.04	1.31	0.59	1.71
30	-3.33	-1.7	-0.89	0.68	1.58	1.68	2.02	1.46	0.21	-0.36	2.5	0.77	0.76
45	-4.17	-0.68	-0.36	1.76	1.16	3.01	2.77	2.29	1.05	-1.7	3.11	0.21	-1.33
60	-4.78	-0.93	-1.62	0.11	-1.49	1.29	0.82	0.16	0.36	-1.58	2.47	-0.39	-3.87
75	-5.85	-2.22	-3.94	-4.21	-4.77	-2.94	-2.95	-4.29	-3.81	-3.36	0.16	-1.45	-6.19
90	-6.33	-4.43	-6.26	-9.66	-8.28	-9.46	-10.14	-8.3	-13.25	-7.01	-4.58	-3.8	-6.44
105	-6.74	-8.18	-13.37	-16.79	-19.57	-13.43	-13.51	-15.82	-18.67	-10.97	-14.26	-8.12	-4.49
120	-7.1	-10.94	-16.88	-9.81	-10.37	-7.69	-7.6	-12.85	-12.36	-18.55	-8.79	-10.02	-2
135	-6	-7.88	-6.19	-5.29	-5.04	-6.75	-4.07	-10.06	-5.31	-10.43	-2.26	-5.56	0.07
150	-4.61	-4.76	-2.34	-1.17	0.15	-0.99	1.18	-4.04	-1.18	-3.31	0.13	-2.91	1.32
165	-3.56	-3.63	-1.12	0.65	1.56	2.99	2.36	1.5	-0.75	-0.31	0.3	-1.74	1.95
180	-3.04	-4.15	-1.94	-0.6	-0.67	2.22	0.01	1.22	-2.25	-0.81	-1.38	-1.79	2.04
195	-3.07	-6.49	-4.59	-3.48	-6.25	-2.54	-6.04	-6	-6.37	-3.5	-4.5	-3.13	1.59
210	-4.06	-10.76	-6.38	-5.59	-9.7	-6	-8.9	-12.28	-6.92	-6.04	-6.53	-5.28	0.83
225	-6.12	-12.9	-5.61	-6.96	-6.04	-5.64	-7.86	-6.36	-6.59	-6.39	-7.43	-7.68	-0.57
240	-7.88	-9.55	-4.18	-6.72	-3.5	-5.5	-4.24	-4.93	-4.64	-6.37	-11.46	-8.14	-2.71
255	-8.28	-8.28	-3.47	-4.78	-3.95	-2.73	-4.18	-3.34	-4.55	-9.7	-20.16	-5.76	-6.68
270	-8.94	-8.9	-2.93	-3.3	-3.88	-2.36	-3.78	-1.95	-6.57	-14.72	-14.52	-4.06	-6.95
285	-9.35	-9.66	-3.07	-3.23	-2.86	-4.39	-3.22	-2.8	-7.21	-17.55	-13.19	-3.35	-3.19
300	-8.86	-10.3	-3.49	-3.06	-2.46	-6.15	-3.5	-4.29	-7.22	-16.37	-11.53	-3.02	-0.71
315	-8.03	-11.17	-4.35	-3.43	-3.62	-6.96	-4.07	-5.54	-11.89	-11.06	-6.67	-2.5	0.64
330	-6.88	-11.13	-4.56	-4.34	-5.84	-7.1	-4.56	-6.26	-18.24	-6.46	-2.73	-1.94	1.21
345	-5.78	-9.23	-3.6	-5.11	-6.39	-4.42	-5.49	-7.33	-6.53	-2.07	-1.83	-0.93	1.63
360	-3.67	-5.51	-2.91	-5.21	-1.69	-2.42	-0.79	-4.75	-1.99	1.9	0.28	0.69	1.95

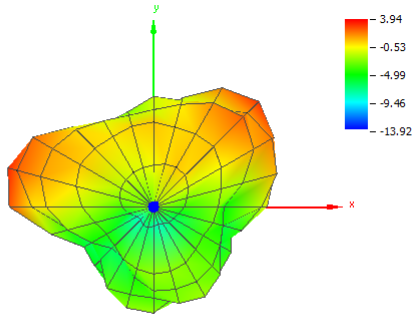


Figure 246. Board #11 (2.40 GHz): Theta = 0, Phi = 0

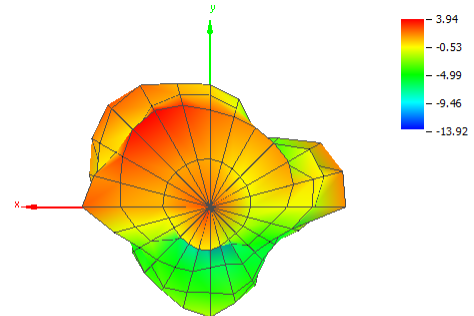


Figure 247. Board #11 (2.40 GHz): Theta = 180, Phi = 0

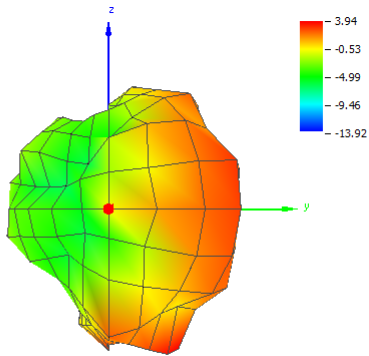


Figure 248. Board #11 (2.40 GHz): Theta = 90, Phi = 0

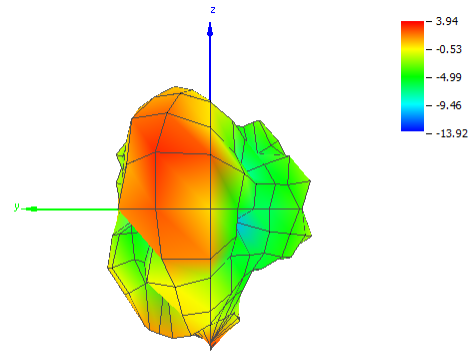


Figure 249. Board #11 (2.40 GHz): Theta = 90, Phi = 180

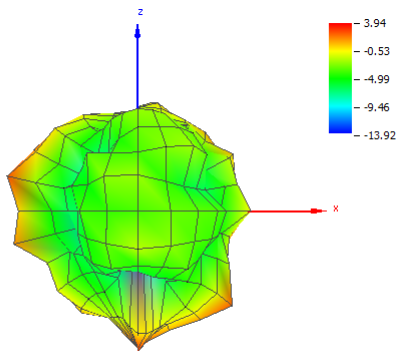


Figure 250. Board #11 (2.40 GHz): Theta = 90, Phi = 270

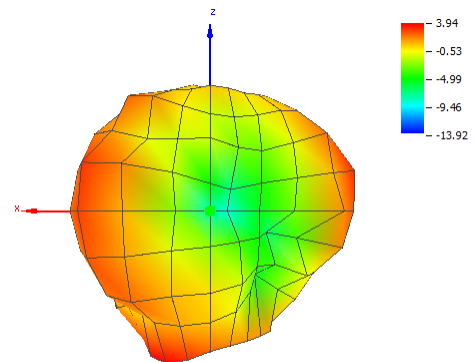


Figure 251. Board #11 (2.40 GHz): Theta = 90, Phi = 90

**A.11.2 2.44 GHz**
**Table 164. Board #11: OTA Evaluation Results (2.44 GHz)**

Test Description	Test Result
Total Radiated Power	-1.64 dBm
Peak EIRP	4.24 dBm
Directivity	5.89 dBi
Efficiency	-1.64 dB
Efficiency	0.6849
Peak Gain	4.24 dBi
NHPRP 45°	-3.18 dBm
NHPRP 45° / TRP	-1.54 dB
NHPRP 45° / TRP	0.7021
NHPRP 30°	-4.57 dBm
NHPRP 30° / TRP	-2.93 dB
NHPRP 30° / TRP	0.5097
NHPRP 22.5°	-5.74 dBm
NHPRP 22.5° / TRP	-4.09 dB
NHPRP 22.5° / TRP	0.3897
UHRP	-4.76 dBm
UHRP / TRP	-3.11 dB
UHRP / TRP	0.4882
LHRP	-4.55 dBm
LHRP / TRP	-2.91 dB
LHRP / TRP	0.5118
PGRP (0-120°)	-3.03 dBm
PGRP / TRP	-1.38 dB
PGRP / TRP	0.7276
Front/Back Ratio	9.63
PhiBW	121.6°
PhiBW Up	81.1°
PhiBW Down	40.5°
ThetaBW	45.0°
ThetaBW Up	34.3°
ThetaBW Down	10.7°
Boresight Phi	60°
Boresight Theta	150°
Maximum Power	4.24 dBm
Minimum Power	-16.33 dBm
Average Power	-1.02 dBm
Max/Min Ratio	20.58 dB
Max/Avg Ratio	5.26 dB
Min/Avg Ratio	-15.32 dB
Worst Single Value	-22.02 dBm
Worst Position	Azi = 225°; Elev = 105°; Pol = Horizontal
Best Single Value	3.38 dBm
Best Position	Azi = 45°; Elev = 150°; Pol = Vertical

**Table 165. Board #11: RP\_2440.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-0.5	-1.92	-8.18	-3.59	-4.67	-0.65	-1.62	-5	-5.26	-0.75	0.01	-0.26	2.5
15	-0.31	-1.23	-5.29	-1.77	0.56	-0.08	1.35	-2.52	-1.53	-0.28	0.71	0.85	2.09
30	-0.42	-0.91	-3.5	0.35	1.54	1.04	1.64	1.62	0.09	-0.25	2.5	1.93	1.89
45	-0.54	-1.1	-2.38	1.18	1.13	1.84	2.23	2	0.56	-0.83	3.91	2.29	1.64
60	-1.03	-1.38	-1.02	1.2	1.38	2.12	1.86	1.23	0.33	0.05	4.24	1.9	1.81
75	-2.08	-1.83	-0.13	0.59	1.29	0.9	0.06	1.11	0.69	1.57	3.65	1.68	2.35
90	-2.75	-1.99	-0.65	-1.06	-0.93	-3.24	-4.92	-0.77	0.02	2.01	2.88	1.2	2.6
105	-1.92	-1.91	-1.47	-3.02	-2.91	-5.95	-7.28	-3.39	-1.98	0.4	2.06	0.3	2.57
120	-1.08	-1.62	-0.96	-2.13	-2.96	-4.32	-5.66	-3.82	-4.08	-2.6	1.65	-0.14	2.69
135	-0.79	-1.21	0.28	-0.86	-0.72	-2.27	-3.26	-6.6	-3.98	-4.76	1.4	-0.24	2.52
150	-0.97	-1.47	0.63	0.41	2.01	0.82	1.24	-1.43	-0.82	-1.54	1.02	-0.3	2.31
165	-1.1	-2	-0.3	0.95	2.37	3.3	2.39	3.13	-0.3	0.42	0.25	-0.23	2.51
180	-1.03	-2.49	-3.37	-1.15	-0.81	1.93	0.15	2.07	-1.65	-0.88	-1.44	-0.2	2.88
195	-0.99	-3.46	-8.07	-6.71	-4.53	-2.84	-4.03	-4.29	-5.7	-4.95	-4.51	-0.59	3.17
210	-1.21	-4.75	-8.64	-6.42	-5.81	-3.68	-5.46	-10.47	-7.07	-7.8	-6.7	-1.32	3.08
225	-1.61	-6.33	-6.27	-4.59	-3.81	-3.65	-5.02	-6.85	-7.55	-4.75	-6.13	-2.34	2.96
240	-1.73	-7.7	-5.39	-4.56	-2.91	-4.18	-3.35	-6.02	-6.17	-3.94	-6.43	-2.88	2.89
255	-1.53	-8.23	-4.62	-3.27	-3.38	-1.72	-4.38	-3.49	-5.5	-5.6	-9.85	-2.94	2.75
270	-0.94	-6.66	-5.25	-2.51	-3.5	-2.26	-3.83	-1.96	-6.07	-6.84	-16.33	-2.97	2.76
285	-0.57	-5.51	-6.48	-3.42	-3.71	-4.6	-3.39	-2.72	-4.43	-5.68	-15.26	-2.72	2.95
300	-0.42	-4.58	-7.97	-5.29	-4.37	-5.09	-4.09	-4.37	-3.94	-4.91	-12.75	-2.33	3.92
315	-0.26	-3.24	-9.96	-6.7	-6.24	-4.63	-4.88	-4.33	-5.3	-4.8	-7.68	-2.29	4.17
330	-0.24	-2.84	-11.44	-6.66	-9.36	-5.96	-6.55	-5.92	-7.89	-4.14	-3.64	-2.41	3.77
345	-0.59	-2.59	-11.41	-6.16	-12.79	-6.63	-7.37	-8.32	-9.13	-2.92	-1.28	-2.08	3.21
360	-0.5	-1.92	-8.18	-3.59	-4.67	-0.65	-1.62	-5	-5.26	-0.75	0.01	-0.26	2.5

**Table 166. Board #11: RP\_2440.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-7.94	-11.39	-17.6	-19.07	-19.72	-12.53	-13.78	-14.67	-15.01	-9.62	-10.42	-19.1	-8.88
15	-7.04	-11.03	-15.91	-15.48	-14.88	-10.46	-14.33	-18.51	-11.27	-8.21	-16.61	-13.46	-5.62
30	-5.71	-9.63	-13.03	-10.16	-11.43	-13.71	-13.86	-14.32	-10.25	-11.63	-14.77	-9.16	-2.21
45	-3.98	-7.77	-10.04	-6.89	-10.91	-17.31	-16.36	-9.67	-7.04	-10.25	-5.53	-6.22	-0.28
60	-3.29	-5.6	-6.44	-4.63	-6.95	-8.45	-20.91	-6.41	-3.77	-3.36	-1.4	-3.44	1.03
75	-4.12	-4.42	-2.98	-3.17	-2.97	-5.81	-13.32	-4.53	-1.02	-0.15	0.6	-1.16	1.91
90	-4.89	-3.05	-1.51	-2.46	-2.31	-5.74	-11.37	-3.45	-0.38	0.8	1.77	-0.15	1.92
105	-3.88	-2.36	-1.59	-3.14	-3.53	-7.29	-9.93	-4.1	-2.07	-0.3	1.85	-0.17	1.29
120	-3.54	-2.36	-1.42	-2.85	-4.49	-6.33	-8.23	-5.7	-4.84	-2.95	1.04	-0.61	0.19
135	-4.07	-3.04	-1.18	-2.53	-3.1	-3.46	-7.72	-9.57	-10.03	-7.46	-1.19	-1.85	-1.85
150	-5.44	-5.19	-2.55	-3.91	-2.95	-3.62	-9.92	-14.93	-12.07	-11.32	-5.58	-4.23	-5.02
165	-7.66	-8.17	-5.96	-7.79	-5.98	-8.62	-12.9	-12.99	-15.04	-13.54	-12.31	-7.03	-8.16
180	-9.84	-9.65	-10.81	-10.62	-9.79	-11.58	-13.68	-12.11	-21.2	-16.61	-11.6	-8.21	-7.16
195	-9.8	-8.83	-12.04	-10.36	-7.91	-14.74	-9.95	-10.86	-18.82	-13.77	-9.69	-6.78	-3.96
210	-8.1	-7.93	-12.15	-13.69	-14.49	-14.35	-9.27	-18.23	-11.97	-14.75	-9.98	-5.48	-1.92
225	-5.88	-7.44	-14.68	-17.84	-17.28	-12.82	-13.85	-22.02	-12.32	-17.24	-7.99	-4.84	-0.26
240	-4.04	-8.1	-20.32	-17.65	-16.82	-19.43	-18.57	-18.08	-16.81	-15.01	-7.89	-4.78	1.08
255	-3.16	-9.55	-17.54	-14.96	-12.48	-15.56	-19.29	-18.4	-14.9	-11.57	-11.39	-4.6	1.86
270	-2.83	-10.21	-14.06	-10.41	-10.68	-12.85	-19.04	-18.15	-11.05	-9.76	-20.22	-5.06	2.06
285	-3.16	-11.7	-12.97	-8.81	-9.55	-12.98	-17.73	-14.33	-9.6	-7.68	-18.79	-5.47	1.37
300	-4.17	-14.18	-13.23	-10.22	-10.11	-12.49	-15.06	-11.43	-8.43	-5.57	-18.85	-6.13	0.83
315	-5.18	-12.37	-13.37	-13.34	-11.86	-11.31	-12.48	-8.45	-7.64	-5.28	-16.74	-8.16	-0.54
330	-5.74	-9.92	-13.97	-14.92	-15.91	-13.5	-13.43	-10	-8.32	-6.93	-12.7	-10.95	-2.68
345	-7.41	-9.81	-14.61	-15.9	-21.9	-15.85	-19.9	-12.52	-10.88	-8.88	-9.45	-13.8	-6.44
360	-7.94	-11.39	-17.6	-19.07	-19.72	-12.53	-13.78	-14.67	-15.01	-9.62	-10.42	-19.1	-8.88



**Table 167. Board #11: RP\_2440.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-1.36	-2.44	-8.7	-3.72	-4.81	-0.94	-1.89	-5.49	-5.75	-1.36	-0.4	-0.32	2.17
15	-1.35	-1.71	-5.68	-1.96	0.43	-0.5	1.23	-2.63	-2.02	-1.04	0.63	0.69	1.29
30	-1.94	-1.54	-4.01	-0.05	1.32	0.89	1.51	1.51	-0.33	-0.58	2.41	1.58	-0.26
45	-3.15	-2.15	-3.19	0.45	0.84	1.79	2.17	1.69	-0.27	-1.35	3.38	1.63	-2.82
60	-4.95	-3.45	-2.49	-0.11	0.69	1.72	1.84	0.41	-1.81	-2.6	2.86	0.4	-6.02
75	-6.34	-5.31	-3.31	-1.79	-0.75	-0.14	-0.14	-0.28	-4.2	-3.27	0.68	-1.51	-7.88
90	-6.84	-8.64	-8.14	-6.65	-6.57	-6.82	-6.03	-4.14	-10.51	-4.11	-3.6	-4.52	-5.78
105	-6.32	-11.99	-17.03	-18.67	-11.63	-11.71	-10.69	-11.61	-19.06	-7.88	-11.15	-9.57	-3.33
120	-4.72	-9.66	-10.96	-10.29	-8.26	-8.63	-9.18	-8.38	-12.02	-13.82	-7.23	-10.05	-0.91
135	-3.55	-5.85	-5.16	-5.81	-4.47	-8.45	-5.18	-9.65	-5.23	-8.1	-2.09	-5.34	0.55
150	-2.89	-3.87	-2.21	-1.59	0.34	-1.11	0.89	-1.63	-1.16	-2.03	-0.05	-2.55	1.43
165	-2.18	-3.2	-1.68	0.33	1.68	3.01	2.26	3.02	-0.45	0.25	0	-1.24	2.12
180	-1.64	-3.42	-4.23	-1.67	-1.39	1.73	-0.04	1.9	-1.7	-1	-1.87	-0.94	2.43
195	-1.6	-4.95	-10.29	-9.16	-7.21	-3.13	-5.31	-5.37	-5.92	-5.56	-6.08	-1.78	2.24
210	-2.21	-7.6	-11.21	-7.32	-6.44	-4.07	-7.79	-11.27	-8.77	-8.78	-9.45	-3.42	1.43
225	-3.65	-12.79	-6.95	-4.8	-4.01	-4.21	-5.63	-6.98	-9.31	-5	-10.71	-5.93	0.16
240	-5.58	-18.32	-5.53	-4.78	-3.09	-4.31	-3.49	-6.3	-6.56	-4.3	-11.87	-7.38	-1.79
255	-6.58	-14.05	-4.85	-3.58	-3.95	-1.9	-4.52	-3.63	-6.03	-6.86	-15.09	-7.94	-4.55
270	-5.47	-9.19	-5.87	-3.28	-4.42	-2.66	-3.96	-2.07	-7.73	-9.94	-18.62	-7.14	-5.54
285	-4.03	-6.7	-7.58	-4.9	-5.02	-5.28	-3.55	-3.03	-6	-10.02	-17.8	-6.01	-2.22
300	-2.8	-5.08	-9.51	-6.97	-5.71	-5.96	-4.45	-5.32	-5.84	-13.42	-13.97	-4.67	0.99
315	-1.95	-3.8	-12.6	-7.76	-7.63	-5.68	-5.71	-6.46	-9.12	-14.62	-8.25	-3.59	2.38
330	-1.68	-3.78	-14.99	-7.37	-10.45	-6.8	-7.54	-8.07	-18.07	-7.39	-4.21	-3.06	2.65
345	-1.61	-3.5	-14.25	-6.65	-13.35	-7.18	-7.61	-10.39	-13.92	-4.19	-2	-2.39	2.71
360	-1.36	-2.44	-8.7	-3.72	-4.81	-0.94	-1.89	-5.49	-5.75	-1.36	-0.4	-0.32	2.17

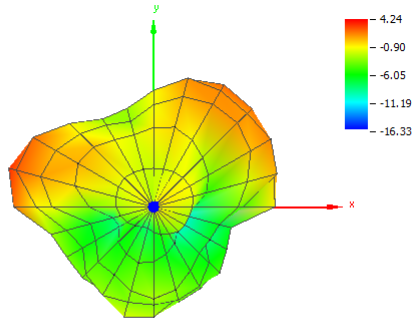


Figure 252. Board #11 (2.44 GHz): Theta = 0, Phi = 0

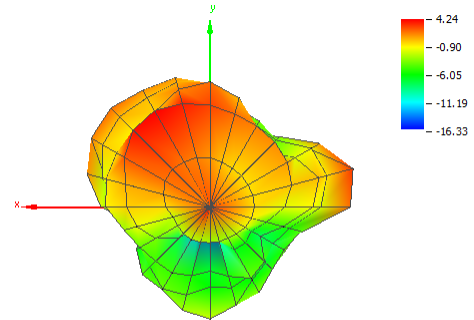


Figure 253. Board #11 (2.44 GHz): Theta = 180, Phi = 0

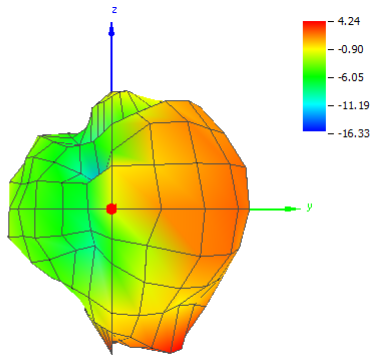


Figure 254. Board #11 (2.44 GHz): Theta = 90, Phi = 0

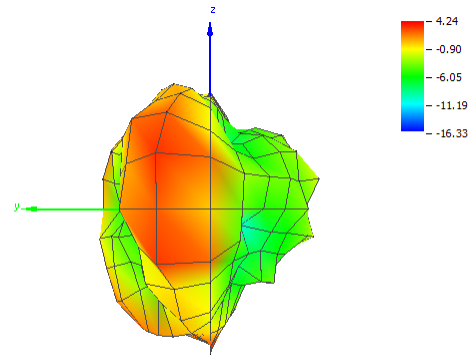


Figure 255. Board #11 (2.44 GHz): Theta = 90, Phi = 180

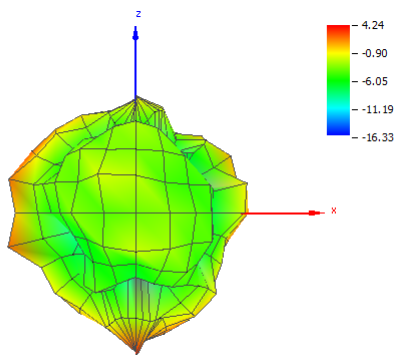


Figure 256. Board #11 (2.44 GHz): Theta = 90, Phi = 270

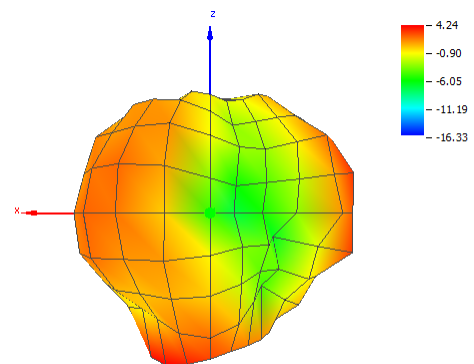


Figure 257. Board #11 (2.44 GHz): Theta = 90, Phi = 90

**A.11.3 2.48 GHz**
**Table 168. Board #11: OTA Evaluation Results (2.48 GHz)**

Test Description	Test Result
Total Radiated Power	-1.15 dBm
Peak EIRP	4.76 dBm
Directivity	5.91 dBi
Efficiency	-1.15 dB
Efficiency	0.7668
Peak Gain	4.76 dBi
NHPRP 45°	-2.68 dBm
NHPRP 45° / TRP	-1.53 dB
NHPRP 45° / TRP	0.7033
NHPRP 30°	-4.12 dBm
NHPRP 30° / TRP	-2.96 dB
NHPRP 30° / TRP	0.5053
NHPRP 22.5°	-5.29 dBm
NHPRP 22.5° / TRP	-4.13 dB
NHPRP 22.5° / TRP	0.386
UHRP	-4.69 dBm
UHRP / TRP	-3.53 dB
UHRP / TRP	0.4431
LHRP	-3.70 dBm
LHRP / TRP	-2.54 dB
LHRP / TRP	0.5569
PGRP (0-120°)	-2.67 dBm
PGRP / TRP	-1.52 dB
PGRP / TRP	0.7046
Front/Back Ratio	13.97
PhiBW	107.3°
PhiBW Up	68.0°
PhiBW Down	39.3°
ThetaBW	116.4°
ThetaBW Up	33.6°
ThetaBW Down	82.9°
Boresight Phi	60°
Boresight Theta	150°
Maximum Power	4.76 dBm
Minimum Power	-13.72 dBm
Average Power	-0.76 dBm
Max/Min Ratio	18.48 dB
Max/Avg Ratio	5.52 dB
Min/Avg Ratio	-12.96 dB
Worst Single Value	-22.00 dBm
Worst Position	Azi = 345°; Elev = 75°; Pol = Horizontal
Best Single Value	3.92 dBm
Best Position	Azi = 45°; Elev = 105°; Pol = Vertical

**Table 169. Board #11: RP\_2480.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-2.36	-3.11	-4.97	-0.87	-4.91	-0.47	-2.39	-3.53	-5.23	-2.81	0.23	-0.14	2.87
15	-3.72	-3.48	-2.73	-0.57	-1.6	-0.11	0.78	-2.97	-1.26	0.61	1.05	0.15	2.15
30	-4.6	-2.8	-1.02	0.21	0.84	0.08	2.24	1.88	0.62	1.82	2.91	0.48	1.42
45	-5.07	-2.38	-0.21	1.75	1.43	2.11	3.24	4.09	2.41	1.85	4.29	0.97	1.32
60	-5.94	-2.74	-0.33	2.42	0.88	2.73	2.42	4.22	3.39	3.02	4.76	2	1.82
75	-6.77	-3.19	-1.36	1.32	-1.11	0.29	-1.46	2.82	2.09	3.61	4.08	2.39	2.3
90	-4.18	-2.81	-2.5	-1.6	-2.64	-4.63	-6.85	-1.06	0.09	2.54	3.2	1.53	2.38
105	-2.65	-2.4	-1.41	-2.53	-1.75	-5.62	-6.55	-4.02	-1.41	0.04	2.54	0.95	2.73
120	-2.18	-2.12	-0.25	-1.97	-1.74	-2.83	-5.55	-5.28	-3.19	-3.23	2.06	0.47	3.21
135	-2.07	-3.2	0.06	-1.11	0.27	-0.57	-1.71	-8.45	-1.91	-2.77	1.51	-0.05	3.07
150	-2.23	-3.71	0.15	-0.26	2.54	1.89	2.35	-0.97	1.5	1.43	1.7	-0.22	3.13
165	-2.02	-3.28	-0.17	0.91	2.55	3.95	2.69	3.71	1.47	2.65	1.59	0.18	3.2
180	-1.88	-2.45	-1.58	0.13	-0.51	1.49	0.23	2.58	-0.44	0.34	-0.61	0.24	3.54
195	-1.95	-2.41	-4.52	-4.42	-5.93	-4.51	-3.03	-4.23	-4.46	-3.25	-4.9	0.3	3.87
210	-2.15	-3.45	-8.17	-13.6	-8.72	-4.55	-5.23	-7.35	-3.12	-7.06	-7.06	0	3.82
225	-2.5	-4.16	-9.69	-11.54	-6.17	-3.12	-3.61	-4.13	-4.22	-4.39	-6.93	-0.81	3.34
240	-3.25	-4.18	-9.21	-10.08	-5.01	-3.45	-2.21	-3.79	-2.72	-3.59	-6.79	-1.27	2.71
255	-3.69	-3.91	-8.25	-6.85	-3.98	-1.48	-2.83	-1.29	-3.13	-7.53	-8.72	-1.84	2.55
270	-3.49	-2.59	-6.91	-5.53	-4.42	-3.33	-2.12	-1.51	-4.46	-6.84	-13.72	-2.37	2.66
285	-3.05	-1.94	-6.06	-5.52	-7.31	-6.34	-2.73	-5.06	-3.75	-5.38	-10.93	-2.62	2.51
300	-2.38	-1.62	-5.67	-5.09	-9.84	-7.61	-4.39	-7.86	-3.21	-5.93	-9.54	-2.75	3.04
315	-1.37	-1.14	-5.42	-3.97	-9.94	-7.21	-6.48	-6.95	-4.79	-4.38	-8.43	-2.32	3.87
330	-0.57	-0.99	-5.92	-2.79	-7.42	-6.61	-6.18	-6.51	-8.54	-3.49	-4.03	-2.11	4.16
345	-0.52	-1.76	-6.37	-1.9	-5.94	-5.43	-5.13	-6.03	-11.37	-4.61	-1.35	-1.69	3.84
360	-2.36	-3.11	-4.97	-0.87	-4.91	-0.47	-2.39	-3.53	-5.23	-2.81	0.23	-0.14	2.87

**Table 170. Board #11: RP\_2480.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-13.74	-15.95	-21.04	-15.88	-17.19	-12.06	-13.03	-16.63	-8.94	-5.67	-7.56	-19.15	-7.41
15	-11.75	-15.35	-19.36	-13.24	-12	-8.96	-12.88	-14	-9.41	-6.27	-9.98	-15.17	-5.43
30	-8.79	-10.64	-11.98	-9.59	-8.47	-15.74	-12.66	-12.06	-10.37	-16.86	-16.66	-11.29	-2.53
45	-7.2	-6.78	-7.68	-5.89	-7.94	-13.6	-19.63	-10.04	-7.84	-8.62	-6.32	-6.62	-0.51
60	-7.05	-5.37	-4.46	-3.05	-5.57	-7.47	-18.3	-6.17	-2.91	-1.79	-1.56	-2.41	0.98
75	-7.8	-4.93	-3.22	-1.79	-3.66	-5.34	-15.88	-4.03	-0.75	0.92	0.91	-0.64	1.68
90	-4.82	-3.44	-2.78	-2.36	-2.83	-5.52	-11.56	-4.51	-0.62	1.04	2.15	-0.25	1.39
105	-3.45	-2.52	-1.56	-3.11	-2.91	-7.85	-10.97	-5.27	-1.7	-0.88	2.24	0.2	0.79
120	-3.66	-2.37	-0.59	-2.66	-3.38	-6.03	-9.73	-7.29	-4.65	-4.51	1.3	-0.02	-0.21
135	-4.29	-4.12	-1.29	-2.39	-1.67	-2.49	-8.89	-13.28	-10.36	-12.41	-1.34	-1.36	-2.09
150	-6.01	-7.06	-3.7	-5.09	-2.44	-4.33	-10.77	-13.98	-8.76	-13.51	-6.54	-4.06	-4.76
165	-7.79	-9.94	-7.72	-8.74	-7.01	-8.37	-12.01	-7.94	-12.09	-17.74	-14.72	-6.82	-8.24
180	-9.26	-10.57	-9.38	-9.03	-8.34	-11.97	-9.2	-12.87	-20.95	-13.78	-9.91	-8.05	-8.07
195	-9.33	-8.75	-8.81	-10.78	-8.39	-16.05	-8.23	-11.54	-18.34	-9.14	-9.03	-6.88	-4.56
210	-8.35	-7.42	-9.66	-15.36	-13.65	-17.99	-10.75	-15.43	-9.6	-12.18	-10.37	-5.34	-1.85
225	-7.13	-6.92	-11.19	-17.19	-18.87	-9.21	-10.17	-16.75	-10.38	-20.3	-10.2	-4.53	-0.36
240	-5.88	-6.62	-12.79	-13.69	-16.63	-9.59	-18.81	-18.1	-19.16	-11.77	-10.58	-4.05	0.72
255	-5.08	-7.01	-13.52	-16.68	-14.27	-16.33	-18.25	-16.66	-12.74	-10.74	-13.59	-3.98	1.52
270	-5.32	-8.49	-15.52	-17.74	-16.51	-13.86	-17.34	-19.27	-10.28	-9.82	-17.58	-4.31	1.95
285	-6.23	-10.1	-16.83	-15.47	-15.85	-13.17	-16.97	-17.56	-10.87	-7.6	-13.5	-5.2	1.35
300	-8.41	-12.52	-17.34	-16.24	-13.37	-13.89	-14.83	-12.44	-9.53	-6.71	-12.13	-6.71	0.47
315	-12.63	-12.09	-15.08	-16.38	-15.82	-19.37	-15.51	-11.17	-10.4	-7	-12.98	-9.06	-0.5
330	-13.73	-10.72	-13.52	-17.62	-21.84	-20.44	-17.46	-13.01	-12.7	-9.2	-11.52	-12.79	-2.37
345	-13.57	-11.47	-14.26	-17.04	-18.98	-22	-18.8	-19.6	-13.83	-10.65	-8.84	-16.49	-5.02
360	-13.74	-15.95	-21.04	-15.88	-17.19	-12.06	-13.03	-16.63	-8.94	-5.67	-7.56	-19.15	-7.41

**Table 171. Board #11: RP\_2480.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-2.68	-3.34	-5.08	-1.01	-5.17	-0.78	-2.79	-3.75	-7.64	-5.98	-0.56	-0.2	2.44
15	-4.47	-3.77	-2.82	-0.81	-2.01	-0.71	0.59	-3.32	-1.99	-0.39	0.69	0.02	1.32
30	-6.69	-3.58	-1.39	-0.27	0.3	-0.03	2.1	1.7	0.26	1.76	2.86	0.18	-0.82
45	-9.2	-4.34	-1.06	0.93	0.89	1.99	3.22	3.92	1.98	1.44	3.9	0.13	-3.32
60	-12.42	-6.17	-2.45	0.97	-0.23	2.29	2.38	3.81	2.23	1.28	3.61	0.05	-5.7
75	-13.54	-8.01	-5.94	-1.6	-4.64	-1.1	-1.62	1.81	-1.09	0.25	1.22	-0.6	-6.45
90	-12.79	-11.5	-14.62	-9.52	-16.5	-11.95	-8.65	-3.67	-8.14	-2.79	-3.5	-3.19	-4.56
105	-10.39	-17.96	-16.08	-11.5	-8.05	-9.59	-8.5	-10.02	-13.36	-7.14	-9.29	-7.04	-1.71
120	-7.59	-14.62	-11.43	-10.31	-6.78	-5.65	-7.64	-9.6	-8.62	-9.16	-5.9	-9.24	0.56
135	-6.04	-10.42	-5.68	-7.02	-4.16	-5.03	-2.64	-10.18	-2.58	-3.27	-1.68	-5.9	1.49
150	-4.59	-6.4	-2.15	-1.99	0.89	0.71	2.14	-1.19	1.07	1.28	1	-2.53	2.36
165	-3.35	-4.34	-1.01	0.41	2.04	3.69	2.54	3.4	1.27	2.61	1.49	-0.79	2.87
180	-2.75	-3.18	-2.37	-0.43	-1.3	1.29	-0.3	2.46	-0.48	0.17	-1.15	-0.45	3.23
195	-2.83	-3.56	-6.54	-5.56	-9.57	-4.82	-4.59	-5.12	-4.64	-4.54	-7.02	-0.62	3.2
210	-3.34	-5.68	-13.53	-18.39	-10.4	-4.75	-6.66	-8.09	-4.23	-8.66	-9.78	-1.5	2.44
225	-4.33	-7.43	-15.04	-12.92	-6.41	-4.34	-4.69	-4.38	-5.42	-4.5	-9.69	-3.21	0.92
240	-6.67	-7.86	-11.72	-12.56	-5.32	-4.66	-2.31	-3.96	-2.82	-4.3	-9.14	-4.53	-1.65
255	-9.32	-6.83	-9.77	-7.33	-4.41	-1.63	-2.96	-1.42	-3.63	-10.34	-10.43	-5.92	-4.22
270	-8.14	-3.89	-7.56	-5.8	-4.7	-3.73	-2.26	-1.58	-5.77	-9.87	-16.02	-6.8	-5.53
285	-5.9	-2.66	-6.44	-5.98	-7.96	-7.36	-2.9	-5.31	-4.69	-9.35	-14.43	-6.11	-3.77
300	-3.62	-1.99	-5.98	-5.44	-12.39	-8.77	-4.8	-9.72	-4.36	-13.79	-13	-4.98	-0.47
315	-1.71	-1.5	-5.92	-4.23	-11.24	-7.48	-7.06	-9.02	-6.19	-7.82	-10.3	-3.36	1.9
330	-0.79	-1.48	-6.74	-2.94	-7.58	-6.79	-6.52	-7.62	-10.64	-4.85	-4.89	-2.5	3.07
345	-0.74	-2.25	-7.14	-2.03	-6.16	-5.52	-5.32	-6.22	-15	-5.86	-2.2	-1.84	3.24
360	-2.68	-3.34	-5.08	-1.01	-5.17	-0.78	-2.79	-3.75	-7.64	-5.98	-0.56	-0.2	2.44

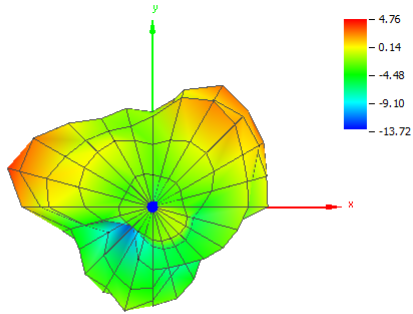


Figure 258. Board #11 (2.48 GHz): Theta = 0, Phi = 0

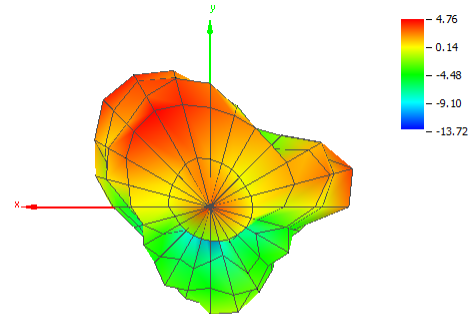


Figure 259. Board #11 (2.48 GHz): Theta = 180, Phi = 0

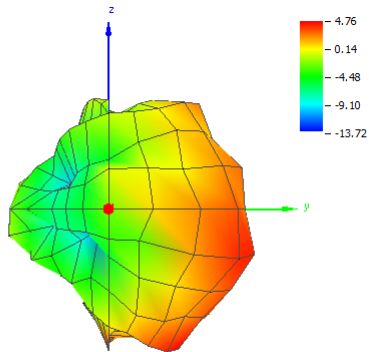


Figure 260. Board #11 (2.48 GHz): Theta = 90, Phi = 0

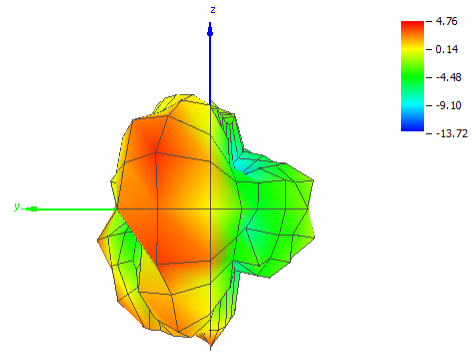


Figure 261. Board #11 (2.48 GHz): Theta = 90, Phi = 180

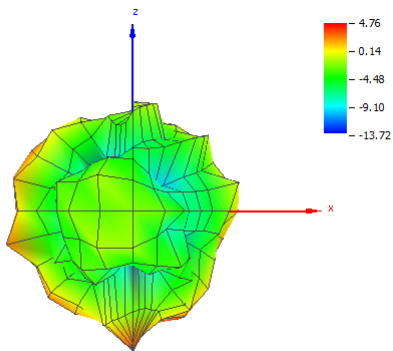


Figure 262. Board #11 (2.48 GHz): Theta = 90, Phi = 270

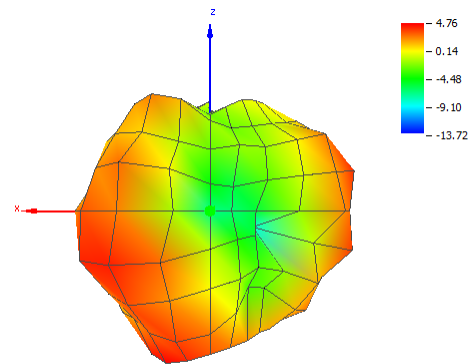


Figure 263. Board #11 (2.48 GHz): Theta = 90, Phi = 90

**A.12 Board #12: 868/915/920 MHz Single-Sided Compact PCB Antenna**
**A.12.1 868 MHz**
**Table 172. Board #12: OTA Evaluation Results (868 MHz)**

Test Description	Test Result
Total Radiated Power	-3.38 dBm
Peak EIRP	1.02 dBm
Directivity	4.40 dBi
Efficiency	-3.38 dB
Efficiency	0.4594
Peak Gain	1.02 dBi
NHPRP 45°	-5.52 dBm
NHPRP 45° / TRP	-2.15 dB
NHPRP 45° / TRP	0.6101
NHPRP 30°	-7.20 dBm
NHPRP 30° / TRP	-3.82 dB
NHPRP 30° / TRP	0.4151
NHPRP 22.5°	-8.42 dBm
NHPRP 22.5° / TRP	-5.04 dB
NHPRP 22.5° / TRP	0.3135
UHRP	-7.08 dBm
UHRP / TRP	-3.70 dB
UHRP / TRP	0.4267
LHRP	-5.79 dBm
LHRP / TRP	-2.42 dB
LHRP / TRP	0.5733
PGRP (0-120°)	-5.25 dBm
PGRP / TRP	-1.87 dB
PGRP / TRP	0.6503
Front/Back Ratio	0.51
PhiBW	119.9°
PhiBW Up	64.0°
PhiBW Down	55.9°
ThetaBW	48.1°
ThetaBW Up	18.1°
ThetaBW Down	30.0°
Boresight Phi	90°
Boresight Theta	30°
Maximum Power	1.02 dBm
Minimum Power	-18.23 dBm
Average Power	-3.26 dBm
Max/Min Ratio	19.25 dB
Max/Avg Ratio	4.28 dB
Min/Avg Ratio	-14.97 dB
Worst Single Value	-27.47 dBm
Worst Position	Azi = 150°; Elev = 75°; Pol = Horizontal
Best Single Value	0.79 dBm
Best Position	Azi = 240°; Elev = 150°; Pol = Horizontal



**Table 173. Board #12: RP\_868.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-10.34	-9.44	-8.75	-8.07	-4.53	-2.47	-3.96	-13.12	-4.58	-1.39	-1.21	-1.77	-2.54
15	-10.14	-7.79	-5.89	-5.52	-2.9	-2.94	-8.85	-10.74	-2.16	-2.77	-2.47	-2.36	-3
30	-8.18	-5.67	-2.55	-2.34	-2.5	-3.92	-7.93	-3.04	-1.65	-5.03	-3.67	-3.52	-3.66
45	-5.71	-3.52	-0.44	-0.47	-3.01	-4.13	-2.18	0.2	-2.68	-7.94	-3.91	-4.62	-4.53
60	-3.75	-1.89	0.58	0.05	-3.89	-3.17	0.22	0.65	-4.04	-8.17	-2.89	-4.85	-5.31
75	-2.41	-0.77	0.99	-0.26	-4.93	-2.3	0.17	-0.75	-4.34	-5.63	-1.45	-4.24	-5.64
90	-1.66	-0.28	1.02	-0.92	-6.01	-2.61	-2.08	-3.39	-3.79	-3.75	-0.4	-3.43	-5.47
105	-1.39	-0.34	0.78	-1.92	-6.56	-3.86	-6.97	-6.79	-3.13	-2.73	0.19	-2.68	-5.1
120	-1.62	-0.84	0.31	-2.69	-5.31	-4.36	-13.38	-6.87	-3.13	-2.52	0.27	-2.3	-4.73
135	-2.17	-1.66	-0.38	-2.76	-3.14	-3.15	-6.94	-3.33	-3.38	-2.61	0.06	-2.13	-4.47
150	-2.82	-2.53	-1.45	-2.53	-1.76	-2.02	-3.62	-0.62	-3.15	-2.44	-0.21	-2.12	-4.53
165	-3.56	-3.53	-3.45	-2.65	-1.25	-2.05	-3.87	0.6	-2.88	-1.69	-0.33	-2.25	-4.94
180	-4.26	-4.57	-6.59	-3.51	-1.44	-3.11	-7.3	-0.47	-3.22	-0.56	-0.18	-2.35	-5.54
195	-4.84	-5.67	-10.63	-5.55	-2.34	-4.28	-10.03	-5.57	-4.6	0.53	0.22	-2.33	-6.25
210	-5.26	-6.86	-9.38	-7.63	-4.47	-4.92	-8.58	-18.23	-6.01	0.95	0.61	-2.2	-6.58
225	-5.64	-8.02	-6.28	-6.29	-8.2	-5.76	-7.24	-5.66	-5.05	0.54	0.87	-1.93	-6.06
240	-6.11	-8.78	-4.81	-4.02	-9.55	-7.77	-6.3	-2.67	-4.04	-0.71	0.87	-1.54	-4.89
255	-6.73	-8.96	-4.58	-3.33	-8.93	-11.36	-7.05	-2.63	-4.75	-2.69	0.68	-0.98	-3.57
270	-6.94	-9	-5.46	-4.1	-9.01	-14.42	-10.23	-4.66	-7.06	-4.49	0.51	-0.46	-2.72
285	-6.46	-8.75	-7.04	-5.66	-8.85	-14.3	-15.47	-9.06	-9.32	-5.06	0.51	-0.01	-2.14
300	-6.01	-8.37	-7.84	-6.64	-8.19	-11.83	-9.65	-10.24	-8.59	-4.13	0.72	0.16	-1.9
315	-6.42	-8.27	-7.69	-6.79	-7.59	-8.45	-4.4	-6	-6.84	-2.82	0.75	0.09	-1.96
330	-7.61	-8.68	-7.87	-6.92	-7.3	-5.64	-2	-3.91	-6.08	-1.92	0.41	-0.25	-2.21
345	-8.79	-9.74	-8.56	-7.92	-6.86	-3.63	-1.57	-4.61	-5.74	-1.44	-0.03	-0.55	-2.32
360	-10.34	-9.44	-8.75	-8.07	-4.53	-2.47	-3.96	-13.12	-4.58	-1.39	-1.21	-1.77	-2.54

**Table 174. Board #12: RP\_868.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-12.97	-10.09	-9.32	-9.85	-7.45	-7.79	-12.81	-14.12	-6.25	-3.1	-5.53	-10.57	-11.16
15	-11.14	-8.39	-8.74	-10.03	-6.86	-6.69	-12.12	-17.18	-6.39	-5.2	-6.61	-8.83	-8.61
30	-9.53	-7.24	-8.1	-9.46	-6.27	-5.95	-12.52	-19.49	-9.8	-8.53	-6.54	-7.28	-6.93
45	-8.32	-6.41	-7.27	-7.71	-5.73	-6.3	-16.08	-15.22	-22.3	-11.14	-5.55	-6.21	-6
60	-7.91	-5.83	-5.79	-5.76	-5.41	-7.99	-21.75	-12.55	-13.87	-9.27	-4.25	-5.47	-5.65
75	-8.59	-5.4	-3.81	-4.1	-5.54	-10.48	-22.76	-10.98	-6.91	-6.37	-2.84	-4.74	-5.76
90	-10.7	-5.35	-2.38	-3.15	-6.31	-12.53	-20.61	-9.81	-4.29	-4.81	-1.79	-4.15	-6.21
105	-14.96	-6.13	-1.77	-3.13	-8.01	-13.59	-18.95	-9.4	-3.27	-4.28	-1.13	-3.66	-7.37
120	-17.2	-7.83	-2.2	-3.86	-10.19	-15.28	-18.48	-10.52	-3.68	-4.57	-0.99	-3.51	-9.46
135	-13.55	-10.56	-3.55	-5.22	-12.56	-20.54	-21.52	-13.37	-5.39	-5.13	-1.18	-3.62	-12.95
150	-10.98	-12.25	-5.67	-6.96	-14.49	-27.47	-26.77	-17.07	-7.93	-5.1	-1.36	-3.79	-15.57
165	-9.27	-11.32	-8.54	-9.08	-15.52	-18.98	-18.37	-19.8	-10.57	-4.24	-1.35	-3.85	-12.96
180	-7.95	-9.49	-10.67	-11.21	-15.03	-15.13	-13.04	-22.43	-10.44	-2.85	-1.04	-3.63	-10.13
195	-6.77	-8.11	-11.07	-13.64	-14.76	-12.73	-10.33	-26.04	-8.32	-1.37	-0.47	-3.14	-8.13
210	-6.03	-7.77	-11.25	-16.42	-15.2	-11.39	-9.69	-19.79	-7.26	-0.49	0.14	-2.56	-6.95
225	-5.83	-8.33	-12.73	-18.88	-15.48	-11.13	-10.69	-16.37	-7.78	-0.34	0.63	-1.99	-6.14
240	-6.48	-9.99	-15.2	-15.83	-14.31	-11.94	-12.31	-15.52	-9.92	-1.07	0.79	-1.56	-5.69
255	-8.52	-13.21	-15.29	-11.56	-12.33	-13.69	-14.12	-15.25	-14.25	-2.76	0.61	-1.25	-5.57
270	-11.92	-19.2	-12.98	-8.99	-10.65	-14.98	-16.01	-14.76	-18.93	-4.61	0.23	-1.2	-5.89
285	-14.27	-23.08	-11.4	-7.88	-9.45	-14.61	-17.31	-13.92	-16.4	-5.31	-0.2	-1.59	-6.82
300	-13.08	-19.02	-10.66	-7.64	-8.75	-13.21	-17.03	-13.09	-13.71	-4.38	-0.5	-2.63	-8.76
315	-13.3	-16.9	-10.47	-8.07	-8.44	-11.47	-16.04	-13.01	-11.2	-3.07	-1.11	-4.63	-12.88
330	-14.98	-15.18	-10.69	-8.81	-8.32	-10.11	-15.56	-13.41	-8.64	-2.27	-2.13	-7.24	-20.74
345	-14.9	-13.65	-10.65	-9.38	-8.05	-8.87	-15.02	-13.59	-6.54	-2.07	-3.53	-8.49	-18.66
360	-12.97	-10.09	-9.32	-9.85	-7.45	-7.79	-12.81	-14.12	-6.25	-3.1	-5.53	-10.57	-11.16

**Table 175. Board #12: RP\_868.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-13.76	-17.99	-17.83	-12.82	-7.63	-3.98	-4.57	-19.97	-9.54	-6.26	-3.21	-2.38	-3.18
15	-16.99	-16.69	-9.07	-7.41	-5.12	-5.32	-11.63	-11.86	-4.22	-6.43	-4.58	-3.47	-4.39
30	-13.93	-10.87	-3.97	-3.28	-4.87	-8.19	-9.78	-3.14	-2.37	-7.59	-6.84	-5.89	-6.42
45	-9.16	-6.66	-1.45	-1.38	-6.34	-8.18	-2.36	0.07	-2.73	-10.77	-8.93	-9.74	-9.94
60	-5.86	-4.13	-0.56	-1.27	-9.19	-4.91	0.2	0.44	-4.52	-14.66	-8.6	-13.61	-16.56
75	-3.61	-2.6	-0.76	-2.57	-13.74	-3.02	0.15	-1.19	-7.84	-13.68	-7.07	-13.85	-21.23
90	-2.24	-1.89	-1.63	-4.87	-17.78	-3.08	-2.14	-4.52	-13.39	-10.38	-6.03	-11.58	-13.53
105	-1.58	-1.67	-2.75	-8.07	-12.06	-4.35	-7.26	-10.25	-18.35	-7.95	-5.63	-9.65	-9.01
120	-1.74	-1.81	-3.26	-8.93	-7.01	-4.73	-14.99	-9.33	-12.37	-6.78	-5.72	-8.43	-6.51
135	-2.49	-2.26	-3.25	-6.4	-3.67	-3.23	-7.09	-3.78	-7.67	-6.18	-6.02	-7.49	-5.14
150	-3.54	-3.02	-3.51	-4.47	-1.99	-2.03	-3.65	-0.72	-4.91	-5.82	-6.55	-7.08	-4.89
165	-4.91	-4.32	-5.06	-3.78	-1.42	-2.14	-4.03	0.56	-3.69	-5.21	-7.12	-7.35	-5.69
180	-6.68	-6.26	-8.75	-4.32	-1.64	-3.39	-8.65	-0.49	-4.13	-4.44	-7.61	-8.26	-7.4
195	-9.31	-9.34	-20.88	-6.28	-2.6	-4.94	-21.74	-5.61	-6.99	-3.98	-8.11	-10.02	-10.8
210	-13.16	-14.08	-13.95	-8.24	-4.86	-6.03	-15.06	-23.43	-12.04	-4.53	-9.24	-13.09	-17.47
225	-19.26	-19.55	-7.4	-6.54	-9.09	-7.25	-9.84	-6.04	-8.37	-6.82	-11.83	-20.6	-23.91
240	-17	-14.94	-5.23	-4.31	-11.31	-9.86	-7.55	-2.9	-5.34	-11.65	-16.48	-24.71	-12.65
255	-11.45	-11.01	-4.96	-4.04	-11.59	-15.18	-8.01	-2.88	-5.26	-20.88	-17.02	-13.22	-7.9
270	-8.6	-9.44	-6.31	-5.81	-14.04	-23.55	-11.57	-5.11	-7.35	-20.07	-11.52	-8.49	-5.57
285	-7.25	-8.91	-9.03	-9.63	-17.79	-25.94	-20.09	-10.78	-10.27	-17.43	-7.75	-5.17	-3.95
300	-6.96	-8.76	-11.04	-13.49	-17.32	-17.47	-10.53	-13.41	-10.19	-16.64	-5.37	-3.08	-2.9
315	-7.41	-8.91	-10.94	-12.74	-15.12	-11.45	-4.71	-6.96	-8.82	-15.27	-3.83	-1.69	-2.32
330	-8.49	-9.78	-11.07	-11.46	-14.09	-7.57	-2.2	-4.43	-9.6	-13.04	-3.12	-1.21	-2.27
345	-10.02	-12	-12.73	-13.36	-13.08	-5.18	-1.77	-5.2	-13.49	-10.18	-2.59	-1.31	-2.42
360	-13.76	-17.99	-17.83	-12.82	-7.63	-3.98	-4.57	-19.97	-9.54	-6.26	-3.21	-2.38	-3.18

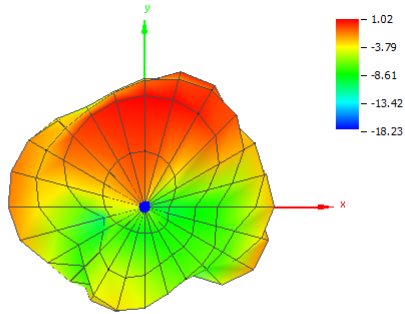


Figure 264. Board #12 (868 MHz): Theta = 0, Phi = 0

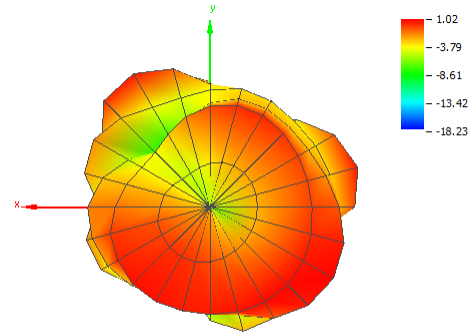


Figure 265. Board #12 (868 MHz): Theta = 180, Phi = 0

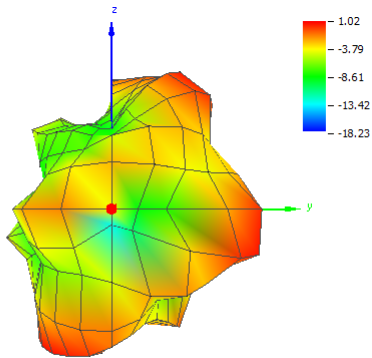


Figure 266. Board #12 (868 MHz): Theta = 90, Phi = 0

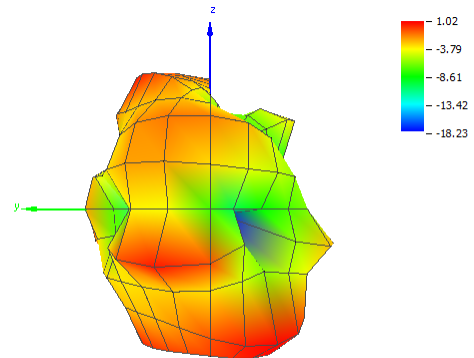


Figure 267. Board #12 (868 MHz): Theta = 90, Phi = 180

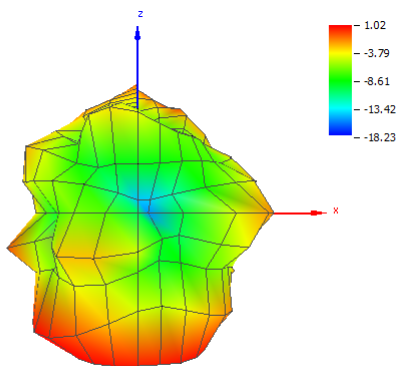


Figure 268. Board #12 (868 MHz): Theta = 90, Phi = 270

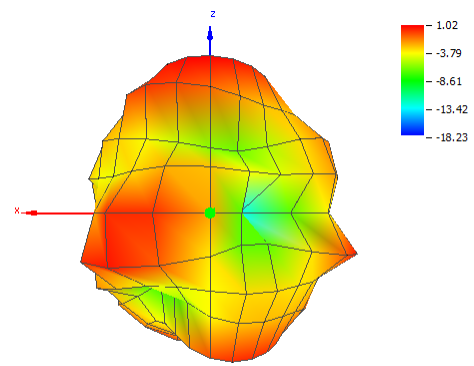


Figure 269. Board #12 (868 MHz): Theta = 90, Phi = 90

**A.12.2 915 MHz**
**Table 176. Board #12: OTA Evaluation Results (915 MHz)**

Test Description	Test Result
Total Radiated Power	-5.11 dBm
Peak EIRP	-0.39 dBm
Directivity	4.72 dBi
Efficiency	-5.11 dB
Efficiency	0.3085
Peak Gain	-0.39 dBi
NHPRP 45°	-7.22 dBm
NHPRP 45° / TRP	-2.11 dB
NHPRP 45° / TRP	0.6152
NHPRP 30°	-8.95 dBm
NHPRP 30° / TRP	-3.85 dB
NHPRP 30° / TRP	0.4126
NHPRP 22.5°	-10.18 dBm
NHPRP 22.5° / TRP	-5.08 dB
NHPRP 22.5° / TRP	0.3106
UHRP	-8.75 dBm
UHRP / TRP	-3.64 dB
UHRP / TRP	0.4322
LHRP	-7.57 dBm
LHRP / TRP	-2.46 dB
LHRP / TRP	0.5678
PGRP (0-120°)	-7.00 dBm
PGRP / TRP	-1.89 dB
PGRP / TRP	0.6469
Front/Back Ratio	6.05
PhiBW	255.9°
PhiBW Up	142.3°
PhiBW Down	113.6°
ThetaBW	37.3°
ThetaBW Up	21.3°
ThetaBW Down	16.0°
Boresight Phi	225°
Boresight Theta	150°
Maximum Power	-0.39 dBm
Minimum Power	-18.60 dBm
Average Power	-4.88 dBm
Max/Min Ratio	18.22 dB
Max/Avg Ratio	4.49 dB
Min/Avg Ratio	-13.72 dB
Worst Single Value	-33.85 dBm
Worst Position	Azi = 165°; Elev = 180°; Pol = Horizontal
Best Single Value	-0.51 dBm
Best Position	Azi = 240°; Elev = 150°; Pol = Horizontal

**Table 177. Board #12: RP\_915.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-9.84	-7.96	-9.44	-15.59	-13.37	-6.68	-5.22	-11.32	-7.49	-4.18	-2.67	-2.35	-2.92
15	-10.53	-8.12	-10.07	-13.06	-9.5	-5.86	-7.49	-14.24	-5.07	-4.99	-4.15	-3.09	-3.78
30	-10.12	-8.31	-8.29	-7.69	-5.91	-5.76	-6.01	-6.82	-3.19	-6.8	-6.11	-3.91	-4.59
45	-9.27	-8.28	-6.44	-4.27	-4.42	-5.98	-2.48	-3.26	-2.67	-8.99	-7.11	-4.6	-5.11
60	-8.47	-8.1	-5.15	-2.52	-4.63	-5.43	-1.03	-2.42	-3.15	-8.91	-6.42	-4.84	-5.39
75	-7.96	-7.64	-4.4	-2.12	-5.95	-4.99	-1.55	-3.79	-3.72	-7.04	-5.13	-4.82	-5.31
90	-7.45	-7.07	-3.95	-2.47	-7.38	-5.46	-3.57	-7.13	-4.08	-5.64	-4.21	-4.71	-4.82
105	-6.72	-6.07	-3.43	-2.9	-7.56	-6.09	-6.49	-12.19	-4.1	-4.95	-3.61	-4.59	-4.2
120	-5.91	-4.84	-2.76	-3	-6.42	-5.81	-9.2	-11.15	-3.75	-4.46	-3.09	-4.42	-3.79
135	-5.28	-3.9	-2.35	-3	-4.96	-4.68	-9.01	-6.1	-3.09	-4.14	-2.65	-4.16	-3.78
150	-4.99	-3.49	-2.54	-3.27	-3.65	-3.59	-8.18	-2.95	-2.33	-3.83	-2.26	-3.84	-3.91
165	-5.12	-3.6	-3.59	-4.34	-3.27	-2.75	-8.8	-1.7	-2.34	-3.07	-1.95	-3.35	-4.17
180	-5.69	-4.34	-5.43	-6.95	-4.73	-2.31	-10.64	-2.55	-3.98	-2.16	-1.57	-2.8	-4.57
195	-6.54	-5.69	-7.14	-10.73	-8.76	-2.97	-10.02	-6.2	-7.9	-1.91	-1.06	-2.33	-5.11
210	-7.59	-7.43	-7.4	-8.78	-11.89	-5.77	-7.13	-18.6	-11.81	-2.37	-0.62	-1.97	-5.62
225	-8.28	-8.89	-6.26	-5.35	-8.53	-10.14	-6.42	-11.58	-8.69	-2.99	-0.39	-1.75	-5.65
240	-8.36	-9.02	-5.24	-3.38	-6.71	-11.03	-8.13	-6.52	-6.54	-3.46	-0.44	-1.69	-5.39
255	-8.23	-8.27	-4.92	-2.72	-6.04	-9.06	-11.15	-6.06	-6.3	-4.15	-0.7	-1.73	-4.83
270	-8.24	-7.27	-4.94	-3.02	-6.17	-8.33	-13.36	-7.95	-7.18	-5.25	-1.1	-1.66	-4.19
285	-8.16	-6.36	-4.93	-3.94	-6.7	-8.67	-12.33	-10.61	-7.86	-6.42	-1.33	-1.35	-3.45
300	-7.68	-5.98	-4.98	-5.13	-7.09	-9.18	-9.66	-9.37	-7.43	-6.78	-1.28	-0.96	-2.74
315	-7.42	-6.14	-5.34	-6.21	-7.53	-9.34	-7.16	-6.33	-7.03	-6.18	-0.99	-0.7	-2.25
330	-7.68	-6.46	-6.13	-7.4	-8.61	-9.05	-5.28	-4.66	-7.56	-5.18	-0.8	-0.75	-2.06
345	-8.1	-6.91	-7.25	-9.23	-10.59	-8.38	-4.49	-5.01	-8.21	-4.45	-1.18	-1.04	-2.23
360	-9.84	-7.96	-9.44	-15.59	-13.37	-6.68	-5.22	-11.32	-7.49	-4.18	-2.67	-2.35	-2.92

**Table 178. Board #12: RP\_915.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-16.09	-11.24	-11.37	-19.56	-15.45	-10.36	-14.48	-22.96	-13.01	-6.83	-7.29	-11.44	-18.17
15	-13.71	-9.59	-10.2	-15.07	-17.12	-9.62	-15.33	-28.55	-14.09	-8.69	-8.97	-11.56	-13.19
30	-11.77	-8.76	-9	-12.43	-16.05	-9.51	-17.68	-25.09	-18.61	-13.66	-11.14	-9.82	-9.33
45	-11.38	-8.96	-8.54	-10.49	-13.35	-10.4	-18.42	-26.88	-19.36	-33.33	-10.98	-8.03	-7.19
60	-12.67	-10.14	-8.4	-8.45	-11.38	-11.95	-18.74	-24.1	-11.93	-13.2	-8.64	-6.58	-5.98
75	-15.52	-11.83	-8.25	-6.85	-10.16	-13.54	-20.55	-17.49	-7.71	-8.3	-6.55	-5.72	-5.48
90	-18.5	-13.99	-8.04	-5.68	-9.52	-15.29	-20.92	-14.81	-5.73	-6.19	-5.36	-5.43	-5.6
105	-19.42	-15.15	-7.86	-5.17	-9.27	-17.14	-20.58	-14.11	-5.08	-5.44	-4.86	-5.65	-6.44
120	-19.96	-14.44	-7.91	-5.44	-9.48	-19.17	-23.03	-14.85	-5.3	-5.4	-4.83	-6.29	-8.17
135	-18.74	-13.24	-8.53	-6.86	-10.4	-22.29	-31.27	-17.96	-6.4	-6.26	-5.18	-7.21	-11.24
150	-15.63	-12.27	-9.7	-9.78	-12.13	-30.16	-20.99	-25.68	-8.89	-8.25	-5.75	-8.01	-16.89
165	-13.03	-11.32	-10.78	-13.67	-15.42	-26.97	-15.52	-19.47	-12.43	-9.32	-5.85	-7.81	-33.85
180	-11.26	-10.51	-10.94	-13.87	-22.82	-21.16	-13.52	-15.58	-13.75	-7.22	-4.74	-6.36	-17.61
195	-10.04	-10	-10.52	-12.01	-21.79	-18.74	-13.29	-16.5	-12.35	-5.05	-2.98	-4.56	-11.48
210	-9.15	-9.94	-10.46	-12.32	-17.5	-16.63	-12.92	-23.45	-12.19	-3.88	-1.56	-3.09	-8.2
225	-8.59	-10.26	-11.16	-14.32	-17.94	-13.88	-12.45	-21.12	-13.81	-3.52	-0.77	-2.16	-6.33
240	-8.48	-10.73	-11.81	-13.1	-16.42	-11.51	-12.89	-15.48	-17.63	-3.81	-0.51	-1.77	-5.43
255	-9.14	-10.84	-10.95	-9.97	-12.2	-10.01	-14.02	-13.3	-24.89	-4.79	-0.71	-1.81	-5.11
270	-10.96	-10.02	-8.86	-7.83	-9.58	-9.46	-15.45	-12.66	-24.54	-6.41	-1.32	-2.13	-5.36
285	-13.92	-8.86	-7.21	-7	-8.39	-9.66	-17.09	-13.12	-18.7	-8.29	-2.06	-2.6	-5.97
300	-16.74	-8.74	-6.72	-7.21	-8.06	-9.92	-18.36	-14.04	-16.1	-9.05	-2.7	-3.27	-7.03
315	-18.49	-10.04	-7.61	-8.54	-8.45	-9.98	-18.24	-14.73	-15.52	-8.11	-3.1	-4.32	-8.89
330	-19.05	-12.04	-9.55	-11.13	-9.33	-10.12	-17.2	-15.46	-15.26	-6.86	-3.63	-6.07	-12.59
345	-17.77	-13.04	-11.66	-14.36	-11.03	-10.37	-15.9	-16.62	-14.07	-6.33	-4.69	-7.75	-20.37
360	-16.09	-11.24	-11.37	-19.56	-15.45	-10.36	-14.48	-22.96	-13.01	-6.83	-7.29	-11.44	-18.17

**Table 179. Board #12: RP\_915.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-11.02	-10.71	-13.91	-17.81	-17.56	-9.12	-5.77	-11.62	-8.91	-7.58	-4.51	-2.92	-3.06
15	-13.38	-13.54	-25.26	-17.38	-10.32	-8.24	-8.27	-14.4	-5.65	-7.4	-5.89	-3.75	-4.3
30	-15.12	-18.41	-16.52	-9.47	-6.35	-8.14	-6.32	-6.88	-3.32	-7.8	-7.75	-5.2	-6.37
45	-13.42	-16.65	-10.6	-5.46	-5.02	-7.93	-2.59	-3.28	-2.77	-9	-9.41	-7.24	-9.3
60	-10.55	-12.36	-7.94	-3.8	-5.66	-6.52	-1.1	-2.45	-3.77	-10.93	-10.4	-9.65	-14.37
75	-8.8	-9.73	-6.71	-3.91	-8.02	-5.64	-1.6	-3.98	-5.93	-13.03	-10.66	-12.09	-19.42
90	-7.8	-8.06	-6.09	-5.3	-11.46	-5.94	-3.65	-7.94	-9.09	-14.88	-10.56	-12.88	-12.66
105	-6.96	-6.64	-5.37	-6.82	-12.44	-6.44	-6.67	-16.66	-11.04	-14.65	-9.63	-11.21	-8.15
120	-6.08	-5.34	-4.34	-6.68	-9.38	-6.02	-9.38	-13.56	-9	-11.55	-7.9	-8.97	-5.76
135	-5.48	-4.44	-3.54	-5.31	-6.42	-4.76	-9.03	-6.39	-5.82	-8.26	-6.19	-7.13	-4.63
150	-5.38	-4.1	-3.47	-4.37	-4.31	-3.6	-8.41	-2.98	-3.42	-5.77	-4.84	-5.94	-4.14
165	-5.89	-4.4	-4.51	-4.88	-3.54	-2.77	-9.84	-1.78	-2.79	-4.25	-4.22	-5.28	-4.17
180	-7.09	-5.54	-6.86	-7.94	-4.8	-2.37	-13.78	-2.77	-4.46	-3.79	-4.44	-5.32	-4.79
195	-9.11	-7.71	-9.8	-16.66	-8.98	-3.09	-12.78	-6.63	-9.83	-4.8	-5.53	-6.28	-6.25
210	-12.8	-11.01	-10.36	-11.32	-13.29	-6.14	-8.46	-20.33	-22.48	-7.69	-7.72	-8.43	-9.11
225	-19.88	-14.58	-7.96	-5.94	-9.06	-12.52	-7.67	-12.09	-10.29	-12.38	-11.13	-12.3	-14.01
240	-23.94	-13.9	-6.33	-3.88	-7.2	-20.83	-9.89	-7.11	-6.89	-14.64	-18.32	-18.91	-26.57
255	-15.48	-11.77	-6.17	-3.63	-7.25	-16.11	-14.3	-6.97	-6.36	-12.78	-25.91	-18.86	-16.8
270	-11.56	-10.56	-7.2	-4.77	-8.82	-14.74	-17.53	-9.74	-7.26	-11.56	-14.07	-11.49	-10.45
285	-9.5	-9.94	-8.84	-6.89	-11.6	-15.57	-14.09	-14.19	-8.24	-10.99	-9.43	-7.37	-7.01
300	-8.26	-9.26	-9.79	-9.33	-14.03	-17.2	-10.29	-11.19	-8.06	-10.68	-6.82	-4.79	-4.76
315	-7.78	-8.41	-9.24	-10.02	-14.71	-17.97	-7.51	-7.01	-7.7	-10.65	-5.13	-3.18	-3.32
330	-8.01	-7.87	-8.76	-9.79	-16.76	-15.66	-5.57	-5.04	-8.37	-10.1	-4	-2.26	-2.46
345	-8.59	-8.12	-9.2	-10.82	-20.73	-12.73	-4.82	-5.32	-9.51	-9.01	-3.74	-2.08	-2.3
360	-11.02	-10.71	-13.91	-17.81	-17.56	-9.12	-5.77	-11.62	-8.91	-7.58	-4.51	-2.92	-3.06



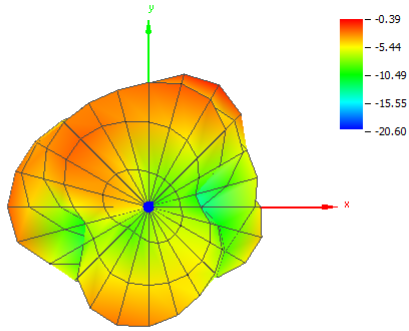


Figure 270. Board #12 (915 MHz): Theta = 0, Phi = 0

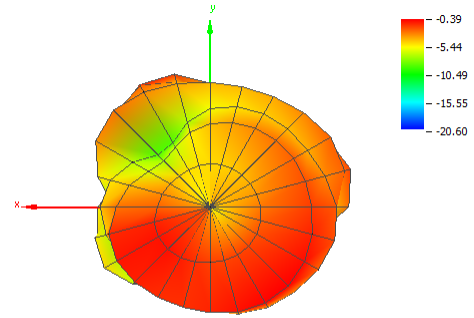


Figure 271. Board #12 (915 MHz): Theta = 180, Phi = 0

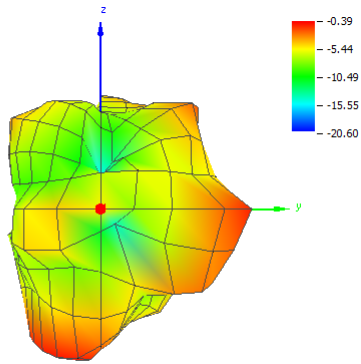


Figure 272. Board #12 (915 MHz): Theta = 90, Phi = 0

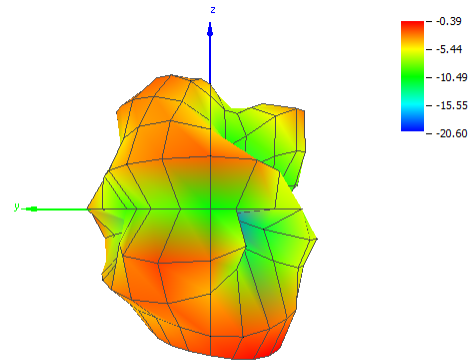


Figure 273. Board #12 (915 MHz): Theta = 90, Phi = 180

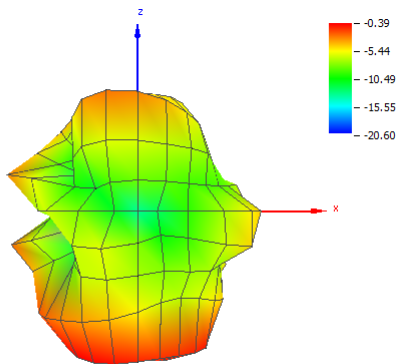


Figure 274. Board #12 (915 MHz): Theta = 90, Phi = 270

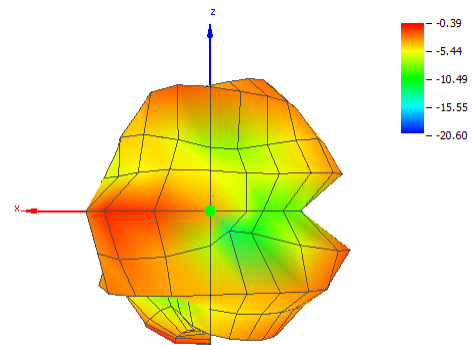


Figure 275. Board #12 (915 MHz): Theta = 90, Phi = 90

**A.13 433-MHz Kit Antenna**
**Table 180. 433-MHz Kit Antenna: OTA Evaluation Results**

Test Description	Test Result
Total Radiated Power	-0.80 dBm
Peak EIRP	2.82 dBm
Directivity	3.62 dBi
Efficiency	-0.80 dB
Efficiency	83.13%
Peak Gain	2.82 dBi
NHPRP 45°	-2.37 dBm
NHPRP 45° / TRP	-1.57 dB
NHPRP 45° / TRP	69.72%
NHPRP 30°	-3.98 dBm
NHPRP 30° / TRP	-3.18 dB
NHPRP 30° / TRP	48.07%
NHPRP 22.5°	-5.23 dBm
NHPRP 22.5° / TRP	-4.43 dB
NHPRP 22.5° / TRP	36.06%
UHRP	-4.22 dBm
UHRP / TRP	-3.42 dB
UHRP / TRP	45.51%
LHRP	-3.44 dBm
LHRP / TRP	-2.64 dB
LHRP / TRP	54.49%
PGRP (0-120°)	-2.24 dBm
PGRP / TRP	-1.44 dB
PGRP / TRP	71.74%
Front/Back Ratio	2.34
PhiBW	88.0°
PhiBW Up	41.9°
PhiBW Down	46.1°
ThetaBW	180.0°
ThetaBW Up	180.0°
ThetaBW Down	180.0°
Boresight Phi	210°
Boresight Theta	105°
Maximum Power	2.82 dBm
Minimum Power	-21.10 dBm
Average Power	-0.62 dBm
Max/Min Ratio	23.92 dB
Max/Avg Ratio	3.45 dB
Min/Avg Ratio	-20.47 dB
Worst Single Value	-34.75 dBm
Worst Position	Azi = 285°; Elev = 105°; Pol = Horizontal
Best Single Value	2.82 dBm
Best Position	Azi = 210°; Elev = 105°; Pol = Vertical

**Table 181. 433-MHz Kit Antenna: RP\_433.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	0.16	0.25	0.59	0.74	0.91	0.35	0.33	1.5	2.31	2.15	1.57	1.15	1.08
15	1.12	0.84	1.23	1.15	1.24	0.61	0.75	1.77	2.74	2.6	2.14	1.58	1.6
30	1.49	1.22	1.24	1.24	0.93	0.48	0.57	1.84	2.62	2.72	2.17	1.81	1.55
45	1.34	1.04	0.67	0.74	0.02	-0.24	-0.32	1.29	1.96	2.37	1.75	1.61	1.04
60	0.63	0.33	-0.54	-0.33	-1.6	-1.65	-2.12	0.04	0.73	1.65	0.93	1.05	0.14
75	-0.59	-1.02	-2.38	-2.11	-4.07	-4.09	-5.18	-2.01	-0.96	0.54	-0.15	0.11	-0.99
90	-2.52	-2.88	-4.88	-4.47	-7.63	-7.99	-10.82	-5.14	-3.1	-0.78	-1.45	-0.92	-2.13
105	-5.06	-5.32	-7.22	-7.15	-11.23	-14.87	-21.1	-8.82	-4.95	-2.06	-2.44	-1.99	-2.79
120	-6.78	-6.64	-6.65	-7.67	-9.11	-12.78	-9.84	-8.98	-5.12	-2.92	-2.8	-2.68	-2.7
135	-5.62	-5.51	-4.21	-5.5	-5.24	-6.72	-4.44	-5.37	-3.62	-3.08	-2.44	-2.8	-2.01
150	-3.24	-3.38	-2.02	-3.11	-2.6	-3.2	-1.43	-2.28	-1.78	-2.52	-1.68	-2.37	-1.15
165	-1.28	-1.55	-0.51	-1.26	-0.75	-0.95	0.53	-0.02	-0.05	-1.51	-0.83	-1.61	-0.29
180	0.04	-0.18	0.52	0.04	0.38	0.53	1.76	1.59	1.21	-0.35	-0.11	-0.66	0.39
195	0.78	0.7	1.13	0.93	1.01	1.35	2.34	2.53	1.99	0.57	0.4	0.05	0.91
210	1.11	1.22	1.38	1.41	1.25	1.62	2.32	2.82	2.19	1.07	0.55	0.54	1.16
225	1.13	1.35	1.33	1.5	1.06	1.33	1.66	2.44	1.77	1.07	0.3	0.67	1.14
240	0.78	1.09	0.86	1.18	0.46	0.53	0.34	1.34	0.64	0.49	-0.33	0.43	0.82
255	0.05	0.39	-0.12	0.36	-0.77	-0.85	-1.67	-0.57	-1.24	-0.76	-1.45	-0.22	0.11
270	-1.23	-0.85	-1.61	-1.09	-2.54	-2.77	-4.46	-3.36	-3.86	-2.66	-2.96	-1.32	-0.93
285	-3	-2.71	-3.57	-3.21	-4.5	-4.94	-7.44	-7	-6.33	-4.87	-4.4	-2.58	-2.06
300	-4.8	-4.87	-5.21	-5.37	-5.28	-6.18	-7.81	-8.42	-5.82	-5.73	-4.61	-3.53	-2.75
315	-5.3	-5.82	-4.81	-5.57	-3.94	-5.06	-5.32	-5.65	-3.16	-4.03	-3.22	-3.39	-2.36
330	-3.77	-4.38	-2.87	-3.54	-1.92	-2.96	-2.84	-2.69	-0.74	-1.59	-1.33	-2.11	-1.2
345	-2.38	-2.02	-1.53	-1.33	-0.66	-1.14	-1.34	-0.59	0.64	0.42	-0.2	-0.54	-0.44
360	0.16	0.25	0.59	0.74	0.91	0.35	0.33	1.5	2.31	2.15	1.57	1.15	1.08

**Table 182. 433-MHz Kit Antenna: RP\_433.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-12.91	-12.33	-11.73	-10.78	-9.57	-9.85	-12.04	-18.7	-29.61	-24	-16.45	-11.68	-9.39
15	-15.92	-16.18	-14.02	-13.1	-10.67	-11.03	-13.04	-18.44	-24.67	-27.11	-22.74	-18.37	-12.67
30	-21.93	-22.78	-18.78	-17	-12.99	-12.92	-14.21	-18.16	-19.47	-17.62	-24.83	-28.89	-22.02
45	-25.32	-26.49	-30.05	-25.58	-17.04	-15.79	-15.74	-17.34	-15.63	-12.61	-14.67	-14.67	-19.16
60	-18.17	-18.52	-23.8	-26.22	-24.33	-19.75	-17.7	-15.87	-12.42	-9.26	-10.1	-9.55	-11.36
75	-13.68	-13.96	-16.27	-16.79	-23.11	-23.04	-19.7	-14.06	-9.79	-6.85	-7.14	-6.6	-7.41
90	-10.78	-10.93	-12.17	-12.53	-16.73	-21.4	-21.62	-12.5	-7.83	-5.03	-5.17	-4.71	-5.14
105	-8.66	-8.91	-9.76	-10.17	-13.28	-18.63	-23.25	-11.41	-6.35	-3.83	-3.71	-3.48	-3.62
120	-7.23	-7.62	-8.33	-9.06	-11.62	-16.79	-24.96	-11.04	-5.55	-3.2	-2.91	-2.91	-2.88
135	-6.47	-7.13	-7.85	-8.99	-11.03	-15.92	-27.29	-11.53	-5.41	-3.2	-2.69	-2.91	-2.75
150	-6.44	-7.51	-8.28	-10	-11.47	-15.9	-28.63	-12.87	-5.93	-3.82	-3.07	-3.55	-3.29
165	-7.29	-8.95	-9.8	-12.32	-13.11	-16.57	-25.74	-15.38	-7.2	-5.22	-4.18	-4.99	-4.58
180	-9.28	-11.84	-12.83	-16.69	-15.82	-17.41	-22.68	-19	-9.44	-7.54	-6.11	-7.31	-6.95
195	-13.32	-17.16	-18.66	-20.45	-17.96	-17.34	-21.02	-25.02	-12.93	-11.44	-9.35	-11.7	-10.97
210	-20.81	-19.35	-19.59	-15.45	-15.69	-16.01	-20.57	-30.97	-18.82	-18	-15.45	-21.02	-19.88
225	-15.99	-12.74	-13.02	-11.19	-12.49	-14.33	-20.55	-25.7	-22.71	-19.67	-28.99	-20.05	-20.31
240	-10.38	-8.81	-9.15	-8.61	-10.16	-12.81	-20.59	-22.55	-17.04	-13.67	-15.15	-11.99	-11.46
255	-7.44	-6.58	-6.93	-7.06	-8.6	-11.57	-19.84	-22.39	-14.09	-10.73	-10.42	-8.36	-7.71
270	-5.89	-5.46	-5.73	-6.3	-7.74	-10.62	-18.17	-25.32	-13.2	-9.55	-8.23	-6.4	-5.51
285	-5.3	-5.1	-5.28	-6.09	-7.29	-9.88	-16.25	-34.75	-13.73	-9.48	-7.22	-5.37	-4.31
300	-5.41	-5.34	-5.38	-6.33	-7.18	-9.37	-14.48	-31.06	-15.5	-10.24	-7.03	-5.04	-3.72
315	-6.12	-6.12	-5.98	-6.89	-7.3	-9.07	-13.2	-23.85	-18.33	-11.65	-7.52	-5.32	-3.73
330	-7.32	-7.33	-6.97	-7.75	-7.62	-8.97	-12.39	-20.75	-22.38	-13.7	-8.61	-6.24	-4.32
345	-9.09	-8.63	-8.46	-8.65	-8.14	-8.93	-12.1	-18.39	-28.03	-16.36	-10.48	-7.56	-5.58
360	-12.91	-12.33	-11.73	-10.78	-9.57	-9.85	-12.04	-18.7	-29.61	-24	-16.45	-11.68	-9.39

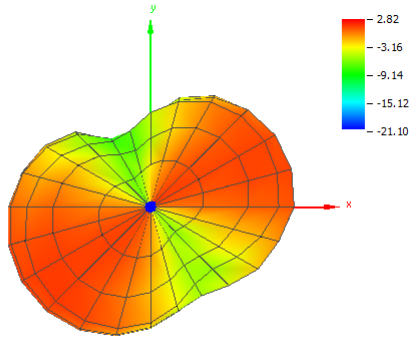


Figure 276. 433-MHz Kit Antenna: Theta = 0, Phi = 0

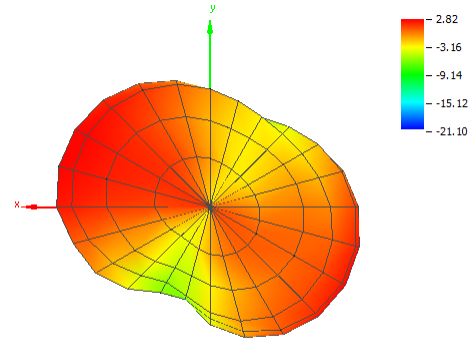


Figure 277. 433-MHz Kit Antenna: Theta = 180, Phi = 0

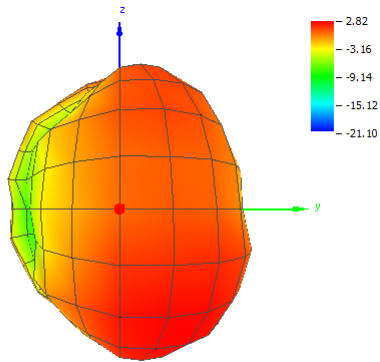


Figure 278. 433-MHz Kit Antenna: Theta = 90, Phi = 0

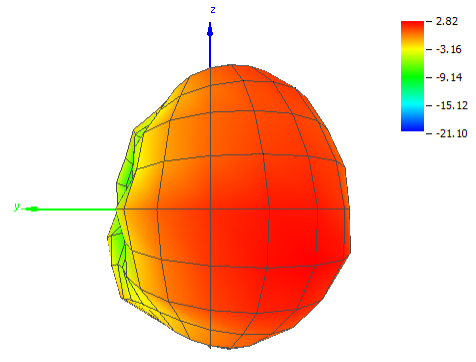


Figure 279. 433-MHz Kit Antenna: Theta = 90, Phi = 180

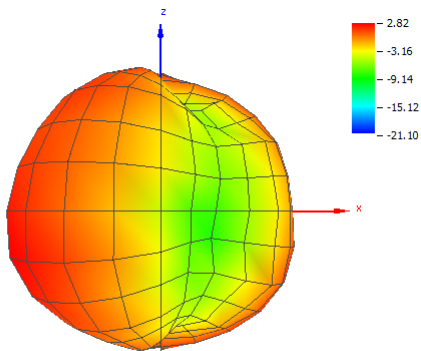


Figure 280. 433-MHz Kit Antenna: Theta = 90, Phi = 270

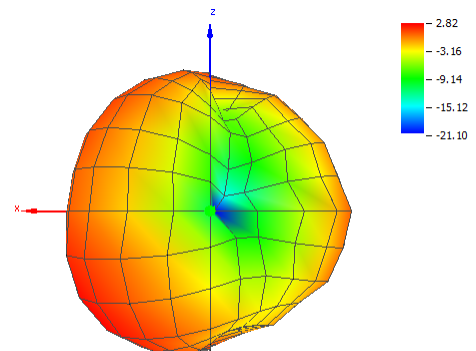


Figure 281. 433-MHz Kit Antenna: Theta = 90, Phi = 90

## A.14 470-510 MHz Kit Antenna

### A.14.1 Impedance of 490-MHz Kit Antenna

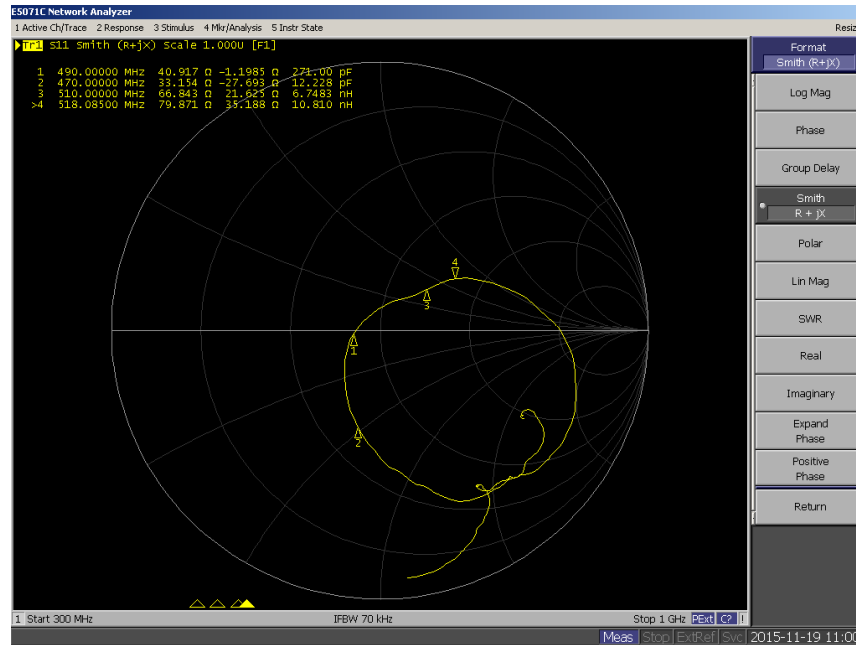


Figure 282. Impedance of 490-MHz Kit Antenna

### A.14.2 SWR of 490-MHz Kit Antenna

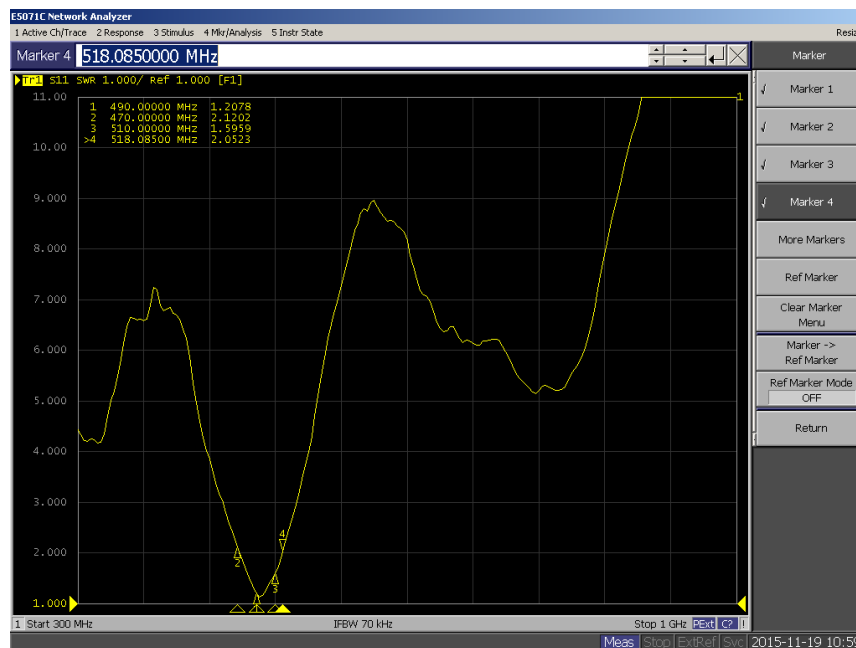


Figure 283. SWR of 490-MHz Kit Antenna

**A.14.3 470 MHz**
**Table 183. 470-MHz Kit Antenna: OTA Evaluation Results**

Test Description	Test Result
Total Radiated Power	-7.64 dBm
Peak EIRP	-4.44 dBm
Directivity	3.20 dBi
Efficiency	-7.64 dB
Efficiency	0.1723
Peak Gain	-4.44 dBi
NHPRP 45°	-8.23 dBm
NHPRP 45° / TRP	-0.60 dB
NHPRP 45° / TRP	0.8715
NHPRP 30°	-9.26 dBm
NHPRP 30° / TRP	-1.62 dB
NHPRP 30° / TRP	0.6887
NHPRP 22.5°	-10.31 dBm
NHPRP 22.5° / TRP	-2.68 dB
NHPRP 22.5° / TRP	0.5398
UHRP	-10.32 dBm
UHRP / TRP	-2.68 dB
UHRP / TRP	0.5391
LHRP	-11.00 dBm
LHRP / TRP	-3.36 dB
LHRP / TRP	0.4609
PGRP (0-120°)	-8.11 dBm
PGRP / TRP	-0.47 dB
PGRP / TRP	0.8973
Front/Back Ratio	1.96
PhiBW	360.0°
PhiBW Up	360.0°
PhiBW Down	360.0°
ThetaBW	49.6°
ThetaBW Up	15.7°
ThetaBW Down	33.9°
Boresight Phi	90°
Boresight Theta	105°
Maximum Power	-4.44 dBm
Minimum Power	-29.03 dBm
Average Power	-8.88 dBm
Max/Min Ratio	24.59 dB
Max/Avg Ratio	4.45 dB
Min/Avg Ratio	-20.15 dB
Worst Single Value	-39.82 dBm
Worst Position	Azi = 165°; Elev = 150°; Pol = Vertical
Best Single Value	-4.47 dBm
Best Position	Azi = 90°; Elev = 105°; Pol = Horizontal

**Table 184. 470-MHz Kit Antenna: RP\_470.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-8.47	-12.56	-11.65	-8.27	-7.42	-8.14	-6.31	-5.63	-7.73	-10.25	-11.02	-12.68	-15.74
15	-8.49	-12.44	-12.15	-8.55	-7.71	-8.25	-5.98	-5.26	-7.92	-10.07	-10.63	-12.07	-14.74
30	-8.7	-12.74	-12.63	-8.86	-7.92	-8.24	-5.73	-4.95	-7.53	-9.81	-10.49	-11.68	-14.21
45	-9.14	-13.24	-13.11	-9.17	-8.12	-8.11	-5.46	-4.69	-7.25	-9.79	-10.62	-11.53	-13.86
60	-9.76	-13.91	-13.46	-9.42	-8.23	-7.88	-5.23	-4.54	-7.12	-10	-10.93	-11.54	-13.59
75	-10.68	-14.93	-13.66	-9.57	-8.25	-7.53	-4.99	-4.45	-7.14	-10.46	-11.5	-11.73	-13.27
90	-11.73	-16.13	-13.63	-9.58	-8.12	-7.19	-4.81	-4.44	-7.27	-11.06	-12.08	-11.93	-12.98
105	-13.1	-17.66	-13.21	-9.34	-7.86	-6.84	-4.67	-4.48	-7.52	-11.79	-12.65	-12.13	-12.68
120	-14.39	-18.86	-12.63	-8.95	-7.52	-6.6	-4.61	-4.56	-7.78	-12.5	-13.11	-12.29	-12.46
135	-15.56	-19.32	-11.8	-8.34	-7.09	-6.4	-4.62	-4.72	-8.16	-13.18	-13.44	-12.45	-12.26
150	-16.18	-18.74	-10.97	-7.71	-6.65	-6.28	-4.7	-4.92	-8.43	-13.76	-13.68	-12.62	-12.15
165	-16.28	-17.72	-10.15	-7.08	-6.13	-6.17	-4.88	-5.2	-8.7	-14.39	-13.94	-12.92	-12.11
180	-15.98	-16.73	-9.55	-6.52	-5.67	-6.04	-5.1	-5.47	-9.02	-14.72	-14.3	-13.32	-12.28
195	-15.5	-15.91	-9.07	-6.06	-5.25	-5.9	-5.29	-5.81	-9.42	-15.1	-14.87	-13.98	-12.64
210	-14.99	-15.47	-8.83	-5.77	-4.97	-5.8	-5.5	-6.09	-9.8	-15.38	-15.53	-14.86	-13.24
225	-14.31	-15.24	-8.76	-5.69	-4.82	-5.78	-5.7	-6.34	-10.13	-15.61	-16.6	-16.23	-14.18
240	-13.66	-15.1	-8.88	-5.76	-4.91	-5.86	-5.89	-6.54	-10.44	-15.76	-17.71	-18.03	-15.43
255	-12.85	-15.01	-9.14	-5.99	-5.14	-6.1	-6.1	-6.67	-10.51	-15.57	-18.76	-21.01	-17.5
270	-12.02	-14.79	-9.49	-6.29	-5.46	-6.4	-6.31	-6.75	-10.37	-15.11	-18.98	-25.2	-20.06
285	-11.1	-14.35	-9.85	-6.65	-5.86	-6.79	-6.47	-6.77	-10.21	-14.37	-17.88	-29.03	-24.51
300	-10.31	-13.85	-10.17	-7	-6.23	-7.15	-6.56	-6.72	-9.98	-13.61	-16.3	-24.47	-28.15
315	-9.59	-13.29	-10.49	-7.35	-6.61	-7.5	-6.57	-6.57	-9.68	-12.68	-14.57	-19.71	-24.63
330	-9.06	-12.88	-10.82	-7.64	-6.93	-7.78	-6.52	-6.35	-9.35	-11.94	-13.26	-16.8	-20.79
345	-8.72	-12.56	-11.3	-8	-7.21	-8	-6.4	-6.03	-8.76	-11.01	-12.34	-14.51	-18.58
360	-8.47	-12.56	-11.65	-8.27	-7.42	-8.14	-6.31	-5.63	-7.73	-10.25	-11.02	-12.68	-15.74



**Table 185. 470-MHz Kit Antenna: RP\_470.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-12.52	-31.1	-14.27	-8.7	-7.47	-8.26	-6.41	-5.65	-8.36	-14.13	-18.27	-23.19	-30.5
15	-12.17	-27.44	-14.92	-9.08	-7.79	-8.34	-6.05	-5.27	-8.7	-14.08	-18.54	-22.2	-30.8
30	-11.99	-24.68	-15.3	-9.38	-7.99	-8.3	-5.77	-4.95	-8.34	-13.91	-18.28	-20.8	-26.2
45	-12.03	-22.34	-15.36	-9.62	-8.17	-8.14	-5.47	-4.7	-8.05	-13.9	-17.77	-18.83	-21.44
60	-12.26	-20.87	-15.06	-9.73	-8.26	-7.9	-5.23	-4.56	-7.86	-13.88	-17.08	-17.07	-18.22
75	-12.74	-19.82	-14.51	-9.72	-8.27	-7.57	-5	-4.48	-7.76	-13.81	-16.17	-15.46	-15.87
90	-13.37	-19.38	-13.99	-9.61	-8.18	-7.29	-4.83	-4.47	-7.74	-13.77	-15.36	-14.38	-14.39
105	-14.32	-19.28	-13.36	-9.36	-8.03	-7.03	-4.72	-4.51	-7.82	-13.63	-14.6	-13.55	-13.34
120	-15.32	-19.41	-12.87	-9.06	-7.83	-6.89	-4.69	-4.59	-7.94	-13.63	-14.11	-13.07	-12.78
135	-16.43	-19.68	-12.34	-8.62	-7.59	-6.84	-4.73	-4.74	-8.22	-13.69	-13.81	-12.84	-12.49
150	-17.4	-19.84	-11.86	-8.17	-7.34	-6.85	-4.86	-4.95	-8.44	-13.92	-13.76	-12.9	-12.5
165	-18.3	-20.05	-11.37	-7.72	-7.01	-6.92	-5.12	-5.26	-8.71	-14.41	-13.95	-13.26	-12.77
180	-18.92	-20.02	-10.97	-7.29	-6.68	-6.98	-5.41	-5.57	-9.05	-14.79	-14.39	-13.84	-13.28
195	-19.39	-19.91	-10.61	-6.91	-6.34	-6.99	-5.74	-5.98	-9.5	-15.36	-15.15	-14.82	-14.14
210	-19.68	-19.92	-10.4	-6.62	-6.06	-6.97	-6.05	-6.35	-9.94	-15.84	-16.02	-16.04	-15.25
225	-19.79	-20.06	-10.31	-6.49	-5.85	-6.96	-6.33	-6.69	-10.34	-16.27	-17.28	-17.79	-16.79
240	-19.76	-20.44	-10.36	-6.47	-5.81	-6.95	-6.53	-6.95	-10.75	-16.58	-18.6	-19.89	-18.53
255	-19.35	-21.21	-10.53	-6.56	-5.85	-7.02	-6.67	-7.11	-10.92	-16.57	-20.01	-22.91	-21.15
270	-18.53	-22.39	-10.87	-6.74	-5.98	-7.12	-6.79	-7.17	-10.87	-16.36	-21.13	-26.43	-23.69
285	-17.42	-24.11	-11.29	-7	-6.18	-7.28	-6.84	-7.13	-10.8	-16.03	-21.35	-30	-27.08
300	-16.27	-26.32	-11.75	-7.28	-6.4	-7.46	-6.83	-7	-10.61	-15.67	-20.96	-30.12	-28.86
315	-15.09	-29.71	-12.3	-7.61	-6.68	-7.67	-6.78	-6.76	-10.34	-15.11	-20.24	-27.37	-28.63
330	-14.14	-33.48	-12.91	-7.94	-6.96	-7.89	-6.69	-6.47	-10.02	-14.76	-19.7	-25.6	-28.07
345	-13.27	-33.35	-13.61	-8.38	-7.23	-8.09	-6.55	-6.09	-9.54	-14.03	-19.15	-23.73	-28.41
360	-12.52	-31.1	-14.27	-8.7	-7.47	-8.26	-6.41	-5.65	-8.36	-14.13	-18.27	-23.19	-30.5

**Table 186. 470-MHz Kit Antenna: RP\_470.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-10.64	-12.62	-15.08	-18.49	-26.38	-23.75	-22.43	-29.22	-16.42	-12.54	-11.93	-13.09	-15.89
15	-10.93	-12.58	-15.41	-17.97	-25.45	-25.04	-23.71	-32.79	-15.72	-12.27	-11.39	-12.51	-14.85
30	-11.45	-13.03	-16	-18.33	-25.84	-26.43	-25.7	-33.09	-15.24	-11.95	-11.27	-12.24	-14.49
45	-12.27	-13.81	-17.05	-19.28	-27.58	-29.4	-29.11	-29.47	-15.01	-11.93	-11.55	-12.42	-14.7
60	-13.34	-14.89	-18.59	-21	-30.49	-31.51	-33.96	-27.15	-15.16	-12.28	-12.14	-12.97	-15.43
75	-14.91	-16.63	-21.14	-24.22	-31.35	-27.79	-32.22	-25.83	-15.9	-13.16	-13.31	-14.12	-16.74
90	-16.76	-18.92	-24.6	-30.5	-26.64	-23.74	-27.59	-25.55	-17.17	-14.4	-14.84	-15.58	-18.55
105	-19.2	-22.73	-27.93	-32.86	-22.11	-20.45	-24.16	-26.3	-19.28	-16.4	-17.07	-17.69	-21.15
120	-21.51	-28.11	-25.29	-25.01	-19.15	-18.39	-22.19	-27.48	-22.1	-18.89	-19.97	-20.13	-23.88
135	-22.99	-30.34	-21.06	-20.36	-16.67	-16.63	-20.43	-28.43	-26.83	-22.72	-24.33	-23.07	-25.09
150	-22.32	-25.25	-18.28	-17.7	-14.95	-15.35	-18.99	-27.13	-34.07	-28.12	-31.14	-24.62	-23.32
165	-20.57	-21.54	-16.27	-15.69	-13.5	-14.14	-17.62	-24.19	-35.99	-39.81	-39.82	-24.14	-20.64
180	-19.06	-19.48	-15.08	-14.42	-12.49	-13.17	-16.82	-21.83	-30.24	-32.84	-31.16	-22.74	-19.14
195	-17.77	-18.12	-14.33	-13.6	-11.78	-12.41	-15.4	-19.87	-26.74	-27.57	-26.89	-21.56	-17.99
210	-16.79	-17.41	-14.01	-13.29	-11.48	-12.04	-14.72	-18.5	-24.82	-25.4	-25.28	-21.11	-17.56
225	-15.75	-16.98	-14.01	-13.42	-11.59	-12.02	-14.38	-17.47	-23.24	-24.14	-24.93	-21.44	-17.64
240	-14.88	-16.61	-14.3	-14	-12.19	-12.4	-14.49	-16.96	-22.05	-23.39	-25.06	-22.62	-18.35
255	-13.95	-16.19	-14.76	-15.04	-13.32	-13.32	-15.14	-16.86	-20.92	-22.43	-24.76	-25.53	-19.96
270	-13.12	-15.61	-15.12	-16.36	-14.93	-14.51	-16.06	-17.1	-20.01	-21.13	-23.06	-31.28	-22.53
285	-12.26	-14.83	-15.35	-17.83	-17.37	-16.49	-17.37	-17.82	-19.2	-19.35	-20.47	-36	-28.01
300	-11.58	-14.1	-15.32	-19.08	-20.33	-18.78	-18.71	-18.81	-18.68	-17.85	-18.11	-25.85	-36.36
315	-11.02	-13.39	-15.16	-19.66	-24.5	-21.66	-19.92	-20.32	-18.17	-16.36	-15.94	-20.52	-26.84
330	-10.68	-12.91	-15.01	-19.45	-28.47	-23.92	-20.63	-22.19	-17.74	-15.16	-14.37	-17.41	-21.69
345	-10.59	-12.59	-15.15	-18.76	-31.23	-24.93	-21.01	-24.81	-16.64	-14.01	-13.35	-15.06	-19.05
360	-10.64	-12.62	-15.08	-18.49	-26.38	-23.75	-22.43	-29.22	-16.42	-12.54	-11.93	-13.09	-15.89

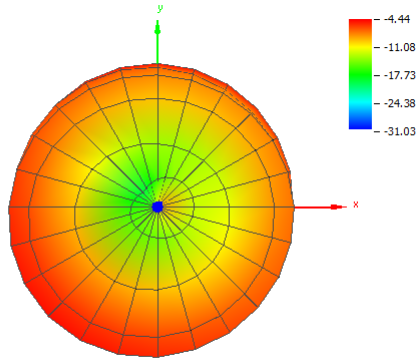


Figure 284. 470-MHz Kit Antenna: Theta = 0, Phi = 0

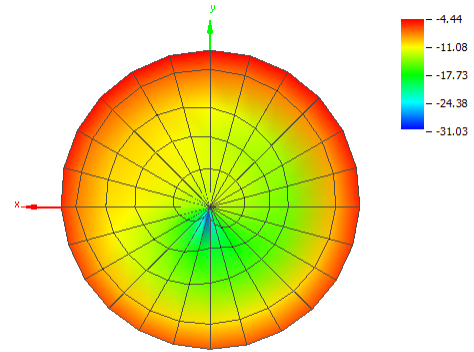


Figure 285. 470-MHz Kit Antenna: Theta = 180, Phi = 0

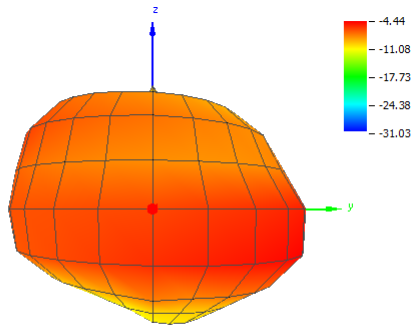


Figure 286. 470-MHz Kit Antenna: Theta = 90, Phi = 0

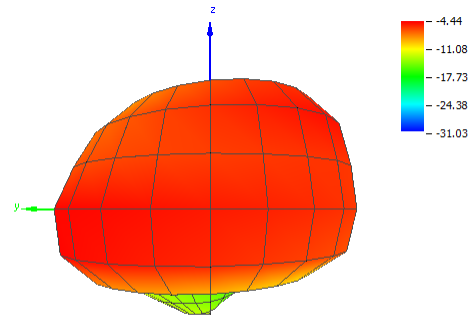


Figure 287. 470-MHz Kit Antenna: Theta = 90, Phi = 180

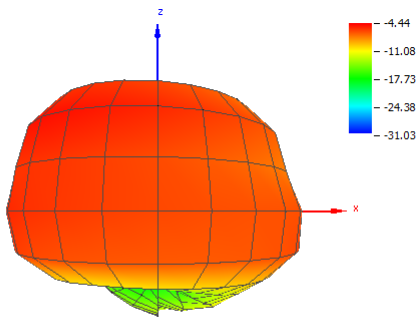


Figure 288. 470-MHz Kit Antenna: Theta = 90, Phi = 270

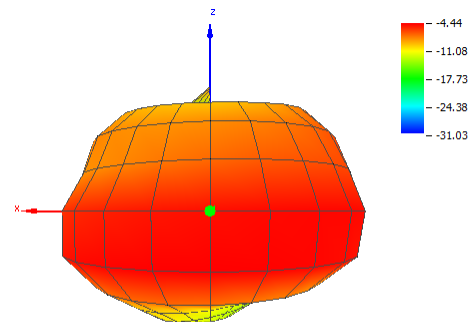


Figure 289. 470-MHz Kit Antenna: Theta = 90, Phi = 90

**A.14.4 490 MHz**
**Table 187. 490-MHz Kit Antenna: OTA Evaluation Results**

Test Description	Test Result
Total Radiated Power	-5.43 dBm
Peak EIRP	-1.70 dBm
Directivity	3.73 dBi
Efficiency	-5.43 dB
Efficiency	0.2867
Peak Gain	-1.70 dBi
NHPRP 45°	-5.96 dBm
NHPRP 45° / TRP	-0.54 dB
NHPRP 45° / TRP	0.8836
NHPRP 30°	-6.90 dBm
NHPRP 30° / TRP	-1.47 dB
NHPRP 30° / TRP	0.7128
NHPRP 22.5°	-7.90 dBm
NHPRP 22.5° / TRP	-2.48 dB
NHPRP 22.5° / TRP	0.565
UHRP	-7.40 dBm
UHRP / TRP	-1.97 dB
UHRP / TRP	0.6347
LHRP	-9.80 dBm
LHRP / TRP	-4.37 dB
LHRP / TRP	0.3653
PGRP (0-120°)	-5.73 dBm
PGRP / TRP	-0.31 dB
PGRP / TRP	0.9317
Front/Back Ratio	2.42
PhiBW	360.0°
PhiBW Up	360.0°
PhiBW Down	360.0°
ThetaBW	50.9°
ThetaBW Up	19.2°
ThetaBW Down	31.7°
Boresight Phi	135°
Boresight Theta	90°
Maximum Power	-1.70 dBm
Minimum Power	-27.77 dBm
Average Power	-6.81 dBm
Max/Min Ratio	26.07 dB
Max/Avg Ratio	5.11 dB
Min/Avg Ratio	-20.96 dB
Worst Single Value	-38.78 dBm
Worst Position	Azi = 225°; Elev = 135°; Pol = Vertical
Best Single Value	-1.71 dBm
Best Position	Azi = 135°; Elev = 90°; Pol = Horizontal

**Table 188. 490-MHz Kit Antenna: RP\_490.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-8.6	-10.03	-8.38	-5.41	-3.59	-4.04	-4.11	-5.44	-8.1	-8.8	-10.75	-19.15	-17.98
15	-8.47	-9.94	-8.93	-5.83	-3.82	-4.06	-3.95	-4.98	-7.75	-8.41	-10.18	-17.29	-19.27
30	-8.5	-10.07	-9.48	-6.23	-4.05	-3.99	-3.66	-4.52	-7.31	-8.12	-9.87	-15.61	-19.71
45	-8.73	-10.28	-10.01	-6.59	-4.24	-3.8	-3.28	-4.1	-7.03	-8.08	-9.83	-14.43	-18.65
60	-9.2	-10.64	-10.48	-6.92	-4.38	-3.55	-2.91	-3.75	-6.93	-8.31	-10	-13.54	-17.03
75	-9.89	-11.15	-10.9	-7.19	-4.46	-3.26	-2.52	-3.51	-7.02	-8.77	-10.26	-12.84	-15.5
90	-10.79	-11.84	-11.28	-7.43	-4.48	-2.99	-2.2	-3.34	-7.25	-9.42	-10.57	-12.35	-14.31
105	-11.92	-12.72	-11.56	-7.56	-4.46	-2.74	-1.94	-3.26	-7.62	-10.17	-10.82	-11.88	-13.38
120	-13.12	-13.54	-11.59	-7.56	-4.41	-2.59	-1.77	-3.23	-7.96	-10.96	-11.04	-11.55	-12.67
135	-14.16	-14.16	-11.32	-7.36	-4.35	-2.55	-1.7	-3.28	-8.39	-11.75	-11.28	-11.29	-12.06
150	-14.78	-14.32	-10.71	-6.96	-4.26	-2.6	-1.73	-3.41	-8.76	-12.45	-11.48	-11.14	-11.54
165	-15.03	-14.05	-9.91	-6.42	-4.09	-2.71	-1.85	-3.63	-9.18	-13.37	-11.75	-11.09	-11.07
180	-14.98	-13.5	-9.13	-5.79	-3.84	-2.82	-2.06	-3.91	-9.59	-14.12	-12.2	-11.12	-10.73
195	-14.92	-12.92	-8.4	-5.16	-3.52	-2.89	-2.3	-4.28	-10.15	-15.13	-12.93	-11.27	-10.45
210	-14.89	-12.43	-7.83	-4.6	-3.18	-2.9	-2.59	-4.68	-10.79	-16.05	-13.86	-11.56	-10.26
225	-14.83	-12.02	-7.39	-4.22	-2.88	-2.9	-2.86	-5.11	-11.47	-16.98	-15.33	-11.99	-10.14
240	-14.61	-11.72	-7.14	-3.97	-2.69	-2.9	-3.12	-5.48	-12.04	-17.81	-17.42	-12.66	-10.16
255	-14.17	-11.51	-7.01	-3.87	-2.58	-2.95	-3.35	-5.8	-12.3	-17.78	-20.2	-13.65	-10.32
270	-13.4	-11.34	-6.99	-3.89	-2.58	-3.05	-3.57	-6.04	-12.01	-16.7	-23.19	-14.99	-10.55
285	-12.41	-11.11	-7.06	-4	-2.64	-3.21	-3.8	-6.22	-11.53	-15.13	-21.95	-16.91	-11.02
300	-11.4	-10.78	-7.17	-4.17	-2.77	-3.4	-3.98	-6.29	-10.93	-13.52	-18.59	-19.66	-11.71
315	-10.48	-10.49	-7.33	-4.4	-2.94	-3.59	-4.12	-6.26	-10.27	-12	-15.63	-23.97	-12.64
330	-9.72	-10.23	-7.6	-4.66	-3.15	-3.77	-4.21	-6.1	-9.64	-10.75	-13.63	-27.77	-13.82
345	-9.14	-10.04	-7.91	-4.84	-3.36	-3.87	-4.25	-5.83	-8.99	-9.79	-12.3	-24.41	-15.34
360	-8.6	-10.03	-8.38	-5.41	-3.59	-4.04	-4.11	-5.44	-8.1	-8.8	-10.75	-19.15	-17.98

**Table 189. 490-MHz Kit Antenna: RP\_490.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-13.55	-23.39	-12.2	-6.32	-3.76	-4.04	-4.13	-5.66	-10.08	-14.6	-18.16	-28.59	-18.04
15	-12.61	-20.35	-13.3	-6.84	-4	-4.06	-3.96	-5.18	-9.81	-14.29	-17.32	-23.27	-19.69
30	-11.83	-18.09	-14.21	-7.31	-4.25	-3.99	-3.66	-4.7	-9.29	-14	-16.31	-19.77	-20.65
45	-11.37	-16.33	-14.62	-7.69	-4.44	-3.81	-3.29	-4.27	-8.92	-13.97	-15.43	-17.19	-19.57
60	-11.21	-15.14	-14.47	-7.97	-4.57	-3.57	-2.92	-3.92	-8.66	-14.02	-14.64	-15.28	-17.63
75	-11.33	-14.39	-13.97	-8.1	-4.61	-3.27	-2.54	-3.66	-8.53	-14.07	-13.8	-13.85	-15.9
90	-11.73	-14.02	-13.36	-8.11	-4.6	-3.01	-2.22	-3.46	-8.49	-14.04	-13.06	-12.91	-14.66
105	-12.39	-14	-12.72	-8.02	-4.53	-2.77	-1.96	-3.35	-8.56	-13.87	-12.44	-12.21	-13.84
120	-13.27	-14.16	-12.14	-7.81	-4.46	-2.62	-1.79	-3.29	-8.62	-13.76	-12.02	-11.84	-13.37
135	-14.29	-14.4	-11.52	-7.48	-4.4	-2.59	-1.71	-3.3	-8.81	-13.65	-11.84	-11.7	-13.15
150	-15.35	-14.57	-10.87	-7.05	-4.32	-2.64	-1.74	-3.42	-9.01	-13.66	-11.81	-11.81	-13.1
165	-16.41	-14.62	-10.18	-6.55	-4.19	-2.79	-1.89	-3.63	-9.34	-14.08	-12.02	-12.17	-13.18
180	-17.3	-14.49	-9.53	-6	-4.01	-2.94	-2.12	-3.92	-9.7	-14.49	-12.53	-12.74	-13.41
195	-18.13	-14.29	-8.93	-5.44	-3.76	-3.07	-2.4	-4.3	-10.22	-15.3	-13.42	-13.63	-13.65
210	-18.8	-14.13	-8.46	-4.94	-3.45	-3.13	-2.73	-4.72	-10.83	-16.11	-14.53	-14.78	-13.79
225	-19.38	-14.06	-8.11	-4.6	-3.17	-3.17	-3.05	-5.17	-11.48	-17.01	-16.1	-16.11	-13.74
240	-19.9	-14.23	-7.96	-4.36	-2.97	-3.18	-3.32	-5.55	-12.09	-18.05	-18.13	-17.55	-13.5
255	-20.64	-14.72	-7.96	-4.26	-2.82	-3.2	-3.56	-5.9	-12.53	-18.78	-20.53	-18.92	-13.17
270	-21.25	-15.63	-8.16	-4.29	-2.77	-3.26	-3.76	-6.18	-12.59	-18.95	-23.7	-20.11	-12.83
285	-21.58	-17.03	-8.5	-4.43	-2.79	-3.36	-3.95	-6.39	-12.59	-18.65	-26.05	-21.32	-12.68
300	-20.97	-18.9	-8.95	-4.64	-2.89	-3.49	-4.1	-6.5	-12.44	-18.05	-26.24	-22.8	-12.86
315	-19.32	-21.72	-9.54	-4.95	-3.06	-3.64	-4.2	-6.49	-12.14	-17.06	-24.29	-25.47	-13.34
330	-17.39	-25	-10.28	-5.3	-3.27	-3.79	-4.27	-6.33	-11.71	-16.15	-22.09	-29.7	-14.18
345	-15.54	-26.87	-11.13	-5.58	-3.5	-3.88	-4.29	-6.05	-11.07	-15.37	-20.13	-35.47	-15.51
360	-13.55	-23.39	-12.2	-6.32	-3.76	-4.04	-4.13	-5.66	-10.08	-14.6	-18.16	-28.59	-18.04

**Table 190. 490-MHz Kit Antenna: RP\_490.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-10.27	-10.24	-10.71	-12.69	-17.97	-38.67	-28.07	-18.51	-12.47	-10.12	-11.62	-19.67	-36.81
15	-10.59	-10.36	-10.9	-12.68	-17.71	-38.23	-30.52	-18.56	-11.98	-9.71	-11.11	-18.55	-29.7
30	-11.2	-10.82	-11.27	-12.82	-17.62	-34.46	-31.86	-18.35	-11.66	-9.42	-10.98	-17.71	-26.81
45	-12.15	-11.52	-11.85	-13.09	-17.73	-31.7	-30.89	-18.15	-11.55	-9.38	-11.23	-17.71	-25.85
60	-13.5	-12.54	-12.69	-13.6	-18.14	-29.82	-28.9	-17.99	-11.76	-9.67	-11.83	-18.37	-25.94
75	-15.38	-13.93	-13.86	-14.45	-18.95	-27.83	-26.75	-18.2	-12.35	-10.29	-12.81	-19.67	-26.14
90	-17.9	-15.87	-15.49	-15.77	-20.24	-26.48	-25.68	-18.83	-13.3	-11.25	-14.18	-21.52	-25.39
105	-21.84	-18.63	-17.87	-17.56	-21.91	-25.38	-25.56	-20.15	-14.72	-12.57	-15.91	-23.21	-23.37
120	-27.73	-22.3	-20.83	-20	-23.53	-24.64	-26.24	-22.24	-16.49	-14.2	-17.99	-23.43	-20.91
135	-29.28	-26.93	-24.67	-22.83	-24.33	-23.86	-26.76	-25.38	-18.67	-16.26	-20.48	-21.77	-18.61
150	-23.91	-26.81	-25.09	-23.82	-22.7	-22.52	-25.68	-29.75	-21.2	-18.6	-22.86	-19.62	-16.75
165	-20.69	-23.15	-22.2	-21.67	-20.25	-20.49	-23.12	-33.01	-23.73	-21.55	-23.95	-17.65	-15.21
180	-18.8	-20.39	-19.68	-19.09	-18.06	-18.55	-20.75	-29.91	-25.73	-25.01	-23.5	-16.17	-14.1
195	-17.74	-18.6	-17.84	-17.13	-16.36	-16.84	-18.82	-26.86	-27.82	-29.31	-22.65	-15.05	-13.27
210	-17.15	-17.32	-16.56	-15.78	-15.31	-15.69	-17.49	-25.01	-30.56	-34.95	-22.37	-14.37	-12.8
225	-16.71	-16.28	-15.55	-14.98	-14.79	-15.02	-16.72	-23.99	-35.33	-38.78	-23.22	-14.11	-12.64
240	-16.14	-15.3	-14.78	-14.61	-14.8	-14.96	-16.43	-23.09	-31.5	-30.66	-25.61	-14.37	-12.87
255	-15.28	-14.33	-14.04	-14.48	-15.3	-15.44	-16.66	-22.13	-25.14	-24.66	-31.55	-15.18	-13.49
270	-14.17	-13.36	-13.25	-14.4	-16.23	-16.37	-17.31	-21.08	-20.99	-20.62	-32.73	-16.58	-14.46
285	-12.98	-12.39	-12.55	-14.26	-17.31	-18.03	-18.37	-20.23	-18.15	-17.69	-24.09	-18.86	-16
300	-11.9	-11.51	-11.89	-13.98	-18.26	-20.23	-19.74	-19.53	-16.27	-15.4	-19.41	-22.54	-18.03
315	-11.09	-10.83	-11.33	-13.65	-18.76	-23.22	-21.46	-19.15	-14.83	-13.62	-16.27	-29.33	-20.89
330	-10.53	-10.37	-10.96	-13.27	-18.76	-26.85	-23.21	-18.91	-13.86	-12.24	-14.3	-32.22	-24.83
345	-10.27	-10.13	-10.73	-12.92	-18.44	-31.95	-24.54	-18.77	-13.17	-11.19	-13.08	-24.76	-29.54
360	-10.27	-10.24	-10.71	-12.69	-17.97	-38.67	-28.07	-18.51	-12.47	-10.12	-11.62	-19.67	-36.81

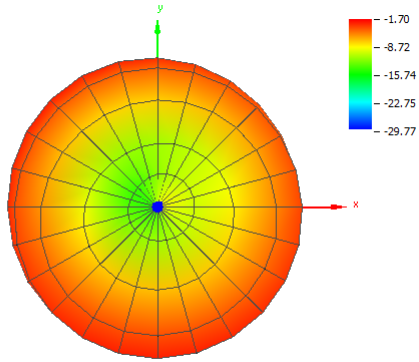


Figure 290. 490-MHz Kit Antenna: Theta = 0, Phi = 0

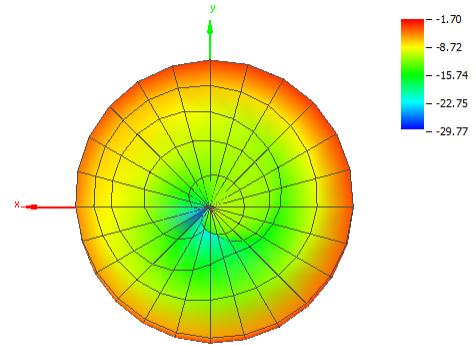


Figure 291. 490-MHz Kit Antenna: Theta = 180, Phi = 0

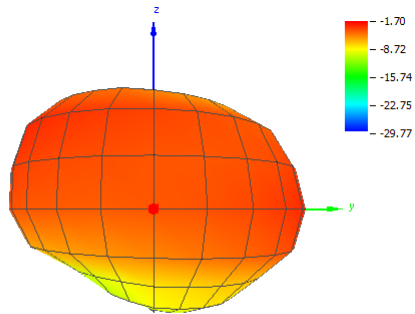


Figure 292. 490-MHz Kit Antenna: Theta = 90, Phi = 0

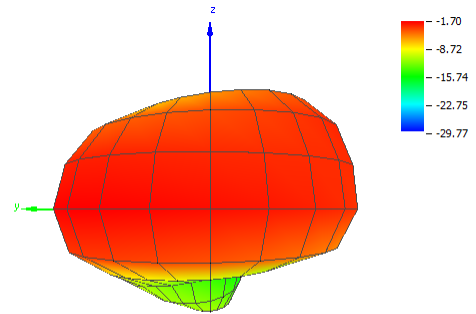


Figure 293. 490-MHz Kit Antenna: Theta = 90, Phi = 180

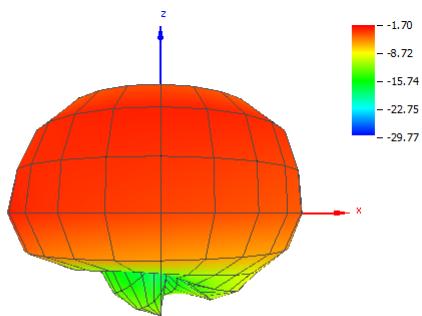


Figure 294. 490-MHz Kit Antenna: Theta = 90, Phi = 270

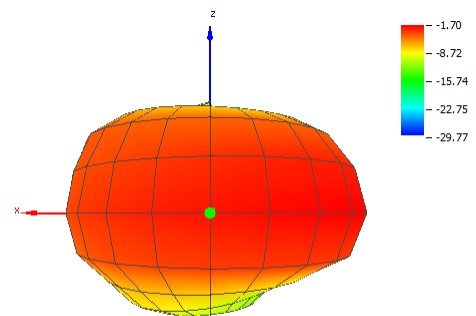


Figure 295. 490-MHz Kit Antenna: Theta = 90, Phi = 90



**A.14.5 510 MHz**
**Table 191. 510-MHz Kit Antenna: OTA Evaluation Results**

Test Description	Test Result
Total Radiated Power	-3.69 dBm
Peak EIRP	0.10 dBm
Directivity	3.79 dBi
Efficiency	-3.69 dB
Efficiency	0.4274
Peak Gain	0.10 dBi
NHPRP 45°	-4.33 dBm
NHPRP 45° / TRP	-0.63 dB
NHPRP 45° / TRP	0.8642
NHPRP 30°	-5.19 dBm
NHPRP 30° / TRP	-1.50 dB
NHPRP 30° / TRP	0.7086
NHPRP 22.5°	-6.19 dBm
NHPRP 22.5° / TRP	-2.50 dB
NHPRP 22.5° / TRP	0.5629
UHRP	-5.97 dBm
UHRP / TRP	-2.28 dB
UHRP / TRP	0.5914
LHRP	-7.58 dBm
LHRP / TRP	-3.89 dB
LHRP / TRP	0.4086
PGRP (0-120°)	-4.17 dBm
PGRP / TRP	-0.48 dB
PGRP / TRP	0.896
Front/Back Ratio	2.78
PhiBW	360.0°
PhiBW Up	360.0°
PhiBW Down	360.0°
ThetaBW	44.2°
ThetaBW Up	18.8°
ThetaBW Down	25.4°
Boresight Phi	135°
Boresight Theta	90°
Maximum Power	0.10 dBm
Minimum Power	-18.21 dBm
Average Power	-4.92 dBm
Max/Min Ratio	18.32 dB
Max/Avg Ratio	5.03 dB
Min/Avg Ratio	-13.29 dB
Worst Single Value	-33.46 dBm
Worst Position	Azi = 240°; Elev = 105°; Pol = Vertical
Best Single Value	0.04 dBm
Best Position	Azi = 135°; Elev = 90°; Pol = Horizontal

**Table 192. 510-MHz Kit Antenna: RP\_510.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-6.75	-6.53	-5.96	-4.57	-2.41	-1.75	-2.46	-3.21	-4.73	-5.7	-9.62	-18.21	-11.94
15	-6.78	-6.46	-6.16	-4.83	-2.68	-1.74	-2.29	-2.85	-4.37	-5.4	-8.95	-16.83	-13.03
30	-6.86	-6.48	-6.33	-5.11	-2.95	-1.66	-1.92	-2.35	-4.11	-5.27	-8.42	-14.83	-14.4
45	-7.14	-6.6	-6.52	-5.38	-3.19	-1.5	-1.55	-2	-4.12	-5.43	-8.17	-13.28	-15.35
60	-7.74	-6.85	-6.78	-5.72	-3.37	-1.24	-1.12	-1.77	-4.32	-5.81	-8	-11.95	-15.7
75	-8.55	-7.24	-7.13	-6.07	-3.51	-0.96	-0.74	-1.65	-4.67	-6.3	-7.82	-10.98	-15.39
90	-9.71	-7.81	-7.59	-6.52	-3.6	-0.71	-0.39	-1.62	-5.15	-6.83	-7.63	-10.11	-14.51
105	-11.01	-8.42	-8.04	-6.93	-3.68	-0.54	-0.14	-1.63	-5.66	-7.27	-7.38	-9.37	-13.44
120	-12.43	-9.05	-8.41	-7.31	-3.8	-0.49	0.04	-1.67	-6.11	-7.56	-7.04	-8.69	-12.34
135	-13.43	-9.45	-8.63	-7.49	-3.94	-0.56	0.1	-1.72	-6.41	-7.63	-6.72	-8.15	-11.35
150	-13.74	-9.57	-8.54	-7.37	-4.09	-0.75	0.05	-1.85	-6.53	-7.58	-6.34	-7.67	-10.44
165	-13.33	-9.37	-8.11	-6.93	-4.15	-1.01	-0.12	-2.03	-6.52	-7.5	-6.05	-7.3	-9.74
180	-12.54	-8.88	-7.43	-6.2	-4.02	-1.29	-0.42	-2.28	-6.54	-7.46	-5.86	-7.02	-9.19
195	-11.73	-8.35	-6.77	-5.38	-3.68	-1.47	-0.75	-2.6	-6.66	-7.58	-5.88	-6.86	-8.76
210	-10.89	-7.82	-6.09	-4.61	-3.15	-1.57	-1.16	-3	-6.99	-8.01	-6.13	-6.84	-8.49
225	-10.22	-7.42	-5.63	-4.08	-2.65	-1.55	-1.49	-3.42	-7.4	-8.73	-6.71	-6.95	-8.35
240	-9.63	-7.1	-5.3	-3.68	-2.2	-1.44	-1.83	-3.8	-8.01	-9.87	-7.68	-7.27	-8.29
255	-9.2	-6.93	-5.12	-3.49	-1.93	-1.37	-2.06	-4.11	-8.35	-11.1	-9.04	-7.78	-8.28
270	-8.76	-6.83	-5.06	-3.44	-1.79	-1.34	-2.29	-4.3	-8.28	-12.07	-11	-8.64	-8.32
285	-8.36	-6.8	-5.07	-3.49	-1.74	-1.37	-2.45	-4.38	-8.04	-12.07	-13.21	-9.68	-8.45
300	-7.92	-6.74	-5.12	-3.64	-1.77	-1.44	-2.59	-4.35	-7.45	-10.97	-15.14	-11.2	-8.67
315	-7.55	-6.67	-5.25	-3.84	-1.88	-1.54	-2.68	-4.22	-6.81	-9.51	-15.01	-13.03	-9.04
330	-7.15	-6.62	-5.44	-4.07	-2.03	-1.65	-2.72	-4	-6.12	-8.03	-13.2	-15.44	-9.65
345	-6.91	-6.59	-5.7	-4.21	-2.19	-1.71	-2.74	-3.69	-5.6	-6.81	-11.7	-17.52	-10.39
360	-6.75	-6.53	-5.96	-4.57	-2.41	-1.75	-2.46	-3.21	-4.73	-5.7	-9.62	-18.21	-11.94

**Table 193. 510-MHz Kit Antenna: RP\_510.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-15.35	-13.28	-10.84	-6.23	-2.81	-1.91	-2.63	-4.08	-8.08	-11.53	-13.26	-19.76	-13.78
15	-13.97	-12.82	-11.23	-6.7	-3.14	-1.92	-2.49	-3.73	-8	-11.43	-12.53	-18.16	-15.42
30	-12.78	-11.98	-11.31	-7.09	-3.45	-1.88	-2.14	-3.23	-7.7	-11.38	-11.35	-15.8	-18.21
45	-12.04	-11.25	-11.02	-7.36	-3.69	-1.73	-1.78	-2.86	-7.61	-11.28	-10.41	-13.96	-20.93
60	-11.72	-10.64	-10.54	-7.55	-3.84	-1.47	-1.35	-2.57	-7.52	-11.03	-9.51	-12.45	-21.92
75	-11.75	-10.27	-10.16	-7.69	-3.91	-1.17	-0.95	-2.37	-7.52	-10.63	-8.77	-11.38	-20.14
90	-12.12	-10.1	-9.87	-7.81	-3.92	-0.89	-0.57	-2.22	-7.54	-10.08	-8.11	-10.49	-17.62
105	-12.71	-10.08	-9.68	-7.91	-3.92	-0.7	-0.28	-2.1	-7.52	-9.51	-7.58	-9.76	-15.71
120	-13.51	-10.07	-9.49	-7.95	-3.95	-0.61	-0.06	-2.02	-7.43	-8.91	-7.08	-9.15	-14.29
135	-14.23	-9.99	-9.21	-7.84	-4.02	-0.63	0.04	-1.98	-7.37	-8.42	-6.73	-8.74	-13.45
150	-14.84	-9.79	-8.76	-7.49	-4.12	-0.79	0.02	-2.04	-7.23	-8.07	-6.47	-8.52	-13.06
165	-15.16	-9.46	-8.16	-6.95	-4.17	-1.02	-0.13	-2.18	-7.13	-7.93	-6.38	-8.55	-13.18
180	-15.15	-8.99	-7.46	-6.21	-4.1	-1.3	-0.43	-2.4	-7.13	-7.98	-6.5	-8.86	-13.86
195	-14.9	-8.56	-6.85	-5.45	-3.85	-1.53	-0.76	-2.7	-7.22	-8.26	-6.86	-9.4	-14.92
210	-14.46	-8.18	-6.27	-4.74	-3.41	-1.69	-1.2	-3.07	-7.47	-8.86	-7.49	-10.26	-16.34
225	-14.09	-7.96	-5.91	-4.24	-2.94	-1.74	-1.56	-3.45	-7.73	-9.62	-8.37	-11.22	-17.24
240	-13.82	-7.9	-5.74	-3.87	-2.48	-1.66	-1.93	-3.81	-8.13	-10.57	-9.57	-12.29	-16.72
255	-13.95	-8.08	-5.77	-3.71	-2.16	-1.58	-2.17	-4.13	-8.37	-11.44	-10.92	-13.26	-15.2
270	-14.44	-8.52	-6.03	-3.71	-1.97	-1.52	-2.39	-4.38	-8.44	-12.11	-12.54	-14.13	-13.47
285	-15.32	-9.18	-6.45	-3.87	-1.89	-1.5	-2.55	-4.56	-8.59	-12.47	-14	-14.82	-12.23
300	-16.79	-10.11	-7.06	-4.19	-1.92	-1.54	-2.66	-4.66	-8.56	-12.51	-15.21	-15.69	-11.36
315	-18.36	-11.19	-7.82	-4.61	-2.06	-1.61	-2.74	-4.65	-8.51	-12.31	-15.69	-16.74	-11.07
330	-19.08	-12.33	-8.79	-5.12	-2.26	-1.72	-2.8	-4.56	-8.44	-12	-15.44	-18.17	-11.3
345	-18.08	-13.05	-9.76	-5.5	-2.49	-1.81	-2.85	-4.36	-8.32	-11.59	-14.76	-19.18	-11.96
360	-15.35	-13.28	-10.84	-6.23	-2.81	-1.91	-2.63	-4.08	-8.08	-11.53	-13.26	-19.76	-13.78

**Table 194. 510-MHz Kit Antenna: RP\_510.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-7.4	-7.56	-7.68	-9.56	-13.03	-16.15	-16.71	-10.63	-7.42	-7.01	-12.08	-23.46	-16.54
15	-7.7	-7.6	-7.78	-9.41	-12.7	-15.46	-15.62	-10.2	-6.83	-6.65	-11.45	-22.6	-16.77
30	-8.14	-7.92	-8	-9.46	-12.6	-14.69	-14.87	-9.74	-6.61	-6.49	-11.52	-21.82	-16.73
45	-8.84	-8.42	-8.43	-9.75	-12.8	-14.37	-14.44	-9.49	-6.7	-6.74	-12.11	-21.65	-16.76
60	-9.96	-9.2	-9.16	-10.34	-13.31	-14.18	-14.13	-9.52	-7.15	-7.37	-13.3	-21.65	-16.88
75	-11.38	-10.23	-10.11	-11.16	-14	-14.17	-14.07	-9.85	-7.85	-8.3	-14.9	-21.48	-17.16
90	-13.42	-11.67	-11.48	-12.43	-15.08	-14.48	-14.35	-10.52	-8.9	-9.62	-17.4	-20.84	-17.42
105	-15.92	-13.4	-13.06	-13.9	-16.35	-14.94	-15.06	-11.48	-10.23	-11.21	-20.82	-20	-17.35
120	-19.01	-15.82	-14.99	-15.92	-18.25	-16.24	-16.41	-12.72	-11.91	-13.3	-27.66	-18.64	-16.75
135	-21.15	-18.75	-17.66	-18.68	-21.12	-18.25	-18.39	-14.07	-13.45	-15.44	-31.24	-17.13	-15.5
150	-20.22	-22.69	-21.63	-23.05	-25.85	-21.77	-21.53	-15.5	-14.78	-17.36	-21.75	-15.21	-13.88
165	-17.96	-26.22	-27.42	-30.94	-26.78	-27.54	-25.72	-16.72	-15.36	-17.82	-17.36	-13.33	-12.36
180	-16	-24.89	-29.4	-31.13	-21.52	-25.65	-28.43	-17.92	-15.55	-16.95	-14.47	-11.64	-11
195	-14.59	-21.68	-24.07	-23.76	-17.73	-20.28	-24.68	-19.09	-15.78	-15.94	-12.8	-10.4	-9.97
210	-13.4	-18.77	-20.16	-20.11	-15.57	-16.91	-21.16	-21.41	-16.77	-15.52	-11.83	-9.48	-9.27
225	-12.52	-16.72	-17.59	-18.41	-14.53	-15.19	-19.27	-25.05	-18.83	-16.03	-11.7	-8.98	-8.95
240	-11.71	-14.82	-15.48	-17.35	-14.34	-14.41	-18.32	-33.46	-23.56	-18.12	-12.21	-8.91	-8.97
255	-10.97	-13.26	-13.72	-16.6	-14.79	-14.5	-18.09	-27.93	-30.74	-22.34	-13.57	-9.23	-9.27
270	-10.14	-11.76	-12.05	-15.55	-15.68	-15.29	-18.5	-21.64	-22.64	-33.04	-16.23	-10.08	-9.9
285	-9.34	-10.54	-10.74	-14.3	-16.35	-16.58	-19.27	-18.26	-17.33	-22.63	-21.01	-11.26	-10.81
300	-8.52	-9.41	-9.56	-12.88	-16.45	-18.19	-20.35	-16.01	-13.93	-16.22	-33.35	-13.11	-12.02
315	-7.93	-8.56	-8.74	-11.72	-15.81	-19.26	-20.75	-14.51	-11.71	-12.74	-23.4	-15.44	-13.31
330	-7.44	-7.99	-8.13	-10.76	-14.77	-19.42	-20.01	-13.23	-9.96	-10.26	-17.14	-18.75	-14.65
345	-7.25	-7.7	-7.86	-10.12	-14.03	-18.22	-18.79	-12.15	-8.91	-8.56	-14.65	-22.51	-15.55
360	-7.4	-7.56	-7.68	-9.56	-13.03	-16.15	-16.71	-10.63	-7.42	-7.01	-12.08	-23.46	-16.54

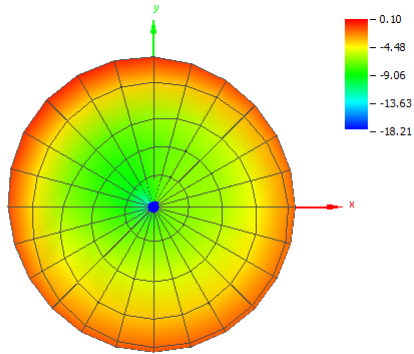


Figure 296. 510-MHz Kit Antenna: Theta = 0, Phi = 0

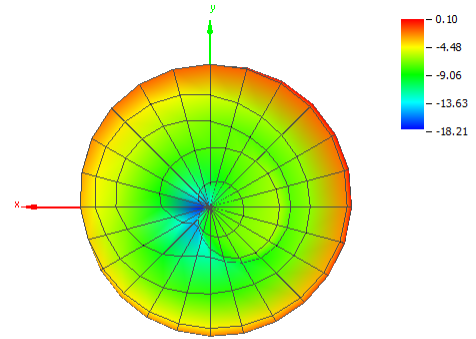


Figure 297. 510-MHz Kit Antenna: Theta = 180, Phi = 0

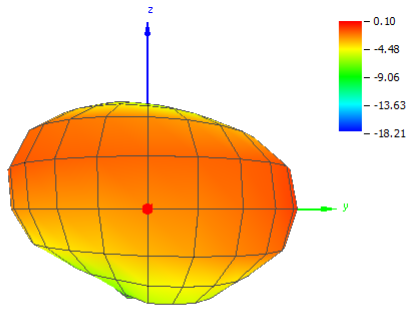


Figure 298. 510-MHz Kit Antenna: Theta = 90, Phi = 0

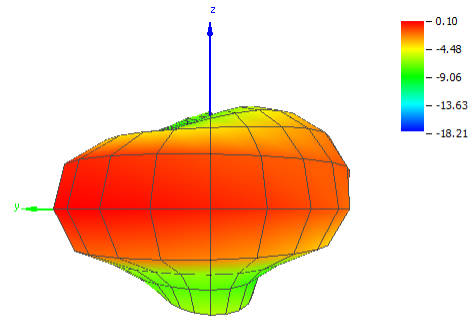


Figure 299. 510-MHz Kit Antenna: Theta = 90, Phi = 180

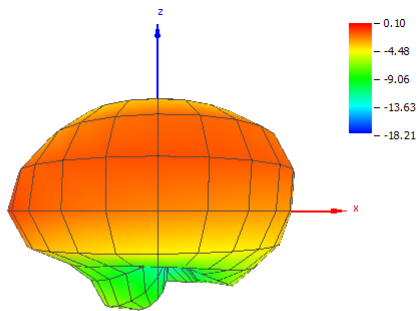


Figure 300. 510-MHz Kit Antenna: Theta = 90, Phi = 270

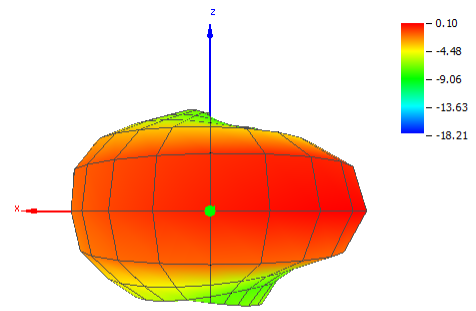


Figure 301. 510-MHz Kit Antenna: Theta = 90, Phi = 90

## A.15 868/915-MHz Kit Antenna

### A.15.1 Impedance of 868/915-MHz Kit Antenna

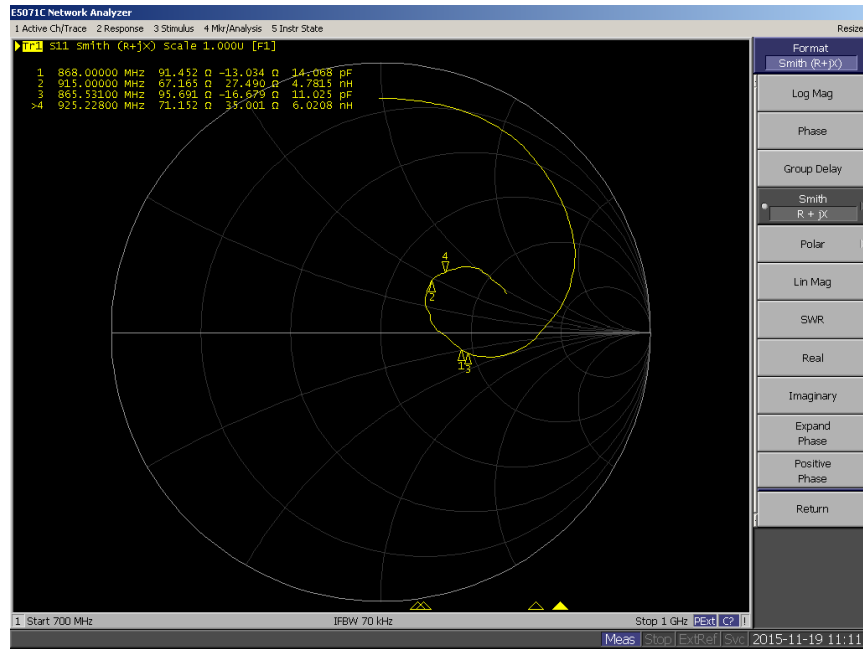


Figure 302. Impedance of 868/915-MHz Kit Antenna

### A.15.2 SWR of 868/915-MHz Kit Antenna

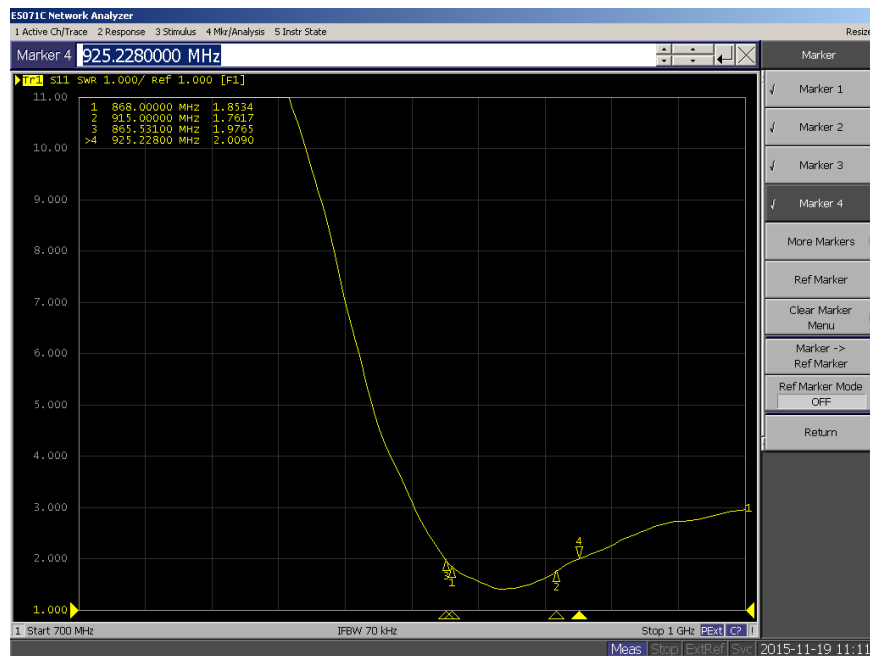


Figure 303. SWR of 868/915-MHz Kit Antenna

**A.15.3 868 MHz**
**Table 195. 868-MHz Kit Antenna: OTA Evaluation Results**

Test Description	Test Result
Total Radiated Power	-2.07 dBm
Peak EIRP	1.38 dBm
Directivity	3.45 dBi
Efficiency	-2.07 dB
Efficiency	0.6207
Peak Gain	1.38 dBi
NHPRP 45°	-2.68 dBm
NHPRP 45° / TRP	-0.61 dB
NHPRP 45° / TRP	0.8691
NHPRP 30°	-3.57 dBm
NHPRP 30° / TRP	-1.50 dB
NHPRP 30° / TRP	0.7081
NHPRP 22.5°	-4.51 dBm
NHPRP 22.5° / TRP	-2.44 dB
NHPRP 22.5° / TRP	0.5697
UHRP	-5.48 dBm
UHRP / TRP	-3.41 dB
UHRP / TRP	0.4559
LHRP	-4.71 dBm
LHRP / TRP	-2.64 dB
LHRP / TRP	0.5441
PGRP (0-120°)	-2.84 dBm
PGRP / TRP	-0.77 dB
PGRP / TRP	0.8376
Front/Back Ratio	0.56
PhiBW	360.0°
PhiBW Up	360.0°
PhiBW Down	360.0°
ThetaBW	44.3°
ThetaBW Up	24.1°
ThetaBW Down	20.2°
Boresight Phi	195°
Boresight Theta	90°
Maximum Power	1.38 dBm
Minimum Power	-18.61 dBm
Average Power	-3.50 dBm
Max/Min Ratio	19.99 dB
Max/Avg Ratio	4.87 dB
Min/Avg Ratio	-15.11 dB
Worst Single Value	-28.89 dBm
Worst Position	Azi = 30°; Elev = 0°; Pol = Horizontal
Best Single Value	0.94 dBm
Best Position	Azi = 210°; Elev = 90°; Pol = Horizontal

**Table 196. 868-MHz Kit Antenna: RP\_868.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-17.95	-11.36	-8.14	-4.59	-3.95	-1.85	0.61	1.12	-1.11	-4.9	-5.96	-6.6	-8.69
15	-18.36	-11.31	-7.8	-4.57	-3.79	-1.97	0.82	0.77	-2.02	-4.93	-5.6	-6.78	-8.5
30	-18.61	-11.07	-7.72	-4.48	-3.59	-1.73	0.77	0.49	-2.53	-4.38	-5.12	-6.76	-8.01
45	-17.82	-10.73	-7.64	-4.43	-3.33	-1.56	0.8	-0.07	-2.95	-4.23	-4.75	-6.93	-7.99
60	-16.77	-10.38	-7.68	-4.38	-3.13	-1.21	0.82	-0.55	-3.26	-3.9	-4.5	-7.28	-8.13
75	-16.17	-10.16	-7.69	-4.43	-3	-1.08	0.73	-1.02	-3.39	-3.75	-4.56	-7.96	-8.56
90	-16.1	-10.03	-7.61	-4.48	-2.9	-0.98	0.66	-1.34	-3.36	-3.38	-4.76	-8.87	-8.86
105	-16.51	-10.06	-7.41	-4.46	-2.76	-0.82	0.58	-1.58	-3.33	-3.53	-4.94	-10.05	-9.2
120	-16.81	-10.21	-7.11	-4.35	-2.64	-0.72	0.53	-1.62	-3.34	-3.26	-5.39	-11.55	-9.09
135	-16.46	-10.54	-6.81	-4.1	-2.59	-0.58	0.63	-1.68	-3.24	-3.51	-5.62	-12.77	-8.85
150	-15.38	-10.93	-6.64	-3.76	-2.62	-0.55	0.81	-1.46	-3.33	-3.39	-5.61	-13	-8.46
165	-14.16	-11.41	-6.64	-3.34	-2.78	-0.61	1.11	-1.08	-3.18	-3.01	-4.96	-12.09	-7.97
180	-13.33	-11.98	-6.82	-2.99	-2.9	-0.52	1.32	-0.6	-3	-2.35	-4.43	-10.6	-7.62
195	-12.56	-12.26	-7.14	-2.74	-2.66	-1.07	1.38	-0.15	-2.56	-2.35	-3.85	-8.98	-7.41
210	-11.43	-12.6	-7.43	-2.62	-2.48	-1.44	1.26	0.21	-2.39	-1.99	-3.26	-7.65	-7.22
225	-11.8	-12.65	-7.59	-2.42	-1.99	-1.57	0.93	0.36	-2.28	-1.99	-2.62	-6.62	-7.37
240	-11.95	-12.59	-7.65	-2.95	-2	-1.65	0.67	0.41	-2.03	-2.33	-2.44	-5.88	-7.63
255	-12.21	-12.35	-7.82	-3.4	-2.05	-1.45	0.69	0.41	-2.24	-3.06	-3.13	-5.47	-8.03
270	-12.49	-12.36	-8.06	-3.88	-2.39	-1.24	0.5	0.44	-2.44	-3.39	-3.64	-5.52	-9.47
285	-13.36	-12.19	-8.29	-4.35	-2.79	-1.16	0.62	0.56	-2.24	-5.06	-4.6	-5.59	-10.5
300	-14.01	-12.31	-8.38	-4.67	-3.16	-1.25	0.65	0.87	-1.91	-5.76	-5.24	-5.56	-10.61
315	-14.7	-12.17	-8.4	-4.79	-3.51	-1.46	0.65	0.88	-1.54	-6.1	-6.13	-6.36	-10.85
330	-15.31	-12.04	-8.2	-4.74	-3.75	-1.7	0.61	1.02	-1.32	-5.76	-6.56	-6.19	-10.29
345	-15.57	-12.17	-8.11	-4.82	-3.93	-2.14	0.65	1.08	-1.34	-5.51	-6.59	-6.53	-9.99
360	-17.95	-11.36	-8.14	-4.59	-3.95	-1.85	0.61	1.12	-1.11	-4.9	-5.96	-6.6	-8.69



**Table 197. 868-MHz Kit Antenna: RP\_868.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-23.81	-15.73	-9.74	-5.09	-4.26	-1.87	0.25	0.63	-1.45	-5.92	-6.98	-9.01	-16.29
15	-25.37	-15.36	-9.35	-5.13	-4.14	-2	0.43	0.22	-2.41	-5.9	-6.57	-9.64	-19.66
30	-28.89	-15.09	-9.43	-5.11	-3.99	-1.78	0.33	-0.02	-2.85	-5.1	-5.94	-10.42	-24.05
45	-25.94	-14.79	-9.46	-5.14	-3.74	-1.64	0.32	-0.52	-3.15	-4.65	-5.4	-11.6	-24.05
60	-22.37	-14.61	-9.76	-5.13	-3.51	-1.3	0.33	-0.91	-3.37	-4.06	-4.99	-12.57	-18.92
75	-20.08	-14.38	-9.98	-5.22	-3.3	-1.16	0.24	-1.32	-3.5	-3.78	-4.94	-13.84	-15.1
90	-18.82	-13.96	-10.09	-5.28	-3.12	-1.04	0.18	-1.61	-3.54	-3.4	-5.04	-14.9	-12.61
105	-18.1	-13.43	-9.97	-5.28	-2.92	-0.87	0.08	-1.86	-3.56	-3.6	-5.14	-15.51	-10.93
120	-17.61	-12.86	-9.62	-5.23	-2.75	-0.76	0	-1.92	-3.59	-3.36	-5.5	-15.22	-9.9
135	-17.26	-12.58	-9.02	-5.08	-2.71	-0.63	0.05	-2.05	-3.46	-3.61	-5.65	-14.37	-9.32
150	-17.07	-12.42	-8.45	-4.79	-2.81	-0.64	0.2	-1.89	-3.55	-3.5	-5.64	-13.38	-9.18
165	-17.01	-12.47	-7.92	-4.35	-3.1	-0.78	0.5	-1.6	-3.48	-3.17	-5.1	-12.35	-9.34
180	-17.3	-12.82	-7.6	-3.95	-3.41	-0.75	0.75	-1.16	-3.46	-2.59	-4.78	-11.44	-9.9
195	-17.52	-13.16	-7.43	-3.52	-3.37	-1.36	0.92	-0.72	-3.23	-2.75	-4.41	-10.44	-10.9
210	-17.77	-14.13	-7.5	-3.21	-3.38	-1.72	0.94	-0.28	-3.27	-2.49	-3.95	-9.48	-11.8
225	-17.88	-15.57	-7.82	-3.07	-2.81	-1.9	0.79	0.01	-3.26	-2.54	-3.28	-8.48	-12.94
240	-18.48	-17.35	-8.36	-3.17	-2.73	-1.78	0.62	0.21	-3.03	-2.88	-3	-7.6	-13.91
255	-18.38	-19.32	-9.1	-3.51	-2.55	-1.56	0.59	0.3	-2.79	-3.52	-3.55	-6.97	-12.04
270	-18.28	-20.56	-9.77	-3.95	-2.71	-1.37	0.25	0.42	-2.7	-3.59	-3.94	-6.62	-13.77
285	-18.46	-20.54	-10.27	-4.4	-2.96	-1.3	0.26	0.5	-2.3	-5.19	-4.67	-6.37	-13.28
300	-18.39	-20.52	-10.34	-4.74	-3.26	-1.37	0.23	0.72	-1.95	-5.8	-5.32	-6.19	-12.83
315	-18.45	-19.66	-10.27	-4.93	-3.62	-1.55	0.23	0.61	-1.66	-6.28	-6.43	-7.17	-13.02
330	-18.8	-18.5	-9.91	-4.99	-3.91	-1.75	0.21	0.66	-1.54	-6.16	-7.18	-7.14	-13.71
345	-18.96	-18.41	-9.6	-5.19	-4.13	-2.17	0.26	0.64	-1.6	-6.15	-7.42	-7.89	-14.45
360	-23.81	-15.73	-9.74	-5.09	-4.26	-1.87	0.25	0.63	-1.45	-5.92	-6.98	-9.01	-16.29

**Table 198. 868-MHz Kit Antenna: RP\_868.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-19.26	-13.34	-13.25	-14.27	-15.65	-26.68	-10.4	-8.56	-12.36	-11.73	-12.74	-10.31	-9.52
15	-19.33	-13.49	-13.02	-13.71	-14.87	-24.18	-9.9	-8.46	-12.68	-11.95	-12.59	-9.94	-8.84
30	-19.04	-13.26	-12.61	-13.12	-14.17	-21.23	-9.32	-9.06	-13.98	-12.55	-12.77	-9.21	-8.12
45	-18.55	-12.89	-12.29	-12.67	-13.78	-19.18	-8.98	-10.19	-16.47	-14.57	-13.32	-8.74	-8.1
60	-18.17	-12.44	-11.89	-12.33	-13.92	-18.25	-8.94	-11.54	-19.06	-18.45	-14.22	-8.8	-8.5
75	-18.43	-12.22	-11.56	-12.25	-14.69	-18.52	-9.05	-12.8	-19.5	-26.77	-15.43	-9.26	-9.64
90	-19.41	-12.29	-11.21	-12.26	-15.86	-19.58	-9.09	-13.58	-17.42	-27.03	-16.73	-10.12	-11.24
105	-21.64	-12.74	-10.92	-12.09	-17.37	-20.35	-9.05	-13.64	-16.18	-21.35	-18.57	-11.51	-14.03
120	-24.56	-13.6	-10.7	-11.71	-18.54	-21.64	-8.81	-13.37	-15.93	-19.61	-21.21	-13.98	-16.79
135	-24.22	-14.8	-10.8	-11.08	-18.31	-20.34	-8.41	-12.63	-16.32	-19.68	-27.69	-17.88	-18.79
150	-20.29	-16.32	-11.31	-10.52	-16.45	-17.68	-7.98	-11.69	-16.26	-19.6	-27.58	-23.75	-16.63
165	-17.35	-18.05	-12.59	-10.14	-14.31	-14.7	-7.7	-10.55	-14.91	-17.42	-19.8	-24.36	-13.66
180	-15.56	-19.53	-14.67	-10.04	-12.48	-13.47	-7.79	-9.77	-12.95	-15.1	-15.58	-18.17	-11.51
195	-14.23	-19.56	-19.1	-10.55	-10.91	-12.94	-8.6	-9.33	-11.03	-12.92	-12.98	-14.41	-9.98
210	-12.58	-17.85	-25.12	-11.6	-9.78	-13.61	-10.14	-9.52	-9.76	-11.65	-11.6	-12.31	-9.08
225	-13.03	-15.76	-20.54	-10.99	-9.63	-13	-14.08	-10.68	-9.22	-11.23	-11.15	-11.2	-8.78
240	-13.04	-14.35	-15.89	-16.02	-10.11	-17.07	-18.41	-12.99	-8.92	-11.6	-11.62	-10.74	-8.8
255	-13.42	-13.32	-13.76	-19.15	-11.75	-17.29	-15.73	-15.59	-11.48	-13.03	-13.45	-10.84	-10.22
270	-13.81	-13.07	-12.93	-21.81	-13.91	-16.64	-12.15	-22.81	-14.76	-16.79	-15.36	-12	-11.49
285	-14.97	-12.87	-12.66	-23.45	-16.85	-16.14	-10.34	-17.73	-20.38	-20.38	-22.58	-13.44	-13.76
300	-15.99	-13.02	-12.77	-22.43	-19.57	-16.79	-9.65	-13.84	-22.42	-26.87	-22.58	-14.22	-14.6
315	-17.08	-13.02	-12.98	-19.68	-19.79	-18.33	-9.72	-11.38	-17.23	-19.96	-17.92	-14.07	-14.91
330	-17.89	-13.16	-13.08	-17.36	-18.14	-20.81	-9.97	-10.02	-14.29	-16.34	-15.35	-13.27	-12.92
345	-18.23	-13.35	-13.46	-15.72	-17.44	-24.6	-9.97	-9.1	-13.57	-14.12	-14.21	-12.21	-11.91
360	-19.26	-13.34	-13.25	-14.27	-15.65	-26.68	-10.4	-8.56	-12.36	-11.73	-12.74	-10.31	-9.52

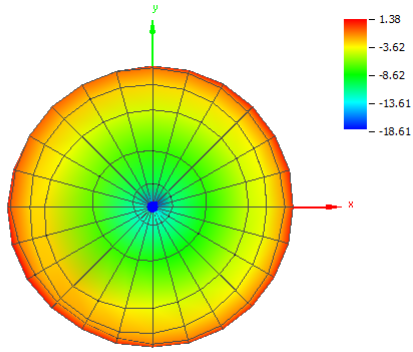


Figure 304. 868-MHz Kit Antenna: Theta = 0, Phi = 0

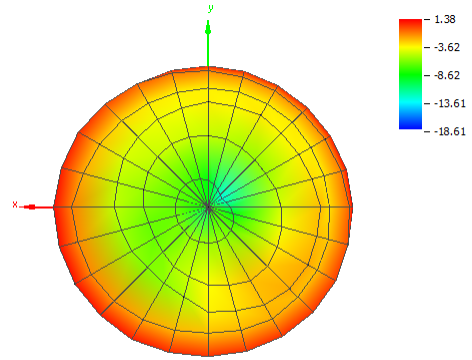


Figure 305. 868-MHz Kit Antenna: Theta = 180, Phi = 0

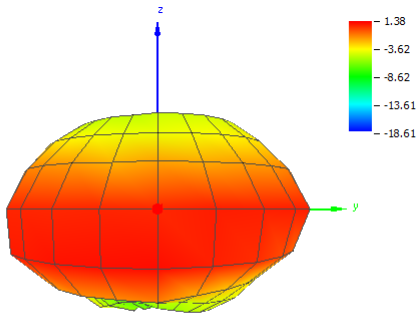


Figure 306. 868-MHz Kit Antenna: Theta = 90, Phi = 0

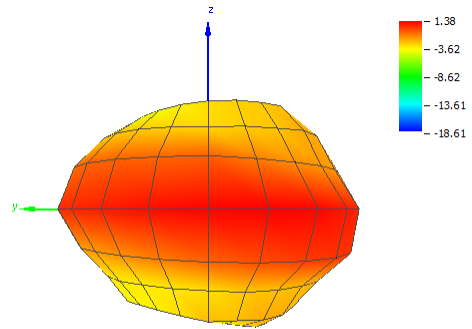


Figure 307. 868-MHz Kit Antenna: Theta = 90, Phi = 180

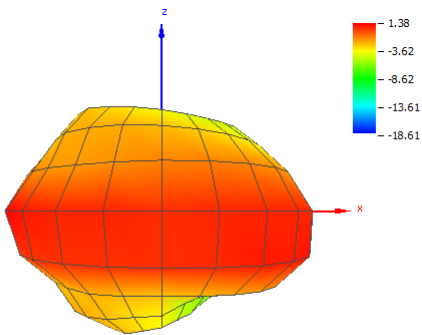


Figure 308. 868-MHz Kit Antenna: Theta = 90, Phi = 270

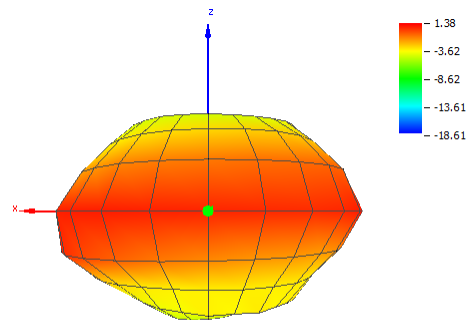


Figure 309. 868-MHz Kit Antenna: Theta = 90, Phi = 90

**A.15.4 915 MHz**
**Table 199. 915-MHz Kit Antenna: OTA Evaluation Results**

Test Description	Test Result
Total Radiated Power	-4.50 dBm
Peak EIRP	-0.67 dBm
Directivity	3.83 dBi
Efficiency	-4.50 dB
Efficiency	0.3548
Peak Gain	-0.67 dBi
NHPRP 45°	-6.06 dBm
NHPRP 45° / TRP	-1.56 dB
NHPRP 45° / TRP	0.6975
NHPRP 30°	-7.44 dBm
NHPRP 30° / TRP	-2.94 dB
NHPRP 30° / TRP	0.5082
NHPRP 22.5°	-8.52 dBm
NHPRP 22.5° / TRP	-4.02 dB
NHPRP 22.5° / TRP	0.3959
UHRP	-9.03 dBm
UHRP / TRP	-4.53 dB
UHRP / TRP	0.3521
LHRP	-6.38 dBm
LHRP / TRP	-1.88 dB
LHRP / TRP	0.6479
PGRP (0-120°)	-6.47 dBm
PGRP / TRP	-1.98 dB
PGRP / TRP	0.6345
Front/Back Ratio	6.99
PhiBW	360.0°
PhiBW Up	360.0°
PhiBW Down	360.0°
ThetaBW	34.4°
ThetaBW Up	20.2°
ThetaBW Down	14.2°
Boresight Phi	270°
Boresight Theta	150°
Maximum Power	-0.67 dBm
Minimum Power	-18.82 dBm
Average Power	-5.06 dBm
Max/Min Ratio	18.15 dB
Max/Avg Ratio	4.39 dB
Min/Avg Ratio	-13.76 dB
Worst Single Value	-33.12 dBm
Worst Position	Azi = 105°; Elev = 75°; Pol = Vertical
Best Single Value	-0.86 dBm
Best Position	Azi = 255°; Elev = 150°; Pol = Horizontal

**Table 200. 915-MHz Kit Antenna: RP\_915.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-13.4	-11.72	-9.89	-8.21	-6.38	-6.26	-4.04	-2.88	-4.92	-4.72	-1.09	-2.45	-5.24
15	-13.26	-11.57	-9.54	-7.25	-5.9	-5.87	-4.16	-3.29	-5.43	-4.25	-0.98	-2.71	-5.16
30	-13.19	-11.44	-9.06	-6.53	-5.33	-5.52	-4.15	-3.84	-5.86	-3.64	-1	-3.01	-5.25
45	-13.25	-11.35	-8.65	-5.98	-4.87	-5.06	-4.09	-4.38	-6.09	-3	-0.95	-3.44	-5.51
60	-13.52	-11.35	-8.32	-5.62	-4.58	-4.67	-4.12	-5.07	-5.93	-2.45	-1.04	-4.03	-6.29
75	-14.15	-11.37	-8	-5.49	-4.39	-4.41	-4.38	-5.68	-5.48	-2.19	-1.2	-4.81	-7.21
90	-15.41	-11.3	-7.66	-5.65	-4.36	-4.17	-4.82	-6.08	-5	-2.04	-1.53	-5.81	-8.11
105	-16.81	-11.02	-7.29	-6.09	-4.54	-3.89	-5.29	-6.22	-4.58	-2	-1.97	-6.94	-9.1
120	-17.71	-10.39	-7	-6.74	-4.81	-3.59	-5.43	-6.17	-4.21	-1.93	-2.42	-8.14	-9.91
135	-17.49	-9.77	-6.61	-7.33	-5.22	-3.31	-5.09	-6.03	-3.94	-1.76	-2.8	-9.22	-10.62
150	-16.74	-9.21	-6.17	-7.5	-5.76	-3.25	-4.39	-5.75	-3.83	-1.52	-2.91	-9.72	-10.83
165	-16.31	-8.95	-5.72	-6.82	-6.4	-3.32	-3.51	-5.56	-3.95	-1.18	-2.79	-9.27	-10
180	-16.01	-9.22	-5.45	-6.12	-7.13	-3.74	-2.9	-5.2	-4.4	-0.86	-2.46	-8.08	-9.07
195	-16.62	-9.59	-5.61	-5.31	-7.5	-4.47	-2.46	-4.6	-5.12	-0.84	-1.99	-6.61	-8.08
210	-17.21	-10.62	-6.32	-4.92	-7.11	-5.46	-2.39	-3.76	-5.9	-0.7	-1.54	-5.23	-7.35
225	-17.89	-12.02	-7.62	-5.19	-6.18	-6.41	-2.63	-2.86	-6.33	-1.3	-1.06	-4.17	-6.93
240	-18.54	-13.83	-9.55	-6.15	-5.39	-7.75	-3.2	-2.17	-6.29	-1.69	-0.82	-3.33	-6.65
255	-18.82	-15.61	-12.05	-7.35	-5.02	-7.81	-3.77	-1.81	-5.97	-2.79	-0.68	-2.77	-6.37
270	-18.34	-17	-14.73	-9.61	-5.64	-7.29	-4.18	-1.7	-5.55	-3.84	-0.67	-2.39	-6.11
285	-17.19	-17.27	-16.38	-11.12	-6.46	-6.84	-4.23	-1.75	-5.09	-4.67	-0.78	-2.03	-5.73
300	-15.91	-16.28	-15.41	-12.88	-7.46	-6.62	-4.11	-1.81	-4.85	-5.21	-0.92	-2.04	-5.38
315	-14.77	-14.59	-13.58	-12.35	-8.06	-6.56	-3.93	-1.91	-4.62	-5.33	-1.03	-2.1	-5.15
330	-14	-13.24	-11.99	-11.13	-8.15	-6.54	-3.89	-2.08	-4.57	-5.19	-1.11	-2.15	-5.06
345	-13.61	-12.34	-11.04	-9.91	-7.52	-6.52	-3.91	-2.22	-4.65	-5.1	-1.1	-2.13	-5.16
360	-13.4	-11.72	-9.89	-8.21	-6.38	-6.26	-4.04	-2.88	-4.92	-4.72	-1.09	-2.45	-5.24

**Table 201. 915-MHz Kit Antenna: RP\_915.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-18.31	-14.99	-12.51	-9.05	-6.72	-6.39	-4.12	-2.94	-5.36	-5.67	-2.92	-4.86	-8.76
15	-18.86	-14.84	-12.2	-8.2	-6.32	-5.96	-4.22	-3.32	-5.83	-5	-2.97	-5.73	-9.98
30	-19.77	-14.75	-11.54	-7.68	-5.74	-5.58	-4.18	-3.85	-6.21	-4.3	-2.94	-6.9	-12.1
45	-20.65	-14.61	-10.89	-7.19	-5.24	-5.12	-4.11	-4.42	-6.45	-3.63	-2.92	-8.21	-14.61
60	-20.96	-14.35	-10.18	-6.7	-4.88	-4.73	-4.18	-5.17	-6.38	-3.06	-3	-9.87	-16.8
75	-20.74	-13.85	-9.4	-6.37	-4.61	-4.45	-4.52	-5.87	-6.01	-2.78	-3.13	-11.61	-17.1
90	-20.22	-13.06	-8.63	-6.29	-4.52	-4.18	-5.07	-6.4	-5.57	-2.61	-3.38	-13.22	-15.18
105	-19.48	-12.1	-8.01	-6.55	-4.67	-3.9	-5.74	-6.72	-5.12	-2.51	-3.68	-14.14	-13.37
120	-18.8	-11.06	-7.64	-7.09	-5.01	-3.64	-6.15	-6.88	-4.71	-2.35	-3.91	-14.1	-12.31
135	-17.95	-10.29	-7.33	-7.67	-5.66	-3.46	-6.14	-6.95	-4.41	-2.13	-3.99	-13.49	-11.9
150	-17.37	-9.72	-7.06	-7.93	-6.65	-3.59	-5.68	-6.8	-4.3	-1.86	-3.82	-12.49	-12.01
165	-17.3	-9.49	-6.8	-7.38	-7.85	-3.99	-4.82	-6.51	-4.39	-1.53	-3.47	-11.25	-12.21
180	-17.39	-9.78	-6.66	-6.9	-8.91	-4.87	-4.06	-5.78	-4.73	-1.27	-2.95	-9.8	-12.87
195	-18.8	-10.06	-6.84	-6.33	-8.93	-6.23	-3.36	-4.84	-5.28	-1.21	-2.35	-8.28	-13.38
210	-20.25	-10.98	-7.41	-6.19	-7.92	-7.77	-3.04	-3.87	-5.95	-1.02	-1.8	-6.76	-13.57
225	-21.85	-12.24	-8.48	-6.66	-6.79	-8.33	-3.13	-3.07	-6.62	-1.57	-1.25	-5.45	-12.91
240	-23.7	-13.91	-10.09	-7.66	-6.01	-8.8	-3.52	-2.52	-7.16	-1.91	-0.98	-4.32	-11.33
255	-26.19	-15.81	-12.27	-8.69	-5.68	-8.08	-3.93	-2.19	-7.37	-2.9	-0.86	-3.49	-9.57
270	-30.32	-17.9	-14.81	-10.81	-6.33	-7.32	-4.21	-1.98	-7.09	-3.97	-0.95	-2.92	-8.08
285	-29.38	-19.71	-17.24	-11.78	-7.14	-6.96	-4.24	-1.89	-6.37	-4.99	-1.23	-2.45	-6.92
300	-23.93	-20.06	-17.84	-13.09	-8.02	-6.89	-4.17	-1.85	-5.82	-5.92	-1.62	-2.5	-6.19
315	-20.43	-18.19	-16.73	-12.43	-8.5	-6.9	-4.02	-1.93	-5.34	-6.42	-2.03	-2.75	-5.96
330	-18.63	-16.58	-15.13	-11.4	-8.49	-6.86	-3.99	-2.14	-5.16	-6.43	-2.43	-3.15	-6.24
345	-18.01	-15.53	-13.99	-10.41	-7.83	-6.77	-4	-2.31	-5.2	-6.29	-2.72	-3.61	-6.95
360	-18.31	-14.99	-12.51	-9.05	-6.72	-6.39	-4.12	-2.94	-5.36	-5.67	-2.92	-4.86	-8.76

**Table 202. 915-MHz Kit Antenna: RP\_915.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-15.09	-14.49	-13.32	-15.77	-17.62	-21.61	-21.3	-21.03	-15.09	-11.79	-5.74	-6.14	-7.8
15	-14.66	-14.34	-12.93	-14.33	-16.27	-22.71	-22.83	-24.73	-16.05	-12.24	-5.33	-5.71	-6.89
30	-14.27	-14.18	-12.68	-12.89	-15.77	-23.92	-26.13	-30.21	-16.98	-12.14	-5.42	-5.3	-6.25
45	-14.12	-14.13	-12.59	-12.12	-15.76	-24.04	-26.58	-25.13	-17.06	-11.68	-5.34	-5.19	-6.08
60	-14.38	-14.36	-12.9	-12.17	-16.35	-23.54	-22.6	-21.56	-16.03	-11.3	-5.44	-5.34	-6.69
75	-15.22	-14.98	-13.58	-12.86	-17.44	-24.33	-19.46	-19.43	-14.85	-11.11	-5.66	-5.82	-7.68
90	-17.15	-16.09	-14.66	-14.25	-18.9	-28.28	-17.29	-17.58	-14.09	-11.15	-6.13	-6.68	-9.06
105	-20.19	-17.6	-15.48	-16.03	-19.81	-33.12	-15.42	-15.82	-13.87	-11.61	-6.86	-7.86	-11.14
120	-24.26	-18.85	-15.6	-17.88	-18.3	-23.54	-13.54	-14.36	-13.81	-12.23	-7.79	-9.41	-13.64
135	-27.51	-19.24	-14.77	-18.56	-15.41	-18.01	-11.75	-13.21	-13.8	-12.67	-8.99	-11.26	-16.56
150	-25.45	-18.79	-13.49	-17.7	-13.08	-14.46	-10.28	-12.43	-13.73	-12.72	-10.16	-12.97	-17.08
165	-23.24	-18.24	-12.29	-15.94	-11.85	-11.75	-9.35	-12.65	-14.1	-12.26	-11.19	-13.62	-13.99
180	-21.64	-18.39	-11.59	-13.97	-11.86	-10.14	-9.18	-14.22	-15.74	-11.25	-12.17	-12.94	-11.42
195	-20.66	-19.41	-11.69	-12.12	-13.03	-9.23	-9.75	-17.43	-19.64	-11.71	-13.02	-11.57	-9.6
210	-20.18	-21.62	-12.85	-10.85	-14.8	-9.3	-10.9	-19.77	-24.77	-12.25	-13.93	-10.52	-8.54
225	-20.13	-25.06	-15.03	-10.62	-14.99	-10.89	-12.26	-16.04	-18.14	-13.56	-14.8	-10.1	-8.2
240	-20.12	-30.87	-18.87	-11.46	-14.11	-14.43	-14.62	-13.24	-13.71	-14.74	-15.27	-10.26	-8.46
255	-19.71	-29.06	-25.27	-13.14	-13.52	-20.03	-18.24	-12.59	-11.57	-18.63	-14.61	-10.9	-9.2
270	-18.62	-24.26	-32.26	-15.77	-13.96	-28.05	-26.05	-13.79	-10.82	-19.06	-12.84	-11.81	-10.5
285	-17.46	-20.93	-23.86	-19.61	-14.89	-22.46	-28.85	-16.95	-11.02	-16.15	-10.8	-12.38	-11.93
300	-16.65	-18.64	-19.09	-25.94	-16.62	-18.9	-22.97	-22.57	-11.83	-13.42	-9.16	-12.02	-13.11
315	-16.14	-17.07	-16.45	-29.85	-18.24	-17.74	-20.98	-25.43	-12.79	-11.87	-7.92	-10.67	-12.87
330	-15.82	-15.94	-14.87	-23.33	-19.3	-18.02	-20.47	-21.15	-13.58	-11.26	-6.92	-9	-11.28
345	-15.57	-15.18	-14.1	-19.59	-19.08	-19.14	-20.47	-19.25	-13.83	-11.29	-6.17	-7.53	-9.87
360	-15.09	-14.49	-13.32	-15.77	-17.62	-21.61	-21.3	-21.03	-15.09	-11.79	-5.74	-6.14	-7.8

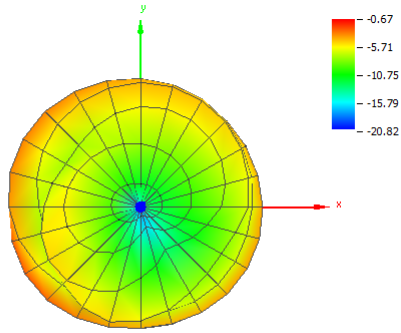


Figure 310. 915-MHz Kit Antenna: Theta = 0, Phi = 0

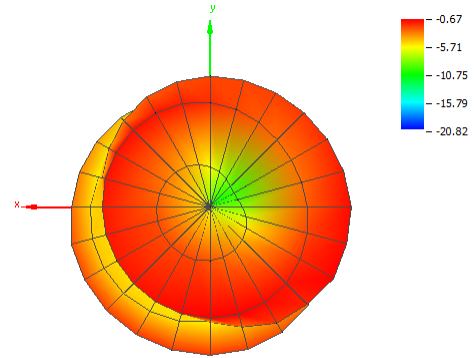


Figure 311. 915-MHz Kit Antenna: Theta = 180, Phi = 0

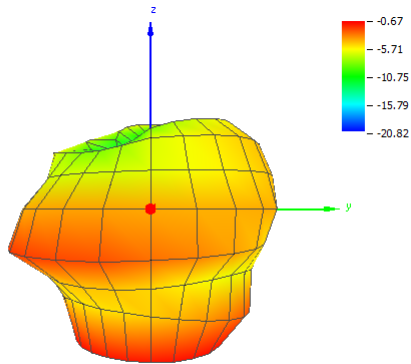


Figure 312. 915-MHz Kit Antenna: Theta = 90, Phi = 0

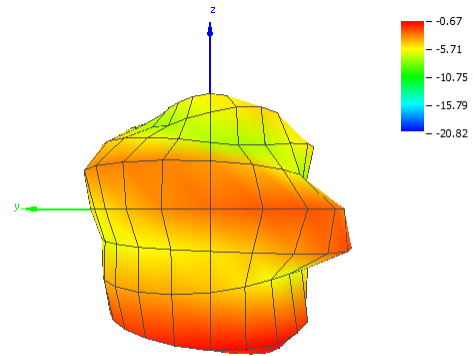


Figure 313. 915-MHz Kit Antenna: Theta = 90, Phi = 180

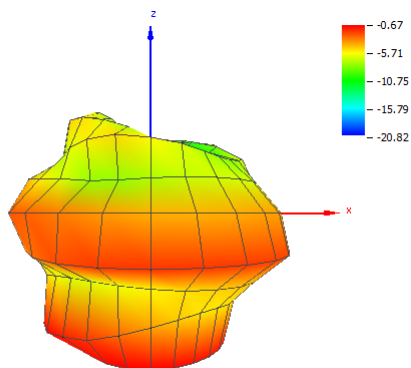


Figure 314. 915-MHz Kit Antenna: Theta = 90, Phi = 270

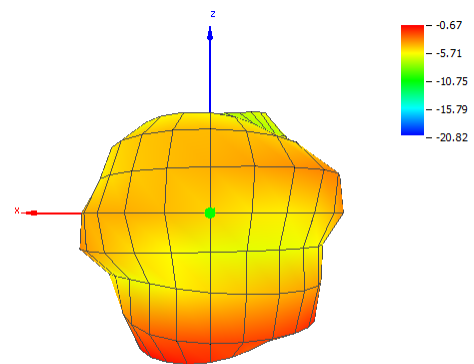


Figure 315. 915-MHz Kit Antenna: Theta = 90, Phi = 90



**A.16 2.4 GHz Kit Antenna**
**A.16.1 2.40 GHz**
**Table 203. 2.40-GHz Kit Antenna: OTA Evaluation Results**

Test Description	Test Result
Total Radiated Power	-1.66 dBm
Peak EIRP	2.11 dBm
Directivity	3.77 dBi
Efficiency	-1.66 dB
Efficiency	0.682
Peak Gain	2.11 dBi
NHPRP 45°	-2.29 dBm
NHPRP 45° / TRP	-0.63 dB
NHPRP 45° / TRP	0.8653
NHPRP 30°	-3.38 dBm
NHPRP 30° / TRP	-1.71 dB
NHPRP 30° / TRP	0.6739
NHPRP 22.5°	-4.45 dBm
NHPRP 22.5° / TRP	-2.79 dB
NHPRP 22.5° / TRP	0.5261
UHRP	-4.27 dBm
UHRP / TRP	-2.60 dB
UHRP / TRP	0.549
LHRP	-5.12 dBm
LHRP / TRP	-3.46 dB
LHRP / TRP	0.451
PGRP (0-120°)	-2.36 dBm
PGRP / TRP	-0.70 dB
PGRP / TRP	0.8513
Front/Back Ratio	1.67
PhiBW	360.0°
PhiBW Up	360.0°
PhiBW Down	360.0°
ThetaBW	44.5°
ThetaBW Up	11.6°
ThetaBW Down	32.9°
Boresight Phi	210°
Boresight Theta	90°
Maximum Power	2.11 dBm
Minimum Power	-19.08 dBm
Average Power	-2.93 dBm
Max/Min Ratio	21.19 dB
Max/Avg Ratio	5.04 dB
Min/Avg Ratio	-16.16 dB
Worst Single Value	-23.09 dBm
Worst Position	Azi = 195°; Elev = 0°; Pol = Horizontal
Best Single Value	2.01 dBm
Best Position	Azi = 210°; Elev = 90°; Pol = Horizontal

**Table 204. 2.40-GHz Kit Antenna: RP\_2400.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-12.27	-10.71	-6.48	-3.62	-0.34	0.3	0.19	-0.73	-1.17	-5.47	-4.81	-5.19	-5.51
15	-12.01	-11.55	-6.51	-3.27	-0.38	0.15	0.4	-1.31	-1.73	-5.3	-5.34	-5.65	-5.55
30	-11.94	-12.06	-6.68	-3.05	-0.43	-0.16	0.44	-1.64	-2.54	-4.73	-5.02	-6.64	-5.7
45	-11.83	-12.26	-6.56	-3.2	-0.58	-0.04	0.03	-2.2	-1.98	-4.12	-4.63	-7.72	-6.15
60	-11.53	-12.44	-6.59	-3.44	-0.85	0.15	-0.21	-2.2	-1.35	-3.95	-4.4	-7.38	-6.64
75	-10.58	-11.94	-6.53	-3.63	-1.08	-0.06	-0.47	-1.17	-1.81	-4.38	-4.06	-6.45	-6.93
90	-10.41	-10.46	-6.02	-3.84	-0.89	-0.35	-0.72	-0.57	-2.76	-4.61	-3.63	-6.26	-7.23
105	-12.22	-9.73	-5.76	-3.93	-0.55	-0.86	-0.37	-0.6	-2.95	-5.29	-3.46	-6.25	-7.41
120	-13.64	-10.92	-6.16	-4.2	0.01	-1.43	0.27	-0.99	-2.38	-6.43	-3.69	-6.54	-6.9
135	-14.44	-11.11	-5.88	-4.46	0.29	-1.41	0.91	-1.42	-1.77	-7.05	-3.58	-7	-6.81
150	-16.02	-10.28	-5.02	-4.7	0.39	-0.47	1.12	-1.58	-1.13	-6.41	-3.2	-6.31	-6.99
165	-16.97	-10.73	-4.88	-4.72	0.56	0.22	0.46	-0.66	-1.31	-4.63	-2.99	-4.64	-6.84
180	-18.11	-10.88	-5.04	-3.88	0.97	-0.43	-0.08	0.42	-2.91	-3.27	-3.12	-3.53	-6.63
195	-19.08	-10.28	-5.39	-2.71	0.65	-0.9	1.45	-0.07	-6	-2.95	-4.31	-2.8	-6.15
210	-17.98	-10.26	-5.38	-2.44	-0.52	0.77	2.11	-1.76	-5.53	-3.32	-6.99	-2.56	-5.7
225	-15.83	-11.14	-4.56	-3.38	0.11	1.07	0.63	-1.84	-3.36	-3.75	-8.99	-2.94	-5.35
240	-14.12	-12.85	-3.67	-3.97	1.56	-0.42	-0.1	-0.62	-2.86	-4.27	-7.26	-4.3	-4.82
255	-12.99	-14.24	-3.74	-2.99	1.29	-1	0.91	-0.42	-2.77	-6.01	-4.68	-7.13	-4.2
270	-13.05	-13.98	-4.46	-1.97	0.16	-0.01	1.29	-1.02	-3.15	-5.89	-3.77	-9.78	-3.84
285	-14.06	-13.03	-5.48	-1.73	-0.45	0.43	0.87	-1.59	-3.46	-3.05	-4.19	-10.42	-3.86
300	-14.2	-12.12	-6.09	-2.43	-0.12	0.21	0.57	-1.67	-2.68	-1.31	-5.45	-9.06	-4.01
315	-13.03	-10.85	-5.92	-3.54	0.2	-0.08	0.45	-1.39	-1.62	-1.01	-6.89	-7.65	-4.12
330	-12.23	-10.2	-5.54	-4.07	0.29	-0.25	0.52	-1	-1.05	-2	-7.21	-6.79	-4.28
345	-12.21	-10.12	-5.4	-4.14	0.2	-0.1	0.57	-0.57	-0.82	-3.98	-6.75	-5.63	-4.74
360	-12.27	-10.71	-6.48	-3.62	-0.34	0.3	0.19	-0.73	-1.17	-5.47	-4.81	-5.19	-5.51

**Table 205. 2.40-GHz Kit Antenna: RP\_2400.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-17.19	-11.64	-6.75	-3.74	-0.39	0.25	0.12	-0.89	-1.57	-5.79	-5.11	-9.46	-14.87
15	-17.56	-13.07	-6.93	-3.4	-0.42	0.1	0.36	-1.43	-2.27	-5.65	-5.6	-9.42	-12.33
30	-17.98	-14.45	-7.53	-3.14	-0.47	-0.2	0.4	-1.76	-3.07	-5.5	-5.43	-10.02	-10.57
45	-19.62	-15.65	-7.51	-3.28	-0.63	-0.09	0	-2.4	-2.48	-5.59	-5.46	-10.43	-9.04
60	-20.82	-17.2	-7.12	-3.53	-0.94	0.03	-0.27	-2.33	-1.75	-5.53	-5.73	-9.6	-8.11
75	-18.98	-18.72	-7.08	-3.71	-1.3	-0.19	-0.71	-1.28	-2.11	-5.04	-5.99	-8.71	-7.82
90	-19.62	-16.82	-6.91	-3.91	-1.25	-0.41	-1.07	-0.61	-2.97	-4.75	-5.72	-8.81	-8.04
105	-21.18	-14.57	-6.7	-4.01	-0.93	-0.89	-0.69	-0.63	-3.29	-5.38	-5.42	-8.97	-8.24
120	-18.15	-14.69	-6.9	-4.3	-0.31	-1.48	-0.01	-1.17	-3.29	-6.63	-5.41	-8.96	-7.7
135	-18.2	-14.16	-6.68	-4.62	0.1	-1.54	0.68	-2.39	-3.21	-7.63	-4.97	-8.69	-7.91
150	-20.32	-13.02	-5.77	-4.83	0.26	-0.64	1.01	-3.17	-2.82	-8.05	-4.67	-7.19	-8.84
165	-20.07	-12.63	-5.43	-4.85	0.37	0.08	0.41	-1.48	-2.92	-8.04	-4.78	-5.15	-9.47
180	-20.89	-12.27	-5.44	-4.11	0.76	-0.46	-0.6	0.2	-4.08	-7.09	-4.99	-4.08	-9.91
195	-23.09	-11.5	-5.77	-2.93	0.53	-1.09	0.94	-0.22	-6.26	-5.28	-5.9	-3.57	-10.06
210	-22.2	-11.29	-5.94	-2.56	-0.58	0.52	2.01	-2.09	-6.49	-3.93	-8.34	-3.7	-9.55
225	-18.91	-12	-5.32	-3.48	-0.09	1.03	0.55	-1.97	-4.38	-3.91	-11.34	-4.67	-8.78
240	-16.21	-13.5	-4.4	-4.44	1.39	-0.56	-0.33	-0.75	-3.12	-5.65	-8.74	-6.59	-7.96
255	-14.36	-15.04	-4.2	-3.58	1.22	-1.35	0.82	-0.6	-2.96	-8.11	-4.93	-9.68	-7.27
270	-14.26	-15.09	-4.59	-2.28	0.08	-0.23	1.23	-1.1	-4.13	-6.23	-3.91	-13.31	-6.89
285	-14.98	-14.21	-5.6	-1.86	-0.59	0.31	0.79	-1.78	-4.69	-3.34	-4.86	-16.06	-6.89
300	-14.93	-13.26	-6.5	-2.58	-0.24	0.14	0.48	-2.05	-3.31	-2.15	-7.04	-14.4	-7.28
315	-13.98	-11.88	-6.46	-3.77	0.1	-0.11	0.36	-1.7	-1.79	-2.25	-9.71	-12.1	-8.12
330	-13.68	-11.05	-5.94	-4.28	0.21	-0.3	0.43	-1.15	-1.09	-3.4	-9.77	-11.05	-9.07
345	-14.87	-10.95	-5.63	-4.31	0.1	-0.16	0.49	-0.66	-0.87	-5.08	-7.8	-9.15	-10.8
360	-17.19	-11.64	-6.75	-3.74	-0.39	0.25	0.12	-0.89	-1.57	-5.79	-5.11	-9.46	-14.87

**Table 206. 2.40-GHz Kit Antenna: RP\_2400.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-13.96	-17.88	-18.74	-19.12	-19.74	-18.88	-17.88	-15.36	-11.77	-16.97	-16.48	-7.23	-6.05
15	-13.42	-16.86	-16.85	-18.66	-19.92	-19.22	-20.09	-16.93	-11.01	-16.53	-17.75	-8.02	-6.57
30	-13.19	-15.81	-14.19	-19.87	-21.52	-20.23	-19.97	-17.04	-12	-12.62	-15.46	-9.32	-7.41
45	-12.62	-14.92	-13.6	-20.51	-20.37	-18.83	-22.01	-15.72	-11.63	-9.53	-12.23	-11.06	-9.29
60	-12.08	-14.2	-15.98	-20.48	-17.93	-15.28	-18.73	-17.5	-11.95	-9.09	-10.19	-11.37	-12.08
75	-11.26	-12.97	-15.84	-21.18	-14.24	-15.55	-13.07	-17.36	-13.65	-12.91	-8.53	-10.37	-14.27
90	-10.96	-11.61	-13.31	-21.93	-11.87	-18.72	-11.86	-20.7	-15.97	-19.61	-7.81	-9.79	-14.94
105	-12.81	-11.45	-12.86	-21.65	-11.33	-21.88	-11.78	-21.96	-14.15	-22.26	-7.85	-9.56	-15.01
120	-15.53	-13.28	-14.18	-20.35	-11.43	-20.8	-11.87	-14.95	-9.63	-19.94	-8.53	-10.23	-14.62
135	-16.82	-14.08	-13.65	-18.8	-13.42	-16.85	-11.86	-8.39	-7.27	-16.11	-9.21	-11.92	-13.32
150	-18.03	-13.59	-12.99	-19.84	-14.79	-14.67	-15.08	-6.71	-6.06	-11.43	-8.62	-13.66	-11.6
165	-19.9	-15.22	-14.12	-19.84	-13.12	-14.78	-19.08	-8.29	-6.42	-7.27	-7.71	-14.18	-10.26
180	-21.36	-16.51	-15.65	-16.79	-12.31	-21.18	-9.57	-12.67	-9.16	-5.6	-7.66	-12.82	-9.38
195	-21.28	-16.41	-16.1	-15.67	-15.04	-14.63	-8.11	-14.93	-18.26	-6.76	-9.44	-10.66	-8.42
210	-20.04	-16.99	-14.6	-18.11	-19.57	-11.86	-14.51	-13.05	-12.6	-12.16	-12.71	-8.92	-8.01
225	-18.76	-18.59	-12.5	-19.85	-13.39	-20.08	-16.89	-17.02	-10.14	-18.11	-12.78	-7.78	-7.98
240	-18.31	-21.4	-11.77	-13.81	-12.58	-15.48	-13.04	-16.04	-15.19	-9.91	-12.66	-8.17	-7.7
255	-18.67	-21.94	-13.74	-11.95	-16.65	-12.14	-15.79	-14.31	-16.52	-10.18	-17.12	-10.65	-7.15
270	-19.17	-20.42	-19.63	-13.64	-17.15	-13.09	-16.87	-17.98	-10.1	-17.11	-18.92	-12.32	-6.82
285	-21.25	-19.26	-20.93	-16.87	-15.25	-15.19	-16.49	-15.32	-9.52	-14.92	-12.62	-11.8	-6.85
300	-22.29	-18.46	-16.62	-16.92	-15.55	-17.96	-16.11	-12.4	-11.34	-8.84	-10.59	-10.57	-6.77
315	-20.09	-17.61	-15.19	-16.45	-16.06	-21.39	-16.32	-13.03	-15.93	-7.07	-10.1	-9.59	-6.33
330	-17.71	-17.67	-16.03	-17.19	-17.03	-20.2	-16.72	-15.85	-21.94	-7.62	-10.71	-8.84	-6.03
345	-15.61	-17.71	-18.4	-18.2	-16.43	-18.51	-17.08	-17.41	-20.35	-10.48	-13.44	-8.18	-5.98
360	-13.96	-17.88	-18.74	-19.12	-19.74	-18.88	-17.88	-15.36	-11.77	-16.97	-16.48	-7.23	-6.05

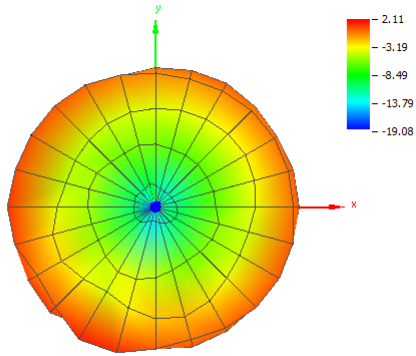


Figure 316. 2.40-GHz Kit Antenna: Theta = 0, Phi = 0

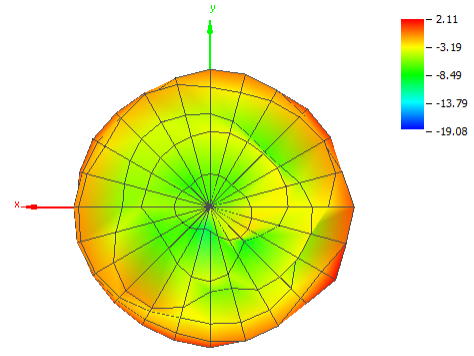


Figure 317. 2.40-GHz Kit Antenna: Theta = 180, Phi = 0

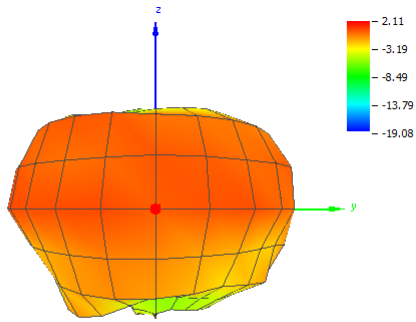


Figure 318. 2.40-GHz Kit Antenna: Theta = 90, Phi = 0

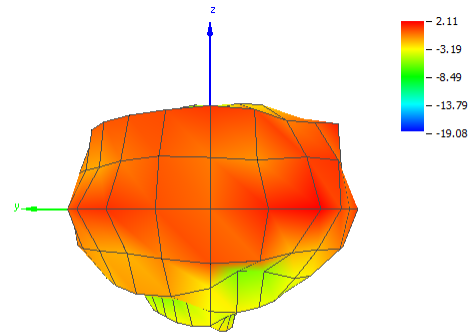


Figure 319. 2.40-GHz Kit Antenna: Theta = 90, Phi = 180

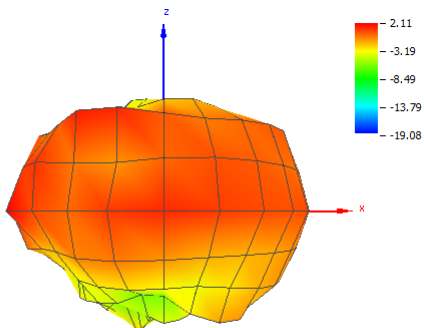


Figure 320. 2.40-GHz Kit Antenna: Theta = 90, Phi = 270

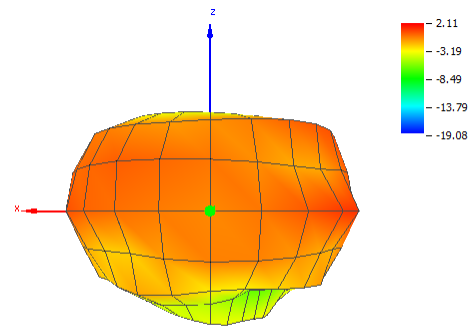


Figure 321. 2.40-GHz Kit Antenna: Theta = 90, Phi = 90

**A.16.2 2.44 GHz**
**Table 207. 2.44-GHz Kit Antenna: OTA Evaluation Results**

Test Description	Test Result
Total Radiated Power	-2.97 dBm
Peak EIRP	0.51 dBm
Directivity	3.48 dBi
Efficiency	-2.97 dB
Efficiency	0.505
Peak Gain	0.51 dBi
NHPRP 45°	-3.69 dBm
NHPRP 45° / TRP	-0.72 dB
NHPRP 45° / TRP	0.8469
NHPRP 30°	-4.81 dBm
NHPRP 30° / TRP	-1.84 dB
NHPRP 30° / TRP	0.6549
NHPRP 22.5°	-5.88 dBm
NHPRP 22.5° / TRP	-2.92 dB
NHPRP 22.5° / TRP	0.5109
UHRP	-5.85 dBm
UHRP / TRP	-2.88 dB
UHRP / TRP	0.5148
LHRP	-6.11 dBm
LHRP / TRP	-3.14 dB
LHRP / TRP	0.4852
PGRP (0-120°)	-3.82 dBm
PGRP / TRP	-0.85 dB
PGRP / TRP	0.8221
Front/Back Ratio	2.46
PhiBW	340.9°
PhiBW Up	257.2°
PhiBW Down	83.7°
ThetaBW	56.4°
ThetaBW Up	20.6°
ThetaBW Down	35.8°
Boresight Phi	270°
Boresight Theta	90°
Maximum Power	0.51 dBm
Minimum Power	-16.35 dBm
Average Power	-4.10 dBm
Max/Min Ratio	16.86 dB
Max/Avg Ratio	4.61 dB
Min/Avg Ratio	-12.25 dB
Worst Single Value	-23.23 dBm
Worst Position	Azi = 90°; Elev = 0°; Pol = Horizontal
Best Single Value	0.41 dBm
Best Position	Azi = 270°; Elev = 90°; Pol = Horizontal

**Table 208. 2.44-GHz Kit Antenna: RP\_2440.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-12.05	-9.05	-7.3	-4.03	-1.74	-1.81	-1.08	-3.2	-2.97	-6.54	-6.32	-8.52	-4.48
15	-11.63	-8.91	-6.99	-3.72	-1.83	-1.91	-1.12	-3.74	-3.53	-7.37	-6.44	-9.58	-4.35
30	-11.16	-8.54	-6.64	-3.84	-1.89	-1.41	-1.33	-4.36	-3.68	-6.76	-6.75	-10.88	-4.68
45	-10.52	-8.51	-7.17	-3.73	-2.42	-1.06	-1.4	-4.23	-3.23	-5.53	-7.29	-10.66	-5.61
60	-9.97	-8.4	-7.74	-3.66	-2.99	-1.27	-1.83	-3.2	-2.63	-5.01	-6.98	-9.31	-6.73
75	-9.84	-7.65	-6.89	-4.26	-2.93	-1.37	-2.26	-1.94	-2.31	-4.82	-6.33	-7.94	-7.73
90	-10.97	-7.92	-6	-4.72	-3.07	-1.29	-1.95	-1.16	-2.72	-4.97	-6.26	-7.73	-8.32
105	-13.21	-10.08	-6.41	-5.13	-3	-1.57	-1.66	-1.06	-3.41	-6.18	-6.41	-8.5	-7.69
120	-14.01	-11.35	-6.34	-5.24	-2.73	-1.98	-1.45	-1.7	-3.42	-6.91	-5.55	-9.42	-6.5
135	-14.99	-10.78	-5.83	-5.03	-2.74	-1.97	-1.03	-2.76	-2.68	-7.46	-4.8	-9.27	-5.85
150	-16.35	-11.46	-6	-5.07	-2.93	-1.43	-0.88	-3.07	-2.6	-7.57	-4.68	-7.74	-5.29
165	-15.86	-12.01	-6.27	-5.19	-2.63	-1.23	-2.3	-1.46	-3.52	-4.85	-3.82	-6.1	-5.01
180	-15.89	-11.6	-6.47	-4.85	-2.09	-2.73	-3.58	-0.17	-5.44	-2.29	-2.93	-4.78	-5.07
195	-15.61	-11.21	-6.86	-4.41	-2.5	-3.7	-1	-0.92	-7.54	-1.41	-3.3	-3.73	-5.42
210	-14.65	-11.16	-6.86	-4.82	-4.36	-0.92	0.16	-3.15	-7.84	-1.95	-5.66	-3.04	-6.05
225	-13.97	-11.52	-5.94	-6.57	-2.83	-0.53	-1.66	-2.36	-4.79	-2.93	-9.21	-3.18	-5.82
240	-13.61	-12.04	-4.73	-7.69	-0.33	-2.67	-2.21	-0.94	-3	-3.33	-7.61	-4.39	-5.61
255	-14.07	-12.08	-4.76	-5.29	-0.32	-2.43	-0.23	-1.01	-3.15	-4	-4.41	-6.5	-5.67
270	-14.58	-12.02	-6.08	-3.64	-1.76	-0.73	0.51	-1.47	-4.21	-4.19	-3.42	-9.72	-5.65
285	-14.27	-11.52	-8.04	-3.9	-2.03	-0.41	0.26	-2.06	-4.11	-2.46	-3.99	-12.02	-5.51
300	-13.41	-10.14	-8.63	-5.11	-1.11	-1	-0.21	-2.55	-2.8	-0.96	-5.49	-11.01	-5.37
315	-12.38	-8.92	-8.01	-6.03	-0.55	-1.66	-0.46	-2.64	-1.81	-0.8	-7.25	-9.2	-5.06
330	-11.96	-8.44	-7.39	-6.09	-0.62	-1.9	-0.52	-2.49	-1.64	-1.74	-7.99	-8.19	-4.81
345	-12.19	-8.56	-7.23	-5.47	-1.03	-1.62	-0.85	-2.35	-1.98	-3.45	-7.4	-7.71	-4.69
360	-12.05	-9.05	-7.3	-4.03	-1.74	-1.81	-1.08	-3.2	-2.97	-6.54	-6.32	-8.52	-4.48

**Table 209. 2.44-GHz Kit Antenna: RP\_2440.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-14.34	-10.92	-7.83	-5.13	-1.95	-1.96	-1.21	-3.41	-3.18	-6.99	-6.58	-13.15	-10.48
15	-14.33	-11.05	-7.91	-4.82	-1.94	-2.05	-1.23	-3.86	-3.81	-7.81	-6.71	-13.54	-11.13
30	-15.34	-10.84	-7.87	-4.69	-2.07	-1.54	-1.5	-4.54	-4.25	-7.73	-7.05	-14	-11.03
45	-18.11	-11.02	-8.21	-4.39	-2.68	-1.3	-1.48	-4.44	-3.96	-7.02	-7.81	-13.54	-10.31
60	-21.83	-11.93	-8.78	-4.24	-3.26	-1.52	-1.96	-3.3	-3.68	-5.95	-8.28	-12.17	-9.93
75	-22.53	-12.18	-8.43	-4.81	-3.29	-1.6	-2.4	-2.03	-3.79	-5.24	-7.77	-11.17	-10.82
90	-23.23	-12.68	-7.42	-5.23	-3.34	-1.47	-2.23	-1.27	-3.8	-5.43	-7.54	-11.48	-11.9
105	-22.84	-14.42	-7.52	-5.55	-3.22	-1.78	-1.99	-1.18	-3.96	-6.52	-8.18	-12.21	-10.92
120	-21.31	-14.74	-7.12	-5.59	-2.91	-2.33	-1.73	-1.88	-4.27	-7.21	-7.58	-13.45	-10.11
135	-22.13	-13.69	-6.49	-5.34	-2.82	-2.29	-1.29	-3.66	-4	-7.66	-6.77	-13.09	-10.93
150	-19.99	-13.86	-6.61	-5.36	-3	-1.65	-1.1	-4.54	-3.97	-8.64	-6.92	-9.66	-11.74
165	-17.6	-13.86	-6.82	-5.49	-2.75	-1.67	-2.41	-2.4	-4.87	-8.25	-6.48	-7.01	-12.04
180	-17.7	-13.08	-6.92	-5.09	-2.38	-3.25	-3.97	-0.64	-7.07	-6.13	-5.75	-5.41	-11.39
195	-18.28	-12.58	-7.28	-4.58	-2.96	-3.79	-1.57	-1.19	-10.03	-4.25	-6.22	-4.55	-10.81
210	-17.02	-12.78	-7.23	-5.06	-4.6	-1.18	-0.08	-3.36	-9.24	-3.02	-8.91	-4.68	-10.18
225	-15.75	-13.46	-6.44	-7	-3.03	-0.74	-1.72	-2.78	-5.49	-3.04	-12.44	-5.63	-9.08
240	-15.02	-13.82	-5.64	-7.99	-0.72	-2.73	-2.48	-1.23	-3.53	-4.78	-8.62	-7.48	-8.46
255	-15.28	-13.64	-5.87	-5.88	-0.68	-2.99	-0.4	-1.11	-3.38	-6.75	-4.78	-10.22	-7.98
270	-15.63	-12.97	-6.86	-4.51	-1.92	-1.38	0.41	-1.67	-4.48	-4.91	-3.76	-14.21	-7.74
285	-15.39	-12.02	-8.36	-4.79	-2.12	-0.84	0.2	-2.42	-5.11	-2.64	-4.65	-17.9	-7.6
300	-14.87	-10.85	-8.9	-5.86	-1.32	-1.19	-0.28	-2.85	-3.72	-1.9	-6.43	-17.63	-7.63
315	-13.83	-9.94	-8.4	-6.46	-0.84	-1.72	-0.6	-2.75	-2.34	-2.33	-8.11	-14.59	-8.11
330	-13.46	-9.7	-7.81	-6.27	-0.92	-1.97	-0.75	-2.57	-1.86	-3.45	-8.72	-13.09	-8.78
345	-14.03	-9.97	-7.67	-5.83	-1.36	-1.74	-1.12	-2.53	-2.09	-4.63	-7.98	-12.29	-9.51
360	-14.34	-10.92	-7.83	-5.13	-1.95	-1.96	-1.21	-3.41	-3.18	-6.99	-6.58	-13.15	-10.48



**Table 210. 2.44-GHz Kit Antenna: RP\_2440.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-15.93	-13.61	-16.75	-10.51	-15	-16.53	-16.43	-16.34	-16.29	-16.64	-18.65	-10.35	-5.73
15	-14.97	-13.02	-14.18	-10.2	-17.89	-17.08	-16.85	-19.13	-15.52	-17.51	-18.73	-11.81	-5.38
30	-13.26	-12.42	-12.72	-11.33	-15.86	-16.67	-15.71	-18.25	-12.75	-13.73	-18.49	-13.78	-5.83
45	-11.35	-12.09	-13.88	-12.22	-14.76	-13.75	-18.4	-17.63	-11.36	-10.89	-16.71	-13.8	-7.41
60	-10.27	-10.95	-14.44	-12.73	-15.23	-13.7	-17.31	-19.35	-9.32	-12.11	-12.84	-12.47	-9.56
75	-10.08	-9.54	-12.17	-13.49	-13.93	-14.19	-17.28	-19.19	-7.71	-15.24	-11.84	-10.74	-10.65
90	-11.23	-9.68	-11.54	-14.28	-15.22	-15.31	-14.01	-17.21	-9.31	-14.91	-12.21	-10.11	-10.83
105	-13.71	-12.08	-12.86	-15.46	-16.04	-14.77	-12.94	-16.47	-12.67	-17.44	-11.16	-10.91	-10.48
120	-14.91	-14.02	-14.17	-16.39	-16.46	-13.12	-13.48	-15.44	-10.91	-18.74	-9.81	-11.6	-8.98
135	-15.92	-13.88	-14.37	-16.7	-20.11	-13.52	-13.31	-10.05	-8.49	-20.95	-9.19	-11.6	-7.46
150	-18.81	-15.17	-14.83	-16.98	-21.06	-14.34	-13.87	-8.47	-8.26	-14.18	-8.62	-12.22	-6.41
165	-20.68	-16.6	-15.56	-16.96	-18.19	-11.4	-18.27	-8.59	-9.26	-7.51	-7.21	-13.33	-5.97
180	-20.55	-17	-16.56	-17.57	-13.99	-12.17	-14.17	-10.04	-10.5	-4.61	-6.15	-13.47	-6.23
195	-18.99	-16.89	-17.15	-18.57	-12.49	-20.57	-10.17	-13.12	-11.15	-4.6	-6.41	-11.36	-6.9
210	-18.41	-16.23	-17.81	-17.51	-17.09	-13.36	-12.46	-16.41	-13.46	-8.57	-8.43	-8.08	-8.17
225	-18.71	-15.95	-15.52	-16.87	-16.2	-13.83	-20.35	-12.71	-13.04	-18.99	-12.01	-6.83	-8.6
240	-19.19	-16.75	-11.96	-19.5	-10.97	-20.78	-14.32	-12.96	-12.39	-8.79	-14.44	-7.33	-8.79
255	-20.23	-17.28	-11.22	-14.21	-11.41	-11.56	-14.37	-17.7	-15.97	-7.3	-15.39	-8.89	-9.51
270	-21.23	-19.08	-13.87	-11.06	-16.08	-9.32	-15.78	-14.97	-16.31	-12.36	-14.67	-11.63	-9.83
285	-20.71	-21.16	-19.47	-11.23	-18.71	-10.67	-18.26	-13.1	-11	-16.25	-12.5	-13.32	-9.7
300	-18.85	-18.39	-20.78	-13.12	-14.36	-14.8	-18.72	-14.33	-10	-8.06	-12.64	-12.08	-9.29
315	-17.83	-15.71	-18.71	-16.21	-12.49	-20.05	-15.42	-18.67	-11.23	-6.08	-14.69	-10.68	-8.03
330	-17.29	-14.41	-17.72	-19.82	-12.41	-19.56	-13.39	-19.66	-14.73	-6.6	-16.11	-9.89	-7.03
345	-16.79	-14.14	-17.46	-16.45	-12.43	-17.43	-13.03	-16.35	-17.97	-9.69	-16.44	-9.57	-6.42
360	-15.93	-13.61	-16.75	-10.51	-15	-16.53	-16.43	-16.34	-16.29	-16.64	-18.65	-10.35	-5.73

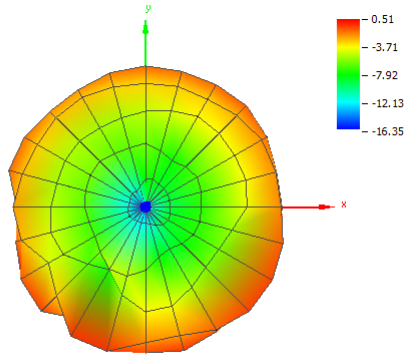


Figure 322. 2.44-GHz Kit Antenna: Theta = 0, Phi = 0

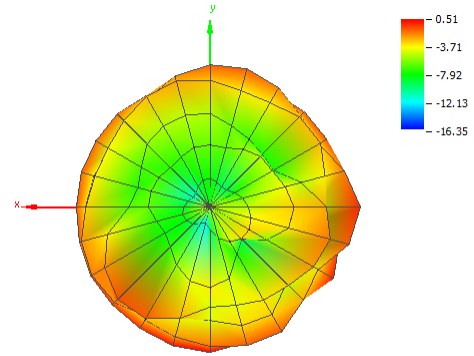


Figure 323. 2.44-GHz Kit Antenna: Theta = 180, Phi = 0

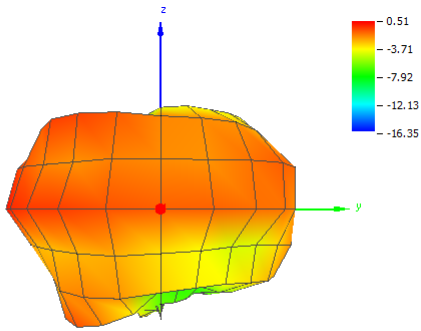


Figure 324. 2.44-GHz Kit Antenna: Theta = 90, Phi = 0

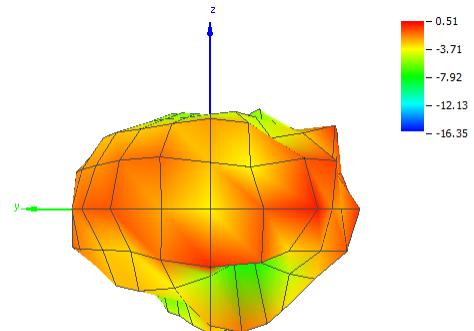


Figure 325. 2.44-GHz Kit Antenna: Theta = 90, Phi = 180

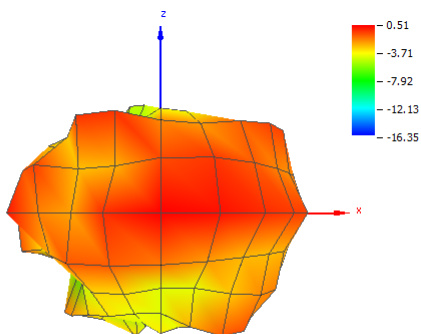


Figure 326. 2.44-GHz Kit Antenna: Theta = 90, Phi = 270

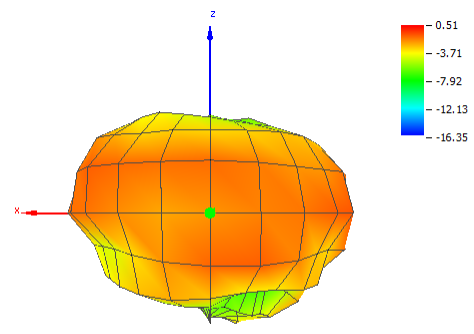


Figure 327. 2.44-GHz Kit Antenna: Theta = 90, Phi = 90

**A.16.3 2.48 GHz**
**Table 211. 2.48-GHz Kit Antenna: OTA Evaluation Results**

Test Description	Test Result
Total Radiated Power	-2.53 dBm
Peak EIRP	0.96 dBm
Directivity	3.50 dBi
Efficiency	-2.53 dB
Efficiency	0.5582
Peak Gain	0.96 dBi
NHPRP 45°	-3.31 dBm
NHPRP 45° / TRP	-0.78 dB
NHPRP 45° / TRP	0.8353
NHPRP 30°	-4.49 dBm
NHPRP 30° / TRP	-1.96 dB
NHPRP 30° / TRP	0.6373
NHPRP 22.5°	-5.61 dBm
NHPRP 22.5° / TRP	-3.07 dB
NHPRP 22.5° / TRP	0.4927
UHRP	-5.56 dBm
UHRP / TRP	-3.03 dB
UHRP / TRP	0.4979
LHRP	-5.52 dBm
LHRP / TRP	-2.99 dB
LHRP / TRP	0.5021
PGRP (0-120°)	-3.46 dBm
PGRP / TRP	-0.93 dB
PGRP / TRP	0.8075
Front/Back Ratio	3.06
PhiBW	173.0°
PhiBW Up	96.4°
PhiBW Down	76.5°
ThetaBW	64.3°
ThetaBW Up	21.1°
ThetaBW Down	43.1°
Boresight Phi	105°
Boresight Theta	105°
Maximum Power	0.96 dBm
Minimum Power	-16.86 dBm
Average Power	-3.67 dBm
Max/Min Ratio	17.83 dB
Max/Avg Ratio	4.63 dB
Min/Avg Ratio	-13.20 dB
Worst Single Value	-22.99 dBm
Worst Position	Azi = 285°; Elev = 0°; Pol = Horizontal
Best Single Value	0.90 dBm
Best Position	Azi = 105°; Elev = 105°; Pol = Horizontal

**Table 212. 2.48-GHz Kit Antenna: RP\_2480.000\_tot**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-12.17	-8.53	-5.3	-3.65	-1.6	-0.85	-0.54	-2.36	-2.91	-5.96	-5.94	-11.5	-4.51
15	-10.92	-8.39	-5.3	-3.81	-1.66	-0.14	-0.45	-2.48	-2.58	-5.34	-5.8	-12.63	-4.42
30	-10.67	-8.94	-6.14	-3.75	-1.73	-0.23	0.02	-1.98	-2.4	-3.73	-5.84	-13.17	-5.03
45	-11.04	-9.22	-7.1	-3.47	-1.97	-0.5	-0.17	-1.24	-1.69	-2.83	-5.17	-12.57	-5.8
60	-11.74	-9.12	-6.76	-3.68	-2.24	-0.28	-1.13	-0.64	-0.62	-2.2	-3.86	-11.88	-6.62
75	-12.71	-9.52	-5.99	-3.66	-2.61	0.06	-1.48	0.04	-0.45	-1.91	-3.26	-11.84	-7.06
90	-13.66	-10.95	-6.32	-3.38	-2.57	-0.12	-1.38	0.71	-1	-2.35	-3.15	-11.71	-5.92
105	-14	-12.78	-6.76	-3.21	-2.28	-0.33	-1.29	0.96	-1.61	-2.65	-2.86	-11.2	-4.92
120	-14.2	-13.08	-6.84	-2.88	-1.85	-0.25	-0.96	0.19	-1.16	-3.14	-2.7	-10.18	-4.38
135	-14.38	-13.18	-7.54	-2.73	-1.58	-0.34	-0.13	-1.16	-0.49	-4.63	-2.87	-9	-4.19
150	-13.97	-12.29	-7.89	-3	-1.66	-0.15	0.1	-1.38	-0.43	-5.69	-2.55	-7.55	-4.07
165	-14.04	-11.27	-7.52	-3.03	-1.68	-0.31	-1.41	-0.03	-1.35	-4.53	-2.26	-5.99	-4.35
180	-13.98	-11	-7.55	-2.57	-1.63	-1.71	-2.51	0.42	-3.94	-2.94	-2.8	-4.73	-5.18
195	-13.03	-10.82	-7.57	-2.35	-2.61	-1.49	-0.98	-1.09	-5.77	-1.96	-4.16	-4.06	-5.62
210	-12.6	-10.15	-7.39	-3.07	-4.03	-0.15	-1.31	-3.29	-4.19	-2.05	-5.99	-3.57	-5.27
225	-13.41	-9.91	-6.48	-3.99	-2.66	-0.88	-3.73	-2.41	-3.53	-3.14	-6.74	-3.6	-4.99
240	-14.37	-9.65	-5.37	-3.42	-1.5	-3.59	-3.69	-1.59	-3.49	-3.83	-5.08	-4.1	-4.98
255	-15.45	-9.4	-5.58	-2.62	-2.27	-3.48	-1.29	-1.79	-4.12	-3.77	-3.84	-5.23	-5.1
270	-16.32	-9.56	-7.29	-2.52	-3.91	-2.12	-0.93	-2.69	-5.89	-3.52	-3.45	-7.84	-5.41
285	-16.86	-9.41	-8.5	-3.05	-3.45	-2.1	-1.41	-3.58	-6.4	-2.74	-3.83	-10.99	-5.49
300	-16.5	-8.99	-8.1	-3.67	-2.17	-2.77	-1.85	-3.87	-4.46	-1.48	-5.25	-11.78	-5.52
315	-15.31	-9.03	-6.84	-4.28	-1.82	-3.03	-1.96	-3.93	-3.24	-1.4	-7.17	-10.36	-5.74
330	-14.73	-9.32	-6.07	-4.59	-1.97	-2.35	-1.78	-3.62	-2.91	-2.62	-7.92	-9.64	-5.84
345	-14.49	-9.32	-5.86	-4.39	-1.84	-1.92	-1.14	-3.19	-3.01	-4.15	-7.28	-9.78	-5.58
360	-12.17	-8.53	-5.3	-3.65	-1.6	-0.85	-0.54	-2.36	-2.91	-5.96	-5.94	-11.5	-4.51

**Table 213. 2.48-GHz Kit Antenna: RP\_2480.000\_hor**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-17.84	-11.46	-6.29	-4.39	-2.15	-0.97	-0.65	-2.52	-3.76	-6.41	-6.14	-13.86	-8.94
15	-17.32	-11.32	-6.58	-4.42	-2.11	-0.23	-0.54	-2.57	-3.44	-5.57	-6.04	-14.23	-8.3
30	-17.77	-12.03	-7.37	-4.13	-2.24	-0.32	-0.04	-2.22	-3.29	-4.03	-6.19	-14.45	-7.88
45	-18.62	-13.26	-7.9	-3.82	-2.4	-0.59	-0.24	-1.44	-2.89	-3.1	-5.84	-13.8	-7.61
60	-19.46	-15.14	-7.54	-4.1	-2.56	-0.33	-1.19	-0.76	-2.01	-2.46	-4.96	-13.38	-7.91
75	-19.82	-16.16	-6.82	-4.06	-2.8	-0.01	-1.66	-0.06	-1.57	-2.22	-4.78	-13.96	-8.1
90	-18.48	-17.56	-7.14	-3.66	-2.66	-0.25	-1.66	0.63	-1.75	-2.58	-5.23	-14.44	-6.87
105	-17.16	-17.97	-7.4	-3.37	-2.35	-0.51	-1.54	0.9	-2.23	-3.02	-4.83	-15.37	-6.12
120	-17.7	-16.74	-7.28	-2.99	-1.95	-0.51	-1.24	0.08	-2	-3.51	-4.48	-16.25	-6.64
135	-17.03	-17.12	-8.09	-2.86	-1.72	-0.54	-0.3	-1.52	-1.61	-4.8	-4.99	-13	-7.79
150	-15.44	-16.27	-8.55	-3.15	-1.79	-0.21	0.05	-2.32	-1.71	-6.12	-4.78	-9.6	-8.35
165	-15.38	-14.75	-8.08	-3.24	-1.76	-0.41	-1.65	-0.87	-2.45	-5.58	-4.18	-7.28	-9.34
180	-16.22	-14.34	-8.03	-2.86	-1.72	-2.15	-3.42	-0.03	-4.49	-4.59	-4.31	-5.78	-10.86
195	-15.87	-14.17	-8.11	-2.56	-2.91	-1.91	-1.42	-1.32	-6.63	-3.74	-5.59	-5.3	-11.04
210	-15.42	-13.58	-7.84	-3.26	-4.39	-0.2	-1.41	-3.78	-5.74	-2.95	-8.63	-5.47	-10.49
225	-16.44	-13.45	-7	-4.73	-2.74	-1.12	-4.14	-2.92	-4.24	-3.23	-10.81	-6.5	-9.78
240	-18.01	-13.27	-6.27	-4.24	-1.8	-4.11	-4.05	-1.82	-3.76	-5.24	-6.67	-8.21	-9.24
255	-19.21	-12.75	-6.88	-2.79	-2.84	-3.64	-1.51	-1.98	-4.91	-6.57	-4.13	-10.75	-9.21
270	-21.23	-11.52	-9.02	-2.74	-4.31	-2.51	-1.12	-3.11	-6.88	-4.38	-3.79	-15.07	-9.21
285	-22.99	-10.4	-9.91	-3.89	-3.55	-2.77	-1.63	-4.47	-7.33	-2.87	-5.13	-20.11	-9.2
300	-21.16	-9.72	-8.75	-5.01	-2.47	-3.37	-2	-4.7	-5.39	-2.6	-8.05	-20.98	-9.14
315	-19.87	-10.16	-7.27	-5.23	-2.34	-3.27	-2.07	-4.26	-3.88	-3.49	-10.17	-17.91	-9.64
330	-20.46	-11.34	-6.58	-4.97	-2.72	-2.45	-1.91	-3.72	-3.4	-5.01	-9.23	-15.91	-10.61
345	-20.56	-11.74	-6.48	-4.83	-2.66	-2.01	-1.27	-3.39	-3.58	-5.79	-7.84	-14.67	-10.58
360	-17.84	-11.46	-6.29	-4.39	-2.15	-0.97	-0.65	-2.52	-3.76	-6.41	-6.14	-13.86	-8.94

**Table 214. 2.48-GHz Kit Antenna: RP\_2480.000\_ver**

Azimuth (°)	0° (dB)	15° (dB)	30° (dB)	45° (dB)	60° (dB)	75° (dB)	90° (dB)	105° (dB)	120° (dB)	135° (dB)	150° (dB)	165° (dB)	180° (dB)
0	-13.54	-11.62	-12.18	-11.69	-10.87	-16.61	-16.54	-16.82	-10.37	-16.02	-19.34	-15.28	-6.45
15	-12.05	-11.49	-11.21	-12.64	-11.7	-16.94	-17.43	-19.41	-10.03	-18.32	-18.49	-17.74	-6.7
30	-11.62	-11.88	-12.22	-14.49	-11.28	-17.15	-18.19	-14.68	-9.73	-15.5	-16.97	-19.11	-8.2
45	-11.87	-11.4	-14.86	-14.51	-12.27	-17.04	-18.29	-14.68	-7.88	-15.07	-13.62	-18.66	-10.47
60	-12.54	-10.37	-14.56	-13.99	-13.79	-19.37	-20.08	-16.56	-6.23	-14.63	-10.36	-17.21	-12.53
75	-13.64	-10.58	-13.61	-14.17	-16.3	-17.94	-15.51	-16.64	-6.89	-13.41	-8.56	-15.99	-13.77
90	-15.39	-12.02	-13.99	-15.5	-19.51	-15.5	-13.53	-16.44	-9.02	-15.39	-7.34	-15.02	-12.96
105	-16.86	-14.34	-15.39	-17.7	-20.31	-14.24	-13.79	-17.2	-10.4	-13.56	-7.23	-13.31	-11.08
120	-16.77	-15.52	-17.01	-18.93	-18.02	-12.51	-12.94	-15.97	-8.7	-14.1	-7.44	-11.42	-8.3
135	-17.78	-15.42	-16.76	-18.06	-16.38	-13.91	-14.35	-12.15	-6.92	-18.71	-7.01	-11.2	-6.67
150	-19.36	-14.51	-16.37	-17.6	-16.84	-19.19	-19.1	-8.5	-6.39	-15.95	-6.52	-11.8	-6.1
165	-19.82	-13.86	-16.65	-16.18	-19.38	-16.97	-14.18	-7.56	-7.86	-11.22	-6.72	-11.88	-6
180	-17.92	-13.7	-17.35	-14.47	-18.49	-11.89	-9.73	-9.65	-13.17	-7.92	-8.12	-11.39	-6.55
195	-16.21	-13.51	-16.9	-15.49	-14.31	-11.86	-11.22	-13.85	-13.19	-6.71	-9.68	-10.1	-7.09
210	-15.8	-12.77	-17.43	-16.78	-14.94	-19.69	-17.63	-13.09	-9.41	-9.32	-9.41	-8.07	-6.82
225	-16.4	-12.45	-15.99	-12.05	-19.73	-13.57	-14.18	-11.98	-11.75	-19.93	-8.9	-6.72	-6.74
240	-16.84	-12.12	-12.66	-11.08	-13.28	-13.05	-14.65	-14.42	-15.64	-9.39	-10.22	-6.23	-7.03
255	-17.82	-12.09	-11.46	-16.83	-11.34	-17.95	-14.23	-15.34	-11.93	-6.99	-15.64	-6.66	-7.23
270	-18.01	-13.96	-12.13	-15.6	-14.47	-12.72	-14.59	-13.07	-12.79	-11	-14.69	-8.75	-7.75
285	-18.08	-16.32	-14.07	-10.59	-19.61	-10.51	-14.58	-10.92	-13.58	-17.88	-9.68	-11.55	-7.89
300	-18.32	-17.07	-16.69	-9.43	-14.03	-11.63	-16.54	-11.45	-11.6	-7.93	-8.48	-12.34	-8
315	-17.18	-15.46	-17.06	-11.31	-11.24	-15.76	-18.08	-15.32	-11.93	-5.57	-10.19	-11.2	-8.02
330	-16.09	-13.61	-15.56	-15.28	-9.95	-18.86	-16.96	-20.1	-12.6	-6.36	-13.77	-10.81	-7.6
345	-15.72	-13.01	-14.65	-14.58	-9.47	-18.41	-16.49	-16.74	-12.14	-9.18	-16.45	-11.48	-7.24
360	-13.54	-11.62	-12.18	-11.69	-10.87	-16.61	-16.54	-16.82	-10.37	-16.02	-19.34	-15.28	-6.45

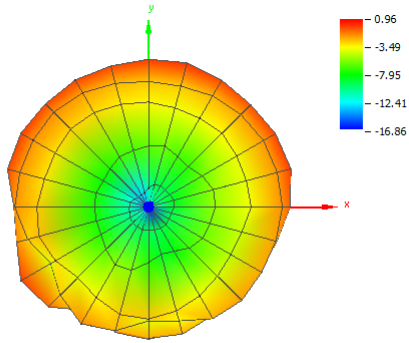


Figure 328. 2.48-GHz Kit Antenna: Theta = 0, Phi = 0

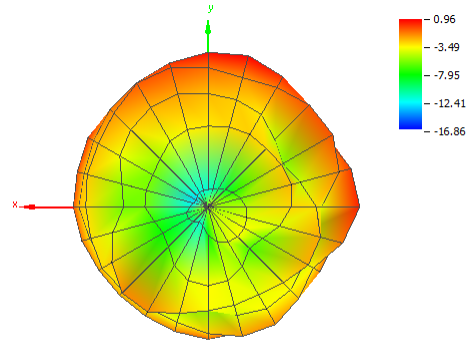


Figure 329. 2.48-GHz Kit Antenna: Theta = 180, Phi = 0

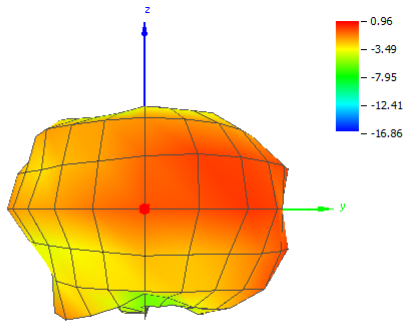


Figure 330. 2.48-GHz Kit Antenna: Theta = 90, Phi = 0

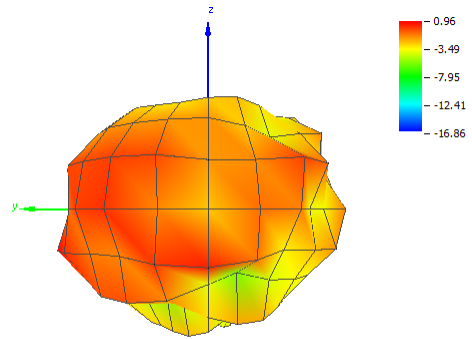


Figure 331. 2.48-GHz Kit Antenna: Theta = 90, Phi = 180

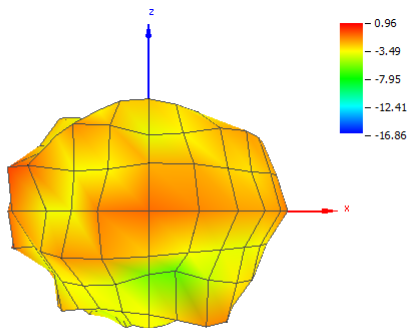


Figure 332. 2.48-GHz Kit Antenna: Theta = 90, Phi = 270

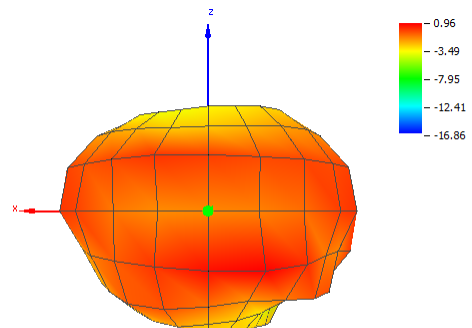


Figure 333. 2.48-GHz Kit Antenna: Theta = 90, Phi = 90

---

## Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (March 2015) to A Revision	Page
• Information was updated in <a href="#">Section 2.1.3</a> .....	22

---



## IMPORTANT NOTICE FOR TI DESIGN INFORMATION AND RESOURCES

Texas Instruments Incorporated ("TI") technical, application or other design advice, services or information, including, but not limited to, reference designs and materials relating to evaluation modules, (collectively, "TI Resources") are intended to assist designers who are developing applications that incorporate TI products; by downloading, accessing or using any particular TI Resource in any way, you (individually or, if you are acting on behalf of a company, your company) agree to use it solely for this purpose and subject to the terms of this Notice.

TI's provision of TI Resources does not expand or otherwise alter TI's applicable published warranties or warranty disclaimers for TI products, and no additional obligations or liabilities arise from TI providing such TI Resources. TI reserves the right to make corrections, enhancements, improvements and other changes to its TI Resources.

You understand and agree that you remain responsible for using your independent analysis, evaluation and judgment in designing your applications and that you have full and exclusive responsibility to assure the safety of your applications and compliance of your applications (and of all TI products used in or for your applications) with all applicable regulations, laws and other applicable requirements. You represent that, with respect to your applications, you have all the necessary expertise to create and implement safeguards that (1) anticipate dangerous consequences of failures, (2) monitor failures and their consequences, and (3) lessen the likelihood of failures that might cause harm and take appropriate actions. You agree that prior to using or distributing any applications that include TI products, you will thoroughly test such applications and the functionality of such TI products as used in such applications. TI has not conducted any testing other than that specifically described in the published documentation for a particular TI Resource.

You are authorized to use, copy and modify any individual TI Resource only in connection with the development of applications that include the TI product(s) identified in such TI Resource. NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER TI INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT OF TI OR ANY THIRD PARTY IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information regarding or referencing third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of TI Resources may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

TI RESOURCES ARE PROVIDED "AS IS" AND WITH ALL FAULTS. TI DISCLAIMS ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING TI RESOURCES OR USE THEREOF, INCLUDING BUT NOT LIMITED TO ACCURACY OR COMPLETENESS, TITLE, ANY EPIDEMIC FAILURE WARRANTY AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

TI SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY YOU AGAINST ANY CLAIM, INCLUDING BUT NOT LIMITED TO ANY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON ANY COMBINATION OF PRODUCTS EVEN IF DESCRIBED IN TI RESOURCES OR OTHERWISE. IN NO EVENT SHALL TI BE LIABLE FOR ANY ACTUAL, DIRECT, SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF TI RESOURCES OR USE THEREOF, AND REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

You agree to fully indemnify TI and its representatives against any damages, costs, losses, and/or liabilities arising out of your non-compliance with the terms and provisions of this Notice.

This Notice applies to TI Resources. Additional terms apply to the use and purchase of certain types of materials, TI products and services. These include; without limitation, TI's standard terms for semiconductor products (<http://www.ti.com/sc/docs/stdterms.htm>), [evaluation modules](#), and [samples](http://www.ti.com/sc/docs/sampterm.htm) (<http://www.ti.com/sc/docs/sampterm.htm>).

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2017, Texas Instruments Incorporated