M8Beacon 2.4 GHz PCB antenna Specification

By KKM

1 KEYWORDS

- *M8Beacon*
- *2.4 GHz*
- *Inverted F Antenna*

2 INTRODUCTION

The PCB antenna used on the M8Beacon reference design is described in this application note.

This application note describes the antenna dimensions, the RF performance and considerations for complying with regulatory limits when using this design.

The antenna design requires no more than 10.0mm x 5.0 mm of space and ensures a VSWR ratio of less than 2 across the 2.4 GHz ISM band when connected to a 50 ohm source.

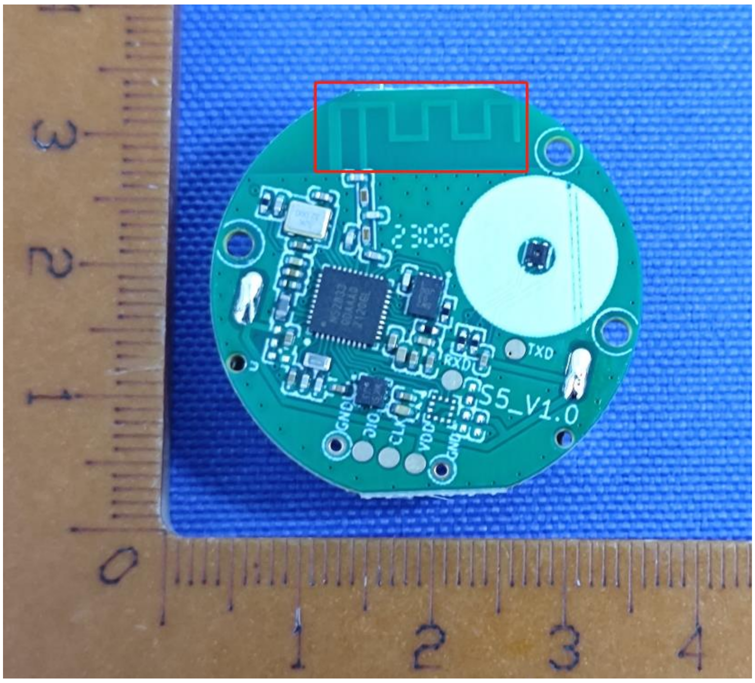

Figure 1: M8Beacon

3 Testing Conditions

Antenna Electrical Characteristics

Parameters	Value
Frequency Range	2400~2480MHz
Band Width	120MHz
VSWR	<2.0
Impendence	50 ohm
Gain	0dBi
Polarization	Single
Azimuth	Omni-directional

Product Testing Conditions

Parameters	Value
Working Temp	-30℃ ~ +60℃

4 ANTENNA DESIGN

The PCB antenna on the M8Beacon reference design is a meandered Inverted F Antenna (IFA). The IFA was designed to match an impedance of 50 ohm at 2.45 GHz. Thus no additional matching components are necessary.

4.1 Design Goals

The reflection at the feed point of the antenna determines how much of the applied power is delivered to the antenna. A reflection of less than -10 dB across the 2.4 GHz ISM band, when connected to a 50 ohm source, was a design goal. Reflection of less than -10 dB, or VSWR less than 2, ensures that more than 90% of the available power is delivered to the antenna. Bandwidth is in this document defined as the frequency band where more than 90% of the available power is delivered to the antenna. Another design goal was to fit the size of the PCB antenna on a M8Beacon and to obtain good performance also when the M8Beacon is connected to a computer.

4.2 Simulation

IE3D from Zeland, which is an electromagnetic simulation tool, was used to design the antenna. The accuracy of the simulation is controlled by the mesh. An increase of the mesh increases the simulation time. Thus, for initial simulations mesh = 1 should be used. When a fairly good result is achieved a higher mesh should be used to obtain more accurate results. Comparison of simulation and measurement results shows that the measured reflection is between the result obtained with mesh = 5 and mesh = 1; see Figure 2 for details.

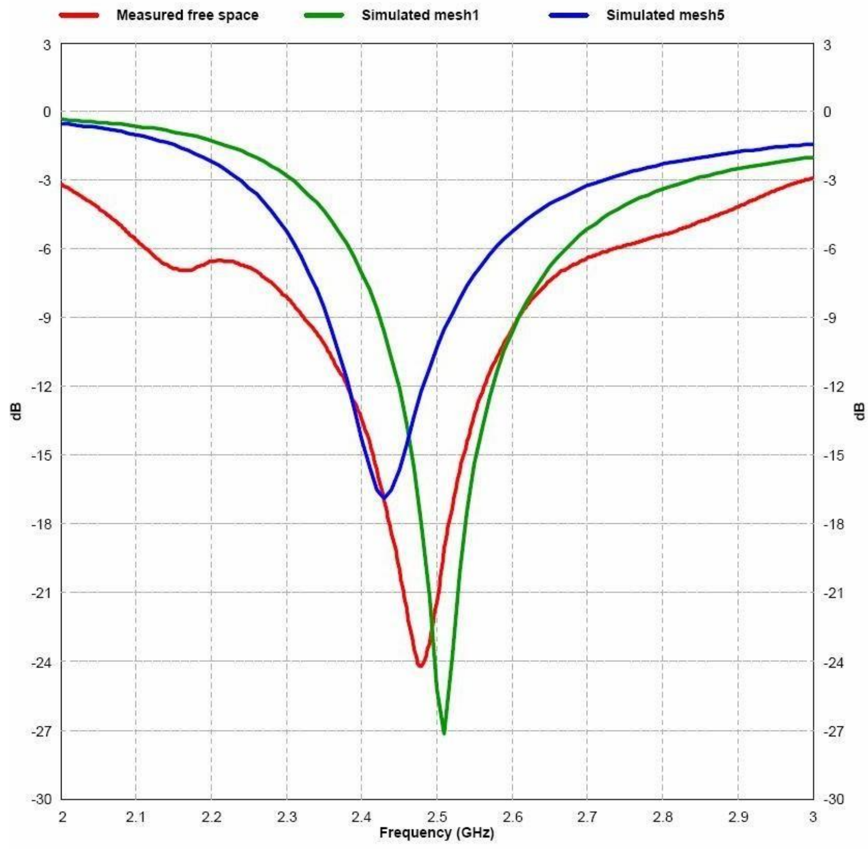

Figure 2: Comparison of Simulation and Measurements Results

4.3 Layout and Implementation

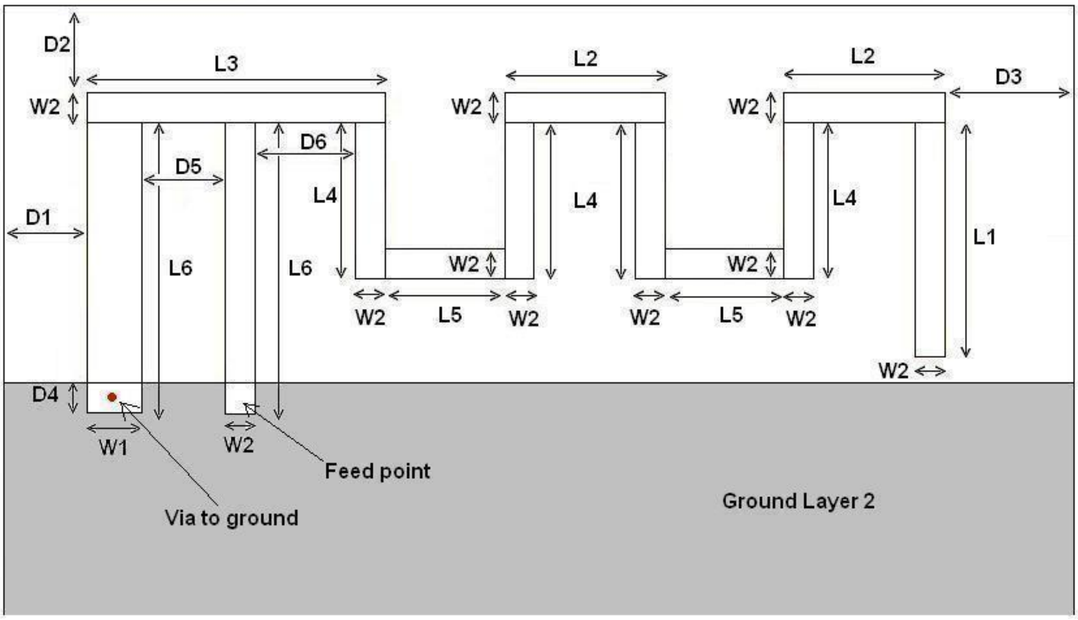

Figure 3: Antenna Dimensions

L1	3.94 mm
L2	2.70 mm
L3	5.00 mm
L4	2.64 mm
L5	2.00 mm
L6	4.90 mm
W1	0.90 mm
W2	0.50 mm
D1	0.50 mm
D2	0.30 mm
D3	0.30 mm
D4	0.50 mm
D5	1.40mm
D6	1.70 mm

Table 1: Antenna Dimensions

5 TEST RESULTS

5.1 Reflection

All the reflection measurements were performed with a network analyzer connected to a semi-rigid coax cable, which was soldered to the feed point of the antenna. Because of the small size antenna and the small ground plane this kind of measurements is heavily affected by the presence and placement of the coax cable. This influence can result in a small uncertainty in resonance frequency and measured reflection. Typically different placement of the semi-rigid coax cable could change the resonance frequency with 5 -10 MHz and the reflection with 3 - 4 dB.

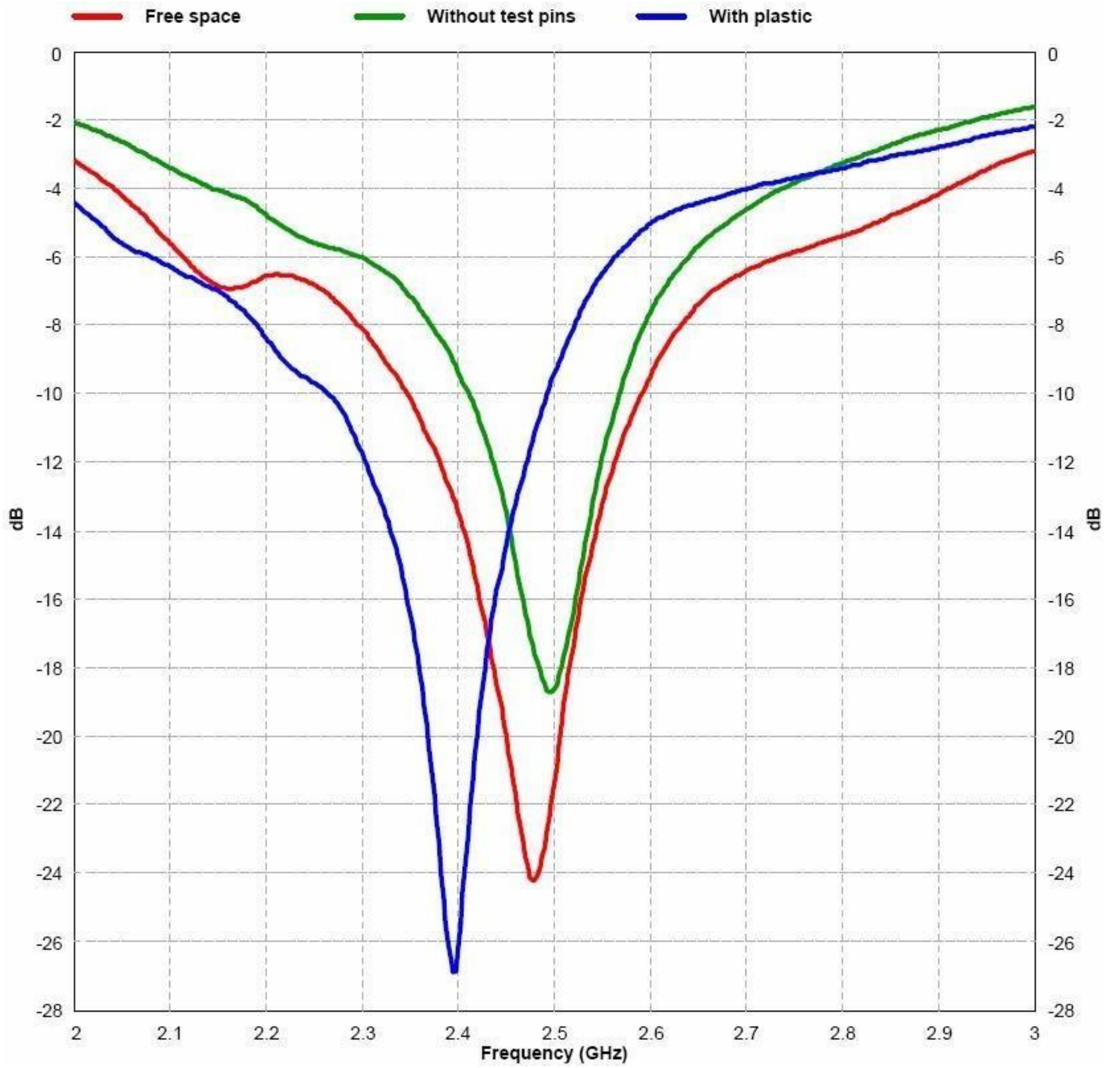

Figure 4: Influence of Plastic Encapsulation and Test Pins

This part of the PCB will typically be omitted in a final application. The red and green graph on Figure 4 shows that removing this part of the PCB has a small impact on the performance. Figure 4 also shows that plastic encapsulation of the M8Beacon will shift the resonance frequency to a lower frequency. This can be compensated by making the antenna slightly shorter.

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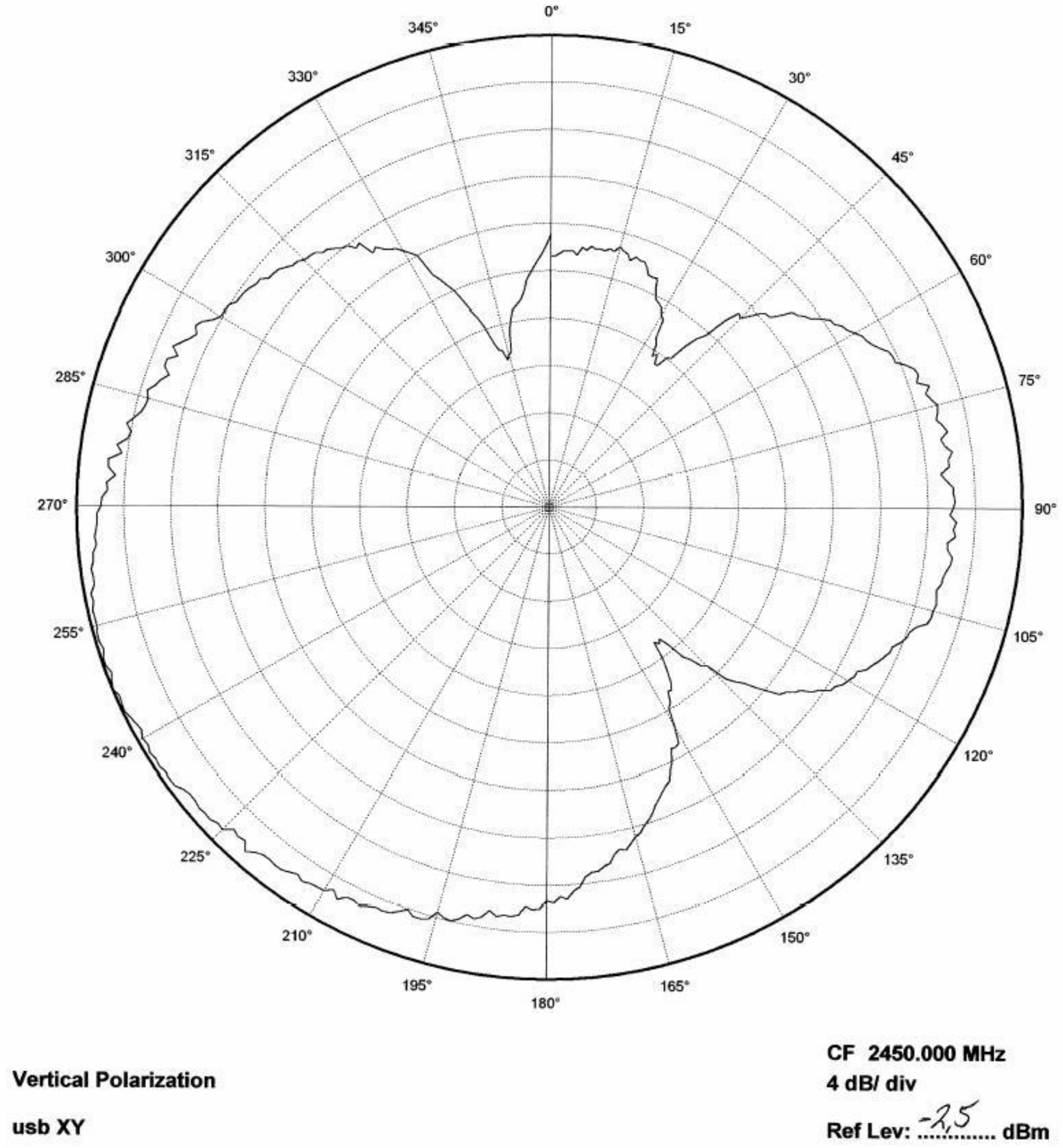

Figure 7:M8Beacon XY Plane

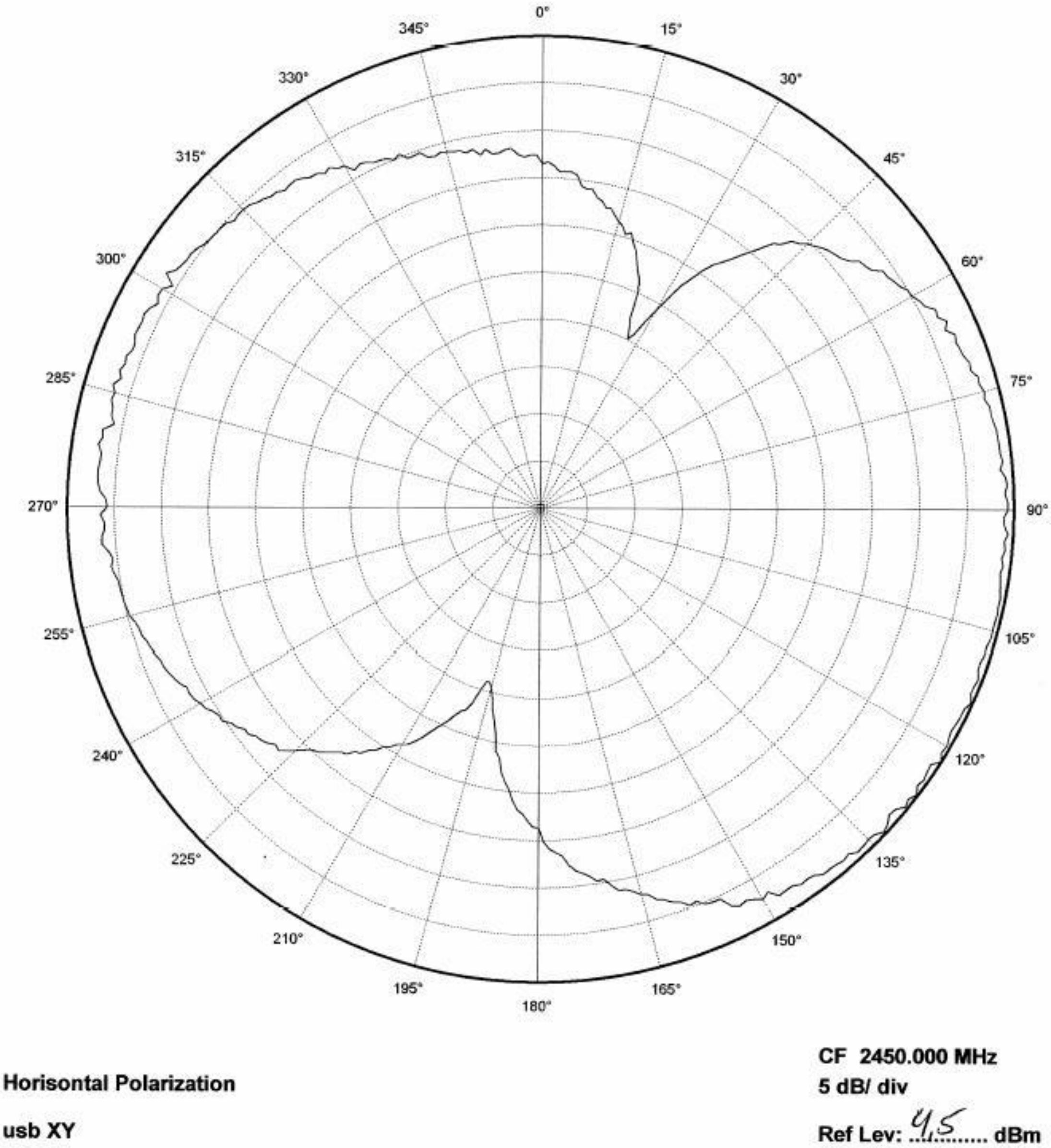

Figure 8: M8Beacon XY Plane

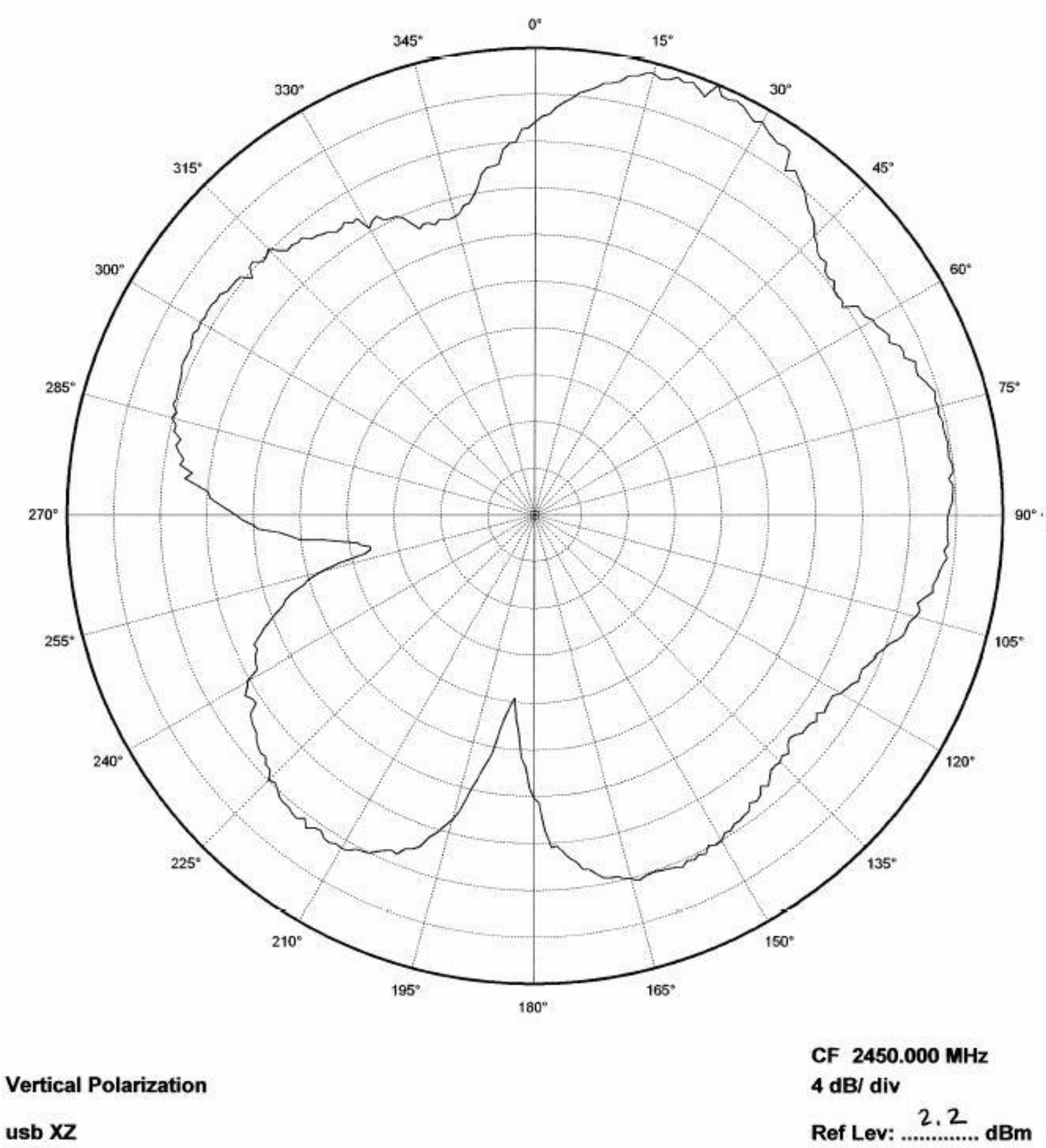

Figure 9:M8Beacon XZ Plane

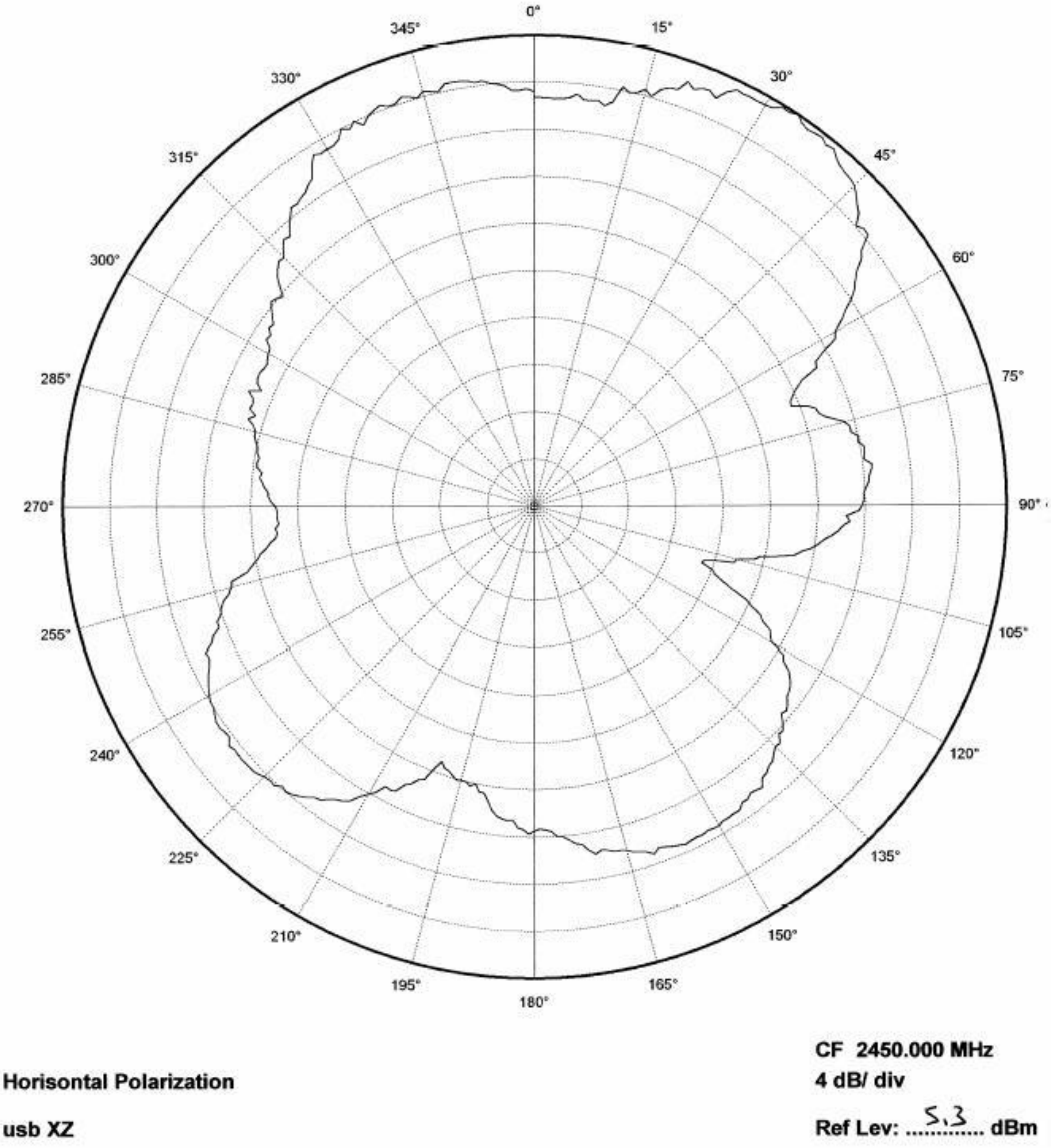

Figure 10:M8Beacon XZ Plane

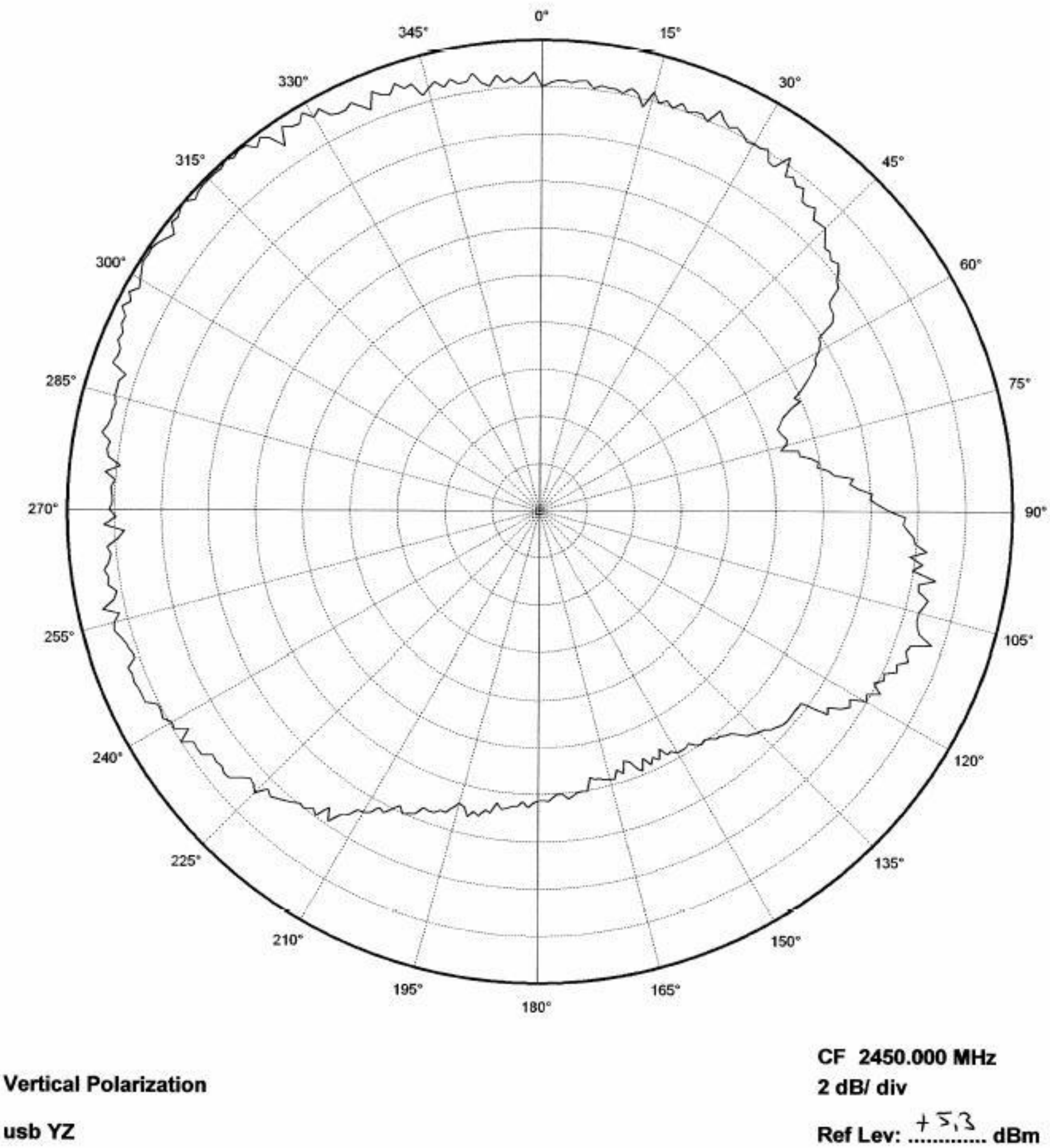

Figure 11: M8Beacon YZ Plane

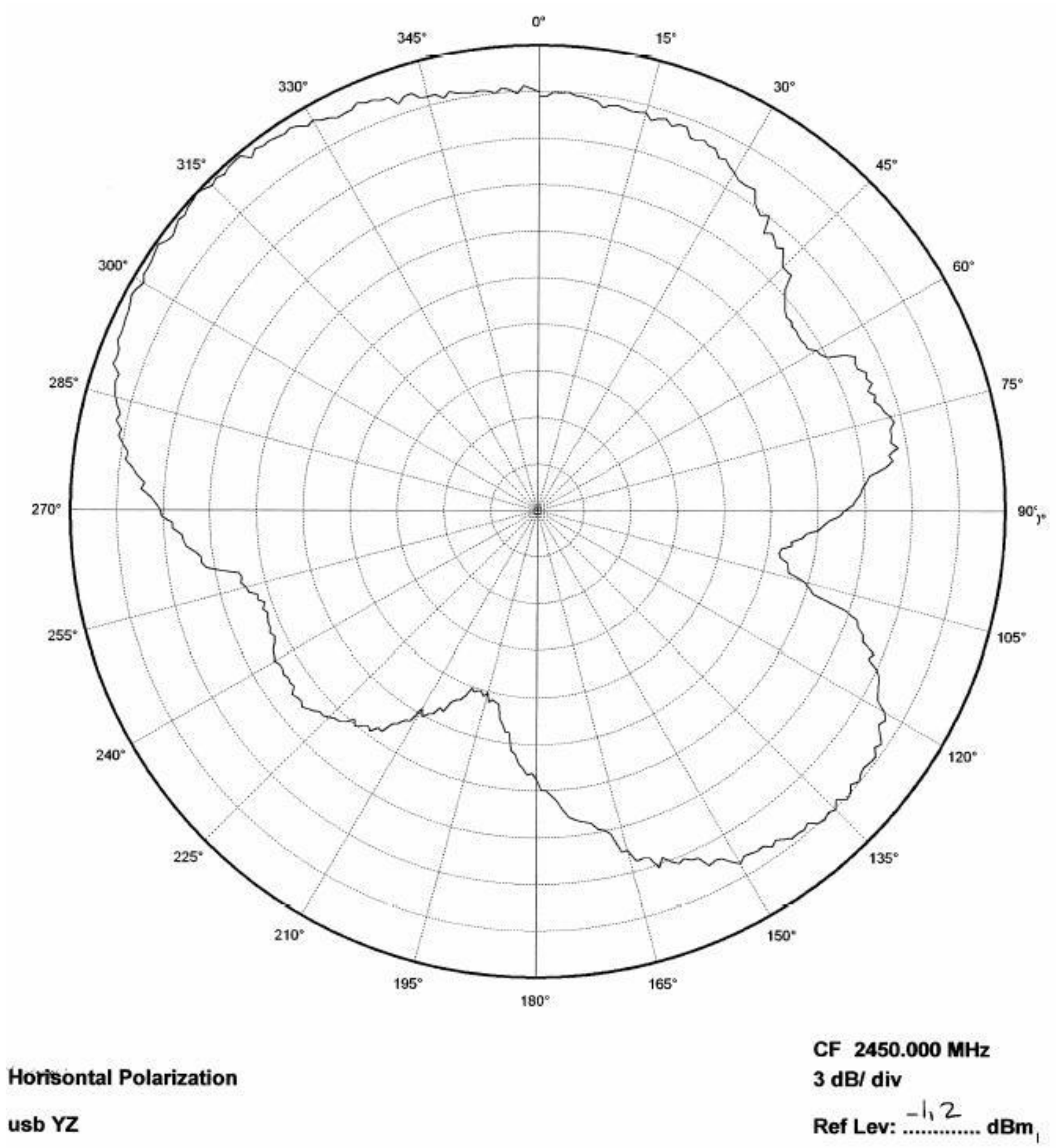

Figure 12: M8Beacon YZ Plane

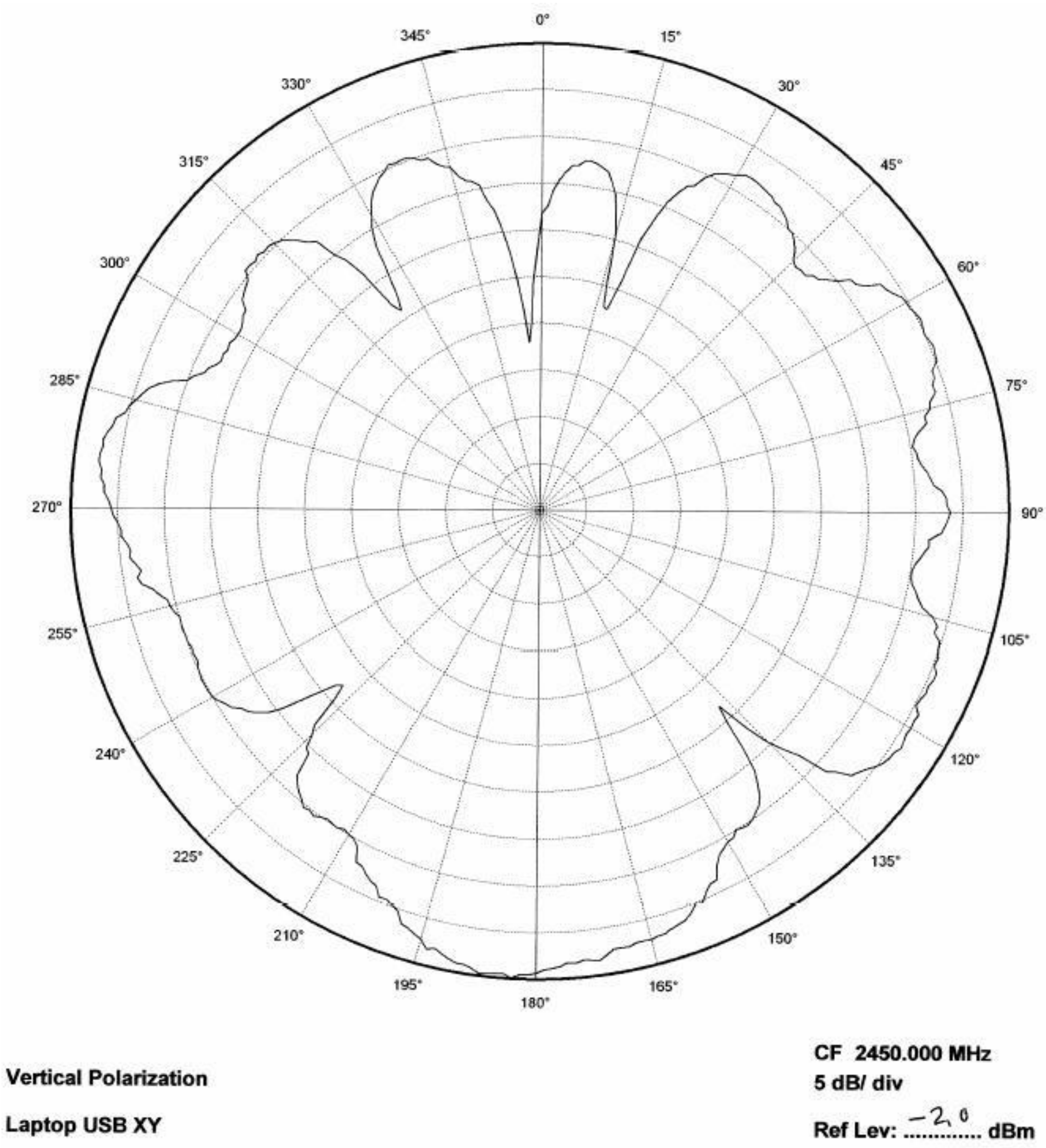

Figure 13:M8Beacon in Laptop XY Plane

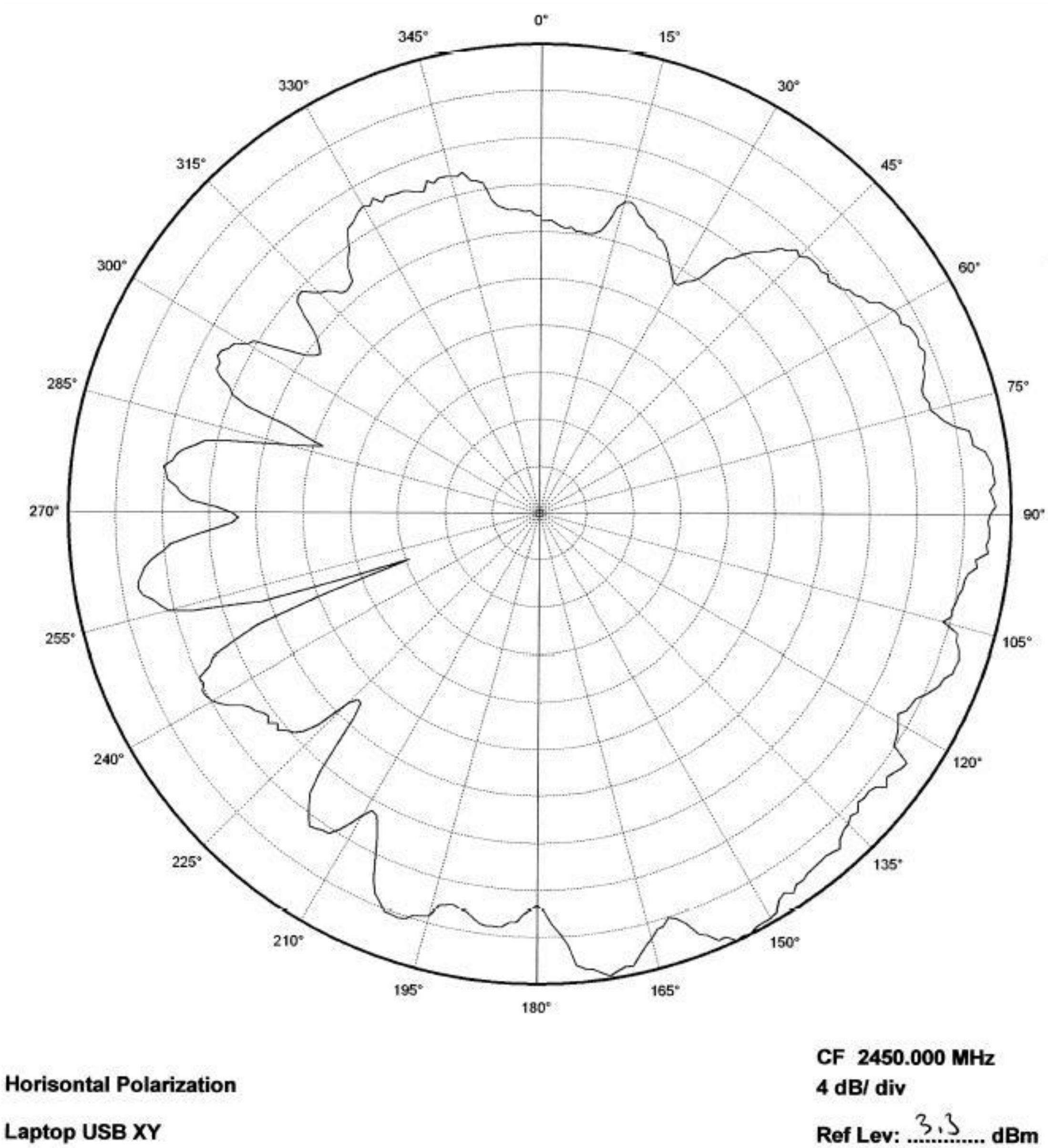

Figure 14: M8Beacon in Laptop XY Plane