

2.4-GHz Inverted F Antenna

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1. ABSTRACT

This document describes a printed circuit board (PCB) antenna design that can be used for all 2.4-GHz transceivers and transmitters. The maximum gain measurement when used on the reference board is +3.3 dBi, and the overall size requirement for this antenna is 23.4×6.9 mm. As shown in Figure 1.

The antenna impedance on the reference board is tuned to 50 ohms. However, impedance can be affected by different sizes and shapes of the ground plane, as well as objects in the near-field of the antenna. It is recommended to add a pi network near the antenna feed point for impedance matching.

The results presented in this document are based on antennas implemented on PCBs using FR-4 material.

All of the results presented in based on measurements performed with the NORDIC nRF52810 evaluation board.

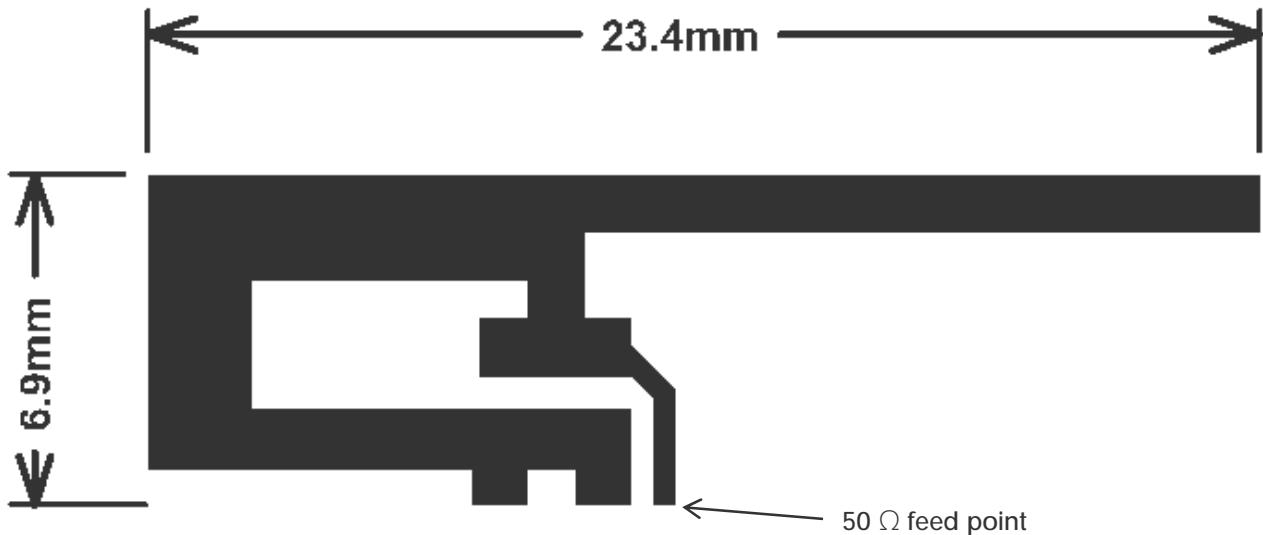


Figure 1

2. Radiation Pattern

Figure 2 shows how to relate all of the radiation patterns to the orientation of the antenna..

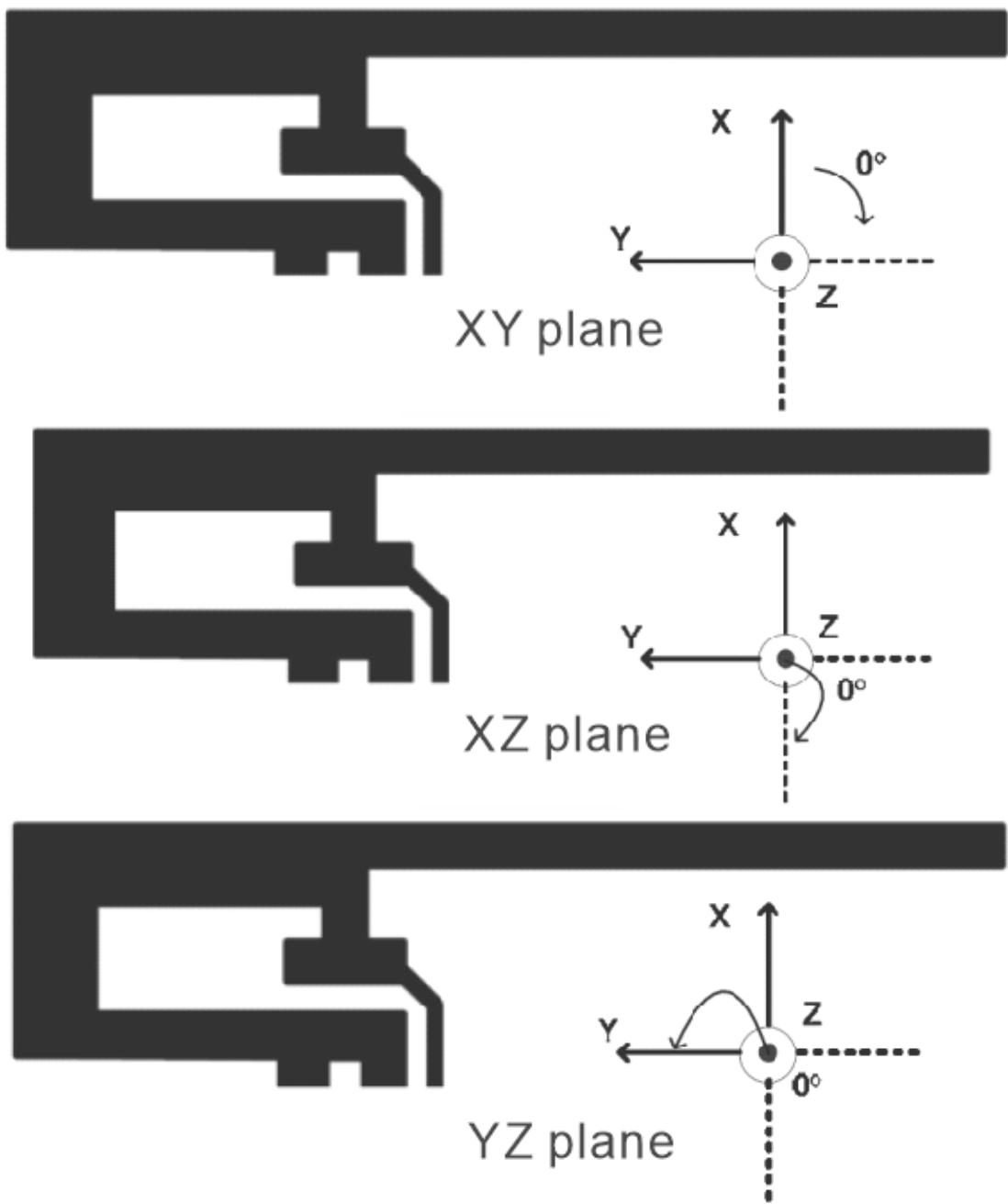


Figure 2.

Figure 3 shows the radiation pattern of antenna XY place.

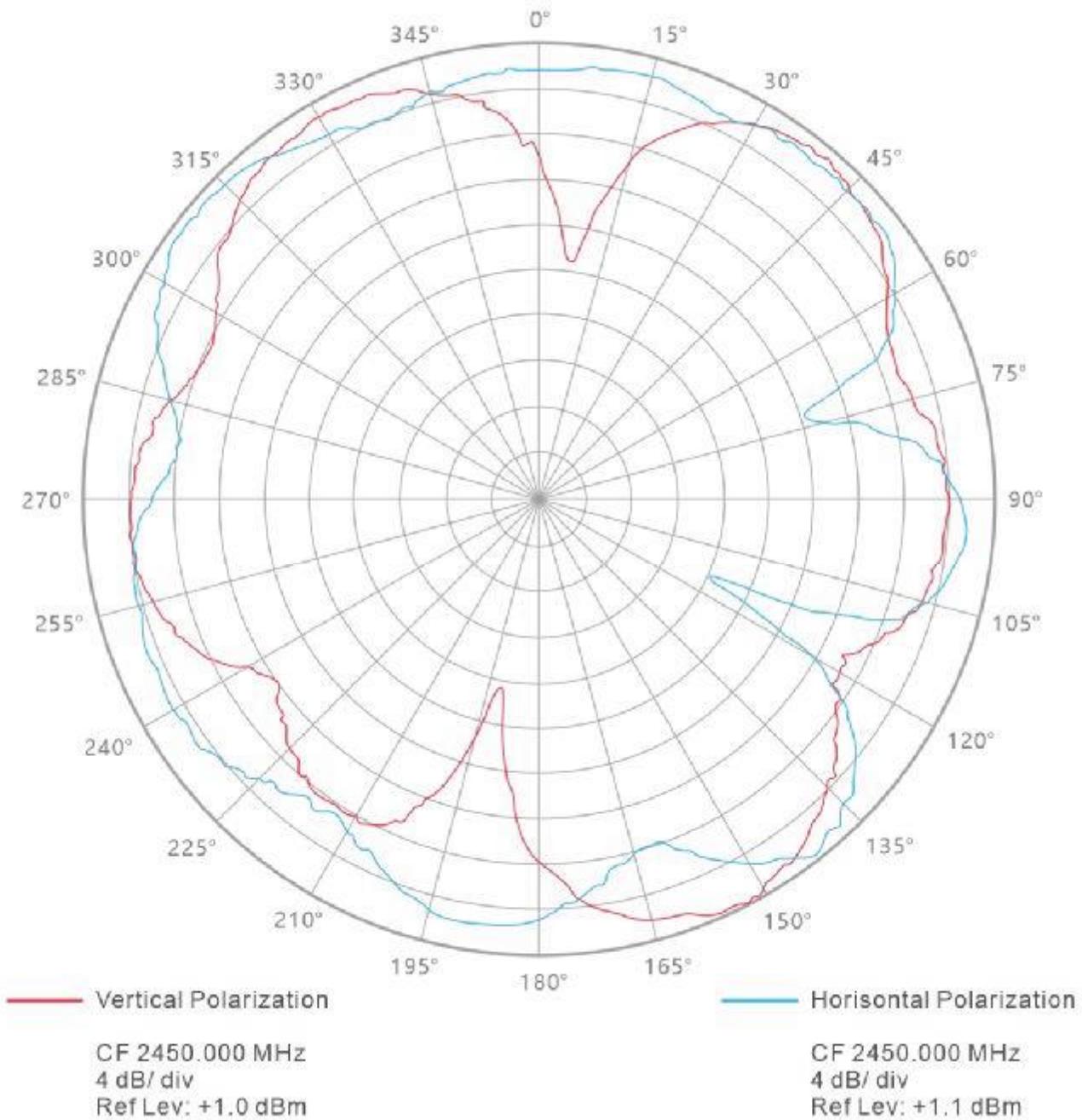


Figure 3

Figure 4 shows the radiation pattern of antenna XZ place.

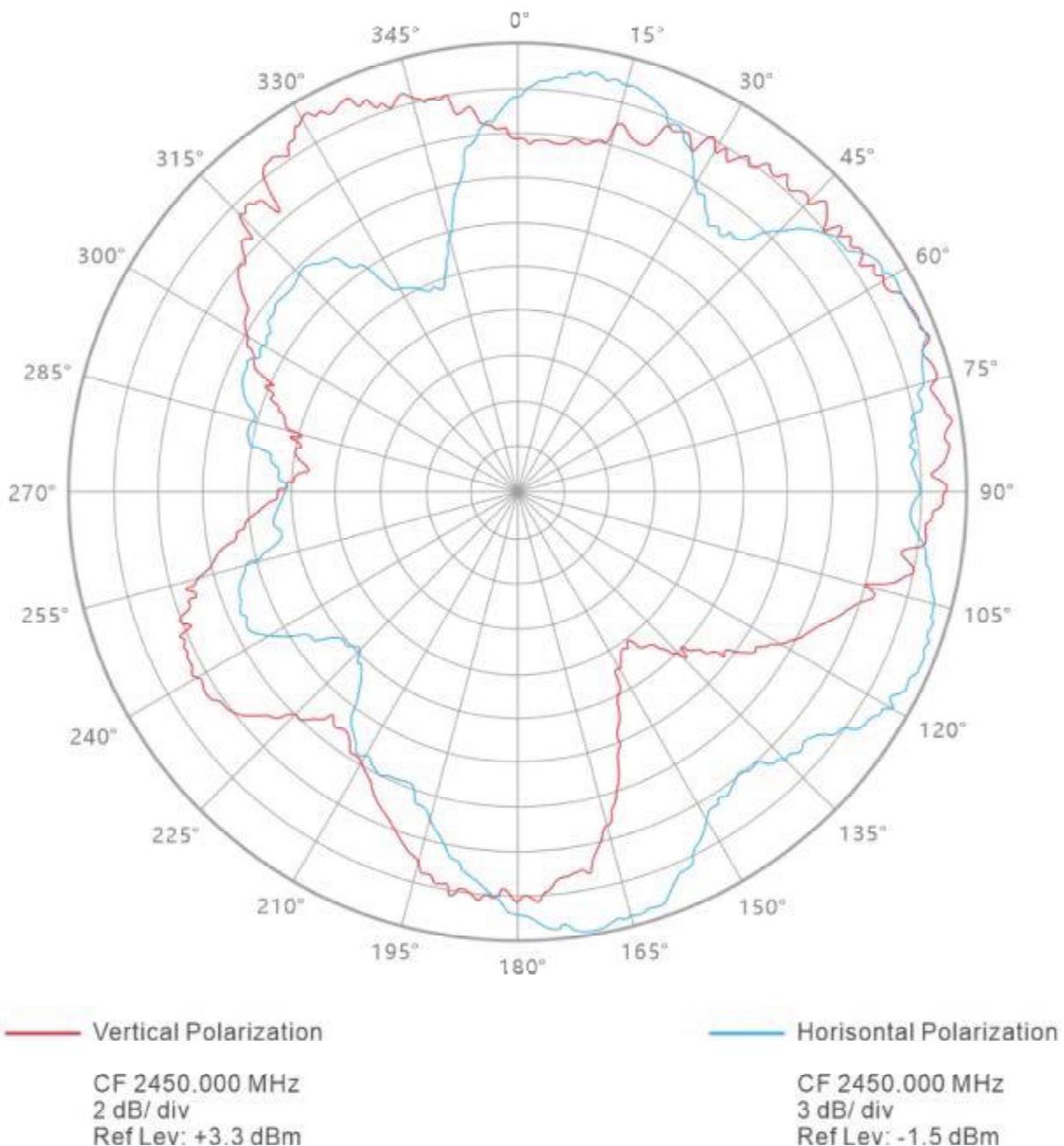


Figure 4

Figure 5 shows the radiation pattern of antenna YZ place.

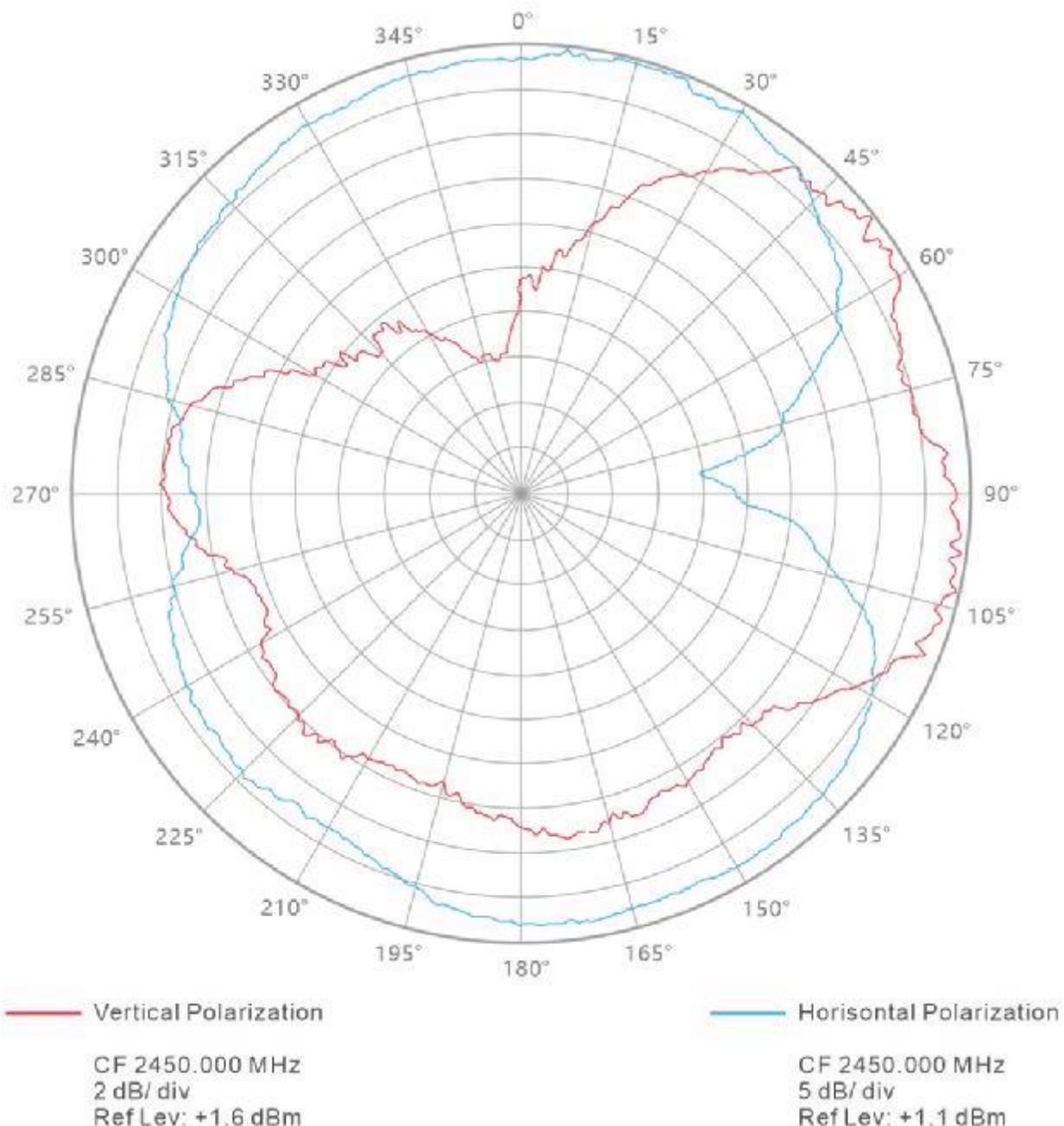


Figure 5

3. Reflection

Figure 6 Figure 5 shows the measurement results of antenna feed point reflection. Within a bandwidth exceeding 300MHz, the reflection of available power is less than 10%.

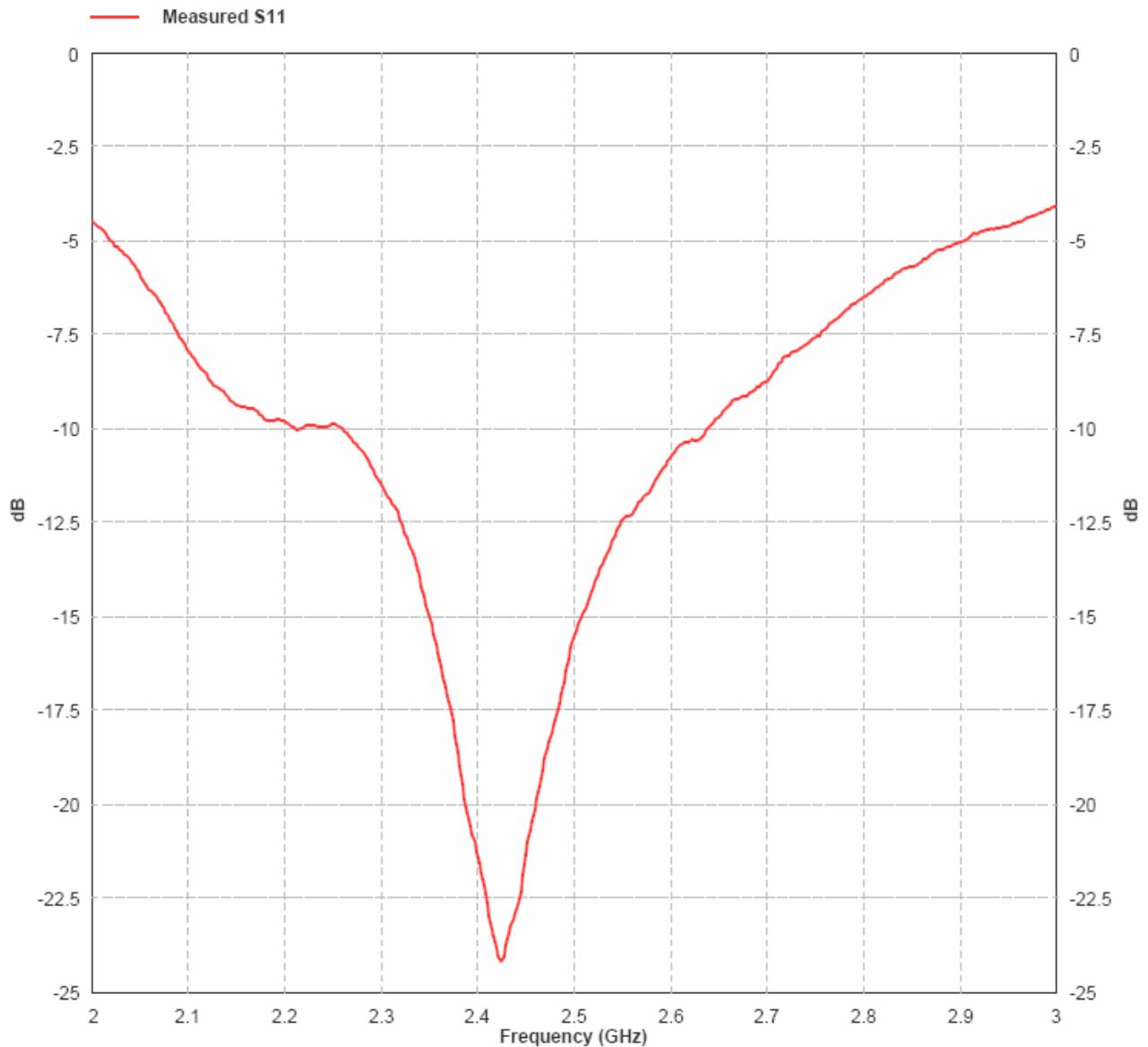


Figure 6

4. Bandwidth

Figure 7 shows how the output power varies on the antenna when the PCB is horizontally oriented and the receiving antenna has horizontal polarization. This measurement was not performed in an anechoic chamber, thus the graph shows only the relative variation for the given frequency band.

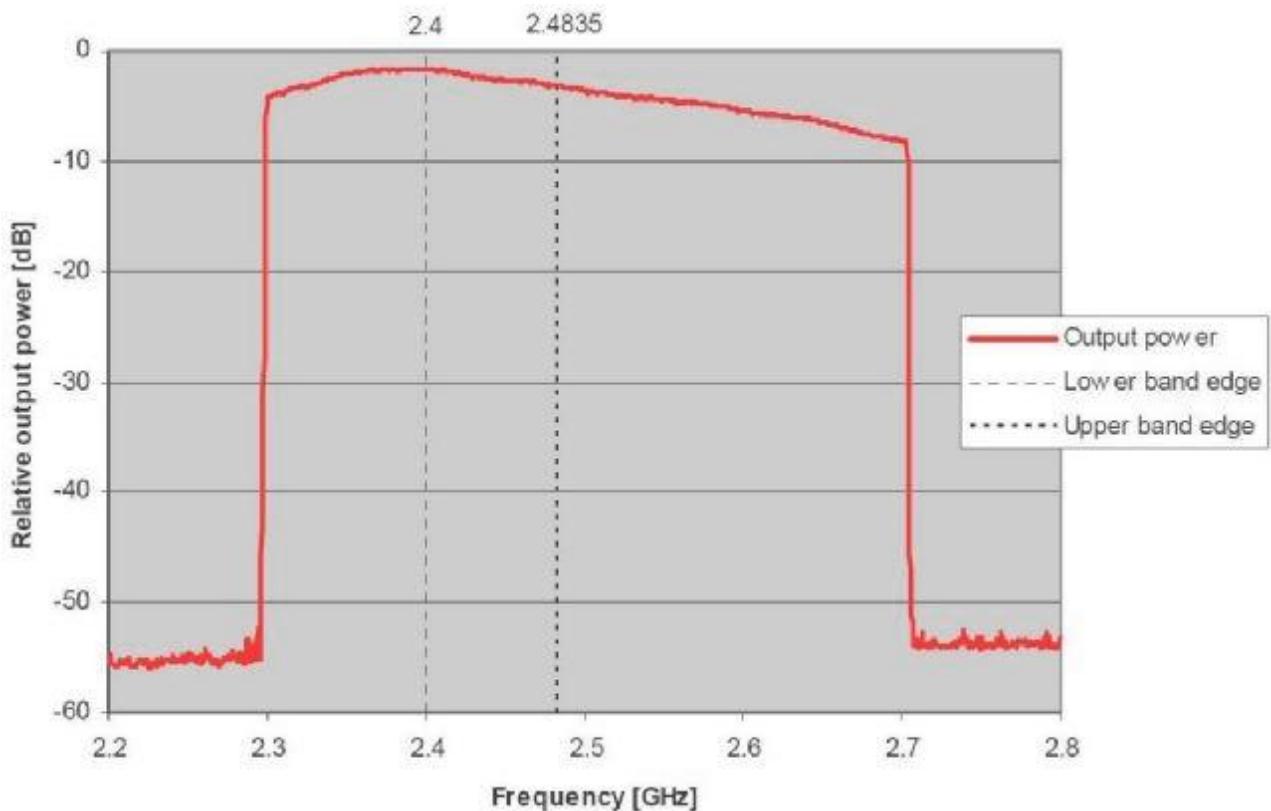


Figure 7

5. Conclusion

This PCB antenna performs well on all frequencies in the 2.4-GHz ISM band. Except for two narrow indentations, the antenna has an omnidirectional radiation pattern within the PCB plane. Regardless of the operating frequency and position of the antenna, these characteristics will ensure stable performance.

The following table lists the main characteristics of PCB antennas.

Gain in XY plane	1.1 dBi
Gain in XZ plane	3.3 dBi
Gain in YZ plane	1.6 dBi
Reflection	< -15 dB
Antenna size	23.4 × 6.9 mm