2.4 GHz Inverted F Antenna

1 Introduction

This PCB antenna Maximum gain is measured o be +3.3 dB

Manufacturer:SHZHEN HEXINGSHENG SMART LINK TECHNOLOGY CO., LTD.
Address:2F, Building 7, Huaxing Industrial Park, Langqin Road. Dalang Street, Longhua District, Shenzhen City, China

2 Description of the Inverted F Antenna Design

Since the impedance of the Inverted F Antenna is matched directly to 50 ohm no external matching components are needed.

2.1 Implementation of the Inverted F Antenna

It is important to make an exact copy of the antenna dimensions to obtain optimum performance. The easiest approach to implement the antenna in a PCB CAD tool is to import the antenna layout from either a gerber or DXF file. Such files are included in CC2430DB reference design [1]. The gerber file is called “Inverted_F_Antenna.spl” and the DXF file is called “Inverted_F_Antenna.dxf”. If the antenna is implemented on a PCB that is wider than the antenna it is important to avoid placing components or having a ground plane close to the end points of the antenna. If the CAD tool being used doesn’t support import of gerber or DXF files, Figure 1 and Table 1 can be used.

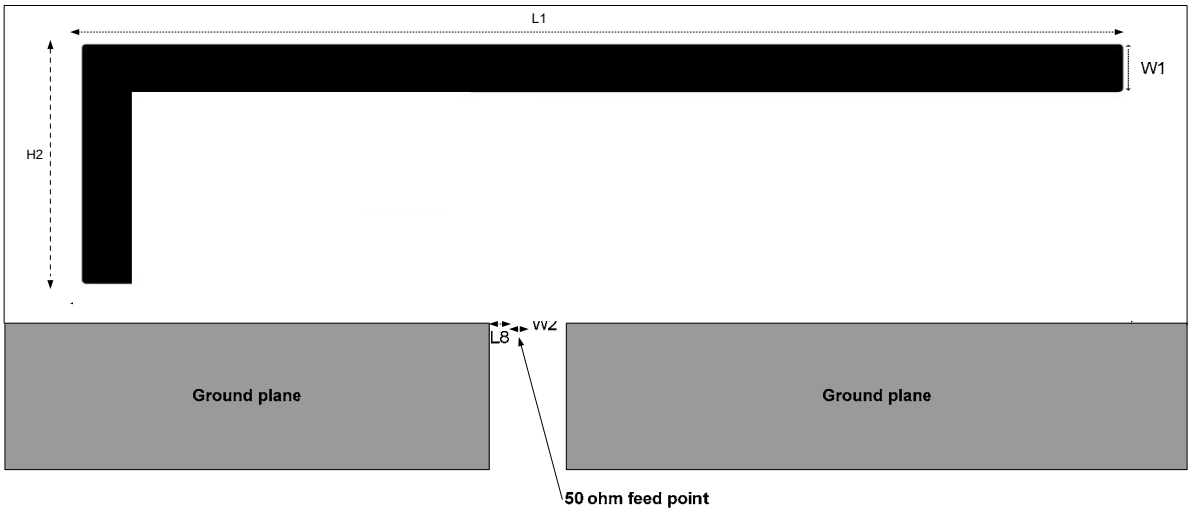

Figure 1. IFA Dimensions

H1	5.70 mm
H2	3.5 mm
W1	1.21 mm

Table 1. IFA Dimensions

Since there is no ground plane beneath the antenna, PCB thickness will have little effect on the performance. The results presented in this design note are based on an antenna implemented on a PCB with 1 mm thickness.

3 Results

All results presented in this chapter are based on measurements performed with CC2430DB [1].

3.1 Radiation Pattern

Figure 2 shows how to relate all the radiation patterns to the orientation of the antenna. The radiation patterns were measured with CC2430 programmed to 0 dBm output power.

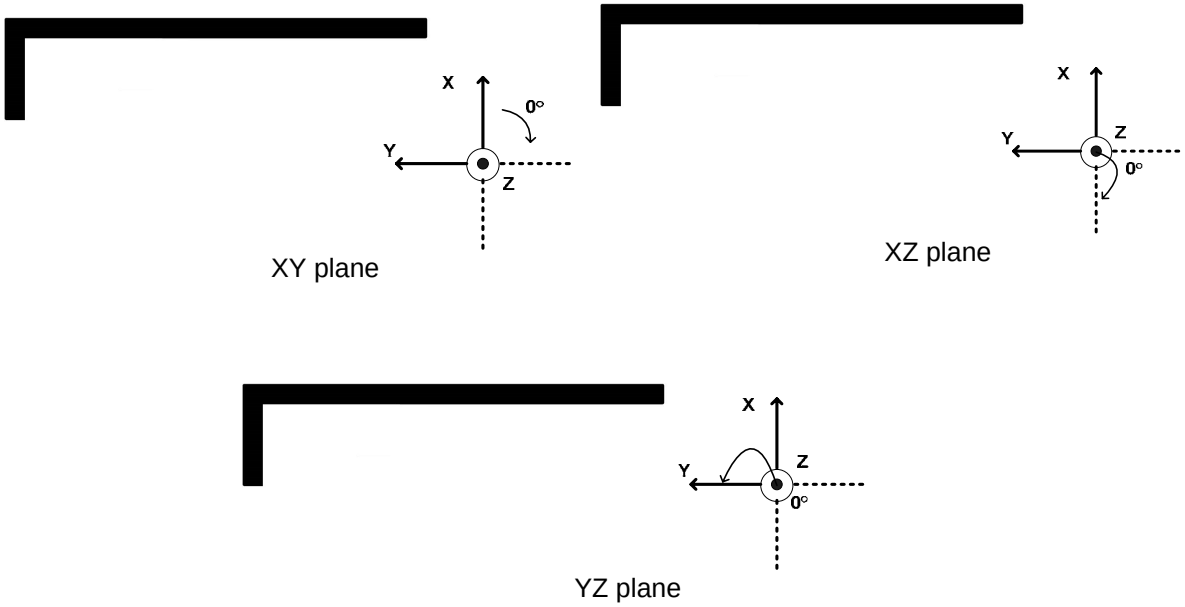

Figure 2. How to Relate the Antenna to the Radiation Patterns

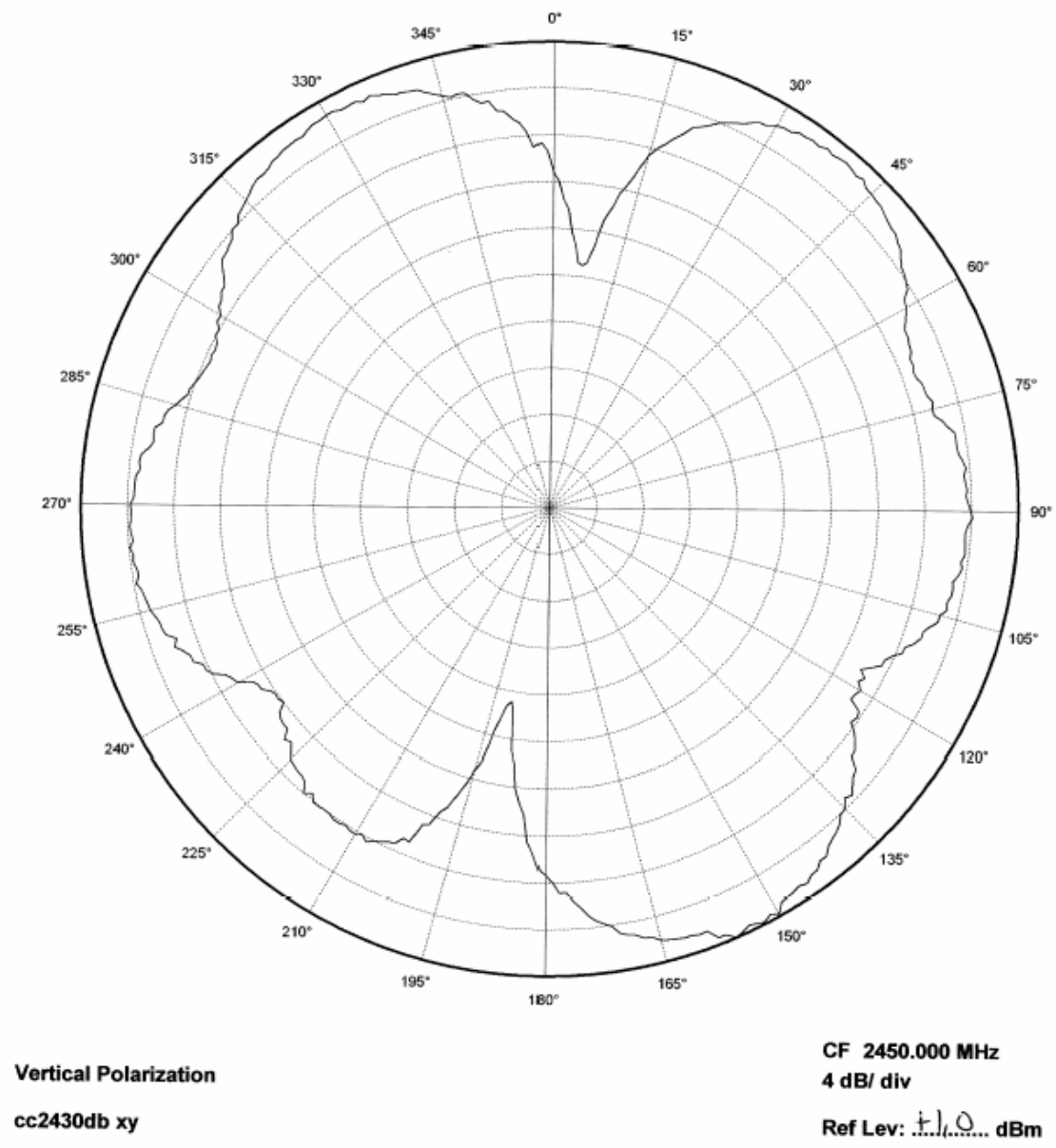

Figure 3. XY Plane Vertical Polarization

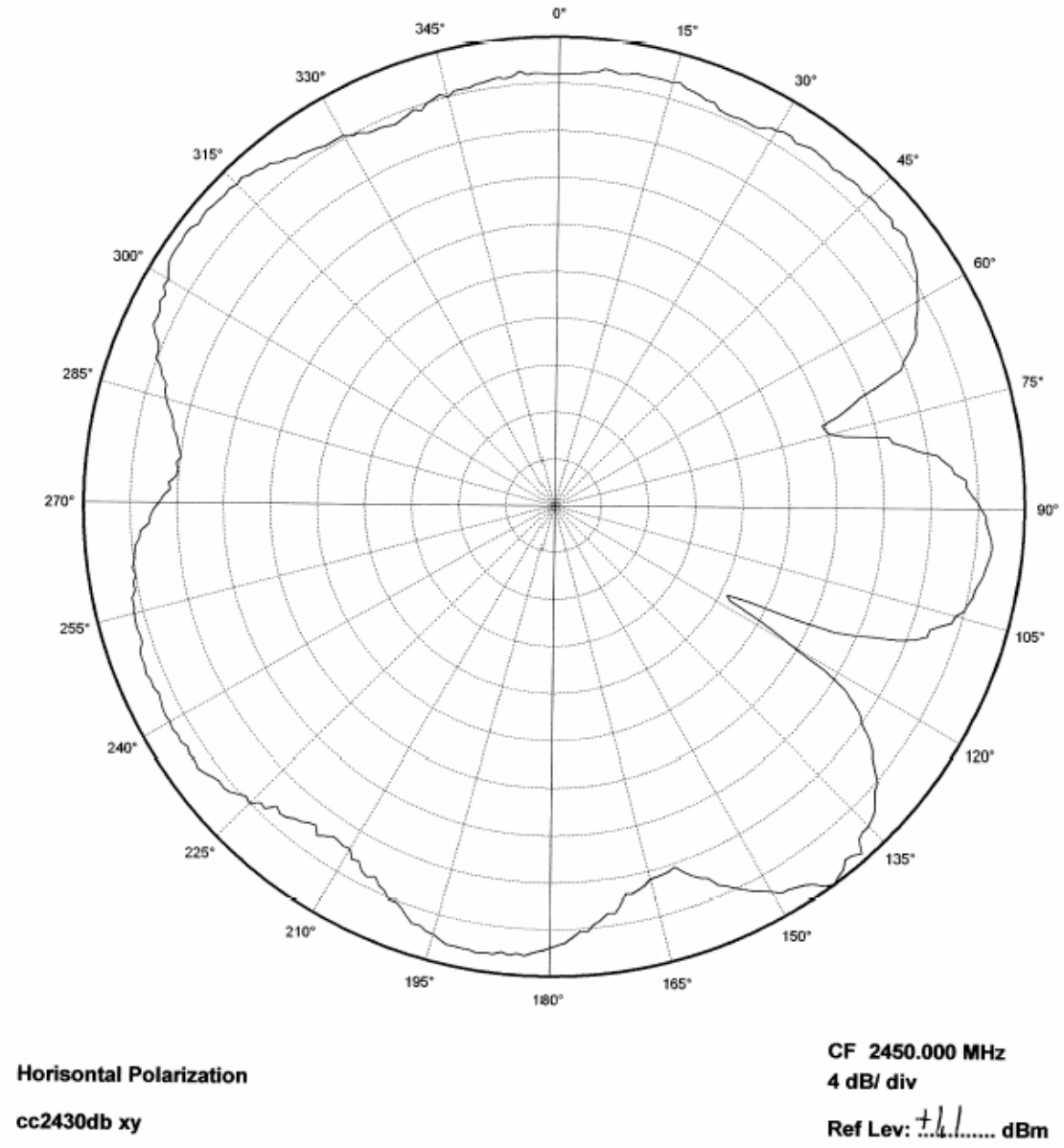

Figure 4. XY Plane Horizontal Polarization

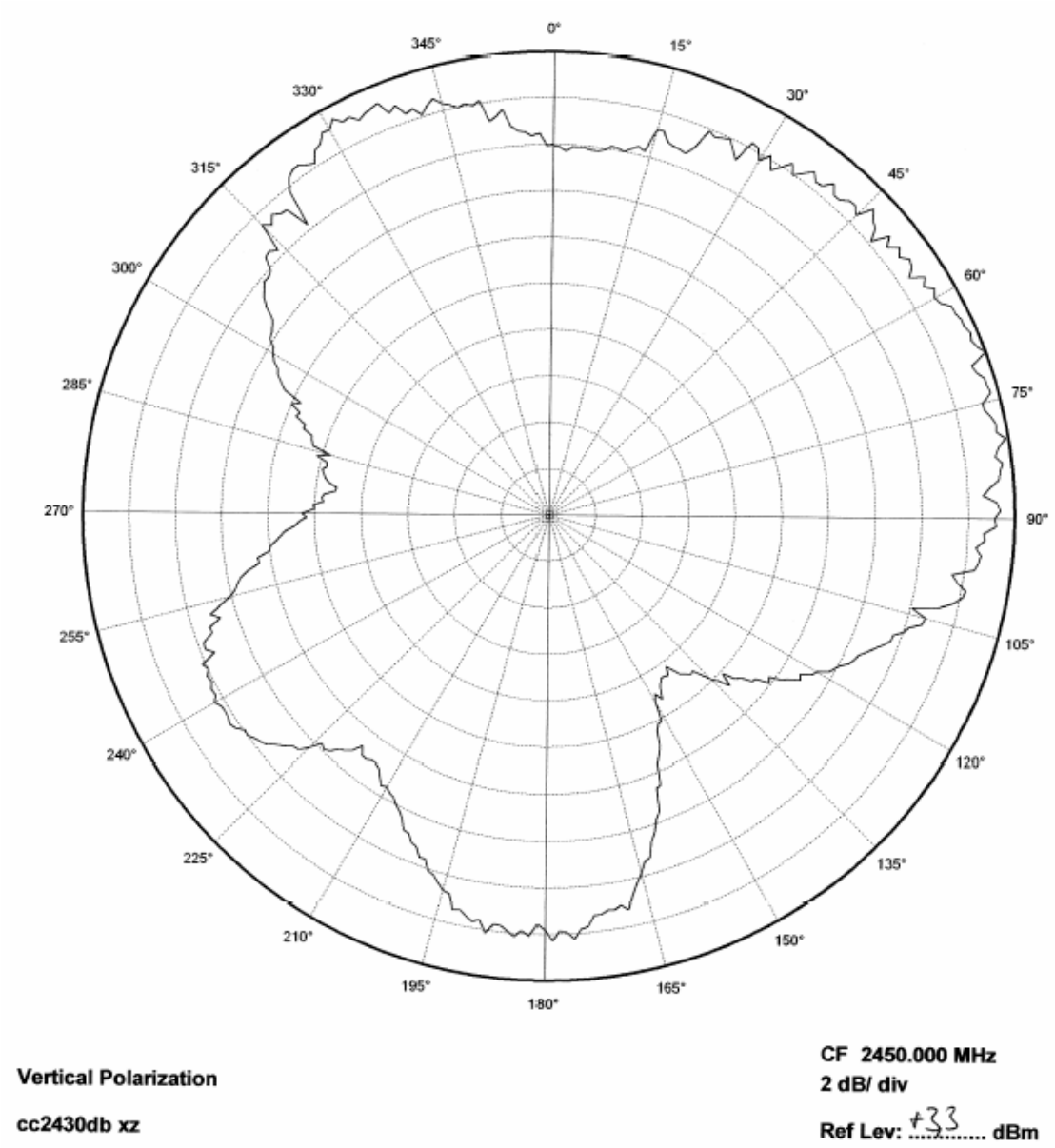

Figure 5. XZ Plane Vertical Polarization

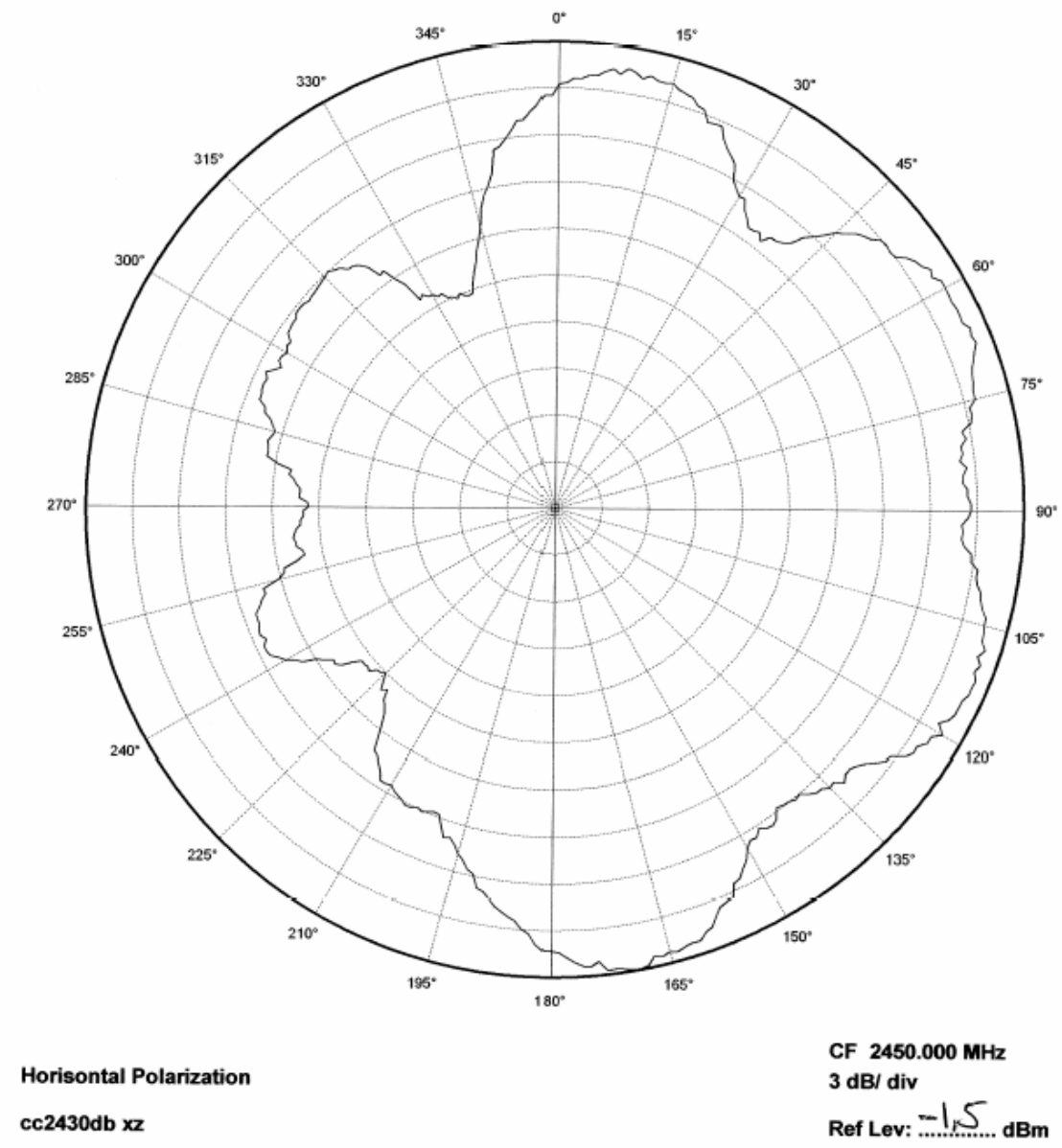

Figure 6. XZ Plane Horizontal Polarization

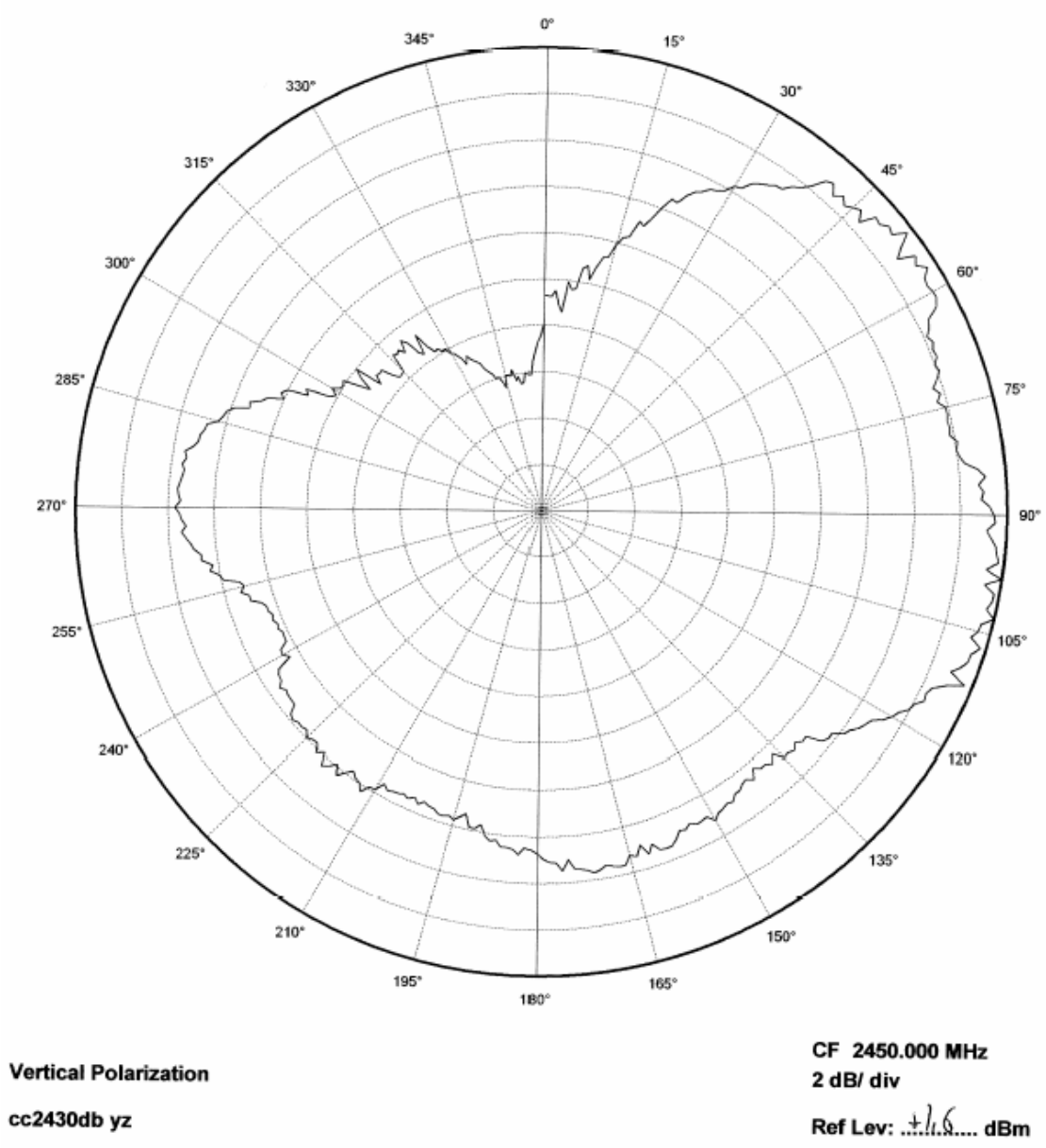

Figure 7. YZ Plane Vertical Polarization

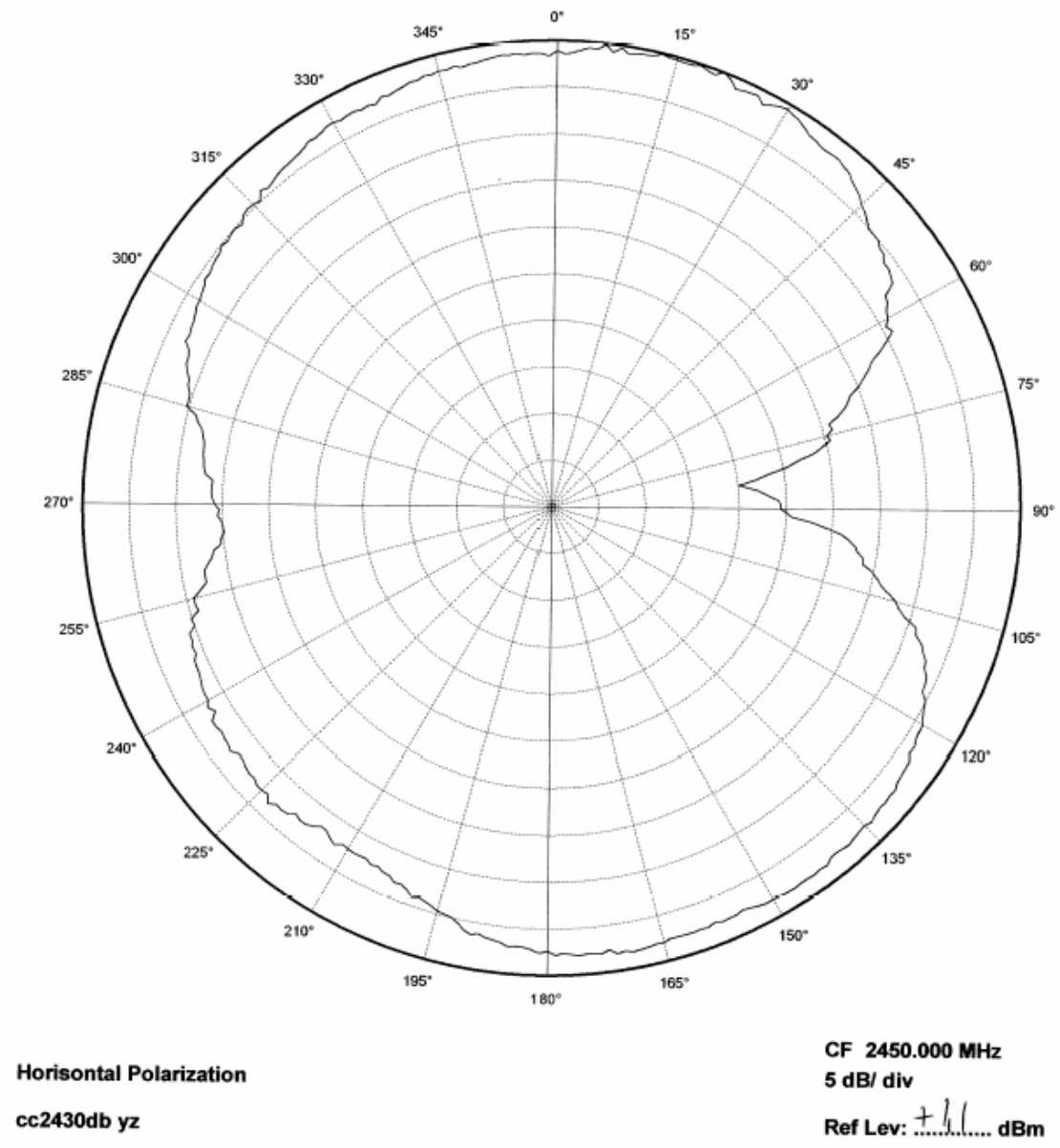

Figure 8. YZ Plane Horizontal Polarization

4.2 Reflection

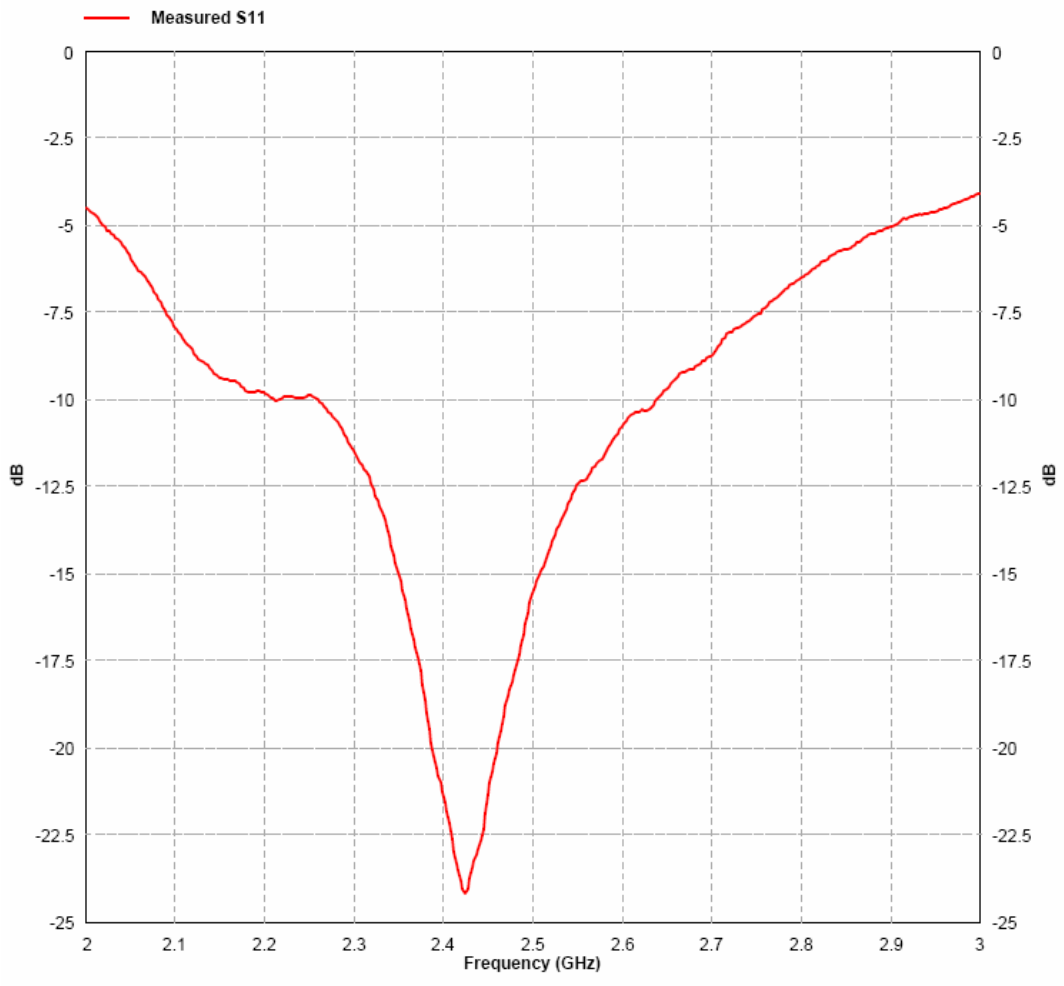

Figure 9. Measured Reflection at the Feed Point of the Antenna

Figure 9 show that the IFA ensures less than 10 % reflection of the available power for a bandwidth of more than 300 MHz. A large bandwidth makes the antenna less sensitive to detuning due to plastic encapsulation or other objects in the vicinity of the antenna.

4.3 Bandwidth

Another way of measuring the bandwidth after the antenna is implemented on a PCB and connected to a transmitter is to write test software that steps a carrier across the frequency band of interest. By using the “Max hold” function on a spectrum analyzer the variation in output power across frequency can easily be measured. Figure 10 shows how the output power varies on the IFA 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.

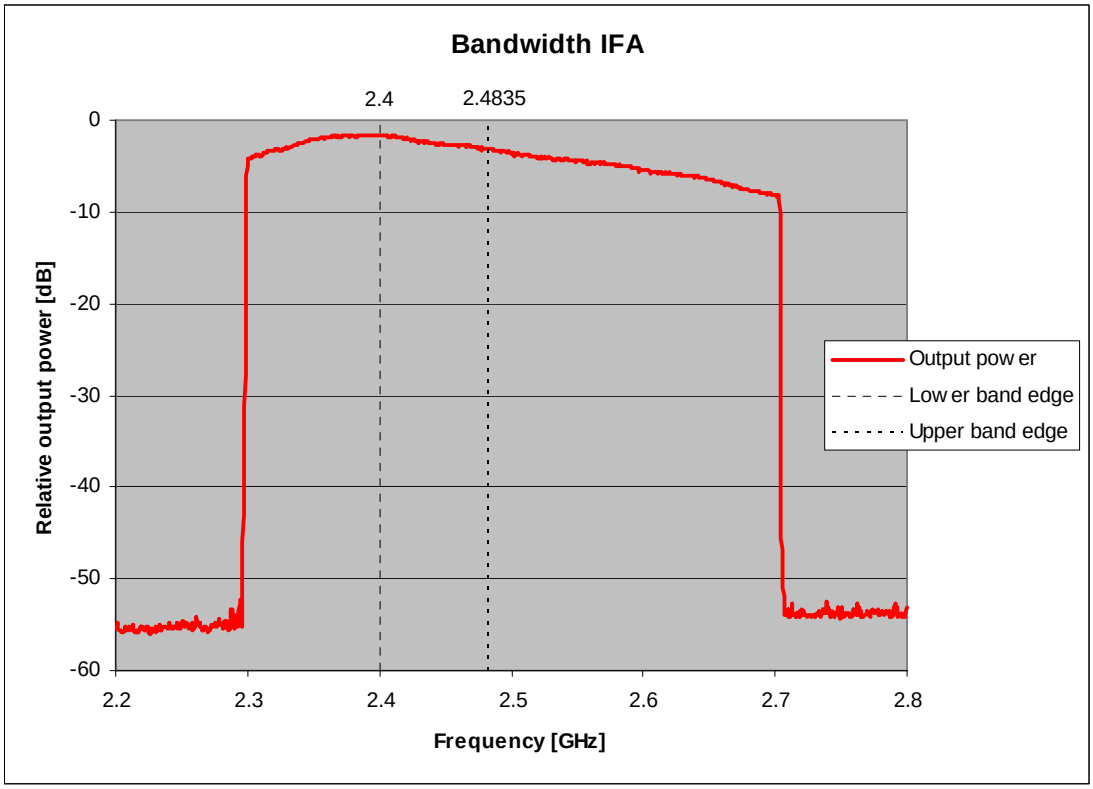

Figure 10. Bandwidth of IFA

5 Conclusion

The PCB antenna introduced in this document performs well at all frequencies in the 2.4GHz ISM frequency band. The antenna has an omnidirectional radiation pattern on the PCB plane. Regardless of the operating frequency and position of the antenna, these characteristics will ensure stable performance. Table 2 lists the most important characteristics of the inverted F antenna.

Gain in XY Plane	1.1 dB
Gain in XZ Plane	3.3 dB
Gain in YZ Plane	1.6 dB
Reflection	< -15 dB
Antenna Size	5.7mmx 3.5 mm x1.21mm

Table 2. Summery of the Properties of the IFA