

7.2 Antenna Feed Consideration

Table 2 provides the “W” value for different PCB thicknesss between the top and bottom layers for a two-layer FR4 substrate (relative dielectric constant = 4.3) for coplanar waveguide model. The top layer contains the antenna trace; the bottom layer is the immediate next layer containing the solid RF ground plane. The remaining PCB area of the bottom layer can be used as a signal ground plane (for the PSoC/ PSoC and other circuitry). Figure 11 relates the PCB thickness to “W” for a typical two-layer PCB.

Table 2. Value of “W” for FR4 PCB: Thickness Between Antenna Layer and Adjacent RF Ground Layer

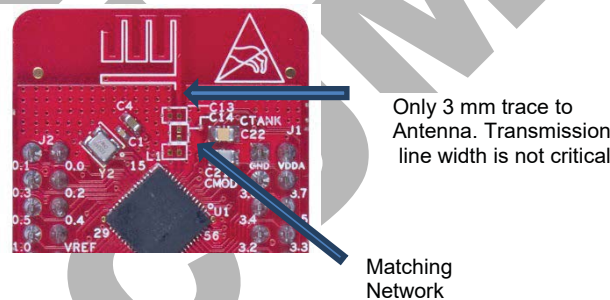
Thickness (mils)	W (mils)
60	65
50	59
40	52
30	44
20	33

Figure 11. Clarification of PCB Thickness



For the small length of PCB trace that feeds the antenna, the width requirement can be relaxed. Ensure that the antenna trace width and the antenna feed connection have the same width. Figure 12 shows one such case where the trace width feeding the antenna is not as wide as recommended in Table 2.

Figure 12. Antenna Feed Width for Short Trace



However, if it is a long transmission line approximately 1 cm from the matching network to antenna or back to the ANT pin of the PSoC/PSOC BLE device, Cypress recommends a transmission line (TLine) type of layout, having a specific width “W” over a bottom ground plane for the feed.

Note: See the coplanar wave guide calculator in Appendix B for the calculation of width for Coplanar transmission line.

Figure 13 plots S_{11} of the MIFA. The MIFA has a bandwidth ($S_{11} \leq -10$ dB) of 230 MHz around 2.44 GHz.

Figure 13. S_{11} of the MIFA (Return Loss = $-S_{11}$)

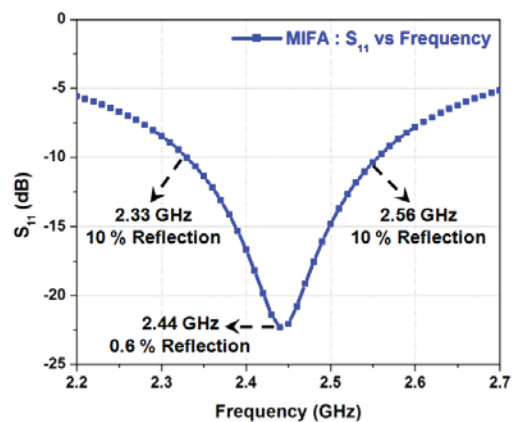
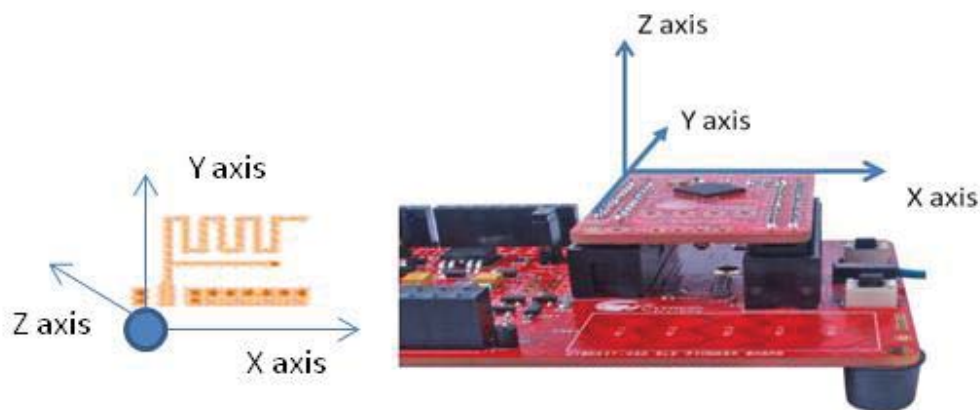
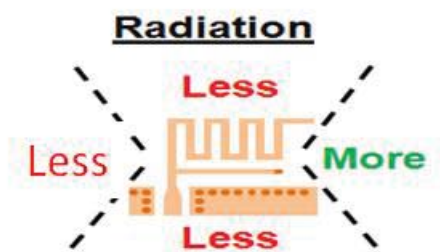


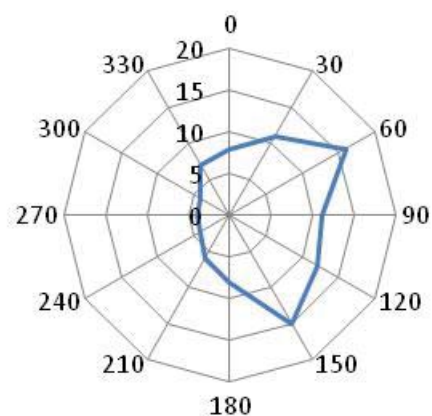
Figure 14 shows the complete 3D radiation-gain pattern of the MIFA at 2.44 GHz. This information is helpful in placing the MIFA for custom applications to maximize the radiation in the desired direction. In this diagram, the antenna is in the XY plane; the Z-axis is vertical to it.

Figure 14. 3D Radiation-Gain Pattern for MIFA

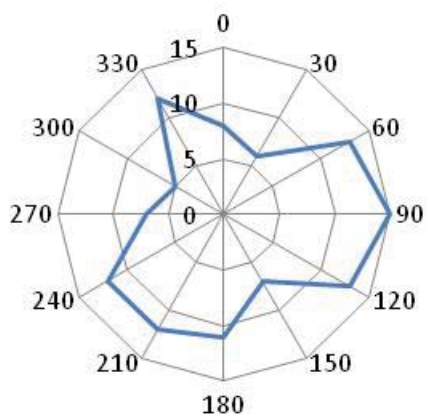




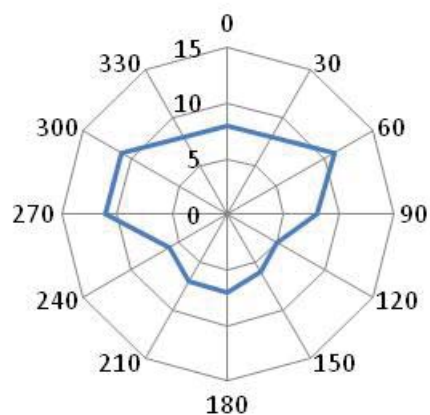
About Z axis



About X axis



About Y axis



The radiation pattern is tested with a 30-degree angular resolution on a Pioneer Board carrying a module with a MIFA antenna. The connecting headers are metals. In a bare board, the radiation pattern is different than what is shown; this is for illustration only to show how to position the antenna in a PCB. You are encouraged to measure similar pattern in your final product assembly to determine the best place for the antenna.

7.3 Antenna Length Considerations

Depending on the PCB thickness, the MIFA antenna should be length-adjusted to adjust the antenna radiation impedance and frequency selectivity. Cypress recommends the values listed in [Table 3](#) for antenna lengths for various board thicknesses.

Figure 15. Length of MIFA

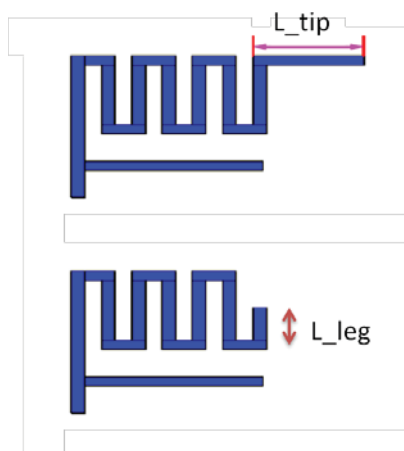


Table 3. Leg and Tip length

PCB Thickness	Antenna L_Tip / L_leg
16 mils	L_tip= 353 Mils
31 mils	L_tip= 165 Mils
47 mils	L_tip= 125 Mils
62 mils	L_leg= 115 Mils

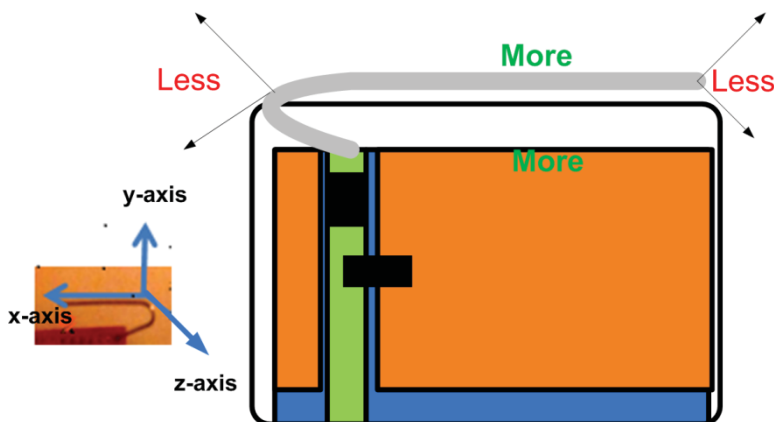
[Figure 15](#) shows two MIFA antennas for two different board thicknesses. Antenna designers should refer to [Table 3](#) for adjusting the length of the MIFA antennas for a specific board thickness.

Please note that the original antenna should start with the full length of antenna. Depending on board thickness the antenna needs to be length adjusted. You cannot increase length as easily in a board than cutting the length. [Table 3](#) should be taken as a guideline to check final length of the antenna for a given board thickness than an exact figure.

The length cutting is a quick method to tune the antenna. If the customer has space to put matching network component and competency for antenna tuning, Cypress recommends putting matching network instead of length adjusting.

A wire antenna is the best in RF performance. They have the best antenna efficiency and directivity compared to other antennas. See [Figure 24](#) for the qualitative radiation pattern out of wire antenna.

Figure 24. Qualitative Radiation Pattern Out of Wire Antenna



10 Antenna Comparison

Use [Table 5](#) as a quick reference to select the appropriate antenna for your application.

Table 5. Comparison of MIFA, IFA, Chip, and Wire Antennas

Properties at 2.44 GHz	MIFA	IFA	Chip Antenna	Wire Antenna
Appearance				
Recommended Applications	Less Area (Mouse, Keyboard, Presenter)	Height Constrain (Heart Rate Monitor)	Small Area (Nano Dongle, BLE Module)	More Height (6 mm) (3D) (Sensor Hub)
Dimensions (mm)	7.2 × 11.1	4 × 20.5	3.2 × 1.6	6 × 30
Dimensions (mils)	284 × 437	157.5 × 807	126 × 63	250 × 1200
Gerber File	Web	Web	Refer to datasheet	
Cost (US\$)	Minimal	Minimal	0.1–0.5	0.1
Bandwidth (MHz) ($S_{11} \leq -10$ dB)	230	220	200	200
Gain (dBi)	1.6	1.1	0.5	2