2.4 / 5.5 GHz FlexPIFA 3 dBi Antenna w/U.FL Cable, 100mm



ORDERING INFORMATION

Order Number	Description
001-0016	2.4 / 5.5 GHz FlexPIFA Antenna w/U.FL cable, 100mm
001-0021	2.4 / 5.5 GHz FlexPIFA Antenna w/MHF4L cable, 100mm

Table 1 Orderable Part Numbers

KEY FEATURES

- Can be installed on different non-conductive surfaces and thicknesses.
- Can be installed near metals or the human body.
- Dual Band Antenna: 2.4 GHz and 5 GHz
- Can be installed on flat or curved surfaces.
- Quick and easy Installation
- Adhesive holds to surface during humidity exposure and hot/cold cycles.
- RoHS Complaint

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SPECIFICATIONS

Specification	Value
2.4 GHz Band Peak Gain	+2.5 dBi
5 GHz Band Peak Gain	+3 dBi
2.4 GHz Average Gain	> -1.9 dBi
5 GHz Average Gain	> -4.0 dBi
Impedance	50 ohms
Type	Flexible Planar Inverted F Antenna (FlexPIFA)
Polarization	Linear
VSWR	<3.0:1, 2400 – 2480 MHz
	<3.0:1, 4900 – 5900 MHz
Frequency	2400 - 2480 MHz, 4900 - 5900 MHz
Weight	1.13g
Size	38.6mm × 12.7mm × 2.5mm
Antenna Color	Clear Yellow
Adhesive	3M 100MP
Operating Temp	-40°C to +85°C
Connector Mating Height	U.FL: 2.5mm Max
	MHF4L: 1.4mm Max

Table 2 Specifications

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PHYSICAL DIMENSIONS (MM)

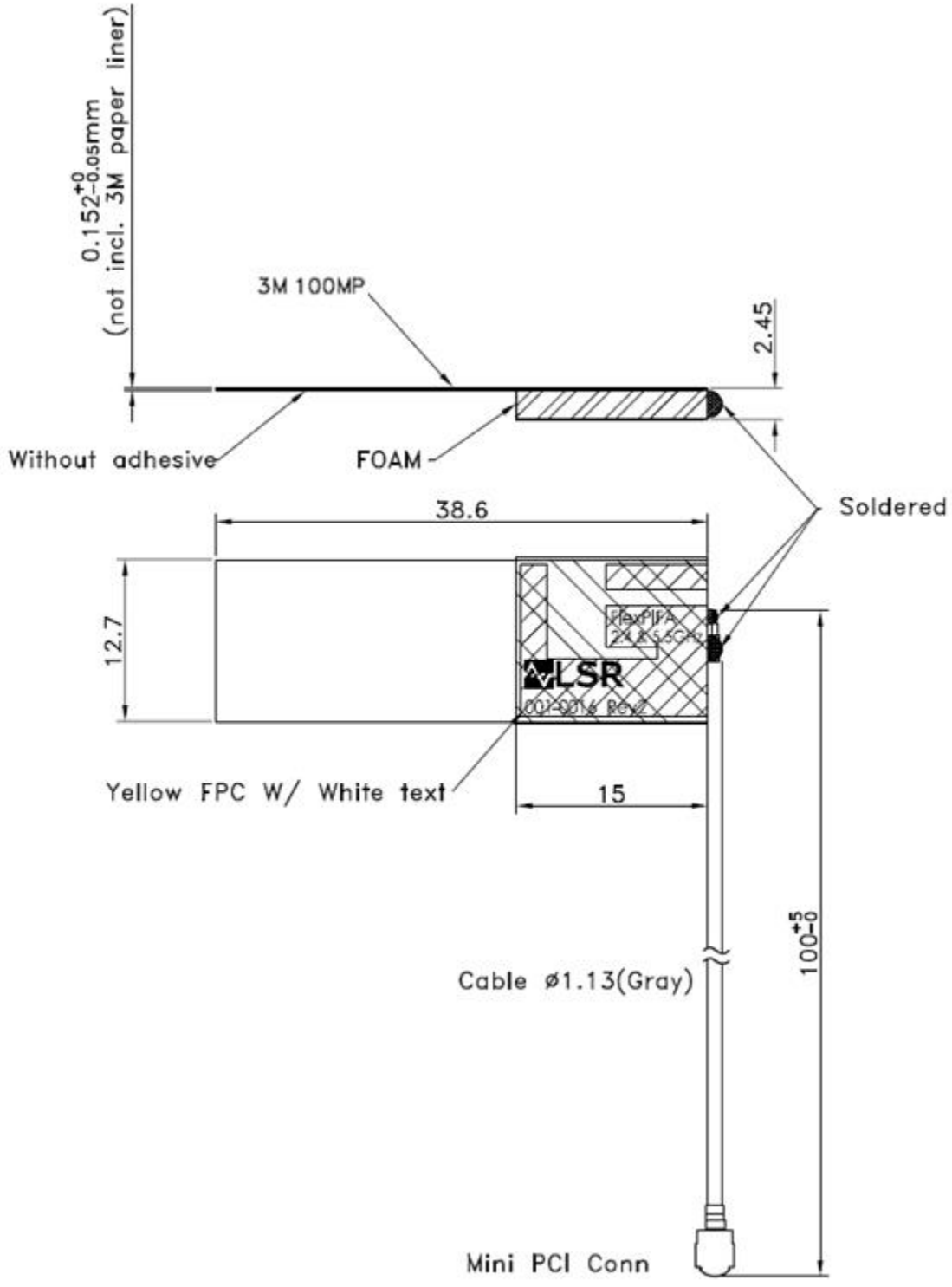


Figure 1 Physical Dimensions

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TEST SETUP

Antenna measurements such as VSWR were measured with an Agilent E5071C Vector Network Analyzer. Radiation patterns were measured with an Agilent 5181A Signal Generator and Agilent E4445A Spectrum Analyzer in a 3 meter Anechoic Chamber.

Flat surface measurements were done with the antenna centered on a 1.5 mm thick plate of Polycarbonate. Curved surface measurements were taken by placing the antenna on the inside and outside of different diameter PVC tubing.

FLAT SURFACE ANTENNA MEASUREMENTS

VSWR

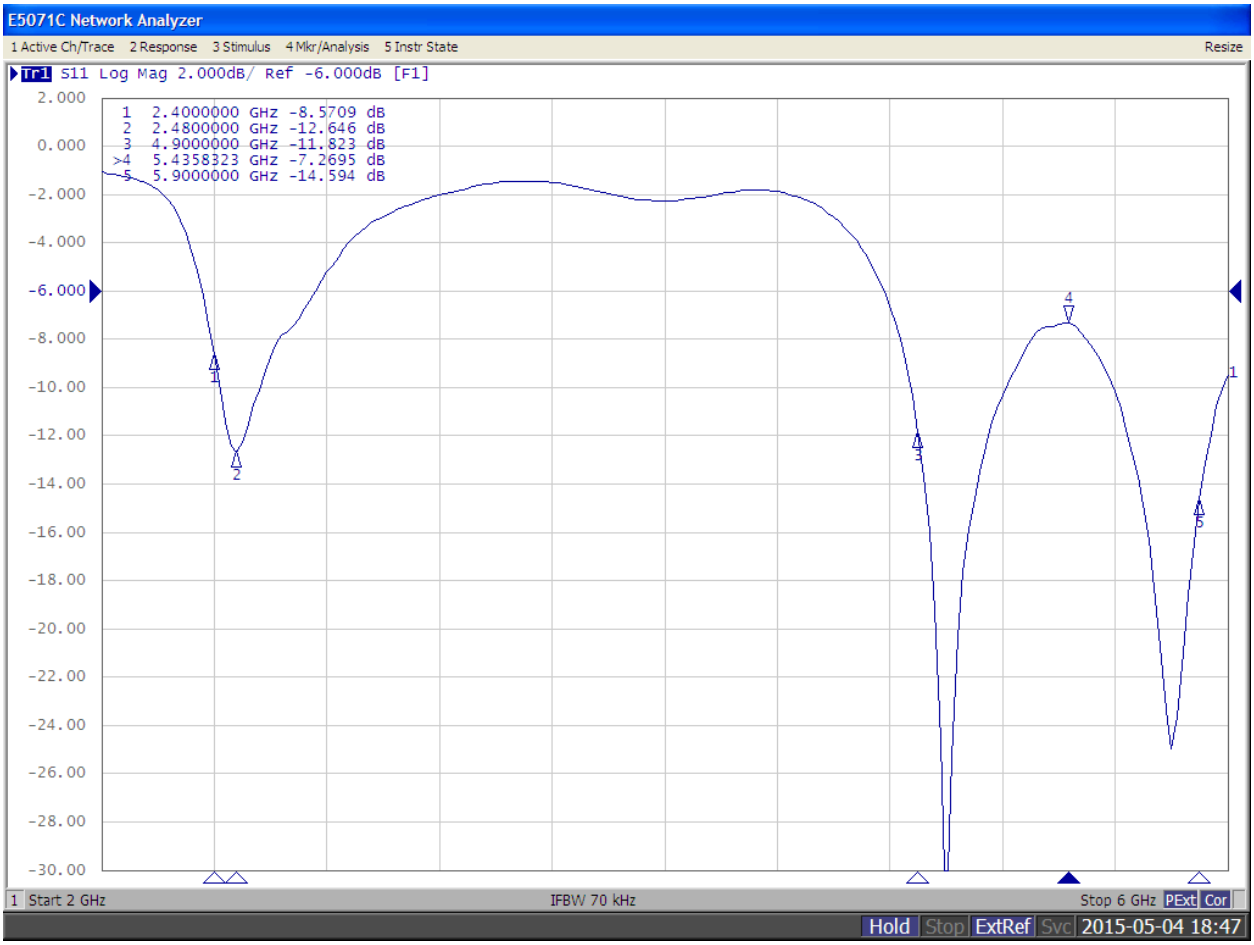


Figure 2 Antenna VSWR measured on a 1.5 mm thick plate of Polycarbonate

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FLAT SURFACE ANTENNA RADIATION PERFORMANCE

FlexPIFA centered on a 1.5 mm thick plate of Polycarbonate

Antenna Measurement Set-Up:

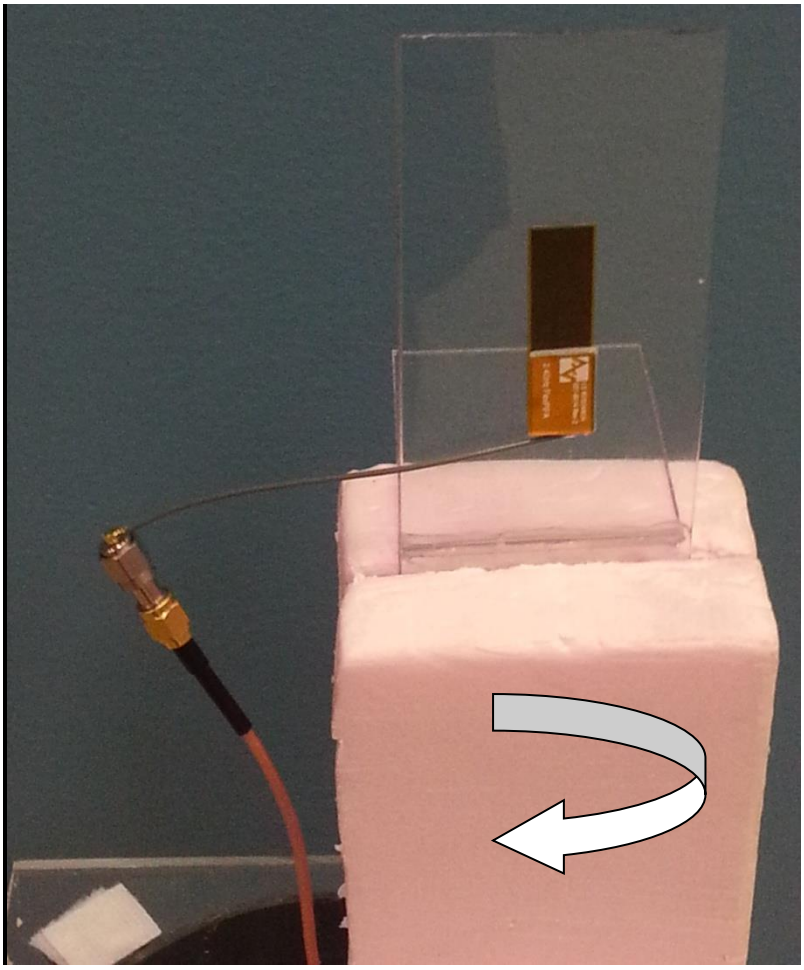


Figure 3 Vertical Orientation Set-Up

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Vertical Orientation at 2440 MHz:

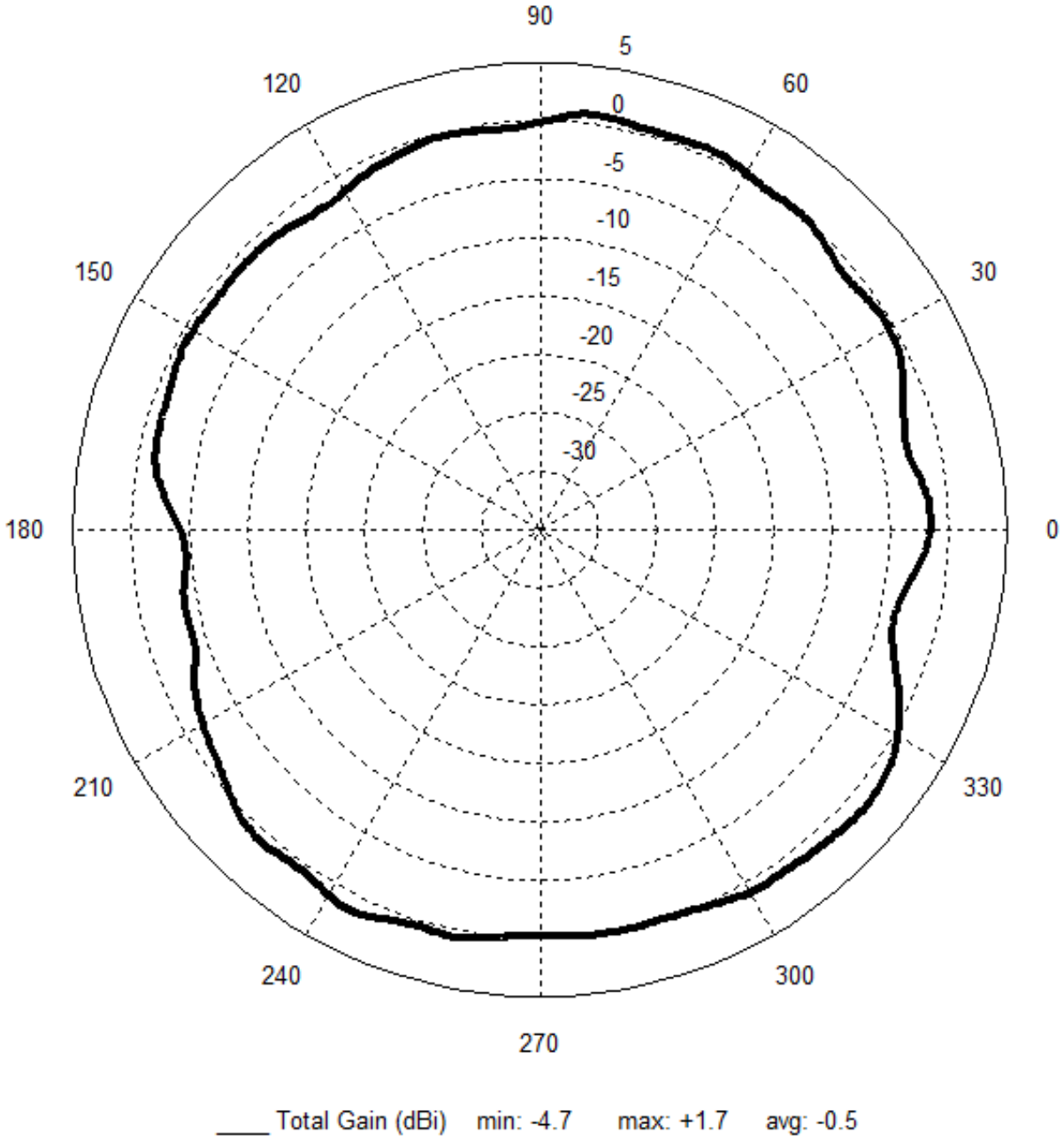


Figure 4 Vertical Orientation Pattern

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Antenna Measurement Set-Up:

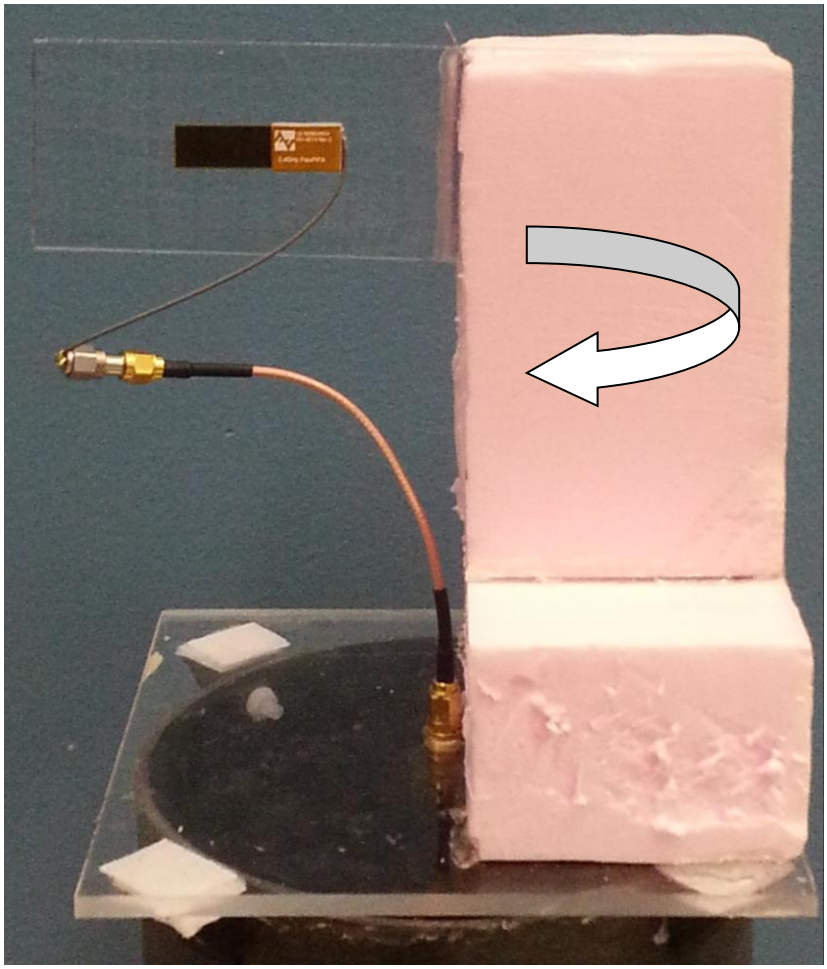


Figure 5 Horizontal Orientation Set-Up

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Horizontal Orientation at 2440 MHz:

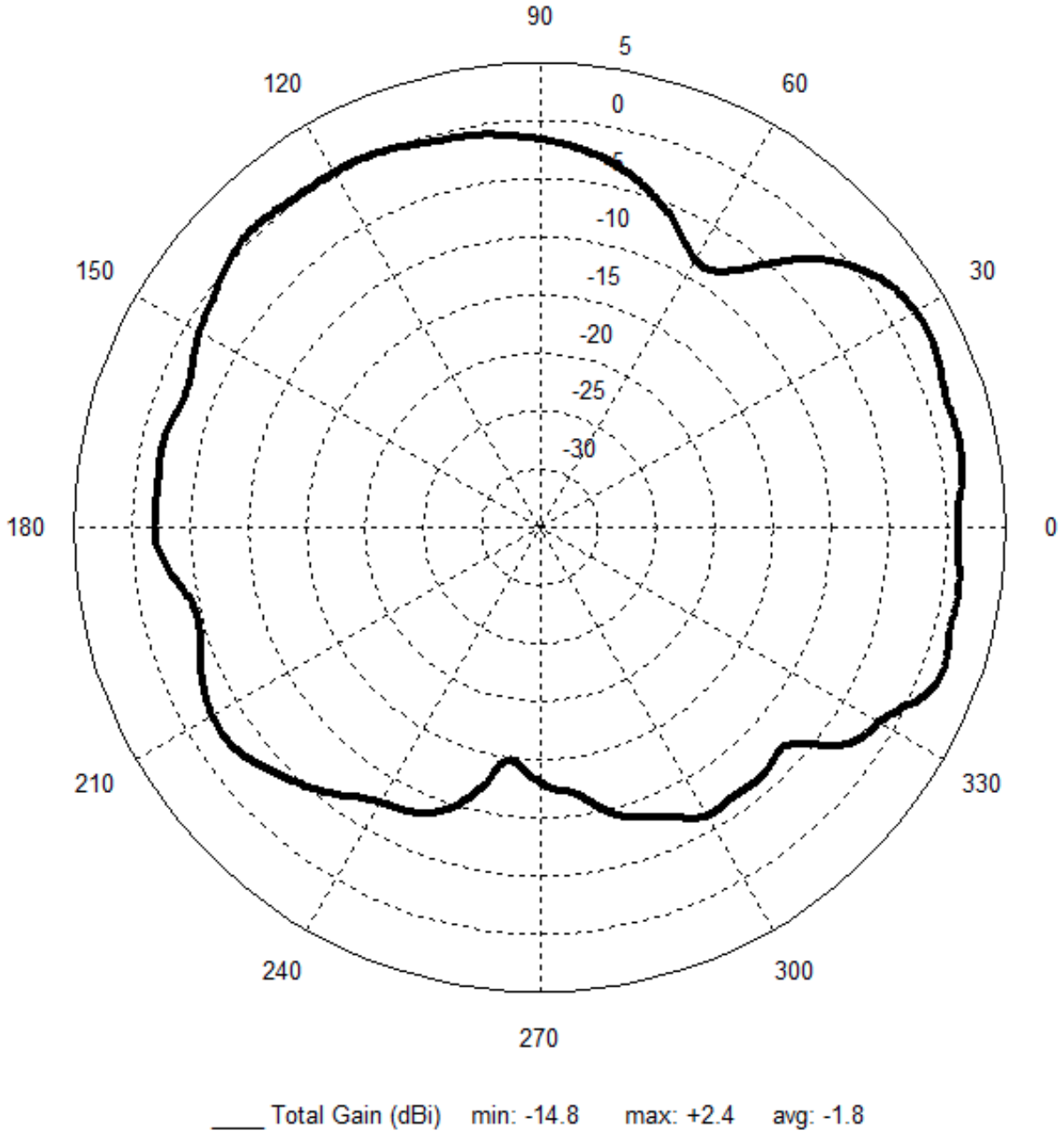


Figure 6 Horizontal Orientation Pattern

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Antenna Measurement Set-Up:

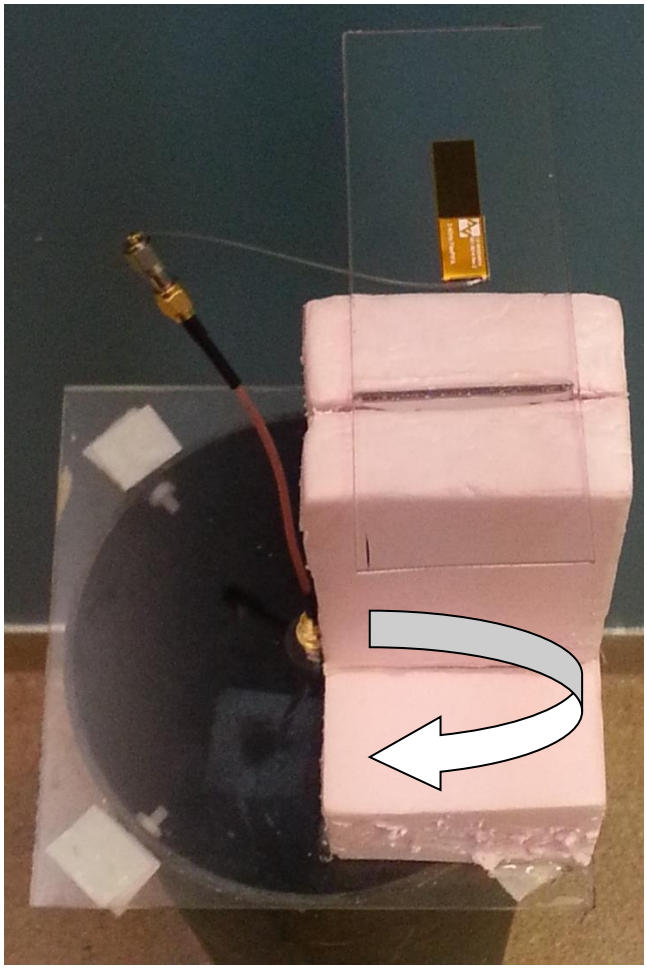


Figure 7 Flat Orientation Set-Up

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Flat Orientation at 2440 MHz:

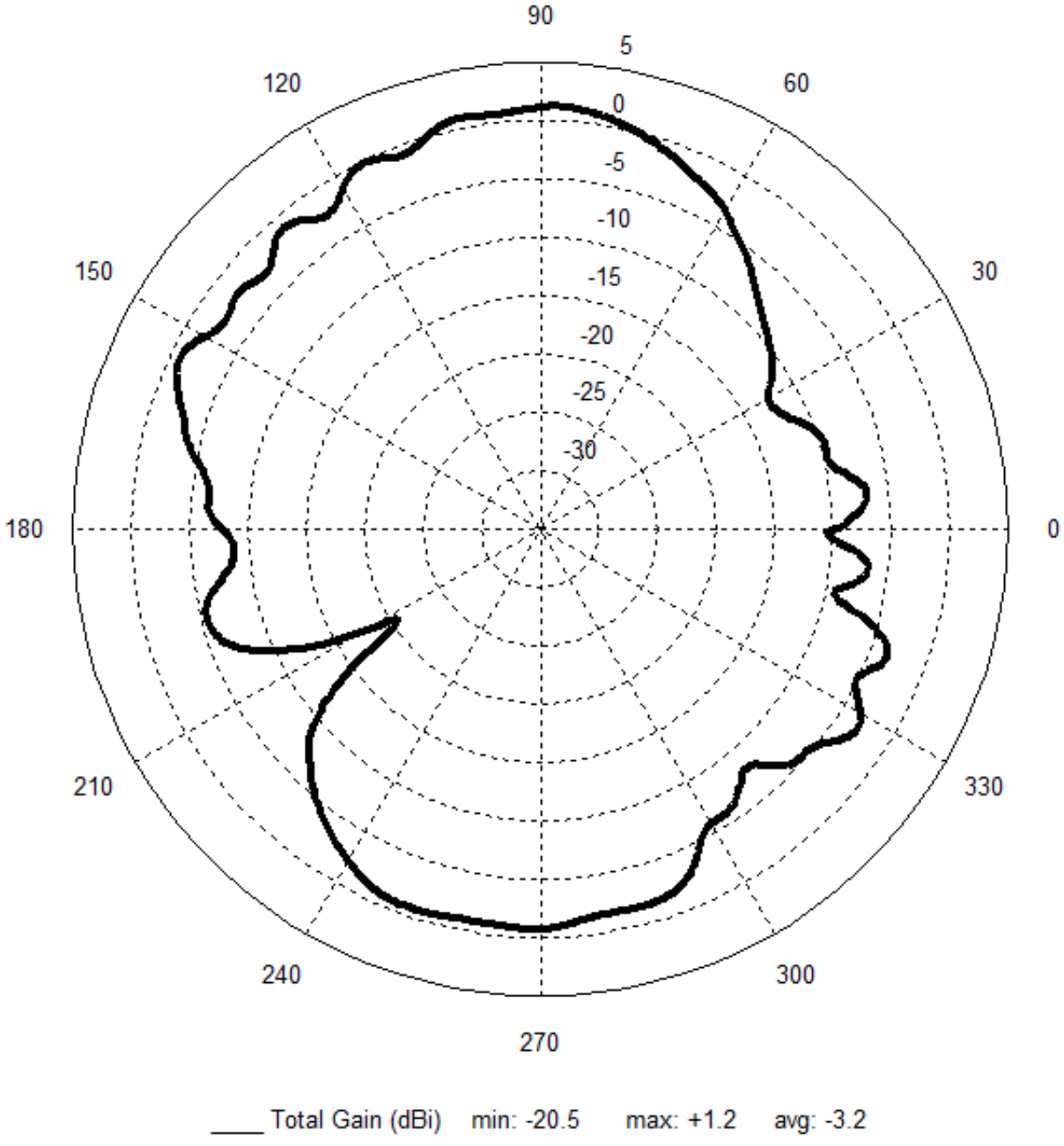


Figure 8 Flat Orientation Pattern

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5 GHz Band

FlexPIFA centered on a 1.5 mm thick plate of Polycarbonate

Antenna Measurement Set-Up:

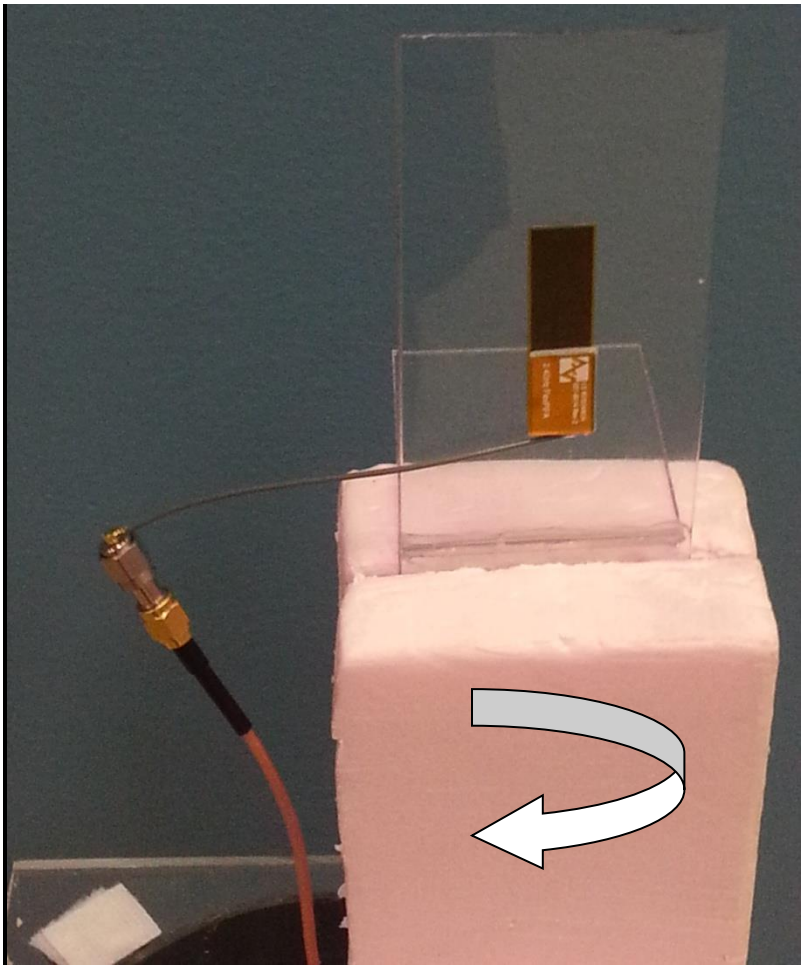


Figure 9 Vertical Orientation Set-Up

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Vertical Orientation at 4900 MHz:

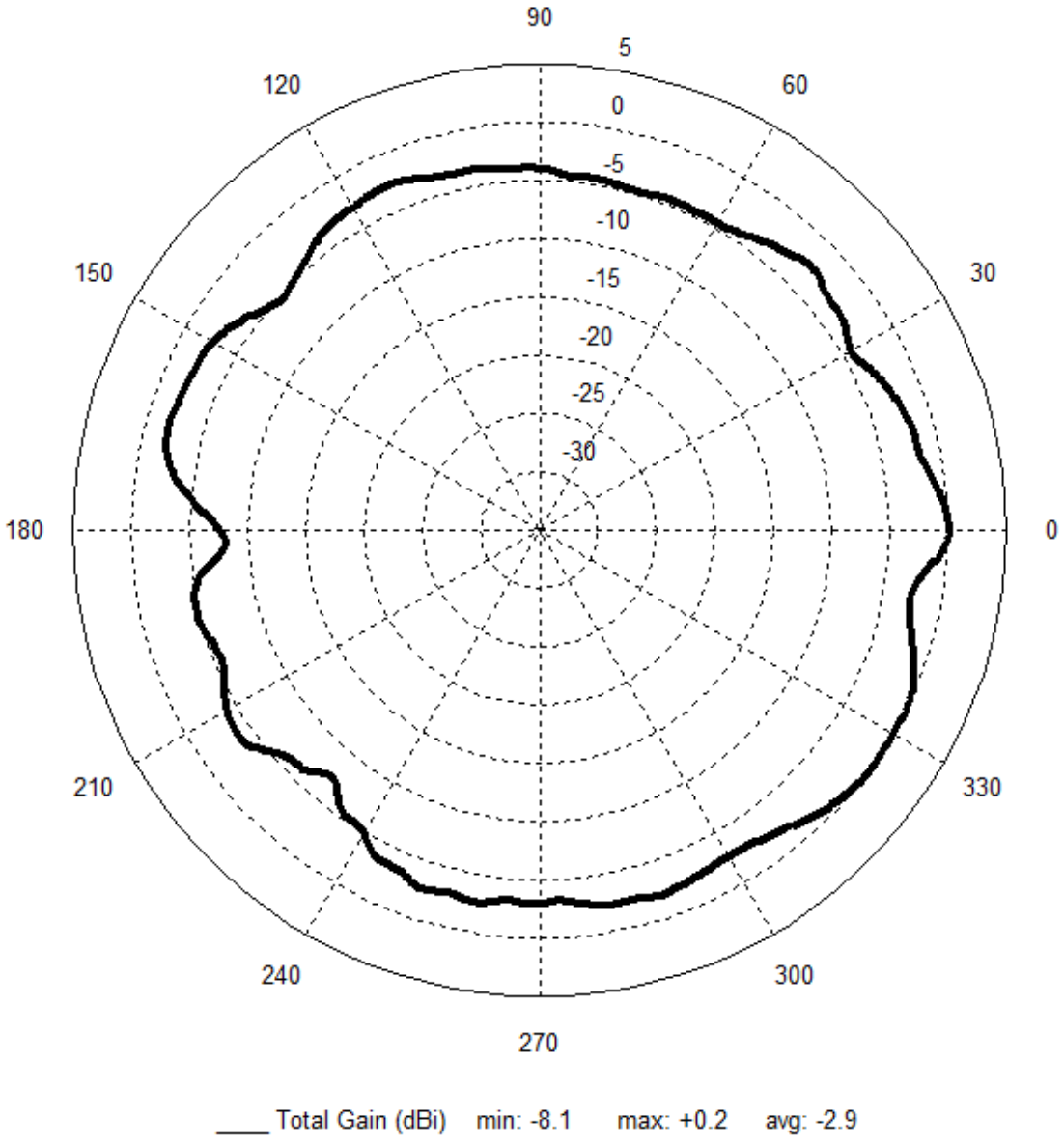


Figure 10 Vertical Orientation Pattern

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Vertical Orientation at 5400 MHz:

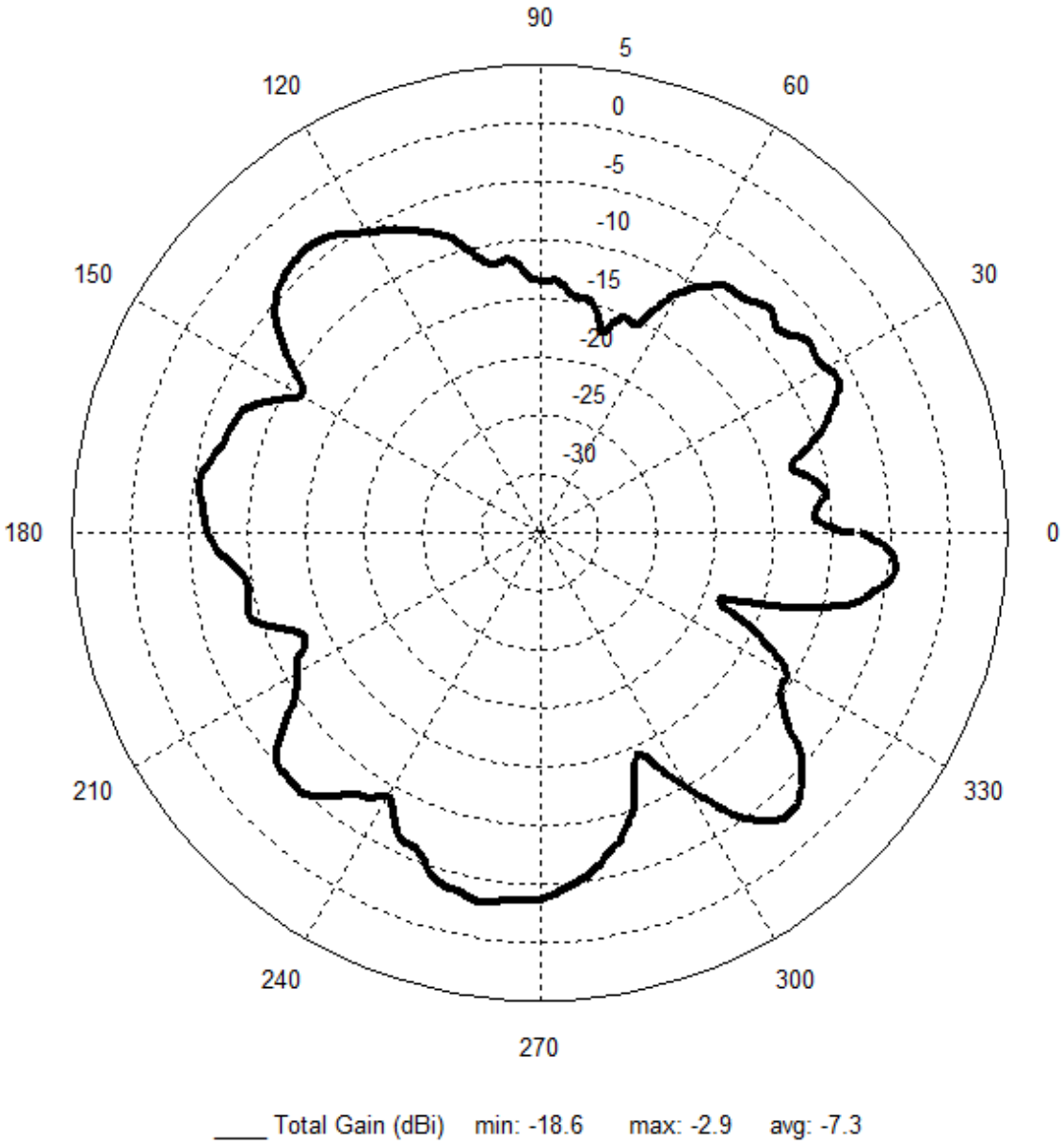


Figure 11 Vertical Orientation Pattern

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Vertical Orientation at 5900 MHz:

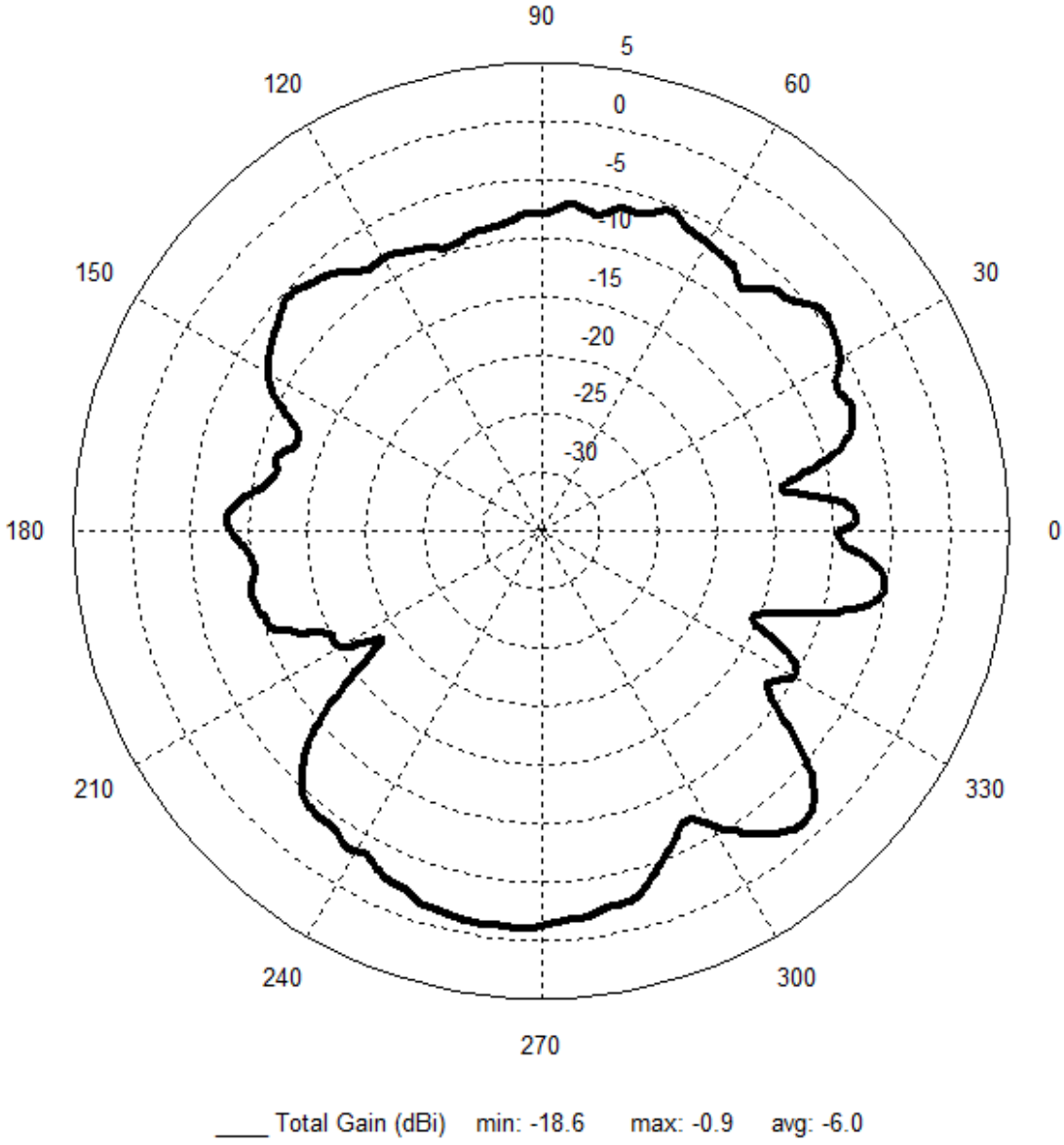


Figure 12 Vertical Orientation Pattern

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Antenna Measurement Set-Up:

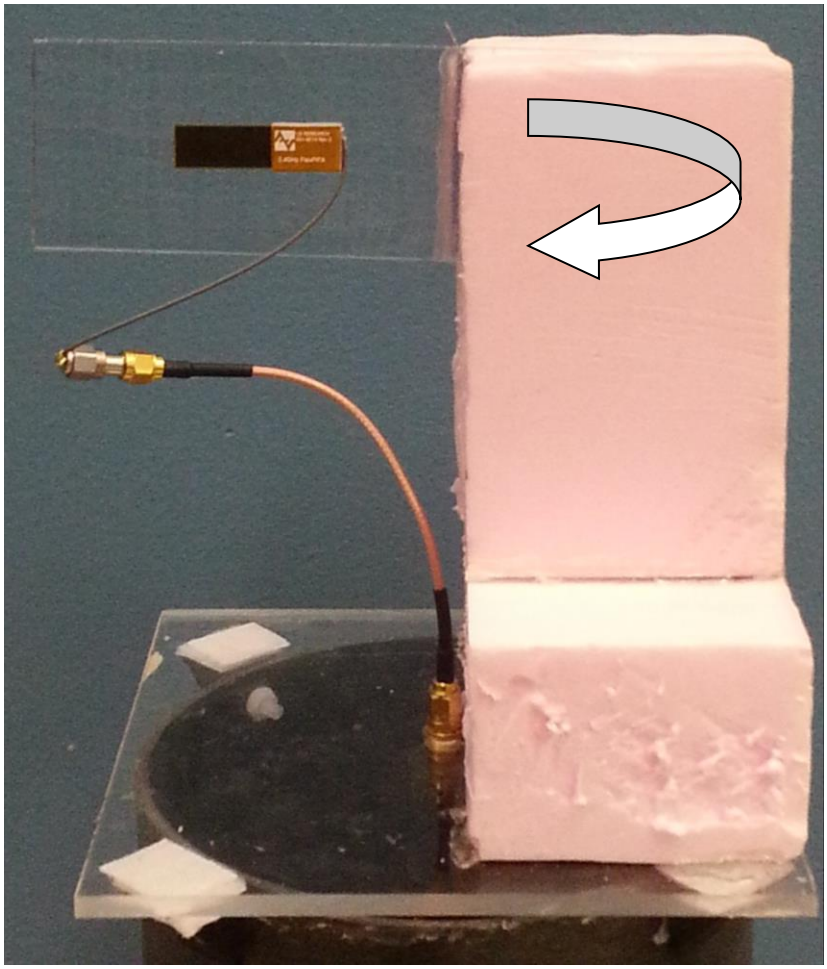


Figure 13 Horizontal Orientation Set-Up

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Horizontal Orientation at 4900 MHz:

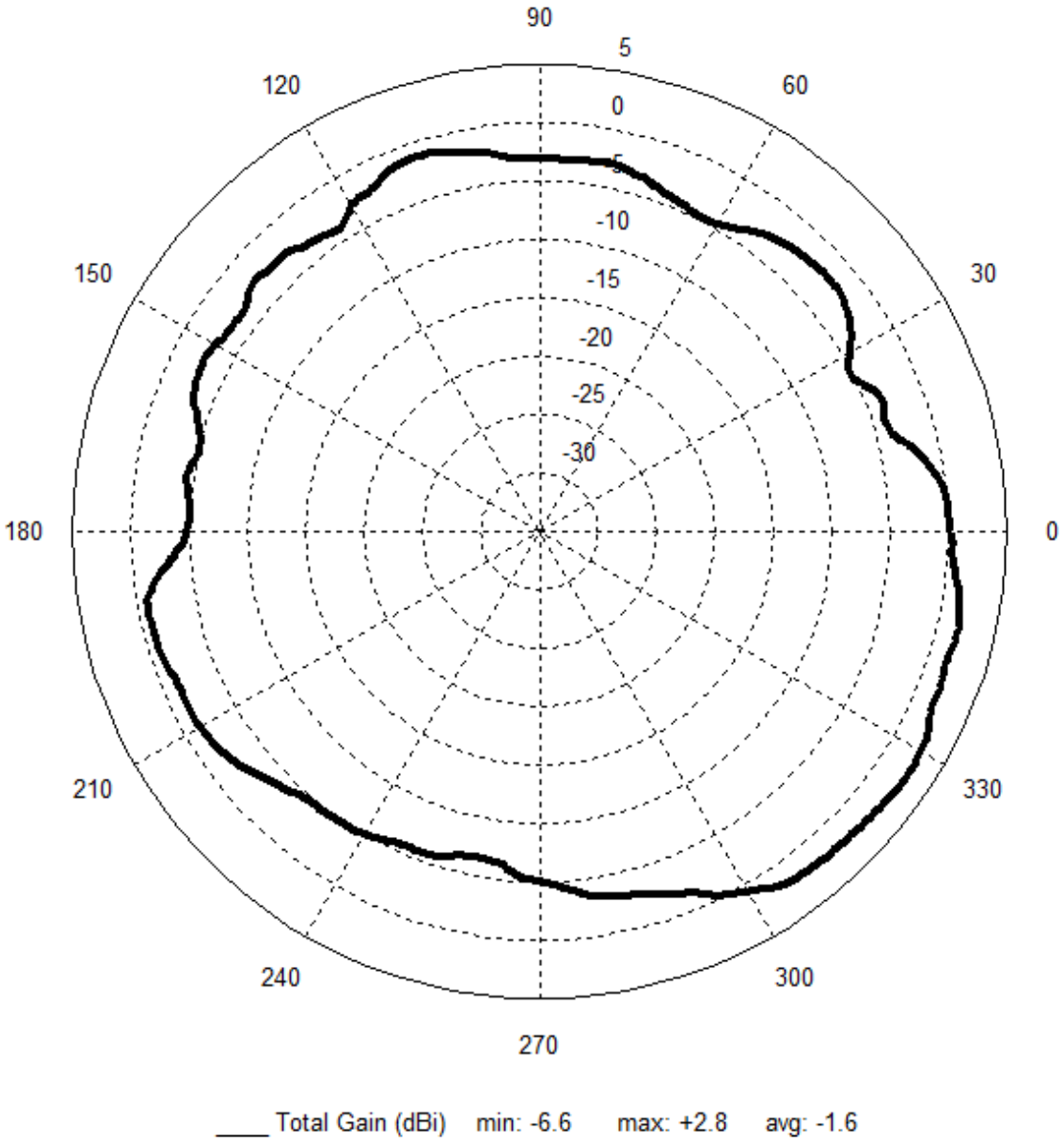


Figure 14 Horizontal Orientation Pattern

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Horizontal Orientation at 5400 MHz:

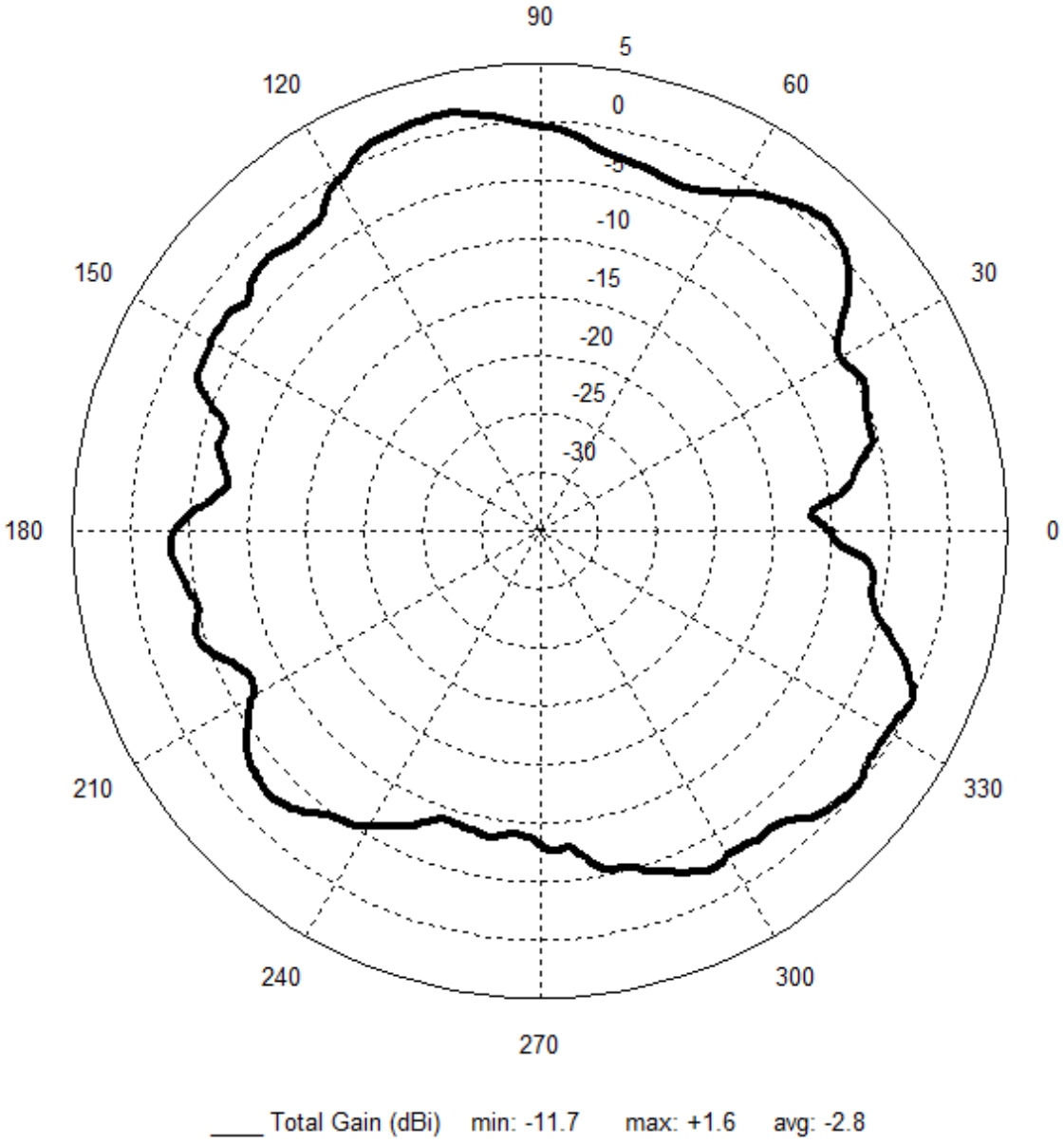


Figure 15 Horizontal Orientation Pattern

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Horizontal Orientation at 5900 MHz:

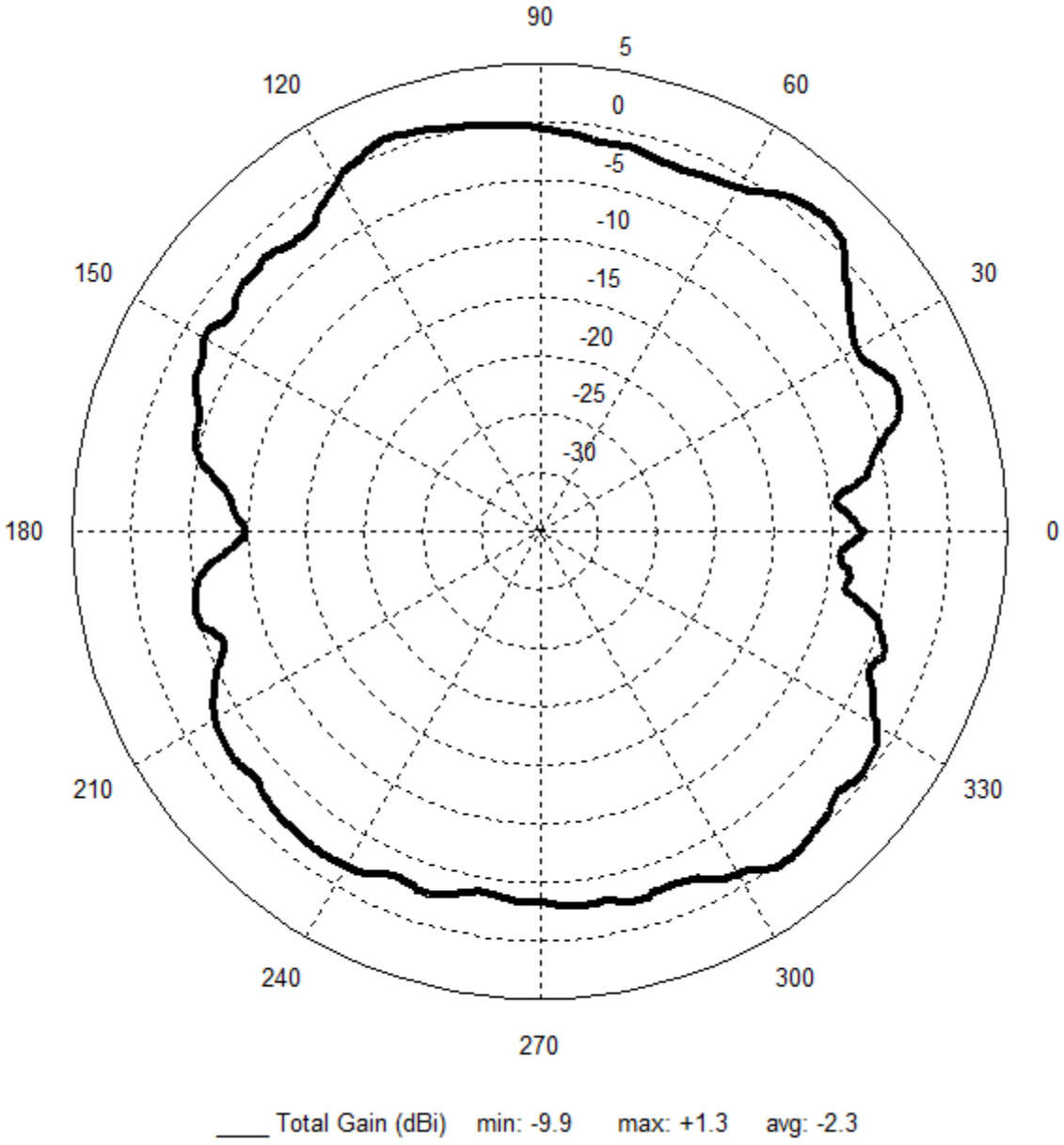


Figure 16 Horizontal Orientation Pattern

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Antenna Measurement Set-Up:

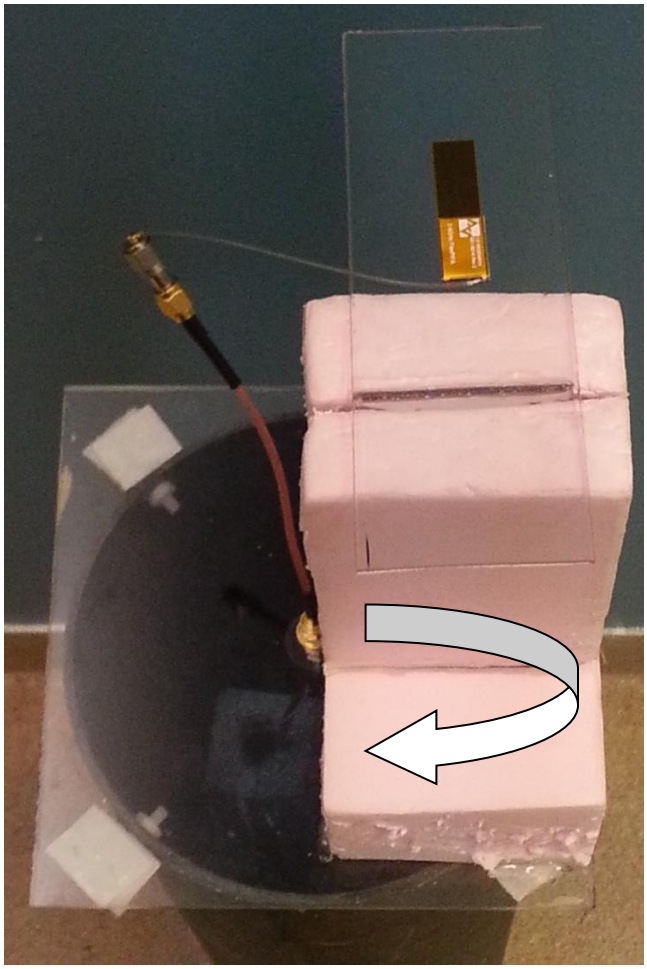


Figure 17 Flat Orientation Set-Up

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Flat Orientation at 4900 MHz:

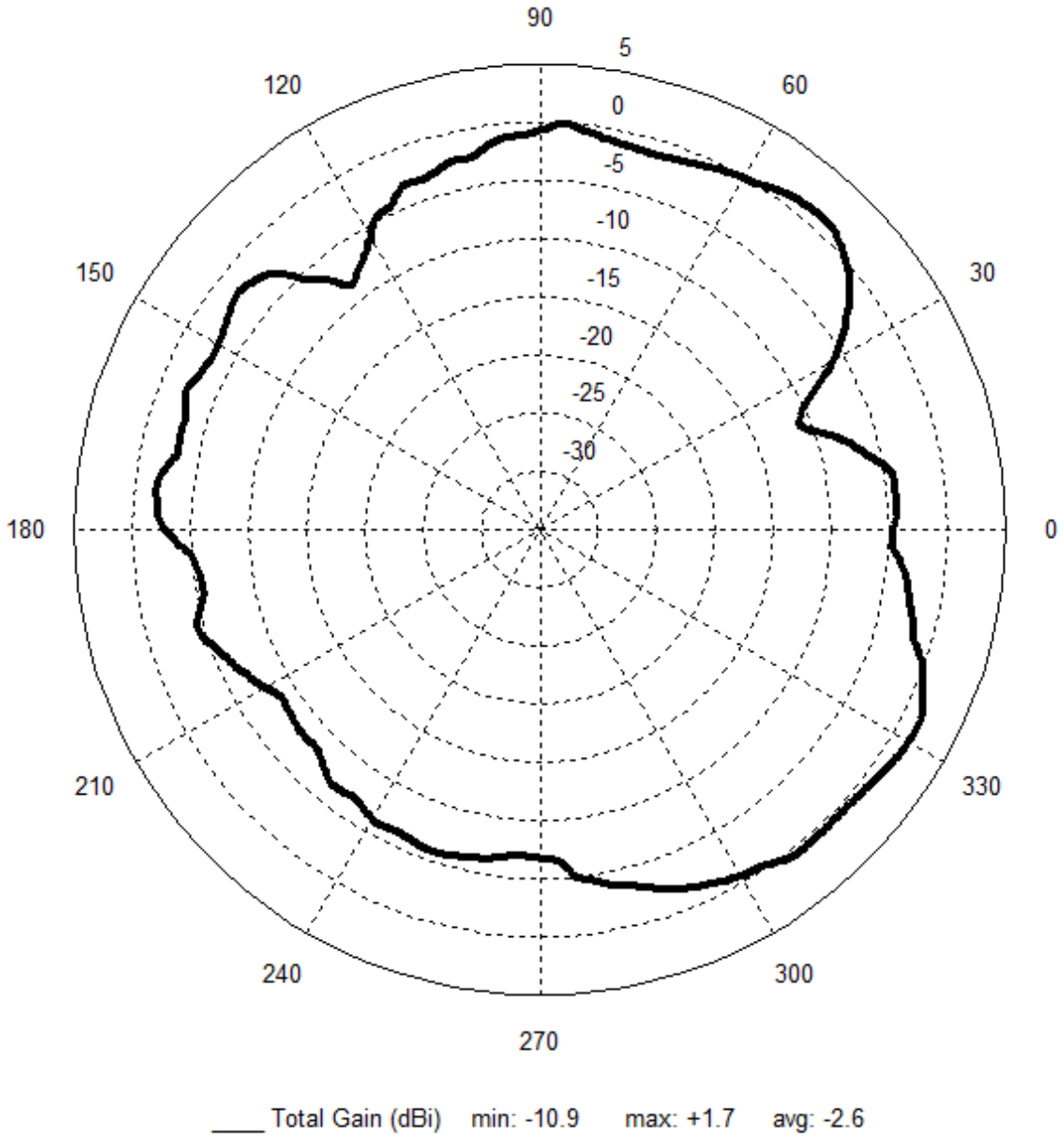


Figure 18 Flat Orientation Pattern

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Flat Orientation at 5400 MHz:

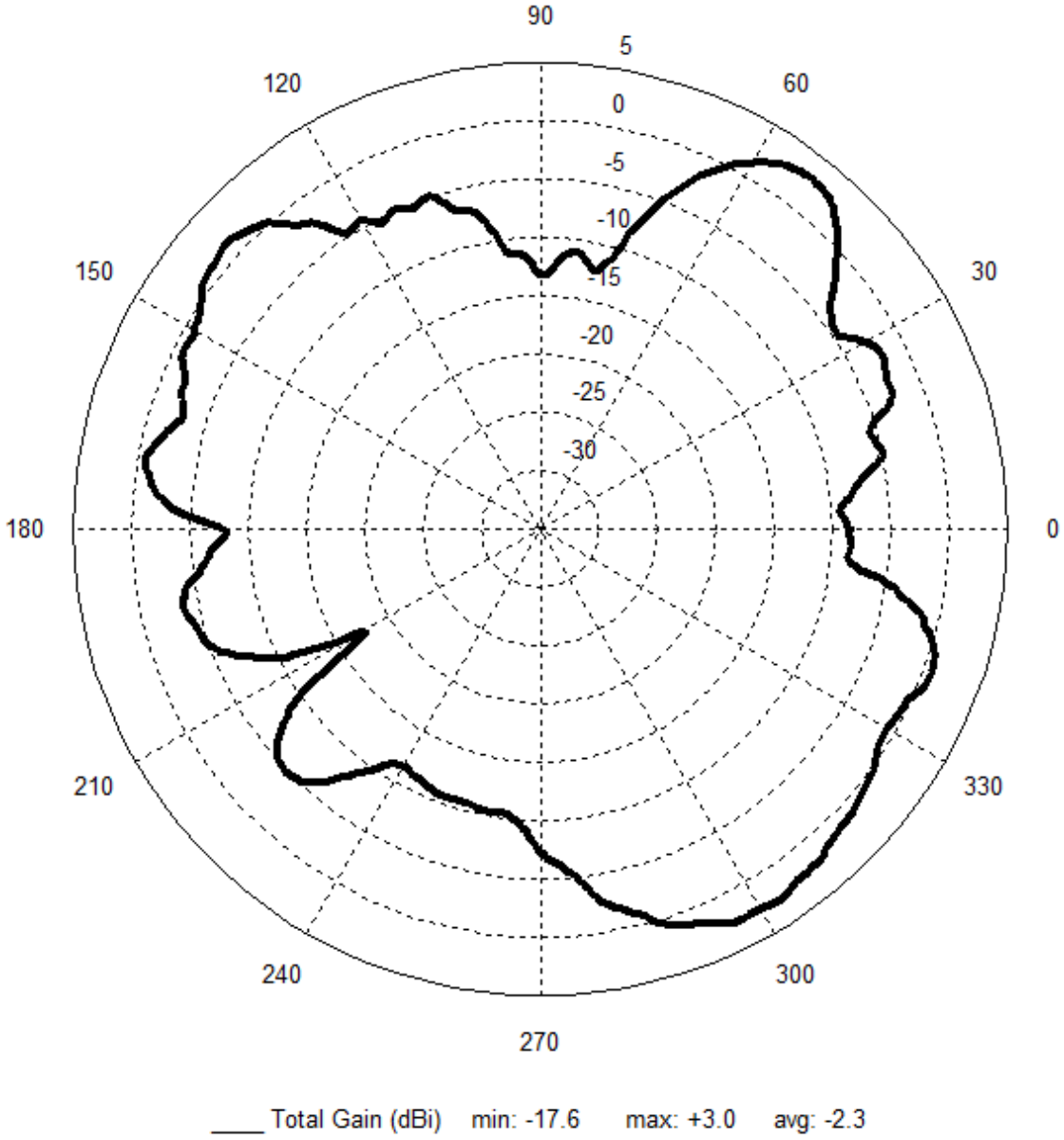


Figure 19 Flat Orientation Pattern

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Flat Orientation at 5900 MHz:

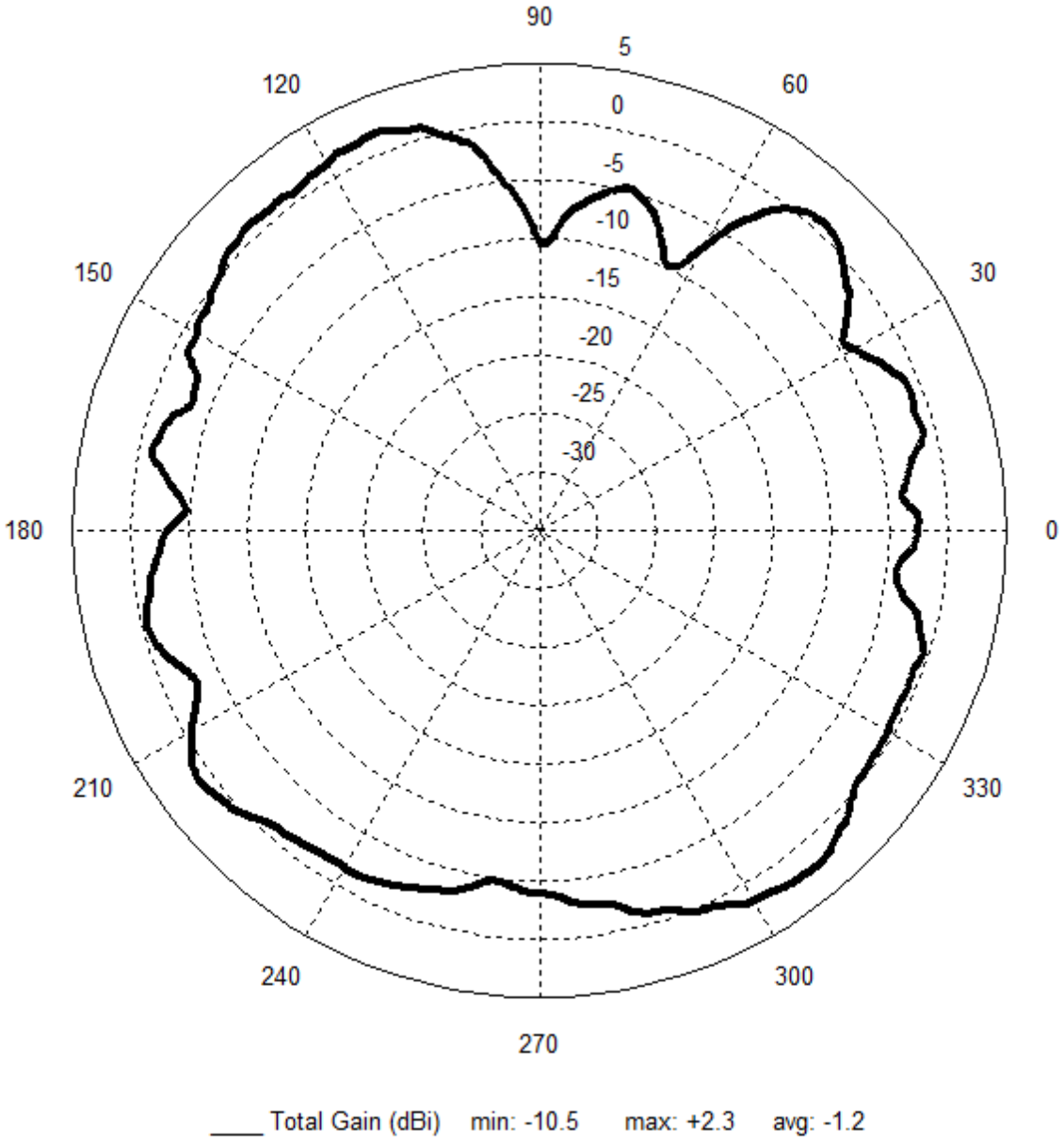


Figure 20 Secondary Elevation Pattern

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OPTIMAL INSTALLATION GUIDE

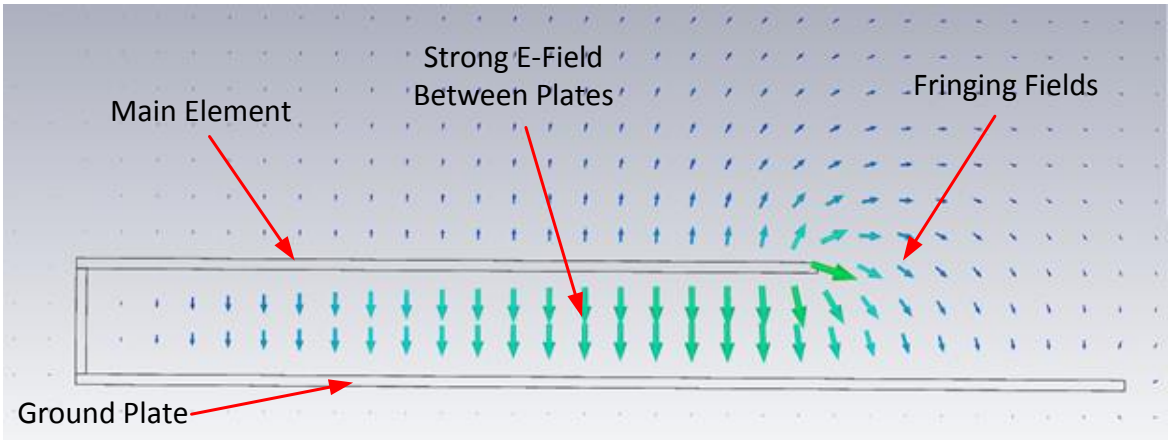


Figure 21 E-Field Radiation from FlexPIFA, Taken from CST Simulation

The main element should be kept clear of any non-metal objects (such as plastics) on top of it by at least 3 mm (see **Figure 22**). Similarly, the two long sides of the FlexPIFA should be kept clear of any non-metal object by at least 2 mm (See **Figure 23**). A 1 mm clearance should be observed from the ground wall to any non-metal object. Mounting the FlexPIFA in a situation that does not allow for these clearance recommendations may change the gain characteristics stated in the datasheet, which could impact overall range of the wireless system.

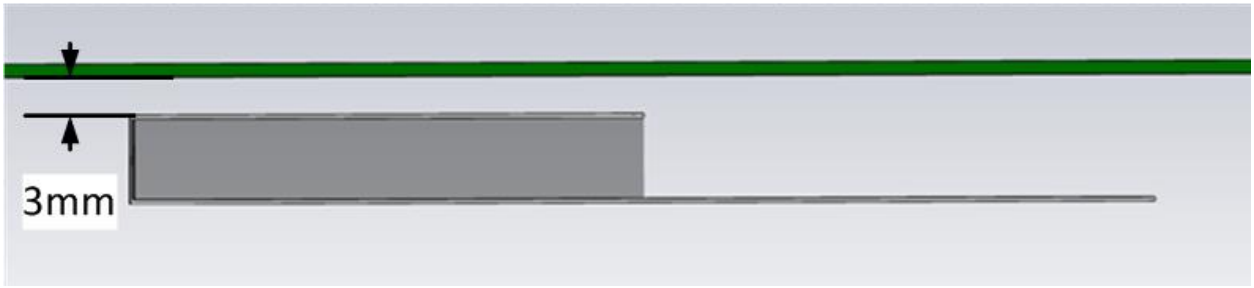
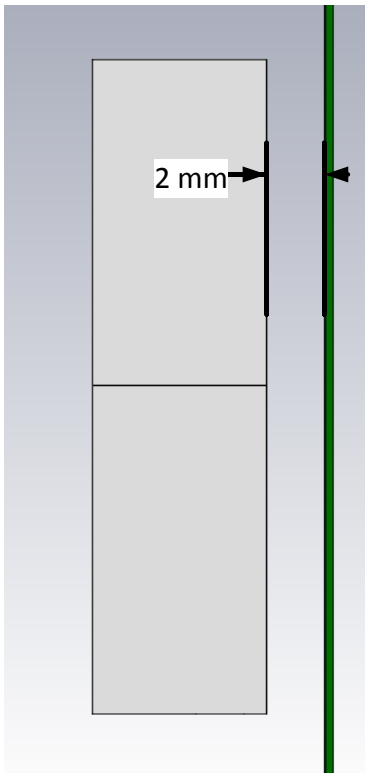
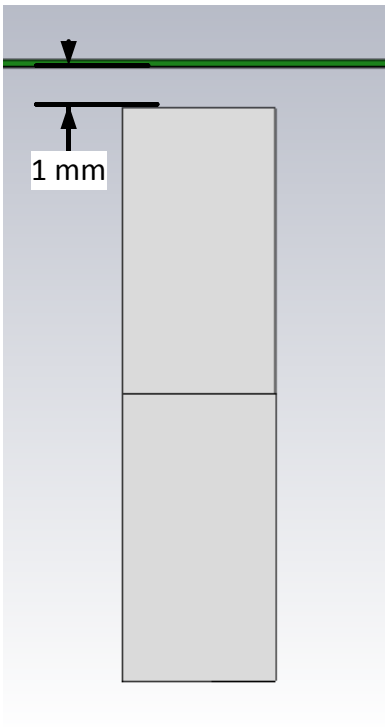


Figure 22 Top Clearance

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Side Clearance



Ground Wall Clearance

Figure 23 Side and Ground Wall Clearance

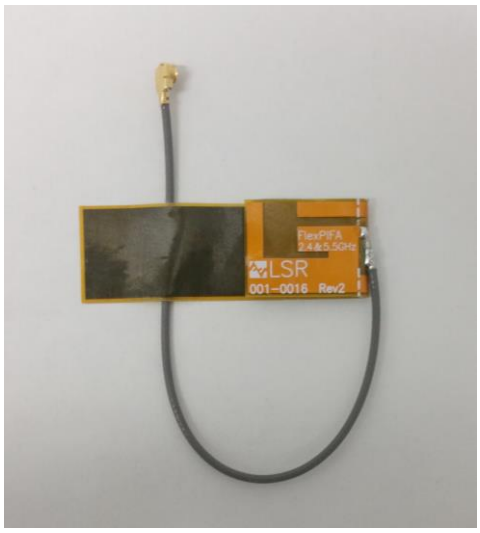
The ideal material for the FlexPIFA to be mounted on is 1.5 mm thick polycarbonate for maximum performance. However, as previously mentioned, the FlexPIFA can tolerate other non-metallic surfaces and thicknesses and still radiate effectively. Depending on the type of material, the FlexPIFA may be detuned.

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The coaxial cable feeding the FlexPIFA should be routed away from the antenna. Do not run the coaxial cable over the top of the FlexPIFA or near the tip of the main element. The cable should be routed perpendicular to the side of the FlexPIFA (this is the way the cable comes assembled), underneath the ground plate, or away from the ground wall. All three of these options are shown in **Figure 24**.



Perpendicular to the side



Underneath the FlexPIFA



Away from the Ground wall

Figure 24 Recommended Cable Routing

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As with any antenna, care should be taken not to place conductive materials or objects near the antenna (except as described in the next section). The radiated fields from the antenna will induce currents on the surface of the metal; as a result those currents then produce their own radiation. These re-radiating fields from the metal will interfere with the fields radiating from the FlexPIFA (this is true for any antenna). Other objects, such as an LCD display, placed in close proximity to the antenna may not affect its tuning but it can distort the radiation pattern. Materials that absorb electromagnetic fields should be kept away from the antenna to maximize performance. Common things to keep in mind when placing the antenna:

Wire Routing

Speakers – these generate magnetic fields

Metal Chassis and Frames

Battery Location

Proximity to Human Body

Display Screen – these will absorb radiation

Paint – do not use metallic coating or flakes

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Flex Limits of the FlexPIFA

One of the unique features of the FlexPIFA is its ability to flex. However, due to the adhesive there are limits as to how much the antenna can be flexed and remain secured to the device. The FlexPIFA should not be flexed in a convex position with a radius less than 16mm. Going smaller than this may result in the antenna peeling off the surface over time. Should a tighter radius of curvature be required, it is recommended you contact LS Research for assistance.

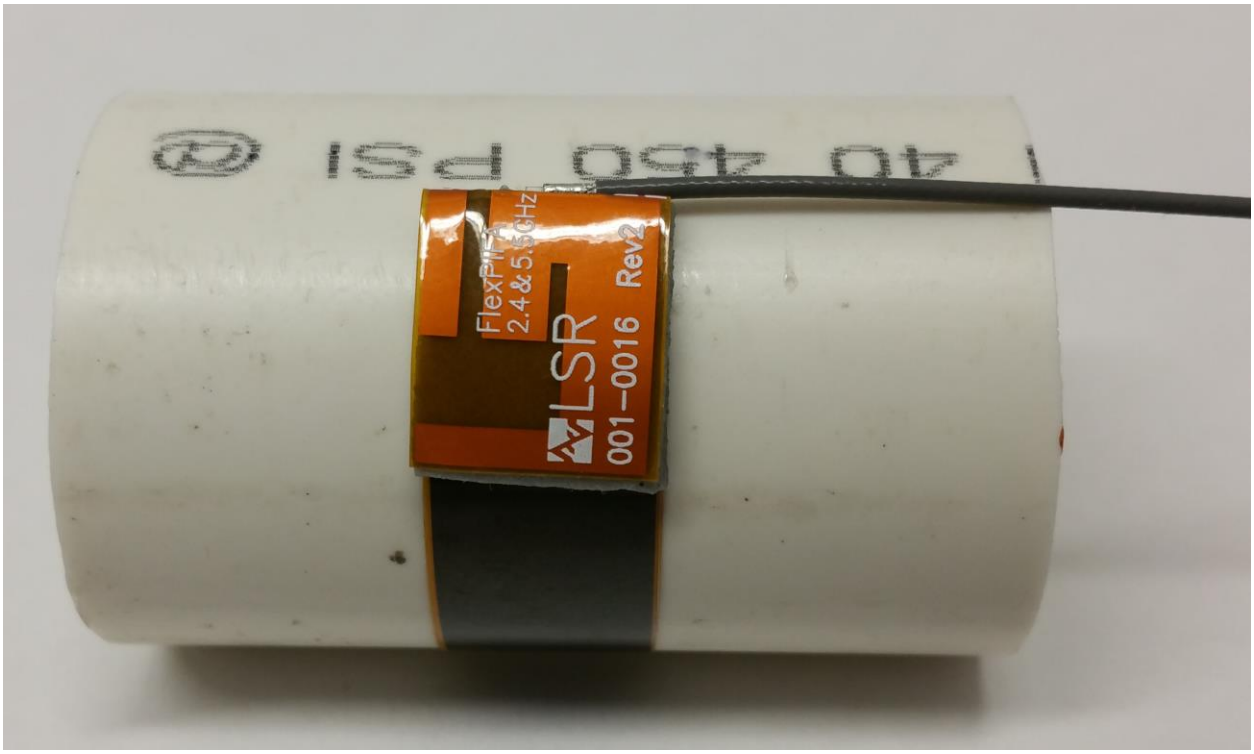


Figure 25 Convex Mounted

The FlexPIFA should not be flexed in a concave position with a radius less than 25mm. In this scenario, the limiting factor is performance. The ground plate of the antenna is pressed closer to the main element. As previously discussed in the introduction of this application note, the fringing fields developing off the end of the element are responsible for most of the radiation. In a concave position with a radius of curvature less than 25mm, the fringing fields are adversely affected and gain suffers. If a tighter radius of curvature is required, it is recommended you contact LS Research for assistance.

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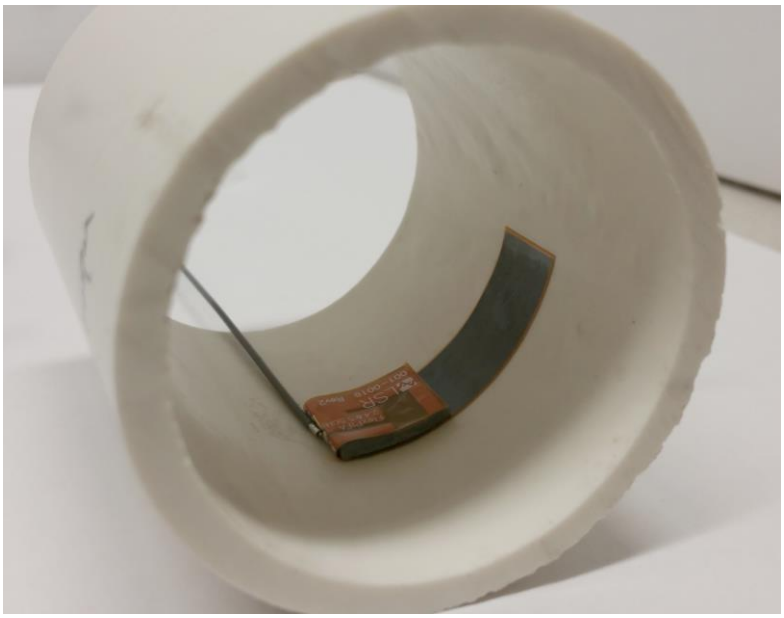


Figure 26 Concave Mounted

The FlexPIFA is not designed to be twisted or crumpled. The adhesive back should lay flush with the surface it is mounted on.

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Mounting on Metal and Body Loaded Applications

The FlexPIFA can tolerate being mounted on conductive surfaces. There will be some detuning of the antenna, which translates into some gain reduction. Even though the FlexPIFA is optimized to work on non-metallic surfaces, it still radiates efficiently due to the fringing fields (Shown in **Figure 21**). The ground plate of the FlexPIFA carries the adhesive backing; placing the antenna onto a metal surface simply enlarges the size of the ground beneath the main element. Previously the fringing fields only interacted with the small ground of the FlexPIFA - however they are now interacting with the much larger ground. The fringing fields still develop and radiate, but the antenna will no longer tune as well to the 2.4 GHz frequency band. Consequently the VSWR increases and there is some loss in radiated power. If the FlexPIFA cannot meet your range requirements after being implemented on a metal surface, contact LS Research for metal tuned samples.

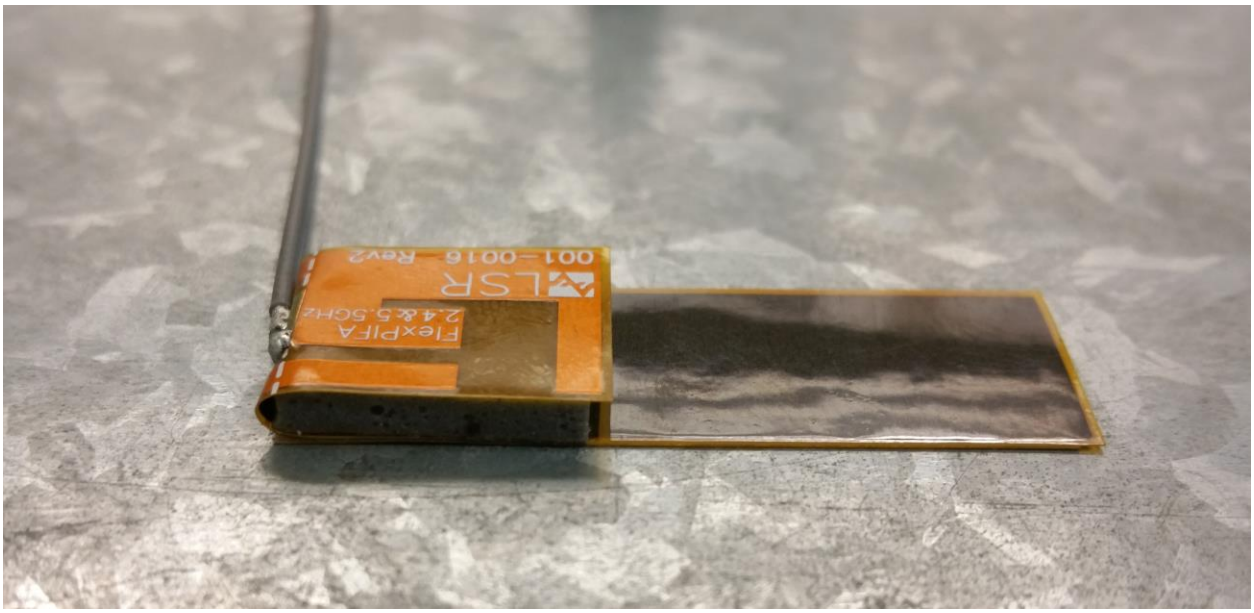


Figure 27 FlexPIFA Mounted on Metal

Do not mount the FlexPIFA where metal is within 10 mm above the main element (see **Figure 29**). Not only will this severely limit the radiation pattern (mainly due to the re-radiation problem previously described) it will detune the antenna inside of this range. Similarly, the two long sides of the FlexPIFA should be kept clear of any metal object by at least 5 mm. These keep out requirements pertain to **conductive** materials only, and are different from those listed in the previous sections which apply to **non-conductive** materials. In general, it is good practice to always keep metals as far away from the antenna as possible.

For the best performance, a spacer should be placed between the FlexPIFA and the conductive surface (see **Figure 28**). The spacer should be 1.5 mm thick polycarbonate. This will significantly improve performance and tuning of the FlexPIFA on a metal surface. Other non-conductive materials such as ABS plastic can be used; however polycarbonate will provide the best results.

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Figure 28 FlexPIFA Mounted on Metal Surface with 1.5mm Thick Polycarbonate Spacer

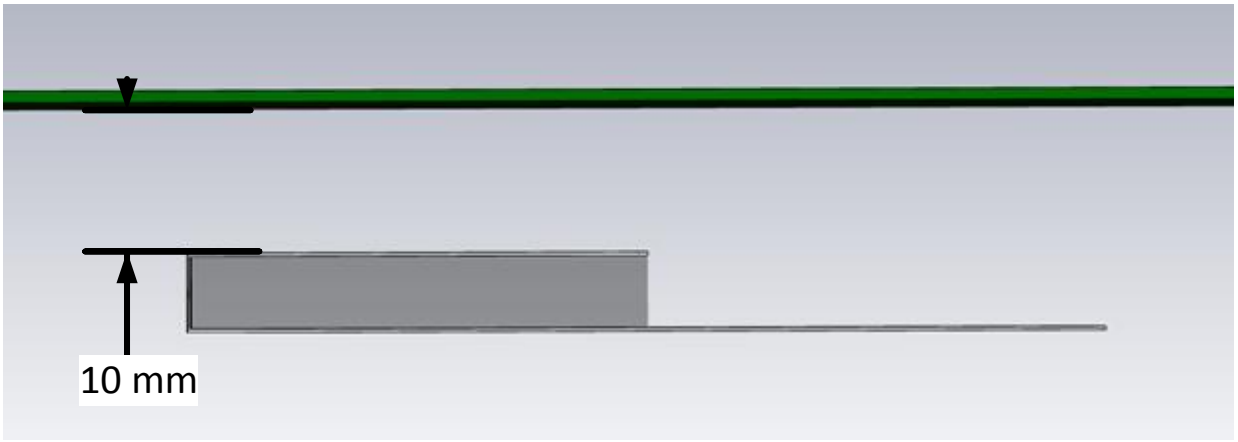


Figure 29 Metal near Main Element

For body worn applications, the FlexPIFA can tolerate the presence of the human body. It is not recommended that the antenna be mounted directly on body tissue, this will detune the FlexPIFA. Additionally the human body is an excellent absorber of 2.4GHz RF signals. As a result of this, expect a reduction in range due to the presence of a body. In a body worn application, the ground plate of the FlexPIFA should be closest to the body tissue. The main element should be pointed away from the body. Additionally, for handheld devices the FlexPIFA should be mounted in a location where it will not be covered by the hand. If the antenna is mounted in a location where the main element will be covered or near a human body, ensure that there is at least a 10mm separation distance between the main element and the body as shown in **Figure 29**.

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Additionally, when the FlexPIFA is mounted very close to body tissue, use a spacer to create separation distance between the body tissue and ground plate. This will ensure maximum performance and prevent the antenna from detuning. As previously mentioned, the ideal spacer material is 1.5 mm thick polycarbonate.

Quite often this separation distance between the body tissue and the FlexPIFA is already provided by the enclosure. **Figure 30** below is an example of a bracelet with the FlexPIFA integrated inside it. The enclosure provides enough spacing between the antenna and body tissue to prevent any major detuning. The enclosure is made of polycarbonate.



Figure 30 FlexPIFA Integrated into Bracelet

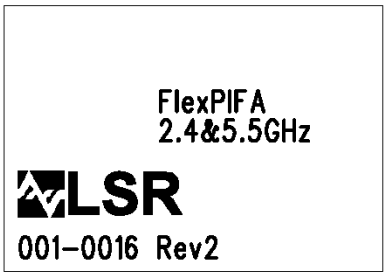
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PRODUCT REVISION HISTORY

Rev 1: Initial Production Release



Rev 2:



Updated LSR Logo

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CONTACTING LSR

Headquarters
LS Research, LLC
W66 N220 Commerce Court
Cedarburg, WI 53012-2636
USA
Tel: 1(262) 375-4400
Fax: 1(262) 375-4248

Website www.lsr.com

Technical Support forum.lsr.com

Sales Contact sales@lsr.com

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