Datasheet

ANT-2.4-FPC-LH Series
Flexible Embedded 2.4 GHz FPC Antennas

The Linx ANT-2.4-FPC-LH series antennas are 45 mm x 7 mm adhesive flexible printed circuit (FPC) antennas for 2.4 GHz ISM applications including Bluetooth® and ZigBee®, as well as single-band WiFi.

The ANT-2.4-FPC-LH antennas provide a ground plane independent dipole internal/embedded antenna solution. The flexibility and adhesive backing makes the ANT-2.4-FPC-LH series easy to mount in RF transparent (e.g. plastic) enclosures, enabling environmental sealing and for protection from antenna damage.

Connection is made to the radio via a coaxial cable terminated in an MHF1/U.FL-type plug (female socket), MHF4 plug (female socket) or MMCX plug (male pin) connector.

Features

- Performance at 2.4 GHz to 2.5 GHz
  - VSWR: ≤ 1.4
  - Peak Gain: 6.1 dBi
  - Efficiency: 81%
- Ground plane independent dipole antenna
- Compact, low-profile
  - 45.2 mm x 7.2 mm x 0.1 mm
- Adhesive backing permanently adheres to non-metal enclosures using 3M 467MP™/200MP adhesive
- Flexible to fit in challenging enclosures

Applications

- 2.4 GHz ISM
  - Bluetooth®
  - ZigBee®
- Single-band WiFi/802.11
- Sensing and remote monitoring
- Hand-held devices
- Internet of Things (IoT) devices

Ordering Information

Part Number	Cable Length	Connector
ANT-2.4-FPC-LH50UF	50 mm (1.97 in)	U.FL
ANT-2.4-FPC-LH100UF	100 mm (3.94 in)	U.FL
ANT-2.4-FPC-LH150UF	150 mm (5.91 in)	U.FL
ANT-2.4-FPC-LH200UF	200 mm (7.87 in)	U.FL
ANT-2.4-FPC-LH50M4	50 mm (1.97 in)	MHF4
ANT-2.4-FPC-LH100M4	100 mm (3.94 in)	MHF4
ANT-2.4-FPC-LH150M4	150 mm (5.91 in)	MHF4
ANT-2.4-FPC-LH200M4	200 mm (7.87 in)	MHF4
ANT-2.4-FPC-LH100MX	100 mm (3.94 in)	MMCX

Available from Linx Technologies and select distributors and representatives.

Table 1. Electrical Specifications

Parameter	Value
Frequency Range	**2.4 GHz to 2.5 GHz**
VSWR (max.)	1.4
Peak Gain (dBi)	6.1
Average Gain (dBi)	-1.1
Efficiency (%)	81
Polarization	Linear
Radiation	Omnidirectional
Impedance	50 Ω
Wavelength	1/2-wave
Max Power	2 W
Electrical Type	Dipole

Electrical specifications and plots measured with the antenna on a 2 mm (0.08 in) thick plastic sheet.

Table 2. Mechanical Specifications

Part Number	Connection	Coaxial Cable, minimum inside bend radius	Weight
ANT-2.4-FPC-LH50UF	MHF1/U.FL-type plug	1.13 mm: 5.0 mm (0.20 in)	0.4 g (0.01 oz)
ANT-2.4-FPC-LH100UF	MHF1/U.FL-type plug	1.13 mm: 5.0 mm (0.20 in)	0.6 g (0.02 oz)
ANT-2.4-FPC-LH150UF	MHF1/U.FL-type plug	1.13 mm: 5.0 mm (0.20 in)	0.7 g (0.03 oz)
ANT-2.4-FPC-LH200UF	MHF1/U.FL-type plug	1.13 mm: 5.0 mm (0.20 in)	0.9 g (0.03 oz)
ANT-2.4-FPC-LH50M4	MHF4-type plug	1.13 mm: 5.0 mm (0.20 in)	0.4 g (0.01 oz)
ANT-2.4-FPC-LH100M4	MHF4-type plug	1.13 mm: 5.0 mm (0.20 in)	0.5 g (0.02 oz)
ANT-2.4-FPC-LH150M4	MHF4-type plug	1.13 mm: 5.0 mm (0.20 in)	0.7 g (0.02 oz)
ANT-2.4-FPC-LH200M4	MHF4-type plug	1.13 mm: 5.0 mm (0.20 in)	0.8 g (0.03 oz)
ANT-2.4-FPC-LH100MX	MMCX plug	1.13 mm: 5.0 mm (0.20 in)	1.2 g (0.04 oz)
Operating Temp. Range	-40 °C to +85 °C (-40 °F to 185 °F)		
Storage Temp. Range	-40 °C to +85 °C (-40 °F to 185 °F)		
Dimensions	45.2 mm x 7.2 mm x 0.1 mm (1.78 in x 0.28 in x 0.004 in)		

Packaging Information

The ANT-2.4-FPC-LH antennas are packaged in bags of 100 pcs. Distribution channels may offer alternative packaging options.

Antenna Mounting

The ANT-2.4-FPC-LH antenna is a flexible, adhesive backed antenna that allows it to be permanently installed onto non-metallic surfaces. The adhesive backing is 3M 467MP™/200MP, which provides outstanding adhesion to high surface energy plastics. The adhesive delivers excellent shear strength to resist slippage and edge lifting, but can be repositioned before the adhesive cures, allowing for accurate positioning. This adhesive is highly resistant to solvents, humidity and moisture, as well as heat up to 204 °C (400 °F) for short periods.

The antenna should never be bent to the point of creating a crease or allowing the angle of the bend to fall below 90 degrees (i.e. become acute) as this will impair function and may cause permanent damage.

Product Dimensions

Figure 1 provides dimensions for the ANT-2.4-FPC-LH series antenna.

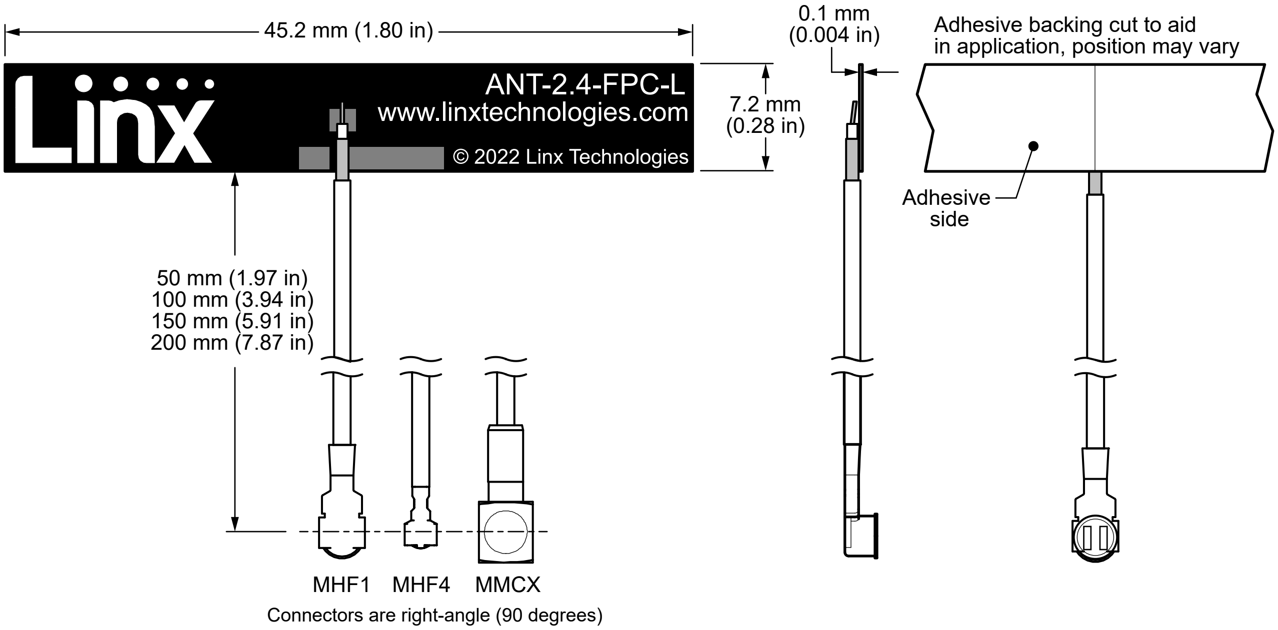


Figure 1. ANT-2.4-FPC-LH Series Antenna Dimensions

VSWR

Figure 2 provides the voltage standing wave ratio (VSWR) across the antenna bandwidth. VSWR describes the power reflected from the antenna back to the radio. A lower VSWR value indicates better antenna performance at a given frequency. Reflected power is also shown on the right-side vertical axis as a gauge of the percentage of transmitter power reflected back from the antenna.

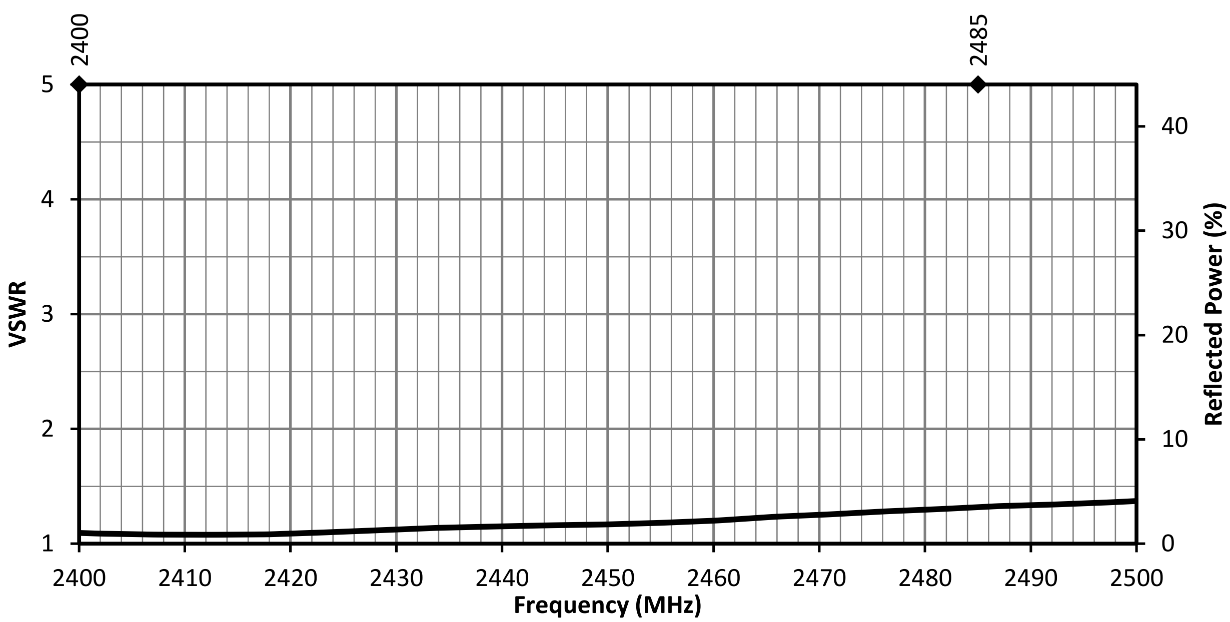


Figure 2. ANT-2.4-FPC-LH Antenna VSWR

Return Loss

Return loss (Figure 3), represents the loss in power at the antenna due to reflected signals. Like VSWR, a lower return loss value indicates better antenna performance at a given frequency.

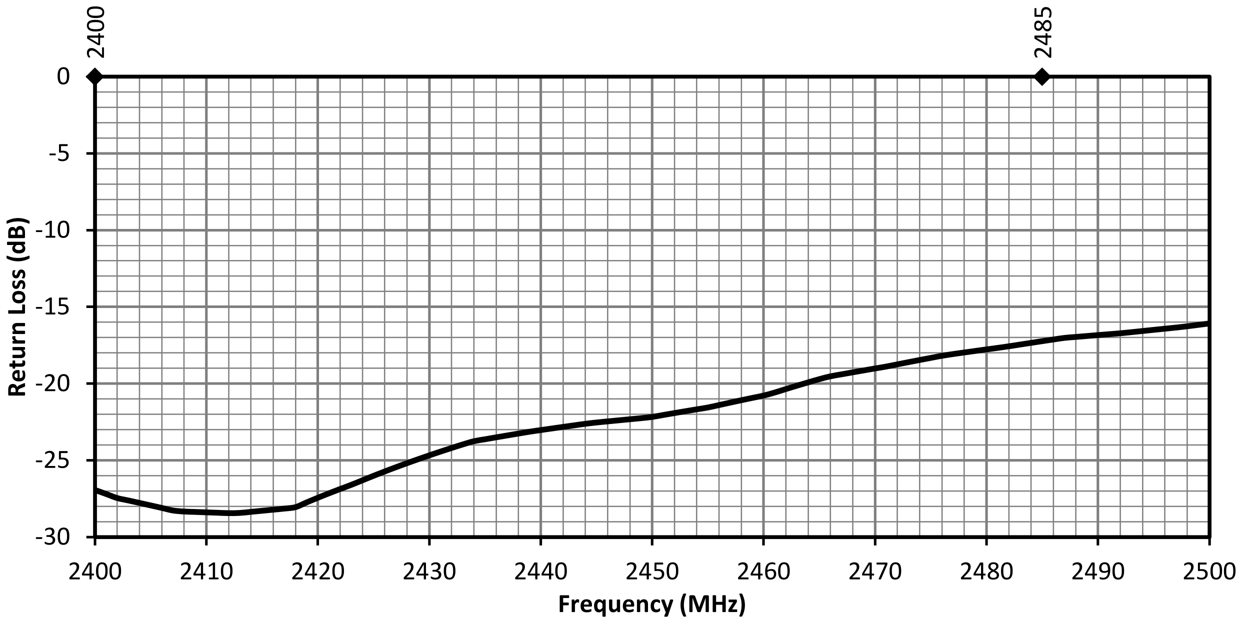


Figure 3. ANT-2.4-FPC-LH Antenna Return Loss

Peak Gain

The peak gain across the antenna bandwidth is shown in Figure 4. Peak gain represents the maximum antenna input power concentration across 3-dimensional space, and therefore peak performance, at a given frequency, but does not consider any directionality in the gain pattern.

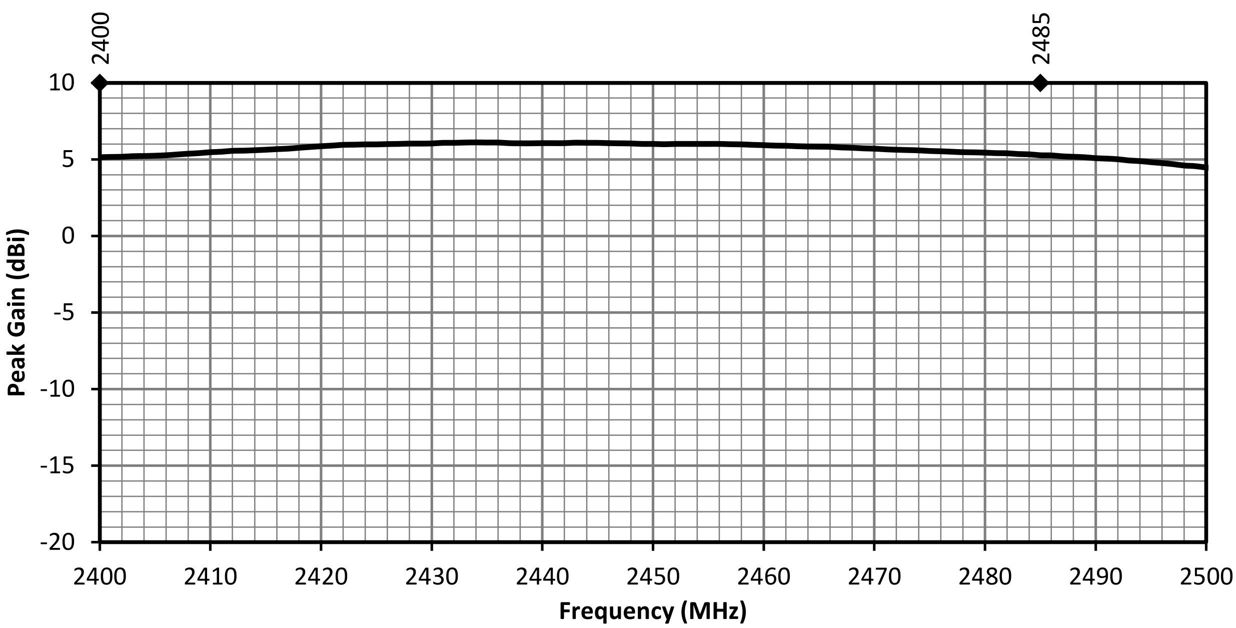


Figure 4. ANT-2.4-FPC-LH Antenna Peak Gain

Average Gain

Average gain (Figure 5), is the average of all antenna gain in 3-dimensional space at each frequency, providing an indication of overall performance without expressing antenna directionality.

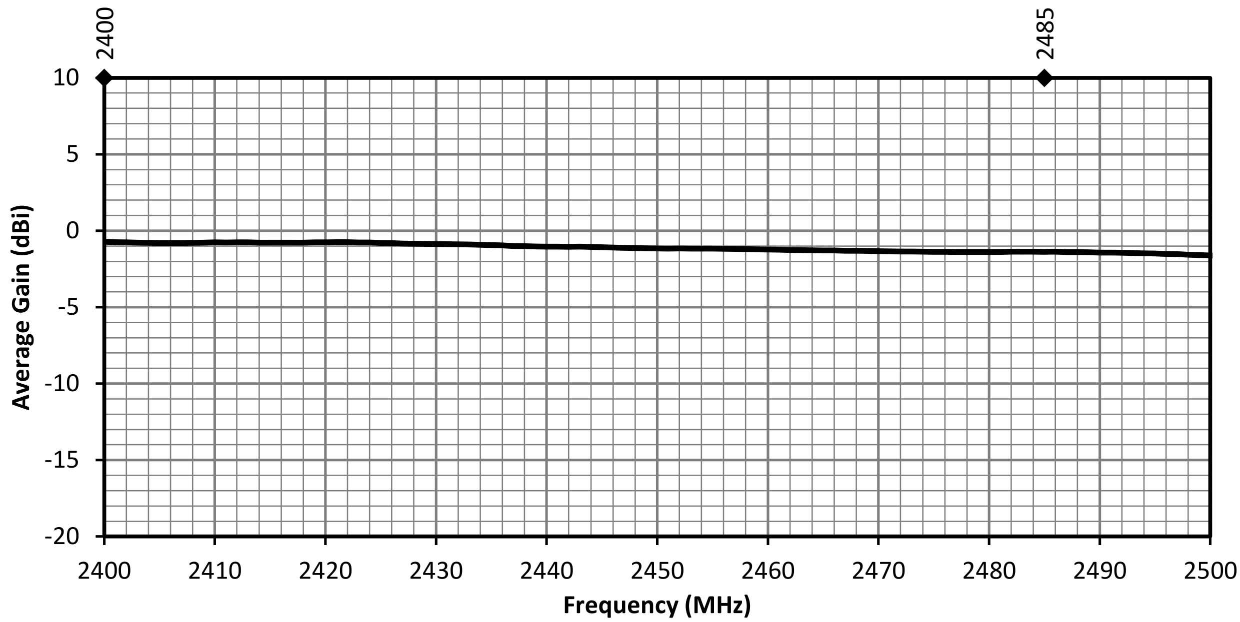


Figure 5. ANT-2.4-FPC-LH Antenna Average Gain

Radiation Efficiency

Radiation efficiency (Figure 6), shows the ratio of power delivered to the antenna relative to the power radiated at the antenna, expressed as a percentage, where a higher percentage indicates better performance at a given frequency.

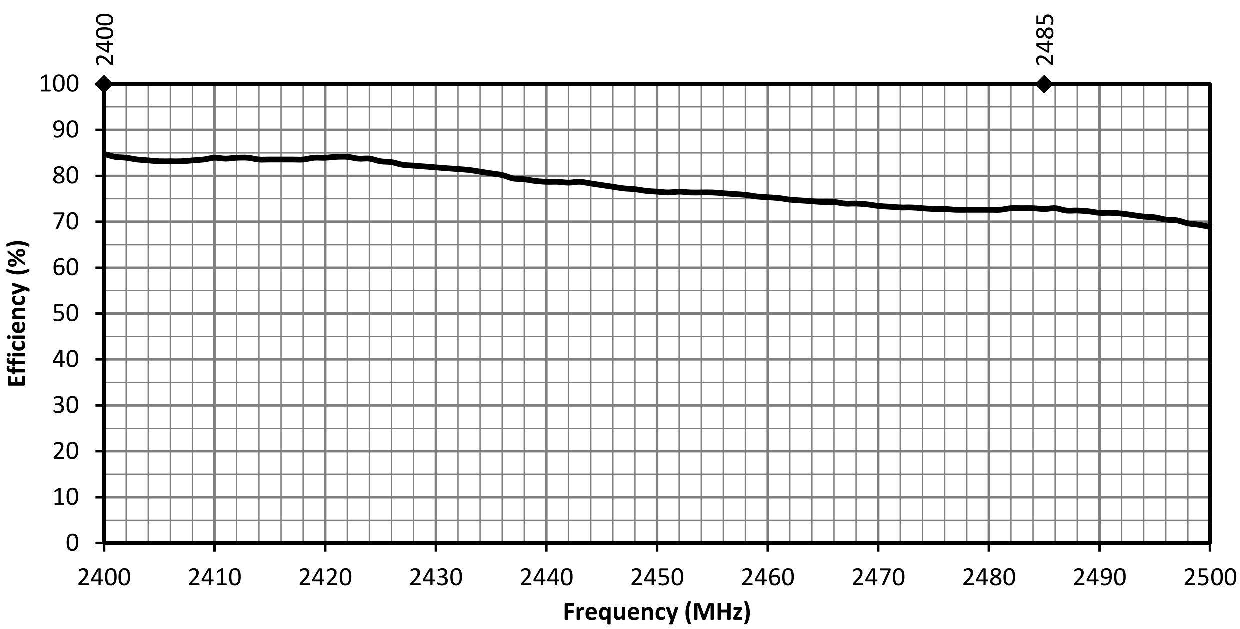
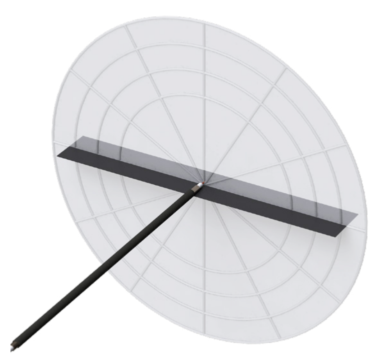


Figure 6. ANT-2.4-FPC-LH Antenna Radiation Efficiency

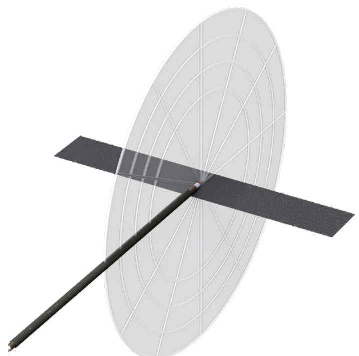
Radiation Patterns

Radiation patterns provide information about the directionality and 3-dimensional gain performance of the antenna by plotting gain at specific frequencies in three orthogonal planes. Antenna radiation patterns (Figure 7), are shown using polar plots covering 360 degrees. The antenna graphic above the plots provides reference to the plane of the column of plots below it. Note: when viewed with typical PDF viewing software, zooming into radiation patterns is possible to reveal fine detail.

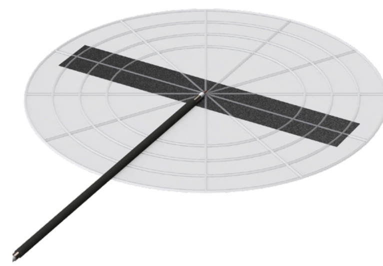
Radiation Patterns - Horizontally Polarized



XZ-Plane Gain

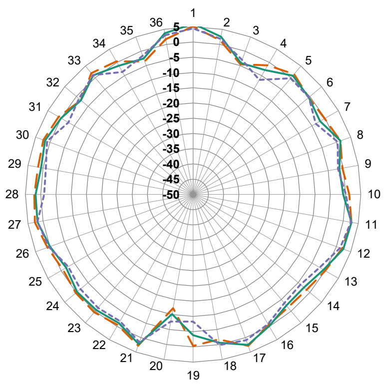


YZ-Plane Gain

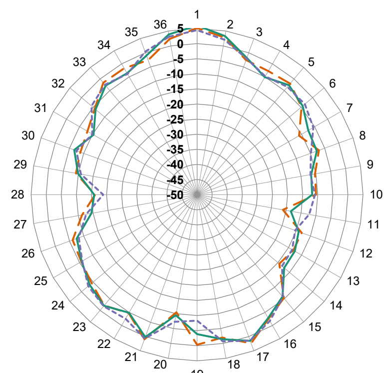


XY-Plane Gain

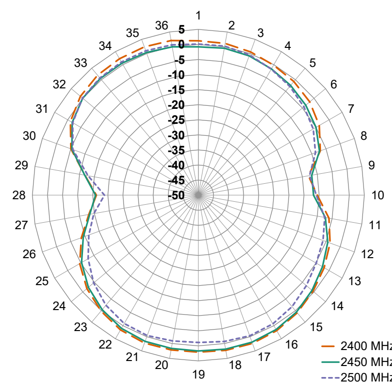
2400 MHz to 2500 MHz (2450 MHz)



XZ-Plane Gain



YZ-Plane Gain



XY-Plane Gain

Figure 7. Radiation Patterns for ANT-2.4-FPC-LH Series Antenna

Antenna Definitions and Useful Formulas

VSWR - Voltage Standing Wave Ratio. VSWR is a unitless ratio that describes the power reflected from the antenna back to the radio. A lower VSWR value indicates better antenna performance at a given frequency. VSWR is easily derived from Return Loss.

$$\mathrm{VSWR} = \frac{10^{\left[\frac{\mathrm{Return\ Loss}}{20}\right]} + 1}{10^{\left[\frac{\mathrm{Return\ Loss}}{20}\right]} - 1}$$

Return Loss - Return loss represents the loss in power at the antenna due to reflected signals, measured in decibels. A lower return loss value indicates better antenna performance at a given frequency. Return Loss is easily derived from VSWR.

$$\mathrm{Return\ Loss} = -20 \log_{10}\left[\frac{\mathrm{VSWR} - 1}{\mathrm{VSWR} + 1}\right]$$

Efficiency (η) - The total power radiated from an antenna divided by the input power at the feed point of the antenna as a percentage.

Total Radiated Efficiency - (TRE) The total efficiency of an antenna solution comprising the radiation efficiency of the antenna and the transmitted (forward) efficiency from the transmitter.

$$\mathrm{TRE} = \eta \cdot \left(1 - \left(\frac{\mathrm{VSWR} - 1}{\mathrm{VSWR} + 1}\right)^2\right)$$

Gain - The ratio of an antenna's efficiency in a given direction (G) to the power produced by a theoretical lossless (100% efficient) isotropic antenna. The gain of an antenna is almost always expressed in decibels.

$$\mathrm{G_{db}} = 10 \log_{10}(\mathrm{G})$$

$$\mathrm{G_{dBd}} = \mathrm{G_{dBi}} - 2.51\mathrm{dB}$$

Peak Gain - The highest antenna gain across all directions for a given frequency range. A directional antenna will have a very high peak gain compared to average gain.

Average Gain - The average gain across all directions for a given frequency range.

Maximum Power - The maximum signal power which may be applied to an antenna feed point, typically measured in watts (W).

Reflected Power - A portion of the forward power reflected back toward the amplifier due to a mismatch at the antenna port.

$$\left(\frac{\mathrm{VSWR} - 1}{\mathrm{VSWR} + 1}\right)^2$$

decibel (dB) - A logarithmic unit of measure of the power of an electrical signal.

decibel isotropic (dBi) - A comparative measure in decibels between an antenna under test and an isotropic radiator.

decibel relative to a dipole (dBd) - A comparative measure in decibels between an antenna under test and an ideal half-wave dipole.

Dipole - An ideal dipole comprises a straight electrical conductor measuring 1/2 wavelength from end to end connected at the center to a feed point for the radio.

Isotropic Radiator - A theoretical antenna which radiates energy equally in all directions as a perfect sphere.

Omnidirectional - Term describing an antenna radiation pattern that is uniform in all directions. An isotropic antenna is the theoretical perfect omnidirectional antenna. An ideal dipole antenna has a donut-shaped radiation pattern and other practical antenna implementations will have less perfect but generally omnidirectional radiation patterns which are typically plotted on three axes.