2.4 GHz VERTICAL HELICAL ANTENNA

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The 2.4 GHz Vertical Helical Antenna is a compact surface mount helical antenna designed for 2.4 GHz ISM frequency band applications such as Bluetooth® and ZigBee®.

The 2.4 GHz Vertical Helical Antenna is made from 0.6 mm diameter nickel plated high-carbon steel for use in PCB-mount installations requiring a rugged, compact and omnidirectional embedded antenna.

The connector-style base of the antenna ensures proper mounting for uniform performance in high-volume manufacturing.

FEATURES

- Performance at 2.4 GHz
  - VSWR: ≤ 1.8
  - Peak Gain: 3.0 dBi
  - Efficiency: 68%
- Direct PCB attachment
- Reflow- or hand-solder assembly
- Omnidirectional radiation pattern
- Compact size
  - 36.9 mm x 7.0 mm x 7.0 mm

APPLICATIONS

- Single-band WiFi/WLAN/802.11
  - WiFi 4
- 2.4 GHz ISM applications
  - Bluetooth®
  - ZigBee®
- U-NII and ISM applications
- Internet of Things (IoT) devices
- Smart Home networking
- Sensing and remote monitoring

ORDERING INFORMATION

Part Number	Description
2445750-1	2.4 GHz helical antenna with connector-style PCB-mount base
2445750-2	2.4 GHz helical antenna evaluation kit

Available from Linx Technologies and select distributors and representatives.

TABLE 1. ELECTRICAL SPECIFICATIONS

Parameter	Value
Frequency Range	2400 MHz to 2500 MHz
VSWR (max.)	1.8
Peak Gain (dBi)	3.0
Average Gain (dBi)	-2.1
Efficiency (%)	68
Polarization	Linear
Radiation	Omnidirectional
Max Power	15 W
Wavelength	1/4-wave
Electrical Type	Monopole
Impedance	50 Ω
ESD Sensitivity	NOT ESD sensitive. As a best practice, Linx may use ESD packaging.

Electrical specifications and plots measured with a 100 mm x 100 mm (3.94 in x 3.94 in) reference ground plane.

TABLE 2. MECHANICAL SPECIFICATIONS

Parameter	Value
Connection	Solder pin
Operating Temperature Range	-40 °C to +80 °C
Weight	0.7 g (0.02 oz)
Dimensions	36.9 mm x 7.0 mm x 7.0 (1.45 in x 0.28 in x 0.28 in)

PRODUCT DIMENSIONS

Figure 1 provides dimensions of the 2.4 GHz Vertical Helical Antenna antenna.

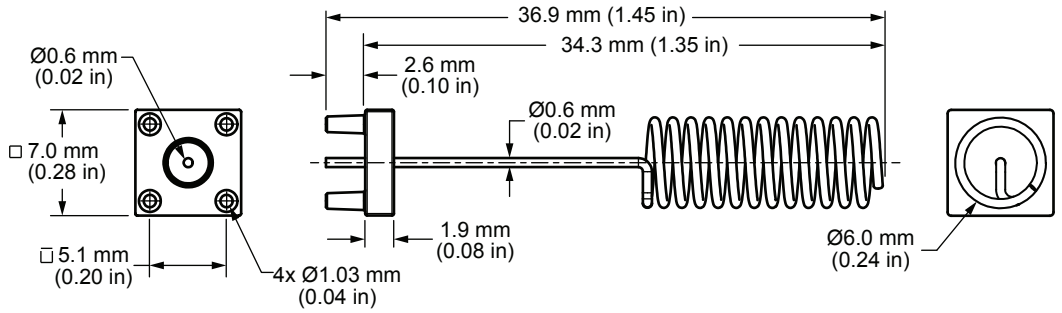


Figure 1. 2.4 GHz Vertical Helical Antenna Dimensions

ANTENNA INSTALLATION

The 2.4 GHz Vertical Helical Antenna feed is mounted in a non-conductive 4-pin connector-style base which simplifies insertion during manufacturing and helps maintain antenna alignment for consistent end-product performance.

PACKAGING INFORMATION

The 2.4 GHz Vertical Helical Antenna antenna is packaged in a protective plastic tray in quantities of 90 pcs. 33 trays totalling 2,970 pcs. are packaged in a carton. Distribution channels may offer alternative packaging options.

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.

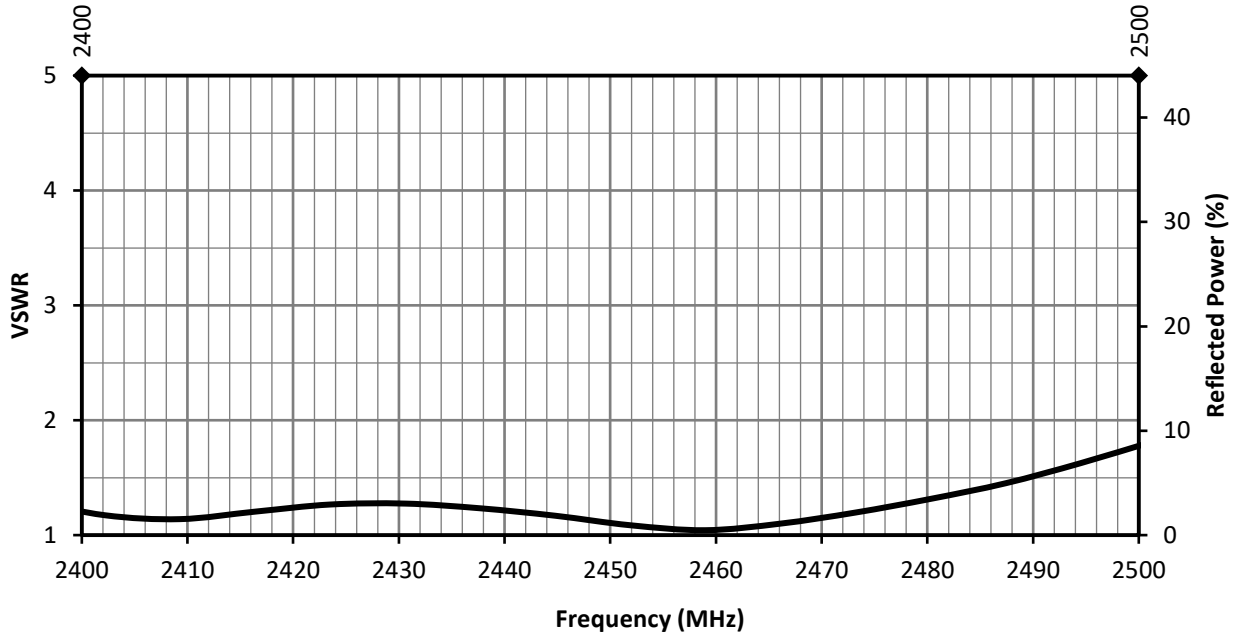


Figure 2. 2.4 GHz Vertical Helical Antenna VSWR

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.

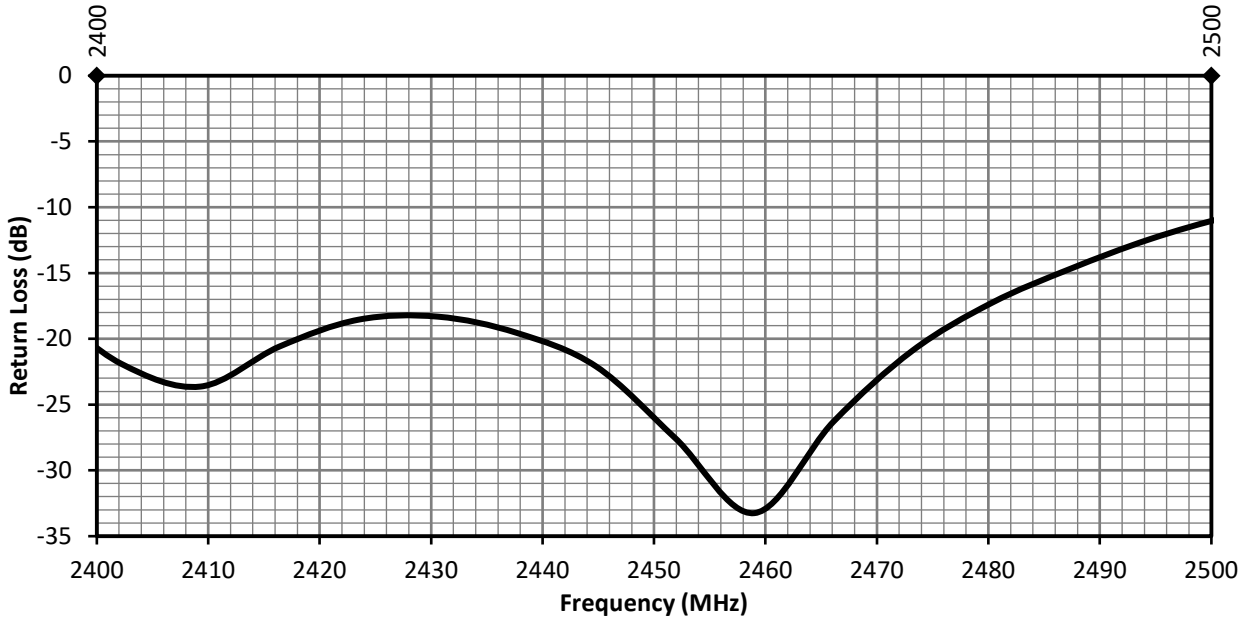


Figure 3. 2.4 GHz Vertical Helical Antenna Return Loss

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.

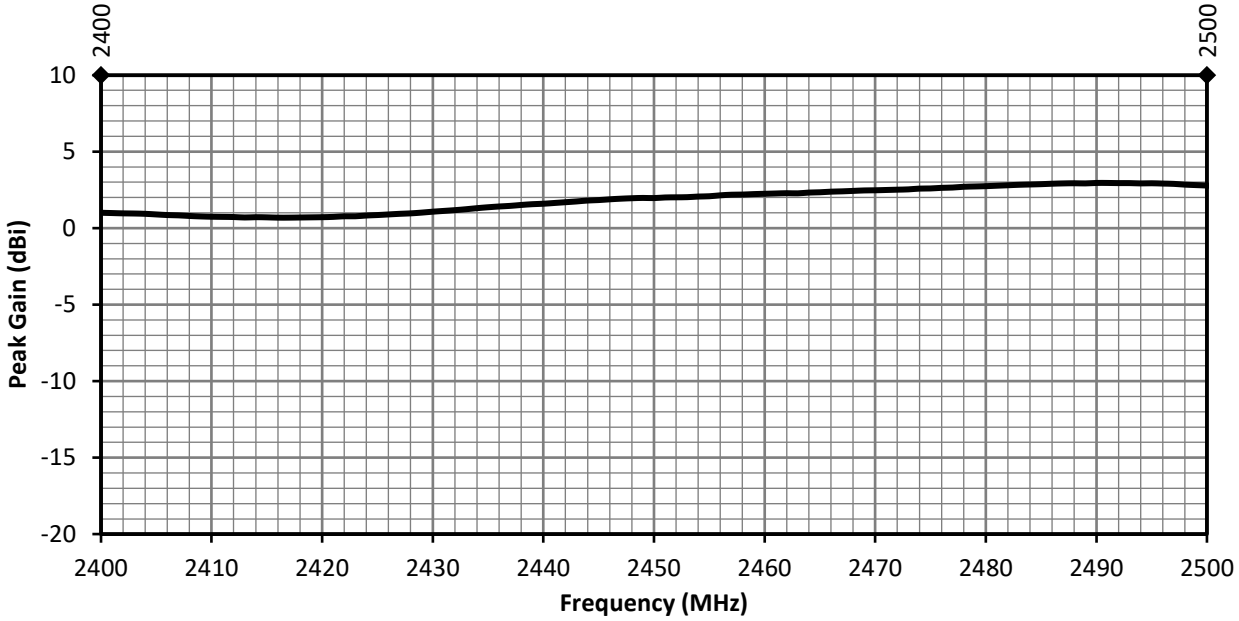


Figure 4. 2.4 GHz Vertical Helical Antenna Peak Gain

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.

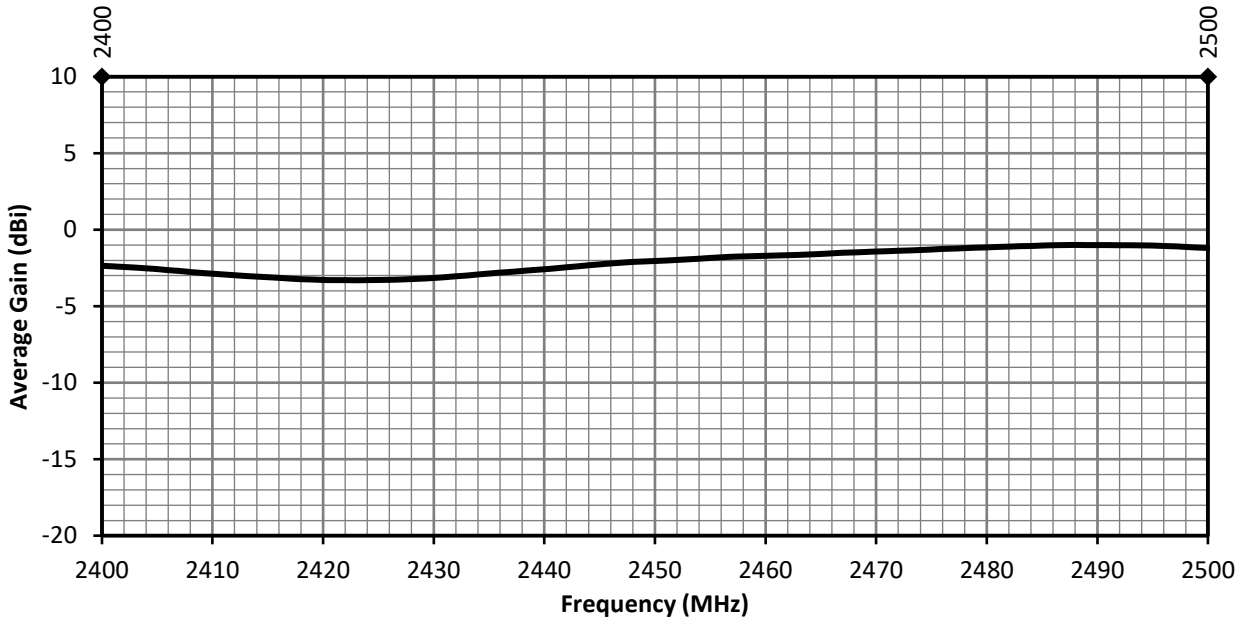


Figure 5. 2.4 GHz Vertical Helical Antenna Average Gain

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.

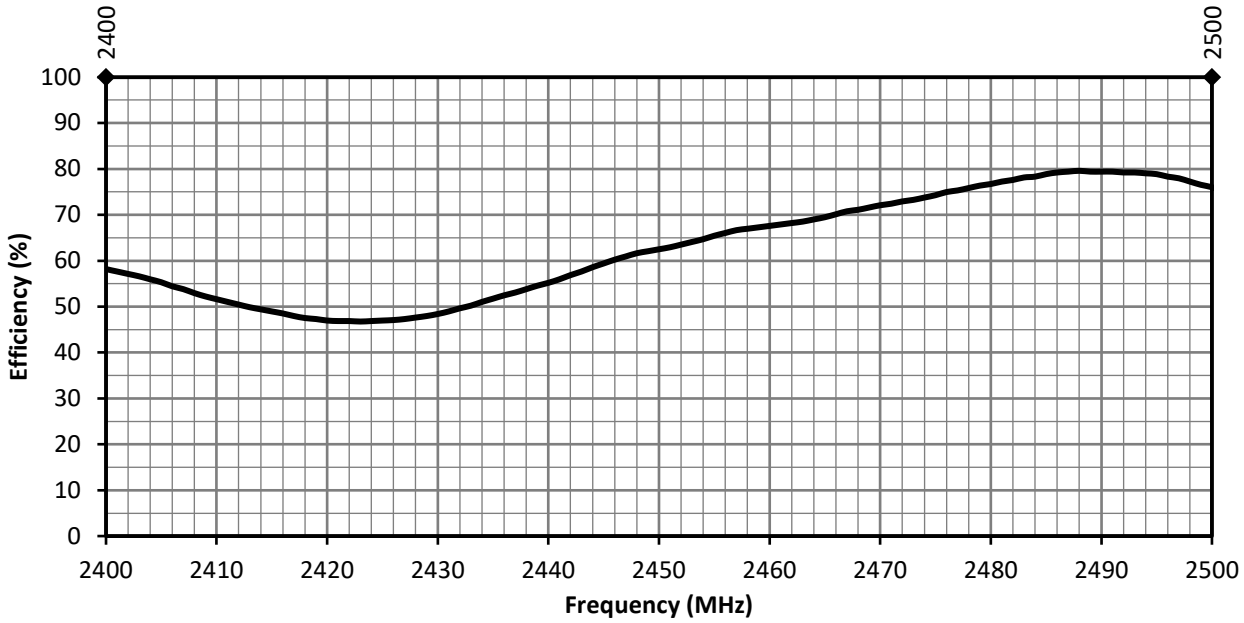


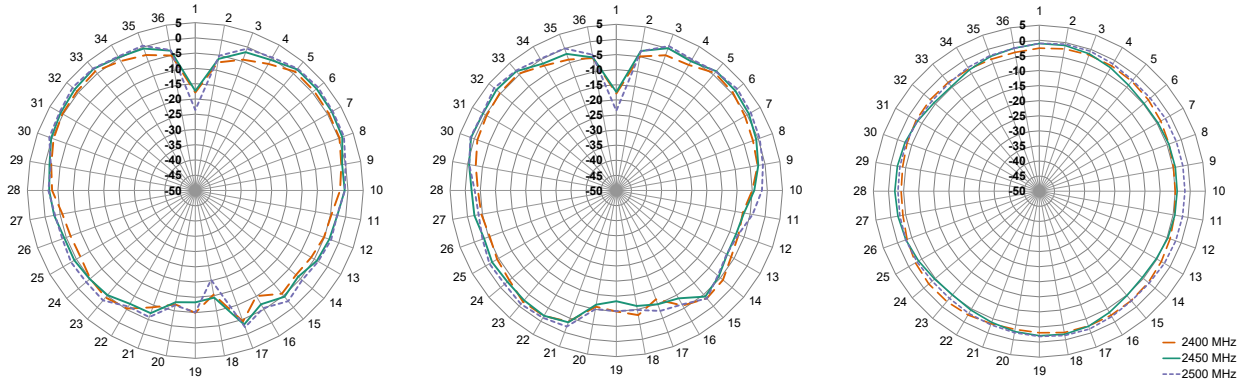
Figure 6. 2.4 GHz Vertical Helical Antenna Radiation Efficiency

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 for an orientation at the center of the ground plane are shown in Figure 7 using polar plots covering 360 degrees. The antenna graphic at the top of the page 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.

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 2.4 GHz Vertical Helical Antenna

GROUND PLANE

1/4-Wave monopole antennas require an associated ground plane counterpoise for proper operation. The size and location of the ground plane relative to the antenna will affect the overall performance of the antenna in the final design. When used in conjunction with a ground plane smaller than that used to tune the antenna, the center frequency typically will shift higher in frequency and the bandwidth will decrease. The proximity of other circuit elements and packaging near the antenna will also affect the final performance.

For further discussion and guidance on the importance of the ground plane counterpoise, please refer to Linx Application Note, AN-00501: Understanding Antenna Specifications and Operation.

RECOMMENDED LAYOUT

The recommended printed circuit board (PCB) layout for the 2.4 GHz Vertical Helical Antenna is shown in Figure 8. Contact Linx for availability of PCB layout design files. Linx offers an antenna evaluation board, AEK-2.4-VHETH, using the recommended layout.

The recommended layout includes a matching network, ground plane and PCB transmission line from the antenna to the matching network, and to the connector or radio circuitry. The connector used on the evaluation board is not intended for production use of the 2.4 GHz Vertical Helical Antenna. The transmission line may be run directly to the radio if on the same PCB.

Linx recommends inclusion of at least a 3-element, surface mount pi matching network of two parallel components, (X1, X3) and one serial component, (X2) in all designs (Figure 9). Surface mount components should be 0603 size. 0402 size components are also supported. The 2.4 GHz Vertical Helical Antenna, as designed, does not require matching, but matching may improve end-product antenna performance depending on the effects of the enclosure, PCB and other electronic components. If no matching is necessary, the serial element may be populated with a zero-ohm resistor and no component in the two capacitor positions. This is the configuration of the Linx evaluation board as supplied. Linx believes in wireless made simple® and offers matching network design support.

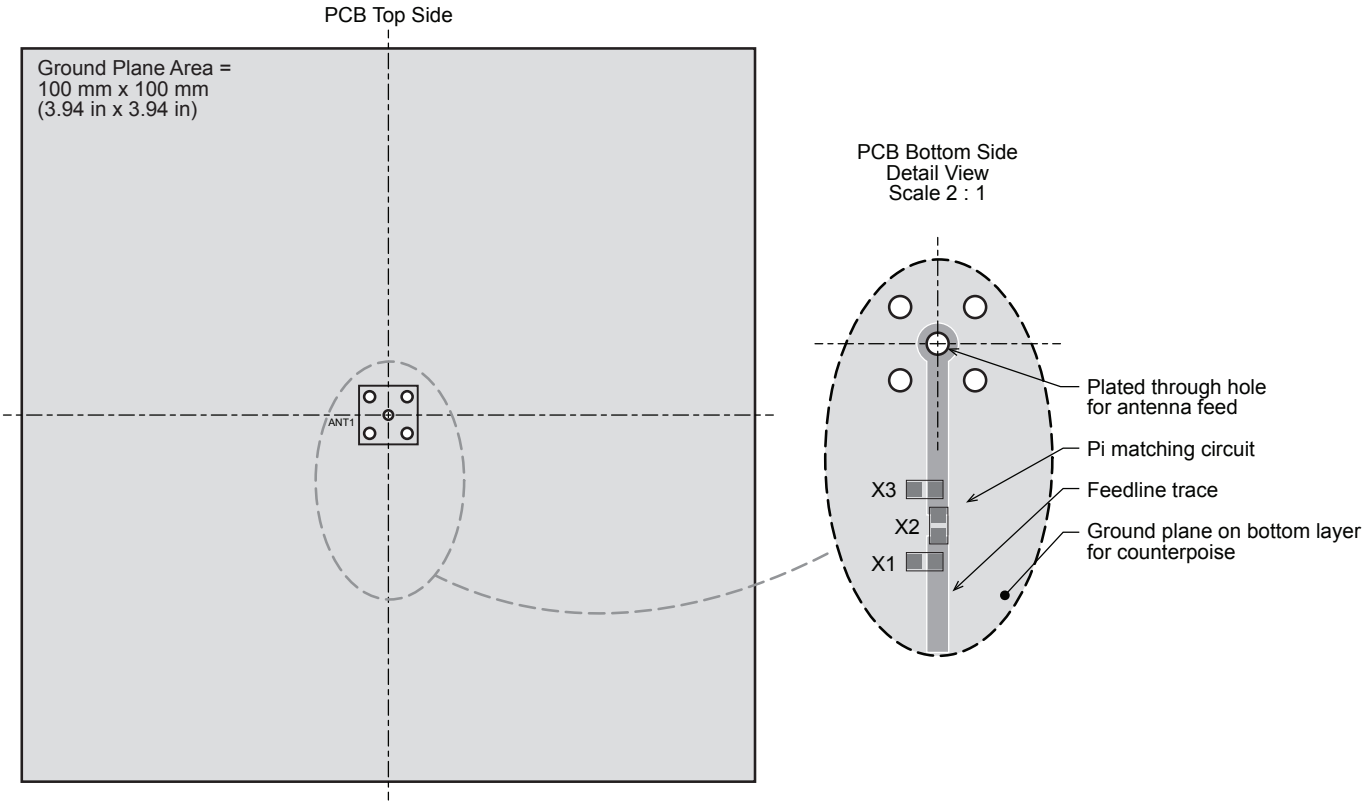


Figure 8. 2.4 GHz Vertical Helical Antenna Recommended Layout

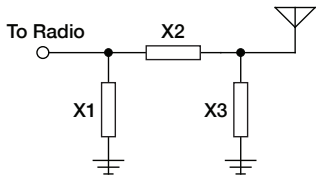


Figure 9. Matching Network Recommendation

RECOMMENDED PCB FOOTPRINT

Figure 10 shows the recommended printed circuit board footprint and spacing for the 2.4 GHz Vertical Helical Antenna. The footprint recommendation should be used in conjunction with the recommended layout configuration shown in Figure 8.

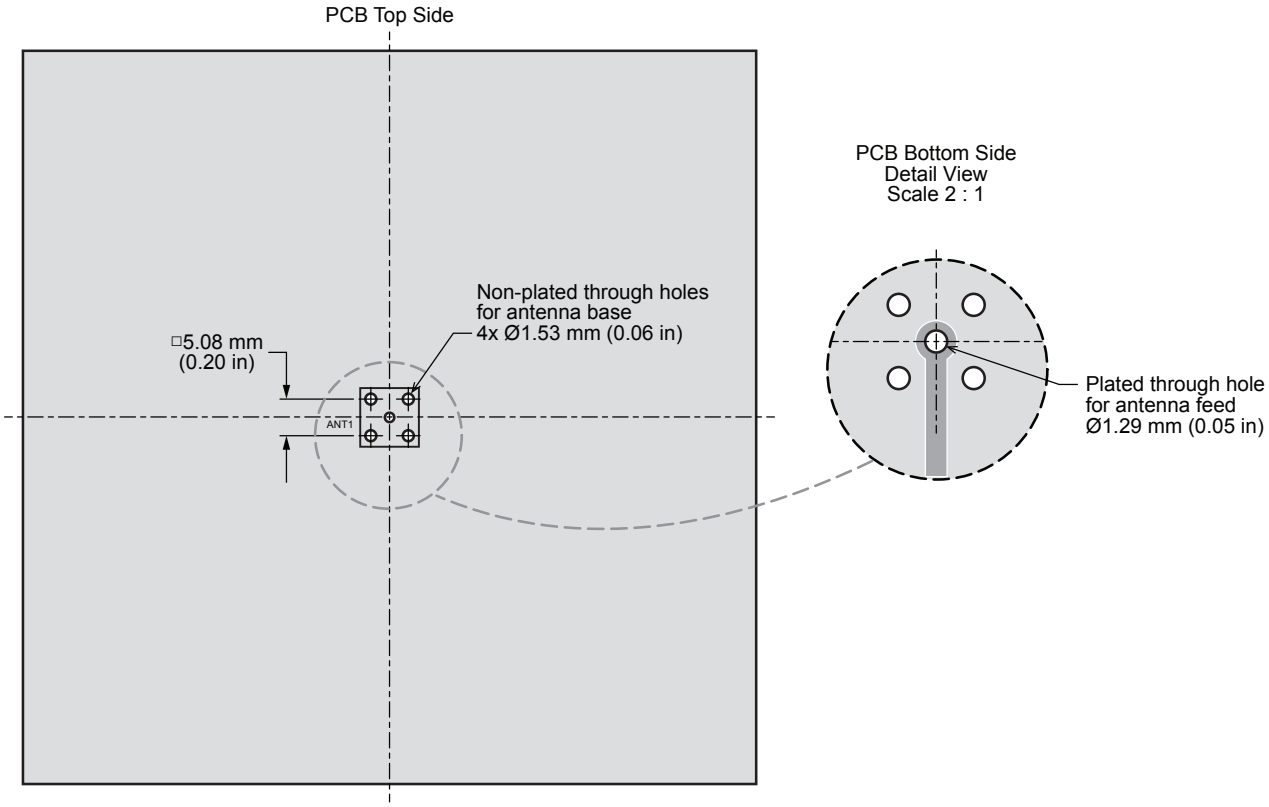


Figure 10. 2.4 GHz Vertical Helical Antenna Placement on PCB

TRANSMISSION LINES FOR EMBEDDED ANTENNAS

For most designs, Linx recommends a microstrip transmission line for the 2.4 GHz Vertical Helical Antenna. A microstrip transmission line is a PCB trace that runs over a ground plane to maintain the characteristic impedance for optimal signal transfer between the antenna and radio circuitry. Linx designs all antennas with a characteristic impedance of 50 Ω.

Important practices to observe when designing a transmission line are:

- Keep all transmission lines to a minimum length for best signal performance.
- Use RF components that also operate at a 50 Ω impedance.
- If the radio is not on the same PCB as the antenna, the microstrip should be terminated in a connector, enabling a shielded cable to complete the antenna connection to the radio.
- For designs subject to significant electromagnetic interference, a coplanar waveguide transmission line may be used on the PCB.

The design of a PCB transmission line can be aided by many commercially available software packages which can calculate the correct transmission line width and gap dimensions based upon the PCB thickness and dielectric constant used. Linx offers PCB design reviews to help optimize solution performance.

REFLOW SOLDER PROFILE

The 2.4 GHz Vertical Helical Antenna uses a typical RoHS solder reflow profile as shown in Figure 11. Refer to application note AN-00504 on the Linx website for more information.

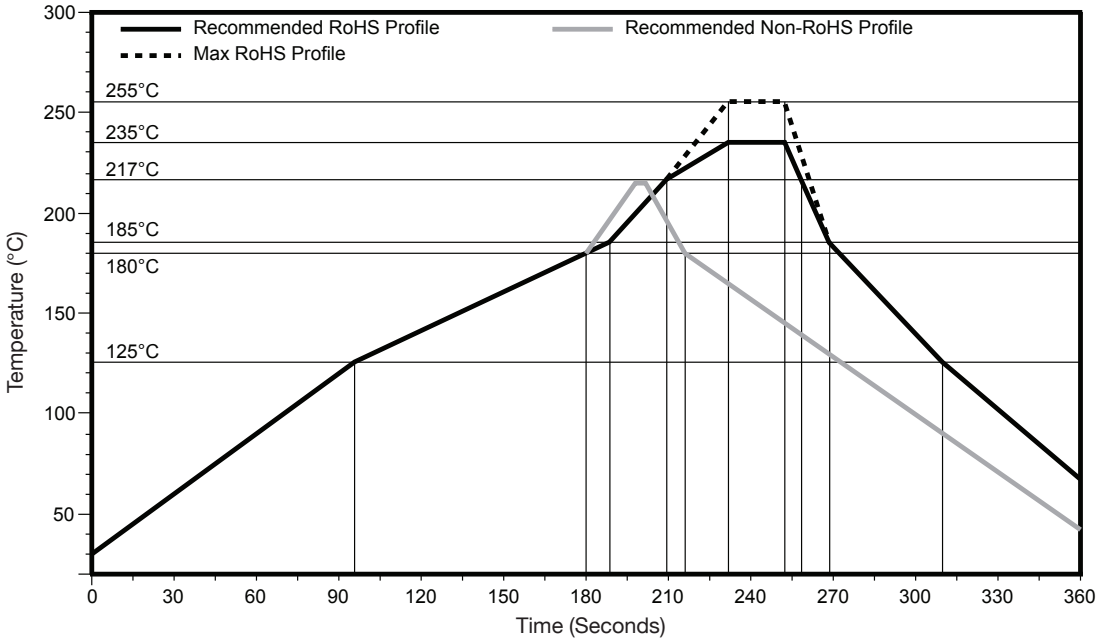


Figure 11. Solder Profile for the 2.4 GHz Vertical Helical Antenna

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