

Antenna Application Note



ethertronics
shaping antenna technology™

Prestta™ Standard WLAN Embedded Antennas



Applications:
Access Points/Gateways/Routers
Healthcare
Industrial Devices
WiFi enabled Televisions & Monitors

WLAN



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PROPRIETARY INFORMATION

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Product specifications subject to change without notice.

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Antenna Application Note

1. Purpose

This document provides information for incorporating Ethertronics' Prestta™ standard embedded antennas into wireless products. Specifications, design recommendations, board layout, packaging and manufacturing recommendations are included.

This document is divided into two parts: a main section and appendices. The main section addresses points and issues common to all products. The appendices provide product-specific information.

2. Overview

The Prestta Product Line

The Prestta series of standard WLAN embedded antennas represents a new category of standard, internal antennas. Ethertronics' antennas utilize proprietary and patented Isolated Magnetic Dipole (IMD) technology to meet the needs of device designers for higher functionality and performance in smaller/thinner designs.

IMD Technology Advantages

Real-World Performance and Implementation

Ethertronics continues to set the standard for antenna performance with its award-winning IMD technology, which uses patented design configurations to confine the current flow to the antenna element rather than exciting the main circuit board. Other antennas may contain simple PiFA or monopole designs that interact with their surroundings, complicating layout or changing performance with user position. Ethertronics' antennas utilize patented IMD technology to deliver a unique size and performance combination.

IMD technology offers important real-world advantages over other approaches. Please see our white paper and Website www.ethertronics.com for a full explanation.

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MD Features, Advantages and Benefits Summary

Feature	Advantage	Benefits
High performance	High efficiency	Meet and exceed design performance specs. Lower design risks. Enhance end-user satisfaction.
	High isolation	Less interaction with surrounding components. Smallest effective antenna size when component keep-out areas are included. Resists de-tuning due to orientation on circuit board. Lowers design risk and time to market. One antenna part number can serve multiple designs. Simplifies design and ordering.
	High selectivity	Eliminates need for additional band-pass filters and other circuitry. Saves cost and space.
Superior RF Field Containment	Virtually eliminates detuning	Better performance. Higher end-user satisfaction.

Prestta Features and Benefits Summary

Features	Benefits
Stamped Metal Antennas with SMD capability	<ul style="list-style-type: none"> Flexibility in antenna placement with direct placement on customer PCB Ease of manufacturing
Embedded Solutions for WLAN	<ul style="list-style-type: none"> Eliminates external antennas More desirable form factors Can be used in Access Points, Routers, Gateways, Wireless Displays/TVs, and other consumer electronic devices
High Performance	<ul style="list-style-type: none"> Better performance than external dipole in diversity antenna situation
Ground Cleared Solution	<ul style="list-style-type: none"> Enables flexibility in antenna placement within end device Can be used within Access Points, Routers, Handhelds, Displays
Extensive Design Collateral and Apps Support	<ul style="list-style-type: none"> Speeds development time
Standard "Off the Shelf" Product	<ul style="list-style-type: none"> Speeds development time and reduces costs by reducing NRE and custom development time

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Product Selector Guide

Antenna PN	Application	Type	Typical Deliverable Size (Antenna with PCB)
1000146	WLAN 2.4, 4.9 GHz 5.2, 5.8 GHz	<ul style="list-style-type: none"> • Ground Cleared • 2.4 & 5 GHz • Flexible antenna placement • Antenna element from 1000418 	<ul style="list-style-type: none"> • Antenna element only • SMT • 17.9 x 6.9 x 4.3 mm (Antenna only)

Additional antennas are under development, please see Ethertronics' Website, or ask your Ethertronics salesperson about additional products to meet your needs.

3. Design Guidelines

3.1 Introduction

The Prestta standard WLAN embedded antenna can be designed into many wireless product types. The following sections explain Ethertronics' recommended layouts to help the designer integrate the 1000146 antenna element into a device with optimum performance.

3.2 Antenna Placement Guidelines

Figure 1 at the right shows the optimal placement of the 1000146 antenna, with its pad layout, on a PCB:

- Antenna should always be placed along the edge of the board unless there are special conditions preventing this
- The antenna can be placed on either the top or bottom side of the PCB. The recommended antenna location, when you are looking at the board, lies at the corner where its upper and right edges align with the two board edges.

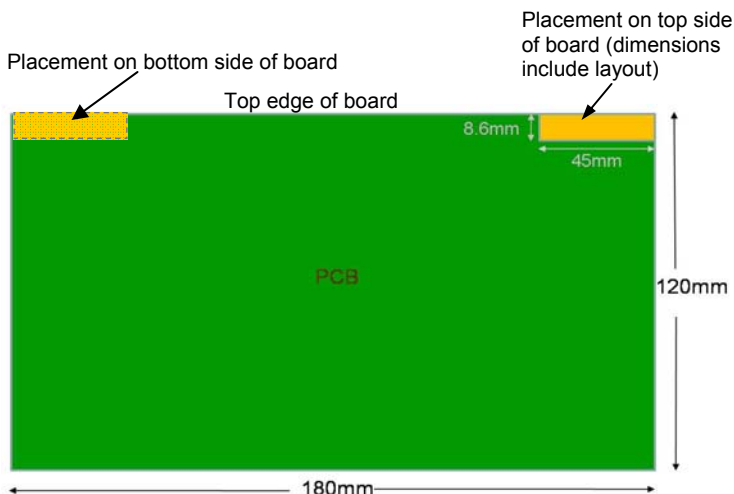


Figure 1

3.3 Tuning Guideline Introduction

The 1000146 is the metal element of the 1000418 assembly with PCB, RF cable and connector. The 1000146 metal antenna can be mounted onto any PCB using Ethertronics' recommended ground layout. For the purposes of the Design Guidelines section, the 1000146 has been mounted on a PCB demo board to approximate a standard sized PCB in an end device (e.g. router, access point).

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3.4 Antenna Pad Layout

Figure 2 at the right shows the Prestta Standard 100146 Antenna pad layout (bottom view)

- **Maximum Dimensions:** 17.9 x 6.9 x 4.3 mm
- **RF Mounting:** antenna is SMD attached to the main PCB

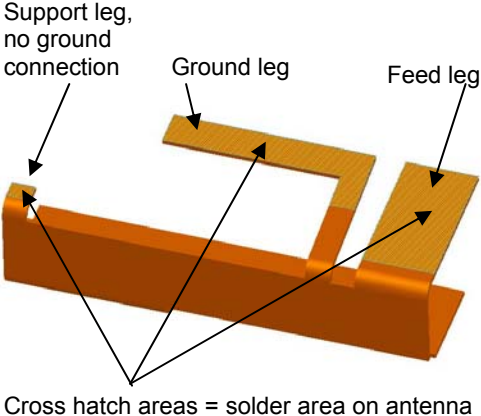


Figure 2

3.5 PCB Land Pattern

Figure 3 below shows the typical PCB land Pattern (top view).

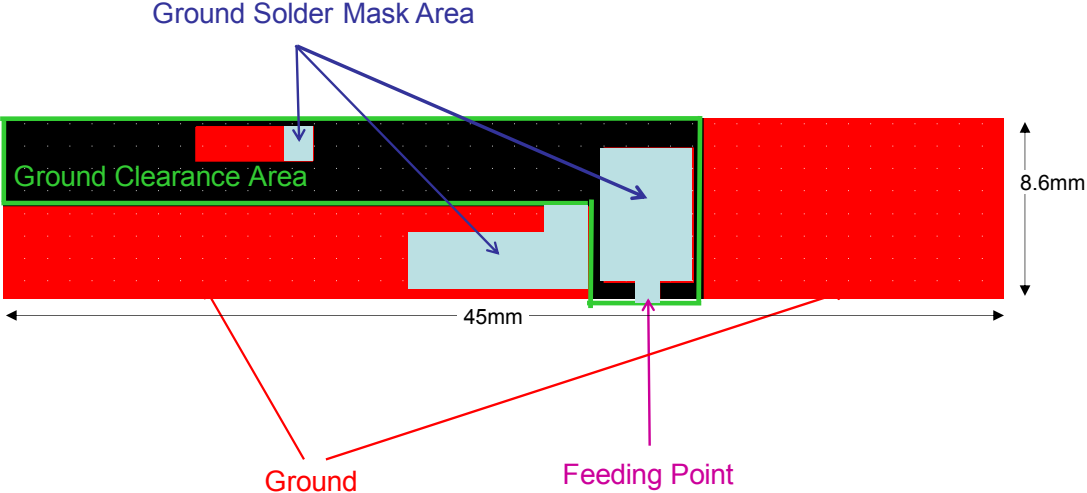


Figure 3

3.6 Typical Performance

Typical performance figures were done by placing the 1000146 antenna on a PCB (topside) as shown in Figure 1. Figure 4 below shows the typical VSWR performance (bg band)

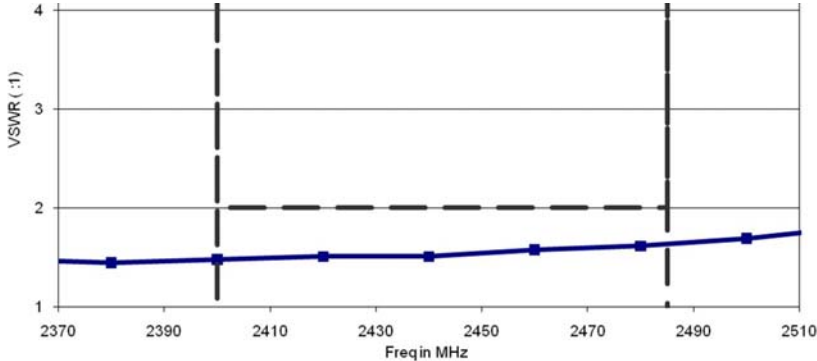


Figure 4

Figure 5 below shows typical VSWR performance (a band)

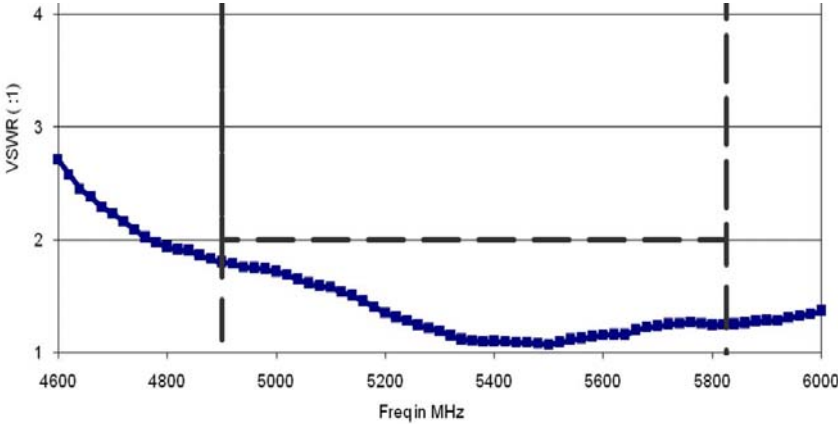


Figure 5

Figure 6 below shows the typical Efficiency performance (bg band)

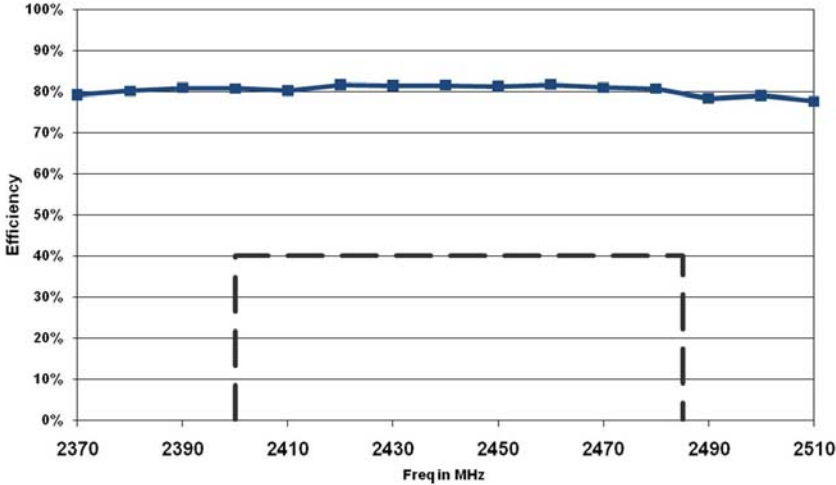


Figure 6

Figure 7 below shows typical Efficiency performance (a band)

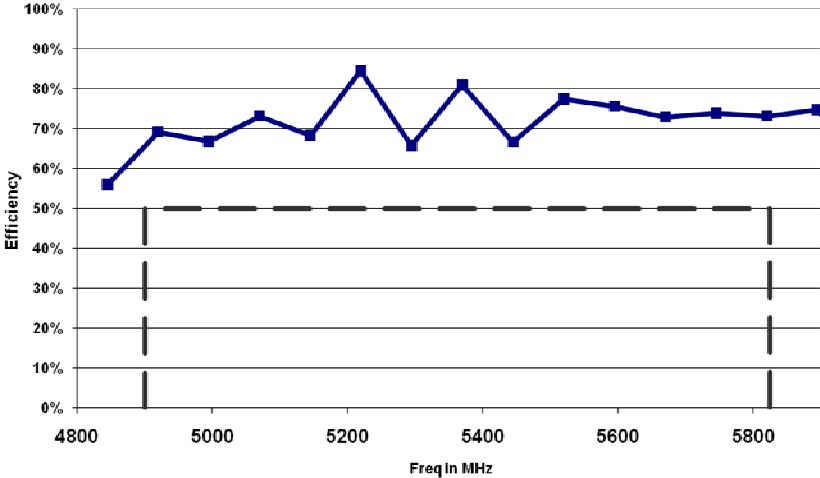


Figure 7

3.7 Tuning Guidelines

In a real application environment, variation of the antenna resonating frequency may be caused by the following effects

- Different antenna locations
- PCB board variations
- Components and shield cans located close to the antenna
- Outside Cover

The following methods can be applied to solve the above effects

- bg band: pad tuning
- a band: slot tuning

bg Band Tuning: Varying the Pad Size

- bg center frequency can be tuned by changing the pad length (Figure 8 at right)
- For frequency tuning, the right edge remains unchanged, whereas the left edge moves to different positions.

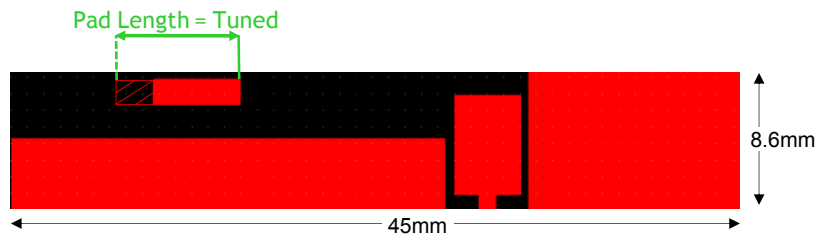


Figure 8

See Figure 9 at right and Figure 10 below for a and bg band tuning demonstrations

- The longer the pad is, the lower the bg band center frequency shifts

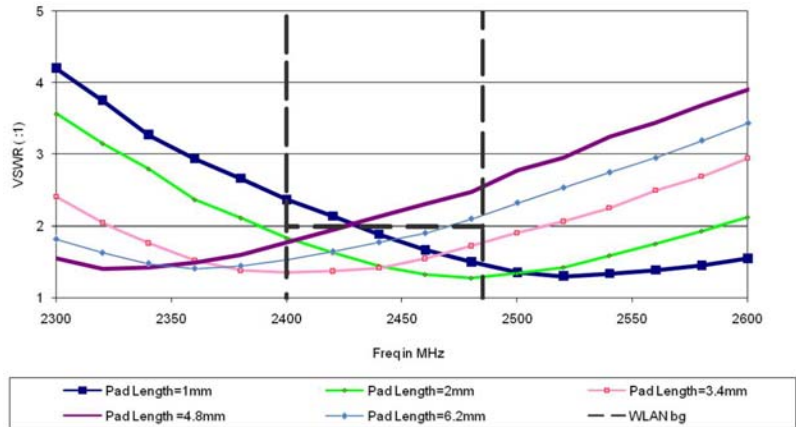


Figure 9

- a band is not affected by varying the pad size

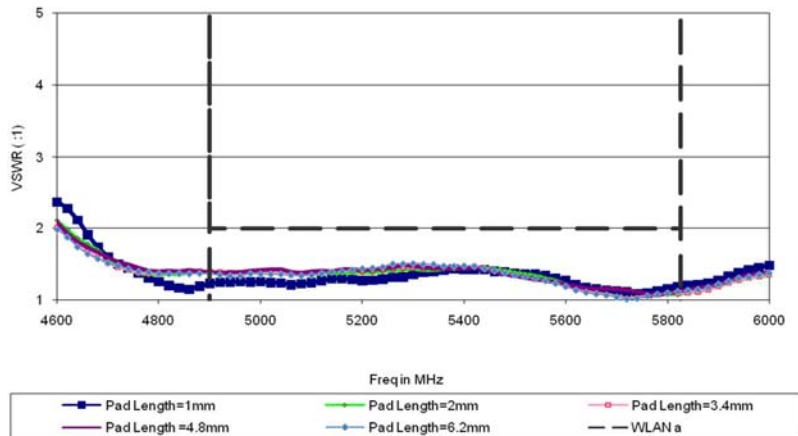


Figure 10

a Band Tuning: Inserting a Slot

- a band center frequency can be tuned by inserting a slot at the antenna ground plane (Figure 11 at right)
- The distance of the slot and the left edge of the ground determines the frequency shift
- Recommended slot dimension = 11mm x 1mm

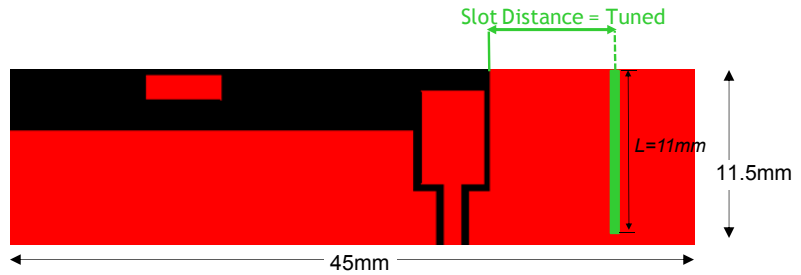


Figure 11

See Figure 12 and Figure 13 below for a and bg tuning demonstrations

- The farther the slot is, the lower a band center frequency shifts

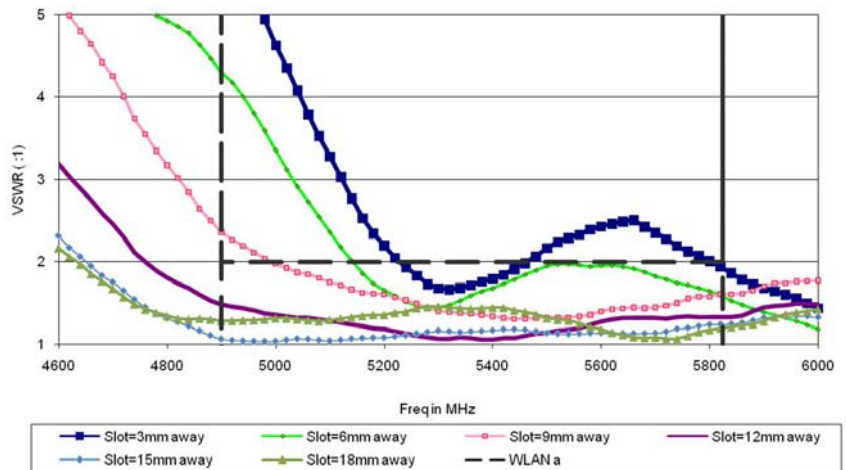


Figure 12

- bg band is not affected by inserting a slot

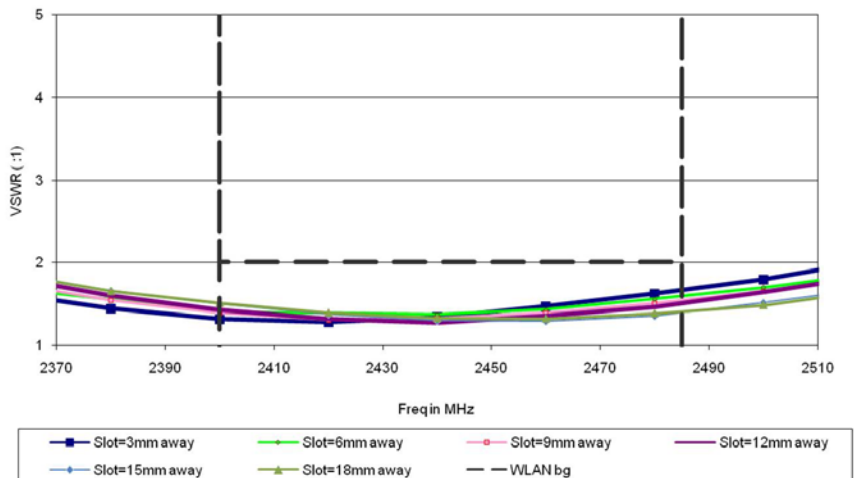


Figure 13

Recommended Ground Layout for Tuning

Figure 14 below shows the recommended ground layout for tuning.

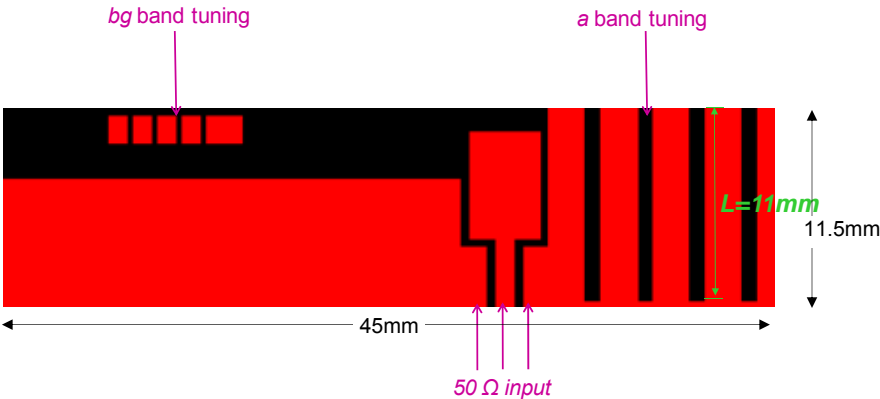


Figure 14

3.8 Shield Can Tuning Guidelines

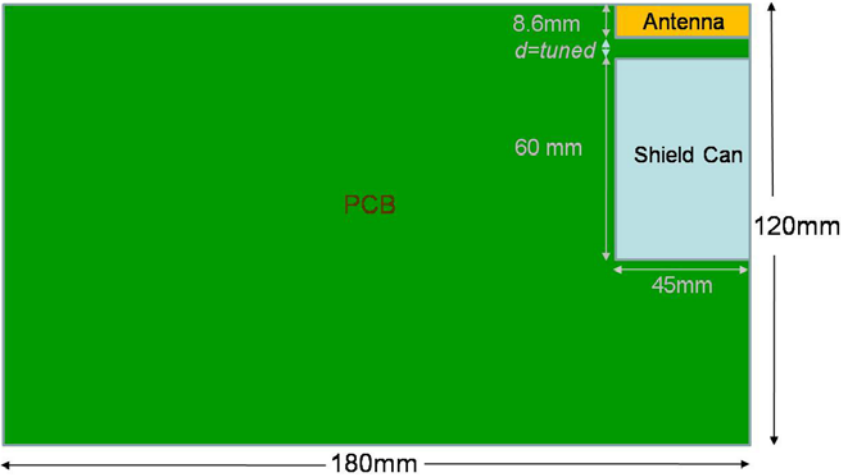


Figure 15

Figure 15 above provides examples of a shield can demonstration. A 60x45x5 mm shield can is placed close to the antenna to show its effect. The shield can causes frequency shifting of the antenna but the peak efficiency is not affected. Therefore, when a shield can is placed close to the antenna, the de-tuning effect can be compensated by frequency tuning through methods mentioned earlier.

Figures 16 and 17 below show the shield can effect on VSWR for a and bg bands

- The shield can causes the bg band center frequency to shift lower.
- The closer the shield can is, the more the frequency shift.

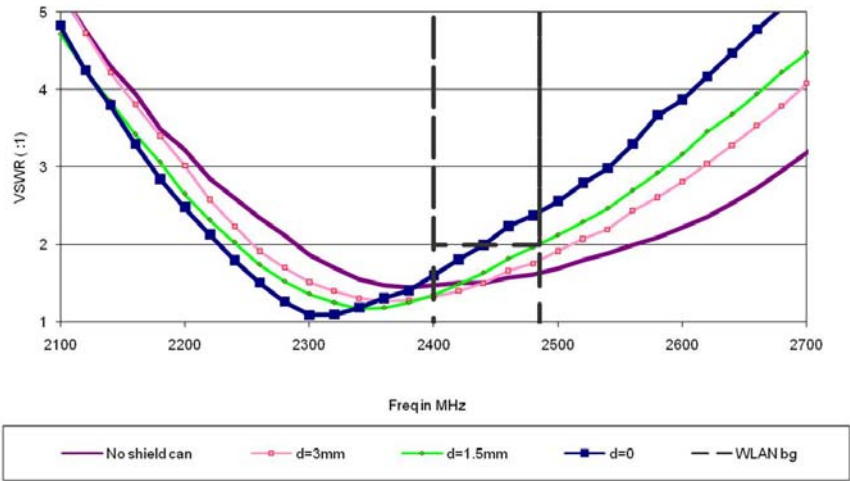


Figure 16

- Shield can effect on a band matching is relatively small

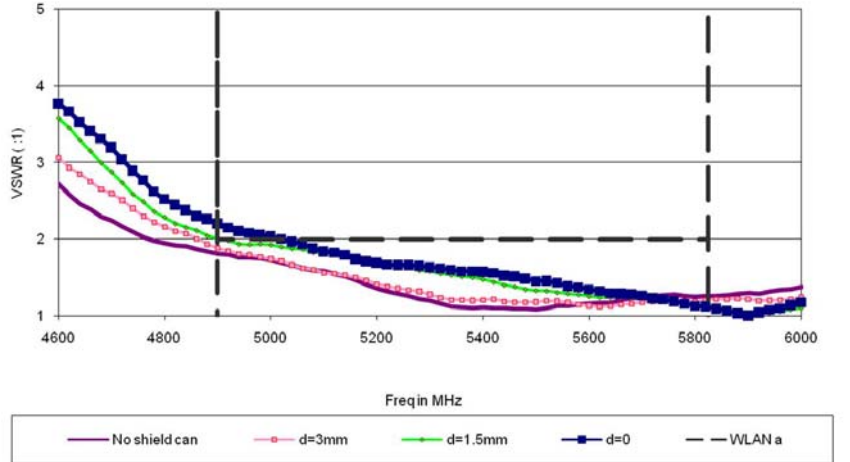


Figure 17

Figures 18 and 19 below show the shield can effect on Efficiency for a and bg bands

bg bands

- The frequency at which the peak efficiency appears to shift is due to the shield can effect, however, the same peak value is always achieved.

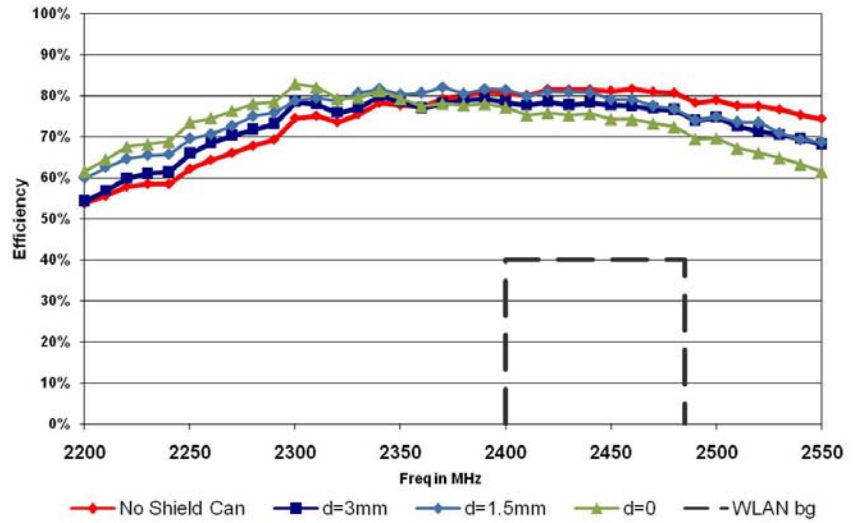


Figure 18

- Shield can effect on a band matching is relatively small

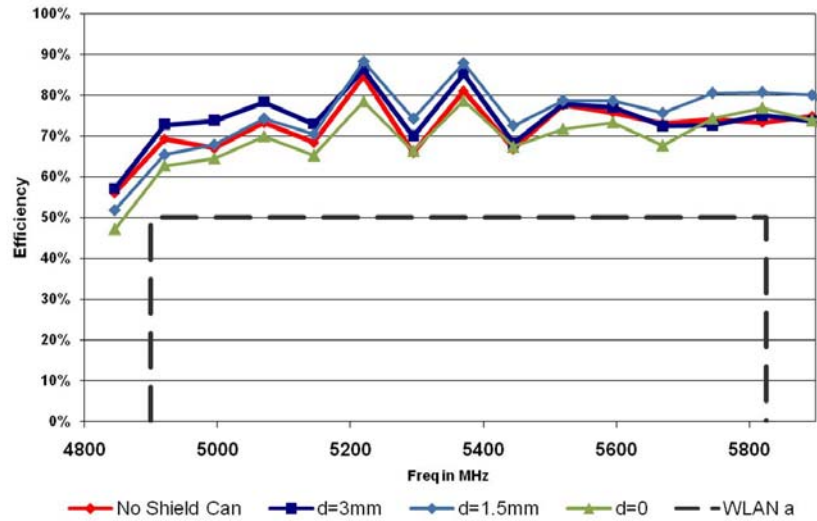


Figure 19

Space Saving Configuration—PCB Land Pattern

With the Space Saving Configuration, less ground clearance area needs to be kept underneath the antenna. Figure 20 below shows the PCB Land Pattern -

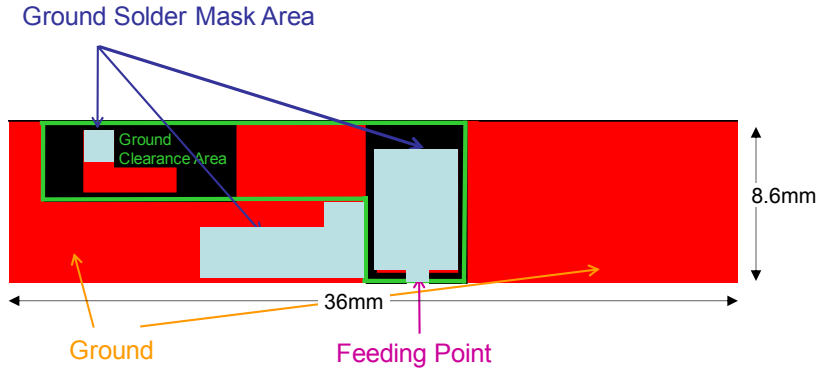


Figure 20

Figures 21 and 22 below show the Space Saving Configuration effect on VSWR for a and bg bands.

- Maximum VSWR in BG band will increase from 1.7:1 to 2:1

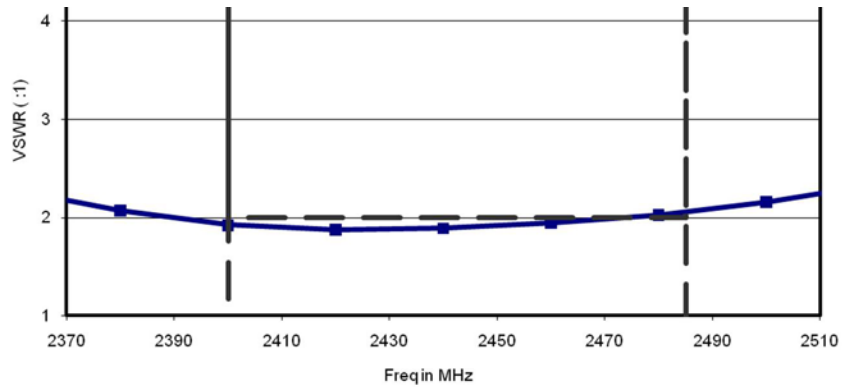


Figure 21

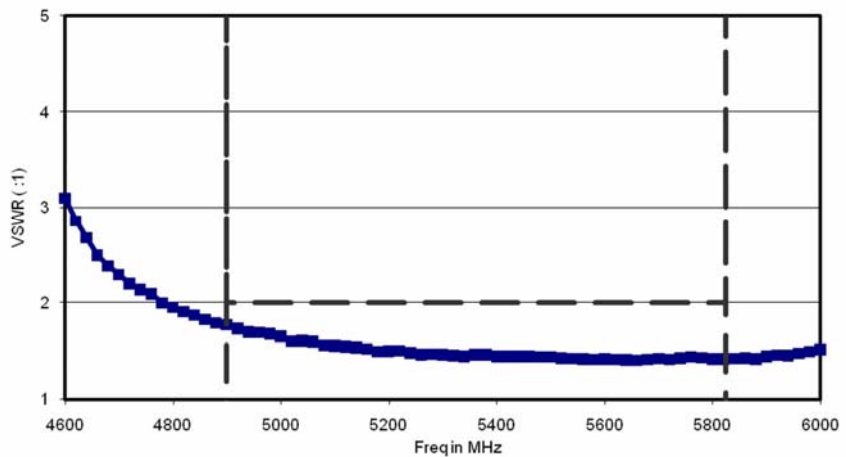


Figure 22

Figures 23 and 24 below show the Space Saving Configuration effect on Efficiency for a and bg bands.

- Average efficiency in bg band will decrease from 81% to 69%

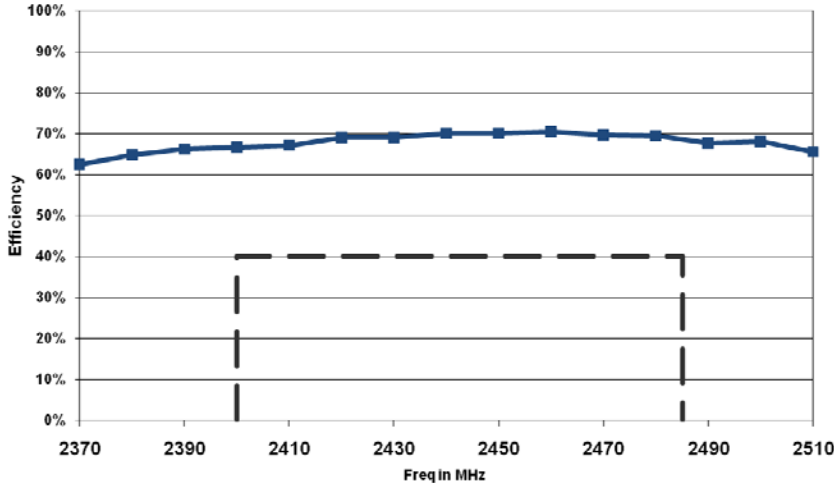


Figure 23

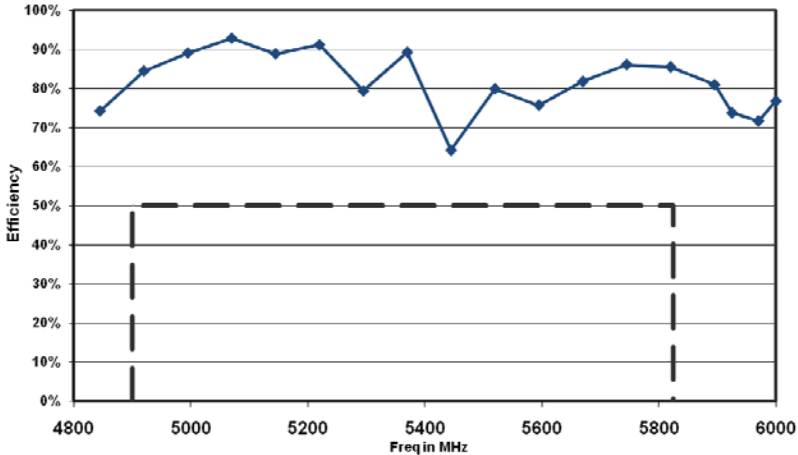


Figure 24

Space Saving Configuration—Recommended Layout for Tuning

Figure 25 below shows the recommended layout for tuning.

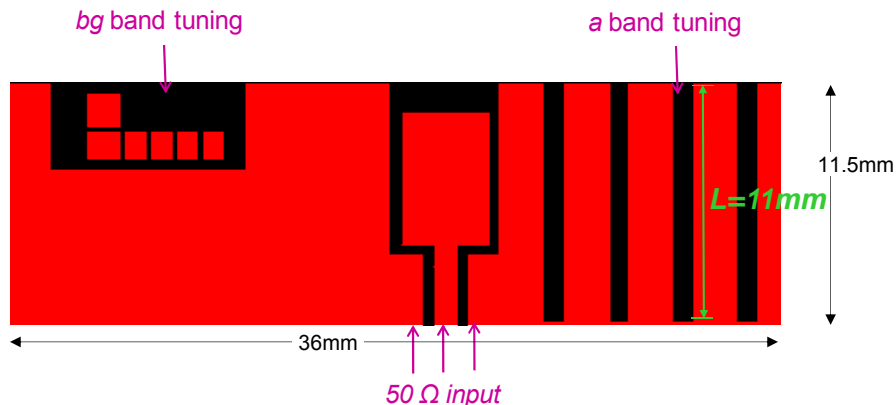


Figure 25

MIMO Application Guidelines

Figure 26 at right shows the recommended layout for MIMO applications.

- Place two antennas on two perpendicular edges of a board.
- The recommended antenna edge-to-edge distance is 85mm or larger for in-band isolation of 20dB or greater. (Note, this will depend on the environment in which the two antennas are located).
- To improve isolation in limited space, Ethertronics has developed a special isolator approach. As an example, minimum 30dB isolation can be achieved with an antenna edge-to-edge distance of 45mm.

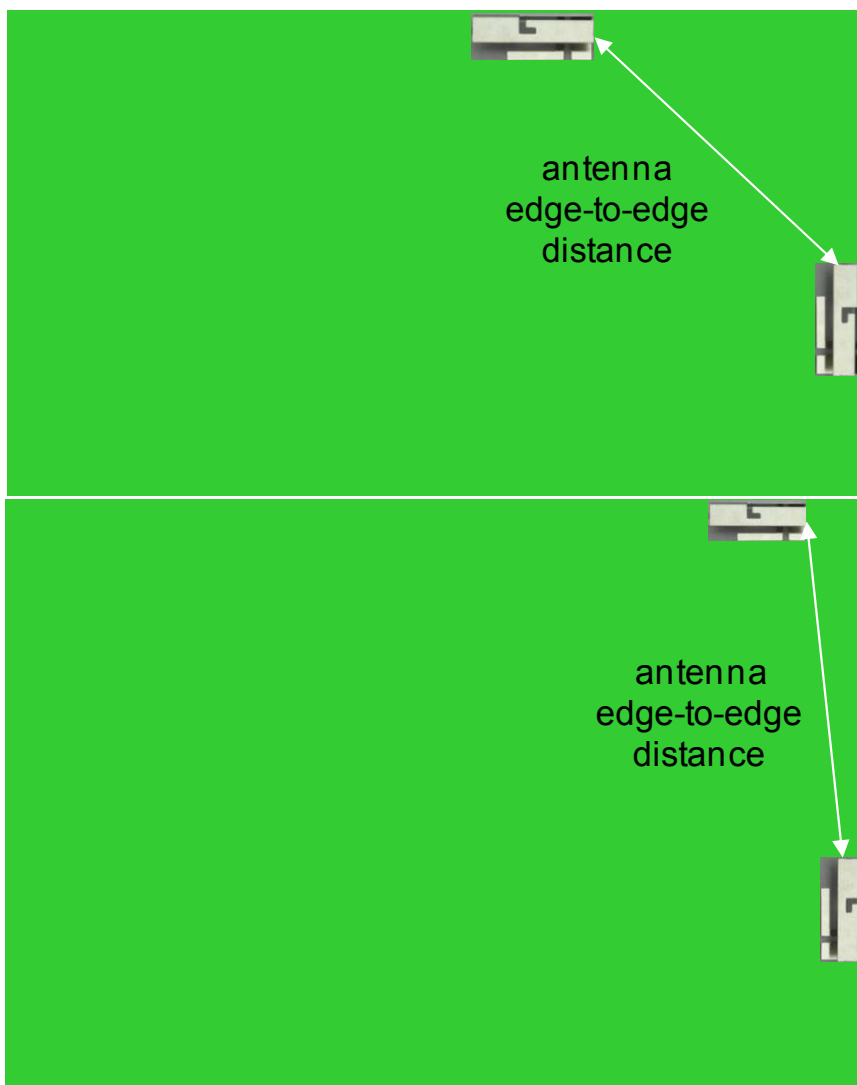


Figure 26

Please contact Ethertronics

Figure 27 below shows the recommended guidelines when two antennas must be placed on the same edge of a PCB.

- The edge-to-edge distance should be 80mm or greater for in-band isolation of 20dB or greater.

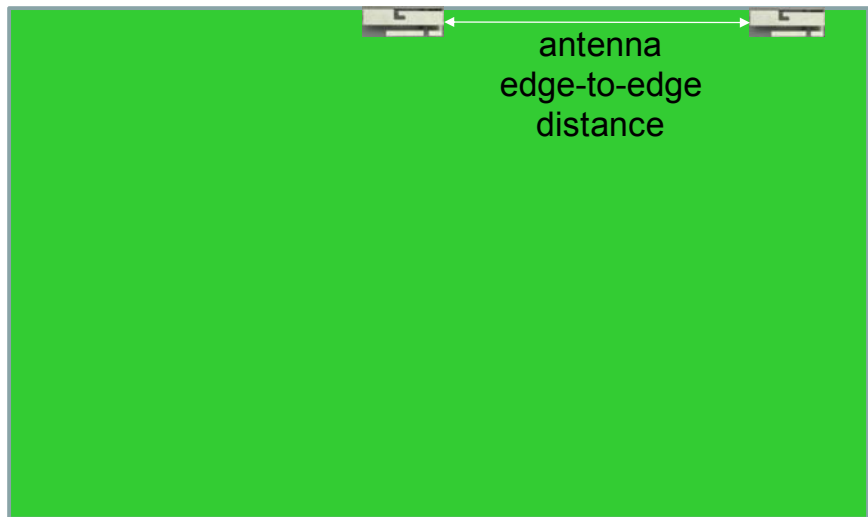


Figure 27

Figure 28 below shows the recommended guidelines when two antennas must be placed on opposite edges of a PCB.

- The edge-to-edge distance should be 100mm or greater.



Figure 28

MIMO Application Example

Figure 29 below shows a typical MIMO configuration where two 1000146 antennas and a shield can are placed close together in the corner of a PCB.

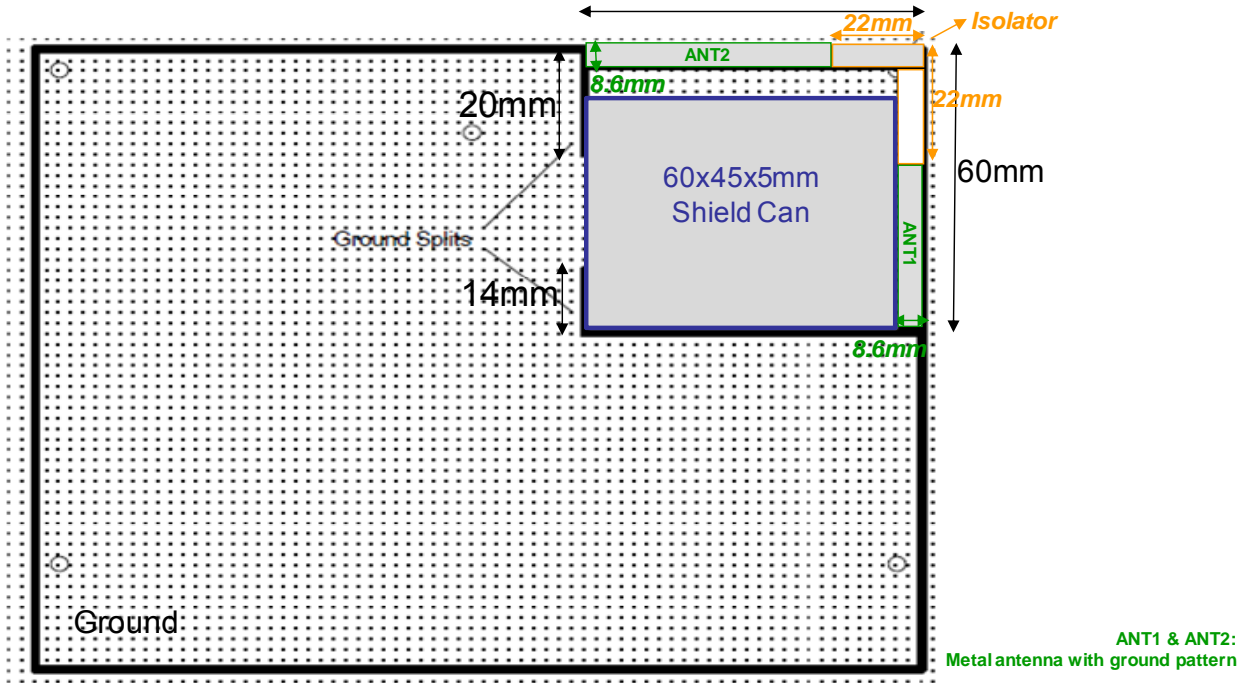


Figure 29

- Both antennas have typical VSWR and efficiency performances described above.
- In-band isolation is less than -30dB as shown in Figure 30 below.

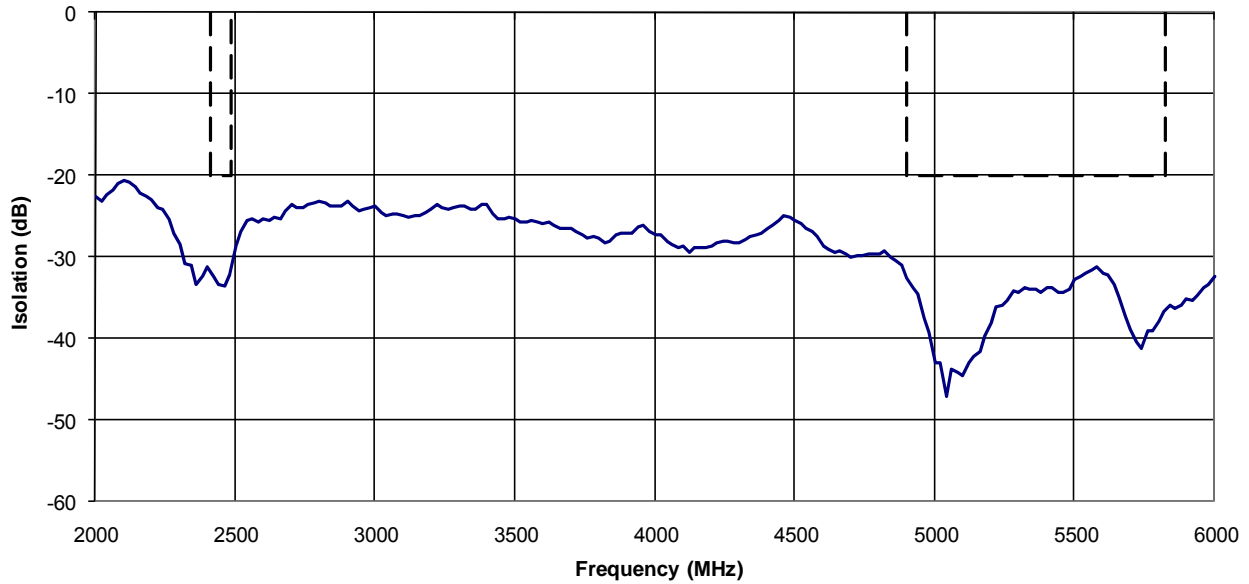


Figure 30

Antenna Application Note

4. Material Specifications

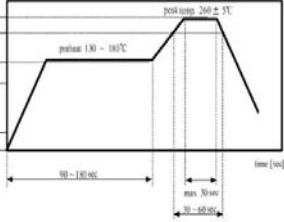
Item	Material
Metal Element	C5210
Contact Finish	Ni and selective Au standard

5. Product Testing

NO	Test Type	Items	Test condition	Test method
1	Environment test	High Temp.	85°C±3°C 120hr ±2hr	<p>Step 1: Test VSWR (by jig for antenna only elements/no PCB). Step 2: Put it in the chamber. Step 3: Test it like this picture which explains temp. cycle. Step 4: Test VSWR after 1hr in normal Temp. & normal Humidity</p>
2		Low Temp.	-40°C±3°C 120hr ±2hr	<p>Step 1: Test VSWR (by jig for antenna only elements/no PCB). Step 2: Put it in the chamber. Step 3: Test it like this picture which explains temp. cycle. Step 4: Test VSWR after 1hr in normal Temp. & normal Humidity</p>
3		High Temp. & High Humidity	85°C±3°C RH=85% 120hr ±2hr	<p>Step 1: Test VSWR (by jig for antenna only elements/no PCB). Step 2: Put it in the chamber. Step 3: Test it like this picture which explains temp. cycle. Step 4: Test VSWR after 1hr in normal Temp. & normal Humidity</p>
4		Salt Spray	Nacl 5%, 35°C , 48hr	<p>Step 1: Test VSWR (by jig for antenna only elements/no PCB). Step 2: Put it in the chamber. Step 3: Start test. Step 4: Wash the samples. Step 5: Test VSWR after 1hr in normal Temp. & normal Humidity</p>
5		Thermal shock	-40°C±3°C/30min, 85°C±3°C/30min, 32cycle	<p>Step 1: Test VSWR (by jig for antenna only elements/no PCB). Step 2: Put it in the chamber. Step 3: Test it like this picture which explains temp. cycle. Step 4: Test VSWR after 1hr in normal Temp. & normal Humidity</p>

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NO	Test Type	Items	Test condition	Test method
6	Reflow test	Reflow test	Pre Heating 200°C±5°C 30~60sec Peak Heating 260°C±5°C 30sec Max	 <p data-bbox="1052 430 1396 541"> <u>Step 1:</u> Put it in REFLOW <u>Step 2:</u> Test it like this picture which explains temp. Cycle by EV board </p>

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6. Manufacturing and Assembly Guidelines

Ethertronics' Prestta Standard WLAN antennas are designed for high volume board assembly. Because different product designs use different numbers and types of devices, solder paste, and circuit boards, no single manufacturing process is best for all PCBs. The following recommendations have been determined by Ethertronics, based on successful manufacturing processes.

The metal antenna only and metal antenna with carrier solutions are designed for automated pick and place surface mounting. However, as with any SMT device, Ethertronics antennas can be damaged by the use of excessive force during the handling or mounting operation.

Component Handling Recommendations

The following are some recommendations for component handling and automated mounting:

- For manual mounting and handling, vacuum pens should be used to pick-up, transfer and mount the antennas.
- Take care not to deform the metal antenna

Metal Component Handling Recommendations

Ethertronics' metal antennas are not moisture sensitive and the antennas meet the requirements for a Level 1 classification of J-STD-020A (moisture/reflow sensitivity classification for non-hermetic solid state surface mount devices from the Institute for Interconnecting and Packaging Electronic Circuits). Nevertheless, as a precaution to maintain the highest level of solder ability, Ethertronics antennas are dry-packed.

(NOTE: Normal oxidation may result in a slight discoloration of the gold nickel surface. This has no effect on the performance of the antenna.)

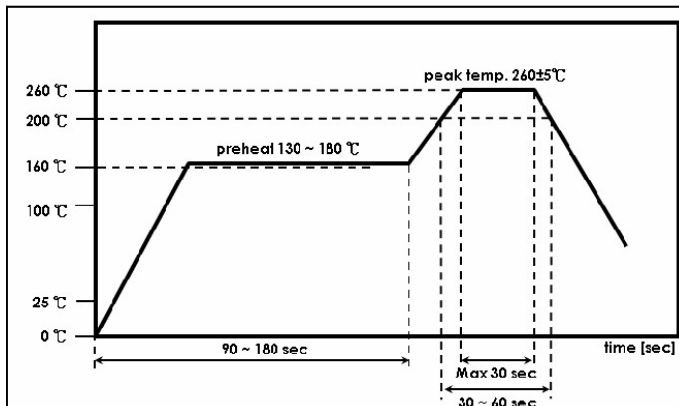
Paste Stencil Recommendation

Ethertronics recommends application of paste stencil to a thickness of 0.1mm, applied to within 0.05 mm of the solder mask surrounding each exposed metal pad on the PCB. PCB layouts for each antenna are provided below.

Soldering Recommendations

The recommended method for soldering the antenna to the board is forced convection reflow soldering. The following suggestions provide information on how to optimize the reflow process for the ceramic antenna:

- Adjust the reflow duration to create good solder joints without raising the antenna temperature beyond the allowed maximum of 260° C.



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Cleaning Recommendations

After the soldering process, a simple wash with de-ionized water sufficiently removes most residues from the PCB. Most board assembly manufacturers use either water-soluble fluxes with water wash, or “no clean” fluxes that do not require cleaning after reflow.

Acceptable cleaning solvents are CFC alternatives, Isopropyl Alcohol (IPA), and water. If the application uses other types of solvents, please consult with Ethertronics.

Cleaning processes that should be avoided are ultrasonic cleaning and any abrasive techniques, such as scrubbing with an abrasive material.

Rework & Removal Recommendations

There may be a need to rework or remove the antenna from the PCB. Although Ethertronics’ antennas are designed for ease-of-use, use care when separating them from the PCBs. Careless heating or removal of the antenna can cause thermal, mechanical or lead damage. These degradations may render the antenna useless, impeding any failure analysis and preventing the reuse of the device. Therefore it is recommended to observe the following precautions:

- The component can be reworked and soldered by hand using a soldering iron. However care should be used so the temperature does not exceed 260°. The soldering iron should not touch the composite material while soldering the leads of the antenna.
- The component can be reworked and soldered using a hot air rework station. However, care should be taken to ensure that the temperature does not exceed 260° C.
- Once the solder on the PCB is sufficiently heated, use a vacuum pen to lift the antenna straight up off the PCB. Avoid twisting or rotating the device while removing it.

Packaging Specifications

Tape & Reel

PN	Box Dims	Tape & Reel Dims	# Reels/Box	# Parts/Reel	# Parts/Box
1000146	350x370x290 mm	Φ330*32.4(H)	6	1,200	7,200

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7. Glossary of Terms

For a complete list of terms, please visit the Ethertronics Web site at www.ethertronics.com/resources/glossary/, or enter http://files.ctia.org/pdf/Telecom_Glossary_of_Terms.pdf into your browser.

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Appendix 1 Summary of Prestta™ Antenna Part No. 1000146

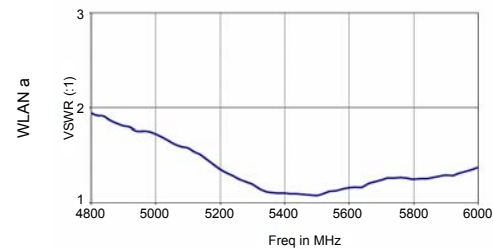
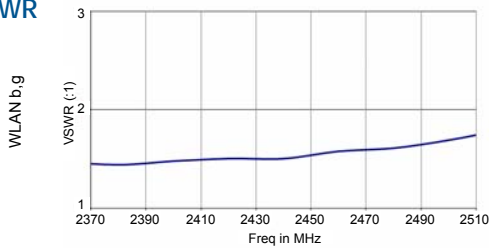
Electrical Specifications Typical Characteristics

WLAN a/b/g/n + Japan Antenna (GHz)	2.390-2.490 b, g	4.900-5.100 Japan	5.150-5.350 a	5.70-5.900 a
Peak Gain	1.5-2.5 dBi	1.5-3.5 dBi	2-3.5 dBi	2-3.5 dBi
Average Efficiency	81%	70%	75%	72%
VSWR Match	<1.6:1	<1.8:1	<1.5:1	<1.3:1
Feed Point Impedance	50 Ω unbalanced (other if required)			

Mechanical Specifications

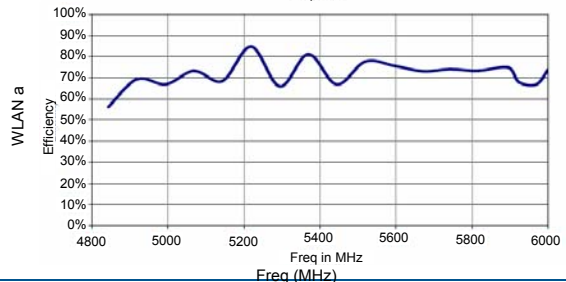
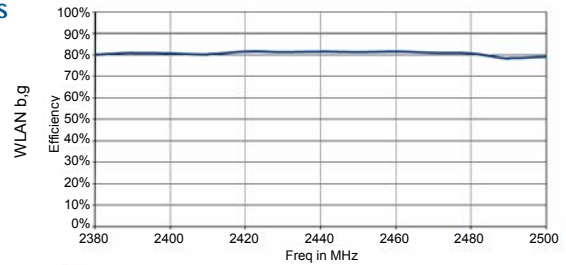
Dimensions	17.9 x 6.9 x 4.3 mm
Weight	.33 g

VSWR



Freq (MHz)

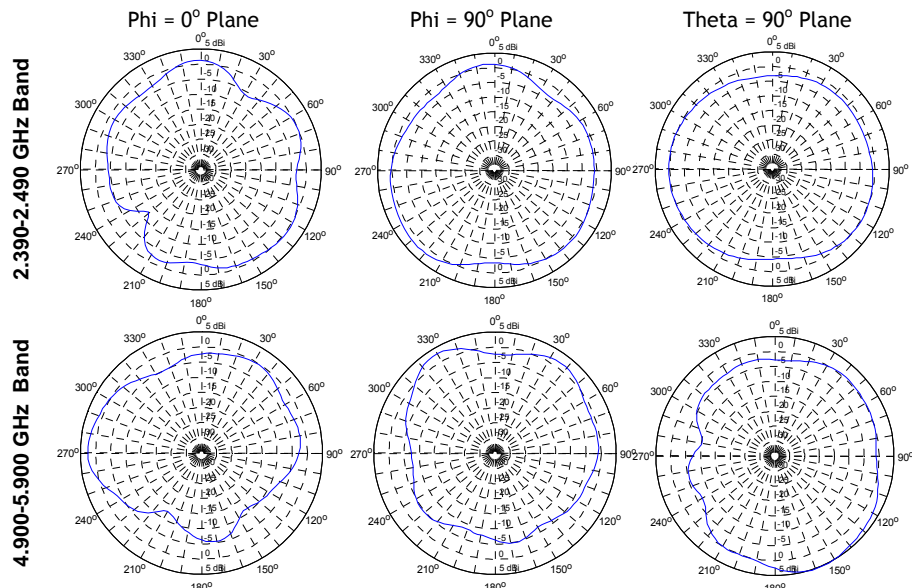
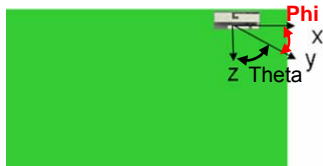
Efficiencies



Freq (MHz)

Antenna Radiation Patterns

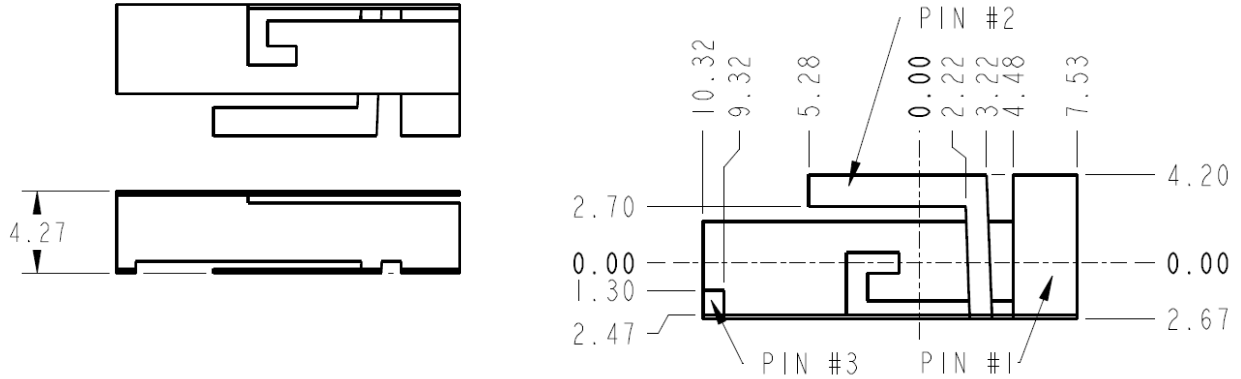
Typical Performance
Ethertronics' Test Board
PCB: 120 x 180 mm



Antenna Application Note

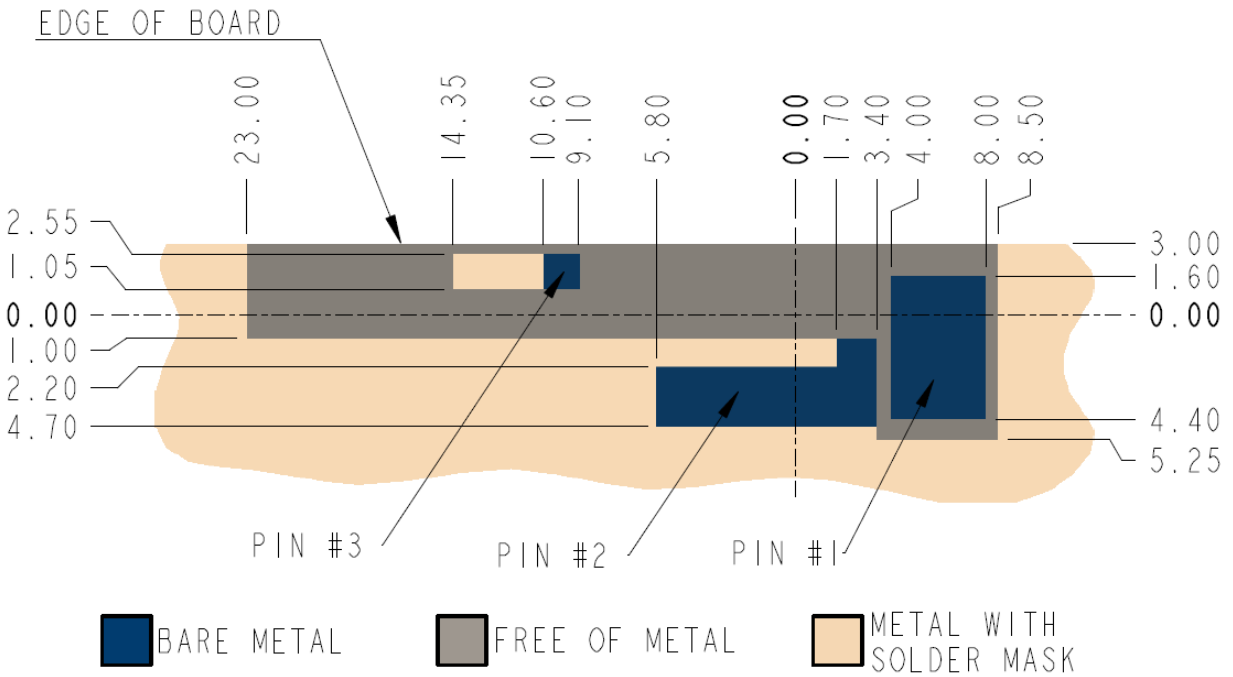
To optimize designs using Ethertronics' Prestta™ WLAN antenna, the PCB should use the recommended land pattern shown in the Figures below.

Antenna Pad Layout



Pin	Description
1	Feed
2	Ground
3	Dummy Pad

PCB Layout



Ethertronics provides antenna layout files in .DXF format. This is a universal file format and should be converted into your specific file format