2.4 GHz 3D Helix Chip Antenna

AANI-CH-0246

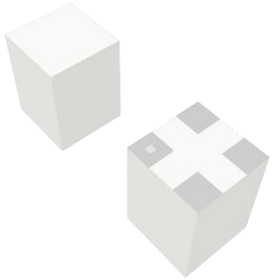
Request Samples

Check Inventory

3.0 x 3.0 x 4.0 mm
RoHS/RoHS II Compliant
MSL Level = 1

Description

This 2.4 GHz chip antenna uniquely integrates a 3D helix/spring radiator onto a ceramic chip body, combining the helix's small ground keep-out, tolerance to nearby metal, and flexible mounting with the ceramic's dramatic miniaturization. This antenna is available for on-ground and off-ground solutions. Measuring just 3.0 x 3.0 x 4.0 mm with a 5.7 × 6.9 mm keep-out, the AANI-CH-0246 delivers 4 dBi peak gain and > 69% average efficiency across 2400-2500 MHz. Supporting BLE, Wi-Fi, Thread, and Matter, this RoHS-compliant, MSL Level 1 antenna is ideal for hearables, wearables, smart home devices, and intelligent lighting systems.



Features

- 3D Ceramic Helix Antenna Construction
- Works Well "On-Ground" and "Off-Ground"
- Flexible Corner/End/Edge/Center Mounting
- Ultra-Compact 3.0 x 3.0 x 4.0 mm
- High Peak Gain: 4 dBi
- 69% Average Radiation Efficiency
- Small 5.7 x 6.9 mm Keep-Out
- RoHS Compliant | MSL Level 1

Applications

- Bluetooth®/ ZigBee / Thread / Matter/ Wi-Fi
- Bluetooth®/ Wi-Fi Modules
- Hearables & Wearables
- Smart Home & Smart Building
- Smart Metering
- Intelligent lighting

Ordering Information

Part Number	Description
AANI-CH-0246	2.4 GHz 3D Helix Chip Antenna on Cut Tape
AANI-CH-0246-T	2.4 GHz 3D Helix Chip Antenna on Tape & Reel

Note: Other options not listed may be available upon request via Abracon online support

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RoHS/RoHS II Compliant
MSL Level = 1

Electrical Specification

Parameter	Specification		Unit
	Off-Ground	On-Ground	
Operating Frequency	2400 - 2500		MHz
Return Loss	≤ -6	≤ -4.1	dB
VSWR	≤ 2.9	≤ 4.3	:1
Peak Gain	4		dBi
Maximum Efficiency	-1.25 (75)	-1.67 (68)	dB (%)
Average Efficiency	-1.61 (69)	-2.44 (57)	dB (%)
Minimum Efficiency	-2.08 (62)	-3.87 (41)	dB (%)
Polarization	Linear		-
Impedance	50		Ω
Radiation Pattern	Omni-directional		-
Input Power	≤ 2.0		W

Note: All measurements were conducted on the evaluation board in free space. Performance will vary depending on the ground plane, application, and environment.

Mechanical Specification

Parameter	Specification
Antenna Dimension	3.0 x 3.0 x 4.0 mm
Evaluation board Dimension	100 x 45 mm
Clearance Dimensions	5.7 x 6.9 mm
Mounting Type	Surface Mount
Mounting Location	PCB Corner Mount

Environmental Specification

Parameter	Specification
Operating Temperature	-40ºC ~ +85ºC
Storage Temperature	-10ºC ~ +40ºC
Storage Relative Humidity	70% (Max.)
MSL Level	1
RoHS Complaint	Yes

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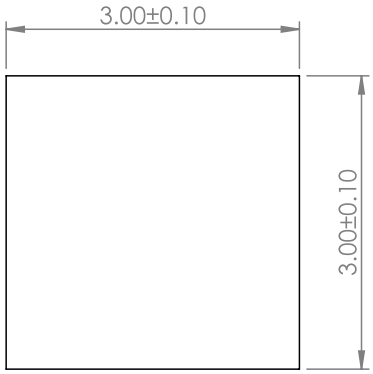
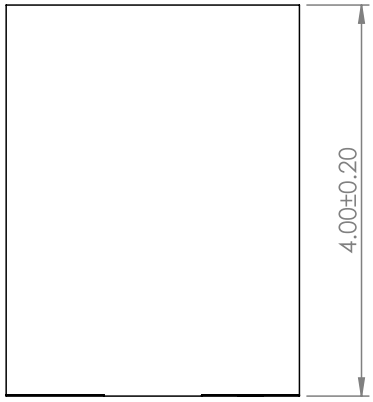
MSL Level = 1

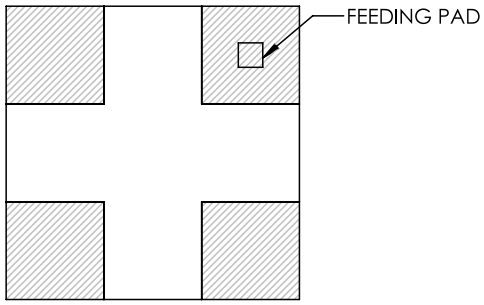
Product Dimensions & Recommended Land Pattern



TOP VIEW

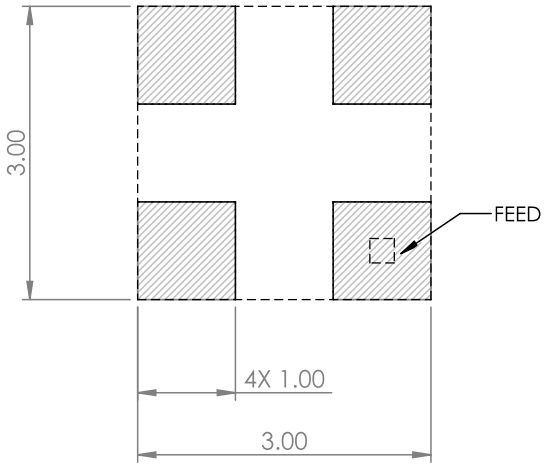


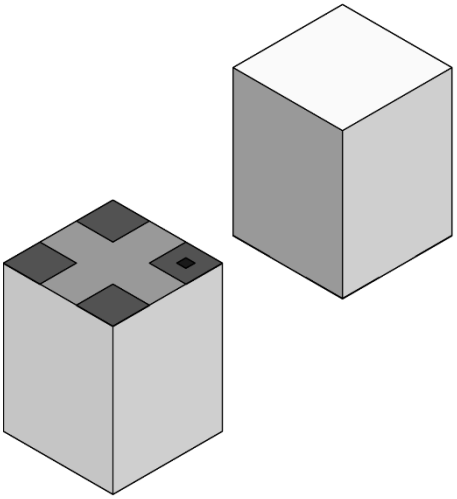
FRONT VIEW



BOTTOM VIEW

RECOMMENDED LAND PATTERN





Unit : mm

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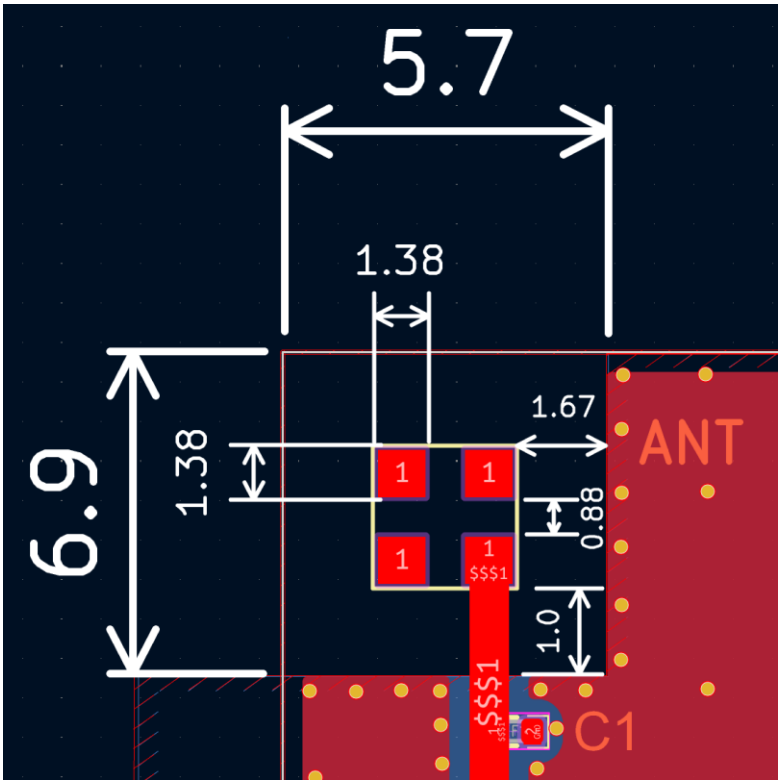
3.0 x 3.0 x 4.0 mm
RoHS/RoHS II Compliant
MSL Level = 1

Clearance Dimensions

For the “Off-Ground” version, a clearance area of 5.7 × 6.9 mm is required on both the top and bottom sides of the EVB. For the “On-Ground” version, the top layer still requires a 5.7 × 6.9 mm clearance area, while the bottom layer can be fully covered with metal.



Unit : mm

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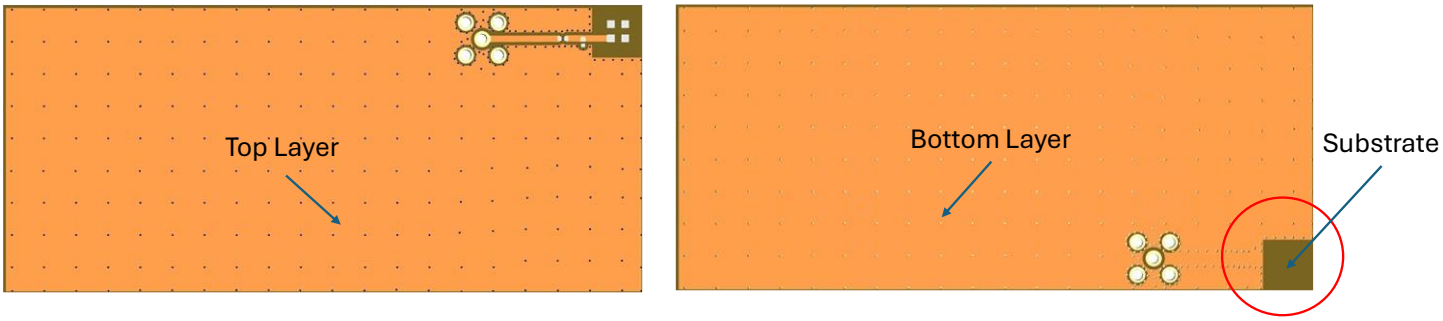
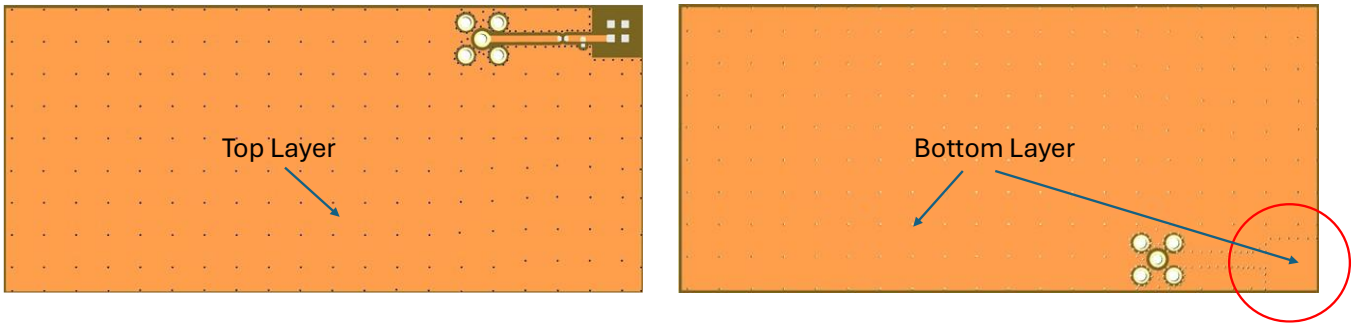
MSL Level = 1

Off-Ground and On-Ground

Off-Ground version



On-Ground version



Top view of PCB without solder mask

Bottom view of PCB without solder mask

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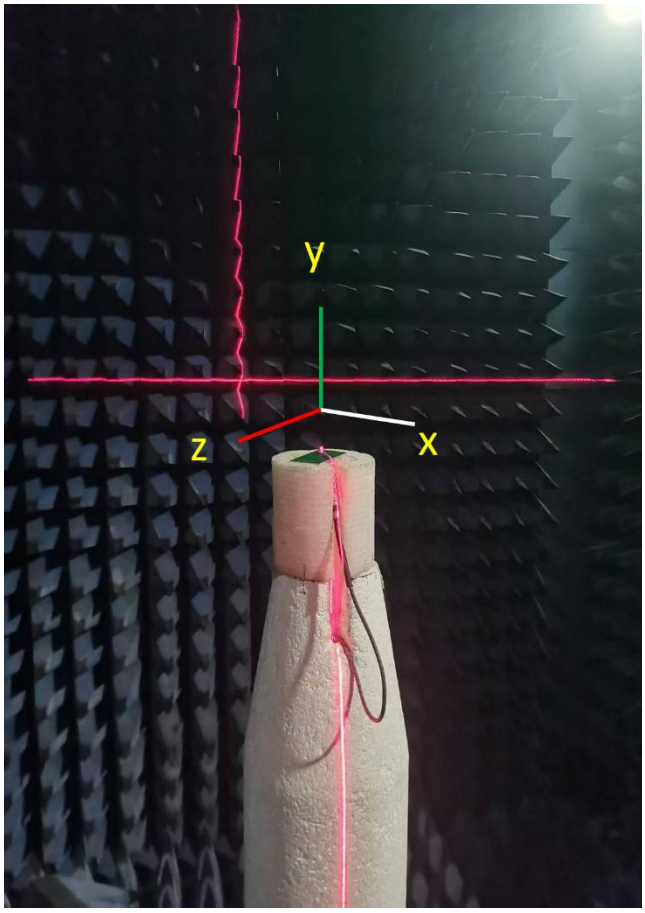
RoHS/RoHS II Compliant
MSL Level = 1

Measurement Setup photo



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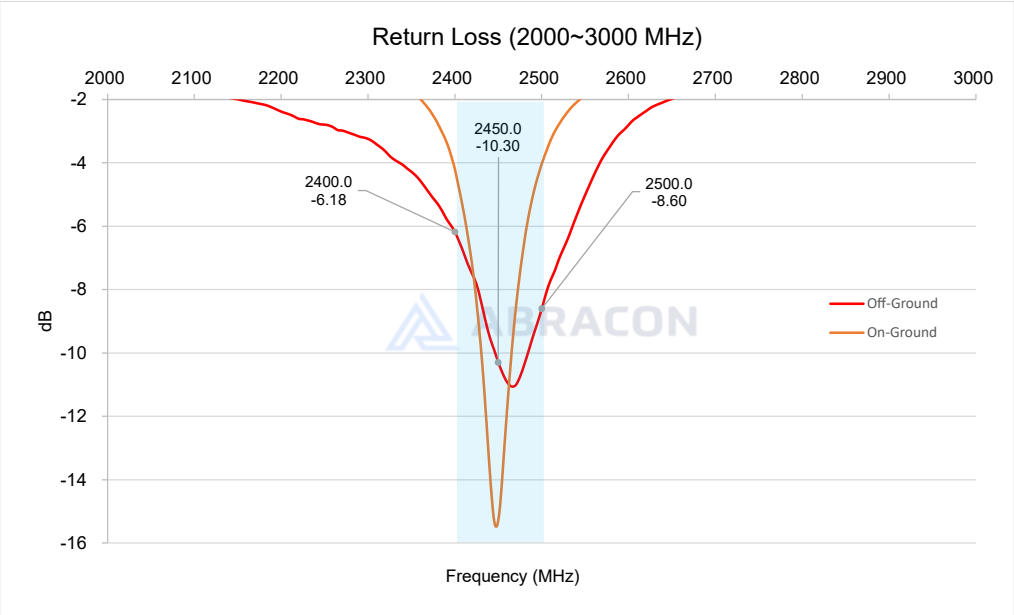
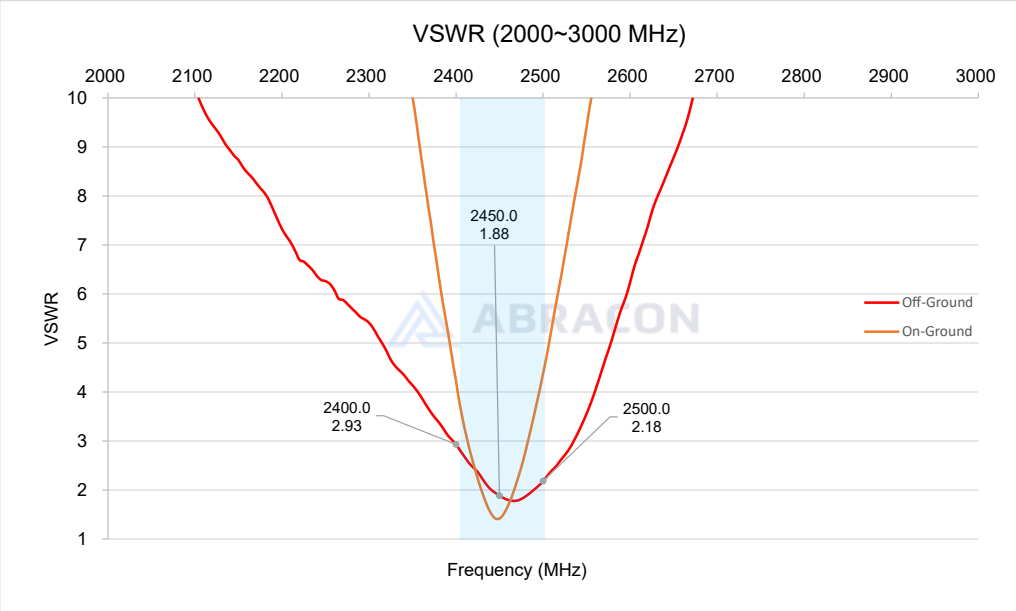
Request Samples Check Inventory

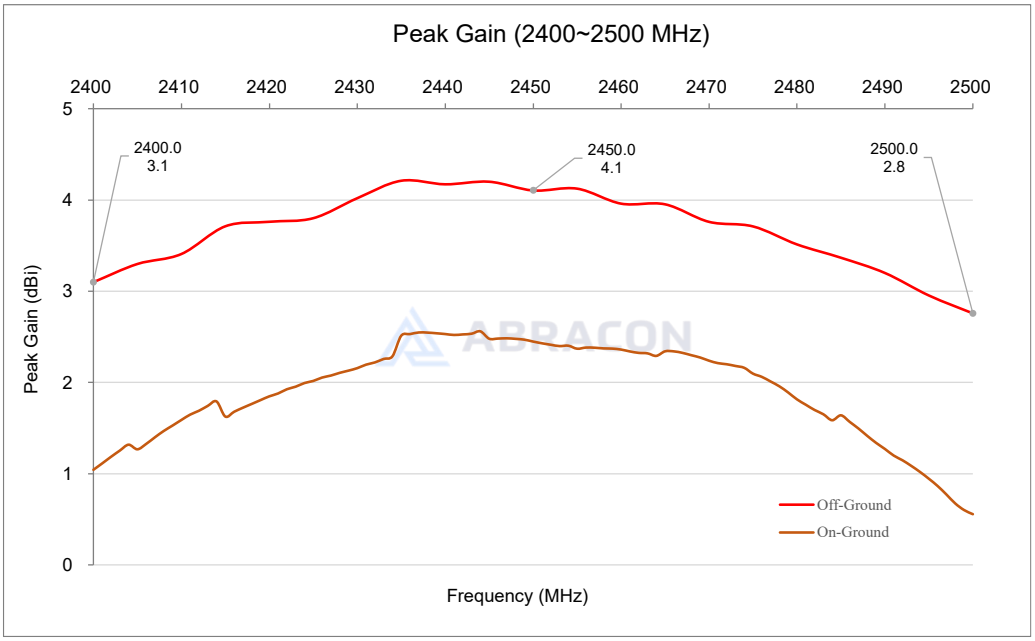
3.0 x 3.0 x 4.0 mm
RoHS/RoHS II Compliant
MSL Level = 1

Reflection Characteristics – Return Loss & VSWR

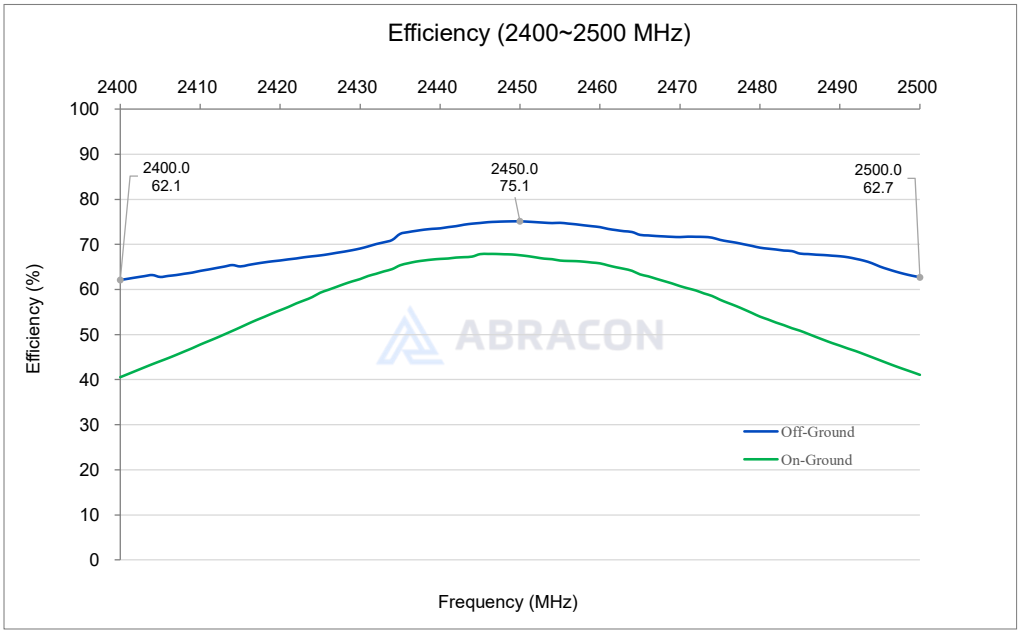




Radiation Characteristics – Peak Gain



Radiation Characteristics – Total Efficiency (%)



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3.0 x 3.0 x 4.0 mm
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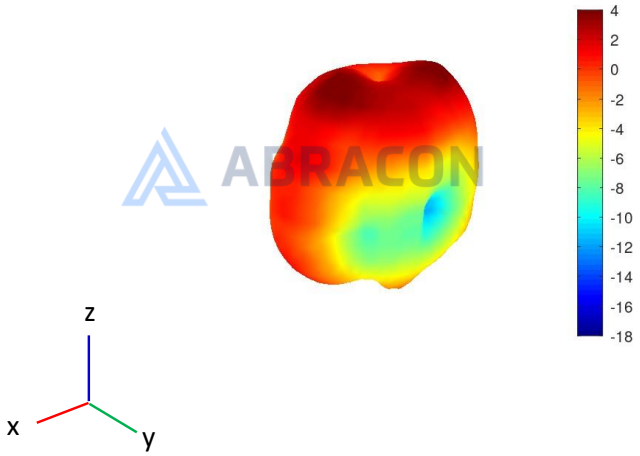
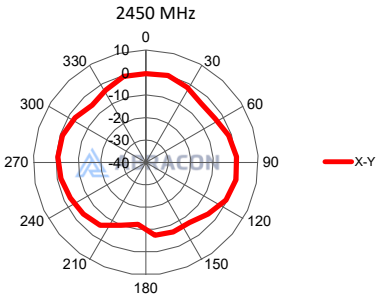
MSL Level = 1

Radiation Characteristics – 3D & 2D pattern (Off-Ground)

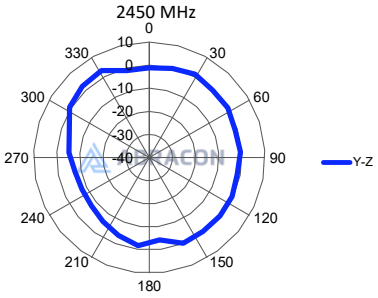
2450MHz



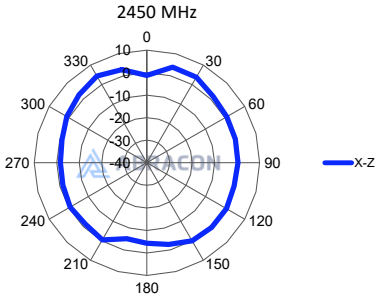
XY plane



YZ plane



XZ plane



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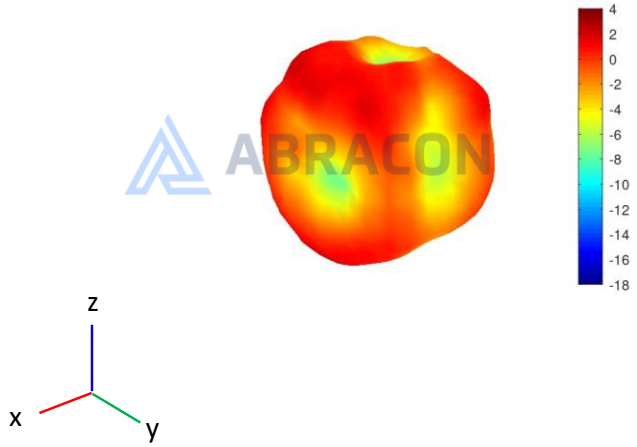
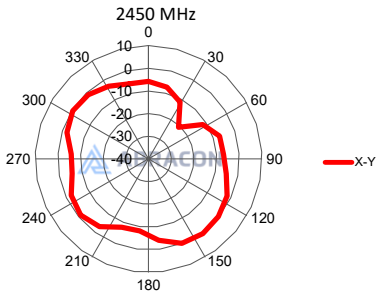
Radiation Characteristics – 3D & 2D pattern (On-Ground)

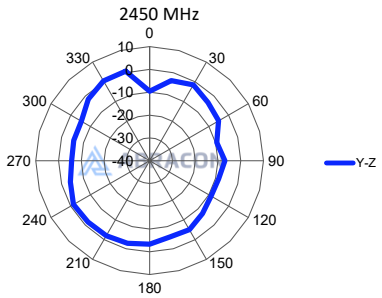
2450MHz



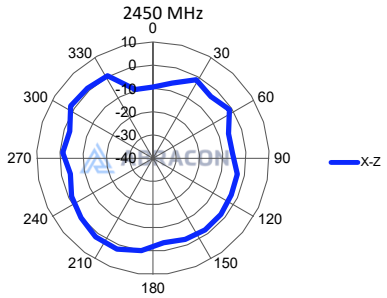
XY plane



YZ plane



XZ plane



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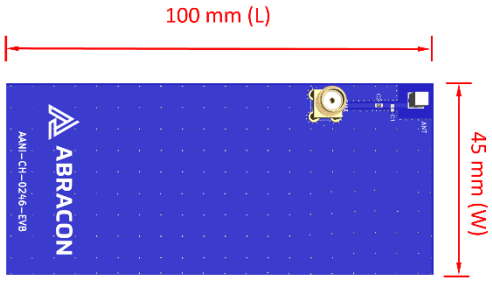
Evaluation Board Outline & Matching Circuit

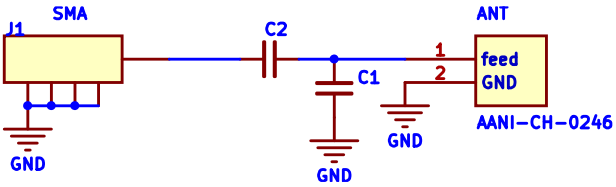
The evaluation board (Abracon AANI-CH-0246-EVB) is developed to simplify antenna testing and evaluation. It has a size of 100mm(L) x 45mm(W) and includes an SMA connector. The purpose is to give a reference design for an optimal antenna implementation. The evaluation board can also be used to test other implementations by cutting and soldering the PCB into any device.



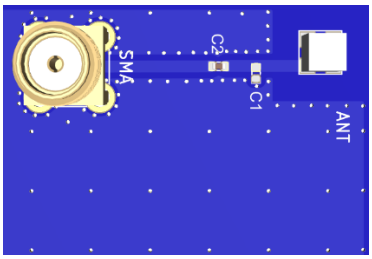
The evaluation board has a matching circuit implemented next to the antenna. This is aimed at enabling optimization possibilities for the user. The component positions are sized for 0402 (1005 metric) SMD components.

The antenna requires a matching circuit to fine-tune the resonant frequency and achieve optimal balance. The evaluation board is pre-tuned for optimal performance in the 2.4 - 2.5 GHz range using the components listed below (equivalents may be used):

Schematic



Layout



Component	Description	Off-Ground	On-Ground
ANT.	2.4 GHz 3D Helix Chip Antenna	AANI-CH-0246-T	AANI-CH-0246-T
C1	Matching Component 1	NC	1 pF (0402 / 1005 Metric)
C2	Matching Component 2	2.2 pF (0402 / 1005 Metric)	2.4 pF (0402 / 1005 Metric)

**However, it is common that the resonant frequency will shift during implementation in an arbitrary device. Therefore, this matching may be changed with other values/components/brands for compensation of such effects.

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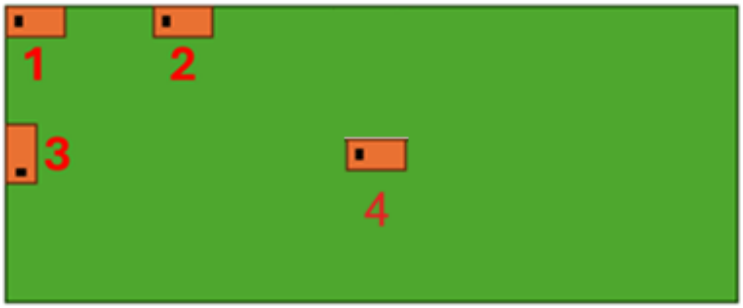
General Implementation Guidelines

The antenna can be positioned in different ways, although there are some positions which are more beneficial. The illustration below shows a typical PCB with examples on two different antenna positions:

- The optimal position is usually Option 1; however, Options 2, 3, and 4 are also possible.



Plastic and metal parts near the antenna can significantly affect tuning and performance. For example, a plastic housing above the antenna often shifts the resonant frequency downward. Because these effects are difficult to predict without detailed design information, antenna performance should be measured in the final device after implementation. To offset possible frequency shifts, a matching network on the antenna feed is recommended.

Another general consideration for surface-mounted antennas relates to PCB population. Electrical components placed near the antenna may impact its tuning and radiation performance. To mitigate this, components in the surrounding area should be positioned below a topographical slope. This slope should begin at the PCB level near the antenna's designated keep-out zone and gradually increase in height as distance from the antenna grows.

For technical assistance, please contact Abracon online support through our online support platform.

Reflow Profile [JEDEC J-STD-020]

Solder paste: Sn/3.0Ag/0.5Cu

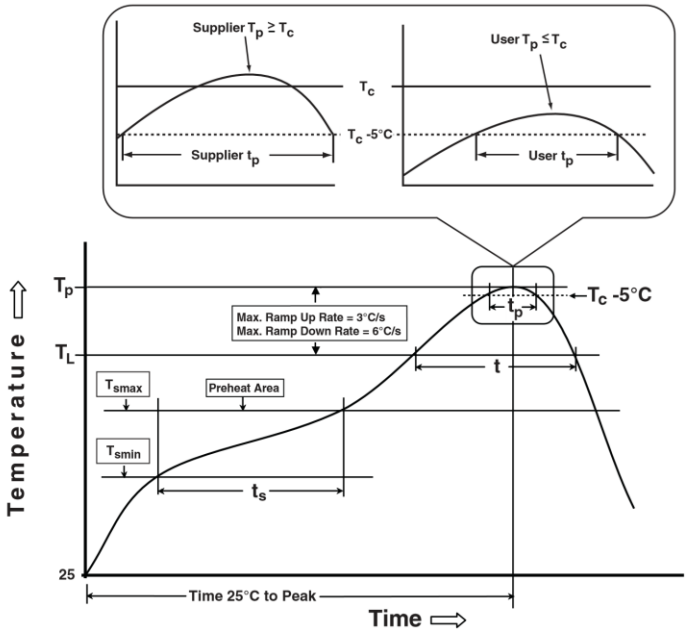


Table 1

SnPb Eutectic Process Classification Temperatures (T_c)		
Package Thickness	**Volume mm³ <350**	**Volume mm³ ≧350**
<2.5mm	235°C	220°C
≧2.5mm	220°C	220°C

Table 2

Pb-Free Process Classification Temperatures (T_c)			
Package Thickness	**Volume mm³ <350**	**Volume mm³ 350-2000**	**Volume mm³ >2000**
<1.6mm	260°C	260°C	260°C
1.6mm - 2.5mm	260°C	250°C	245°C
>2.5mm	250°C	245°C	245°C

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat / soak		
Temperature minimum (T_{smin})	100°C	150°C
Temperature maximum (T_{smax})	150°C	200°C
Time (T_{smin} to T_{smax}) (t_s)	60 – 120 sec.	60 – 90 sec.
Average ramp-up rate (T_{smax} to T_p)	3°C/sec. max	3°C/sec. max
Liquidous temperature (T_L)	183°C	217°C
Time at Liquidous (T_L)	60 – 150 sec.	60 – 150 sec.
Peak package body temperature (T_p)*	**See Table 1**	**See Table 2**
Time (T_p)** within 5°C of the specified classification temperature (T_c)	20 sec.	10 sec.
Ramp-down rate (T_p to T_{smax})	6°C/sec. max	6°C/sec. max
Time 25°C to peak temperature	6 min. max	8 min. max
Reflow cycles	2 max	2 max

*Tolerance for peak profile temperature (T_p) is defined as a supplier minimum and a user maximum.
**Tolerance for time at peak profile temperature (t_p) is defined as a supplier minimum and a user maximum.

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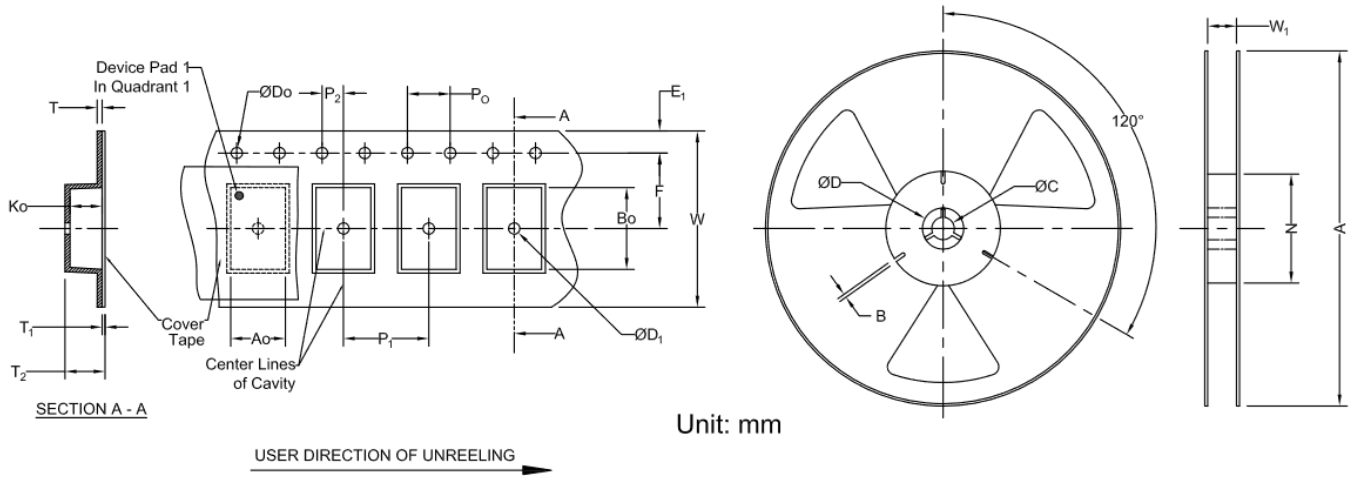
Packaging

Tape & Reel dimensions:



Carrier Tape Specifications (mm)										
Do	K_0	E_1	P_0	F	P_1	P_2	W	A_0	B_0	Reel Qty
1.55 + 0.05	4.3 ± 0.1	1.75 ± 0.1	4.0 ± 0.1	7.5 ± 0.1	8.0 ± 0.1	2.0 ± 0.05	16.0 ± 0.3	3.26 ± 0.1	3.26 ± 0.1	1,800

Reel Specifications (mm)				
A	W_1	N	C	D
330 ± 2.0	12.5 ± 0.5	100	13	21

ATTENTION: Abracon LLC's products are Commercial-Off-The-Shelf ('COTS'), which are designed, intended, and validated for use in commercial, industrial, and automotive applications. The customer is responsible for testing and verifying the performance of an Abracon solution to meet their system-level requirements.

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