# SPECIFICATION

**Part No.** : **HA.31.A**

**Description** : 915MHz 2dBi
Embedded Helical Monopole Antenna

**Features** : Quarter wave-length Monopole Helical Antenna
915MHz ISM Band
2dBi peak gain and 68% efficiency
Direct mounted on board design
Mechanically sturdy in a compact size
Dimensions: 10.7mm, Ø10.2mm
RoHS compliant

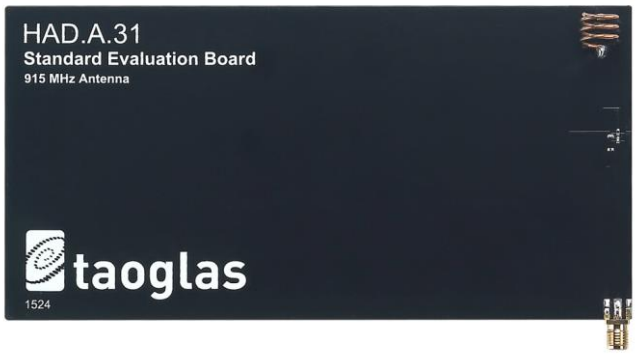
# 1. Introduction

The HA.31.A is an ISM 915MHz quarter wave-length monopole antenna. This helical coil antenna is perfect for your smart meter, smart security system, remote asset monitoring, and other wireless communication devices.

The helical coil antenna has a 2dBi Peak gain and a 68% efficiency at 915MHz on a 126.8 x 80.1mm ground plane with matching components (orthogonally mounted to ground plane, see HAD.B.31 performance).

Made of copper alloy, the helical coil is mechanically sturdy, with a wide-bandwidth. It can be easily mounted on the surface of your device main board by soldering. The antenna must be connected to a ground-plane to radiate efficiently.

Taoglas provides HAD.A.31 and HAD.B.31 evaluation boards to show performance when two antennas are parallel mounted or orthogonally mounted to the ground plane. Small embedded antennas can easily detune and/or have reduced efficiency in different device environments. Taoglas provides matching, and other custom tuning, design and support services, subject to MOQ and NRE. Contact a regional Taoglas facility for details.

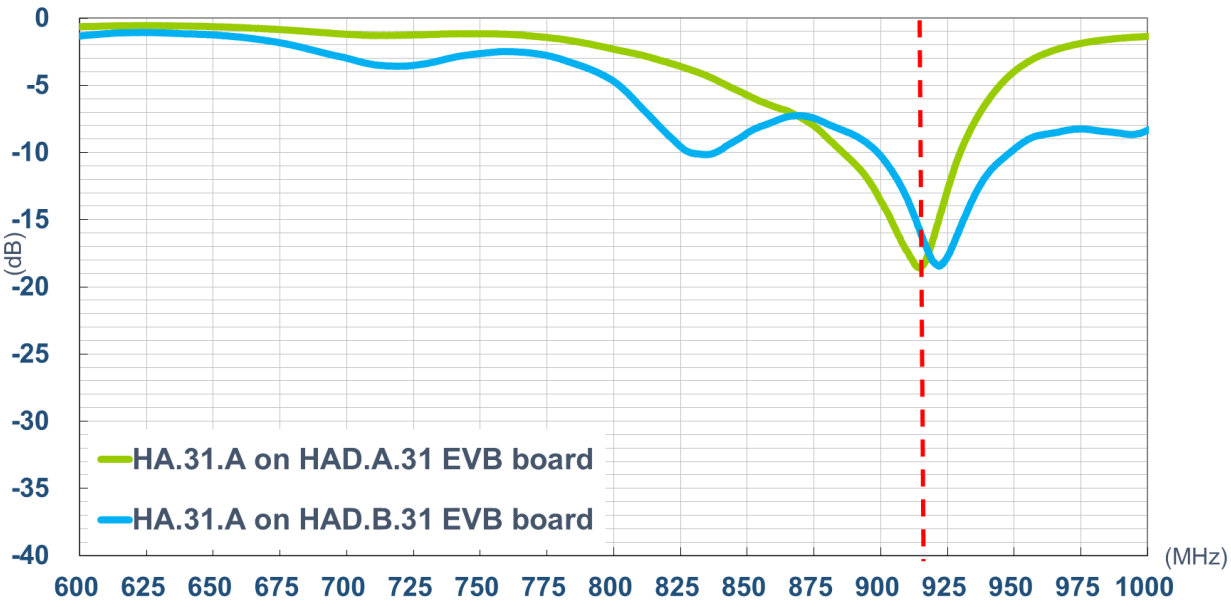


# 2. Specification

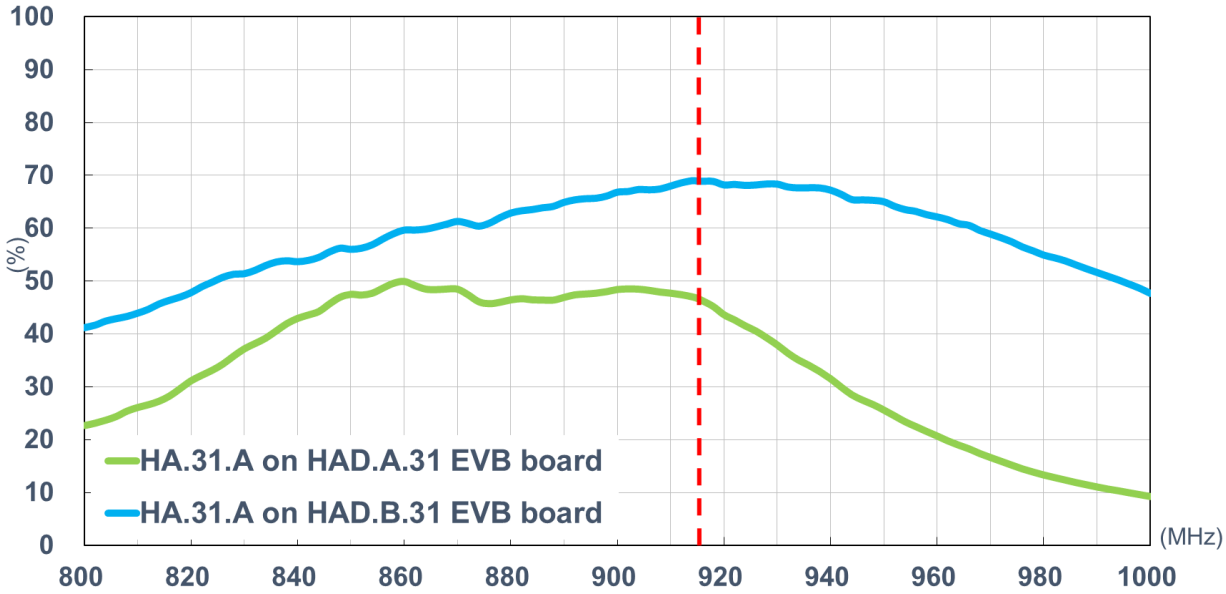
| ELECTRICAL | | | | | | |
|---|---|---|---|---|---|---|
| Application Bands | ISM 915MHz | | | | | |
| Mounting Direction | HAD.A.31 | | | HAD.B.31 | | |
| Frequency (MHz) | 902 | 915 | 928 | 902 | 915 | 928 |
| Return Loss (dB) | <-10 | | | | | |
| Peak Gain (dBi) | 0.41 | 0.05 | -0.74 | 1.89 | 2.09 | 2.04 |
| Average Gain (dBi) | -3.14 | -3.30 | -4.05 | -1.74 | -1.61 | -1.65 |
| Efficiency (%) | 48.51 | 46.73 | 39.28 | 66.95 | 68.94 | 68.37 |
| Polarization | Linear | | | | | |
| Impedance | 50 ohms | | | | | |
| MECHANICAL | | | | | | |
| Helical Coil Dimension (mm) | L: 10.7mm, Ø10.2mm | | | | | |
| Weight (g) | 0.7 | | | | | |
| ENVIRONMENTAL | | | | | | |
| Operation Temperature | -40°C to 85°C | | | | | |
| Humidity | Non-condensing 65°C 95% RH | | | | | |

# 3. Antenna Characteristics

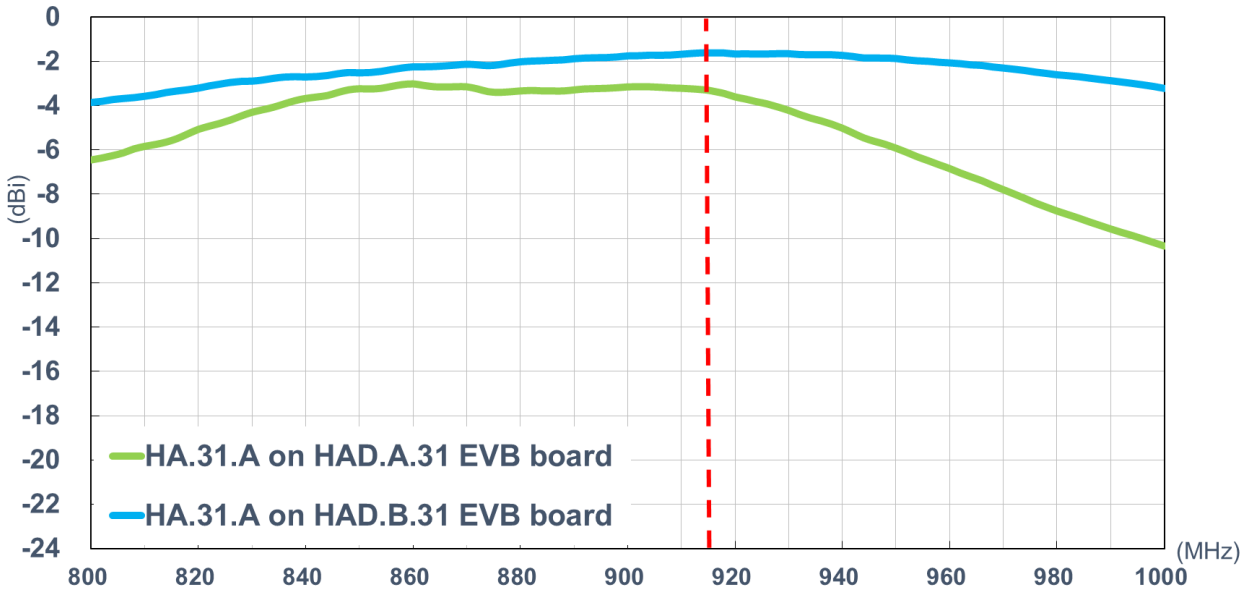
## 3.1 Return Loss



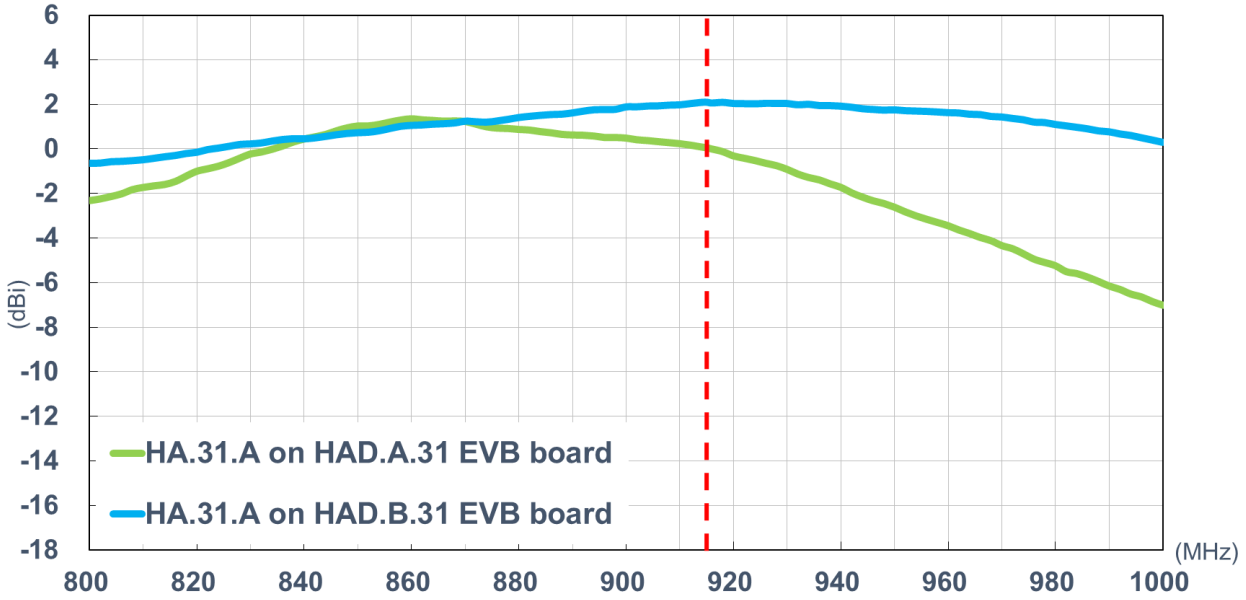

## 3.2 Efficiency



## 3.3 Average Gain



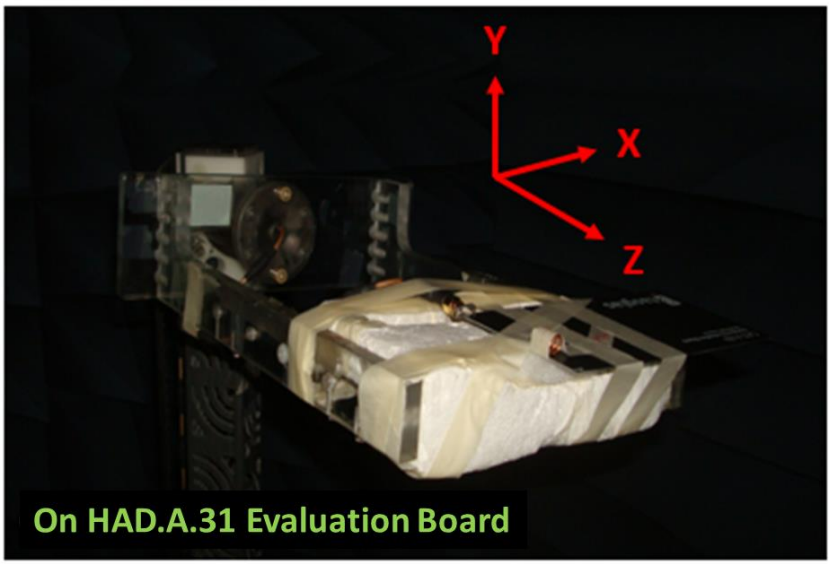

## 3.4 Peak Gain

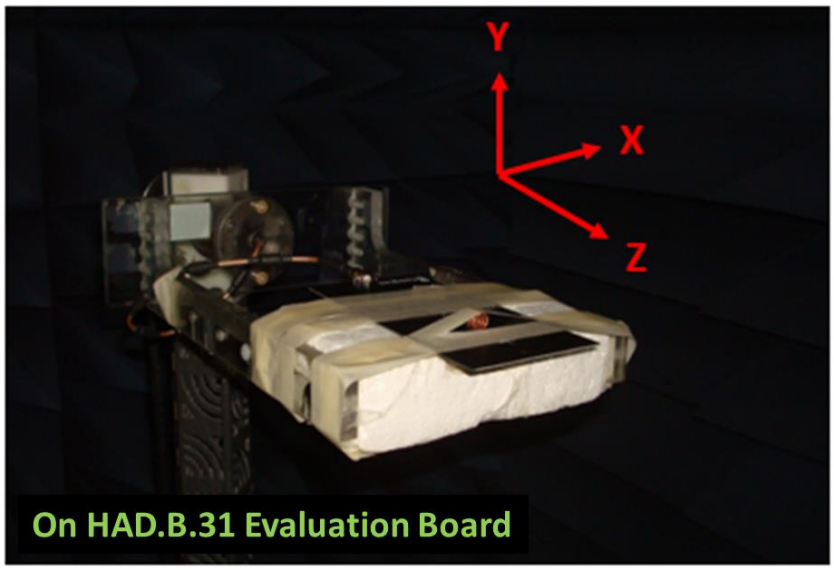


# 4. Antenna Radiation Pattern

## 4.1. Measurement Setup

The HA.31 antenna is tested on HAD.A.31 and HAD.B.31in a CTIA certified ETS-Lindgren Anechoic Chamber. The test setup is shown below.

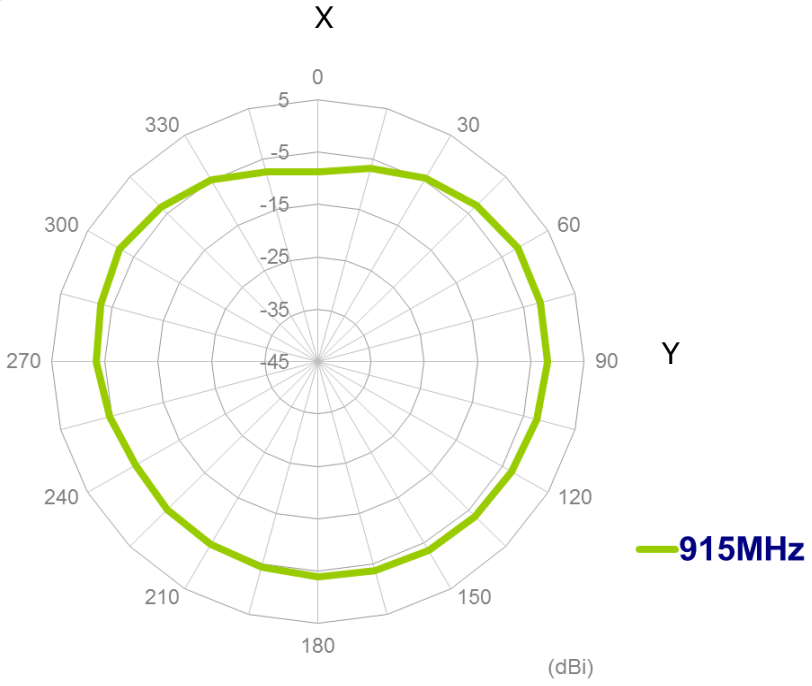


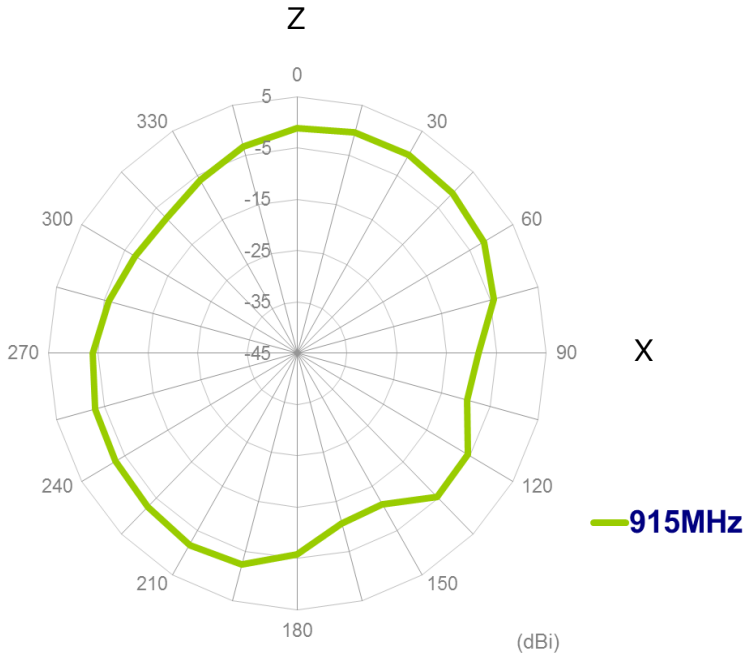
## 4.2. 2D Radiation Pattern

- **On HAD.A.31**

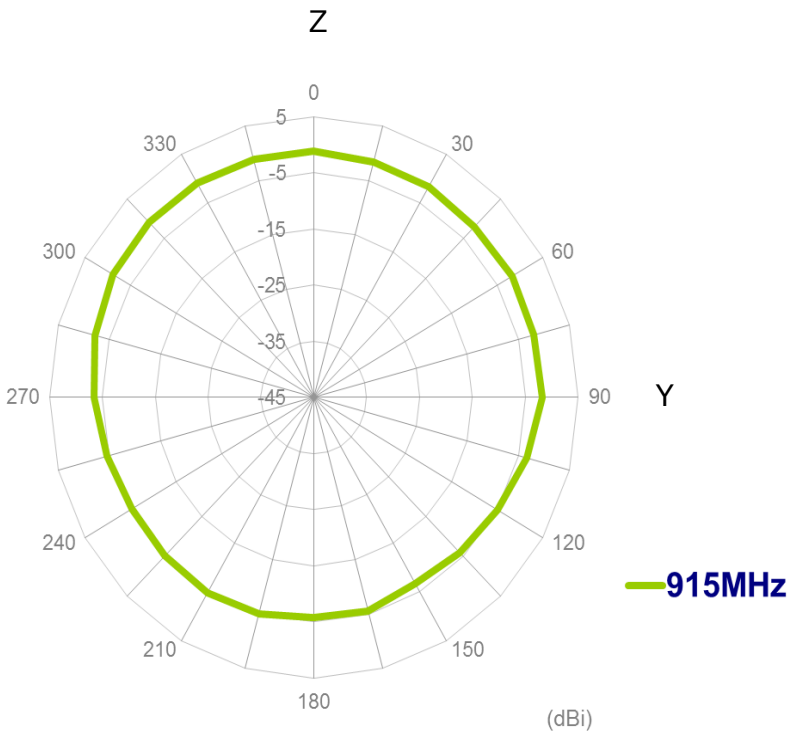
XY Plane



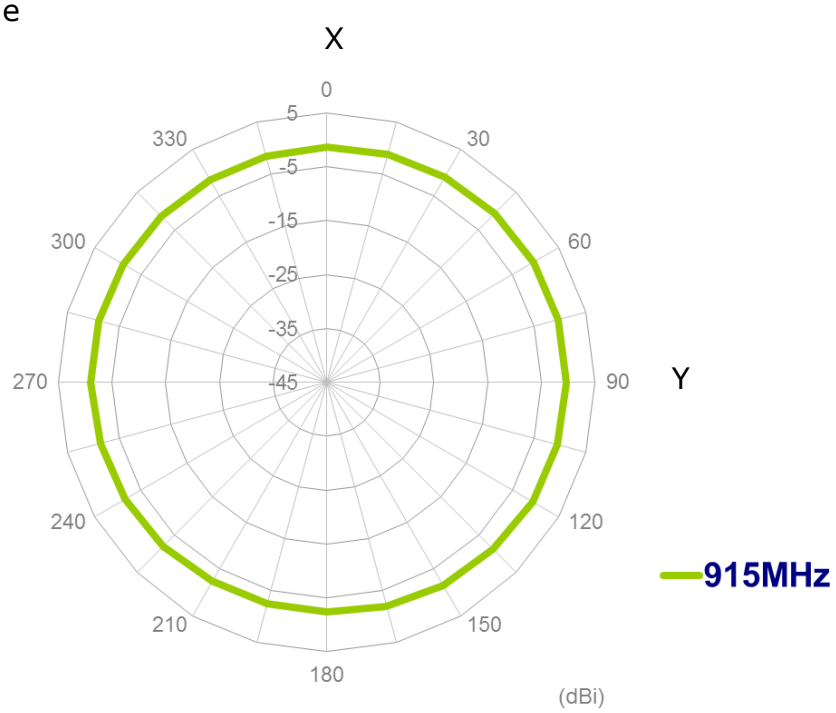

XZ Plane



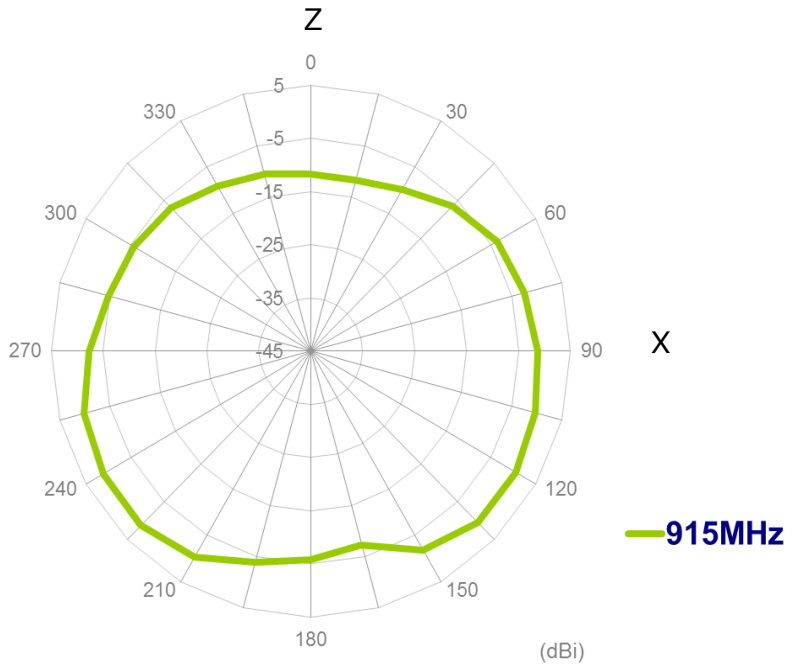
YZ Plane



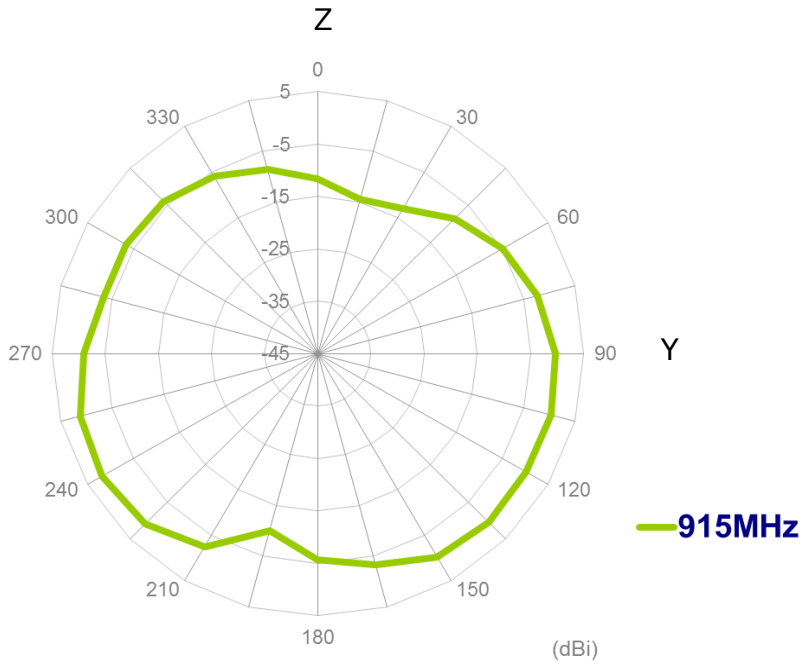

- **On HAD.B.21**
  - XY Plane



- XZ Plane



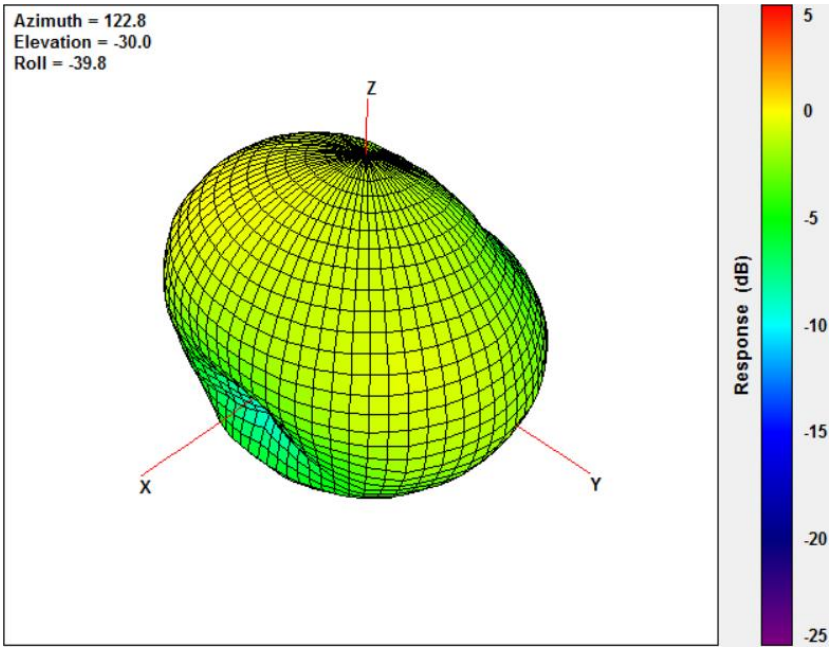

- YZ Plane



## 4.3. 3D Radiation Pattern

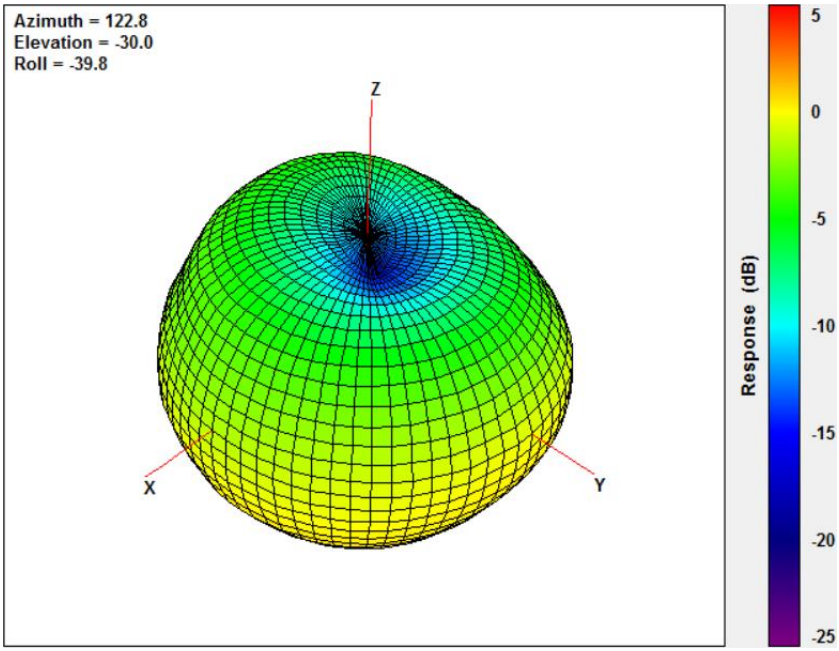
- **On HAD.A.31**

@915MHz



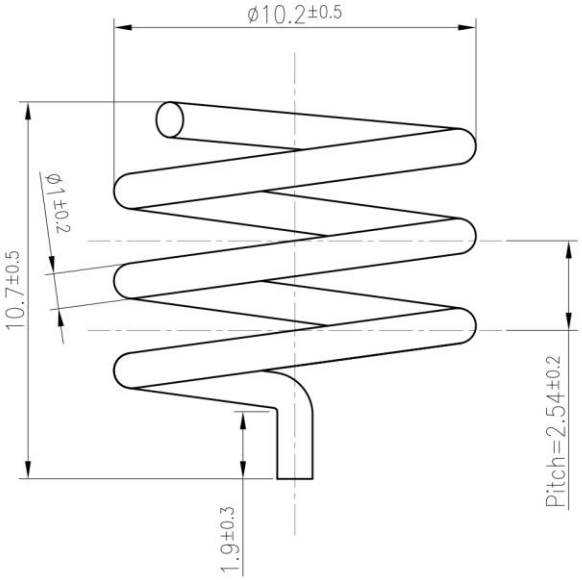

- **On HAD.B.31**

@915MHz

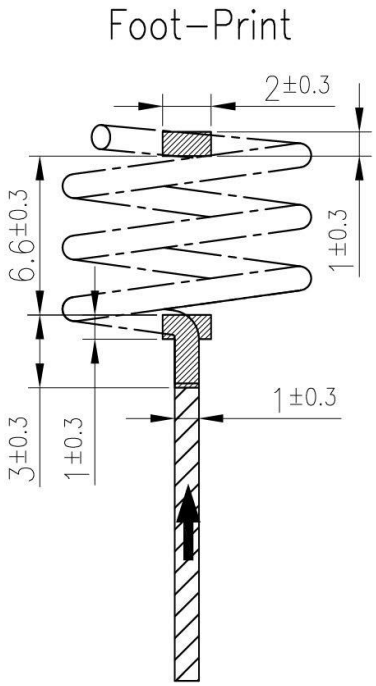


# 5. Mechanical Drawing (Unit: mm)

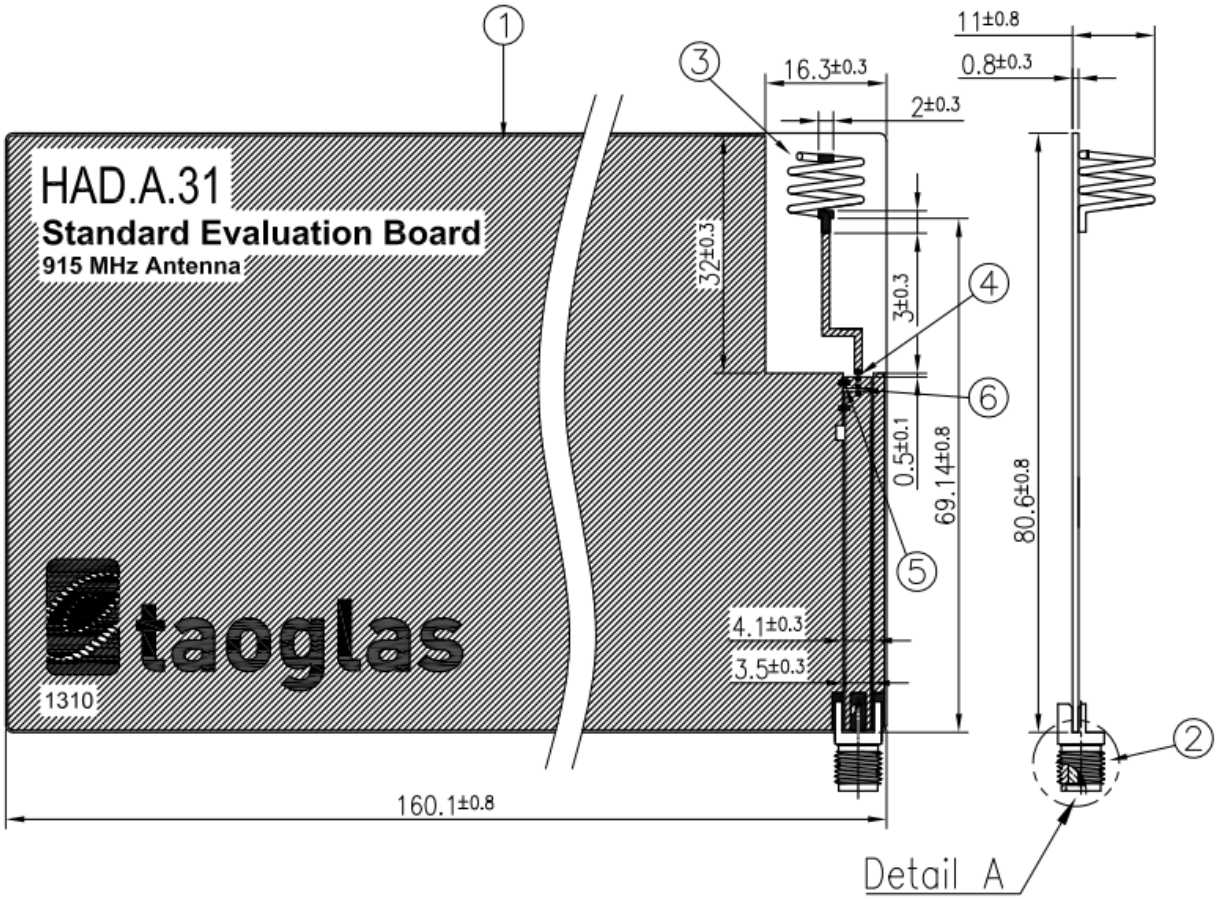
## 5.1 HA.31.A Antenna

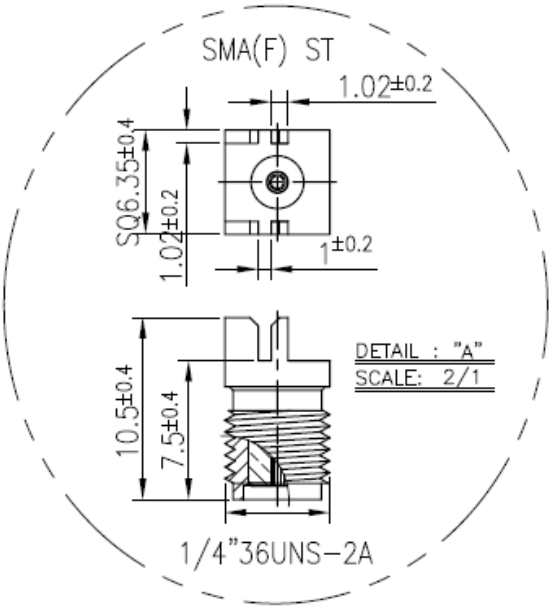



**PCB Footprint**



## 5.2 HAD.A.31 Evaluation Board

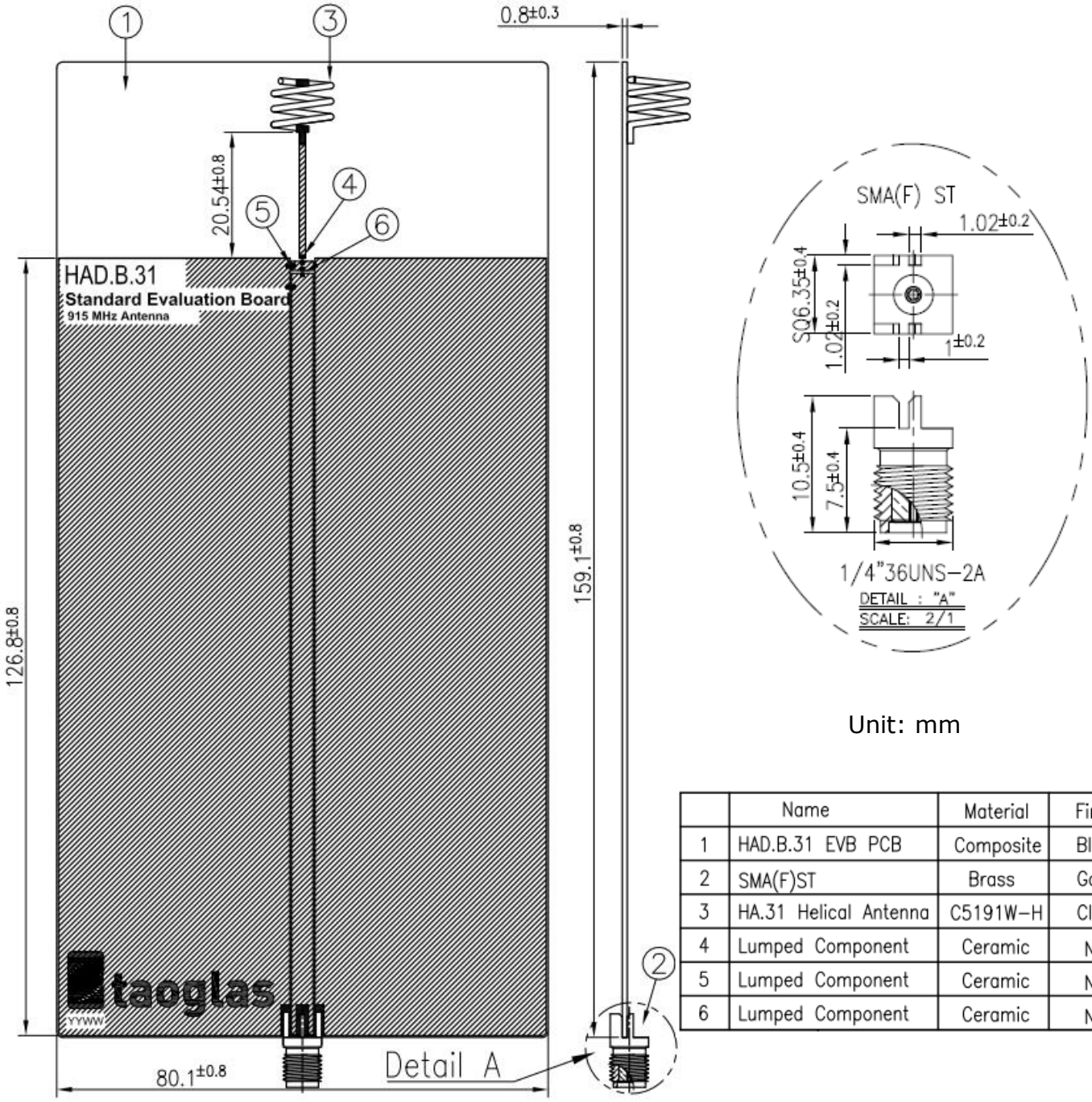



Unit: mm

| | Name | Material | Finish | QTY |
|---|---|---|---|---|
| 1 | HAD.A.31 EVB PCB | Composite | Black | 1 |
| 2 | SMA(F)ST | Brass | Gold | 1 |
| 3 | HA.31 Helical Antenna | C5191W-H | Clear | 1 |
| 4 | Lumped Component | Ceramic | N/A | 1 |
| 5 | Lumped Component | Ceramic | N/A | 1 |
| 6 | Lumped Component | Ceramic | N/A | 1 |

## 5.3 HAD.B.31 Evaluation Board



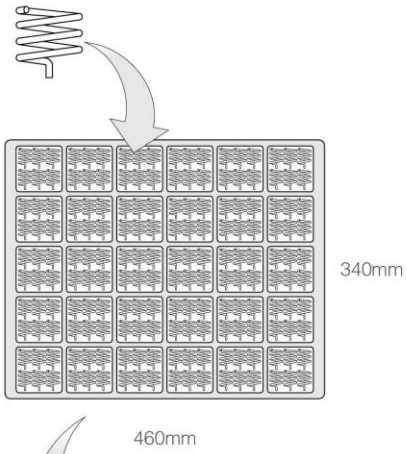

Unit: mm

| | Name | Material | Finish | QTY |
|---|---|---|---|---|
| 1 | HAD.B.31 EVB PCB | Composite | Black | 1 |
| 2 | SMA(F)ST | Brass | Gold | 1 |
| 3 | HA.31 Helical Antenna | C5191W-H | Clear | 1 |
| 4 | Lumped Component | Ceramic | N/A | 1 |
| 5 | Lumped Component | Ceramic | N/A | 1 |
| 6 | Lumped Component | Ceramic | N/A | 1 |

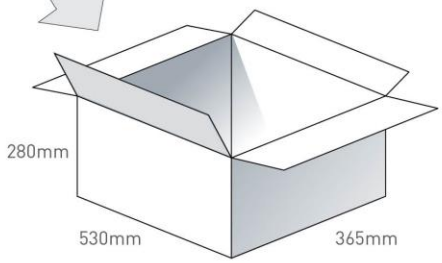
# 6. Packaging

## 6.1. HA.31.A Antenna

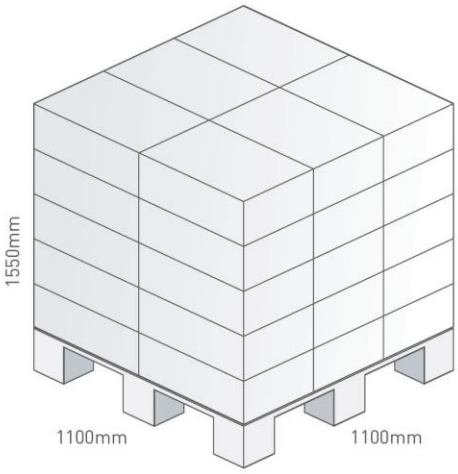
180 pcs HA.31.A per tray
Tray Dimensions - 460x340mm
Weight - 223g



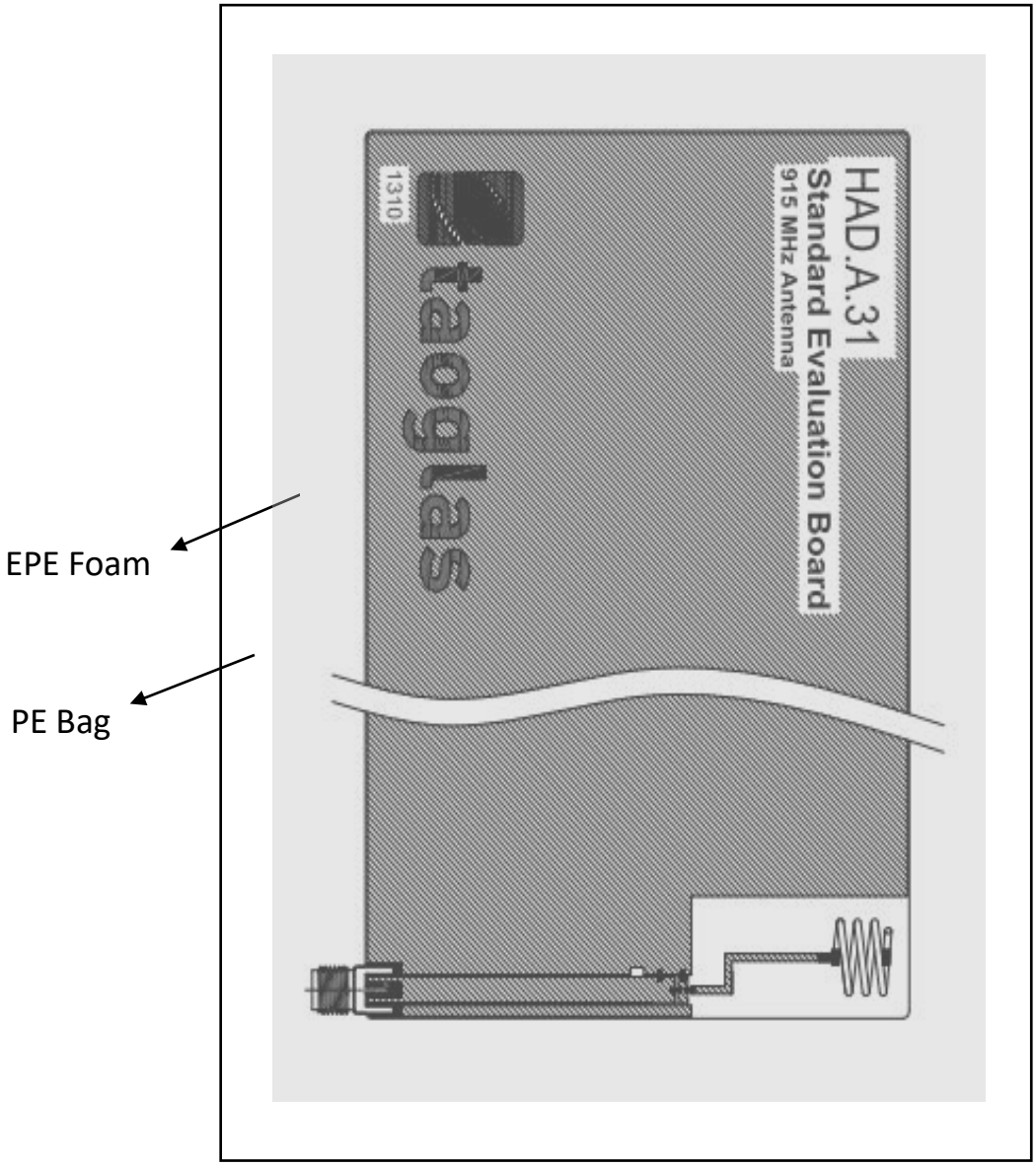

30 trays / 5400 pcs HA.31.A per carton
Carton dimensions - 530x365x280mm
Weight - 8Kg



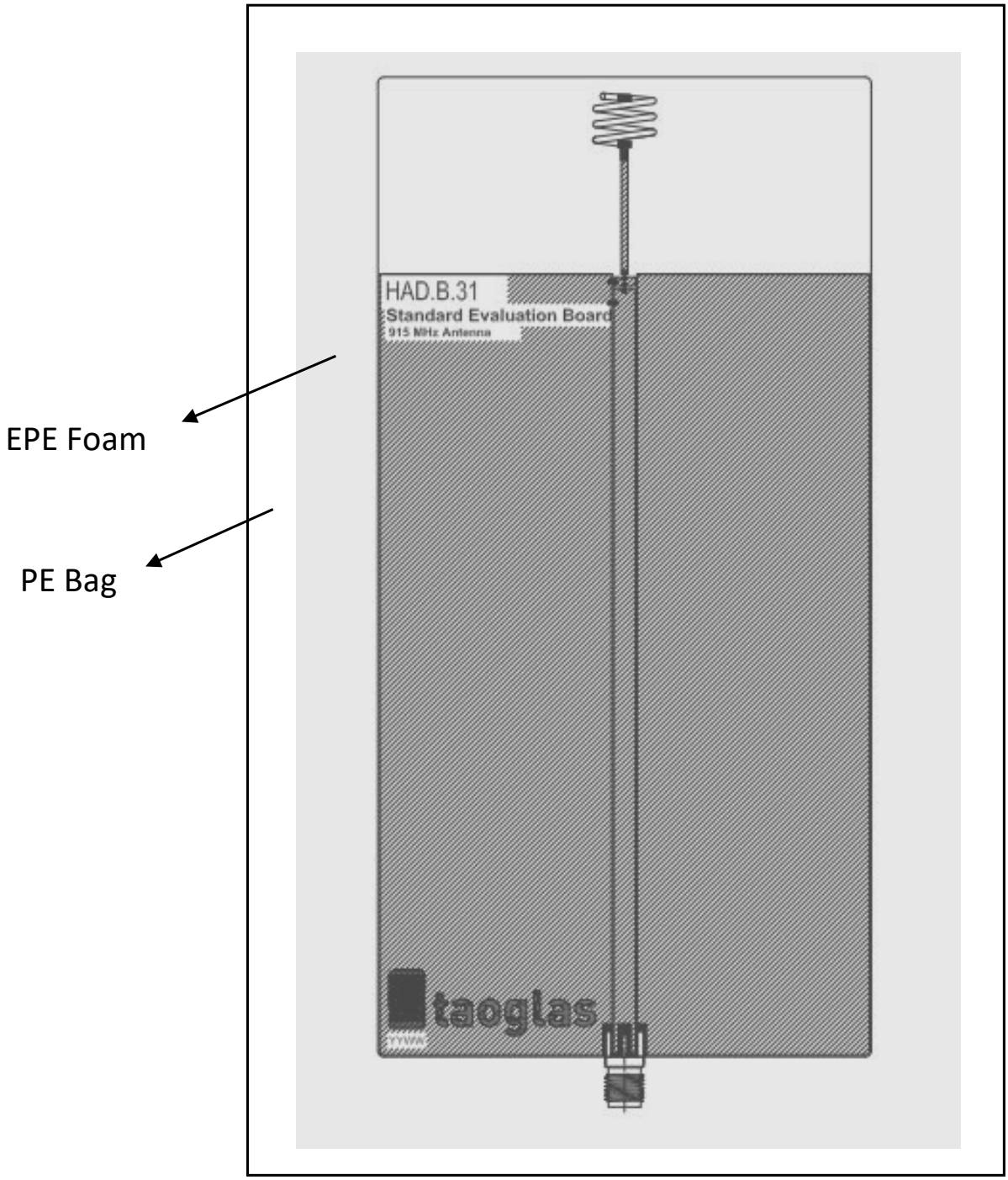

Pallet Dimensions 1100*1100*1550mm
30 Cartons per Pallet
6 Cartons per layer
5 Layers



## 6.2. HAD.A.31


HAD.A.31
Standard Evaluation Board
915 MHz Antenna
taoglas
1310
EPE Foam
PE Bag

## 6.3. HAD.B.31


EPE Foam
PE Bag
HAD.B.31
Standard Evaluation Board
915 MHz Antenna
taoglas
YYWW

# 7. Antenna Application Note

## 7.1 Matching Circuit for Different Ground Plane Variation

### 7.1.1 HAD.A.31 EVB Board

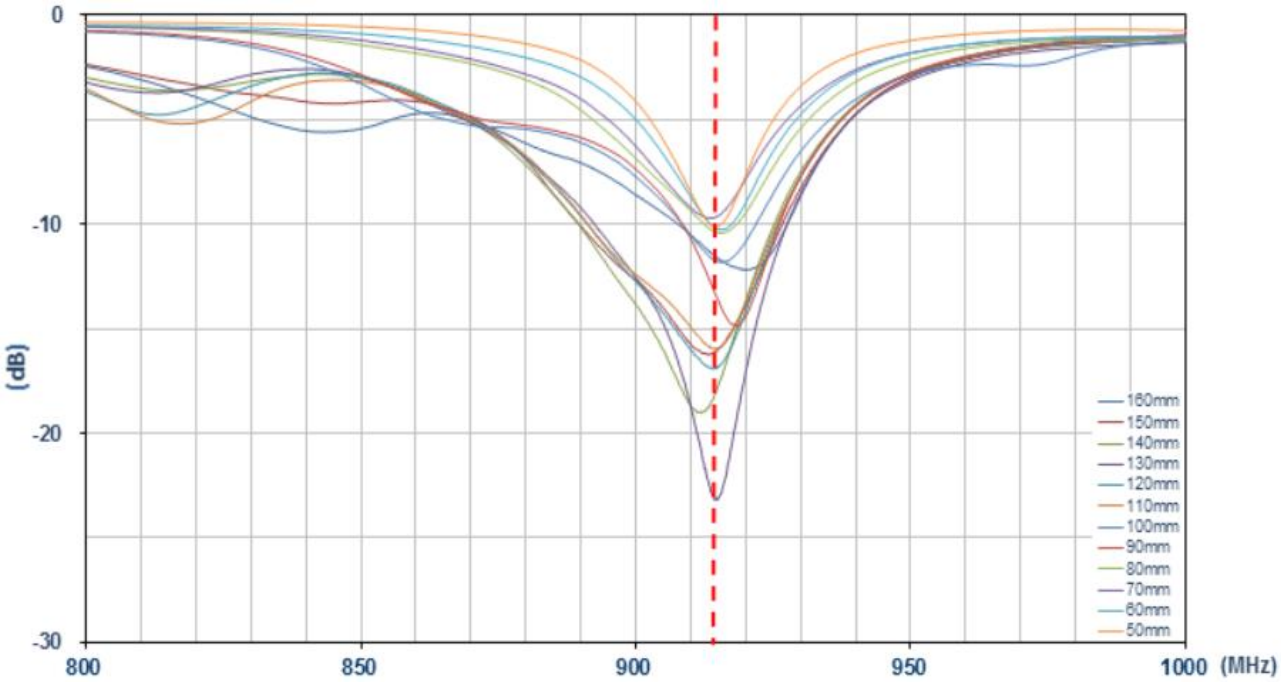
| HAD.A.31 | Ceramic 4 | Ceramic 5 | Ceramic 6 |
|---|---|---|---|
| 160mm | 0 ohm | 3pF | 1.5pF |
| 150mm | 0 ohm | 3.3pF | 1.5pF |
| 140mm | 0 ohm | 3.6pF | 1.5pF |
| 130mm | 0 ohm | 3.9pF | 1.5pF |
| 120mm | 0 ohm | 3.9pF | 1.5pF |
| 110mm | 0 ohm | 3.9pF | 1.5pF |
| 100mm | 0.5pF | 2pF | 1.5pF |
| 90mm | 0.5pF | 1pF | 1.5pF |
| 80mm | 0.5pF | open | 5.1nH |
| 70mm | 0.75pF | open | 3.9pF |
| 60mm | 0.75pF | open | 2.7pF |
| 50mm | 1pF | open | 1pF |

### 7.1.1 HAD.B.31 EVB Board

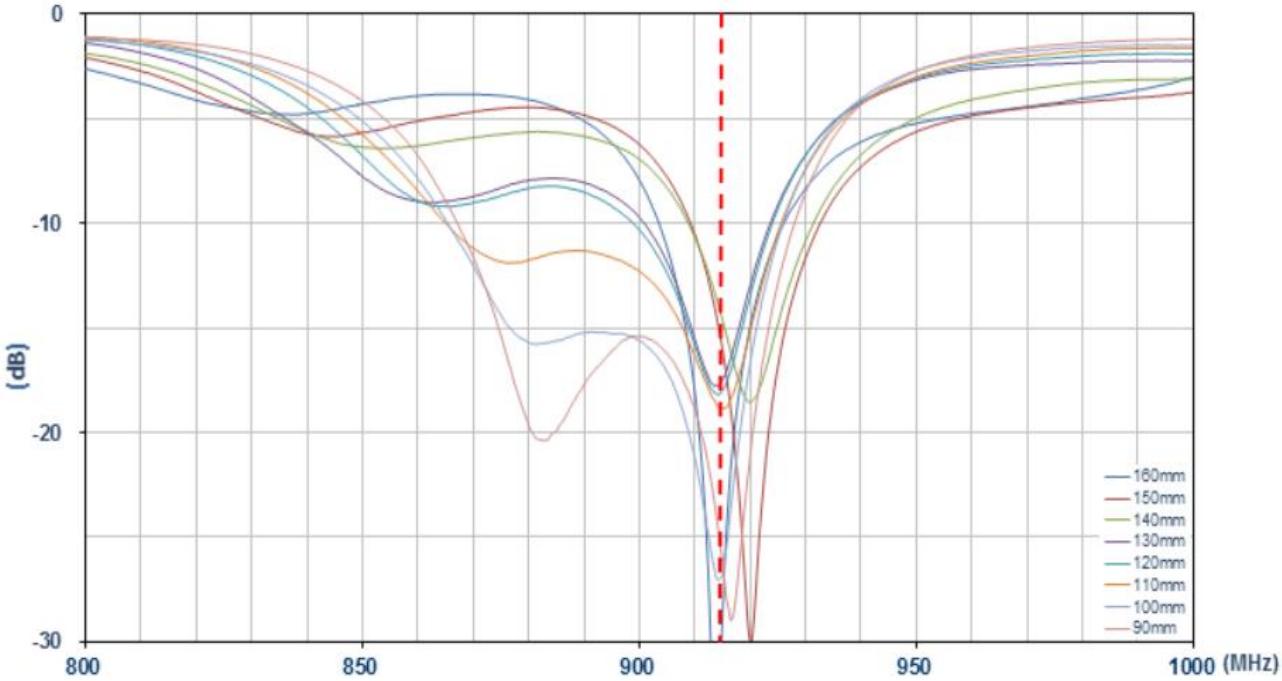
| HAD.B.31 | Ceramic 4 | Ceramic 5 | Ceramic 6 |
|---|---|---|---|
| 160mm | 0 ohm | open | 2.2pF |
| 150mm | 0 ohm | open | 2.7pF |
| 140mm | 0 ohm | open | 3pF |
| 130mm | 0 ohm | open | 3pF |
| 120mm | 0 ohm | open | 3pF |
| 110mm | 0 ohm | open | 3.9pF |
| 100mm | 3.3pF | open | 0 ohm |
| 90mm | 4.7pF | open | 0 ohm |

## 7.2 Return Loss

### 7.2.1 HAD.A.31 EVB Board (Different Ground Lengths)

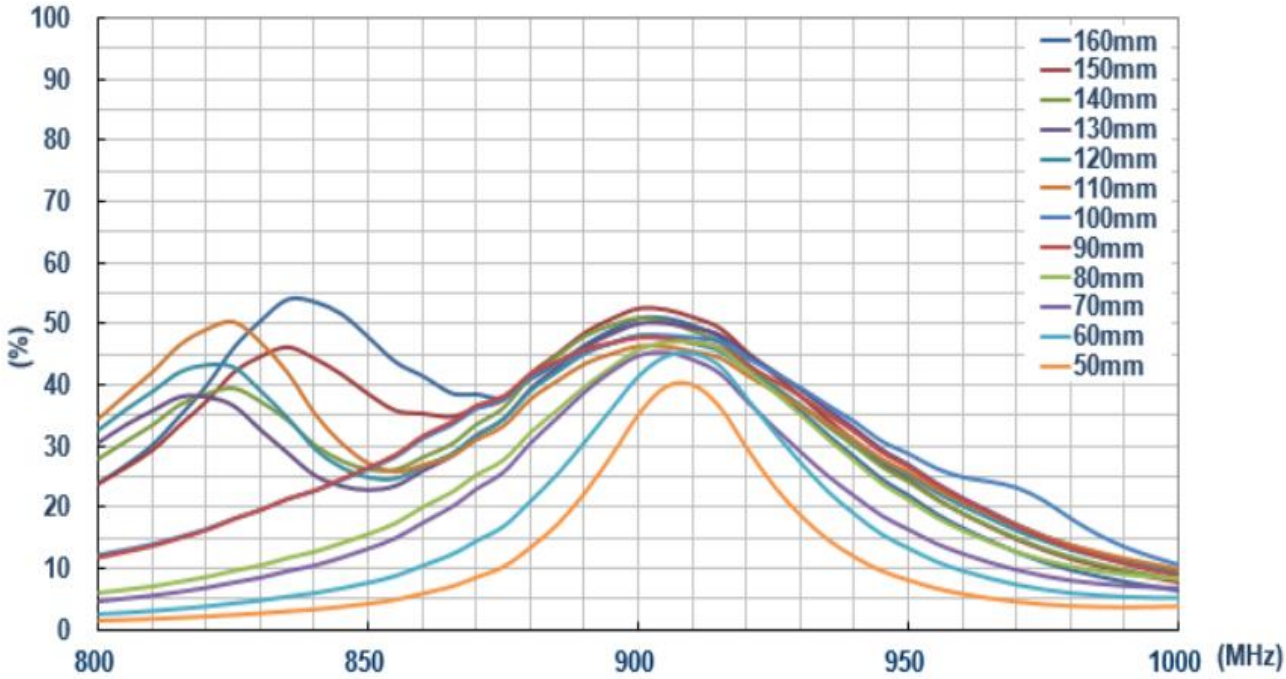



### 7.2.2 HAD.B.31 EVB Board (Different Ground Lengths)

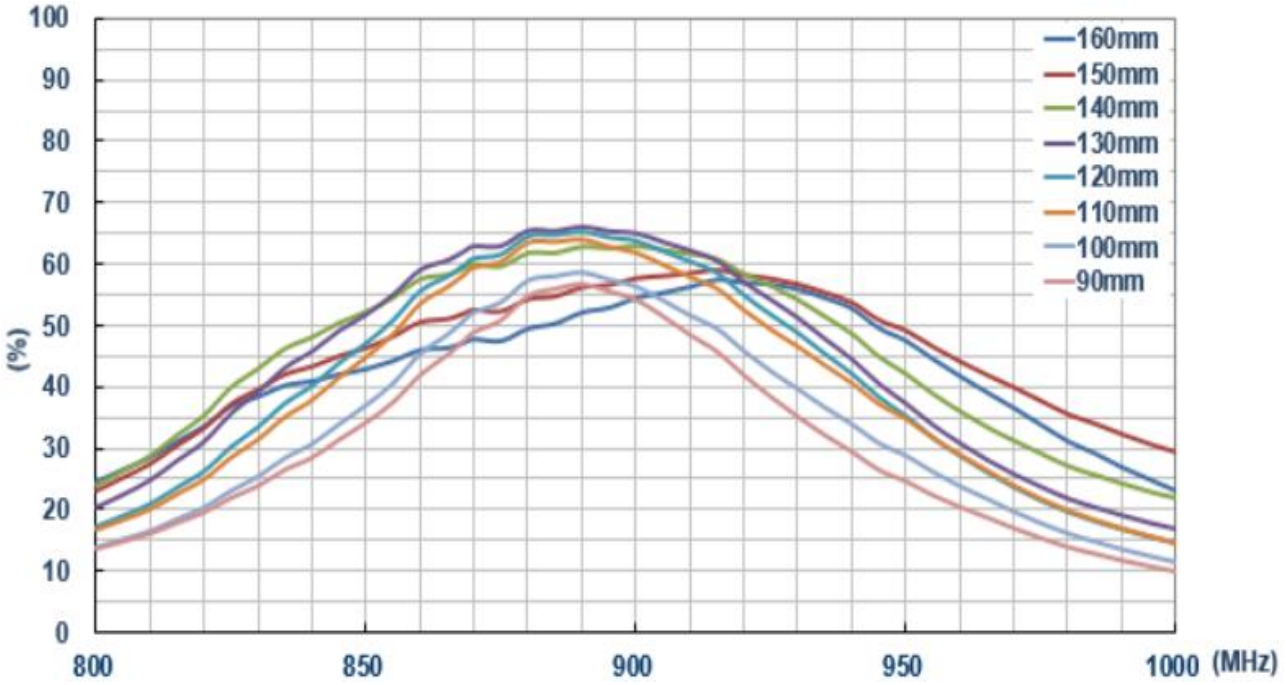


## 7.3 Efficiency

### 7.3.1 HAD.A.31 EVB Board (Different Ground Lengths)

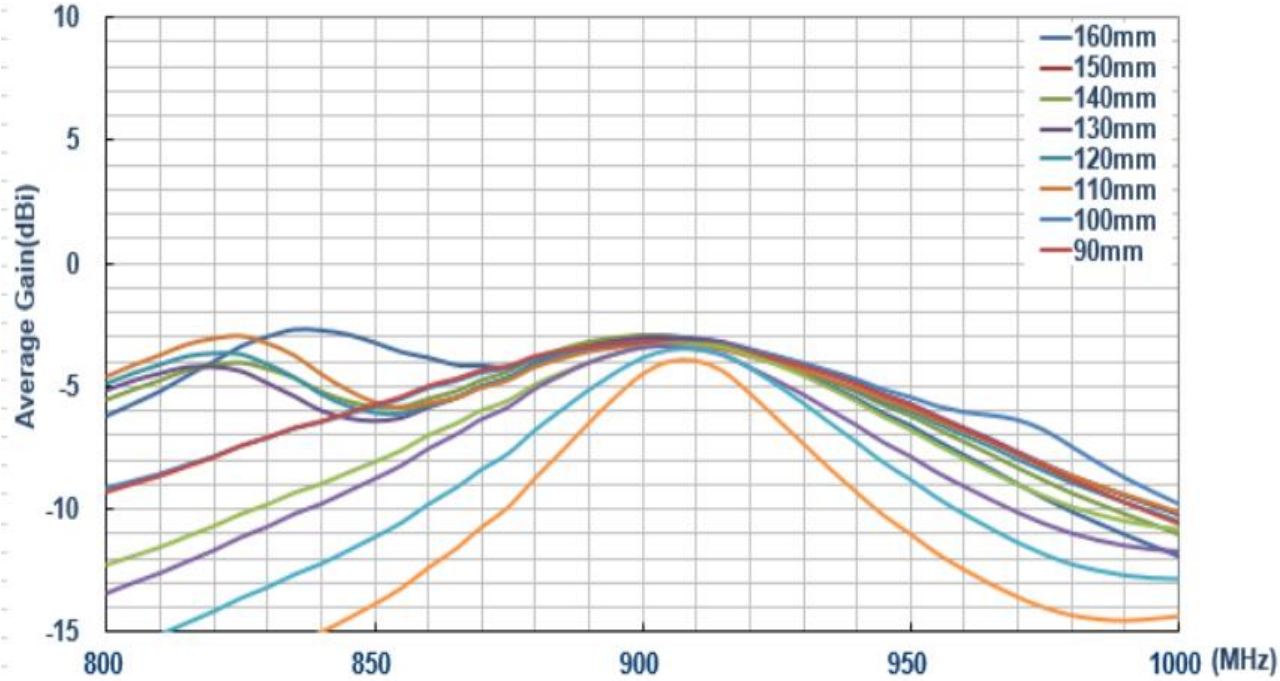



### 7.3.2 HAD.B.31 EVB Board (Different Ground Lengths)

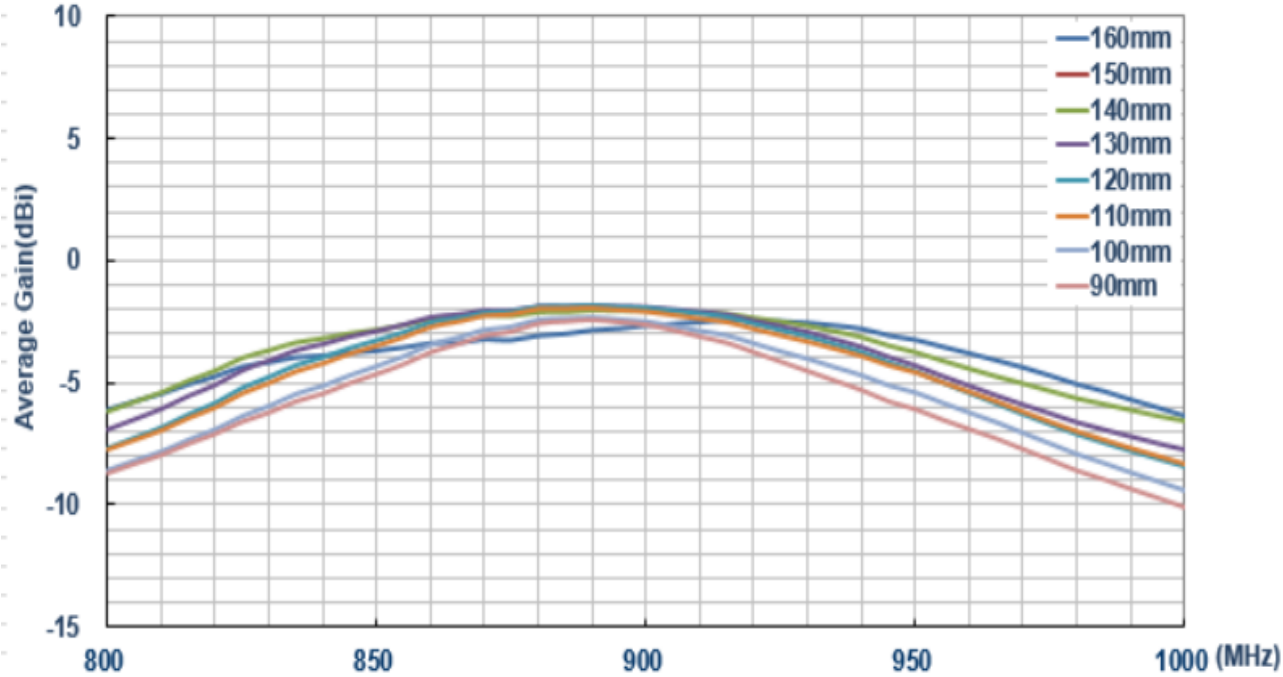


## 7.4 Average Gain

### 7.4.1 HAD.A.31 EVB Board (Different Ground Lengths)

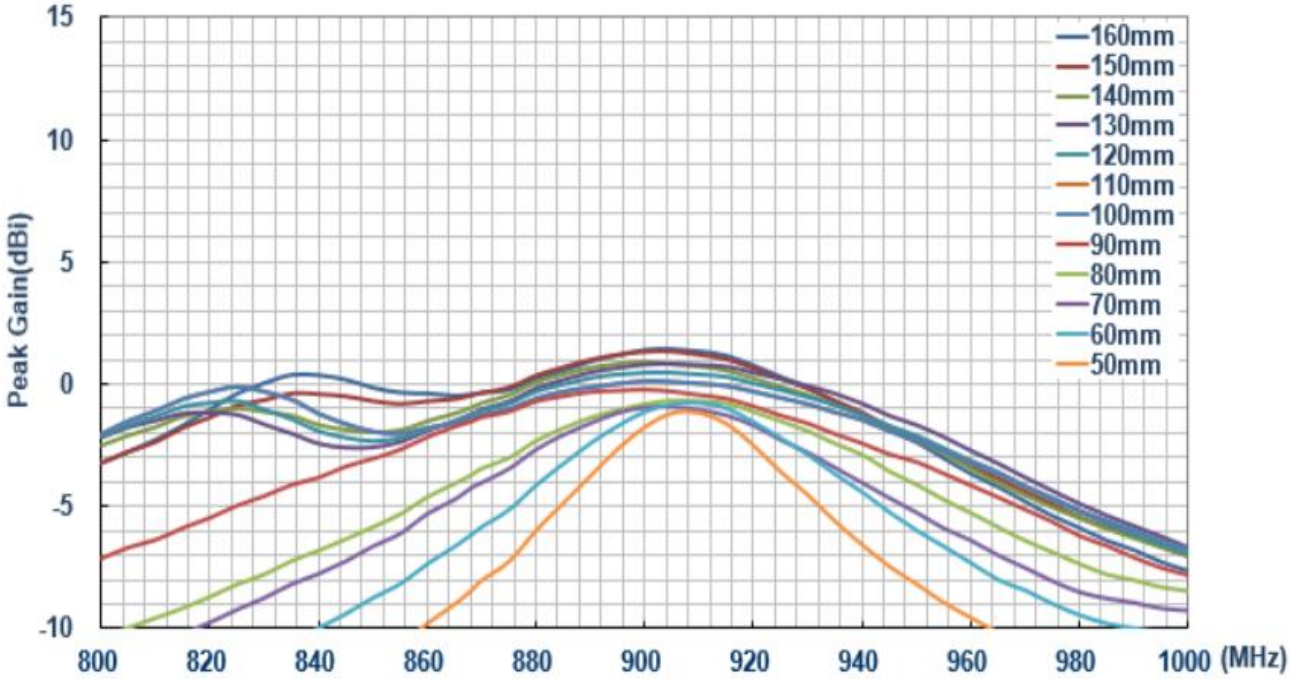



### 7.4.2 HAD.B.31 EVB Board (Different Ground Lengths)

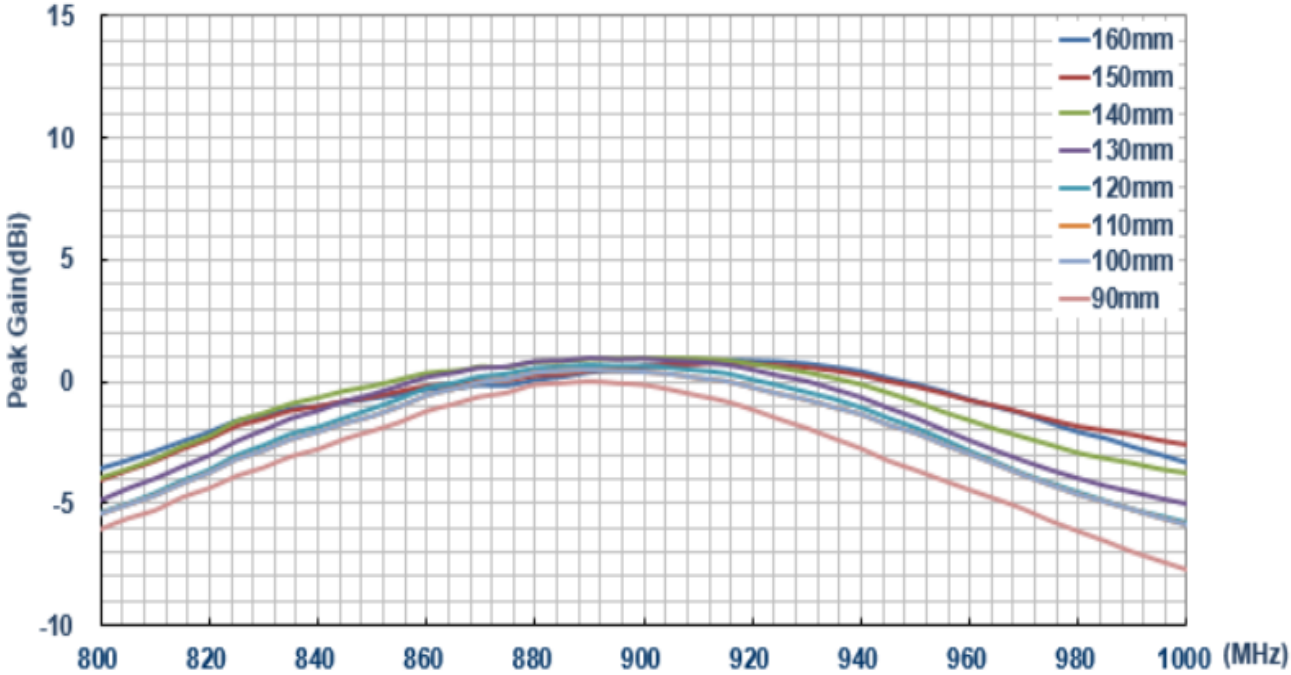


## 7.5 Peak Gain

### 7.5.1 HAD.A.31 EVB Board (Different Ground Lengths)




### 7.5.2 HAD.B.31 EVB Board (Different Ground Lengths)



## 7.6 Antenna Performance Table

| ELECTRICAL | | | | | | |
|---|---|---|---|---|---|---|
| Application Bands | ISM 868MHz | | | | | |
| Mounting Direction | HAD.A.31 | | | HAD.B.31 | | |
| Frequency (MHz) | 902 | 915 | 928 | 902 | 915 | 928 |
| Efficiency | | | | | | |
| Ground plane length 160mm | 50.92 | 47.74 | 35.70 | 54.59 | 57.56 | 56.01 |
| Ground plane length 150mm | 52.62 | 49.34 | 38.06 | 57.57 | 58.93 | 56.60 |
| Ground plane length 140mm | 51.00 | 47.03 | 36.57 | 63.01 | 60.90 | 54.24 |
| Ground plane length 130mm | 50.09 | 48.24 | 39.18 | 65.03 | 60.52 | 51.18 |
| Ground plane length 120mm | 48.20 | 45.61 | 36.69 | 63.62 | 58.40 | 48.61 |
| Ground plane length 110mm | 46.34 | 44.42 | 36.39 | 61.72 | 55.90 | 46.48 |
| Ground plane length 100mm | 48.16 | 47.19 | 39.63 | 56.23 | 49.34 | 39.48 |
| Ground plane length 90mm | 47.83 | 46.16 | 38.14 | 53.94 | 45.51 | 34.89 |
| Ground plane length 80mm | 45.88 | 46.00 | 35.12 | X | X | X |
| Ground plane length 70mm | 44.96 | 41.97 | 29.04 | X | X | X |
| Ground plane length 60mm | 41.46 | 43.03 | 27.19 | X | X | X |
| Ground plane length 50mm | 35.34 | 36.39 | 18.52 | X | X | X |
| Average Gain(dBi) | | | | | | |
| Ground plane length 160mm | -2.93 | -3.21 | -4.47 | -2.62 | -2.40 | -2.51 |
| Ground plane length 150mm | -2.78 | -3.07 | -4.19 | -2.39 | -2.30 | -2.47 |
| Ground plane length 140mm | -2.92 | -3.28 | -4.36 | -2.00 | -2.15 | -2.65 |
| Ground plane length 130mm | -3.02 | -3.17 | -4.06 | -1.86 | -2.18 | -2.90 |
| Ground plane length 120mm | -3.16 | -3.41 | -4.35 | -1.96 | -2.34 | -3.13 |
| Ground plane length 110mm | -3.34 | -3.52 | -4.38 | -2.09 | -2.53 | -3.32 |
| Ground plane length 100mm | -3.17 | -3.26 | -4.02 | -2.49 | -3.07 | -4.03 |
| Ground plane length 90mm | -3.20 | -3.36 | -4.18 | -2.68 | -0.83 | -4.57 |
| Ground plane length 80mm | -3.38 | -3.37 | -4.54 | X | X | X |
| Ground plane length 70mm | -3.47 | -3.77 | -5.37 | X | X | X |
| Ground plane length 60mm | -3.82 | -3.66 | -5.65 | X | X | X |
| Ground plane length 50mm | -4.51 | -4.39 | -7.32 | X | X | X |

| Peak Gain(dBi) | | | | | | |
|---|---|---|---|---|---|---|
| Ground plane length 160mm | 1.37 | 1.13 | -0.19 | 0.62 | 0.87 | 0.74 |
| Ground plane length 150mm | 1.33 | 1.02 | -0.18 | 0.62 | 0.79 | 0.59 |
| Ground plane length 140mm | 0.94 | 0.58 | -0.42 | 0.99 | 0.90 | 0.40 |
| Ground plane length 130mm | 0.75 | 0.67 | -0.12 | 0.89 | 0.66 | -0.02 |
| Ground plane length 120mm | 0.45 | 0.29 | -0.54 | 0.67 | 0.37 | -0.41 |
| Ground plane length 110mm | 0.15 | -0.04 | -0.78 | 0.42 | 0.05 | -0.72 |
| Ground plane length 100mm | -0.29 | -0.40 | -0.97 | -0.15 | -0.66 | -1.60 |
| Ground plane length 90mm | -0.26 | -0.64 | -1.64 | -0.15 | -0.83 | -1.92 |
| Ground plane length 80mm | -0.80 | -0.77 | -1.91 | X | X | X |
| Ground plane length 70mm | -0.94 | -1.27 | -2.80 | X | X | X |
| Ground plane length 60mm | -1.09 | -0.96 | -2.87 | X | X | X |
| Ground plane length 50mm | -1.77 | -1.65 | -4.56 | X | X | X |

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