



# Application Notes: 2108971-X Antennas

## Product Description

- Flexible cable antenna
- Dipole antenna type (Dimension 24.1 x 35.1 x 0.15mm)
- Ground plane independent
- FPC with double-side adhesive for peel and stick
- Mini coax cable and connector
- Cable length: 50mm, 100mm, 150mm, 200mm
- Covers UWB channel 1,2,3,4,5,6,7,8,9 spectrum
- Antenna performance optimized to 150mm cable length

## OVERVIEW

This application note describes the RF performance of the 2108971-X (3100-8500 MHz) antenna series in free space, and how the RF performance is impacted by some common factors when the antennas are integrated into a device. -X in the part number represents antennas with differing cable lengths i.e. 2108971-1 : 50mm 2108971-2 : 100mm etc..

The common factors discussed in this document include the angle of the FPC antenna bending curve, the size and the shape of the ground plane, the antenna cable routing directions, and the clearance distance to some large metallic structures nearby the antennas. The large metallic structures can be the presentative of a different PCB ground plane, metallic enclosure of the device, a display, or any large metallic part inside the device.

This document covers many common installation scenarios. If you have a scenario that is not covered in this document, please contact us to discuss your design-in requirements.

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## 1. BASIC ANTENNA SPECIFICATIONS

### 1 a. Electrical, Mechanical & Environmental Performance\*

Electrical		
Frequency Range (MHz)	3100-5000	5900-8500
VSWR	< 1.8:1	< 1.9:1
Average Efficiency	76 %	80 %
Peak Gain	1.7 dBi	4.3 dBi
Power Handling	10 Watt cw	
Polarization	Linear	
Mechanical		
Size mm (in.)	24.1 x 35.1 x 0.15 mm (0.95 x 1.38 x 0.006 in.)	
Weight g (oz.)	<1.4 g (<0.05 oz.)	
Mounting	Adhesive Tape	
Mating Connectors	MHF and MHF4L type	
Cable	1.13mm and 1.37mm Dia.	
Environmental		
Operating Temperature	-40 to +85°C	
Storage Temperature	-40 to +85°C	

\* Electrical, Mechanical & Environmental Performance in this table is for the 2108971-1 antenna. For full 2108971-X datasheet, drawing, CAD files and specifications please visit [product landing page](#).

## 1 b. Frequency Bands

This antenna covers UWB channel 1,2,3,4,5,6,7,8,9 (3100 - 8500 MHz)

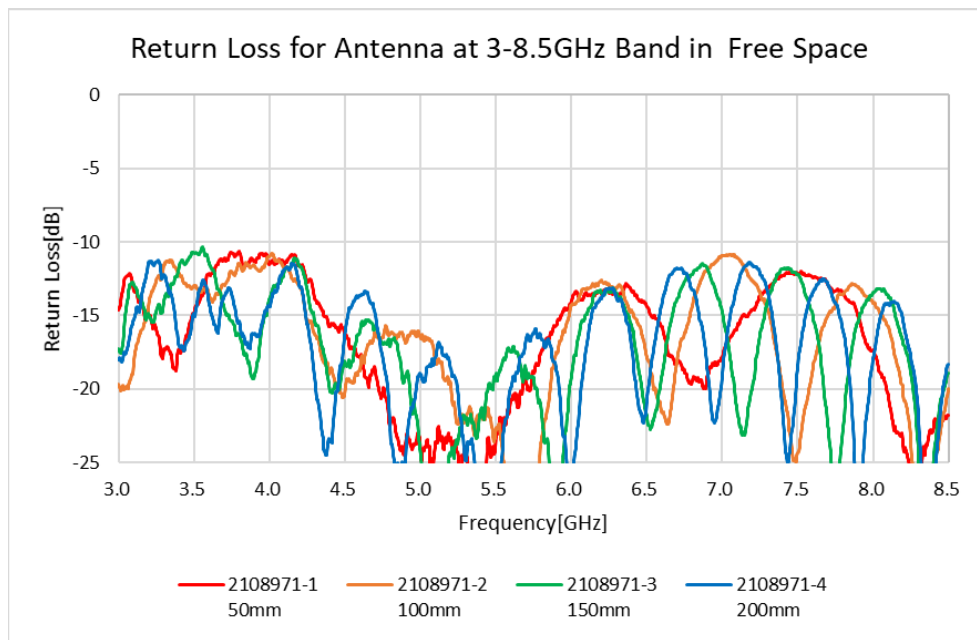
UWB Frequency [MHz]						
Band Group	Channel No.	Start	Center	Stop	Bandwidth	Support
0	0	249.6	499.2	749.6	499.2	X
1	1	3244.8	3494.4	3744	499.2	✓
	2	3744	3993.6	4243.2	499.2	✓
	3	4243.2	4492.8	4742.4	499.2	✓
	4	3328	3993.6	4659.2	1331.2	✓
2	5	6240	6489.6	6739.2	499.2	✓
	6	6739.2	6988.8	7238.4	499.2	✓
	7	5948.8	6489.6	7030.4	1081.6	✓
	8	7238.4	7488	7737.6	499.2	✓
	9	7737.6	7987.2	8236.8	499.2	✓
	10	8236.8	8486.4	8736	499.2	X
	11	7321.6	7987.2	8652.8	1331.2	X
	12	8736	8985.6	9235.2	499.2	X
	13	9235.2	9484.8	9734.4	499.2	X
	14	9734.4	9984	10233.6	499.2	X
	15	8807.315	9484.8	10162.285	1354.97	X

## 2. RF PERFORMANCE IN FREE SPACE

### 2 a. Return Loss

#### Test Setup

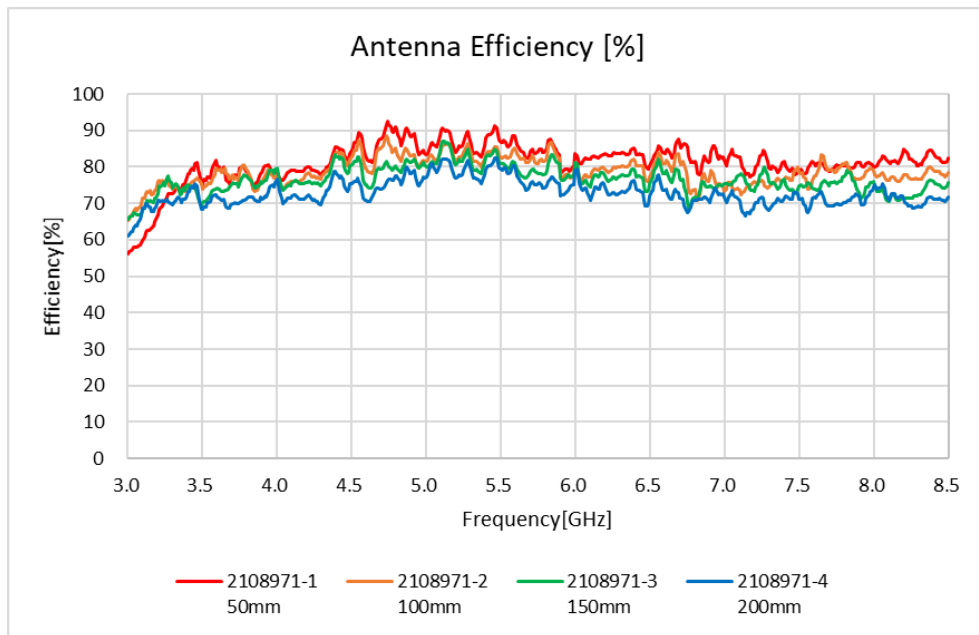
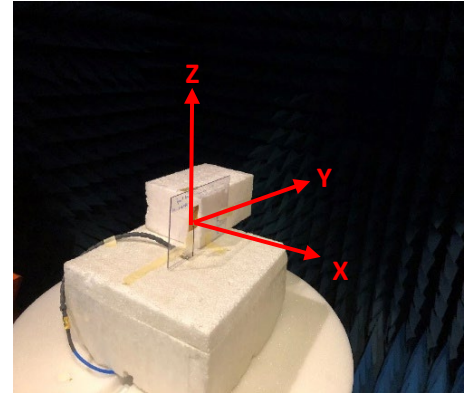
- VNA (100MHz-8.5GHz)
- The antenna is placed on a PC plastic in the size of 165mm x 100mm x 2mm



## 2 b. Total Efficiency

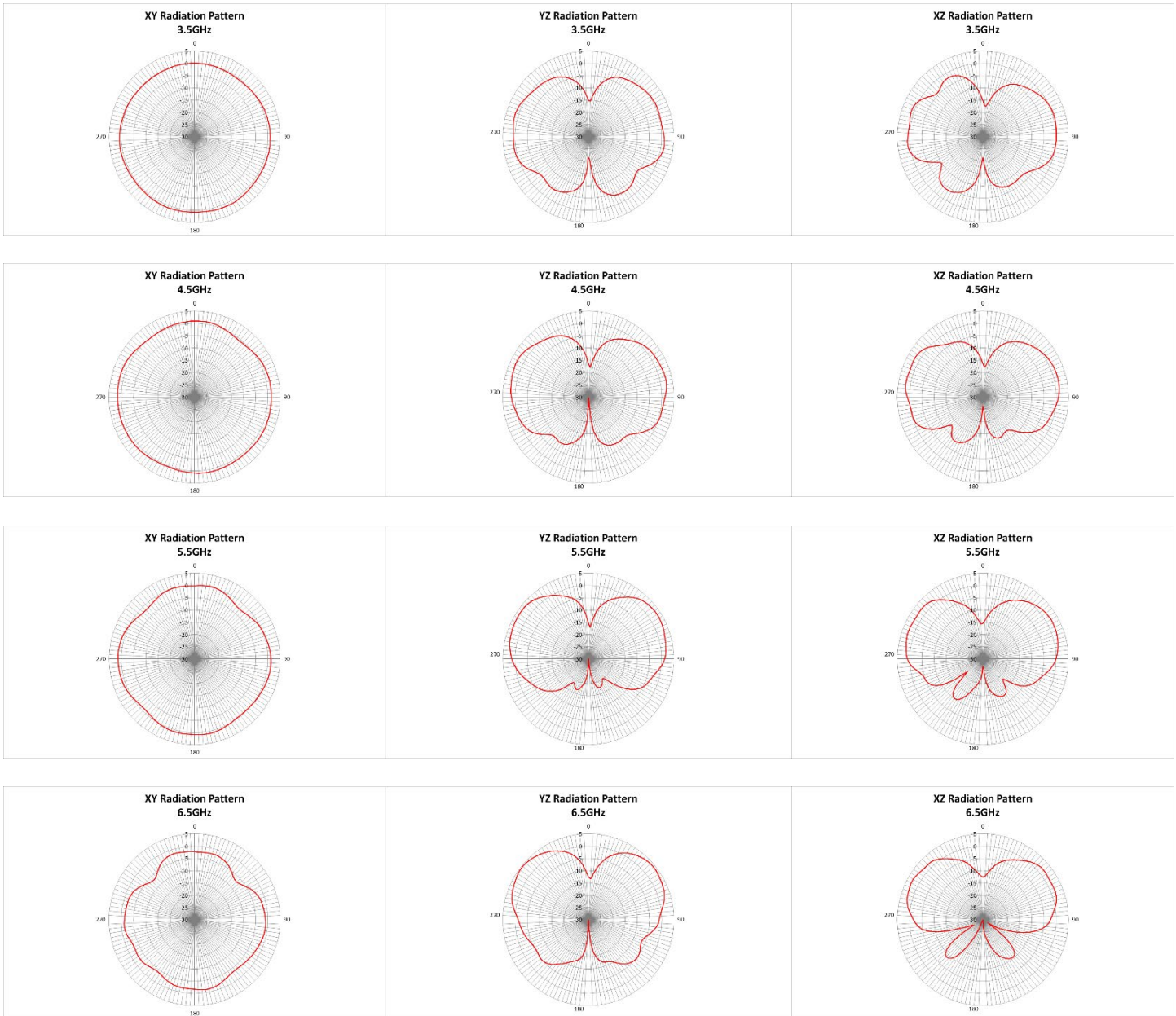
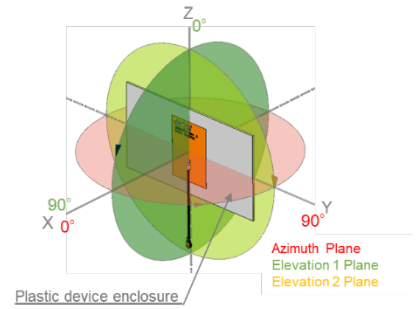
### Test Setup

- Antenna Anechoic Chamber (100MHz-8.5GHz)
- The antenna is placed on a PC plastic in the size of 165mm x 100mm x 2mm



## 2 c. Gain Radiation Patterns 2D

Total Gain Radiation Patterns (2D) of the Antenna with 100mm Cable Length (PN: 2108971-2)

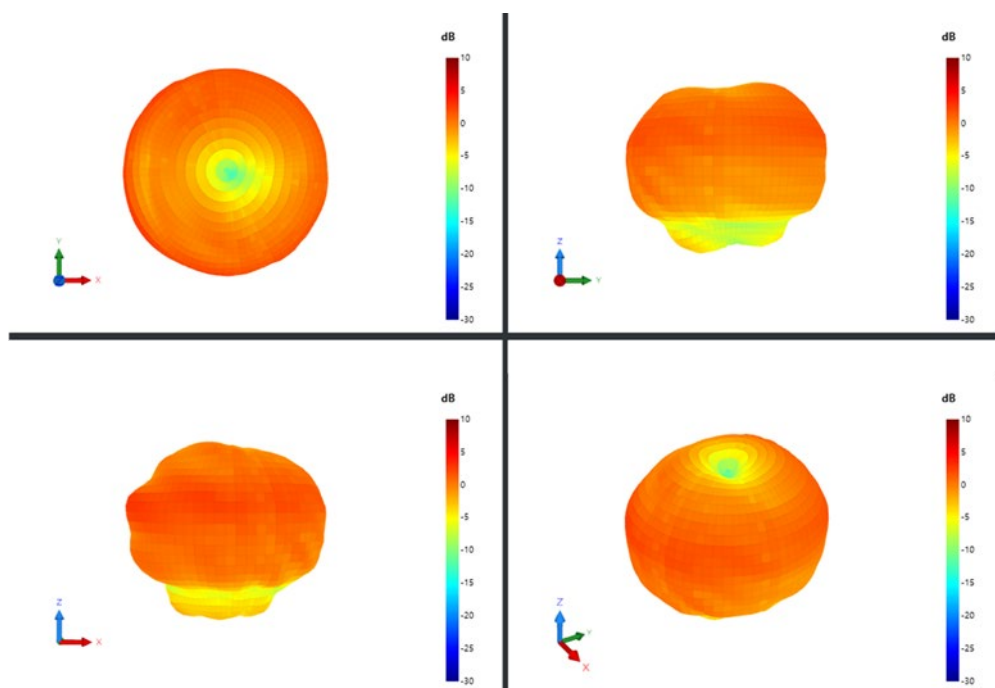
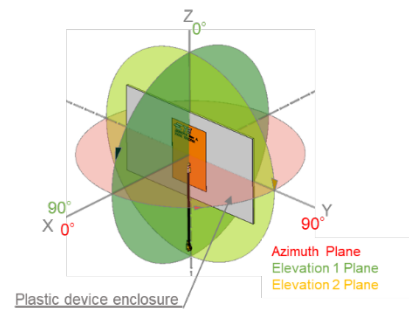


## 2 c. Gain Radiation Patterns 2D



## 2 d. Gain Radiation Patterns 3D

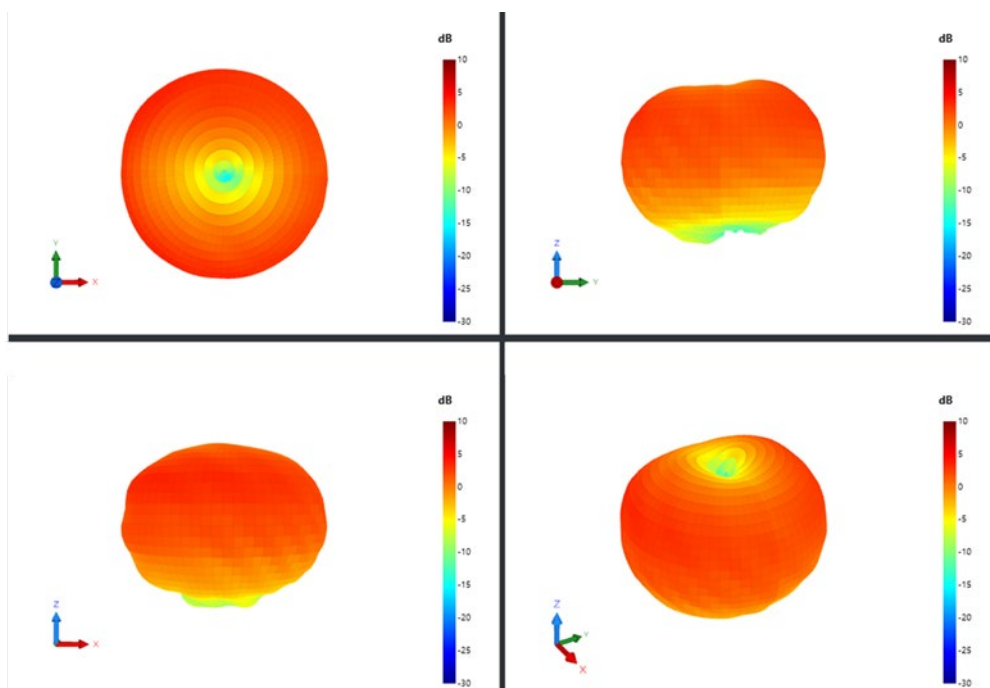
Total Gain Radiation Patterns (3D) of the Antenna with 100mm Cable Length (PN: 2108971-2)



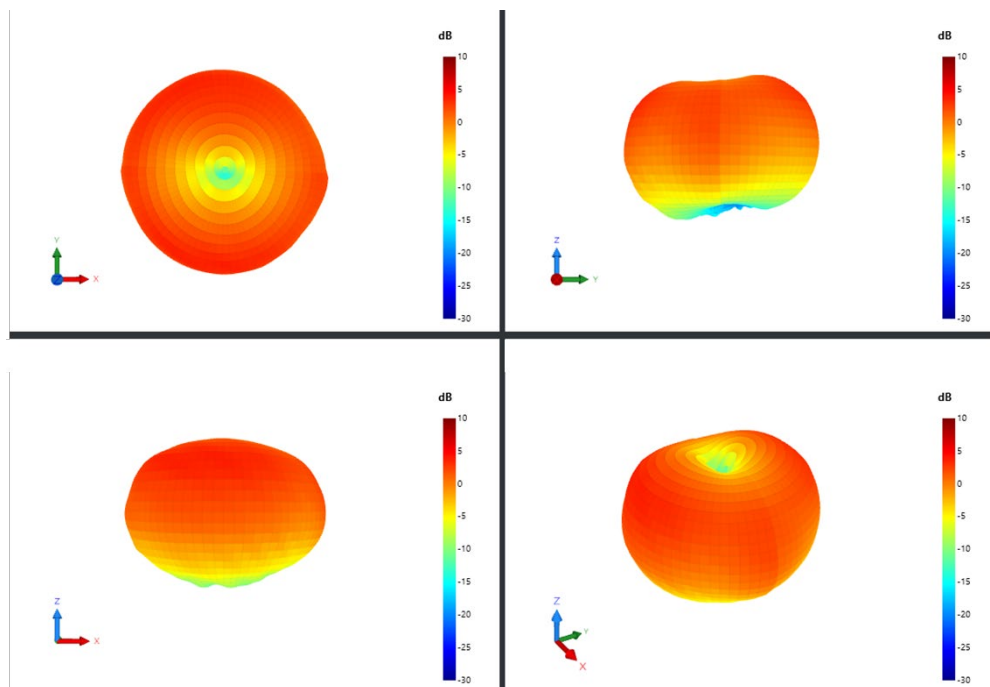
3D Radiation pattern 3.5GHz



## 2 d. Gain Radiation Patterns 3D Contd.

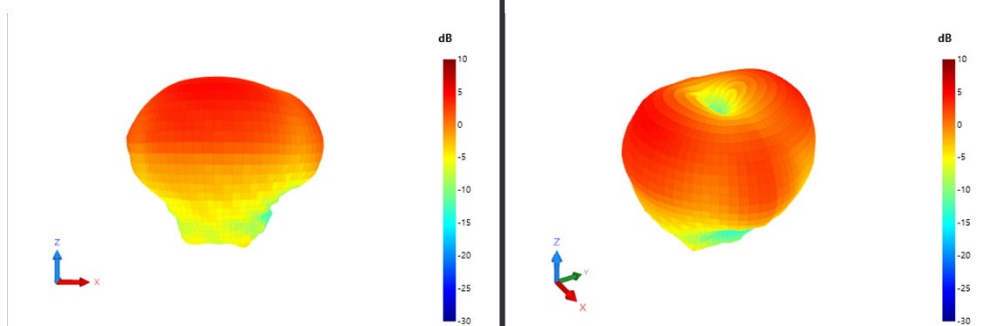
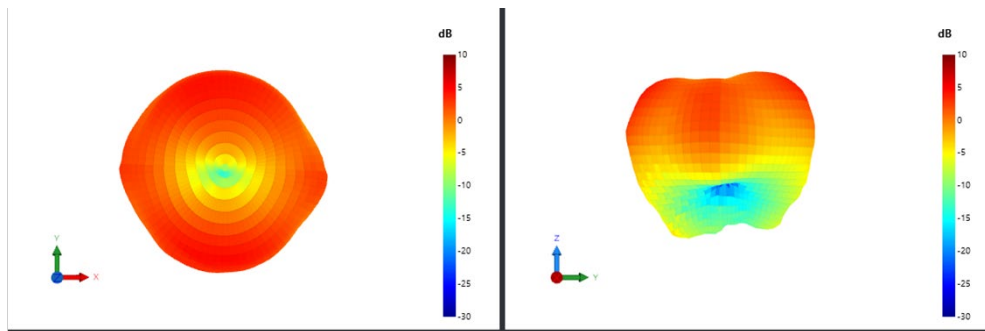


3D Radiation pattern 4.5GHz

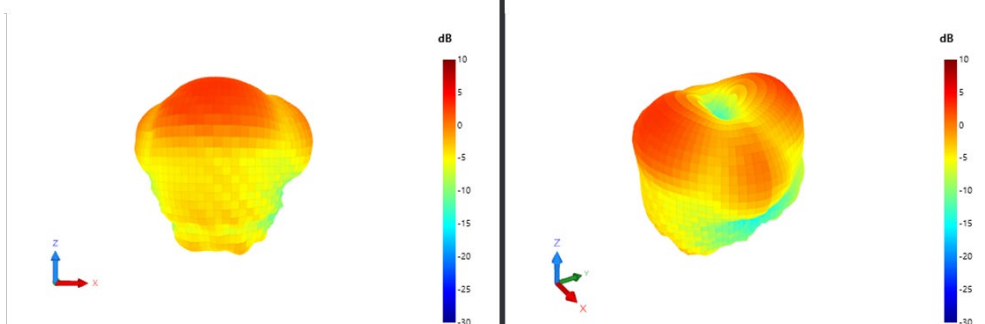
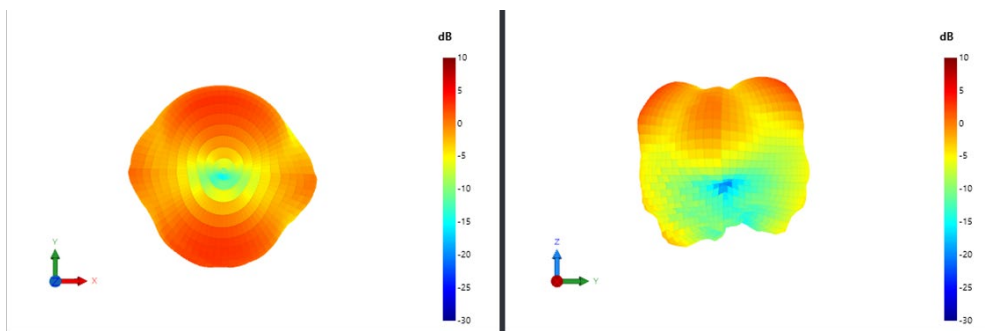


3D Radiation pattern 5.5GHz

## 2 d. Gain Radiation Patterns 3D Contd.

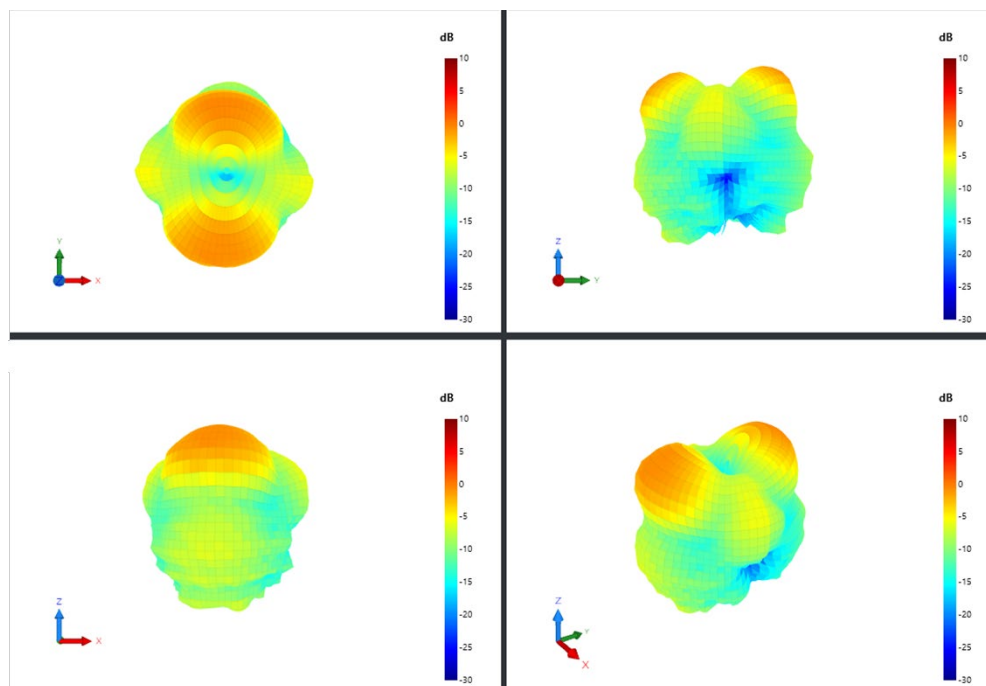


3D Radiation pattern 6.5GHz



3D Radiation pattern 7.5GHz

## 2 d. Gain Radiation Patterns 3D Contd.

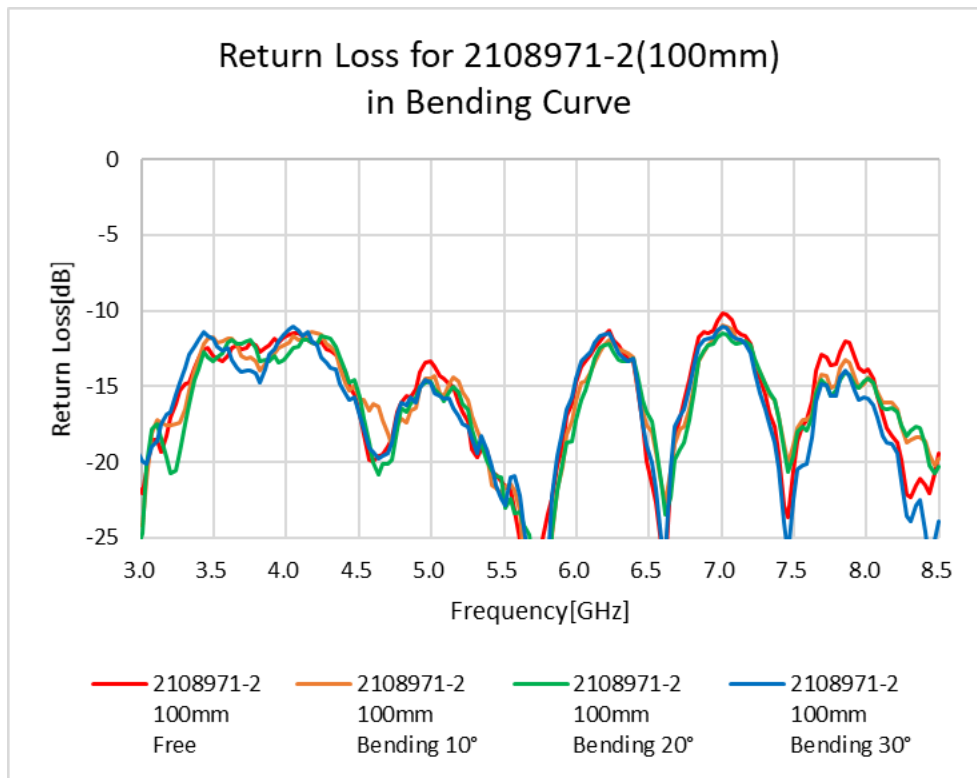
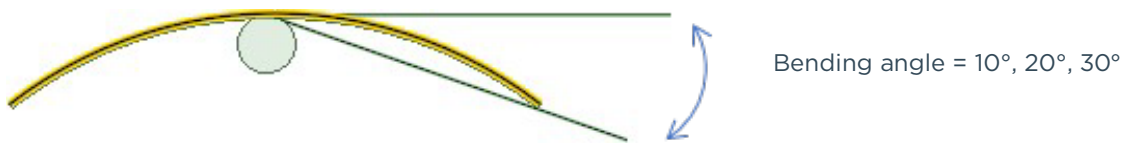


3D Radiation pattern 8.5GHz

### 3. ANTENNA PERFORMANCE VARIATION WITH DIFFERENT ANTENNA DESIGN-IN IMPLEMENTATION

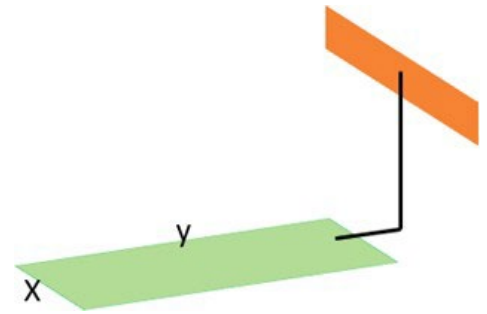
#### 3 a. Performance Variation with FPC Bending Curve

This section shows the effect on return loss of bending the antenna by 10°, 20° and 30° vs a flat position. The effect on return loss is shown in the plots below at various frequencies. This test was conducted on an antenna with a cable length of 100mm (PN: 2108965-2).



### 3 b. Performance Variation with Orthogonal Ground Plane

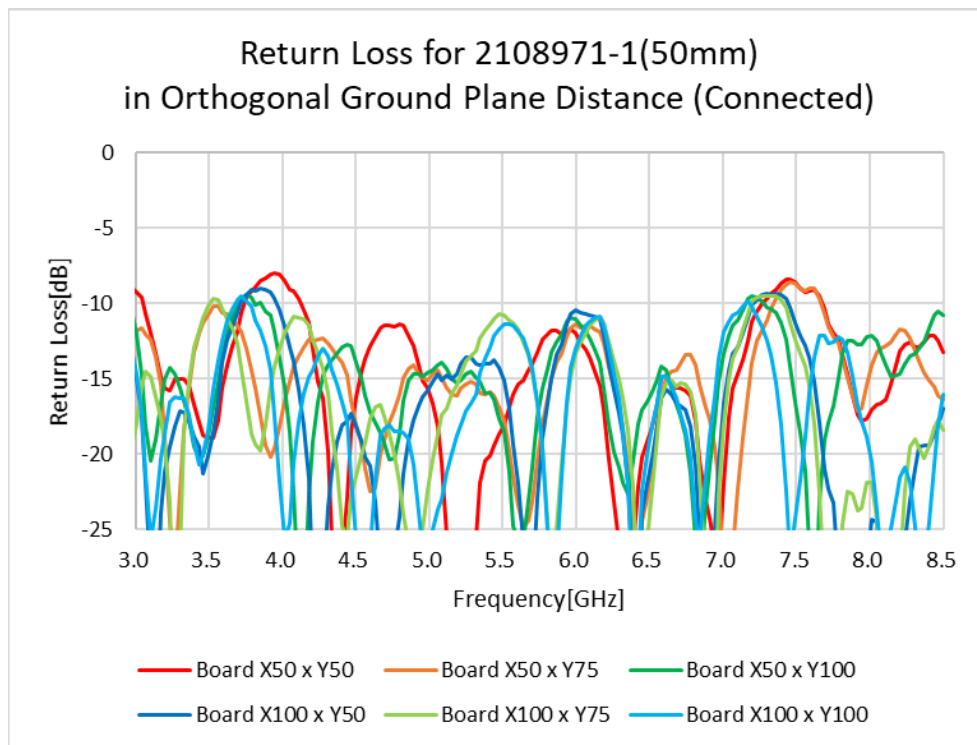
This section shows the effect on return loss of positioning the antenna in the vicinity of various sizes of orthogonally placed ground planes. The antenna is fed from the mini coax connector at the edge of the PCB ground plane. Ensure the cable bending curve doesn't violate the minimum bending radius (especially for 50 mm cable).



Variables:

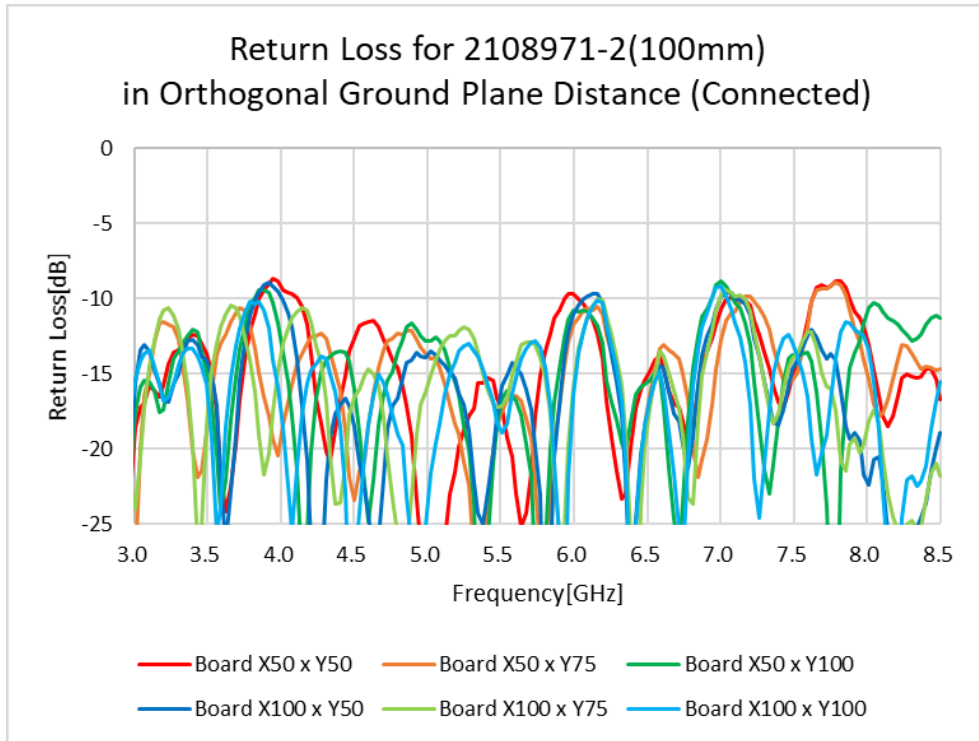
Board Size (mm)	X	Y
Board 50x50	50mm	50mm
Board 50x75	50mm	75mm
Board 50x100	50mm	100mm
Board 100x50	100mm	50mm
Board 100x75	100mm	75mm
Board 100x100	100mm	100mm

#### 50mm Cable

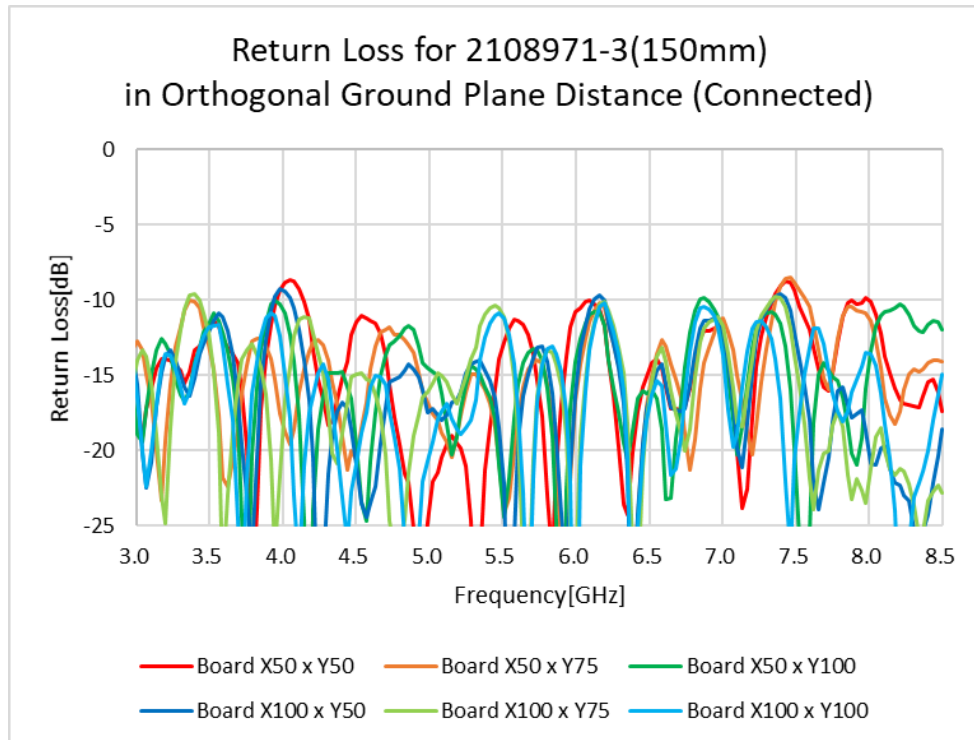


### 3 b. Performance Variation with Orthogonal Ground Plane Contd.

#### 100mm Cable

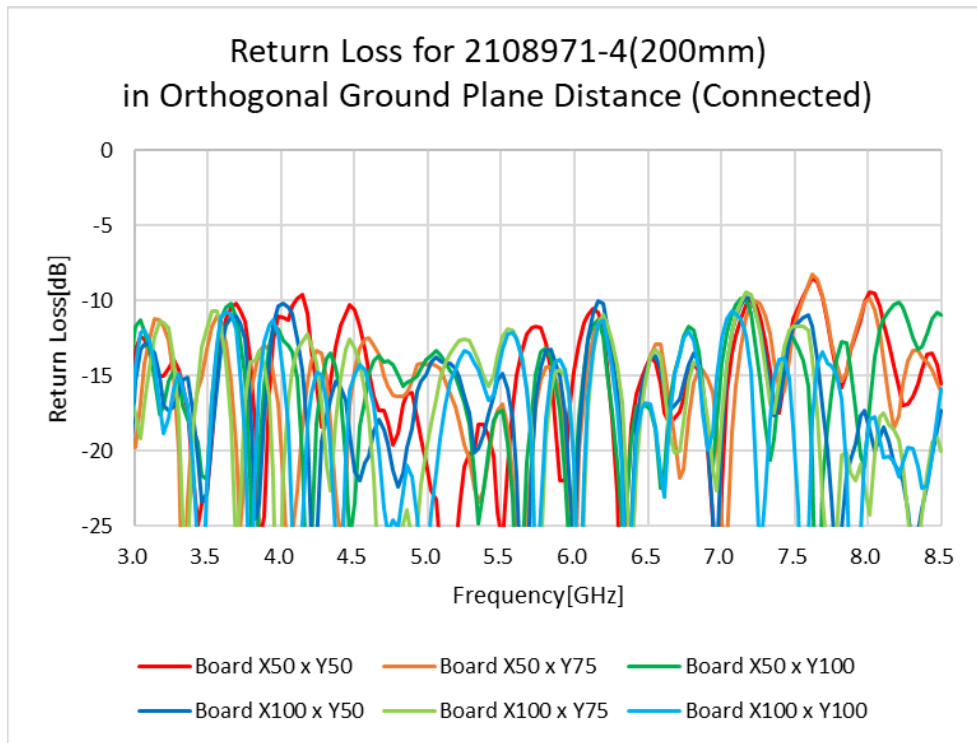


#### 150mm Cable

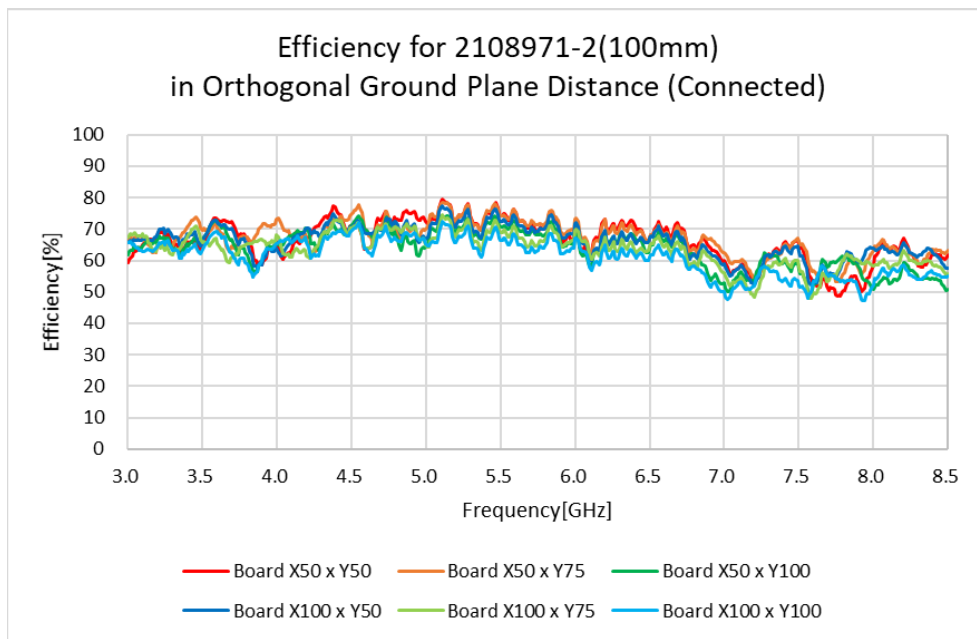


### 3 b. Performance Variation with Orthogonal Ground Plane Contd.

#### 200mm Cable



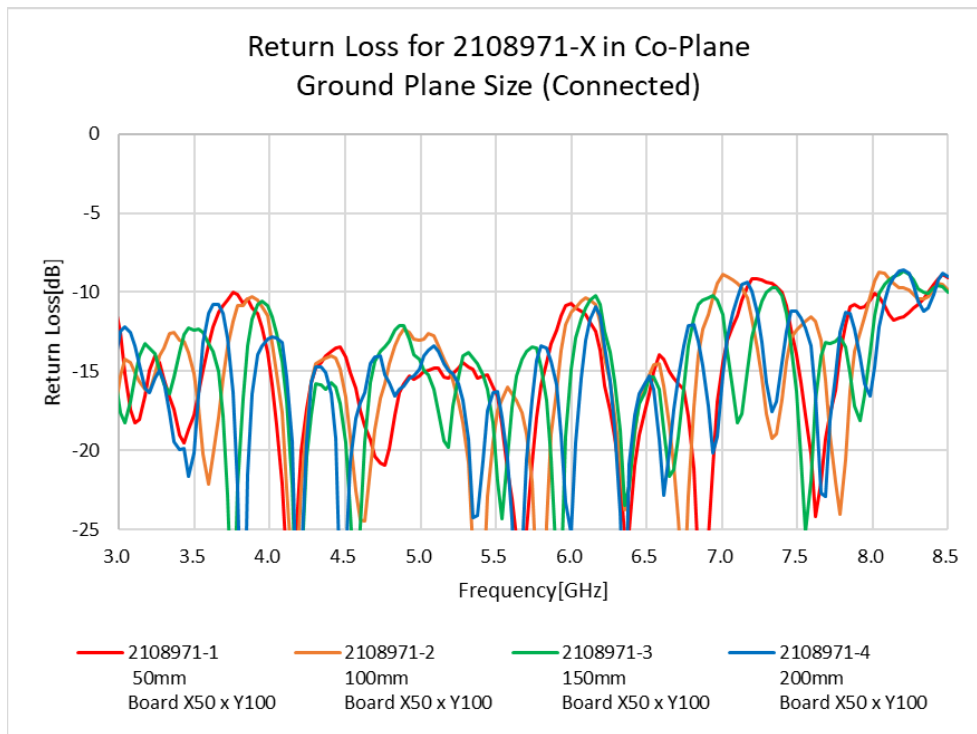
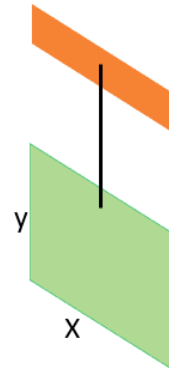
### 3 b. Performance Variation with Orthogonal Ground Plane Contd.



### 3 c. Performance Variation with Co-Plane Ground Plane

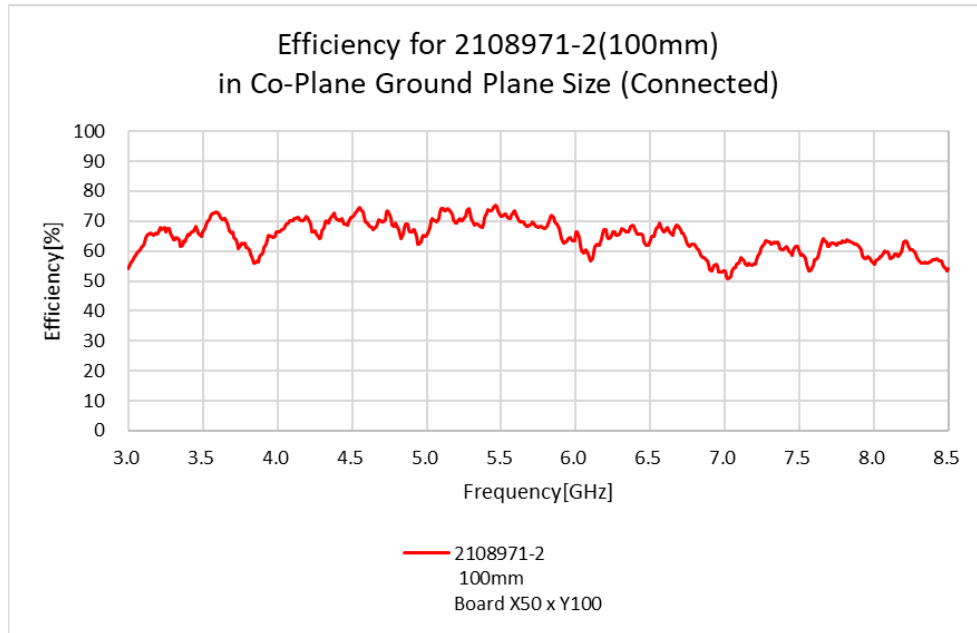
This section shows the effect on return loss of positioning the antenna in line with the ground plane (50x100mm). The antenna is fed from the mini coax connector at the edge of the PCB ground plane.

Variables:  
X=50mm, Y=100mm





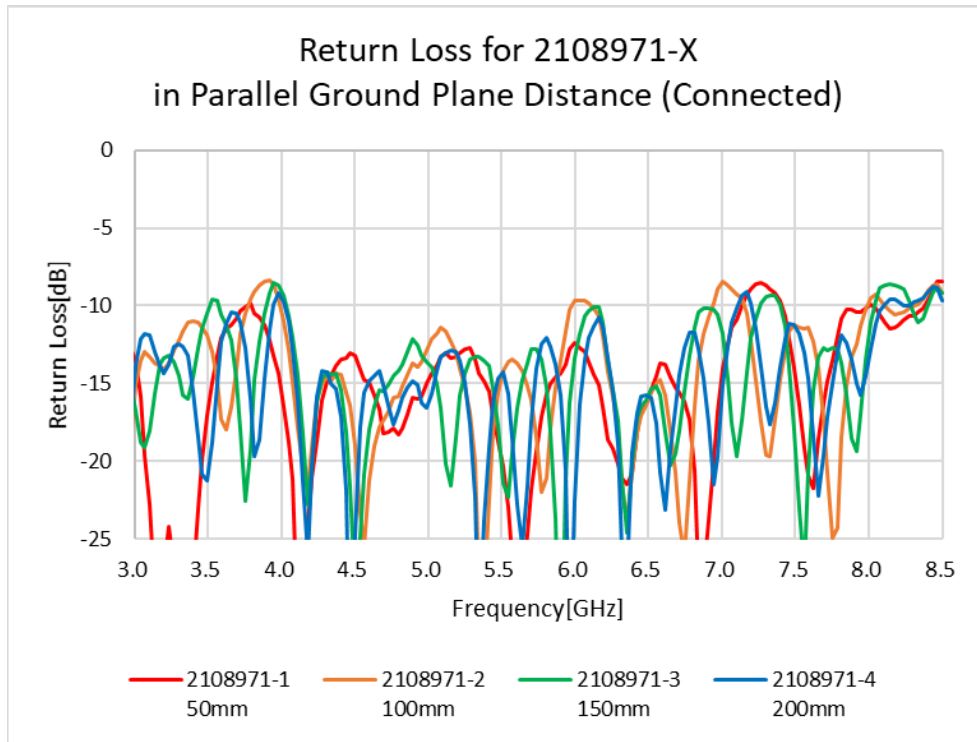
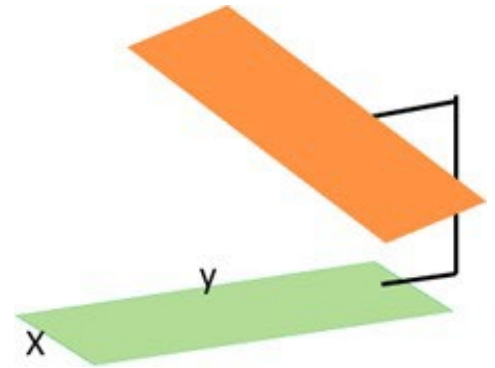
### 3 c. Performance Variation with Co-Plane Ground Plane Contd.



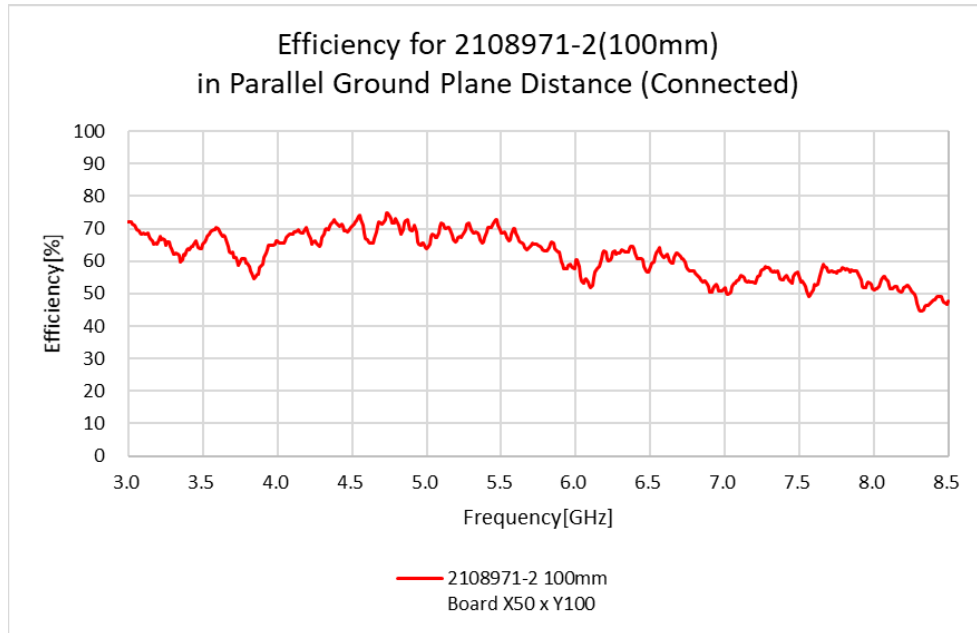
### 3 d. Performance Variation with Parallel Ground Plane

This section shows the effect on return loss of positioning the antenna parallel with the ground plane (100x125mm). The antenna is fed from the mini coax connector at the edge of the PCB ground plane.

Variables:  
100mm, Y=125mm



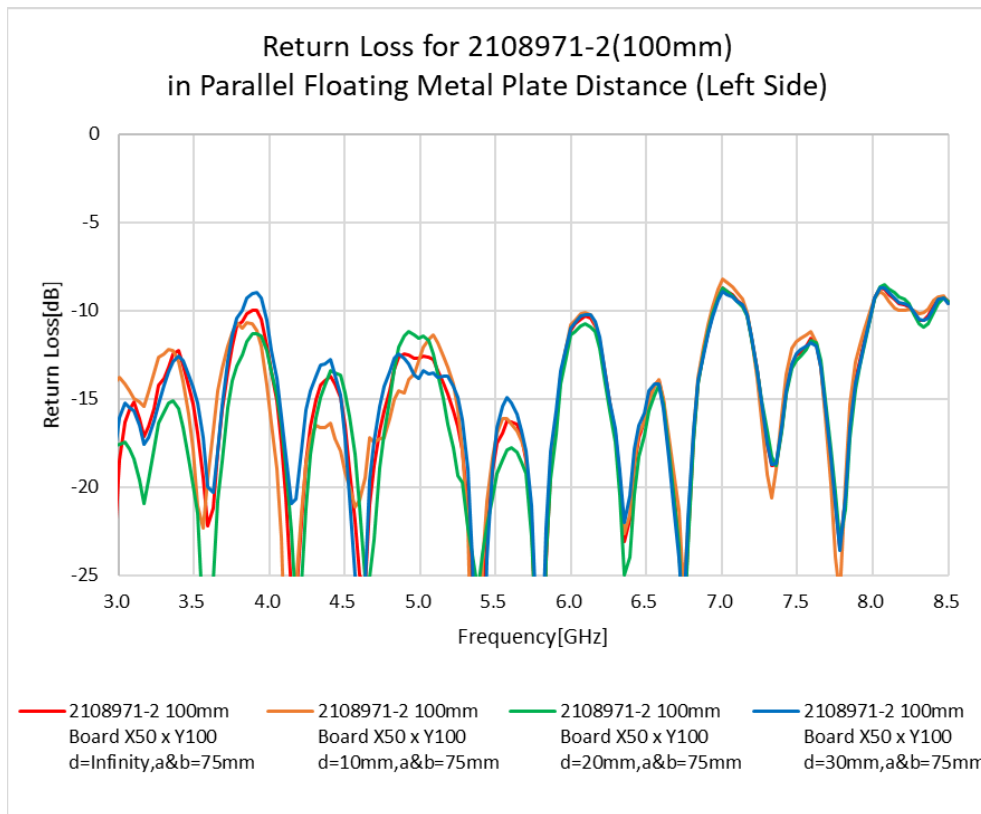
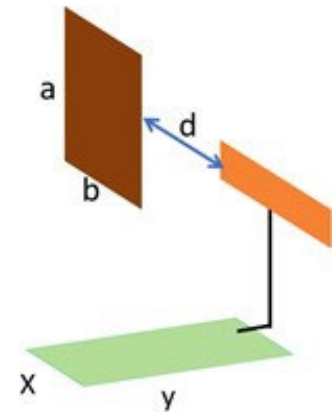
### 3 d. Performance Variation with Parallel Ground Plane Contd.



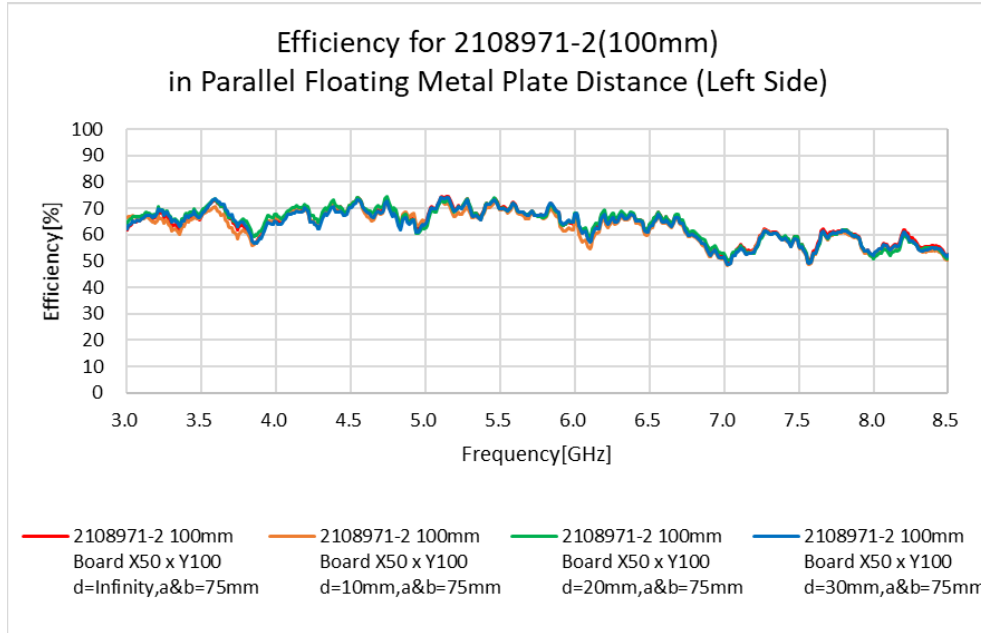
### 3 e. Performance Variation with Parallel Floating Metal Plate (Left Side)

This section shows the effect on return loss of positioning the antenna parallel with a floating metal plate (75x75mm), in various distances to the left of the antenna. The antenna is fed from the mini coax connector at the edge of the PCB ground plane.

Variables:  
 X=50mm, Y=100mm  
 a=75mm, b=75mm  
 d = 10mm, 20mm, 30mm, infinity (without the floating metal plate)  
 Antenna cable length = 100mm (PN: 2108965-2)



### 3 e. Performance Variation with Parallel Floating Metal Plate (Left Side) Contd.



### 3 f. Performance Variation with Parallel Floating Metal Plate (Centered)

This section shows the effect on return loss of positioning the antenna centrally with a floating metal plate in various distances. The antenna is fed from the mini coax connector at the edge of the PCB ground plane.

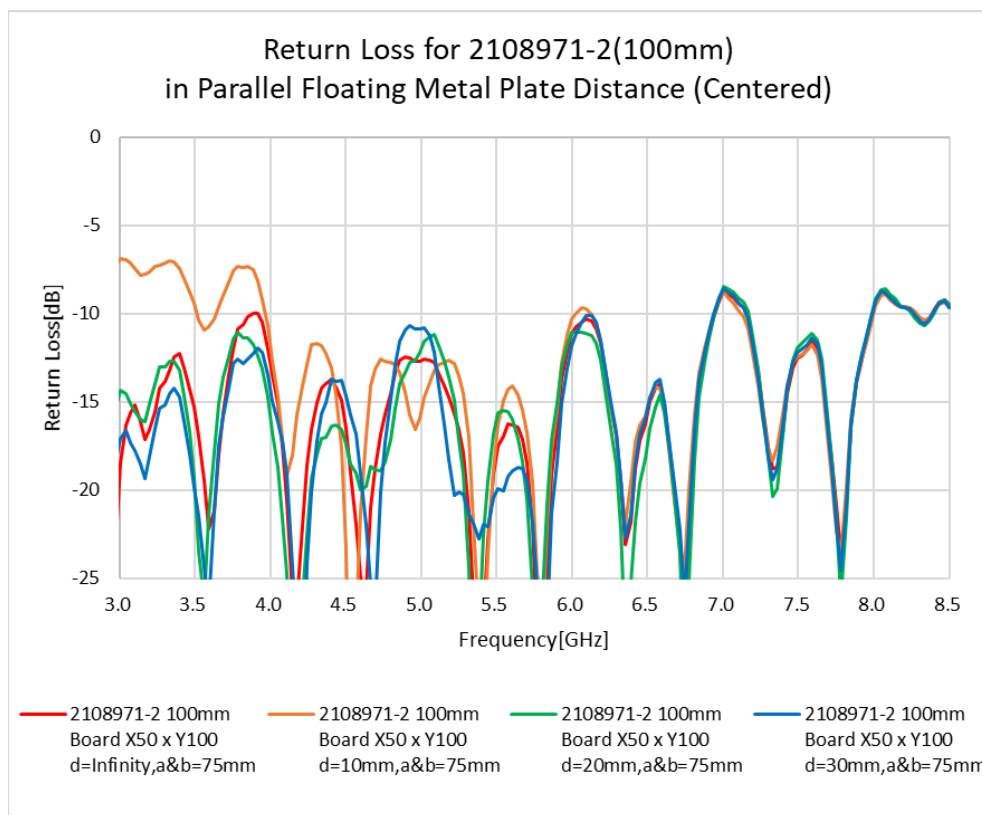
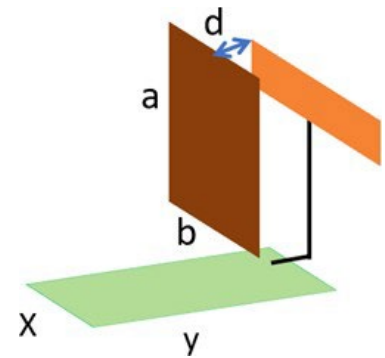
Variables:

X=50mm, Y=100mm

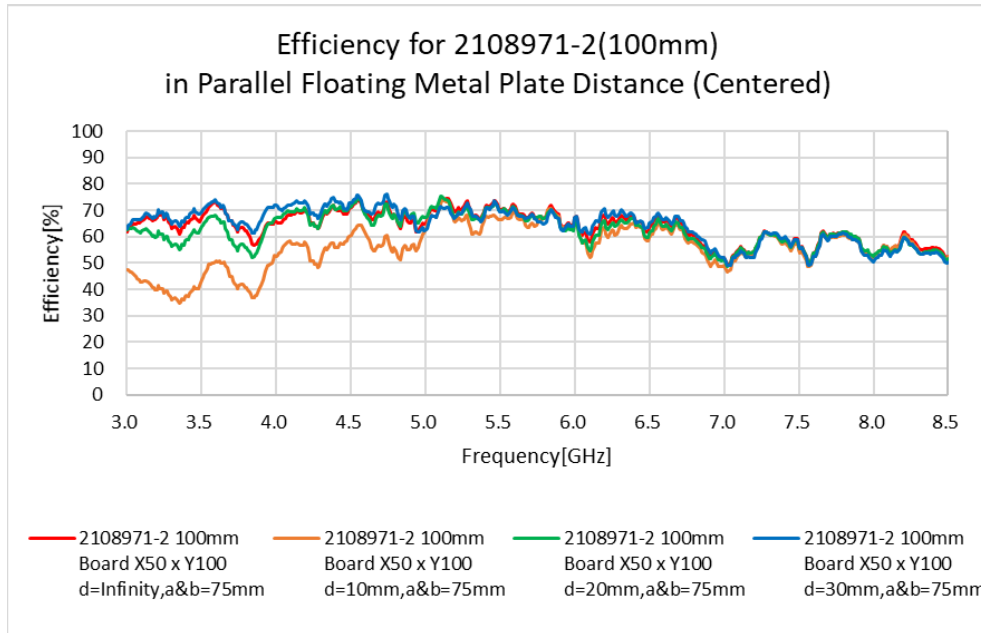
a=75mm, b=75mm

d = 10mm, 20mm, 30mm, infinity (without the floating metal plate)

Antenna cable length = 100mm (PN: 2108965-2)



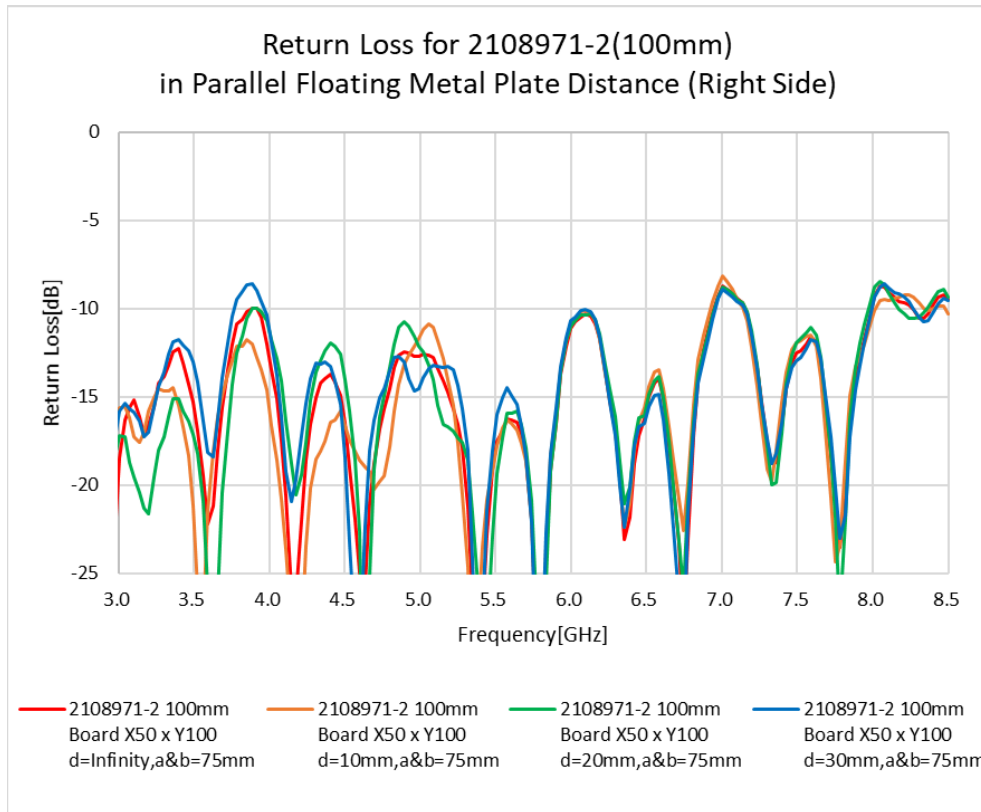
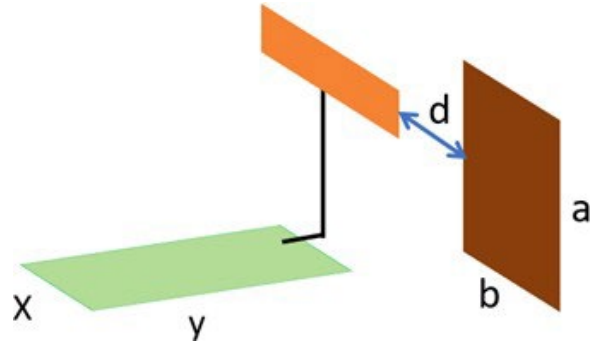
### 3 f. Performance Variation with Parallel Floating Metal Plate (Centered) Contd.



### 3 g. Performance Variation with Parallel Floating Metal Plate (Right Side)

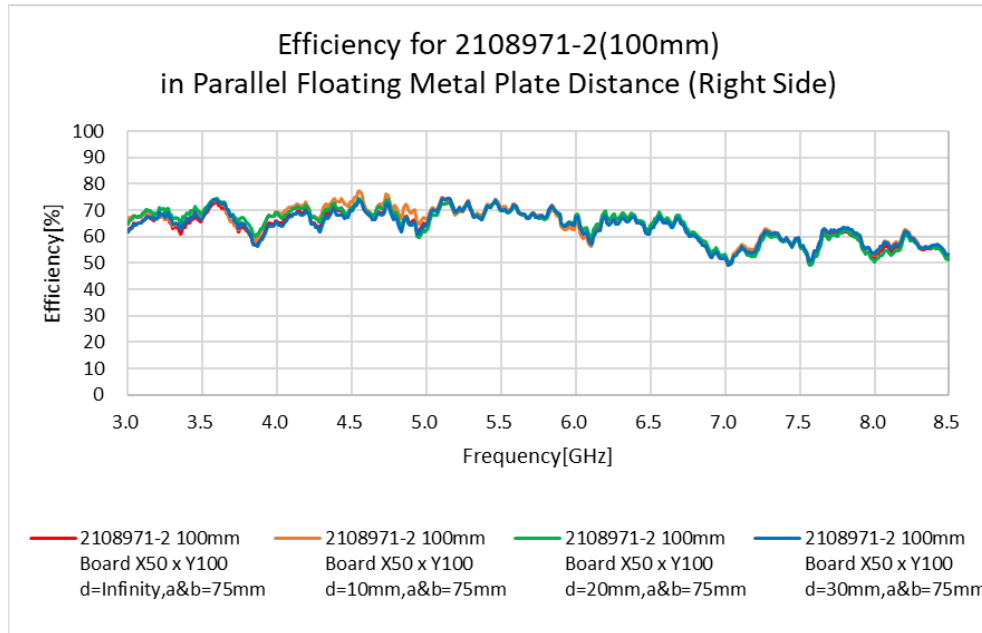
This section shows the effect on return loss of positioning the antenna parallel with a floating metal plate in various distance to the right of the antenna. The antenna is fed from the mini coax connector at the edge of the PCB ground plane.

Variables:  
 X=50mm, Y=100mm  
 a=75mm, b=75mm  
 d = 10mm, 20mm, 30mm, infinity (without the floating metal plate)  
 Antenna cable length = 100mm (PN: 2108965-2)





### 3 g. Performance Variation with Parallel Floating Metal Plate (Right Side) Contd.



### 3 h. Performance Variation with Orthogonal Floating Metal Plate (Centered)

This section shows the effect on return loss of positioning the antenna orthogonally with a floating metal plate at various height to the PCB ground plane. The antenna is fed from the mini coax connector at the edge of the PCB ground plane.

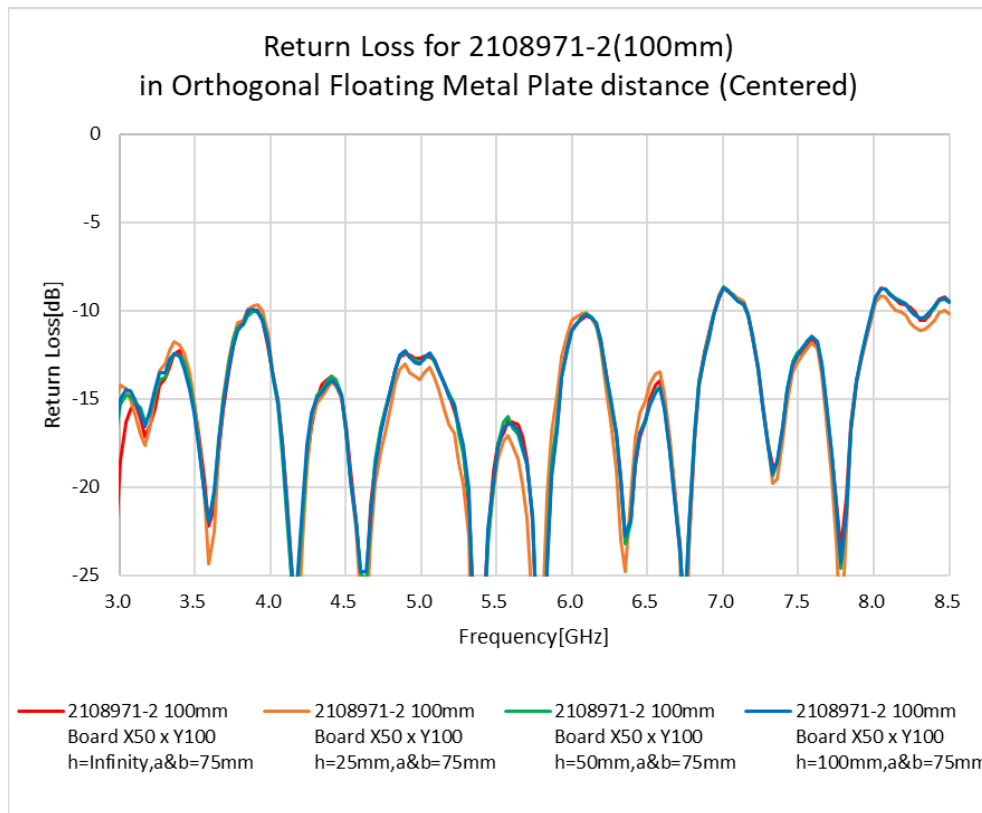
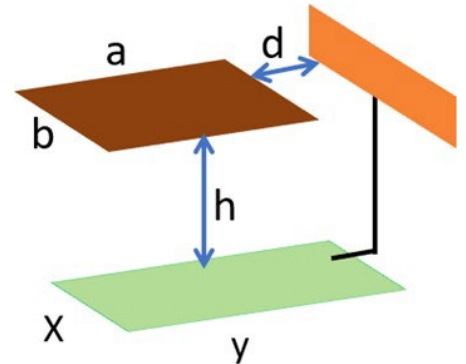
Variables:

X=50mm, Y=100mm

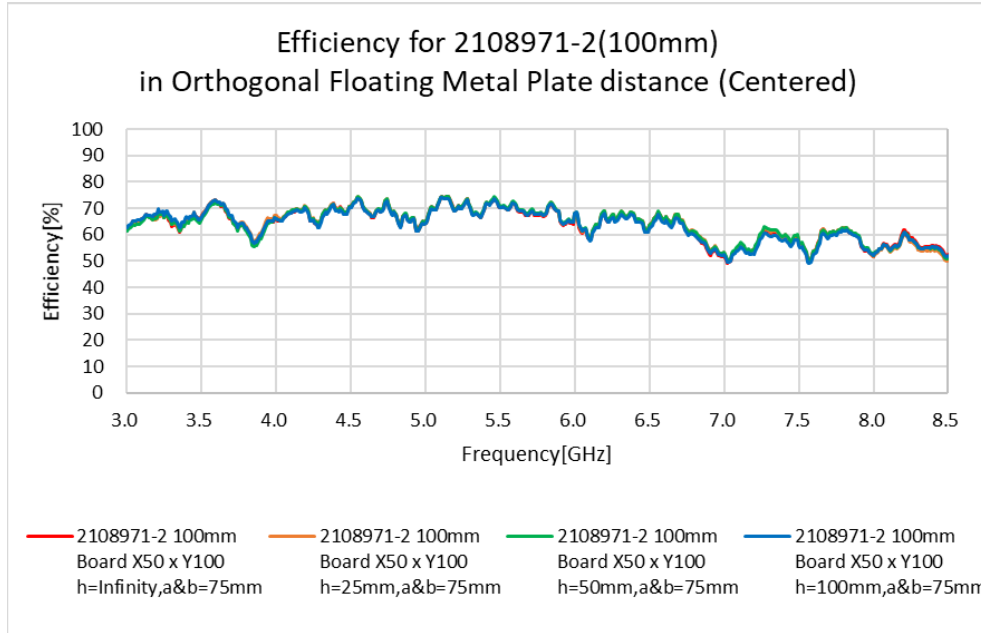
a=75mm, b=75mm, d = 20mm

h= 25mm, 50mm, 100mm, infinity (without the floating metal plate)

Antenna cable length = 100mm (PN: 2108965-2)



### 3 h. Performance Variation with Orthogonal Floating Metal Plate (Centered) Contd.



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