



Application Notes: 2108921-X Antennas

Product Description

- Flexible cable antenna
- Dipole antenna type (Dimensions 119.3 x 20.0 x 0.17mm)
- Ground plane independent
- FPCB with double-side adhesive for peel and stick
- Mini coax cable and connector
- Cable length: 50mm, 100mm, 150mm, 200mm
- Covers 5G global region, BT, Wi-Fi, GNSS spectrum
- Antenna performance optimized to 150mm cable length

OVERVIEW

This application note describes the RF performance of the 2108921-X (617-7125 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. 2108921-1 : 50mm 2108921-2 : 100mm etc..

The common factors discussed in this document include the angle of the PCB 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

[**Instruction:** The information on the following pages has been populated from a the completed 2108921-X Application note. The content is included for guidance but please overwrite with the new content required.]

Electrical							
Frequency Range (MHz)	617-960	1427-1700	1700-2700	3300-4000	4000-5000	5000-6000	6000-7125
VSWR	< 2.2:1	< 2.7:1	< 2.6:1	< 1.7:1	< 2.3:1	< 2.3:1	< 2.3:1
Average Efficiency	62 %	67 %	65 %	69 %	69 %	66 %	66 %
Peak Gain	0.3 dBi	1.9 dBi	4.0 dBi	3.4 dBi	4.7 dBi	3.1 dBi	4.8 dBi
Power Handling	10 Watt cw						
Polarization	Linear						
Mechanical							
Size mm (in.)	119.3 x 20 x 0.17 mm (4.67 x 0.79 x 0.007 in.)						
Weight g (oz.)	3.7 g (0.13 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 2108921-1 antenna. For full 2108921-X datasheet, drawings, CAD files and specifications please visit [product landing page](#).

1 b. Frequency Bands

This antenna covers 5G/4G global bands, GNSS, and BT/Wi-Fi (617 - 7125 MHz)

Band	Up Link (MHz)		Down Link (MHz)		Support	Band	Up Link		Down Link		Support
Band 1	1920	1980	2110	2170	✓	Band 50	1432		1517		✓
Band 2	1850	1910	1930	1990	✓	Band 51	1427		1432		✓
Band 3	1710	1785	1805	1880	✓	Band 53	2483.5		2495		✓
Band 4	1710	1755	2110	2155	✓	Band 65	1920	2010	2110	2200	✓
Band 5	824	849	869	894	✓	Band 66	1710	1780	2110	2200	✓
Band 7	2500	2570	2620	2690	✓	Band 67	N/A		738	758	✓
Band 8	880	915	925	960	✓	Band 68	698	728	753	783	✓
Band 12	699	716	729	746	✓	Band 69	N/A		2570	2620	✓
Band 13	777	787	746	756	✓	Band 70	1695	1710	1995	2020	✓
Band 14	788	798	758	768	✓	Band 71	663	698	617	652	✓
Band 18	815	830	960	875	✓	Band 74	1427	1470	1475	1518	✓
Band 20	832	862	791	821	✓	Band 75	N/A		1432	1517	✓
Band 21	1447.9	1462.9	1495.5	1510.9	✓	Band 76	N/A		1427	1432	✓
Band 22	3410	3500	3510	3600	✓	Band 77	3300		4200		✓
Band 23	2000	2020	2180	2200	✓	Band 78	3300		3800		✓
Band 24	1626.5	1660.5	1525	1559	✓	Band 79	4400		5000		✓
Band 25	1850	1915	1930	1995	✓	Band 80	1710	1785	N/A		✓
Band 26	814	849	859	894	✓	Band 81	880	915	N/A		✓
Band 28	703	748	758	803	✓	Band 82	832	862	N/A		✓
Band 29	N/A		717	728	✓	Band 83	703	748	N/A		✓
Band 30	2305	2315	2350	2360	✓	Band 84	1920	1980	N/A		✓
Band 31	452.5	457.5	462.5	467.5	✗	Band 86	1710	1780	N/A		✓
Band 32	N/A		1452	1496	✓	Band 89	824	849	N/A		✓
Band 34	2010			2025	✓	Band 90	2496		2690		✓
Band 38	2570			2620	✓	Band 91	832	862	1427	1432	✓
Band 39	1880			1920	✓	Band 92	832	862	1432	1517	✓
Band 40	2300			2400	✓	Band 93	880	915	1427	1432	✓
Band 41	2496			2690	✓	Band 94	880	915	1432	1517	✓
Band 42	3400			3600	✓	Band 95	2010	2025	N/A		✓
Band 43	3600			3800	✓	Band 96	5925		7125		✓
Band 44	703			803	✓	Band 97	2300	2400	N/A		✓
Band 46	5150			5925	✓	Band 98	1880	1920	N/A		✓
Band 47	5855			5925	✓	Band 99	1626.5	1660.5	N/A		✓
Band 48	3550			3700	✓						

GNSS, BT and Wi-Fi Bands Coverage

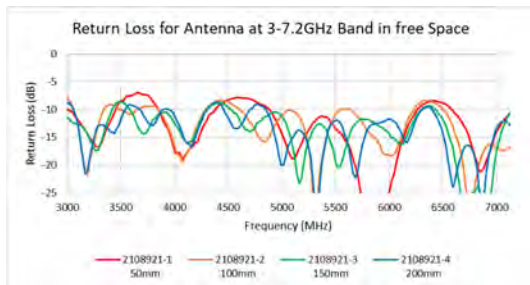
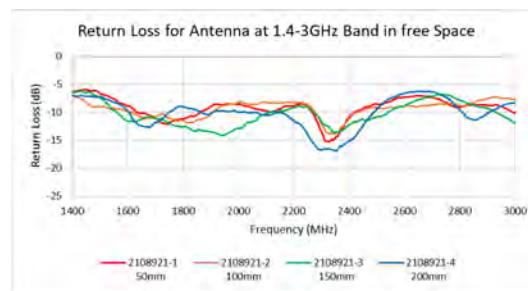
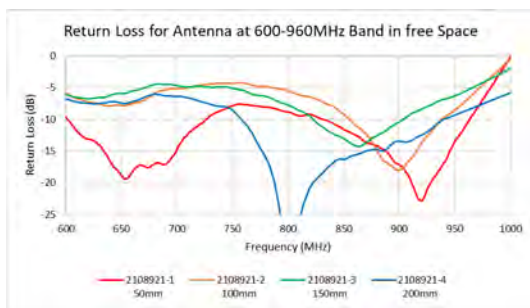
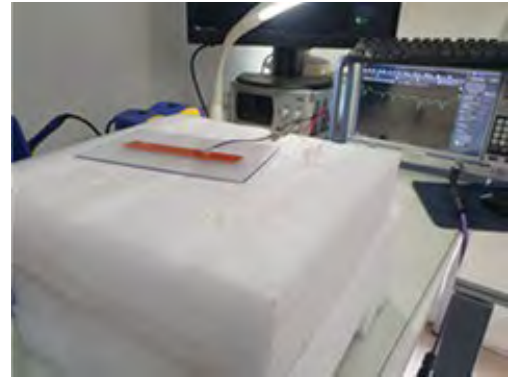
GNSS System	Band	Frequency (MHz)	Fc (MHz)	Support	GNSS System	Band	Frequency (MHz)	Fc (MHz)	Support	BT/ Wi-Fi Band	Frequency (MHz)	Fc (MHz)	Support
GPS	L1	1565 - 1586	1575.42	✓	QZSS	L1	1565 - 1586	1575.42	✓	2.4 GHz	2400 - 2485	2443	✓
	L2	1217 - 1238	1248.06	✗		L2C	1217 - 1238	1227.6	✗	5 GHz	5125 - 5875	5513	✓
	L5	1164 - 1189	1176.45	✗		L5	1164 - 1189	1176.45	✗	6 GHz	5925 - 7125	6525	✓
BeiDou	B1	1559 - 1592	1575.42	✓	L6(LEX)	L6(LEX)	1258 - 1300	1278.75	✗				
	B2a	1164 - 1189	1176.45	✗	IRNSS	L5	1164 - 1189	1176.45	✗				
	B2b	1186 - 1217	1207.14	✗	Other	G1	1596 - 1610	1602	✓				
	B3	1258 - 1280	1268.52	✗		G2	1241 - 1255	1248.06	✗				
Galileo	E1	1563 - 1588	1575.42	✓		G3	1189 - 1212	1207.14	✗				
	E5b	1186 - 1217	1207.17	✗									
	E6	1258 - 1300	1278.75	✗									

2. RF PERFORMANCE IN FREE SPACE

2 a. Return Loss

Test Setup

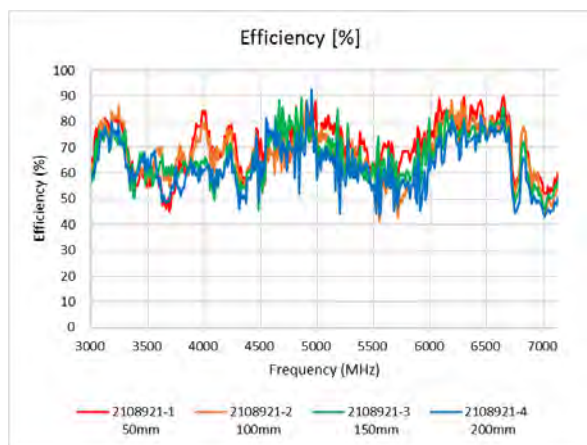
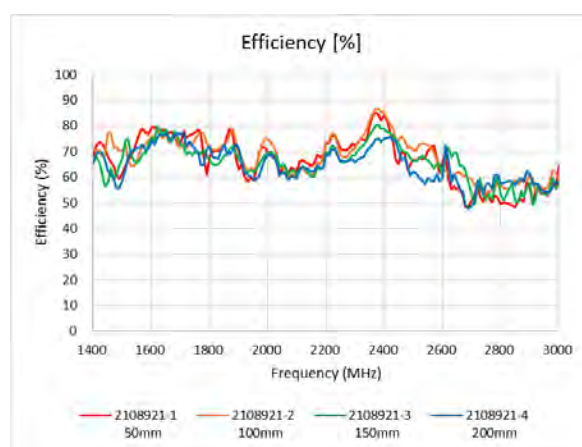
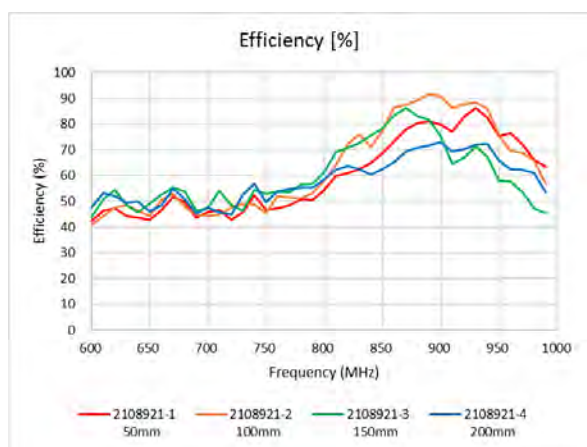
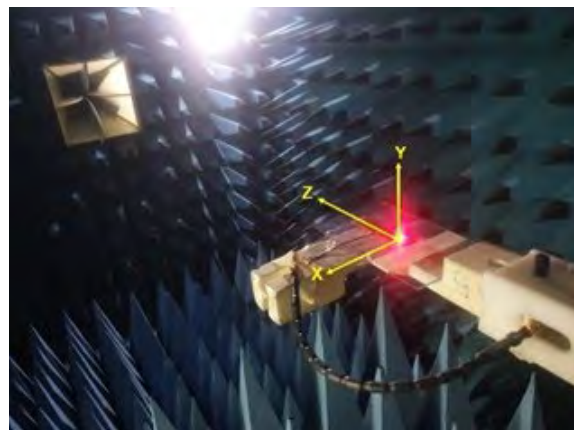
- VNA(9kHz-8.5GHz)
- The antenna is placed a PC plastic in the size of 165mm x 100mm x 2 mm



2 b. Total Efficiency

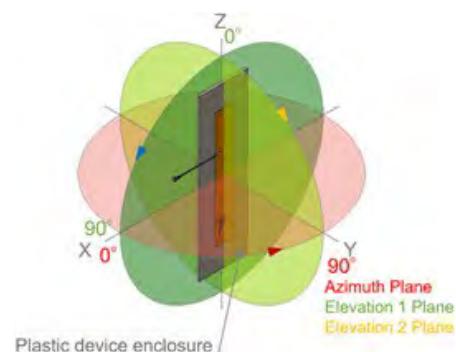
Test Setup

- Test Setup: Antenna Anechoic Chamber (400MHz-8GHz)
- The antenna is placed a PC plastic in the size of 165mm x 100mm x 2 mm

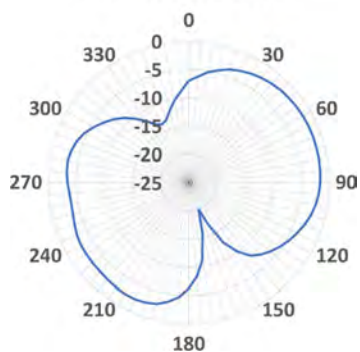


2 c. Gain Radiation Patterns 2D

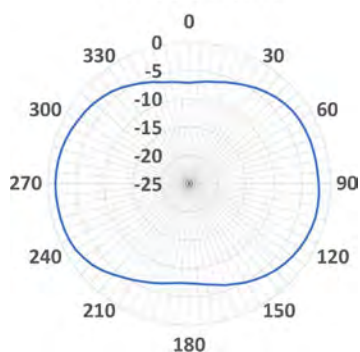
Total Gain Radiation Patterns (2D) of the Antenna with 150mm Cable Length
(PN: 2108921-3)



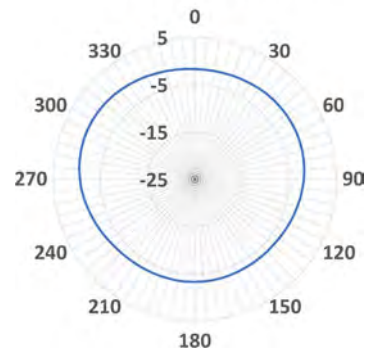
XZ-650MHz



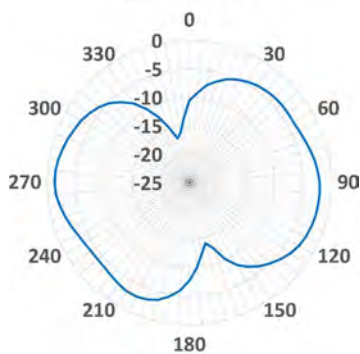
YZ-650MHz



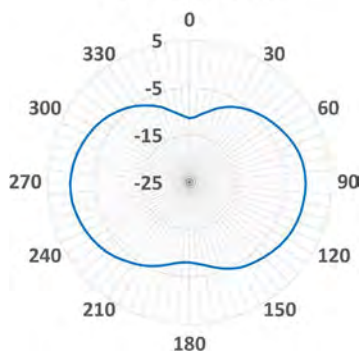
XY-650MHz



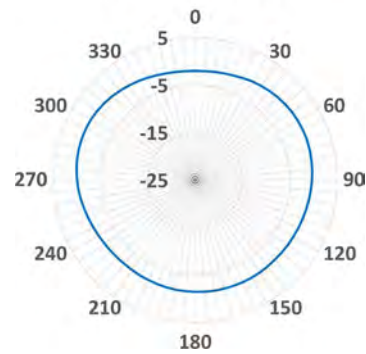
XZ-750MHz



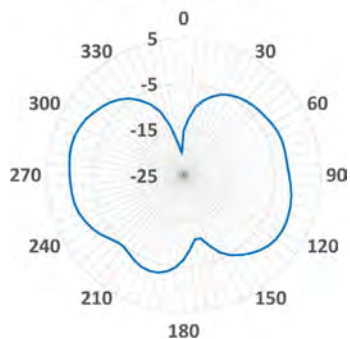
YZ-750MHz



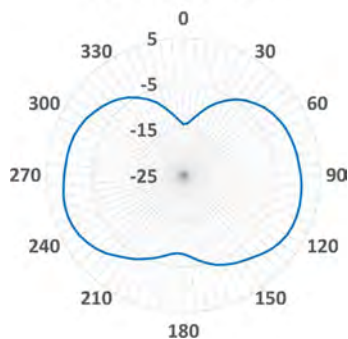
XY-750MHz



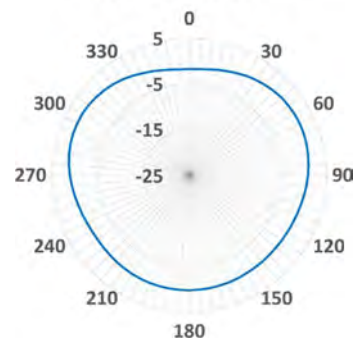
XZ-850MHz



YZ-850MHz

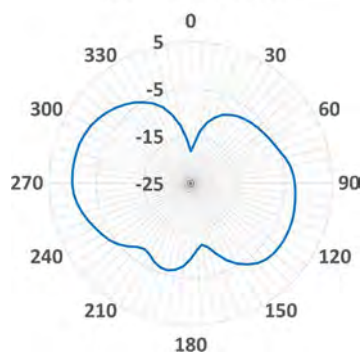


XY-850MHz

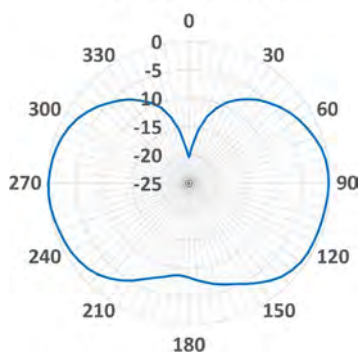


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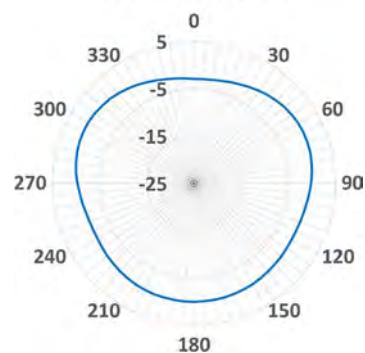
XZ-950MHz



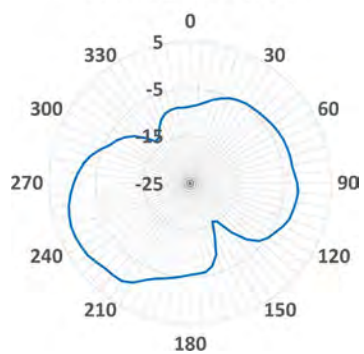
YZ-950MHz



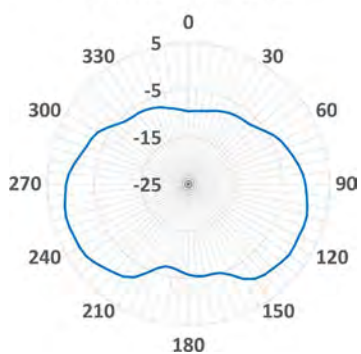
XY-950MHz



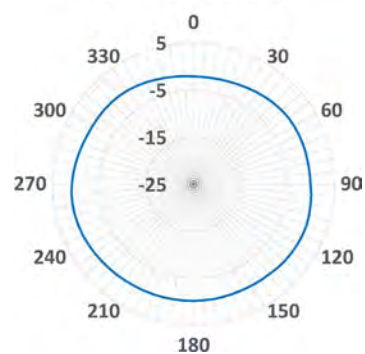
XZ-1575MHz



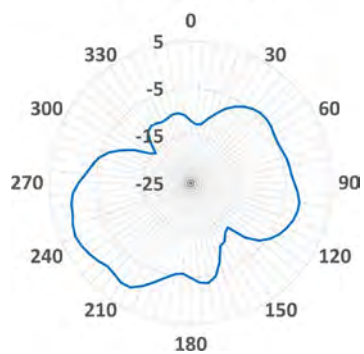
YZ-1575MHz



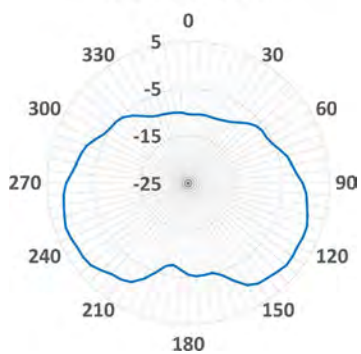
XY-1575MHz



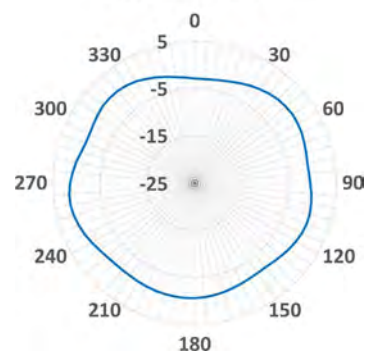
XZ-1.7GHz



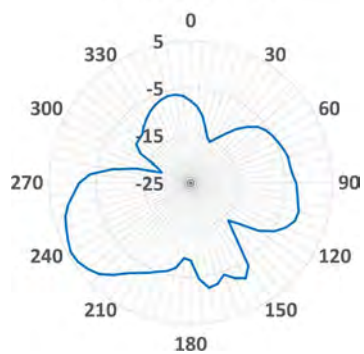
YZ-1.7GHz



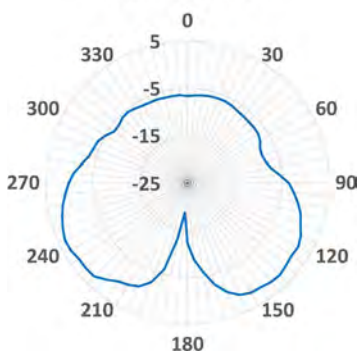
XY-1.7GHz



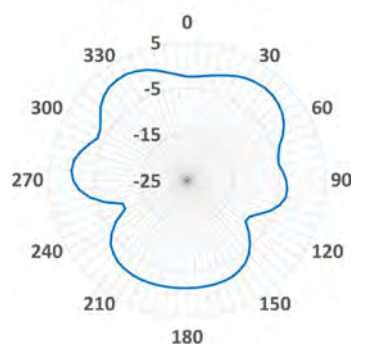
XZ-1.9GHz



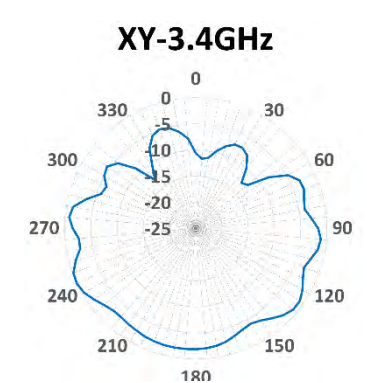
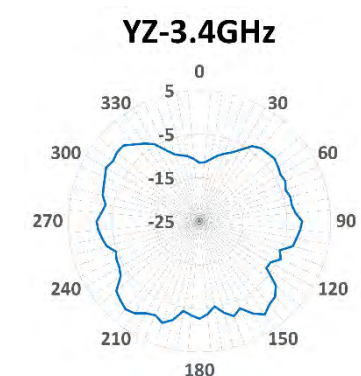
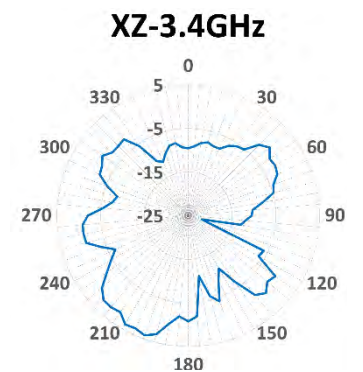
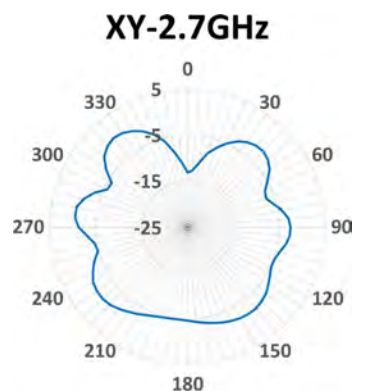
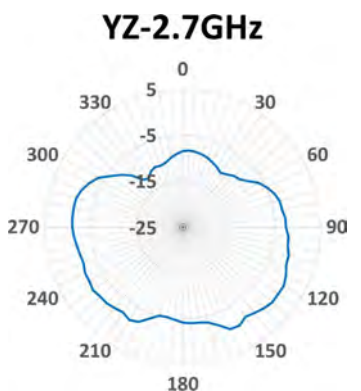
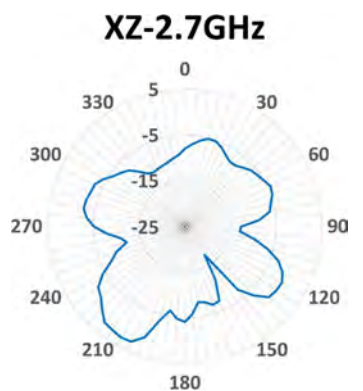
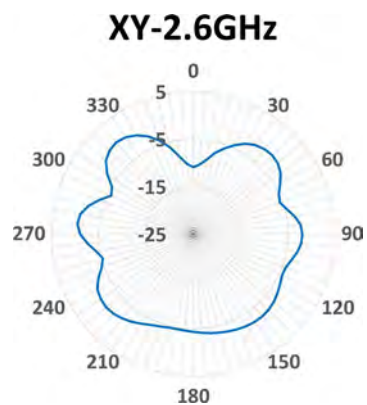
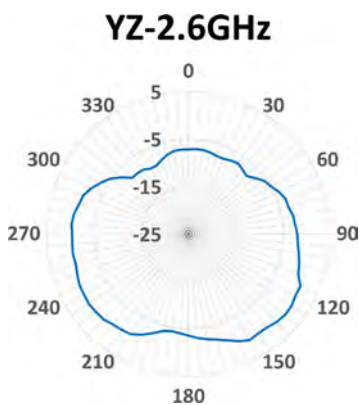
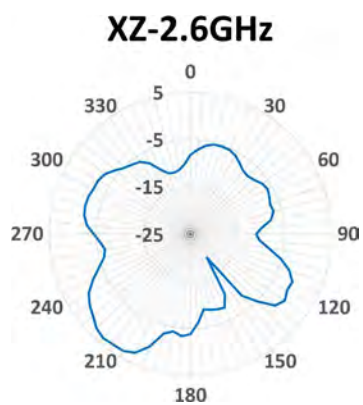
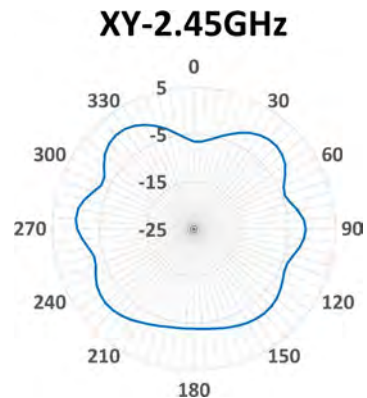
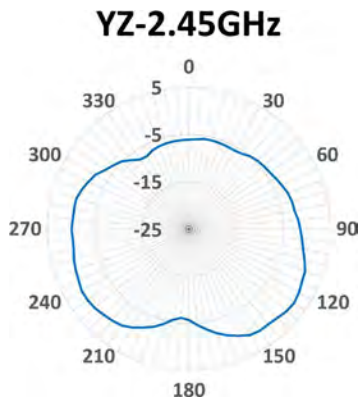
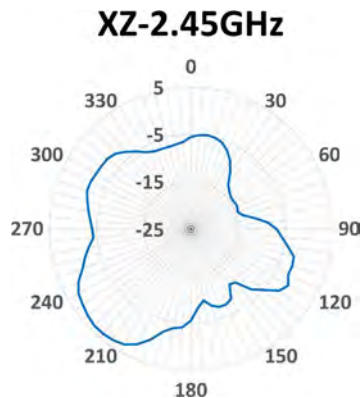
YZ-1.9GHz



XY-1.9GHz

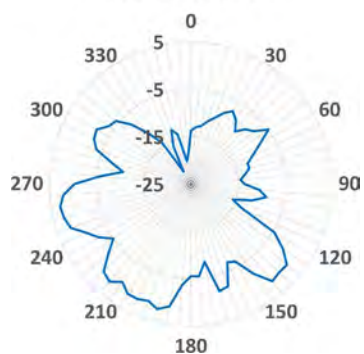


2 c. Gain Radiation Patterns 2D Contd.

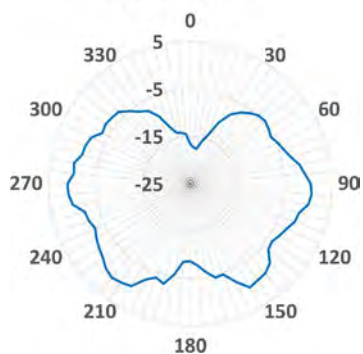


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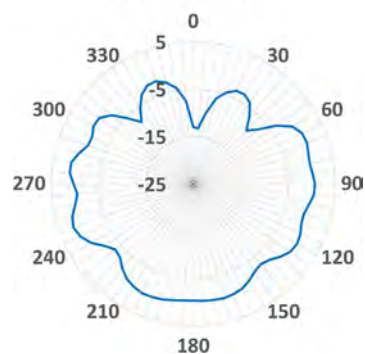
XZ-3.6GHz



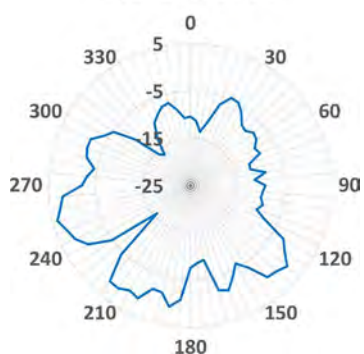
YZ-3.6GHz



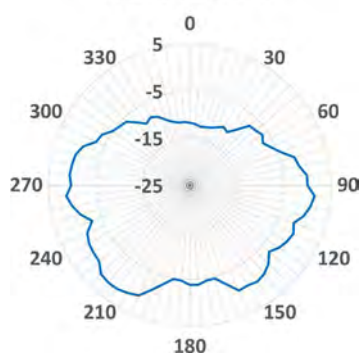
XY-3.6GHz



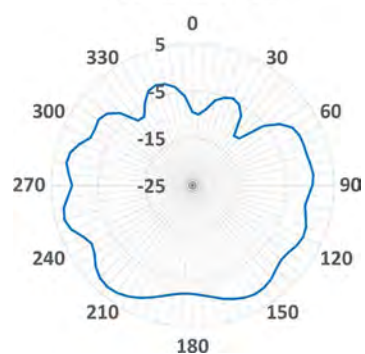
XZ-3.8GHz



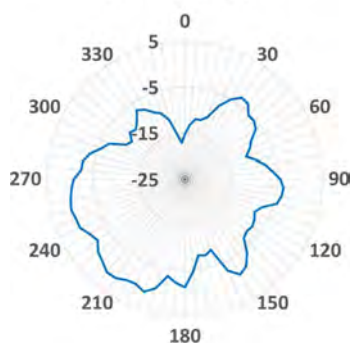
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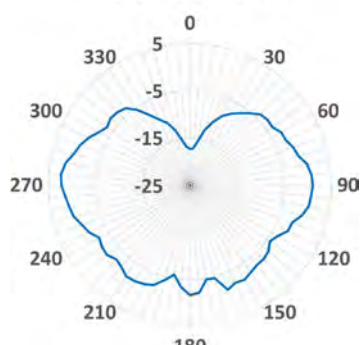
XY-3.8GHz



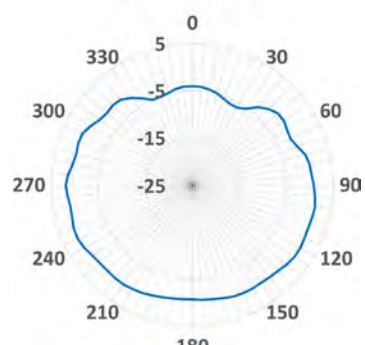
XZ-4.4GHz



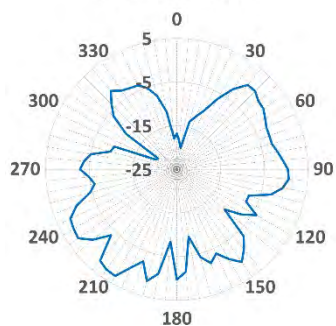
YZ-4.4GHz



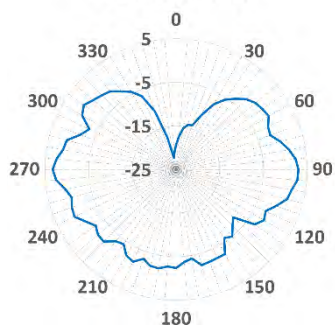
XY-4.4GHz



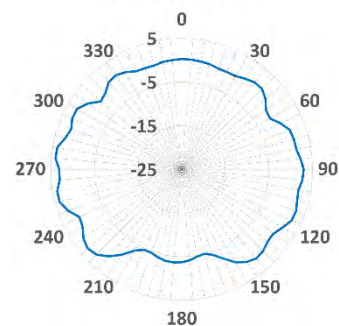
XZ-4.7GHz



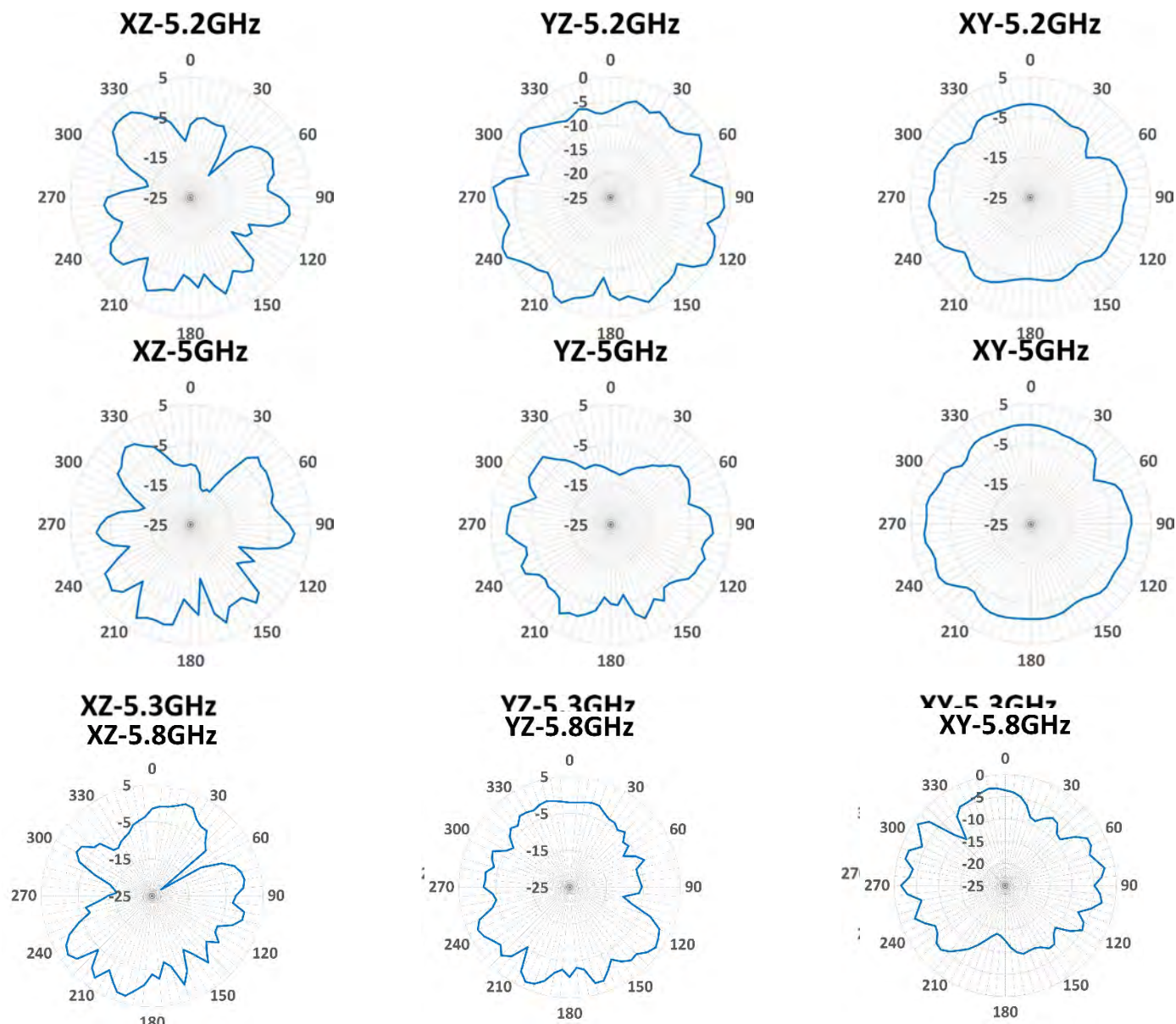
YZ-4.7GHz



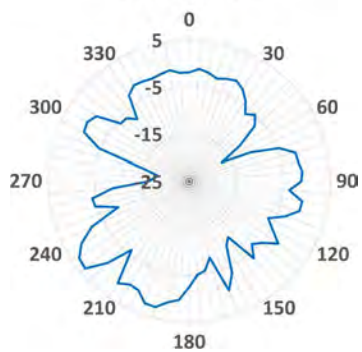
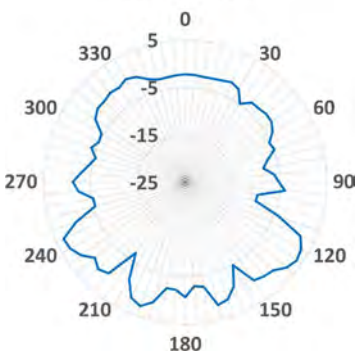
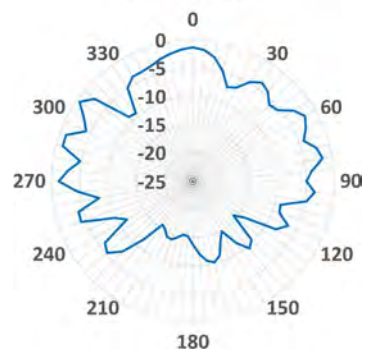
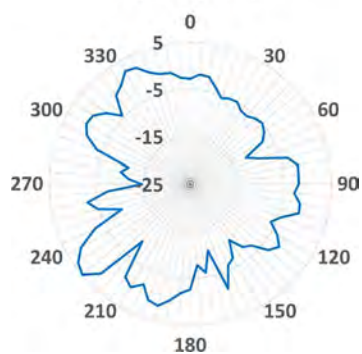
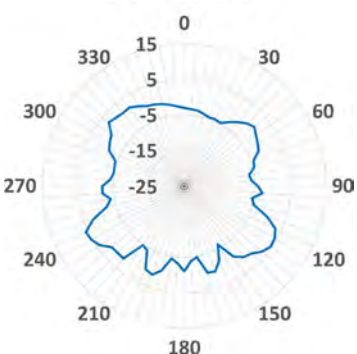
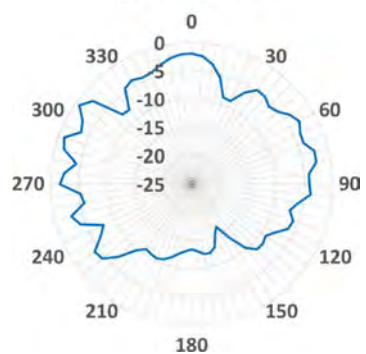
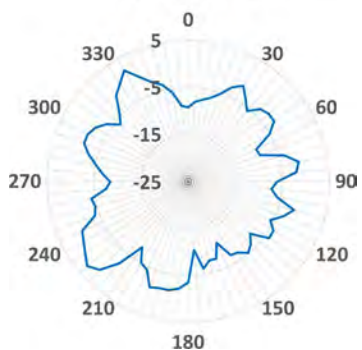
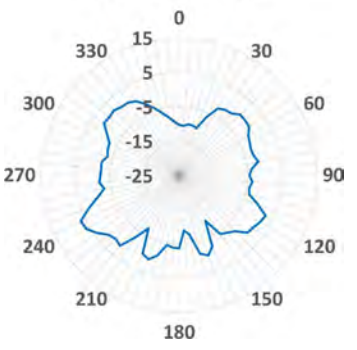
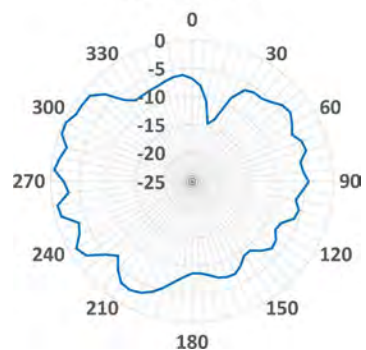
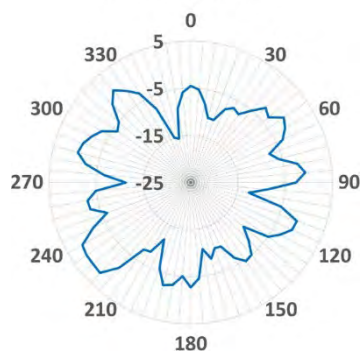
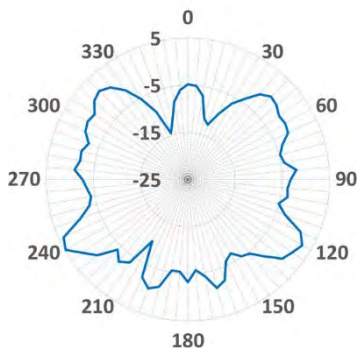
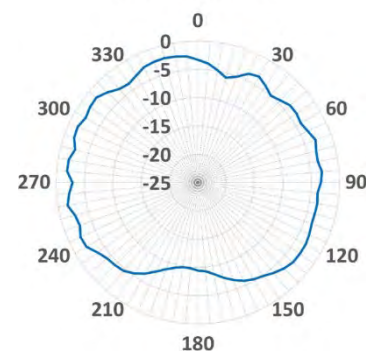
XY-4.7GHz



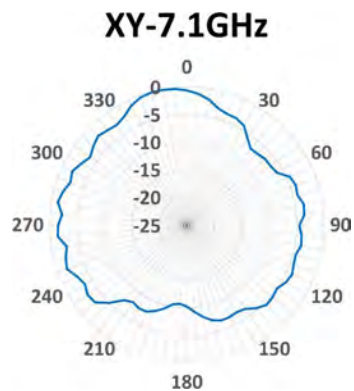
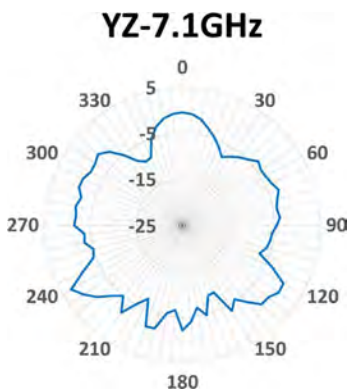
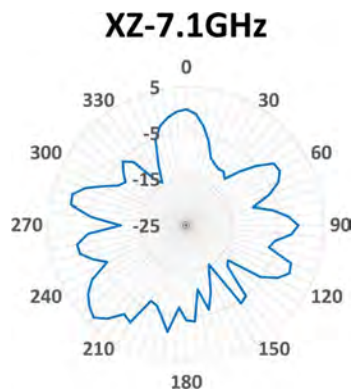
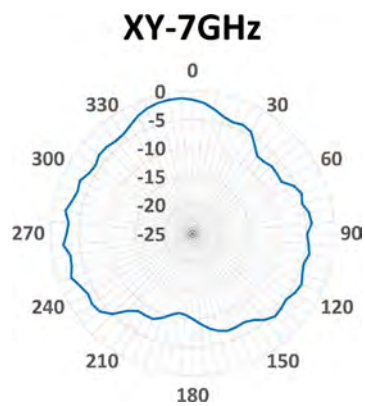
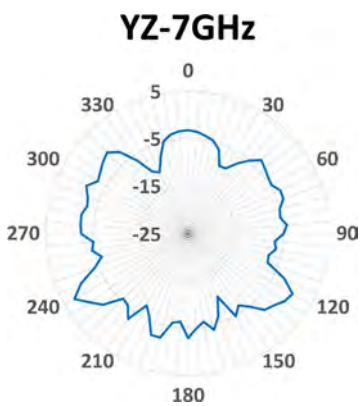
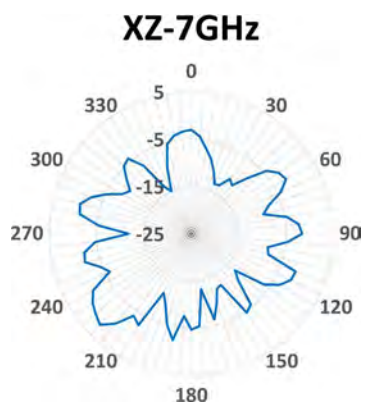
2 c. Gain Radiation Patterns 2D Contd.



2 c. Gain Radiation Patterns 2D Contd.

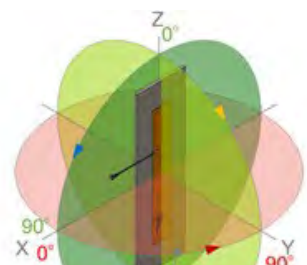
XZ-6GHz**YZ-6GHz****XY-6GHz****XZ-6.2GHz****YZ-6.2GHz****XY-6.2GHz****XZ-6.5GHz****YZ-6.5GHz****XY-6.5GHz****XZ-6.8GHz****YZ-6.8GHz****XY-6.8GHz**

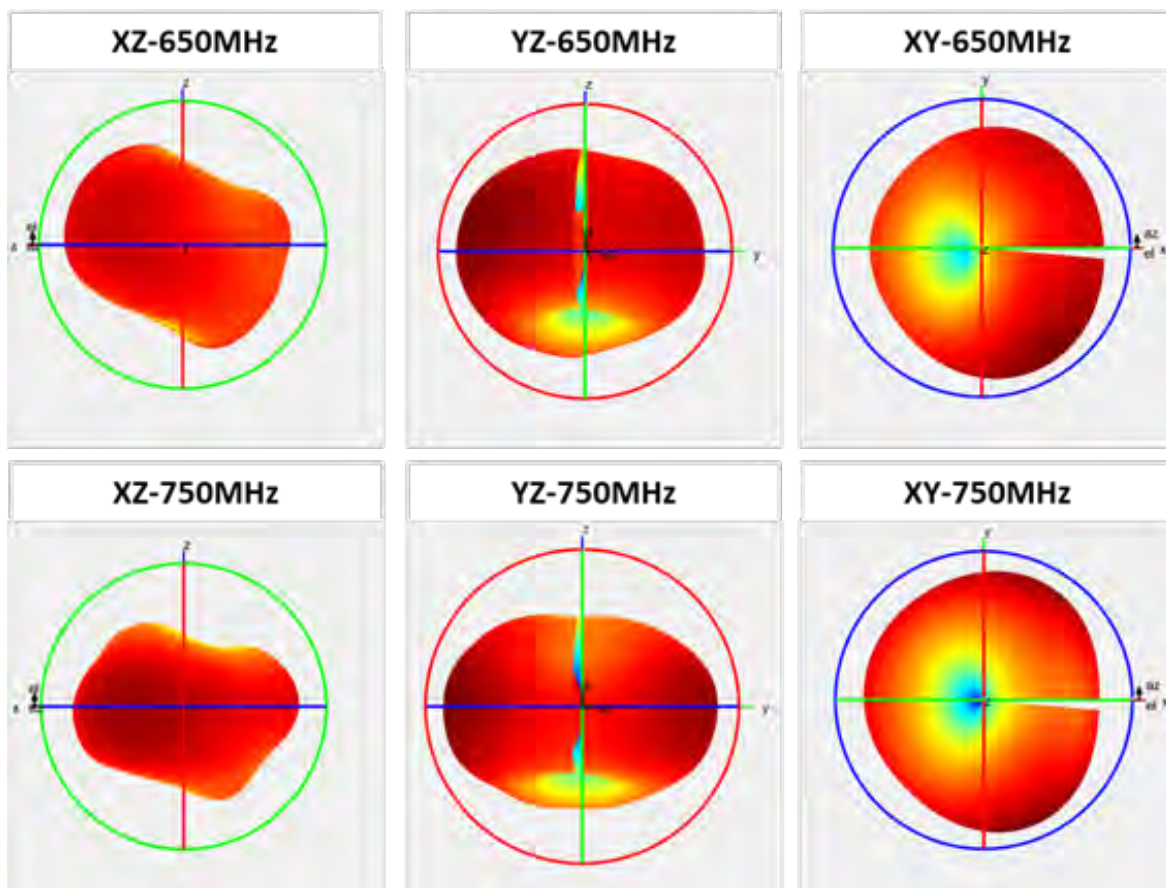
2 c. Gain Radiation Patterns 2D Contd.



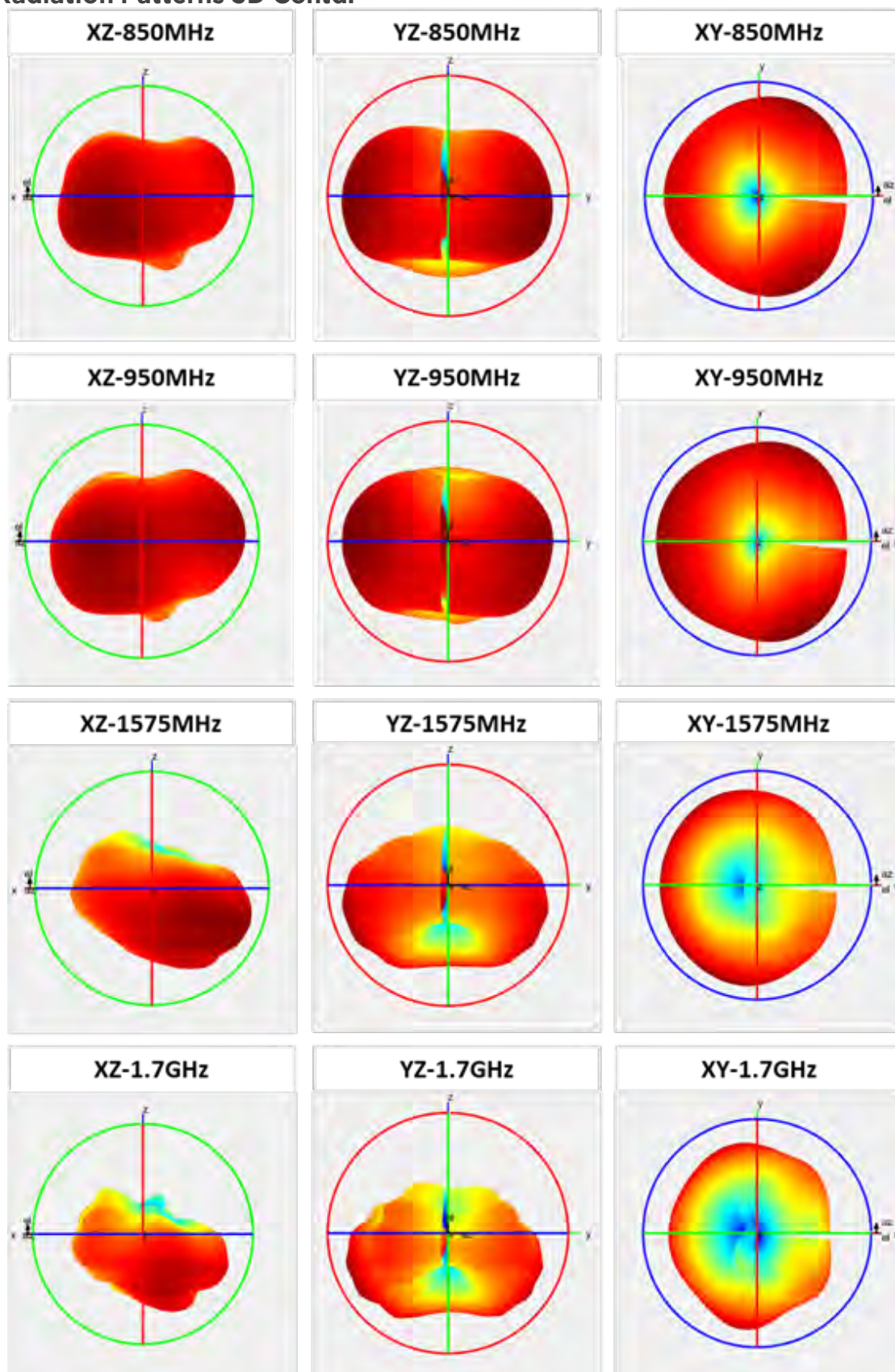
2 d. Gain Radiation Patterns 3D

Total Gain Radiation Patterns (3D) of the Antenna with 150mm Cable Length
(PN: 2108921-3)

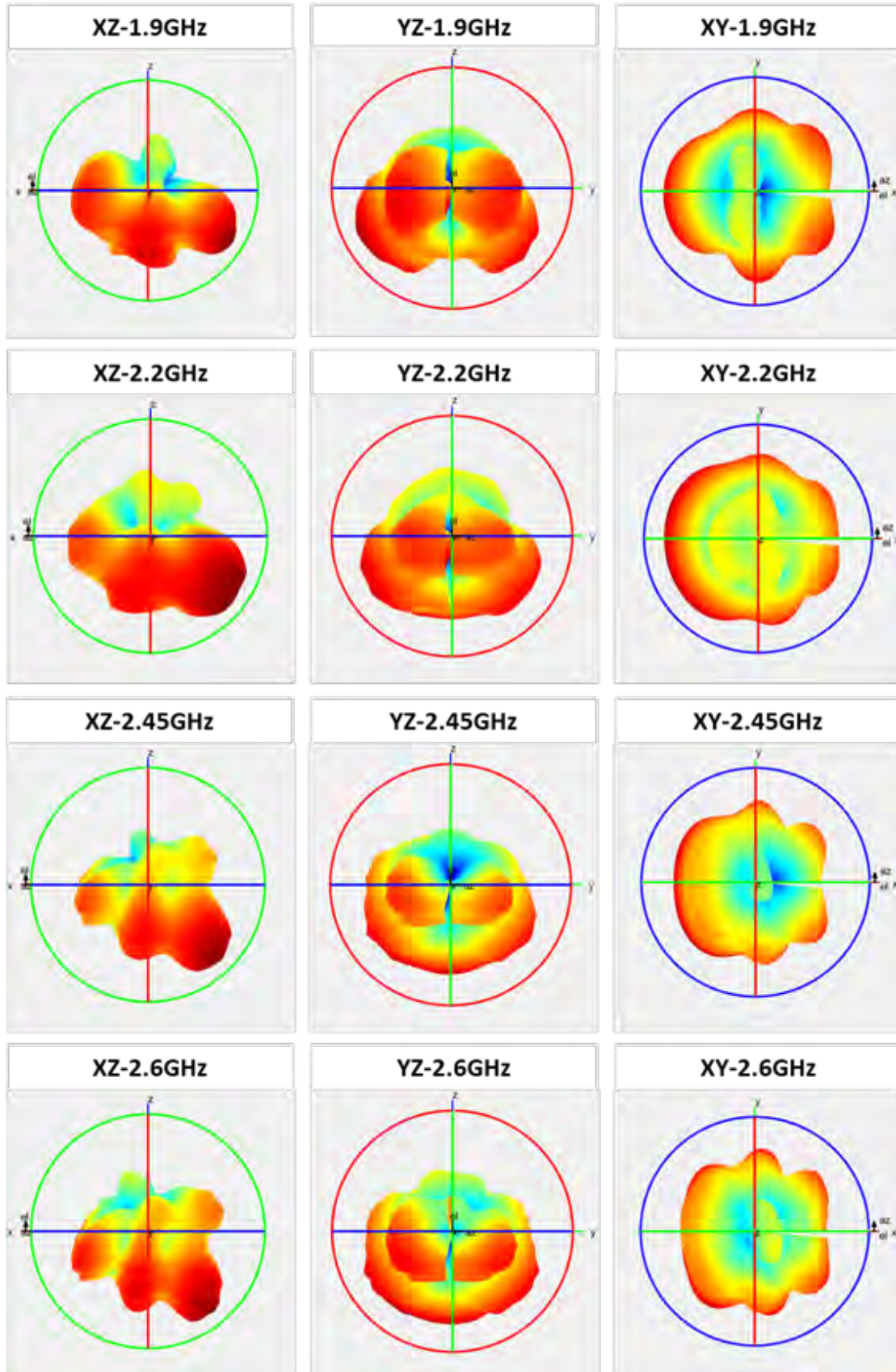




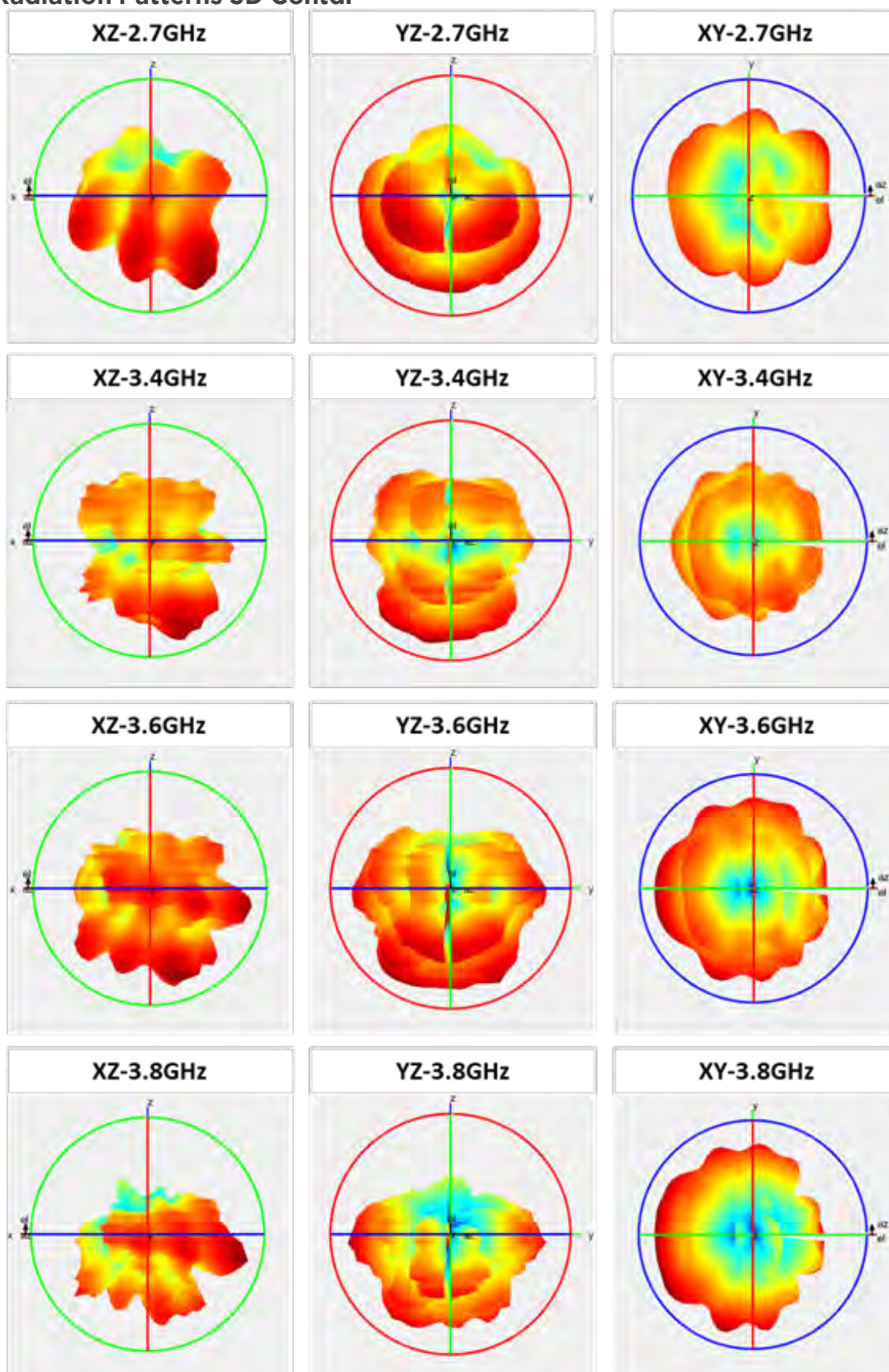
2 d. Gain Radiation Patterns 3D Contd.



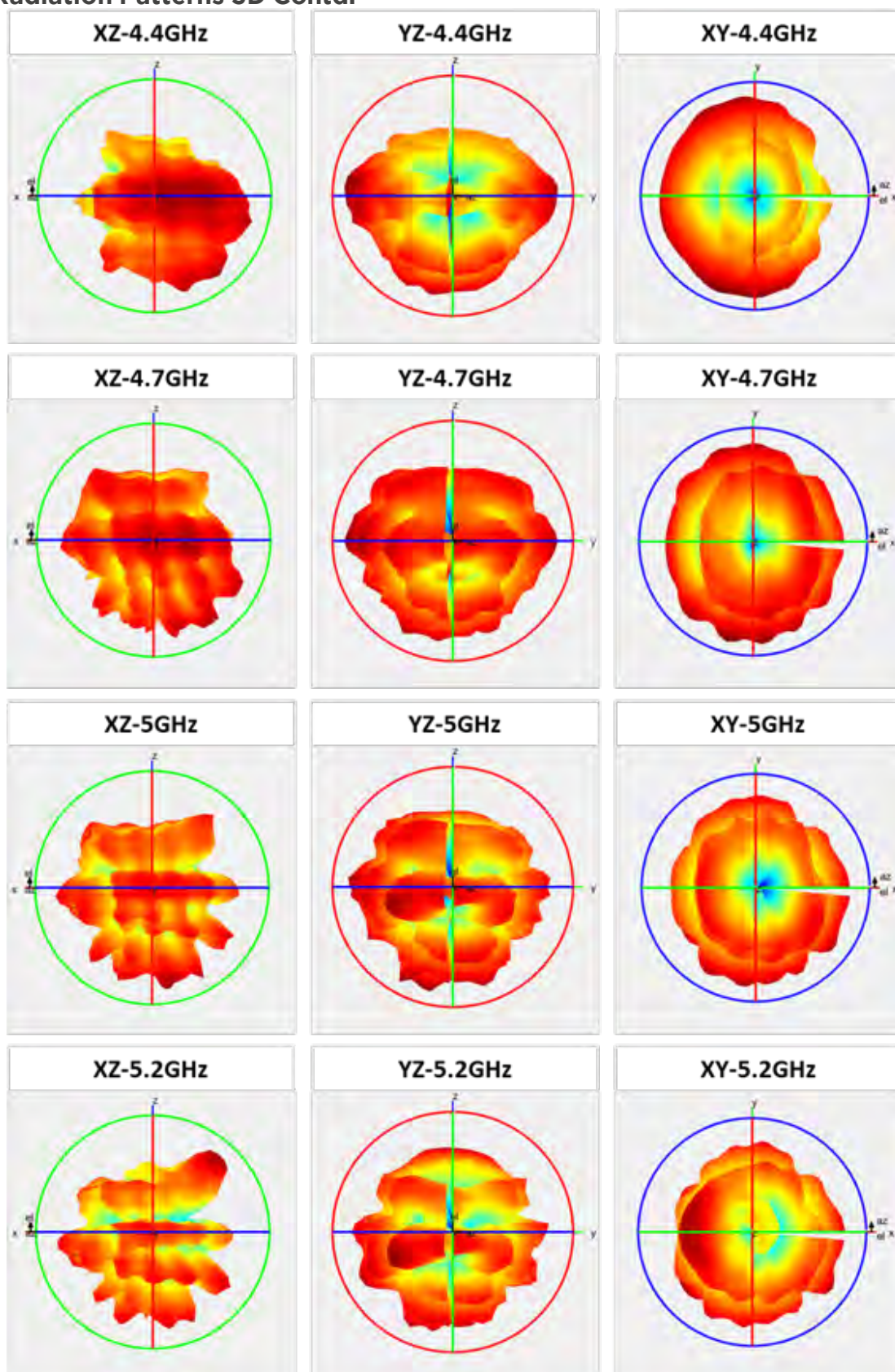
2 d. Gain Radiation Patterns 3D Contd.



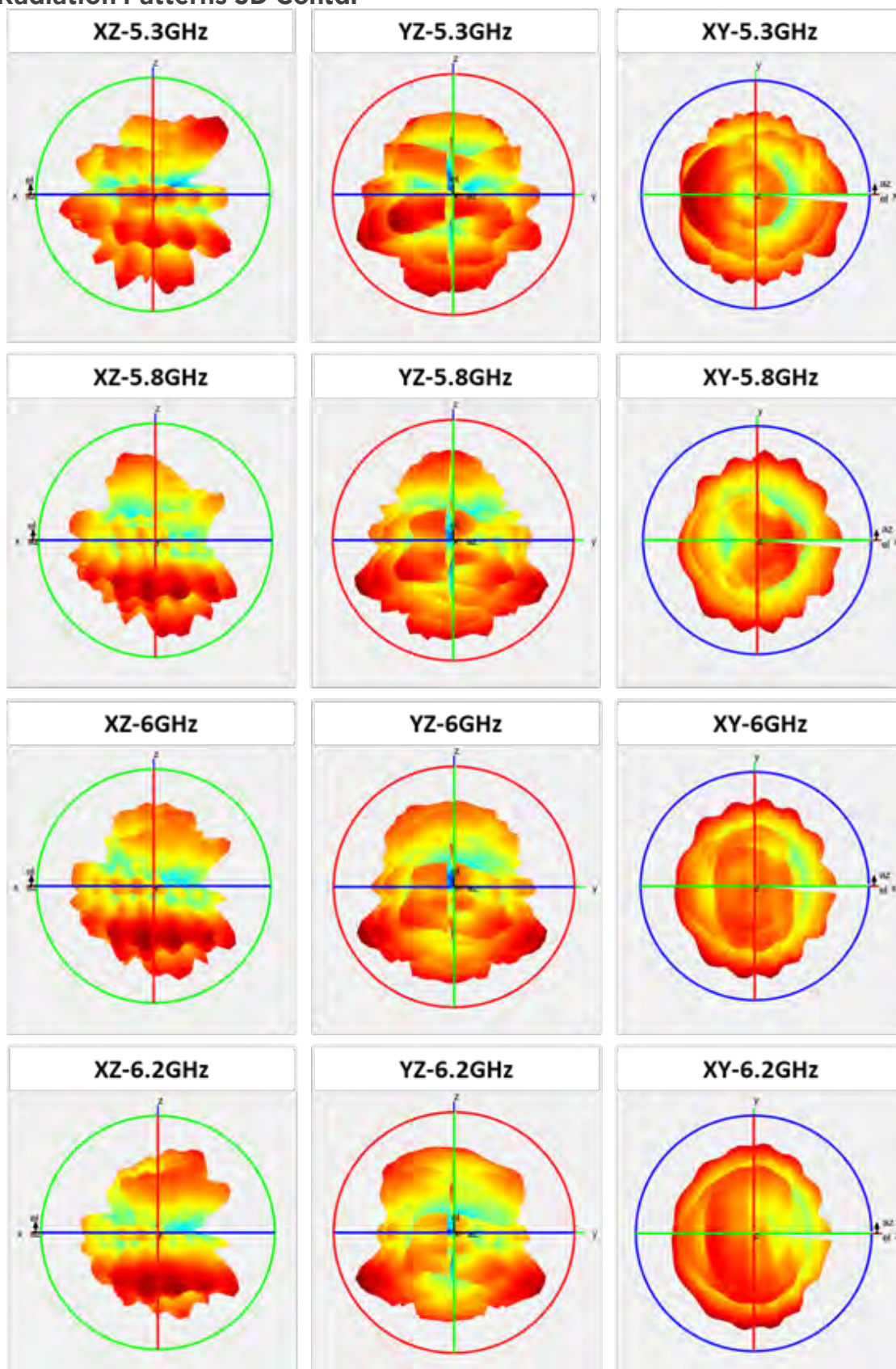
2 d. Gain Radiation Patterns 3D Contd.



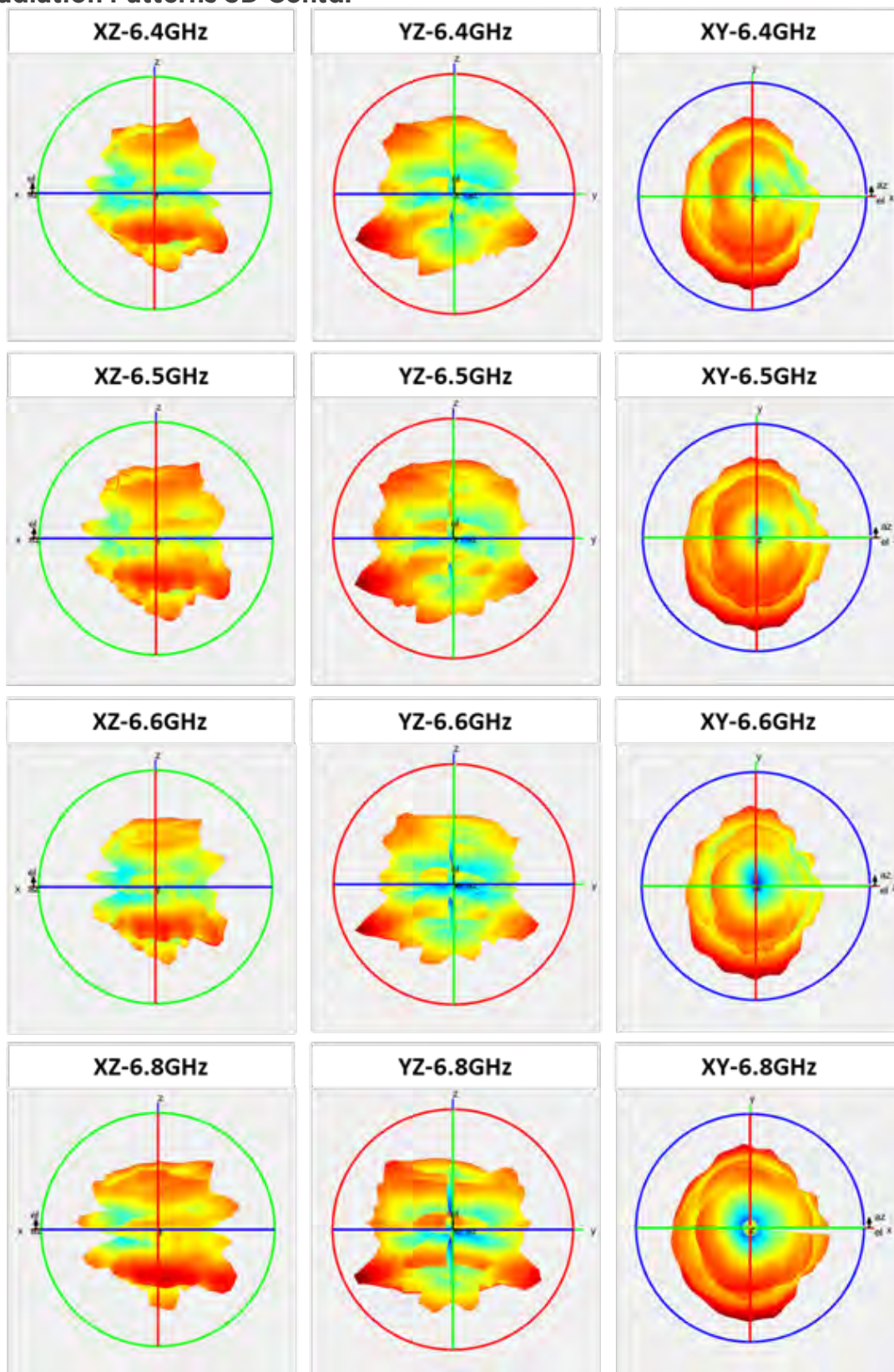
2 d. Gain Radiation Patterns 3D Contd.



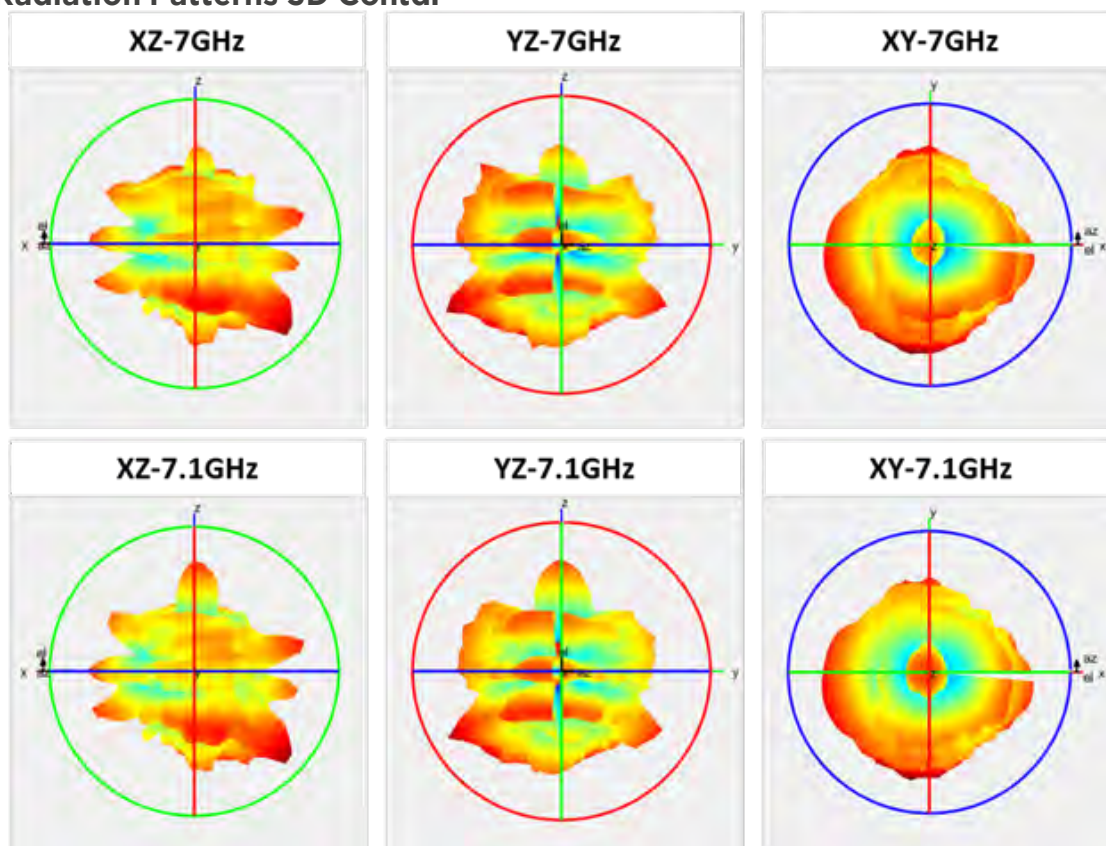
2 d. Gain Radiation Patterns 3D Contd.



2 d. Gain Radiation Patterns 3D Contd.



2 d. Gain Radiation Patterns 3D Contd.



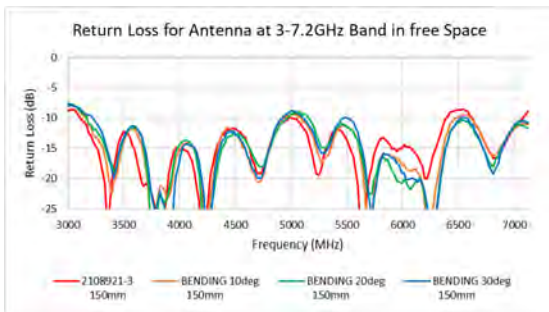
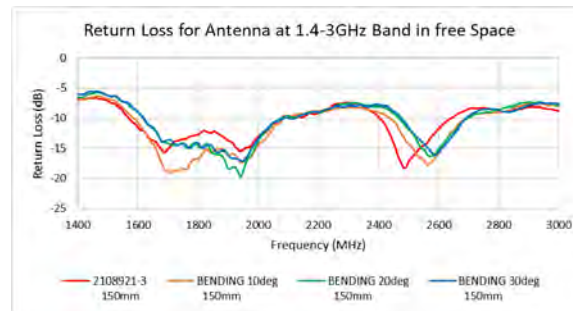
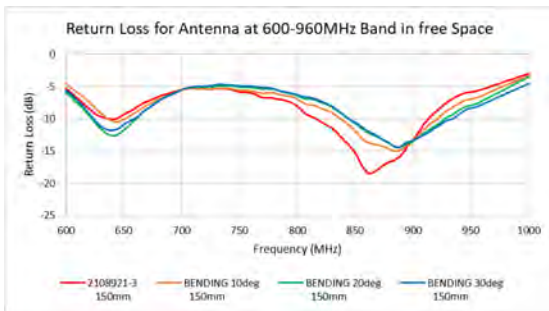
3. ANTENNA PERFORMANCE VARIATION WITH DIFFERENT ANTENNA DESIGN-IN IMPLEMENTATION

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 150mm (PN: 2108921-3).



Bending angle = 10°, 20°, 30°

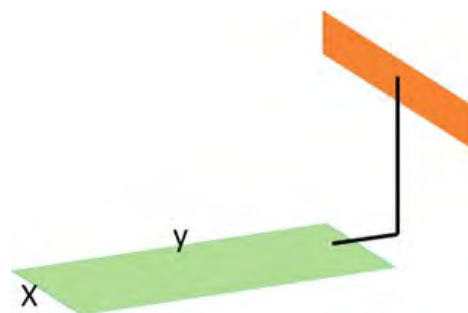


3 b. Performance Variation with Orthogonal Ground Plane

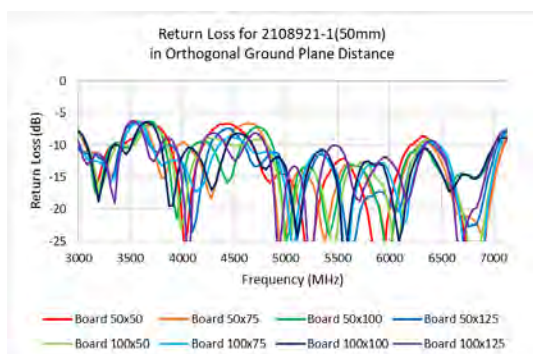
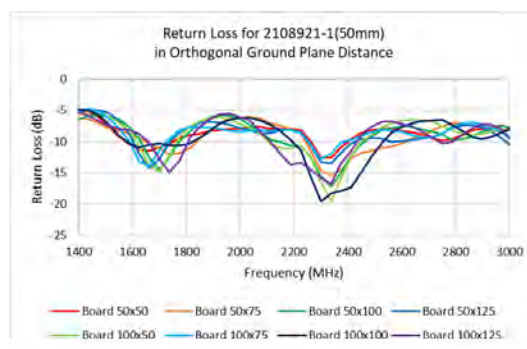
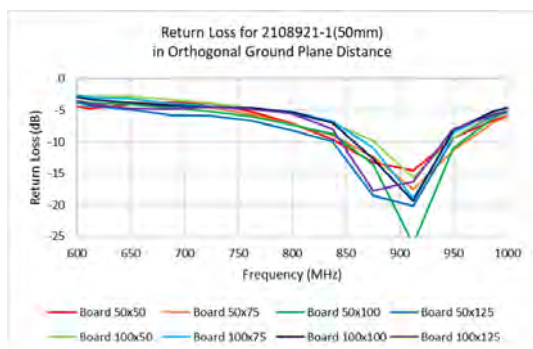
This section shows the effect on return loss of positioning the antenna in the vicinity of various sizes of orthogonally placed ground planes. The antenna is fed from the mini coax connector at the edge of the PCB ground plane. Ensure the cable bending curve doesn't violate the minimum bending radius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

Variables:

Board Size (mm)	X	Y
Board 50x50	50mm	50mm
Board 50x75	50mm	75mm
Board 50x100	50mm	100mm
Board 50x125	50mm	125mm
Board 100x50	100mm	50mm
Board 100x75	100mm	75mm
Board 100x100	100mm	100mm
Board 100x125	100mm	125mm

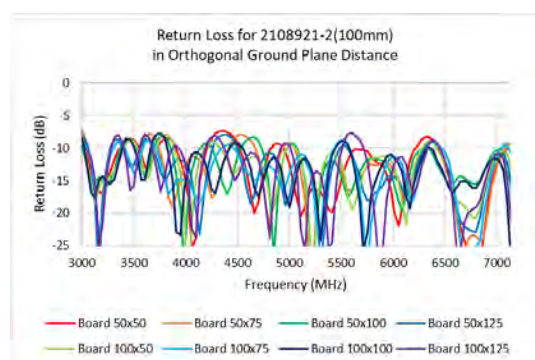
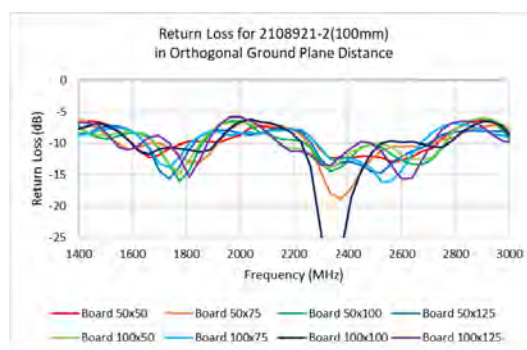
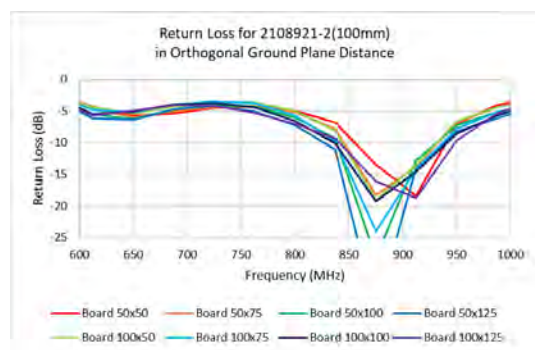


50mm Cable

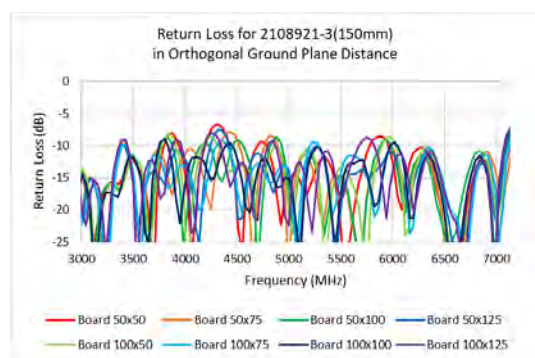
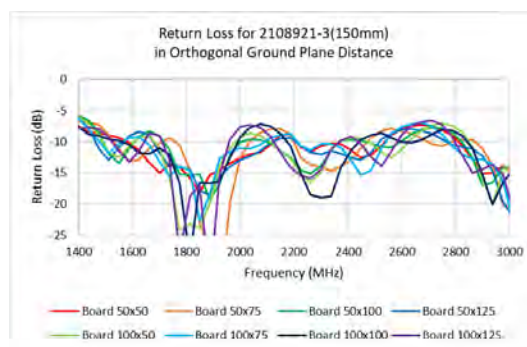
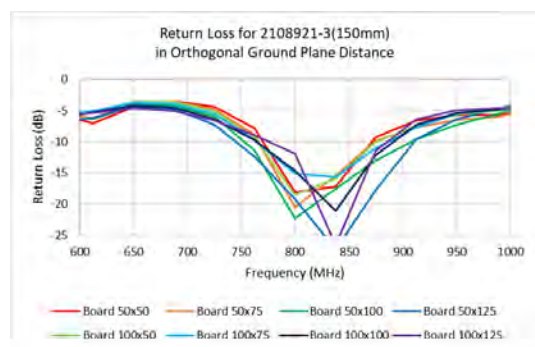


3 b. Performance Variation with Orthogonal Ground Plane Contd.

100mm Cable

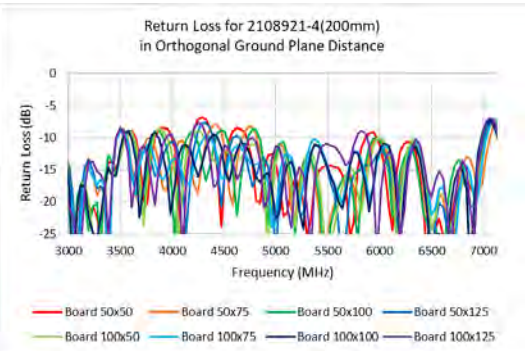
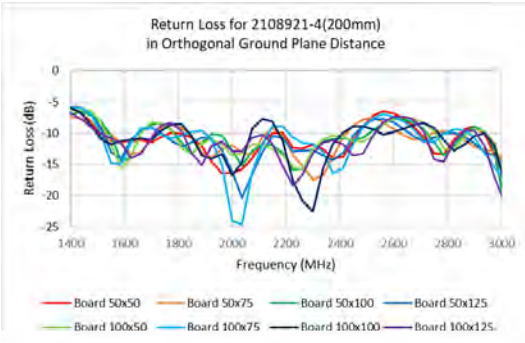
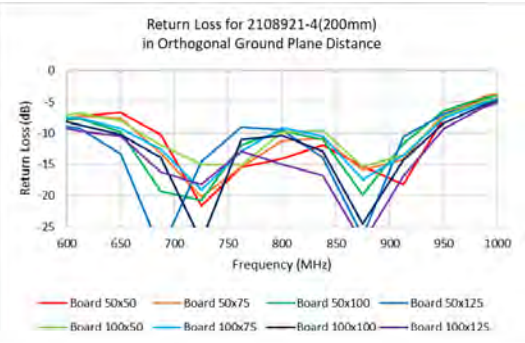


150mm Cable

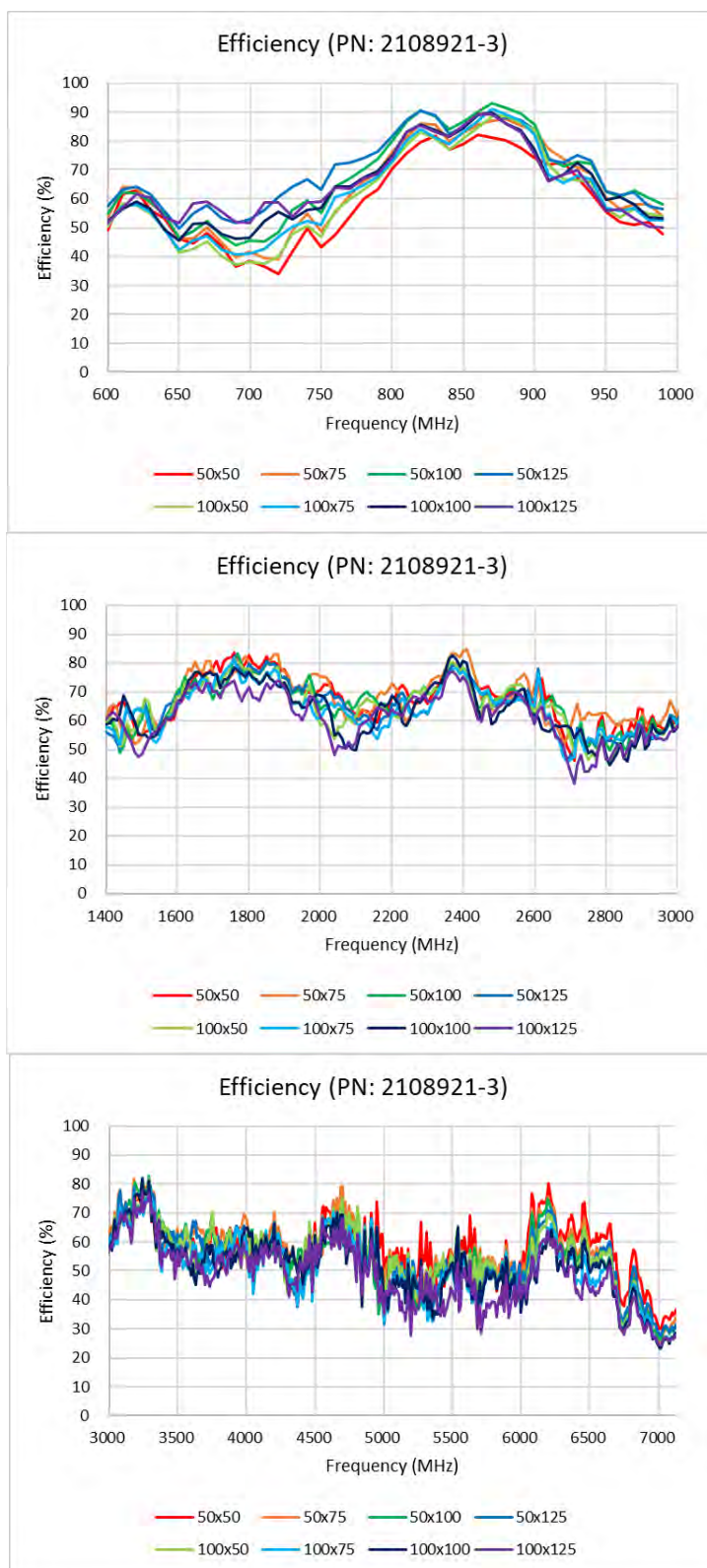


3 b. Performance Variation with Orthogonal Ground Plane Contd.

200mm Cable



3 b. Performance Variation with Orthogonal Ground Plane Contd.

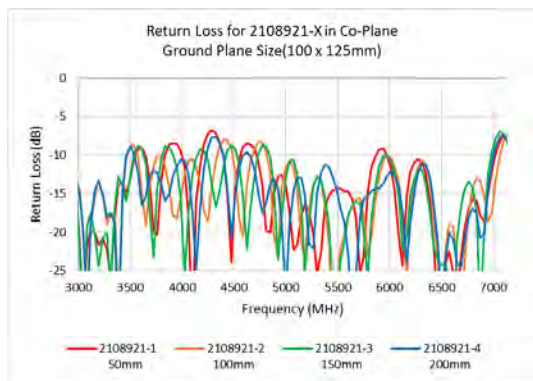
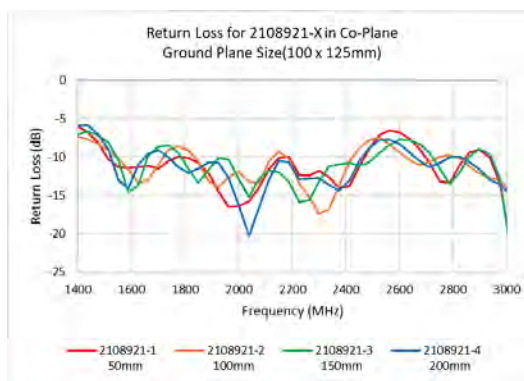
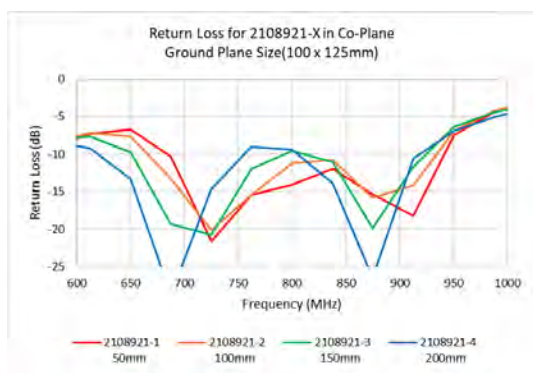
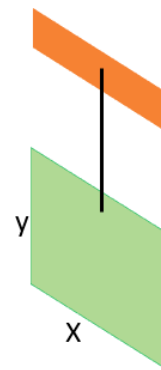


3 c. Performance Variation with Co-Plane Ground Plane

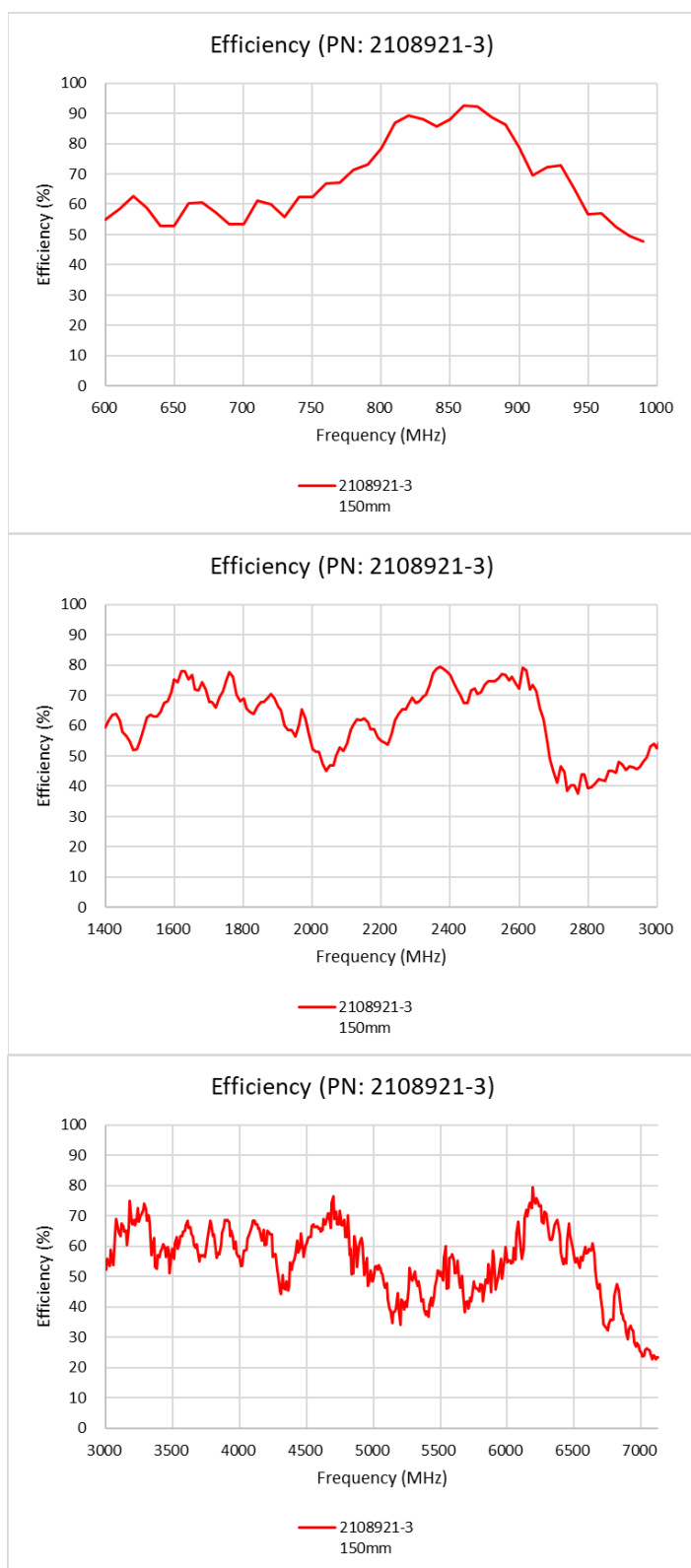
This section shows the effect on return loss of positioning the antenna in line with the ground plane (100x125mm). The antenna is fed from the mini coax connector at the edge of the PCB ground plane.

Variables:

X=100mm, Y=125mm



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

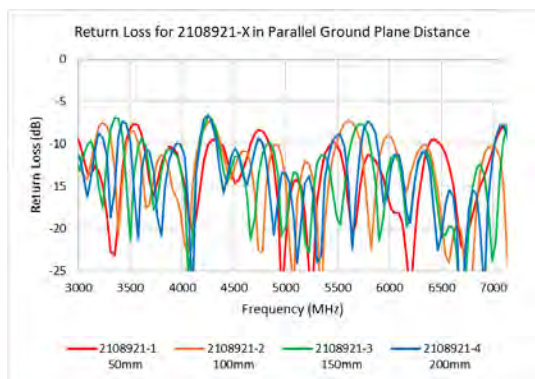
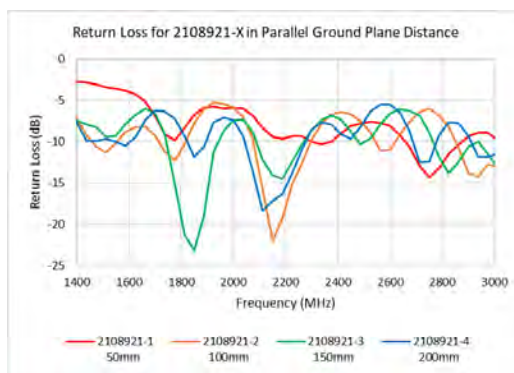
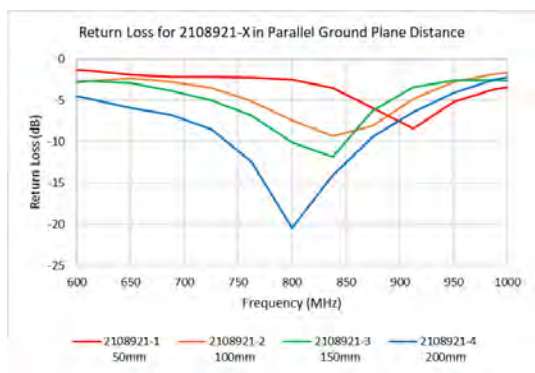
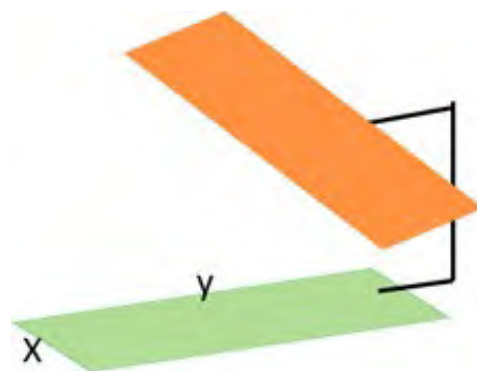


3 d. Performance Variation with Parallel Ground Plane

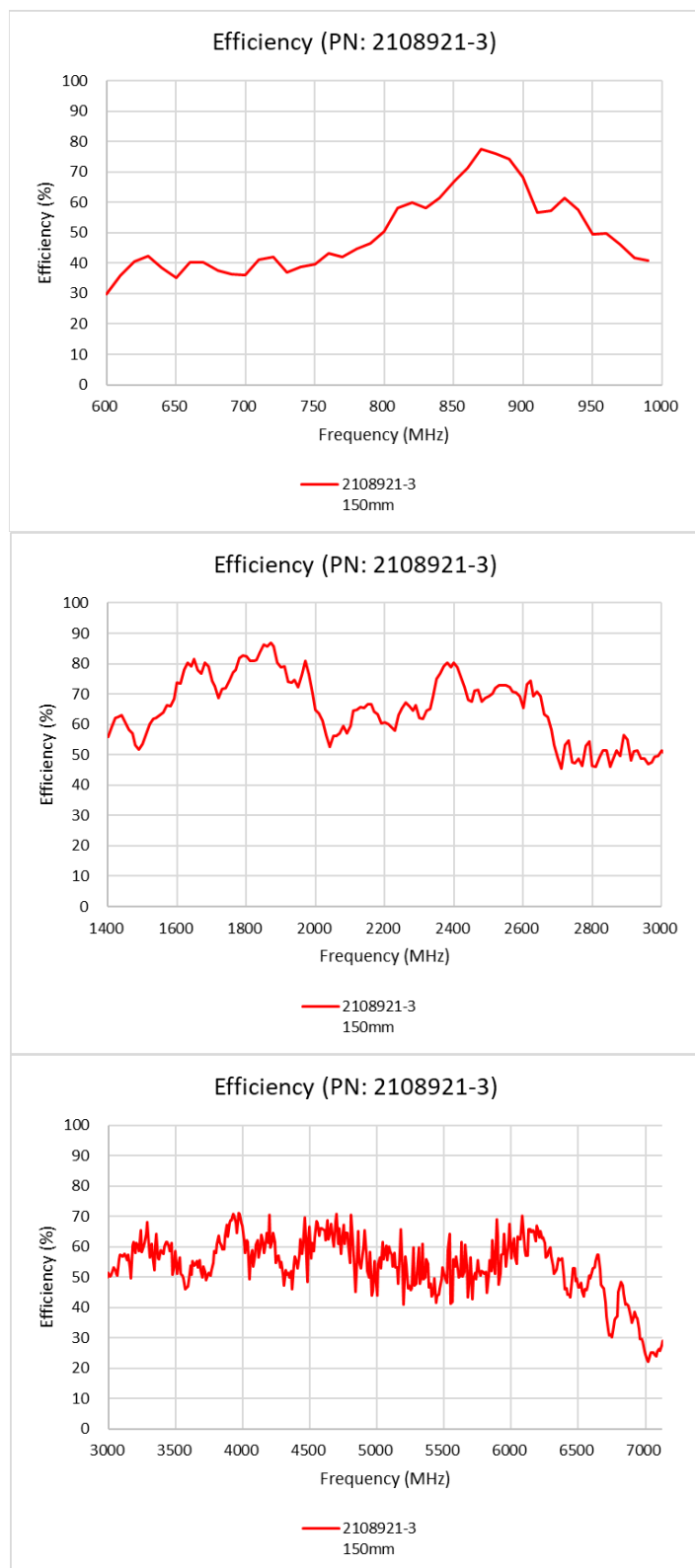
This section shows the effect on return loss of positioning the antenna parallel with the ground plane (100x125mm). The antenna is fed from the mini coax connector at the edge of the PCB ground plane.

Variables:

X=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 (100x100mm), 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.

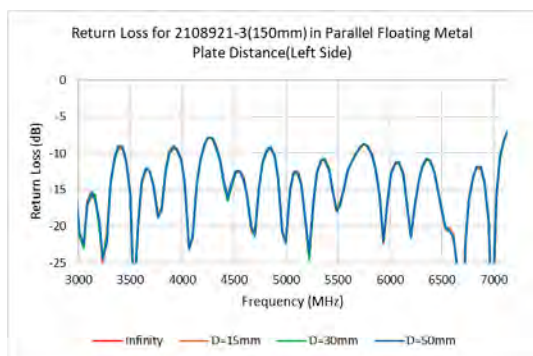
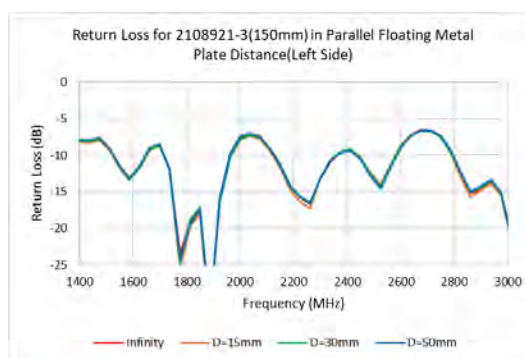
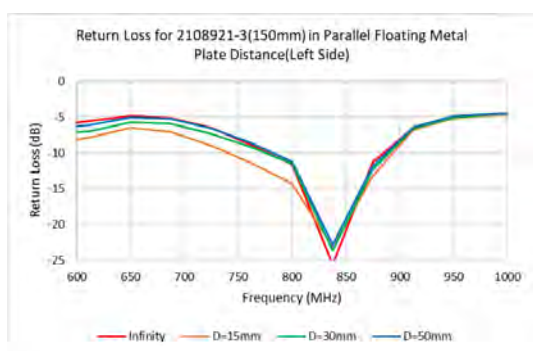
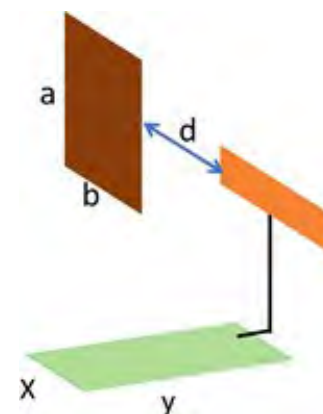
Variables:

X=100mm, Y=125mm

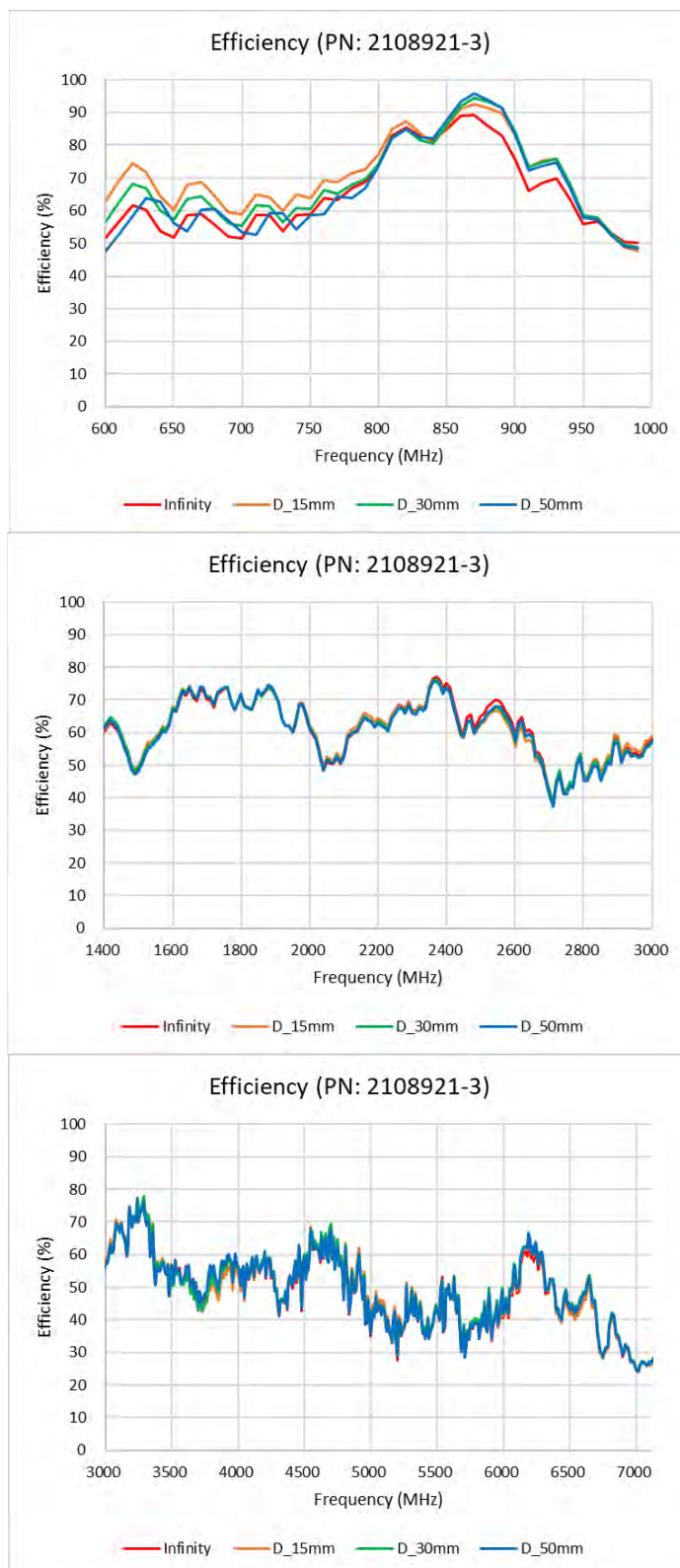
a=100mm, b=100mm

d = 15mm, 30mm, 50mm, infinity (without the floating metal plate)

Antenna cable length = 150mm (PN: 2108921-3)



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.

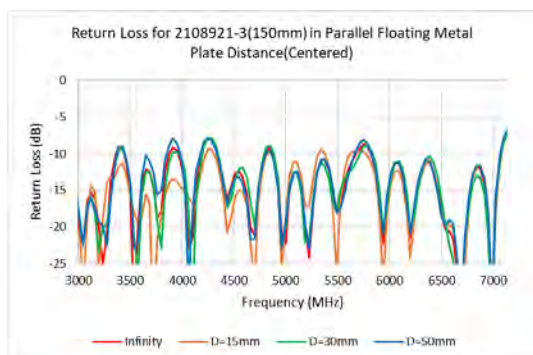
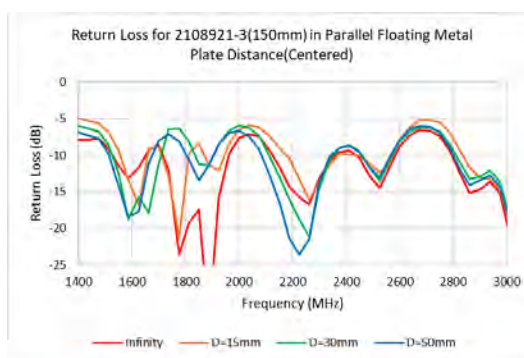
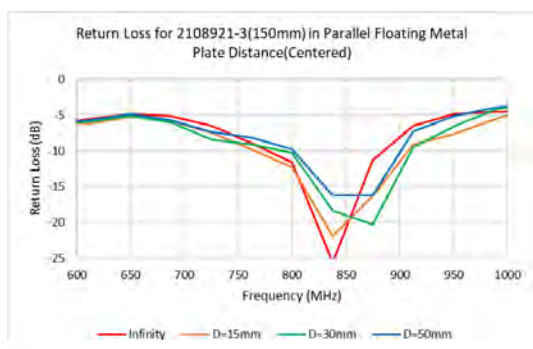
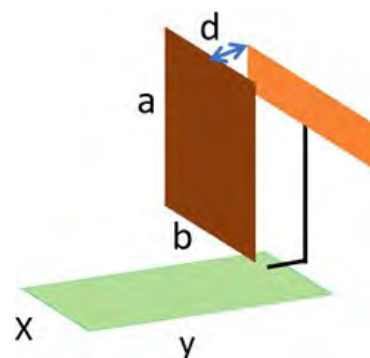
Variables:

X=100mm, Y=125mm

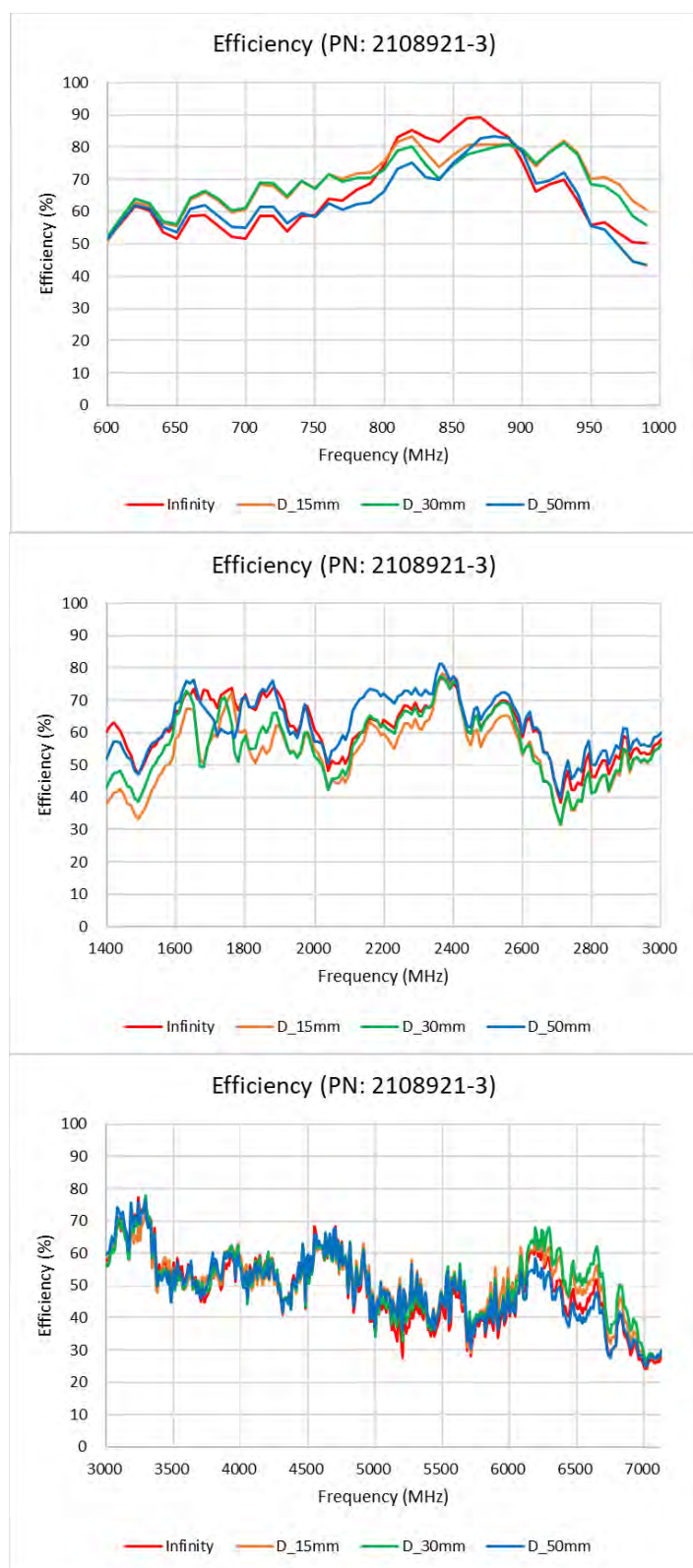
a=100mm, b=100mm

d = 15mm, 30mm, 50mm, infinity (without the floating metal plate)

Antenna cable length = 150mm (PN: 2108921-3)



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.

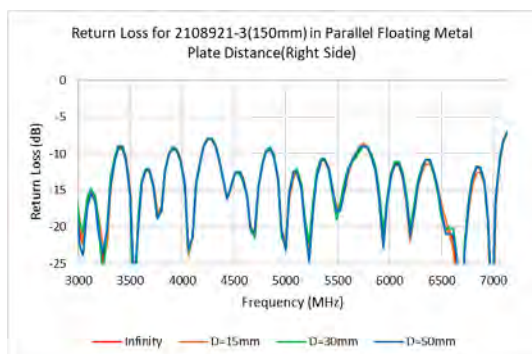
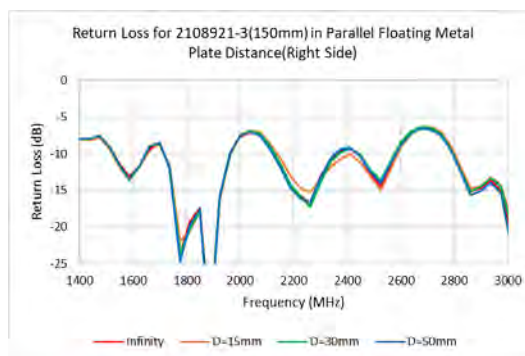
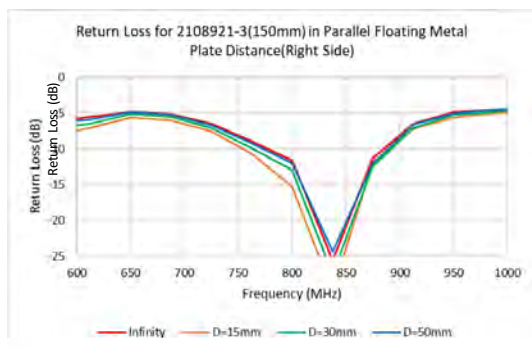
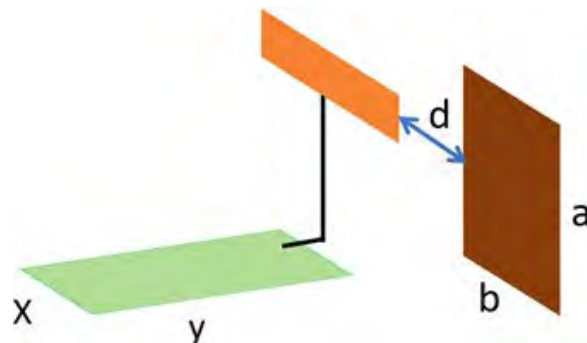
Variables:

X=100mm, Y=125mm

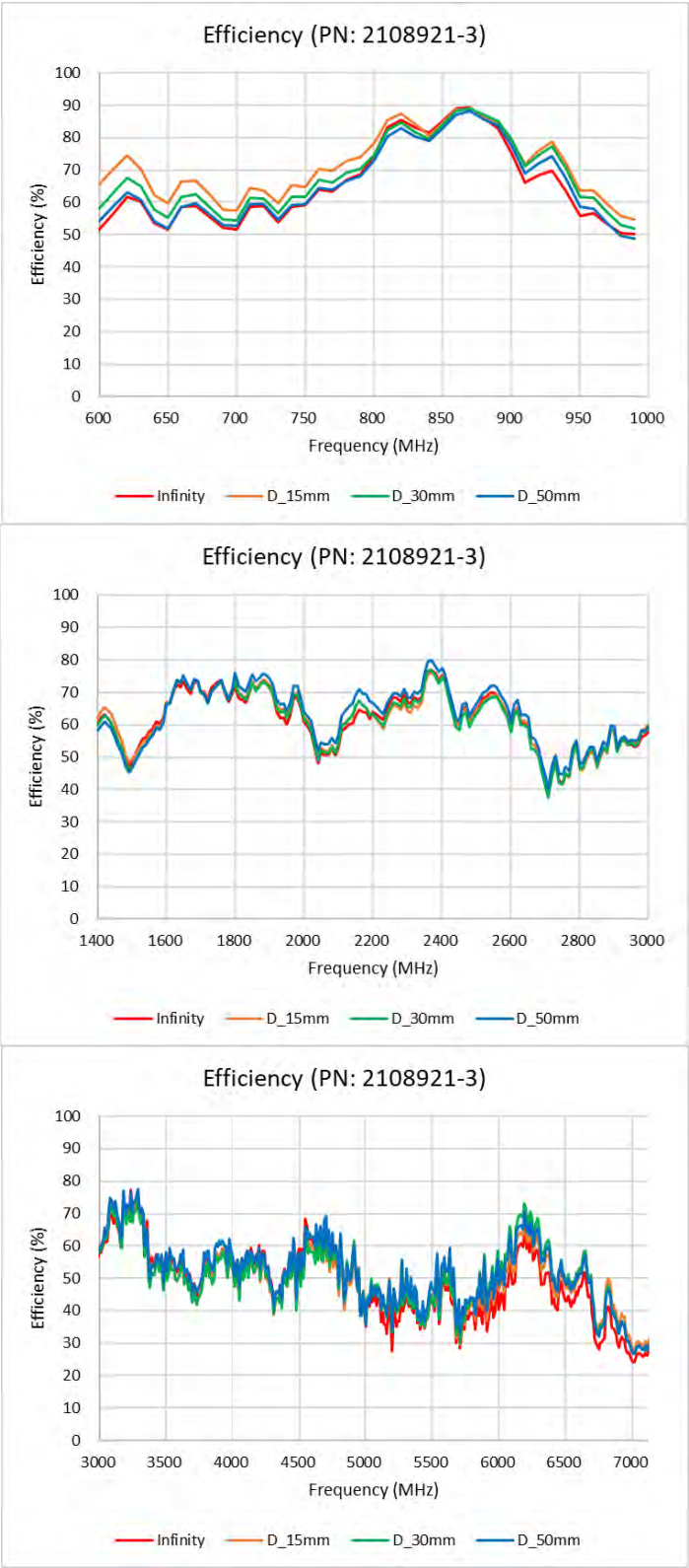
a=100mm, b=100mm,

d = 15mm, 30mm, 50mm, infinity (without the floating metal plate)

Antenna cable length = 150mm (PN: 2108921-3)



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.

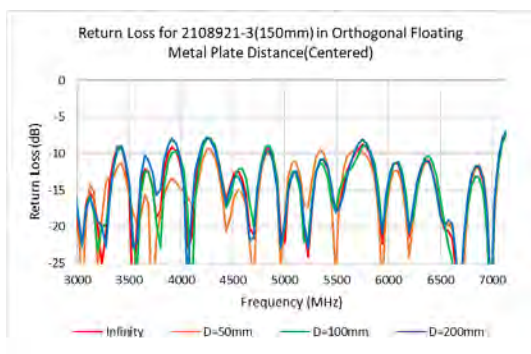
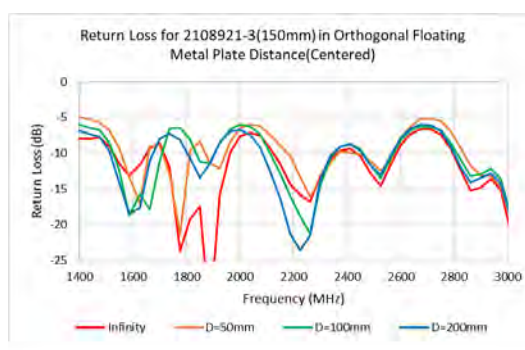
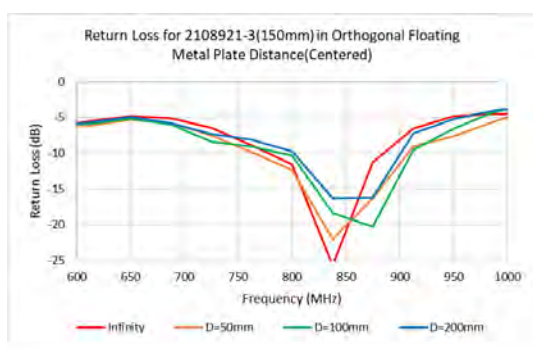
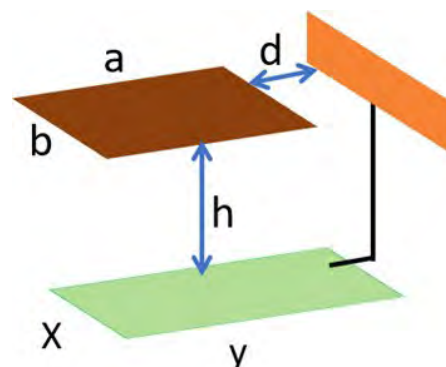
Variables:

X=100mm, Y=125mm

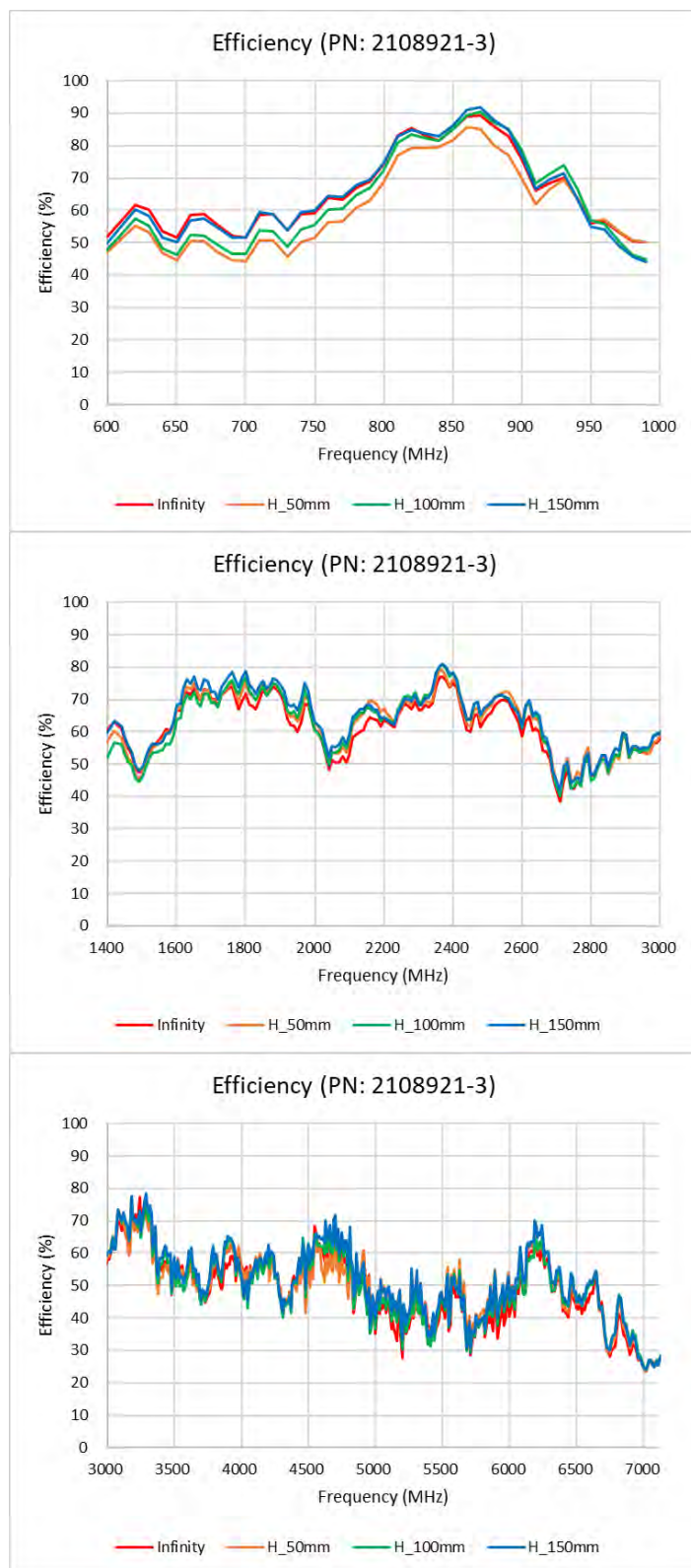
a=100mm, b=100mm, d = 50mm

h = 50mm, 100mm, 150mm, infinity (without the floating metal plate)

Antenna cable length = 150mm (PN: 2108921-3)



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



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