



FAP-234G_Cross dipole DVT Antenna Test Report

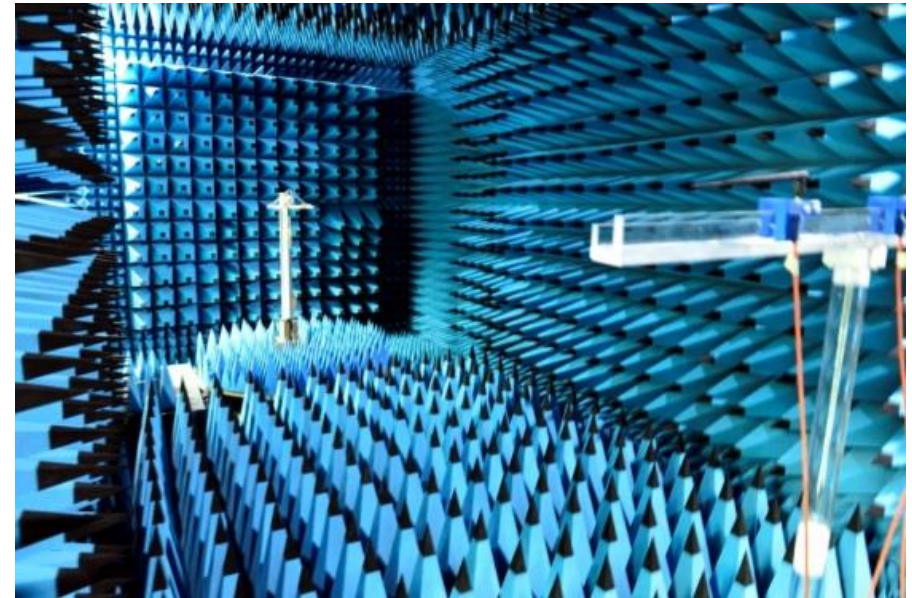
Senao Networks, Inc.

Customer	Fortinet
Project	FAP-234G
Project Description	Wi-Fi_2G*2 Wi-Fi_5G*2 Wi-Fi & Scanning_5G/6G*2 Scanning_2G*2 BLE/Zigbee*1 GPS*1
Date	2023/08/10
Prepared by	Daniel
Report Version	V8-DVT

- **Agenda**
 - Antenna Development Resource
 - Antenna Testing Set Up
 - Placement and Specification
 - S11 & Isolation
 - Radiation Pattern
 - Efficiency and Gain

3D Anechoic Chamber - BWANT

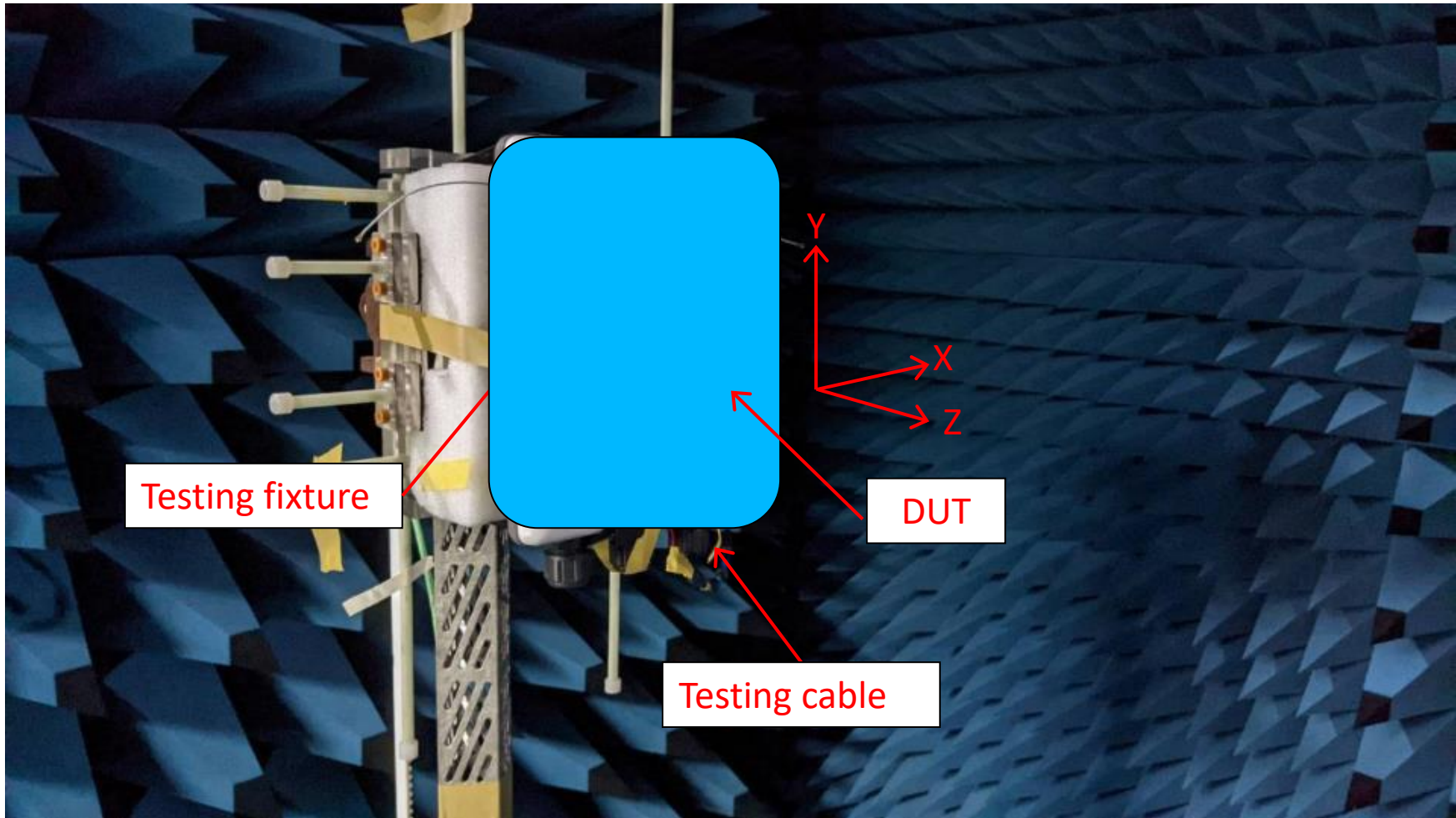
- Size: 7.32M(L)x3.66M(W)X3.66M(H)
- Testing range from 400MHz to 7GHz
- Chamber Isolation : 10KHz to 10GHz >100dB (NSA 94-106)
- Calibration antenna : BWANT SD650 /SD740 /SD900 /SD1150 /SD1575 /SD1800 /SD2140 /SD2450 /SD3200 /SD3600 /SD4550 /SD5400 /HA-0508
- Calibration date: 2022/10/27
- Test software : BWANT 3D Passive



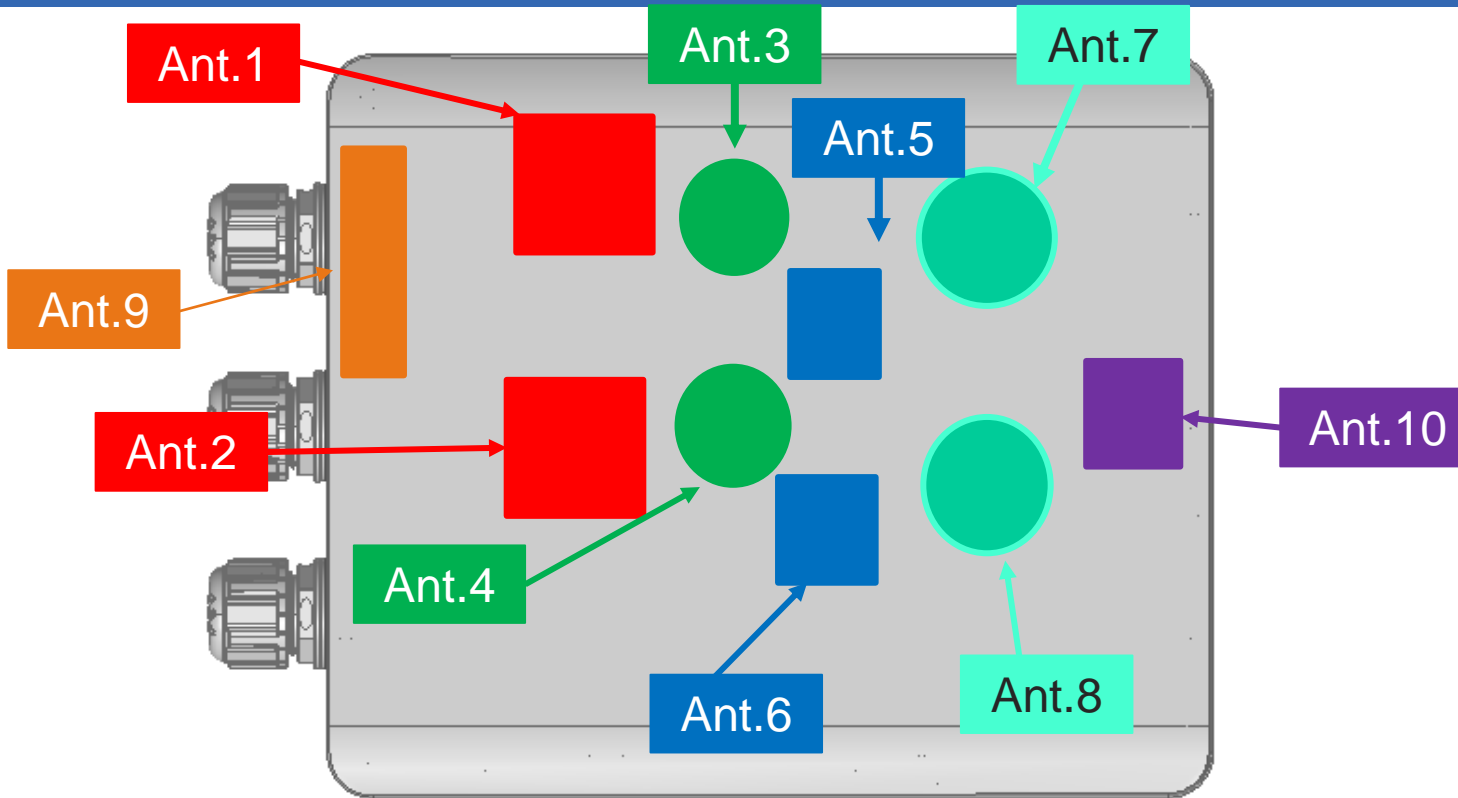
3D Anechoic Chamber

Antenna Testing Set Up

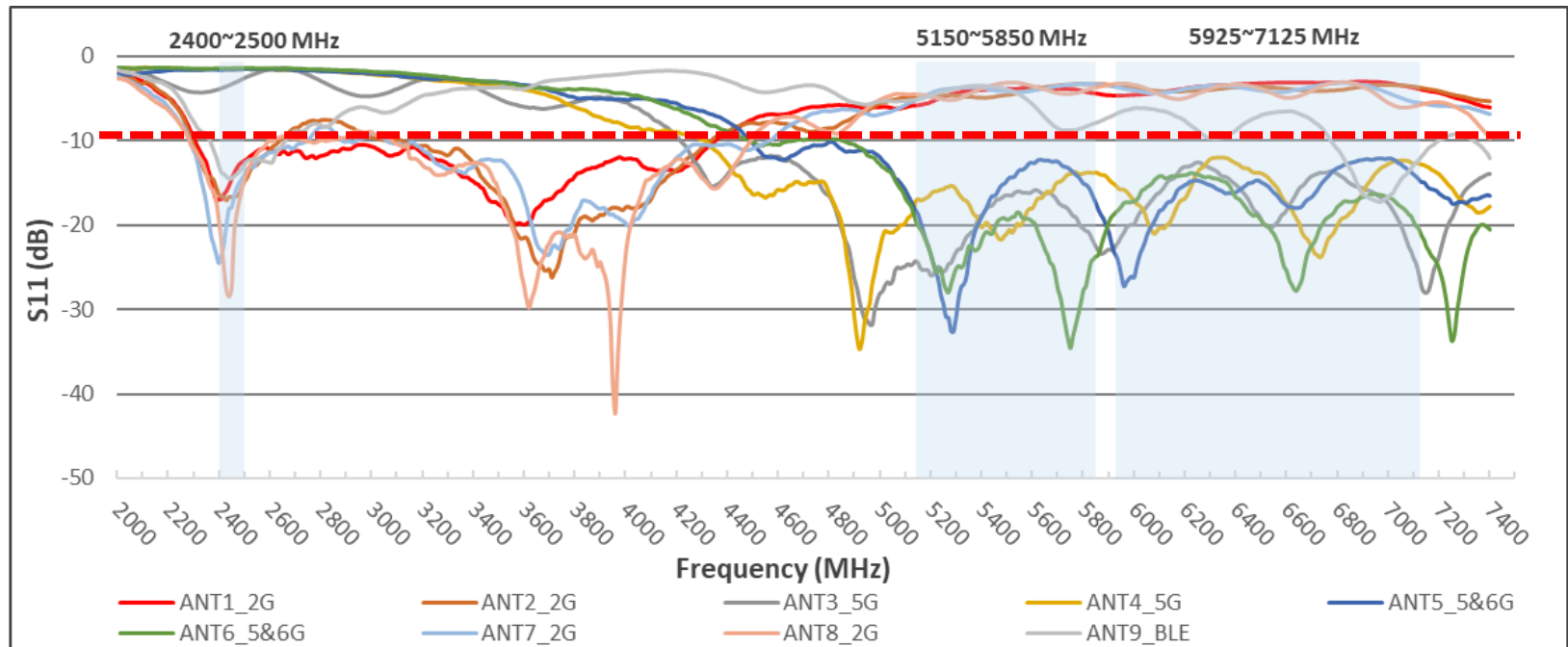
- The DUT is set up on the test fixture and the antenna is connected to the test cable to measure the antenna performance.



Placement and specification

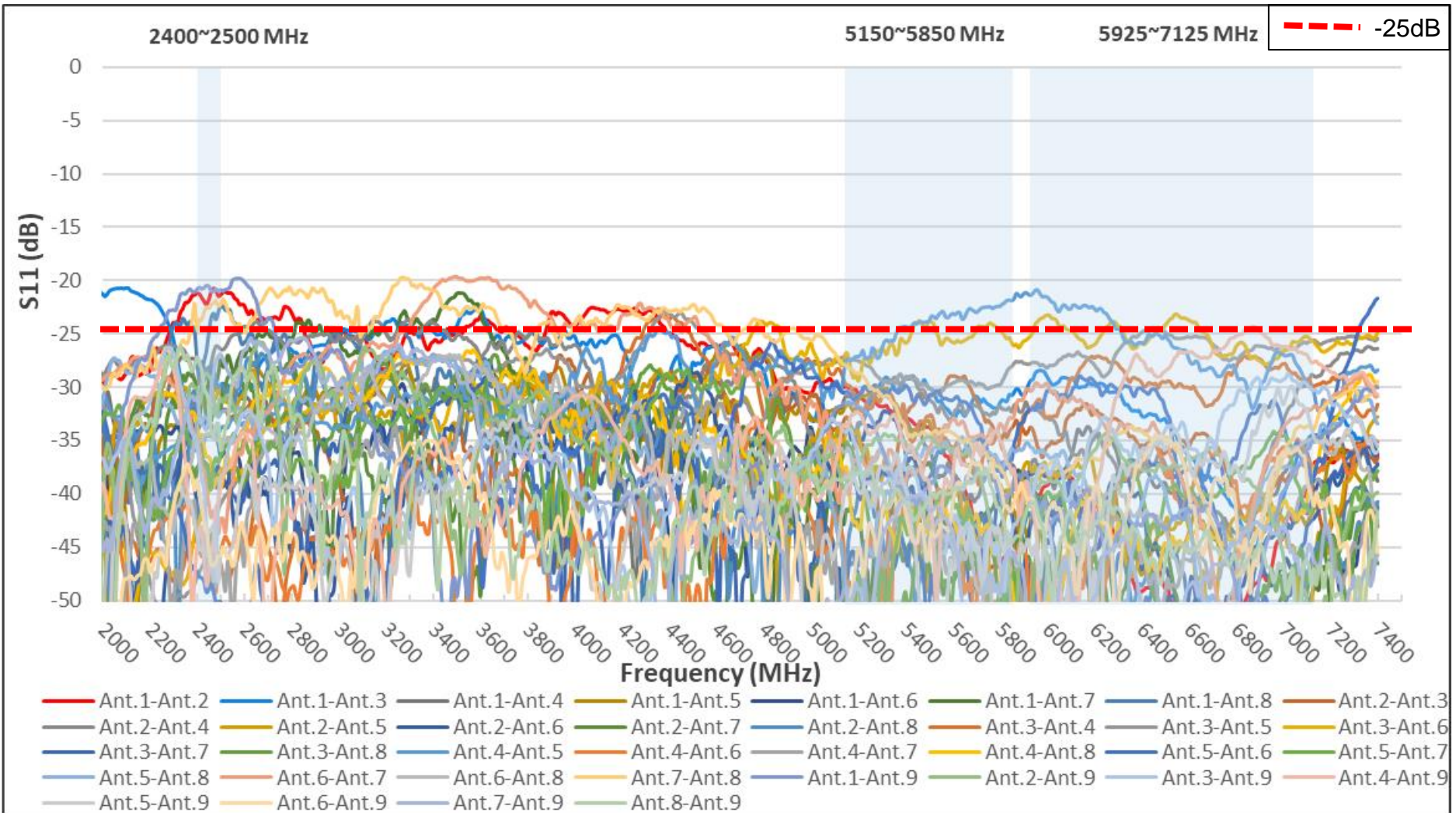


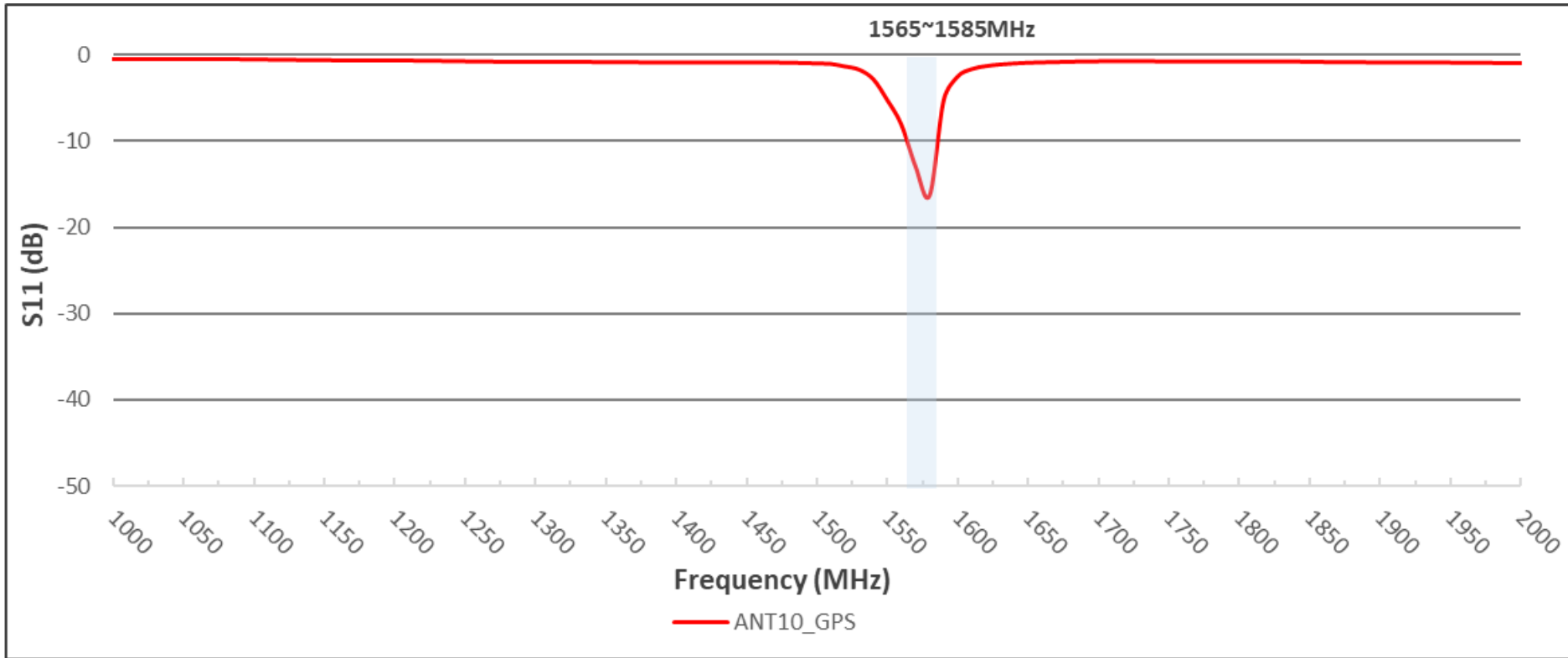
Ant No.	Brand name	P/N	Operating Band	Ant Type	Material	Feeding
Ant.1~2	Awan	7102A0613000	2400MHz ~ 2500 MHz	Cross Dipole	FR4	Cable
Ant.3~4	Awan	7102A0651000	5150MHz ~ 5850 MHz	Cross Dipole	FR4	Cable
Ant.5~6	Awan		5150MHz ~ 5850 MHz 5925MHz ~ 7125 MHz	Cross Dipole	FR4	Cable
Ant.7~8	Awan	7102A0650000	2400MHz ~ 2500 MHz	Cross Dipole	FR4	Cable
Ant.9	Awan	7102A0614000	2400MHz ~ 2500 MHz	Dipole	FR4	Cable
Ant.10	Quectel	7102A0652000	1565MHz ~ 1585 MHz	Patch	ceramic	Cable



Return Loss									
Freq. (MHz)	2400	2450	2500	5150	5500	5850	5925	6500	7125
Ant.1	-17.0	-14.6	-12.4	-5.9	-3.9	-4.5	-4.7	-3.3	-4.1
Ant.2	-16.3	-16.6	-14.8	-4.7	-4.5	-3.2	-3.5	-3.6	-3.8
Ant.3	-3.9	-3.3	-2.6	-24.5	-16.4	-22.6	-21.3	-19.3	-28.0
Ant.4	-1.5	-1.6	-1.5	-16.9	-21.0	-13.8	-15.8	-13.9	-13.1
Ant.5	-1.6	-1.5	-1.5	-18.7	-14.7	-17.4	-26.0	-14.9	-15.3
Ant.6	-1.4	-1.4	-1.4	-20.1	-19.3	-23.7	-17.8	-19.4	-22.5
Ant.7	-24.5	-17.9	-14.1	-5.2	-4.2	-3.4	-3.8	-4.1	-5.7
Ant.8	-19.4	-27.6	-14.7	-4.5	-3.1	-3.7	-3.2	-3.9	-5.6
Ant.9	-12.9	-14.4	-12.8	-5.0	-3.9	-7.8	-6.5	-6.9	-11.1

 -10dB





Return Loss			
Freq. (MHz)	1565	1575	1585
Ant.10	-10.5	-16.3	-10.3



Isolation Table

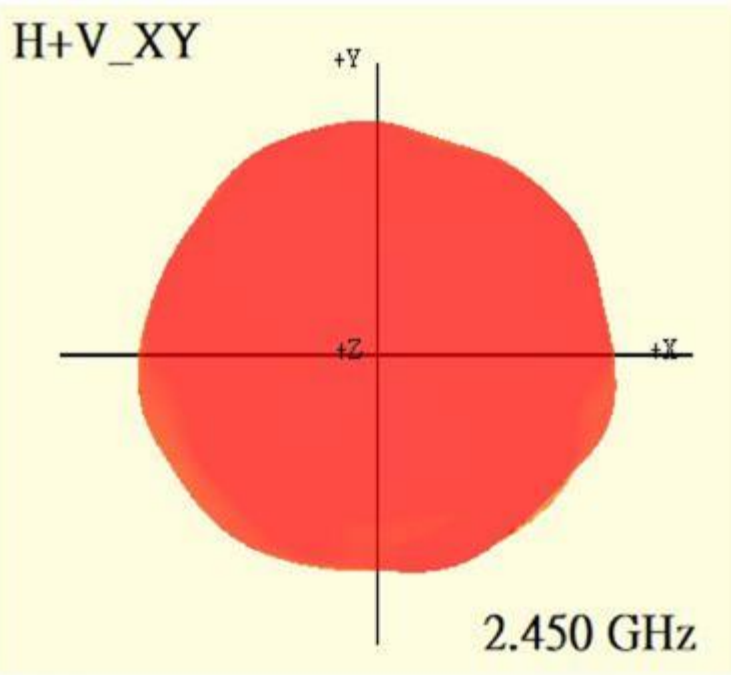
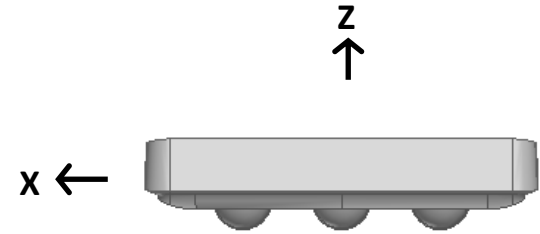
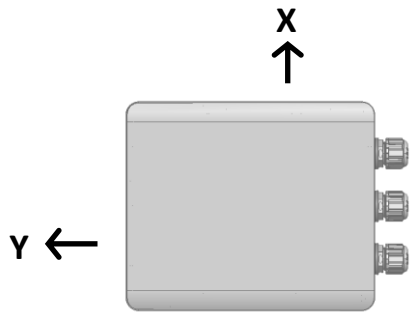
	Isolation									
Freq (MHz)	Ant.1→Ant.2	Ant.1→Ant.3	Ant.1→Ant.4	Ant.1→Ant.5	Ant.1→Ant.6	Ant.1→Ant.7	Ant.1→Ant.8	Ant.2→Ant.3	Ant.2→Ant.4	Ant.2→Ant.5
2400	-21.2	-31.7	-27.6	-32.0	-37.8	-34.1	-27.3	-32.0	-29.8	-31.4
2450	-21.8	-30.6	-28.1	-30.2	-38.6	-29.4	-24.9	-31.5	-28.4	-31.0
2500	-21.3	-29.9	-30.6	-30.6	-38.8	-27.4	-22.4	-32.0	-26.4	-30.3
5150	-29.9	-33.9	-30.8	-31.7	-33.6	-41.5	-47.2	-32.8	-35.9	-33.8
5500	-33.7	-30.1	-35.9	-33.2	-40.1	-37.1	-38.5	-30.8	-31.1	-43.8
5850	-45.0	-30.8	-37.3	-41.2	-39.4	-39.8	-37.3	-33.8	-32.3	-39.9
5925	-40.2	-28.7	-36.8	-41.4	-37.9	-39.9	-40.7	-34.7	-32.1	-37.4
6500	-48.8	-33.0	-39.0	-43.1	-46.9	-52.9	-45.3	-36.2	-37.2	-42.7
7125	-36.9	-34.8	-37.7	-41.0	-45.4	-49.0	-46.6	-41.6	-28.9	-43.6

	Isolation									
Freq (MHz)	Ant.2→Ant.6	Ant.2→Ant.7	Ant.2→Ant.8	Ant.3→Ant.4	Ant.3→Ant.5	Ant.3→Ant.6	Ant.3→Ant.7	Ant.3→Ant.8	Ant.4→Ant.5	Ant.4→Ant.6
2400	-40.9	-30.2	-32.7	-43.9	-44.8	-43.0	-33.3	-37.5	-35.8	-44.3
2450	-38.1	-33.5	-28.7	-45.3	-41.8	-39.7	-33.7	-37.5	-34.6	-46.8
2500	-38.9	-32.1	-29.7	-46.5	-37.9	-37.8	-36.5	-38.6	-33.9	-45.5
5150	-38.2	-54.6	-45.7	-29.8	-24.3	-26.7	-49.5	-35.2	-27.4	-49.1
5500	-40.9	-46.5	-43.8	-32.7	-27.1	-23.8	-50.5	-42.9	-23.8	-41.1
5850	-41.9	-45.9	-45.9	-35.8	-25.1	-25.8	-47.7	-45.7	-21.9	-52.2
5925	-42.7	-47.3	-41.8	-31.6	-24.7	-24.1	-49.1	-46.5	-20.9	-48.8
6500	-49.5	-45.3	-50.7	-29.6	-21.8	-24.2	-38.1	-51.9	-25.1	-38.1
7125	-39.0	-44.5	-44.5	-29.7	-22.9	-26.3	-41.6	-45.6	-32.3	-38.0

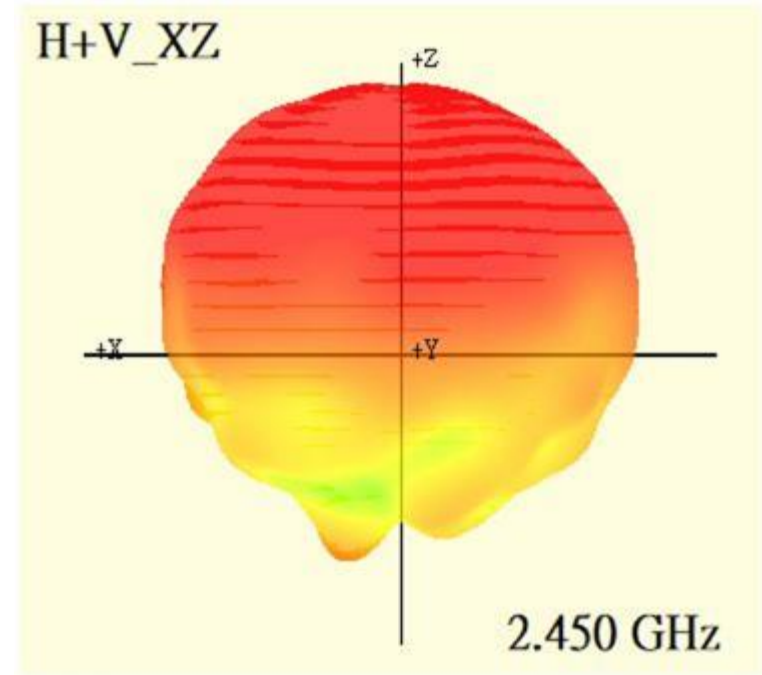
Isolation Table

	Isolation							
Freq (MHz)	Ant.4→Ant.7	Ant.4→Ant.8	Ant.5→Ant.6	Ant.5→Ant.7	Ant.5→Ant.8	Ant.6→Ant.7	Ant.6→Ant.8	Ant.7→Ant.8
2400	-44.1	-33.6	-47.3	-35.2	-33.4	-35.0	-35.3	-24.6
2450	-45.7	-36.5	-48.9	-39.0	-33.0	-41.0	-34.5	-22.6
2500	-46.9	-39.5	-50.1	-36.5	-32.5	-42.3	-34.9	-22.3
5150	-50.0	-37.5	-30.4	-50.7	-48.9	-38.7	-36.0	-28.0
5500	-43.7	-42.0	-30.8	-41.0	-35.9	-35.8	-43.3	-34.6
5850	-47.7	-48.2	-36.8	-47.8	-35.8	-32.9	-66.8	-39.1
5925	-50.8	-56.3	-32.2	-46.4	-36.2	-29.6	-67.6	-39.1
6500	-49.3	-44.6	-32.0	-40.2	-39.9	-35.0	-43.3	-34.7
7125	-38.6	-36.6	-36.7	-40.0	-34.6	-32.0	-34.8	-32.6

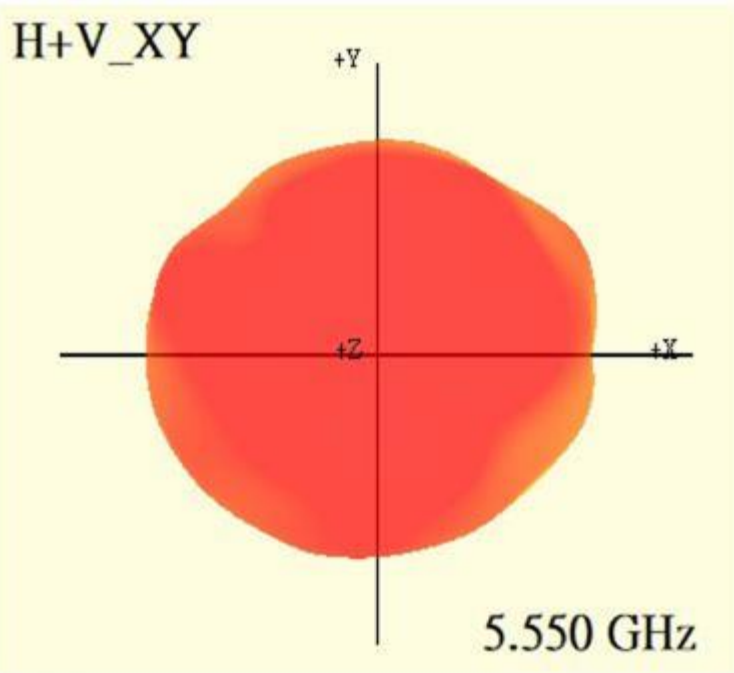
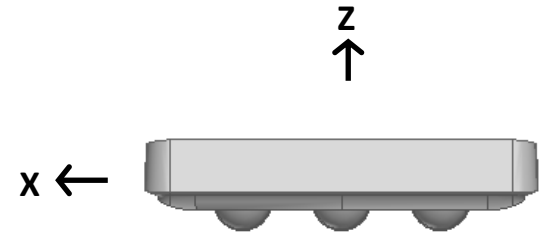
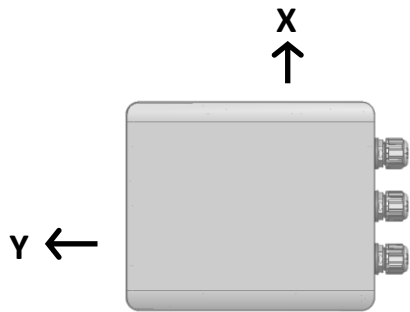
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Freq (MHz)	Ant.1→Ant.9	Ant.2→Ant.9	Ant.3→Ant.9	Ant.4→Ant.9	Ant.5→Ant.9	Ant.6→Ant.9	Ant.7→Ant.9	Ant.8→Ant.9
2400	-12.93	-17.84	-30.13	-35.62	-44.99	-43.79	-38.66	-30.96
2450	-14.41	-17.54	-28.95	-46.83	-47.34	-43.37	-45.28	-32.82
2500	-12.77	-17.87	-31.00	-38.36	-39.23	-45.83	-45.78	-26.91
5150	-5.02	-28.51	-39.09	-34.23	-33.73	-39.36	-53.62	-49.15
5500	-3.86	-36.38	-34.65	-41.28	-39.09	-52.40	-45.32	-41.53
5850	-7.84	-36.89	-52.76	-43.74	-38.15	-45.11	-41.57	-45.84
5925	-6.51	-37.51	-38.97	-38.90	-42.87	-44.81	-41.23	-58.68
6500	-6.92	-40.32	-37.68	-34.03	-28.52	-35.82	-34.97	-57.38
7125	-11.10	-31.66	-53.62	-30.54	-27.82	-35.16	-40.79	-47.13



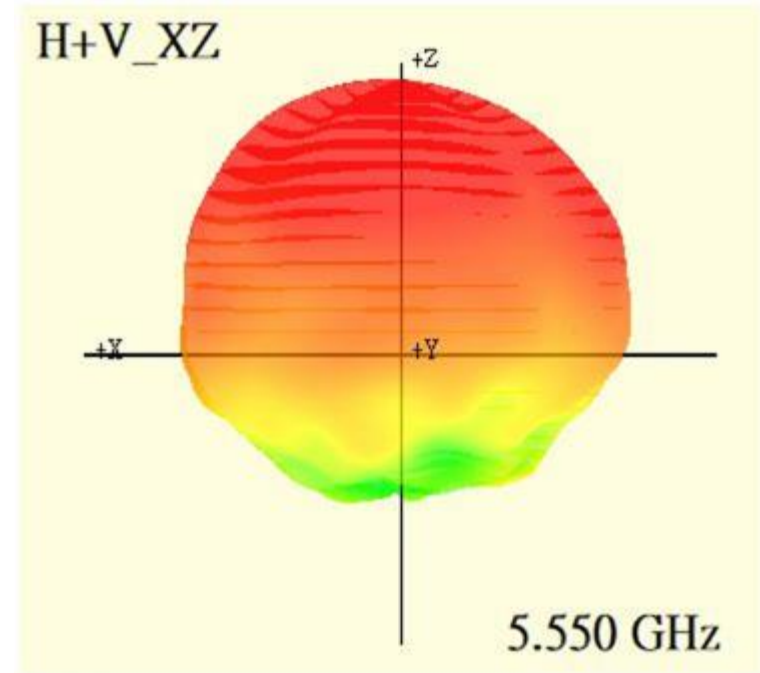
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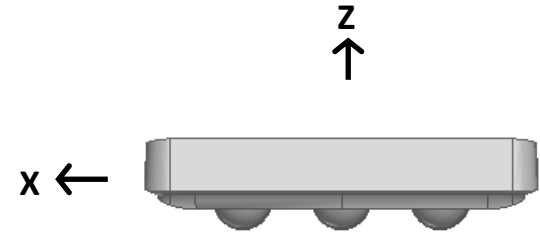
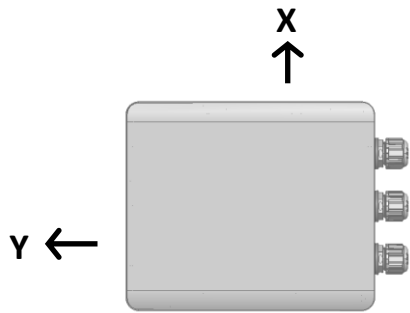
E-Plane



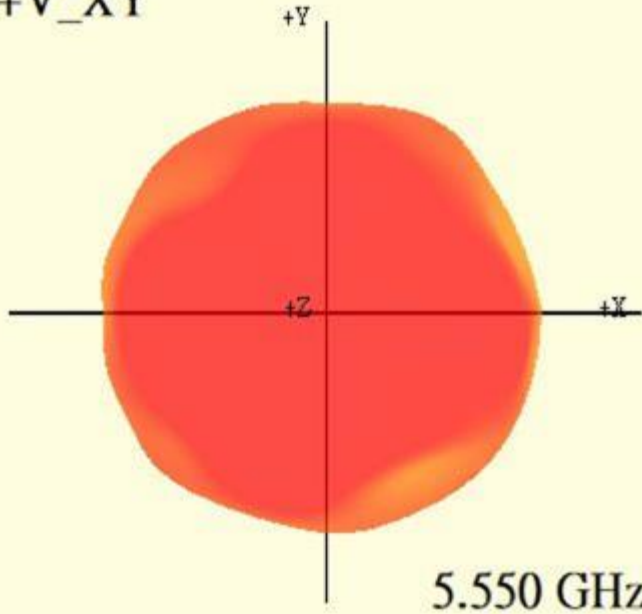
H-Plane



E-Plane



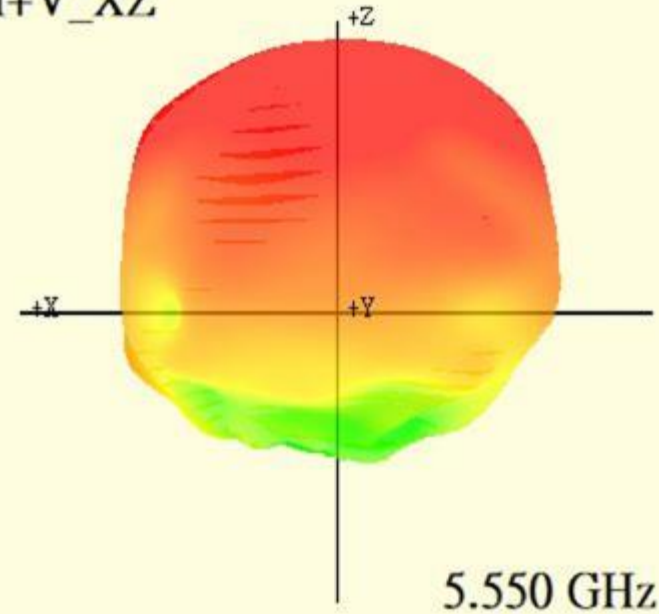
H+V_XY



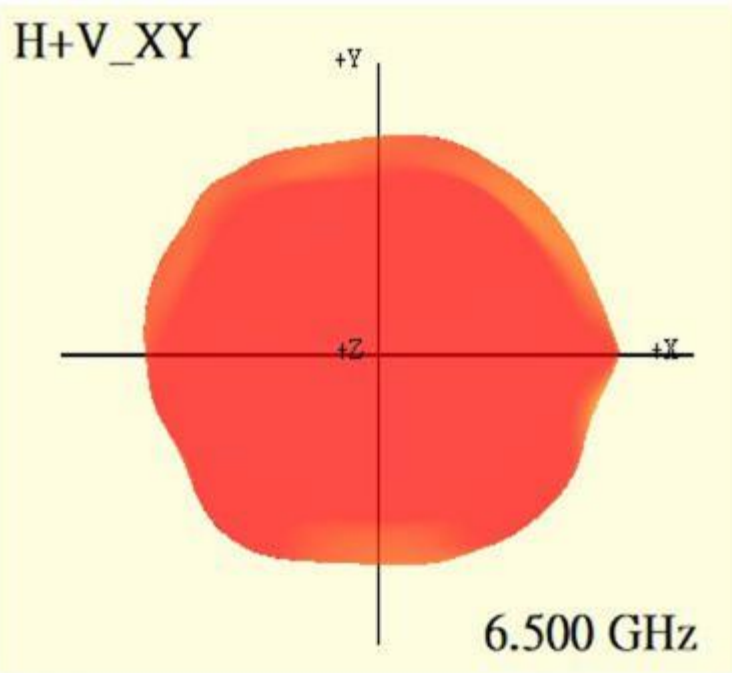
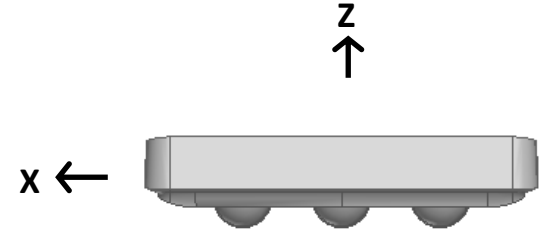
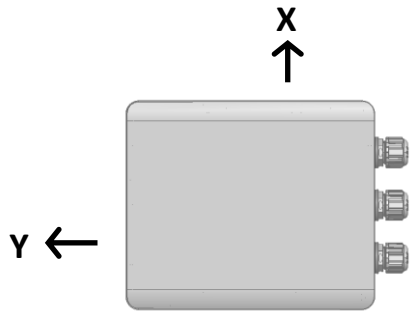
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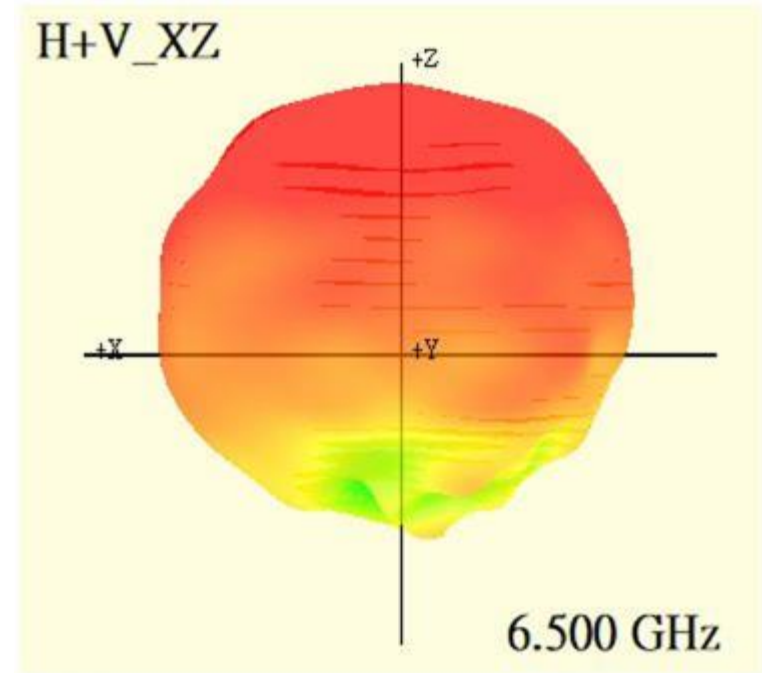
H+V_XZ



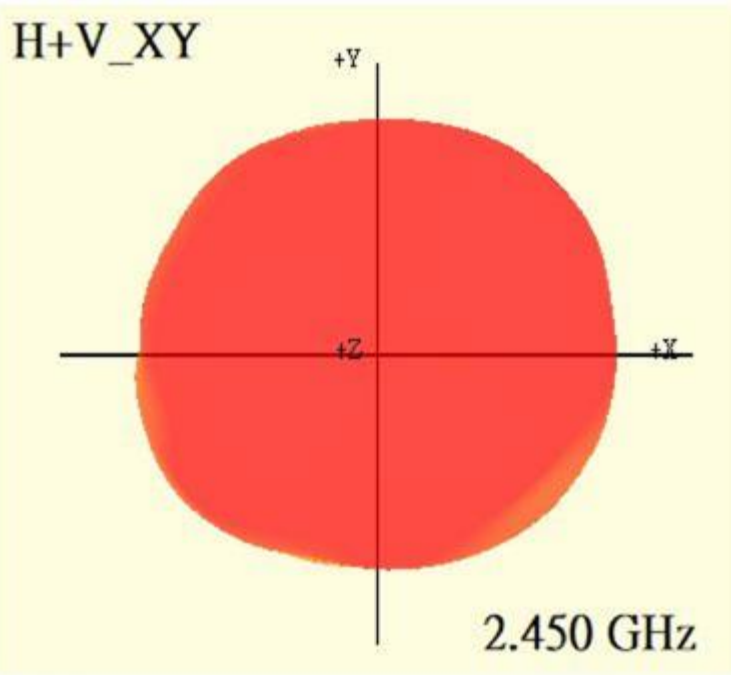
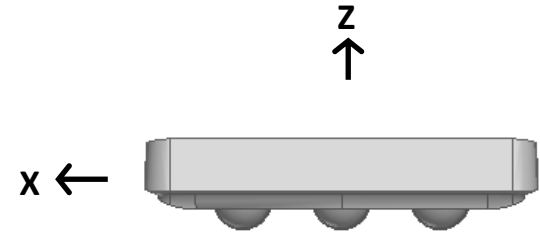
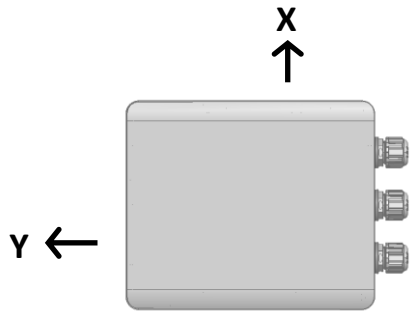
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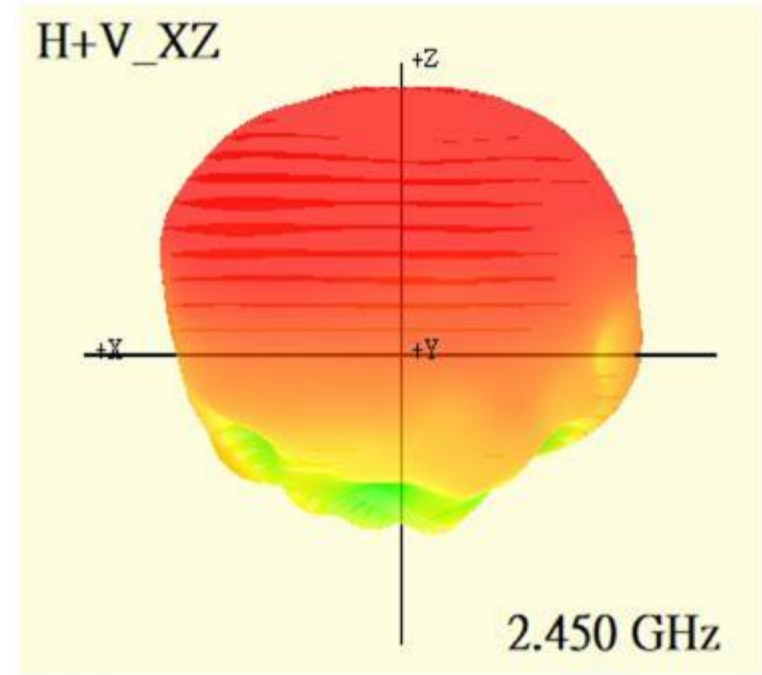
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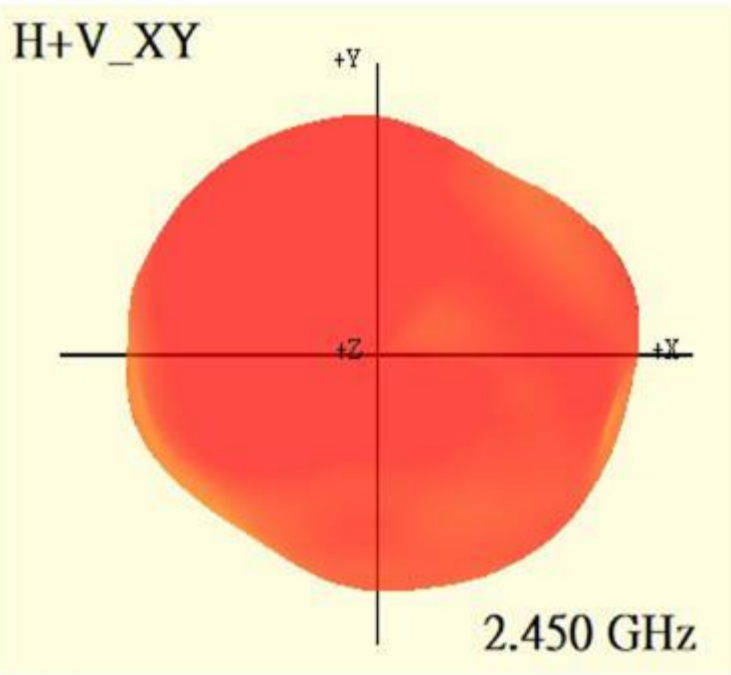
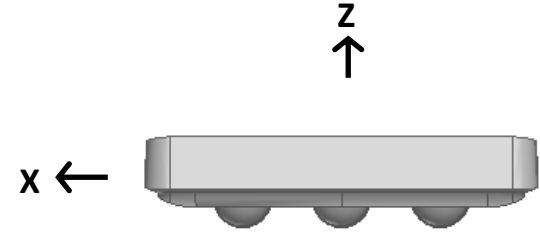
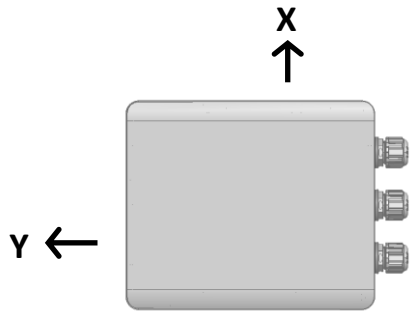
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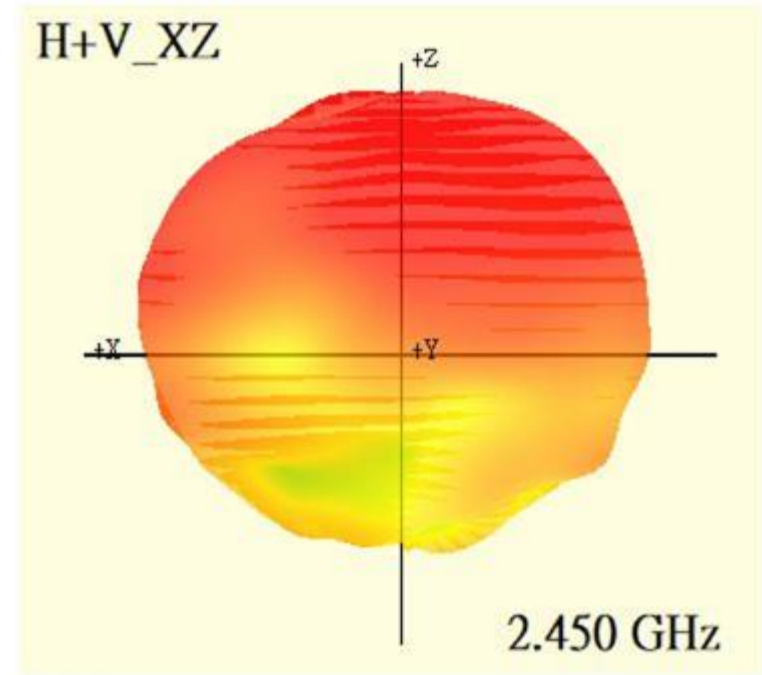
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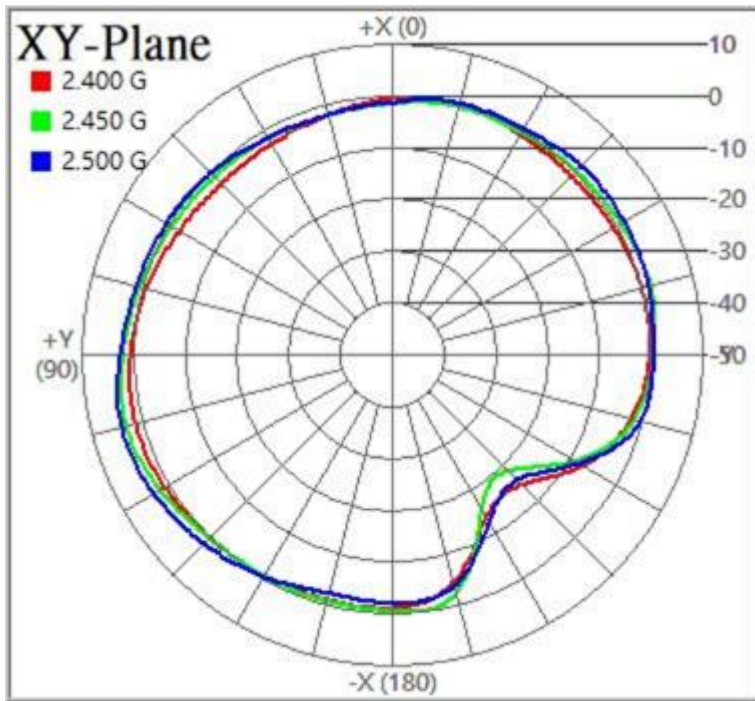
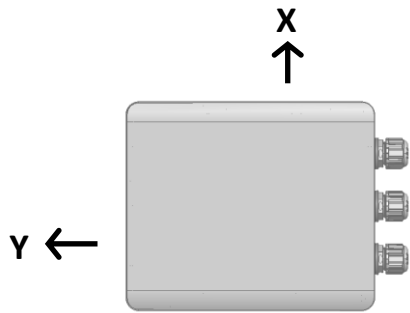
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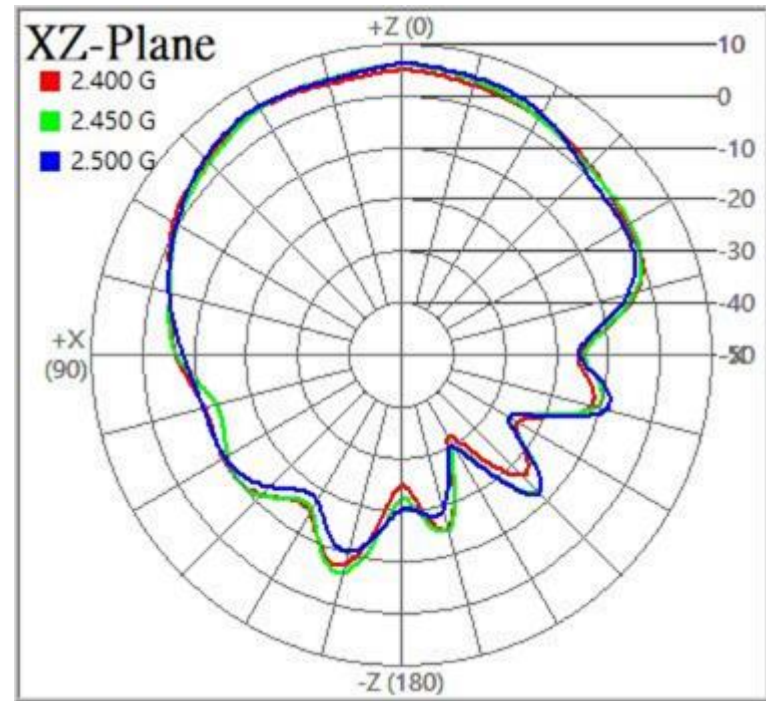
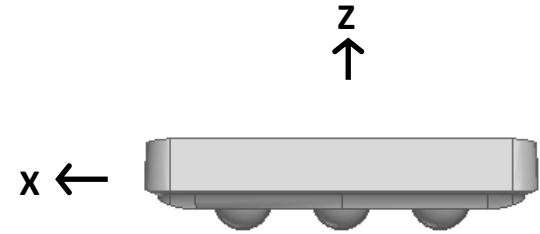
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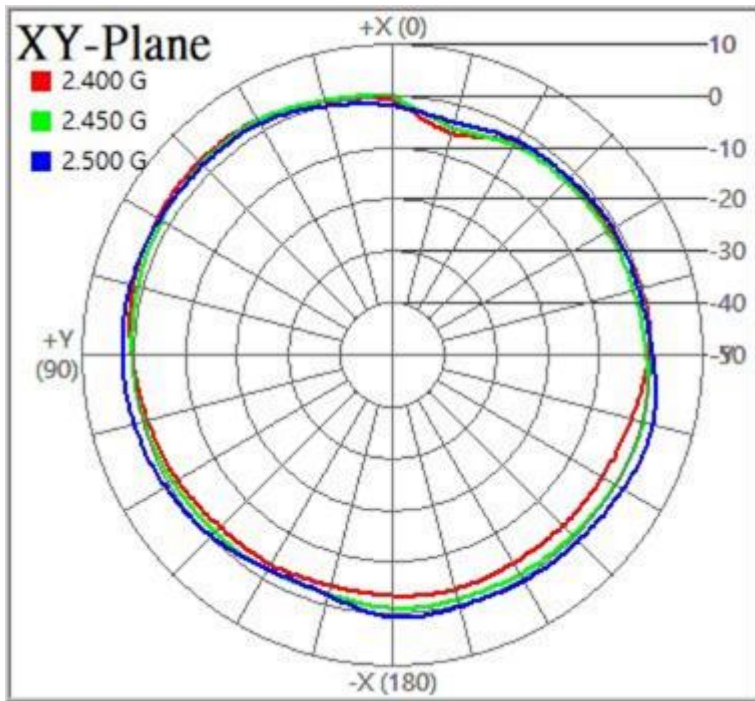
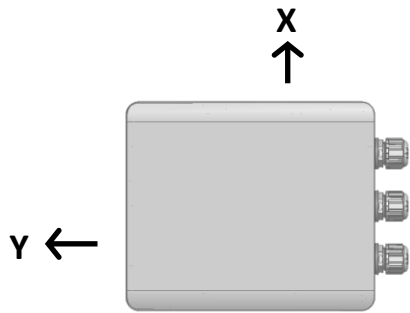
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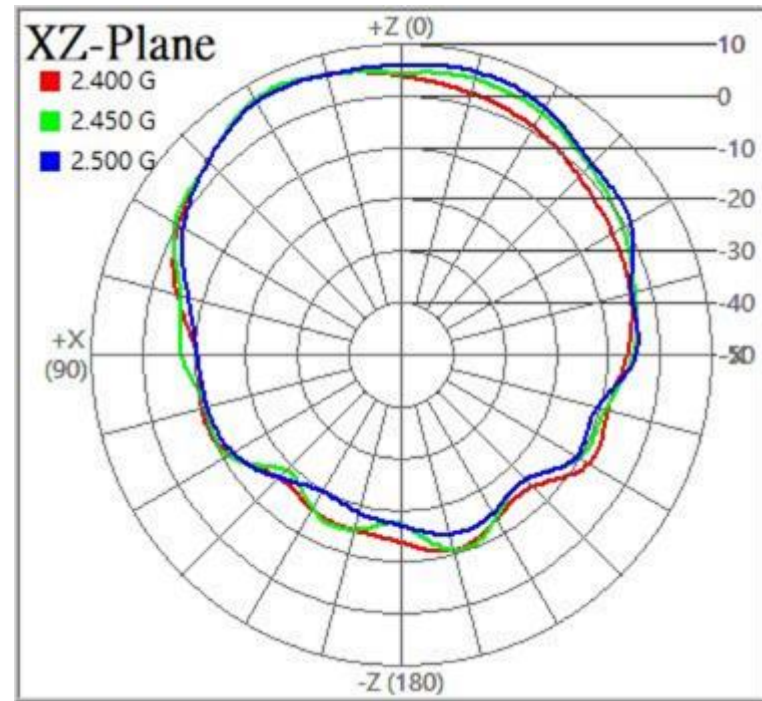
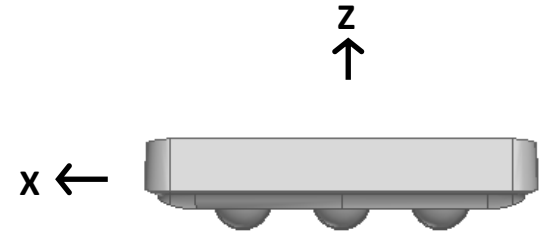
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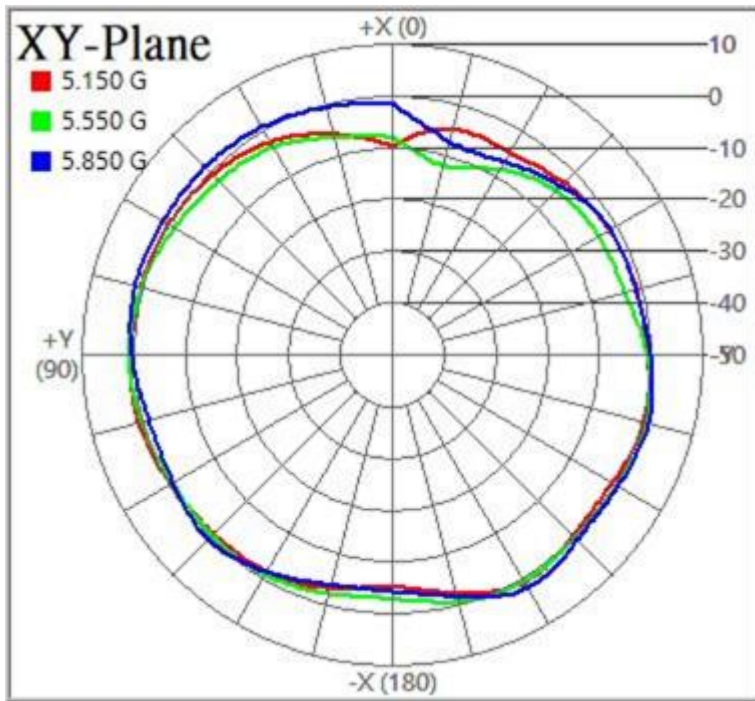
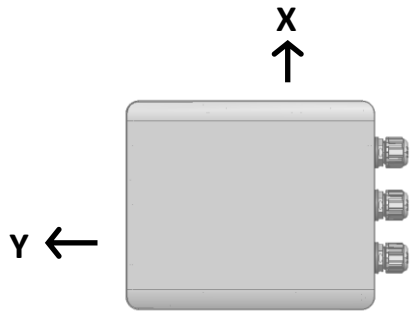
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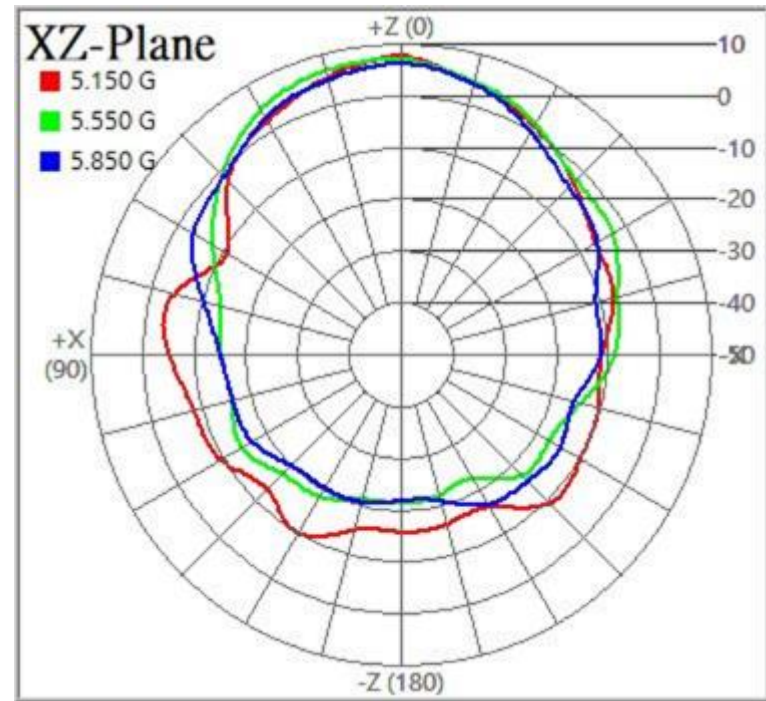
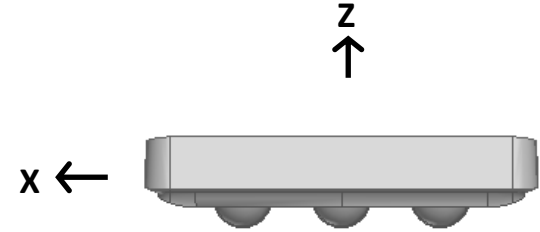
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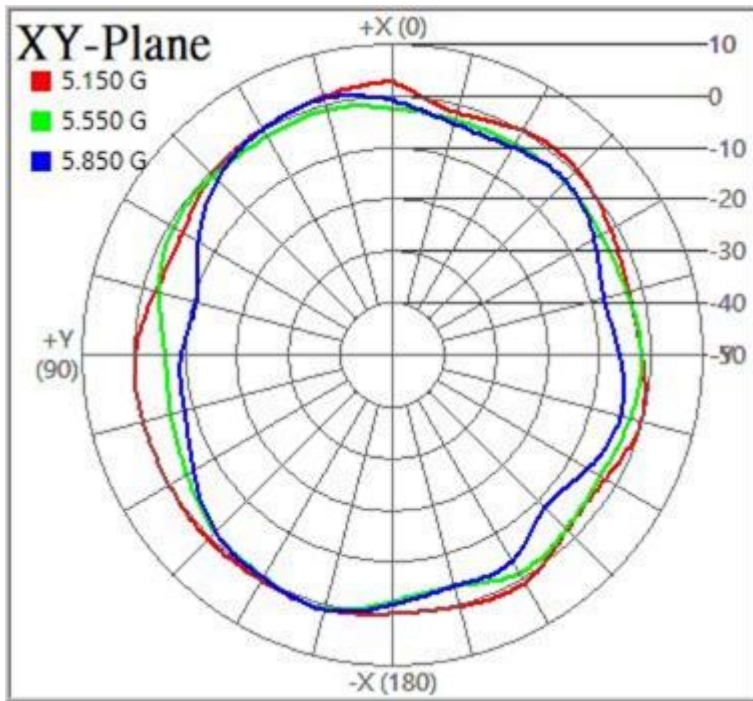
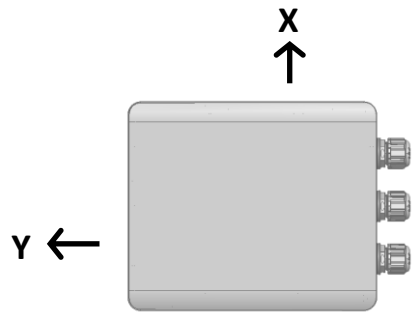
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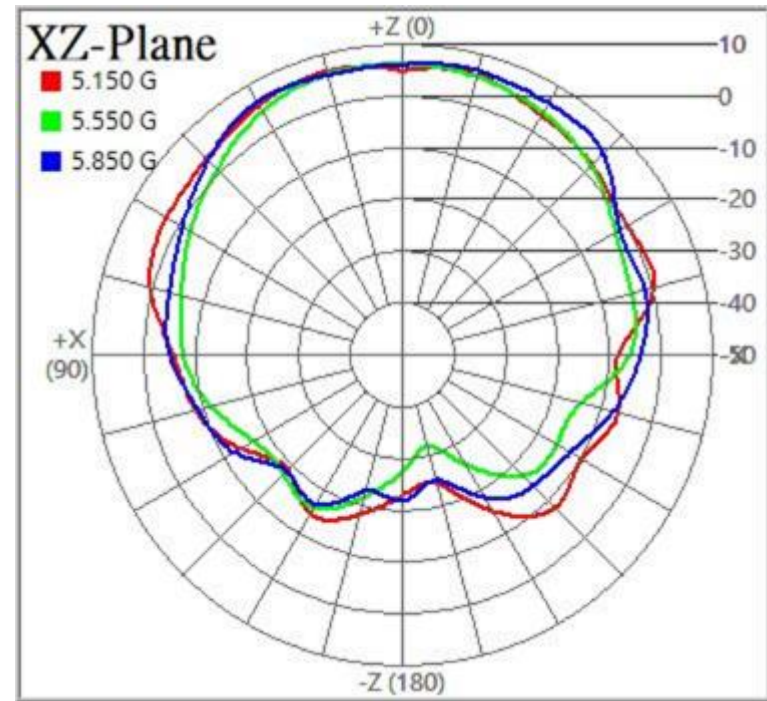
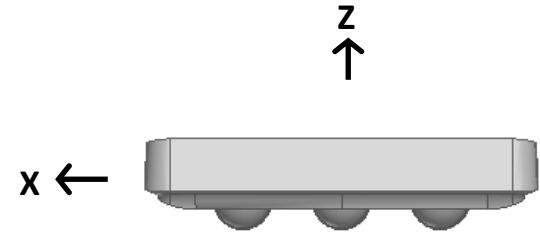
H-Plane



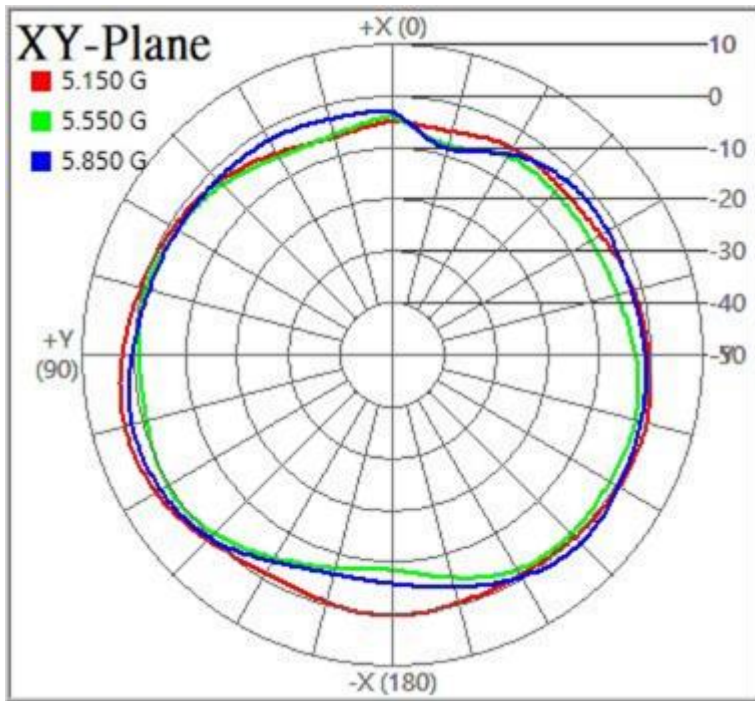
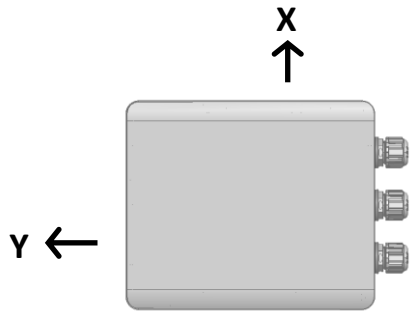
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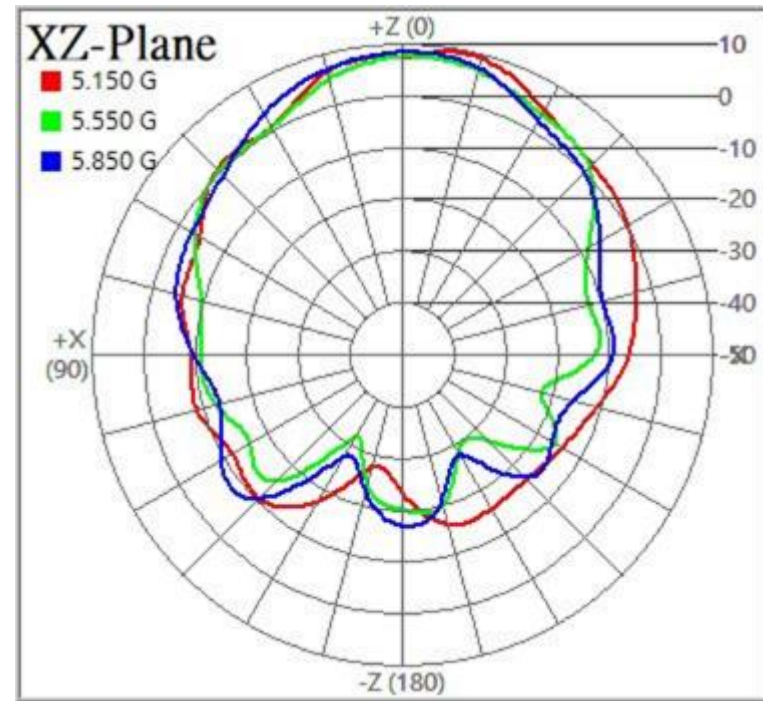
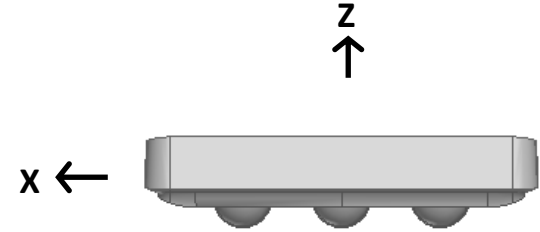
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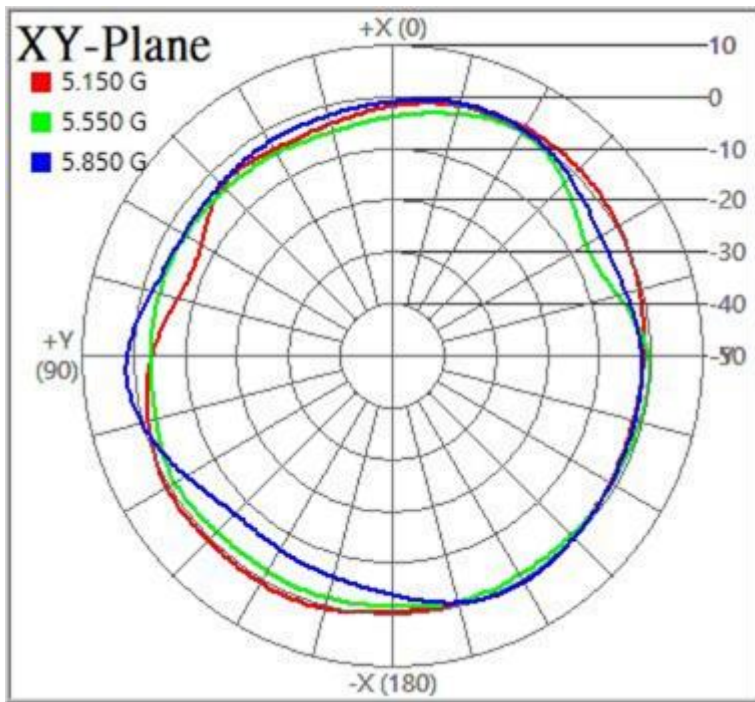
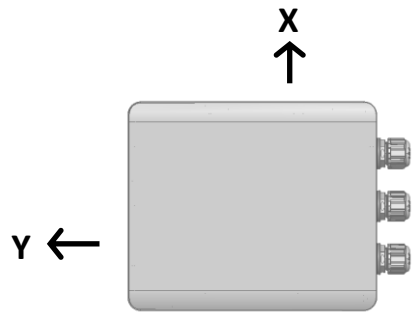
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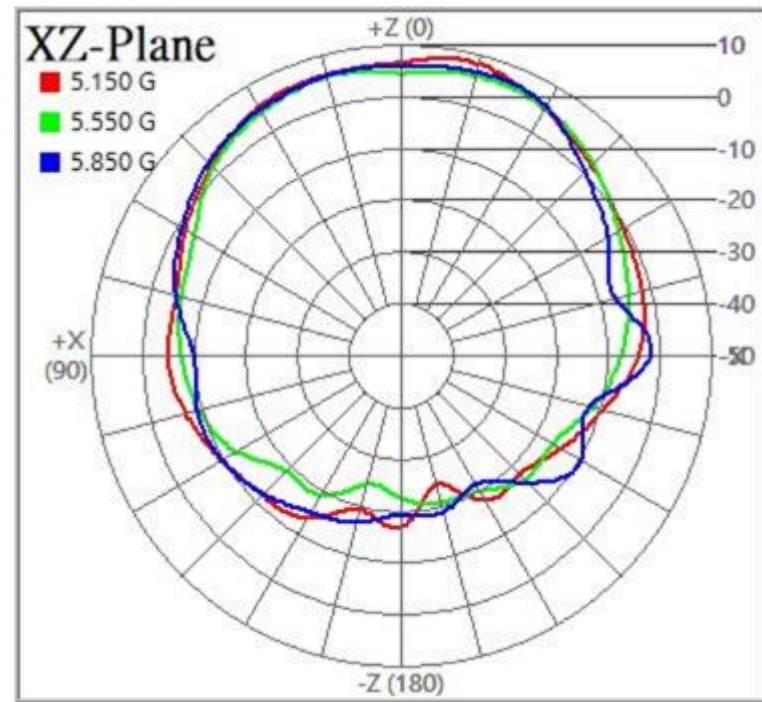
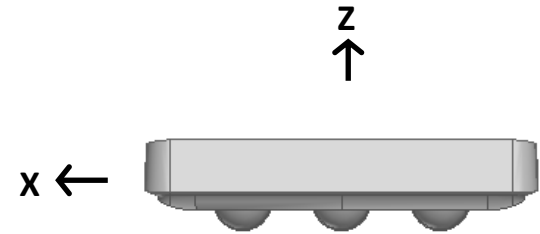
H-Plane



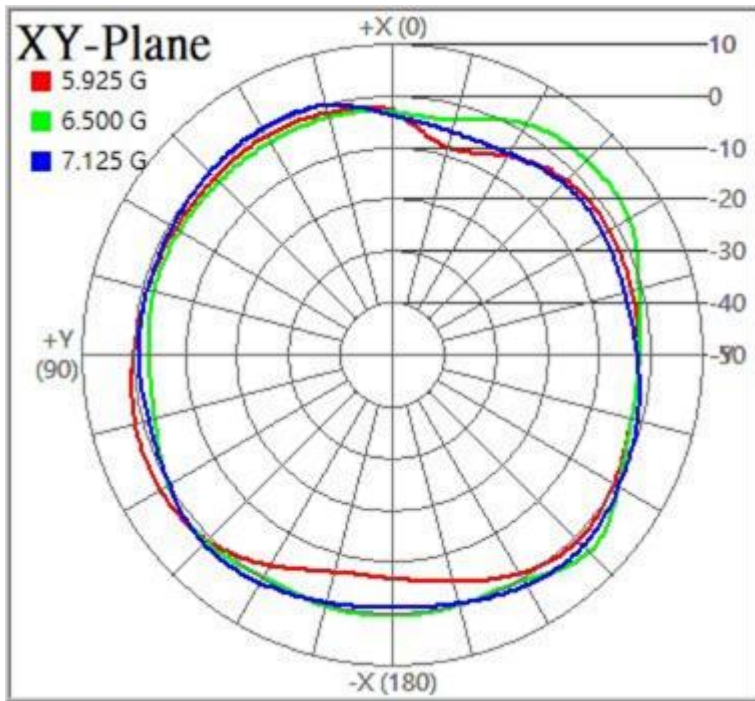
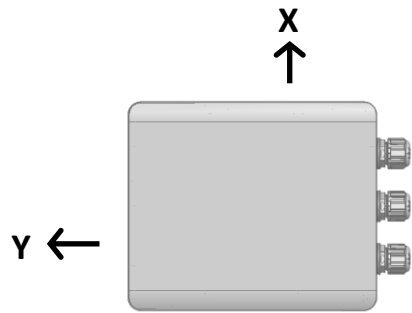
E-Plane



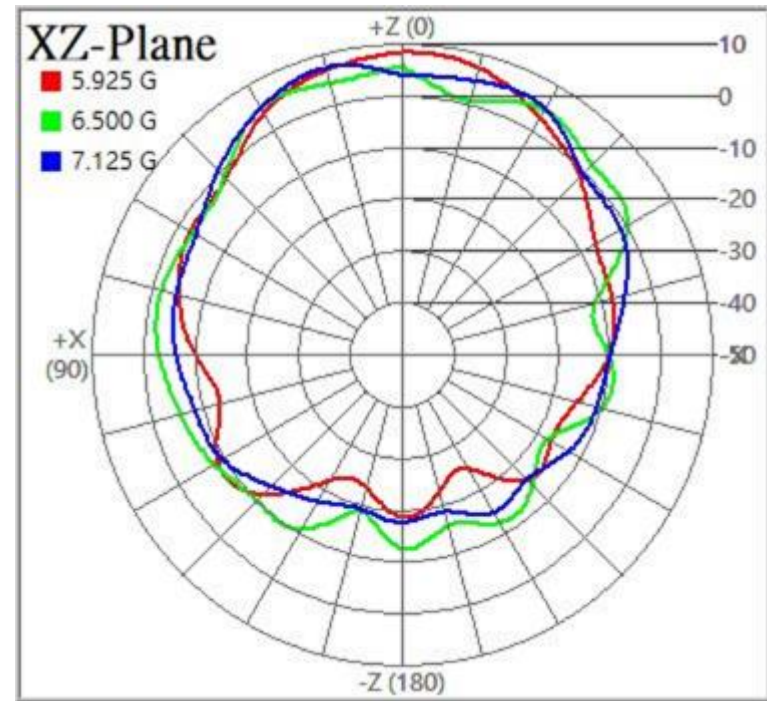
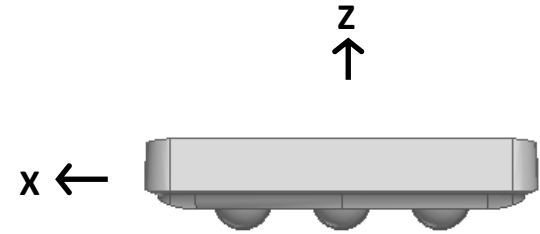
H-Plane



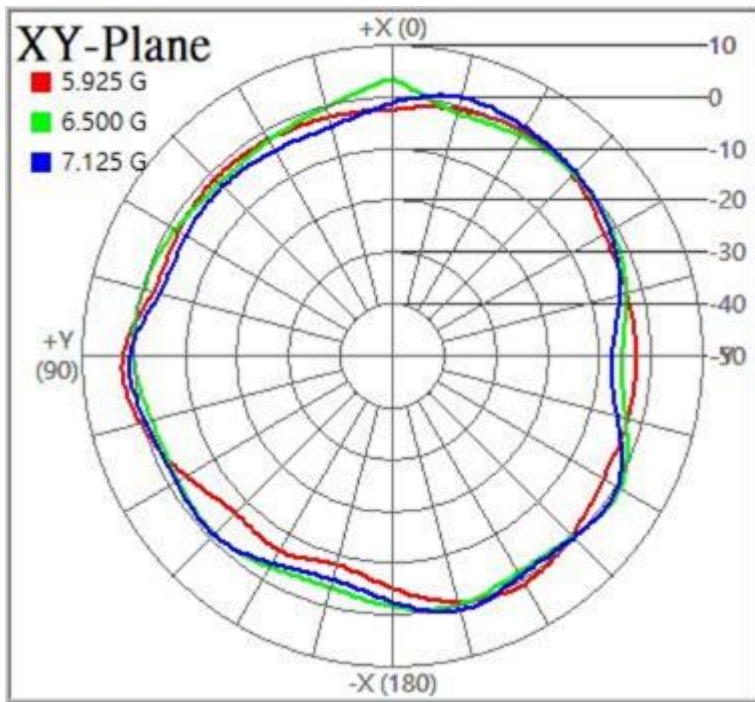
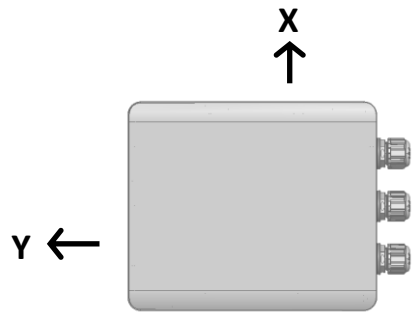
E-Plane



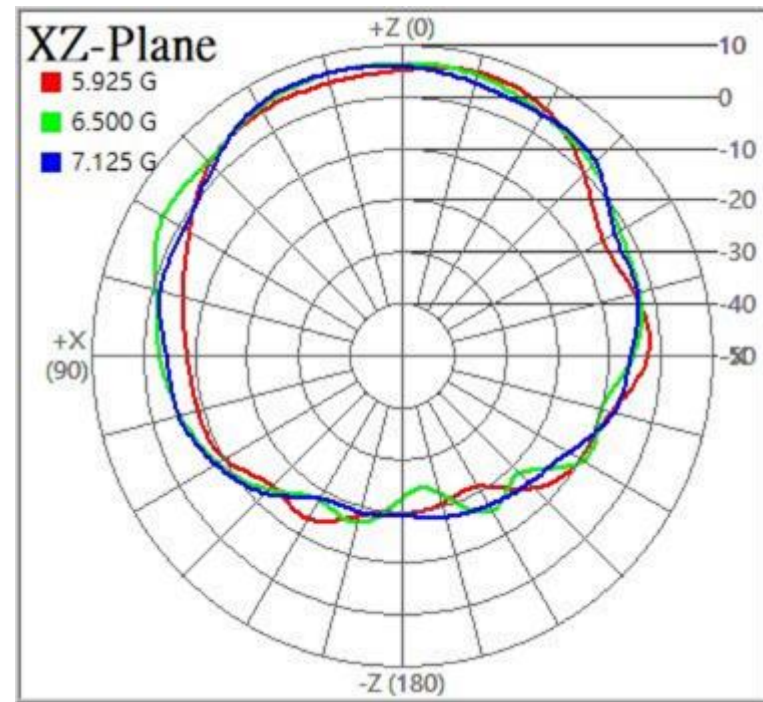
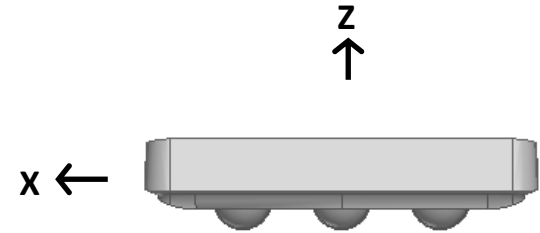
H-Plane



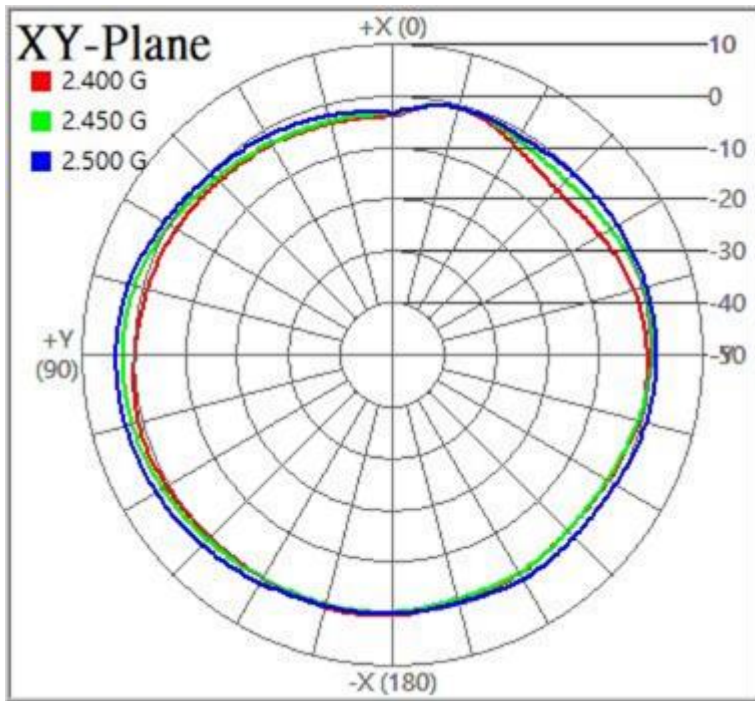
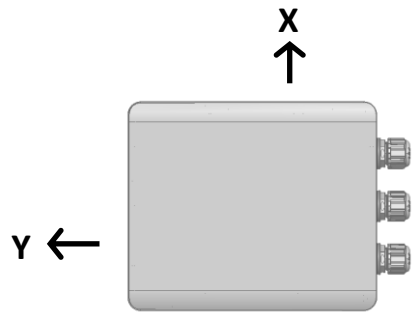
E-Plane



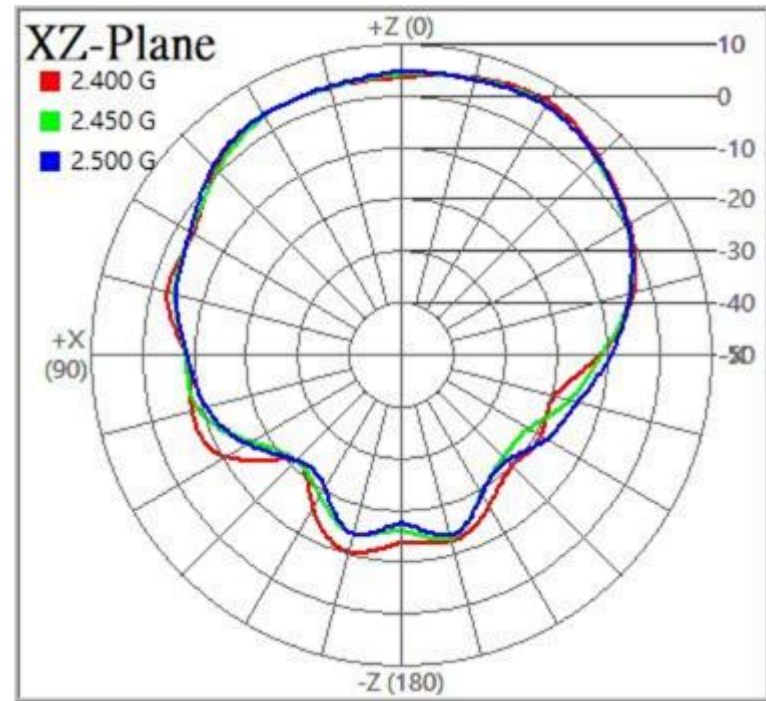
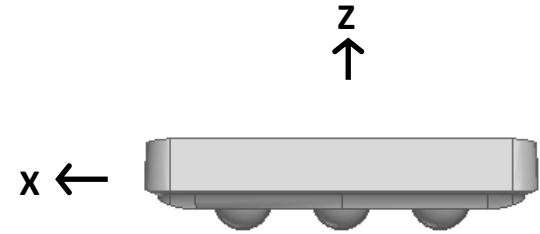
H-Plane



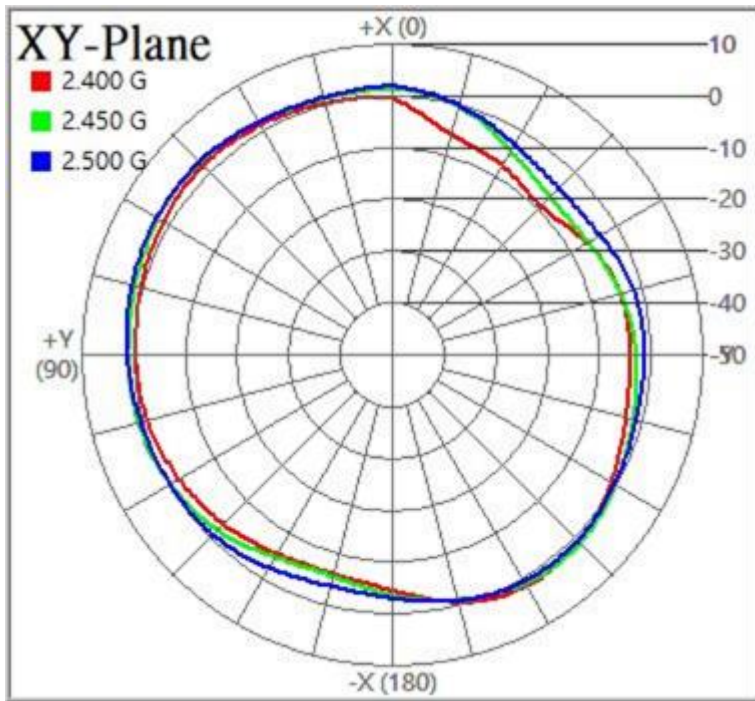
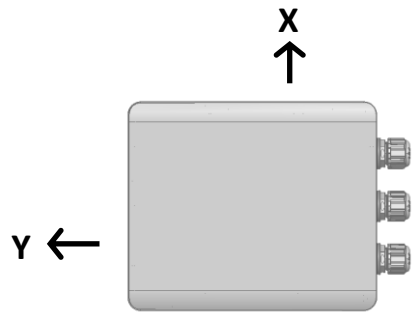
E-Plane



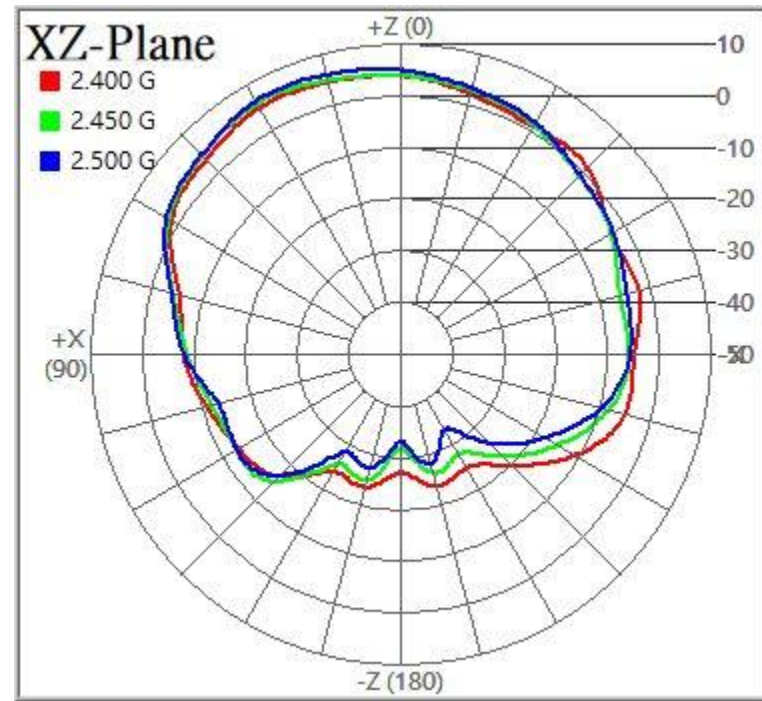
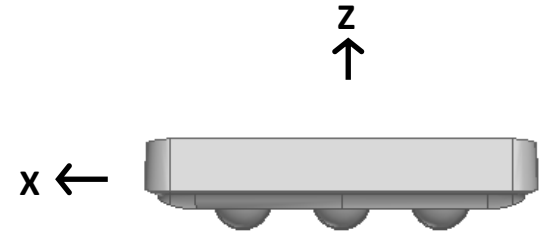
H-Plane



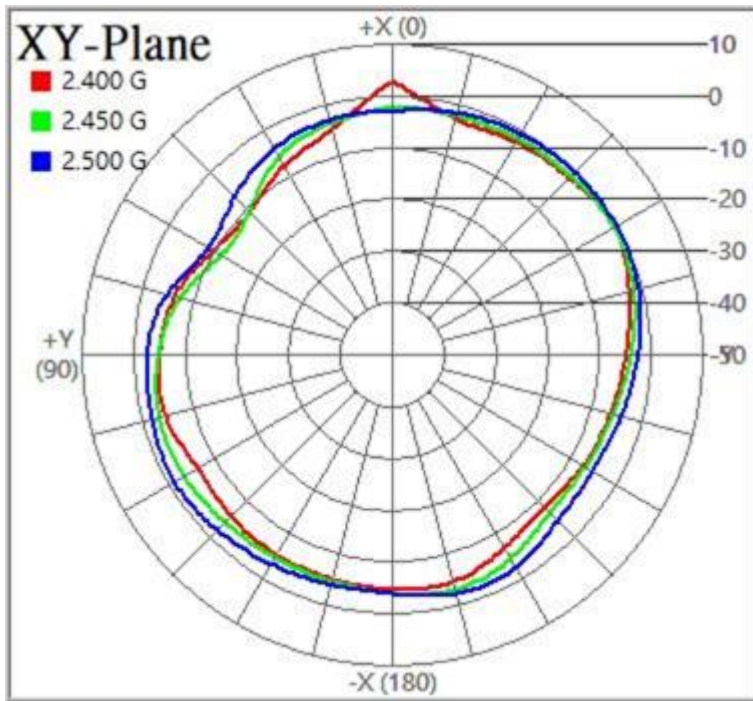
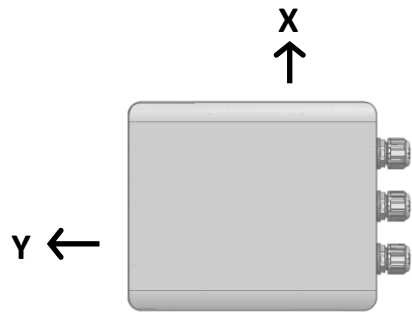
E-Plane



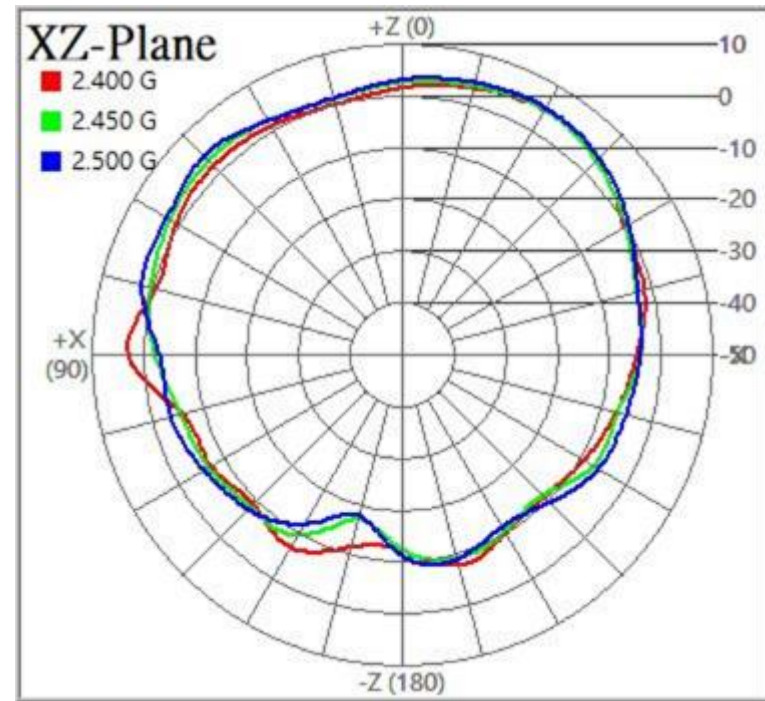
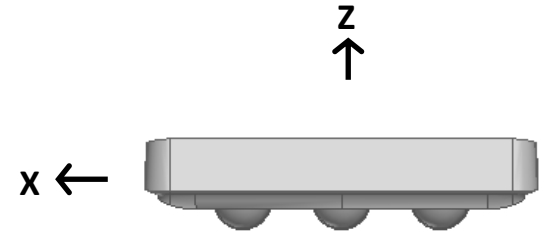
H-Plane



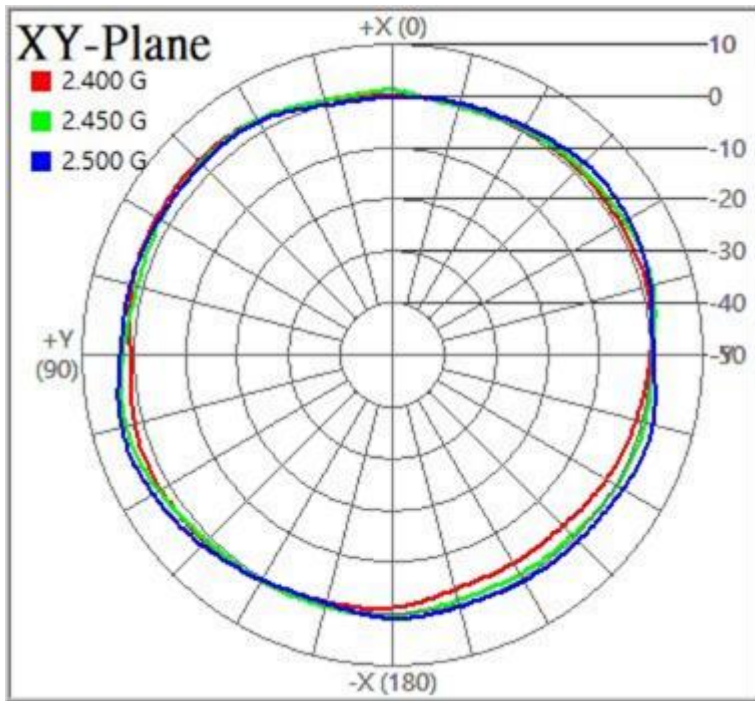
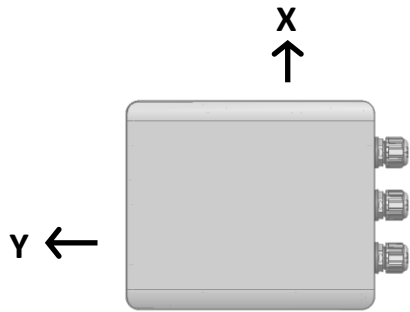
E-Plane



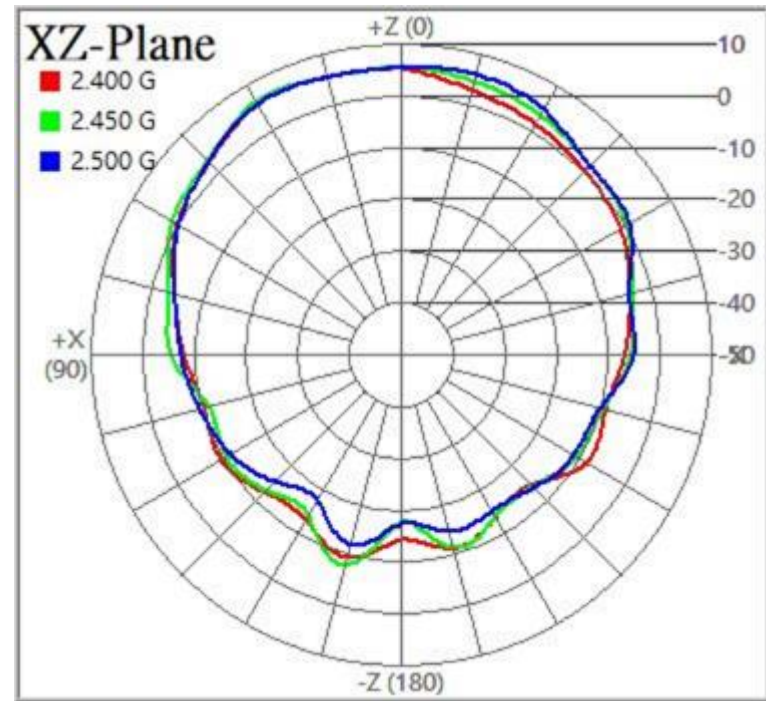
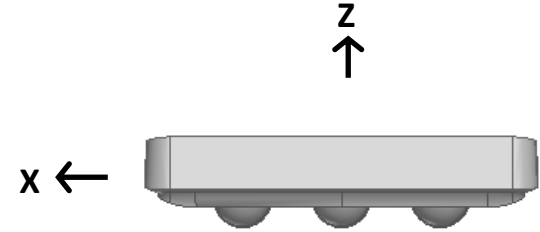
H-Plane



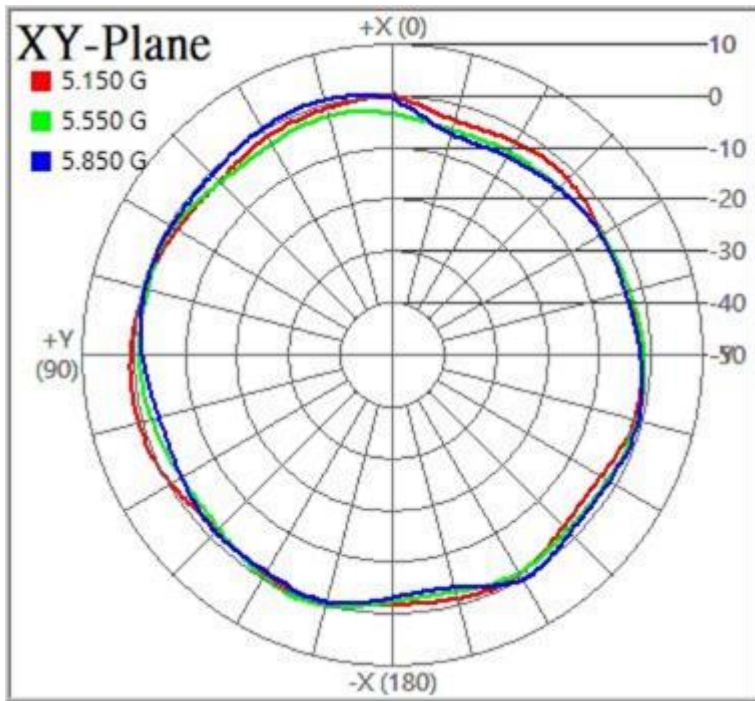
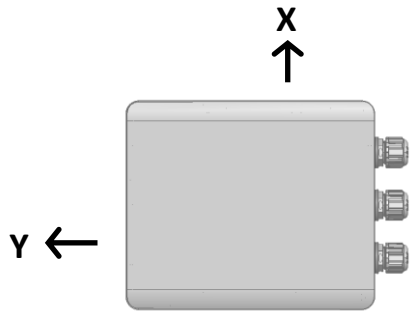
E-Plane



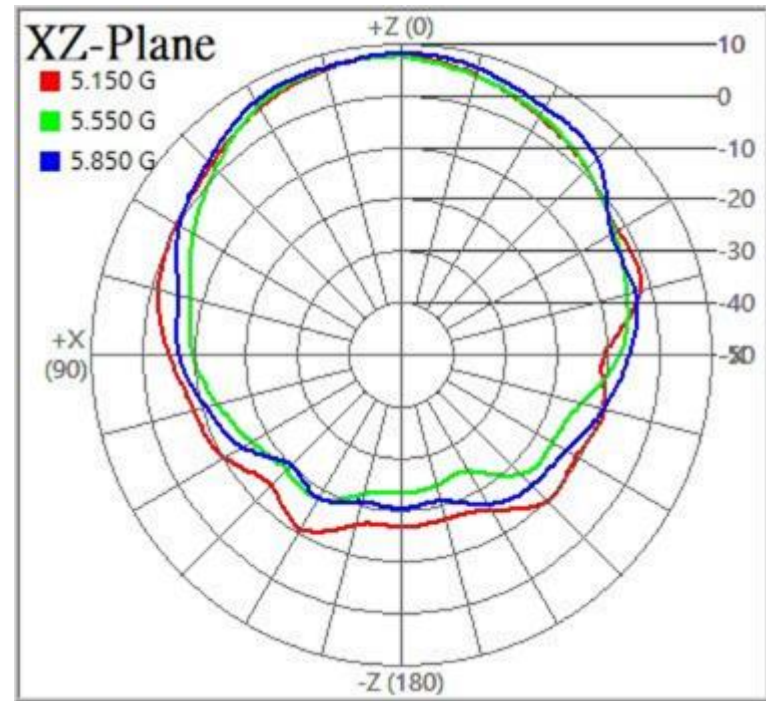
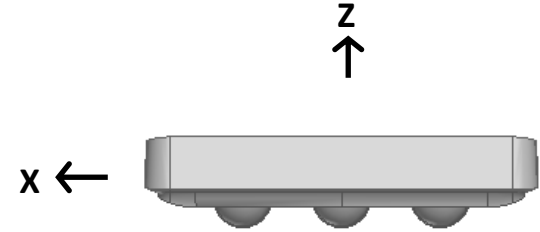
H-Plane



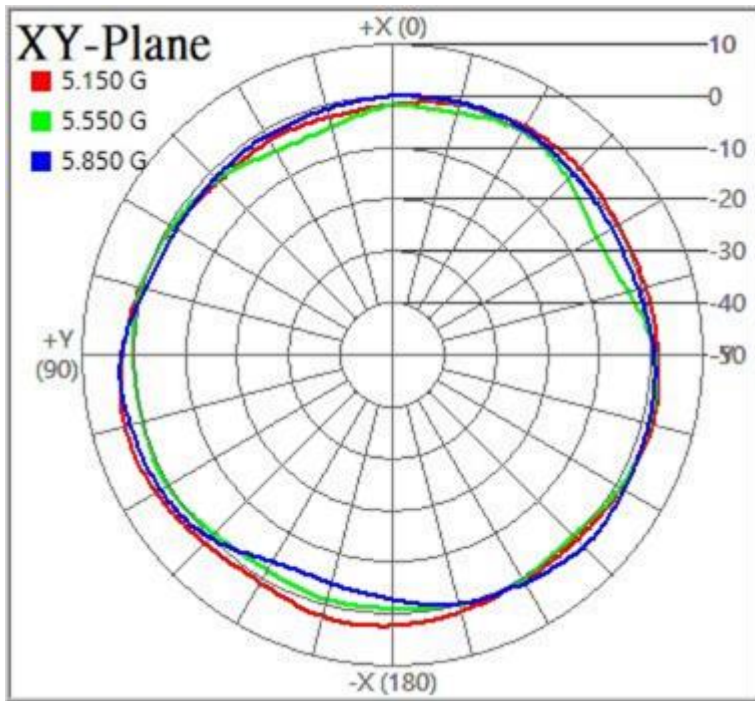
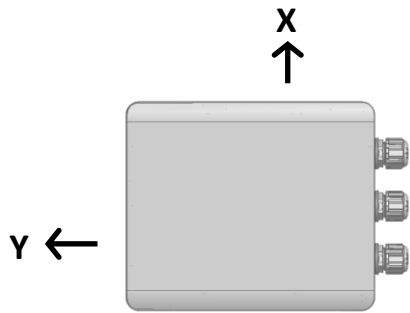
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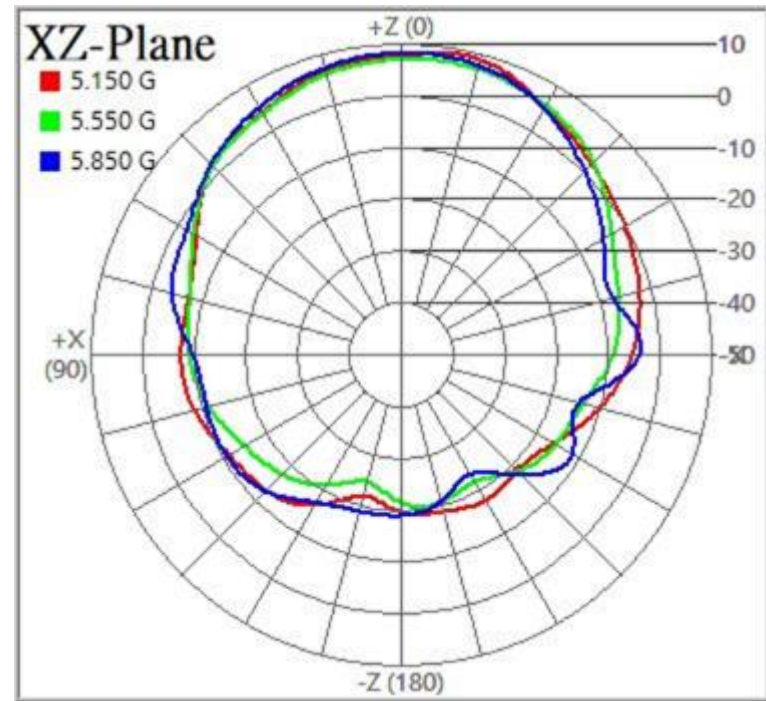
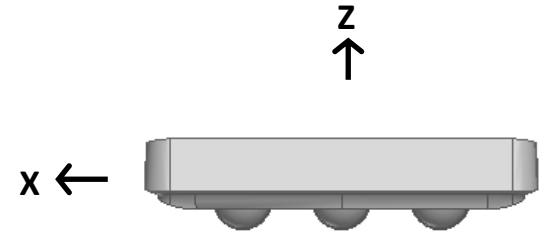
H-Plane



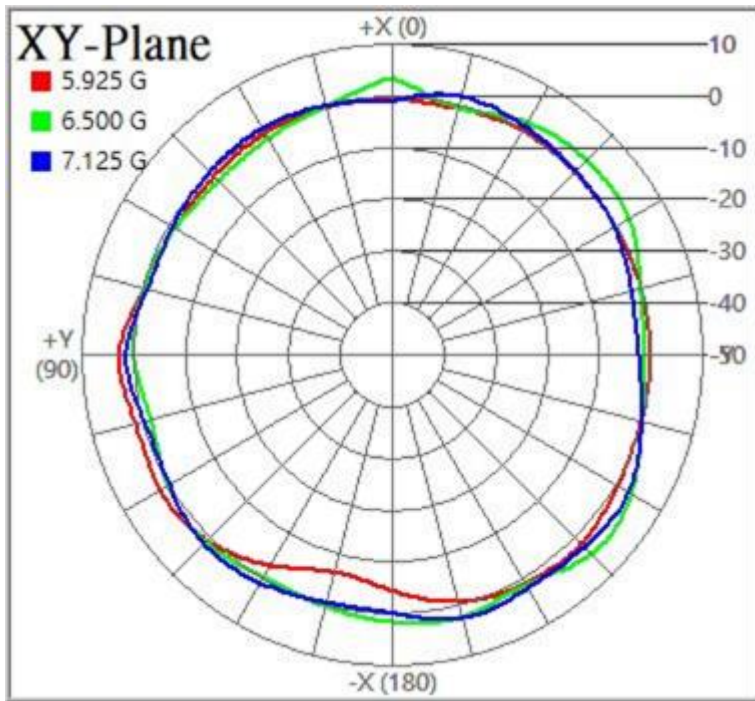
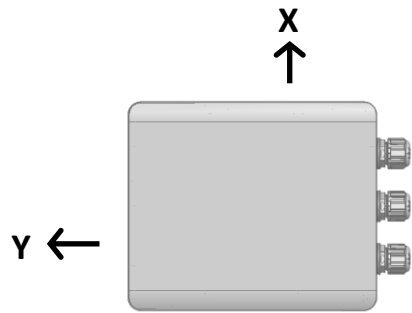
E-Plane



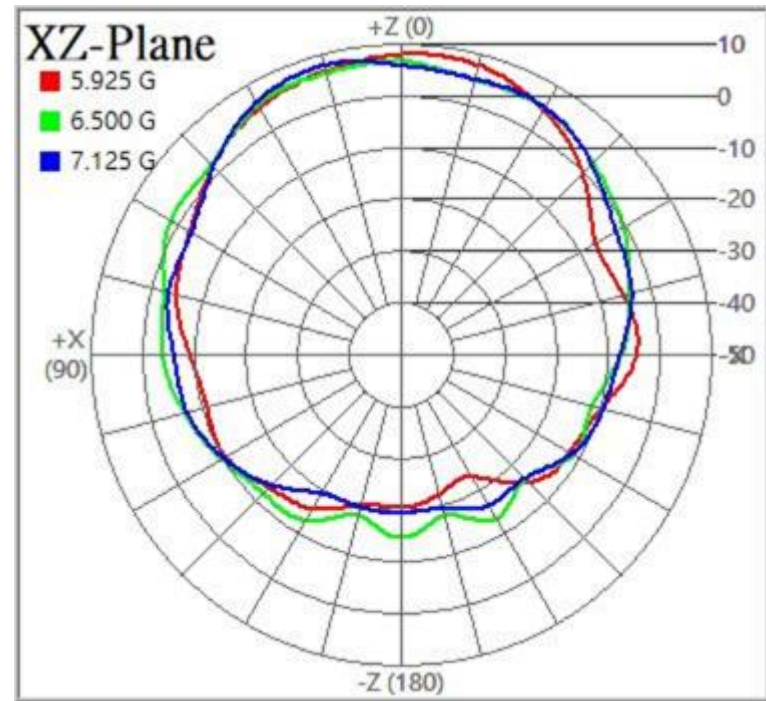
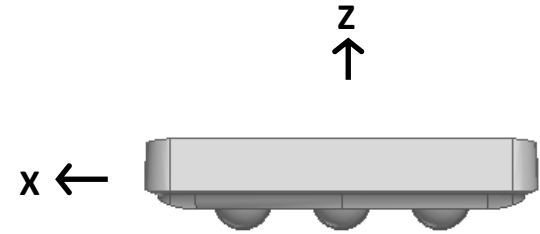
H-Plane



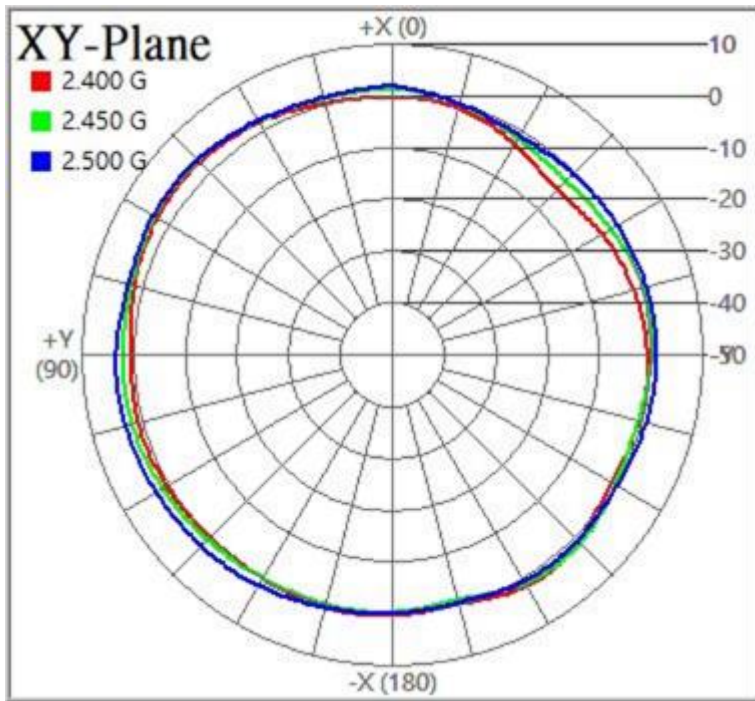
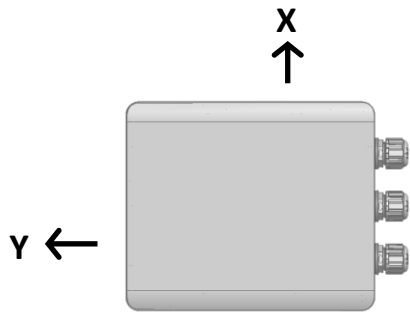
E-Plane



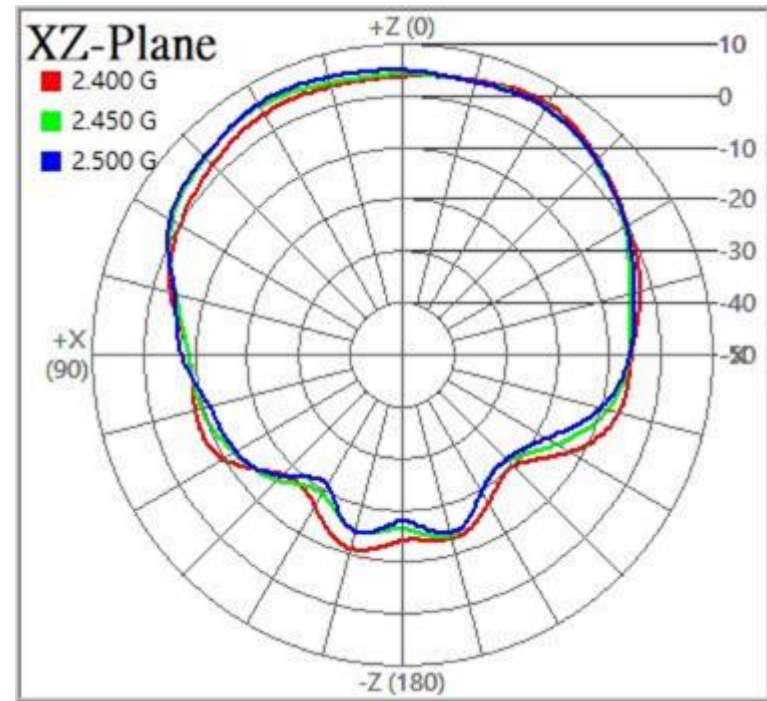
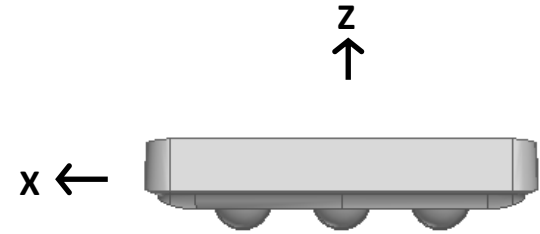
H-Plane



E-Plane



H-Plane



E-Plane

Gain Table

Freq.(MHz)	Ant.1_2G		Ant.2_2G		Ant.3_5G		Ant.4_5G	
	Efficiency(%)	Peak Gain(dBi)	Efficiency(%)	Peak Gain(dBi)	Efficiency(%)	Peak Gain(dBi)	Efficiency(%)	Peak Gain(dBi)
2400	65.7	6.8	70.5	6.8	/	/	/	/
2450	69.5	6.8	77.4	6.6	/	/	/	/
2500	72.7	6.7	72.3	6.5	/	/	/	/
5150	/	/	/	/	62.1	8.2	65.3	7.9
5500	/	/	/	/	71.6	8.4	63.8	8.2
5850	/	/	/	/	67.8	8.3	66.0	8.0
Freq.(MHz)	Ant.5_5/6G		Ant.6_5/6G		Ant.7_2G		Ant.8_2G	
	Efficiency(%)	Peak Gain(dBi)	Efficiency(%)	Peak Gain(dBi)	Efficiency(%)	Peak Gain(dBi)	Efficiency(%)	Peak Gain(dBi)
2400	/	/	/	/	75.9	6.6	76.2	6.7
2450	/	/	/	/	78.2	6.6	74.8	6.7
2500	/	/	/	/	71.6	6.5	72.9	6.5
5150	69.4	8.3	71.6	8.3				
5500	62.3	8.1	65.2	8.4				
5850	70.9	8.4	71.9	8.3				
5925	69.2	8.3	68.4	8.3				
6500	62.2	8.2	71.7	7.9				
7125	71.7	7.9	71.1	7.7				
							Ant.9_2G	
							Efficiency(%)	Peak Gain(dBi)
							2400	6.2
							2450	5.6
							2500	5.5