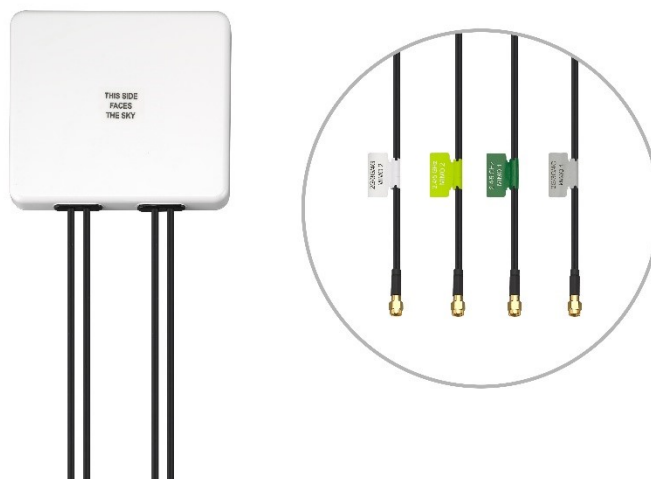


DRAFT SPECIFICATION

PATENT PENDING

- Part No. : **MA961.A.BICG.002**
- Product Name : MA961 **Guardian** 4in1 Adhesive Mount Antenna
LTE*2+Wi-Fi*2
- Features : Low-profile Housing – Mounts flush to Wall
2* LTE MIMO 698-960MHz/1710-2170MHz/ 2490-2690MHz/
3300-3600MHz
2* Wi-Fi MIMO 2.4GHz/5.8GHz
Worldwide 4G Bands including 3G and 2G
IP67 Waterproof Resistant Enclosure
Dims: 146*134*20mm
1M Low Loss KSR200-P and RG174 with SMA(M)/RP-SMA(M) connectors
Cables and Connectors Customizable
RoHS Compliant



1. Introduction

The MA961 Guardian is a next generation combination antenna. The first panel antenna worldwide designed for IoT Gateway and Router devices. It is a low profile 4in1 wall and adhesive mount antenna. It is a heavy-duty, fully IP67 waterproof resistant external M2M antenna for use by RF professionals in

- IoT Gateway and Routers
- HD Video Streaming
- Transportation
- Remote Monitoring Applications

This antenna delivers powerful MIMO antenna technology for worldwide 4G LTE bands at 698-960MHz/1710-2170MHz/2490-2690MHz/3300-3600MHz bands and dual 2.4/5.8GHz Wi-Fi. It enables designers to install only one antenna to cover all of these technologies.

4G wireless applications demand high speed data uplink and downlink. High efficiency and high gain MIMO antennas are necessary to achieve the required signal to noise ratio and throughput required to solve these challenges. Taoglas also takes care to have high isolation among these antennas to prevent self-interference. Low loss cables used to keep efficiency high over long cable lengths.

The housing dimension is 146*134*20mm. It is IP67 waterproof and comes with 3M foam adhesive. The antenna can be mounted internally or externally on a vehicle. The MA961 comes with 1 meter, low loss KSR-200P coaxial cables for the LTE and Wi-Fi antennas, and RG174 coaxial cable for the GNSS antenna as standard. Customized cables and connector versions are also available.

2. Specification

2G/3G/4G LTE Antenna

Frequency (MHz)		LTE700	GSM850	GSM900	DCS	PCS	UMTS1	LTE2600	LTE3500
		698~803	824~894	880~960	1710~1880	1850~1990	1920~2170	2490~2690	3300~3600
Efficiency (%)									
MIMO_1	Free space	50.82	55.85	41.29	66.47	70.19	71.51	49.20	50.92
	ABS	68.31	69.61	61.27	66.31	70.86	70.00	50.61	51.88
	Glass	67.99	67.37	62.94	66.89	71.80	69.58	51.00	52.83
	Metal	42.12	51.55	58.33	39.49	47.20	47.71	44.36	44.85
	Wall	67.97	70.42	66.80	63.91	64.94	63.35	50.37	51.49
MIMO_2	Free space	54.13	58.97	48.65	61.54	68.31	68.39	54.62	52.55
	ABS	71.74	66.05	58.58	63.18	69.29	69.23	53.95	54.95
	Glass	64.53	55.70	45.22	64.94	67.87	65.86	50.05	51.77
	Metal	55.62	63.13	56.59	32.14	40.89	43.97	54.22	52.90
	Wall	61.91	48.38	52.88	58.00	56.47	56.36	54.68	48.72
Average Gain (dBi)									
MIMO_1	Free space	-2.96	-2.62	-3.85	-1.78	-1.54	-1.46	-3.12	-2.96
	ABS	-1.68	-1.59	-2.13	-1.79	-1.50	-1.55	-3.00	-2.87
	Glass	-1.73	-1.73	-2.02	-1.75	-1.44	-1.58	-2.96	-2.79
	Metal	-3.94	-2.88	-2.37	-4.07	-3.27	-3.23	-3.57	-3.51
	Wall	-1.70	-1.53	-1.76	-1.95	-1.88	-1.99	-3.00	-2.89
MIMO_2	Free space	-2.72	-2.32	-3.17	-2.11	-1.66	-1.66	-2.65	-2.83
	ABS	-1.47	-1.81	-2.33	-2.00	-1.59	-1.60	-2.71	-2.63
	Glass	-1.93	-2.56	-3.46	-1.88	-1.68	-1.82	-3.04	-2.87
	Metal	-2.61	-2.00	-2.50	-4.95	-3.90	-3.59	-2.67	-2.77
	Wall	-2.09	-3.15	-2.79	-2.37	-2.48	-2.50	-2.63	-3.15
Peak Gain (dBi)									
MIMO_1	Free space	3.18	3.60	2.14	3.98	4.37	4.37	3.70	4.49
	ABS	4.65	4.00	3.45	5.24	6.05	6.05	4.69	3.18
	Glass	3.71	3.92	4.35	5.28	6.16	7.67	5.34	3.87
	Metal	5.09	3.10	4.73	4.50	4.96	5.69	6.02	4.96
	Wall	4.74	4.97	3.67	5.44	4.84	4.84	5.08	3.75
MIMO_2	Free space	5.83	3.66	2.57	3.78	4.01	4.01	3.87	3.97
	ABS	4.33	4.52	4.41	4.34	4.73	5.69	5.64	5.42
	Glass	3.02	3.14	1.36	4.99	5.89	6.02	6.18	4.42
	Metal	3.54	3.11	3.33	3.12	4.36	5.02	7.16	4.95
	Wall	3.21	1.77	2.15	5.49	5.49	7.20	6.10	4.74

2G/3G/4G LTE Antenna	
Impedance	50Ω
Polarization	Linear
VSWR	< 3
Cable	1 meter KSR200-P standard, fully customizable
Connector	SMA(M) standard, fully customizable

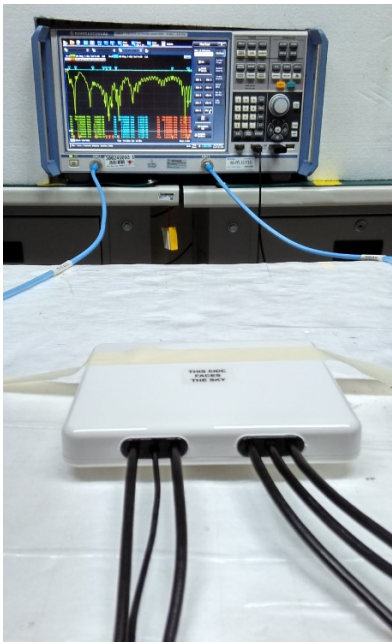
2.4GHz/5.8GHz Wi-Fi Antenna			
Frequency (MHz)		2400~2500	4900~5850
Efficiency (%)			
MIMO_1	Free space	57.73	48.06
	ABS	53.59	49.42
	Glass	53.98	47.16
	Metal	51.80	46.70
	Wall	61.02	46.29
MIMO_2	Free space	44.09	47.04
	ABS	46.34	46.79
	Glass	40.79	46.88
	Metal	45.58	45.59
	Wall	50.62	43.60
Average Gain (dBi)			
MIMO_1	Free space	-2.39	-3.25
	ABS	-2.71	-3.13
	Glass	-2.68	-3.36
	Metal	-2.86	-3.44
	Wall	-2.15	-3.42
MIMO_2	Free space	-3.57	-3.33
	ABS	-3.37	-3.36
	Glass	-3.91	-3.35
	Metal	-3.45	-3.52
	Wall	-2.96	-3.67
Peak Gain (dBi)			
MIMO_1	Free space	4.35	4.84
	ABS	5.34	5.18
	Glass	2.99	5.03
	Metal	5.22	5.98
	Wall	5.47	5.77
MIMO_2	Free space	2.94	5.70
	ABS	2.18	5.43
	Glass	3.75	7.07
	Metal	6.02	6.76
	Wall	3.23	5.97

2.4GHz/5.8GHz Wi-Fi Antenna	
Impedance	50Ω
Polarization	Linear
VSWR	< 3
Cable	1 meter KSR200-P standard, fully customizable
Connector	RP-SMA(M) standard, fully customizable
MECHANICAL	
Antenna Dimensions	146*134*20mm
Casing	ASA
Weight (including cable)	438g
Ingress Protection Rating	IP67
ENVIRONMENTAL	
Operation Temperature	-40°C to 85°C
Storage Temperature	-40°C to 90°C
Humidity	Non-condensing 65°C 95% RH

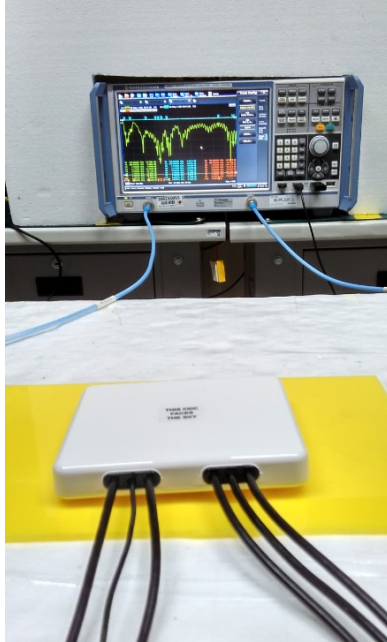
3. Antenna Characteristics

3.1 LTE_MIMO/Wi-Fi_MIMO Antenna

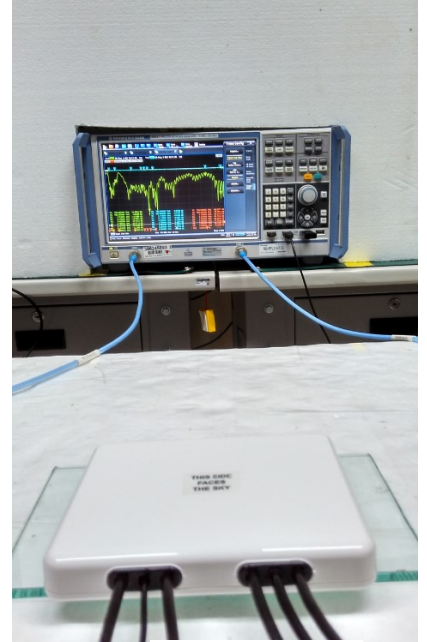
3.1.1 Test Setup



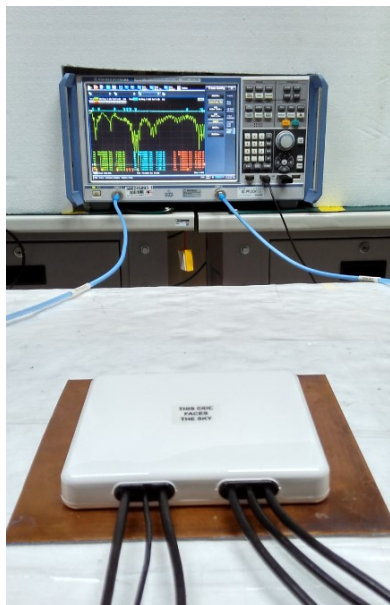
Free space



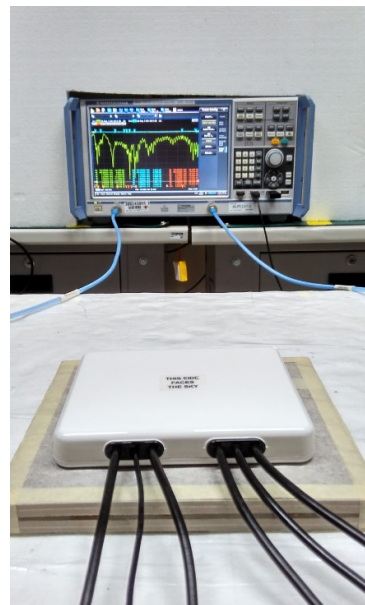
ABS



Glass



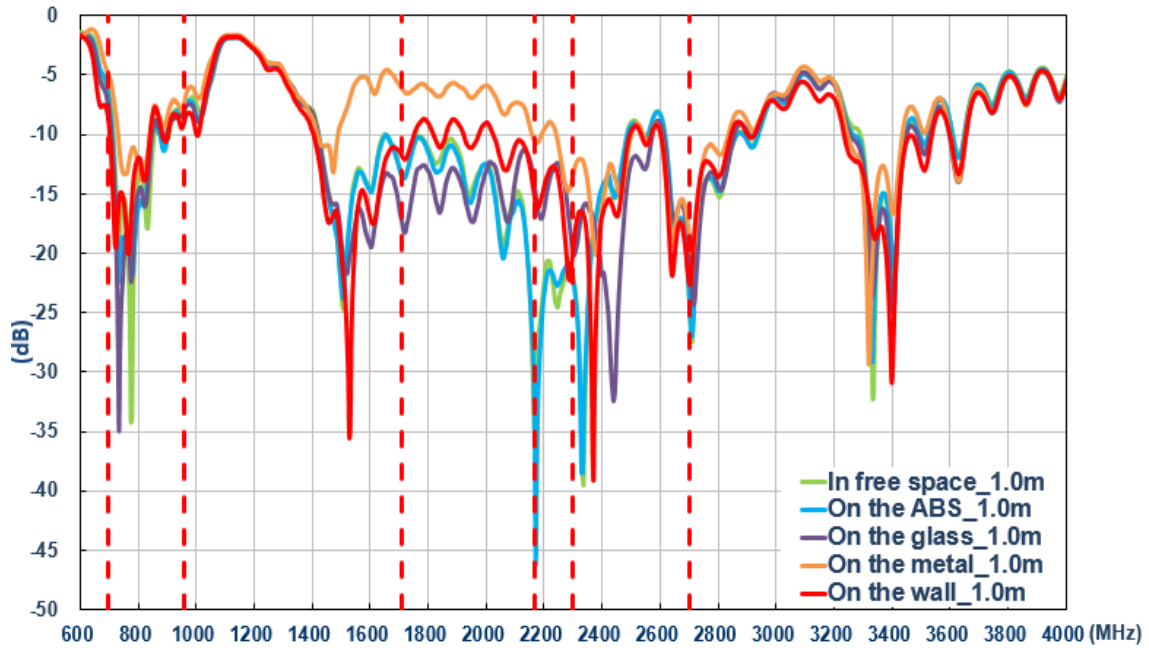
Metal



Wall

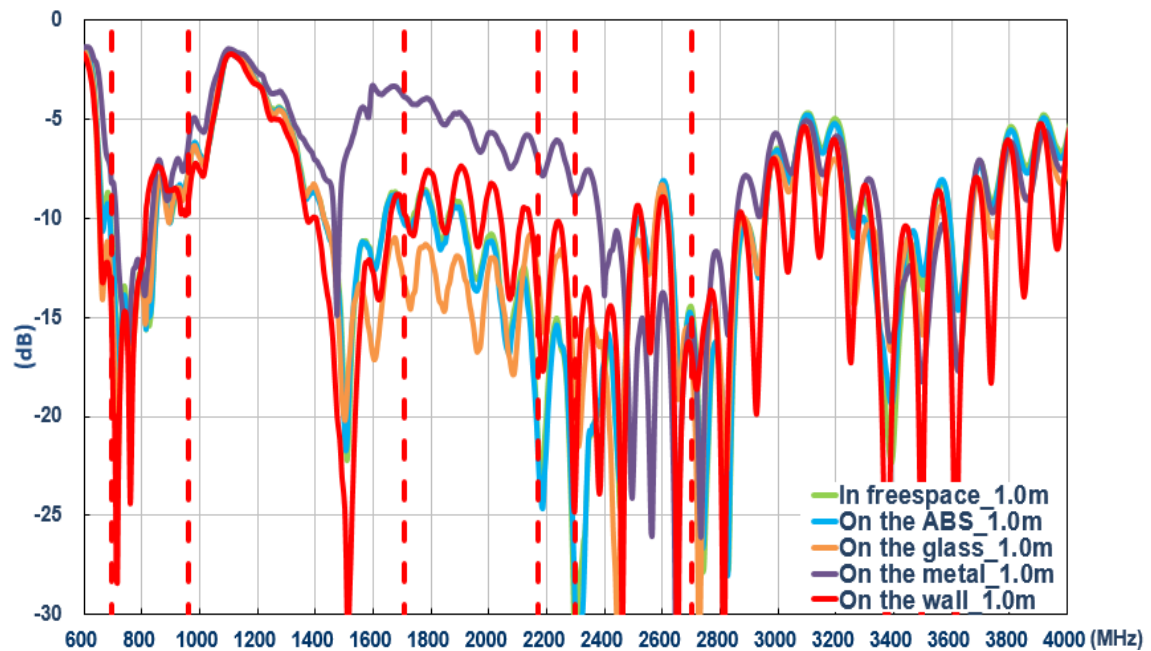
3.1.2 LTE_1 Antenna Return Loss

Performance in different environments with 1 meter cable length



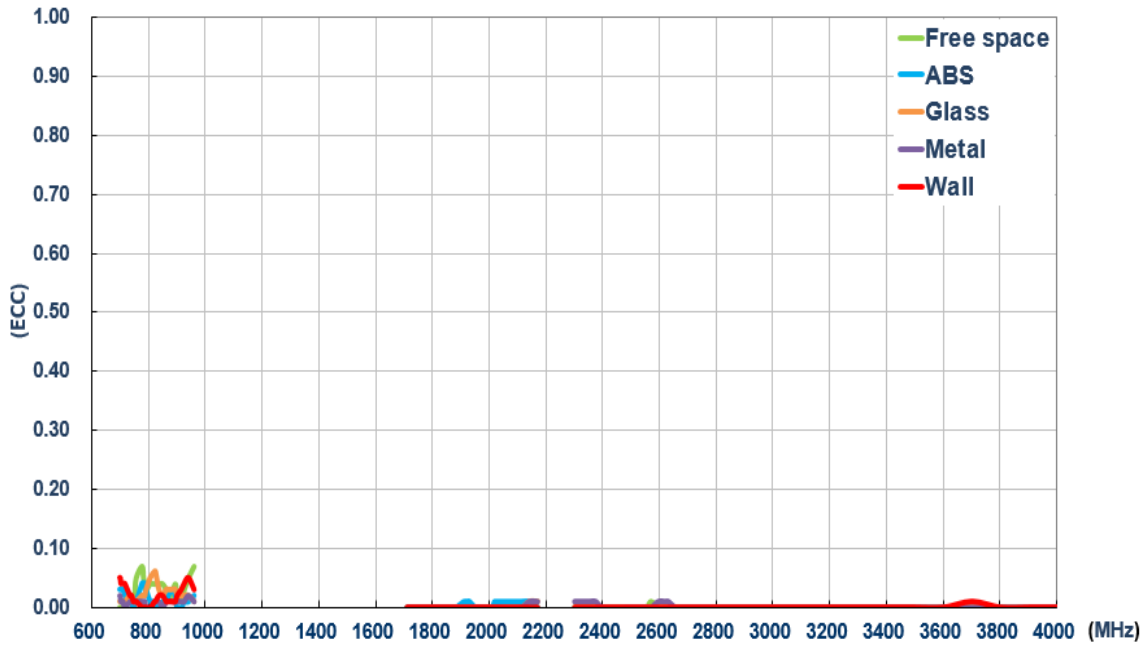
3.1.3 LTE_2 Antenna Return Loss

Performance in different environments with 1 meter cable length



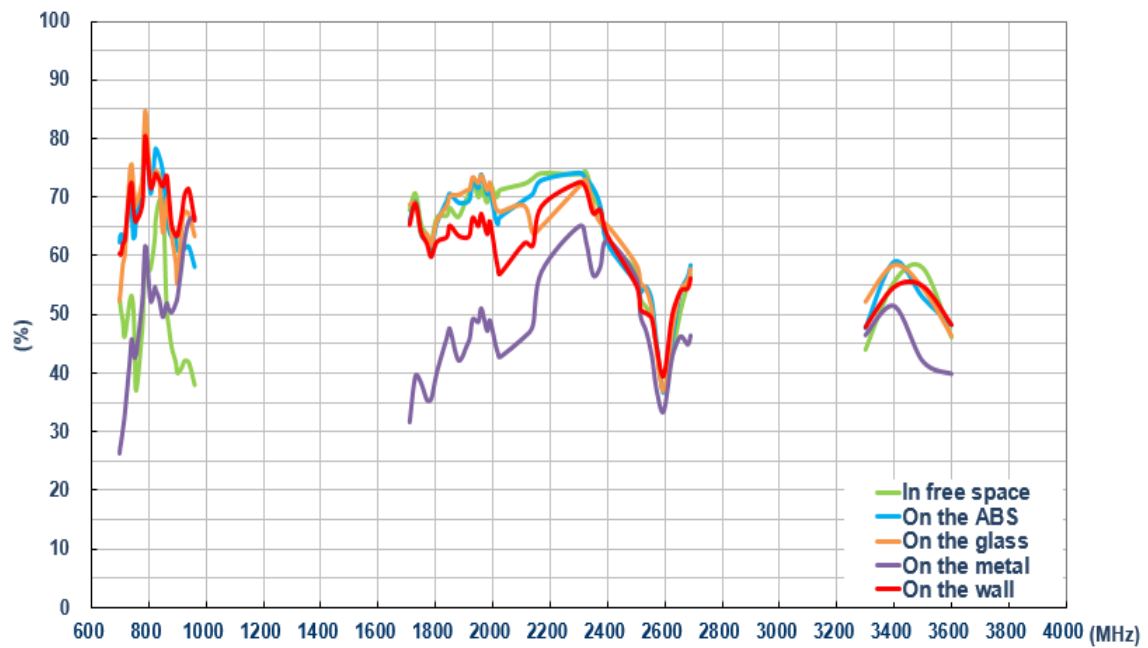
3.1.4 LTE Envelope Correlation Coefficient

Performance in different environments with 1 meter cable length



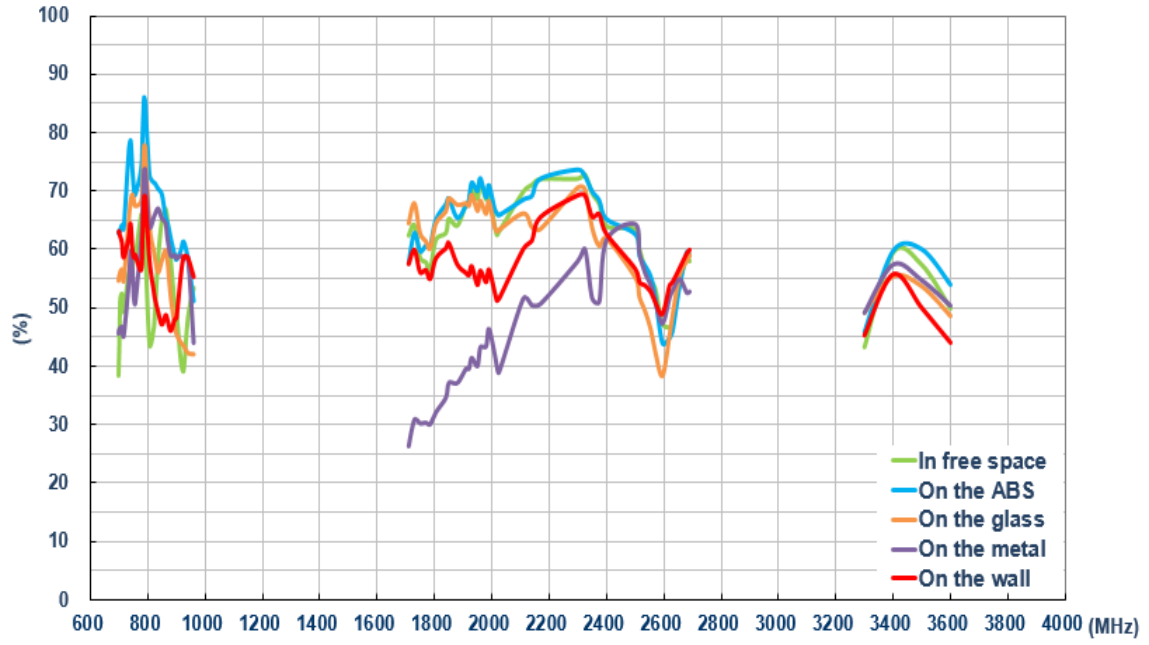
3.1.5 LTE_1 Antenna Efficiency

Performance in different environments with 1 meter cable length



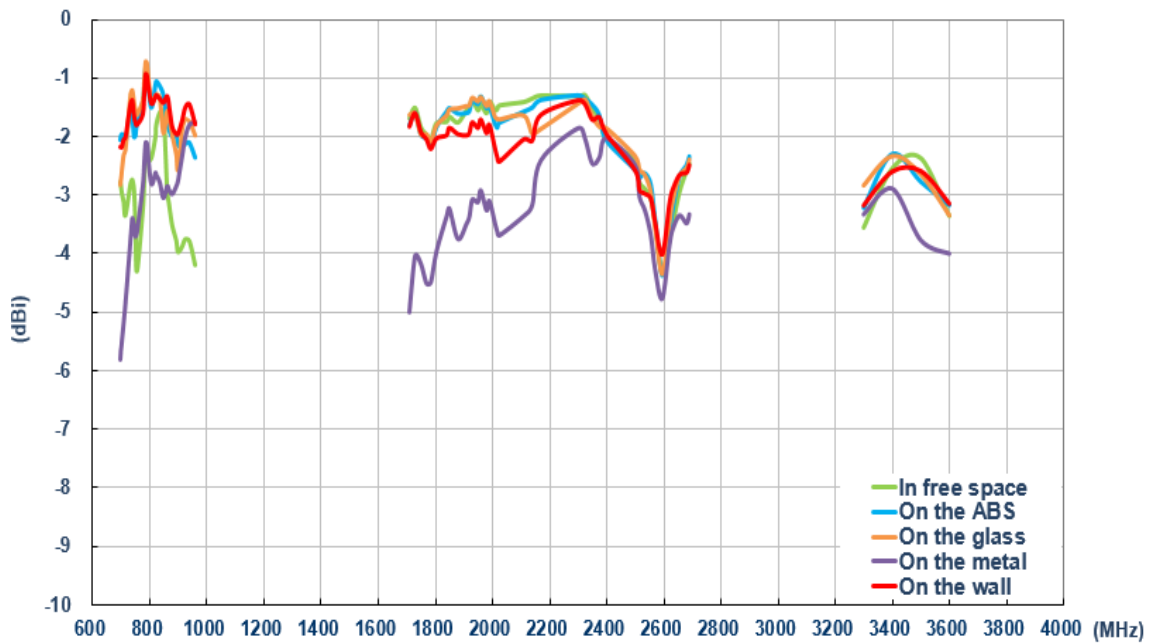
3.1.6 LTE_2 Antenna Efficiency

Performance in different environments with 1 meter cable length



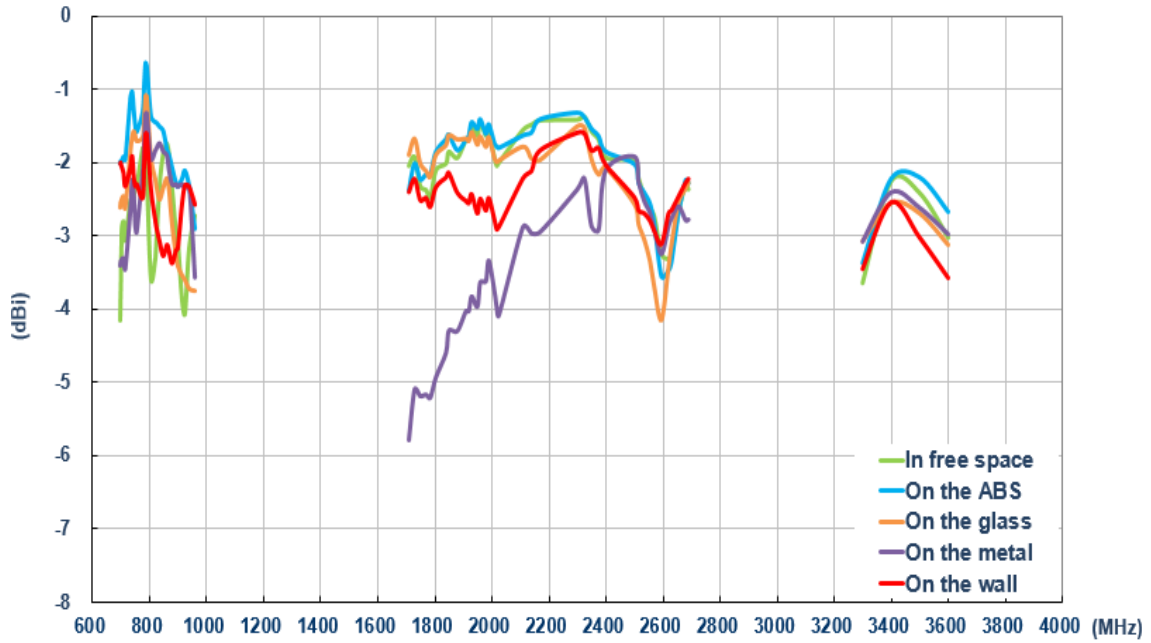
3.1.7 LTE_1 Antenna Average Gain

Performance in different environments with 1 meter cable length



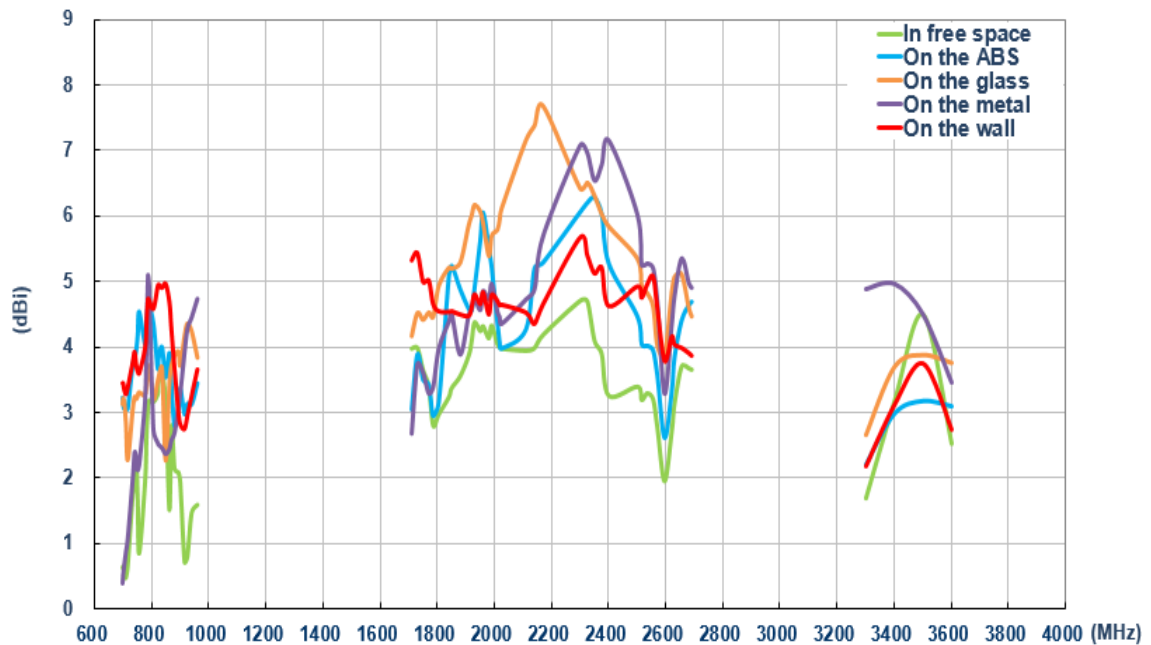
3.1.8 LTE_2 Antenna Average Gain

Performance in different environments with 1 meter cable length



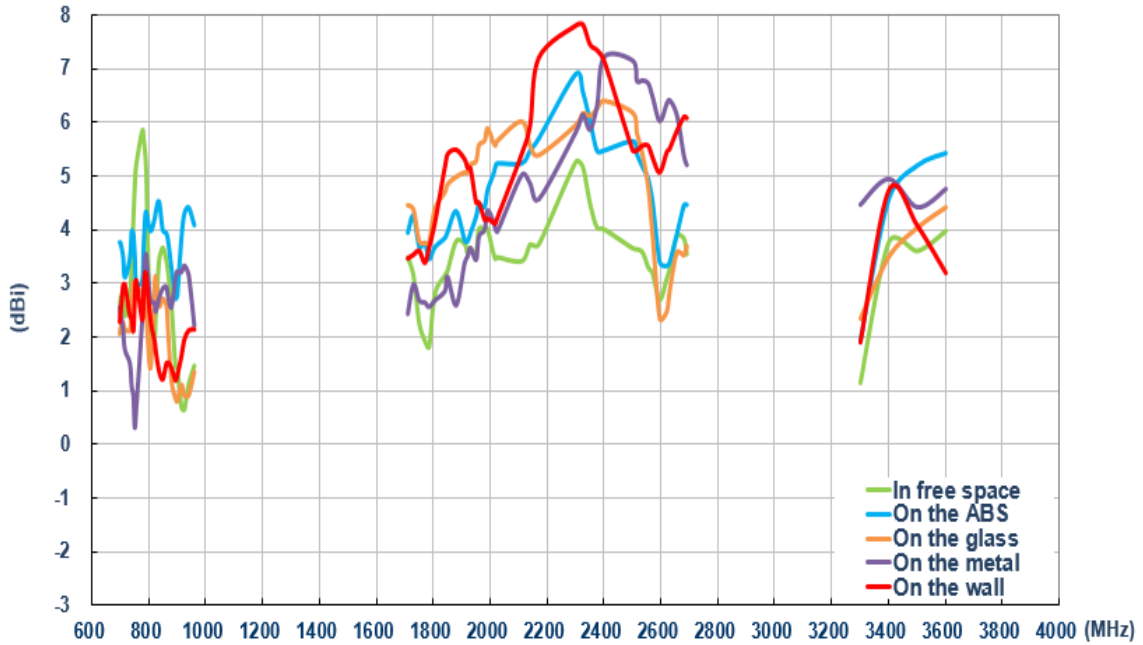
3.1.9 LTE_1 Antenna Peak Gain

Performance in different environments with 1 meter cable length



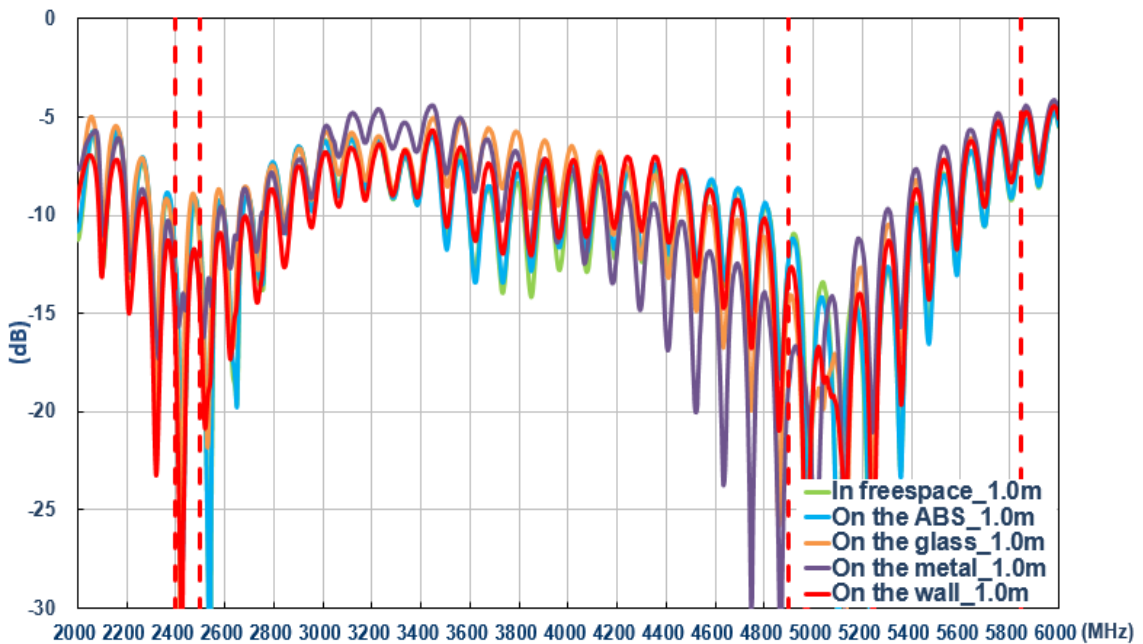
3.1.10 LTE_2 Antenna Peak Gain

Performance in different environments with 1 meter cable length



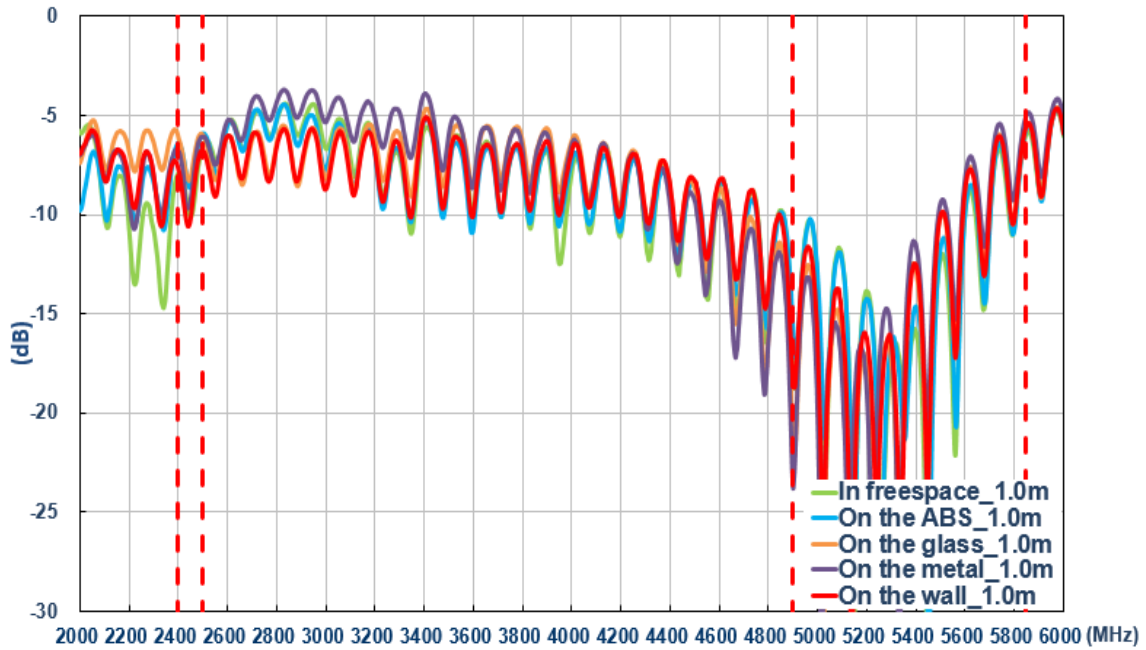
3.1.11 Wi-Fi_1 Antenna Return Loss

Performance in different environments with 1 meter cable length



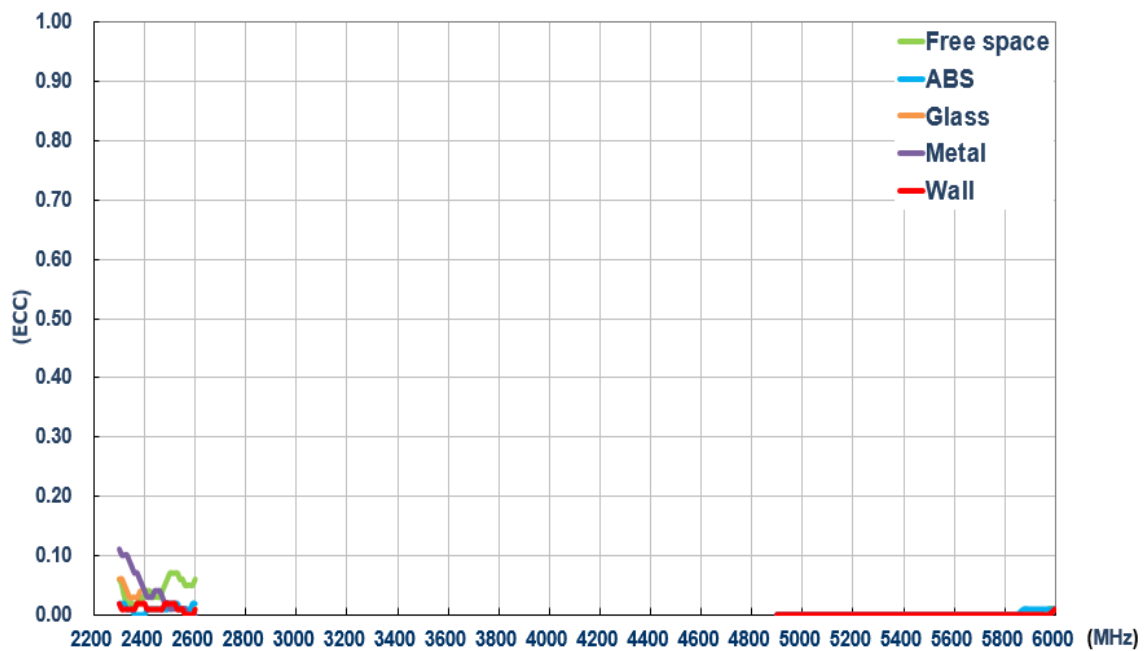
3.1.12 Wi-Fi_2 Antenna Return Loss

Performance in different environments with 1 meter cable length



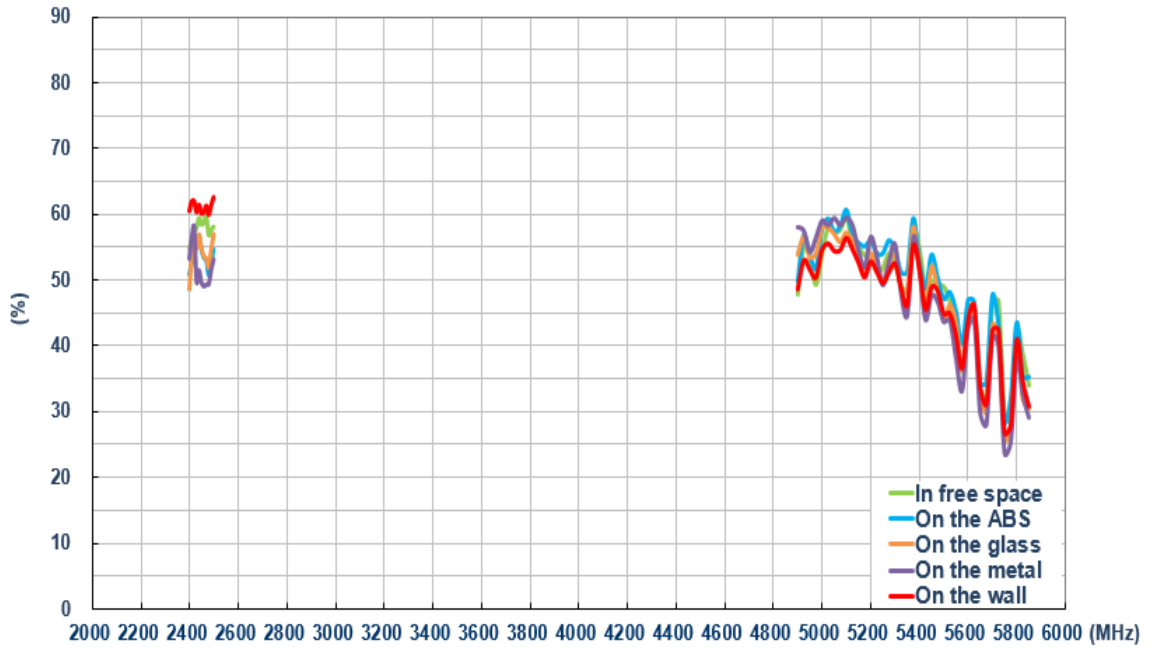
3.1.13 Wi-Fi Envelope Correlation Coefficient

Performance in different environments with 1 meter cable length



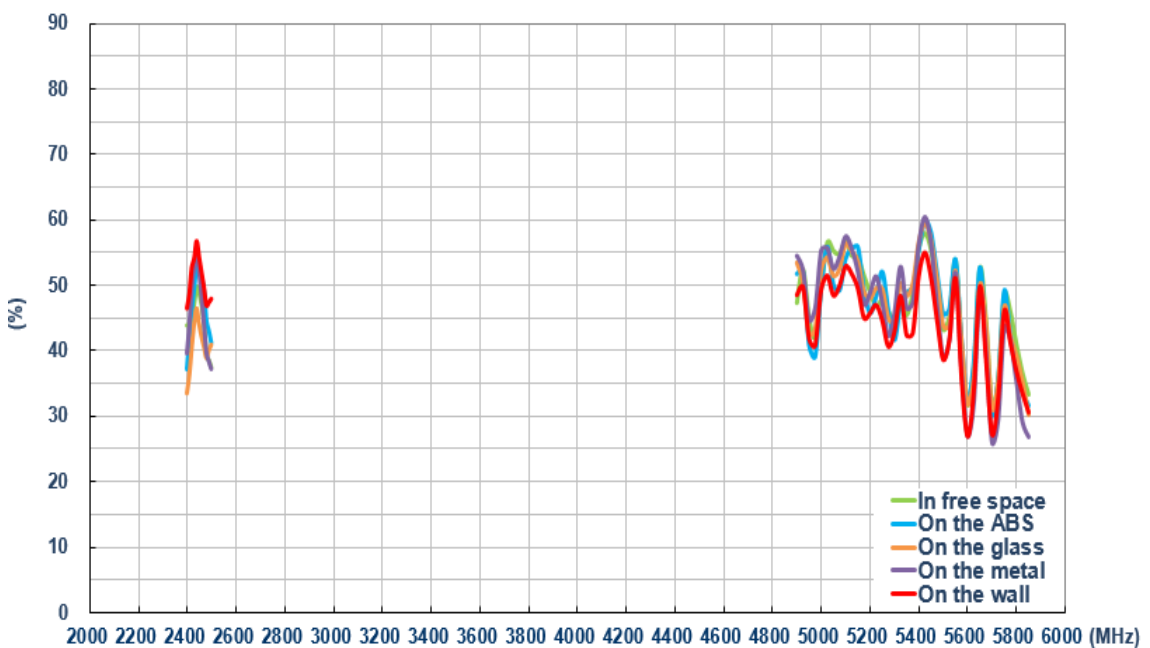
3.1.14 Wi-Fi_1 Antenna Efficiency

Performance in different environments with 1 meter cable length



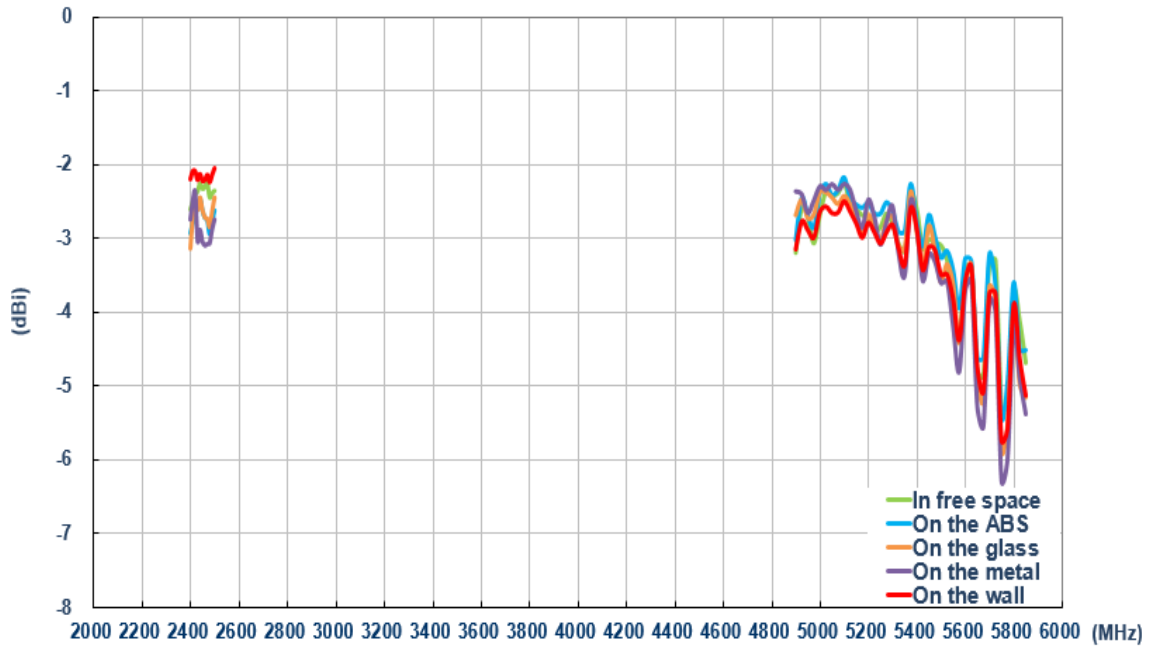
3.1.15 Wi-Fi_2 Antenna Efficiency

Performance in different environments with 1 meter cable length



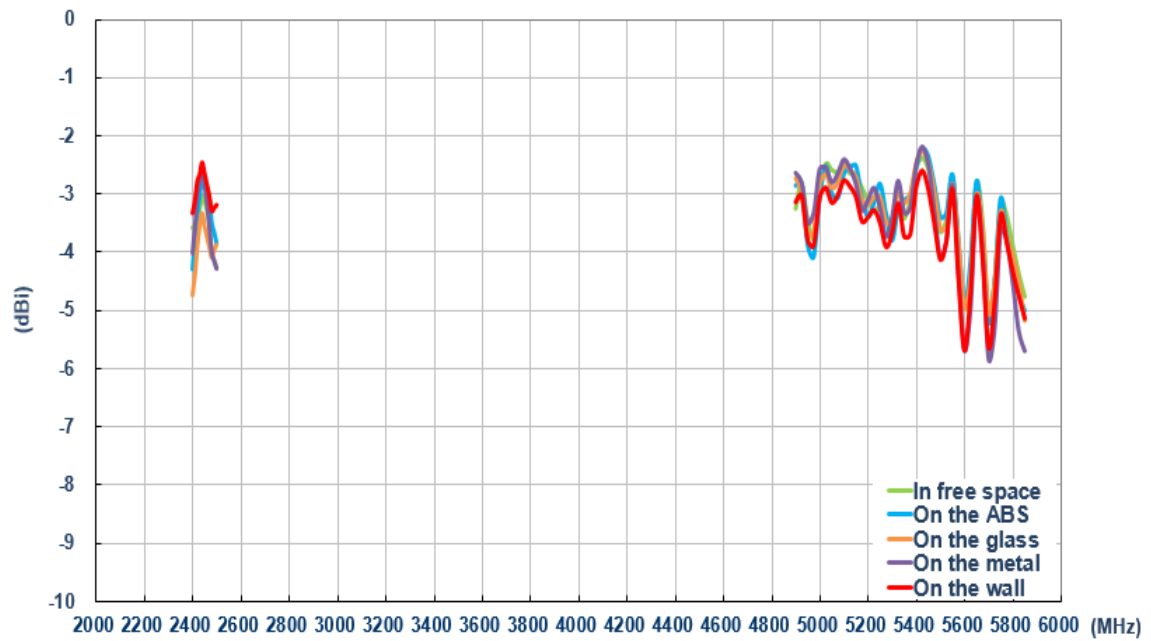
3.1.16 Wi-Fi_1 Antenna Average Gain

Performance in different environments with 1 meter cable length



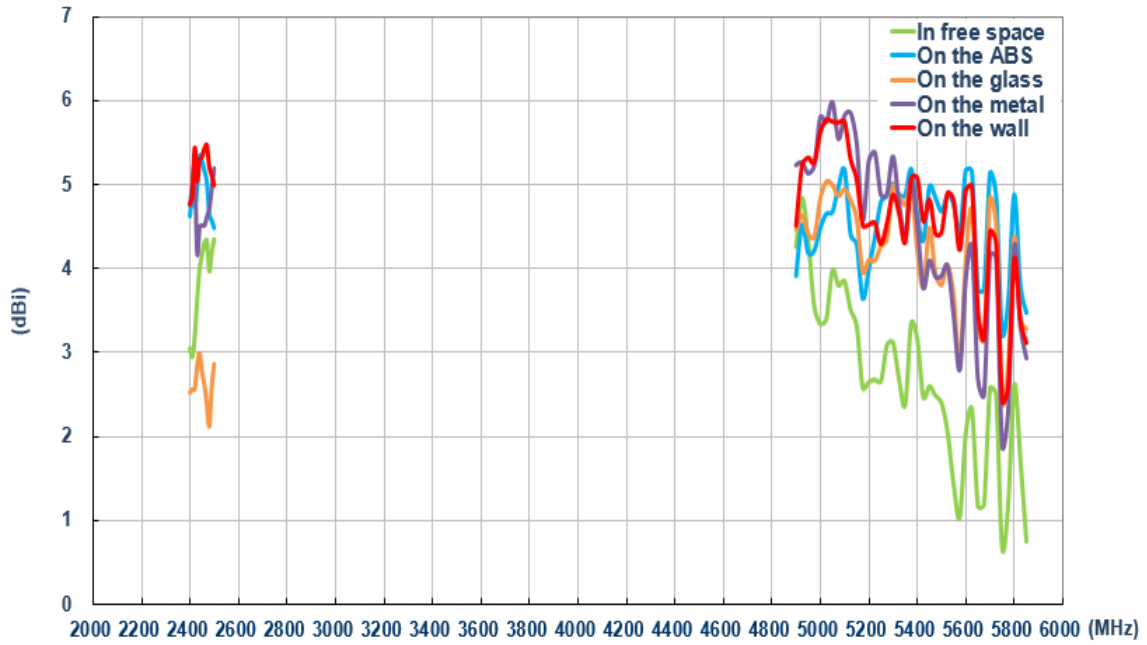
3.1.17 Wi-Fi_2 Antenna Average Gain

Performance in different environments with 1 meter cable length



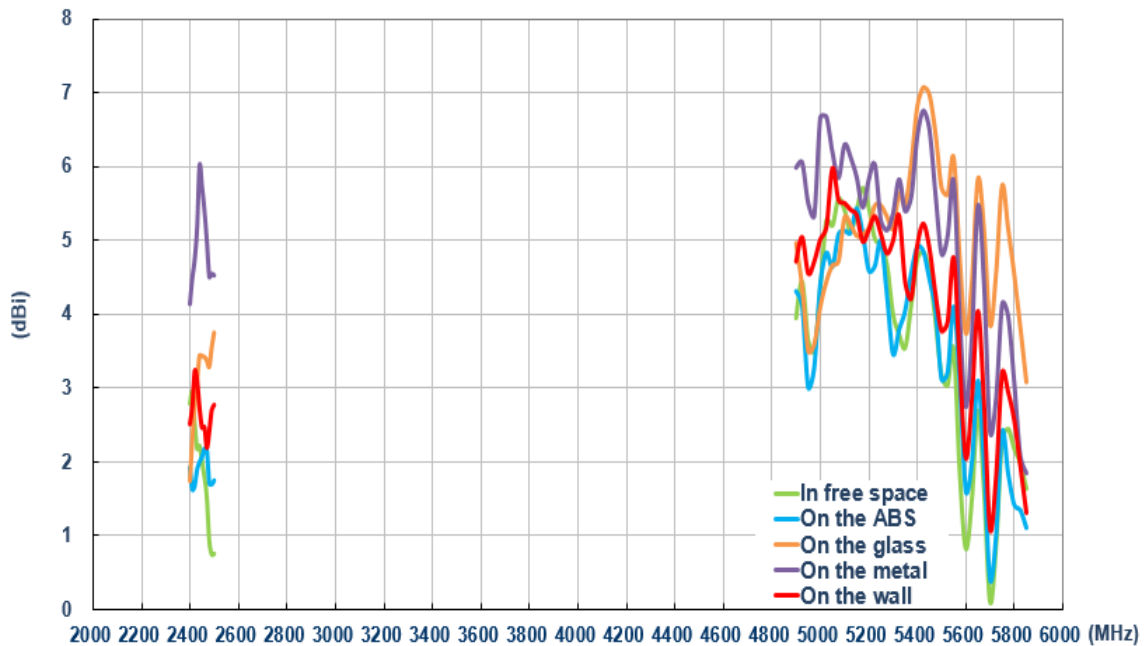
3.1.18 Wi-Fi_1 Antenna Peak Gain

Performance in different environments with 1 meter cable length

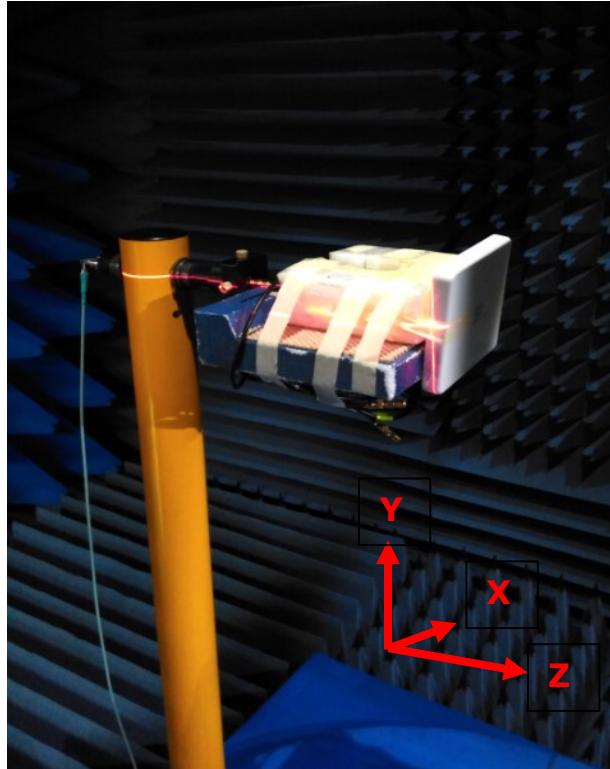


3.1.19 Wi-Fi_2 Antenna Peak Gain

Performance in different environments with 1 meter cable length



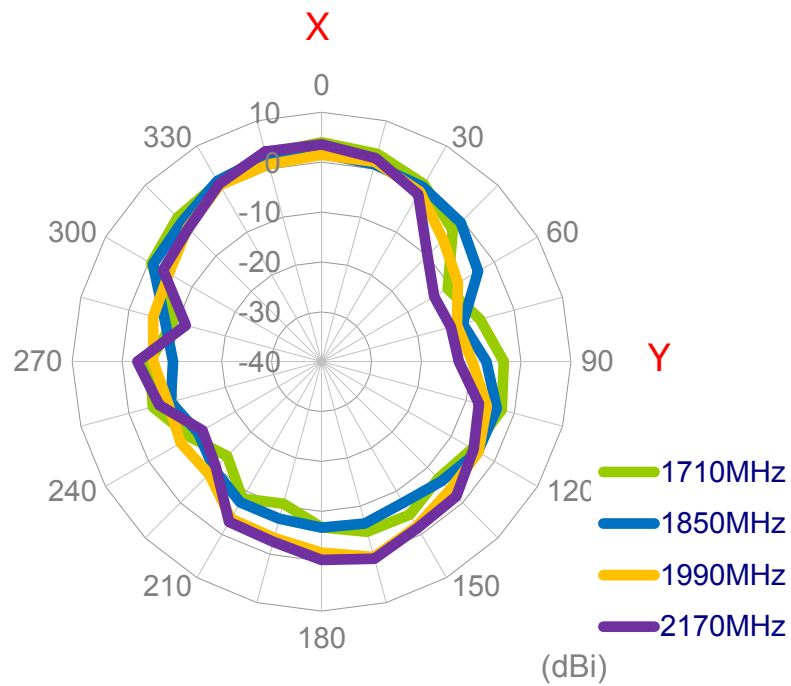
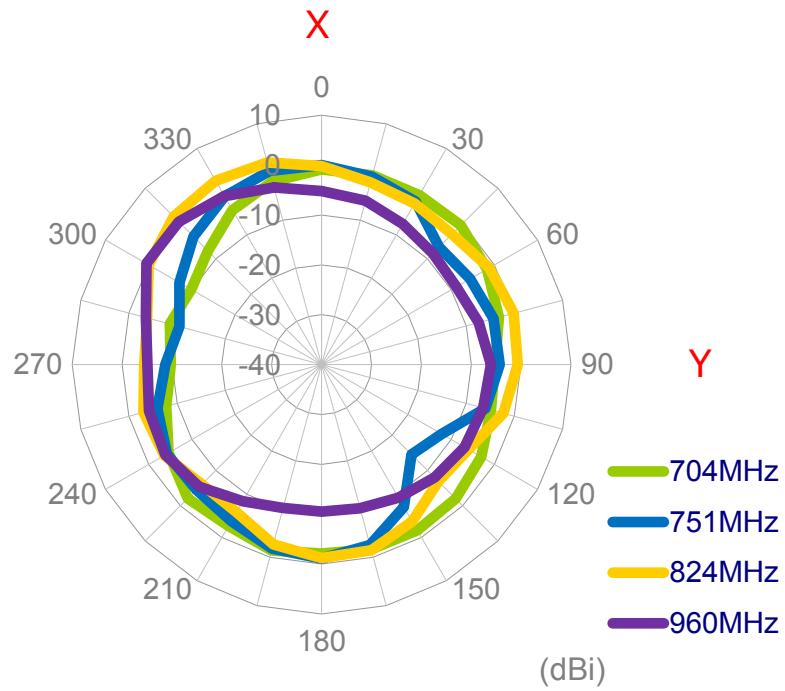
3.1.20 Test Setup For Antenna Radiation Pattern

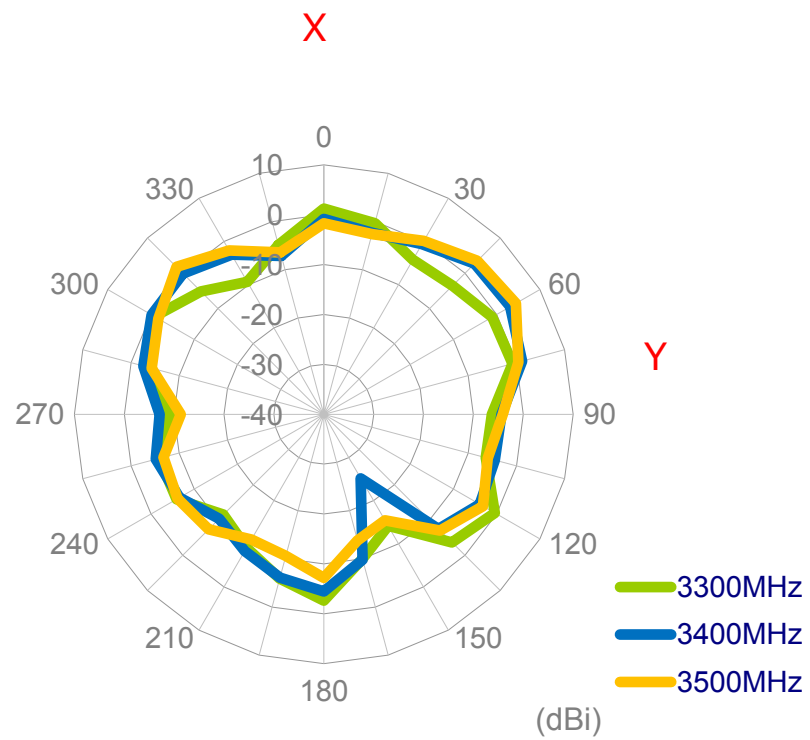
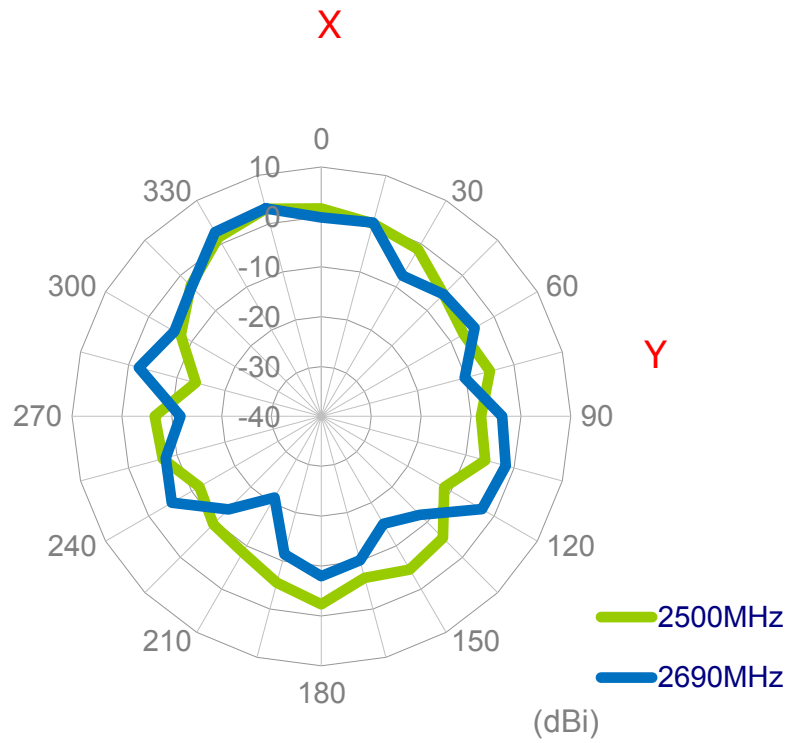


In free space

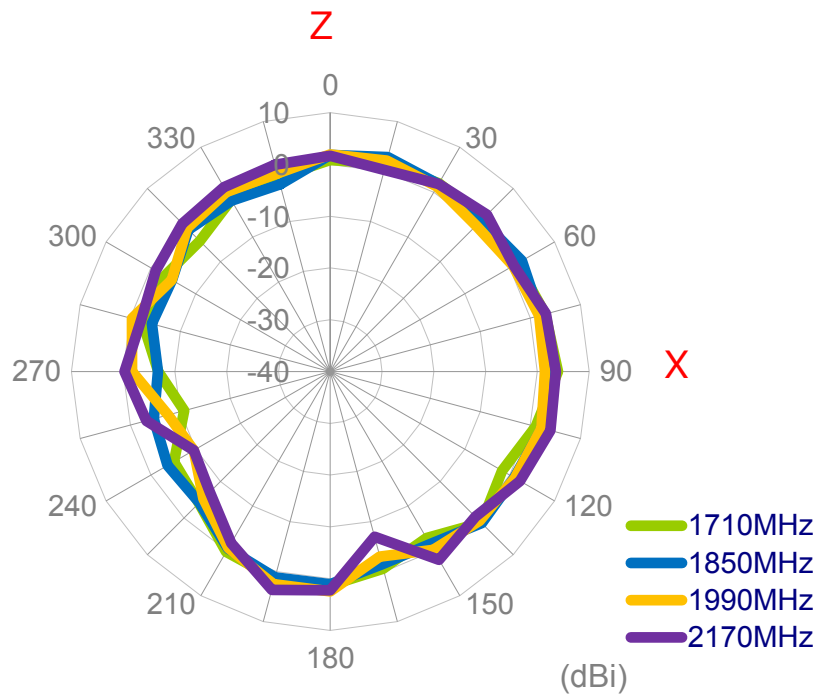
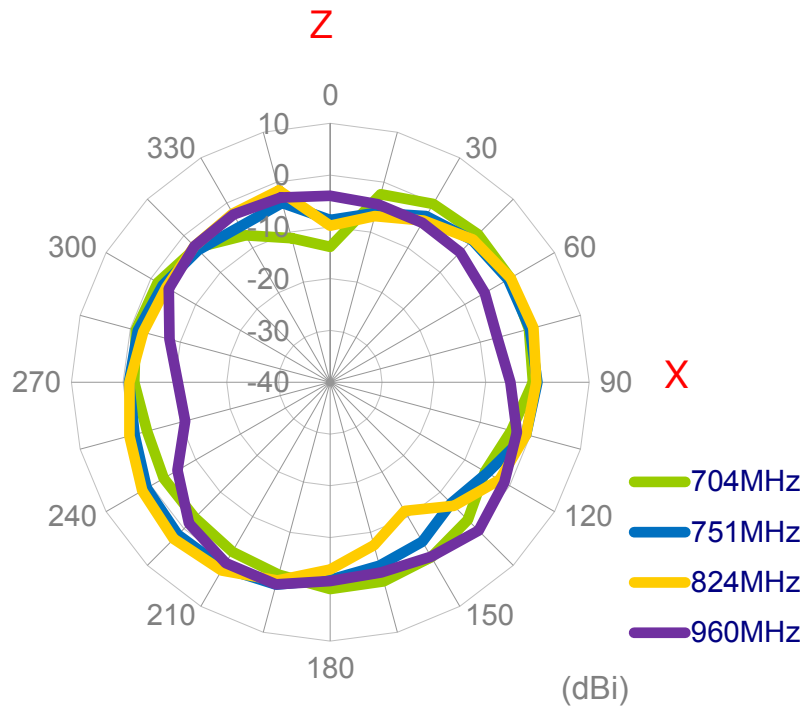
3.1.21 2D Radiation Pattern (LTE_MIMO1 with 1M cable length in free space)

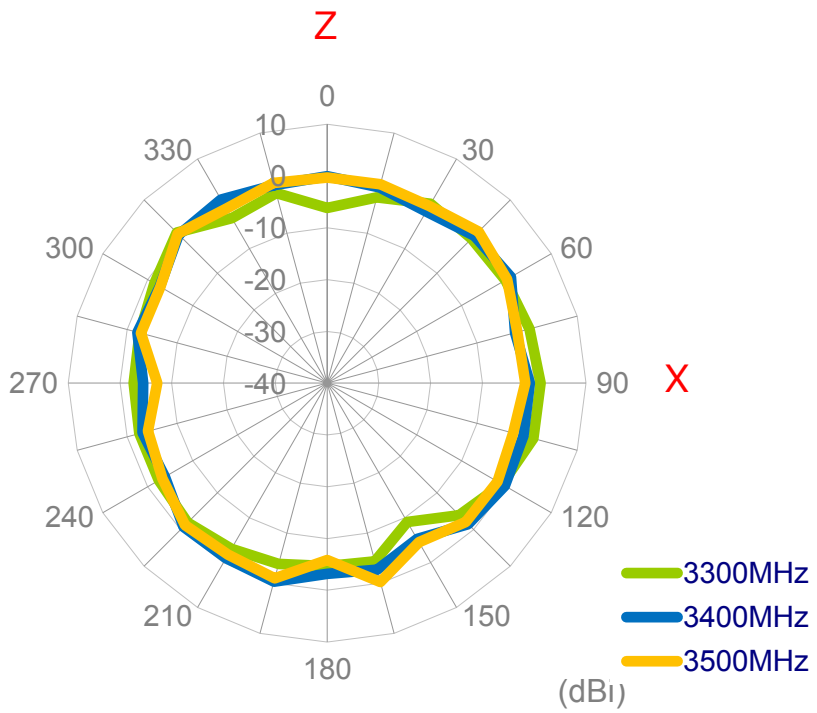
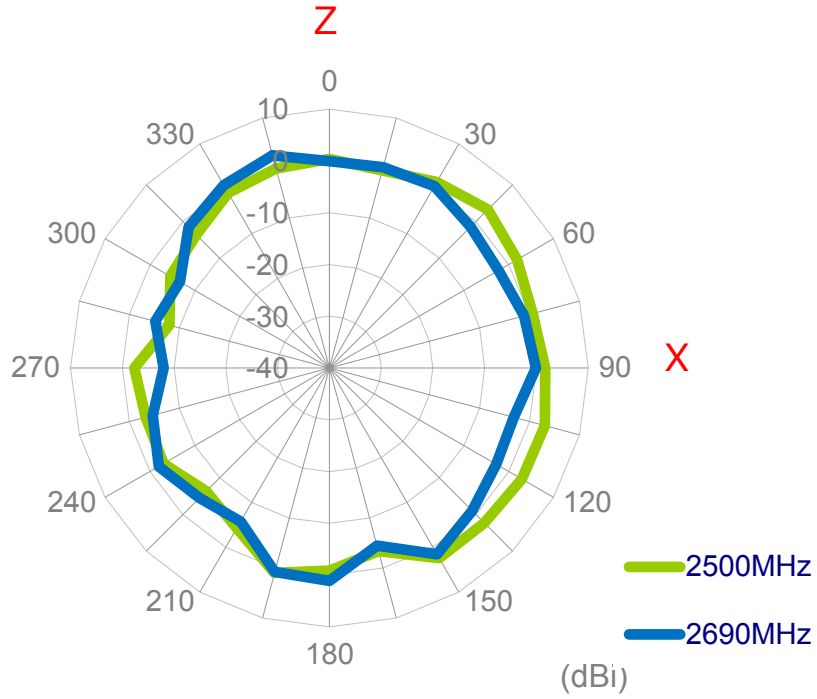
XY Plane



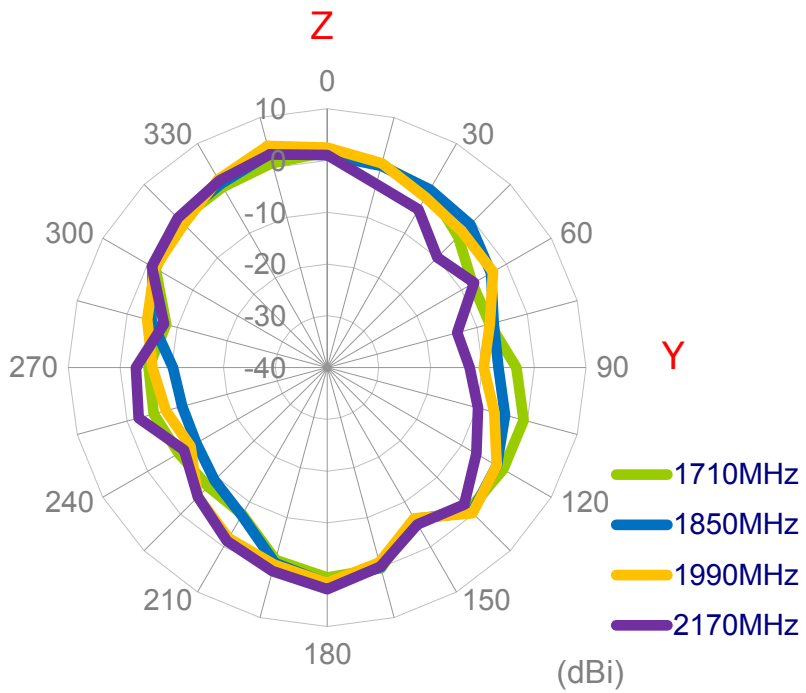
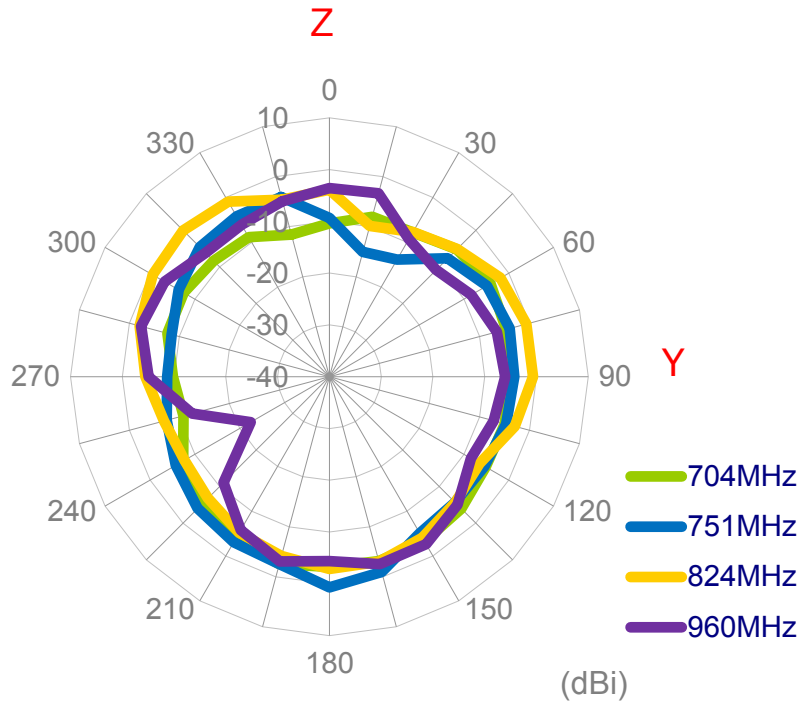


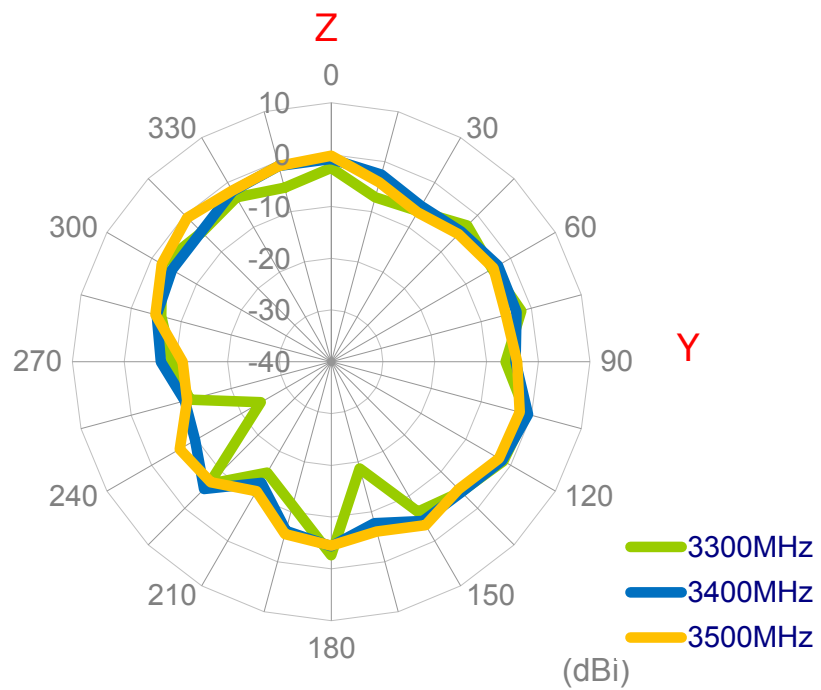
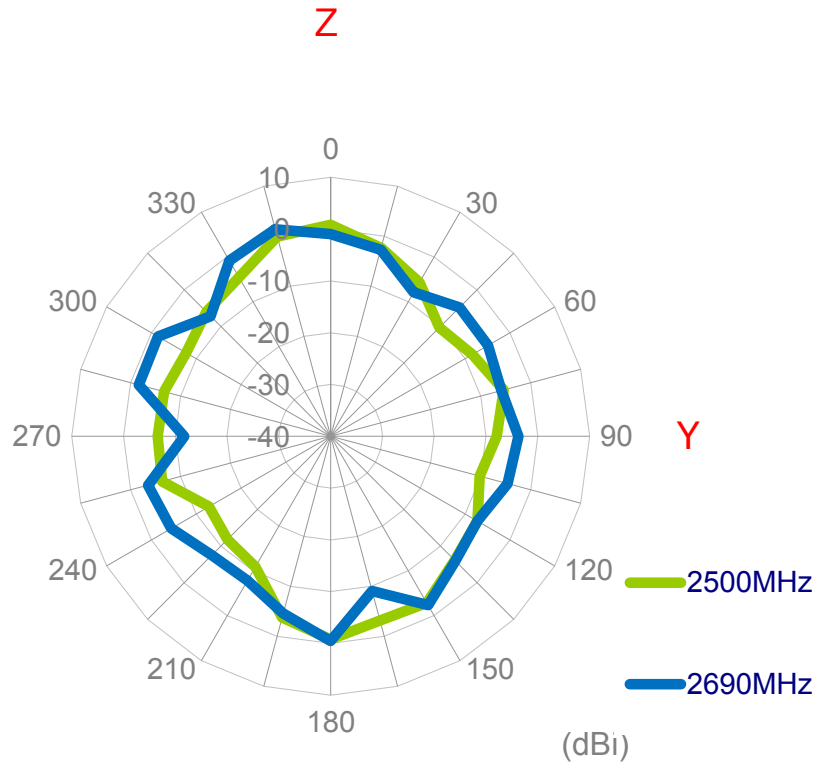
XZ Plane



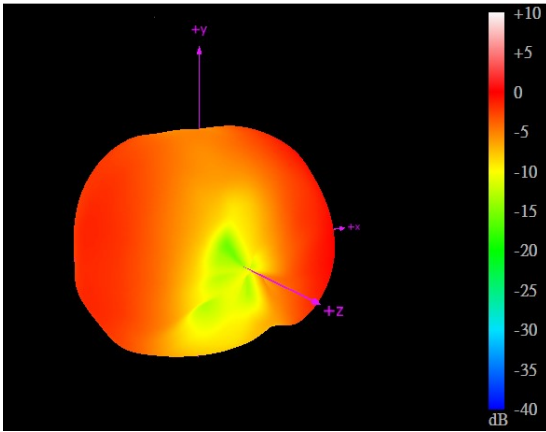


YZ Plane

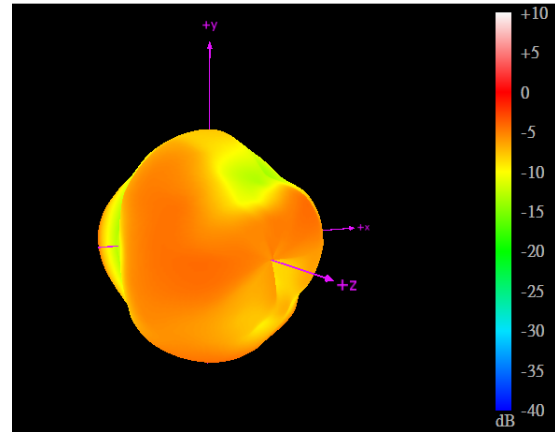




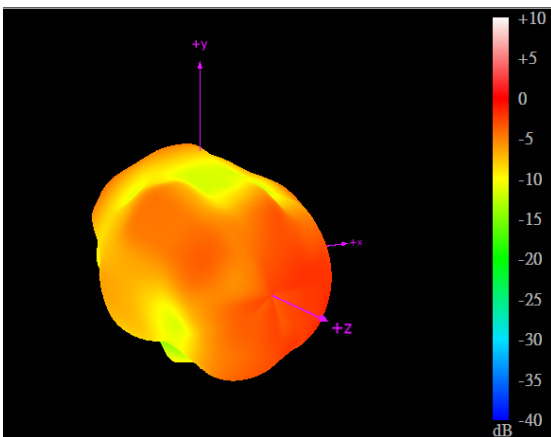
3.1.22 3D Radiation Pattern (LTE_MIMO1 with 1M cable length in free space)



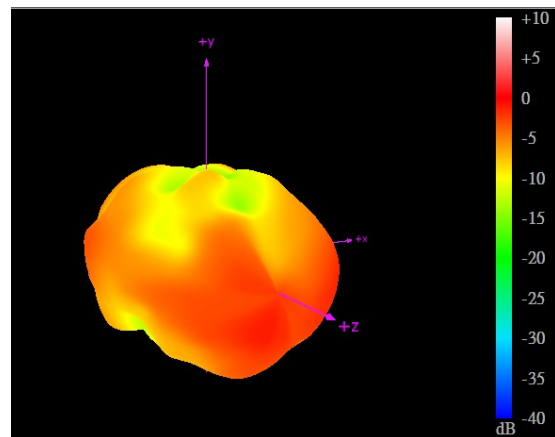
704MHz



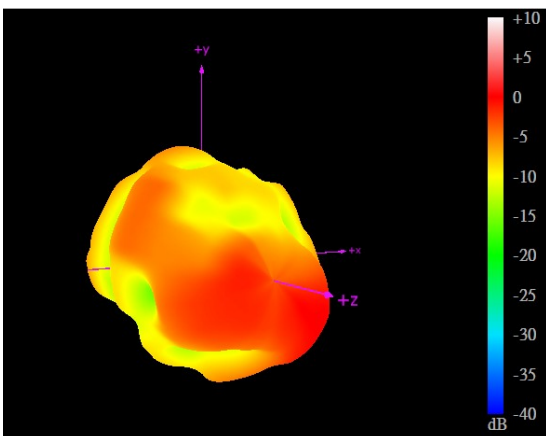
960MHz



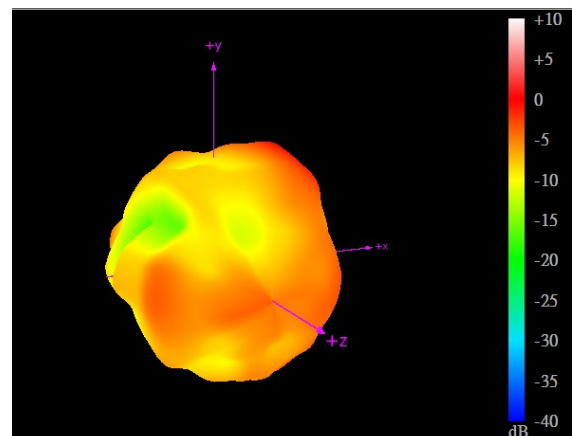
1710MHz



2170MHz



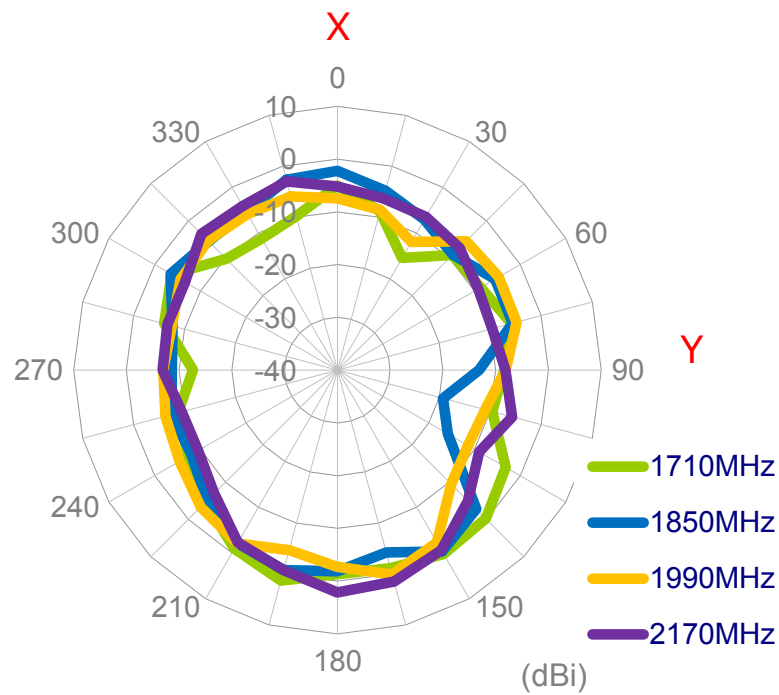
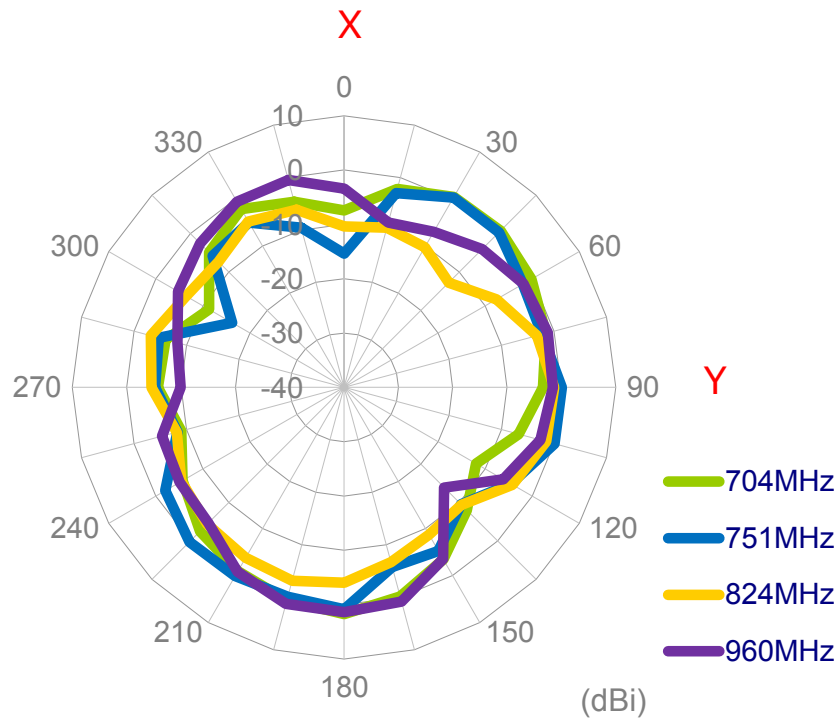
2690MHz

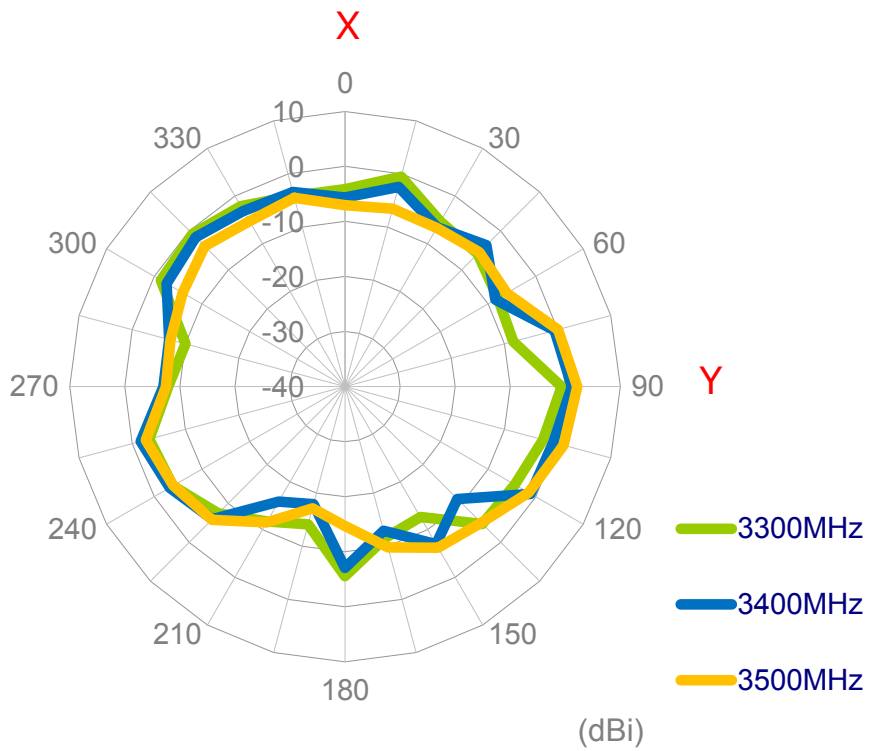
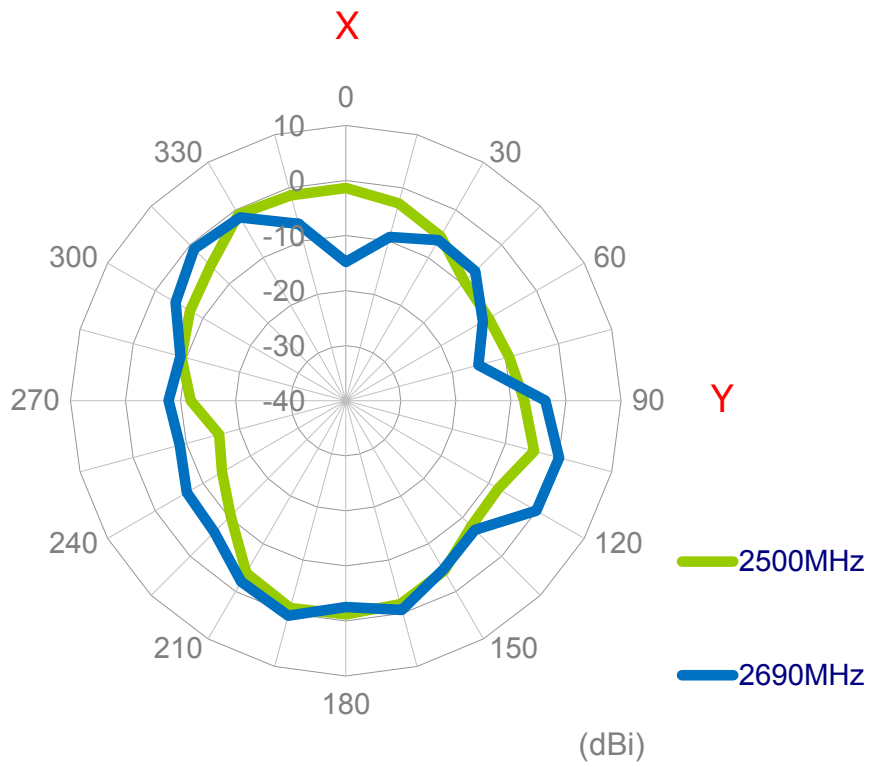


3500MHz

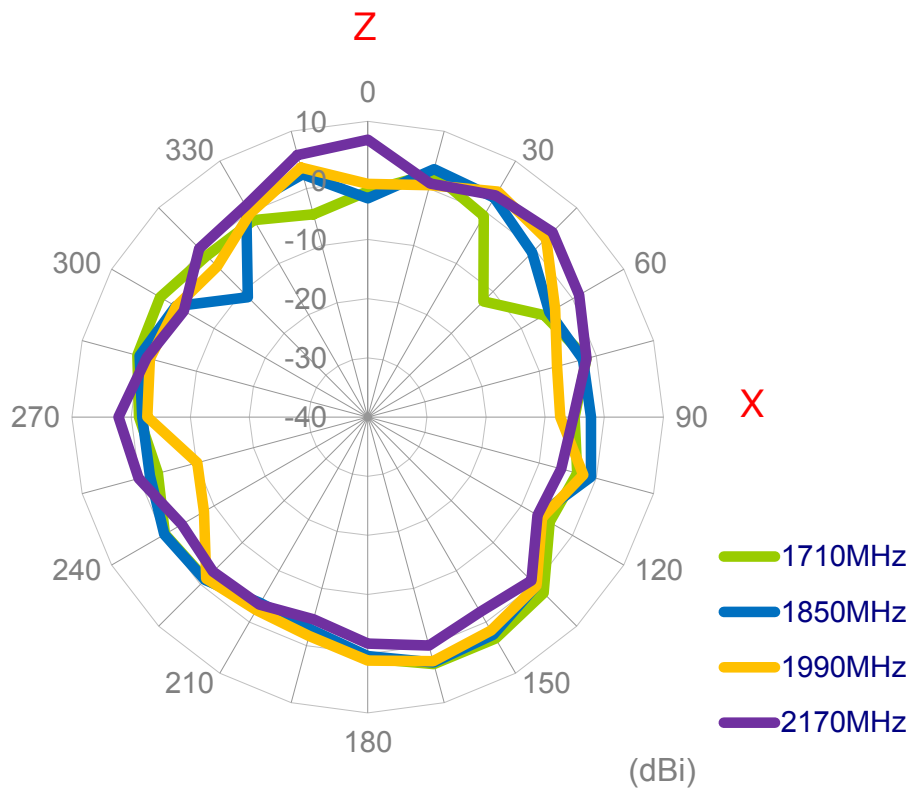
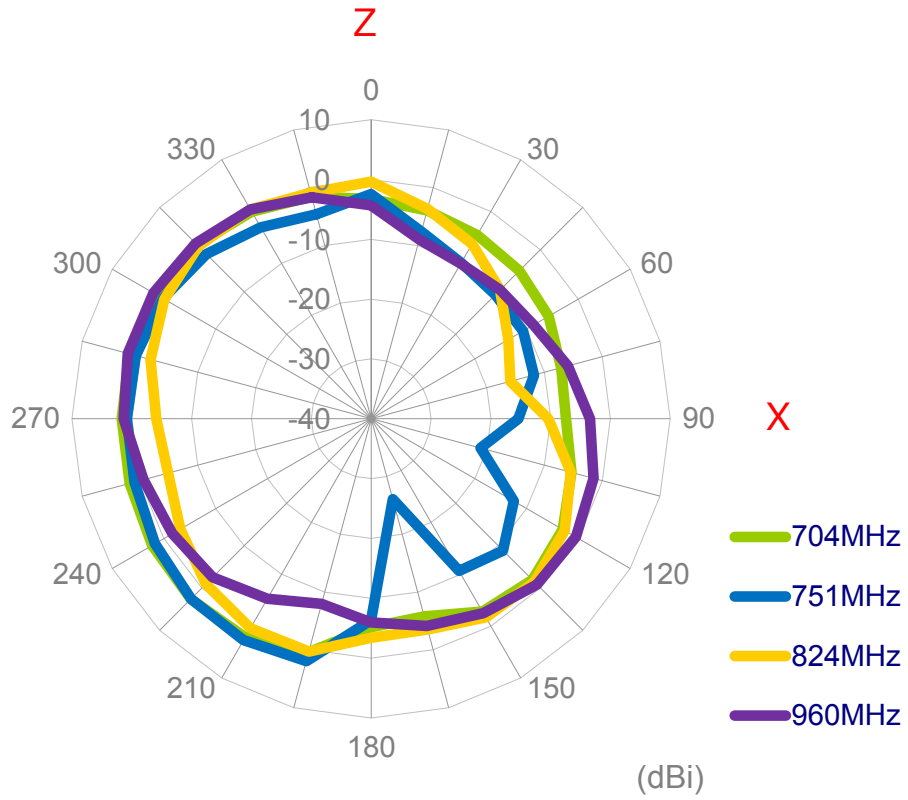
3.1.23 2D Radiation Pattern (LTE_MIMO2 with 1M cable length in free space)

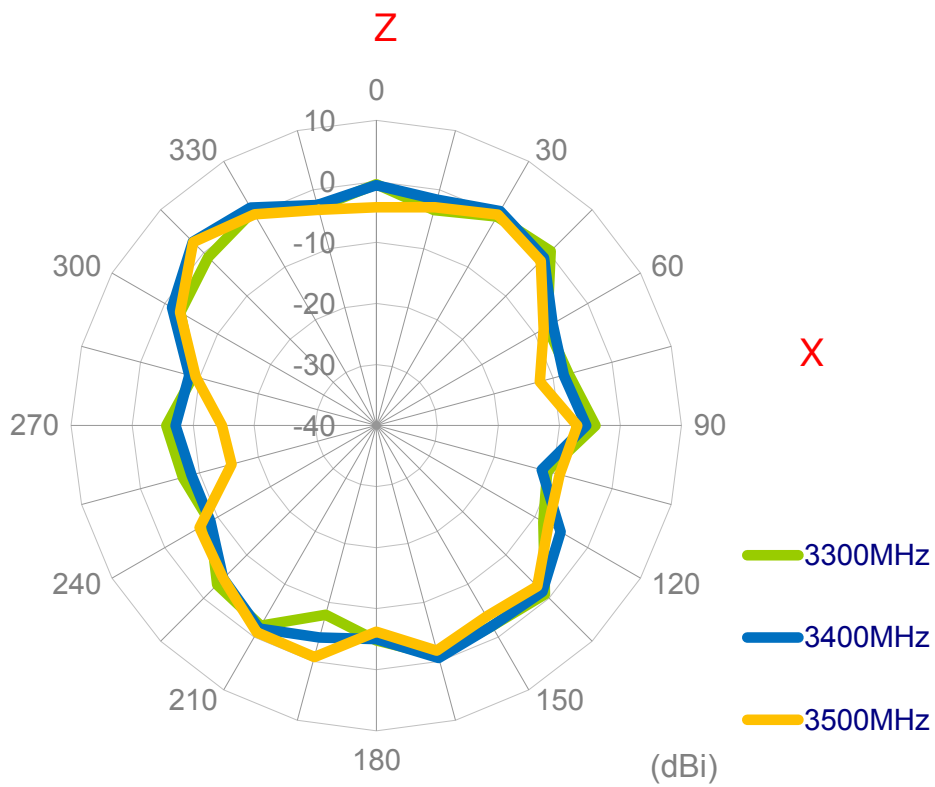
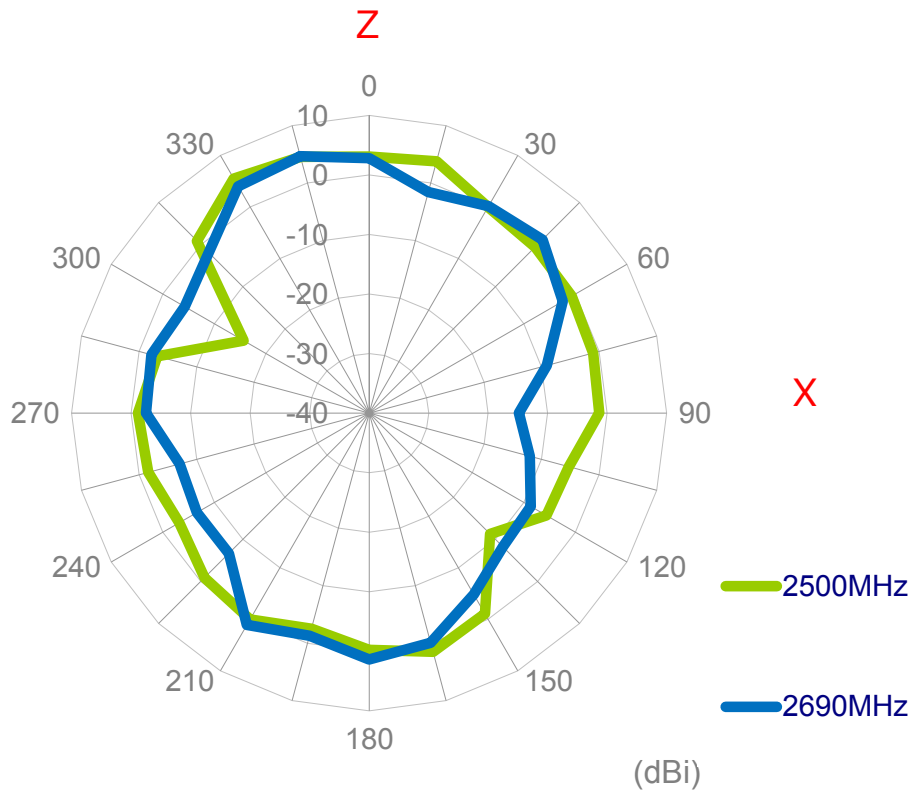
XY Plane



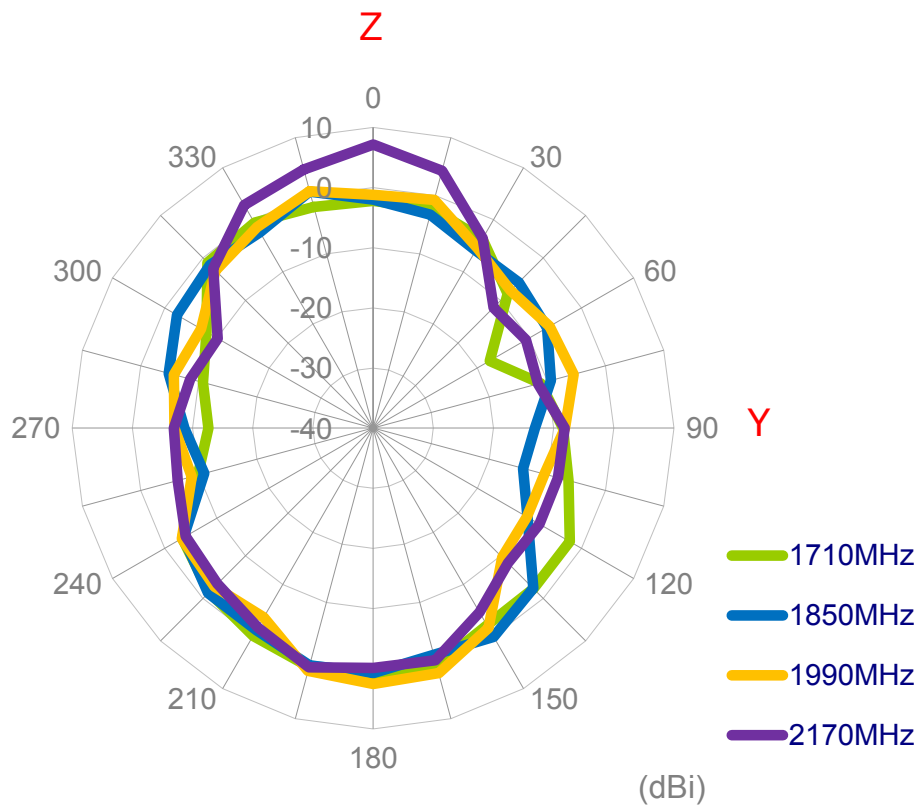
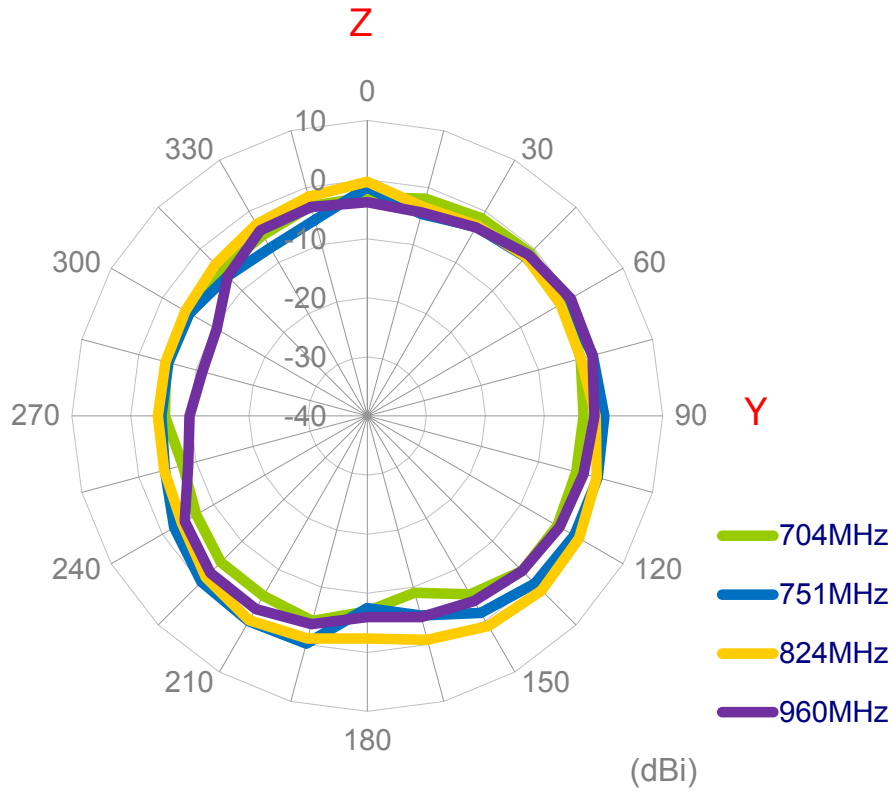


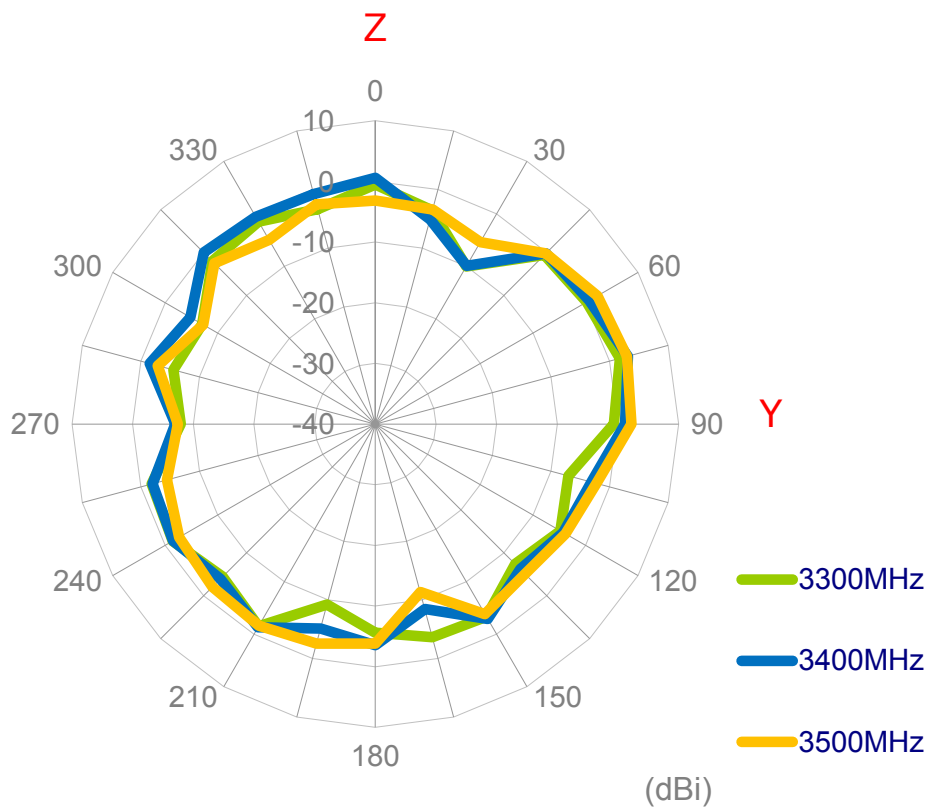
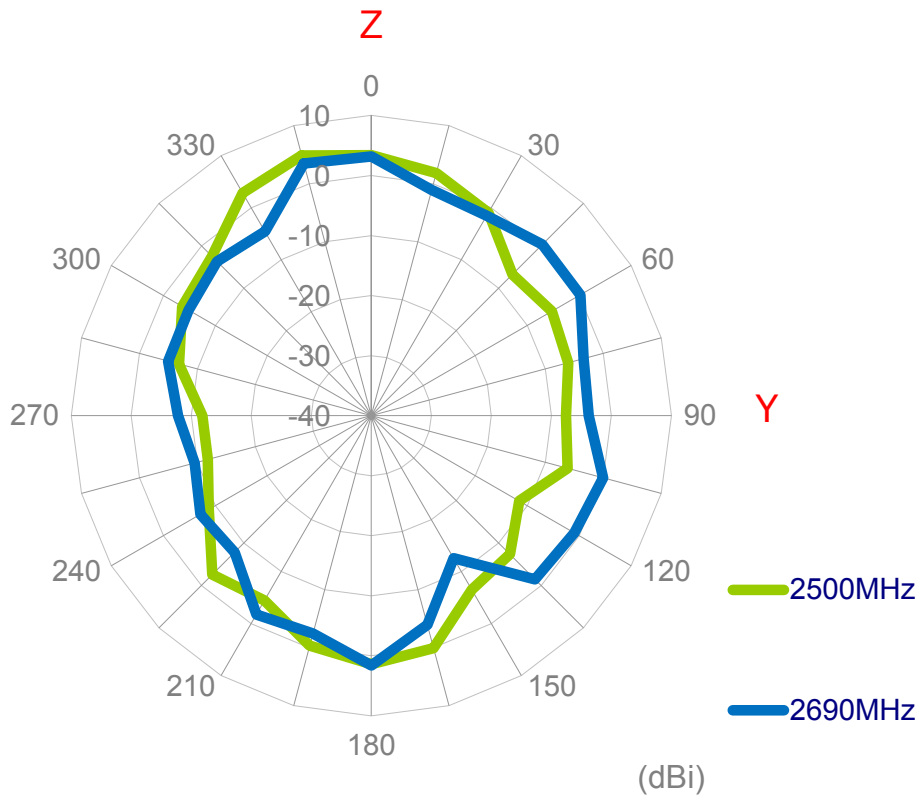
XZ Plane



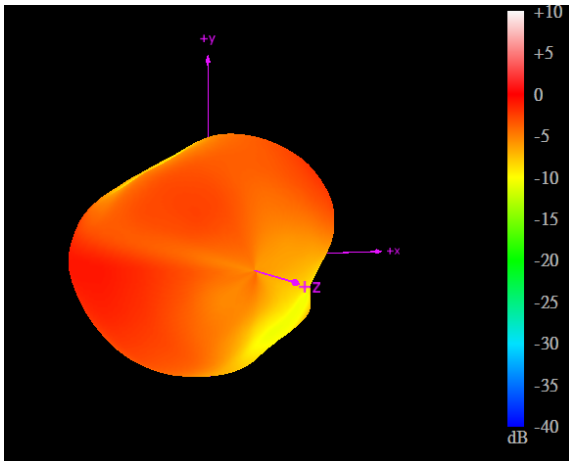


YZ Plane

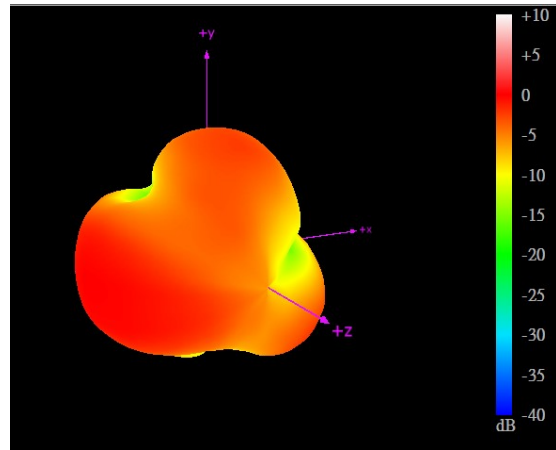




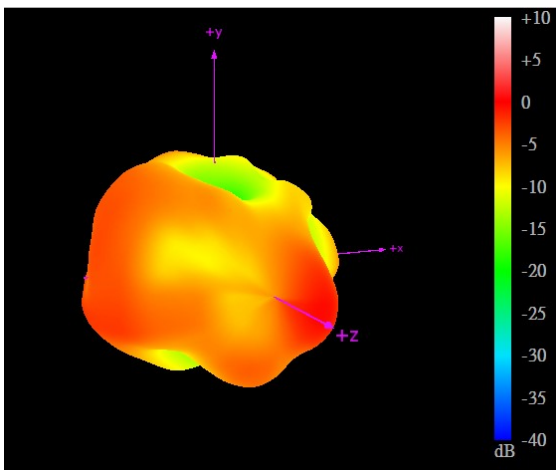
3.1.24 3D Radiation Pattern (LTE_MIMO2 with 1M cable length in free space)



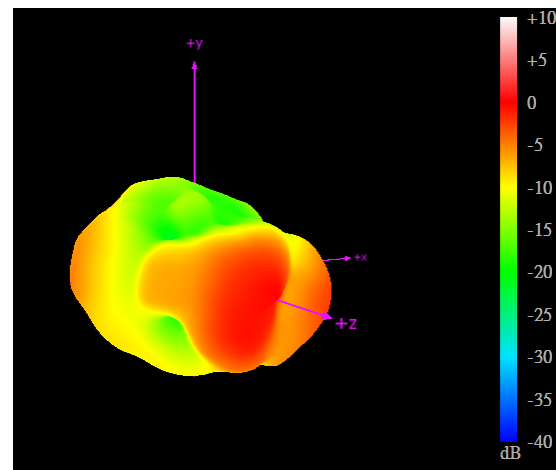
704MHz



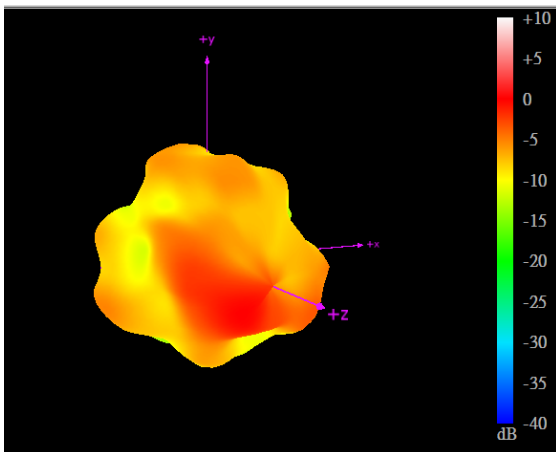
960MHz



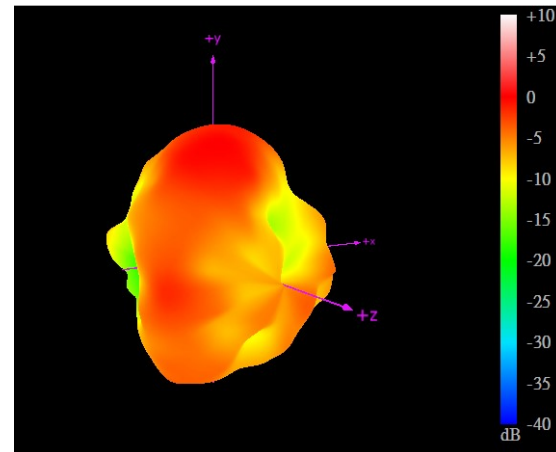
1710MHz



2170MHz



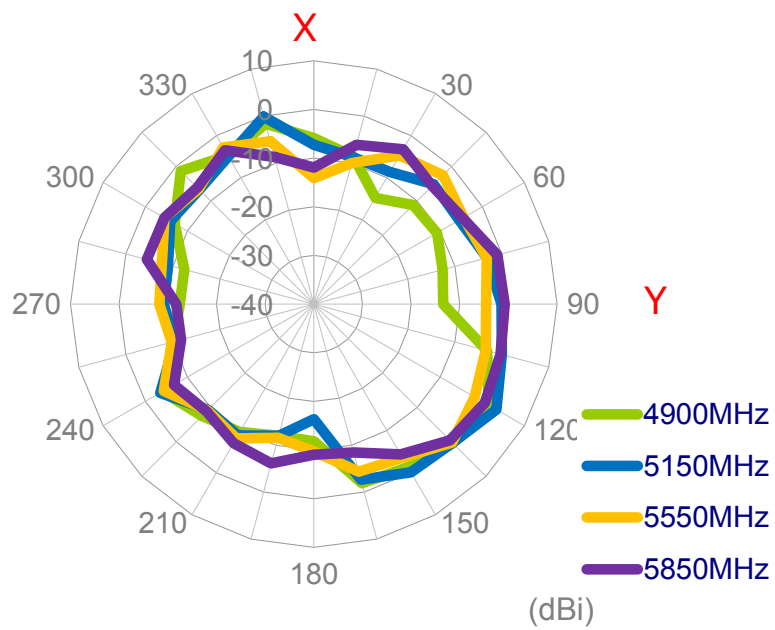
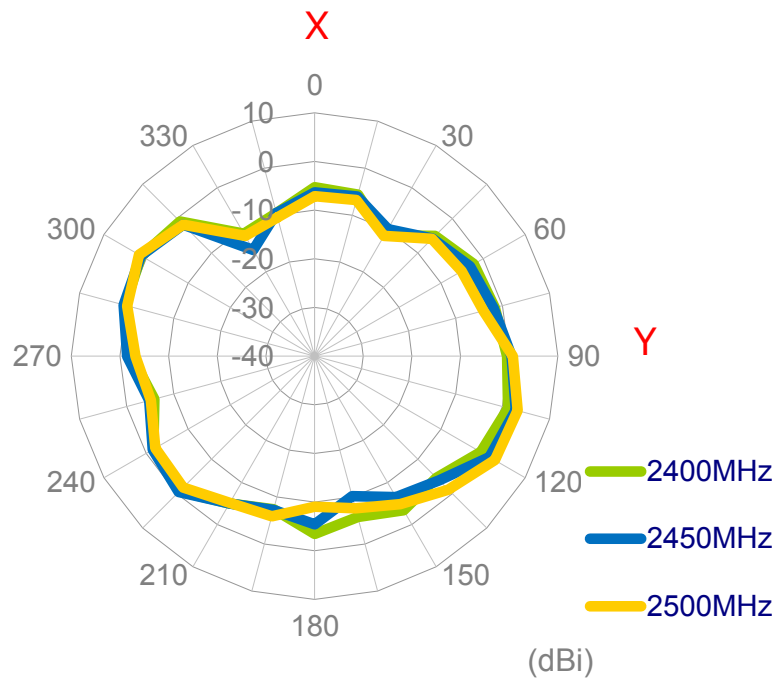
2690MHz



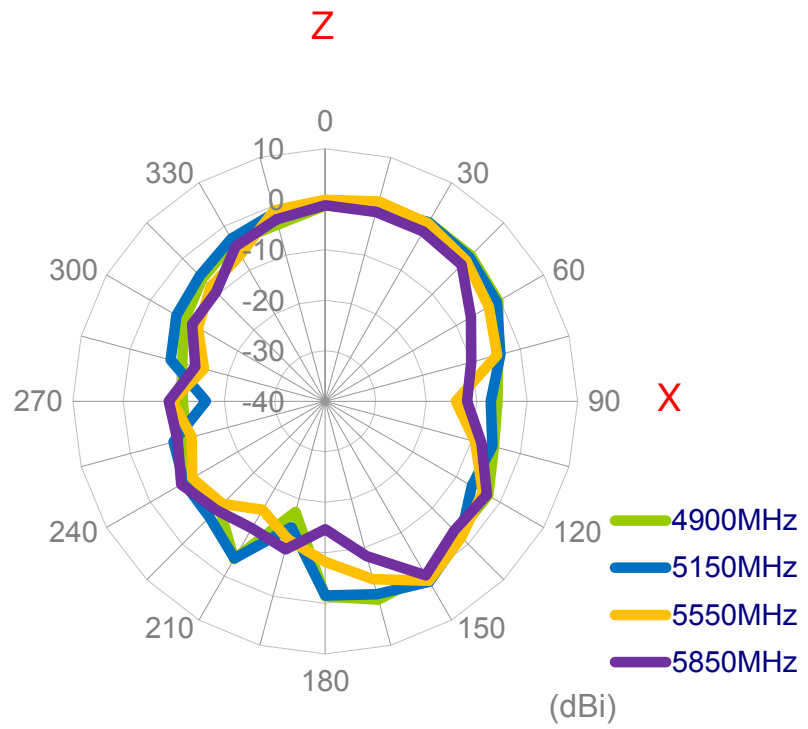
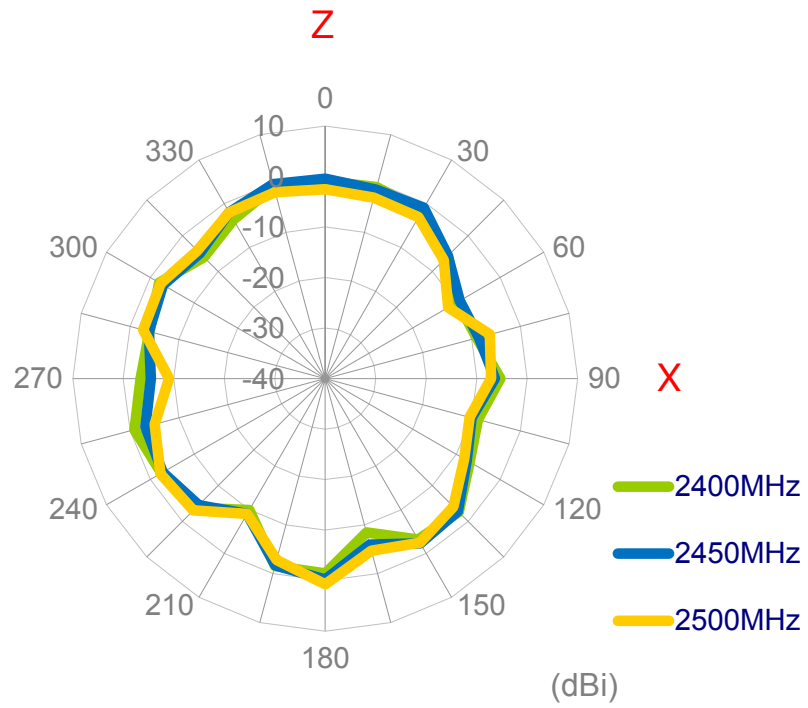
3500MHz

3.1.25 2D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length in free space)

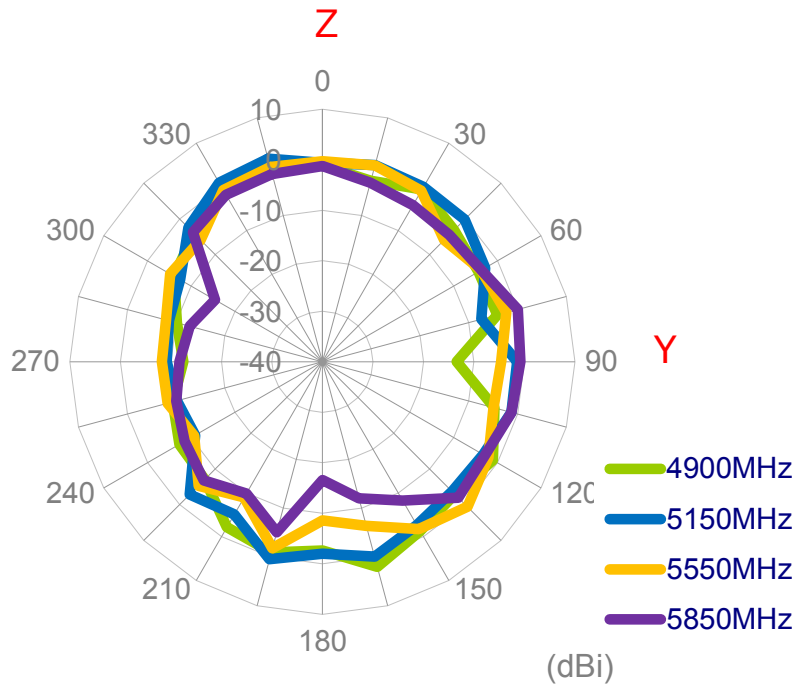
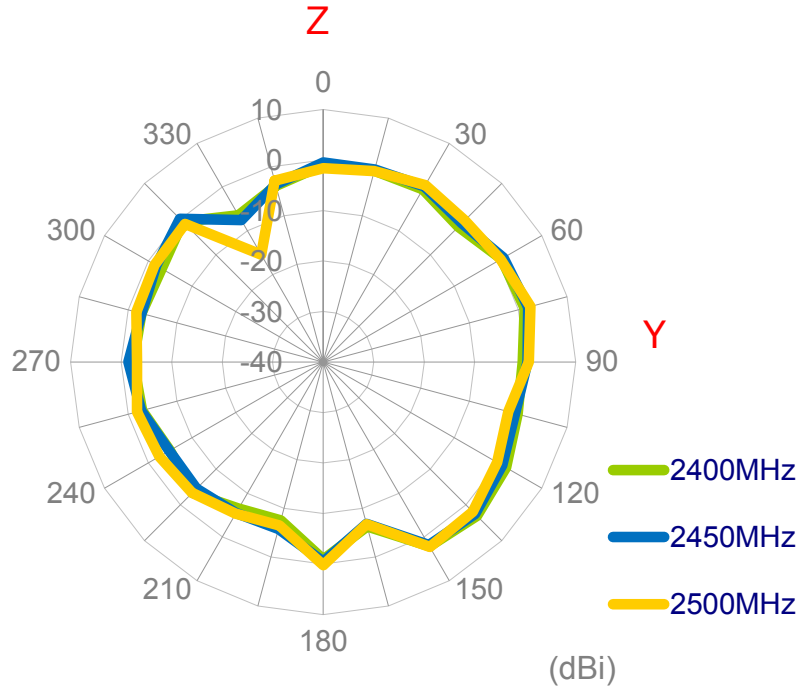
XY Plane



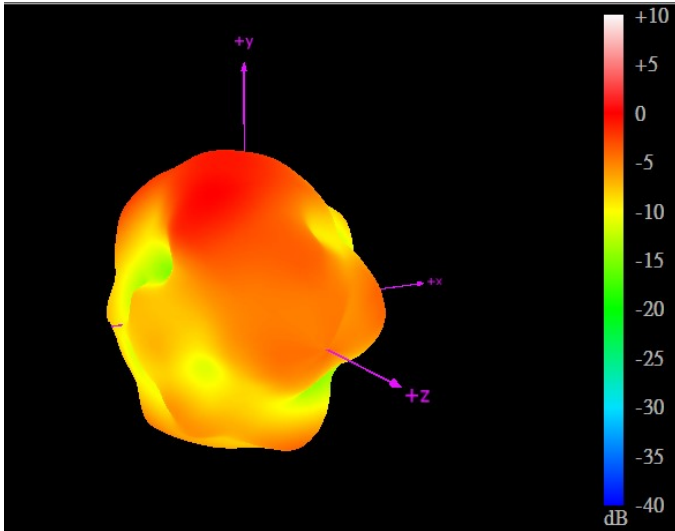
XZ Plane



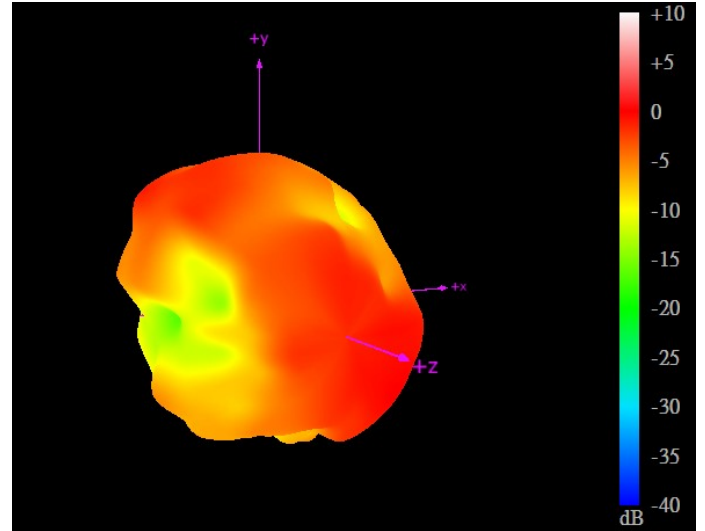
YZ Plane



3.1.26 3D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length in free space)



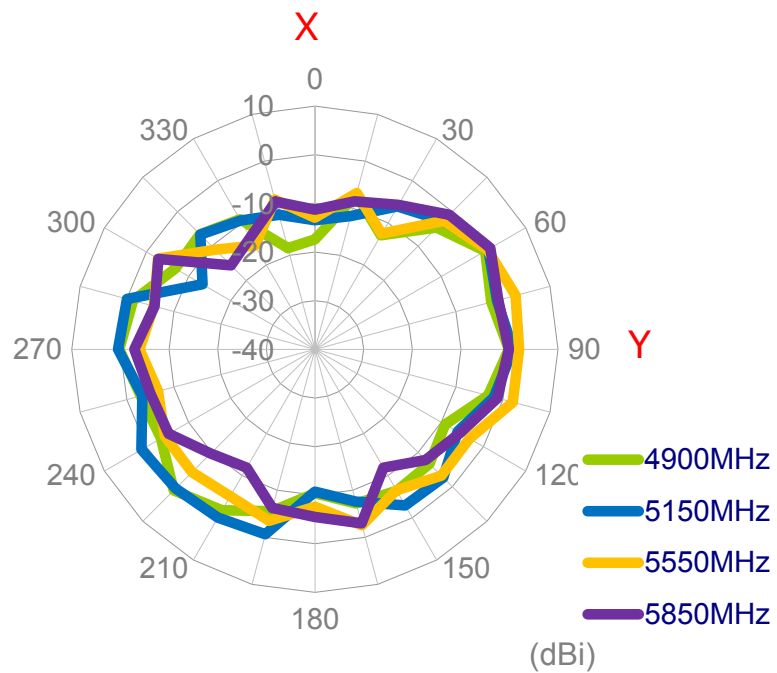
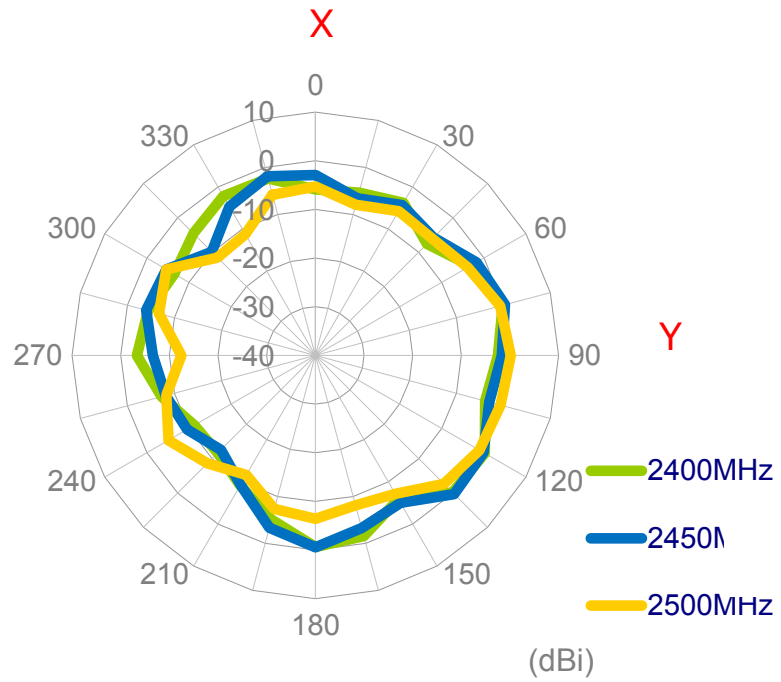
2450MHz



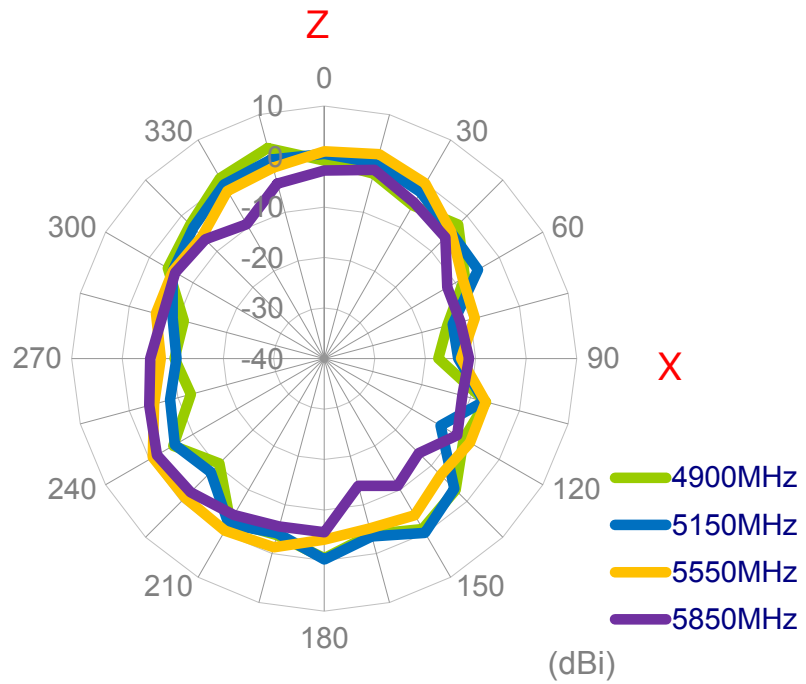
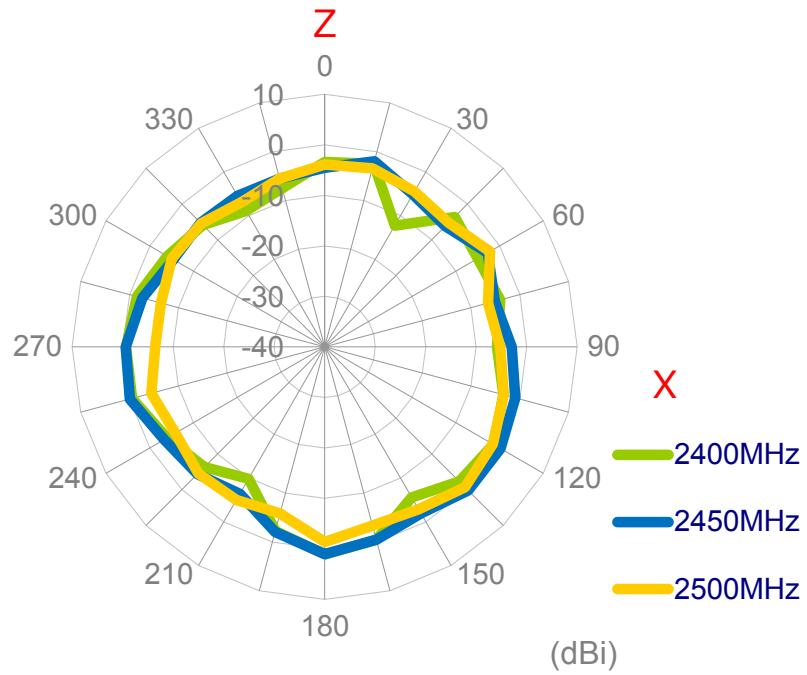
5550MHz

3.1.27 2D Radiation Pattern (Wi-Fi_MIMO2 with 3M cable length in free space)

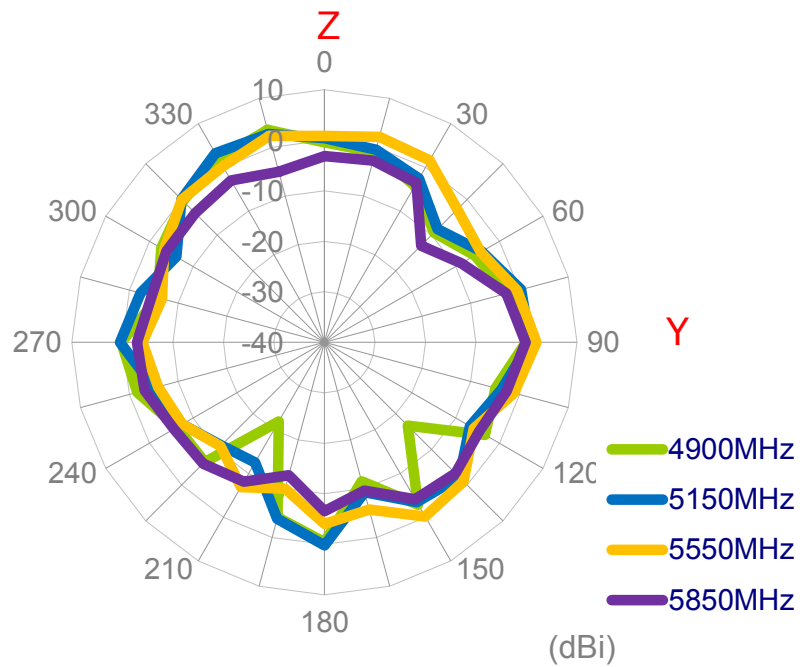
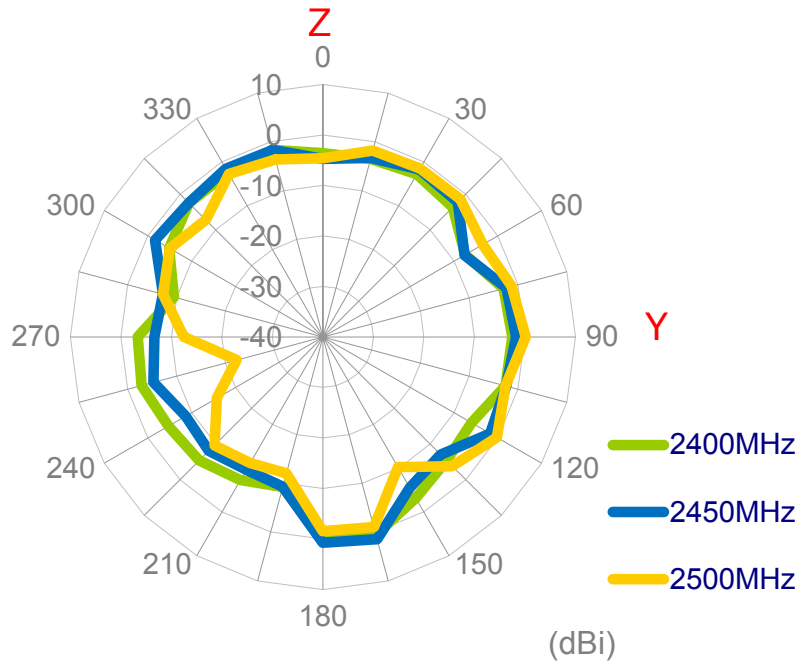
XY Plane



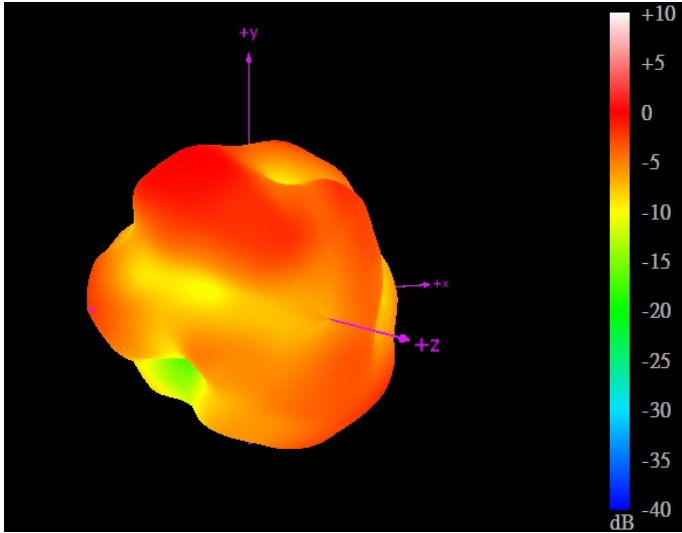
XZ Plane



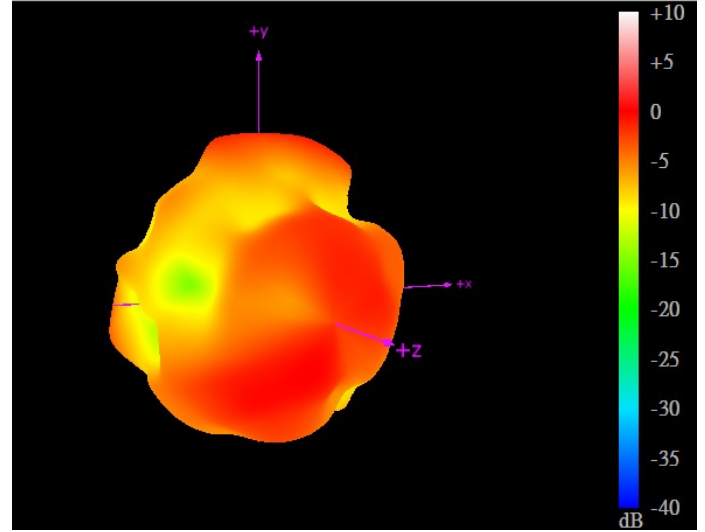
YZ Plane



3.1.28 3D Radiation Pattern (Wi-Fi_MIMO2 with 1M cable length in free space)



2450MHz



5550MHz

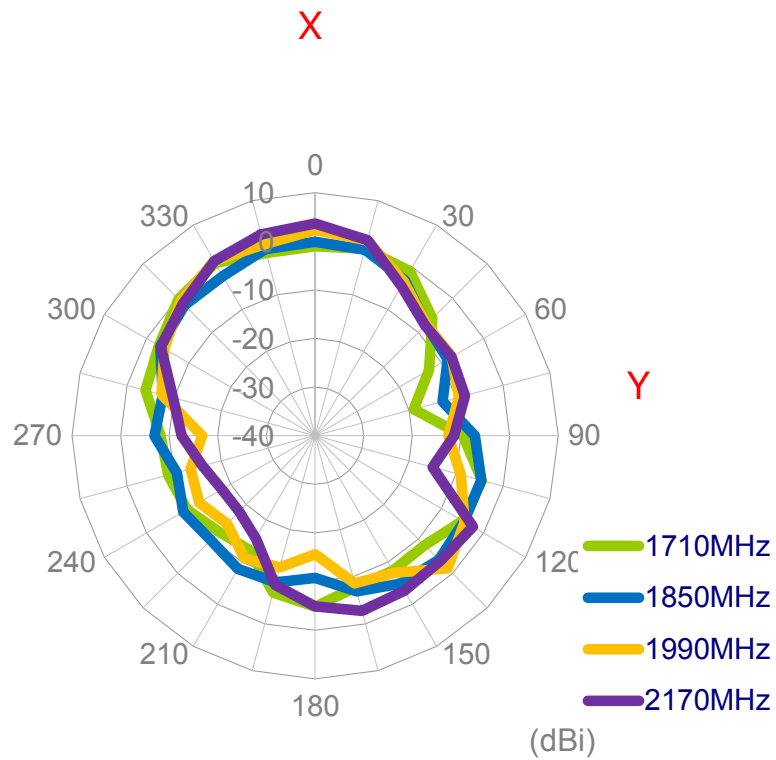
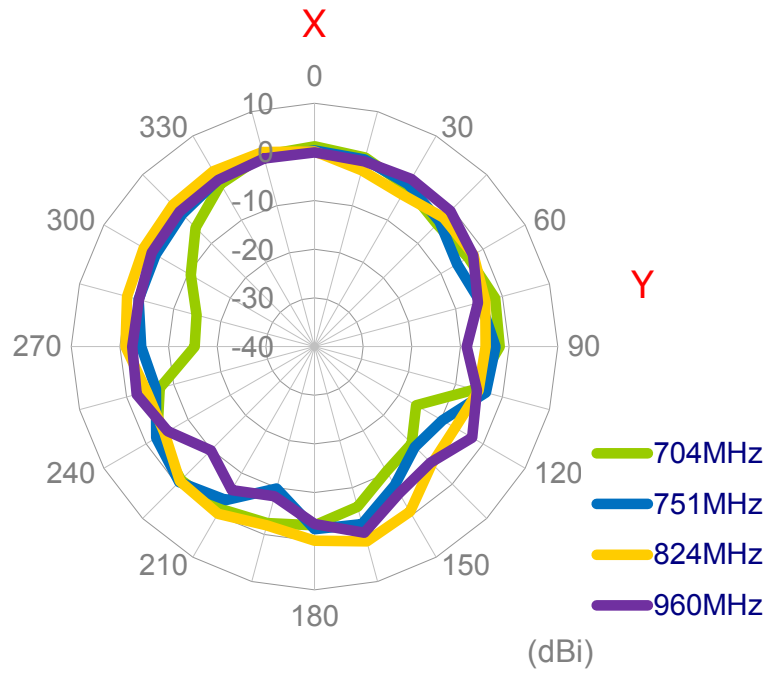
3.1.29 Test Setup for Antenna Radiation Pattern

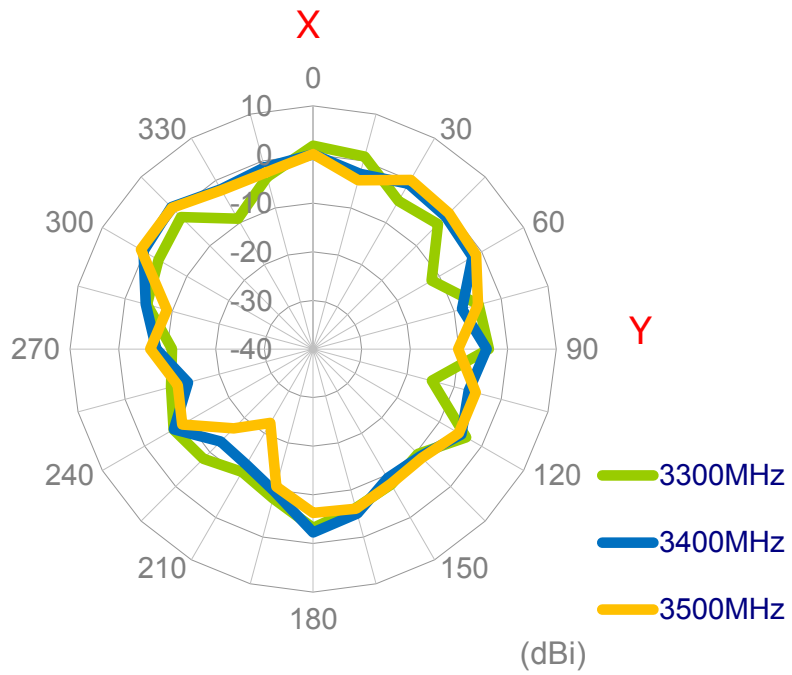
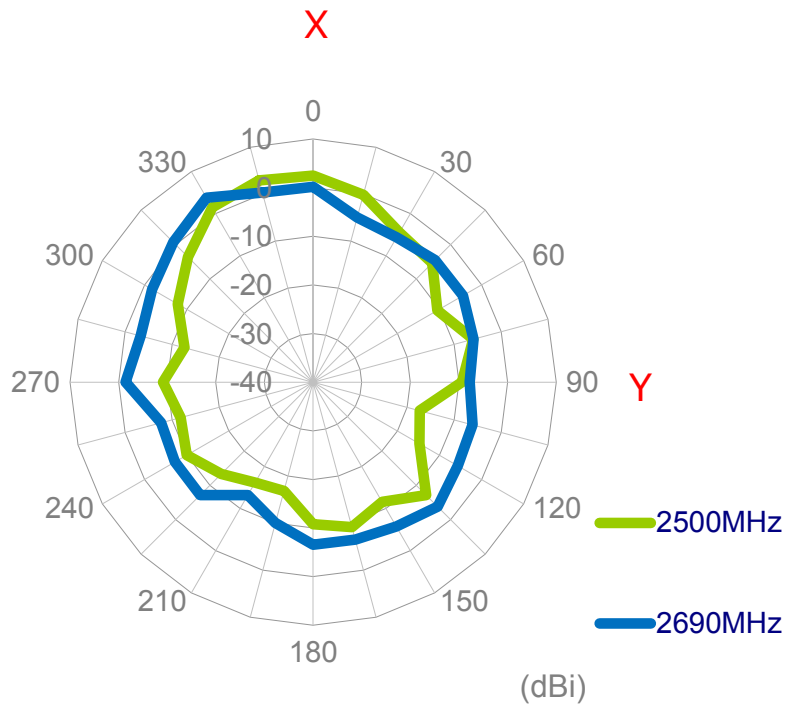


On the ABS

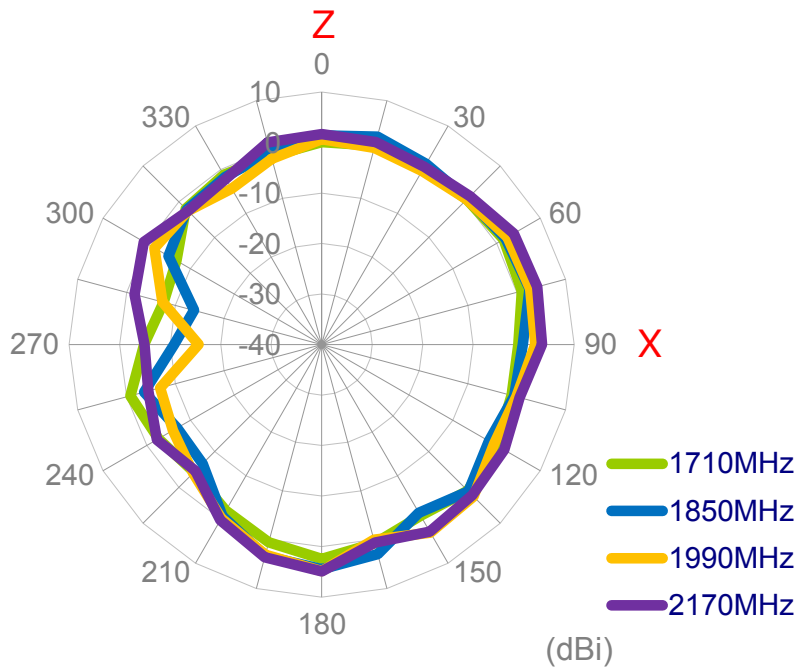
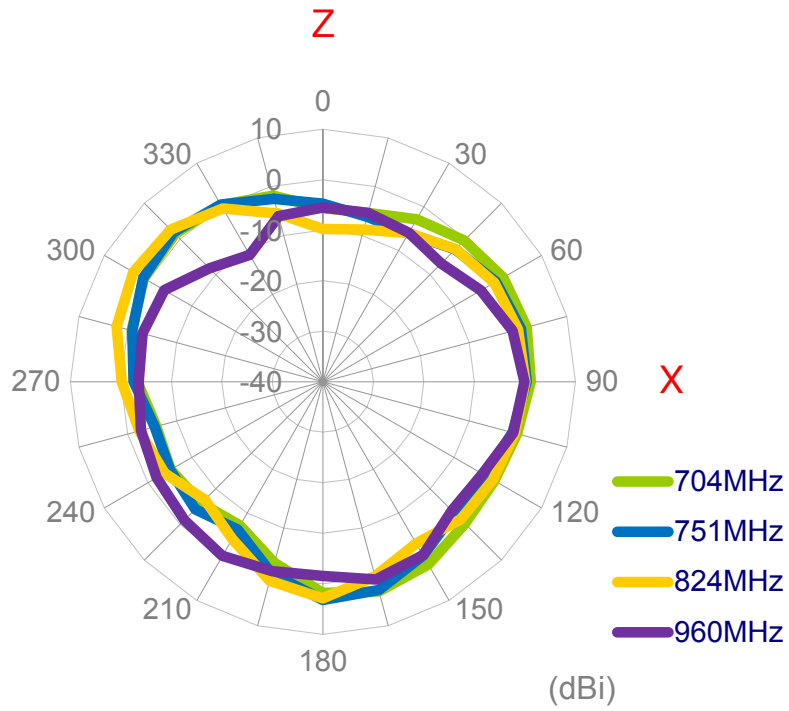
3.1.30 2D Radiation Pattern (LTE_MIMO1 with 1M cable length on ABS)

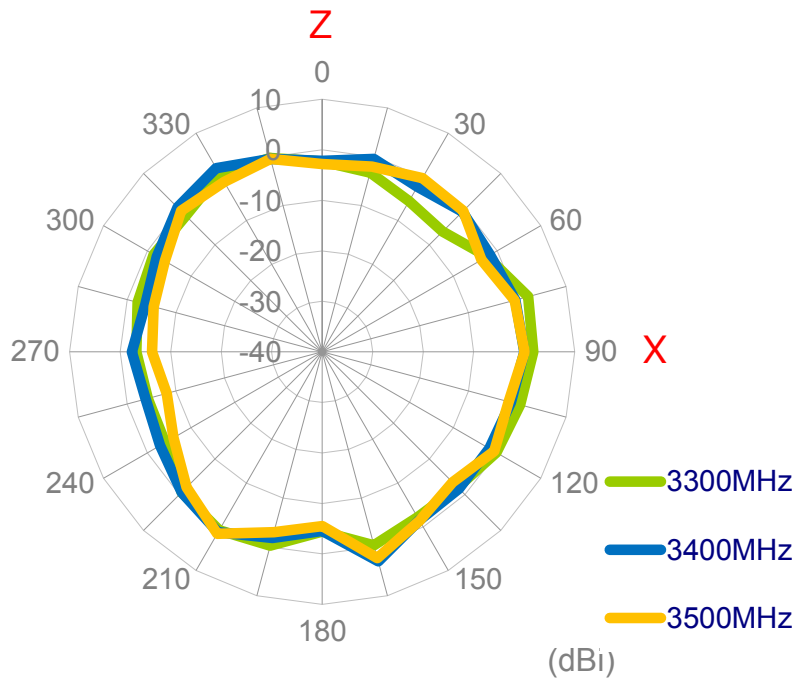
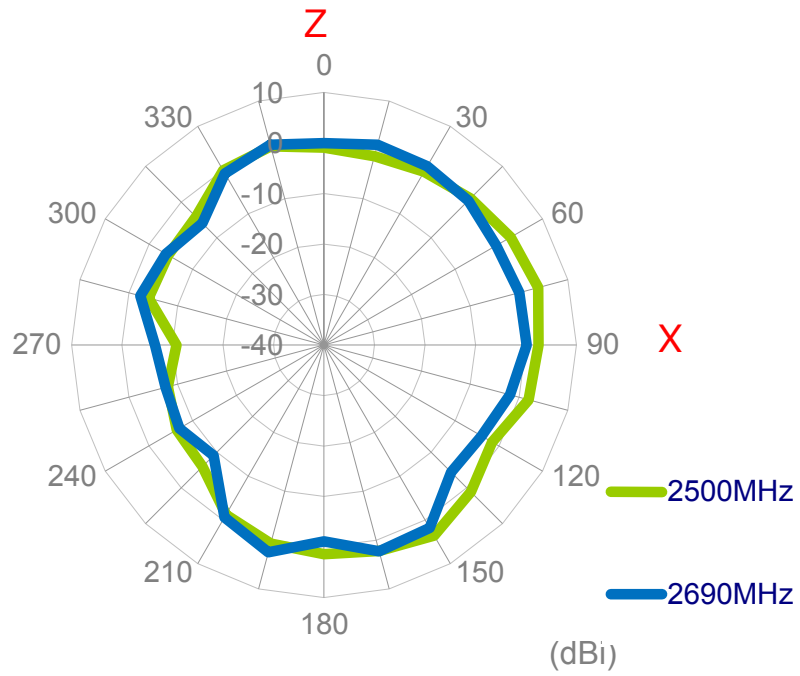
XY Plane



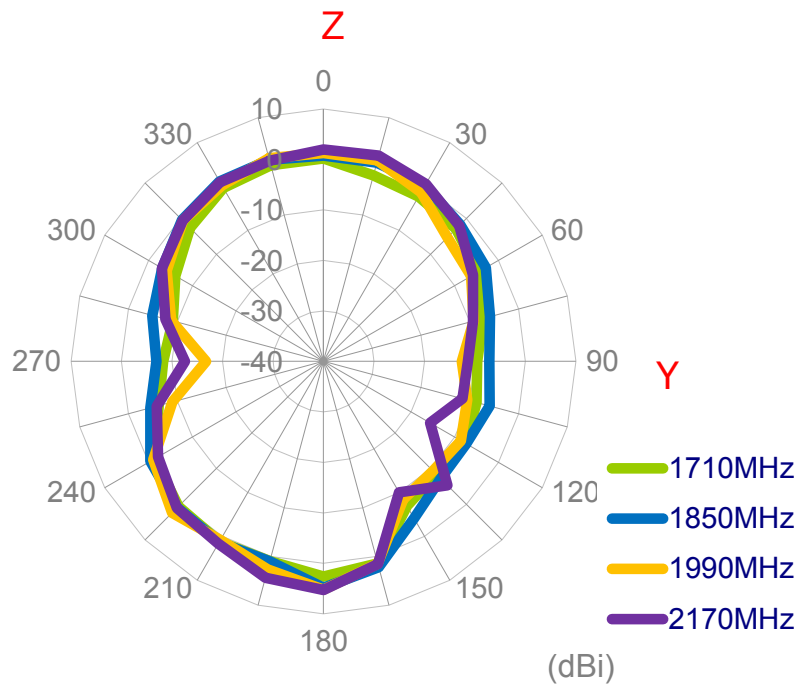
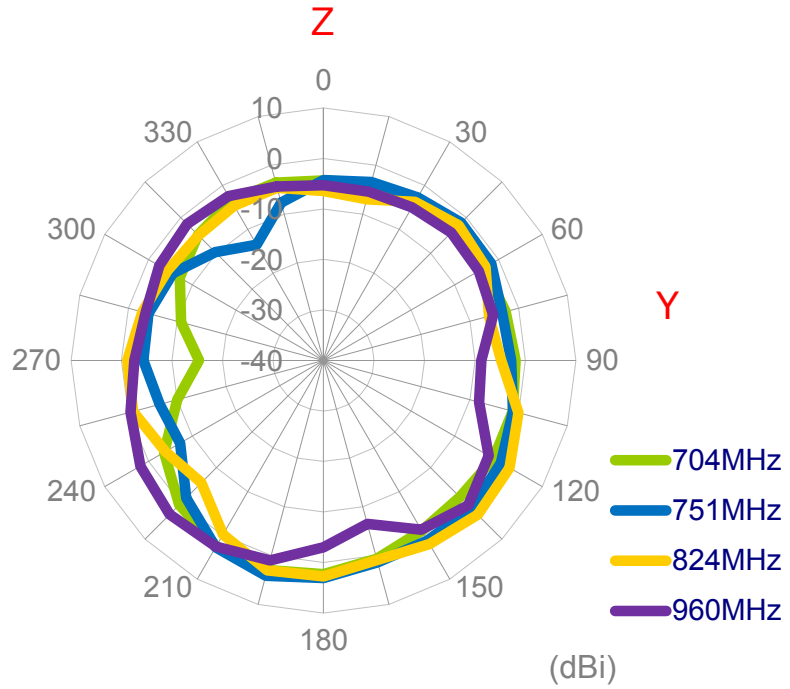


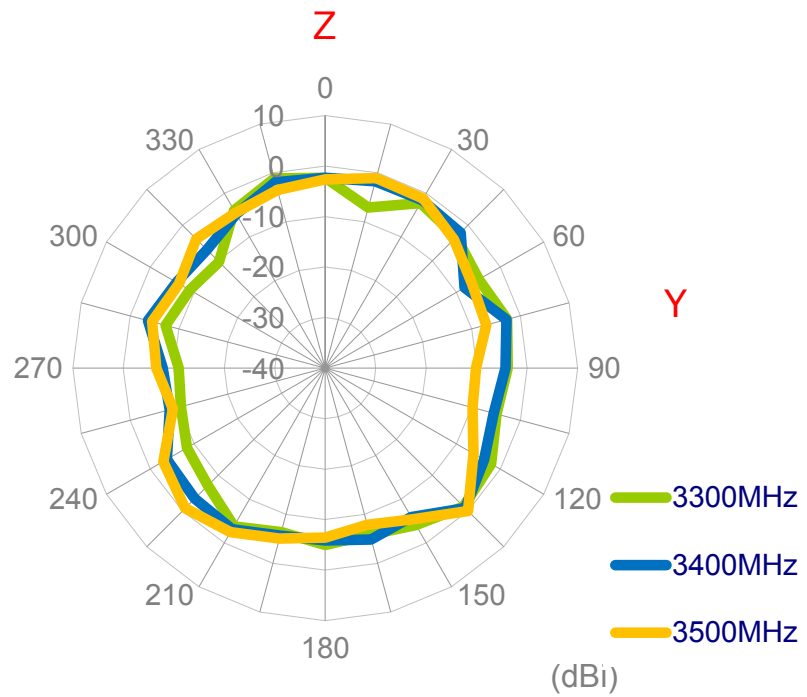
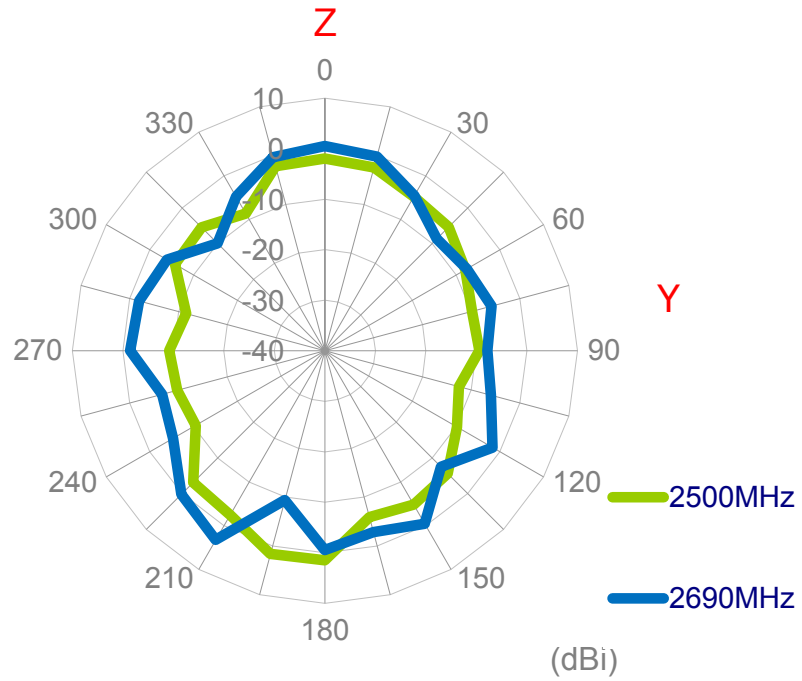
XZ Plane



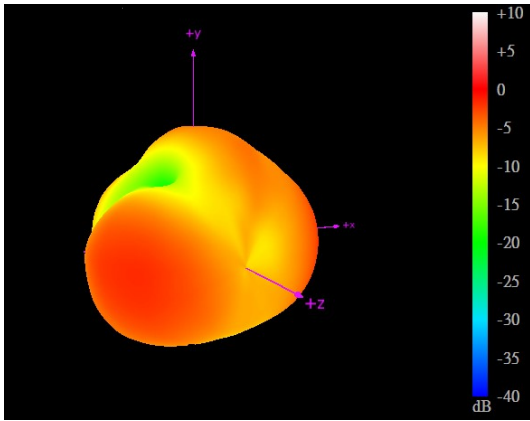


YZ Plane

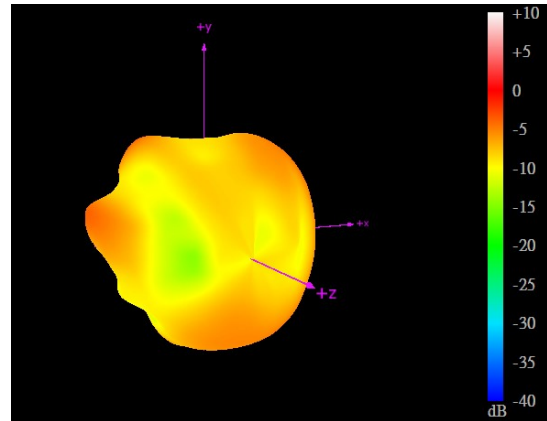




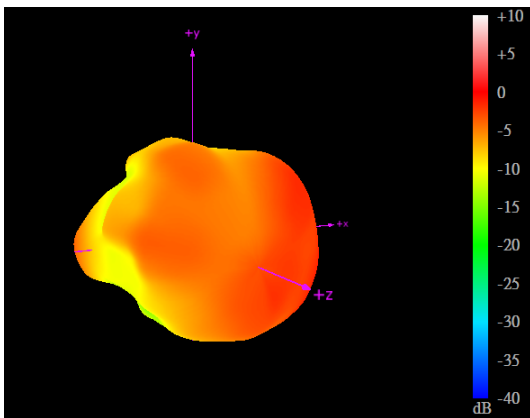
3.1.31 3D Radiation Pattern (LTE_MIMO1 with 1M cable length on ABS)



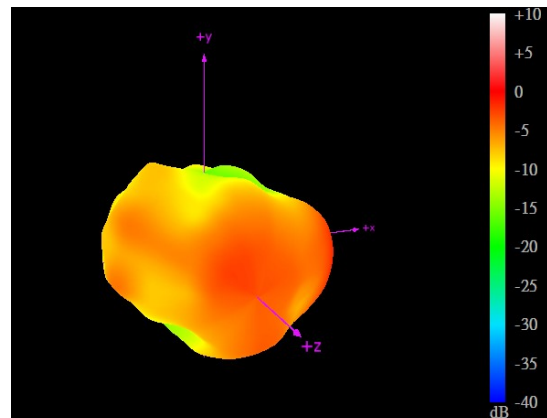
704MHz



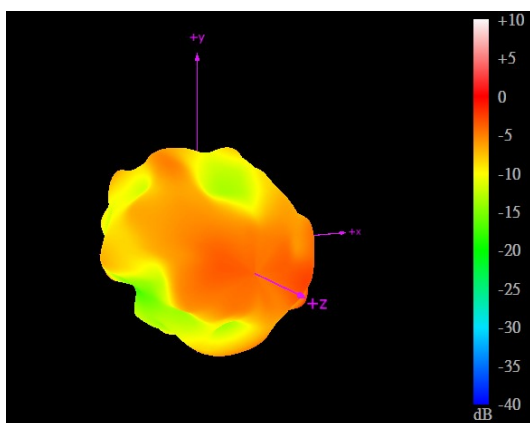
960MHz



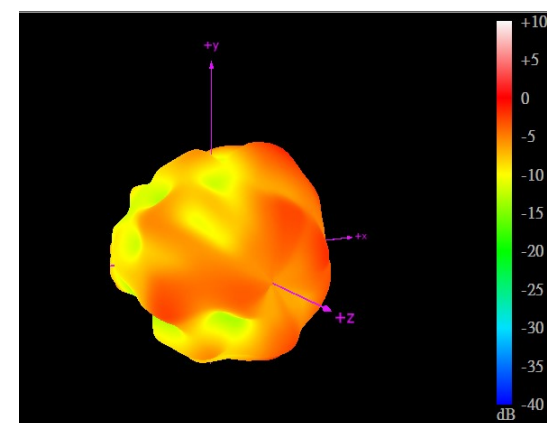
1710MHz



2170MHz



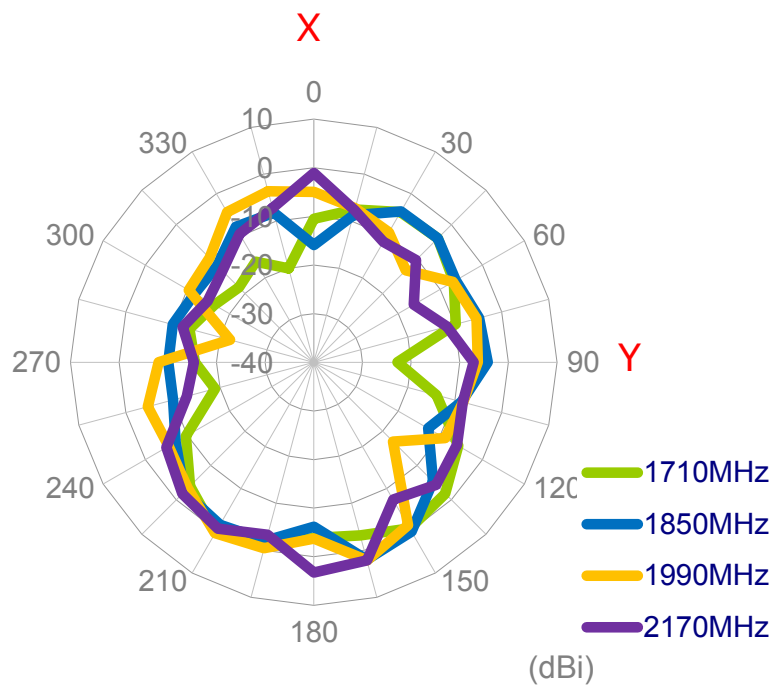
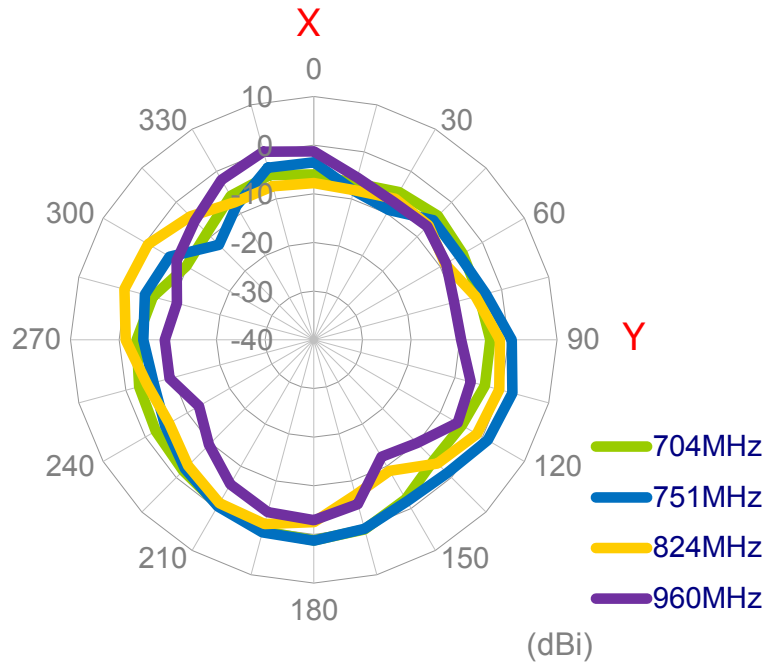
2690MHz

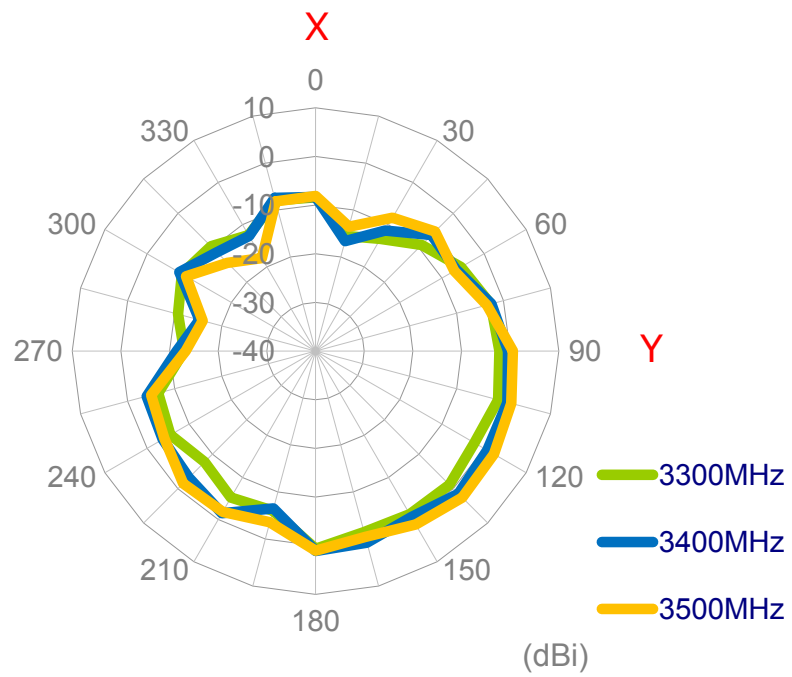
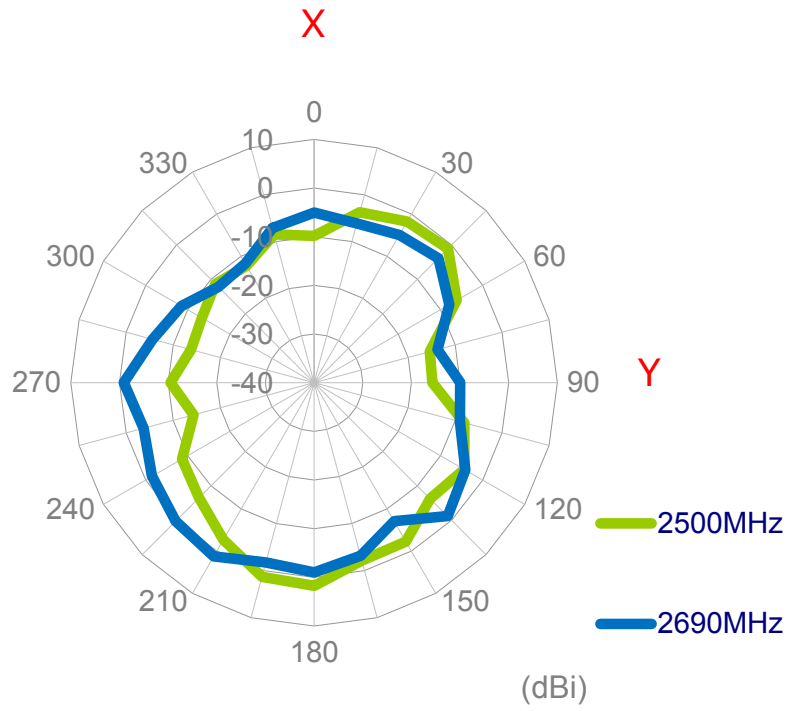


3500MHz

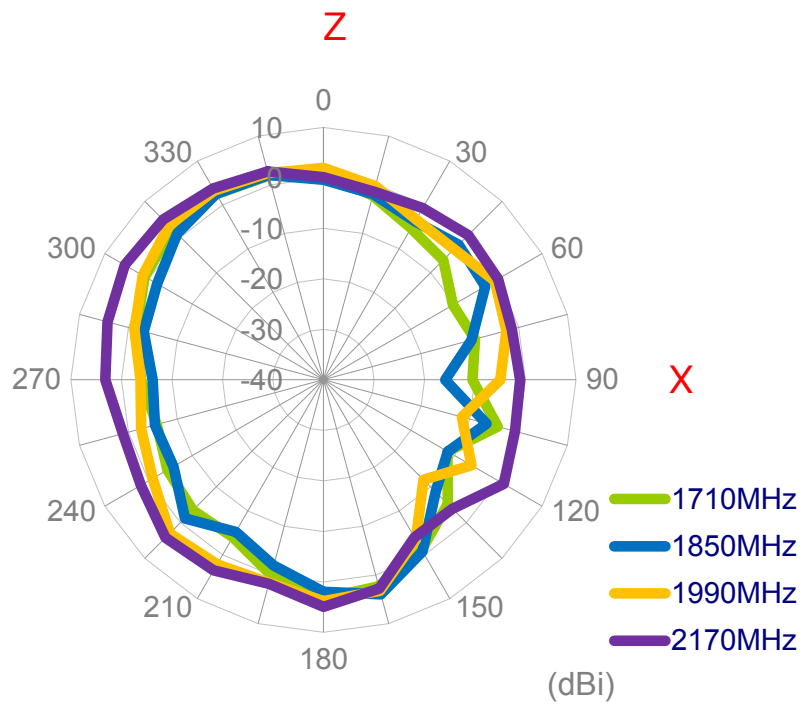
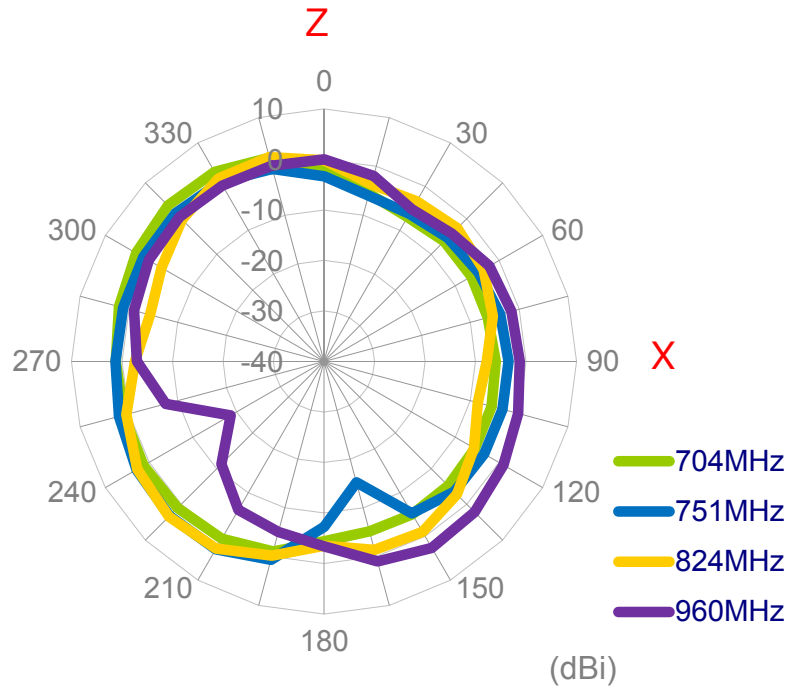
3.1.32 2D Radiation Pattern (LTE_MIMO2 with 1M cable length on ABS)

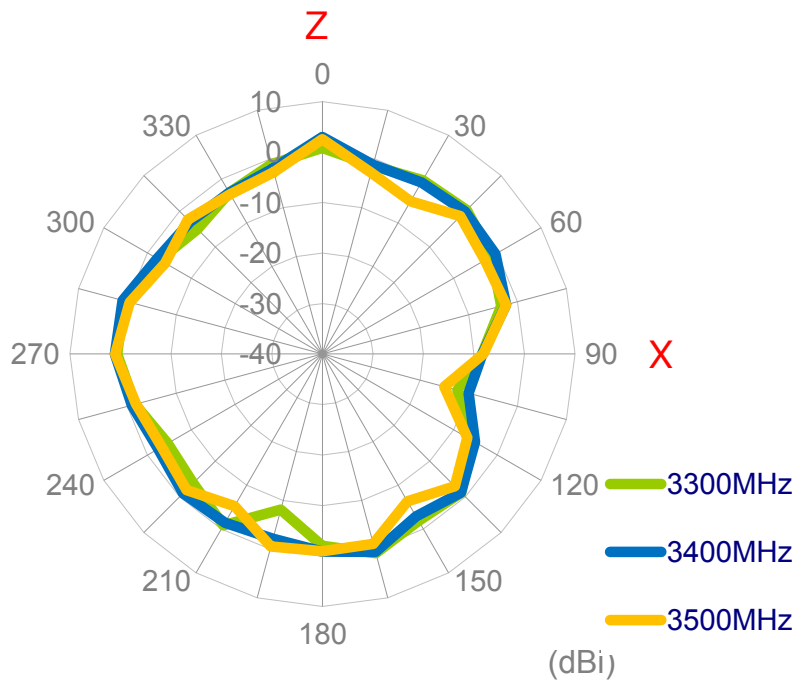
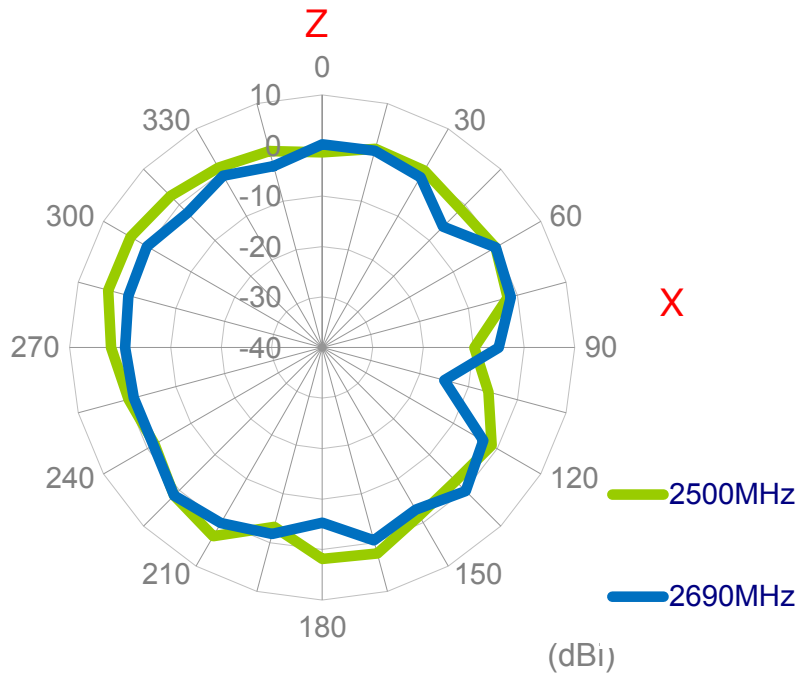
XY Plane



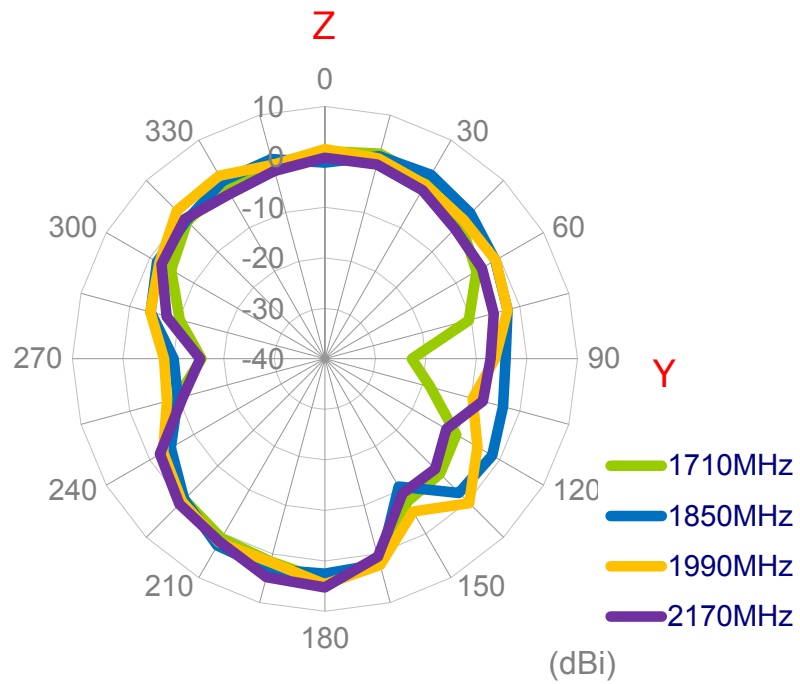
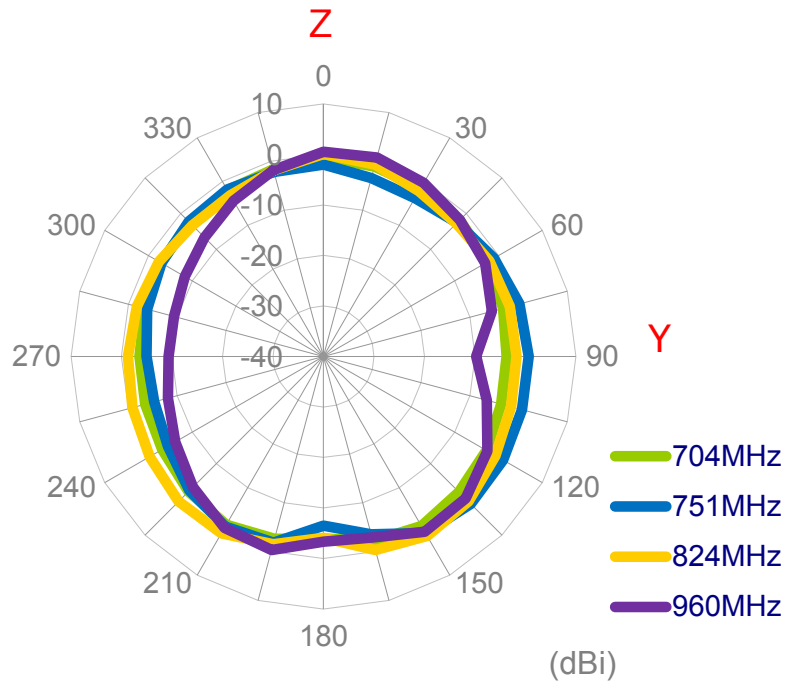


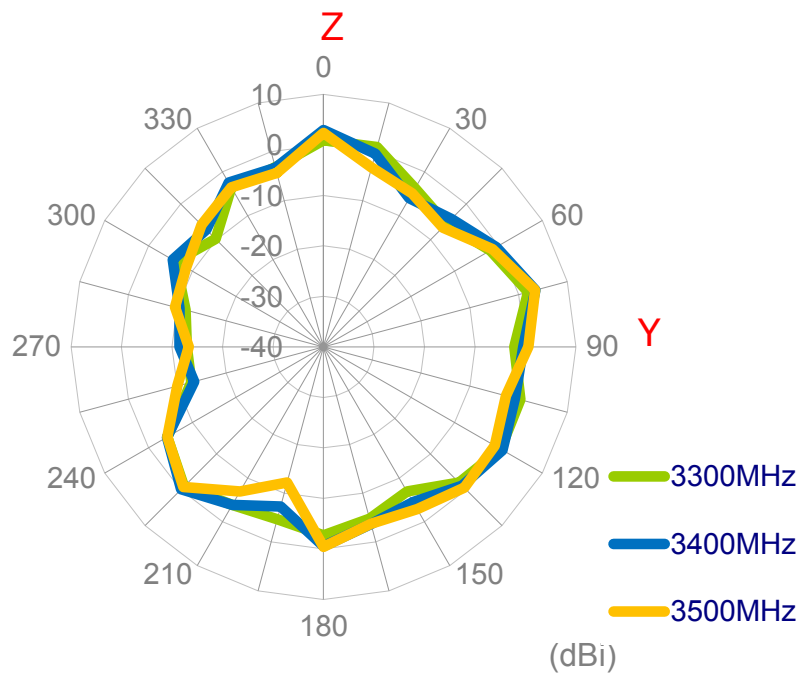
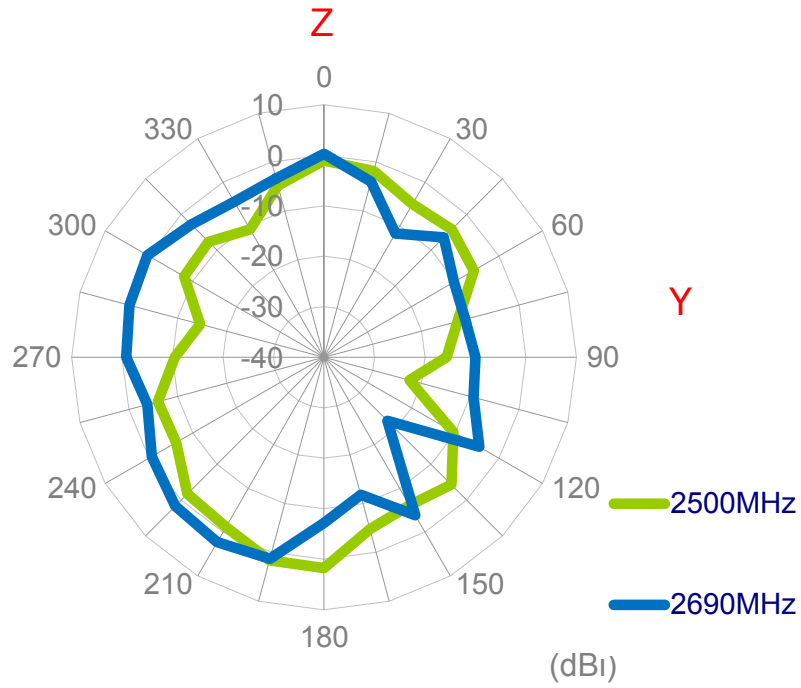
XZ Plane



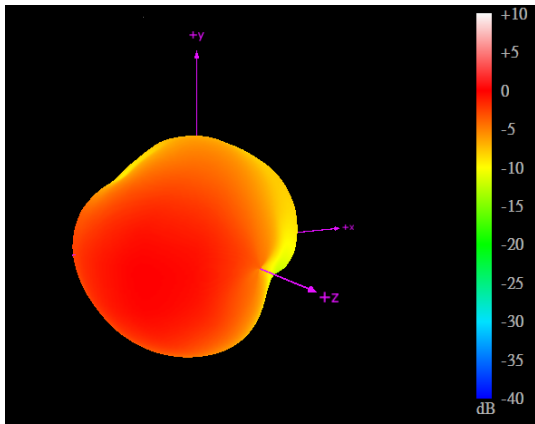


YZ Plane

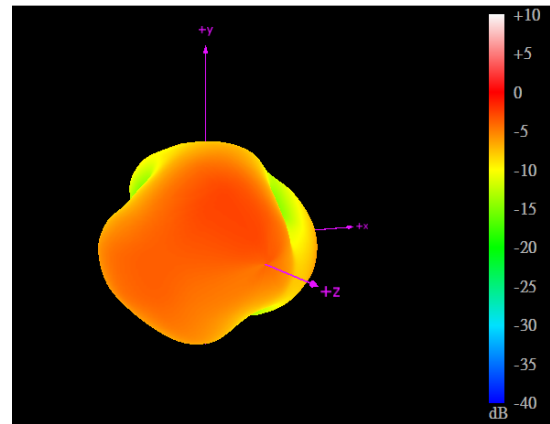




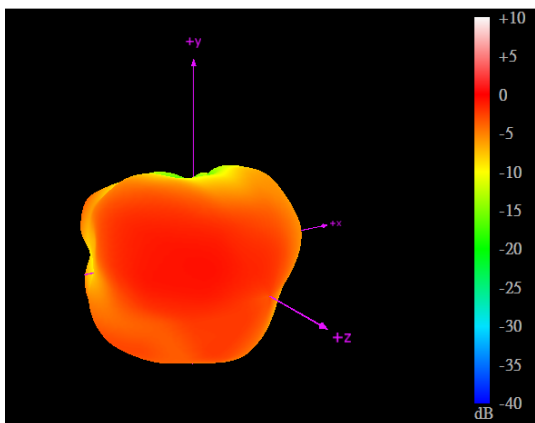
3.1.33 3D Radiation Pattern (LTE_MIMO2 with 1M cable length on ABS)



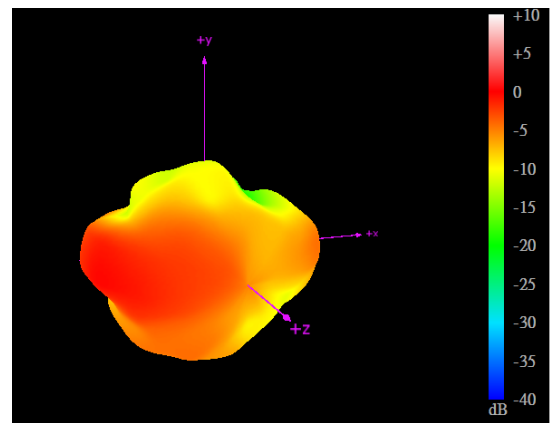
704MHz



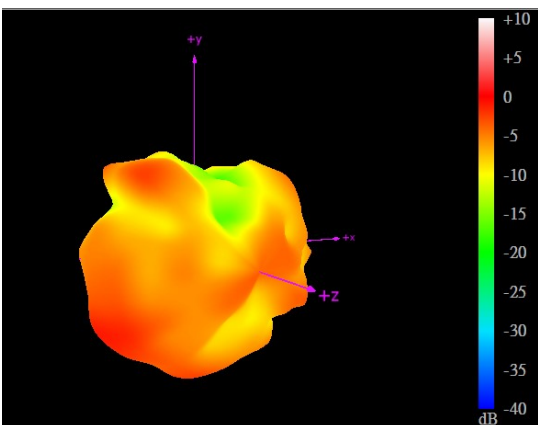
960MHz



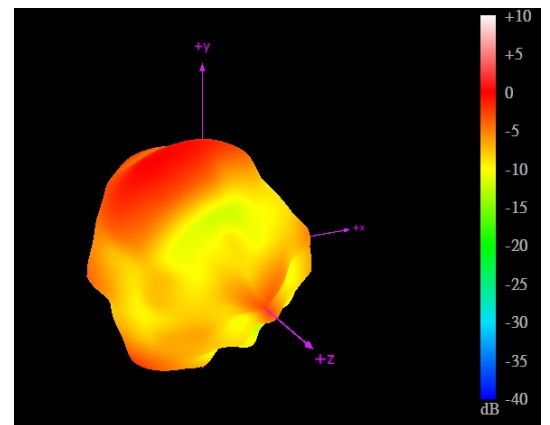
1710MHz



2170MHz



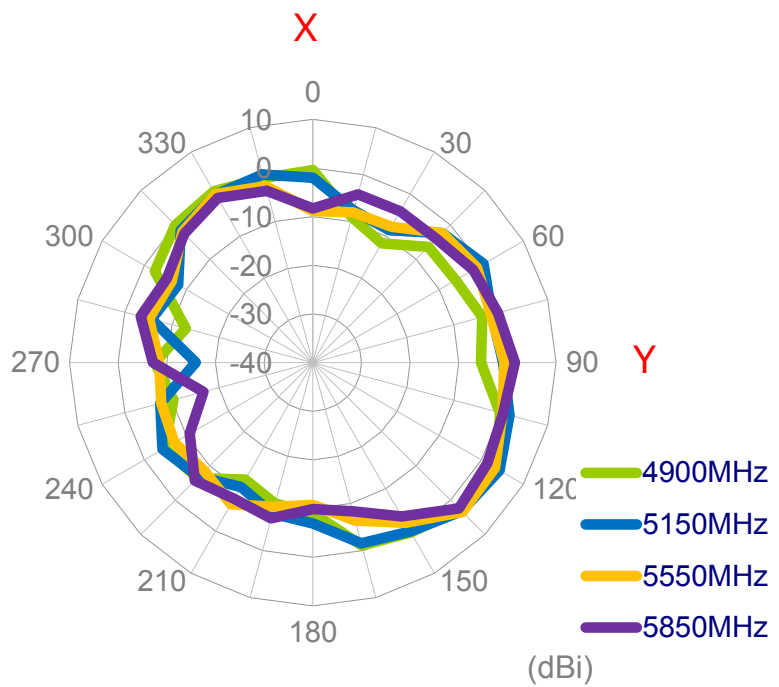
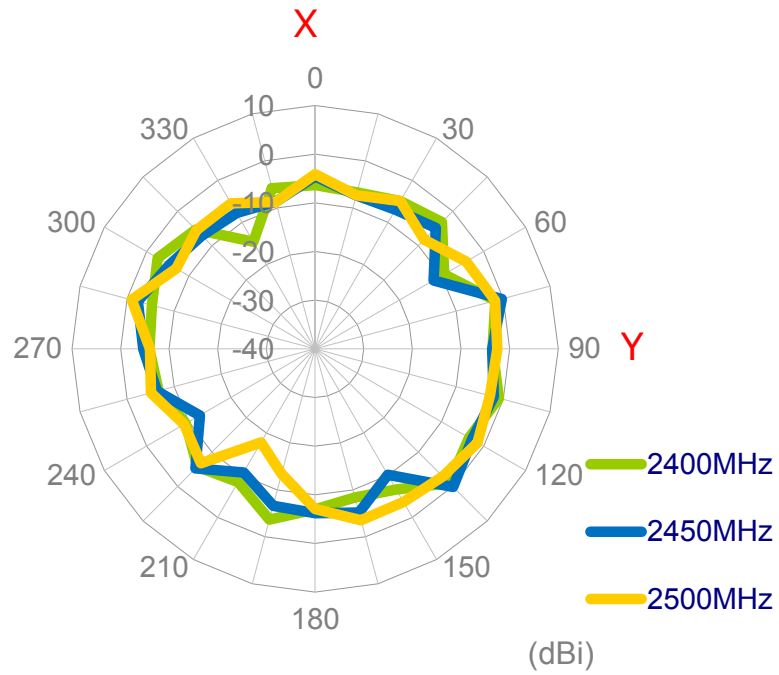
2690MHz



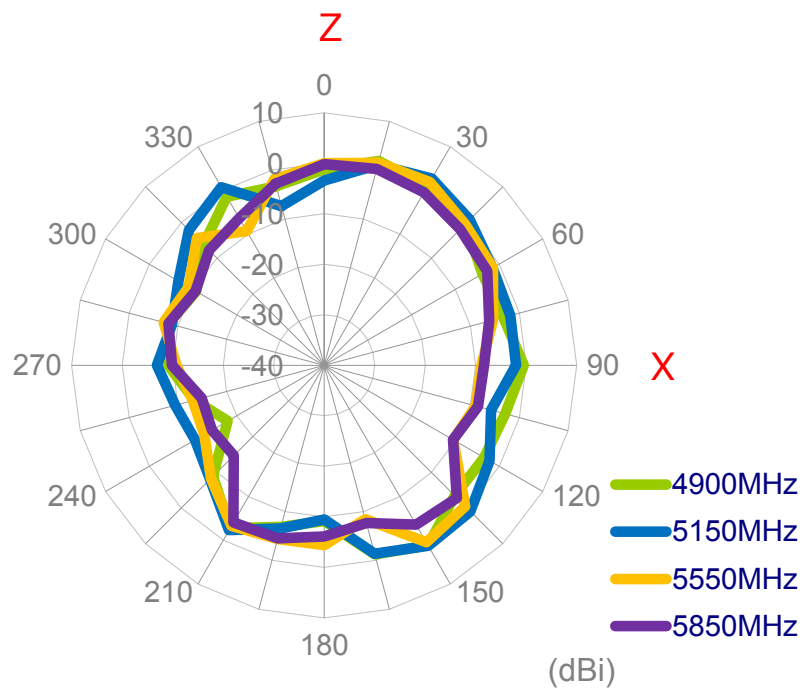
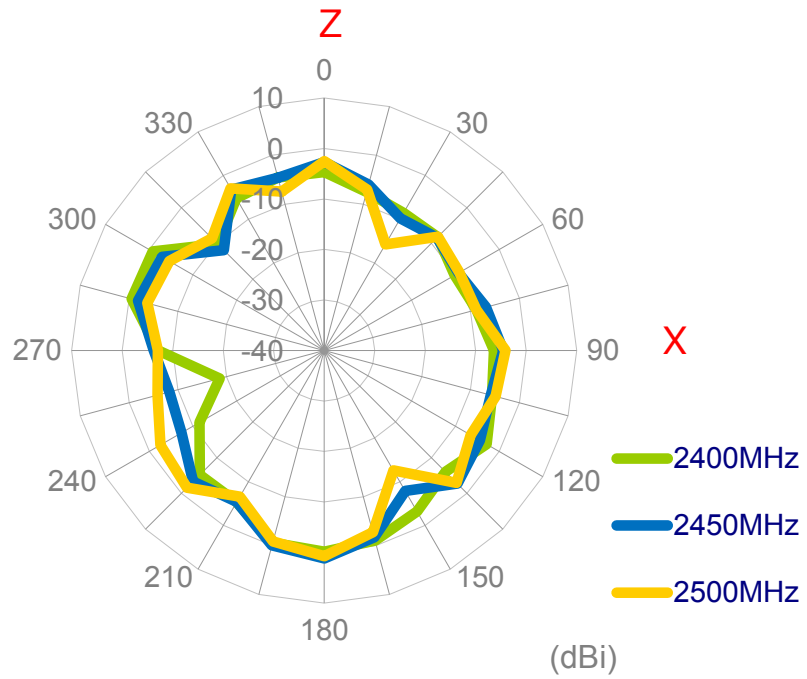
3500MHz

3.1.34 2D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length on ABS)

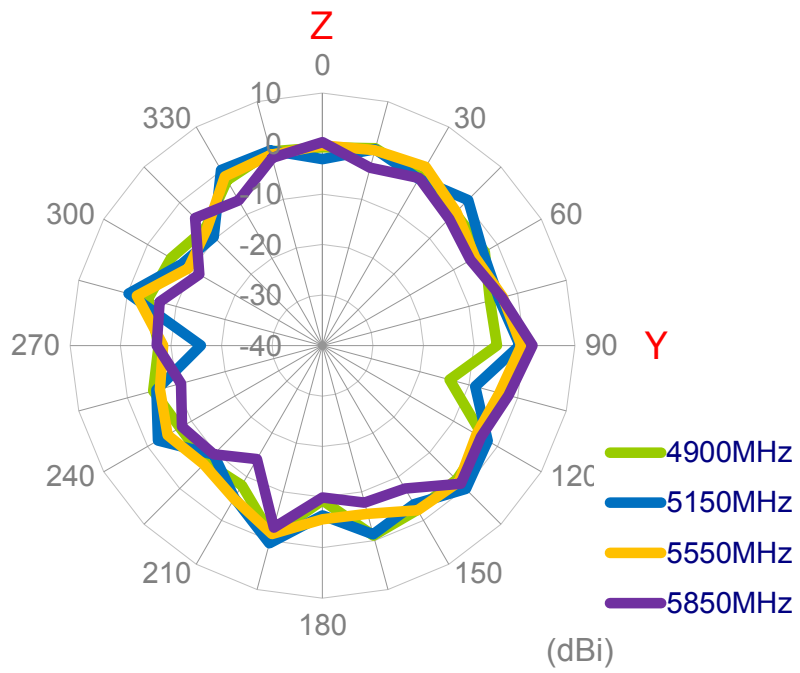
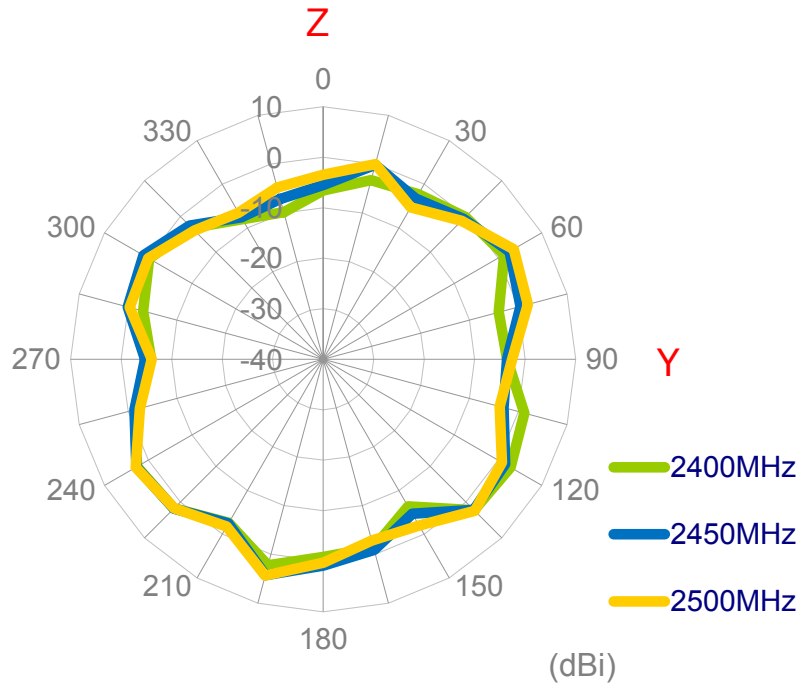
XY Plane



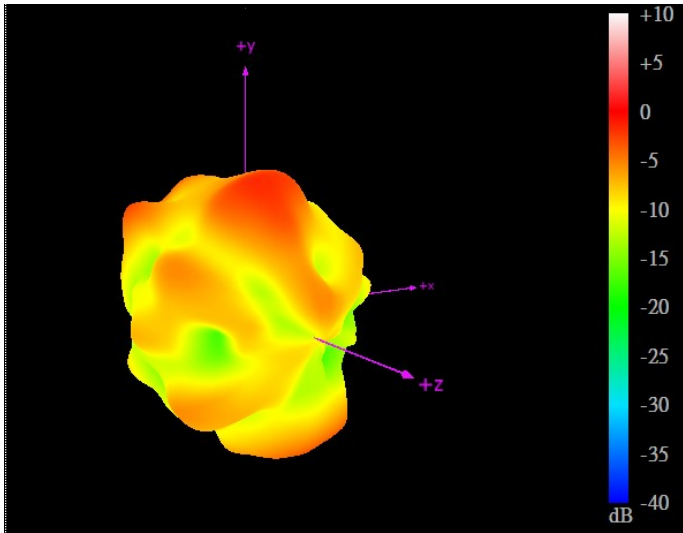
XZ Plane



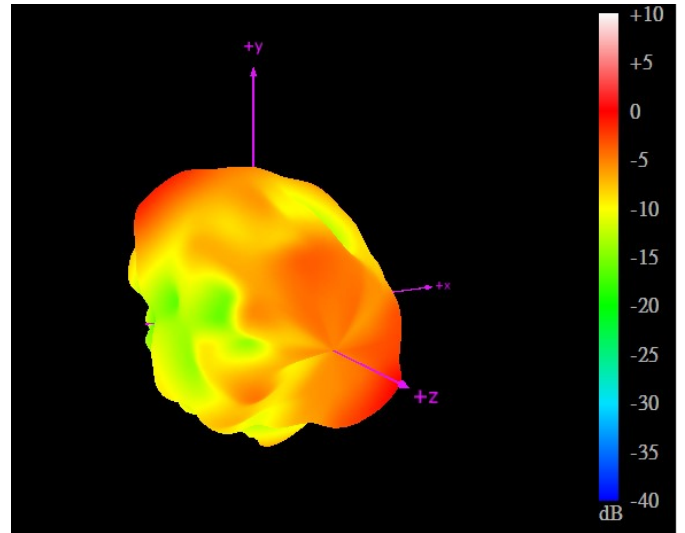
YZ Plane



3.1.35 3D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length o ABS)



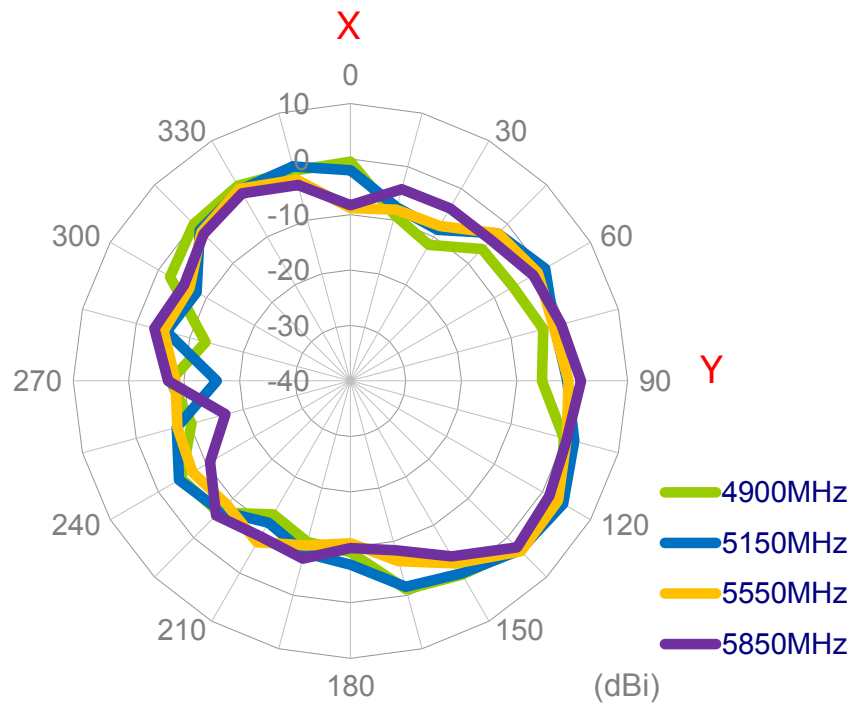
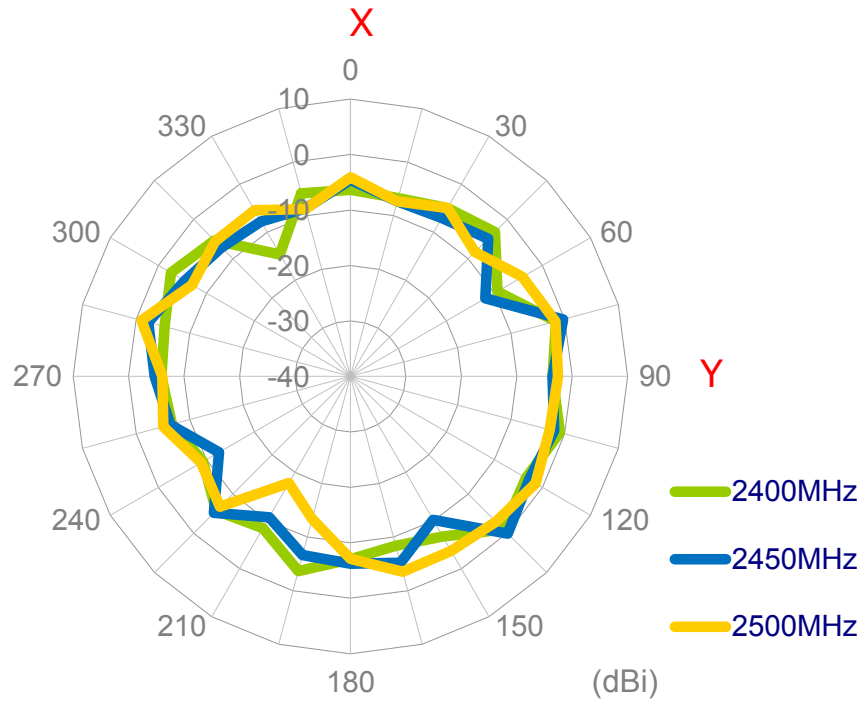
2450MHz



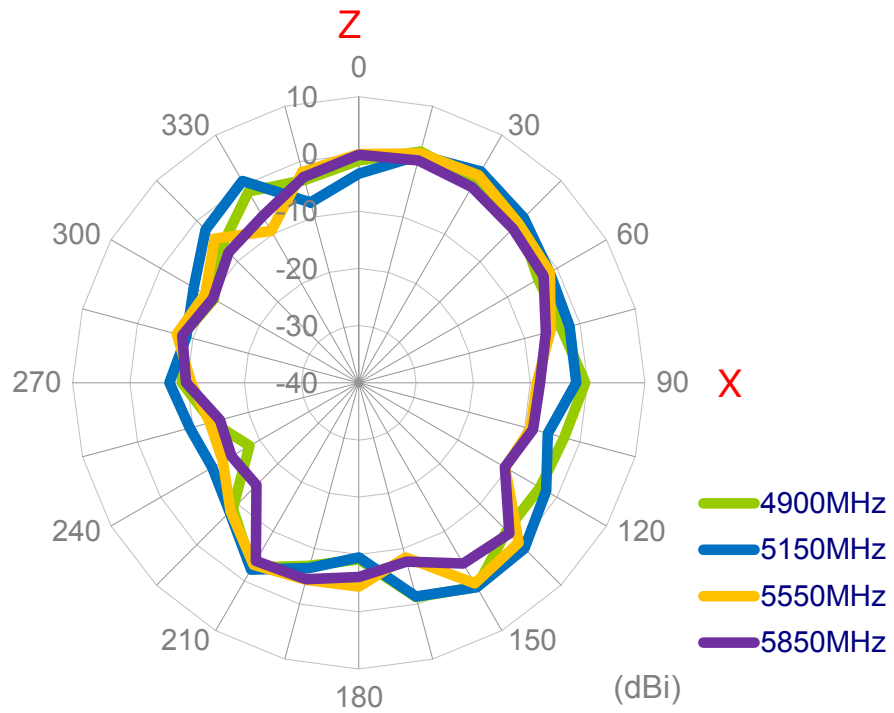
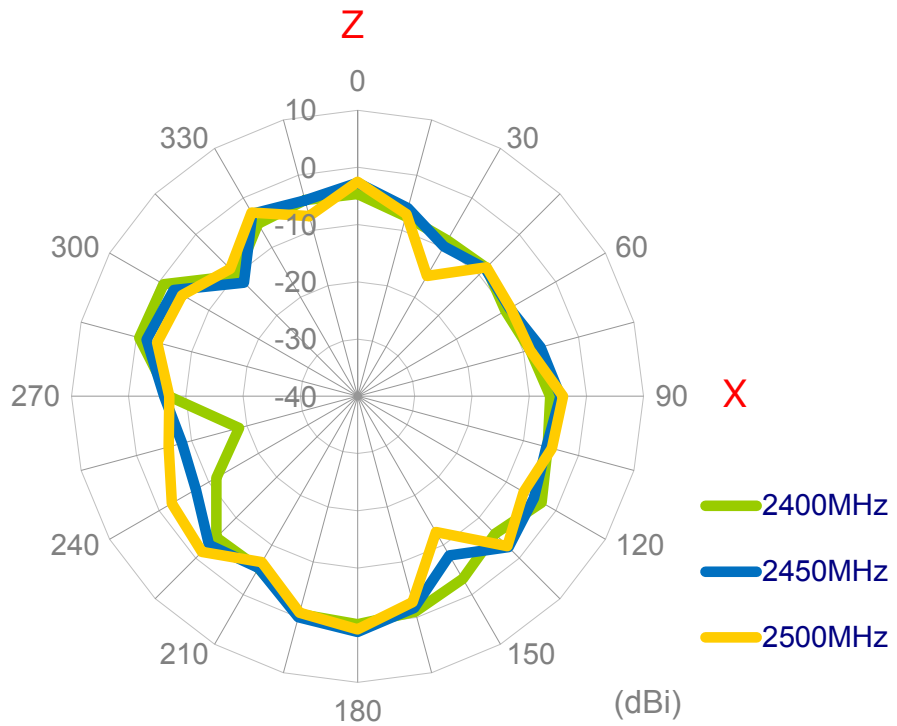
5550MHz

3.1.36 2D Radiation Pattern (Wi-Fi_MIMO2 with 3M cable length o ABS)

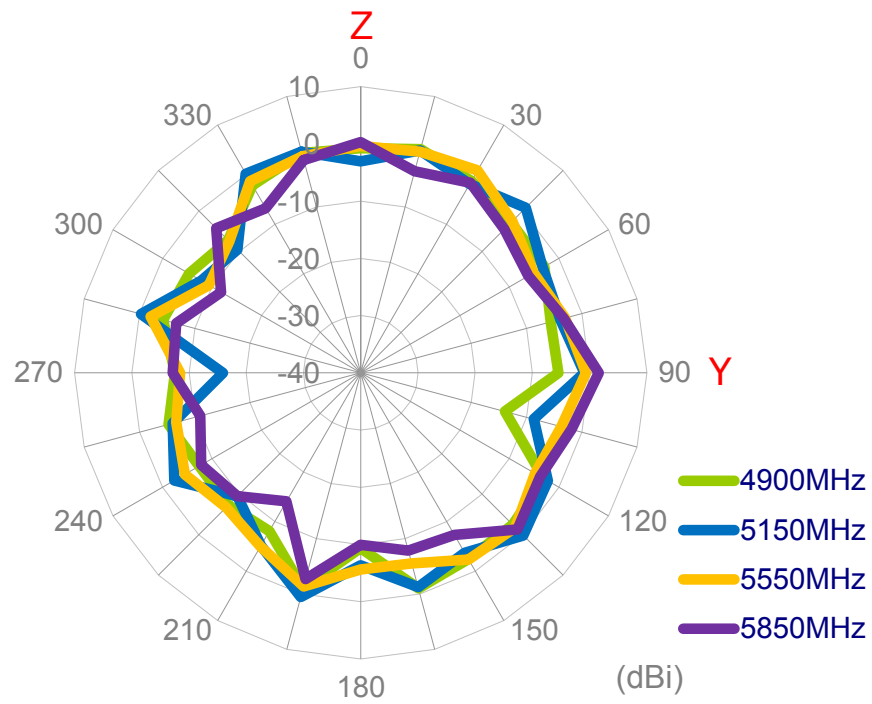
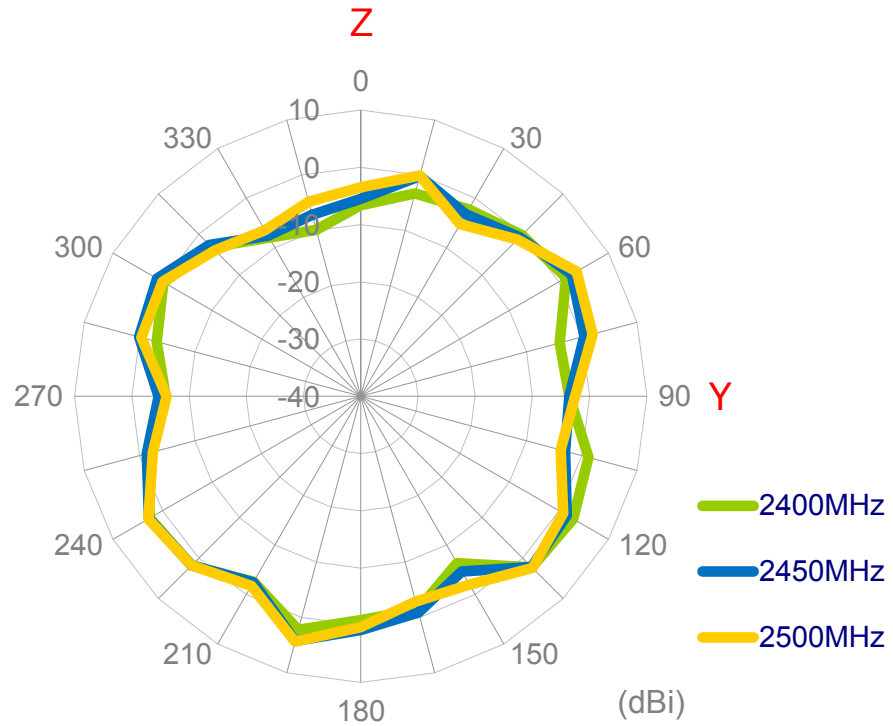
XY Plane



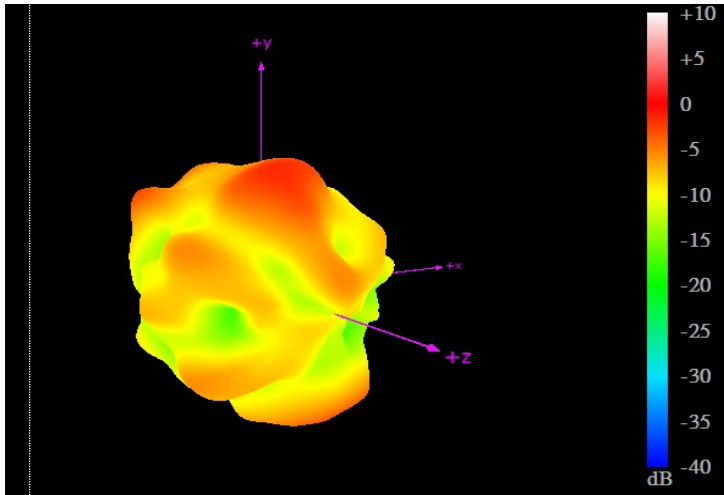
XZ Plane



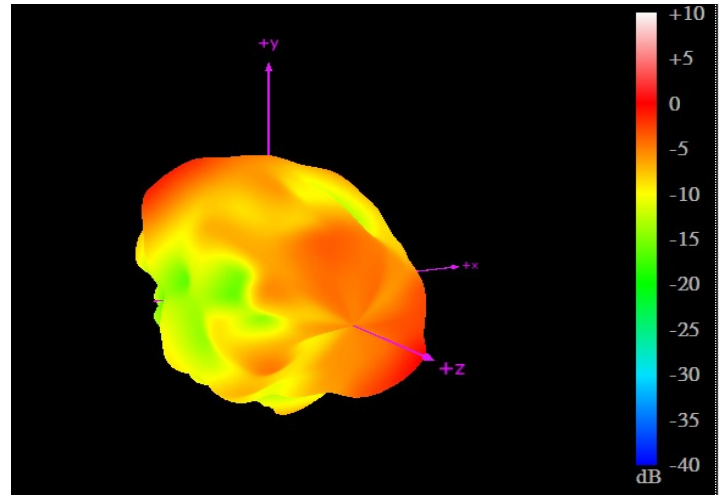
YZ Plane



3.1.37 3D Radiation Pattern (Wi-Fi_MIMO2 with 1M cable length on ABS)



2450MHz



5550MHz

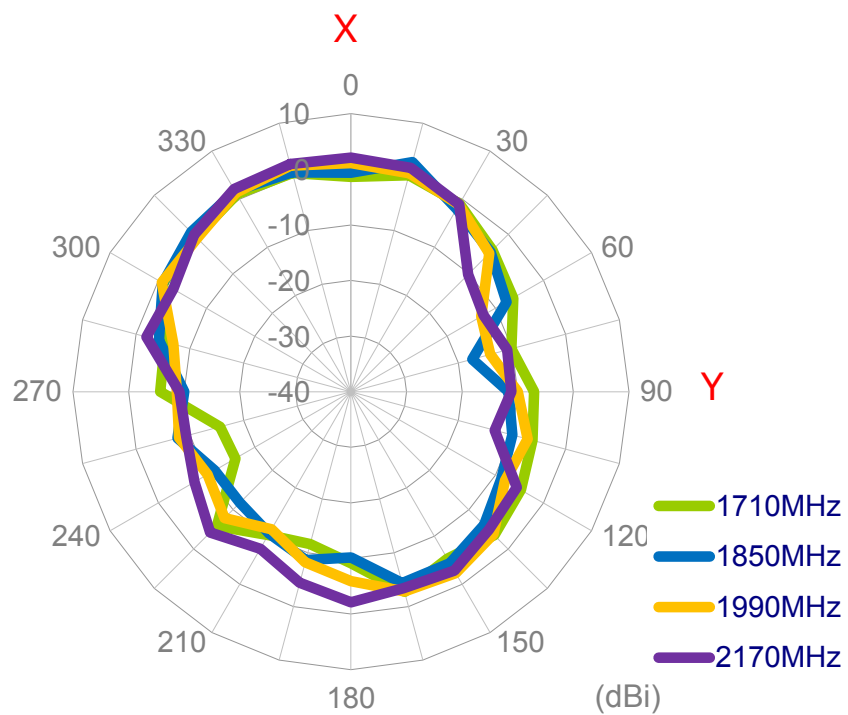
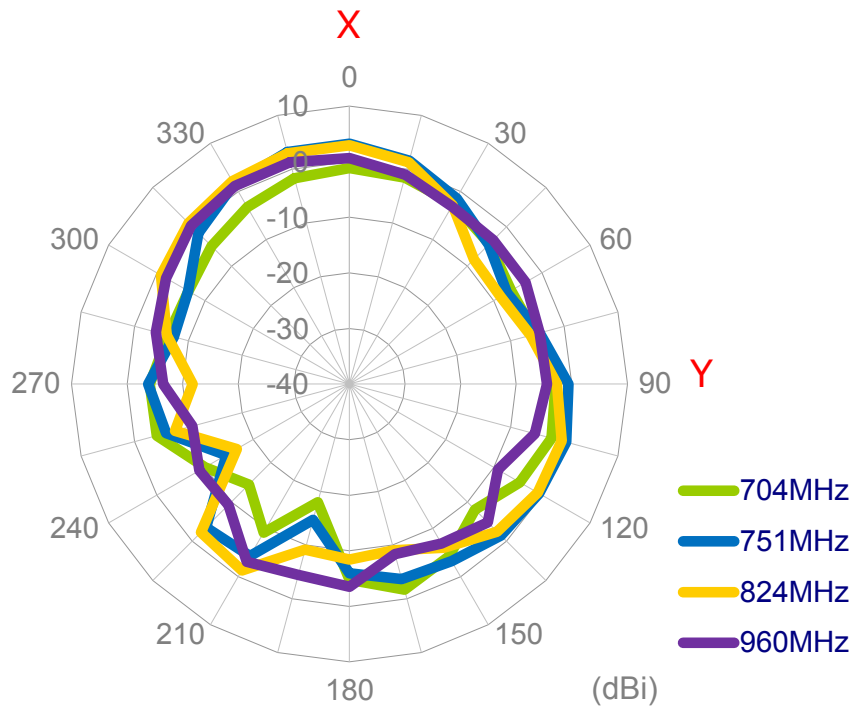
3.1.38 Test Setup For Antenna Radiation Pattern

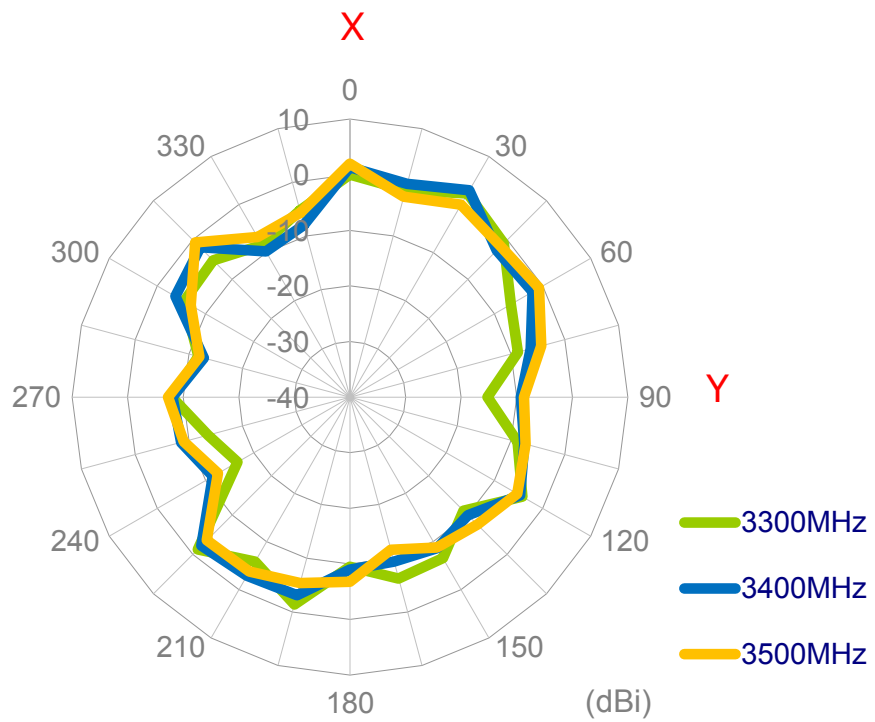
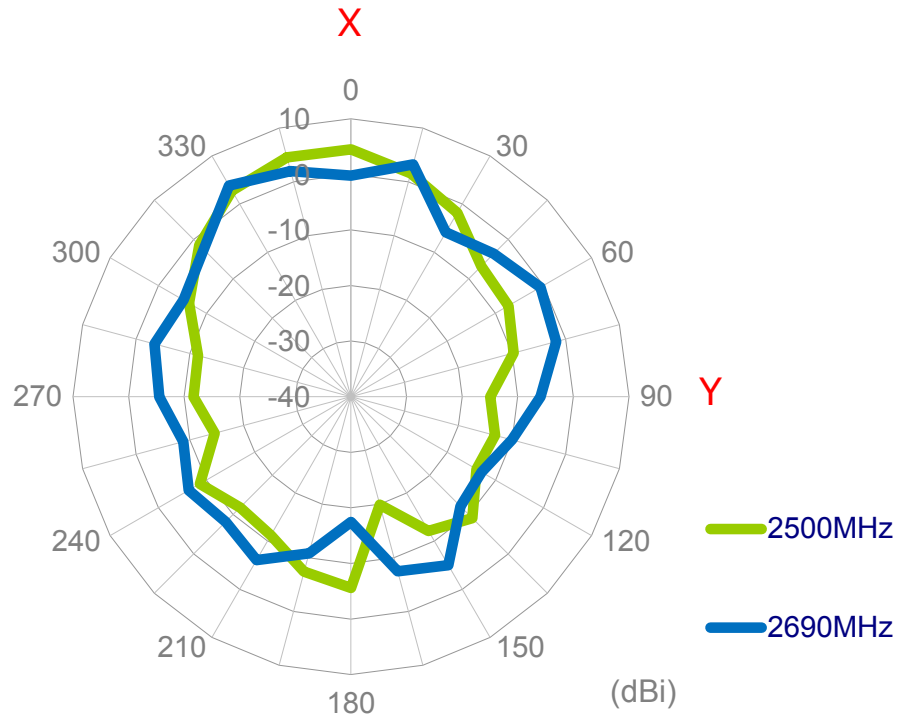


On glass

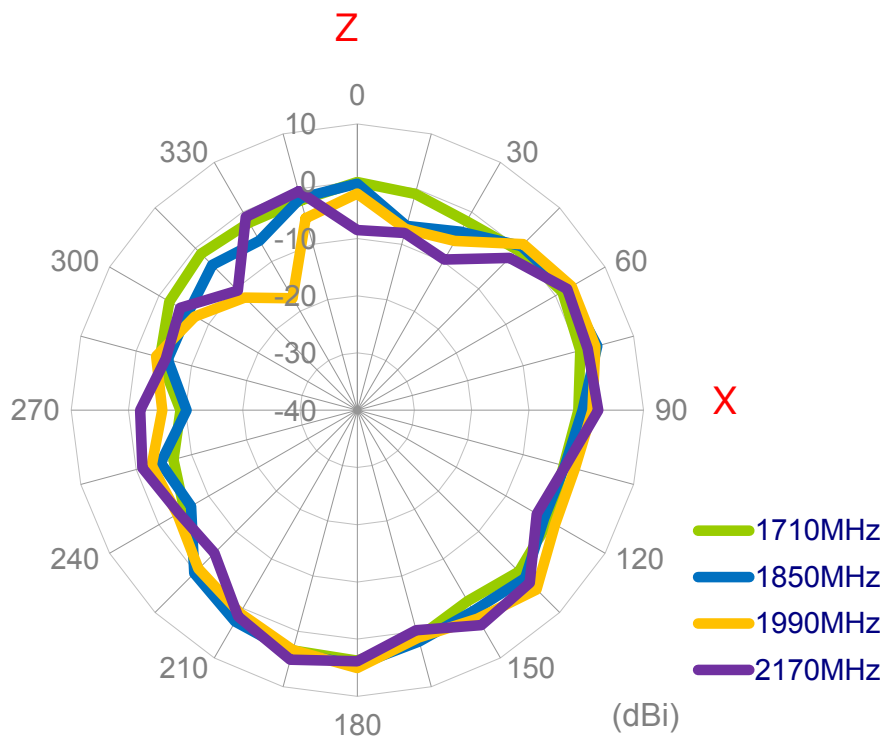
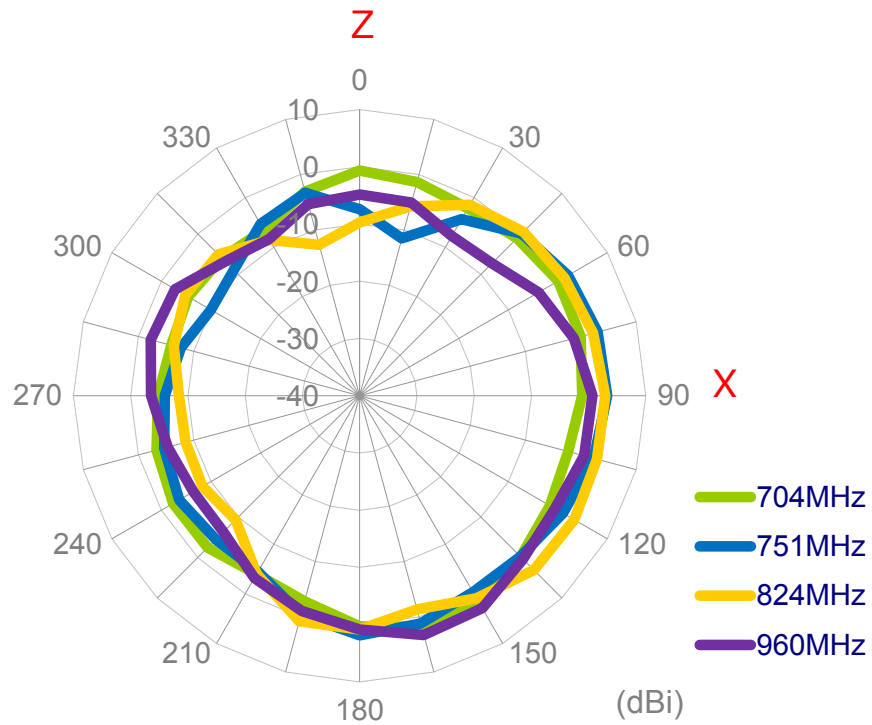
3.1.39 2D Radiation Pattern (LTE_MIMO1 with 1M cable length on glass)

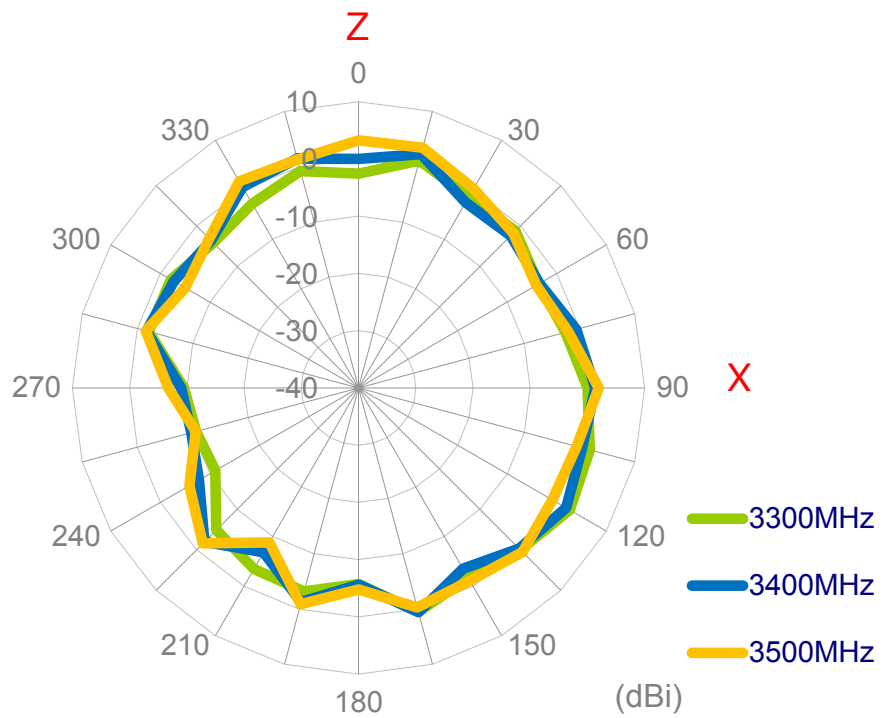
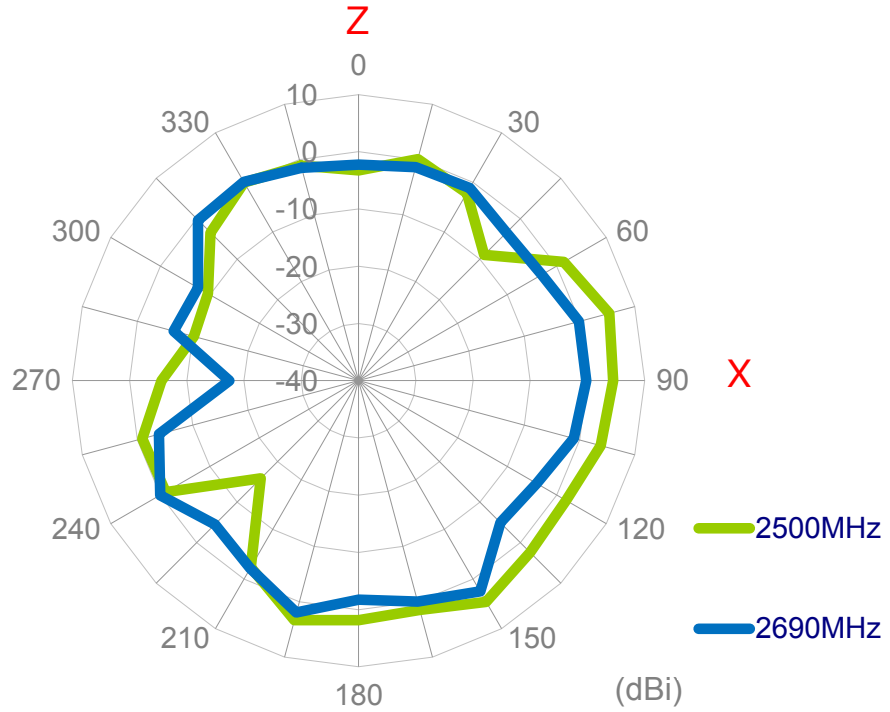
XY Plane



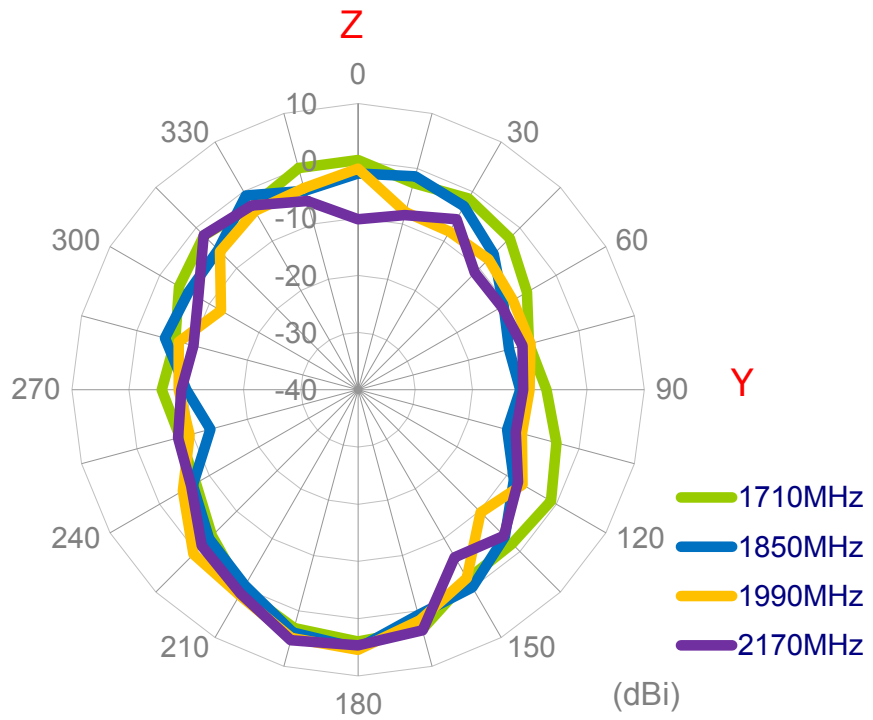
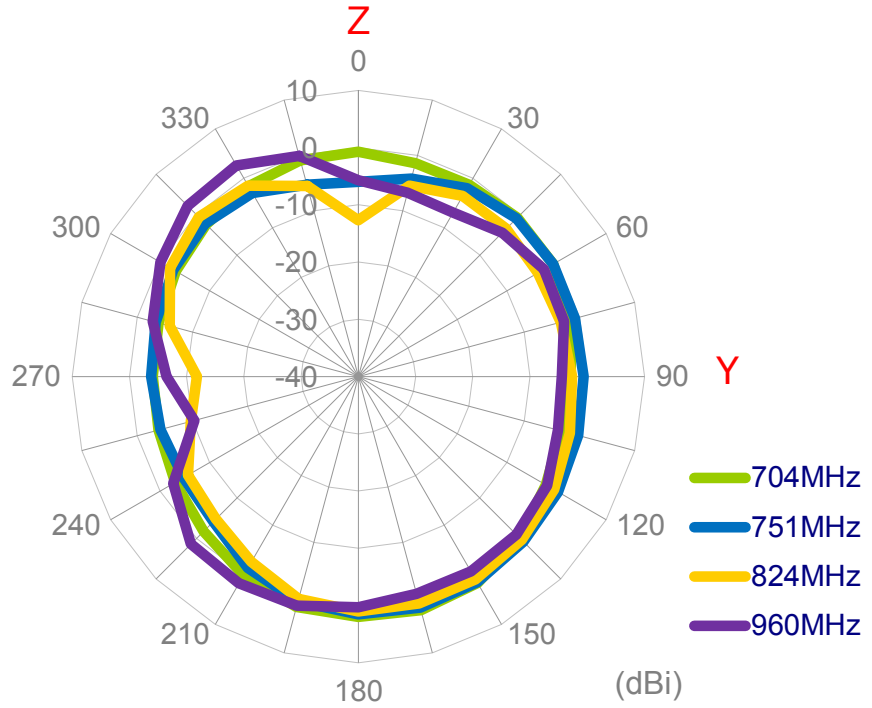


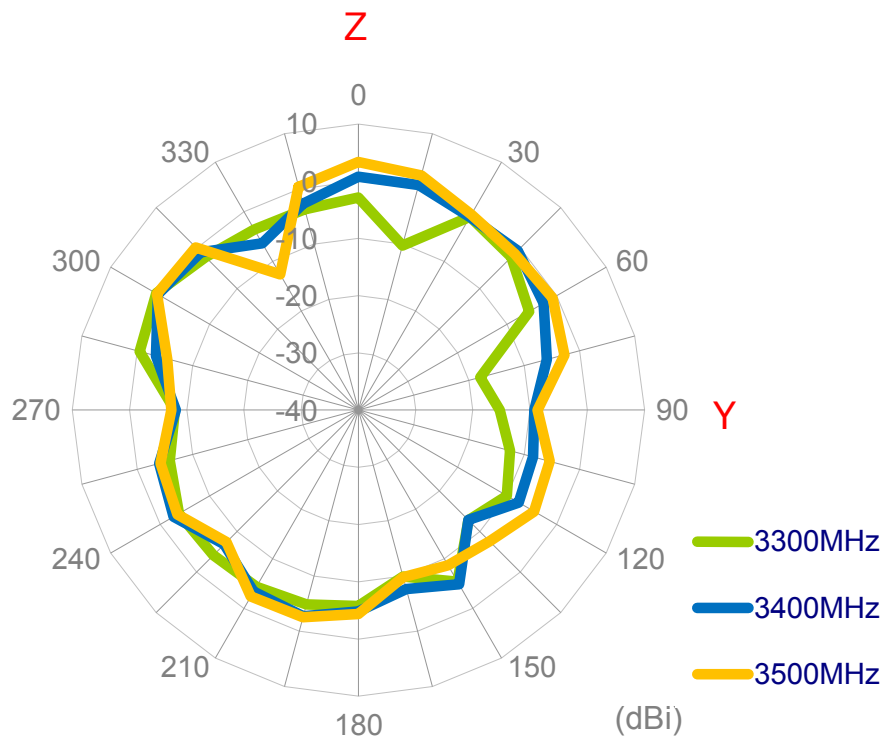
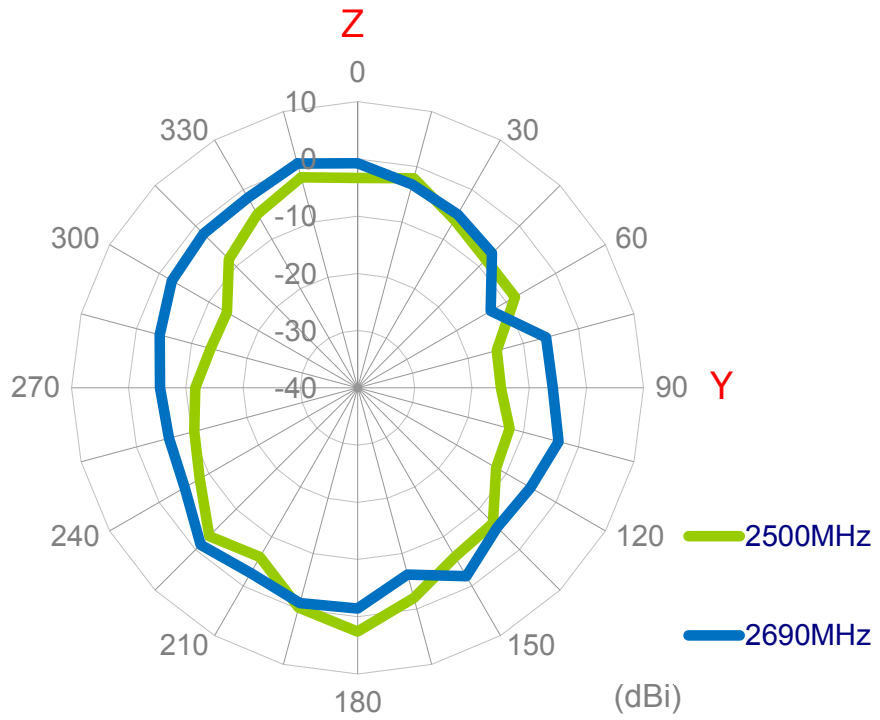
XZ Plane



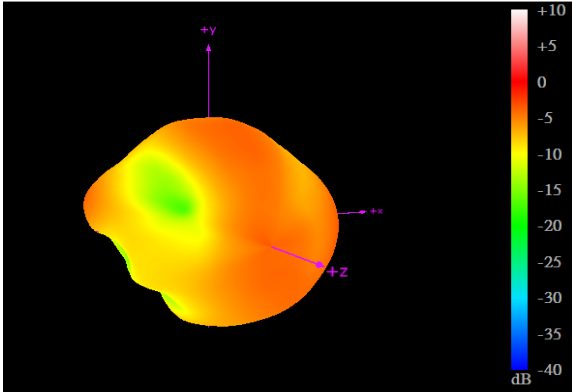


YZ Plane

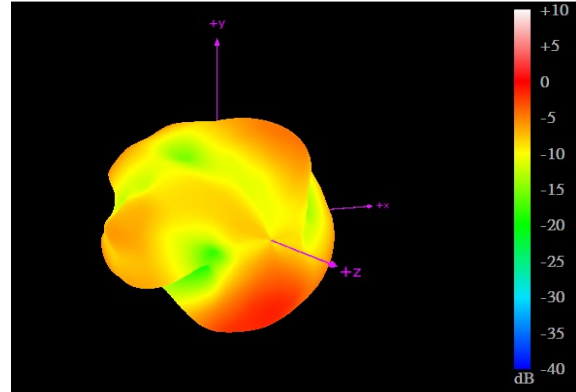




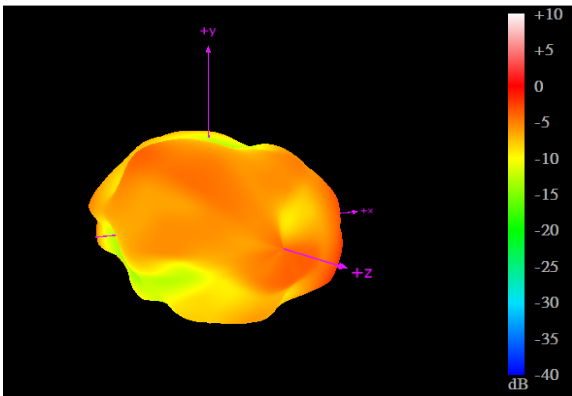
3.1.40 3D Radiation Pattern (LTE_MIMO1 with 1M cable length o glass)



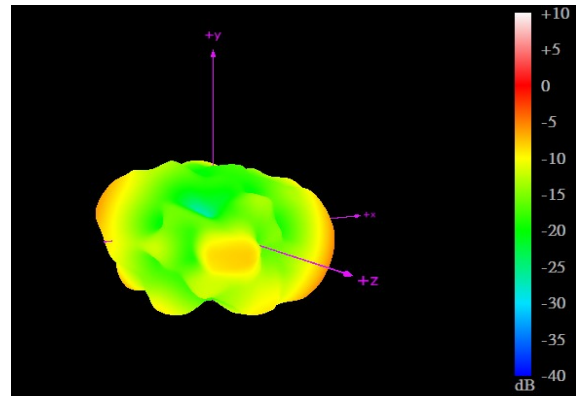
704MHz



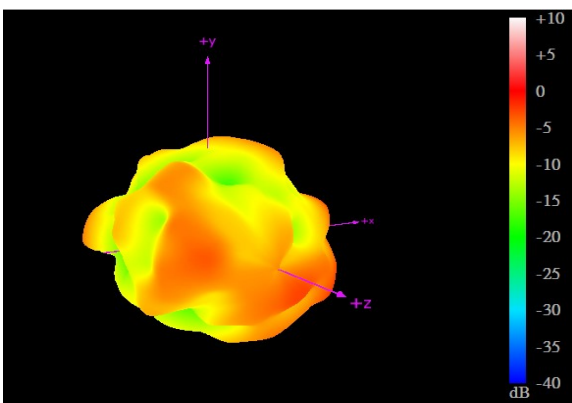
960MHz



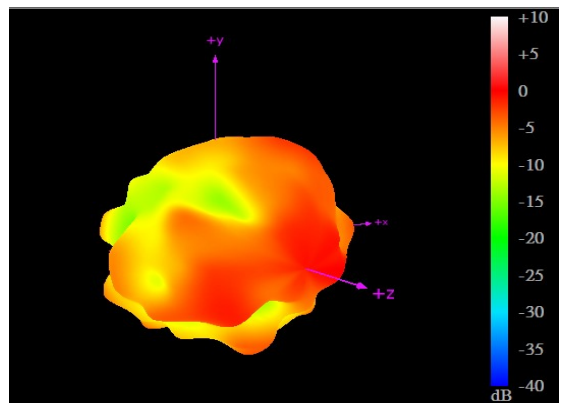
1710MHz



2170MHz



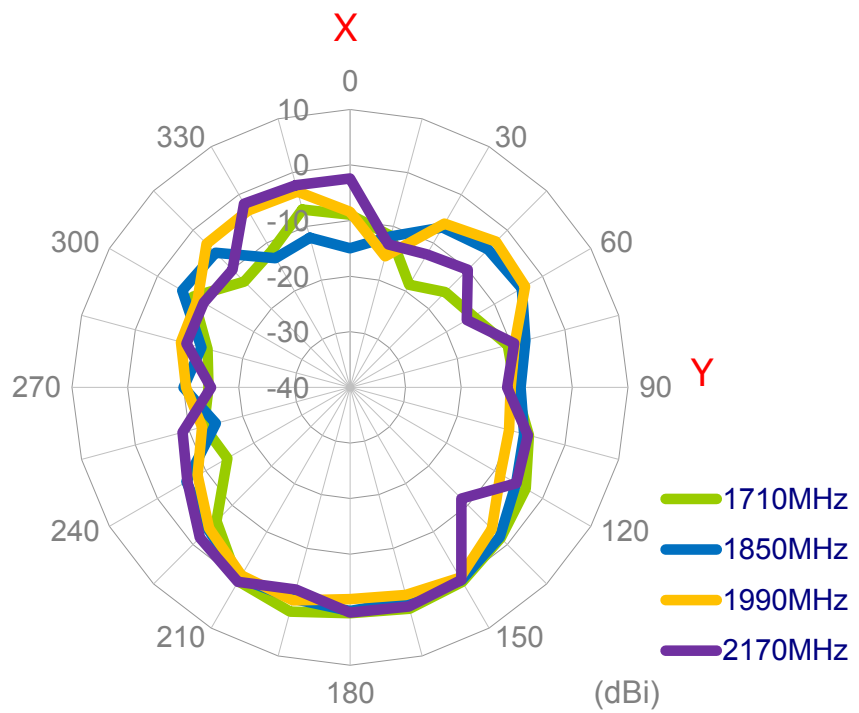
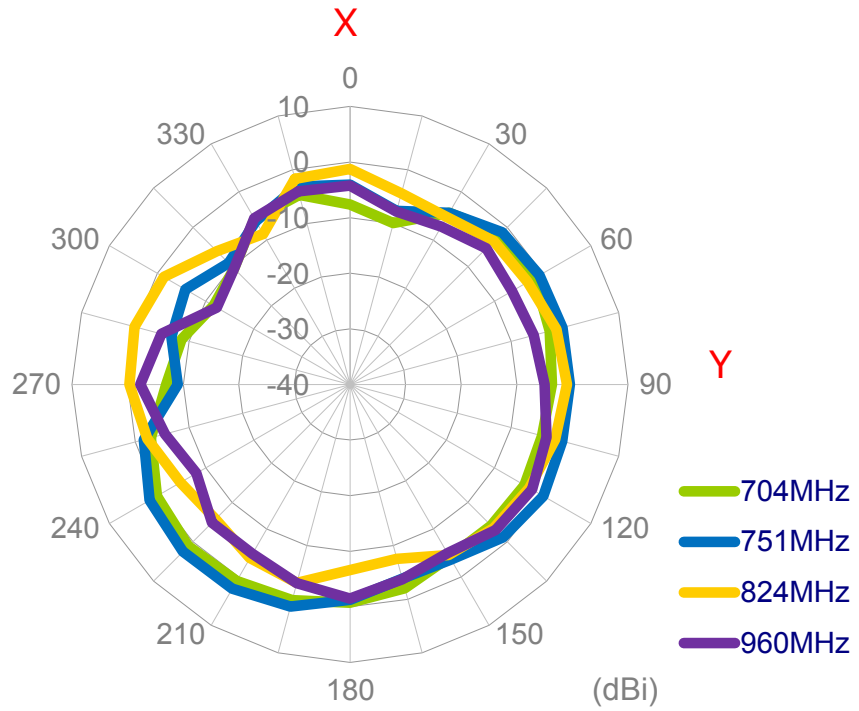
2690MHz

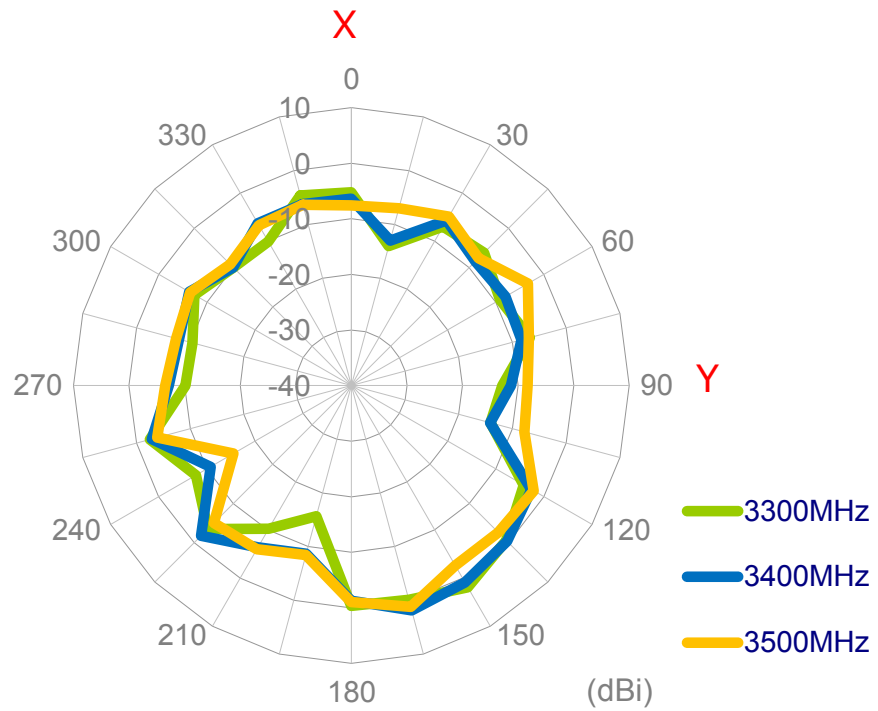
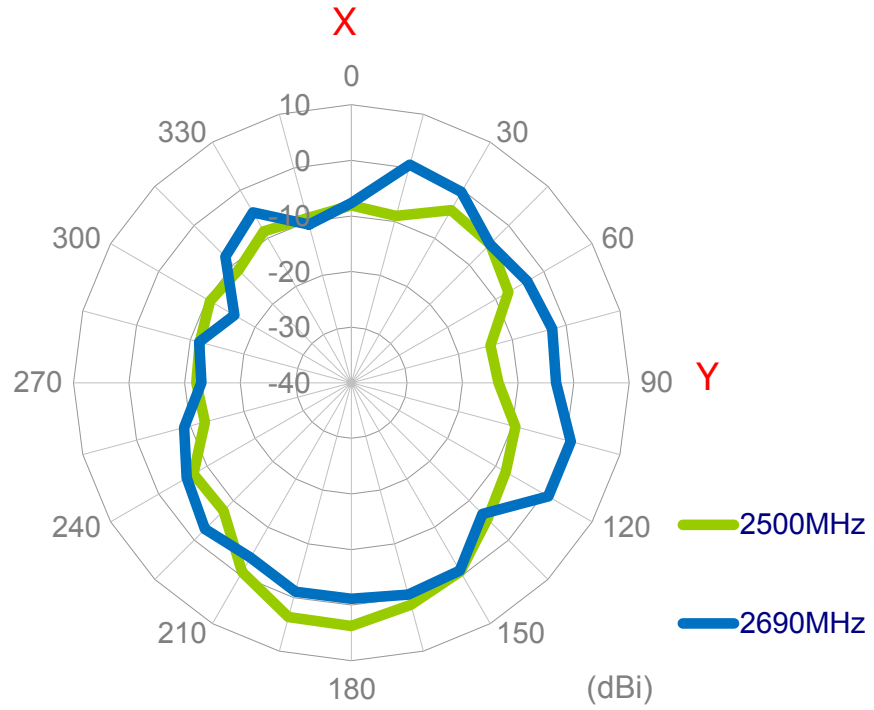


3500MHz

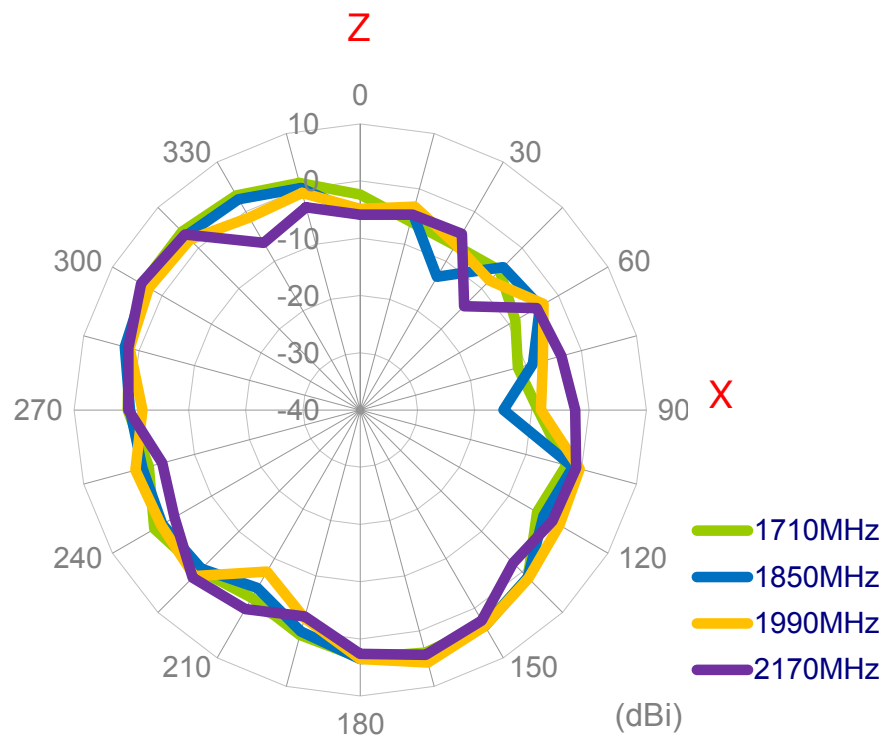
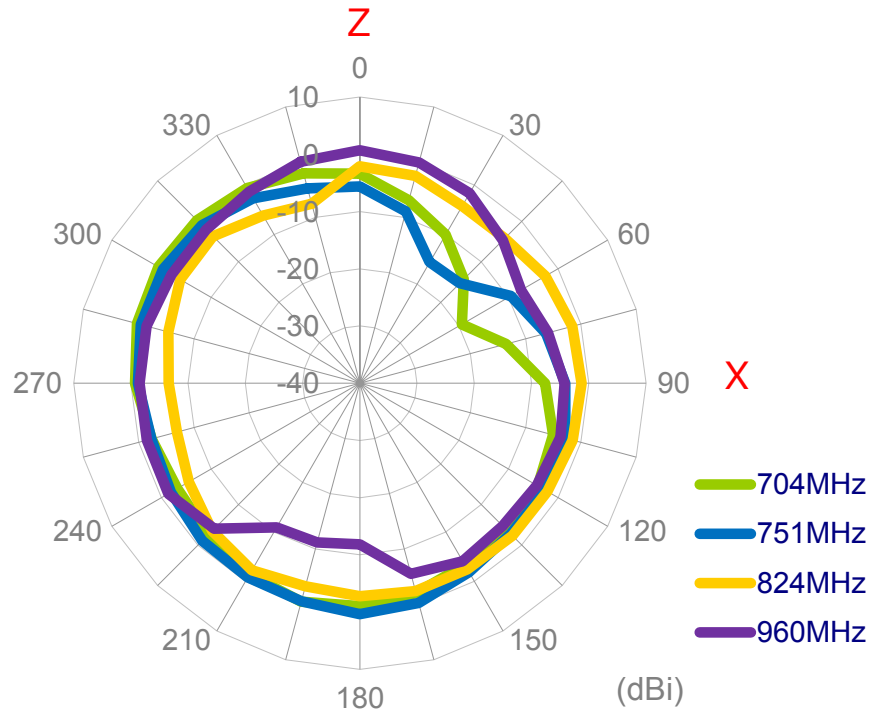
3.1.41 2D Radiation Pattern (LTE_MIMO2 with 1M cable length on glass)

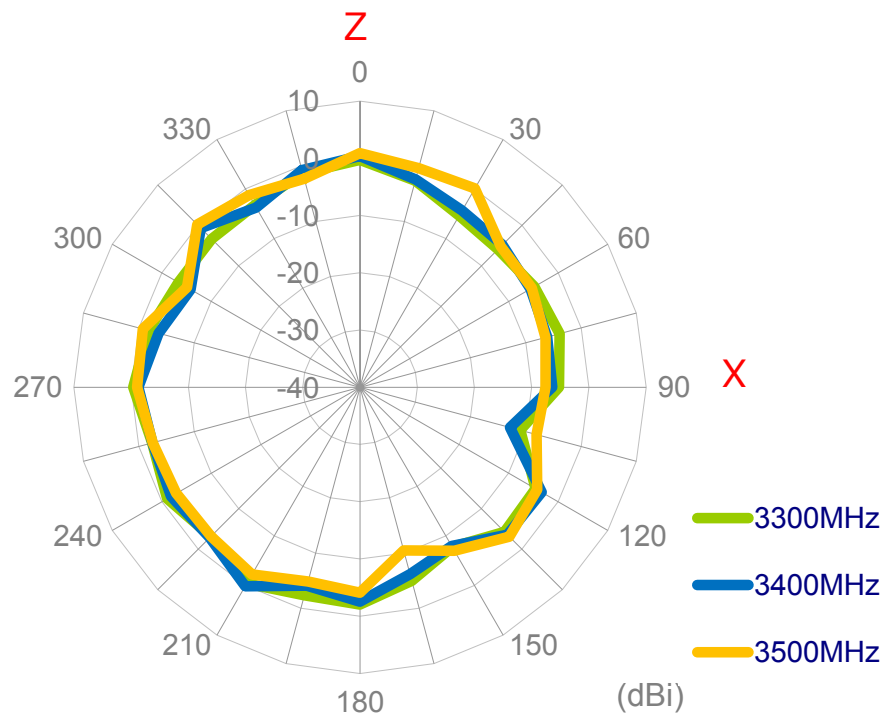
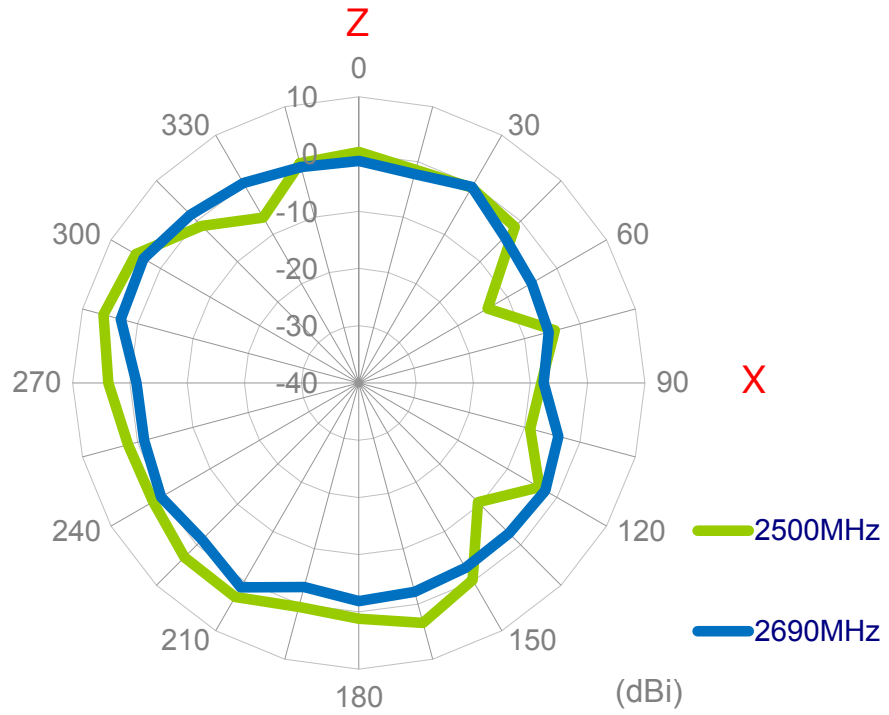
XY Plane



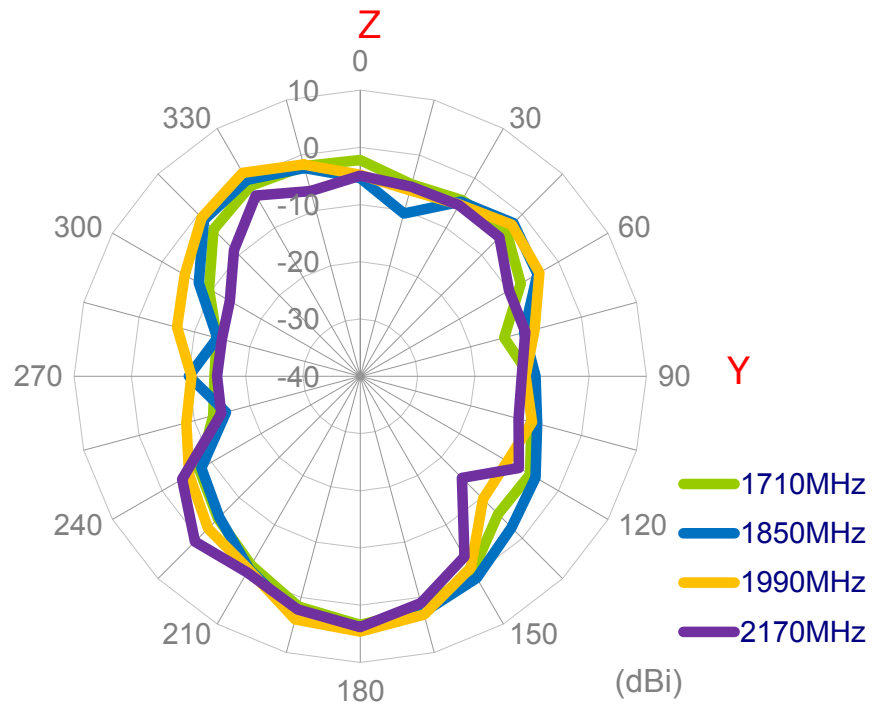
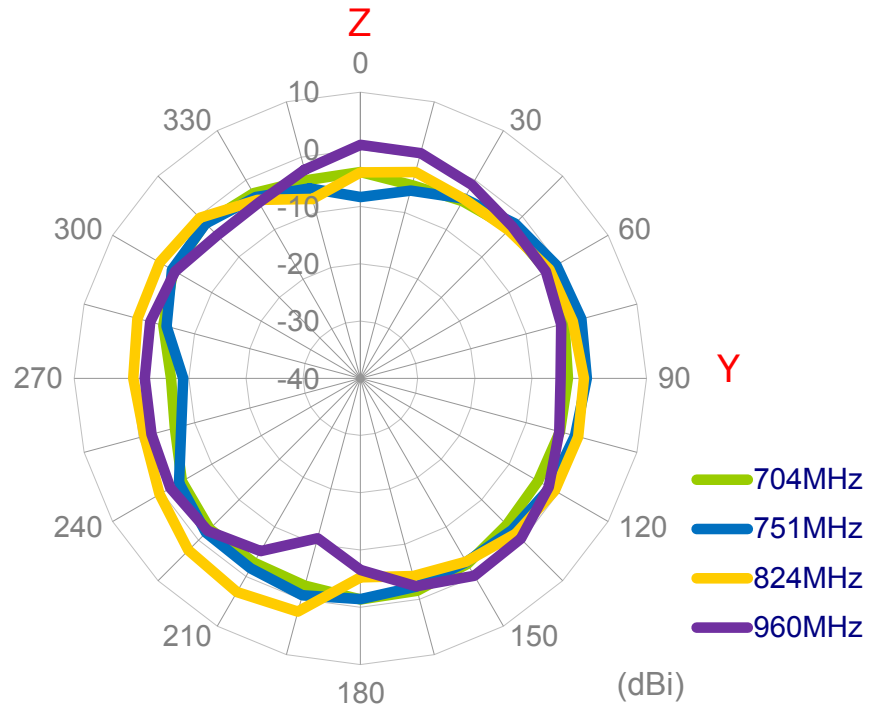


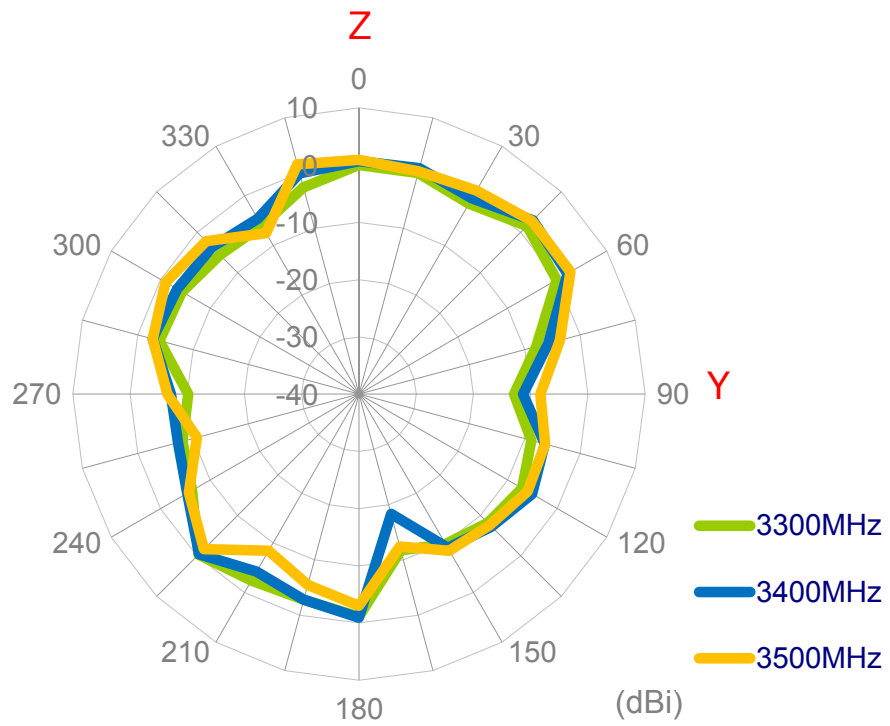
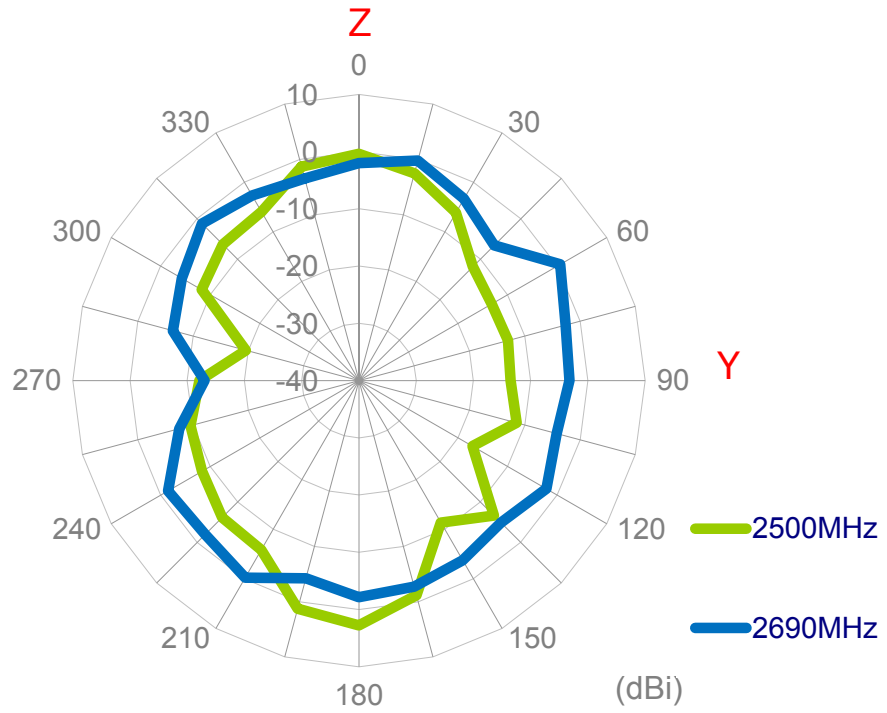
XZ Plane



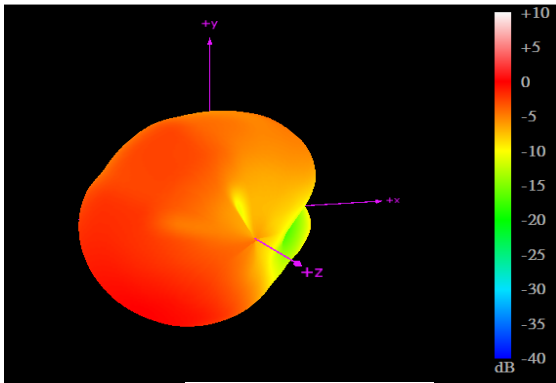


YZ Plane

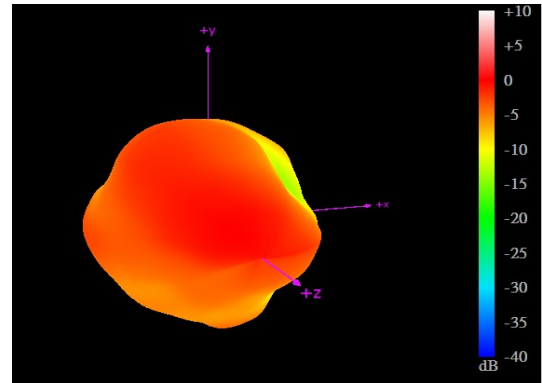




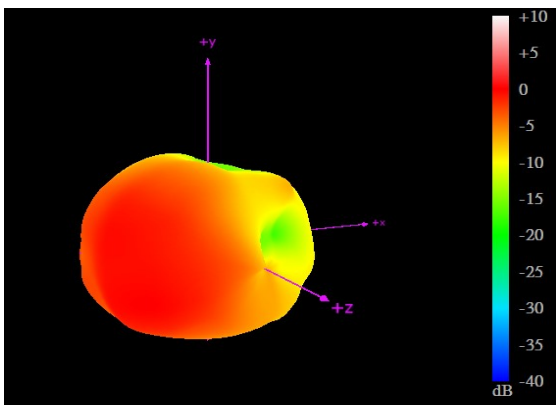
3.1.42 3D Radiation Pattern (LTE_MIMO2 with 1M cable length on glass)



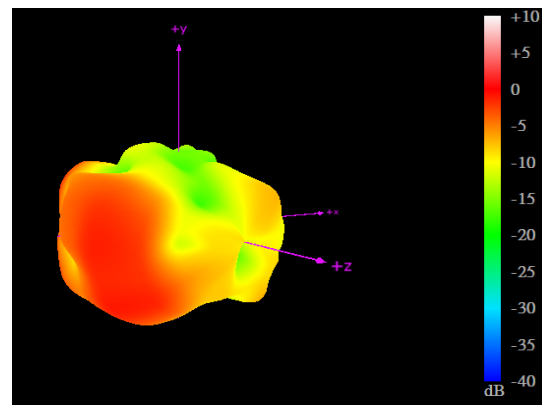
704MHz



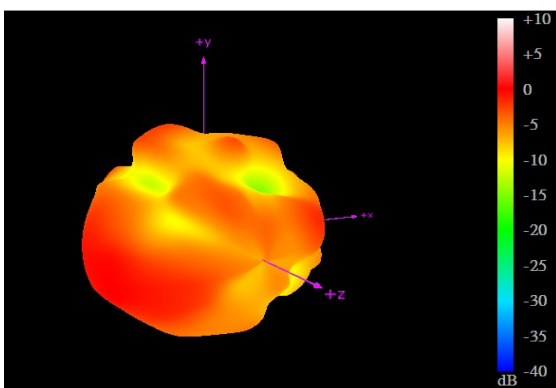
960MHz



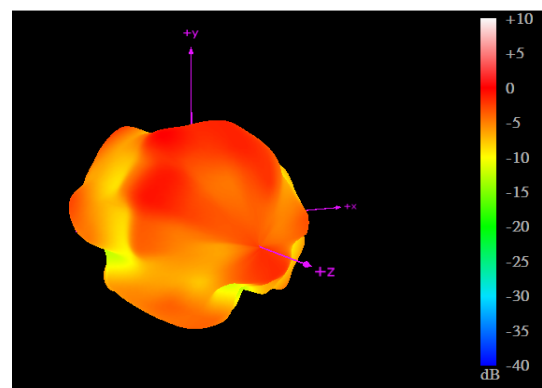
1710MHz



2170MHz



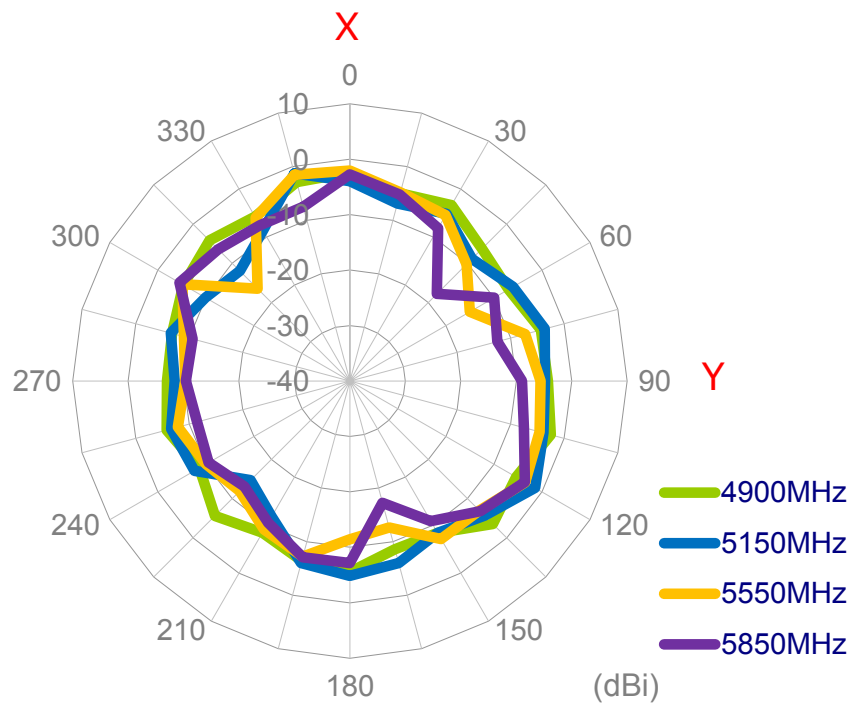
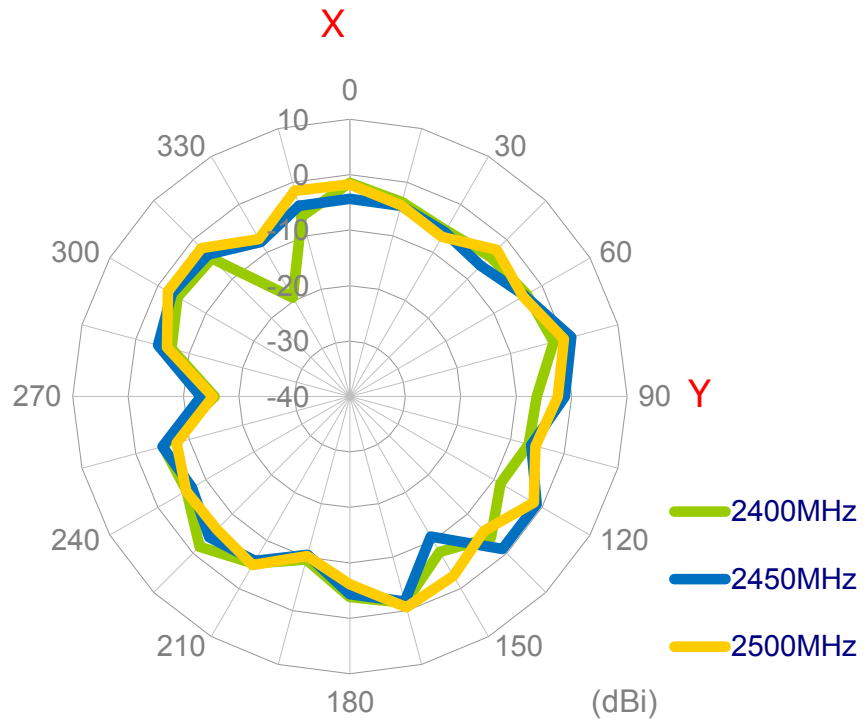
2690MHz



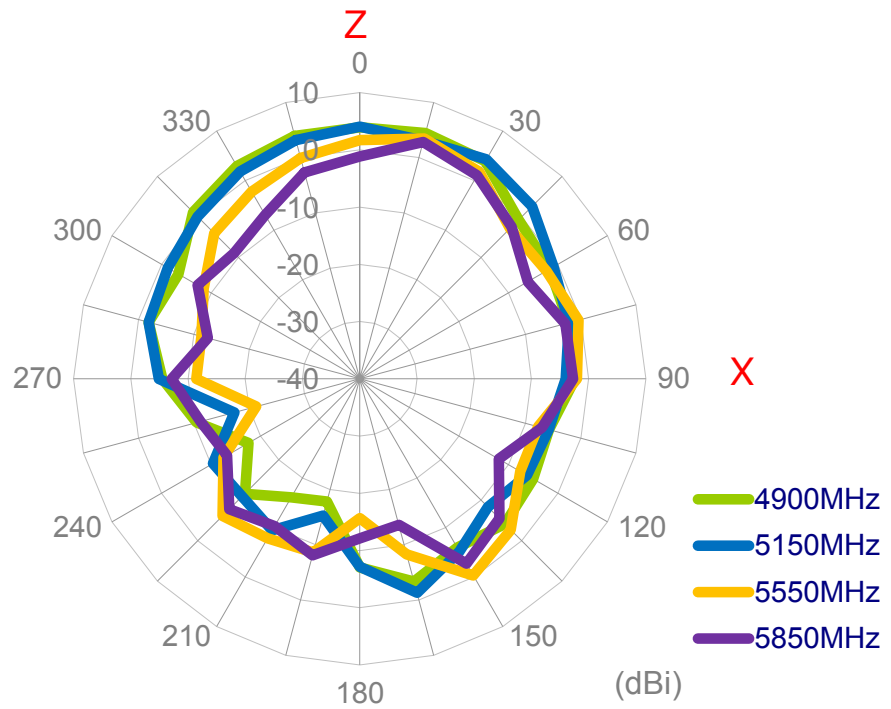
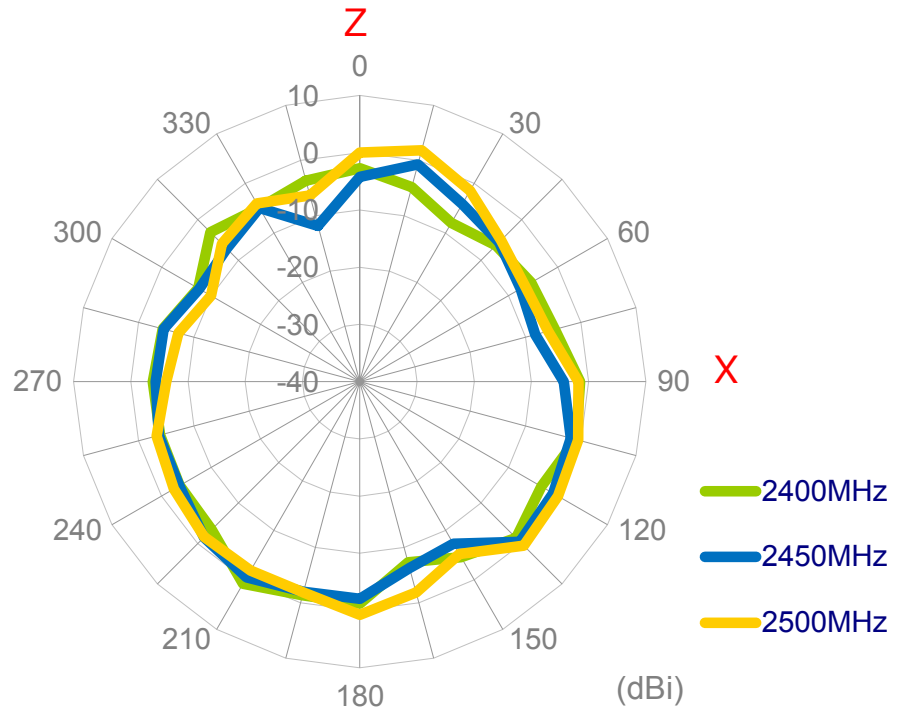
3500MHz

3.1.43 2D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length on glass)

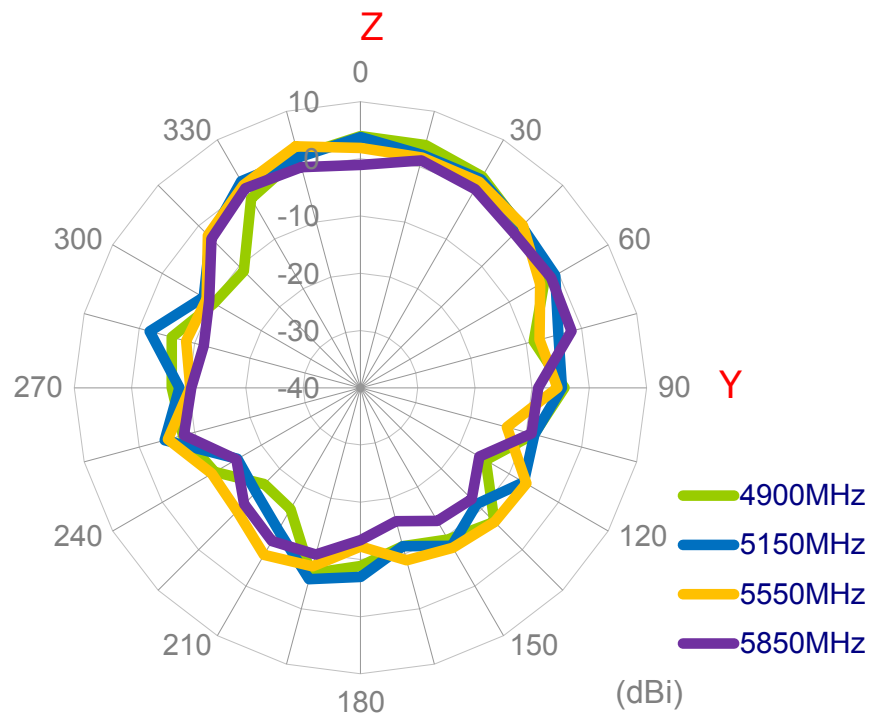
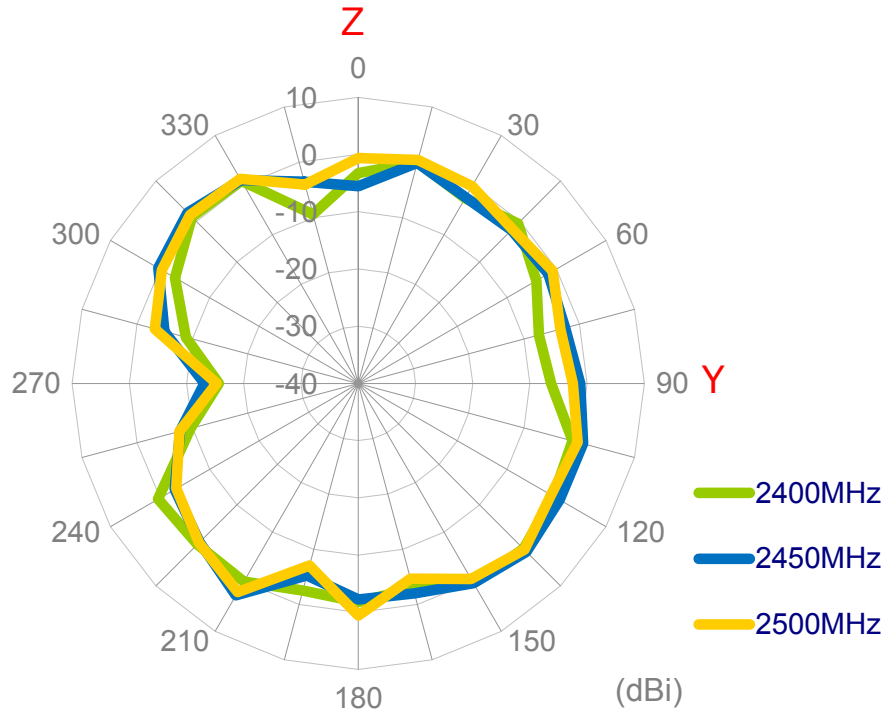
XY Plane



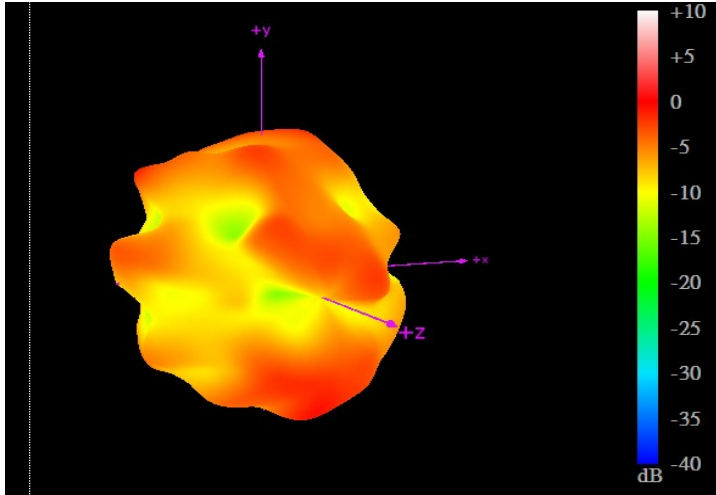
XZ Plane



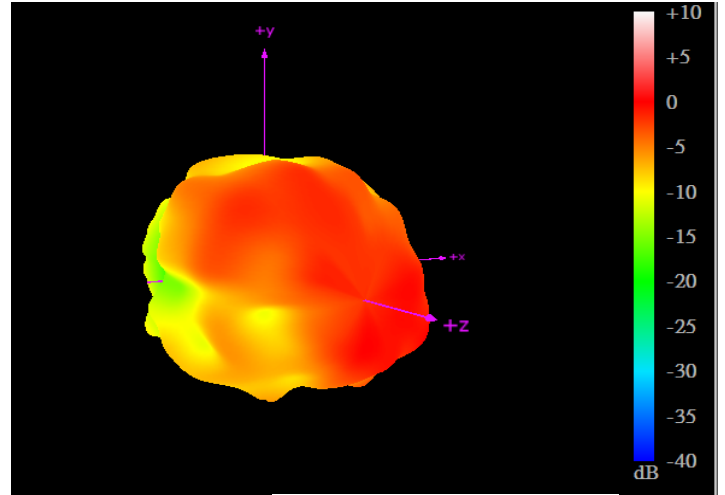
YZ Plane



3.1.44 3D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length on glass)



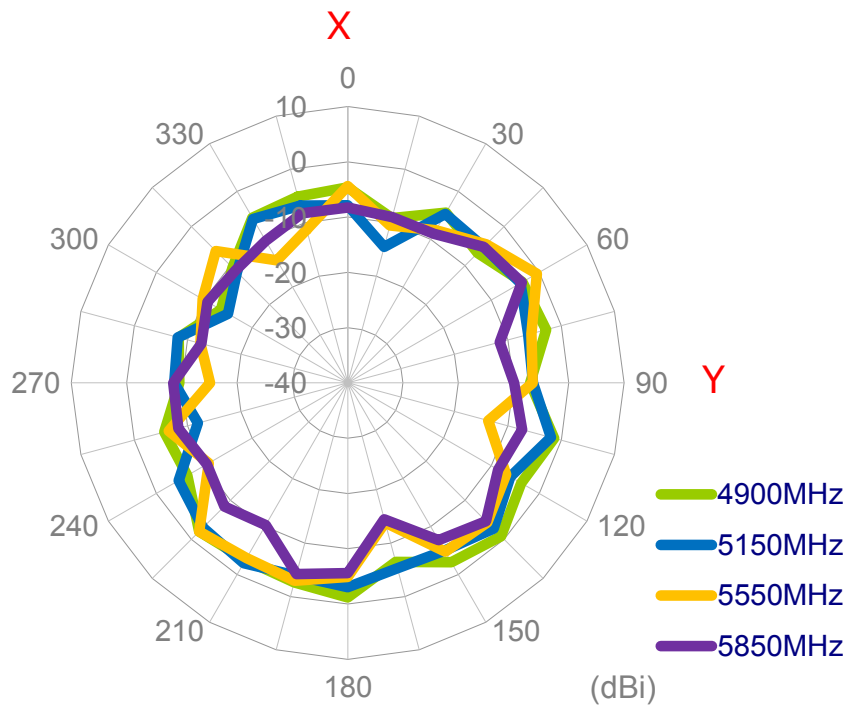
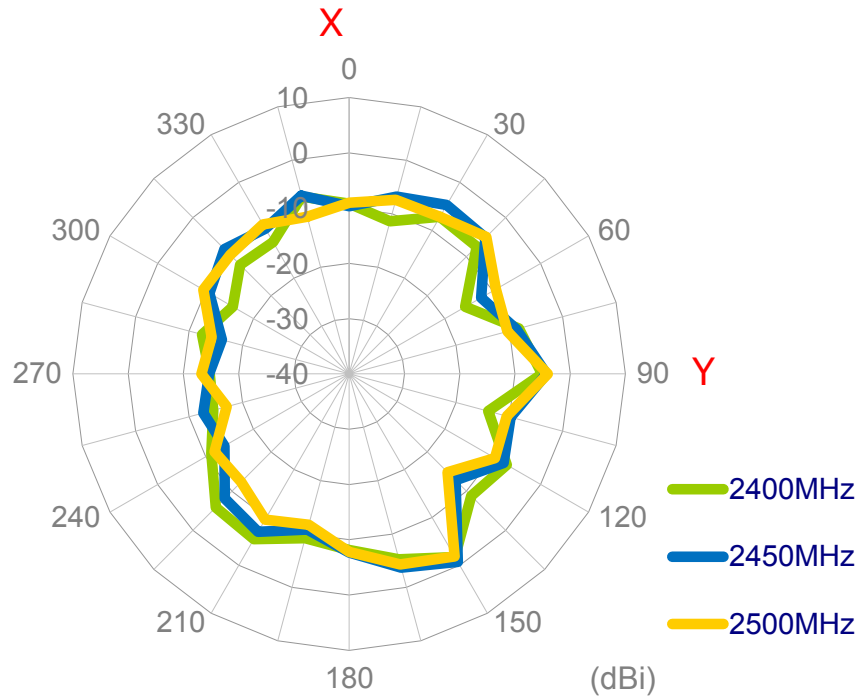
2450MHz



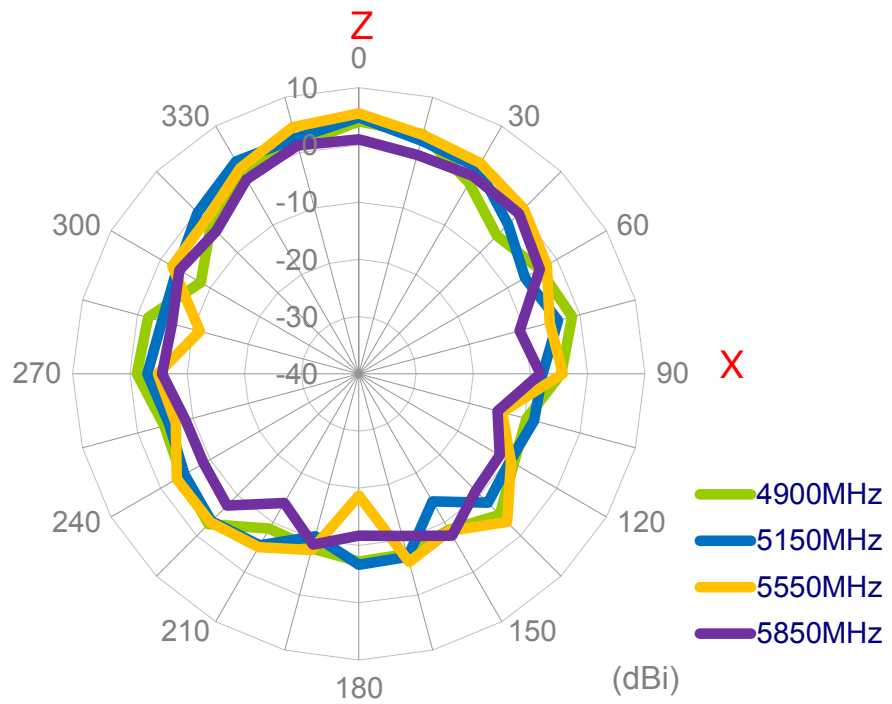
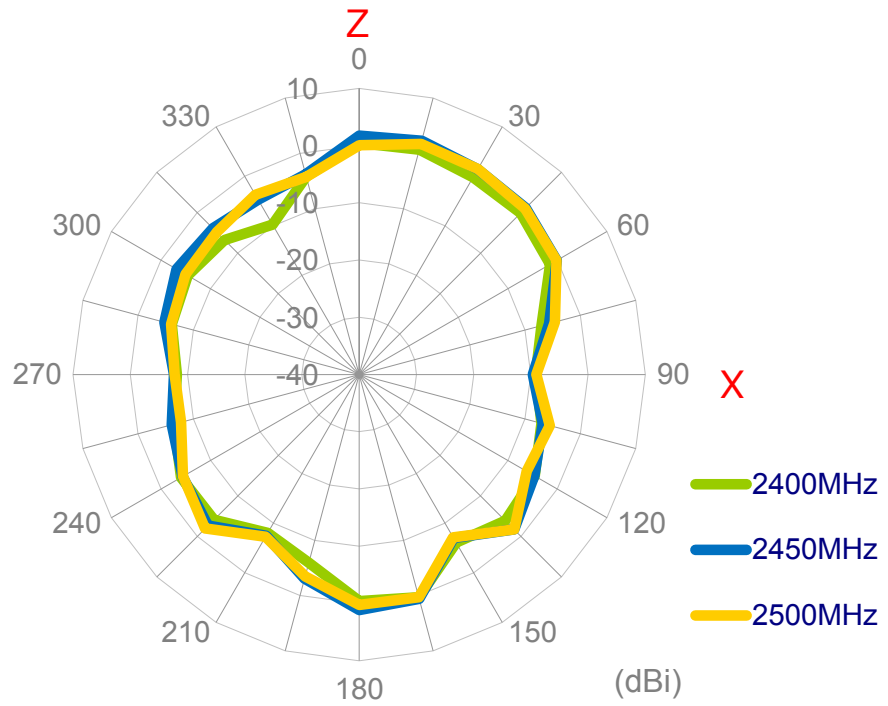
5550MHz

3.1.45 2D Radiation Pattern (Wi-Fi_MIMO2 with 3M cable length on glass)

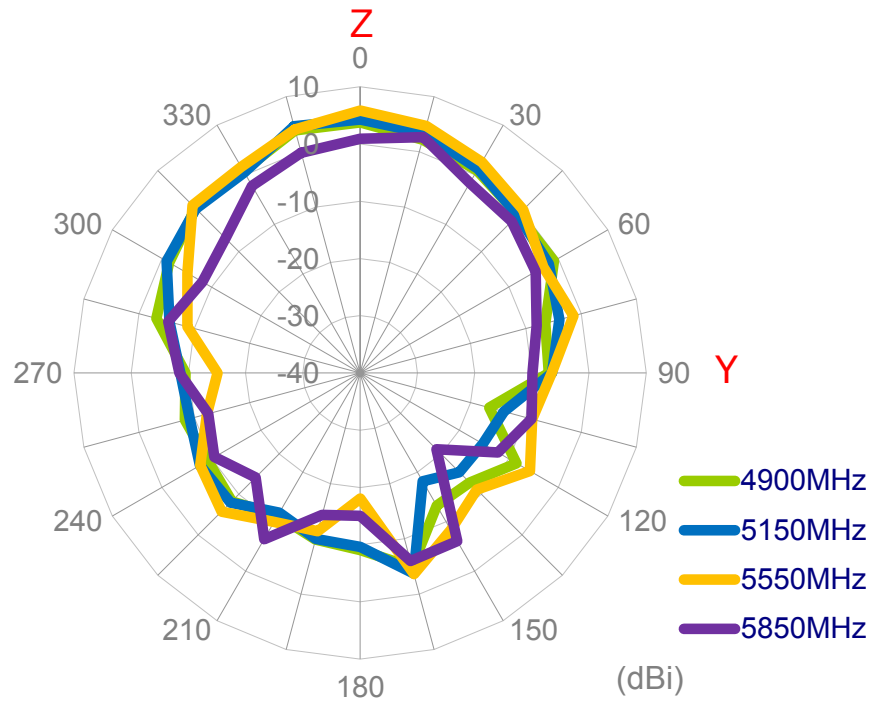
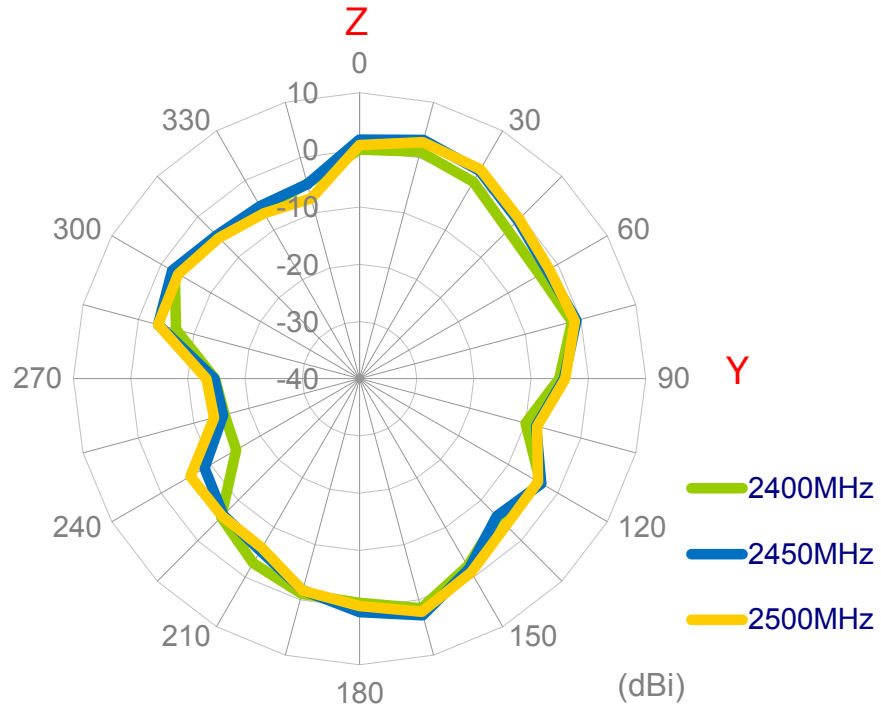
XY Plane



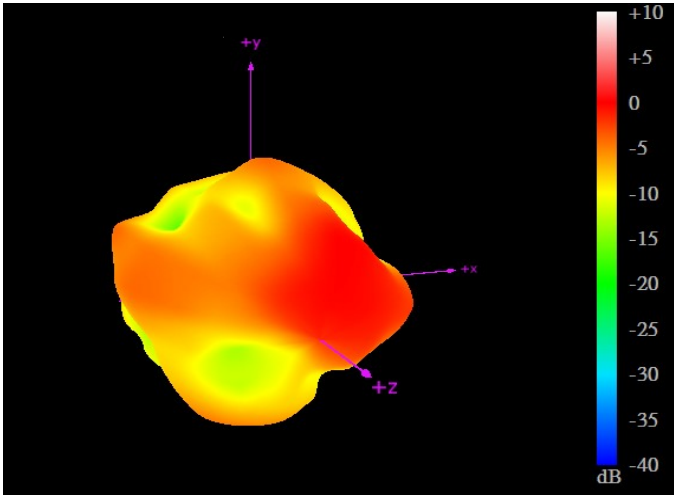
XZ Plane



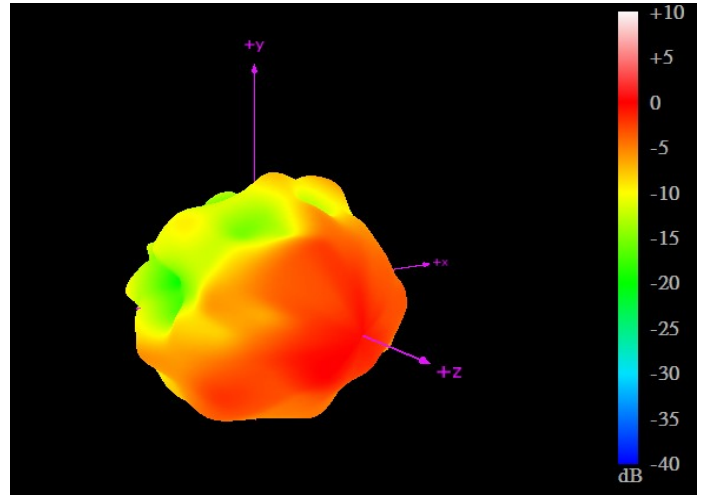
YZ Plane



3.1.46 3D Radiation Pattern (Wi-Fi_MIMO2 with 1M cable length on glass)

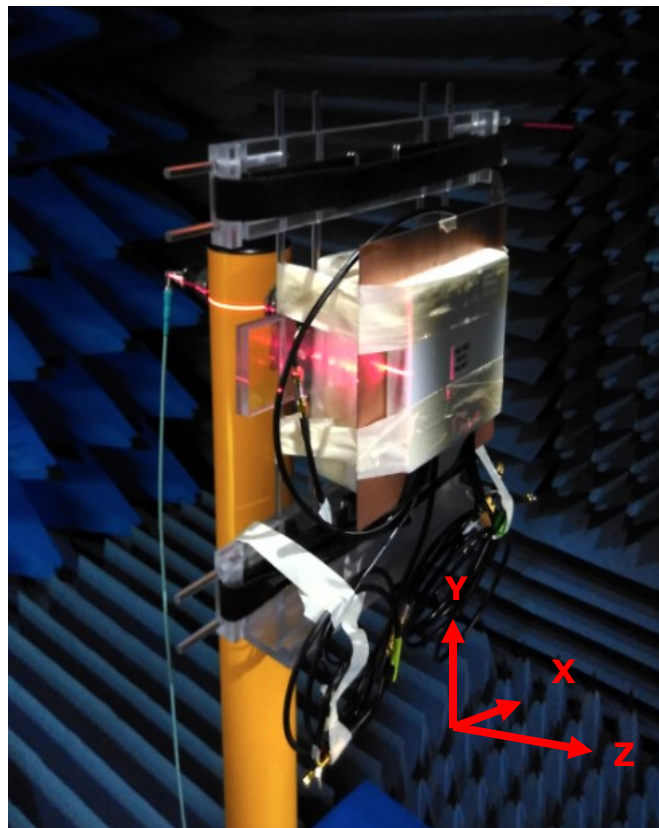


2450MHz



5550MHz

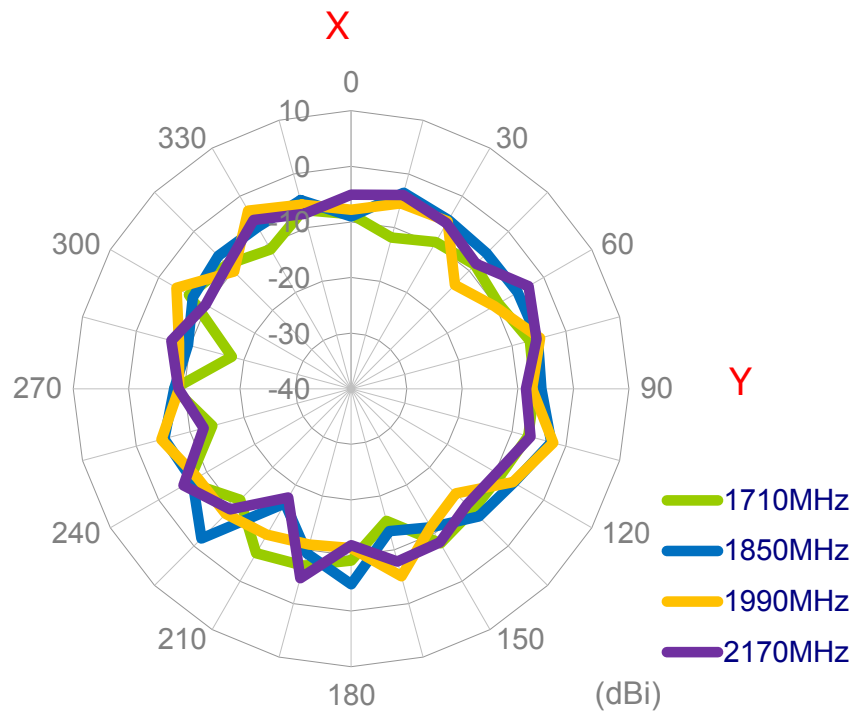
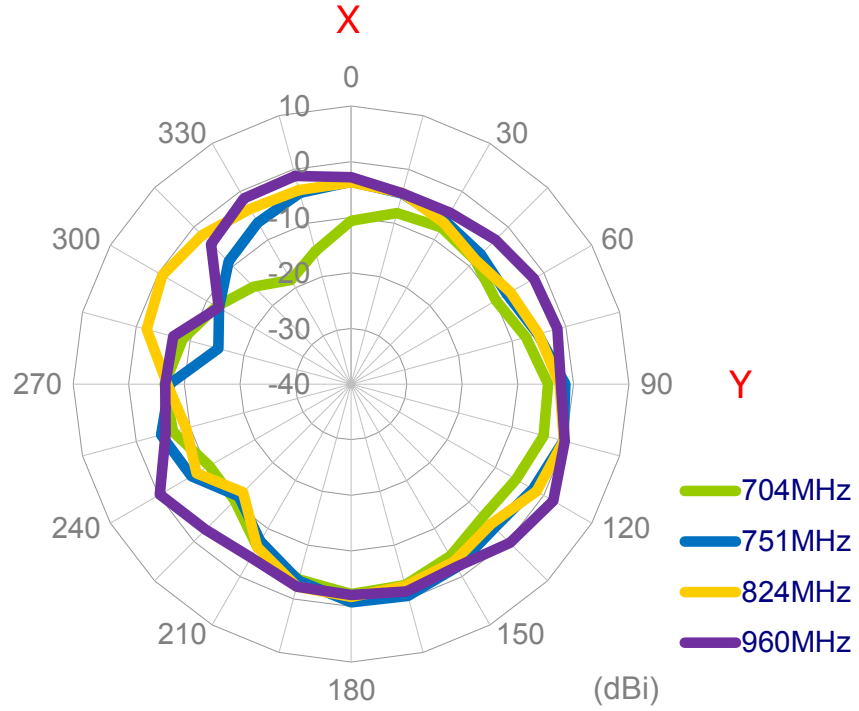
3.1.47 Test Setup For Antenna Radiation Pattern

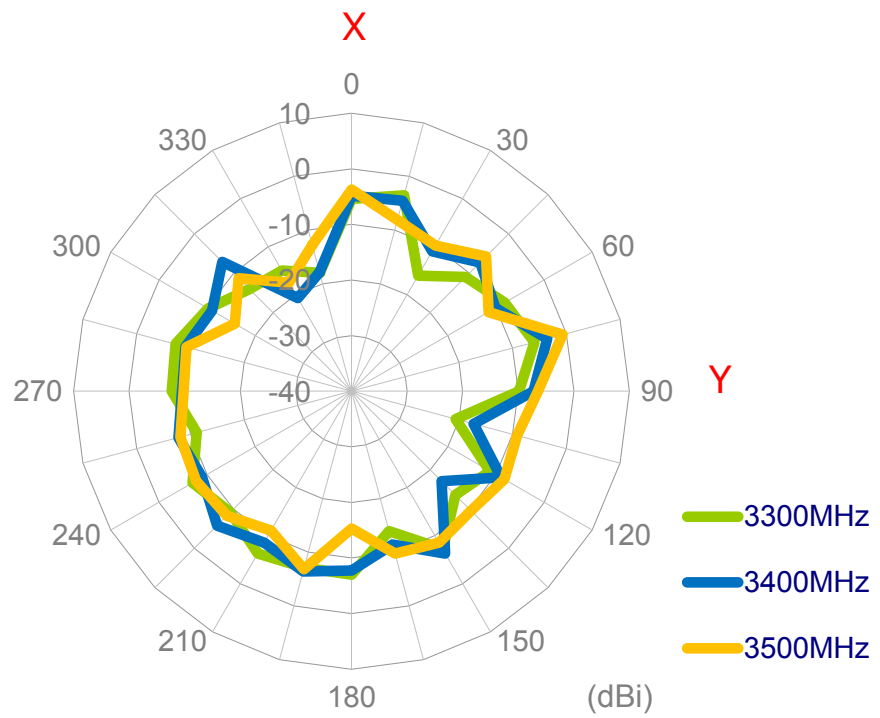
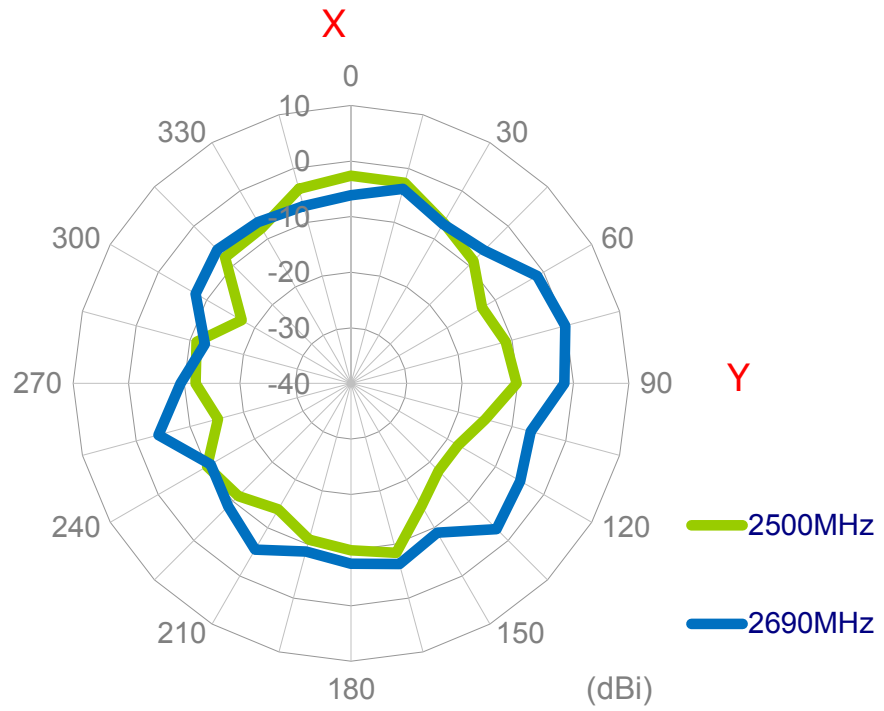


On metal

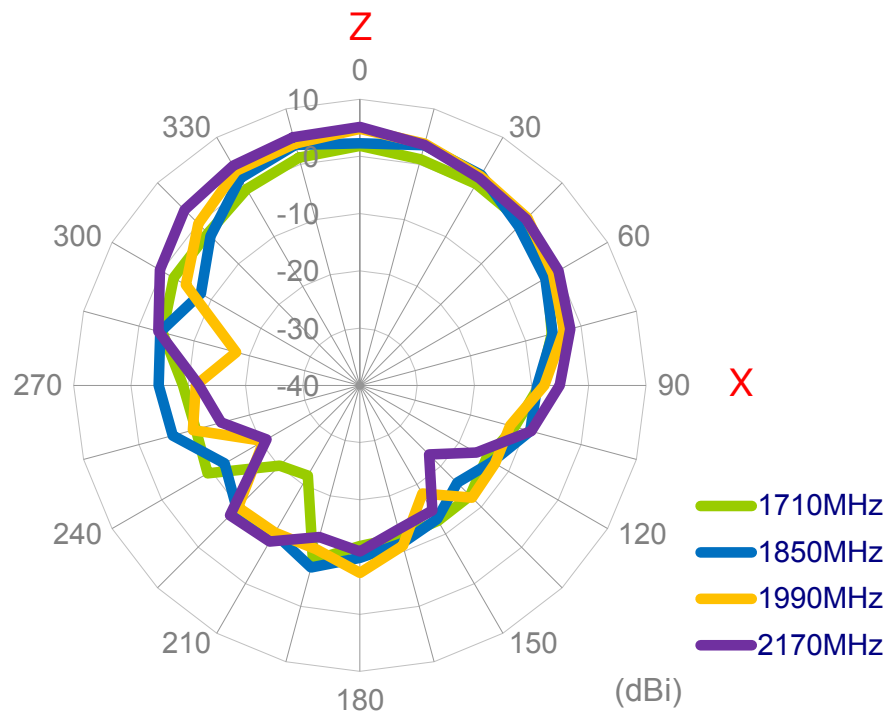
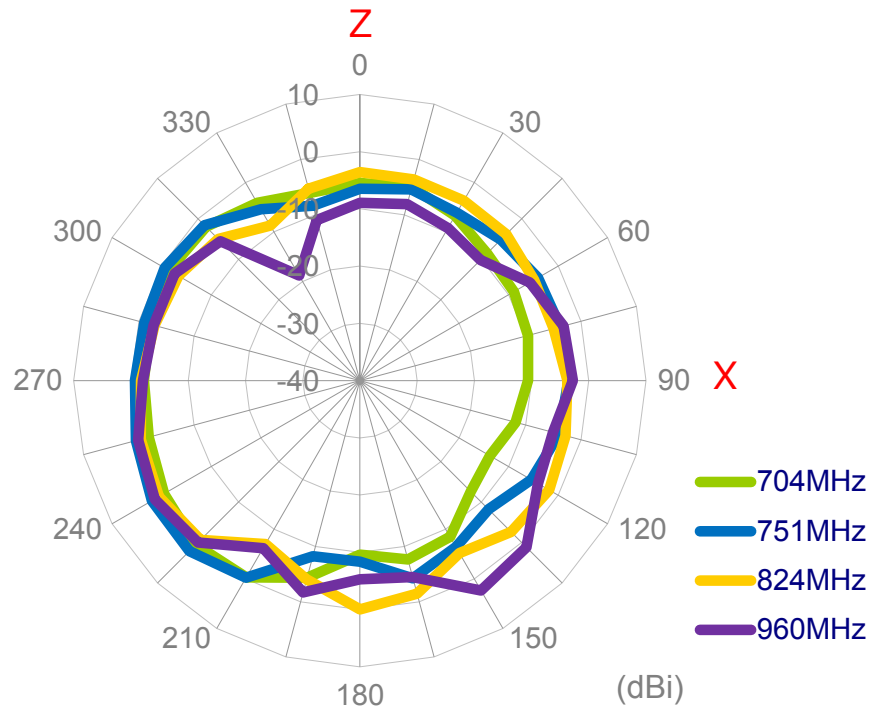
3.1.48 2D Radiation Pattern (LTE_MIMO1 with 1M cable length on metal)

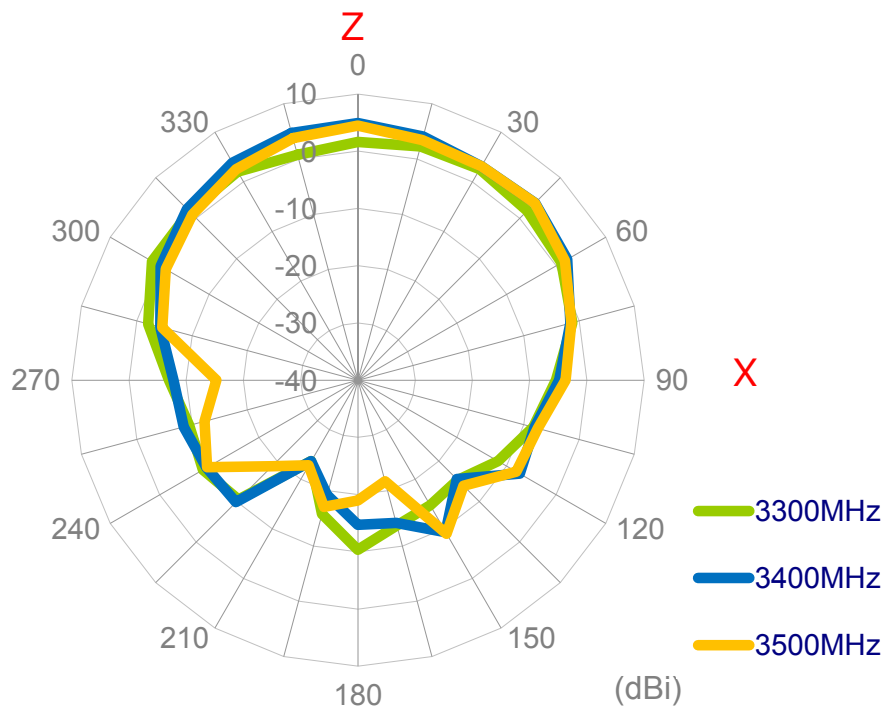
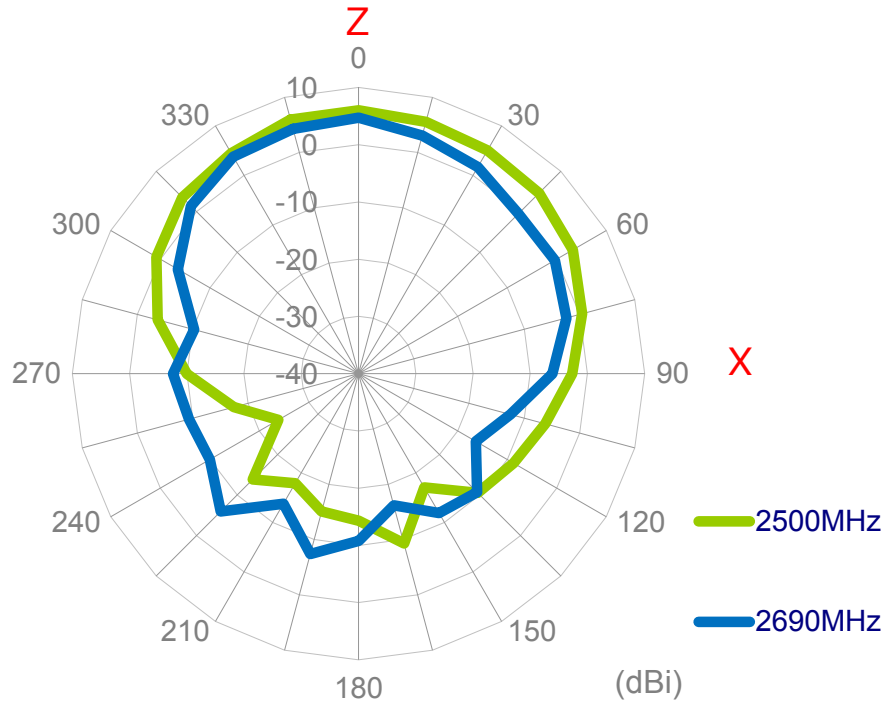
XY Plane



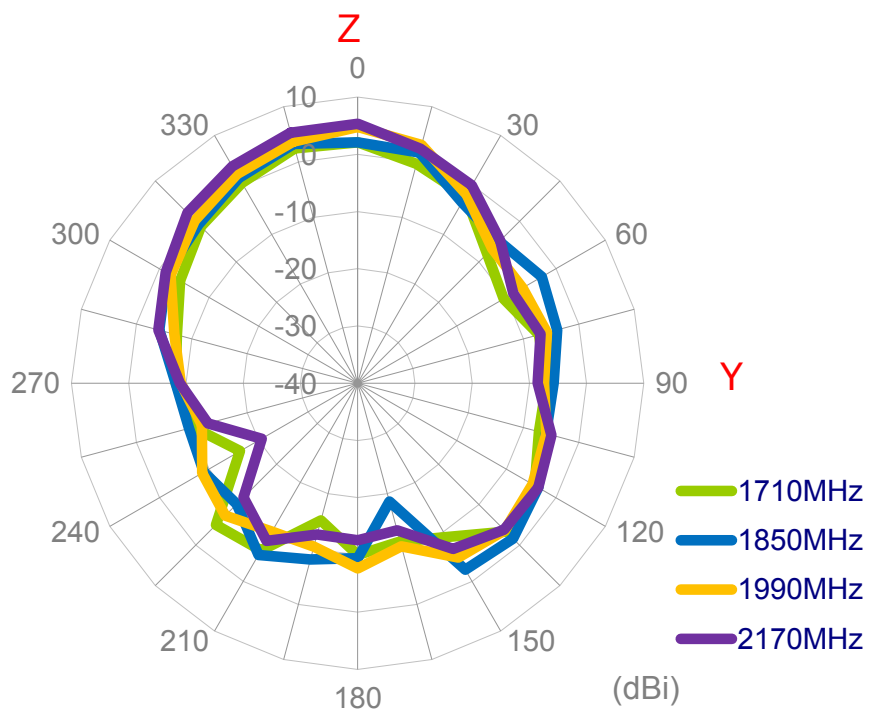
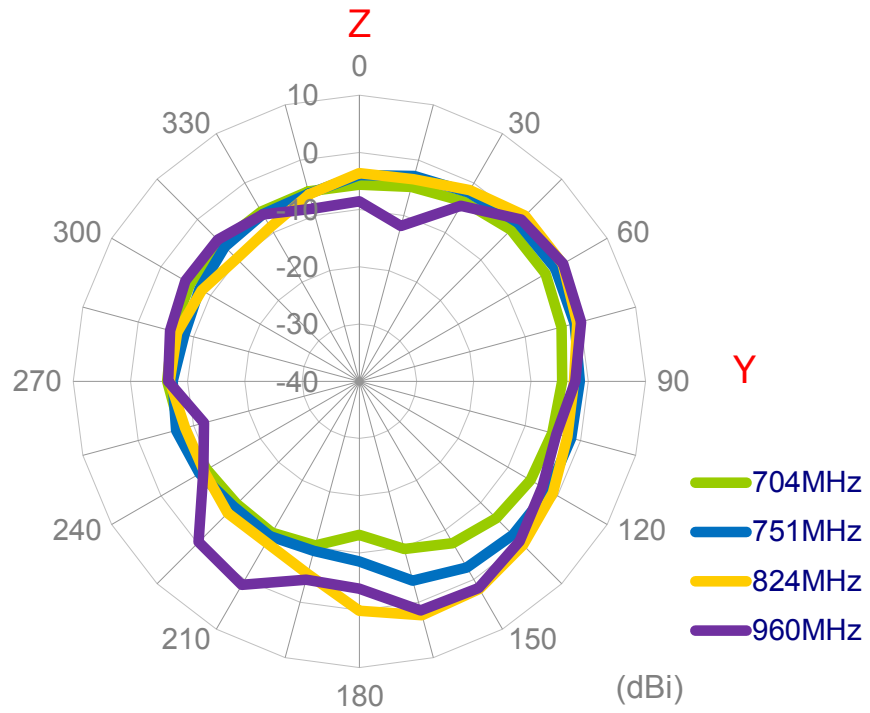


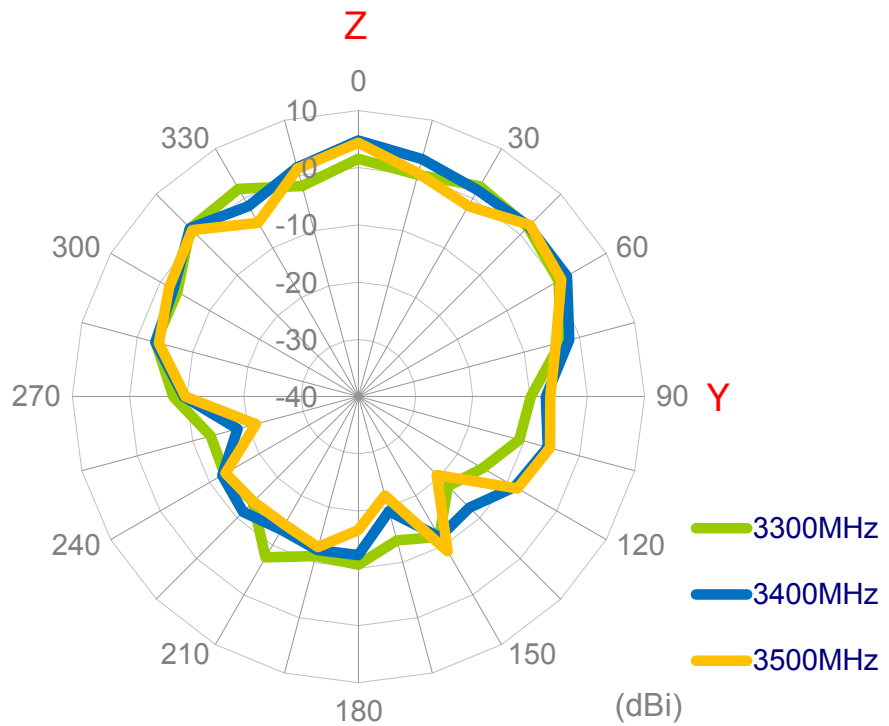
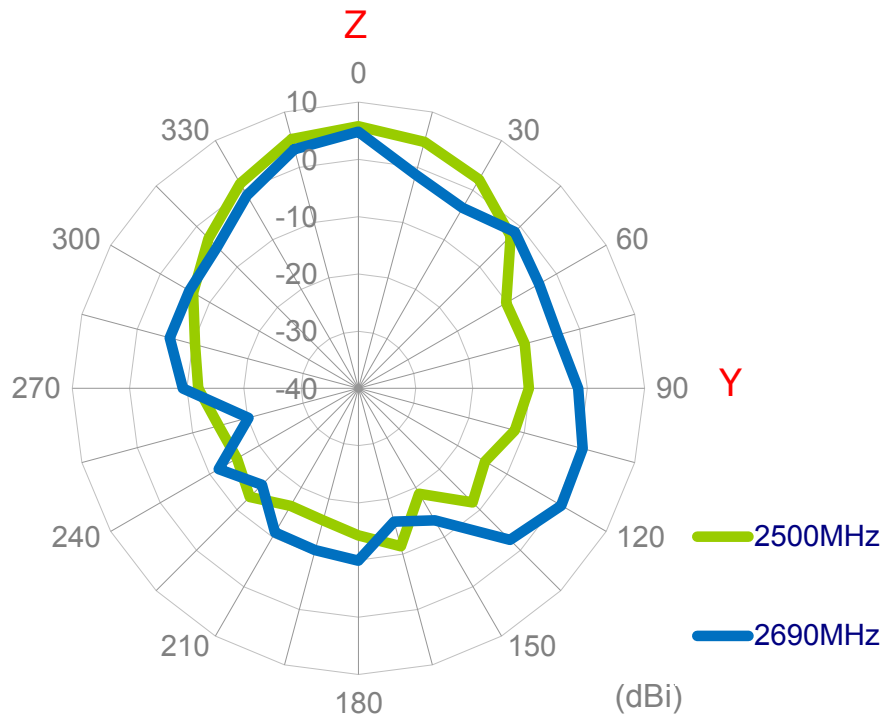
XZ Plane



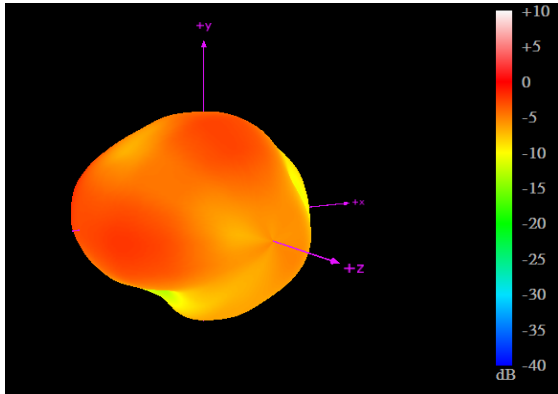


YZ Plane

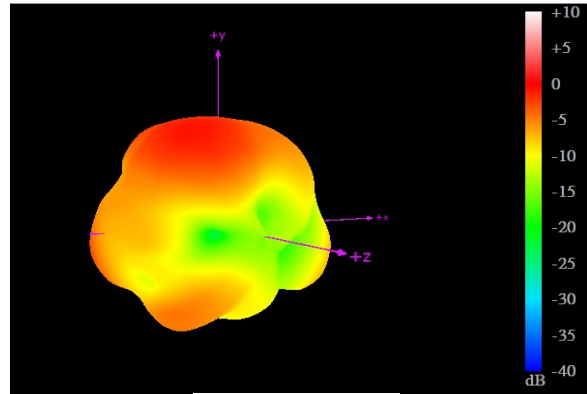




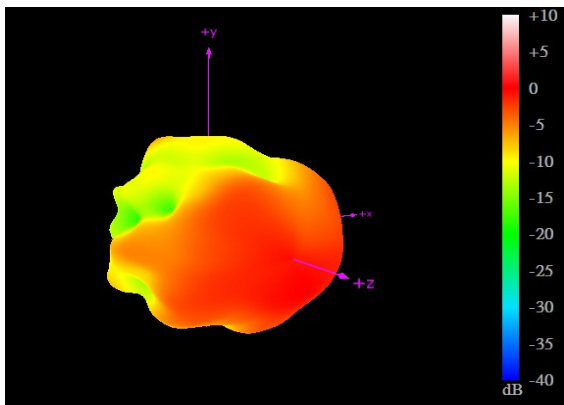
3.1.49 3D Radiation Pattern (LTE_MIMO1 with 1M cable length on metal)



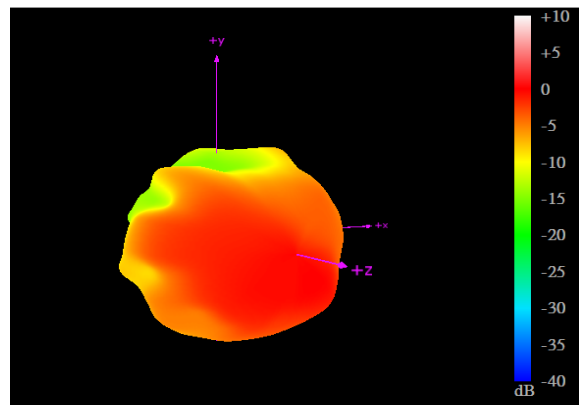
704MHz



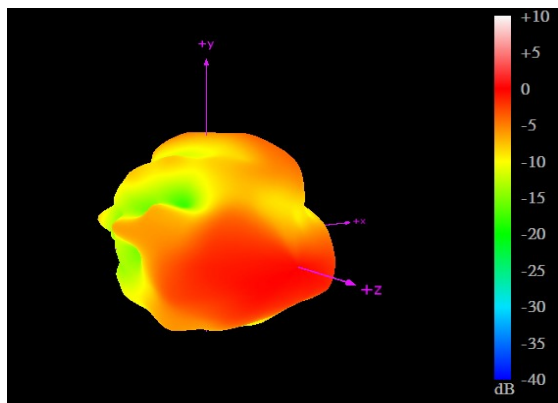
960MHz



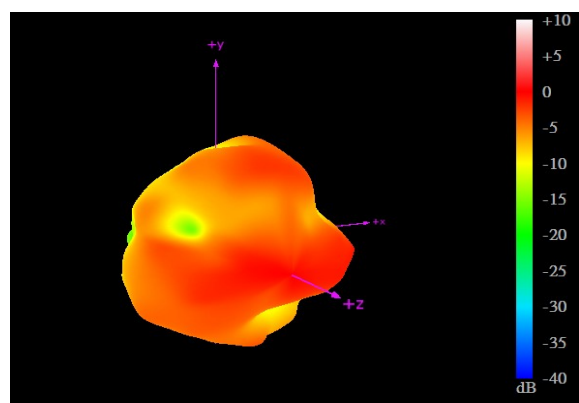
1710MHz



2170MHz

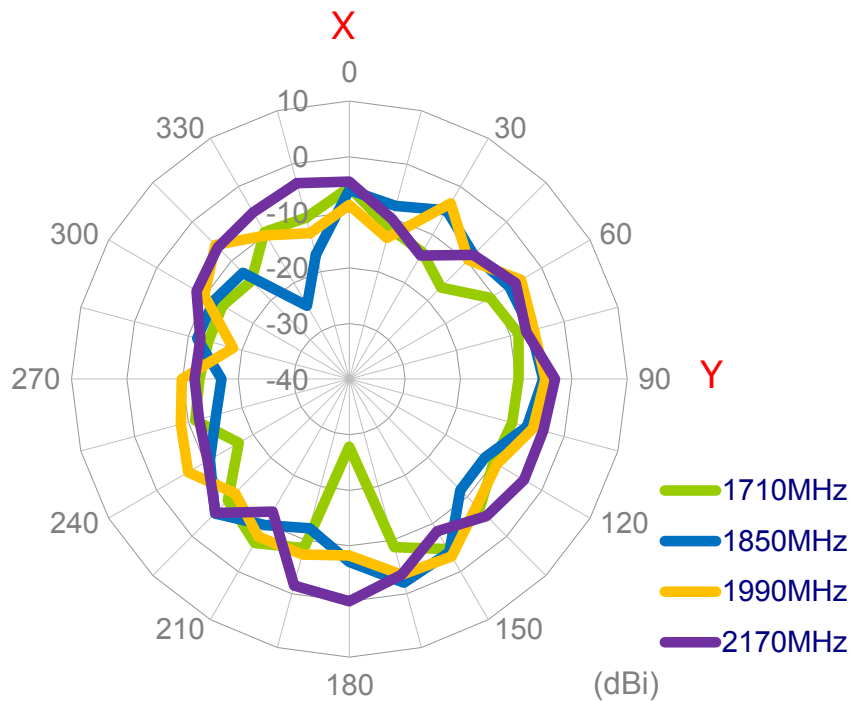
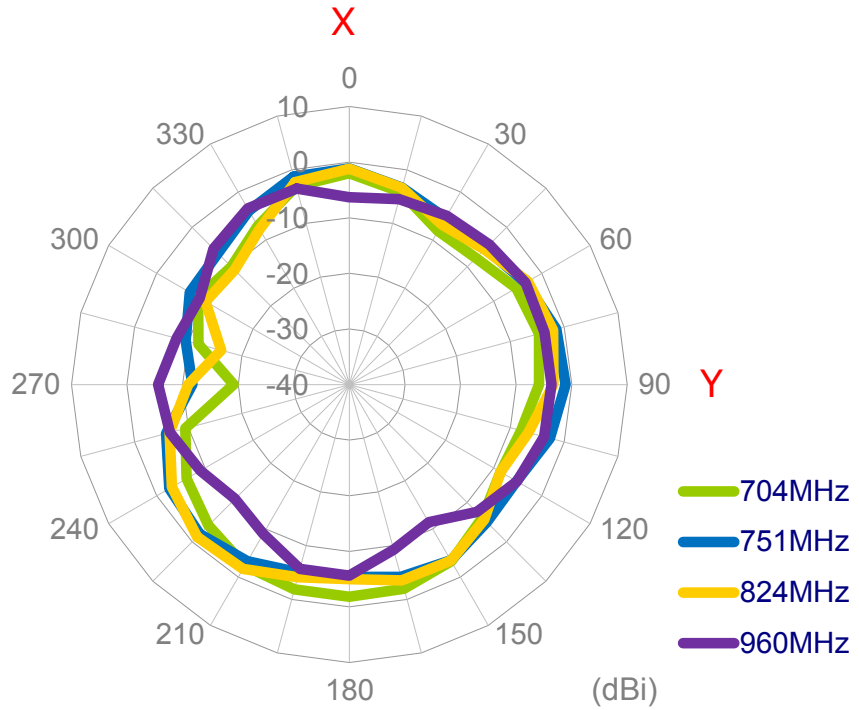


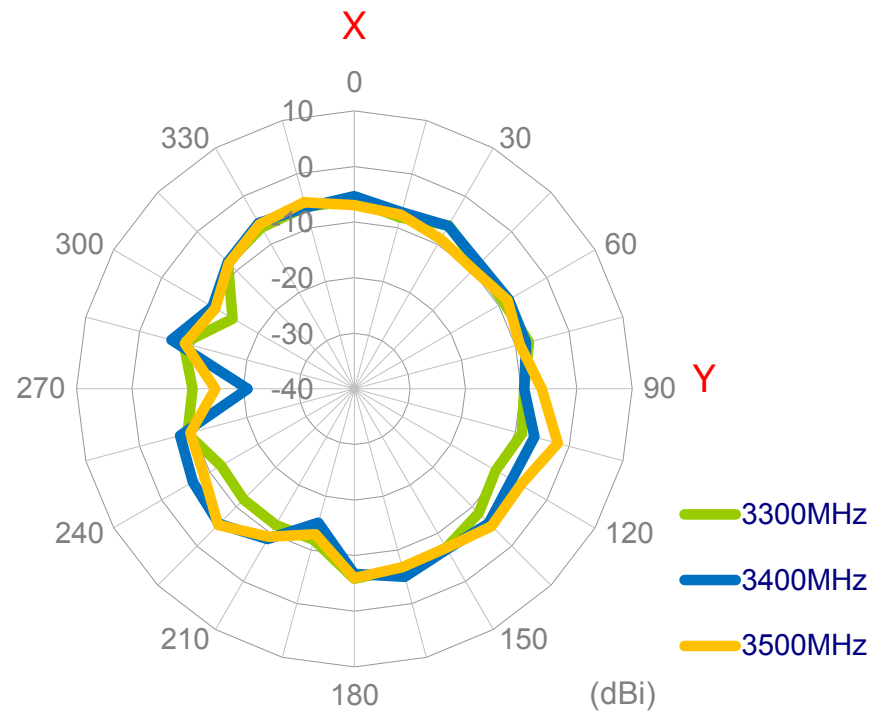
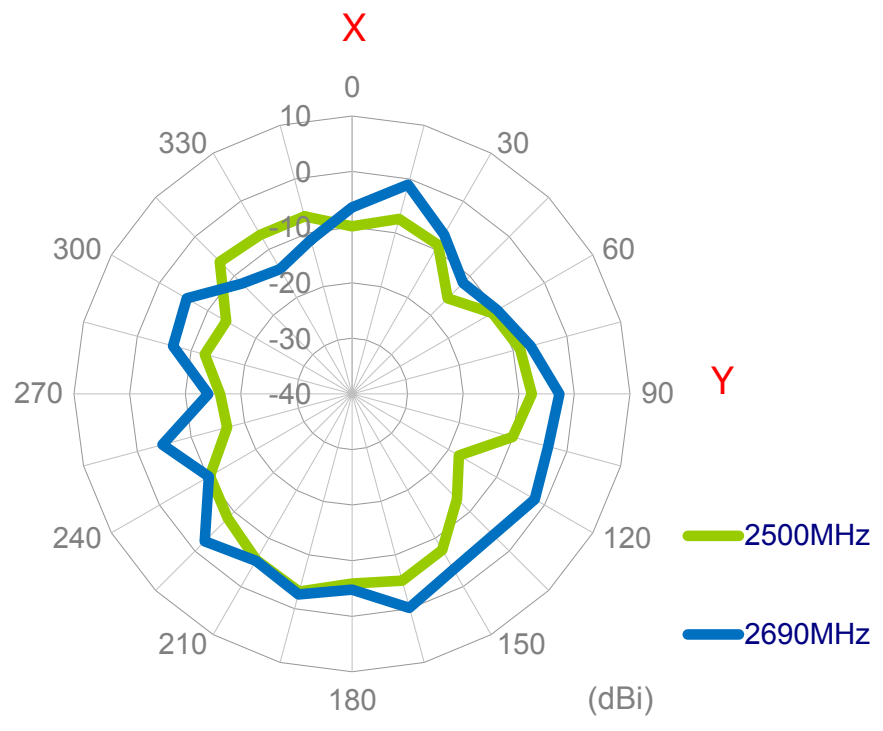
2690MHz



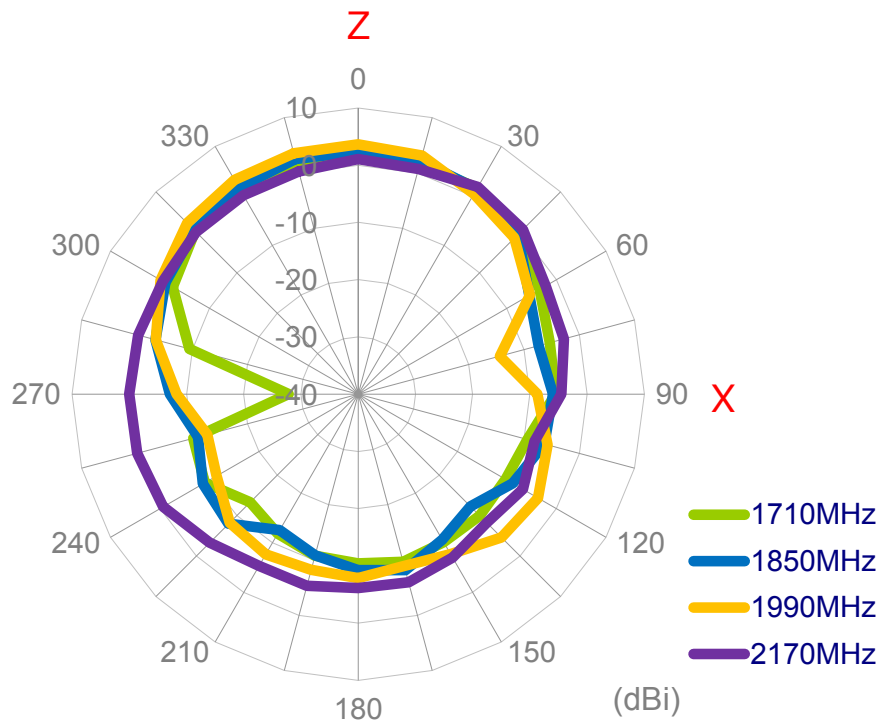
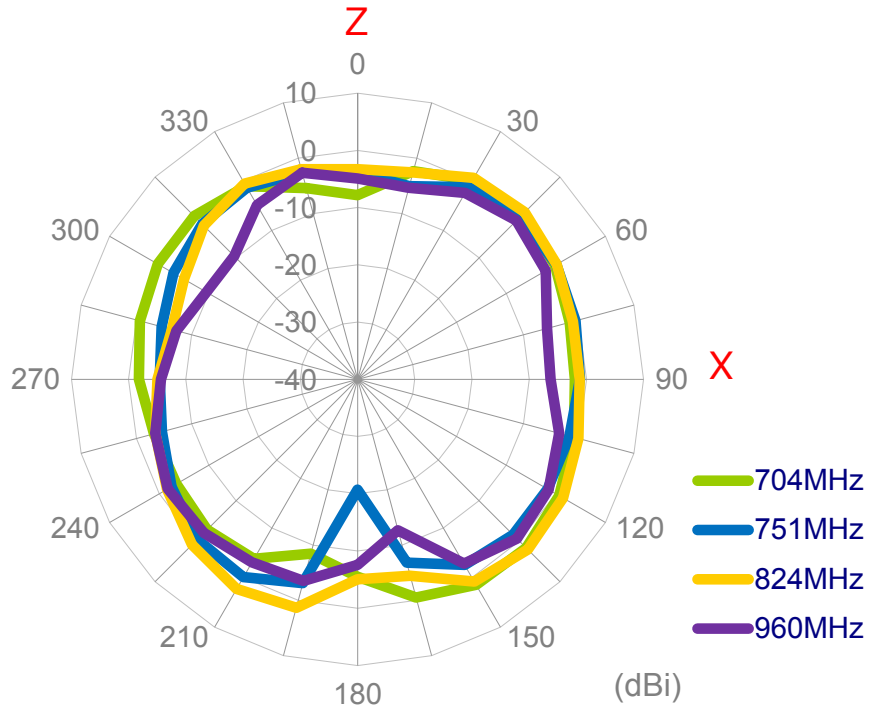
3500MHz

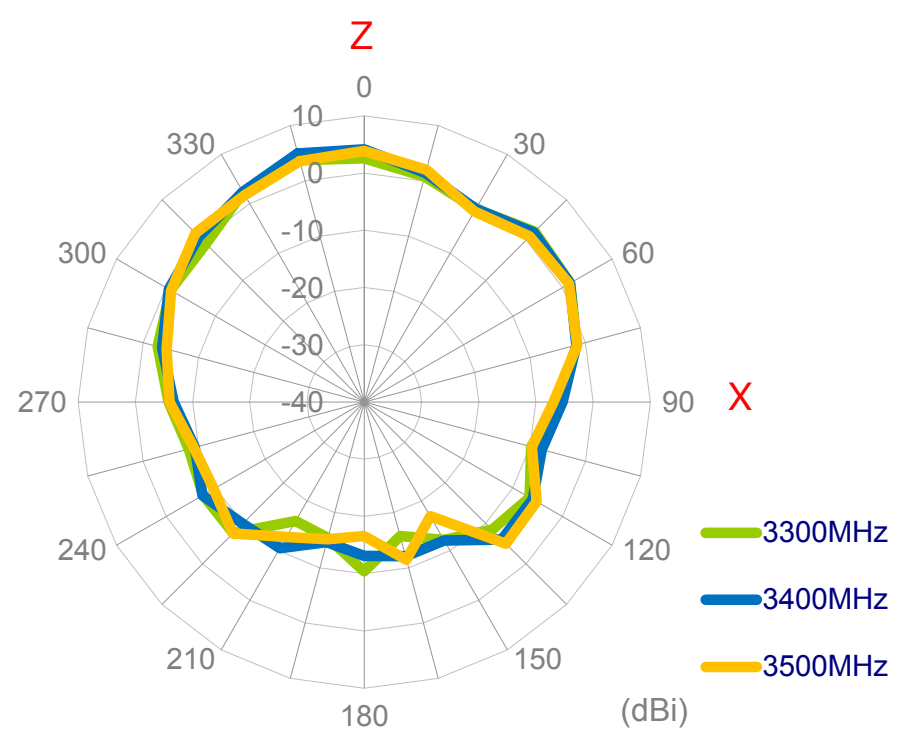
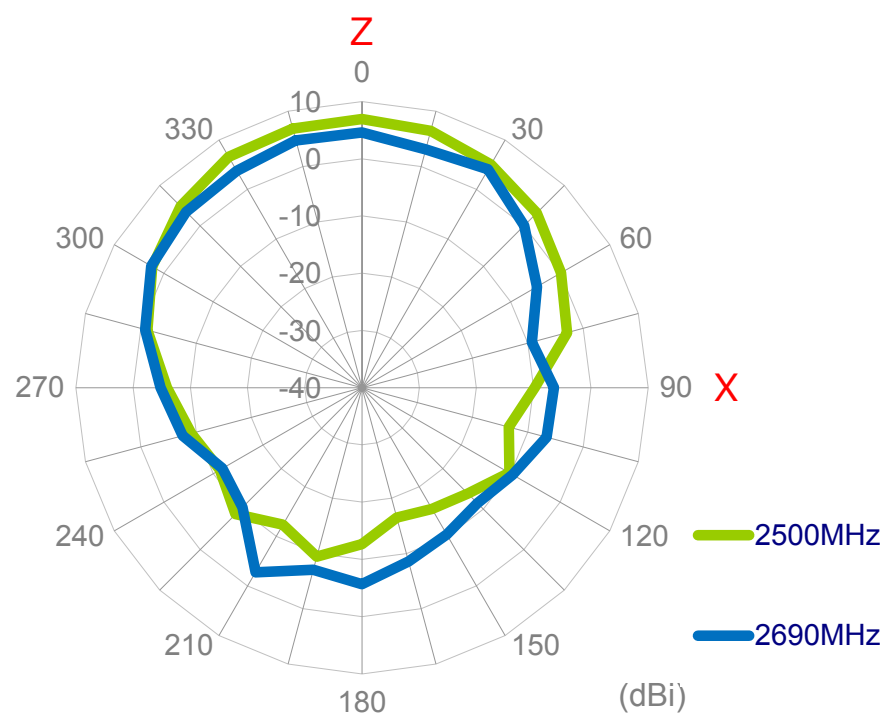
3.1.50 2D Radiation Pattern (LTE_MIMO2 with 1M cable length on metal) XY Plane



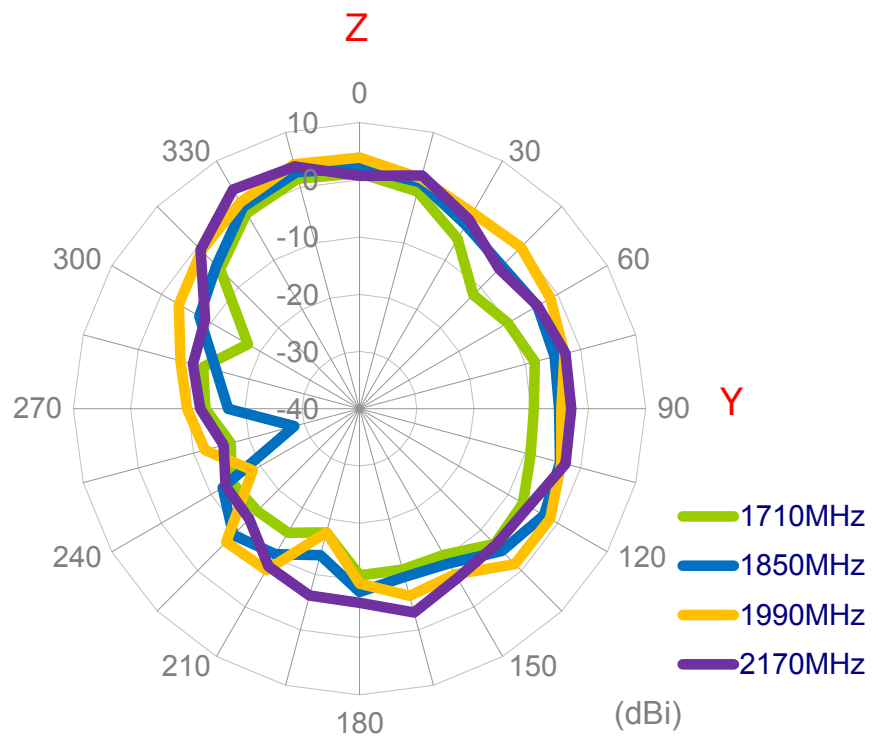
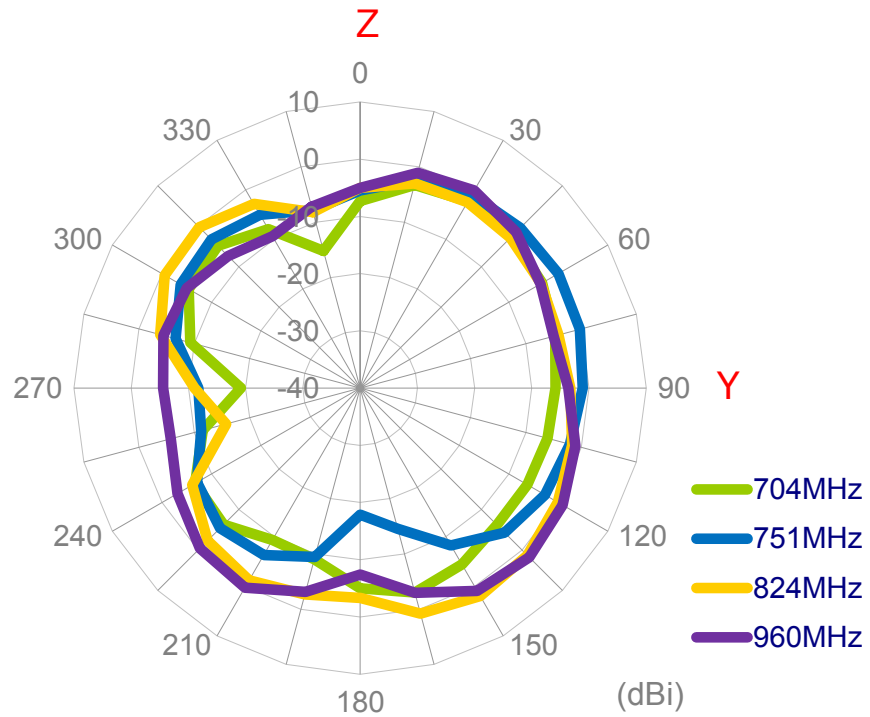


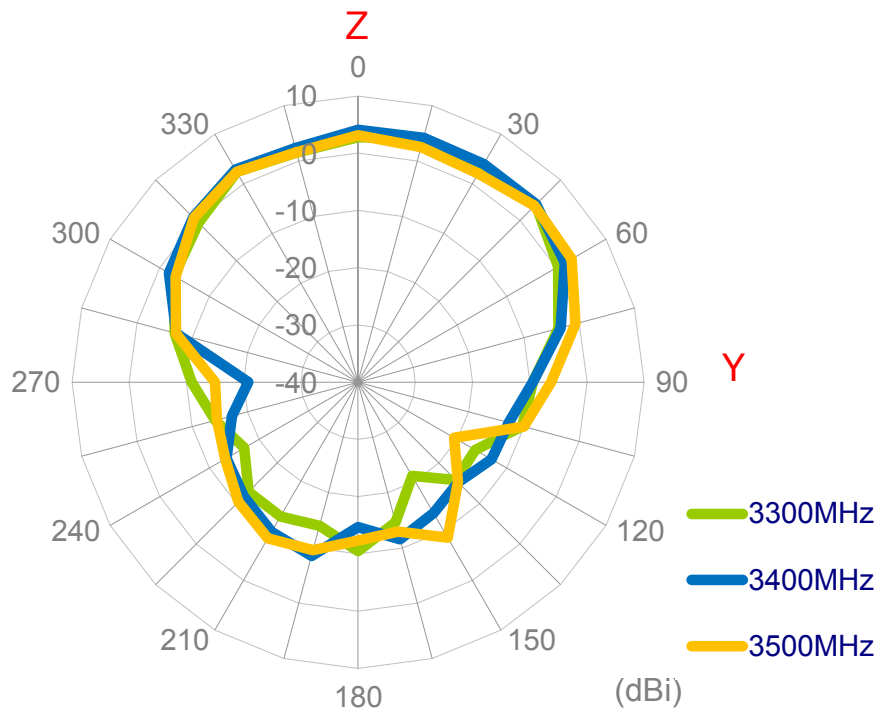
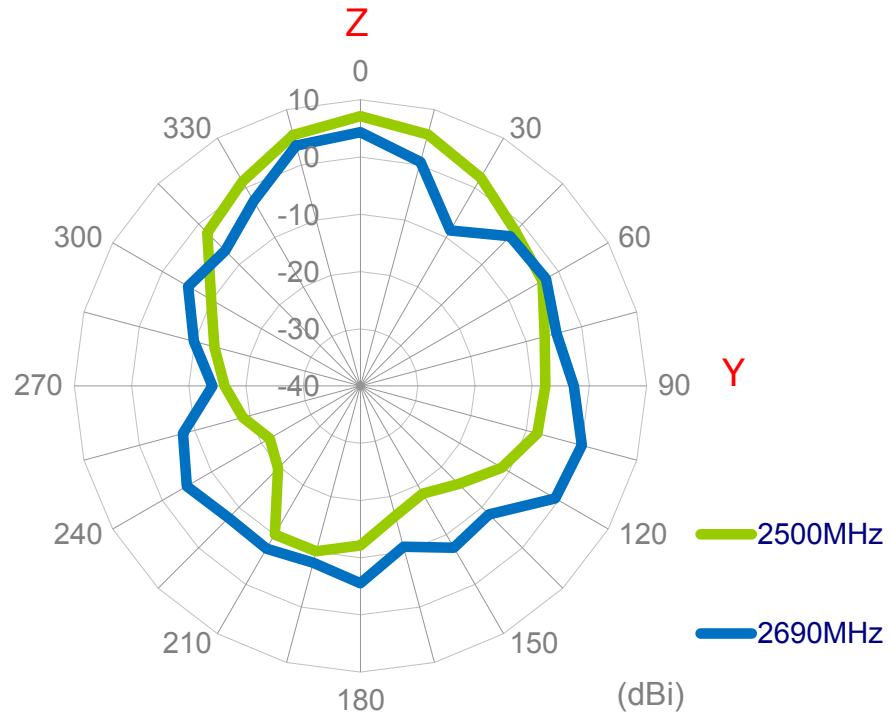
XZ Plane



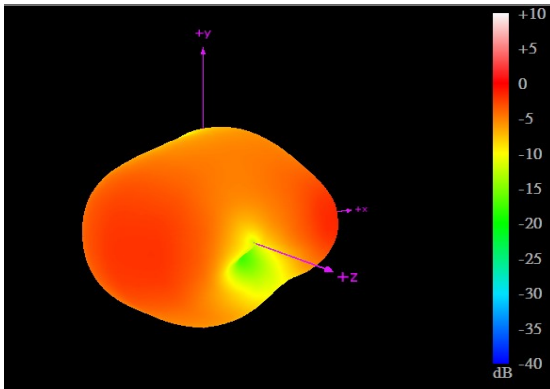


YZ Plane

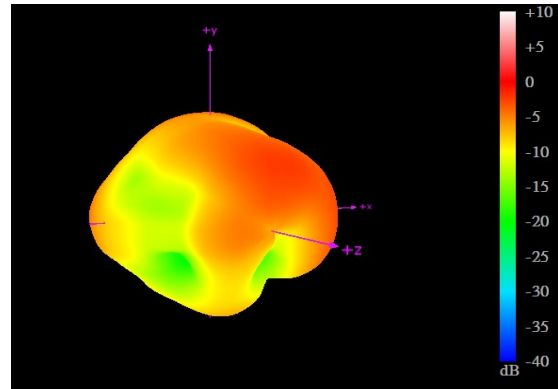




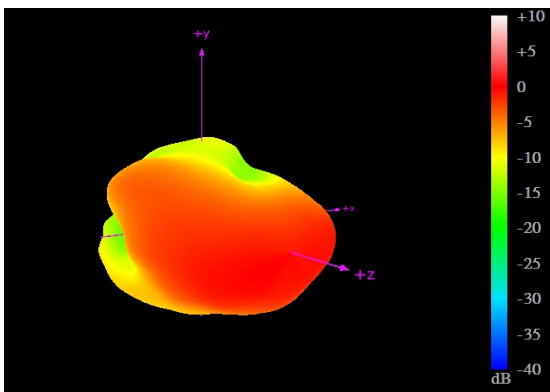
3.1.51 3D Radiation Pattern (LTE_MIMO2 with 1M cable length on metal)



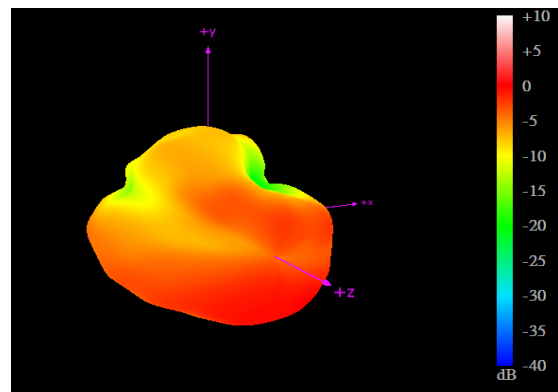
704MHz



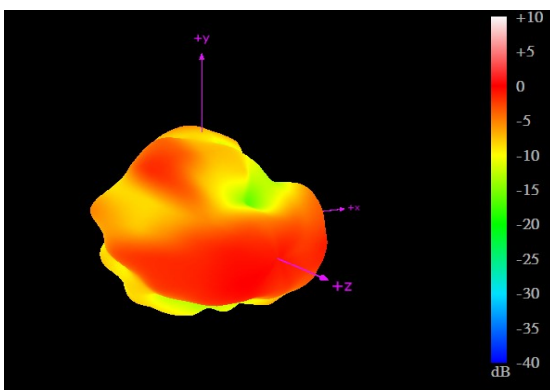
960MHz



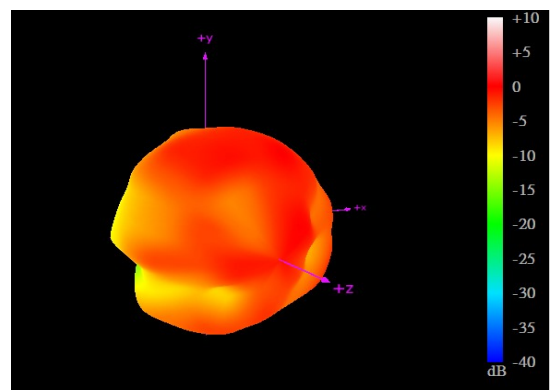
1710MHz



2170MHz



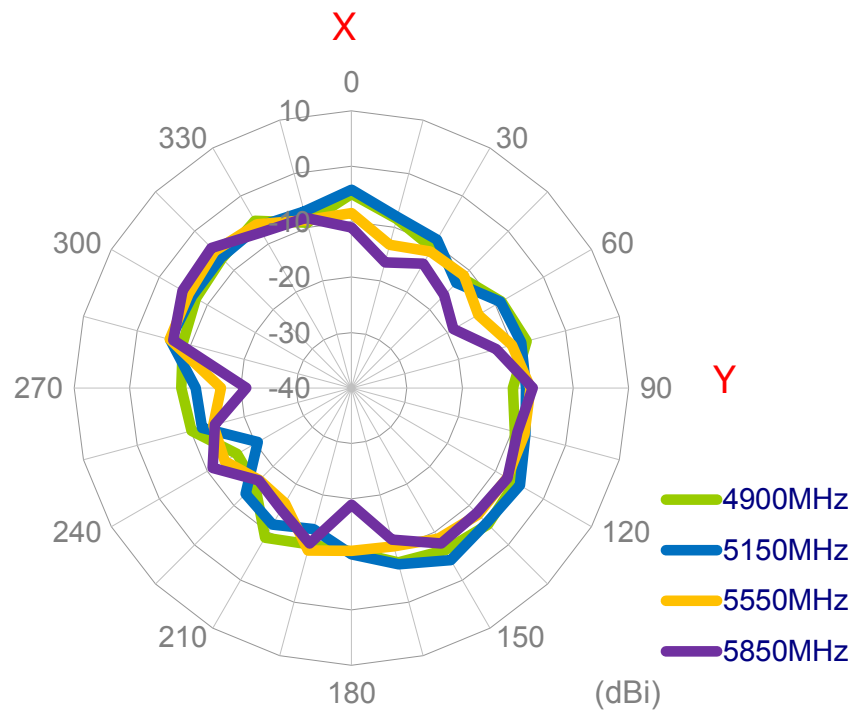
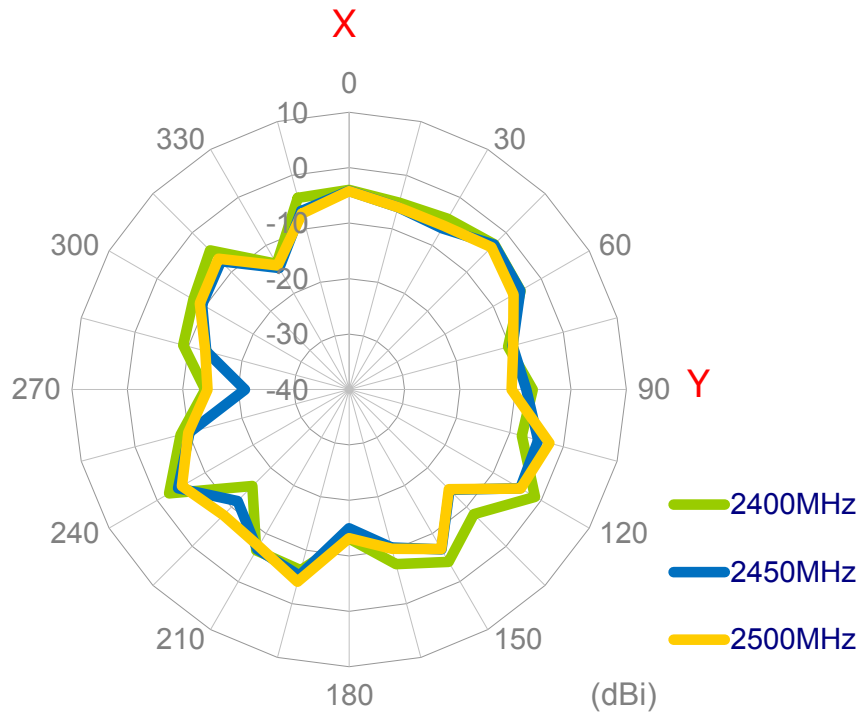
2690MHz



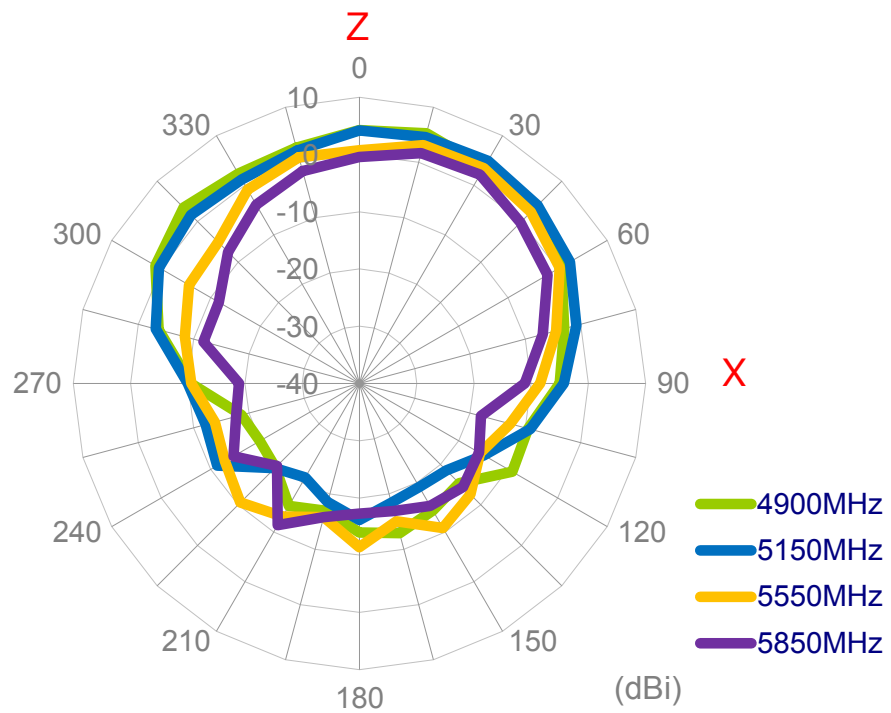
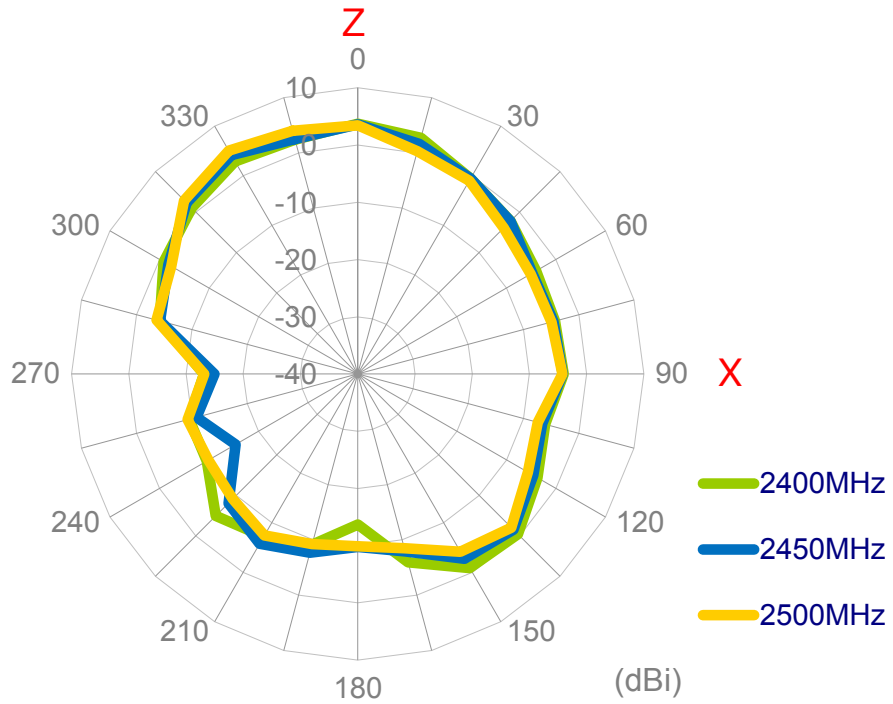
3500MHz

3.1.52 2D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length on metal)

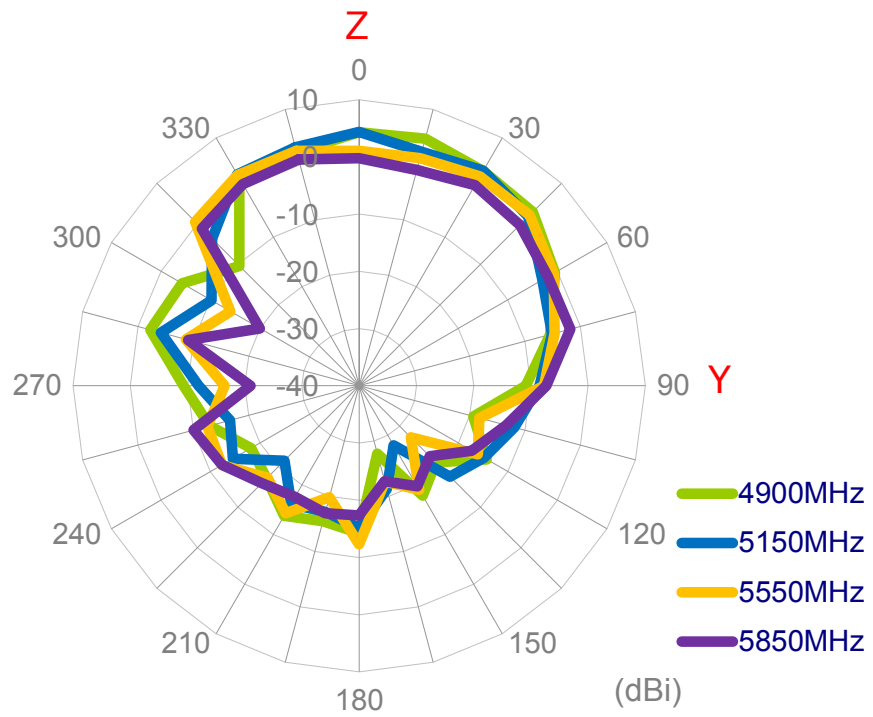
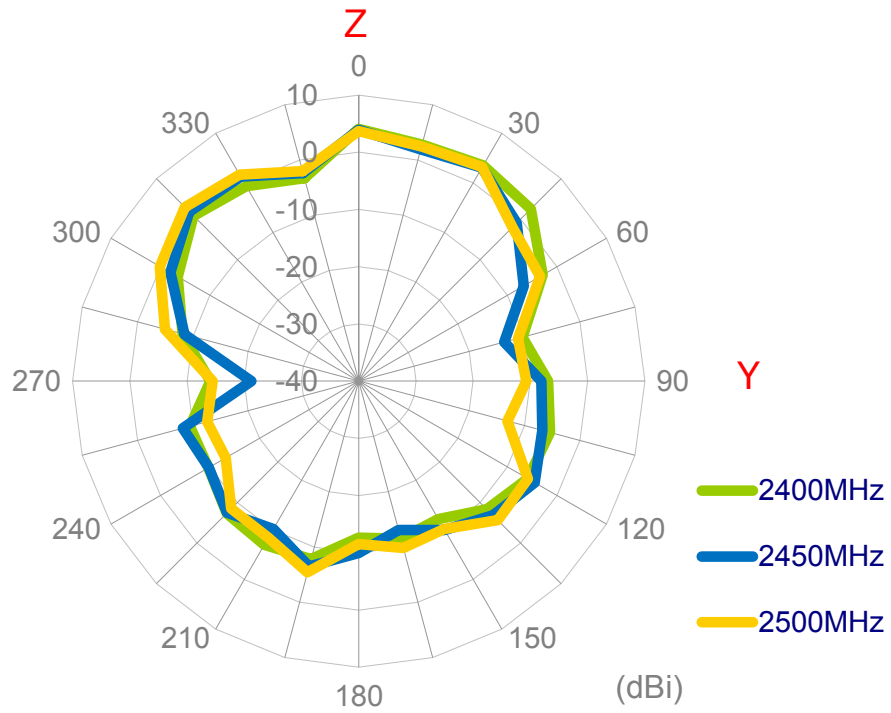
XY Plane



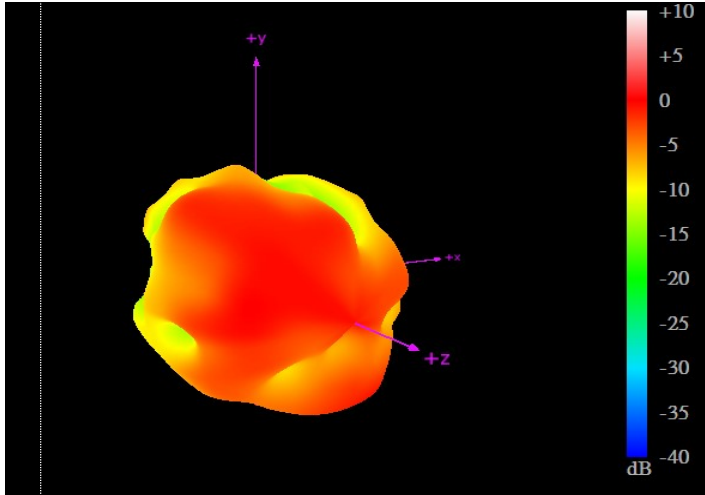
XZ Plane



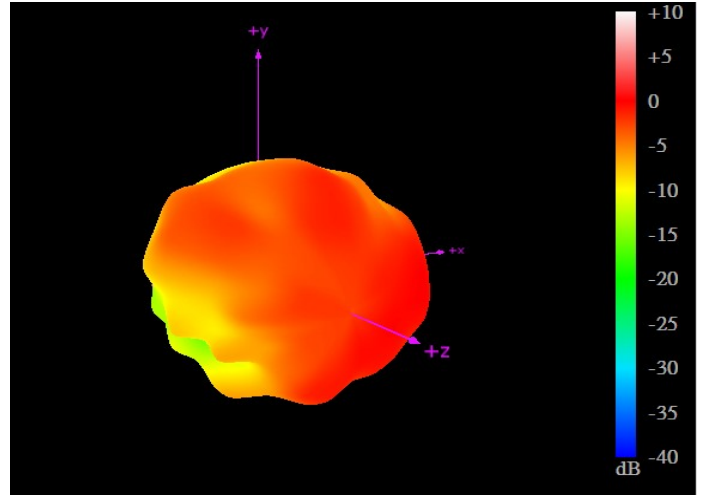
YZ Plane



3.1.53 3D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length on metal)



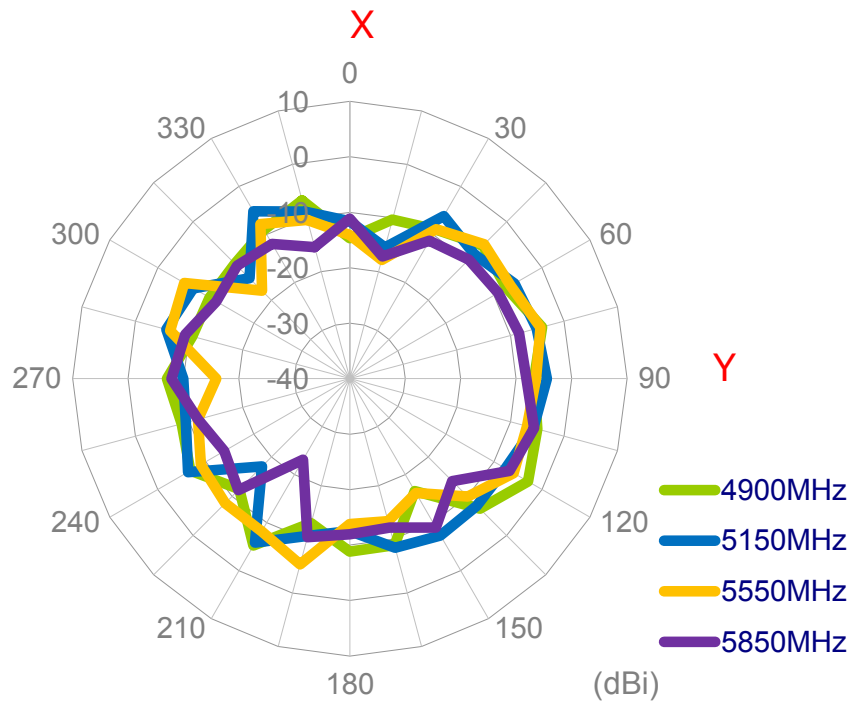
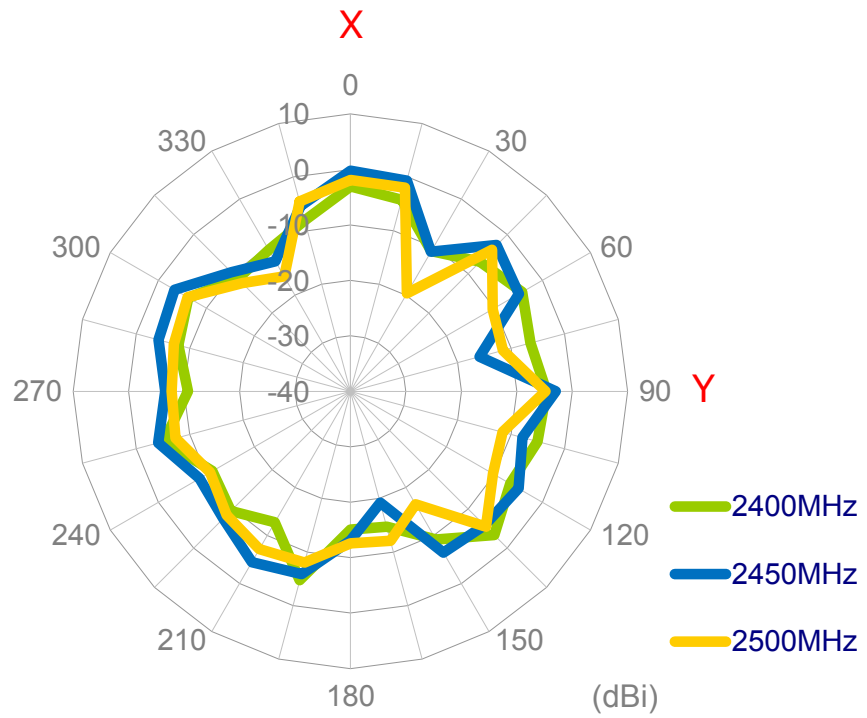
2450MHz



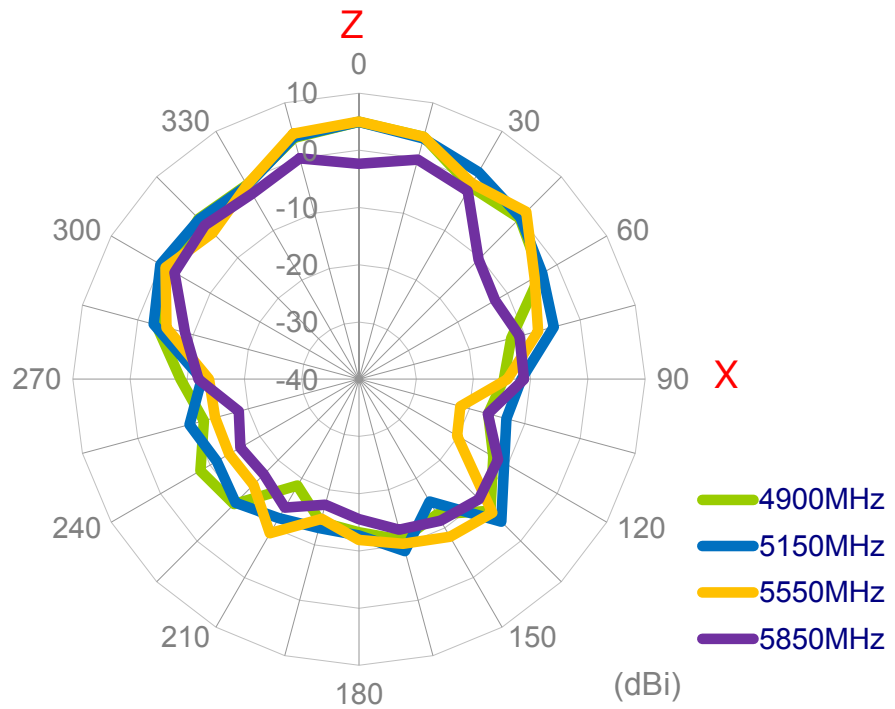
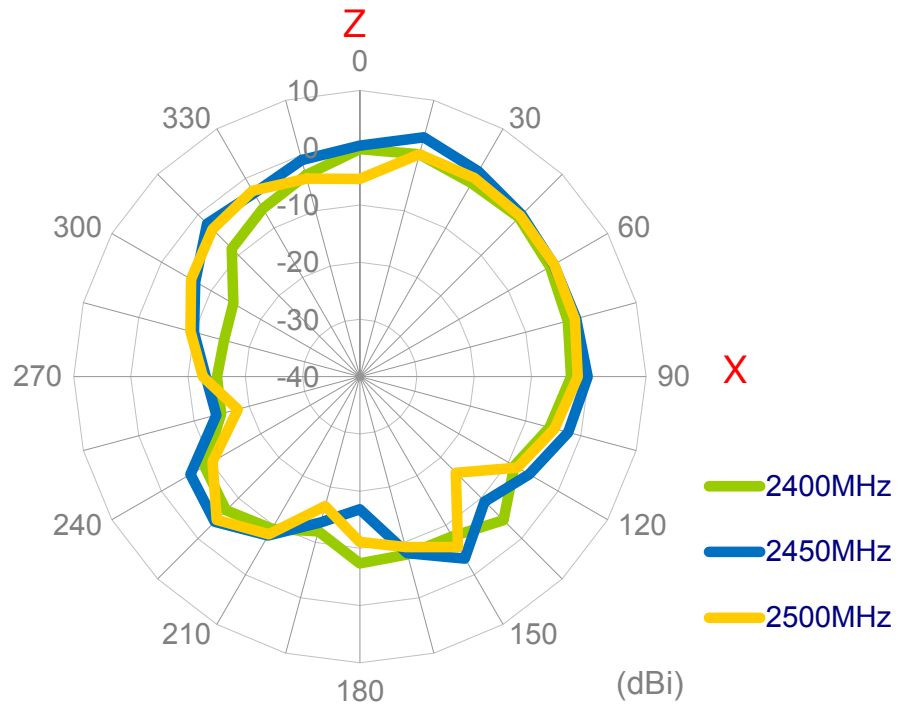
5550MHz

3.1.54 2D Radiation Pattern (Wi-Fi_MIMO2 with 3M cable length on metal)

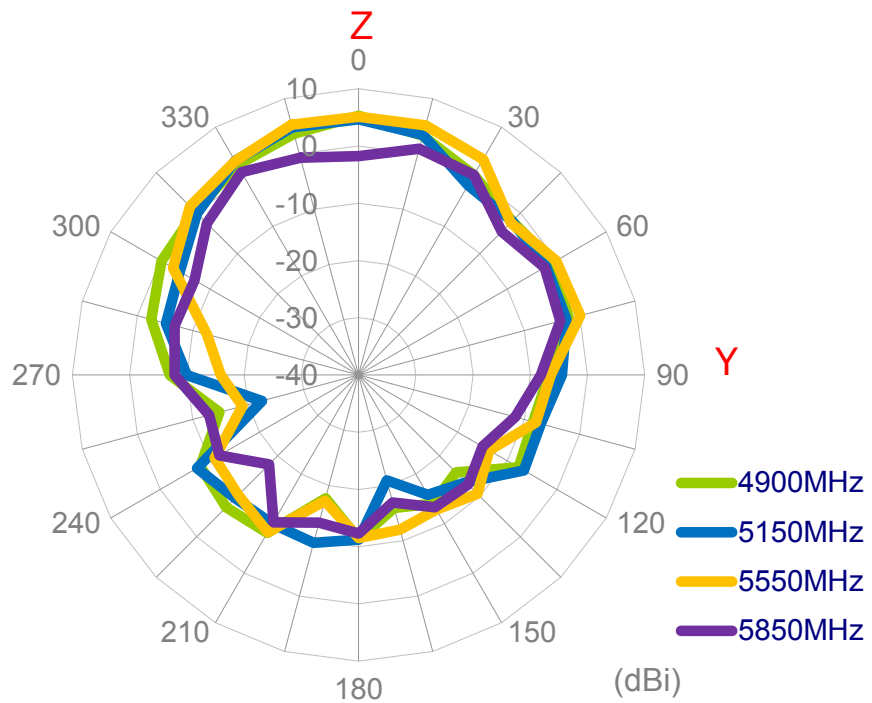
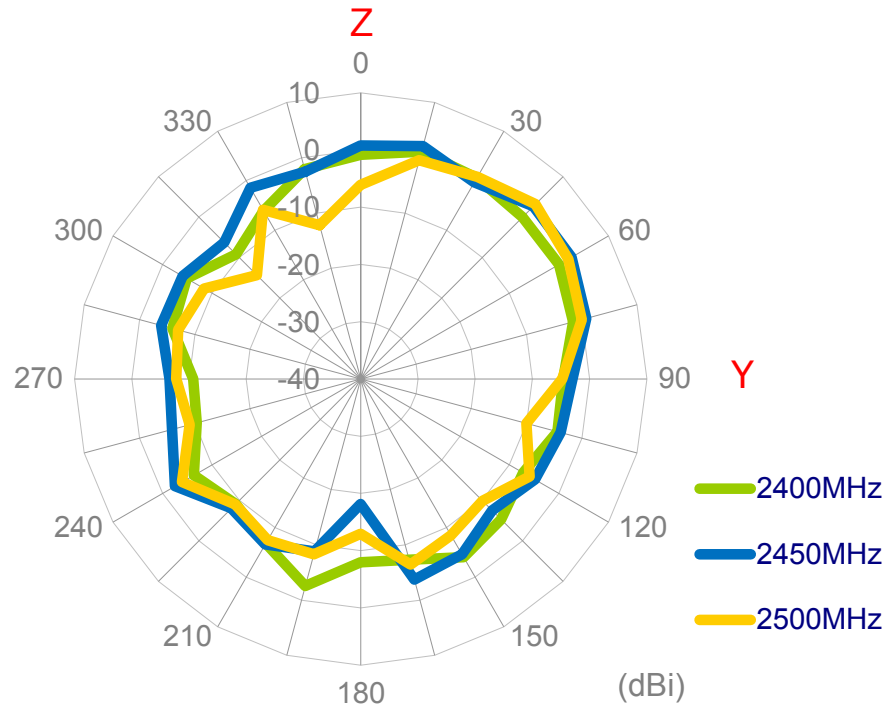
XY Plane



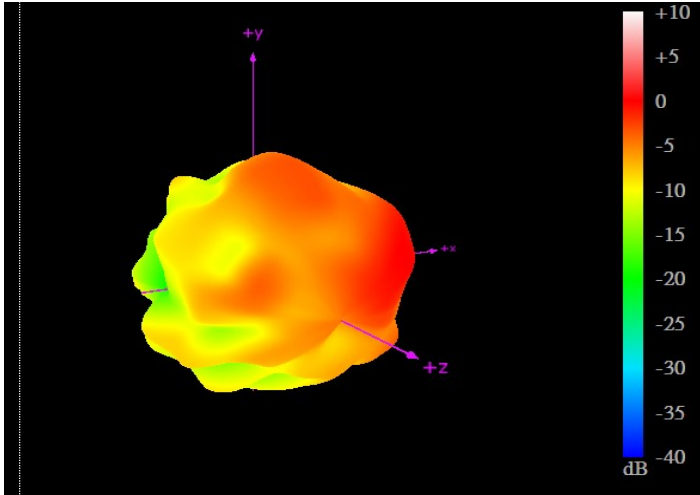
XZ Plane



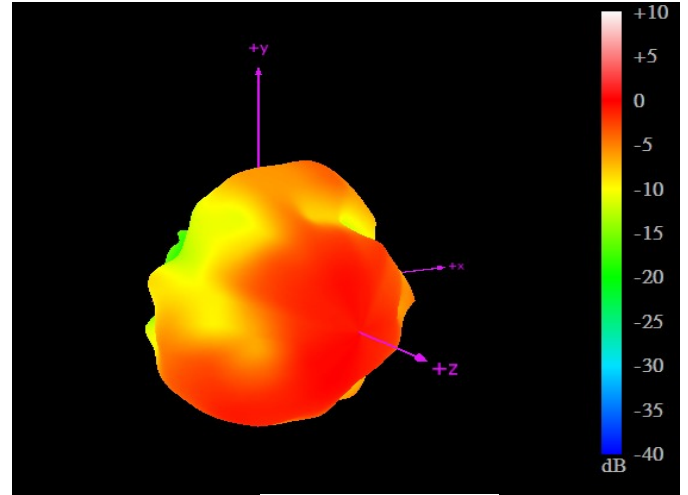
YZ Plane



3.1.55 3D Radiation Pattern (Wi-Fi_MIMO2 with 1M cable length on metal)

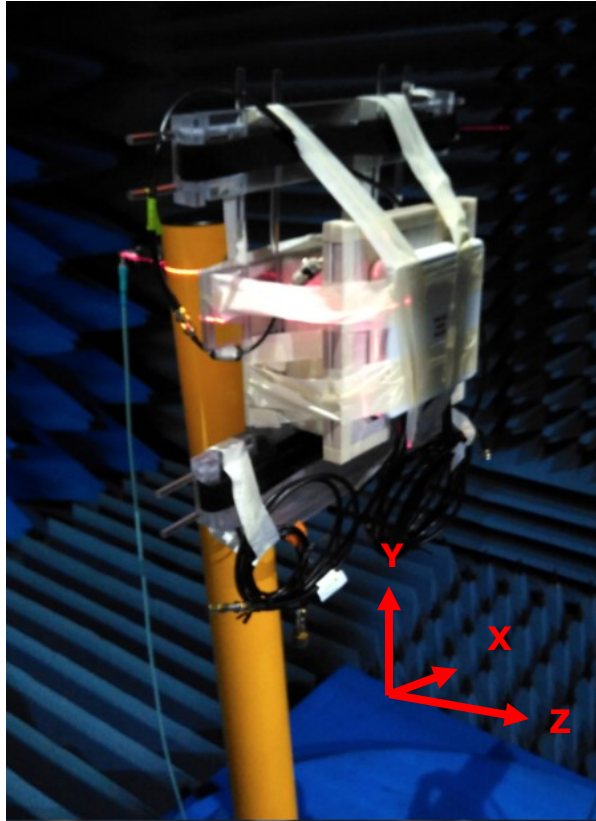


2450MHz



5550MHz

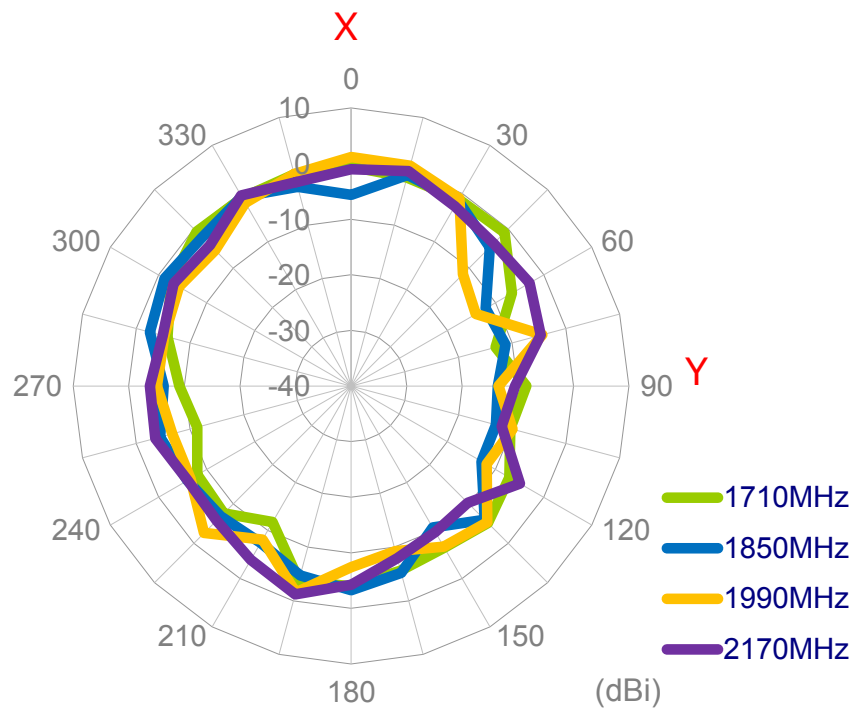
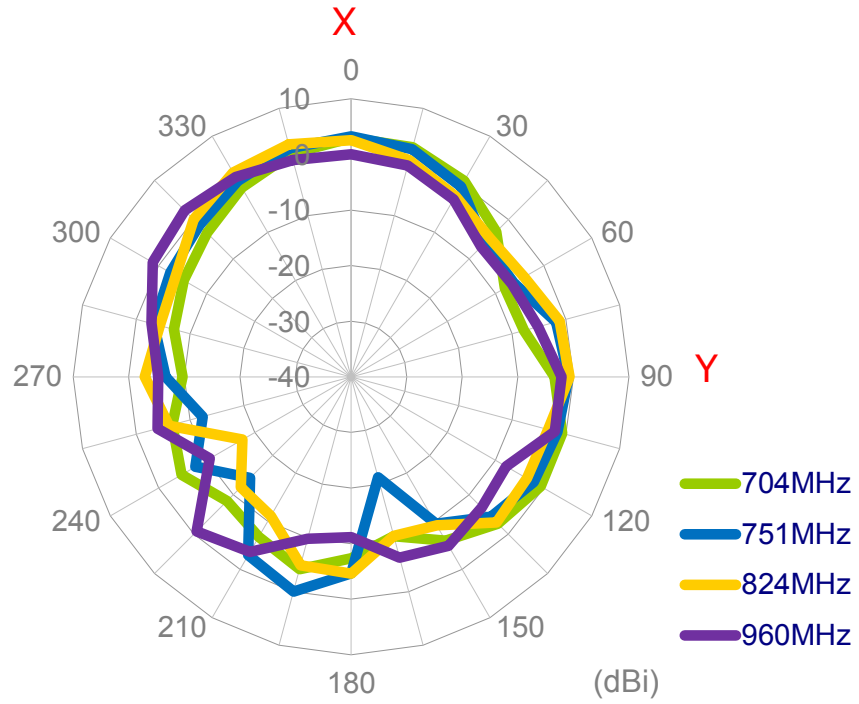
3.1.56 Test Setup for Antenna Radiation Pattern

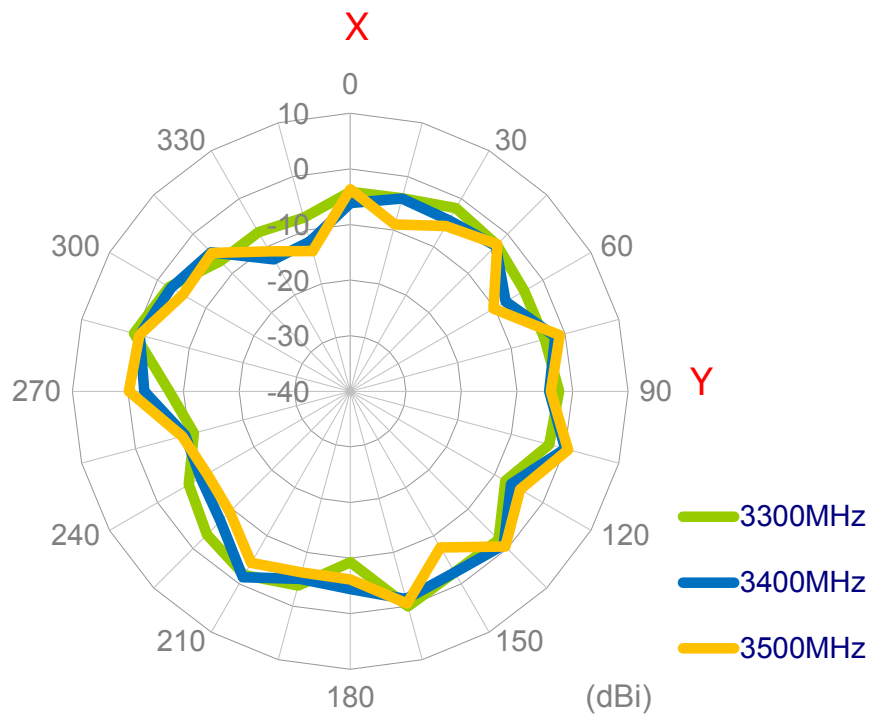
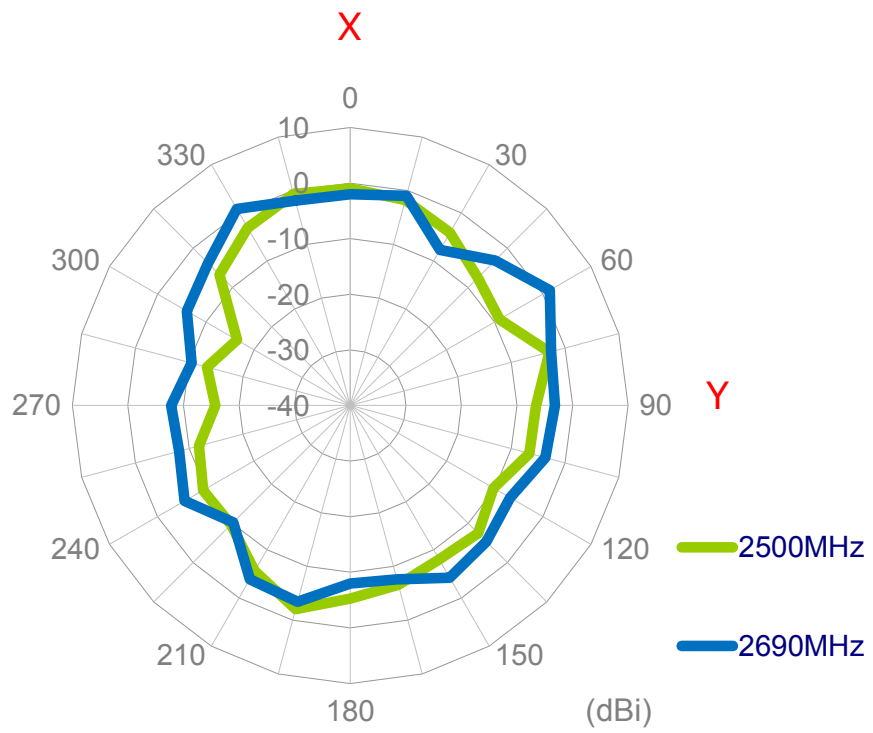


On the Wall

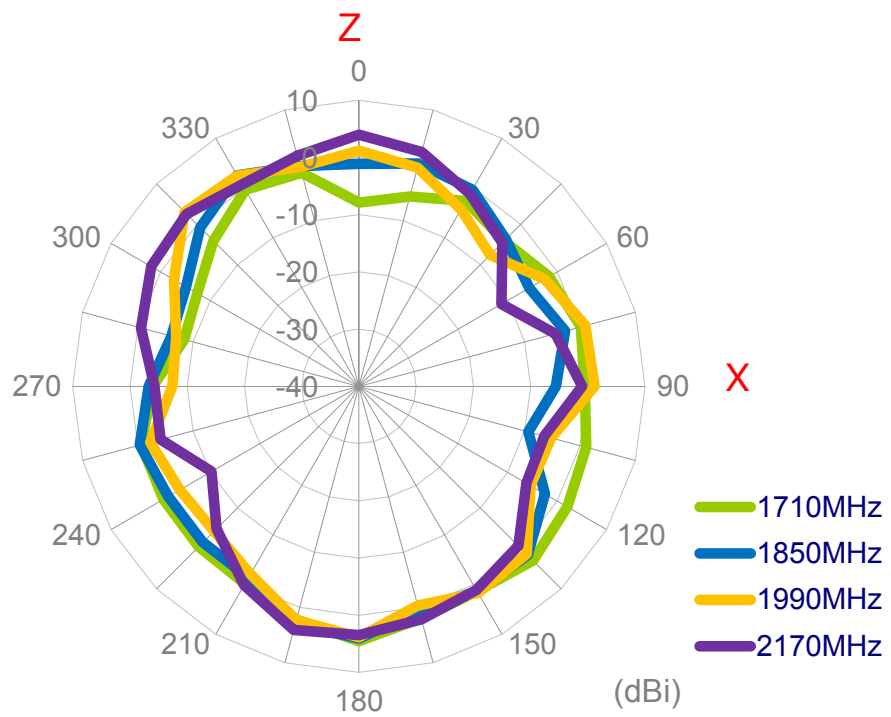
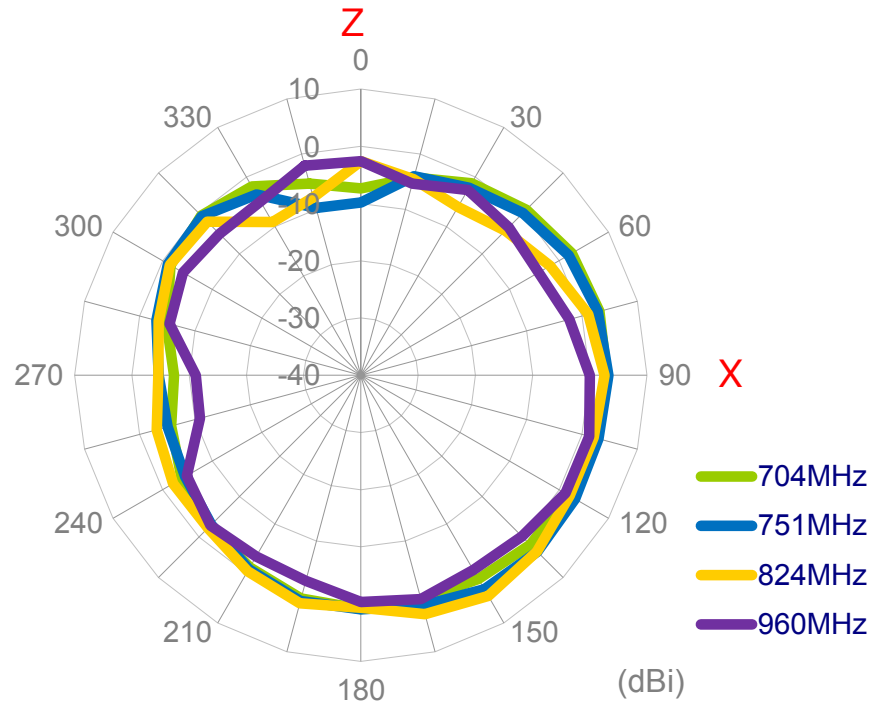
3.1.57 2D Radiation Pattern (LTE_MIMO1 with 1M cable length on the wall)

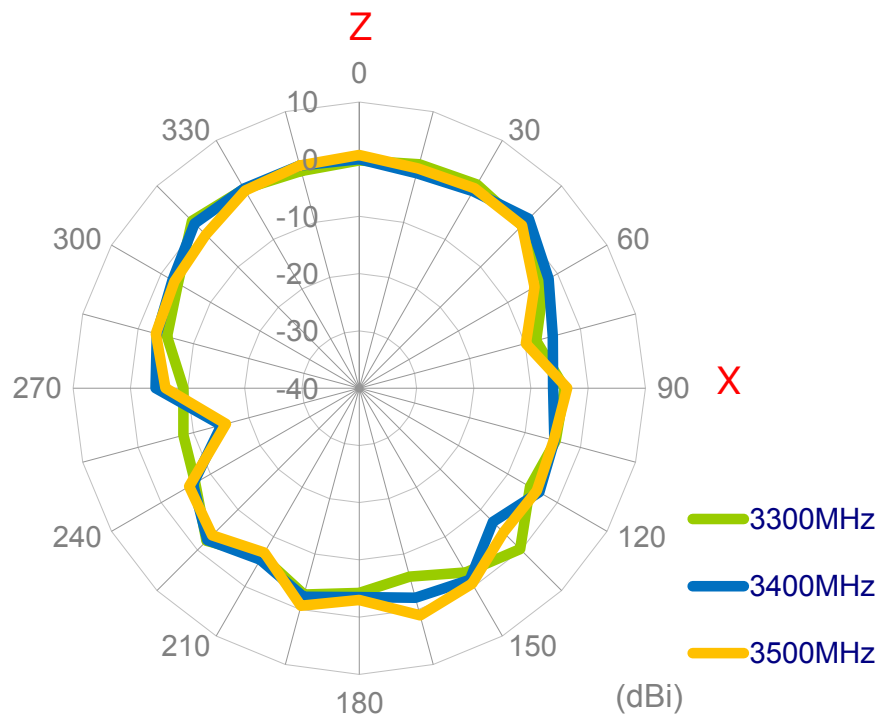
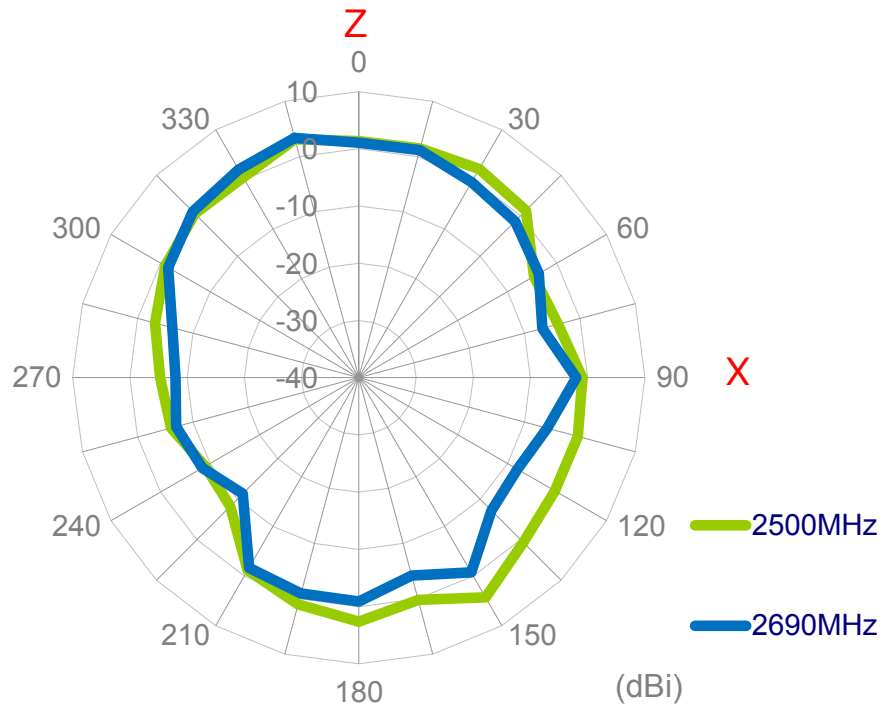
XY Plane



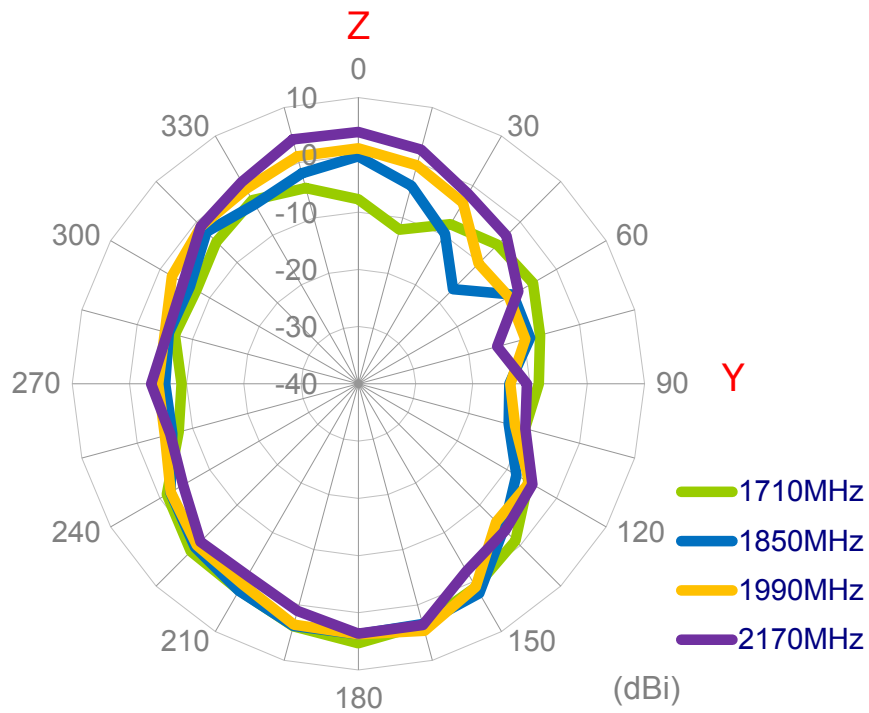
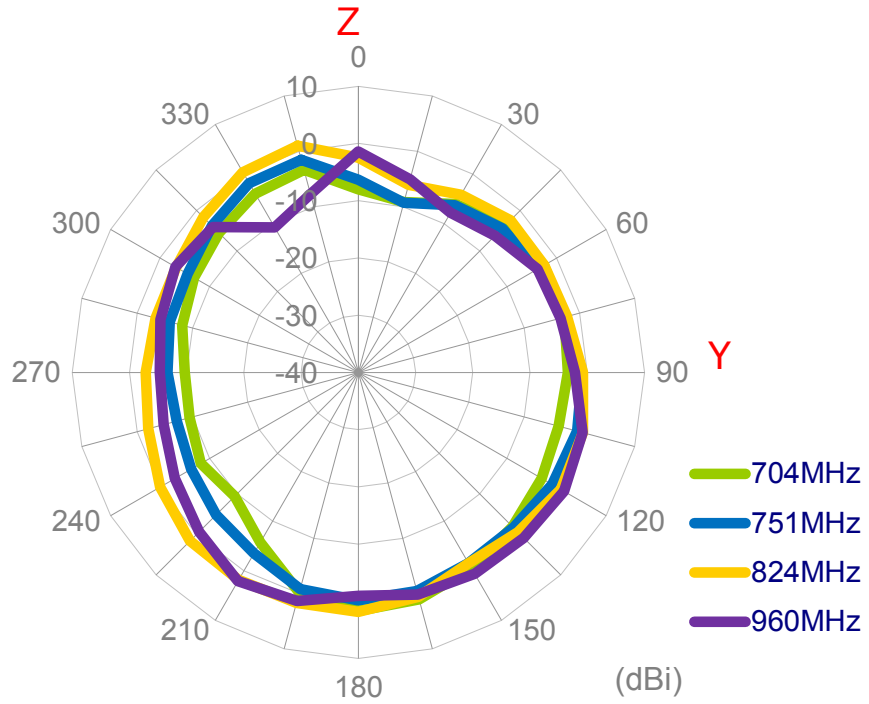


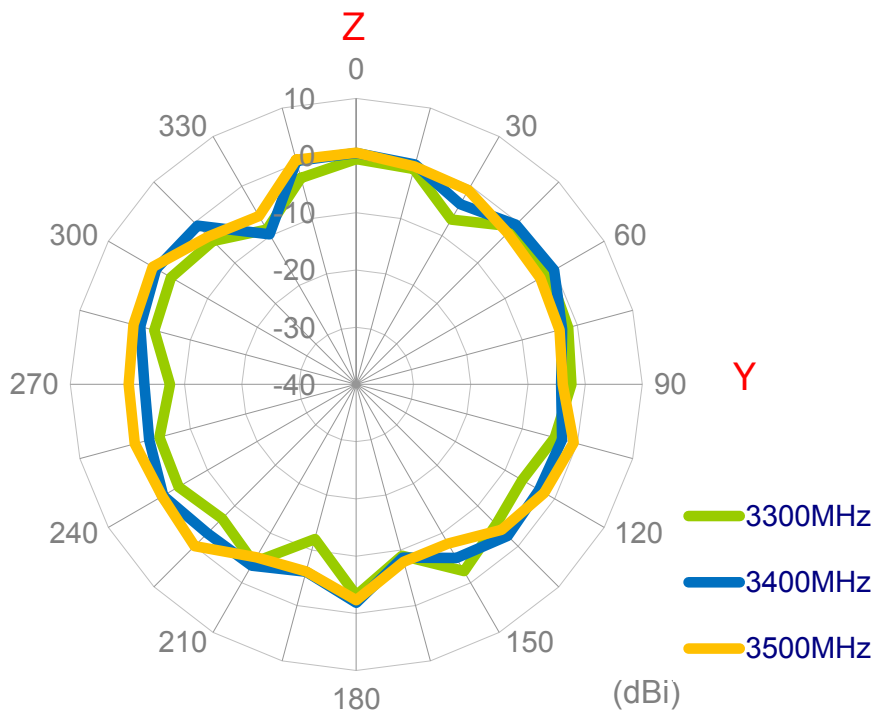
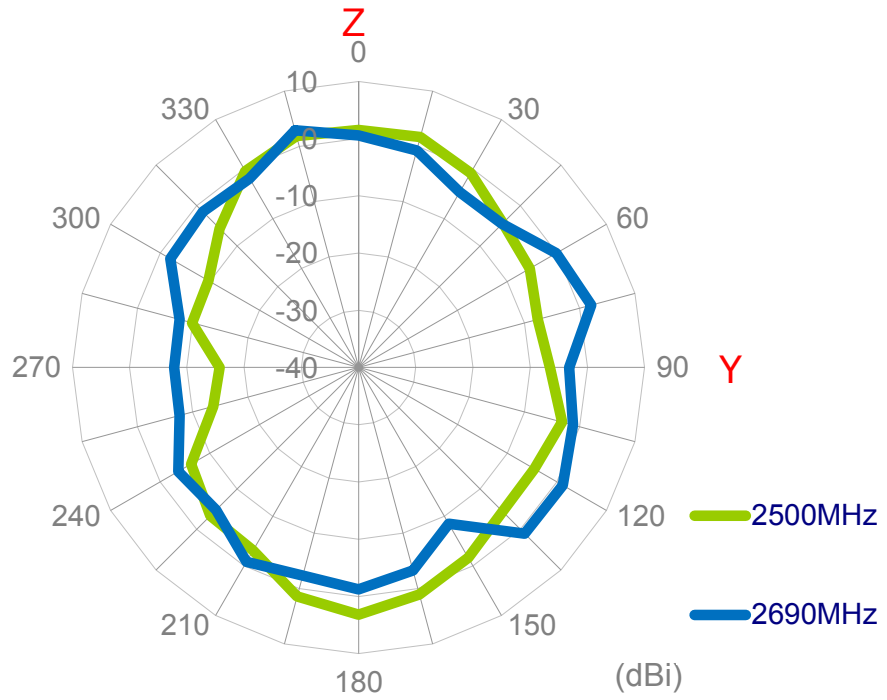
XZ Plane



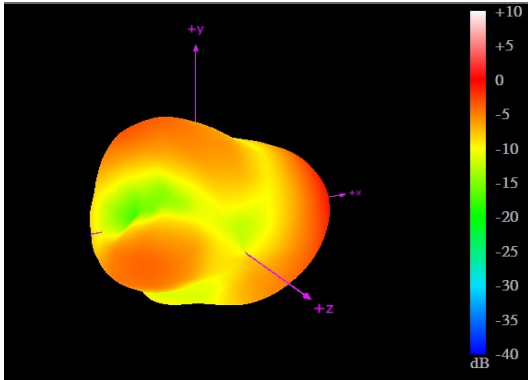


YZ Plane

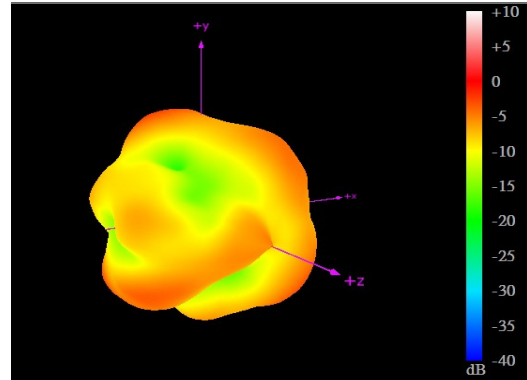




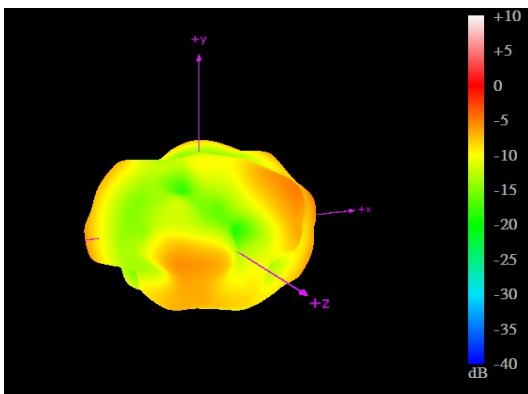
3.1.58 3D Radiation Pattern (LTE_MIMO1 with 1M cable length on the wall)



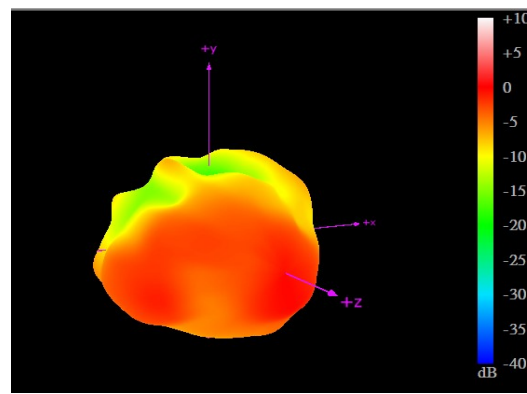
704MHz



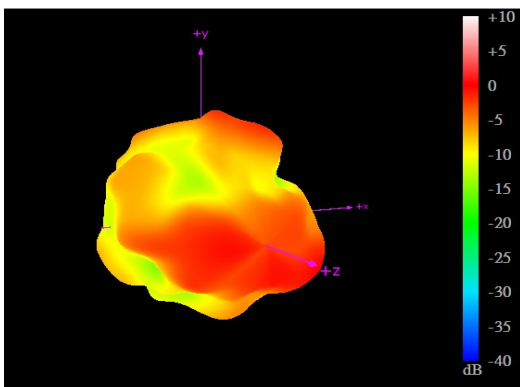
960MHz



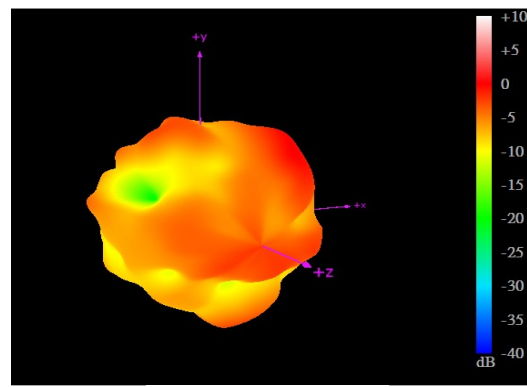
1710MHz



2170MHz



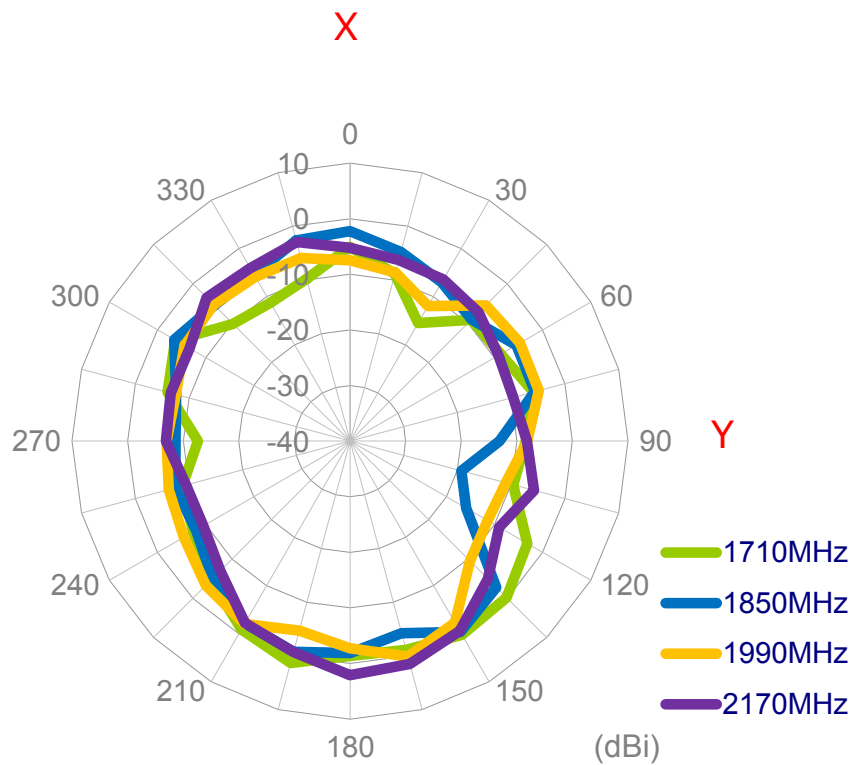
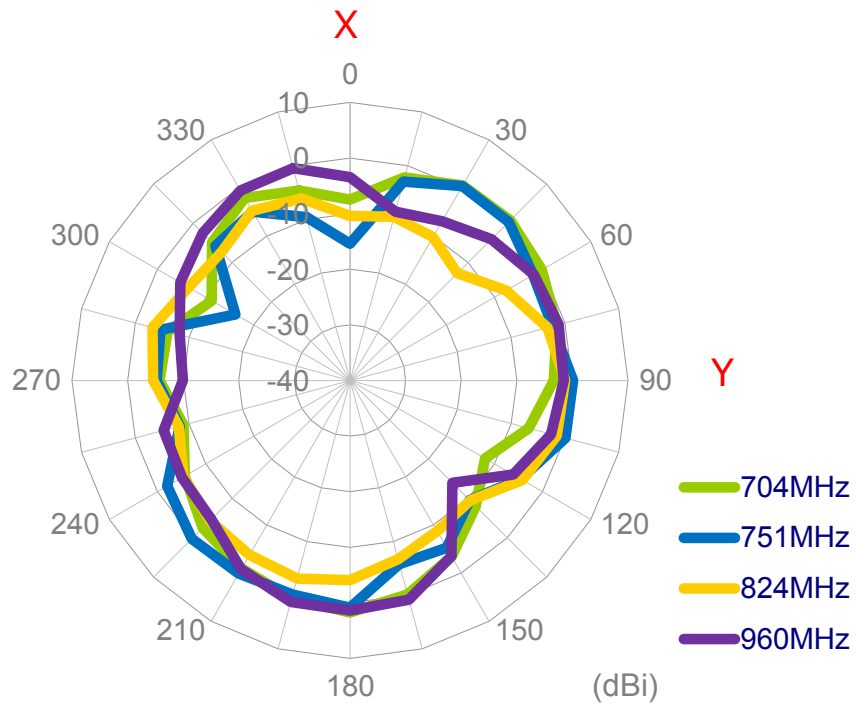
2690MHz

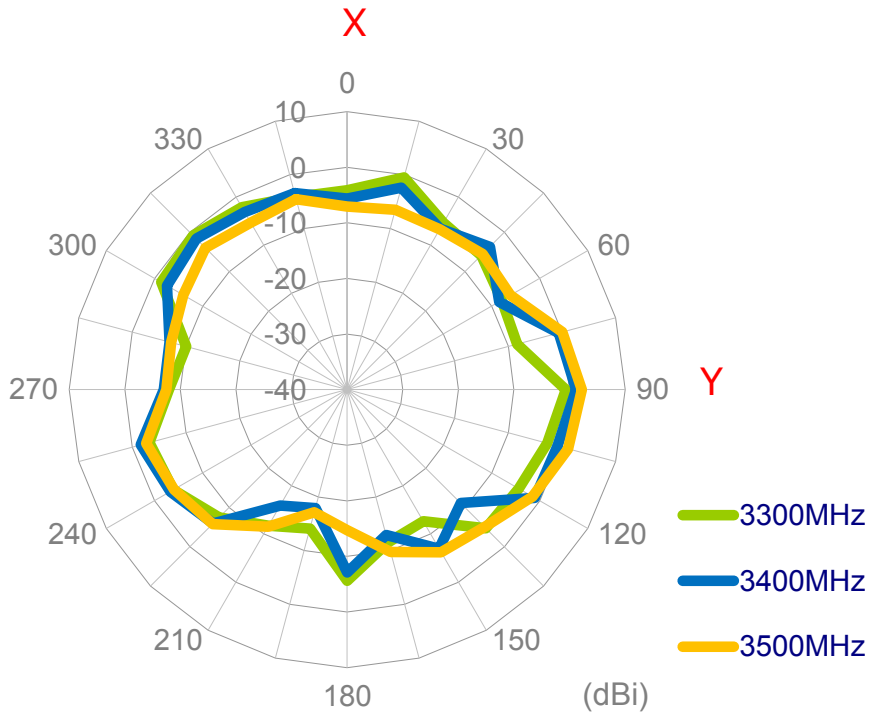
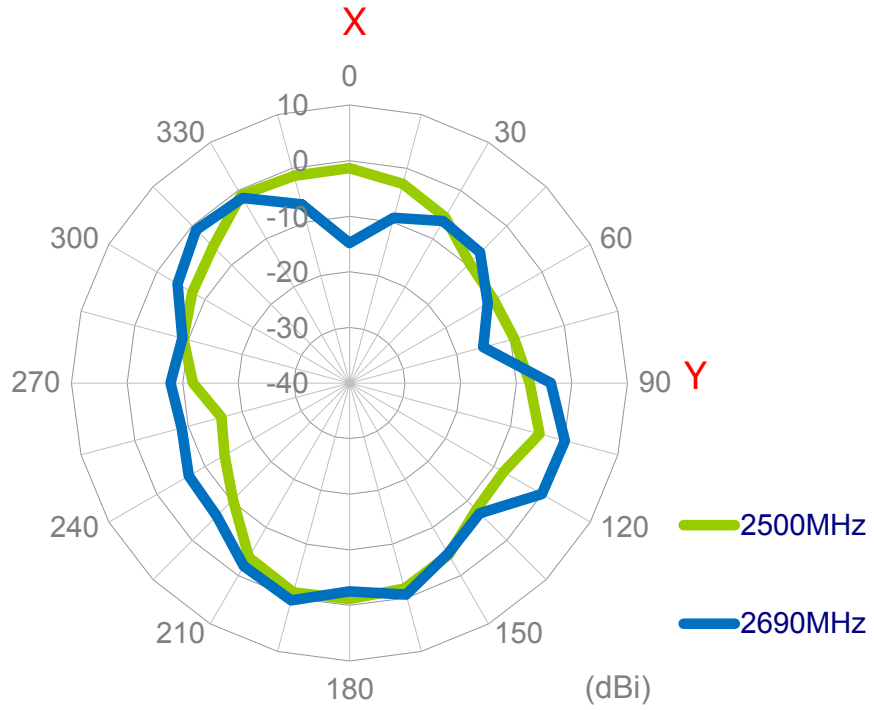


3500MHz

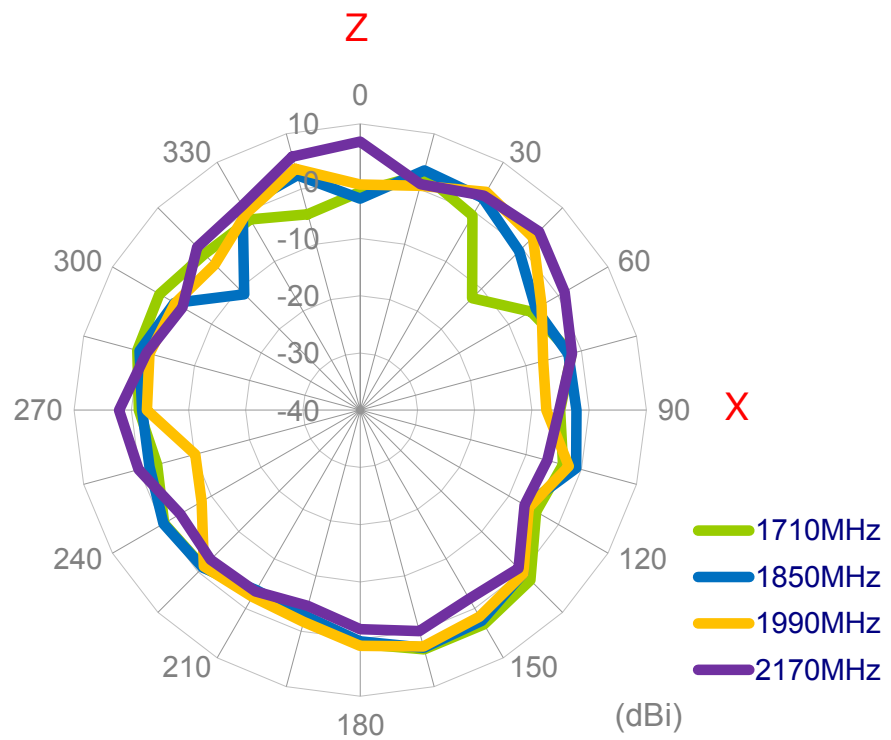
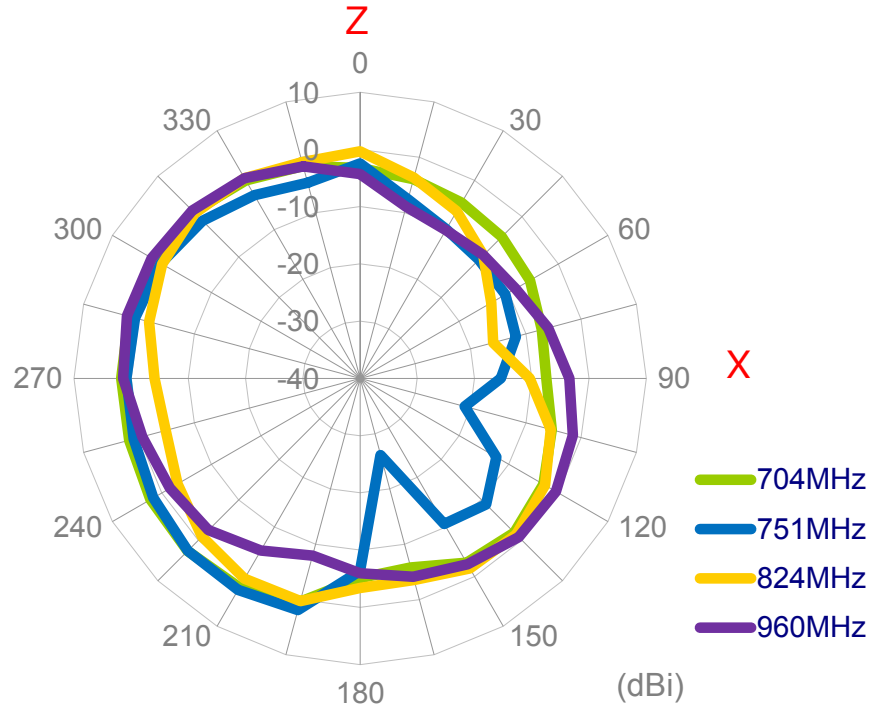
3.1.59 2D Radiation Pattern (LTE_MIMO2 with 1M cable length on the wall)

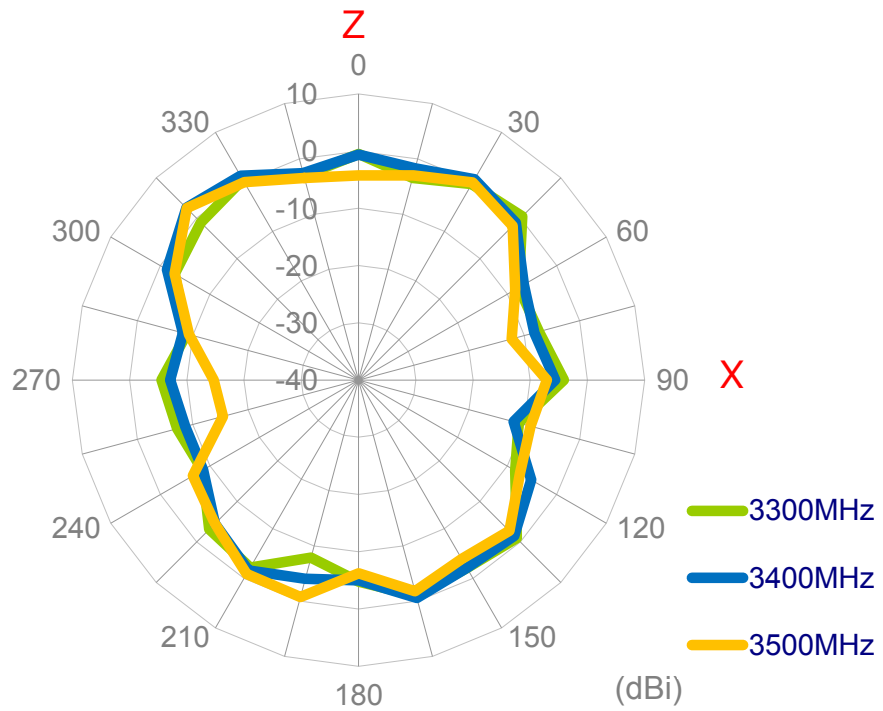
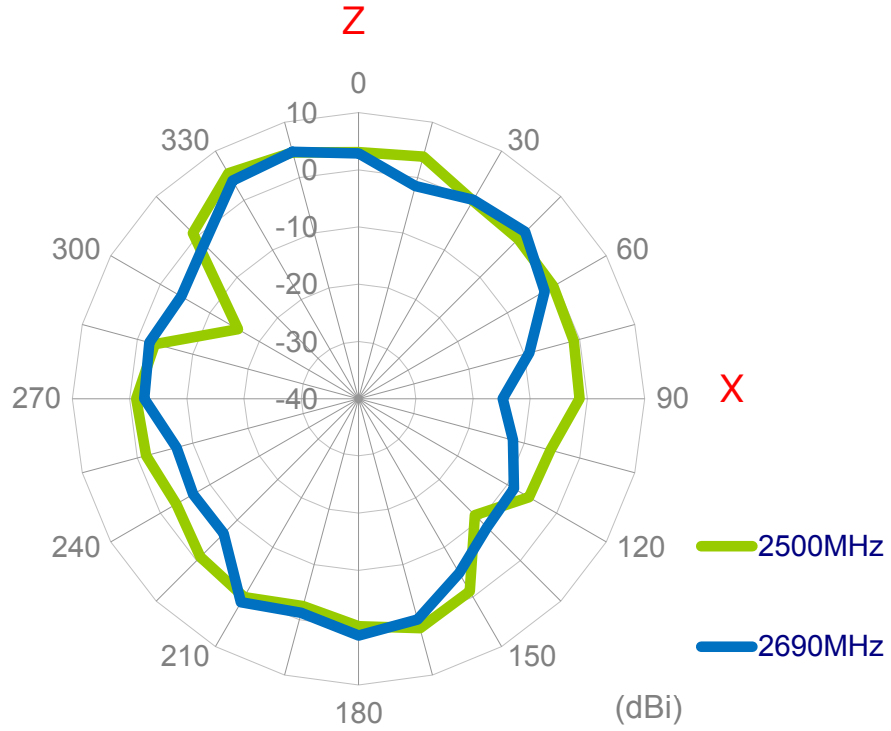
XY Plane



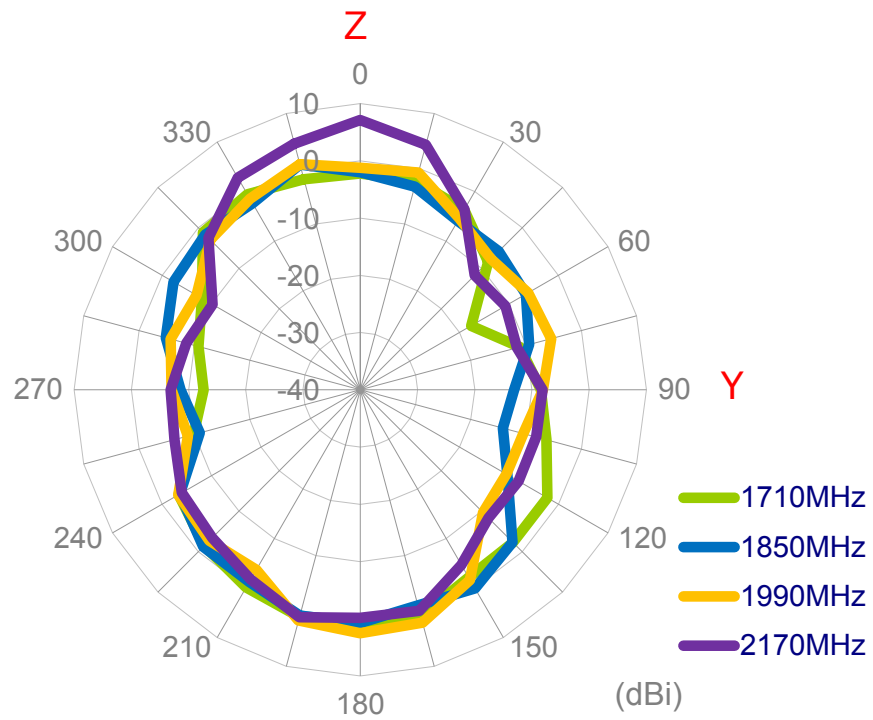
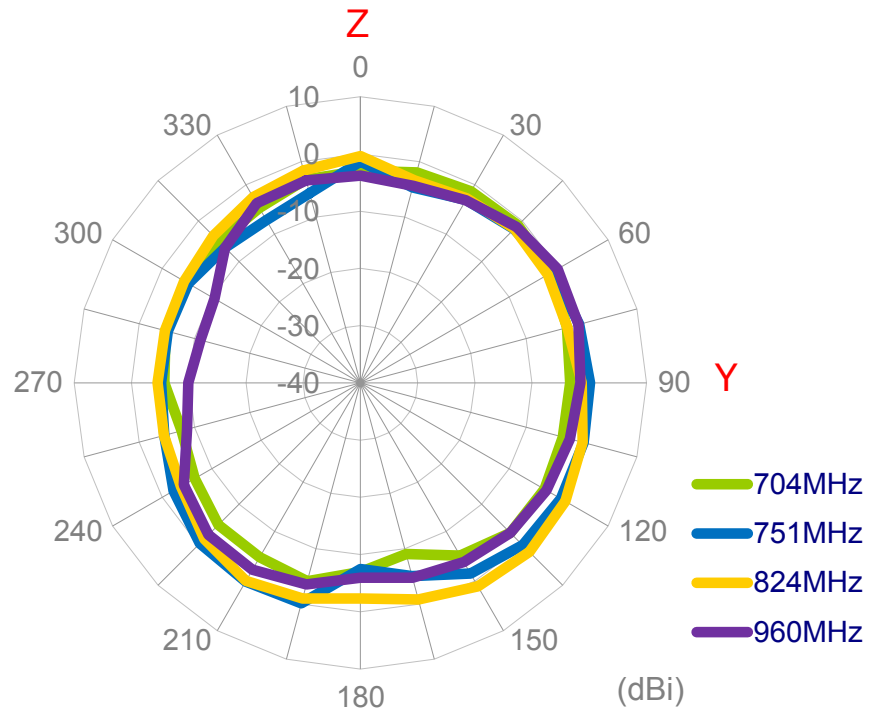


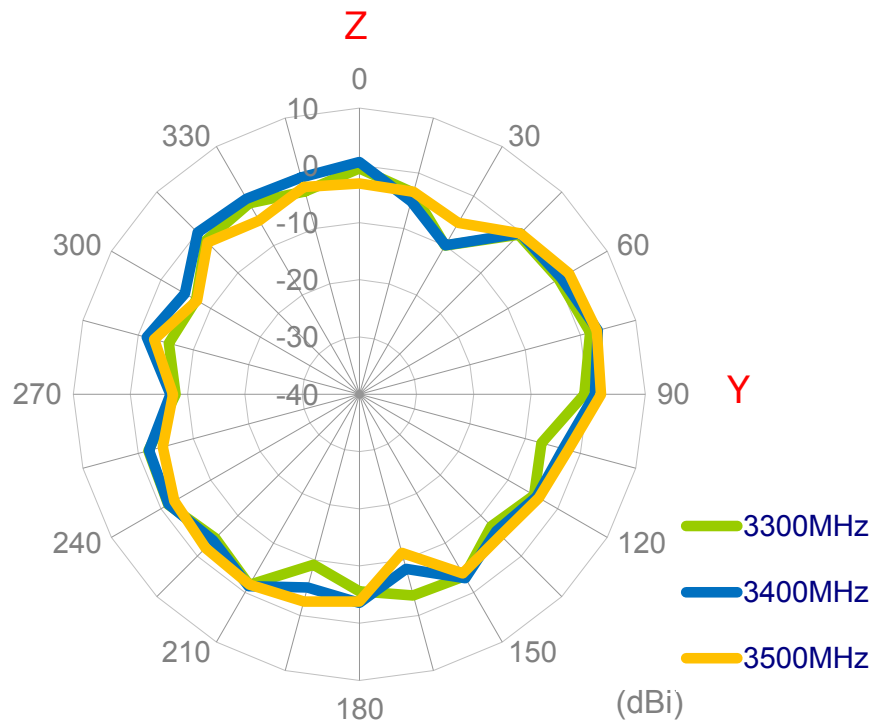
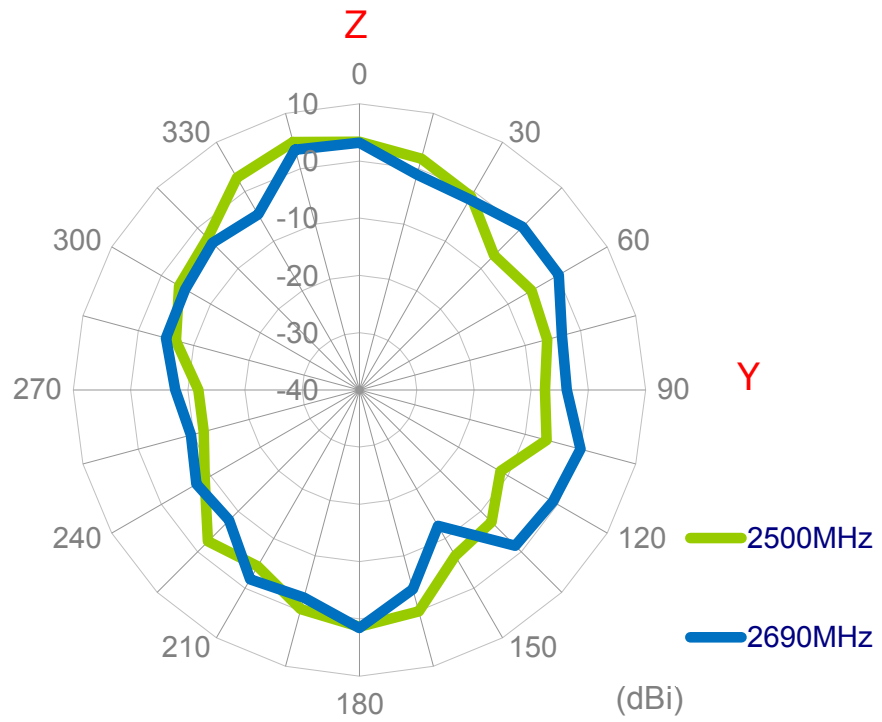
XZ Plane



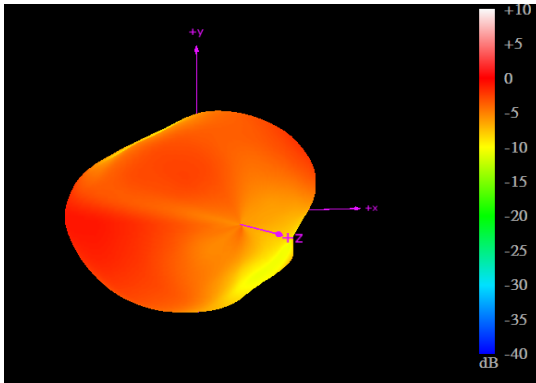


YZ Plane

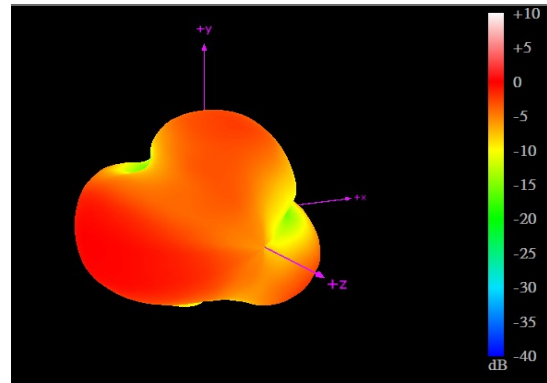




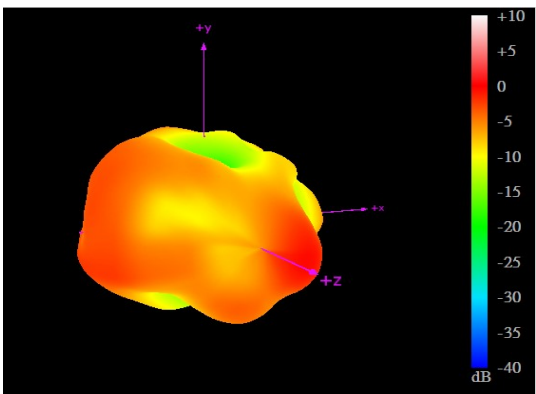
3.1.60 3D Radiation Pattern (LTE_MIMO2 with 1M cable length on the wall)



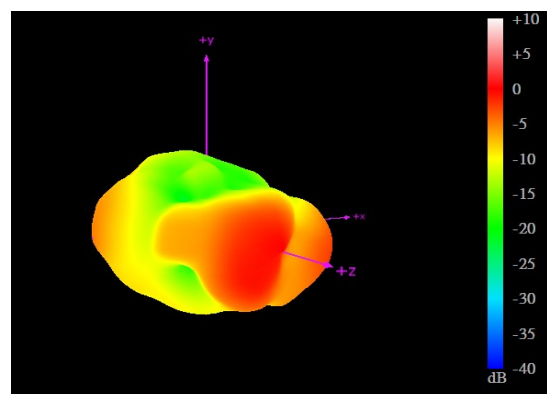
704MHz



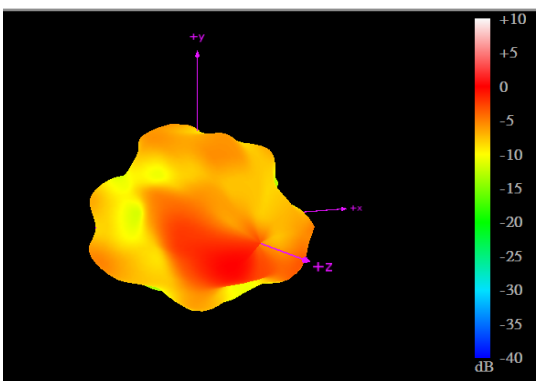
960MHz



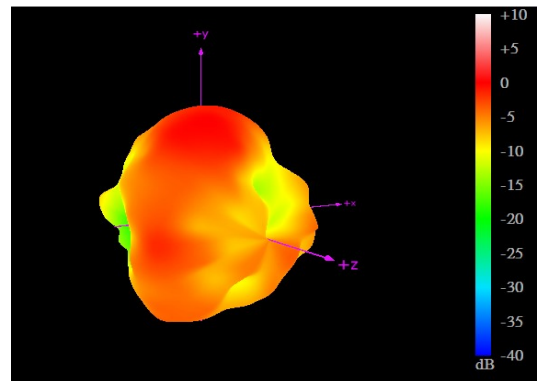
1710MHz



2170MHz



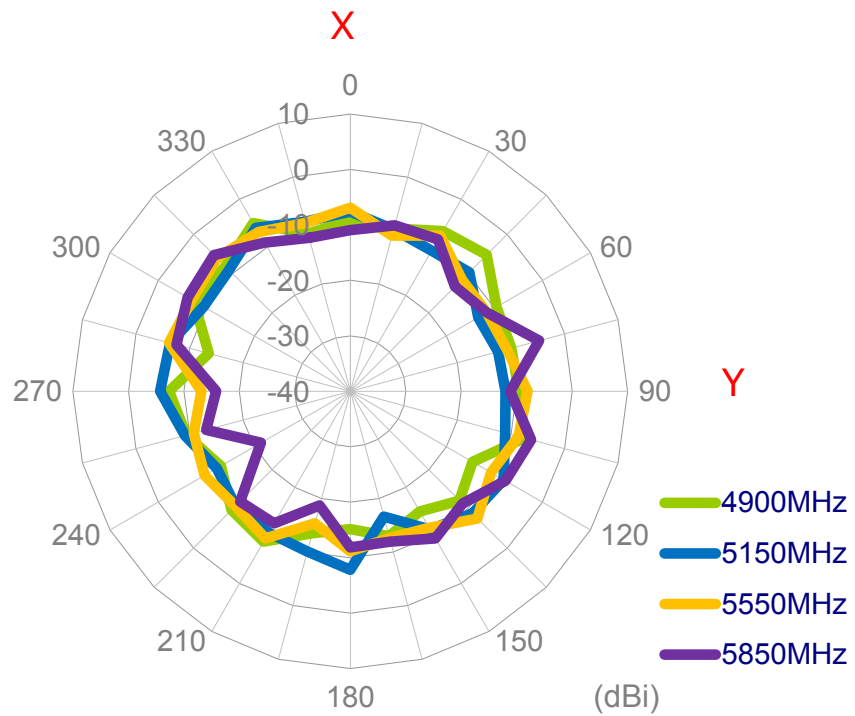
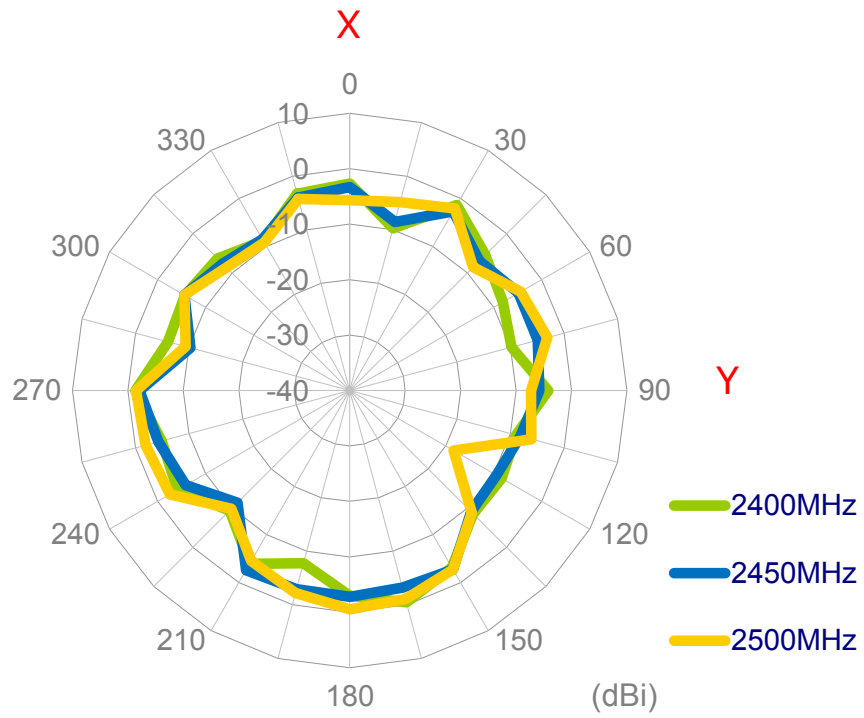
2690MHz



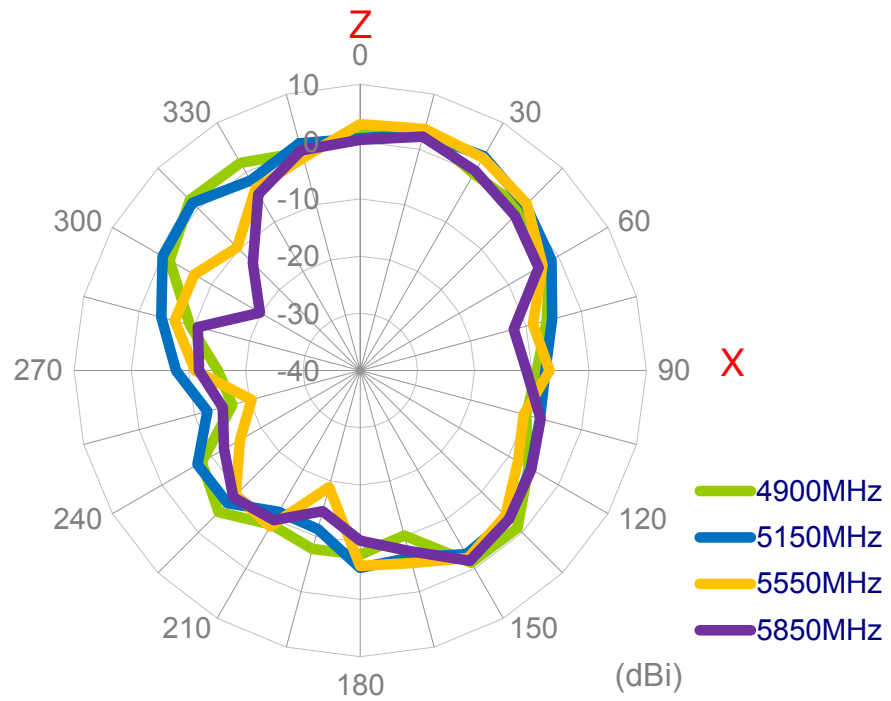
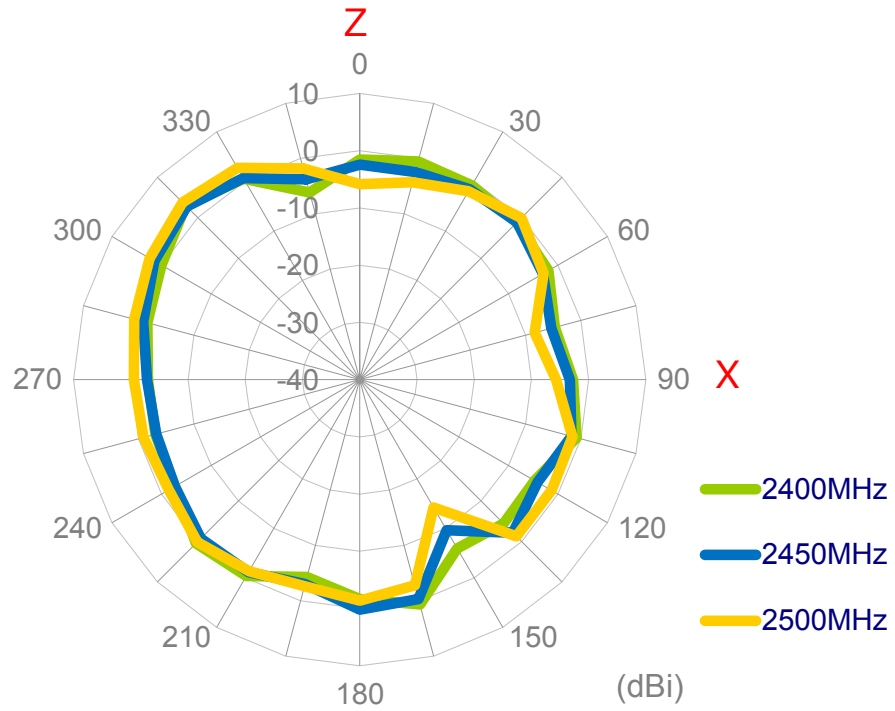
3500MHz

3.1.61 2D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length in free space)

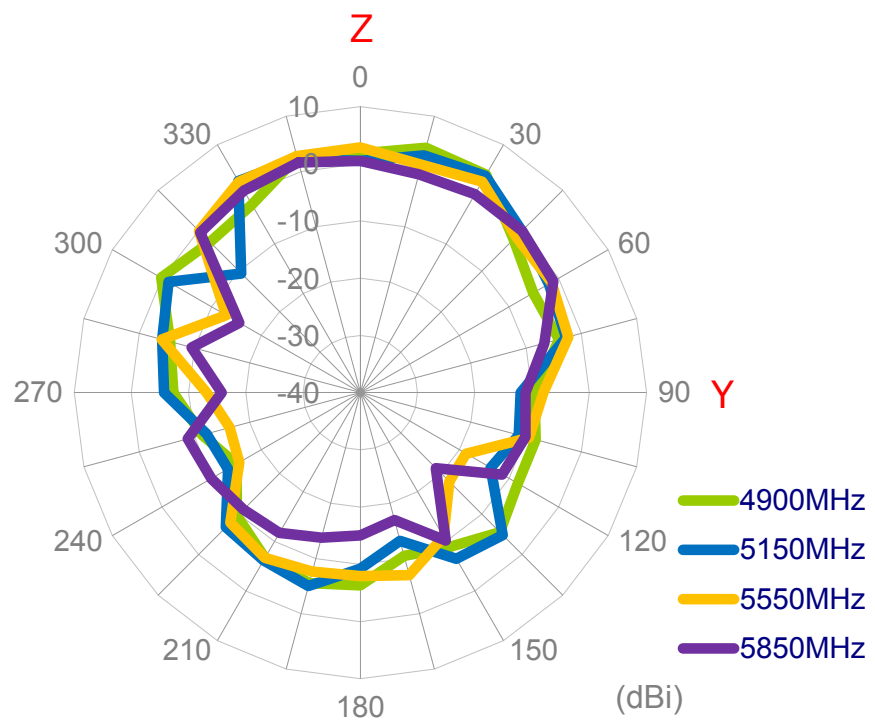
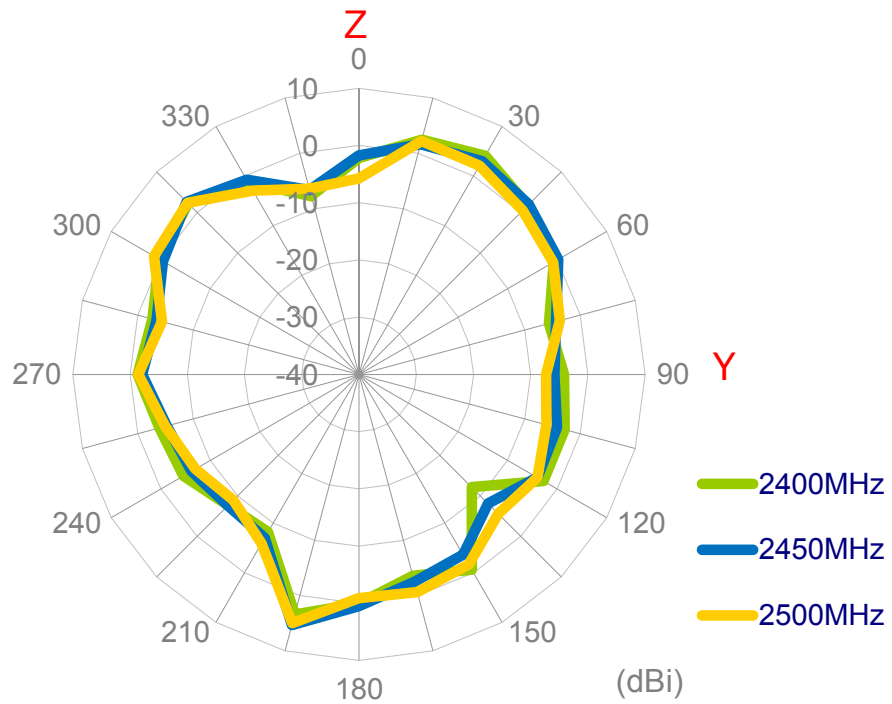
XY Plane



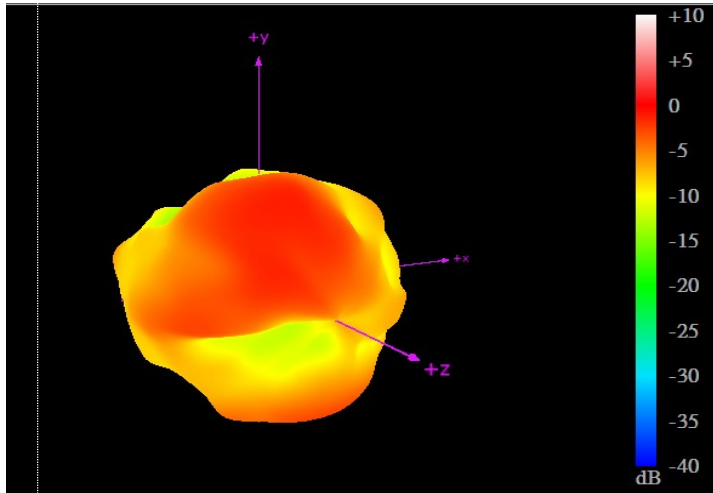
XZ Plane



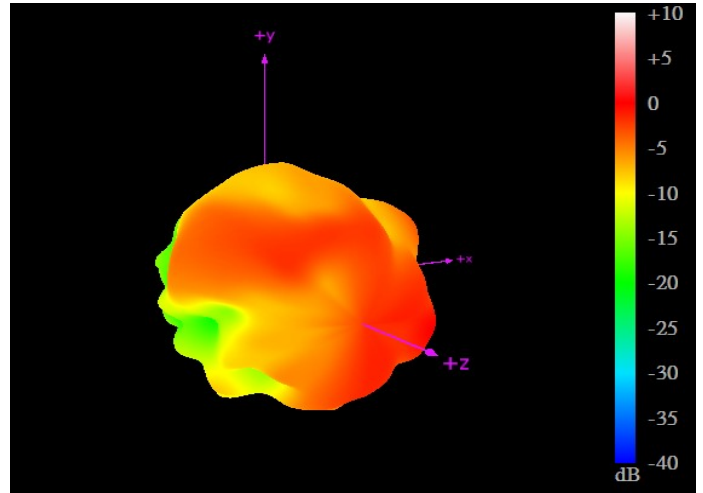
YZ Plane



3.1.62 3D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length in free space)



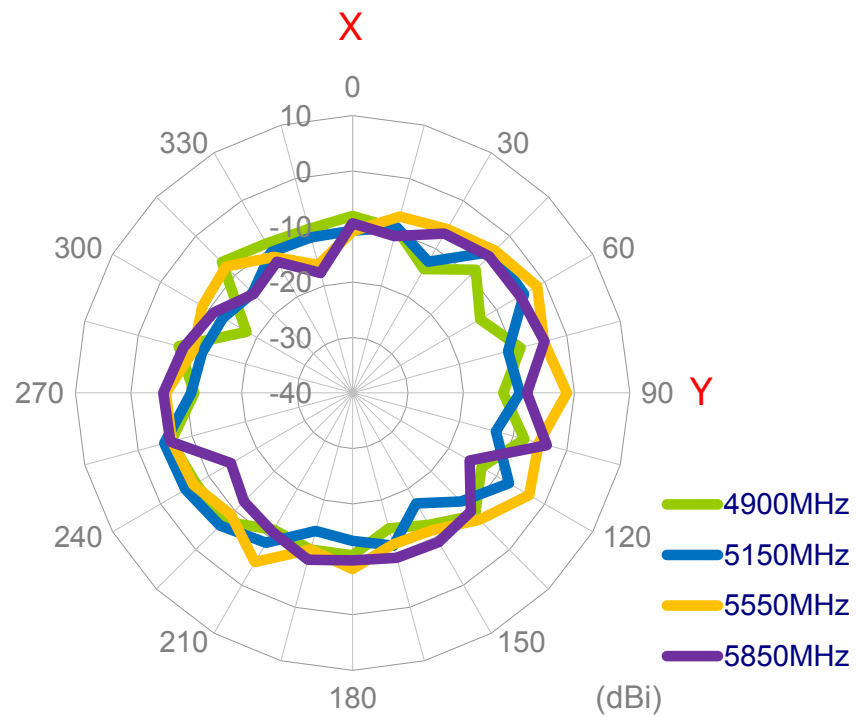
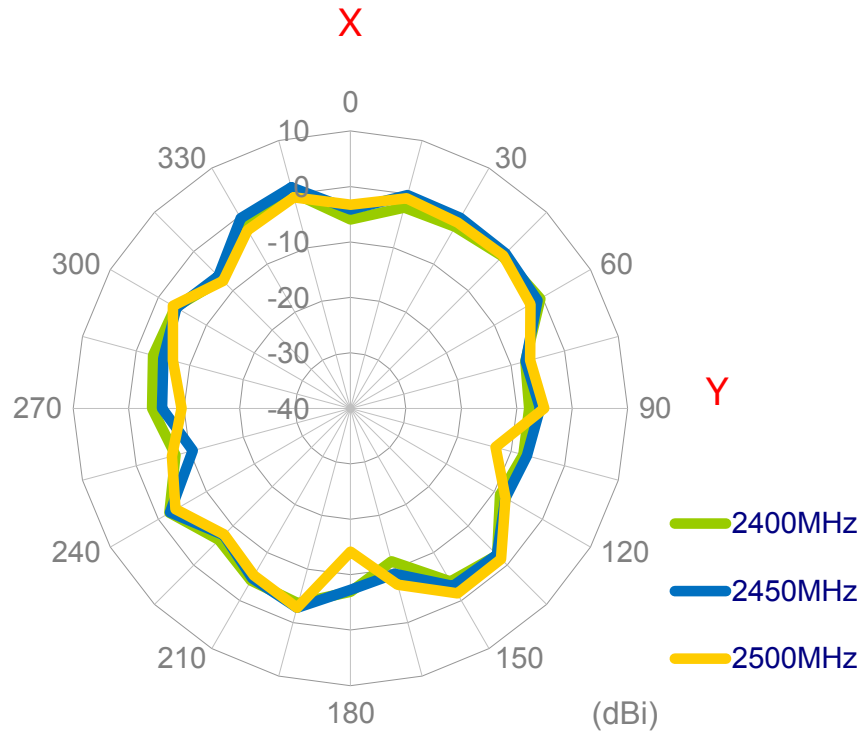
2450MHz



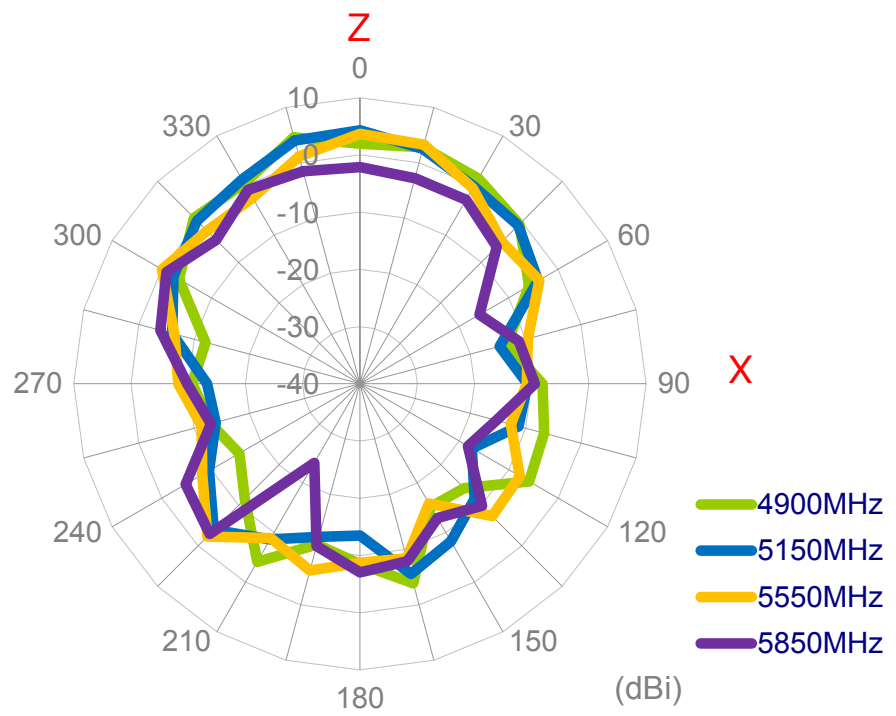
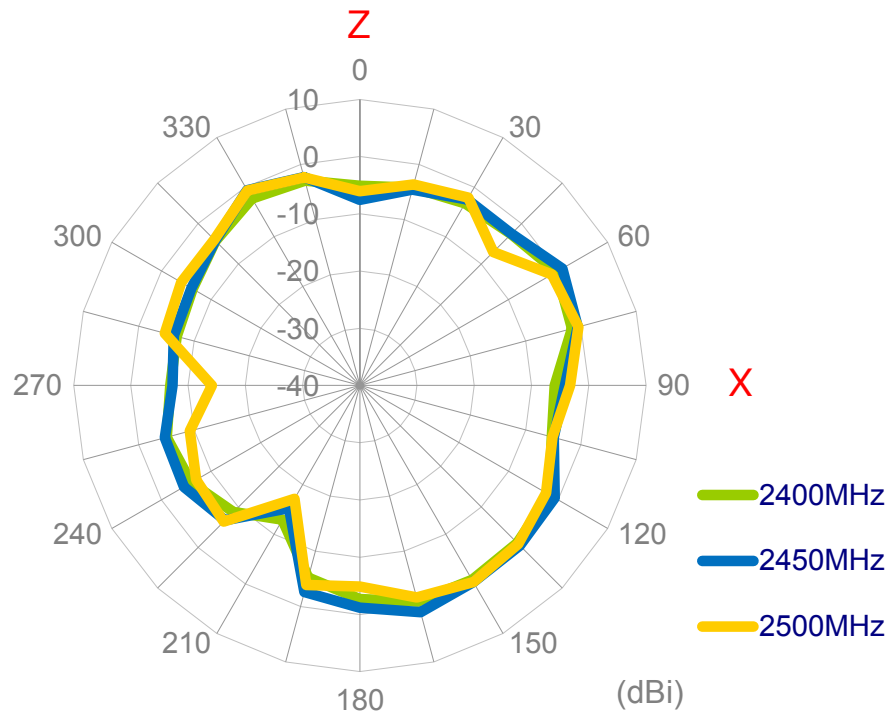
5550MHz

3.1.63 2D Radiation Pattern (Wi-Fi_MIMO2 with 3M cable length in free space)

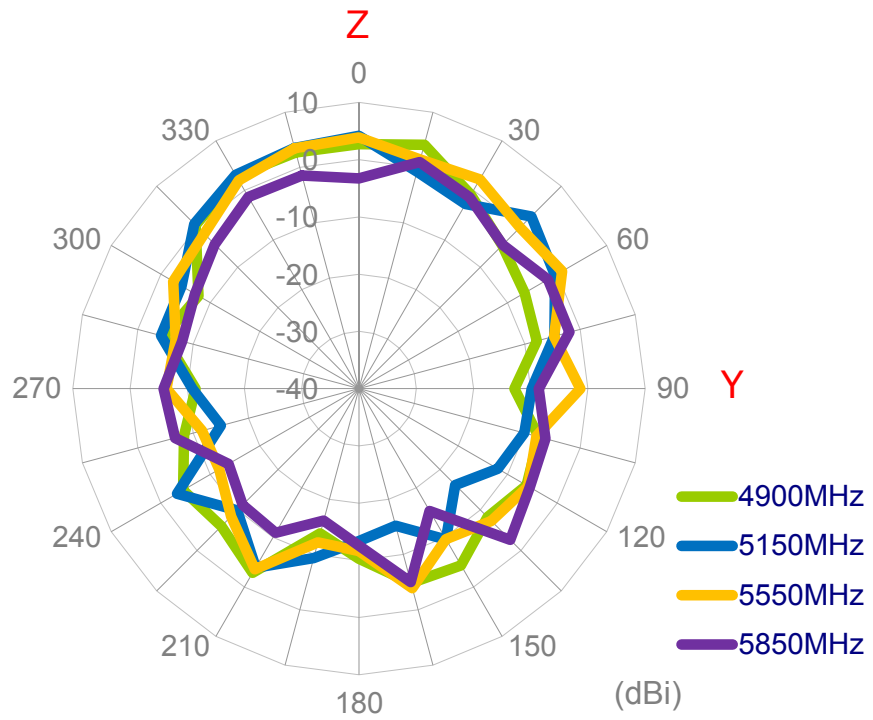
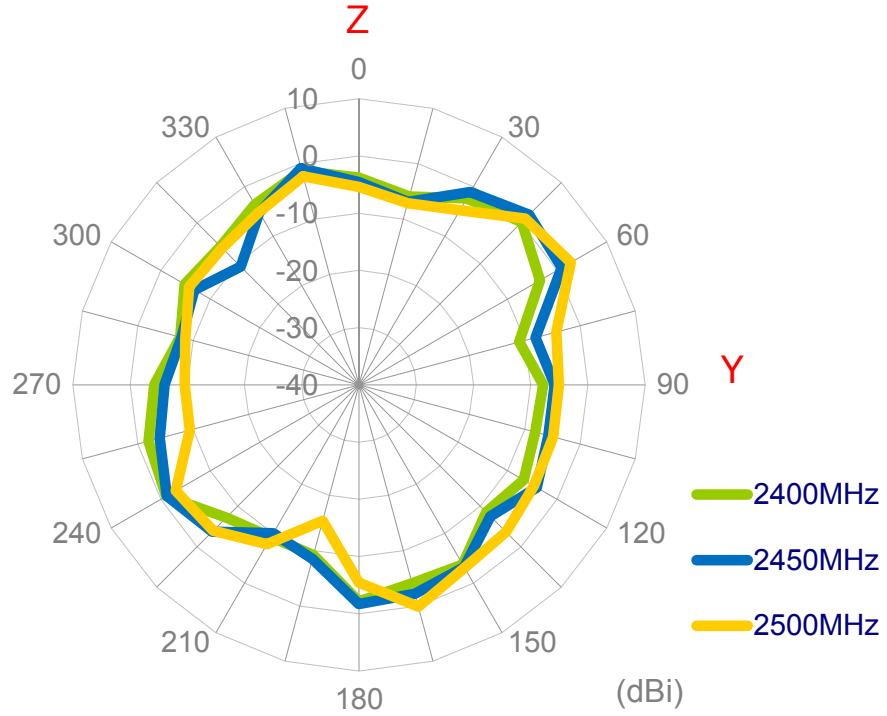
XY Plane



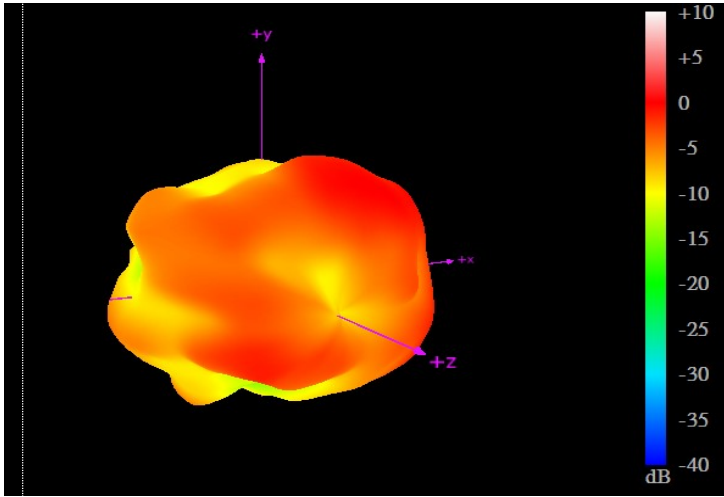
XZ Plane



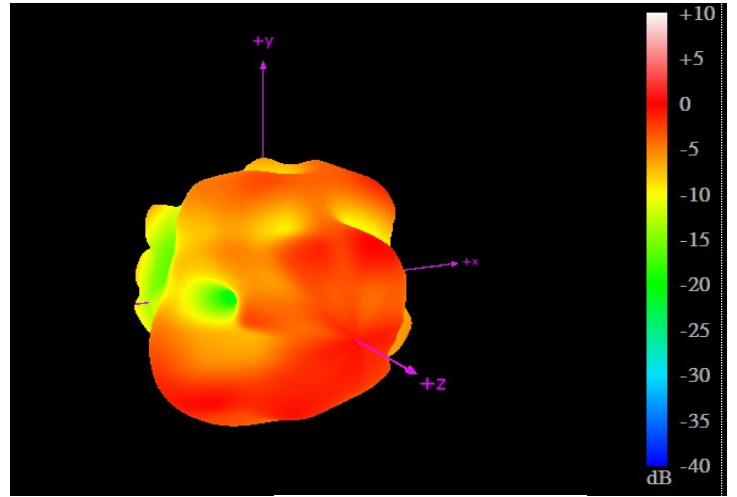
YZ Plane



3.1.64 3D Radiation Pattern (Wi-Fi_MIMO2 with 1M cable length in free space)



2450MHz



5550MHz

5. Packaging

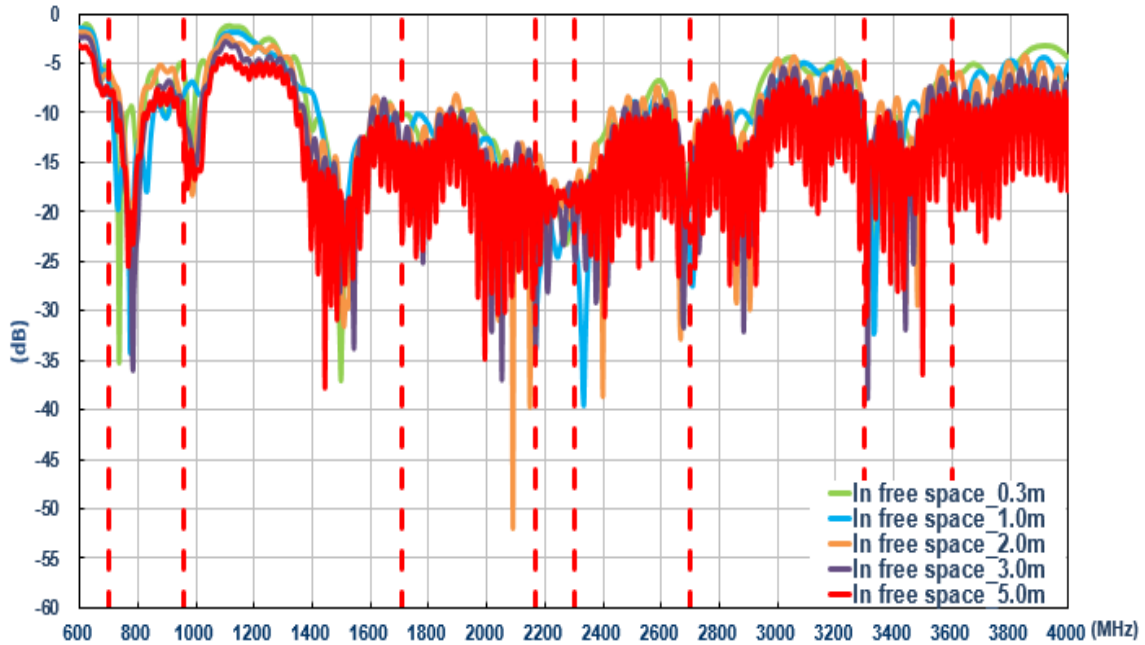
TBD.

6. Application Note

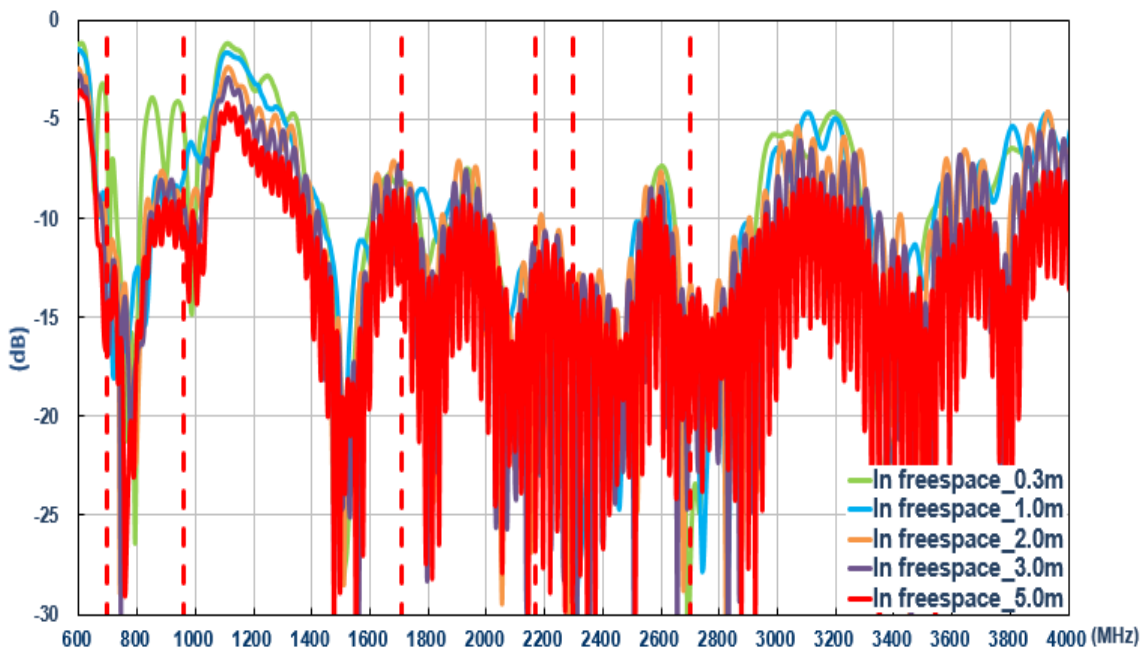
The MA961 antenna performance with different cable lengths is shown below.

6.1 In free space (LTE)

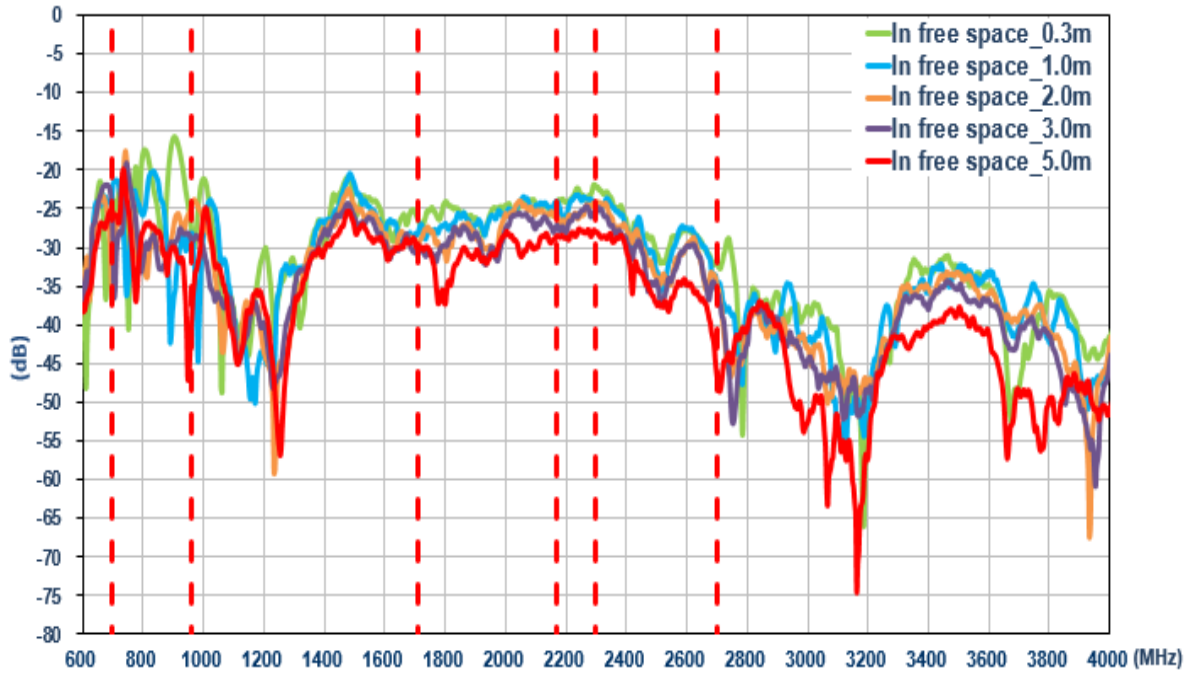
6.1.1 Return Loss (LTE_MIMO_1)



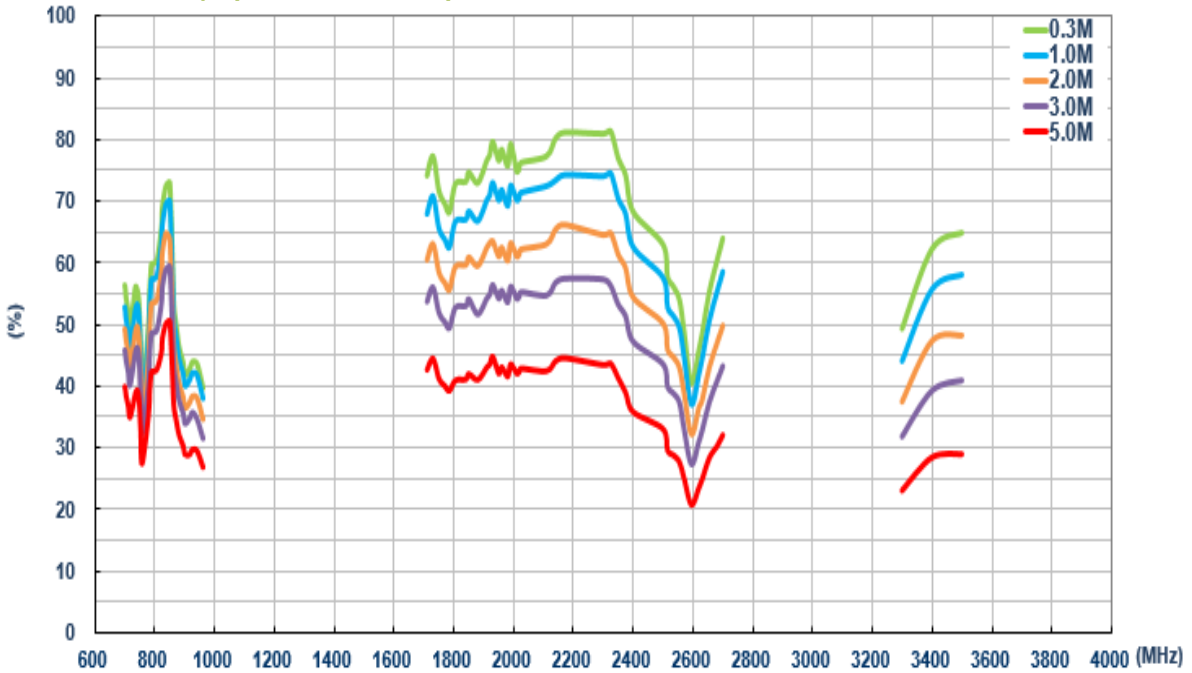
6.1.2 Return Loss (LTE_MIMO_2)



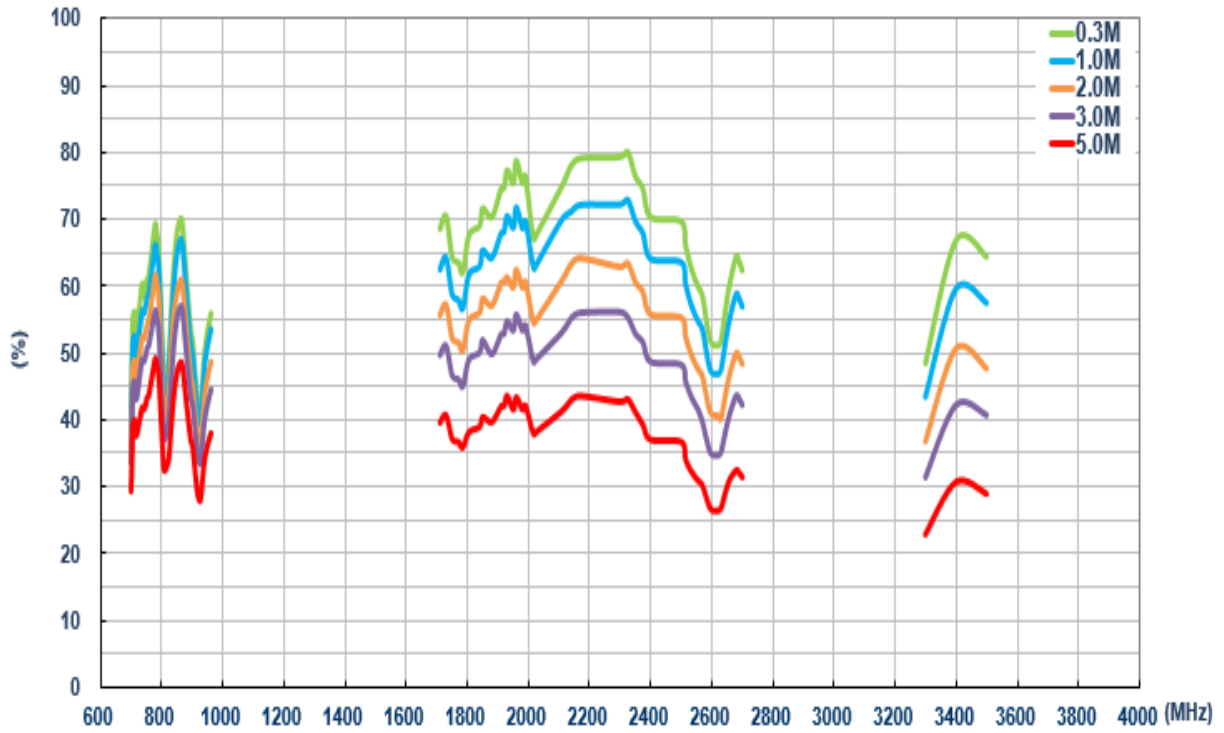
6.1.3 Isolation (LTE antenna)



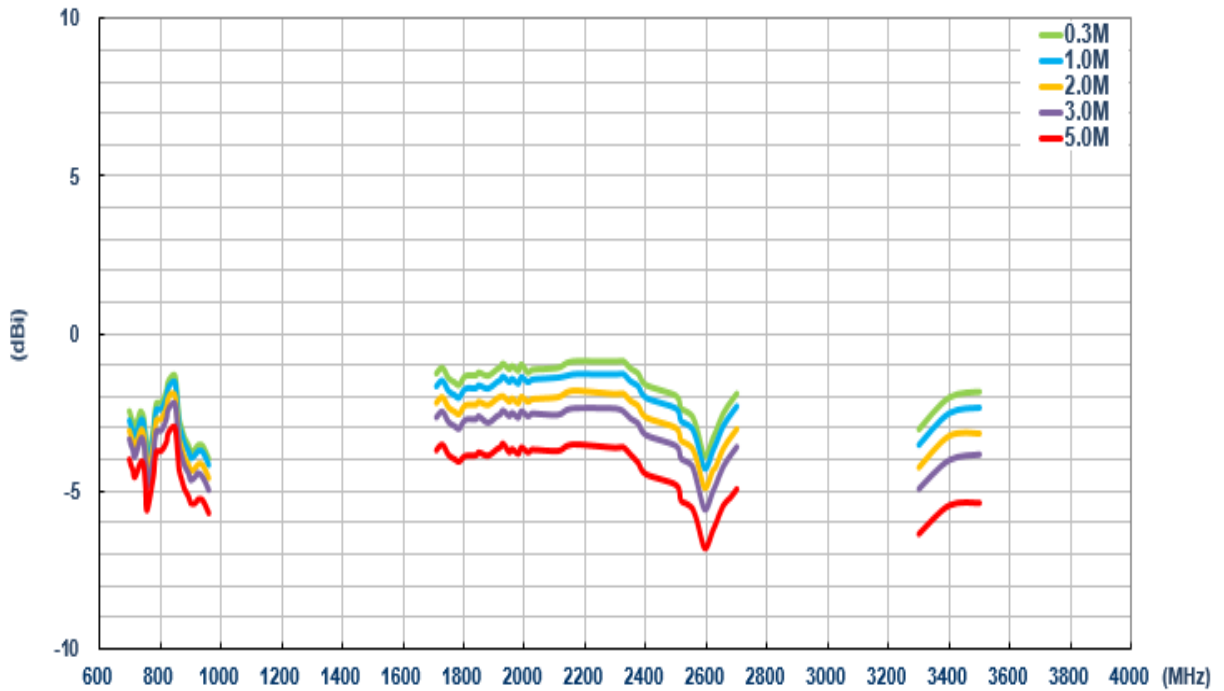
6.1.4 Efficiency (LTE MIMO_1)



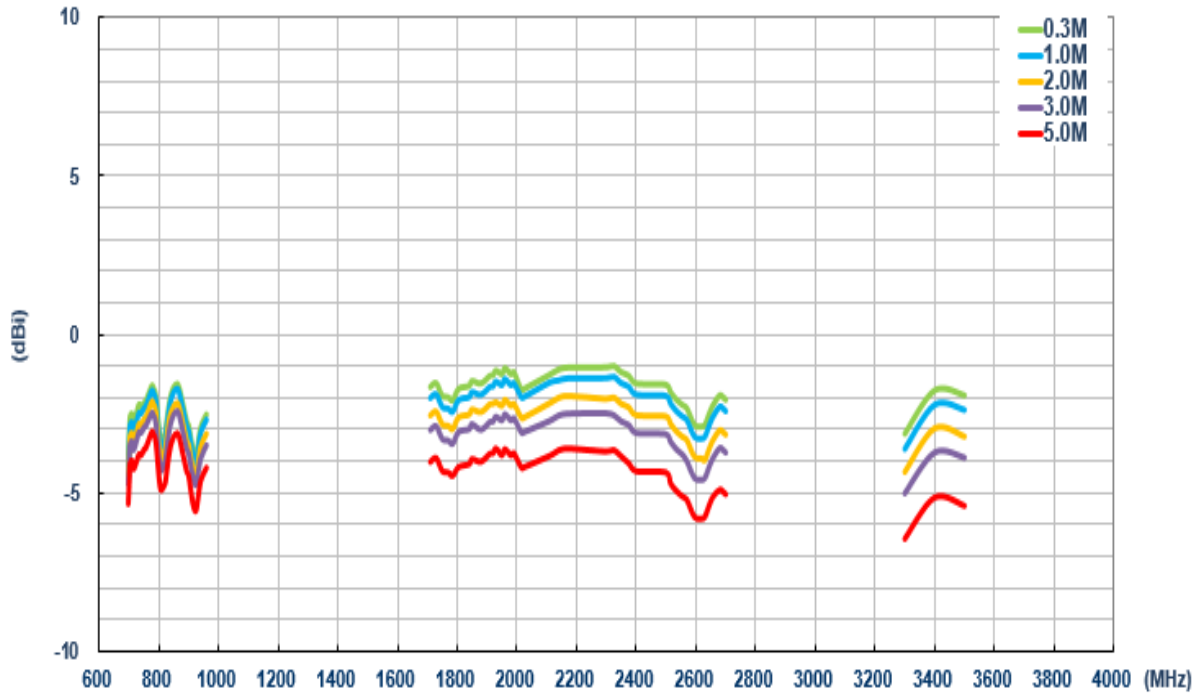
6.1.5 Efficiency (LTE MIMO_2)



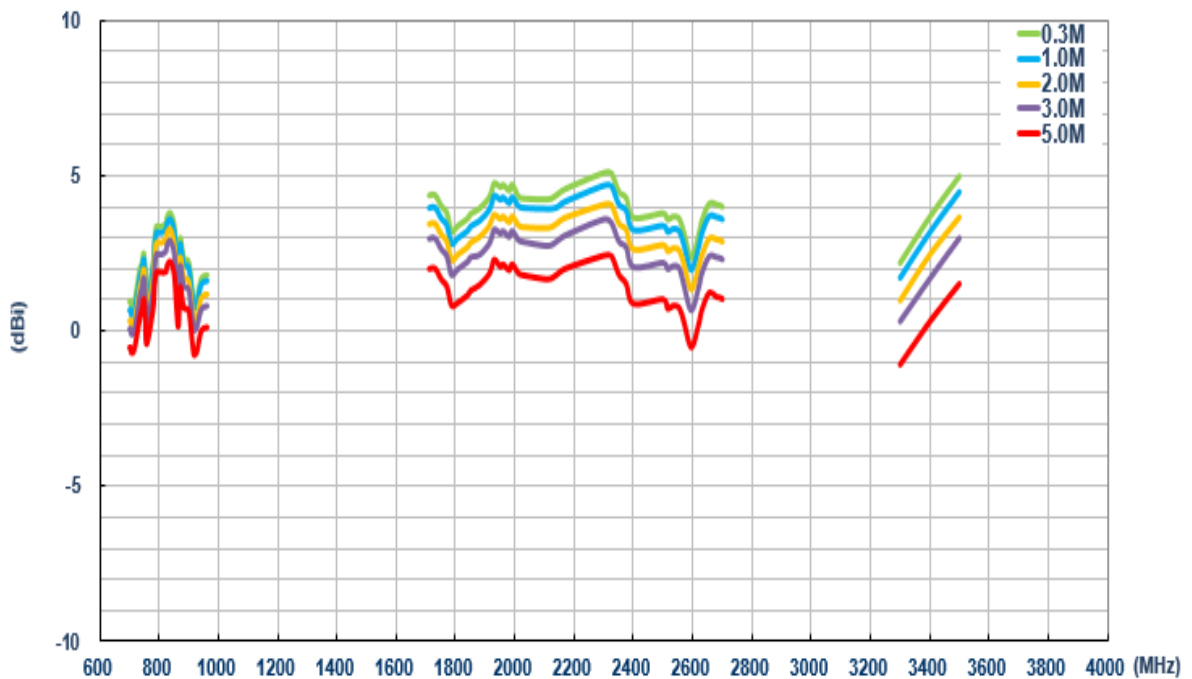
6.1.6 Average Gain (LTE MIMO_1)



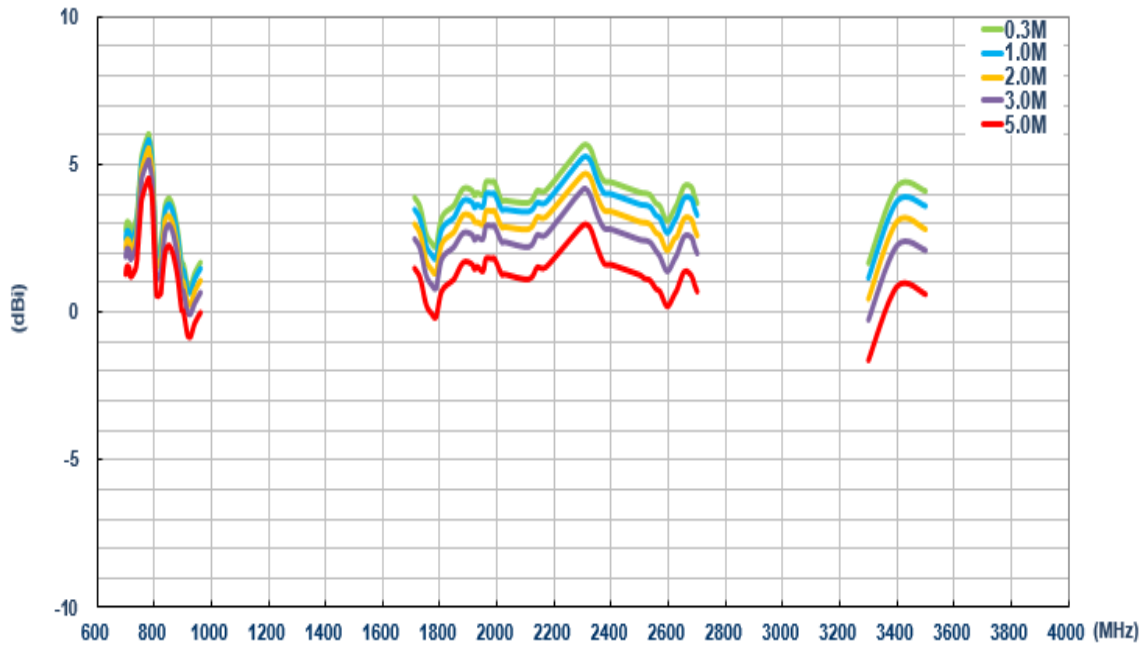
6.1.7 Average Gain (LTE MIMO_2)



6.1.8 Peak Gain (LTE MIMO_1)

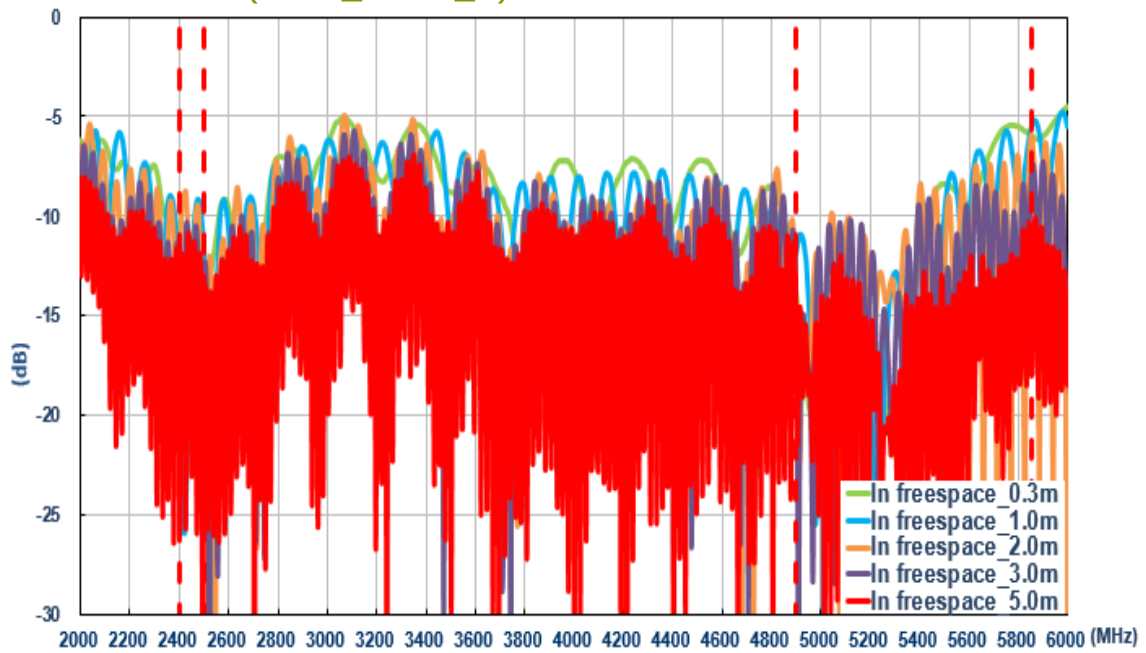


6.1.9 Peak Gain (LTE MIMO_2)

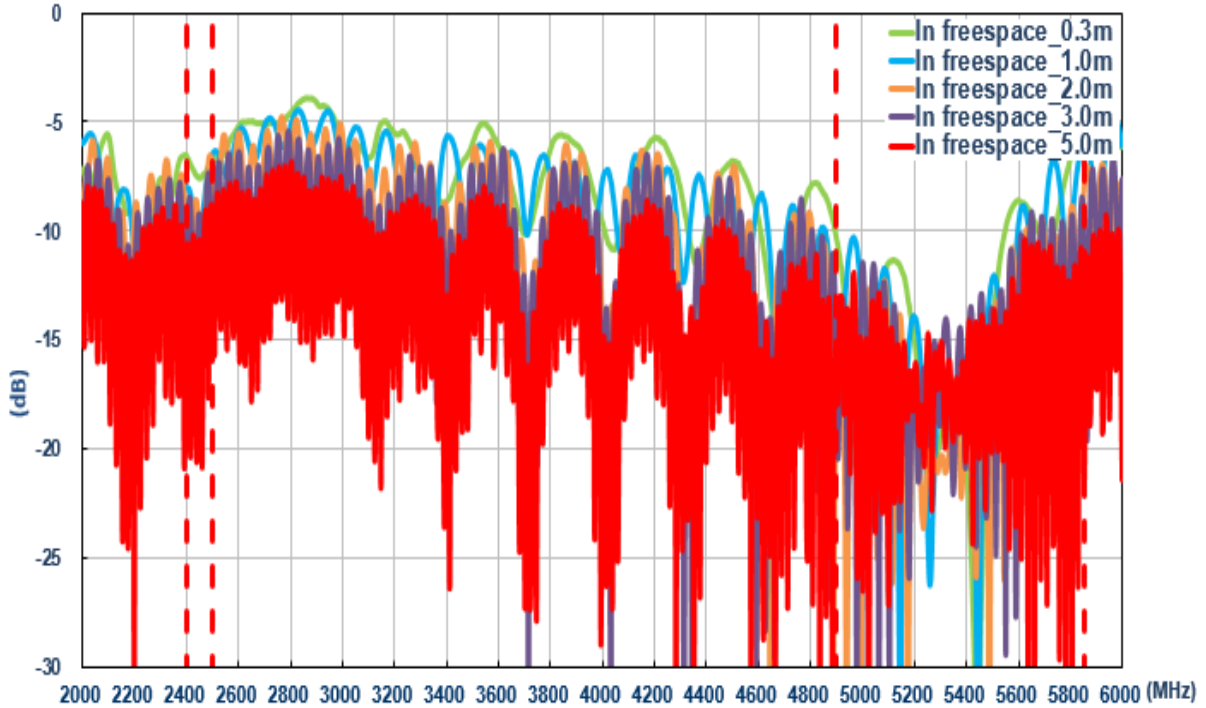


6.2 In free space (Wi-Fi)

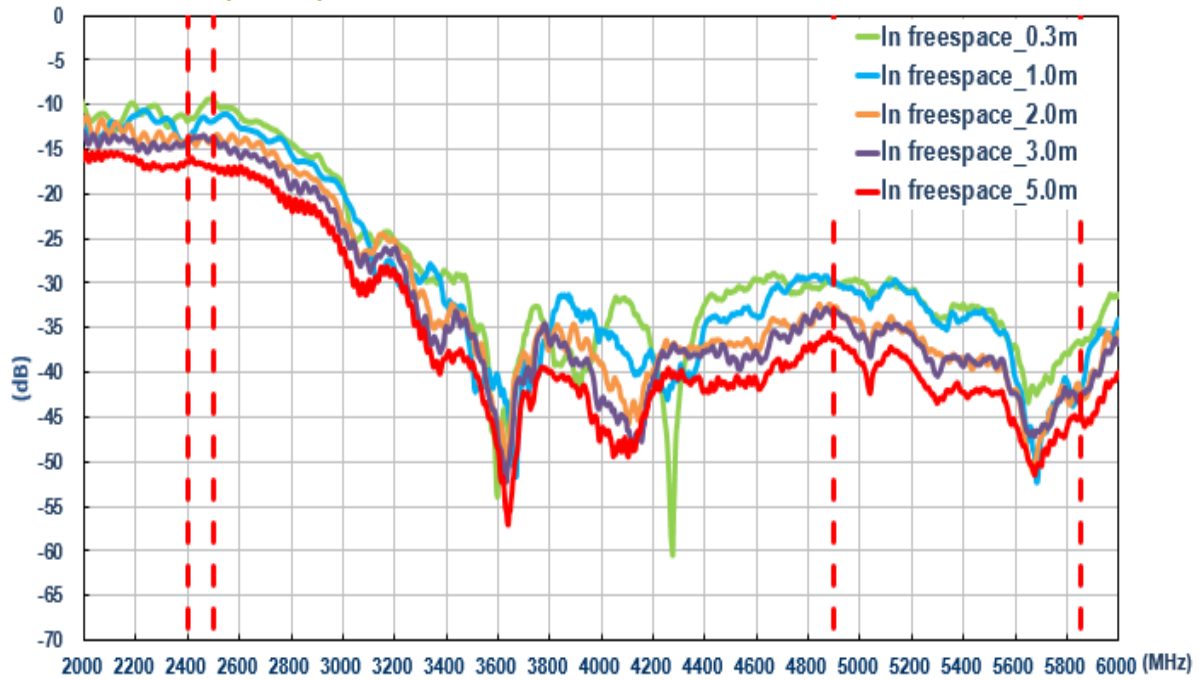
6.2.1 Return Loss (Wi-Fi_MIMO_1)



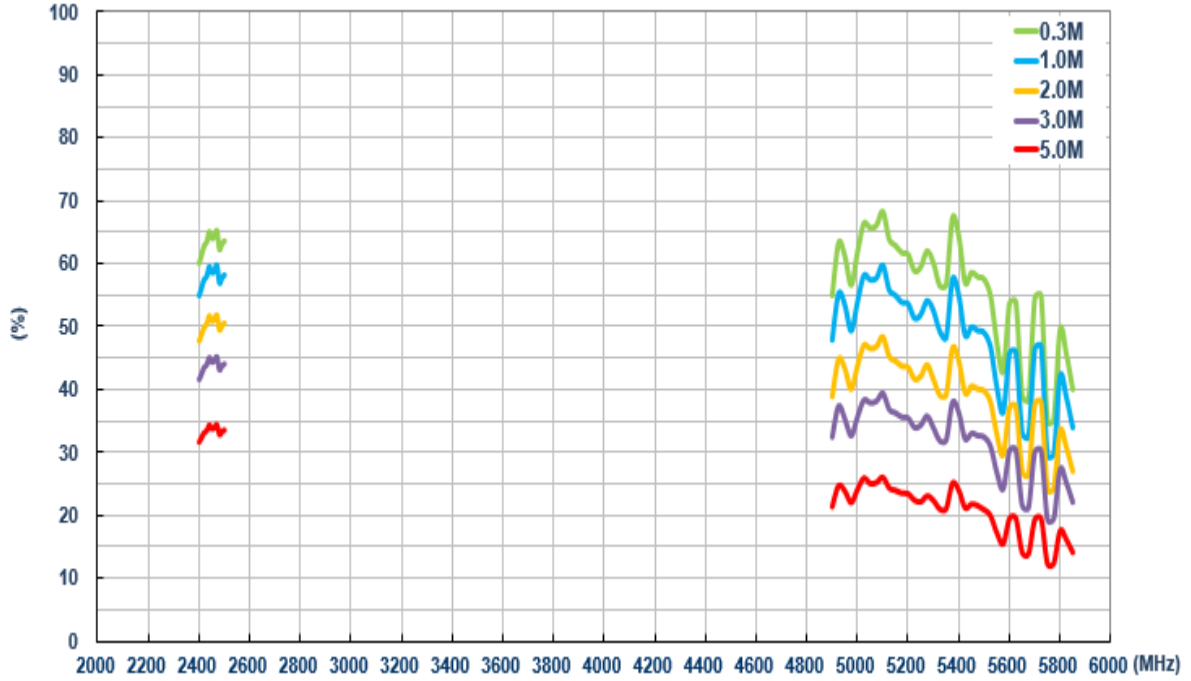
6.2.2 Return Loss (Wi-Fi_MIMO_2)



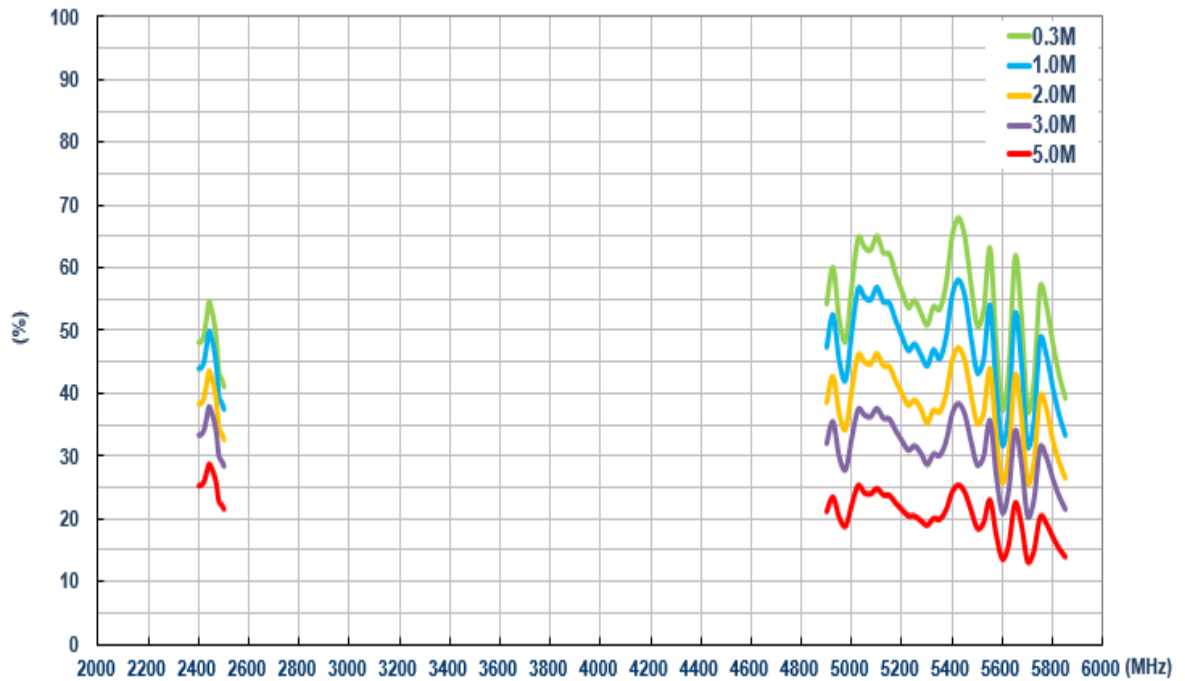
6.2.3 Isolation (Wi-Fi)



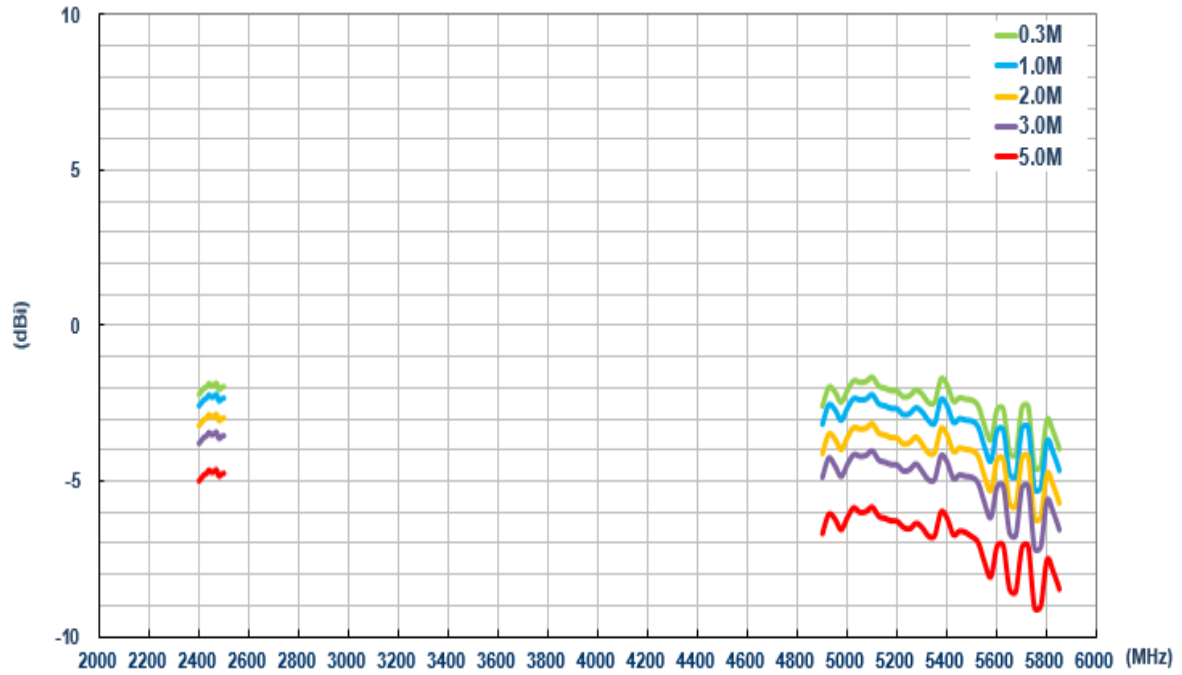
6.2.4 Efficiency (Wi-Fi MIMO_1)



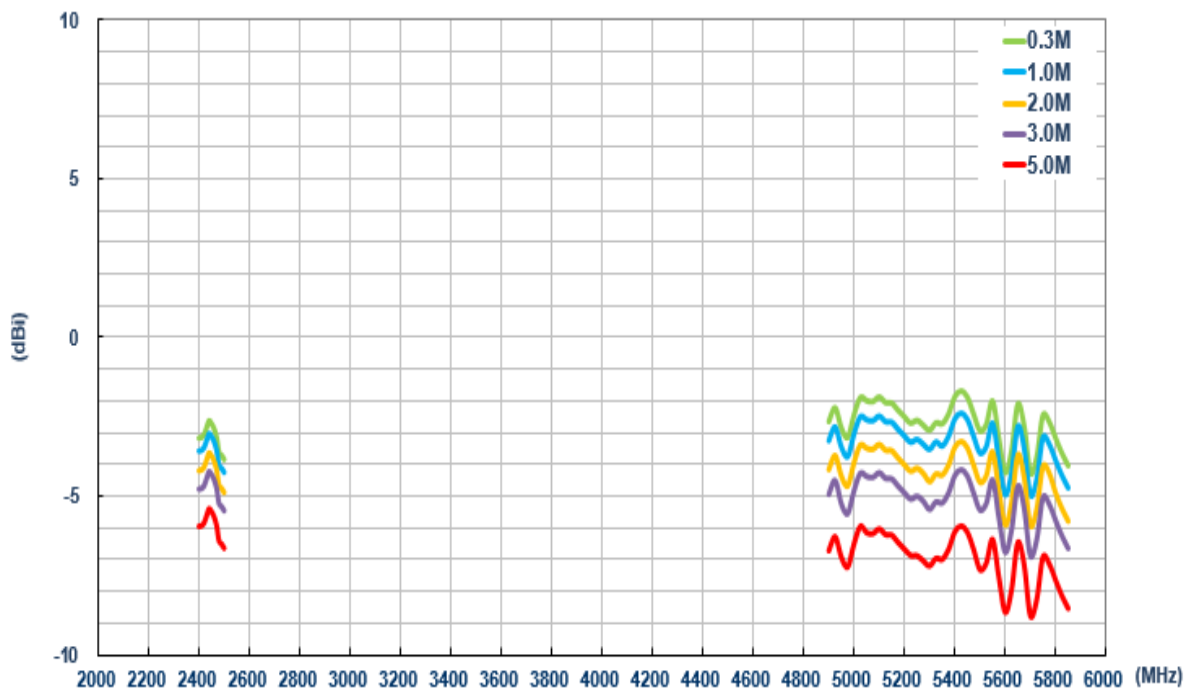
6.2.5 Efficiency (Wi-Fi MIMO_2)



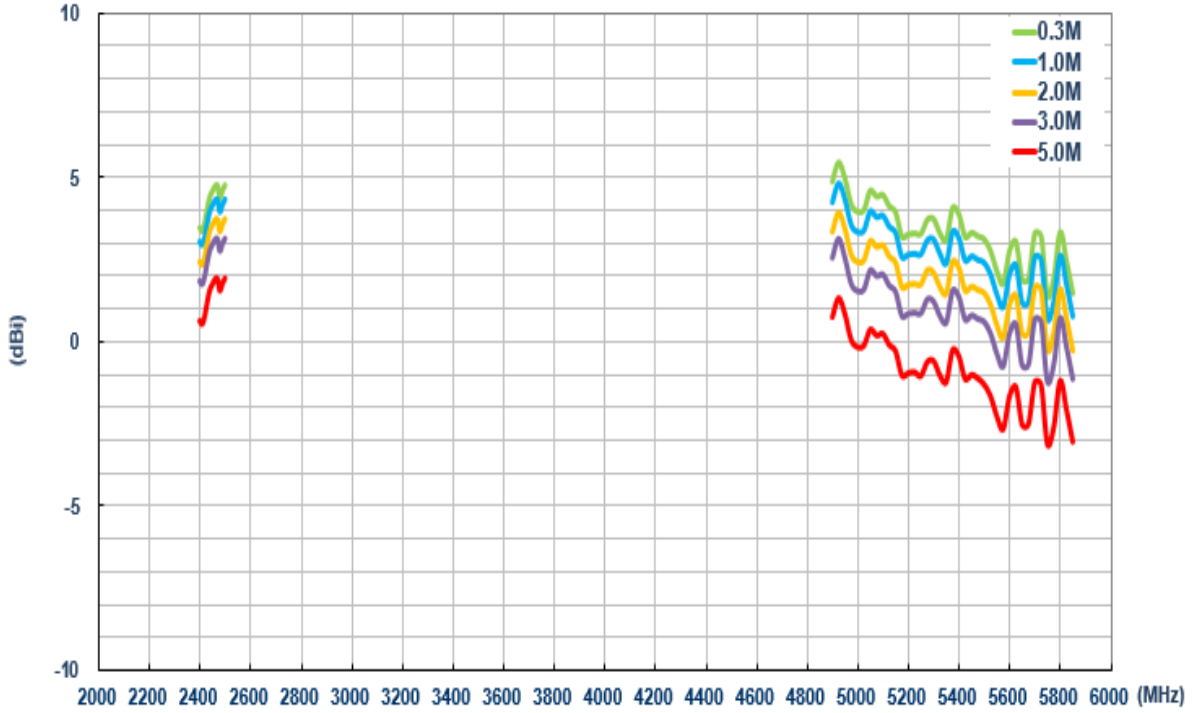
6.2.6 Average Gain (Wi-Fi MIMO_1)



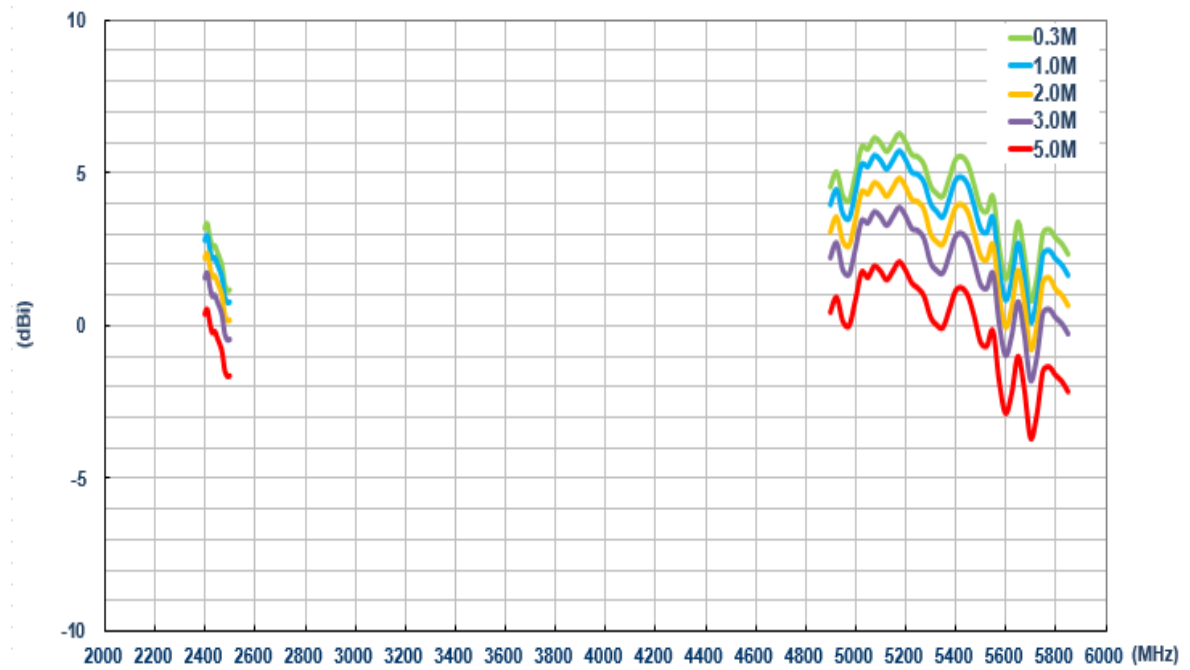
6.2.7 Average Gain (Wi-Fi MIMO_2)



6.2.8 Peak Gain (Wi-Fi MIMO_1)

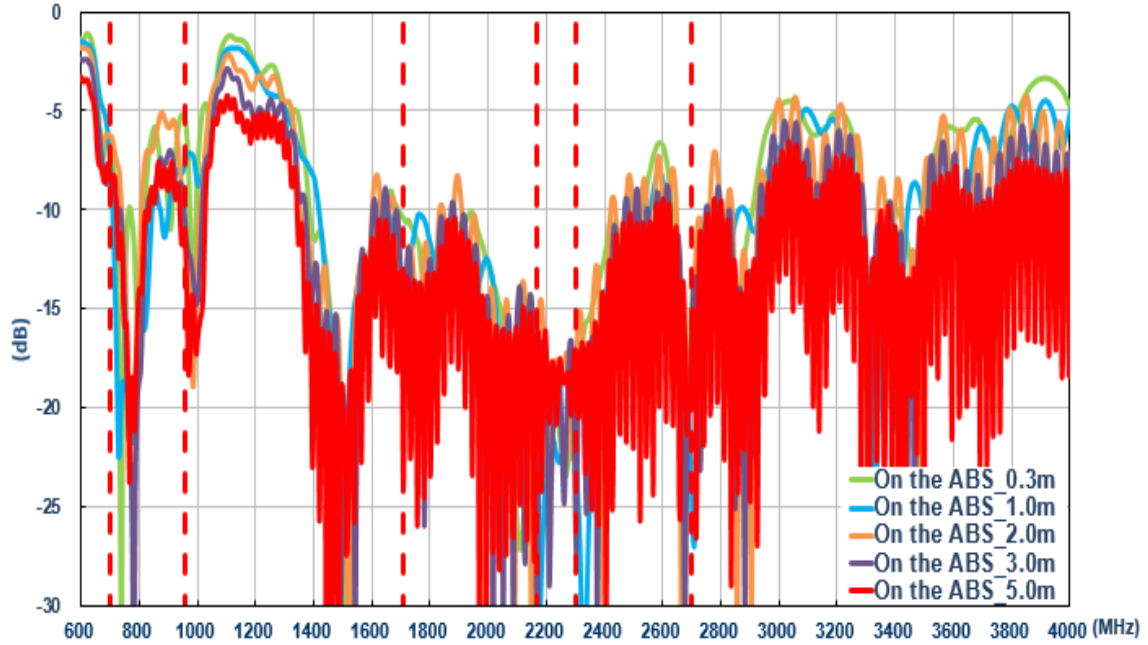


6.2.9 Peak Gain (Wi-Fi MIMO_2)

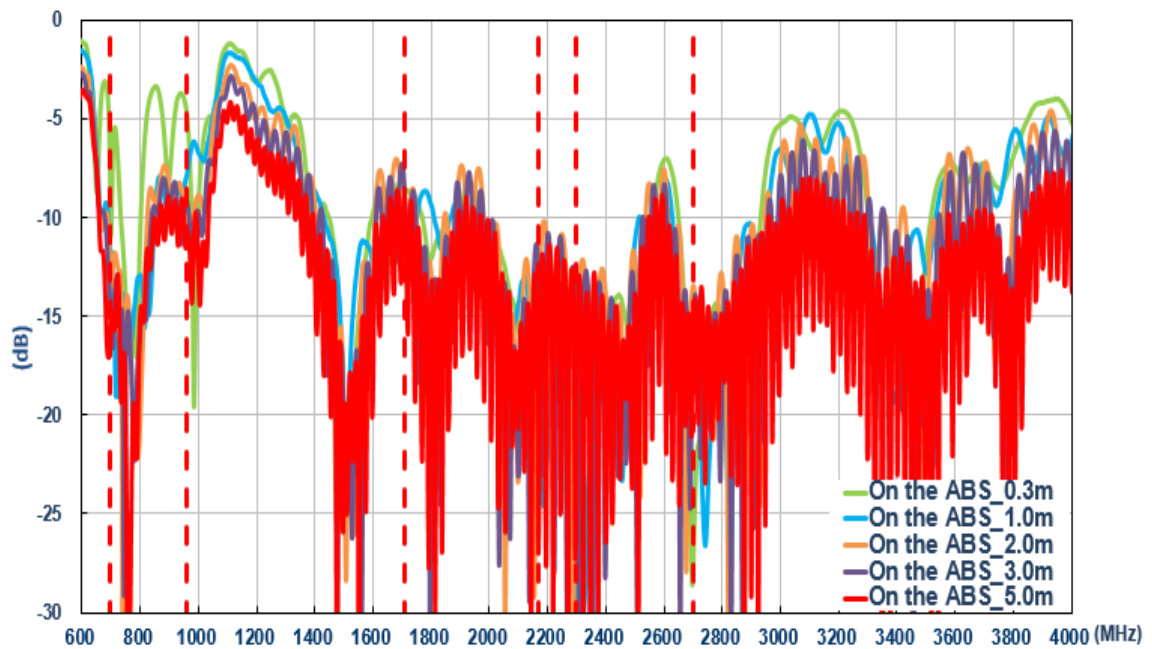


6.3 On the ABS (LTE)

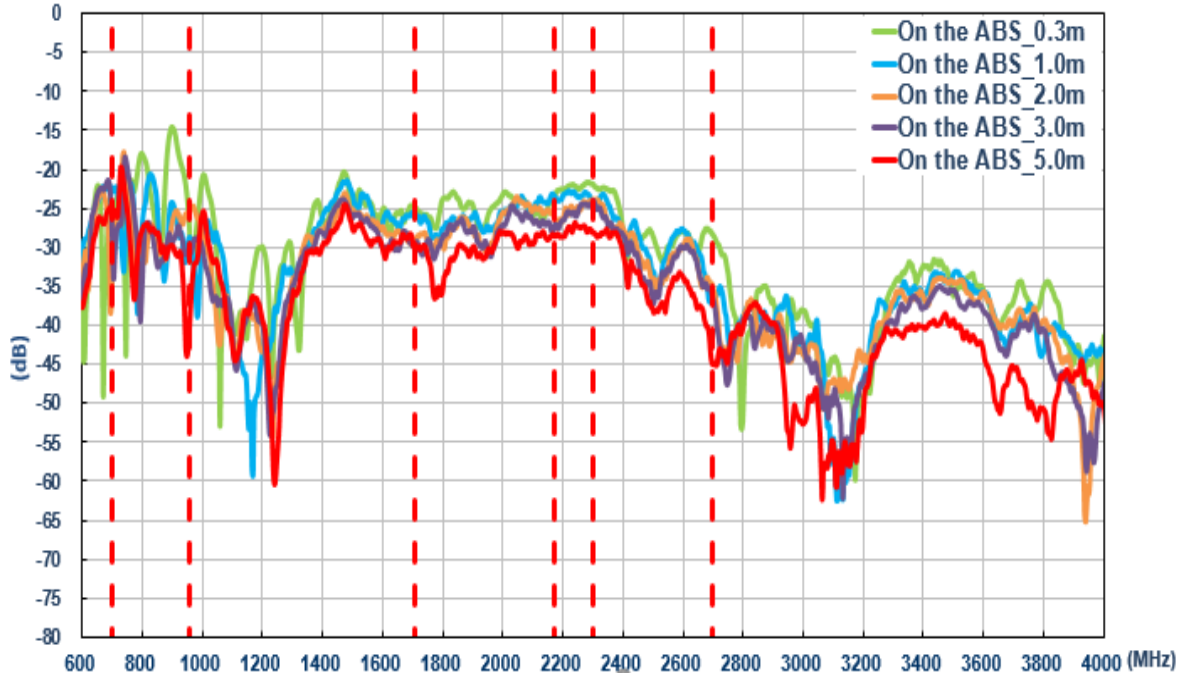
6.3.1 Return Loss (LTE_MIMO_1)



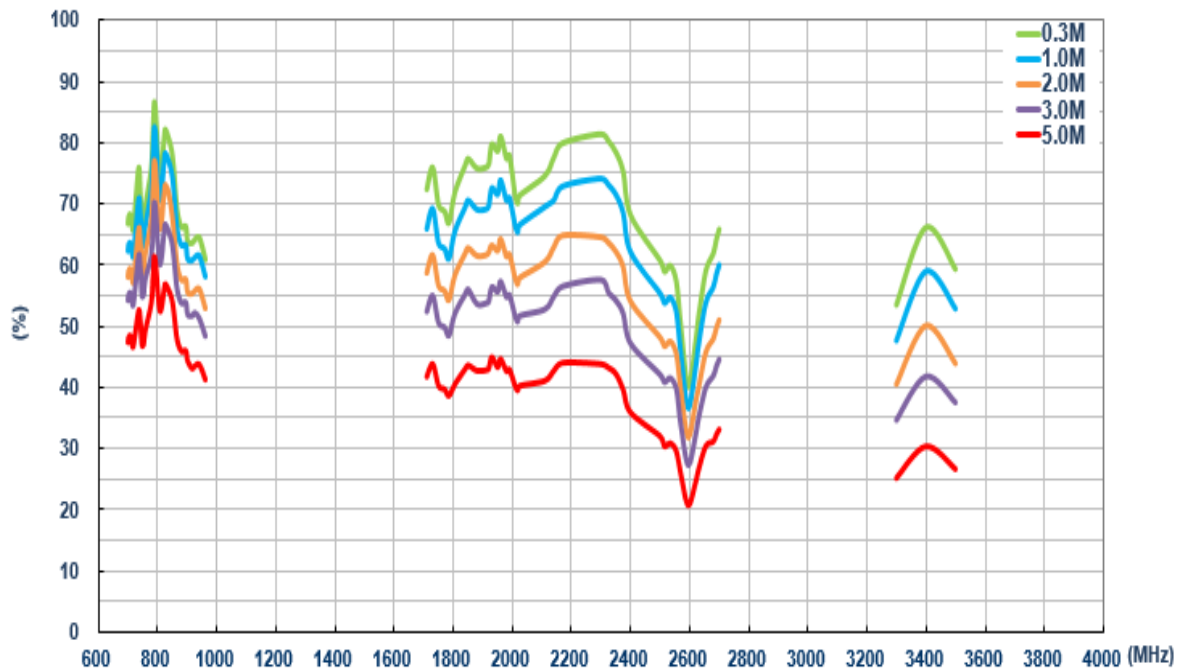
6.3.2 Return Loss (LTE_MIMO_2)



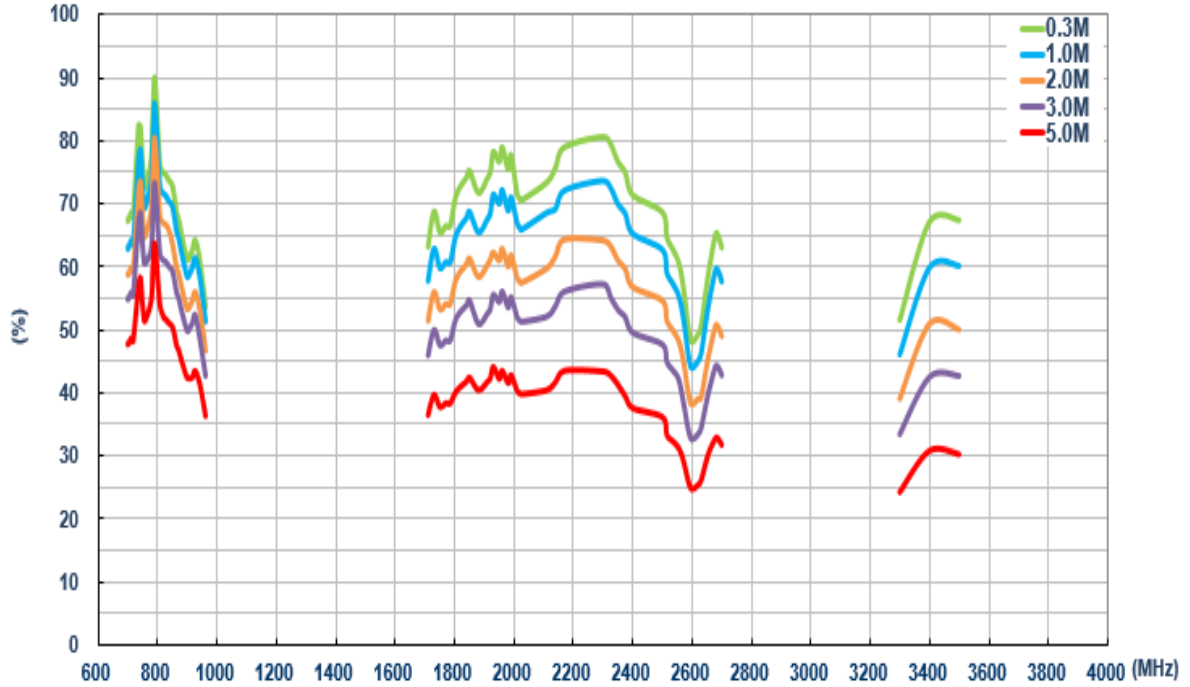
6.3.3 Isolation (LTE antenna)



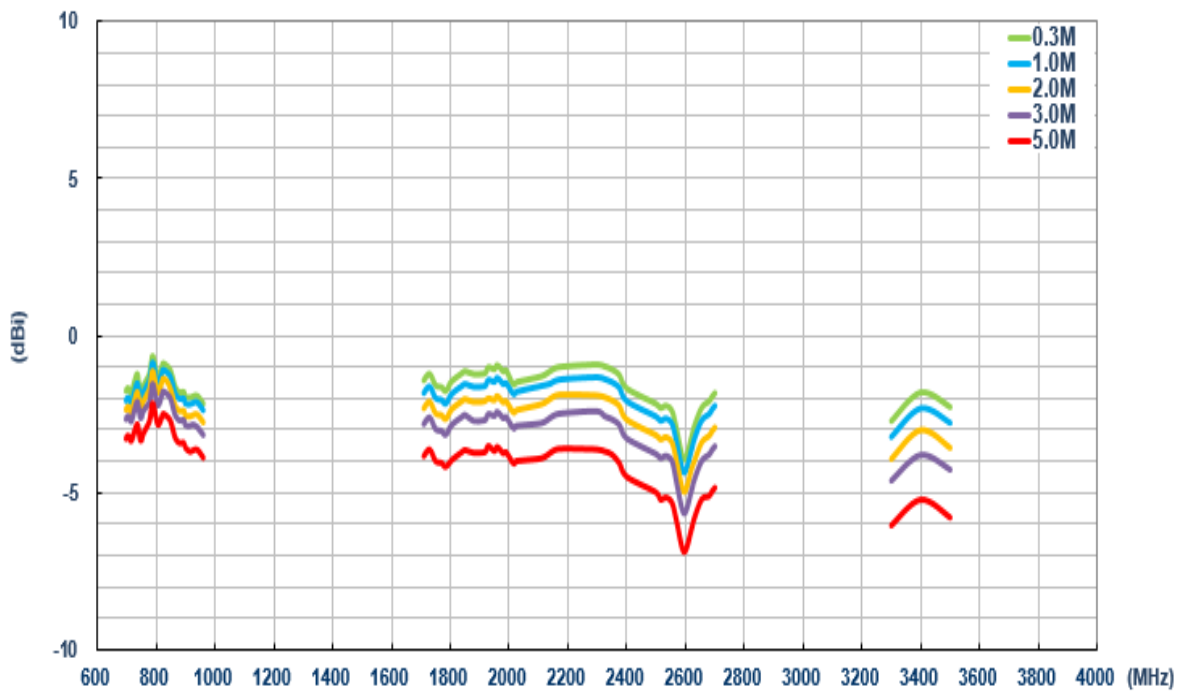
6.3.4 Efficiency (LTE MIMO_1)



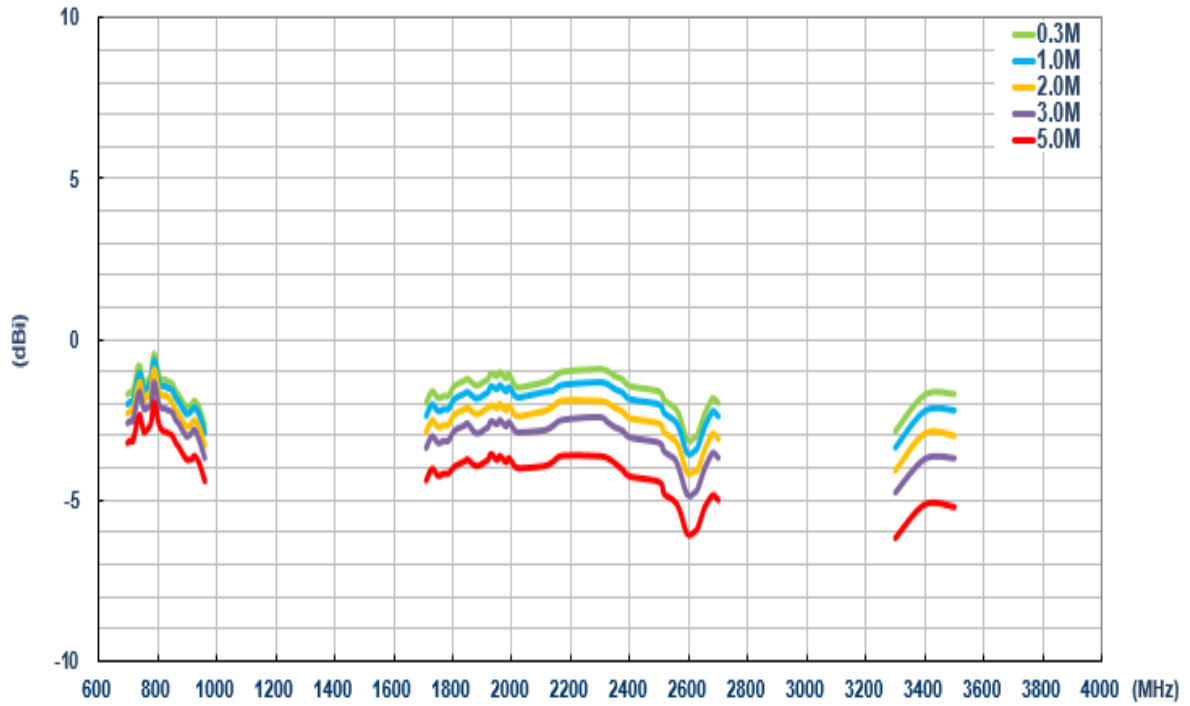
6.3.5 Efficiency (LTE MIMO_2)



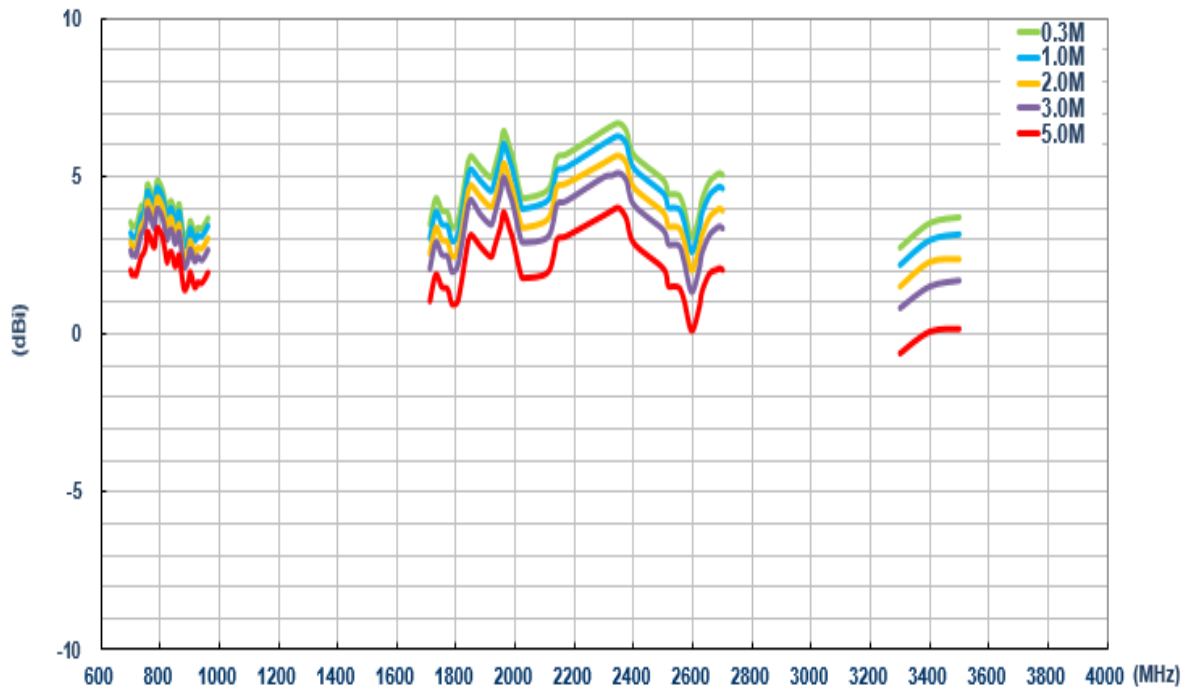
6.3.6 Average Gain (LTE MIMO_1)



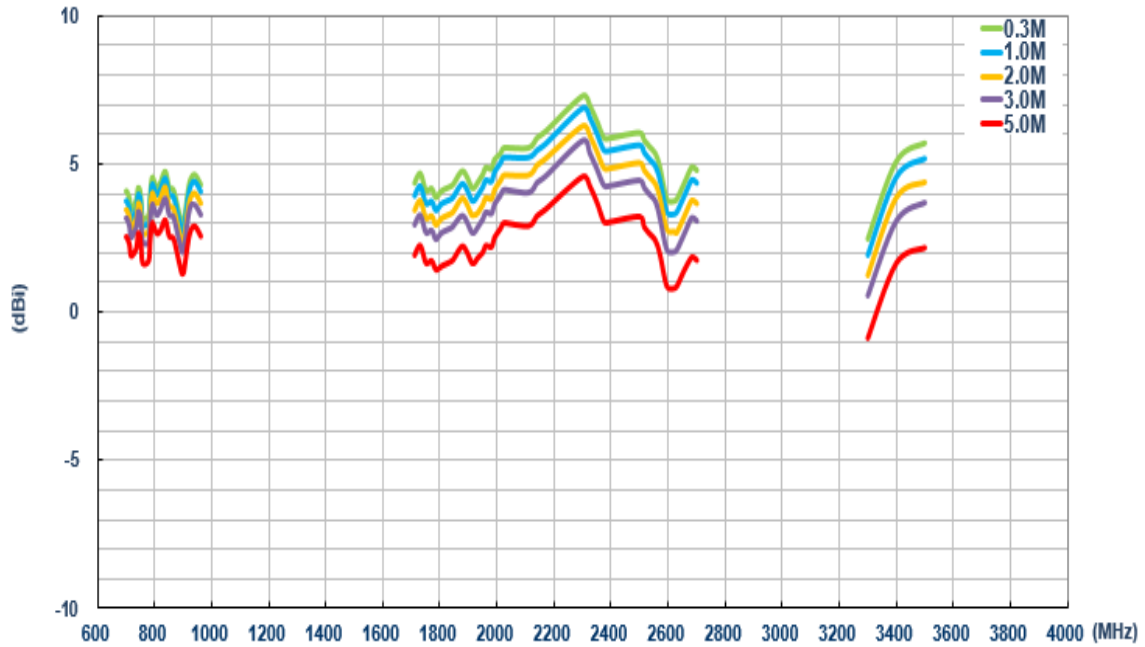
6.3.7 Average Gain (LTE MIMO_2)



6.3.8 Peak Gain (LTE MIMO_1)

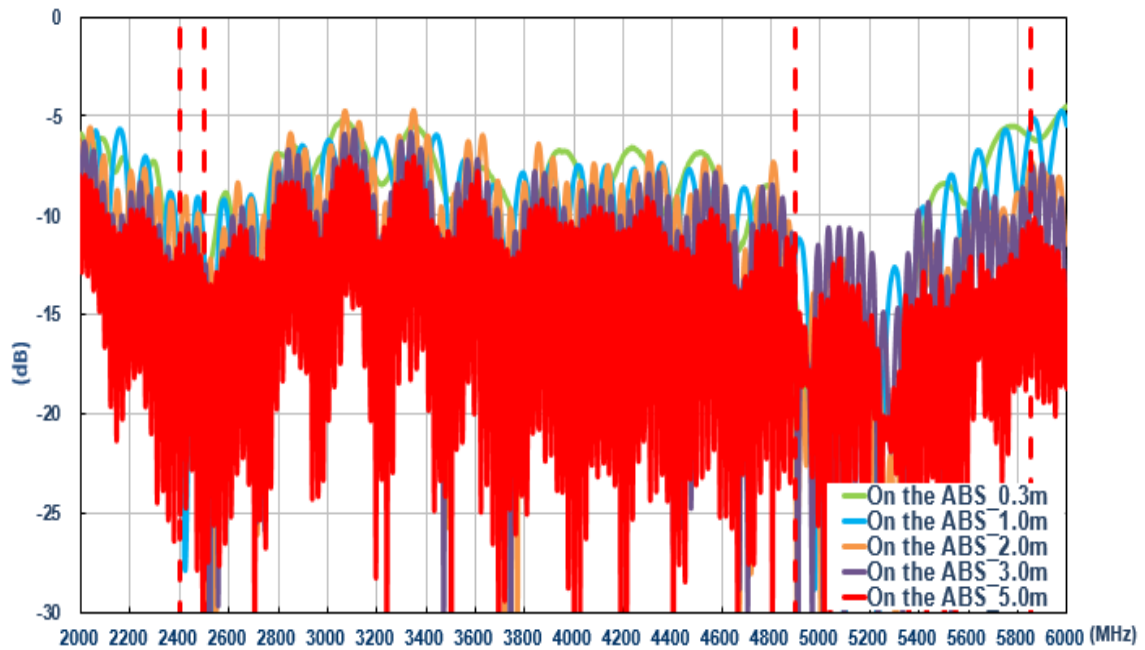


6.3.9 Peak Gain (LTE MIMO_2)

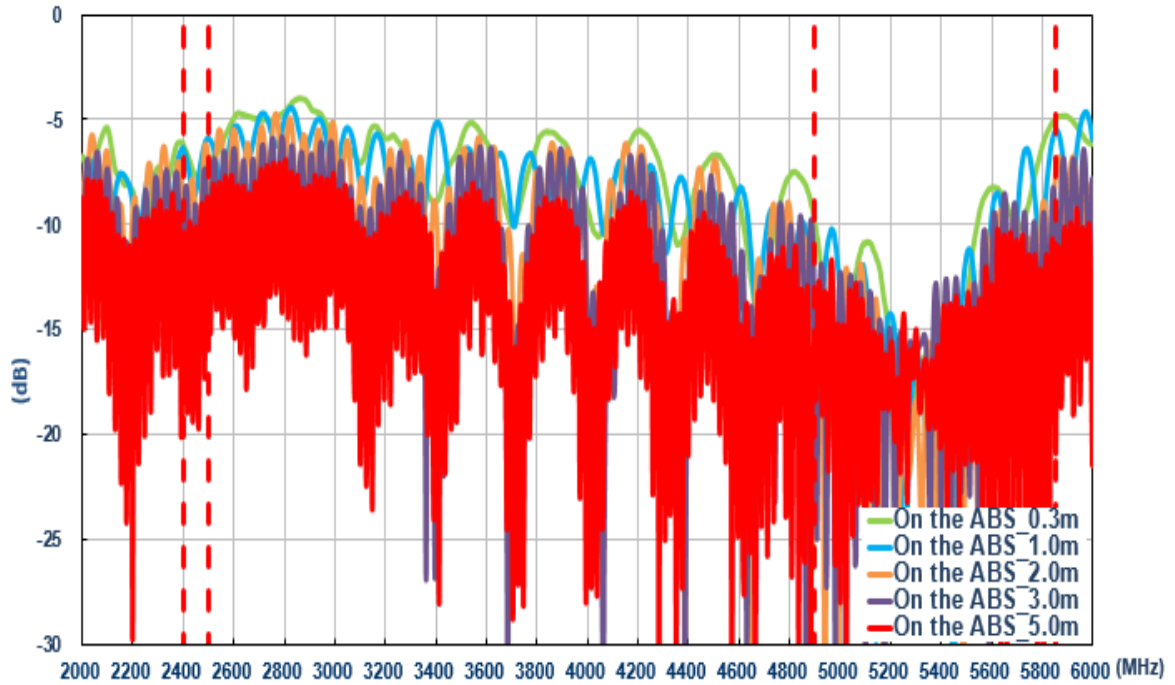


6.4 On ABS (Wi-Fi)

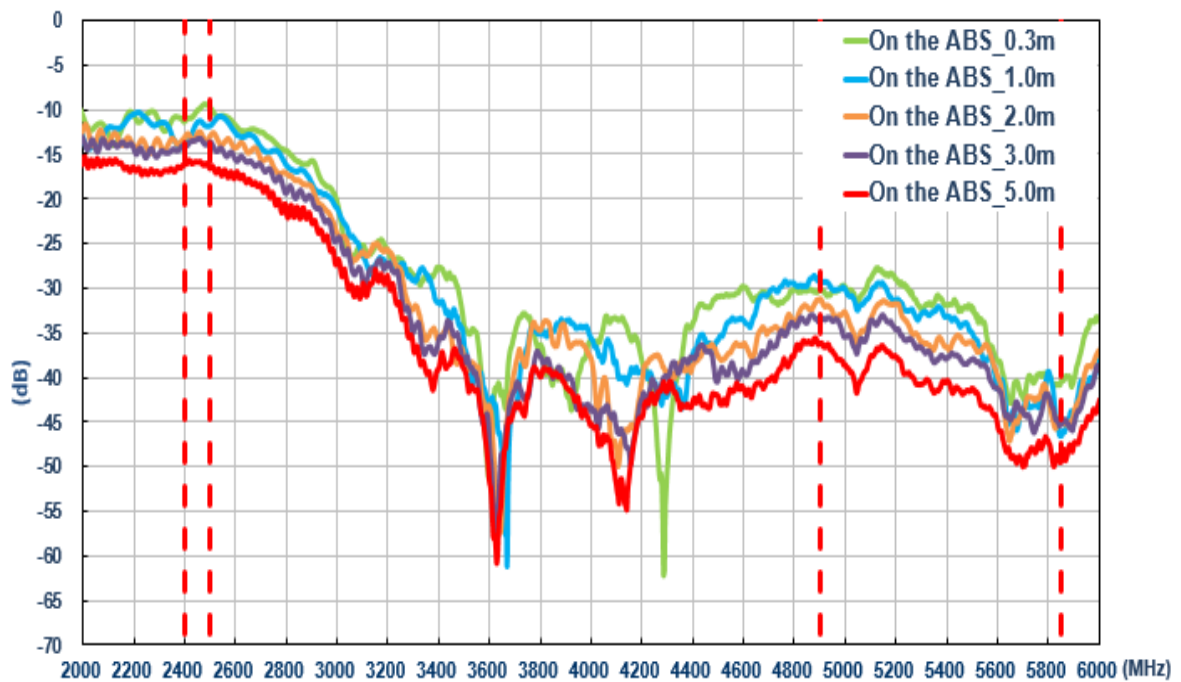
6.4.1 Return Loss (Wi-Fi_MIMO_1)



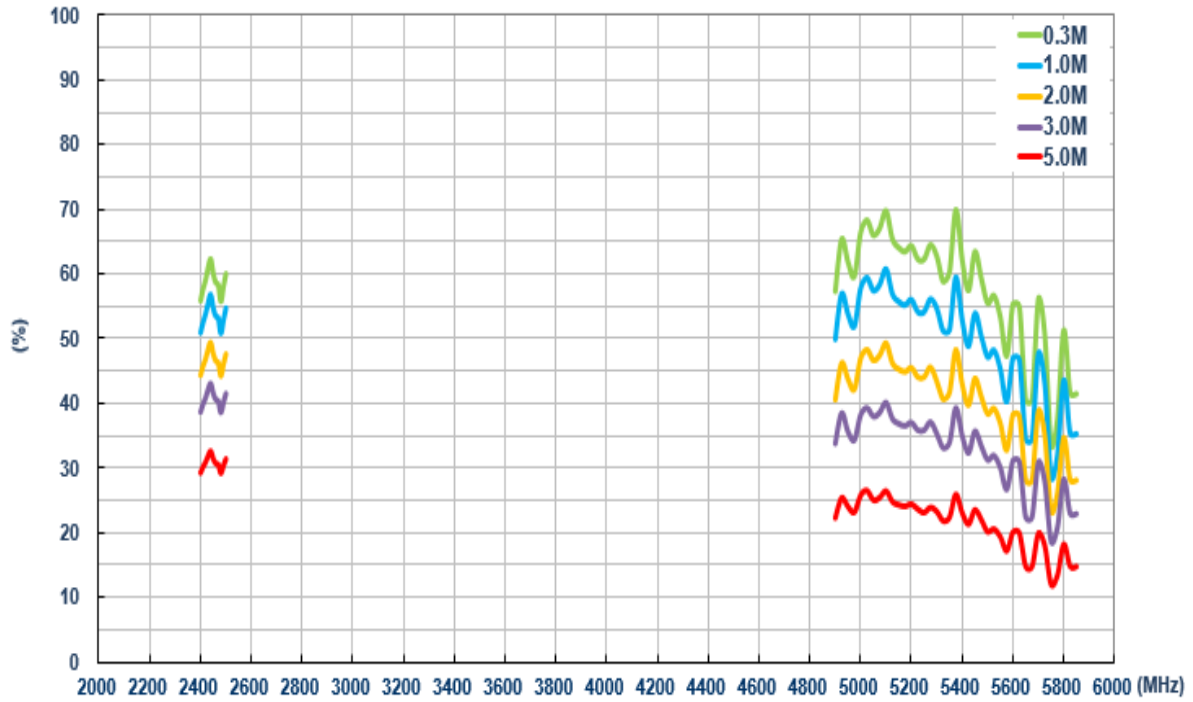
6.4.2 Return Loss (Wi-Fi_MIMO_2)



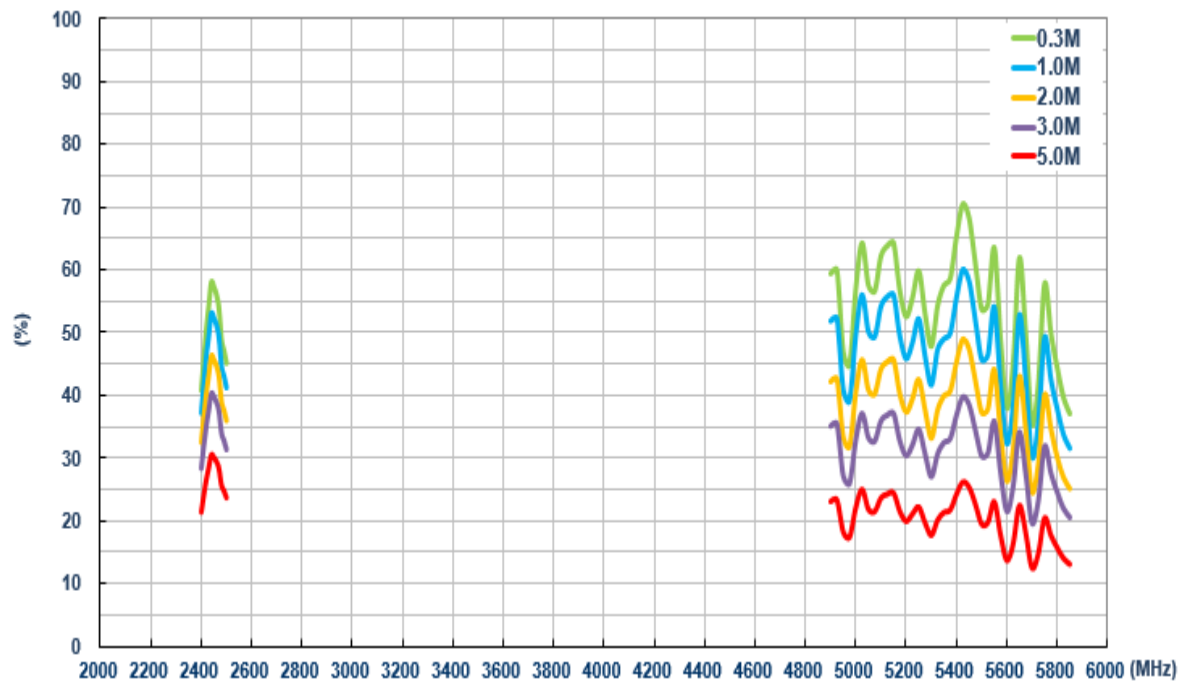
6.4.3 Isolation (Wi-Fi)



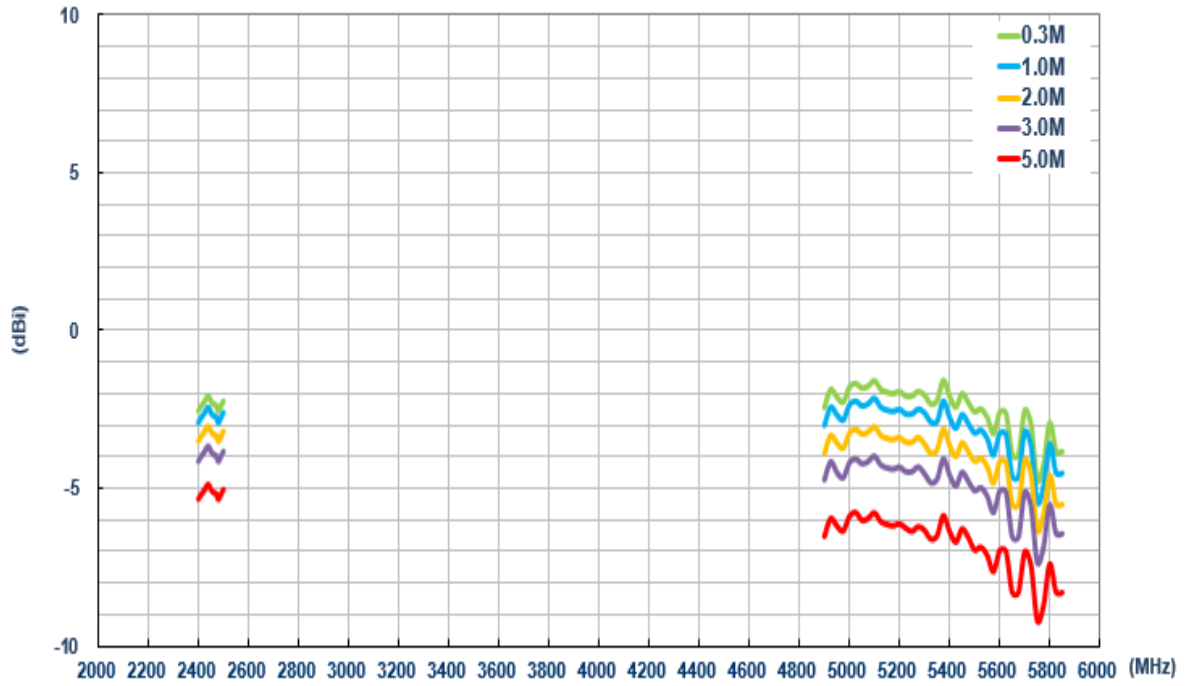
6.4.4 Efficiency (Wi-Fi MIMO_1)



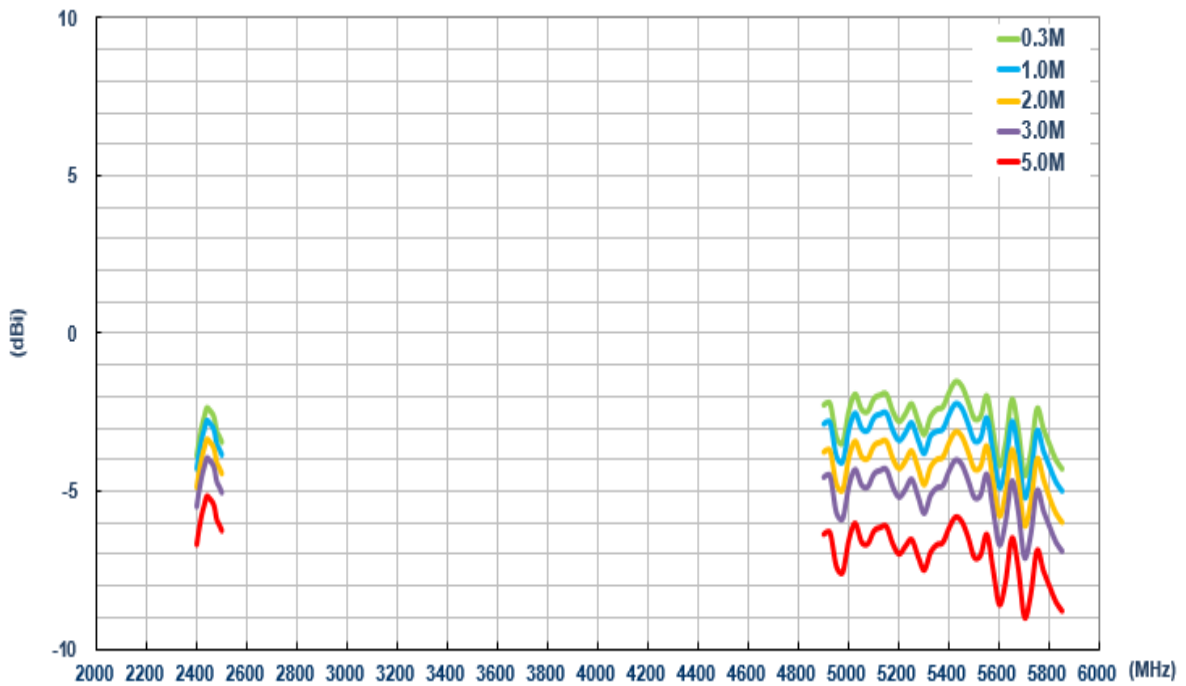
6.4.5 Efficiency (Wi-Fi MIMO_2)



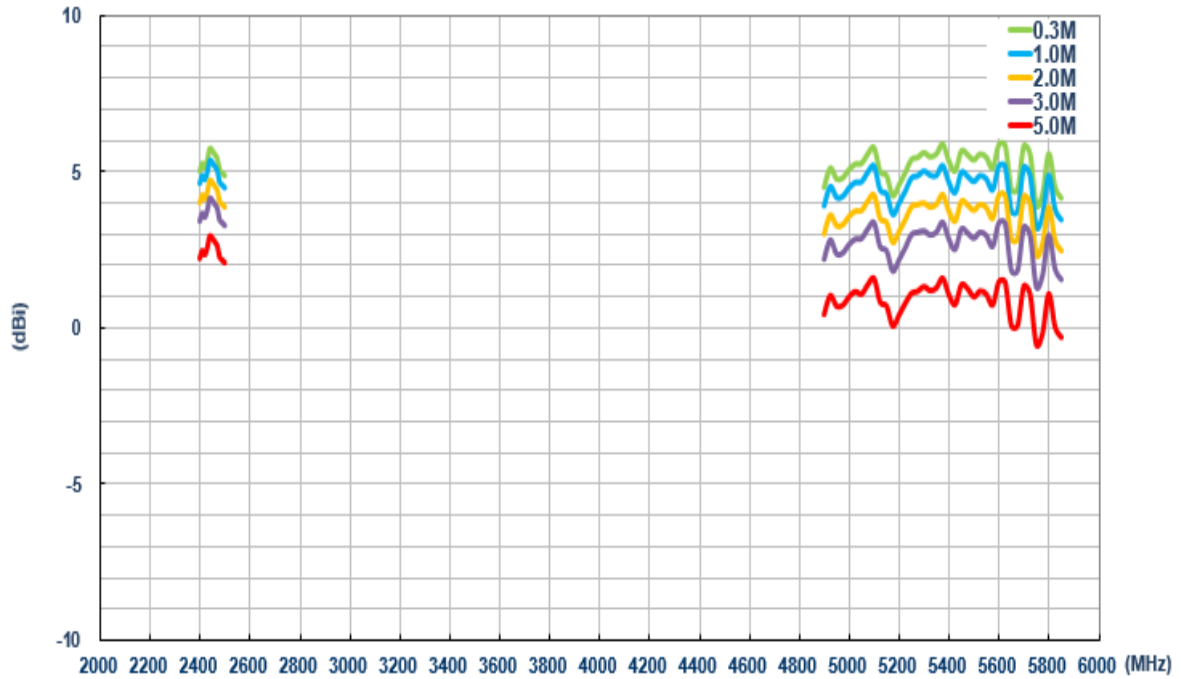
6.4.6 Average Gain (Wi-Fi MIMO_1)



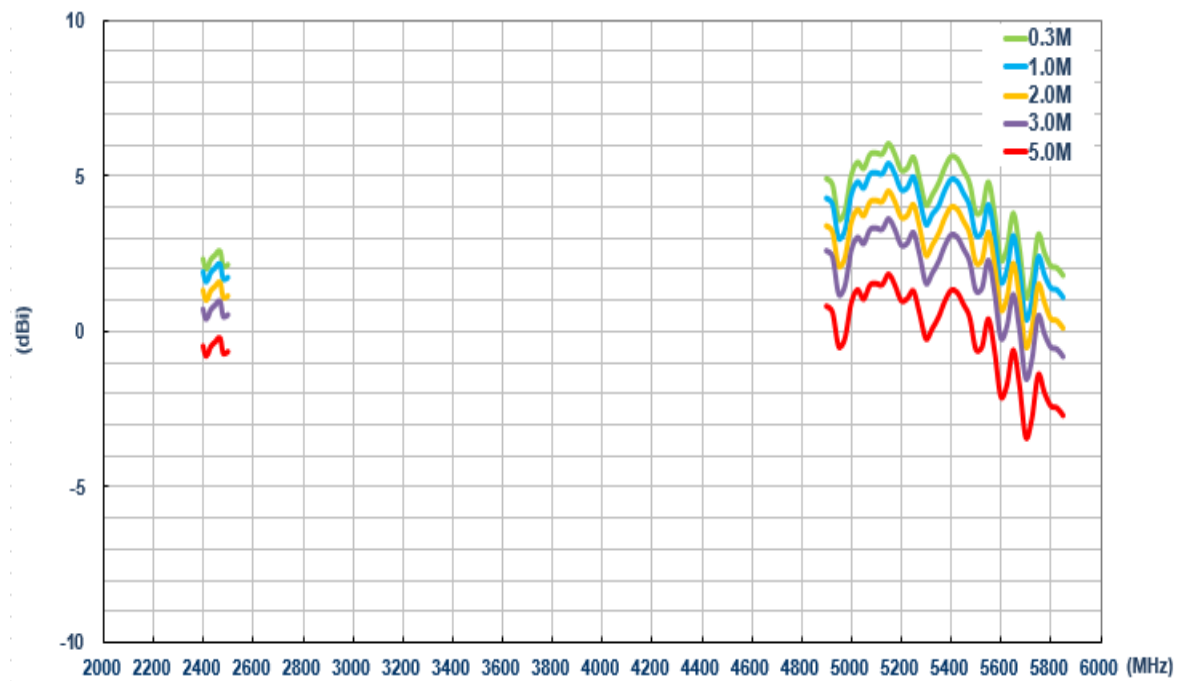
6.4.7 Average Gain (Wi-Fi MIMO_2)



6.4.8 Peak Gain (Wi-Fi MIMO_1)

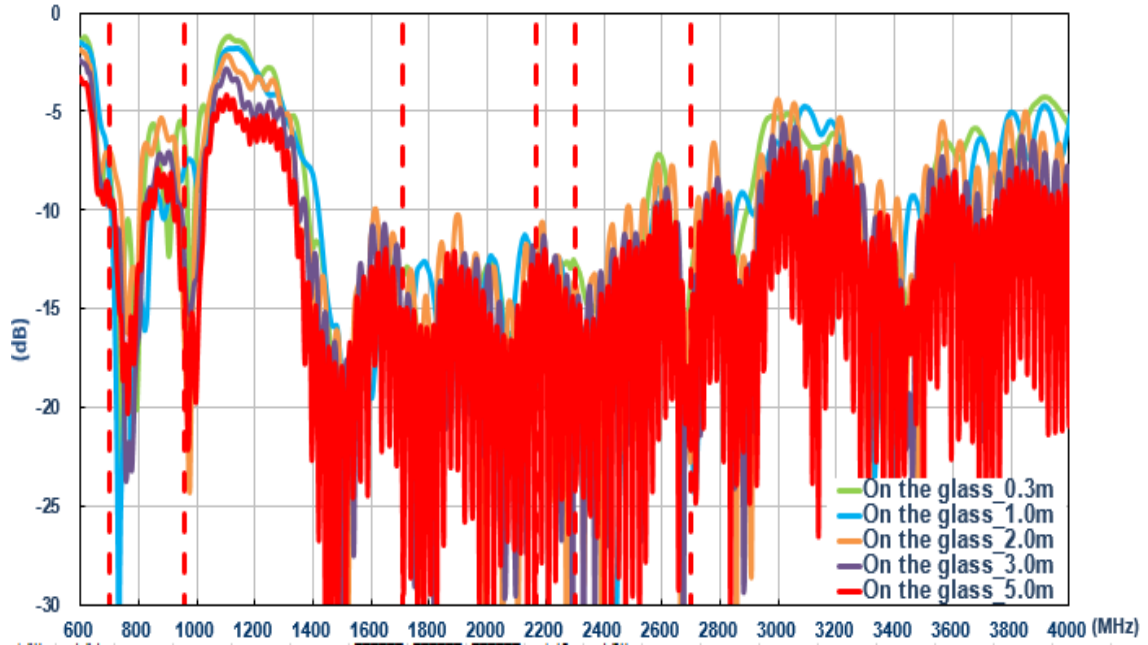


6.4.9 Peak Gain (Wi-Fi MIMO_2)

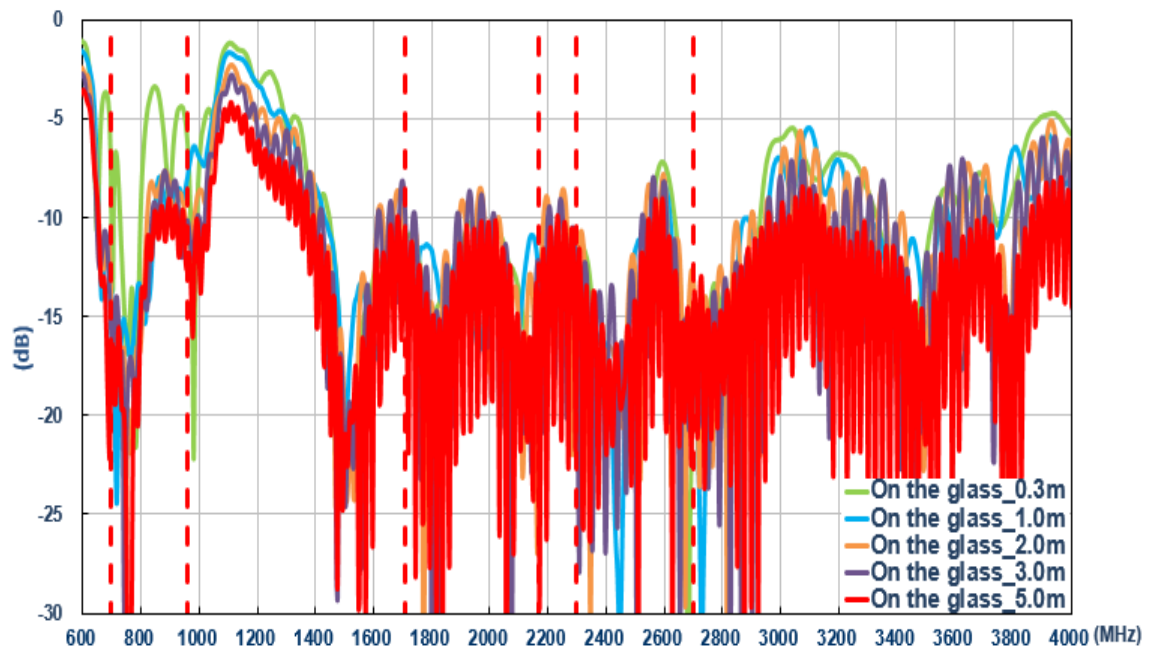


6.5 On glass (LTE)

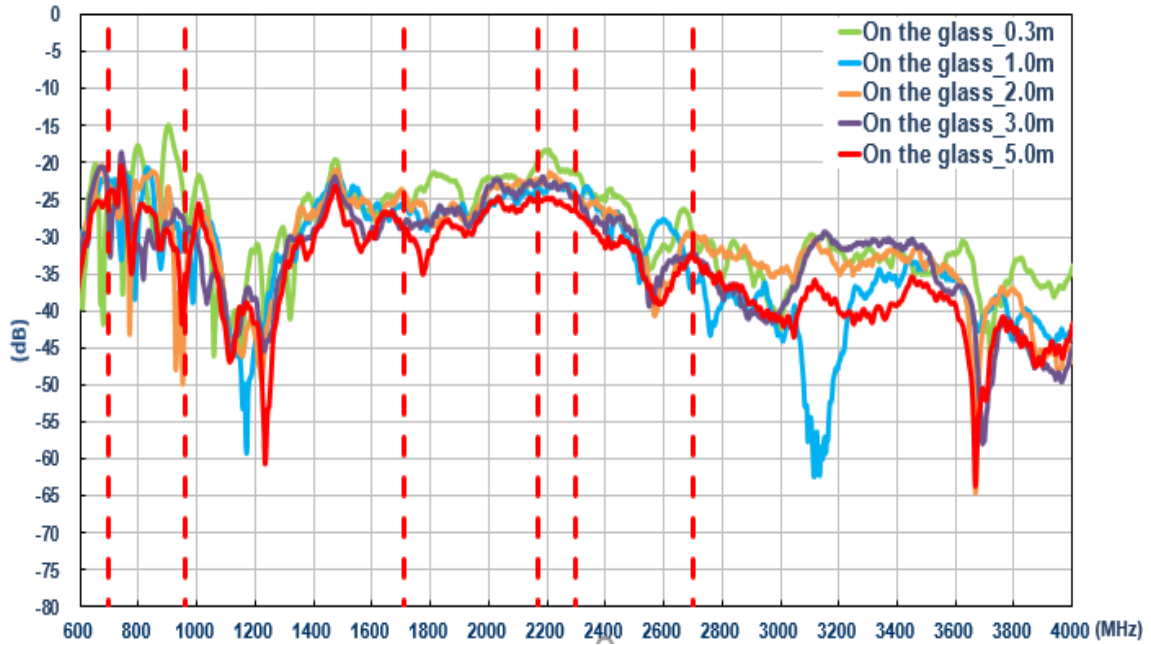
6.5.1 Return Loss (LTE_MIMO_1)



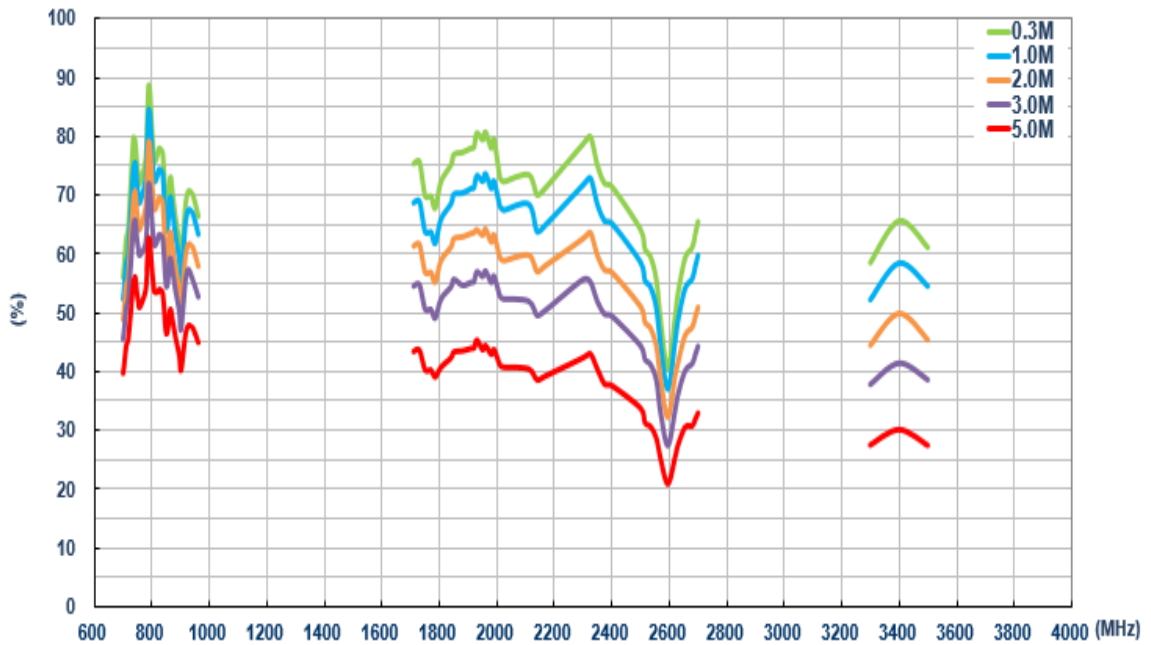
6.5.2 Return Loss (LTE_MIMO_2)



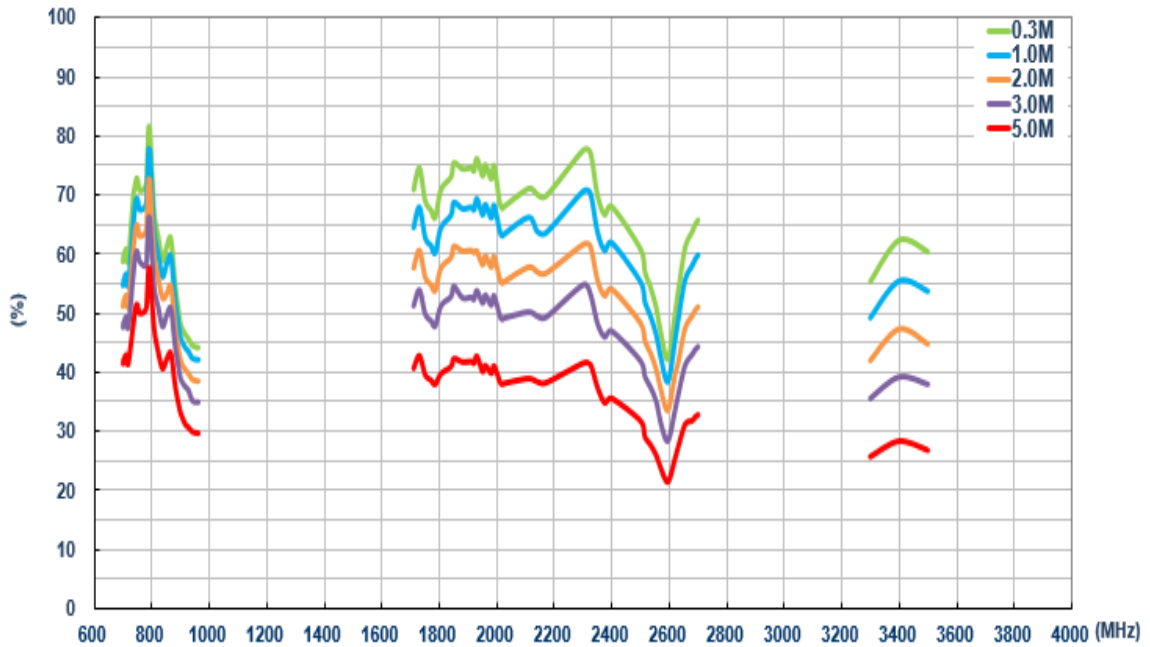
6.5.3 Isolation (LTE antenna)



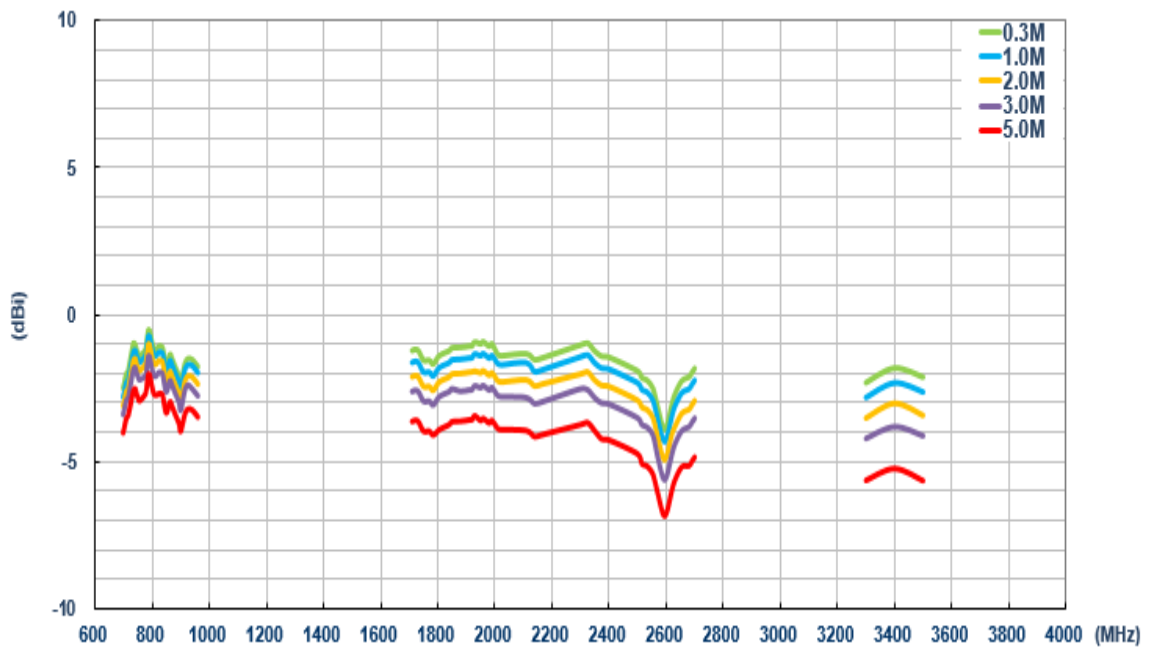
6.5.4 Efficiency (LTE MIMO_1)



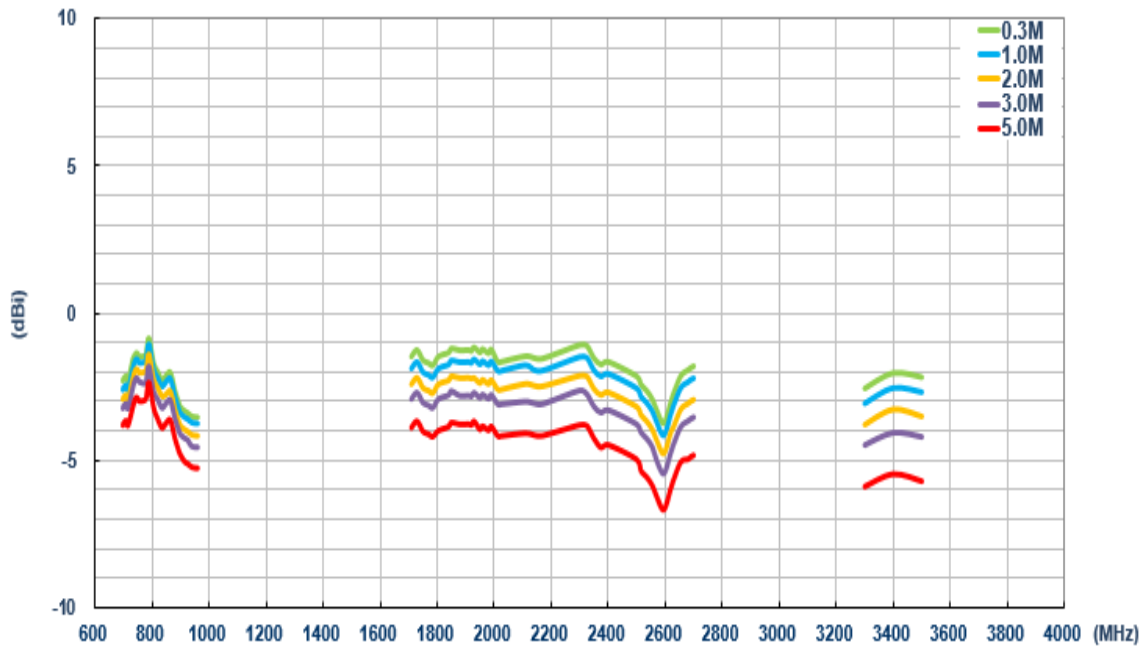
6.5.5 Efficiency (LTE MIMO_2)



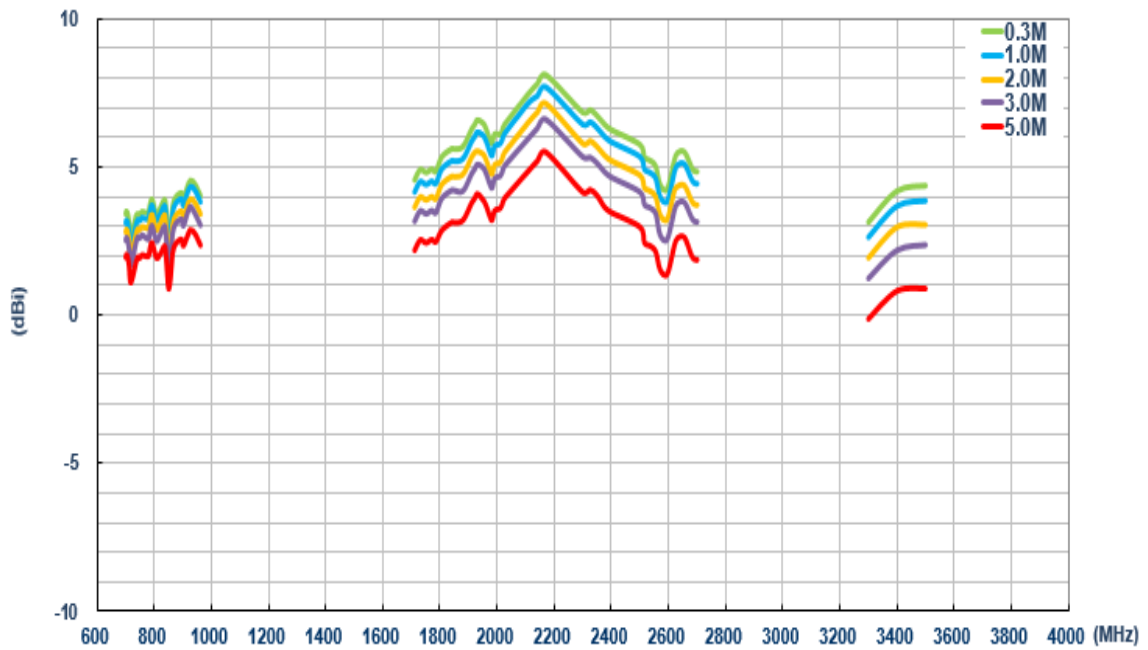
6.5.6 Average Gain (LTE MIMO_1)



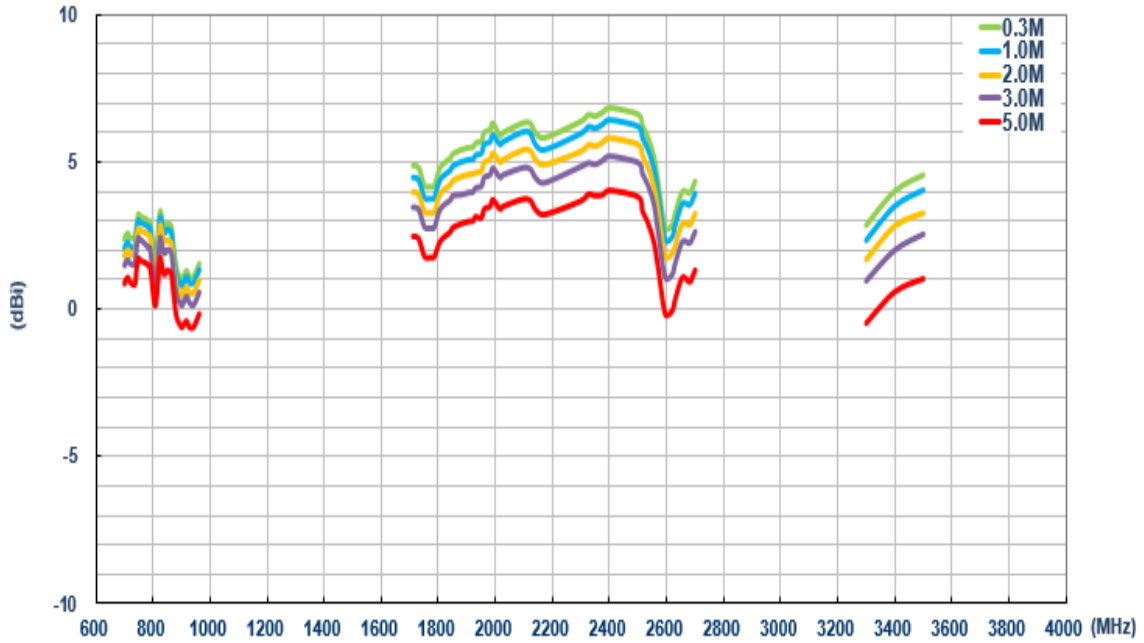
6.5.7 Average Gain (LTE MIMO_2)



6.5.8 Peak Gain (LTE MIMO_1)

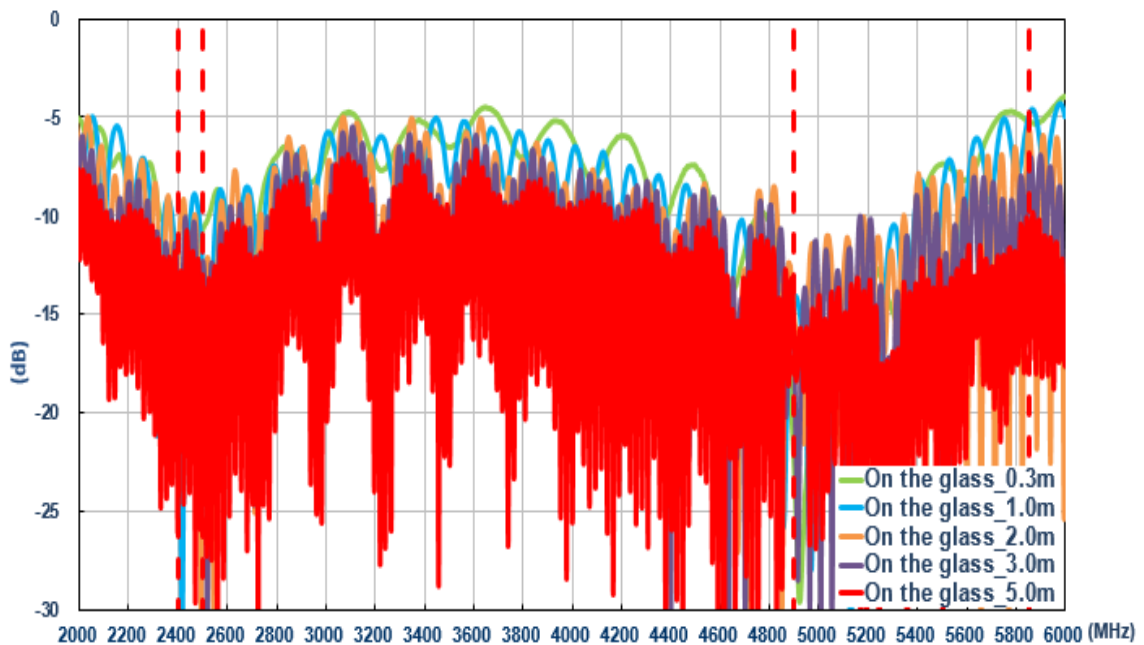


6.5.9 Peak Gain (LTE MIMO_2)

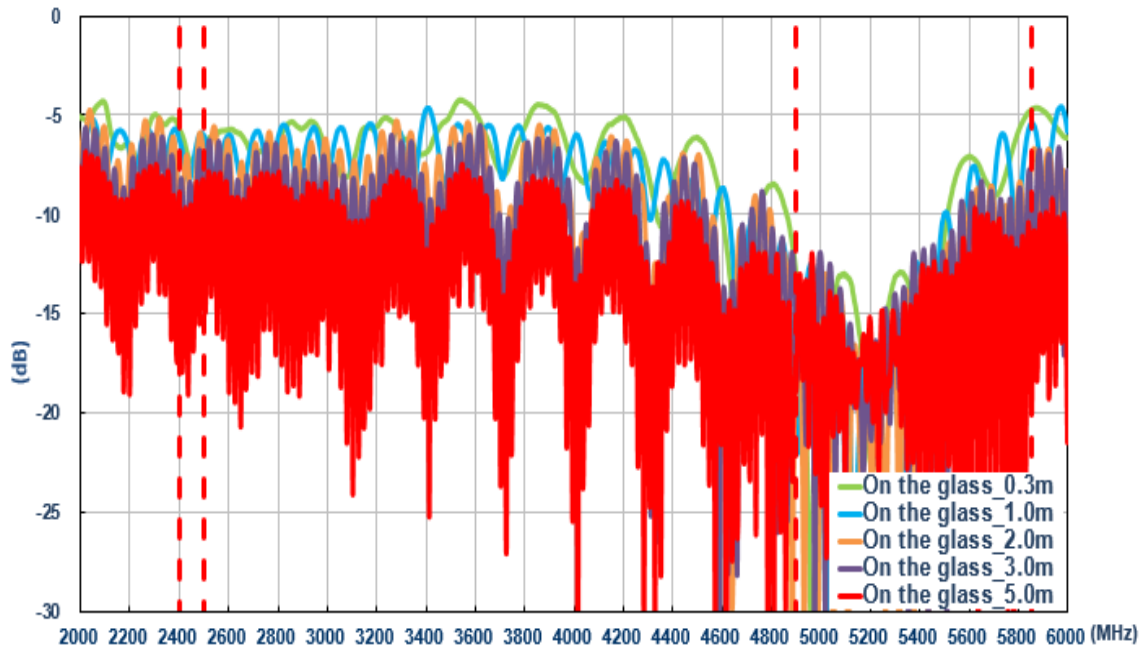


6.6 On glass (Wi-Fi)

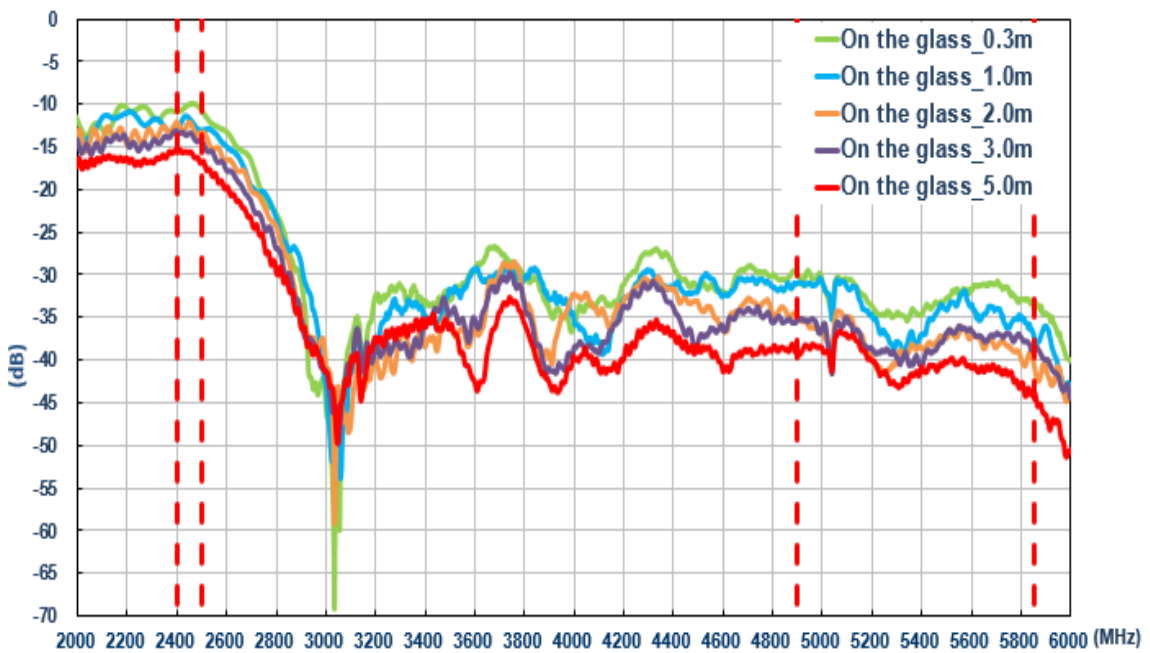
6.6.1 Return Loss (Wi-Fi _MIMO_1)



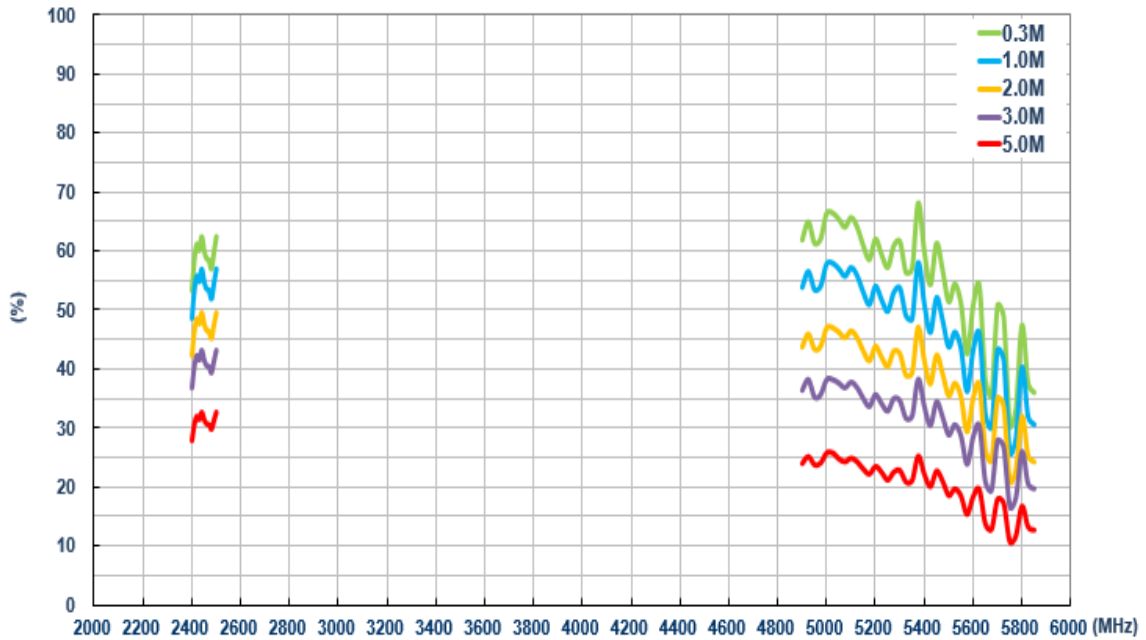
6.6.2 Return Loss (Wi-Fi _MIMO_2)



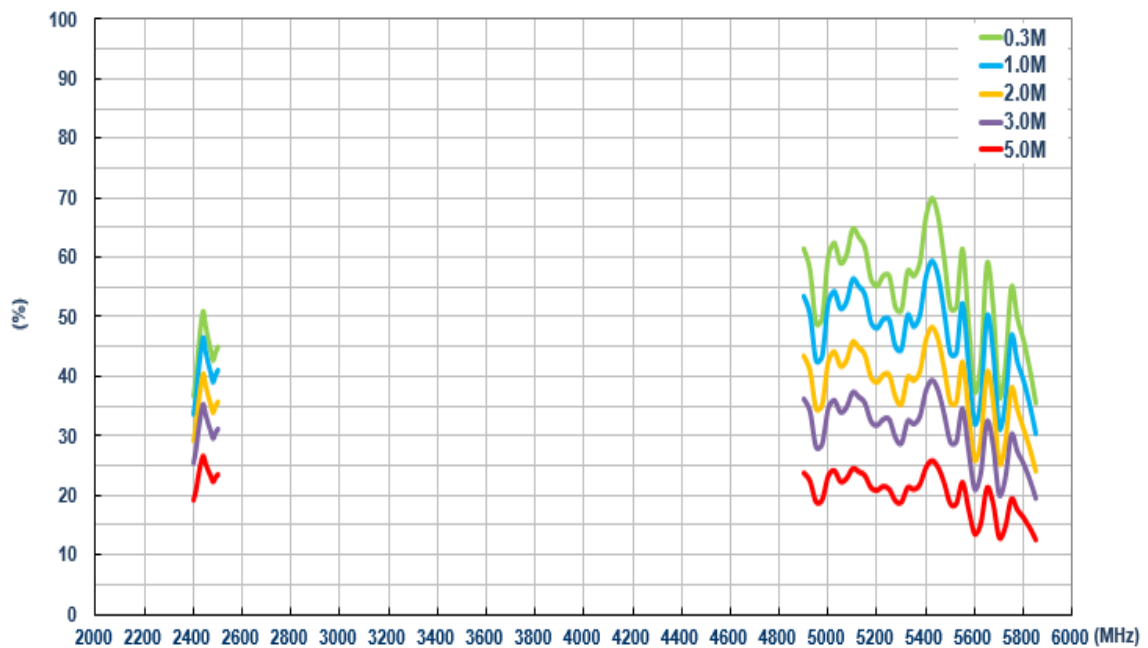
6.6.3 Isolation (Wi-Fi)



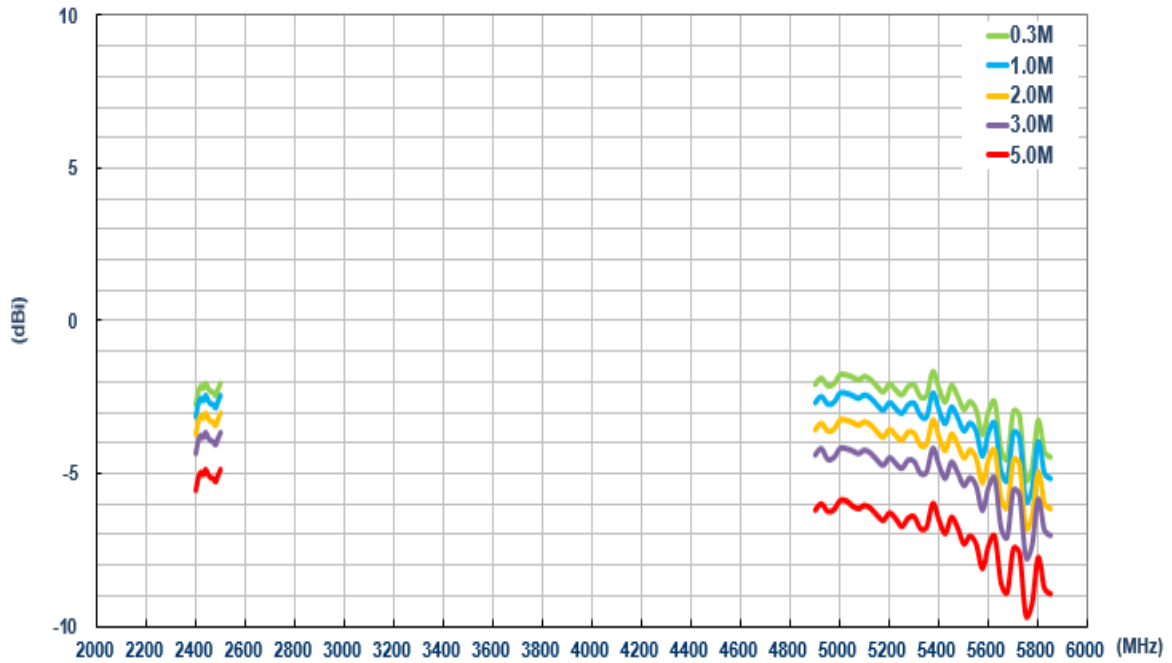
6.6.4 Efficiency (Wi-Fi_MIMO_1)



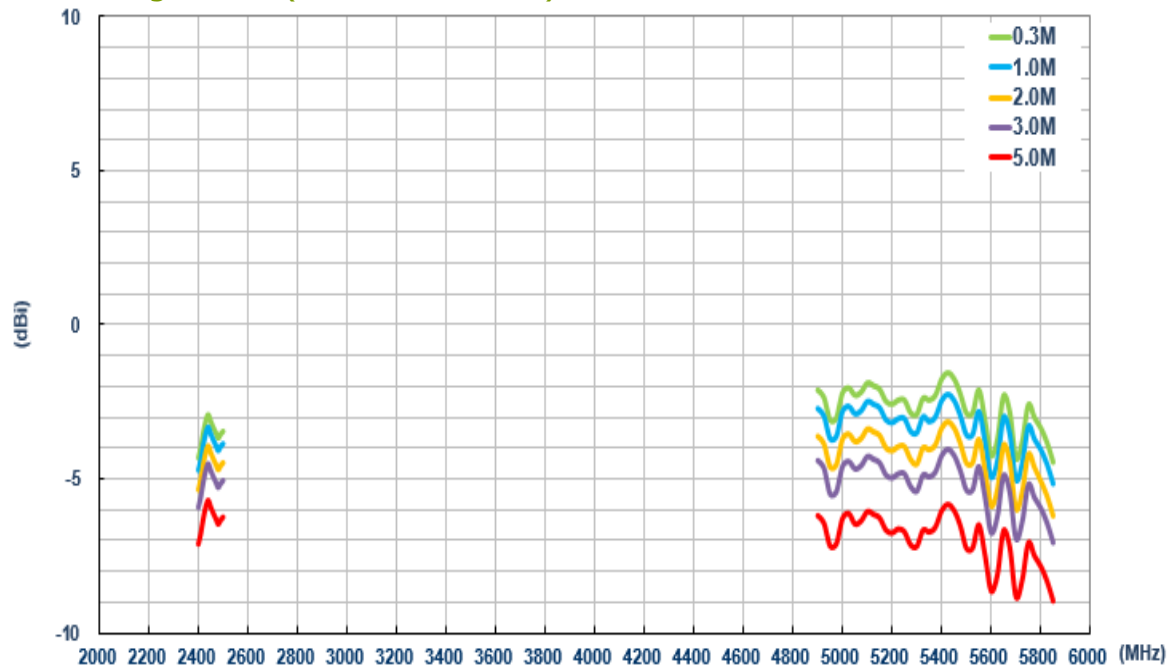
6.6.5 Efficiency (Wi-Fi_MIMO_2)



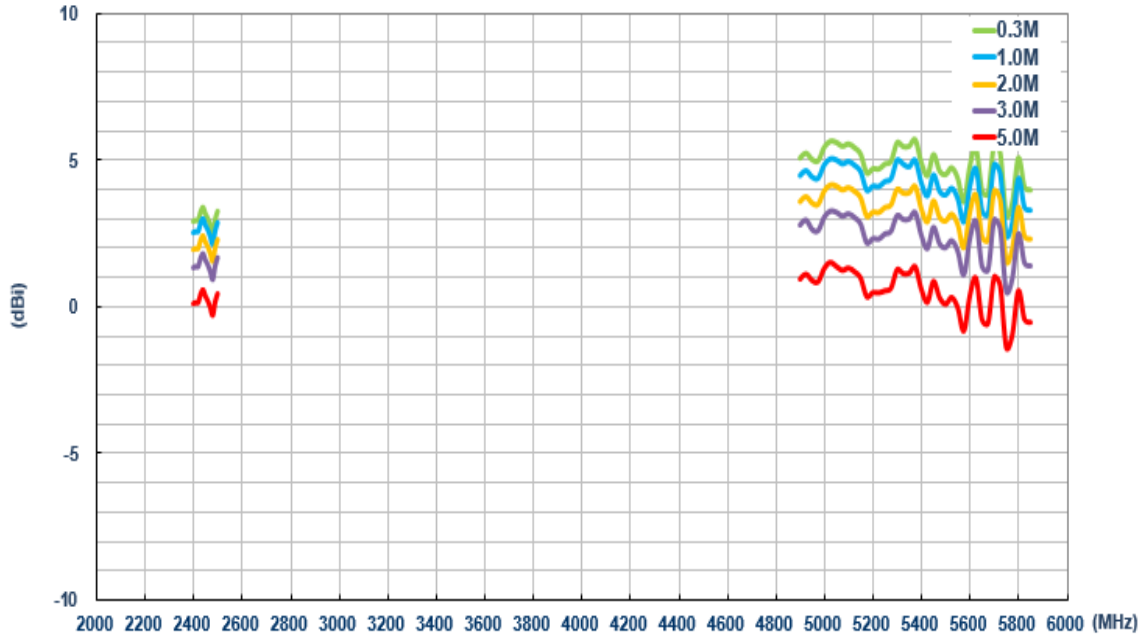
6.6.6 Average Gain (Wi-Fi_MIMO_1)



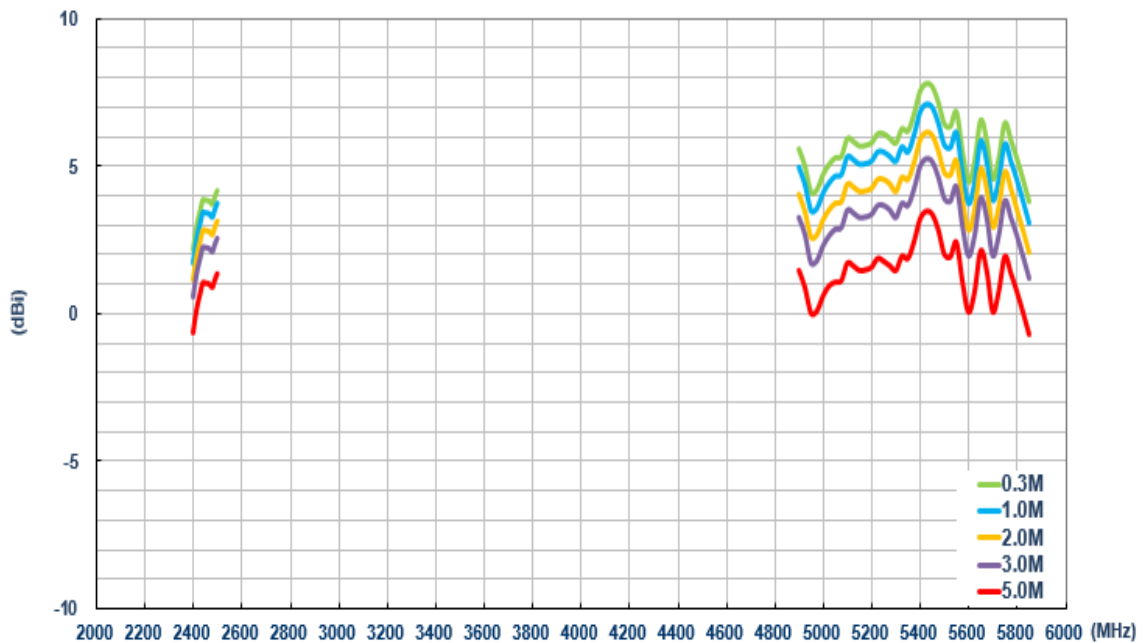
6.6.7 Average Gain (Wi-Fi_MIMO_2)



6.6.8 Peak Gain (Wi-Fi _MIMO_1)

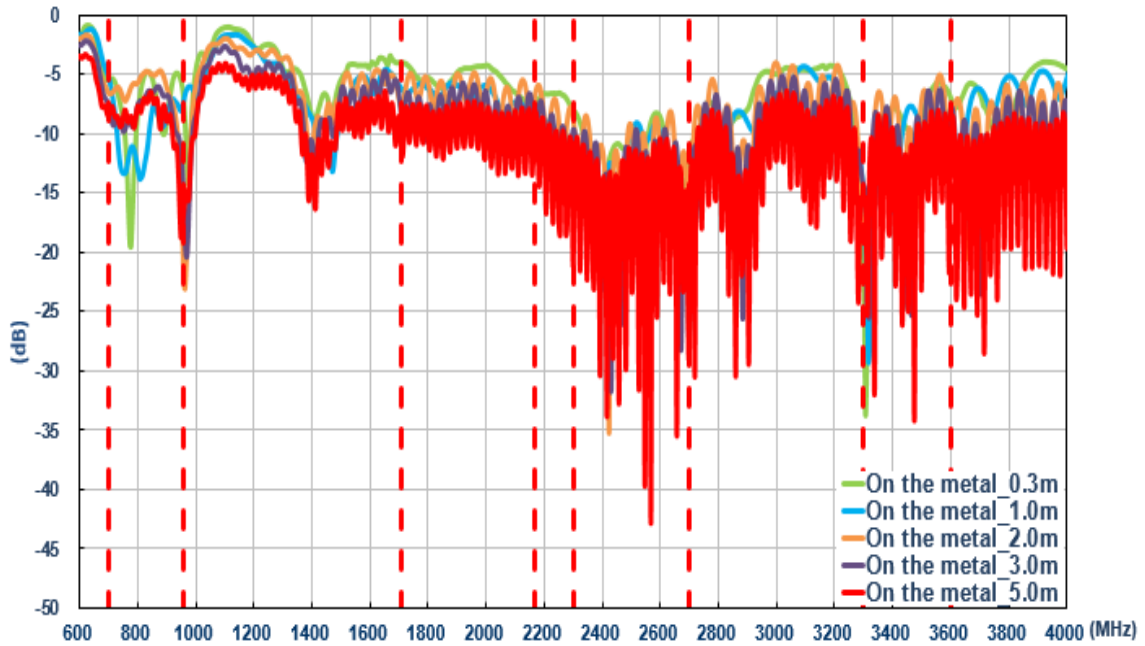


6.6.9 Peak Gain (Wi-Fi _MIMO_2)

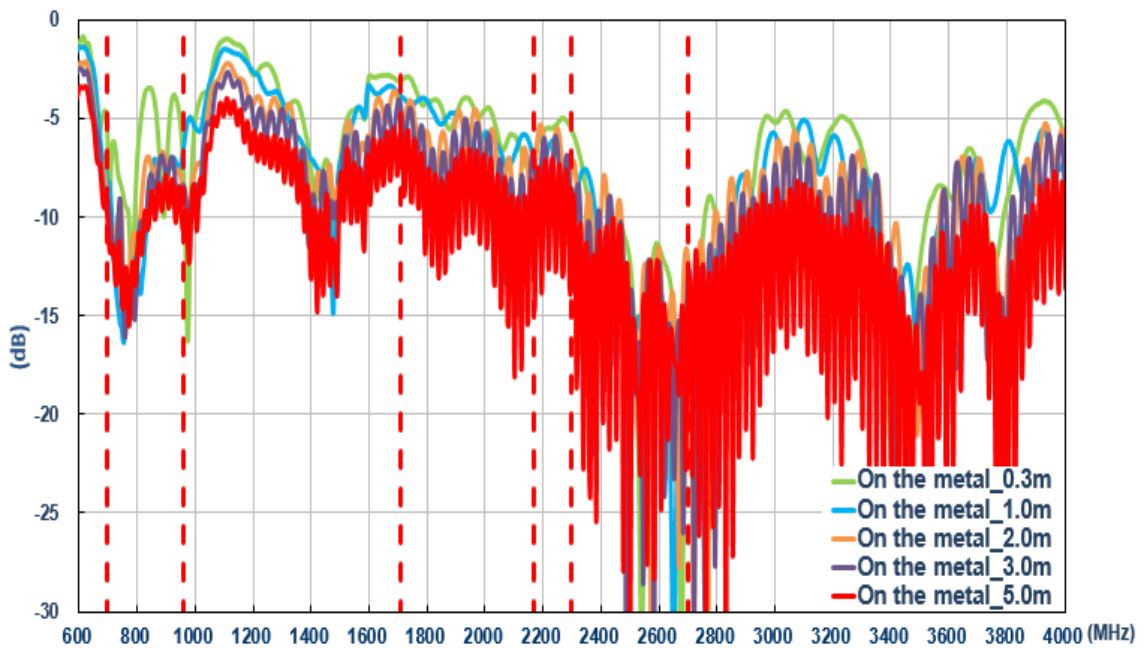


6.7 On metal (LTE)

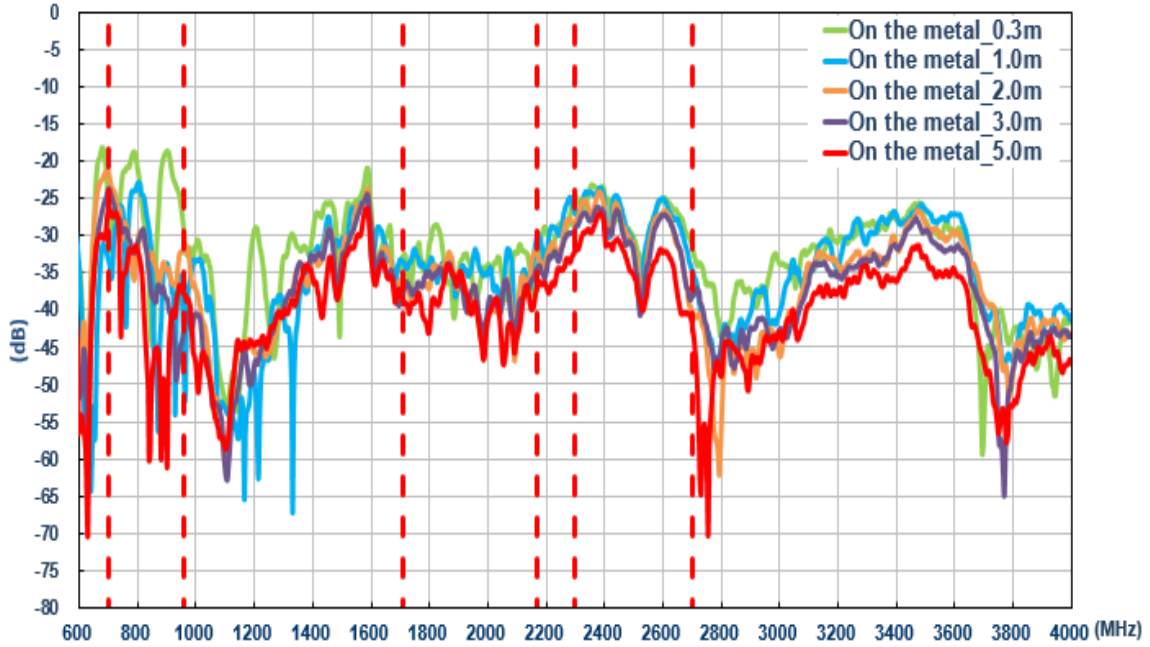
6.7.1 Return Loss (LTE_MIMO_1)



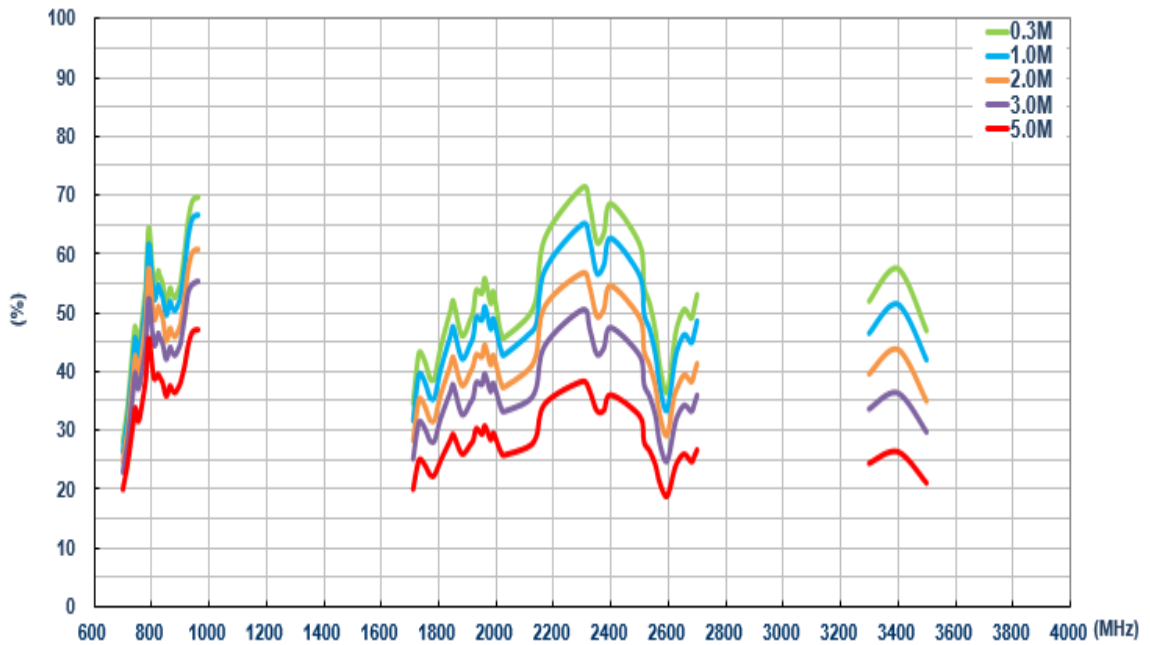
6.7.2 Return Loss (LTE_MIMO_2)



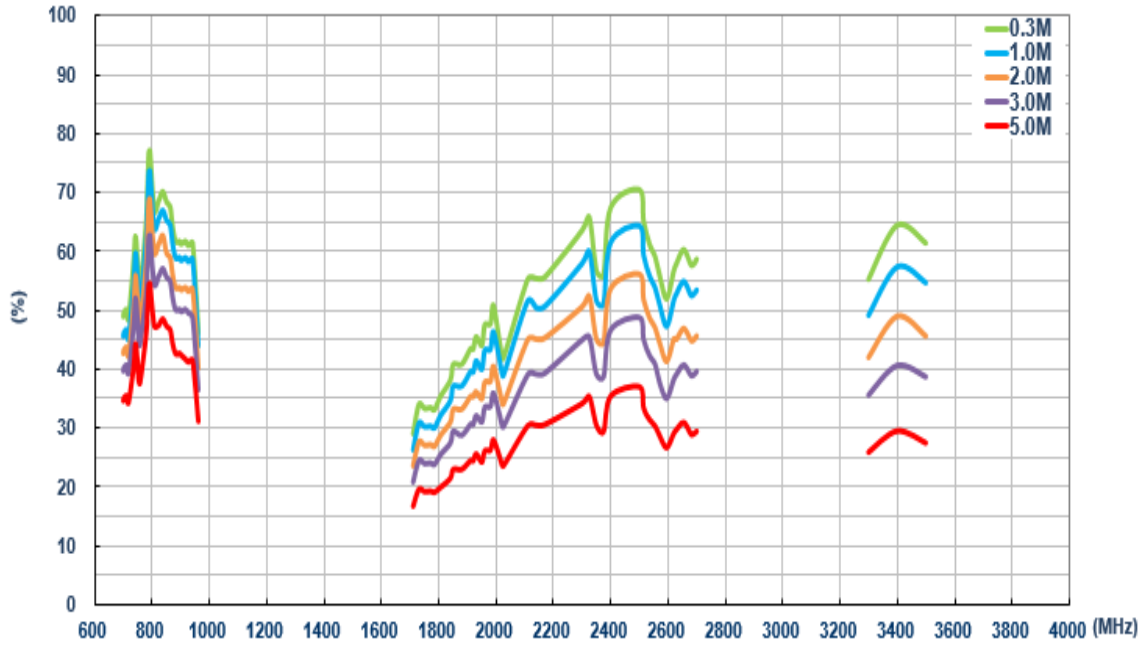
6.7.3 Isolation (LTE antenna)



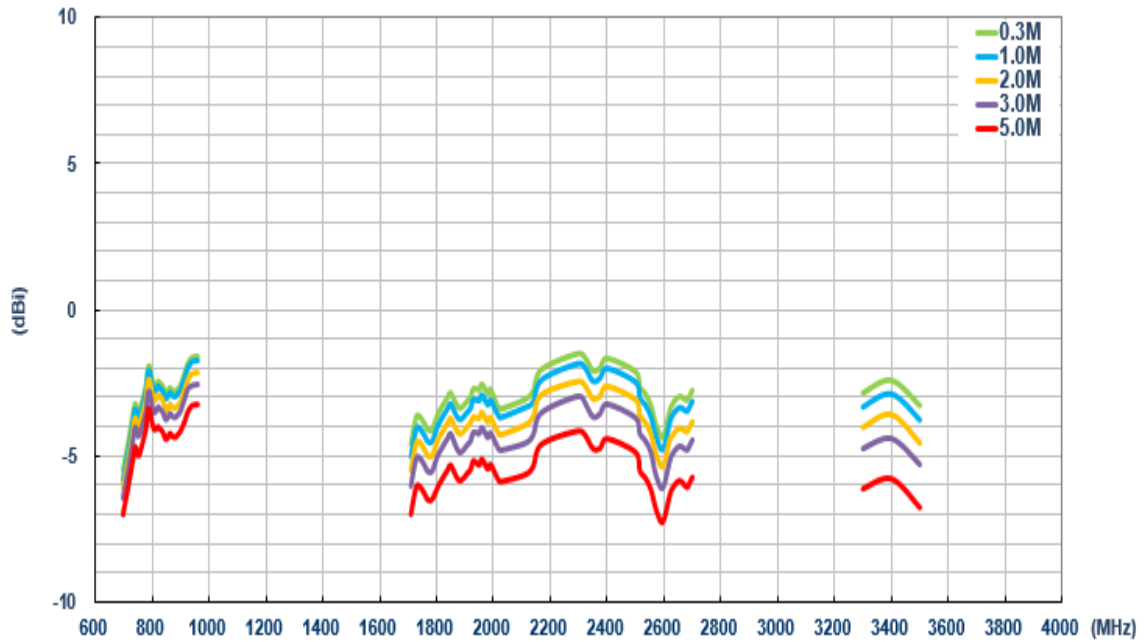
6.7.4 Efficiency (LTE_MIMO_1)



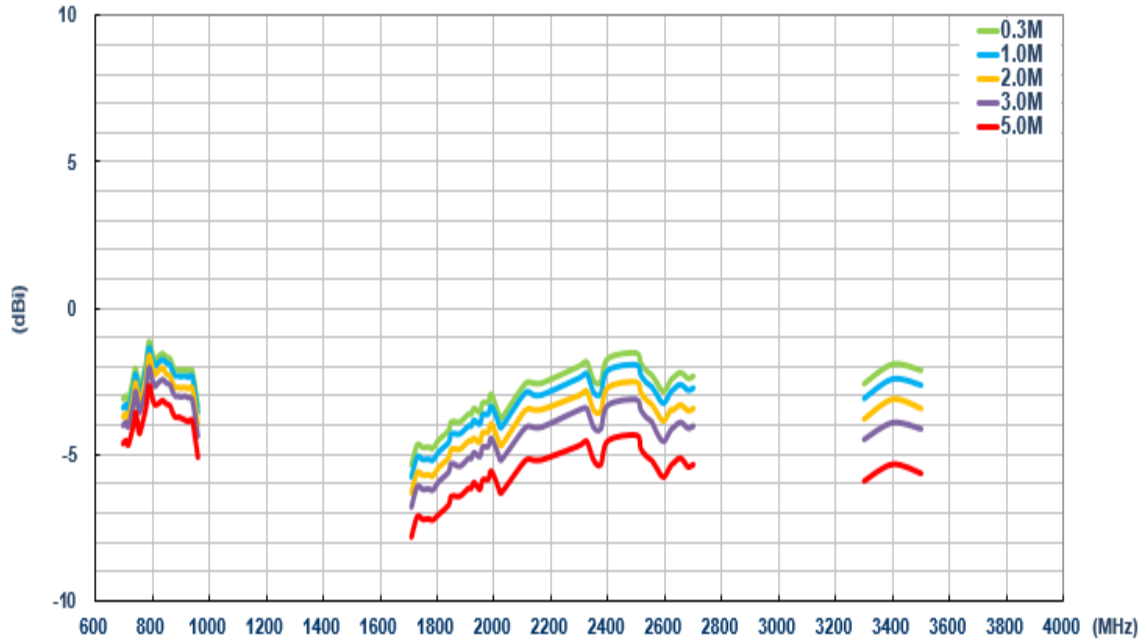
6.7.5 Efficiency (LTE_MIMO_2)



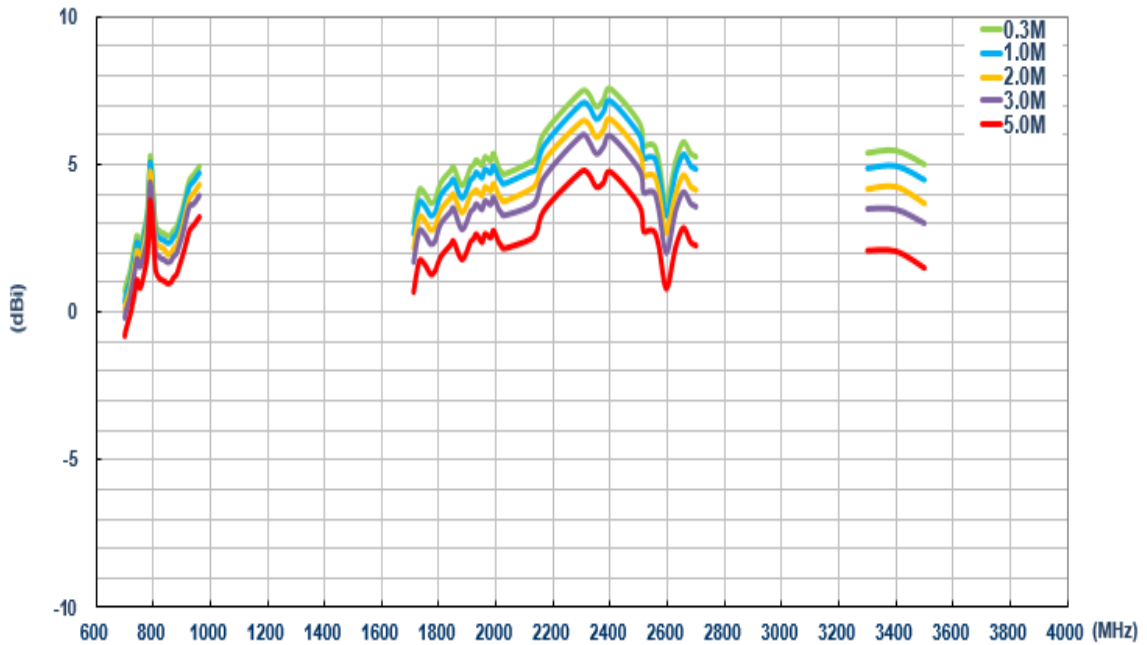
6.7.6 Average Gain (LTE_MIMO_1)



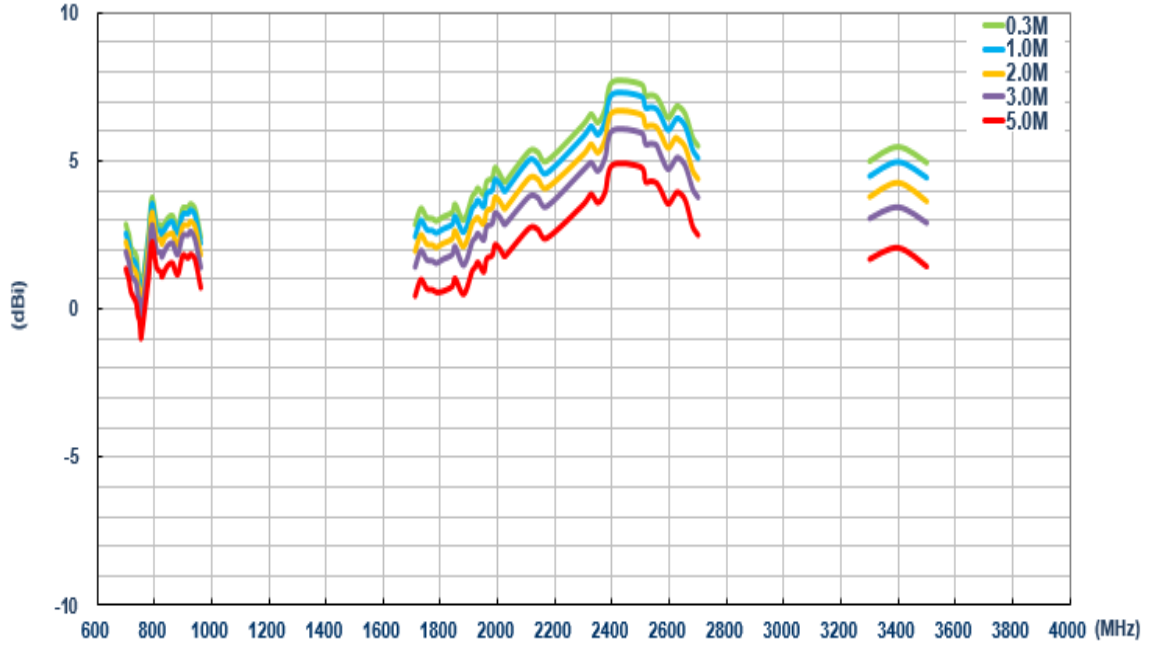
6.7.7 Average Gain (LTE_MIMO_2)



6.7.8 Peak Gain (LTE_MIMO_1)

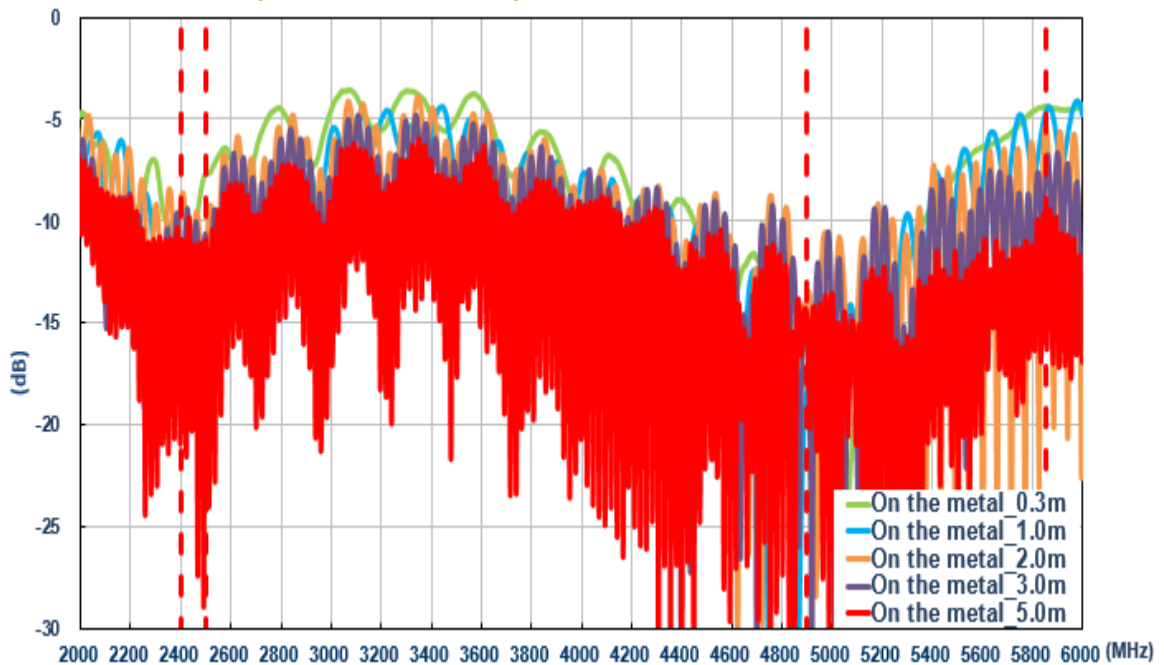


6.7.9 Peak Gain (LTE_MIMO_2)

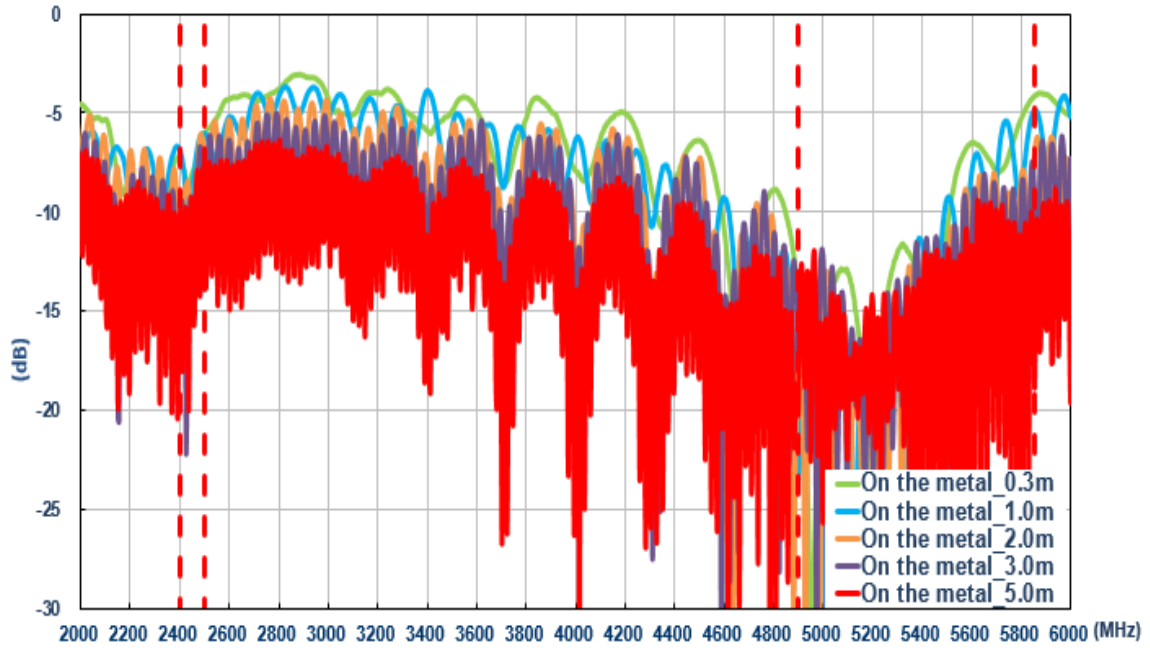


6.8 On metal (Wi-Fi)

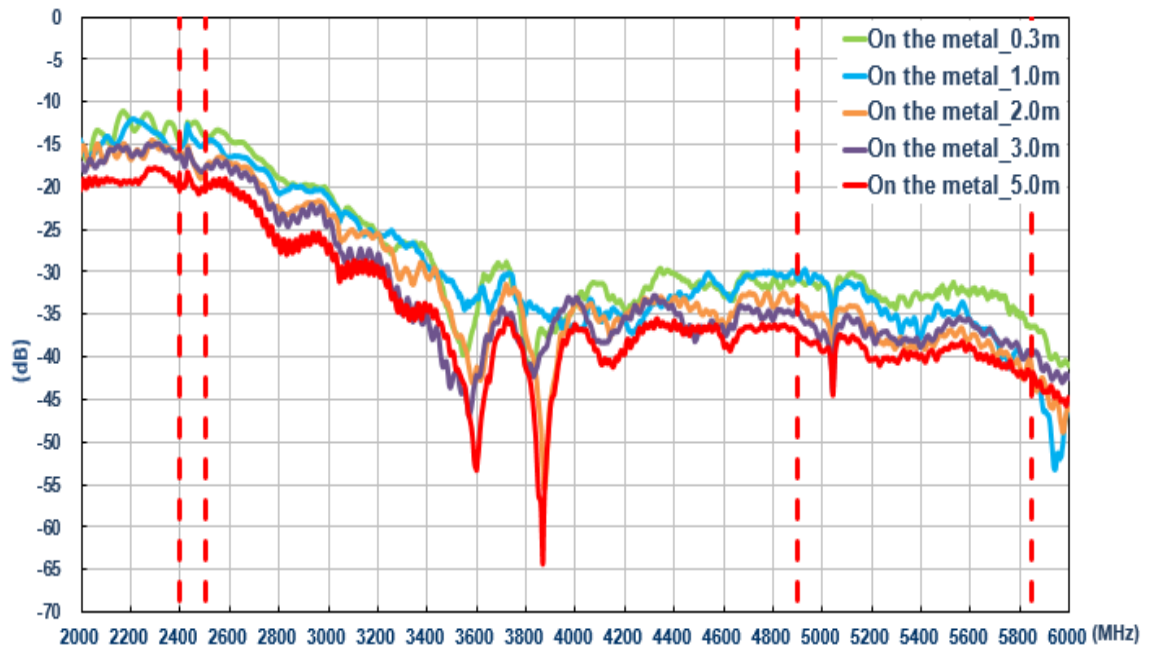
6.8.1 Return Loss (Wi-Fi _MIMO_1)



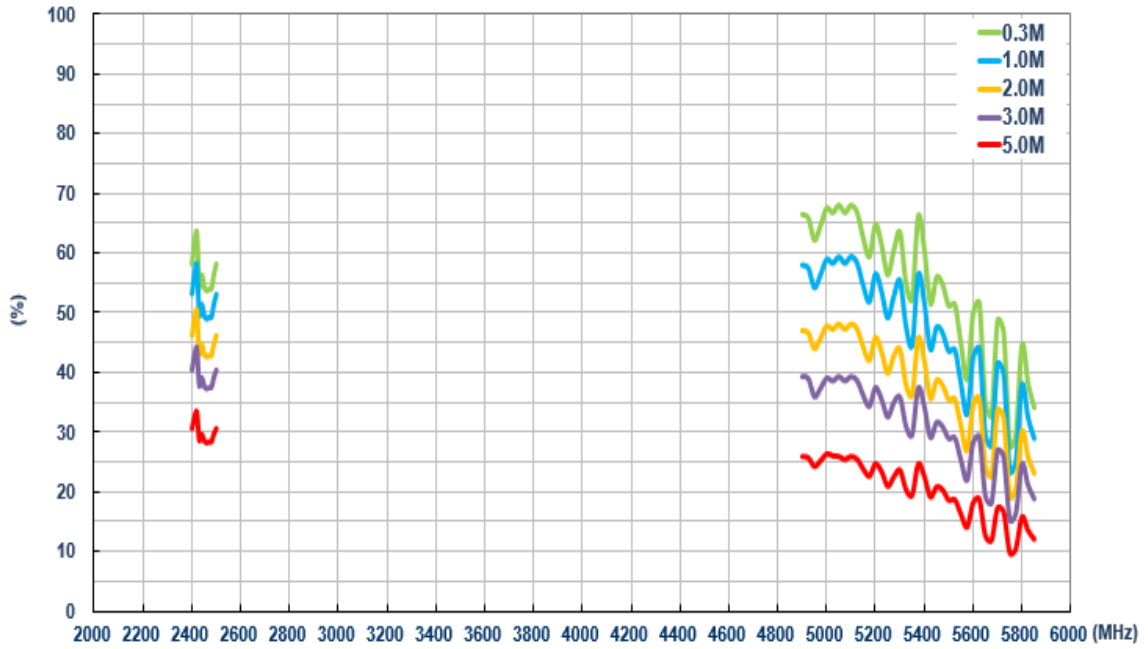
6.8.2 Return Loss (Wi-Fi_MIMO_2)



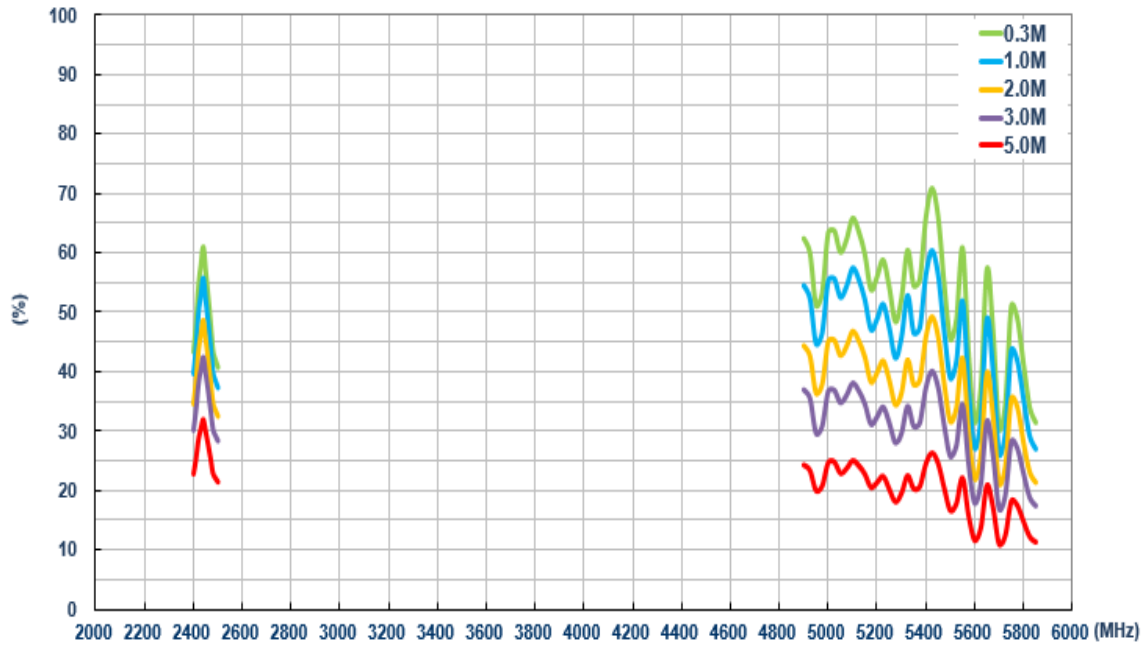
6.8.3 Isolation (Wi-Fi)



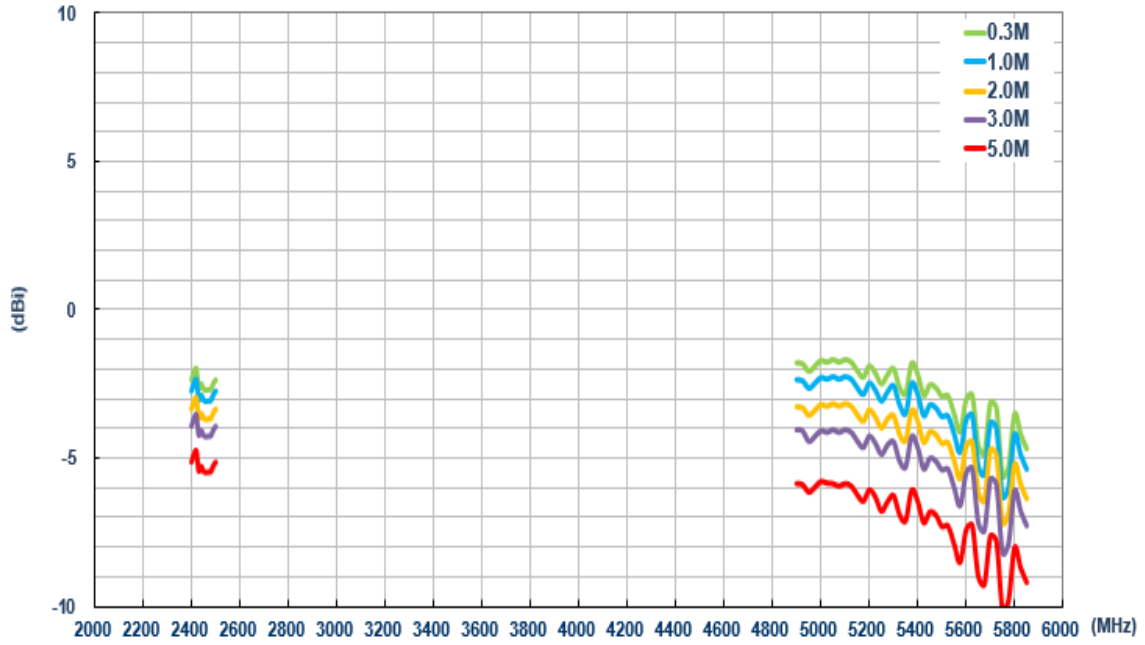
6.8.4 Efficiency (Wi-Fi_MIMO_1)



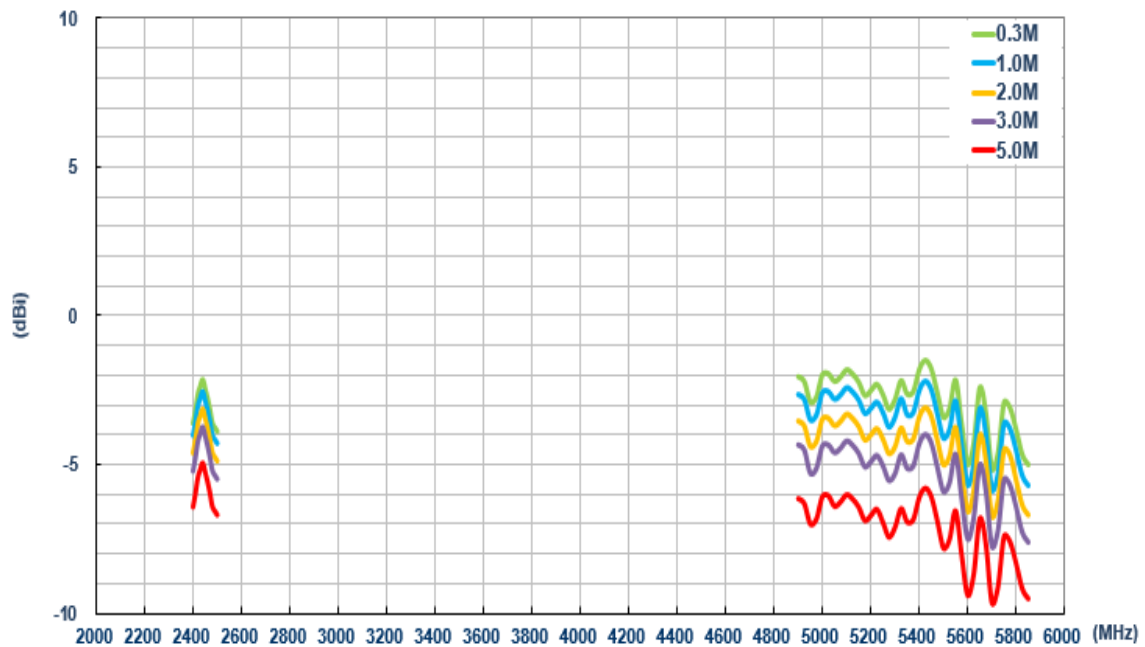
6.8.5 Efficiency (Wi-Fi_MIMO_2)



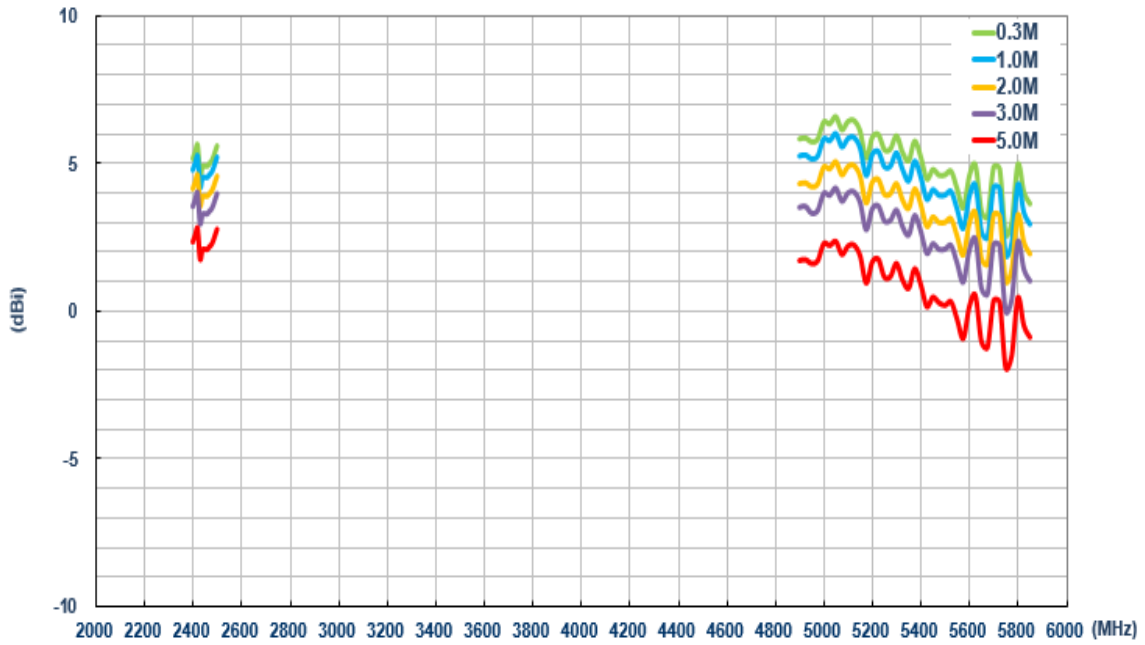
6.8.6 Average Gain (Wi-Fi_MIMO_1)



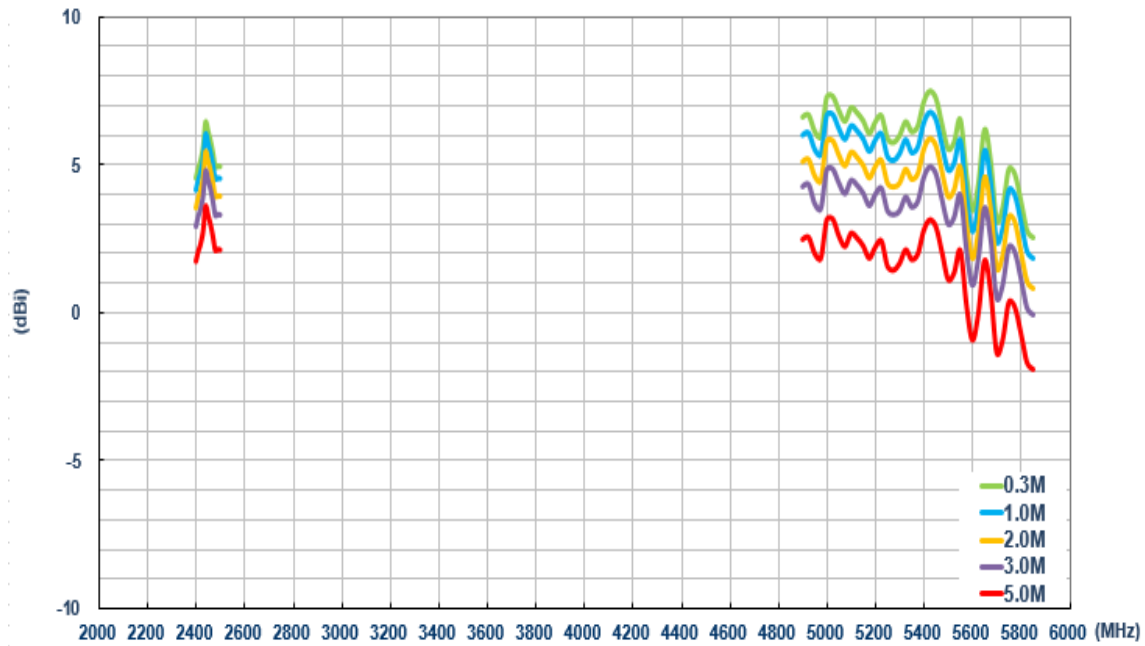
6.8.7 Average Gain (Wi-Fi_MIMO_2)



6.8.8 Peak Gain (Wi-Fi_MIMO_1)

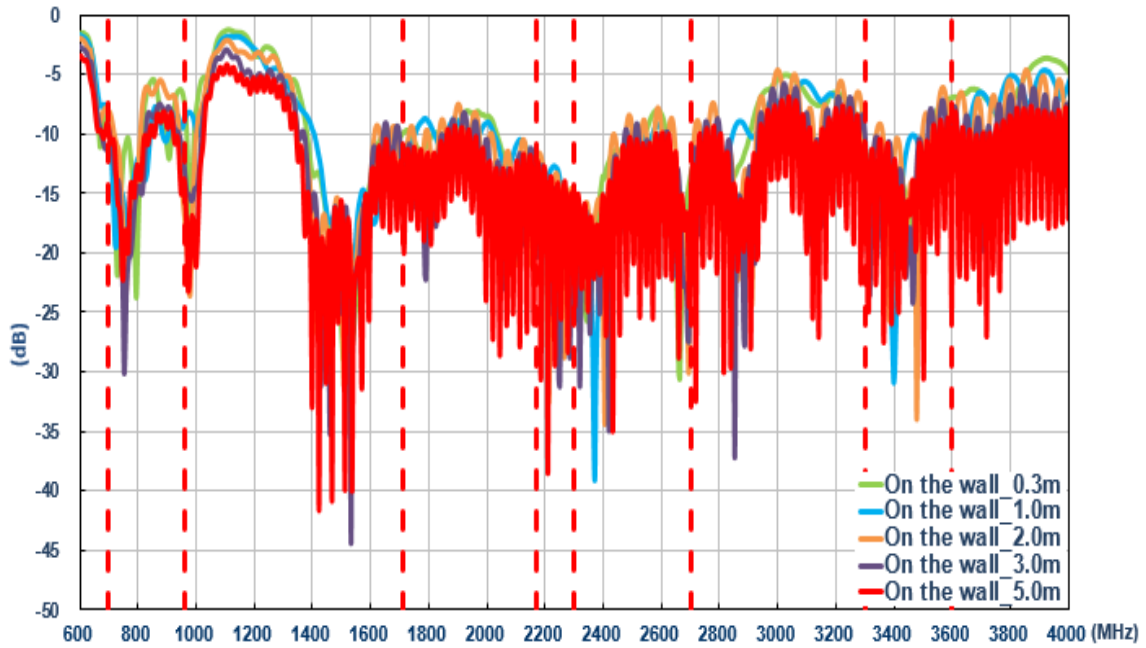


6.8.9 Peak Gain (Wi-Fi_MIMO_2)

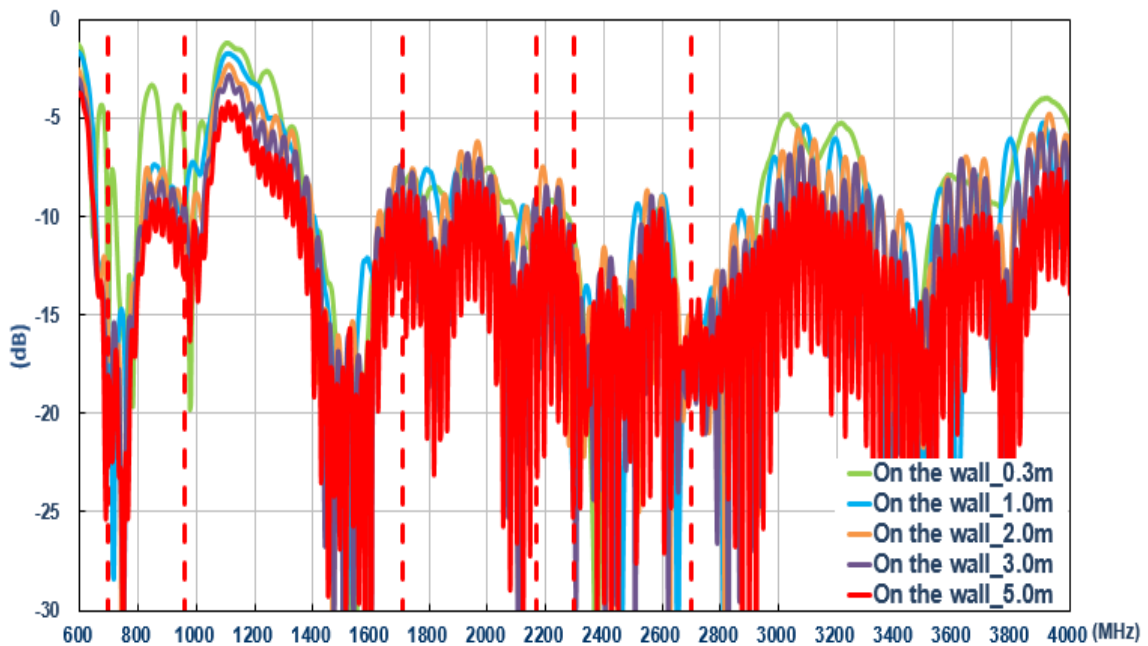


6.9 On the wall (LTE)

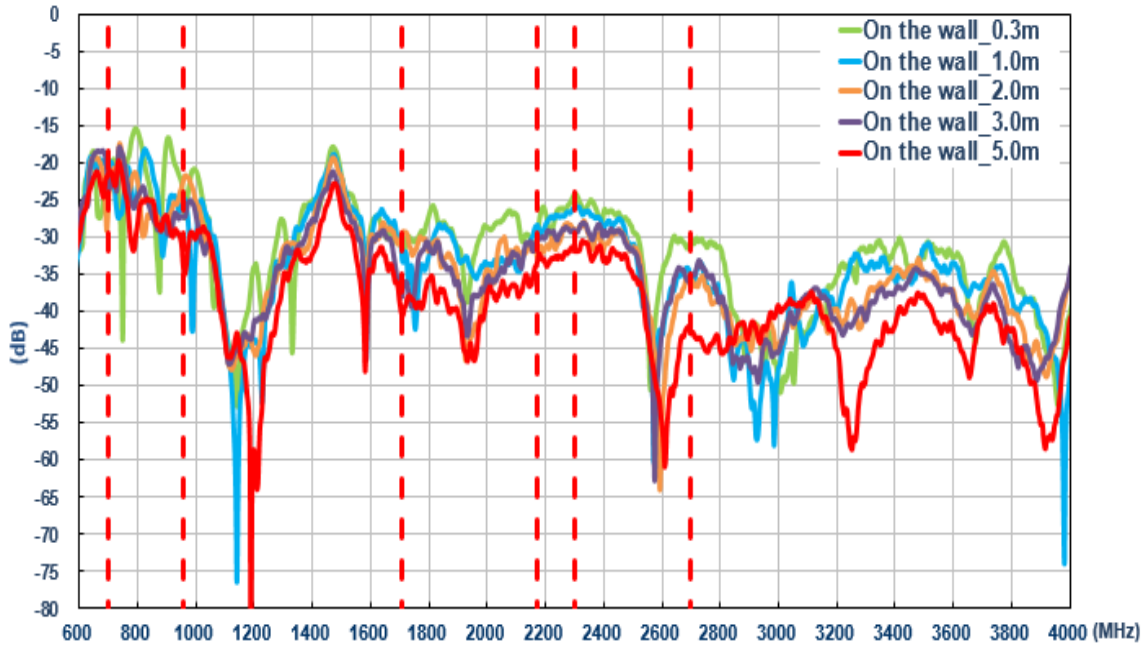
6.9.1 Return Loss (LTE_MIMO_1)



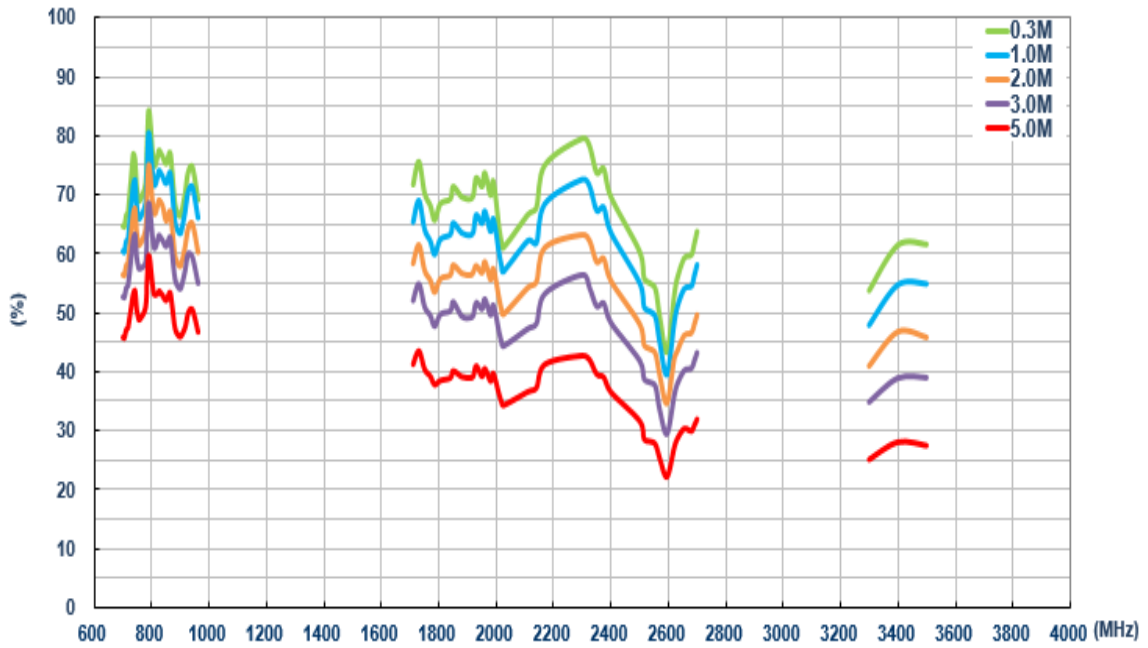
6.9.2 Return Loss (LTE_MIMO_2)



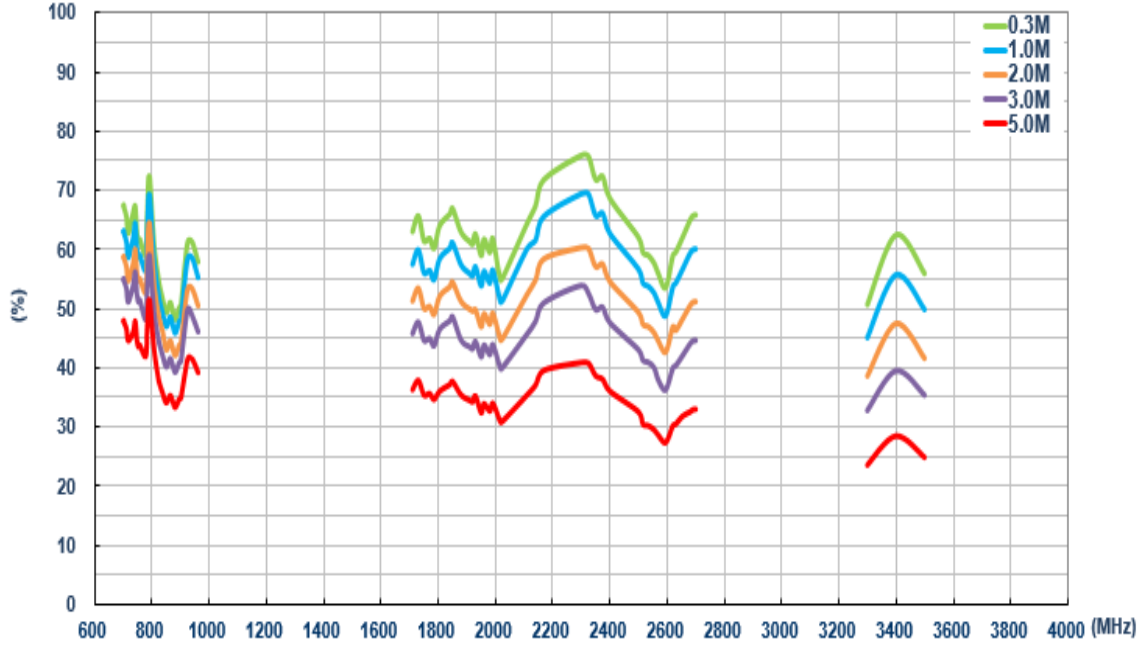
6.9.3 Isolation (LTE antenna)



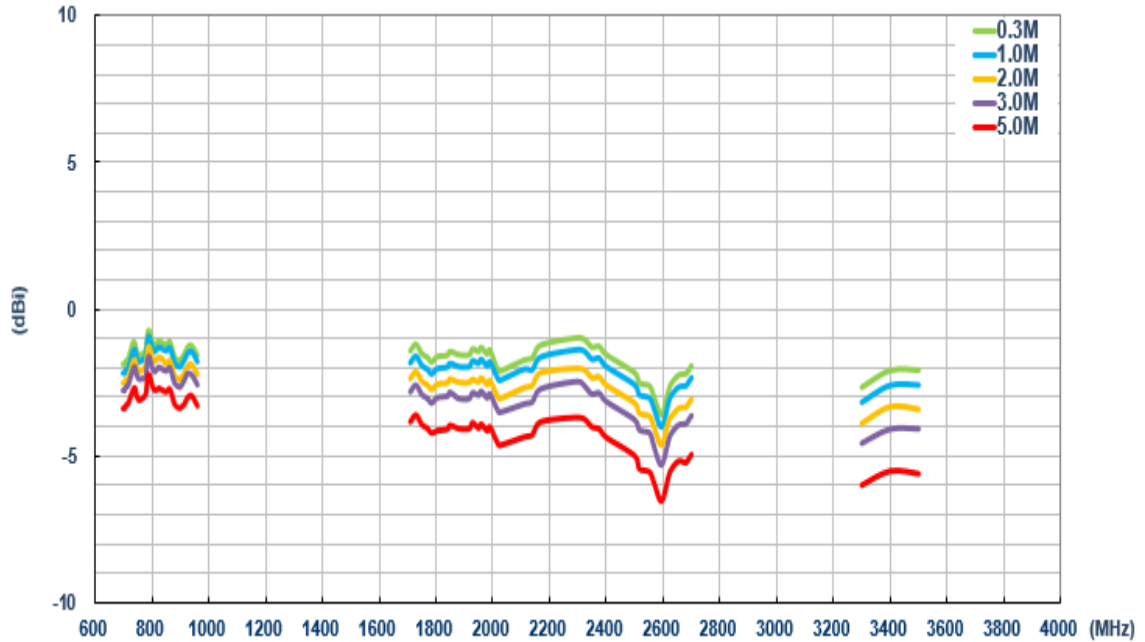
6.9.4 Efficiency (LTE_MIMO_1)



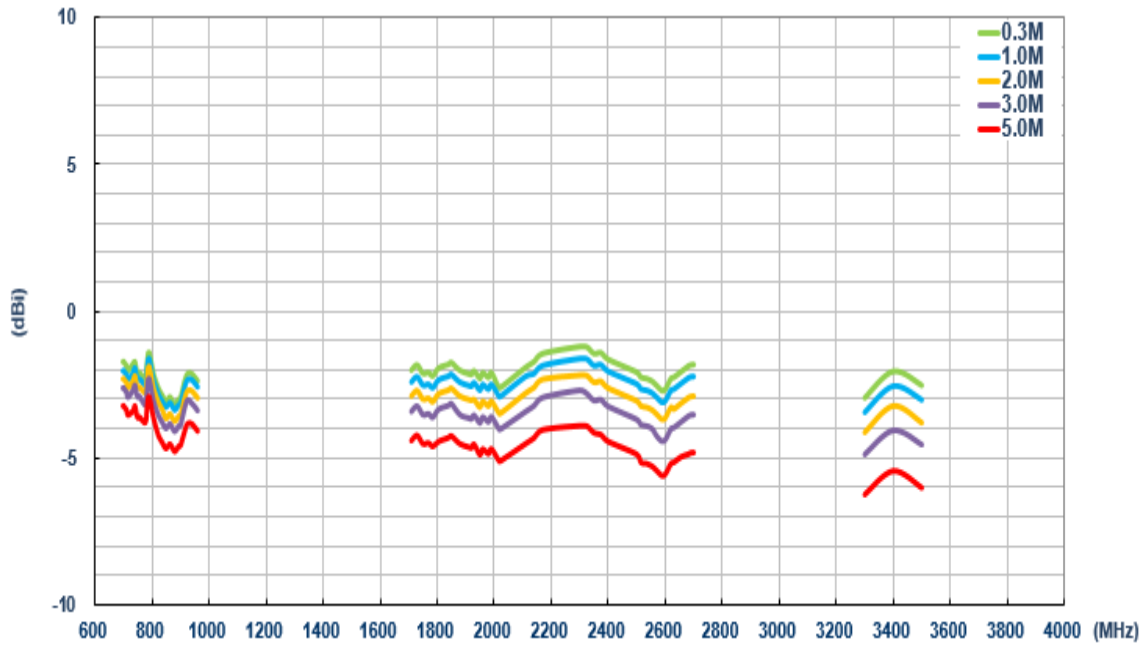
6.9.5 Efficiency (LTE_MIMO_2)



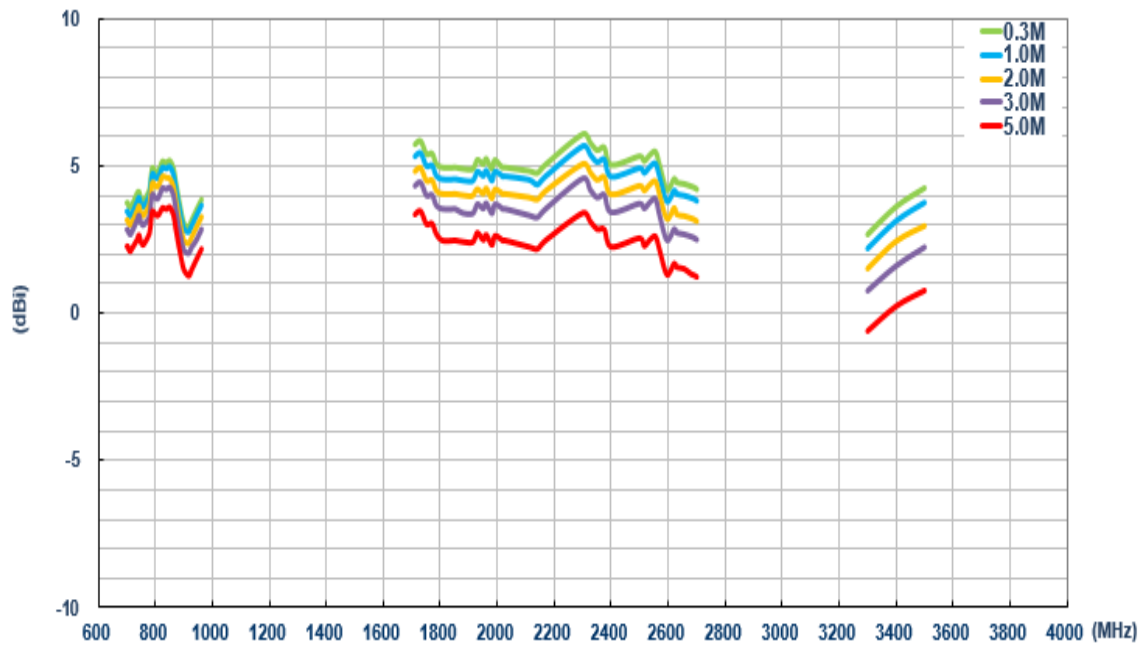
6.9.6 Average Gain (LTE_MIMO_1)



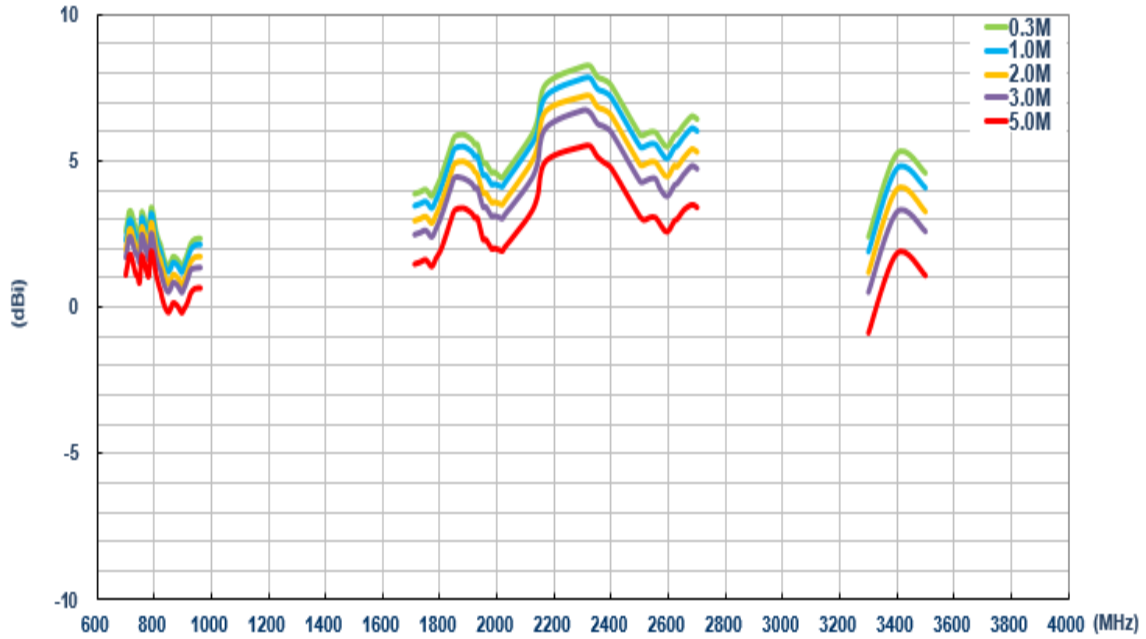
6.9.7 Average Gain (LTE_MIMO_2)



6.9.8 Peak Gain (LTE_MIMO_1)

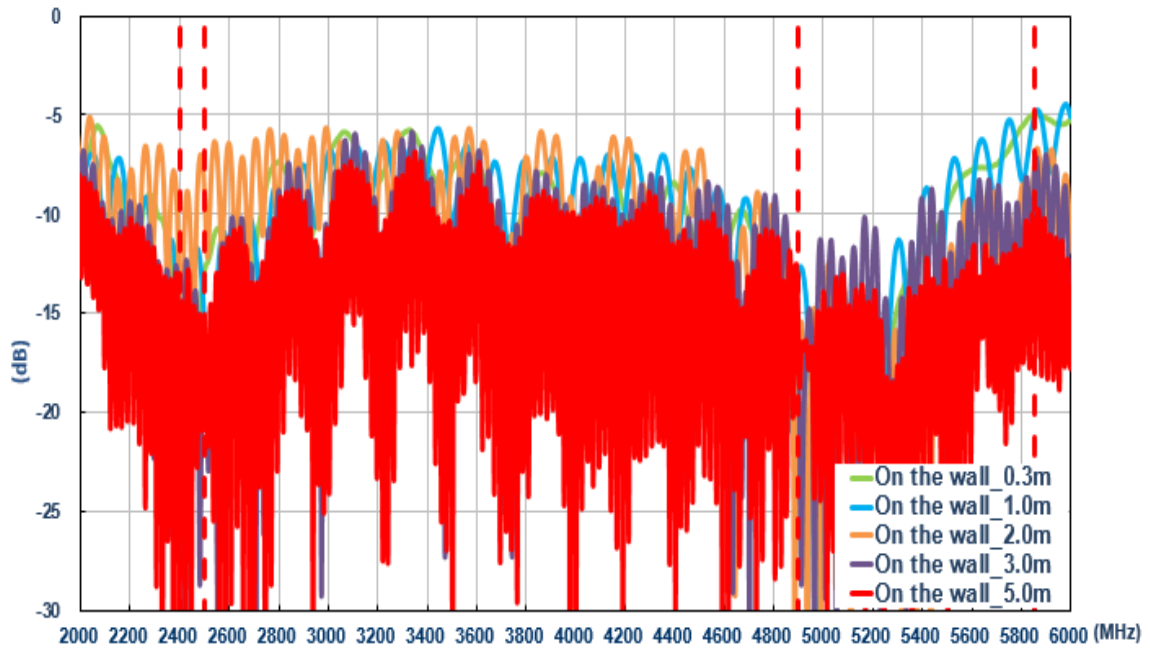


6.1.9 Peak Gain (LTE_MIMO_2)

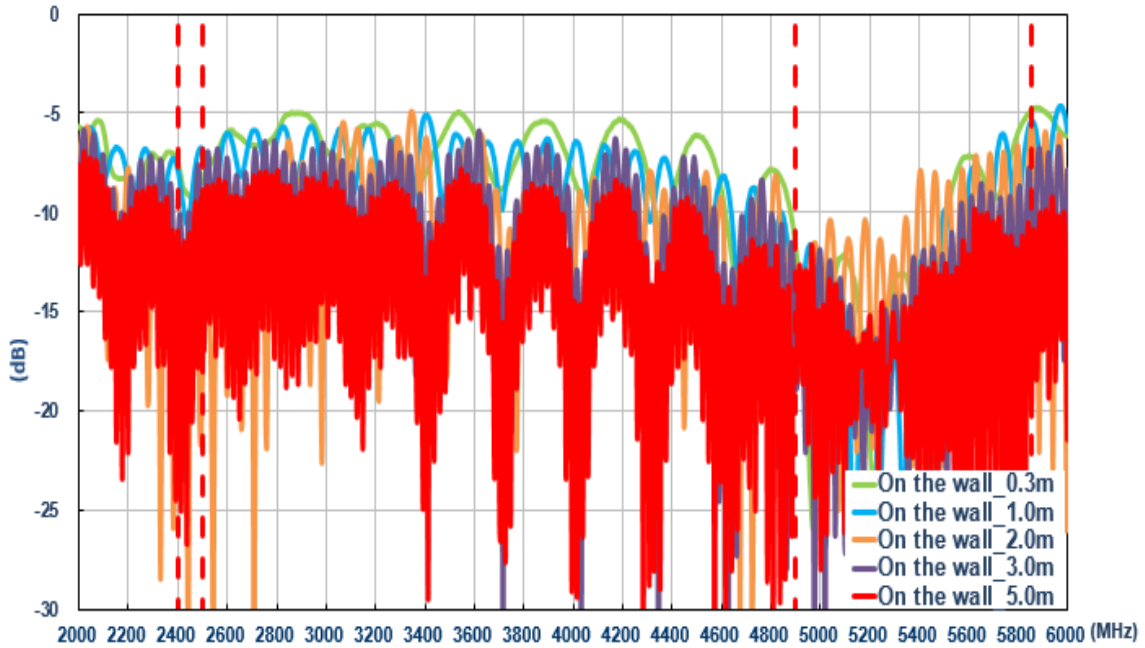


6.10 On the wall (Wi-Fi)

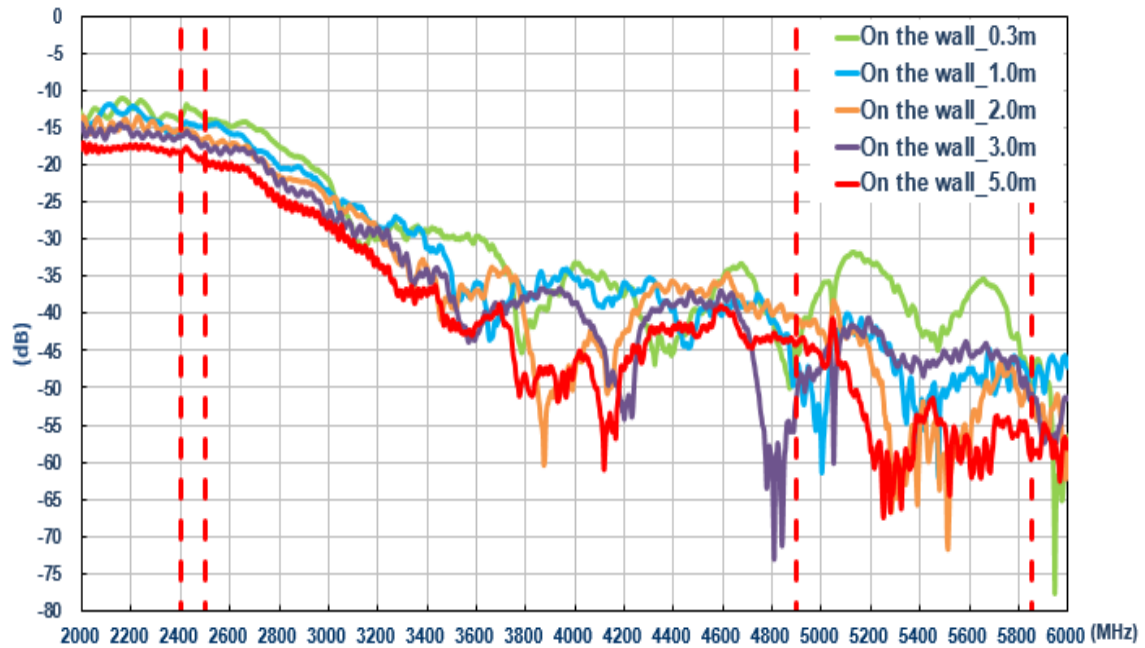
6.10.1 Return Loss (Wi-Fi_MIMO_1)



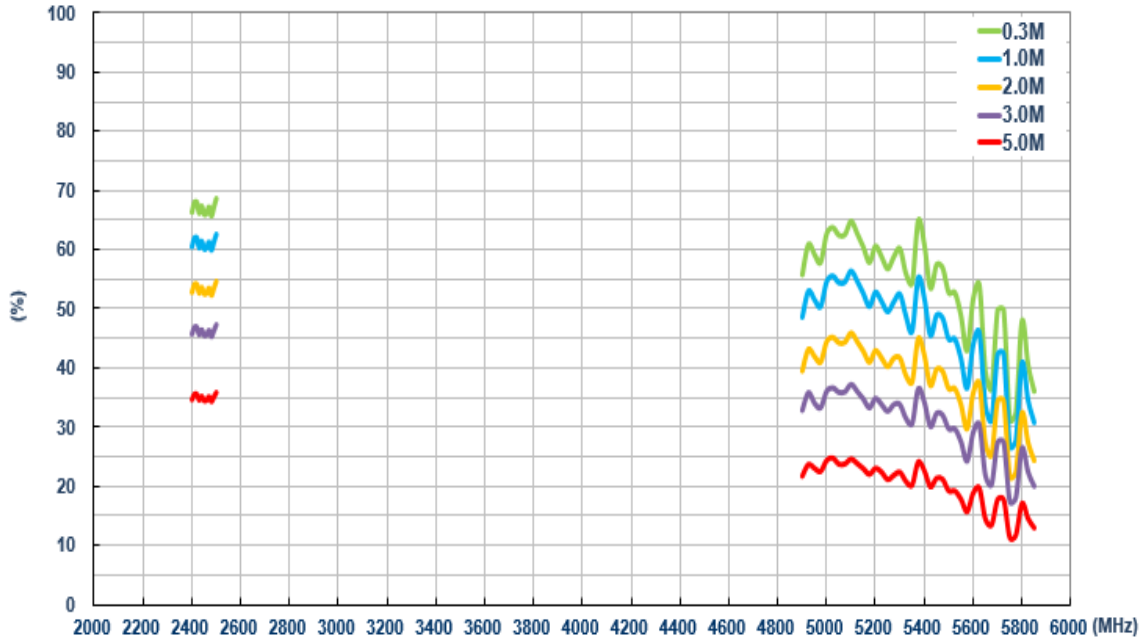
6.10.2 Return Loss (Wi-Fi_MIMO_2)



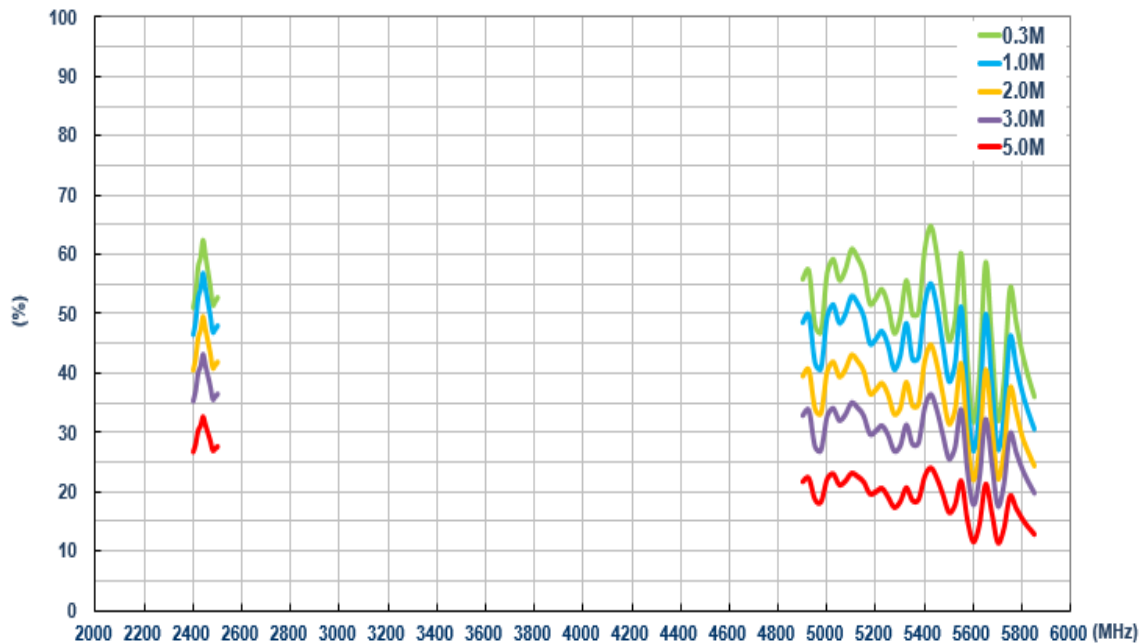
6.10.3 Isolation (Wi-Fi)



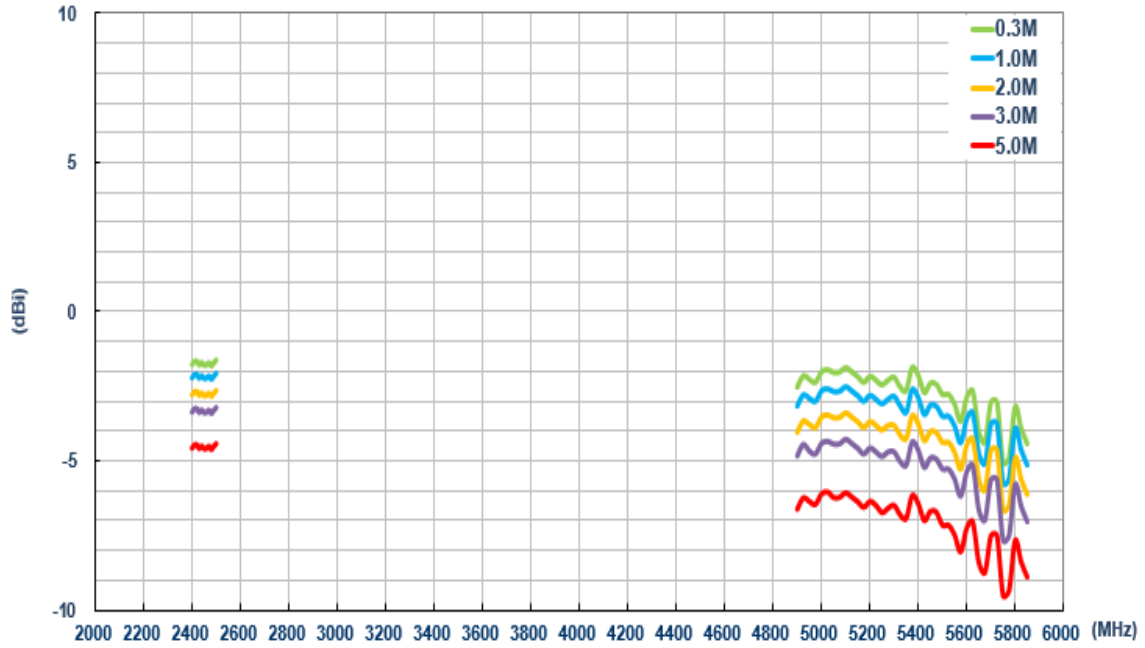
6.10.4 Efficiency (Wi-Fi_MIMO_1)



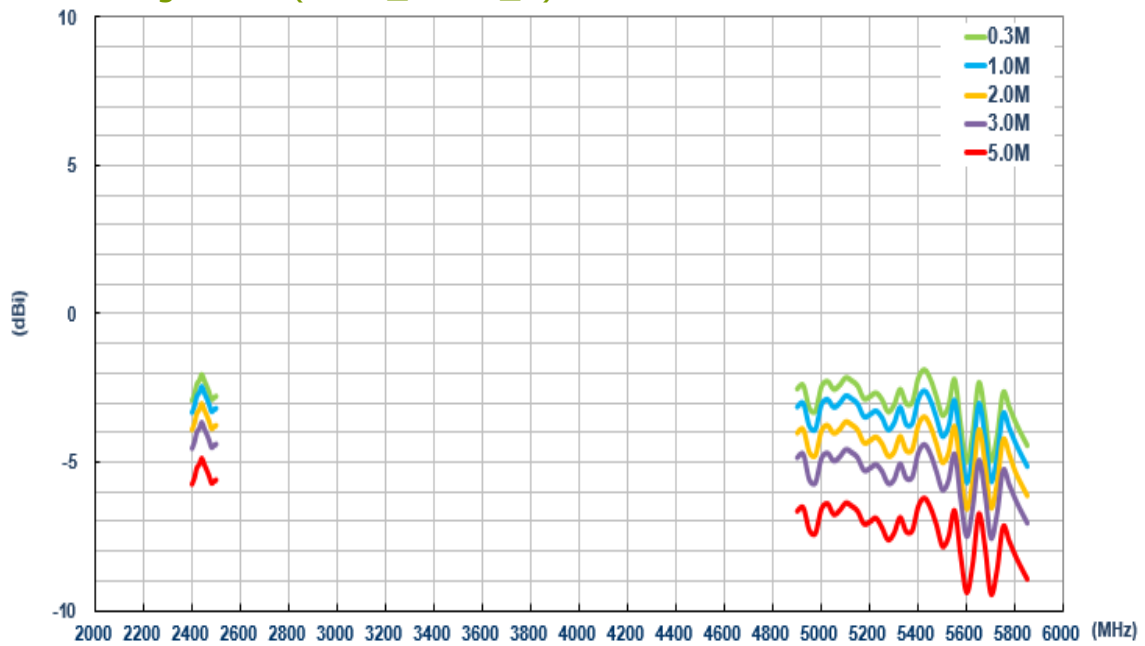
6.10.5 Efficiency (Wi-Fi_MIMO_2)



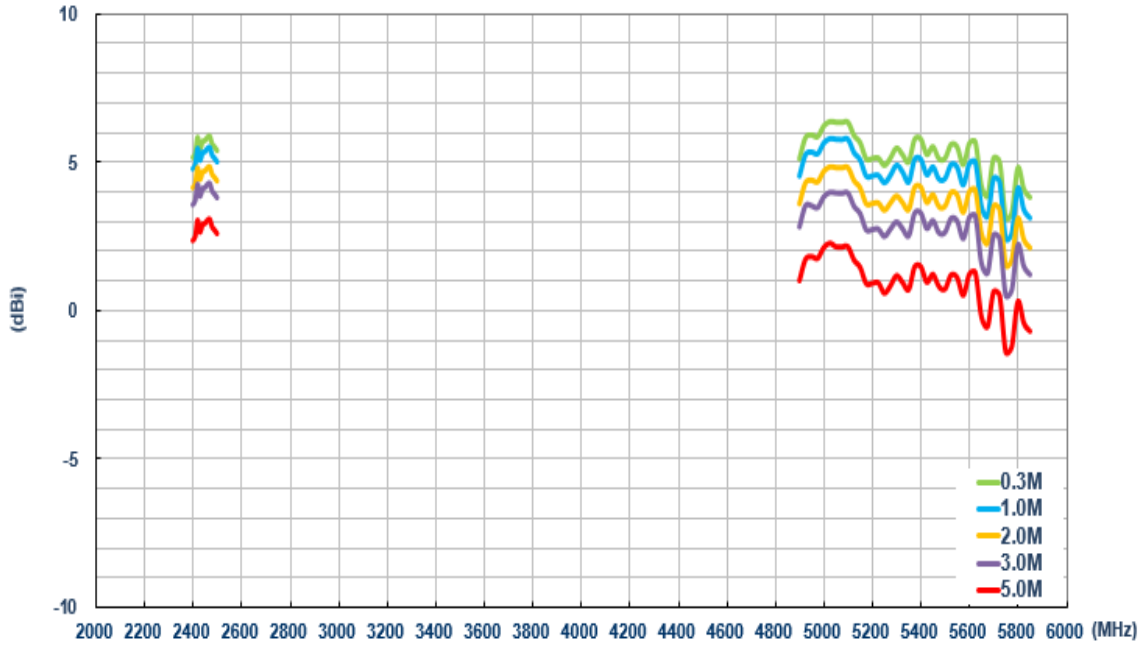
6.10.6 Average Gain (Wi-Fi_MIMO_1)



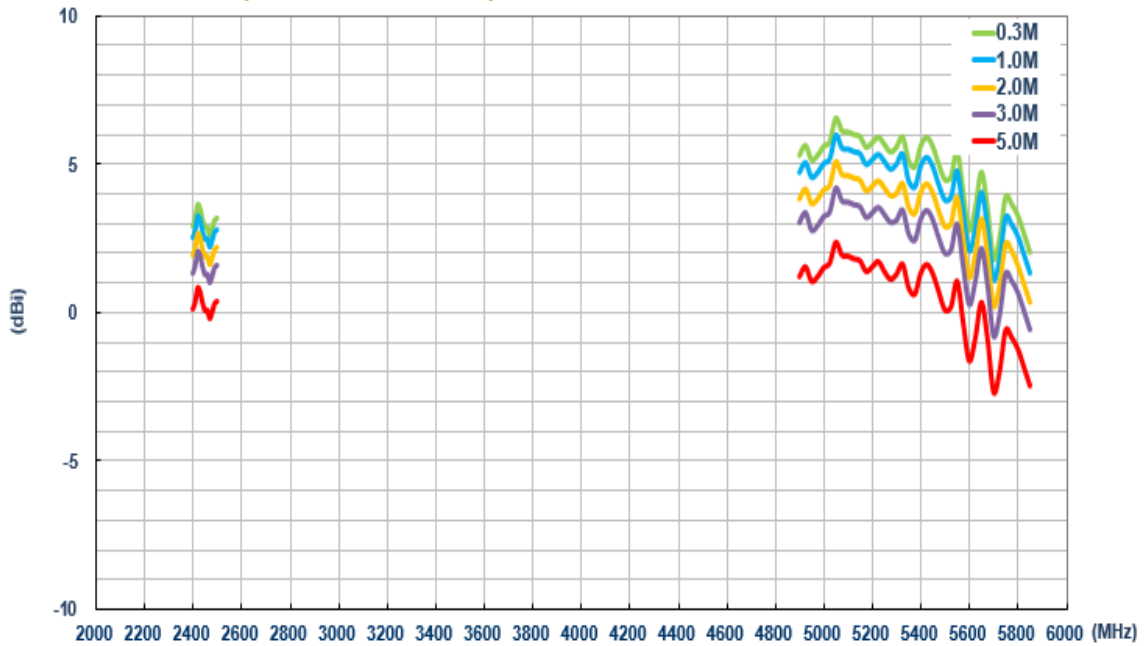
6.10.7 Average Gain (Wi-Fi_MIMO_2)



6.10.8 Peak Gain (Wi-Fi_MIMO_1)



6.10.9 Peak Gain (Wi-Fi_MIMO_2)



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