

SPECIFICATION

- Part No. : **MA450.K.LBICG.004**
- Product Name : Storm MA450 5in1 Permanent Mount Antenna
LTE MIMO*2 + Wi-Fi MIMO*2 + GNSS
- Features : Aerodynamic, super low-profile, vandal resistant housing
2*LTE MIMO 698-960MHz/1710-2170MHz/
2490-2690MHz/ 3300-3600MHz
2* Wi-Fi 2.4GHz/5.8GHz
1* GPS-GLONASS-BeiDou L1 Antenna
Screw-Mount [Permanent Mount]
Worldwide 4G Bands including 3G and 2G
IP67 Enclosure
Dims: 216*93*31mm
3 Meters Low Loss CFD-200 and RG-174 Cable with
SMA(M) & RP-SMA(M) connectors
Custom Cables and Connectors Available
RoHS Compliant



1. Introduction

The Storm MA450 antenna is a world first, a 5in1 low profile, heavy-duty, fully IP67 waterproof external antenna for use in worldwide telematics and IoT applications which require best in class LTE, GNSS, and Wi-Fi performance. Until the arrival of the Storm, achieving high efficiency in LTE and Wi-Fi required the use of large dome antennas typically 80mm+ in height.

However, this unique product, at only 31mm high, delivers powerful worldwide 4G LTE MIMO antenna technology plus GPS-GLONASS-BeiDou for next generation location accuracy. The antenna also covers legacy 2G and 3G bands for devices that fallback where 4G is unavailable. Dual-band MIMO Wi-Fi antennas enable high throughput Wi-Fi speeds.

Typical applications include:

- Internet of Things (IoT) Gateways and Routers
- Remote Asset and Pipeline Monitoring
- HD Video over LTE
- First Responder and Emergency Services
- Automotive Vehicle Tracking and Telematics

LTE 4G 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 between the two MIMO antennas to prevent self-interference. The MA410 does not require a ground plane. Low loss cables are used to keep efficiency high over long cable lengths. In contrast, smaller MIMO antennas with thinner, poorer quality cables will have much reduced efficiency and isolation, which would lead to a large drop in system throughput or drops, and may not make a system connection at all.

The GPS-GLONASS-BeiDou active antenna has been carefully designed for excellent performance across all L1 bands, leading to higher location accuracy and stability of tracking in urban environments. Cable length and connector types are customizable. Contact your regional Taoglas sales office for support.



Conformity is declared under the following standard: **EN55022 Class B**

This is to declare that the product listed above conform to the EMC directive 2014/30/EU.

2. Specification

BeiDou-GPS-GLONASS				
Center Frequency	BeiDou: 1561.098±2.046MHz GPS: 1575.42±1.023MHz GLONASS: 1602±5MHz			
Passive Antenna Efficiency(with cable loss)	BeiDou: 32% GPS: 27% GLONASS: 32%			
Passive Antenna Average gain(with cable loss)	BeiDou: -4.8dBi GPS: -5.5dBi GLONASS: -4.8dBi			
Passive Antenna Peak gain(with cable loss)	BeiDou: 1.0dBi GPS: 0.9dBi GLONASS: 0.6dBi			
VSWR	2:1 Max			
Impedance	50Ω			
Axial Ratio	BeiDou: <17.03 GPS: <12.48 GLONASS: <12.33			
Polarization	RHCP			
Cable	3 meter RG-174 standard, fully customizable			
Connector	SMA(M), standard, fully customizable			
LNA and Filter Electrical Properties				
Center Frequency	BeiDou: 1561.098±2.046MHz GPS: 1575.42±1.023MHz GLONASS: 1602±5MHz			
Pout 1dB gain Compression point	-6dBm Min. -2dBm Typ. (1561MHz, 1575.42MHz, 1602MHz)			
Output Impedance	50Ω			
VSWR	<2:1			
Return Loss	10 dB Min.			
LNA Gain, Current Draw, and Noise Figure @ GPS	Voltage	LNA Gain (Typ)	Current Draw(mA) Typ	Noise Figure (Typ)
	Min 1.8V	19dB	5mA	2.4dB
	Typ 3.0V	27dB	10mA	2.7dB
	Max 5.5V	30dB	23mA	3.1dB
Total specification(Through Antenna, SAW Filter, and LNA)				
Frequency	1561.098±2.046MHz	1575.42±1.023MHz	1602±5MHz	
Gain@3V	1561MHz: 29±3dBi	1575.42MHz: 29±3dBi	1602MHz: 32±3dBi	
Output Impedance	50Ω			

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	30cm	41.15	34.38	41.39	65.93	42.47	41.42	44.70	51.91
	1M	38.97	32.83	39.52	60.13	38.74	38.05	40.76	46.02
	2M	36.37	30.12	36.05	53.59	34.14	33.38	35.20	38.94
	3M	33.71	27.94	33.39	47.67	30.17	29.48	30.50	32.97
	5M	29.09	23.78	28.23	37.61	23.68	22.98	22.88	23.62
MIMO_2	30cm	53.42	35.10	39.18	69.08	51.06	44.92	47.27	45.91
	1M	50.50	33.52	37.42	63.00	46.57	41.27	43.11	40.74
	2M	47.13	30.76	34.13	56.15	41.04	36.16	37.23	34.50
	3M	43.75	28.53	31.62	49.94	36.26	31.97	32.23	29.18
	5M	37.75	24.28	26.73	39.38	28.47	24.94	24.19	20.94
Average Gain(dBi)									
MIMO_1	30cm	-3.98	-4.65	-3.86	-1.86	-3.77	-3.88	-3.54	-2.87
	1M	-4.22	-4.85	-4.06	-2.26	-4.17	-4.25	-3.94	-3.39
	2M	-4.52	-5.22	-4.46	-2.76	-4.73	-4.82	-4.58	-4.12
	3M	-4.85	-5.55	-4.79	-3.27	-5.26	-5.35	-5.21	-4.84
	5M	-5.48	-6.25	-5.52	-4.30	-6.32	-6.44	-6.45	-6.29
MIMO_2	30cm	-2.86	-4.56	-4.08	-1.62	-2.97	-3.50	-3.26	-3.46
	1M	-3.11	-4.76	-4.28	-2.02	-3.37	-3.87	-3.66	-3.98
	2M	-3.41	-5.13	-4.68	-2.52	-3.93	-4.44	-4.30	-4.71
	3M	-3.74	-5.46	-5.01	-3.03	-4.46	-4.97	-4.93	-5.43
	5M	-4.37	-6.16	-5.74	-4.07	-5.52	-6.06	-6.17	-6.88
Peak Gain(dBi)									
MIMO_1	30cm	2.05	0.97	2.16	6.88	5.62	4.81	5.37	4.41
	1M	1.85	0.77	1.96	6.48	5.22	4.41	4.97	4.41
	2M	1.55	0.37	1.56	5.98	4.72	3.91	4.37	3.71
	3M	1.25	0.07	1.16	5.48	4.22	3.31	3.77	3.01
	5M	0.55	-0.63	0.46	4.48	3.12	2.31	2.57	1.61
MIMO_2	30cm	2.56	0.58	0.90	6.69	5.85	5.42	6.09	5.33
	1M	2.36	0.38	0.70	6.29	5.45	5.02	5.69	4.83
	2M	2.06	-0.02	0.30	5.79	4.95	4.52	5.09	4.13
	3M	1.76	-0.32	-0.10	5.29	4.45	3.92	4.44	3.43
	5M	1.06	-1.02	-0.80	4.29	3.35	2.92	3.19	2.03
Envelope Correlation Coefficient			All bands <0.3						
Impedance			50Ω						
Polarization			Linear						
VSWR			<3						
Cable			3 meters CFD200 standard, fully customizable						
Connector			SMA(M) standard, fully customizable						

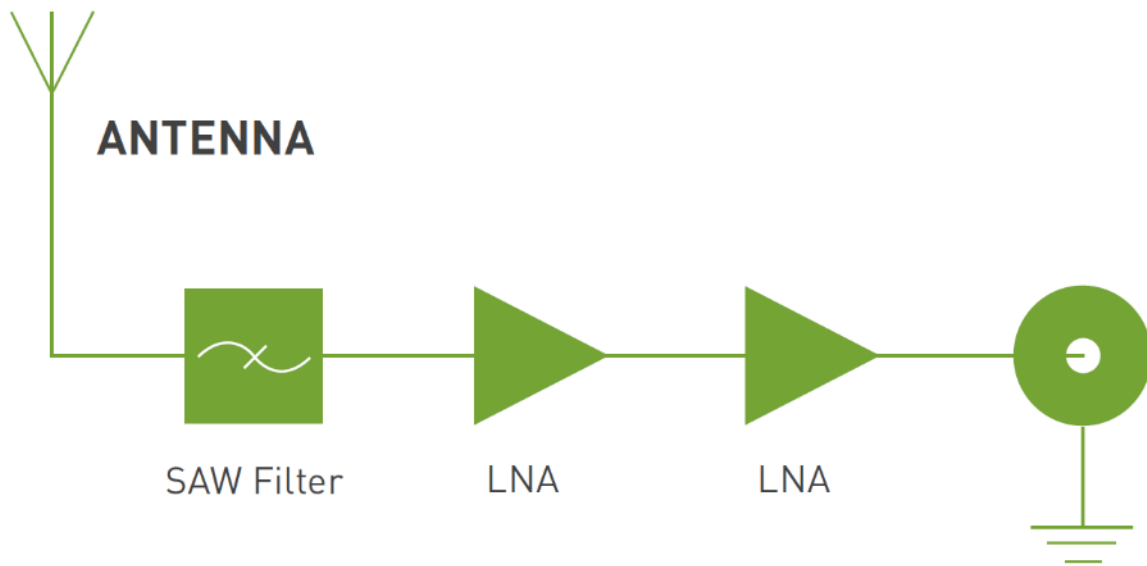
2.4GHz/5.8GHz Wi-Fi Antenna			
Frequency (MHz)		2400~2500	4900~5850
Efficiency (%)			
MIMO_1	30cm	68.43	56.73
	1M	62.41	48.80
	2M	54.36	39.53
	3M	47.34	32.06
	5M	35.91	21.05
MIMO_2	30cm	69.16	50.87
	1M	63.08	43.80
	2M	54.94	35.50
	3M	47.85	28.80
	5M	36.30	18.93
Average Gain(dBi)			
MIMO_1	30cm	-1.66	-2.48
	1M	-2.06	-3.14
	2M	-2.66	-4.05
	3M	-3.26	-4.96
	5M	-4.46	-6.79
MIMO_2	30cm	-1.62	-2.99
	1M	-2.02	-3.64
	2M	-2.62	-4.56
	3M	-3.22	-5.47
	5M	-4.42	-7.30
Peak Gain(dBi)			
MIMO_1	30cm	5.37	6.68
	1M	5.37	6.68
	2M	4.77	5.78
	3M	4.17	4.88
	5M	2.97	3.18
MIMO_2	30cm	4.18	7.99
	1M	4.18	7.39
	2M	3.58	6.49
	3M	2.98	5.59
	5M	1.78	3.79
Envelope Correlation Coefficient	2400-2500MHz <0.3 4900-5850MHz <0.3		
Impedance	50Ω		
Polarization	Linear		
VSWR	< 2		
Cable	3 meters CFD-200 standard, fully customizable		
Connector	RP-SMA(M) standard, fully customizable		

MECHANICAL	
Antenna Dimensions	216.24*93.25*30.95mm
Casing	ABS+PC
Base and thread	Nickel Plated Aluminum
Weight (including cable)	1120g
Ingress Protection Rating	IP67
Maximum Assembly Torque	39.2 N-m
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 GPS-GLONASS-BeiDou Antenna

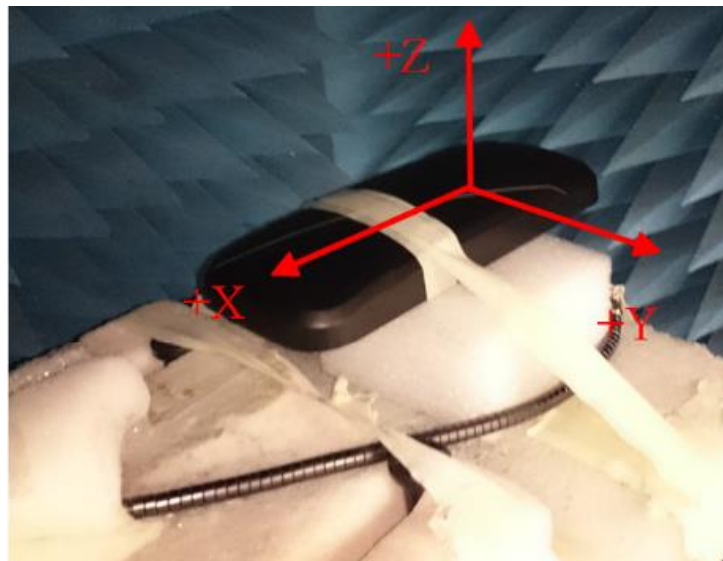
3.1.1 Block Diagram (Active Antenna)



3.1.2 Test Setup

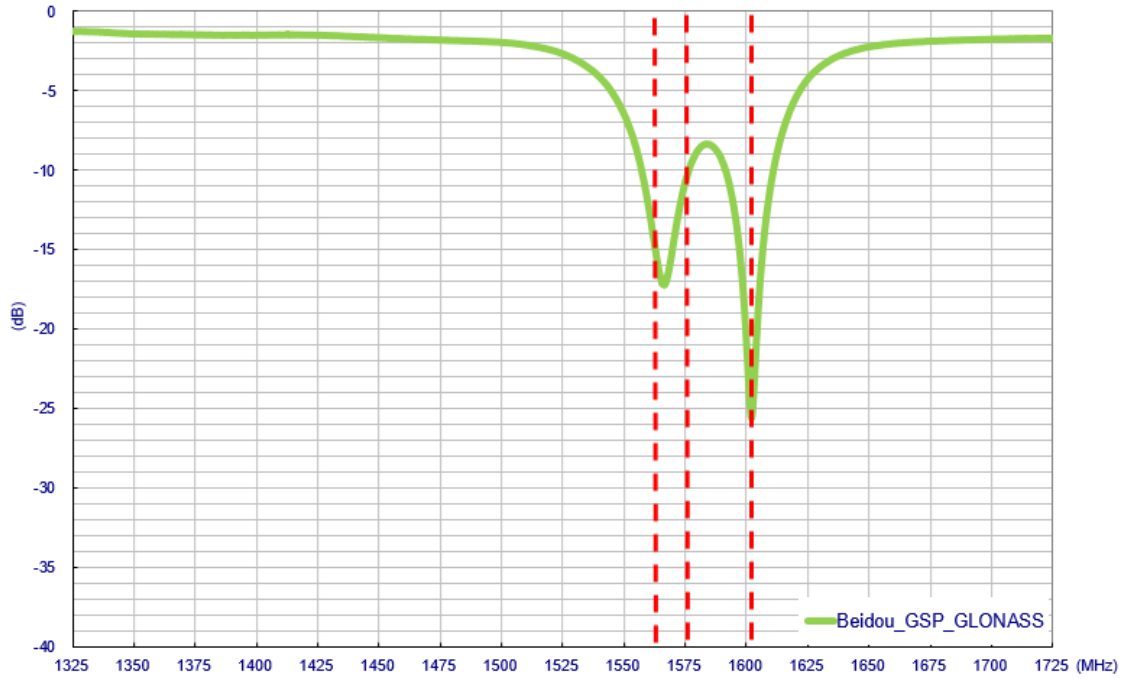


XZ Plane

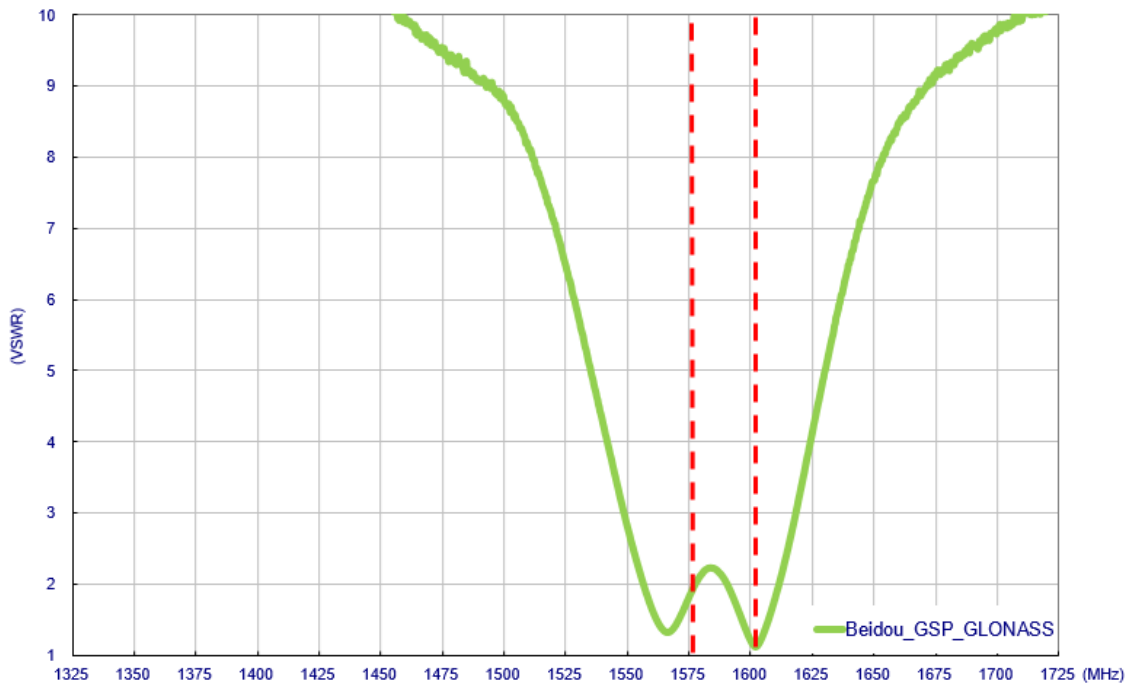


YZ Plane

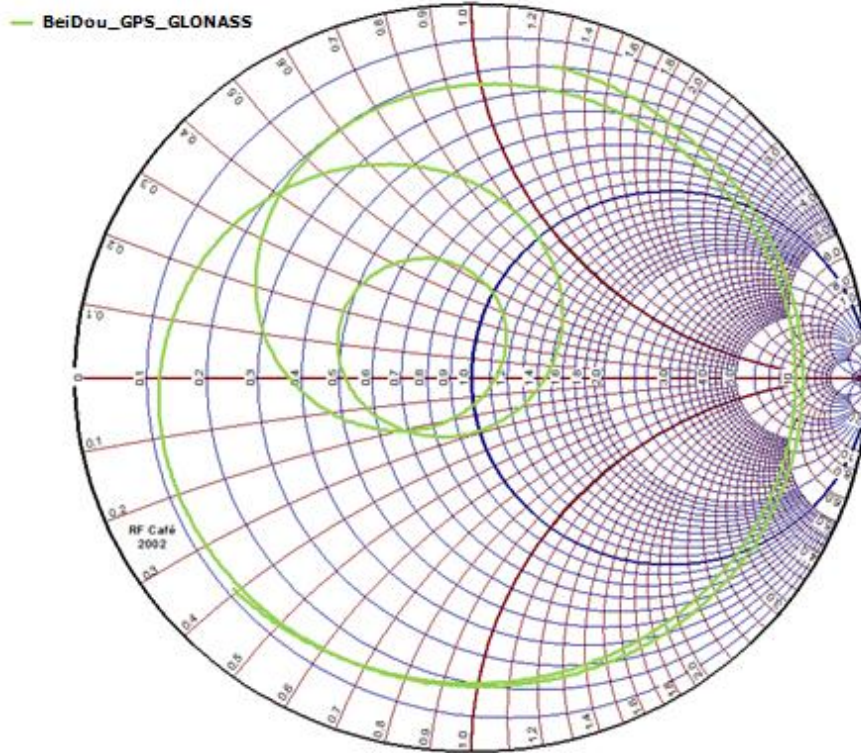
3.1.3 GPS-GLONASS-BeiDou Return Loss (Passive Antenna)



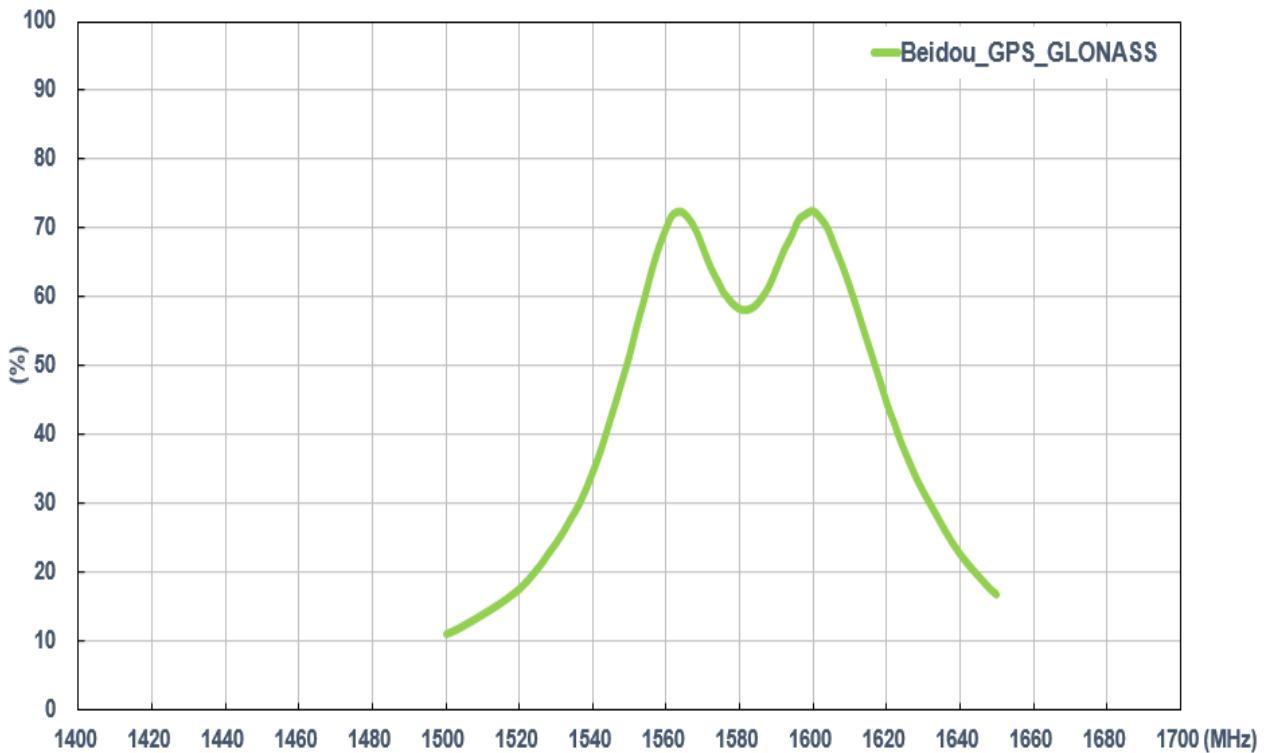
3.1.4 GPS-GLONASS-BeiDou VSWR (Passive Antenna)



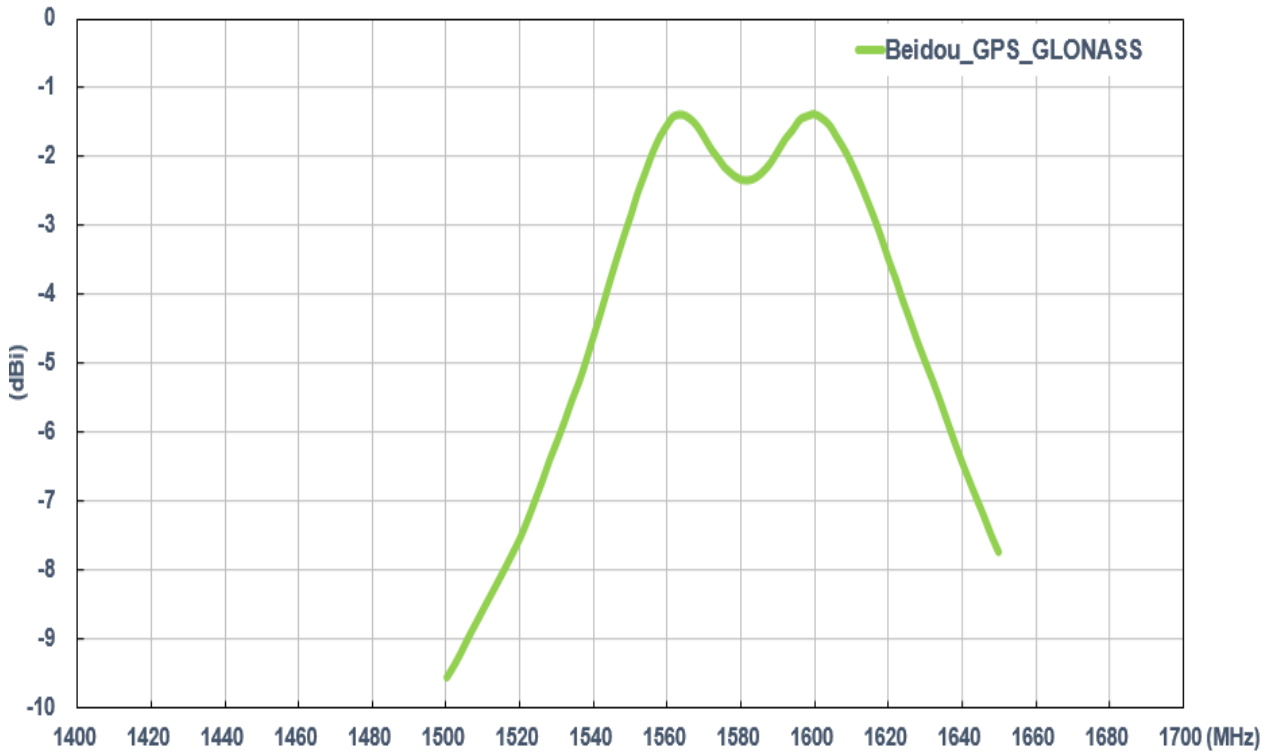
3.1.5 GPS-GLONASS-BeiDou Smith Chart (Passive Antenna)



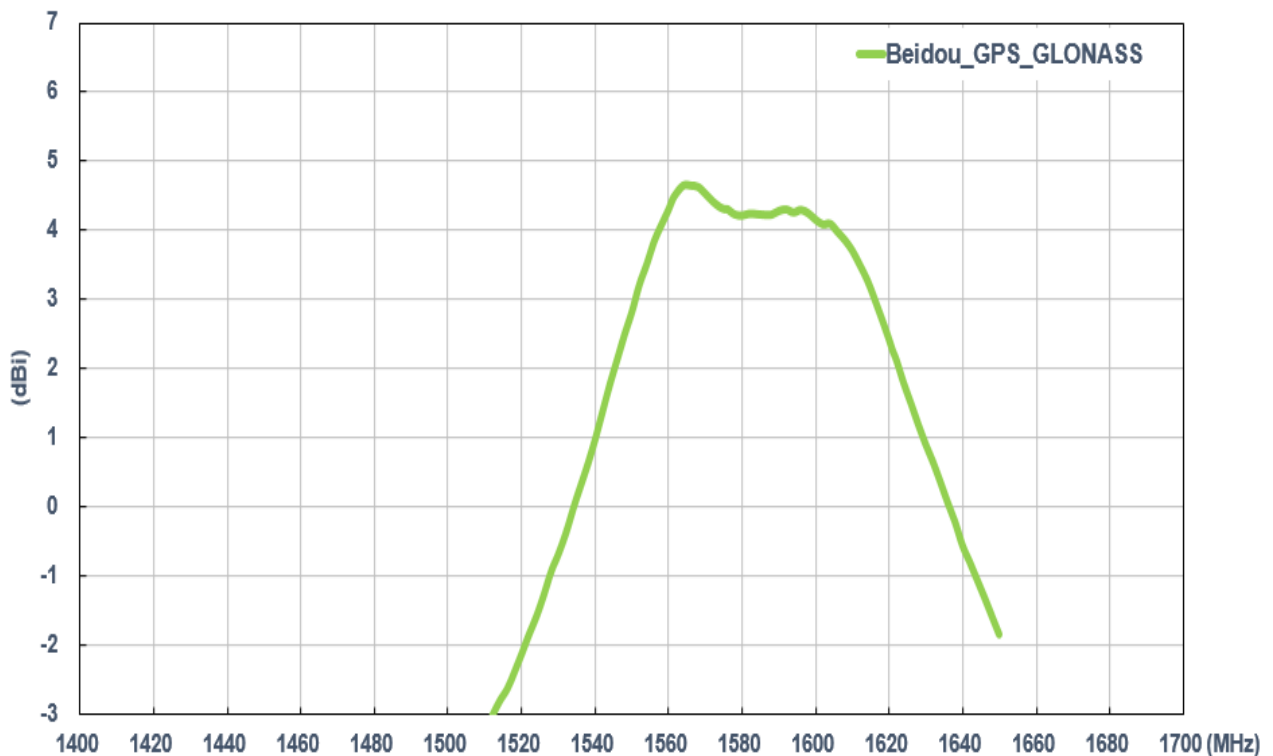
3.1.6 GPS-GLONASS-BeiDou Efficiency (Passive Antenna)



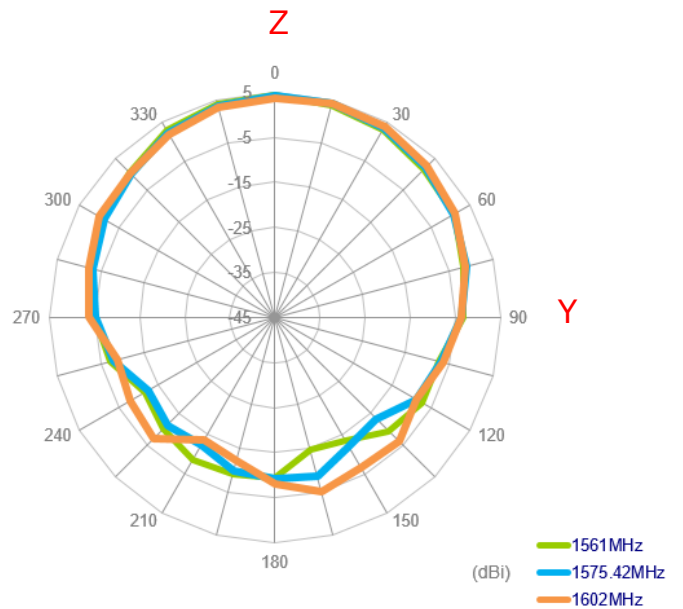
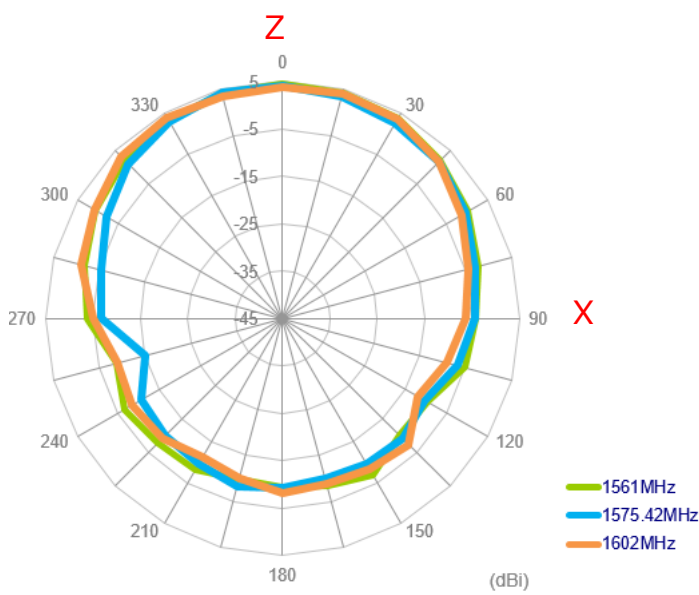
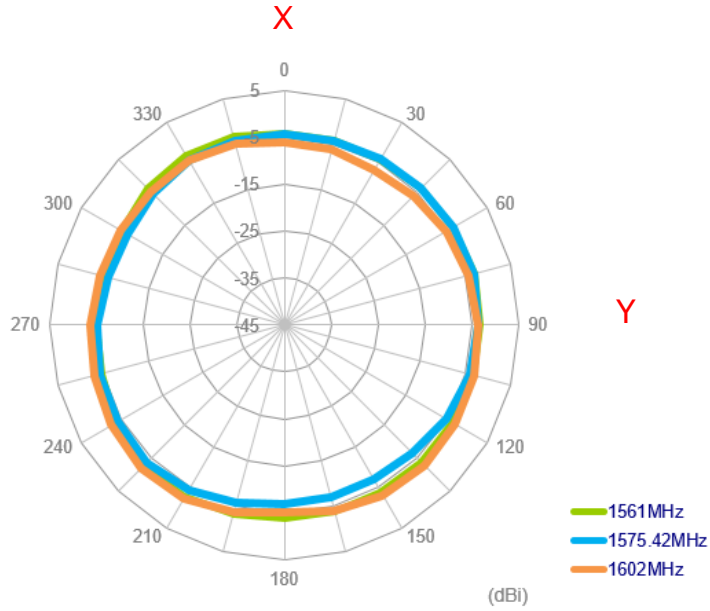
3.1.7 GPS-GLONASS-BeiDou Average Gain (Passive Antenna)



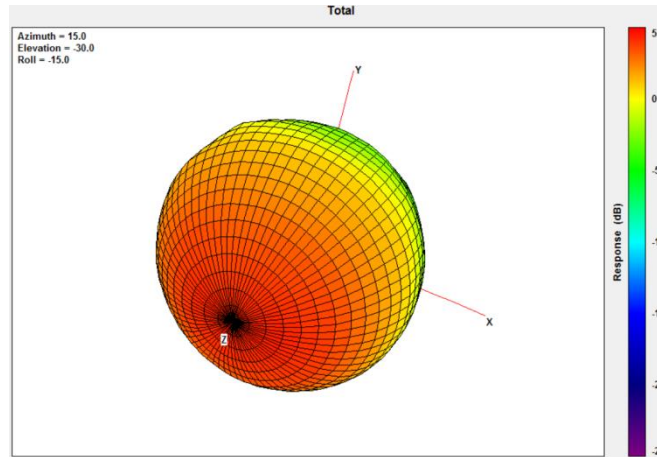
3.1.8 GPS-GLONASS-BeiDou Peak Gain (Passive Antenna)



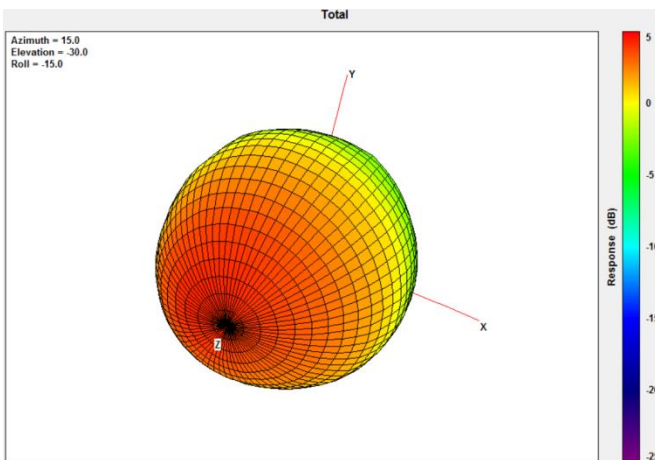
3.1.9 GPS-GLONASS-BeiDou Radiation Pattern (Passive Antenna) 2D Radiation pattern



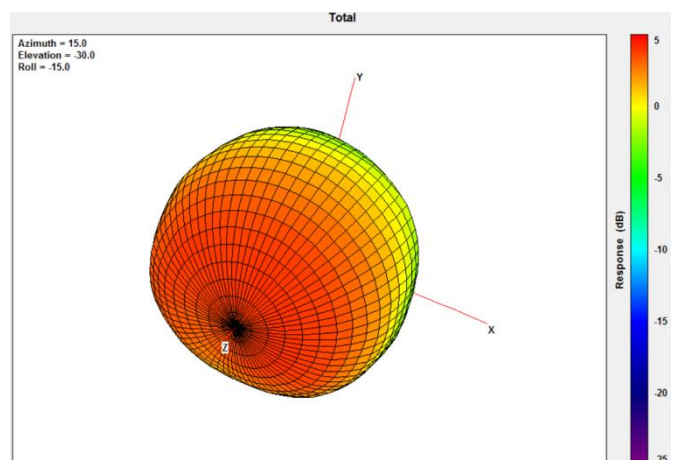
3D Radiation Pattern (Passive antenna)



1561MHz

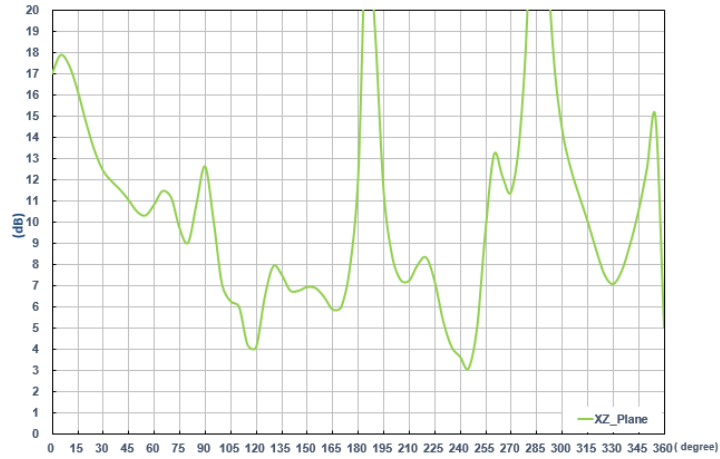


1575.42MHz

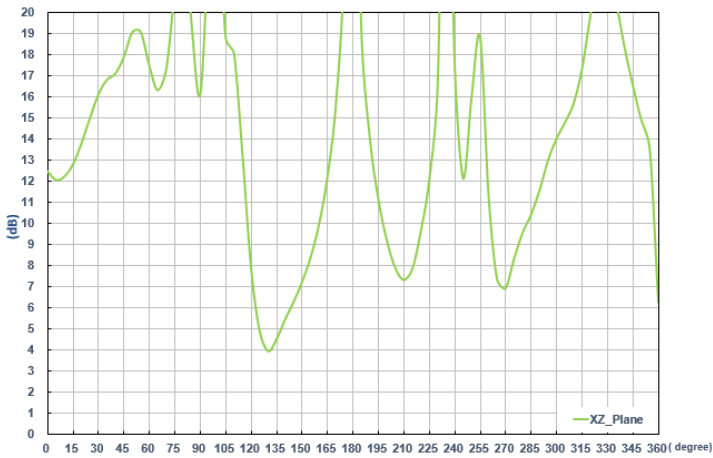


1602MHz

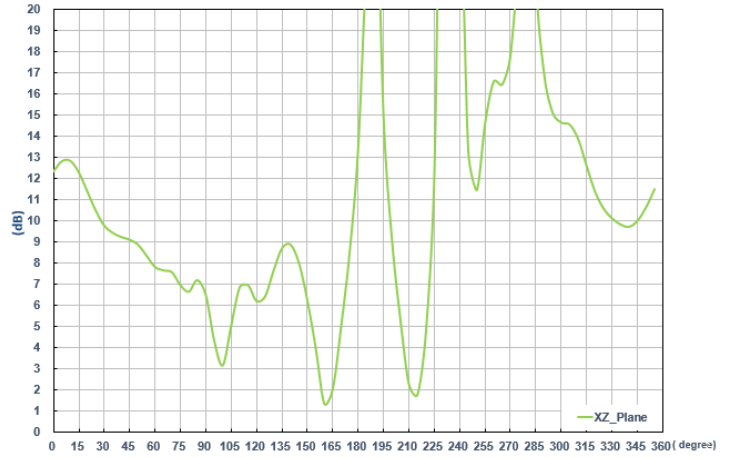
3.1.10 Axial Ratio Pattern (Passive antenna)



1561MHz

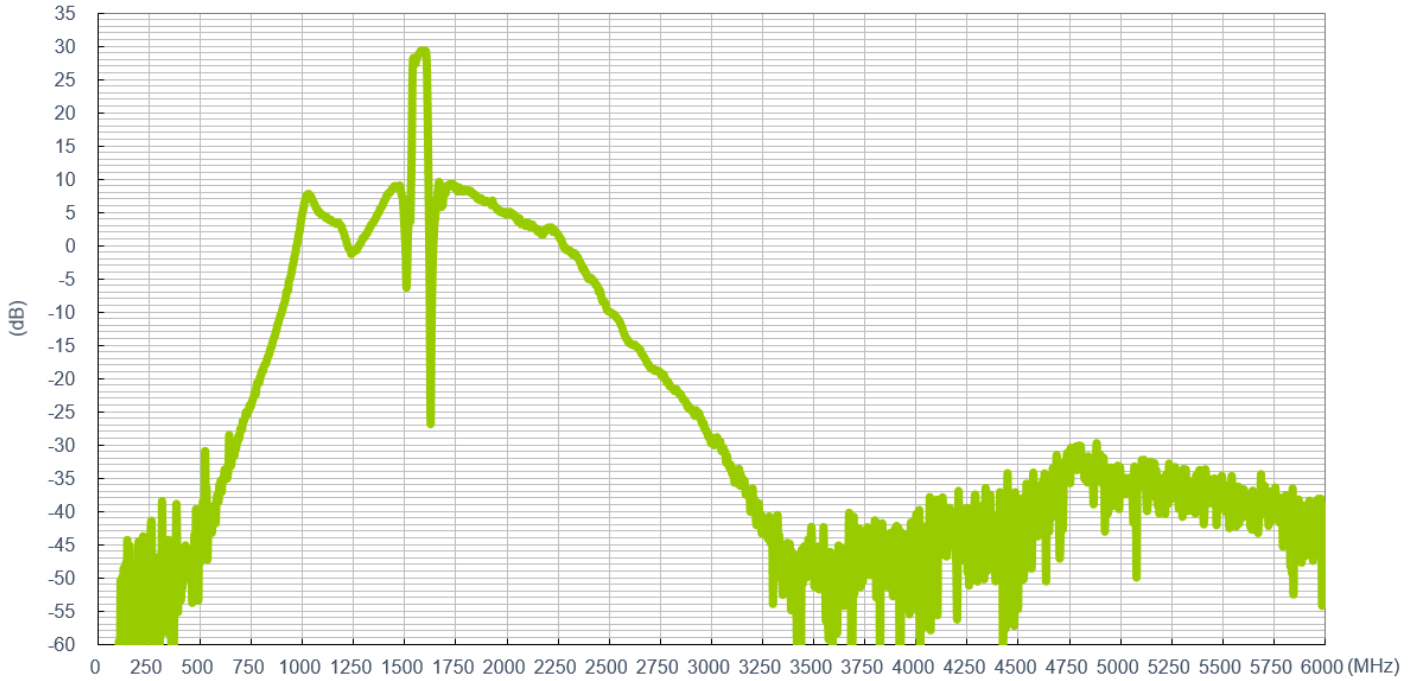


1575.42MHz

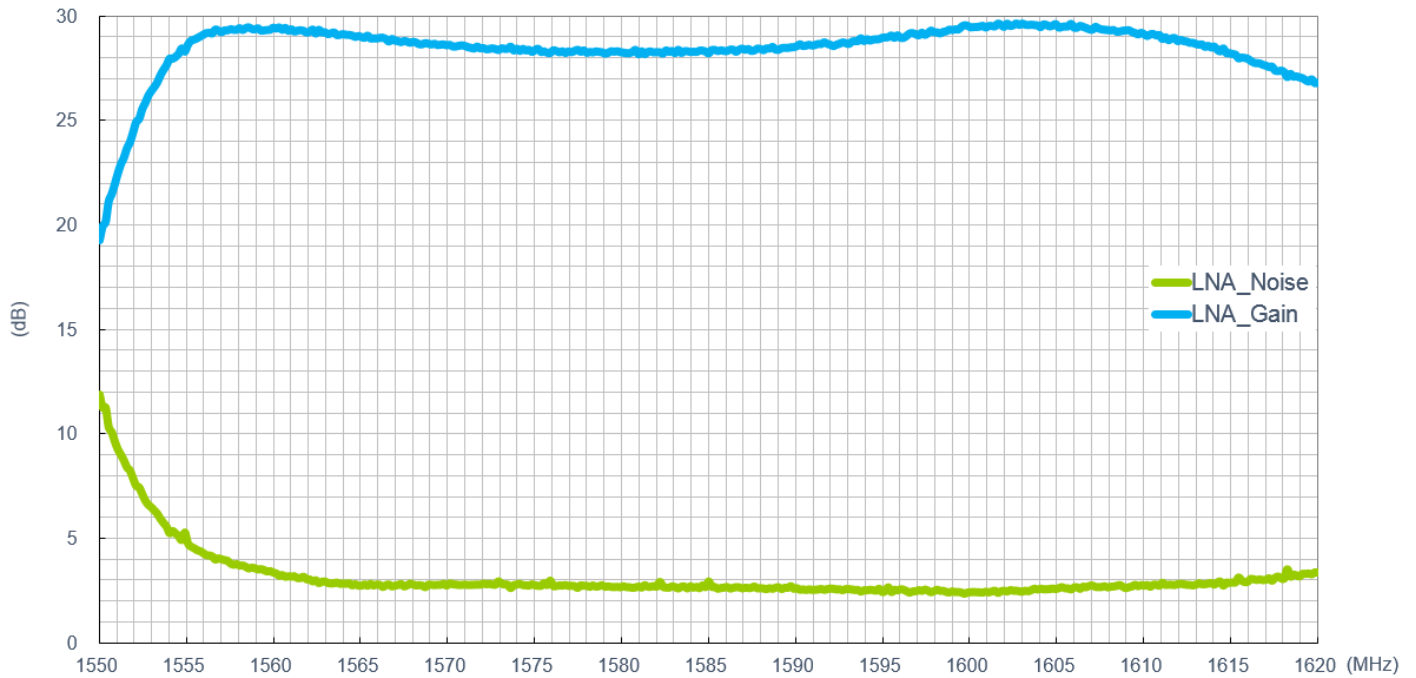


1602MHz

3.1.11 GPS-GLONASS-BeiDou LNA Gain and Noise Figure (Active antenna)



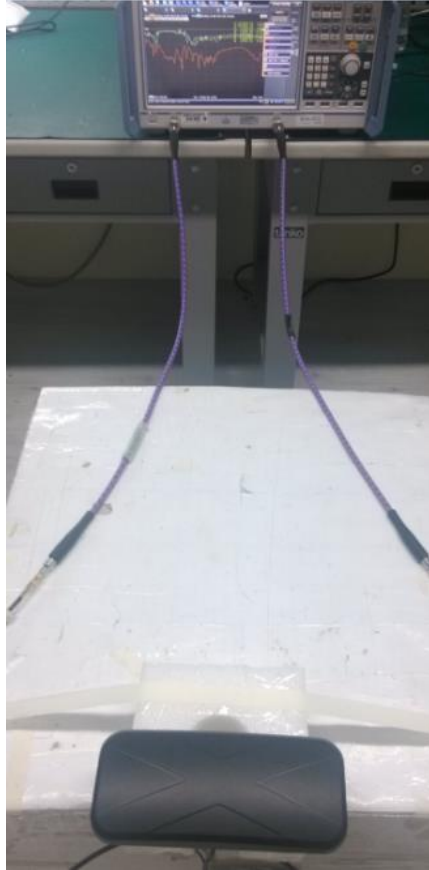
LNA Gain@3.0V



LNA Noise Figure@3.0V

3.2 LTE_MIMO Antenna

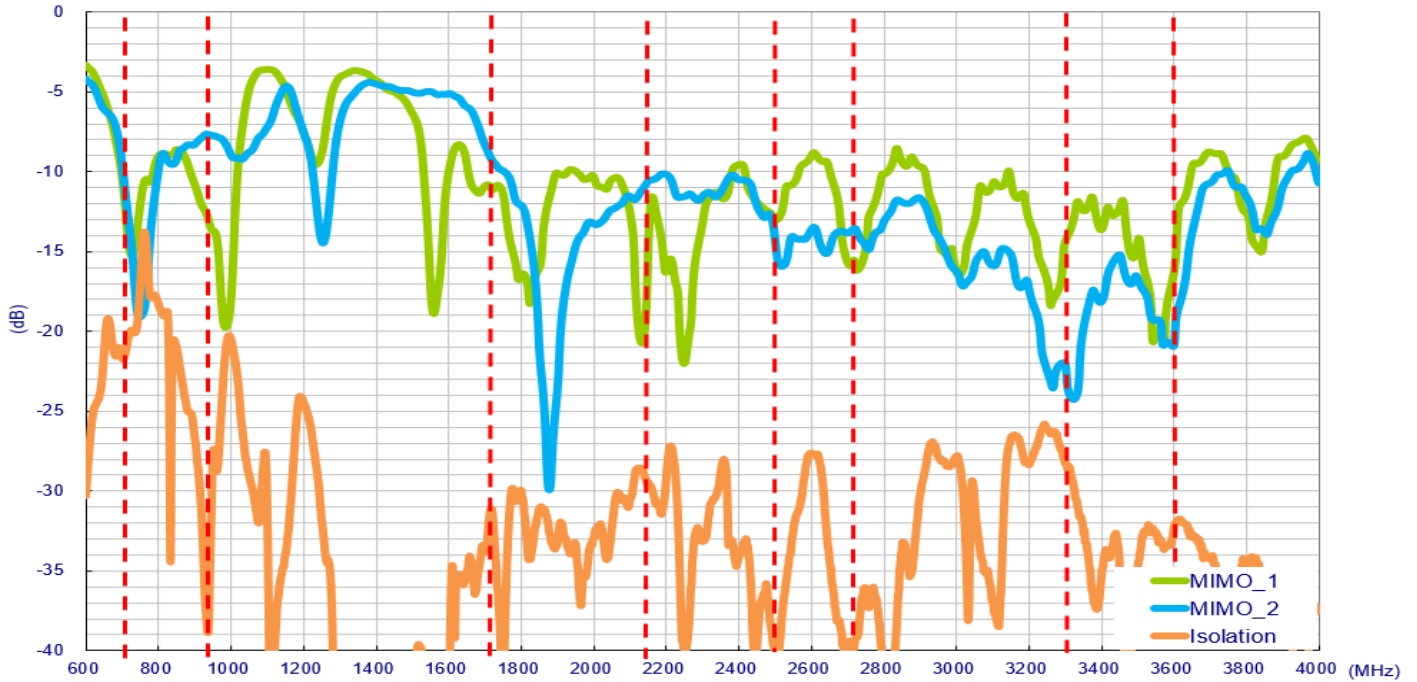
3.2.1 Test Setup



In free space

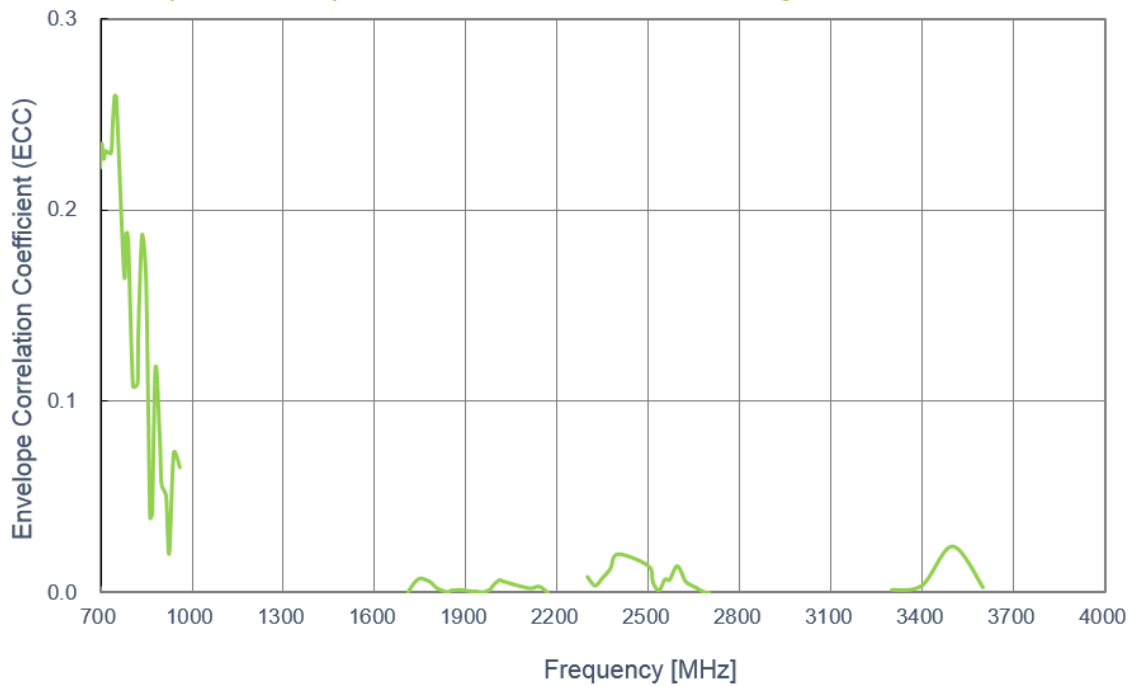
3.2.2 LTE Antenna Return Loss

Setup in free space with 3 meter cable length



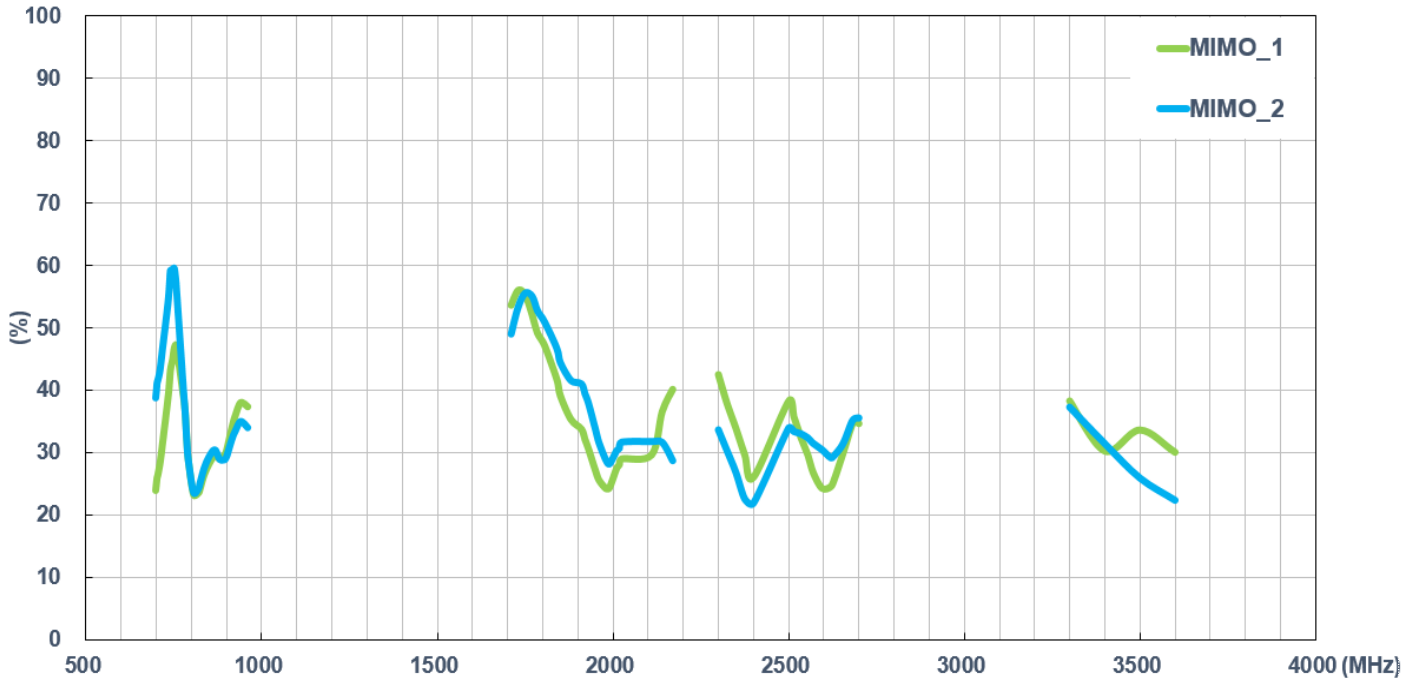
3.2.3 LTE Envelope Correlation Coefficient

Setup in free space with 3 meter cable length



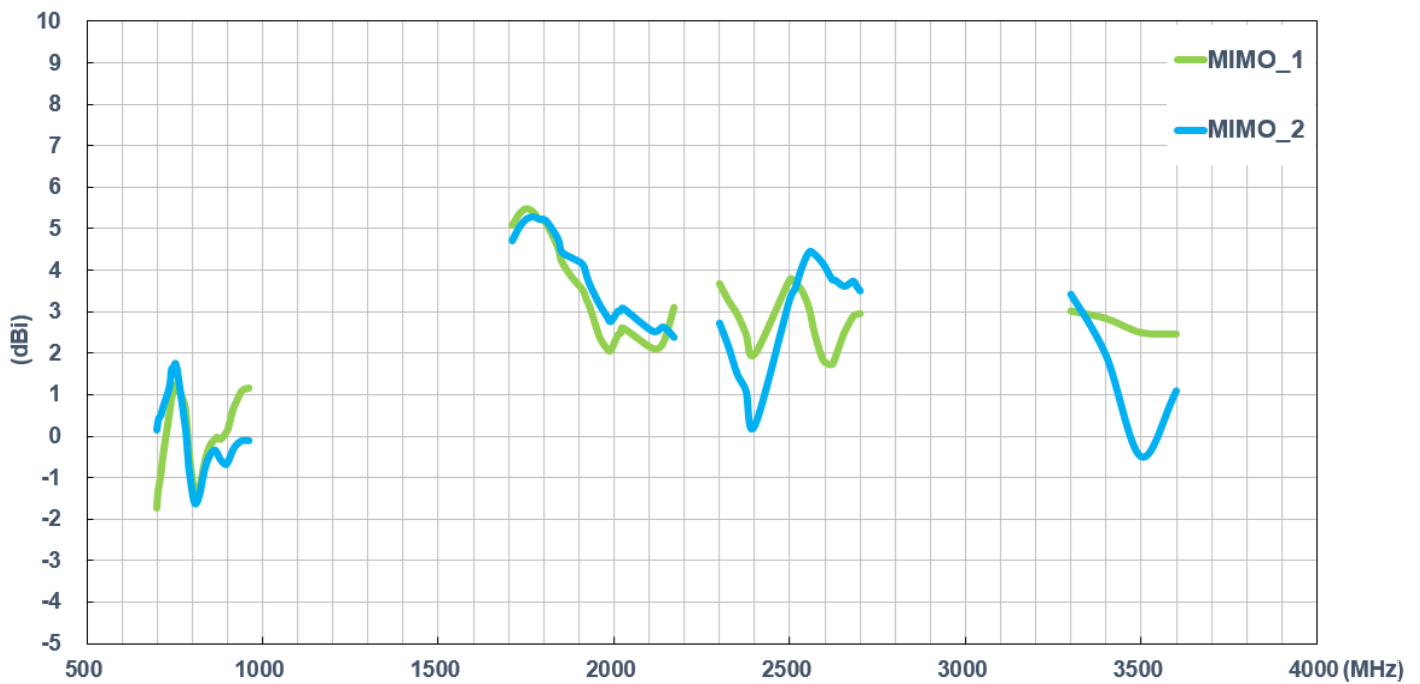
3.2.4 LTE Antenna Efficiency

Setup in free space with 3 meters cable length



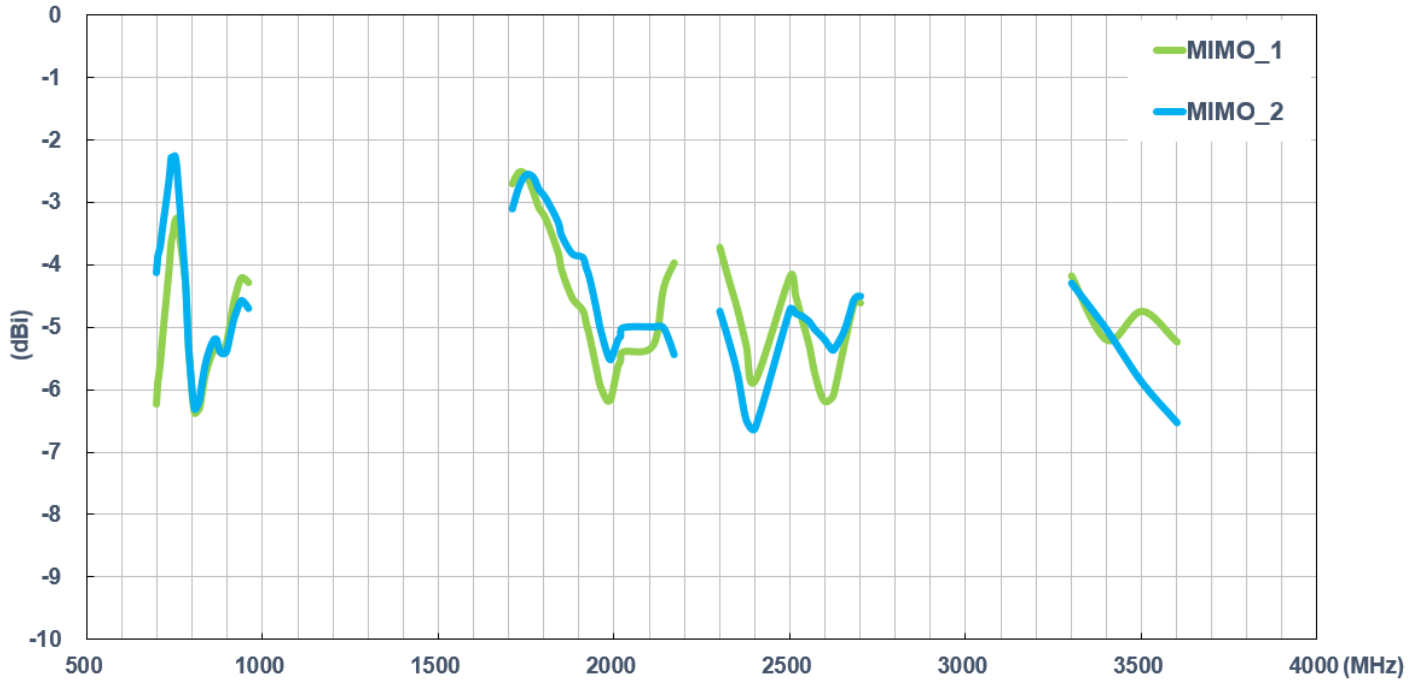
3.2.5 LTE Antenna Peak Gain

Setup in free space with 3 meter cable length



3.2.6 LTE Antenna Average Gain

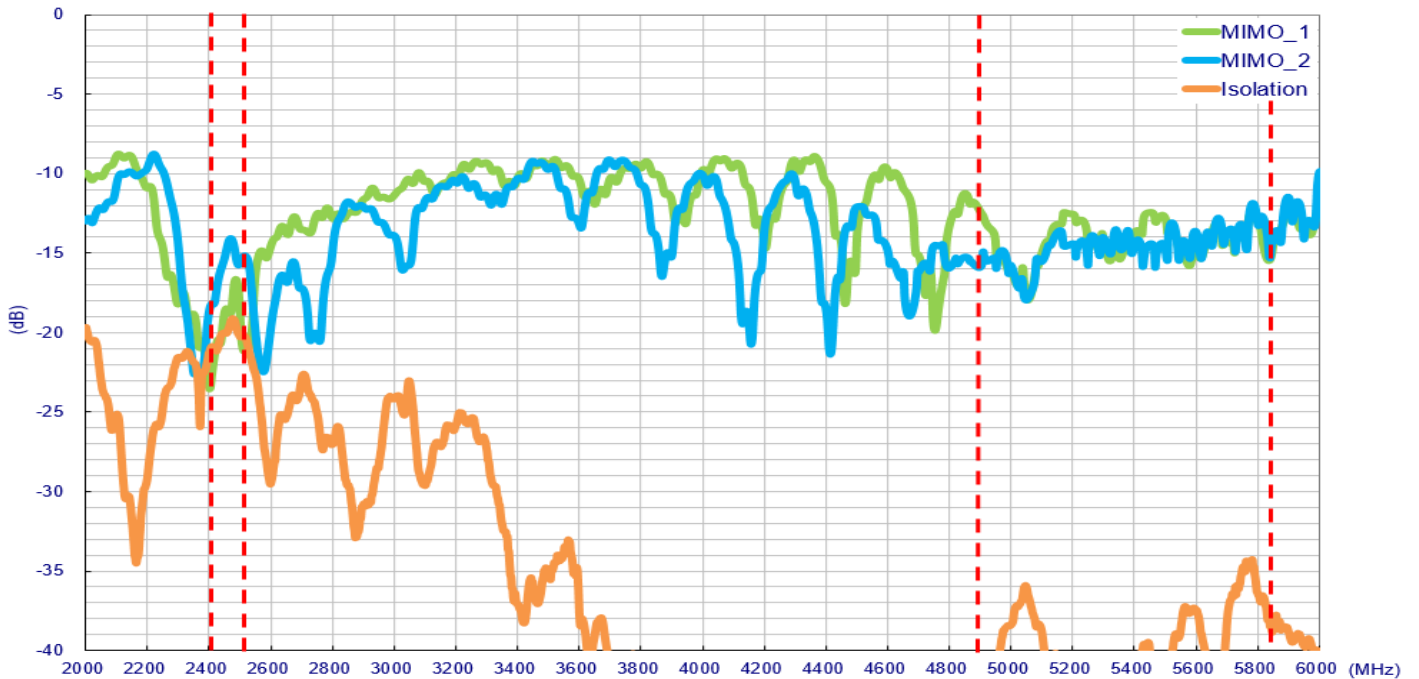
Setup in free space with 3 meter cable length



3.3 Wi-Fi_MIMO Antenna

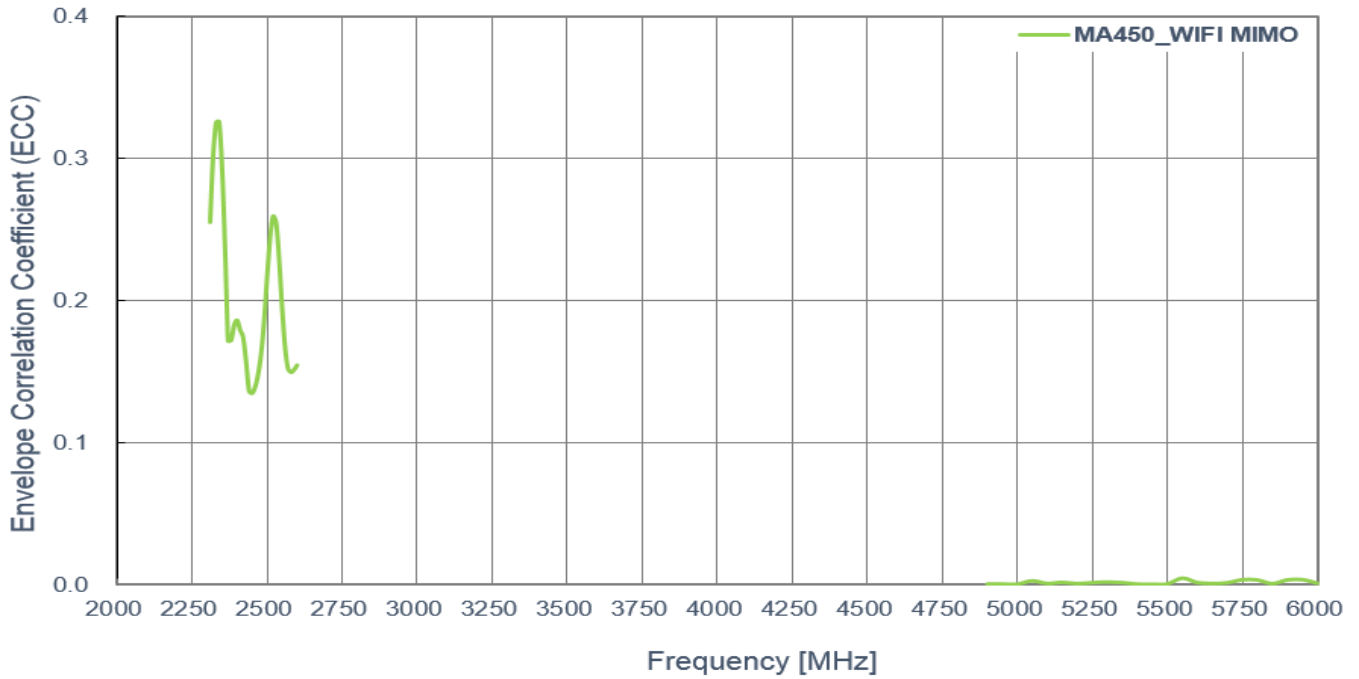
3.3.1 Wi-Fi Antenna Return Loss

Setup in free space with 3 meter cable length



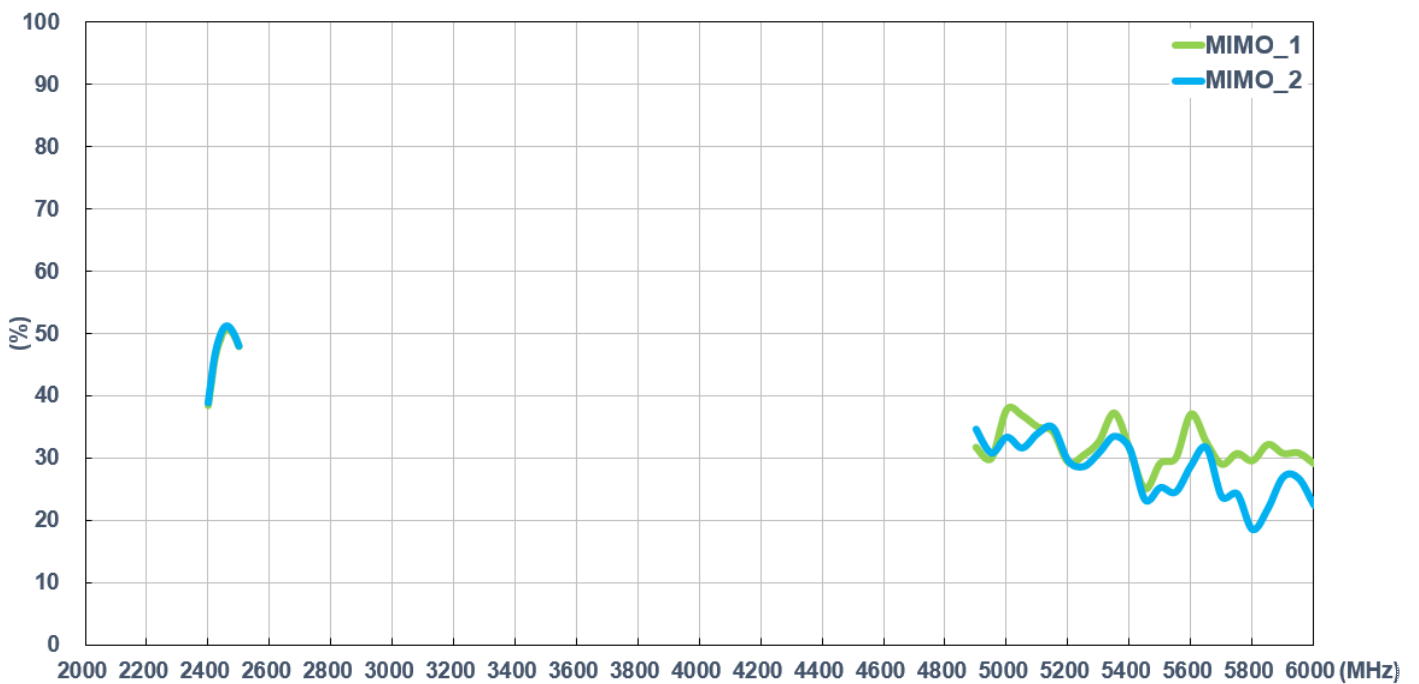
3.3.2 Wi-Fi Envelope Correlation Coefficient

Setup in free space with 3 meter cable length



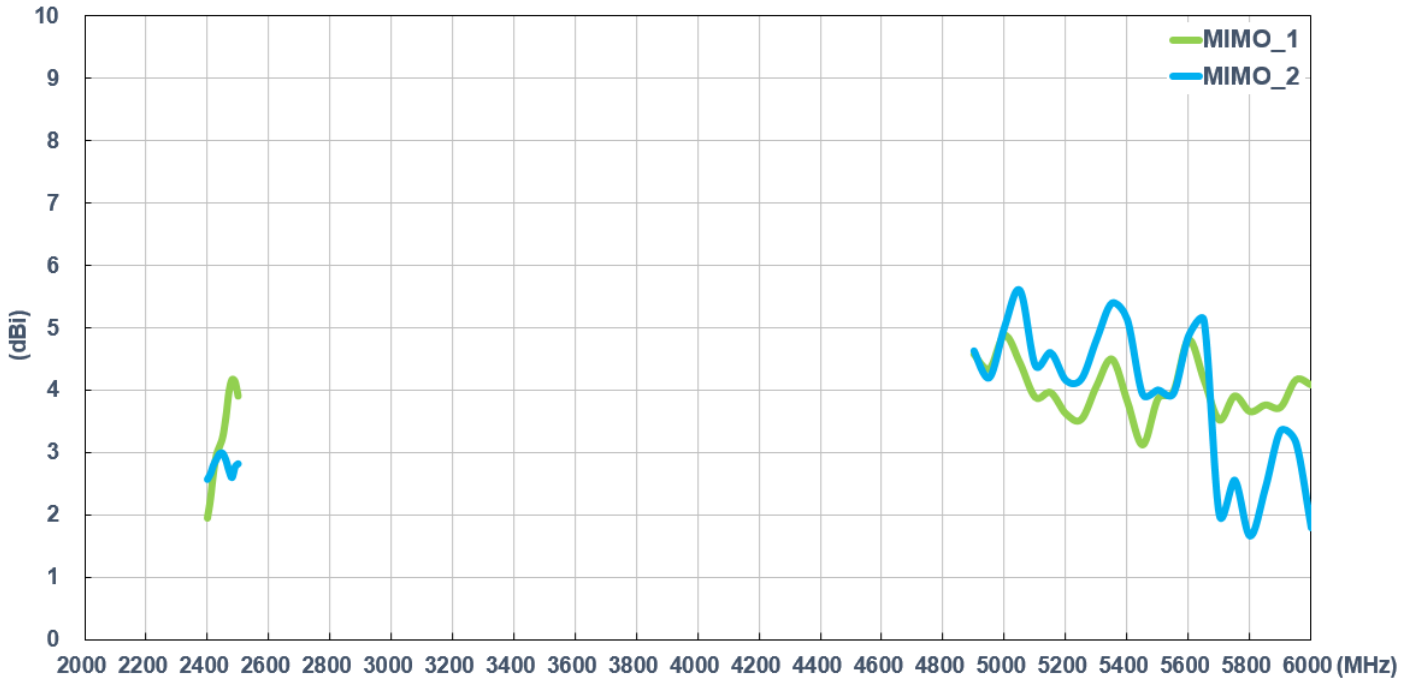
3.3.3 Wi-Fi Antenna Efficiency

Setup in free space with 3 meter cable length



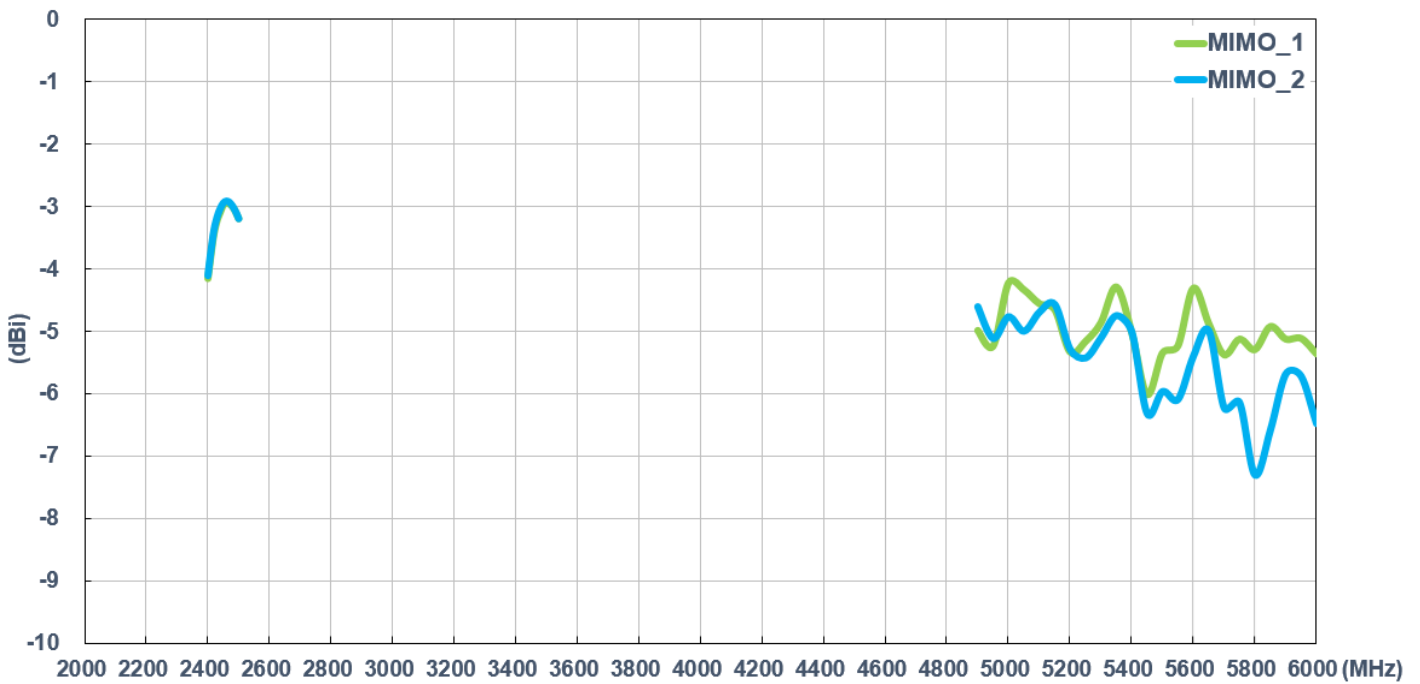
3.3.4 Wi-Fi Antenna Peak Gain

Setup in free space with 3 meter cable length

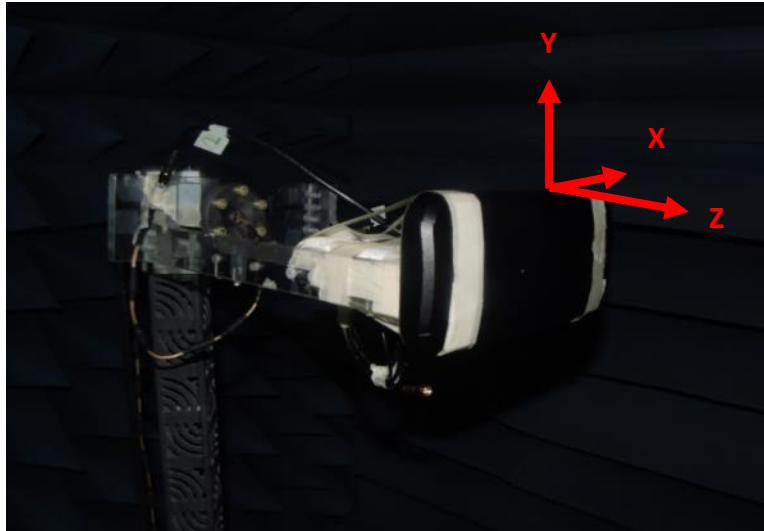


3.3.5 Wi-Fi Antenna Average Gain

Setup in free space with 3 meter cable length



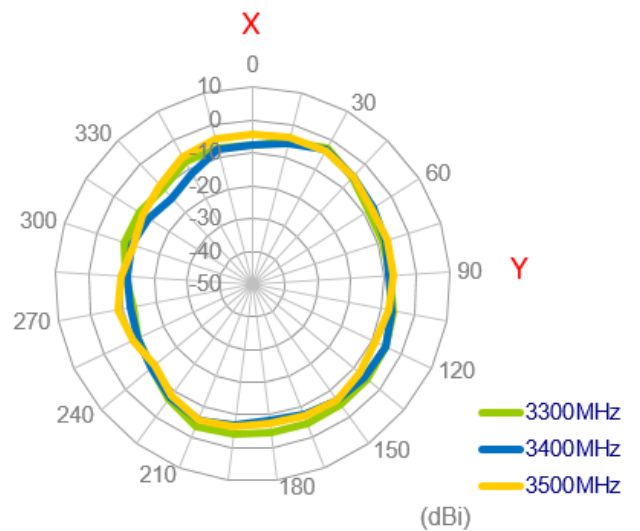
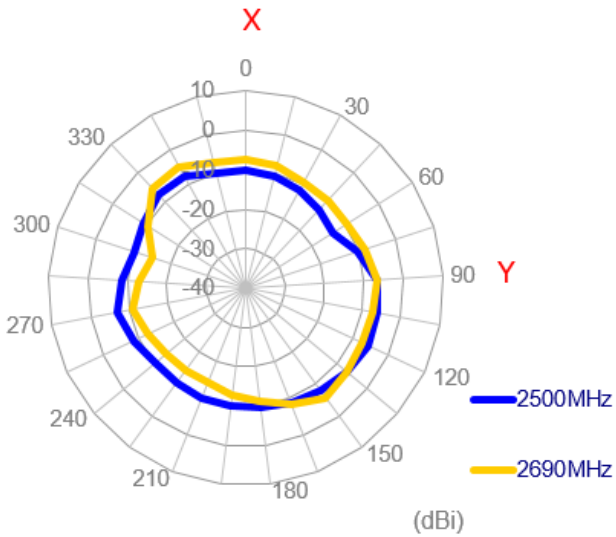
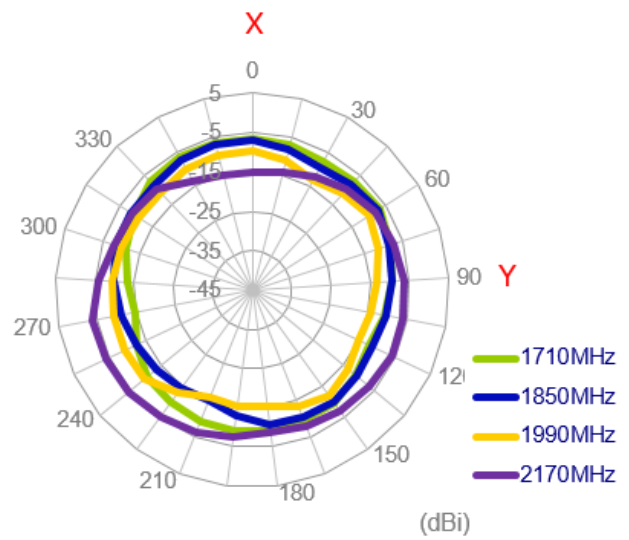
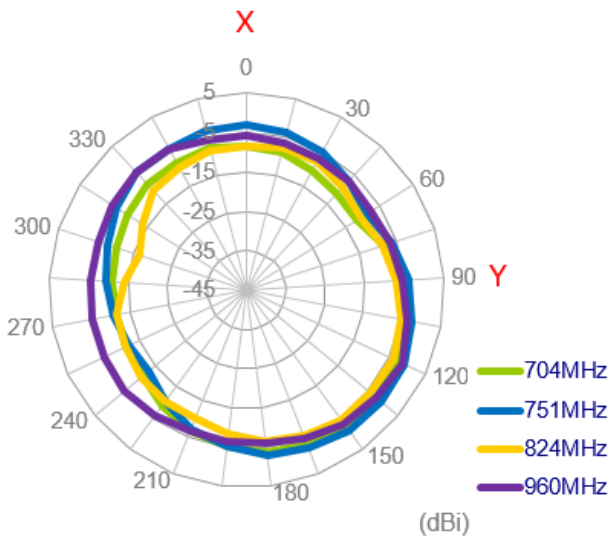
3.3.6 Test Setup for Antenna Radiation Pattern (ETS Anechoic chamber)



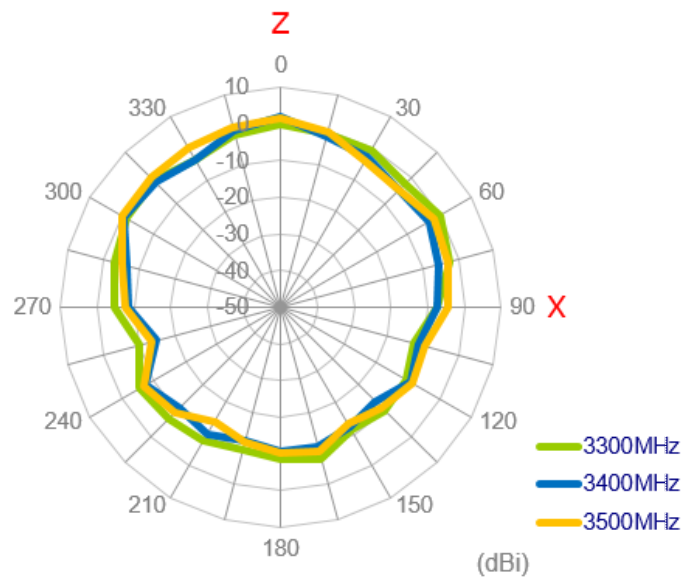
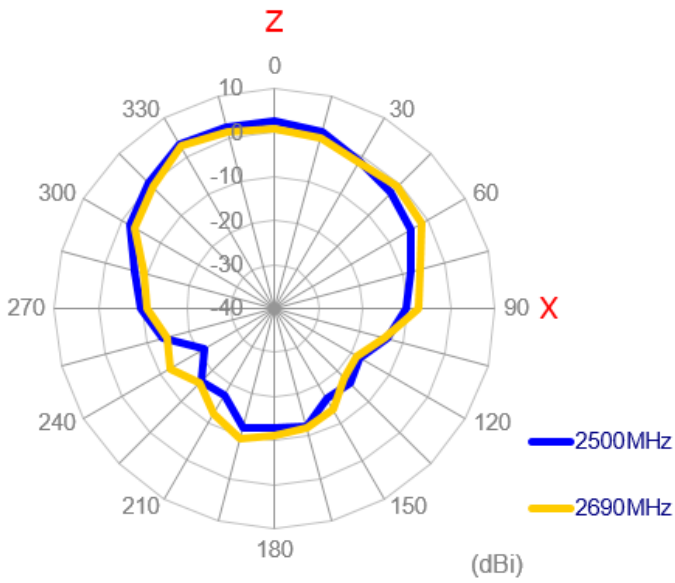
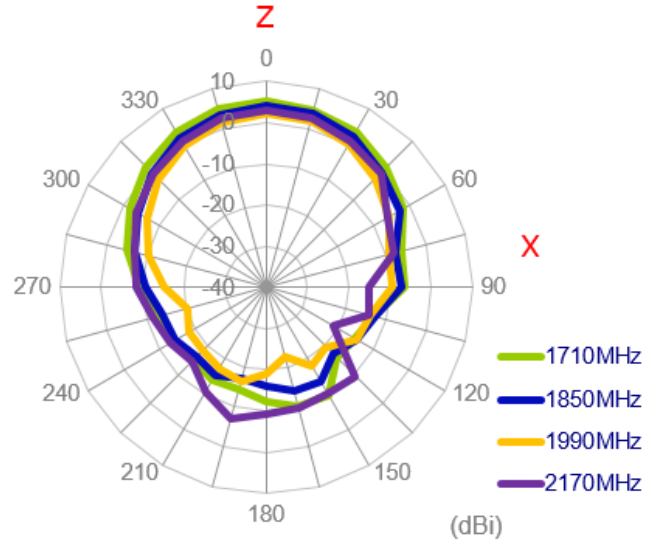
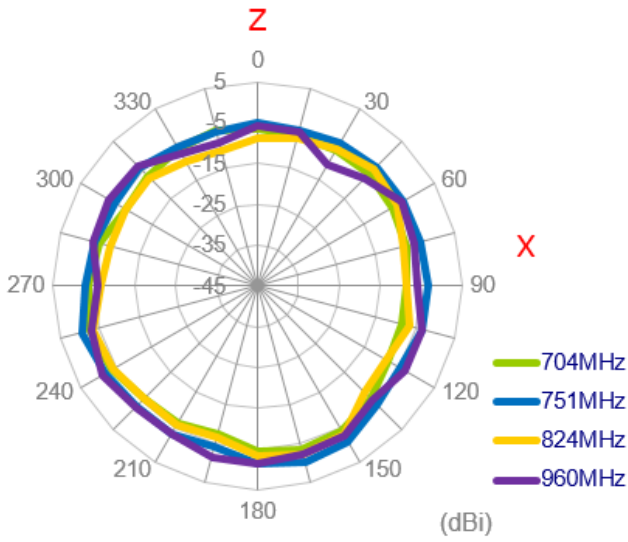
In free space

3.4 2D Radiation Pattern (LTE_MIMO1 with 3M cable length in free space)

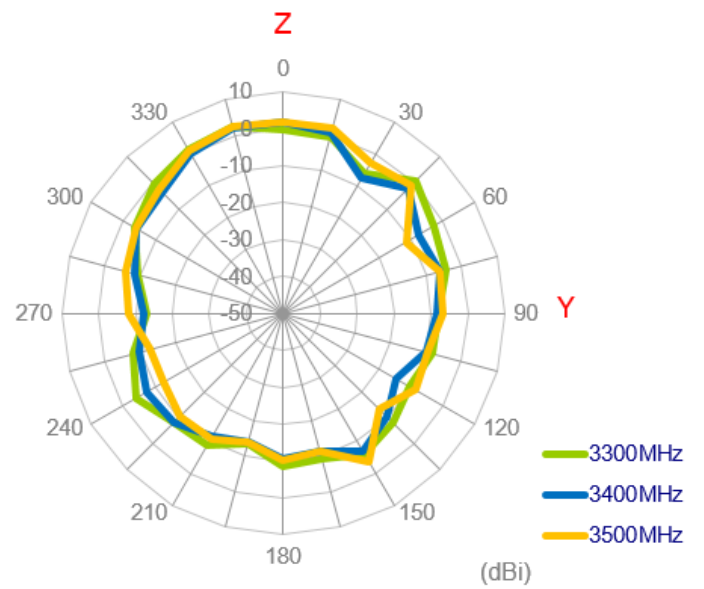
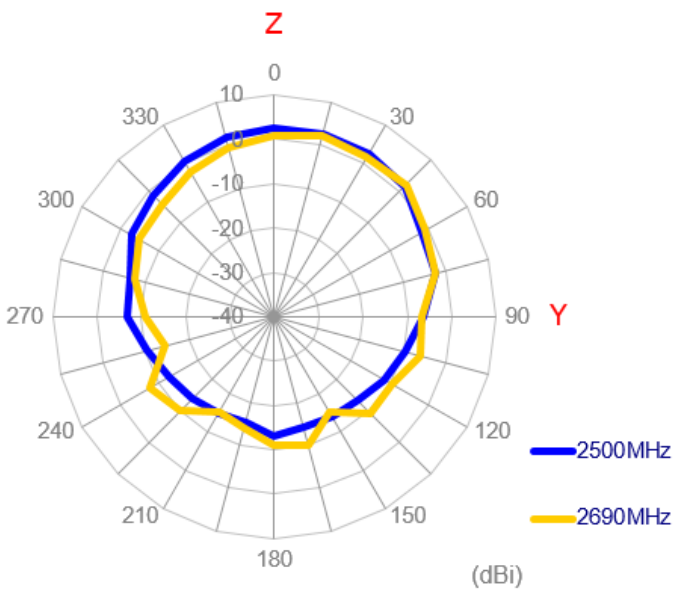
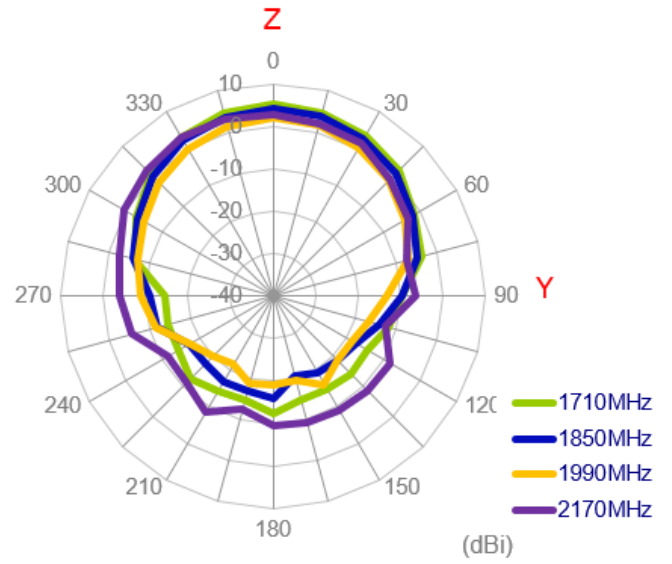
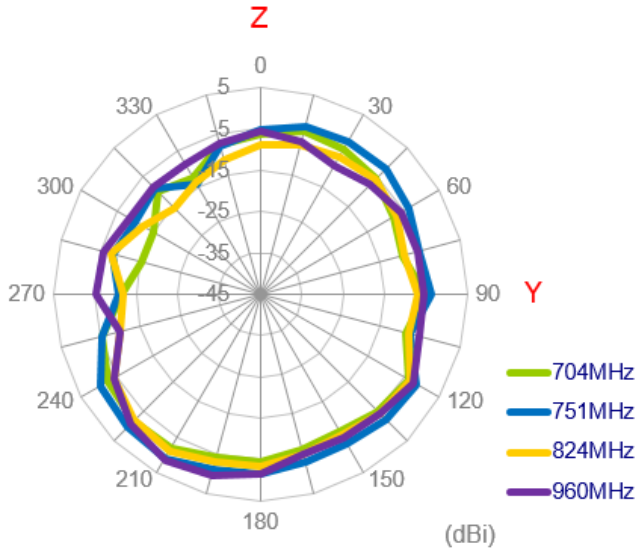
XY Plane



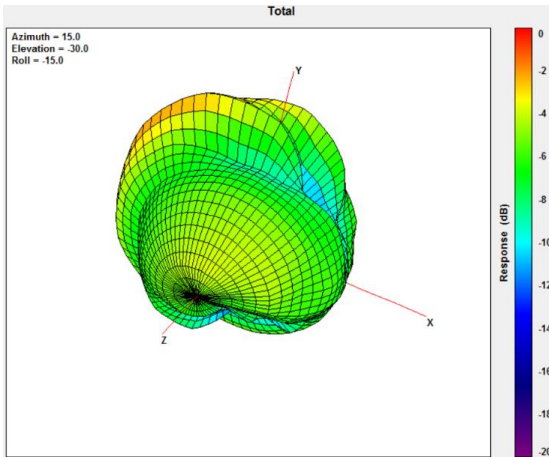
XZ Plane



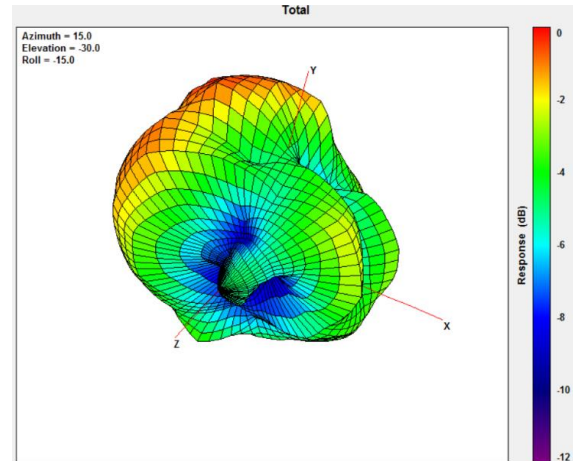
YZ Plane



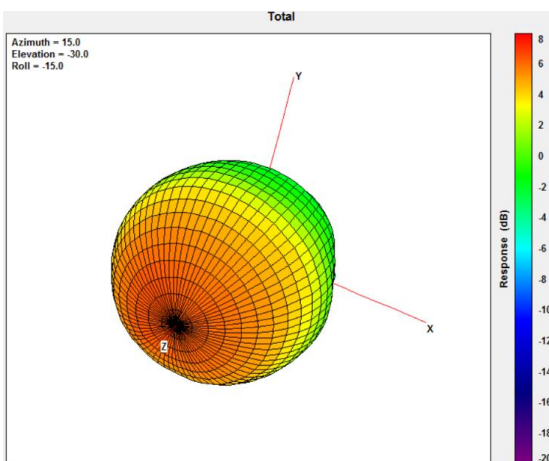
3.4.2 3D Radiation Pattern (LTE_MIMO1 with 3M cable length in free space)



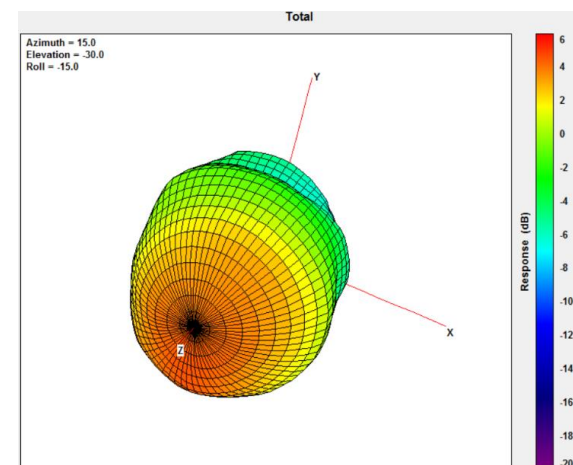
704MHz



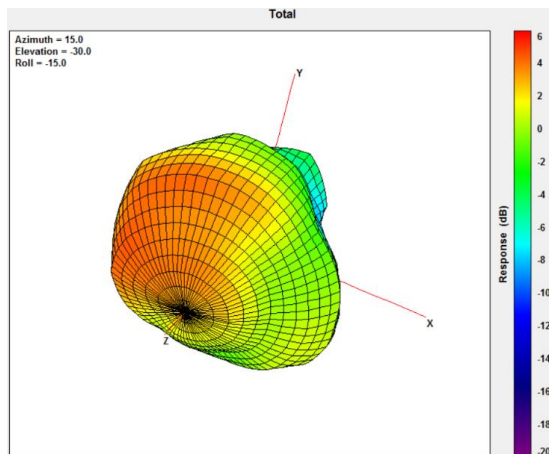
960MHz



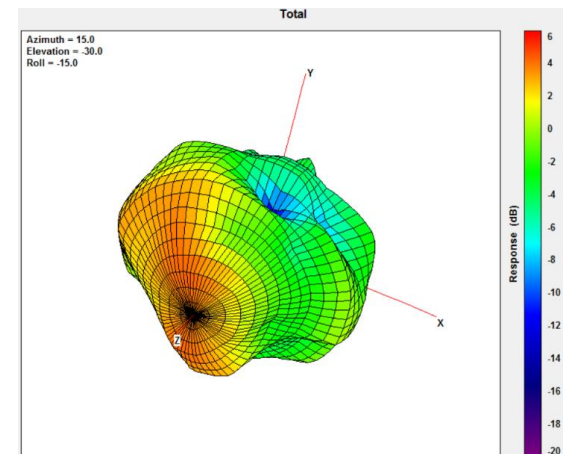
1710MHz



2170MHz



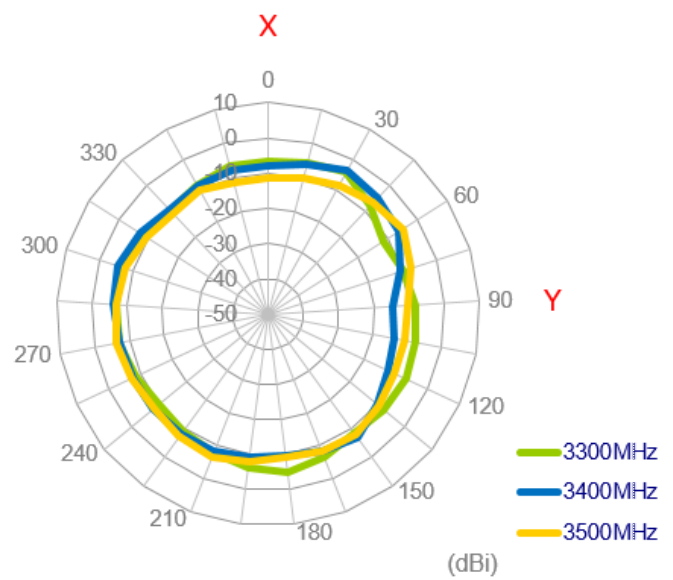
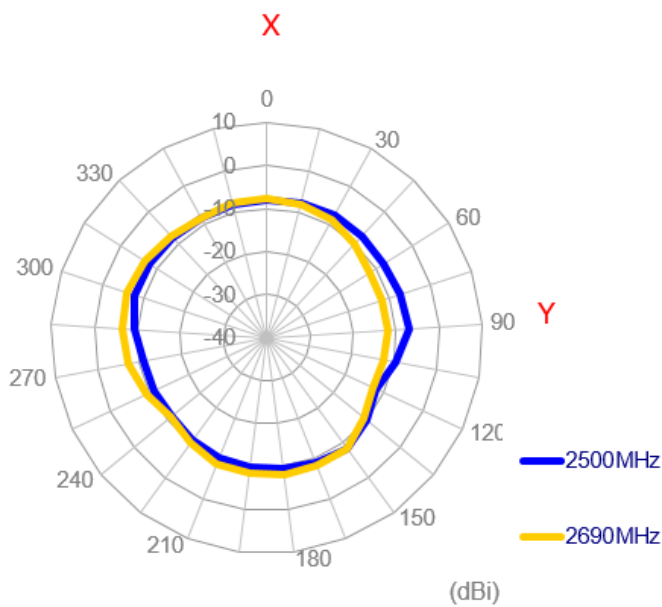
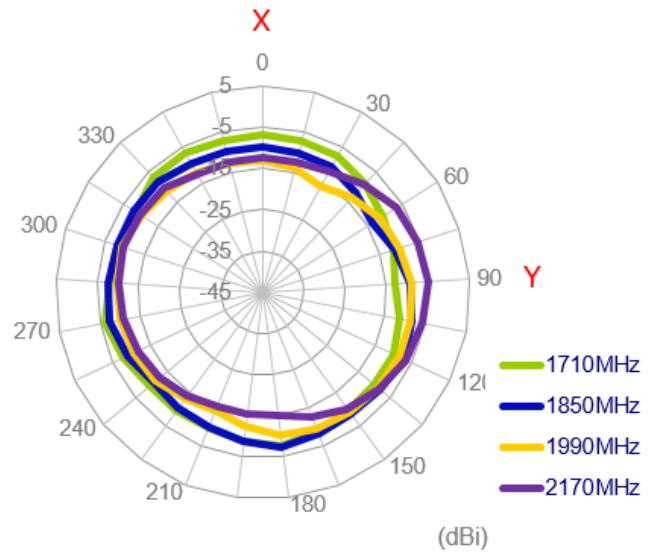
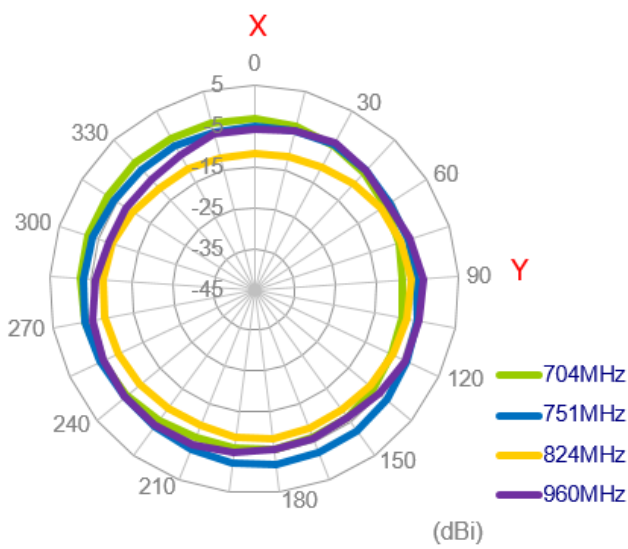
2690MHz



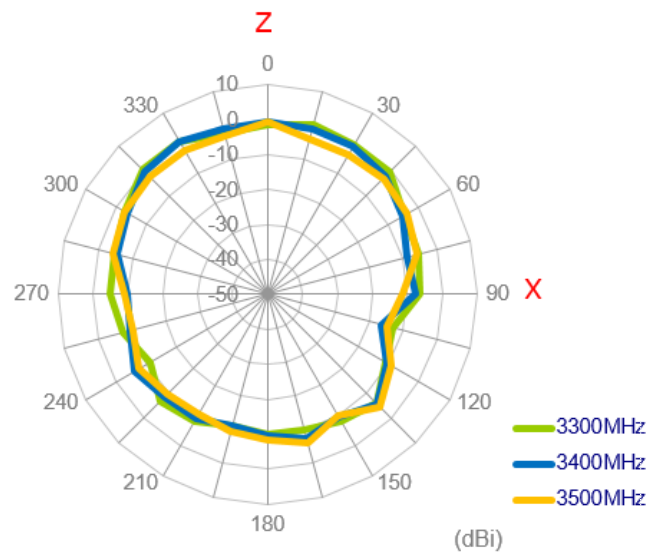
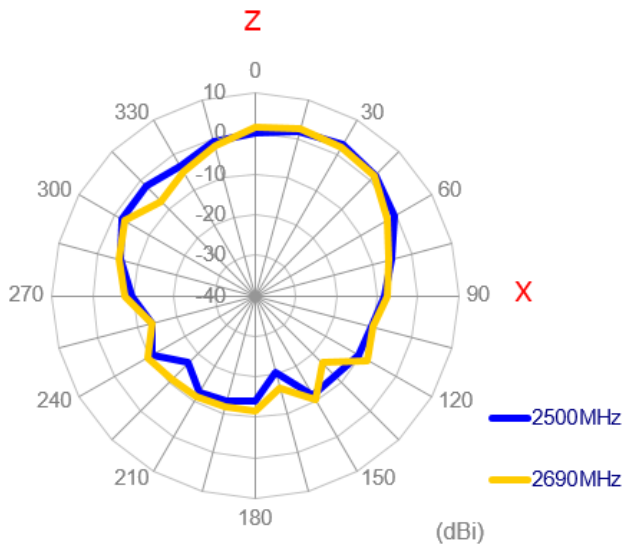
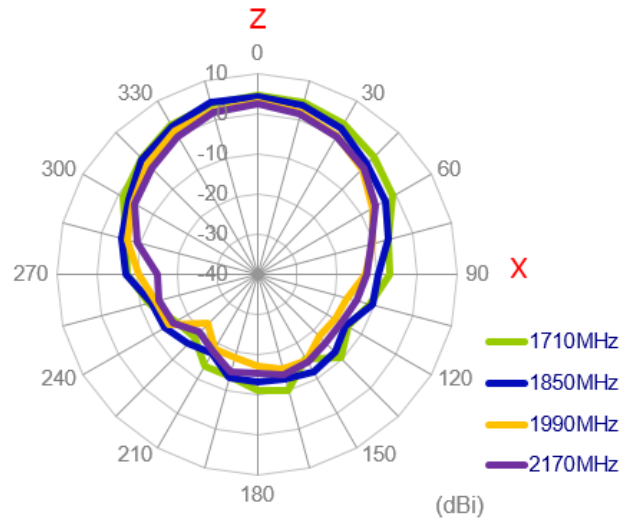
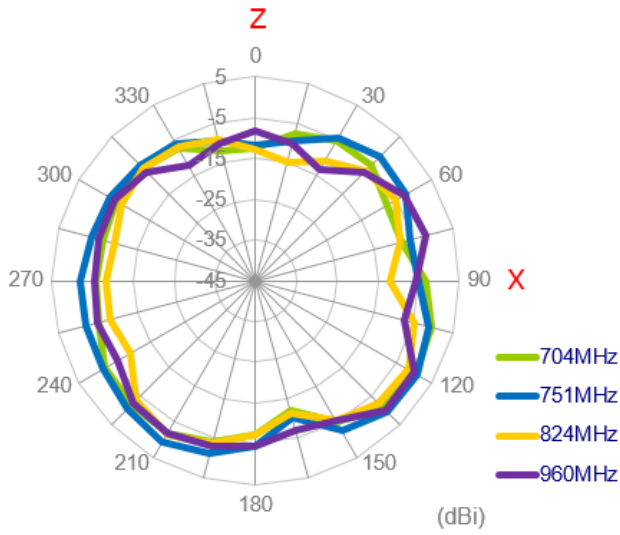
3500MHz

3.4.3 2D Radiation Pattern (LTE_MIMO2 with 3M cable length in free space)

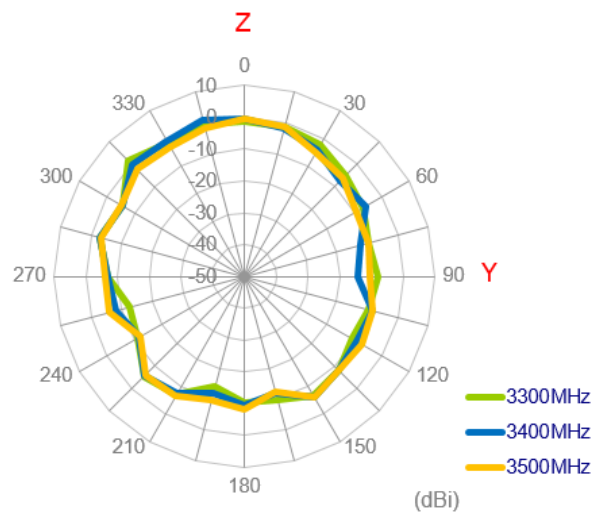
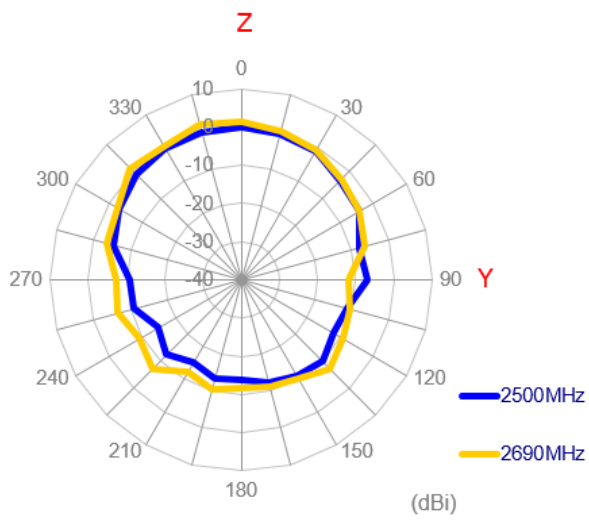
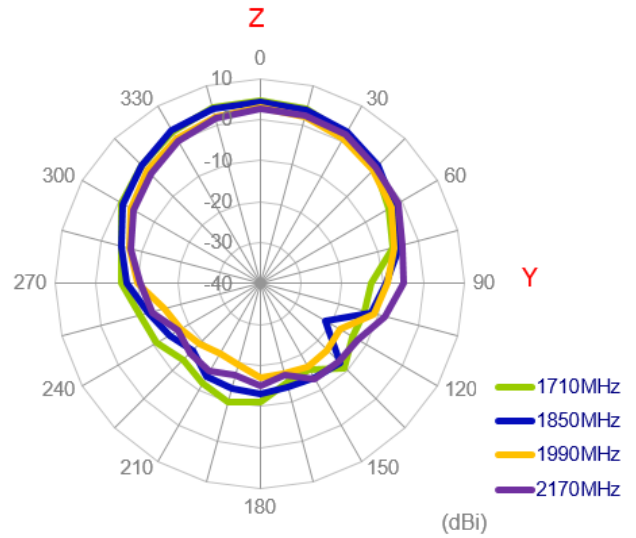
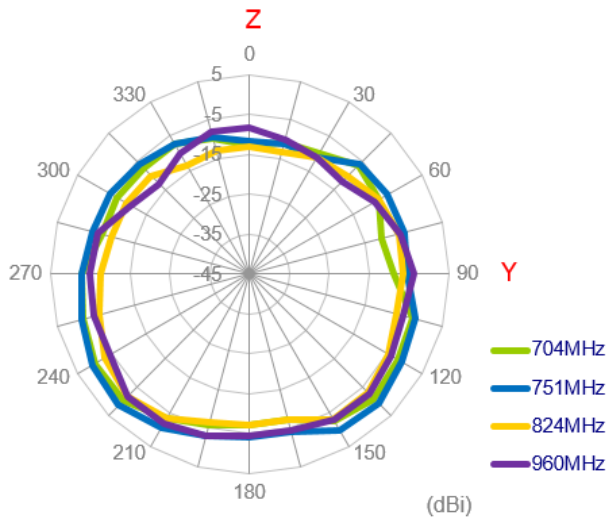
XY Plane



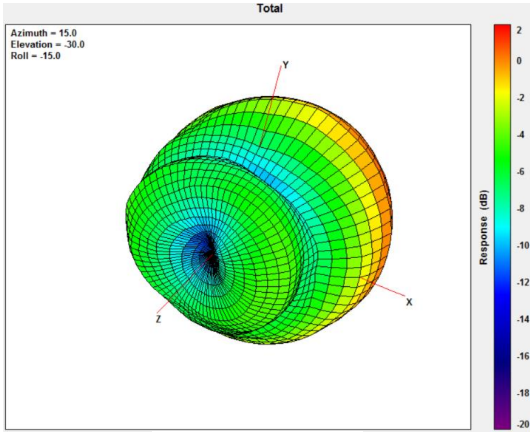
XZ Plane



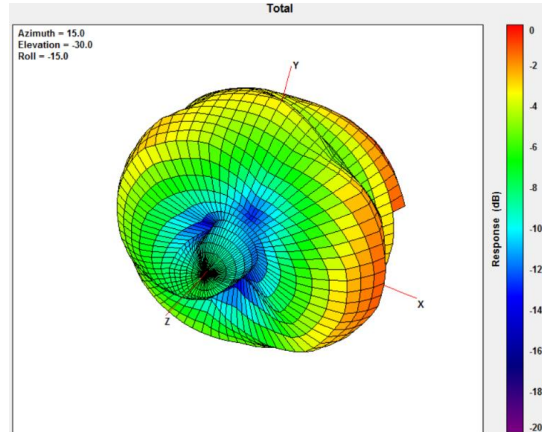
YZ Plane



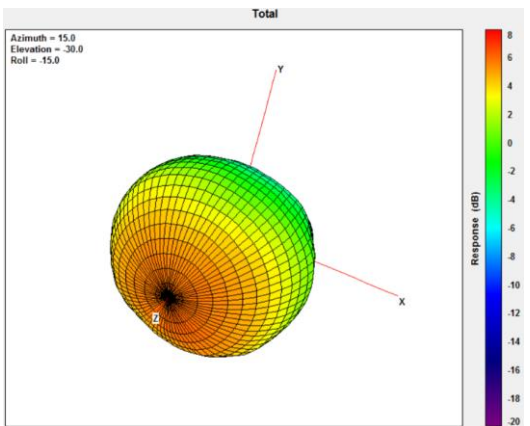
3.4.4 2D Radiation Pattern (LTE_MIMO2 with 3M cable length in free space)



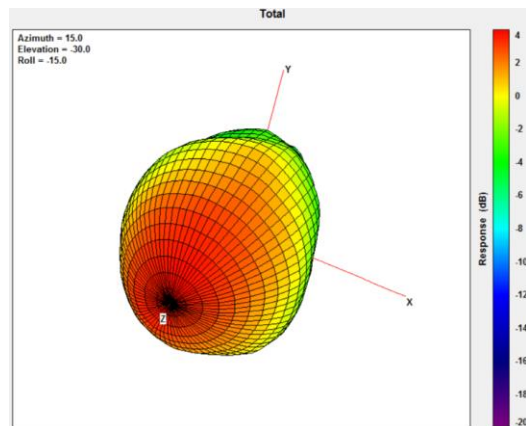
704MHz



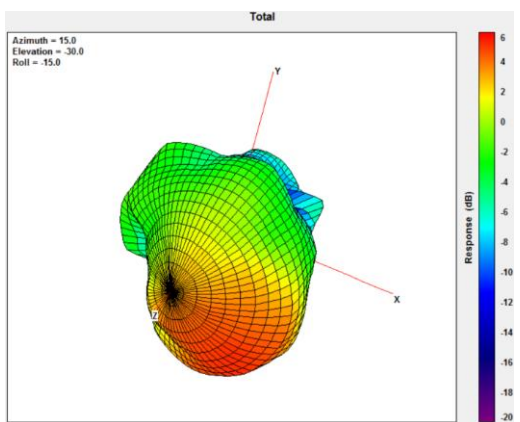
960MHz



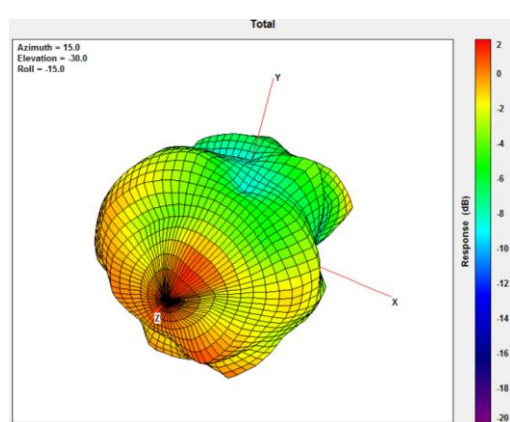
1710MHz



2170MHz



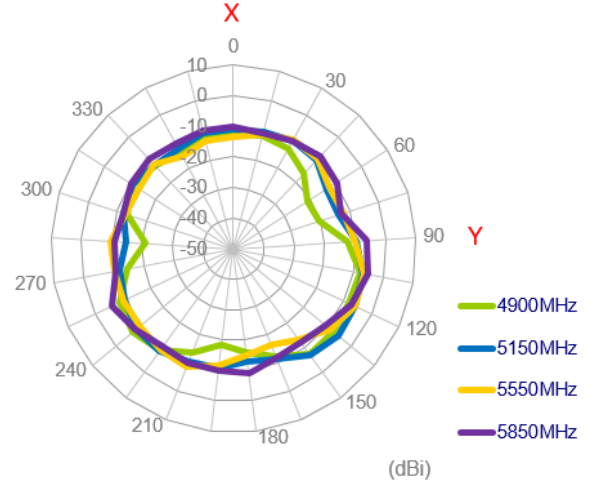
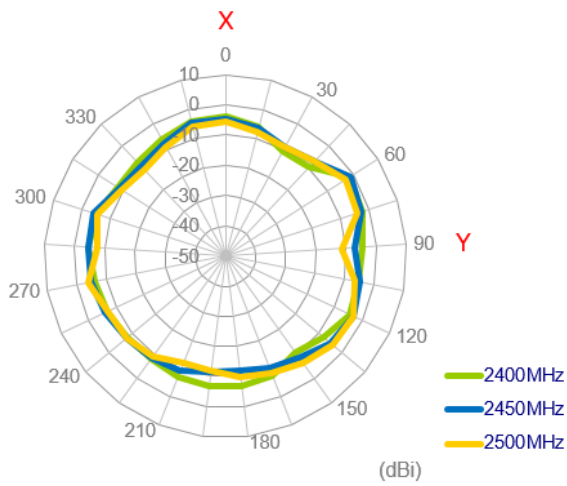
2690MHz



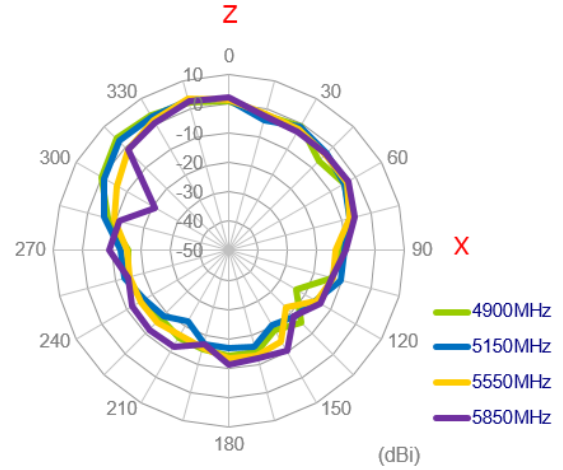
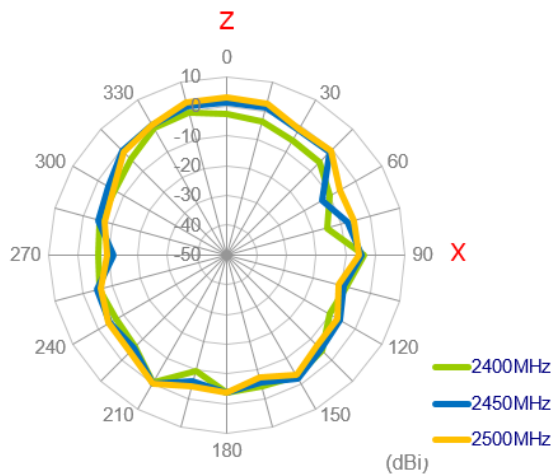
3500MHz

3.4.5 2D Radiation Pattern (Wi-Fi_MIMO1 with 3M cable length in free space)

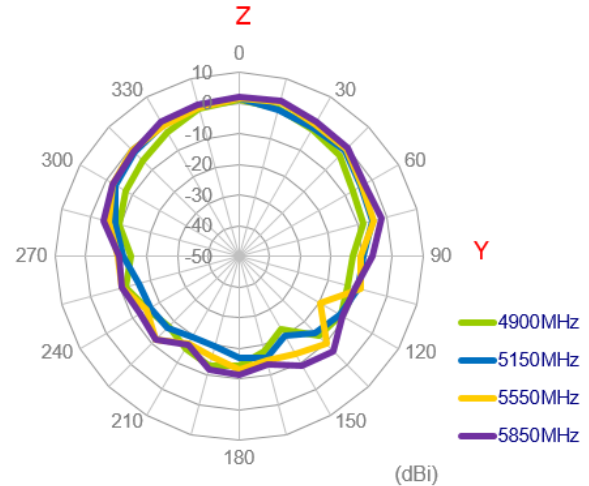
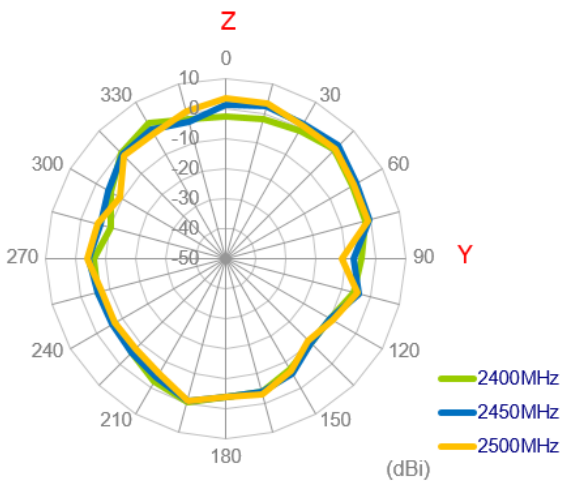
XY Plane



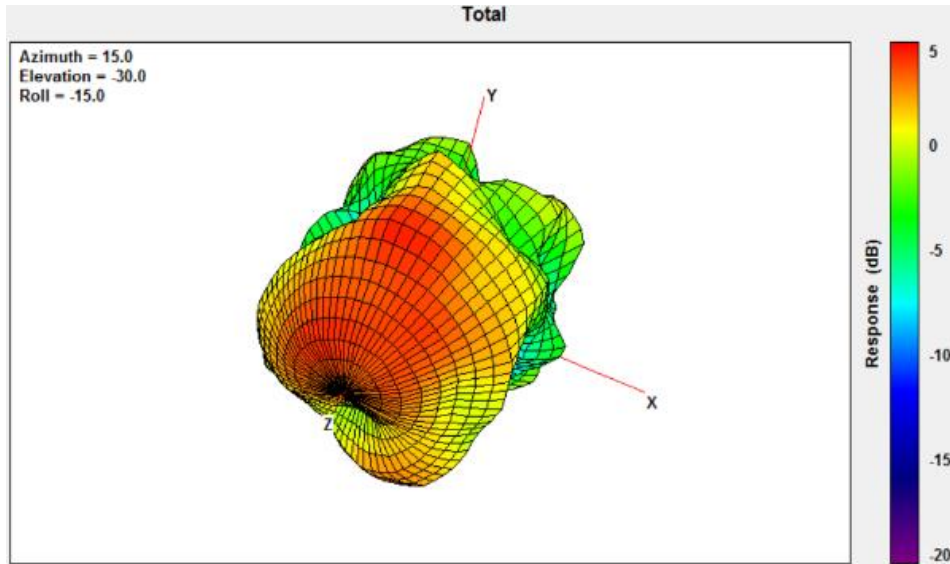
XZ Plane



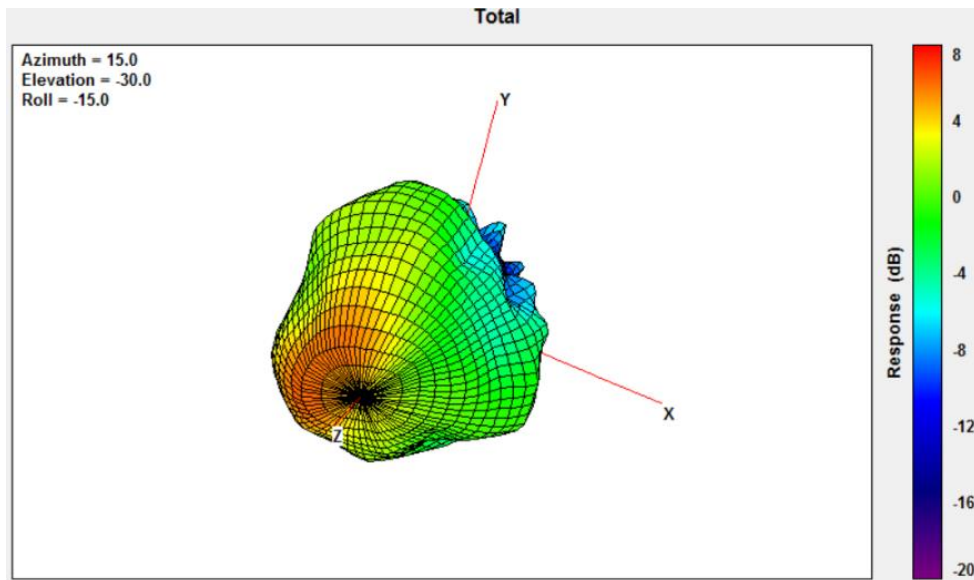
YZ Plane



3.4.6 3D Radiation Pattern (Wi-Fi_MIMO1 with 3M cable length in free space)



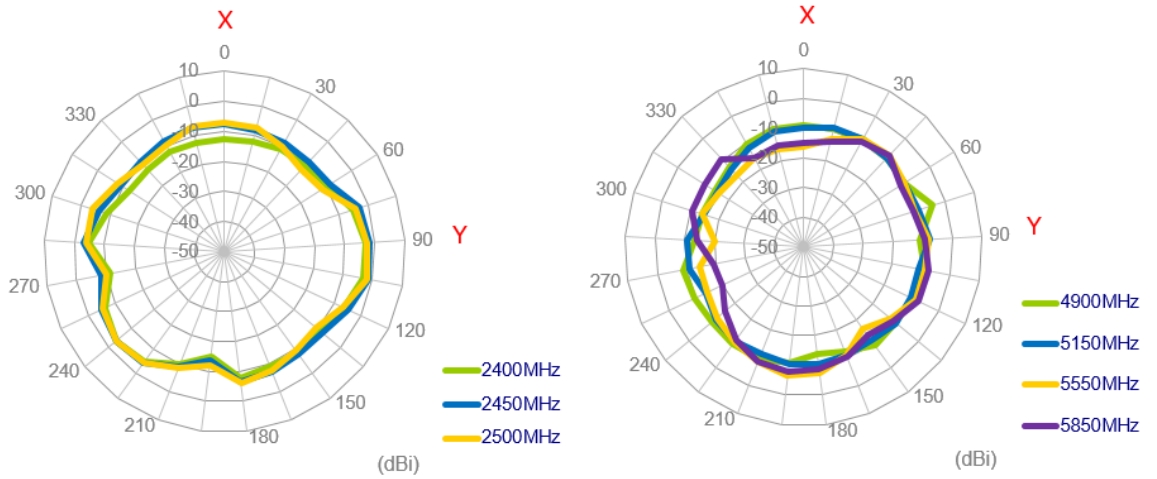
2450MHz



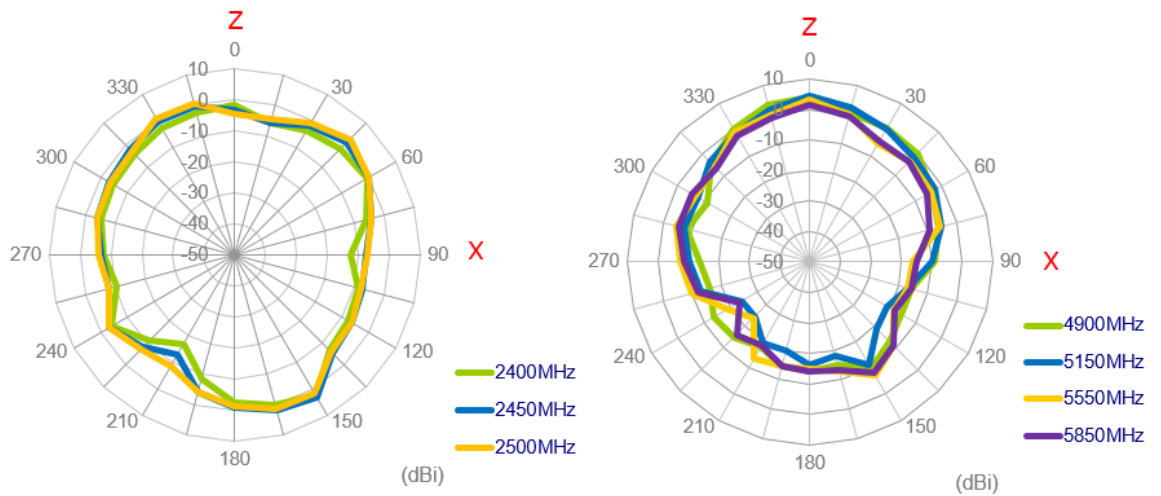
5550MHz

3.4.7 2D Radiation Pattern (Wi-Fi_MIMO2 with 3M cable length in free space)

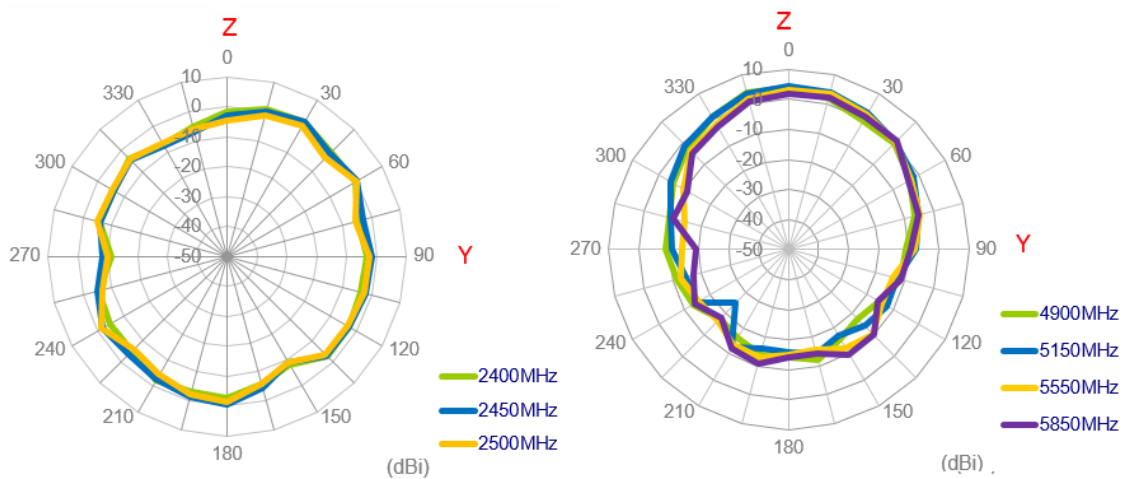
XY Plane



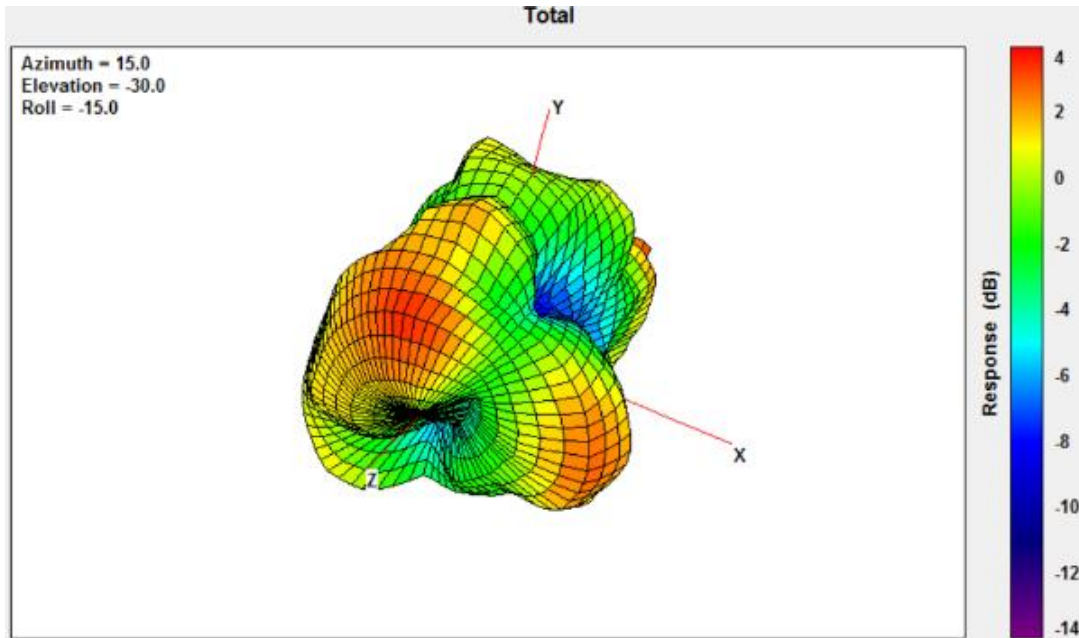
XZ Plane



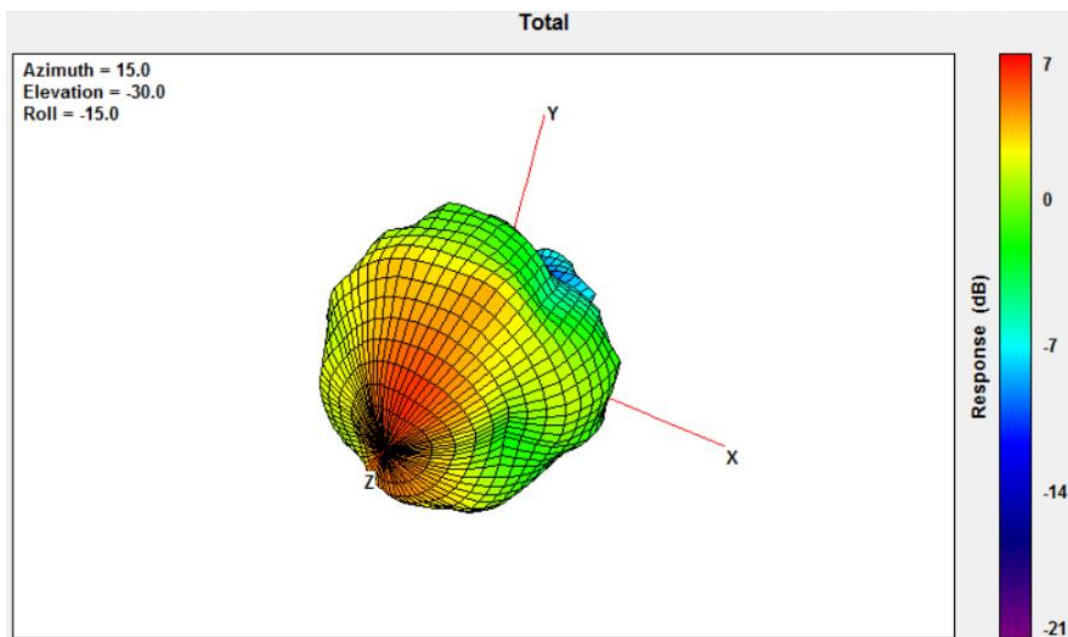
YZ Plane



3.4.8 2D Radiation Pattern (Wi-Fi_MIMO2 with 3M cable length in free space)

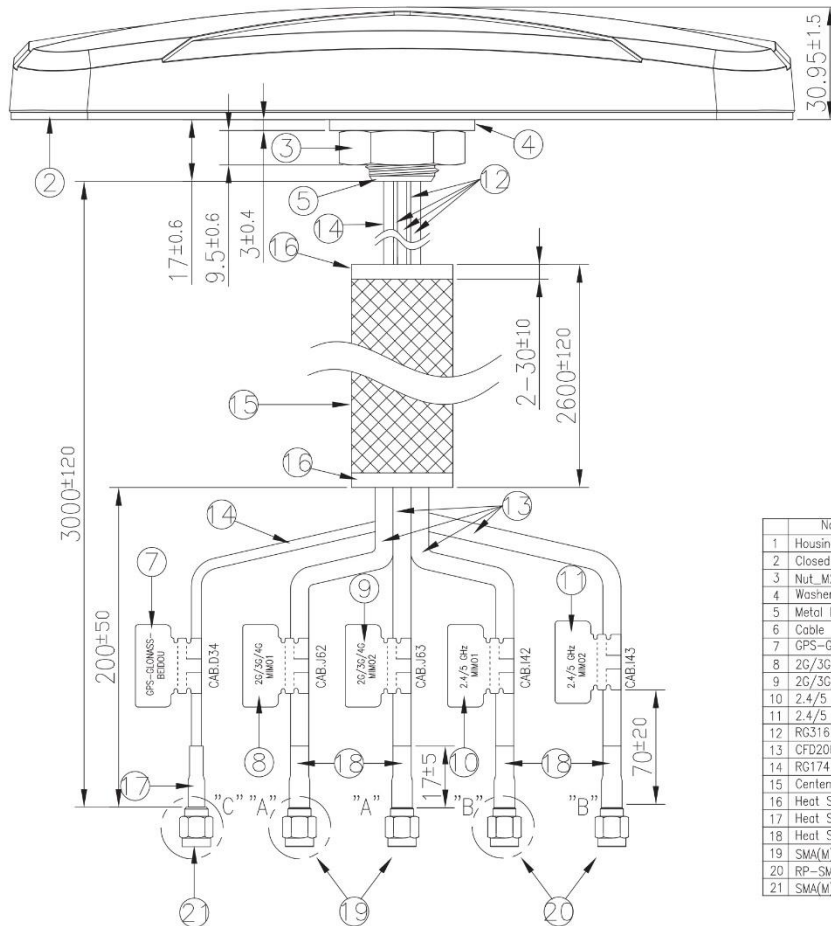
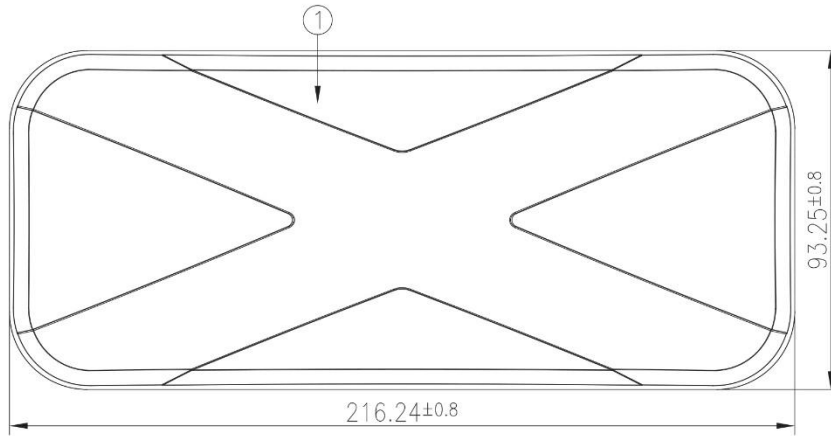


2450MHz

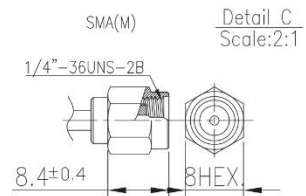
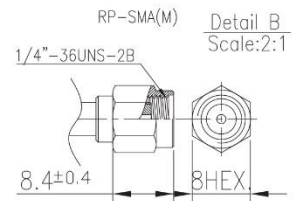
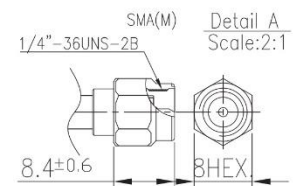
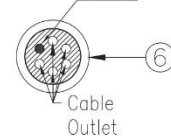


5550MHz

4. Mechanical Drawing (Unit: mm)

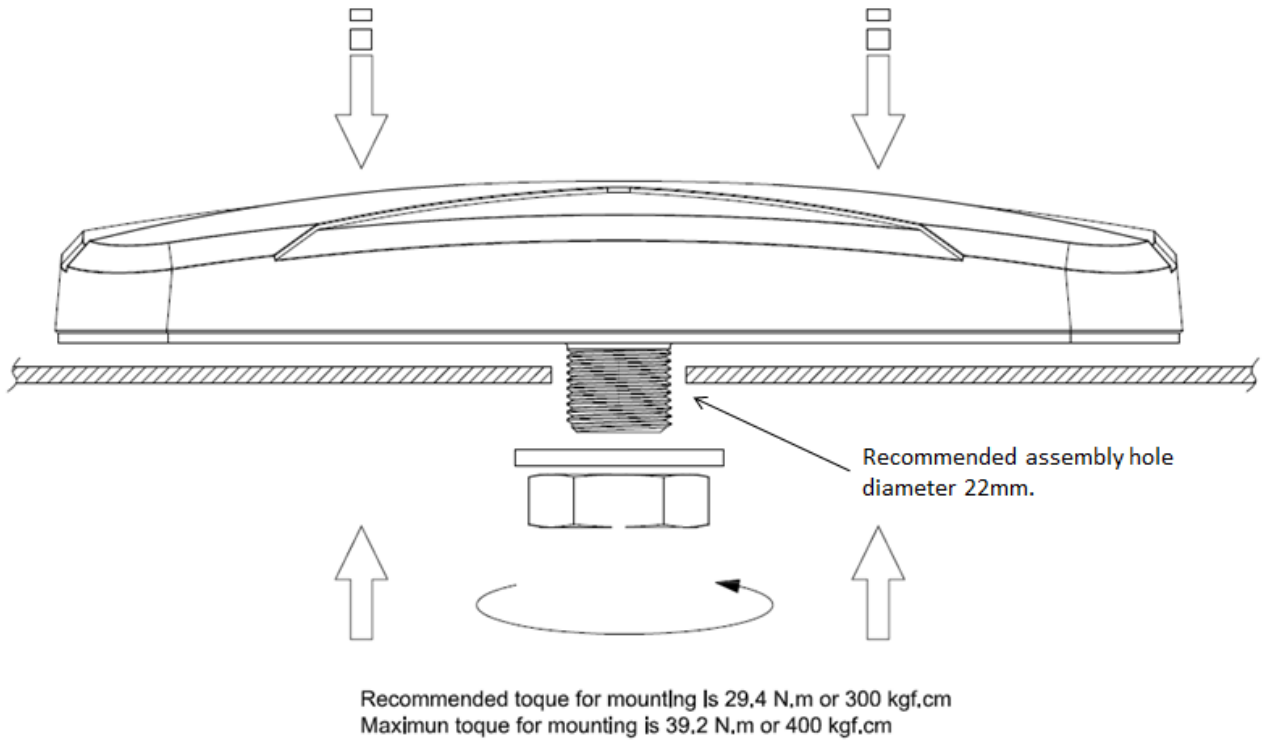


Bottom Thread View



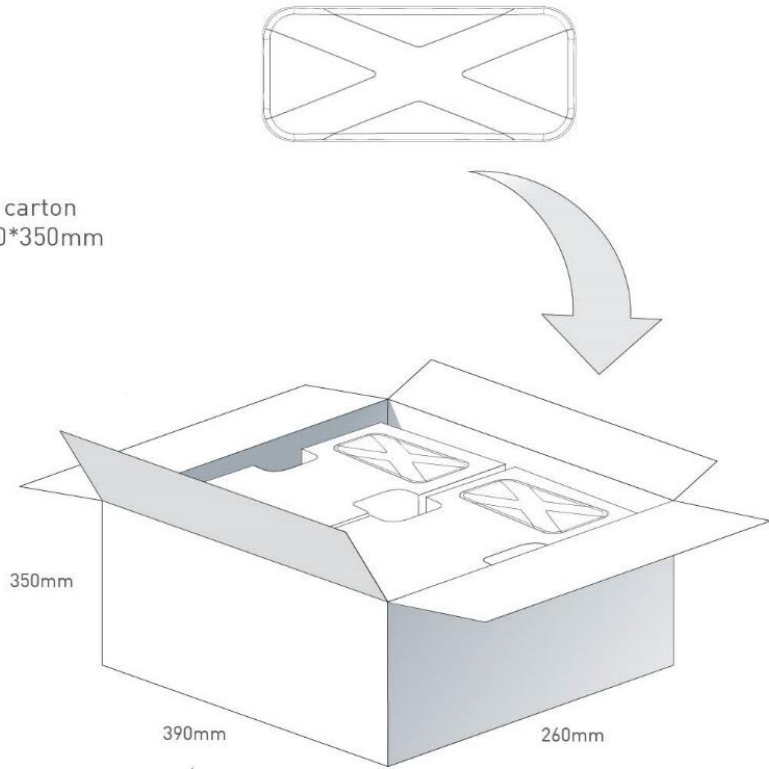
Name	Material	Finish	QTY
1 Housing	ABS+PC	Black	1
2 Closed Cell Foam and Adhesive Tape	3M 9448+CR-4305	Black	1
3 Nut_M20x1.5Px10H Cut	Steel	Ni Plated	1
4 Washer_Cut	Steel	Ni Plated	1
5 Metal Base	AL	Ni Plated	1
6 Cable Rubber	Silicone Rubber	Black	1
7 GPS-GLONASS-BEIDOU Label	Coated Paper	Orange	1
8 2G/3G/4G MIMO1 Label	Coated Paper	Light Gray	1
9 2G/3G/4G MIMO2 Label	Coated Paper	White	1
10 2.4/5 GHz MIMO1 Label	Coated Paper	Dark Green	1
11 2.4/5 GHz MIMO2 Label	Coated Paper	Green Yellow	1
12 RG316 Coaxial Cable	FEP	Brown	4
13 CFD200 Coaxial Cable	PVC	Black	4
14 RG174 Coaxial Cable	PVC	Black	2
15 Centenary Braid	BSPET	Black	1
16 Heat Shrink Tube	PE With Glue	Black	2
17 Heat Shrink Tube	PE	Black	1
18 Heat Shrink Tube	PE	Black	4
19 SMA(M)ST	Brass	Au Plated	2
20 RP-SMA(M)ST	Brass	Au Plated	2
21 SMA(M)ST	Brass	Au Plated	1

5. Installation

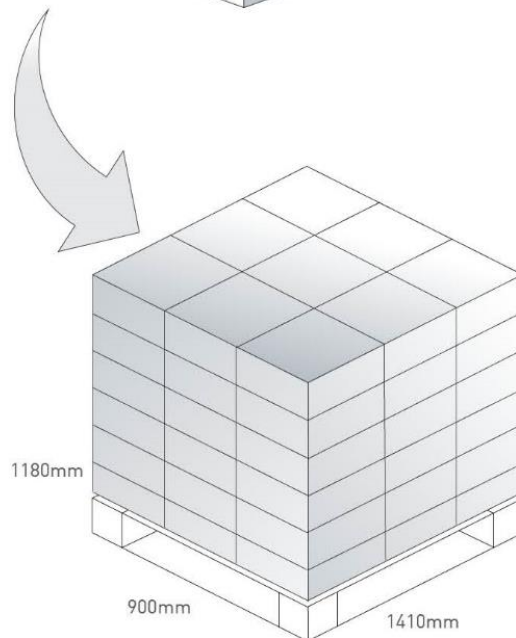


6. Packaging

2 pc MA450.K.LBICG.004 per carton
 Carton Dimensions - 390*260*350mm
 Total Weight - 1.42Kg



Pallet Dimensions 1180*900*1410mm
 54 Cartons per pallet
 9 Cartons per layer
 6 Layers

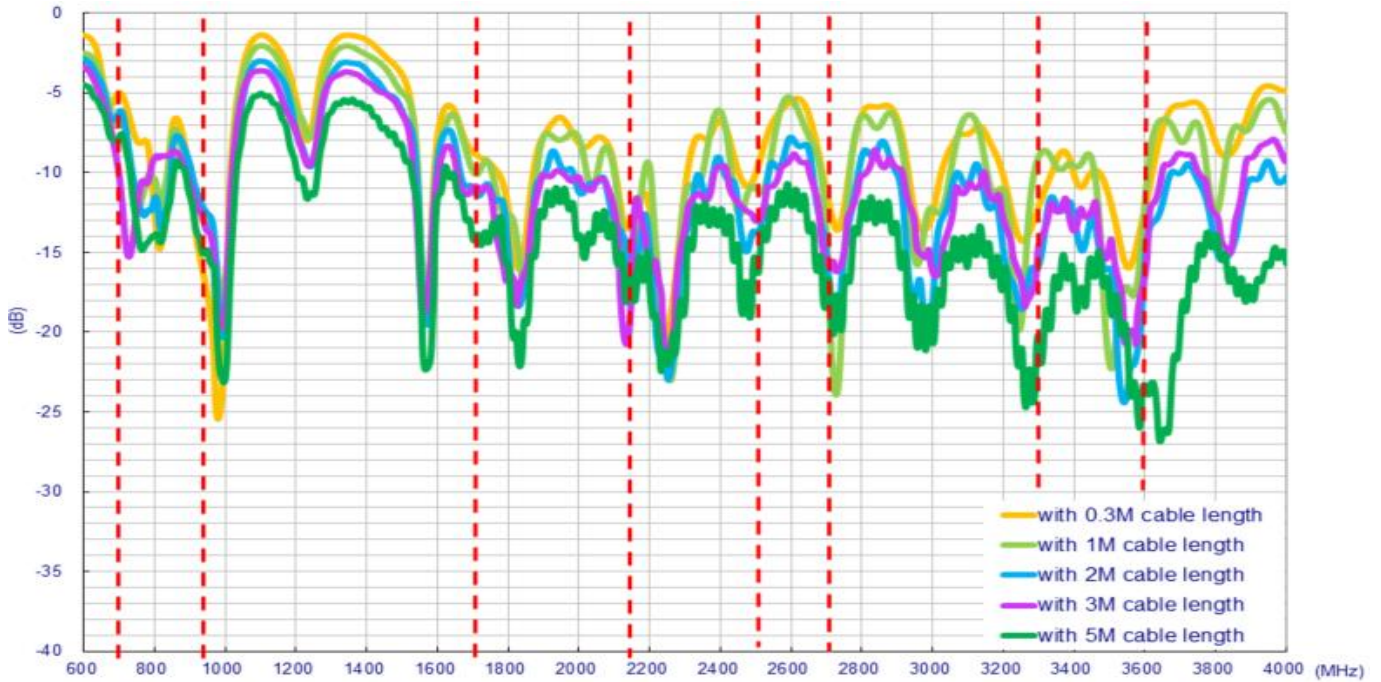


7. Application Note

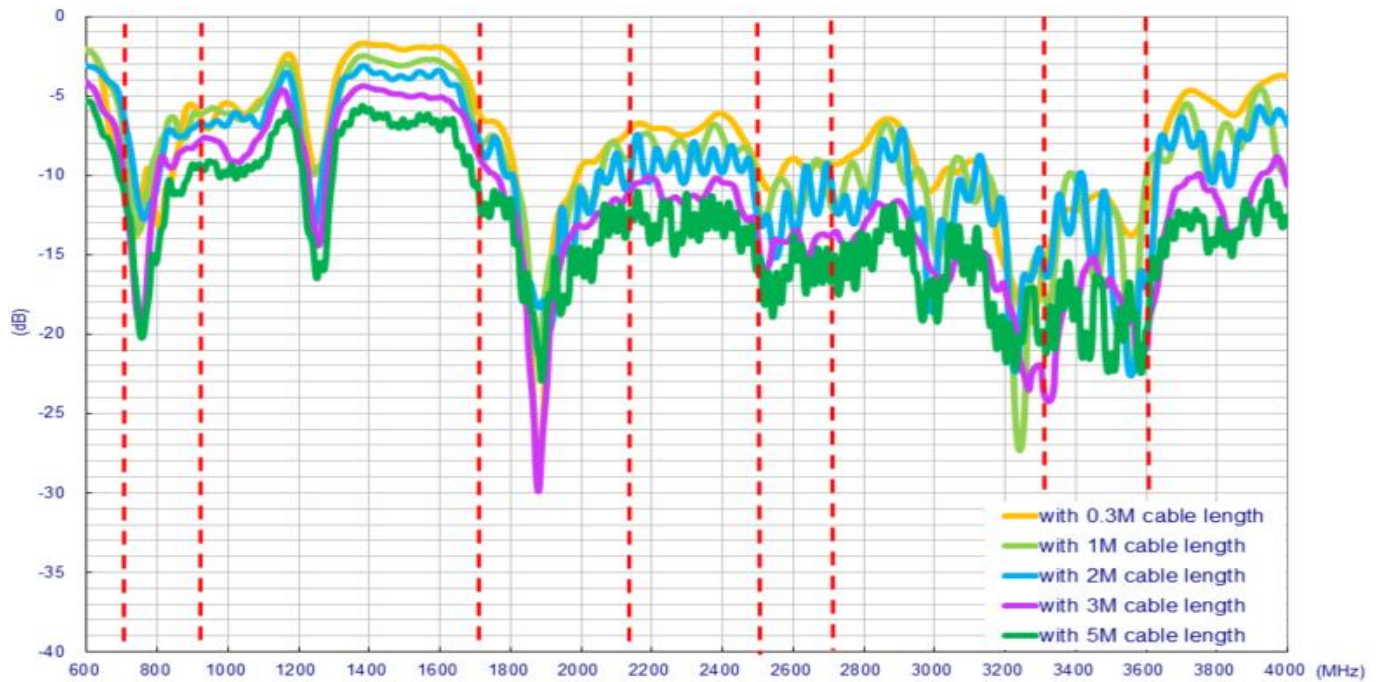
The MA450 antenna performance with different cable lengths is shown below.

7.1 In free space (LTE MIMO Antenna)

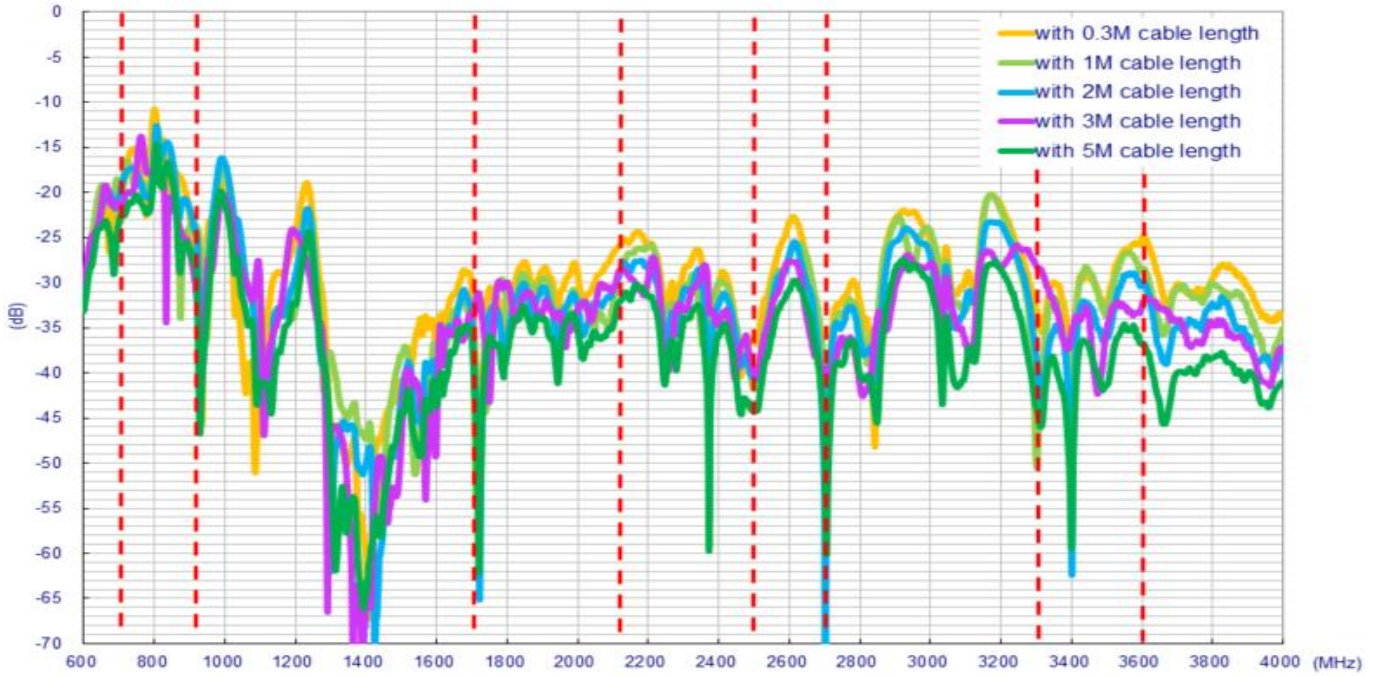
7.1.1 Return Loss (LTE MIMO_1)



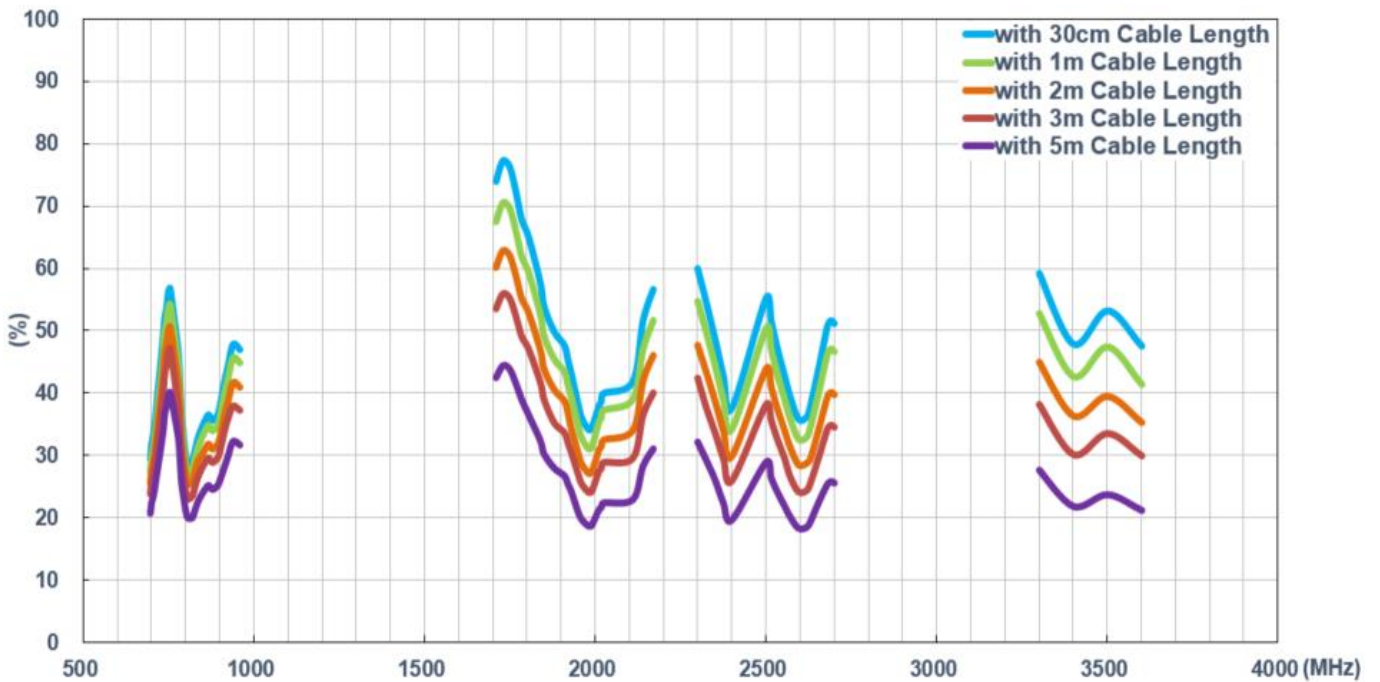
7.1.2 Return Loss (LTE MIMO_2)



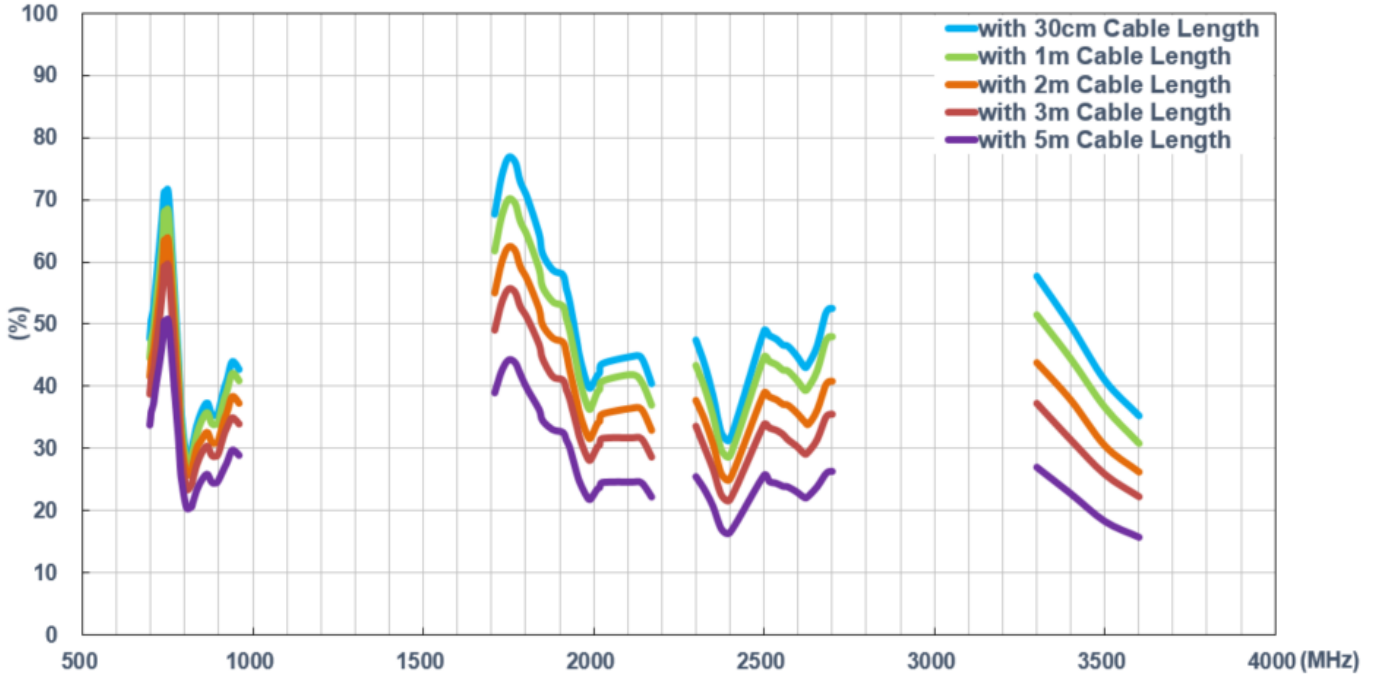
7.1.3 Insertion Loss



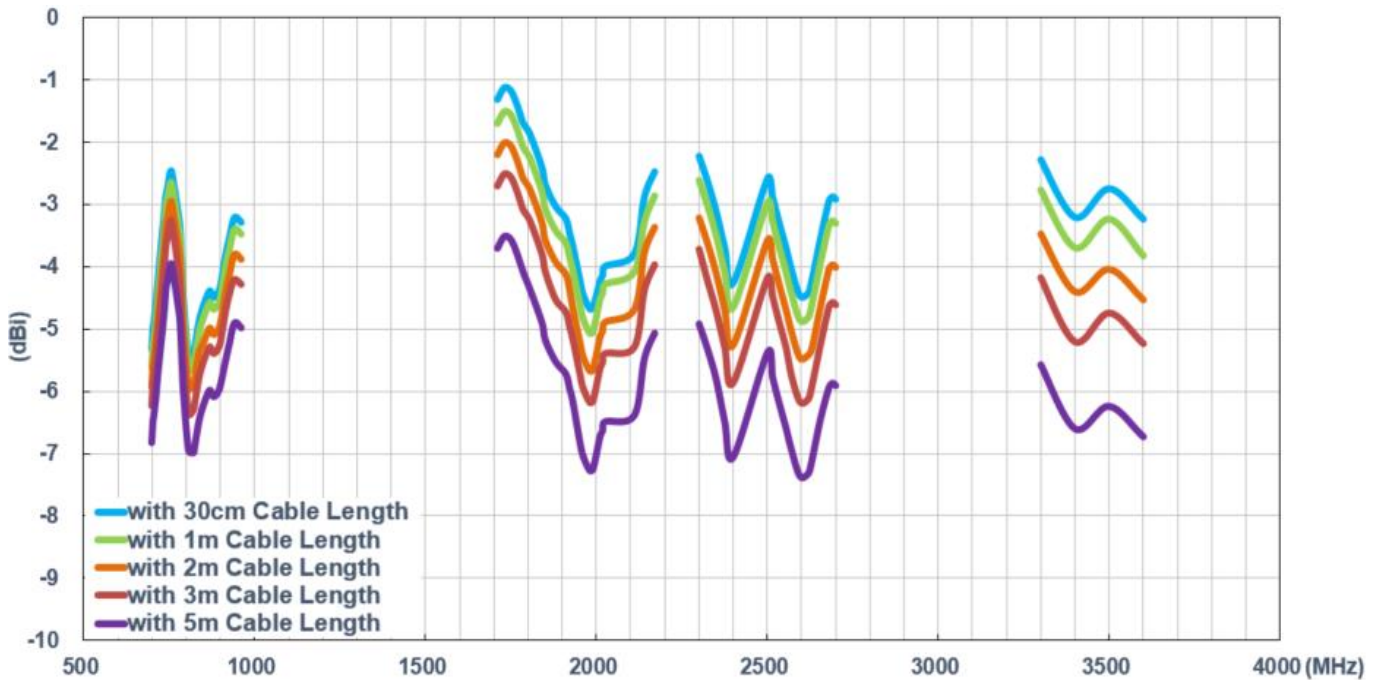
7.1.4 Efficiency (LTE MIMO_1)



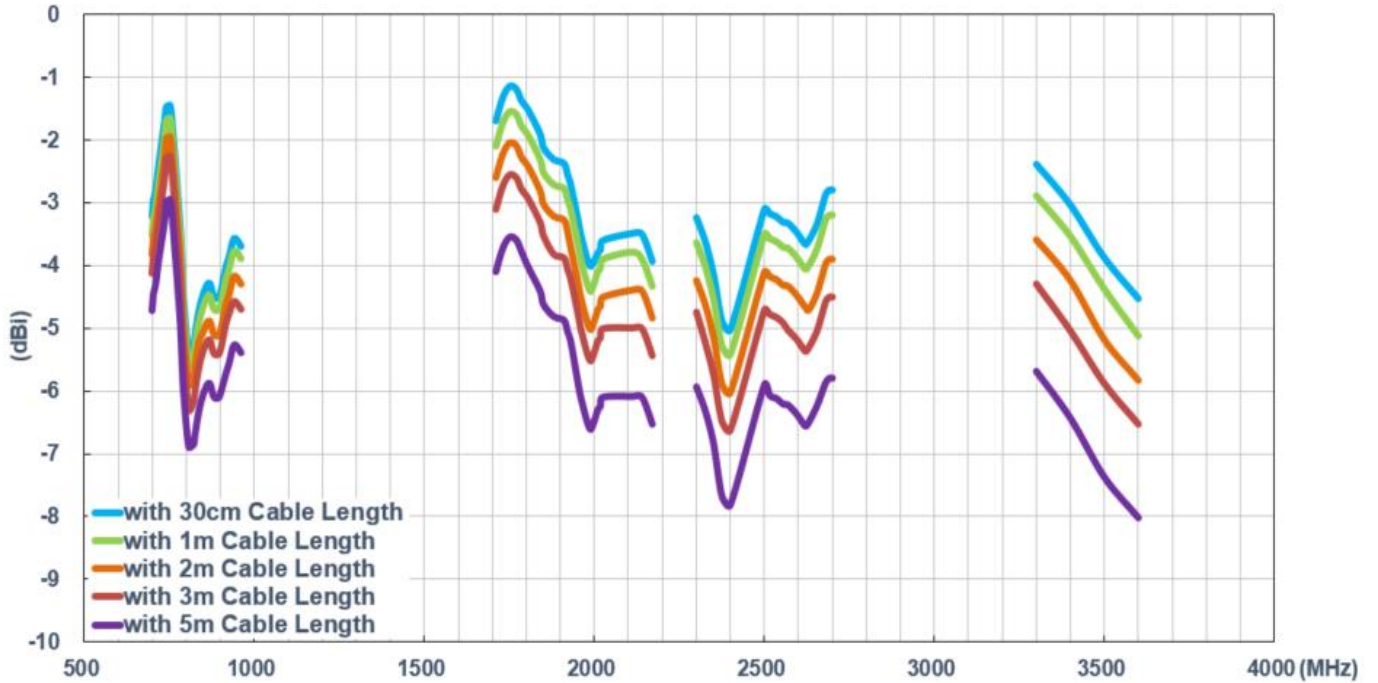
7.1.5 Efficiency (LTE MIMO_2)



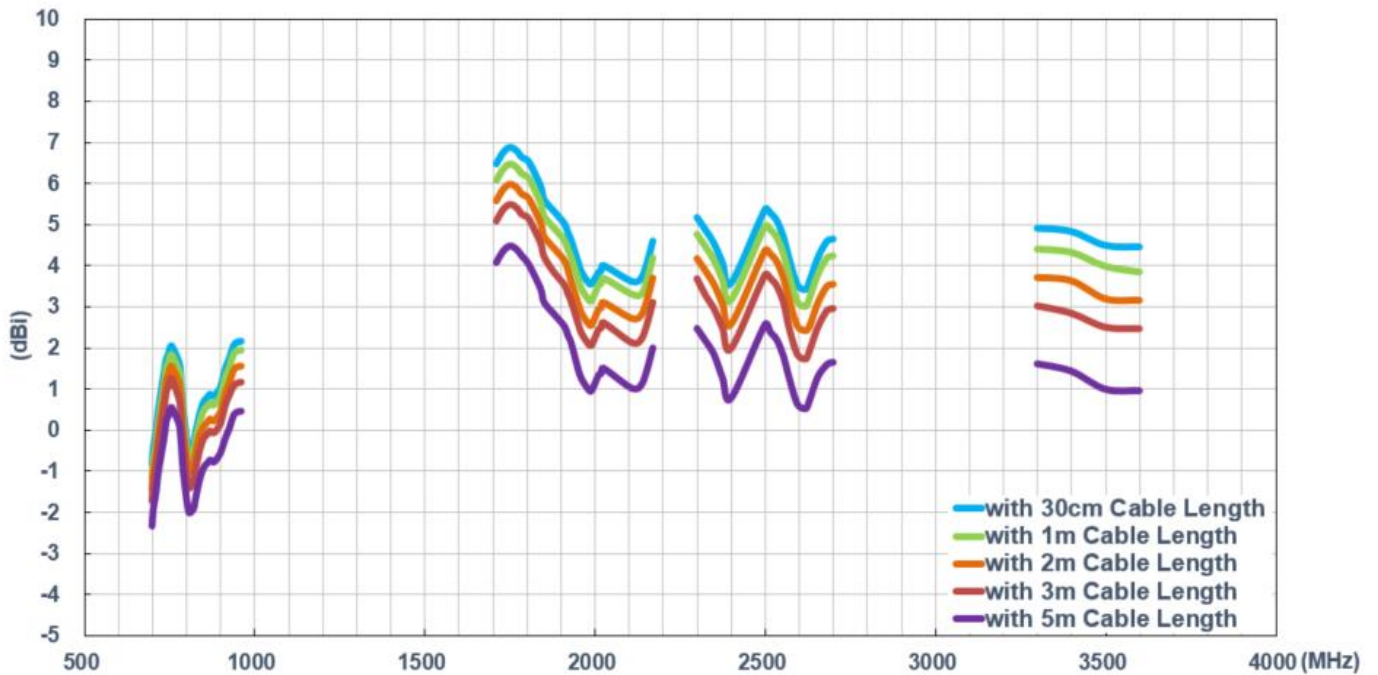
7.1.6 Average Gain (LTE MIMO_1)



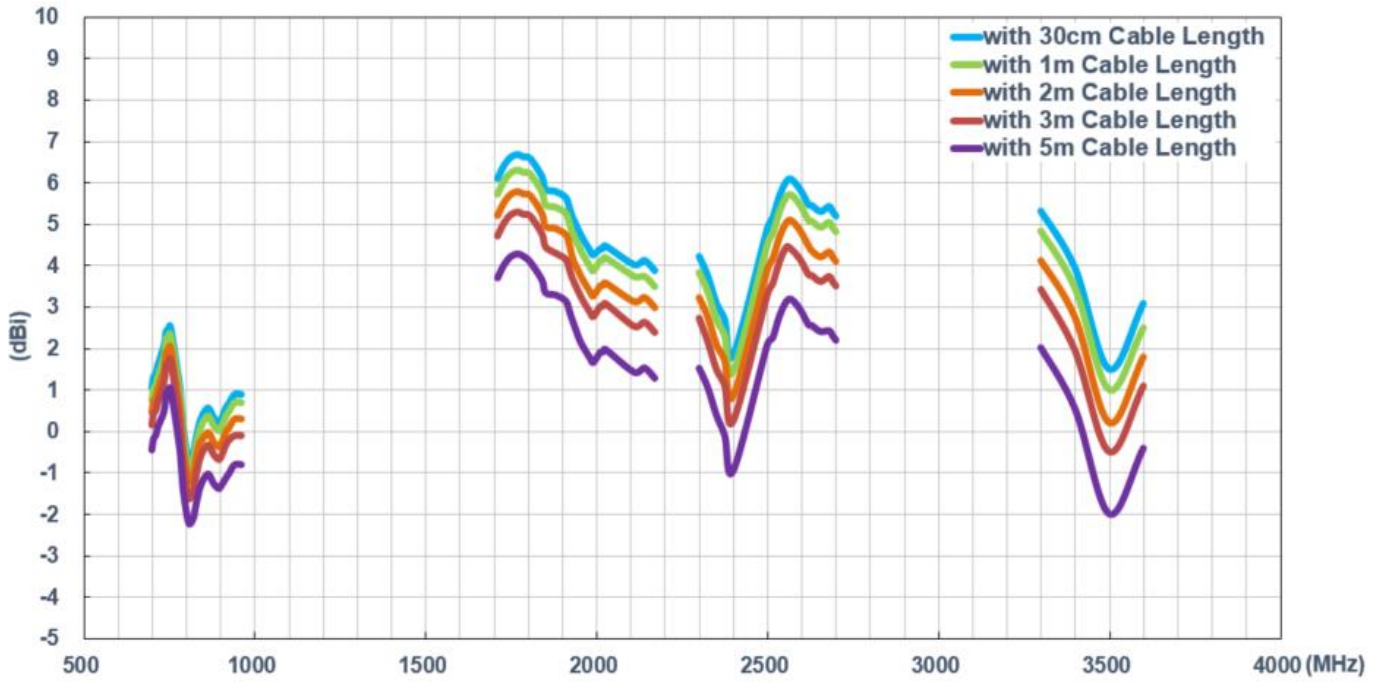
7.1.7 Average Gain (LTE MIMO_2)



7.1.8 Peak Gain (LTE MIMO_1)

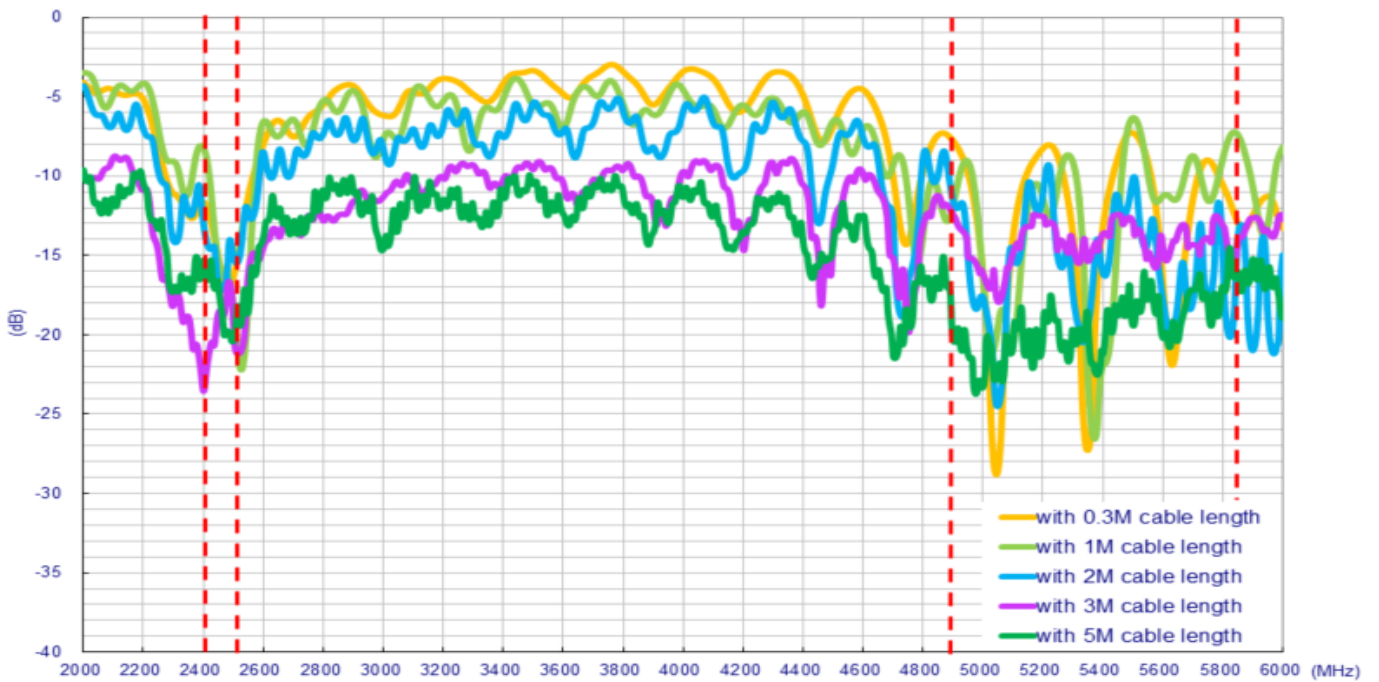


7.1.9 Peak Gain (LTE MIMO_2)

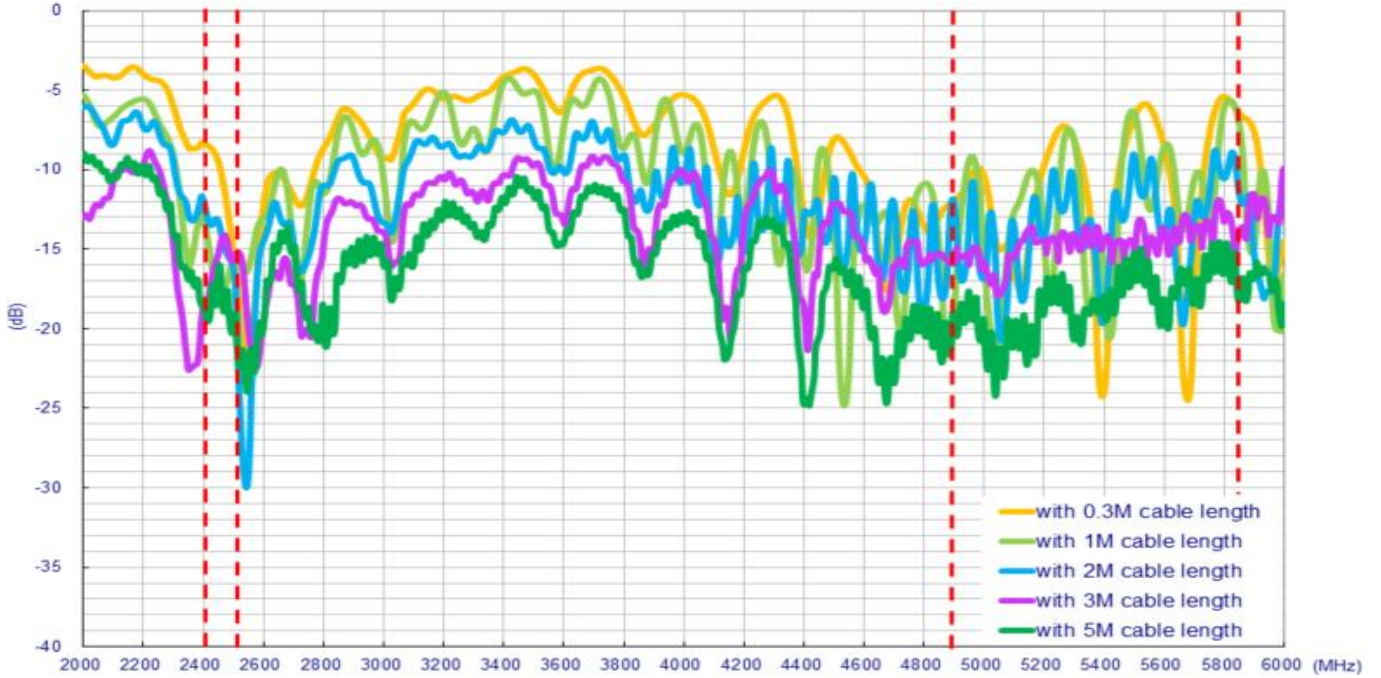


7.2 In free space (Wi-Fi MIMO Antenna)

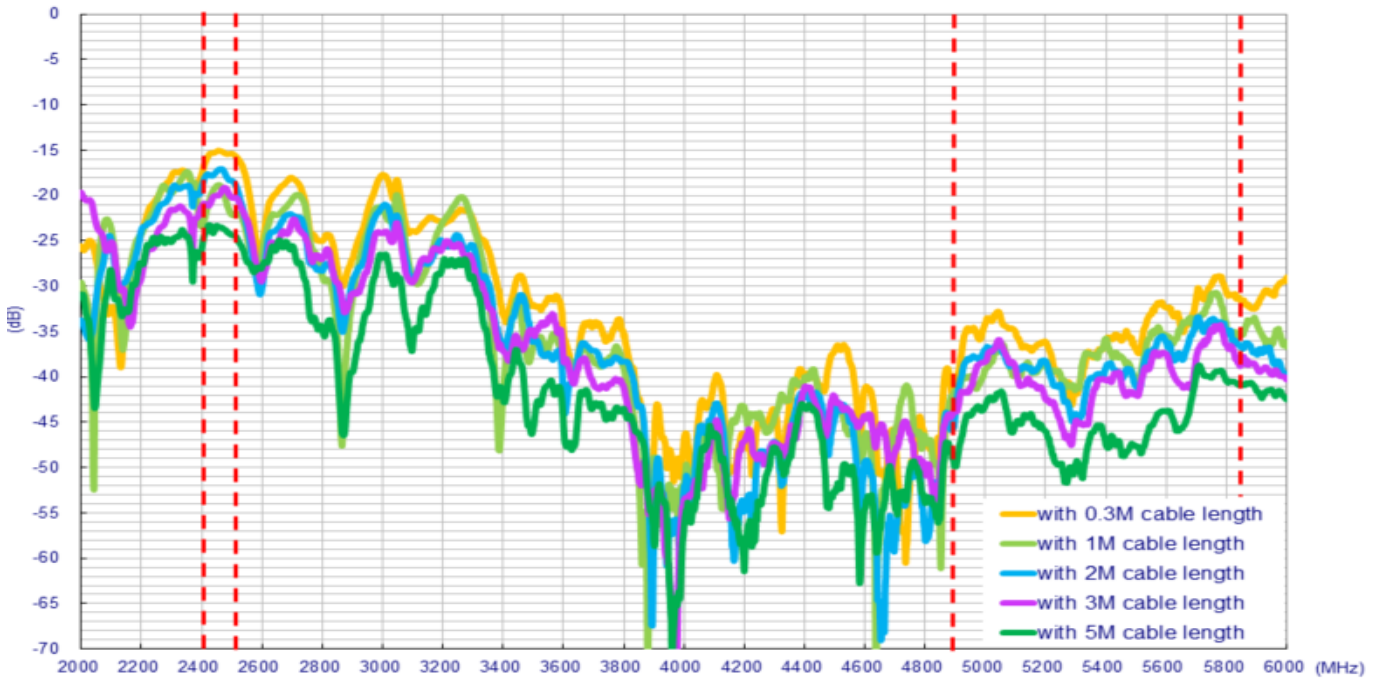
7.2.1 Return Loss (Wi-Fi MIMO_1)



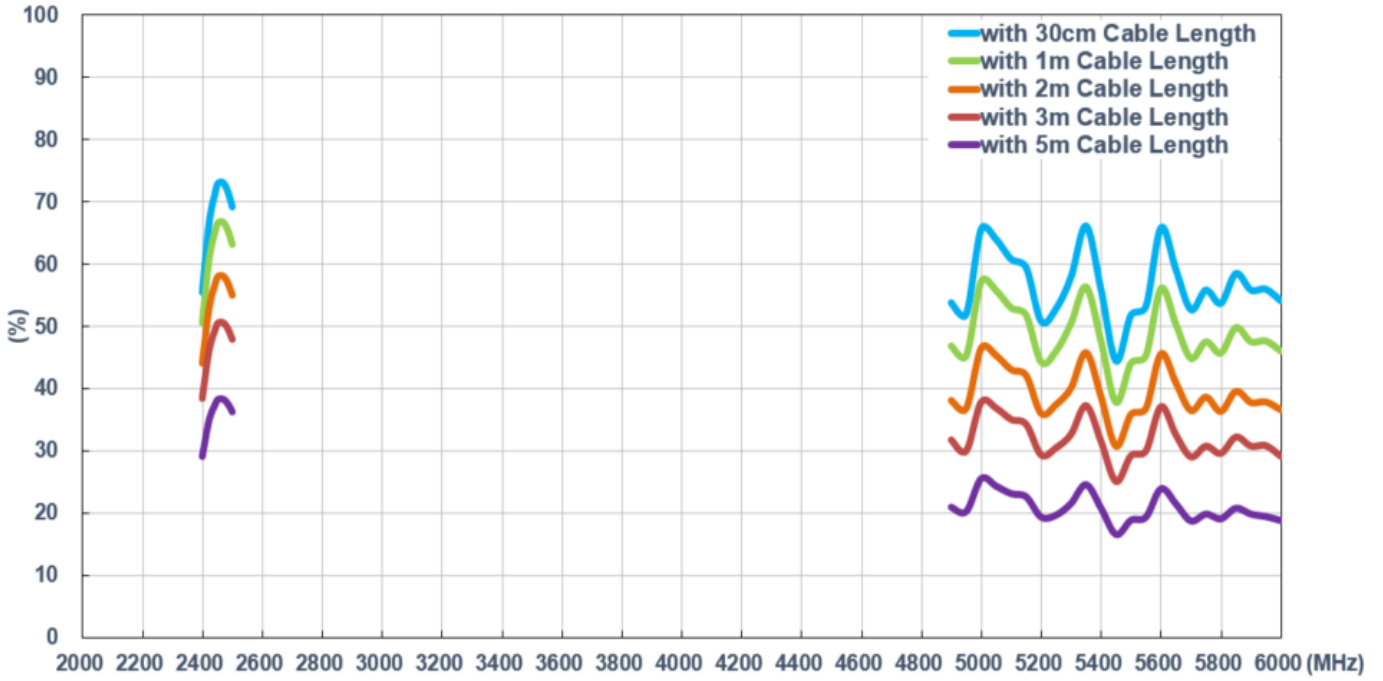
7.2.2 Return Loss (Wi-Fi MIMO_2)



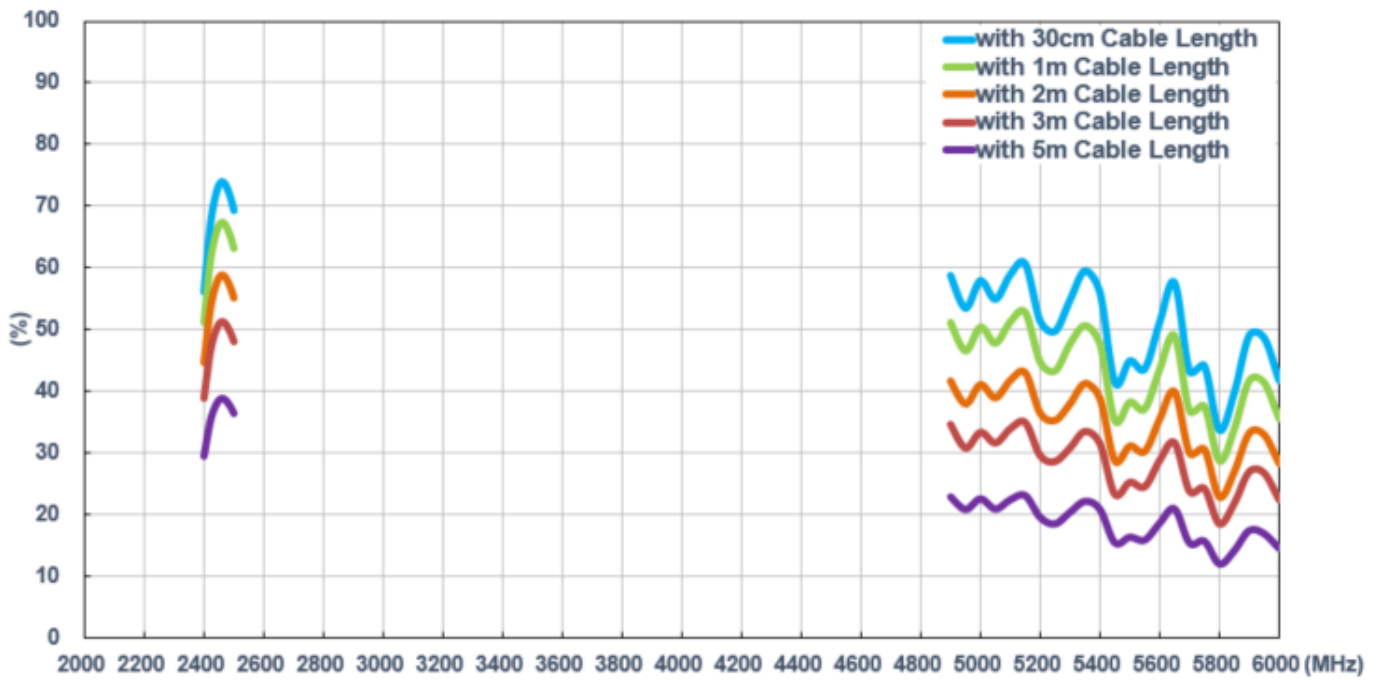
7.2.3 Insertion Loss



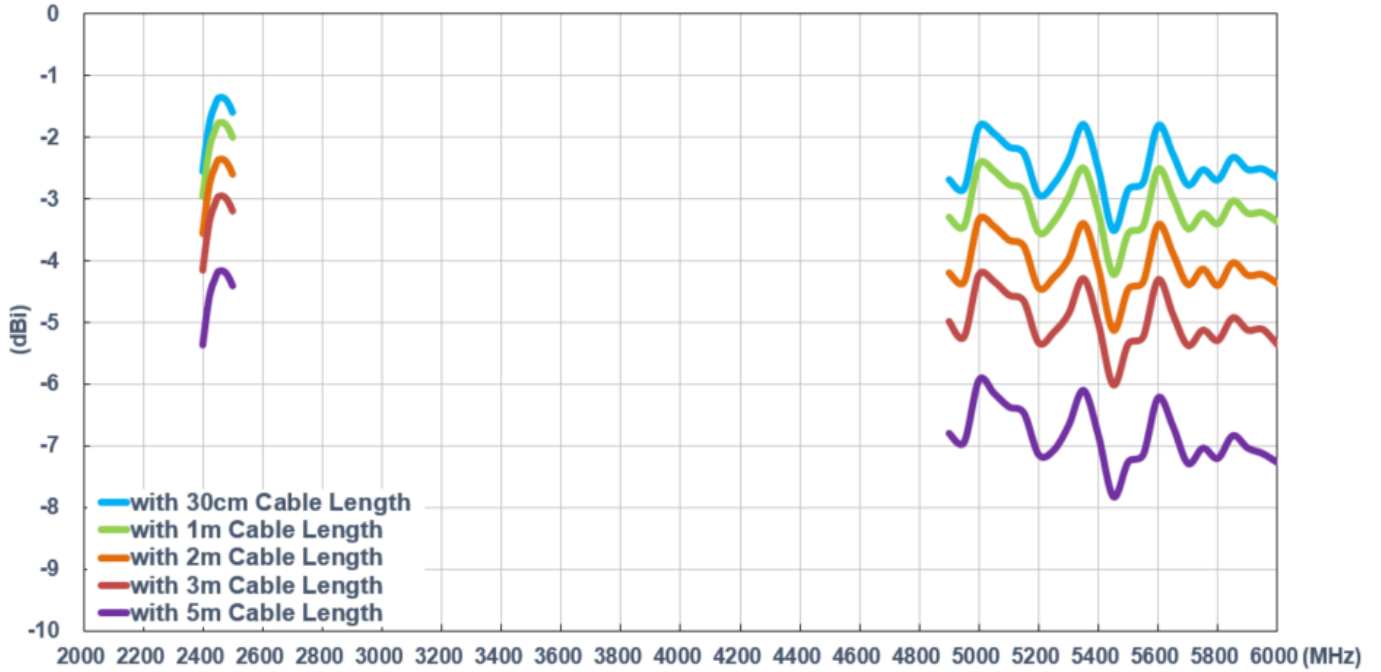
7.2.4 Efficiency (Wi-Fi MIMO_1)



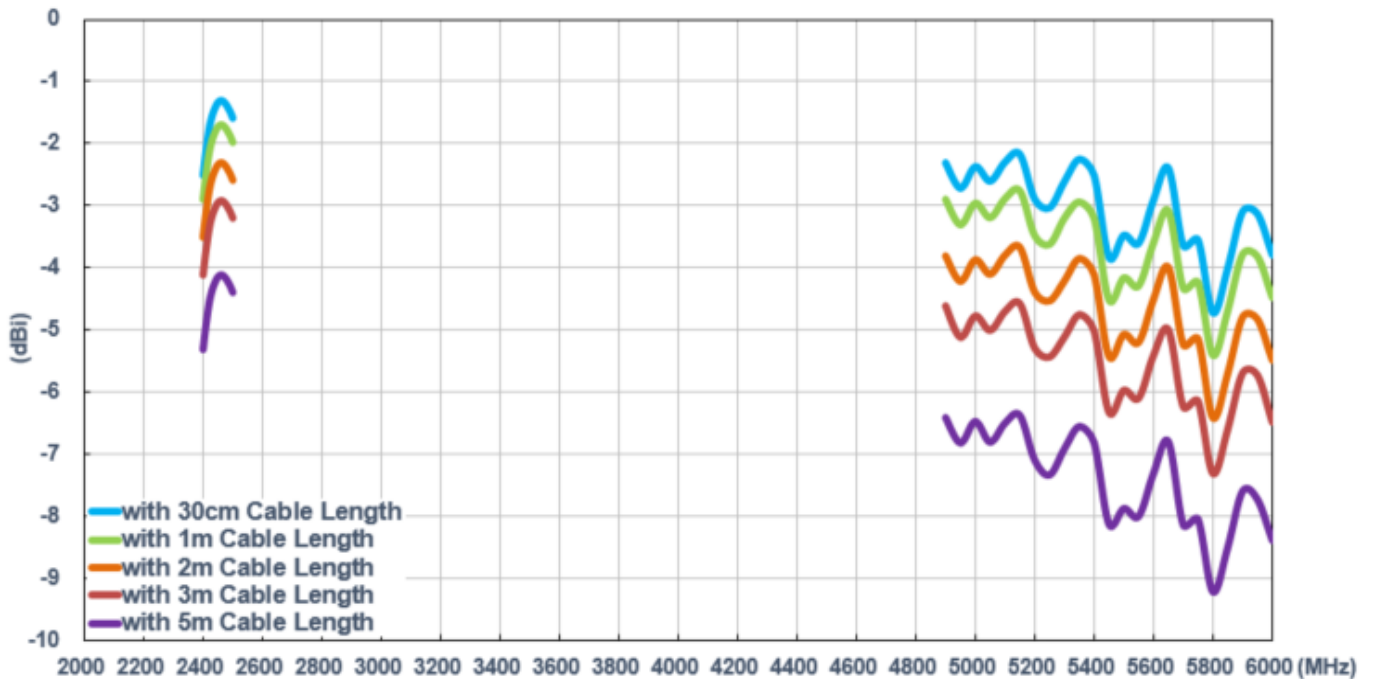
7.2.5 Efficiency (Wi-Fi MIMO_2)



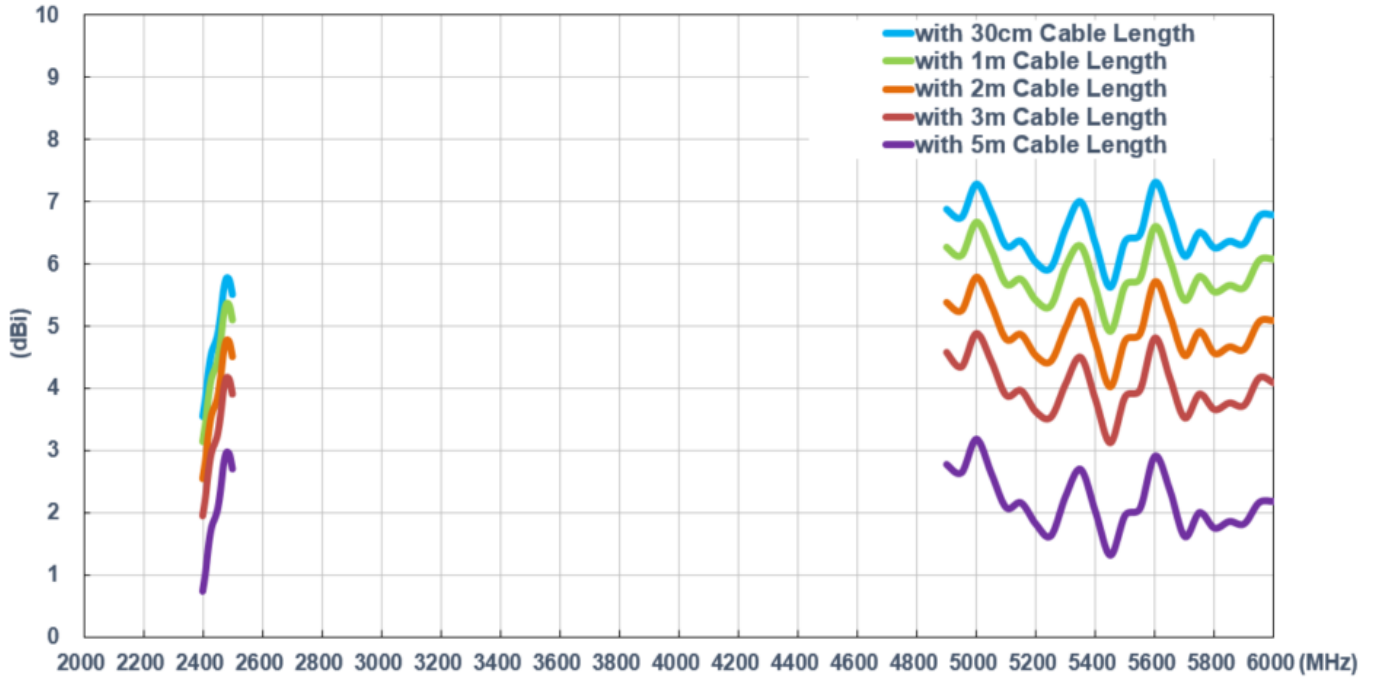
7.2.6 Average Gain (Wi-Fi MIMO_1)



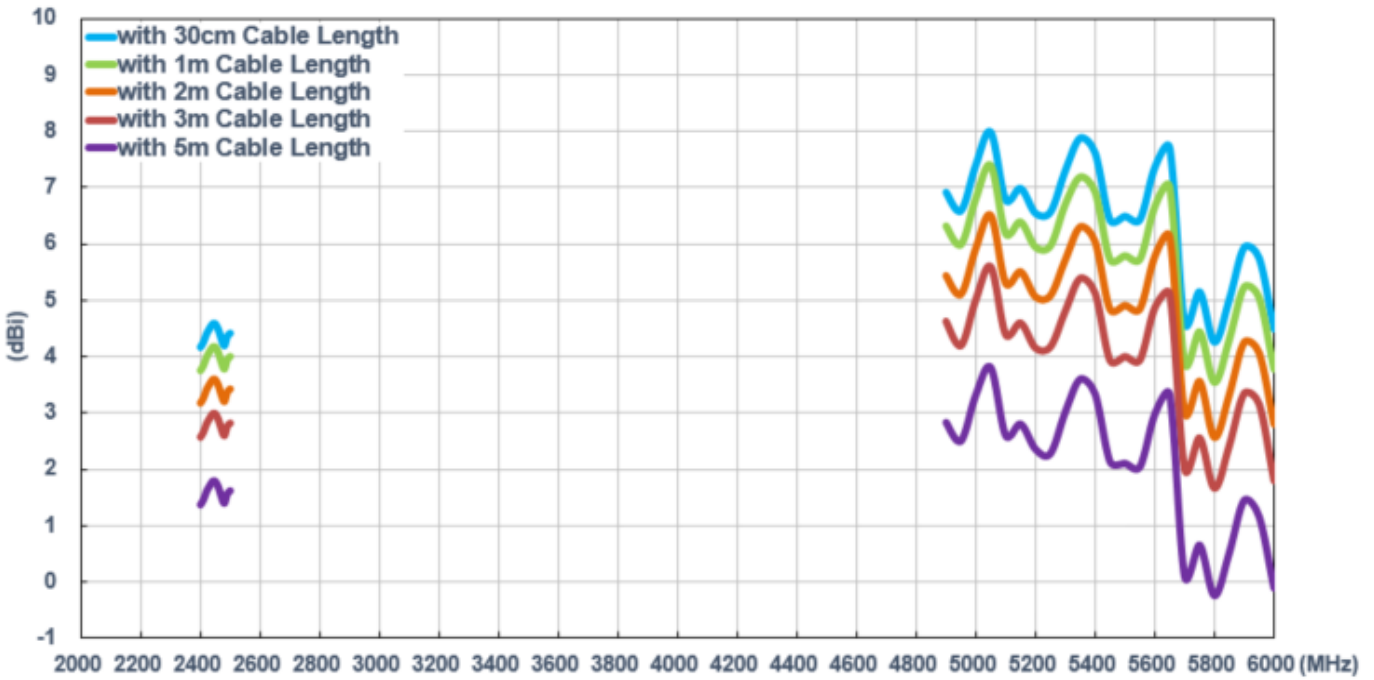
7.2.7 Average Gain (Wi-Fi MIMO_2)



7.2.8 Peak Gain (Wi-Fi MIMO_1)



7.2.9 Peak Gain (Wi-Fi MIMO_2)





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