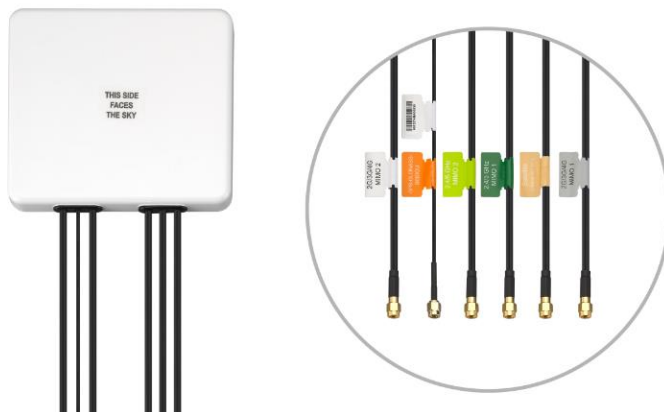


DRAFT SPECIFICATION

PATENT PENDING

- Part No. : **MA930.W.A.LBICGJ.005**
- Product Name : Guardian 6in1 Adhesive and Wall Mount Antenna
LTE*2+Wi-Fi*2+GNSS+Satellite L Band Antenna
- 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
1* GPS-GLONASS-GALILEO-BeiDou Antenna
1* Satellite L Band Antenna
Worldwide 4G Bands including fallback to 3G & 2G
IP67 Waterproof ASA Enclosure
Dims: 146*134*20mm
1M Low Loss KSR200-P and RG174 Cables with SMA(M)/RP-SMA(M) connectors
Cables and Connectors Customizable

RoHS Compliant



1. Introduction

The MA930 Guardian is a next generation combination antenna. It is the first panel antenna worldwide designed for IoT Gateway and Router devices with multiple wireless technologies. It is a low profile 6in1 wall and adhesive mount antenna. It is a heavy-duty, fully IP67 waterproof 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, Satellite L band, dual-band 2.4/5.8GHz Wi-Fi, plus GPS-GLONASS-GALILEO-BEIDOU for location accuracy. It enables designers to cover a wide range of technologies by installing a single antenna.

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 GPS-GLONASS-GALILEO-BEIDOU active antenna has been carefully designed for excellent performance across all L1 GNSS bands, leading to higher location accuracy and stability of tracking in urban environments.

The housing is IP67 waterproof and comes with a 3M adhesive. The antenna can be mounted internally or externally on a vehicle. The MA931 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

| GPS-GLONASS-GALILEO-BeiDou | | | | |
|--|--|--------------------|----------------------|-------------------|
| Center Frequency | GPS/GALILEO:1575.42±1.023MHz GLONASS:1602±5MHz BeiDou:1561.098±2.046MHz | | | |
| Passive Antenna Efficiency (without cable loss) | GPS/GALILEO: 48% GLONASS: 57% BeiDou: 63% | | | |
| Passive Antenna Average Gain (without cable loss) | GPS/GALILEO: -3.13dBi GLONASS: -2.39dBi BeiDou: -1.97dBi | | | |
| Passive Antenna Peak Gain (without cable loss) | GPS/GALILEO: 1.98dBi GLONASS: 3.01dBi BeiDou: 3dBi | | | |
| VSWR | 3:1 Max | | | |
| Impedance | 50Ω | | | |
| Axial Ratio | GPS/GALILEO:<14.02 GLONASS:<5.9 BeiDou:<9.7 | | | |
| Polarization | RHCP | | | |
| Cable | 1 meter RG174 standard, fully customizable | | | |
| Connector | SMA(M) standard, fully customizable | | | |
| LNA and Filter Electrical Properties | | | | |
| Center Frequency | GPS/GALILEO:1575.42±1.023MHz GLONASS:1602±5MHz BeiDou: 1561.098±2.046MHz | | | |
| Output Impedance | 50Ω | | | |
| VSWR | < 2:1 | | | |
| Return Loss | 10dB Min. | | | |
| LNA Gain, Current Draw, and Noise Figure@GPS | Voltage | LNA Gain(Typ) | Current Draw(mA) Typ | Noise Figure(Typ) |
| | Min 1.8V | 28dB | 7.9mA | 1.13dB |
| | Typ 3.0V | 30dB | 9.0mA | 1.13dB |
| | Max 5.5V | 33dB | 9.9mA | 1.14dB |
| Total Specification (Through Antenna, SAW Filter, and LNA) | | | | |
| Frequency | 1561.098±2.046MHz | 1575.42±1.023MHz | 1602±5MHz | |
| Gain@3V | 1561MHz:28±3dBi | 1575.42MHz:28±3dBi | 1602MHz:28±3dBi | |
| Output Impedance | 50Ω | | | |

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

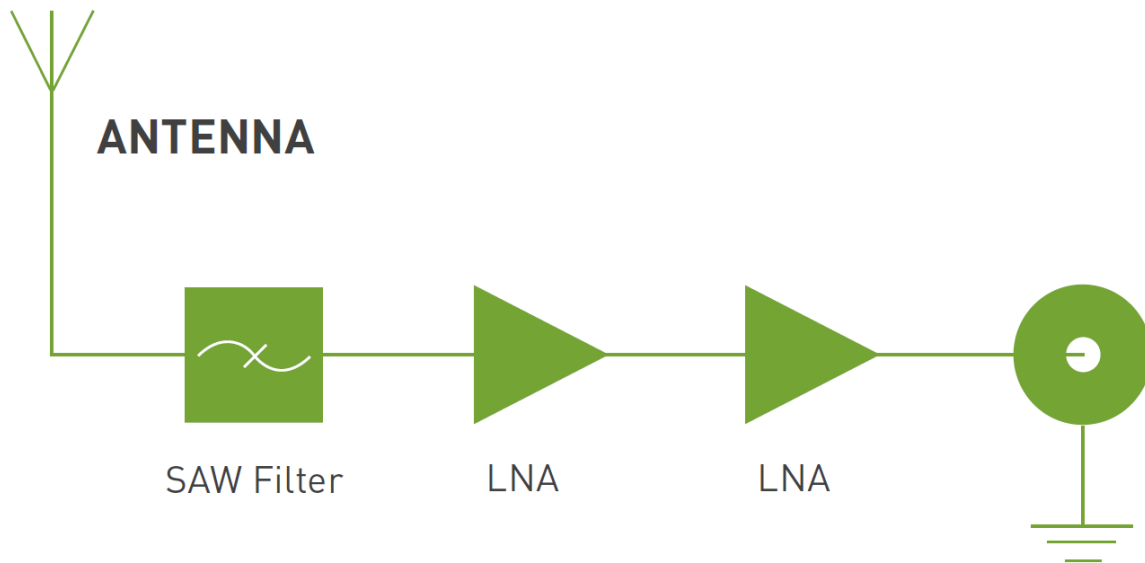
| SATELLITE L BAND 1621MHZ | |
|--------------------------|---|
| Center Frequency | 1621±5 MHz |
| VSWR | < 2 |
| Axial Ratio | 3.6 |
| Polarization | RHCP |
| Average Gain | -1.76dBi |
| Peak Gain | 2.17dBi |
| Antenna Efficiency | 66.67% |
| Cable | 1 meter KSR200-P standard, fully customizable |
| Connector | 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 GPS-GLONASS-GALILEO-BeiDou

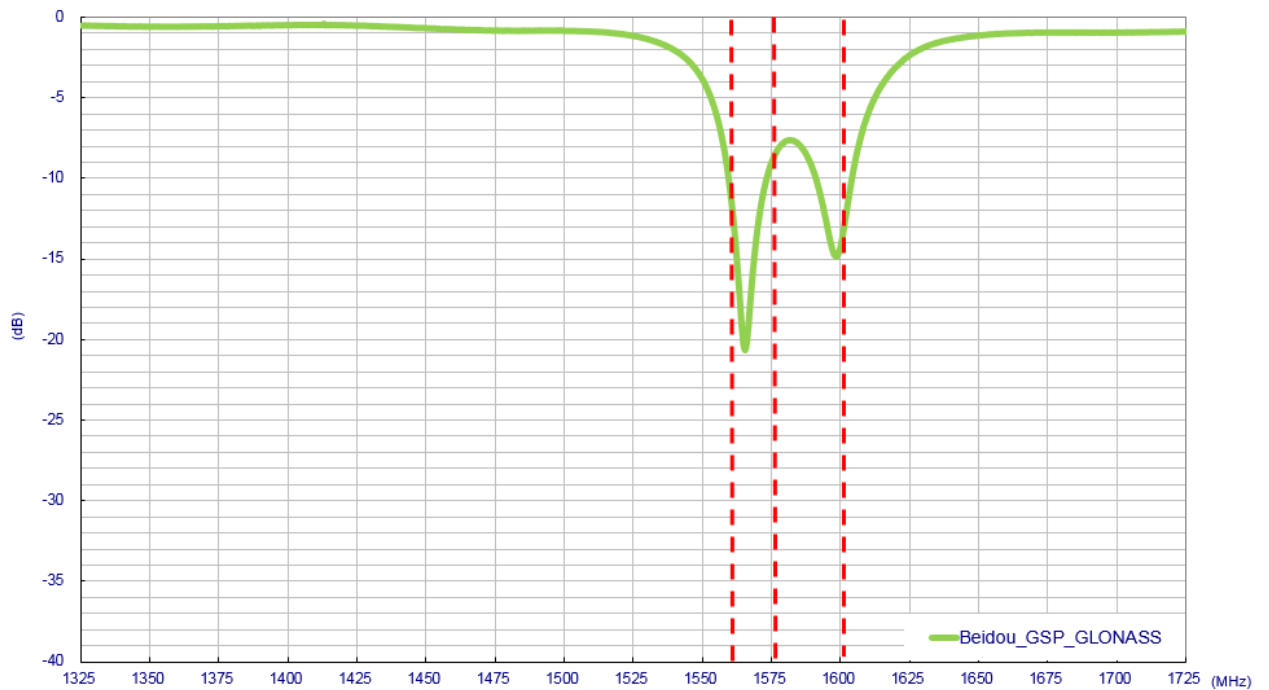
3.1.1 Block Diagram (Active antenna)



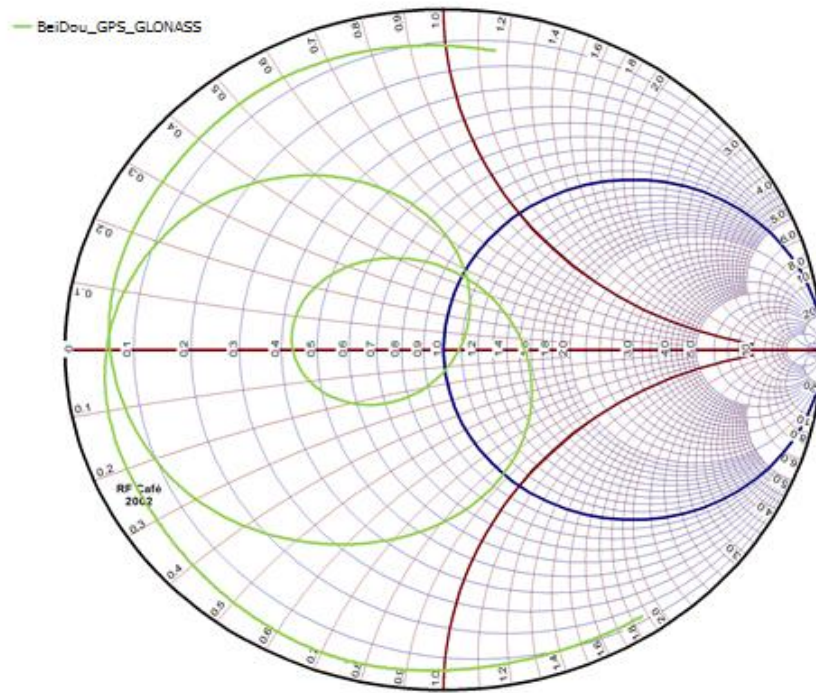
3.1.2 Test Setup



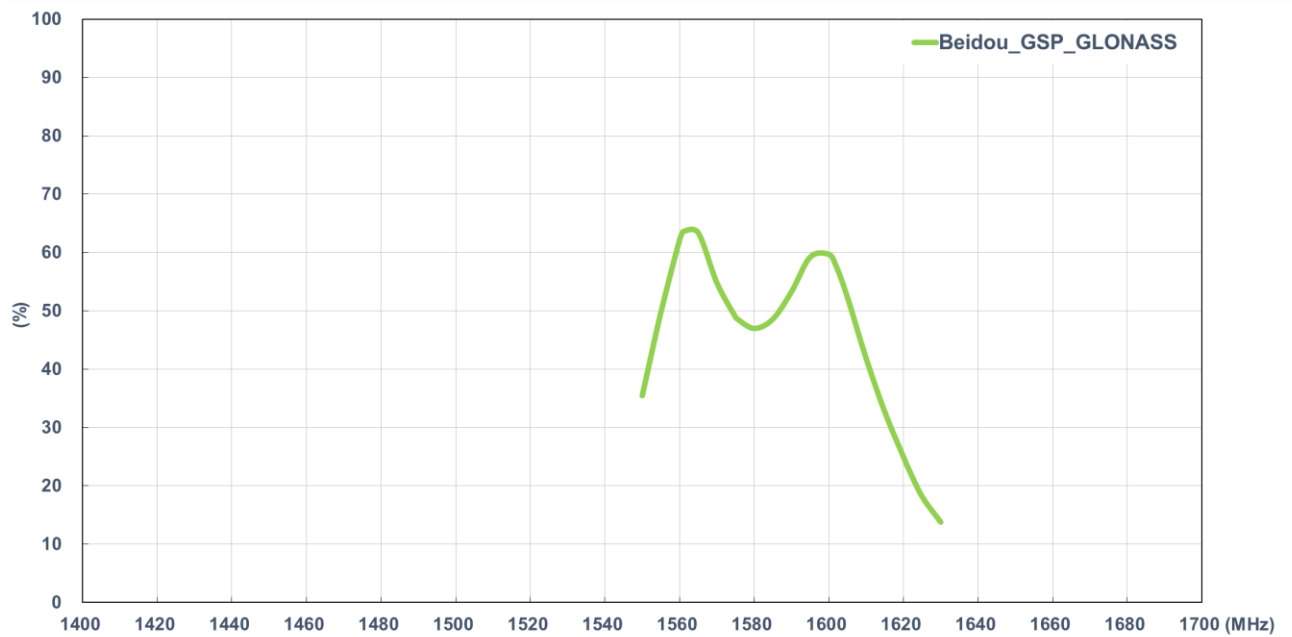
3.1.3 GPS-GLONASS-GALILEO-BeiDou Return Loss (Passive antenna)



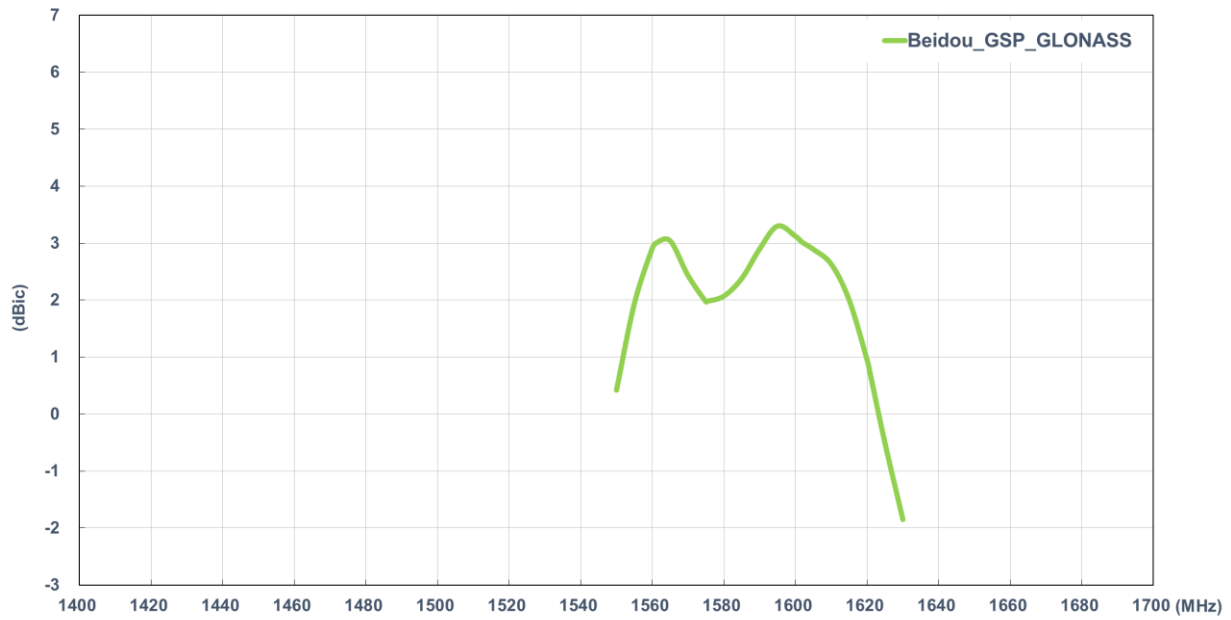
3.1.4 GPS-GLONASS-GALILEO-BeiDou Smith Chart (Passive antenna)



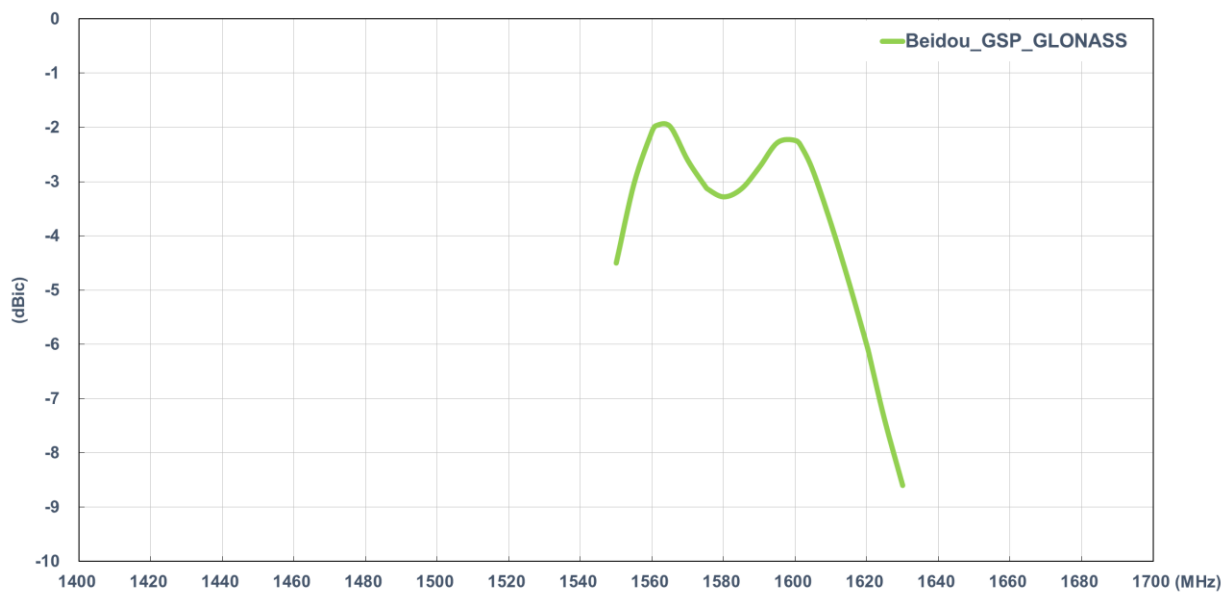
3.1.5 GPS-GLONASS-GALILEO-BeiDou Efficiency (Passive antenna)



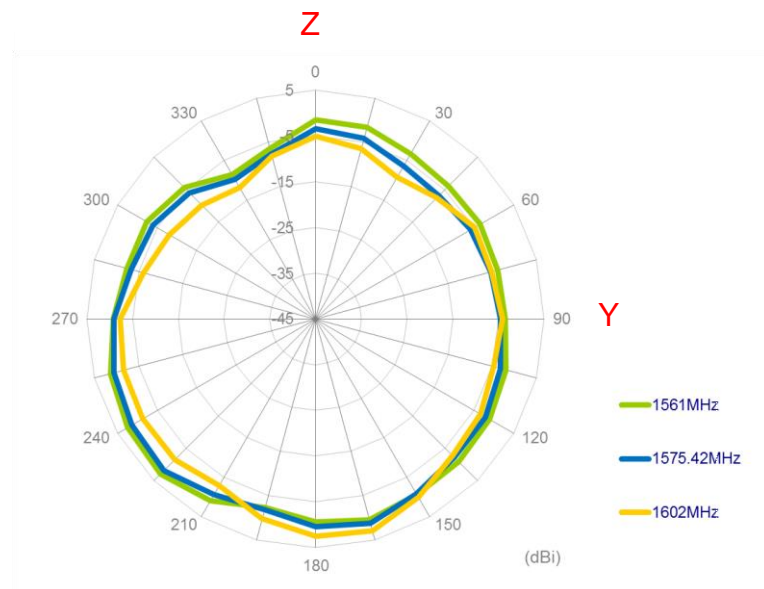
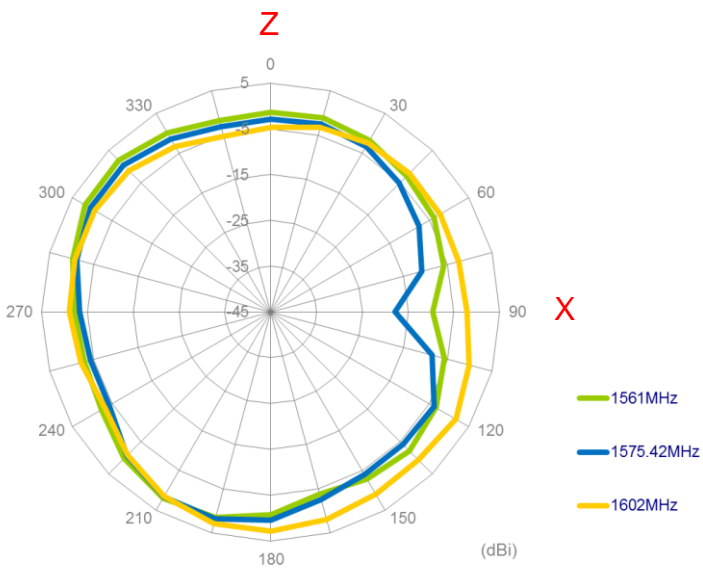
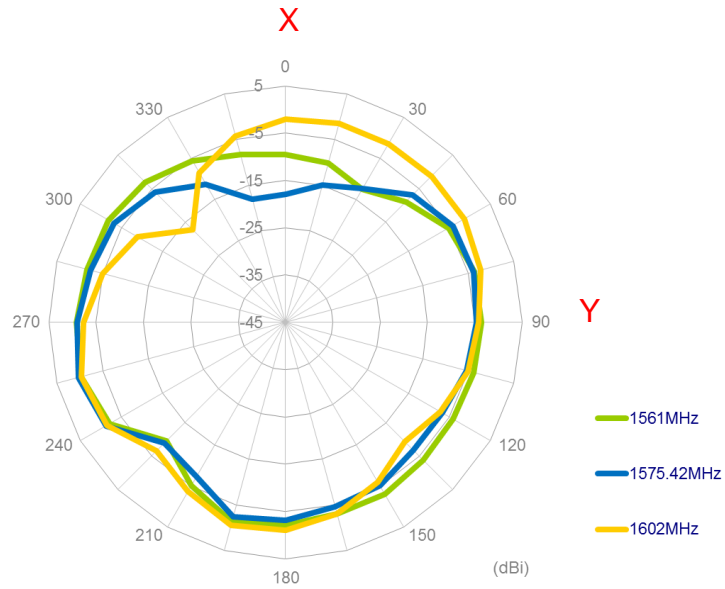
3.1.6 GPS-GLONASS-GALILEO-BeiDou Peak Gain (Passive antenna)



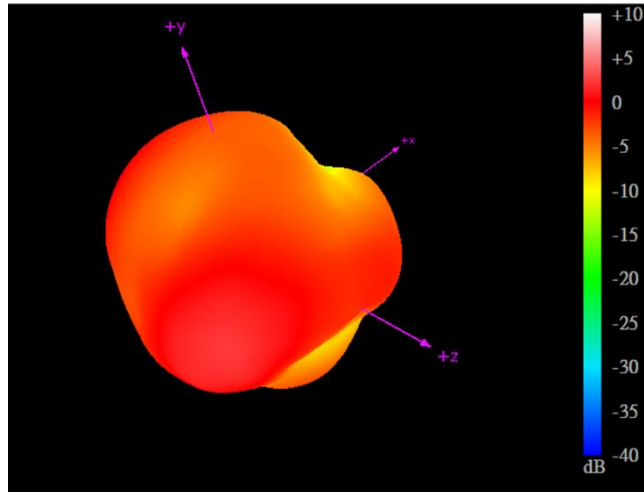
3.1.7 GPS-GLONASS-GALILEO-BeiDou Average Gain (Passive antenna)



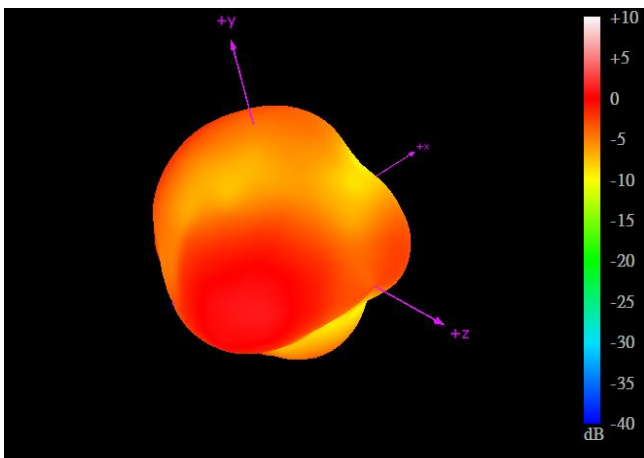
3.1.8 GPS-GLONASS-GALILEO-BeiDou Radiation Pattern (Passive antenna) 2D Radiation Pattern



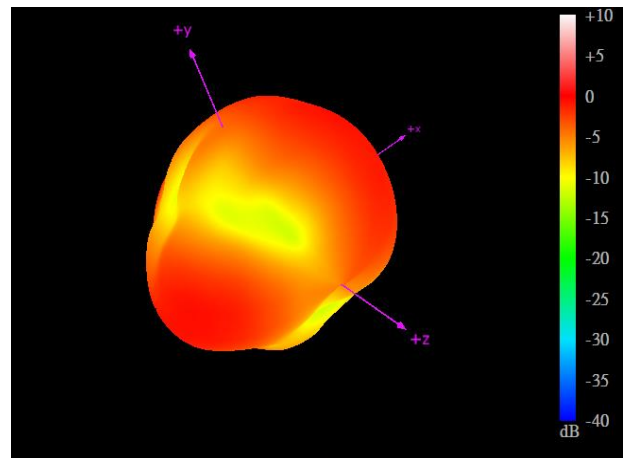
3D Radiation Pattern (Passive antenna)



1561MHz

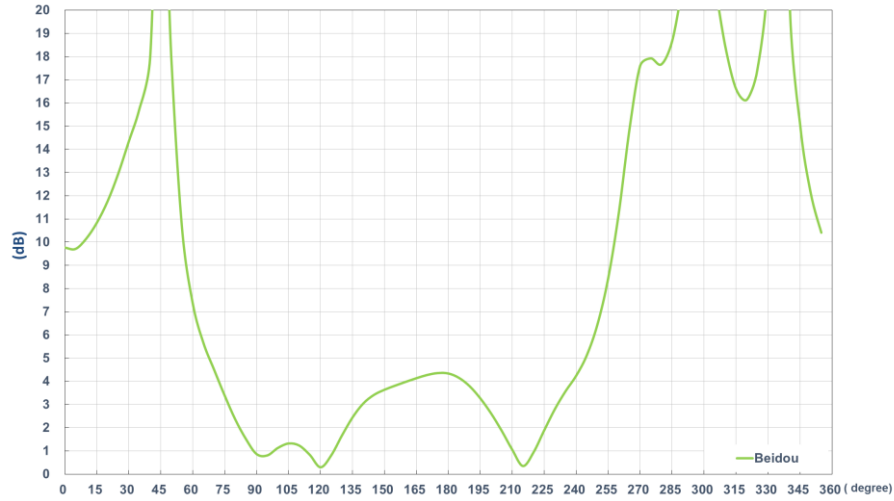


1575.42MHz

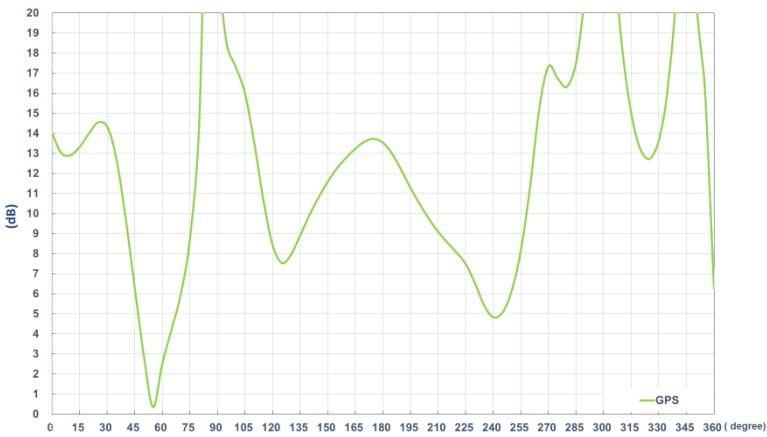


1602MHz

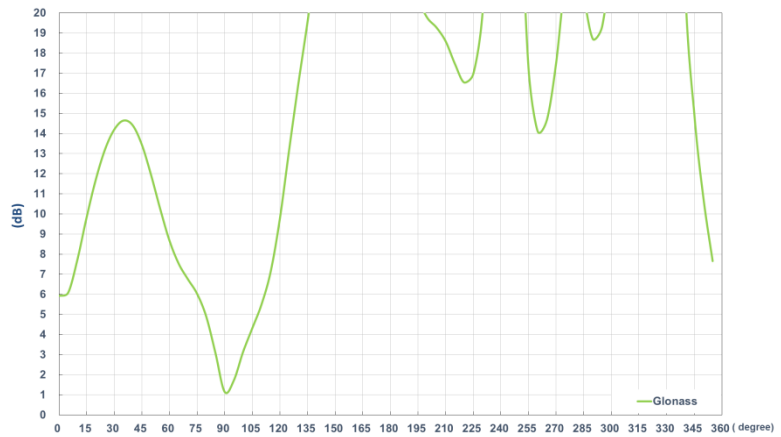
3.1.9 Axial Ratio (Passive antenna)



1561MHz

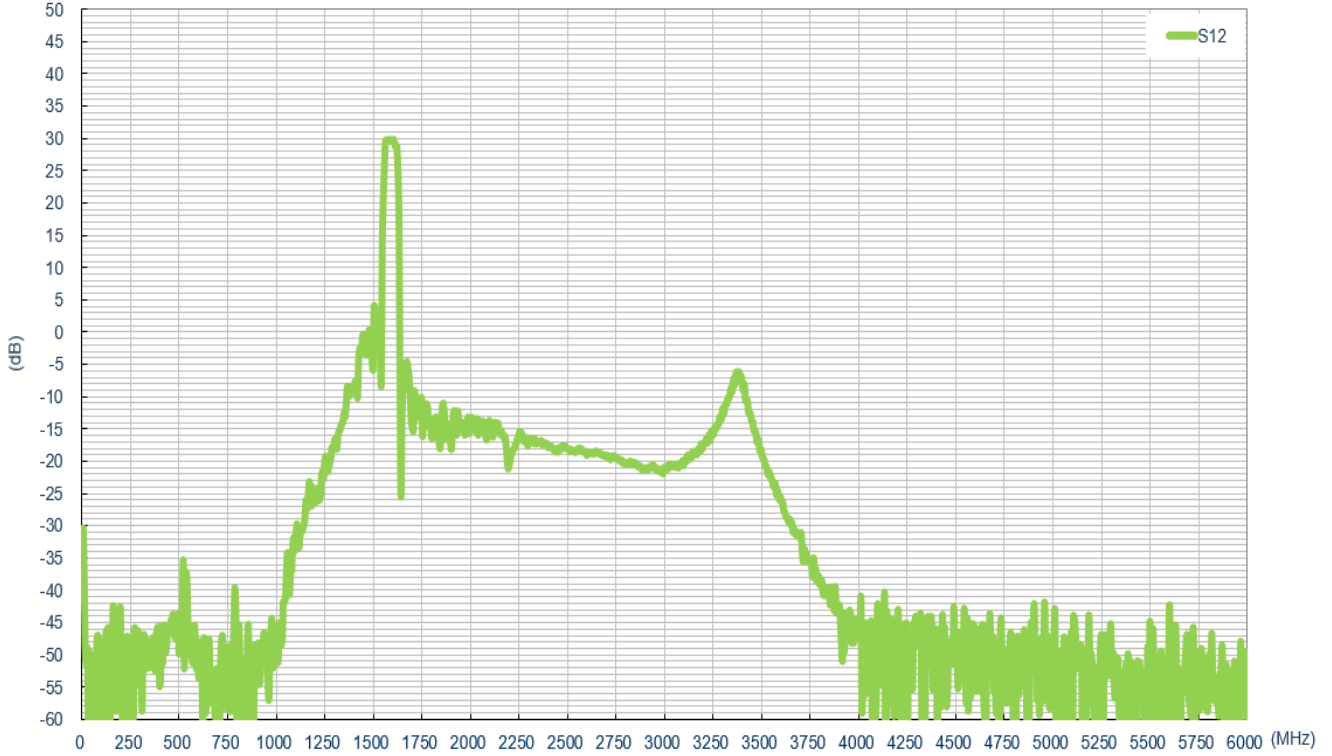


1575.42MHz

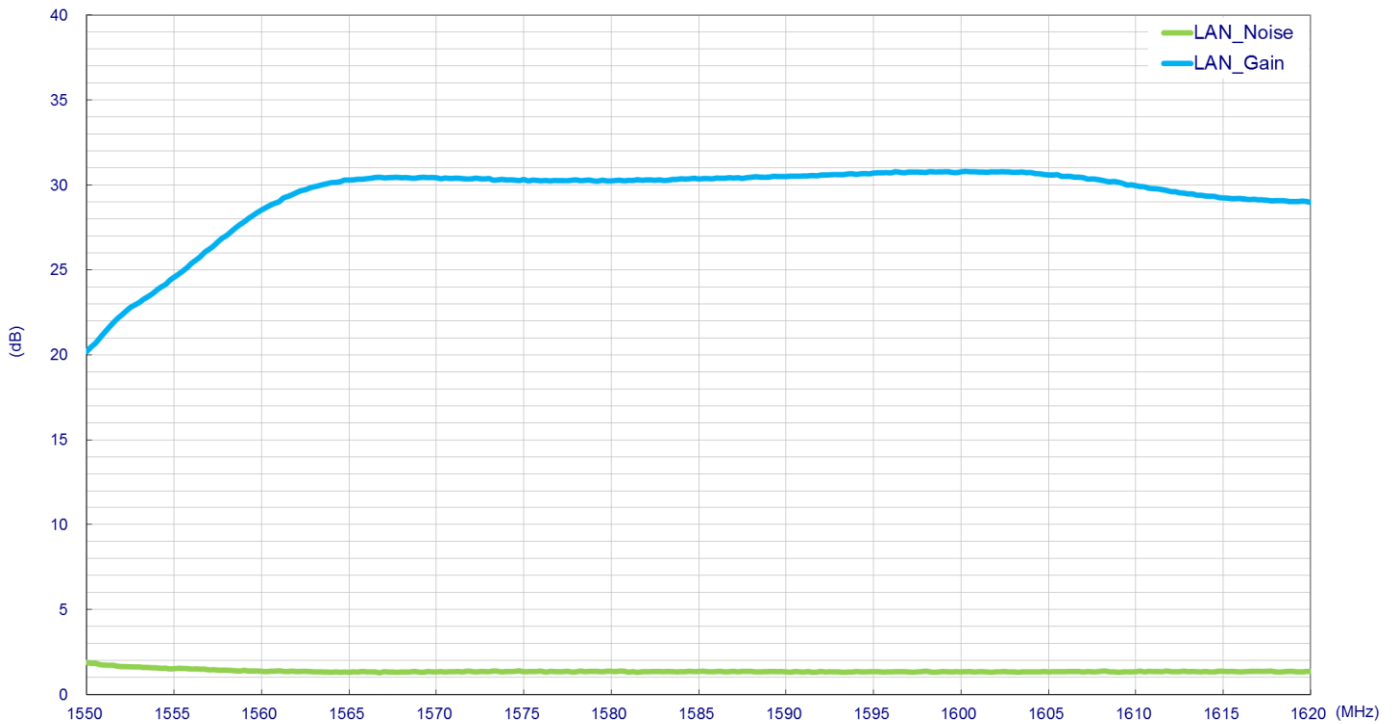


1602MHz

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



LNA Gain@3.0V



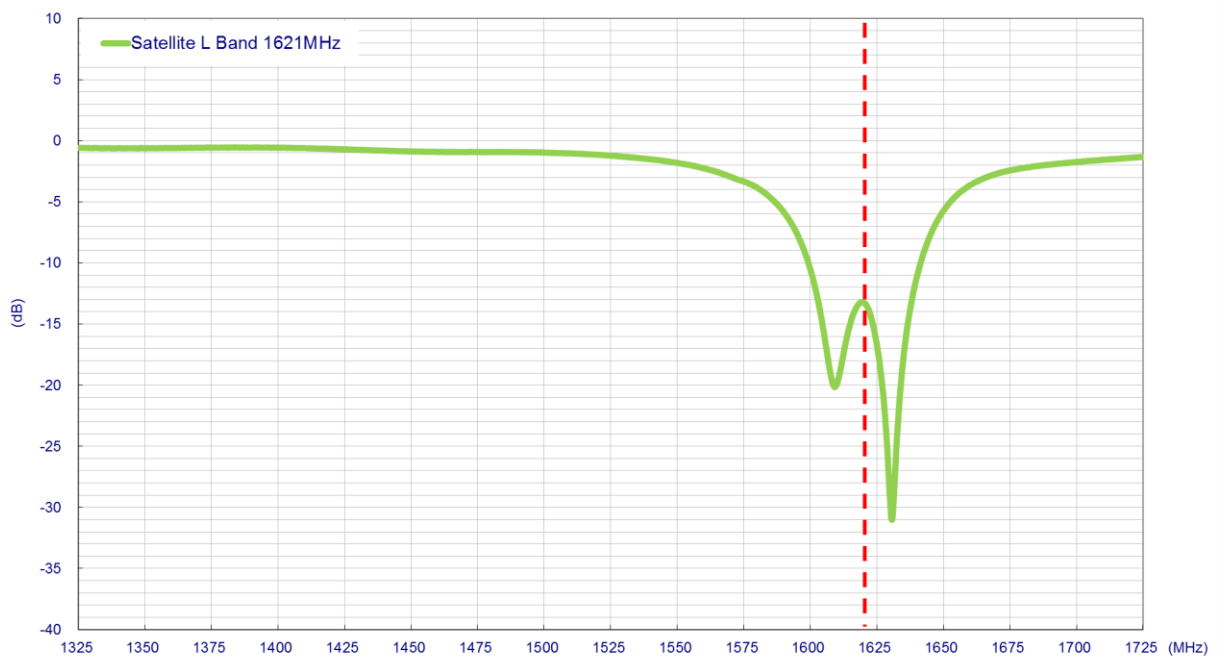
LNA Noise Figure @3.0V

3.2 Satellite L Band 1621MHz Antenna

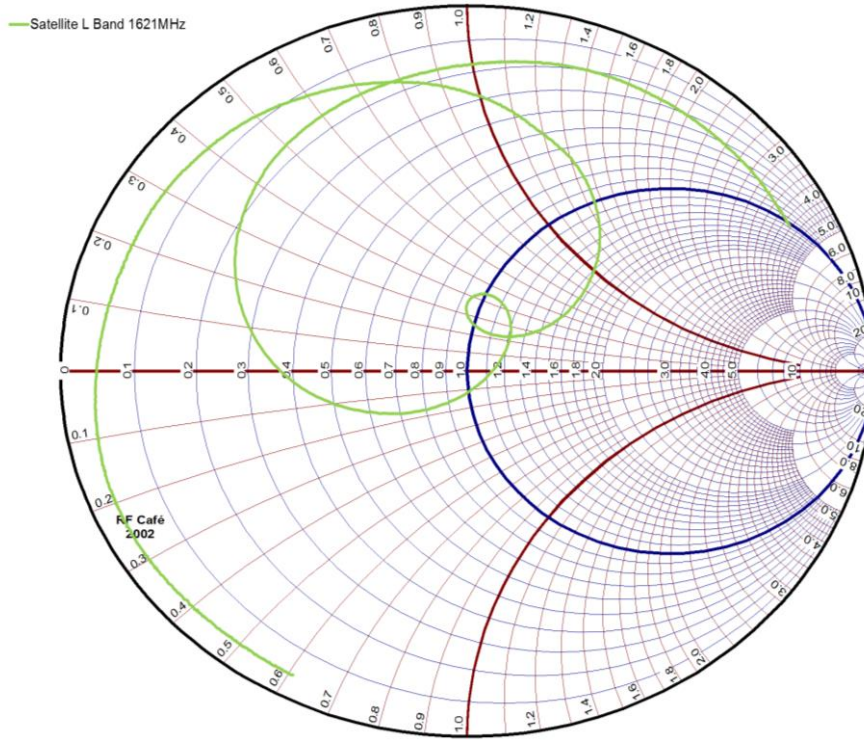
3.2.1 Test Setup



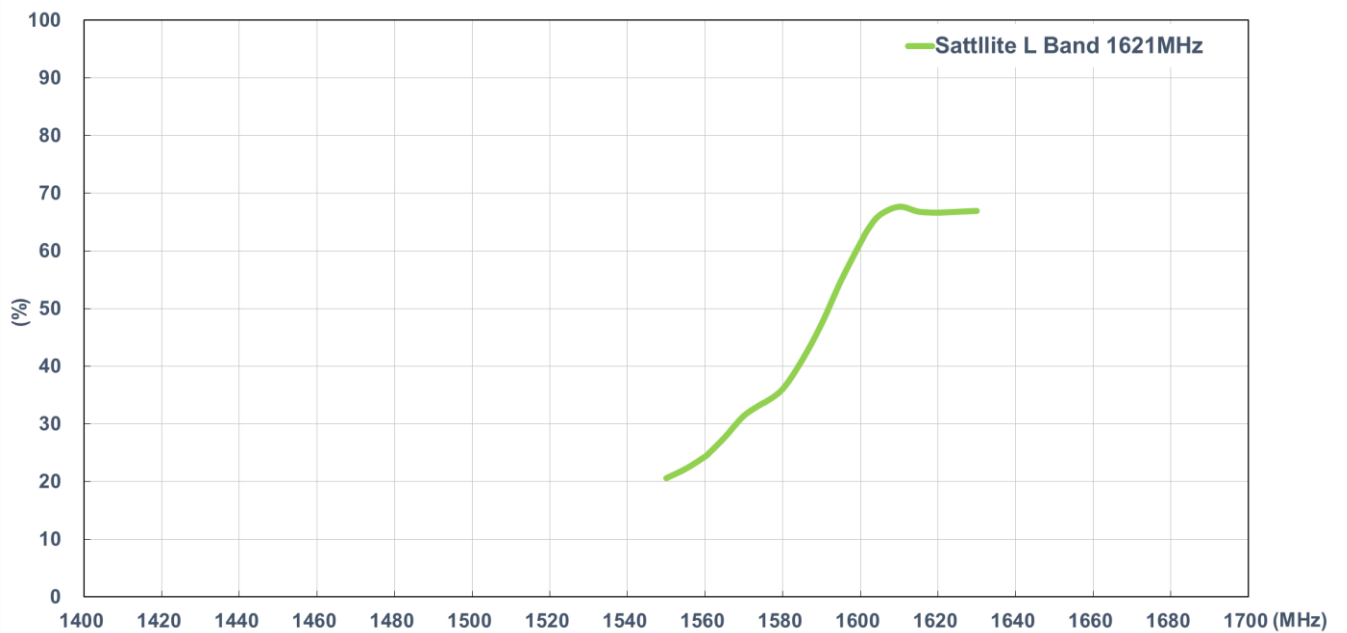
3.2.2 Satellite L Band Return Loss



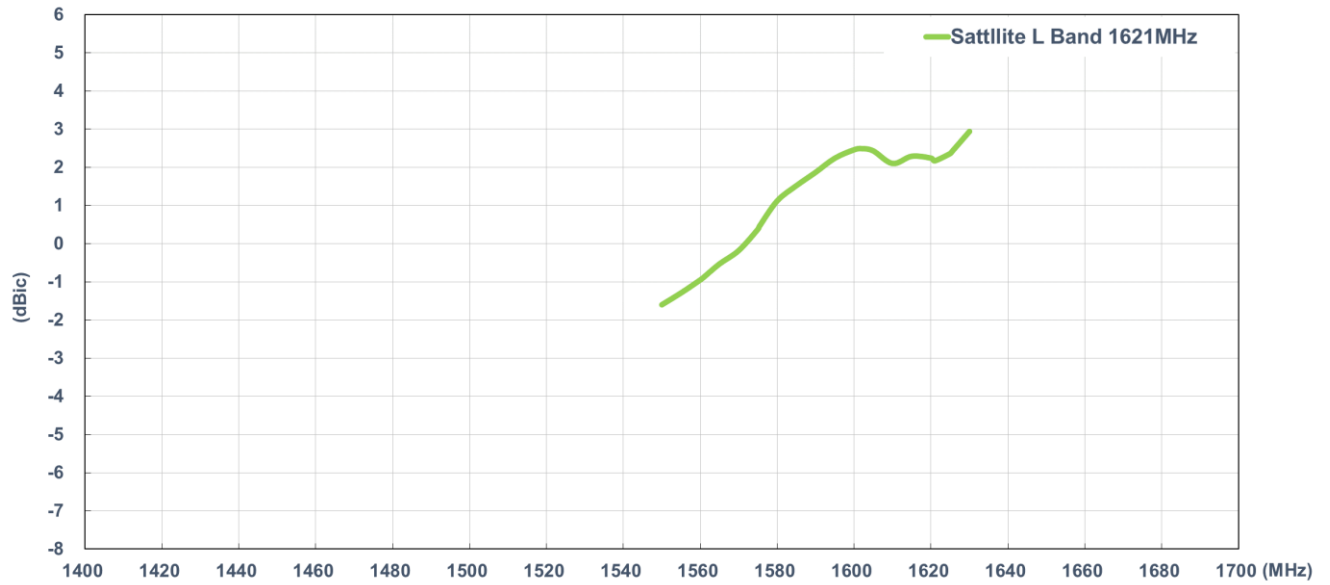
3.2.3 Satellite L Band Smith Chart



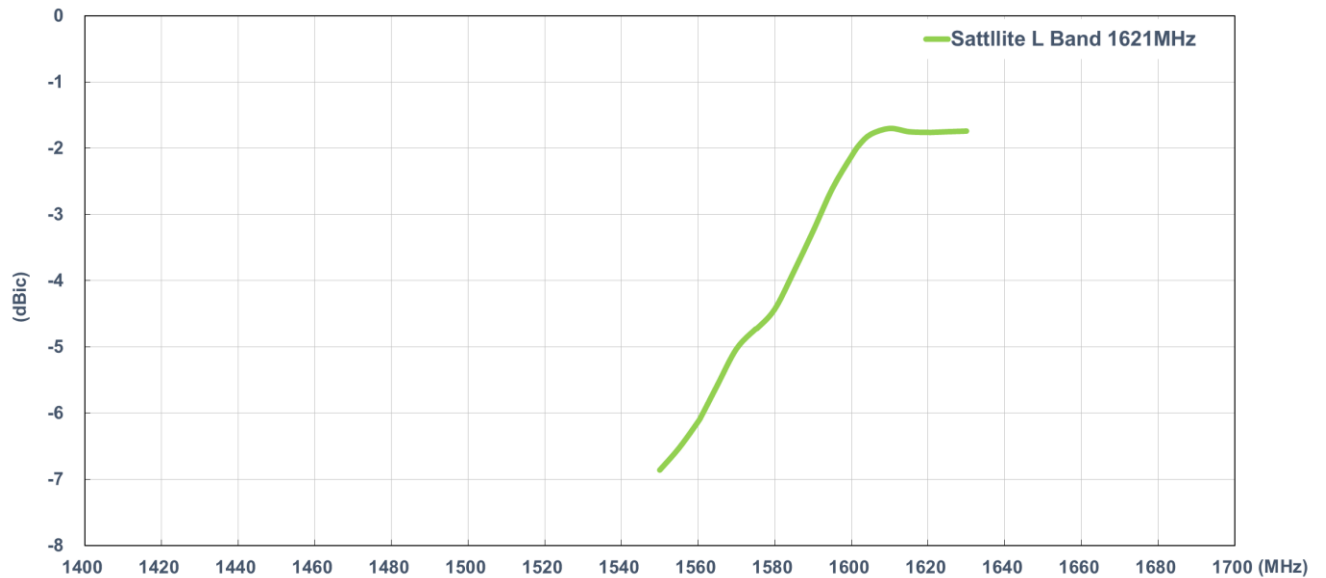
3.2.4 Satellite L Band Efficiency



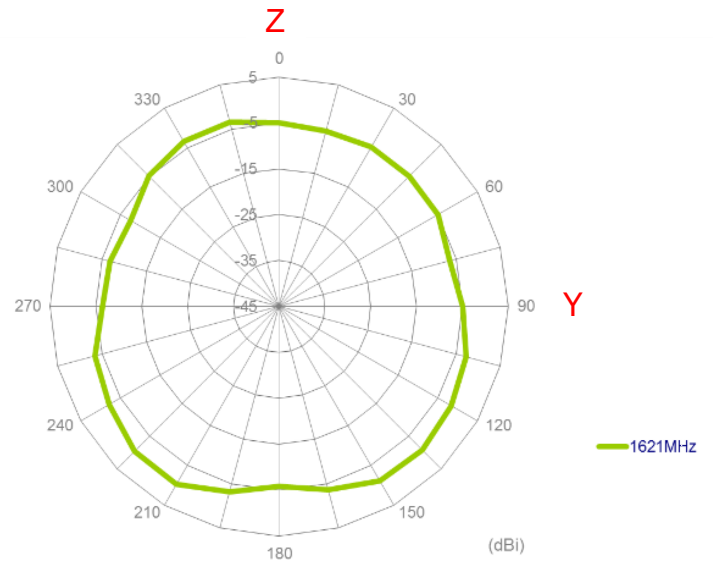
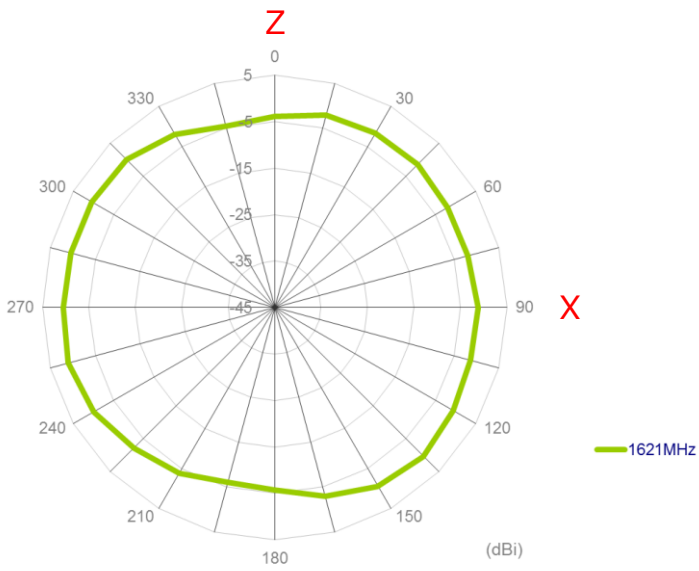
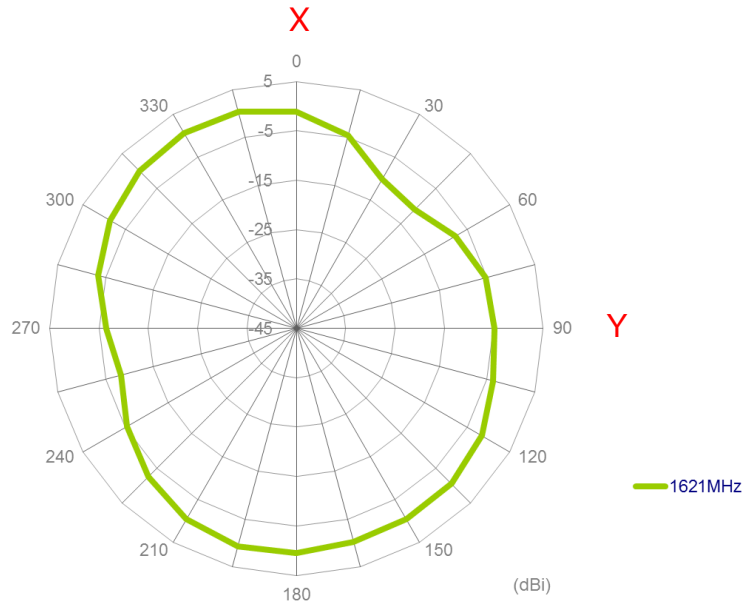
3.2.5 Satellite L Band Peak Gain



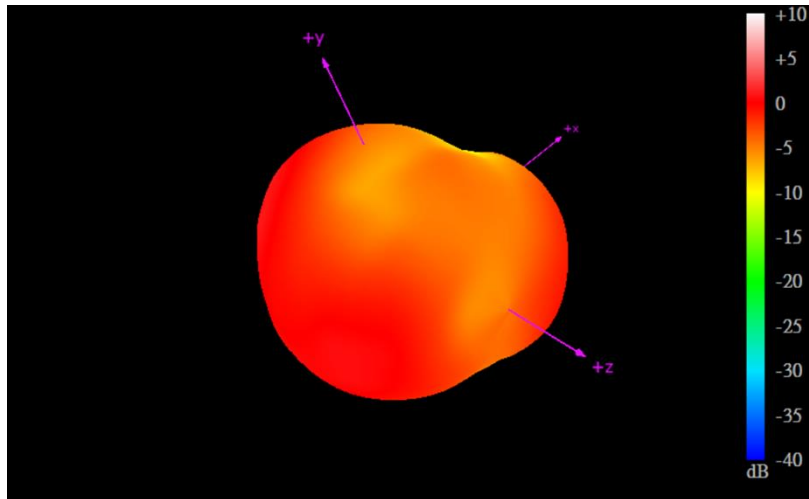
3.2.6 Satellite L Band Average Gain



3.2.7 Satellite L Band Radiation Pattern 2D Radiation Pattern

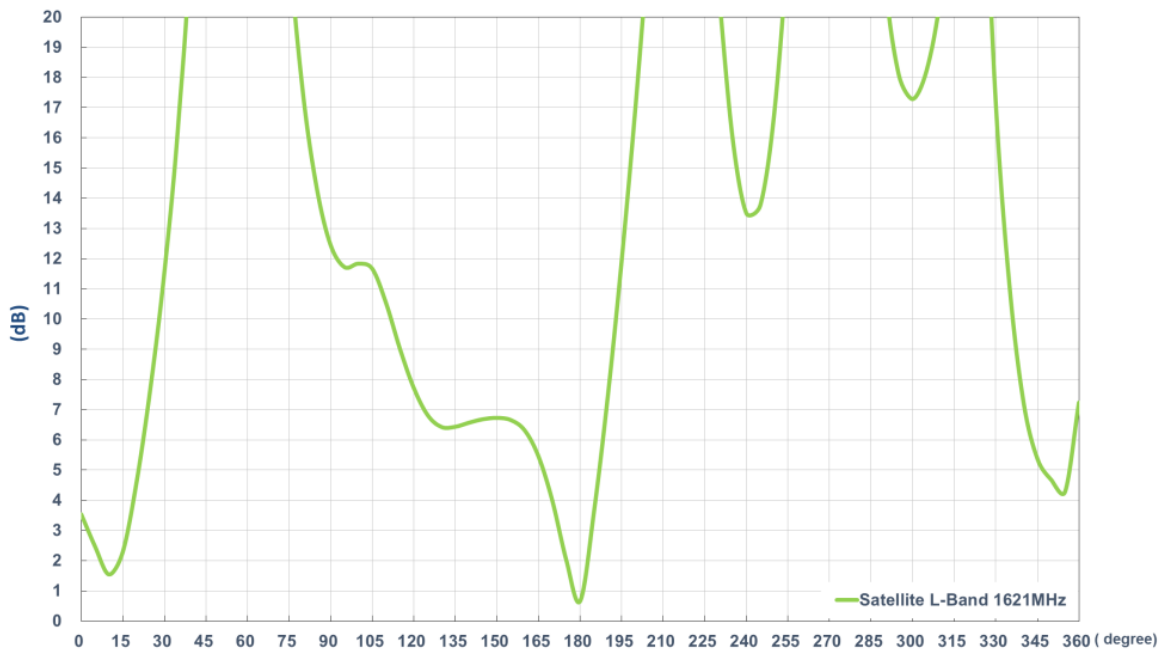


3D Radiation Pattern



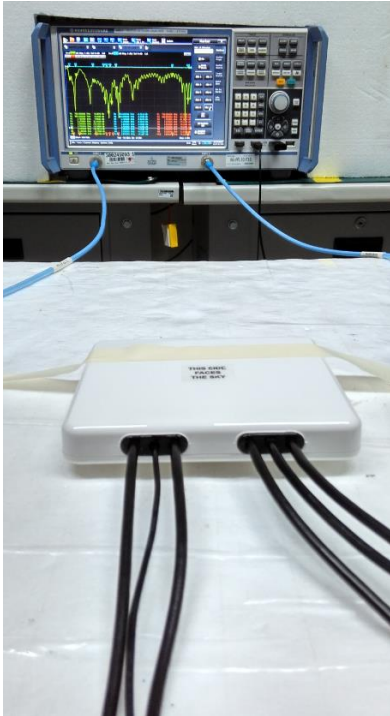
1621MHz

3.2.8 Axial Ratio



3.3 LTE_MIMO/Wi-Fi_MIMO Antenna

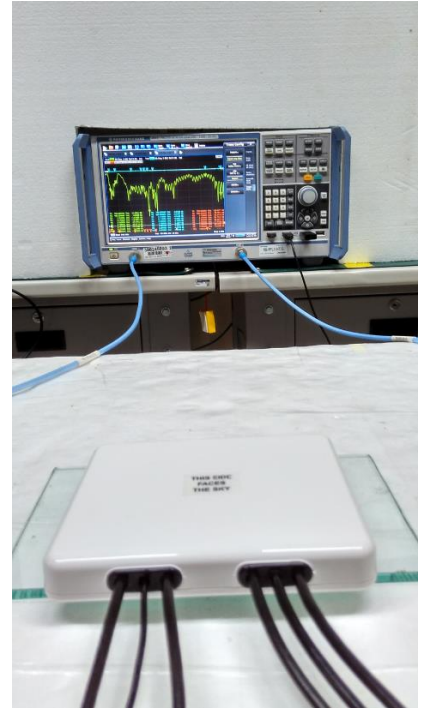
3.3.1 Test Setup



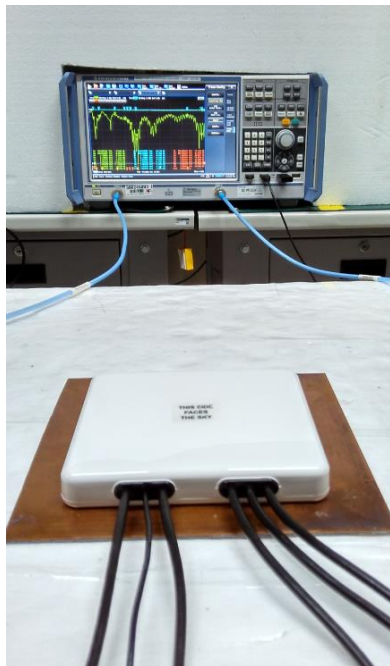
Free space



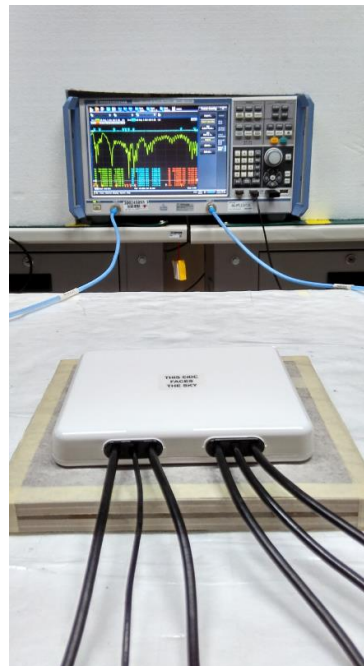
ABS



Glass



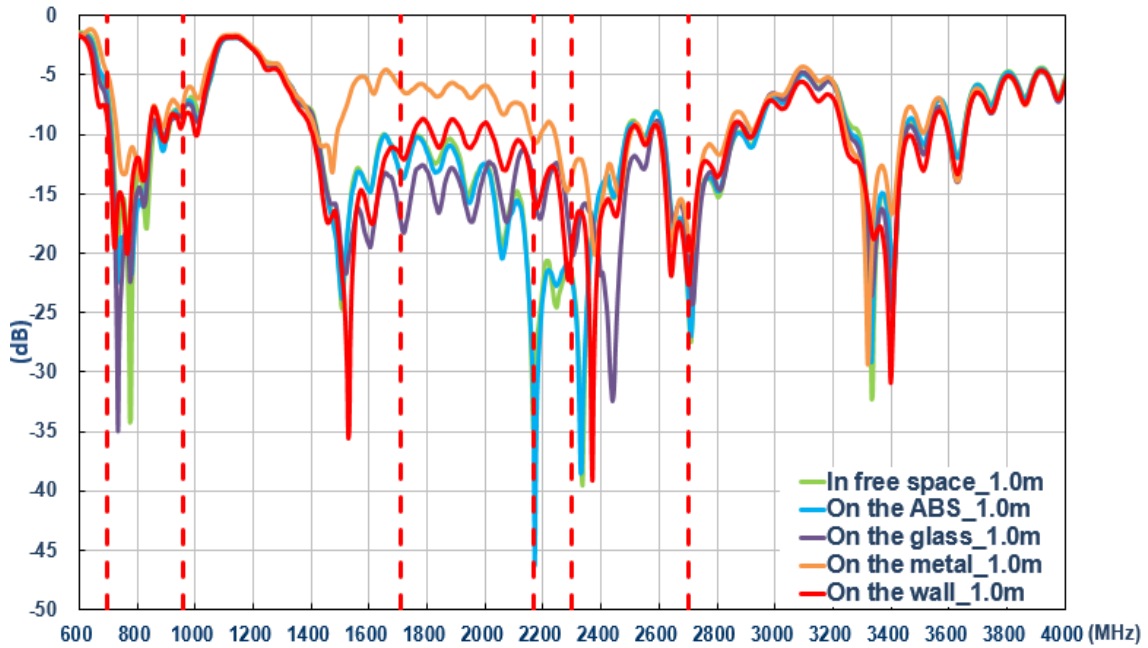
Metal



Wall

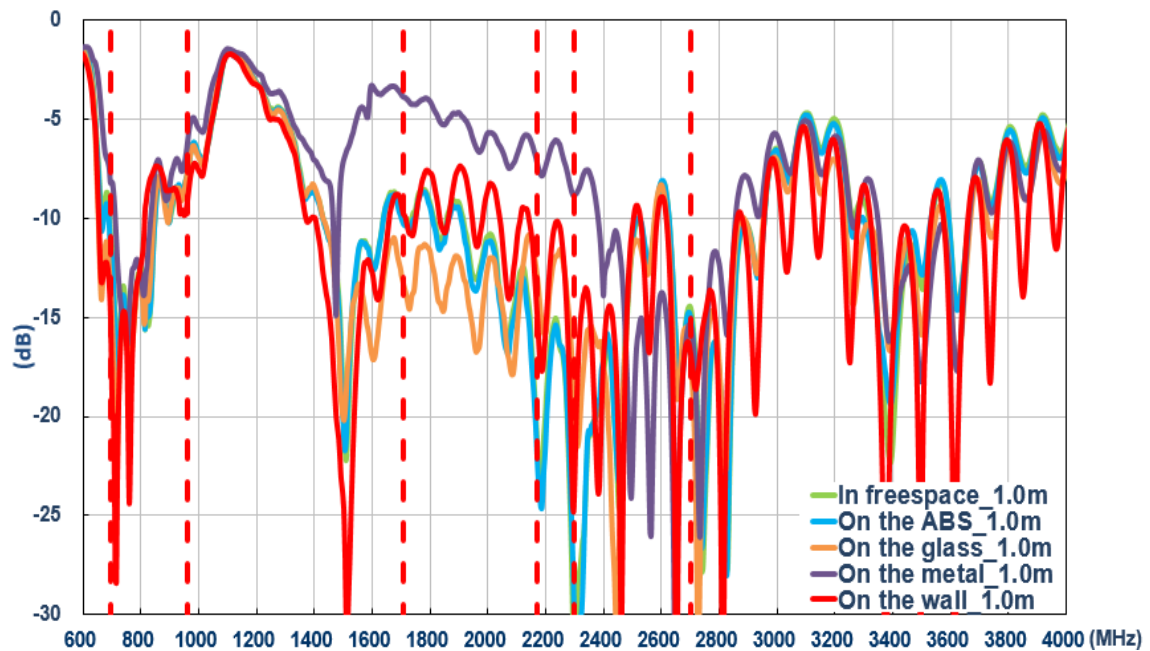
3.3.2 LTE_1 Antenna Return Loss

Performance in different environments with 1 meter cable length



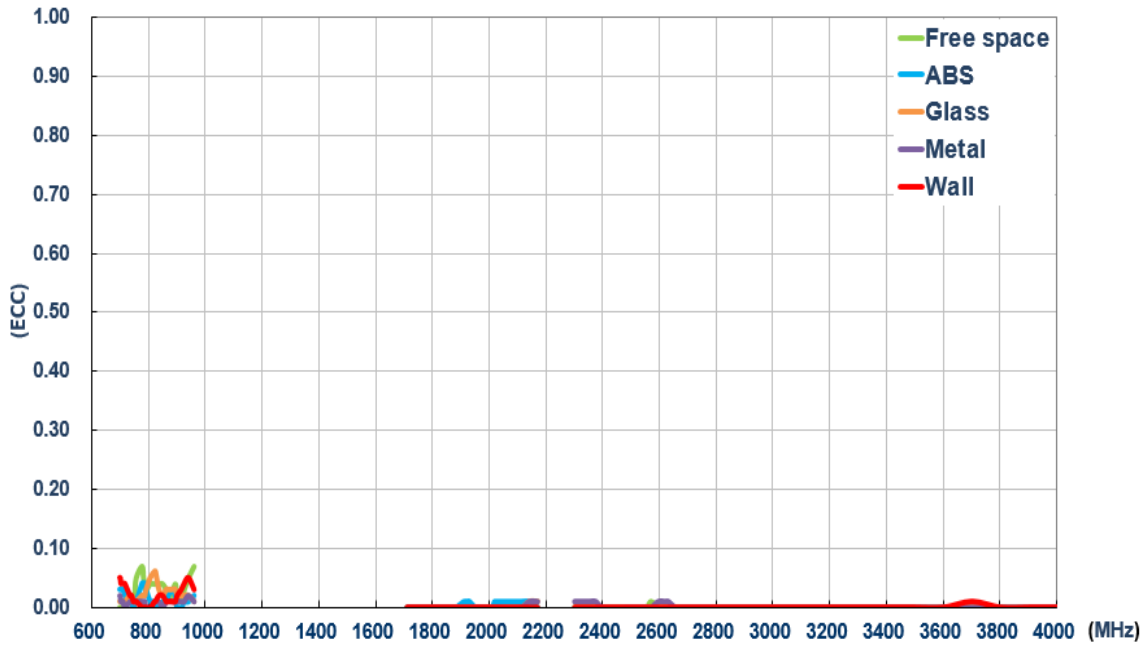
3.3.2 LTE_2 Antenna Return Loss

Performance in different environments with 1 meter cable length



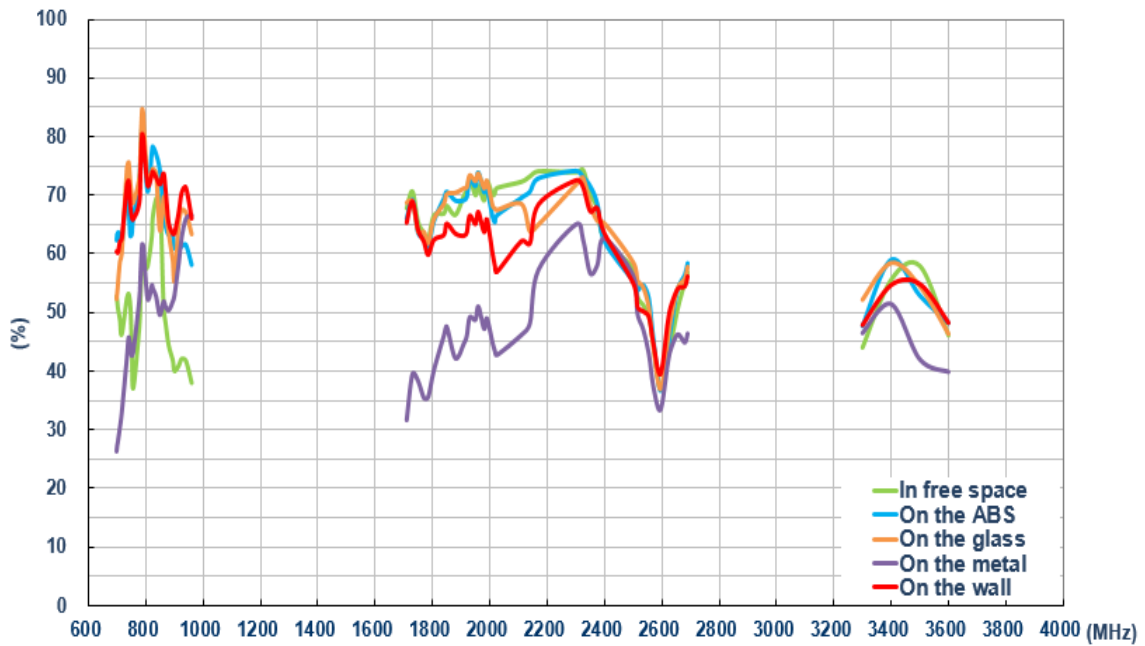
3.3.3 LTE Envelope Correlation Coefficient

Performance in different environments with 1 meter cable length



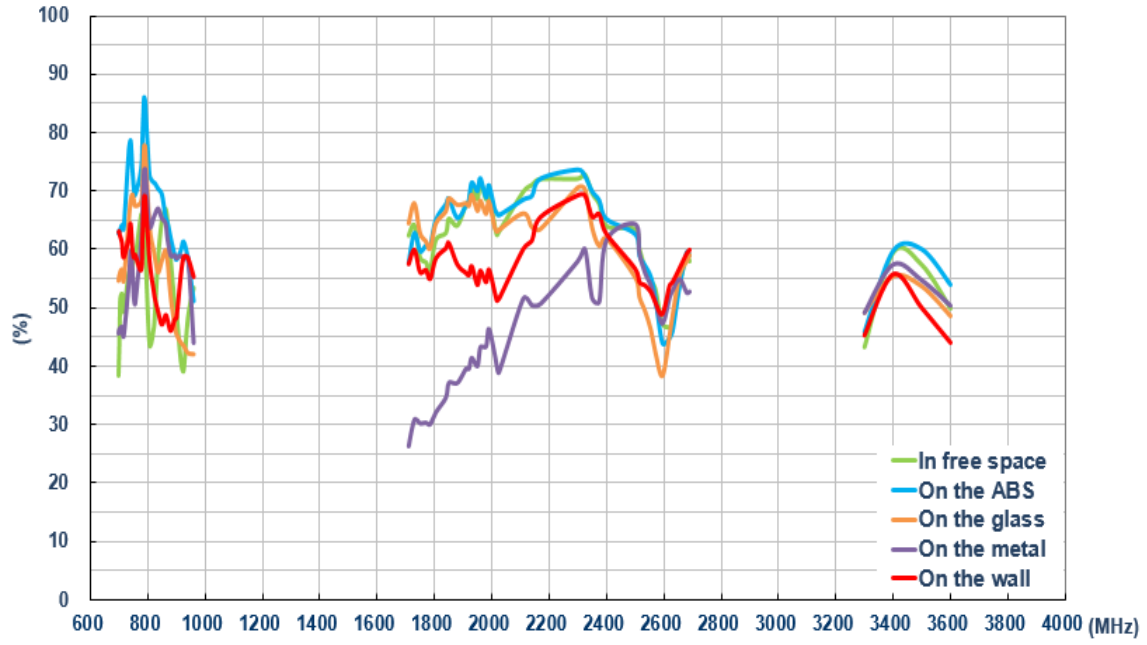
3.3.4 LTE_1 Antenna Efficiency

Performance in different environments with 1 meter cable length



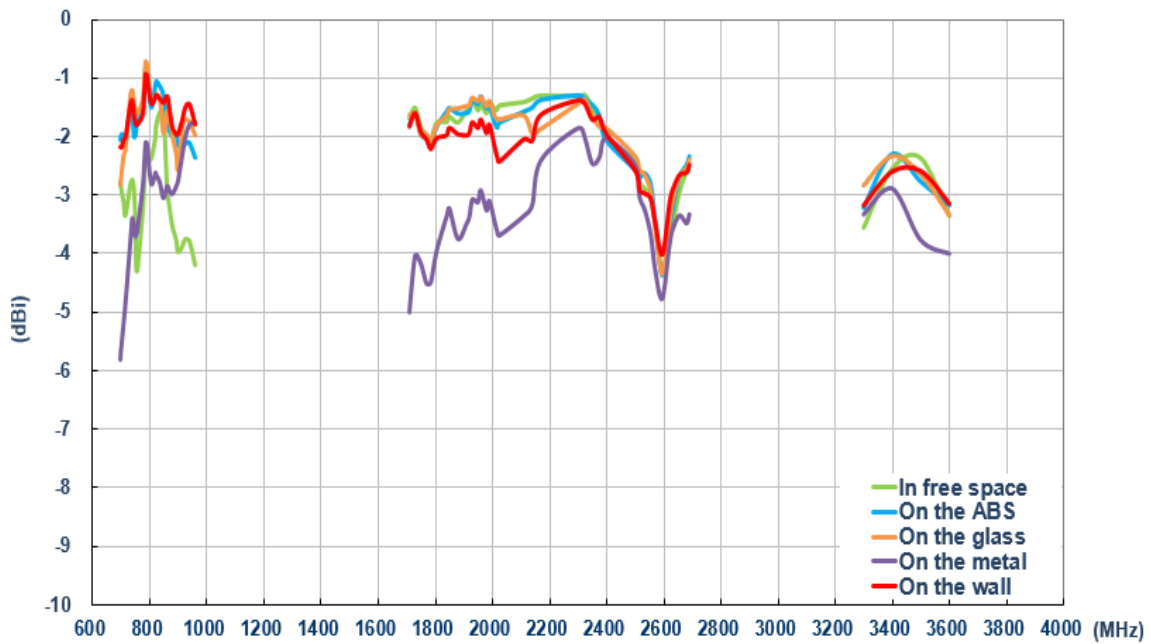
3.3.5 LTE_2 Antenna Efficiency

Performance in different environments with 1 meter cable length



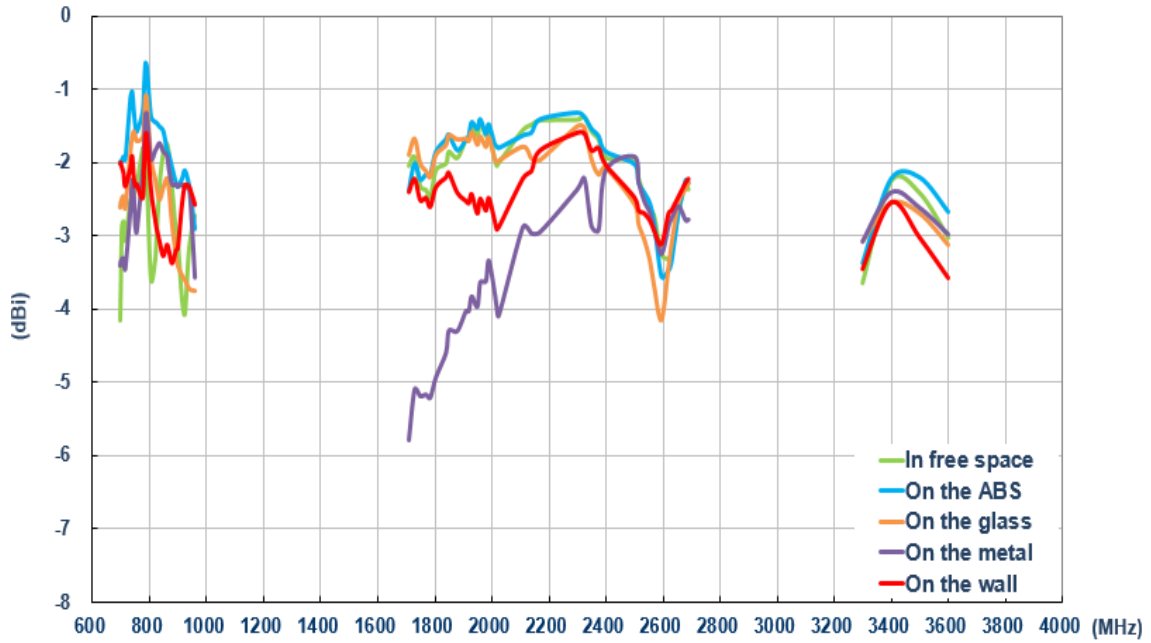
3.3.6 LTE_1 Antenna Average Gain

Performance in different environments with 1 meter cable length



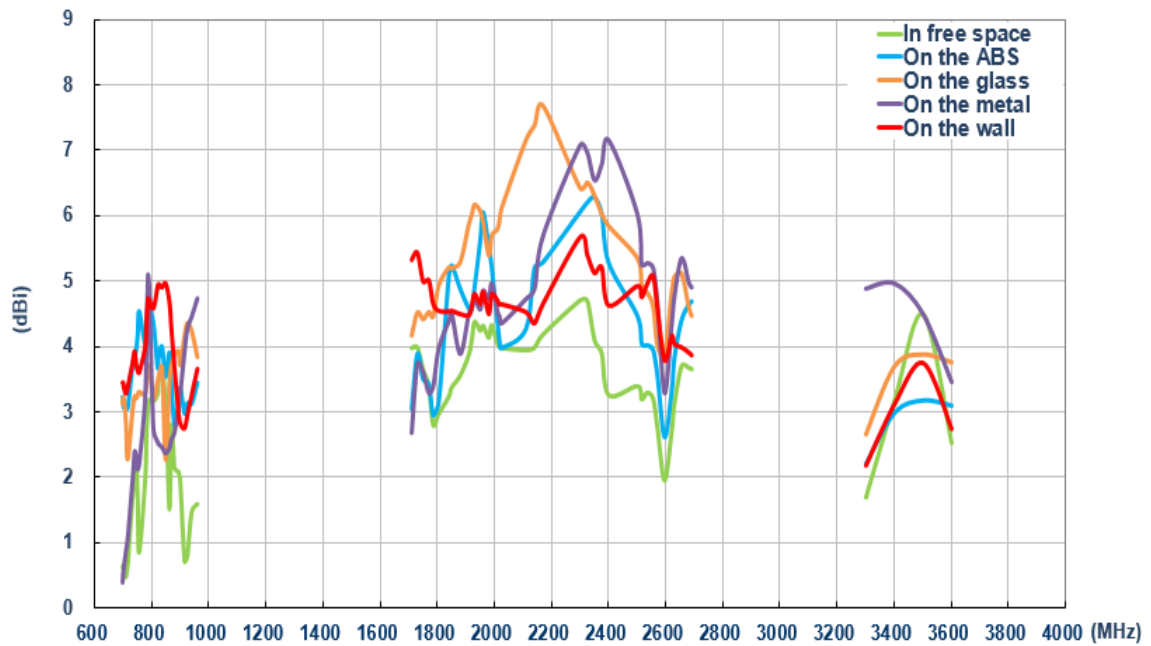
3.3.7 LTE_2 Antenna Average Gain

Performance in different environments with 1 meter cable length



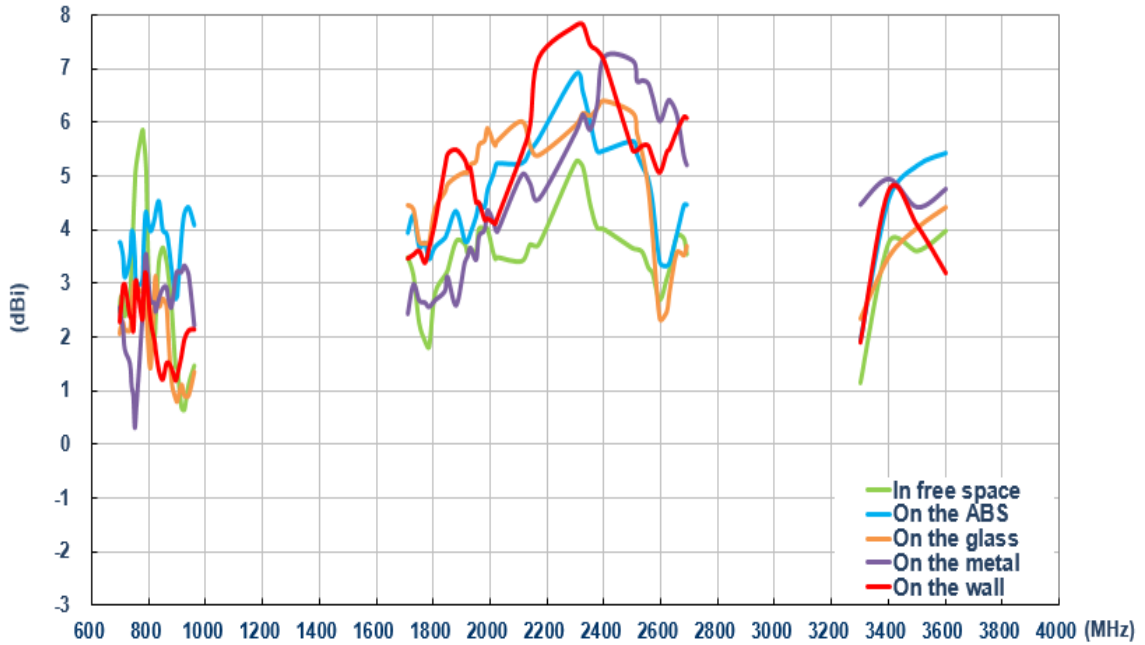
3.3.8 LTE_1 Antenna Peak Gain

Performance in different environments with 1 meter cable length



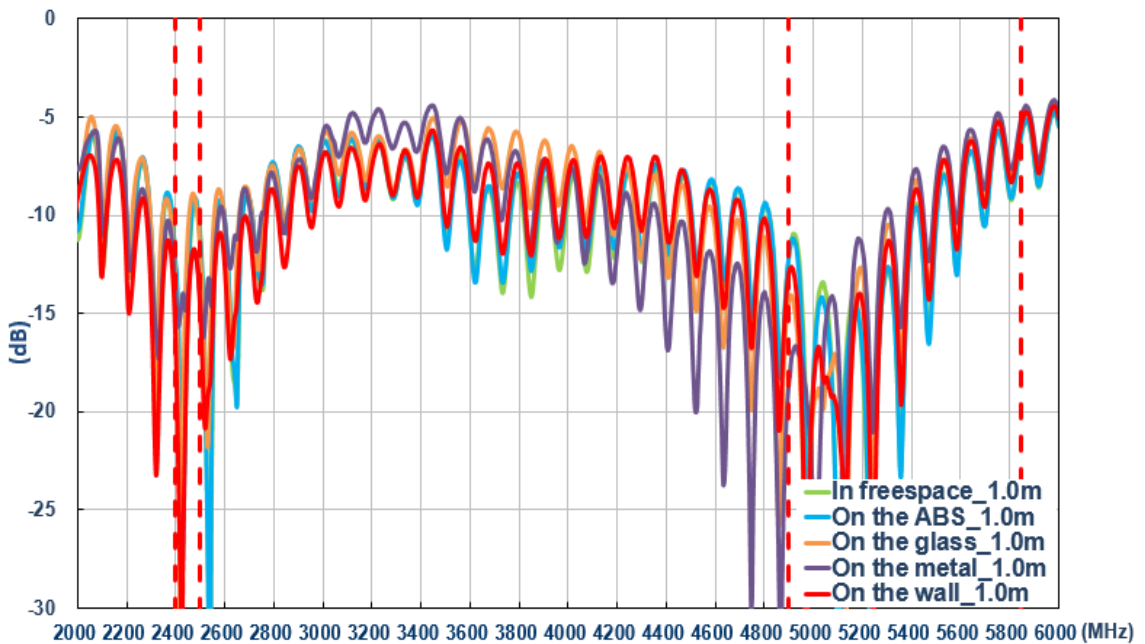
3.3.9 LTE_2 Antenna Peak Gain

Performance in different environments with 1 meter cable length



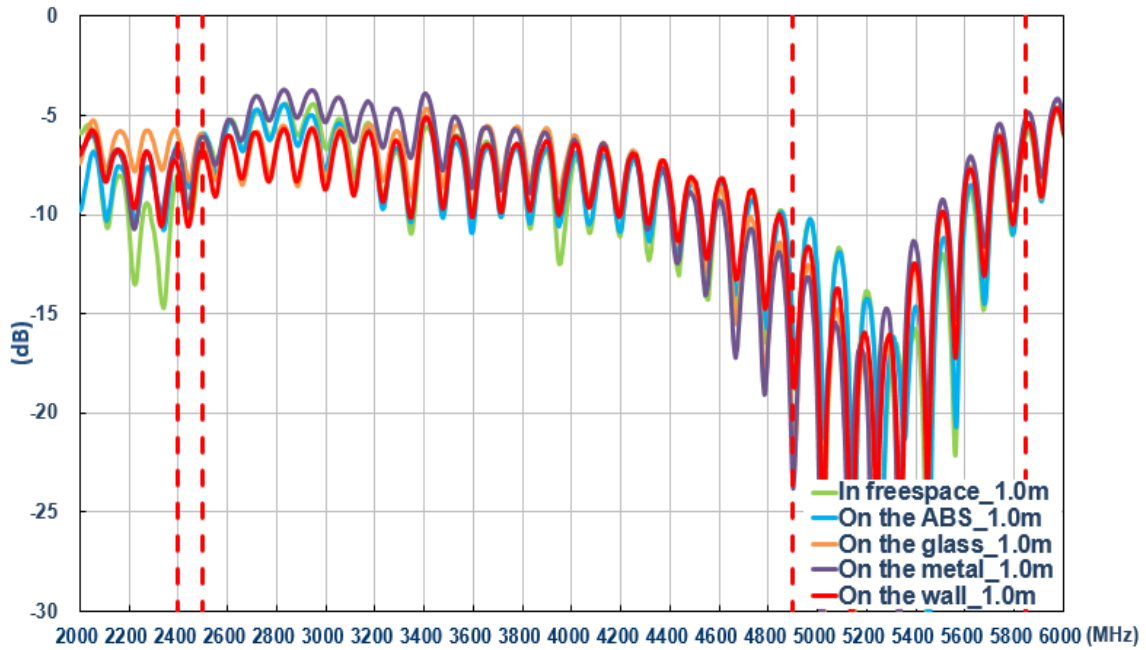
3.3.10 Wi-Fi_1 Antenna Return Loss

Performance in different environments with 1 meter cable length



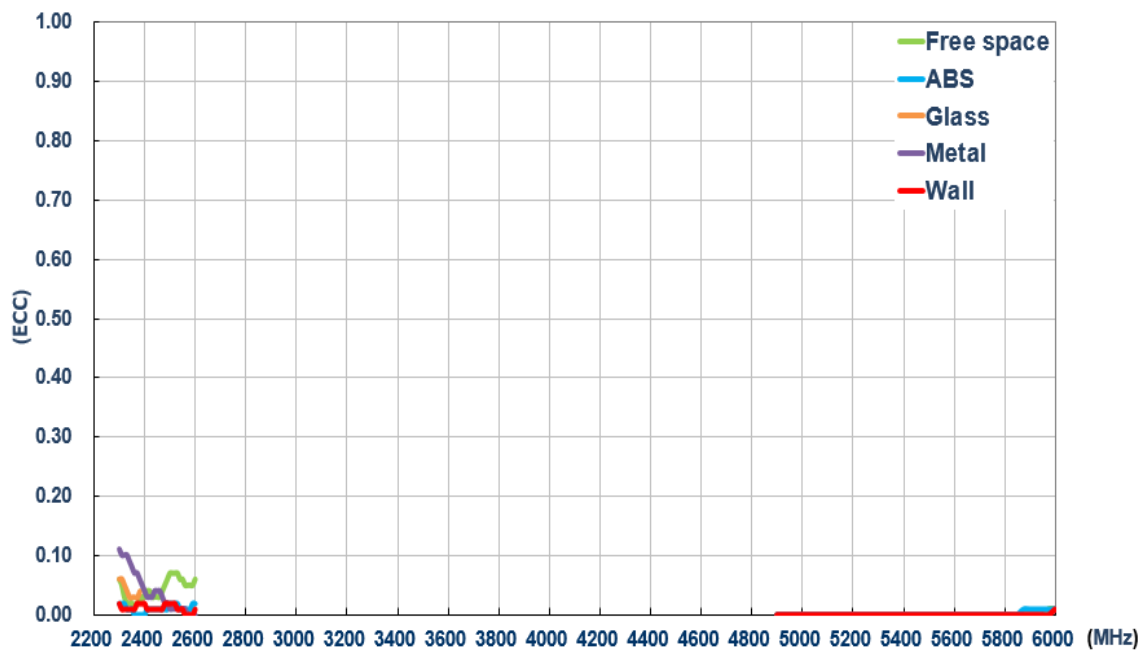
3.3.11 Wi-Fi_2 Antenna Return Loss

Performance in different environments with 1 meter cable length



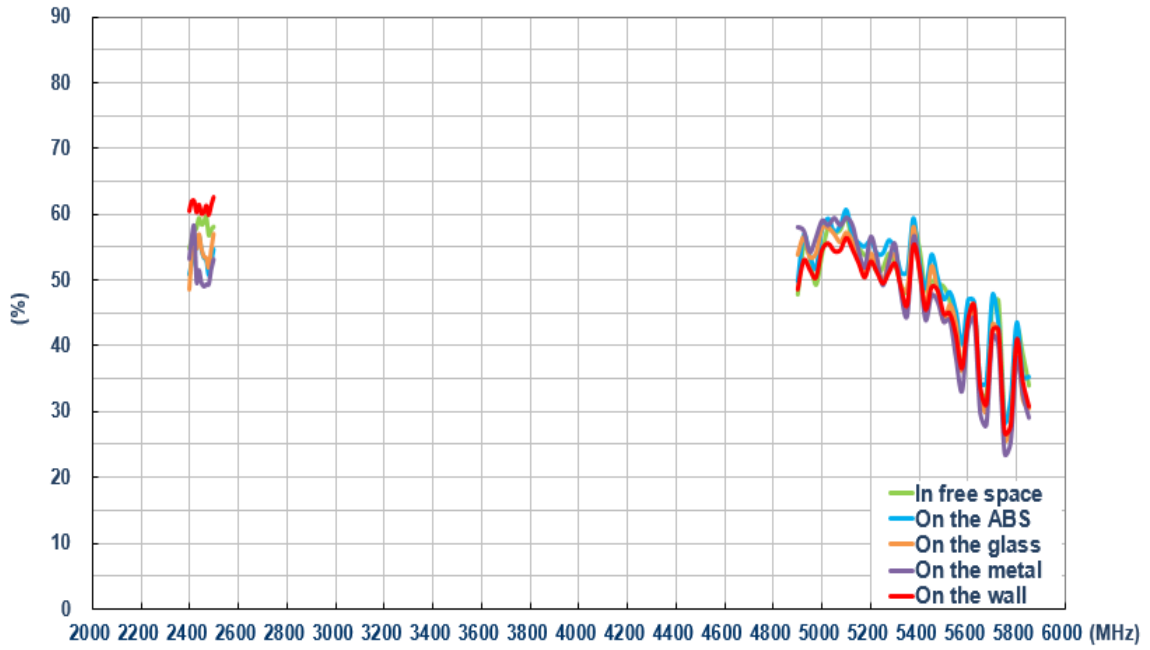
3.3.12 Wi-Fi Envelope Correlation Coefficient

Performance in different environments with 1 meter cable length



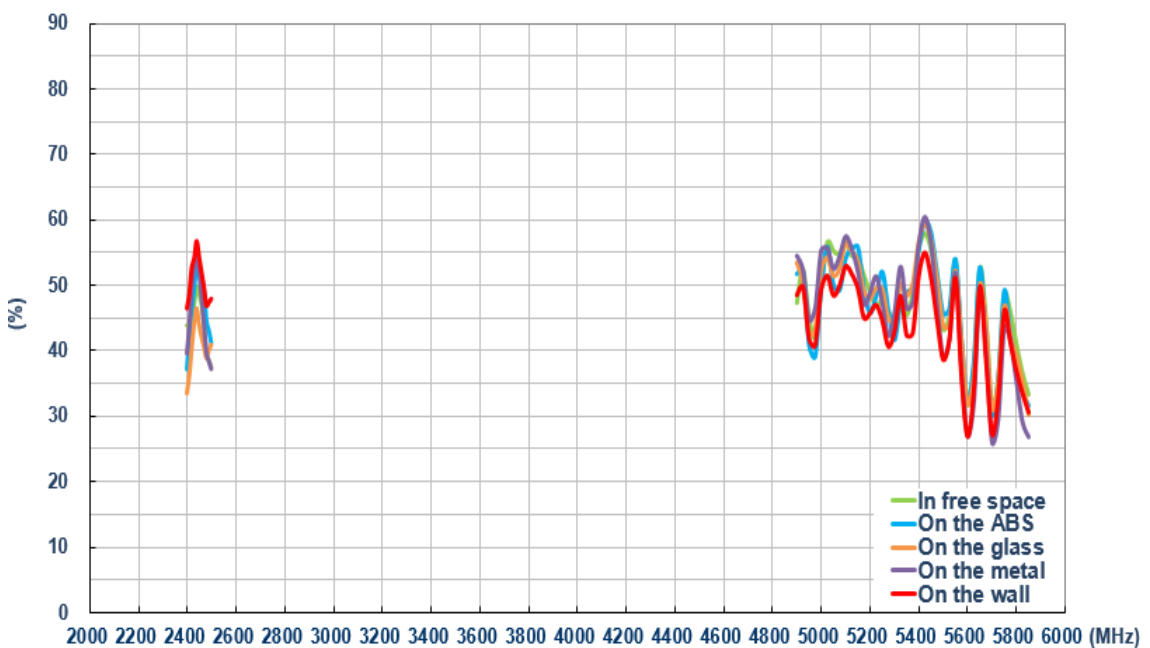
3.3.13 Wi-Fi_1 Antenna Efficiency

Performance in different environments with 1 meter cable length



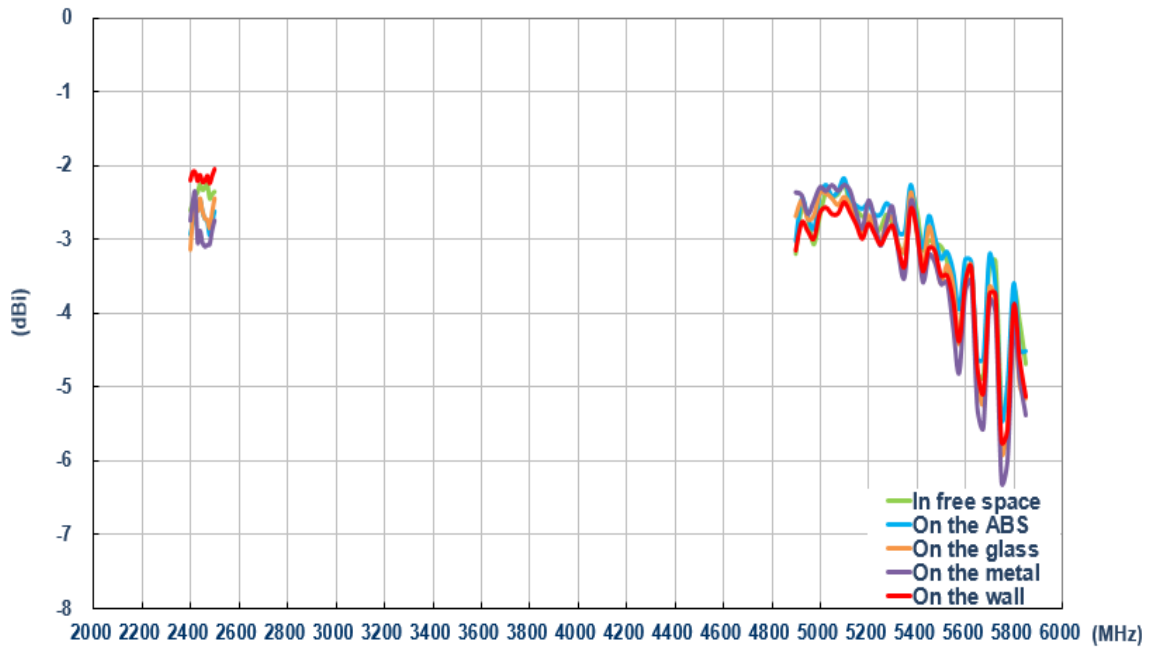
3.3.14 Wi-Fi_2 Antenna Efficiency

Performance in different environments with 1 meter cable length



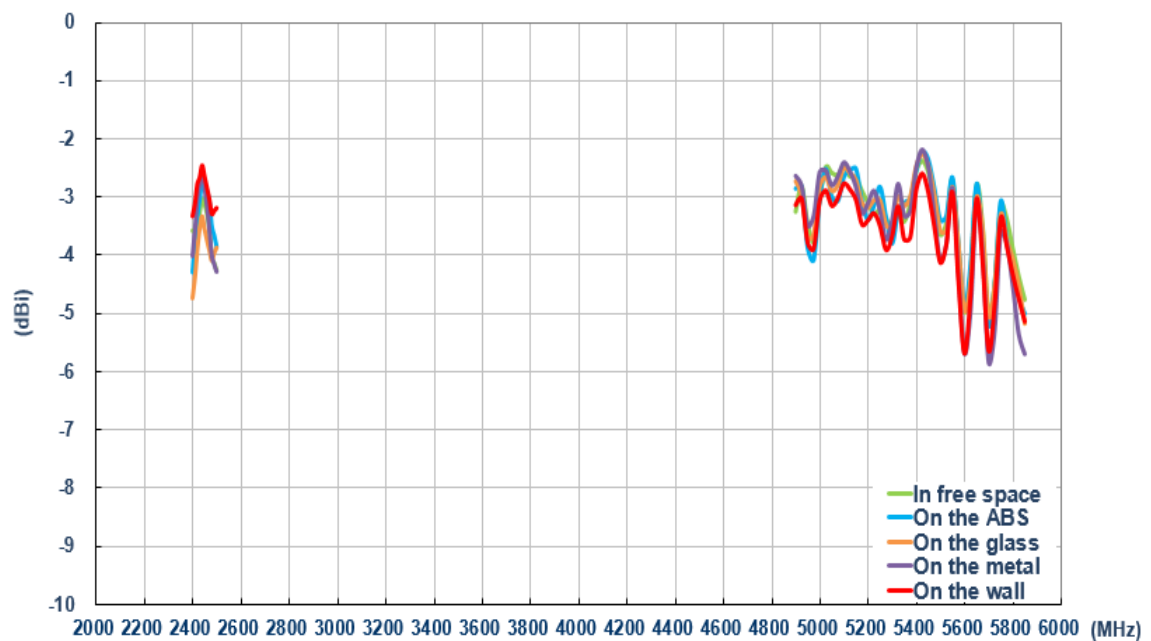
3.3.15 Wi-Fi_1 Antenna Average Gain

Performance in different environments with 1 meter cable length



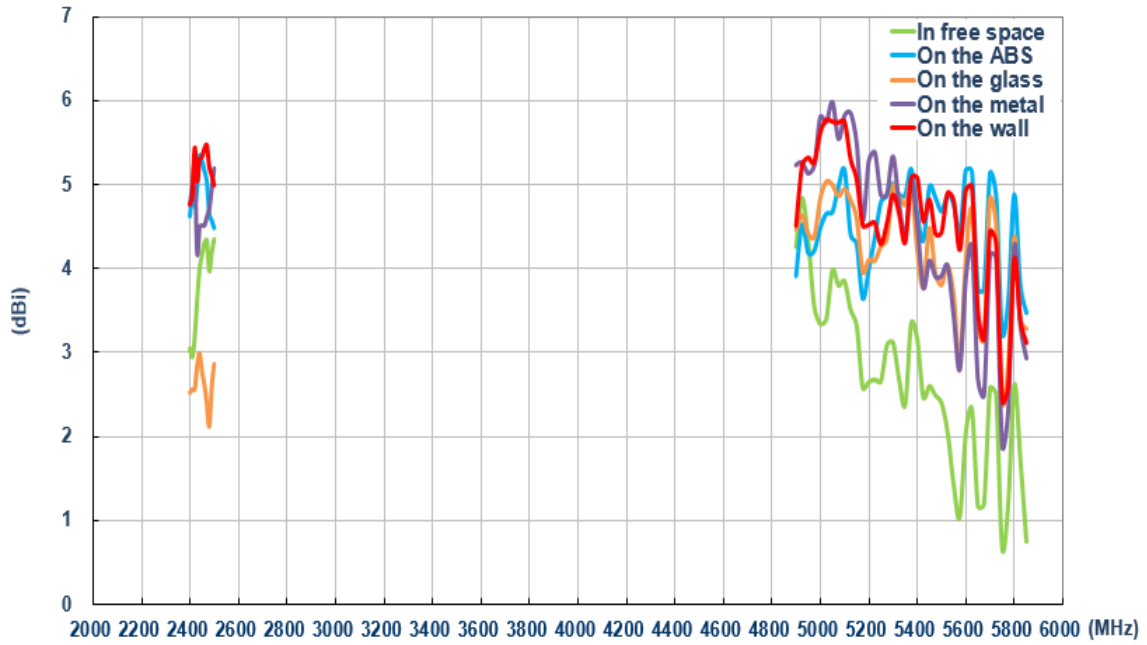
3.3.16 Wi-Fi_2 Antenna Average Gain

Performance in different environments with 1 meter cable length



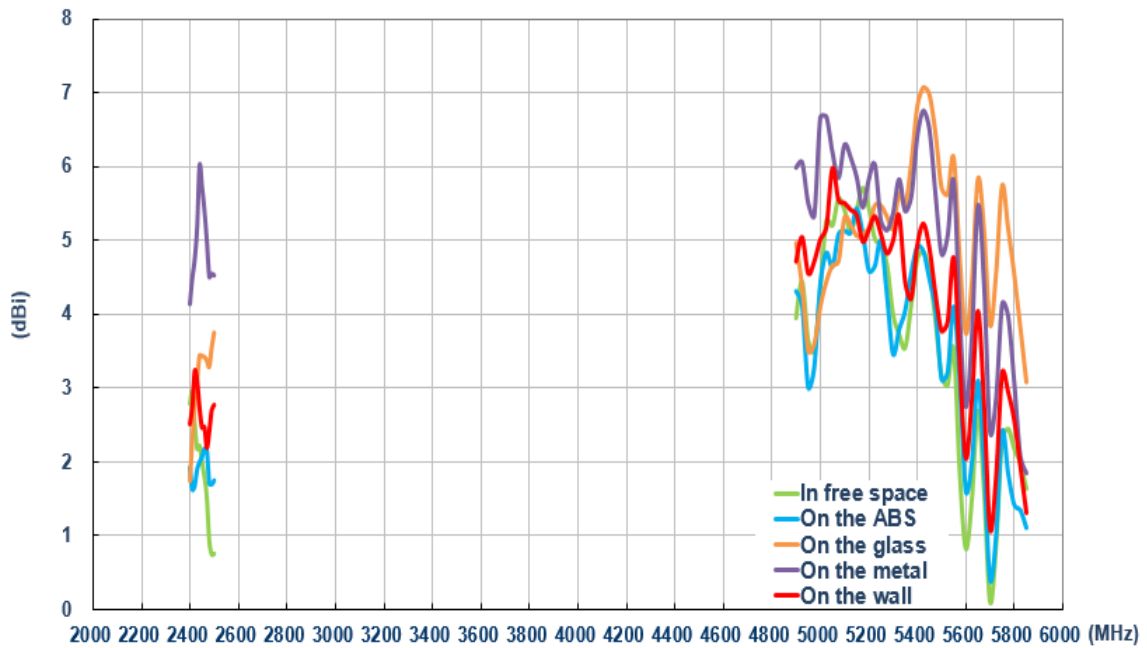
3.3.17 Wi-Fi_1 Antenna Peak Gain

Performance in different environments with 1 meter cable length

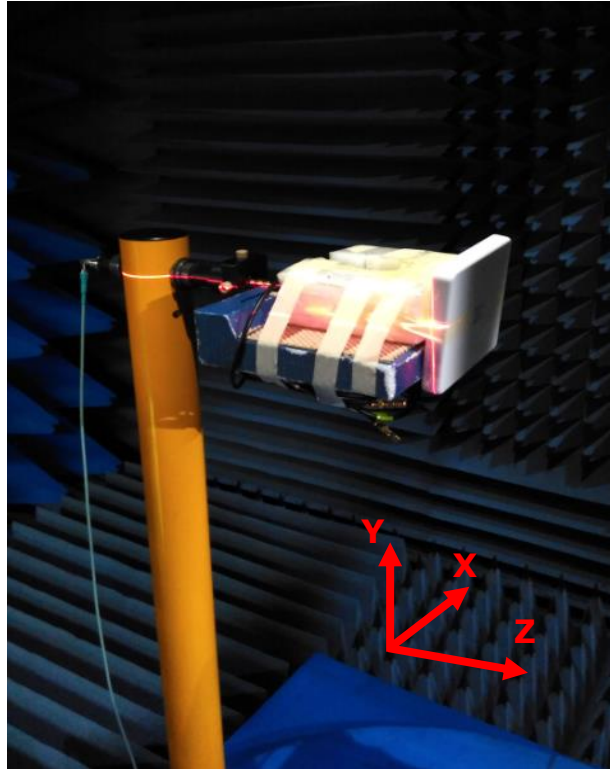


3.3.18 Wi-Fi_2 Antenna Peak Gain

Performance in different environments with 1 meter cable length



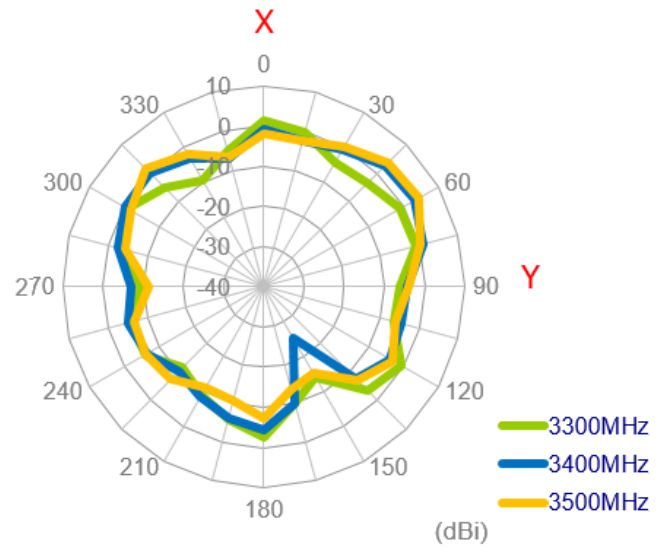
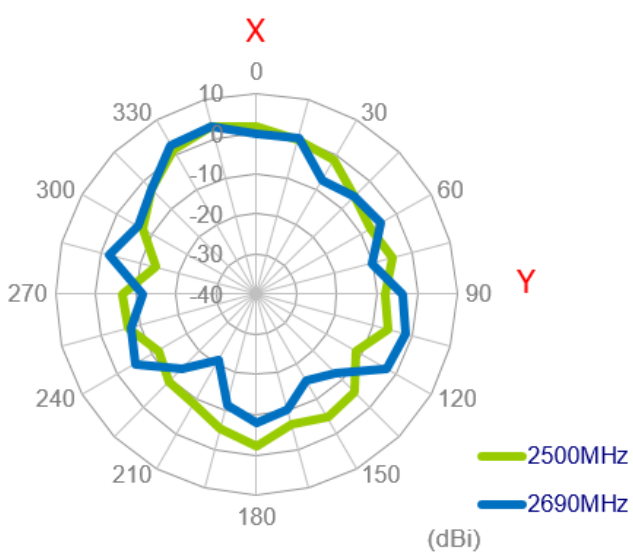
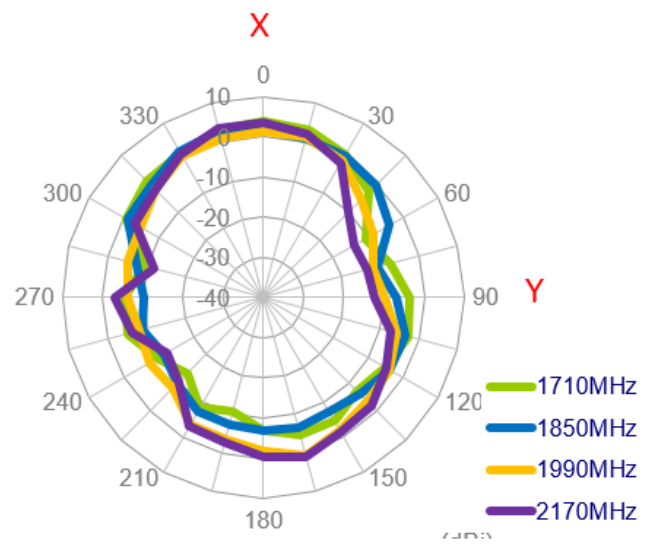
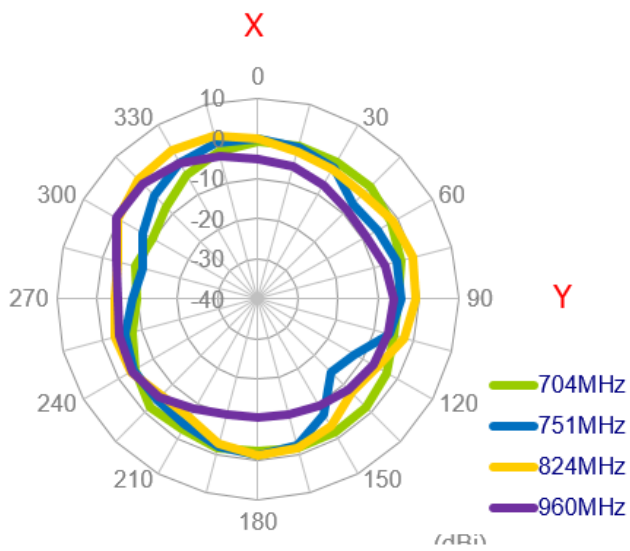
3.3.19 Test Setup for Antenna Radiation Pattern



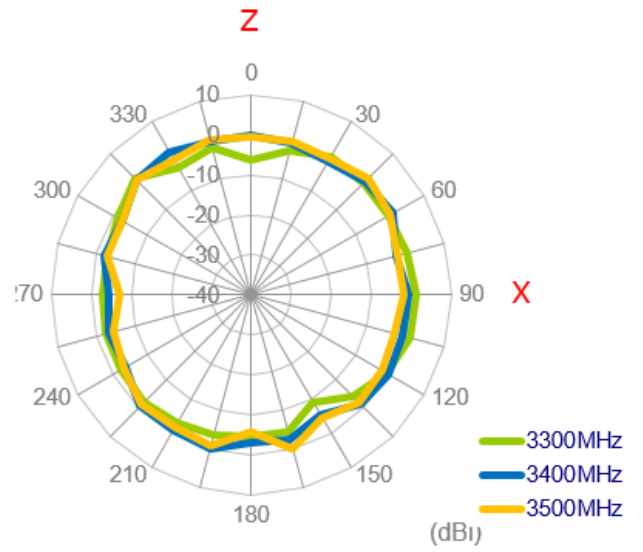
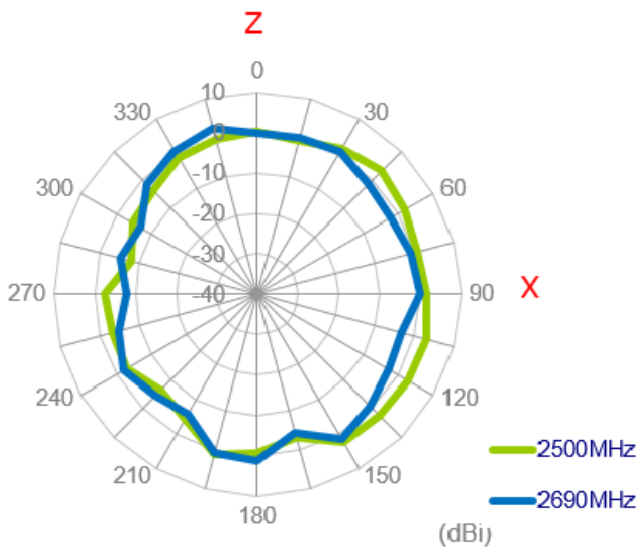
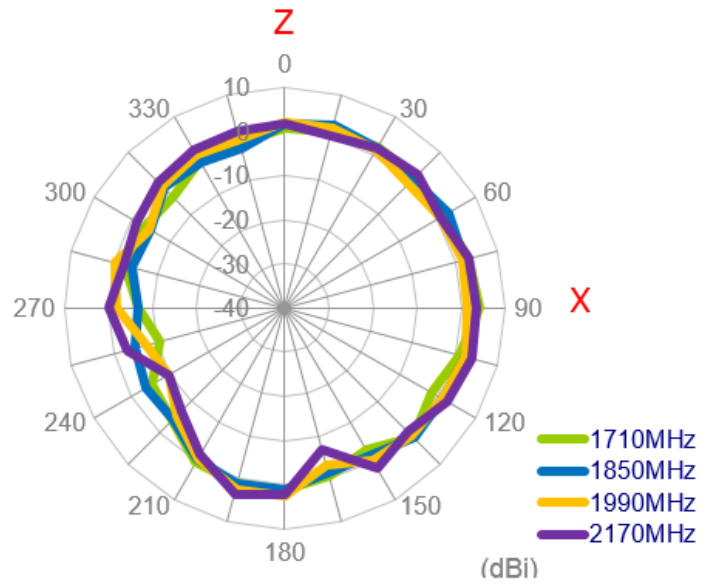
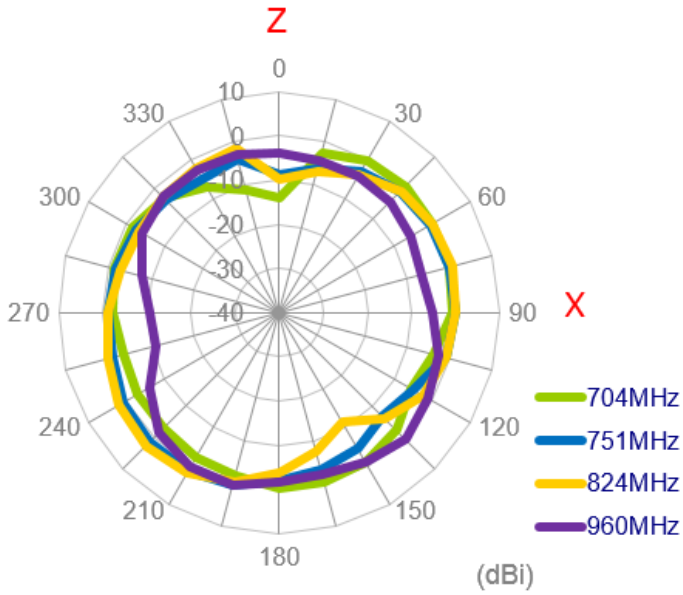
In free space

3.3.20 2D Radiation Pattern (LTE_MIMO1 with 1M cable length in free space)

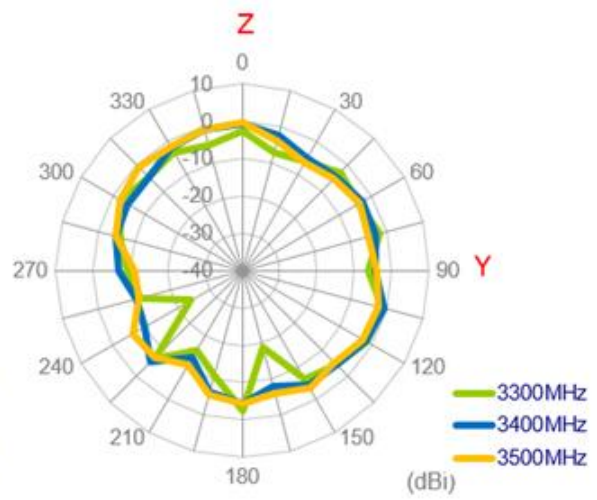
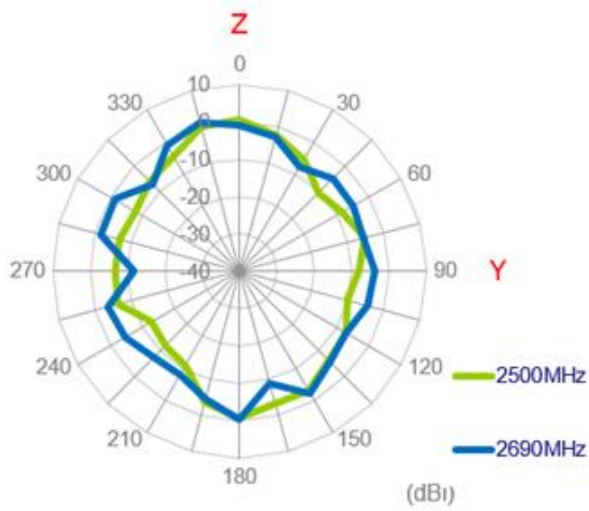
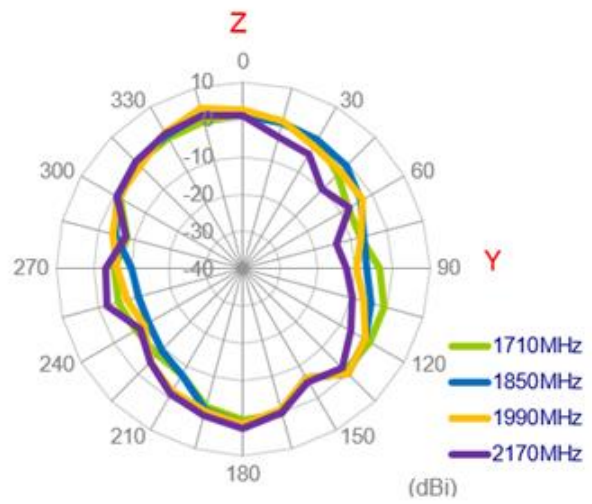
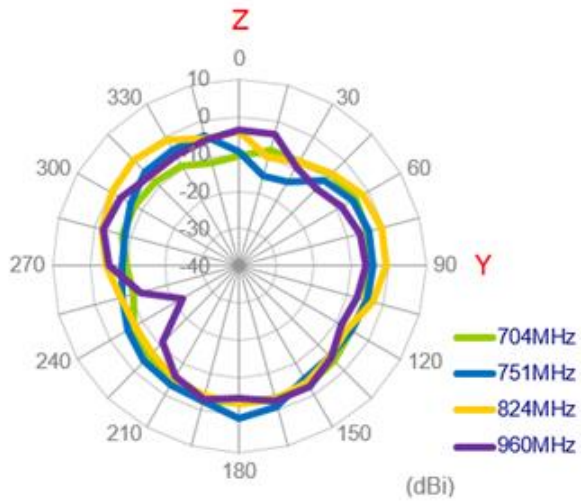
XY Plane



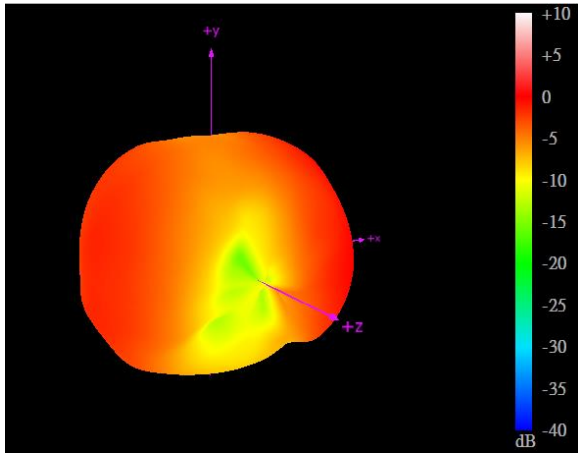
XZ Plane



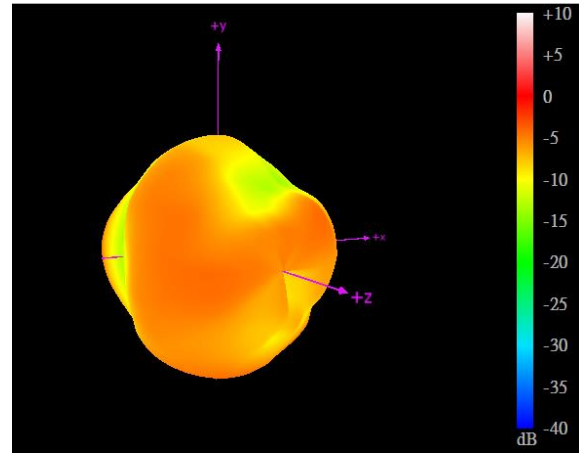
YZ Plane



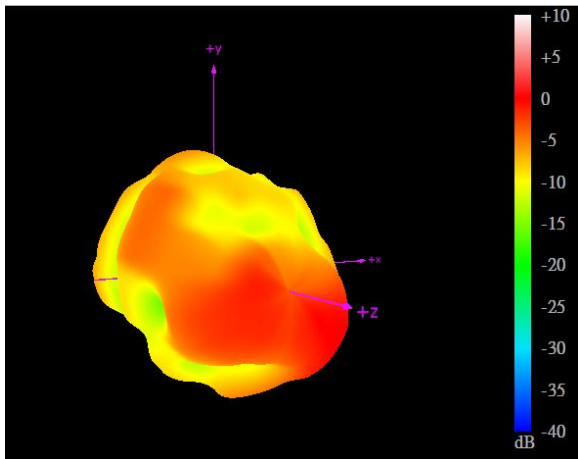
3.3.21 3D Radiation Pattern (LTE_MIMO1 with 1M cable length in free space)



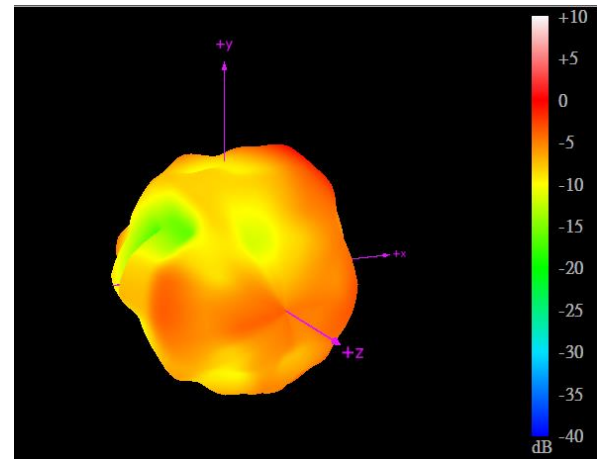
704MHz



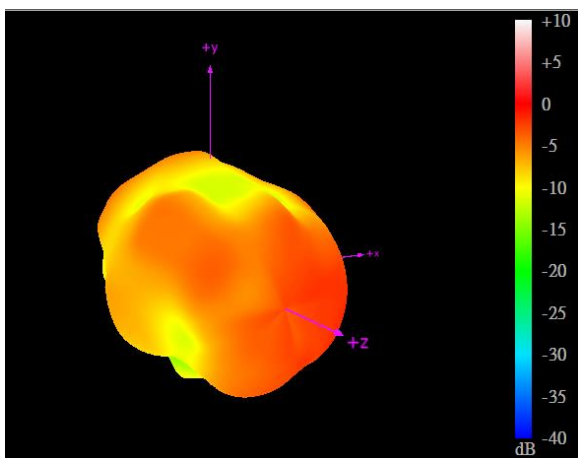
960MHz



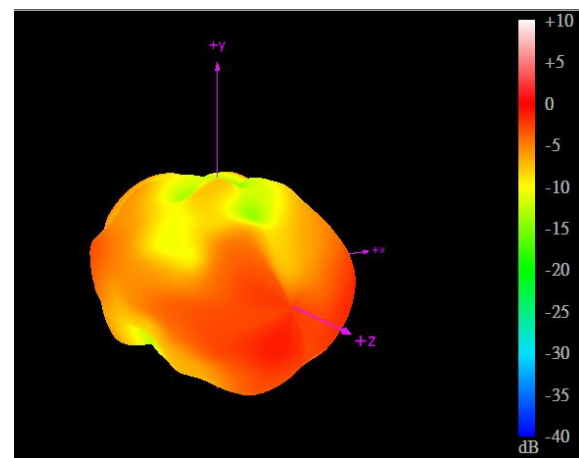
1710MHz



2170MHz



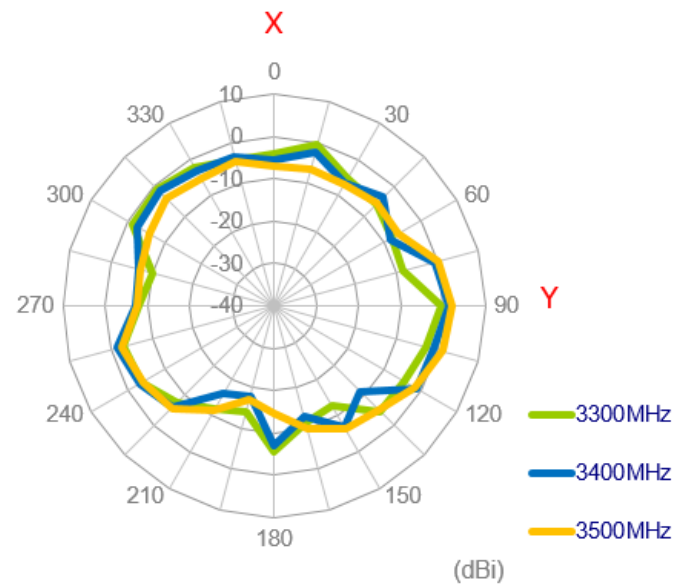
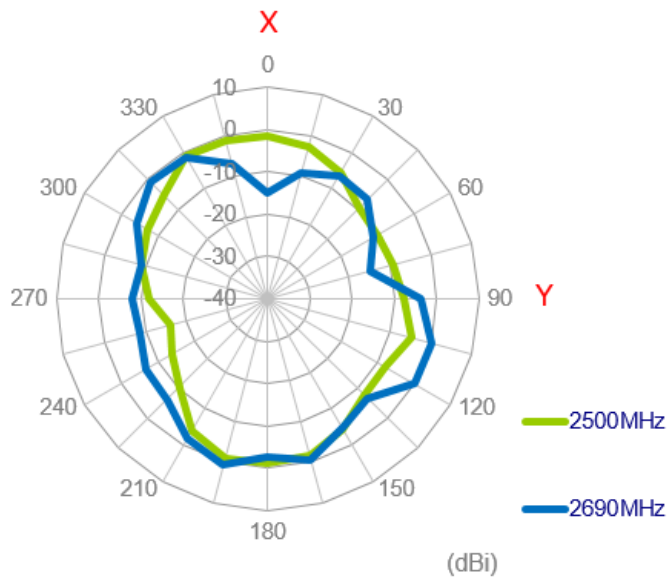
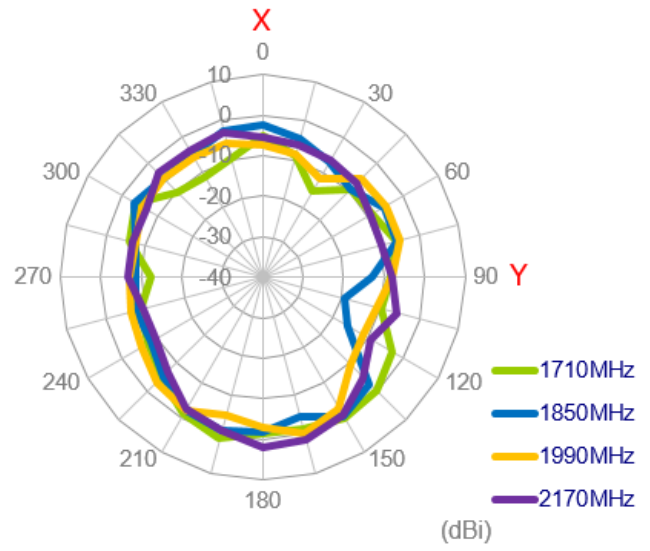
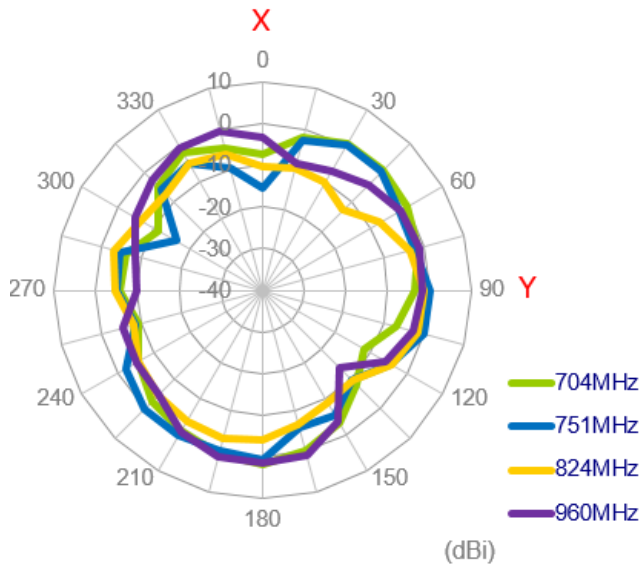
2690MHz



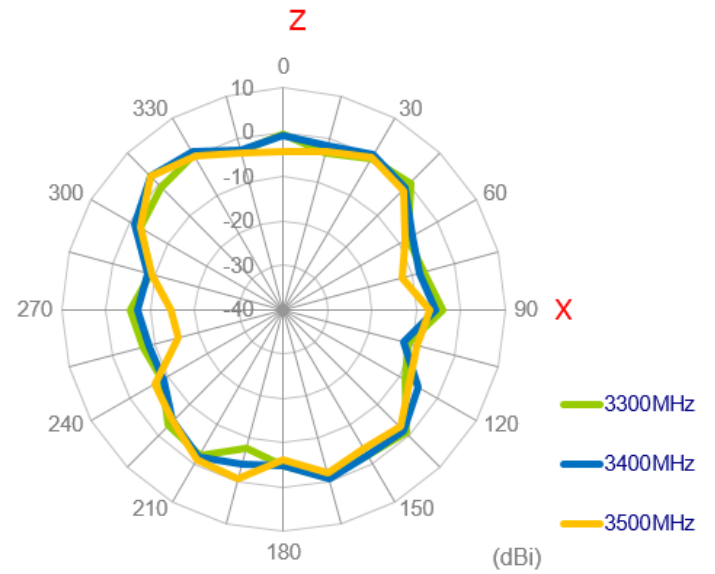
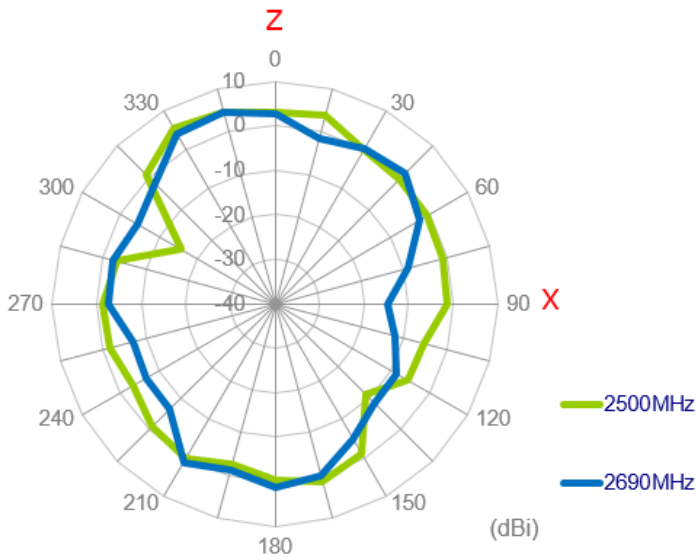
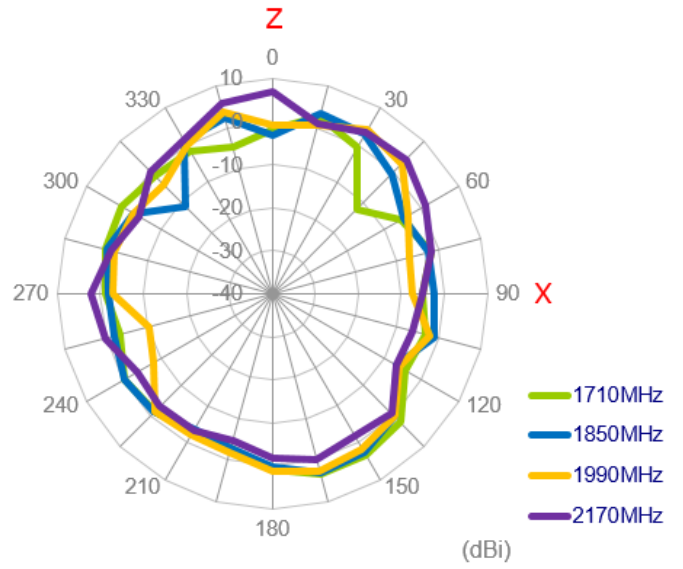
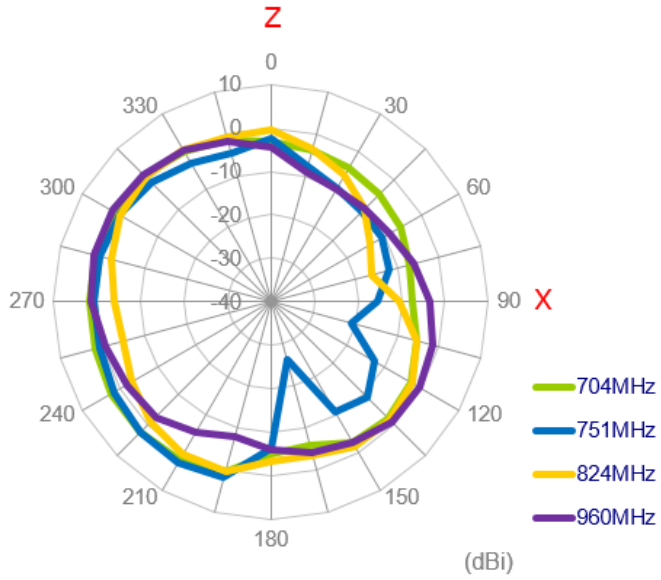
3500MHz

3.3.22 2D Radiation Pattern (LTE_MIMO2 with 1M cable length in free space)

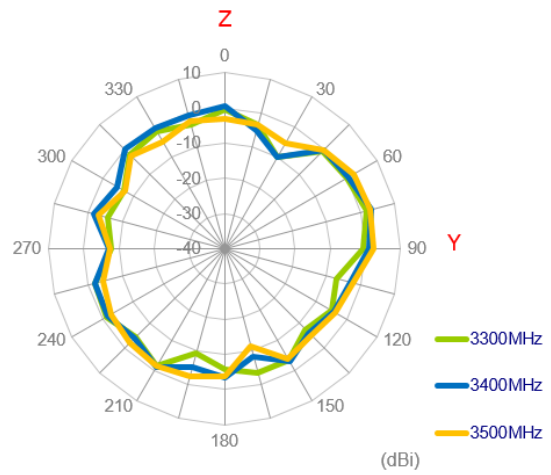
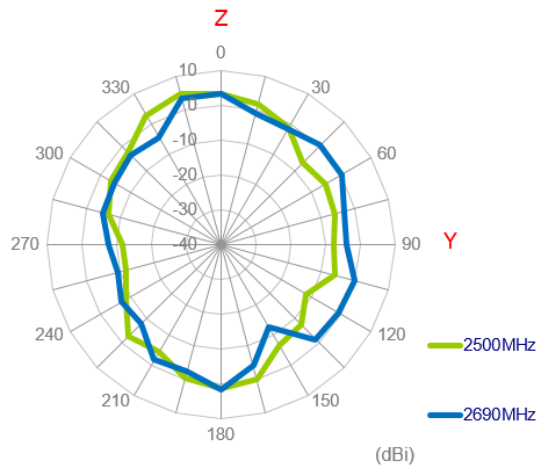
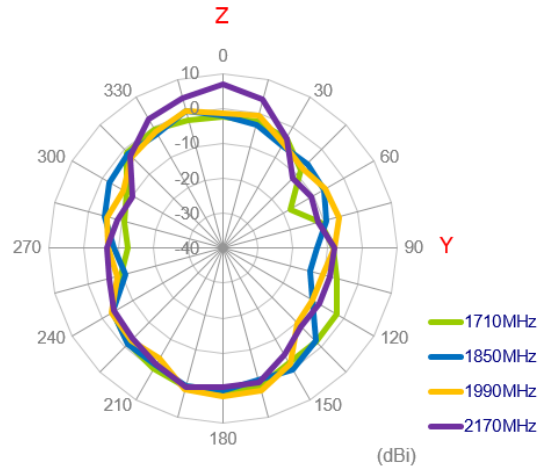
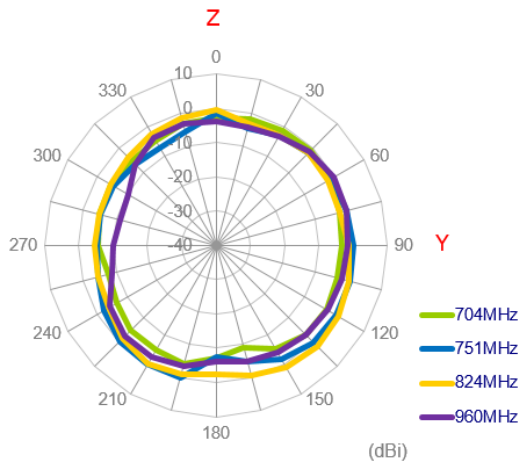
XY Plane



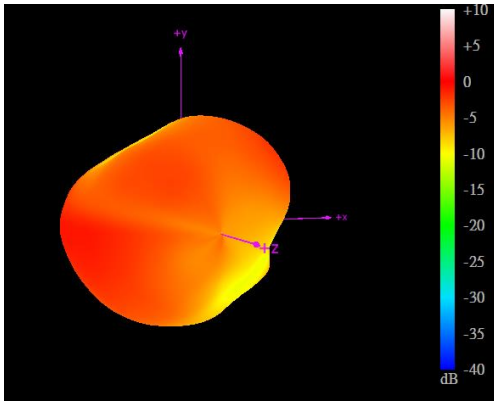
XZ Plane



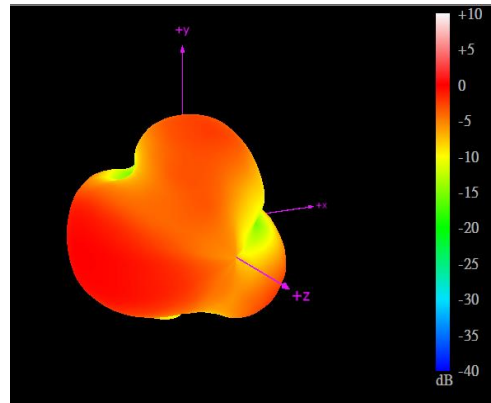
YZ Plane



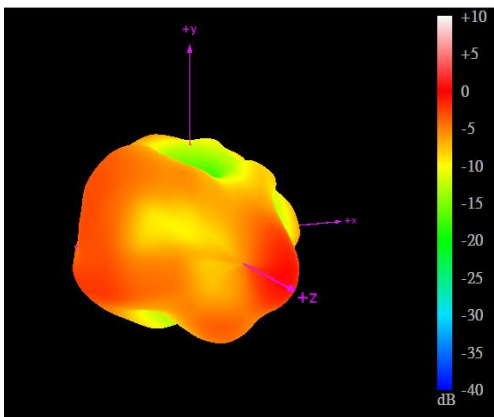
3.3.23 3D Radiation Pattern (LTE_MIMO2 with 1M cable length in free space)



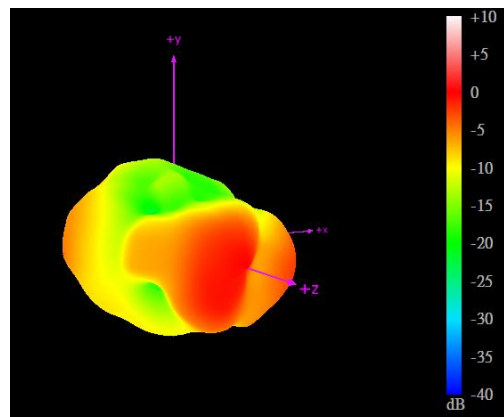
704MHz



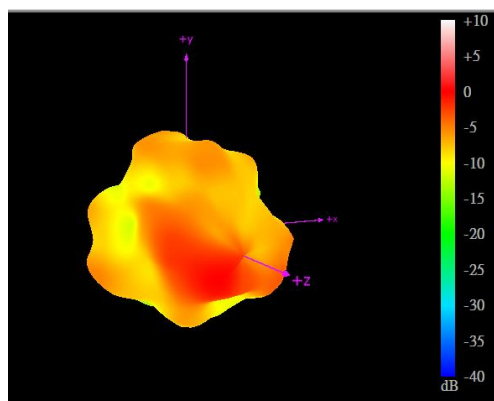
960MHz



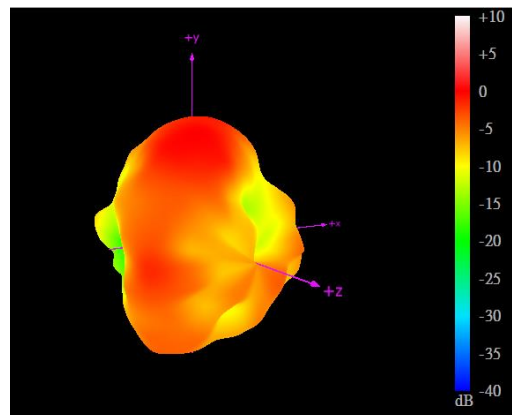
1710MHz



2170MHz



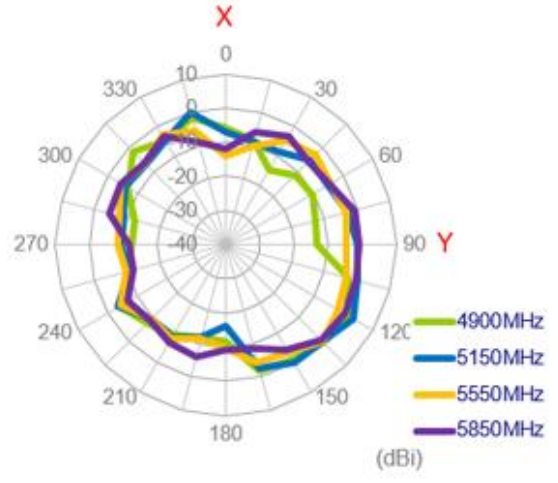
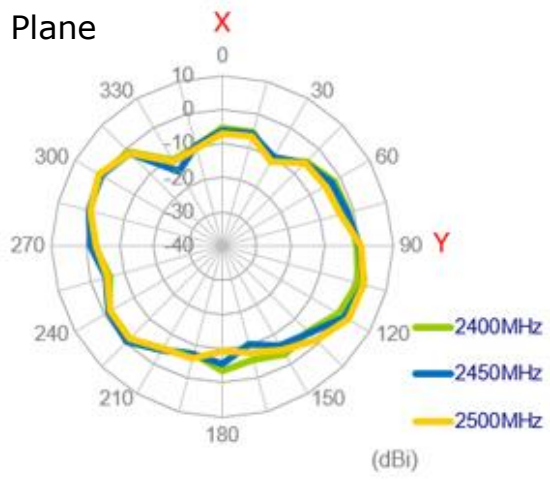
2690MHz



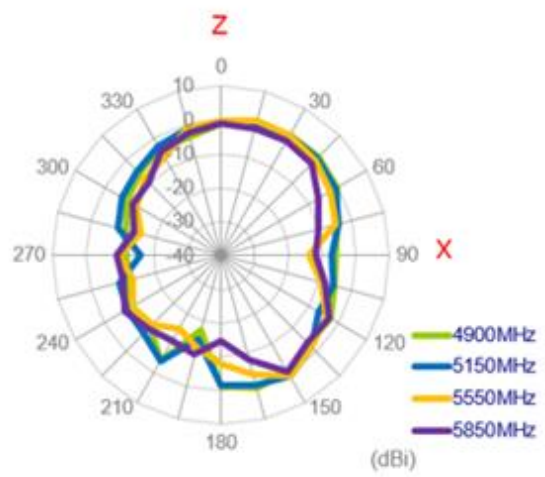
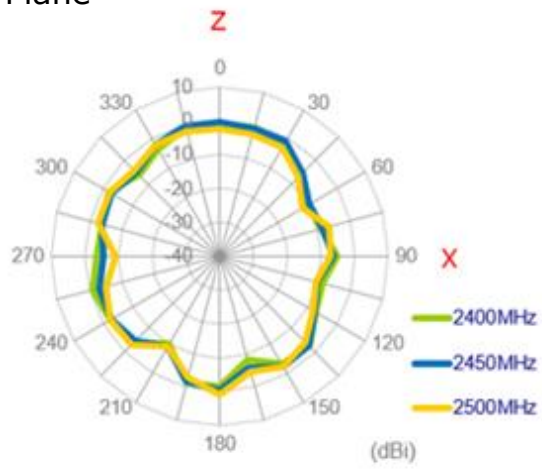
3500MHz

3.3.24 2D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length in free space)

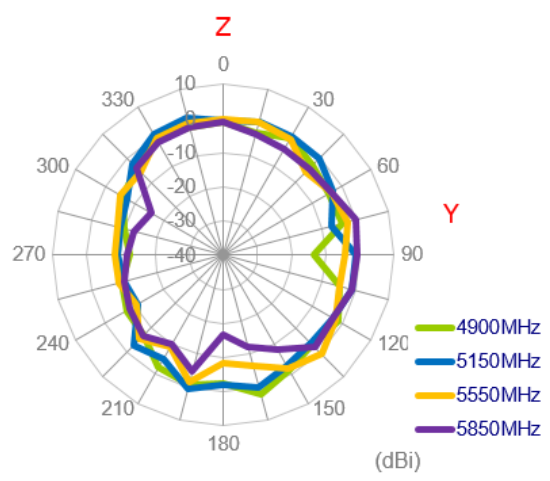
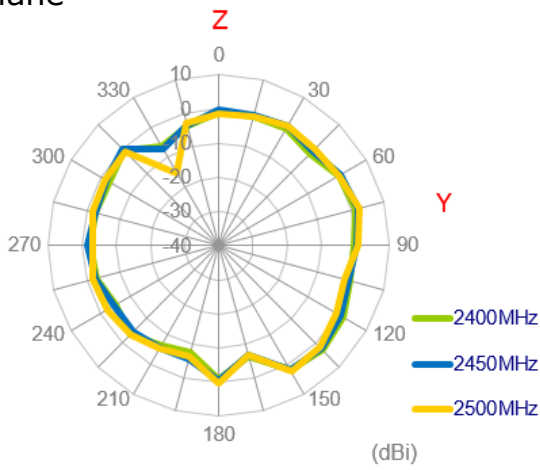
XY Plane



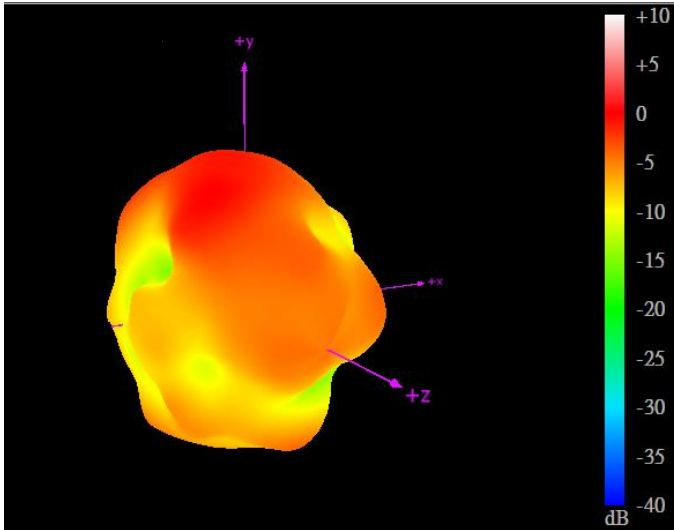
XZ Plane



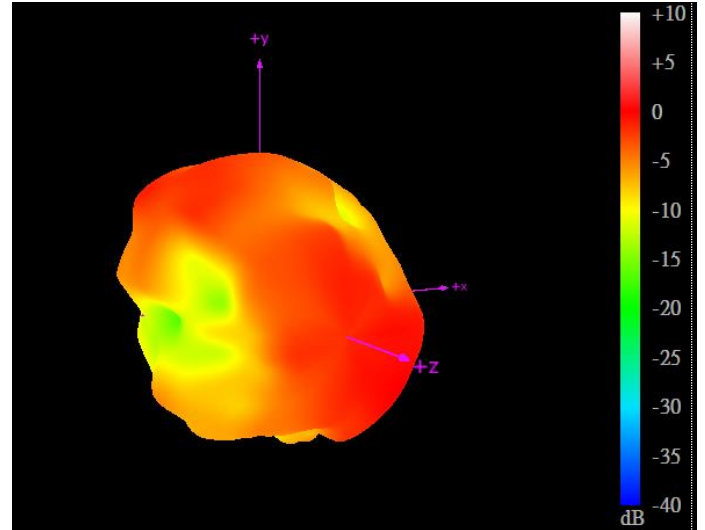
YZ Plane



3.3.25 3D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length in free space)



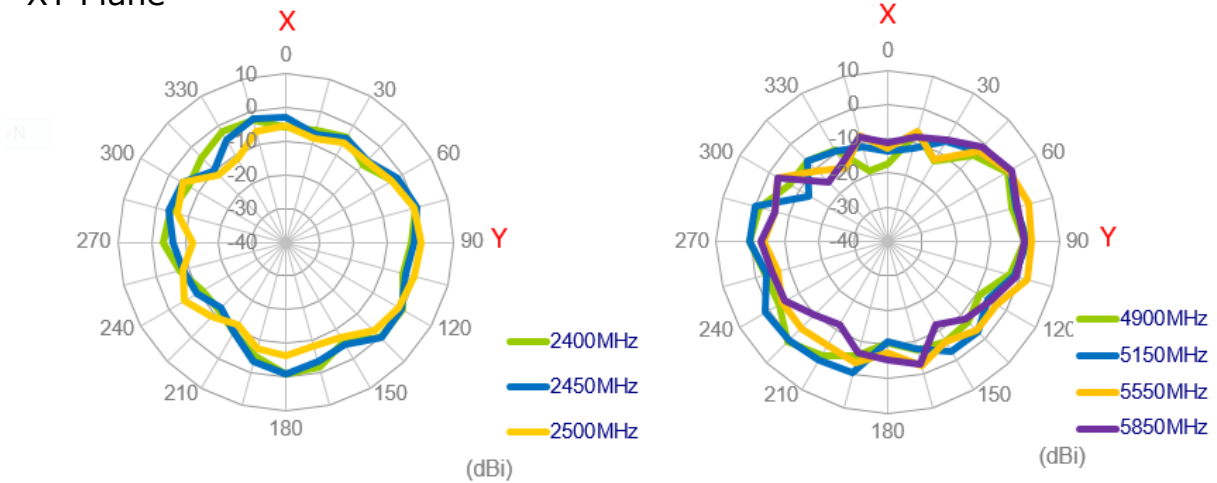
2450MHz



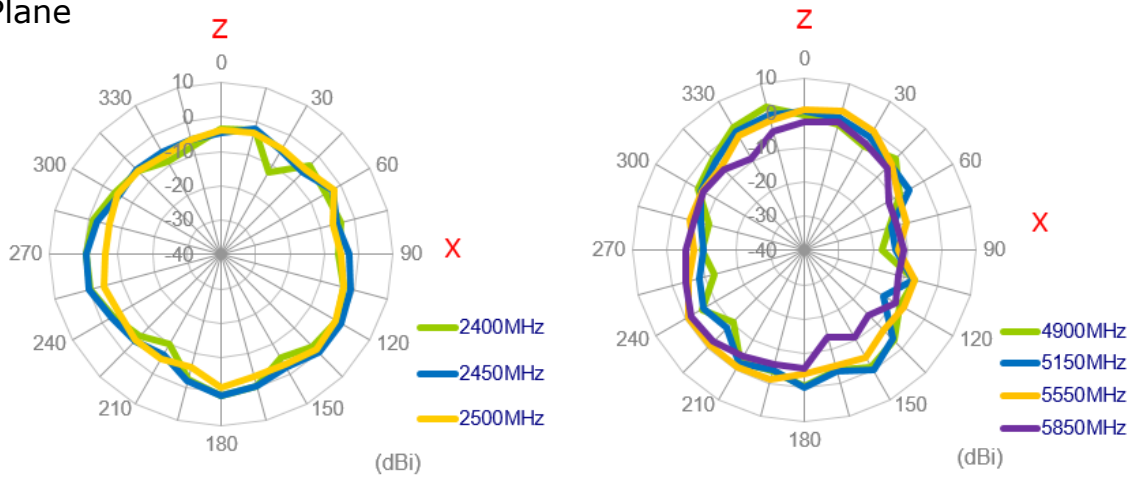
5550MHz

3.3.26 2D Radiation Pattern (Wi-Fi_MIMO2 with 3M cable length in free space)

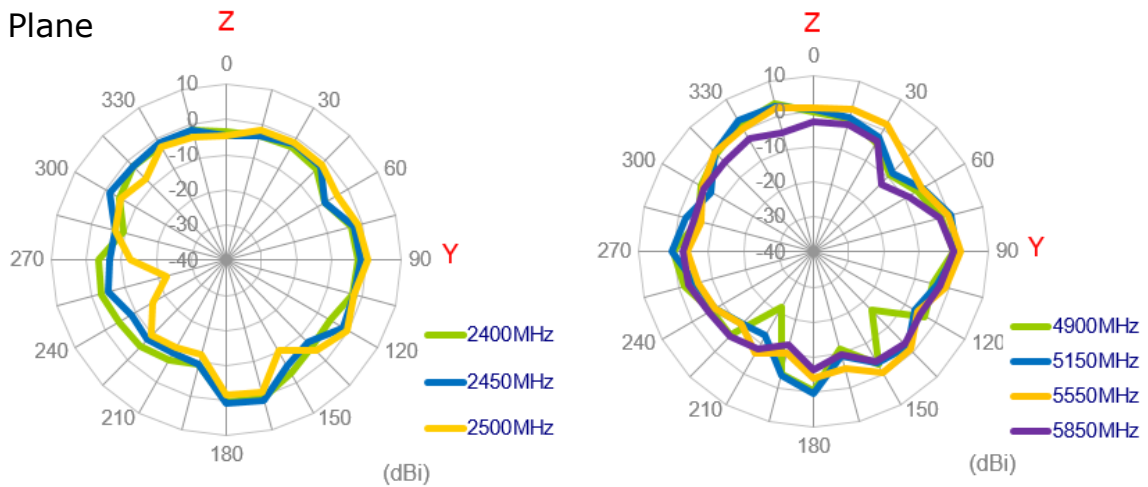
XY Plane



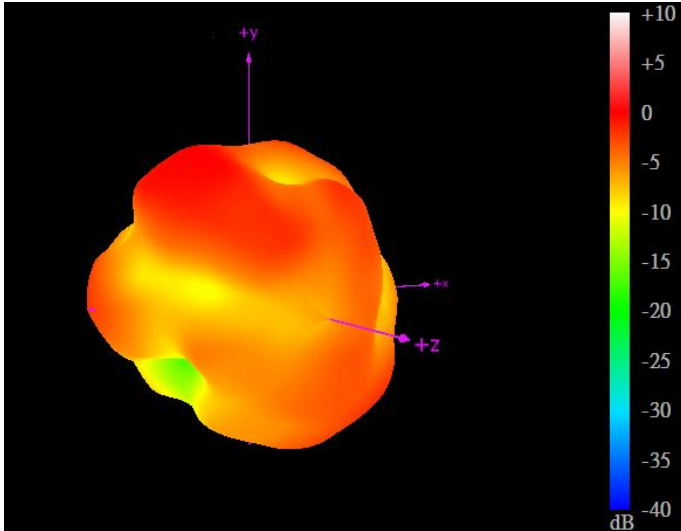
XZ Plane



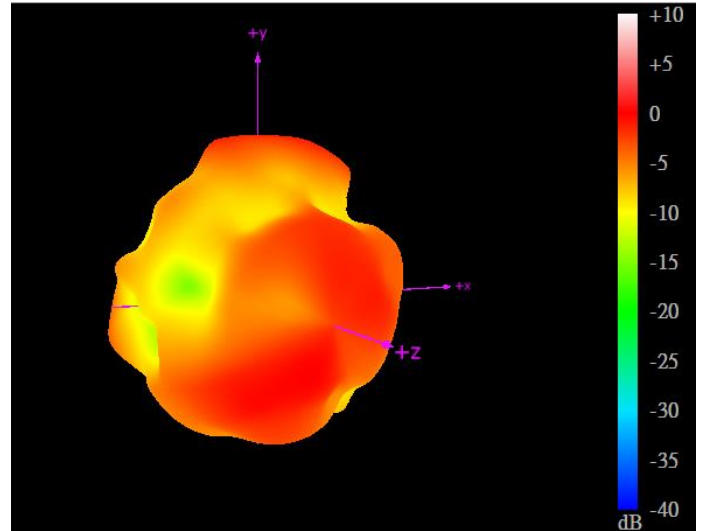
YZ Plane



3.3.27 3D Radiation Pattern (Wi-Fi_MIMO2 with 1M cable length in free space)



2450MHz



5550MHz

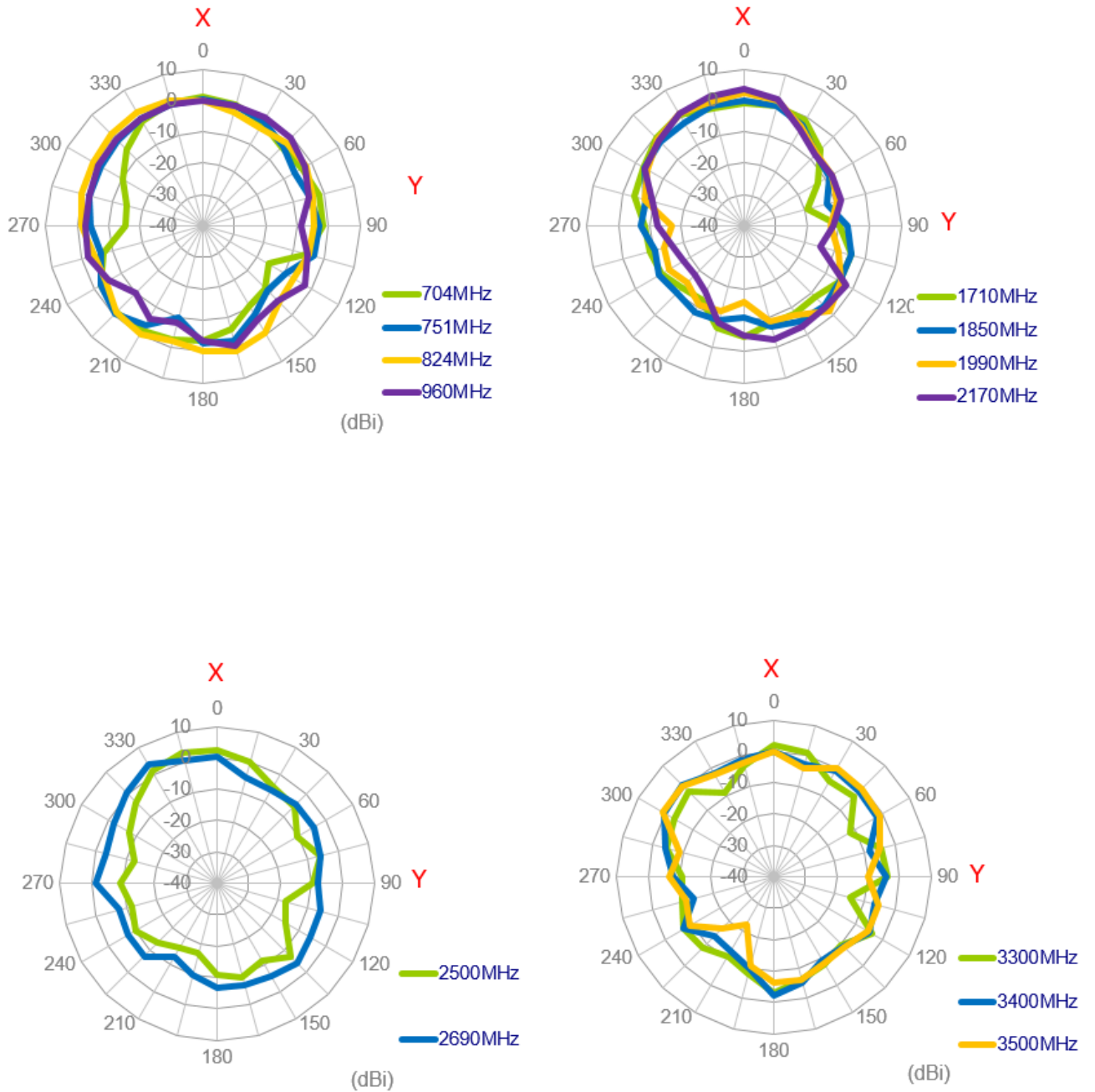
3.3.28 Test Setup for Antenna Radiation Pattern



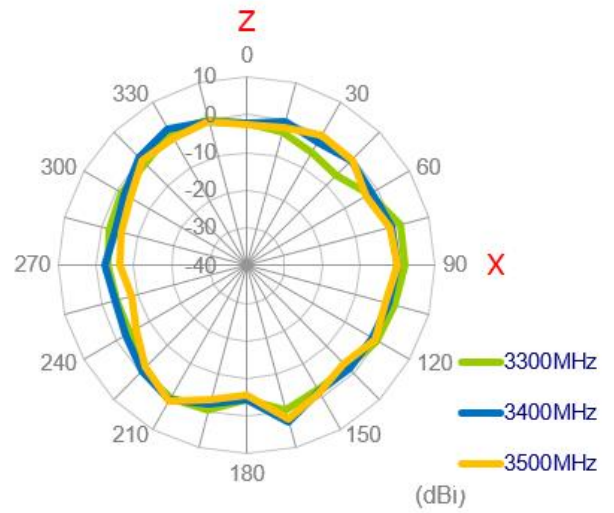
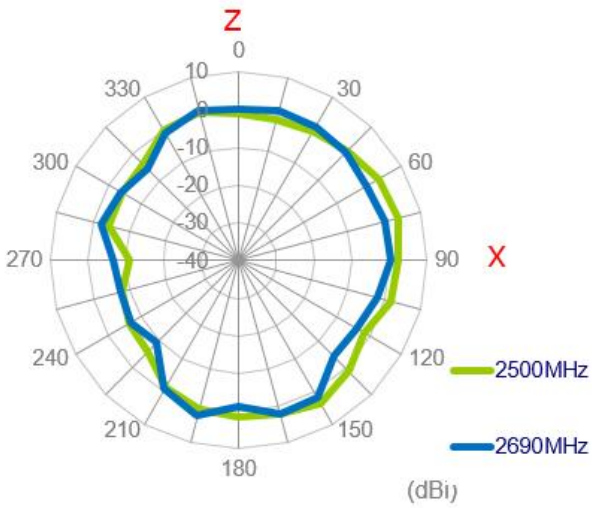
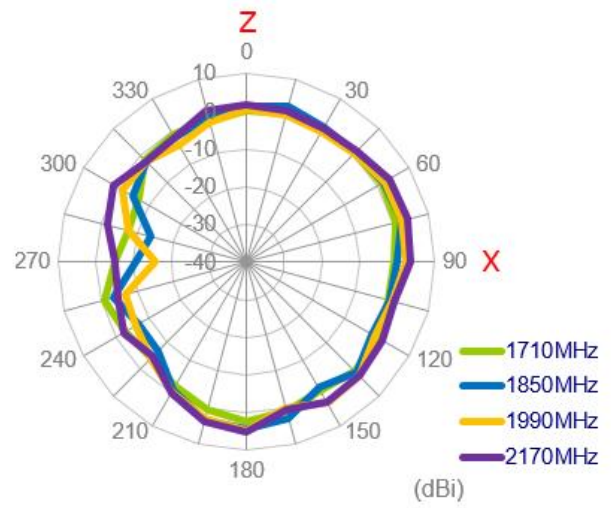
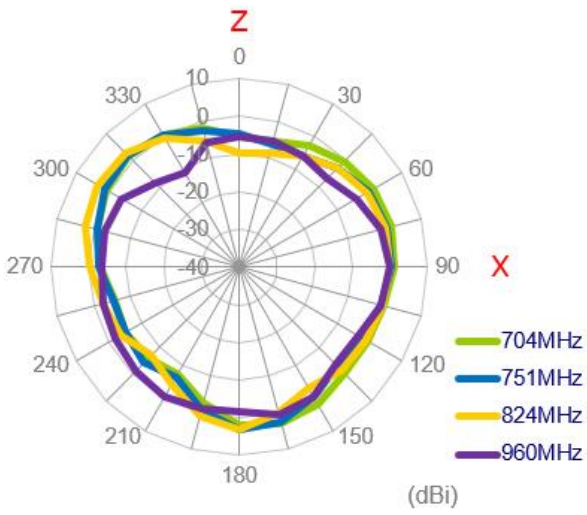
On the ABS

3.3.29 2D Radiation Pattern (LTE_MIMO1 with 1M cable length on ABS)

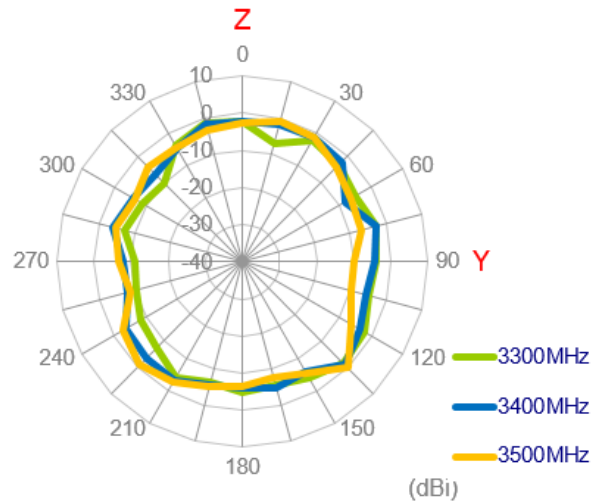
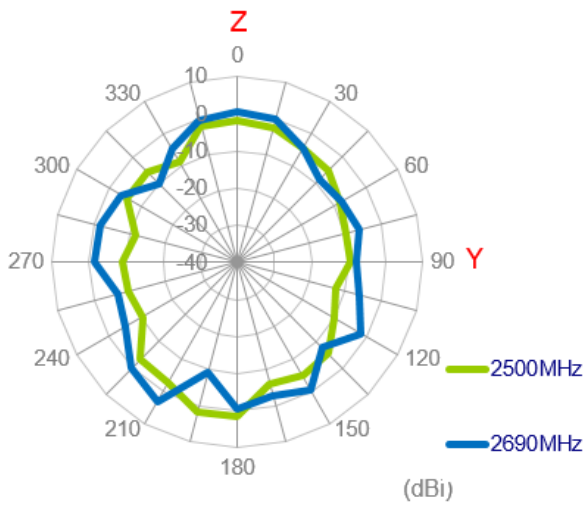
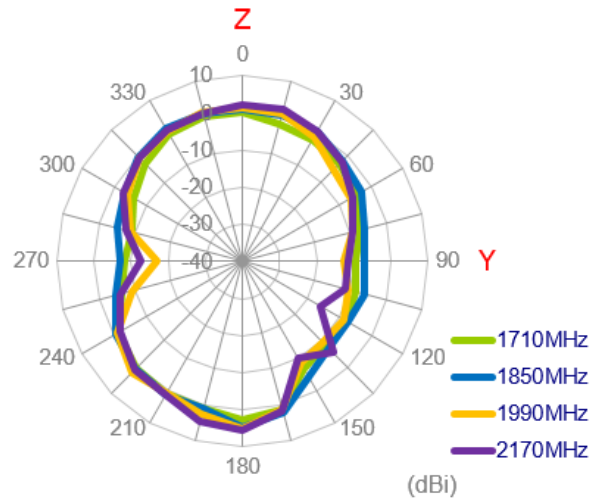
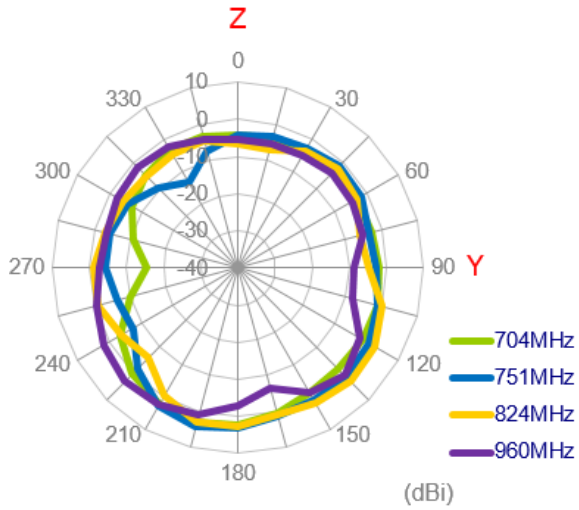
XY Plane



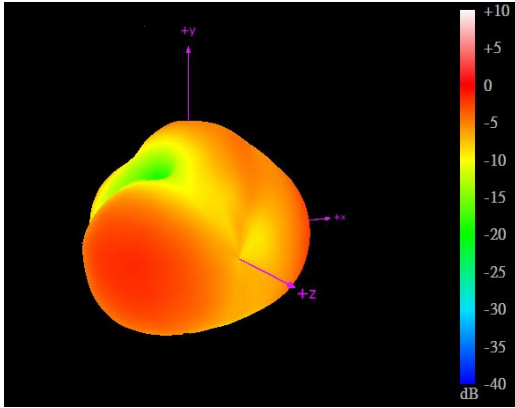
XZ Plane



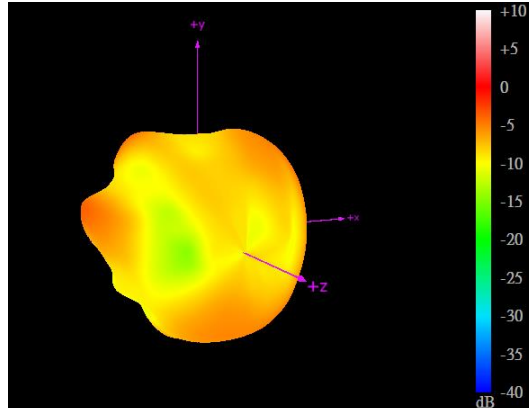
YZ Plane



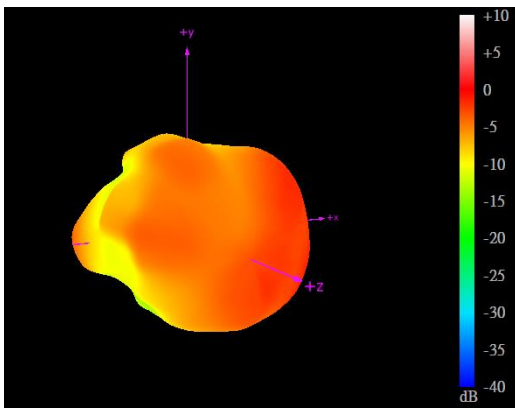
3.3.30 3D Radiation Pattern (LTE_MIMO1 with 1M cable length on ABS)



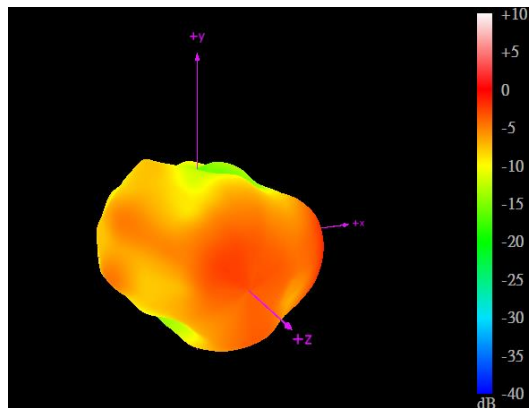
704MHz



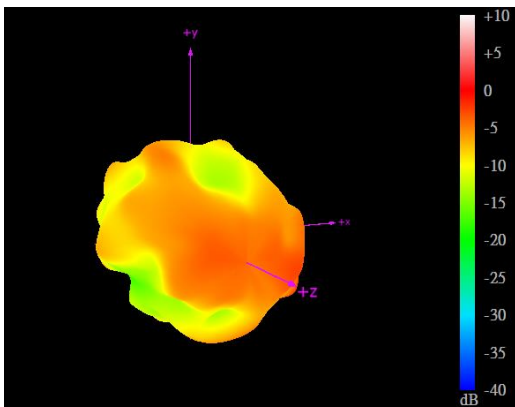
960MHz



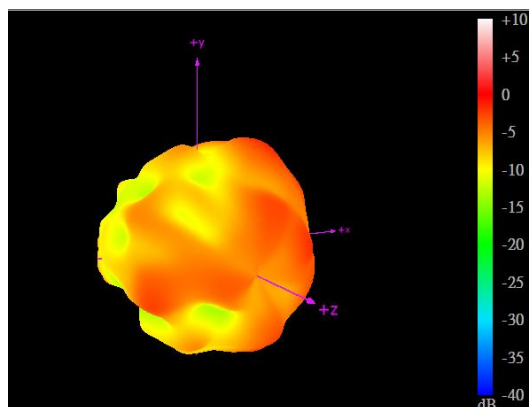
1710MHz



2170MHz



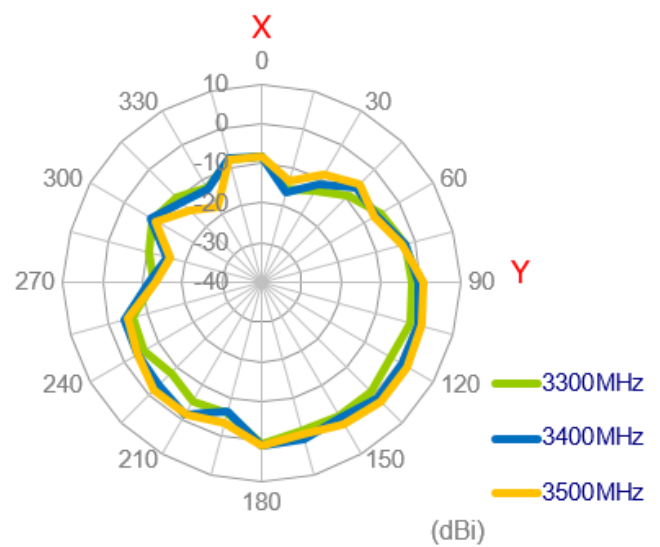
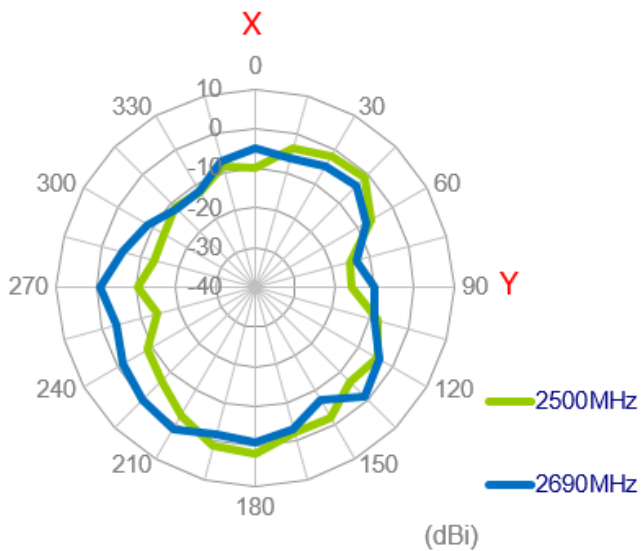
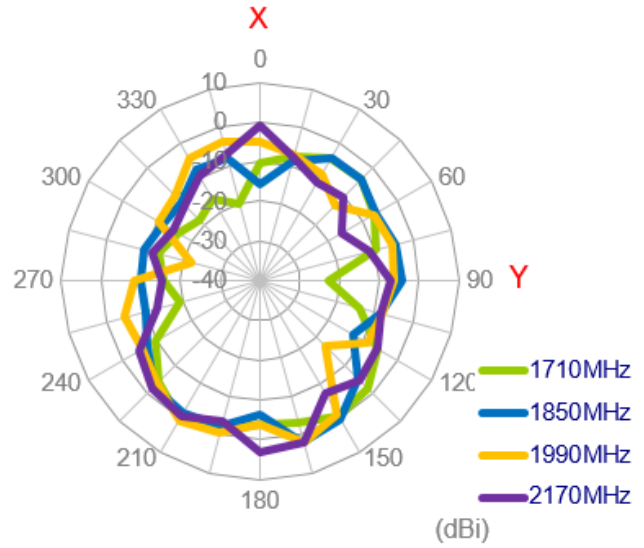
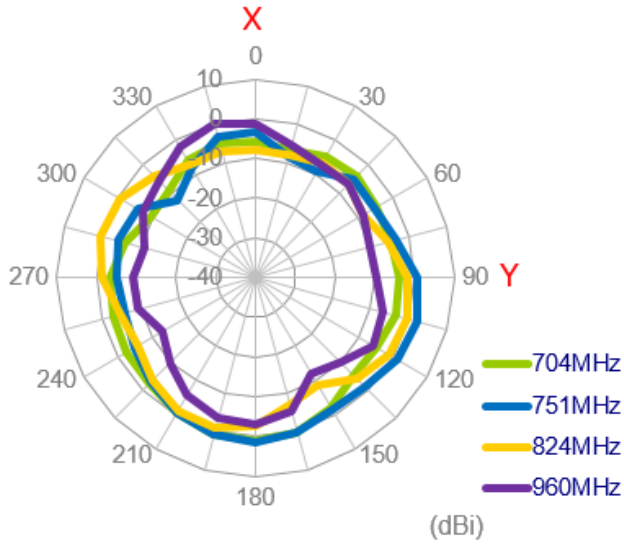
2690MHz



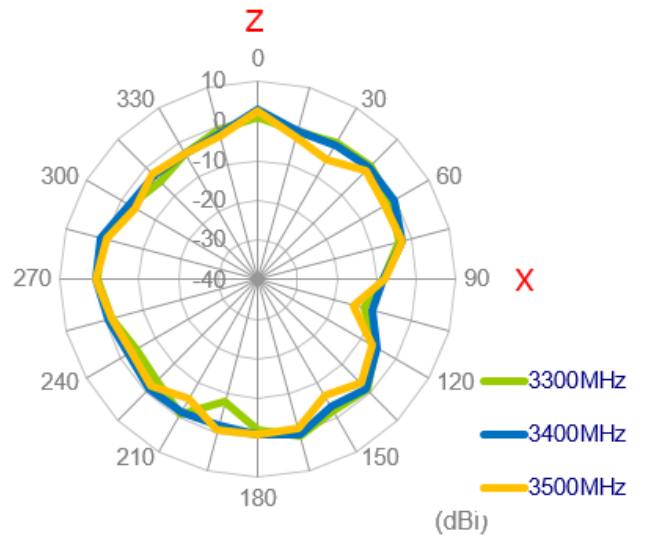
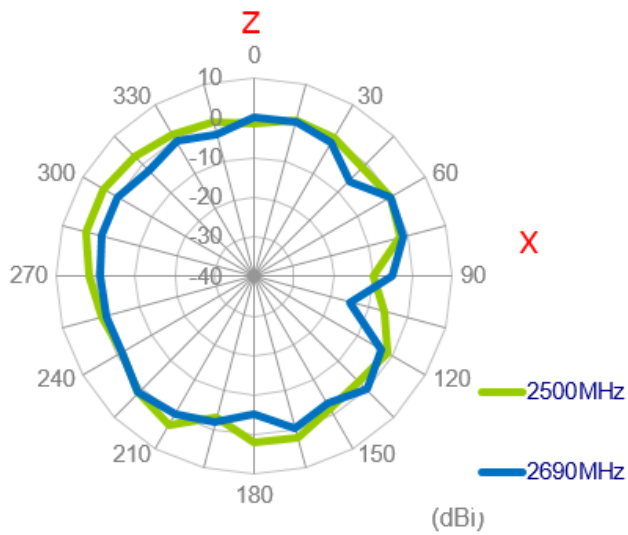
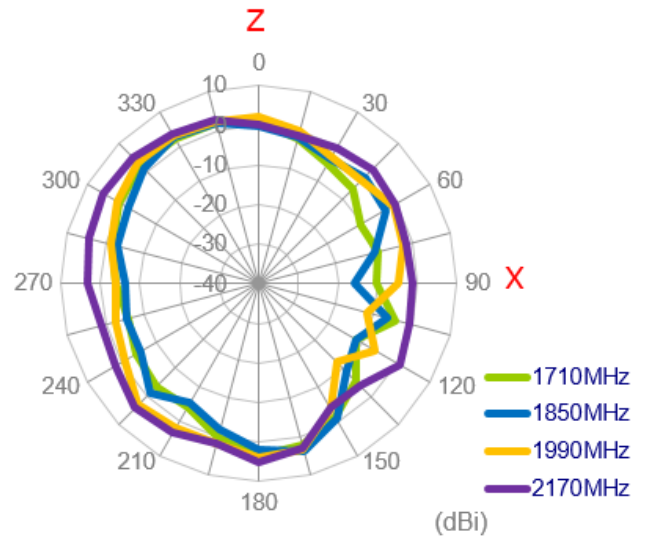
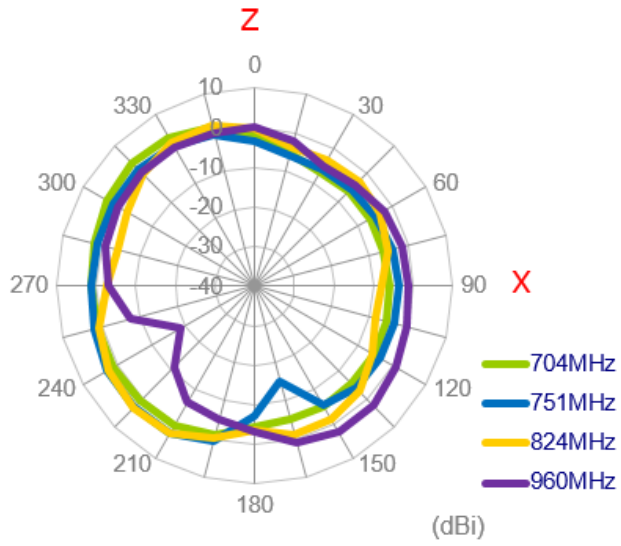
3500MHz

3.3.31 2D Radiation Pattern (LTE_MIMO2 with 1M cable length on ABS)

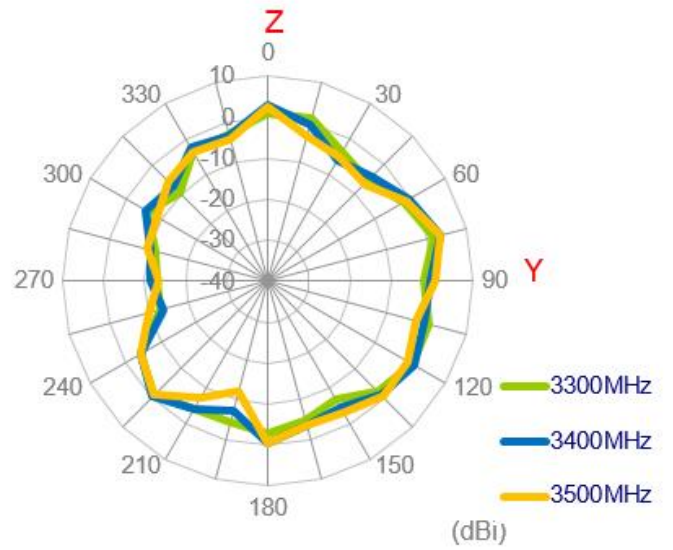
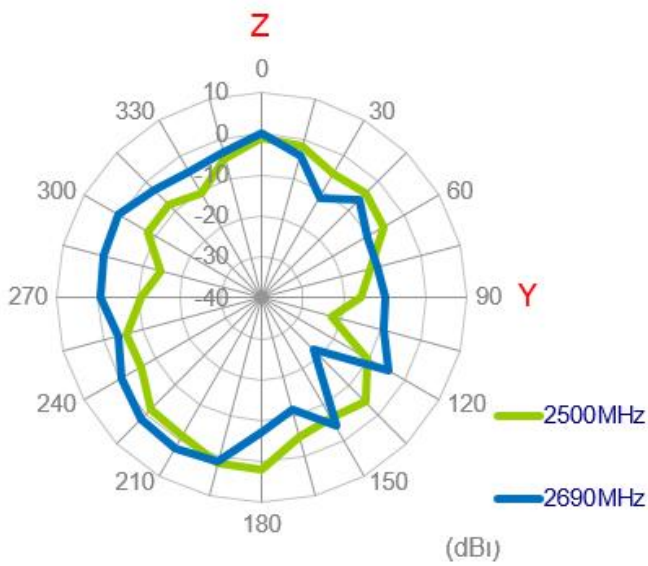
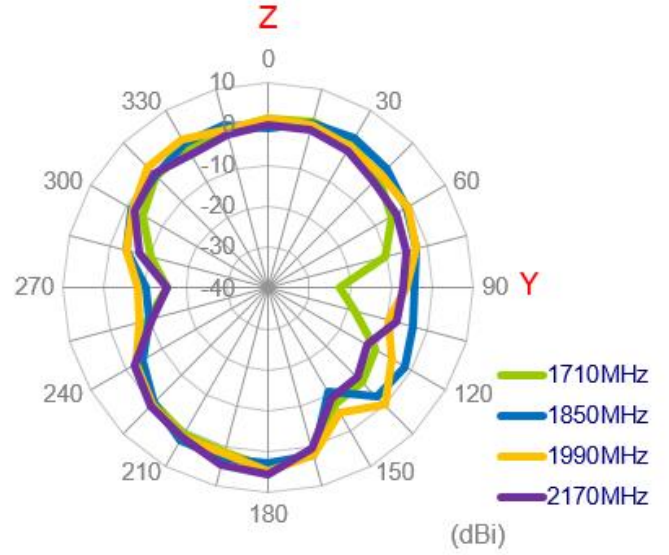
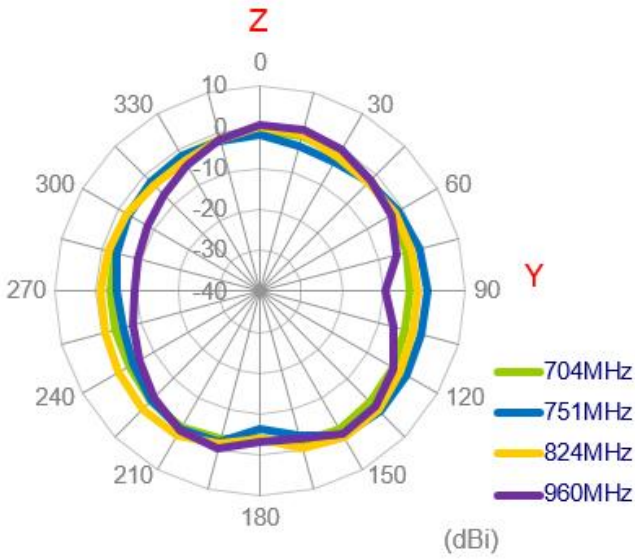
XY Plane



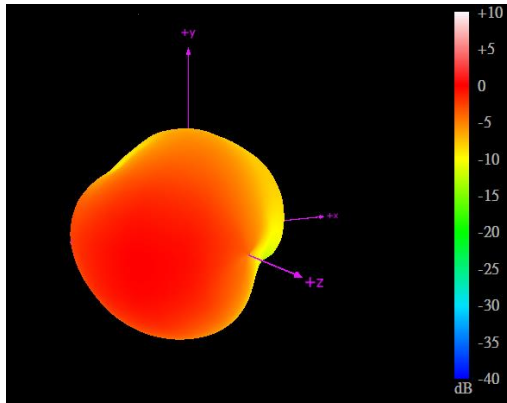
XZ Plane



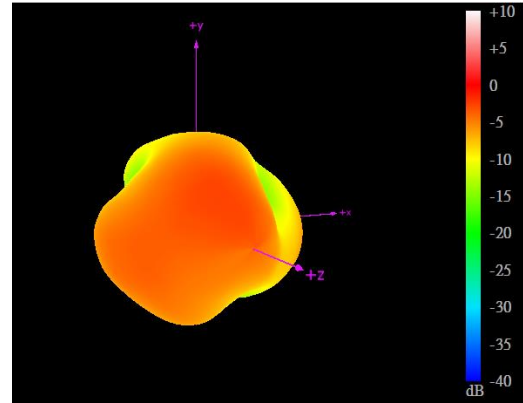
YZ Plane



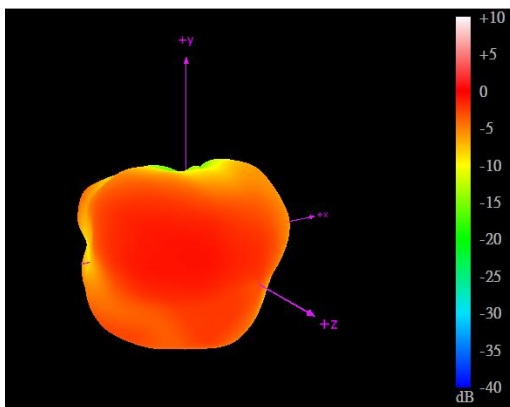
3.3.32 3D Radiation Pattern (LTE_MIMO2 with 1M cable length on ABS)



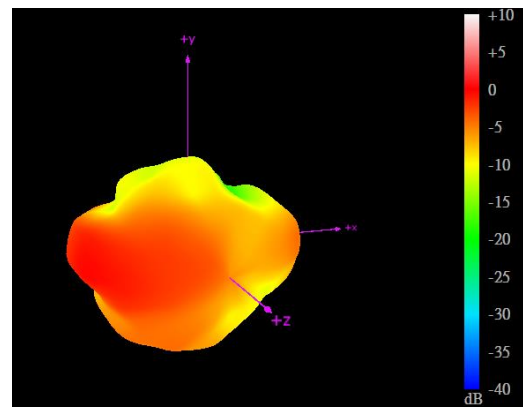
704MHz



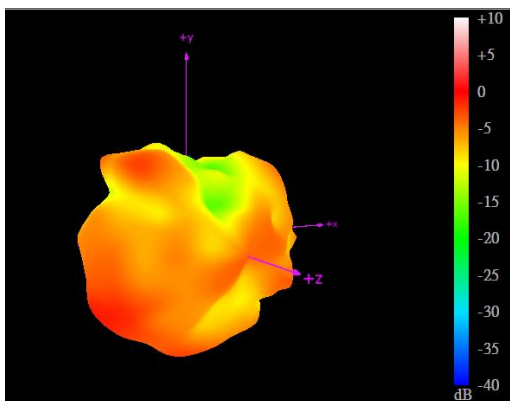
960MHz



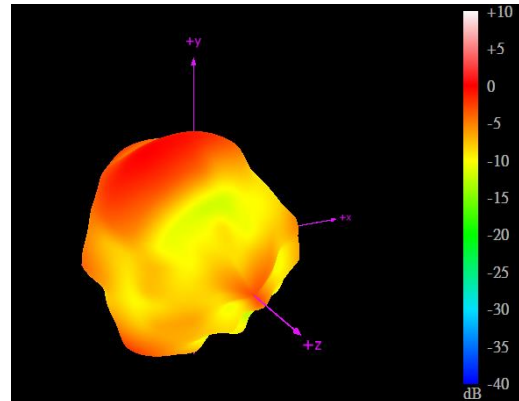
1710MHz



2170MHz



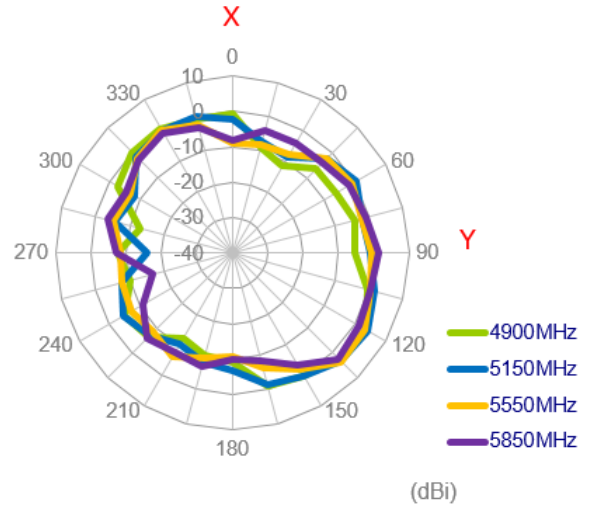
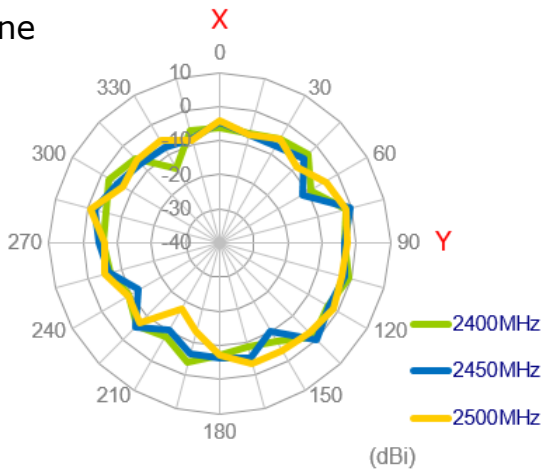
2690MHz



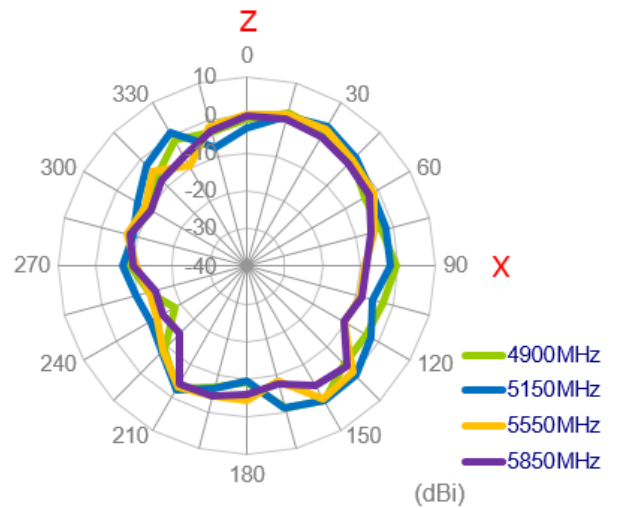
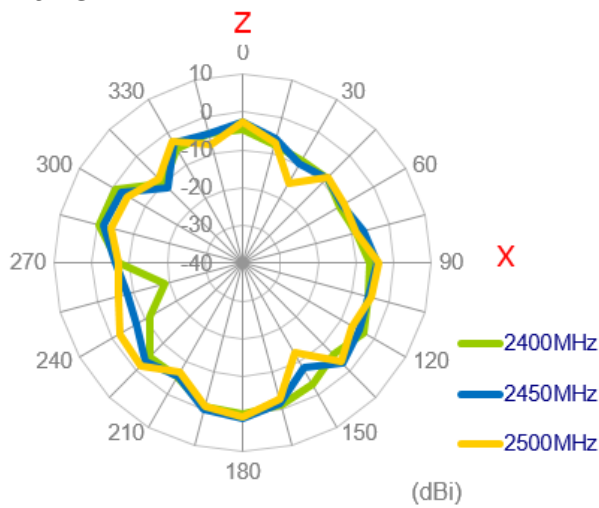
3500MHz

3.3.33 2D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length on ABS)

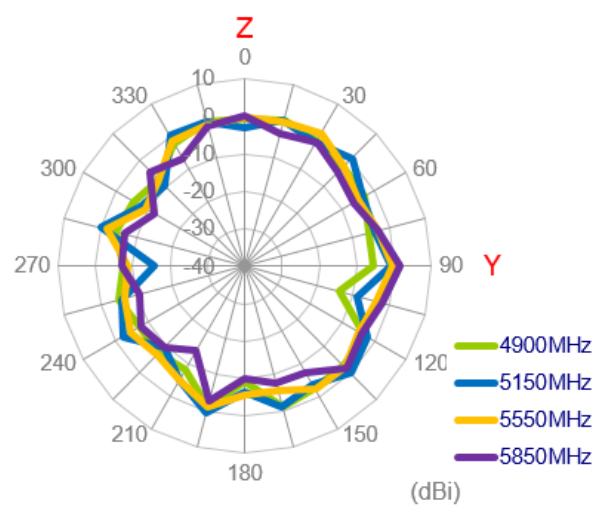
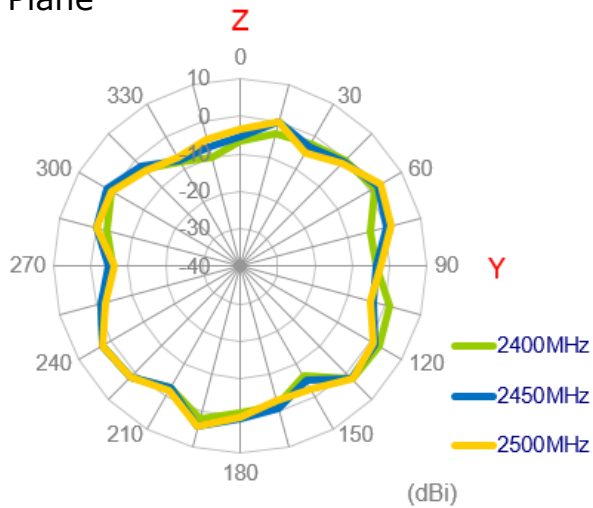
XY Plane



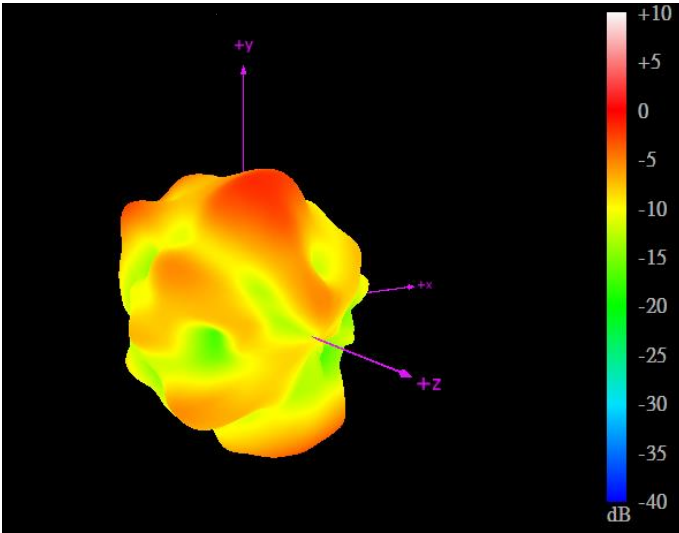
XZ Plane



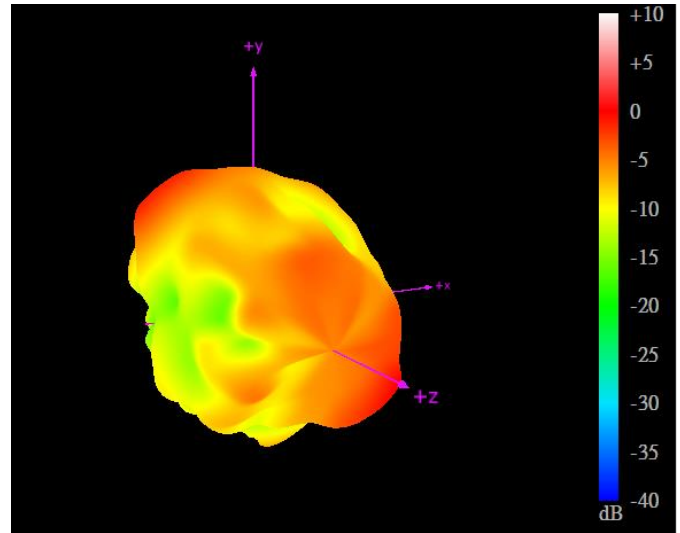
YZ Plane



3.3.34 3D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length on ABS)



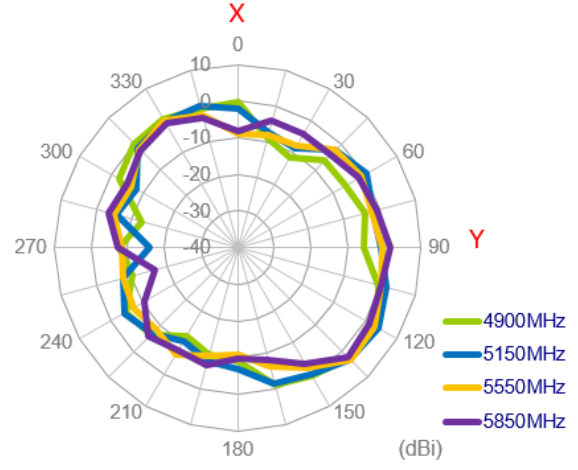
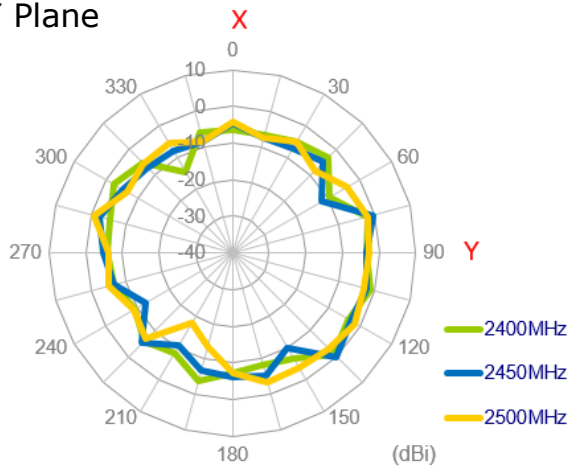
2450MHz



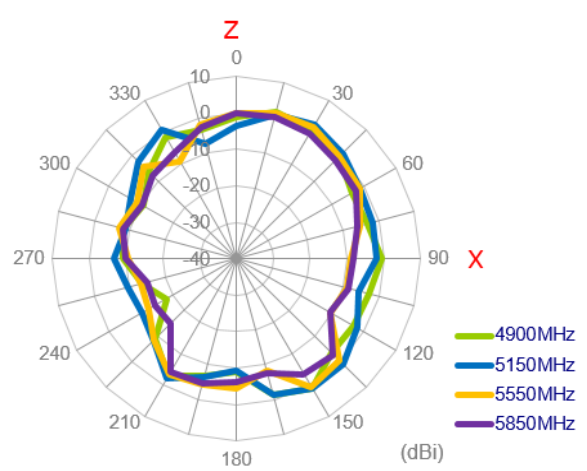
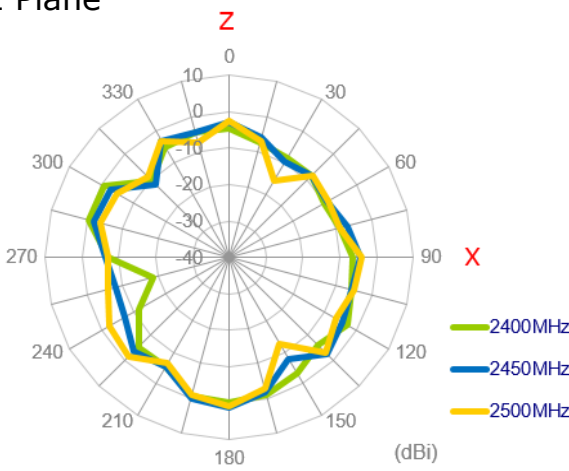
5550MHz

3.3.35 2D Radiation Pattern (Wi-Fi_MIMO2 with 3M cable length on ABS)

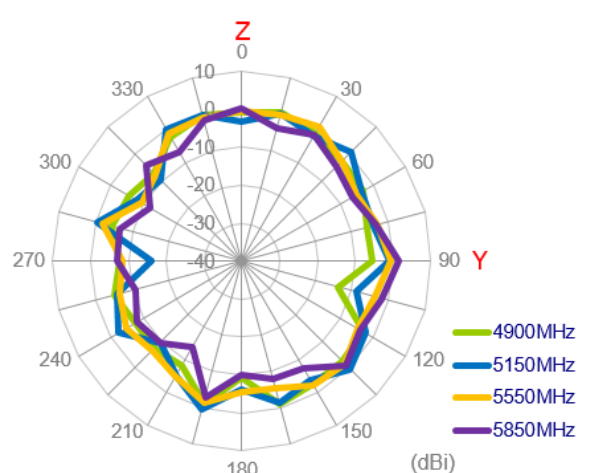
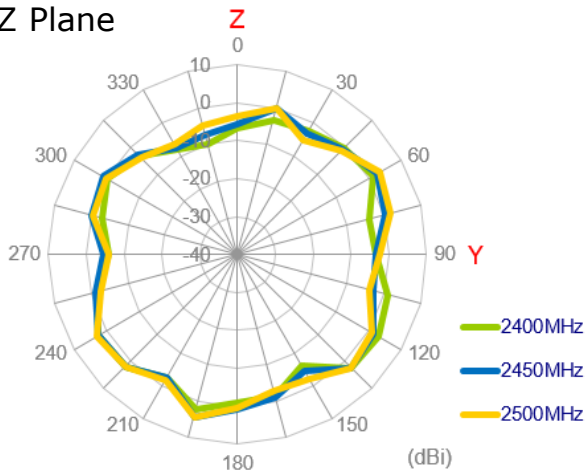
XY Plane



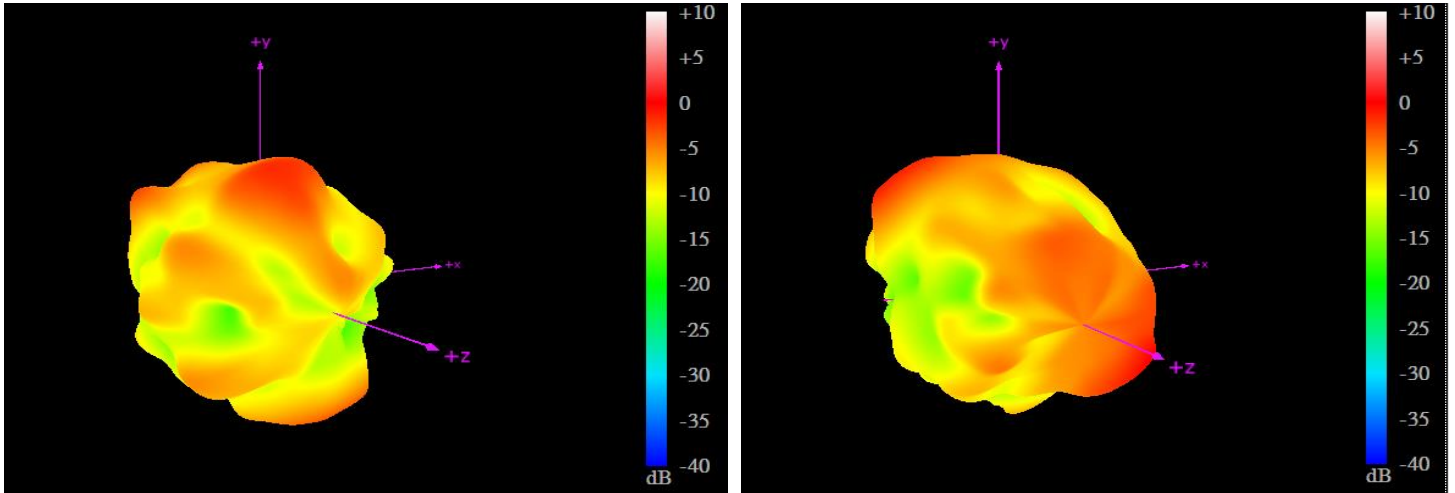
XZ Plane



YZ Plane



3.3.36 3D Radiation Pattern (Wi-Fi_MIMO2 with 1M cable length on ABS)



2450MHz

5550MHz

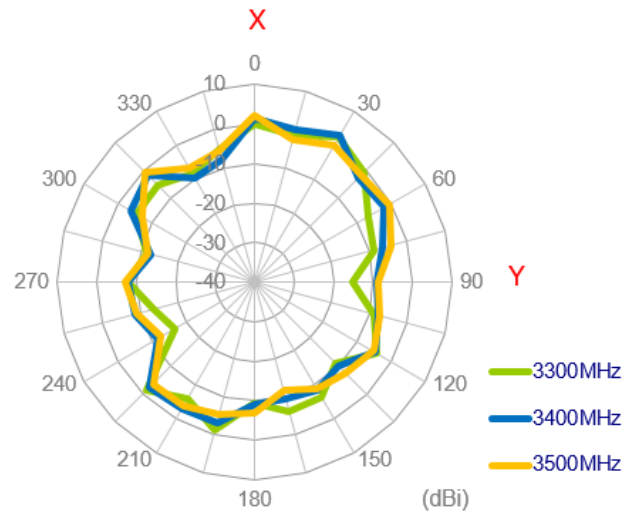
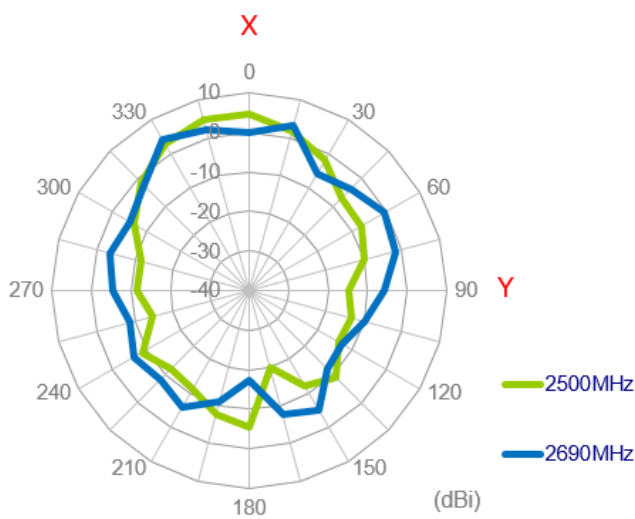
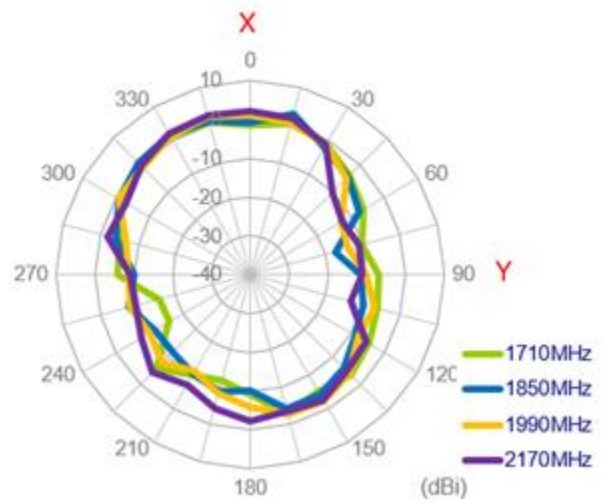
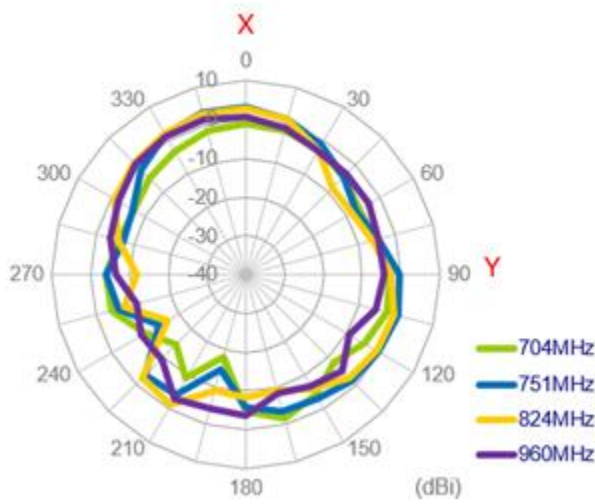
3.3.37 Test Setup for Antenna Radiation Pattern



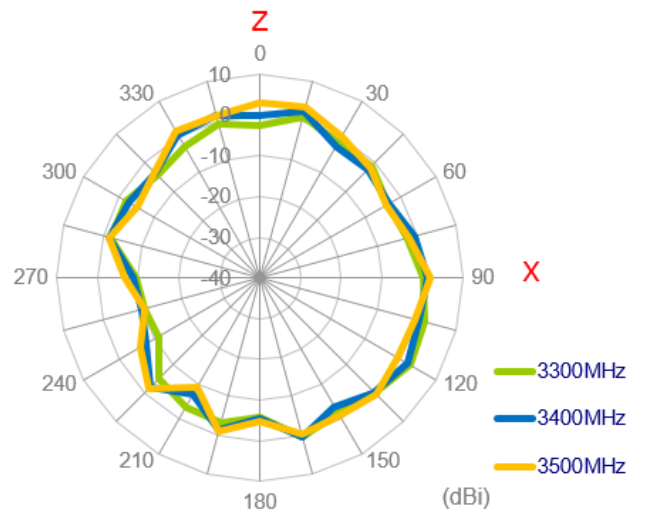
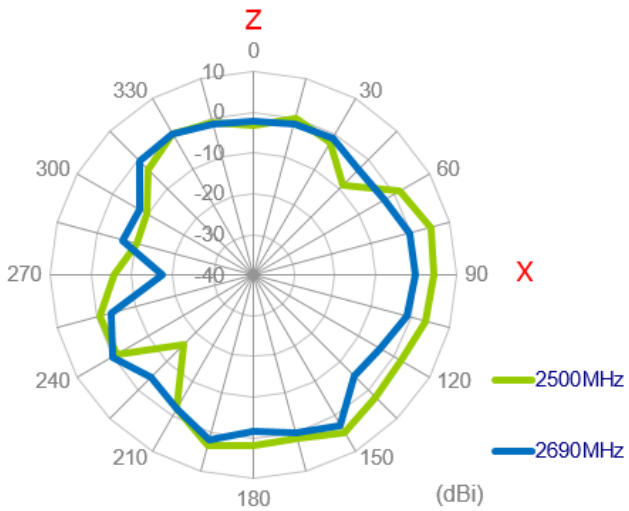
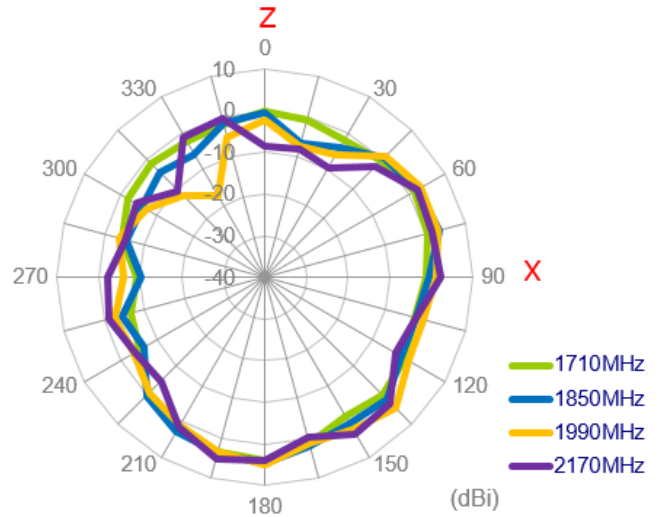
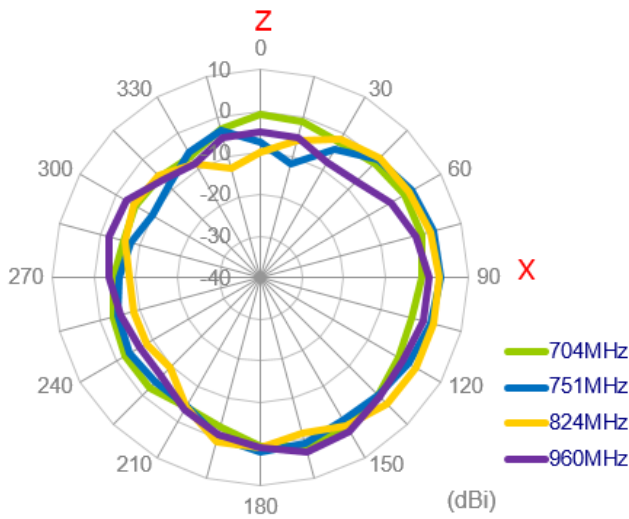
On glass

3.3.38 2D Radiation Pattern (LTE_MIMO1 with 1M cable length on glass)

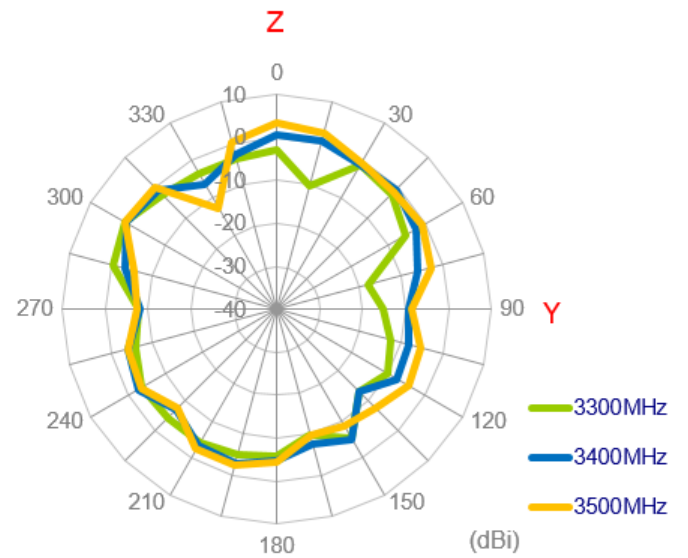
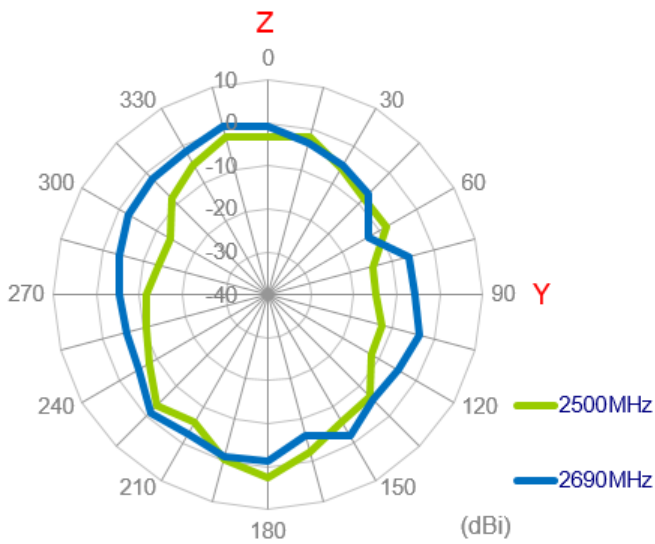
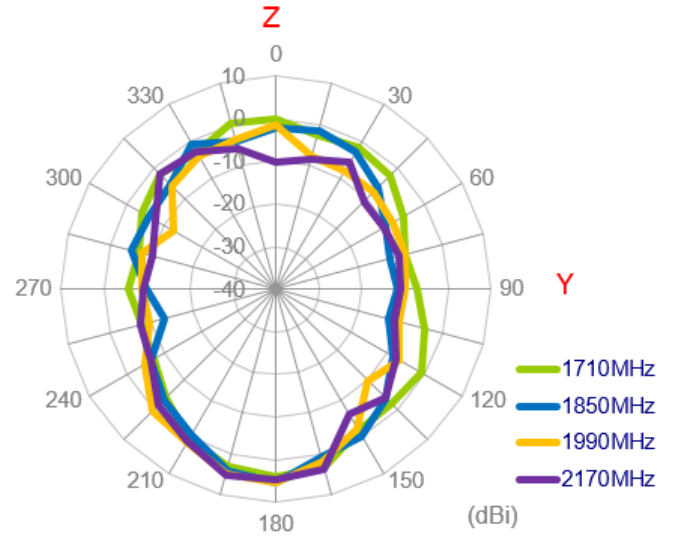
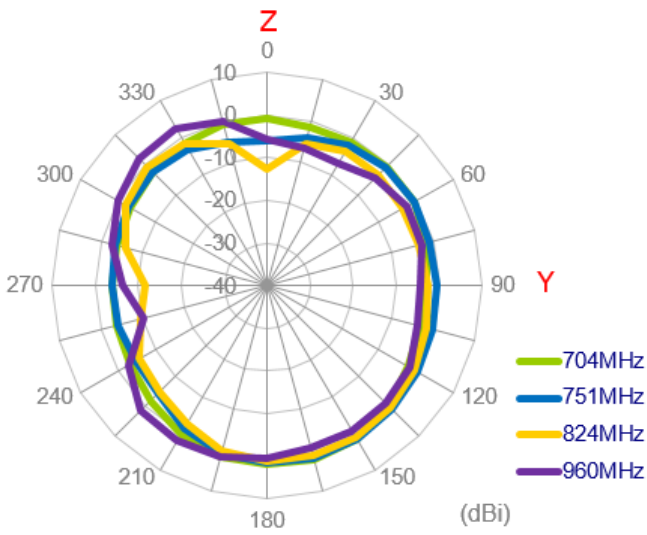
XY Plane



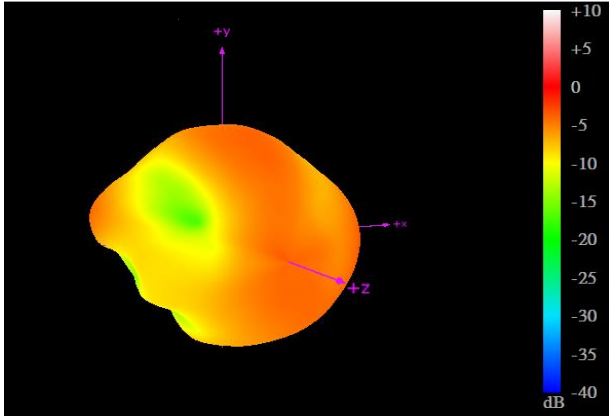
XZ Plane



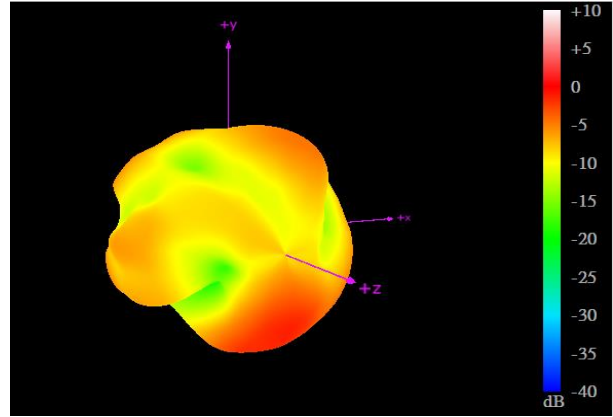
YZ Plane



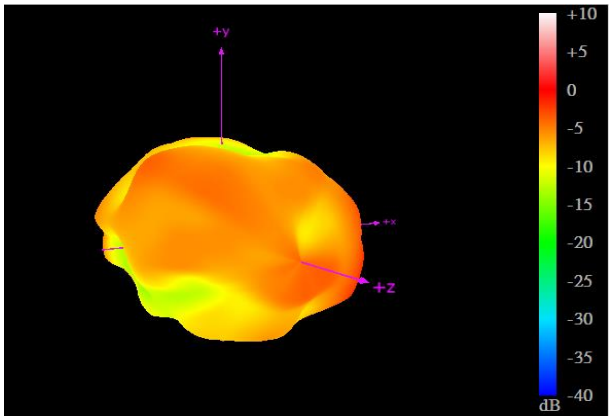
3.3.39 3D Radiation Pattern (LTE_MIMO1 with 1M cable length on glass)



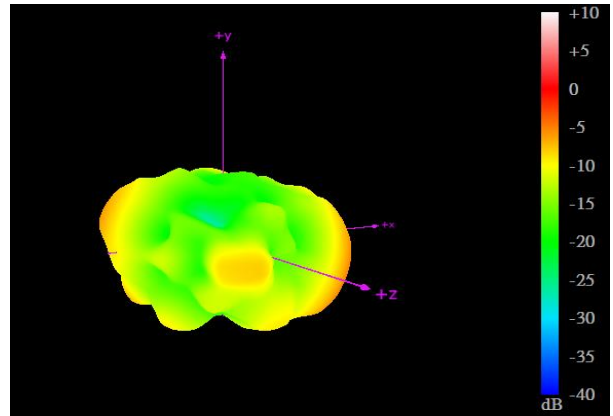
704MHz



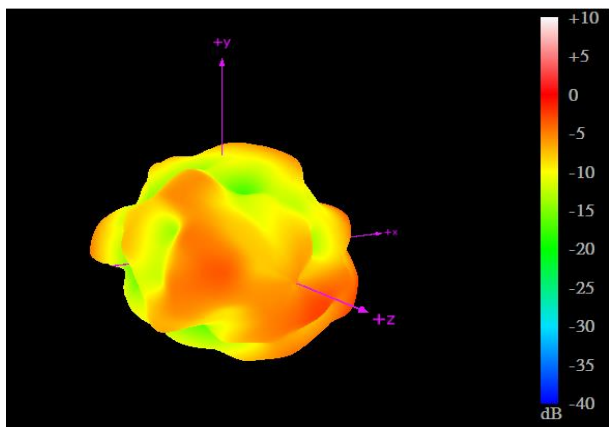
960MHz



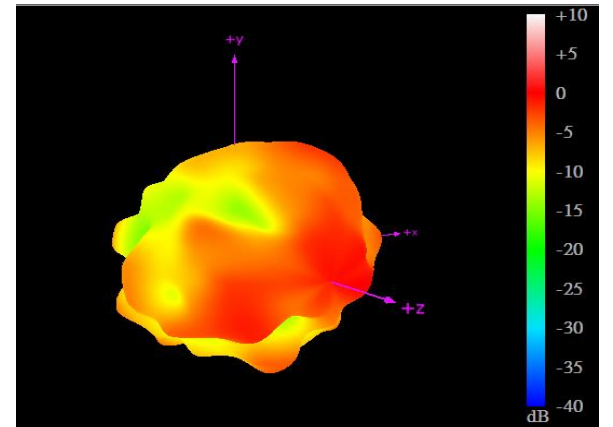
1710MHz



2170MHz



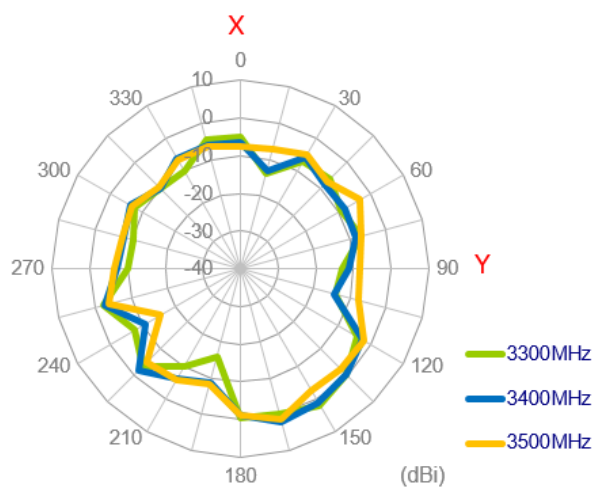
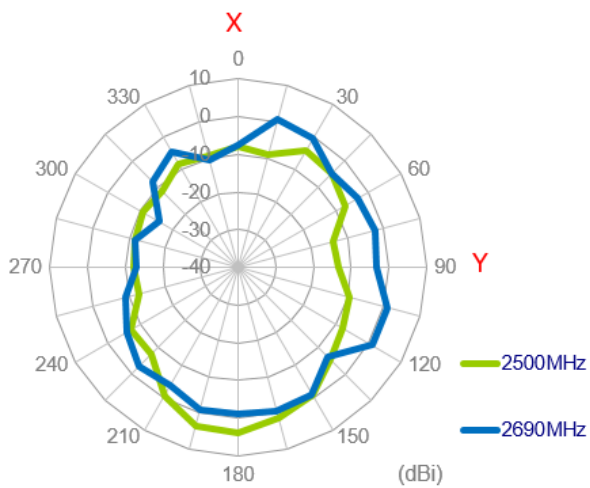
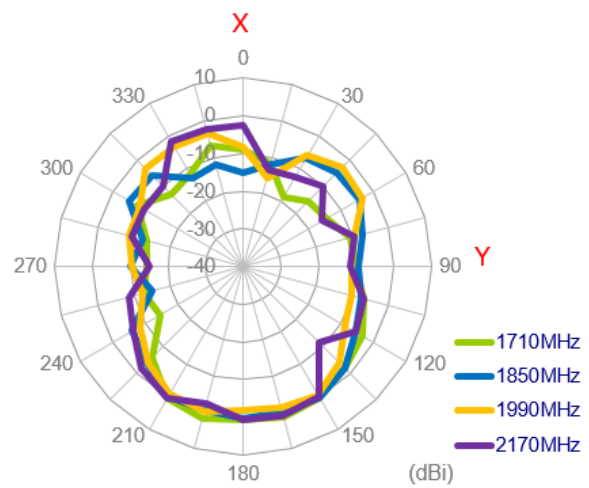
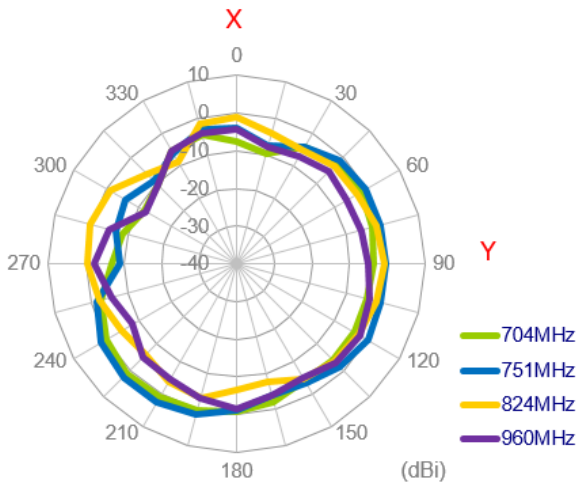
2690MHz



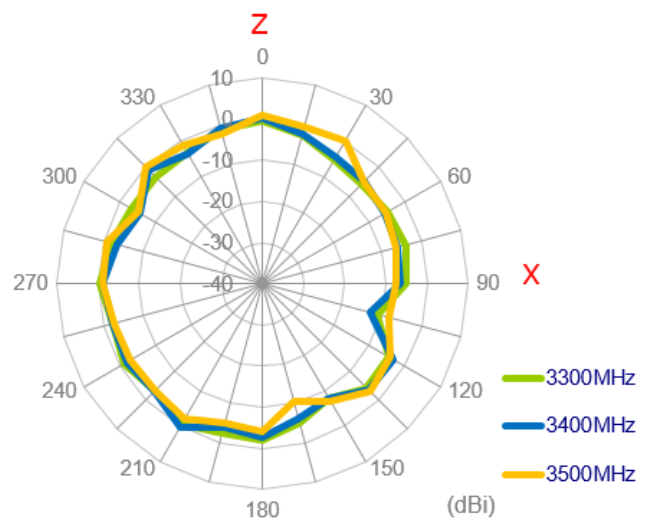
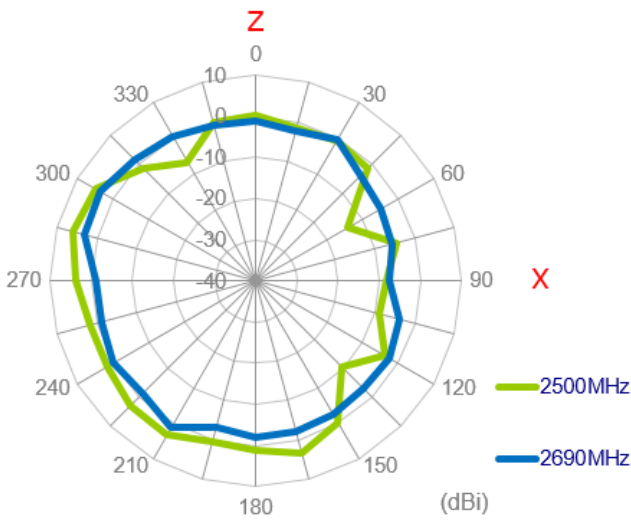
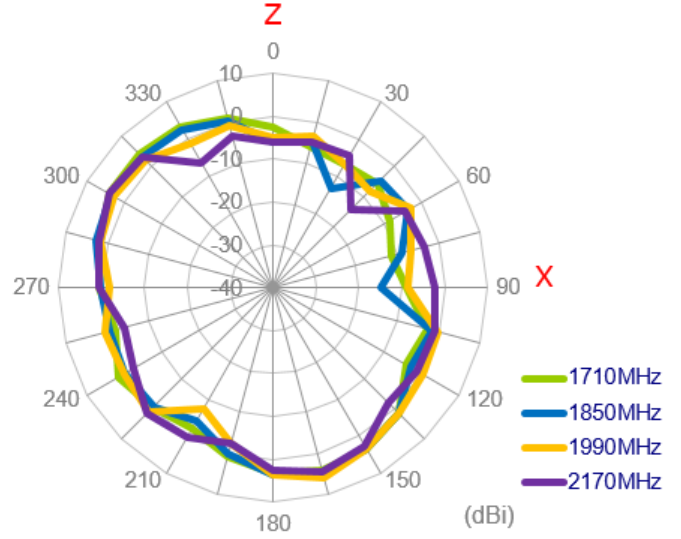
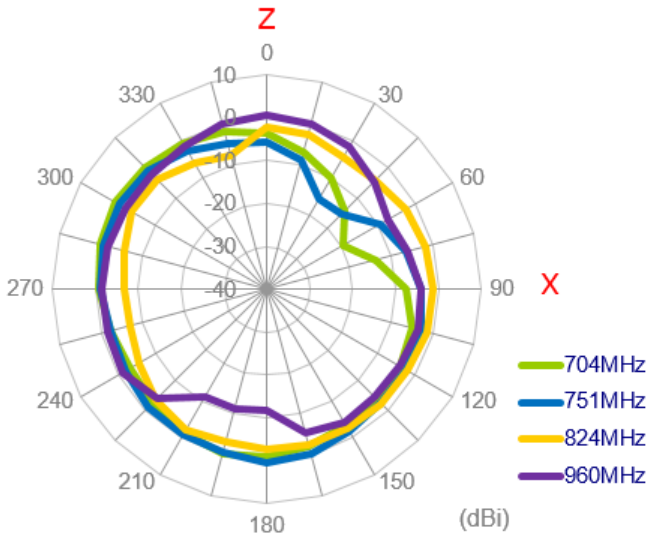
3500MHz

3.3.40 2D Radiation Pattern (LTE_MIMO2 with 1M cable length on glass)

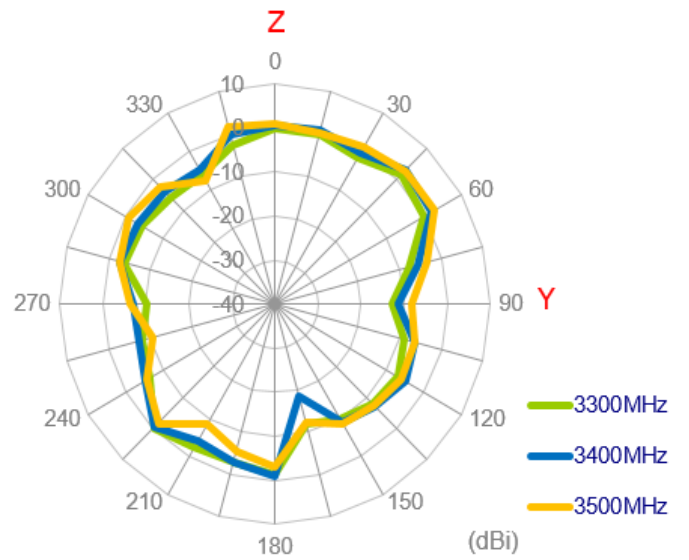
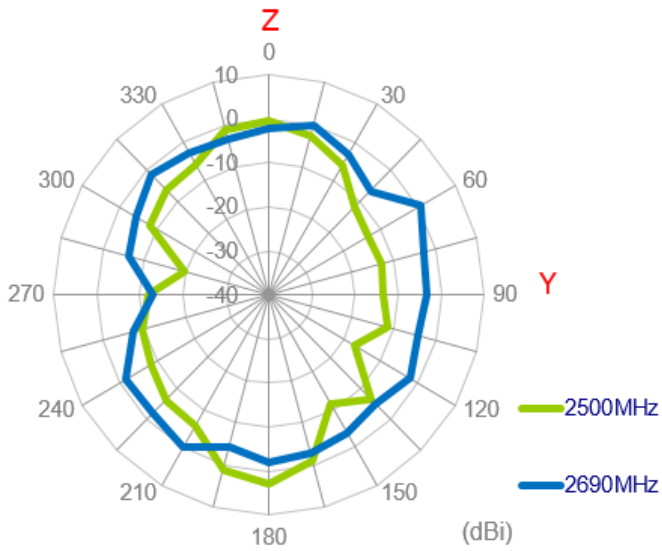
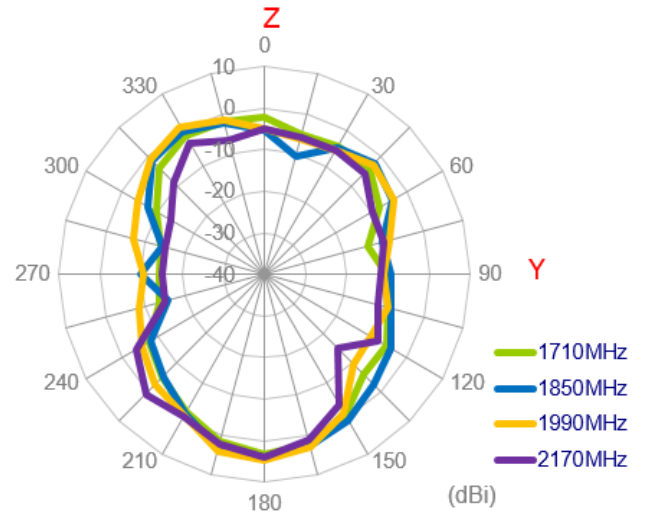
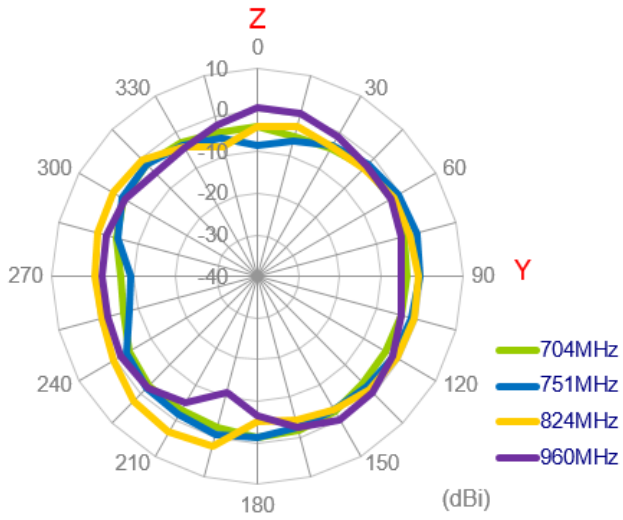
XY Plane



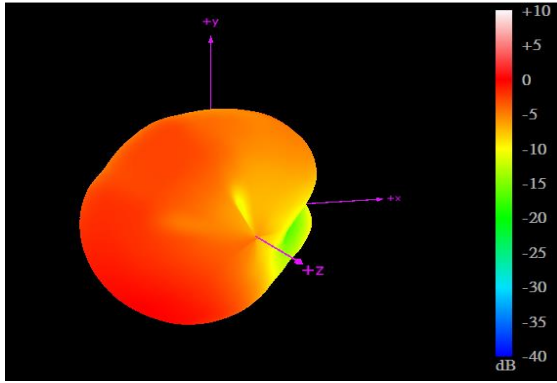
XZ Plane



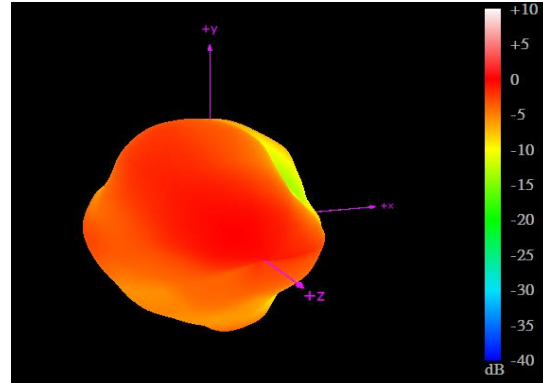
YZ Plane



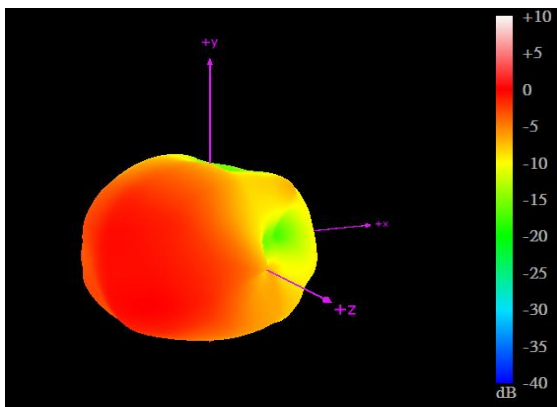
3.3.41 3D Radiation Pattern (LTE_MIMO2 with 1M cable length on glass)



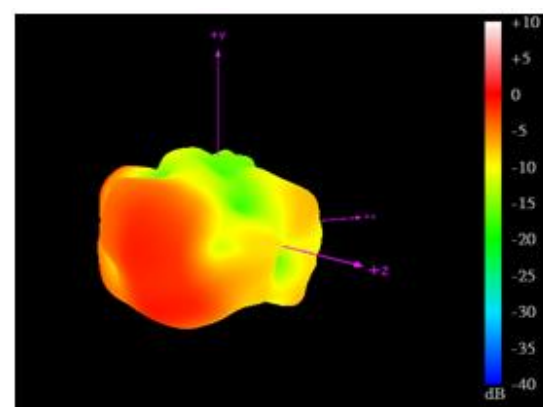
704MHz



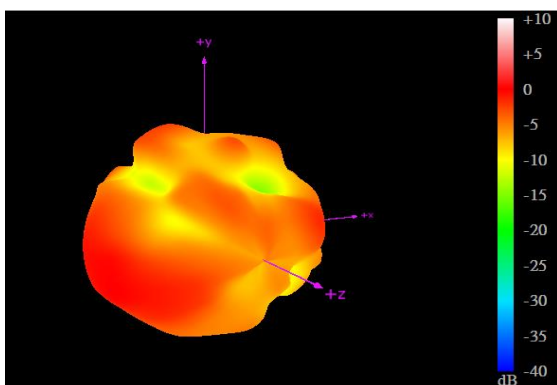
960MHz



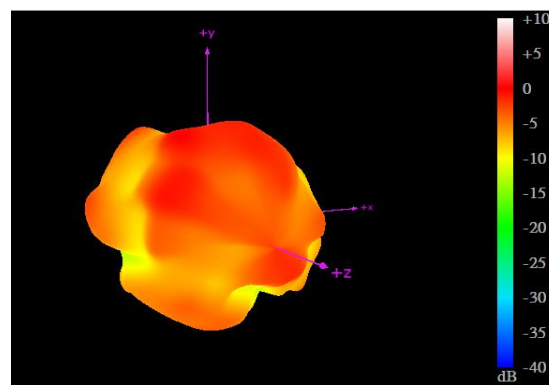
1710MHz



2170MHz



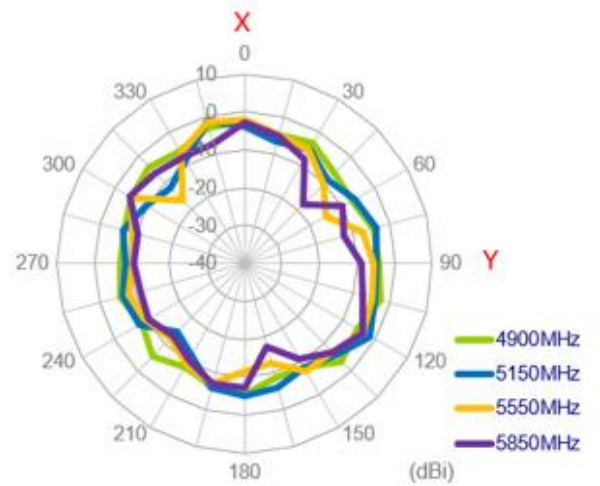
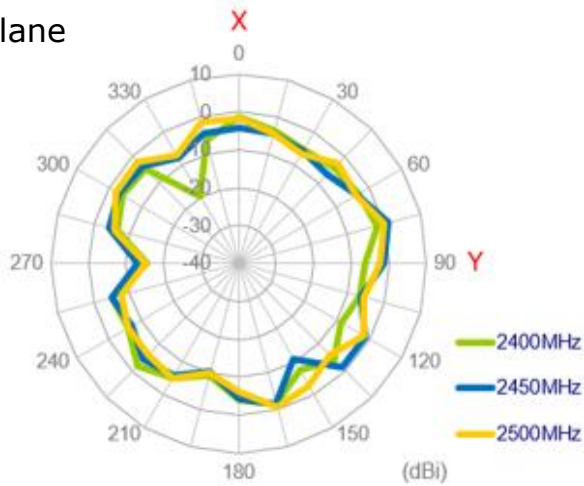
2690MHz



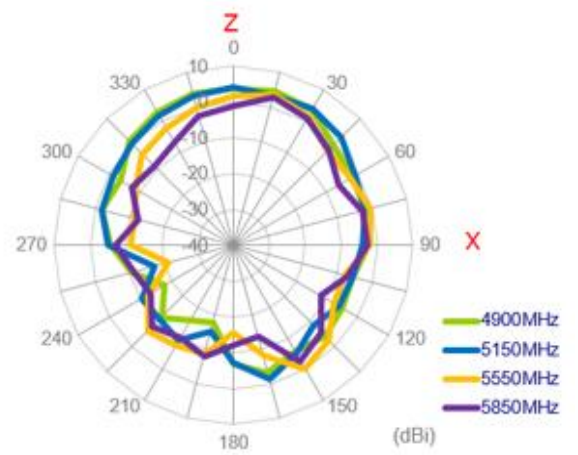
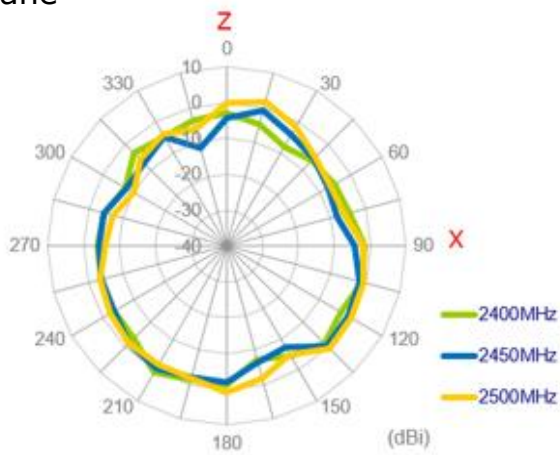
3500MHz

3.3.42 2D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length on glass)

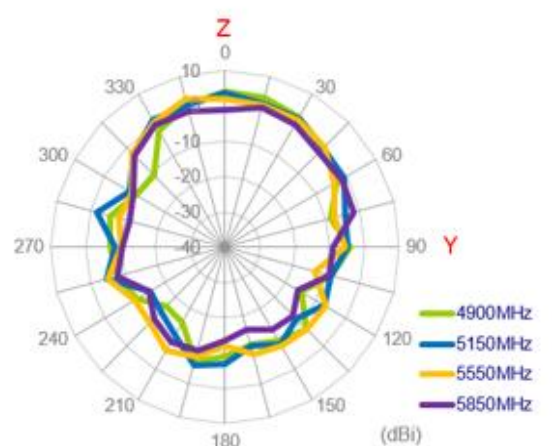
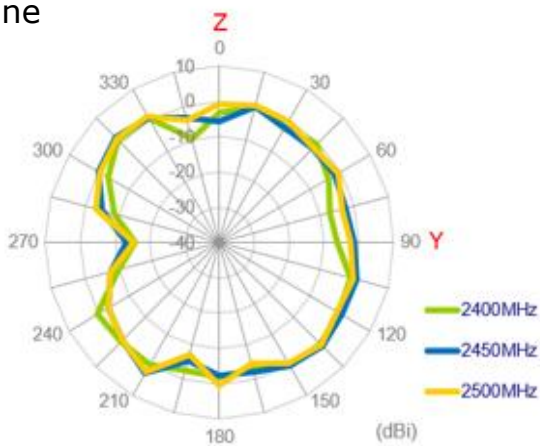
XY Plane



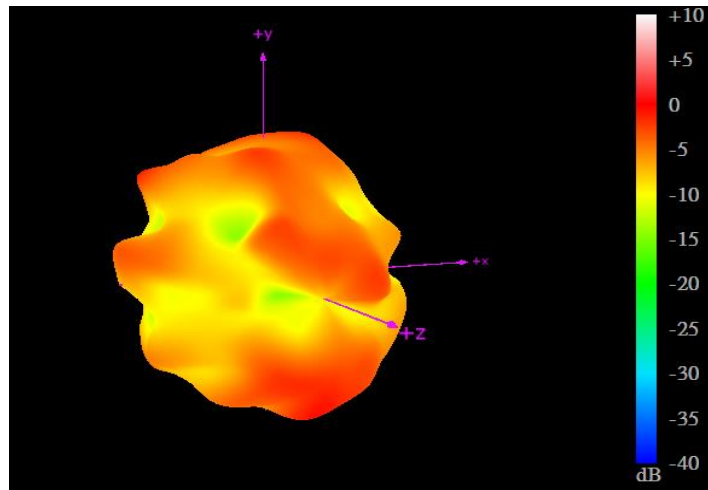
XZ Plane



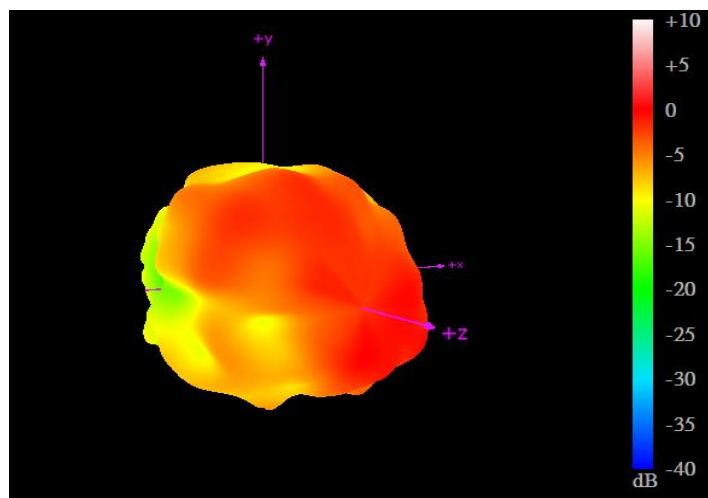
YZ Plane



3.3.43 3D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length on glass)



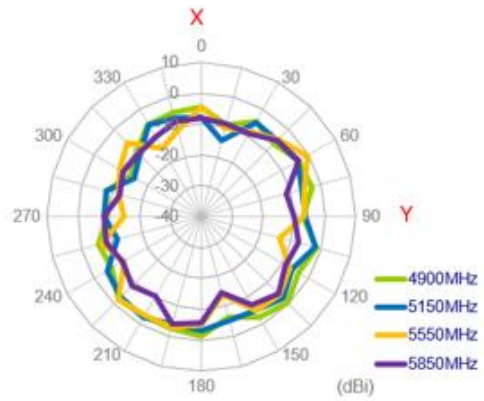
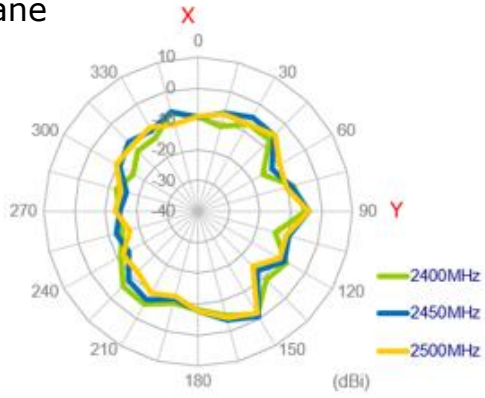
2450MHz



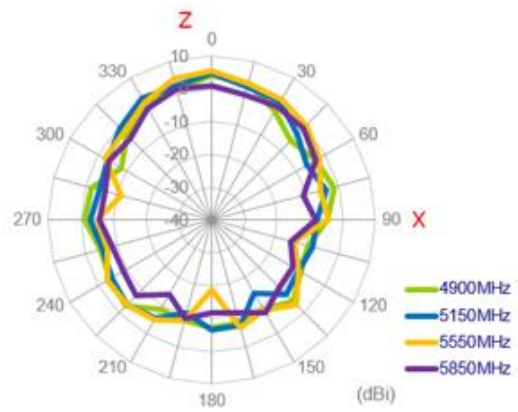
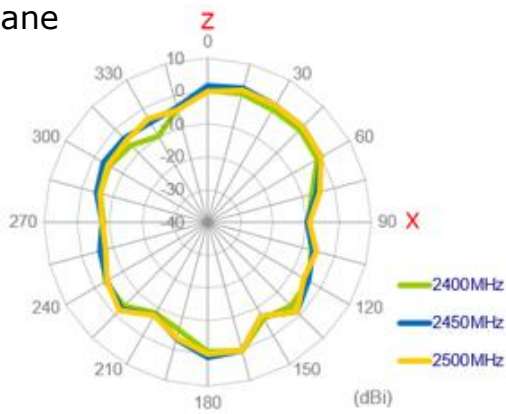
5550MHz

3.3.44 2D Radiation Pattern (Wi-Fi_MIMO2 with 3M cable length on glass)

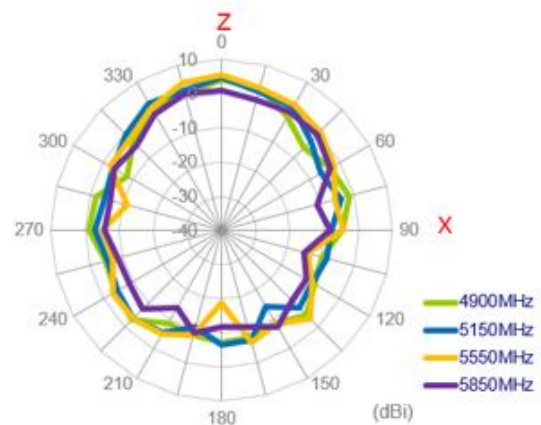
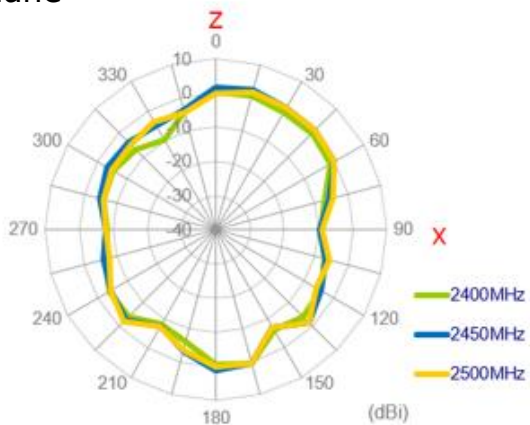
XY Plane



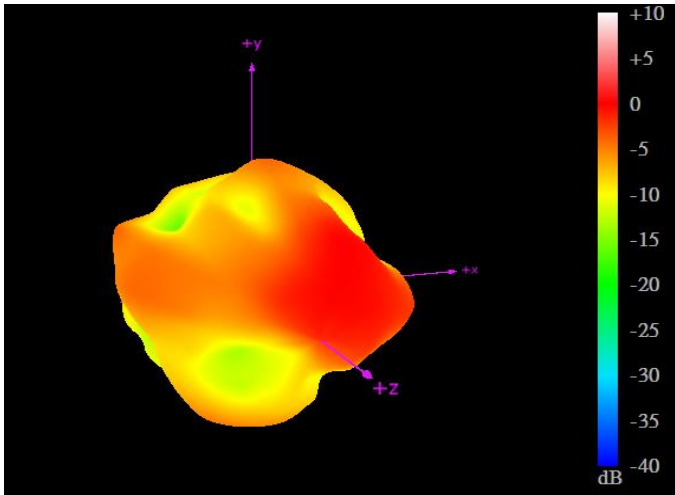
XZ Plane



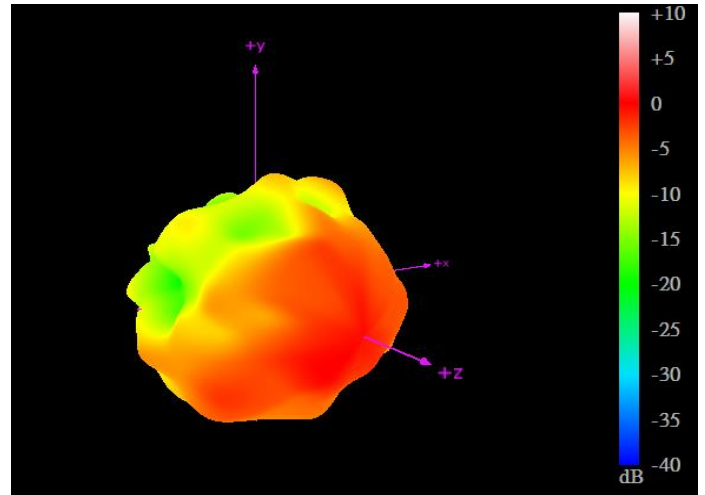
YZ Plane



3.3.45 3D Radiation Pattern (Wi-Fi_MIMO2 with 1M cable length on glass)

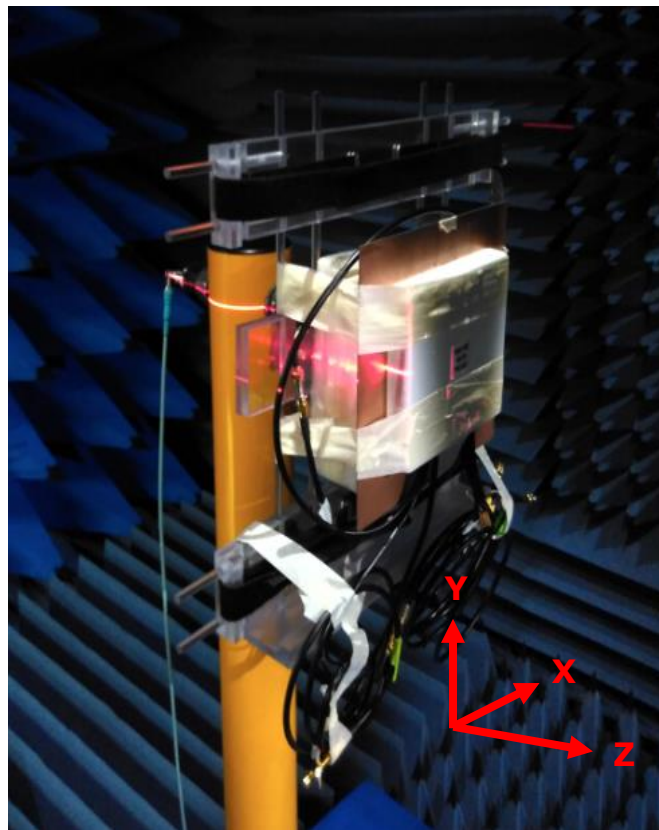


2450MHz



5550MHz

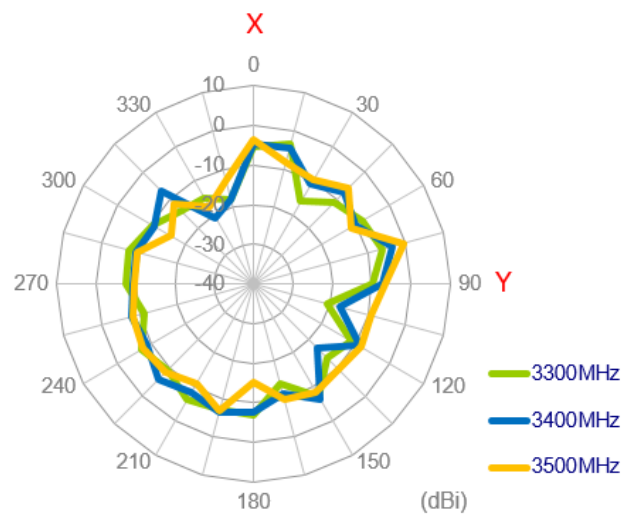
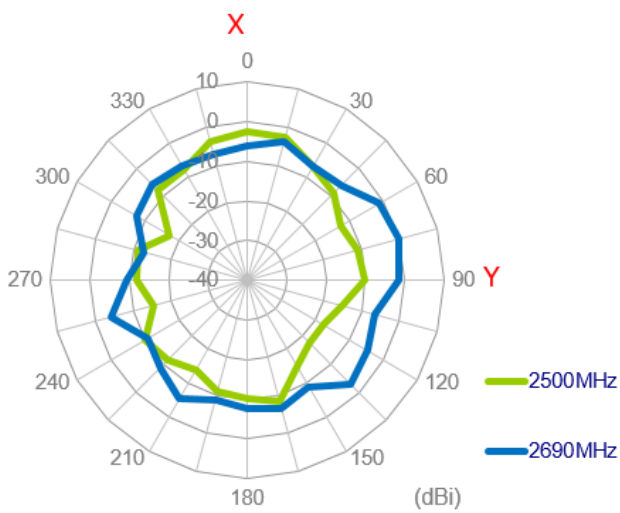
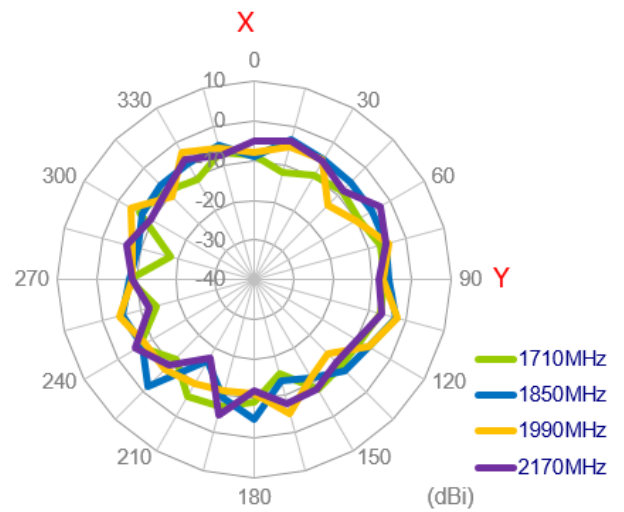
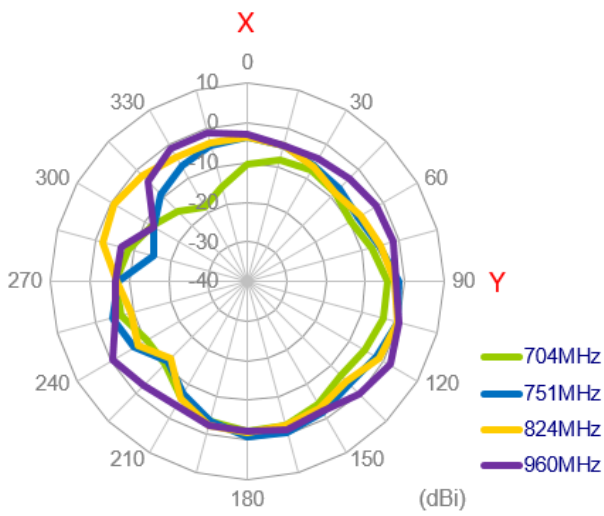
3.3.46 Test Setup for Antenna Radiation Pattern



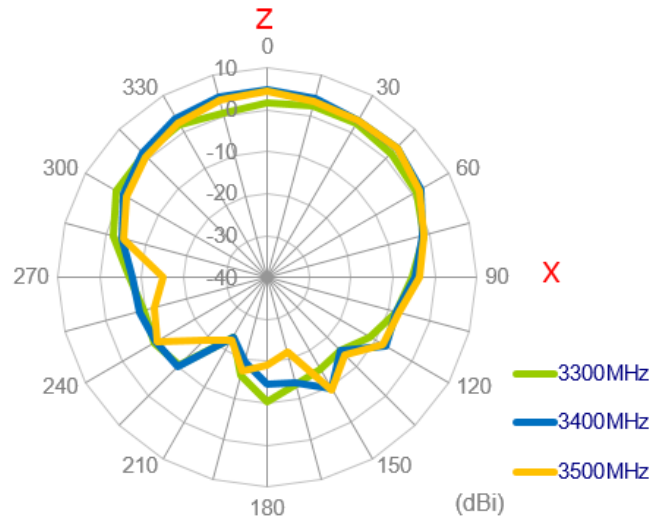
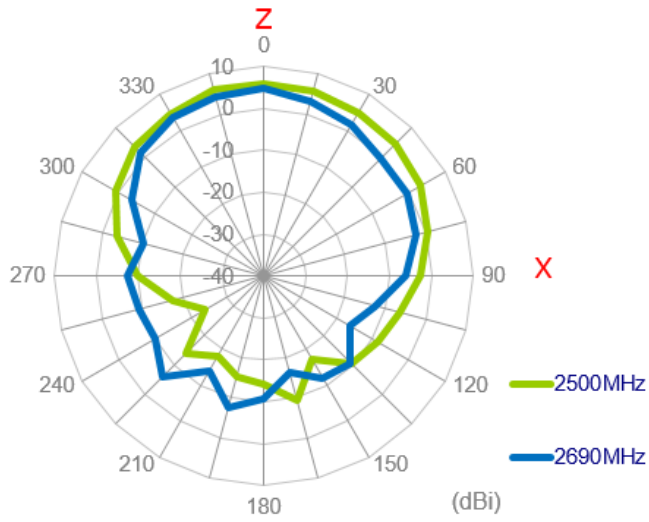
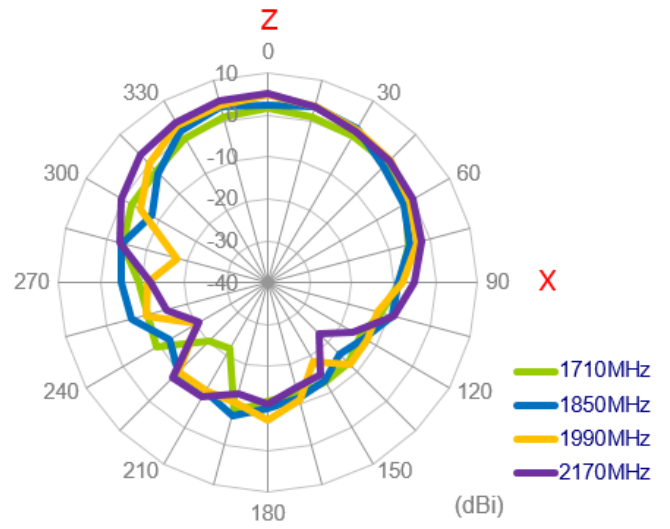
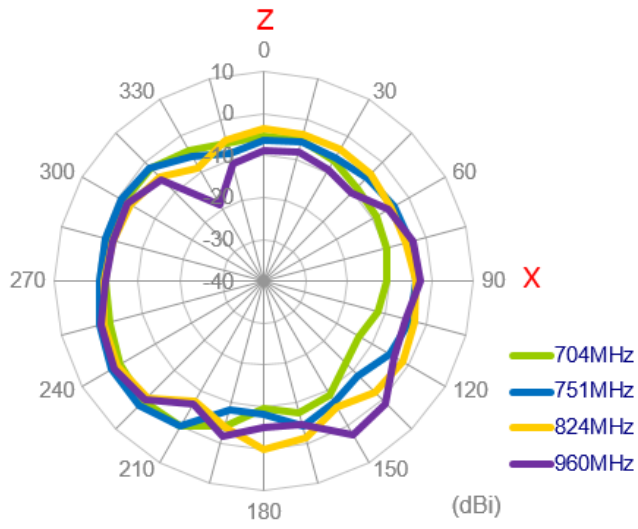
On metal

3.3.47 2D Radiation Pattern (LTE_MIMO1 with 1M cable length on metal)

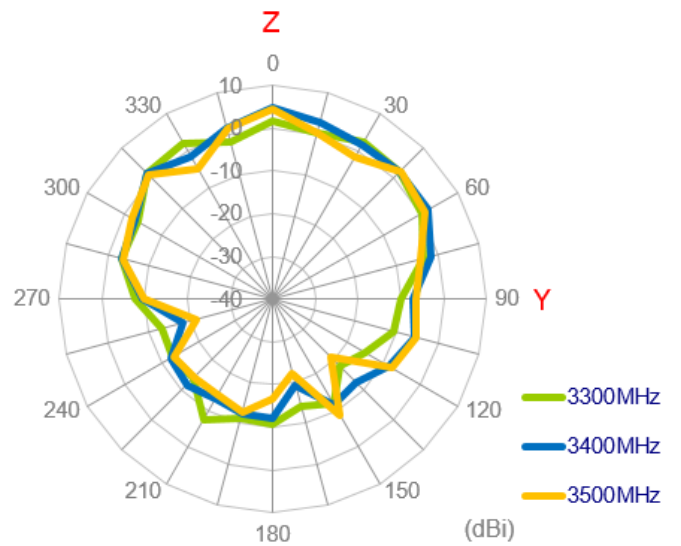
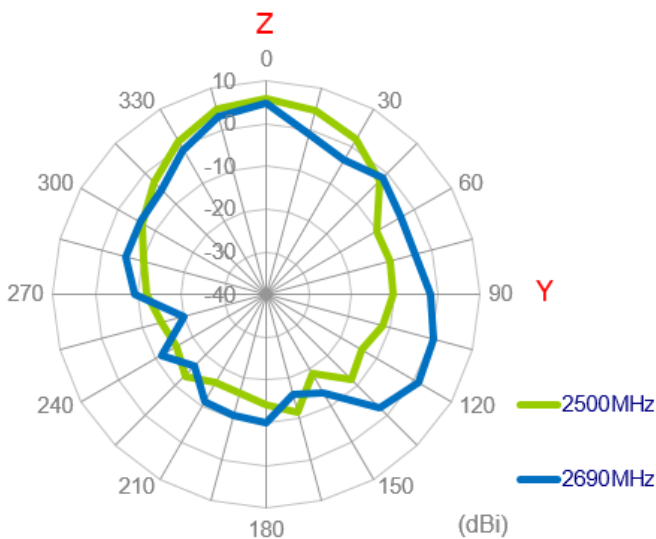
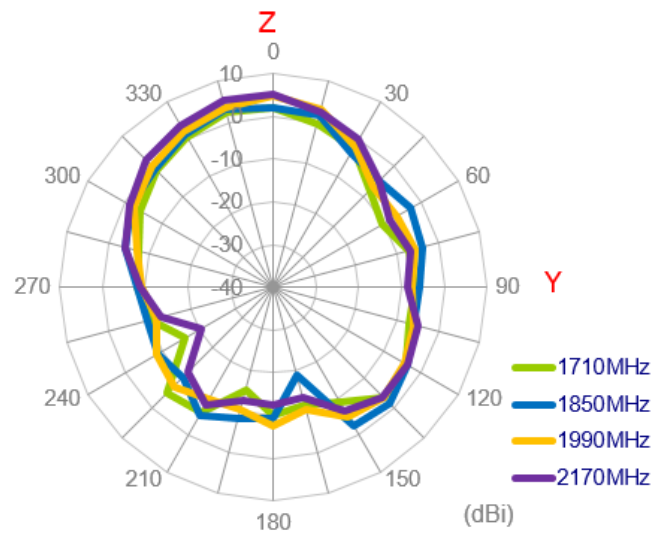
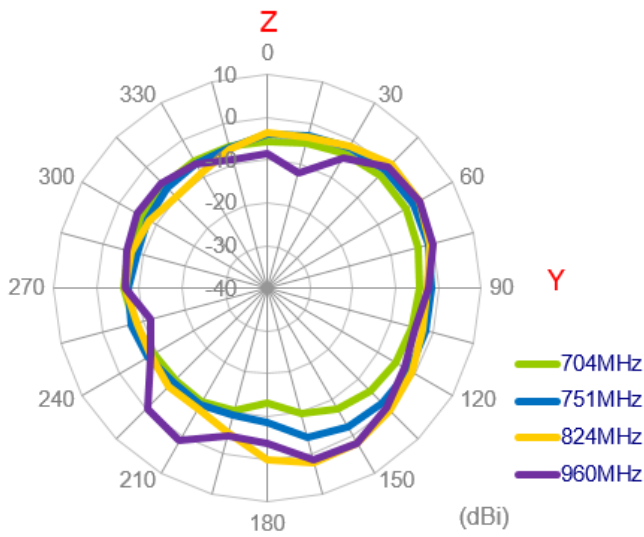
XY Plane



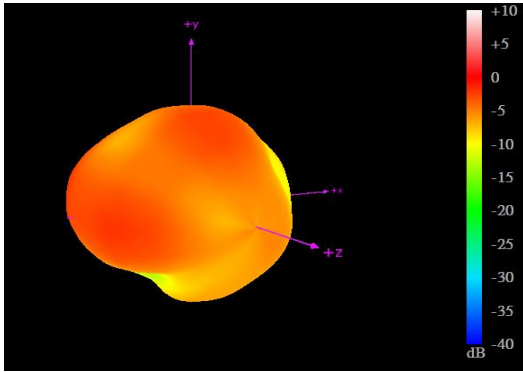
XZ Plane



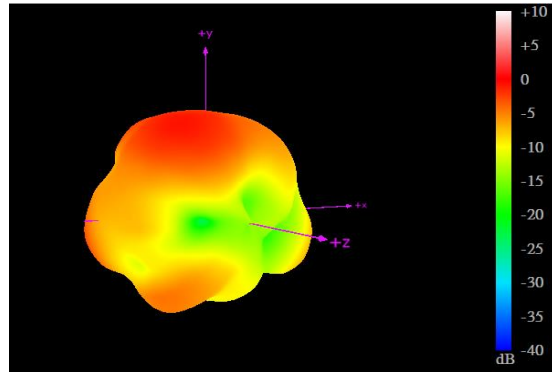
YZ Plane



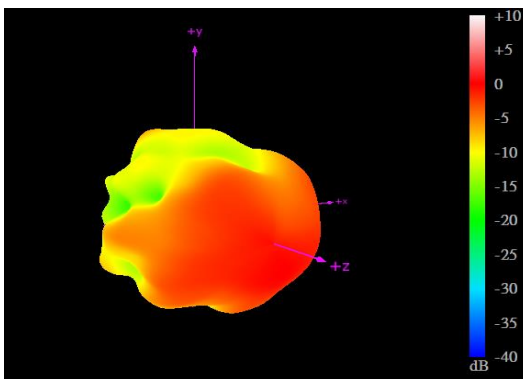
3.3.48 3D Radiation Pattern (LTE_MIMO1 with 1M cable length on metal)



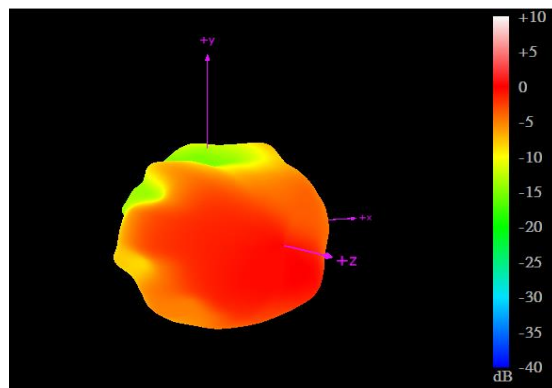
704MHz



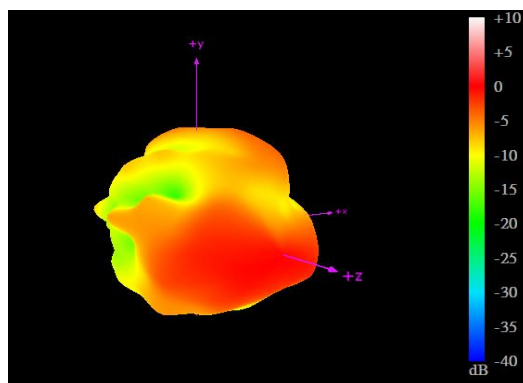
960MHz



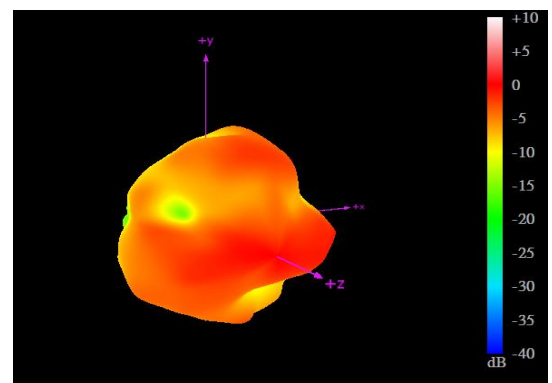
1710MHz



2170MHz

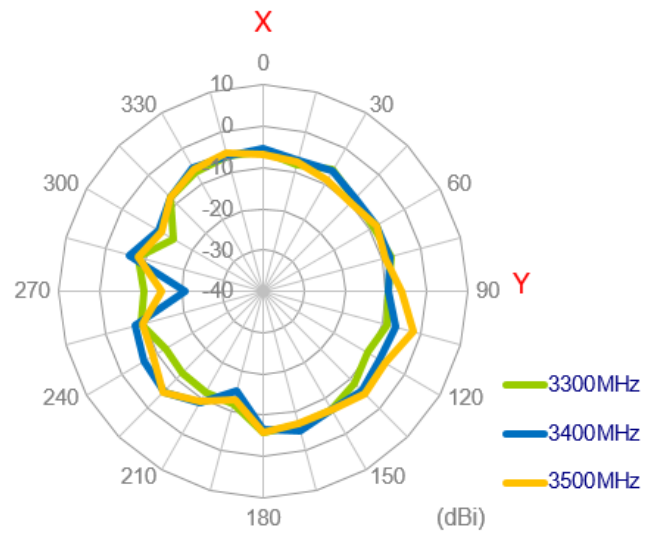
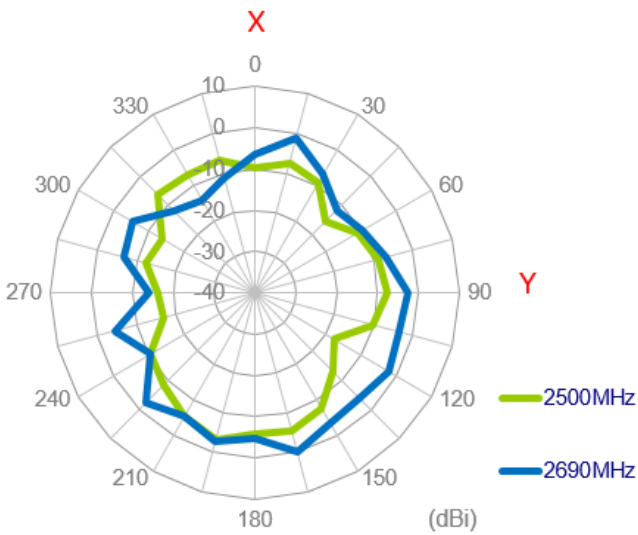
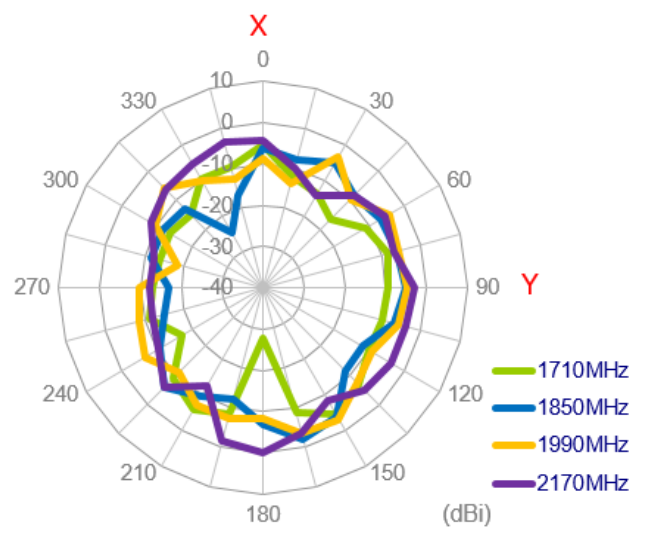
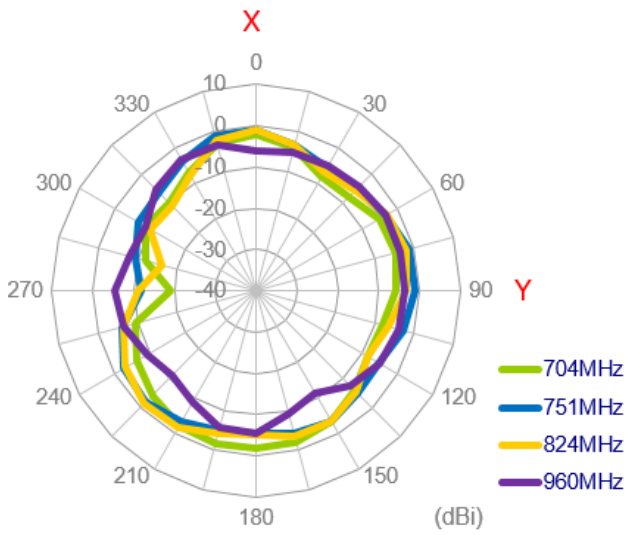


2690MHz

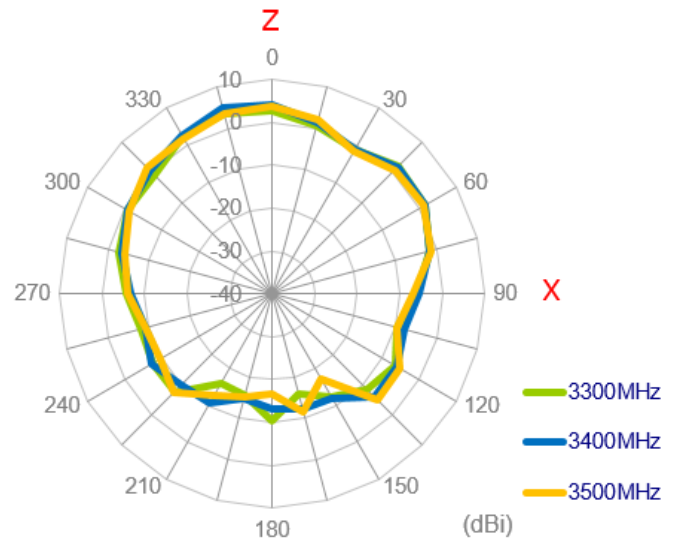
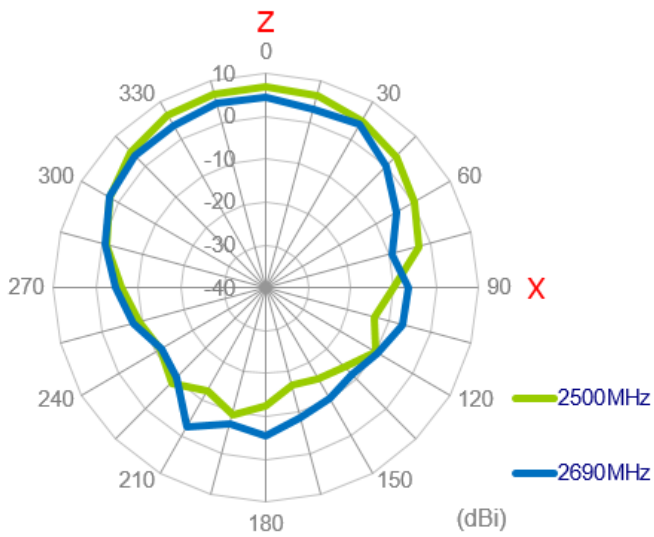
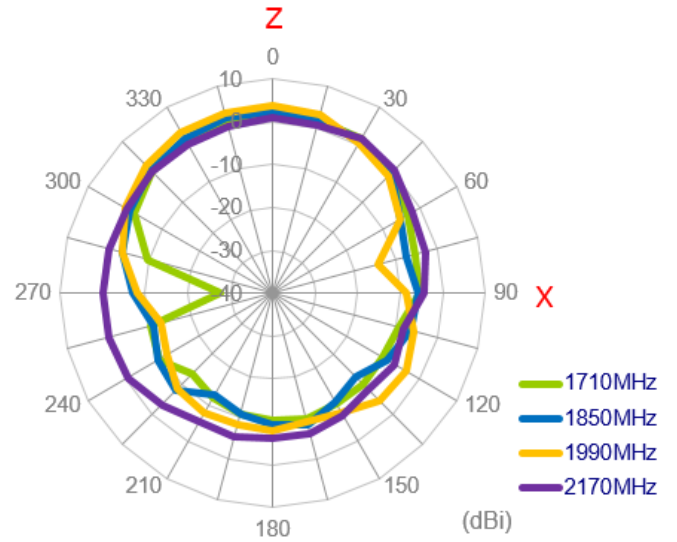
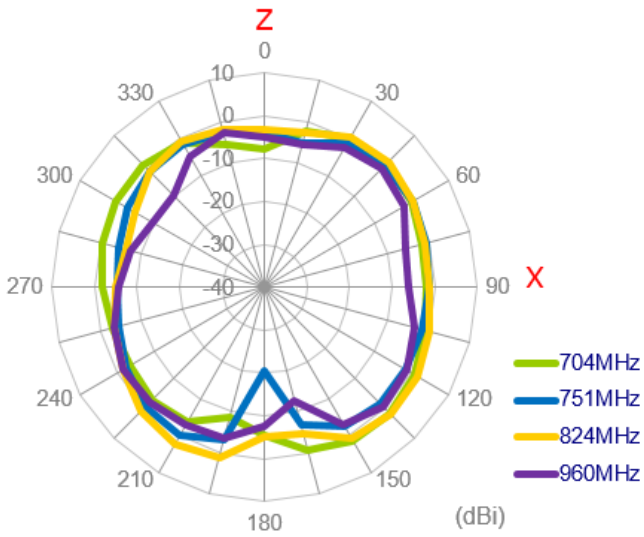


3500MHz

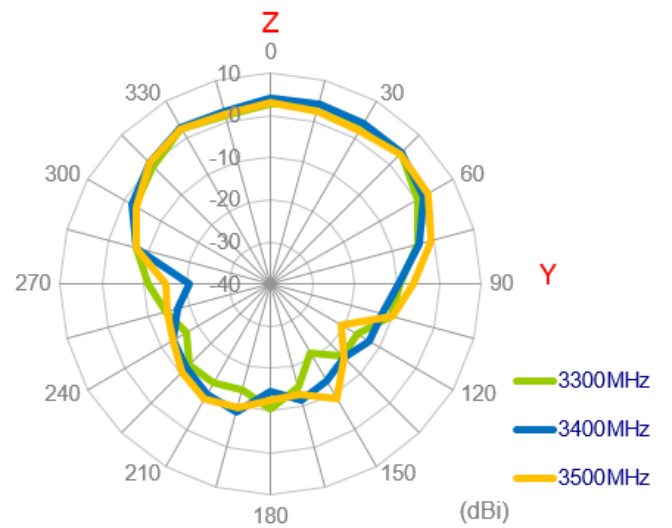
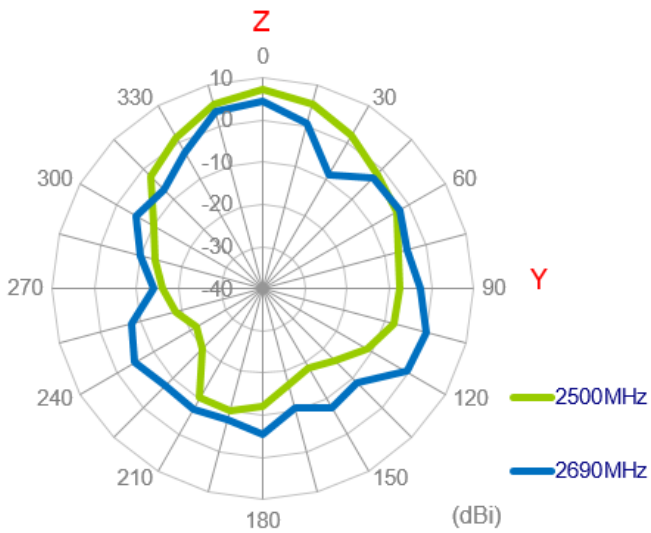
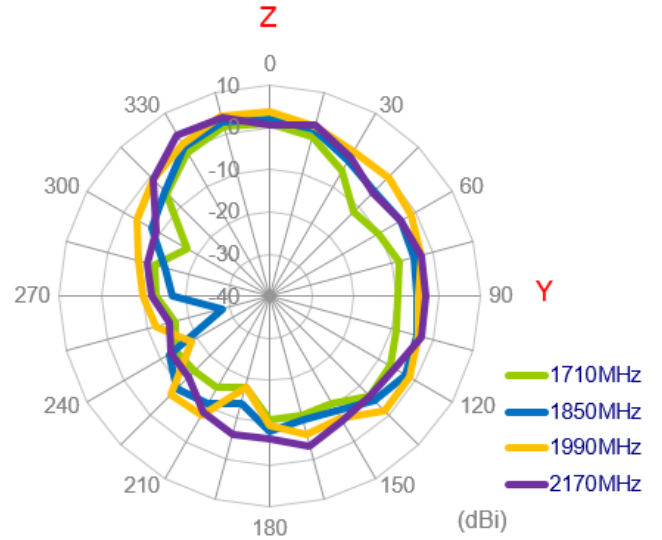
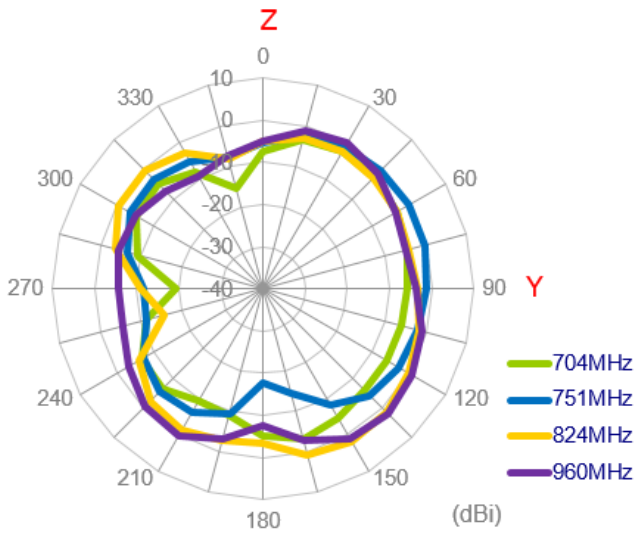
3.3.49 2D Radiation Pattern (LTE_MIMO2 with 1M cable length on metal) XY Plane



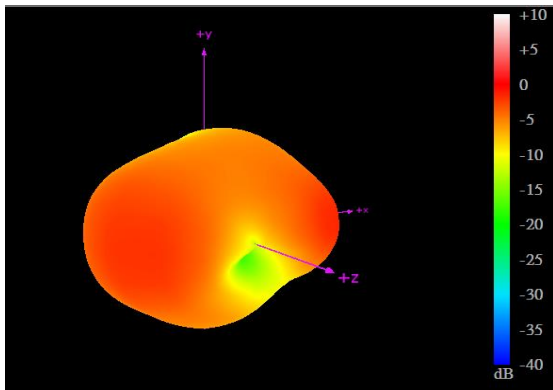
XZ Plane



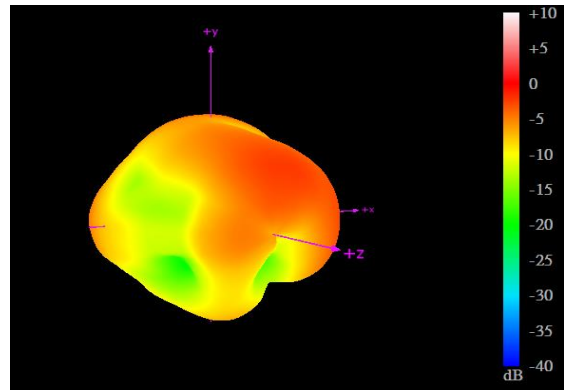
YZ Plane



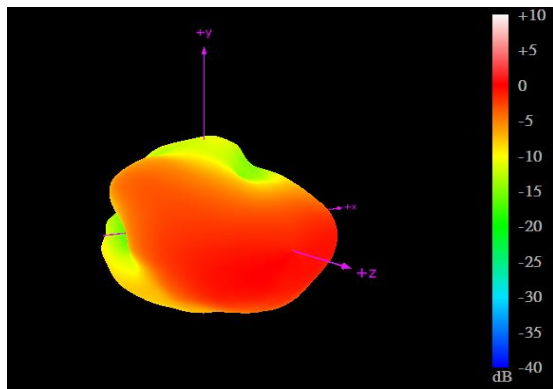
3.3.50 3D Radiation Pattern (LTE_MIMO2 with 1M cable length on metal)



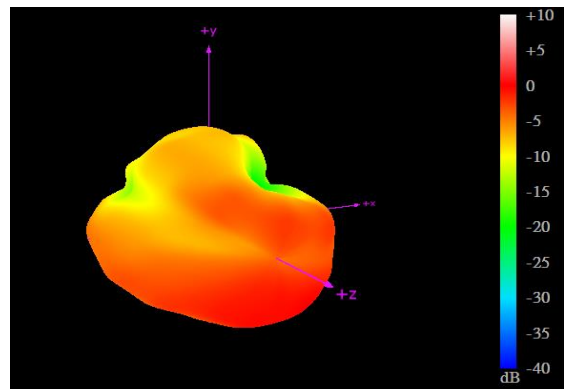
704MHz



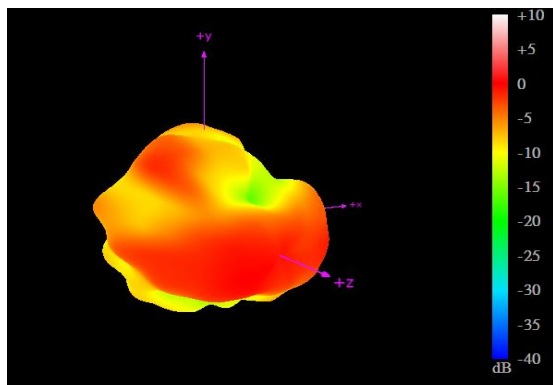
960MHz



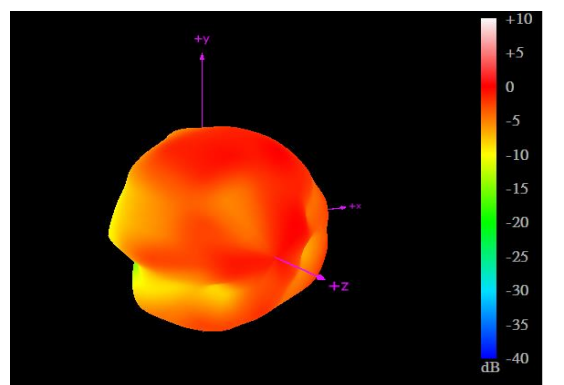
1710MHz



2170MHz



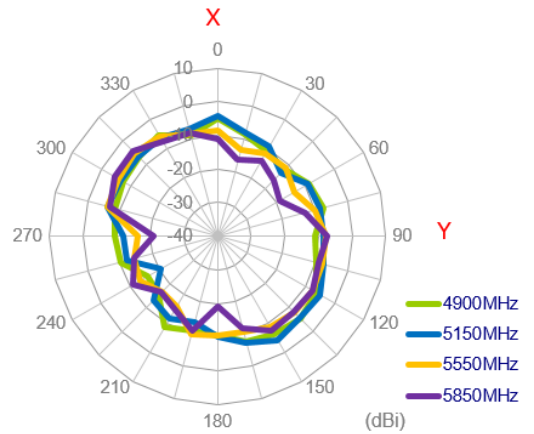
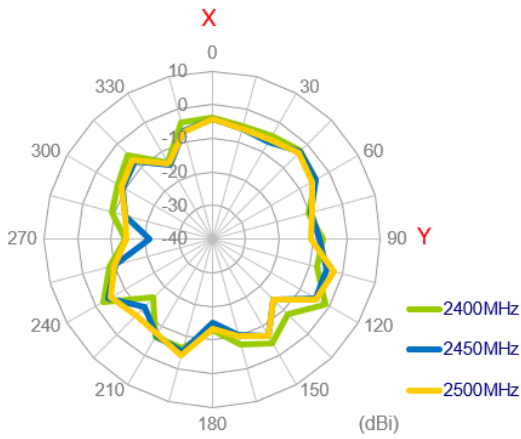
2690MHz



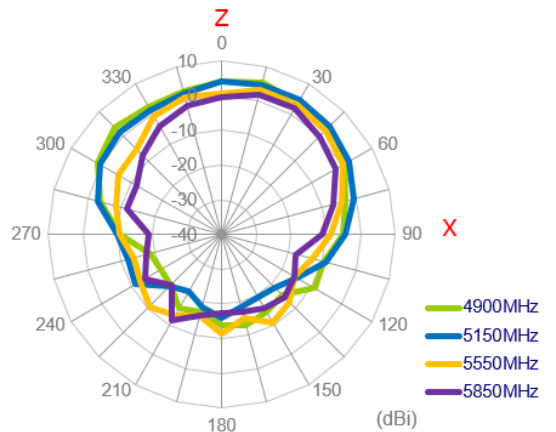
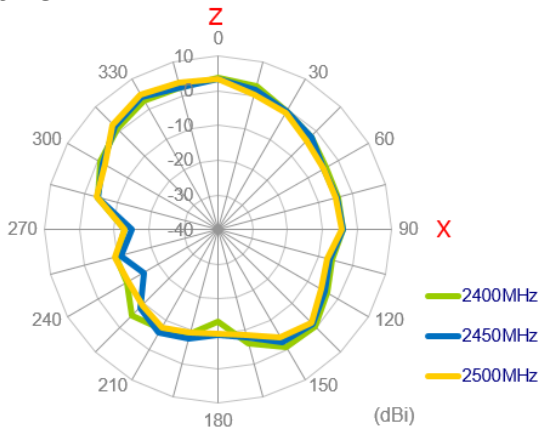
3500MHz

3.3.51 2D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length on metal)

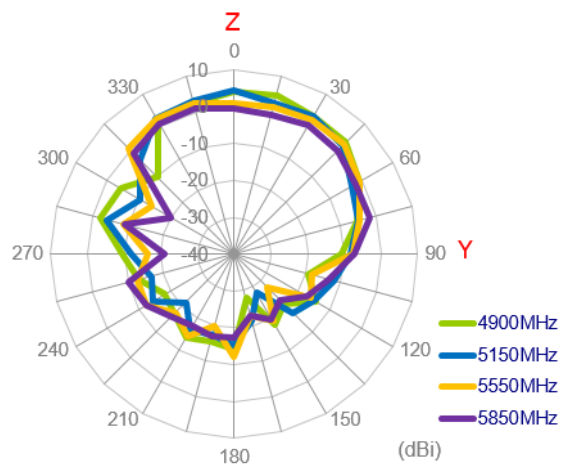
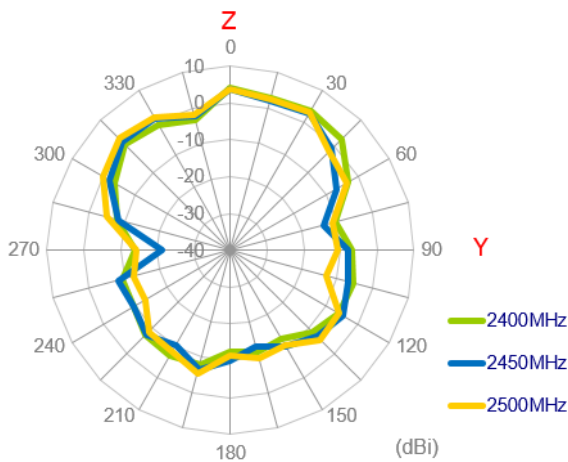
XY Plane



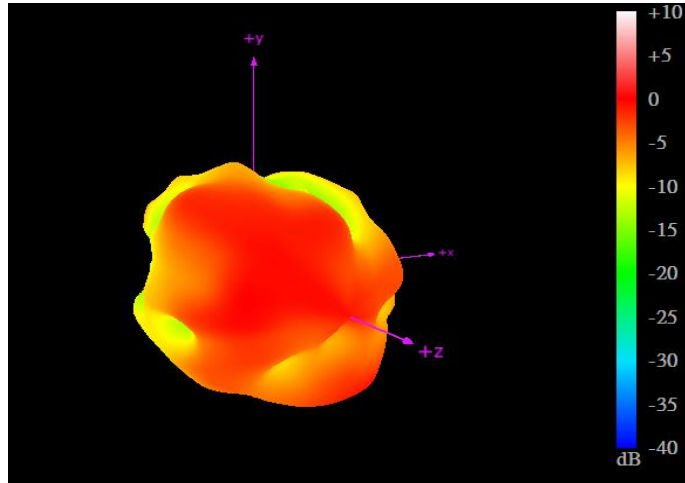
XZ Plane



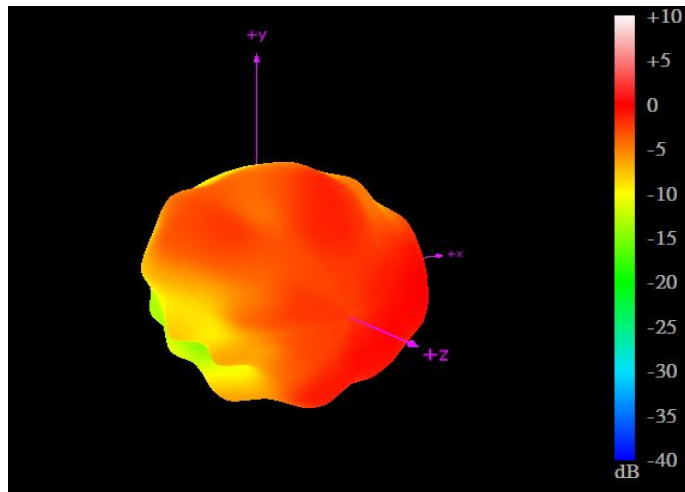
YZ Plane



3.3.52 3D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length on metal)



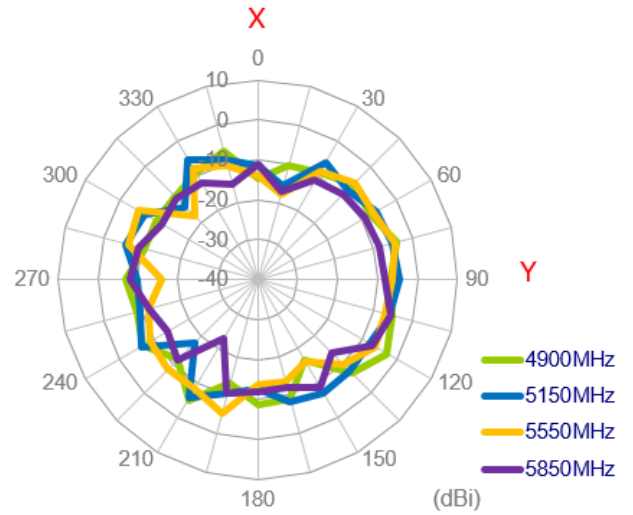
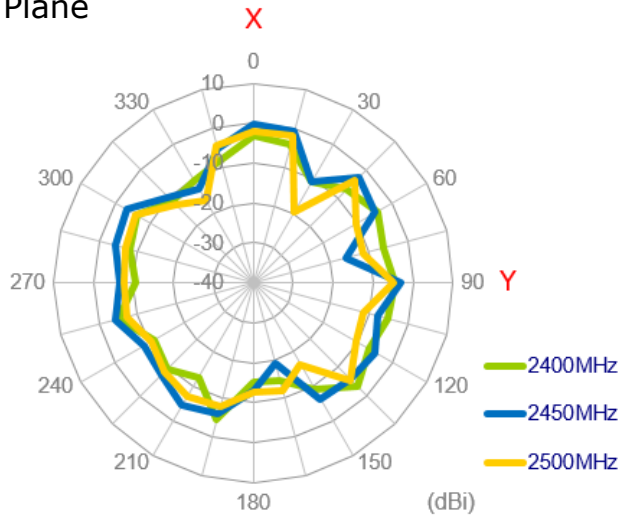
2450MHz



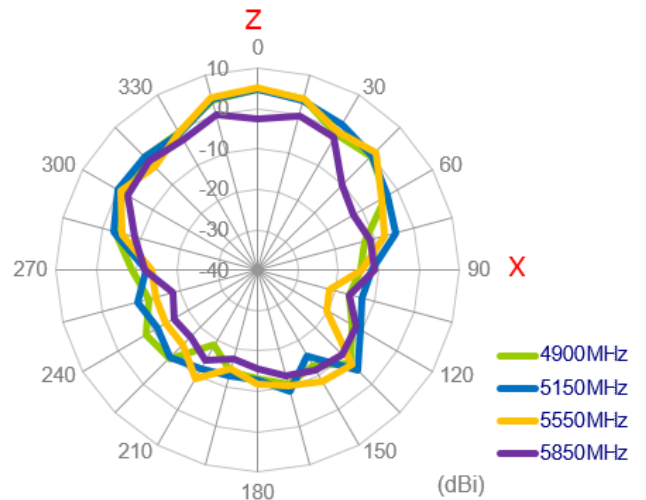
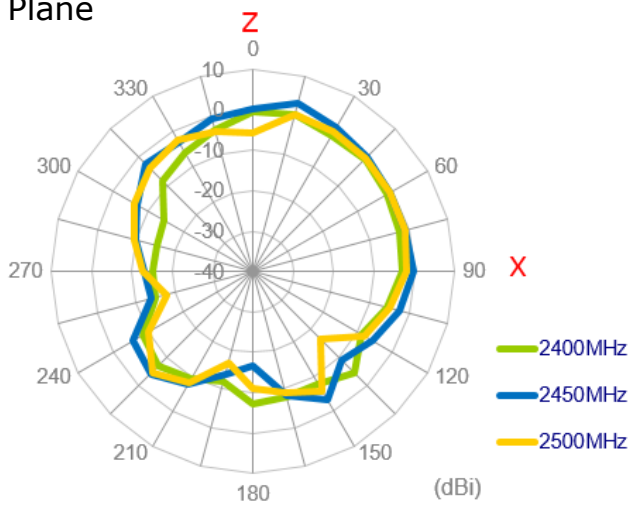
5550MHz

3.3.53 2D Radiation Pattern (Wi-Fi_MIMO2 with 3M cable length on metal)

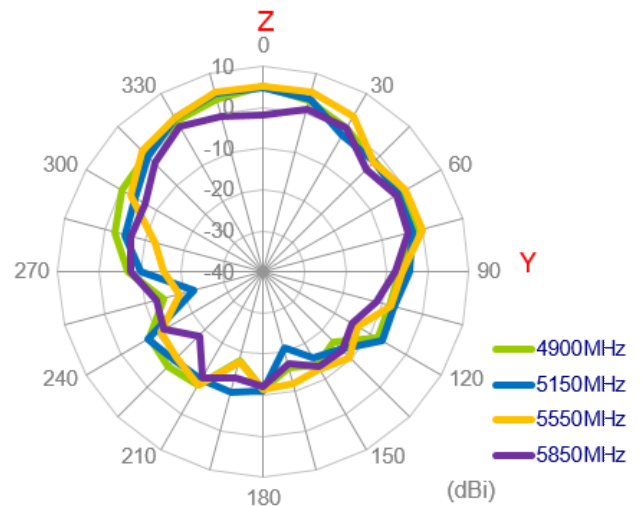
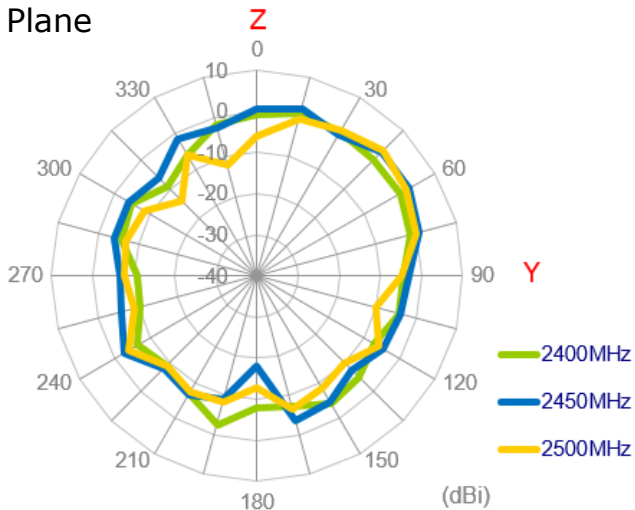
XY Plane



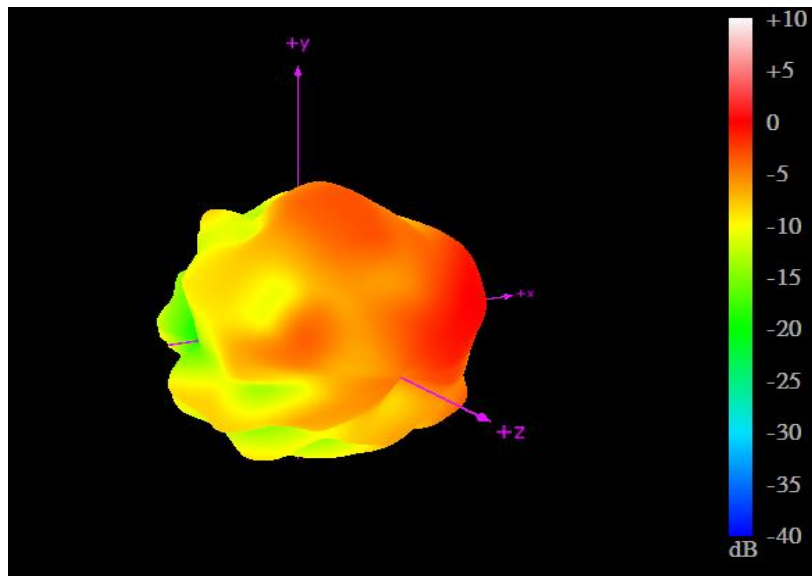
XZ Plane



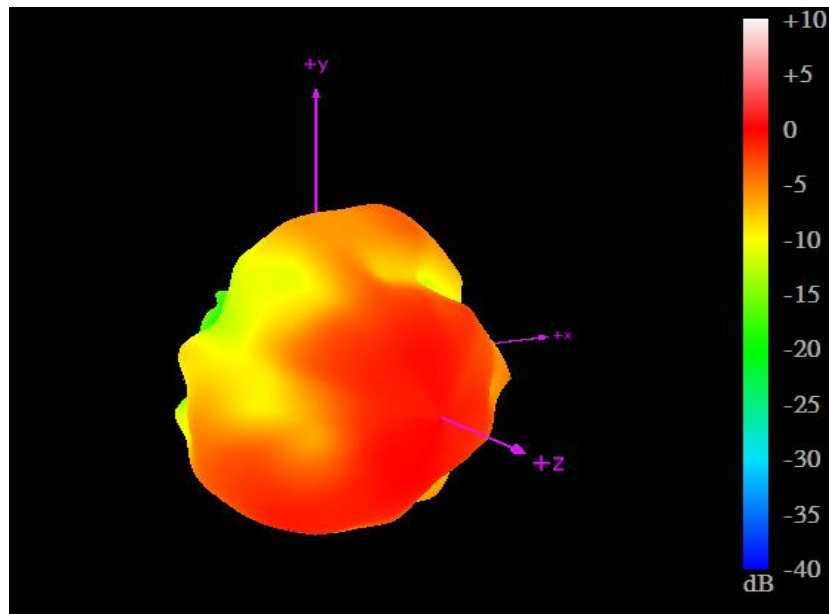
YZ Plane



3.3.54 3D Radiation Pattern (Wi-Fi_MIMO2 with 1M cable length on metal)

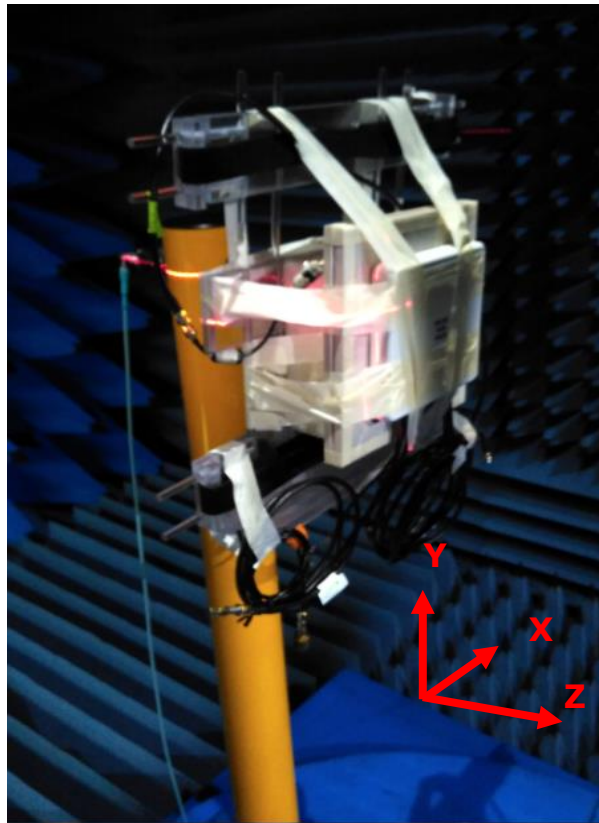


2450MHz



5550MHz

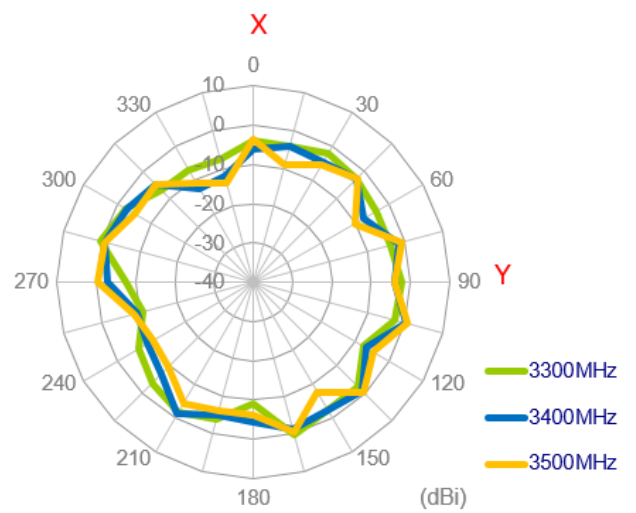
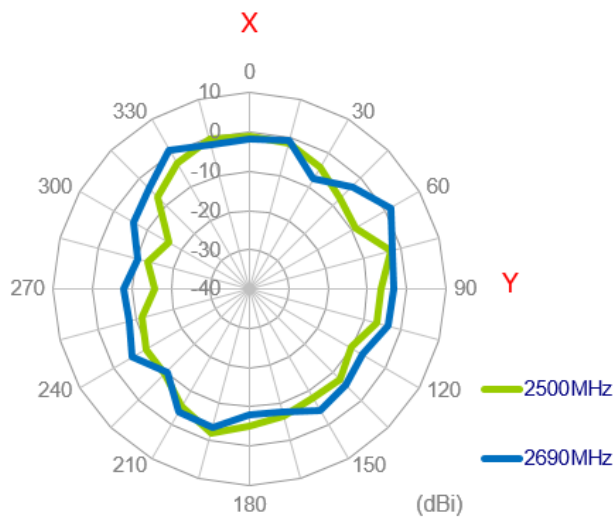
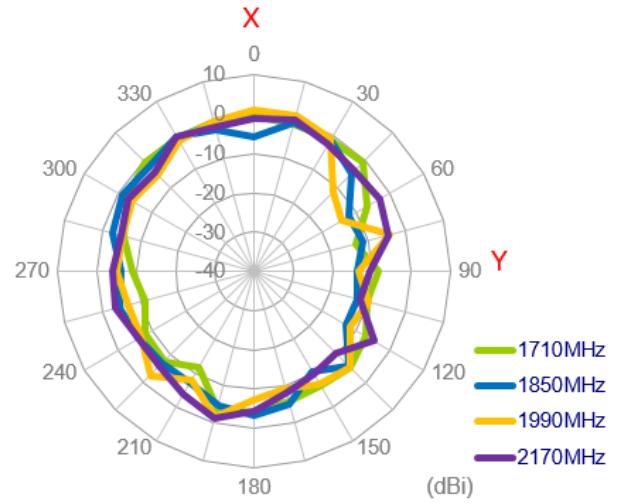
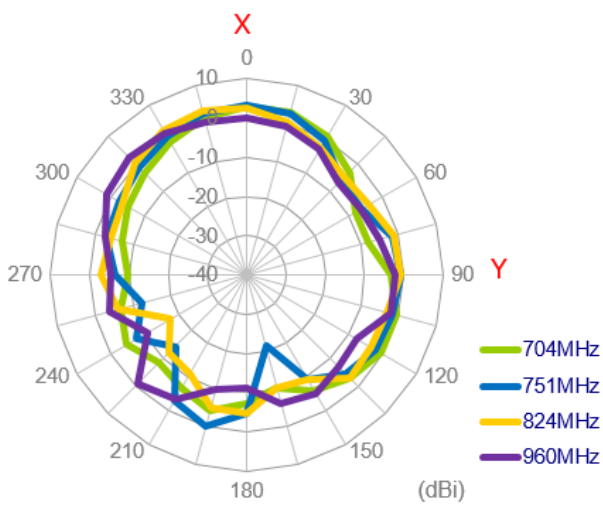
3.3.55 Test Setup for Antenna Radiation Pattern



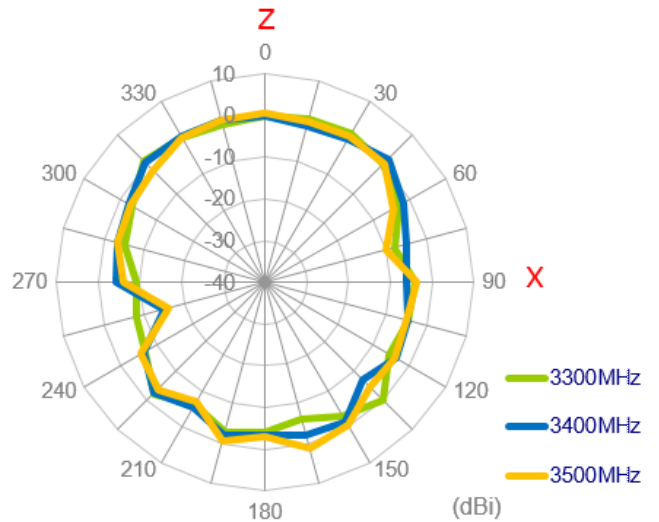
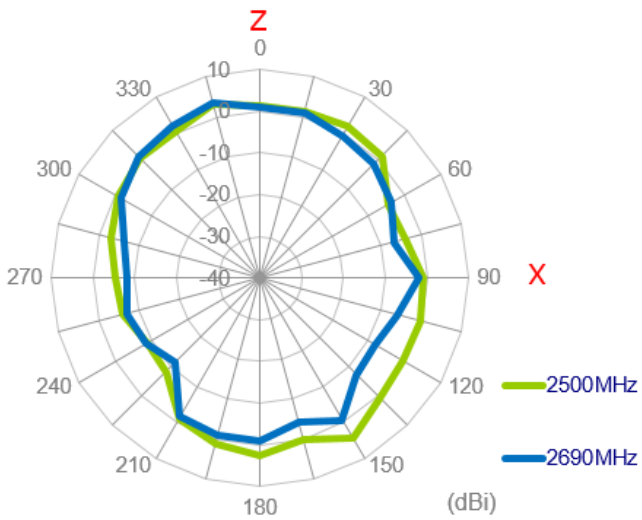
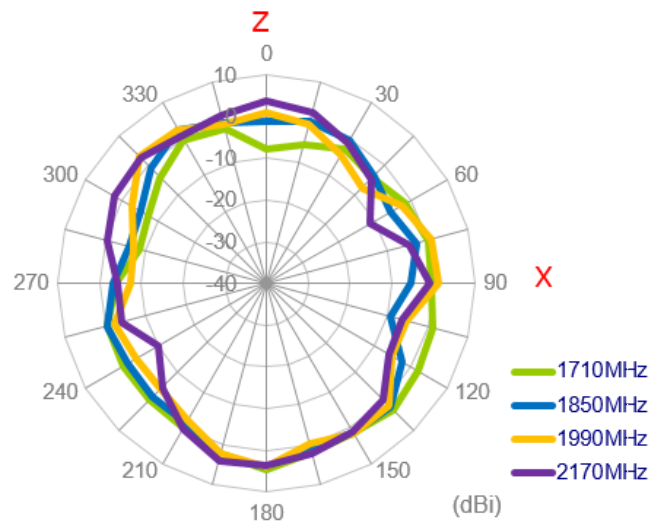
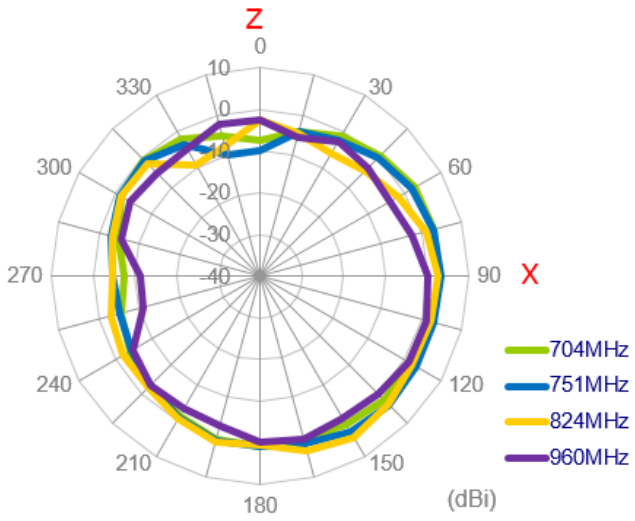
On the Wall

3.3.56 2D Radiation Pattern (LTE_MIMO1 with 1M cable length on the wall)

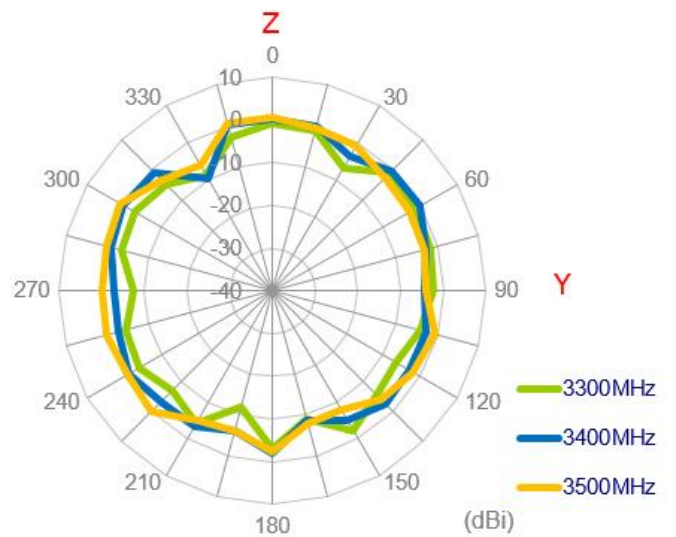
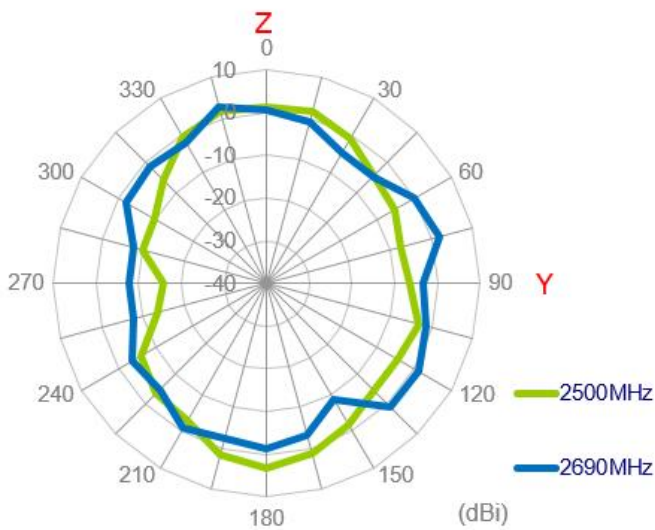
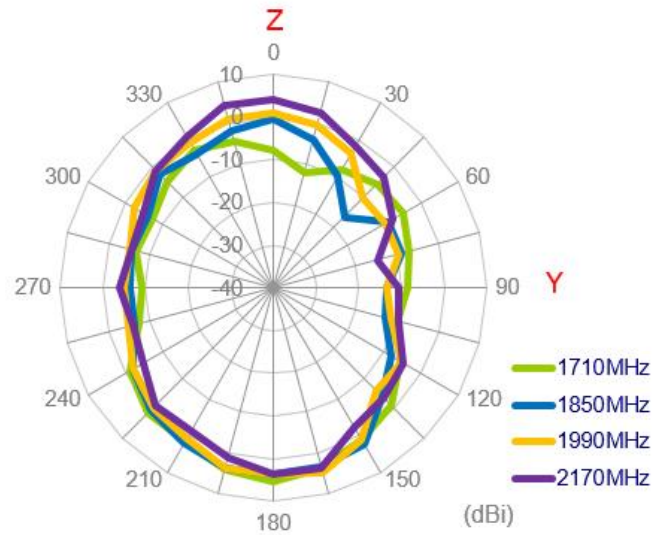
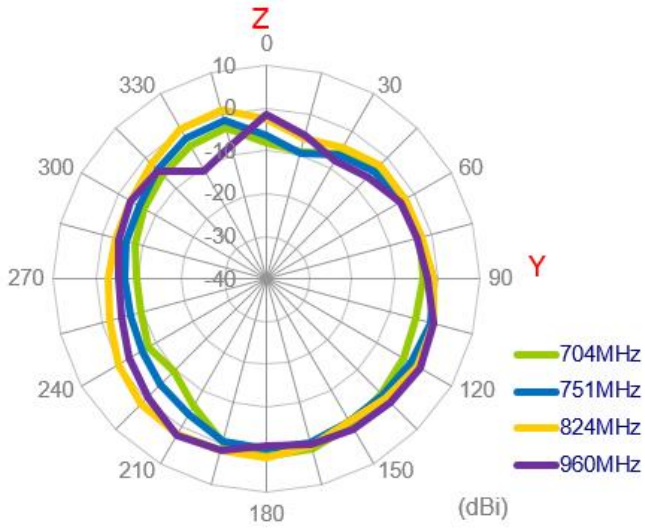
XY Plane



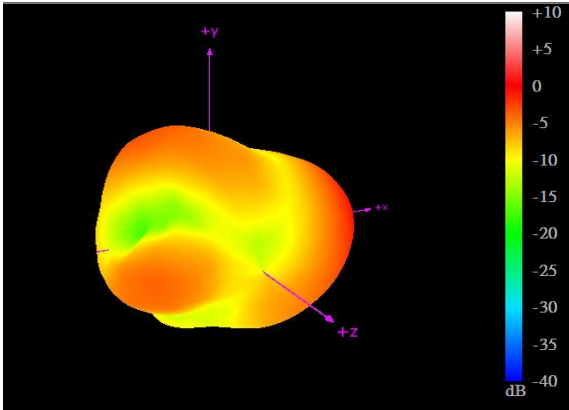
XZ Plane



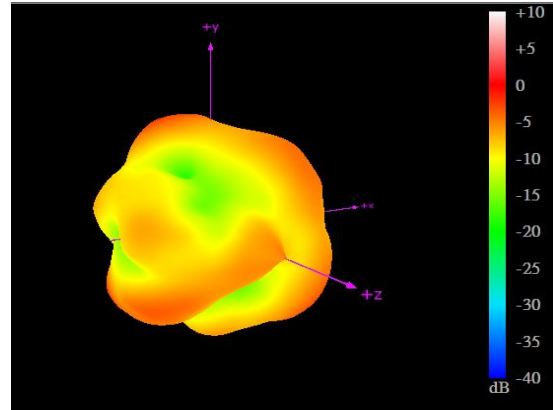
YZ Plane



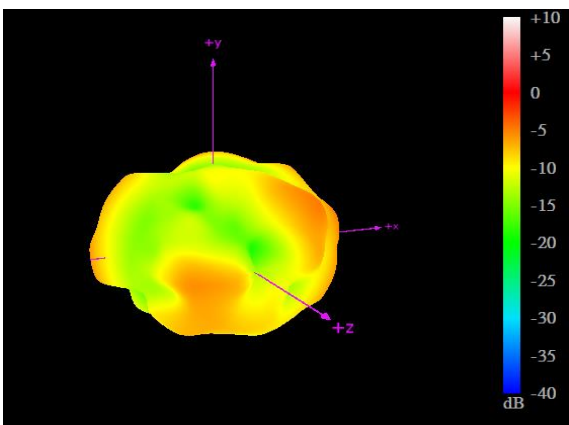
3.3.57 3D Radiation Pattern (LTE_MIMO1 with 1M cable length on the wall)



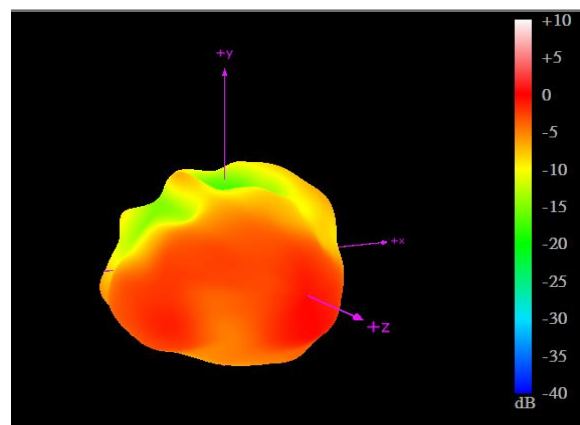
704MHz



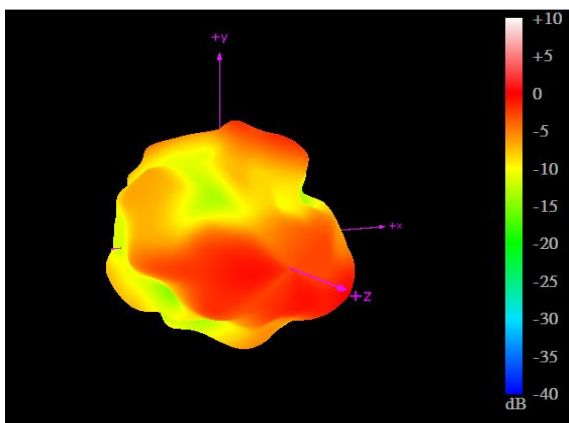
960MHz



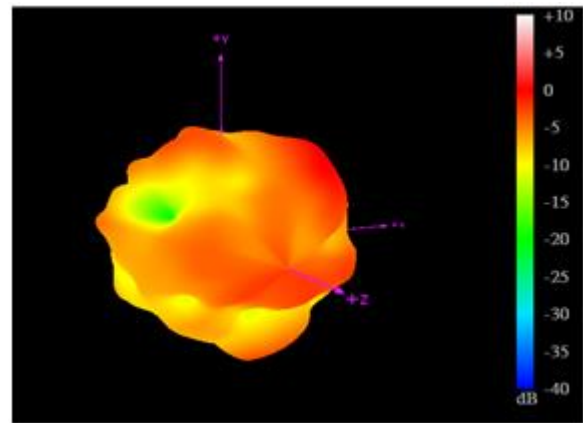
1710MHz



2170MHz



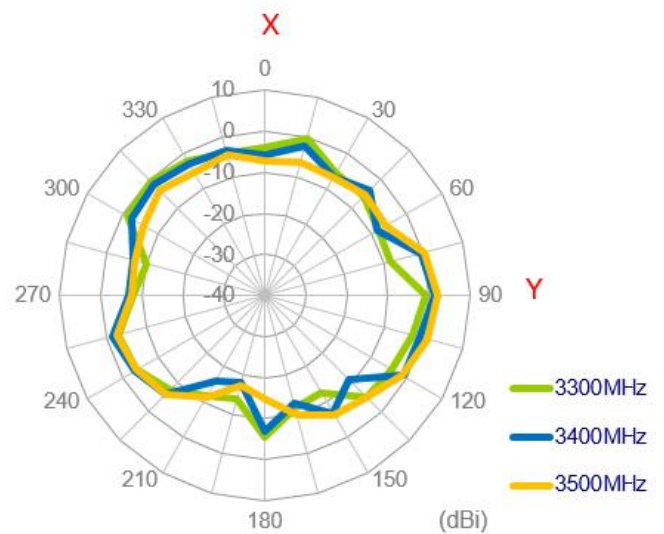
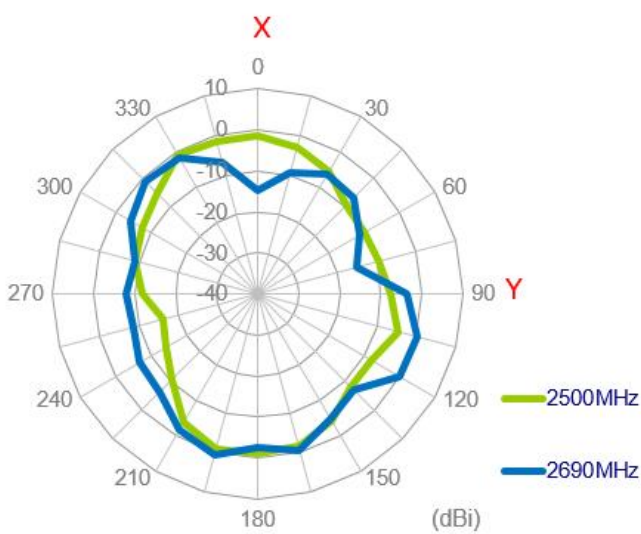
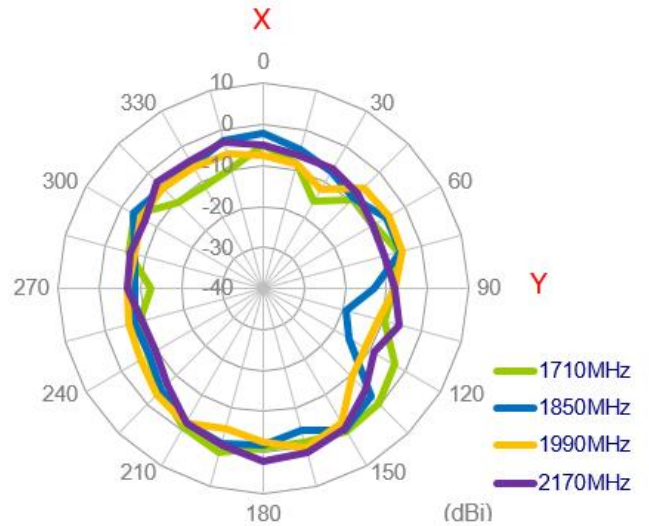
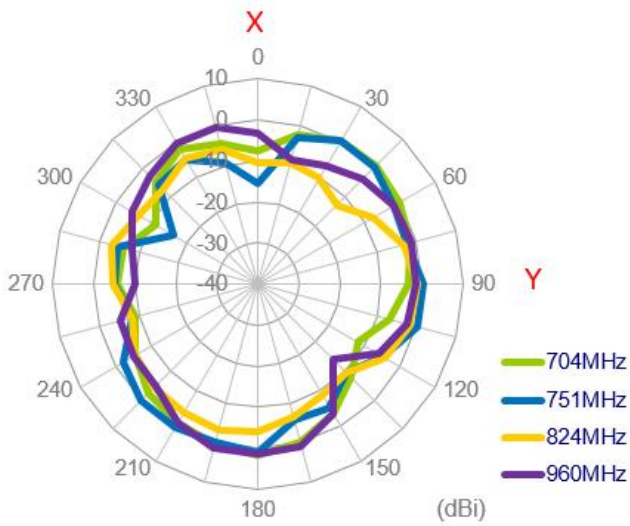
2690MHz



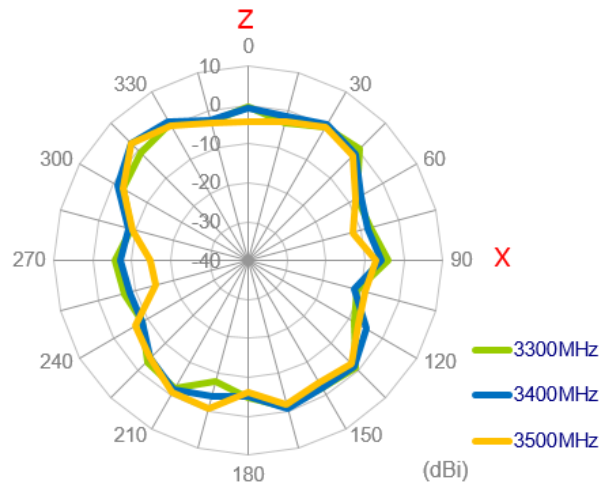
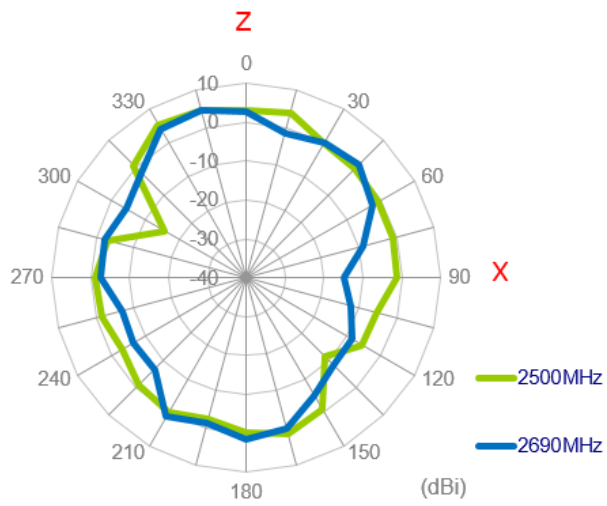
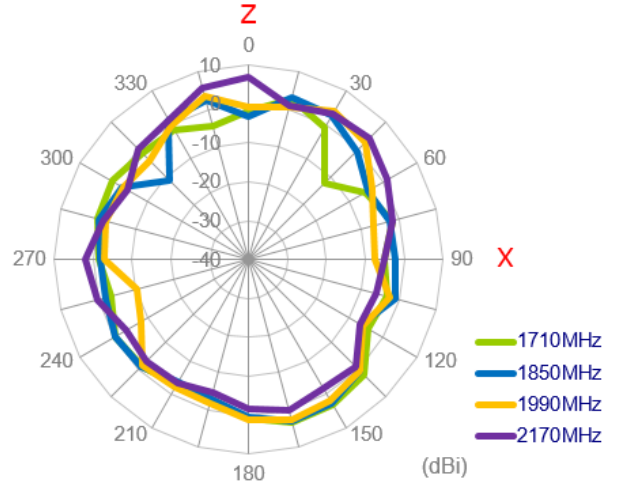
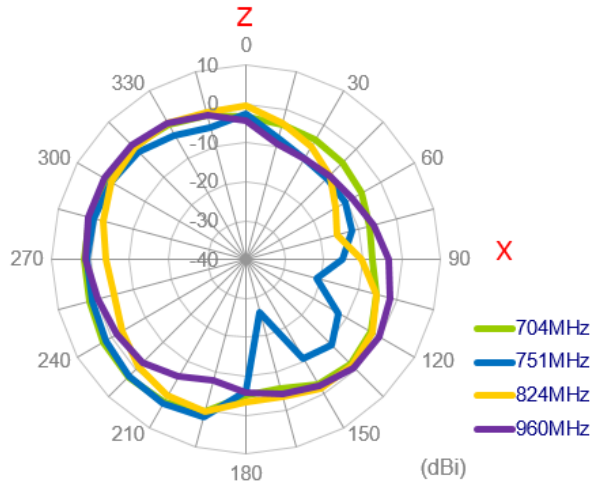
3500MHz

3.3.58 2D Radiation Pattern (LTE_MIMO2 with 1M cable length on the wall)

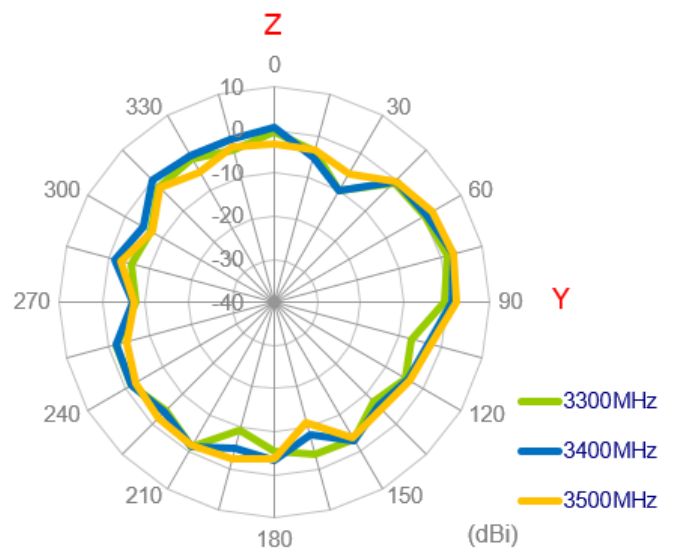
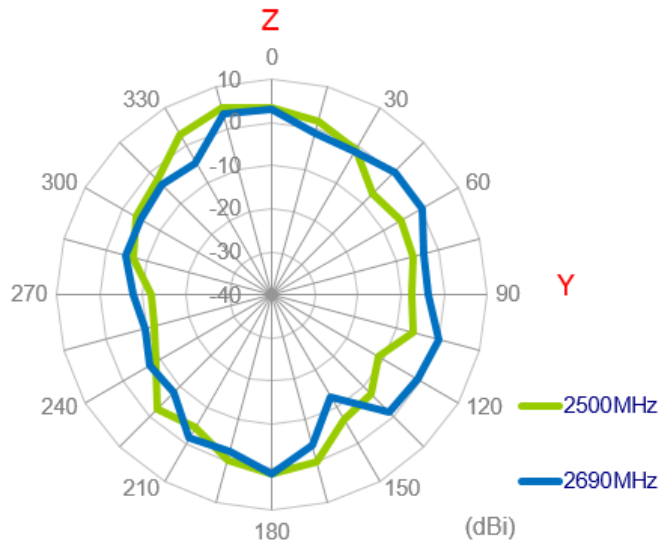
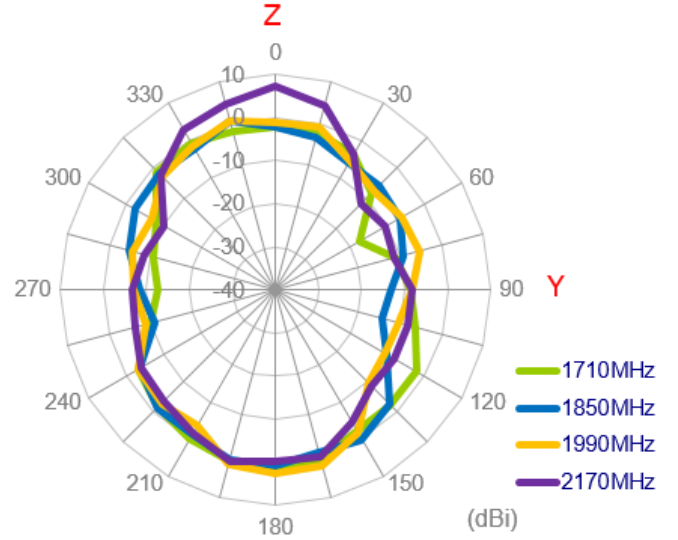
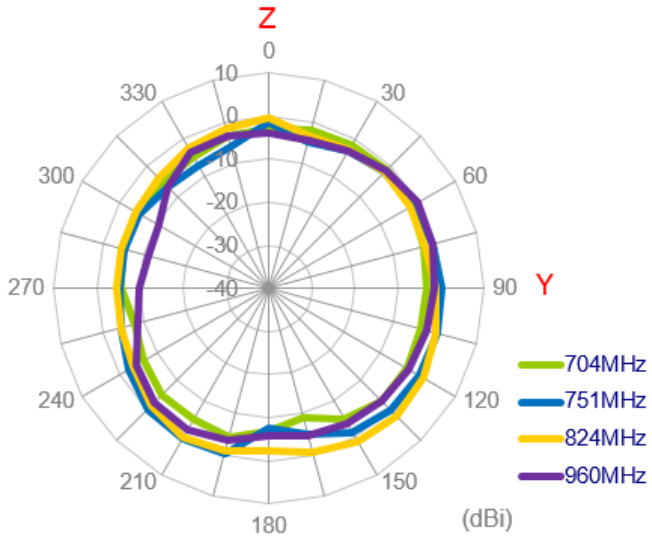
XY Plane



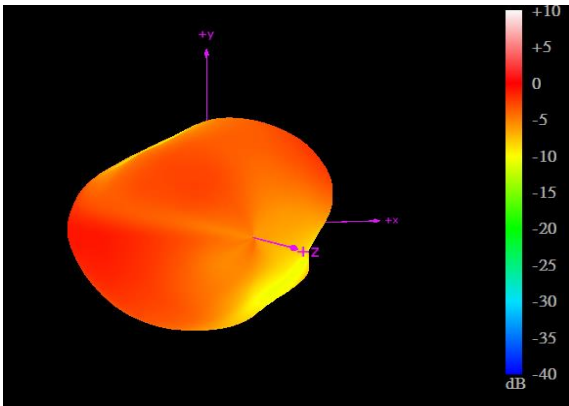
XZ Plane



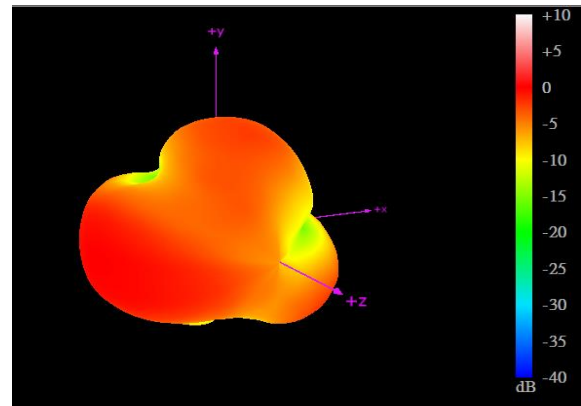
YZ Plane



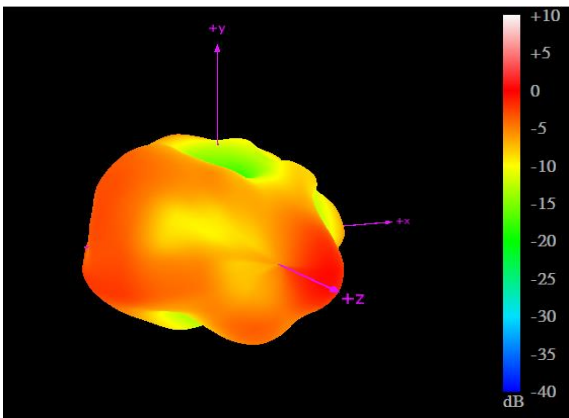
3.3.59 3D Radiation Pattern (LTE_MIMO2 with 1M cable length on the wall)



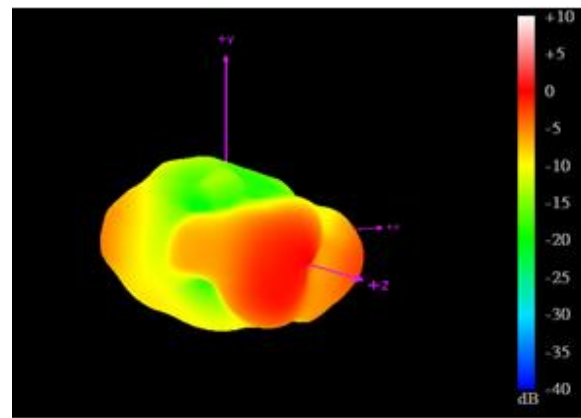
704MHz



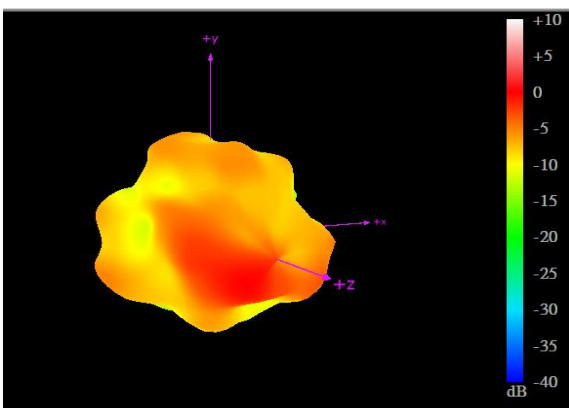
960MHz



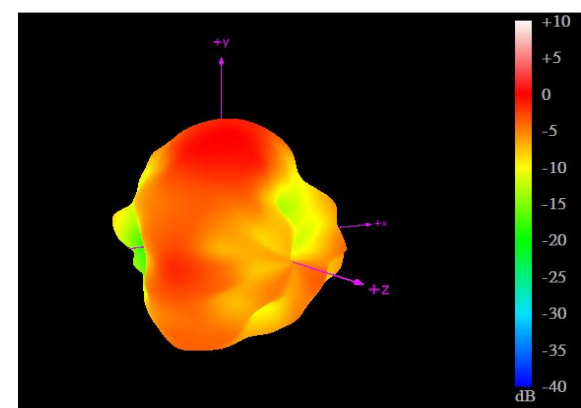
1710MHz



2170MHz



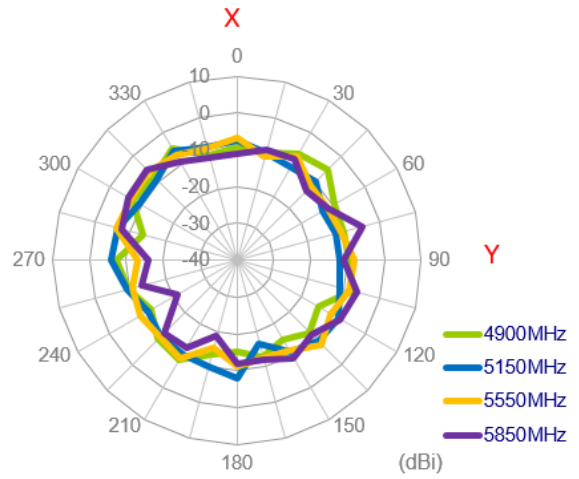
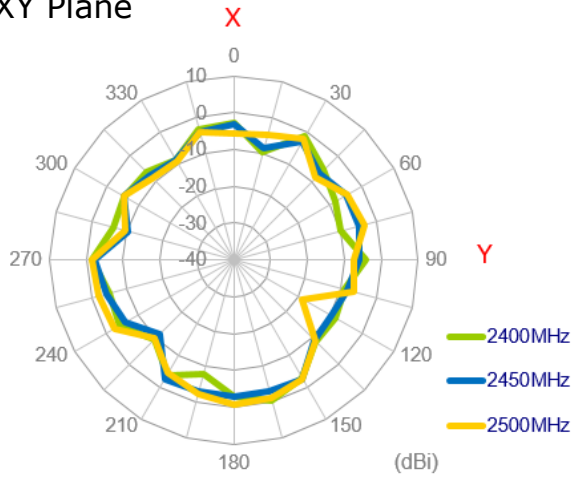
2690MHz



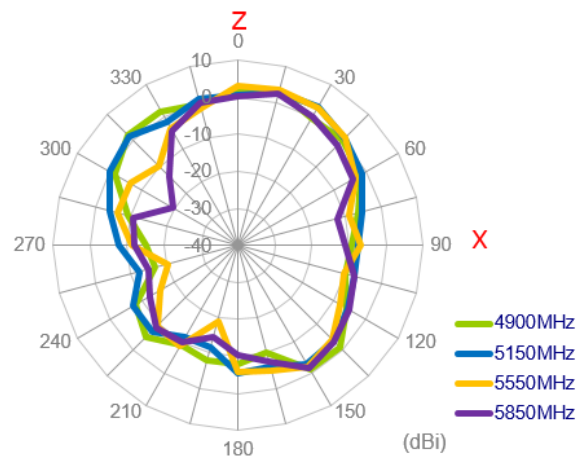
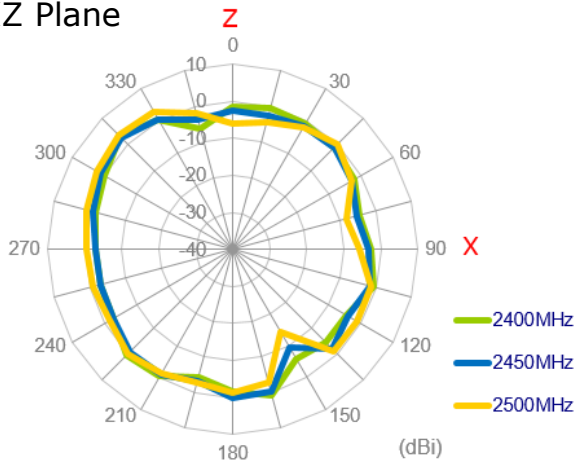
3500MHz

3.3.60 2D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length in free space)

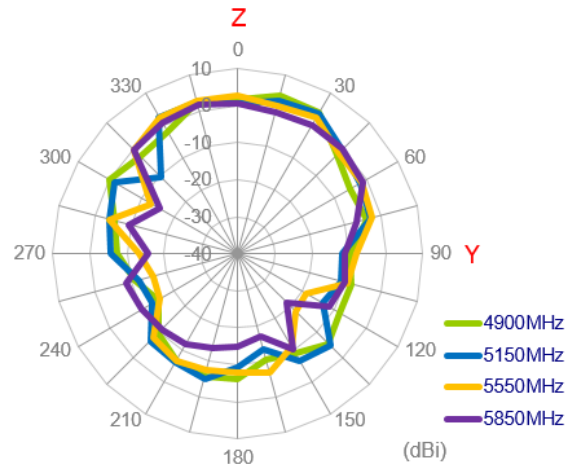
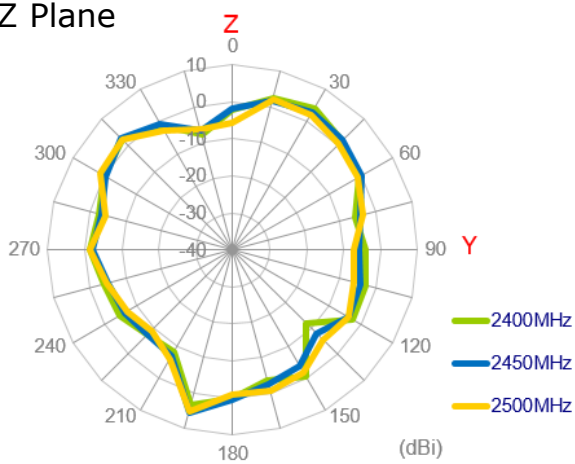
XY Plane



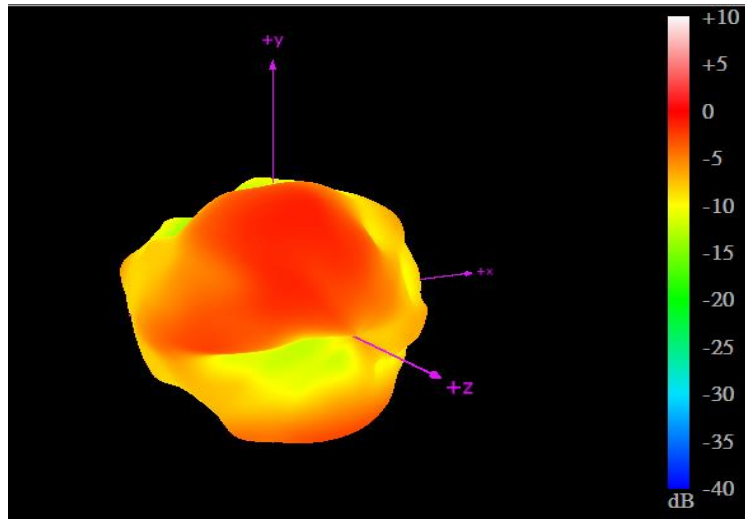
XZ Plane



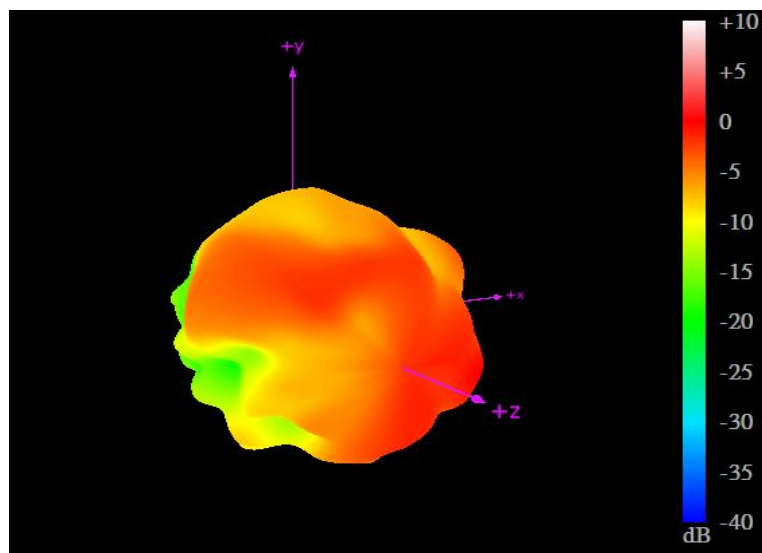
YZ Plane



3.3.61 3D Radiation Pattern (Wi-Fi_MIMO1 with 1M cable length in free space)



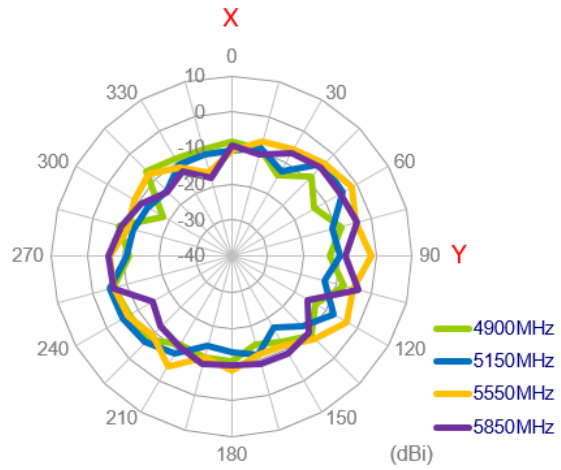
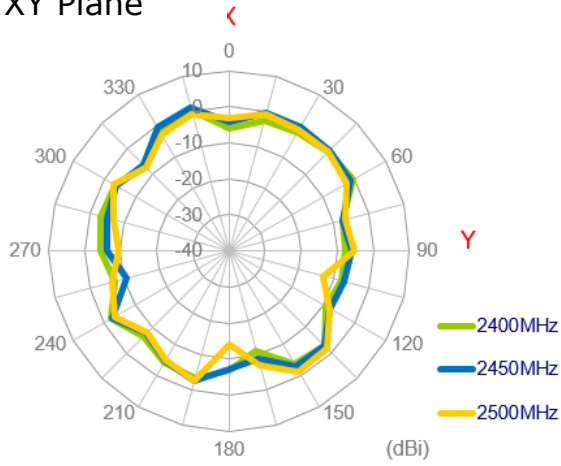
2450MHz



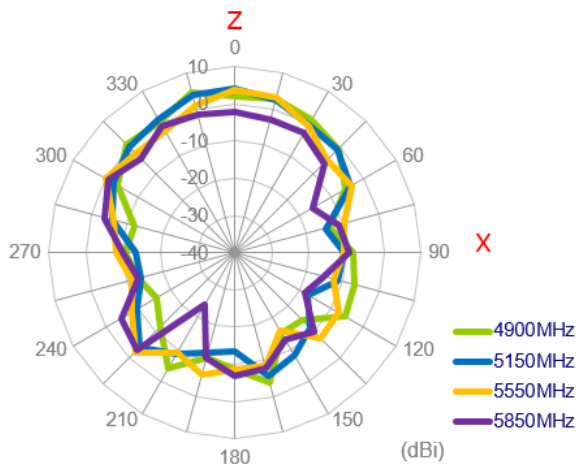
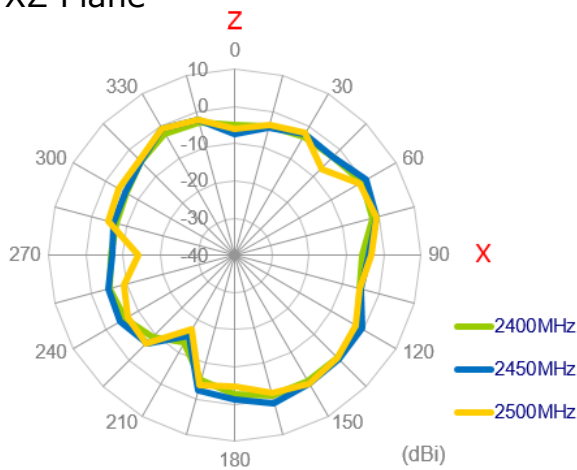
5550MHz

3.3.62 2D Radiation Pattern (Wi-Fi_MIMO2 with 3M cable length in free space)

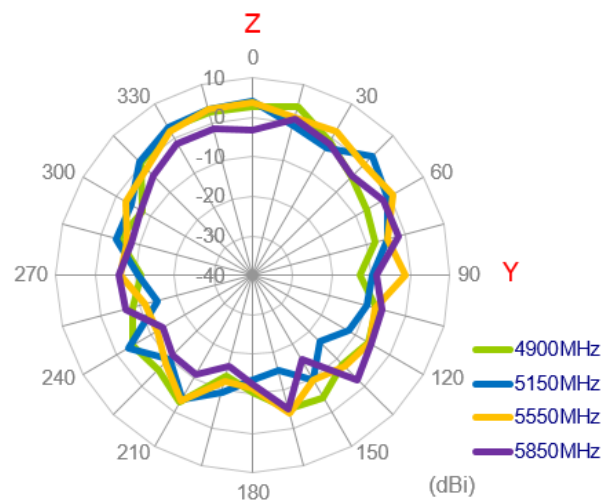
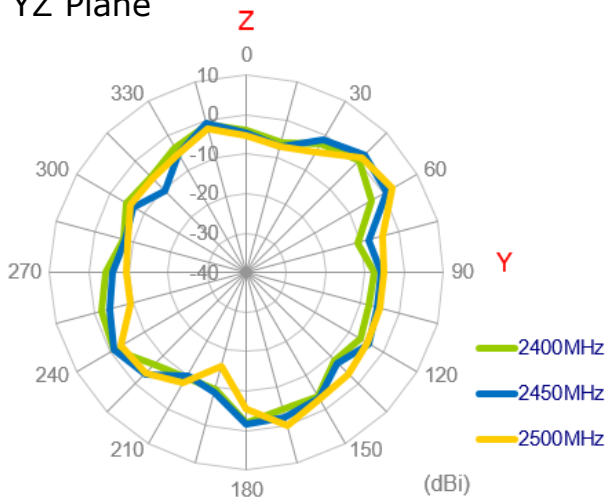
XY Plane



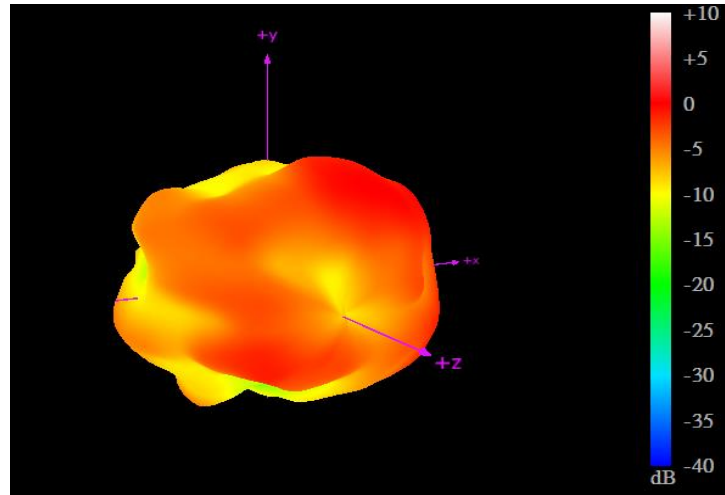
XZ Plane



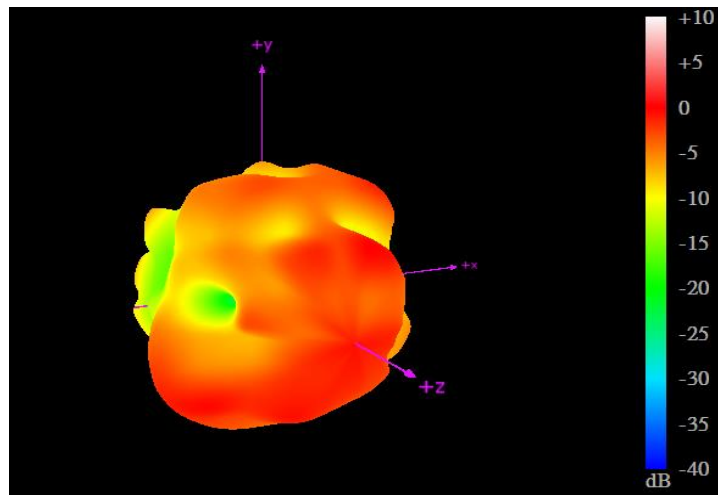
YZ Plane



3.3.63 3D Radiation Pattern (Wi-Fi_MIMO2 with 1M cable length in free space)

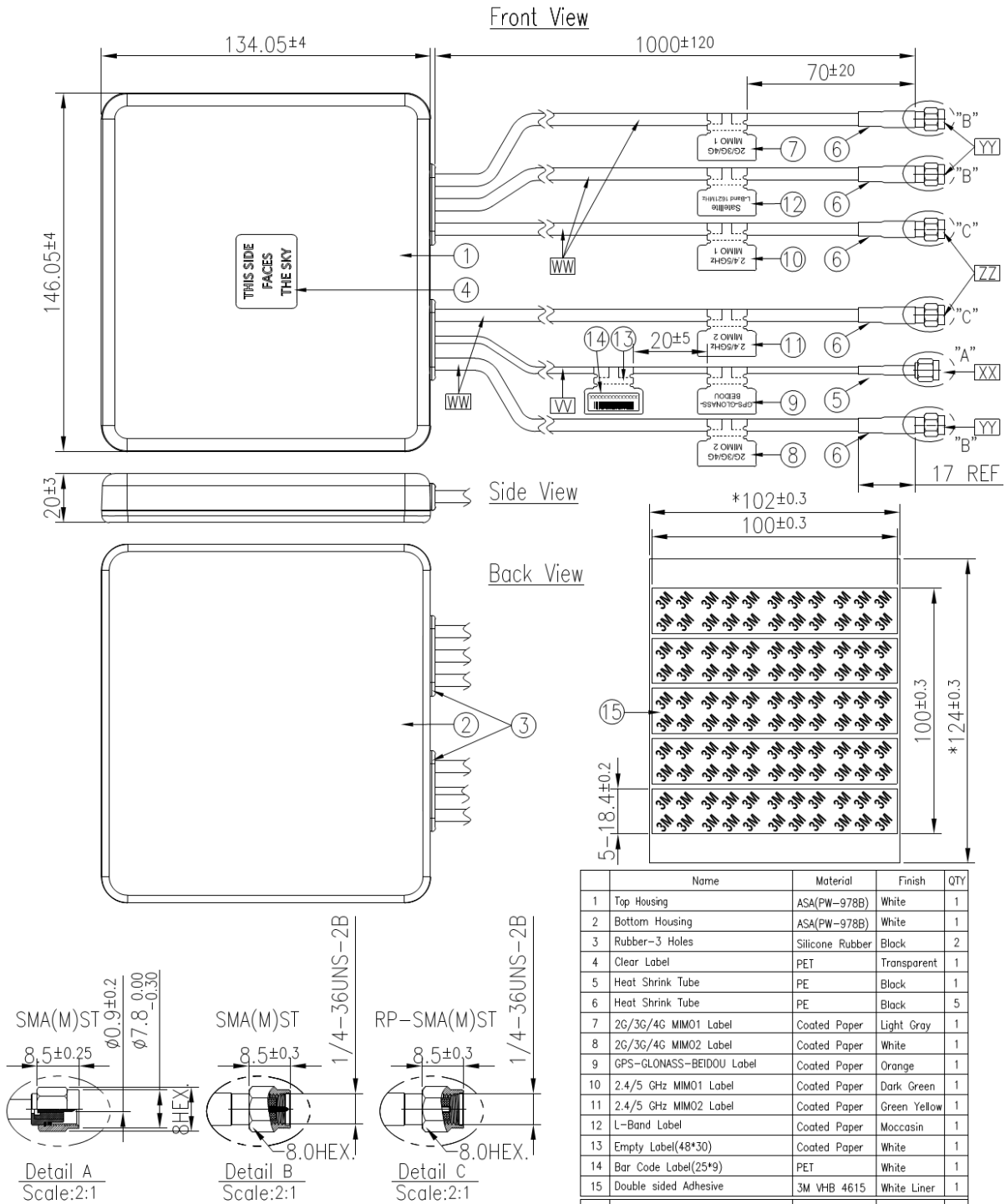


2450MHz



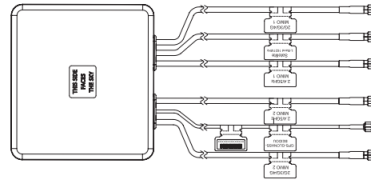
5550MHz

4. Mechanical Drawing (Unit: mm)

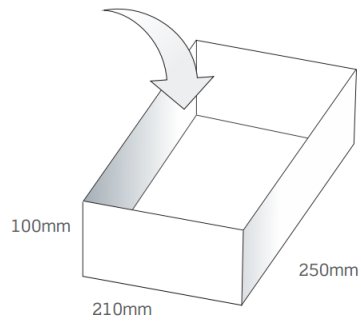


5. Packaging

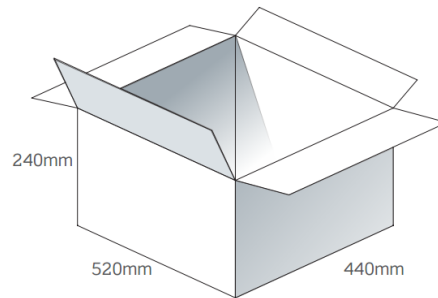
Packaging Specifications



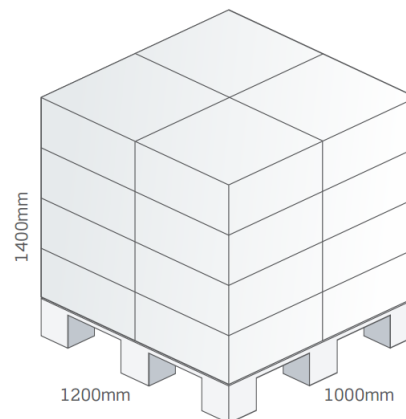
1 No. MA930.W.A.LBICGJ.005 per small box
 Box Dimensions - 250 x 210 x 100mm
 Weight - 680g



1 Outer Carton
 Carton Dimensions - 520 x 440 x 240mm
 8 pcs MA930.W.A.LBICGJ.005 per carton
 Weight - 6.4Kg



Pallet Dimensions 1200*1000*1400mm
 16 Cartons per Pallet
 4 Cartons per layer
 4 Layers

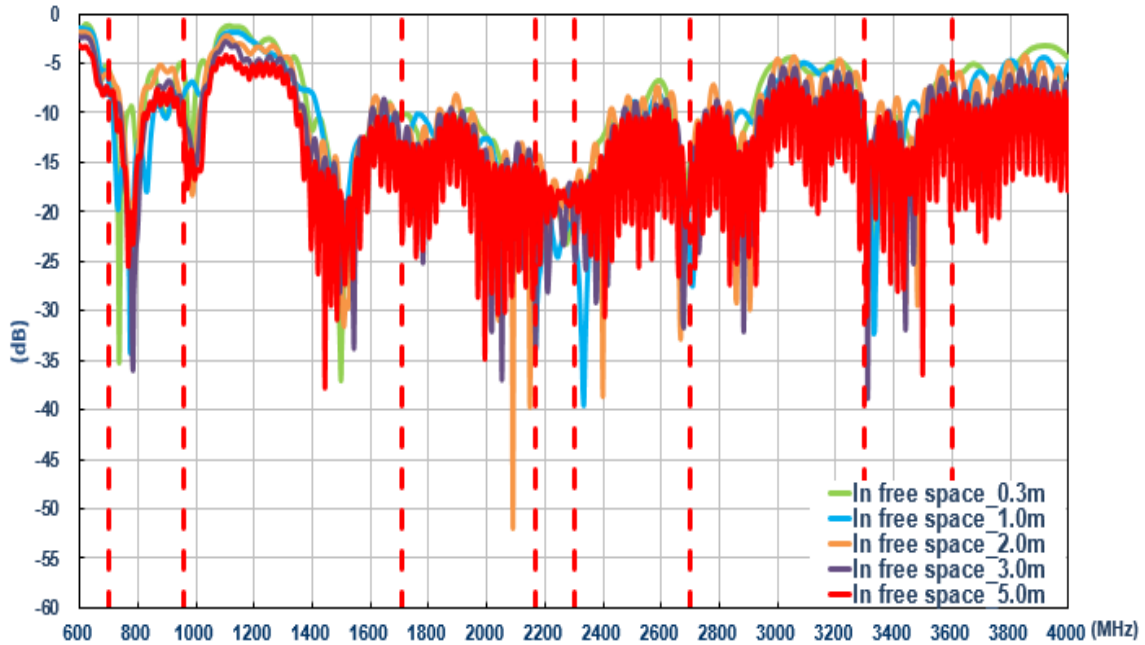


6. Application Note

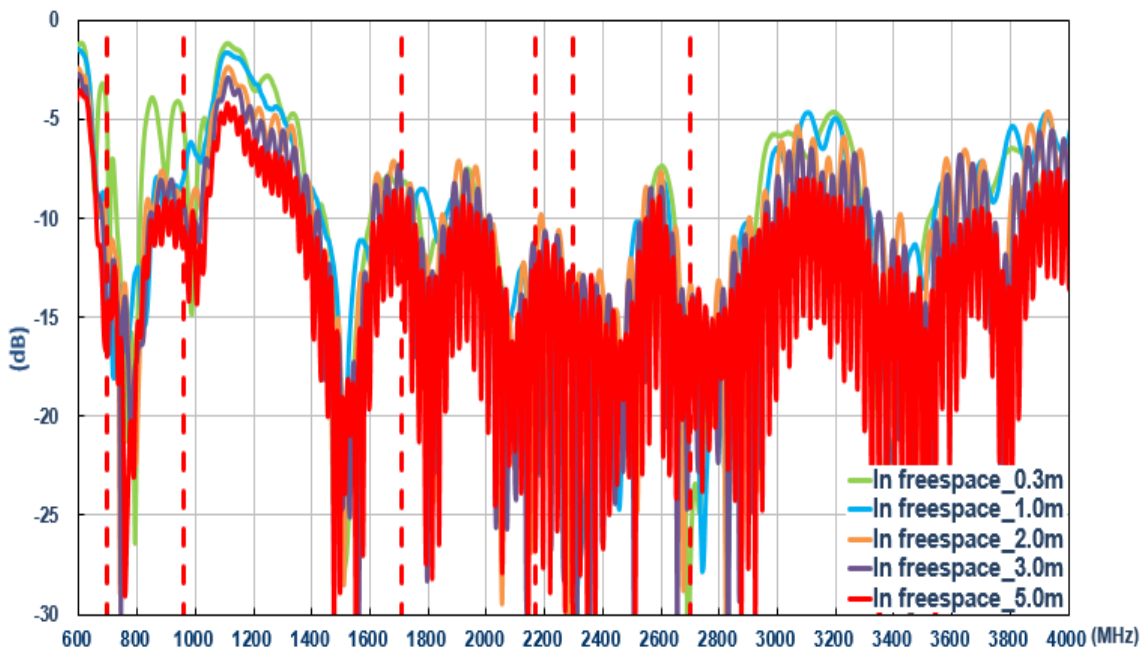
The MA930 antenna performance with different cable lengths is shown below.

6.1 In free space (LTE)

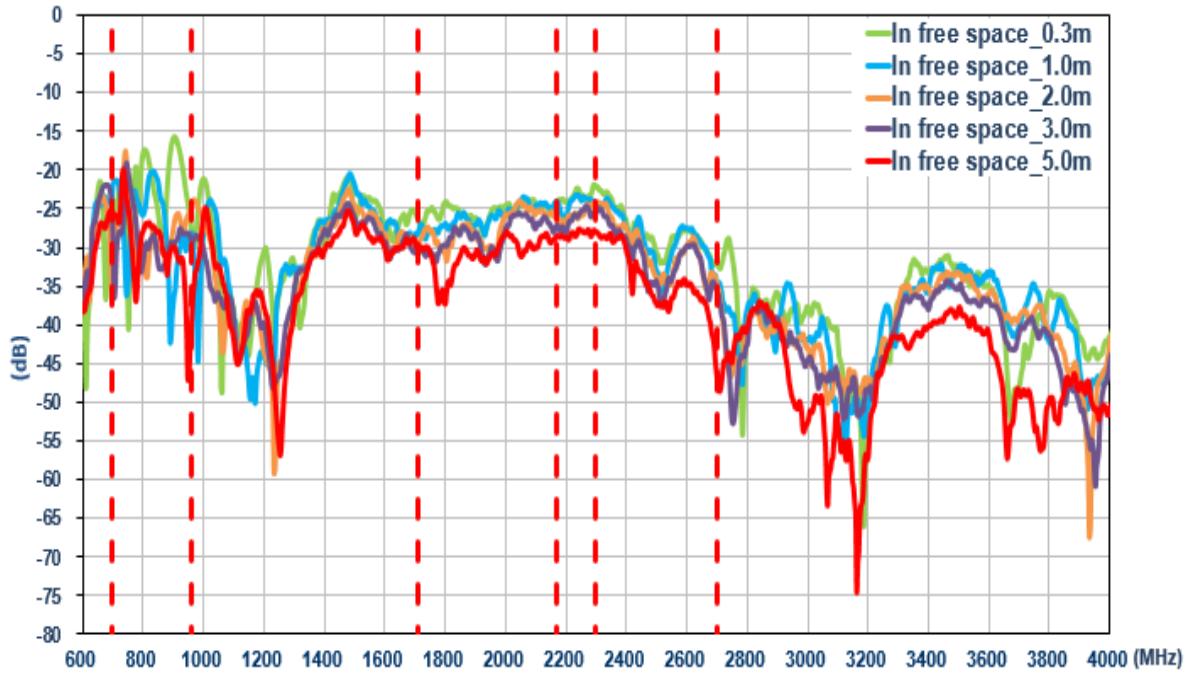
6.1.1 Return Loss (LTE_MIMO_1)



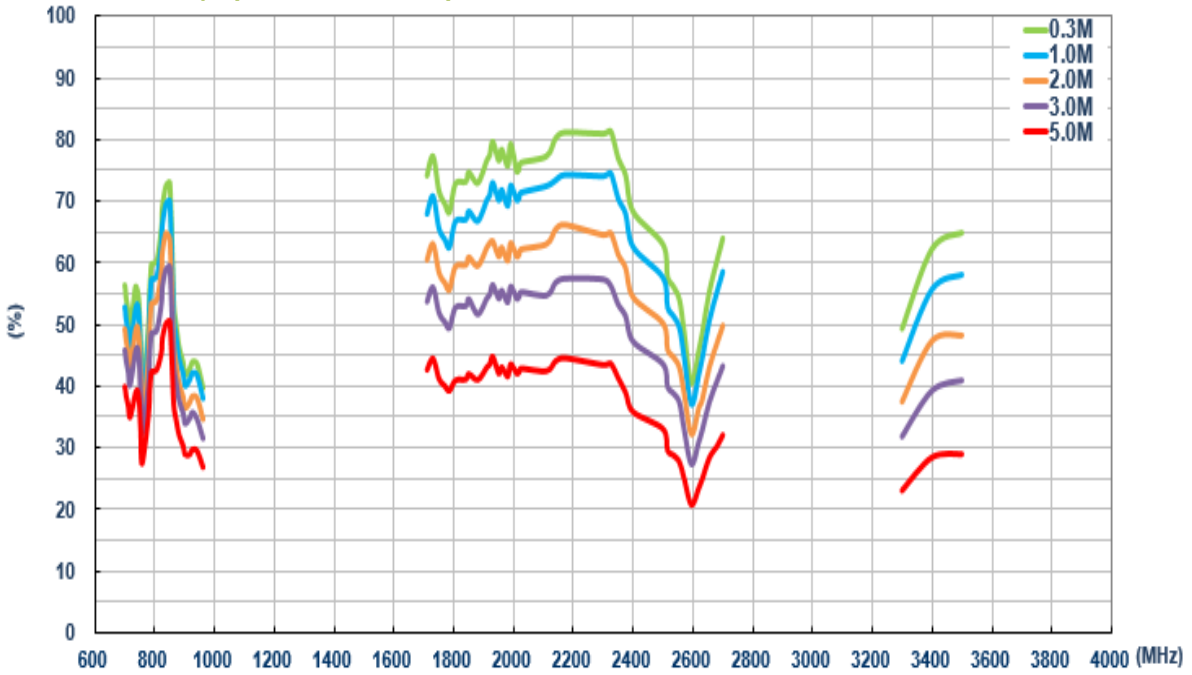
6.1.2 Return Loss (LTE_MIMO_2)



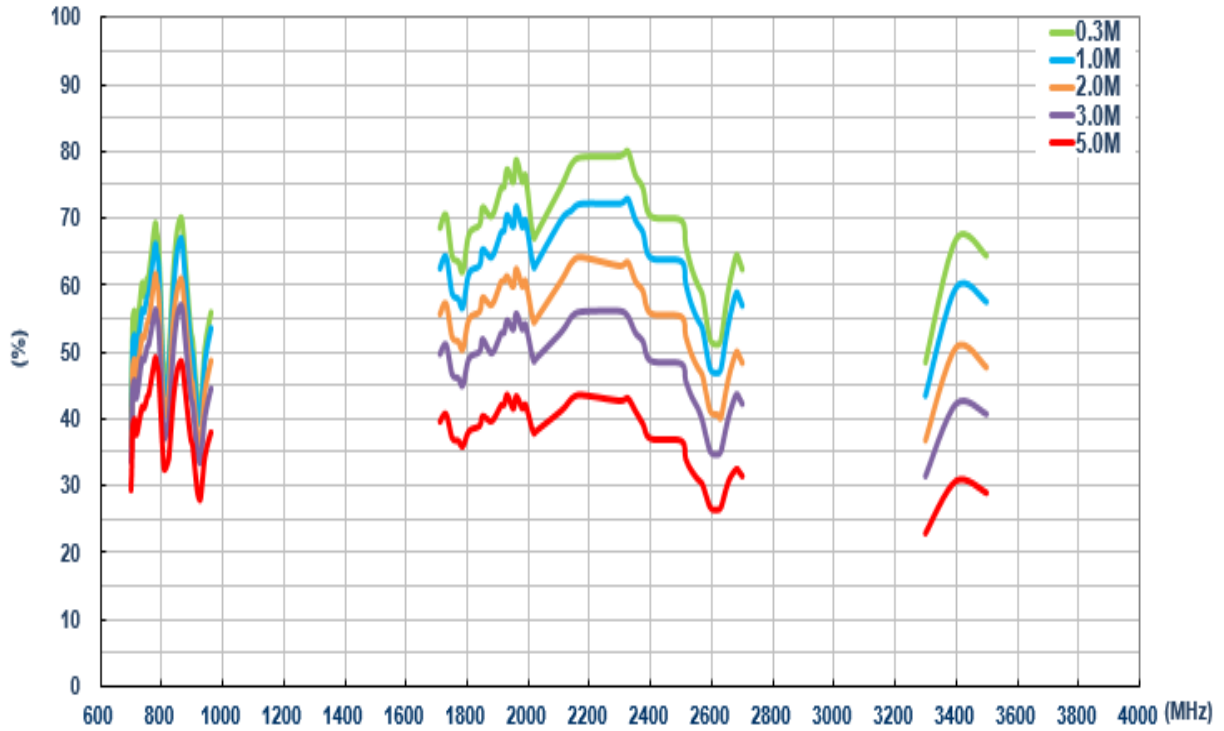
6.1.3 Isolation (LTE antenna)



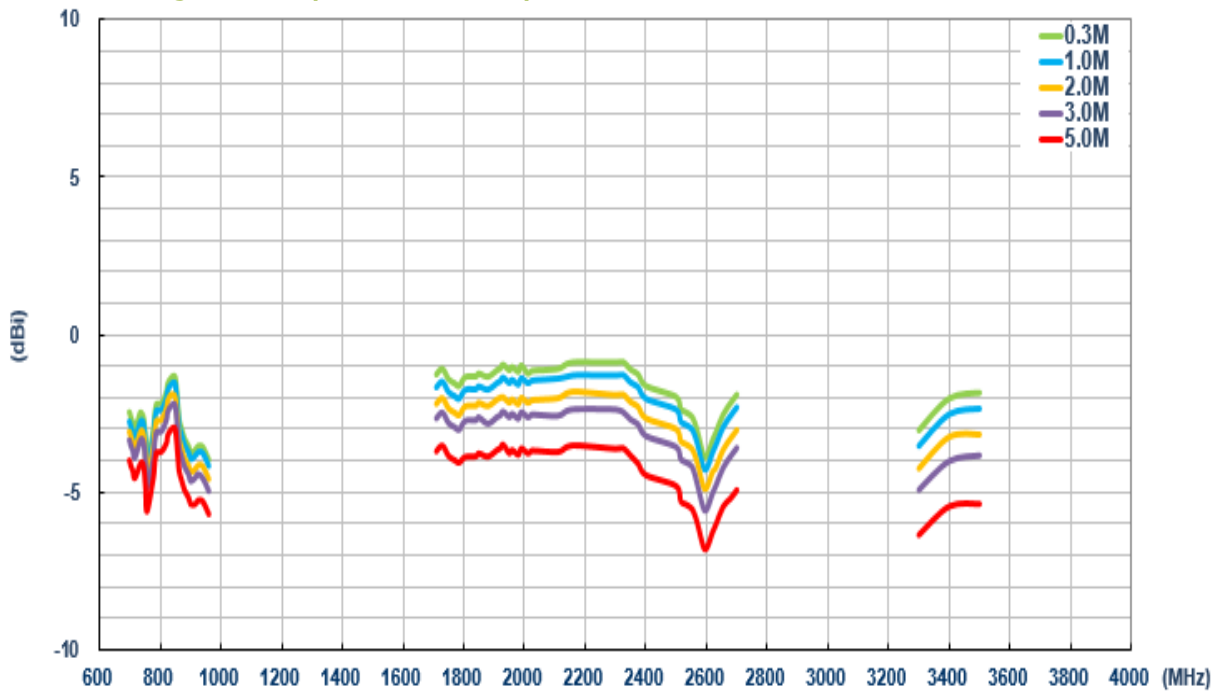
6.1.4 Efficiency (LTE MIMO_1)



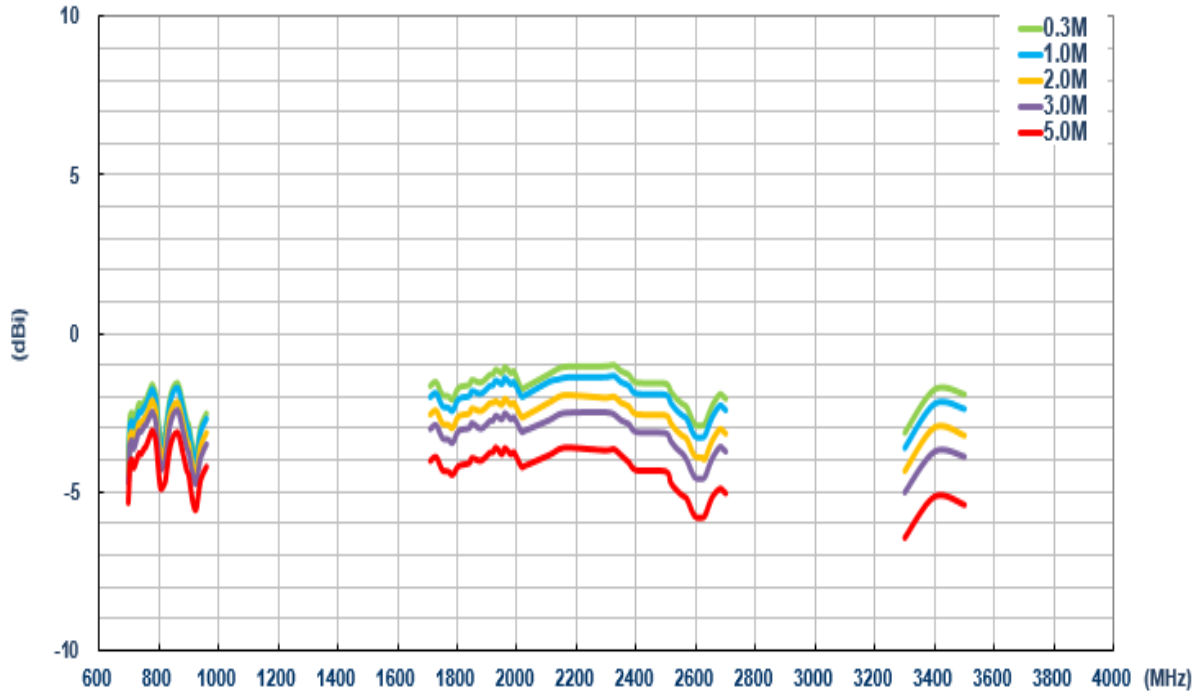
6.1.5 Efficiency (LTE MIMO_2)



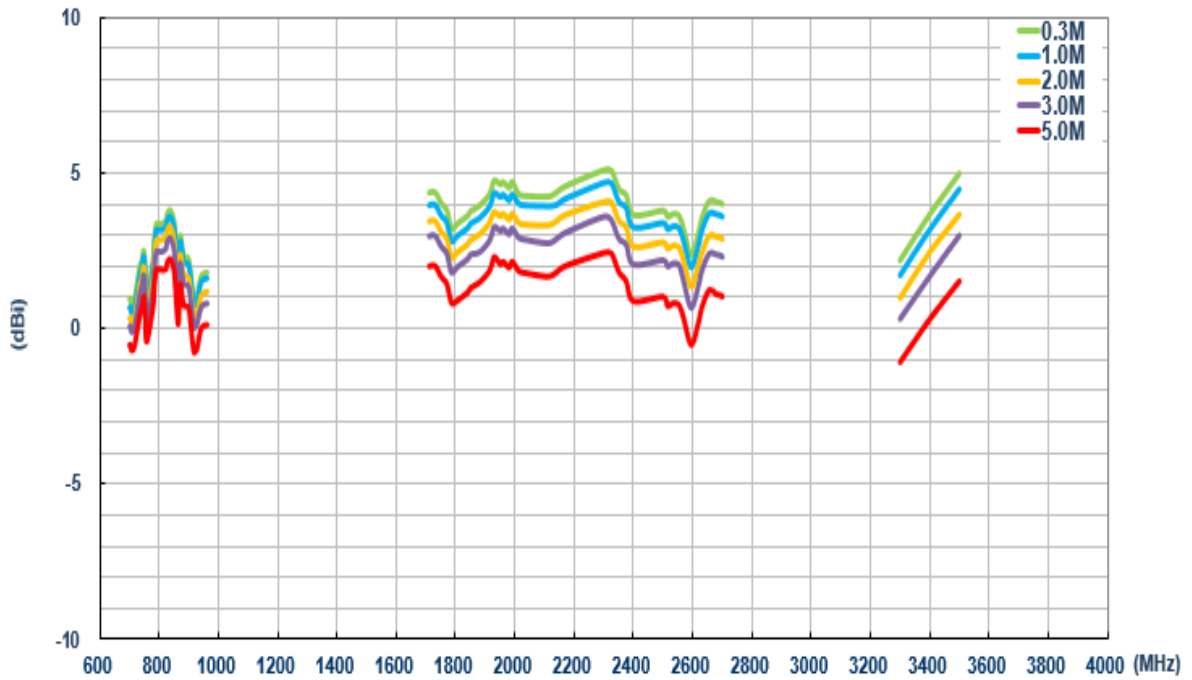
6.1.6 Average Gain (LTE MIMO_1)



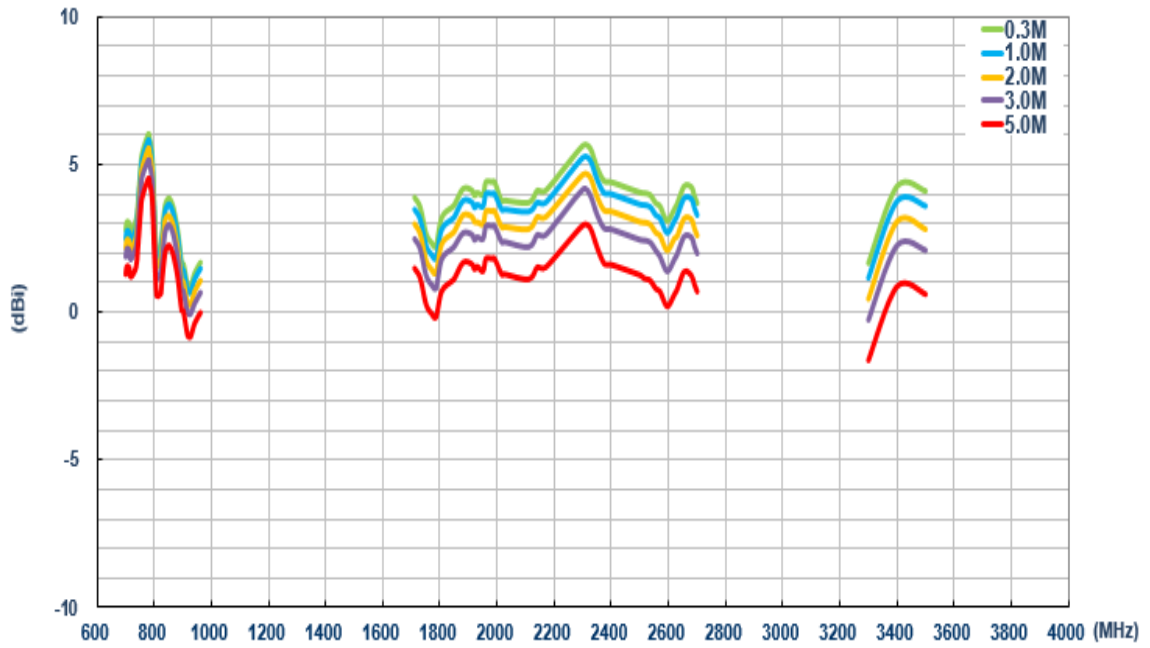
6.1.7 Average Gain (LTE MIMO_2)



6.1.8 Peak Gain (LTE MIMO_1)

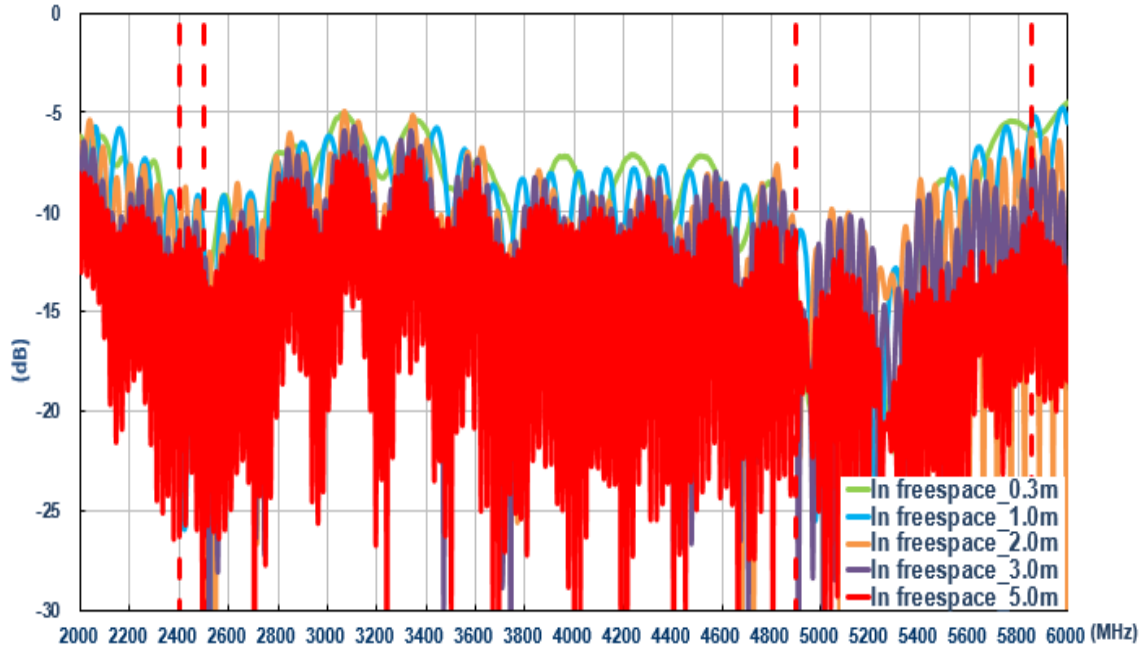


6.1.9 Peak Gain (LTE MIMO_2)

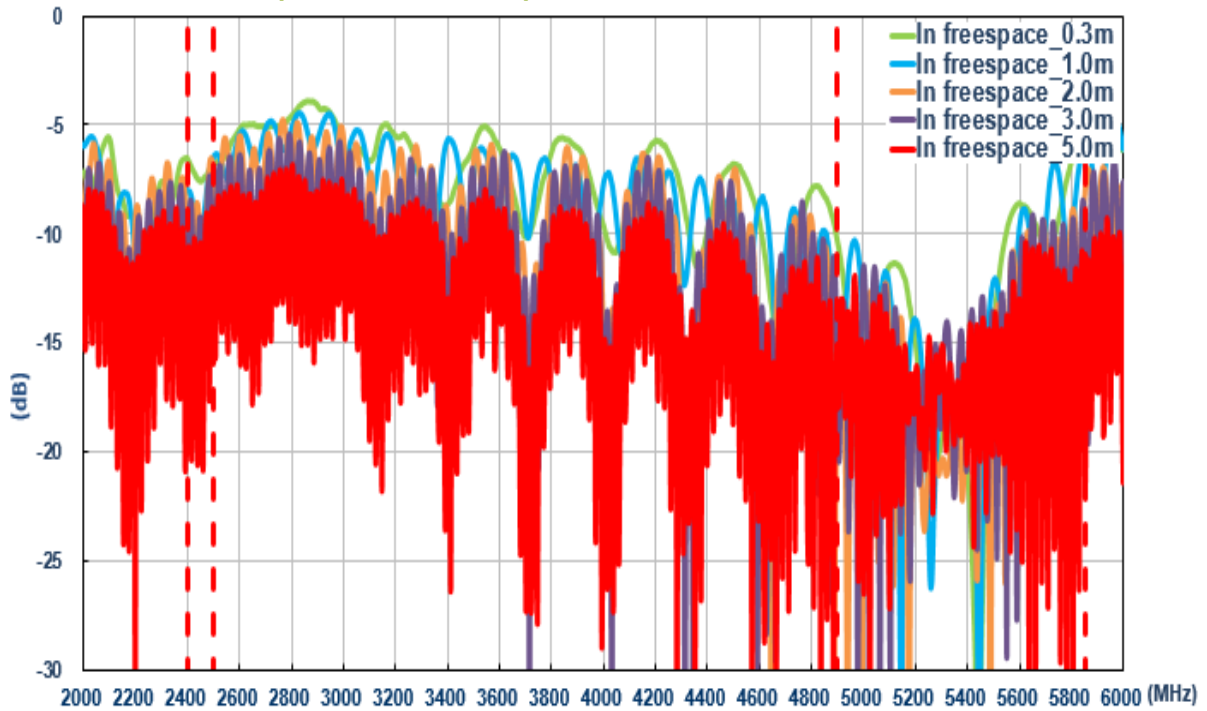


6.2 In free space (Wi-Fi)

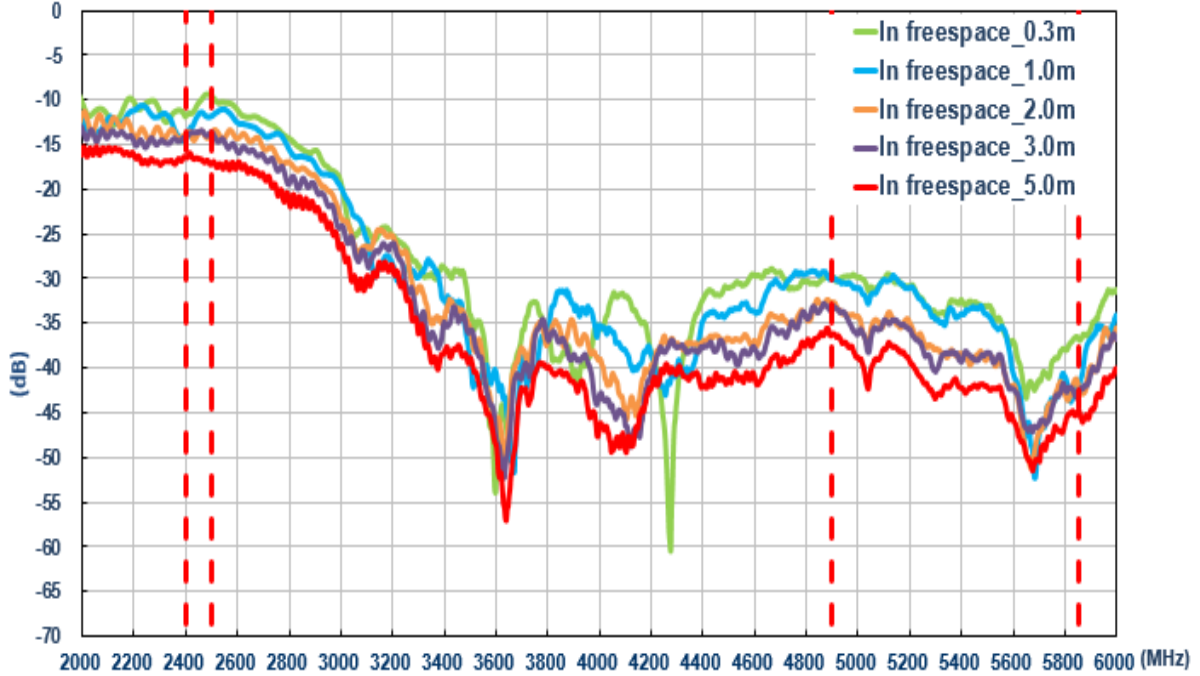
6.2.1 Return Loss (Wi-Fi_MIMO_1)



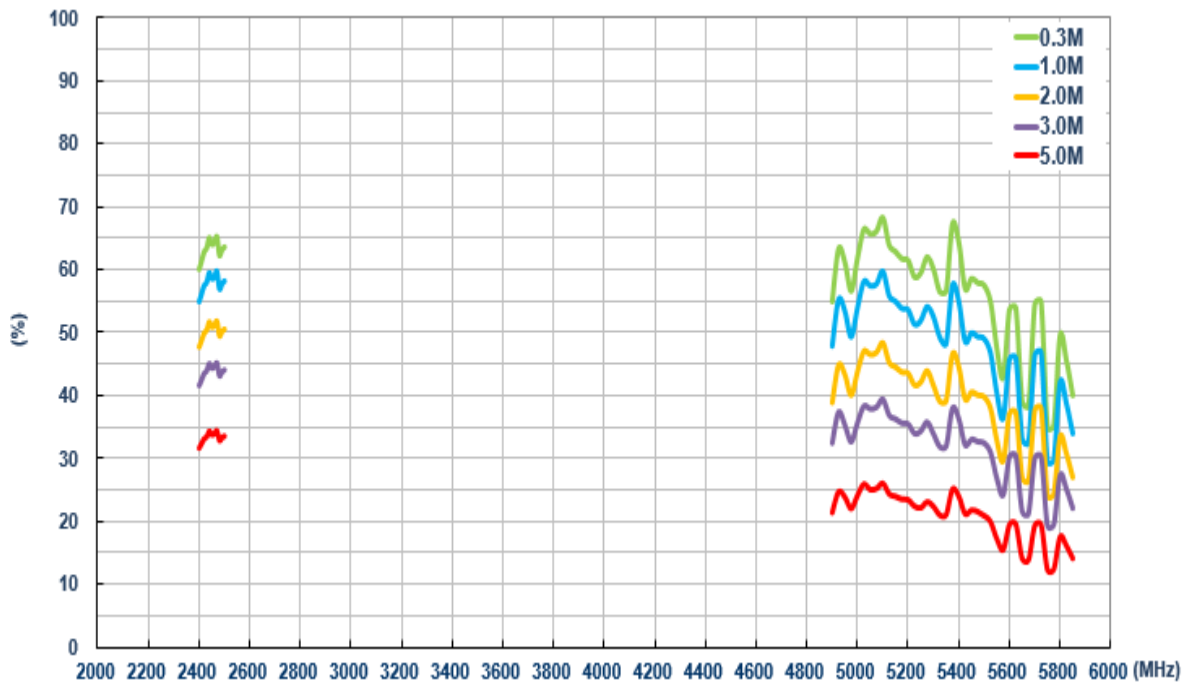
6.2.2 Return Loss (Wi-Fi_MIMO_2)



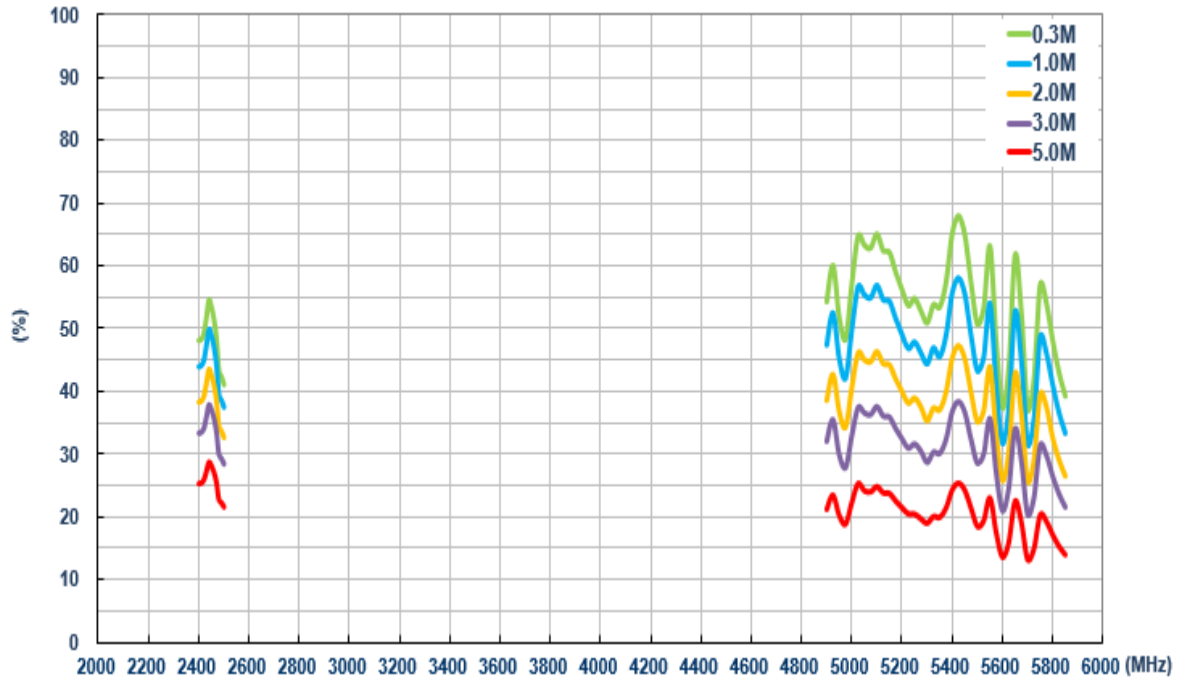
6.2.3 Isolation (Wi-Fi)



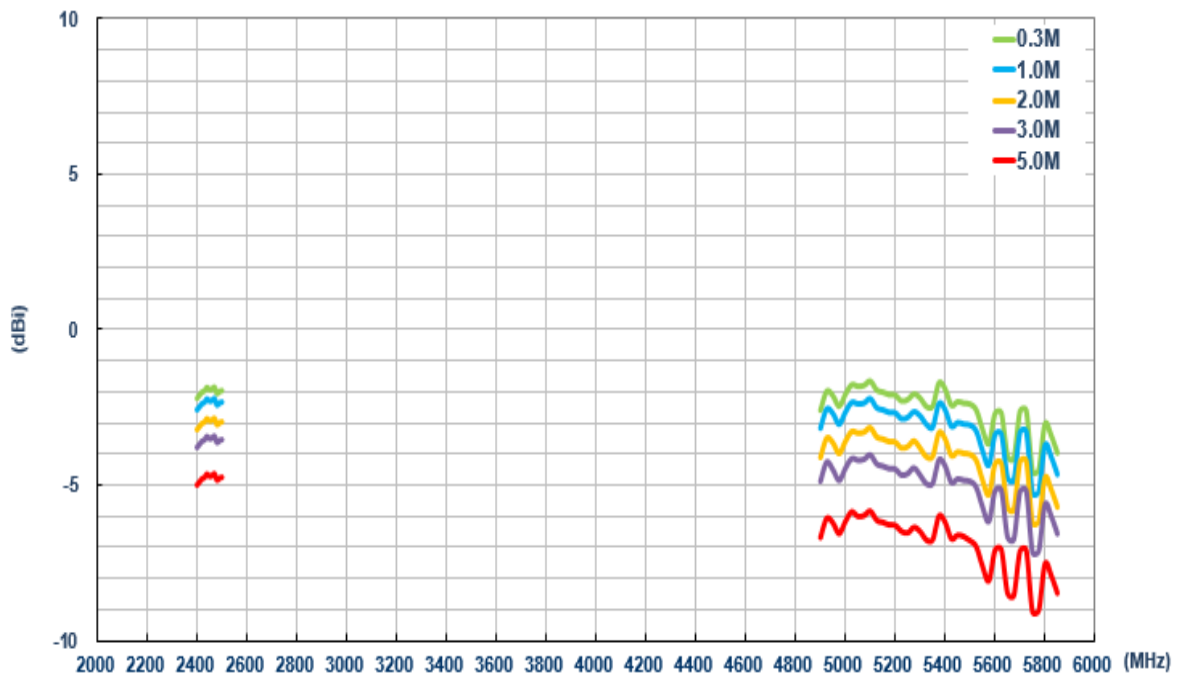
6.2.4 Efficiency (Wi-Fi MIMO_1)



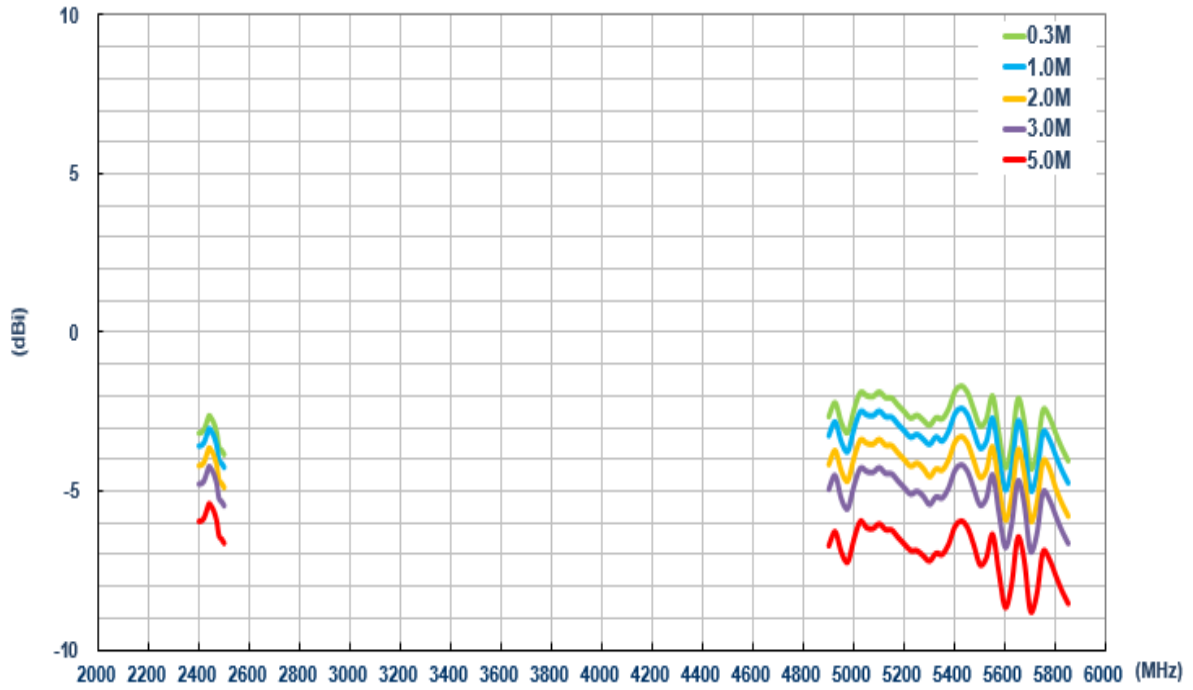
6.2.5 Efficiency (Wi-Fi MIMO_2)



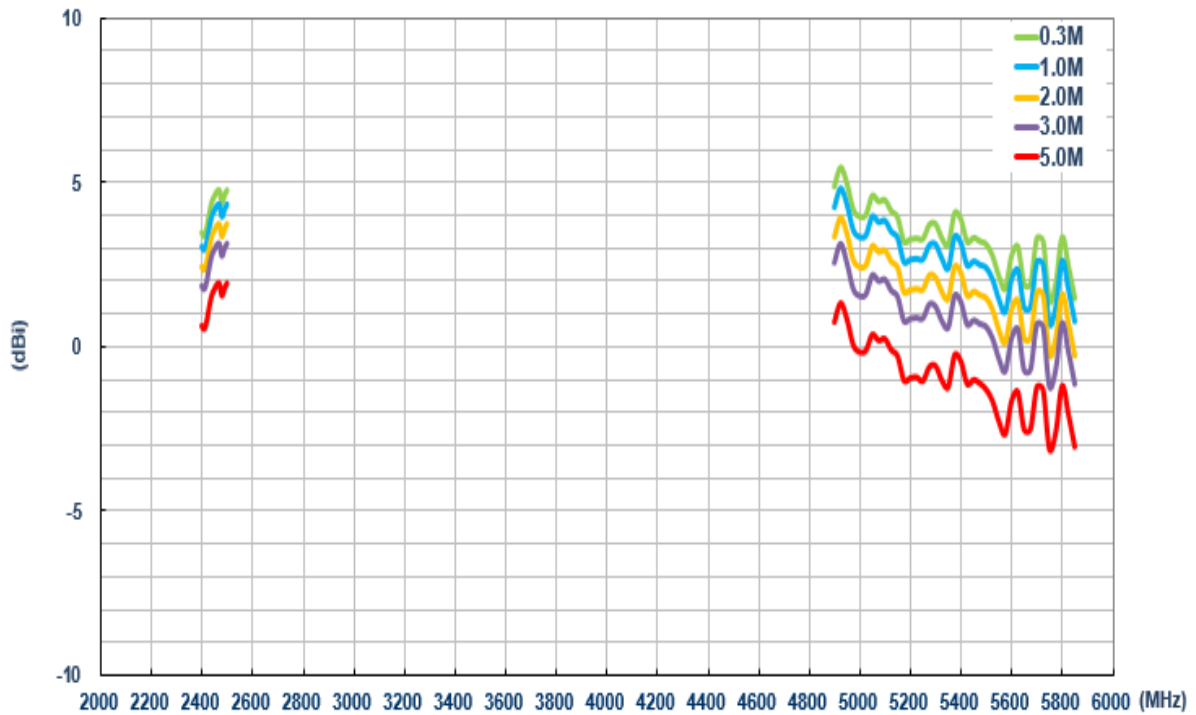
6.2.6 Average Gain (Wi-Fi MIMO_1)



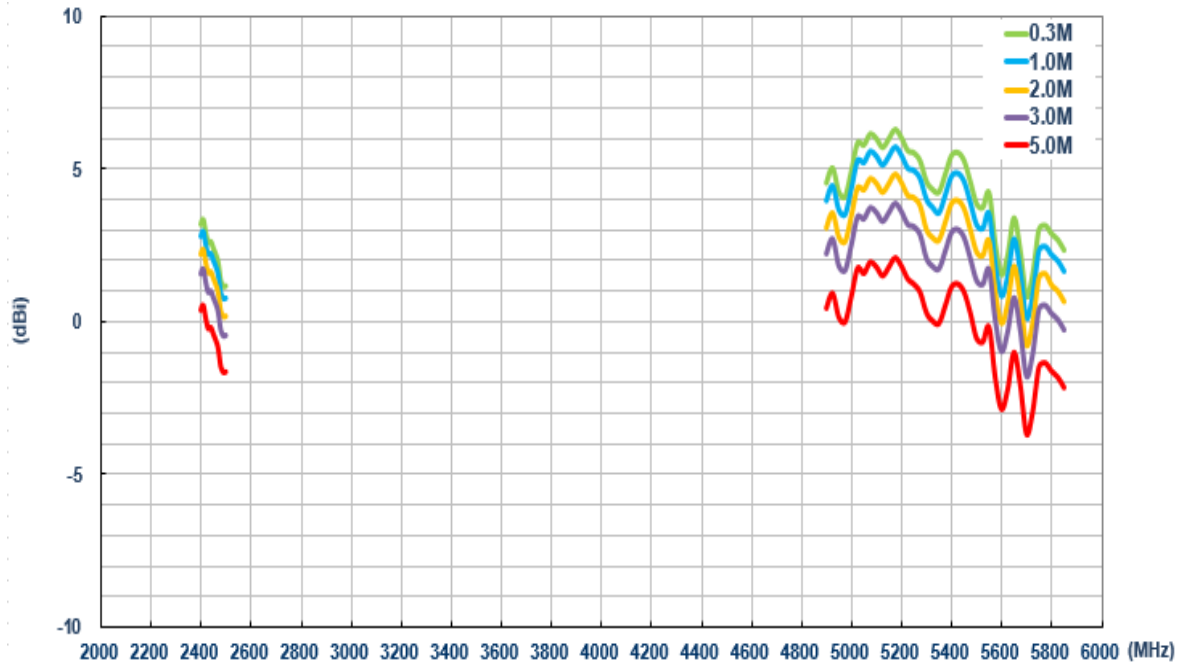
6.2.7 Average Gain (Wi-Fi MIMO_2)



6.2.8 Peak Gain (Wi-Fi MIMO_1)

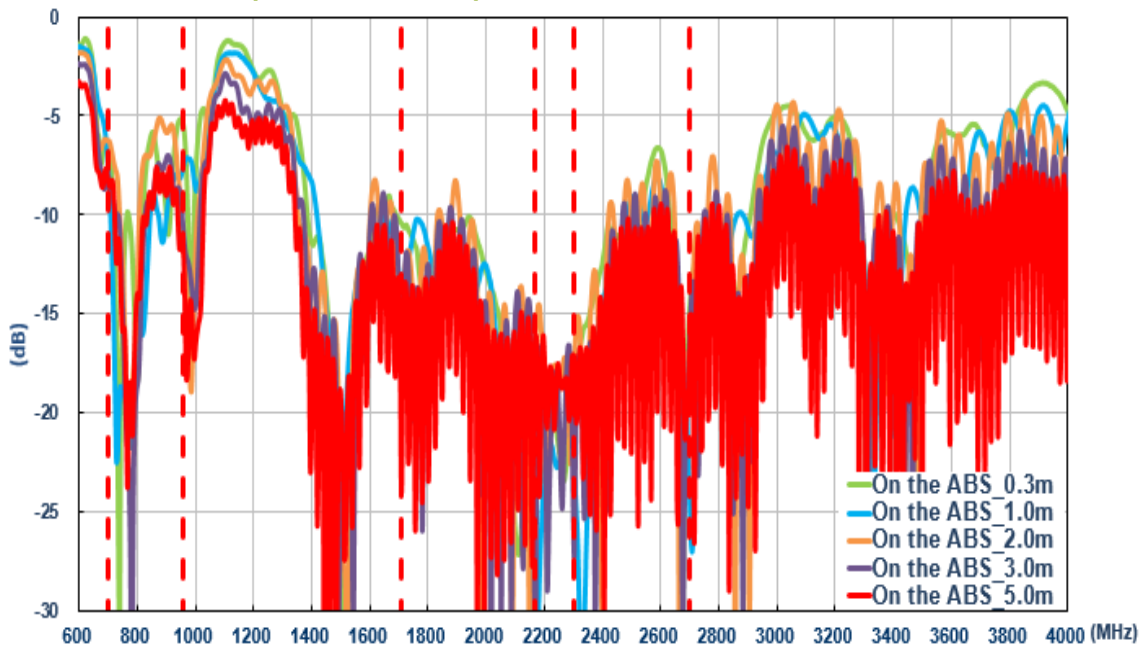


6.2.9 Peak Gain (Wi-Fi MIMO_2)

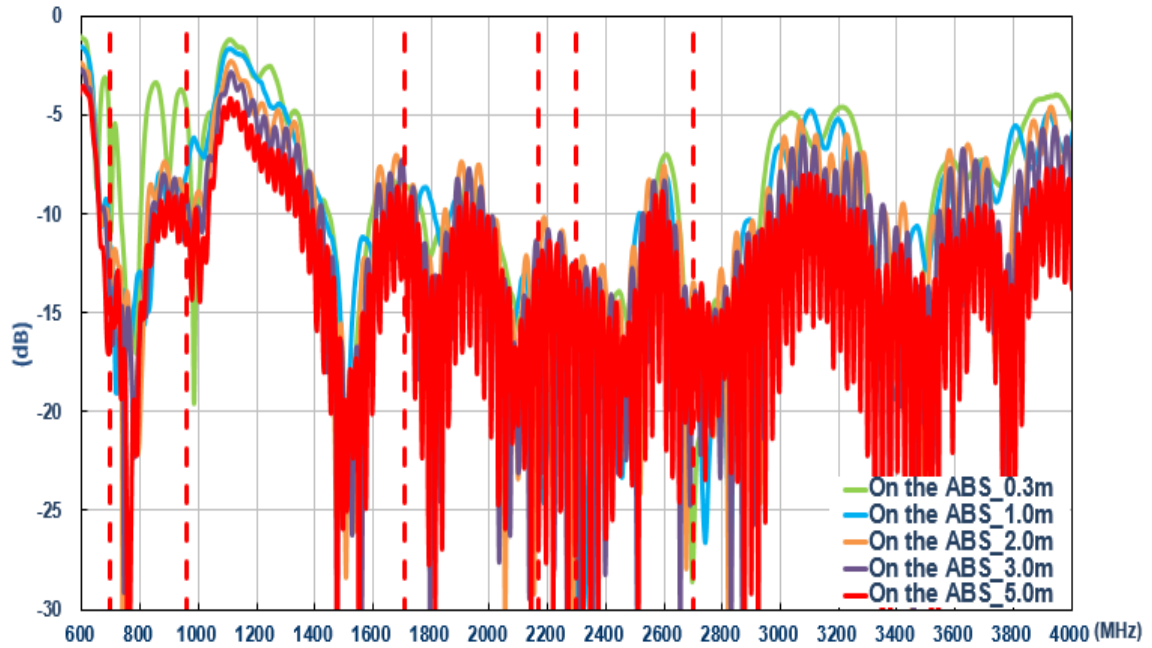


6.3 On the ABS (LTE)

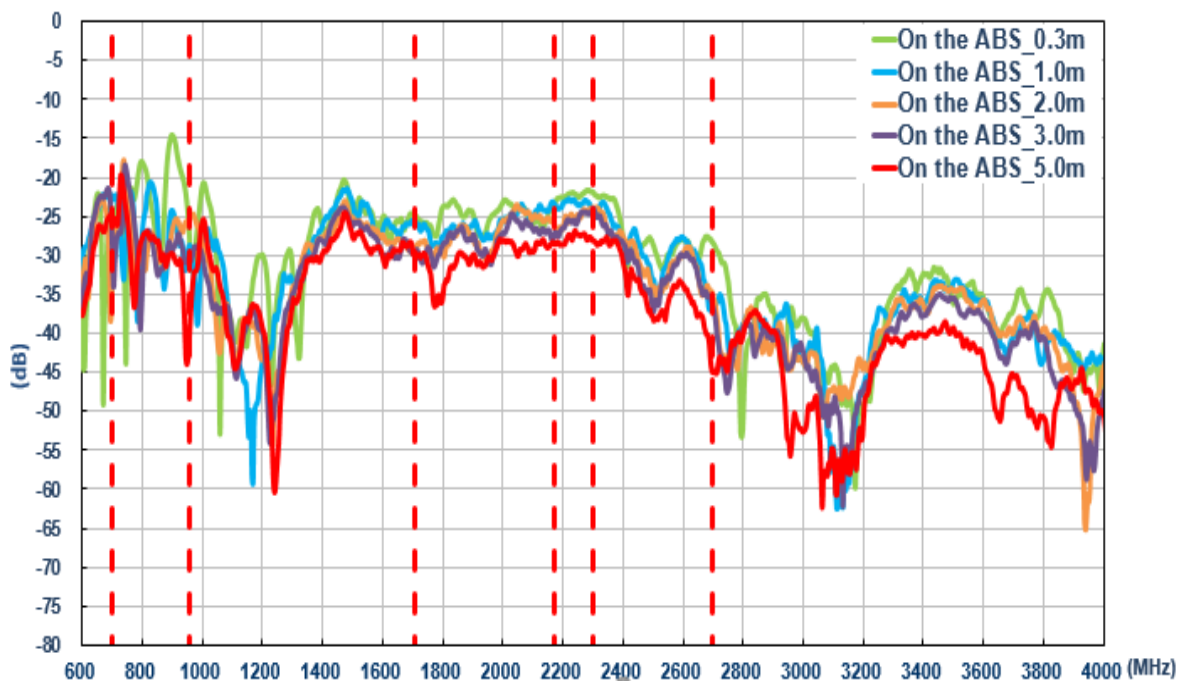
6.3.1 Return Loss (LTE_MIMO_1)



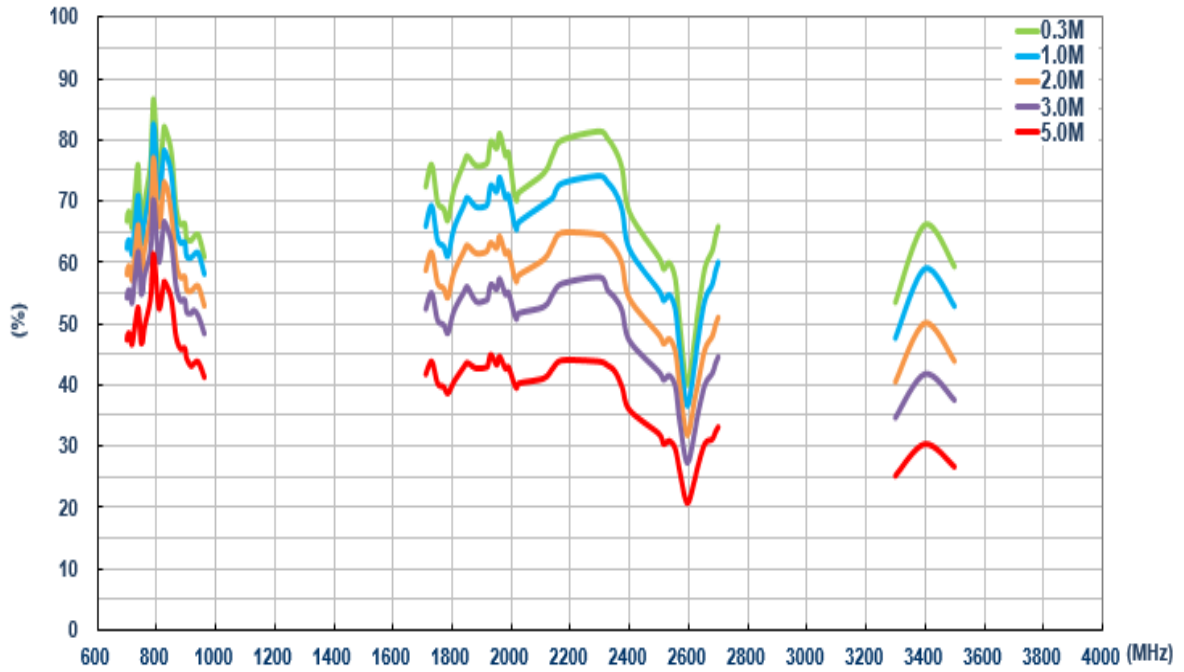
6.3.2 Return Loss (LTE_MIMO_2)



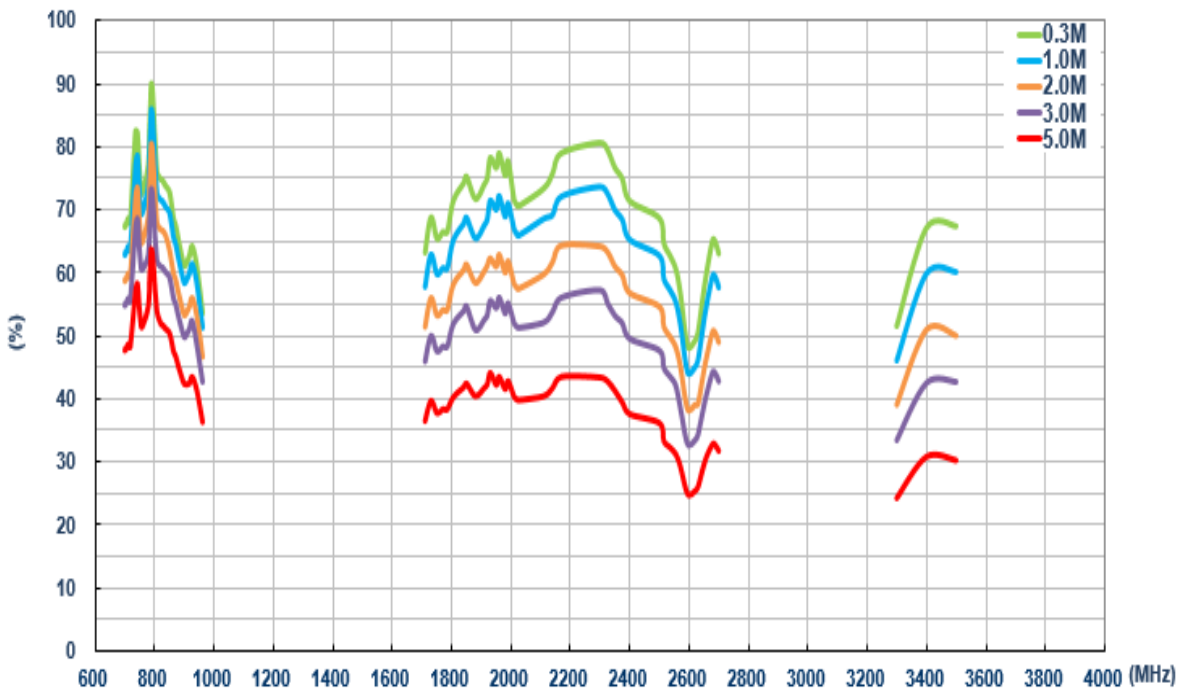
6.3.3 Isolation (LTE antenna)



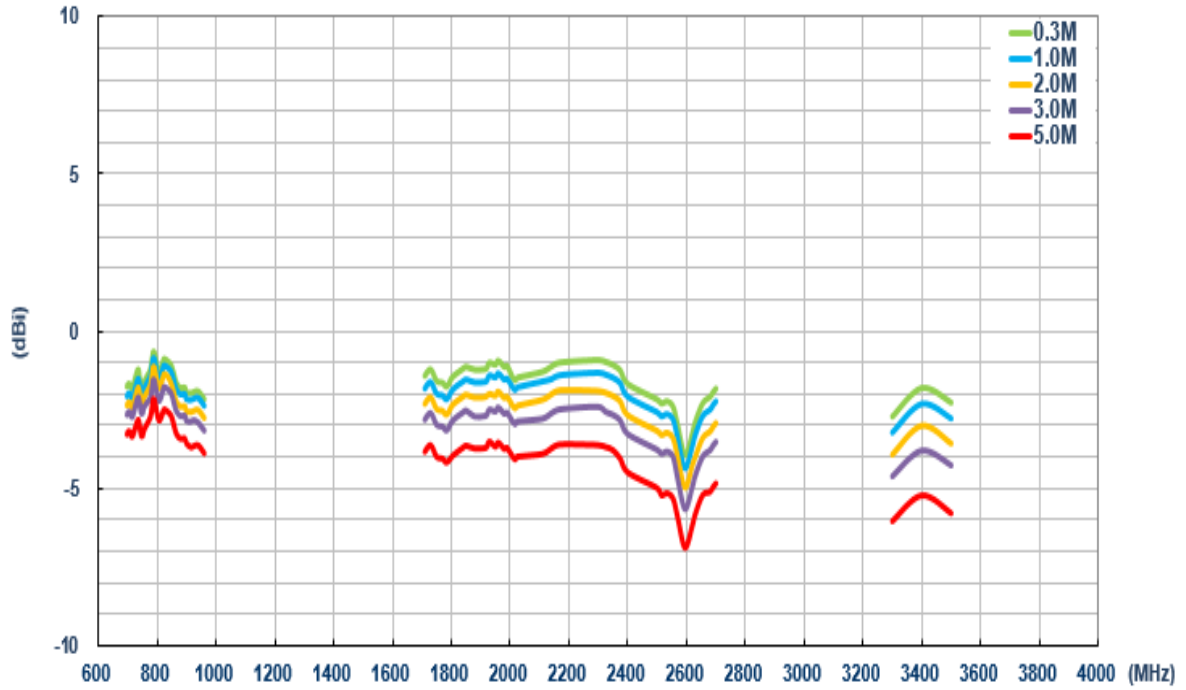
6.3.4 Efficiency (LTE MIMO_1)



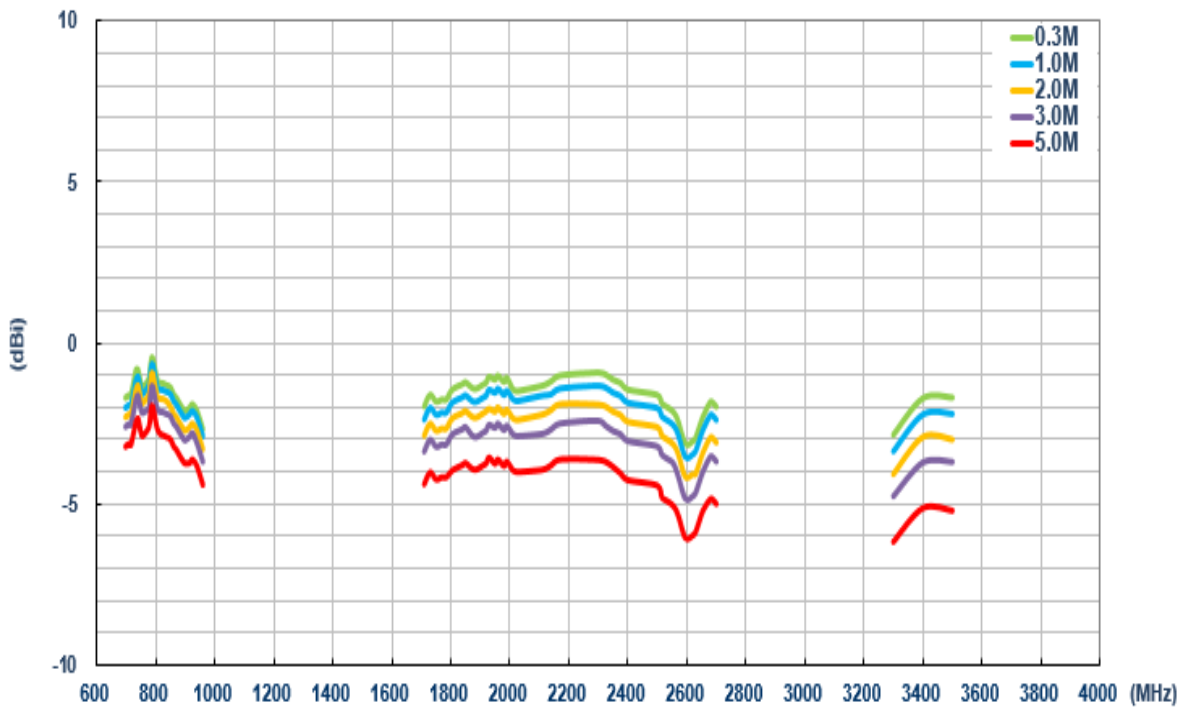
6.3.5 Efficiency (LTE MIMO_2)



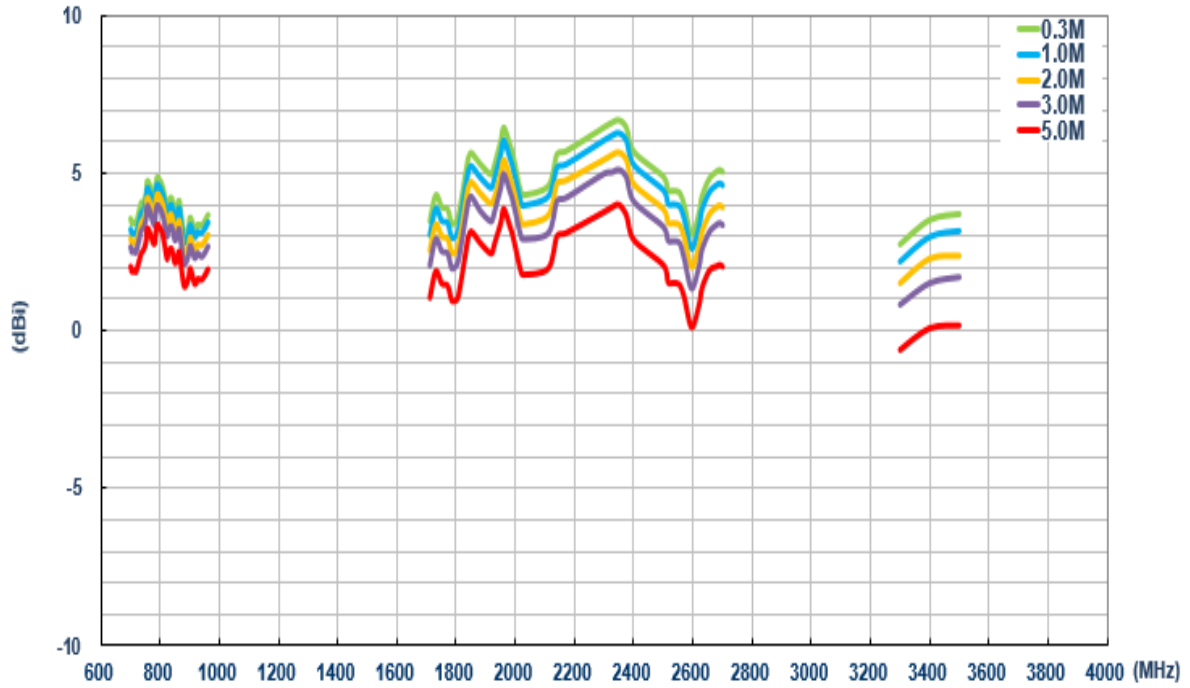
6.3.6 Average Gain (LTE MIMO_1)



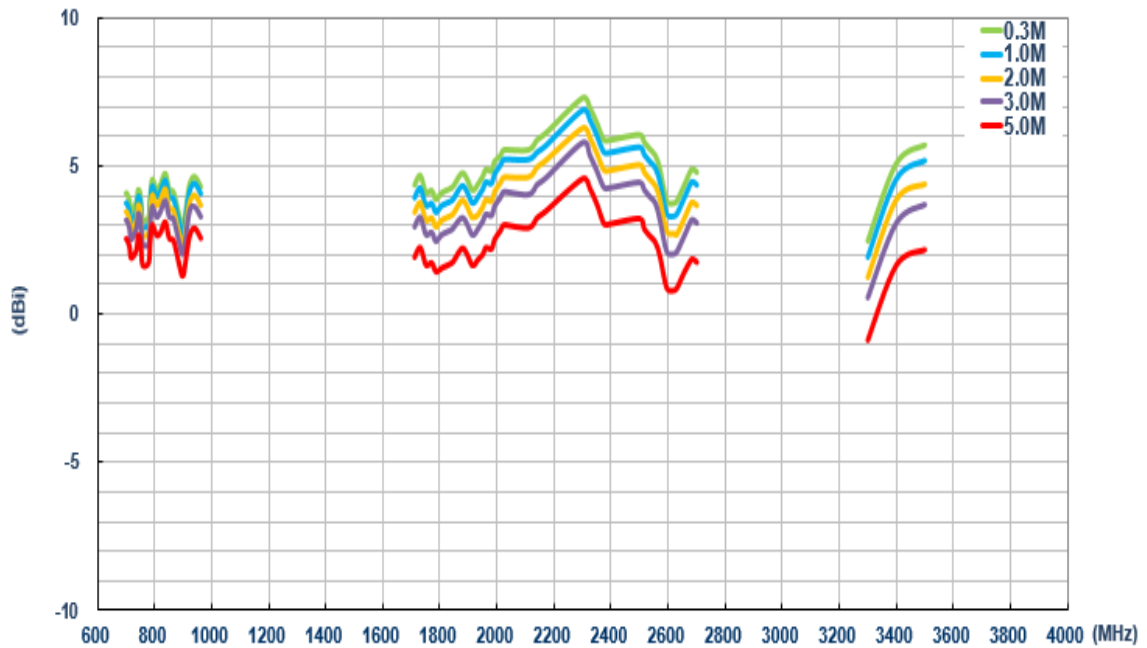
6.3.7 Average Gain (LTE MIMO_2)



6.3.8 Peak Gain (LTE MIMO_1)

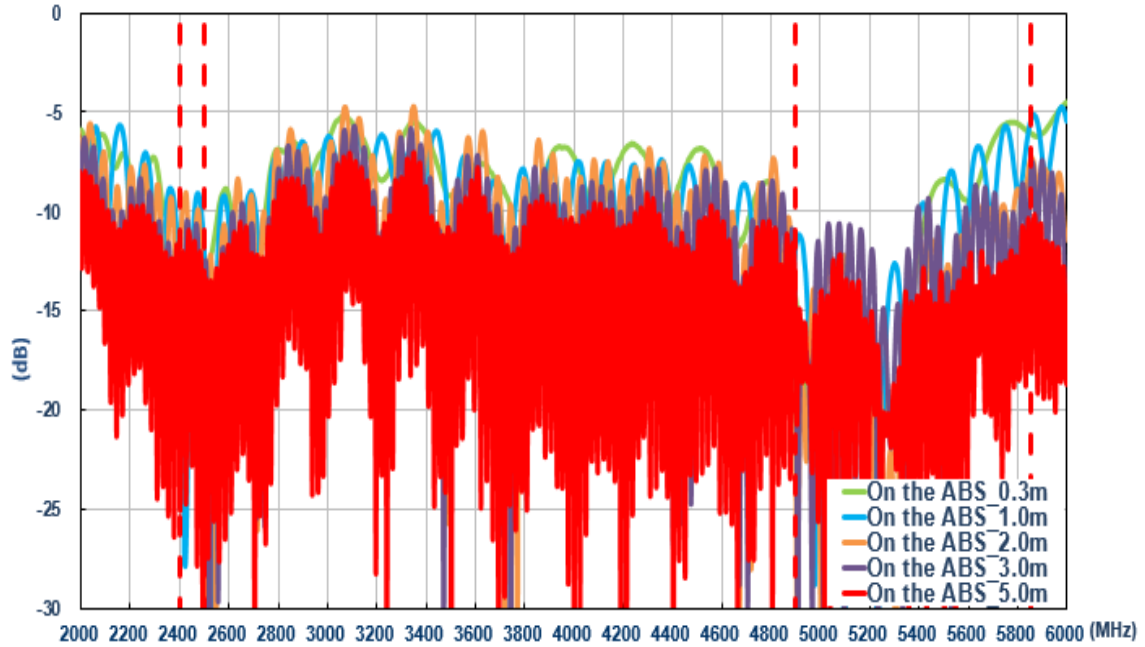


6.3.9 Peak Gain (LTE MIMO_2)

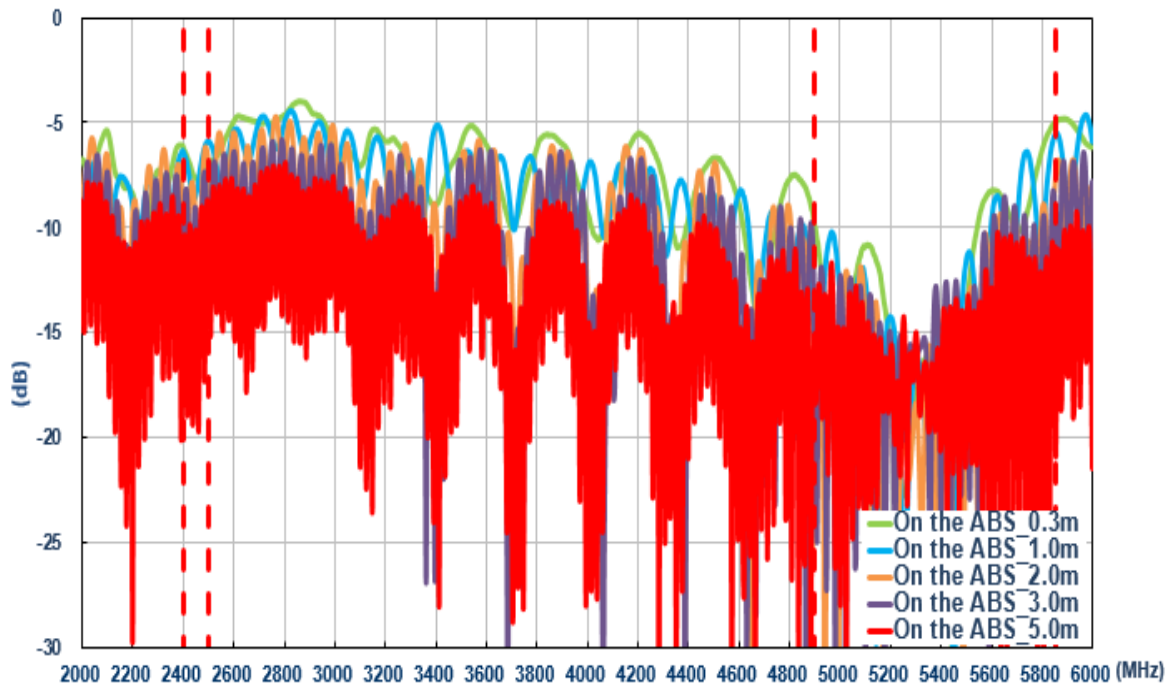


6.4 On ABS (Wi-Fi)

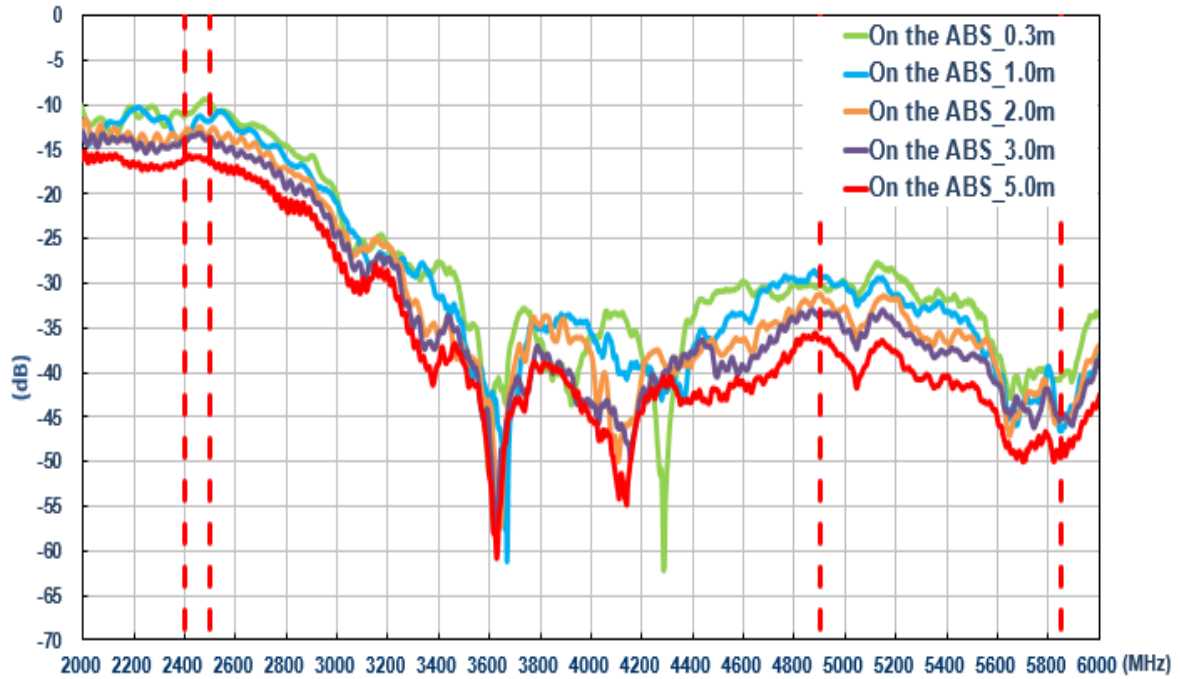
6.4.1 Return Loss (Wi-Fi_MIMO_1)



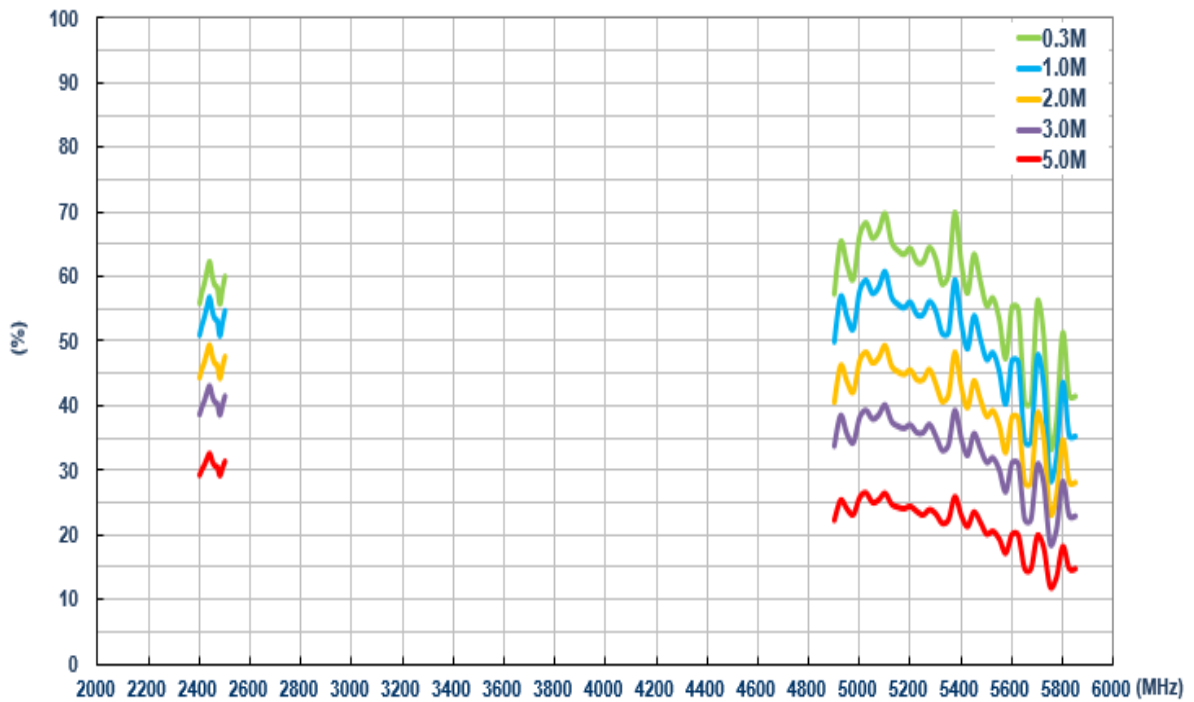
6.4.2 Return Loss (Wi-Fi_MIMO_2)



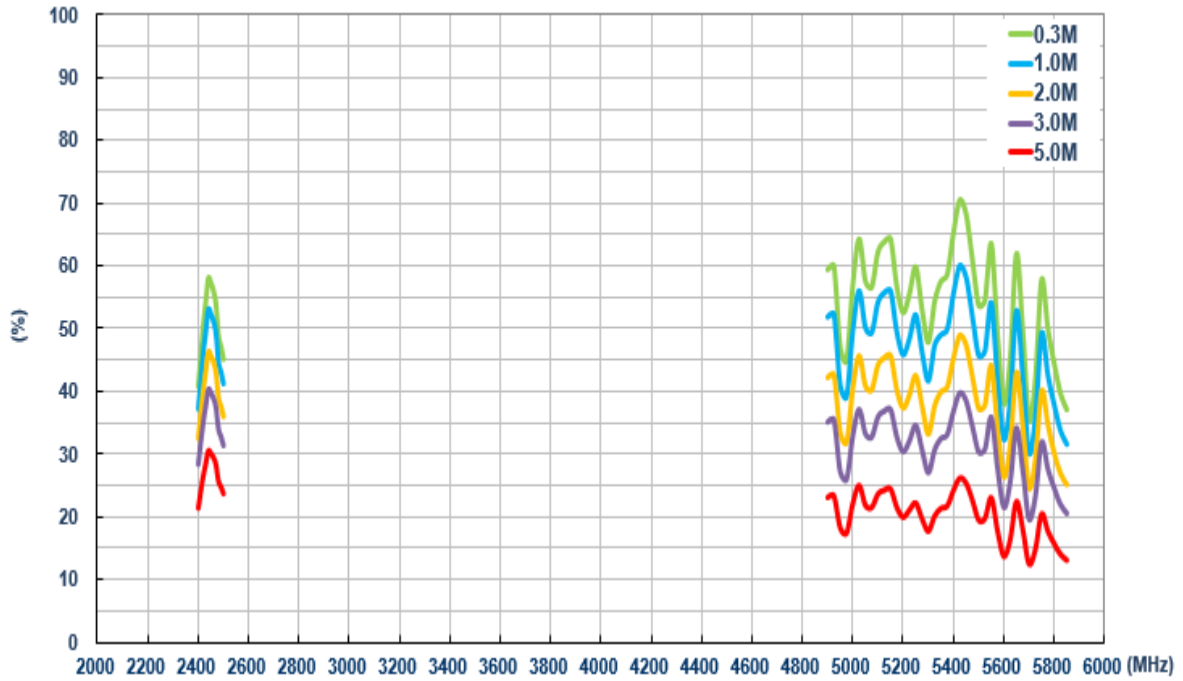
6.4.3 Isolation (Wi-Fi)



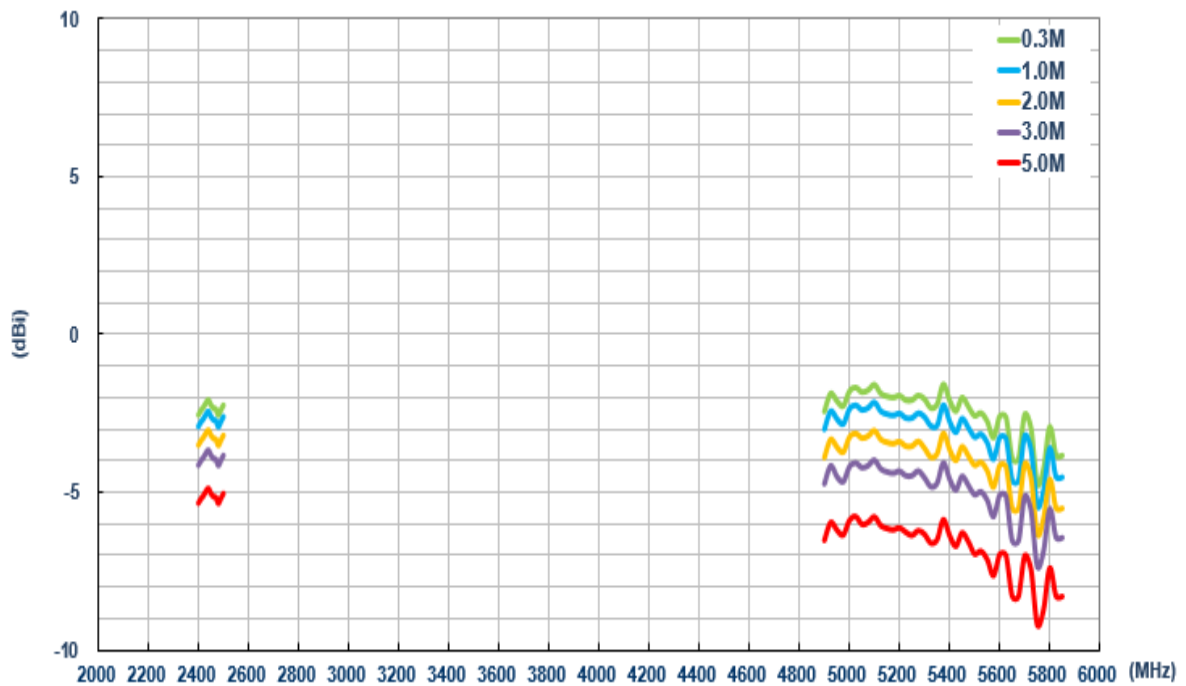
6.4.4 Efficiency (Wi-Fi MIMO_1)



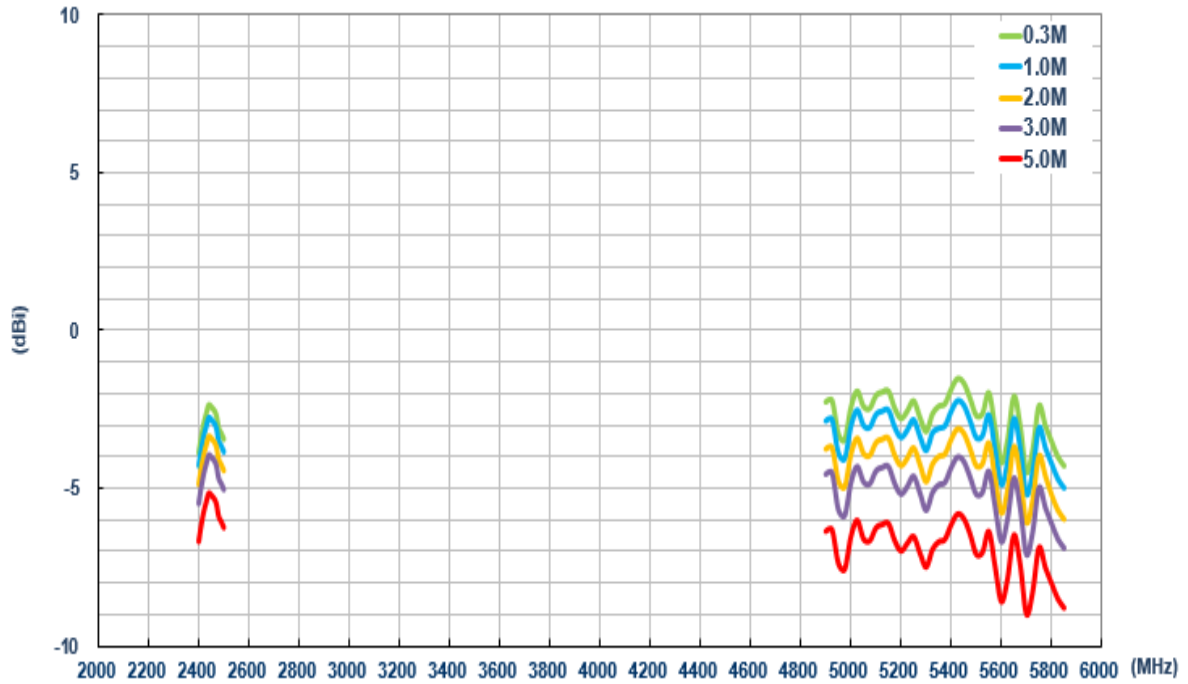
6.4.5 Efficiency (Wi-Fi MIMO_2)



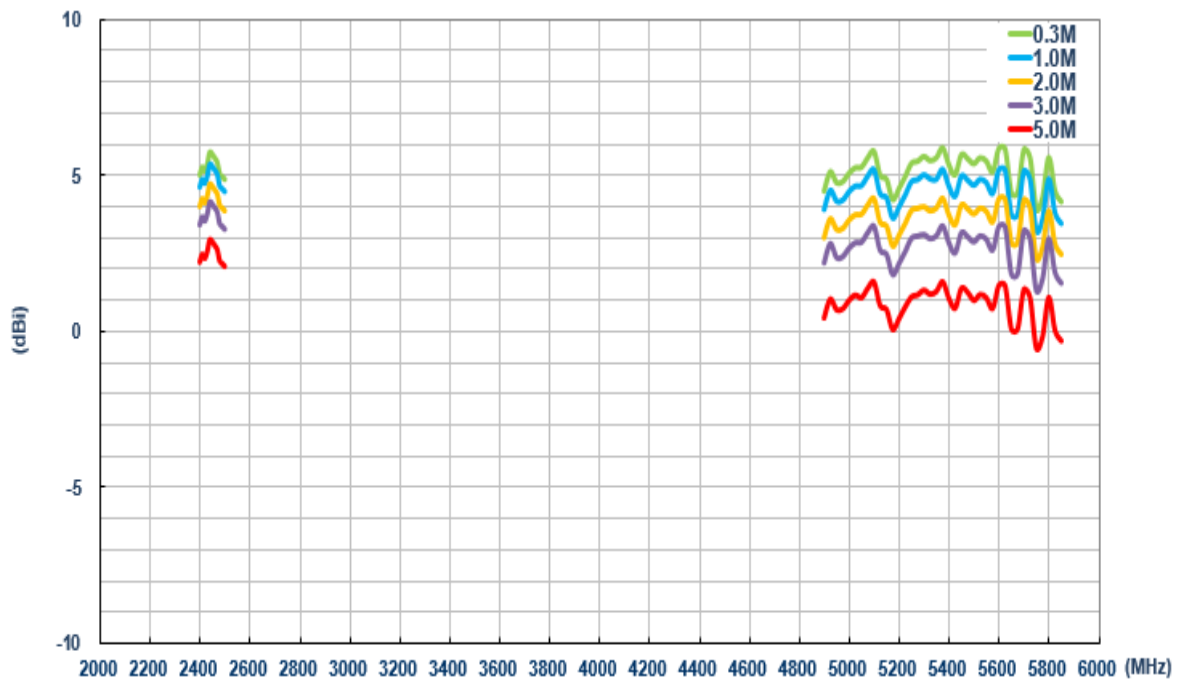
6.4.6 Average Gain (Wi-Fi MIMO_1)



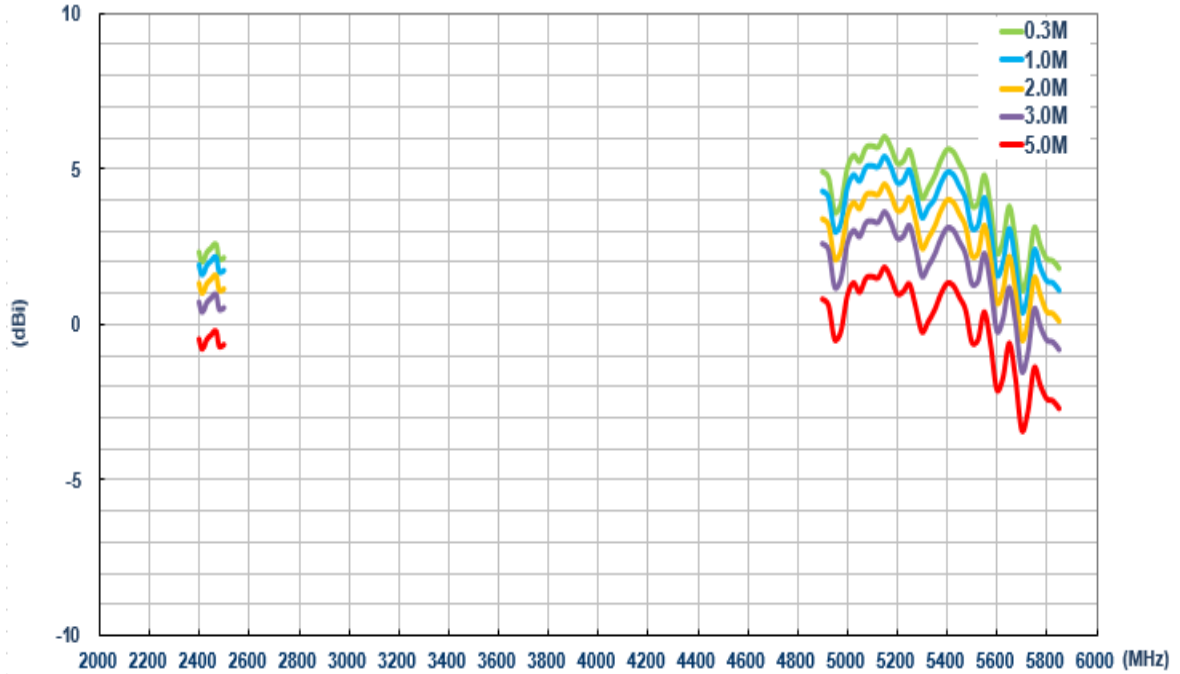
6.4.7 Average Gain (Wi-Fi MIMO_2)



6.4.8 Peak Gain (Wi-Fi MIMO_1)

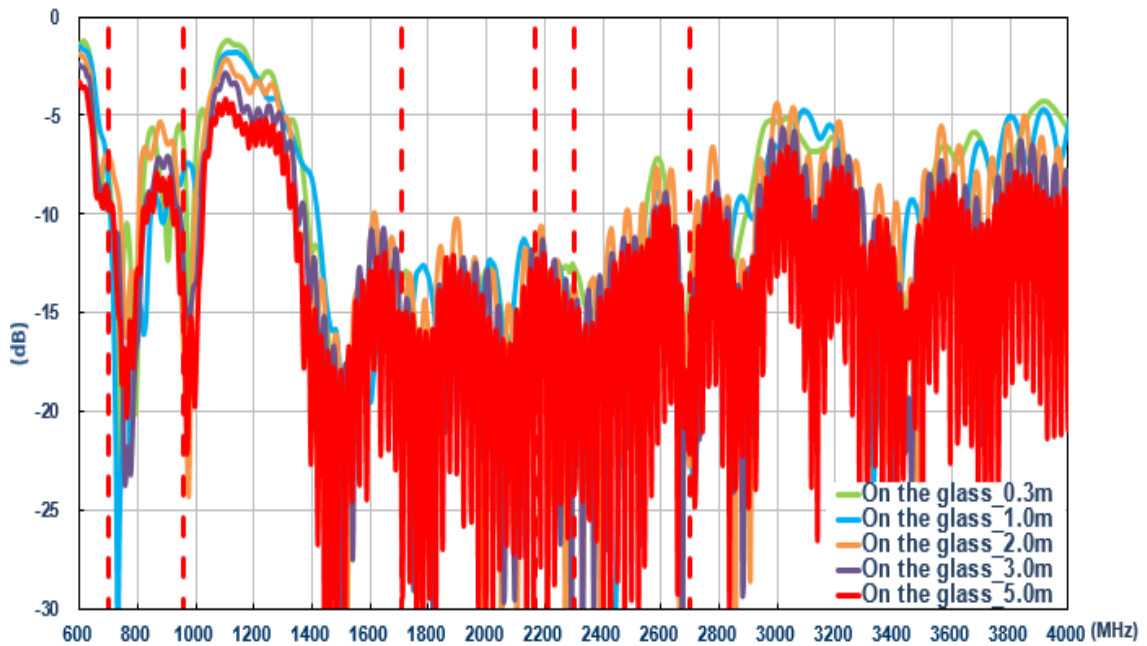


6.4.9 Peak Gain (Wi-Fi MIMO_2)

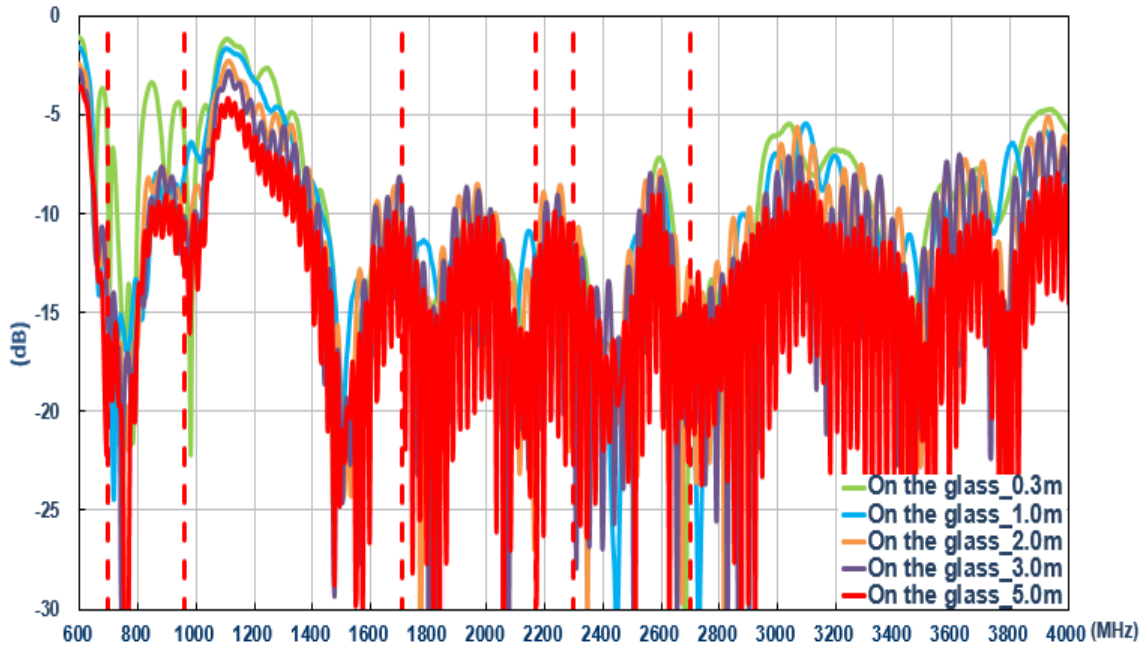


6.5 On glass (LTE)

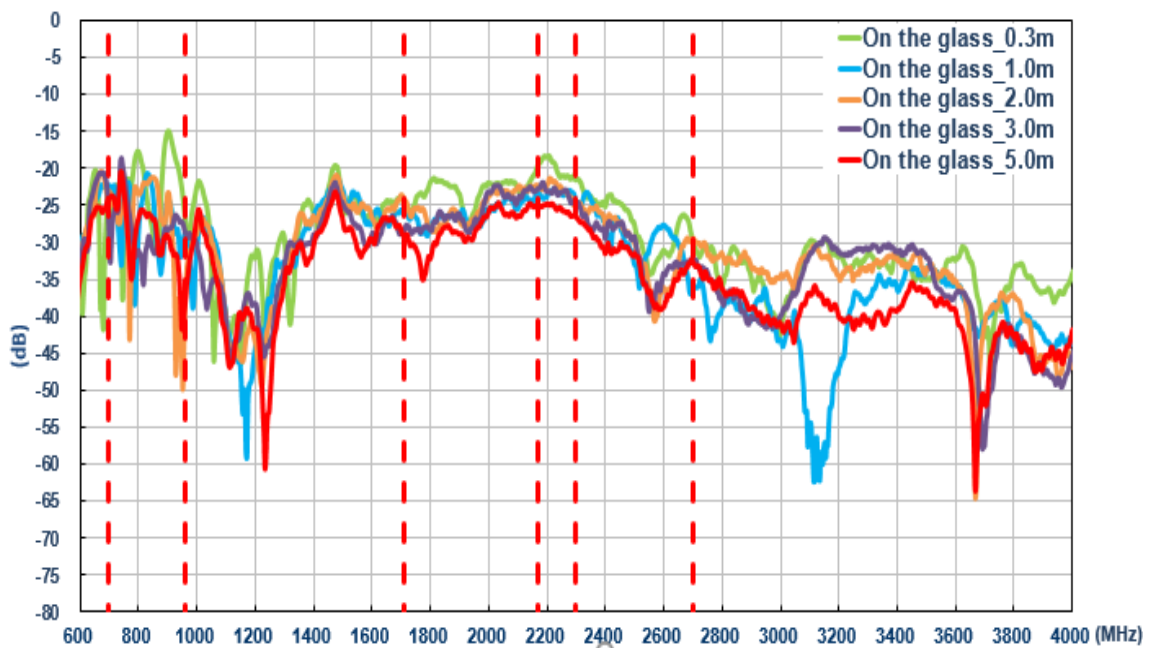
6.5.1 Return Loss (LTE_MIMO_1)



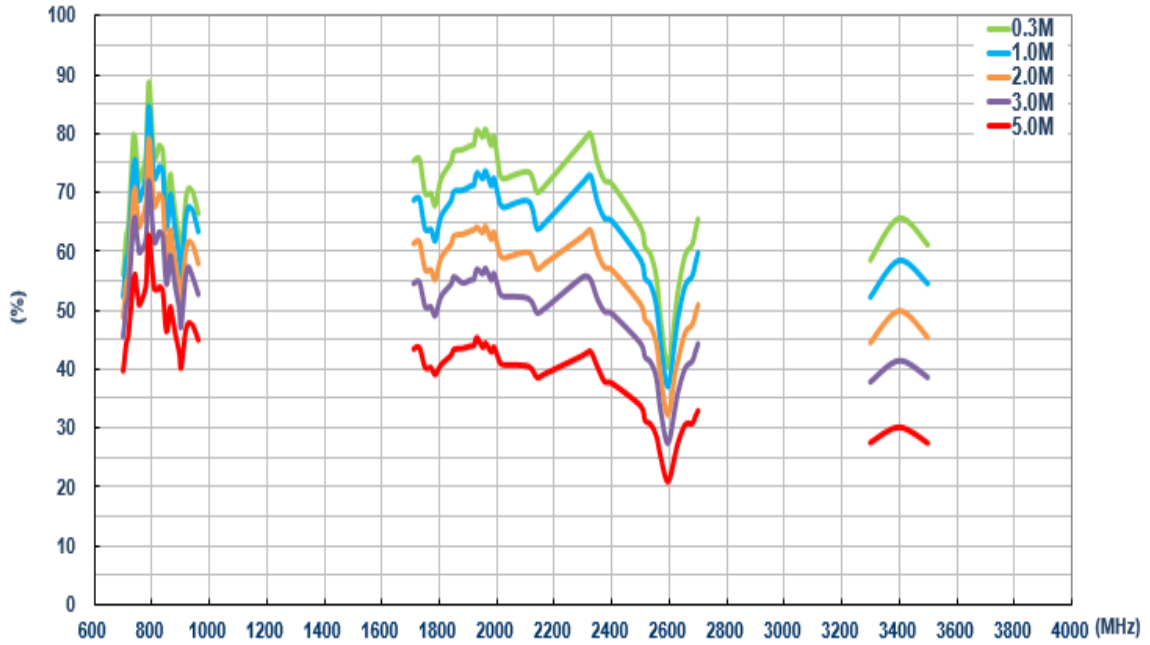
6.5.2 Return Loss (LTE_MIMO_2)



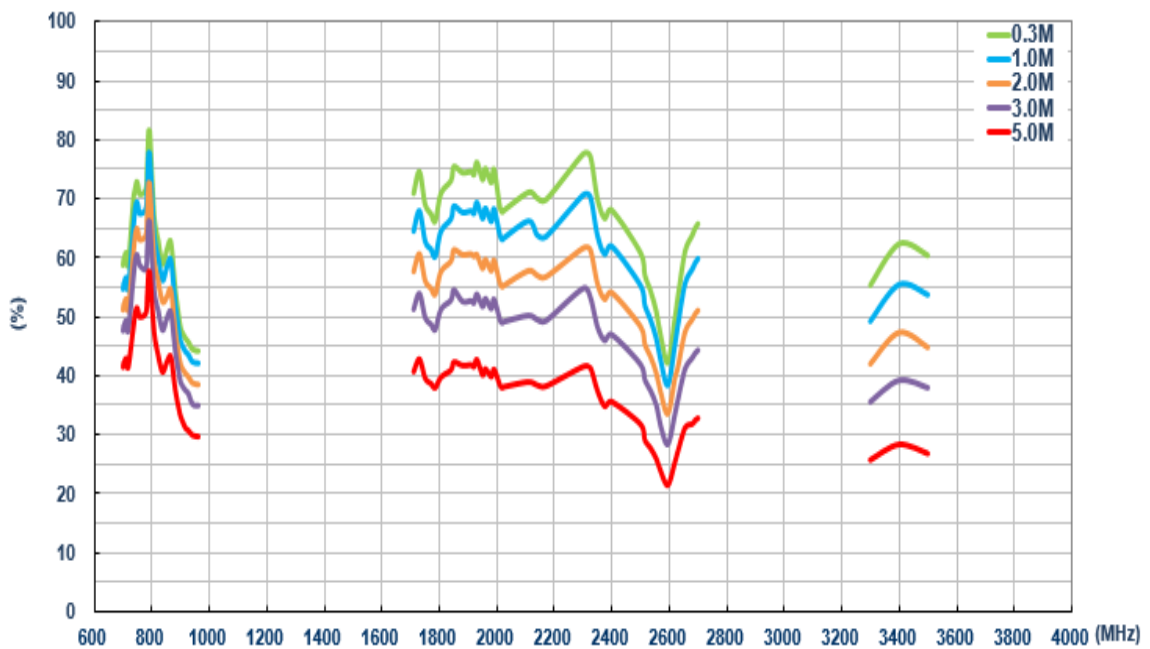
6.5.3 Isolation (LTE antenna)



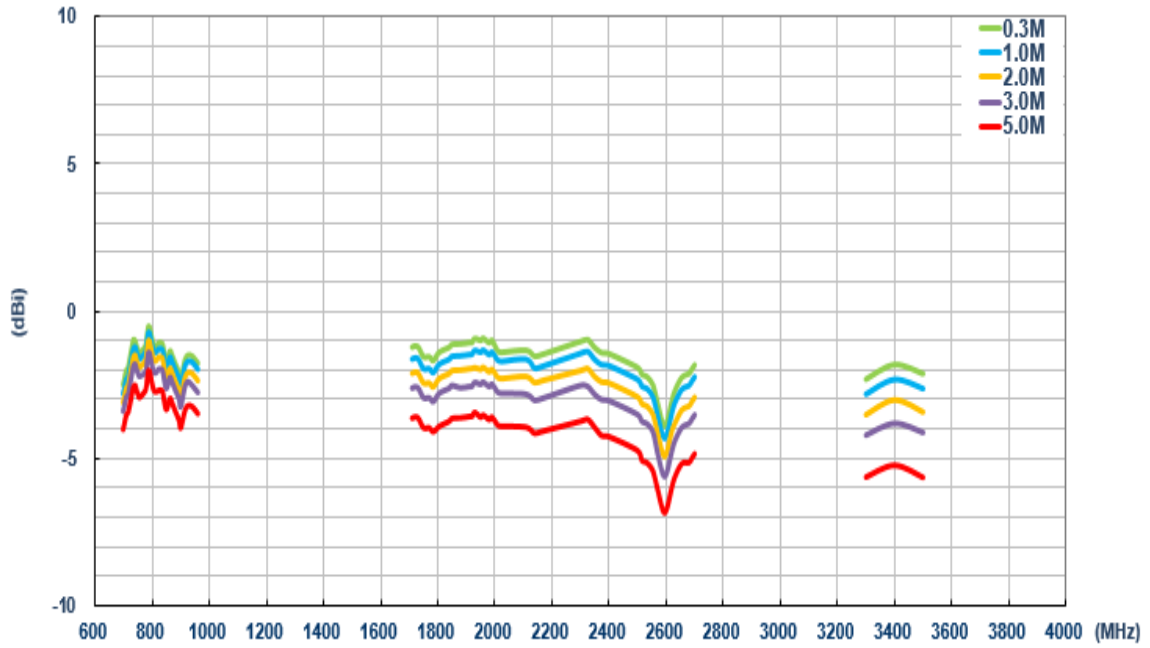
6.5.4 Efficiency (LTE MIMO_1)



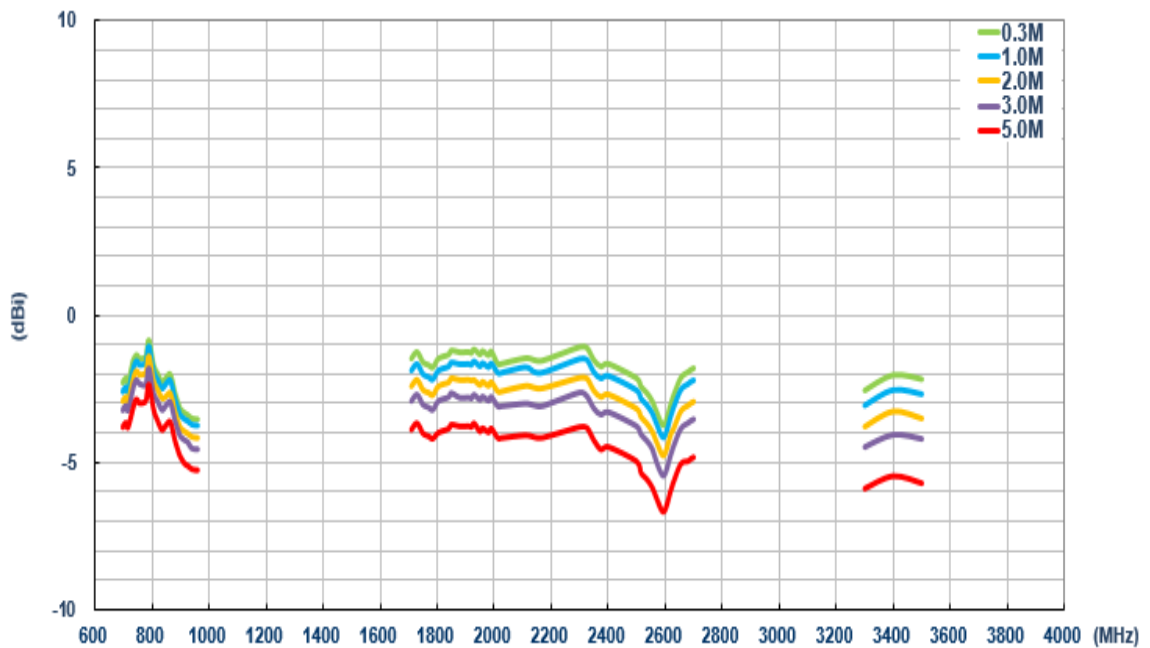
6.5.5 Efficiency (LTE MIMO_2)



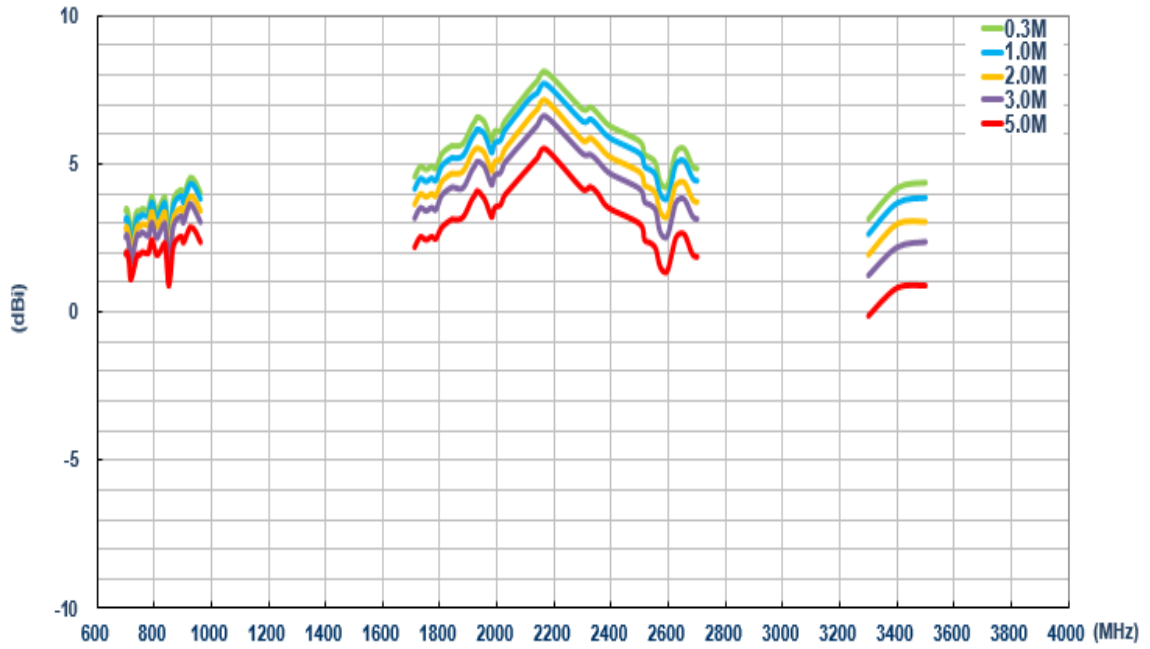
6.5.6 Average Gain (LTE MIMO_1)



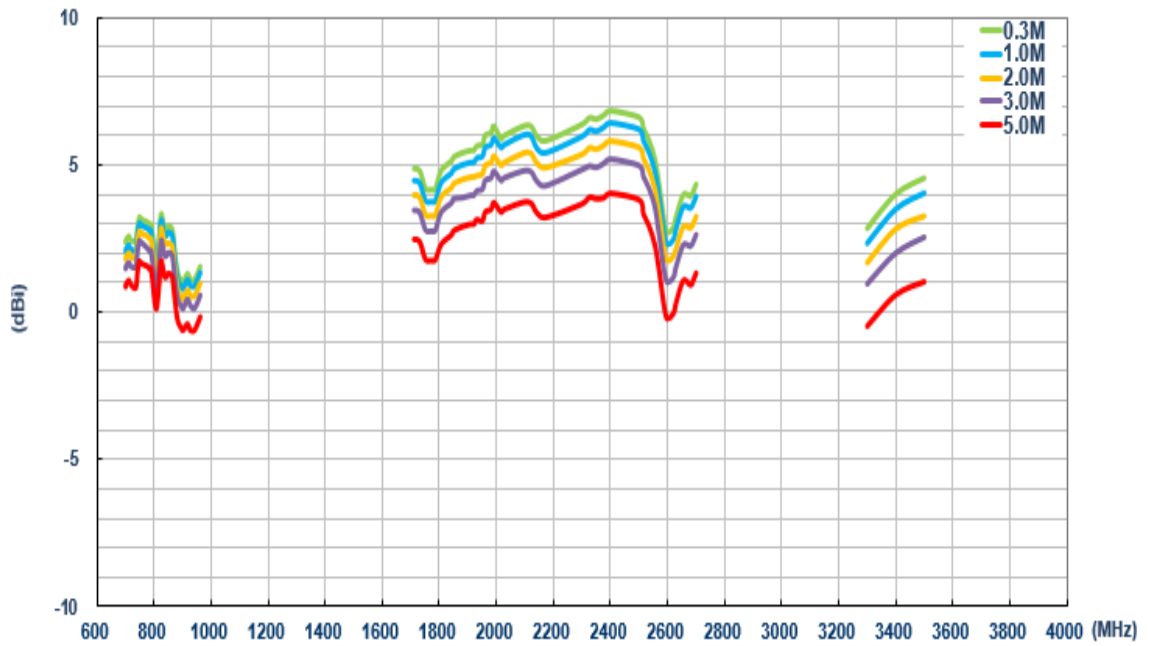
6.5.7 Average Gain (LTE MIMO_2)



6.5.8 Peak Gain (LTE MIMO_1)

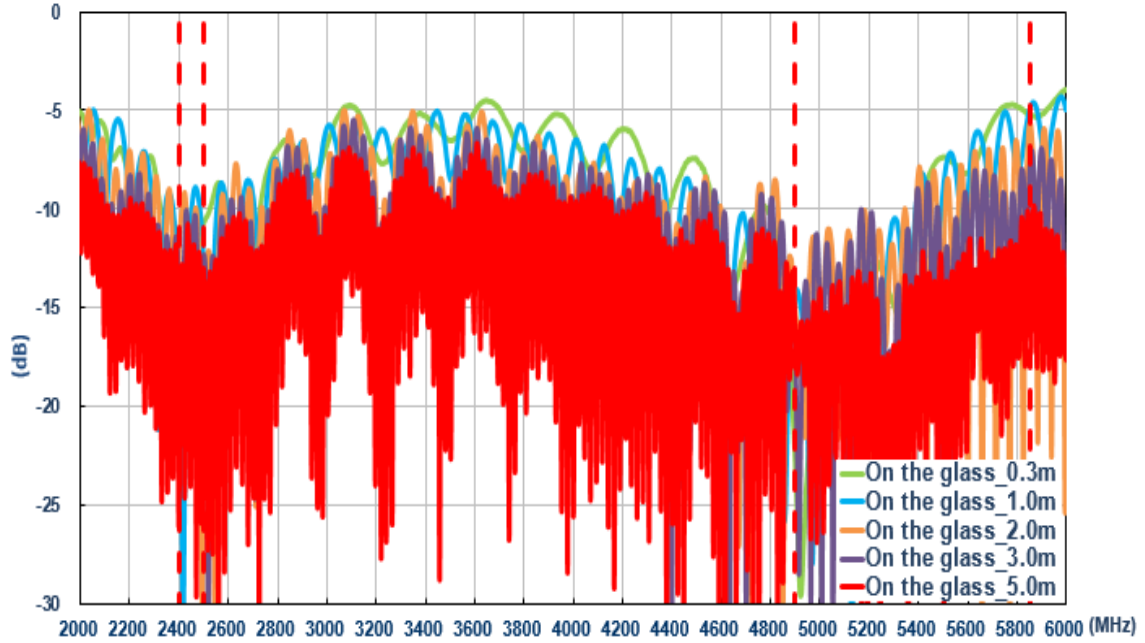


6.5.9 Peak Gain (LTE MIMO_2)

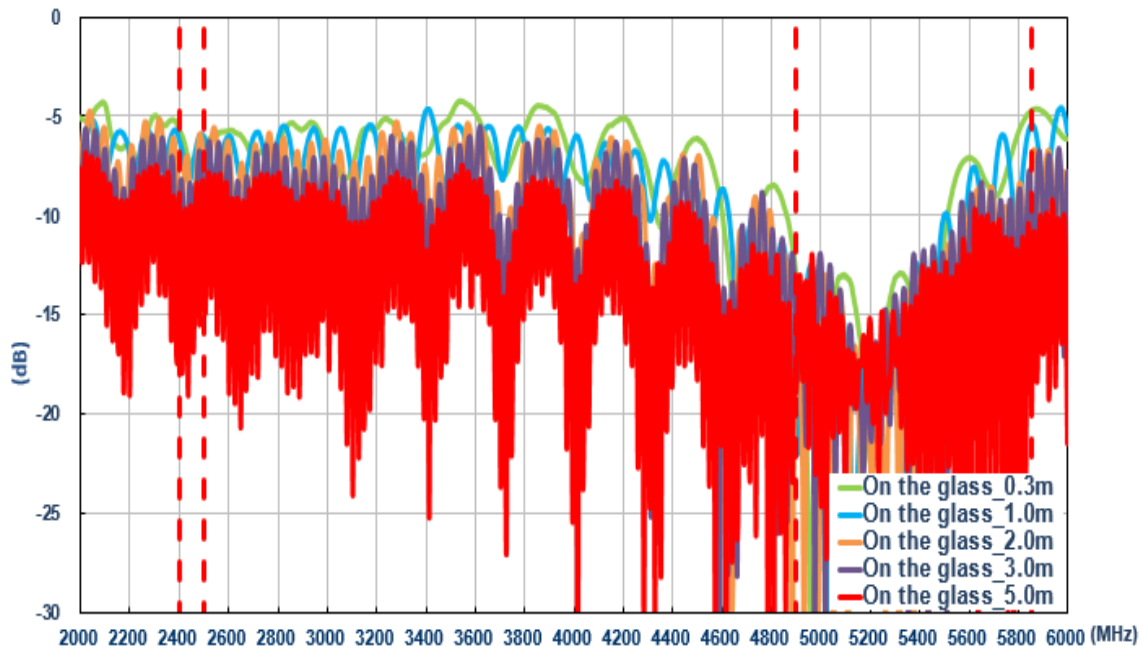


6.6 On glass (Wi-Fi)

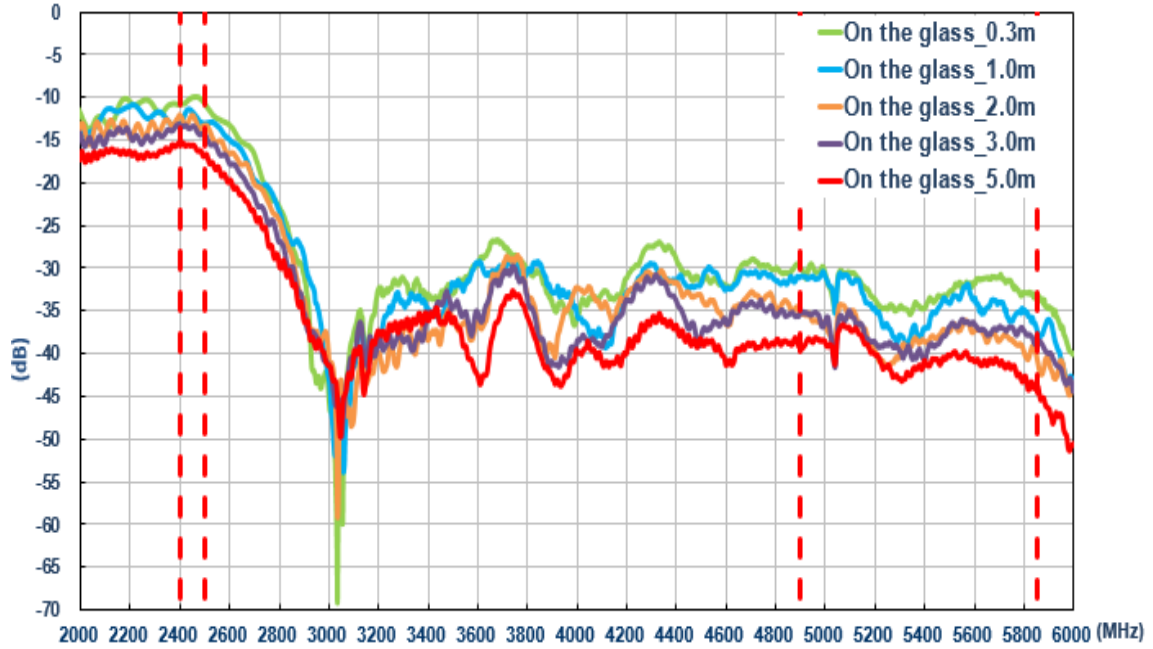
6.6.1 Return Loss (Wi-Fi _MIMO_1)



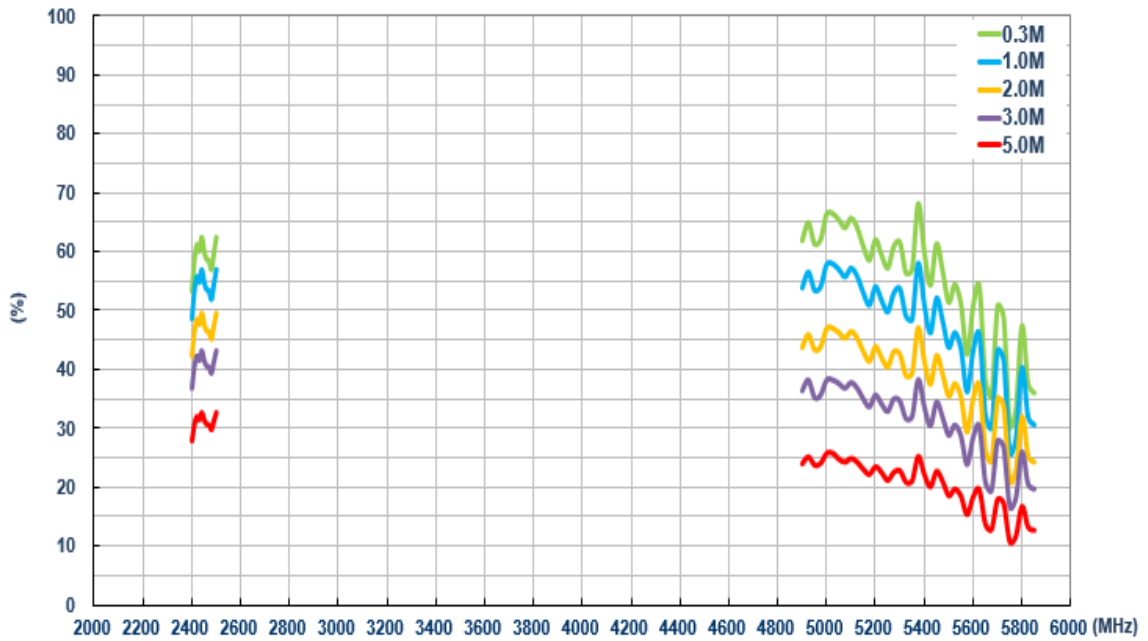
6.6.2 Return Loss (Wi-Fi _MIMO_2)



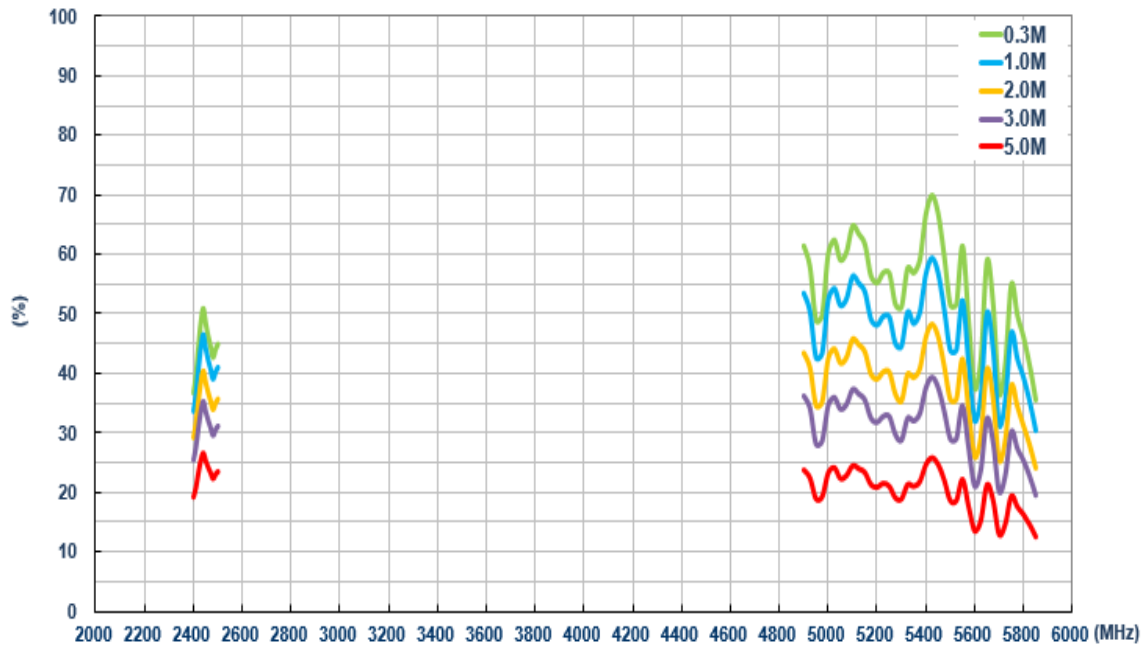
6.6.3 Isolation (Wi-Fi)



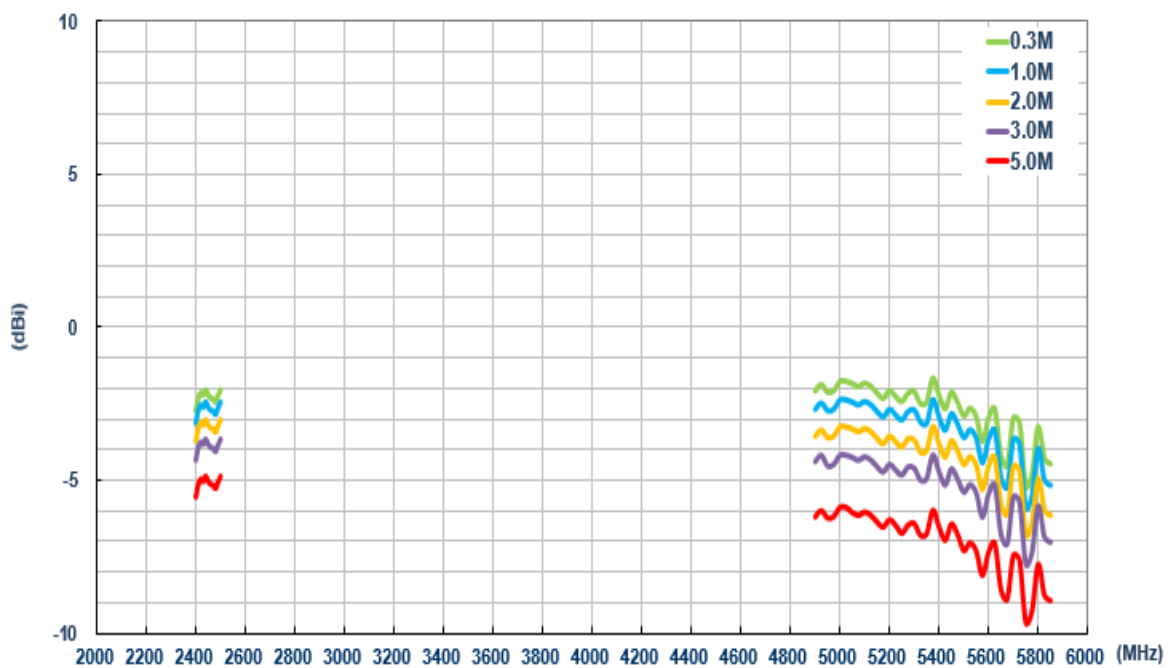
6.6.4 Efficiency (Wi-Fi _MIMO_1)



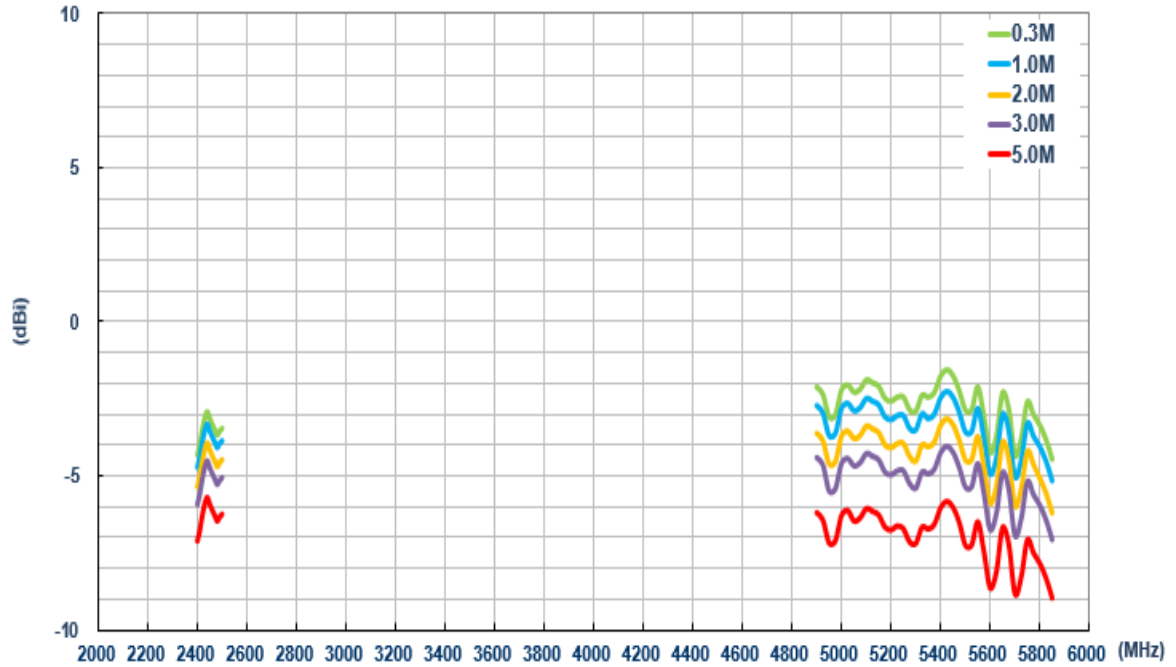
6.6.5 Efficiency (Wi-Fi_MIMO_2)



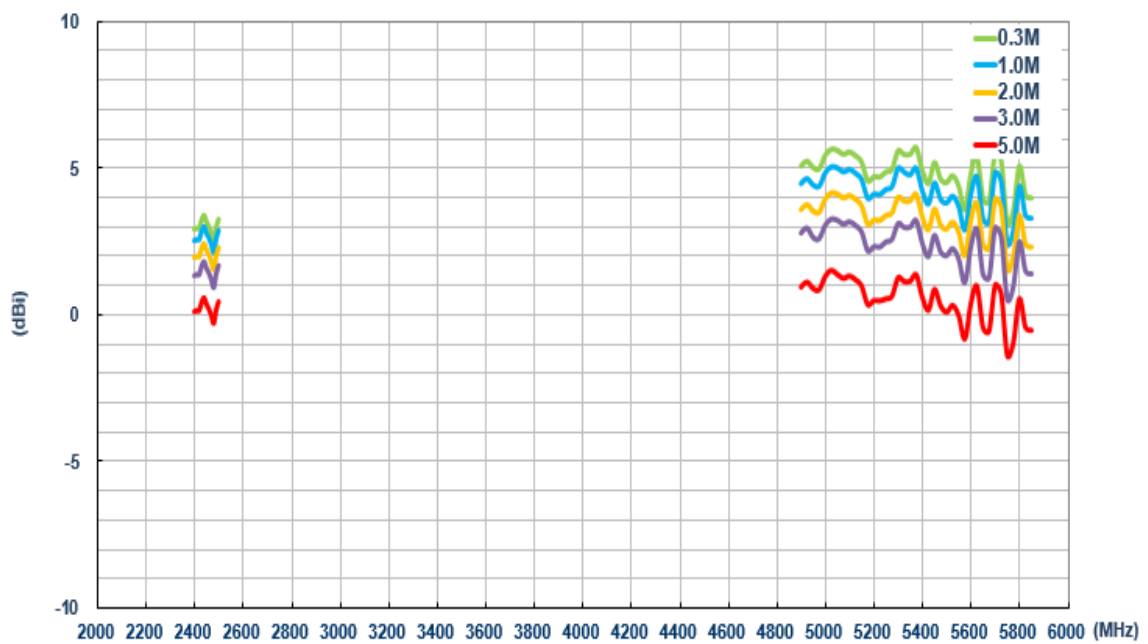
6.6.6 Average Gain (Wi-Fi_MIMO_1)



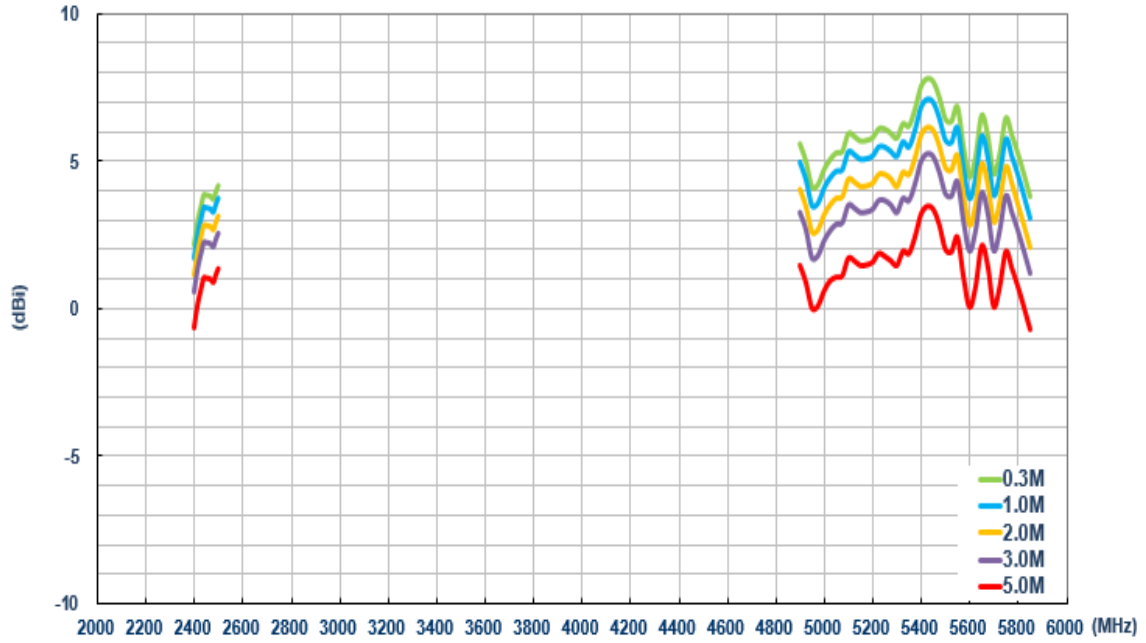
6.6.7 Average Gain (Wi-Fi _MIMO_2)



6.6.8 Peak Gain (Wi-Fi _MIMO_1)

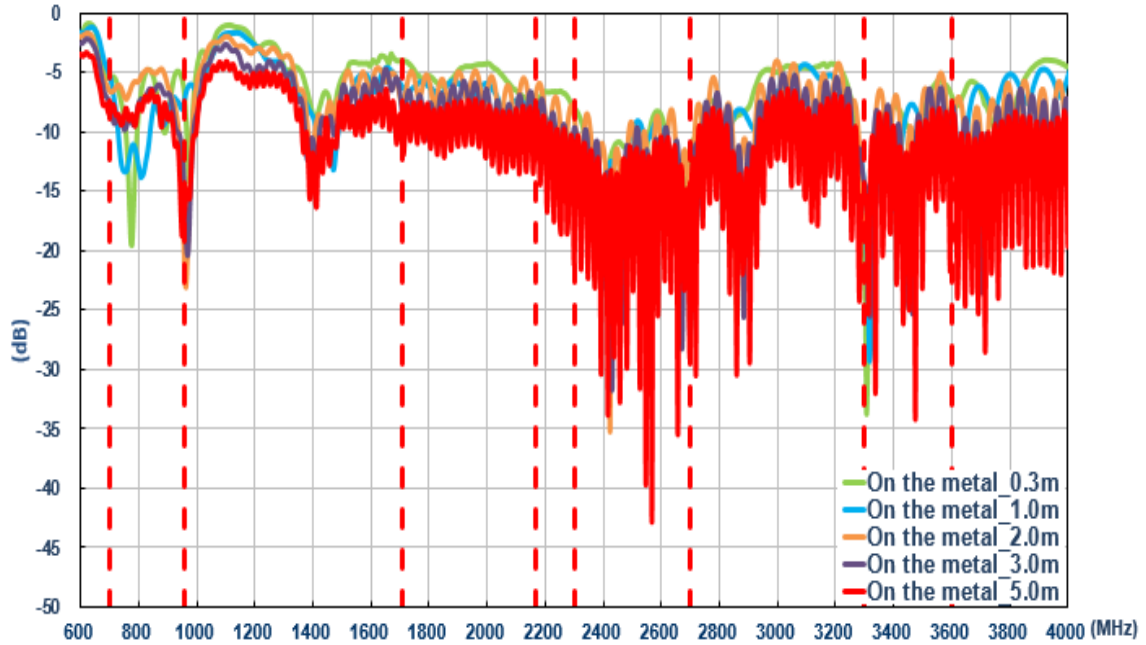


6.6.9 Peak Gain (Wi-Fi _MIMO_2)

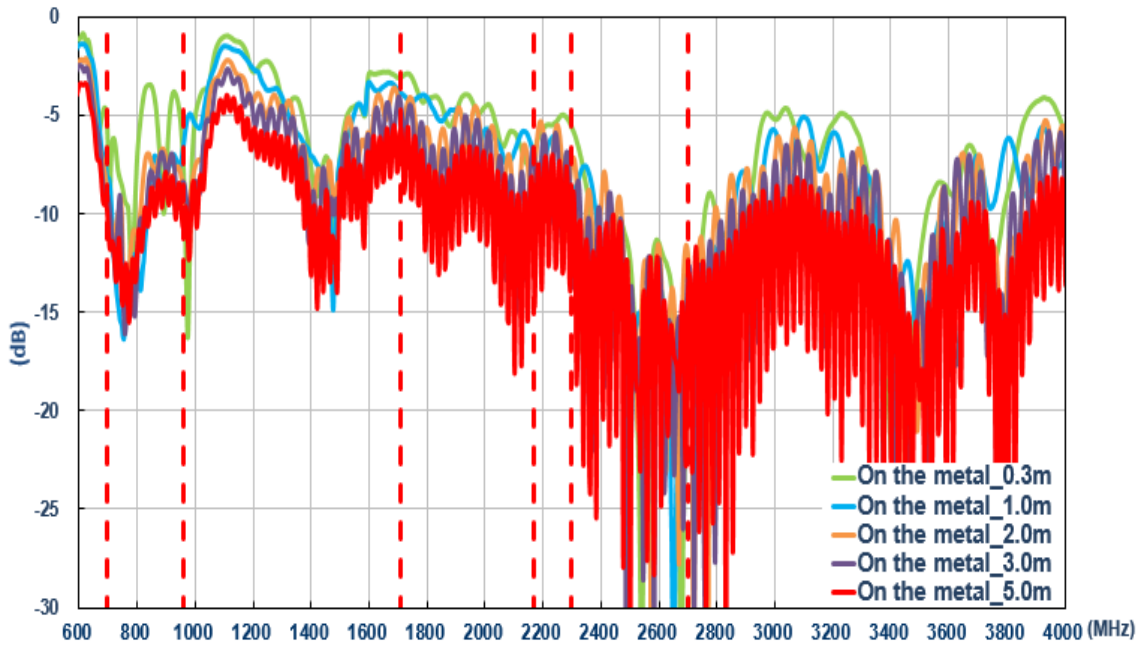


6.7 On metal (LTE)

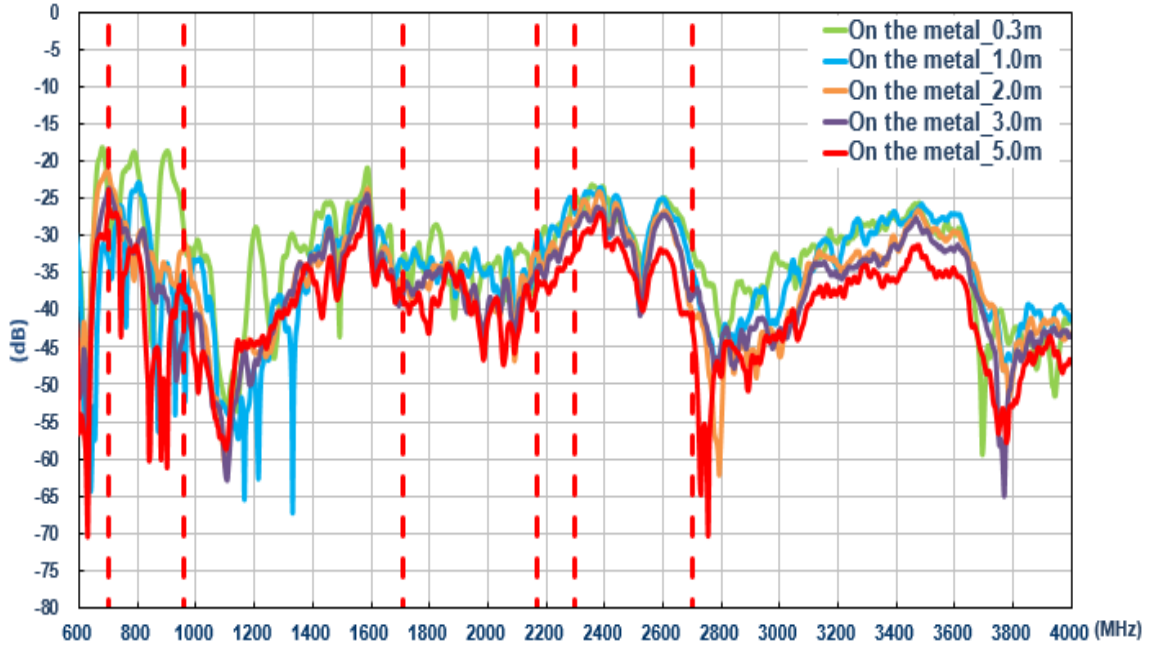
6.7.1 Return Loss (LTE_MIMO_1)



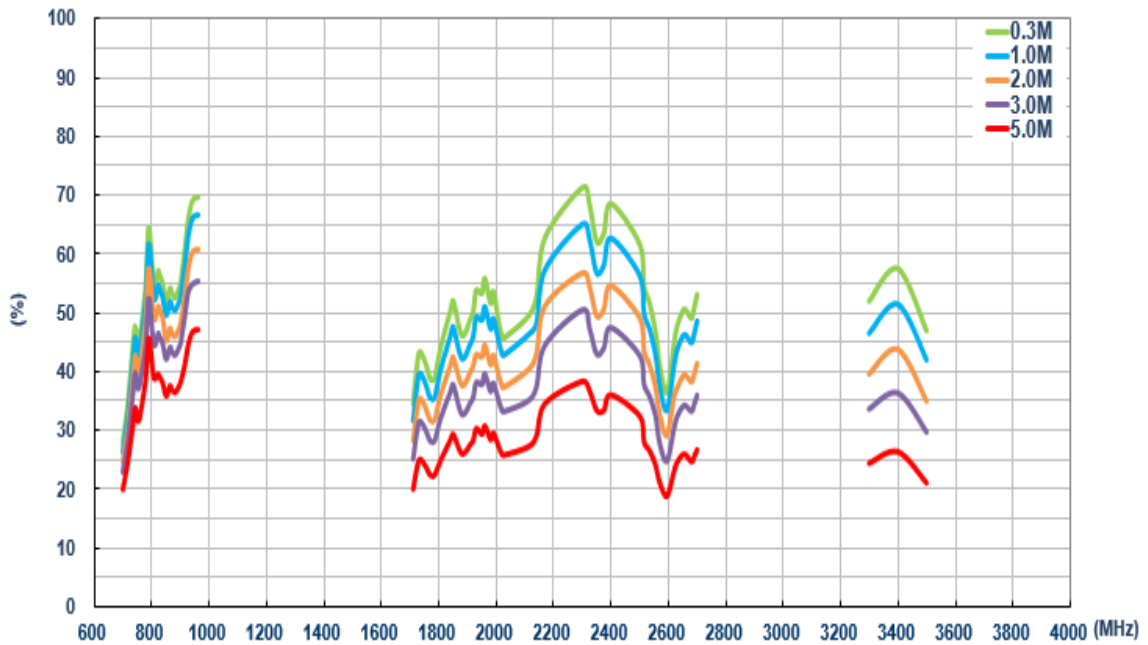
6.7.2 Return Loss (LTE_MIMO_2)



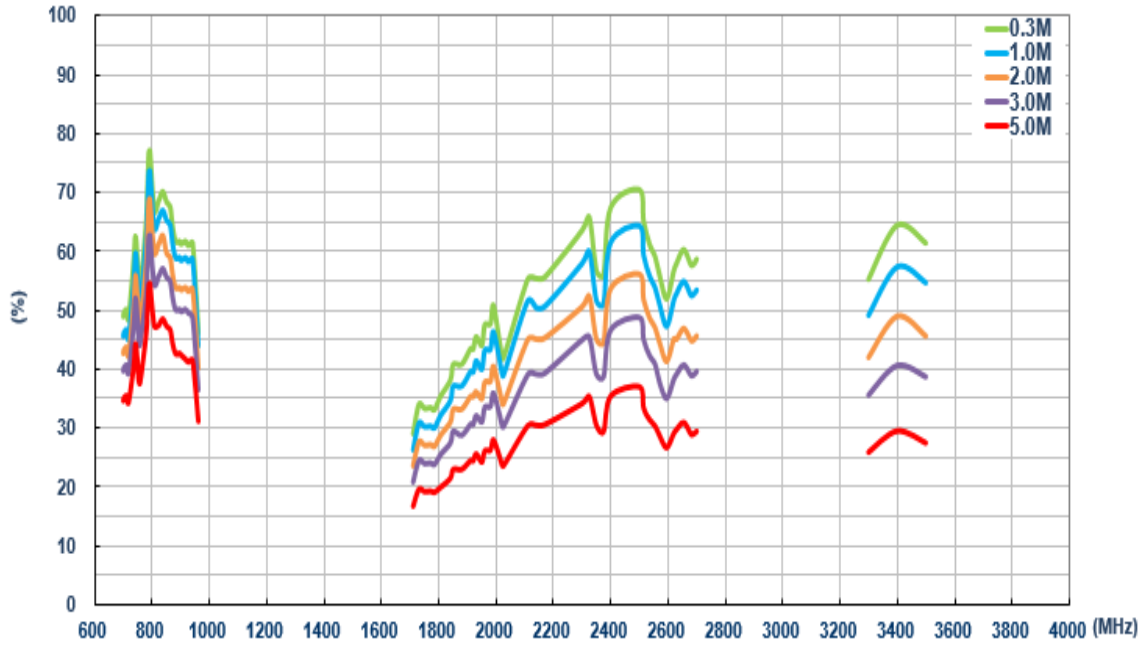
6.7.3 Isolation (LTE antenna)



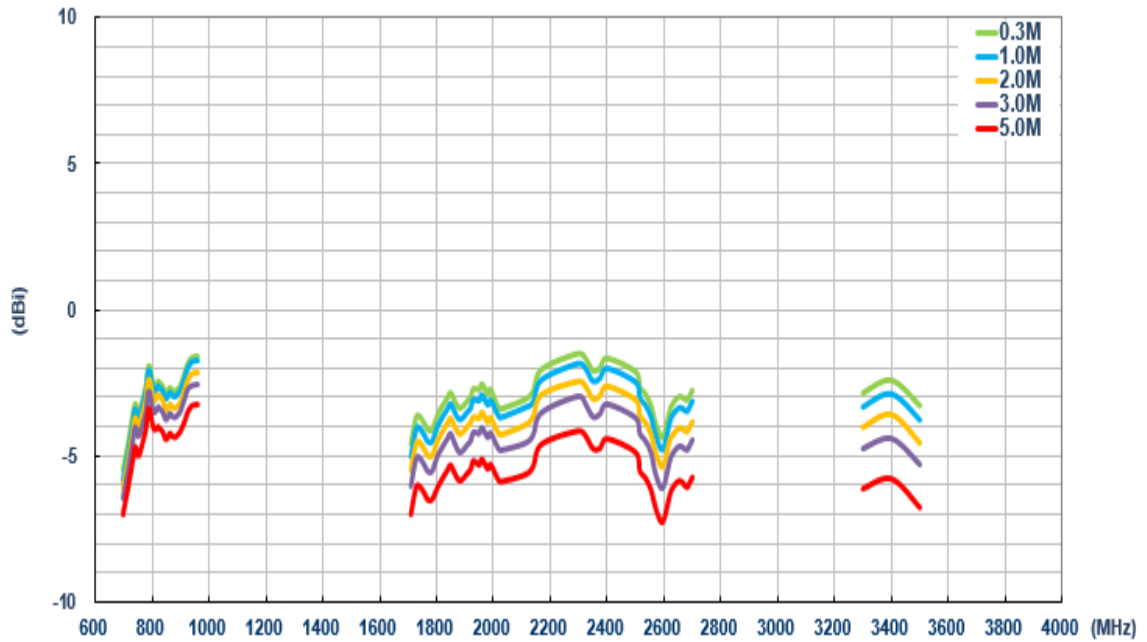
6.7.4 Efficiency (LTE_MIMO_1)



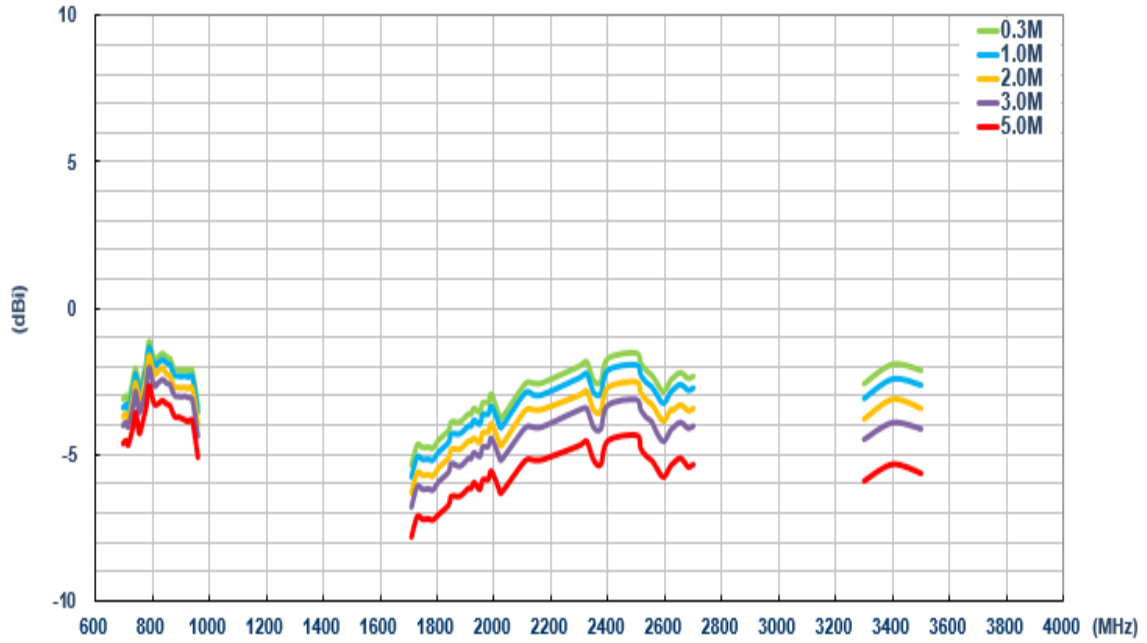
6.7.5 Efficiency (LTE_MIMO_2)



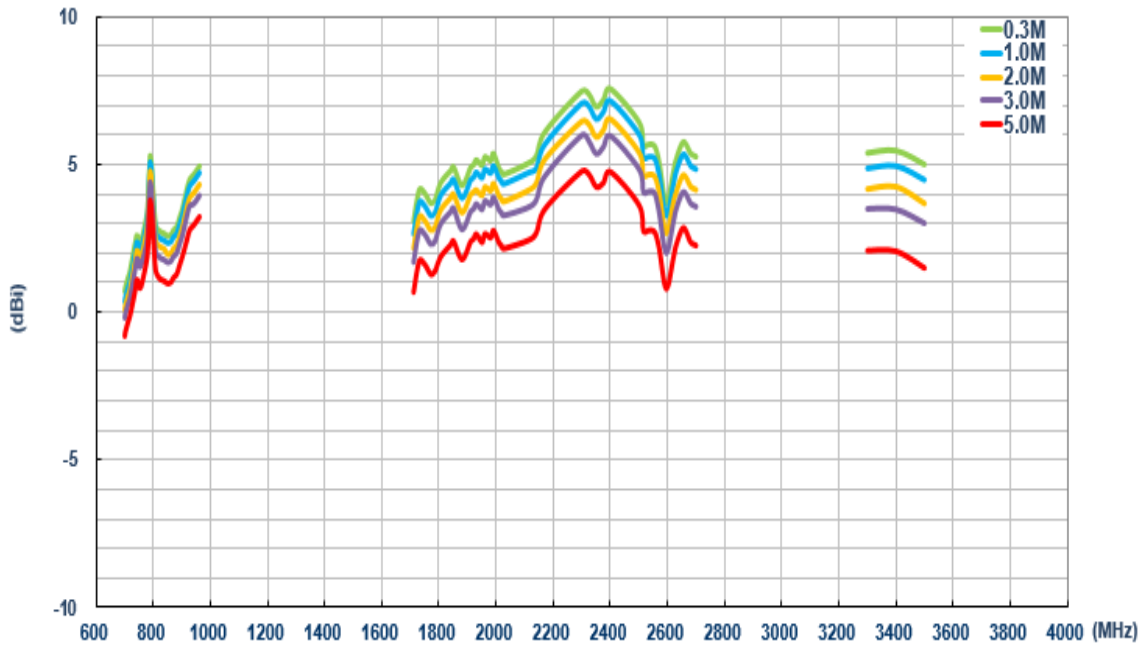
6.7.6 Average Gain (LTE_MIMO_1)



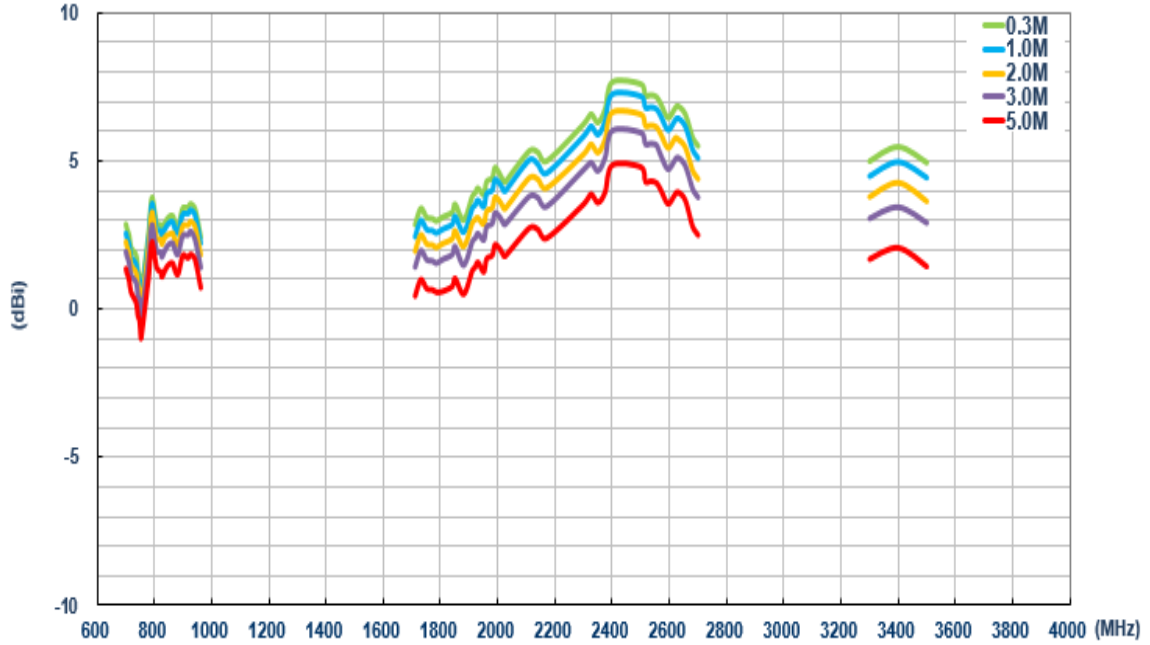
6.7.7 Average Gain (LTE_MIMO_2)



6.7.8 Peak Gain (LTE_MIMO_1)

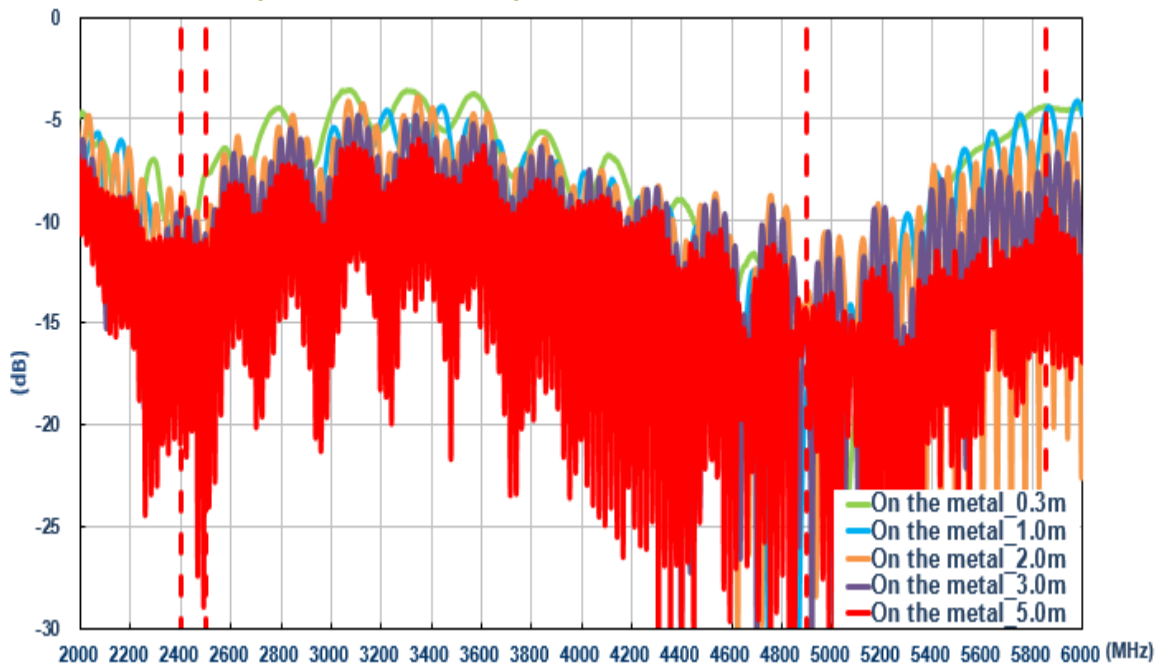


6.7.9 Peak Gain (LTE_MIMO_2)

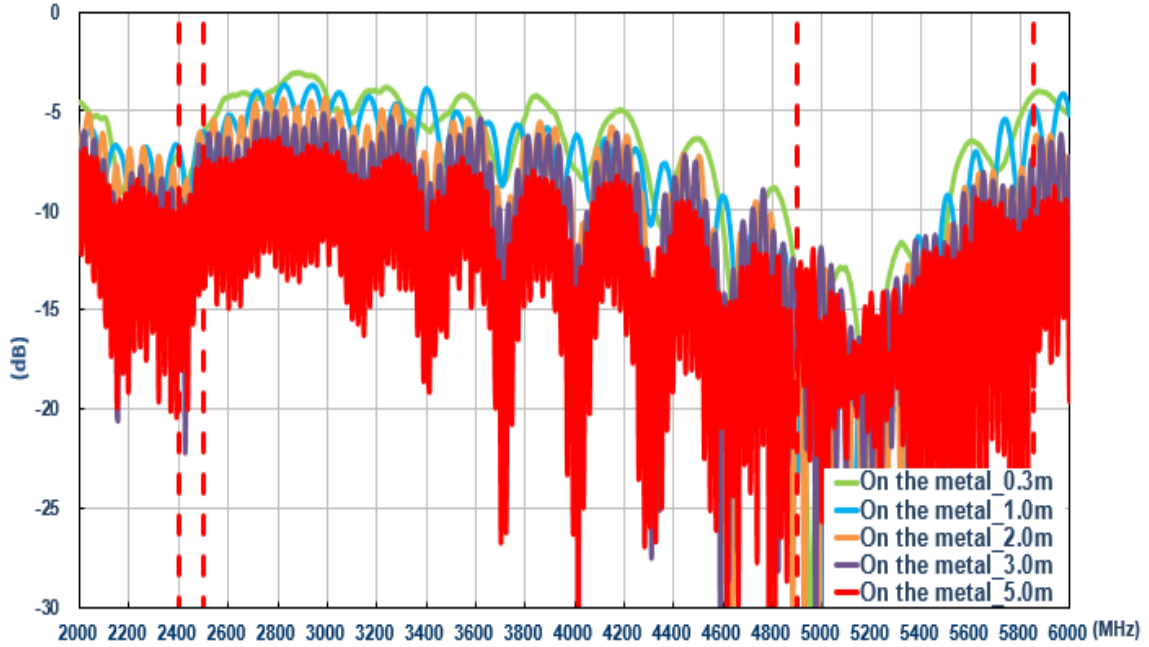


6.8 On metal (Wi-Fi)

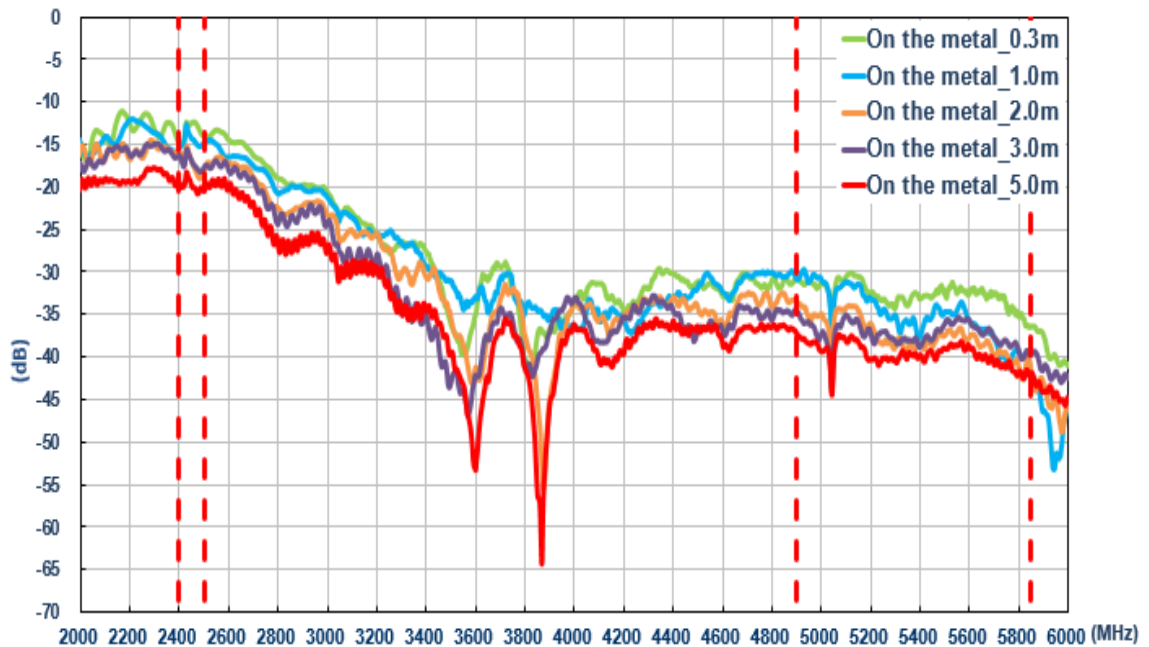
6.8.1 Return Loss (Wi-Fi _MIMO_1)



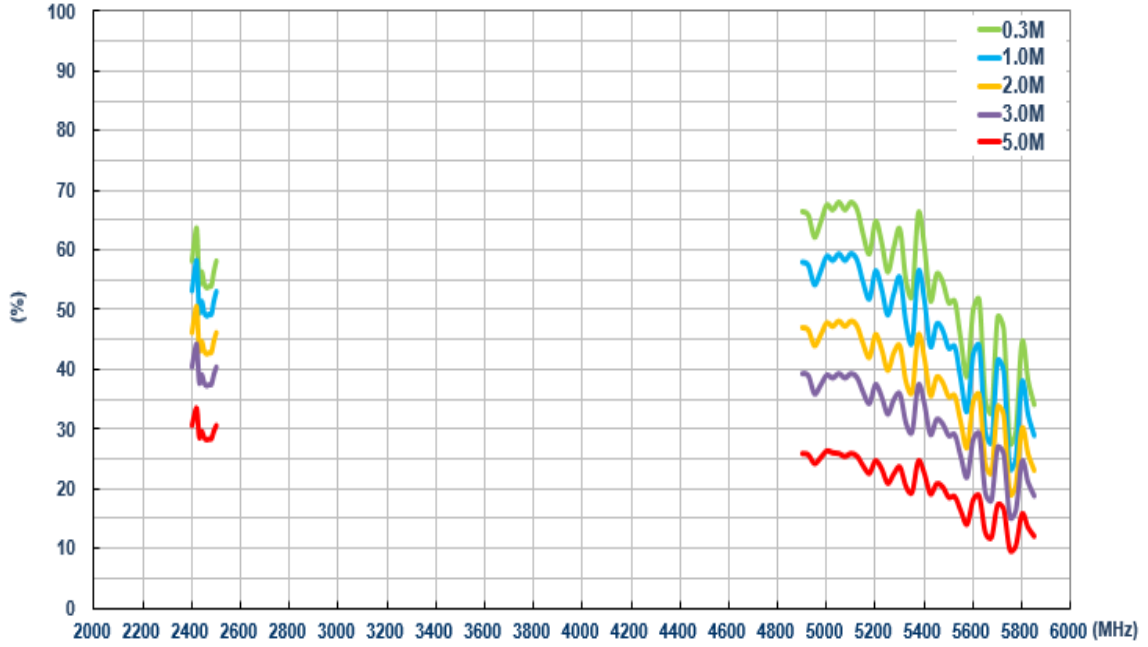
6.8.2 Return Loss (Wi-Fi_MIMO_2)



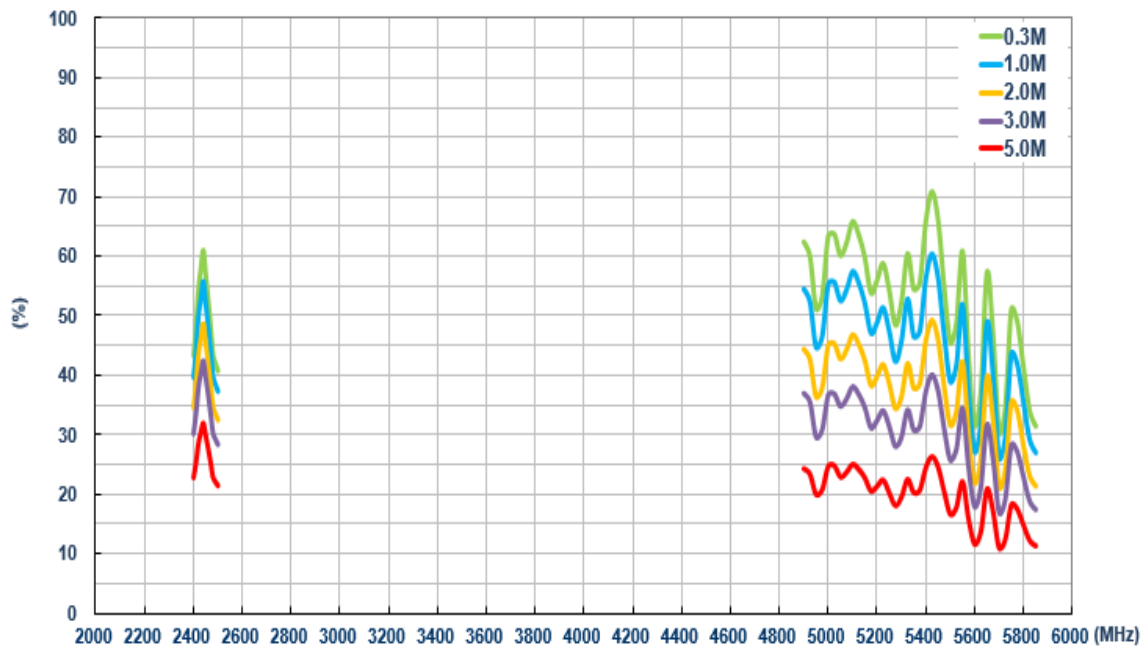
6.8.3 Isolation (Wi-Fi)



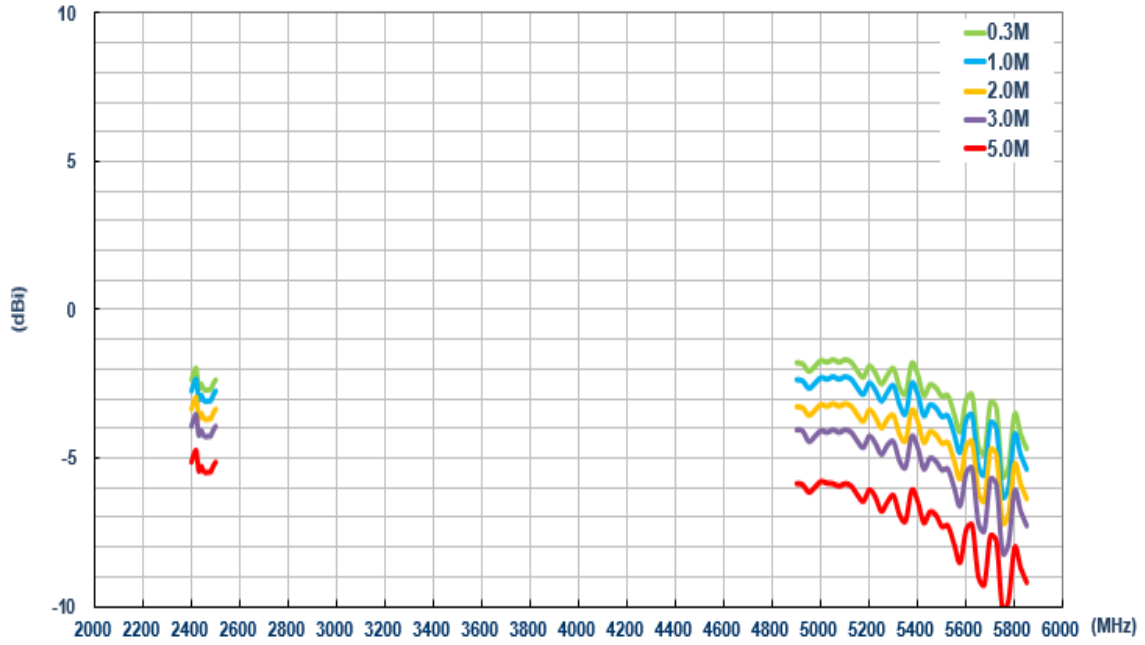
6.8.4 Efficiency (Wi-Fi_MIMO_1)



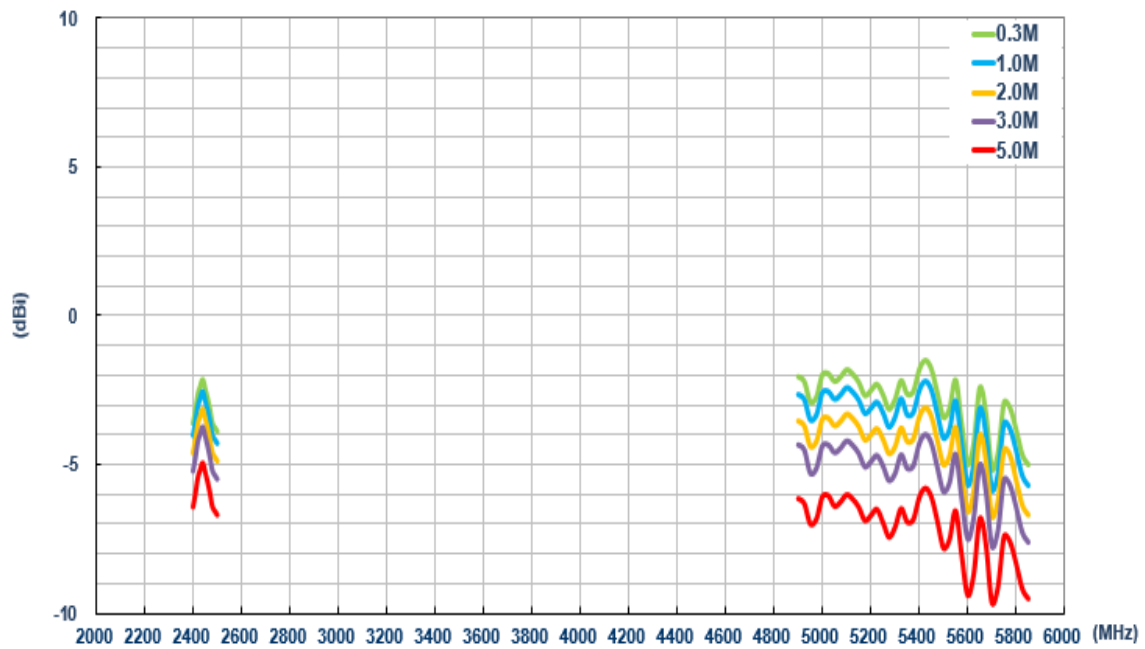
6.8.5 Efficiency (Wi-Fi_MIMO_2)



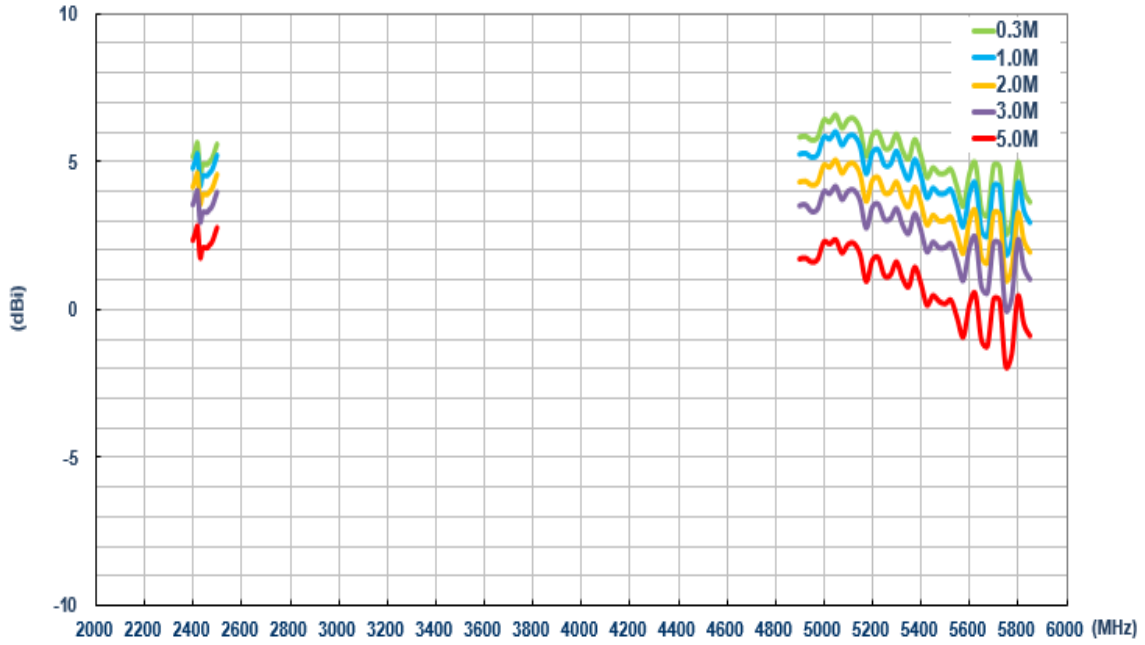
6.8.6 Average Gain (Wi-Fi_MIMO_1)



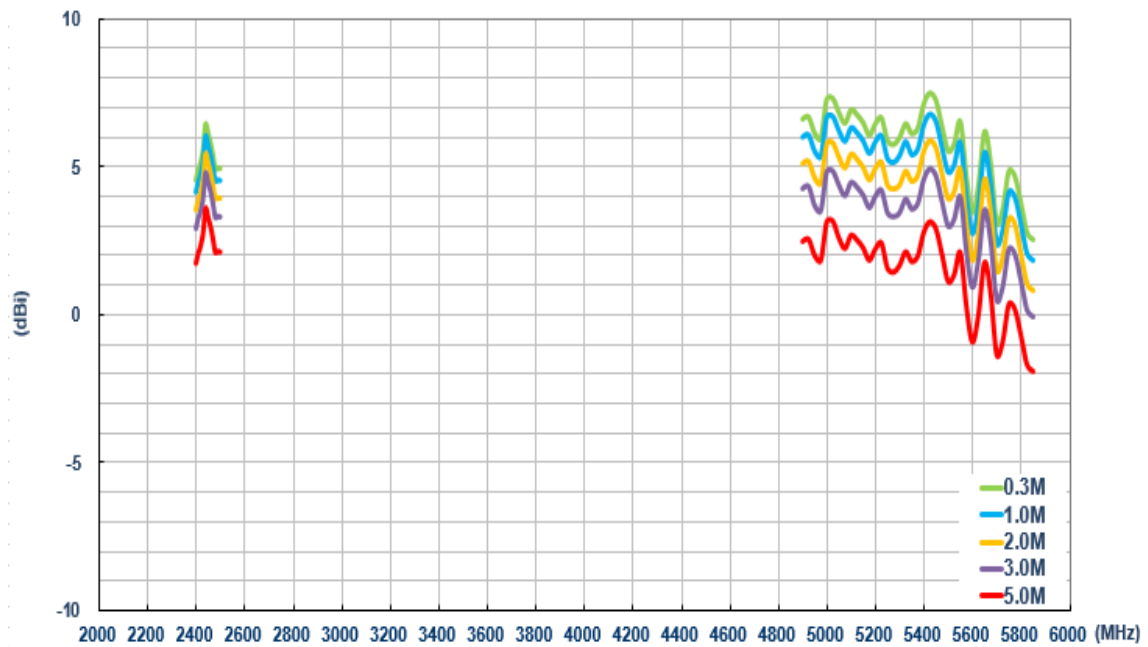
6.8.7 Average Gain (Wi-Fi_MIMO_2)



6.8.8 Peak Gain (Wi-Fi_MIMO_1)

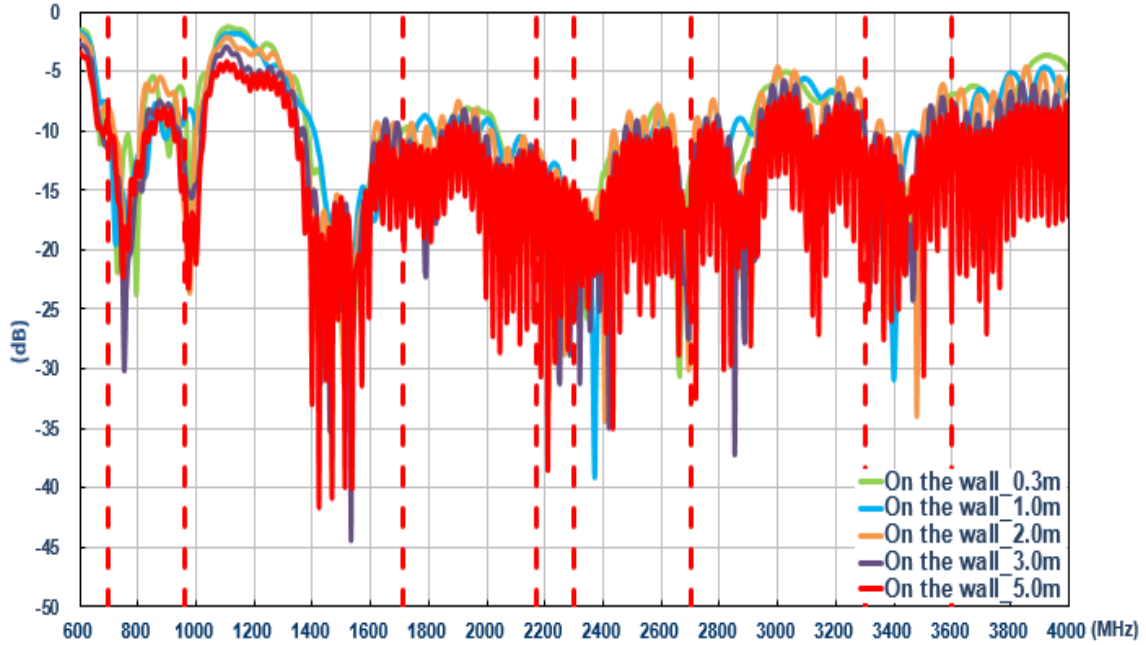


6.8.9 Peak Gain (Wi-Fi_MIMO_2)

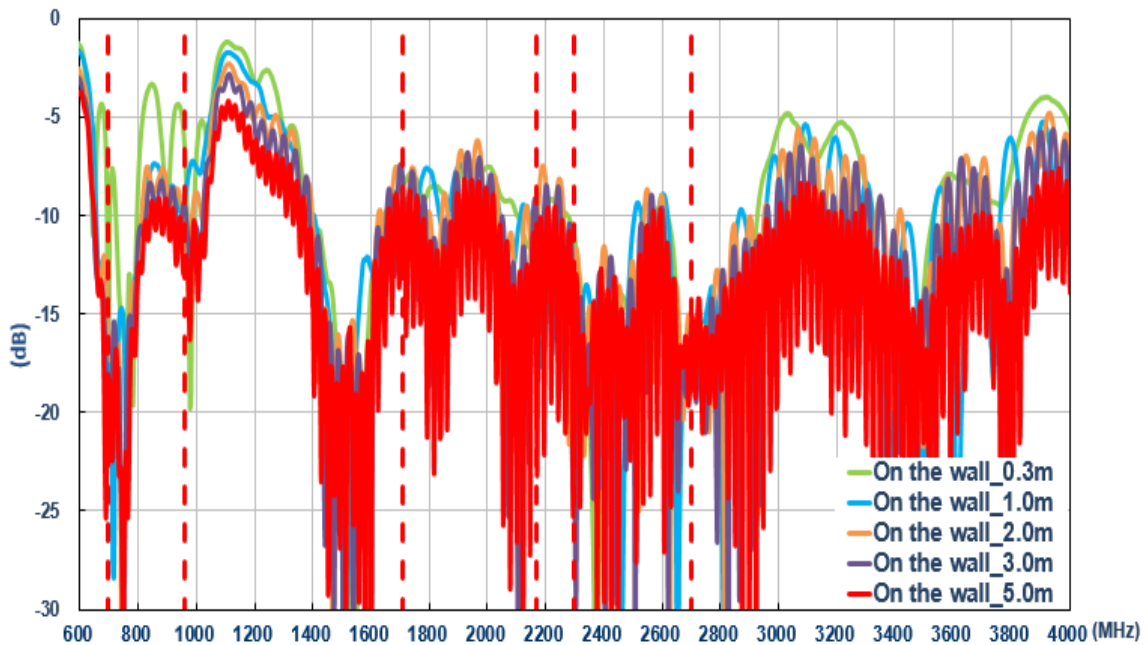


6.9 On the wall (LTE)

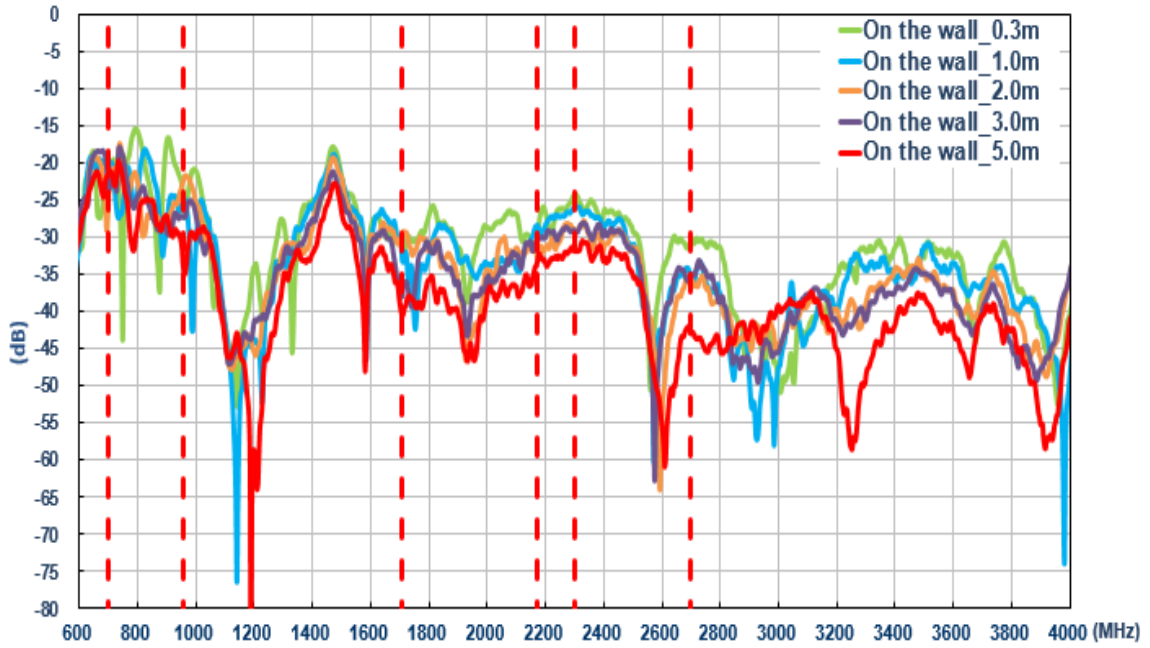
6.9.1 Return Loss (LTE_MIMO_1)



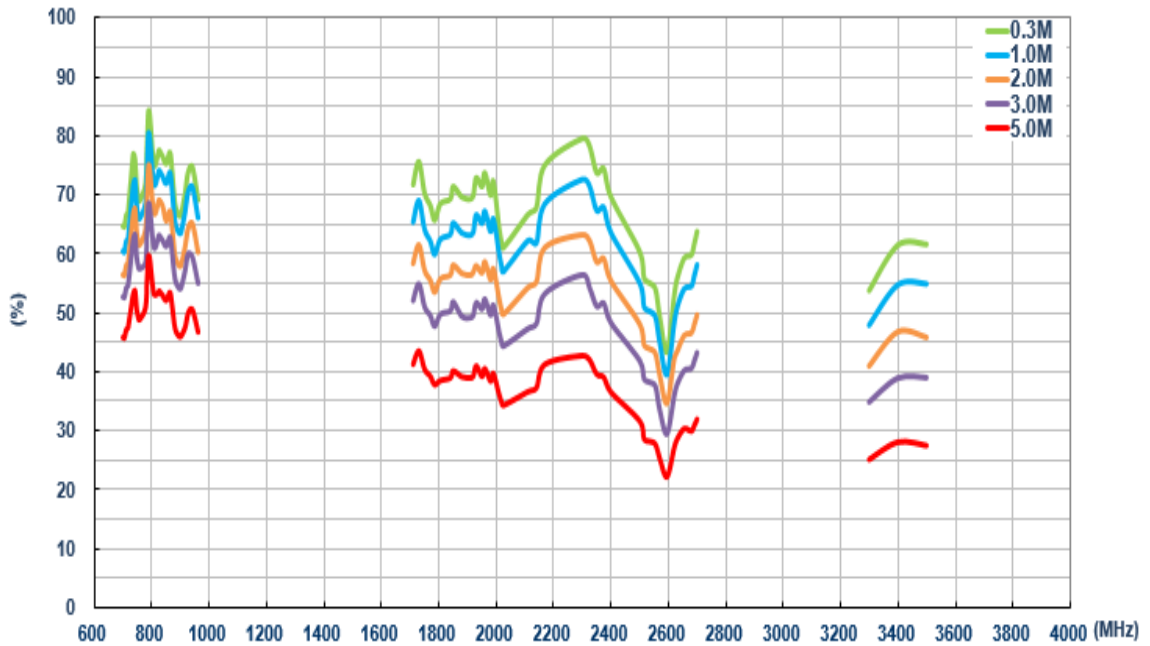
6.9.2 Return Loss (LTE_MIMO_2)



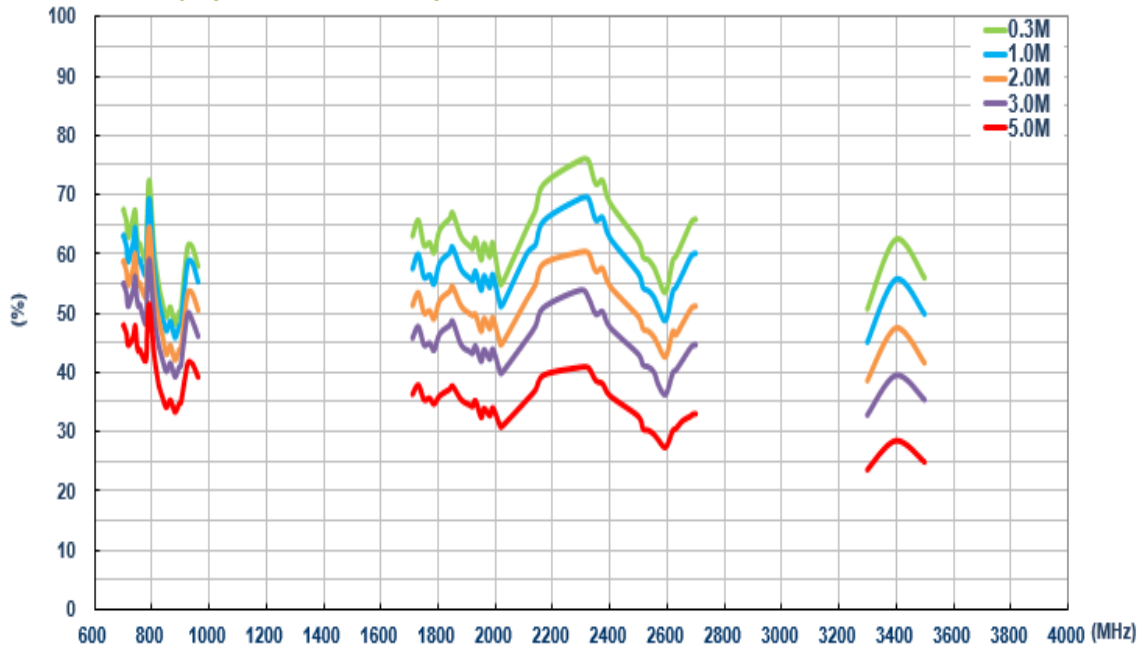
6.9.3 Isolation (LTE antenna)



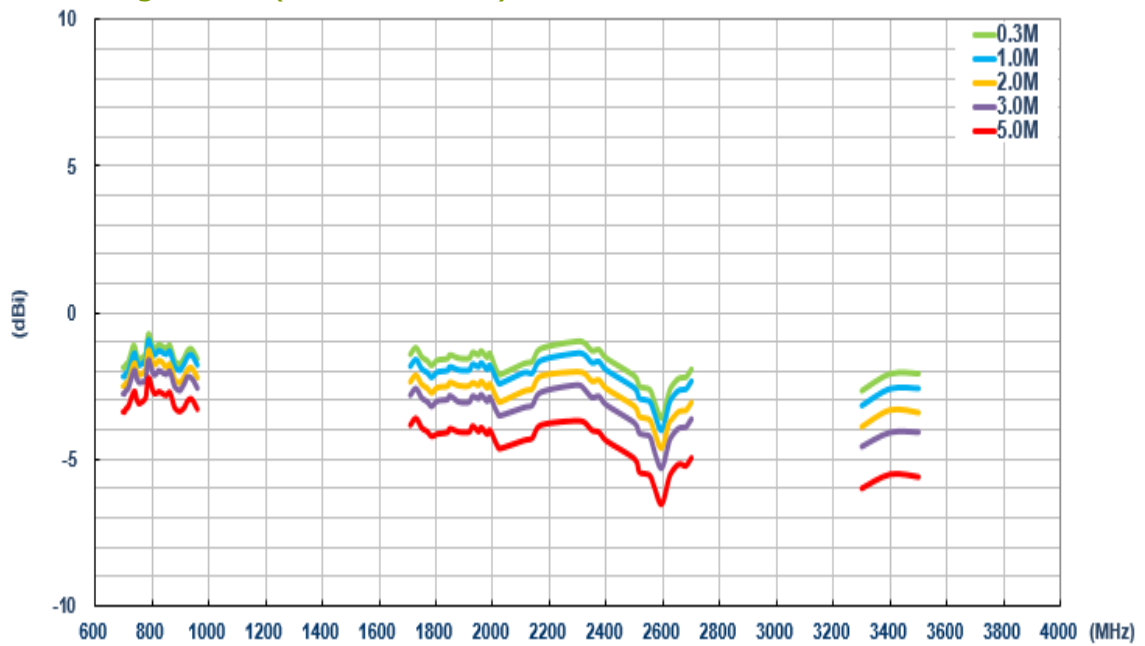
6.9.4 Efficiency (LTE_MIMO_1)



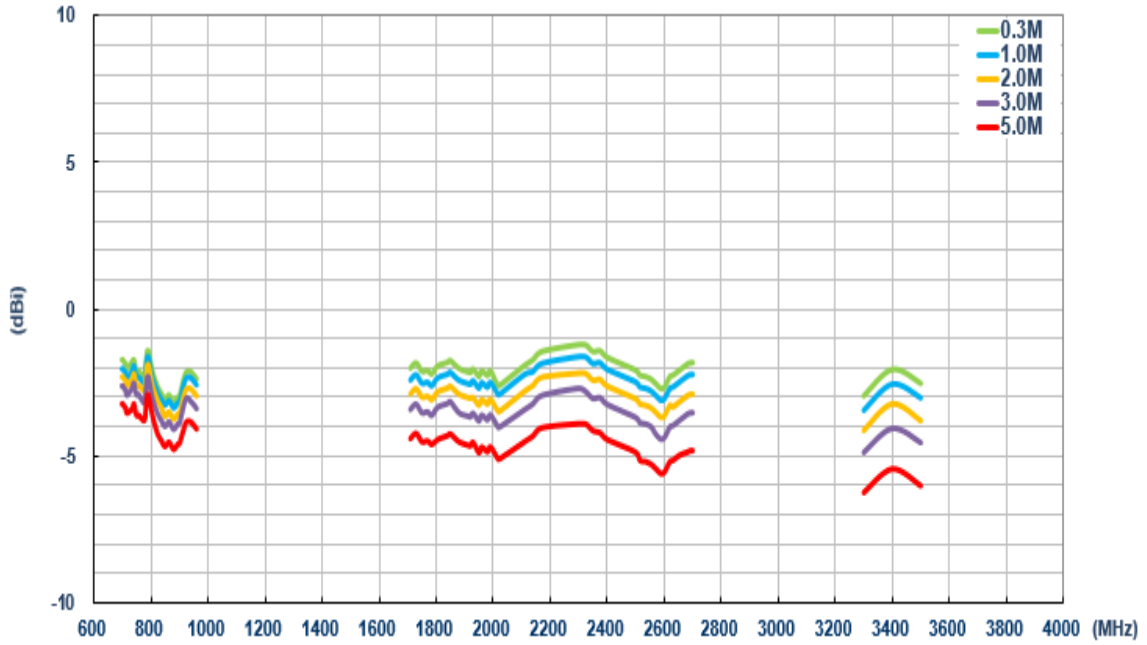
6.9.5 Efficiency (LTE_MIMO_2)



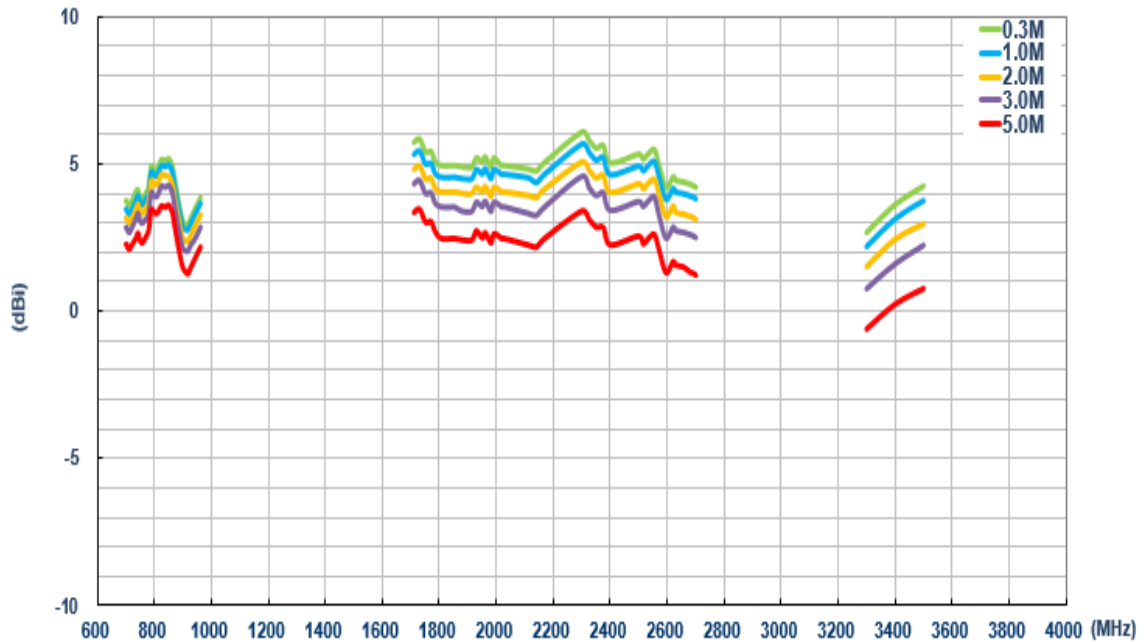
6.9.6 Average Gain (LTE_MIMO_1)



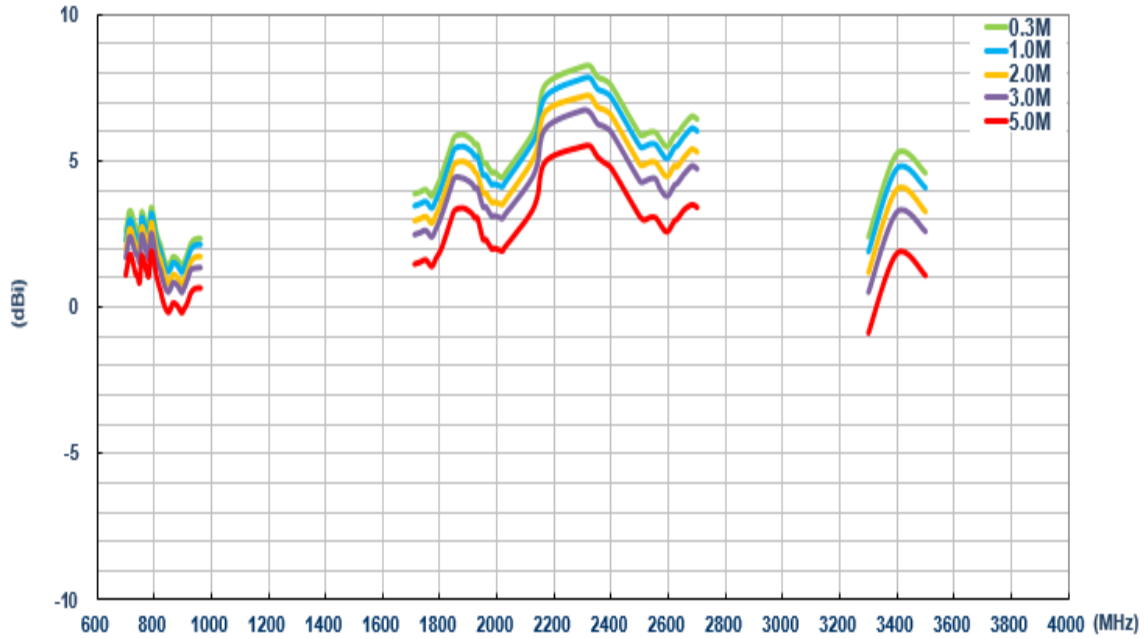
6.9.7 Average Gain (LTE_MIMO_2)



6.9.8 Peak Gain (LTE_MIMO_1)

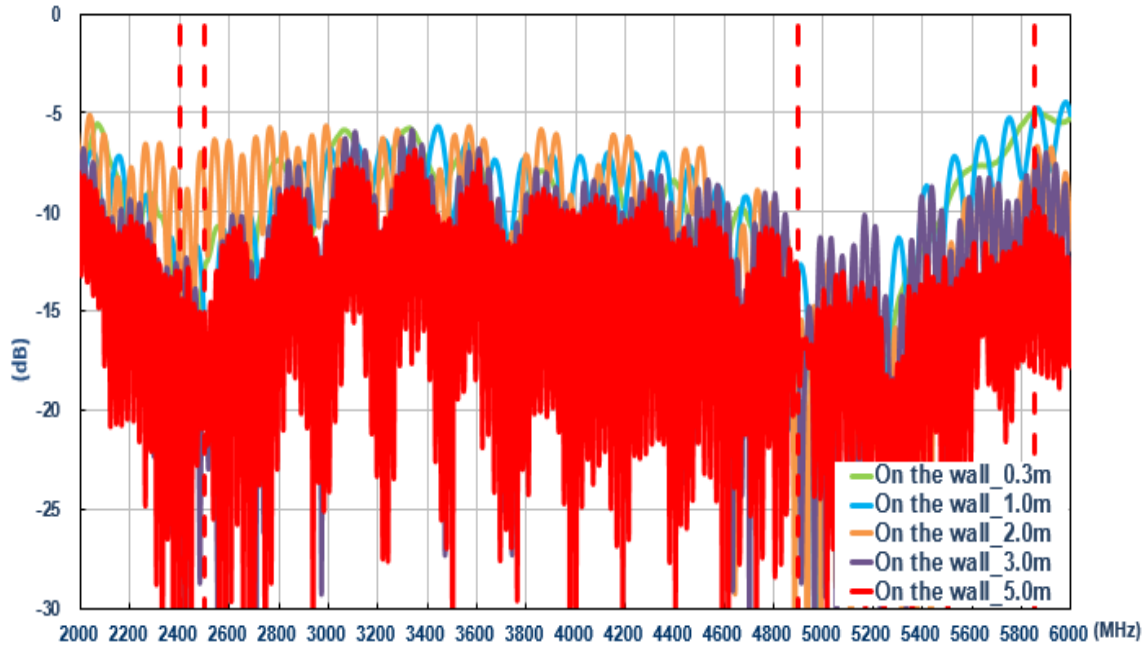


6.1.9 Peak Gain (LTE_MIMO_2)

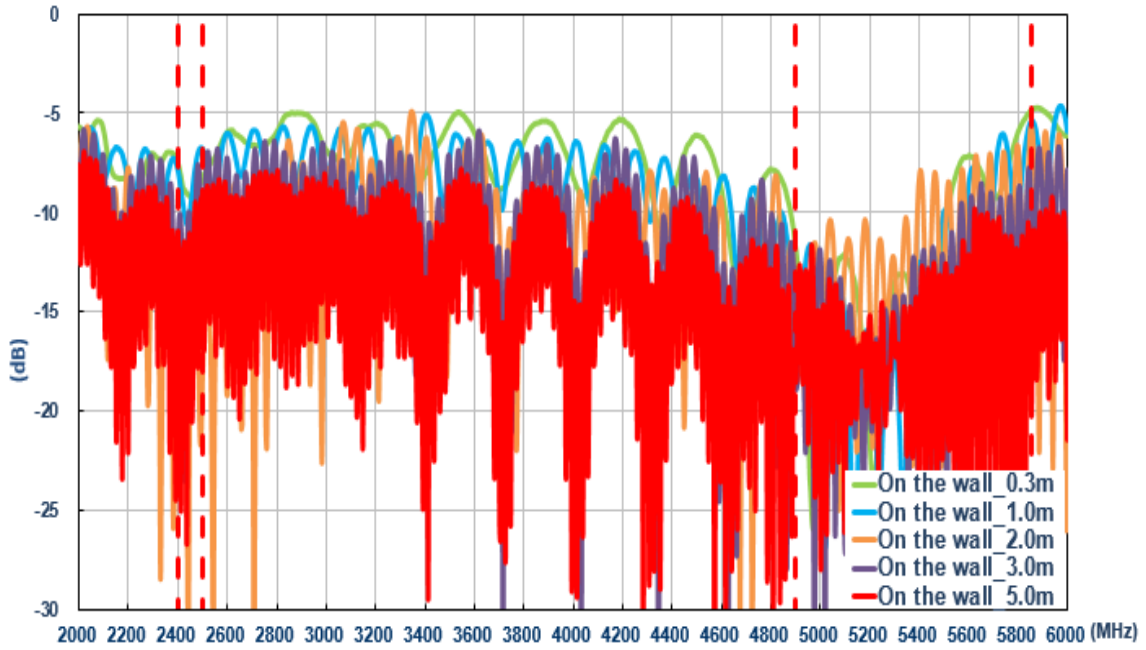


6.10 On the wall (Wi-Fi)

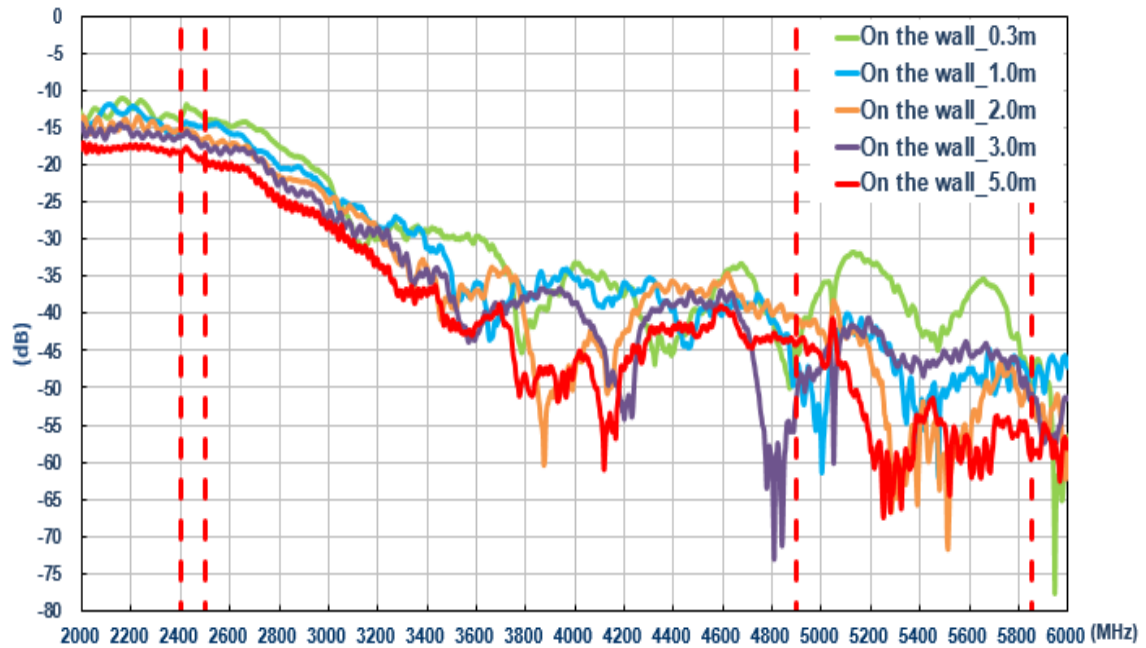
6.10.1 Return Loss (Wi-Fi_MIMO_1)



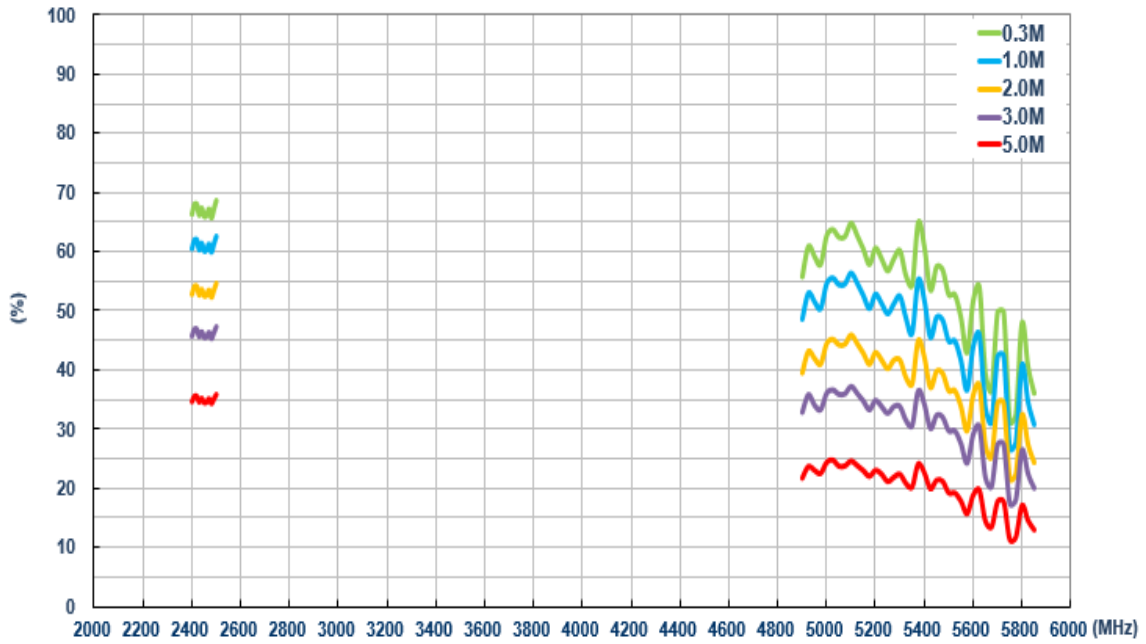
6.10.2 Return Loss (Wi-Fi_MIMO_2)



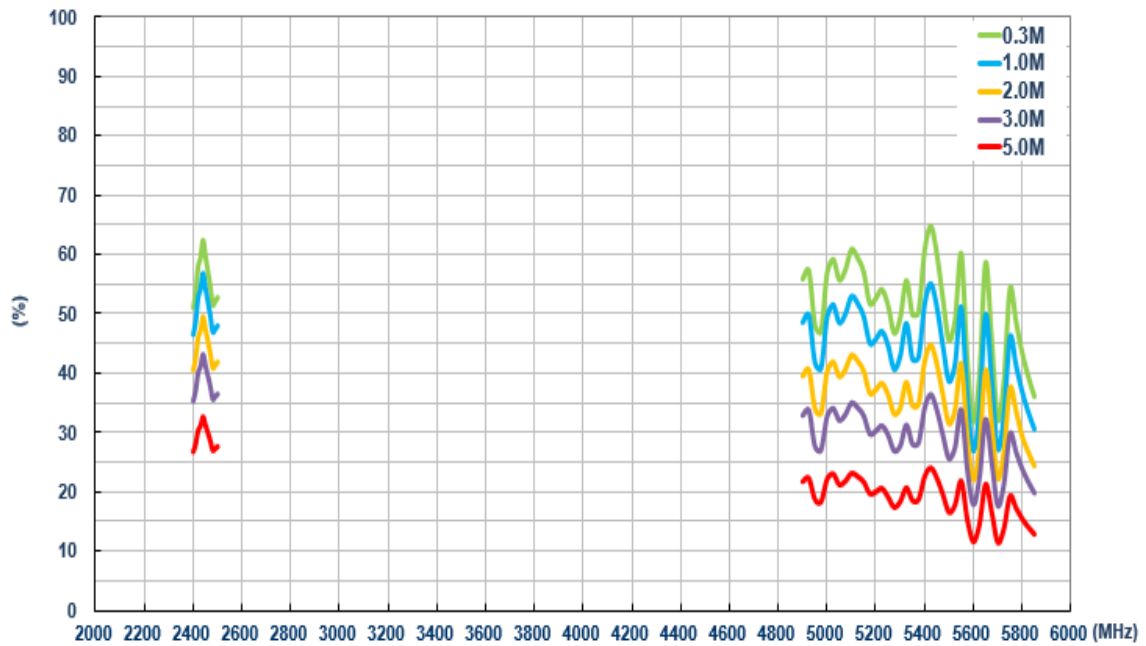
6.10.3 Isolation (Wi-Fi)



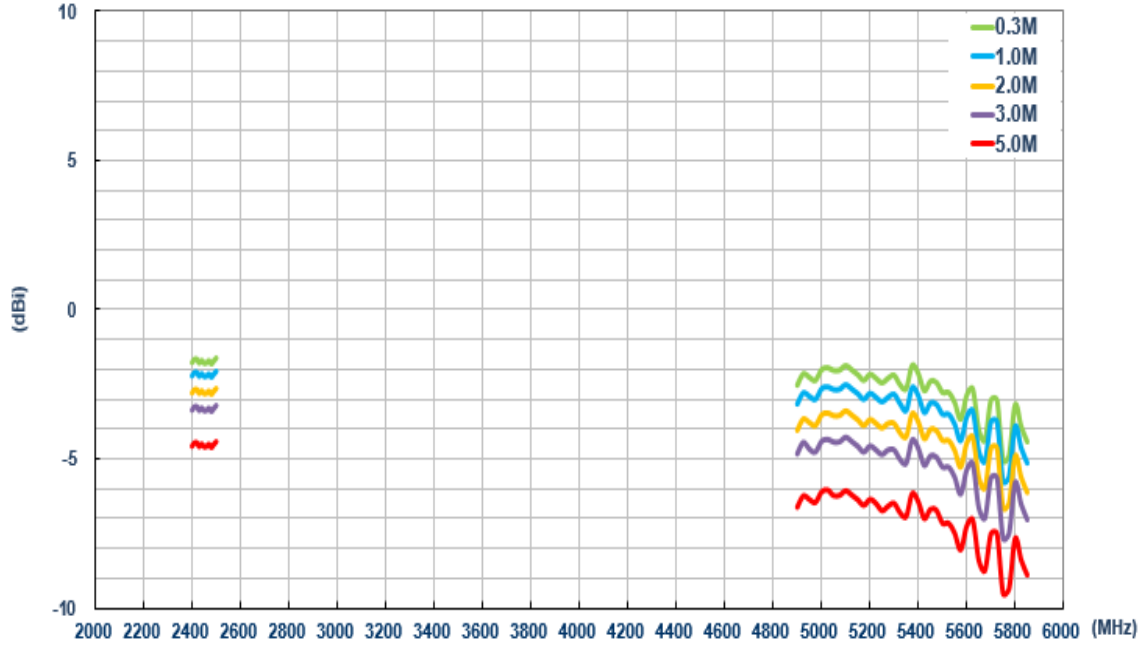
6.10.4 Efficiency (Wi-Fi_MIMO_1)



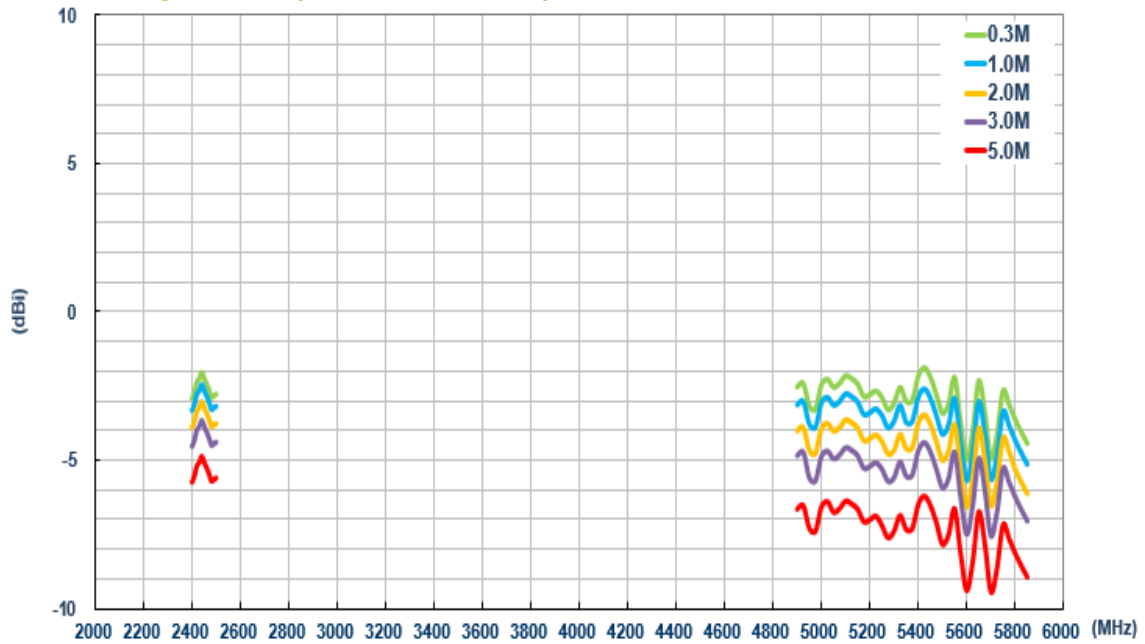
6.10.5 Efficiency (Wi-Fi_MIMO_2)



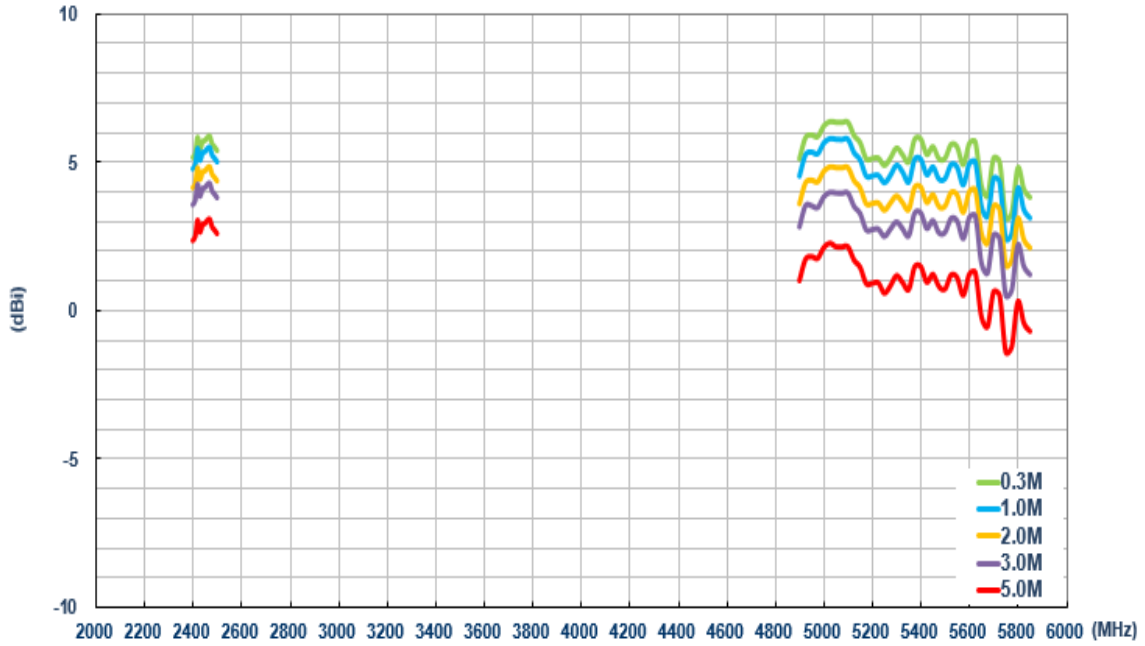
6.10.6 Average Gain (Wi-Fi_MIMO_1)



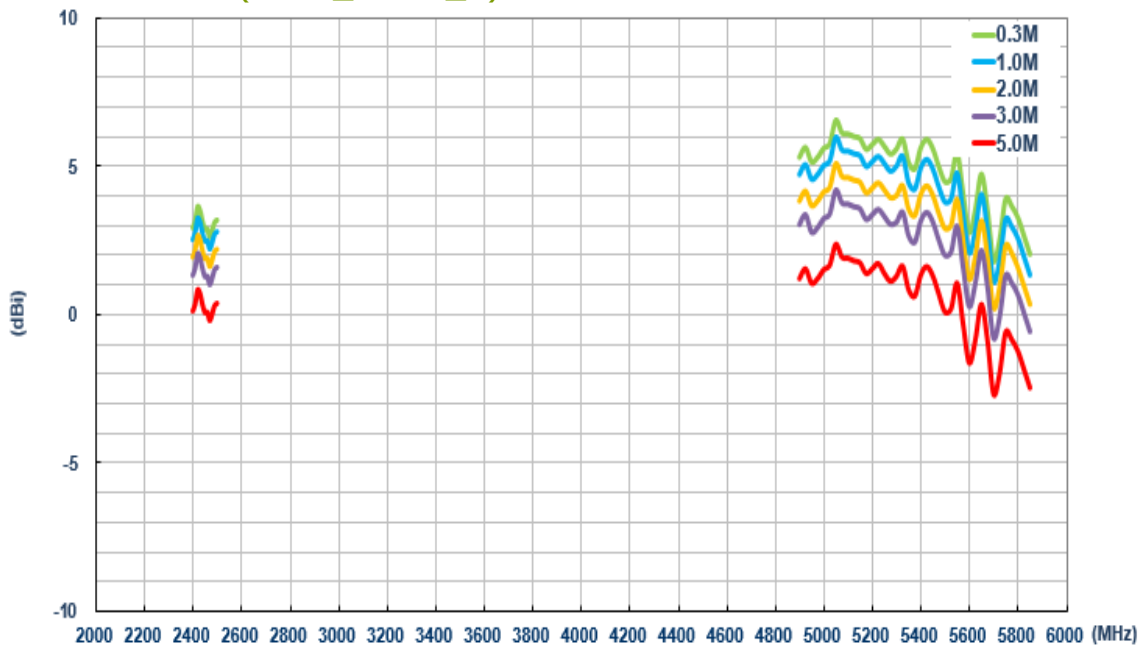
6.10.7 Average Gain (Wi-Fi_MIMO_2)



6.10.8 Peak Gain (Wi-Fi_MIMO_1)



6.10.9 Peak Gain (Wi-Fi_MIMO_2)



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