



Synergy 5-in-1 Antenna

Part No:
MA1505.AK.001

Description:

- 1*Active GNSS with RG-174 & SMA(M)
- 2*5G/4G MIMO with RG-174 & SMA(M)
- 2*Wi-Fi MIMO with RG-174 & RP-SMA(M)

Features:

- 2 x 5G/4G MIMO Antenna
- 2 x Wi-Fi 2.4GHz/5GHz MIMO Antenna
- 1 x Active GPS/GLONASS/BeiDou Antenna Front End GNSS SAW Filter
- IP67 Rated Waterproof Enclosure
- High Efficiency/Peak Gain Outdoor Antenna
- Cable: 300mm RG-174 with 4700mm TGC-200
- Connectors: SMA(M) / RP-SMA(M)
- RoHS & REACH Compliant

| | |
|-----------------------------------|----|
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Antenna designed and manufactured by Taoglas

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1. Introduction



The Taoglas Synergy MA1505 is a 5-in-1 next-generation permanent mount antenna designed for vehicle roof applications. It has a fully IP67 rated waterproof robust PC enclosure and base. The 5 antennas inside support 5G/4G, GPS/GLONASS/BeiDou, Wi-Fi (2.4GHz/5GHz). This outstanding patent-pending antenna delivers powerful MIMO antenna technology for 5G/4G, Wi-Fi 2.4/5.8GHz 802.11n and the emerging 802.11ac, and an optimized GPS/GLONASS/BeiDou patch antenna for location. The 5G/4G antennas also include backward compatibility to work at most worldwide 2G and 3G bands.

Typical Applications:

- Next Generation OEM Automotive Connectivity
- Multimedia, Navigation and Telematics Systems
- V2V, V2X and Fleet Management Applications
- Real-time HD Video Streaming
- First Net Responder Routers

The MA1505 is ideal for applications that require highly sophisticated antennas for real-time streaming applications that demand high-speed video uplink and downlink into the cabin of the vehicle. These challenges are resolved by the highly efficient, high gain MIMO antennas, with high isolation, all of which is necessary to achieve the required signal to noise ratio and throughput.

The MA1505 can also be customized for your particular wireless application and frequency band, subject to NRE and MOQ. There are 4 x RG-174 cables, terminating in SMA(M) connectors for 5G/4G MIMO 2X2, and RP SMA(M) for Wi-Fi MIMO 2X2. There is an RG-174 cable for GNSS terminating in an SMA(M) connector.

All cable lengths and connector types are fully customizable. The Synergy MA1505 can be supplied with low loss TGC-200 cable extensions for longer cable runs. Contact your regional Taoglas customer support team for more information.

2. Specifications

| GNSS Frequency Bands Covered | | | | | | | |
|------------------------------|-------------------------------|---------------------------|------------------|--------------------|------------------|---------------|------------------|
| GPS/QZSS | L1 1575.42MHz | L2 1227.6MHz | L5 1176.45MHz | L6 1278.75MHz | | | |
| | ■ | □ | □ | □ | | | |
| GLONASS | L5R 1176.45MHz | L3PT 1201.5MHz | L2PT 1246MHz | L1CR 1575.42MHz | L1PT 1602MHz | | |
| | □ | □ | □ | ■ | ■ | | |
| Galileo | E5a 1176.45MHz | E5b 1201.5MHz | E4 1215MHz | E3 1256MHz | E6 1278.75MHz | E2 1561MHz | L1 1575.42MHz |
| | □ | □ | □ | □ | □ | ■ | ■ |
| BeiDou | B1 1561MHz | B2 1207.14MHz | B3 1268.52MHz | | | | |
| | ■ | □ | □ | | | | |
| Compass | E5B(B2)/ E6(B3) 1268.56MHz | E2(B1) 1561MHz | | | | | |
| | □ | ■ | | | | | |
| SBAS | Omnistar 1542.5MHz | WAAS/EGN OS 1575.42MHz | | | | | |
| | □ | ■ | | | | | |

| GNSS Electrical | | | |
|---|--------|---------|-------|
| Frequency (MHz) | 1561 | 1575.42 | 1602 |
| VSWR (max.) | 2.5 | 2.5 | 2.5 |
| Passive Antenna Efficiency (%) (Without cable loss) | 40.02 | 48.39 | 44.29 |
| Passive Antenna Gain at Zenith (dBic) (Without cable loss) | 3.75 | 4.44 | 4.54 |
| Axial Ratio (dB) | 20 | 11 | 15 |
| Polarization | RHCP | | |
| Impedance | 50Ω | | |
| Cable | RG-174 | | |
| Connector | SMA(M) | | |

| LNA and Filter Electrical Properties | | | |
|--|-------------|----------------|-------------|
| Frequency (MHz) | 1561 | 1575.42 | 1602 |
| VSWR (max.) | 2.0:1 | 2.0:1 | 2.0:1 |
| Gain@1.8V (dBic) | 28.8 dB | 28.8 dB | 28 dB |
| Gain@3.0V (dBic) | 29 dB | 29 dB | 28.3 dB |
| Gain@5.5V (dBic) | 29.6 dB | 29.4 dB | 28.7 dB |
| Noise@1.8V (dB) | 2.8 dB | 2.3 dB | 2.8 dB |
| Noise@3.0V (dB) | 2.8 dB | 2.2 dB | 2.8 dB |
| Noise@5.5V (dB) | 2.9 dB | 2.3 dB | 2.8 dB |
| Power consumption@1.8V (mA) | 8.7 mA | | |
| Power consumption@3.0V (mA) | 9.0 mA | | |
| Power consumption@5.5V (mA) | 11 mA | | |
| Total Specification (Through Antenna, SAW Filter and LNA) | | | |
| Frequency (MHz) | 1561 | 1575.42 | 1602 |
| Gain@3V (dBic) | 31.7 ± 3 | 32.4 ± 3 | 32.4 ± 3 |
| Output Impedance | 50Ω | | |

| 5G/4G Antenna | | | | | | | | | |
|--|-----------------|--------|----------------|-------------------|-----------------|-----------|-----------------|--------------|-------------------|
| Band | Frequency (MHz) | | Efficiency (%) | Average Gain (dB) | Peak Gain (dBi) | Impedance | Max Input Power | Polarization | Radiation Pattern |
| 5G NR/4G Band 71 | 617~698 | MIMO 1 | 30.79 | -5.12 | -0.08 | 50 Ω | 2W | Linear | Omni |
| | | MIMO 2 | 18.62 | -7.30 | -0.58 | | | | |
| 4G/3G Band 12,13,14,17,28,29 | 698~806 | MIMO 1 | 30.39 | -5.17 | 1.04 | | | | |
| | | MIMO 2 | 31.96 | -4.95 | 0.49 | | | | |
| 4G/3G/NB-IoT/Cat M Band 5,8,18,19,20,26,27 | 824~960 | MIMO 1 | 34.96 | -4.56 | 2.03 | | | | |
| | | MIMO 2 | 30.24 | -5.19 | 1.42 | | | | |
| 5G NR/4G Band 21,32,74,75,76 | 1427~1518 | MIMO 1 | 39.48 | -4.04 | 2.94 | | | | |
| | | MIMO 2 | 43.80 | -3.59 | 3.76 | | | | |
| 4G/3G Band 1,2,3,4,9,23,25,35,39,66 | 1710~2200 | MIMO 1 | 46.48 | -3.33 | 4.55 | | | | |
| | | MIMO 2 | 42.07 | -3.76 | 3.31 | | | | |
| 4G/3G Band 7,30,38,40,41 | 2300~2690 | MIMO 1 | 43.45 | -3.62 | 4.96 | | | | |
| | | MIMO 2 | 44.95 | -3.47 | 4.84 | | | | |
| 5G NR/4G Band 22,42,48,77,78,79 | 3300~4200 | MIMO 1 | 49.25 | -3.08 | 5.82 | | | | |
| | | MIMO 2 | 31.36 | -5.04 | 3.77 | | | | |
| LTE5200/ Wi-Fi 5800 | 5150~5925 | MIMO 1 | 49.39 | -3.06 | 5.90 | | | | |
| | | MIMO 2 | 44.49 | -3.52 | 5.89 | | | | |

Wi-Fi MIMO

| Frequency (MHz) | | Efficiency (%) | Average Gain (dB) | Peak Gain (dBi) | Impedance | Max Input Power | Polarization | Radiation Pattern |
|-----------------|--------|----------------|-------------------|-----------------|-----------|-----------------|--------------|-------------------|
| 2400~2500 | MIMO 1 | 47.59 | -3.22 | 1.40 | 50 Ω | 2W | Linear | Omni |
| | MIMO 2 | 32.75 | -4.85 | 1.37 | | | | |
| 5150~5850 | MIMO 1 | 47.92 | -3.19 | 2.33 | | | | |
| | MIMO 2 | 39.08 | -4.08 | 2.55 | | | | |

Mechanical

| | |
|-------------------|--|
| Height | 57.47mm |
| Planner Dimension | Ø160mm |
| Casing | PC |
| Cable | 0.3m RG-174 with 4.7m TGC-200 for 5G/4G – Fully Customizable 0.3m RG-174 with 4.7m TGC-200 for Wi-Fi – Fully Customizable 0.3m RG174 with 4.7m TGC-200 for GNSS – Fully Customizable |
| Connector | 5G/4G: SMA-Plug – Fully Customizable Wi-Fi: RP-SMA-Plug – Fully Customizable GNSS: SMA-Plug – Fully Customizable |
| Thread Diameter | M22 |
| Sealant | Rubber Stopper and O-Ring |
| Weight | 2.1Kg |

Environmental

| | |
|--------------------|----------------------------|
| Ingress Protection | IP67 |
| Temperature Range | -40°C to 85°C |
| Humidity | Non-condensing 65°C 95% RH |
| Cable Pull | RG-174 4 Kg |

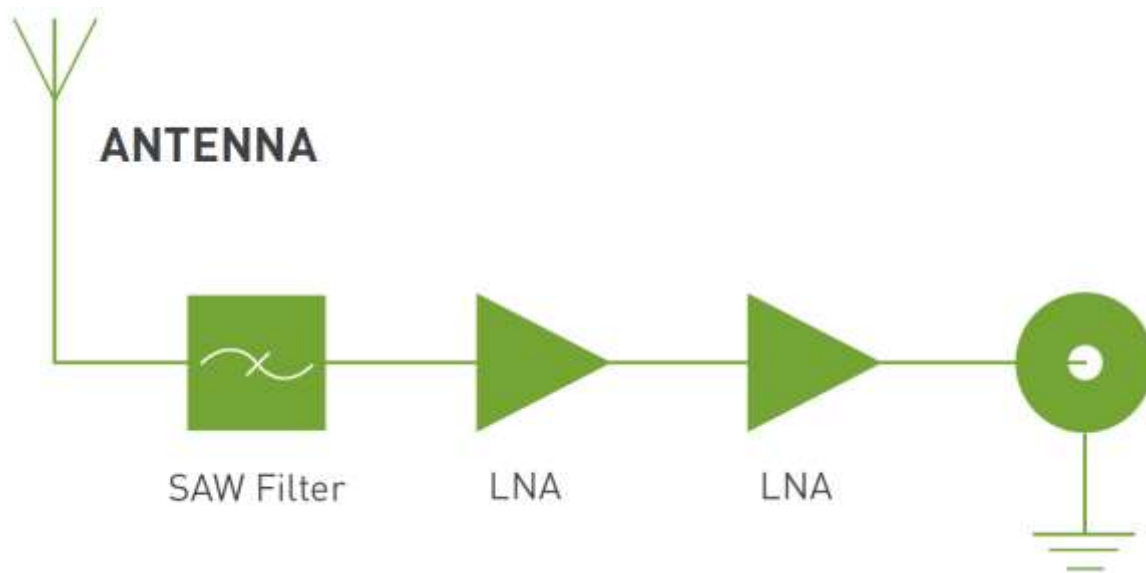
| 5G/4G Bands | | | |
|-------------|--|-------------------------------|---------|
| Band Number | 5G NR / FR1 / LTE / LTE-Advanced / WCDMA / HSPA / HSPA+ / TD-SCDMA | | |
| | Uplink | Downlink | Covered |
| 1 | UL: 1920 to 1980 | DL: 2110 to 2170 | ✓ |
| 2 | UL: 1850 to 1910 | DL: 1930 to 1990 | ✓ |
| 3 | UL: 1710 to 1785 | DL: 1805 to 1880 | ✓ |
| 4 | UL: 1710 to 1755 | DL: 2110 to 2155 | ✓ |
| 5 | UL: 824 to 849 | DL: 869 to 894 | ✓ |
| 7 | UL: 2500 to 2570 | DL: 2620 to 2690 | ✓ |
| 8 | UL: 880 to 915 | DL: 925 to 960 | ✓ |
| 9 | UL: 1749.9 to 1784.9 | DL: 1844.9 to 1879.9 | ✓ |
| 11 | UL: 1427.9 to 1447.9 | DL: 1475.9 to 1495.9 | ✓ |
| 12 | UL: 699 to 716 | DL: 729 to 746 | ✓ |
| 13 | UL: 777 to 787 | DL: 746 to 756 | ✓ |
| 14 | UL: 788 to 798 | DL: 758 to 768 | ✓ |
| 17 | UL: 704 to 716 | DL: 734 to 746 (LTE only) | ✓ |
| 18 | UL: 815 to 830 | DL: 860 to 875 (LTE only) | ✓ |
| 19 | UL: 830 to 845 | DL: 875 to 890 | ✓ |
| 20 | UL: 832 to 862 | DL: 791 to 821 | ✓ |
| 21 | UL: 1447.9 to 1462.9 | DL: 1495.9 to 1510.9 | ✓ |
| 22 | UL: 3410 to 3490 | DL: 3510 to 3590 | ✓ |
| 23 | UL: 2000 to 2020 | DL: 2180 to 2200 (LTE only) | ✓ |
| 24 | UL: 1625.5 to 1660.5 | DL: 1525 to 1559 (LTE only) | ✓ |
| 25 | UL: 1850 to 1915 | DL: 1930 to 1995 | ✓ |
| 26 | UL: 814 to 849 | DL: 859 to 894 | ✓ |
| 27 | UL: 807 to 824 | DL: 852 to 869 (LTE only) | ✓ |
| 28 | UL: 703 to 748 | DL: 758 to 803 (LTE only) | ✓ |
| 29 | UL: - | DL: 717 to 728 (LTE only) | ✓ |
| 30 | UL: 2305 to 2315 | DL: 2350 to 2360 (LTE only) | ✓ |
| 31 | UL: 452.5 to 457.5 | DL: 462.5 to 467.5 (LTE only) | ✗ |
| 32 | UL: - | DL: 1452 - 1496 | ✓ |
| 35 | | 1850 to 1910 | ✓ |
| 38 | | 2570 to 2620 | ✓ |
| 39 | | 1880 to 1920 | ✓ |
| 40 | | 2300 to 2400 | ✓ |
| 41 | | 2496 to 2690 | ✓ |
| 42 | | 3400 to 3600 | ✓ |
| 43 | | 3600 to 3800 | ✓ |
| 48 | | 3550 to 3700 | ✓ |
| 66 | UL: 1710-1780 | DL: 2110-2200 | ✓ |
| 71 | | 617 to 698 | ✓ |
| 74/75/76 | | 1427 to 1518 | ✓ |
| 78 | | 3300 to 3800 | ✓ |
| 79 | | 4400 to 5000 | ✓ |

* Covered Bands represent greater than 20% efficiency

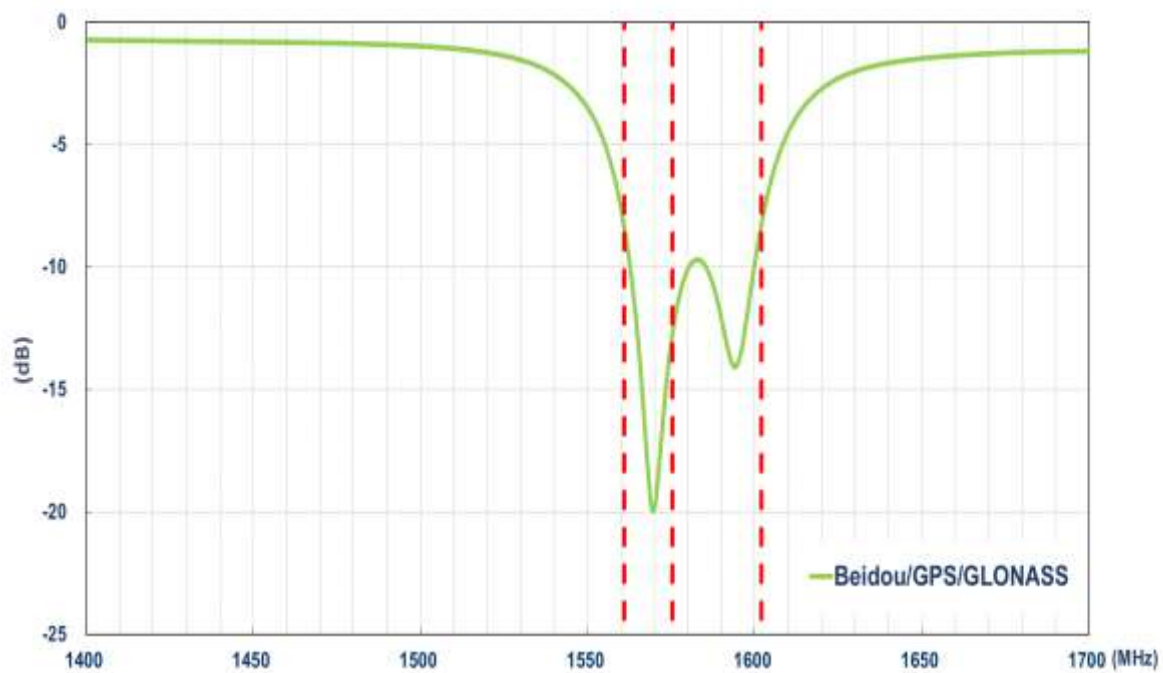
*Measured with 5m cable

3. Active Antenna Characteristics

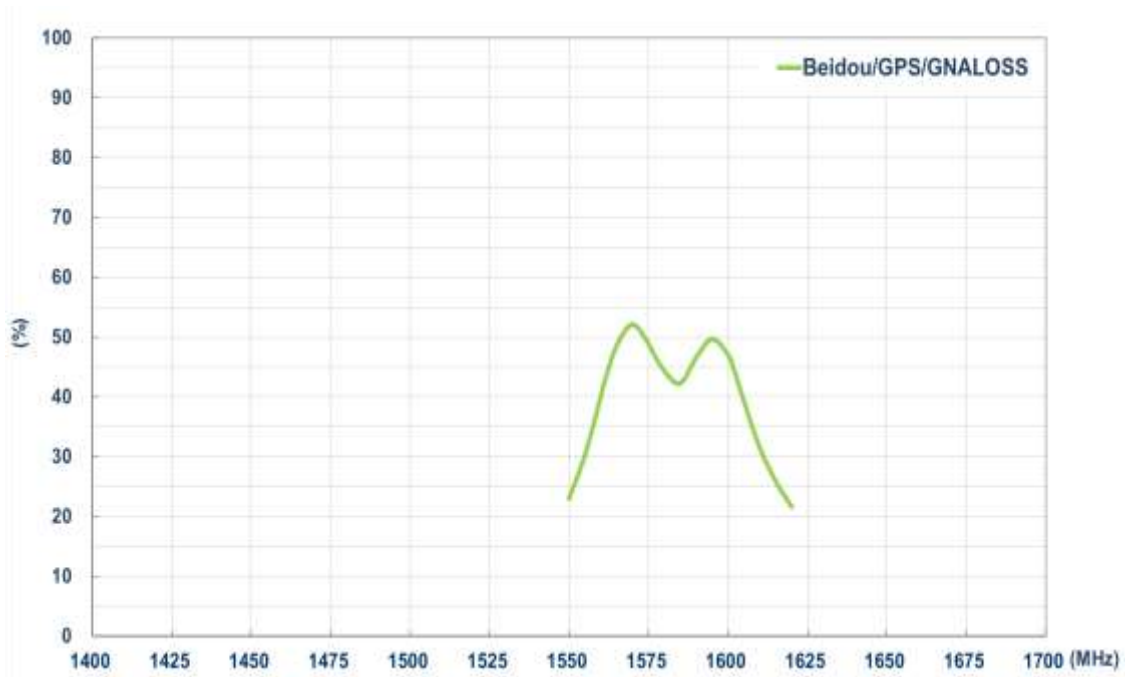
3.1 Block Diagram (Active antenna)



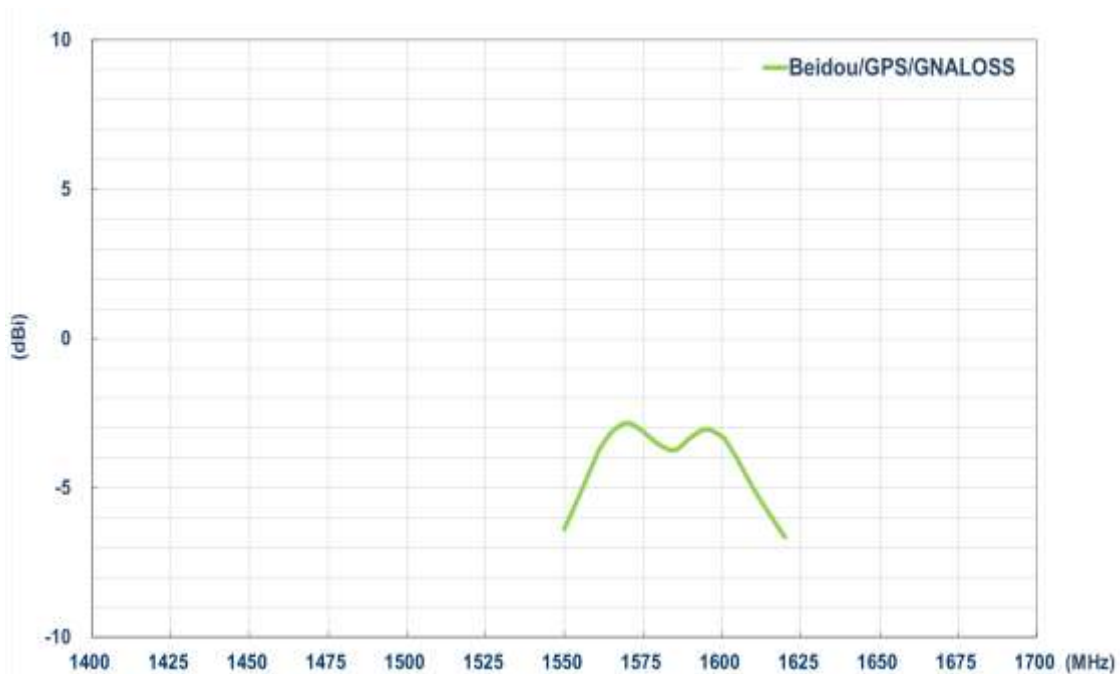
3.2 Passive Antenna Return Loss



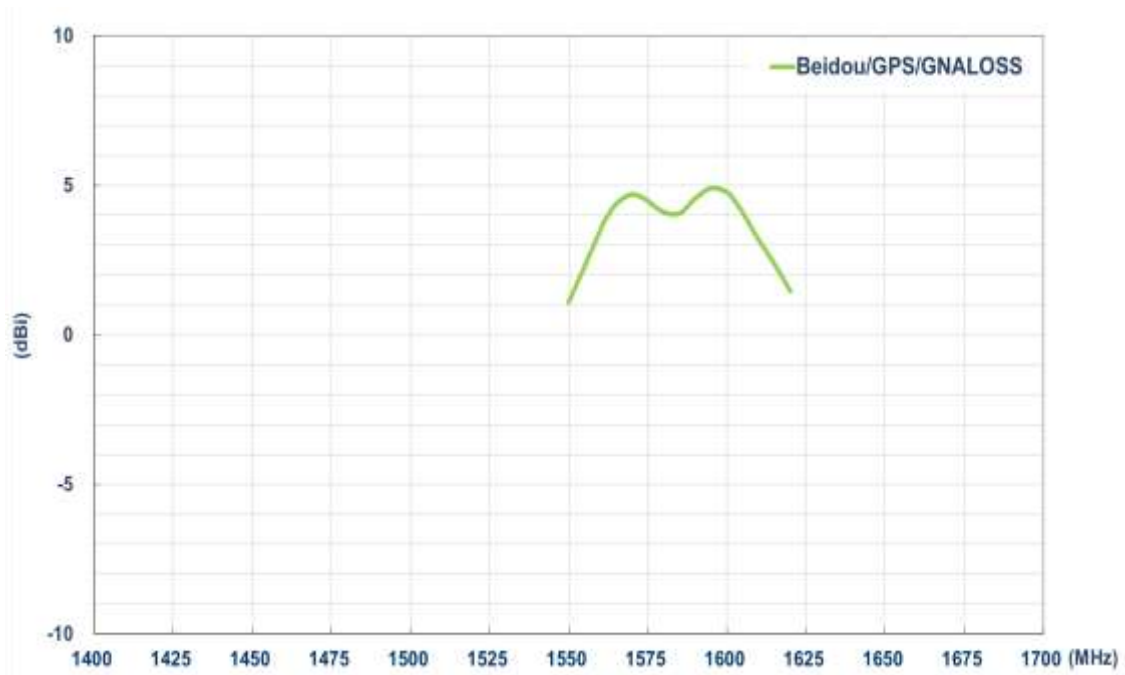
3.3 Passive Antenna Efficiency



3.4 Passive Antenna Average Gain

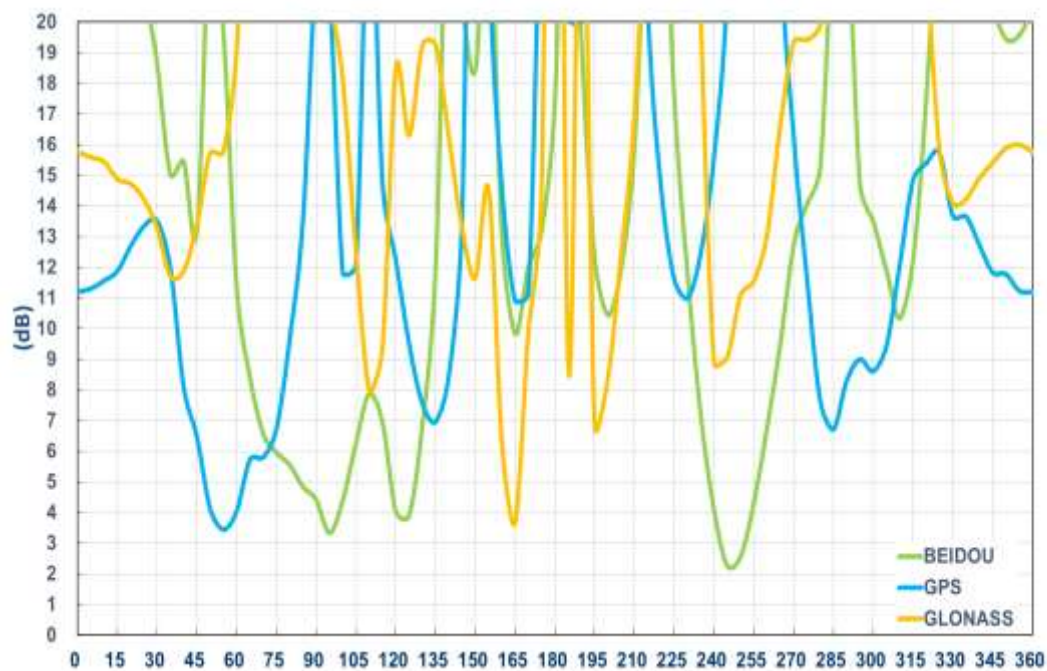


3.5 Passive Antenna Peak Gain

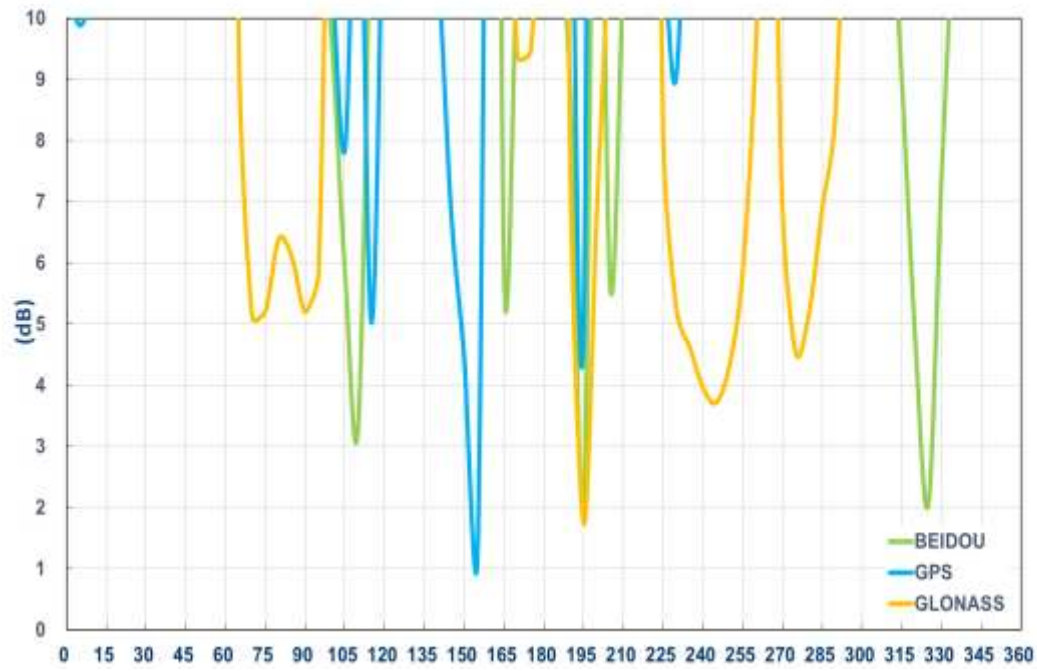


3.6 Passive Antenna Axial Ratio (Zenith is at 0°)

XZ-plane

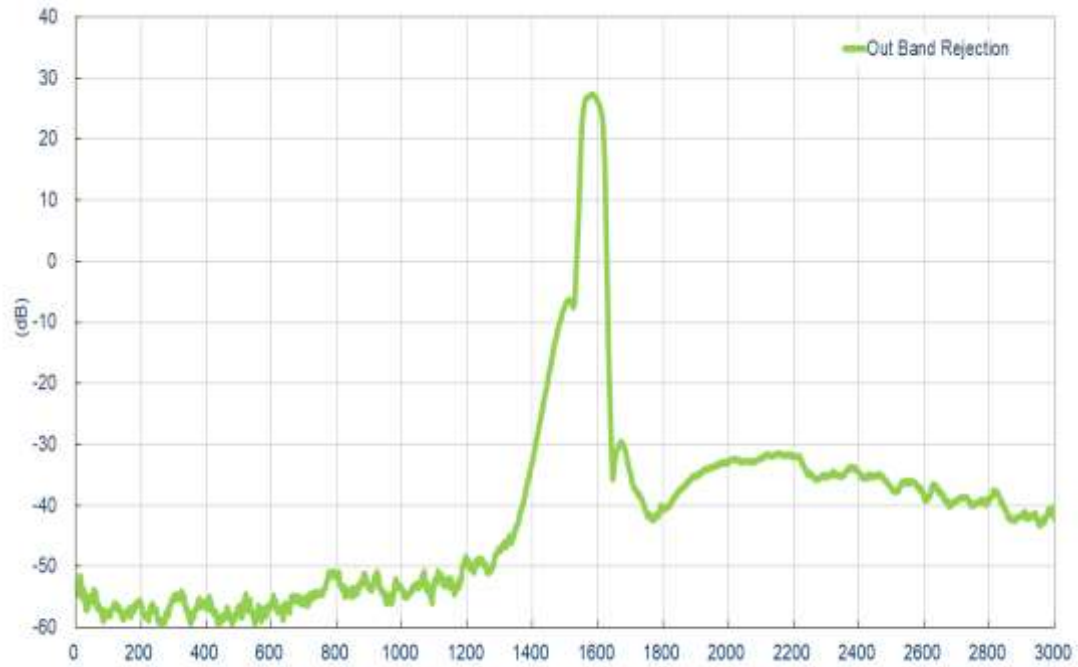


YZ-plane

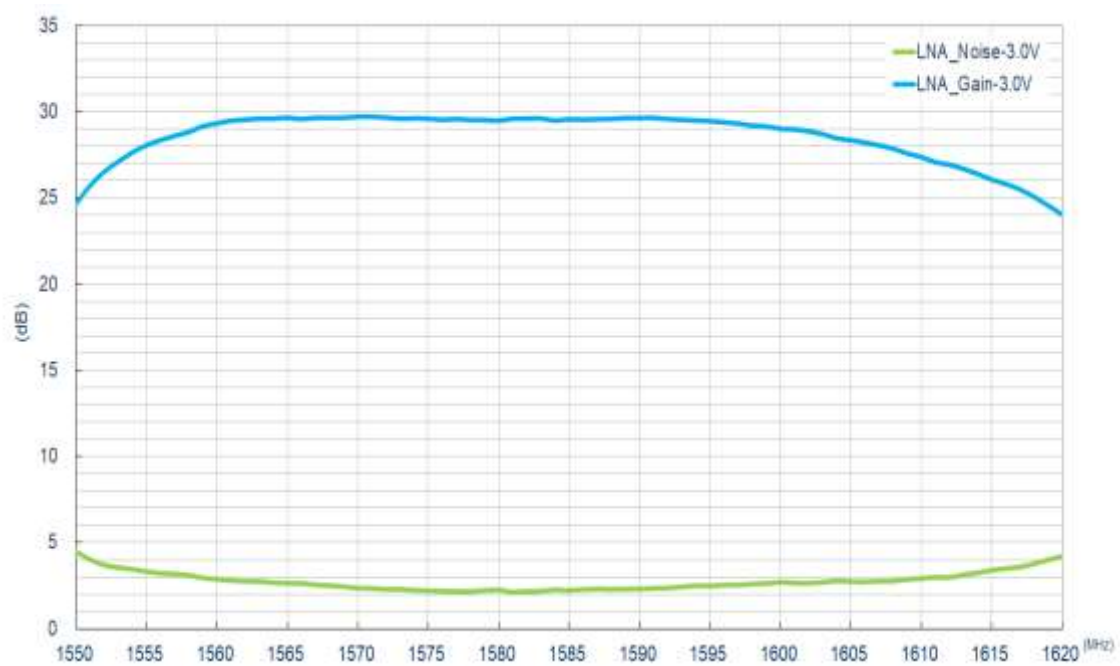


3.7 Active measurements

LNA Gain @ 3.0V

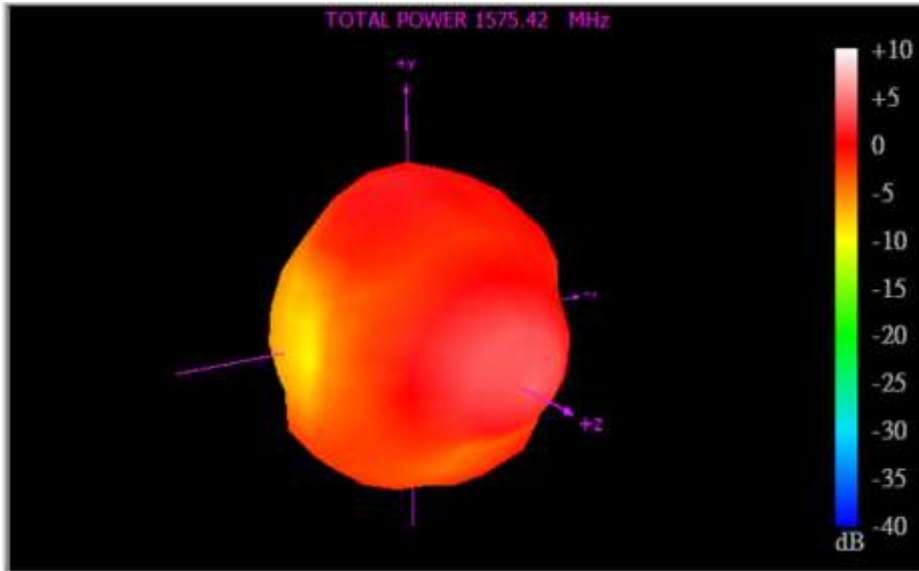


Noise Figure @ 3.0V



3.8 Passive Antenna Radiation Patterns

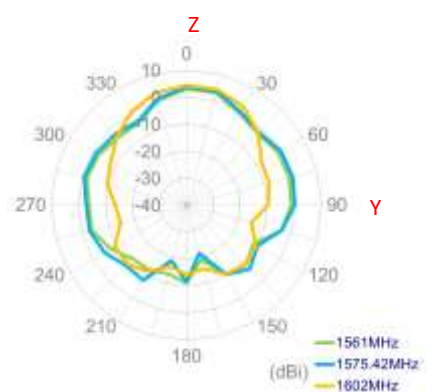
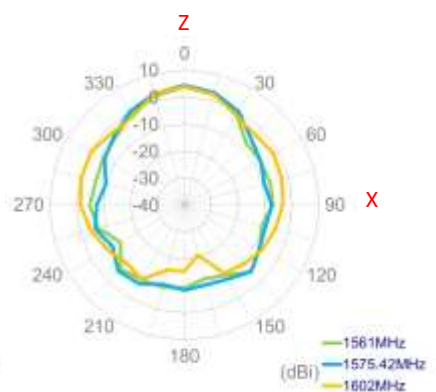
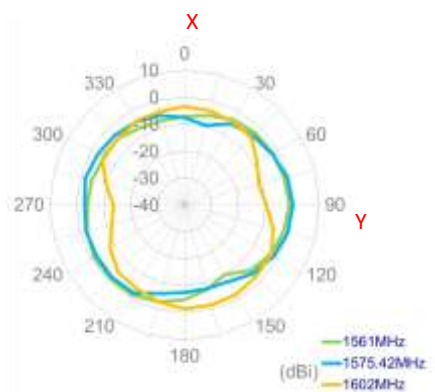
1575.42MHz



XY Plane

XZ Plane

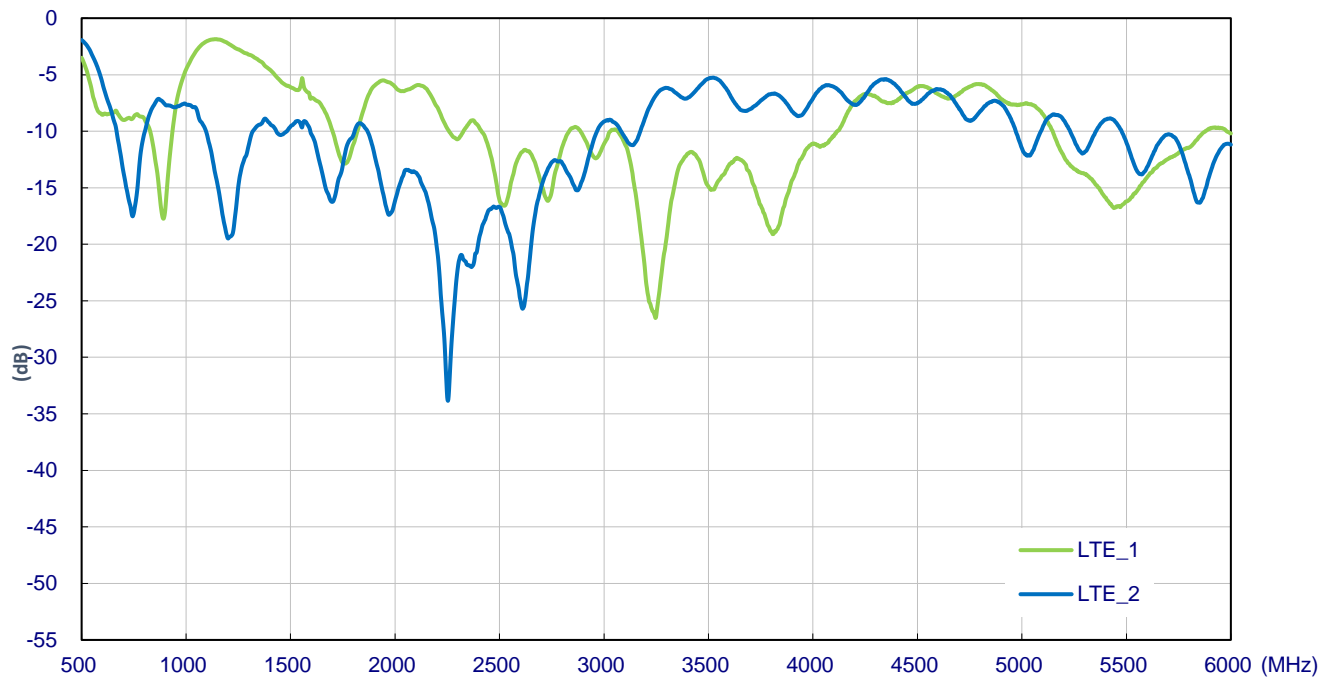
YZ Plane



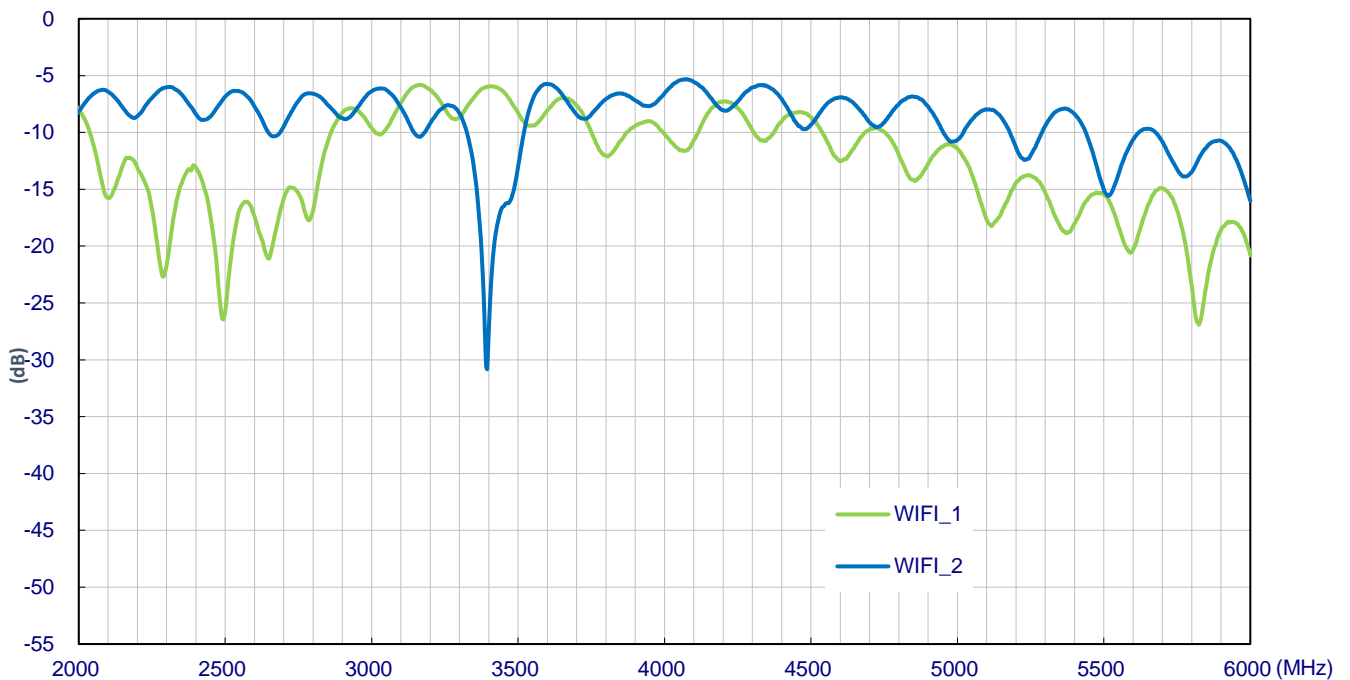
4. Antenna Characteristics

4.1 Return Loss

5G/4G MIMO

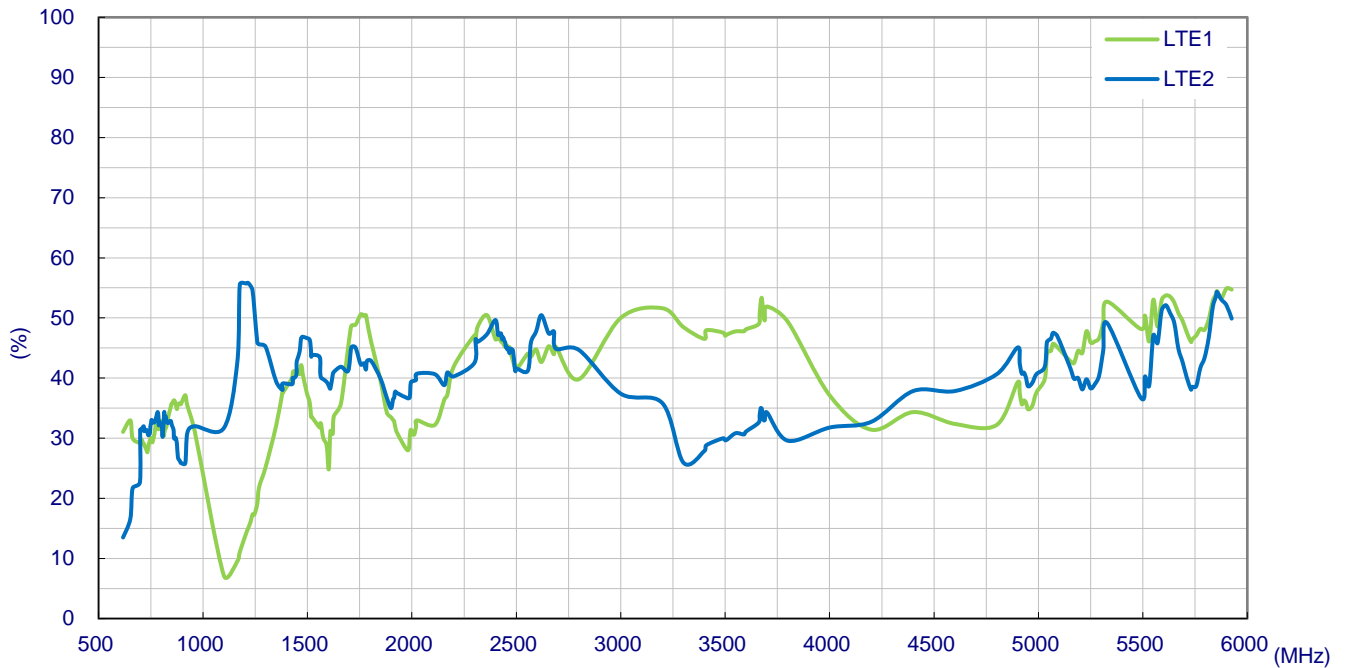


Wi-Fi MIMO

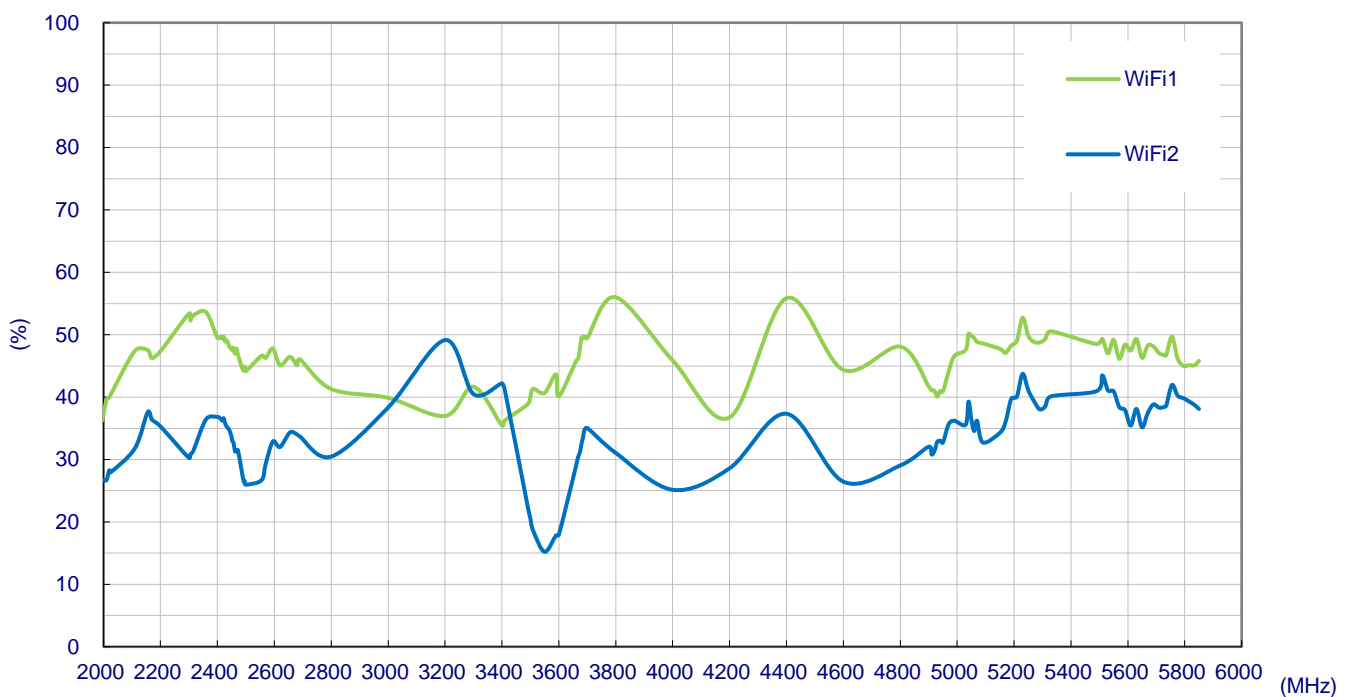


4.2 Efficiency

5G/4G MIMO

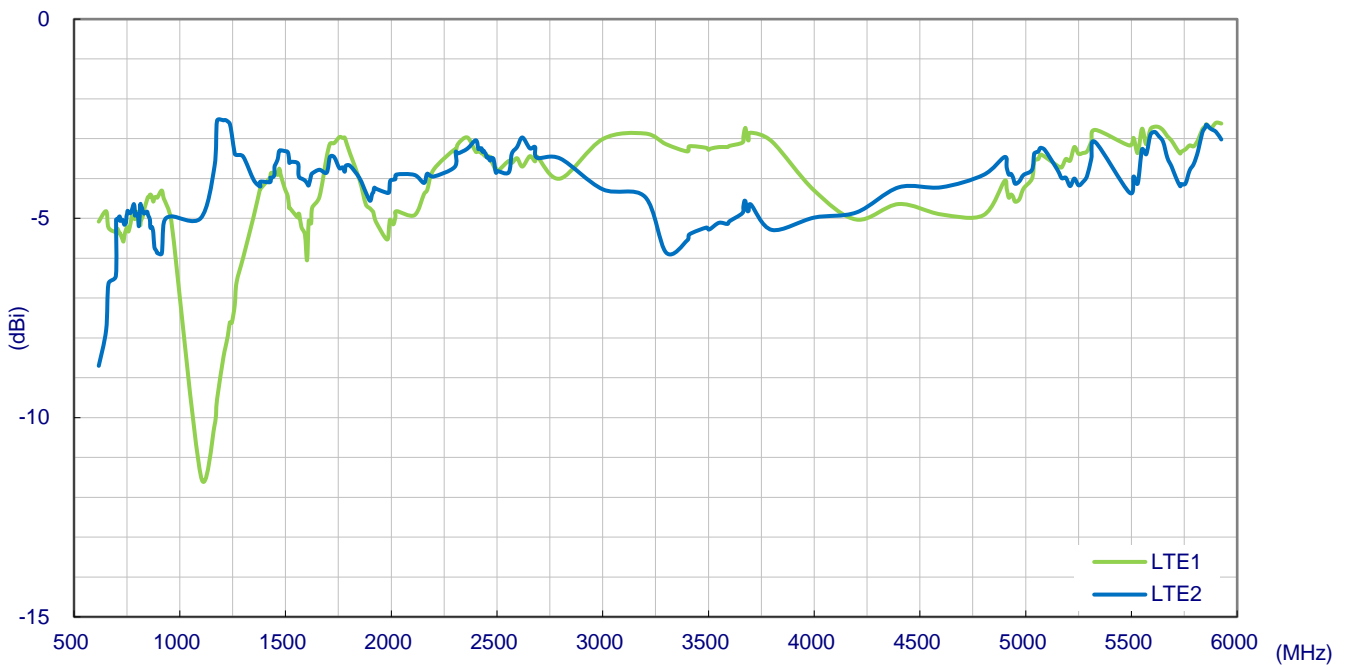


Wi-Fi MIMO

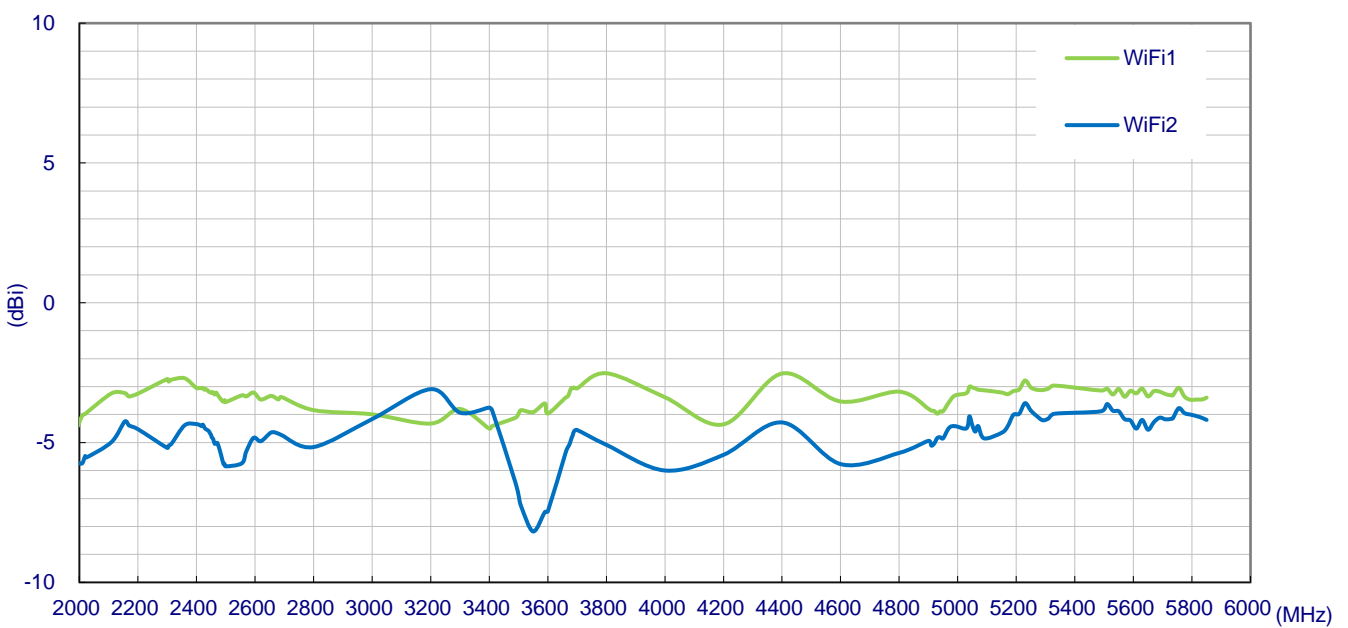


4.3 Average Gain

5G/4G MIMO

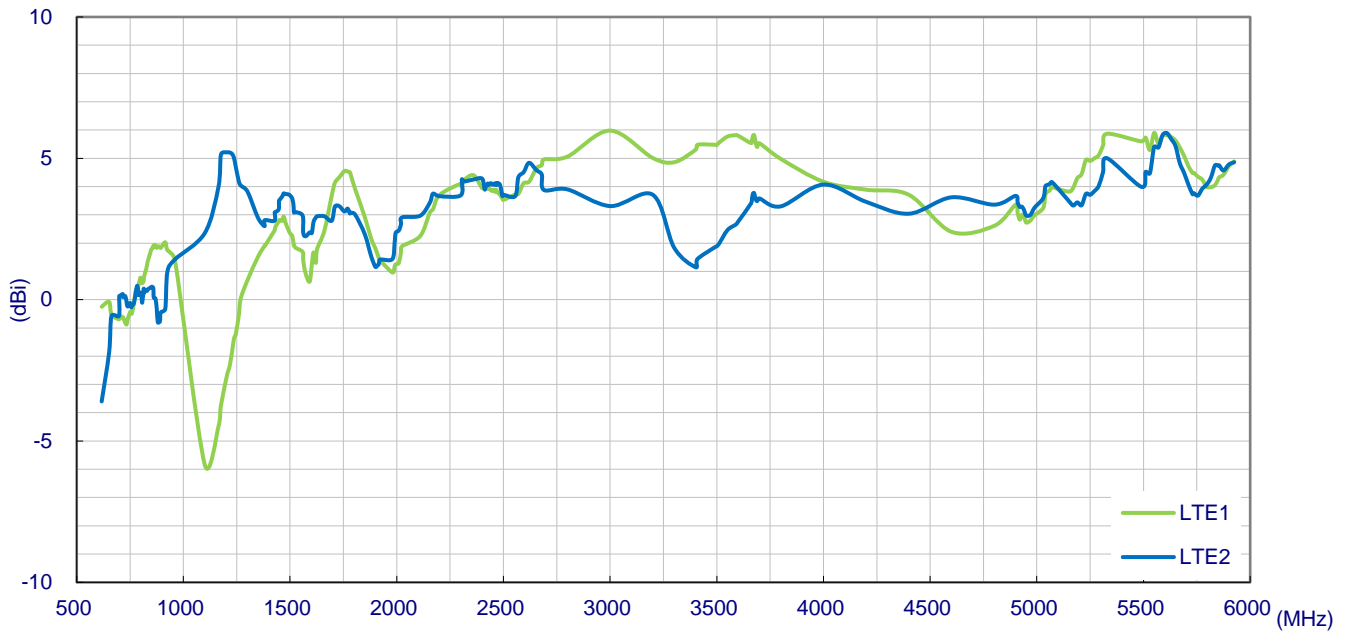


Wi-Fi MIMO

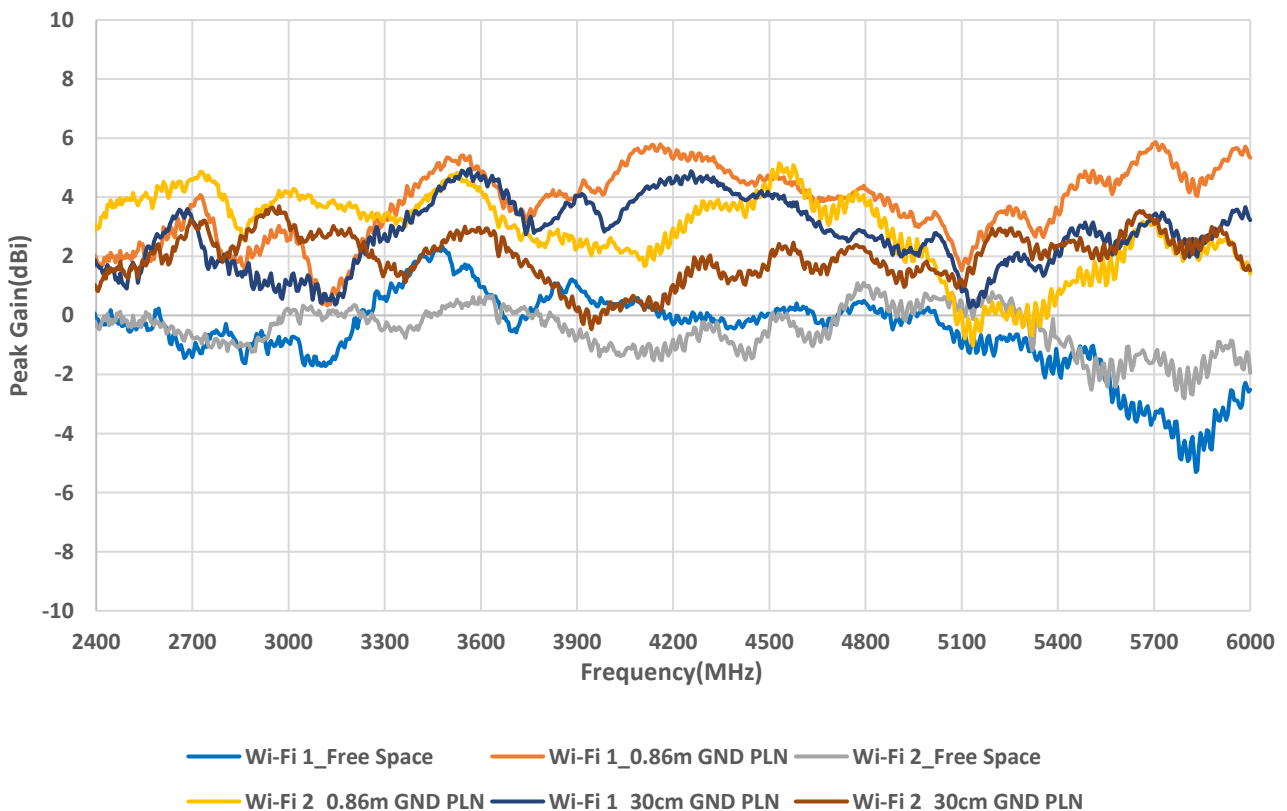


4.4 Peak Gain

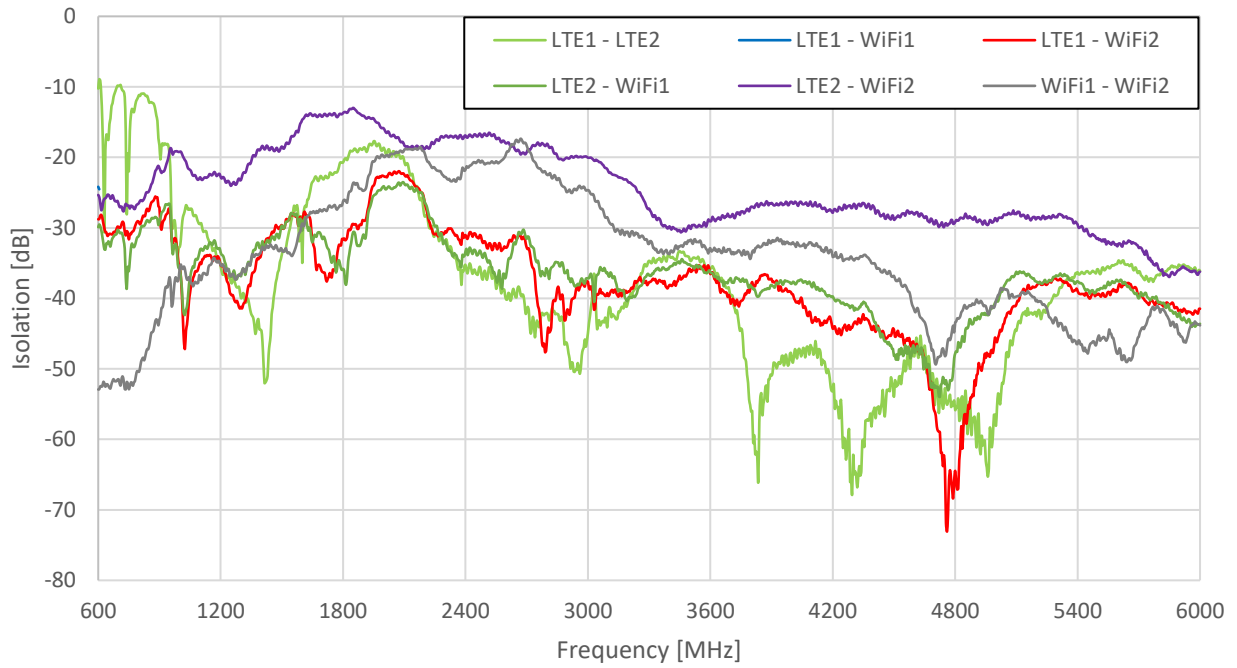
5G/4G MIMO



Wi-Fi MIMO

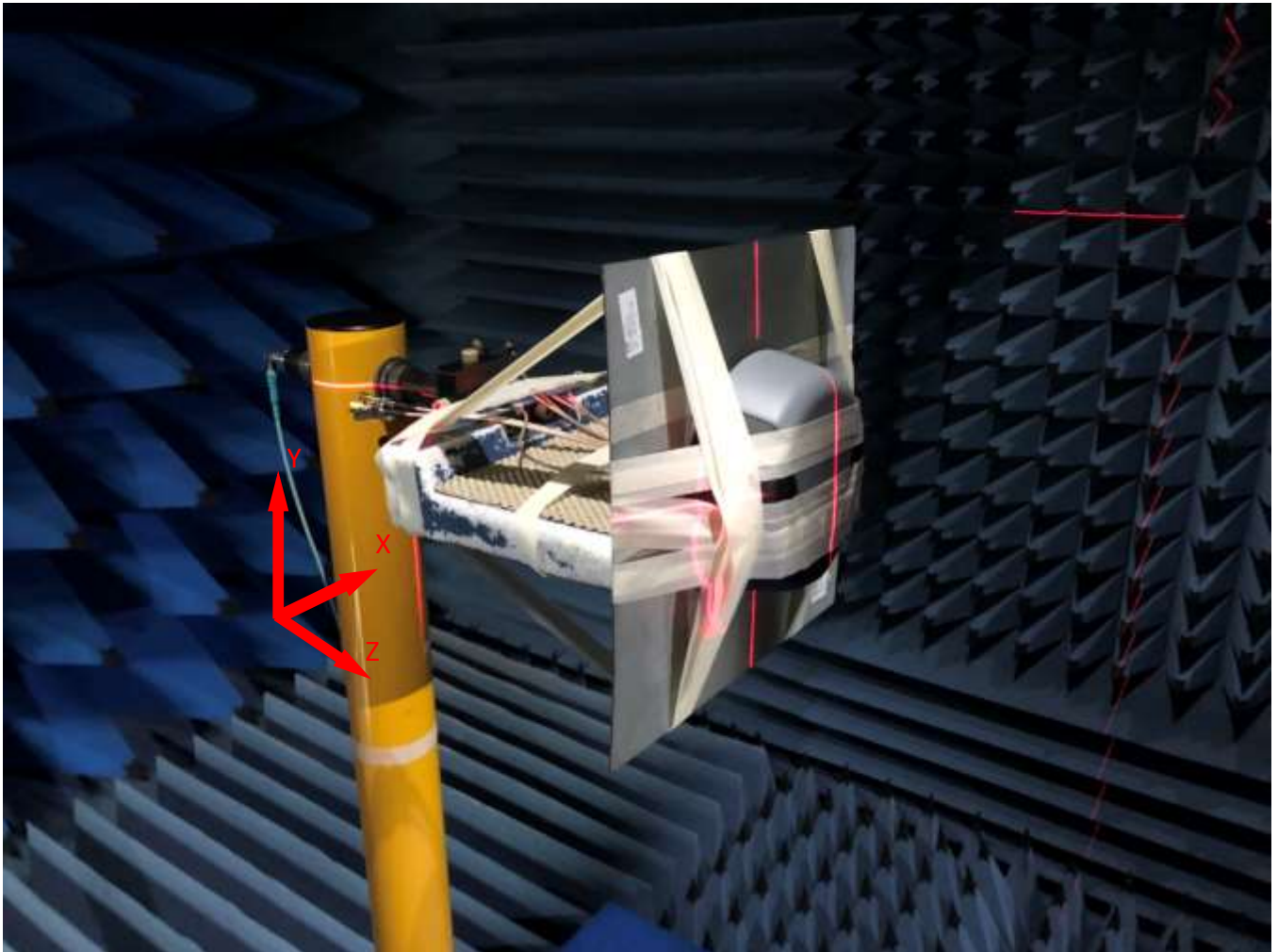


4.5 Isolation



5. Radiation Patterns

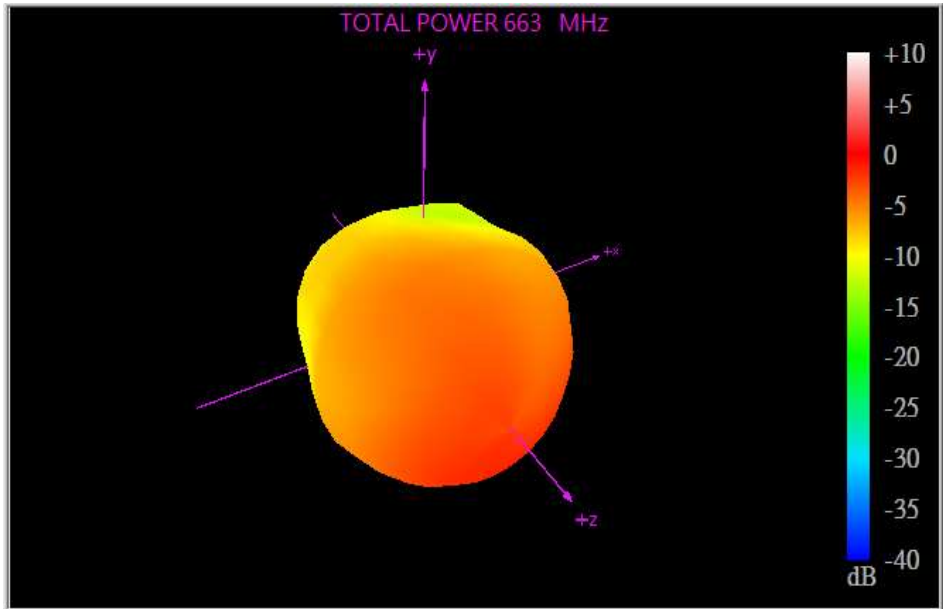
5.1 Test Setup



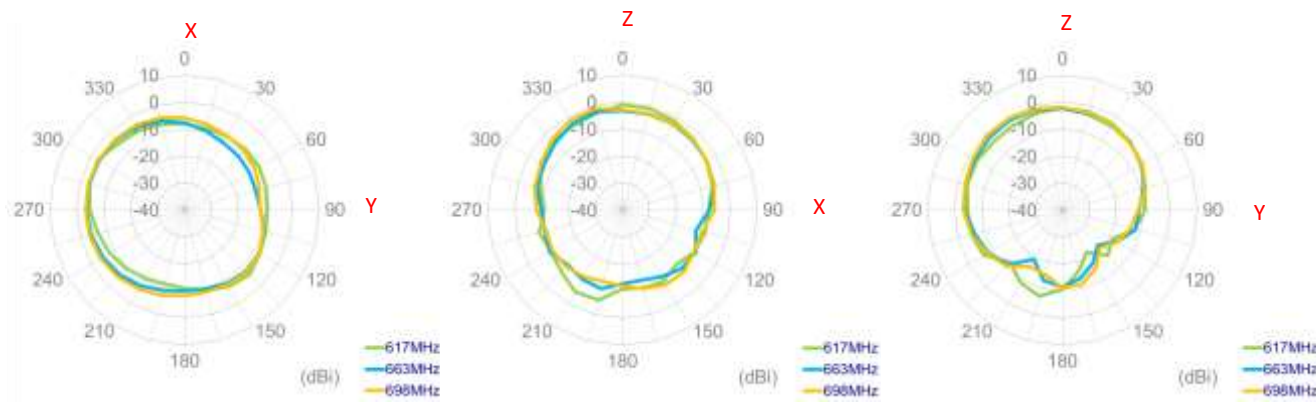
On 30x30cm Ground Plane

5.2 5G/4G MIMO 1 Radiation Pattern

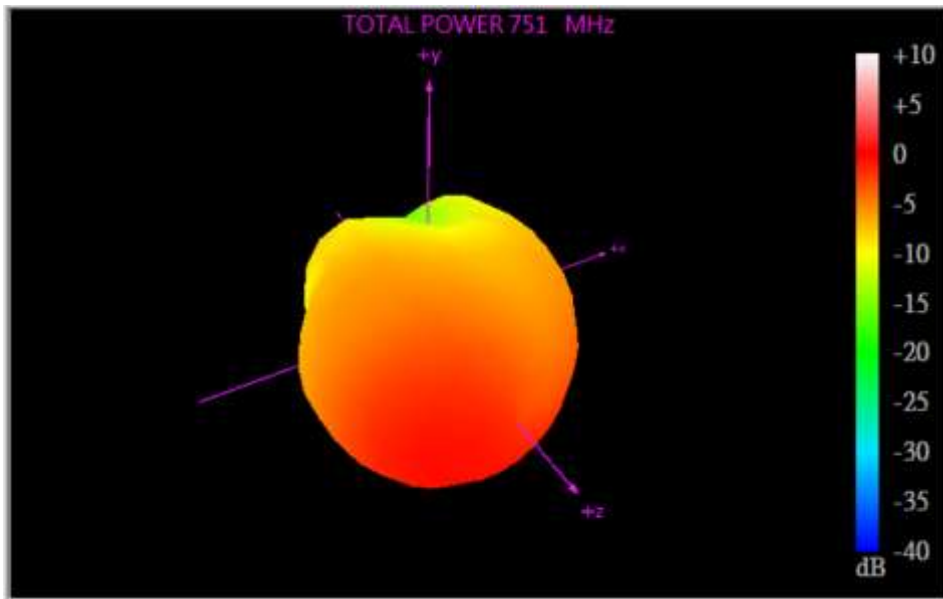
663MHz



XY Plane XZ Plane YZ Plane



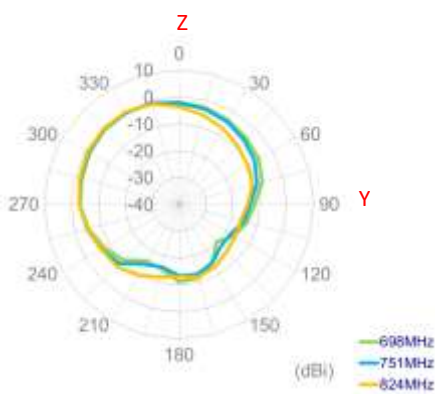
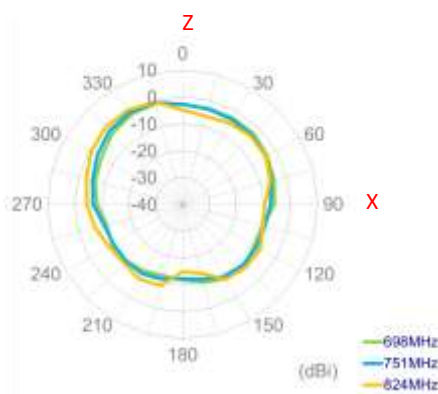
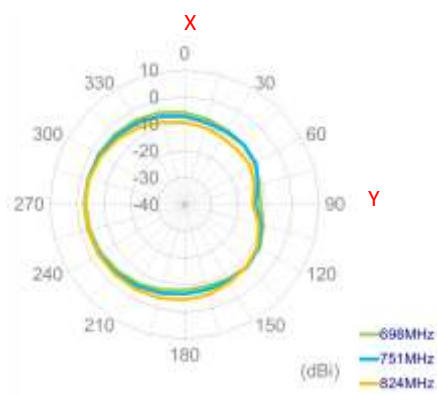
751MHz



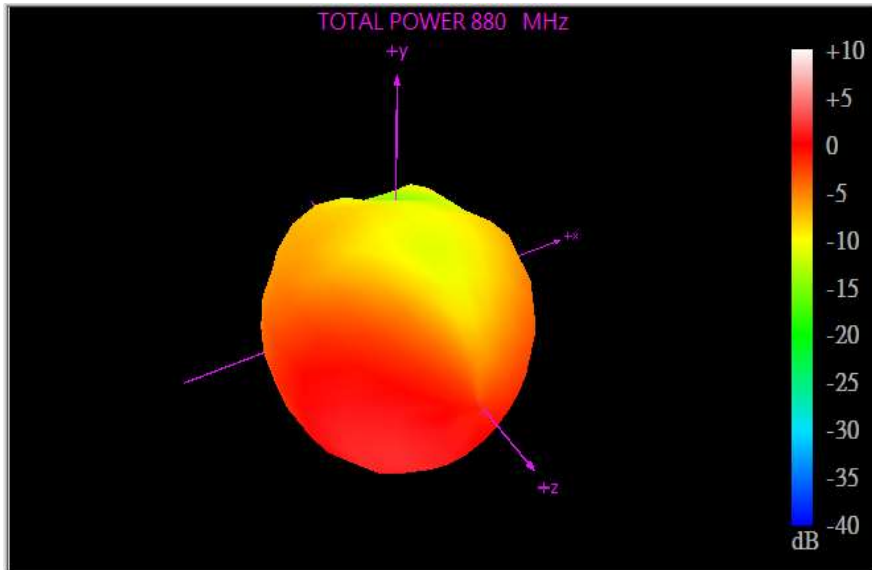
XY Plane

XZ Plane

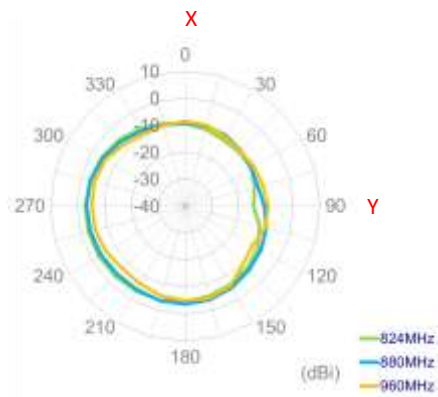
YZ Plane



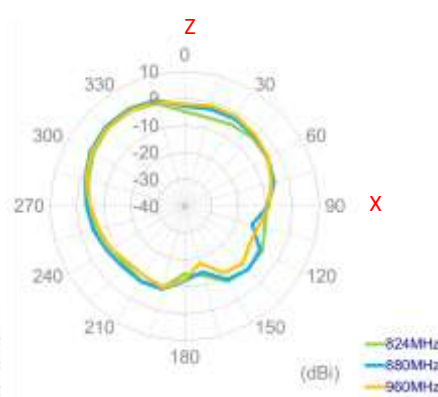
880MHz



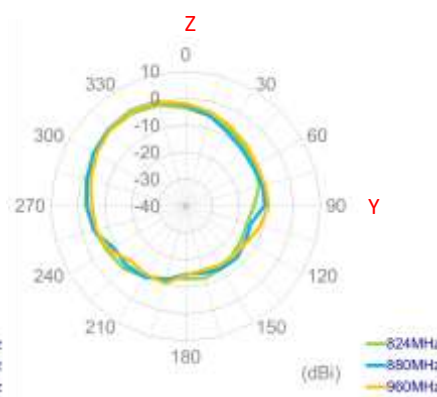
XY Plane



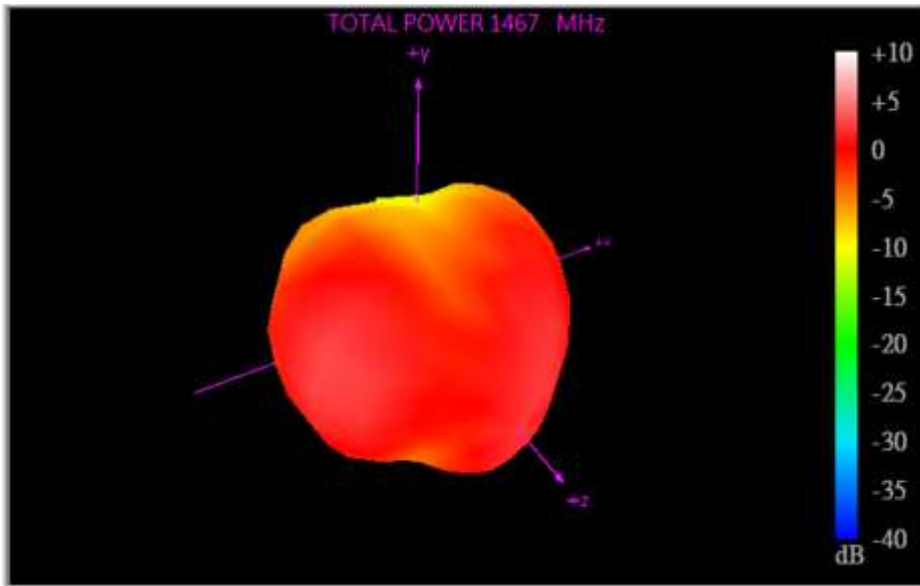
XZ Plane



YZ Plane



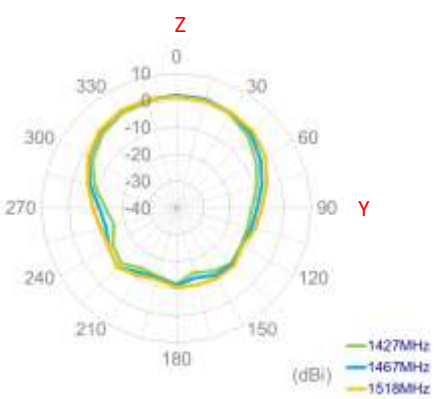
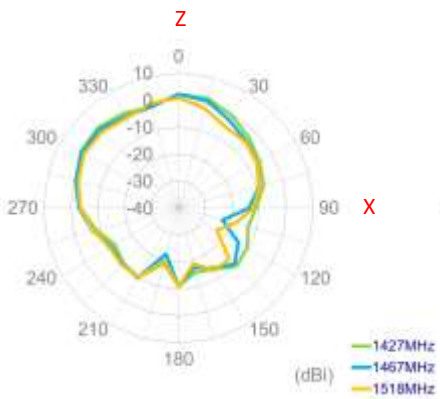
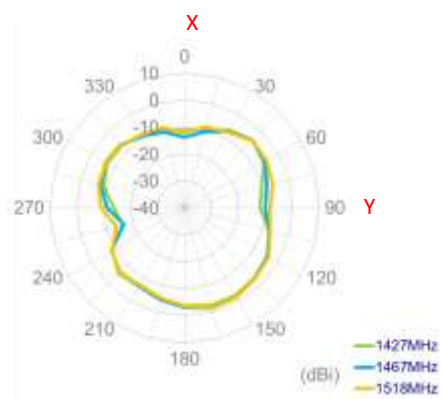
1467MHz



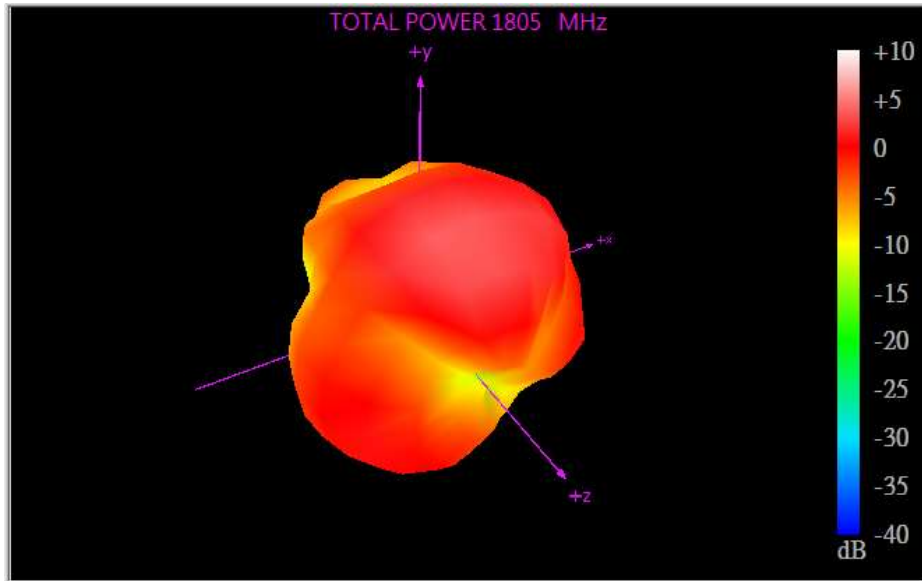
XY Plane

XZ Plane

YZ Plane



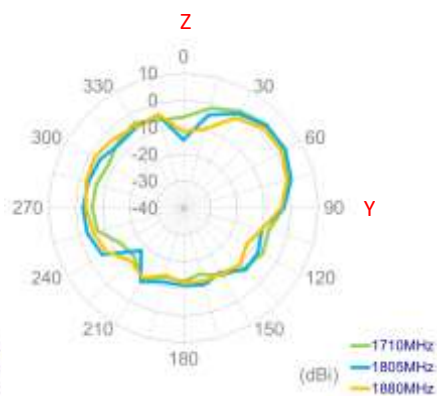
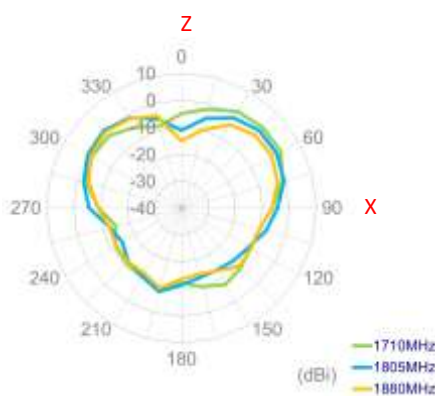
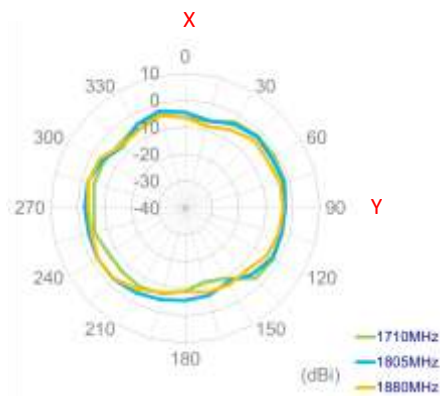
1805MHz



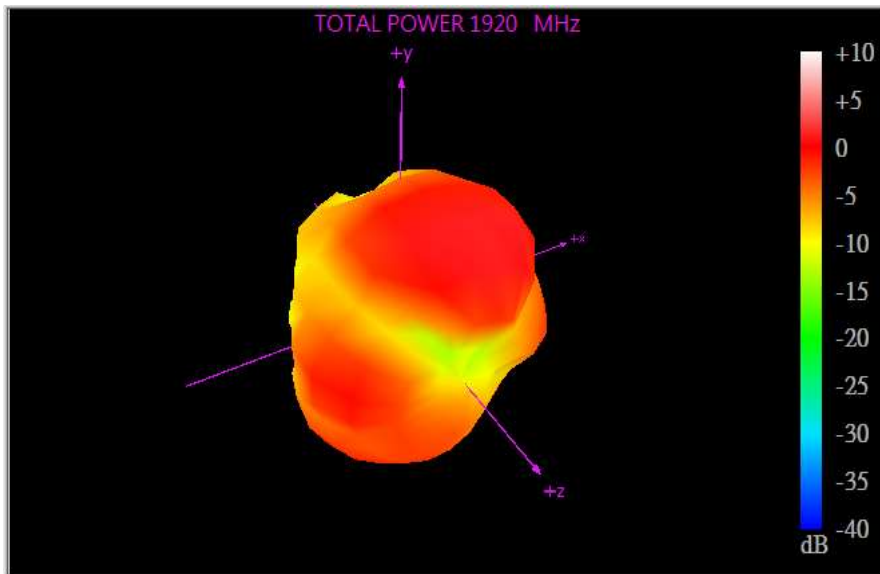
XY Plane

XZ Plane

YZ Plane



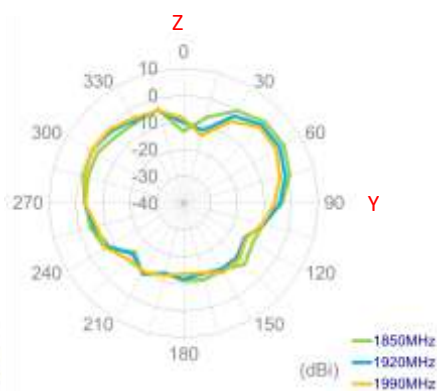
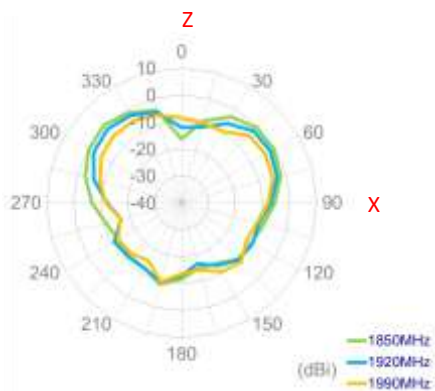
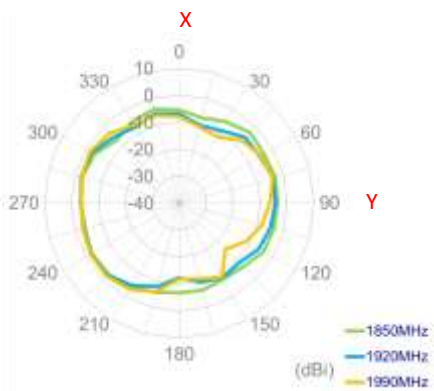
1920MHz



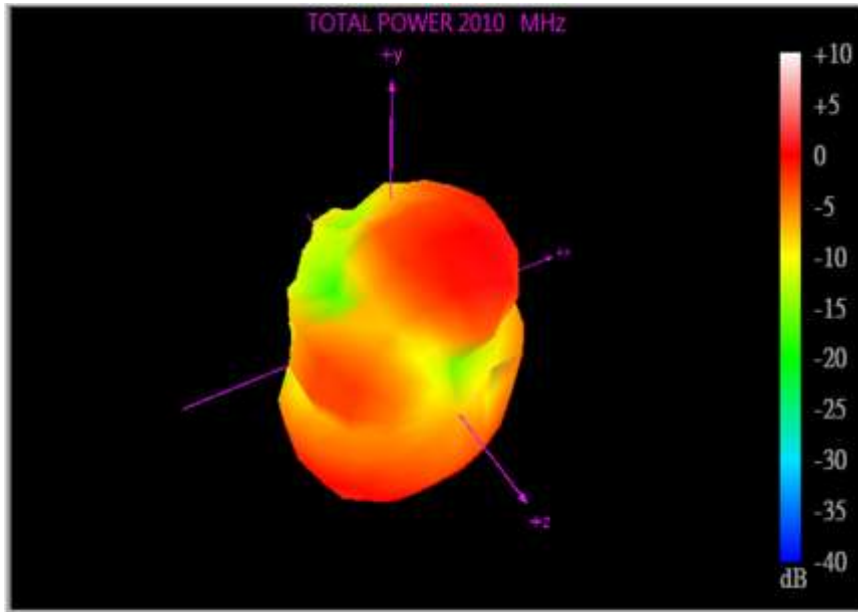
XY Plane

XZ Plane

YZ Plane



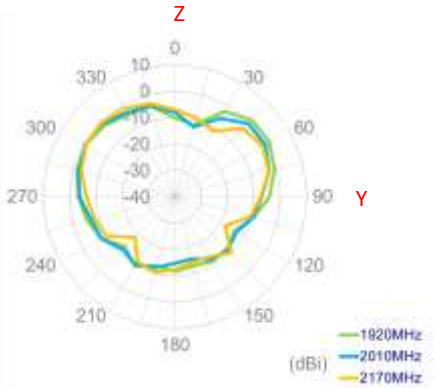
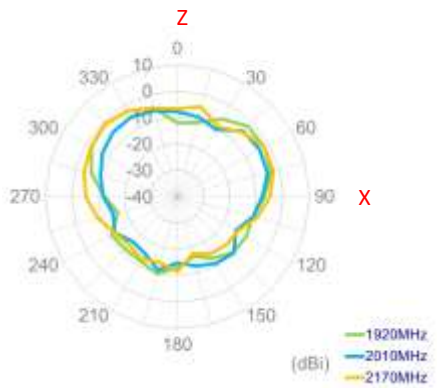
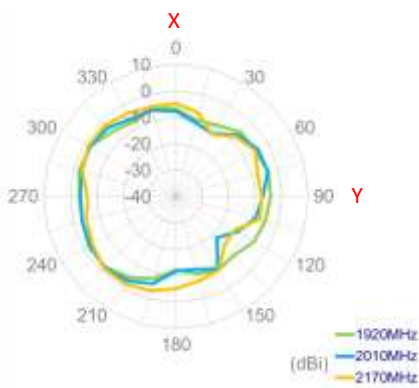
2010MHz



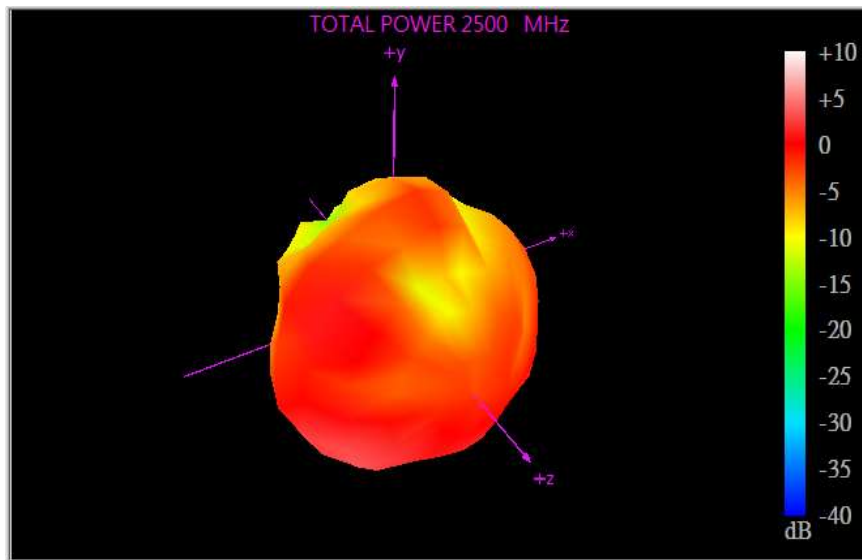
XY Plane

XZ Plane

YZ Plane



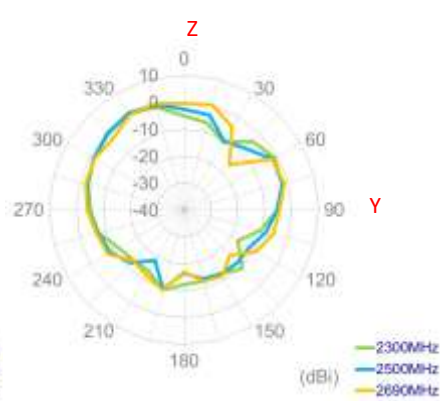
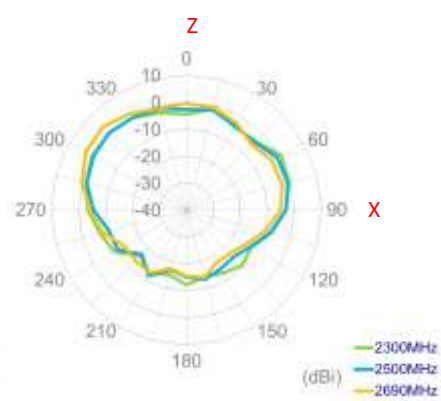
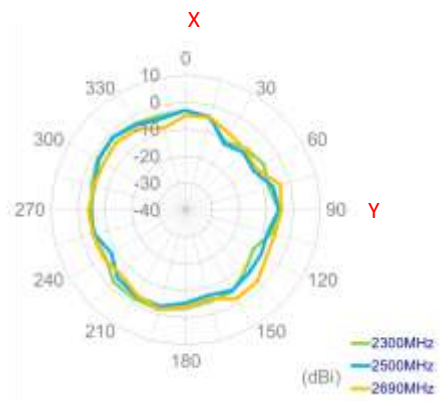
2500MHz



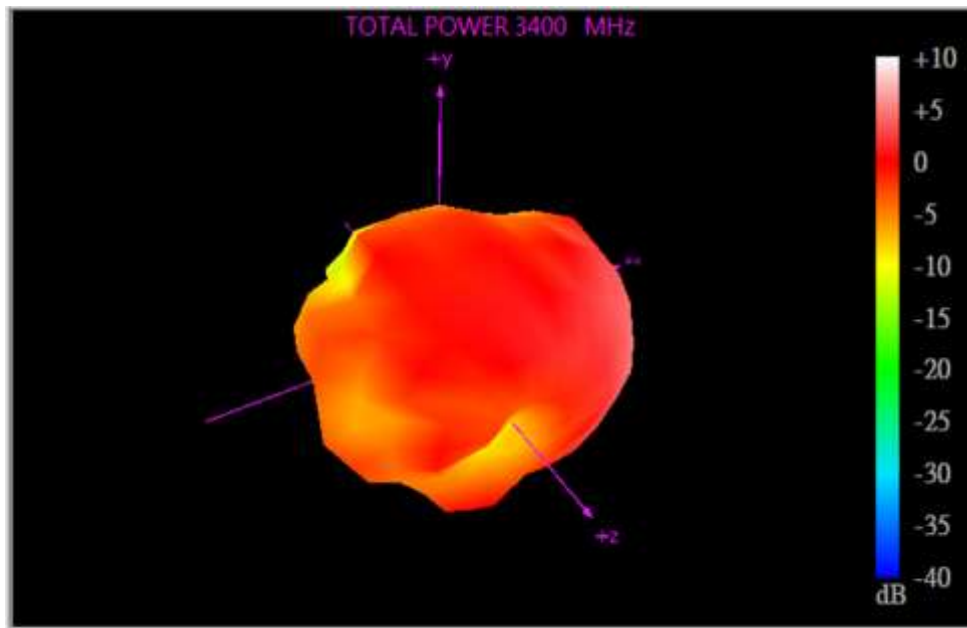
XY Plane

XZ Plane

YZ Plane



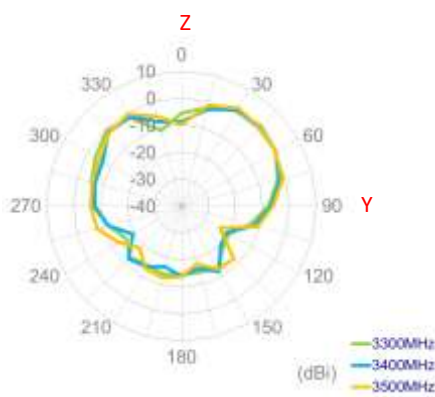
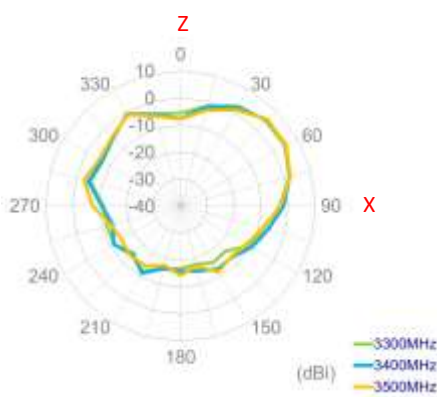
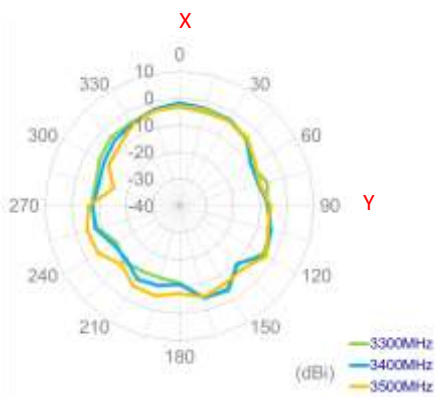
3300MHz



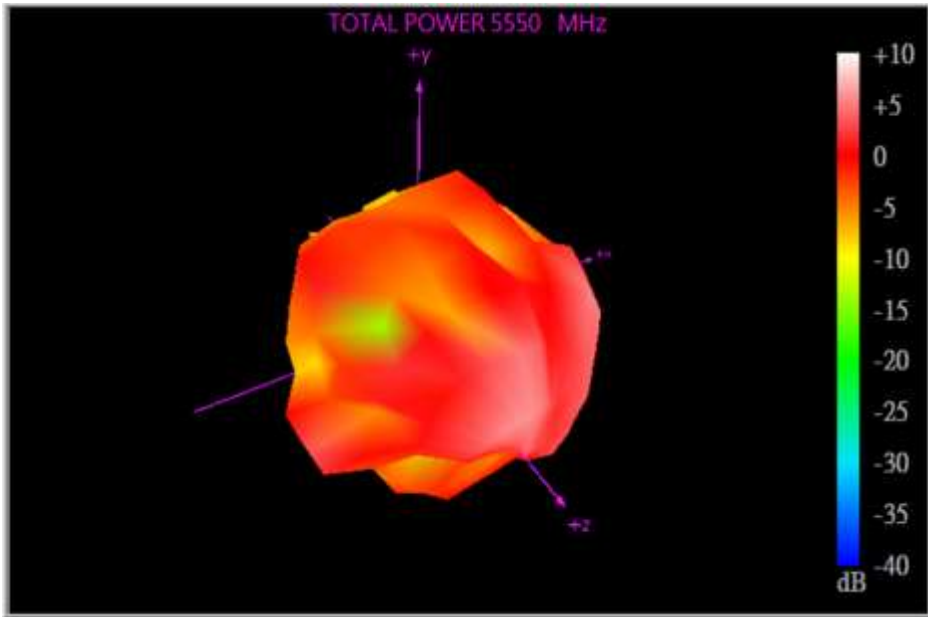
XY Plane

XZ Plane

YZ Plane



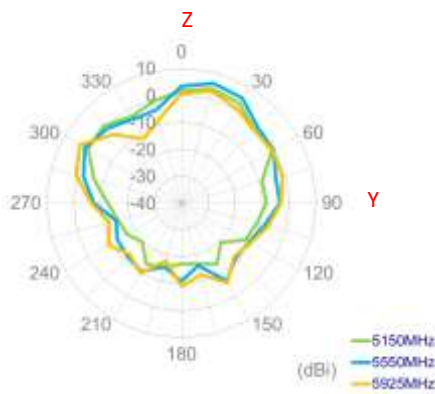
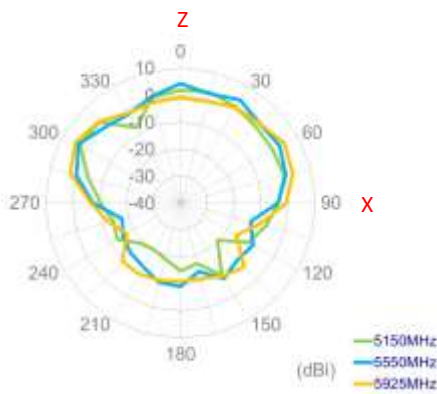
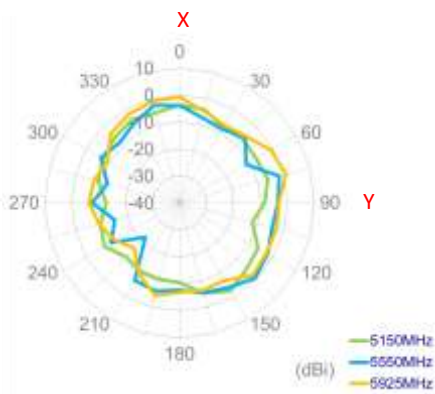
5550MHz



XY Plane

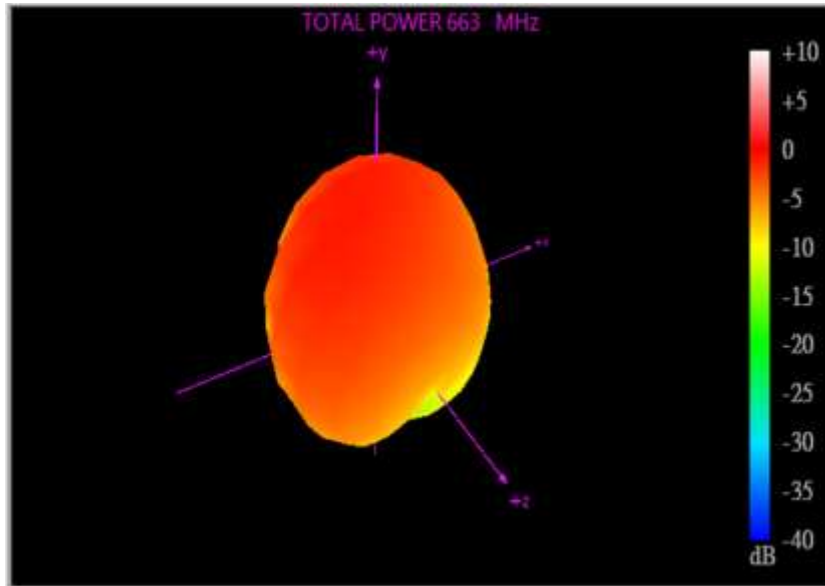
XZ Plane

YZ Plane

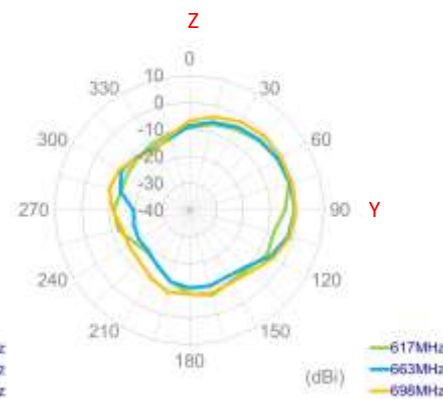
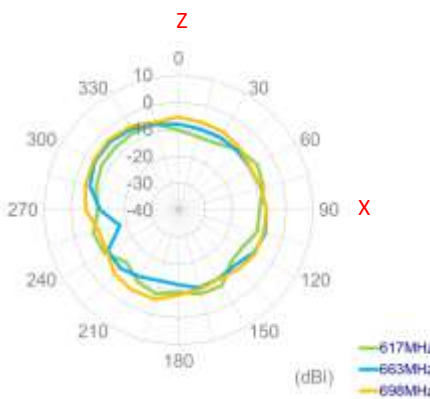
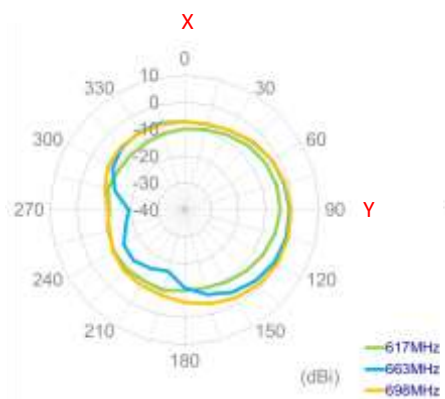


5.3 5G/4G MIMO 2 Radiation Pattern

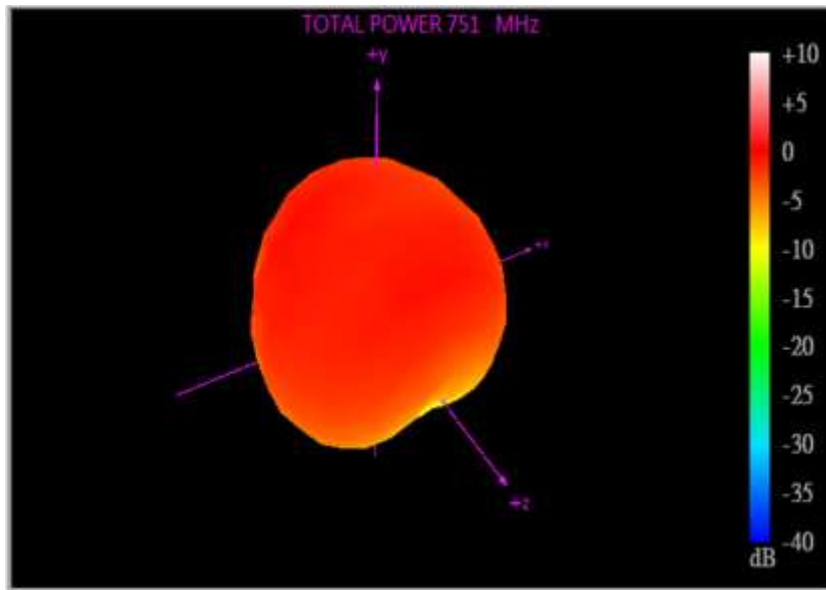
663MHz



XY Plane XZ Plane YZ Plane



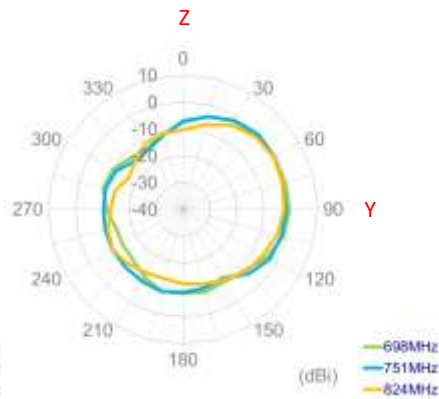
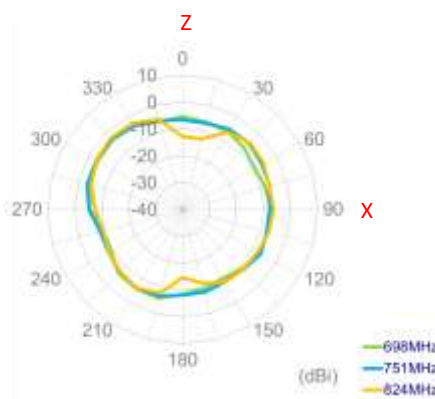
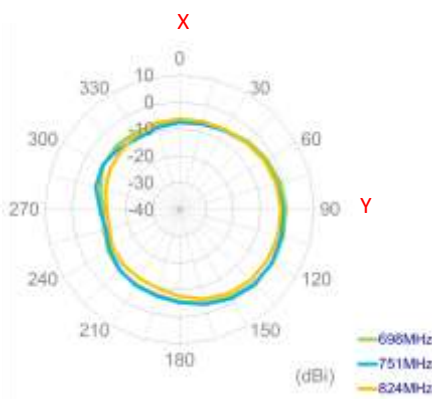
751MHz



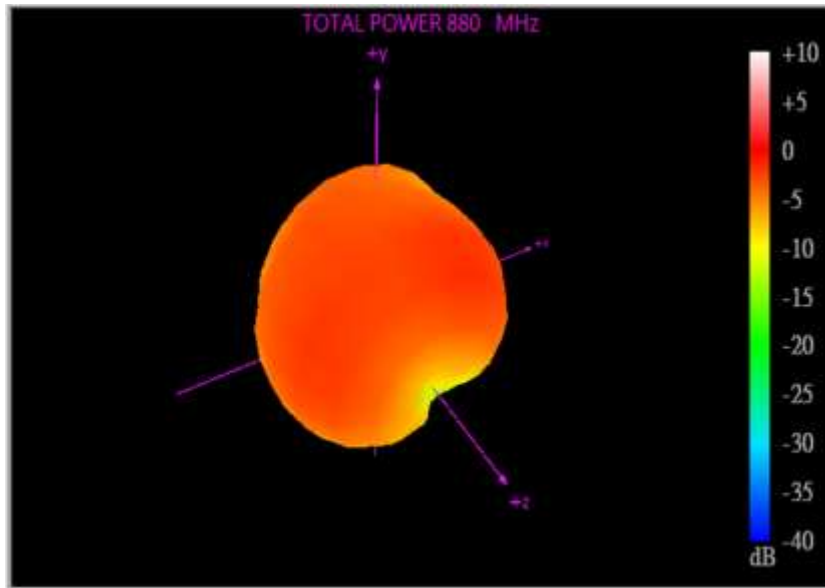
XY Plane

XZ Plane

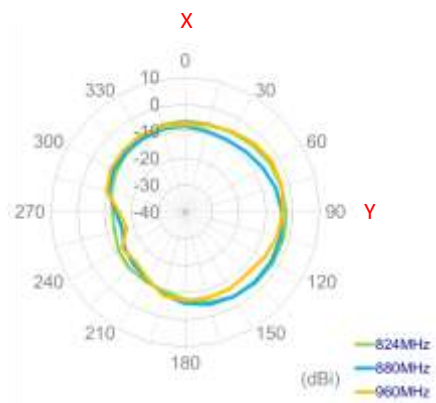
YZ Plane



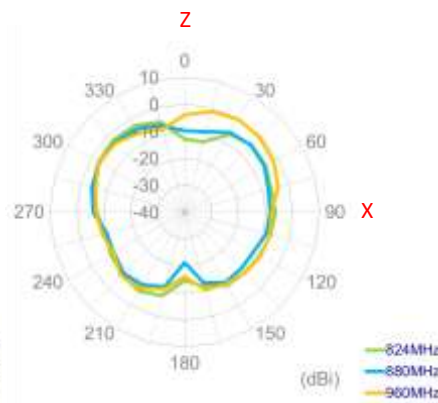
880MHz



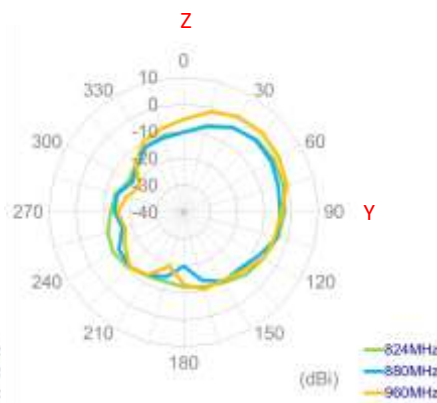
XY Plane



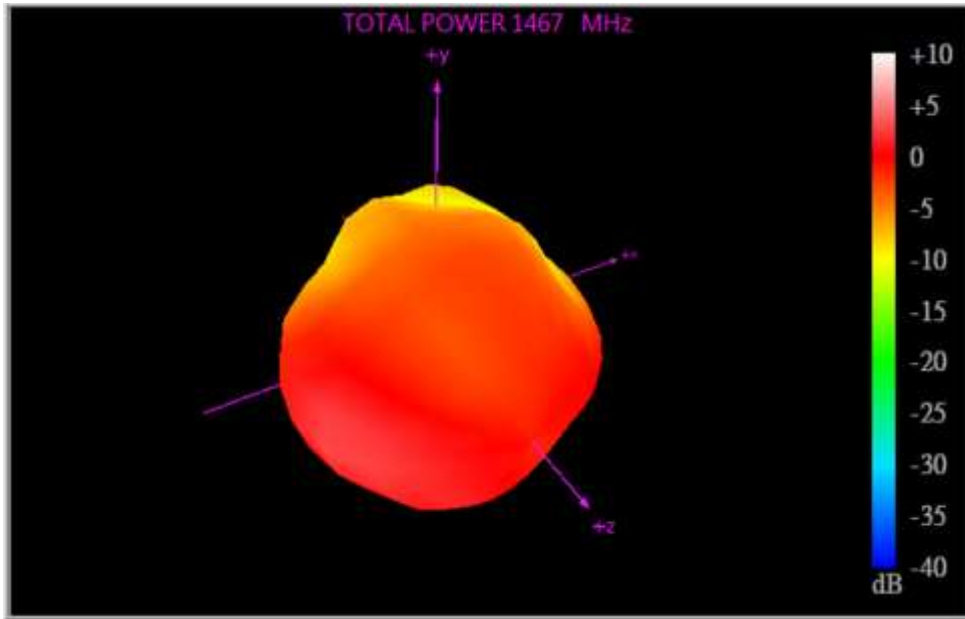
XZ Plane



YZ Plane



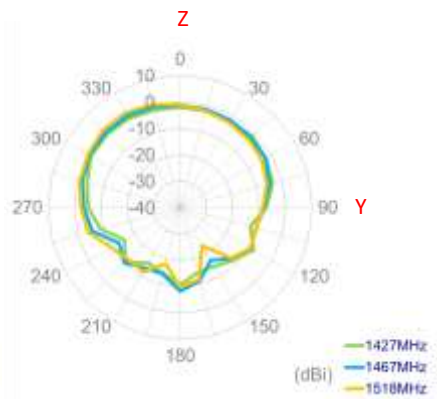
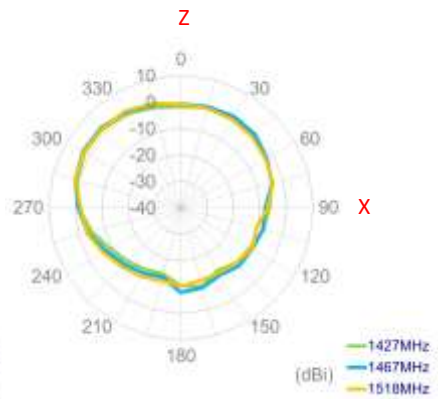
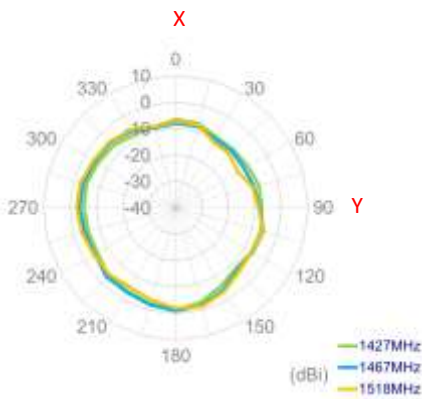
1467MHz



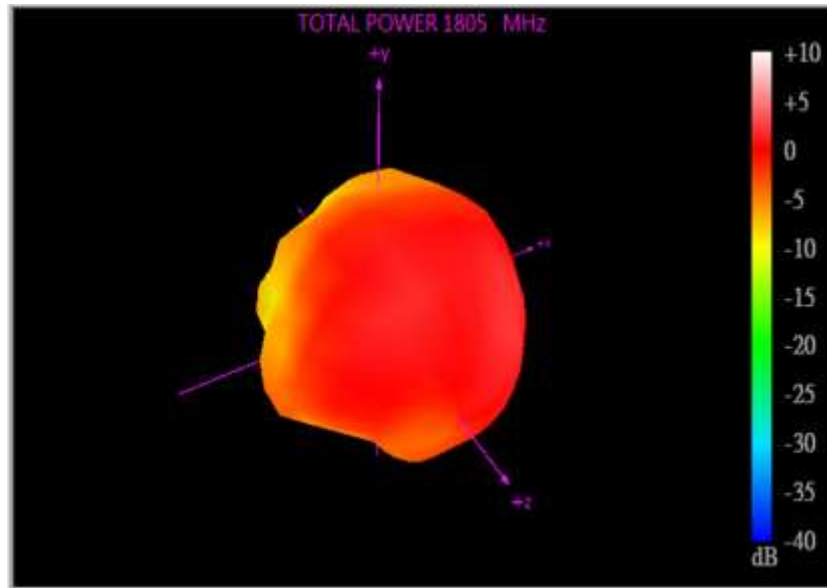
XY Plane

XZ Plane

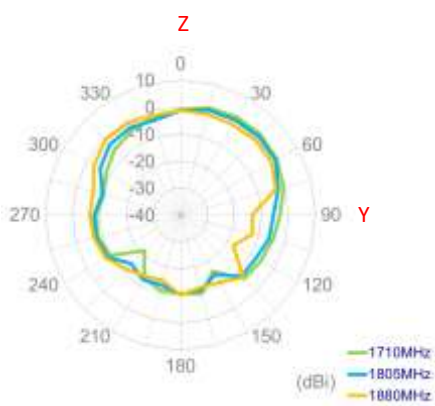
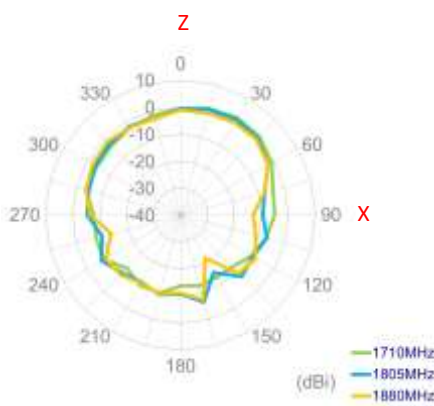
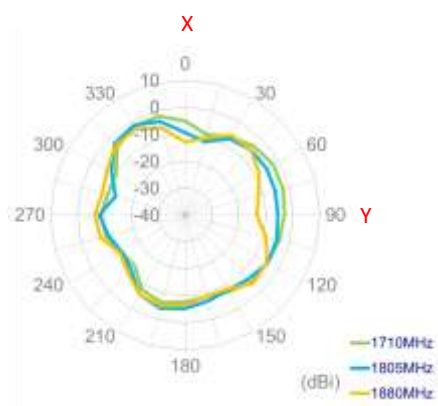
YZ Plane



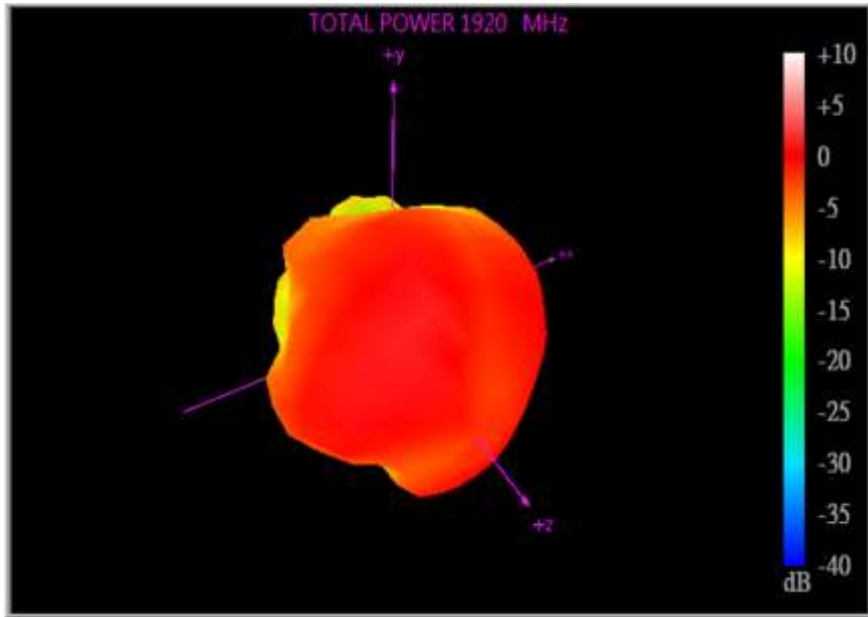
1805MHz



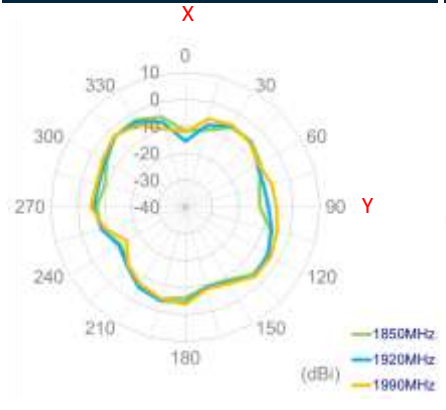
XY Plane XZ Plane YZ Plane



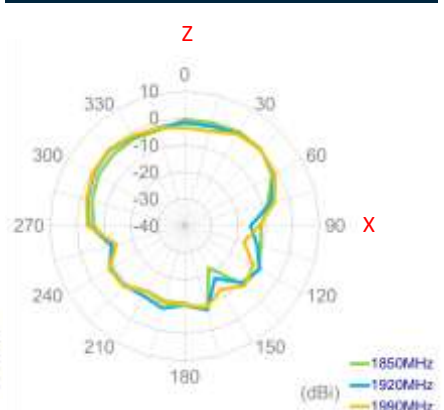
1920MHz



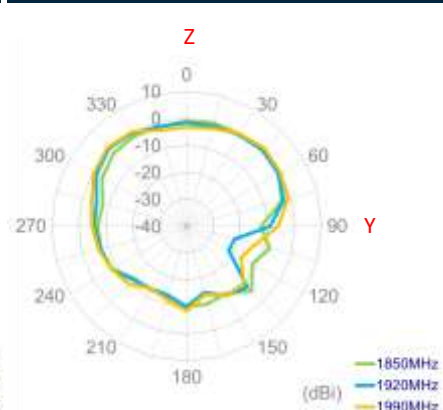
XY Plane



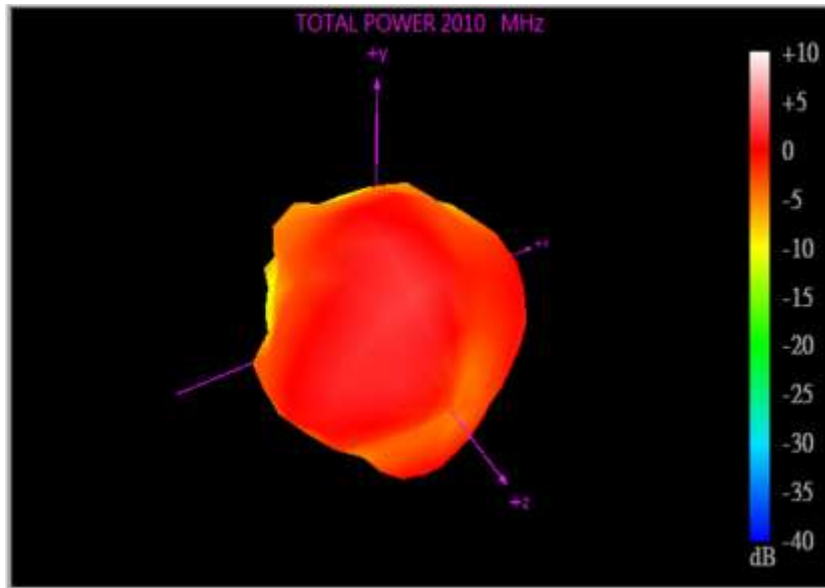
XZ Plane



YZ Plane



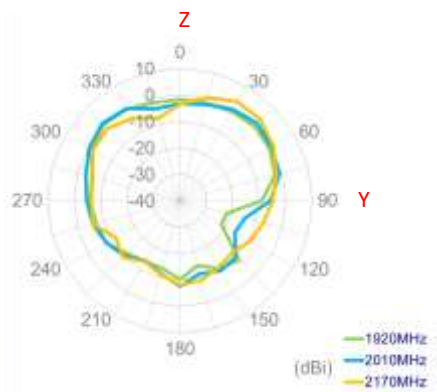
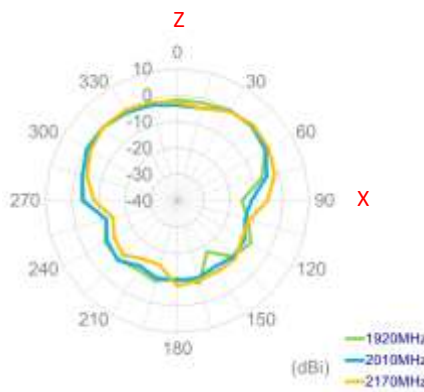
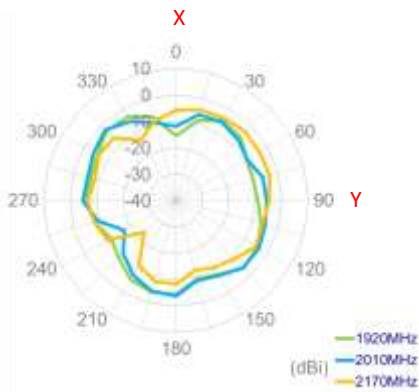
2010MHz



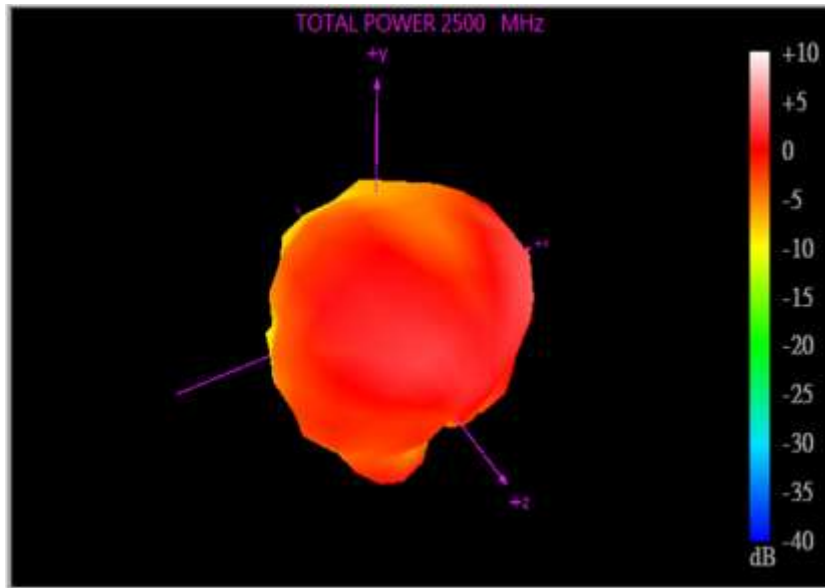
XY Plane

XZ Plane

YZ Plane



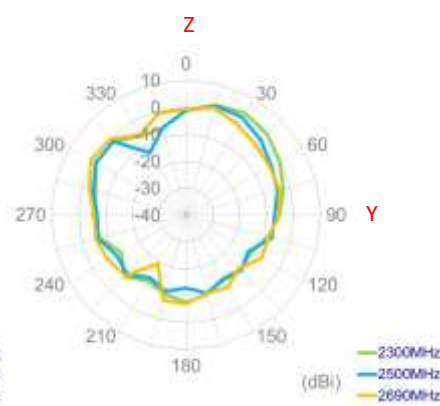
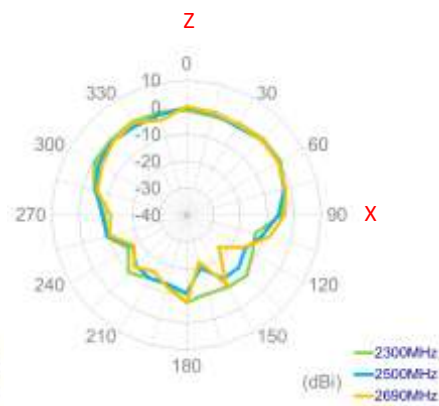
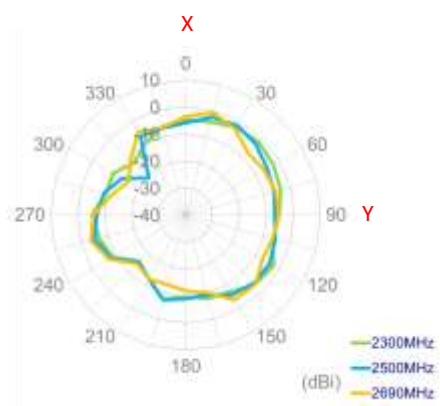
2500MHz



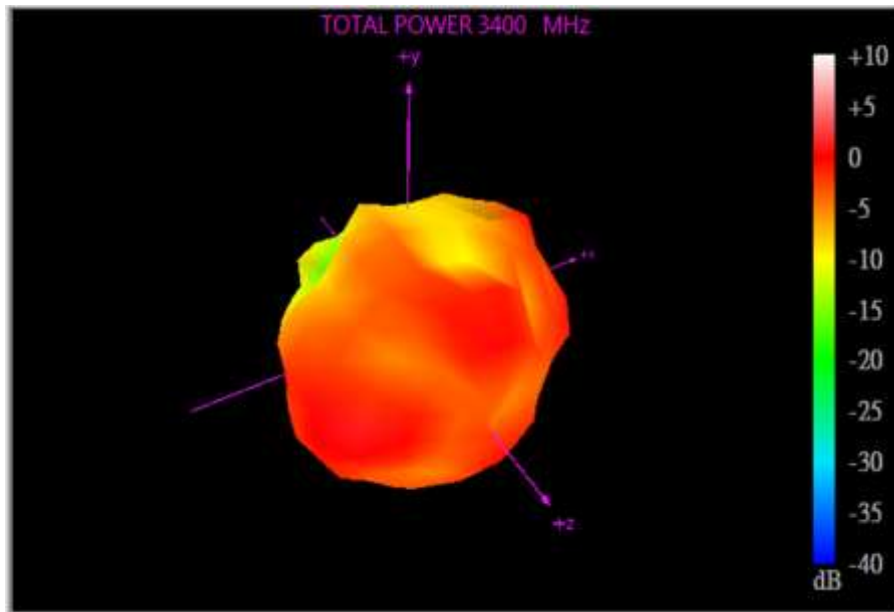
XY Plane

XZ Plane

YZ Plane



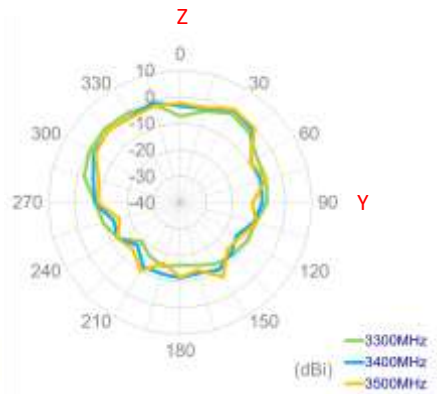
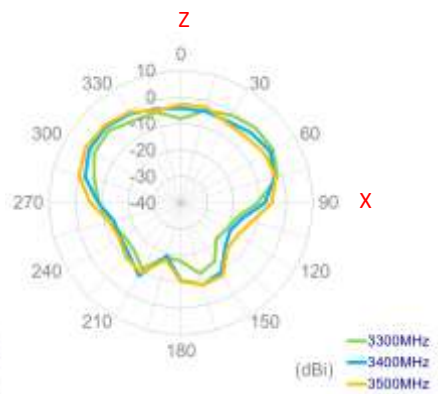
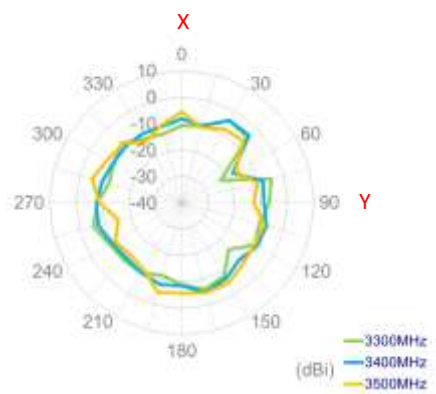
3400MHz



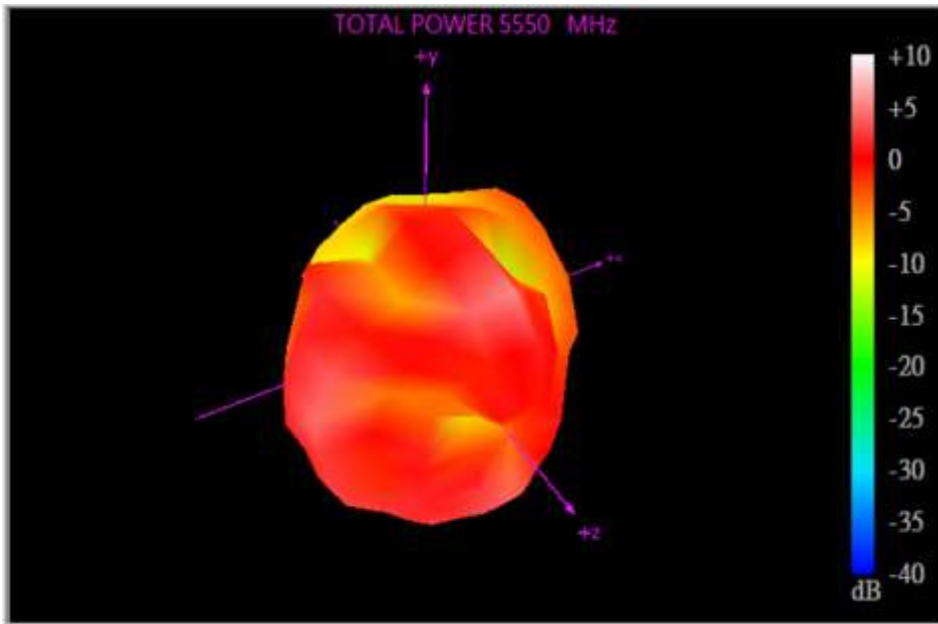
XY Plane

XZ Plane

YZ Plane



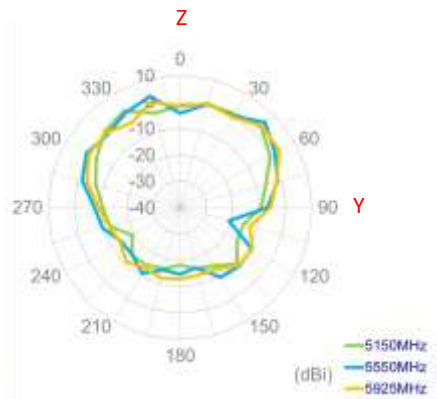
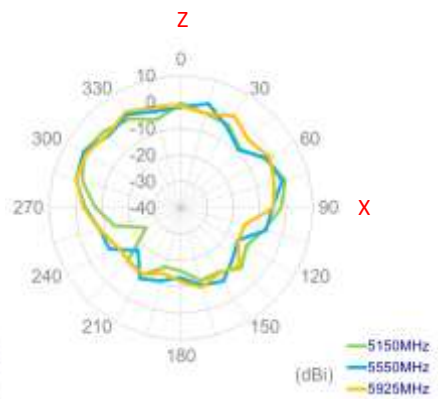
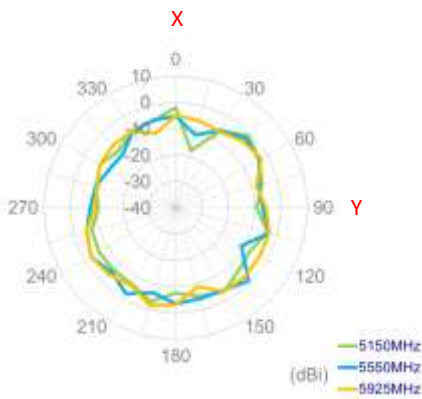
5550MHz



XY Plane

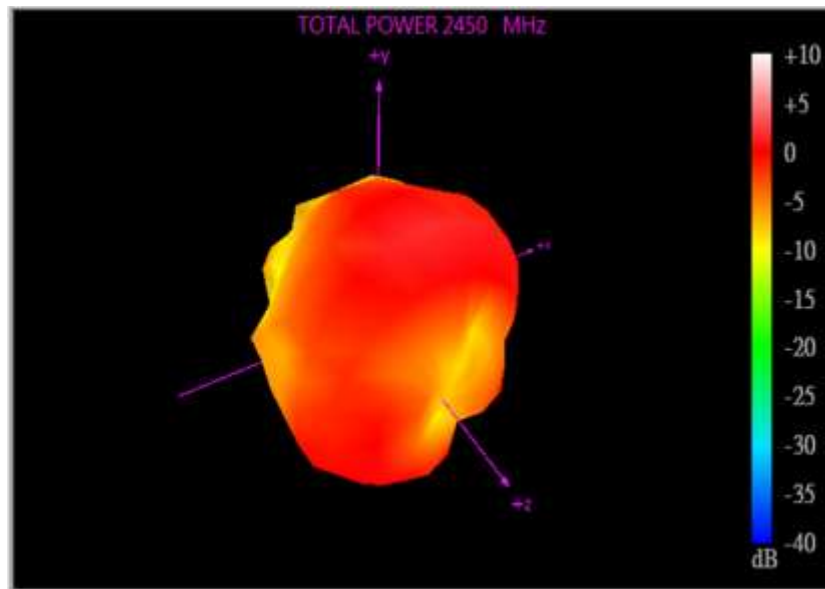
XZ Plane

YZ Plane



5.4 Wi-Fi MIMO 1 Radiation Pattern

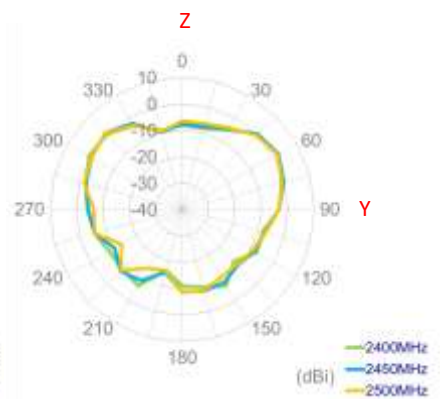
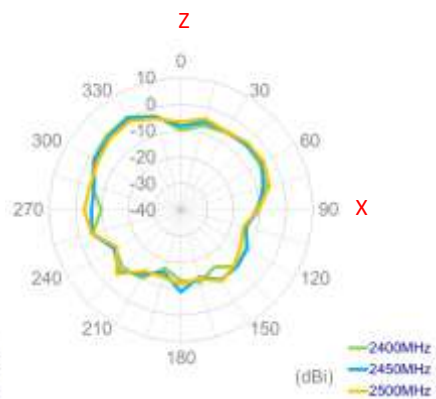
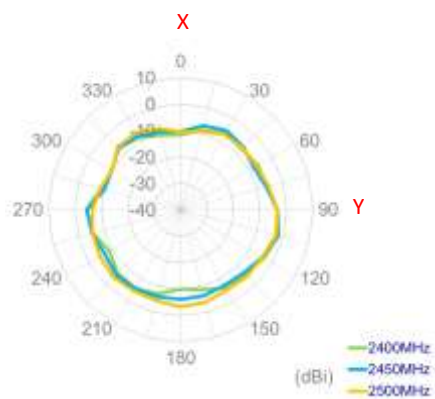
2450MHz



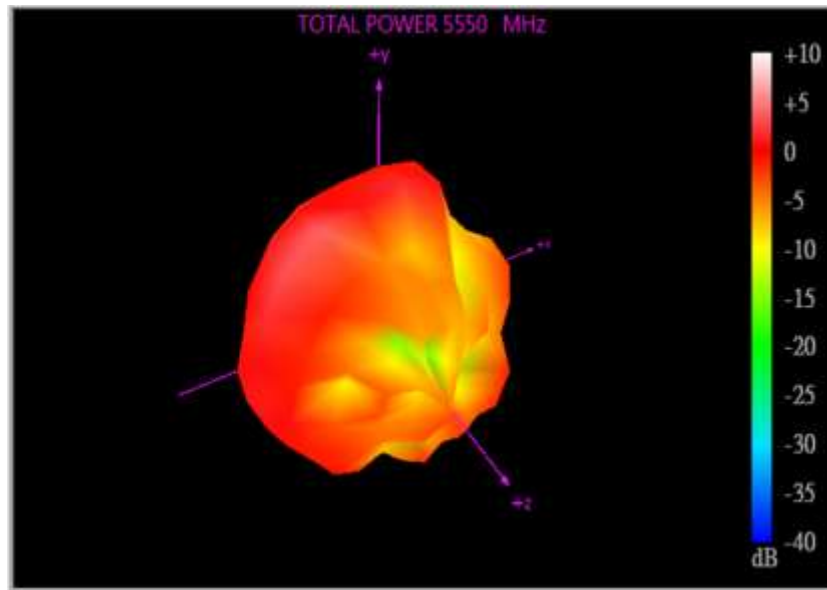
XY Plane

XZ Plane

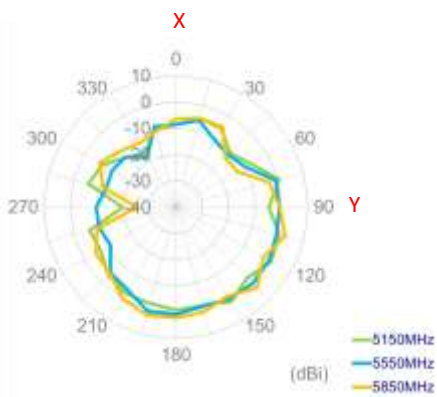
YZ Plane



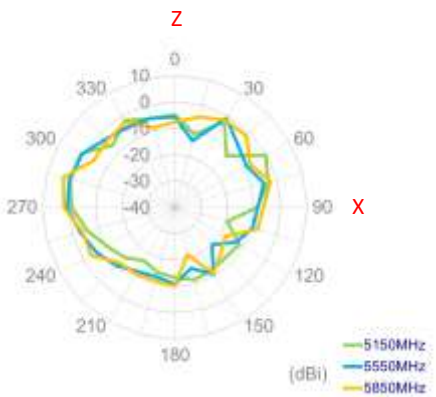
5550MHz



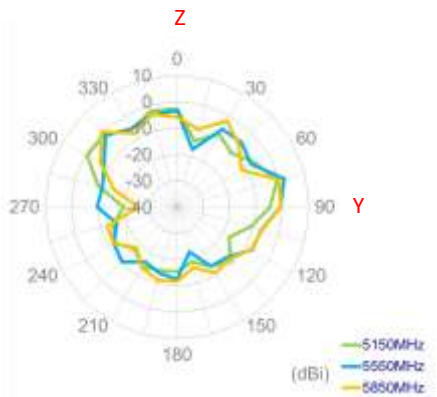
XY Plane



XZ Plane

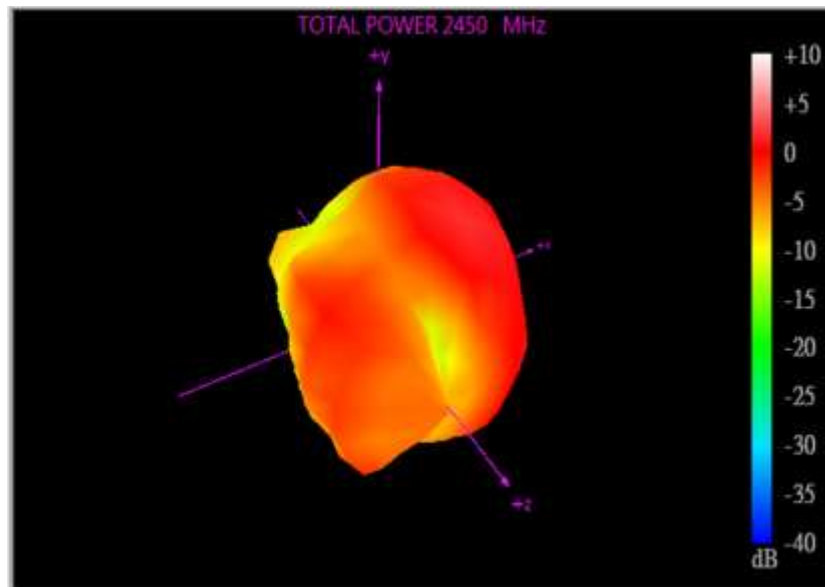


YZ Plane



5.5 Wi-Fi MIMO 2 Radiation Pattern

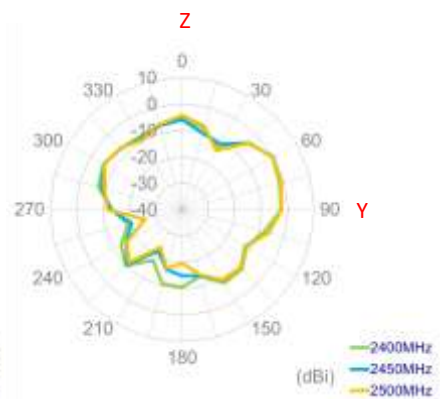
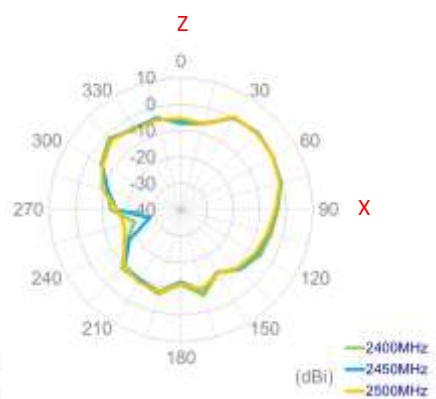
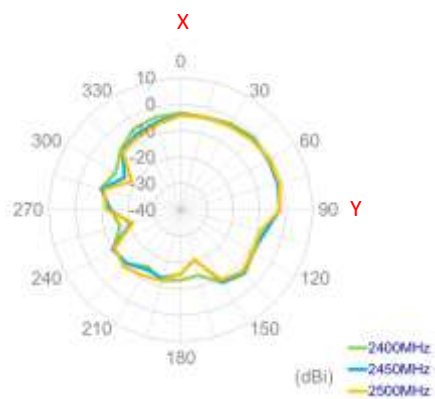
2450MHz



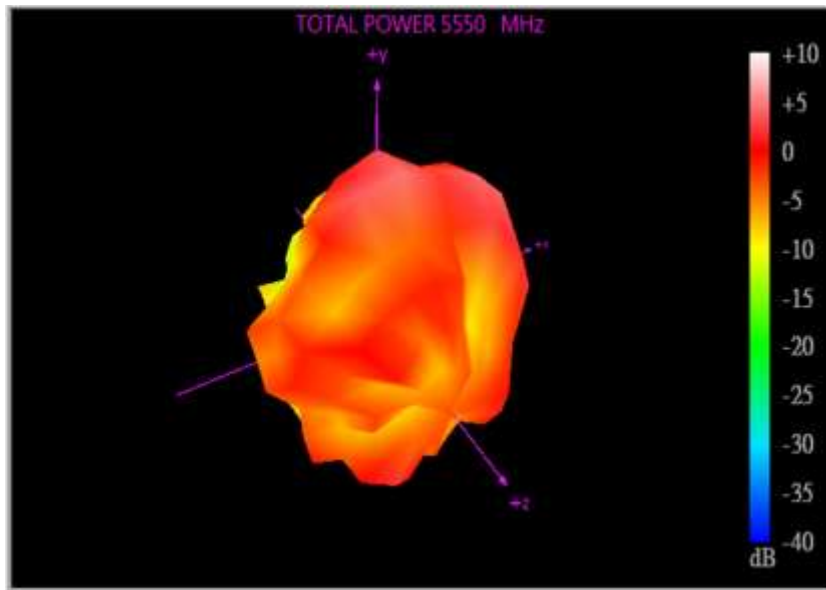
XY Plane

XZ Plane

YZ Plane



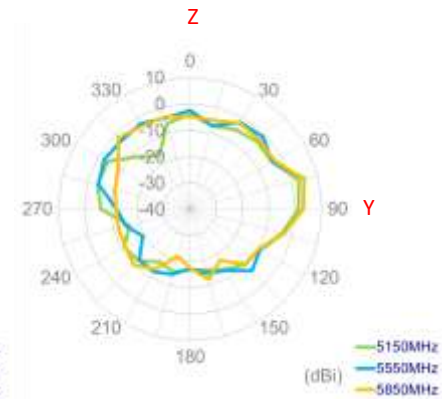
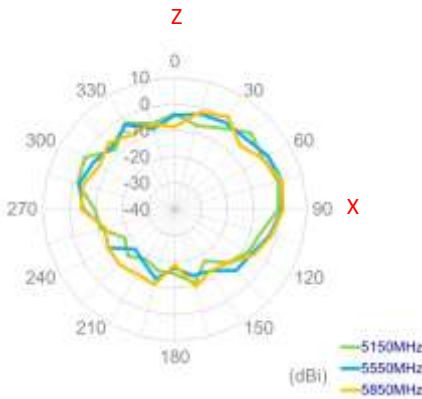
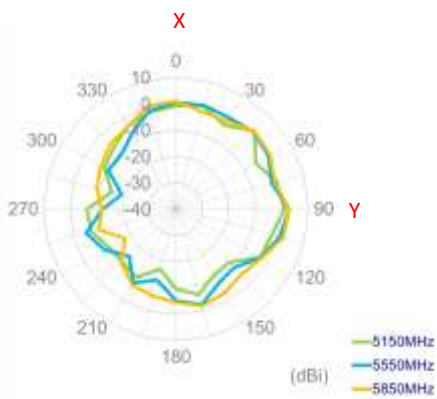
5550MHz



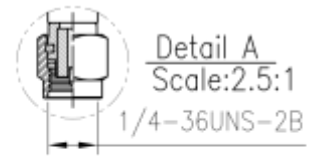
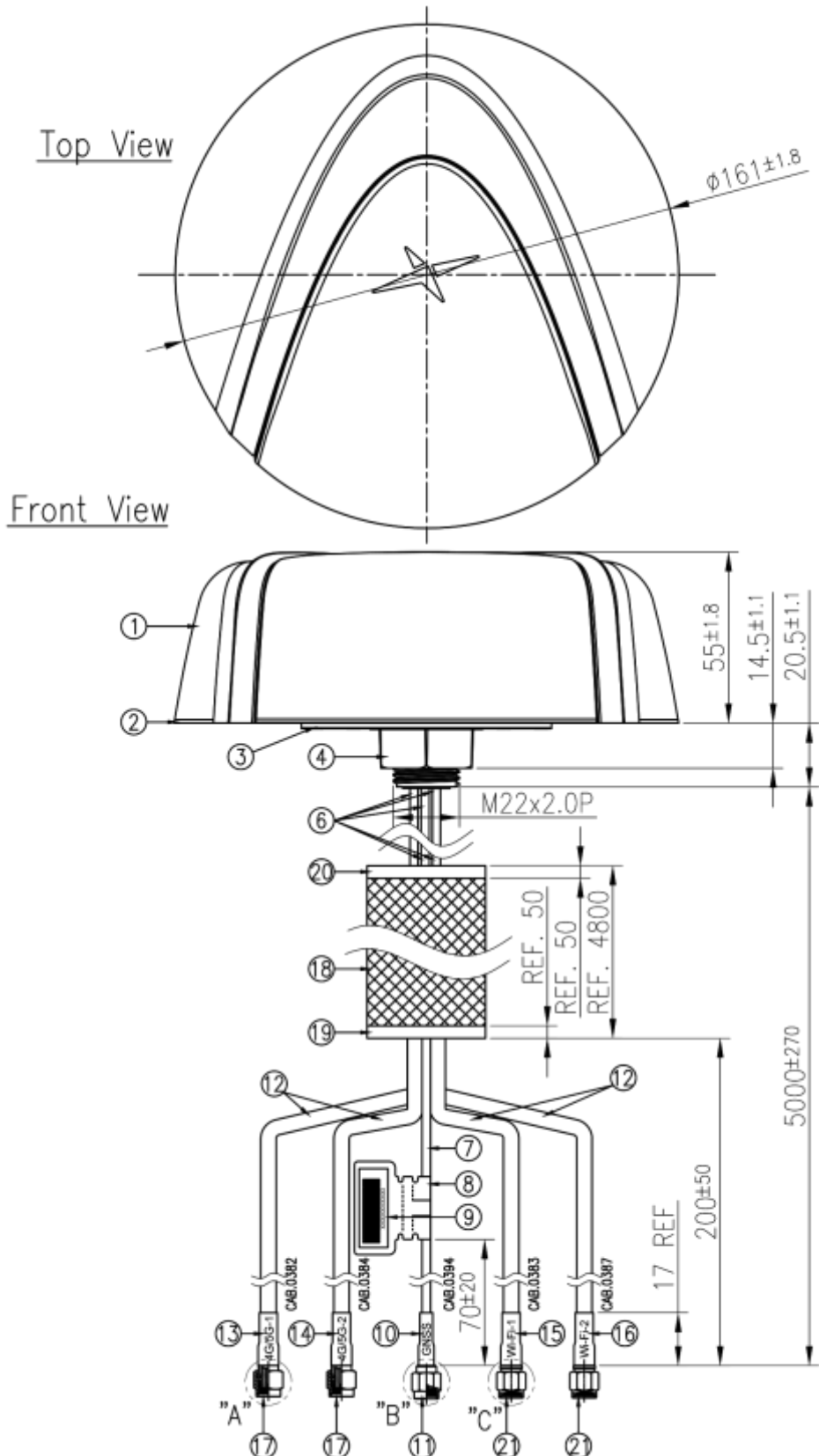
XY Plane

XZ Plane

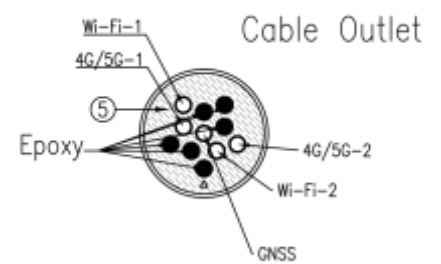
YZ Plane



6. Mechanical Drawing (Units: mm)



Bottom Thread View

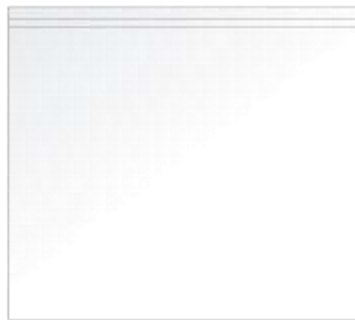


| | Name | Material | Finish | |
|----|--------------------------------|-----------------|------------------------|---|
| 1 | Top Plastic Shell | PC | Black / Grey | 1 |
| 2 | Bottom Plastic | PC | Black | 1 |
| 3 | Double Sided Adhesive | 30219 980 15F | Black Foam/White Liner | 1 |
| 4 | Nut_M22 | Nylon | Black | 1 |
| 5 | Rubber | Silicone Rubber | Black | 1 |
| 6 | RS174 Coaxial Cable (M998A001) | PVC | Black | 5 |
| 7 | RS174 Coaxial Cable (CAB.0394) | PVC | Black | 1 |
| 8 | Empty Label | PETN | White | 1 |
| 9 | Barcode Label | PET | White | 1 |
| 10 | Heat Shrink Tube (2955) | PE | Blue Tube/White Text | 1 |
| 11 | SMA(M)ST for RG-174 | Brass | Au Plated | 1 |
| 12 | TCC-200 Coaxial Cable | PE | Black | 4 |
| 13 | Heat Shrink Tube (4G/5G-1) | PE | Red Tube/White Text | 1 |
| 14 | Heat Shrink Tube (4G/5G-2) | PE | Red Tube/White Text | 1 |
| 15 | Heat Shrink Tube (Wi-Fi-1) | PE | Yellow Tube/Black Text | 1 |
| 16 | Heat Shrink Tube (Wi-Fi-2) | PE | Yellow Tube/Black Text | 1 |
| 17 | SMA(M)ST for TCC-200 | Brass | Au Plated | 2 |
| 18 | Centenary Braid | BSPEF-FRM | Black | 1 |
| 19 | Heat Shrink Tube | PE With Glue | Black | 1 |
| 20 | Heat Shrink Tube | PE With Glue | Black | 1 |
| 21 | RP-SMA(M)ST for TCC-200 | Brass | Au Plated | 2 |

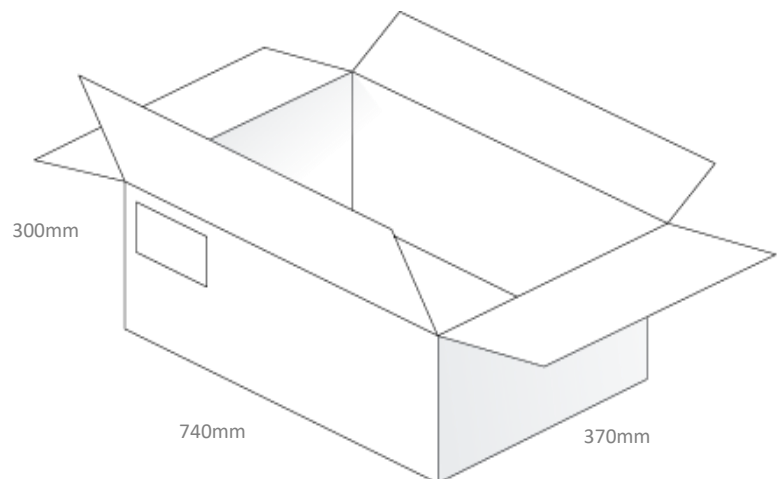
7. Packaging



1pc MA1505.AK.001 per PE Bag
Weight: 2.1Kg



4pcs MA1505.AK.001 per Carton
Carton Dimensions: 740*370*300mm
Weight: 9.3Kg



Changelog for the datasheet

SPE-21-8-055 - MA1505.AK.001

Revision: C (Current Version)

| | |
|---------|----------------------------------|
| Date: | 2023-06-13 |
| Notes: | Mechanical specification updated |
| Author: | Cesar Sousa |

Previous Revisions

Revision: B

| | |
|---------|-----------------------|
| Date: | 2022-04-05 |
| Notes: | Added isolation graph |
| Author: | Gary West |

Revision: A (Original First Release)

| | |
|---------|-----------------|
| Date: | 2021-08-10 |
| Notes: | Initial Release |
| Author: | Gary West |



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