



TAOGLAS®



Datasheet

Synergy X 9-in-1

Part No:
MA1559.A.001

Description

MA1559 - 1*Active Multi Band GNSS 4*5G/4G MIMO 4*Wi-Fi MIMO

Features:

- Low-profile Permanent Mount Enclosure
- 4* 5G/4G MIMO 600-6000MHz
- 4* Wi-Fi MIMO 2.4/5.8/7.125 GHz (Including Wi-Fi 6)
- 1* Multiband GNSS
- Worldwide 5G/4G Bands
- IP67 Waterproof Enclosure
- Dimensions: Ø161.3mm * 67mm
- Staggered RG-174 with SMA(M)/RP-SMA(M) connectors
- RoHS & Reach Compliant

| | | |
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Changelog

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1. Introduction



The Taoglas Synergy X MA1559 is a 9-in-1 next-generation permanent mount antenna designed for exceptional performance when used in conjunction with the next generation of routers.

It has been designed for high precision applications and provides excellent performance on the full GNSS spectrum including (GPS/QZSS L1/L2/L5/L6, GLONASS G1/G2/G3, Galileo E1/E5a/E5b/E6, Bei Dou B1/B2a/B2b/B3, NAVIC L5, as well as SBAS (WAAS/EGNOS/GAGAN/SDCM/SNAS) for high-performance cm-level positional accuracy which allows the user to achieve higher location accuracy, as well as stability of position tracking in urban environments with their device and with the next generation of routers.

The 9 antennas inside support 5G/4G, Multi-Band GNSS, and Wi-Fi (2.4GHz/5-7.125GHz). The 5G/4G antennas are wideband 600MHz to 6GHz to cover the full spectrum of 5G frequencies. The Wi-Fi antenna includes Wi-Fi 6 and 7 capabilities to ensure your design is future-proof for the next generation of Router connectivity.

Combining Multi-band GNSS, 5G/4G, Wi-Fi 6, and an incredibly compact PC enclosure with a fully IP67 rated waterproof, The Synergy X MA1559.A.001 is the right powerful, compact combination antenna for your application.

Typical Applications Include:

- Autonomous Driving
- Precision Positioning for Robotics
- Precision Agriculture
- Inventory Management & Container tracking
- Telematics & Asset Tracking
- Timing Accuracy Synchronization

The Synergy X MA1559.A.001 is the latest external addition to an ongoing product roadmap of high precision antennas by Taoglas. For RTK applications when used on the base and/or the rover, the MA1559.A.001 can achieve genuine cm-level accuracy.

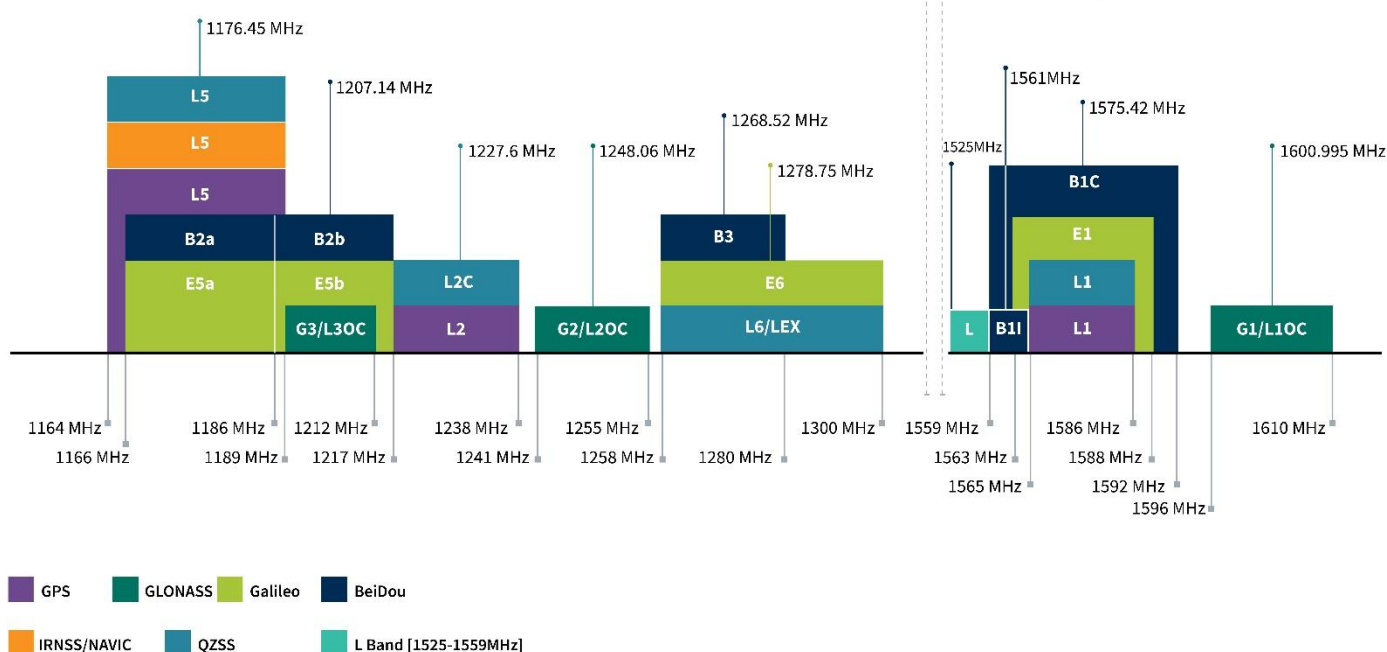
Cable and connectors are customizable. Please contact your regional Taoglas customer support team for further information.

2. Specification

| GNSS Frequency Bands | | | | | |
|----------------------|-------------------------|---------------------------|--------------------|--------------------|-------------------|
| GPS | L1 1575.42 MHz | L2 1227.6 MHz | L5 1176.45 MHz | | |
| | ■ | ■ | ■ | | |
| GLONASS | G1 1602 MHz | G2 1248 MHz | G3 1207 MHz | | |
| | ■ | ■ | ■ | | |
| Galileo | E1 1575.24 MHz | E5a 1176.45 MHz | E5b 1201.5 MHz | E6 1278.75 MHz | |
| | ■ | ■ | ■ | ■ | |
| BeiDou | B1C 1575.42 MHz | B1I 1561 MHz | B2a 1176.45 MHz | B2b 1207.14 MHz | B3 1268.52 MHz |
| | ■ | ■ | ■ | ■ | ■ |
| QZSS (Regional) | L1 1575.42 MHz | L2C 1227.6 MHz | L5 1176.45 MHz | L6 1278.75e6 | |
| | ■ | ■ | ■ | ■ | |
| IRNSS (Regional) | L5 1176.45 MHz | | | | |
| | ■ | | | | |
| SBAS | L1/E1/B1 1575.42 MHz | L5/B2a/E5a 1176.45 MHz | G1 1602 MHz | G2 1248 MHz | G3 1207 MHz |
| | ■ | ■ | ■ | ■ | ■ |

Lower Bands

Upper Bands



| GNSS Electrical | | | | | | |
|---|-------------|--------|---------|-------|---------|-------|
| Frequency (MHz) | 1176.45 | 1227.6 | 1278.75 | 1561 | 1575.42 | 1602 |
| VSWR (max.) | 2:1 | 1:1 | 1:1 | 2:1 | 2:1 | 2:1 |
| Passive Antenna Gain at Zenith (dBic) (Without cable loss) | 31.89 | 30.61 | 30.95 | 31.82 | 33.28 | 32.19 |
| Axial Ratio (dB) | 1.12 | 0.89 | 1.18 | 2.34 | 2.27 | 2.48 |
| Group Delay Mean (ns) | 12.15 | 5.99 | 11.11 | 34.35 | 26.89 | 30.67 |
| Group Delay Variation (ns) | 7 | 6 | 14 | 6 | 21 | 16 |
| Polarization | RHCP | | | | | |
| Impedance | 50 Ω | | | | | |
| Cable | RG174 | | | | | |
| Connector | SMA(M) | | | | | |

| LNA and Filter Electrical Properties | | | | | | |
|--------------------------------------|-----------------|-----------------|----------------|------------------|------------|---------------|
| Frequency (MHz) | L5 1176.45 | GAL E5b 1207 | GPS L2 1227 | L6/E6 1278.75 | B1 1561 | L1 1575.42 |
| Gain (typical) | 25 dB | 26 dB | 25 dB | 22 dB | 27 dB | 28 dB |
| Noise Figure (typical) | 4.0 dB | 3.7 dB | 3.8 dB | 4.5 dB | 3.1 dB | 2.6 dB |
| Current Draw (typical) | < 20 mA | | | | | |
| Input Voltage | +1.8 to +5 VDC | | | | | |
| Out-Of-Band Attenuation (dB) | 100 - 900 MHz | | | > 50 | | |
| | 900 - 1000 MHz | | | > 30 | | |
| | 1350 - 1520 MHz | | | > 25 | | |
| | 1700 - 2000 MHz | | | > 35 | | |
| | 2000 - 6000 MHz | | | > 45 | | |

| LTE Electrical | | | | | | | | | | |
|--|-----------------|--------|--------------|----------------|-------------------|-----------------|-----------|--------------|-------------------|------------------|
| Band | Frequency (MHz) | MIMO | Measurement | Efficiency (%) | Average Gain (dB) | Peak Gain (dBi) | Impedance | Polarization | Radiation Pattern | Max. input power |
| 5G NR/4G Band 71 | 617-698 | MIMO 1 | Free Space | 48.7 | -3.13 | 1.49 | 50 Ω | Linear | Omni | 2W |
| | | | Ground Plane | 21.2 | -6.73 | -0.15 | | | | |
| | | MIMO 2 | Free Space | 45.1 | -3.46 | 0.53 | | | | |
| | | | Ground Plane | 18.6 | -7.31 | -0.47 | | | | |
| | | MIMO 3 | Free Space | 48.4 | -3.15 | 1.32 | | | | |
| | | | Ground Plane | 20.2 | -6.96 | 0.23 | | | | |
| | | MIMO 4 | Free Space | 48.3 | -3.16 | 1.39 | | | | |
| | | | Ground Plane | 18.6 | -7.30 | -0.03 | | | | |
| 4G/3G Band 12,13,14,17,28,29 | 698-806 | MIMO 1 | Free Space | 47.0 | -3.28 | 1.45 | | | | |
| | | | Ground Plane | 30.0 | -5.23 | -0.22 | | | | |
| | | MIMO 2 | Free Space | 45.9 | -3.39 | 0.74 | | | | |
| | | | Ground Plane | 28.5 | -5.45 | -1.24 | | | | |
| | | MIMO 3 | Free Space | 46.8 | -3.30 | 1.17 | | | | |
| | | | Ground Plane | 29.8 | -5.26 | -0.06 | | | | |
| | | MIMO 4 | Free Space | 47.4 | -3.24 | 1.50 | | | | |
| | | | Ground Plane | 30.5 | -5.15 | -0.03 | | | | |
| 4G/3G/NB-IoT/Cat M Band 5,8,18,19,20,26,27 | 824-960 | MIMO 1 | Free Space | 52.4 | -2.80 | 1.51 | | | | |
| | | | Ground Plane | 42.5 | -3.72 | 2.85 | | | | |
| | | MIMO 2 | Free Space | 51.6 | -2.88 | 1.29 | | | | |
| | | | Ground Plane | 42.1 | -3.76 | 3.34 | | | | |
| | | MIMO 3 | Free Space | 52.7 | -2.78 | 1.50 | | | | |
| | | | Ground Plane | 43.3 | -3.63 | 3.98 | | | | |
| | | MIMO 4 | Free Space | 53.7 | -2.70 | 1.88 | | | | |
| | | | Ground Plane | 42.0 | -3.77 | 2.96 | | | | |
| 5G NR/4G Band 21,32,74,75,76 | 1427-1518 | MIMO 1 | Free Space | 58.6 | -2.32 | 2.79 | | | | |
| | | | Ground Plane | 53.6 | -2.71 | 3.00 | | | | |
| | | MIMO 2 | Free Space | 56.3 | -2.50 | 1.74 | | | | |
| | | | Ground Plane | 54.0 | -2.68 | 3.18 | | | | |
| | | MIMO 3 | Free Space | 59.4 | -2.26 | 3.02 | | | | |
| | | | Ground Plane | 55.0 | -2.60 | 2.91 | | | | |
| | | MIMO 4 | Free Space | 55.2 | -2.58 | 2.53 | | | | |
| | | | Ground Plane | 53.0 | -2.76 | 3.15 | | | | |
| 4G/3G Band 1,2,3,4,9,23,25,35,39,66 | 1710-2200 | MIMO 1 | Free Space | 50.8 | -2.94 | 2.72 | | | | |
| | | | Ground Plane | 50.5 | -2.96 | 4.54 | | | | |
| | | MIMO 2 | Free Space | 47.6 | -3.23 | 1.19 | | | | |
| | | | Ground Plane | 48.2 | -3.17 | 3.54 | | | | |
| | | MIMO 3 | Free Space | 48.6 | -3.13 | 1.88 | | | | |
| | | | Ground Plane | 51.3 | -2.90 | 3.92 | | | | |
| | | MIMO 4 | Free Space | 48.2 | -3.17 | 2.57 | | | | |
| | | | Ground Plane | 47.7 | -3.22 | 3.15 | | | | |
| 4G/3G Band 7,30,38,40,41 | 2300-2690 | MIMO 1 | Free Space | 64.7 | -1.89 | 4.20 | | | | |
| | | | Ground Plane | 68.0 | -1.67 | 5.65 | | | | |
| | | MIMO 2 | Free Space | 64.2 | -1.93 | 4.13 | | | | |
| | | | Ground Plane | 67.0 | -1.74 | 4.94 | | | | |
| | | MIMO 3 | Free Space | 63.5 | -1.97 | 4.16 | | | | |
| | | | Ground Plane | 65.0 | -1.87 | 5.30 | | | | |
| | | MIMO 4 | Free Space | 65.4 | -1.85 | 4.00 | | | | |
| | | | Ground Plane | 66.2 | -1.79 | 4.90 | | | | |
| 5G NR/4G Band 22,42,48,77,78,79 | 3300-5000 | MIMO 1 | Free Space | 53.4 | -2.73 | 6.00 | | | | |
| | | | Ground Plane | 52.1 | -2.83 | 6.98 | | | | |
| | | MIMO 2 | Free Space | 61.1 | -2.14 | 5.44 | | | | |
| | | | Ground Plane | 62.6 | -2.03 | 8.11 | | | | |
| | | MIMO 3 | Free Space | 52.0 | -2.84 | 6.31 | | | | |
| | | | Ground Plane | 51.3 | -2.90 | 7.12 | | | | |
| | | MIMO 4 | Free Space | 59.4 | -2.26 | 6.34 | | | | |
| | | | Ground Plane | 59.4 | -2.26 | 8.32 | | | | |
| LTE5200/Wi-Fi5800 | 5150-5925 | MIMO 1 | Free Space | 64.8 | -1.89 | 7.32 | | | | |
| | | | Ground Plane | 62.3 | -2.05 | 9.29 | | | | |
| | | MIMO 2 | Free Space | 41.5 | -3.82 | 4.82 | | | | |
| | | | Ground Plane | 50.5 | -2.97 | 8.16 | | | | |
| | | MIMO 3 | Free Space | 63.3 | -1.98 | 7.72 | | | | |
| | | | Ground Plane | 61.2 | -2.13 | 9.35 | | | | |
| | | MIMO 4 | Free Space | 47.8 | -3.20 | 5.39 | | | | |
| | | | Ground Plane | 47.8 | -3.21 | 7.80 | | | | |

| 5G/4G Bands | | | | | | | | | | |
|-------------|--|------------------|----------------------|------------------------|----------------------|------------------------|----------------------|------------------------|----------------------|------------------------|
| Band Number | 5G NR / FR1 / LTE / LTE-Advanced / WCDMA / HSPA / HSPA+ / TD-SCDMA | | | | | | | | | |
| | Uplink | Downlink | MIMO1_ Free Space | MIMO1_ Ground Plane | MIMO2_ Free Space | MIMO2_ Ground Plane | MIMO3_ Free Space | MIMO3_ Ground Plane | MIMO4_ Free Space | MIMO4_ Ground Plane |
| B1 | 1920 to 1980 | 2110 to 2170 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B2 | 1850 to 1910 | 1930 to 1990 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B3 | 1710 to 1785 | 1805 to 1880 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B4 | 1710 to 1755 | 2110 to 2155 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B5 | 824 to 849 | 869 to 894 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B7 | 2500 to 2570 | 2620 to 2690 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B8 | 880 to 915 | 925 to 960 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B9* | 1749.9 to 1784.9 | 1844.9 to 1879.9 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B11 | 1427.9 to 1447.9 | 1475.9 to 1495.9 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B12 | 699 to 716 | 729 to 746 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B13 | 777 to 787 | 746 to 756 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B14 | 788 to 798 | 758 to 768 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B17 | 704 to 716 | 734 to 746 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B18 | 815 to 830 | 860 to 875 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B19 | 830 to 845 | 875 to 890 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B20 | 832 to 862 | 791 to 821 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B21 | 1447.9 to 1462.9 | 1495.9 to 1510.9 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B22* | 3410 to 3490 | 3510 to 3590 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B23* | 2000 to 2020 | 2180 to 2200 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B24 | 1626.5 to 1660.5 | 1525 to 1559 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B25 | 1850 to 1915 | 1930 to 1995 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B26 | 814 to 849 | 859 to 894 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B27* | 807 to 824 | 852 to 869 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B28 | 703 to 748 | 758 to 803 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B29 | 717 to 728 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B30 | 2305 to 2315 | 2350 to 2360 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B31 | 452.5 to 457.5 | 462.5 to 467.5 | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| B32 | 1452 to 1496 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B34 | 2010 to 2025 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B35 | 1850 to 1910 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B36 | 1930 to 1990 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B37 | 1910 to 1930 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B38 | 2570 to 2620 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B39 | 1880 to 1920 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B40 | 2300 to 2400 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B41 | 2496 to 2690 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B42 | 3400 to 3600 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B43 | 3600 to 3800 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B45 | 1447 to 1467 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B46 | 5150 to 5925 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B47 | 5855 to 5925 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B48 | 3550 to 3700 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B49 | 3550 to 3700 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B50 | 1432 to 1517 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B51 | 1427 to 1432 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B52 | 3300 to 3400 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B53 | 2483.5 to 2495 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B65 | 1920 to 2010 | 2110 to 2200 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B66 | 1710 to 1780 | 2110 to 2200 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B68 | 698 to 728 | 753 to 783 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B69 | 2570 to 2620 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B70 | 1695 to 1710 | 1995 to 2020 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B71 | 663 to 698 | 617 to 652 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B72 | 451 to 456 | 461 to 466 | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| B73 | 450 to 455 | 460 to 465 | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| B74 | 1427 to 1470 | 1475 to 1518 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B75 | 1432 to 1517 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B76 | 1427 to 1432 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B77 | 3300 to 4200 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B78 | 3300 to 3800 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B79 | 4400 to 5000 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B85 | 698 to 716 | 728 to 746 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| B87 | 410 to 415 | 420 to 425 | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| B88 | 412 to 417 | 422 to 427 | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |

| Wi-Fi Electrical | | | | | | | | | | |
|------------------|-----------------|--------|--------------|----------------|-------------------|-----------------|-----------|--------------|-------------------|------------------|
| Band | Frequency (MHz) | MIMO | Measurement | Efficiency (%) | Average Gain (dB) | Peak Gain (dBi) | Impedance | Polarization | Radiation Pattern | Max. input power |
| Wi-Fi - 2GHz | 2400-2500 | MIMO 1 | Free Space | 55.4 | -2.57 | 2.48 | 50 Ω | Linear | Omni | 2W |
| | | | Ground Plane | 59.4 | -2.26 | 4.53 | | | | |
| | | MIMO 2 | Free Space | 51.2 | -2.91 | 2.82 | | | | |
| | | | Ground Plane | 55.6 | -2.55 | 3.97 | | | | |
| | | MIMO 3 | Free Space | 54.8 | -2.61 | 2.21 | | | | |
| | | | Ground Plane | 56.2 | -2.50 | 4.20 | | | | |
| | | MIMO 4 | Free Space | 54.6 | -2.63 | 2.74 | | | | |
| | | | Ground Plane | 60.6 | -2.17 | 4.20 | | | | |
| Wi-Fi - 5GHz | 5150-5850 | MIMO 1 | Free Space | 61.2 | -2.13 | 5.88 | | | | |
| | | | Ground Plane | 55.2 | -2.58 | 7.51 | | | | |
| | | MIMO 2 | Free Space | 54.4 | -2.64 | 5.43 | | | | |
| | | | Ground Plane | 43.8 | -3.59 | 6.67 | | | | |
| | | MIMO 3 | Free Space | 58.2 | -2.35 | 5.20 | | | | |
| | | | Ground Plane | 57.3 | -2.42 | 7.67 | | | | |
| | | MIMO 4 | Free Space | 49.0 | -3.10 | 4.93 | | | | |
| | | | Ground Plane | 48.2 | -3.17 | 7.09 | | | | |
| Wi-Fi - 6GHz | 5925-7125 | MIMO 1 | Free Space | 59.0 | -2.29 | 6.15 | | | | |
| | | | Ground Plane | 56.9 | -2.45 | 9.06 | | | | |
| | | MIMO 2 | Free Space | 65.5 | -1.84 | 6.01 | | | | |
| | | | Ground Plane | 64.0 | -1.94 | 8.75 | | | | |
| | | MIMO 3 | Free Space | 61.2 | -2.13 | 6.82 | | | | |
| | | | Ground Plane | 60.6 | -2.17 | 8.54 | | | | |
| | | MIMO 4 | Free Space | 63.1 | -2.00 | 6.20 | | | | |
| | | | Ground Plane | 61.6 | -2.10 | 8.59 | | | | |

| Mechanical | |
|-------------------|----------------------------|
| Dimensions | Ø161.3mm * 67mm |
| Weight | 535g |
| Material | PC |
| Connector | SMA (M) & RP SMA(M) |
| Cable | RG174 (see ME drawing) |
| Environmental | |
| Protection | IP67 |
| Temperature Range | -40°C to 85°C |
| Humidity | Non-condensing 65°C 95% RH |
| RoHS Compliant | Yes |
| REACH Compliant | Yes |

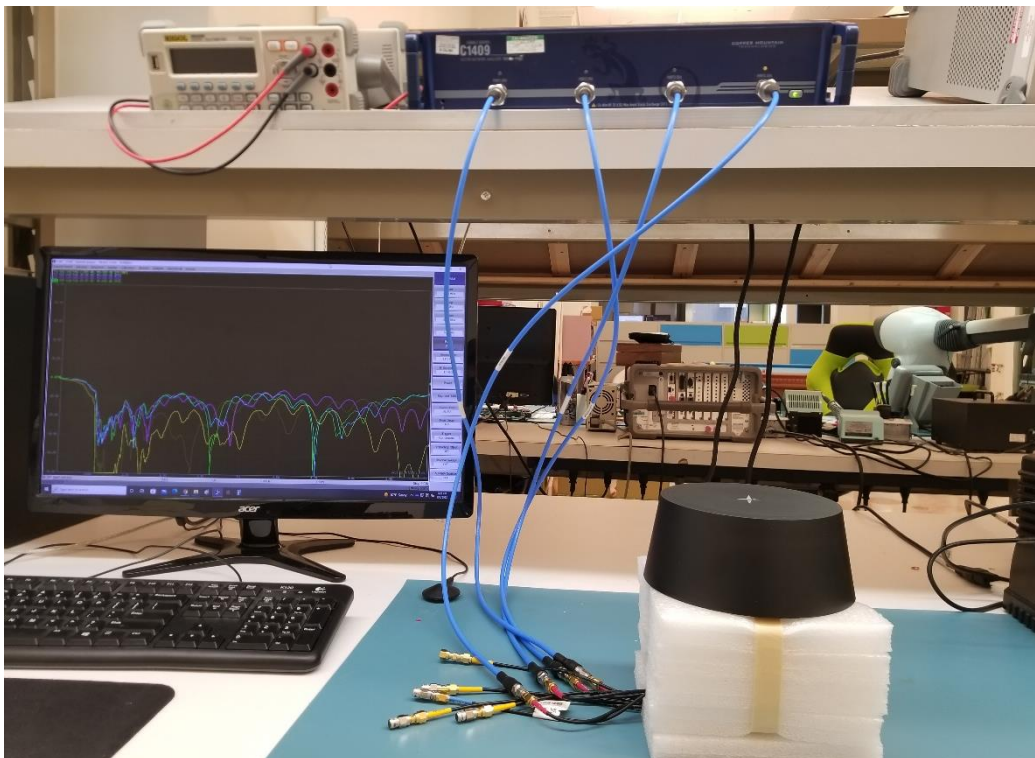
3. Antenna Characteristics

3.1 Test Setup

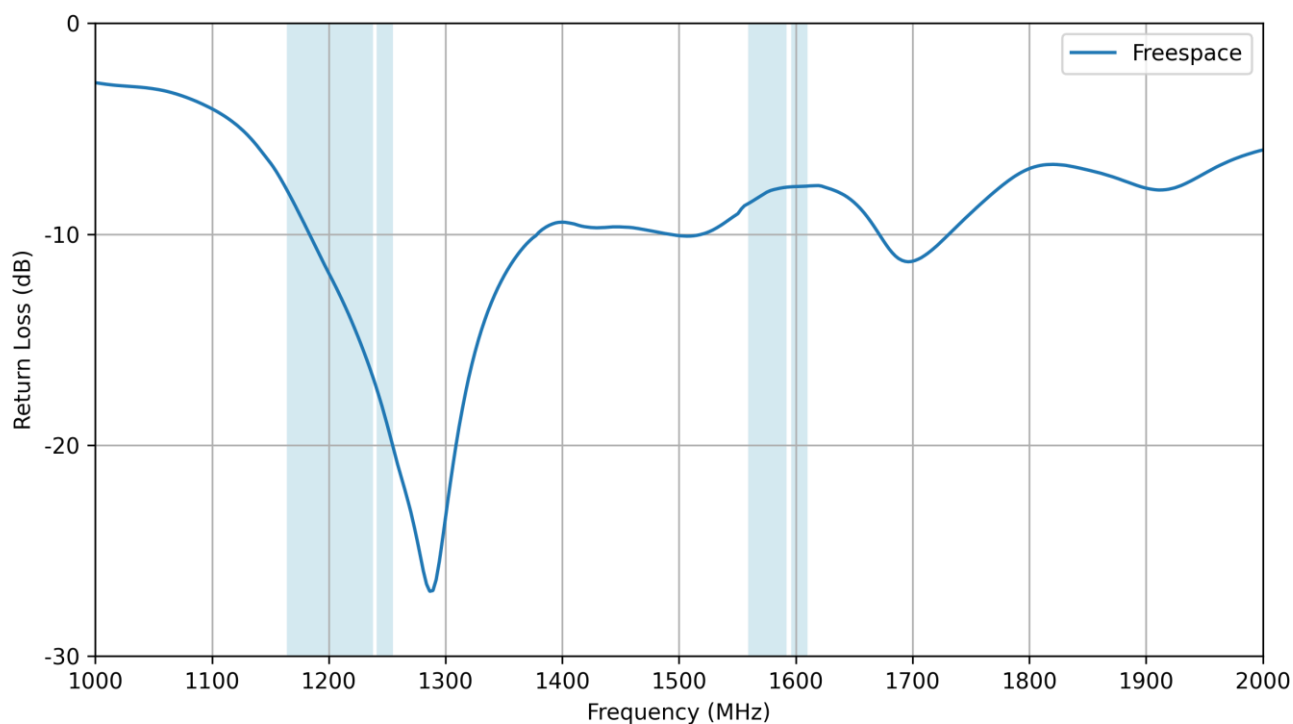
AUT



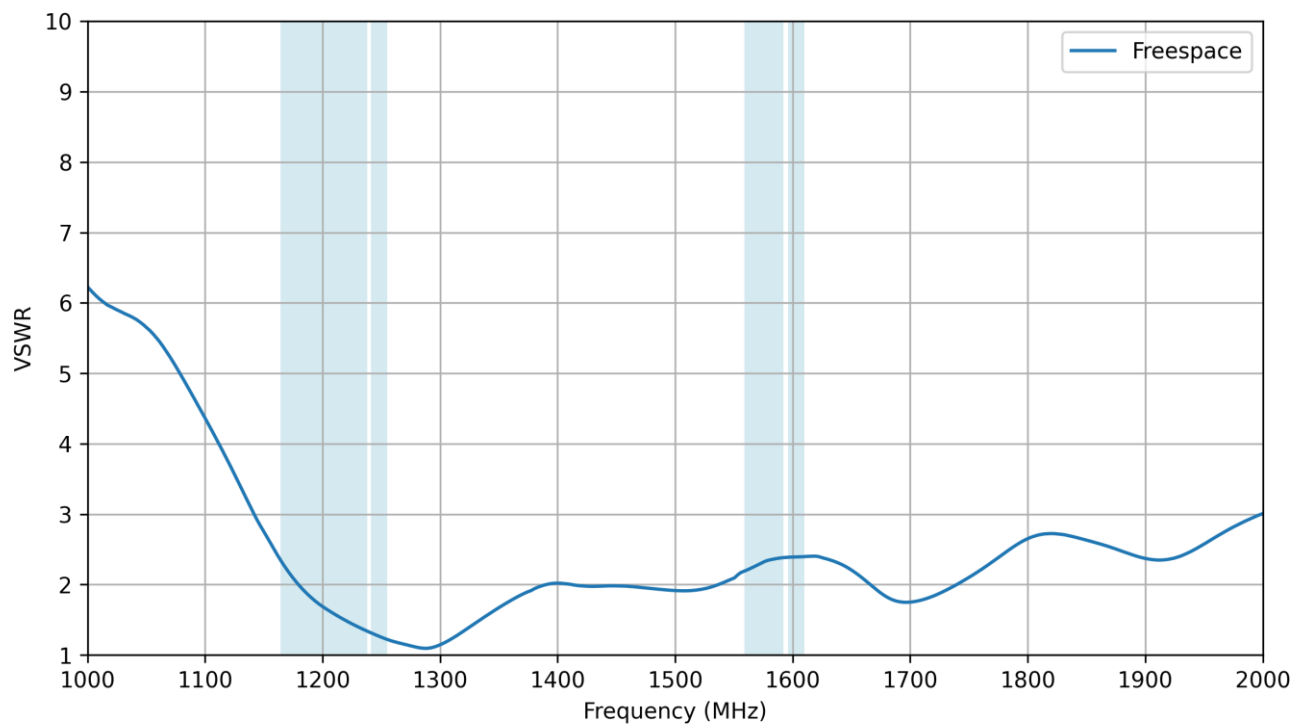
Vector Network Analyzer



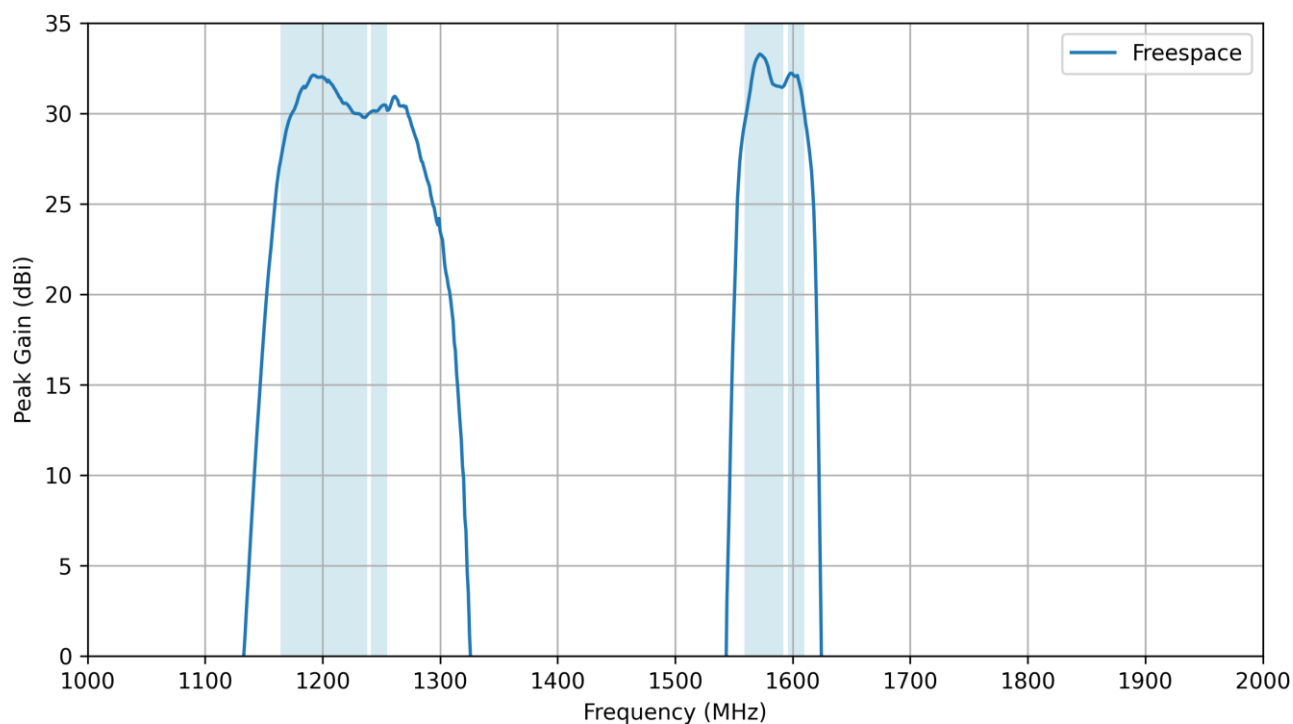
3.2 GNSS - Return Loss



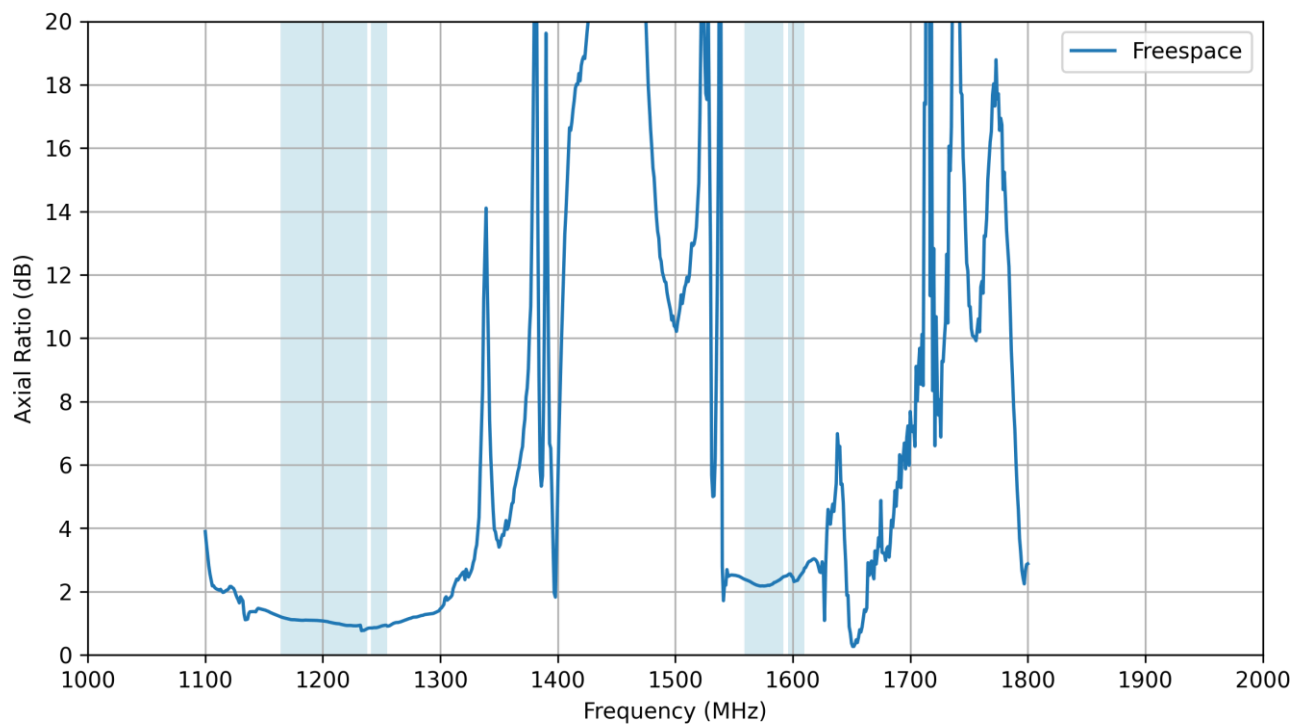
3.3 GNSS - VSWR



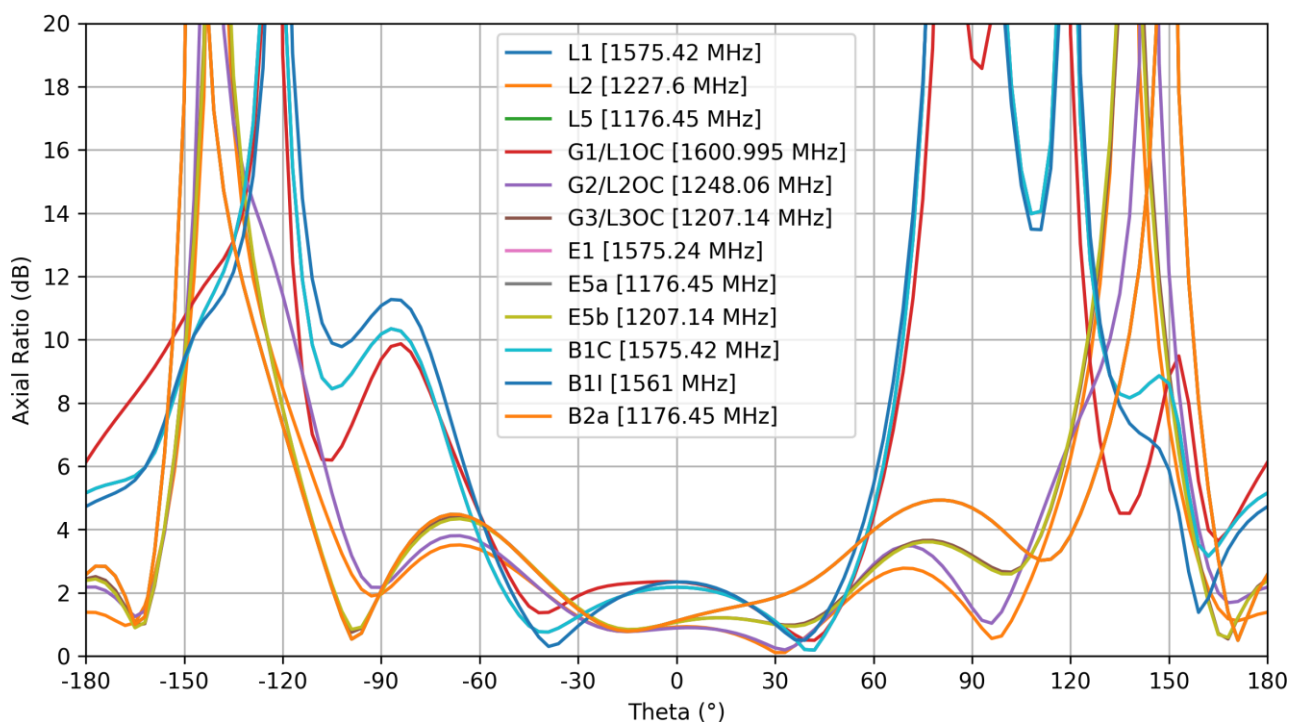
3.4 GNSS - Peak Gain



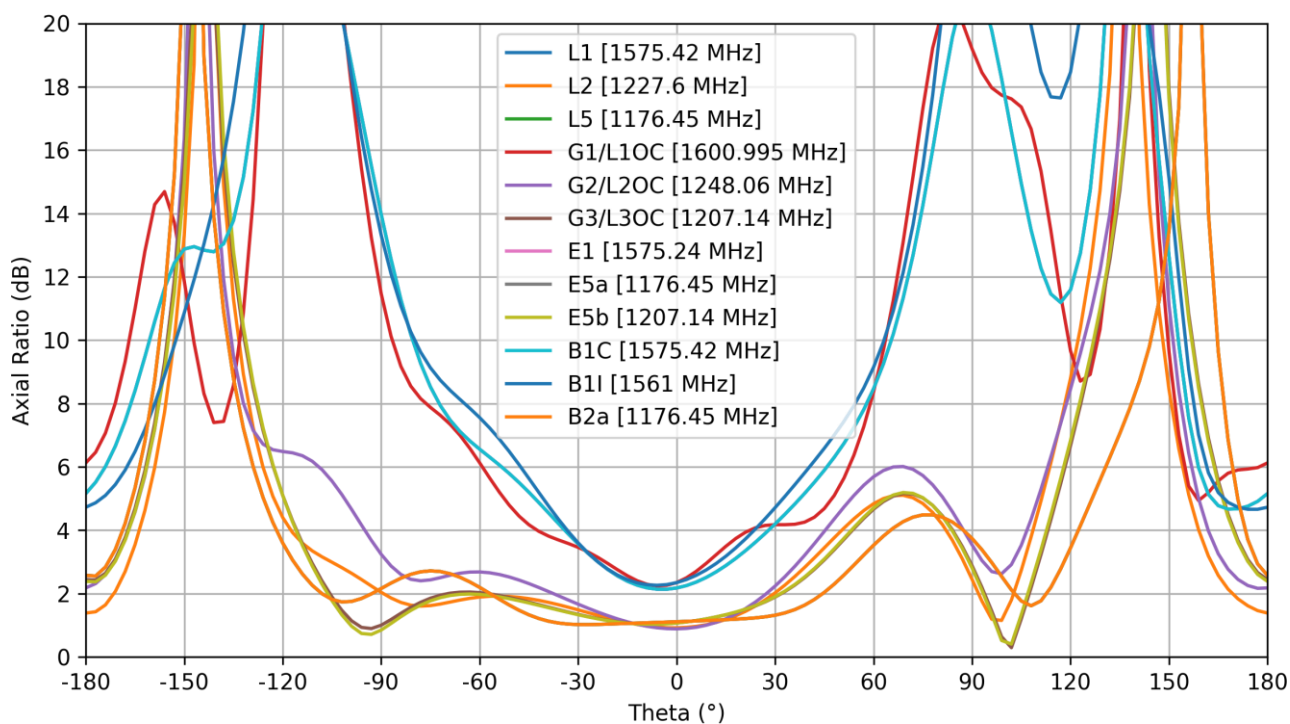
3.5 GNSS - Axial Ratio



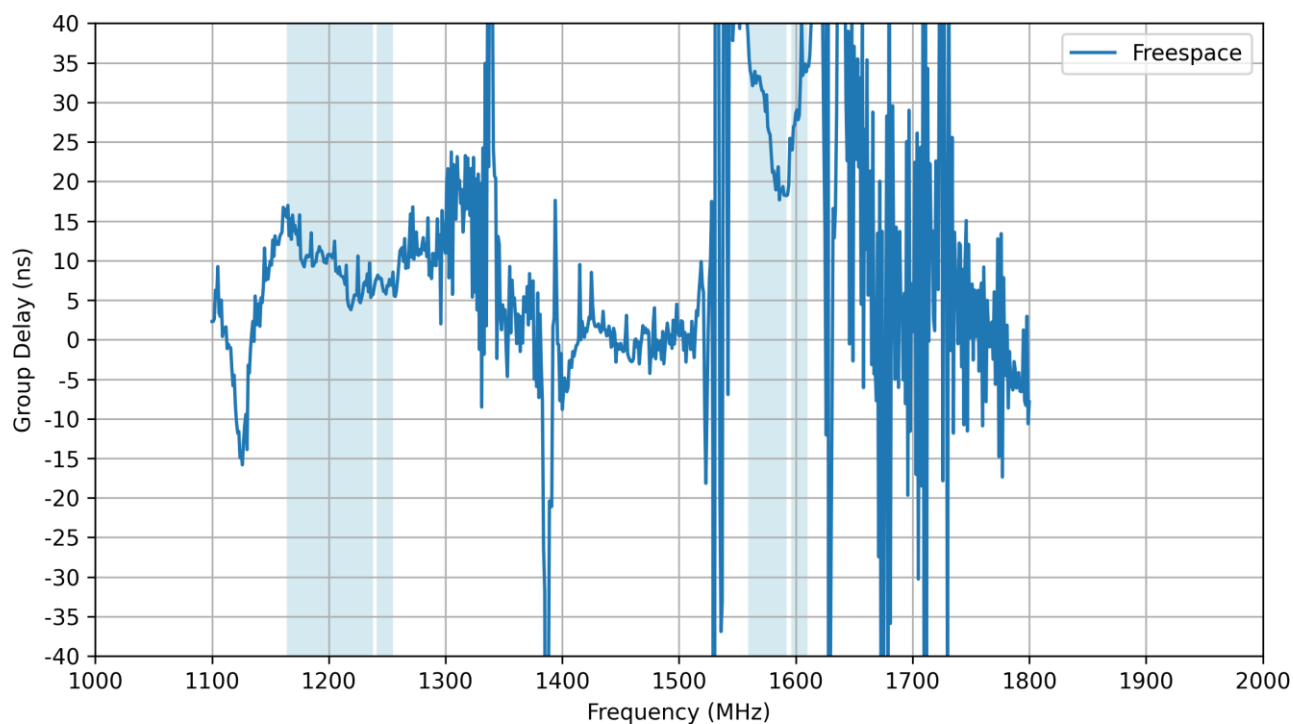
3.6 GNSS - Axial Ratio vs Angle for Phi=0



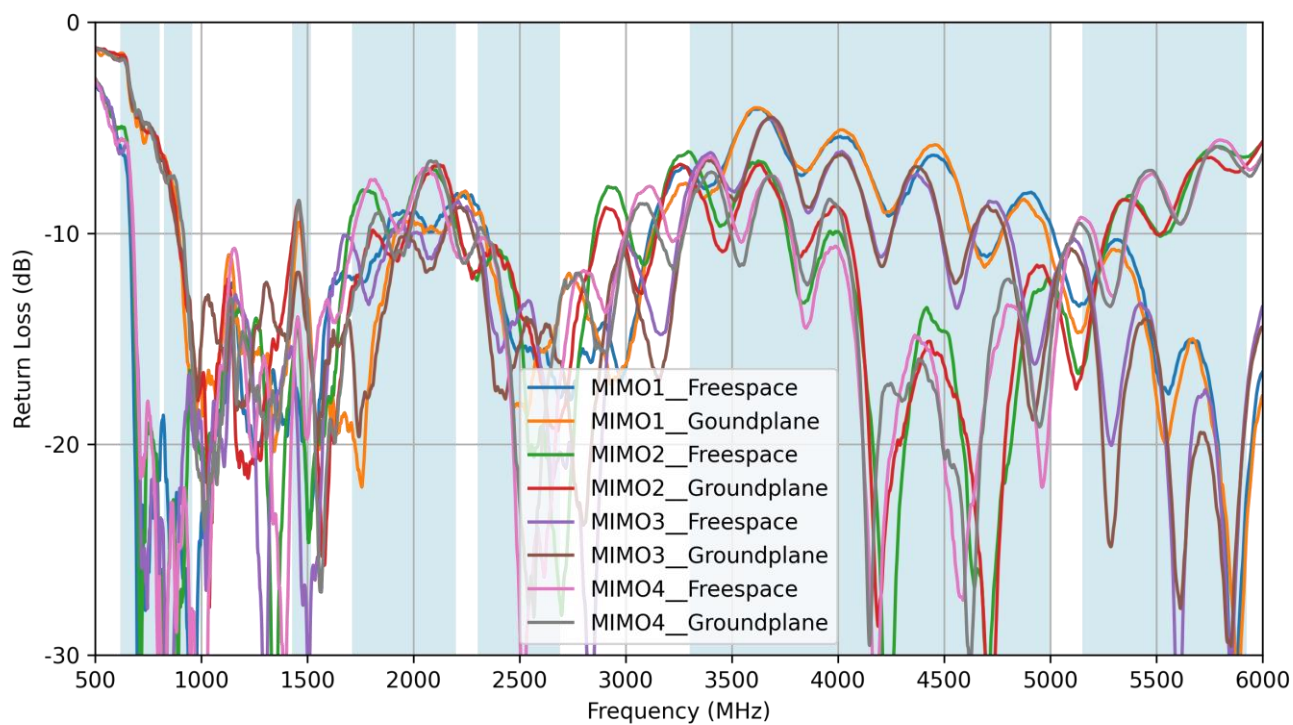
3.7 GNSS - Axial Ratio vs Angle for Phi=90



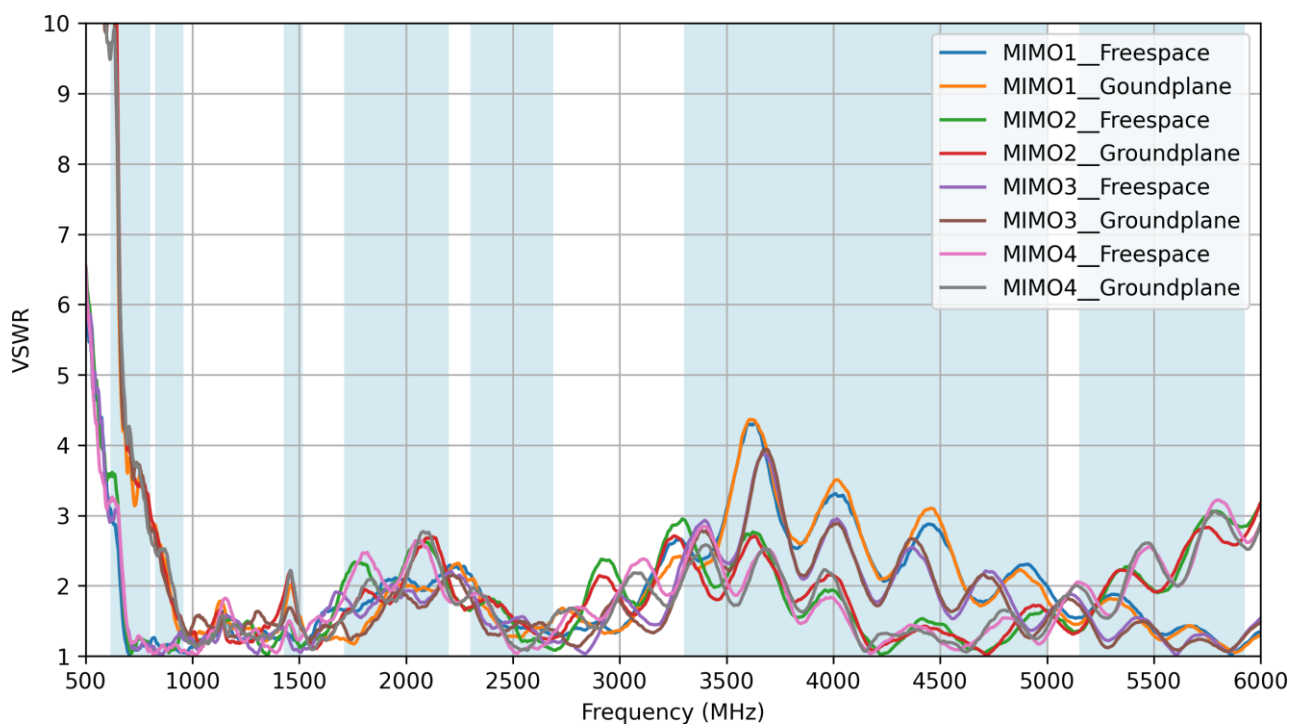
3.8 GNSS - Group Delay



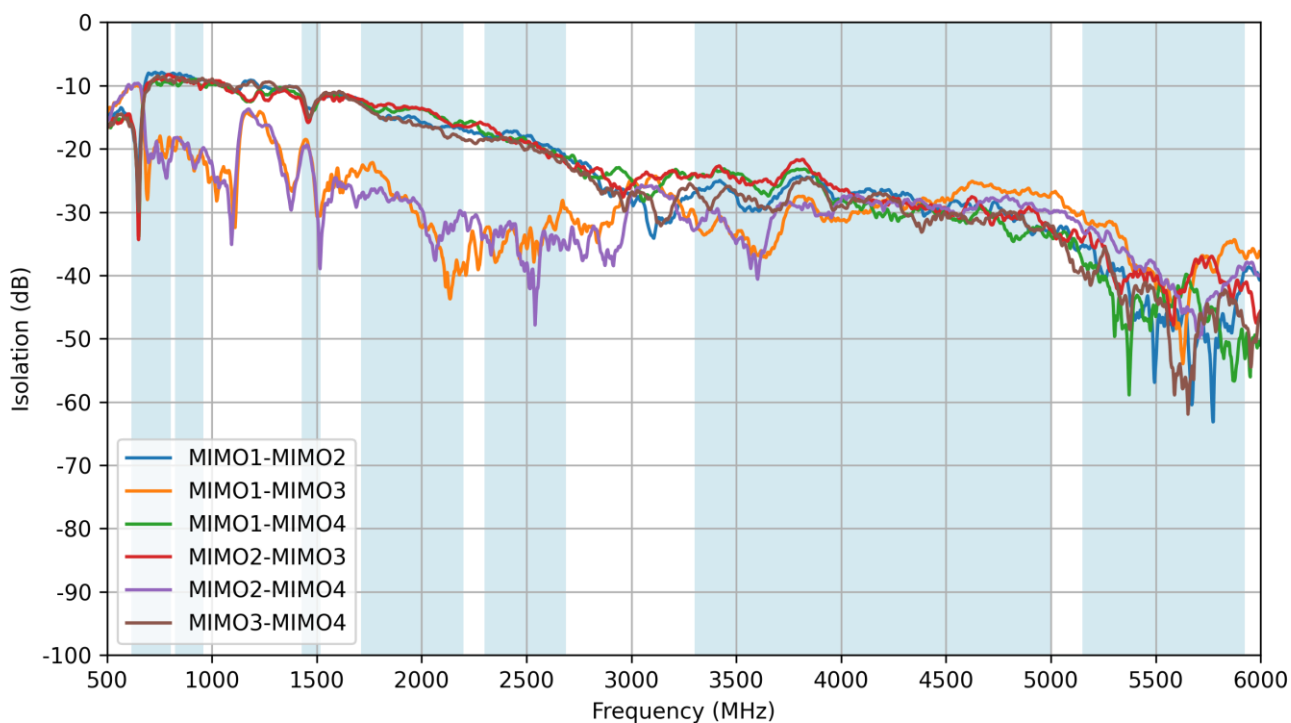
3.9 LTE - Return Loss



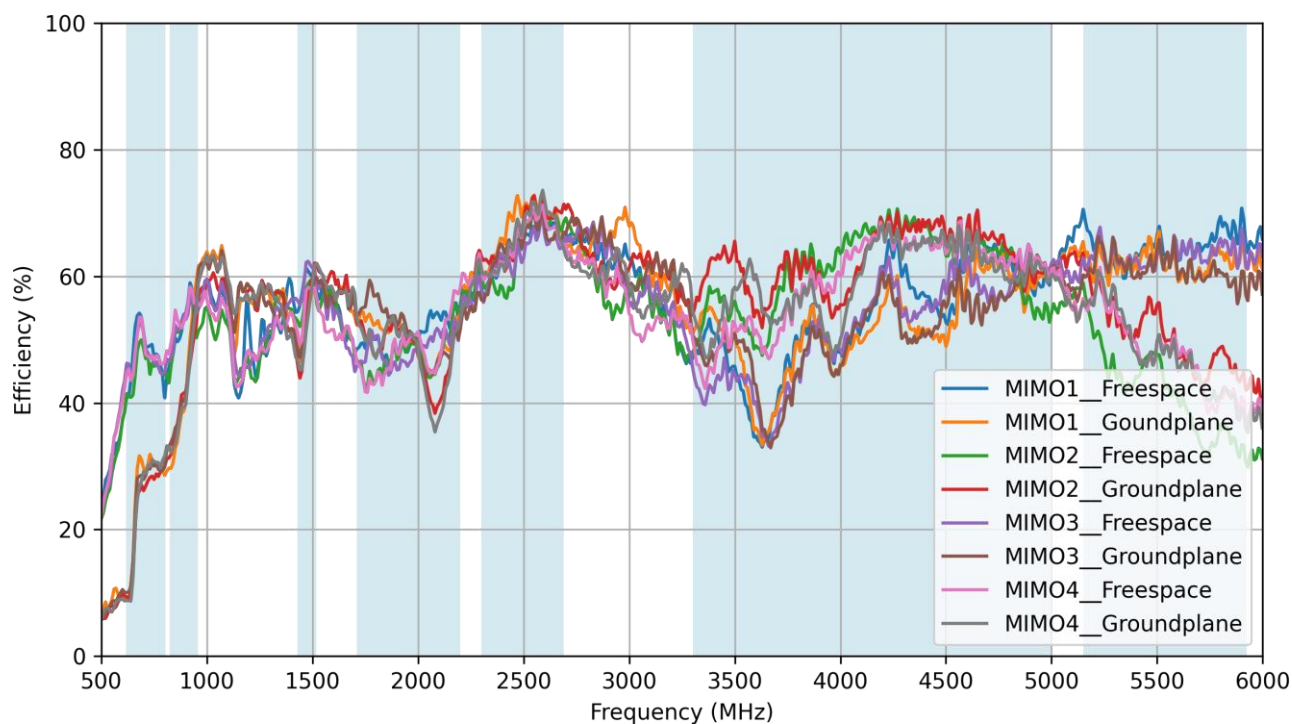
3.10 LTE - VSWR



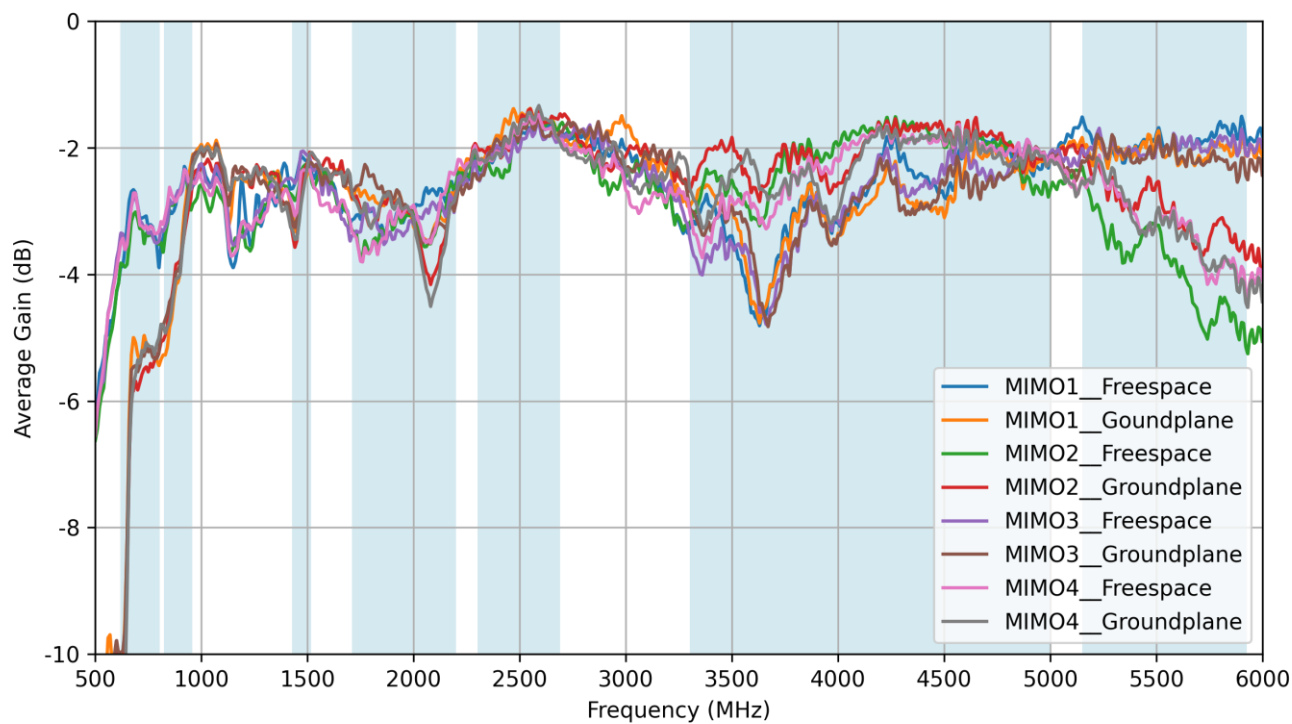
3.11 LTE - Isolation



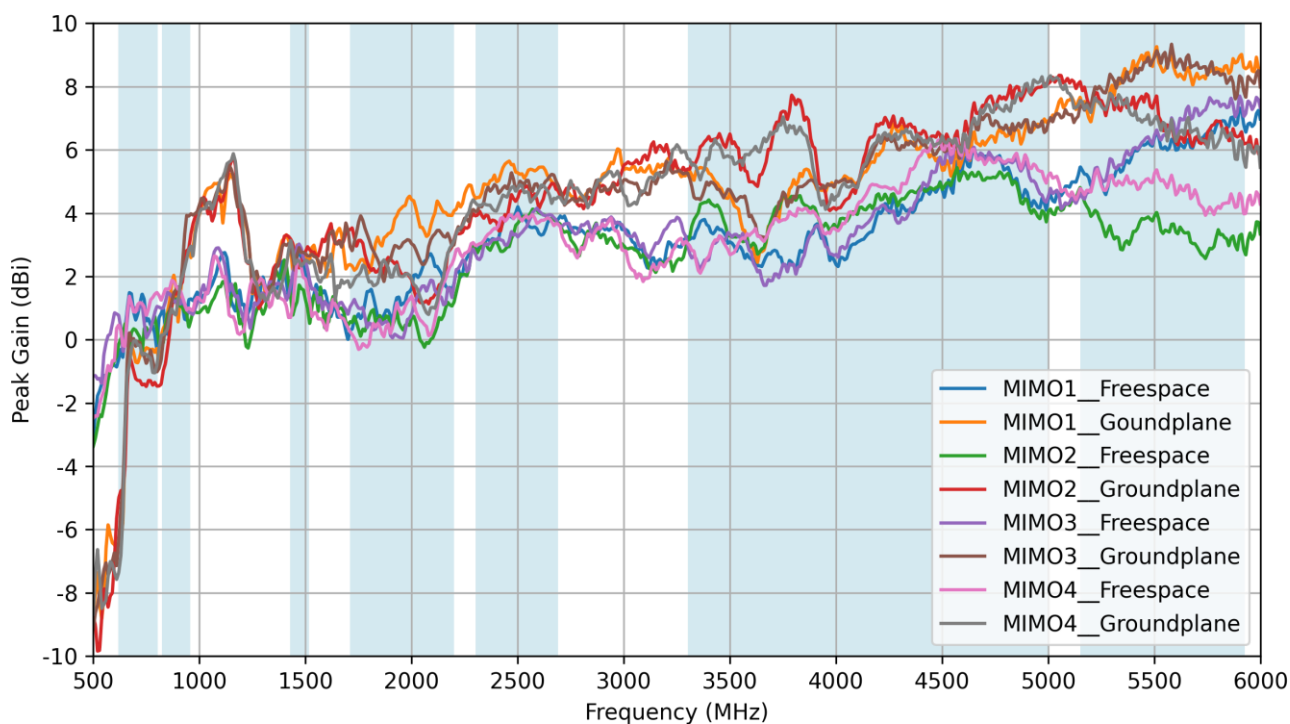
3.12 LTE - Efficiency



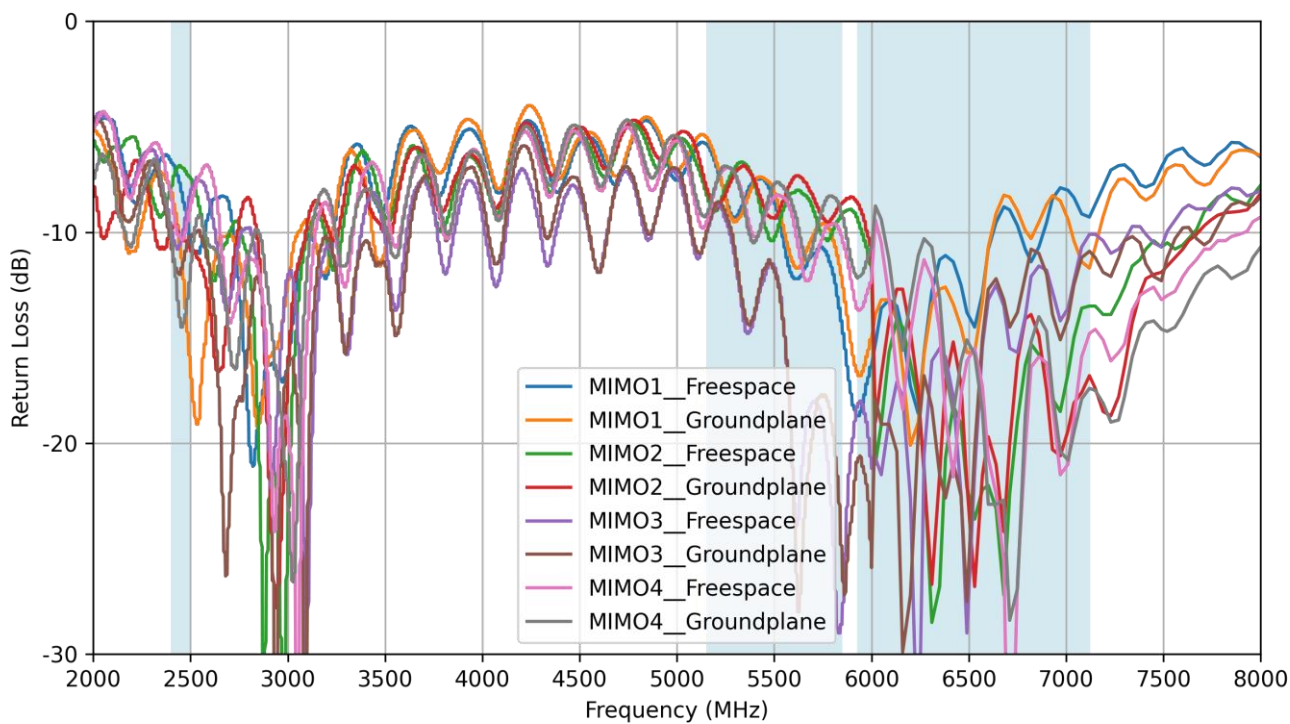
3.13 LTE - Average Gain



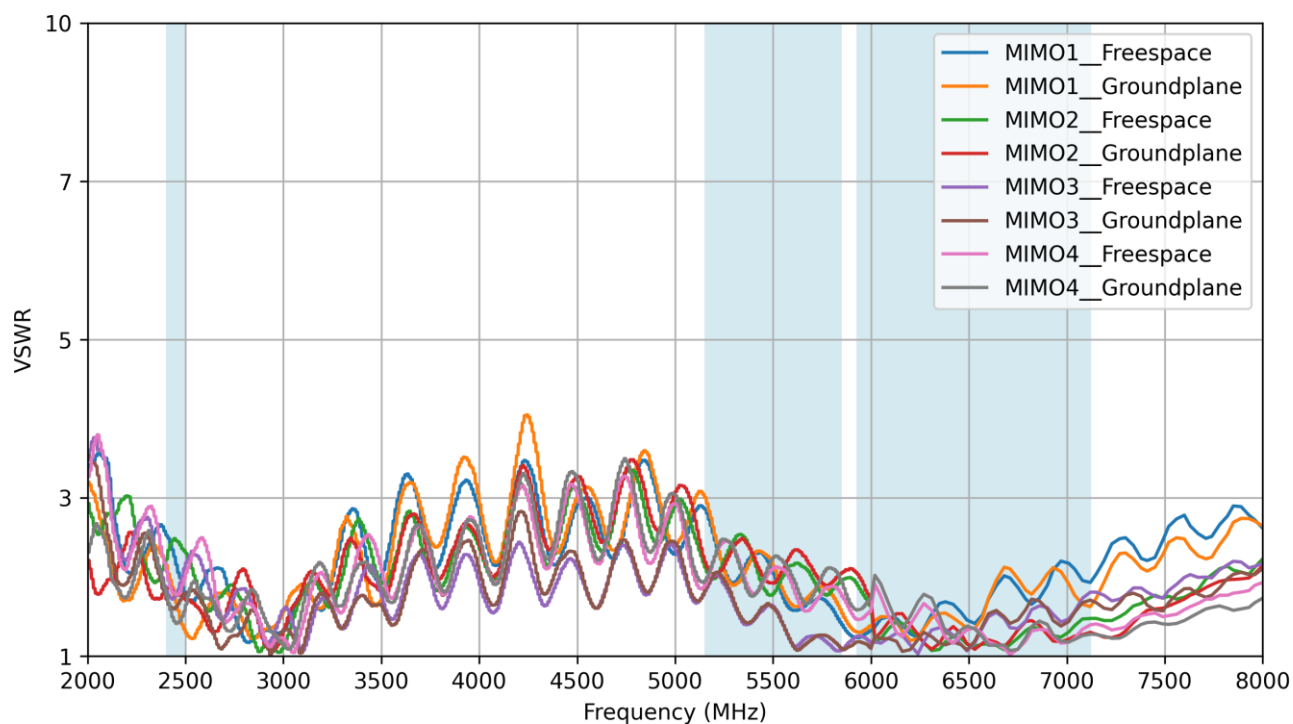
3.14 LTE - Peak Gain



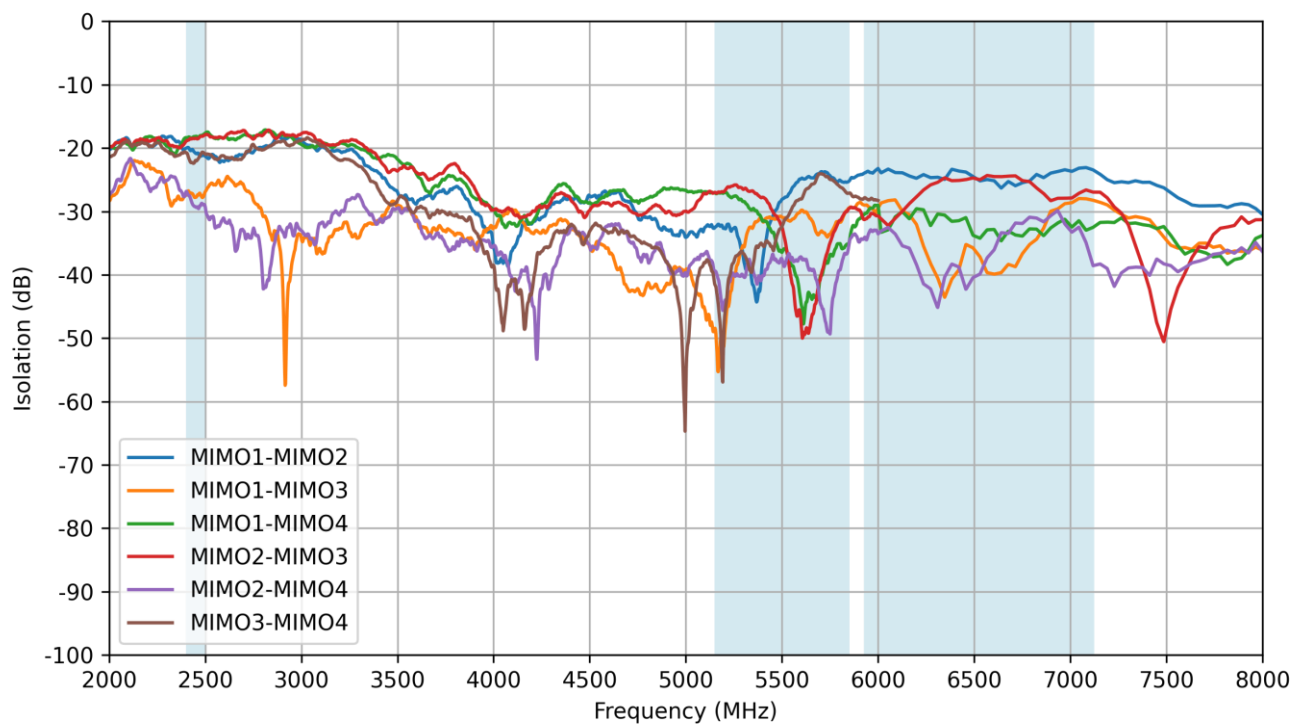
3.15 Wi-Fi - Return Loss



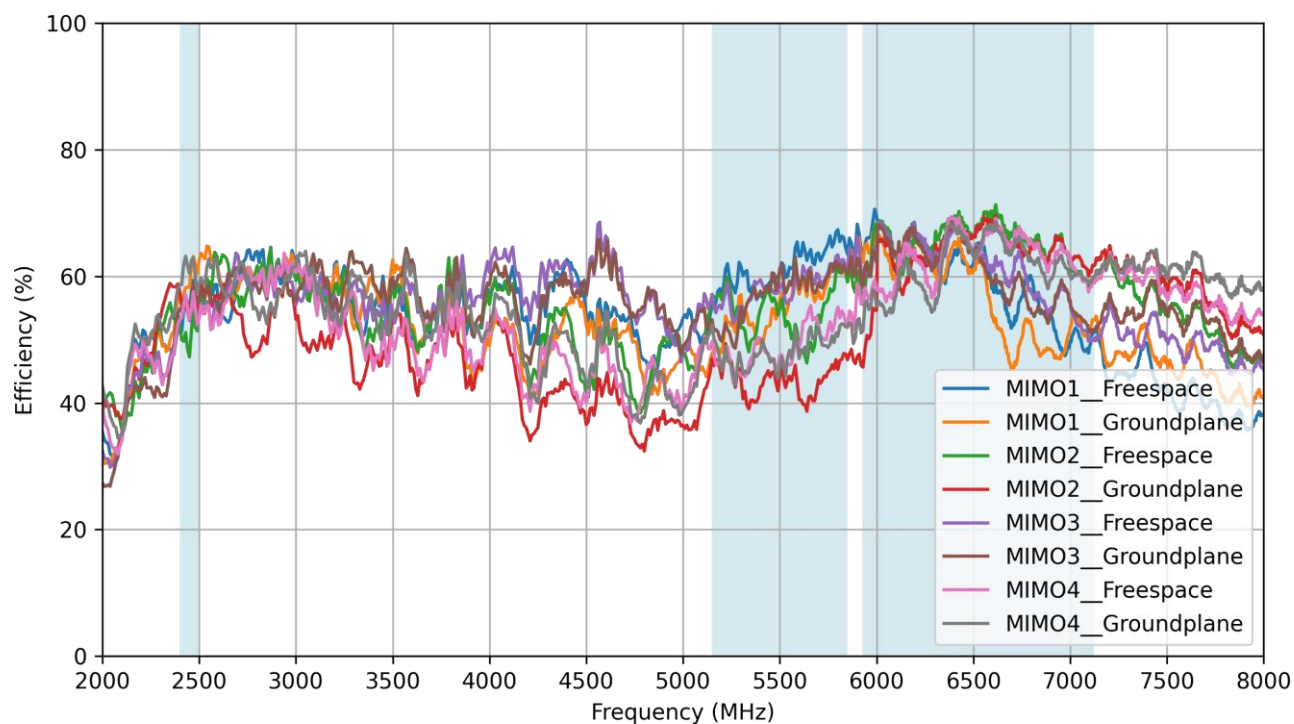
3.16 Wi-Fi - VSWR



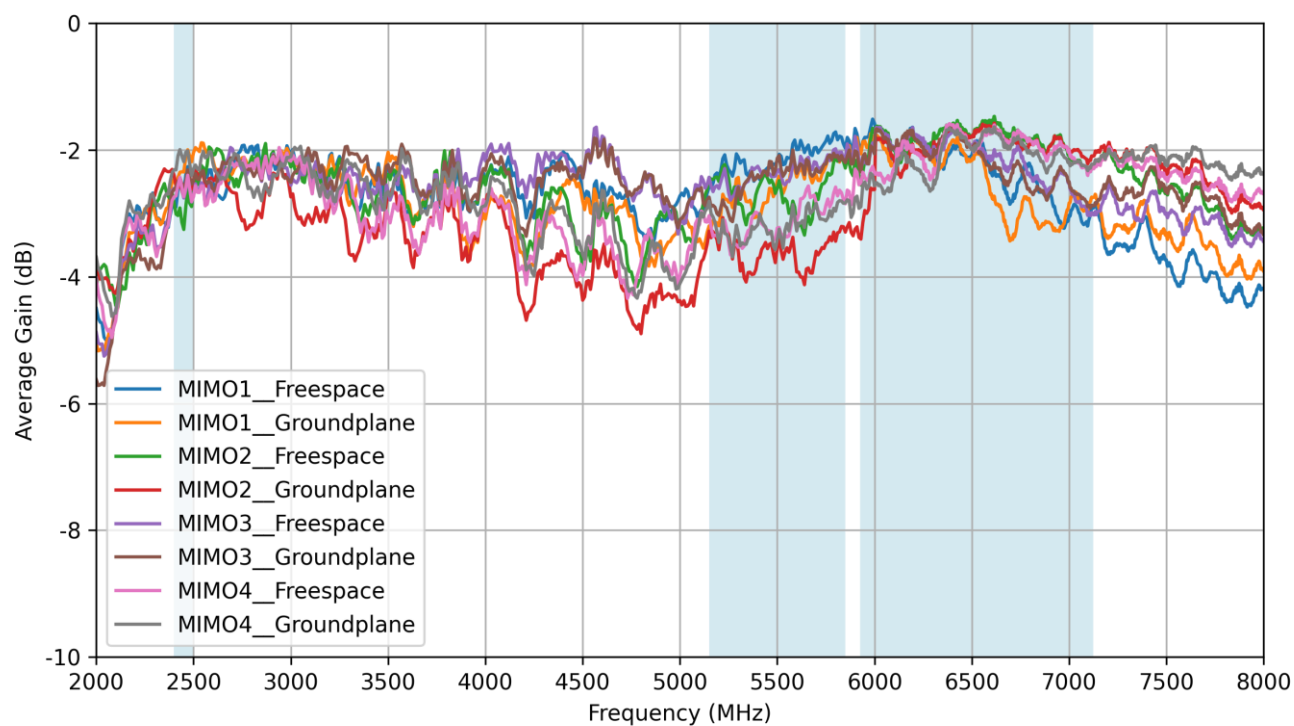
3.17 Wi-Fi - Isolation



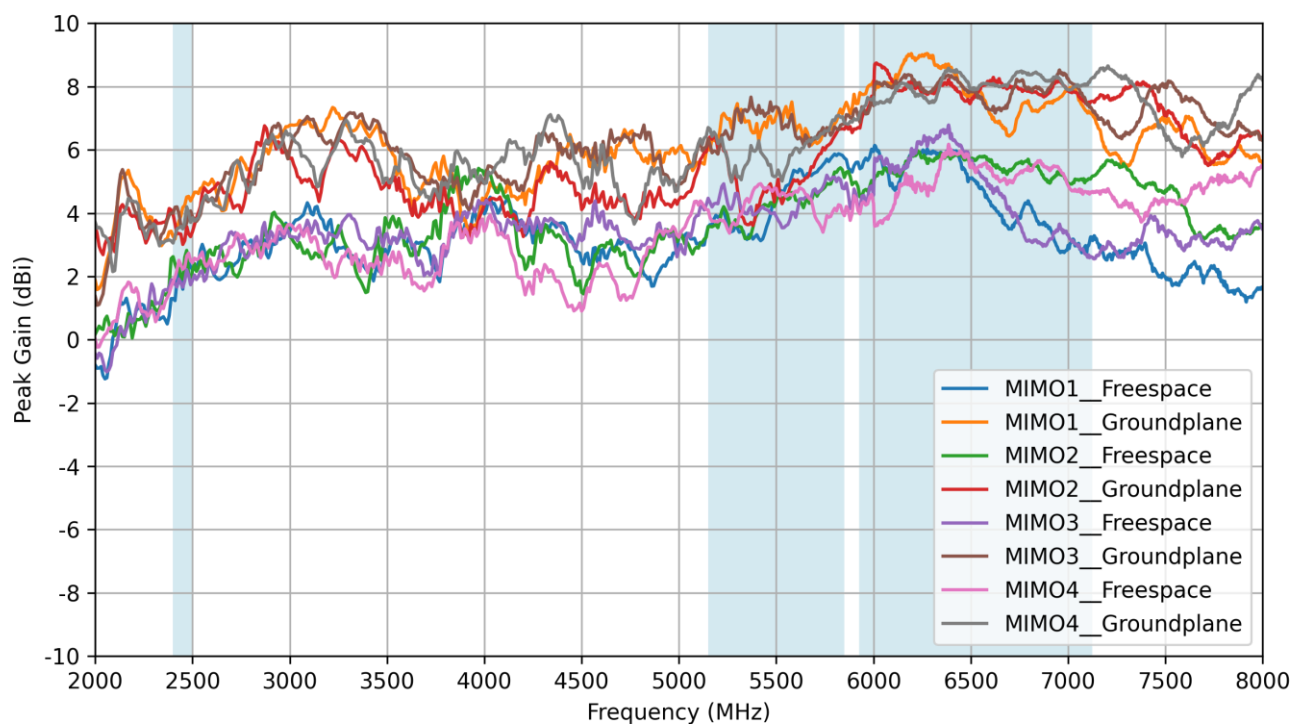
3.18 Wi-Fi - Efficiency



3.19 Wi-Fi - Average Gain



3.20 Wi-Fi - Peak Gain

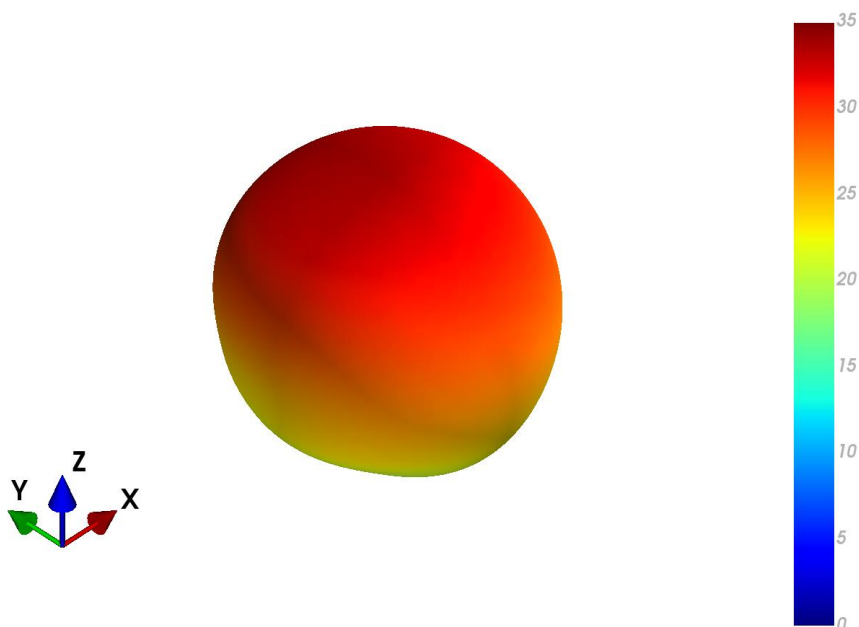


4. Radiation Patterns

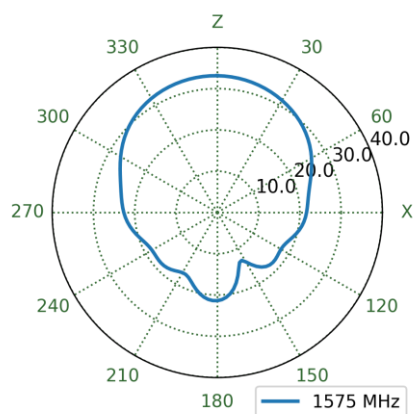
4.1 Test Setup



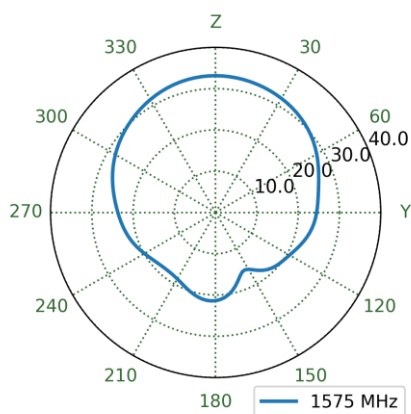
4.2 GNSS Free Space Patterns at 1576 MHz



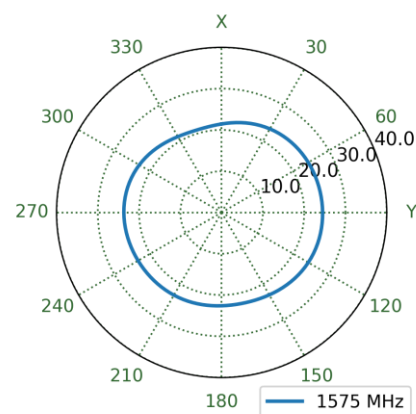
XZ Plane



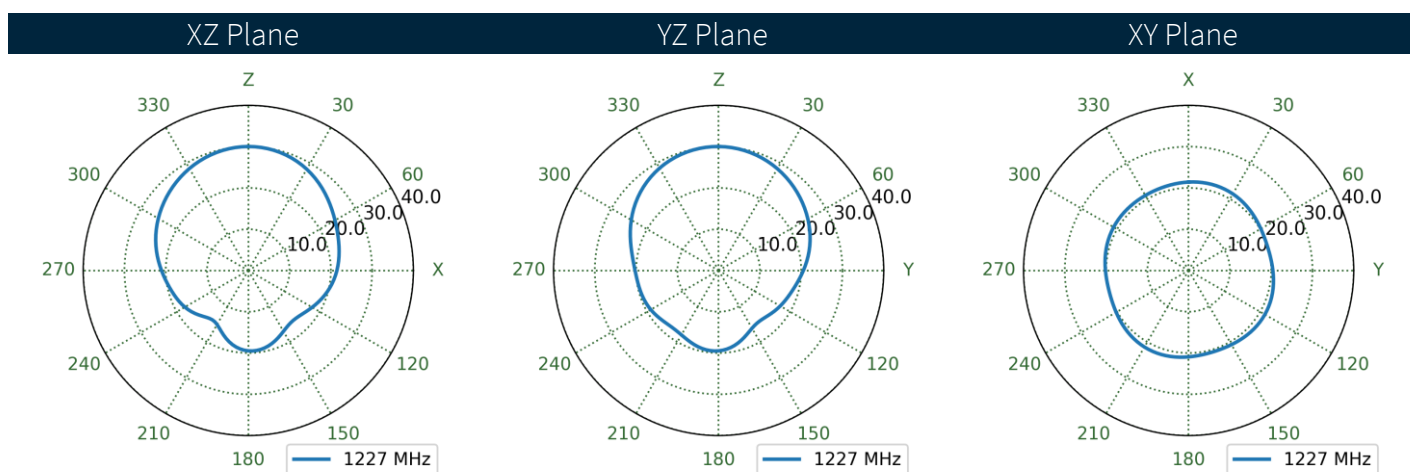
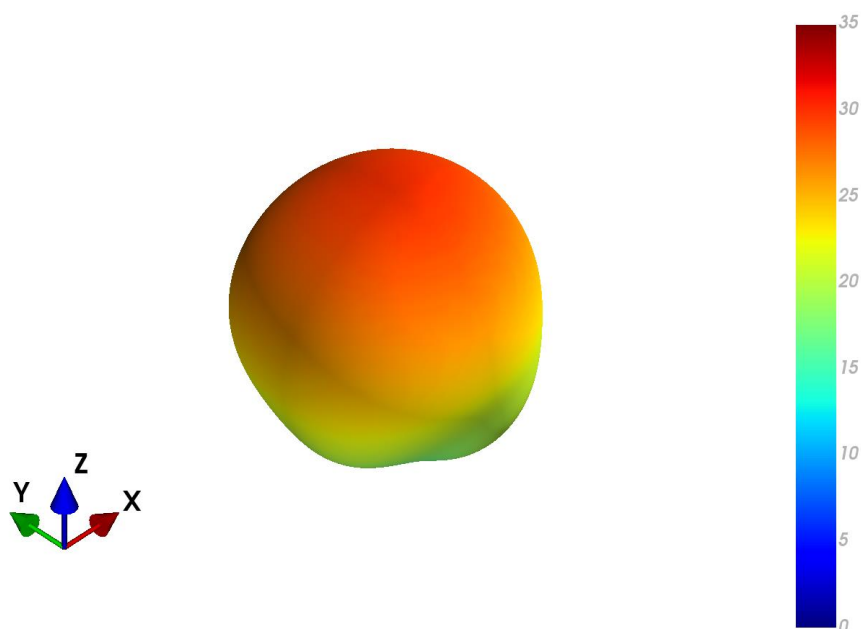
YZ Plane



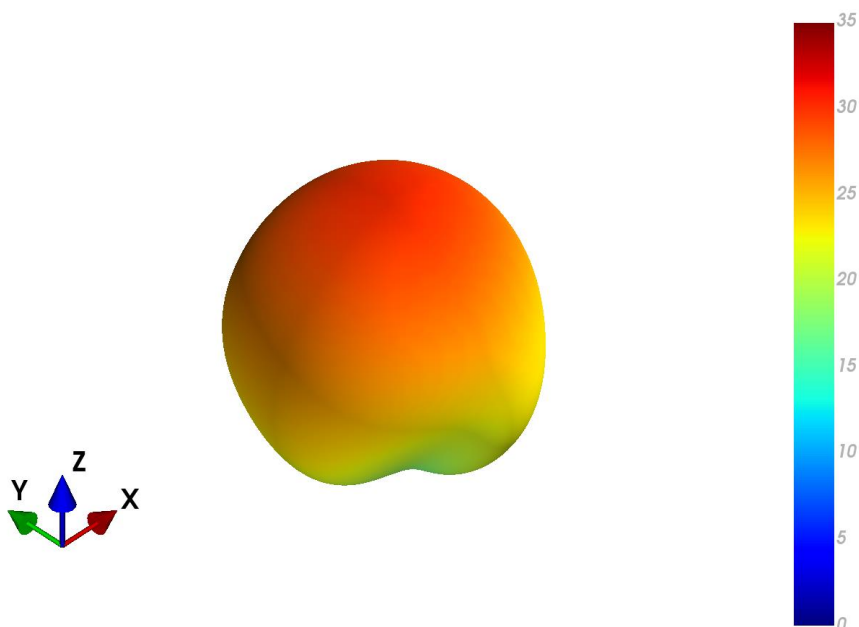
XY Plane



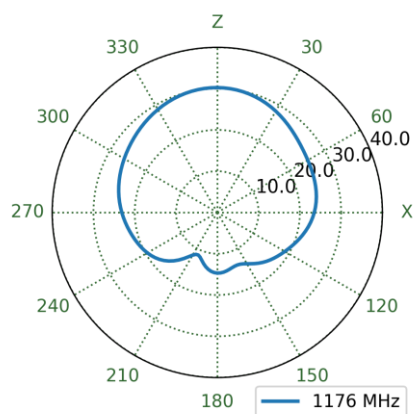
4.3 GNSS Free Space Patterns at 1228 MHz



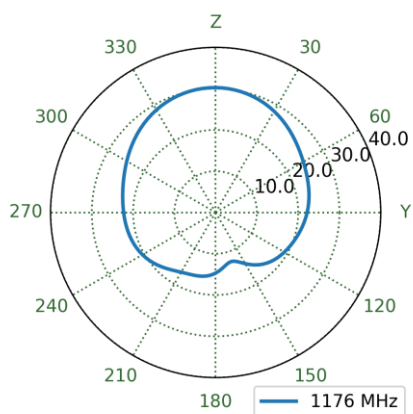
4.4 GNSS Free Space Patterns at 1177 MHz



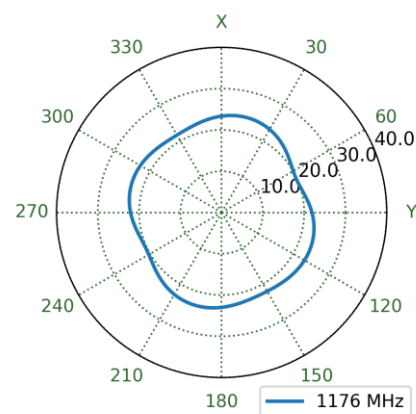
XZ Plane



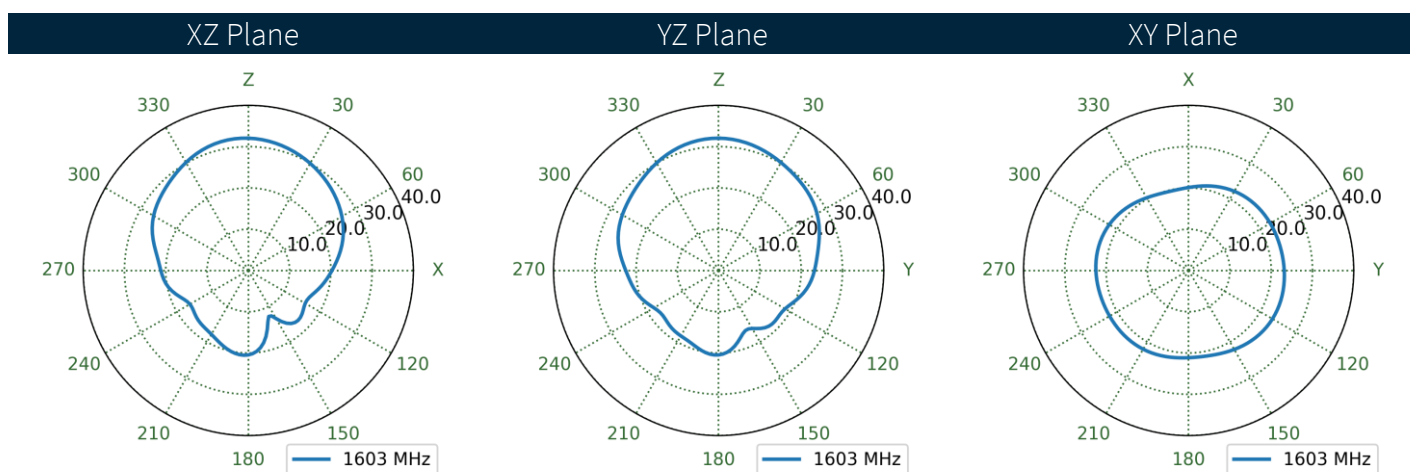
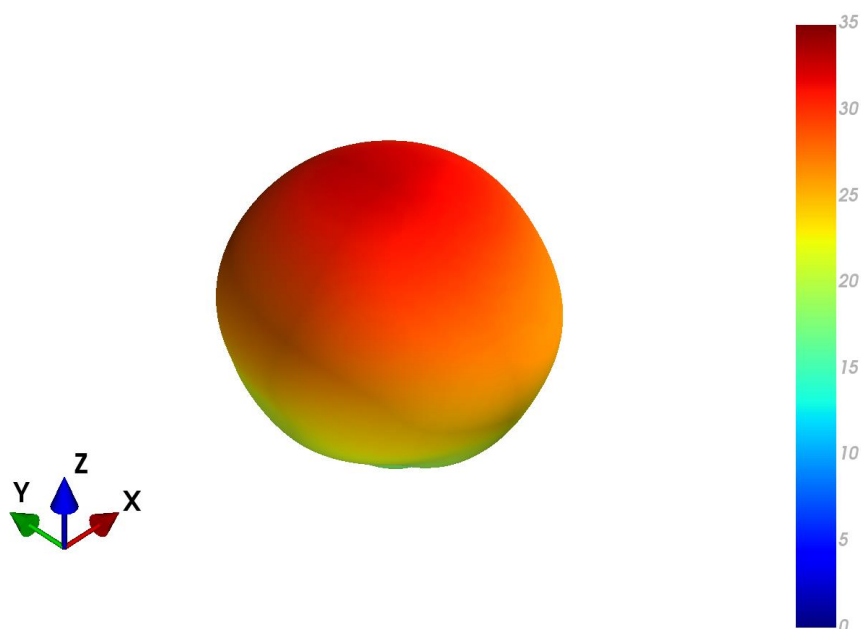
YZ Plane



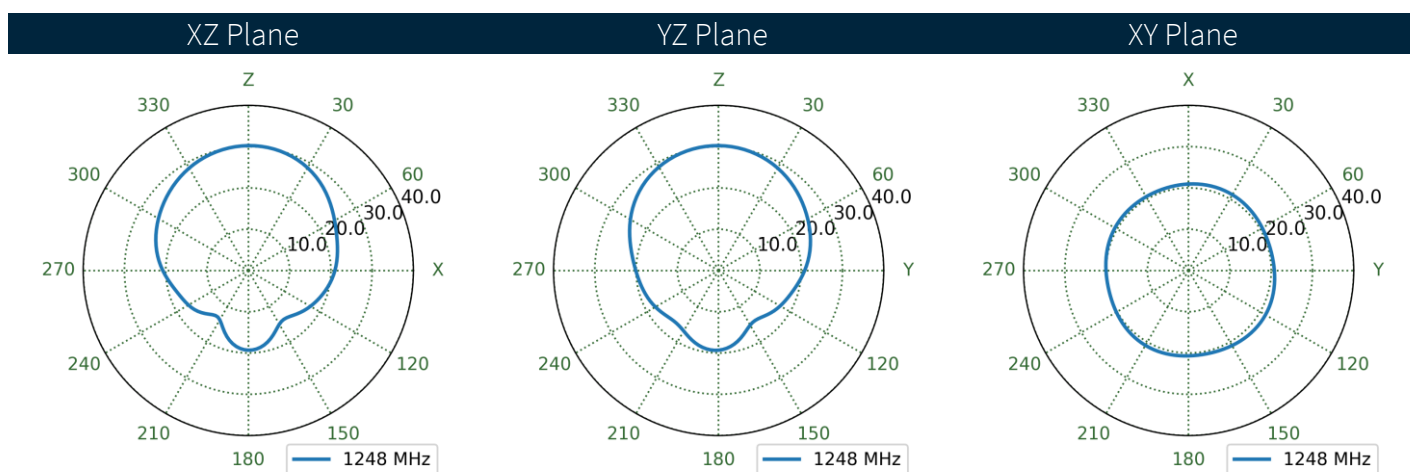
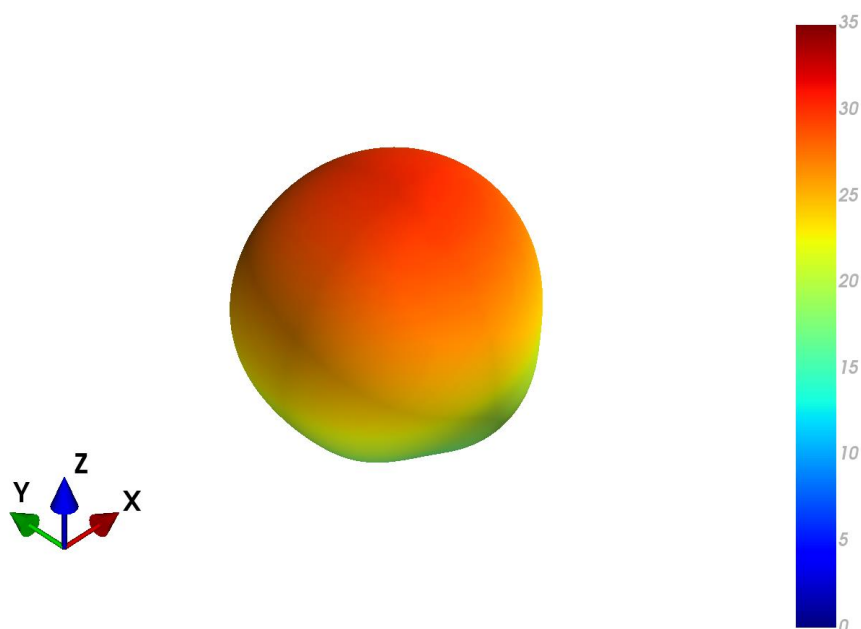
XY Plane



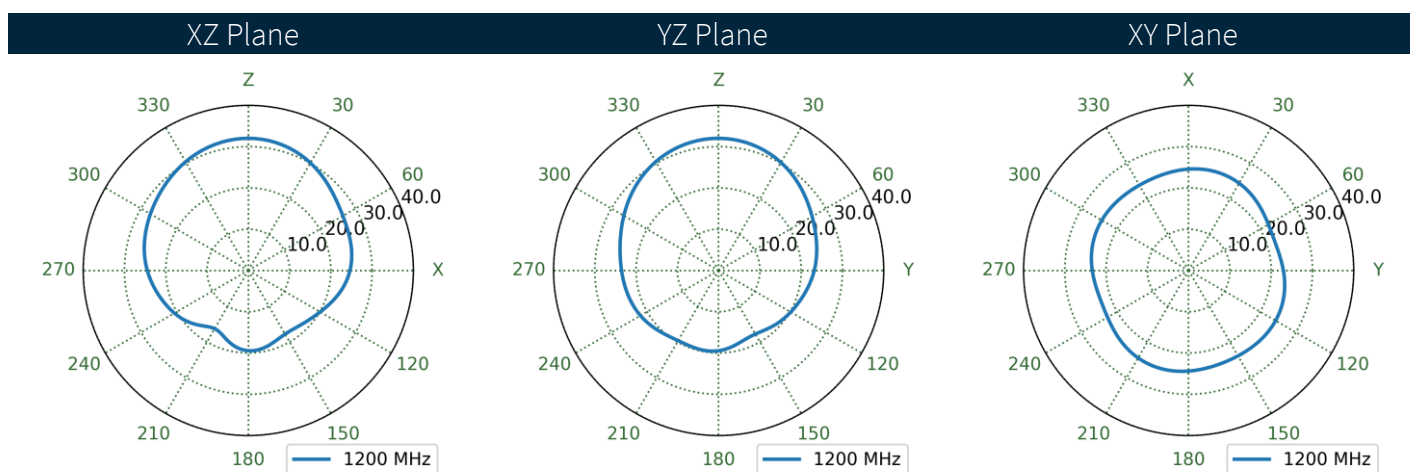
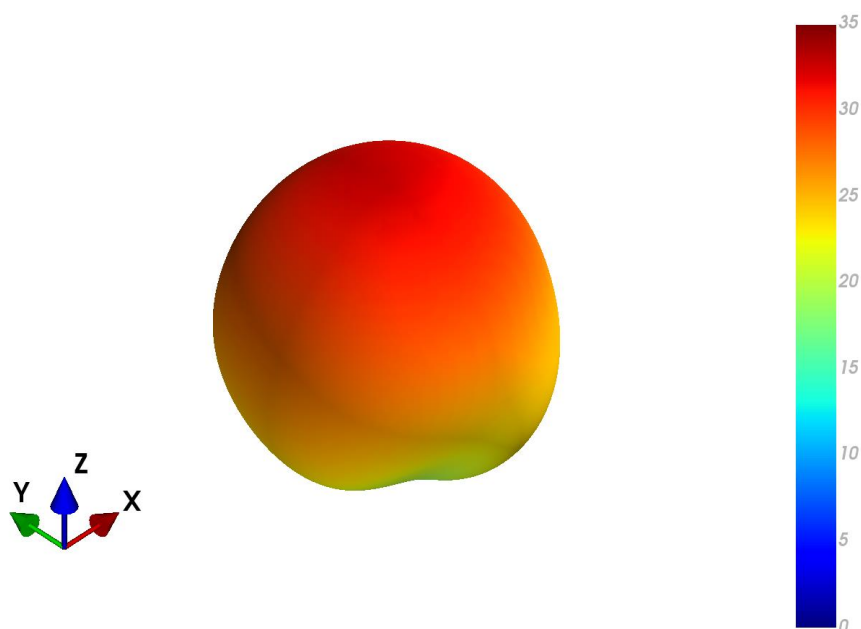
4.5 GNSS Free Space Patterns at 1603 MHz



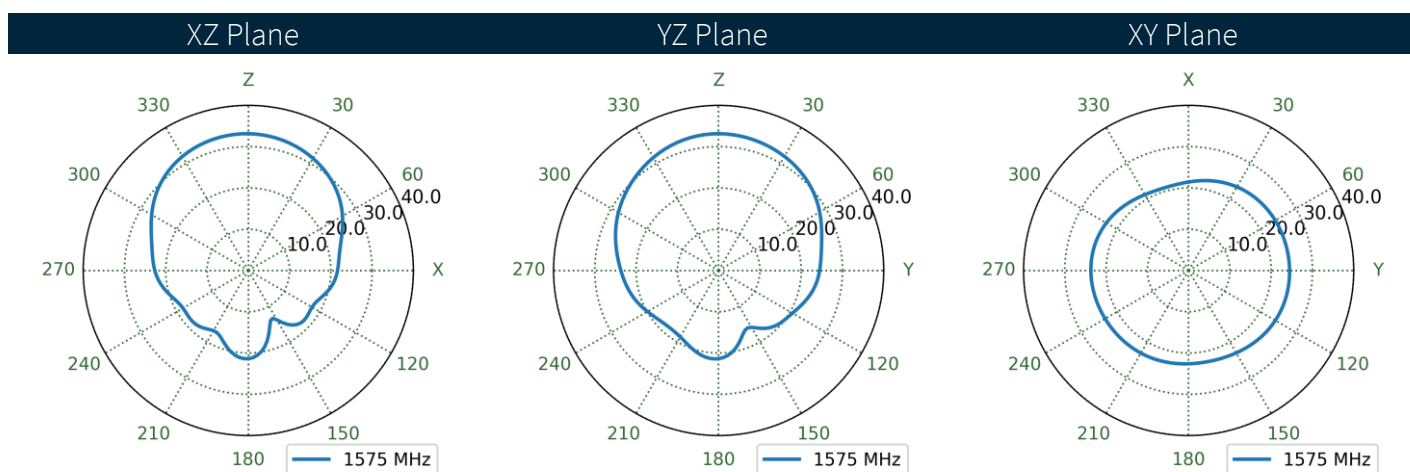
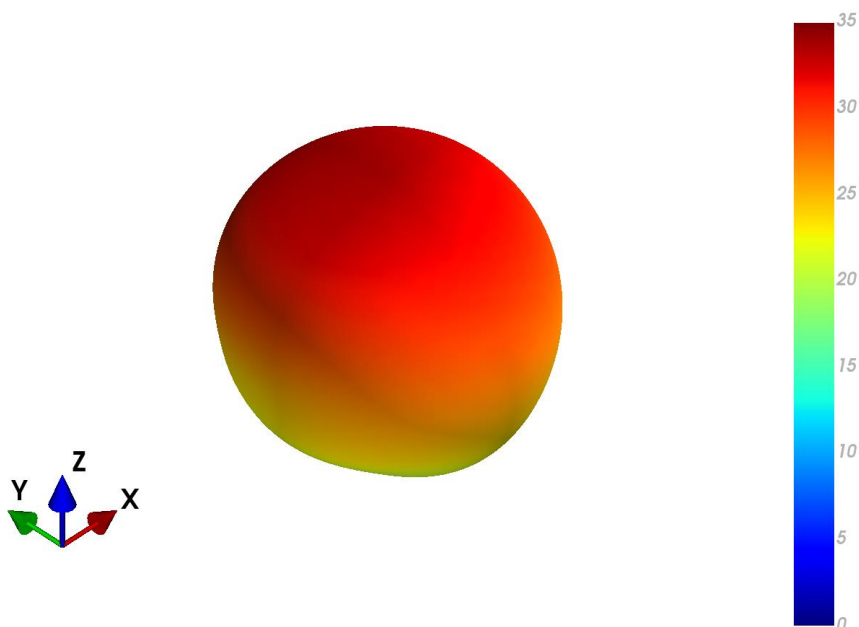
4.6 GNSS Free Space Patterns at 1248 MHz



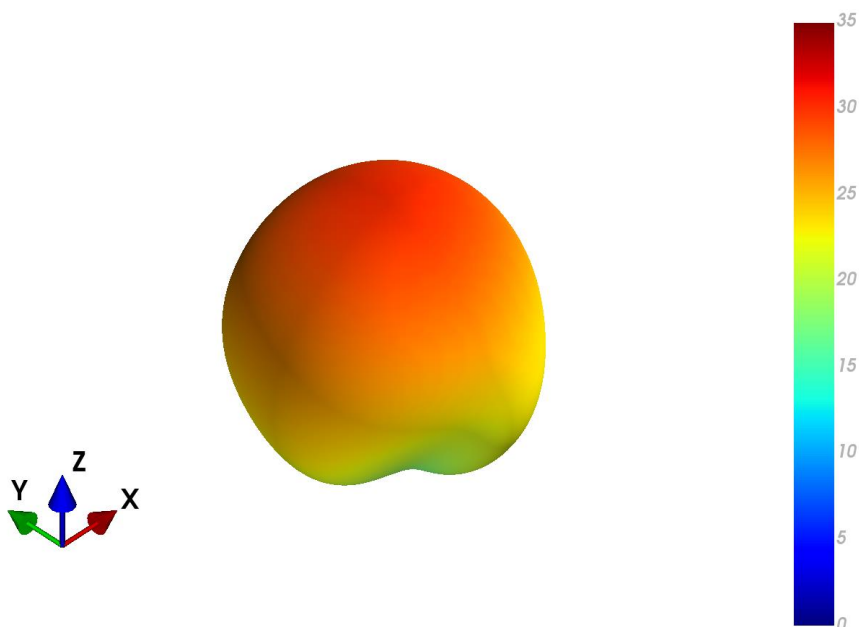
4.7 GNSS Free Space Patterns at 1201 MHz



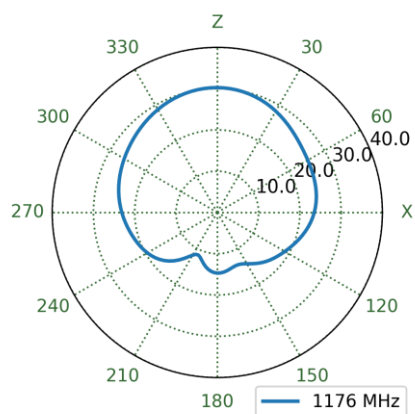
4.8 GNSS Free Space Patterns at 1576 MHz



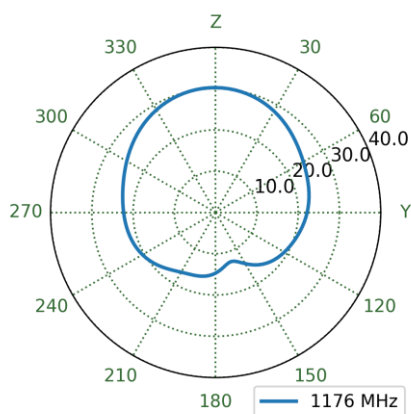
4.9 GNSS Free Space Patterns at 1176 MHz



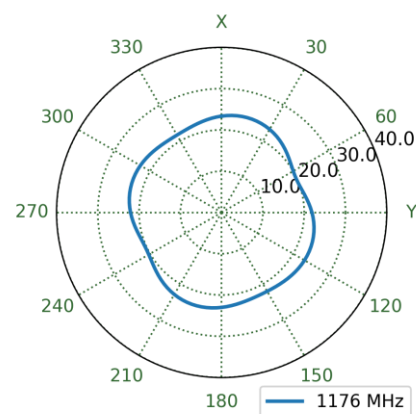
XZ Plane



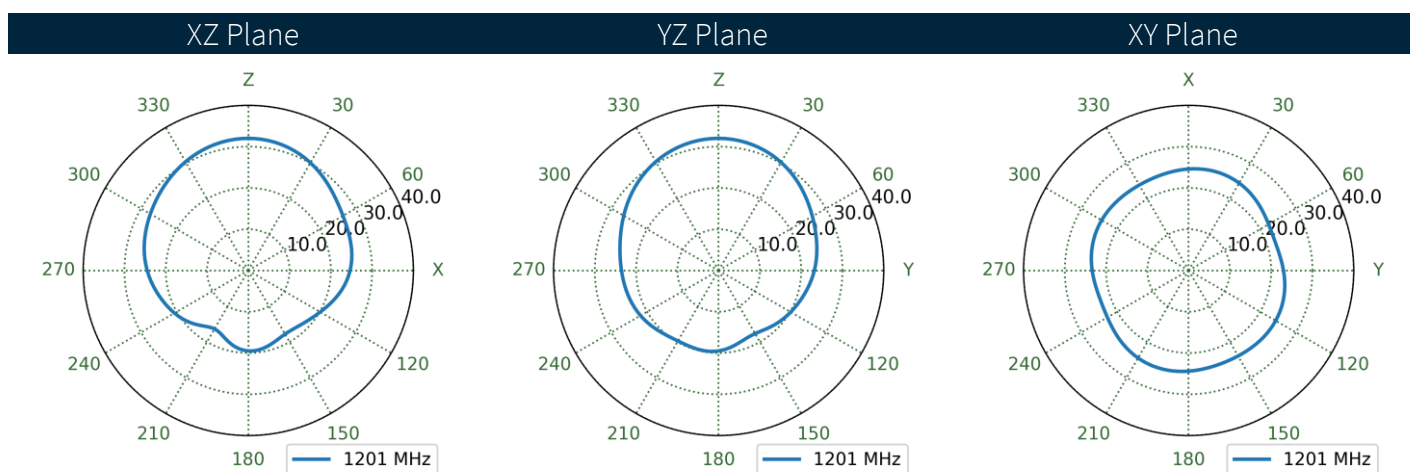
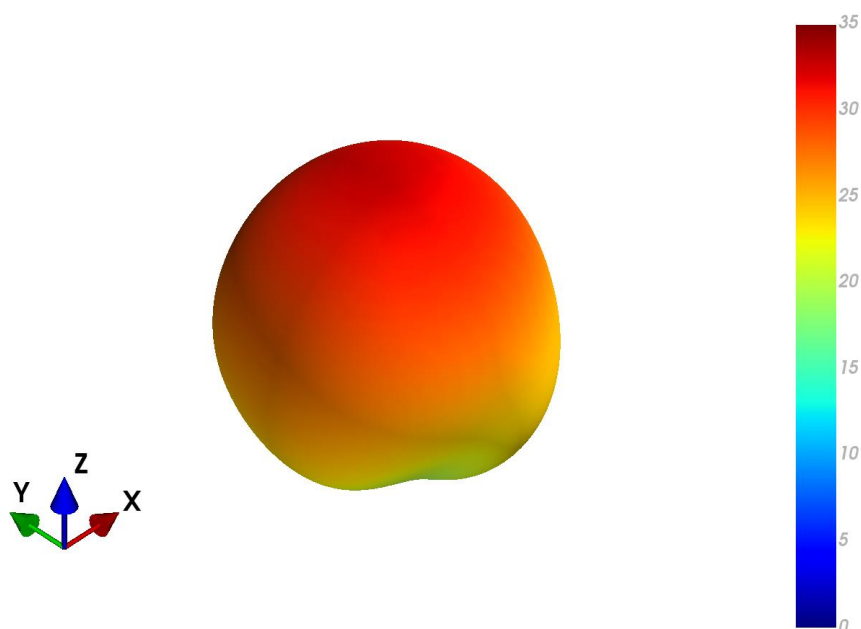
YZ Plane



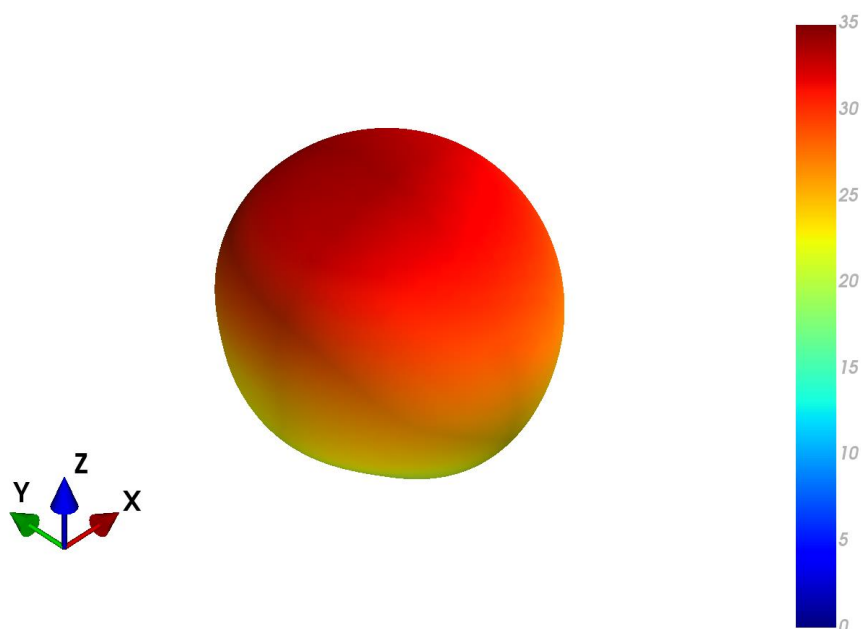
XY Plane



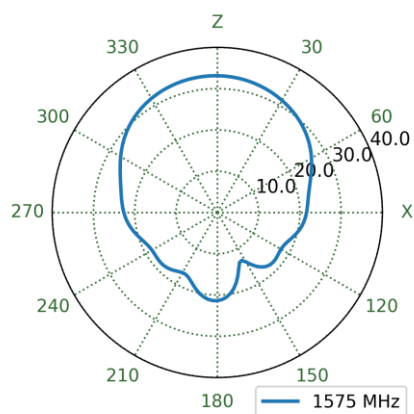
4.10 GNSS Free Space Patterns at 1202 MHz



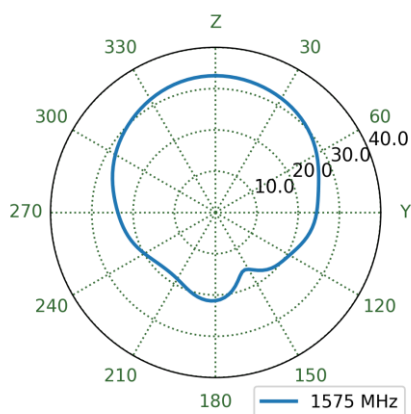
4.11 GNSS Free Space Patterns at 1576 MHz



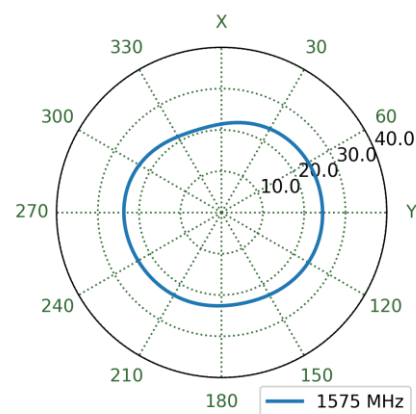
XZ Plane



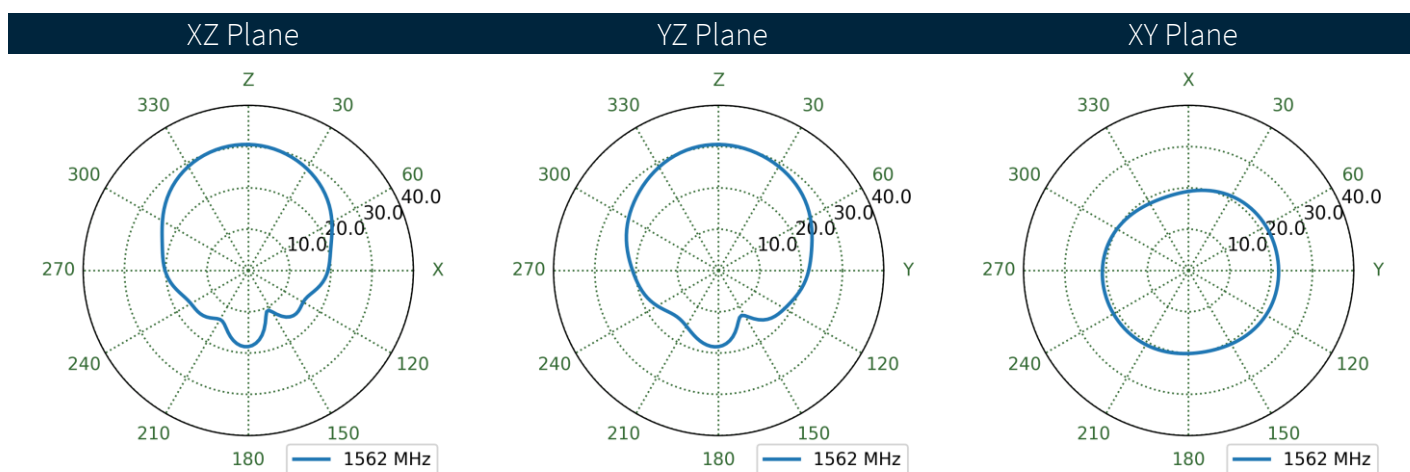
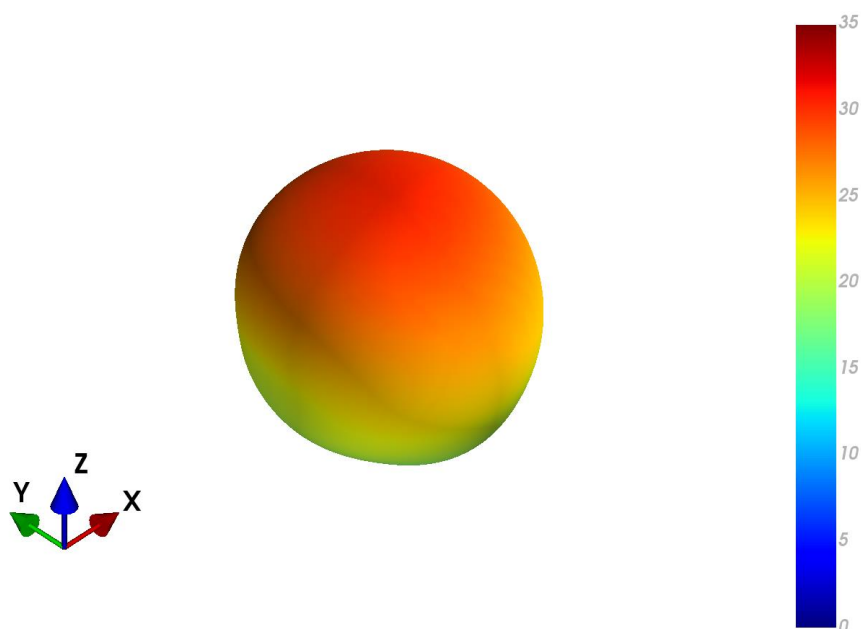
YZ Plane



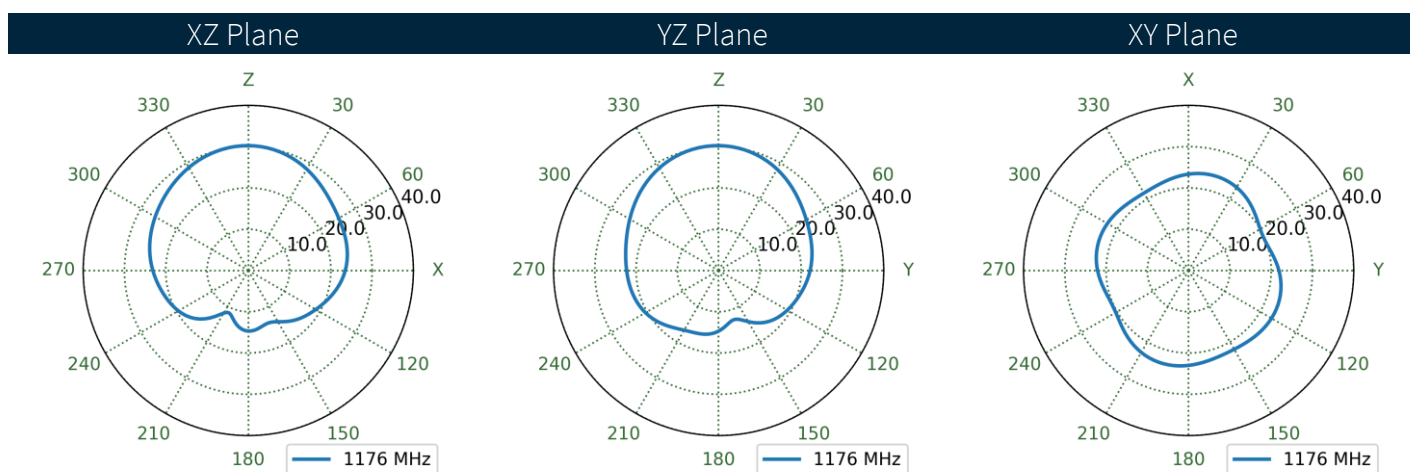
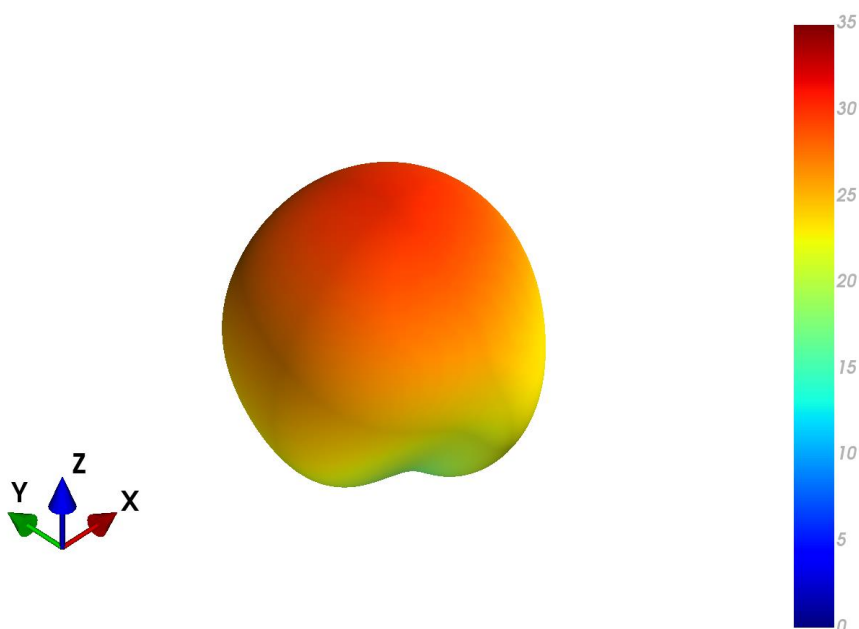
XY Plane



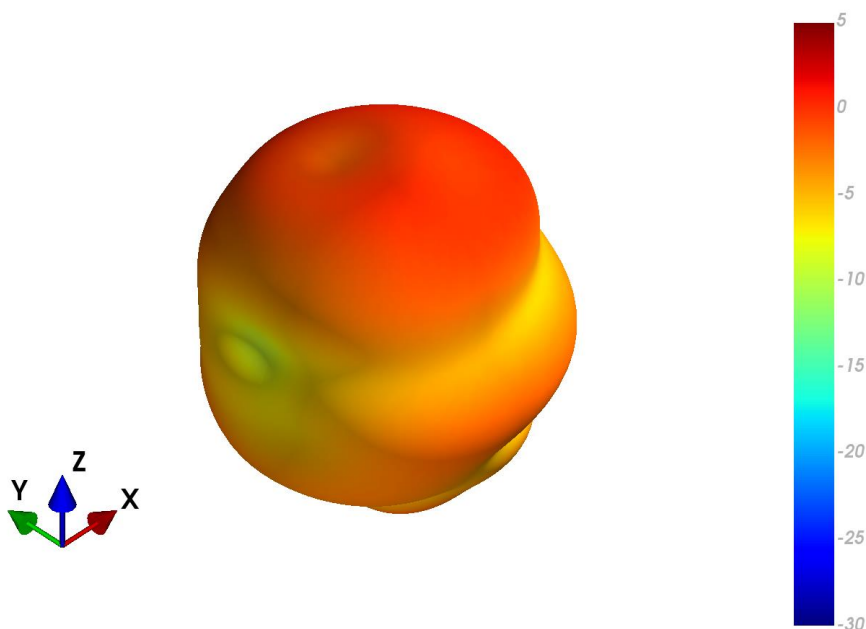
4.12 GNSS Free Space Patterns at 1562 MHz



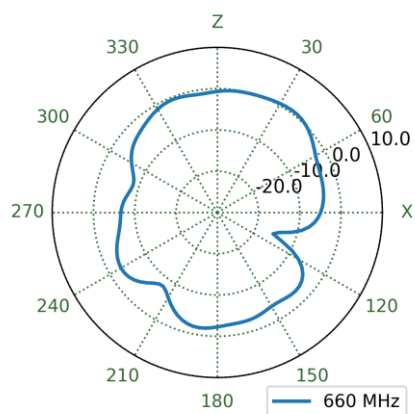
4.13 GNSS Free Space Patterns at 1176 MHz



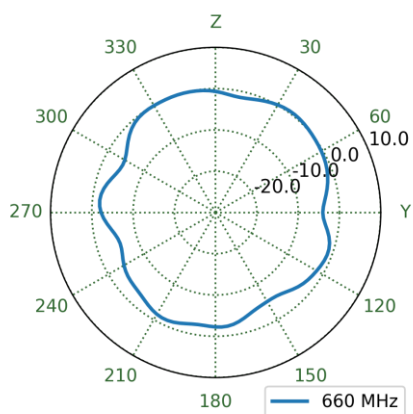
4.14 MIMO1 LTE Free Space Patterns at 658 MHz



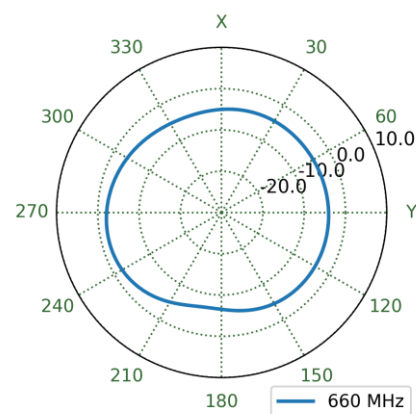
XZ Plane



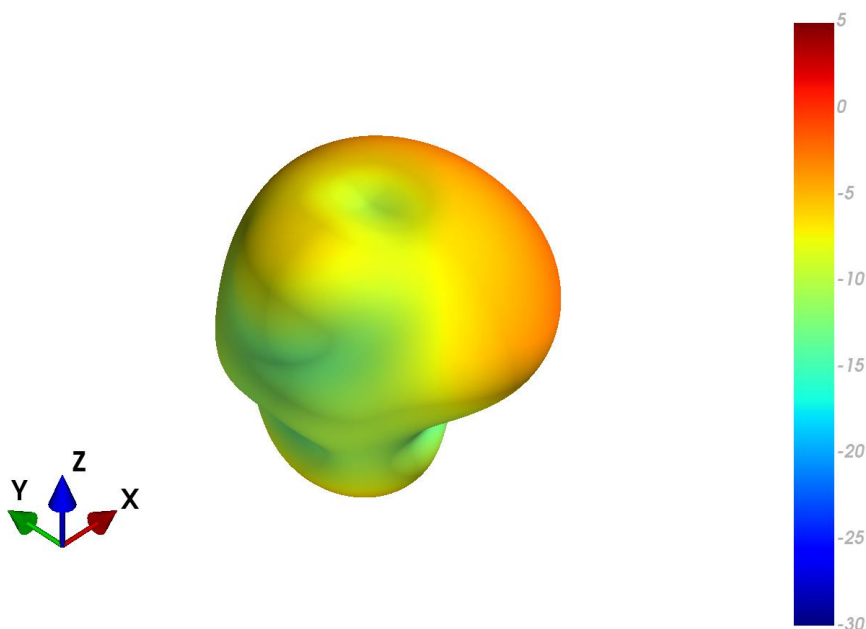
YZ Plane



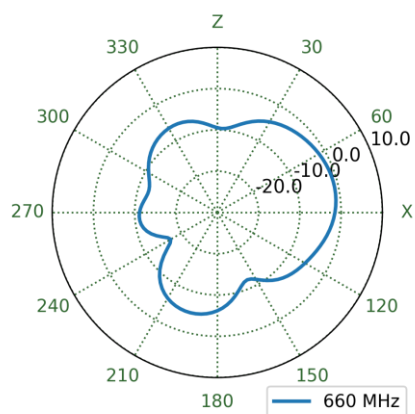
XY Plane



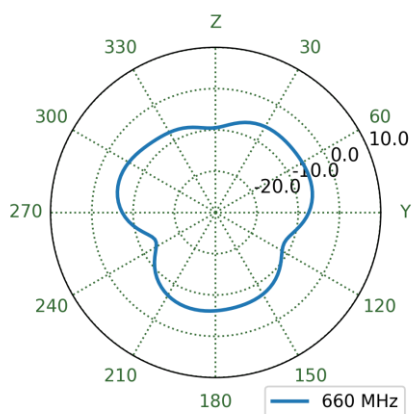
4.15 MIMO1 LTE Ground Plane Patterns at 658 MHz



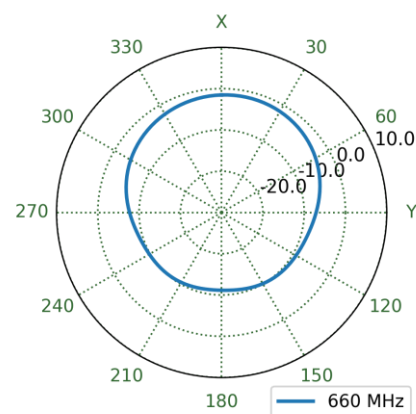
XZ Plane



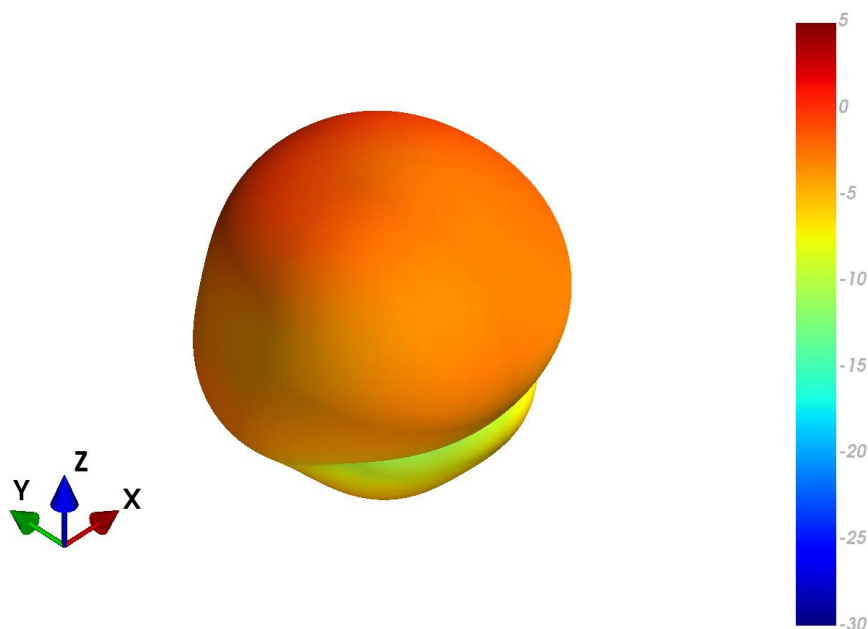
YZ Plane



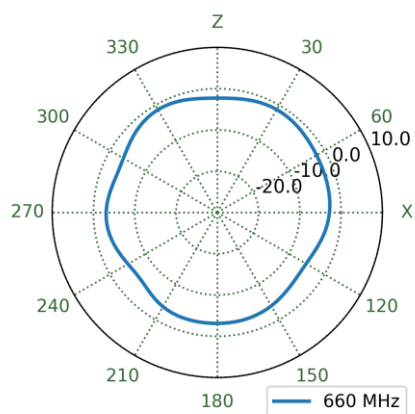
XY Plane



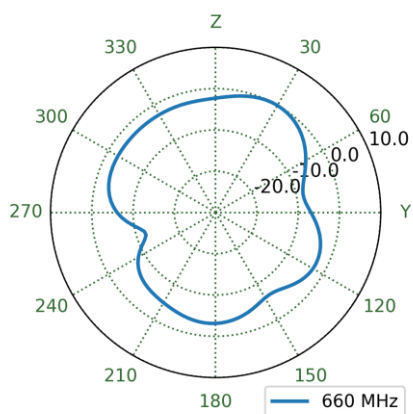
4.16 MIMO2 LTE Free Space Patterns at 658 MHz



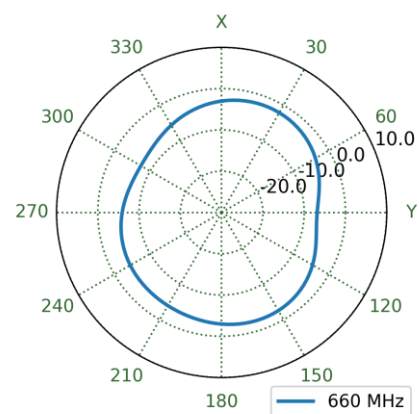
XZ Plane



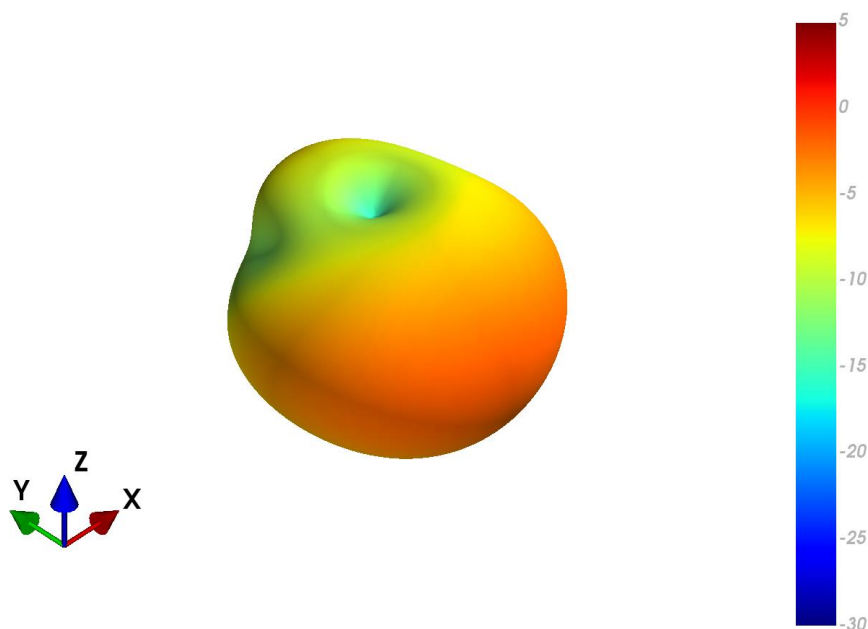
YZ Plane



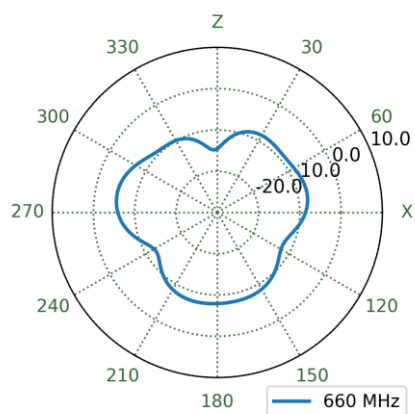
XY Plane



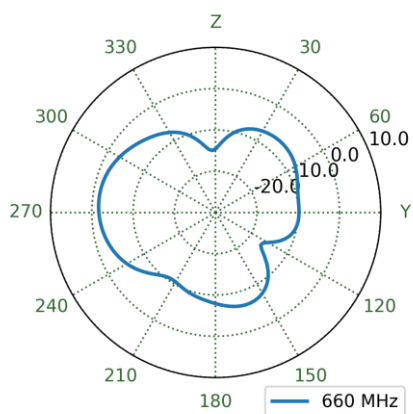
4.17 MIMO2 LTE Ground Plane Patterns at 658 MHz



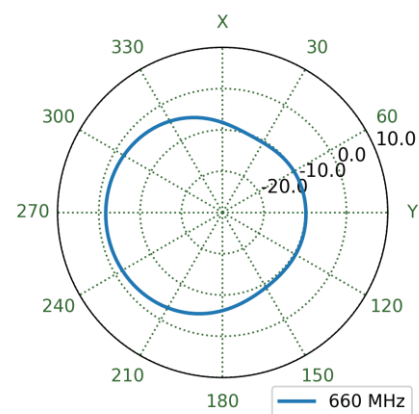
XZ Plane



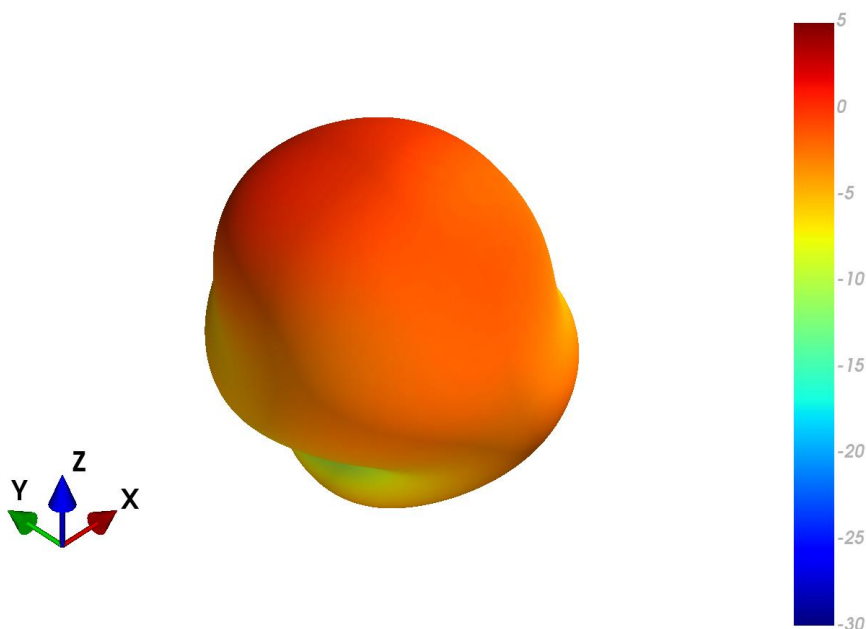
YZ Plane



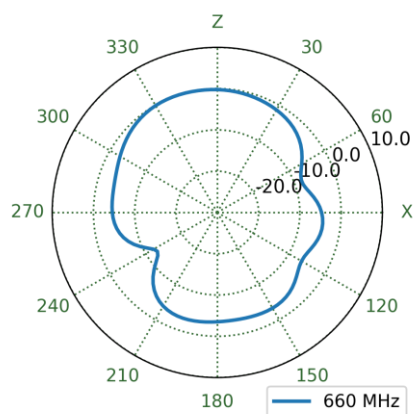
XY Plane



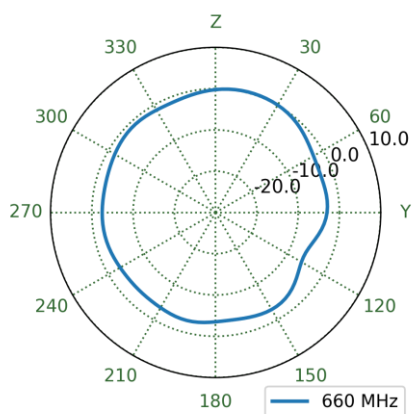
4.18 MIMO3 LTE Free Space Patterns at 658 MHz



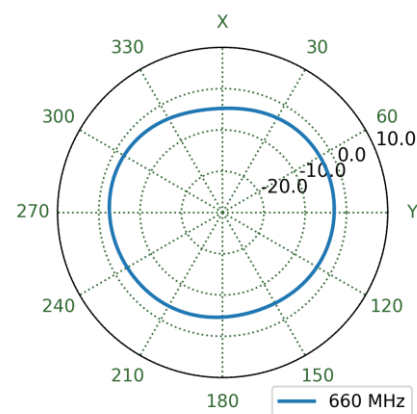
XZ Plane



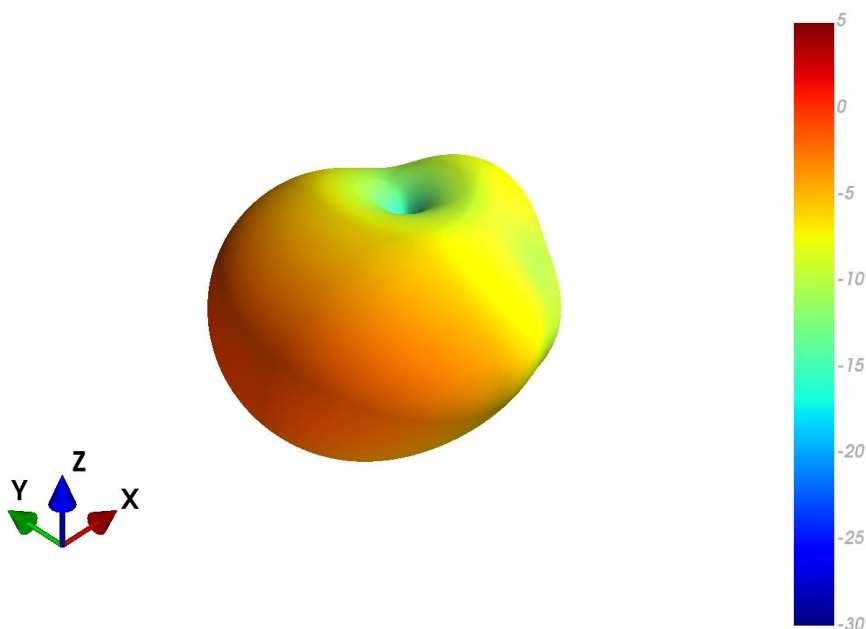
YZ Plane



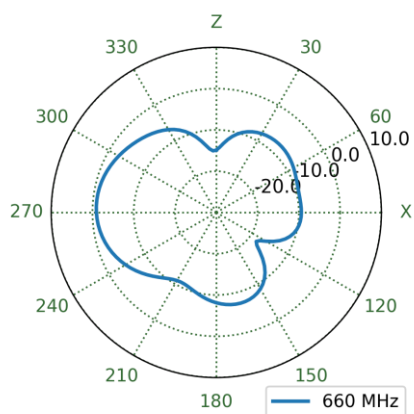
XY Plane



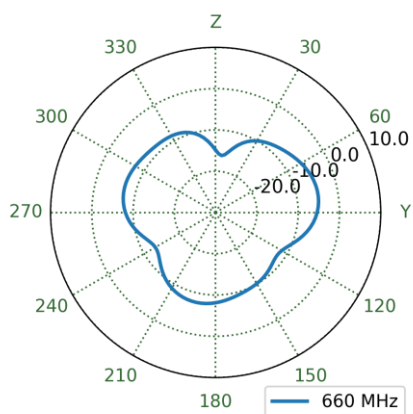
4.19 MIMO3 LTE Ground Plane Patterns at 658 MHz



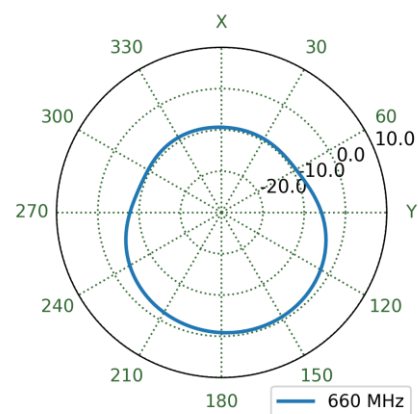
XZ Plane



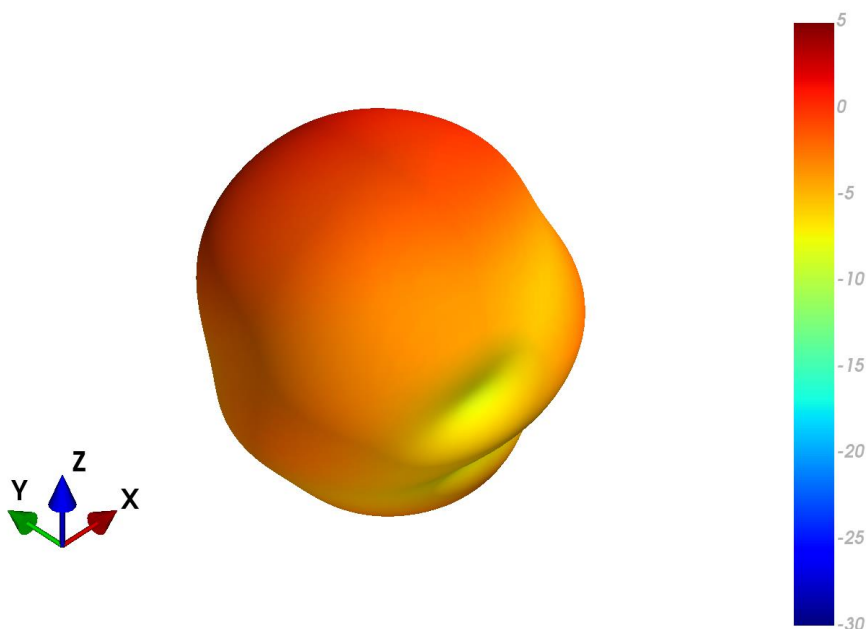
YZ Plane



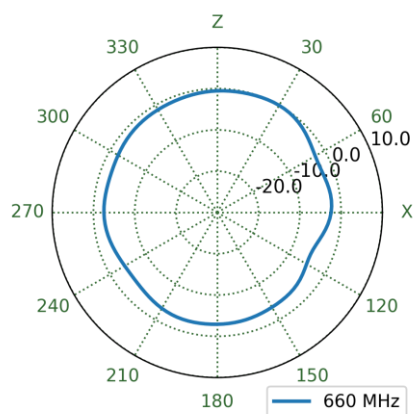
XY Plane



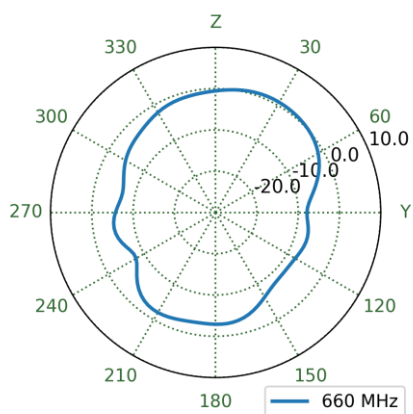
4.20 MIMO4 LTE Free Space Patterns at 658 MHz



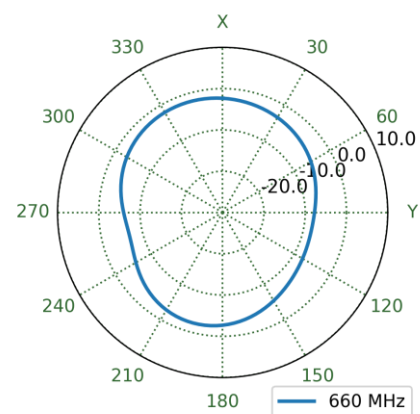
XZ Plane



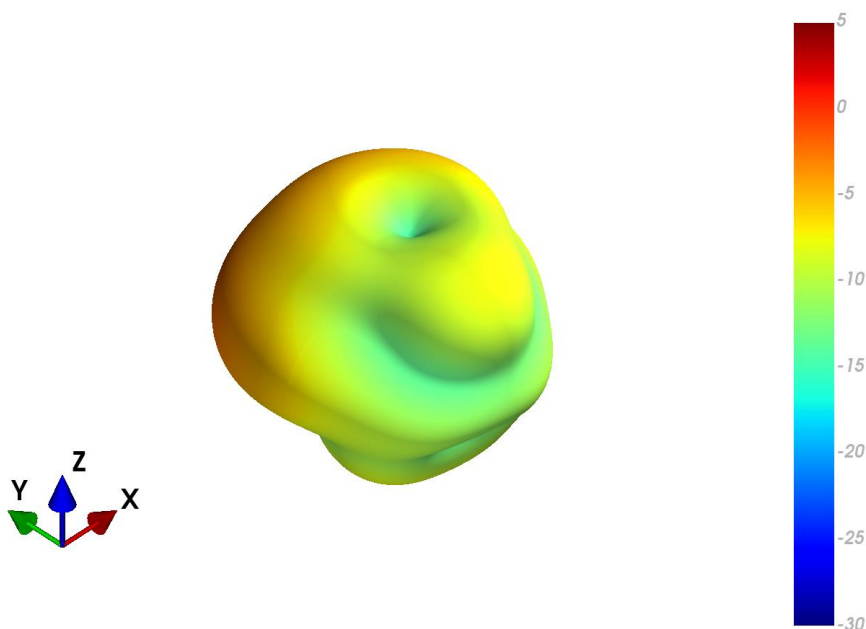
YZ Plane



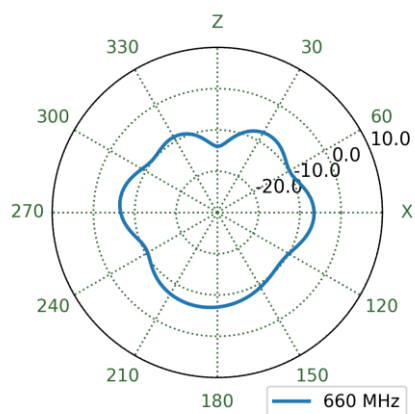
XY Plane



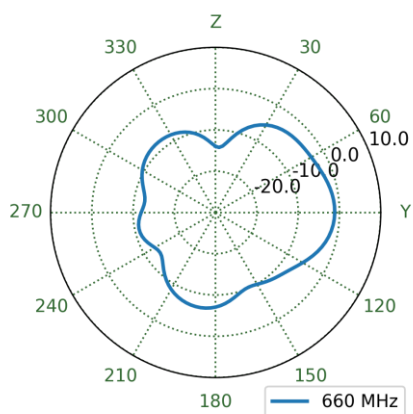
4.21 MIMO4 LTE Ground Plane Patterns at 658 MHz



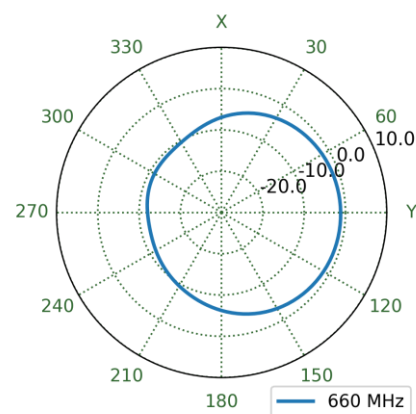
XZ Plane



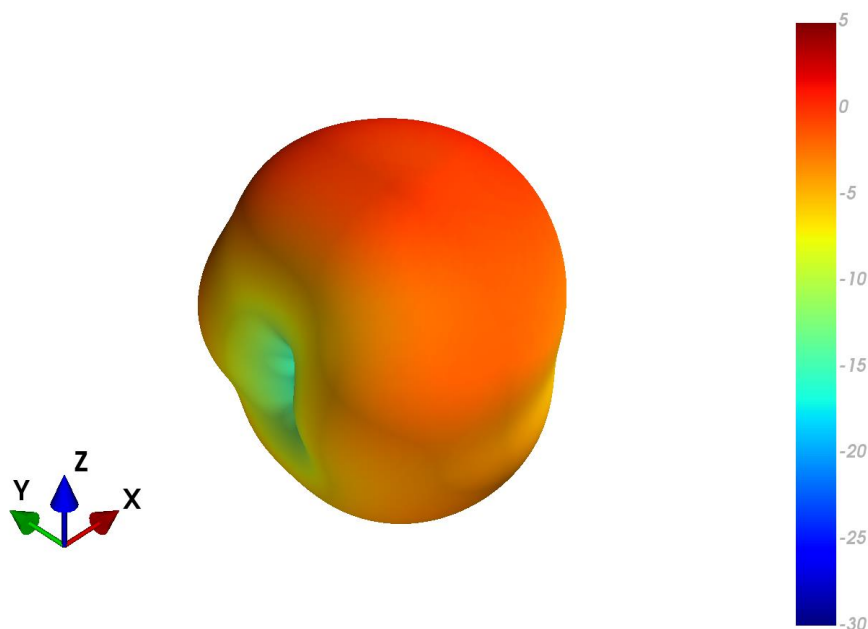
YZ Plane



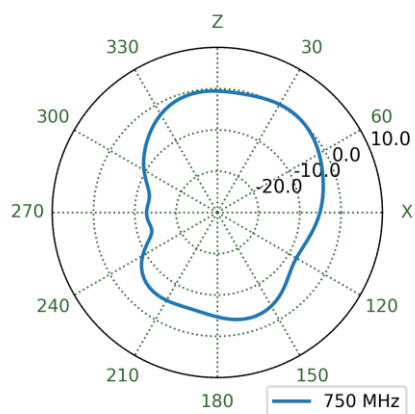
XY Plane



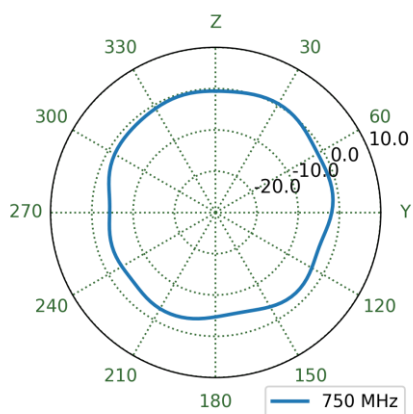
4.22 MIMO1 LTE Free Space Patterns at 752 MHz



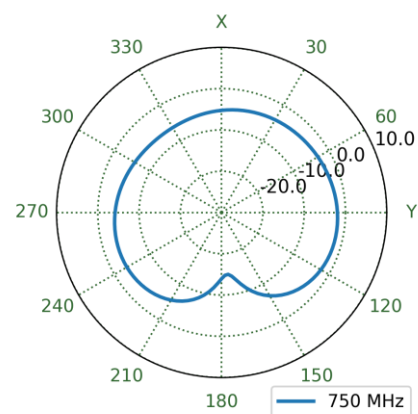
XZ Plane



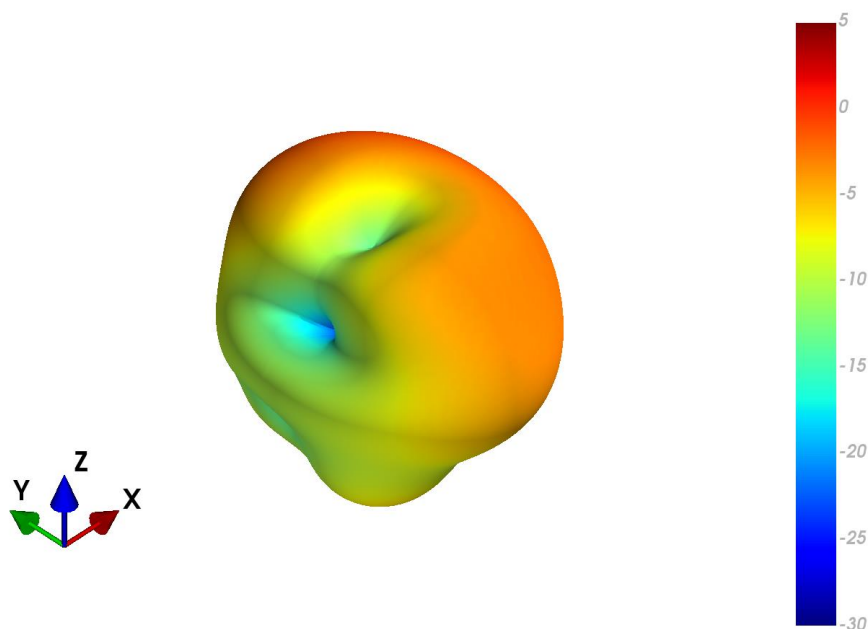
YZ Plane



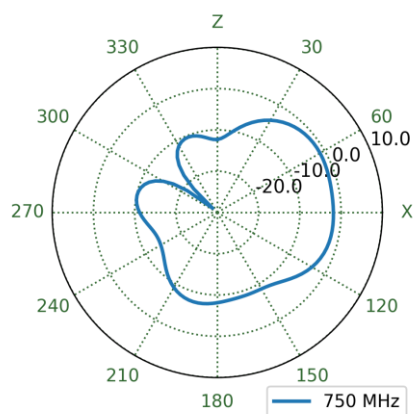
XY Plane



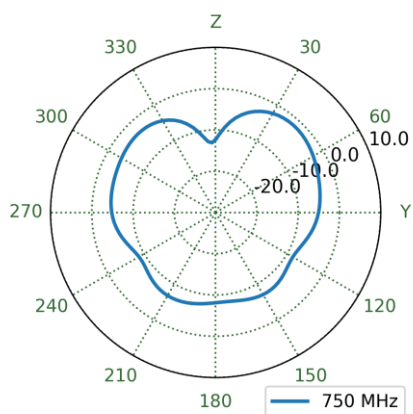
4.23 MIMO1 LTE Ground Plane Patterns at 752 MHz



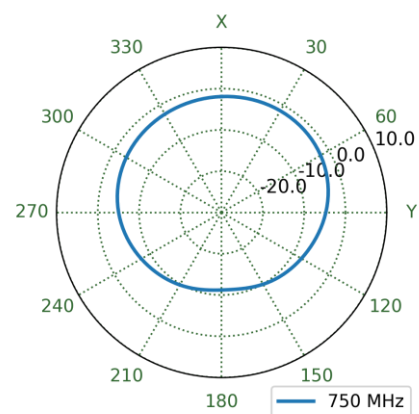
XZ Plane



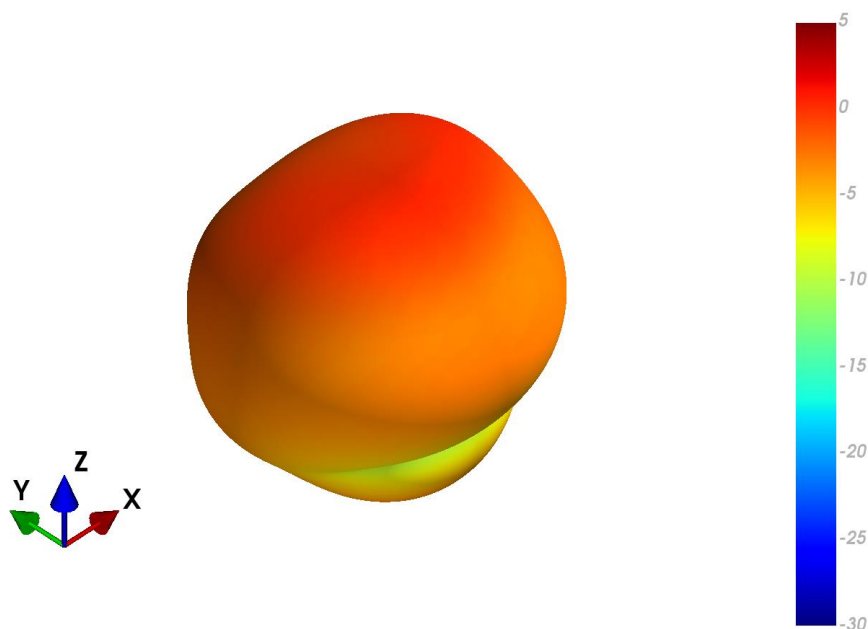
YZ Plane



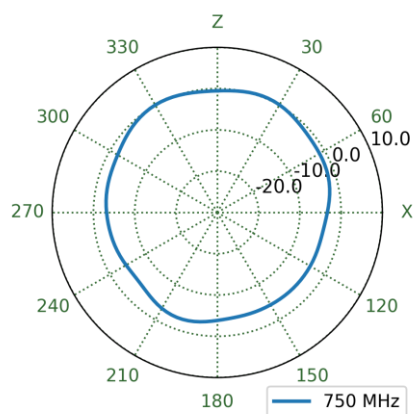
XY Plane



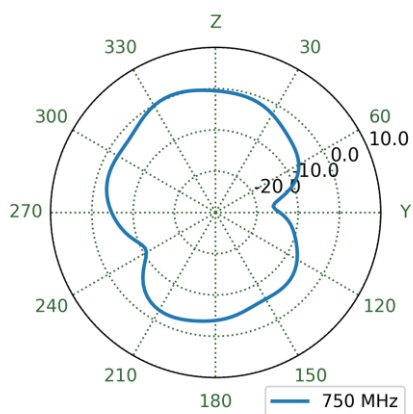
4.24 MIMO2 LTE Free Space Patterns at 752 MHz



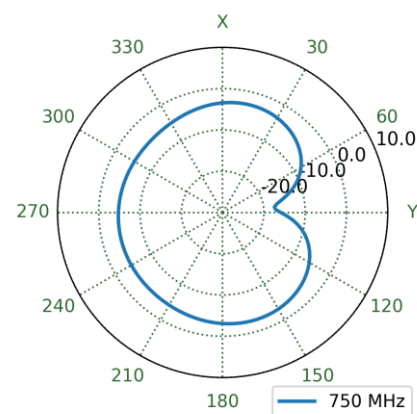
XZ Plane



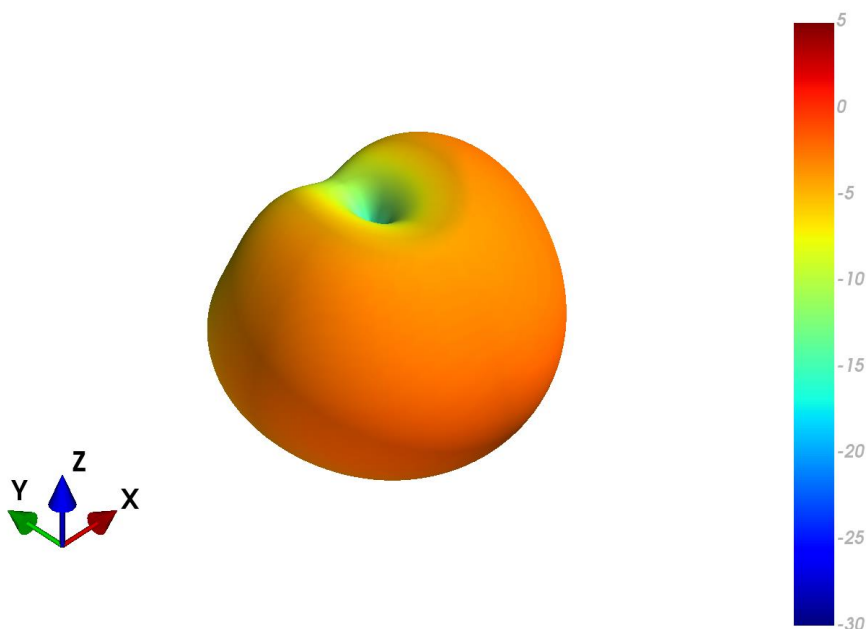
YZ Plane



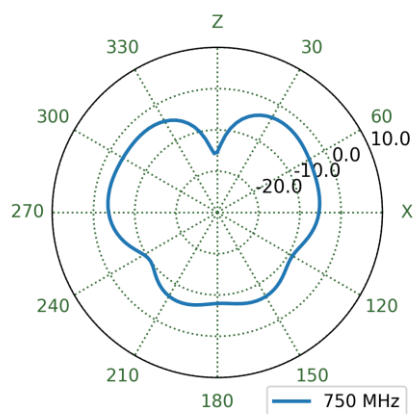
XY Plane



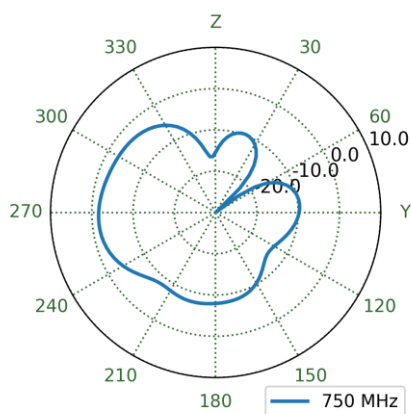
4.25 MIMO2 LTE Ground Plane Patterns at 752 MHz



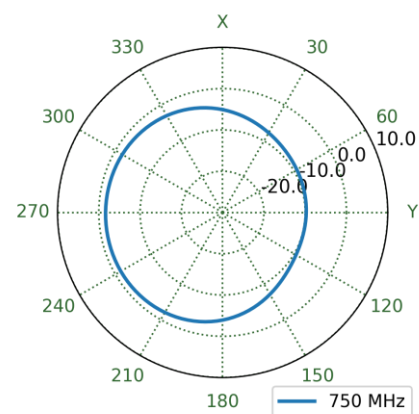
XZ Plane



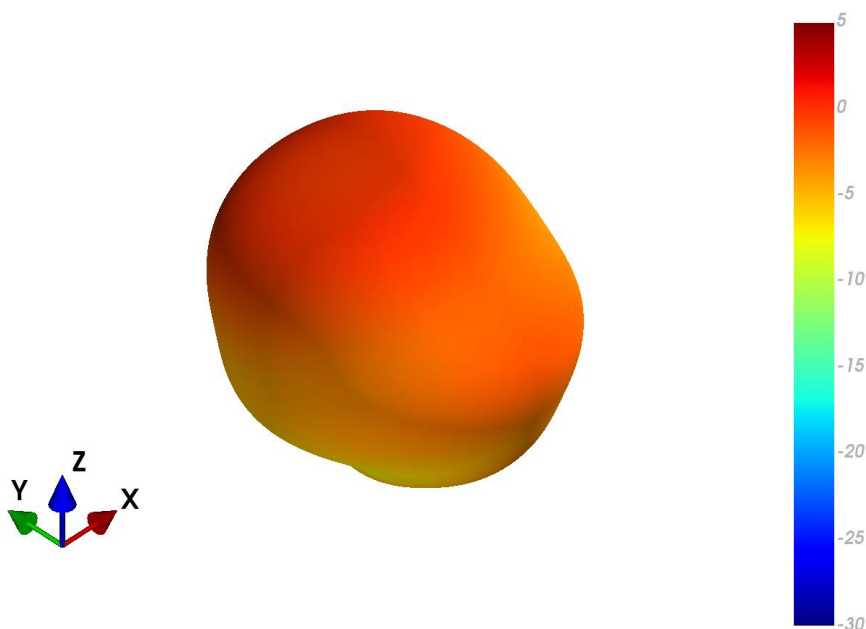
YZ Plane



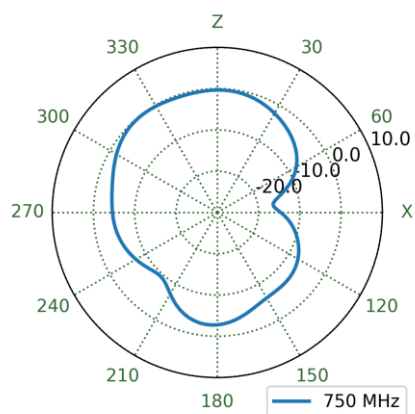
XY Plane



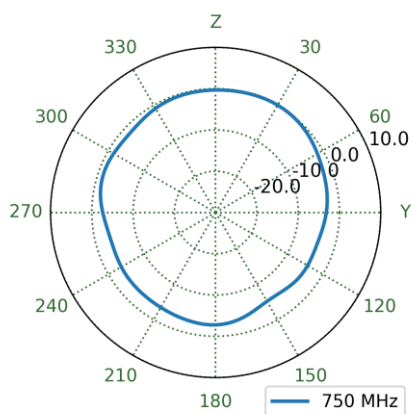
4.26 MIMO3 LTE Free Space Patterns at 752 MHz



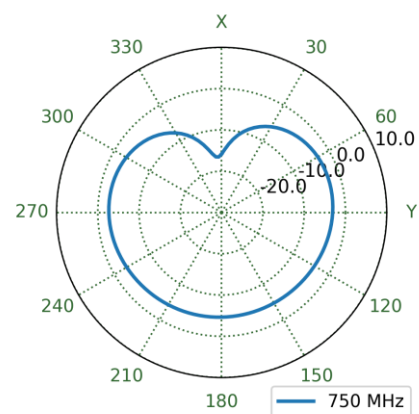
XZ Plane



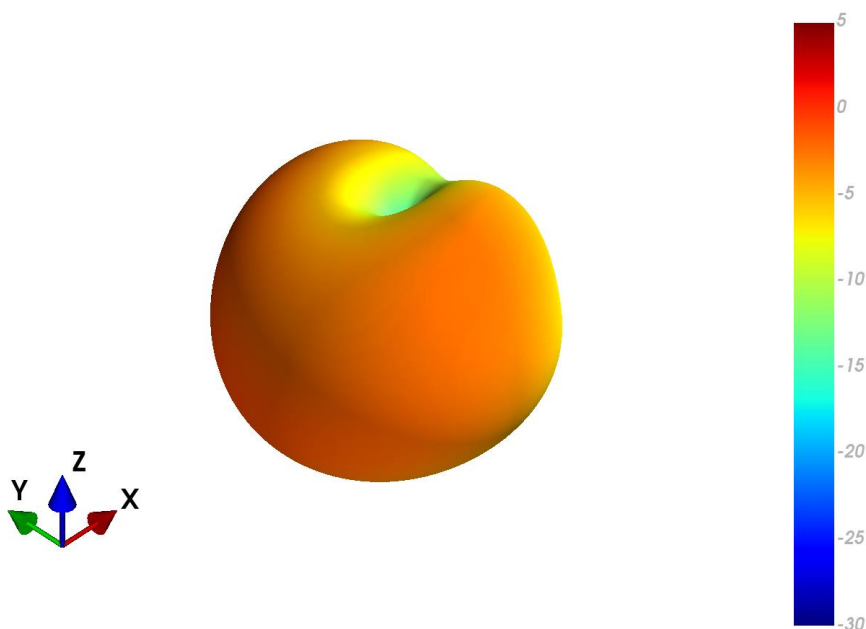
YZ Plane



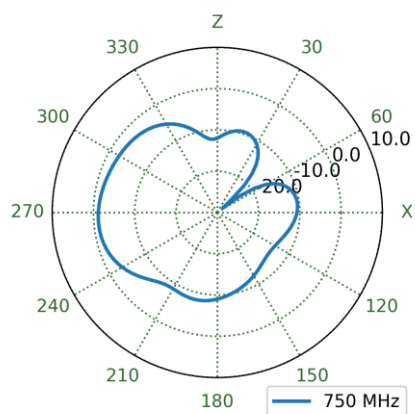
XY Plane



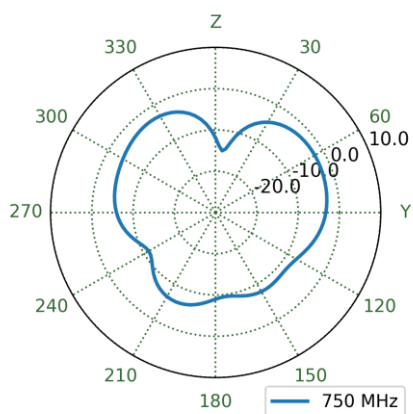
4.27 MIMO3 LTE Ground Plane Patterns at 752 MHz



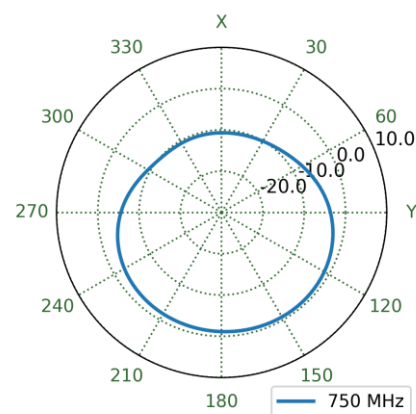
XZ Plane



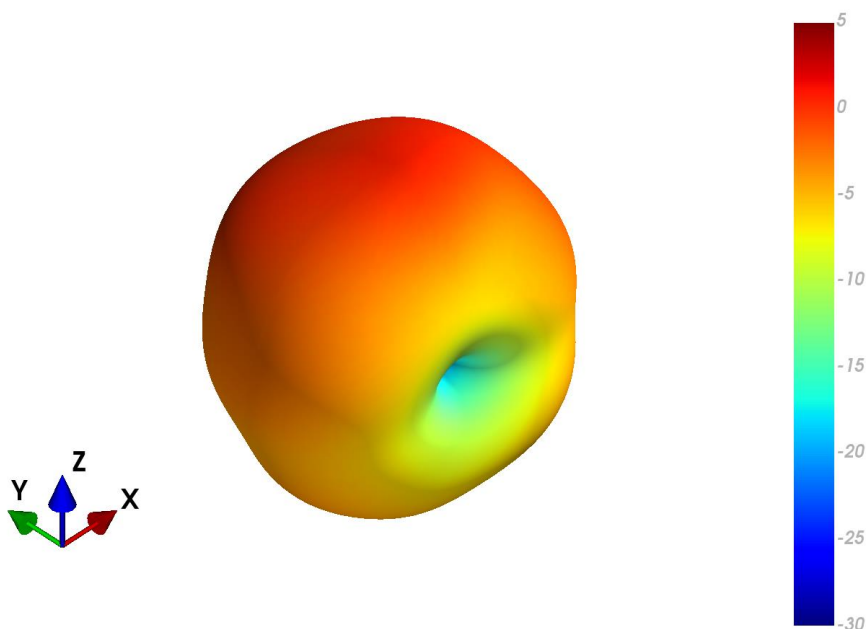
YZ Plane



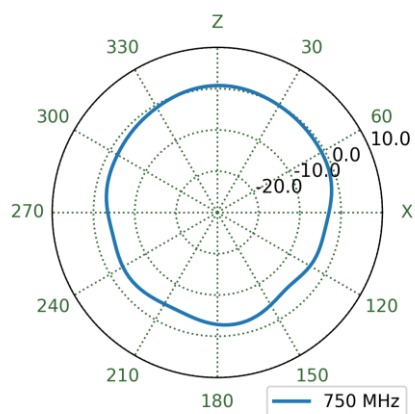
XY Plane



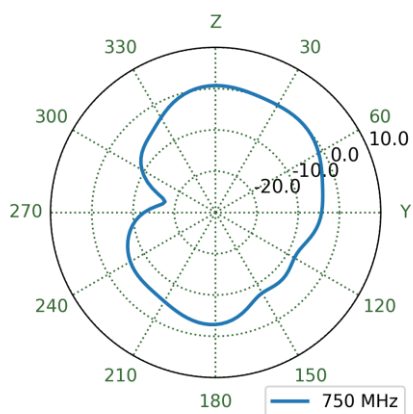
4.28 MIMO4 LTE Free Space Patterns at 752 MHz



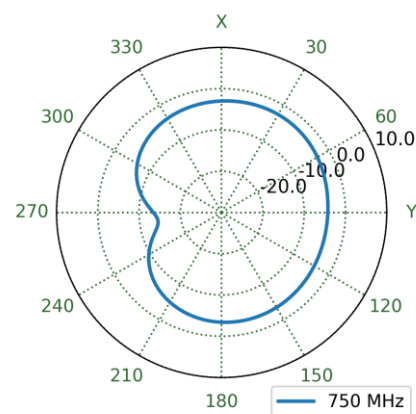
XZ Plane



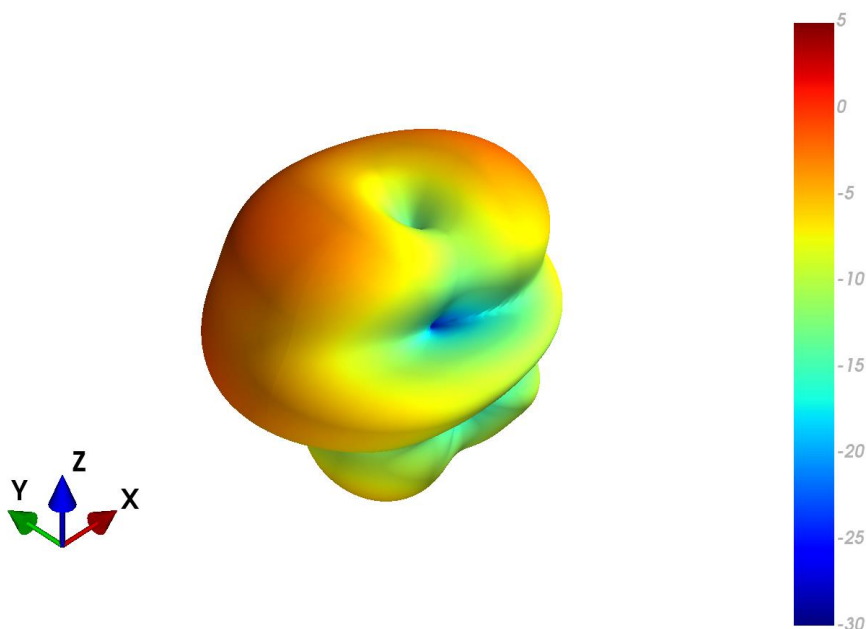
YZ Plane



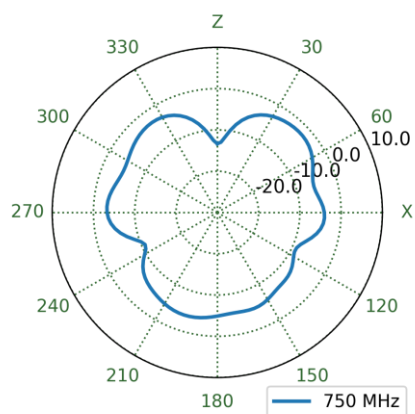
XY Plane



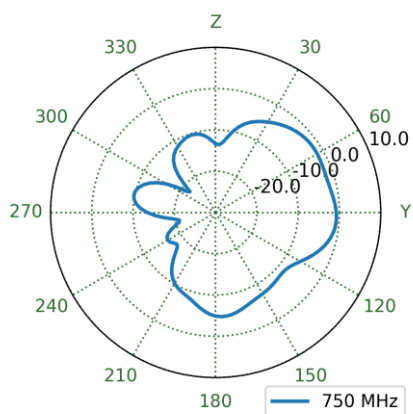
4.29 MIMO4 LTE Ground Plane Patterns at 752 MHz



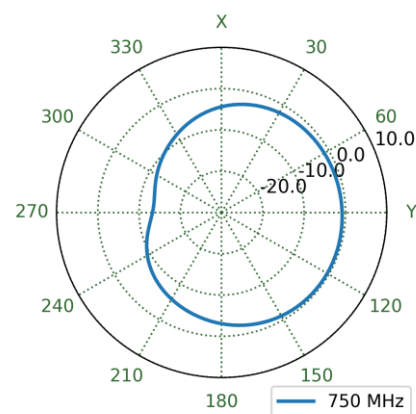
XZ Plane



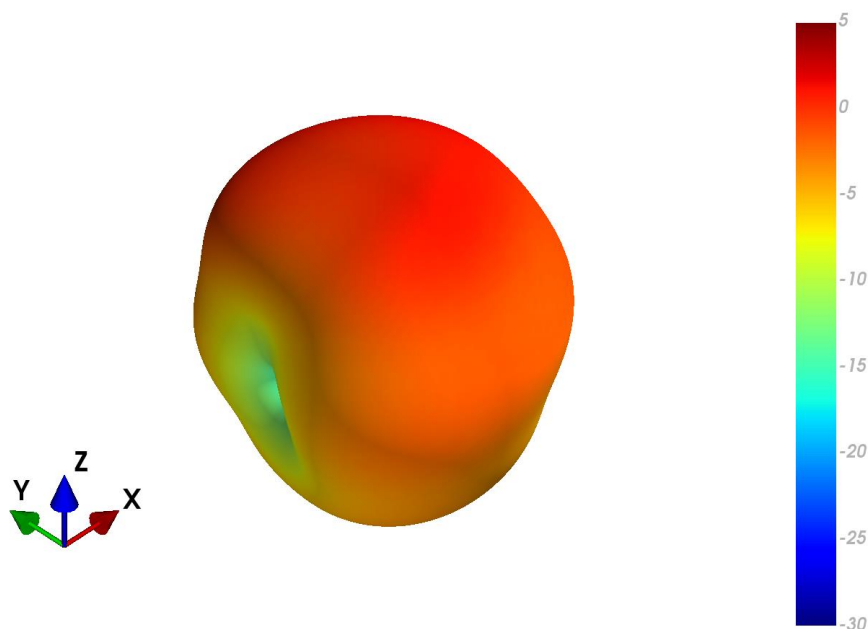
YZ Plane



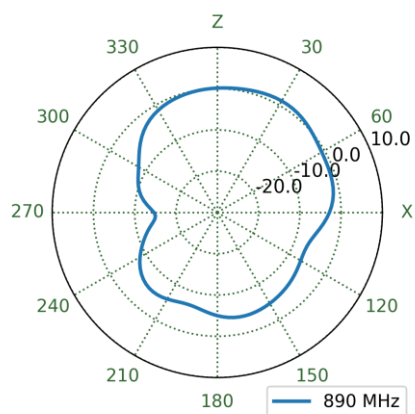
XY Plane



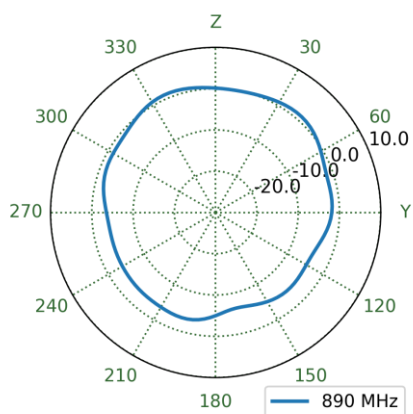
4.30 MIMO1 LTE Free Space Patterns at 892 MHz



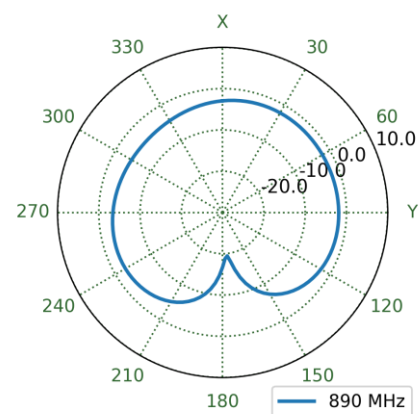
XZ Plane



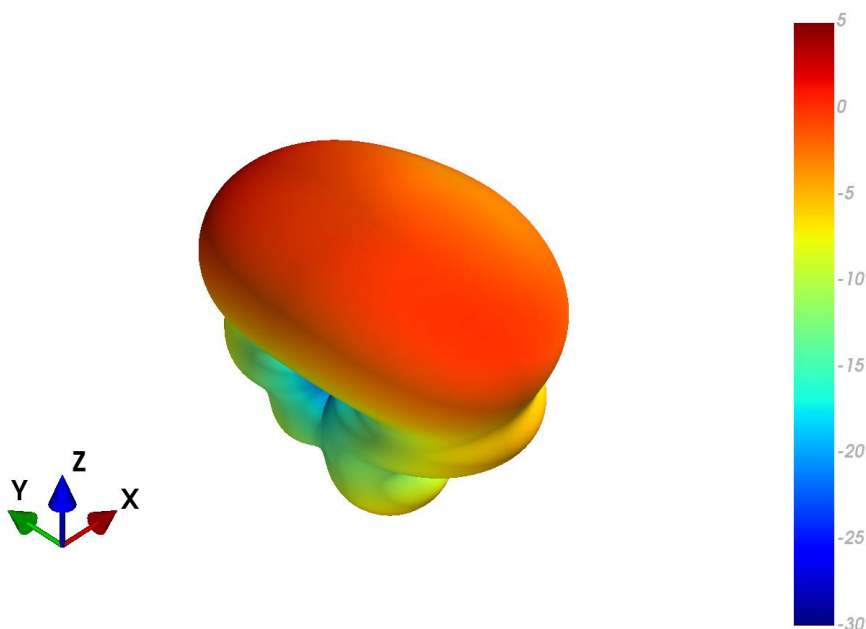
YZ Plane



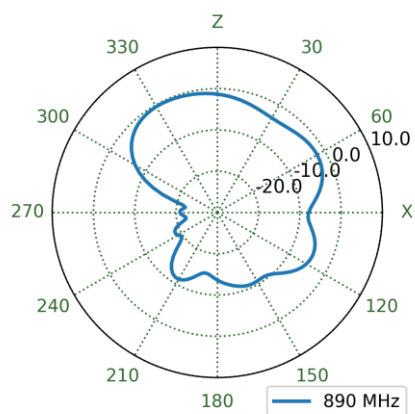
XY Plane



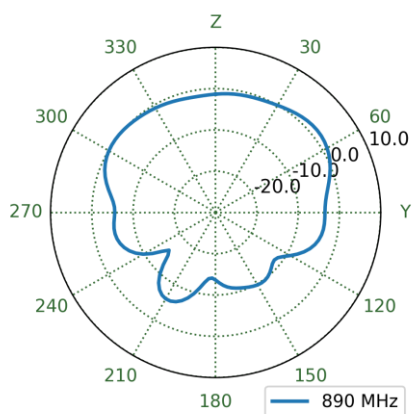
4.31 MIMO1 LTE Ground Plane Patterns at 892 MHz



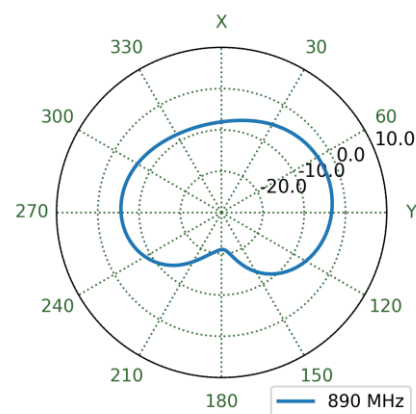
XZ Plane



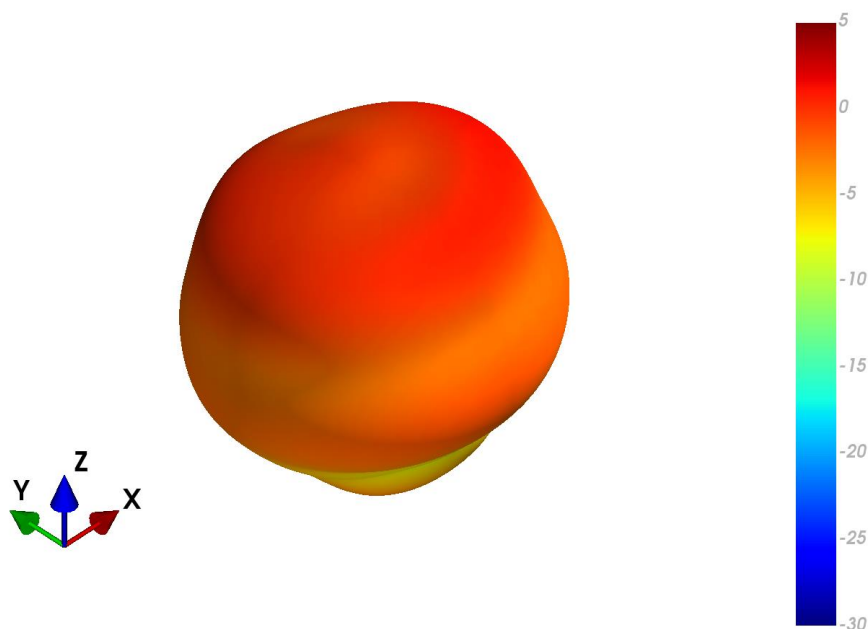
YZ Plane



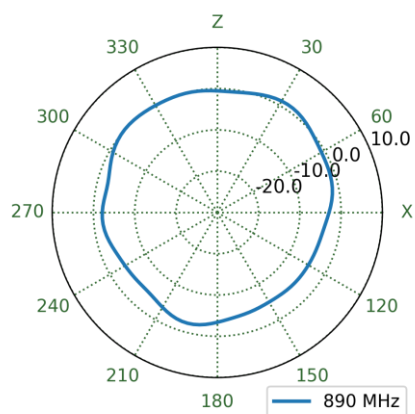
XY Plane



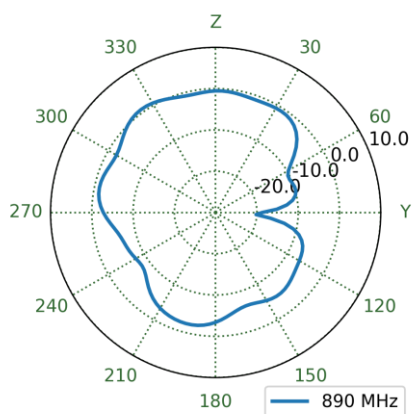
4.32 MIMO2 LTE Free Space Patterns at 892 MHz



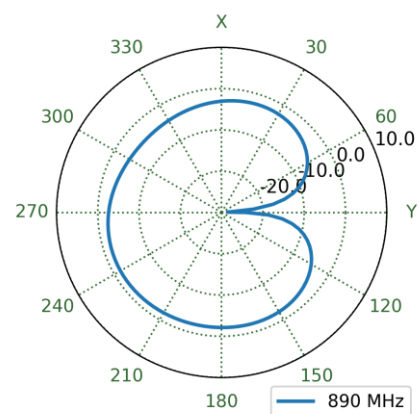
XZ Plane



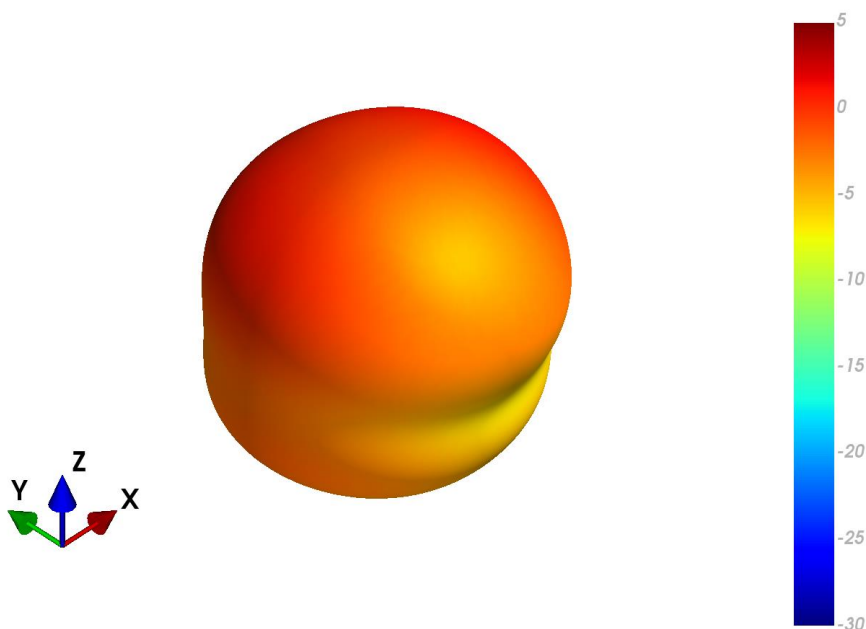
YZ Plane



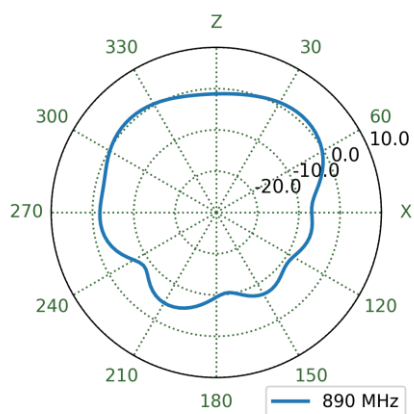
XY Plane



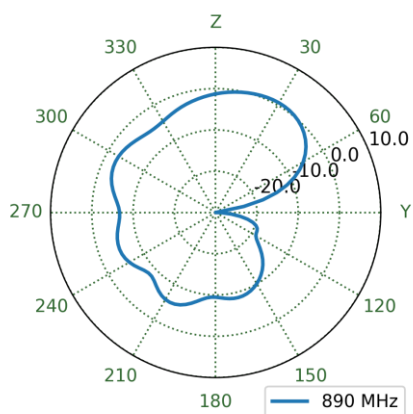
4.33 MIMO2 LTE Ground Plane Patterns at 892 MHz



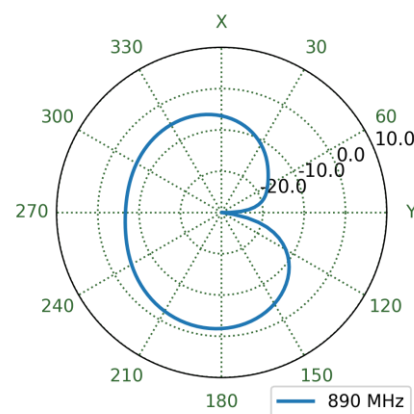
XZ Plane



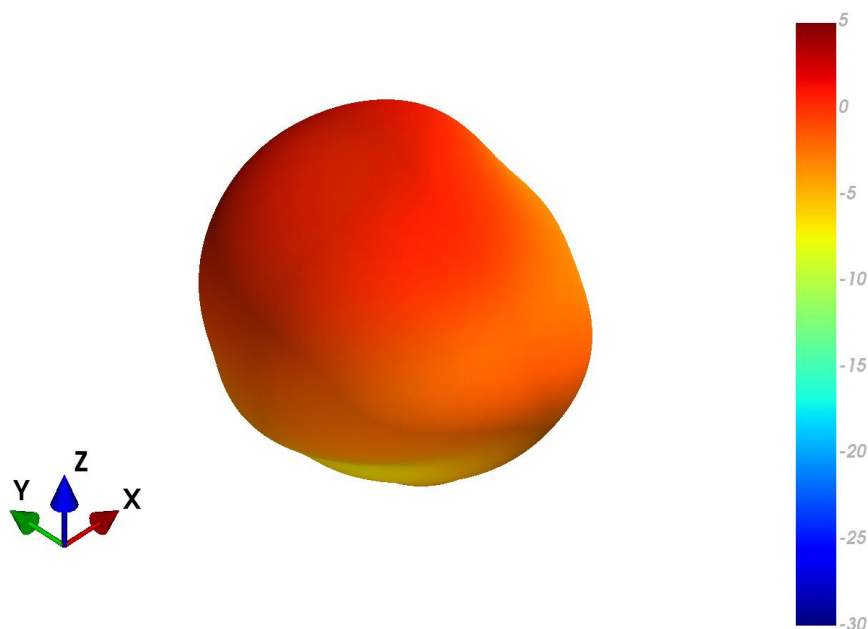
YZ Plane



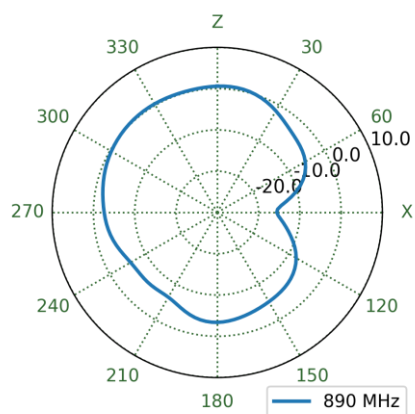
XY Plane



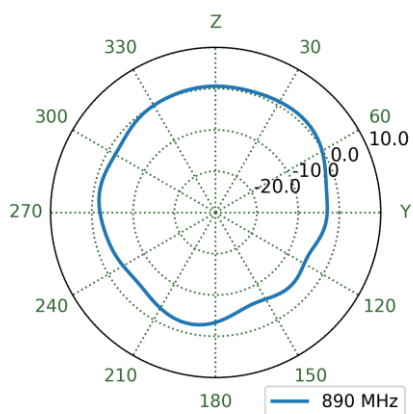
4.34 MIMO3 LTE Free Space Patterns at 892 MHz



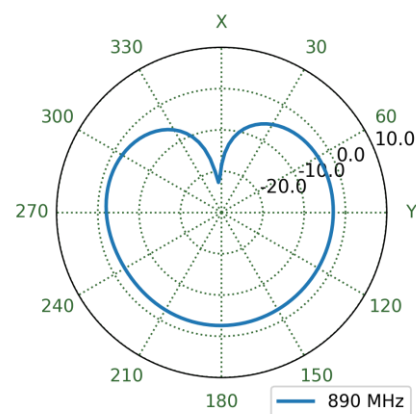
XZ Plane



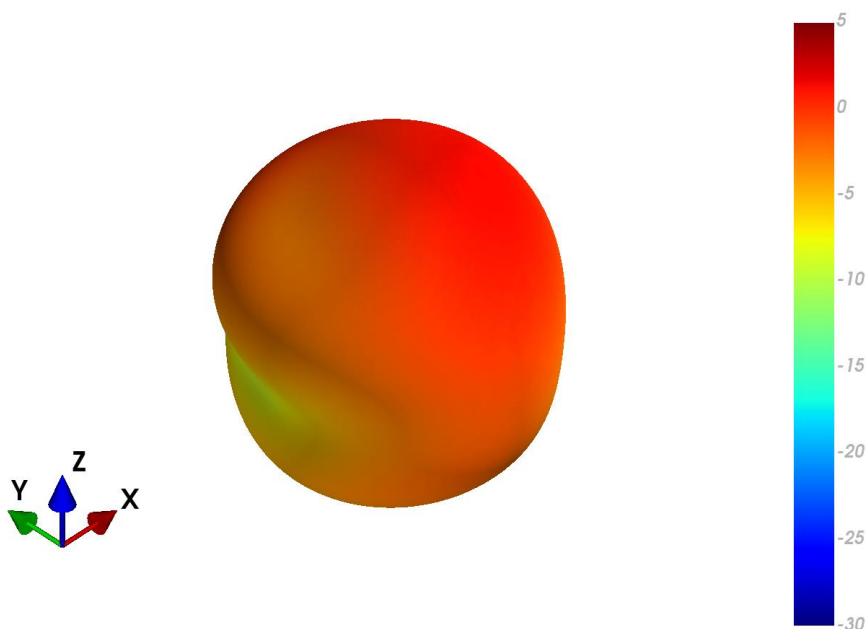
YZ Plane



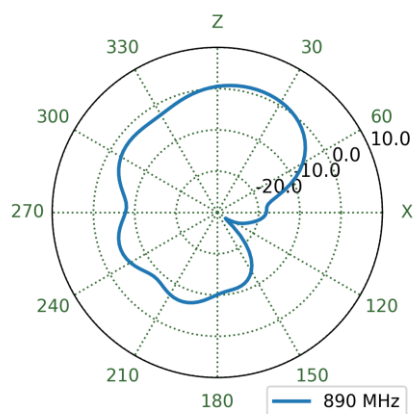
XY Plane



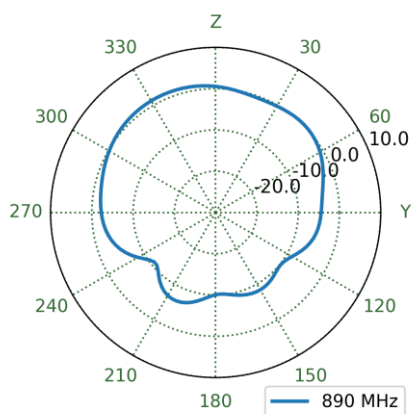
4.35 MIMO3 LTE Ground Plane Patterns at 892 MHz



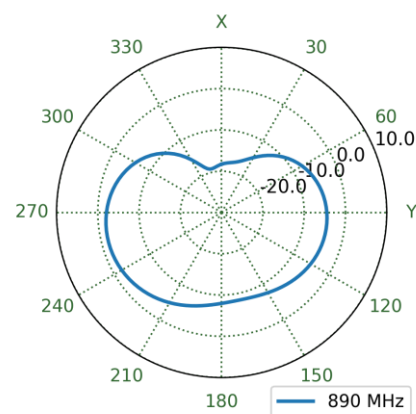
XZ Plane



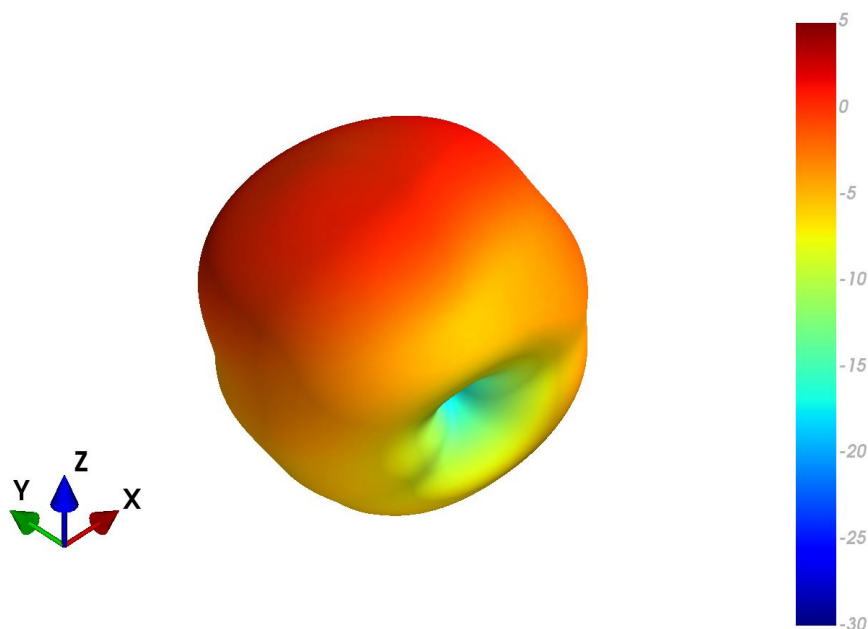
YZ Plane



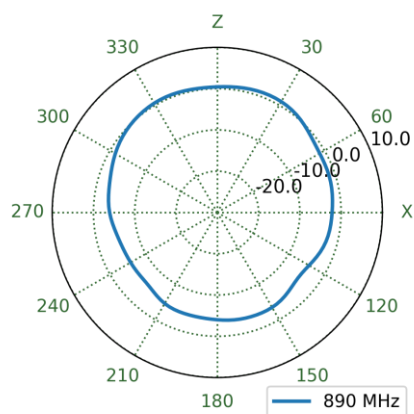
XY Plane



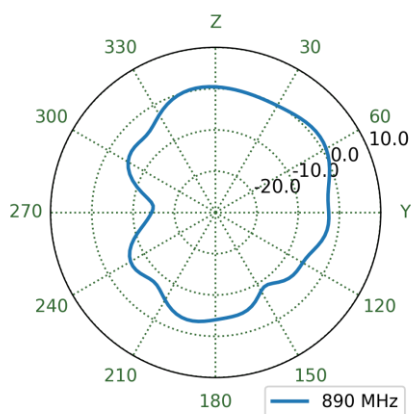
4.36 MIMO4 LTE Free Space Patterns at 892 MHz



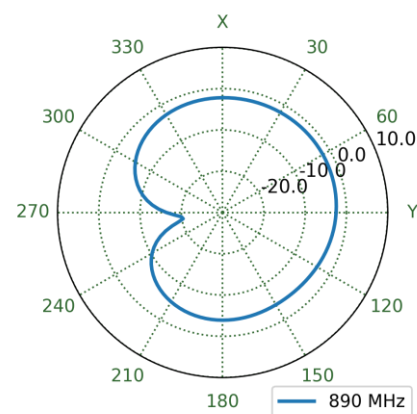
XZ Plane



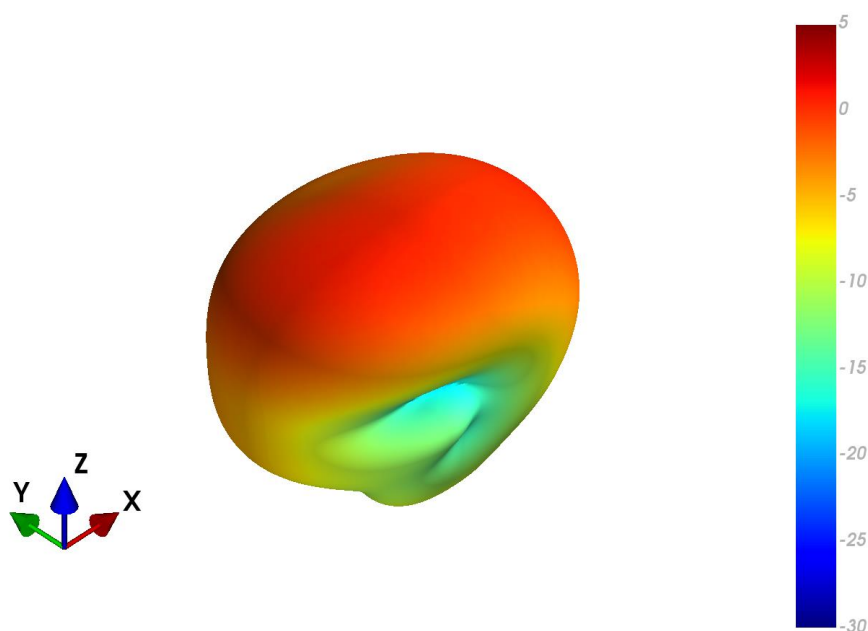
YZ Plane



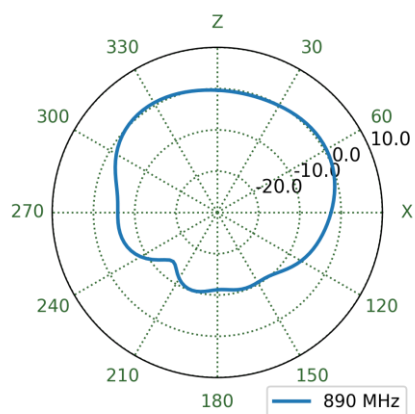
XY Plane



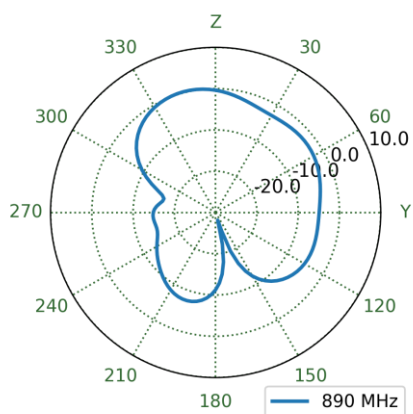
4.37 MIMO4 LTE Ground Plane Patterns at 892 MHz



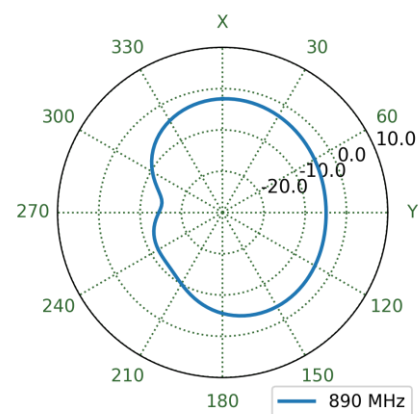
XZ Plane



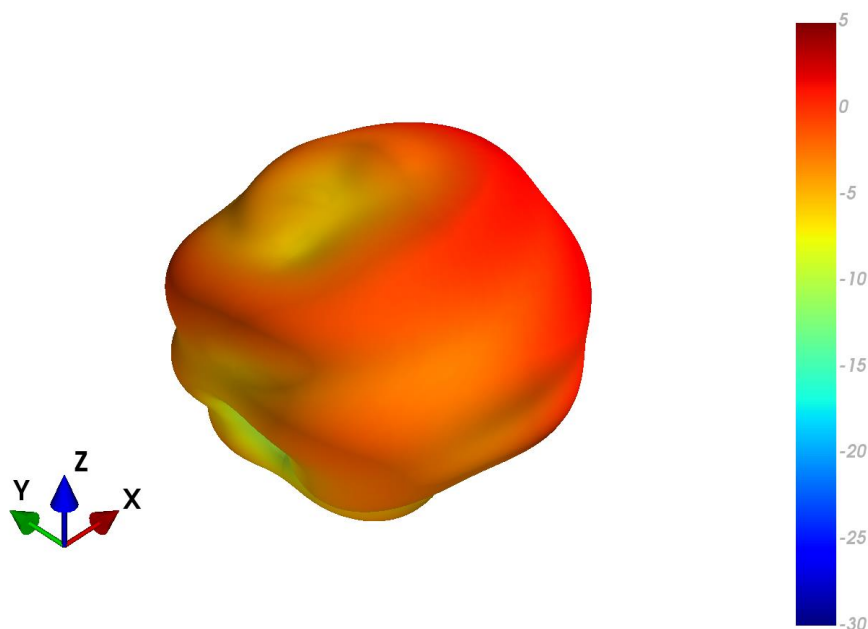
YZ Plane



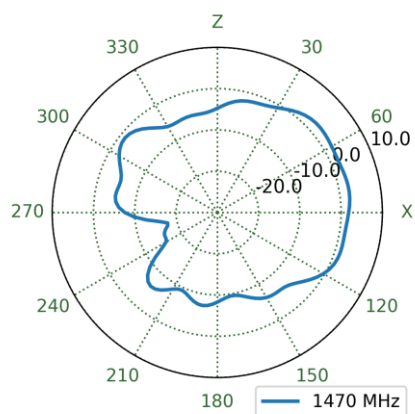
XY Plane



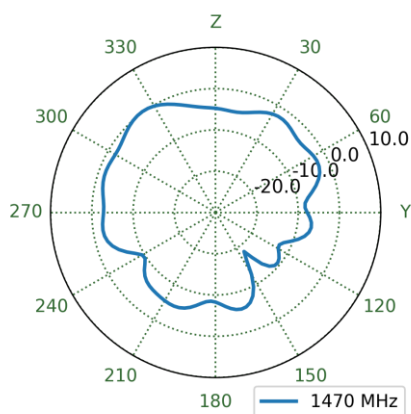
4.38 MIMO1 LTE Free Space Patterns at 1473 MHz



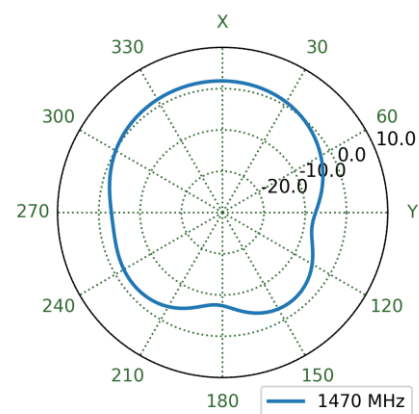
XZ Plane



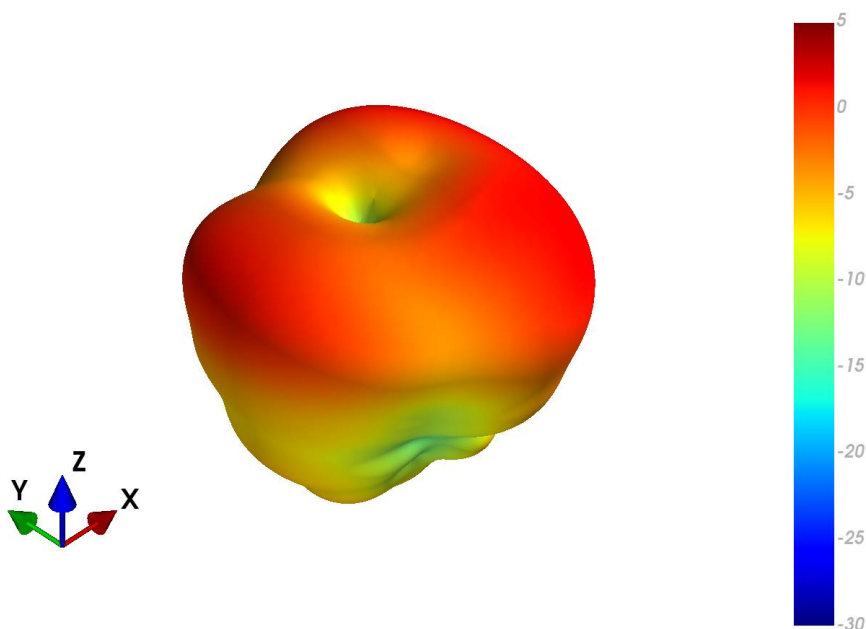
YZ Plane



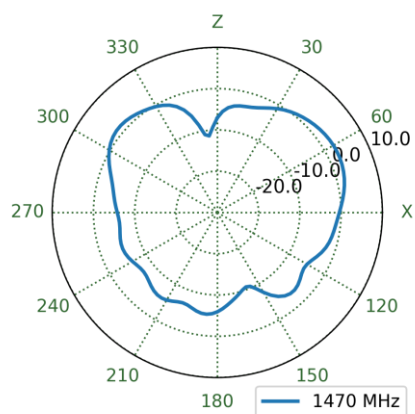
XY Plane



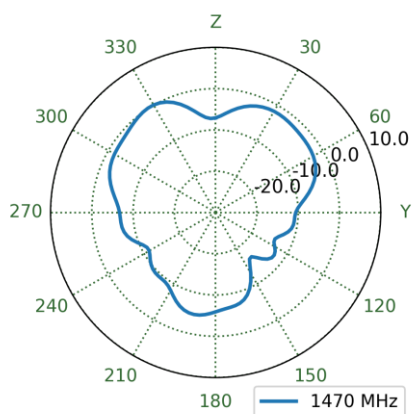
4.39 MIMO1 LTE Ground Plane Patterns at 1473 MHz



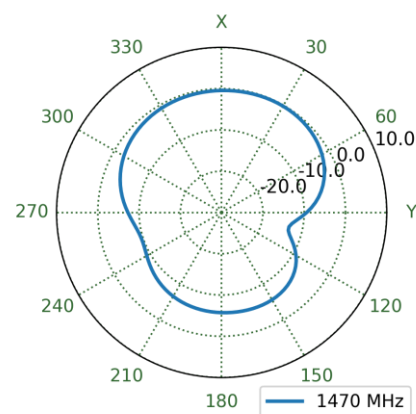
XZ Plane



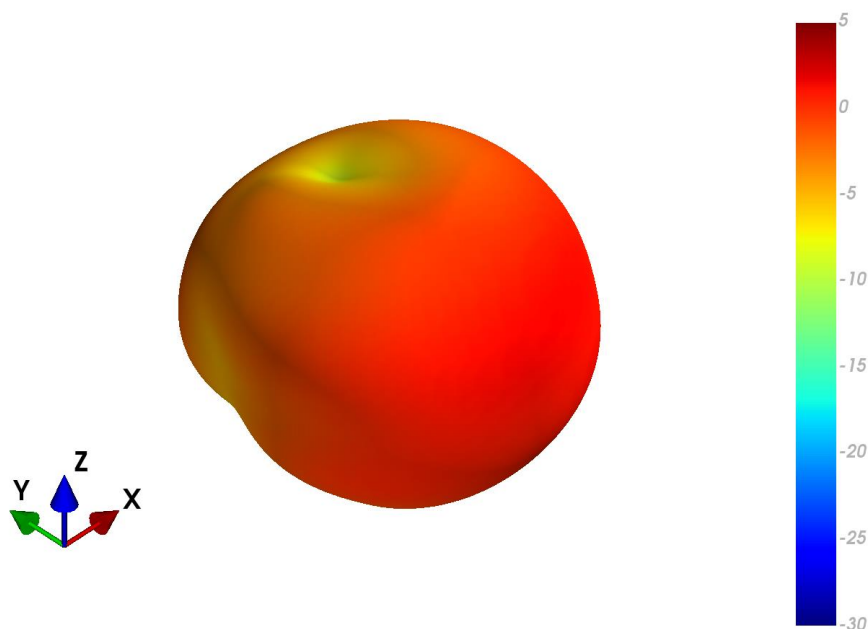
YZ Plane



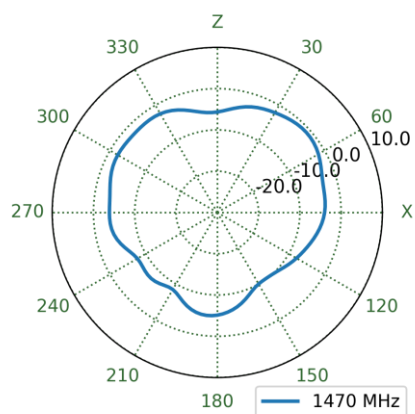
XY Plane



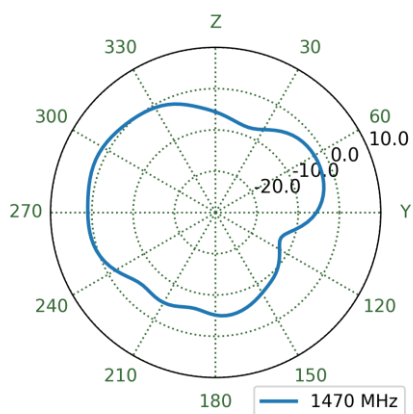
4.40 MIMO2 LTE Free Space Patterns at 1473 MHz



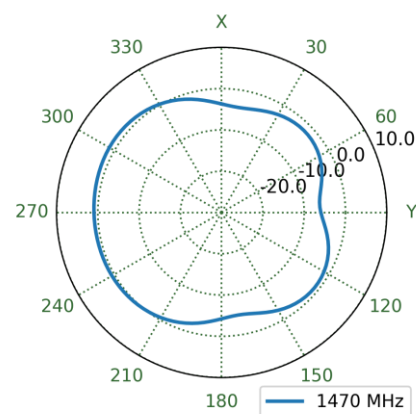
XZ Plane



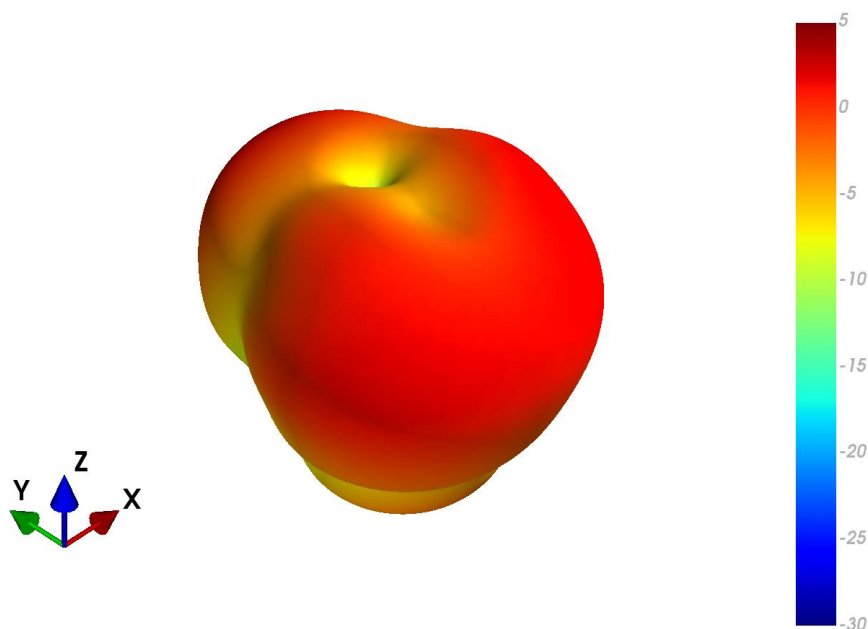
YZ Plane



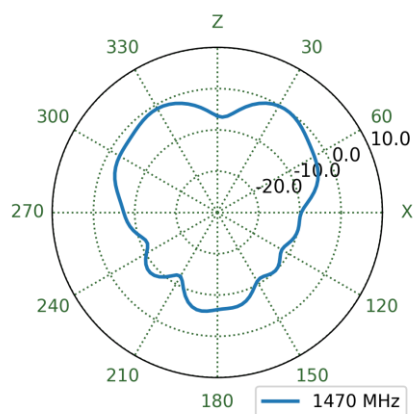
XY Plane



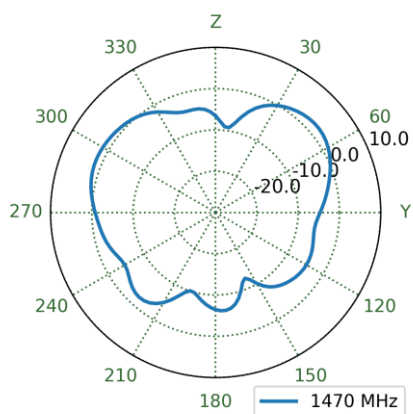
4.41 MIMO2 LTE Ground Plane Patterns at 1473 MHz



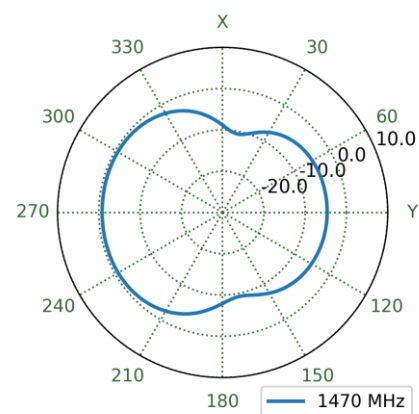
XZ Plane



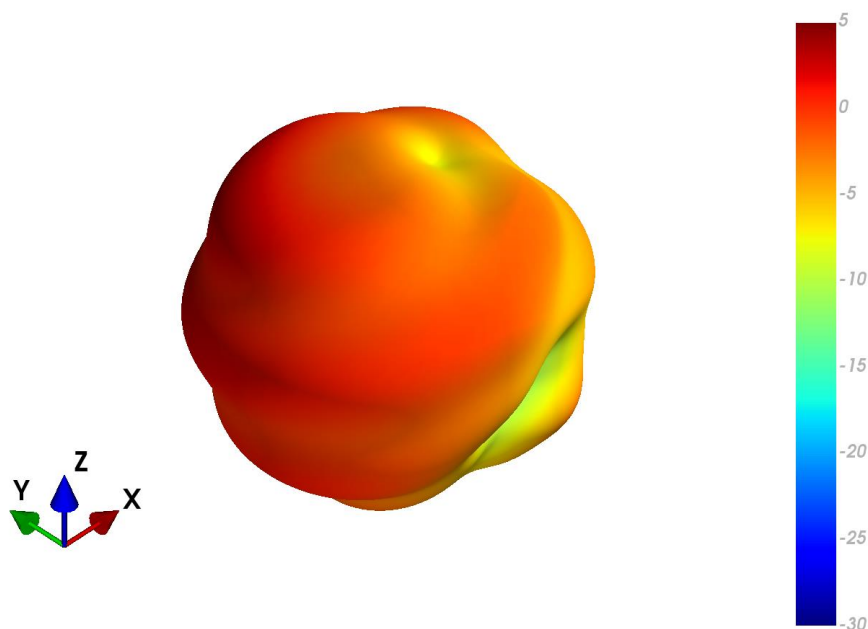
YZ Plane



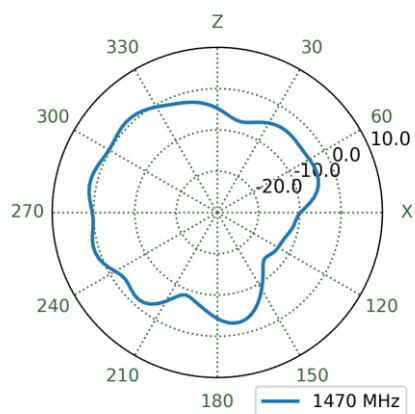
XY Plane



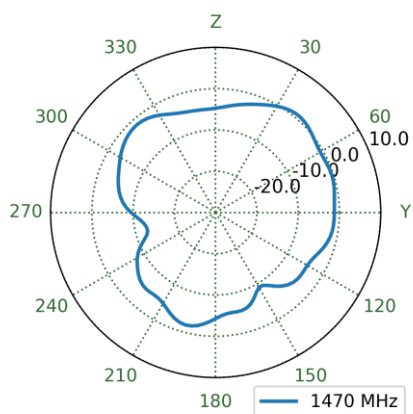
4.42 MIMO3 LTE Free Space Patterns at 1473 MHz



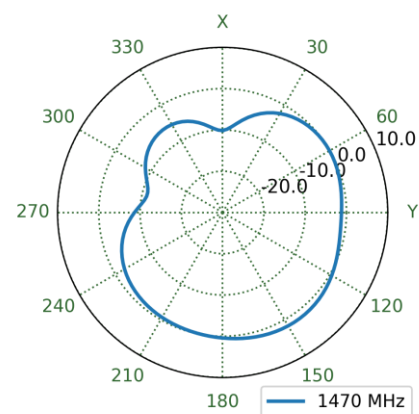
XZ Plane



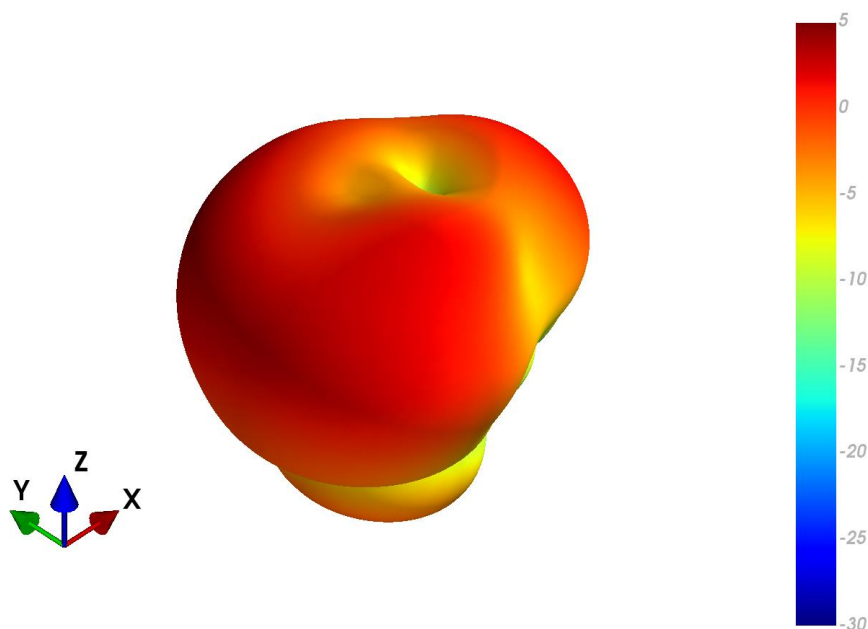
YZ Plane



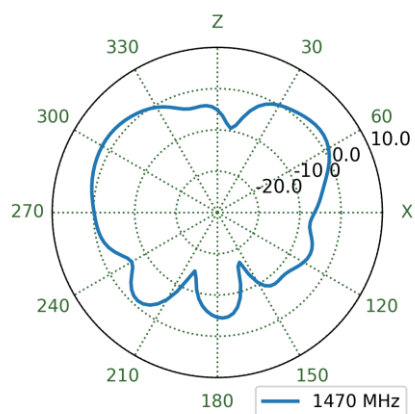
XY Plane



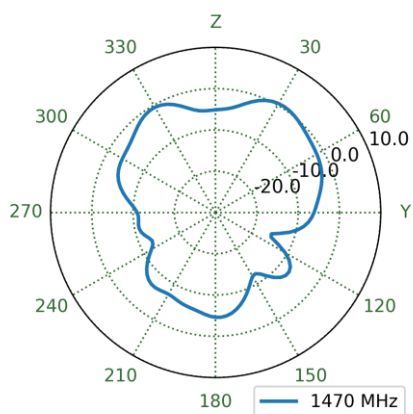
4.43 MIMO3 LTE Ground Plane Patterns at 1473 MHz



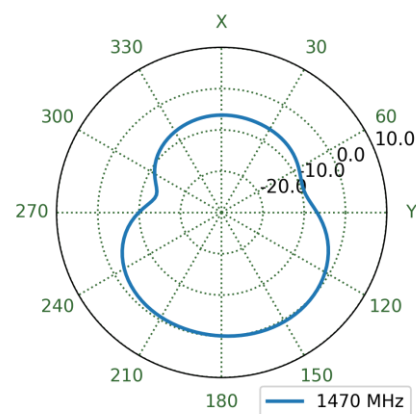
XZ Plane



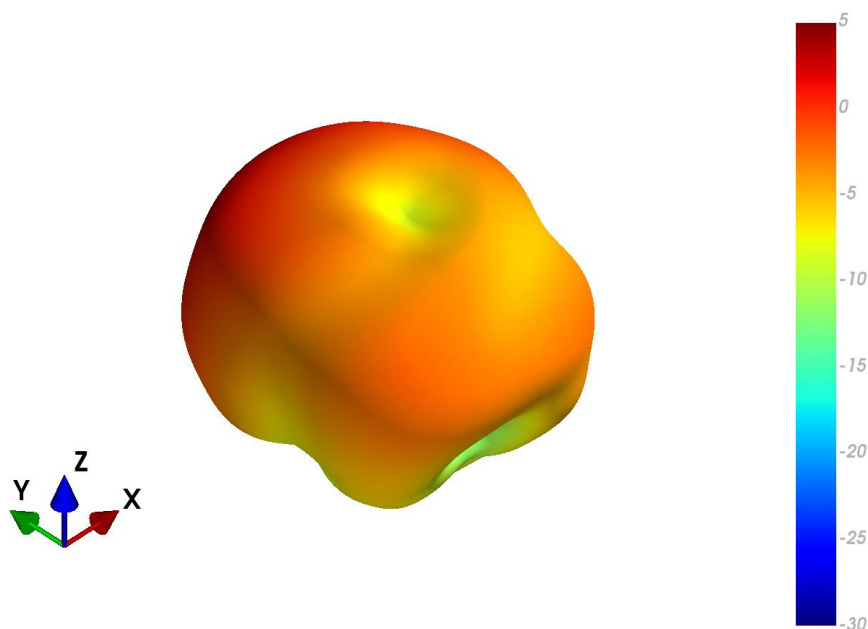
YZ Plane



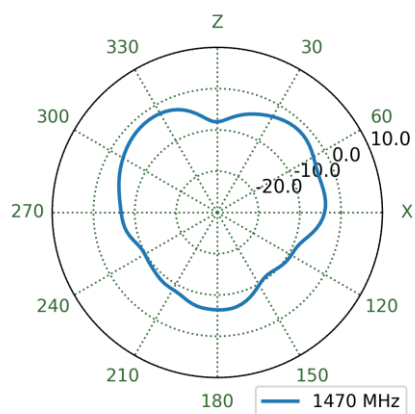
XY Plane



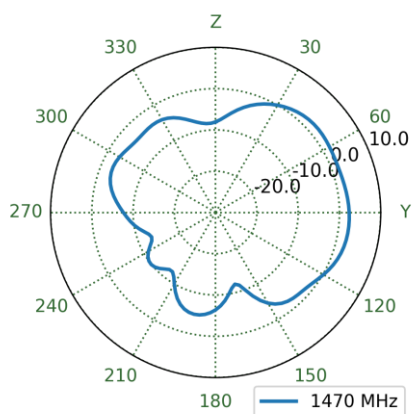
4.44 MIMO4 LTE Free Space Patterns at 1473 MHz



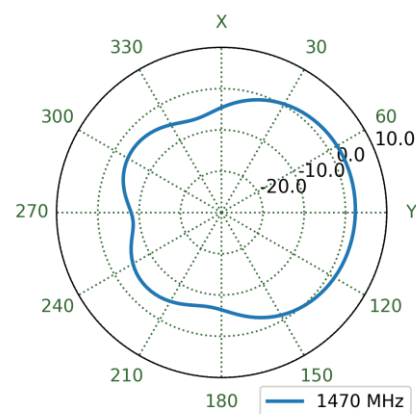
XZ Plane



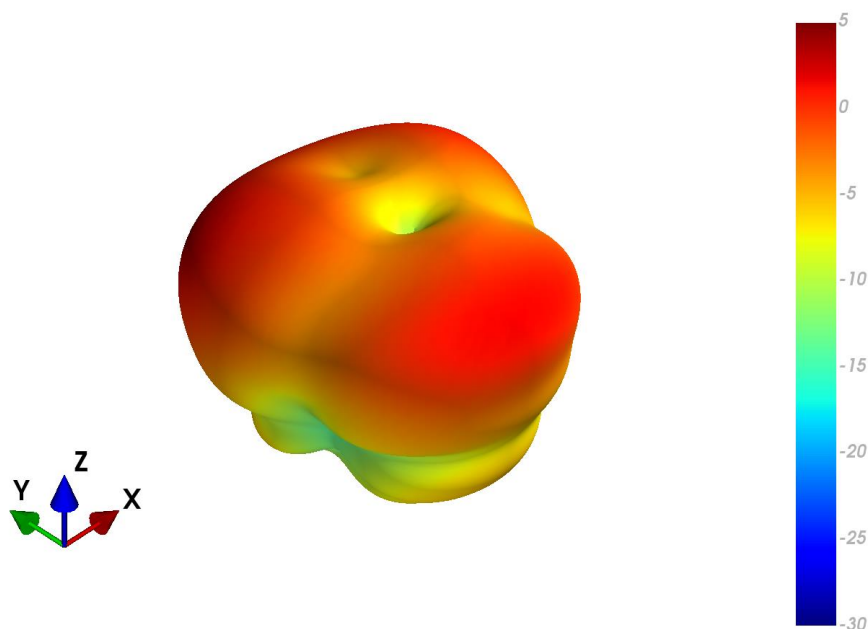
YZ Plane



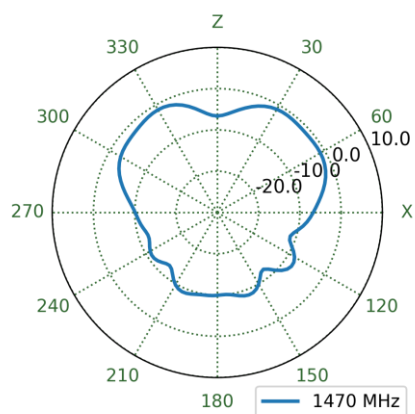
XY Plane



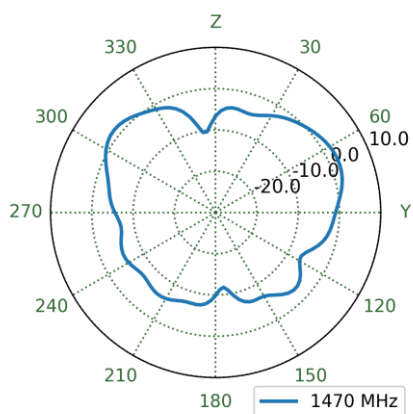
4.45 MIMO4 LTE Ground Plane Patterns at 1473 MHz



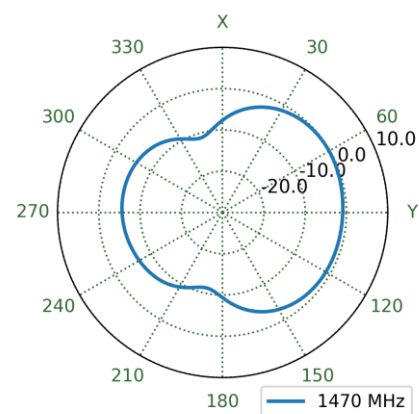
XZ Plane



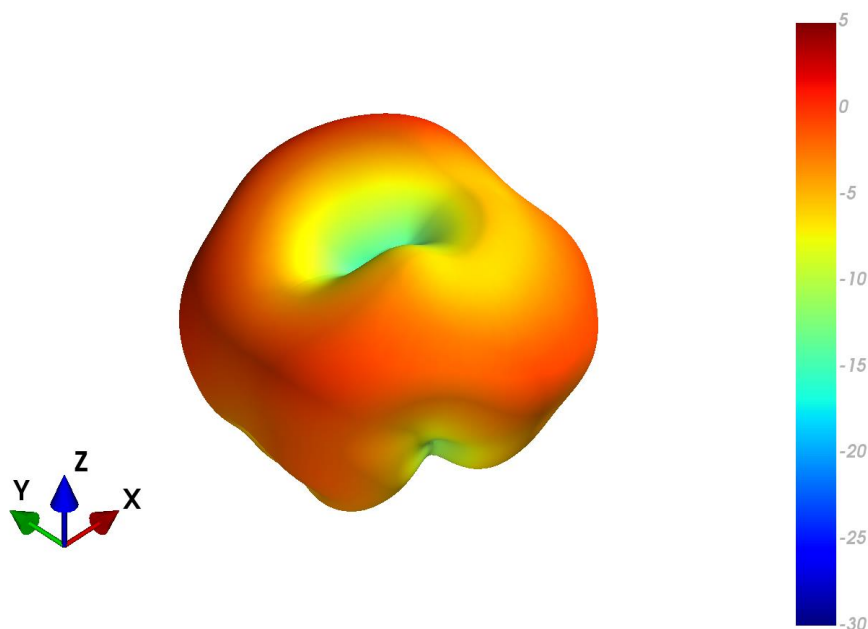
YZ Plane



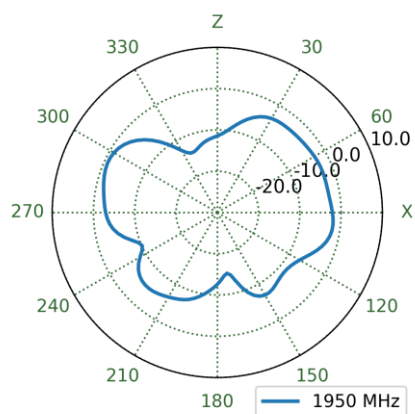
XY Plane



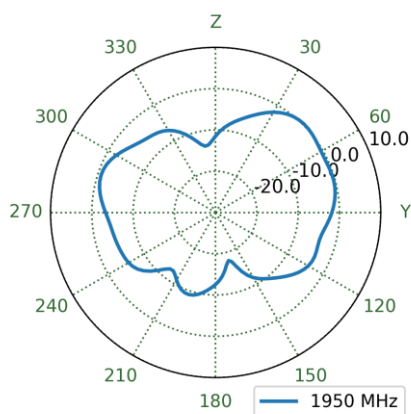
4.46 MIMO1 LTE Free Space Patterns at 1955 MHz



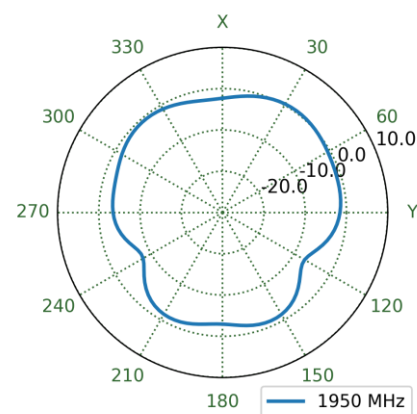
XZ Plane



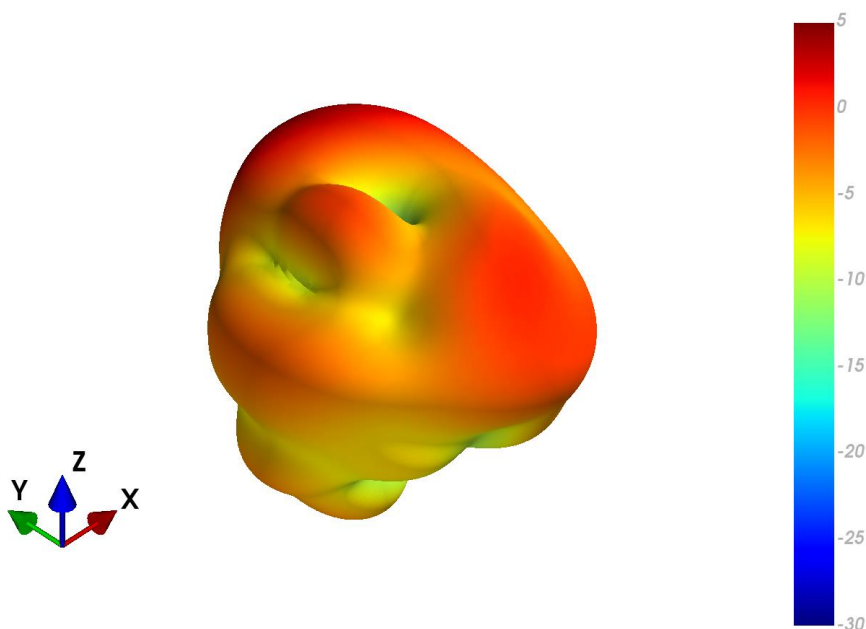
YZ Plane



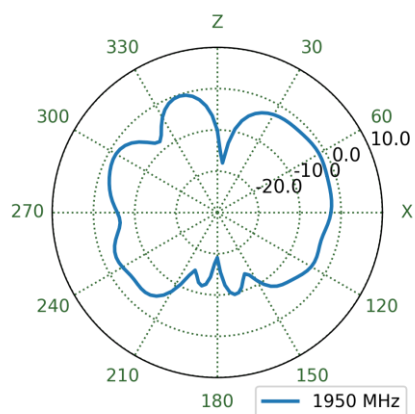
XY Plane



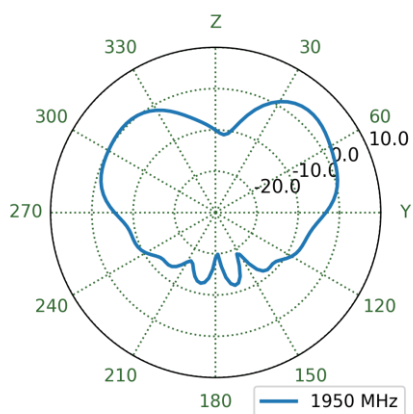
4.47 MIMO1 LTE Ground Plane Patterns at 1955 MHz



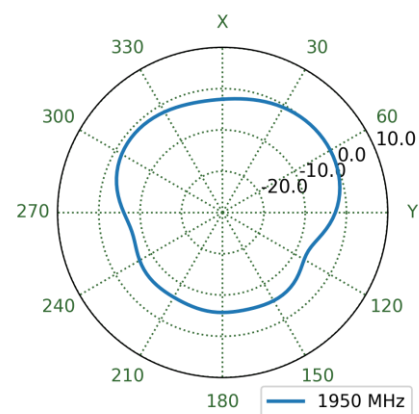
XZ Plane



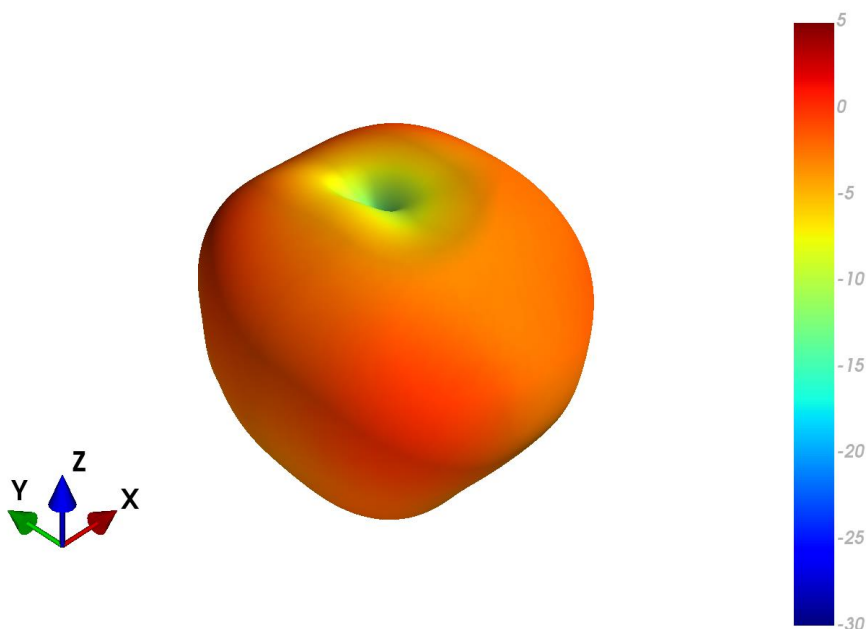
YZ Plane



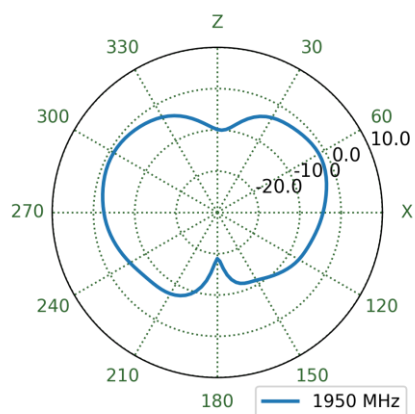
XY Plane



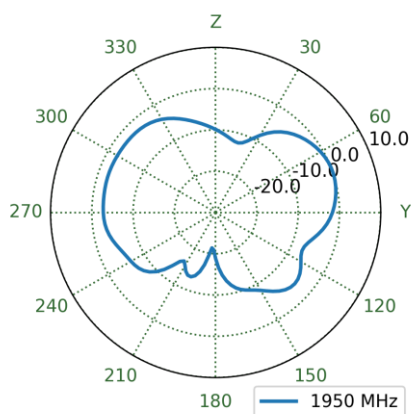
4.48 MIMO2 LTE Free Space Patterns at 1955 MHz



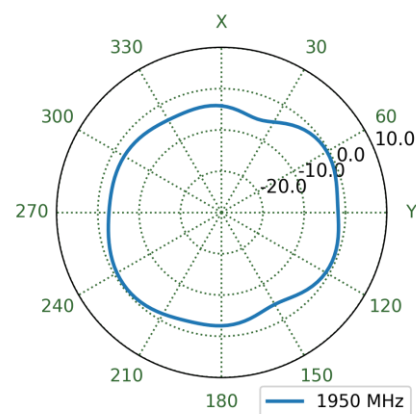
XZ Plane



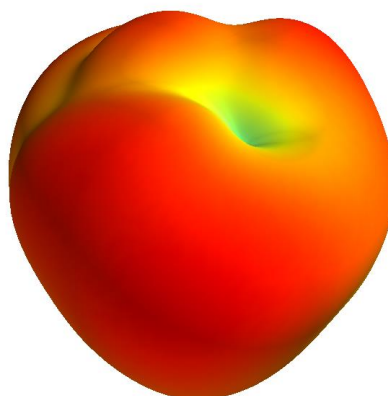
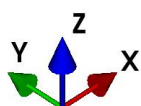
YZ Plane



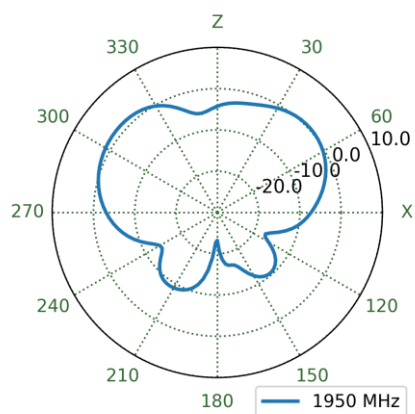
XY Plane



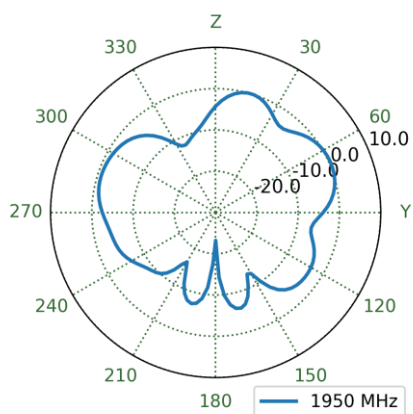
4.49 MIMO2 LTE Ground Plane Patterns at 1955 MHz



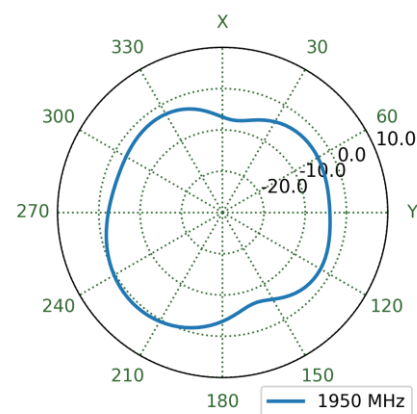
XZ Plane



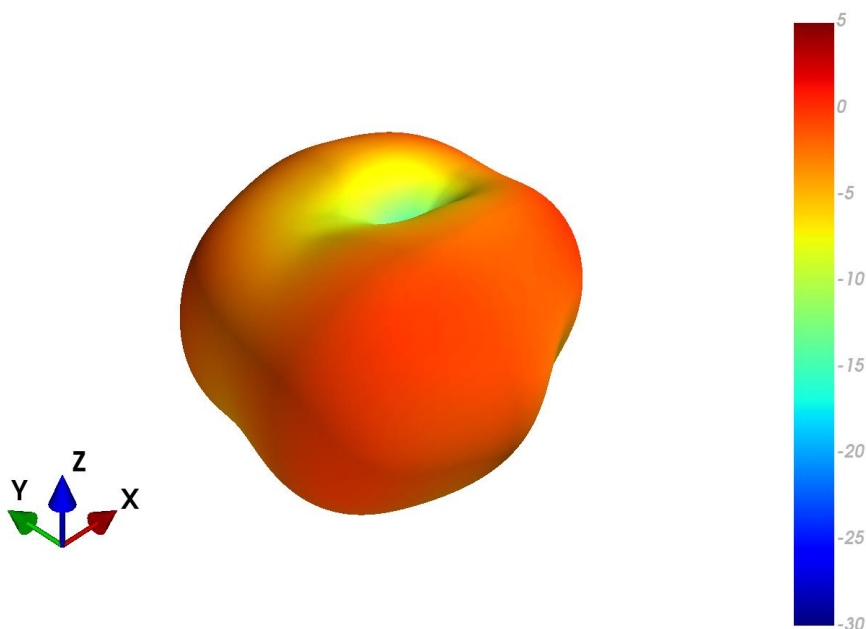
YZ Plane



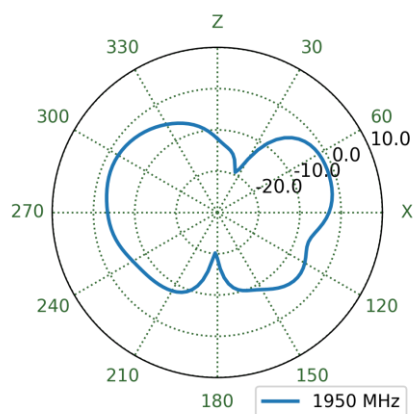
XY Plane



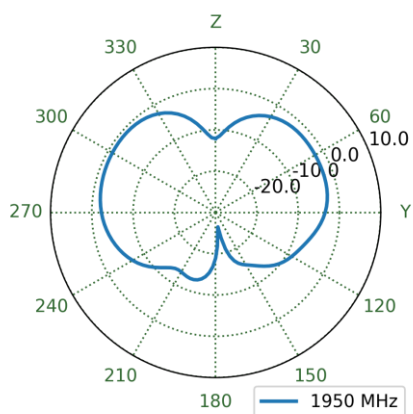
4.50 MIMO3 LTE Free Space Patterns at 1955 MHz



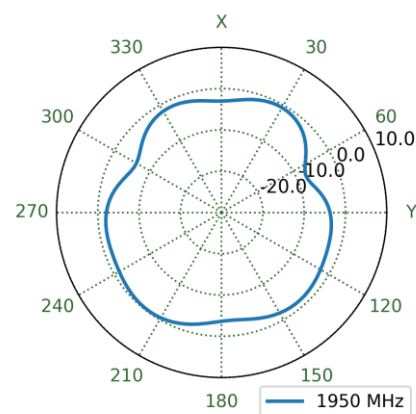
XZ Plane



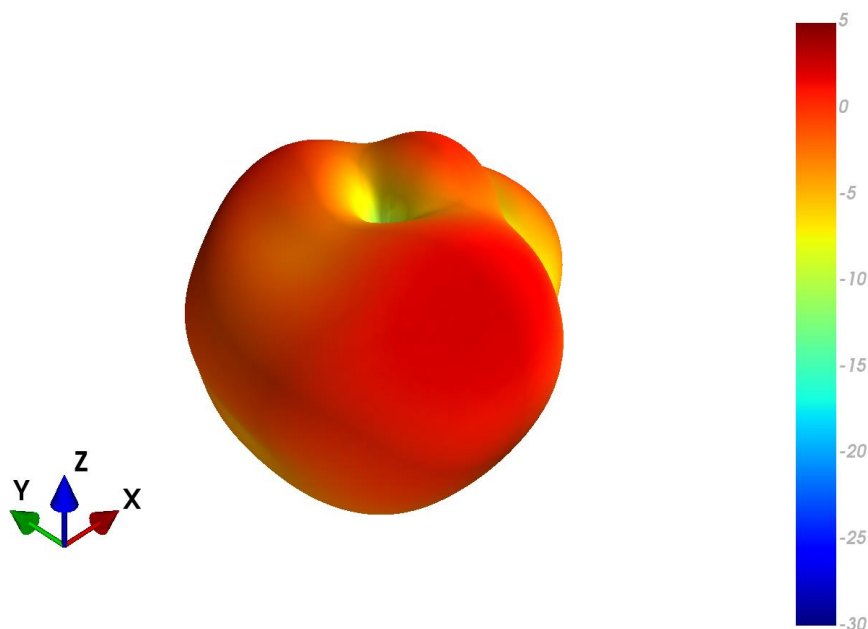
YZ Plane



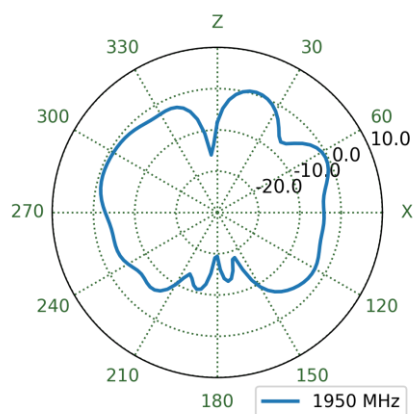
XY Plane



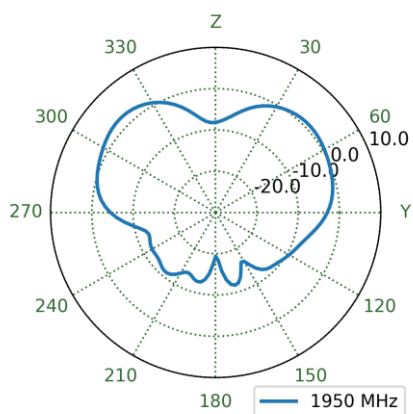
4.51 MIMO3 LTE Ground Plane Patterns at 1955 MHz



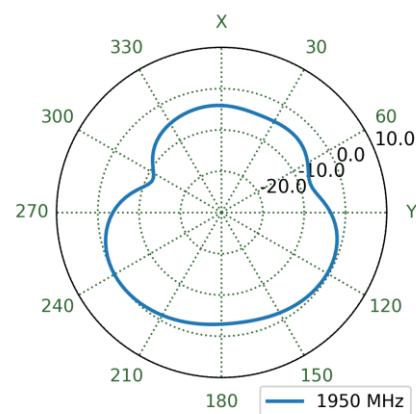
XZ Plane



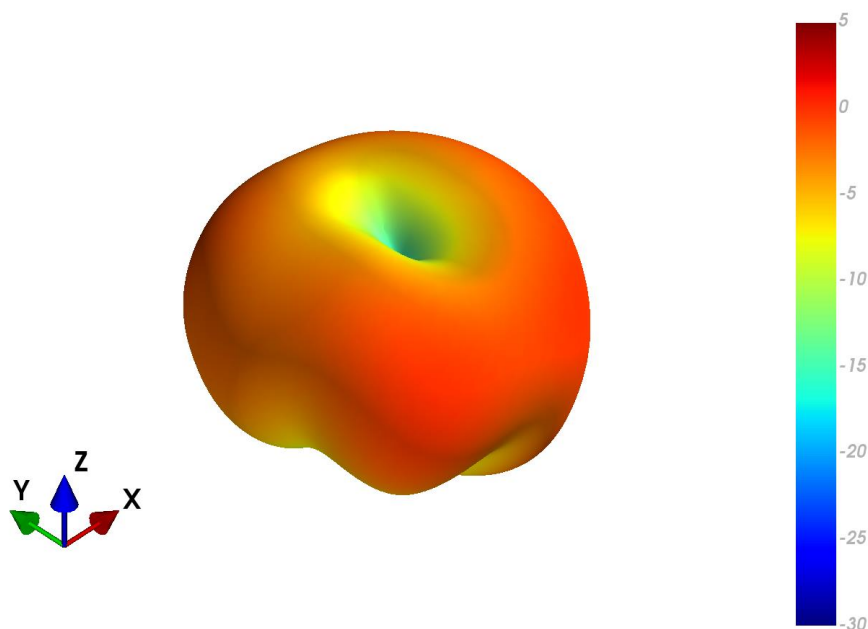
YZ Plane



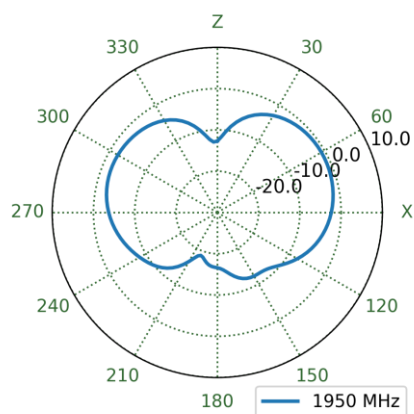
XY Plane



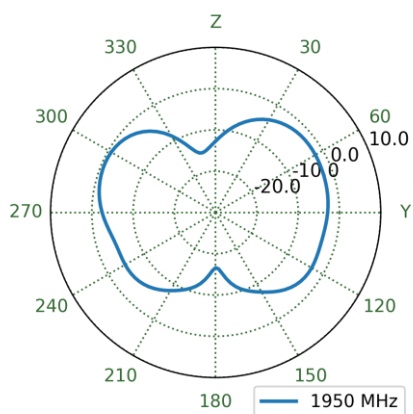
4.52 MIMO4 LTE Free Space Patterns at 1955 MHz



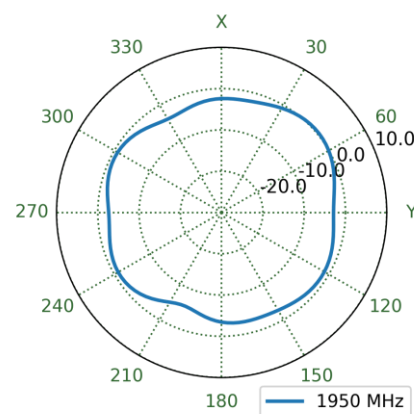
XZ Plane



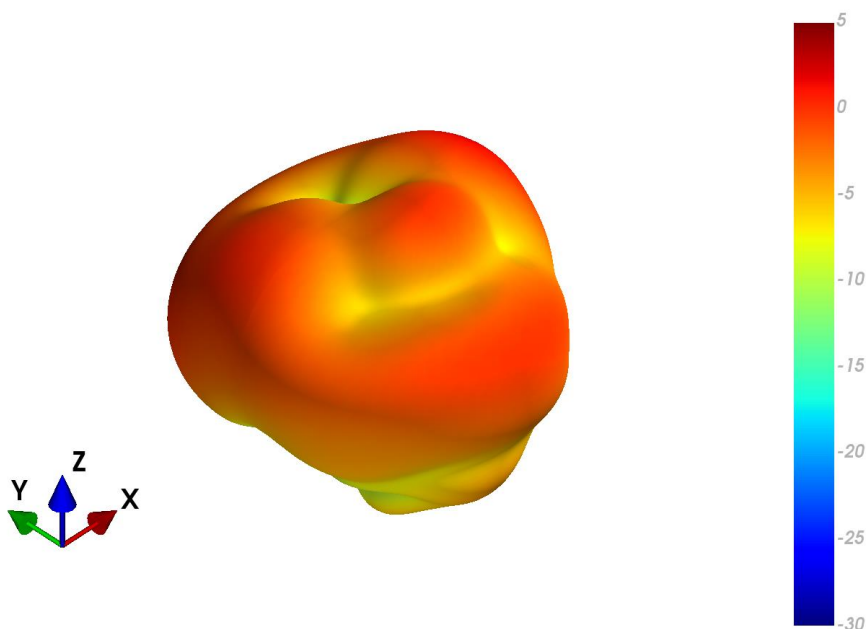
YZ Plane



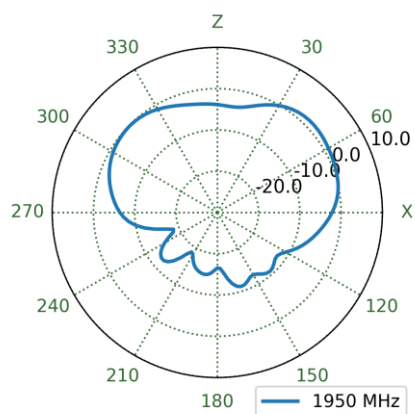
XY Plane



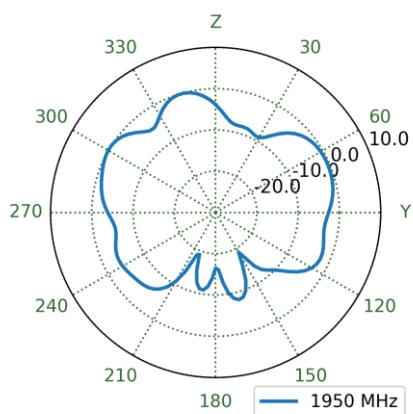
4.53 MIMO4 LTE Ground Plane Patterns at 1955 MHz



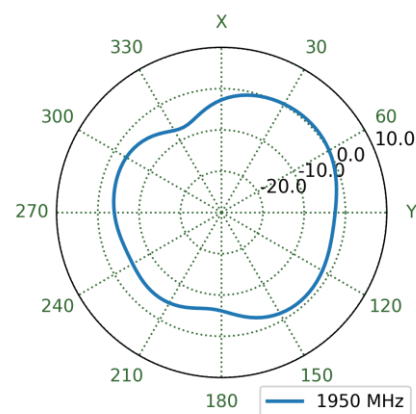
XZ Plane



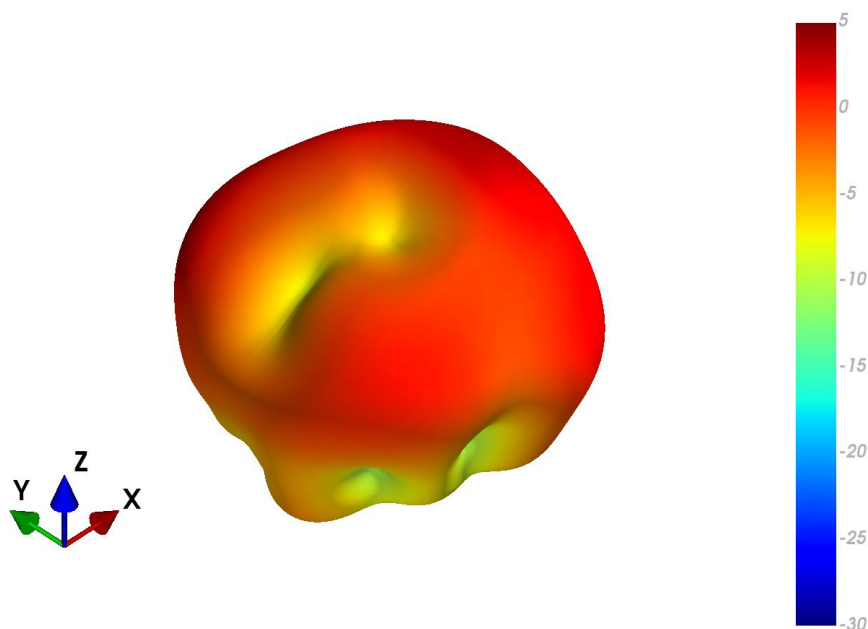
YZ Plane



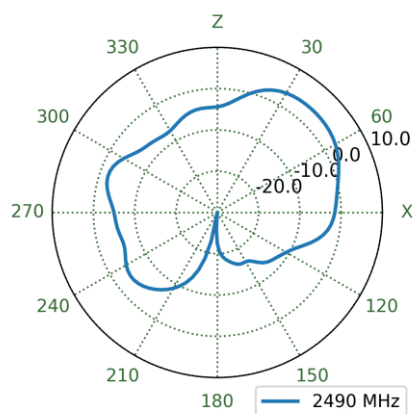
XY Plane



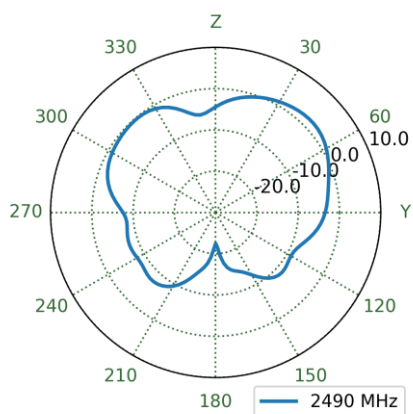
4.54 MIMO1 LTE Free Space Patterns at 2495 MHz



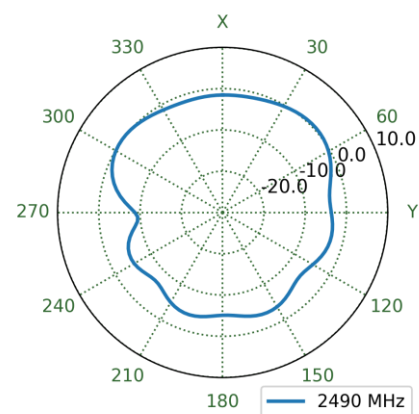
XZ Plane



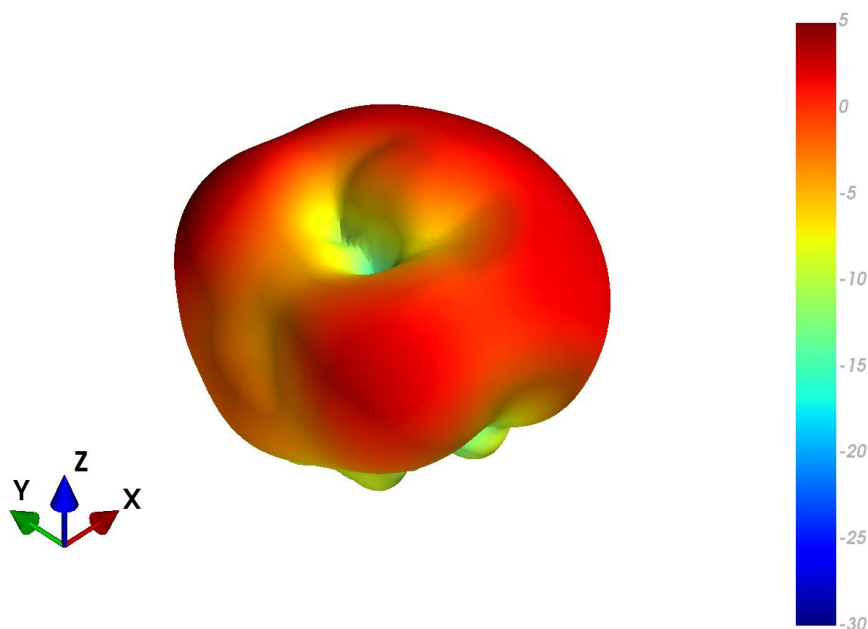
YZ Plane



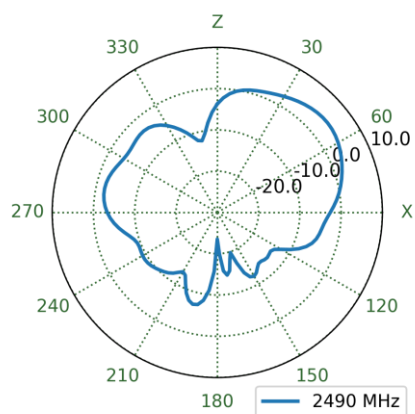
XY Plane



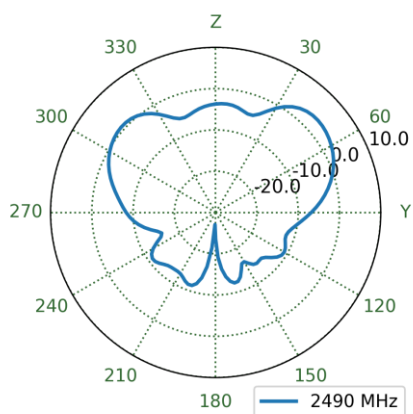
4.55 MIMO1 LTE Ground Plane Patterns at 2495 MHz



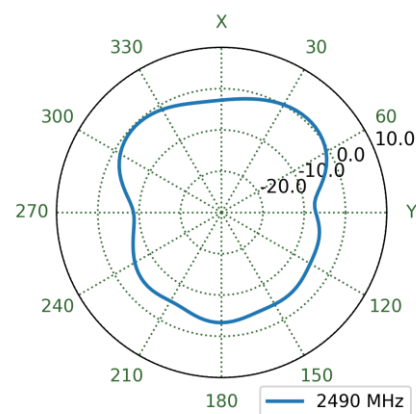
XZ Plane



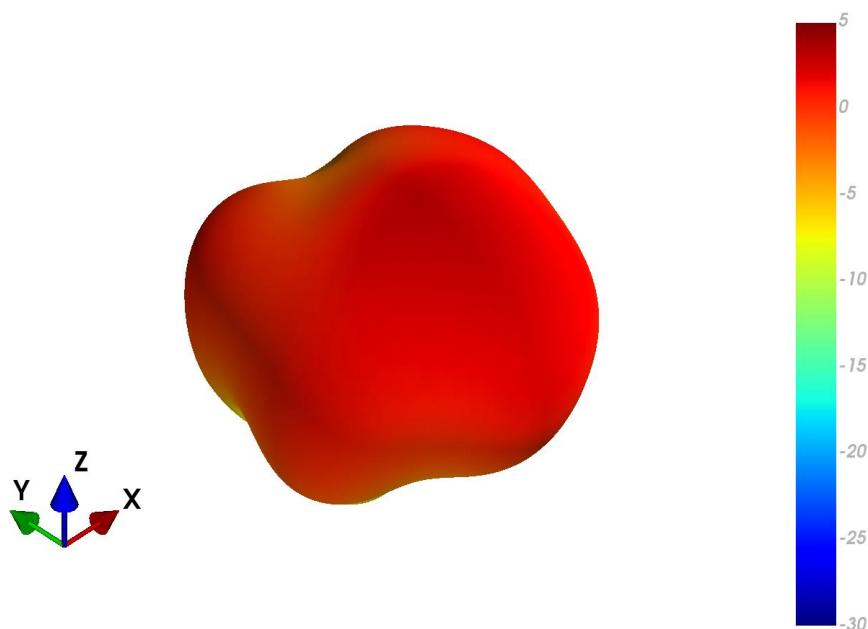
YZ Plane



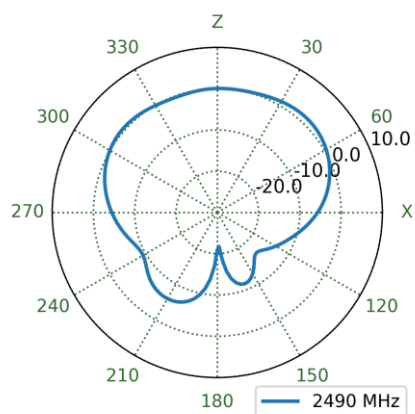
XY Plane



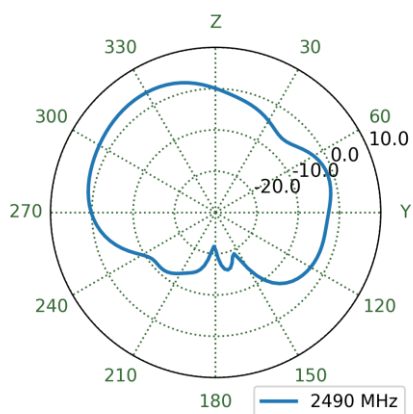
4.56 MIMO2 LTE Free Space Patterns at 2495 MHz



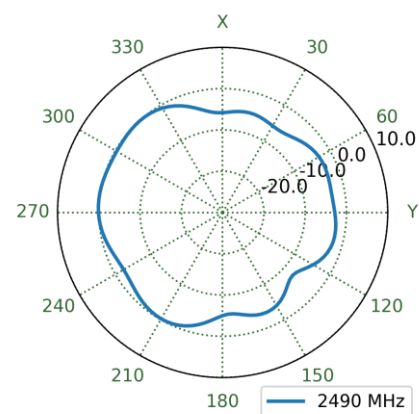
XZ Plane



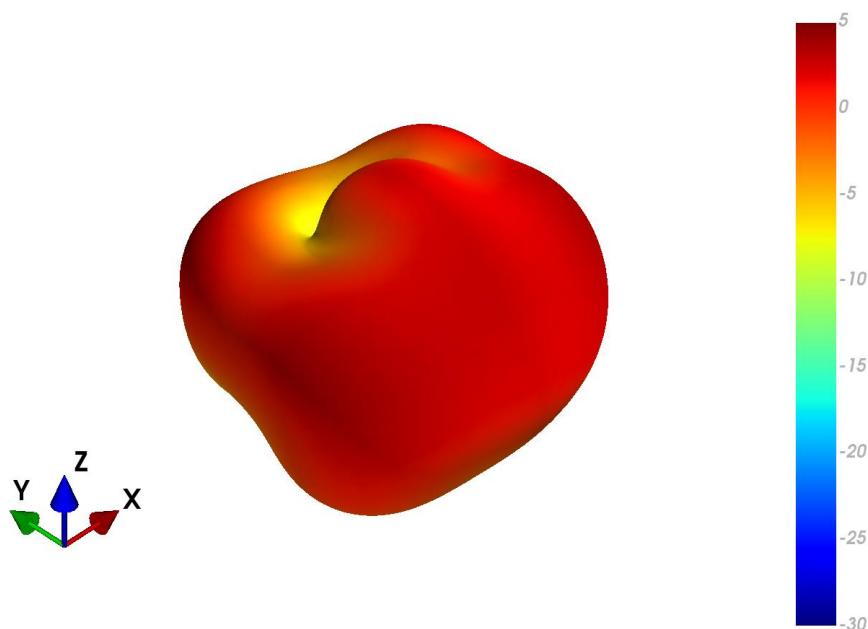
YZ Plane



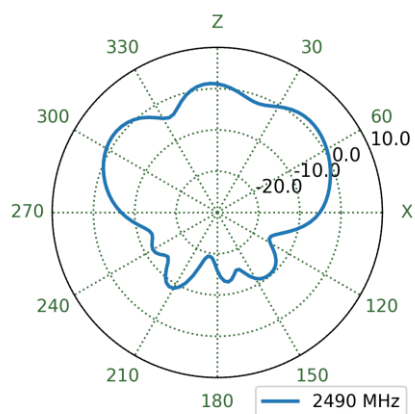
XY Plane



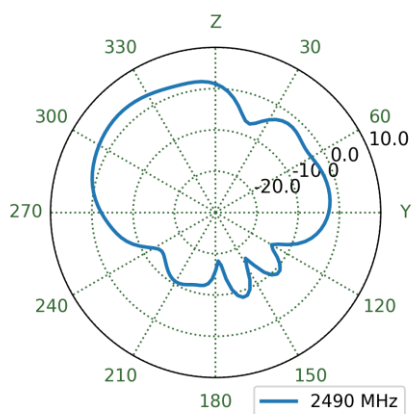
4.57 MIMO2 LTE Ground Plane Patterns at 2495 MHz



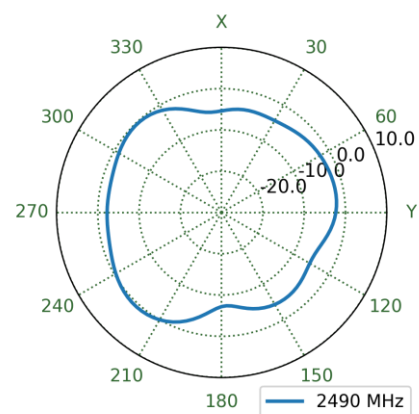
XZ Plane



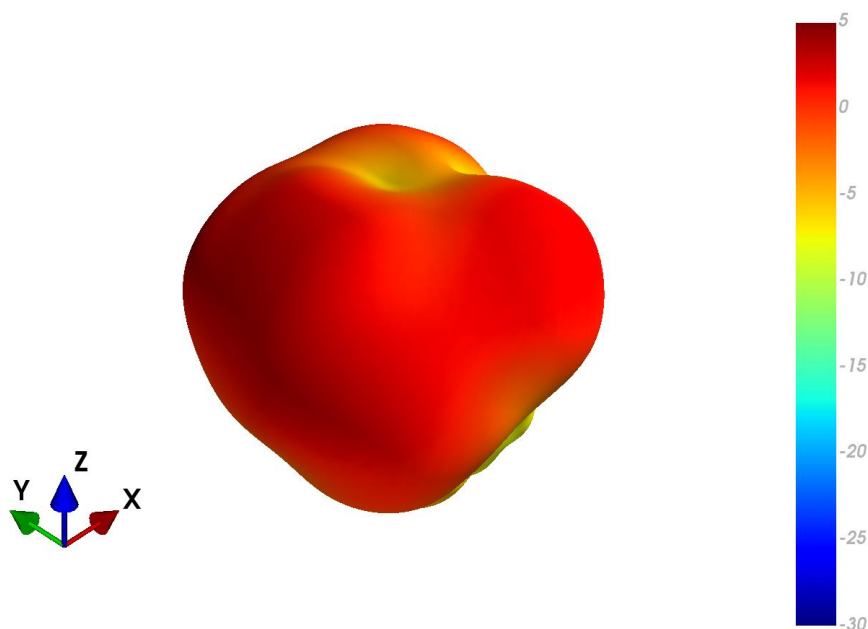
YZ Plane



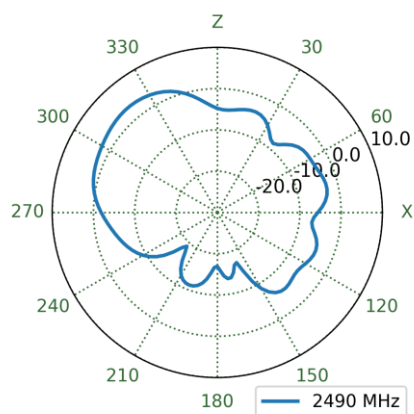
XY Plane



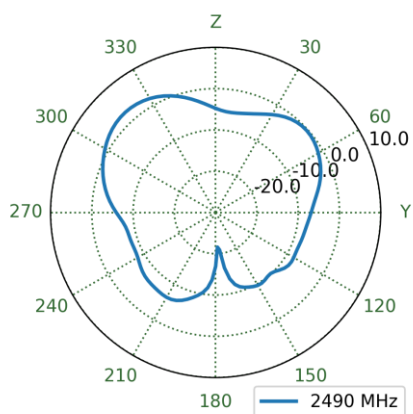
4.58 MIMO3 LTE Free Space Patterns at 2495 MHz



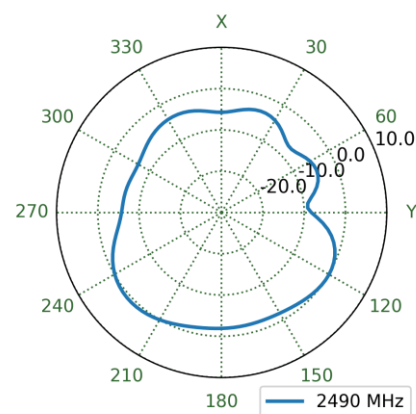
XZ Plane



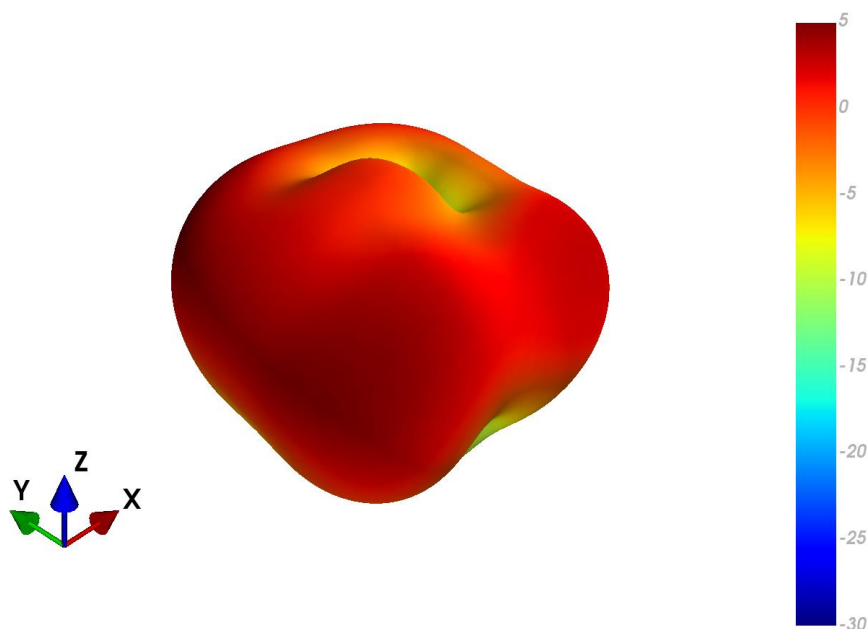
YZ Plane



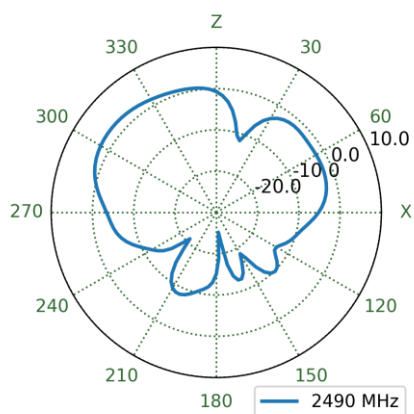
XY Plane



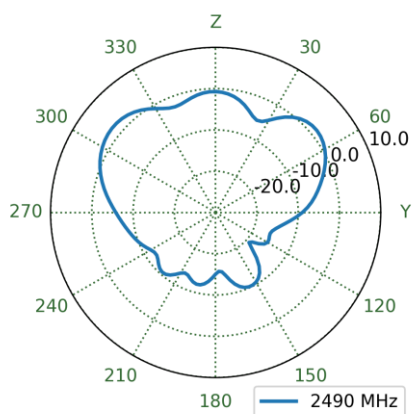
4.59 MIMO3 LTE Ground Plane Patterns at 2495 MHz



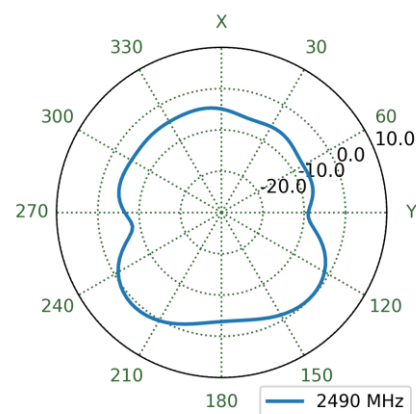
XZ Plane



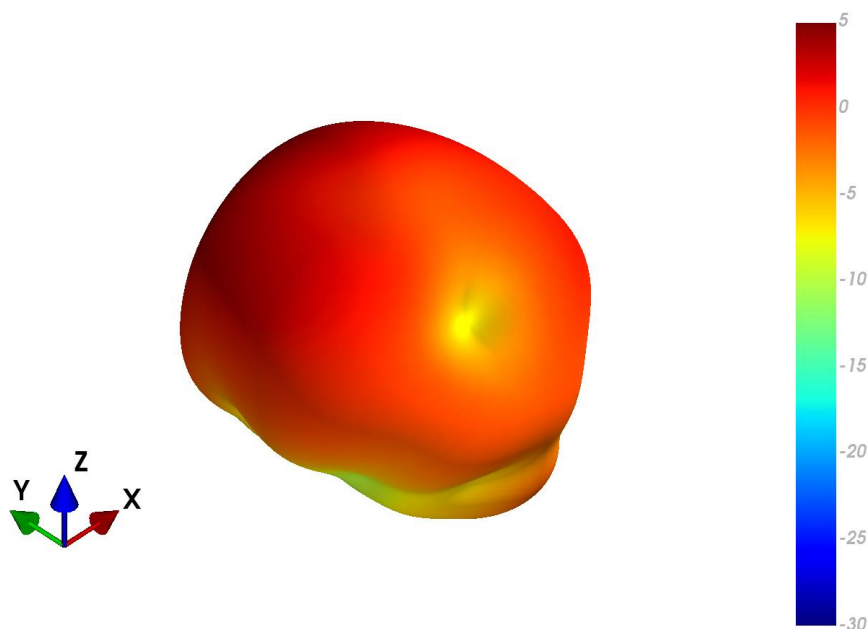
YZ Plane



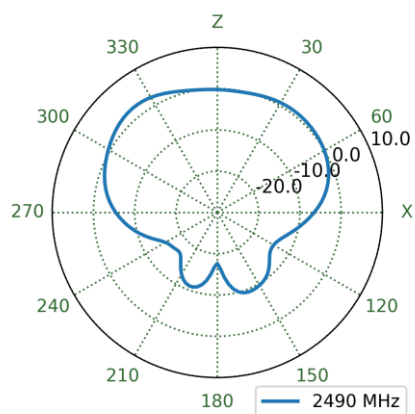
XY Plane



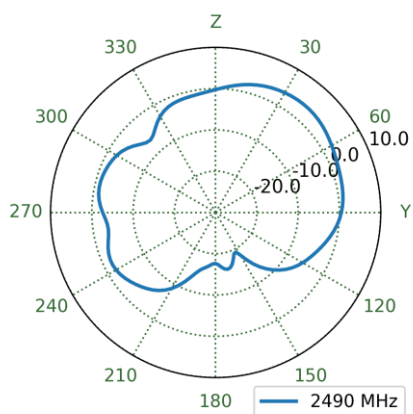
4.60 MIMO4 LTE Free Space Patterns at 2495 MHz



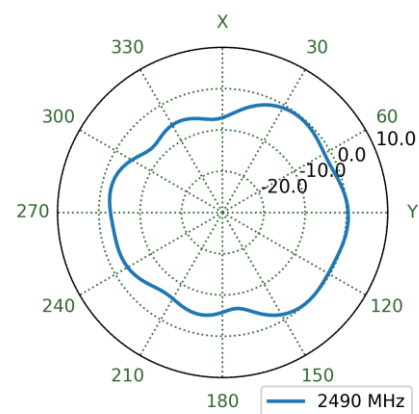
XZ Plane



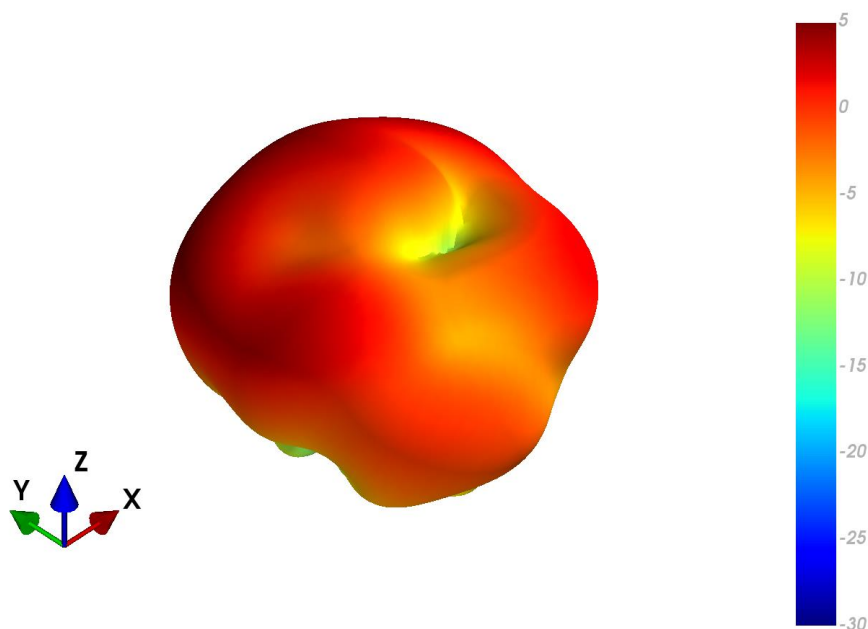
YZ Plane



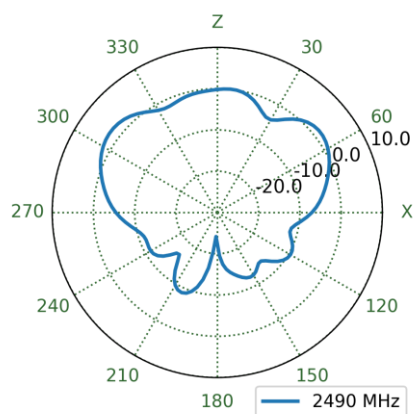
XY Plane



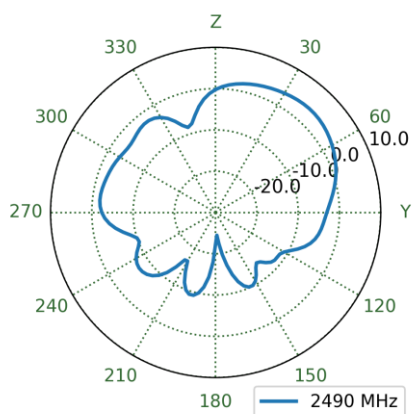
4.61 MIMO4 LTE Ground Plane Patterns at 2495 MHz



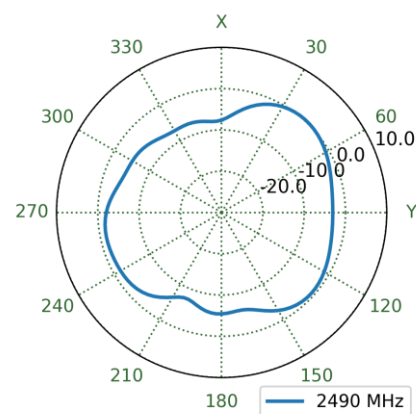
XZ Plane



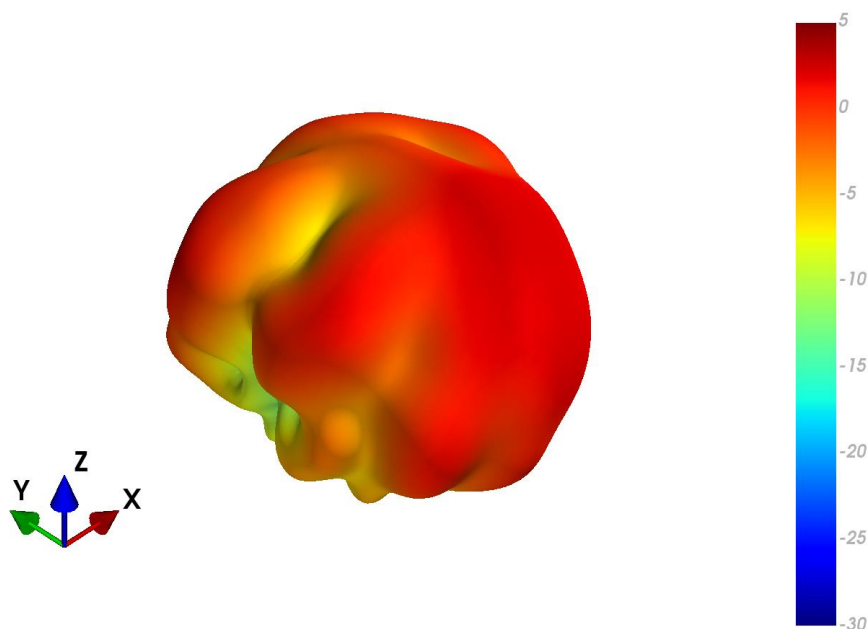
YZ Plane



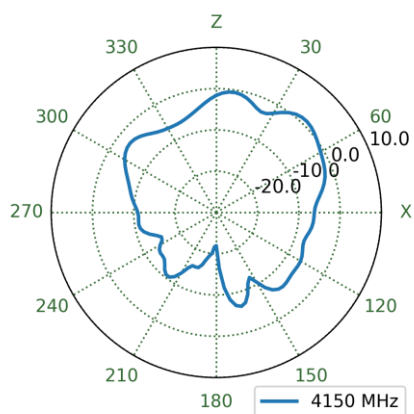
XY Plane



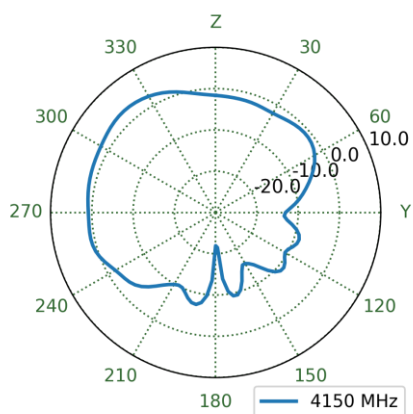
4.62 MIMO1 LTE Free Space Patterns at 4150 MHz



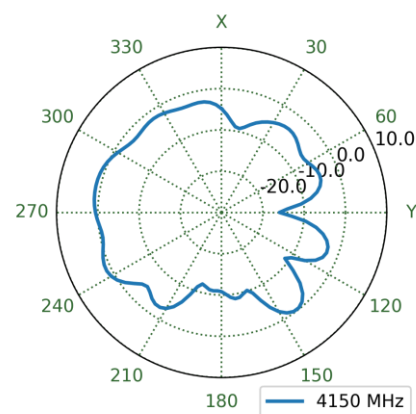
XZ Plane



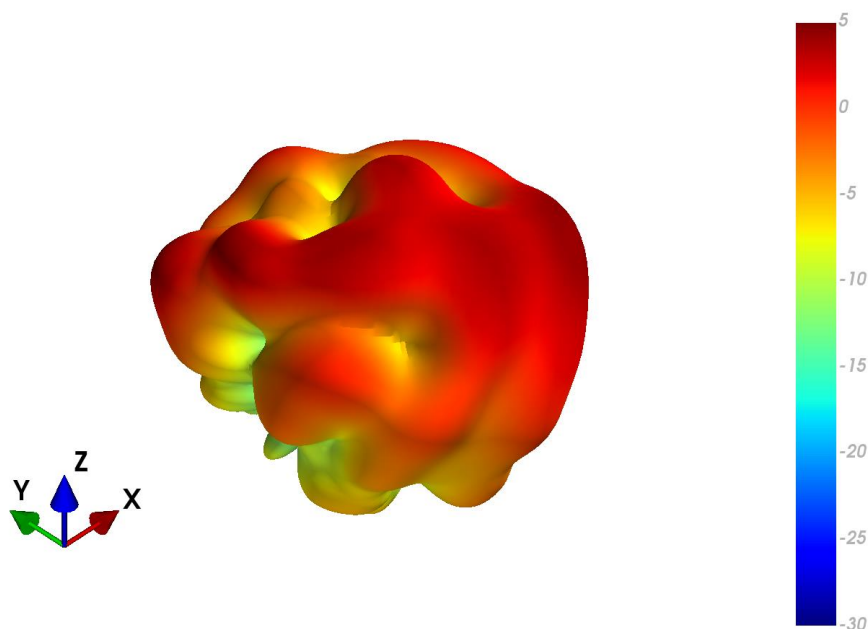
YZ Plane



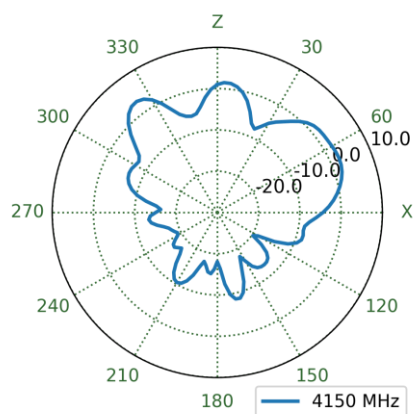
XY Plane



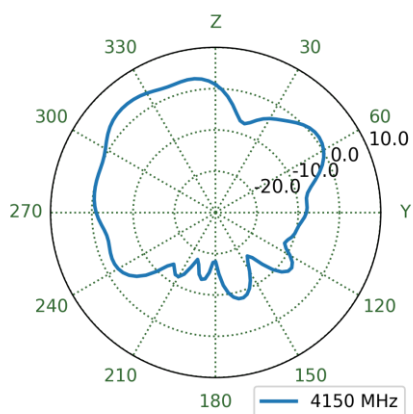
4.63 MIMO1 LTE Ground Plane Patterns at 4150 MHz



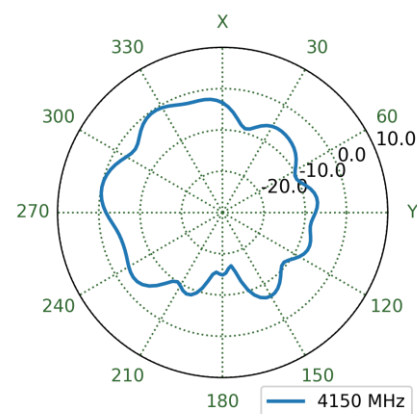
XZ Plane



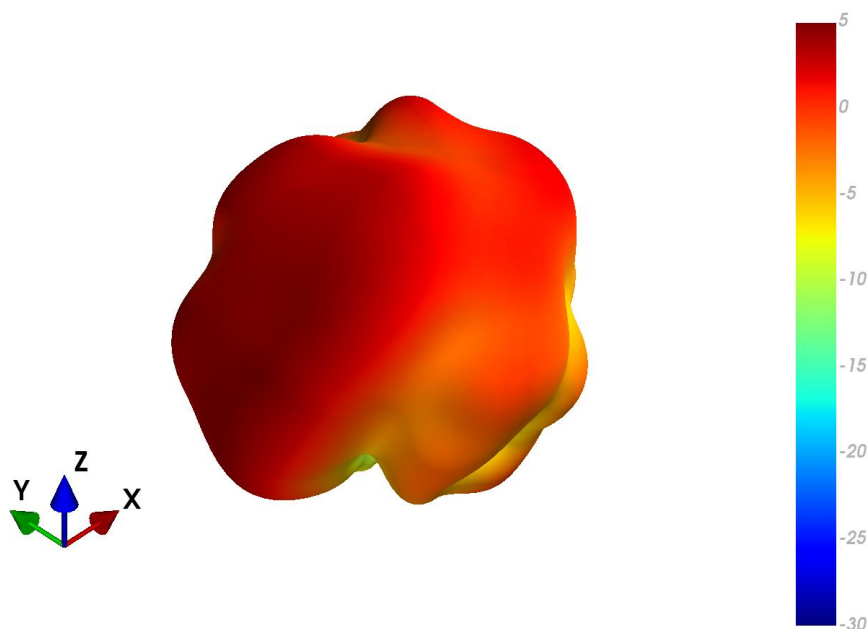
YZ Plane



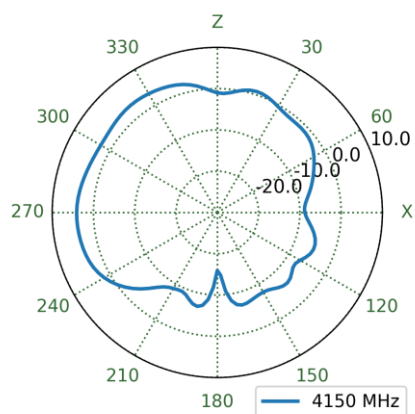
XY Plane



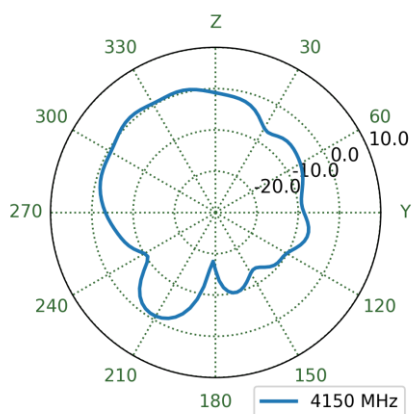
4.64 MIMO2 LTE Free Space Patterns at 4150 MHz



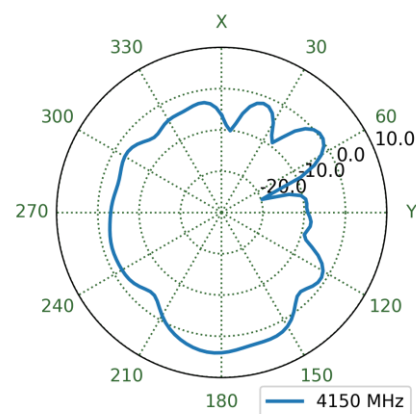
XZ Plane



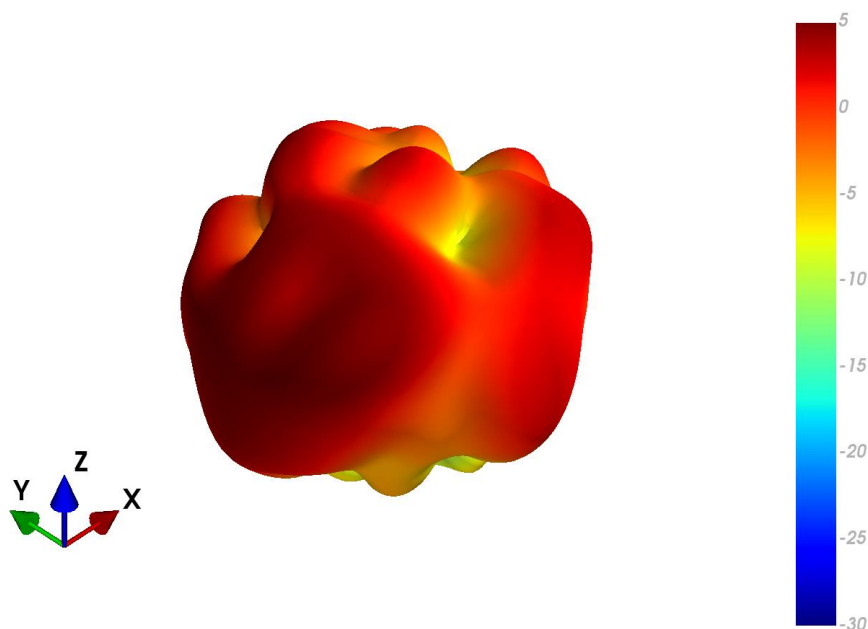
YZ Plane



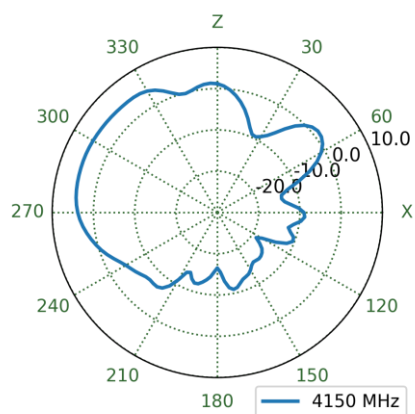
XY Plane



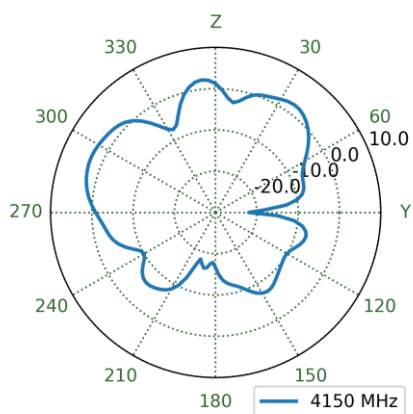
4.65 MIMO2 LTE Ground Plane Patterns at 4150 MHz



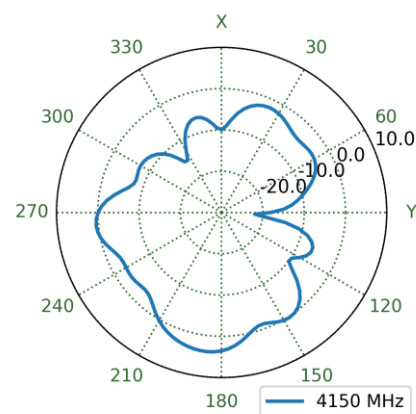
XZ Plane



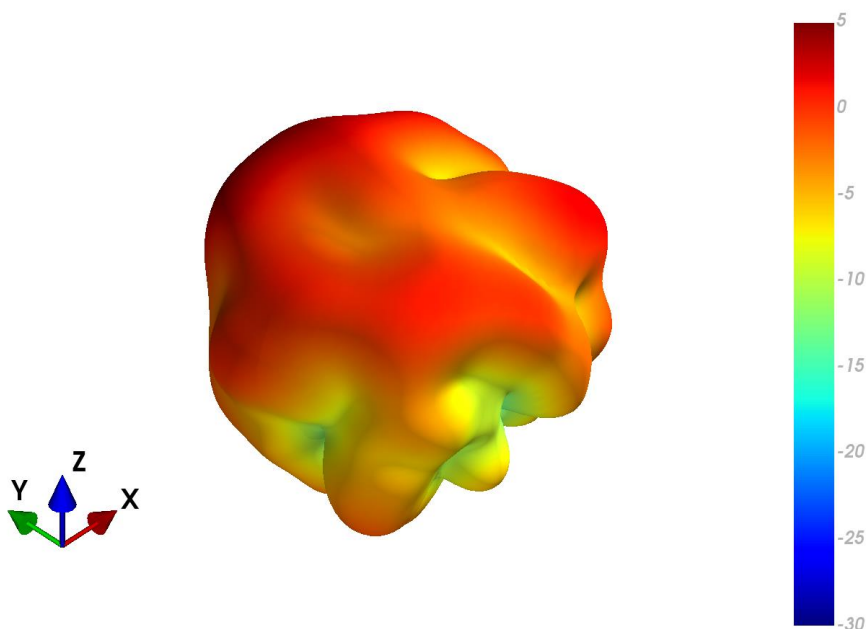
YZ Plane



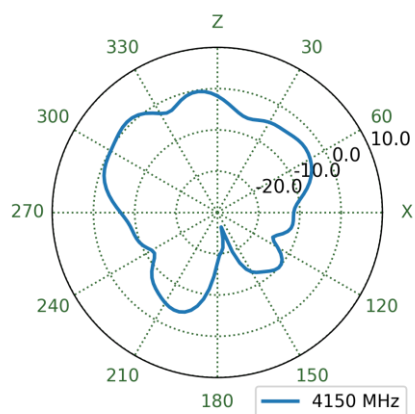
XY Plane



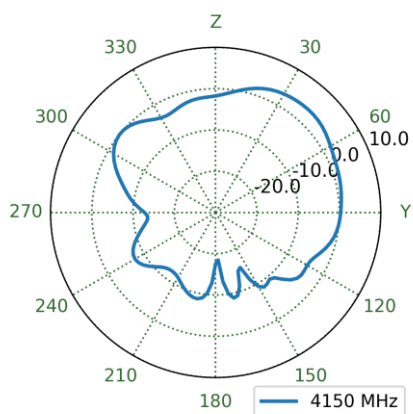
4.66 MIMO3 LTE Free Space Patterns at 4150 MHz



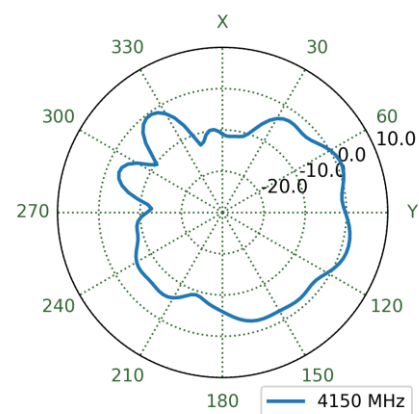
XZ Plane



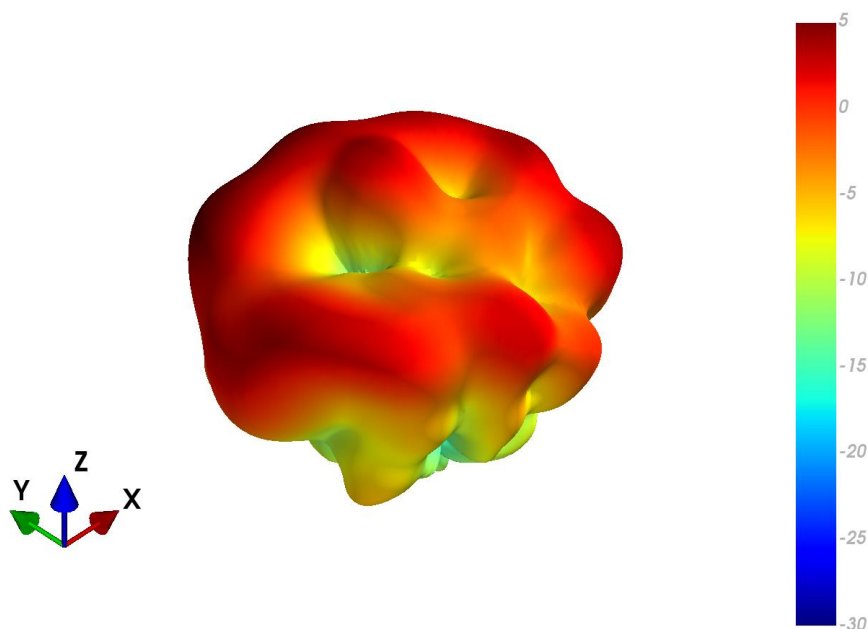
YZ Plane



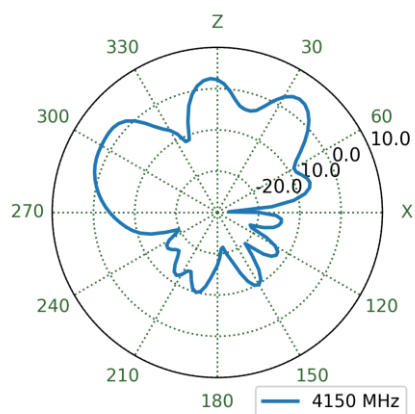
XY Plane



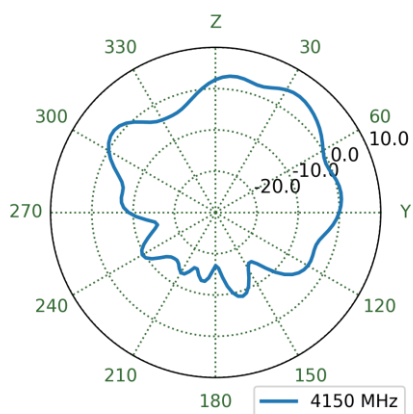
4.67 MIMO3 LTE Ground Plane Patterns at 4150 MHz



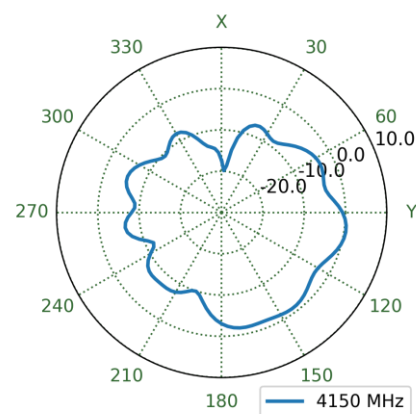
XZ Plane



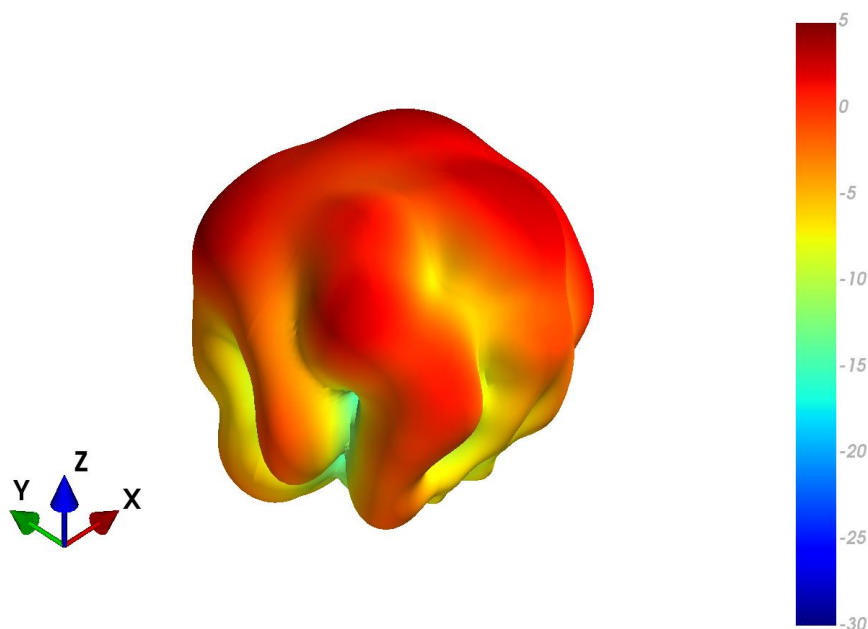
YZ Plane



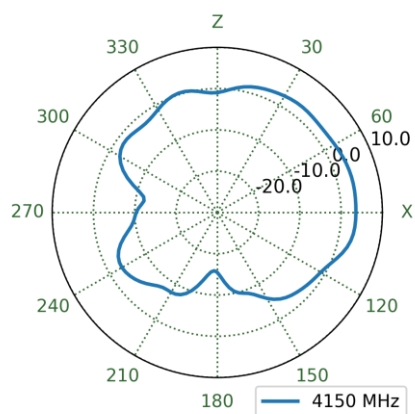
XY Plane



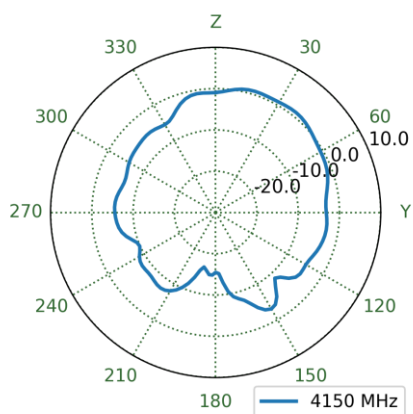
4.68 MIMO4 LTE Free Space Patterns at 4150 MHz



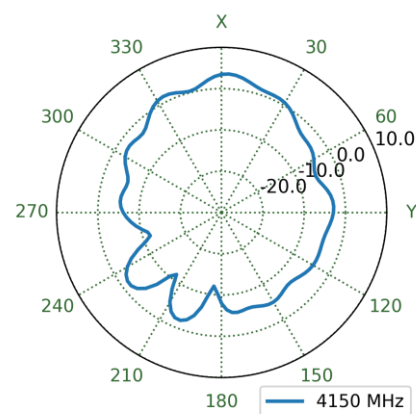
XZ Plane



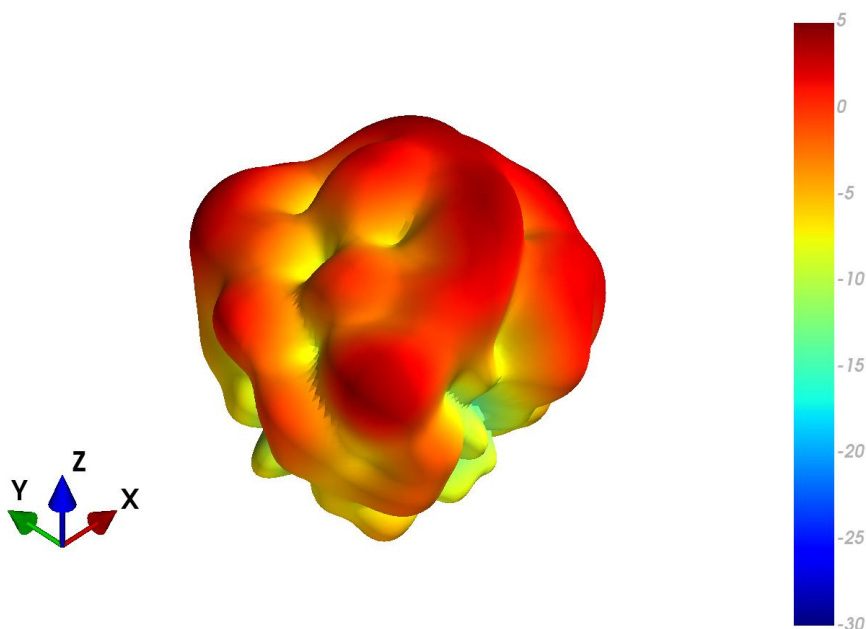
YZ Plane



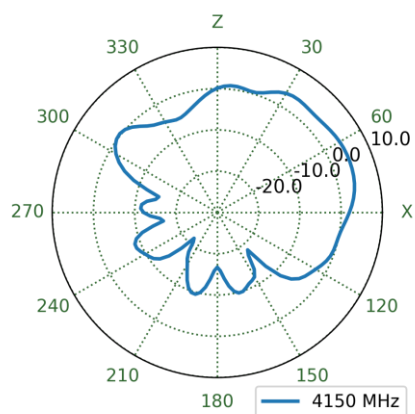
XY Plane



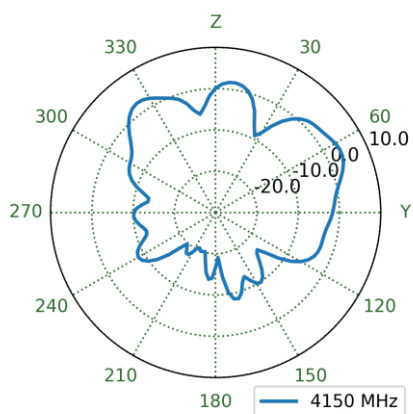
4.69 MIMO4 LTE Ground Plane Patterns at 4150 MHz



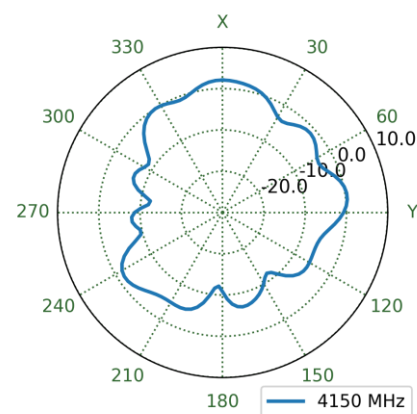
XZ Plane



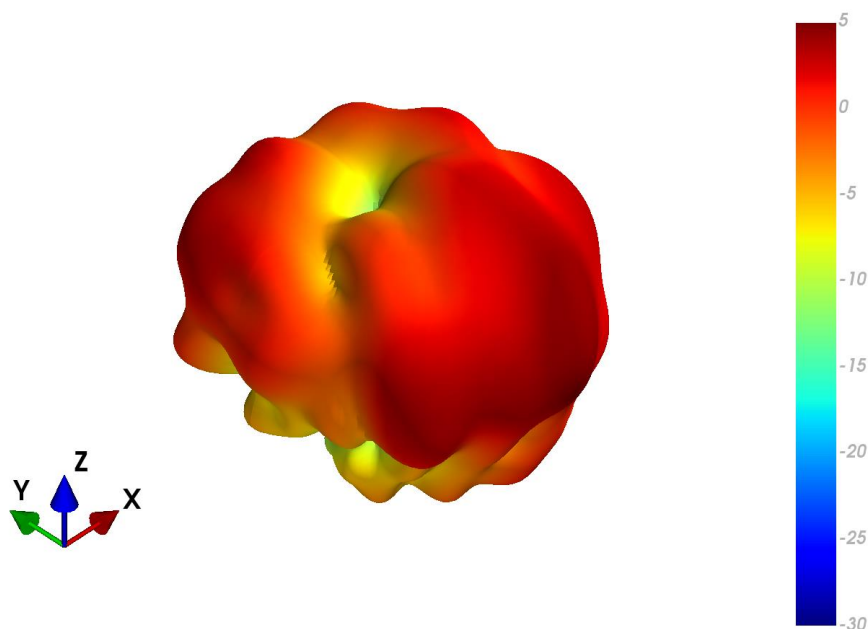
YZ Plane



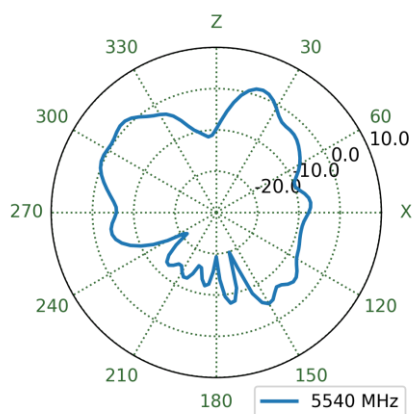
XY Plane



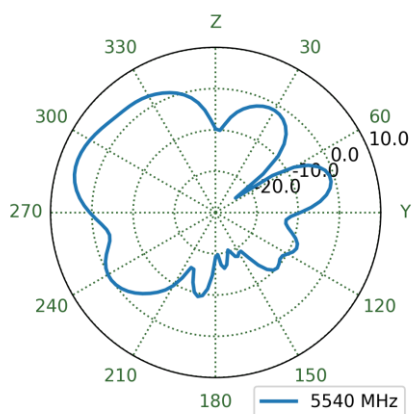
4.70 MIMO1 LTE Free Space Patterns at 5538 MHz



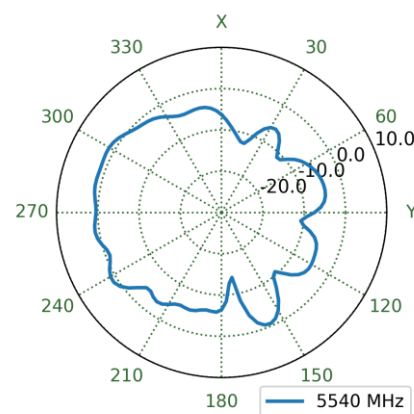
XZ Plane



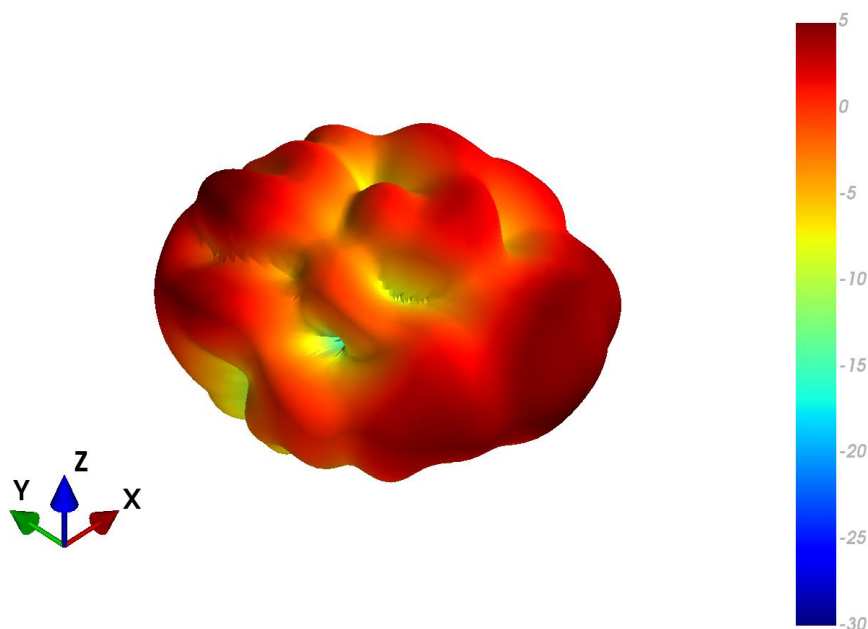
YZ Plane



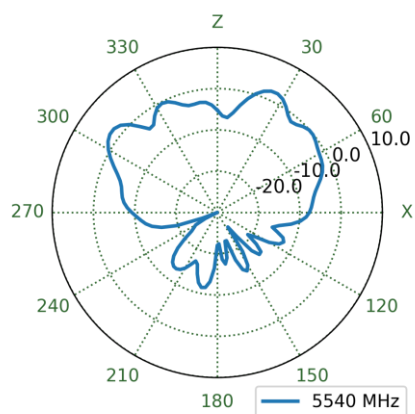
XY Plane



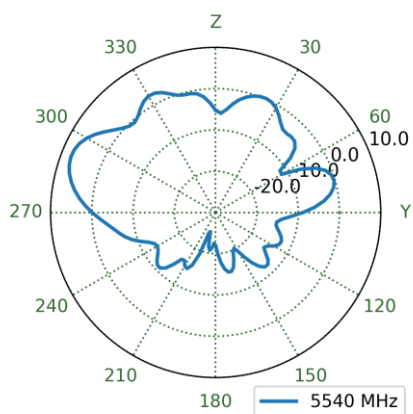
4.71 MIMO1 LTE Ground Plane Patterns at 5538 MHz



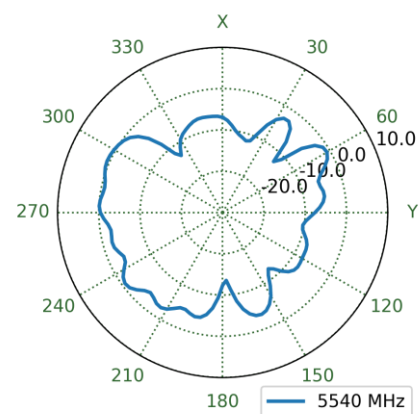
XZ Plane



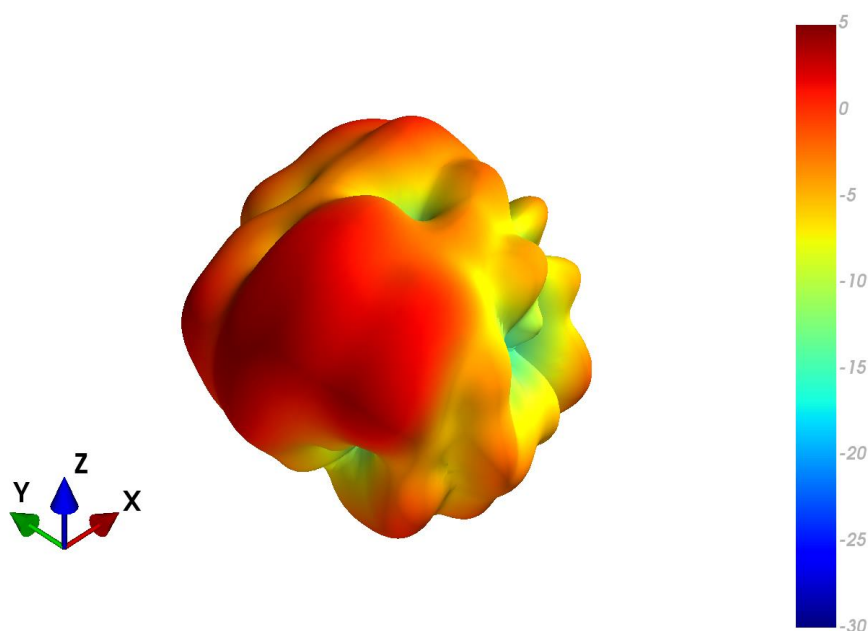
YZ Plane



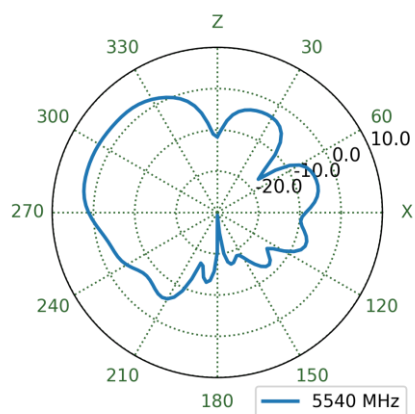
XY Plane



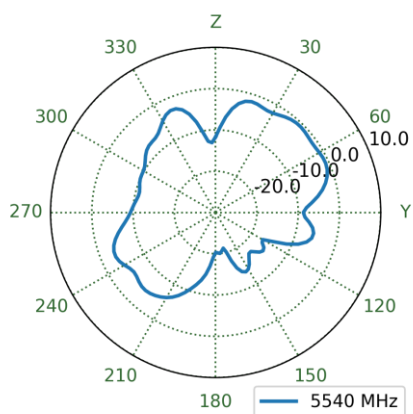
4.72 MIMO2 LTE Free Space Patterns at 5538 MHz



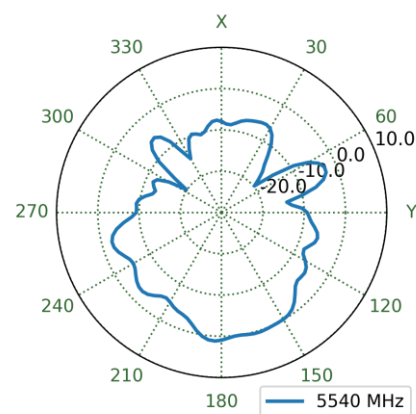
XZ Plane



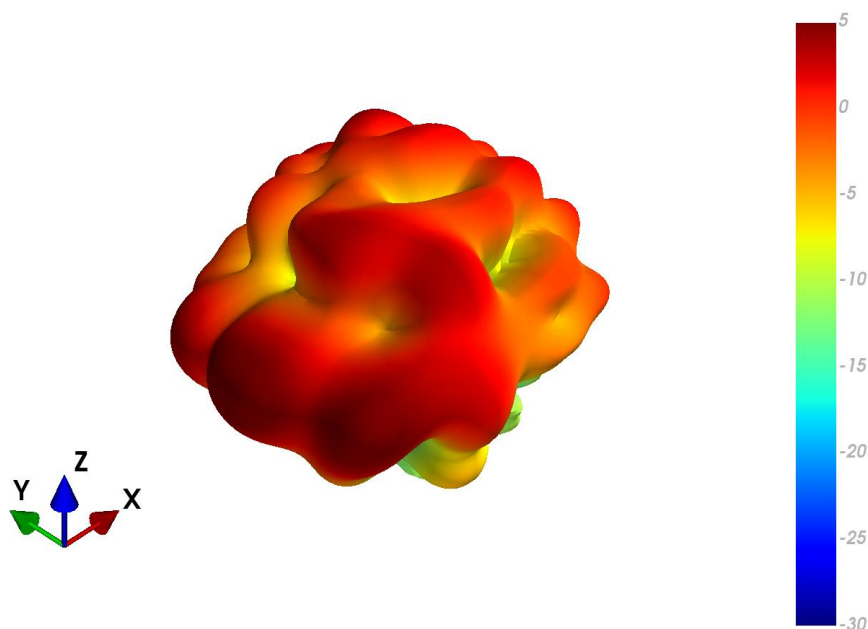
YZ Plane



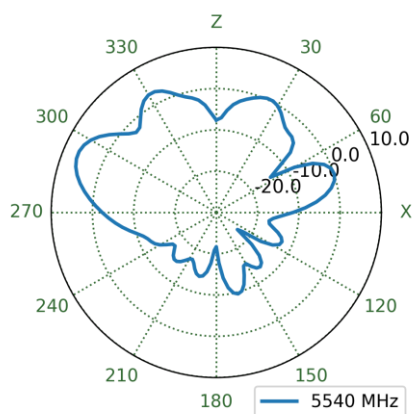
XY Plane



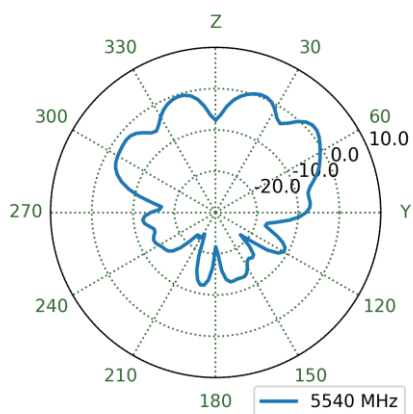
4.73 MIMO2 LTE Ground Plane Patterns at 5538 MHz



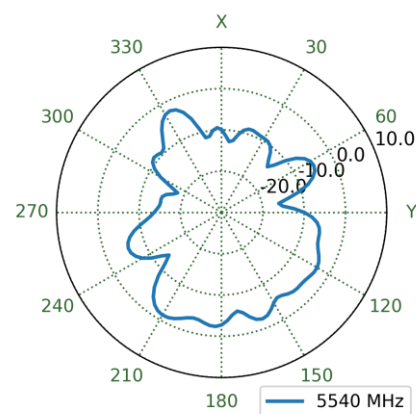
XZ Plane



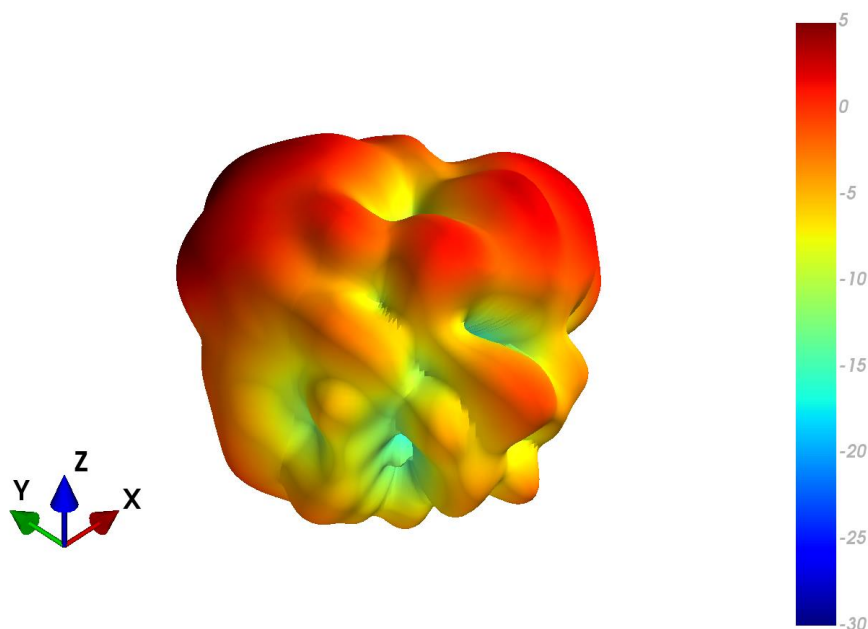
YZ Plane



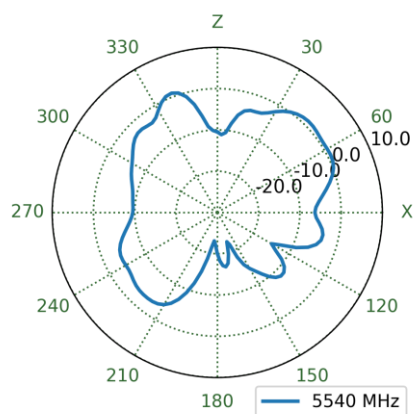
XY Plane



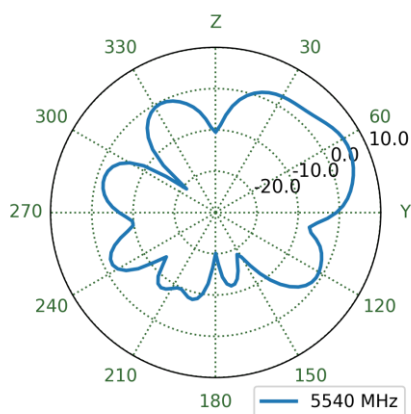
4.74 MIMO3 LTE Free Space Patterns at 5538 MHz



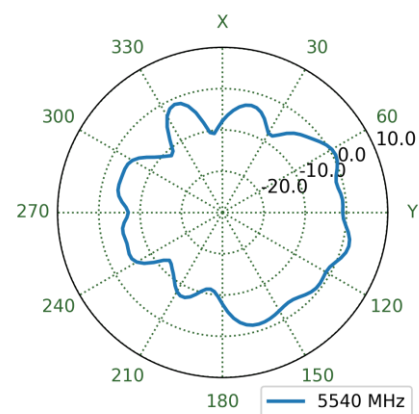
XZ Plane



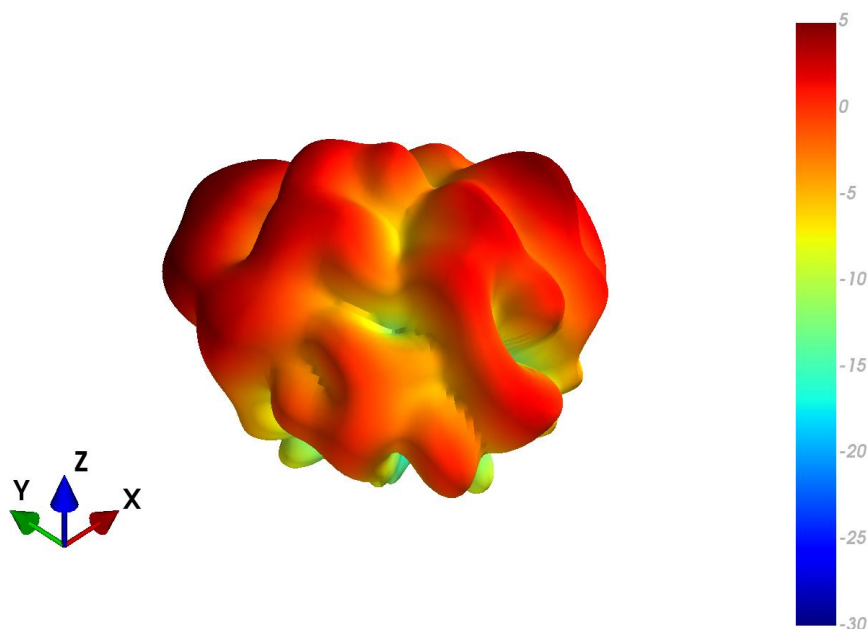
YZ Plane



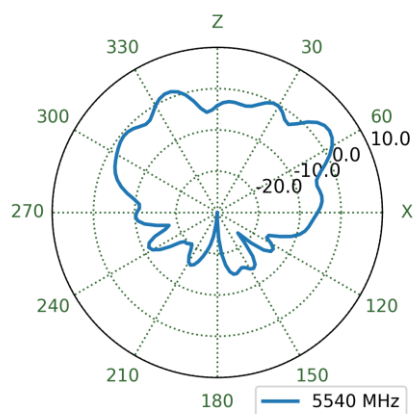
XY Plane



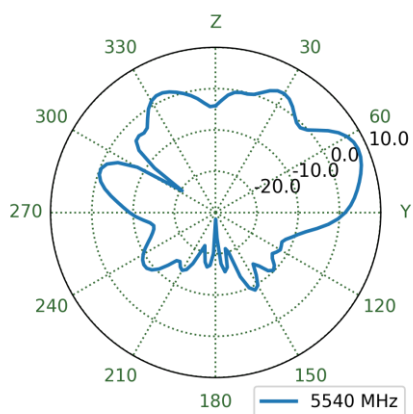
4.75 MIMO3 LTE Ground Plane Patterns at 5538 MHz



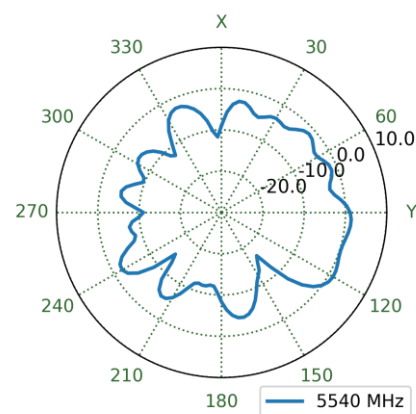
XZ Plane



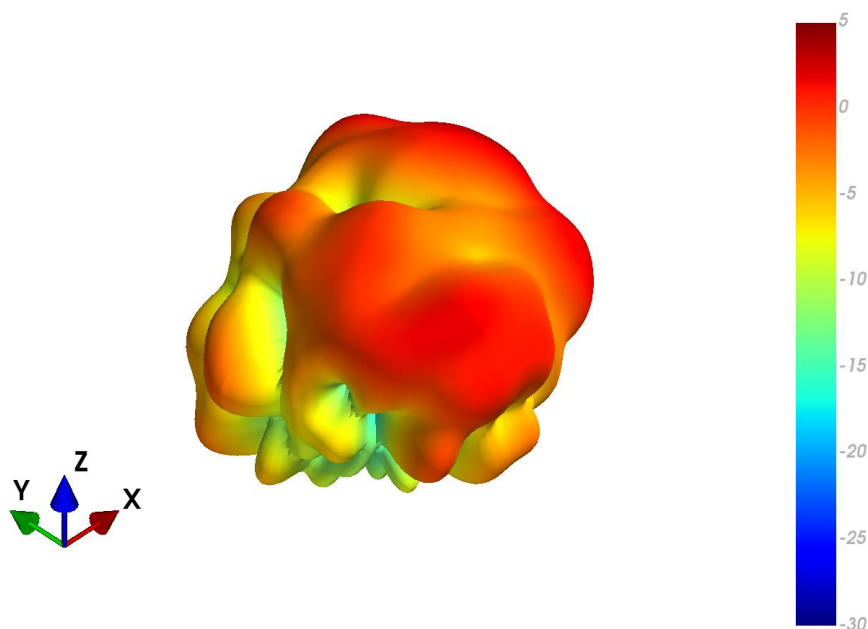
YZ Plane



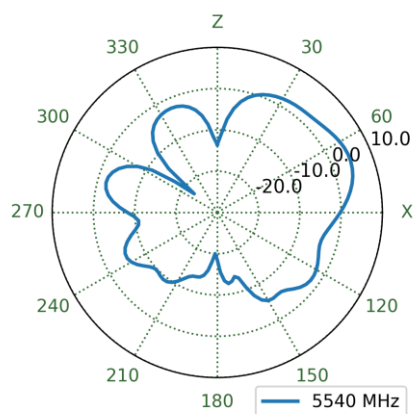
XY Plane



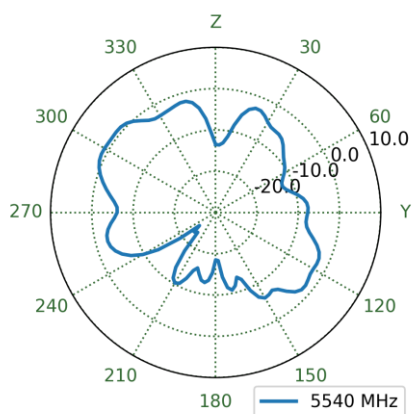
4.76 MIMO4 LTE Free Space Patterns at 5538 MHz



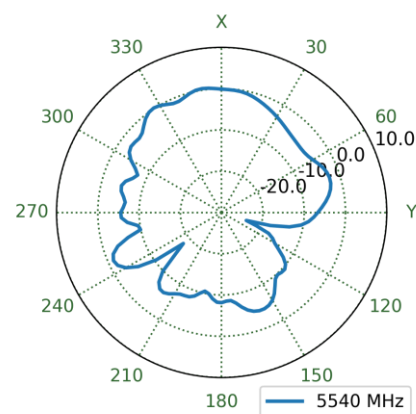
XZ Plane



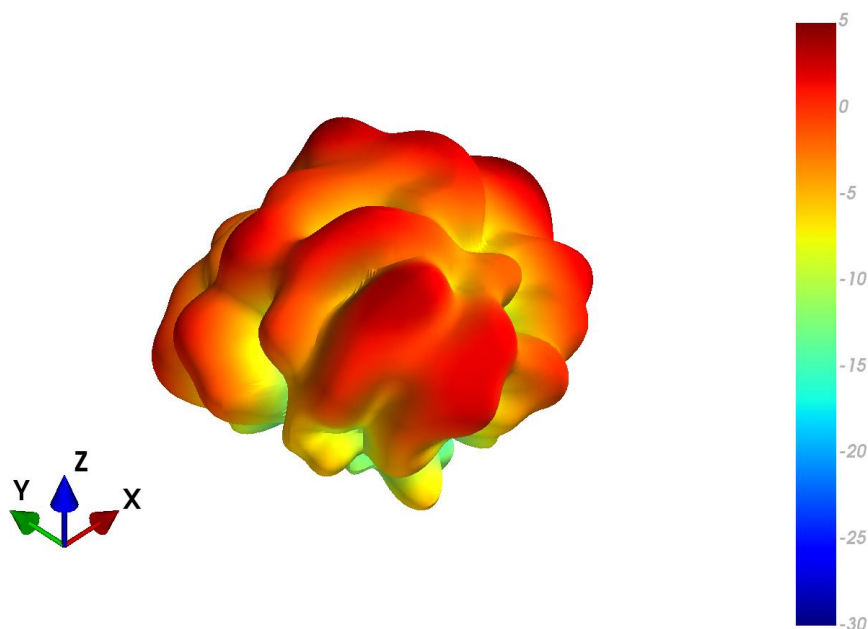
YZ Plane



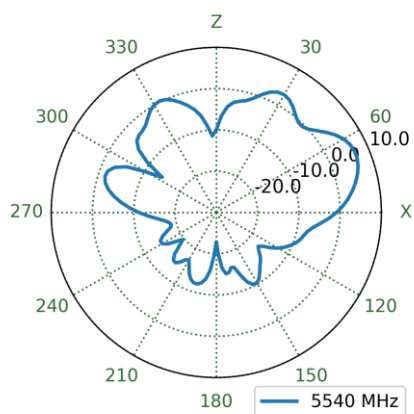
XY Plane



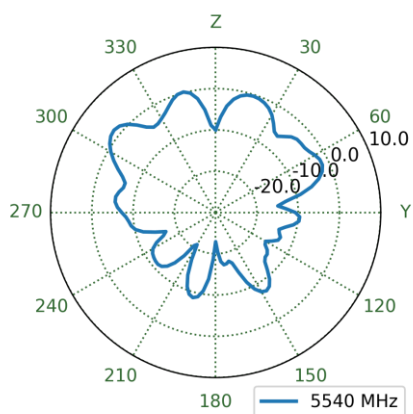
4.77 MIMO4 LTE Ground Plane Patterns at 5538 MHz



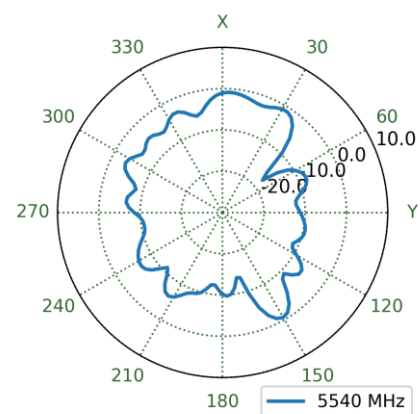
XZ Plane



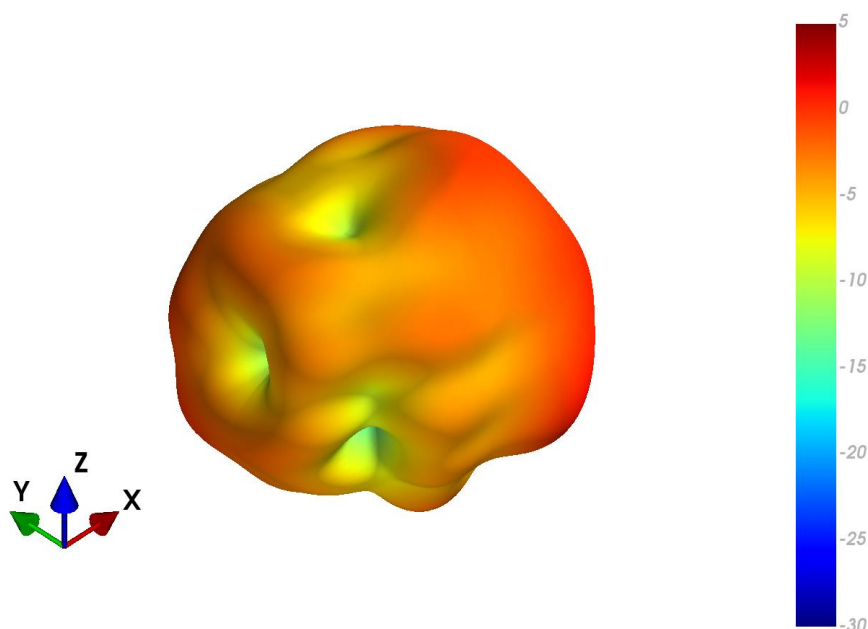
YZ Plane



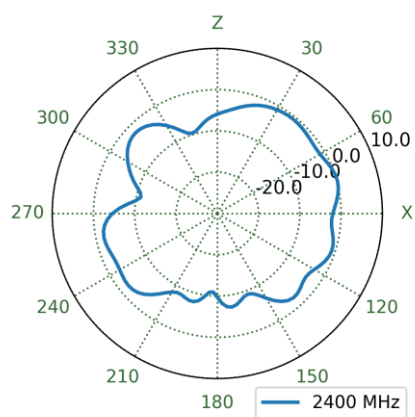
XY Plane



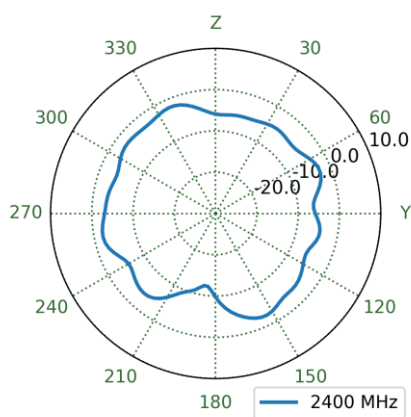
4.78 MIMO1 Wi-Fi Free Space Patterns at 2400 MHz



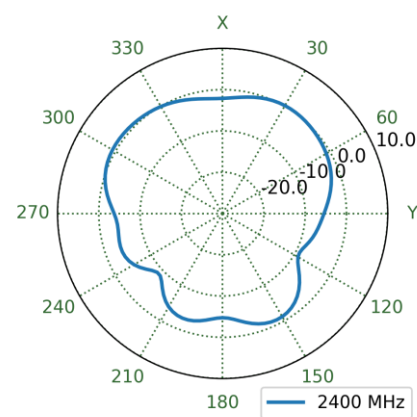
XZ Plane



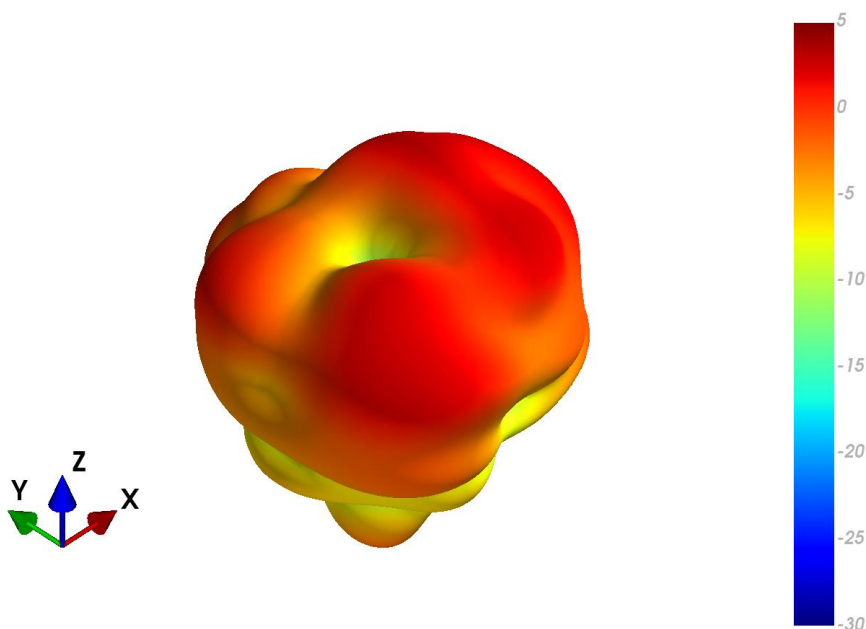
YZ Plane



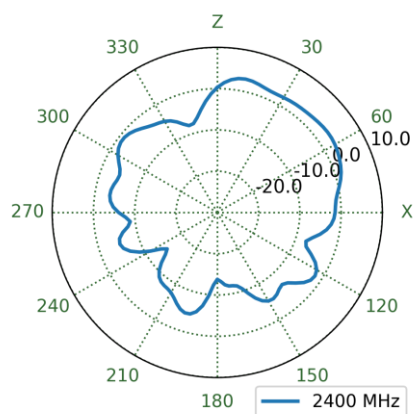
XY Plane



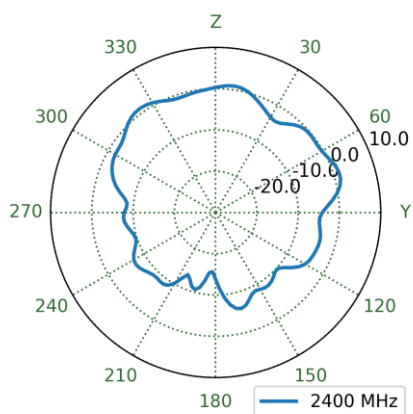
4.79 MIMO1 Wi-Fi Ground Plane Patterns at 2400 MHz



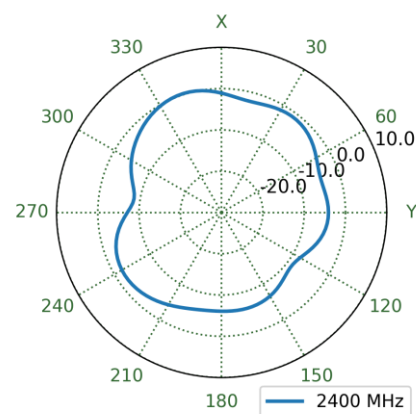
XZ Plane



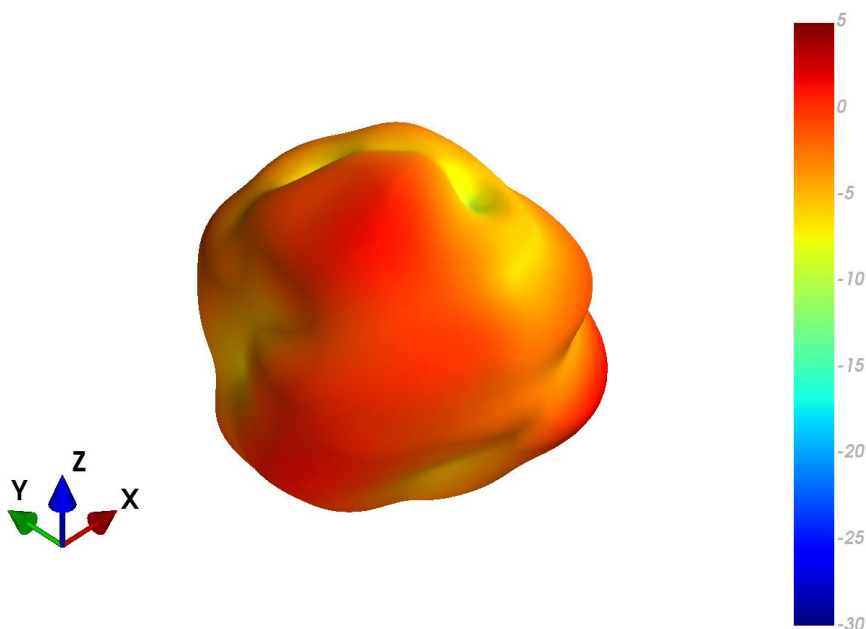
YZ Plane



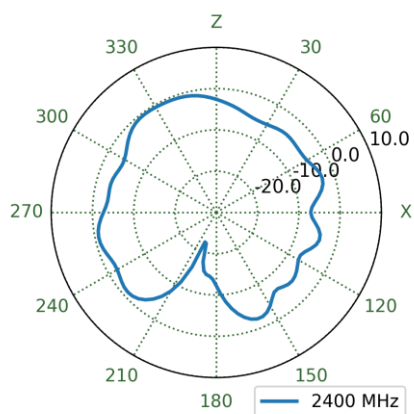
XY Plane



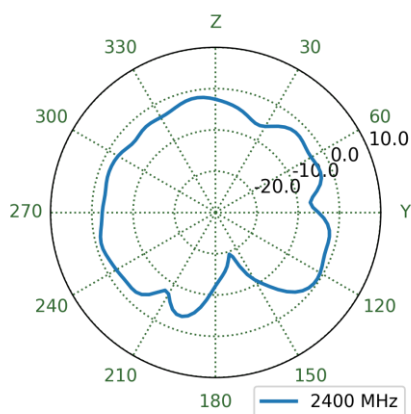
4.80 MIMO2 Wi-Fi Free Space Patterns at 2400 MHz



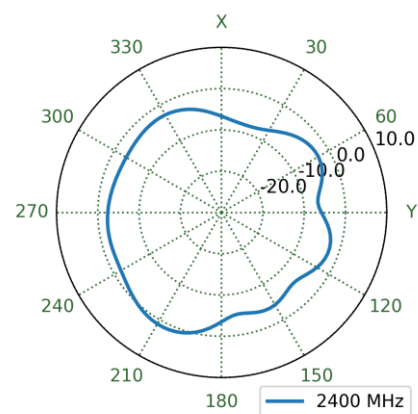
XZ Plane



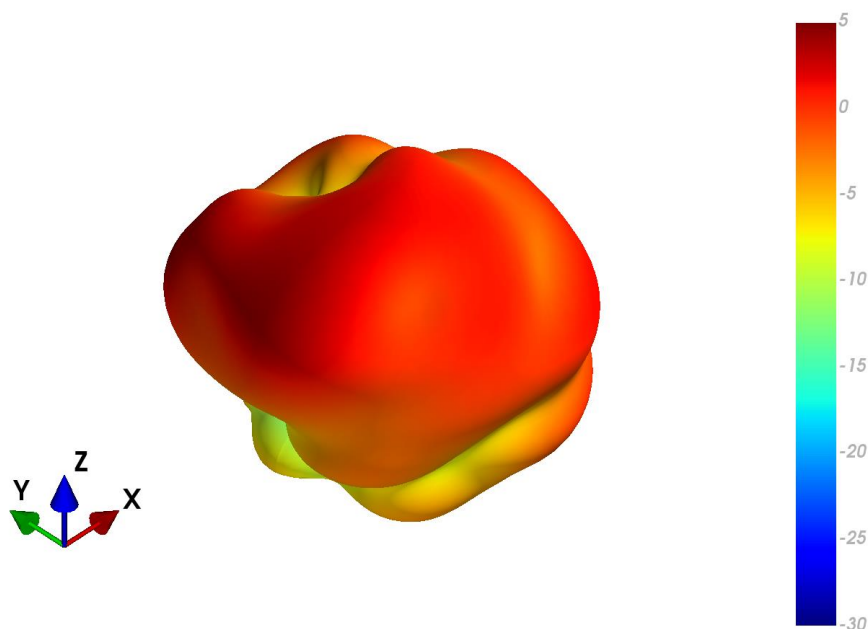
YZ Plane



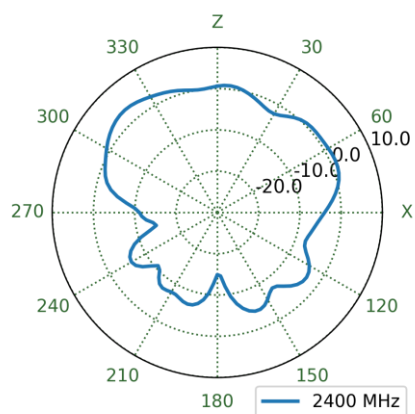
XY Plane



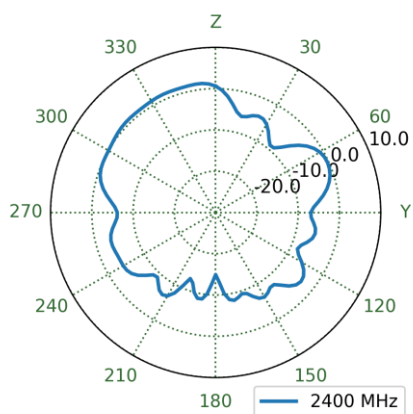
4.81 MIMO2 Wi-Fi Ground Plane Patterns at 2400 MHz



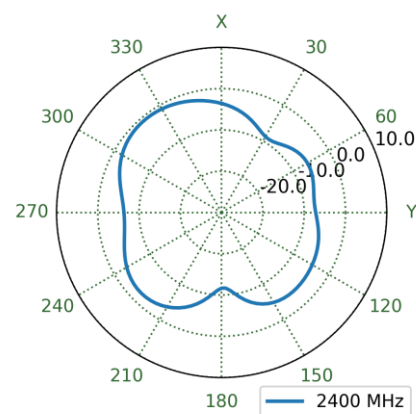
XZ Plane



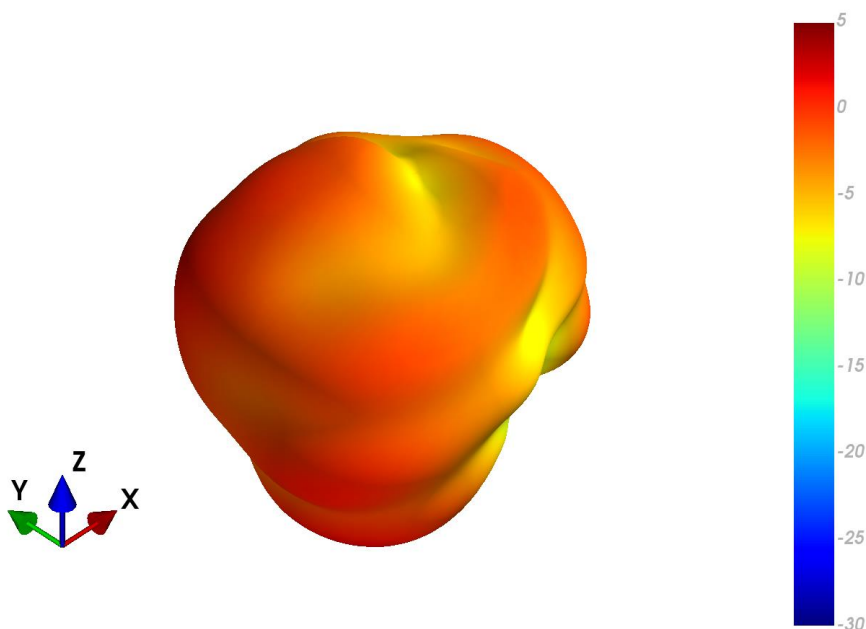
YZ Plane



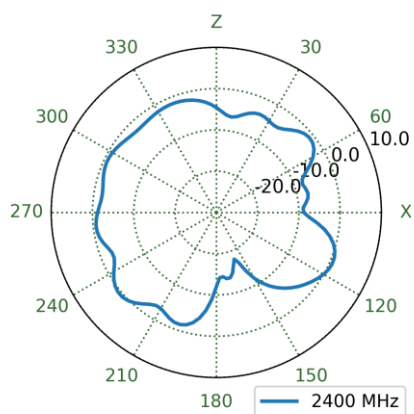
XY Plane



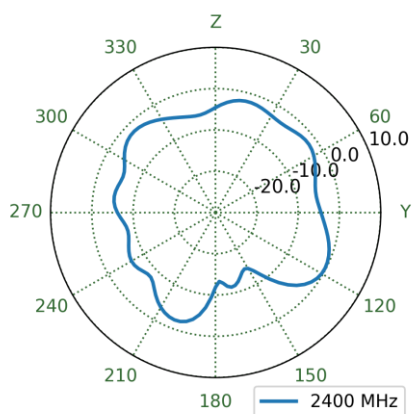
4.82 MIMO3 Wi-Fi Free Space Patterns at 2400 MHz



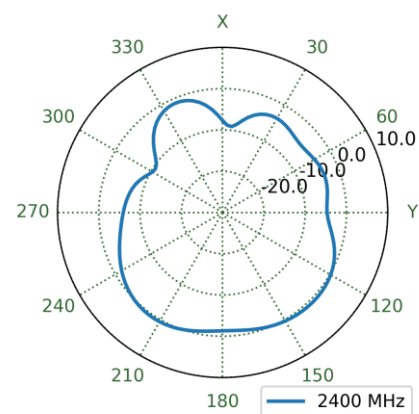
XZ Plane



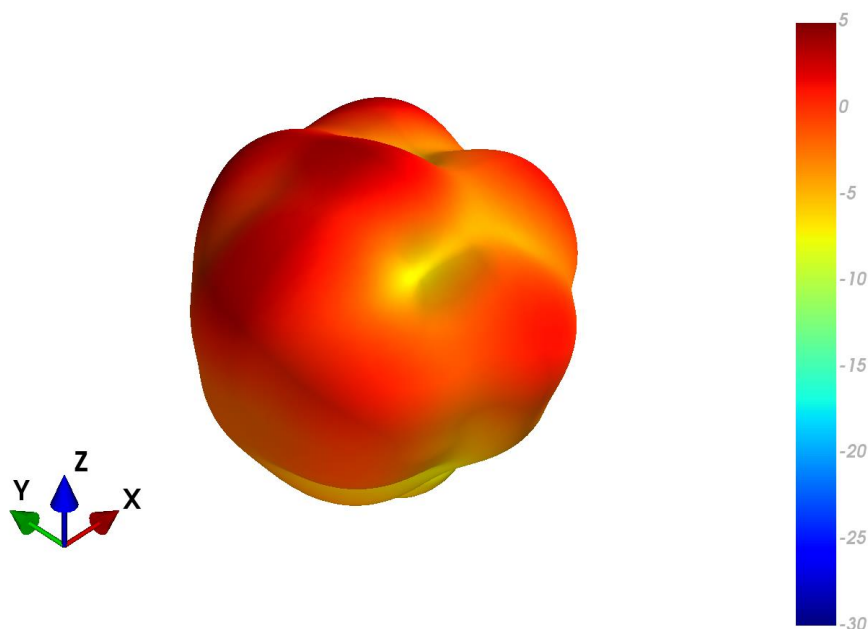
YZ Plane



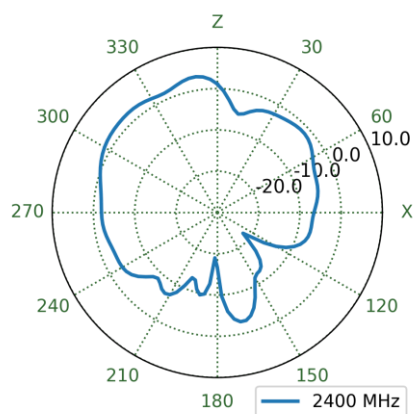
XY Plane



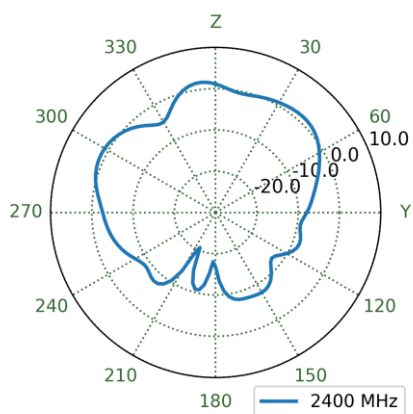
4.83 MIMO3 Wi-Fi Ground Plane Patterns at 2400 MHz



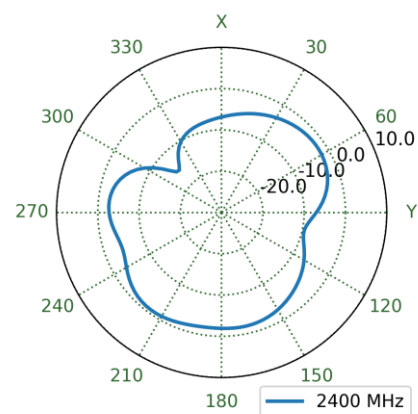
XZ Plane



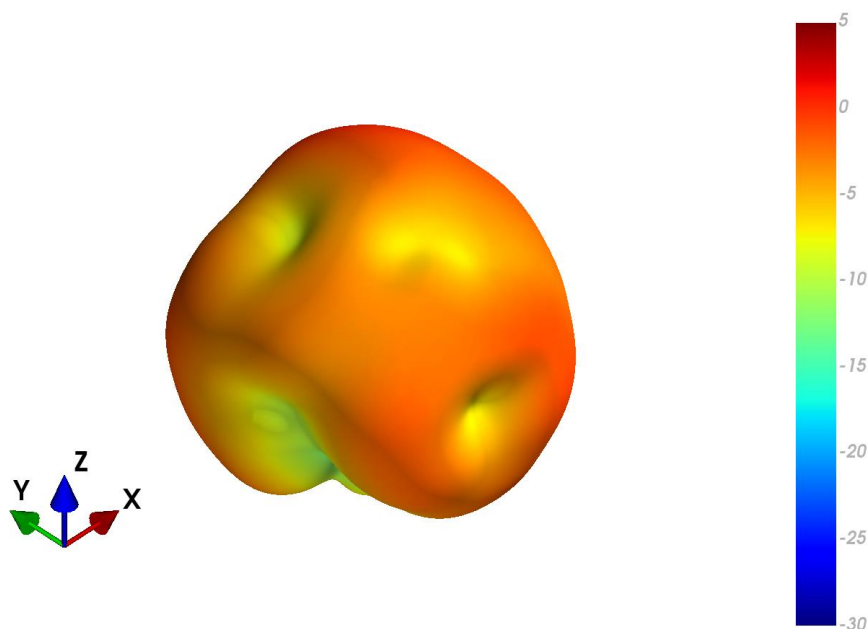
YZ Plane



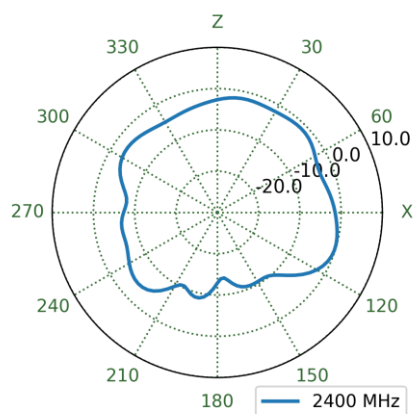
XY Plane



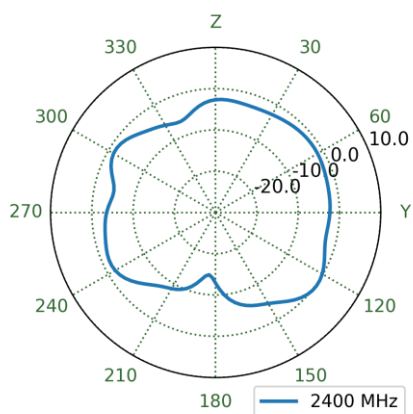
4.84 MIMO4 Wi-Fi Free Space Patterns at 2400 MHz



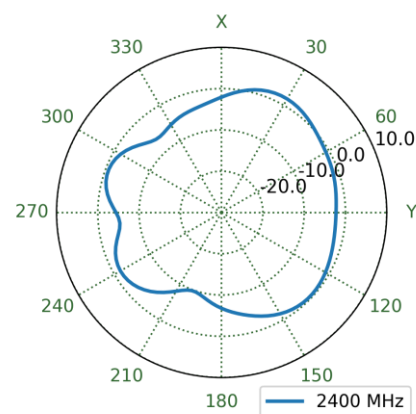
XZ Plane



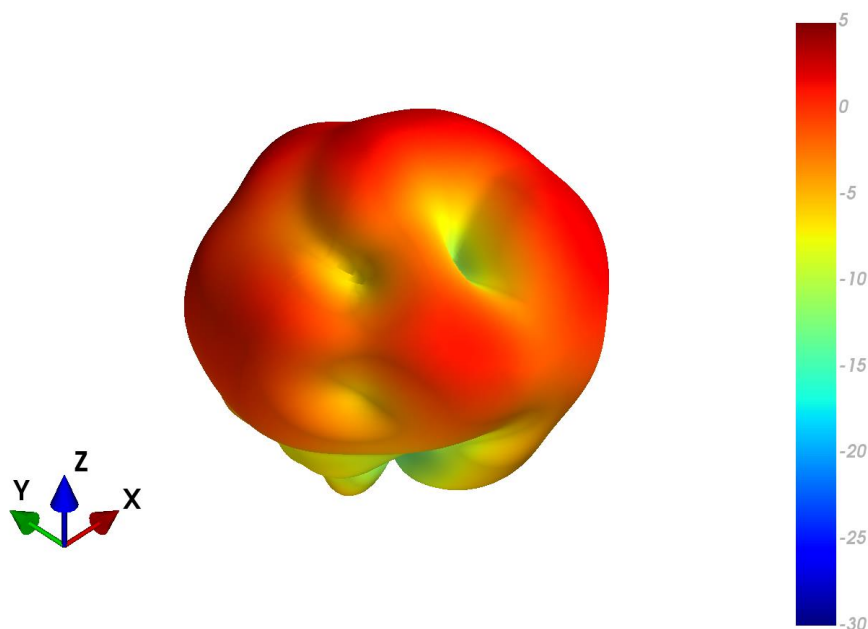
YZ Plane



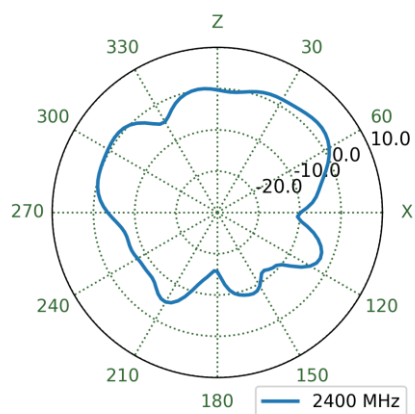
XY Plane



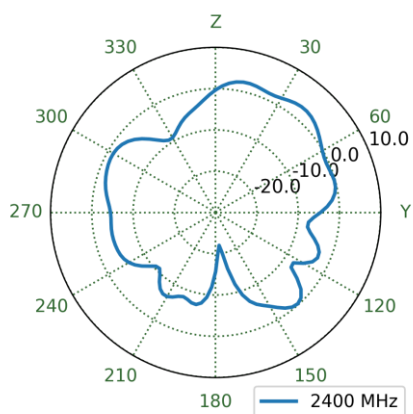
4.85 MIMO4 Wi-Fi Ground Plane Patterns at 2400 MHz



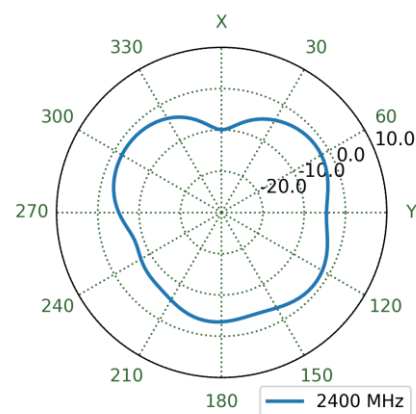
XZ Plane



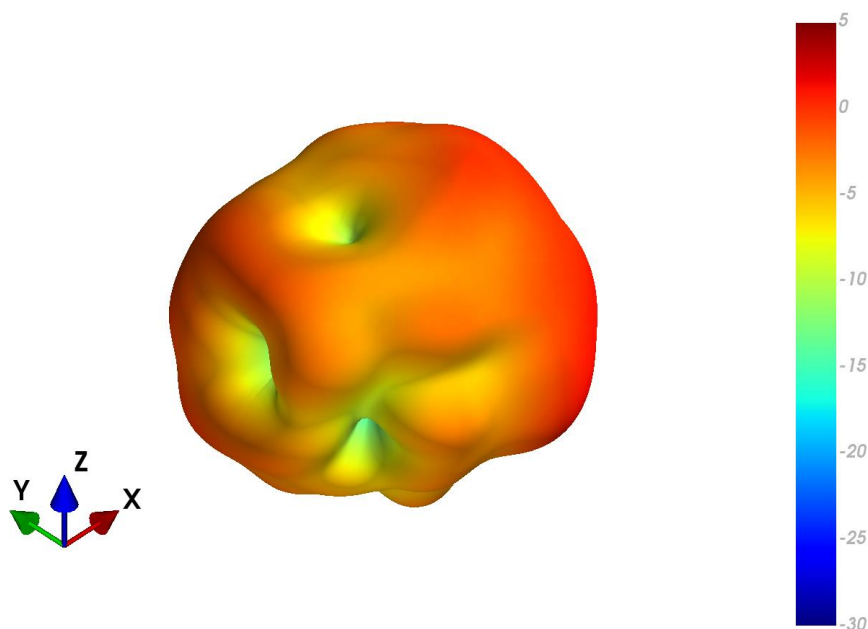
YZ Plane



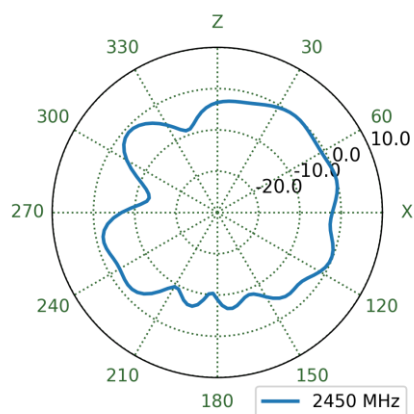
XY Plane



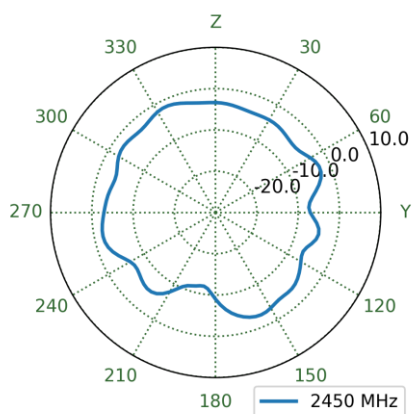
4.86 MIMO1 Wi-Fi Free Space Patterns at 2450 MHz



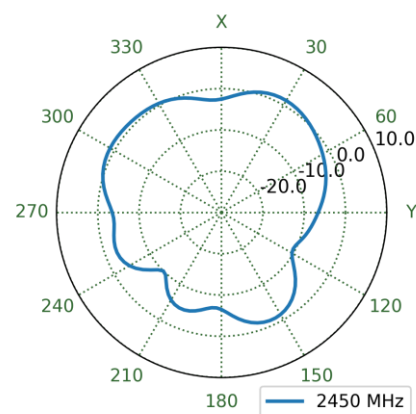
XZ Plane



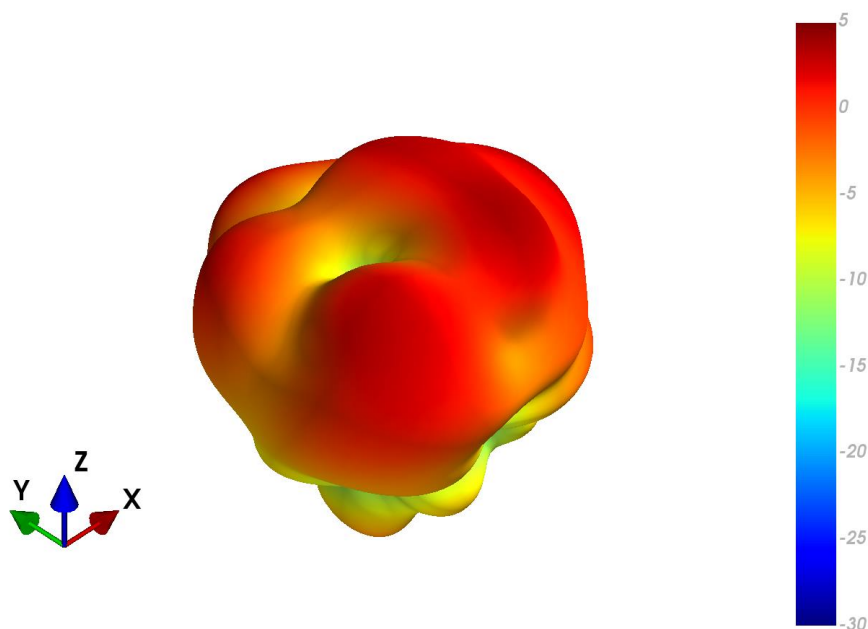
YZ Plane



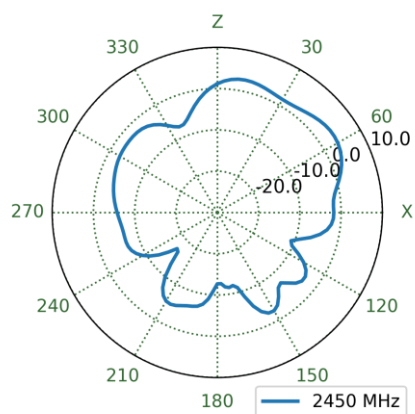
XY Plane



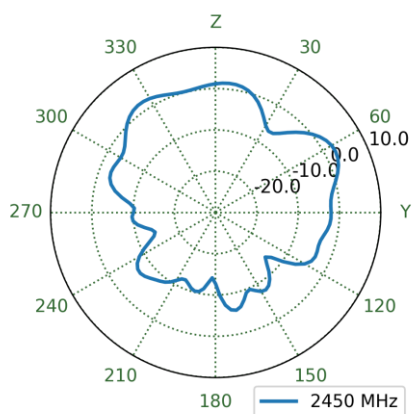
4.87 MIMO1 Wi-Fi Ground Plane Patterns at 2450 MHz



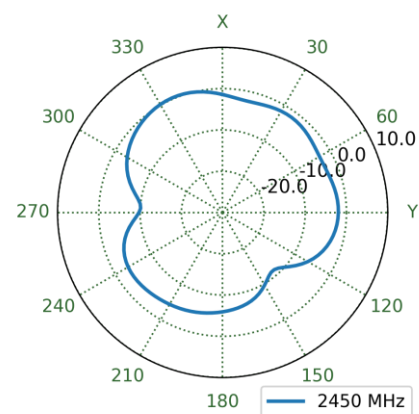
XZ Plane



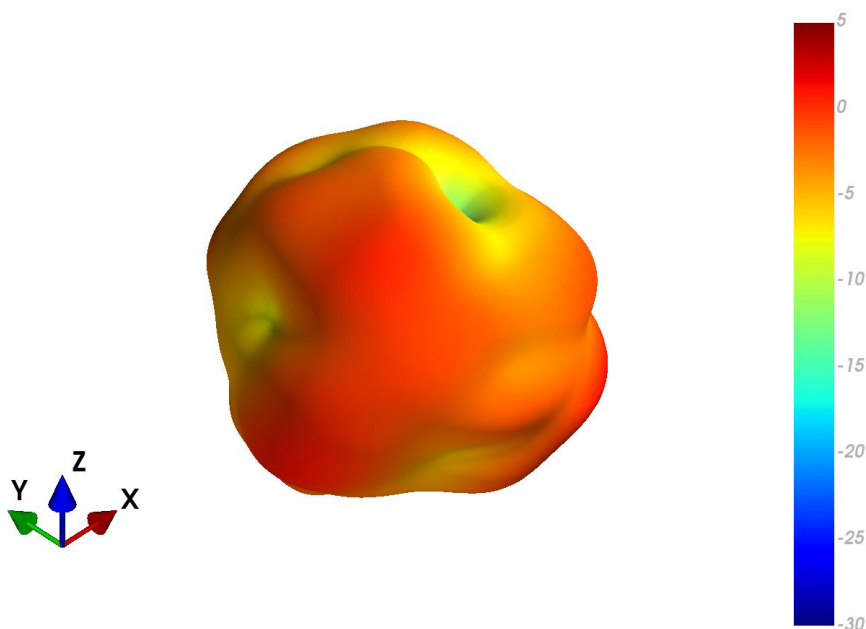
YZ Plane



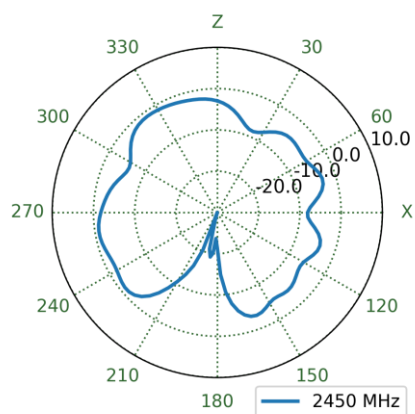
XY Plane



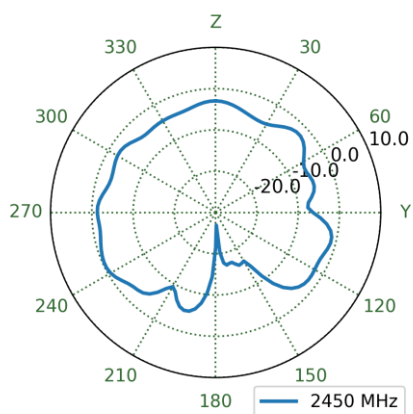
4.88 MIMO2 Wi-Fi Free Space Patterns at 2450 MHz



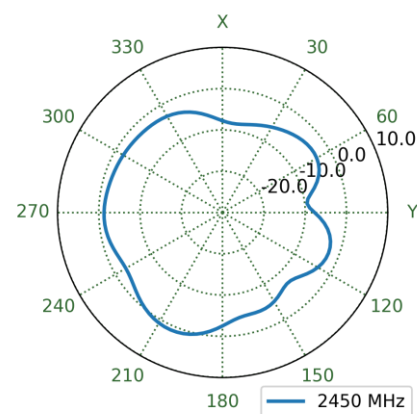
XZ Plane



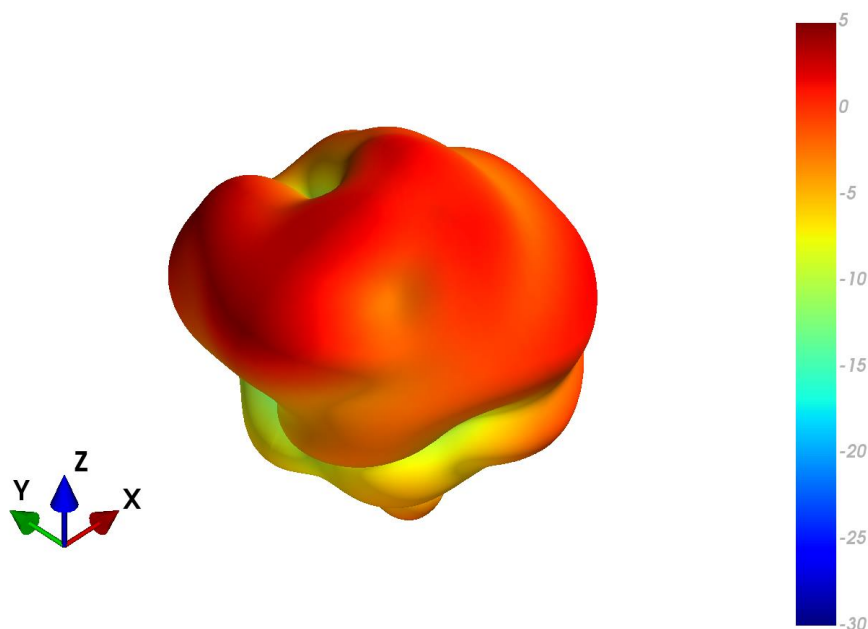
YZ Plane



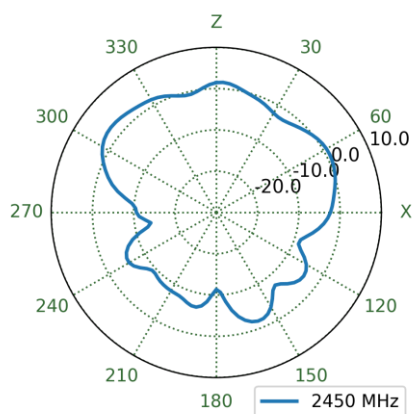
XY Plane



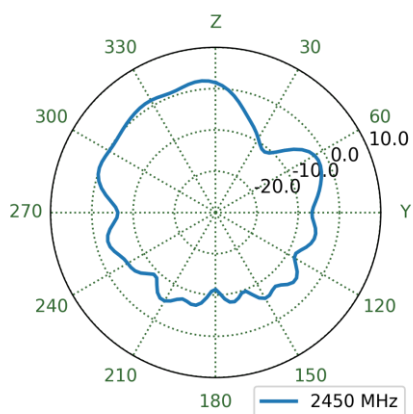
4.89 MIMO2 Wi-Fi Ground Plane Patterns at 2450 MHz



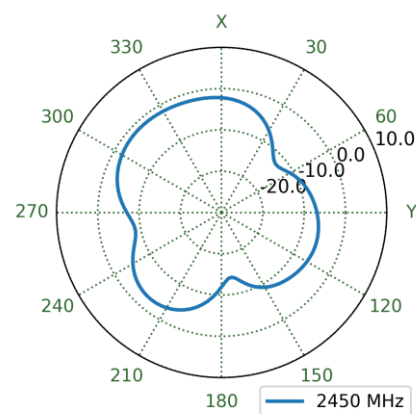
XZ Plane



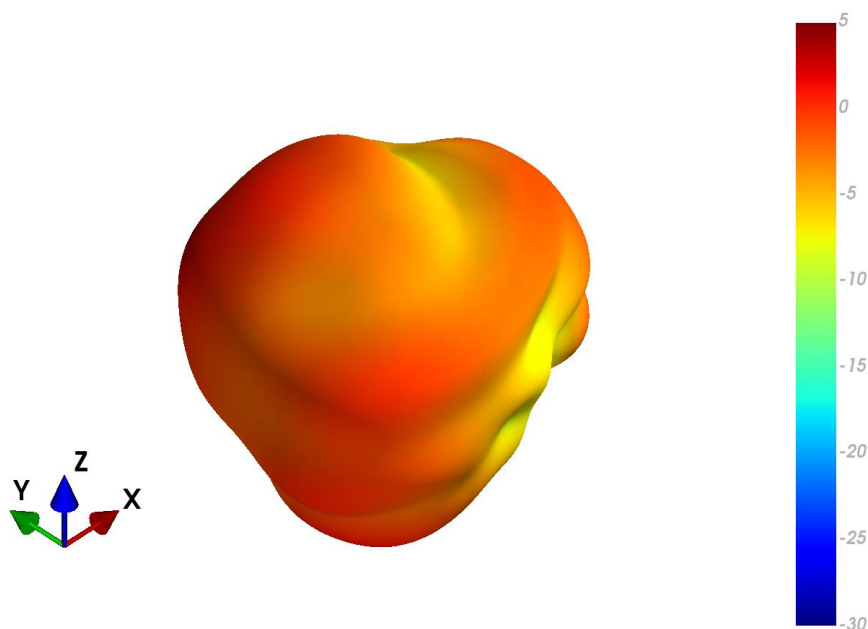
YZ Plane



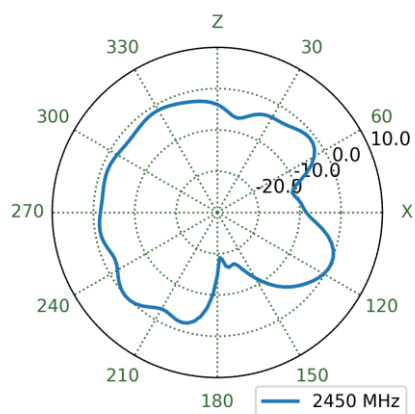
XY Plane



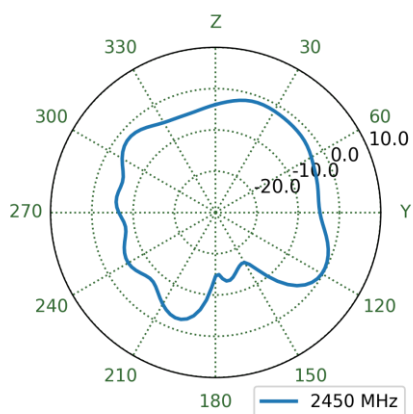
4.90 MIMO3 Wi-Fi Free Space Patterns at 2450 MHz



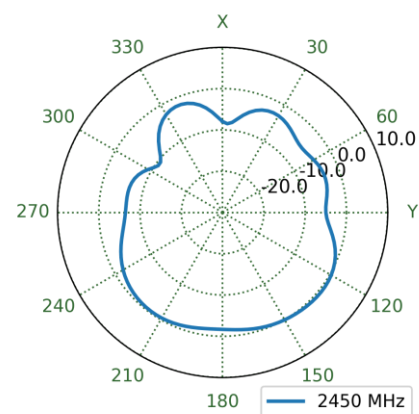
XZ Plane



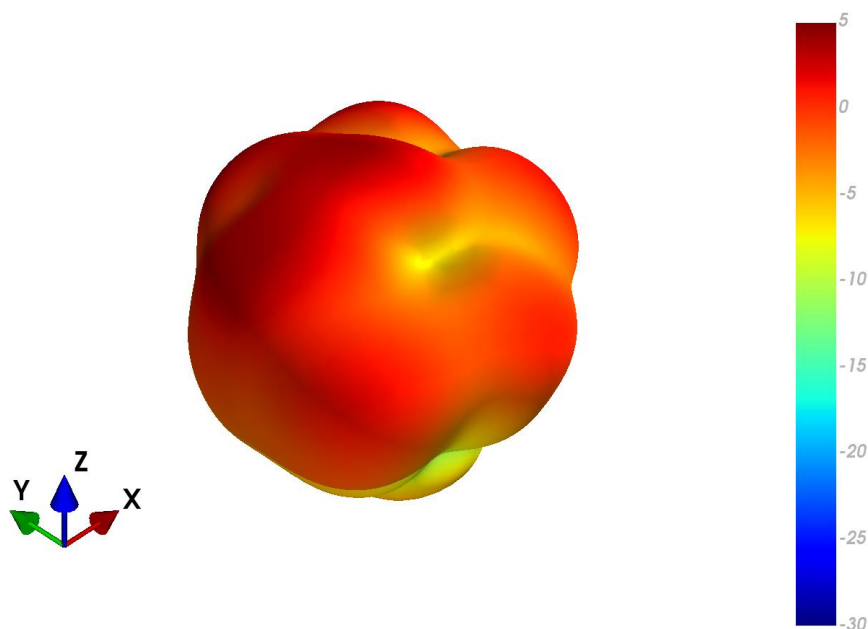
YZ Plane



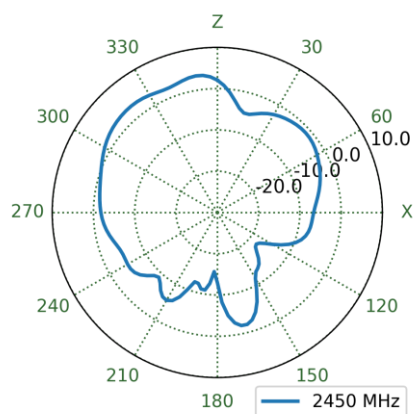
XY Plane



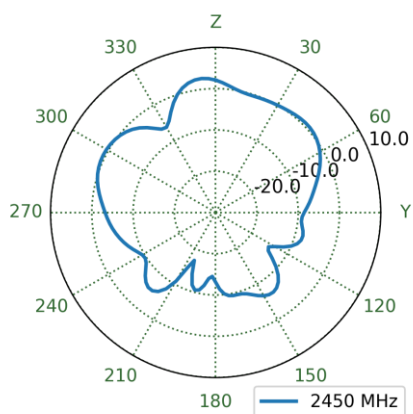
4.91 MIMO3 Wi-Fi Ground Plane Patterns at 2450 MHz



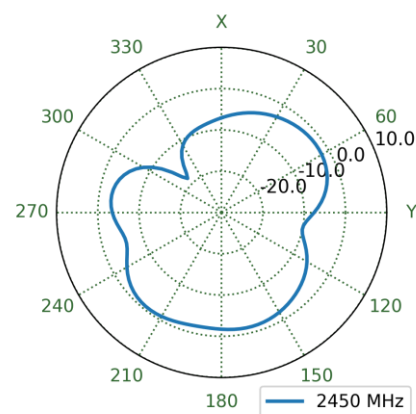
XZ Plane



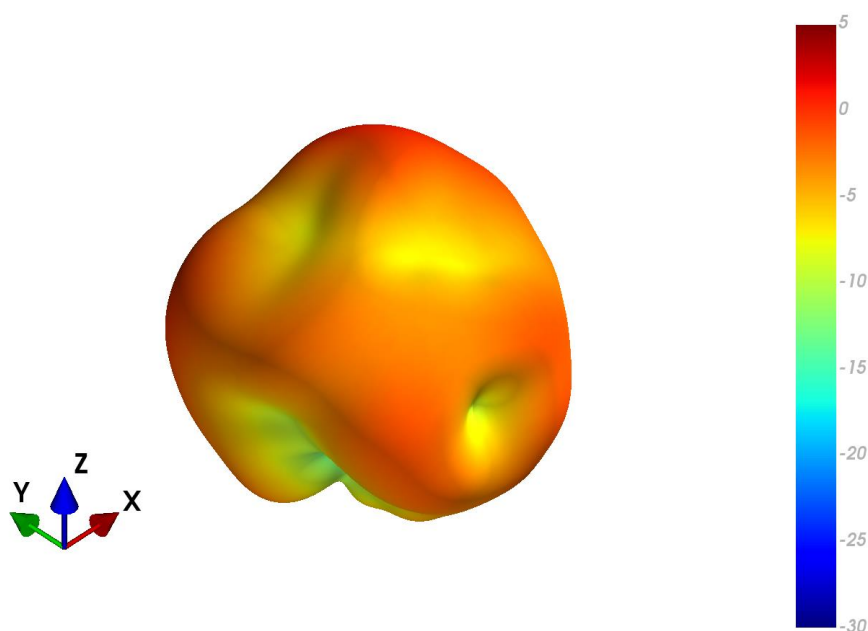
YZ Plane



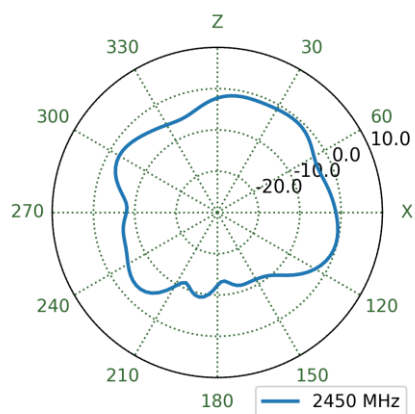
XY Plane



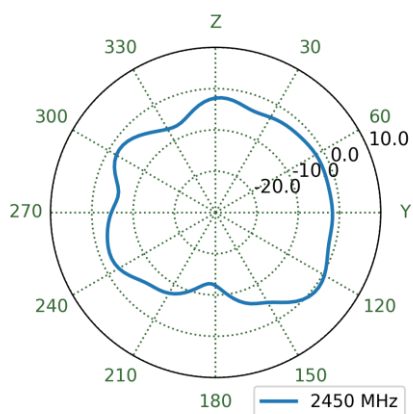
4.92 MIMO4 Wi-Fi Free Space Patterns at 2450 MHz



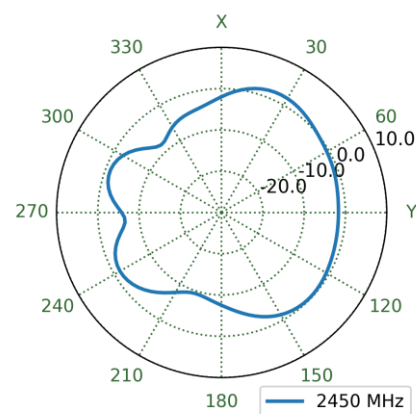
XZ Plane



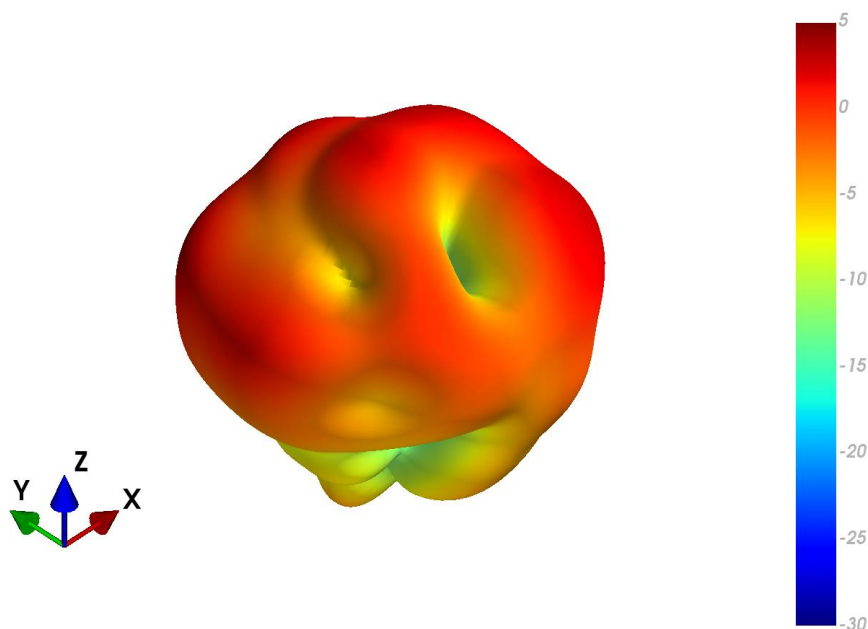
YZ Plane



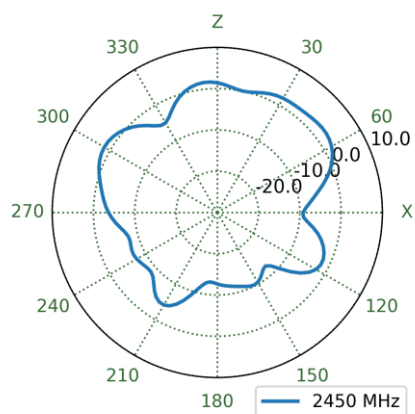
XY Plane



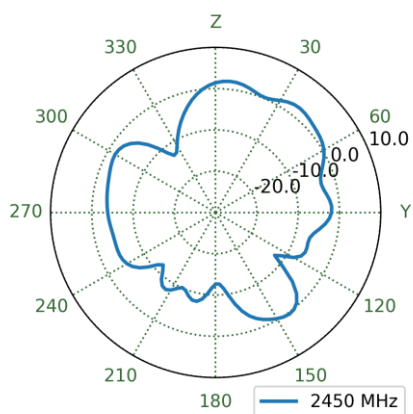
4.93 MIMO4 Wi-Fi Ground Plane Patterns at 2450 MHz



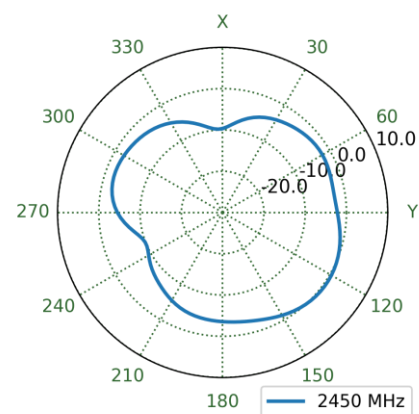
XZ Plane



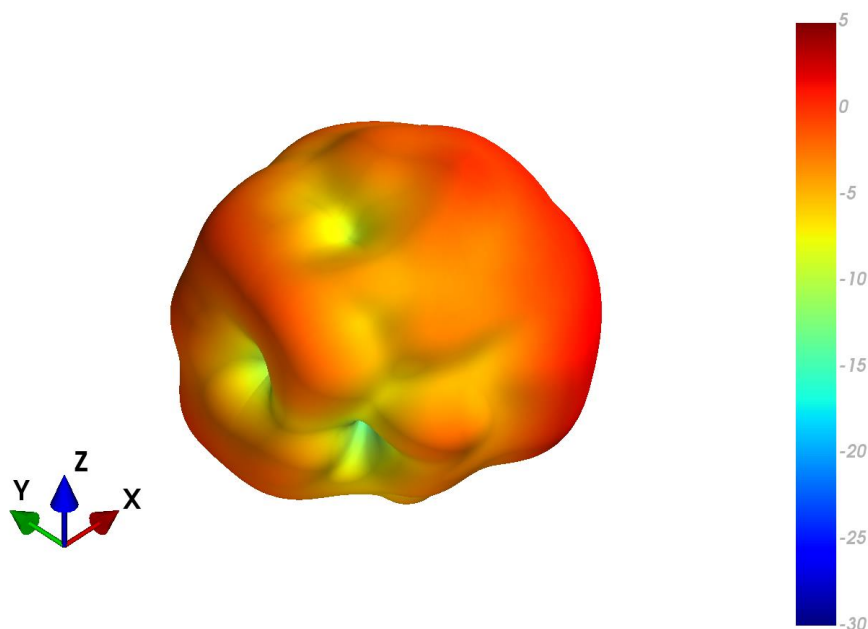
YZ Plane



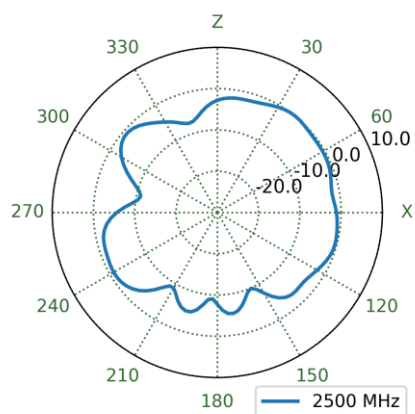
XY Plane



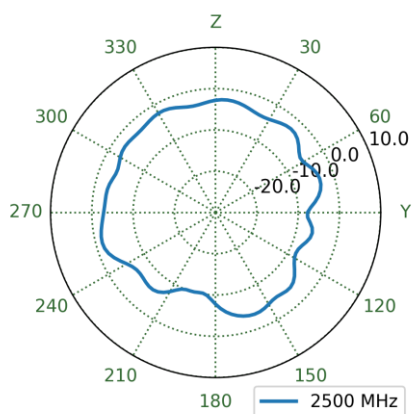
4.94 MIMO1 Wi-Fi Free Space Patterns at 2500 MHz



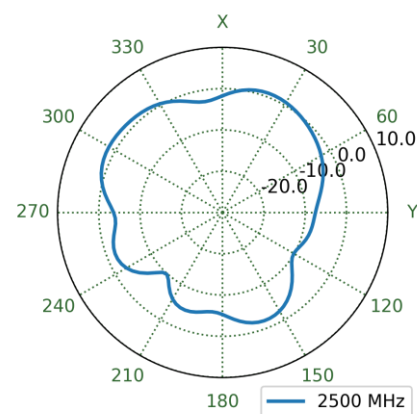
XZ Plane



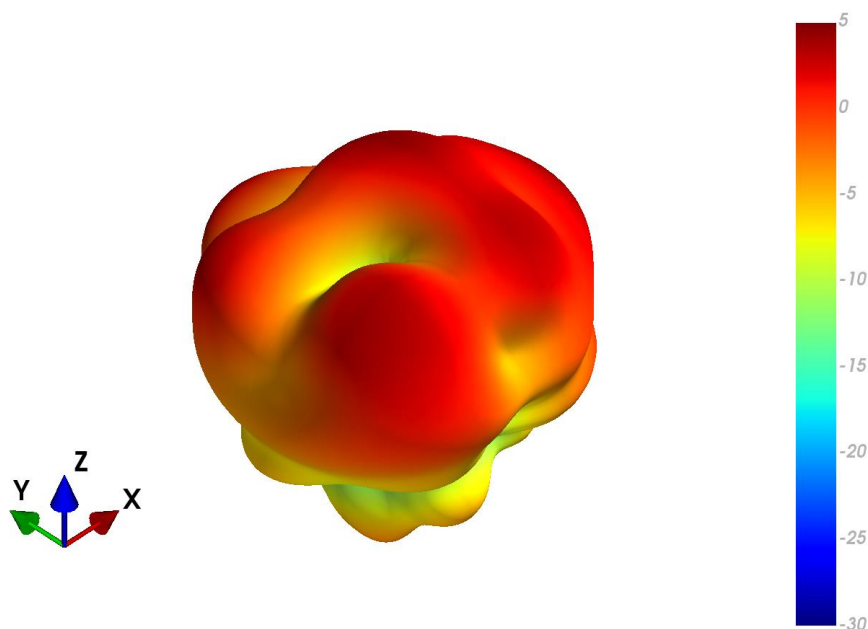
YZ Plane



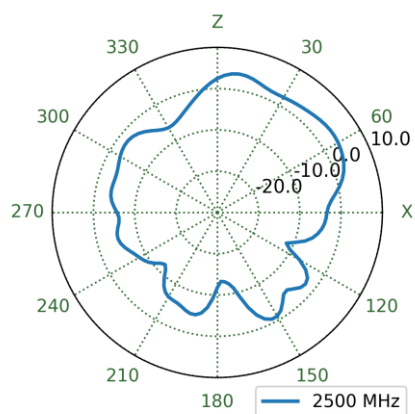
XY Plane



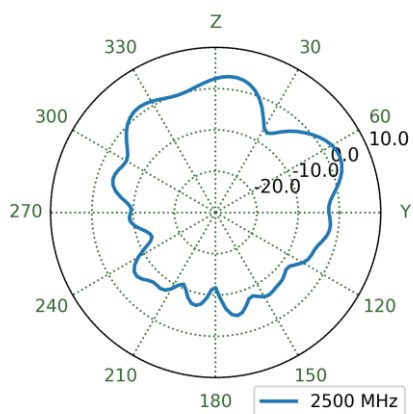
4.95 MIMO1 Wi-Fi Ground Plane Patterns at 2500 MHz



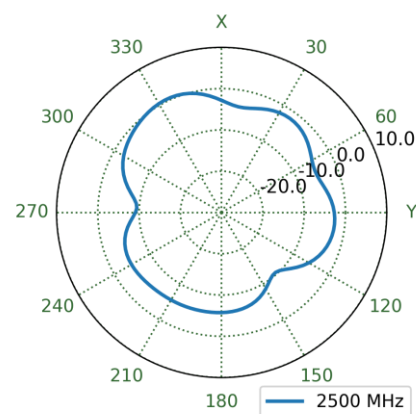
XZ Plane



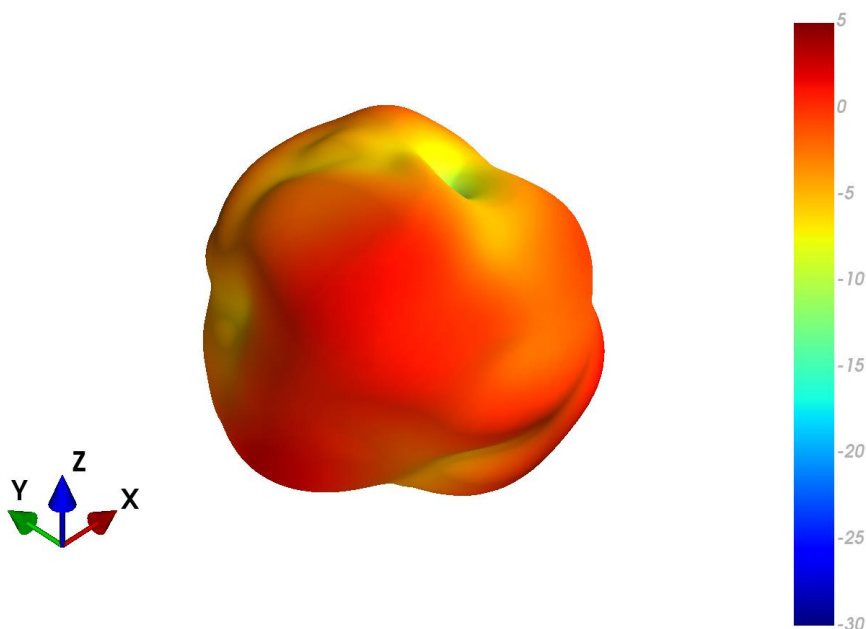
YZ Plane



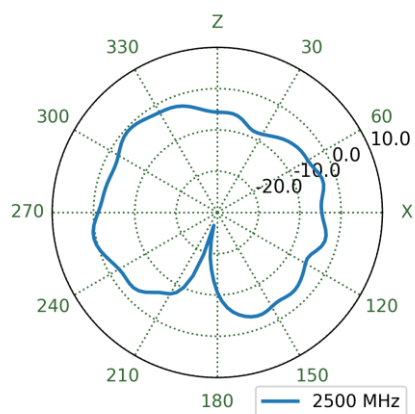
XY Plane



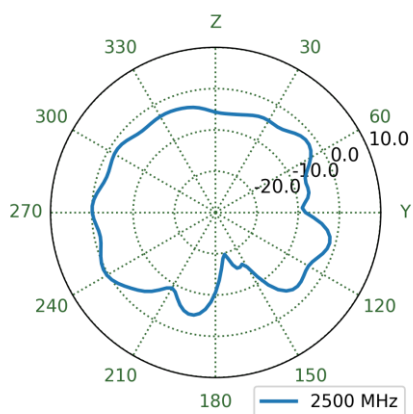
4.96 MIMO2 Wi-Fi Free Space Patterns at 2500 MHz



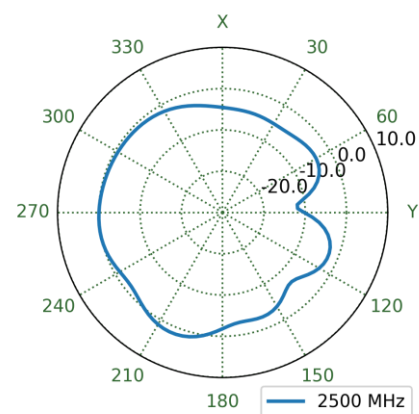
XZ Plane



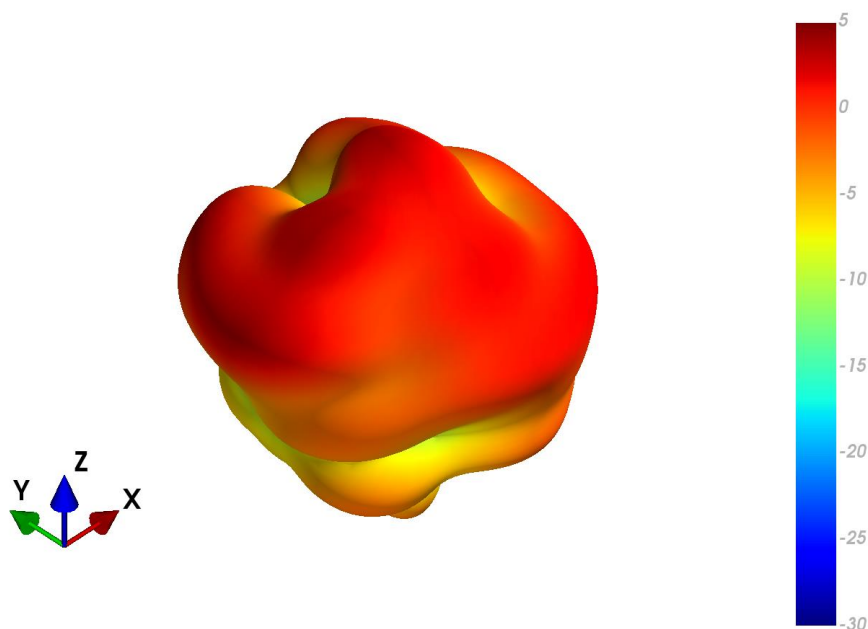
YZ Plane



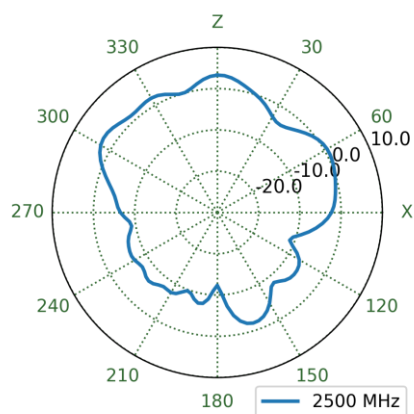
XY Plane



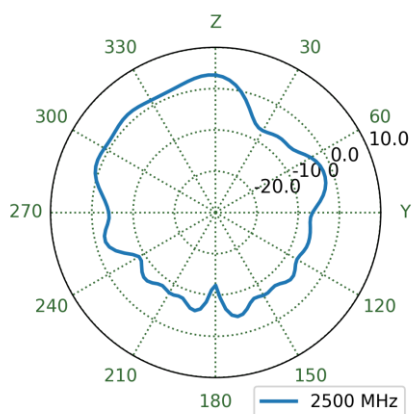
4.97 MIMO2 Wi-Fi Ground Plane Patterns at 2500 MHz



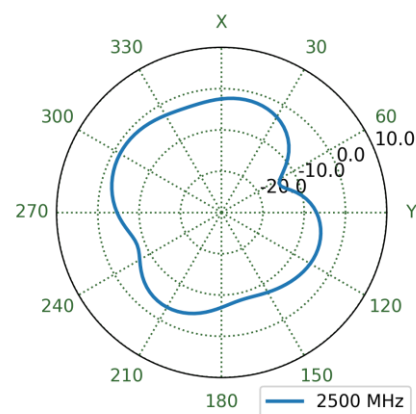
XZ Plane



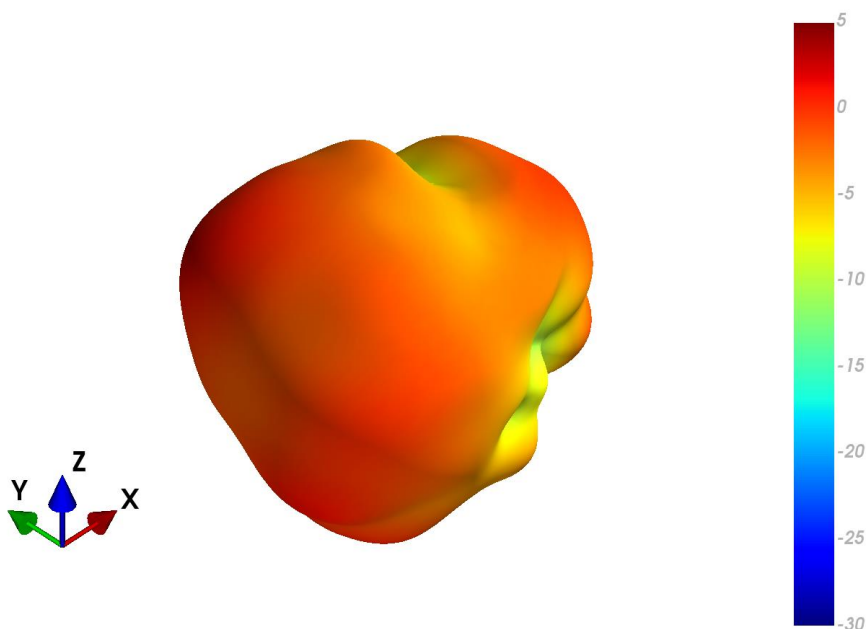
YZ Plane



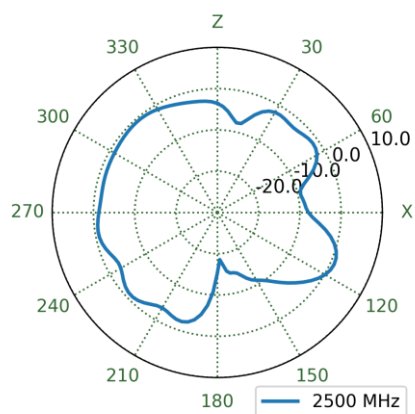
XY Plane



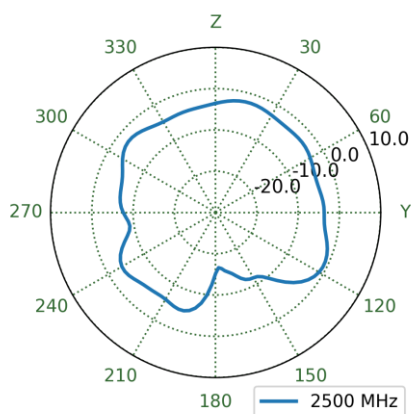
4.98 MIMO3 Wi-Fi Free Space Patterns at 2500 MHz



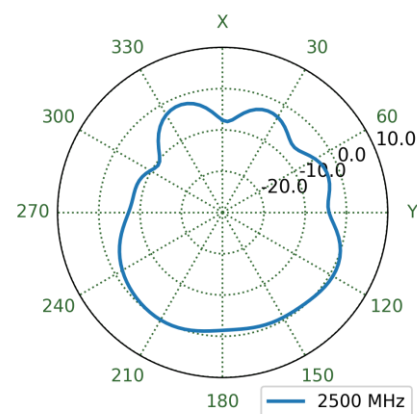
XZ Plane



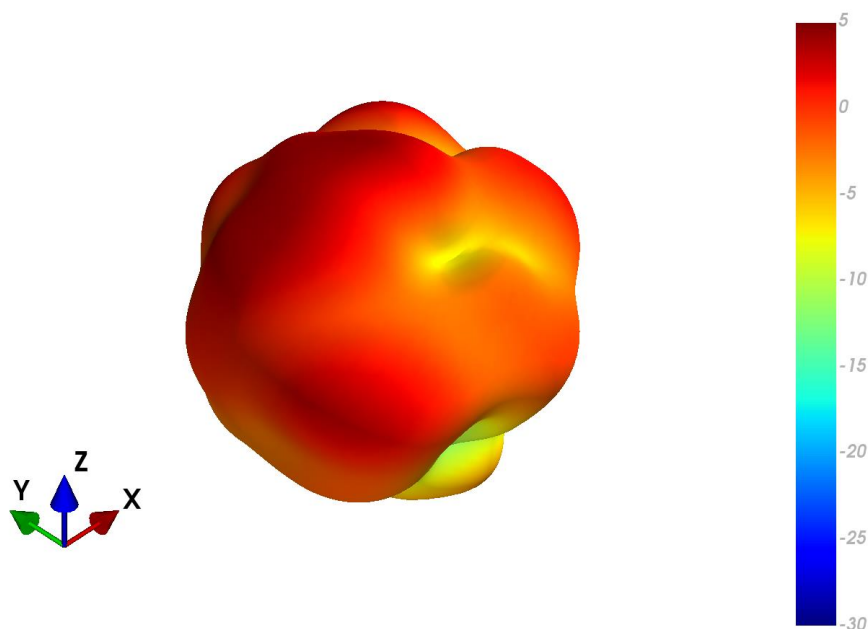
YZ Plane



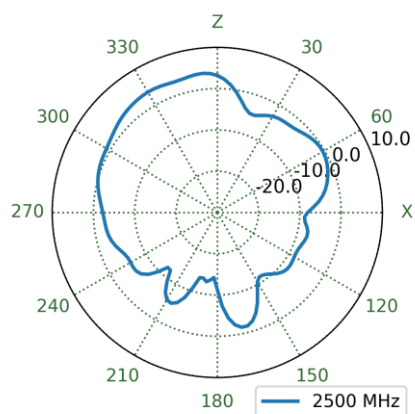
XY Plane



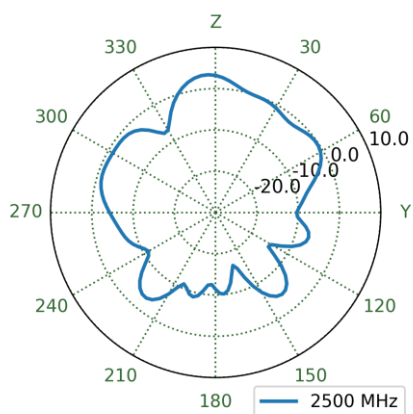
4.99 MIMO3 Wi-Fi Ground Plane Patterns at 2500 MHz



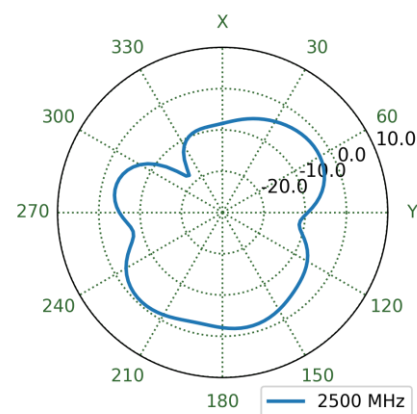
XZ Plane



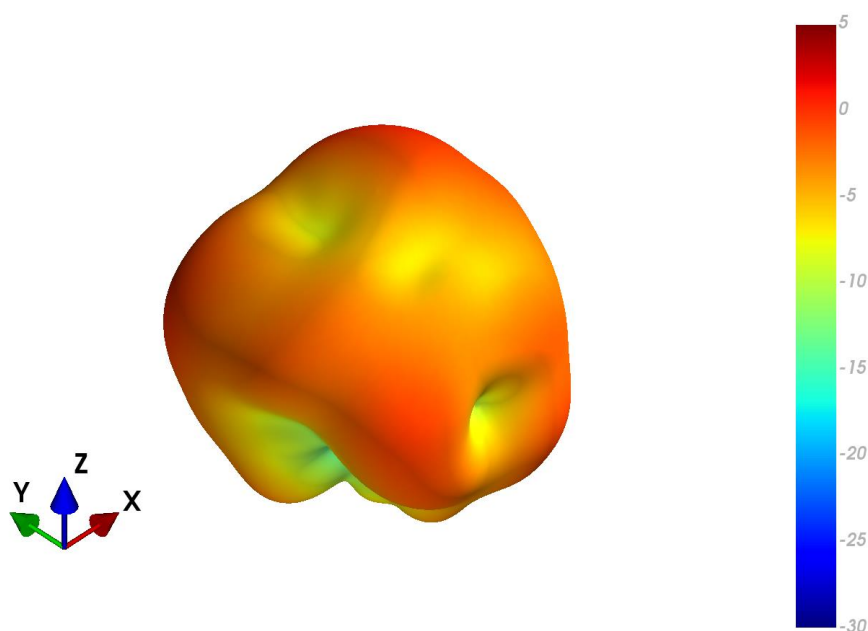
YZ Plane



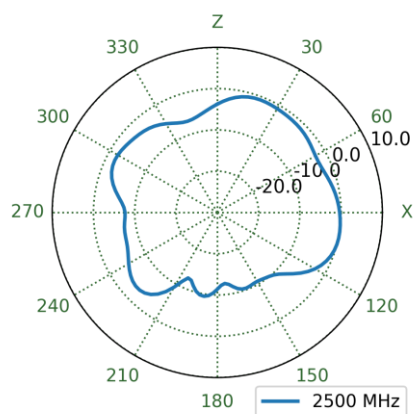
XY Plane



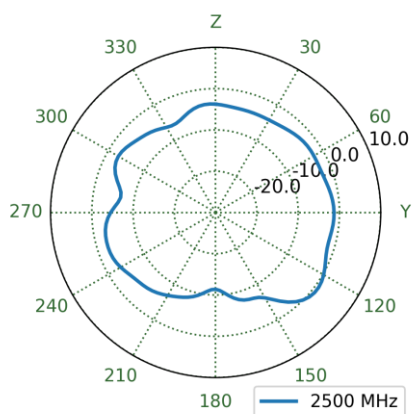
4.100 MIMO4 Wi-Fi Free Space Patterns at 2500 MHz



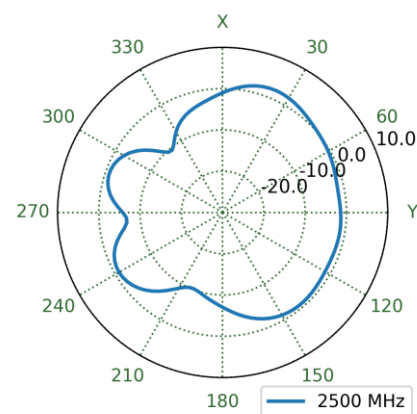
XZ Plane



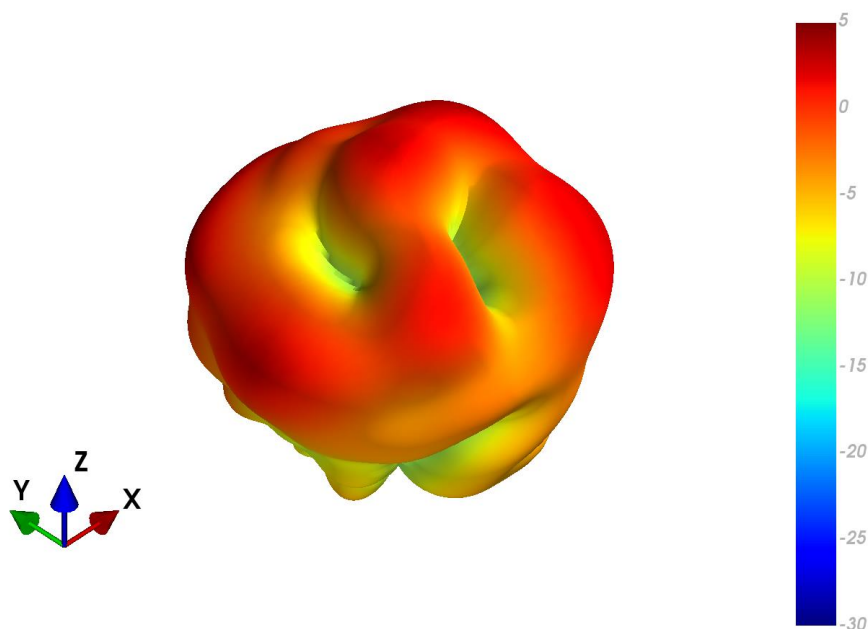
YZ Plane



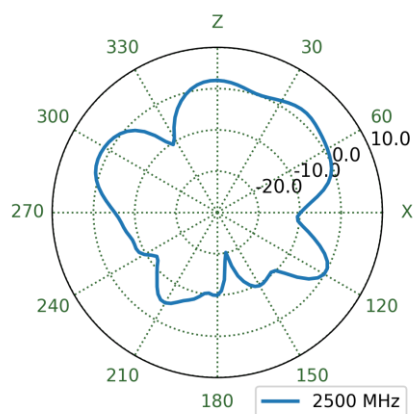
XY Plane



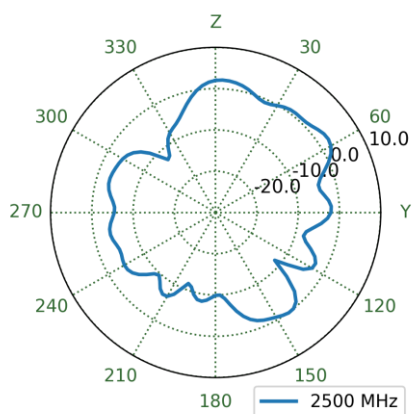
4.101 MIMO4 Wi-Fi Ground Plane Patterns at 2500 MHz



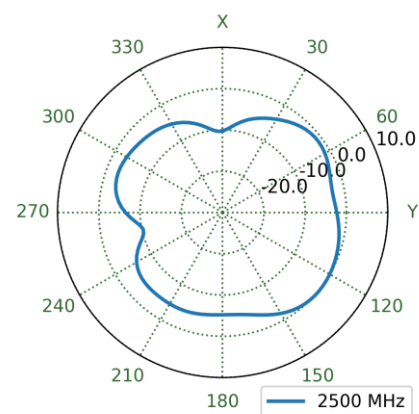
XZ Plane



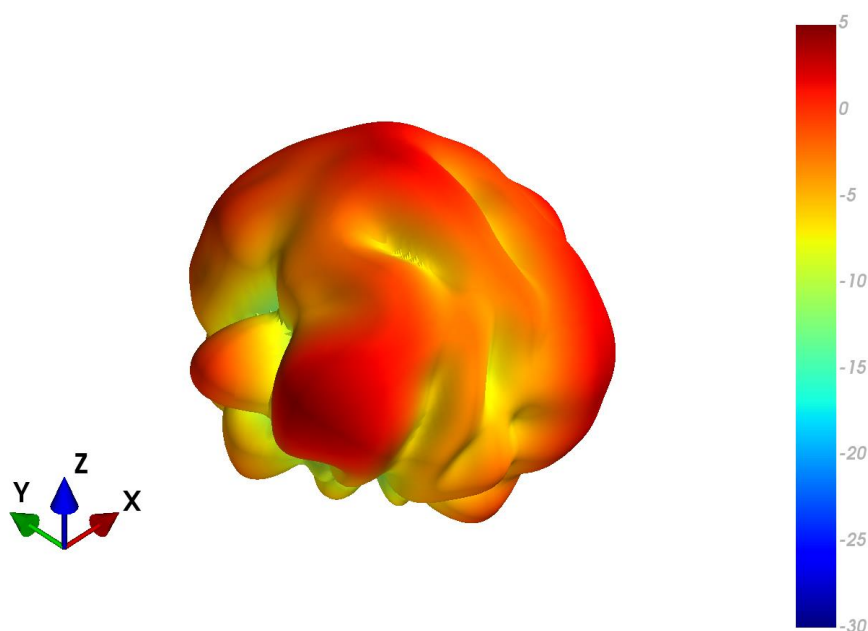
YZ Plane



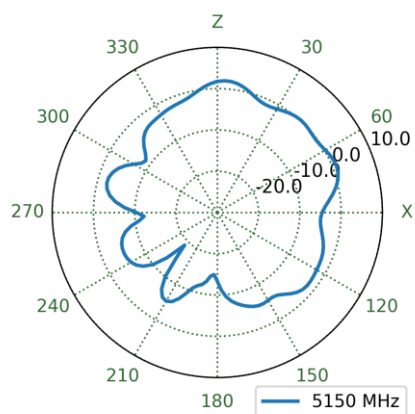
XY Plane



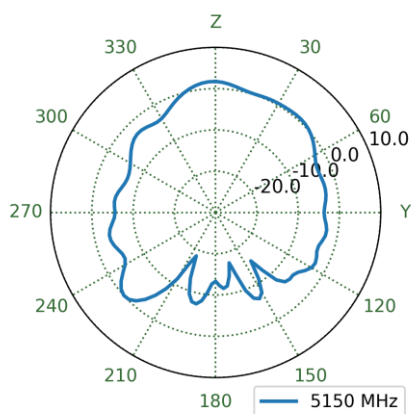
4.102 MIMO1 Wi-Fi Free Space Patterns at 5150 MHz



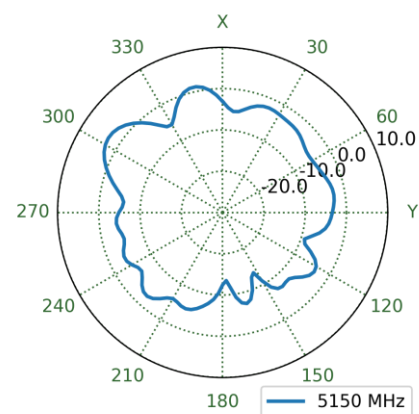
XZ Plane



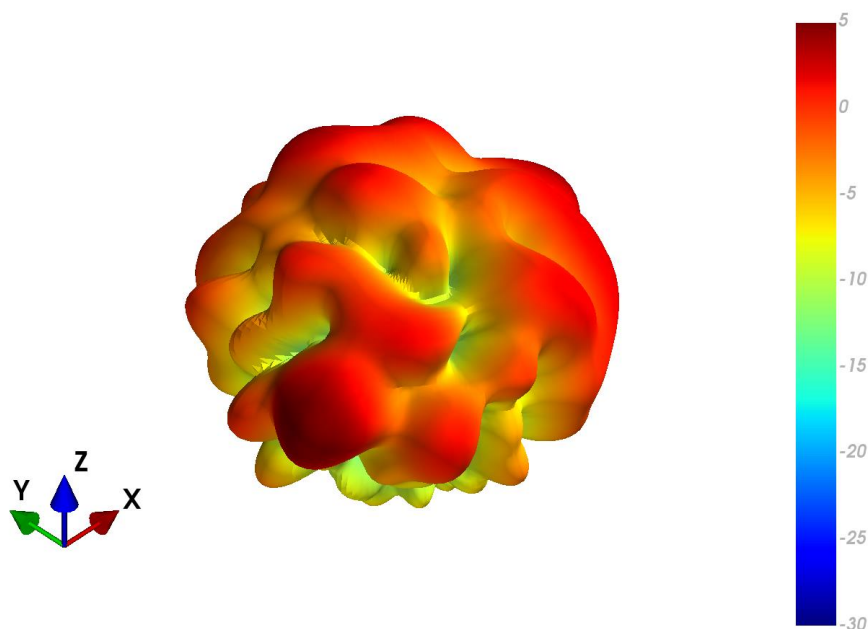
YZ Plane



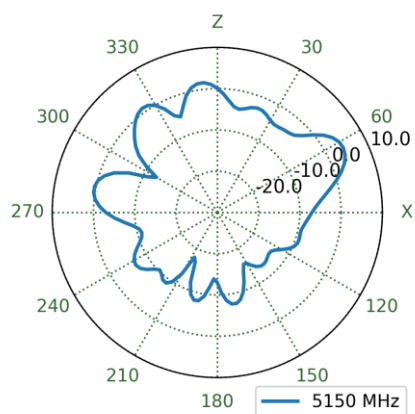
XY Plane



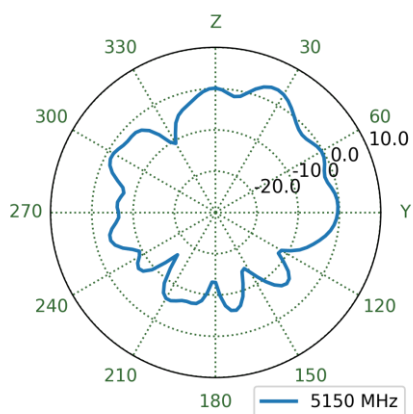
4.103 MIMO1 Wi-Fi Ground Plane Patterns at 5150 MHz



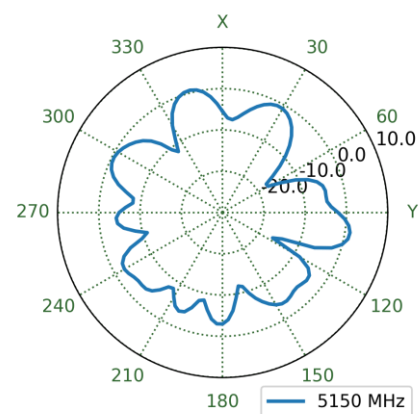
XZ Plane



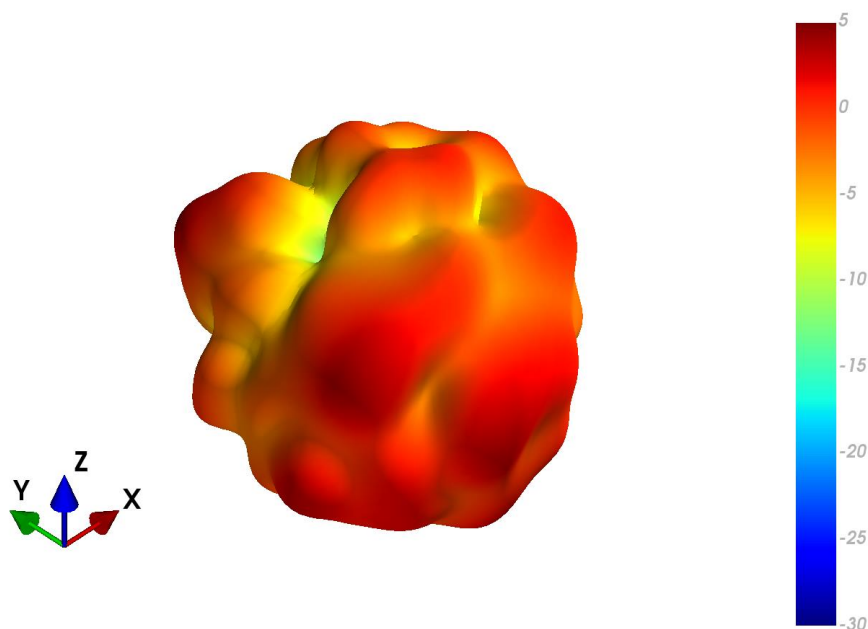
YZ Plane



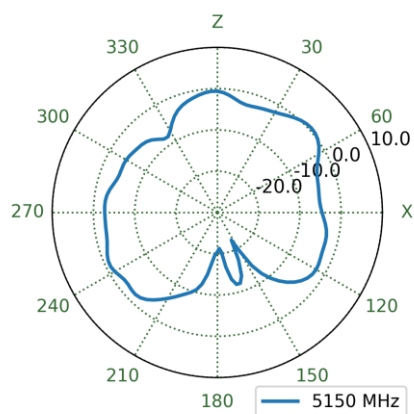
XY Plane



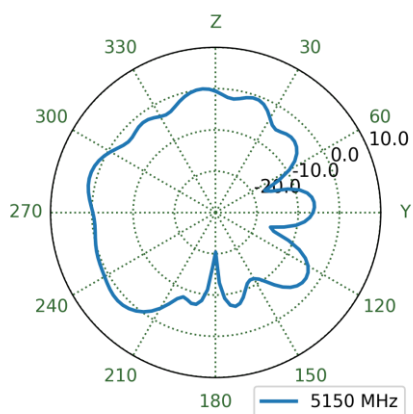
4.104 MIMO2 Wi-Fi Free Space Patterns at 5150 MHz



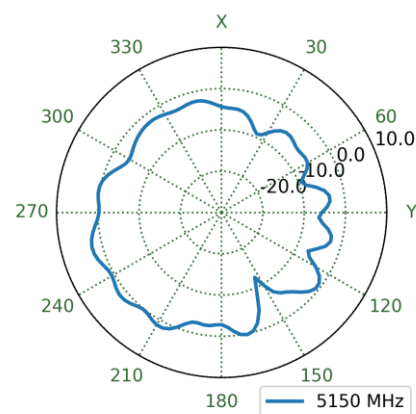
XZ Plane



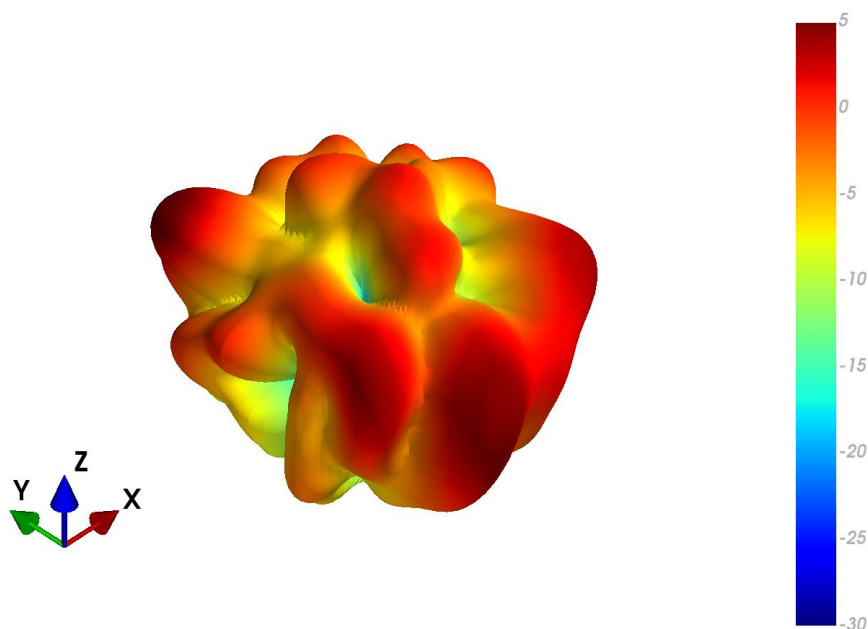
YZ Plane



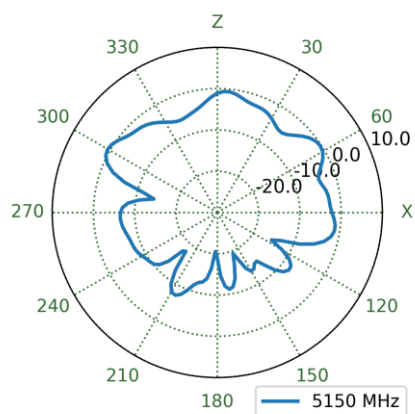
XY Plane



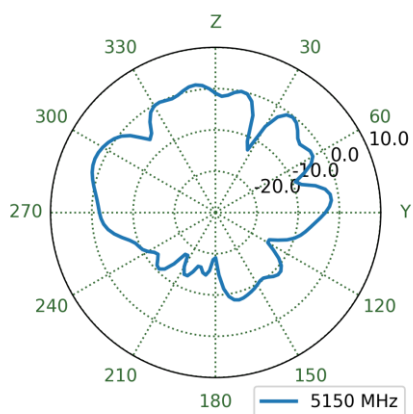
4.105 MIMO2 Wi-Fi Ground Plane Patterns at 5150 MHz



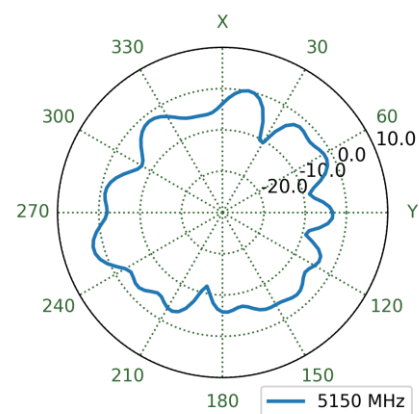
XZ Plane



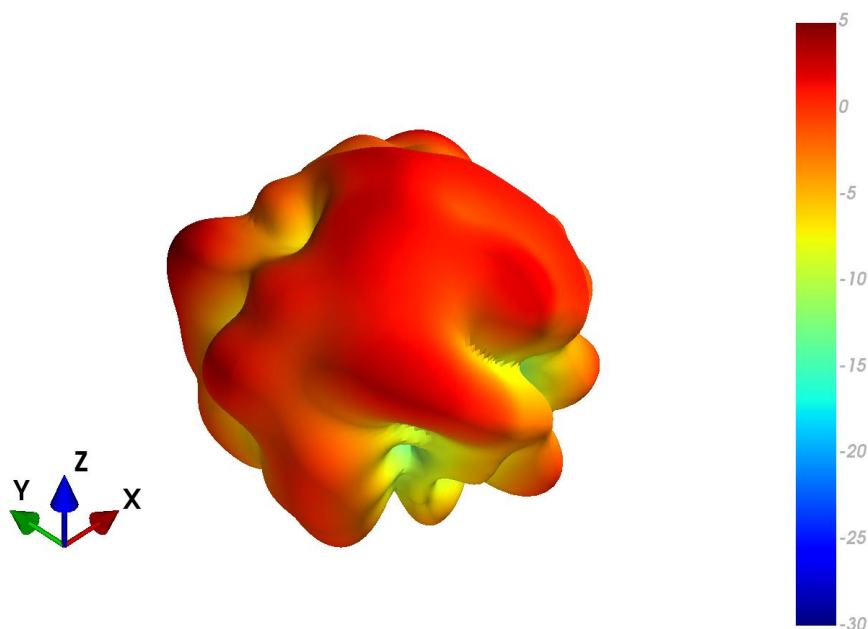
YZ Plane



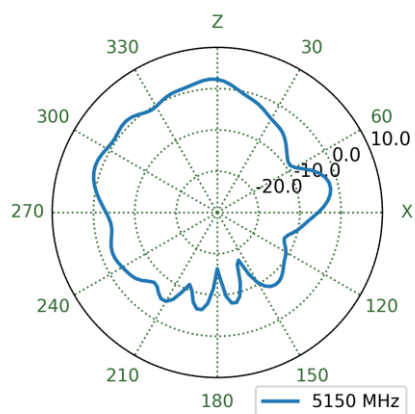
XY Plane



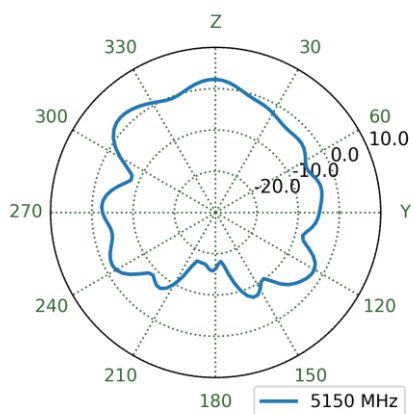
4.106 MIMO3 Wi-Fi Free Space Patterns at 5150 MHz



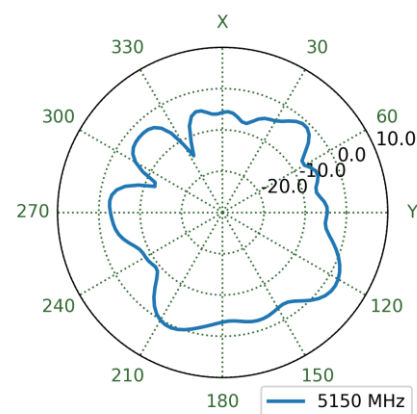
XZ Plane



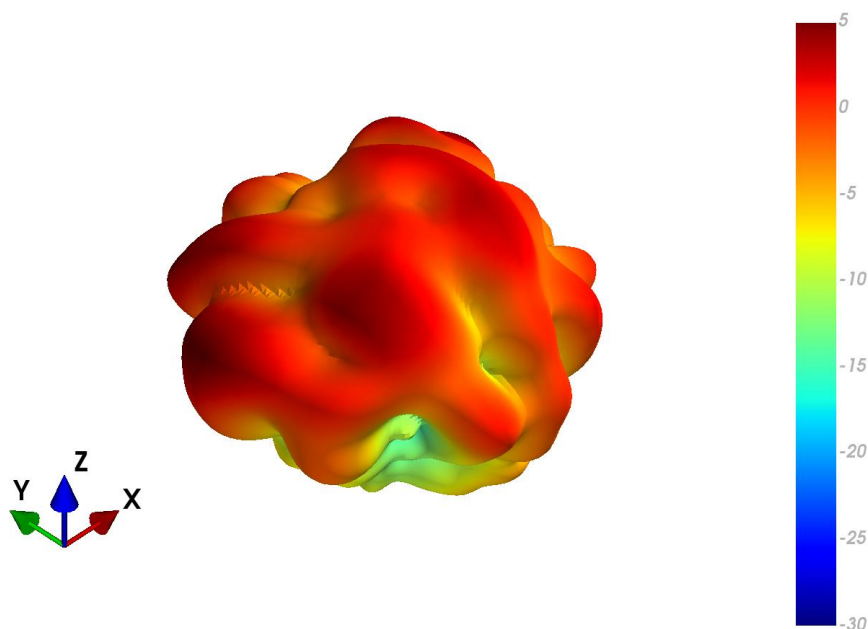
YZ Plane



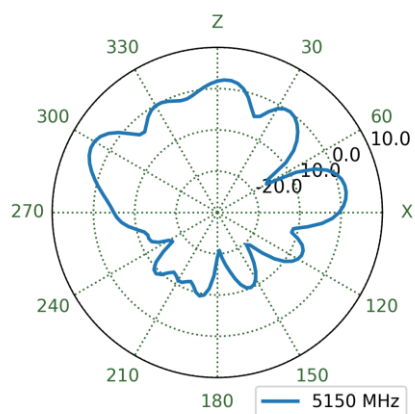
XY Plane



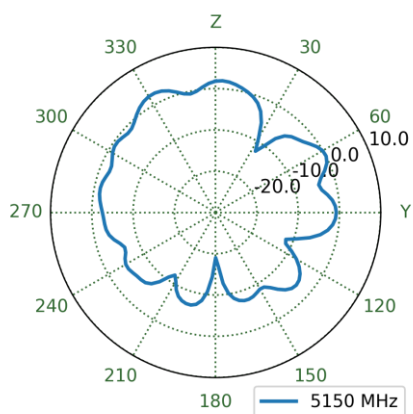
4.107 MIMO3 Wi-Fi Ground Plane Patterns at 5150 MHz



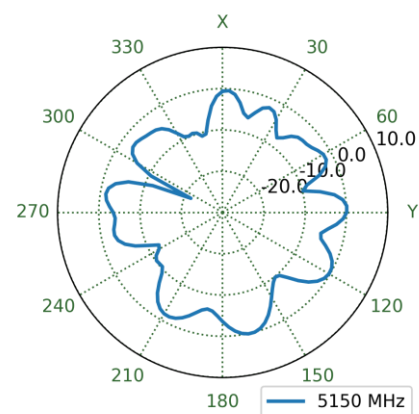
XZ Plane



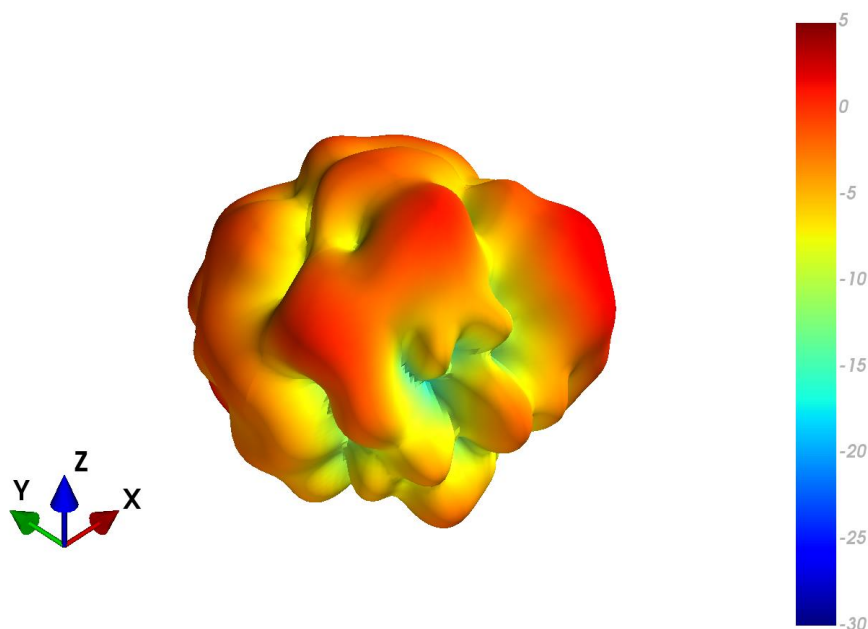
YZ Plane



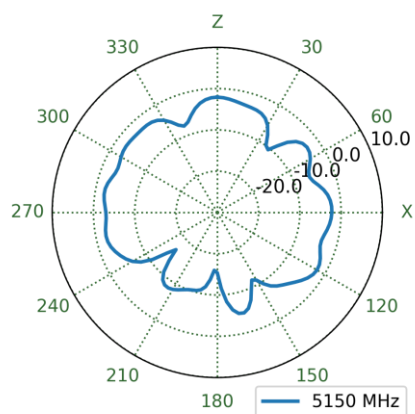
XY Plane



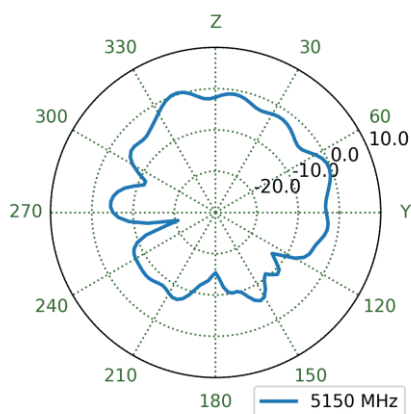
4.108 MIMO4 Wi-Fi Free Space Patterns at 5150 MHz



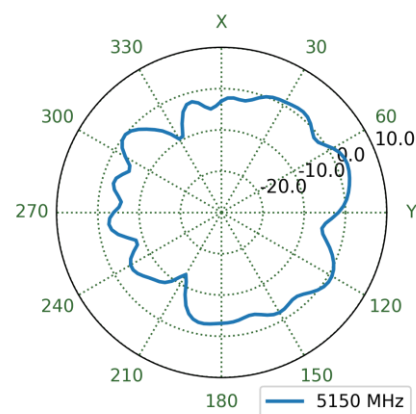
XZ Plane



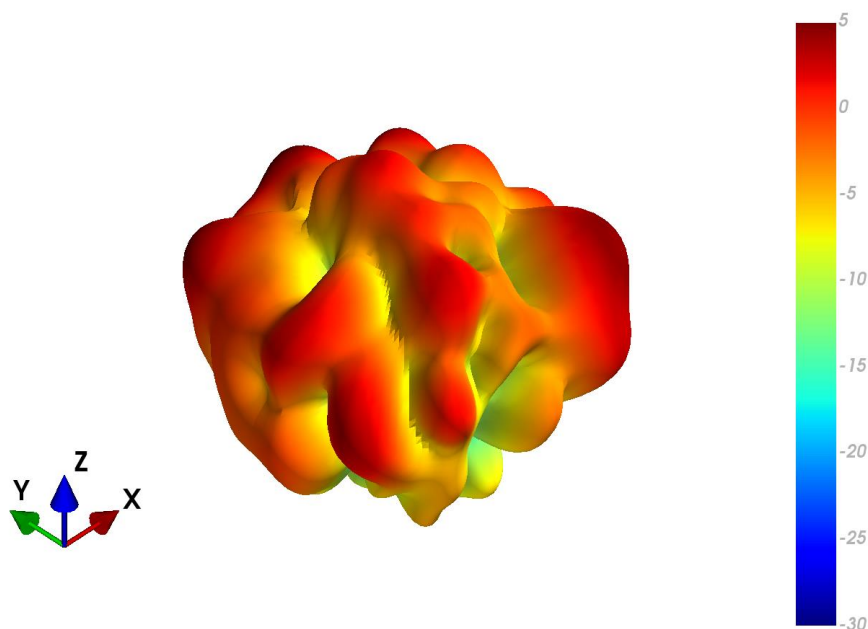
YZ Plane



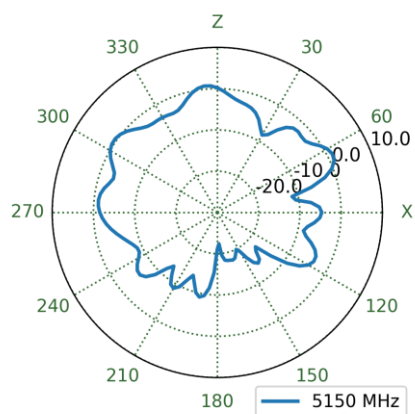
XY Plane



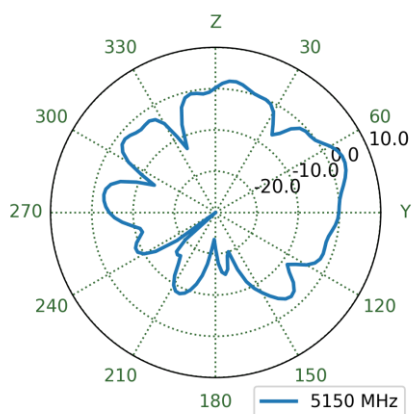
4.109 MIMO4 Wi-Fi Ground Plane Patterns at 5150 MHz



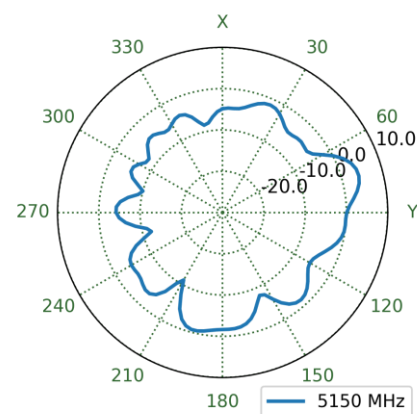
XZ Plane



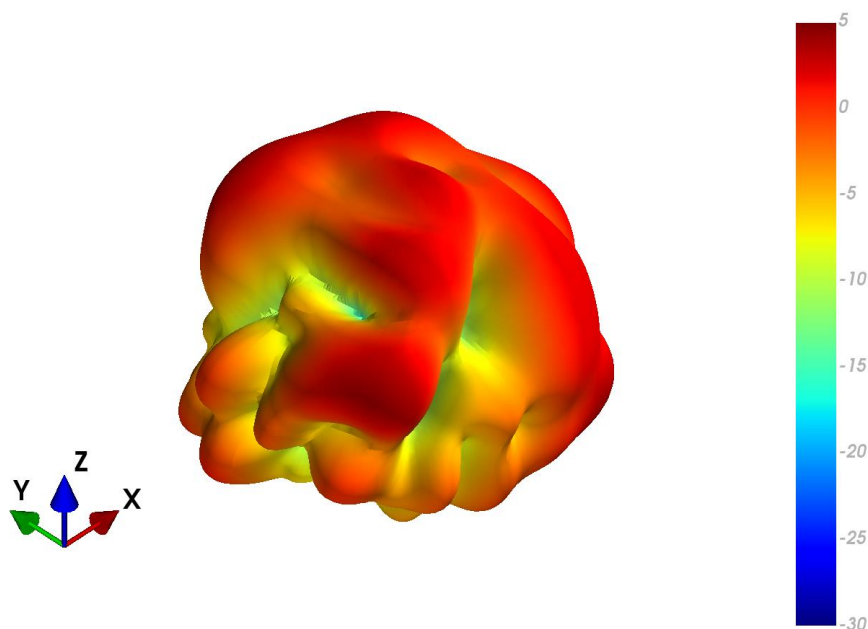
YZ Plane



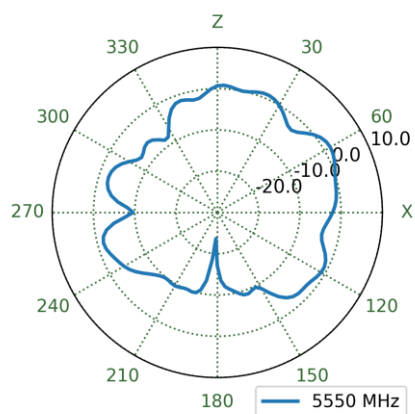
XY Plane



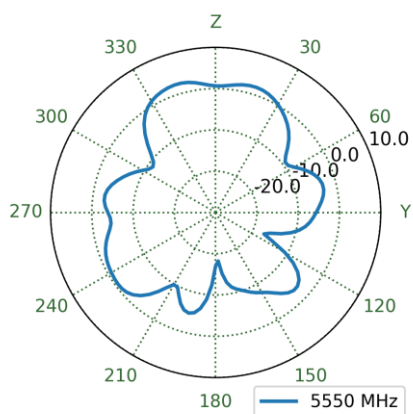
4.110 MIMO1 Wi-Fi Free Space Patterns at 5550 MHz



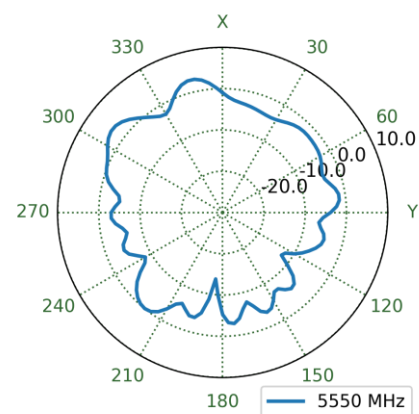
XZ Plane



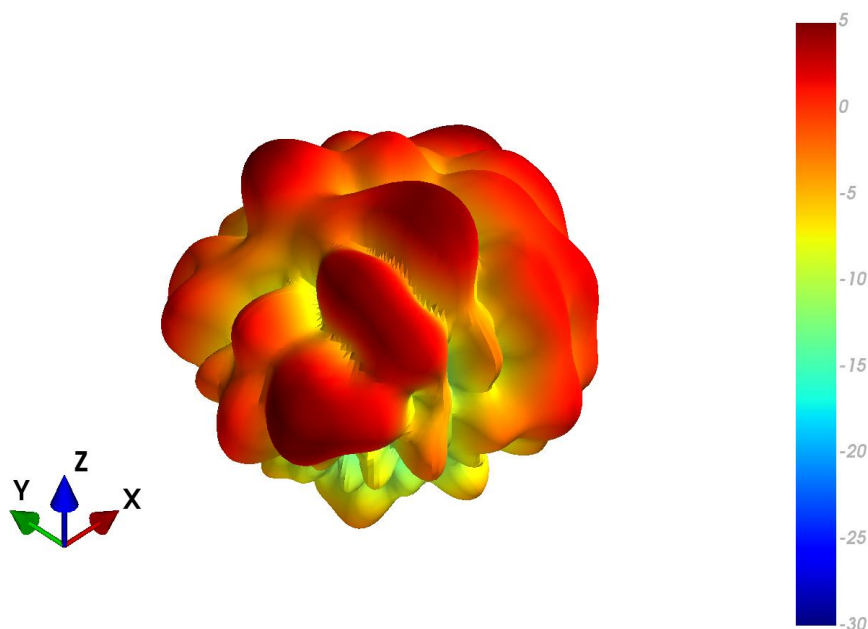
YZ Plane



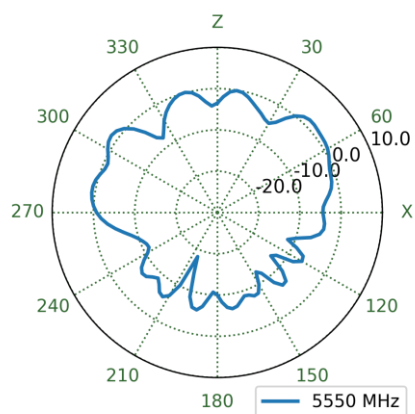
XY Plane



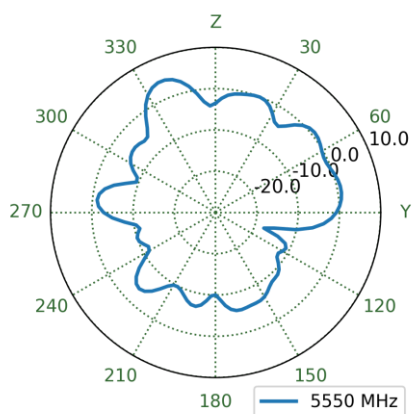
4.111 MIMO1 Wi-Fi Ground Plane Patterns at 5550 MHz



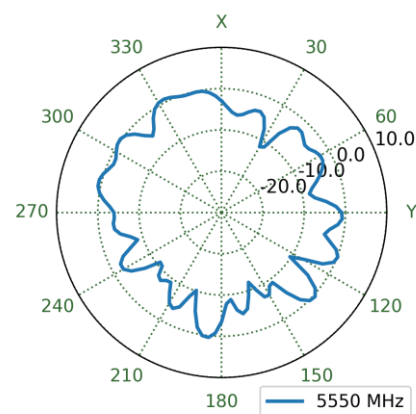
XZ Plane



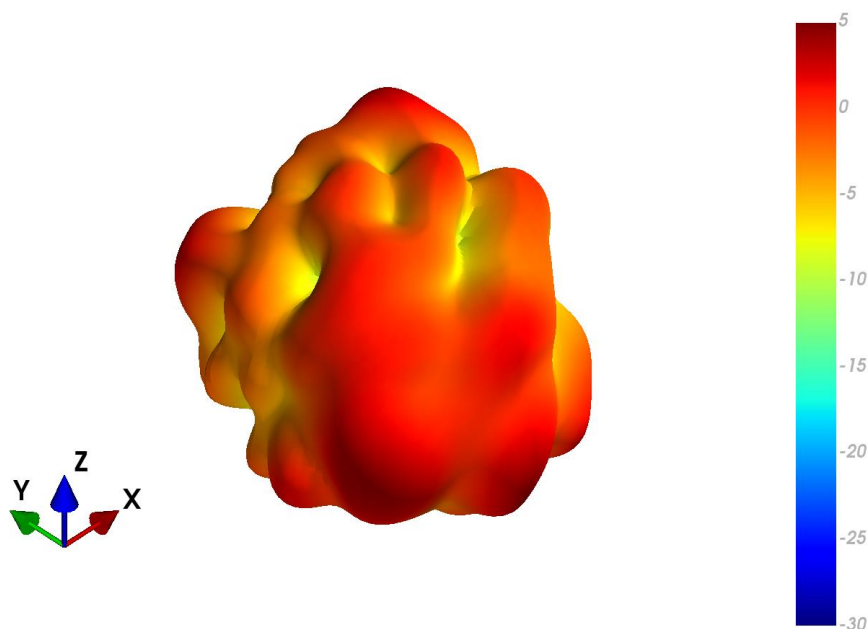
YZ Plane



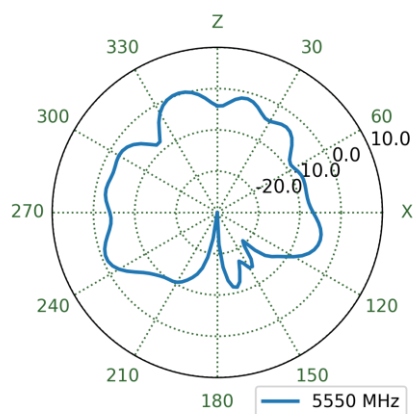
XY Plane



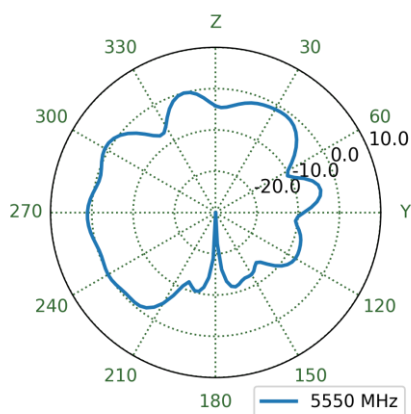
4.112 MIMO2 Wi-Fi Free Space Patterns at 5550 MHz



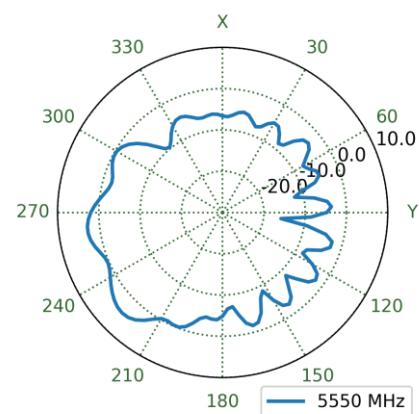
XZ Plane



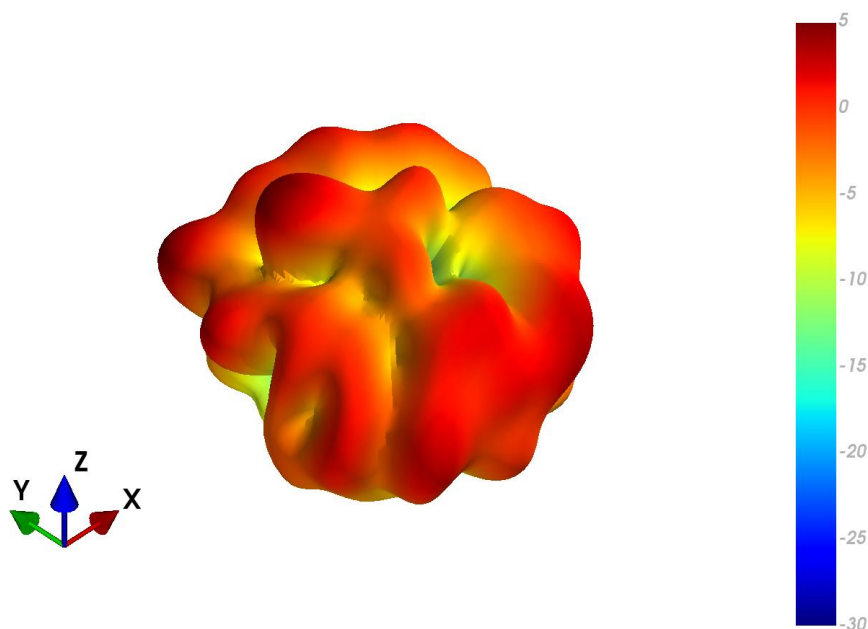
YZ Plane



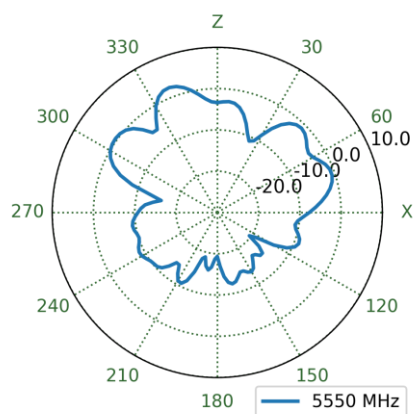
XY Plane



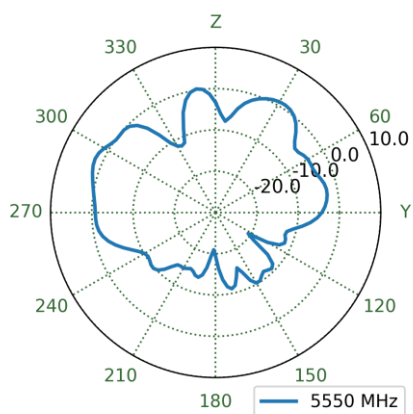
4.113 MIMO2 Wi-Fi Ground Plane Patterns at 5550 MHz



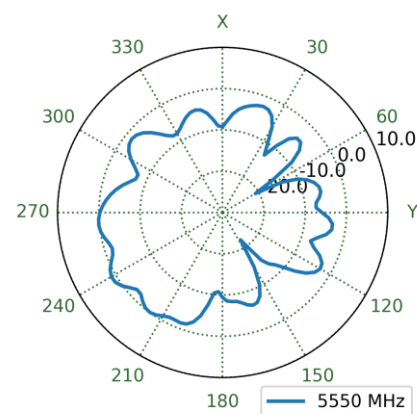
XZ Plane



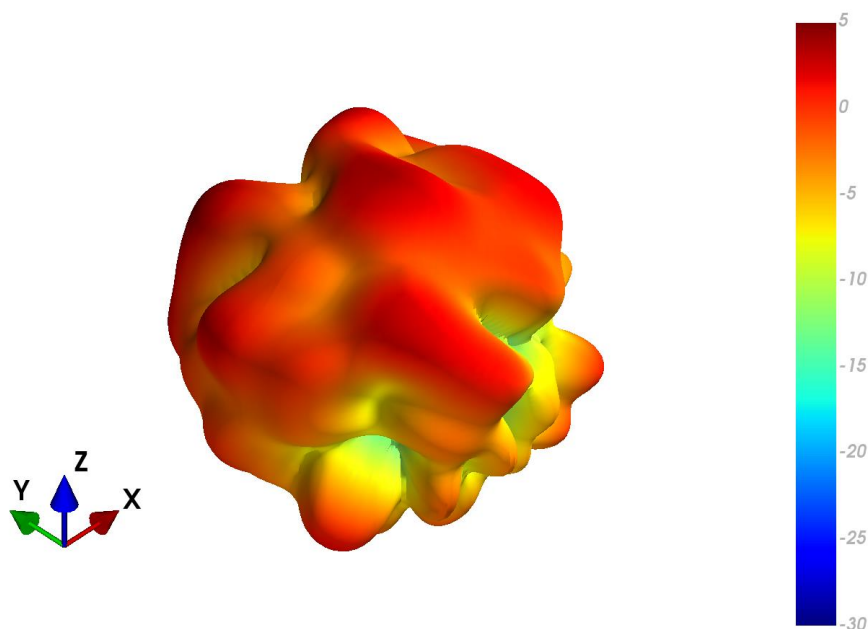
YZ Plane



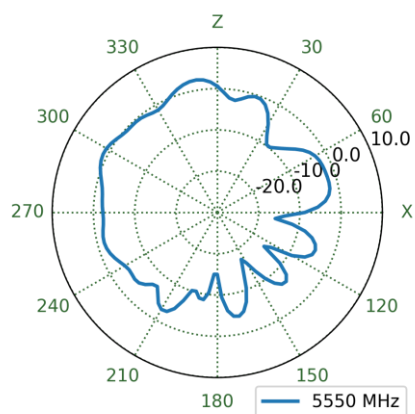
XY Plane



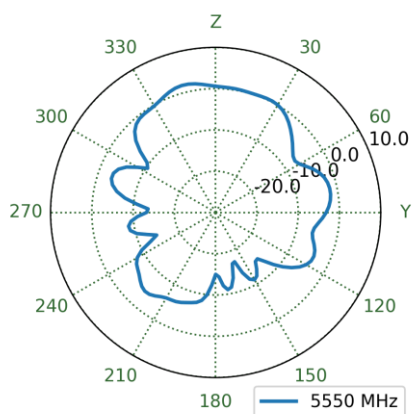
4.114 MIMO3 Wi-Fi Free Space Patterns at 5550 MHz



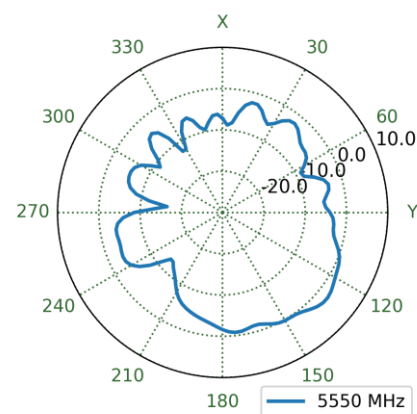
XZ Plane



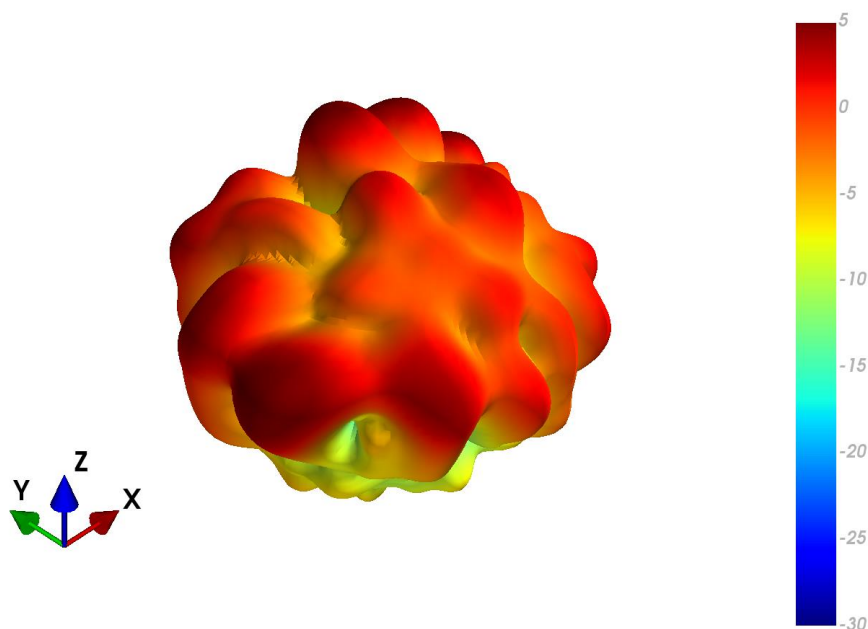
YZ Plane



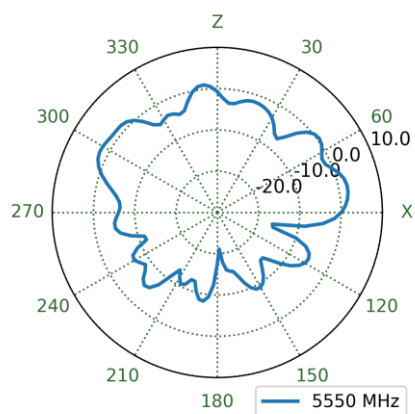
XY Plane



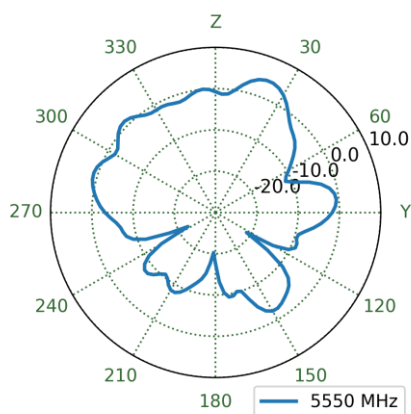
4.115 MIMO3 Wi-Fi Ground Plane Patterns at 5550 MHz



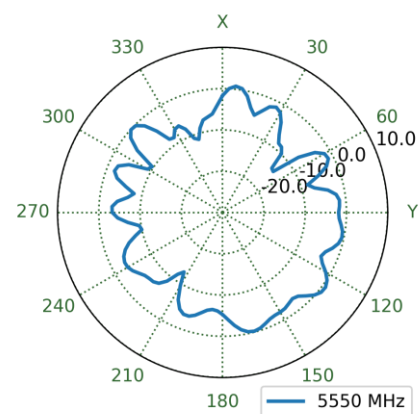
XZ Plane



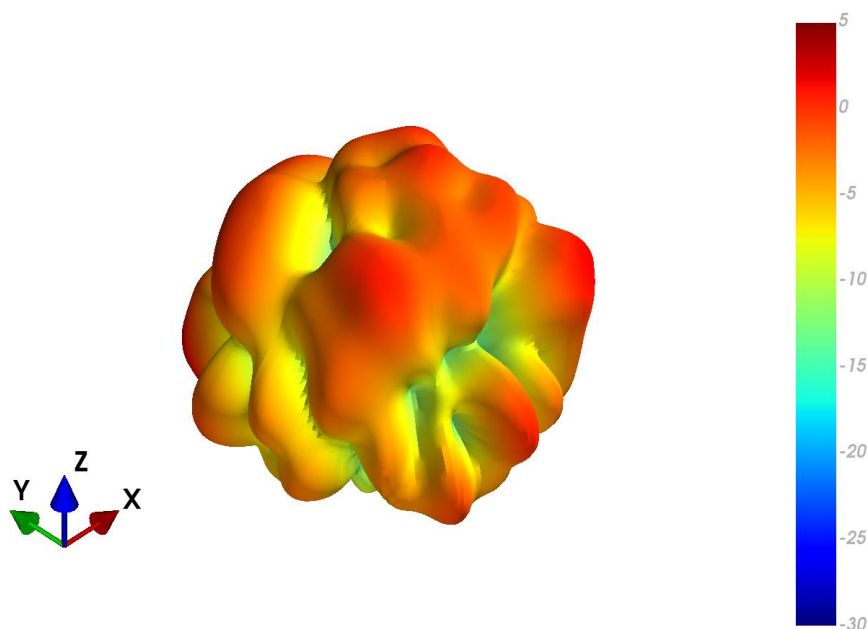
YZ Plane



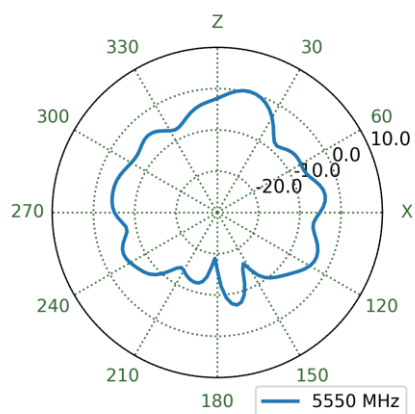
XY Plane



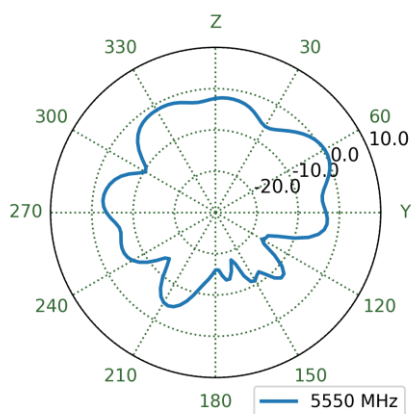
4.116 MIMO4 Wi-Fi Free Space Patterns at 5550 MHz



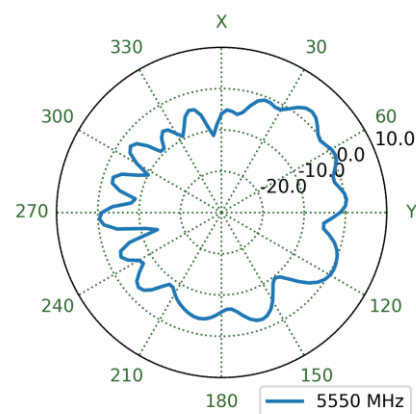
XZ Plane



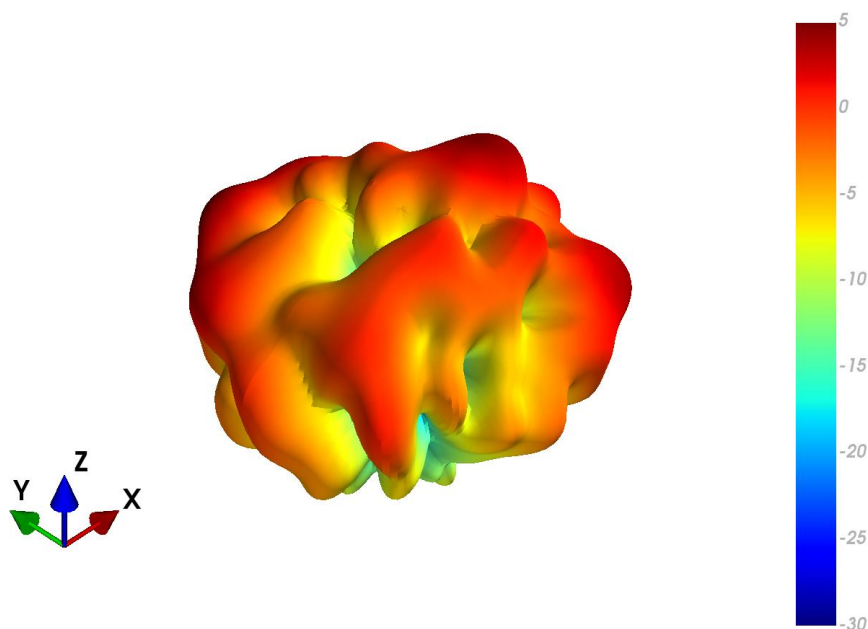
YZ Plane



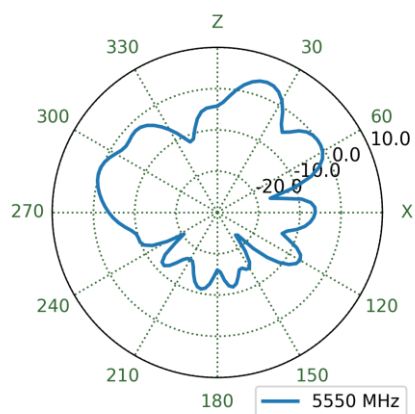
XY Plane



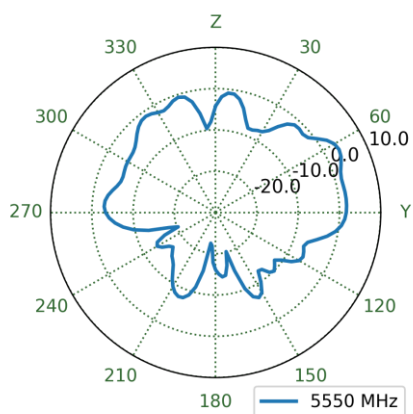
4.117 MIMO4 Wi-Fi Ground Plane Patterns at 5550 MHz



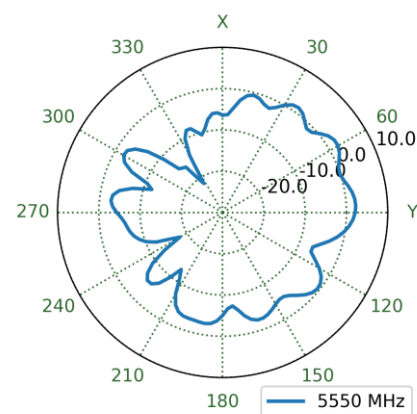
XZ Plane



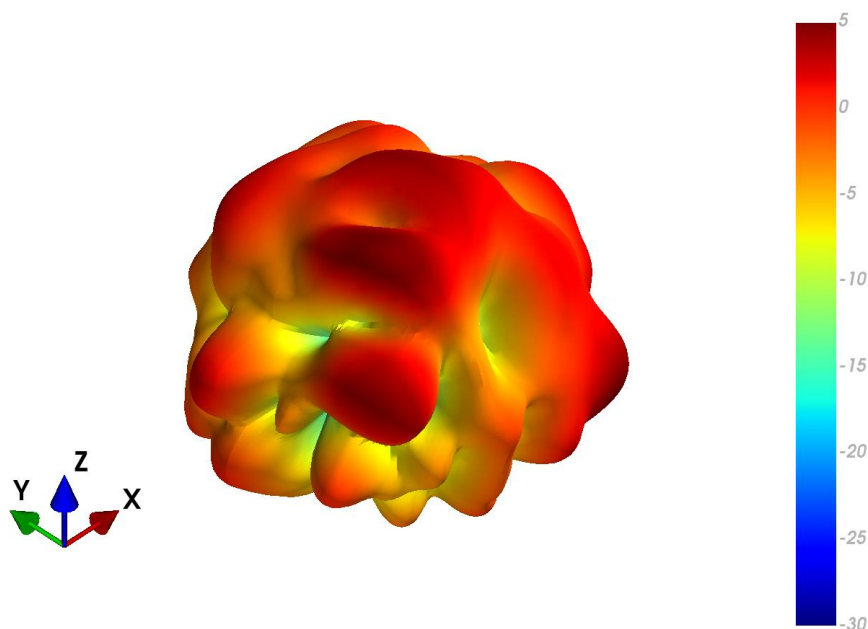
YZ Plane



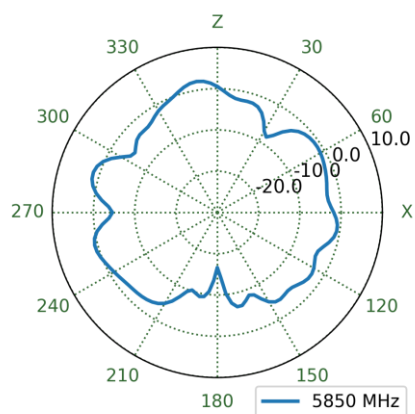
XY Plane



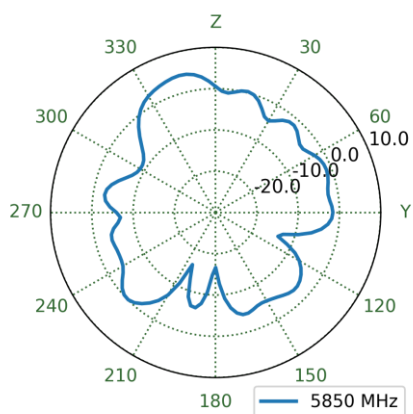
4.118 MIMO1 Wi-Fi Free Space Patterns at 5850 MHz



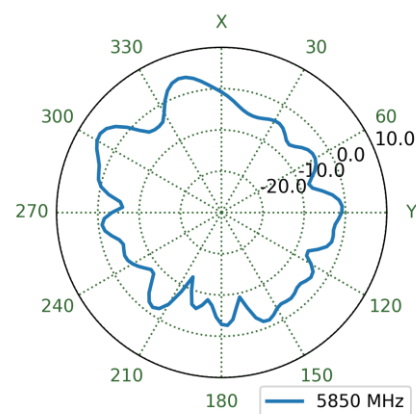
XZ Plane



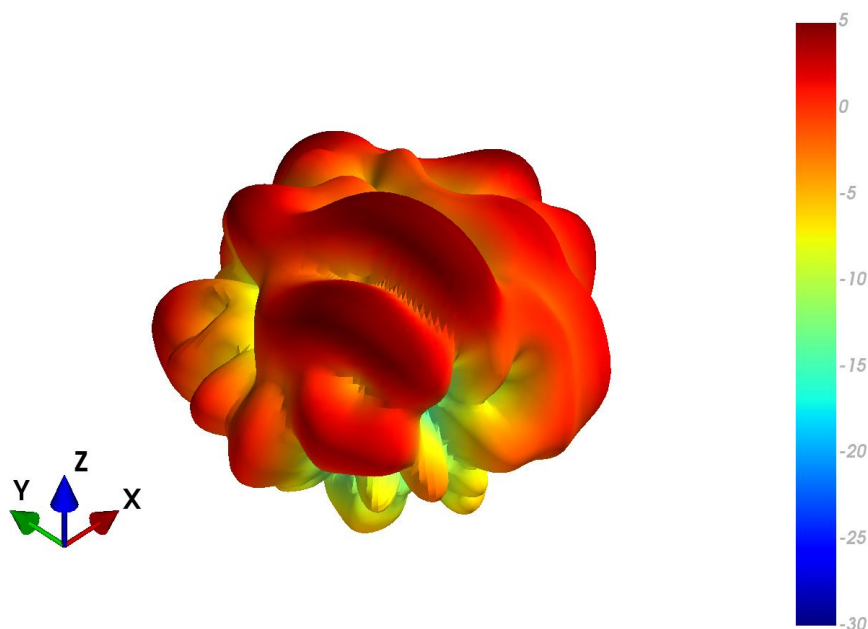
YZ Plane



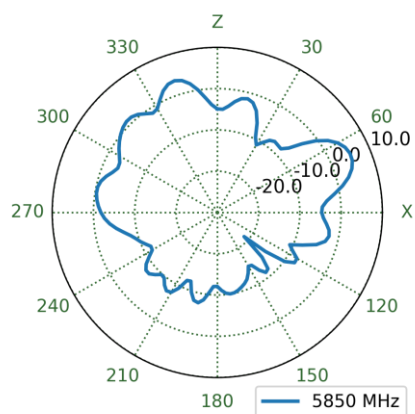
XY Plane



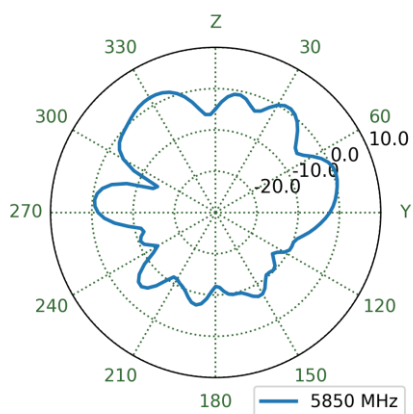
4.119 MIMO1 Wi-Fi Ground Plane Patterns at 5850 MHz



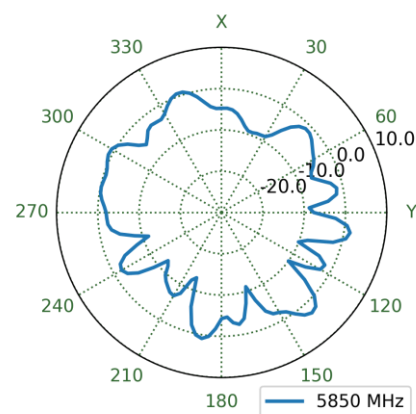
XZ Plane



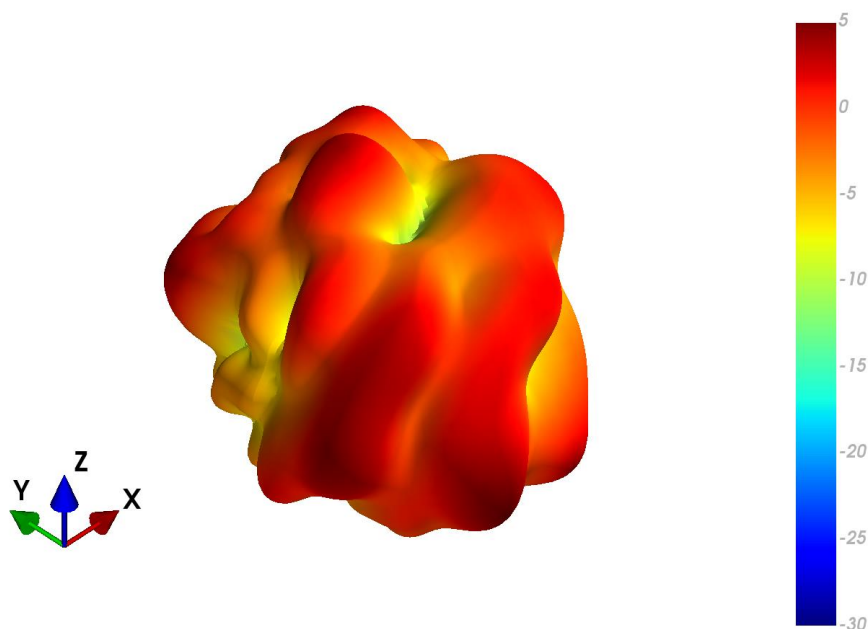
YZ Plane



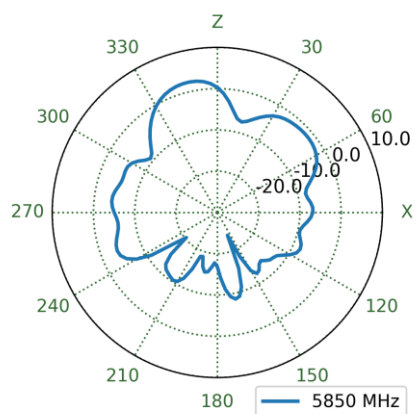
XY Plane



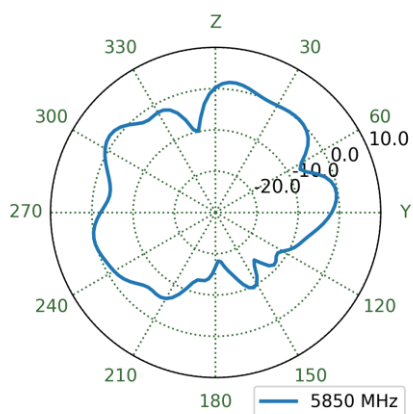
4.120 MIMO2 Wi-Fi Free Space Patterns at 5850 MHz



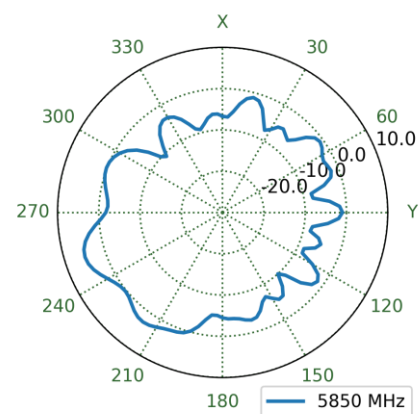
XZ Plane



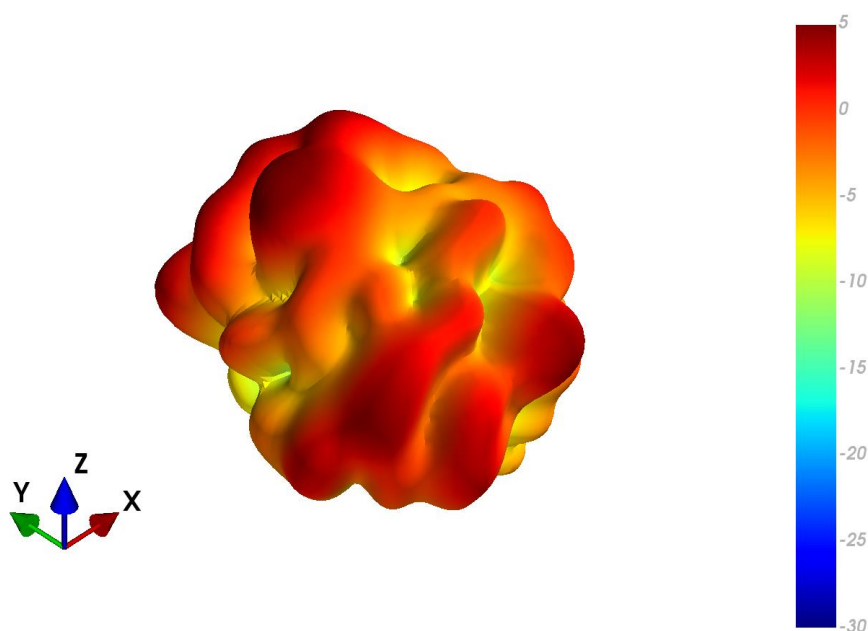
YZ Plane



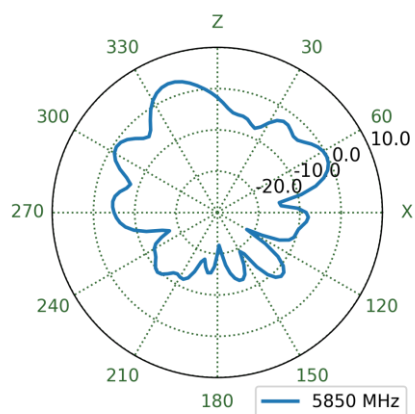
XY Plane



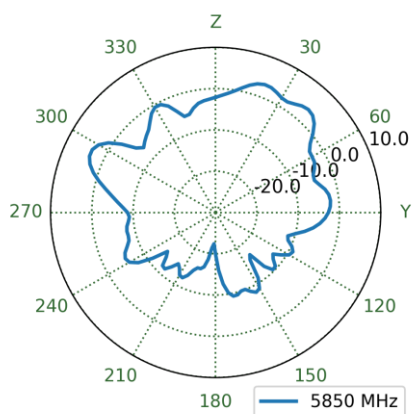
4.121 MIMO2 Wi-Fi Ground Plane Patterns at 5850 MHz



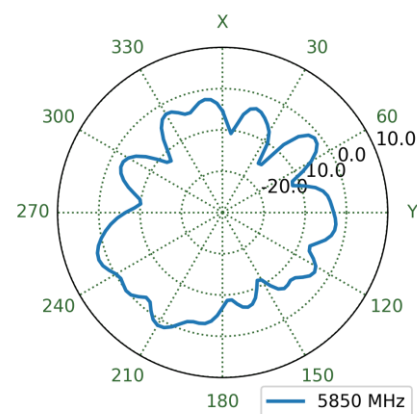
XZ Plane



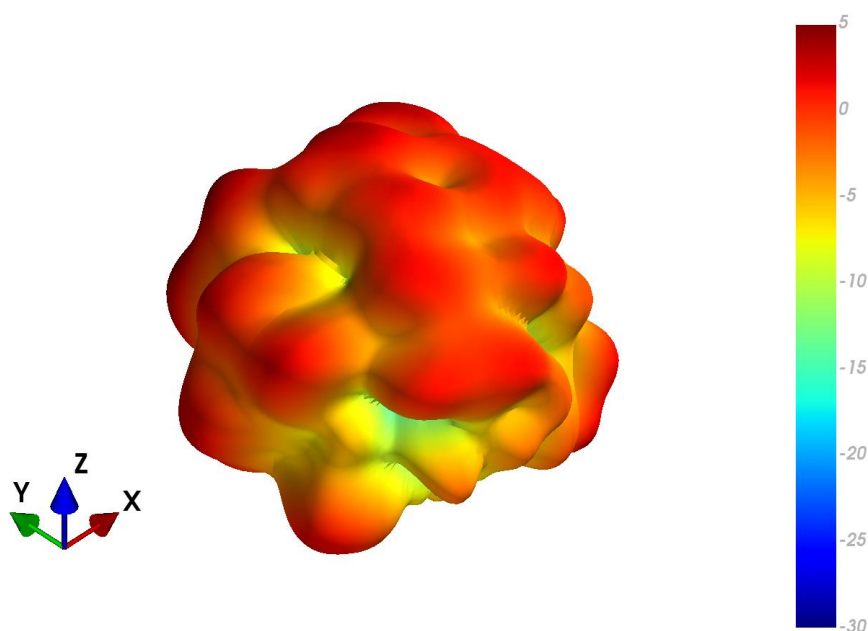
YZ Plane



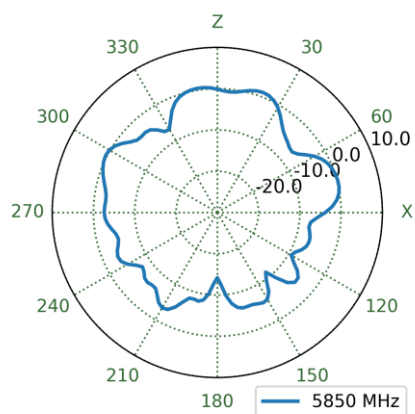
XY Plane



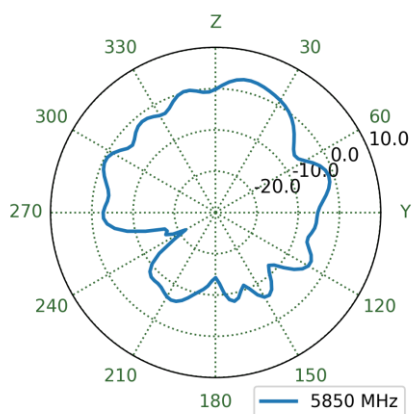
4.122 MIMO3 Wi-Fi Free Space Patterns at 5850 MHz



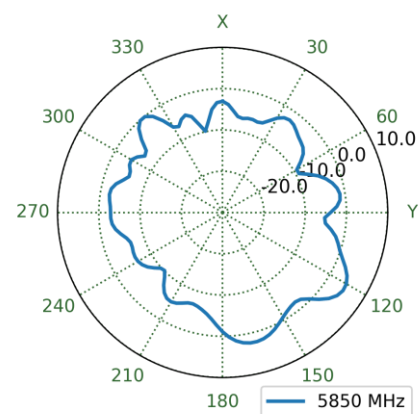
XZ Plane



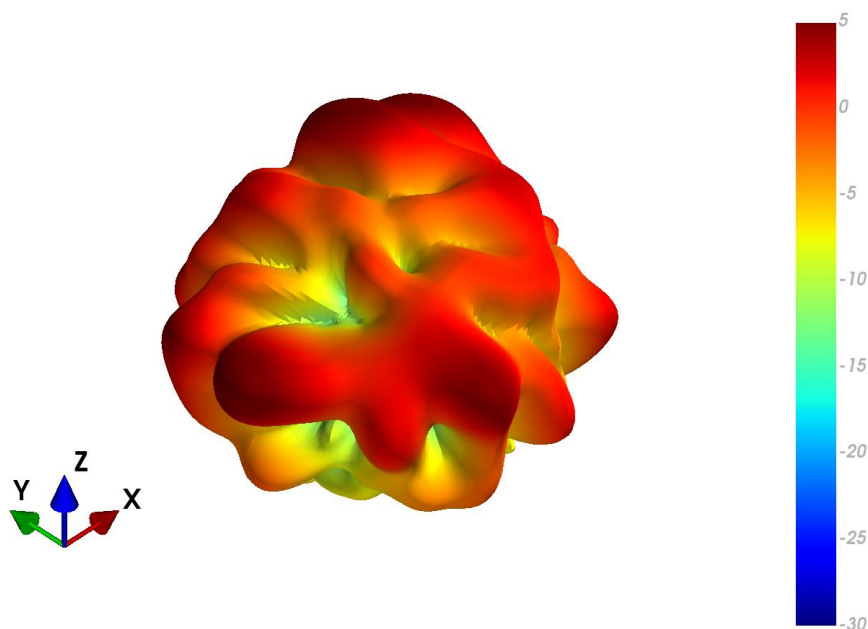
YZ Plane



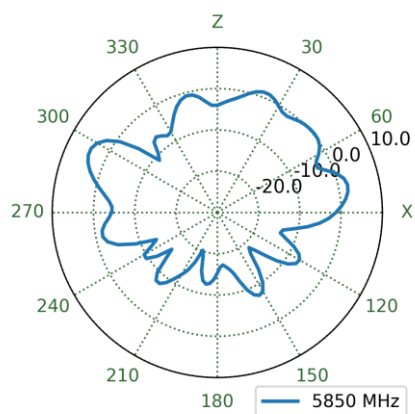
XY Plane



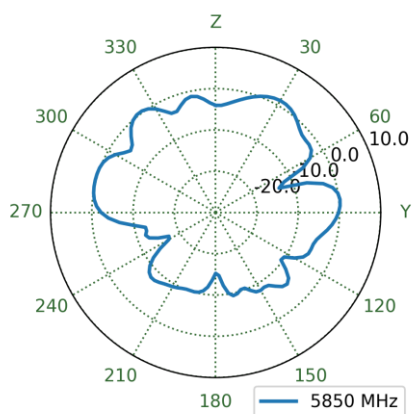
4.123 MIMO3 Wi-Fi Ground Plane Patterns at 5850 MHz



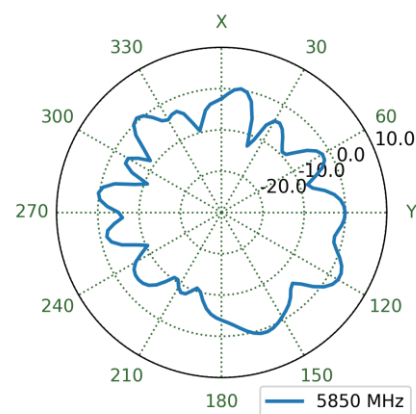
XZ Plane



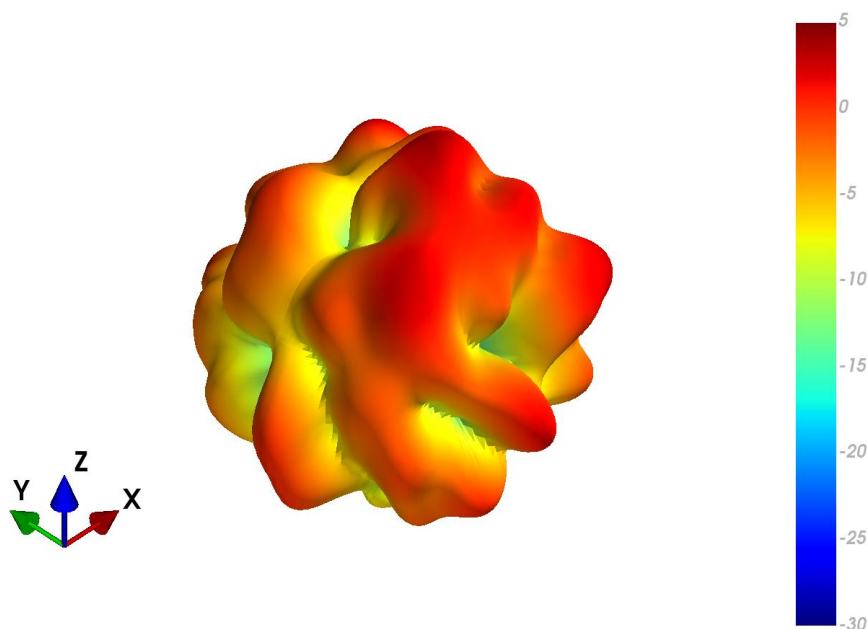
YZ Plane



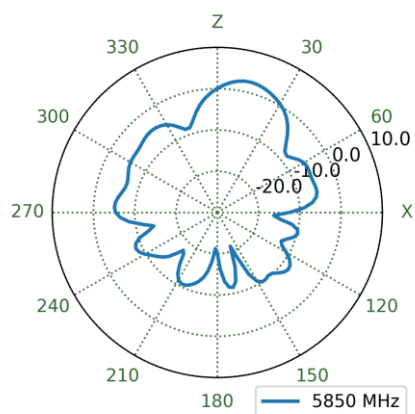
XY Plane



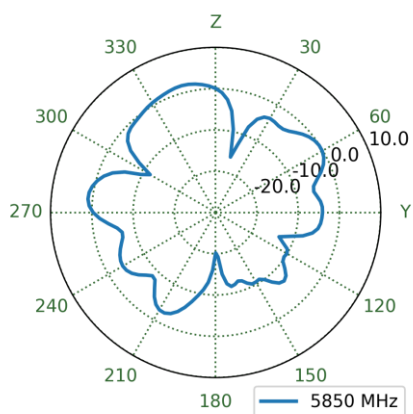
4.124 MIMO4 Wi-Fi Free Space Patterns at 5850 MHz



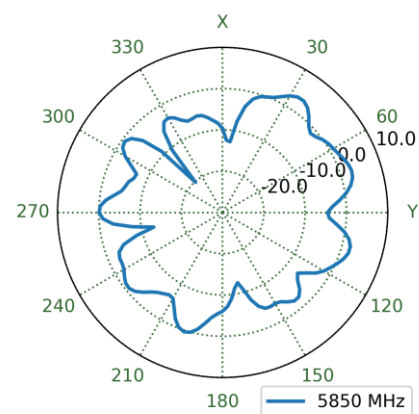
XZ Plane



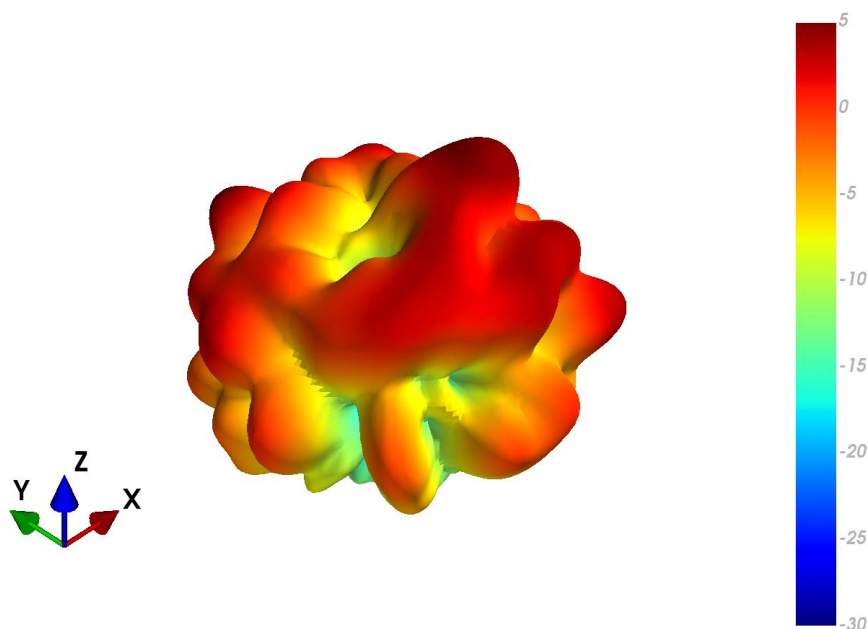
YZ Plane



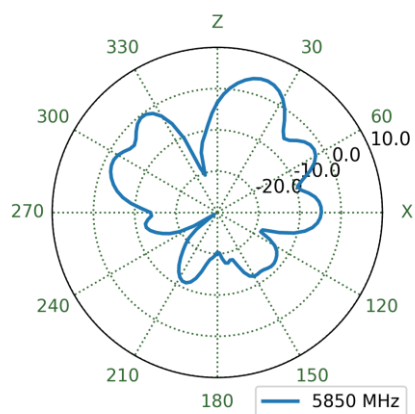
XY Plane



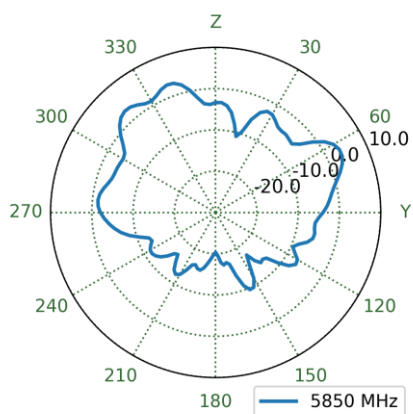
4.125 MIMO4 Wi-Fi Ground Plane Patterns at 5850 MHz



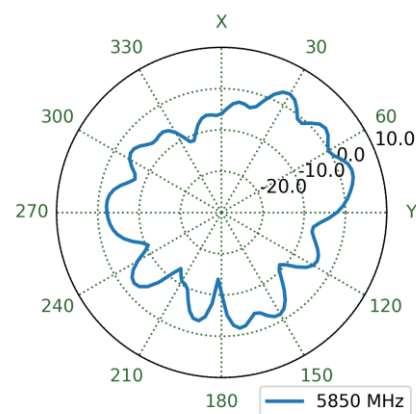
XZ Plane



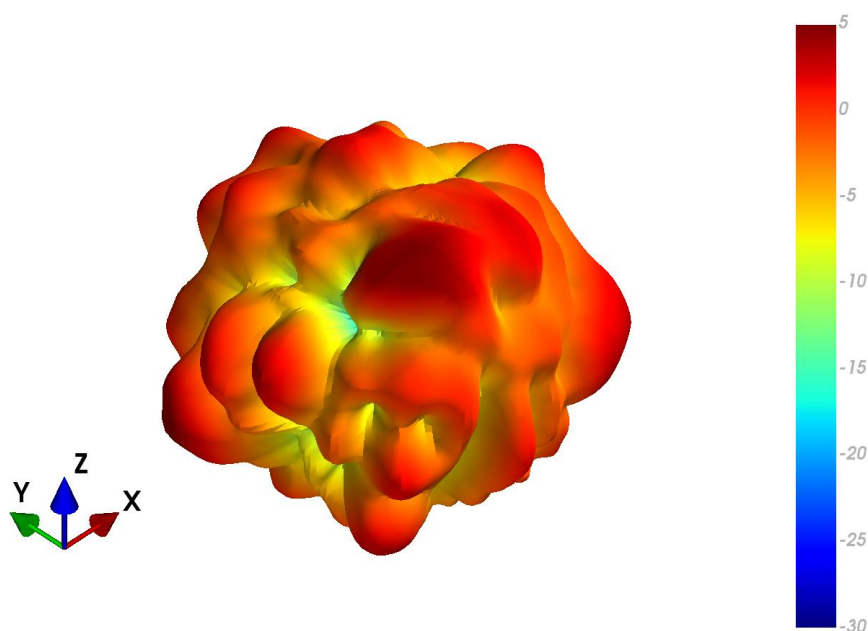
YZ Plane



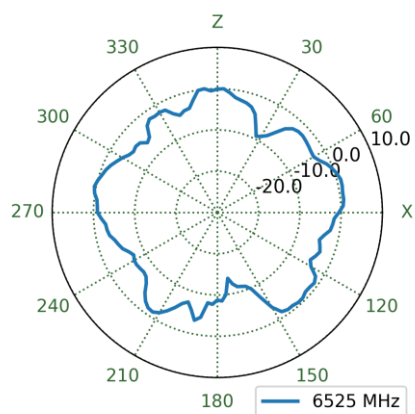
XY Plane



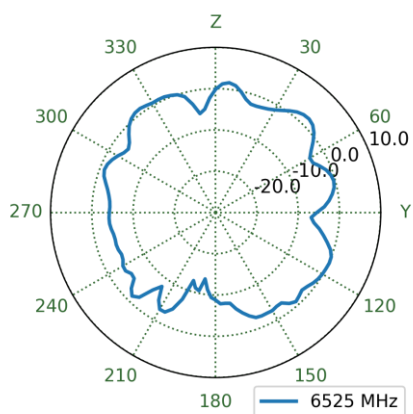
4.126 MIMO1 Wi-Fi Free Space Patterns at 6525 MHz



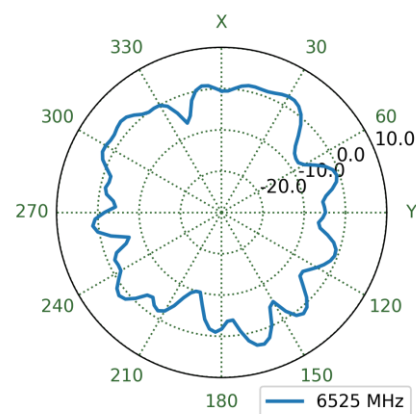
XZ Plane



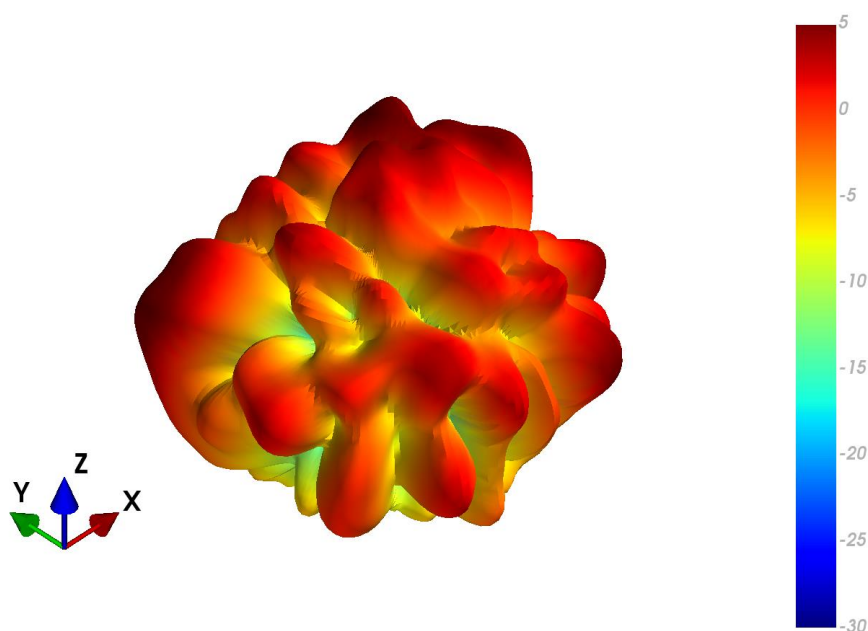
YZ Plane



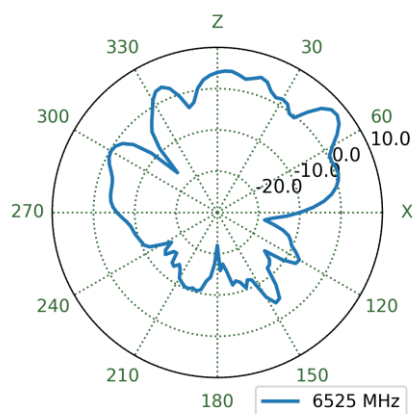
XY Plane



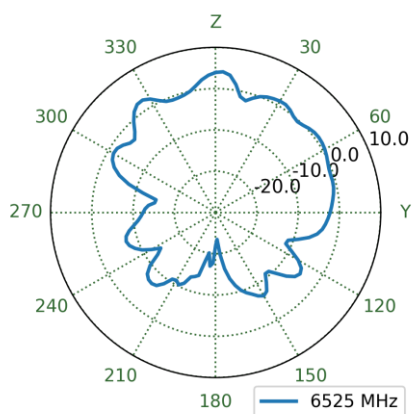
4.127 MIMO1 Wi-Fi Ground Plane Patterns at 6525 MHz



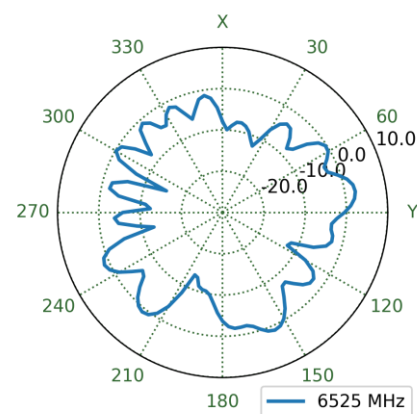
XZ Plane



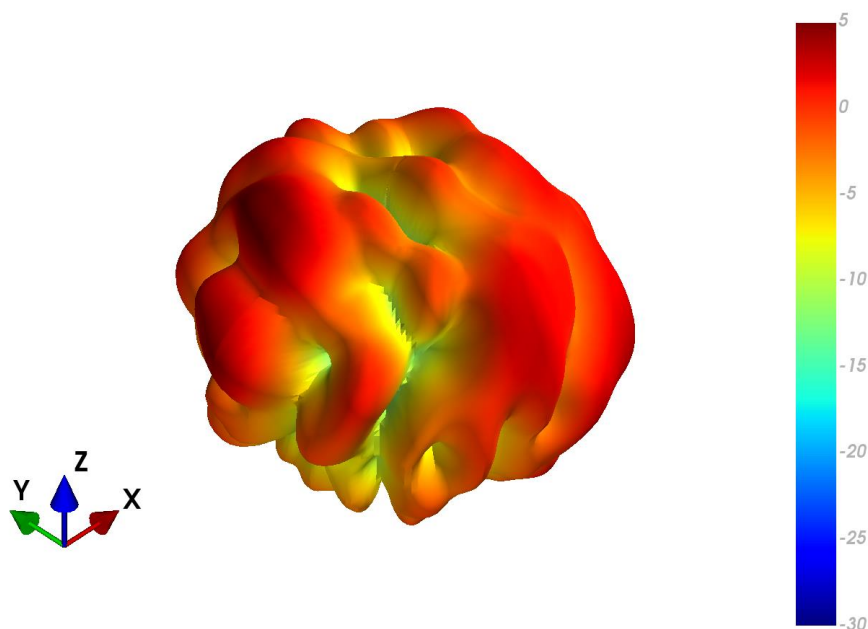
YZ Plane



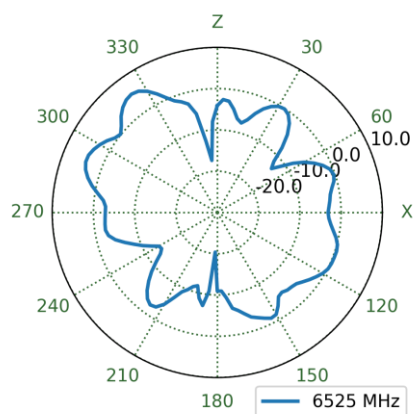
XY Plane



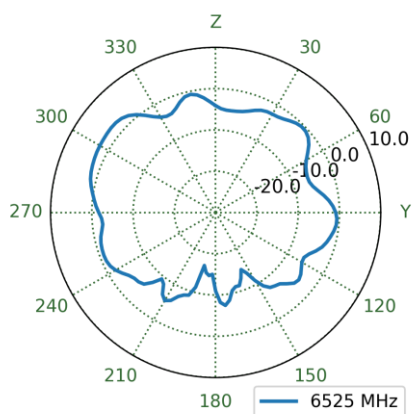
4.128 MIMO2 Wi-Fi Free Space Patterns at 6525 MHz



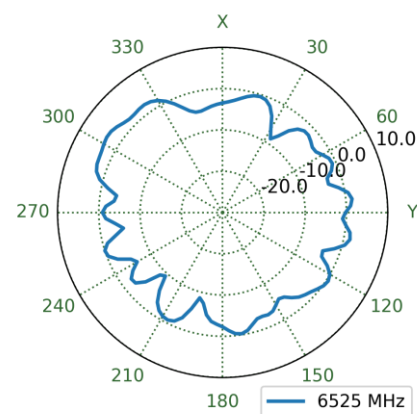
XZ Plane



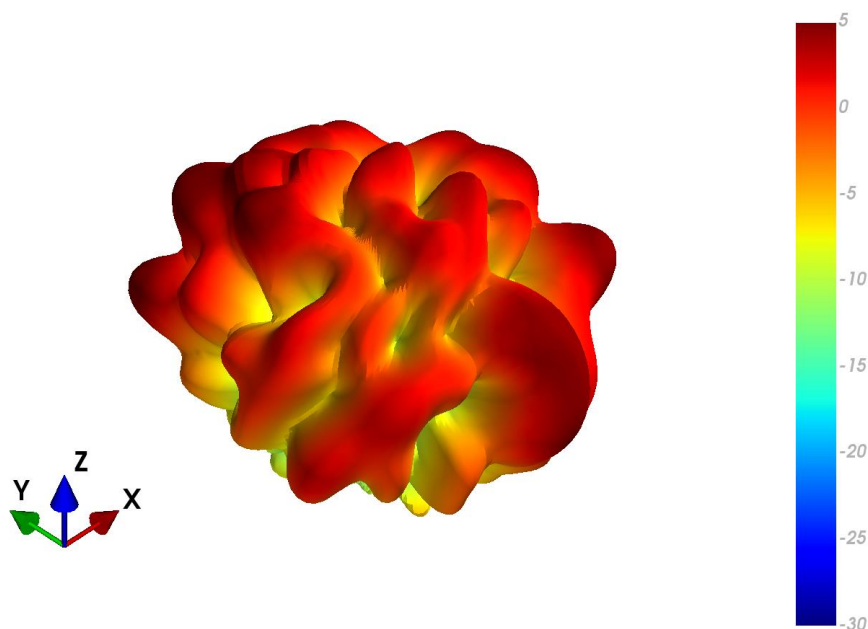
YZ Plane



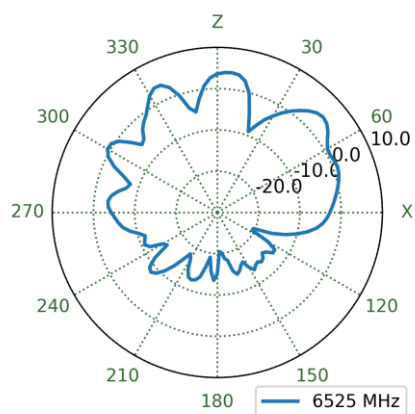
XY Plane



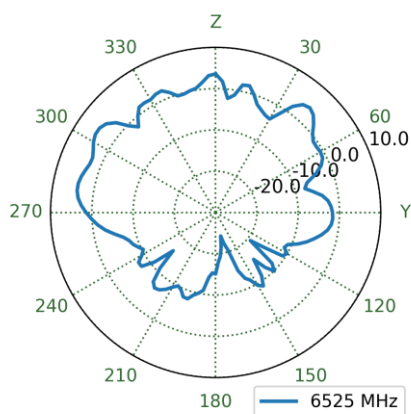
4.129 MIMO2 Wi-Fi Ground Plane Patterns at 6525 MHz



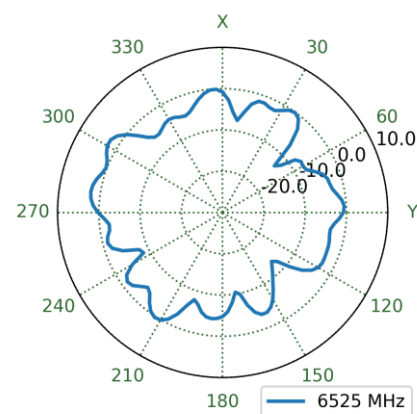
XZ Plane



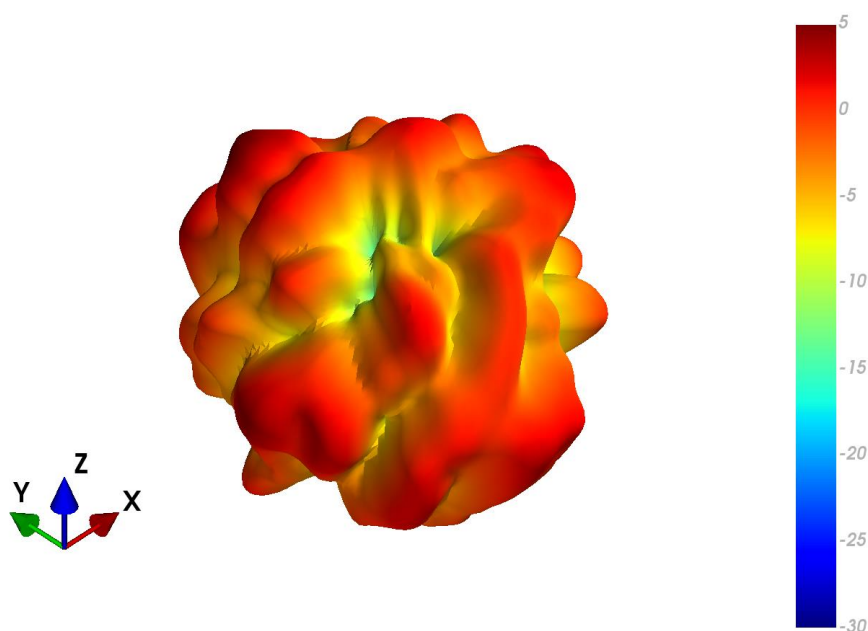
YZ Plane



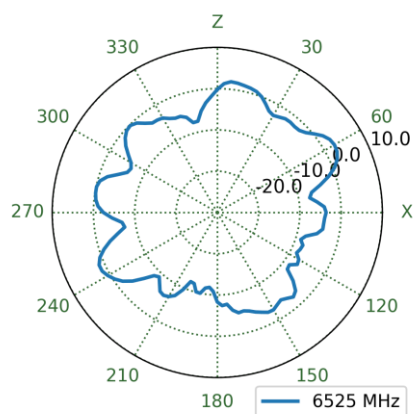
XY Plane



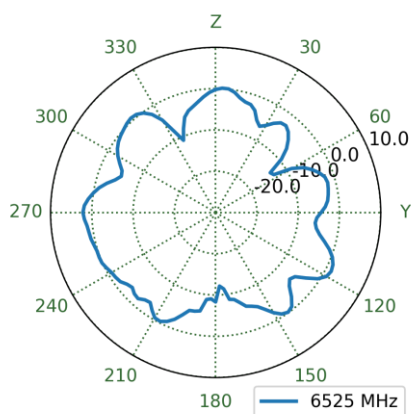
4.130 MIMO3 Wi-Fi Free Space Patterns at 6525 MHz



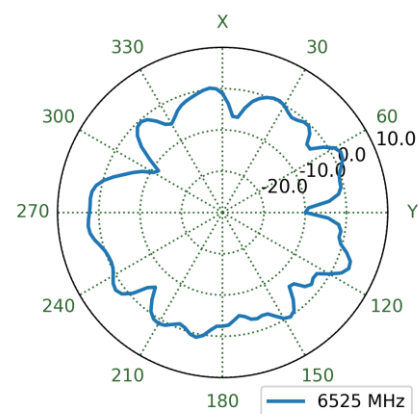
XZ Plane



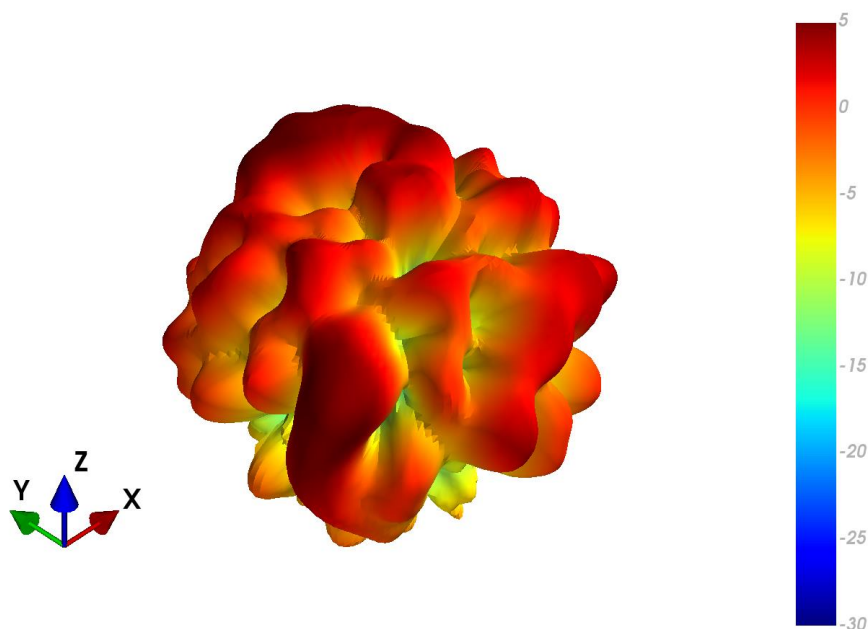
YZ Plane



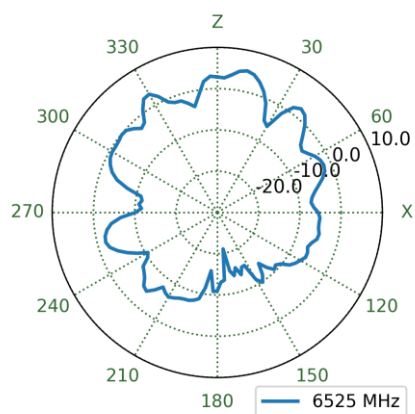
XY Plane



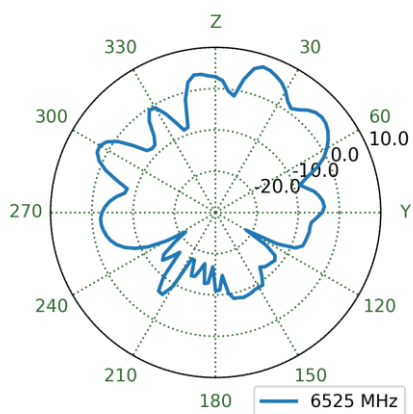
4.131 MIMO3 Wi-Fi Ground Plane Patterns at 6525 MHz



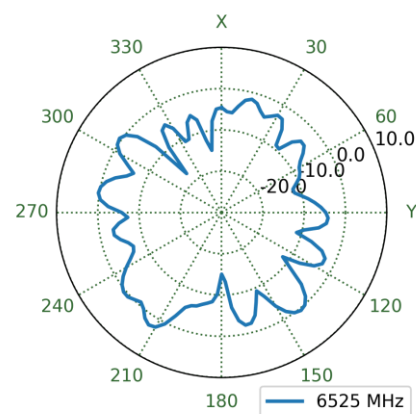
XZ Plane



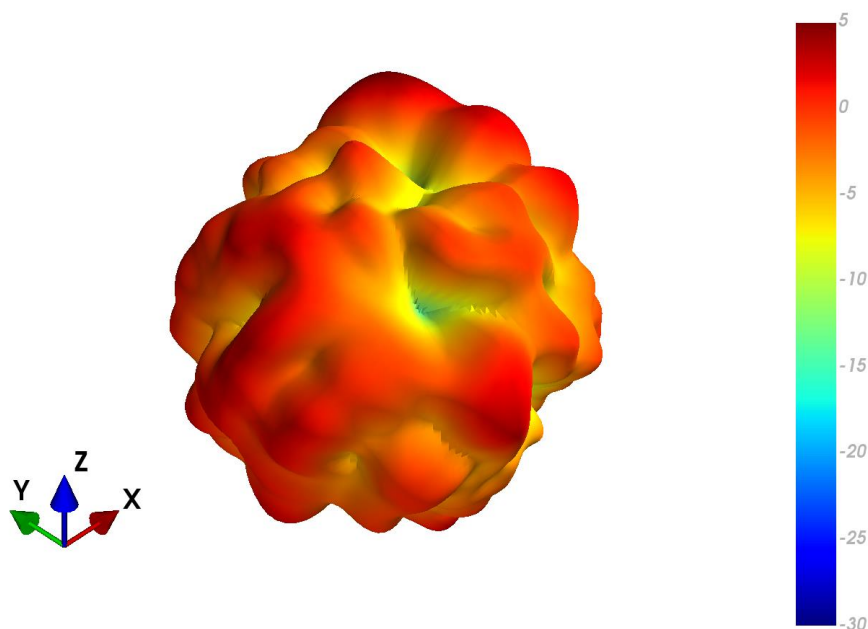
YZ Plane



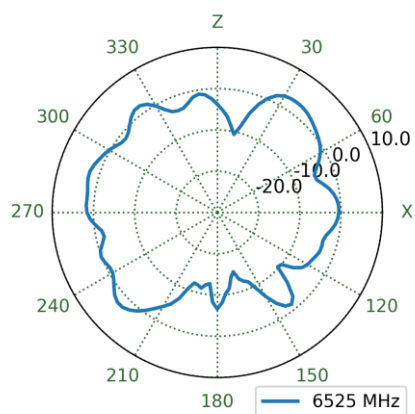
XY Plane



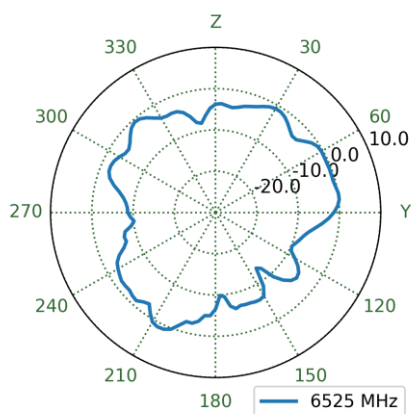
4.132 MIMO4 Wi-Fi Free Space Patterns at 6525 MHz



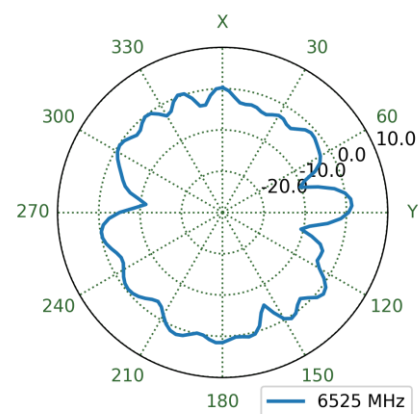
XZ Plane



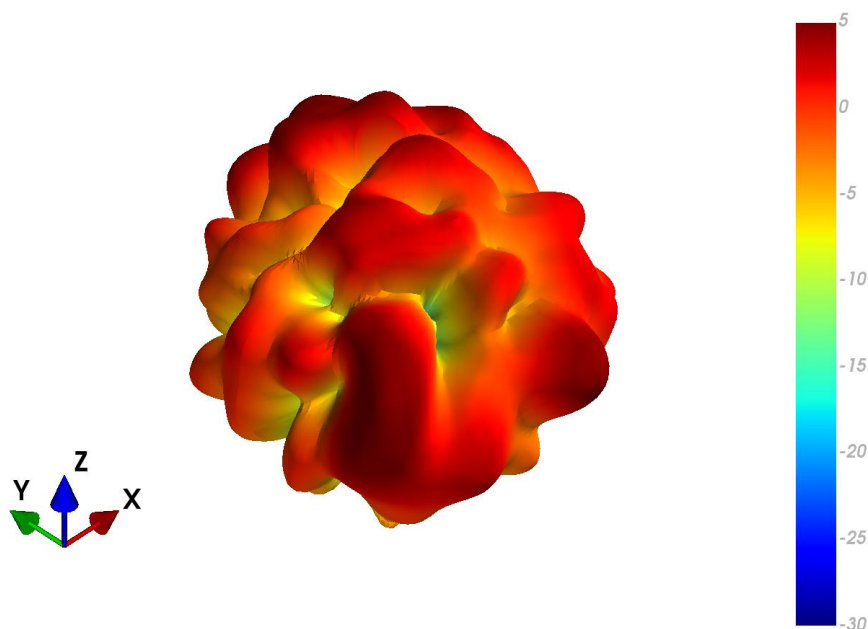
YZ Plane



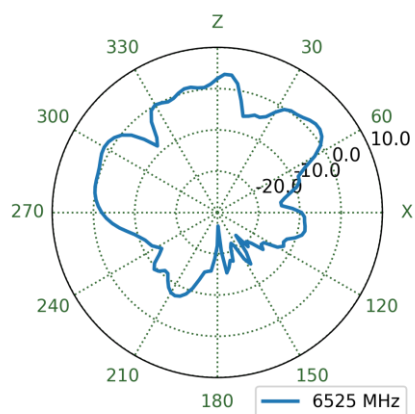
XY Plane



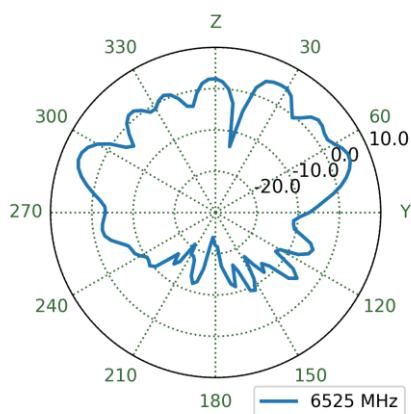
4.133 MIMO4 Wi-Fi Ground Plane Patterns at 6525 MHz



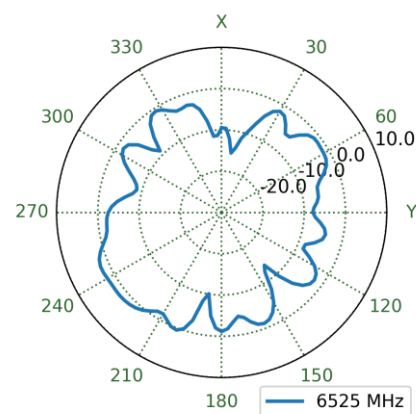
XZ Plane



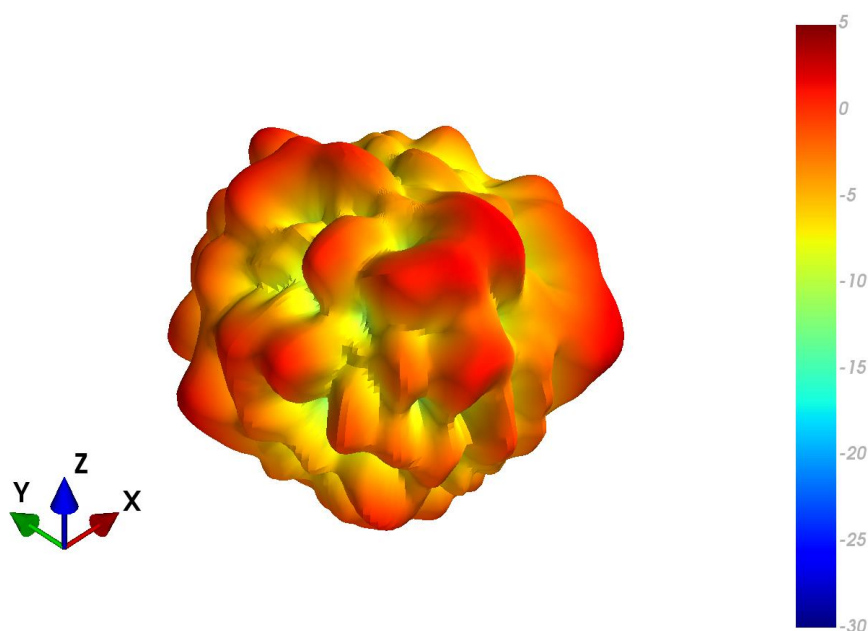
YZ Plane



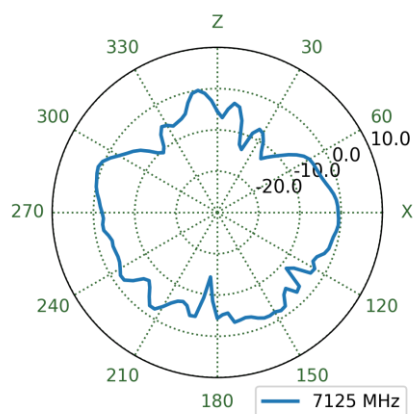
XY Plane



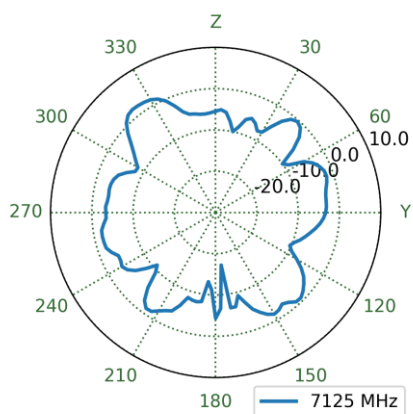
4.134 MIMO1 Wi-Fi Free Space Patterns at 7125 MHz



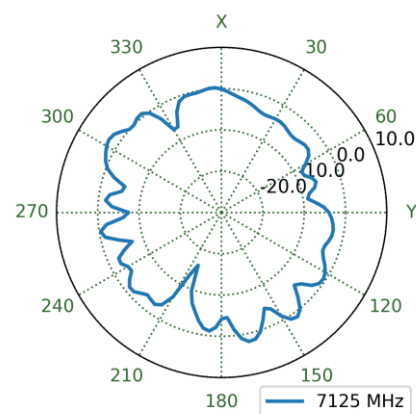
XZ Plane



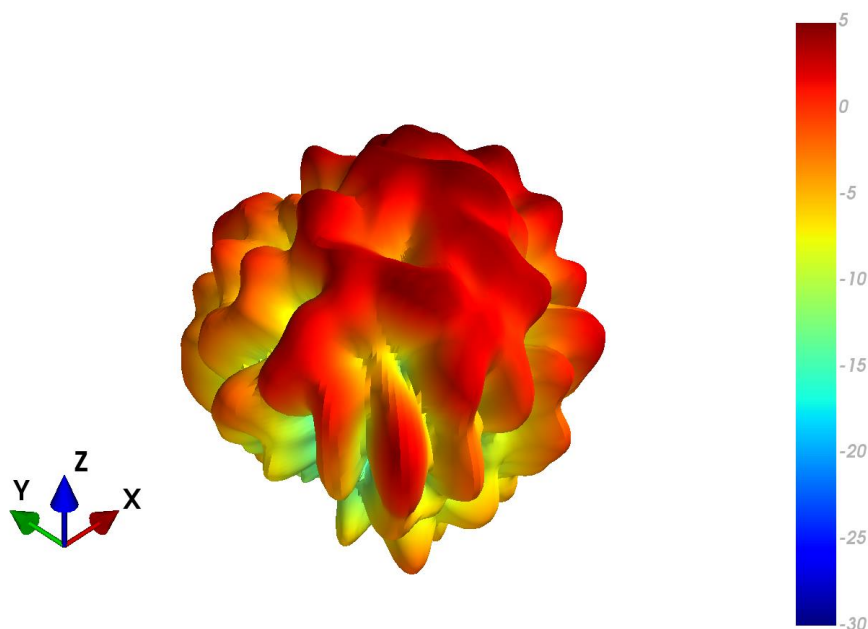
YZ Plane



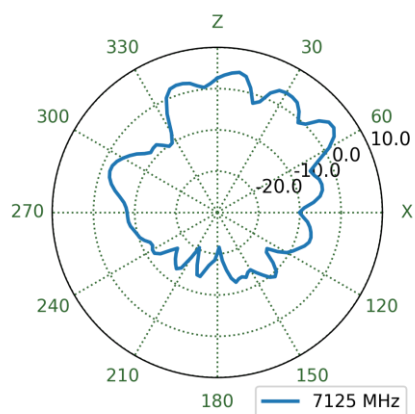
XY Plane



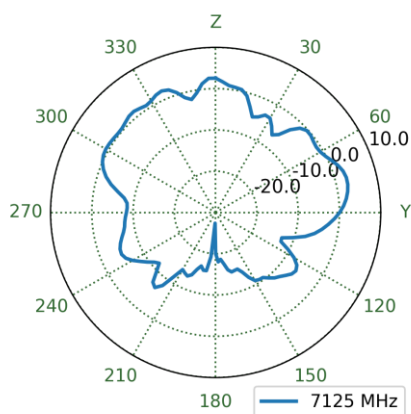
4.135 MIMO1 Wi-Fi Ground Plane Patterns at 7125 MHz



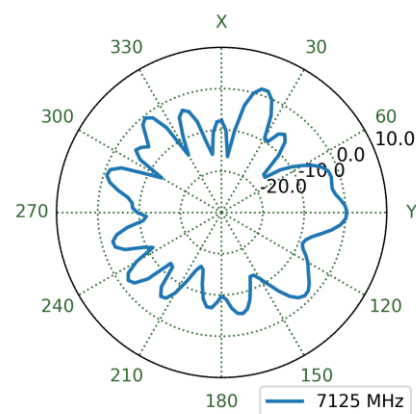
XZ Plane



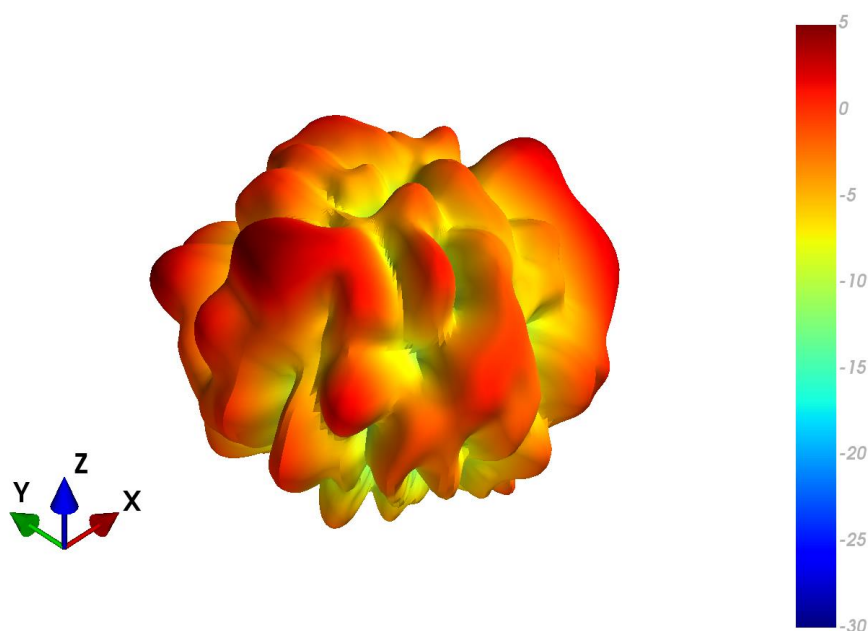
YZ Plane



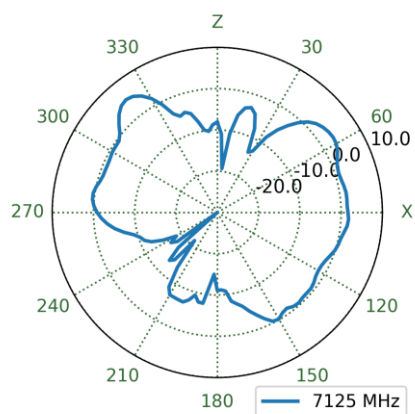
XY Plane



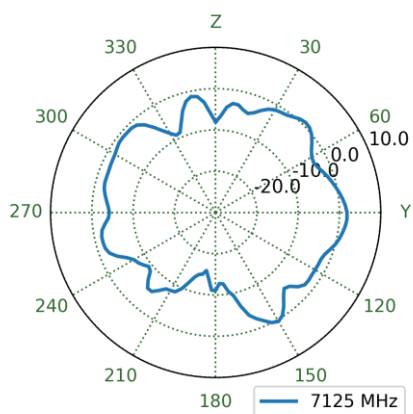
4.136 MIMO2 Wi-Fi Free Space Patterns at 7125 MHz



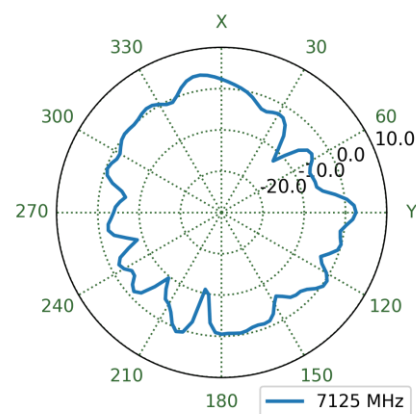
XZ Plane



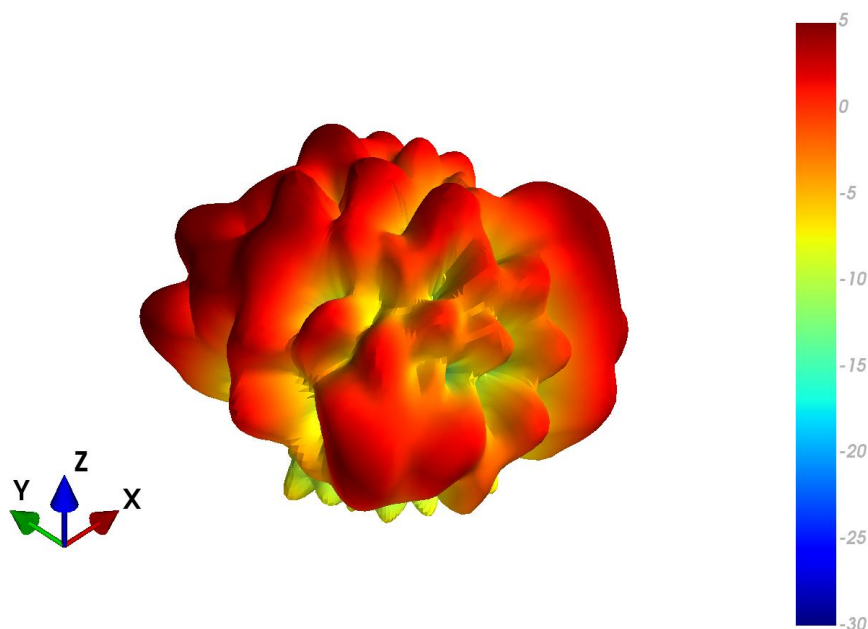
YZ Plane



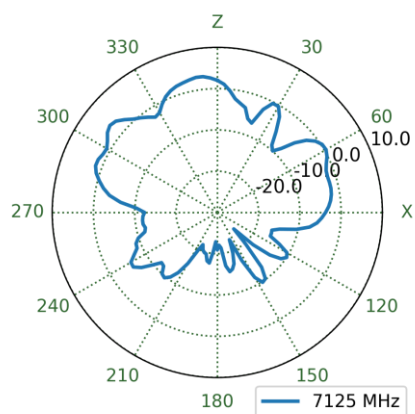
XY Plane



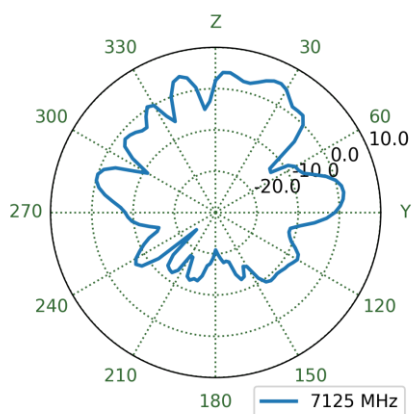
4.137 MIMO2 Wi-Fi Ground Plane Patterns at 7125 MHz



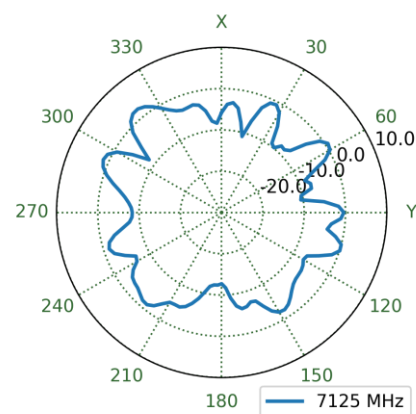
XZ Plane



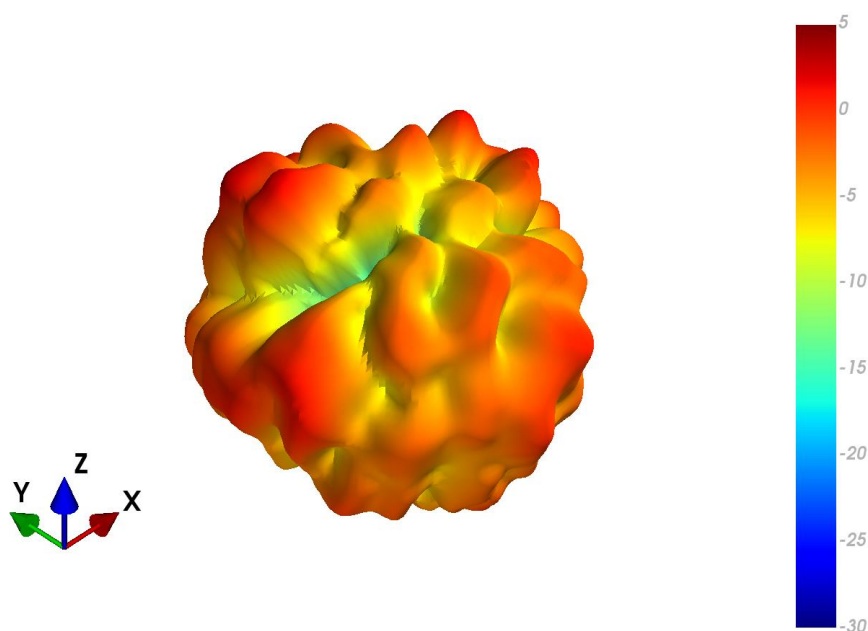
YZ Plane



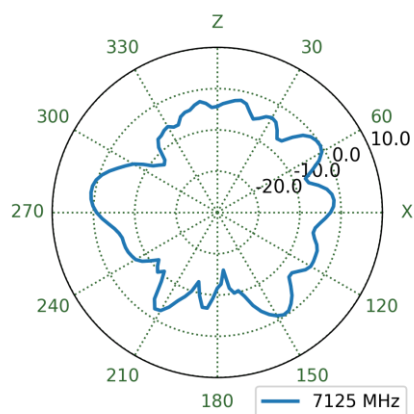
XY Plane



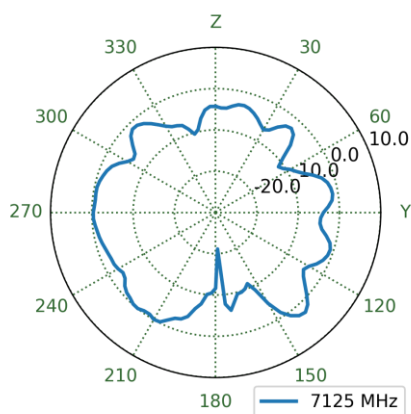
4.138 MIMO3 Wi-Fi Free Space Patterns at 7125 MHz



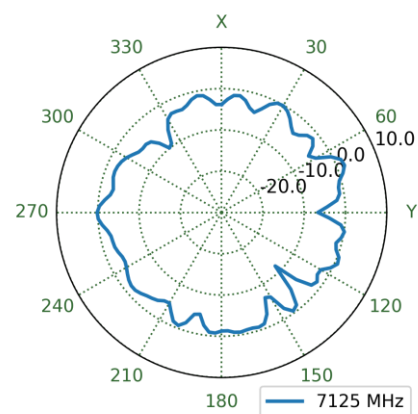
XZ Plane



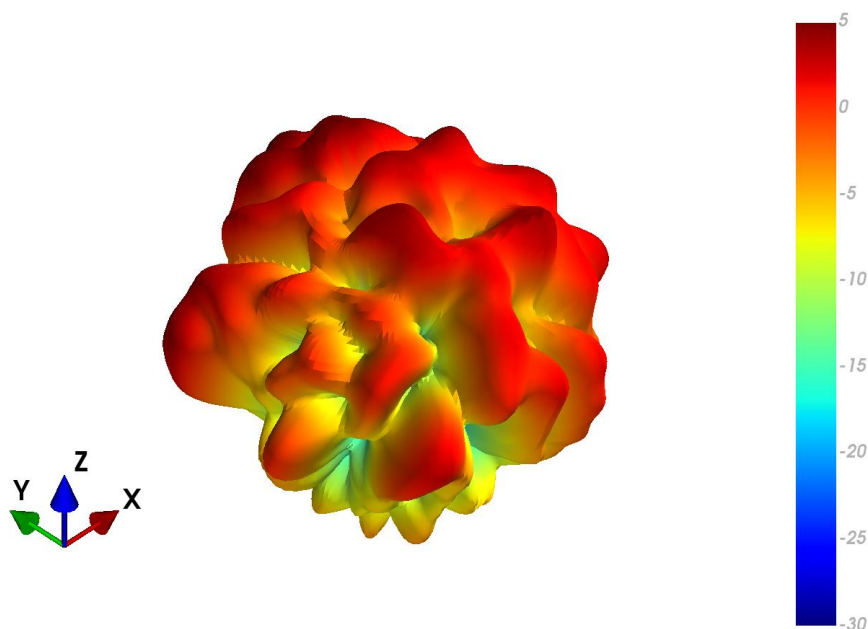
YZ Plane



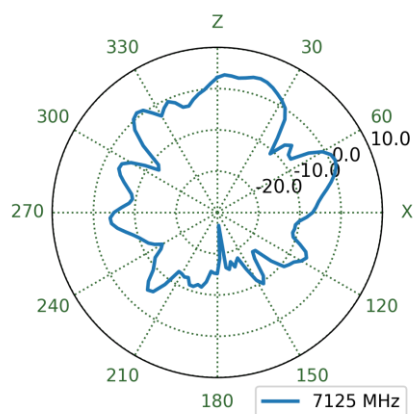
XY Plane



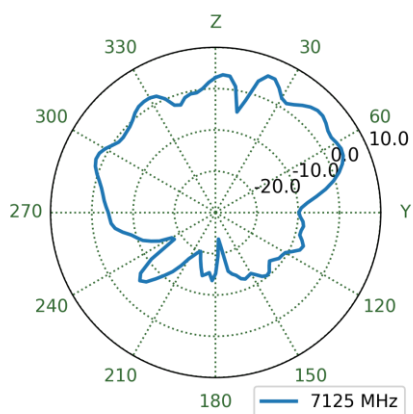
4.139 MIMO3 Wi-Fi Ground Plane Patterns at 7125 MHz



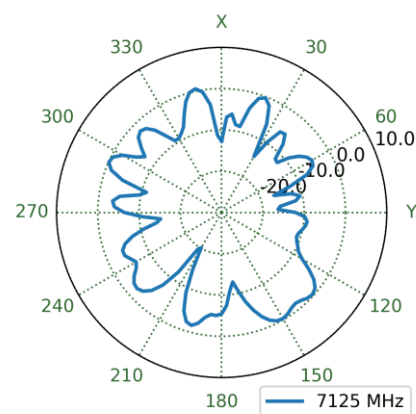
XZ Plane



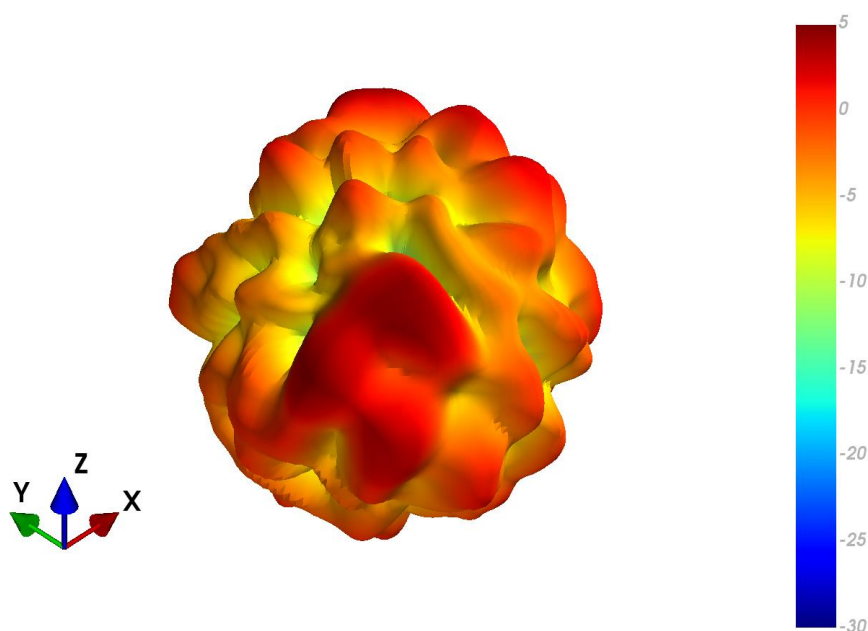
YZ Plane



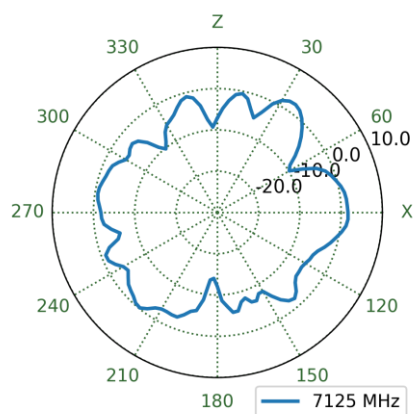
XY Plane



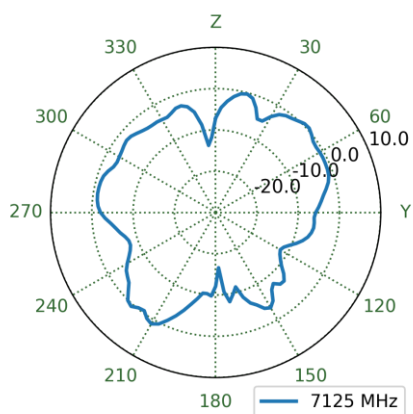
4.140 MIMO4 Wi-Fi Free Space Patterns at 7125 MHz



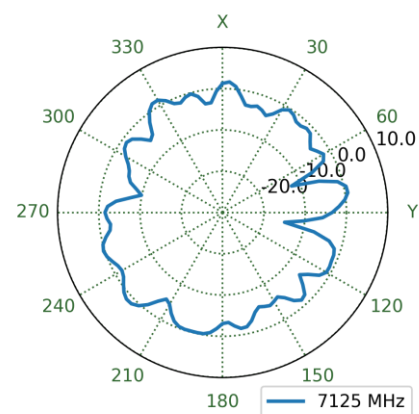
XZ Plane



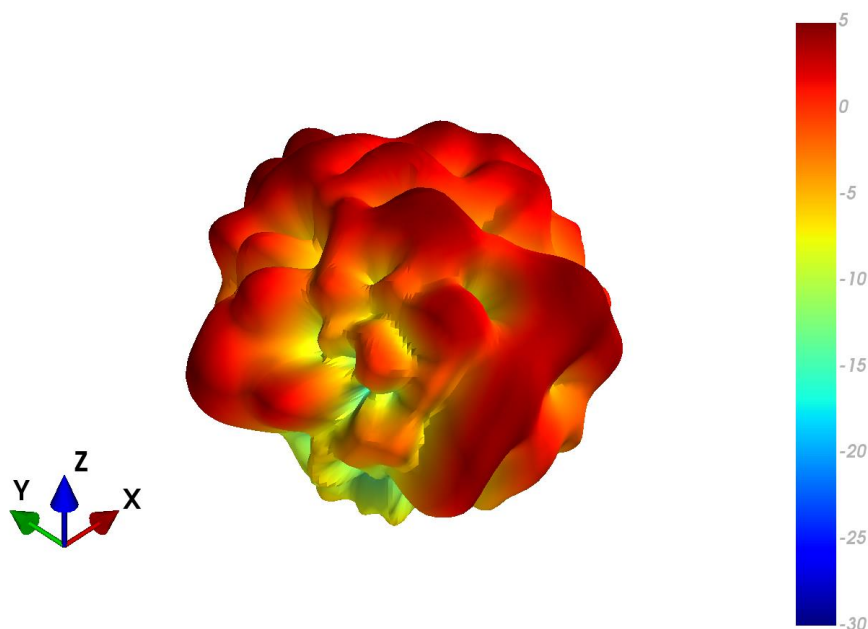
YZ Plane



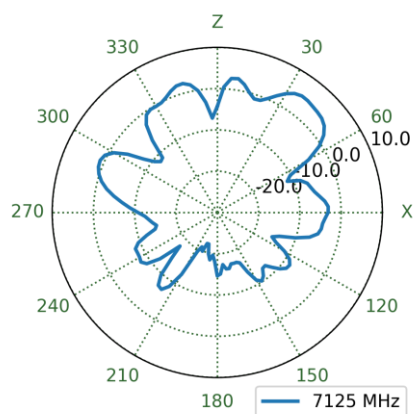
XY Plane



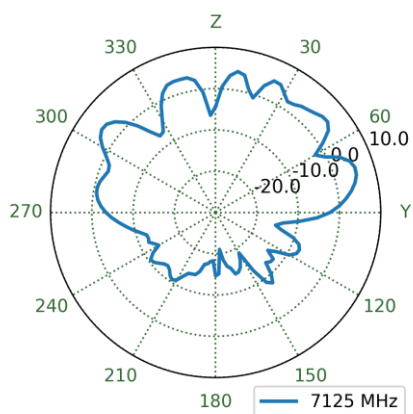
4.141 MIMO4 Wi-Fi Ground Plane Patterns at 7125 MHz



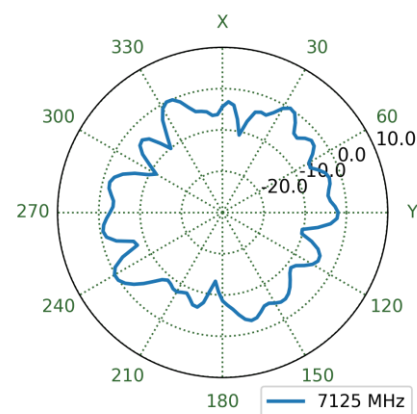
XZ Plane



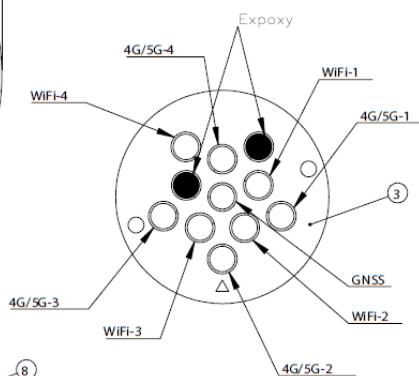
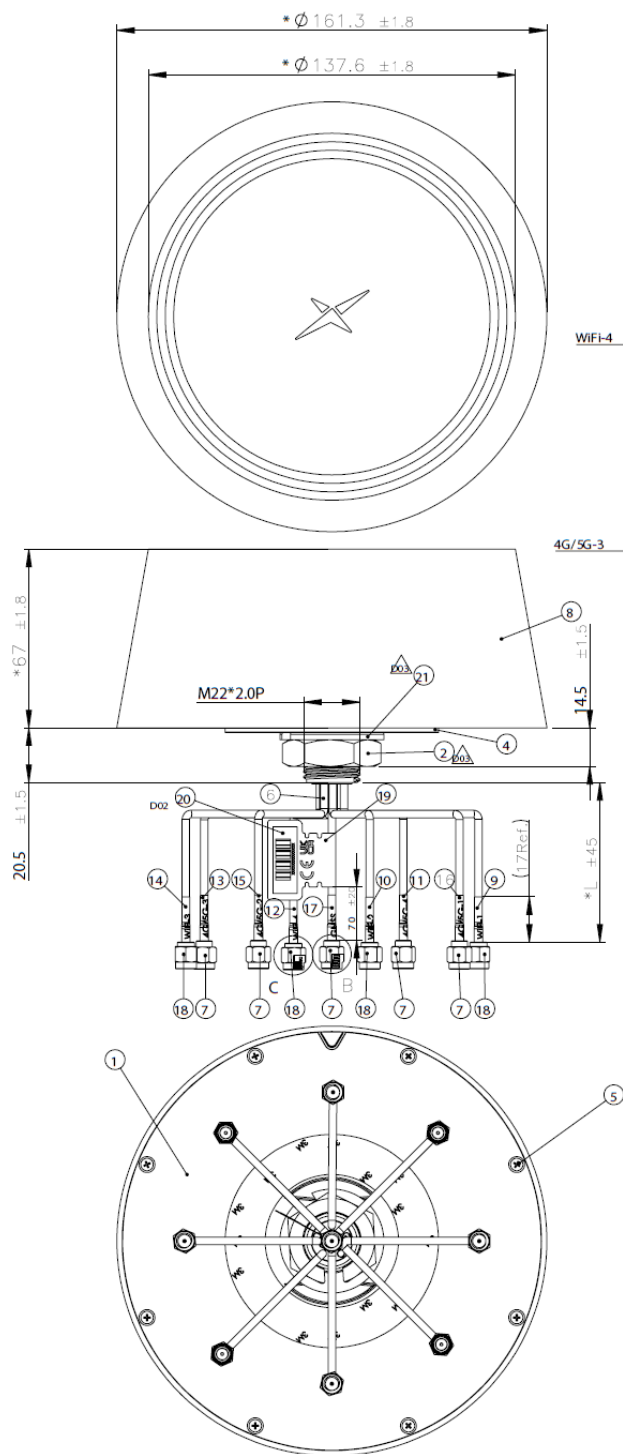
YZ Plane



XY Plane

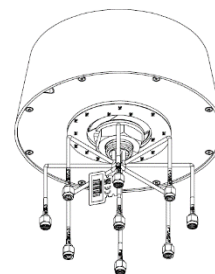


5. Mechanical Drawing

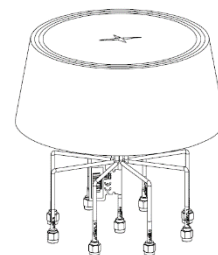


Cable allocation

| Cable length from base | |
|------------------------|-----|
| Cable P/N | L |
| 4G-5G-1 | 150 |
| 4G-5G-2 | 175 |
| 4G-5G-3 | 200 |
| 4G-5G-4 | 225 |
| WiFi-1 | 250 |
| WiFi-2 | 275 |
| WiFi-3 | 300 |
| WiFi-4 | 325 |
| GNSS | 350 |



DETAIL B
SCALE 2 : 1



DETAIL C
SCALE 2 : 1

| | Name | Material | Finish | QTY |
|----|----------------------------------|-----------------|------------------------|-----|
| 1 | Base Housing(Flat) | PC | Black | 1 |
| 2 | Nut Steel M22xP2.0xH10 | S45C | N/A | 1 |
| 3 | Cable Rubber | Silicone Rubber | Black | 1 |
| 4 | Double sided adhesive | E4308+3M 9448HK | Black | 1 |
| 5 | Countersunk screw M3*12 TP-1 | Carbon Steel | Zinc plating | 8 |
| 6 | RG174 Coaxial Cable_PVC_Black | PVC | N/A | 9 |
| 7 | SMA(M)ST for RG174/RG316 | Brass | AU PLATING | 5 |
| 8 | Top Housing _Black_Synergy X | PC | MT9050 | 1 |
| 9 | Heat Shrink Tube (Wi-Fi-1) | PE | Yellow Tube/Black Text | 1 |
| 10 | Heat Shrink Tube (Wi-Fi-2) | PE | Yellow Tube/Black Text | 1 |
| 11 | Heat Shrink Tube (4G/5G-4) | PE | Red Tube /White Text | 1 |
| 12 | Heat Shrink Tube (Wi-Fi-4) | PE | Yellow Tube/Black Text | 1 |
| 13 | Heat Shrink Tube (4G/5G-3) | PE | Red Tube /White Text | 1 |
| 14 | Heat Shrink Tube (Wi-Fi-3) | PE | Yellow Tube/Black Text | 1 |
| 15 | Heat Shrink Tube (4G/5G-2) | PE | Red Tube /White Text | 1 |
| 16 | Heat Shrink Tube (4G/5G-1) | PE | Red Tube /White Text | 1 |
| 17 | Heat Shrink Tube (GNSS) | PE | Blue Tube/White Text | 1 |
| 18 | SMA(M)ST_RP | Brass | AU PLATING | 4 |
| 19 | CE,WEEE and UKCA mark logo Label | PEPA | White/377C | 1 |
| 20 | Date code label | PET | White | 1 |
| 21 | Washer OD39xID24mmx3.0t | S45C | N/A | 1 |

6. Installation Instructions

A Introduction

The Taoglas Synergy X is an external permanent mount, combination antenna that can be provided with combinations of one active GNSS, four 5G/4G and 4 dual-band Wi-Fi antennas. The Synergy is available with an M22 threaded boss for surface mounting, along with 3M adhesive for added sealing. The Synergy X is ideal for vehicle panels of up to 6mm (0.23") thick with a threaded boss length of 20.5mm (0.81"). The Synergy X is IP67 rated and also includes an foam gasket to seal from any water ingress on the mounting surface.



Electrical Safety

The Synergy contains an active GPS/GNSS antenna.

Rated voltage: 3-5VDC Rated current: 20mA maximum

The supply to this device must be provided with overcurrent protection of 1A maximum.

Power consumption@1.8V (mA) 8.7 mA | Power consumption@3.0V (mA) 9.0 mA | Power consumption@5.5V (mA) 11 mA

B Mounting & Location

For prime performance, the Synergy X is recommended to be fitted on a metal panel. Optimum ground plane size is 300mm x 300mm (11.8" x 11.8"). When mounting on a vehicle roof panel ensure to mount on a flat surface, and measure for a central position. Care should be taken to mount the Synergy antenna as far as possible from other roof-mounted features such as the aircon unit, light bar etc.



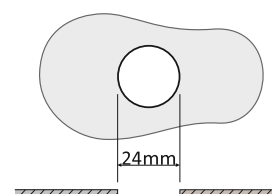
Sealing

In order to ensure that the installation is properly sealed against the mounting surface care must be taken regarding curvature of the mounting panel. It is highly recommended to install the antenna on a clean, flat and level surface. After installation the compression of the foam gasket and adhesive against the mounting panel should be checked and a small bead of neutral cure silicone sealant can be applied around the periphery of the enclosure if required.

C Surface Preparation

When preparing to drill the hole, mask the area around the hole position to protect the surface. Drill a pilot hole and increase the hole size to $\varnothing 24\text{mm}$ ($\frac{1}{2}$ "). Ensure the drill bit does not contact the headliner. Deburr and clean the area around the hole carefully removing all waste.

Remove paint and primer from under panel surface to ensure adequate earth contact by washer and nut. Apply petroleum jelly or paint around cut edge of the hole to prevent corrosion



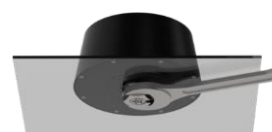
D Adhesive Patch

On the underside of the antenna there is a 3M adhesive foam gasket. Peel away the 3M adhesive protection and feed the cables through the hole. Position the antenna over the hole and press down onto the panel with pressure. This adhesion will make ensure will be securely mounted and will also allow for extremely minimal curvature on the roof of a vehicle.



E Securing the Mount

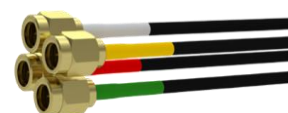
A split nut is used to easily fit onto the thread through the cables. The nut is attached from the underside of the panel, it should easily twist onto the thread and then secured in place with a final tighten with a spanner. After tightening, double check the antenna to make sure that it is properly secured.



| Torque Values | kgf-cm | N-m |
|---------------|--------|-----------|
| Plastic Nut | 85 ±5 | 8.3 ±0.5 |
| Metal Nut | 180 ±5 | 17.6 ±0.5 |

F Cable Routing and Connection

The pigtail cables supplied are RG-174 for all feeds. The heatshrink will denote which cable is which for ease of installation. Connect each individual connector to the correct port of the router, if any cable is unused please fit a 50Ω terminator to the individual connection.



G Notices



Caution

To comply with FCC RF Exposure requirements in section 1.1310 of the FCC Rules, antennas used with this device must be installed to provide a separation distance of at least 20 cm from all persons to satisfy RF exposure compliance.



Warning

Do not operate the equipment in an explosive atmosphere.



European Waste Electronic Equipment Directive 2012/19/EU

Please ensure that your old Waste Electricals and Electronics are recycled do not throw them away into standard waste.



Hazardous Substances Directive (RoHS) 2011/65/EU / 2015/863/EU Directive 2014/53/EU Radio Equipment Directive (RED)

View CE Certificate online:

<https://www.taoglas.com/wp-content/uploads/pdf/CE-Declaration-of-Conformity-RED-RoHS-MA15XX-Synergy-Series.pdf>

Harmonised Standards and References:

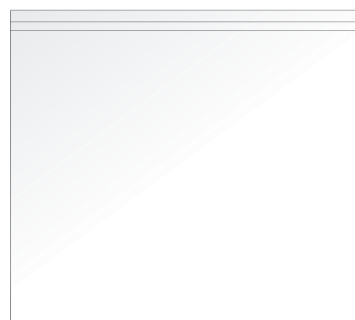
EN 301 489-1 (V2.2.1): ElectroMagnetic Compatibility (EMC) standard for radio equipment and services;
Part 1: Common technical requirements. Referencing CENELEC EN 55032 Class B.

Waiver: This document represents information compiled by Taoglas to the best of our current knowledge. This is not intended to be used as a representation or warranty of fitness of the products described for any particular purpose. This document details guidelines for general information purposes only. When planning installations, always seek specialist advice and ensure that the products are always installed by a properly qualified installer in accordance with applicable regional laws and regulations.
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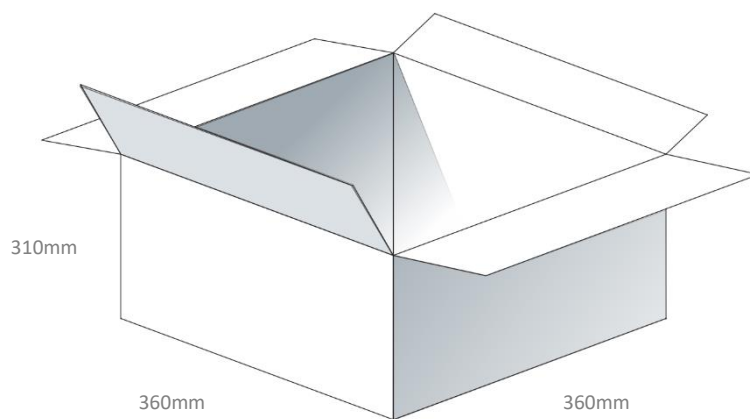
7. Packaging



1pc MA1559.A.001 per PE Bag
Weight: 535g



8pcs MA1559.A.001 per Carton
Carton Dimensions: 360*360*310mm
Weight: 4.5Kg



Changelog for the datasheet

SPE-22-8-161 - MA1559.A.001

| Revision: C (Current Version) | |
|-------------------------------|-----------------------------------|
| Date: | 2023-05-15 |
| Notes: | Updated Installation Instructions |
| Author: | Cesar Sousa |

Previous Revisions

| Revision: A | |
|-------------|------------------------|
| Date: | 2023-02-03 |
| Notes: | Updated specifications |
| Author: | Cesar Sousa |

| Revision: A (Original First Release) | |
|--------------------------------------|-----------------------|
| Date: | 2022-10-12 |
| Notes: | First initial Release |
| Author: | Gary West |



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