



# TAOGLAS®



# Datasheet

## 2-in-1 Ultima

**Part No:**  
MA111.C.LB.001

### **Description:**

MA111 Ultima Series – 2-in-1 Super Low-Profile Combination  
GPS/GLONASS/BeiDou/Galileo and Cellular Permanent Mount Antenna

### **Features:**

Height: 19.6mm (0.77")  
Diameter: 55mm (2.17")  
Heavy duty Permanent Mount  
UV and vandal resistant ABS housing and thread  
IP67 Rated Waterproof  
Cable: 3m RG-174 GNSS, 3m CFD-200 Cellular  
Connector: SMA(M)ST  
RoHS & Reach Compliant

|    |                                |    |
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## 1. Introduction



The MA111 Ultima Series 2-in-1 GPS/GLONASS/BeiDou/Galileo & Cellular Combination Antenna is an extremely low-profile combination high performance GPS/GLONASS/BeiDou/Galileo and cellular antenna solution for professional telematics applications. At only 22 mm height it is one of the lowest profile antennas in the market, with a diameter of 55 mm. It is designed to be mounted and couple to the metal structures it attaches to radiate. Durable UV ABS housing, thread and nut is resistant to vandalism and direct attack.

Typical Applications Include:

- Asset Tracking
- Digital Signage
- Smart Metering

The IP67 waterproof robust plastic body makes it extremely light, economical for shipping and minimum weight impact on vehicles. This also makes it ideal for use in humid environments such as water pits or marine applications as there are no external metal parts to corrode. The closed cell foam with double-sided adhesive provides a permanent waterproof seal and can adjust to different curvatures, stopping water from leaking under the antenna into the mounting hole.

For applications that require mounting on non-metal structures we recommend the Hercules MA105. The cables and connectors are fully customizable, contact your regional Taoglas Customer support teams for more information.

## 2. Specifications

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

| GNSS Electrical      |        |         |       |
|----------------------|--------|---------|-------|
| Frequency (MHz)      | 1561   | 1575.42 | 1602  |
| Efficiency (%)       |        |         |       |
| Free space           | 48.3   | 56.2    | 42.6  |
| 30x30cm Ground plane | 44.7   | 55.7    | 61.5  |
| Average Gain (dB)    |        |         |       |
| Free space           | -3.16  | -2.50   | -3.71 |
| 30x30cm Ground plane | -3.49  | -2.54   | -2.11 |
| Peak Gain (dBi)      |        |         |       |
| Free space           | 1.08   | 1.88    | 1.05  |
| 30x30cm Ground plane | 1.32   | 2.56    | 4.13  |
| Polarization         | RHCP   |         |       |
| Impedance            | 50Ω    |         |       |
| Return Loss          | <-10dB |         |       |

| LNA and Filter Electrical Properties |         |         |         |
|--------------------------------------|---------|---------|---------|
| Frequency (MHz)                      | 1561    | 1575.42 | 1602    |
| Gain@1.8V (Typ.)                     | 22.23dB | 21.65dB | 18.85dB |
| Gain@3.0V (Typ.)                     | 30.11dB | 32.39dB | 28.37dB |
| Gain@5.5V (Typ.)                     | 34.87dB | 39.07dB | 33.09dB |
| Noise@1.8V (Typ.)                    | 1.83dB  | 1.85dB  | 1.99dB  |
| Noise@3.0V (Typ.)                    | 1.5dB   | 1.49dB  | 1.5dB   |
| Noise@5.5V (Typ.)                    | 1.66dB  | 1.61dB  | 1.62dB  |
| Current@1.8V(mA)                     | 4.88mA  |         |         |
| Current@3.0V(mA)                     | 10.84mA |         |         |
| Current@5.5V(mA)                     | 22.83mA |         |         |

| Cellular Antenna     |                  |          |             |            |            |            |            |            |                       |                     |       |
|----------------------|------------------|----------|-------------|------------|------------|------------|------------|------------|-----------------------|---------------------|-------|
| Frequency (MHz)      |                  |          |             |            |            |            |            |            |                       |                     |       |
|                      | 5G NR Band 71    | LTE700   | GSM 850/900 | 5G NR Band | DCS        | PCS        | UMTS1      | LTE2600    | 5G NR Band 77, 78, 79 | LTE5200/ Wi-Fi 5800 |       |
|                      | 617 ~698         | 698 ~806 | 824 ~960    | 1427 ~1518 | 1710 ~1880 | 1850 ~1990 | 1920 ~2170 | 2490 ~2690 | 3300 ~3500            | 5150 ~5925          |       |
| Efficiency (%)       |                  |          |             |            |            |            |            |            |                       |                     |       |
| Free Space           | 3m               | 9.6      | 10.9        | 21.2       | 13.0       | 49.9       | 47.9       | 40.7       | 14.8                  | 28.6                | 26.9  |
| 30x30cm Ground Plane | 3m               | 2.0      | 29.3        | 51.0       | 10.1       | 36.6       | 37.4       | 29.2       | 11.7                  | 25.5                | 20.4  |
| Average Gain (dB)    |                  |          |             |            |            |            |            |            |                       |                     |       |
| Free Space           | 3m               | -10.18   | -9.63       | -6.73      | -8.87      | -3.02      | -3.20      | -3.90      | -8.29                 | -5.44               | -5.70 |
| 30x30cm Ground Plane | 3m               | -16.91   | -5.33       | -2.92      | -9.95      | -4.36      | -4.27      | -5.35      | -9.34                 | -5.94               | -6.91 |
| Peak Gain (dBi)      |                  |          |             |            |            |            |            |            |                       |                     |       |
| Free Space           | 3m               | -5.83    | -5.41       | -1.66      | -3.70      | 2.20       | 2.40       | 1.56       | -3.06                 | 1.10                | -0.44 |
| 30x30cm Ground Plane | 3m               | -10.81   | -0.09       | 2.93       | -1.42      | 2.73       | 4.01       | 3.33       | -2.18                 | 0.60                | 0.11  |
| Impedance            | 50Ω              |          |             |            |            |            |            |            |                       |                     |       |
| Polarization         | Linear           |          |             |            |            |            |            |            |                       |                     |       |
| Radiation Pattern    | Omni-Directional |          |             |            |            |            |            |            |                       |                     |       |

| Mechanical        |                                                      |
|-------------------|------------------------------------------------------|
| Dimensions        | Diameter: 55mm, Height: 30mm                         |
| Cable type        | Cellular: CFD-200 GPS/GLONASS/BeiDou/Galileo: RG-174 |
| Cable length      | 3000mm                                               |
| Casing            | ABS                                                  |
| Connector         | SMA Male                                             |
| Thread Diameter   | M24                                                  |
| Weight            | 0.21Kg                                               |
| Environmental     |                                                      |
| Temperature Range | -40°C to 85°C                                        |
| Waterproof        | IP67                                                 |
| Thermal Shock     | 100 cycles -40°C to +80°C                            |
| Shock (drop test) | 1m drop on concrete 6 axes                           |
| Humidity          | Non-condensing 65°C 95% RH                           |

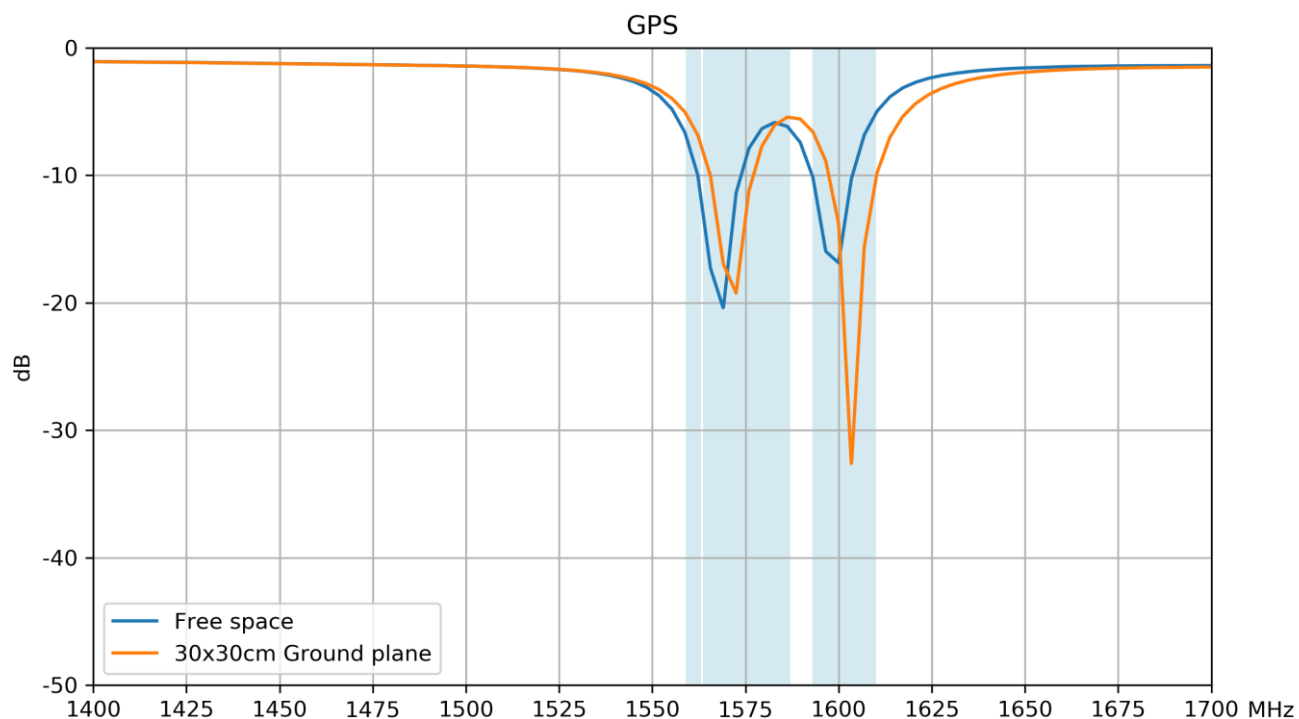
| 5G/4G Bands |                                                                    |                      |         |
|-------------|--------------------------------------------------------------------|----------------------|---------|
| Band Number | 5G NR / FR1 / LTE / LTE-Advanced / WCDMA / HSPA /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

\*Tested on 30\*30cm Ground Plane

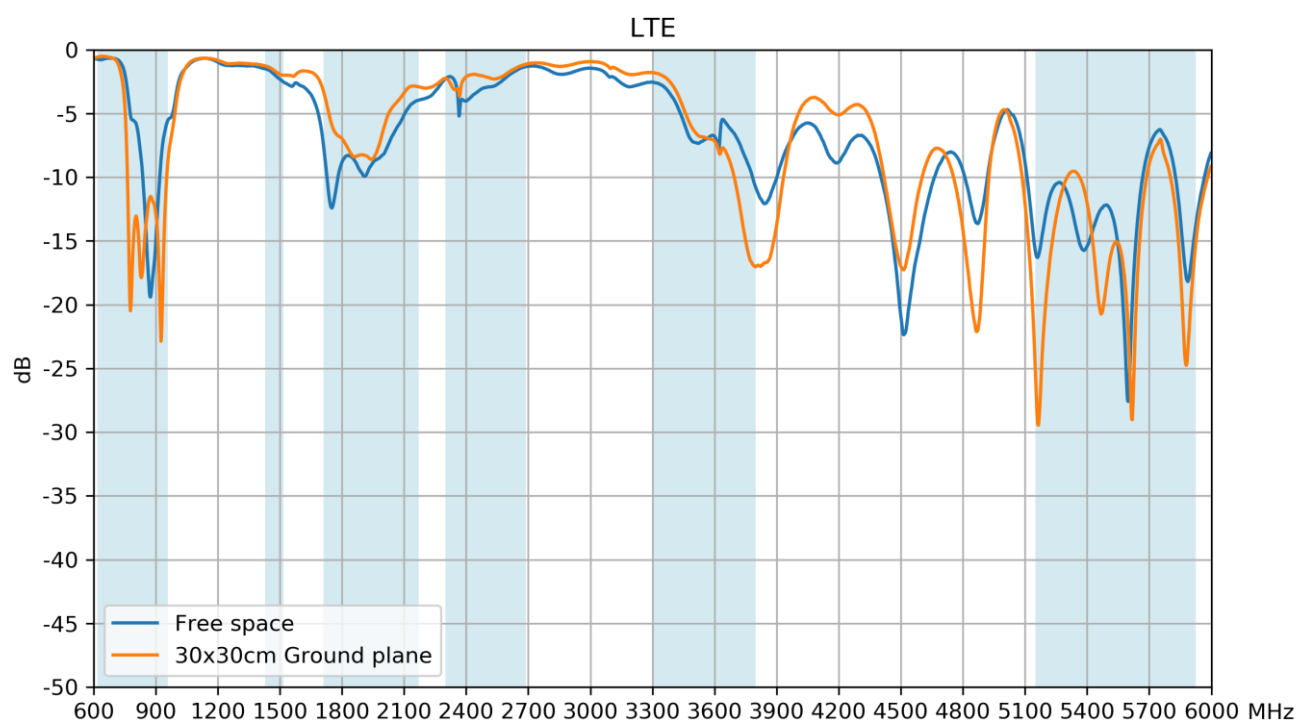
\*\*Covered bands represent greater than 20% Efficiency

## 3. Antenna Characteristics

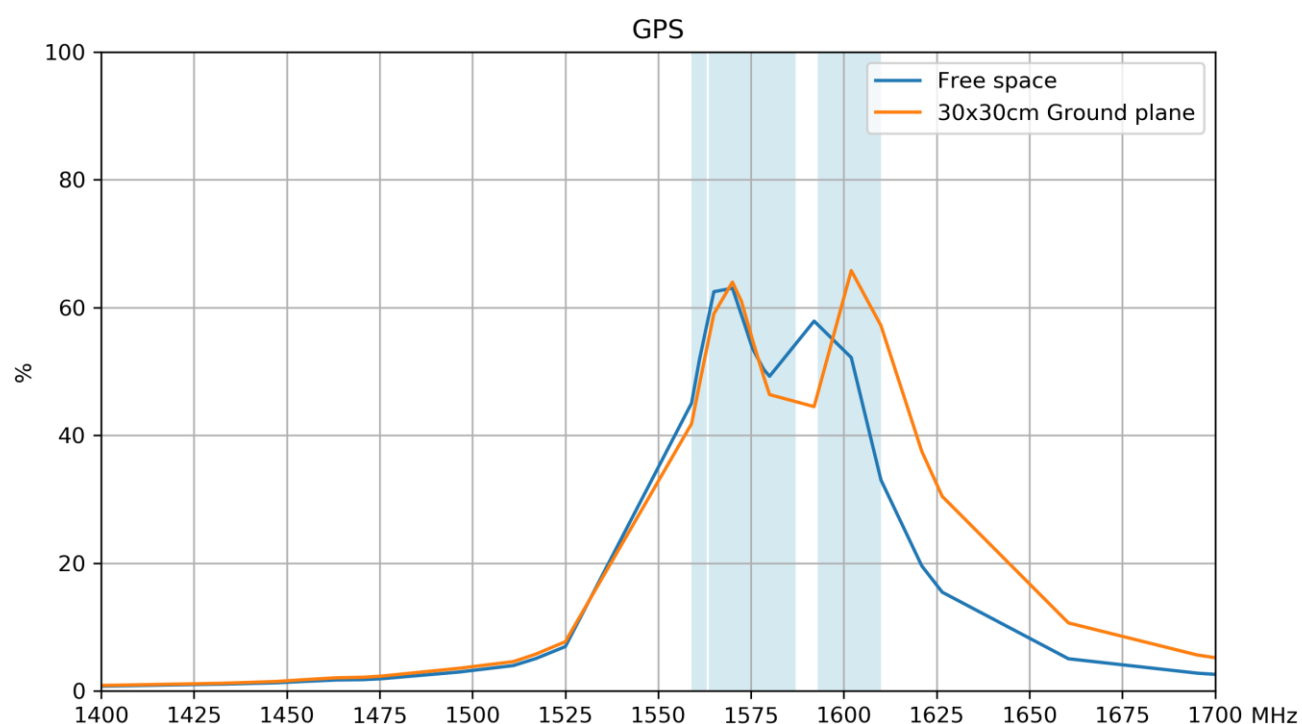
### 3.1 Return Loss – GNSS



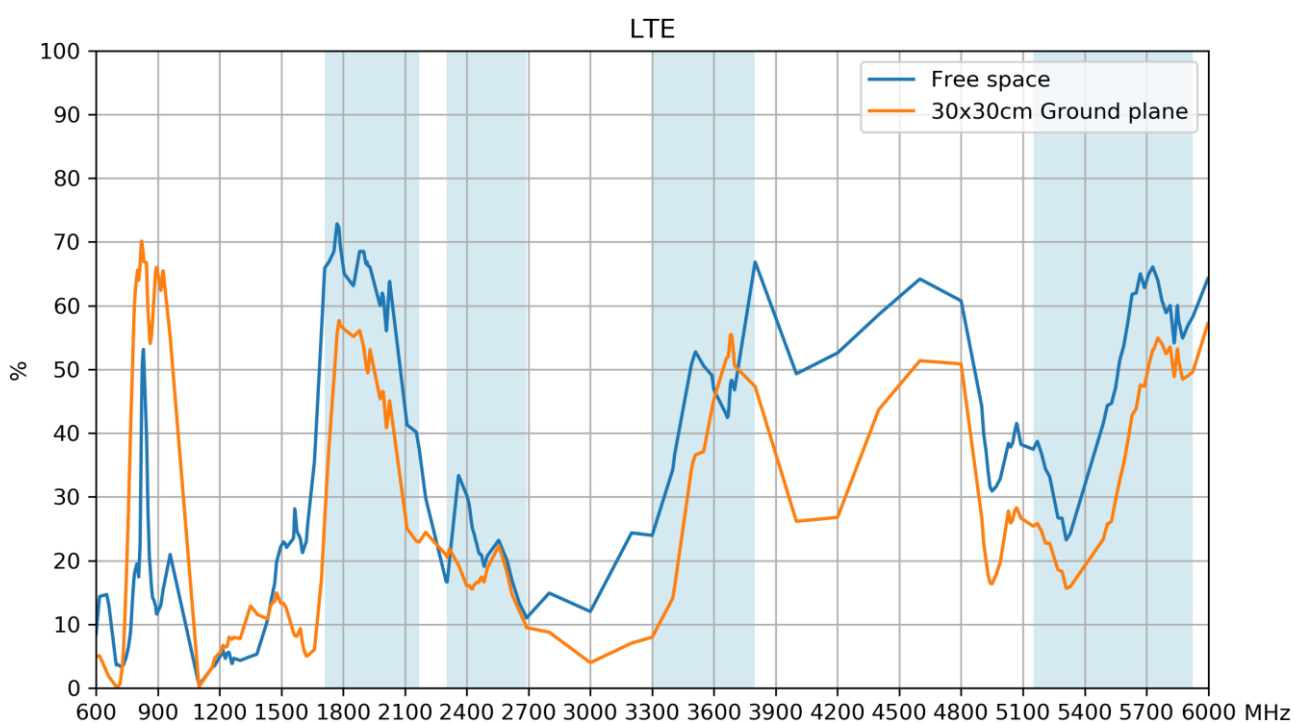
### 3.2 Return Loss – Cellular



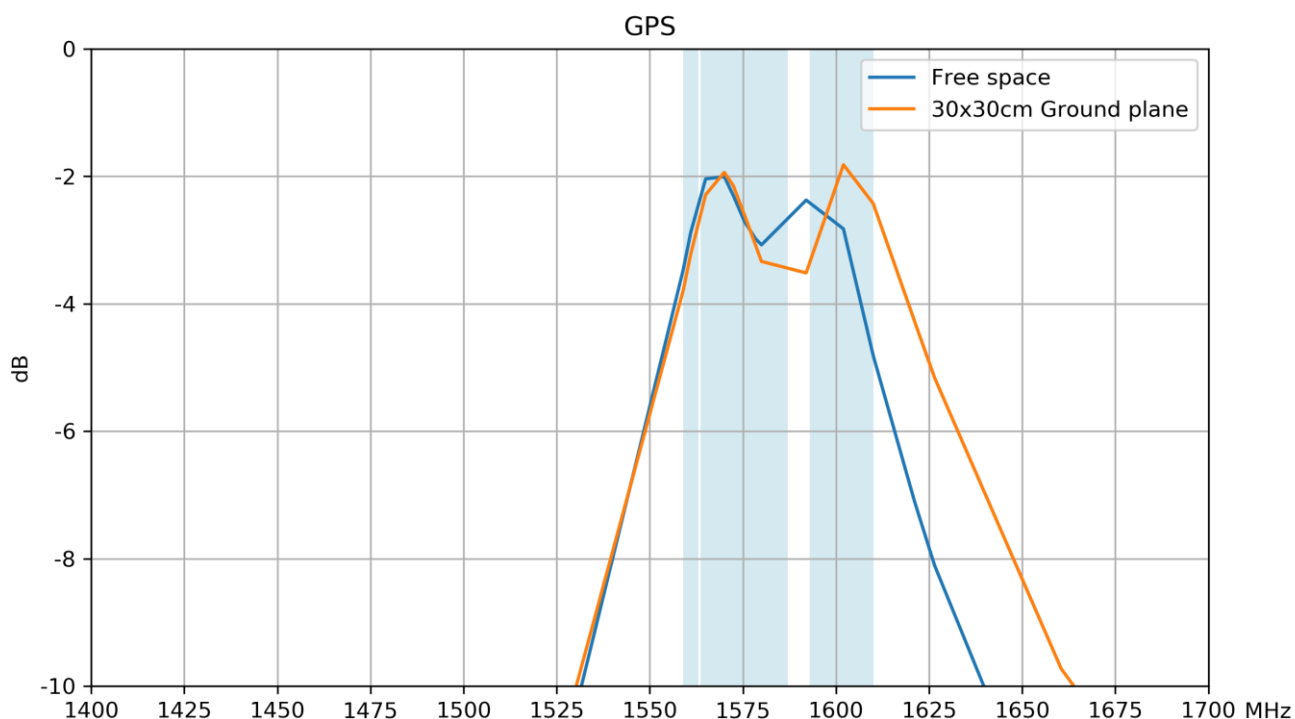
### 3.3 Efficiency – GNSS



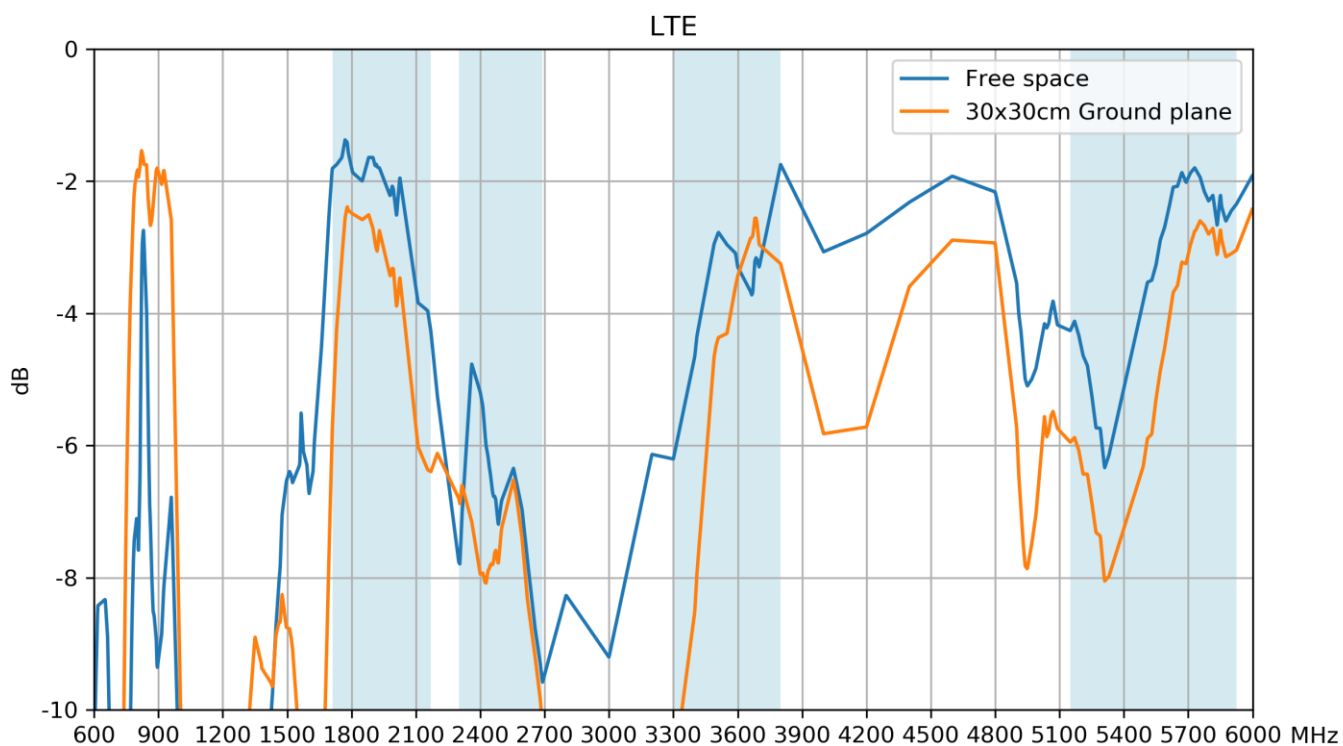
### 3.4 Efficiency – Cellular



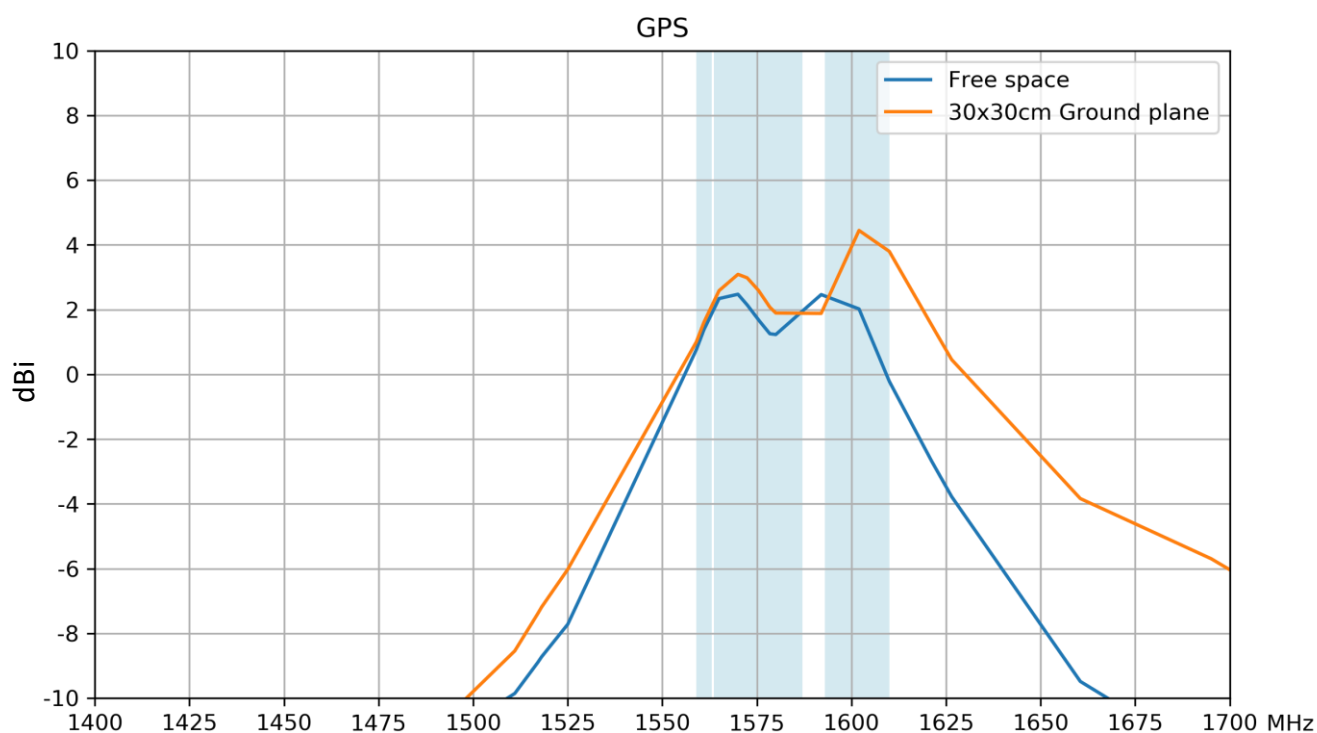
### 3.5 Average Gain – GNSS



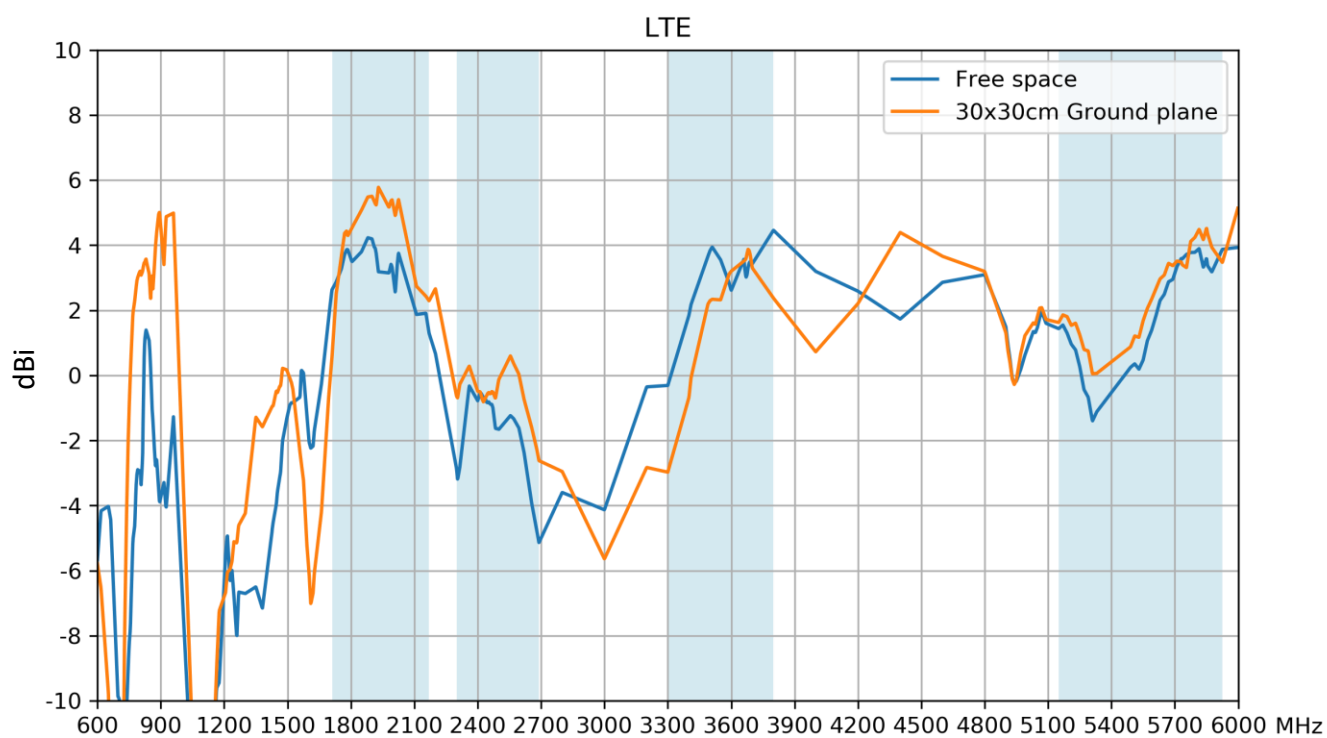
### 3.6 Average Gain – Cellular



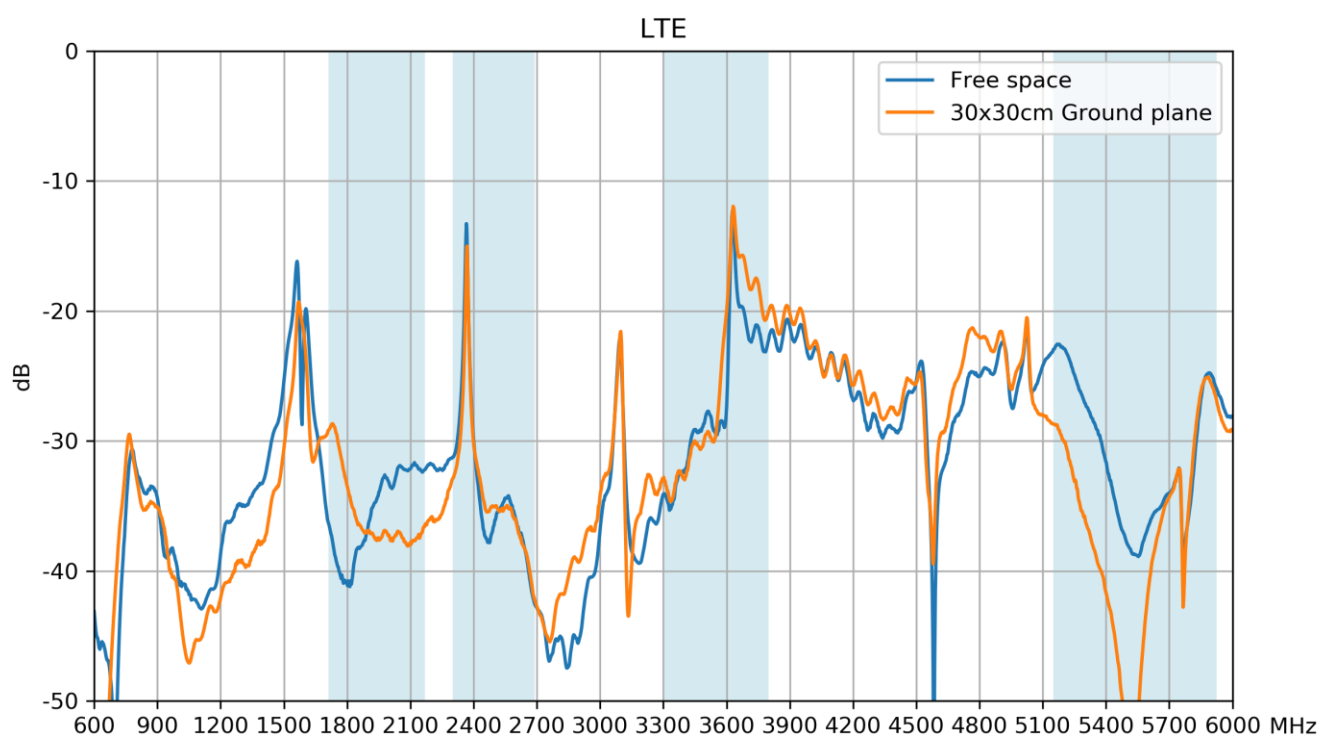
### 3.7 Peak Gain – GNSS



### 3.8 Peak Gain – Cellular

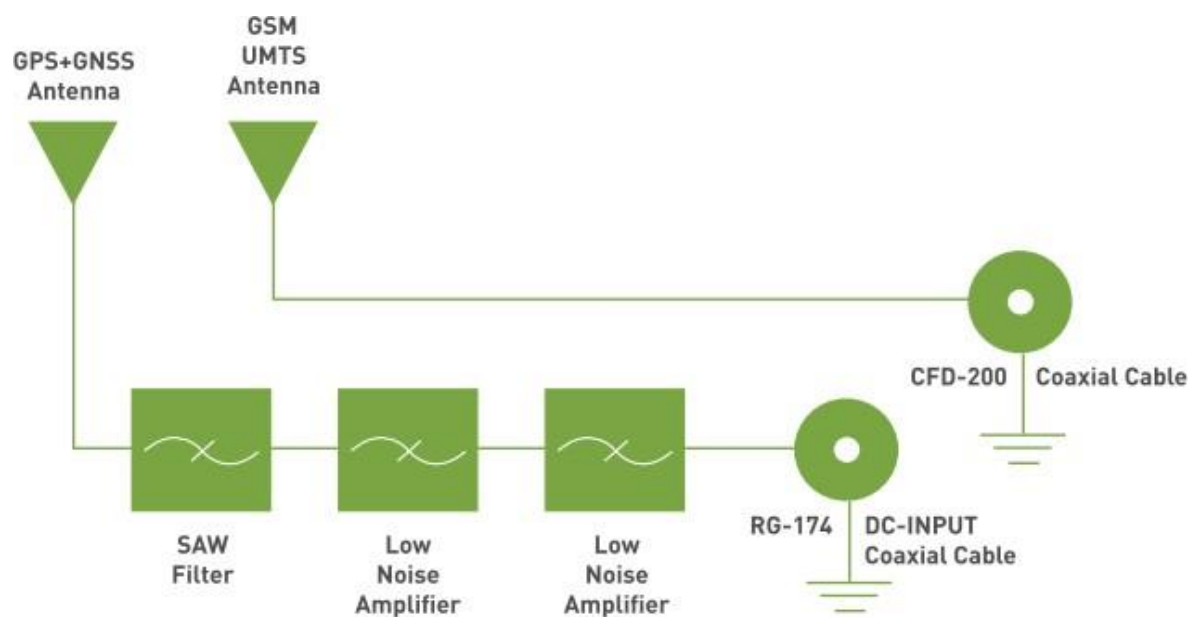


### 3.9 Isolation

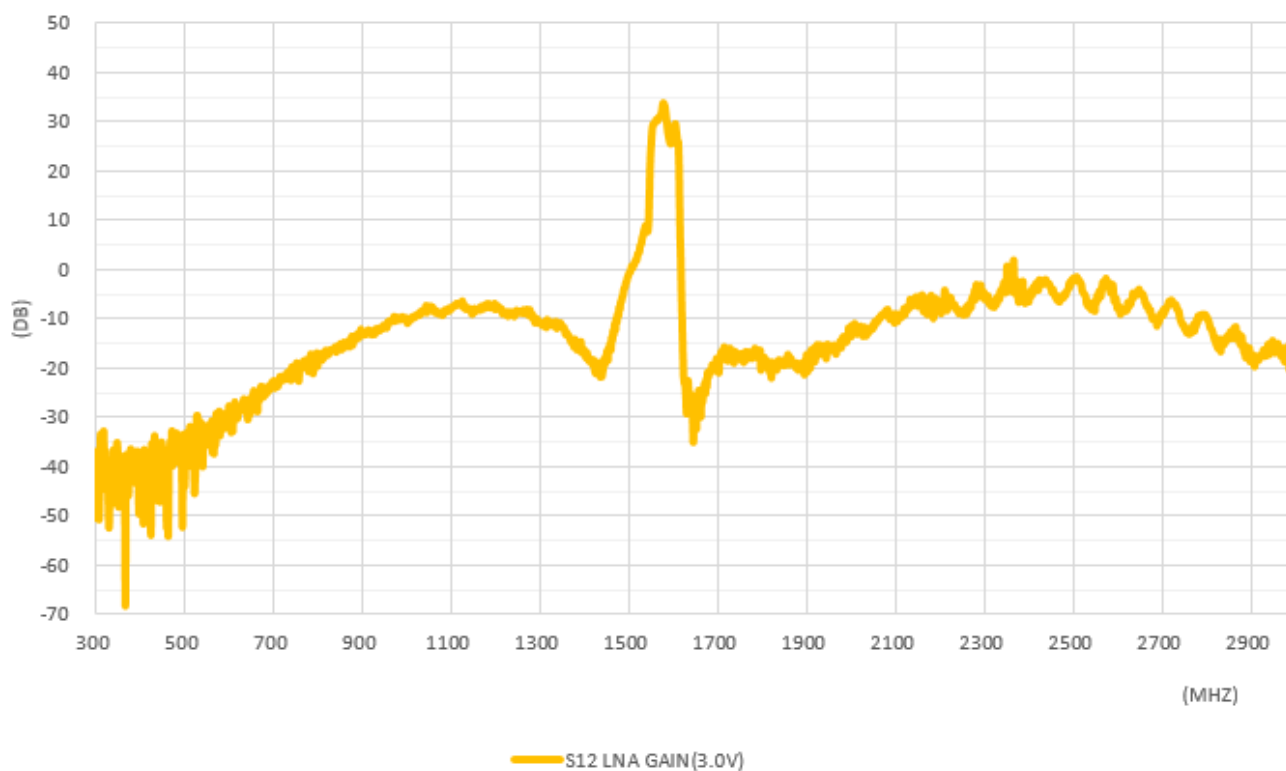


## 4. Active Antenna Characteristics

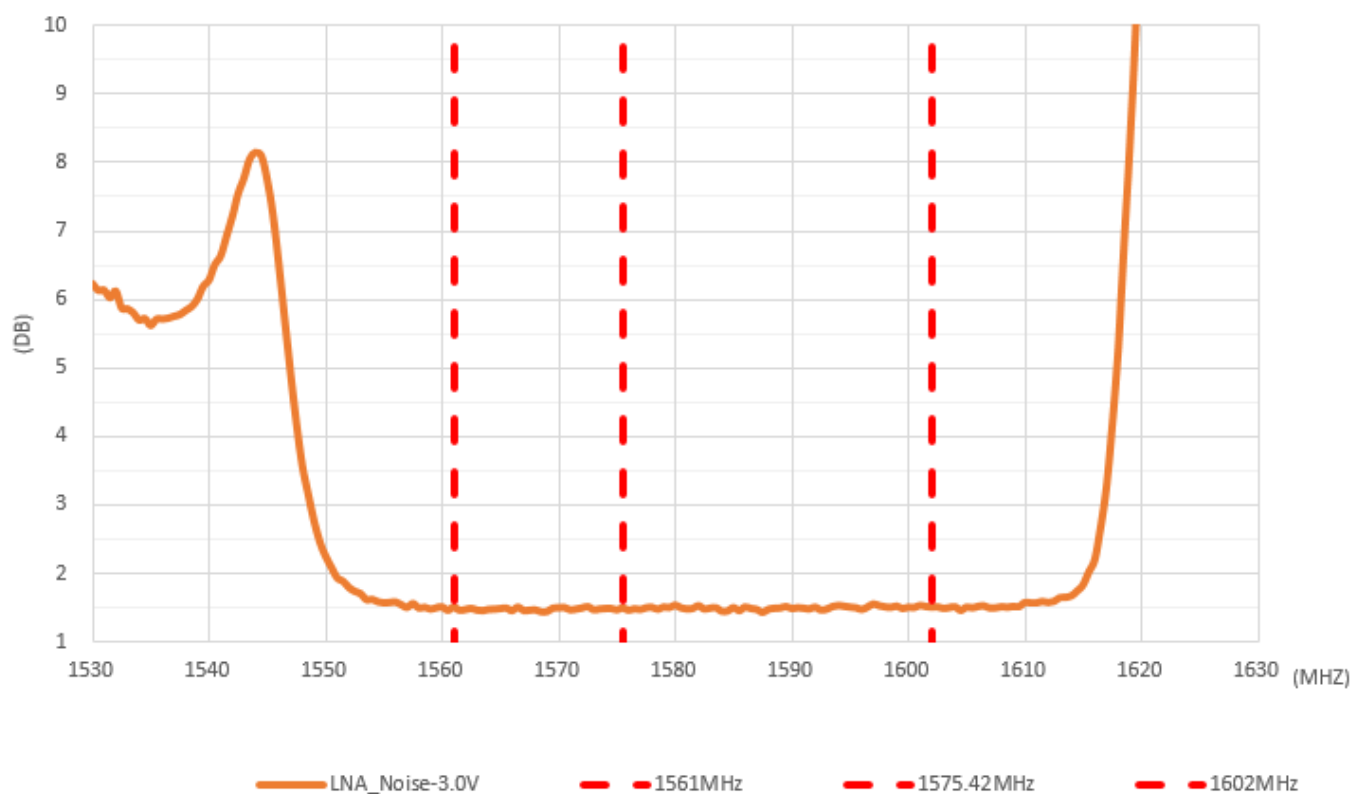
### 4.1 Block Diagram



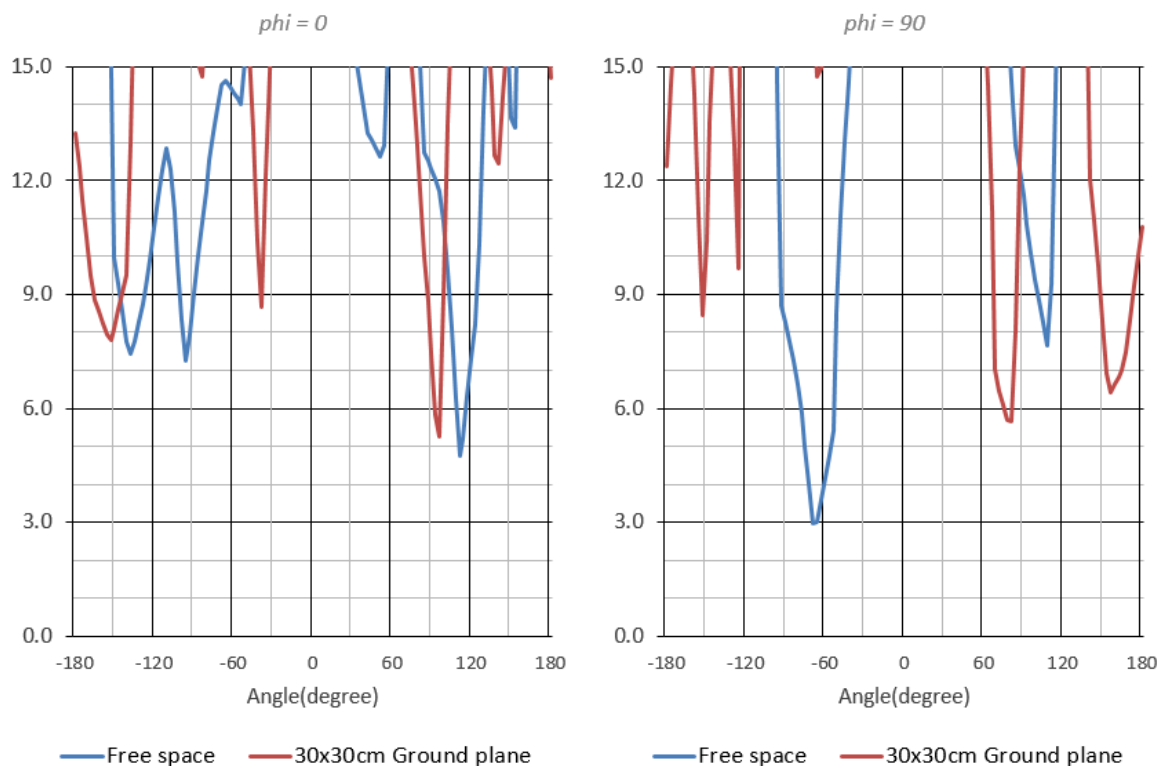
## 4.2 Block Diagram



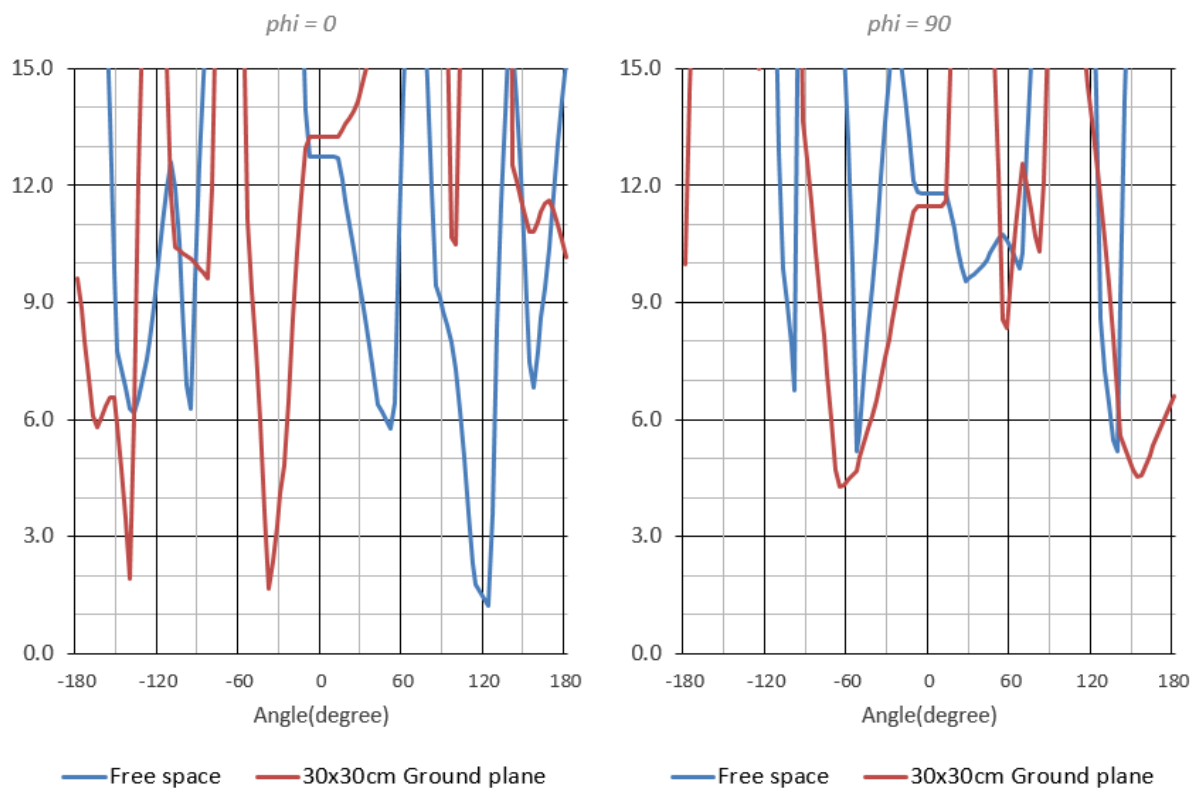
## 4.3 LNA Gain and Noise Figure @ 3.0V



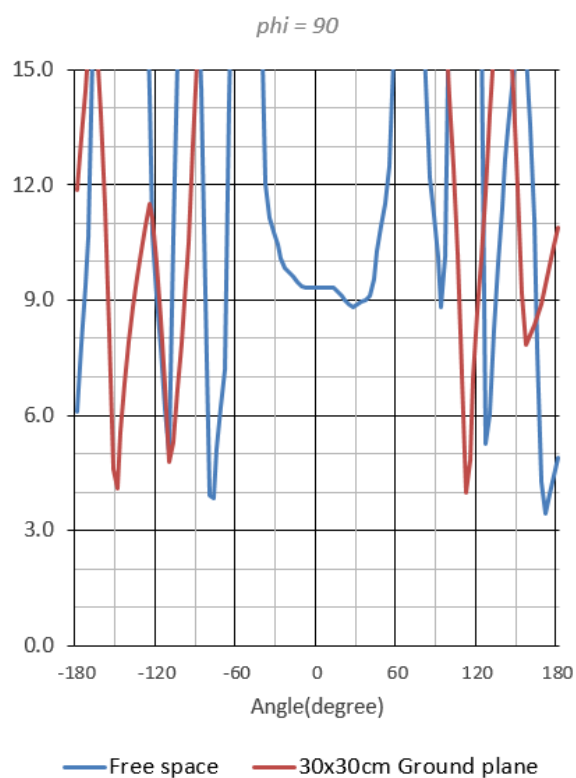
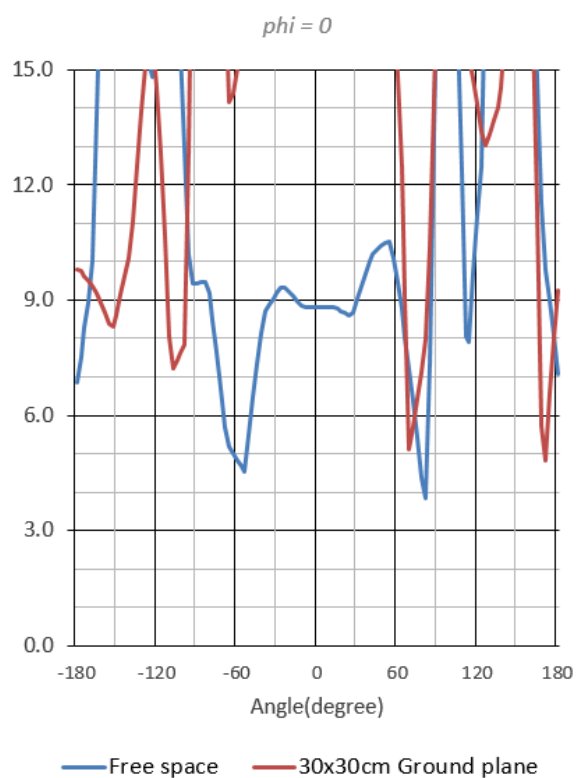
## 4.4 Axial Ratio – BeiDou



## 4.5 Axial Ratio – GPS/Galileo

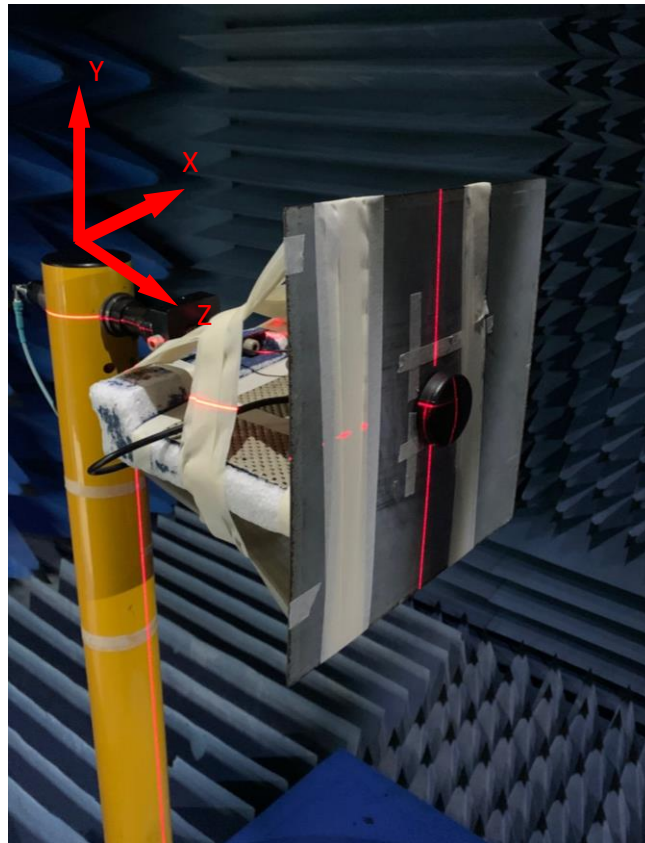


## 4.6 Axial Ratio – GLONASS



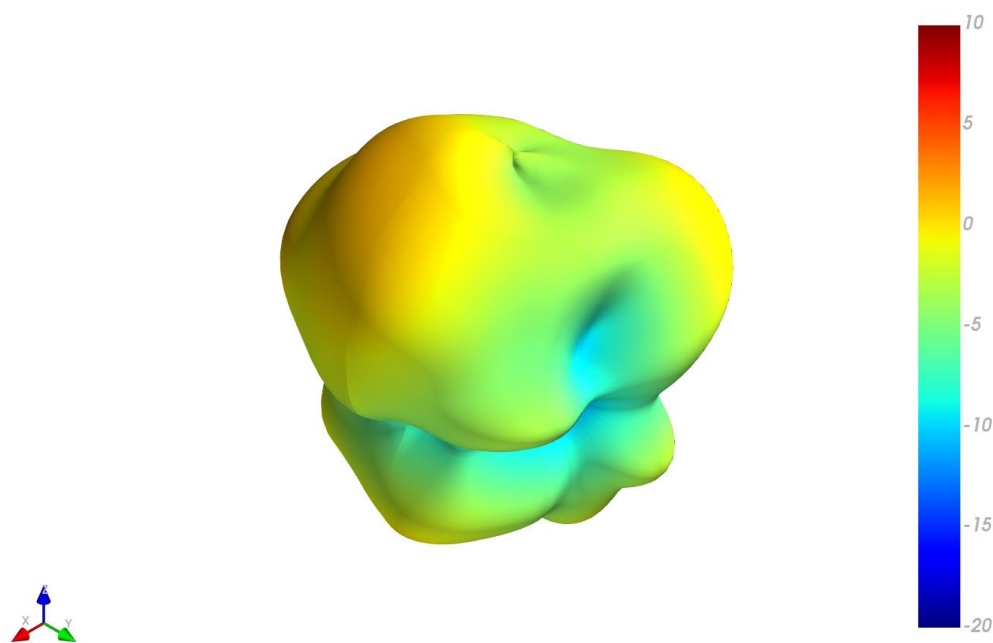
## 5. Radiation Patterns

### 5.1 Test Setup – 30\*30cm Ground Plane

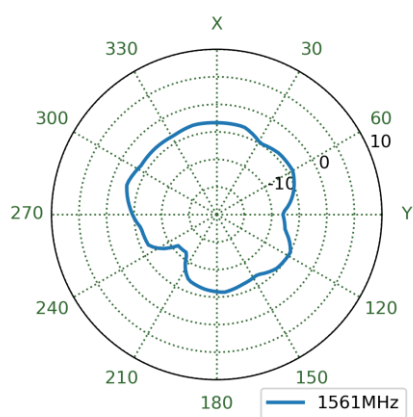


## 5.2 GNSS 3D and 2D Radiation Patterns – 30\*30cm Ground Plane

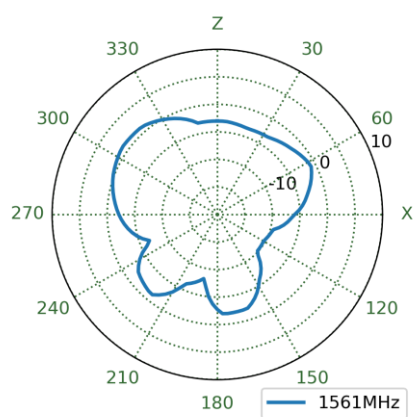
1561MHz



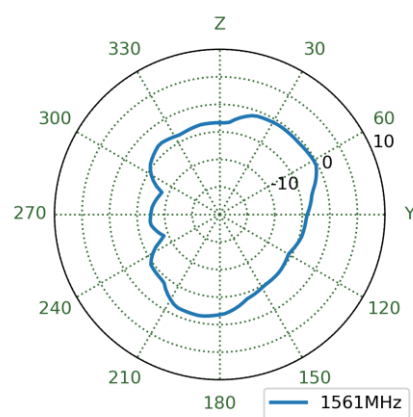
XY Plane



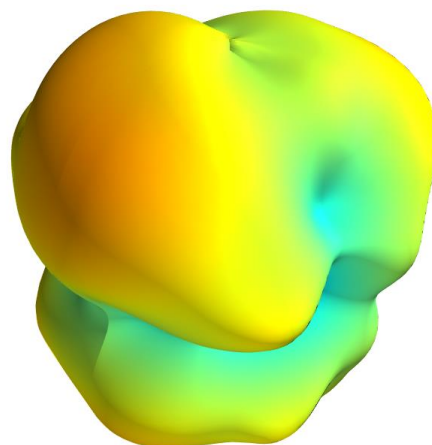
XZ Plane



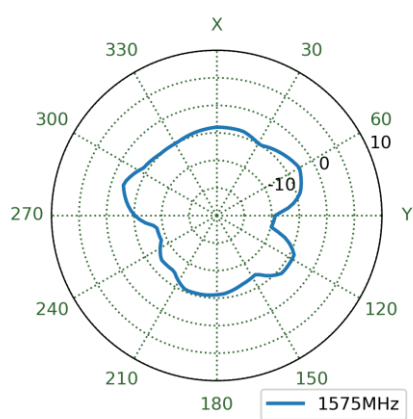
YZ Plane



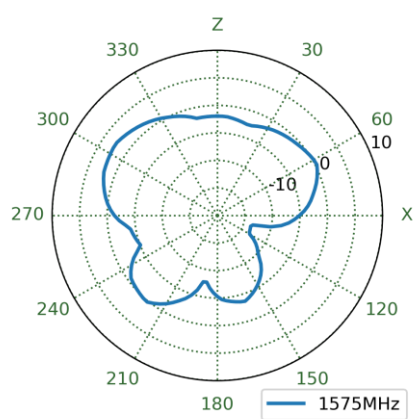
1575.42MHz



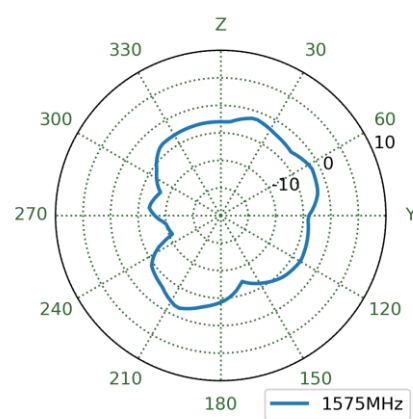
XY Plane



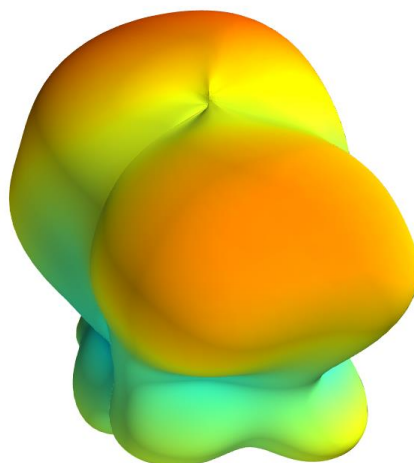
XZ Plane



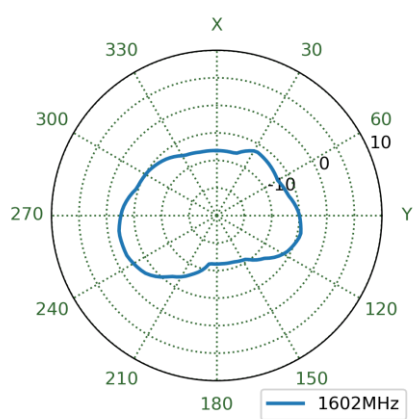
YZ Plane



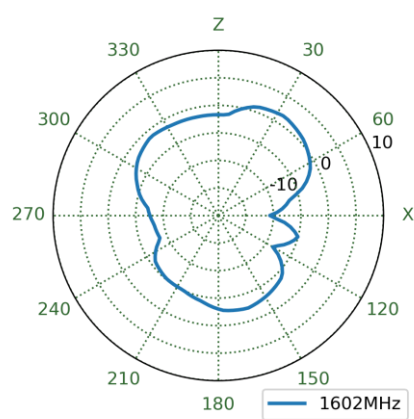
1602MHz



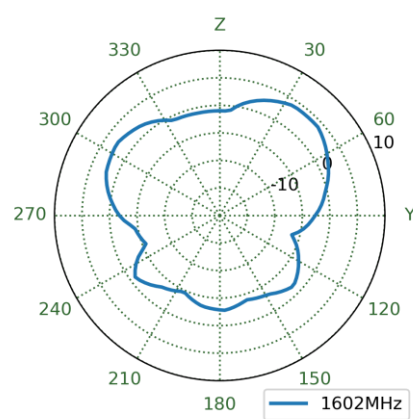
XY Plane



XZ Plane

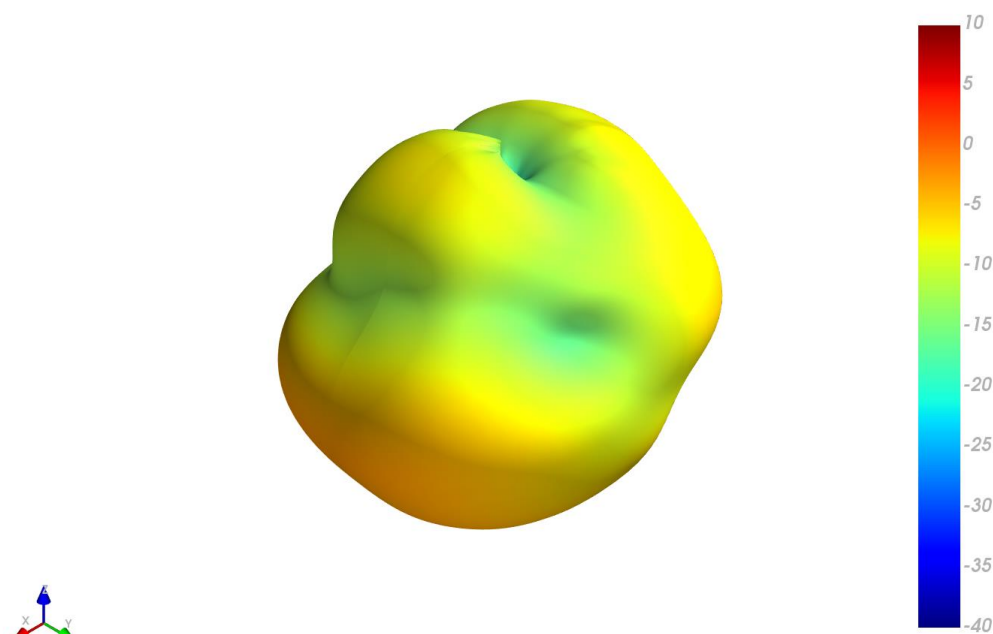


YZ Plane

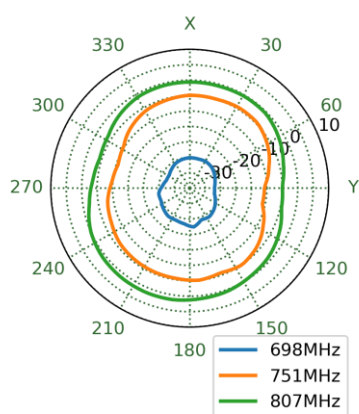


## 5.3 Cellular 3D and 2D Radiation Patterns – 30\*30cm Ground Plane

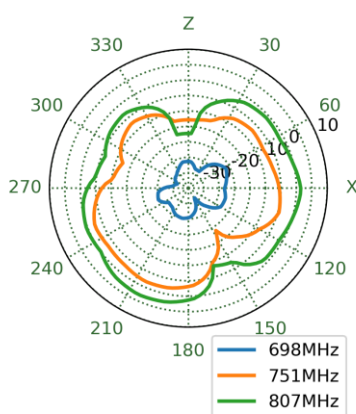
751MHz



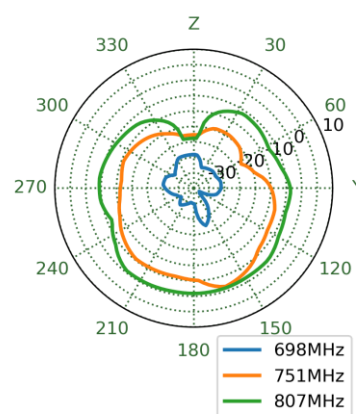
XY Plane



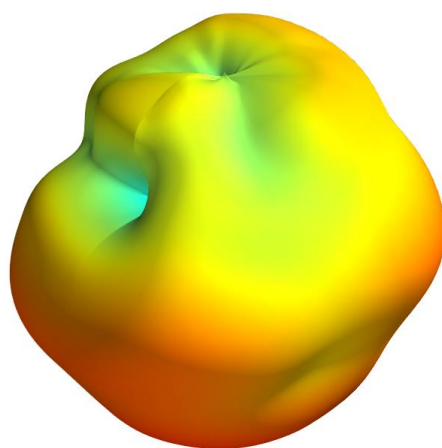
XZ Plane



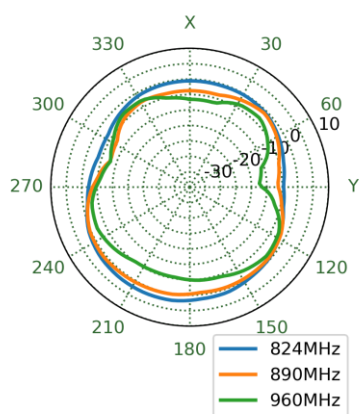
YZ Plane



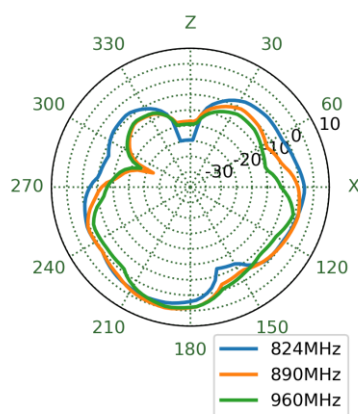
890MHz



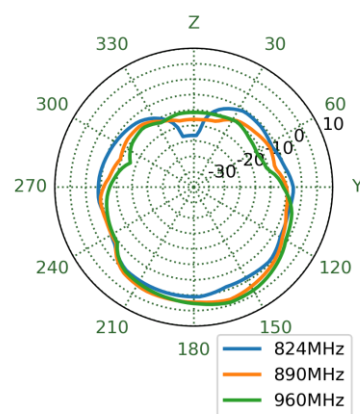
XY Plane



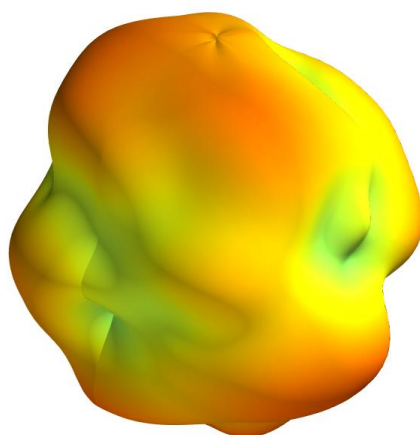
XZ Plane



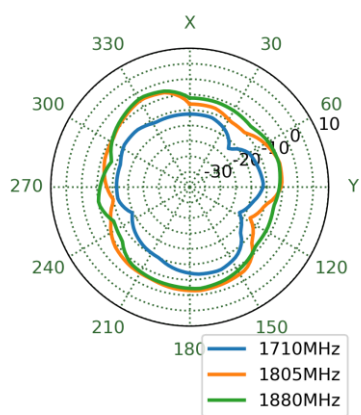
YZ Plane



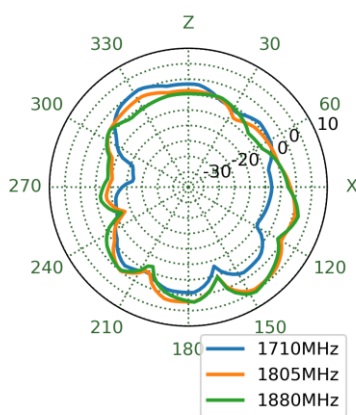
1805MHz



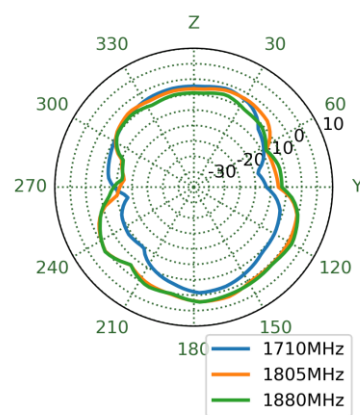
XY Plane



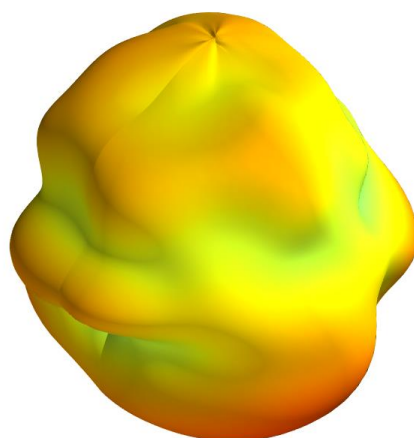
XZ Plane



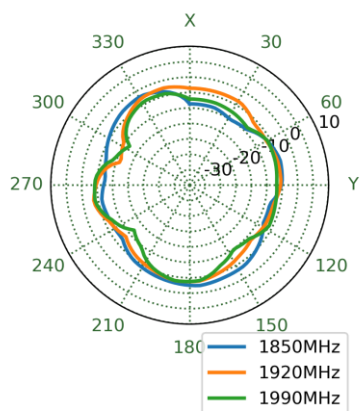
YZ Plane



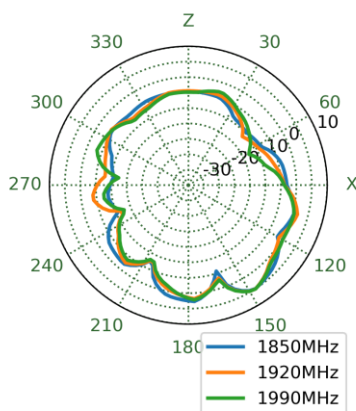
1920MHz



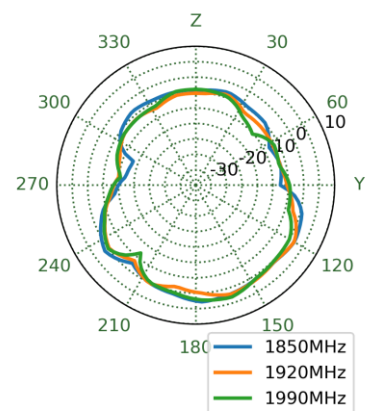
XY Plane



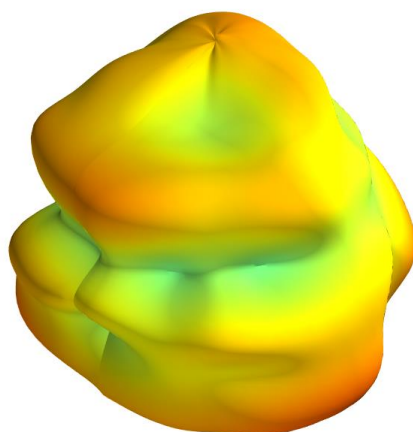
XZ Plane



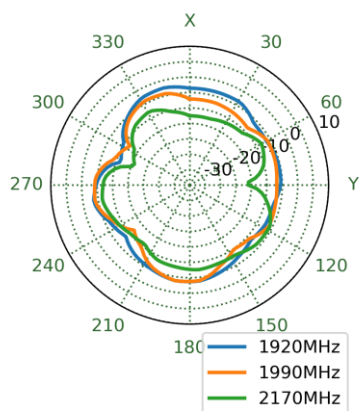
YZ Plane



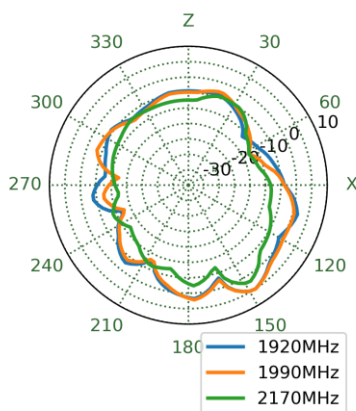
1990MHz



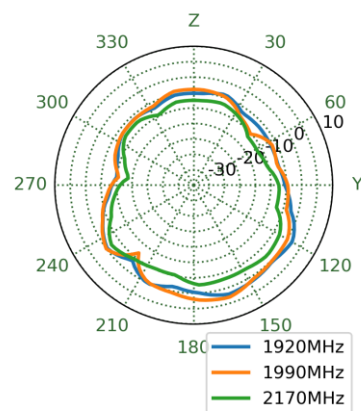
XY Plane



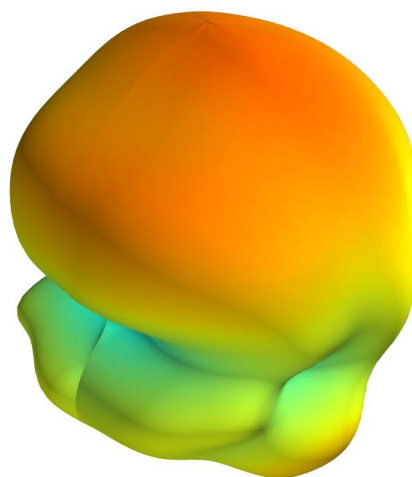
XZ Plane



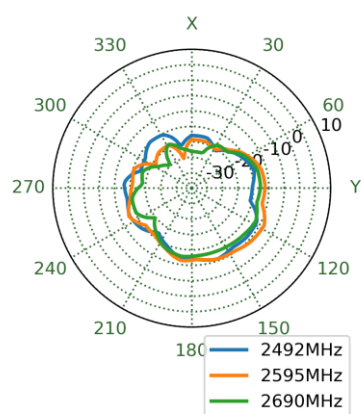
YZ Plane



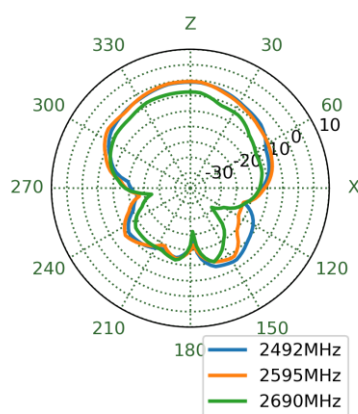
2595MHz



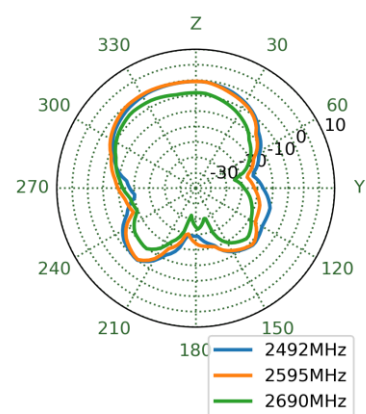
XY Plane



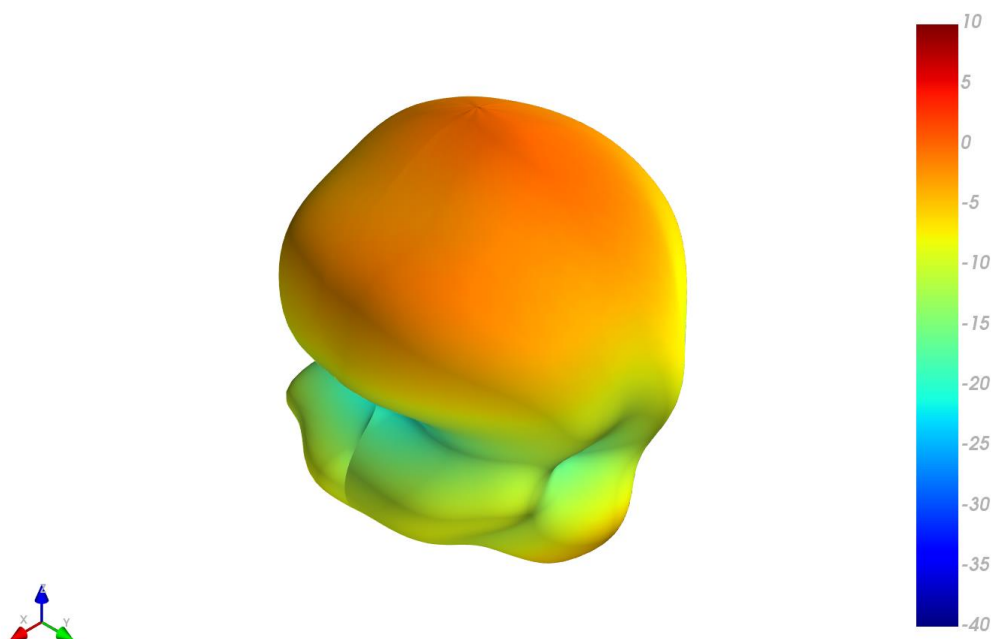
XZ Plane



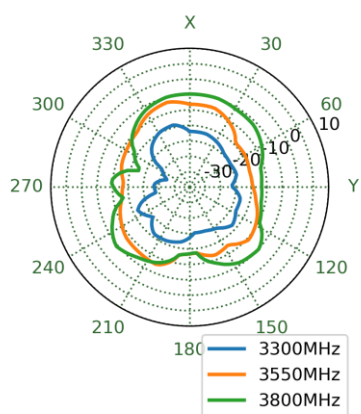
YZ Plane



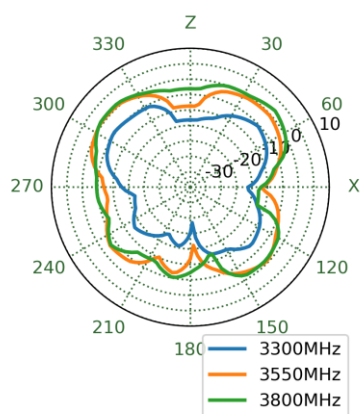
3550MHz



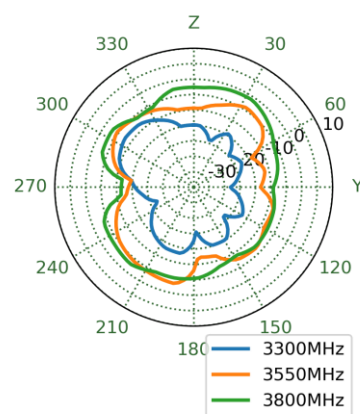
XY Plane



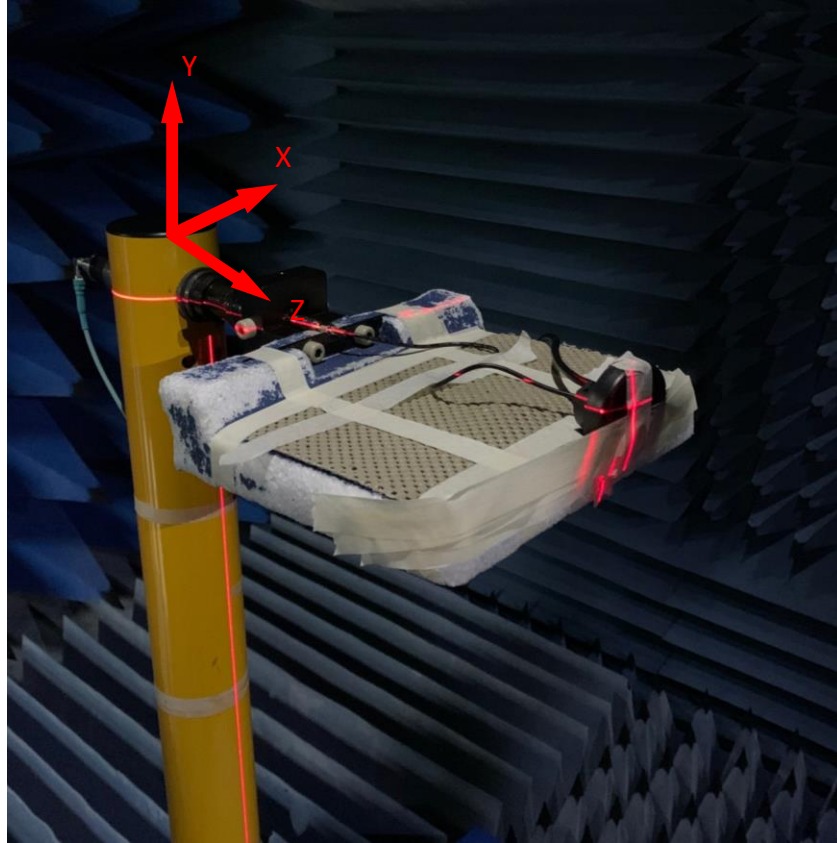
XZ Plane



YZ Plane

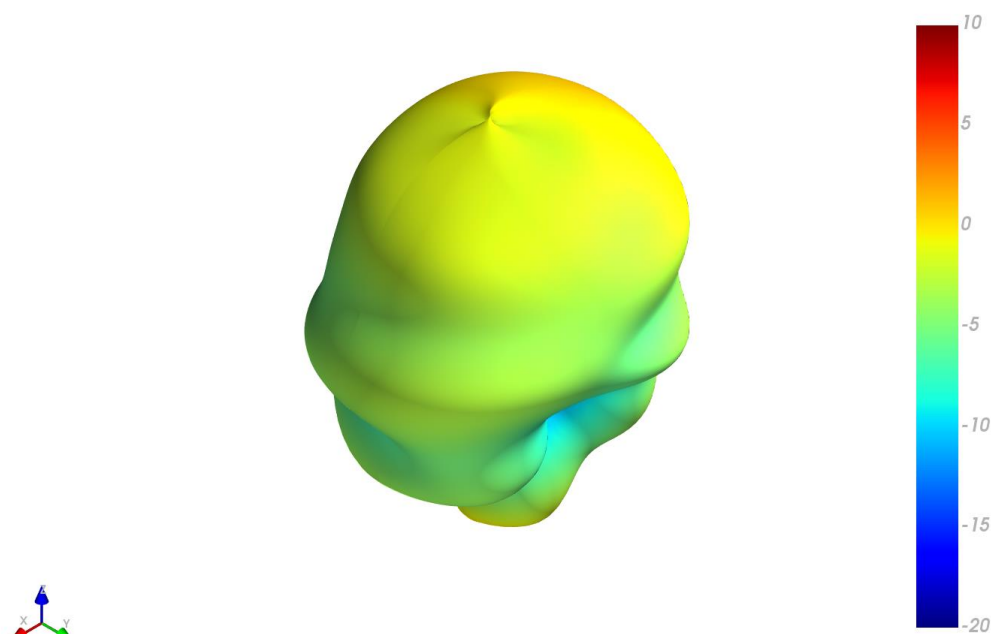


## 5.4 Test Setup – Free Space

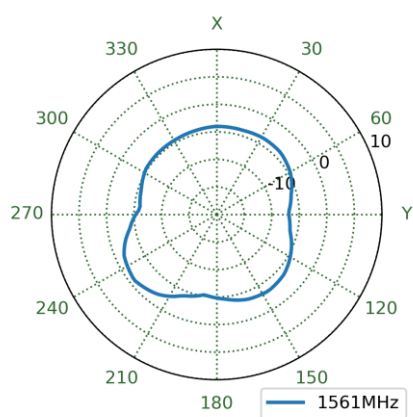


## 5.5 GNSS 3D and 2D Radiation Patterns – Free Space

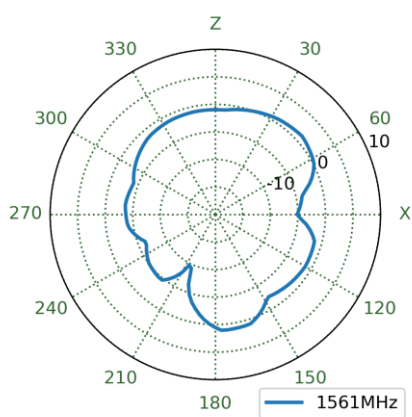
1561MHz



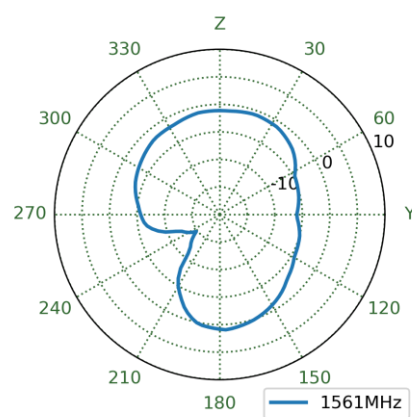
XY Plane



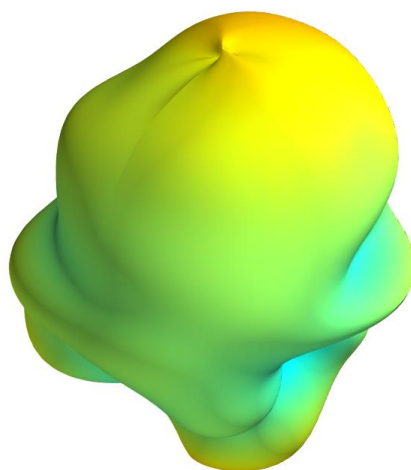
XZ Plane



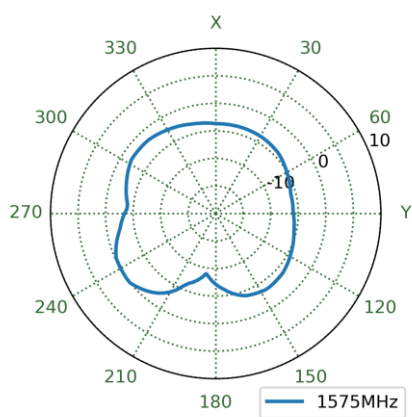
YZ Plane



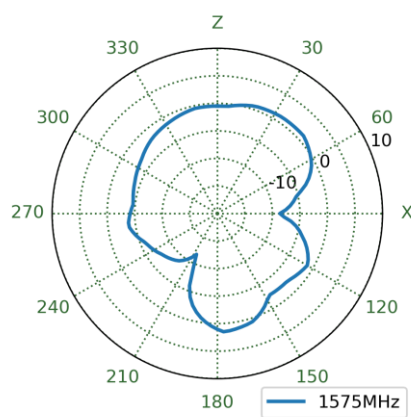
1575.42MHz



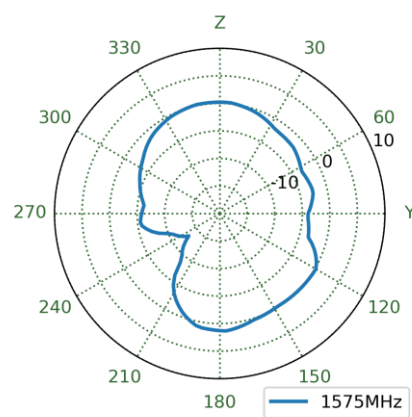
XY Plane



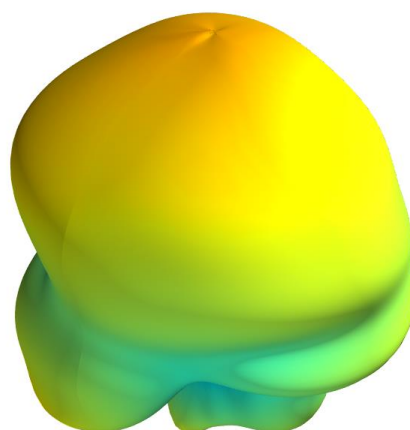
XZ Plane



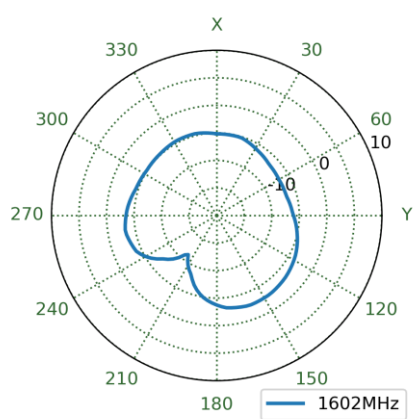
YZ Plane



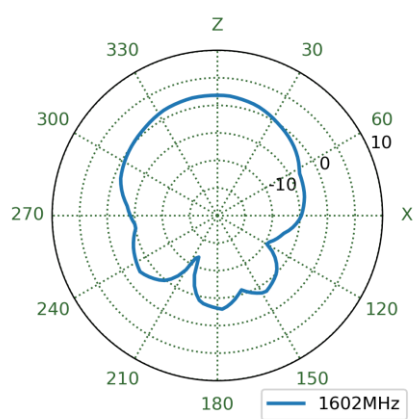
1602MHz



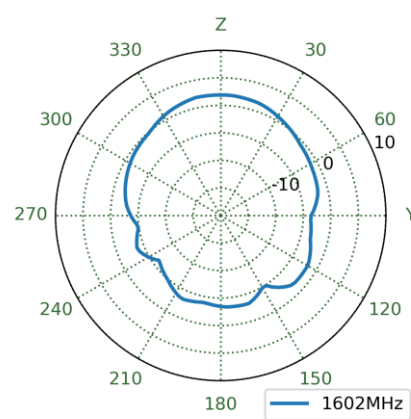
XY Plane



XZ Plane

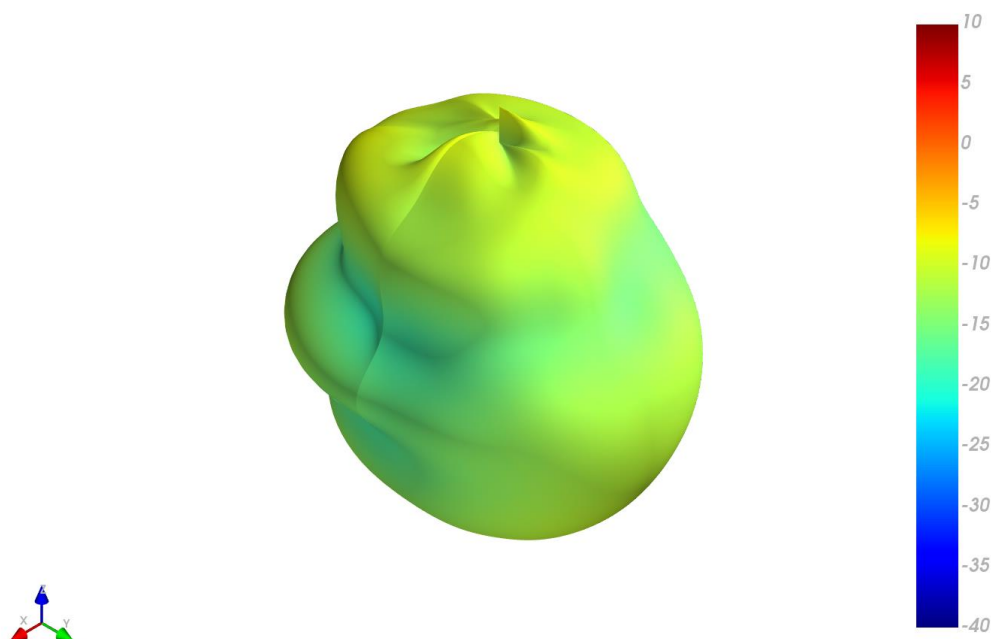


YZ Plane

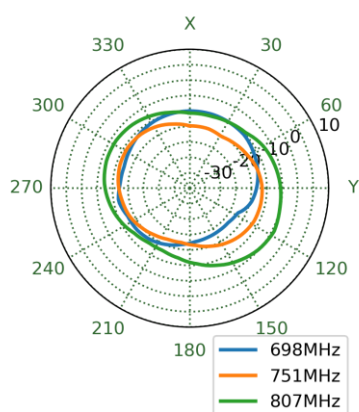


## 5.6 Cellular 3D and 2D Radiation Patterns – Free Space

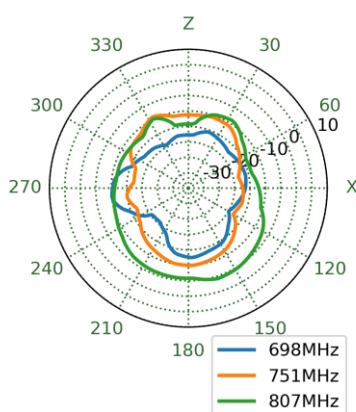
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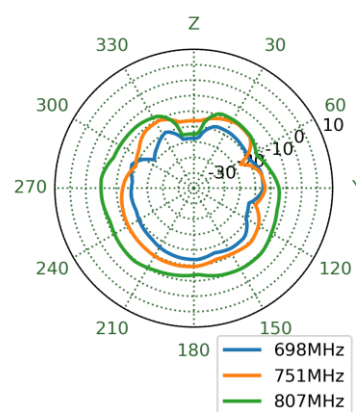
XY Plane



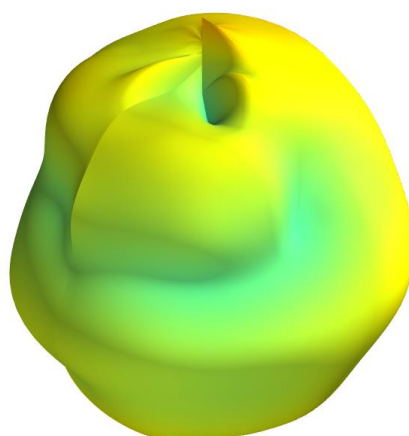
XZ Plane



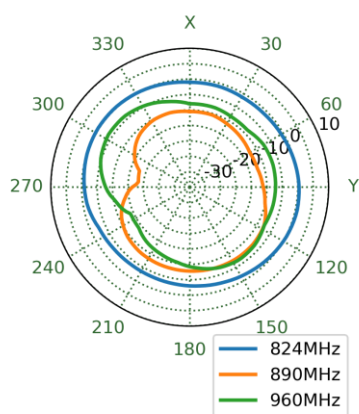
YZ Plane



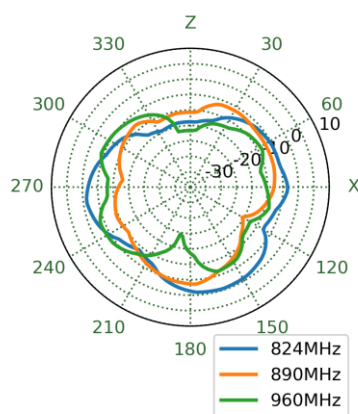
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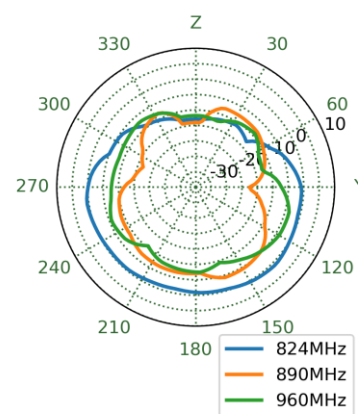
XY Plane



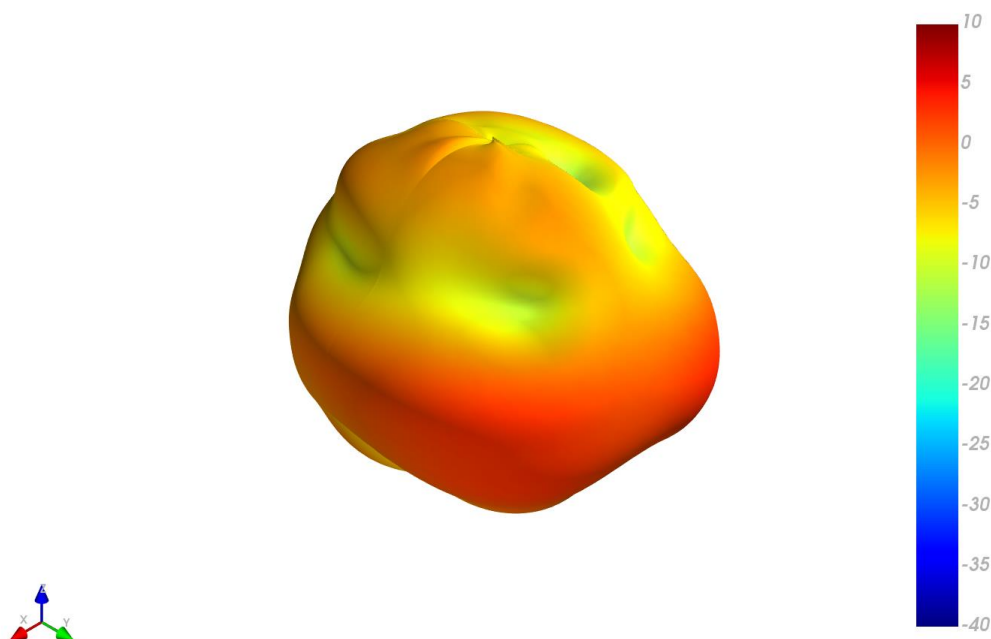
XZ Plane



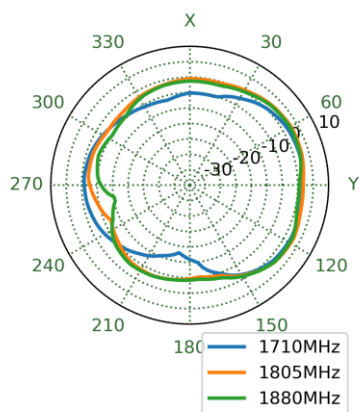
YZ Plane



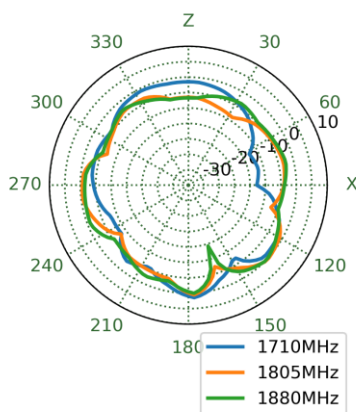
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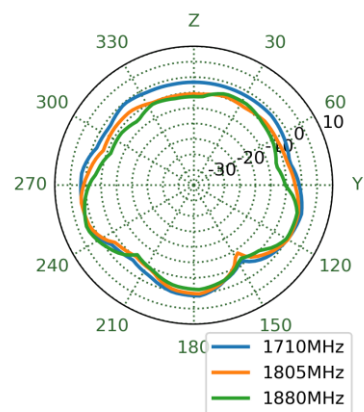
XY Plane



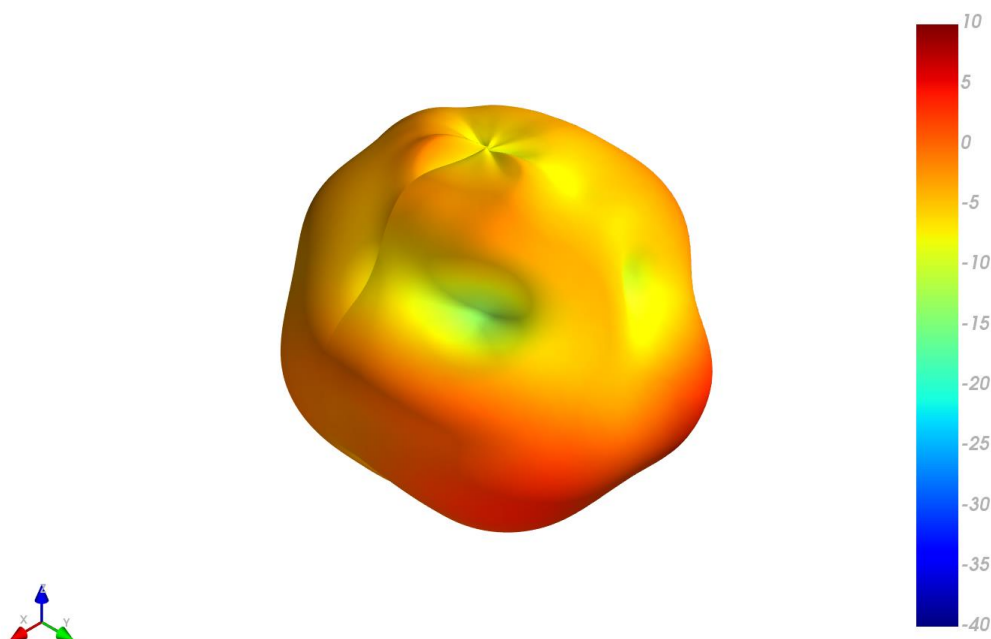
XZ Plane



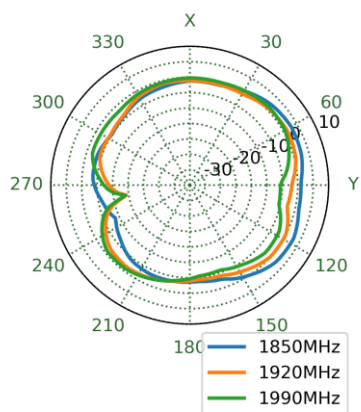
YZ Plane



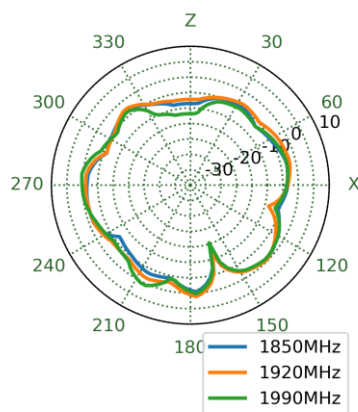
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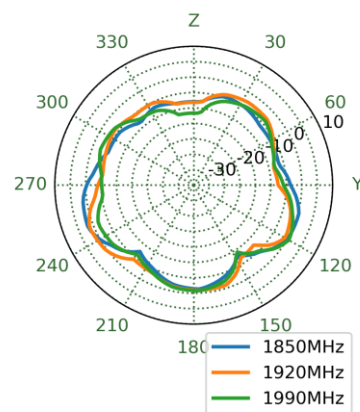
XY Plane



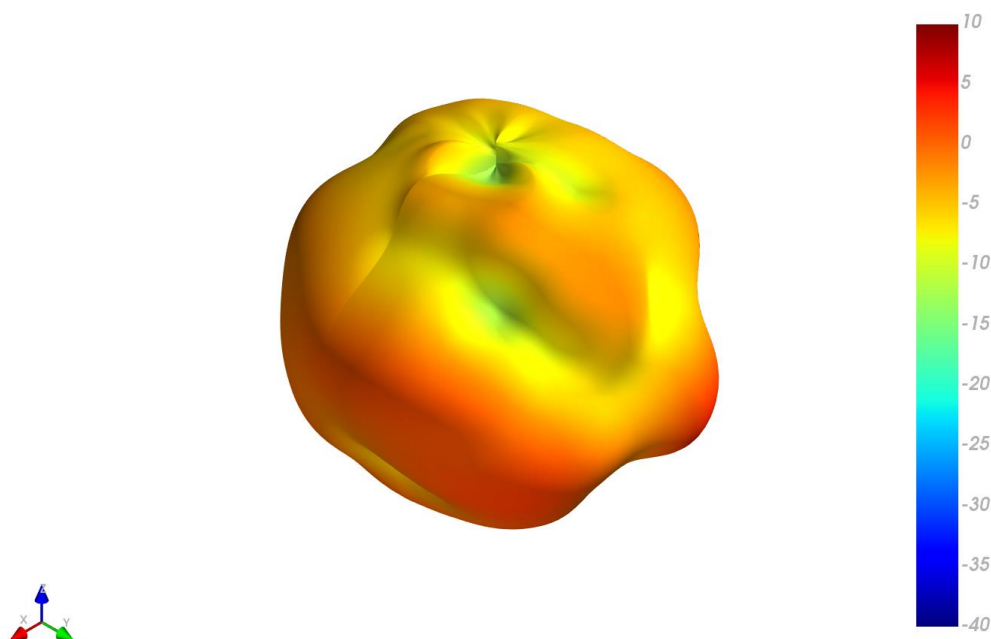
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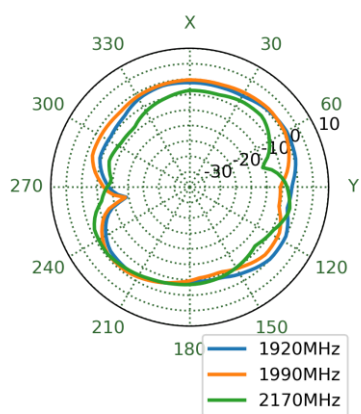
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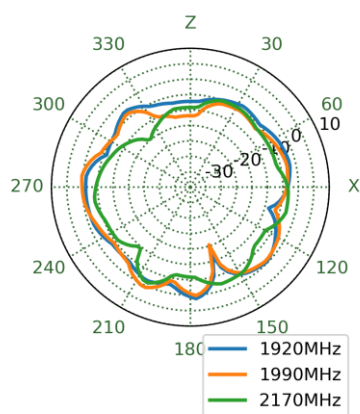
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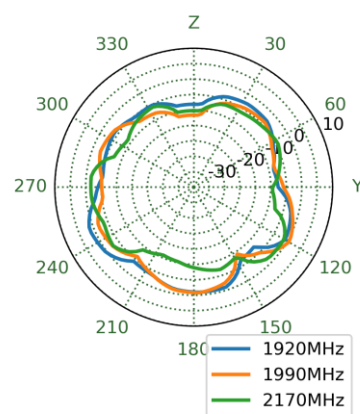
XY Plane



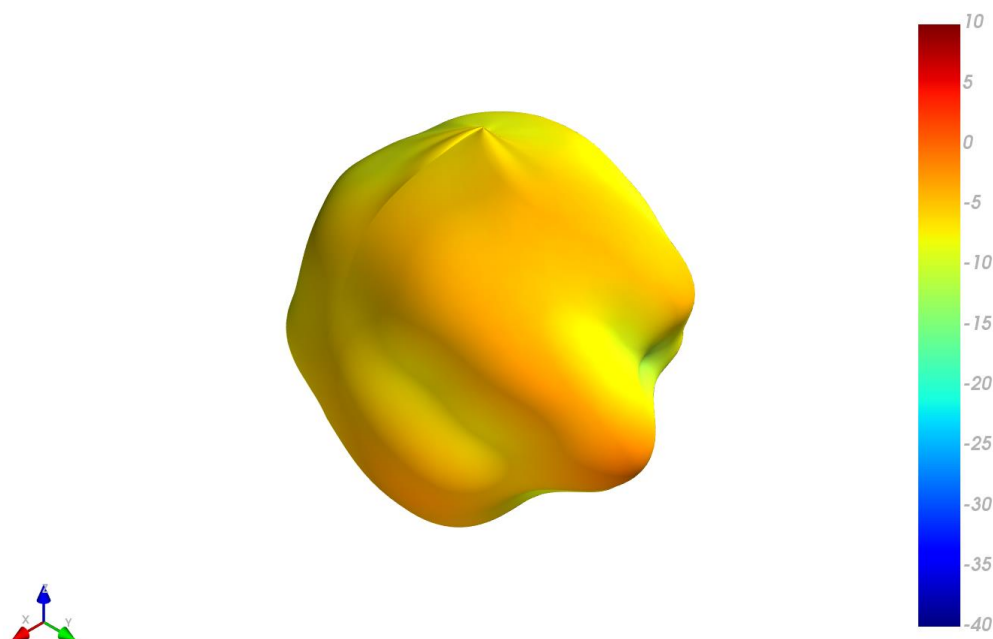
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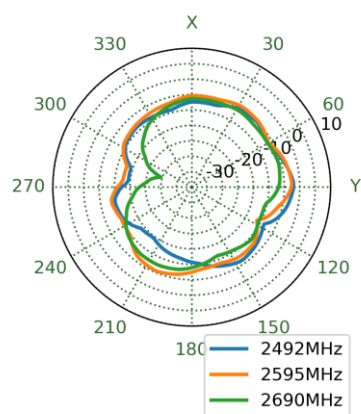
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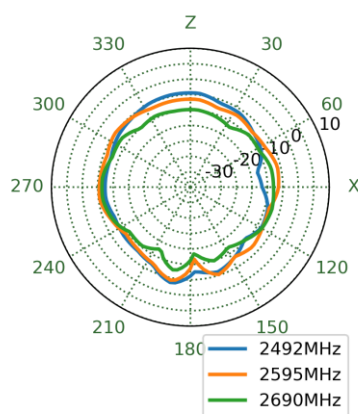
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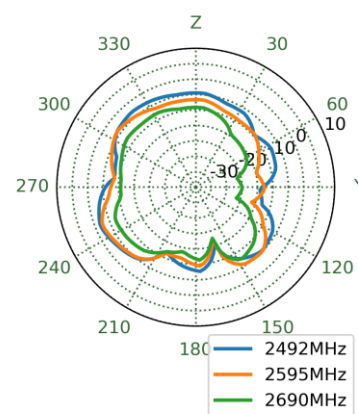
XY Plane



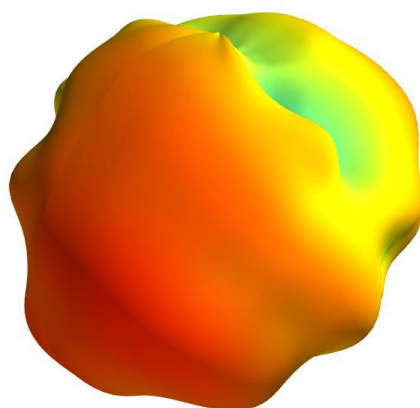
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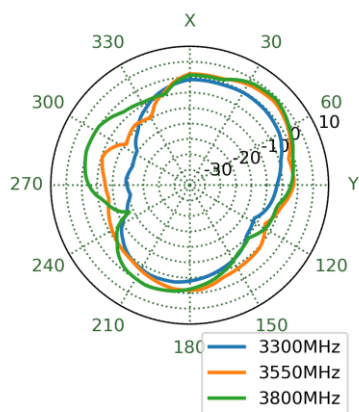
YZ Plane



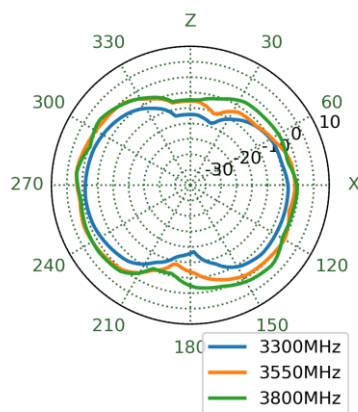
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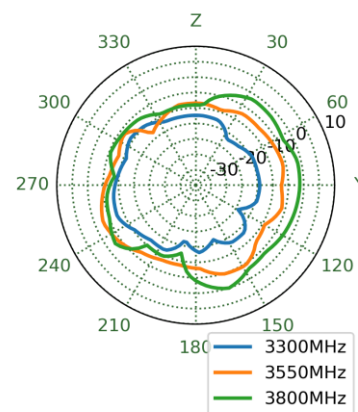
XY Plane



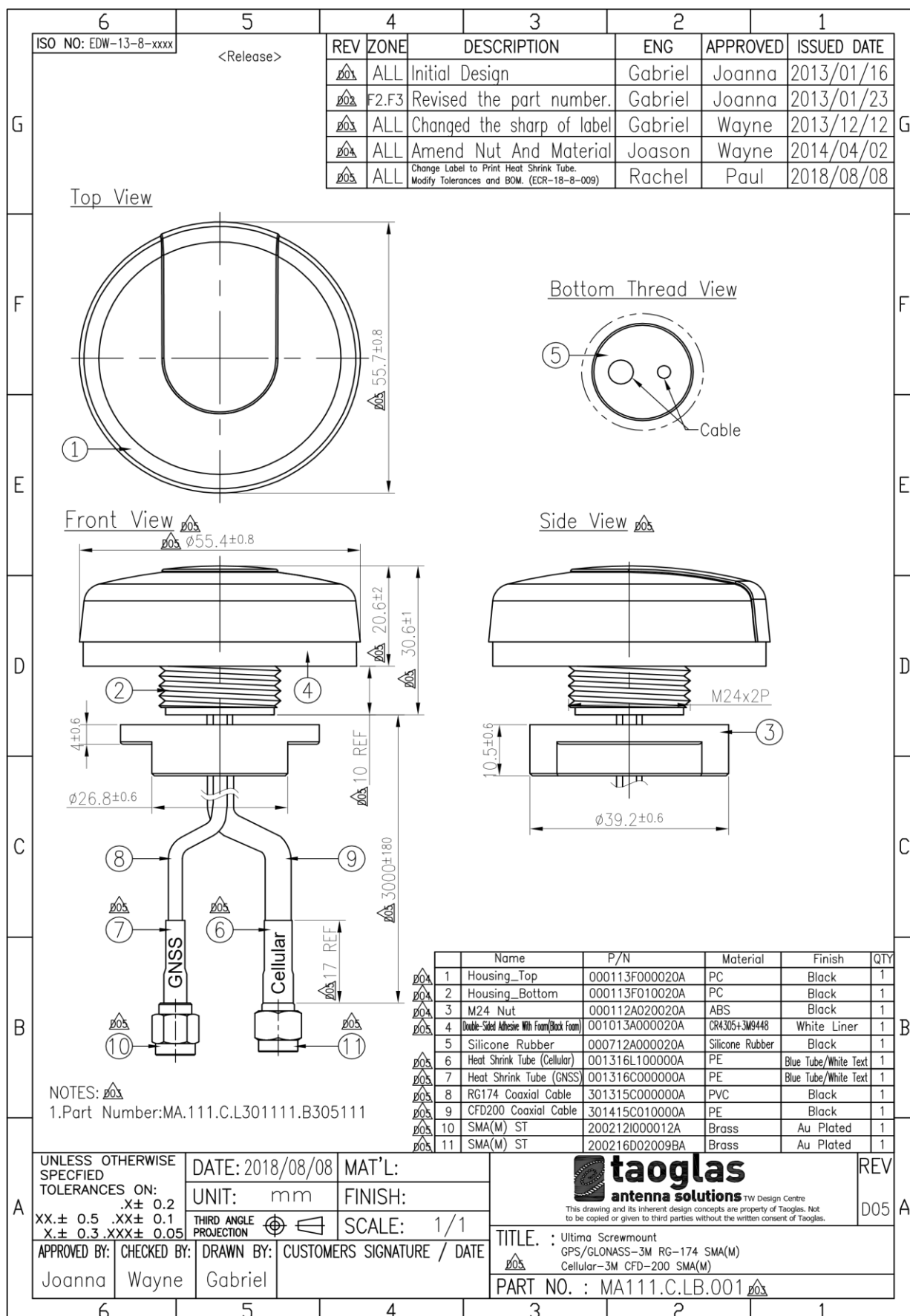
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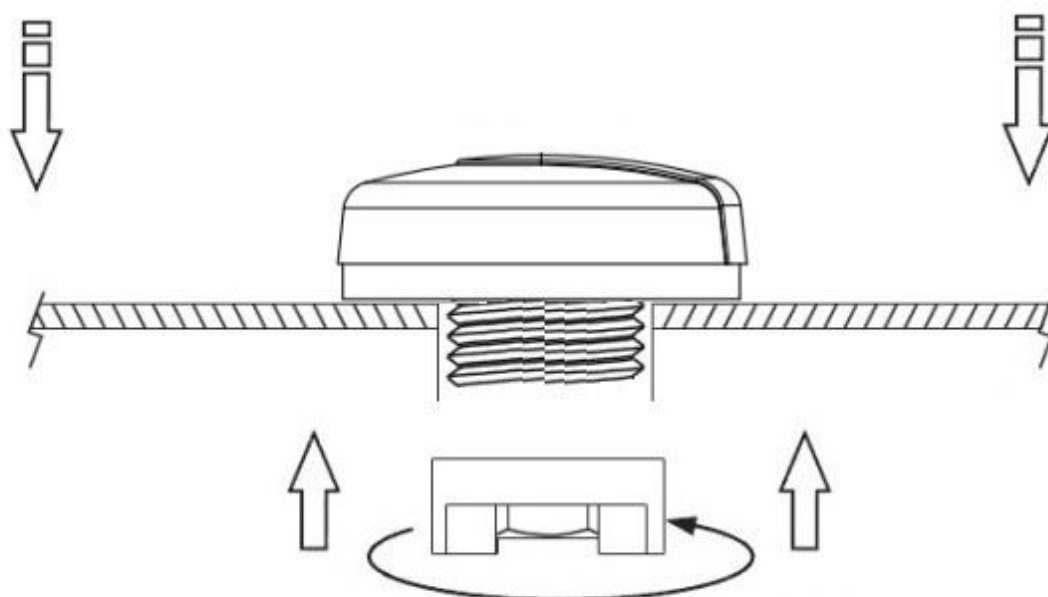
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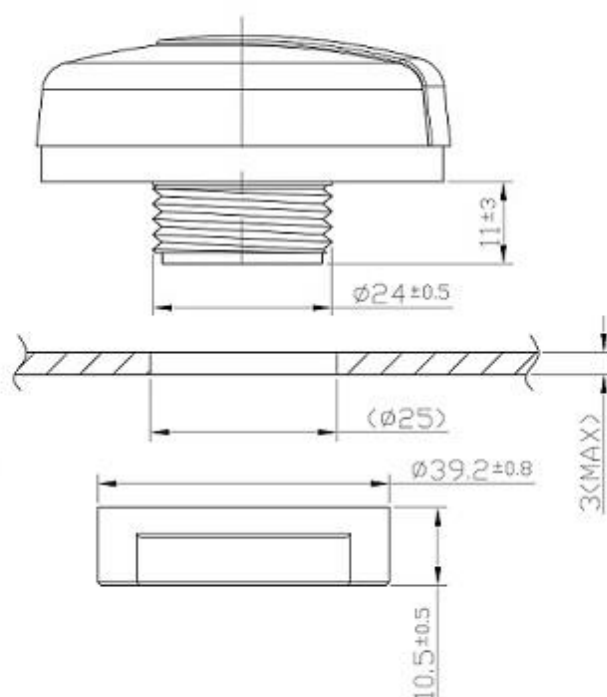
## 6. Mechanical Drawing (Units: mm)



## 7. Installation

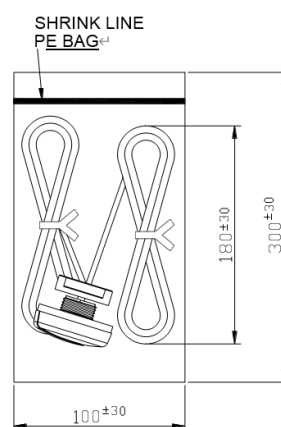


Recommended torque for Mounting is 3.92N·m  
Maximum torque for Mounting is 4.9N·m

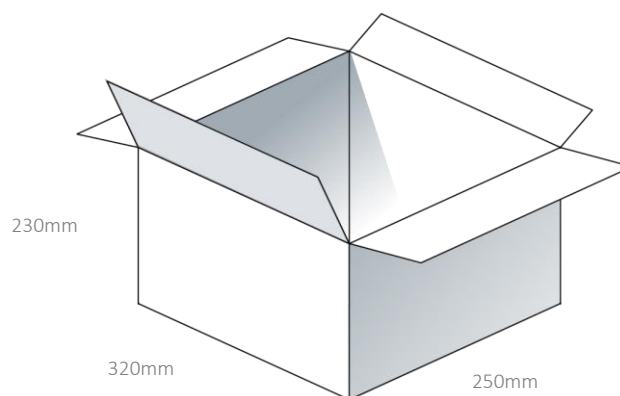


## 8. Packaging

1pcs MA111.C.LB.001 per PE Bag  
 Dimensions - Ø330\*28.4  
 Weight – 0.21Kg

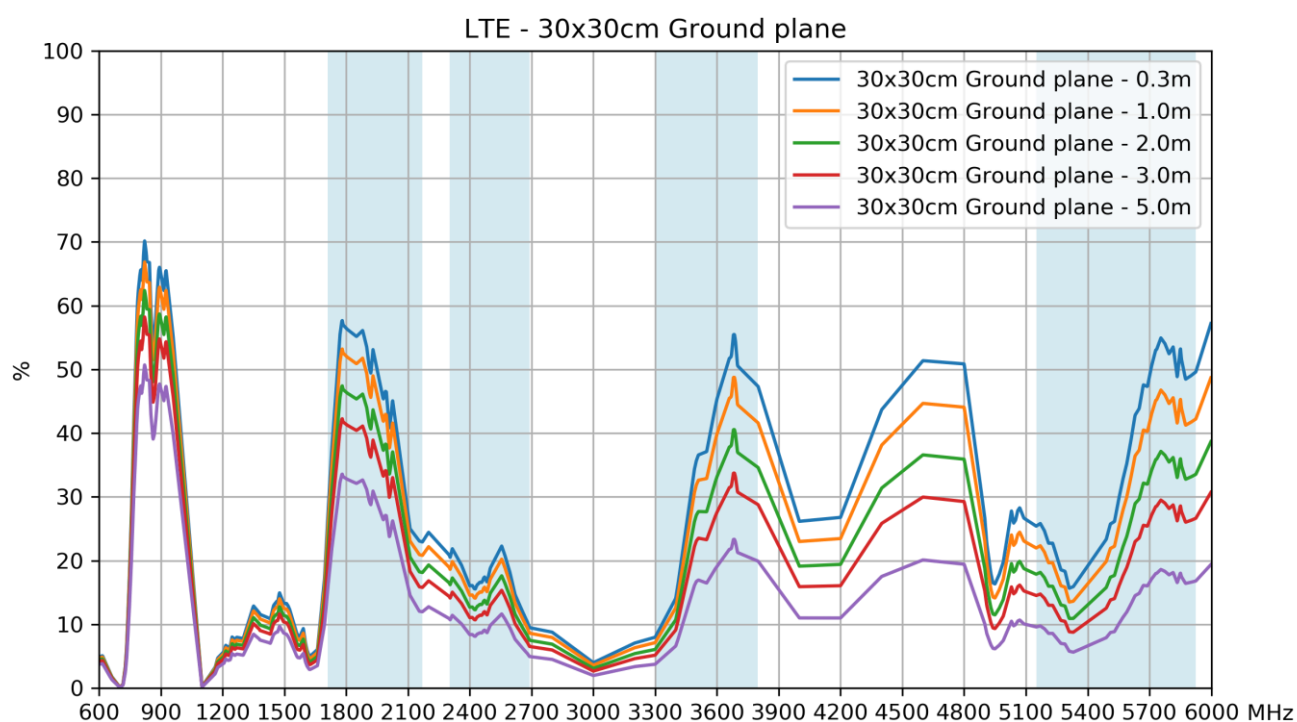
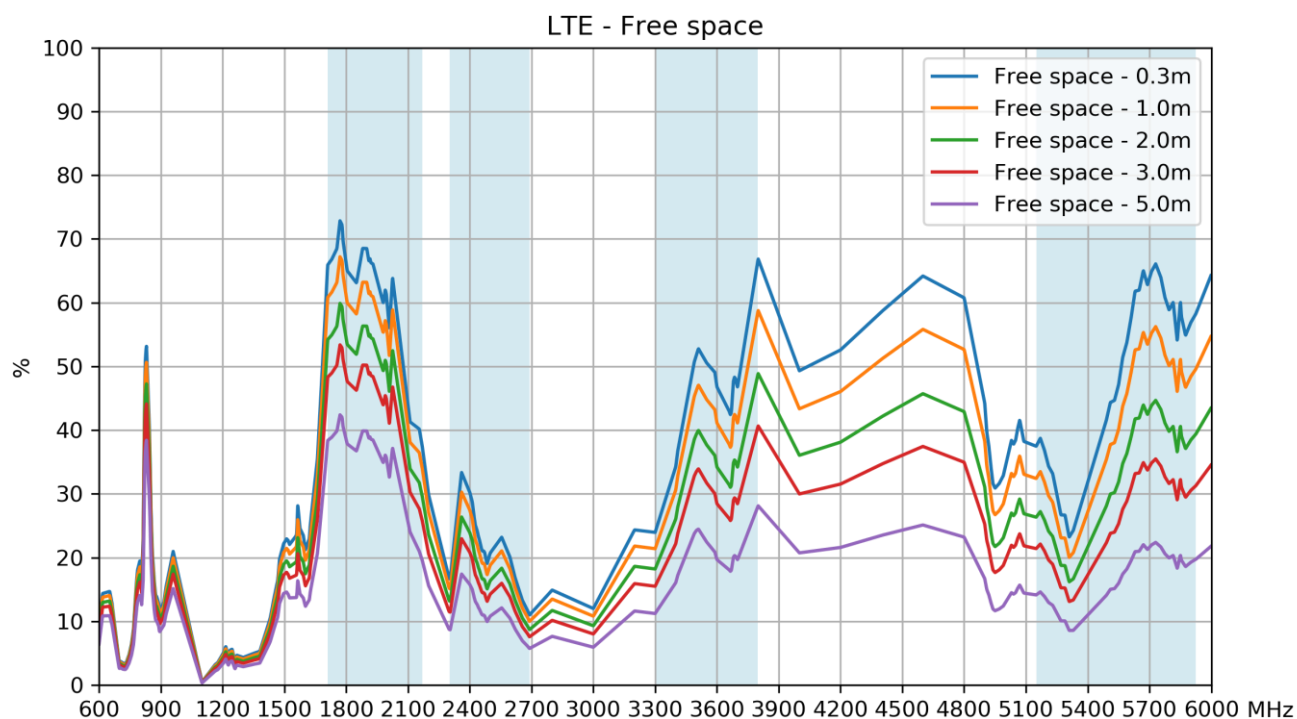


40pcs MA111.C.LB.001 per carton  
 Dimensions - 320\*250\*230mm  
 Weight – 8.7Kg

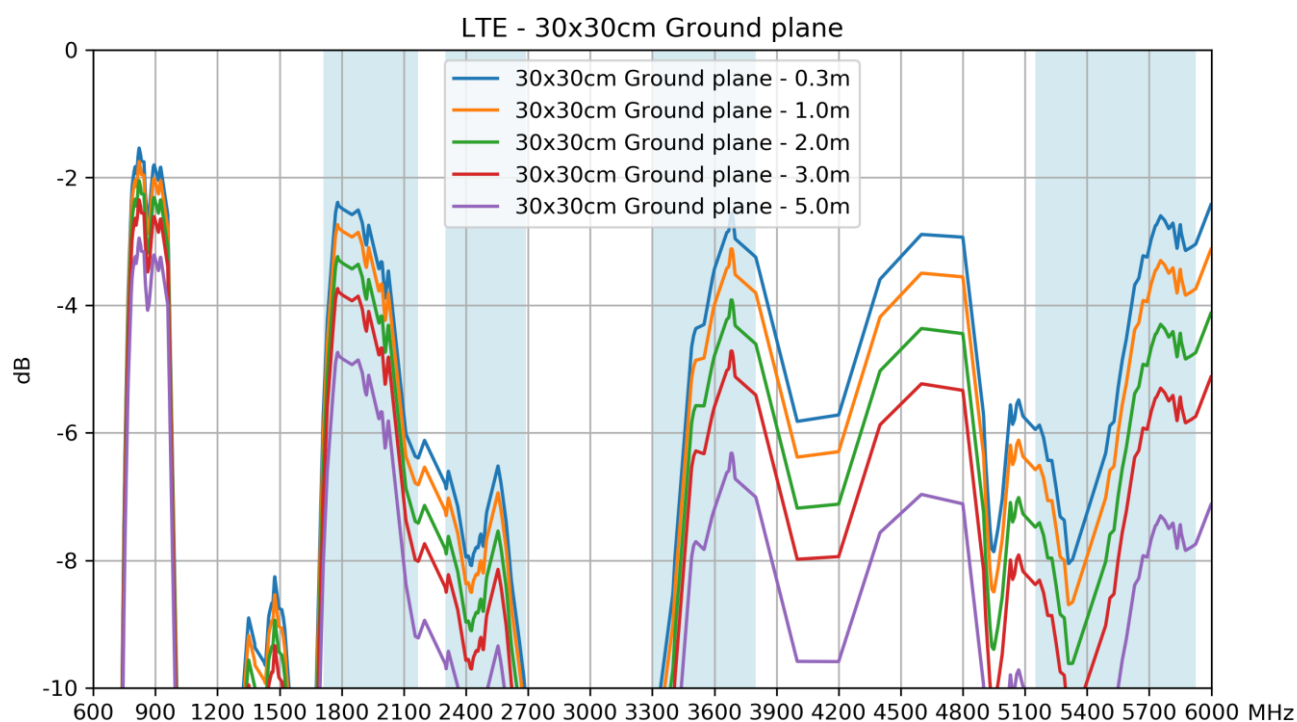
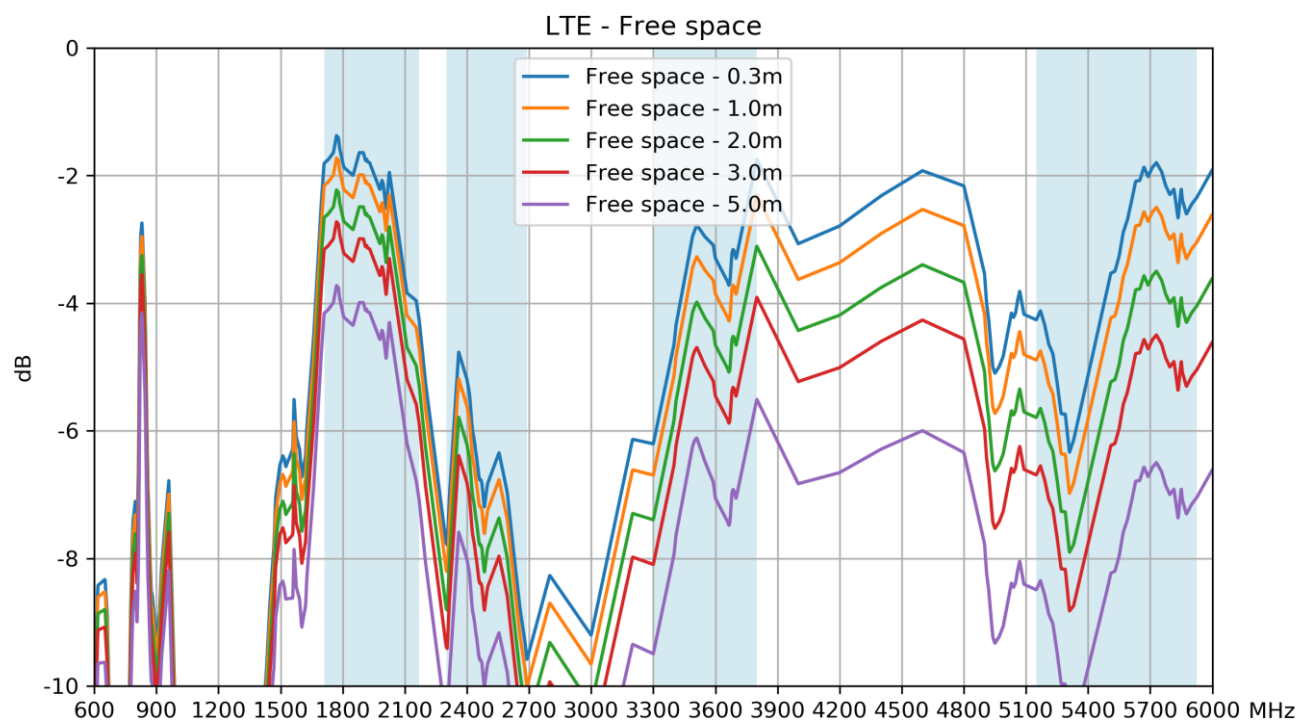


## 9. Application Note

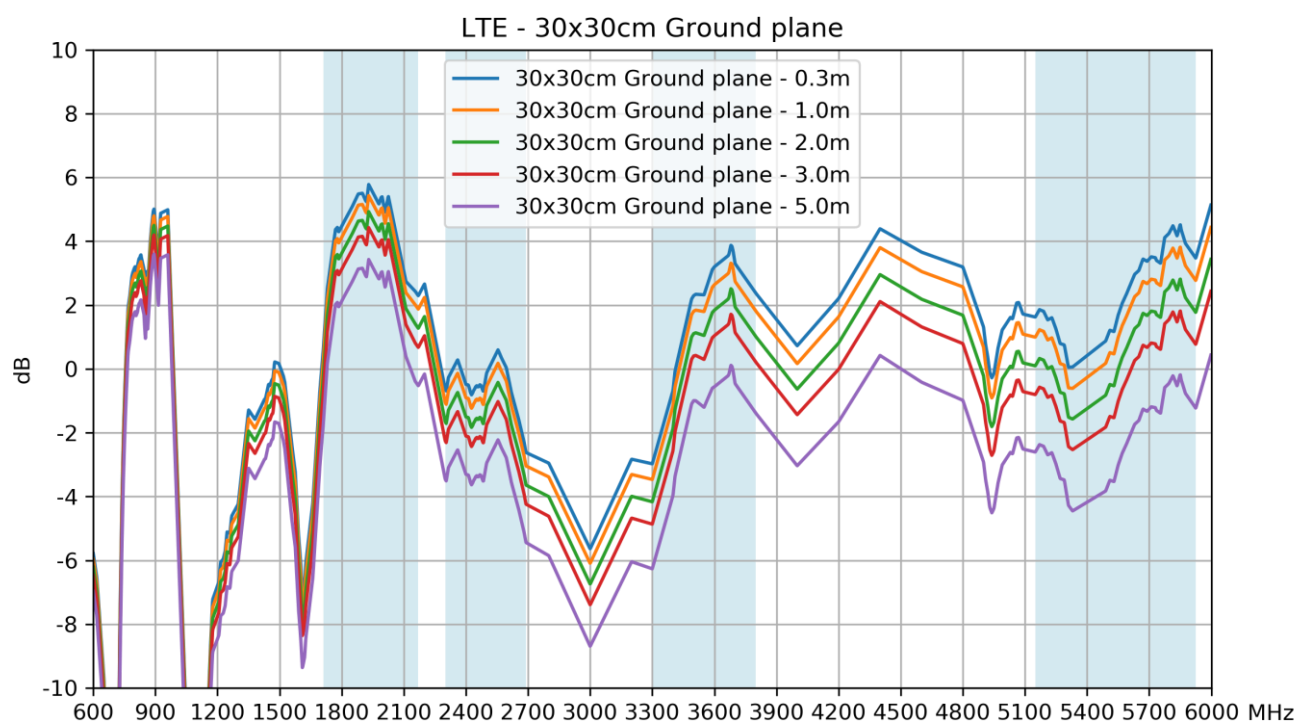
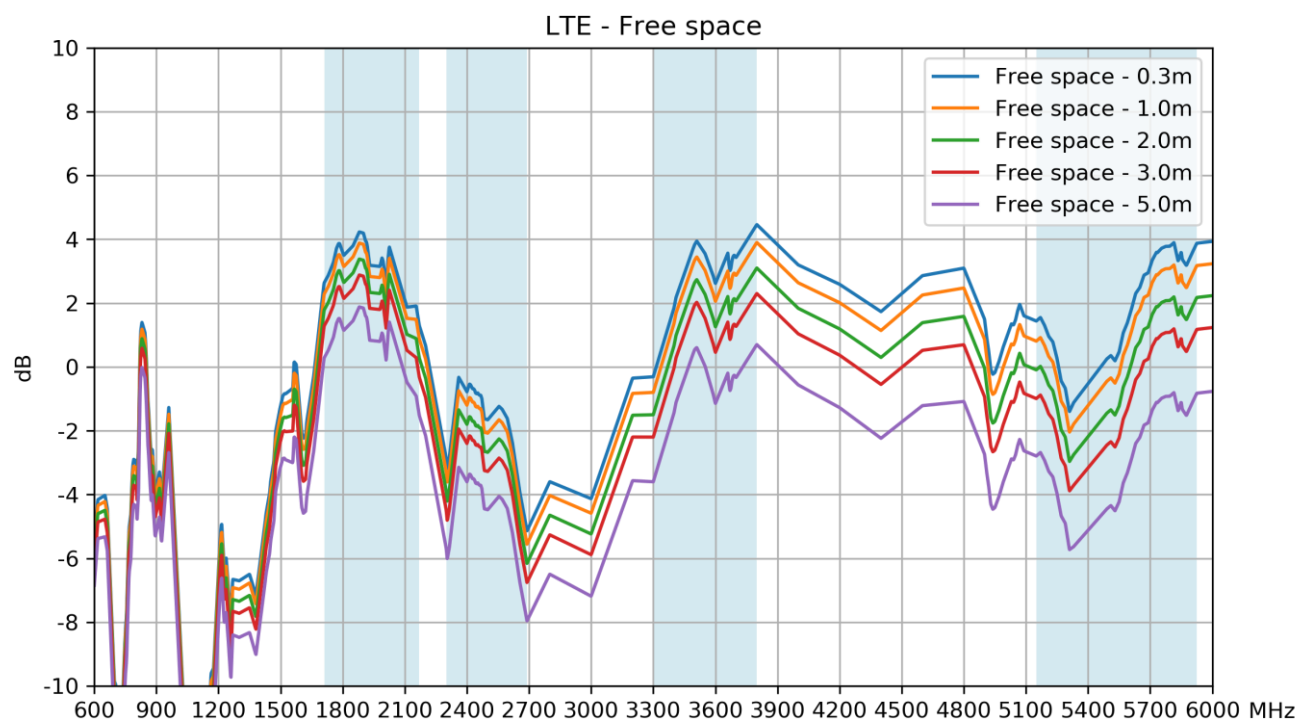
### 9.1 Efficiency – Cellular



## 9.2 Average Gain – Cellular



## 9.3 Peak Gain – Cellular



## Changelog for the datasheet

### SPE-13-8-040 – MA111.C.LB.001

#### Revision: C (Current Version)

|                  |                                   |
|------------------|-----------------------------------|
| Date:            | 2020-02-25                        |
| Changes:         | Updated to show ground plane data |
| Changes Made by: | Jack Conroy                       |

#### Previous Revisions

##### Revision: B

|                  |                 |
|------------------|-----------------|
| Date:            | 2019-01-22      |
| Changes:         | New Table Added |
| Changes Made by: | Jack Conroy     |

##### Revision: A (Original First Release)

|         |            |
|---------|------------|
| Date:   | 2013-05-17 |
| Notes:  |            |
| Author: | Aine Doyle |



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