# SPECIFICATION

| | | |
|---|---|---|
| Part No. | : | **MA220.LB.001** |
| Product Name | : | Optimus MA220 2in1 GPS-GLONASS / LTE External Adhesive Antenna for Glass and Plastic Mount |
| Features | : | GPS-GLONASS - High gain LNA up to 32dB<br>4G LTE band – 698 MHz to 2700MHz<br>Covers legacy worldwide 2G and 3G bands<br>LTE/GSM/CDMA/PCS/DCS/UMTS/GPRS/EDGE/HSPA<br>IP67<br>Height 12mm Diameter 62.8mm<br>RoHS Compliant |

# 1. Introduction

The Optimus MA220 is a combination high performance GPS-GLONASS and 2G/3G/4G LTE (plus GSM /CDMA/PCS/DCS/UMTS/GPRS/EDGE/HSPA) antenna to simplify Automotive Telematic and Fleet management systems worldwide. Its high quality low profile covert housing can be attached onto the glass or even out of sight under the dashboard. This combination of a high gain GPS/Glonass antenna and a LTE antenna is ideal for those applications that require durability, small size and covert installation, and reliable reception and transmission crossing through different mobile networks.

The LTE cellular antenna function covers all main LTE and 2G/3G cellular bands worldwide. It has been designed to work equally well when mounted on glass or on plastic. It is not suitable for mounting on metal.

The GPS/Glonass function means increased accuracy and reliability of location. A front-end SAW protects the LNA from burnout by nearby out of band cellular transmissions and also significantly reduces any compression and consequent reduction of sensitivity.

The standard version has 3 metres RG174 cable and SMA(M) connector on both GPS/Glonass and LTE. For even higher gain and efficiency we recommend if you can to use shorter cable lengths, as shown in the charts below. The cable lengths and connector types are completely customizable according to customer request, subject to a minimum order quantity.

The slim housing is fully IP67 waterproof. A separate automotive approved 3M adhesive pad is provided, allowing the antenna to be mounted correctly facing through glass, or directly onto a plastic surface like the dashboard of a vehicle.

Note if US LTE network certification is required contact Taoglas for advice on correct antenna choice.

## Features

**GPS-GLONASS**

- High LNA Gain up to 32 dB
- Antenna Gain 30 ± 2 dB
- Low Noise 1.5 dB max

**LTE**

- Advanced 4G LTE antenna with 2G/3G application bands included LTE/GSM/CDMA/PCS/DCS/UMTS/GPRS/EDGE/ HSPA

**Other**

- Ultrasonically Welded - Water Resistant IP 67
- UV Resistant
- Quality textured covert design. Low profile
- Comes with automotive approved high grade 3M double sided tape for quick and easy mounting
- Customizable cables and connectors

# 2. Specification

| 2G/3G Antenna | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | LTE | LTE Band 20 | GSM850 | GSM900 | DCS | PCS | WCDMA I / UMTS | WiFi | LTE |
| Frequency (MHz) | 698~798 | 791~862 | 824~894 | 880~960 | 1710~1880 | 1850~1990 | 1920~2170 | 2400~2500 | 2570~2690 |
| Free Space | | | | | | | | | |
| Peak Gain (dBi) * | -1.54 | -0.53 | -0.53 | -1.07 | -0.10 | 0.72 | 0.89 | -2.40 | -1.59 |
| Average Gain (dBi) * | -7.21 | -6.02 | -5.71 | -8.20 | -6.46 | -6.10 | -5.99 | -7.39 | -7.40 |
| Efficiency (%)* | 19.12 | 25.29 | 27.38 | 16.20 | 22.62 | 24.62 | 25.22 | 18.27 | 18.21 |
| On 2mm Thickness ABS | | | | | | | | | |
| Peak Gain (dBi) * | -1.13 | -0.05 | -0.05 | -1.91 | 2.21 | 1.68 | 1.63 | -3.36 | -0.63 |
| Average Gain (dBi) * | -6.72 | -4.78 | -5.01 | -7.96 | -6.01 | -4.99 | -5.73 | -9.07 | -7.64 |
| Efficiency (%)* | 21.66 | 33.32 | 31.52 | 16.59 | 25.37 | 31.75 | 28.06 | 12.36 | 17.21 |
| On Glass | | | | | | | | | |
| Peak Gain (dBi) * | -0.71 | -0.35 | -0.35 | -2.03 | 1.76 | 1.71 | 1.48 | -2.94 | -1.31 |
| Average Gain (dBi) * | -6.44 | -4.99 | -5.36 | -8.37 | -5.76 | -5.29 | -6.18 | -9.21 | -8.04 |
| Efficiency (%)* | 23.01 | 31.79 | 29.03 | 14.93 | 26.78 | 29.61 | 25.07 | 11.97 | 15.70 |
| Return loss (dB) * | < -5 | | | | | | | | |
| Polarization | Linear | | | | | | | | |
| Impedance | 50Ω | | | | | | | | |
| Cable | 3m RG174 standard, fully customizable | | | | | | | | |
| Connector | SMA(M), standard, fully customizable | | | | | | | | |
| Maximum Input Power | 5W | | | | | | | | |

| GPS-GLONASS | |
|---|---|
| Center Frequency | GPS:1575.42±3 MHz<br>GLONASS:1602±0.5 MHz |
| Gain | 3 ±1 dBic typ. |
| VSWR | 1.92:1 Max |
| Impedance | 50Ω |
| Antenna Patch Size | 25x25x4mm |
| Cable | 3m RG174 standard, fully customizable |
| Connector | SMA(M), standard, fully customizable |
| LNA Electrical Properties | |
| Center Frequency fc | GPS:1575.42±3 MHz<br>GLONASS:1602±0.5 MHz |
| Impedance | 50 Ω Nominal |
| VSWR | < 1.92:1 |
| Return Loss | 10 dB Min. |
| Gain | 31 dB Min. @3.3V |
| DC Power Input | 3.3V |
| Noise Figure @3.3V | 1.5dB |
| Power Consumption | 12mA |

| MECHANICAL | |
|---|---|
| Antenna Dimensions | 62.8mm x 68mm x 12mm |
| Casing | ABS |
| Waterproof | IP67 |
| ENVIRONMENTAL | |
| Operation Temperature | -40°C to 85°C |
| Storage Temperature | -40°C to 90°C |
| Humidity | Non-condensing 65°C 95% RH |

***note: includes 3 metre RG174 cable loss**

## 2.1 LTE Bands with 3M Cable

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

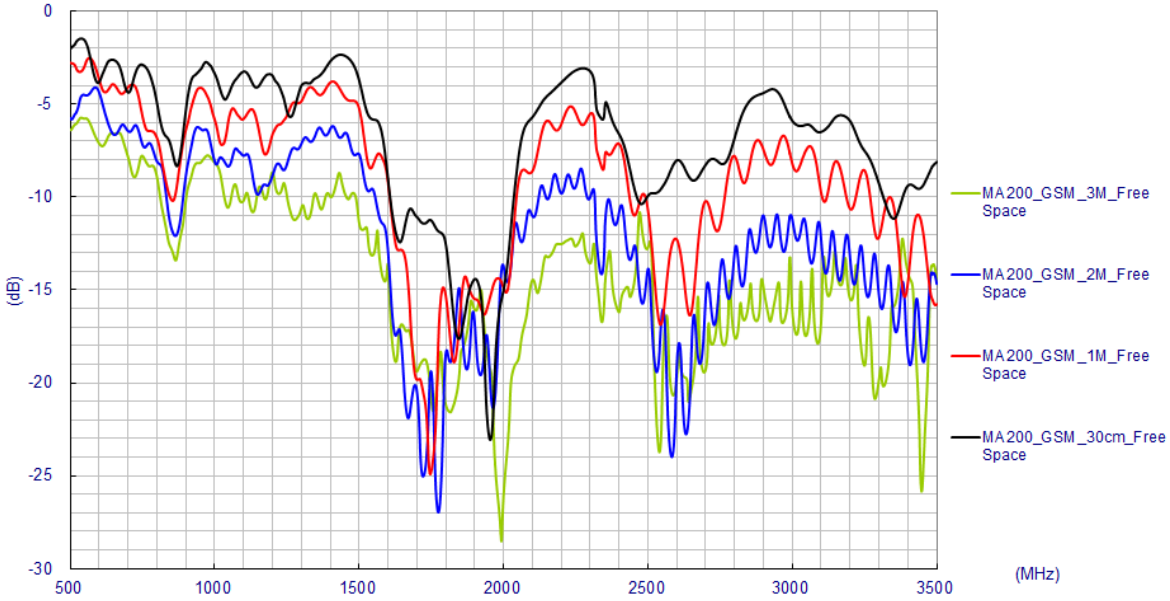
## 2.2 LTE Bands with 300mm Cable

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

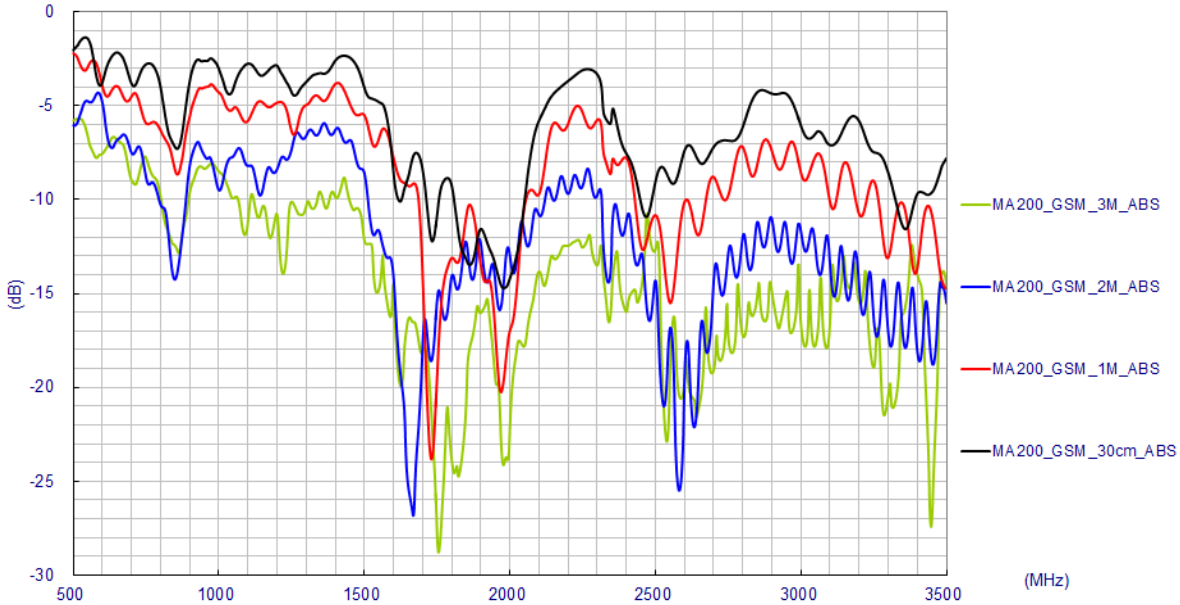
# 3. LTE Antenna Characteristics

## 3.1 Return Loss

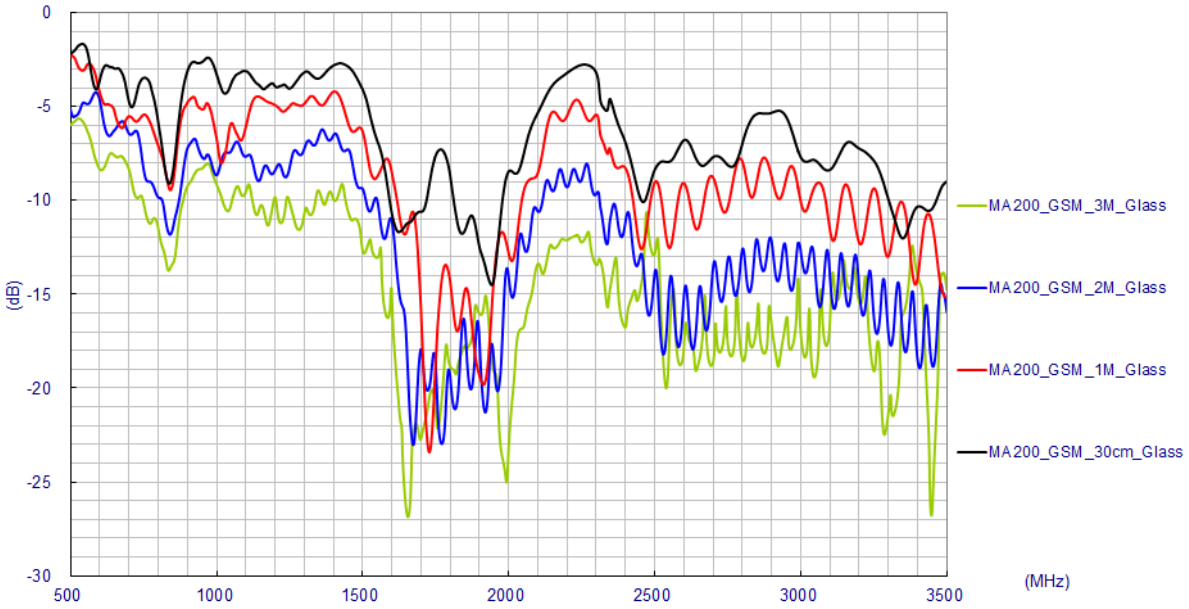
Free Space with RG174 Coaxial Cable




On 2mm thickness ABS Base with RG174 Coaxial Cable

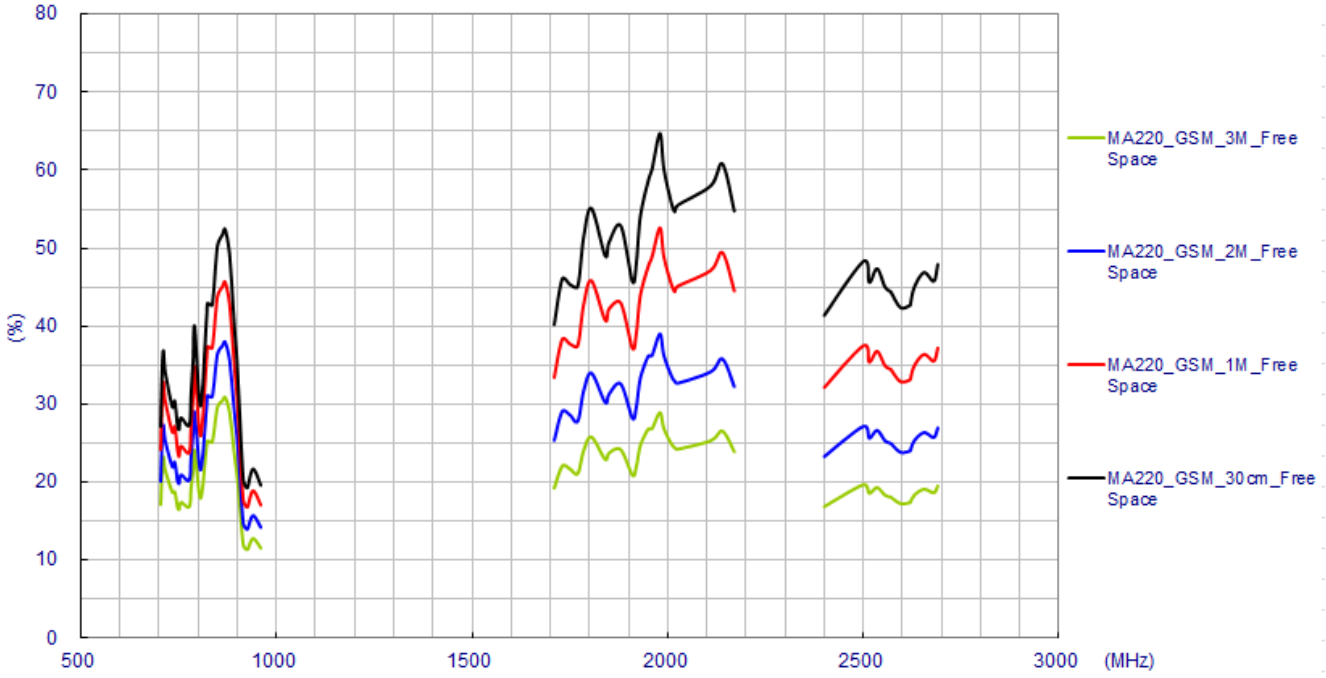


On Glass Base with RG174 Coaxial Cable

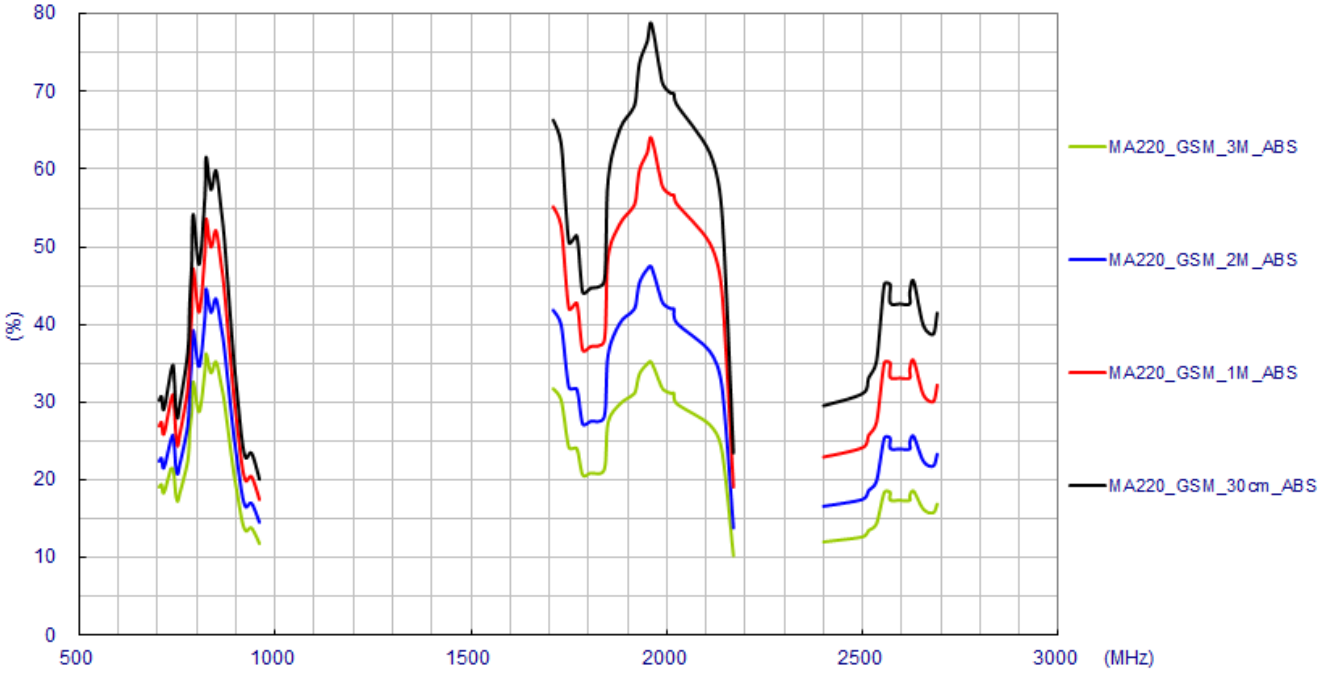


## 3.2 Efficiency

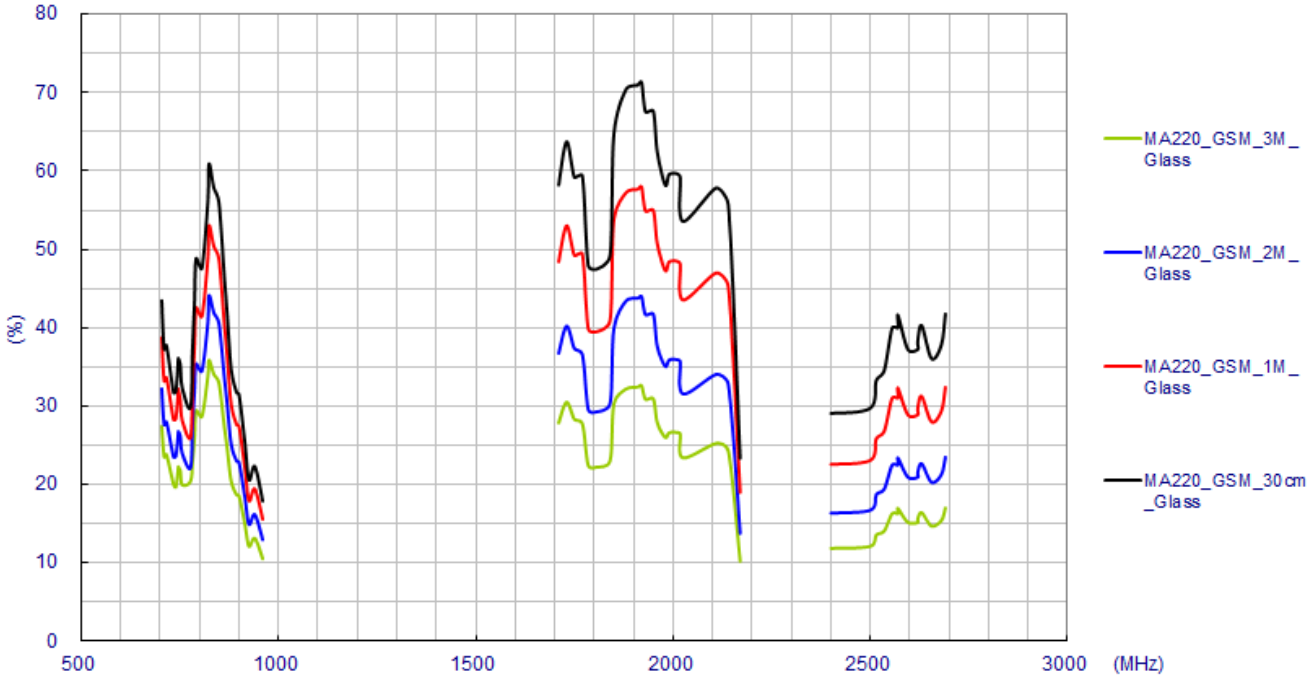
Free Space with RG174 Coaxial Cable




On 2mm thickness ABS Base with RG174 Coaxial Cable

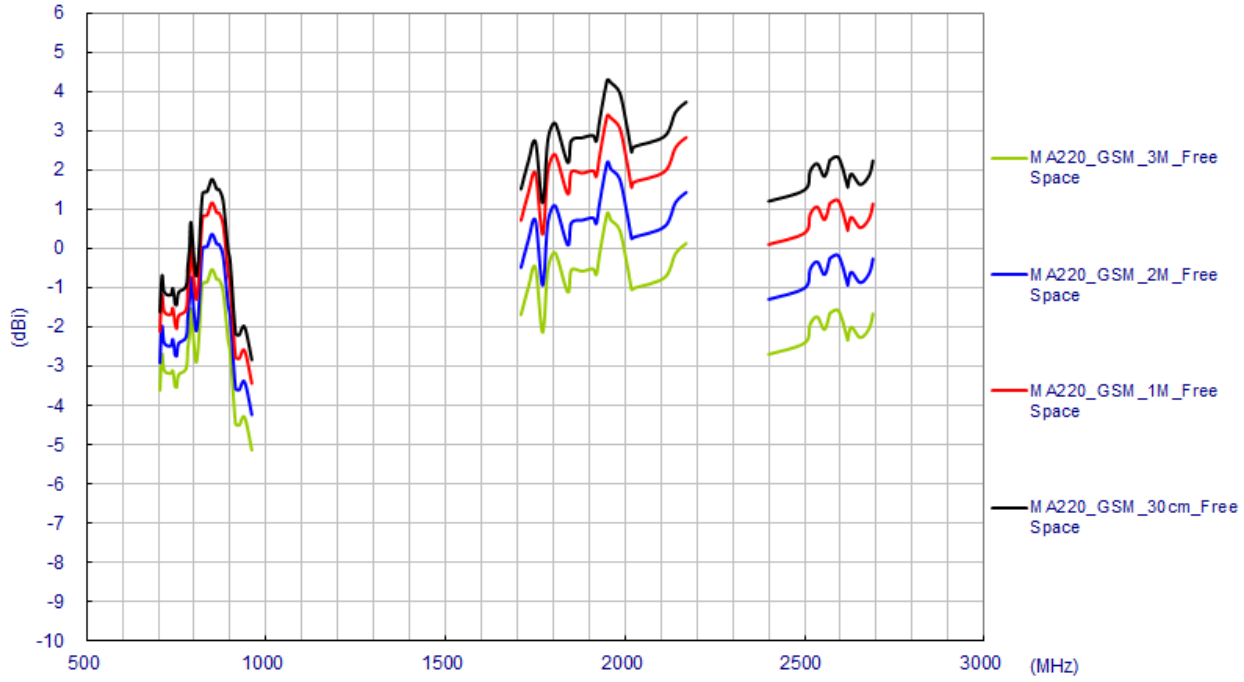


On Glass Base with RG174 Coaxial Cable

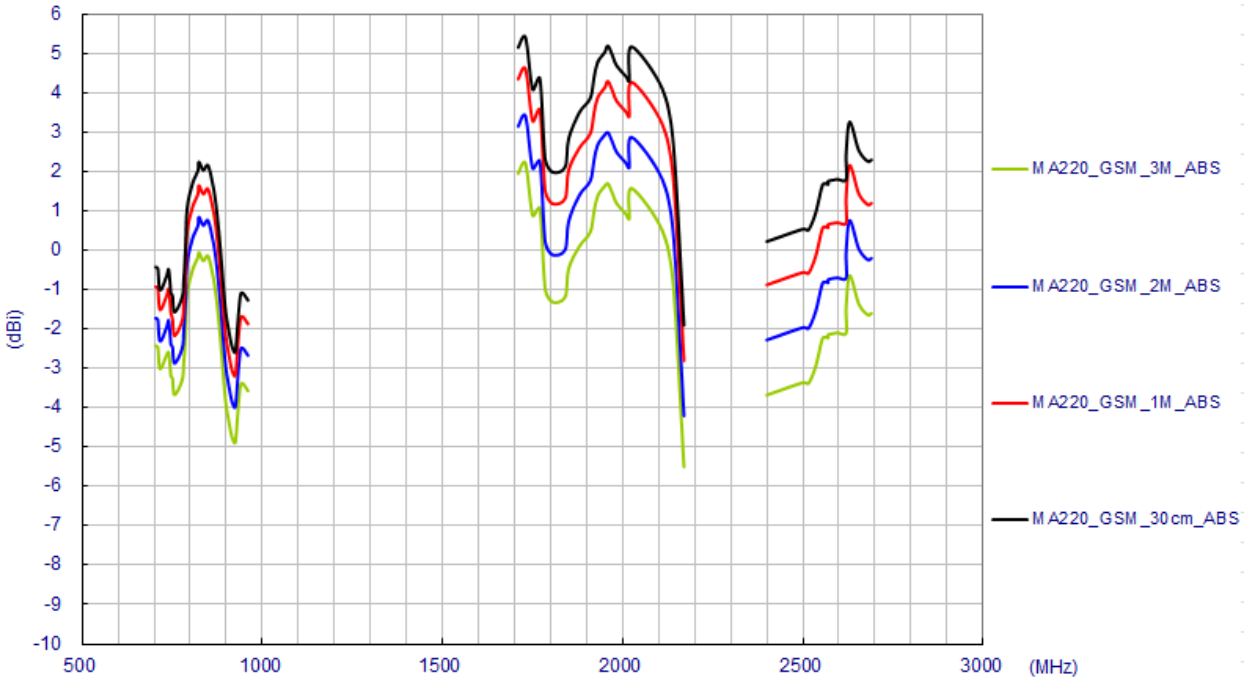


## 3.3 Peak Gain

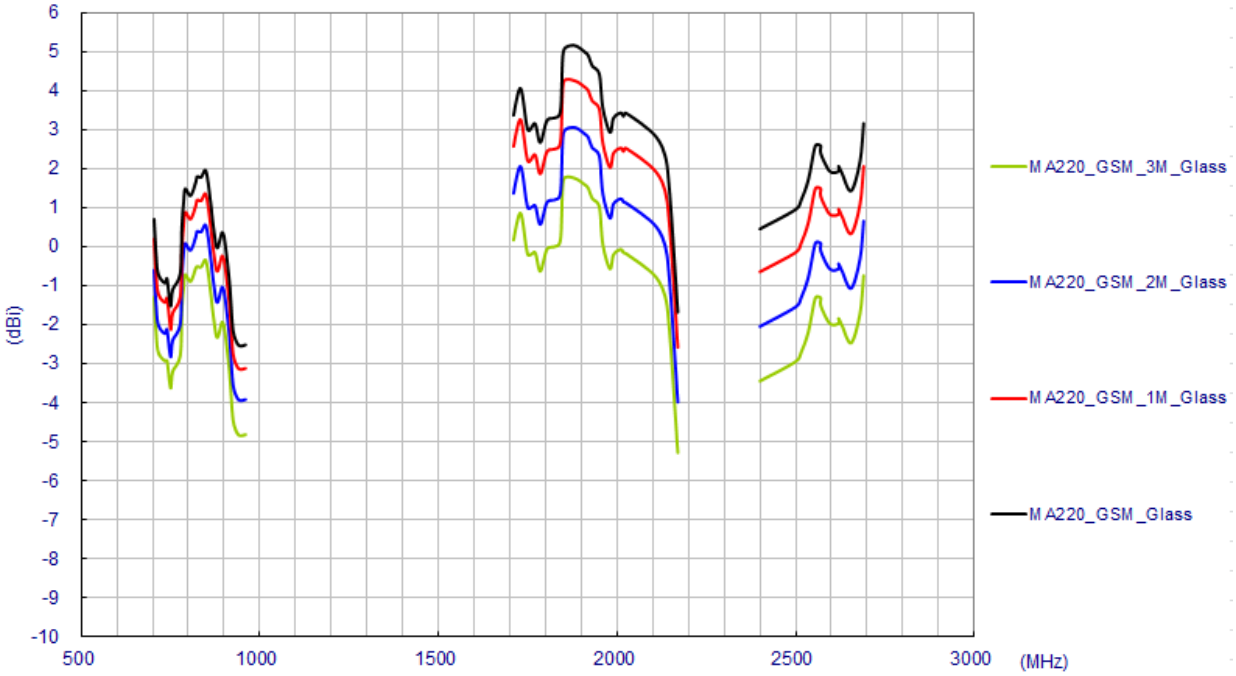
Free Space with RG174 Coaxial Cable




On 2mm thickness ABS Base with RG174 Coaxial Cable

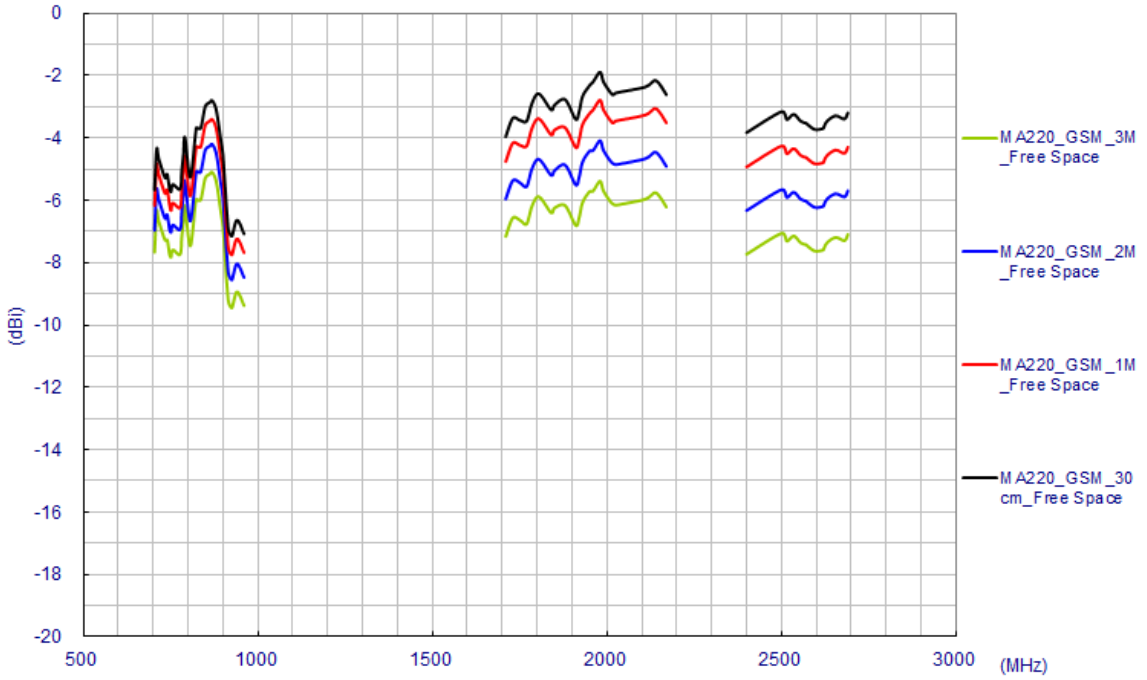



On Glass Base with RG174 Coaxial Cable

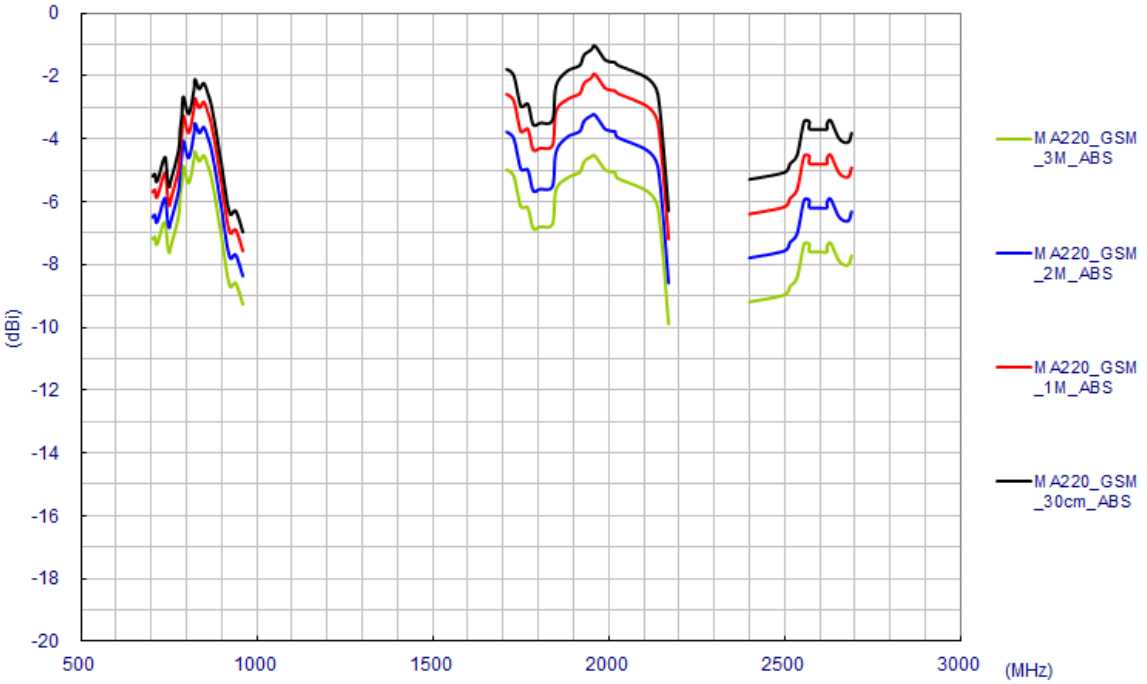

6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
(dBi)
500
1000
1500
2000
2500
3000
(MHz)
MA220_GSM_3M_Glass
MA220_GSM_2M_Glass
MA220_GSM_1M_Glass
MA220_GSM_Glass

## 3.4 Average Gain

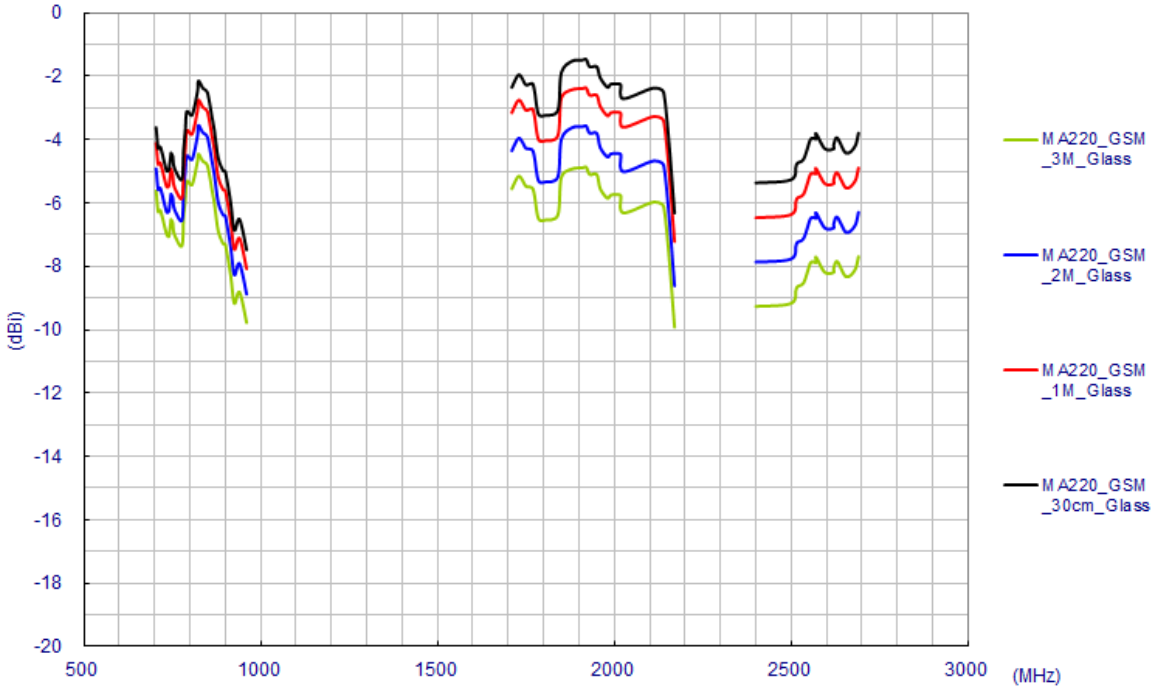
Free Space with RG174 Coaxial Cable



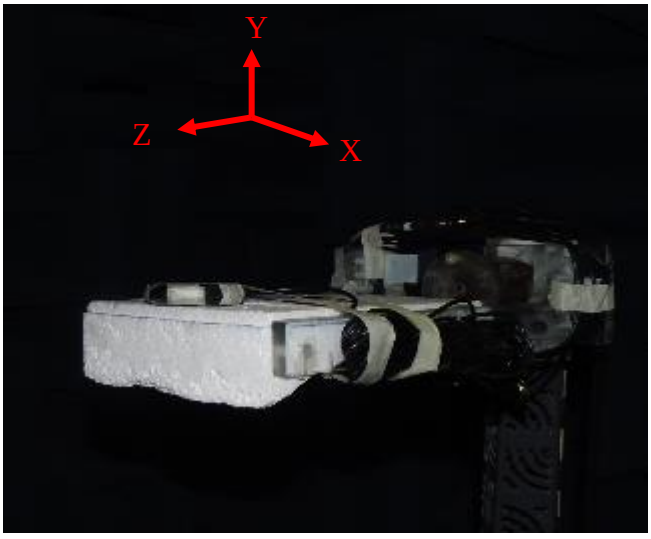

On 2mm thickness ABS Base with RG174 Coaxial Cable



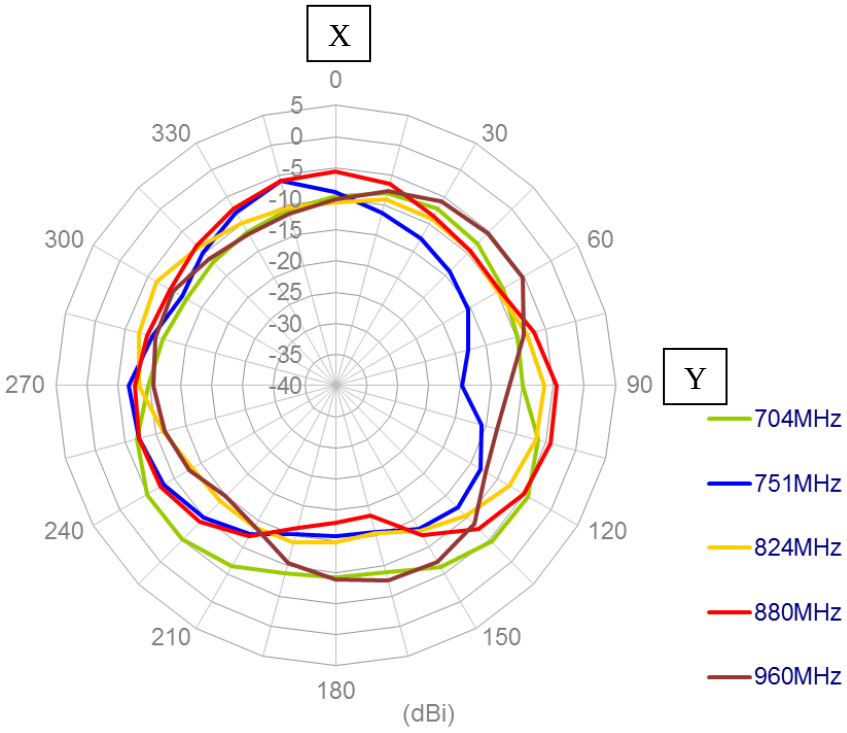

On Glass Base with RG174 Coaxial Cable

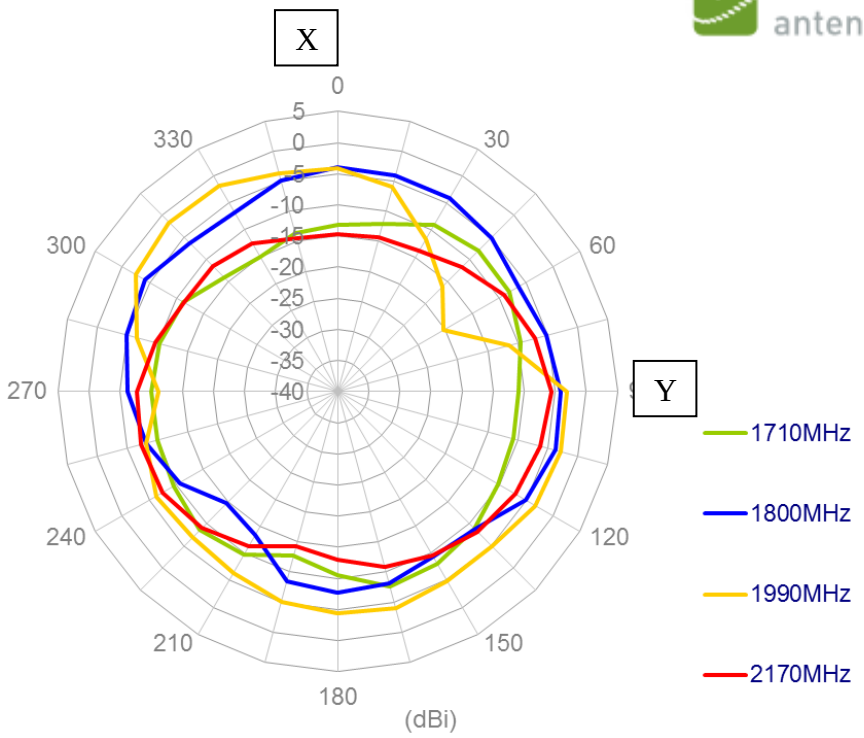

0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
(dBi)
500
1000
1500
2000
2500
3000
(MHz)
MA220_GSM_3M_Glass
MA220_GSM_2M_Glass
MA220_GSM_1M_Glass
MA220_GSM_30cm_Glass

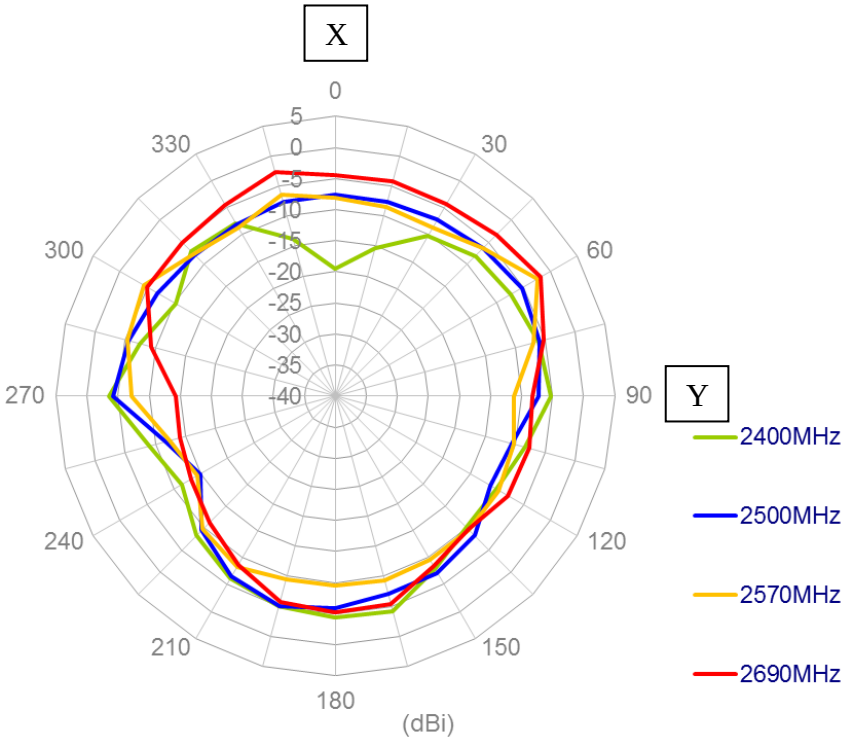
## 3.5 Free Space Radiation Pattern-3meter length cable



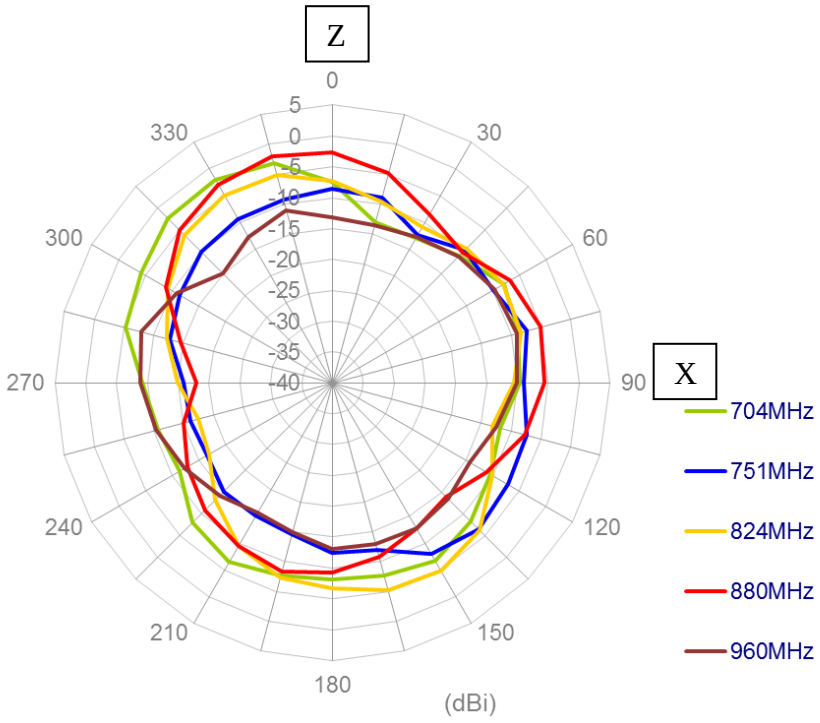

XY-Plane

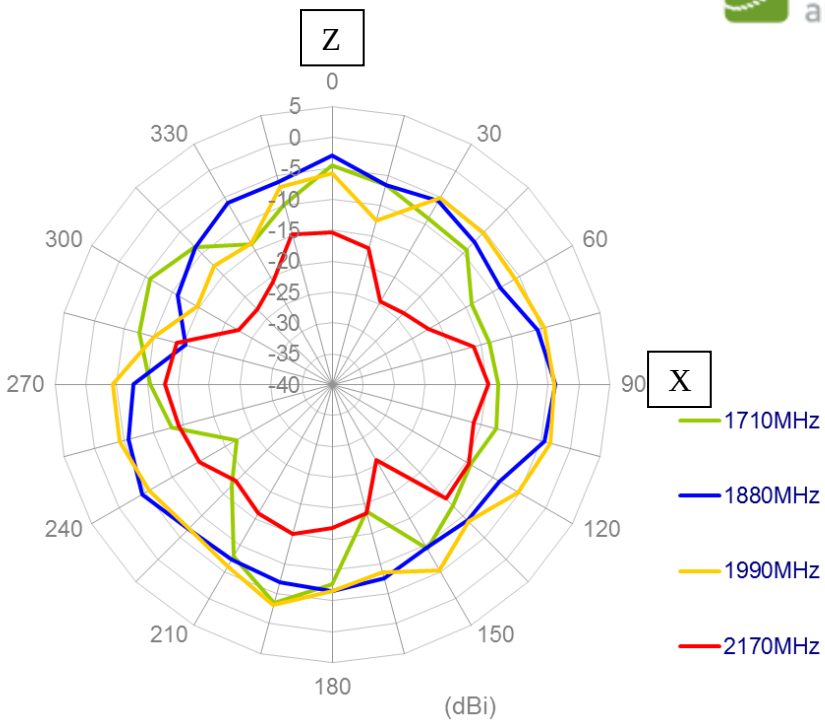


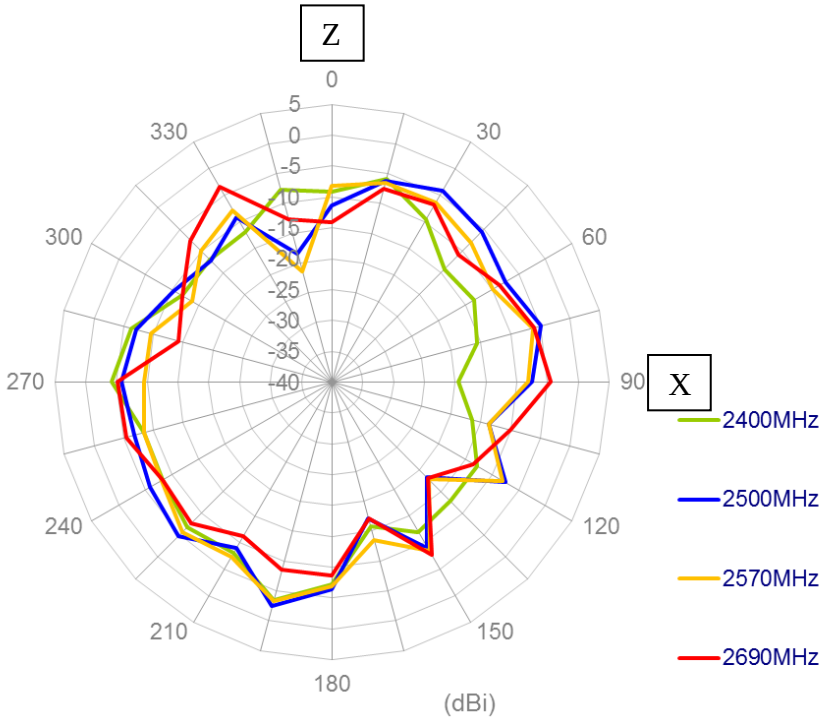

X
0
30
60
90
120
150
180
210
240
270
300
330
5
0
-5
-10
-15
-20
-25
-30
-35
-40
Y
1710MHz
1800MHz
1990MHz
2170MHz
(dBi)


X
0
30
60
90
120
150
180
210
240
270
300
330
5
0
-5
-10
-15
-20
-25
-30
-35
-40
Y
2400MHz
2500MHz
2570MHz
2690MHz
(dBi)

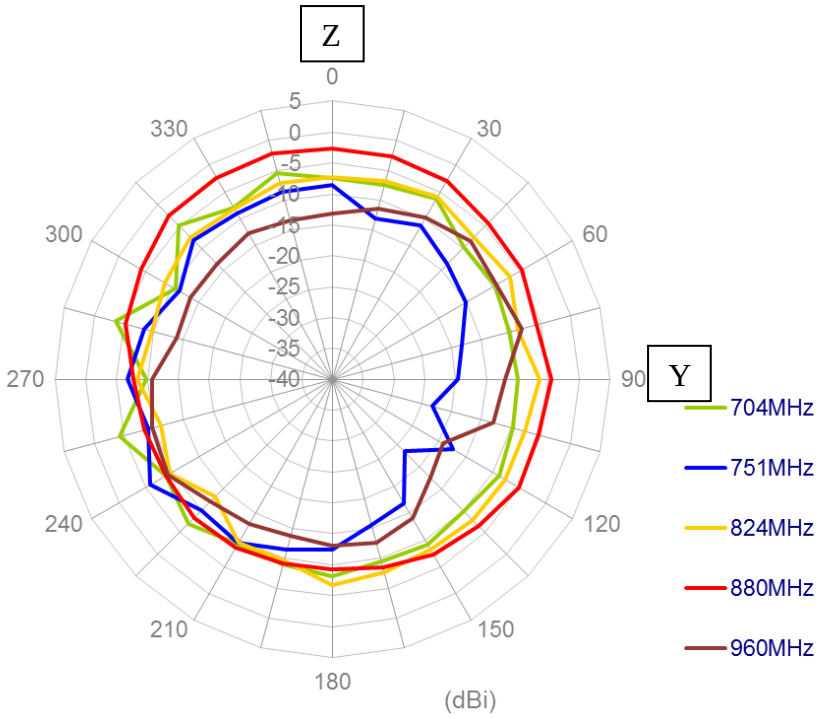
XZ-Plane

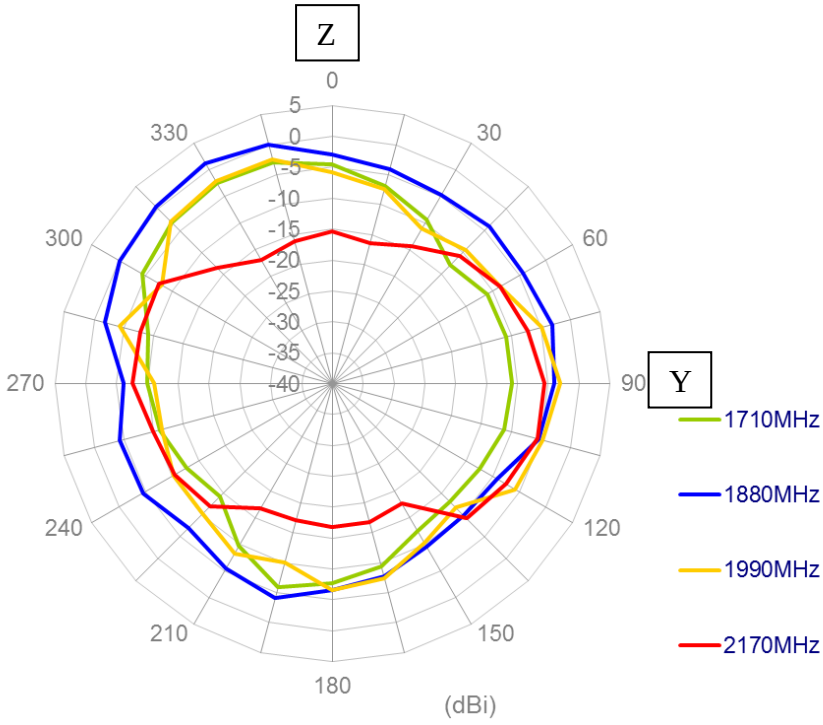

Z
0
30
60
90
120
150
180
210
240
270
300
330
5
0
-5
-10
-15
-20
-25
-30
-35
-40
X
(dBi)
704MHz
751MHz
824MHz
880MHz
960MHz

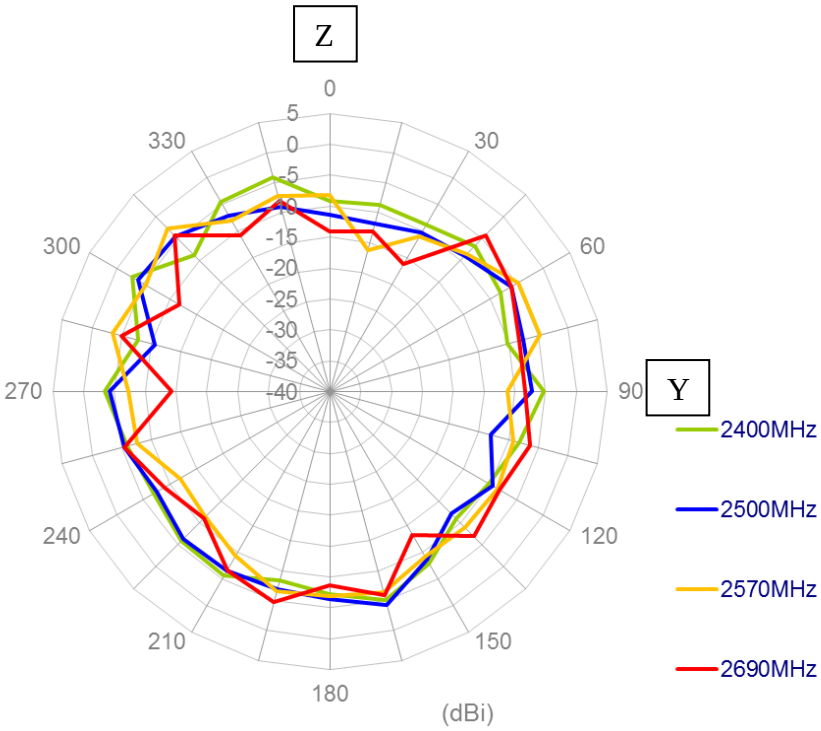

Z
0
30
60
90
120
150
180
210
240
270
300
330
5
0
-5
-10
-15
-20
-25
-30
-35
-40
X
1710MHz
1880MHz
1990MHz
2170MHz
(dBi)


Z
0
30
60
90
120
150
180
210
240
270
300
330
5
0
-5
-10
-15
-20
-25
-30
-35
-40
X
2400MHz
2500MHz
2570MHz
2690MHz
(dBi)

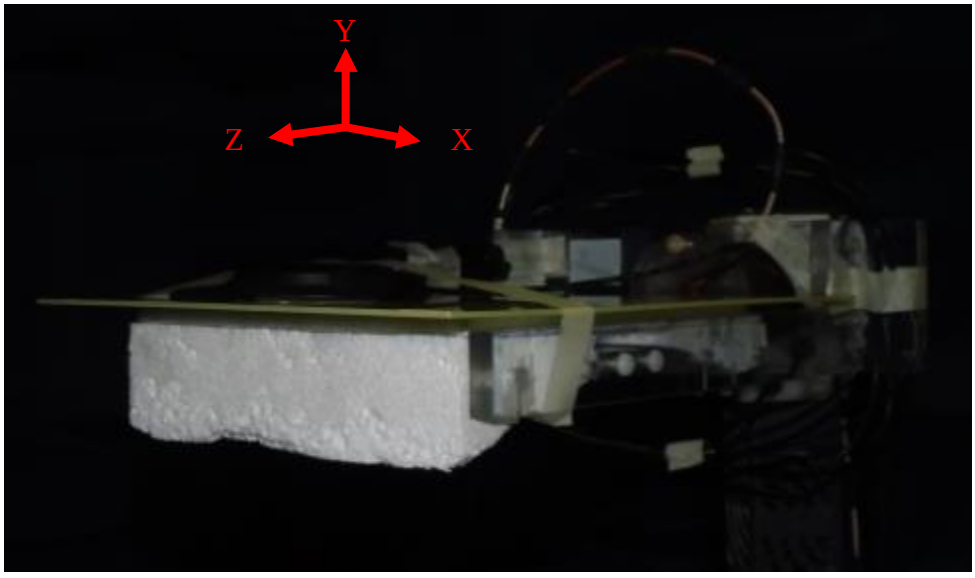
YZ-Plane


Z
0
30
60
90
120
150
180
210
240
270
300
330
5
0
-5
-10
-15
-20
-25
-30
-35
-40
Y
704MHz
751MHz
824MHz
880MHz
960MHz
(dBi)

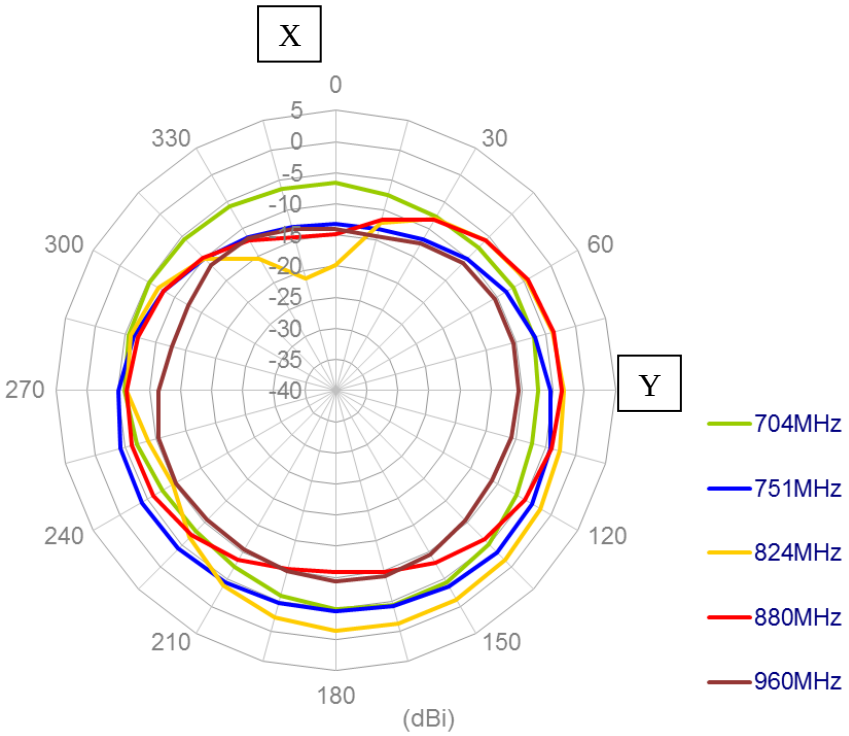

Z
0
30
60
90
120
150
180
210
240
270
300
330
5
0
-5
-10
-15
-20
-25
-30
-35
-40
Y
1710MHz
1880MHz
1990MHz
2170MHz
(dBi)

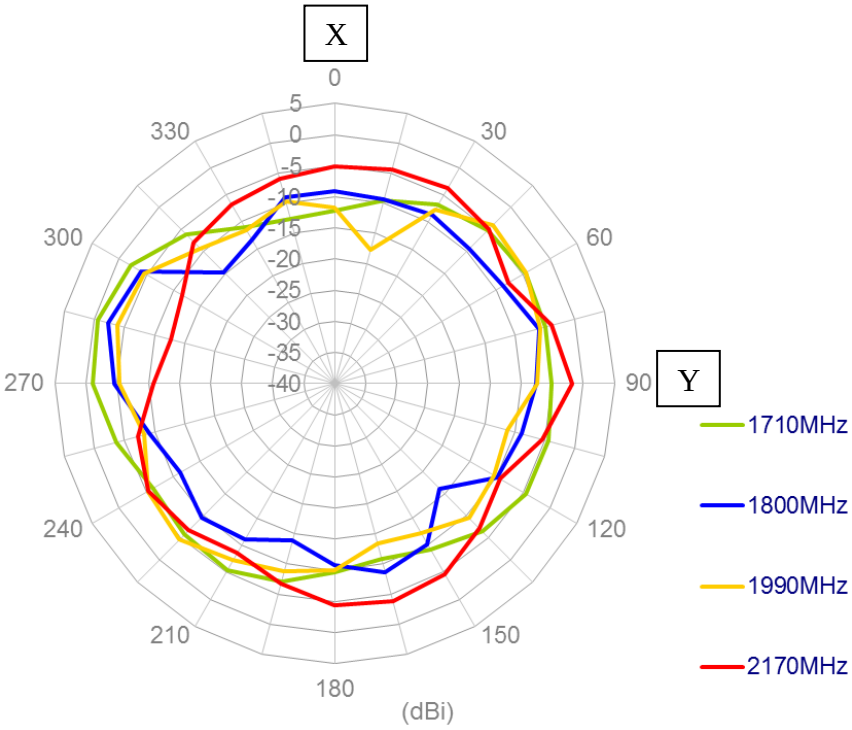

Z
0
30
60
90
120
150
180
210
240
270
300
330
5
0
-5
-10
-15
-20
-25
-30
-35
-40
Y
(dBi)
2400MHz
2500MHz
2570MHz
2690MHz

## 3.6 On 2mm thickness ABS Base Radiation Pattern- 3meter length cable




XY-Plane




X
0
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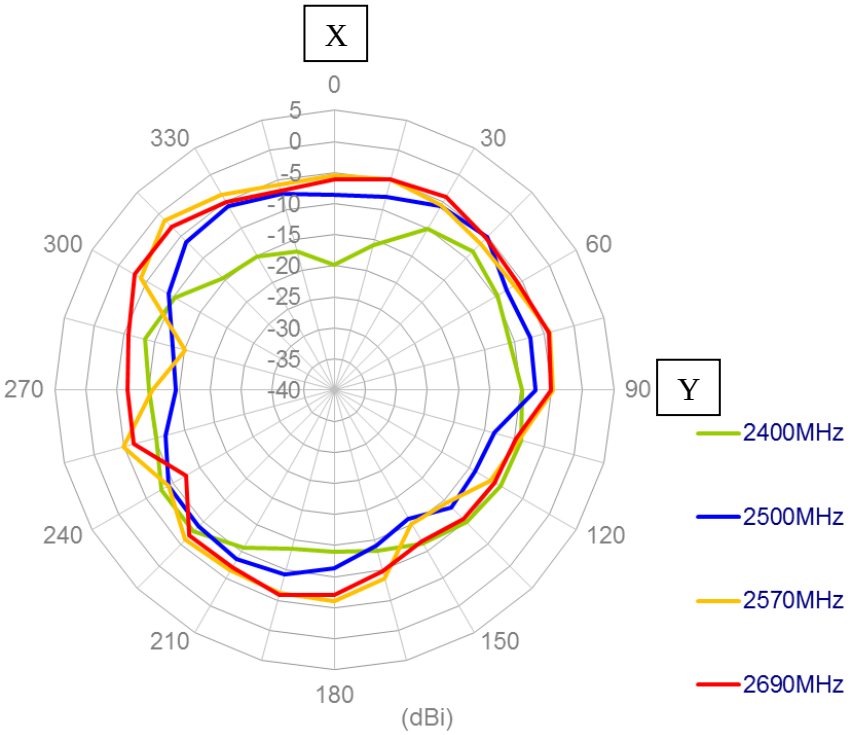
180
210
240
270
300
330
5
0
-5
-10
-15
-20
-25
-30
-35
-40
(dBi)
Y
1710MHz
1800MHz
1990MHz
2170MHz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330
5
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-5
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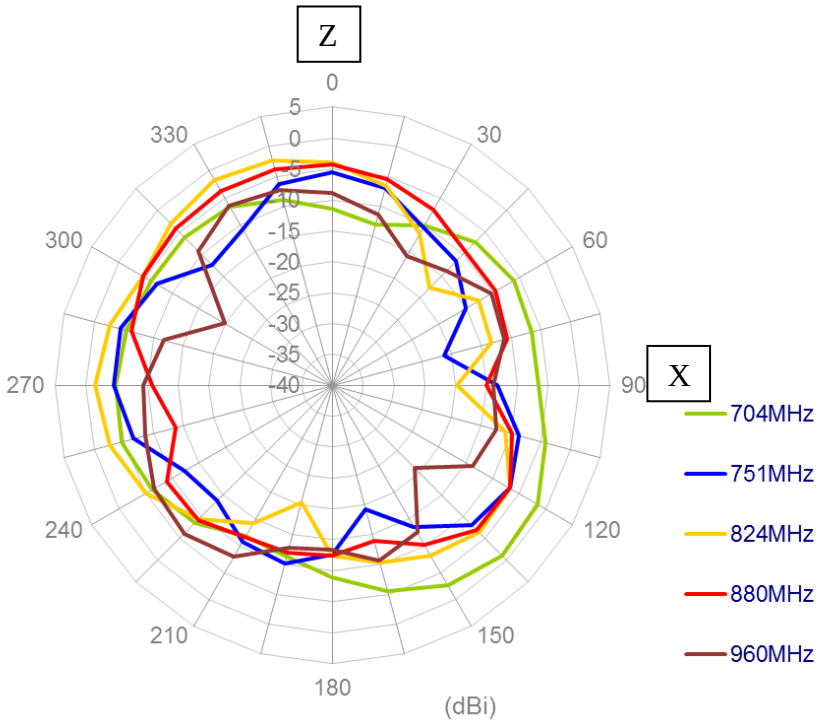
-15
-20
-25
-30
-35
-40
(dBi)
Y
2400MHz
2500MHz
2570MHz
2690MHz

XZ-Plane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300
330
5
0
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-10
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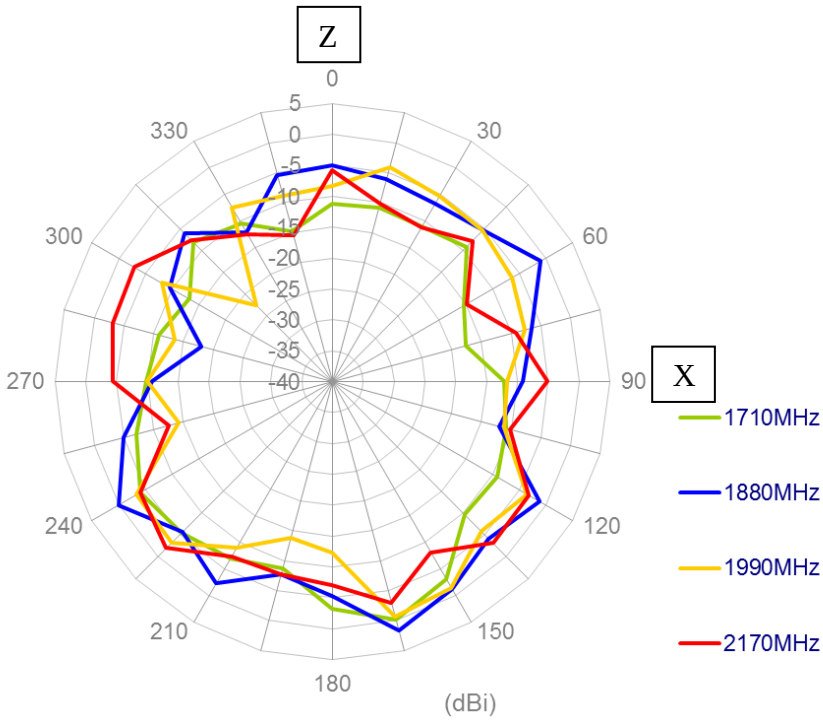
-25
-30
-35
-40
X
704MHz
751MHz
824MHz
880MHz
960MHz
(dBi)


Z
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180
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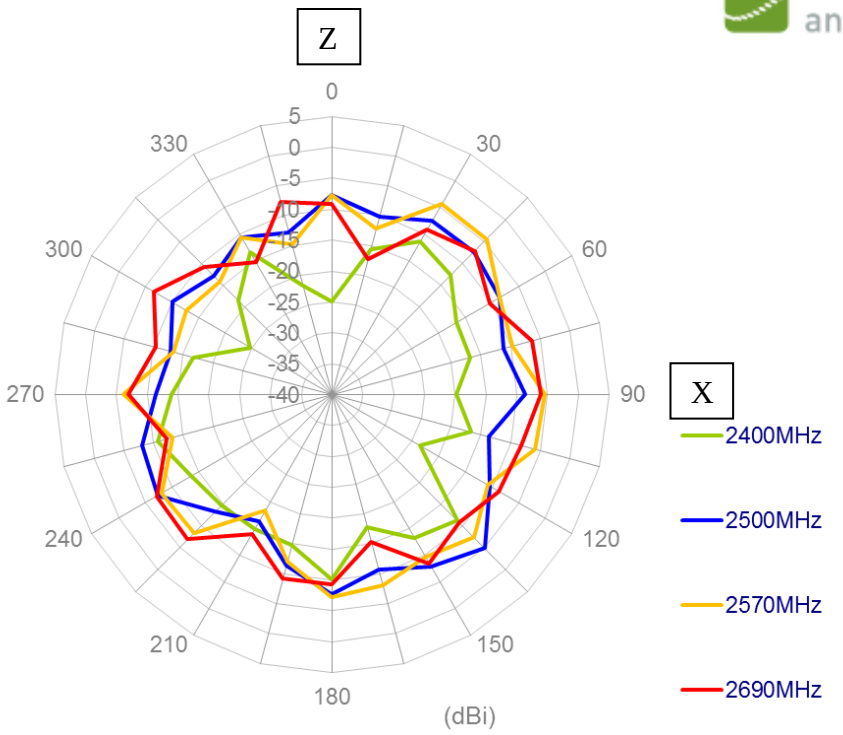
240
270
300
330
5
0
-5
-10
-20
-25
-30
-35
-40
X
1710MHz
1880MHz
1990MHz
2170MHz
(dBi)


Z
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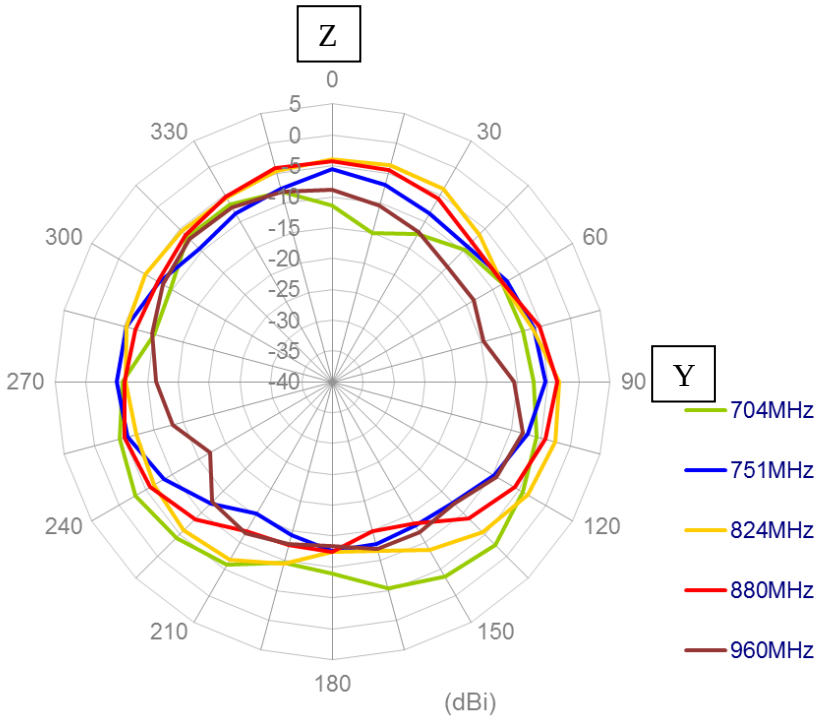
270
300
330
5
0
-5
-10
-15
-20
-25
-30
-35
-40
X
2400MHz
2500MHz
2570MHz
2690MHz
(dBi)

YZ-Plane


Z
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210
240
270
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330
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-10
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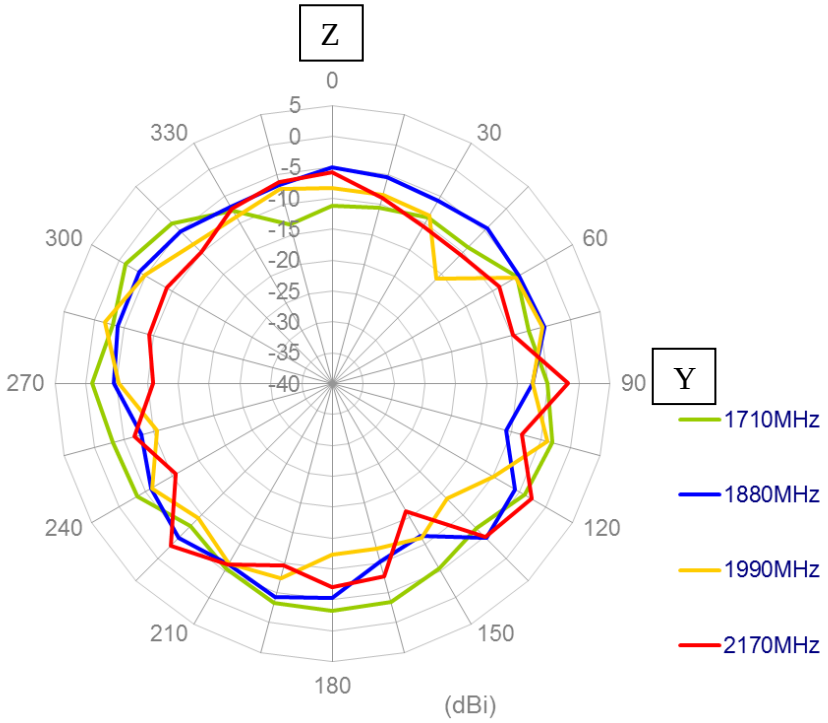
-25
-30
-35
-40
Y
704MHz
751MHz
824MHz
880MHz
960MHz
(dBi)


Z
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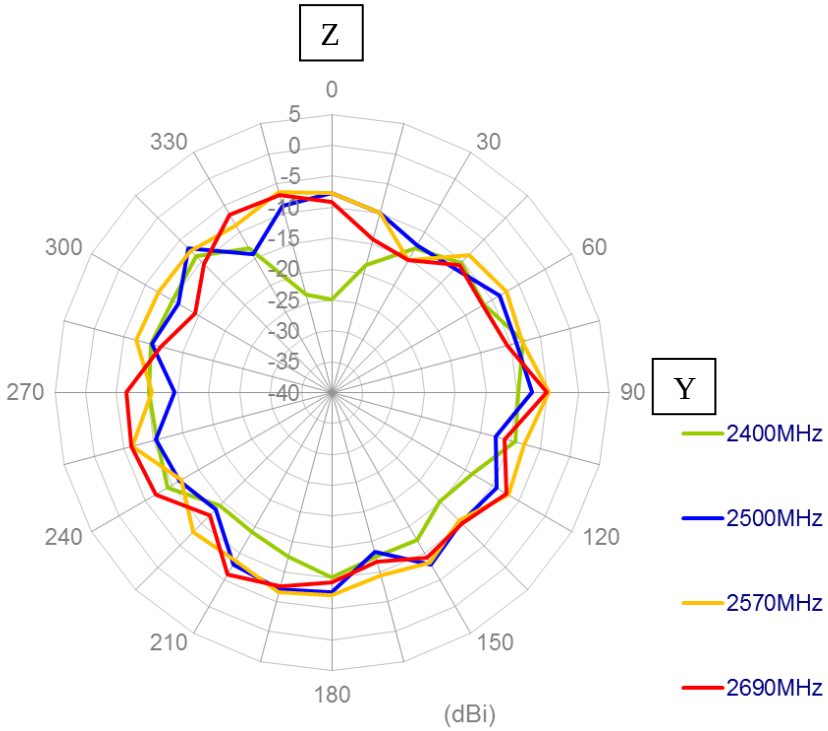
-20
-25
-30
-35
-40
Y
1710MHz
1880MHz
1990MHz
2170MHz
(dBi)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-5
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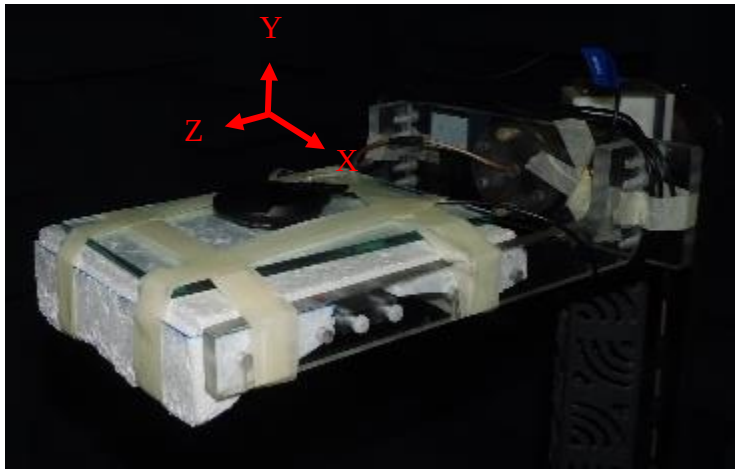
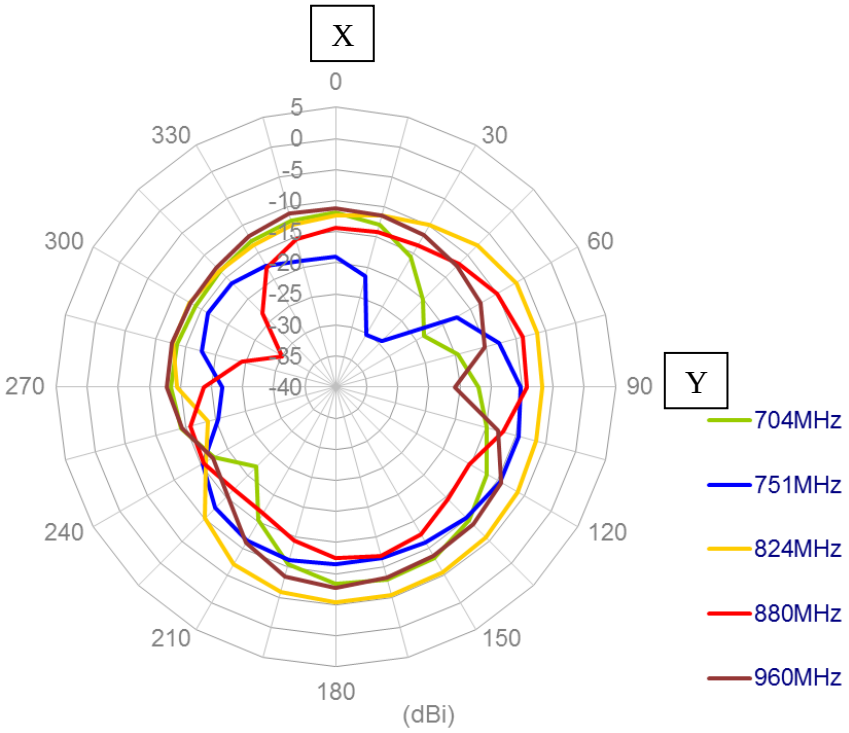
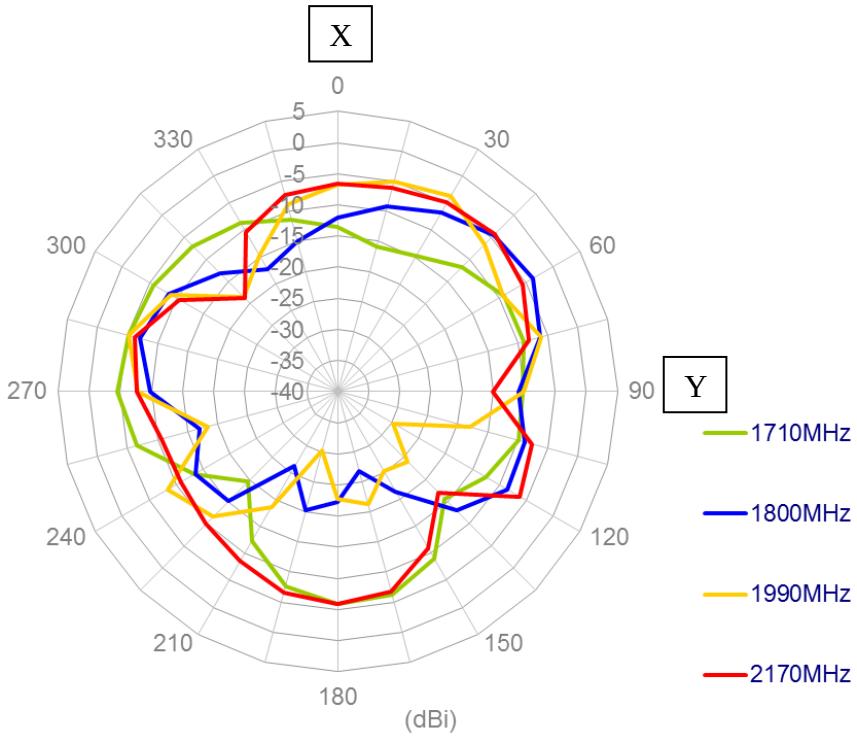
-25
-30
-35
-40
Y
2400MHz
2500MHz
2570MHz
2690MHz
(dBi)

## 3.7 On Glass Base Radiation Pattern-3meter length cable




XY-Plane

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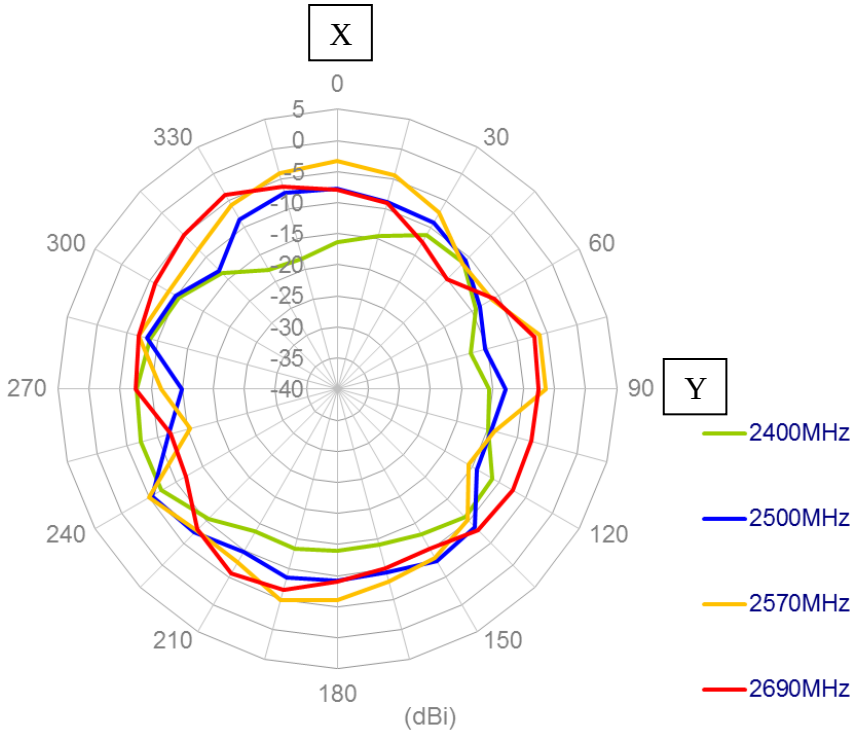
240
270
300
330
5
0
-5
-10
-15
-20
-25
-30
-35
-40
Y
1710MHz
1800MHz
1990MHz
2170MHz
(dBi)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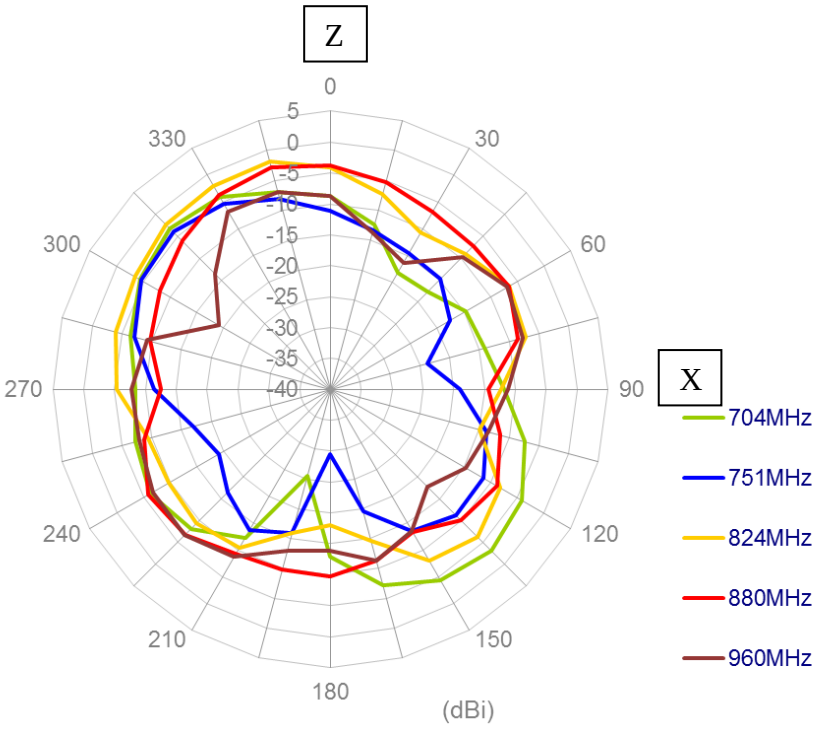
60
90
120
150
180
210
240
270
300
330
5
0
-5
-10
-15
-20
-25
-30
-35
-40
Y
2400MHz
2500MHz
2570MHz
2690MHz
(dBi)

XZ-Plane


Z
0
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210
240
270
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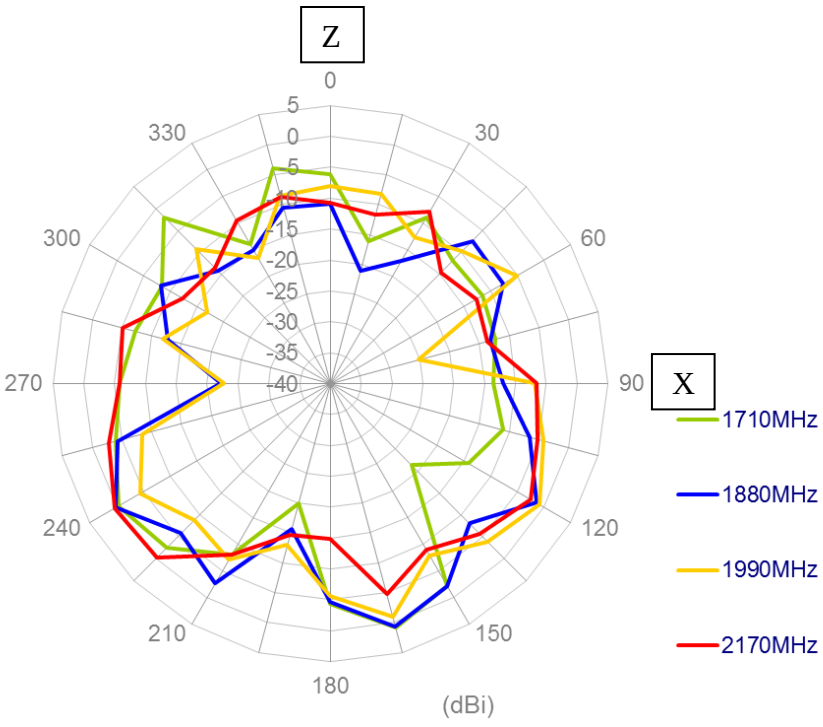
330
5
0
-5
-10
-15
-20
-25
-30
-35
-40
X
704MHz
751MHz
824MHz
880MHz
960MHz
(dBi)


Z
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-10
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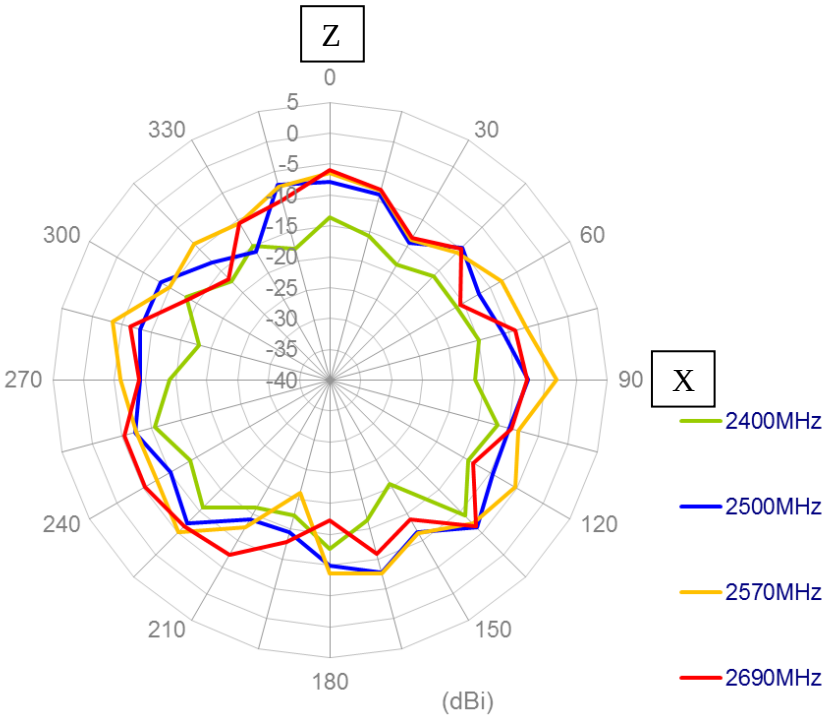
-25
-30
-35
-40
X
1710MHz
1880MHz
1990MHz
2170MHz
(dBi)


Z
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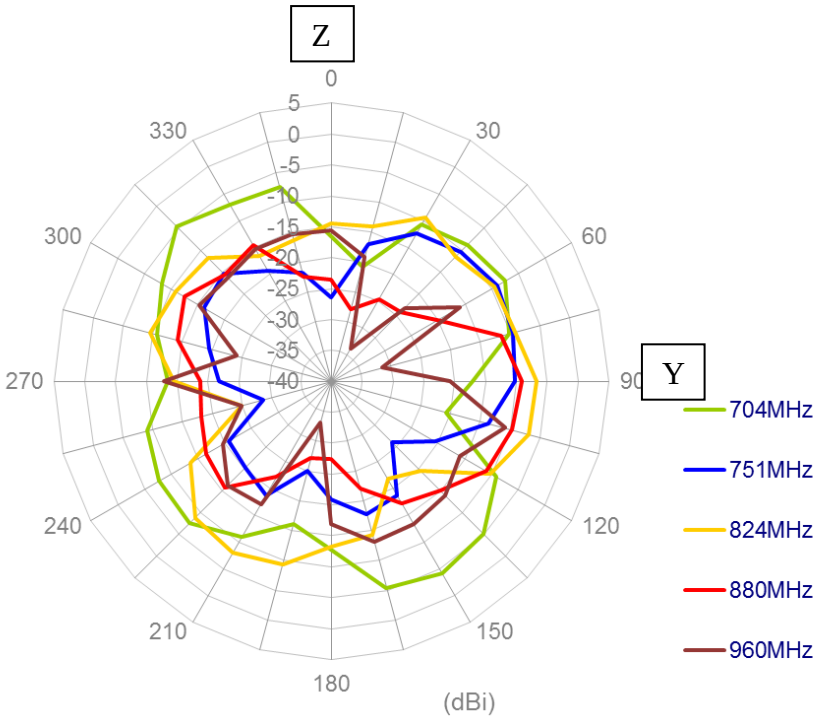
-5
-10
-15
-20
-25
-30
-35
-40
X
(dBi)
2400MHz
2500MHz
2570MHz
2690MHz

YZ-Plane


Z
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120
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210
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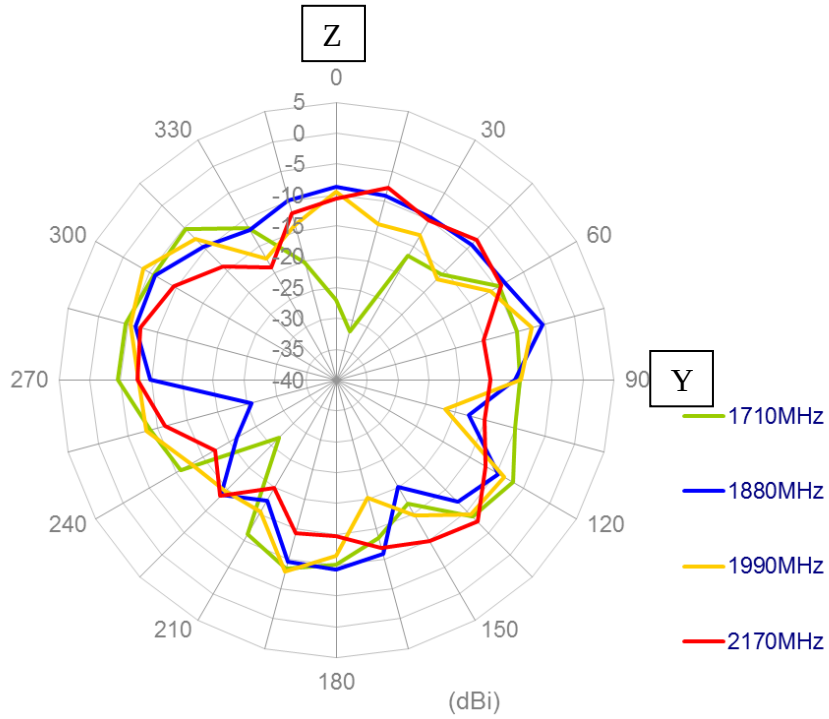
-25
-30
-35
-40
Y
(dBi)
704MHz
751MHz
824MHz
880MHz
960MHz


Z
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-25
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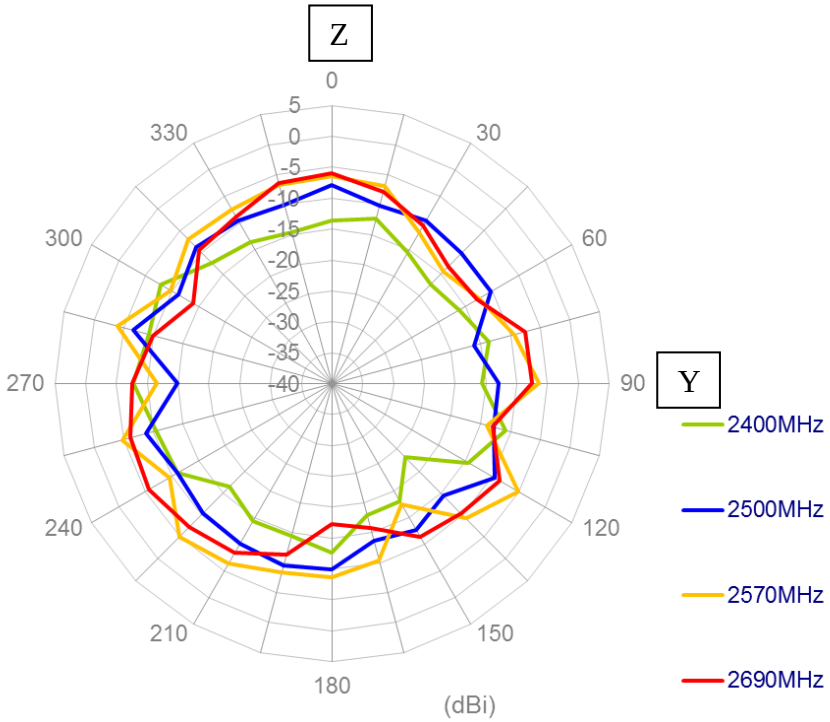
-40
Y
1710MHz
1880MHz
1990MHz
2170MHz
(dBi)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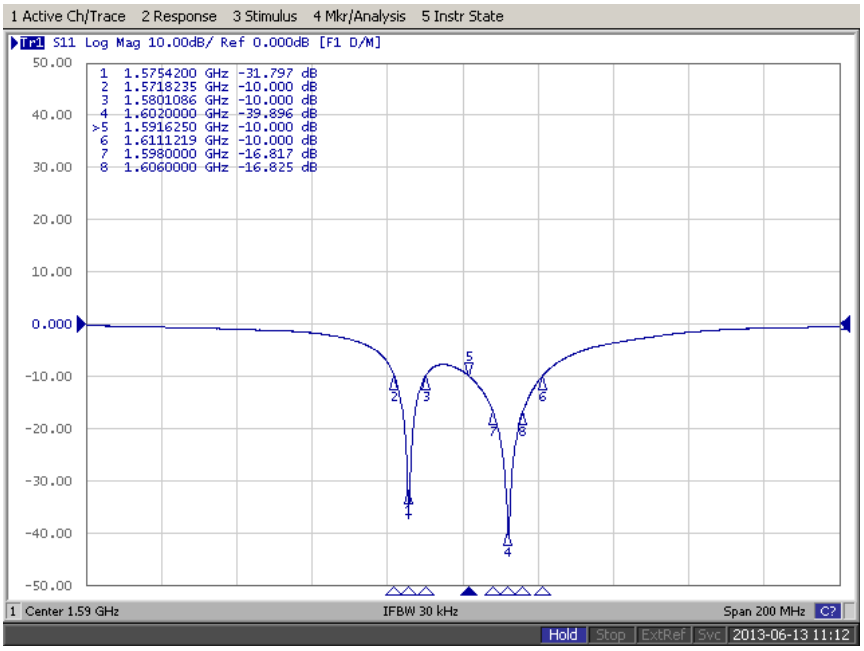
5
0
-5
-10
-15
-20
-25
-30
-35
-40
Y
2400MHz
2500MHz
2570MHz
2690MHz
(dBi)

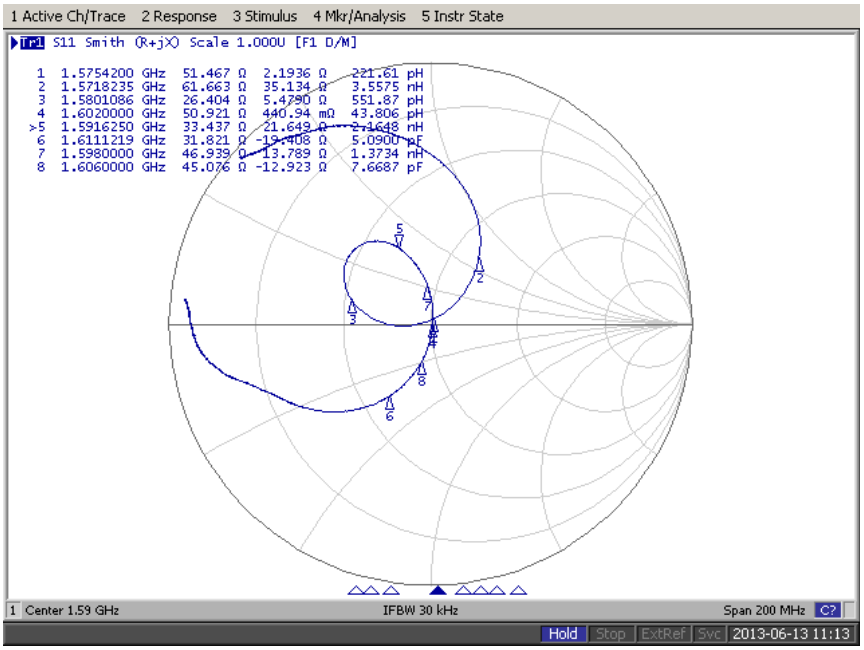
# 4. GPS-GLONASS Antenna Characteristics

## 4.1. Antenna Characteristics

### Return Loss



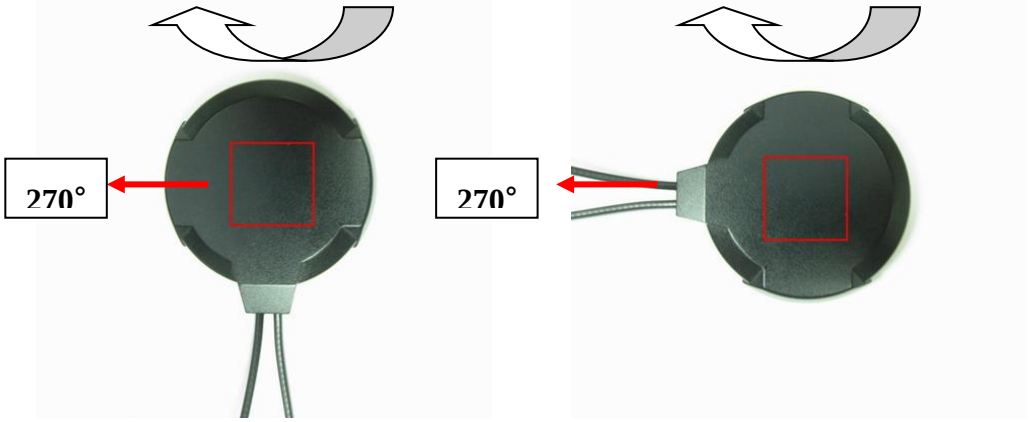

### Smith Chart



## Experiment Results

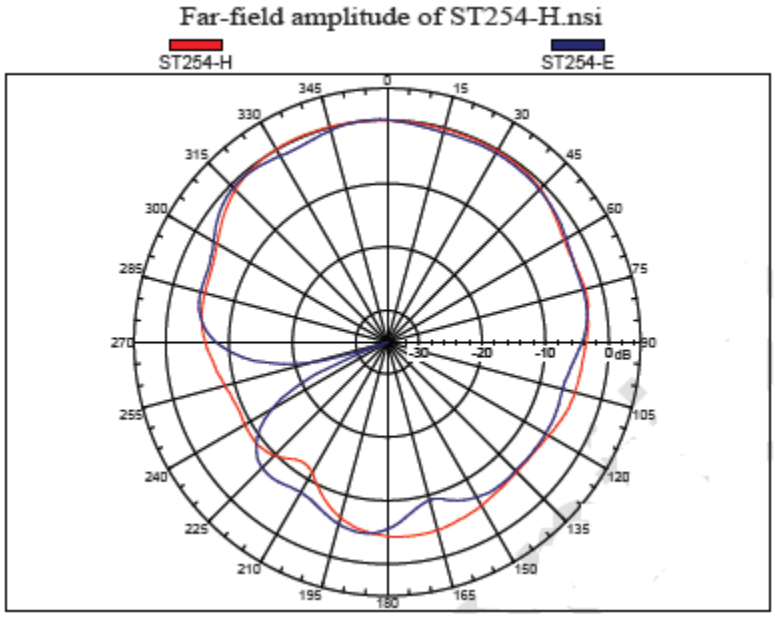
| Dimension (mm) | Fo(MHz) | Return Loss (dB) | Impedance(Ω) | Gain 0° H-Plane(dBic) | Gain 0° E-Plane(dBic) |
|---|---|---|---|---|---|
| 25.0x25.0x4.0 | 1575.42 | -31.7 | 51.4 + j 2.1 | -0.08 | 0.00 |
| | 1598 | -16.8 | 46.9 + j 13.7 | -3.86 | -3.62 |
| | 1602 | -39.8 | 50.9 + j 0.4 | -4.17 | -4.32 |
| | 1606 | -16.8 | 45.0 - j 12.9 | -4.74 | -5.16 |

## Antenna Radiation Pattern

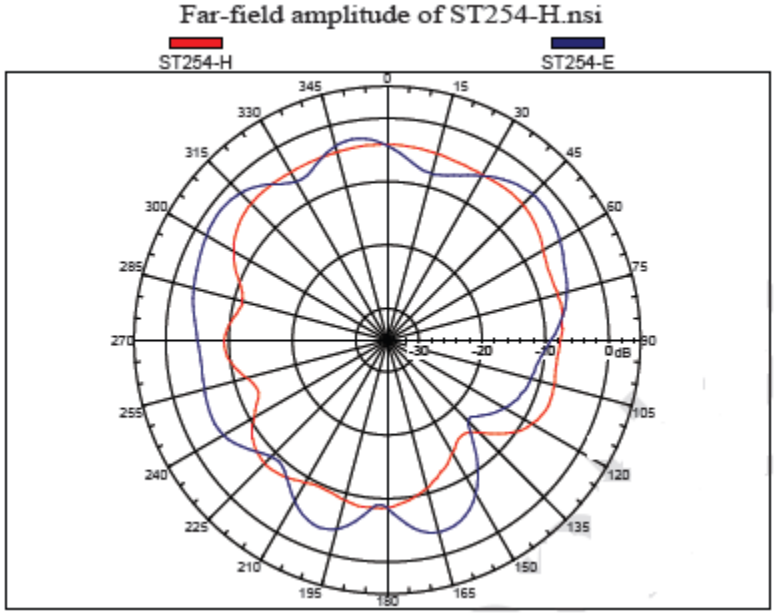



H-Plane E-Plane

**1575.42 MHz**

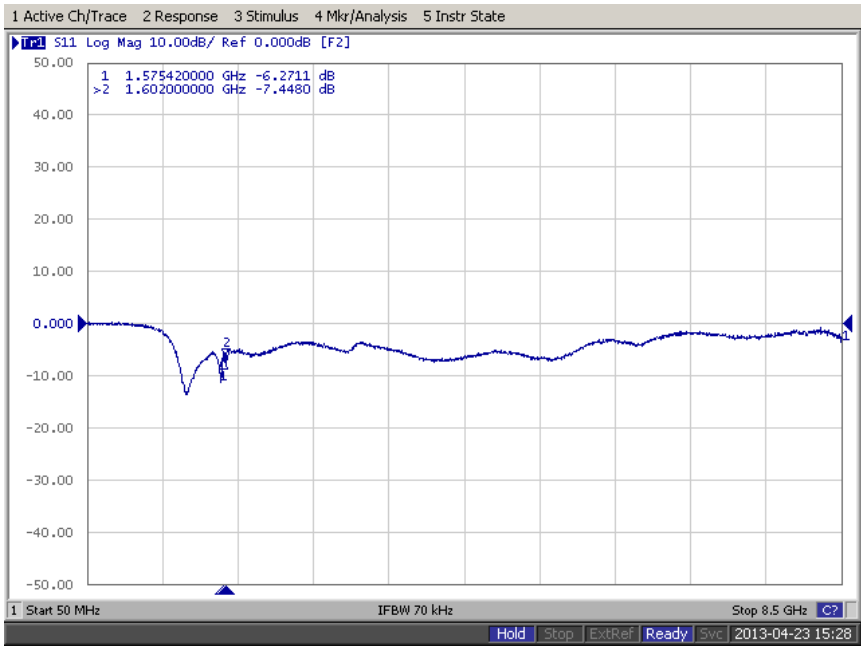



**1602 MHz**

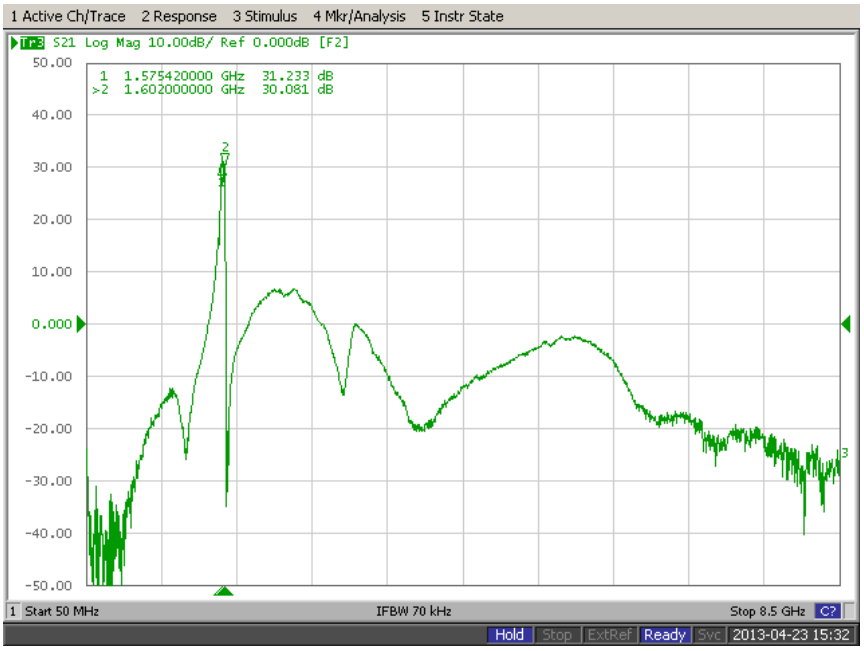


## 4.2. LNA Characteristics

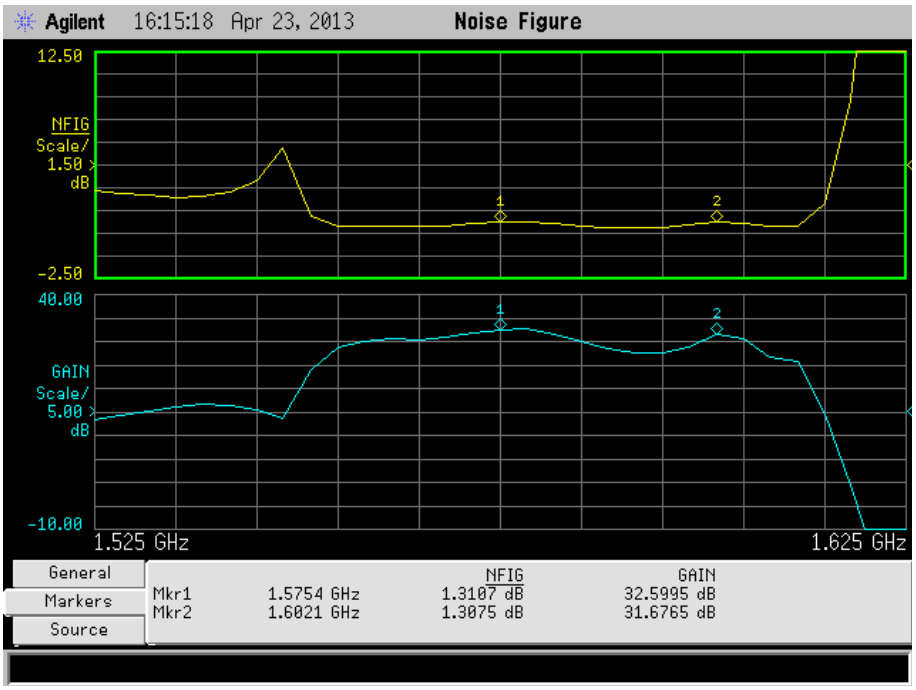
**S11**




**S12**

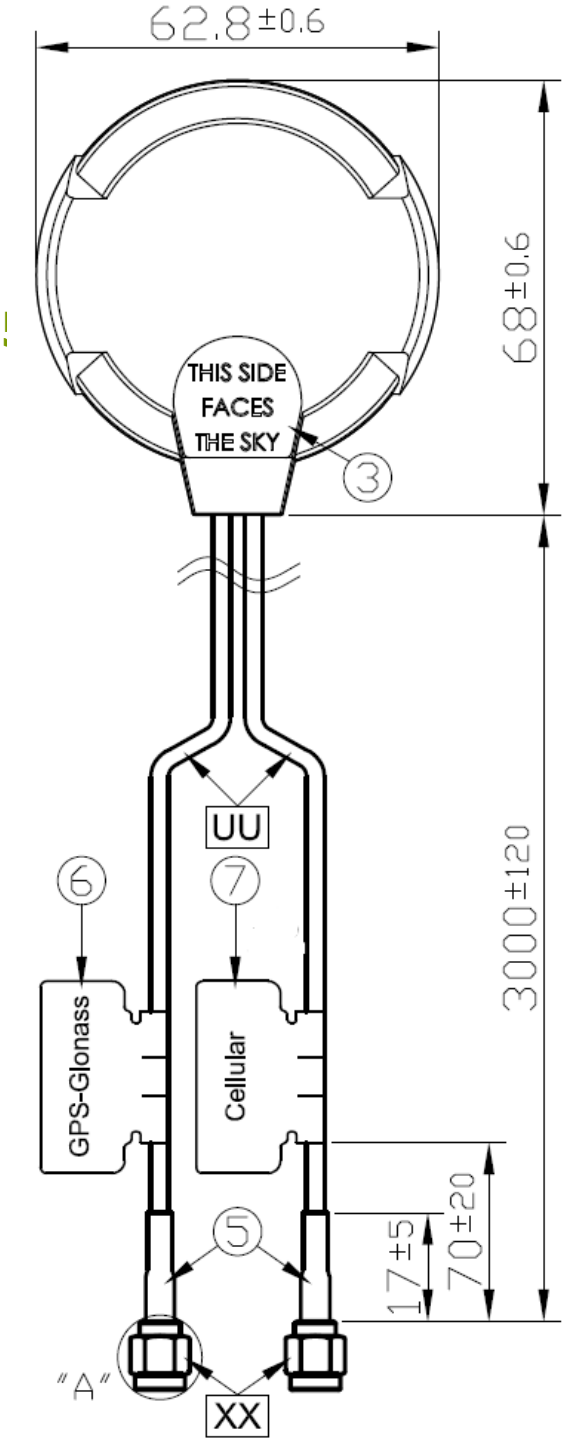


## Noise Figure

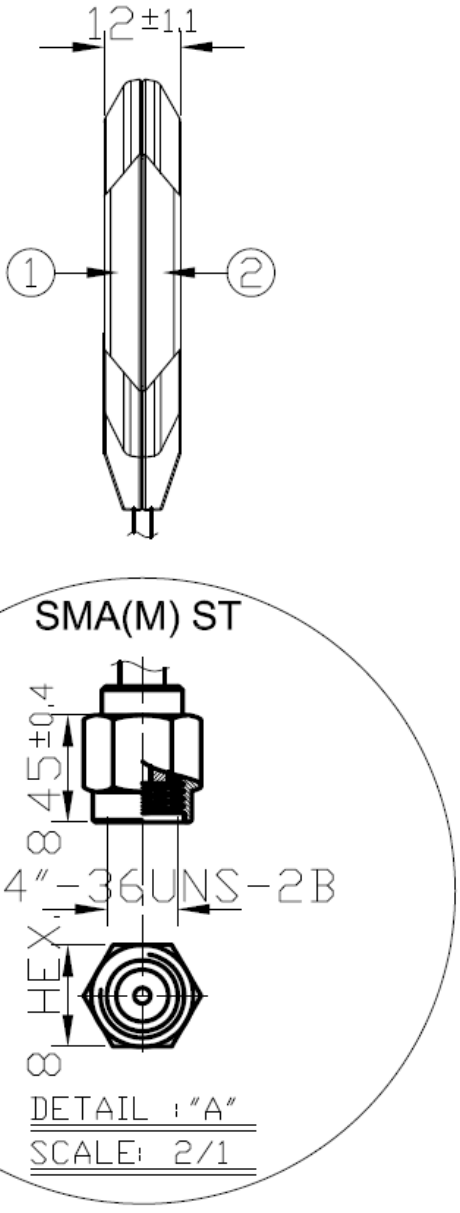


# 5. Drawing

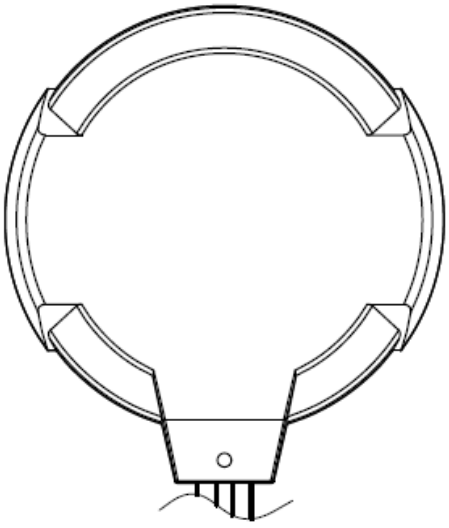
## Top View



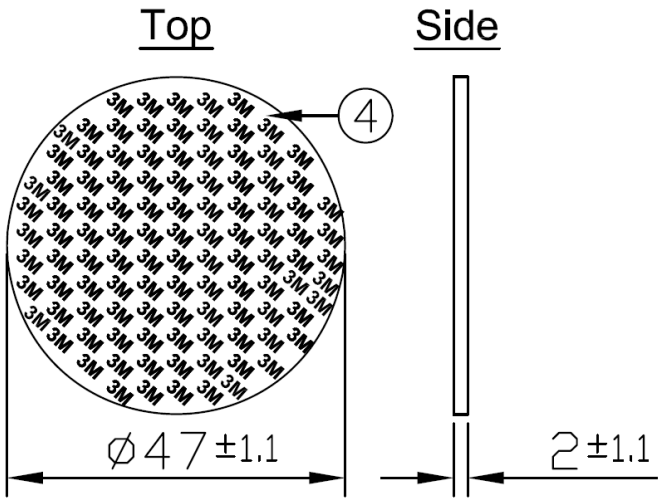

## Side View



**Bottom View**



**Double sided 3M adhesive foam**




| | Name | Material | Finish | QTY |
|---|---|---|---|---|
| 1 | Housing Top | ABS | Black | 1 |
| 2 | Housing Bottom | ABS | Black | 1 |
| 3 | Clear Label | PET | White | 1 |
| 4 | Double Adhesive Foam | 3M 9448+CR-4305 | Black | 1 |
| 5 | Heat Shrink Tube RG-174 | PE | Black | 2 |
| 6 | GPS-Glonass Label | Coated Paper | Orange | 1 |
| 7 | Cellular Label | Coated Paper | Blue | 1 |

| | Name | Spec | Finish | QTY |
|---|---|---|---|---|
| UU | Cable Type | RG-174 | Black | 2 |
| XX | Connector Type | SMA(M) ST | Gold | 2 |

# 6. Packaging