

# Specification

|              |   |                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Part No.     | : | <b>MA9909.A.002</b>                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Product Name | : | GuardianX 1M 9in1 1*Active GNSS RG174 SMA(M)<br>8*LTE MIMO TGC200 SMA(M)                                                                                                                                                                                                                                                                                                                                                                   |
| Features     | : | <p>Low-profile Housing with Wall Mount</p> <p>8* LTE MIMO 698 to 960MHz/1710 to 2170MHz/ 2490 to 2690MHz/ 3300 to 3600MHz</p> <p>1* GPS-GLONASS- Antenna</p> <p>Worldwide 4G Bands including 3G and 2G</p> <p>IP67 Waterproof Resistant Enclosure</p> <p>Dims: 360mm * 160mm * 16.5mm</p> <p>1M Low Loss TGC-200 and RG174 with SMA(M)/RP-SMA(M) connectors</p> <p>Custom Cables and Connectors Available</p> <p><b>RoHS compliant</b></p> |



## 1. Introduction

The Taoglas GuardianX MA9908.A.001 is a low profile heavy duty, fully IP67 waterproof external antenna. Combining 8 elements into one antenna, 1 GPS/GLONASS/Galileo, 8\* LTE MIMO (698 to 960MHz/1710 to 2170MHz/ 2490 to 2690MHz/ 3300 to 3600MHz. This unique product delivers powerful worldwide 4G LTE MIMO antenna technology at 700MHz/800MHz/1700MHz/1800MHz/2600MHz and GNSS.

Typical applications include:

- Passenger Bus / Rail / Air Applications.
- Automotive and Heavy Equipment Vehicle Tracking and Telematics
- Remote Asset and Pipeline Monitoring
- HD Video over LTE
- First Responder and Emergency Services
- M2M Applications/IoT

LTE 4G applications demand high speed data uplink and downlink. High efficiency and high gain MIMO antennas are necessary to achieve the required signal to noise ratio and throughput required to solve these challenges. Taoglas also takes care to have high isolation between the two MIMO antennas to prevent self-interference.

Low loss cables are used to keep efficiency high over long cable lengths. In contrast, smaller MIMO antennas with poorer quality thinner cables will have much reduced efficiency and isolation, which would lead to a large drop in system throughput, increased number of drops, and may indeed not make a system connection at all.

Cable length and connector types are customizable. Contact your regional Taoglas sales office for support.

## 2. Specification

| 2G/3G/4G MIMO Antenna |      |         |         |         |           |           |           |           |
|-----------------------|------|---------|---------|---------|-----------|-----------|-----------|-----------|
| Frequency (MHz)       |      | LTE700  | GSM850  | GSM900  | DCS       | PCS       | UMTS1     | LTE2600   |
|                       |      | 698~806 | 824~894 | 880~960 | 1710~1880 | 1850~1990 | 1920~2170 | 2490~2690 |
| Efficiency (%)        |      |         |         |         |           |           |           |           |
| LTE1                  | 0.3M | 40.43   | 46.11   | 55.89   | 48.39     | 52.24     | 59.34     | 48.34     |
|                       | 1M   | 38.32   | 44.05   | 53.36   | 44.13     | 47.66     | 54.74     | 44.09     |
|                       | 2M   | 35.76   | 40.36   | 48.67   | 39.33     | 42.11     | 47.96     | 38.32     |
|                       | 3M   | 33.11   | 37.49   | 45.22   | 34.96     | 37.09     | 42.41     | 33.39     |
|                       | 5M   | 30.67   | 34.83   | 42.02   | 31.08     | 32.68     | 37.51     | 29.10     |
| LTE2                  | 0.3M | 29.45   | 29.73   | 31.73   | 17.97     | 54.87     | 67.07     | 68.57     |
|                       | 1M   | 27.95   | 28.40   | 30.30   | 16.77     | 50.04     | 61.15     | 63.21     |
|                       | 2M   | 26.09   | 26.03   | 27.64   | 14.95     | 44.60     | 54.04     | 55.36     |
|                       | 3M   | 24.14   | 24.17   | 25.69   | 13.44     | 39.64     | 47.58     | 48.97     |
|                       | 5M   | 22.34   | 22.45   | 23.88   | 12.09     | 35.23     | 41.90     | 43.31     |
| LTE3                  | 0.3M | 42.76   | 53.50   | 53.81   | 56.38     | 63.42     | 65.38     | 46.32     |
|                       | 1M   | 40.55   | 51.09   | 51.38   | 51.41     | 57.85     | 60.26     | 42.24     |
|                       | 2M   | 37.84   | 46.81   | 46.86   | 45.82     | 51.13     | 52.79     | 36.70     |
|                       | 3M   | 35.02   | 43.49   | 43.58   | 40.73     | 45.02     | 46.68     | 31.95     |
|                       | 5M   | 32.42   | 40.40   | 40.53   | 36.20     | 39.64     | 41.28     | 27.82     |
| LTE4                  | 0.3M | 34.69   | 38.21   | 33.37   | 44.24     | 40.48     | 39.12     | 54.81     |
|                       | 1M   | 32.90   | 36.49   | 31.86   | 40.36     | 36.93     | 36.03     | 49.99     |
|                       | 2M   | 30.70   | 33.44   | 29.06   | 35.97     | 32.67     | 31.60     | 43.44     |
|                       | 3M   | 28.42   | 31.06   | 27.04   | 31.98     | 28.75     | 27.90     | 37.83     |
|                       | 5M   | 26.31   | 28.85   | 25.15   | 28.43     | 25.30     | 24.64     | 32.95     |
| LTE5                  | 0.3M | 33.63   | 37.30   | 33.06   | 44.90     | 39.93     | 38.90     | 54.66     |
|                       | 1M   | 31.89   | 35.63   | 31.57   | 40.96     | 36.40     | 35.82     | 49.84     |
|                       | 2M   | 29.76   | 32.65   | 28.80   | 36.51     | 32.21     | 31.43     | 43.30     |
|                       | 3M   | 27.54   | 30.32   | 26.78   | 32.46     | 28.34     | 27.74     | 37.71     |
|                       | 5M   | 25.49   | 28.16   | 24.91   | 28.86     | 24.94     | 24.49     | 32.84     |
| LTE6                  | 0.3M | 43.09   | 51.93   | 52.88   | 55.26     | 64.68     | 66.42     | 45.37     |
|                       | 1M   | 40.85   | 49.59   | 50.50   | 50.41     | 58.99     | 61.21     | 41.39     |
|                       | 2M   | 38.13   | 45.43   | 46.06   | 44.93     | 52.14     | 53.63     | 35.95     |
|                       | 3M   | 35.29   | 42.21   | 42.83   | 39.93     | 45.90     | 47.42     | 31.30     |
|                       | 5M   | 32.67   | 39.21   | 39.83   | 35.49     | 40.42     | 41.94     | 27.26     |
| LTE7                  | 0.3M | 29.19   | 30.19   | 32.01   | 49.76     | 66.45     | 65.00     | 36.72     |
|                       | 1M   | 27.72   | 28.84   | 30.58   | 45.38     | 60.59     | 59.89     | 33.48     |
|                       | 2M   | 25.87   | 26.43   | 27.89   | 40.44     | 53.56     | 52.47     | 29.09     |
|                       | 3M   | 23.93   | 24.55   | 25.92   | 35.93     | 47.15     | 46.40     | 25.34     |
|                       | 5M   | 22.14   | 22.80   | 24.09   | 31.92     | 41.51     | 41.04     | 22.07     |
| LTE8                  | 0.3M | 38.75   | 50.32   | 54.81   | 45.83     | 52.11     | 59.53     | 46.12     |
|                       | 1M   | 36.71   | 48.07   | 52.34   | 41.79     | 47.53     | 54.90     | 42.07     |
|                       | 2M   | 34.26   | 44.05   | 47.74   | 37.25     | 41.99     | 48.09     | 36.57     |

|                          |      |       |       |       |       |       |       |       |
|--------------------------|------|-------|-------|-------|-------|-------|-------|-------|
|                          |      |       |       |       |       |       |       |       |
|                          | 3M   | 31.73 | 40.91 | 44.38 | 33.11 | 36.99 | 42.53 | 31.86 |
|                          | 5M   | 29.39 | 38.01 | 41.26 | 29.43 | 32.59 | 37.62 | 27.77 |
| <b>Average Gain (dB)</b> |      |       |       |       |       |       |       |       |
| LTE1                     | 0.3M | -3.93 | -3.36 | -2.53 | -3.15 | -2.82 | -2.27 | -3.16 |
|                          | 1M   | -4.17 | -3.56 | -2.73 | -3.55 | -3.22 | -2.62 | -3.56 |
|                          | 2M   | -4.47 | -3.94 | -3.13 | -4.05 | -3.76 | -3.19 | -4.17 |
|                          | 3M   | -4.80 | -4.26 | -3.45 | -4.56 | -4.31 | -3.73 | -4.76 |
|                          | 5M   | -5.13 | -4.58 | -3.77 | -5.08 | -4.86 | -4.26 | -5.36 |
| LTE2                     | 0.3M | -5.31 | -5.27 | -4.99 | -7.46 | -2.61 | -1.73 | -1.64 |
|                          | 1M   | -5.54 | -5.47 | -5.19 | -7.75 | -3.01 | -2.14 | -1.99 |
|                          | 2M   | -5.84 | -5.85 | -5.59 | -8.25 | -3.51 | -2.67 | -2.57 |
|                          | 3M   | -6.17 | -6.17 | -5.90 | -8.72 | -4.02 | -3.23 | -3.10 |
|                          | 5M   | -6.51 | -6.49 | -6.22 | -9.18 | -4.53 | -3.78 | -3.63 |
| LTE3                     | 0.3M | -3.69 | -2.72 | -2.69 | -2.49 | -1.98 | -1.85 | -3.34 |
|                          | 1M   | -3.92 | -2.92 | -2.89 | -2.89 | -2.38 | -2.20 | -3.74 |
|                          | 2M   | -4.22 | -3.30 | -3.29 | -3.39 | -2.91 | -2.77 | -4.35 |
|                          | 3M   | -4.56 | -3.62 | -3.61 | -3.90 | -3.47 | -3.31 | -4.96 |
|                          | 5M   | -4.89 | -3.94 | -3.92 | -4.41 | -4.02 | -3.84 | -5.56 |
| LTE4                     | 0.3M | -4.60 | -4.18 | -4.77 | -3.54 | -3.93 | -4.08 | -2.61 |
|                          | 1M   | -4.83 | -4.38 | -4.97 | -3.94 | -4.33 | -4.43 | -3.01 |
|                          | 2M   | -5.13 | -4.76 | -5.37 | -4.44 | -4.86 | -5.00 | -3.62 |
|                          | 3M   | -5.46 | -5.08 | -5.68 | -4.95 | -5.41 | -5.54 | -4.22 |
|                          | 5M   | -5.80 | -5.40 | -5.99 | -5.46 | -5.97 | -6.08 | -4.82 |
| LTE5                     | 0.3M | -4.73 | -4.28 | -4.81 | -3.48 | -3.99 | -4.10 | -2.62 |
|                          | 1M   | -4.96 | -4.48 | -5.01 | -3.88 | -4.39 | -4.46 | -3.02 |
|                          | 2M   | -5.26 | -4.86 | -5.41 | -4.38 | -4.92 | -5.03 | -3.63 |
|                          | 3M   | -5.60 | -5.18 | -5.72 | -4.89 | -5.48 | -5.57 | -4.24 |
|                          | 5M   | -5.94 | -5.50 | -6.04 | -5.40 | -6.03 | -6.11 | -4.84 |
| LTE6                     | 0.3M | -3.66 | -2.85 | -2.77 | -2.58 | -1.89 | -1.78 | -3.43 |
|                          | 1M   | -3.89 | -3.05 | -2.97 | -2.97 | -2.29 | -2.13 | -3.83 |
|                          | 2M   | -4.19 | -3.43 | -3.37 | -3.47 | -2.83 | -2.71 | -4.44 |
|                          | 3M   | -4.52 | -3.75 | -3.68 | -3.99 | -3.38 | -3.24 | -5.04 |
|                          | 5M   | -4.86 | -4.07 | -4.00 | -4.50 | -3.93 | -3.77 | -5.65 |
| LTE7                     | 0.3M | -5.35 | -5.20 | -4.95 | -3.03 | -1.77 | -1.87 | -4.35 |
|                          | 1M   | -5.57 | -5.40 | -5.15 | -3.43 | -2.18 | -2.23 | -4.75 |
|                          | 2M   | -5.87 | -5.78 | -5.55 | -3.93 | -2.71 | -2.80 | -5.36 |
|                          | 3M   | -6.21 | -6.10 | -5.86 | -4.45 | -3.27 | -3.33 | -5.96 |
|                          | 5M   | -6.55 | -6.42 | -6.18 | -4.96 | -3.82 | -3.87 | -6.56 |
| LTE8                     | 0.3M | -4.12 | -2.98 | -2.61 | -3.39 | -2.83 | -2.25 | -3.36 |
|                          | 1M   | -4.35 | -3.18 | -2.81 | -3.79 | -3.23 | -2.60 | -3.76 |
|                          | 2M   | -4.65 | -3.56 | -3.21 | -4.29 | -3.77 | -3.18 | -4.37 |
|                          | 3M   | -4.99 | -3.88 | -3.53 | -4.80 | -4.32 | -3.71 | -4.97 |
|                          | 5M   | -5.32 | -4.20 | -3.85 | -5.31 | -4.87 | -4.25 | -5.56 |
|                          |      |       |       |       |       |       |       |       |

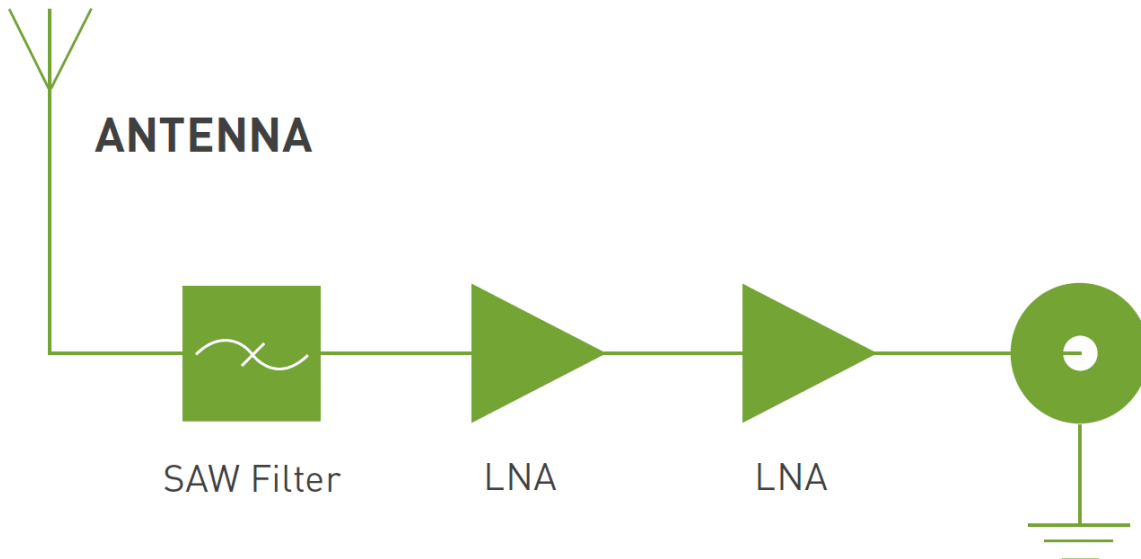
| Peak Gain (dBi) |             |       |       |       |       |       |      |       |
|-----------------|-------------|-------|-------|-------|-------|-------|------|-------|
| LTE1            | 0.3M        | 1.5   | 1.6   | 1.92  | -4.21 | 3.2   | 3.15 | 3.27  |
|                 | 1M          | 1.2   | 1.4   | 1.72  | -4.51 | 2.8   | 2.75 | 2.97  |
|                 | 2M          | 0.9   | 1     | 1.32  | -5.01 | 2.3   | 2.15 | 2.37  |
|                 | 3M          | 0.6   | 0.7   | 1.02  | -5.51 | 1.8   | 1.65 | 1.87  |
|                 | 5M          | 0.3   | 0.4   | 0.72  | -6.01 | 1.3   | 1.15 | 1.37  |
| LTE2            | 0.3M        | -1.01 | -1.44 | -0.5  | -0.96 | 1.38  | 3.07 | 3.42  |
|                 | 1M          | -1.21 | -1.64 | -0.7  | -1.26 | 0.98  | 2.67 | 3.12  |
|                 | 2M          | -1.51 | -2.04 | -1.1  | -1.76 | 0.48  | 2.07 | 2.52  |
|                 | 3M          | -1.85 | -2.34 | -1.4  | -2.26 | -0.02 | 1.57 | 2.02  |
|                 | 5M          | -2.15 | -2.64 | -1.7  | -2.76 | -0.52 | 1.07 | 1.52  |
| LTE3            | 0.3M        | 0.5   | 1.65  | 1.77  | 3.23  | 3.93  | 4.12 | 2.35  |
|                 | 1M          | 0.26  | 1.45  | 1.57  | 2.83  | 3.53  | 3.82 | 1.95  |
|                 | 2M          | -0.04 | 1.05  | 1.17  | 2.33  | 2.93  | 3.22 | 1.25  |
|                 | 3M          | -0.4  | 0.75  | 0.87  | 1.83  | 2.43  | 2.72 | 0.65  |
|                 | 5M          | -0.7  | 0.45  | 0.57  | 1.33  | 1.93  | 2.22 | 0.05  |
| LTE4            | 0.3M        | 1.48  | 1.25  | 0.66  | 2.18  | 2.18  | 2.08 | 3.75  |
|                 | 1M          | 1.28  | 1.05  | 0.46  | 1.78  | 1.78  | 1.68 | 3.35  |
|                 | 2M          | 0.98  | 0.65  | 0.06  | 1.28  | 1.28  | 1.18 | 2.75  |
|                 | 3M          | 0.68  | 0.35  | -0.24 | 0.78  | 0.78  | 0.58 | 2.15  |
|                 | 5M          | 0.38  | 0.05  | -0.54 | 0.28  | 0.28  | 0.05 | 1.55  |
| LTE5            | 0.3M        | 2.02  | 1.11  | 0.45  | 2.16  | 3.03  | 3.03 | 4.11  |
|                 | 1M          | 1.72  | 0.91  | 0.25  | 1.76  | 2.63  | 2.63 | 3.71  |
|                 | 2M          | 1.42  | 0.51  | -0.15 | 1.26  | 2.03  | 2.03 | 3.11  |
|                 | 3M          | 1.12  | 0.21  | -0.45 | 0.76  | 1.53  | 1.53 | 2.51  |
|                 | 5M          | 0.82  | -0.09 | -0.75 | 0.26  | 1.03  | 1.03 | 1.91  |
| LTE6            | 0.3M        | 0.83  | 1.5   | 1.65  | 2.69  | 3.73  | 3.73 | 2.67  |
|                 | 1M          | 0.63  | 1.3   | 1.45  | 2.29  | 3.33  | 3.33 | 2.27  |
|                 | 2M          | 0.33  | 0.9   | 1.05  | 1.79  | 2.73  | 2.73 | 1.57  |
|                 | 3M          | -0.07 | 0.6   | 0.75  | 1.29  | 2.23  | 2.23 | 0.97  |
|                 | 5M          | -0.41 | 0.3   | 0.45  | 0.79  | 1.73  | 1.73 | 0.37  |
| LTE7            | 0.3M        | -0.98 | -1.6  | -0.76 | 1.77  | 2.66  | 3.15 | 0.99  |
|                 | 1M          | -1.18 | -1.8  | -0.96 | 1.37  | 2.26  | 2.85 | 0.59  |
|                 | 2M          | -1.48 | -2.2  | -1.36 | 0.87  | 1.66  | 2.25 | -0.01 |
|                 | 3M          | -1.78 | -2.5  | -1.66 | 0.37  | 1.16  | 1.65 | -0.51 |
|                 | 5M          | -2.08 | -2.8  | -1.96 | -0.13 | 0.66  | 1.05 | -1.01 |
| LTE8            | 0.3M        | 2.32  | 1.55  | 2.78  | 3.07  | 2.73  | 2.35 | 2.46  |
|                 | 1M          | 2.02  | 1.35  | 2.58  | 2.67  | 2.33  | 2.05 | 2.06  |
|                 | 2M          | 1.72  | 0.95  | 2.18  | 2.17  | 1.83  | 1.45 | 1.36  |
|                 | 3M          | 1.42  | 0.65  | 1.88  | 1.67  | 1.33  | 0.95 | 0.76  |
|                 | 5M          | 1.12  | 0.35  | 1.58  | 1.17  | 0.83  | 0.45 | 0.16  |
| Impedance       | 50 $\Omega$ |       |       |       |       |       |      |       |
| Polarization    | Vertical    |       |       |       |       |       |      |       |

| CERAMIC PATCH                                |                                                                    |           |           |
|----------------------------------------------|--------------------------------------------------------------------|-----------|-----------|
| Frequency                                    | 1574~1610MHz                                                       |           |           |
| Gain @ Zenith                                | 1575.42MHz 1.5 dBic Typ. @ Zenith<br>1602MHz +0 dBic Typ. @ Zenith |           |           |
| Gain at 90° with LNA                         | 1575.42MHz: 31 ± 3dBic<br>1602MHz: 30 ± 3dBic                      |           |           |
| Polarization                                 | RHCP                                                               |           |           |
| Axial Ratio                                  | 6.0dB max. @ 1575.42MHz Zenith<br>14.0dB max. @ 1602MHz Zenith     |           |           |
| Patch Dimension                              | 25.1*25.1*4mm                                                      |           |           |
| LNA                                          |                                                                    |           |           |
| Frequency                                    | 1574~1610MHz                                                       |           |           |
| Outer Band Attenuation                       | 1592±140MHz 15dB min.                                              |           |           |
| Output Impedance                             | 50Ω                                                                |           |           |
| Output VSWR                                  | 2.0 Max                                                            |           |           |
| Pout at 1dB Gain                             | Typ. -2dBm                                                         |           |           |
| Compression point                            | Min. -6dBm                                                         |           |           |
| Input Voltage                                | Min:1.8V Typ. 3.0V Max:5V                                          |           |           |
| LNA Gain, Power Consumption and Noise Figure |                                                                    |           |           |
| Input Voltage                                | Min:1.8V                                                           | Typ. 3.0V | Max: 5.5V |
| Total Gain @ Zenith                          | 25dBic                                                             | 31dBic    | 34dBic    |
| Current Consumption                          | 5mA                                                                | 10mA      | 23mA      |
| Noise Figure                                 | 3dB                                                                | 3dB       | 3.3dB     |
| Cable                                        | 3m RG174 standard, fully customizable                              |           |           |
| Connector                                    | SMA(M) standard, standard, fully customizable                      |           |           |

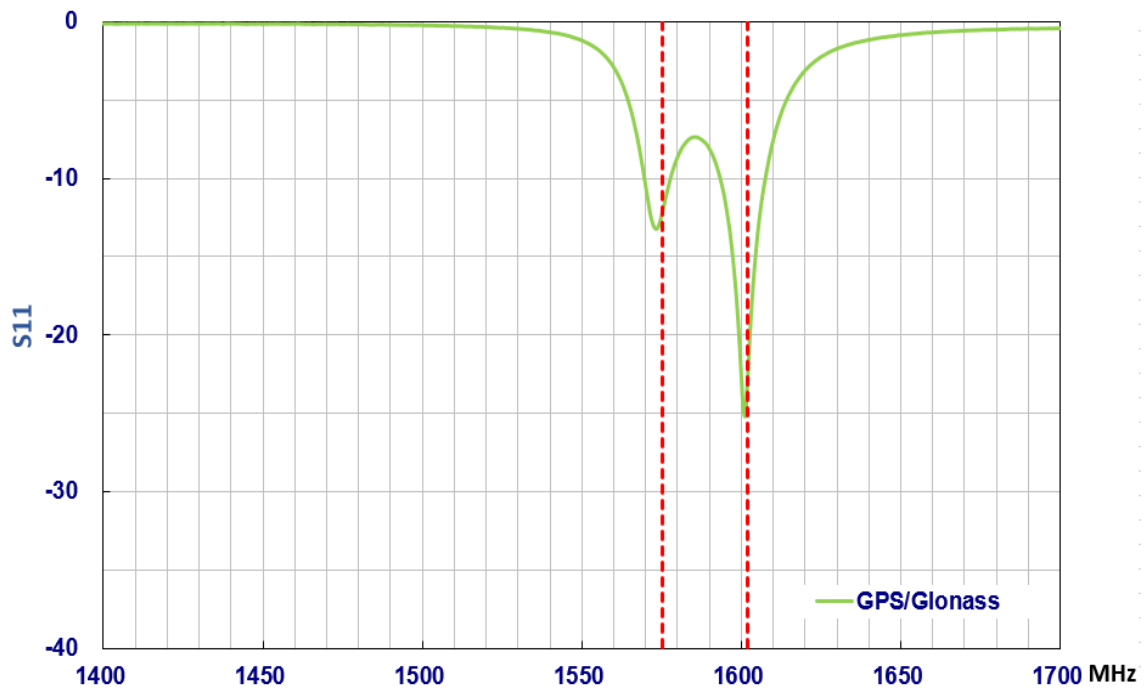
| <b>MECHANICAL</b>    |                                                                                                  |
|----------------------|--------------------------------------------------------------------------------------------------|
| Dimensions           | 360mm * 160mm * 16.5mm                                                                           |
| Cable                | 1M TGC-200 for LTE Antenna – Fully Customizable<br>1M RF174 for GPS Antenna – Fully Customizable |
| Connector            | SMA-Male – Fully Customizable                                                                    |
| Casing               | UV Resistant PC                                                                                  |
| Sealant              | Rubber O-Ring                                                                                    |
| Weight               | 1300g                                                                                            |
| <b>ENVIRONMENTAL</b> |                                                                                                  |
| Protection           | IP67                                                                                             |
| Temperature Range    | -40°C to +85°C                                                                                   |
| Thermal Shock        | 100 cycles -40°C to +85°C                                                                        |
| Humidity             | Non-condensing 65°C 95% RH                                                                       |

## 3. Antenna Characteristics

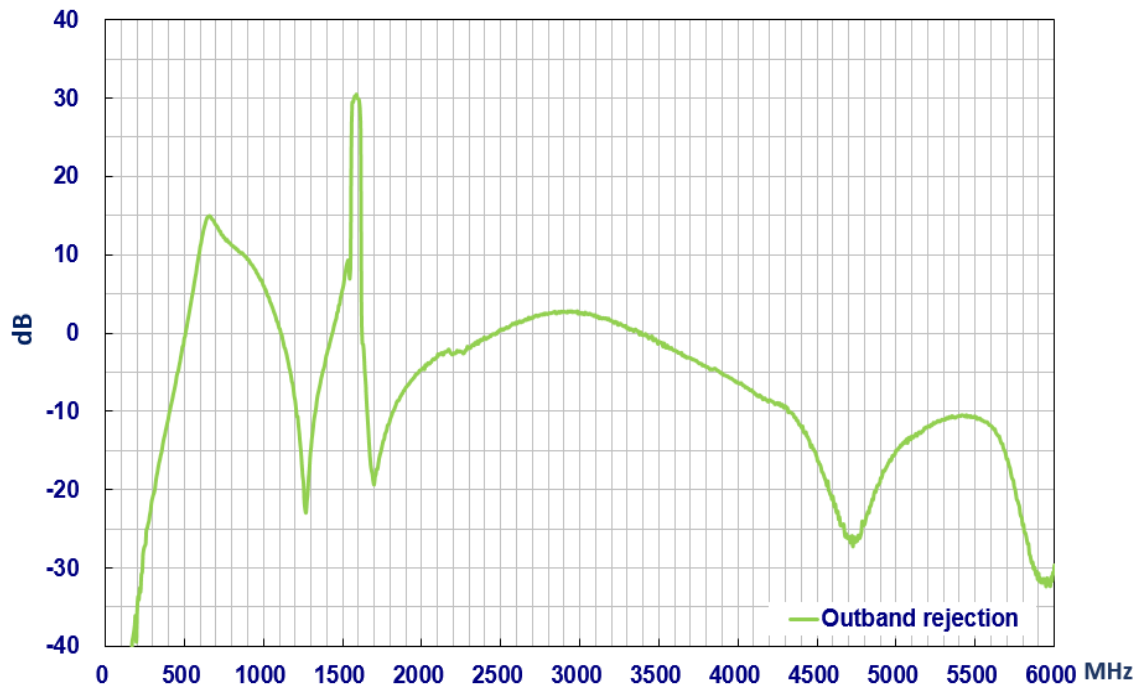
### 3.1 Block Diagram (Active antenna)



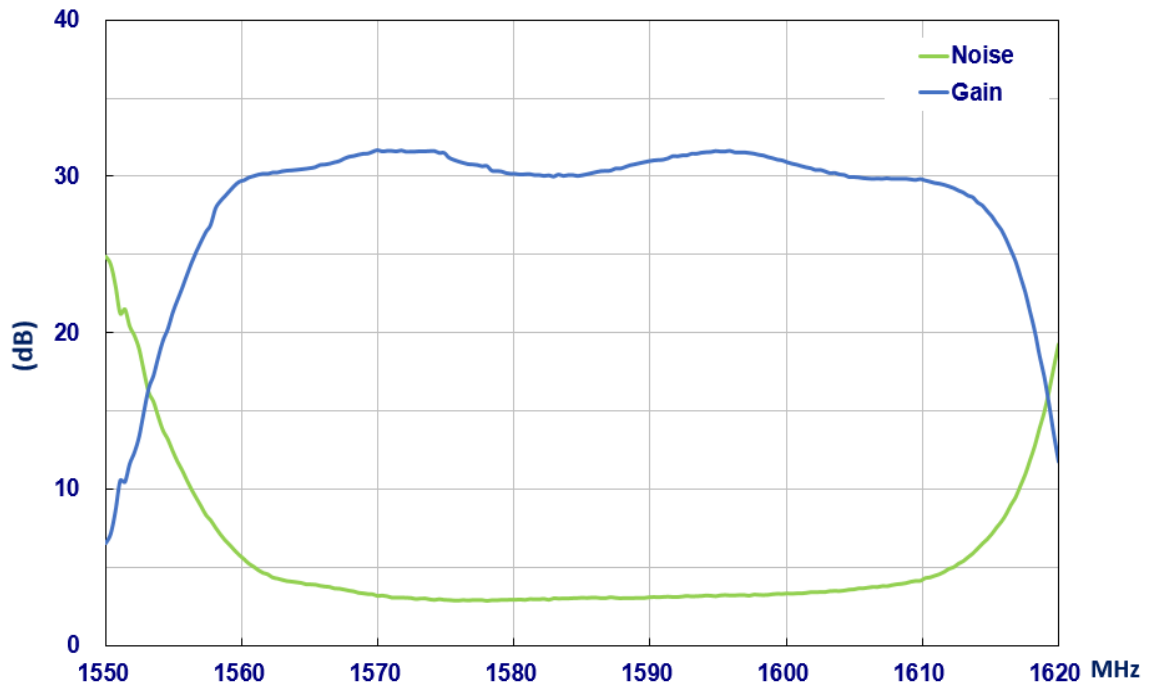
#### 3.1.1 Return Loss



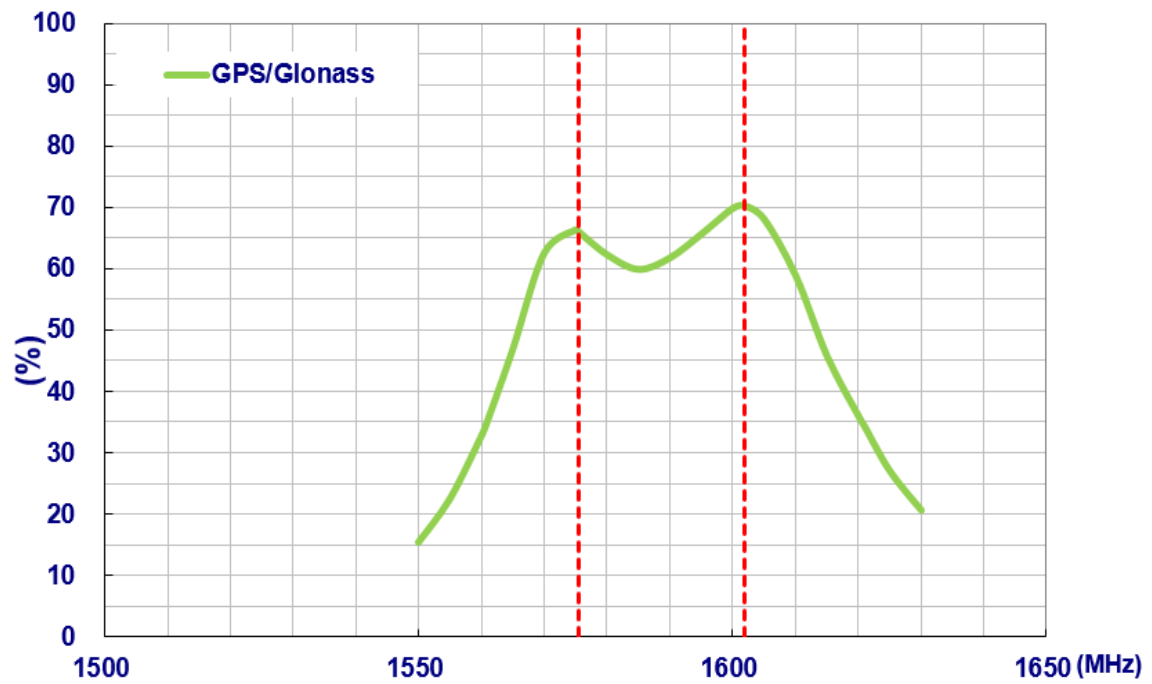
### 3.1.2 Out Band Rejection @3V



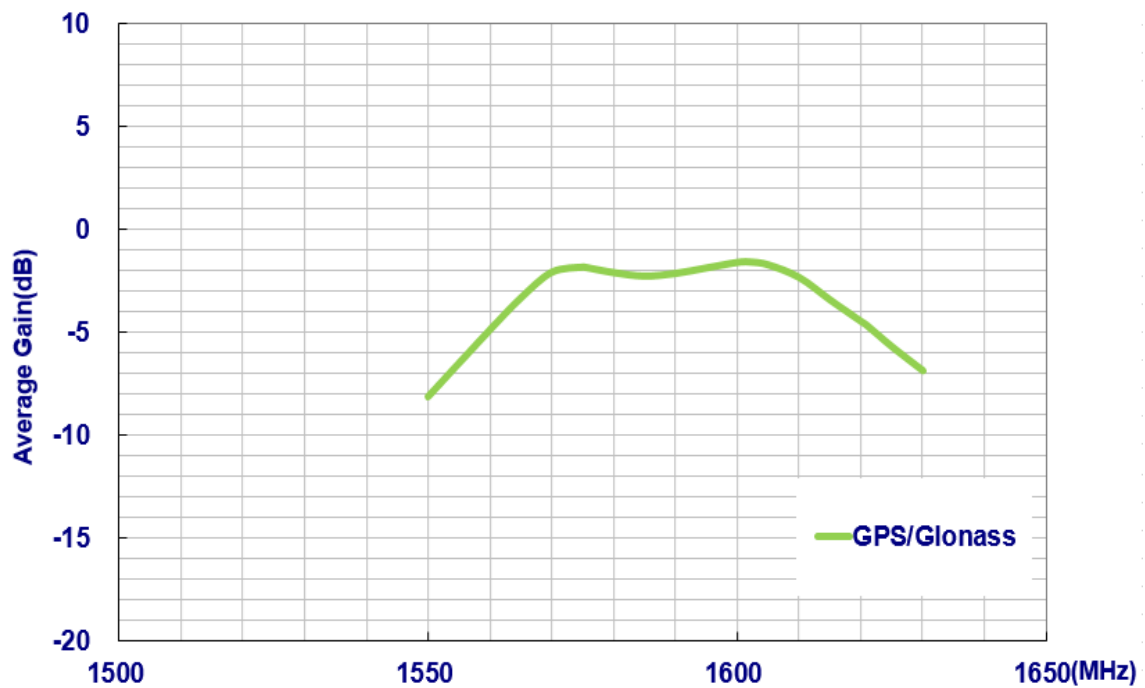
### 3.1.3 LNA Noise Figure and Gain @3V



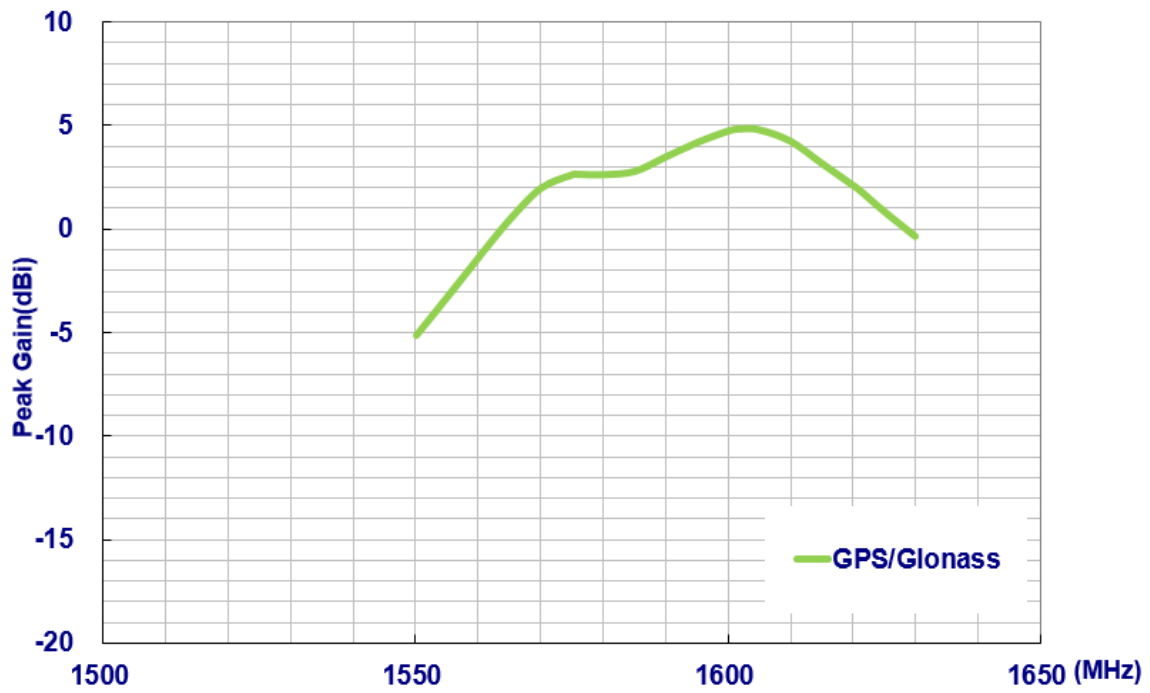
### 3.1.4 Efficiency



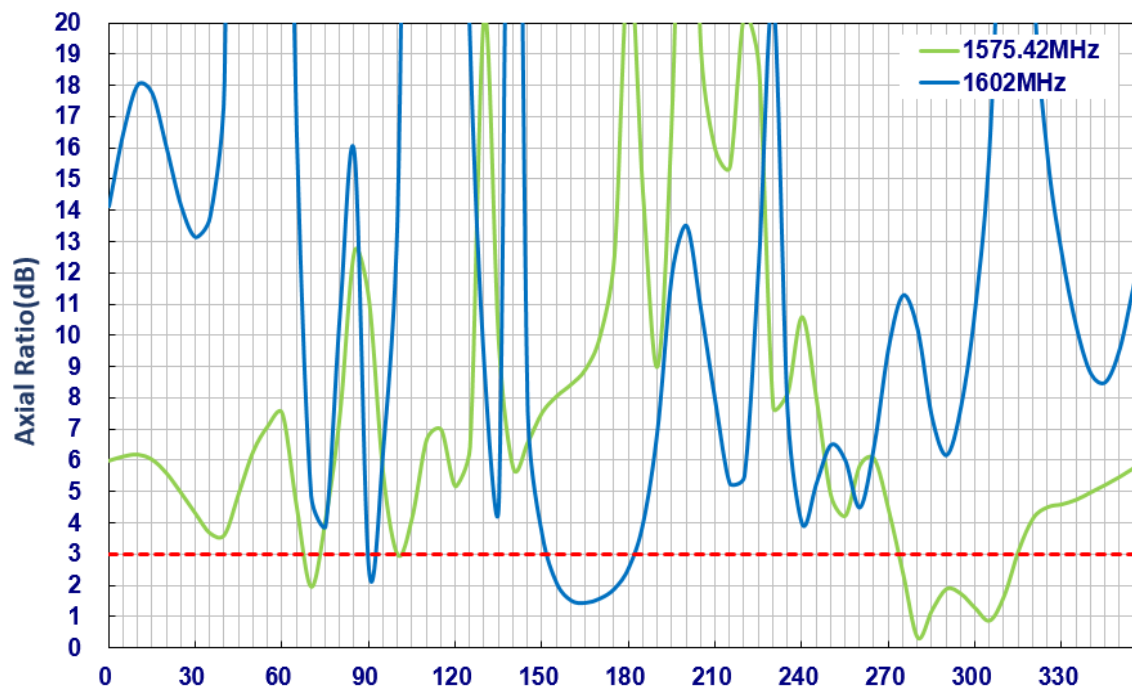
### 3.1.5 Average Gain



### 3.1.6 Peak Gain

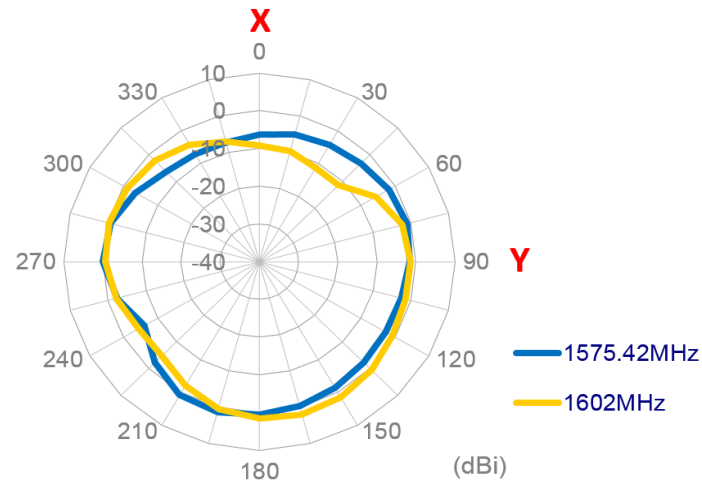


### 3.1.7 Axial Ratio

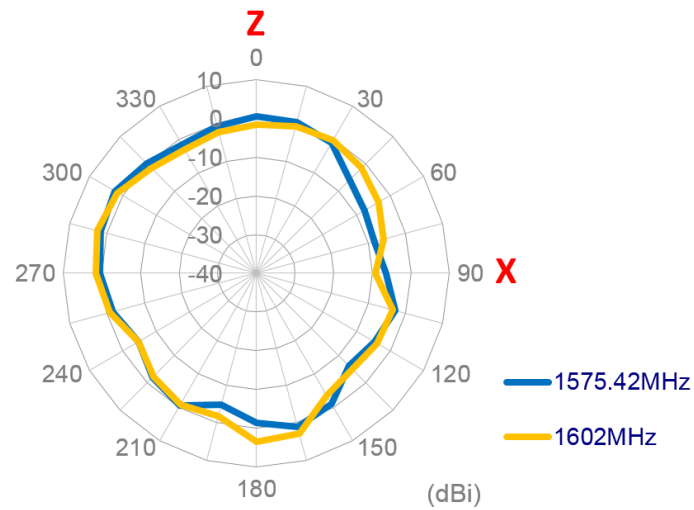


### 3.1.8 2D Radiation Patterns

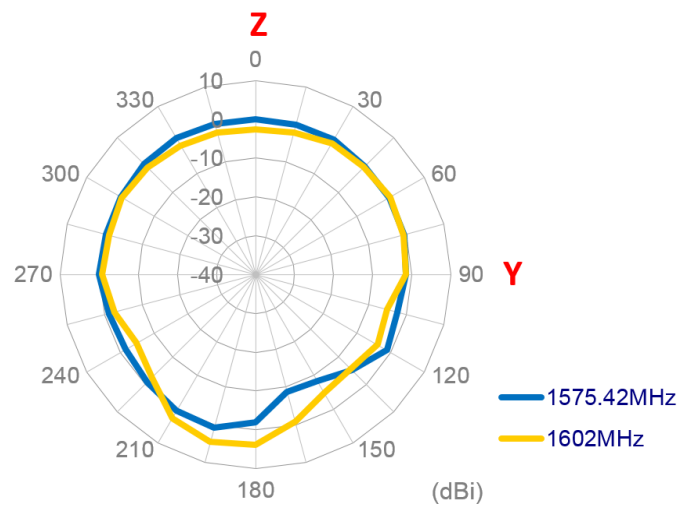
#### XY Plane



#### ZX Plane

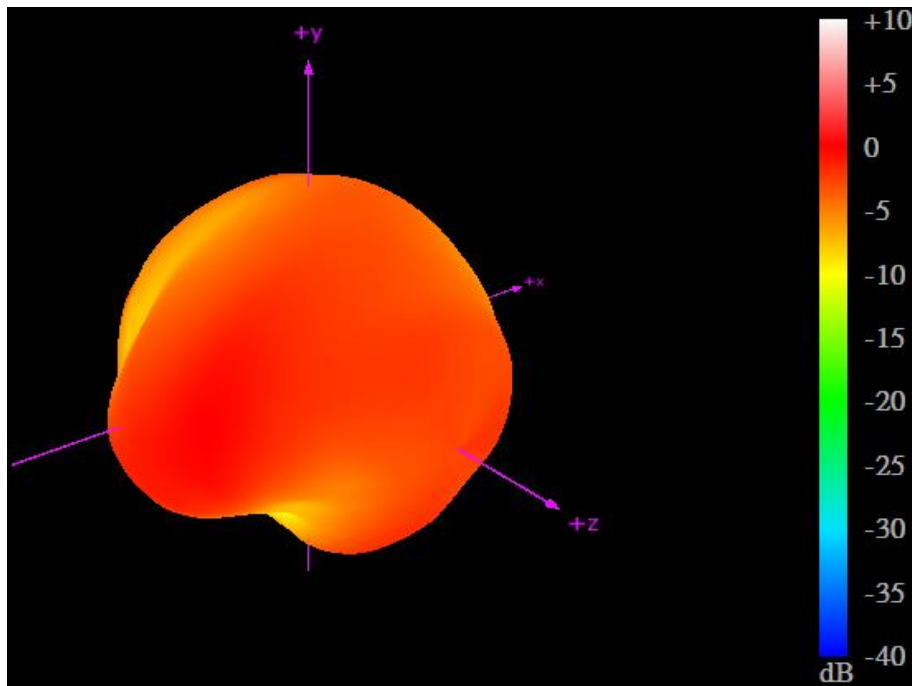


#### ZY Plane

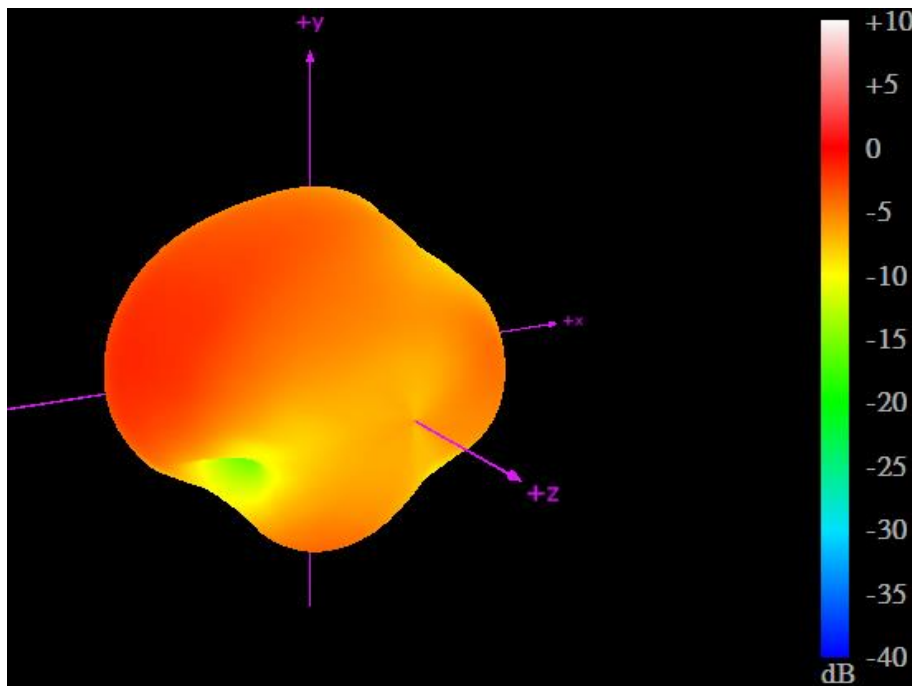


### 3.1.9 3D Radiation Patterns

**1575.42MHz**

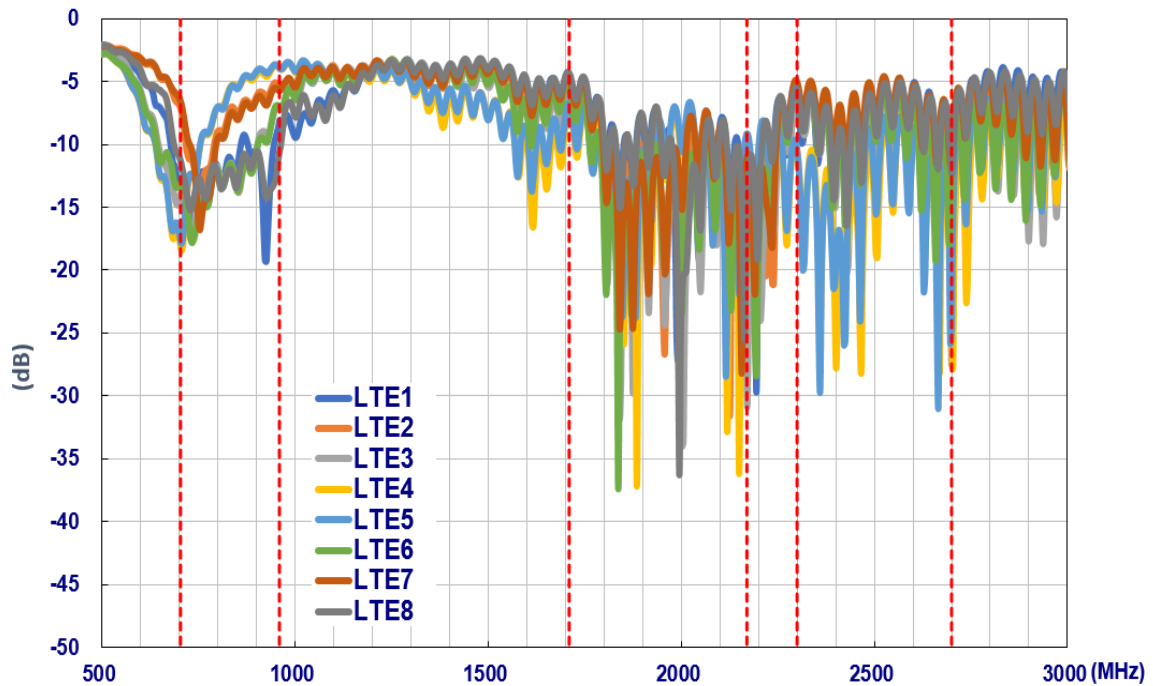


**1602MHz**

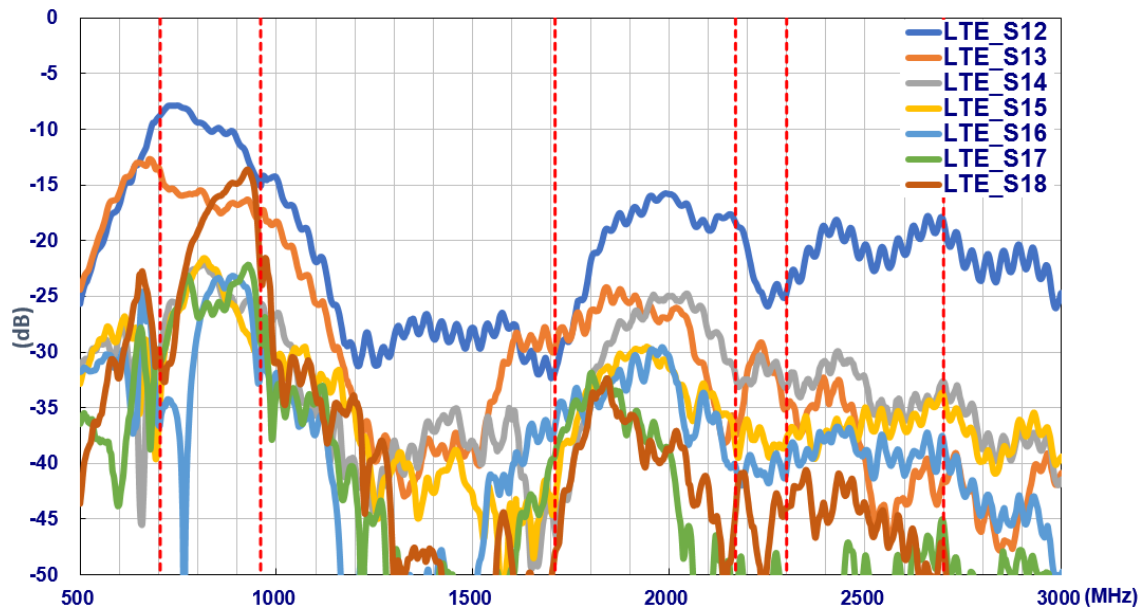


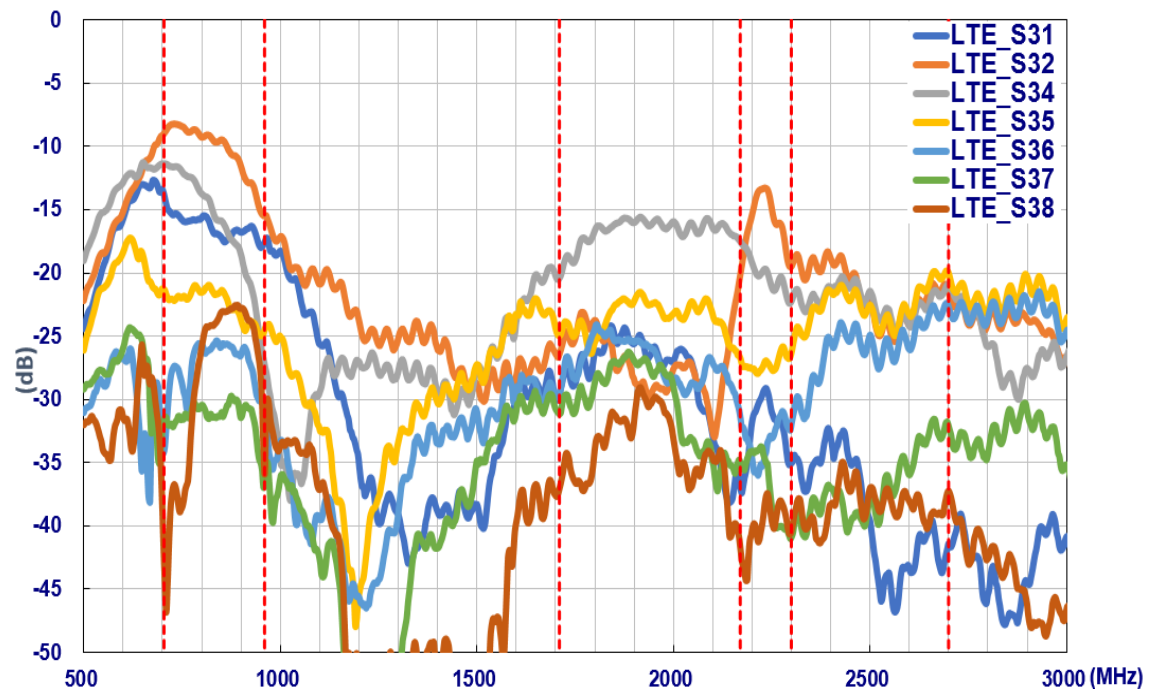
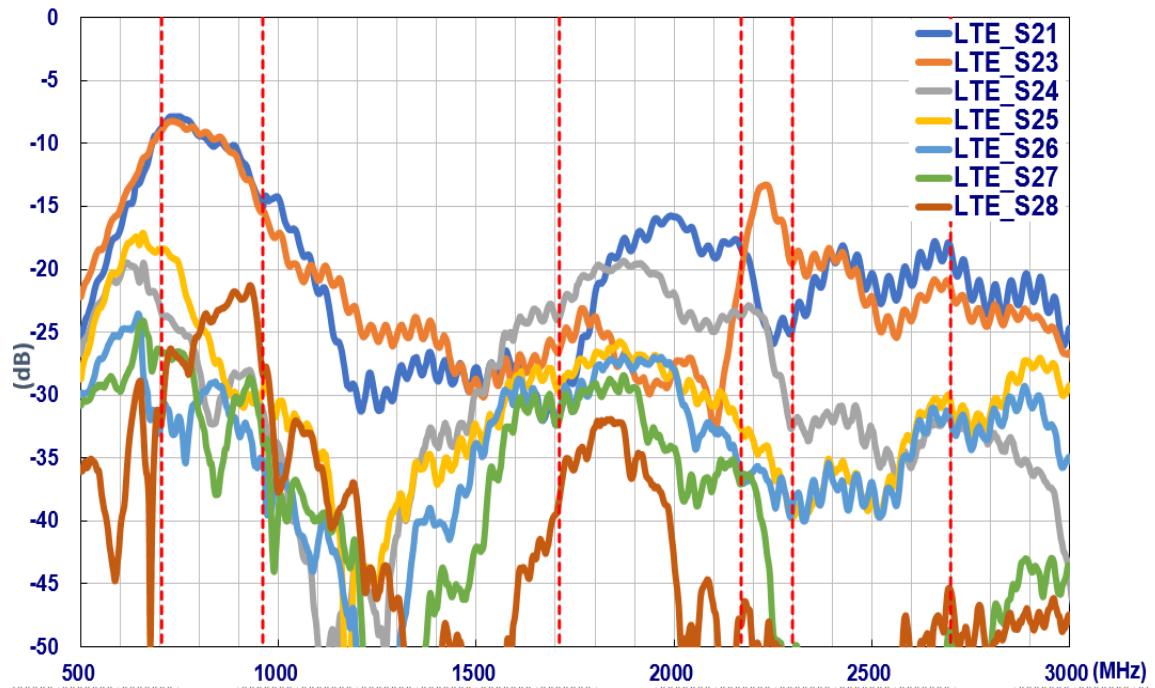
## 3.2 LTE Antenna

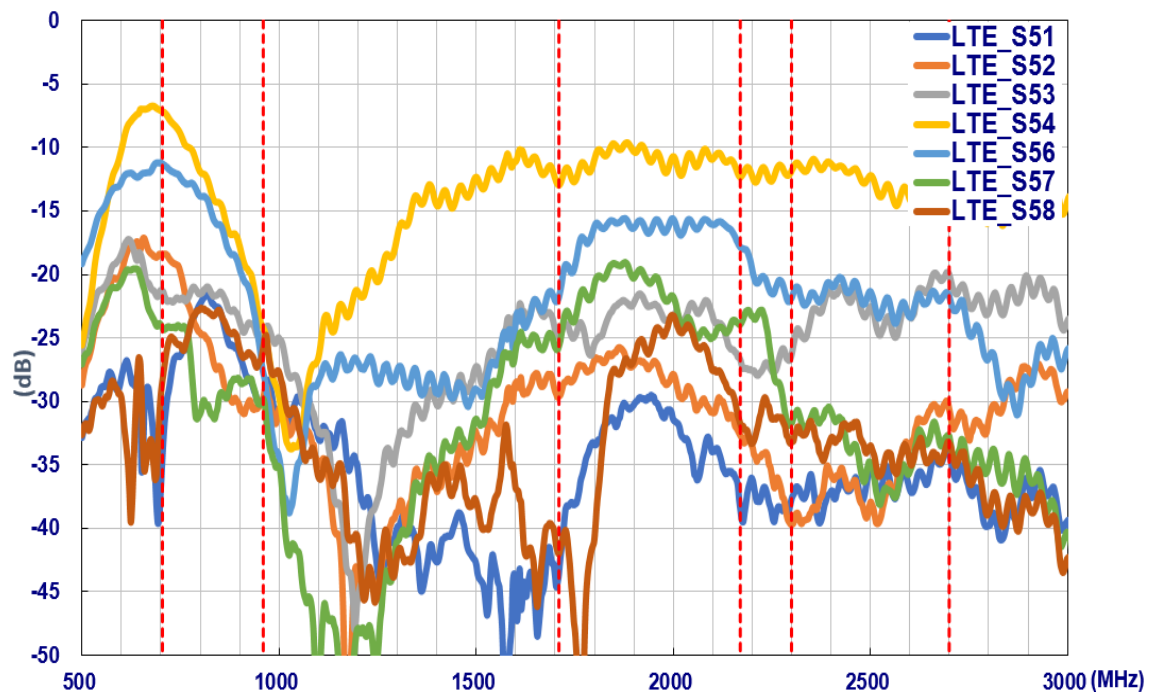
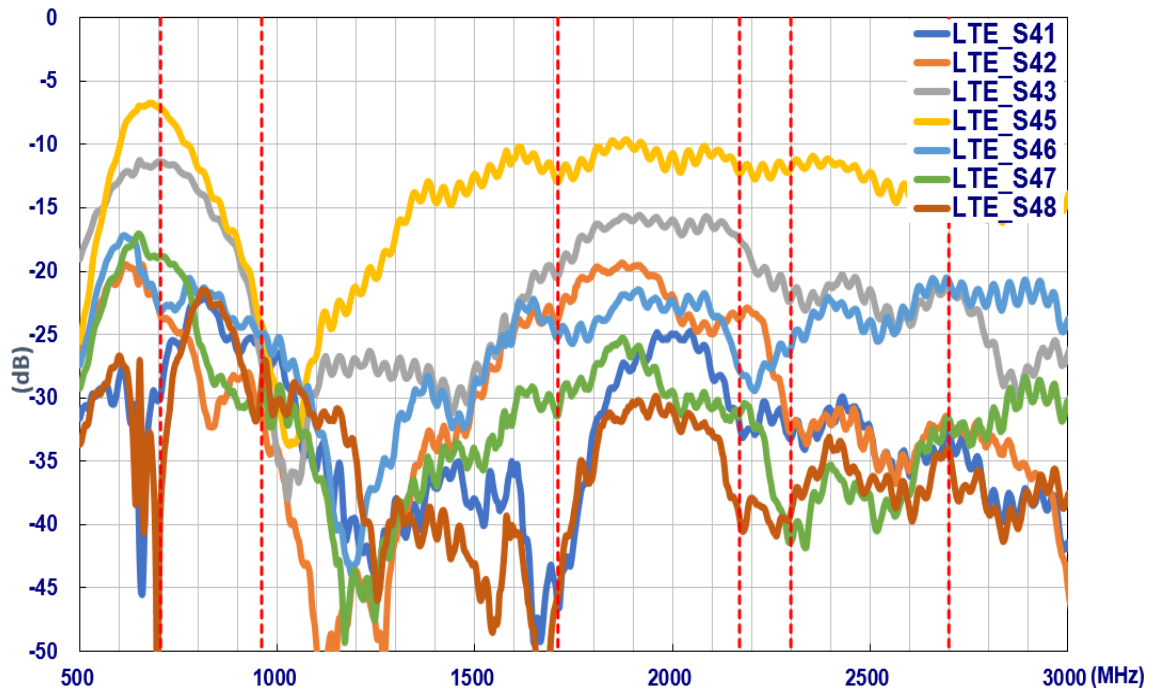
### 3.2.1 Return Loss

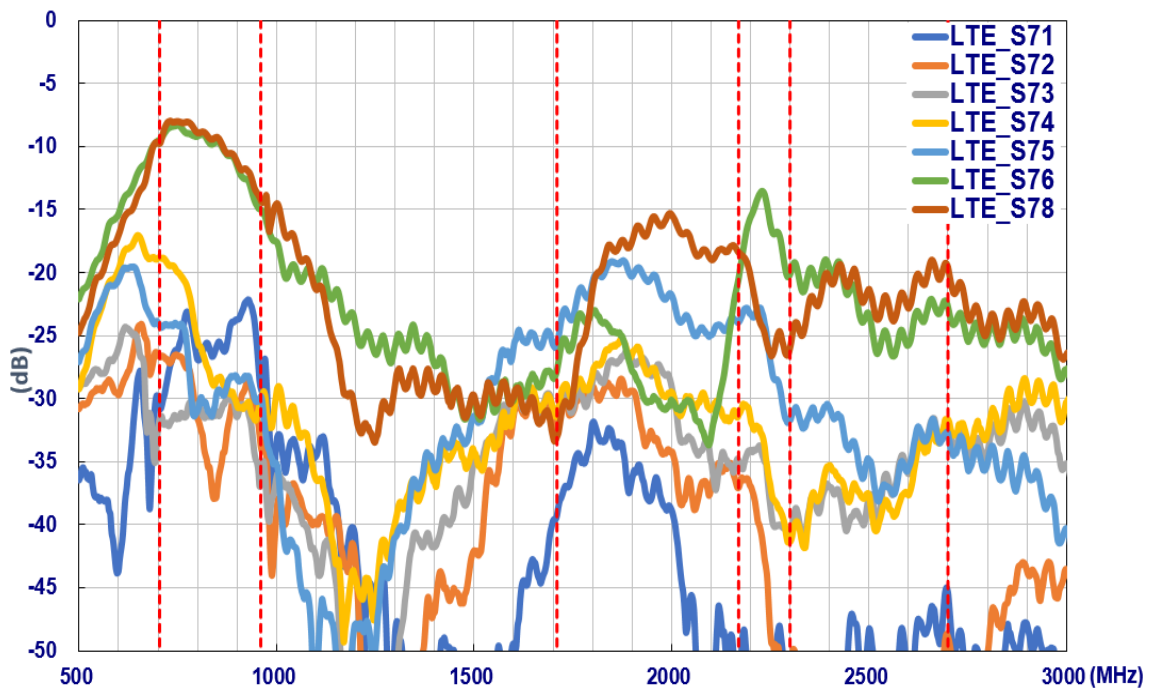
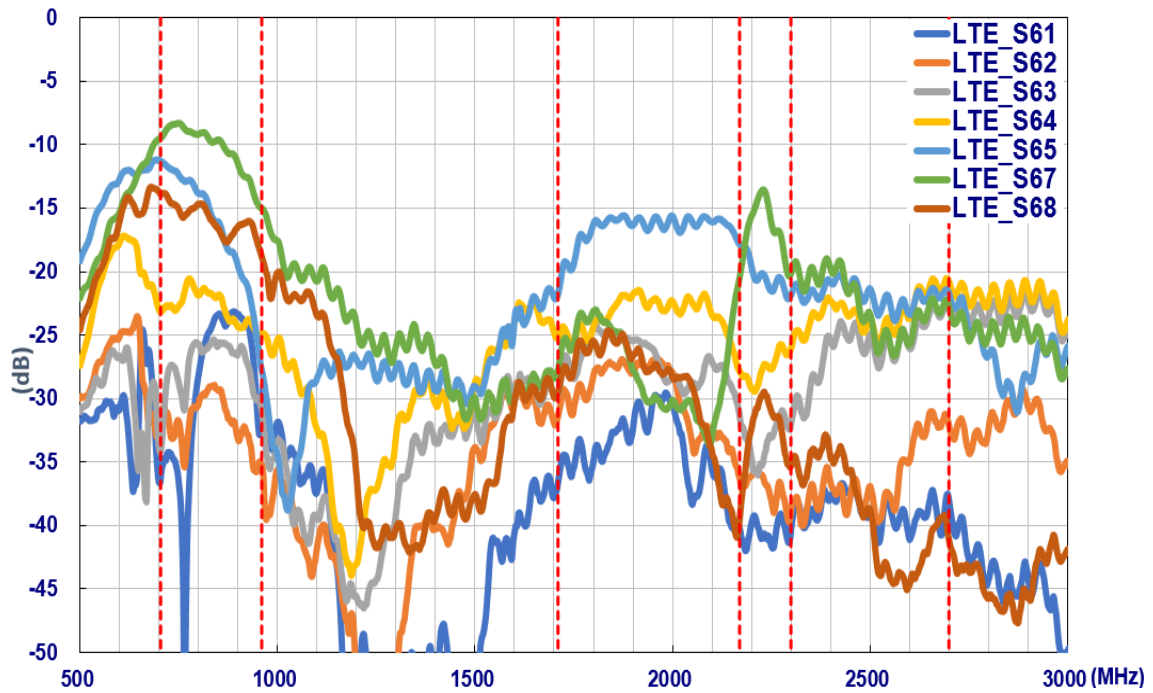


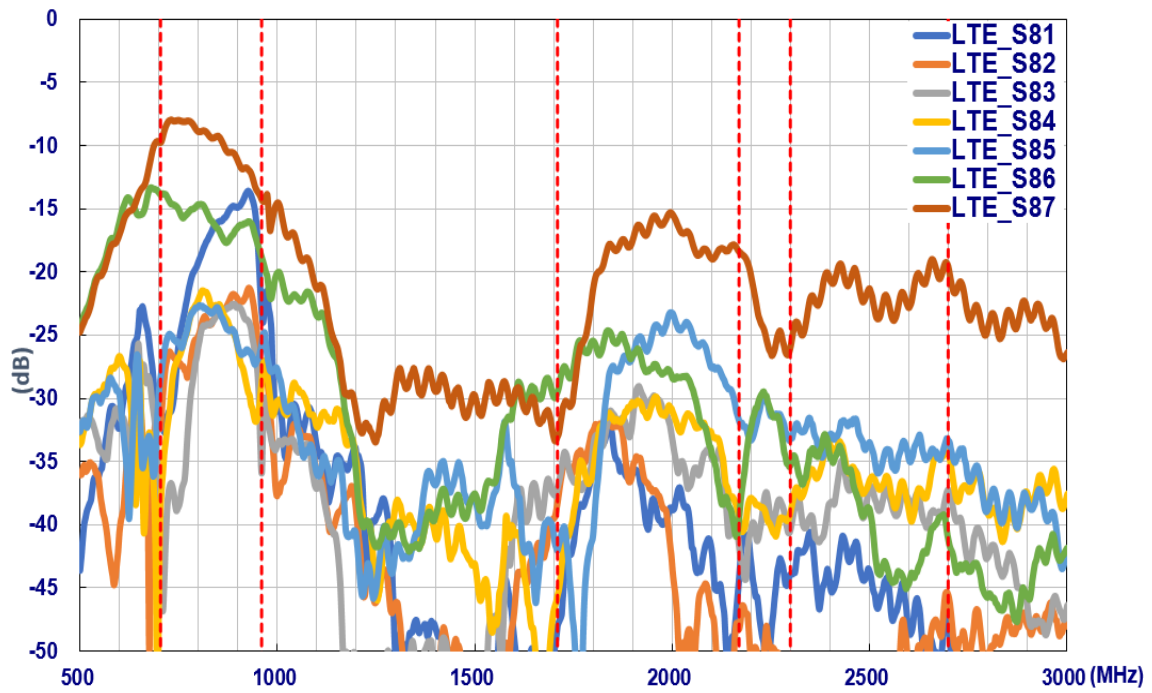
### 3.2.2 Isolation



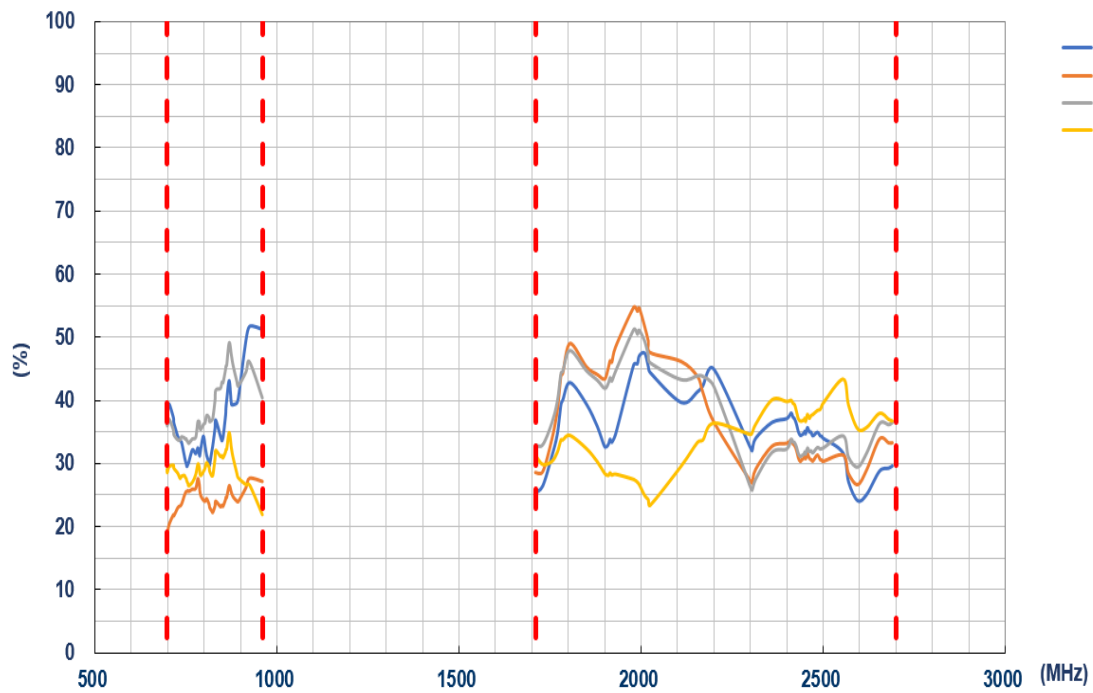


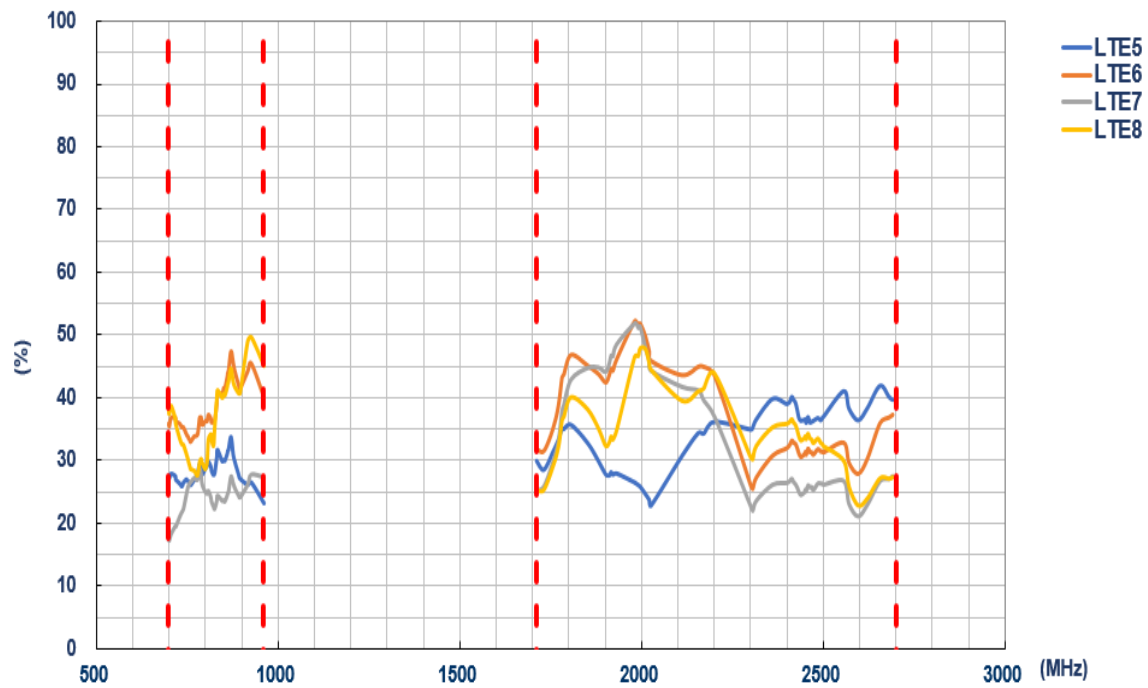




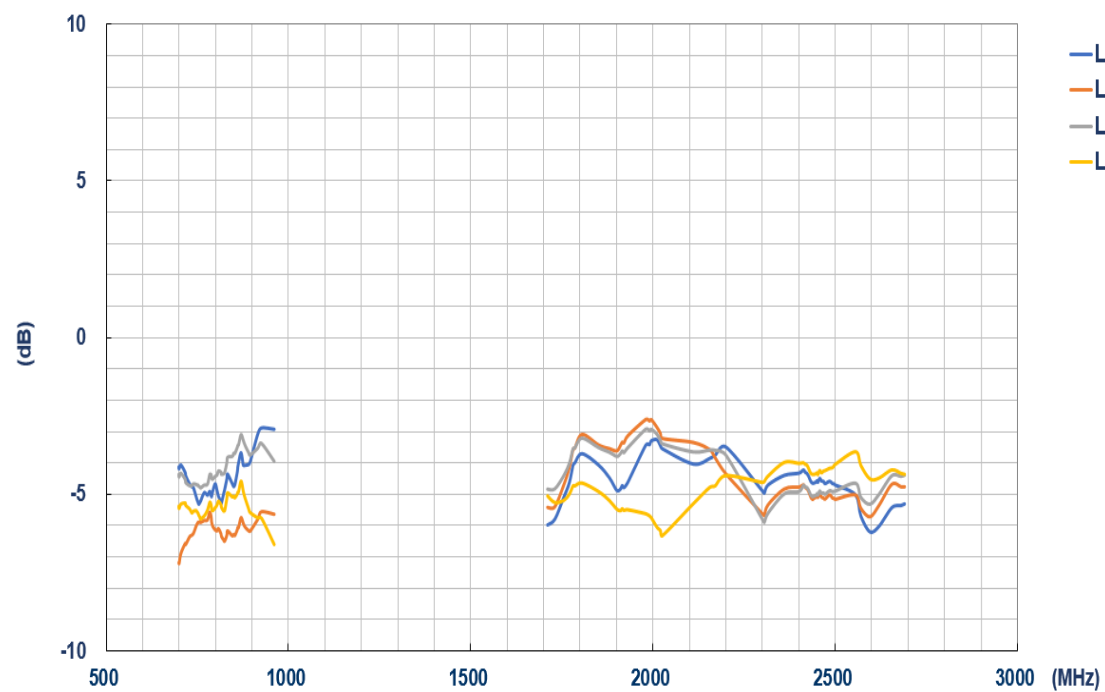


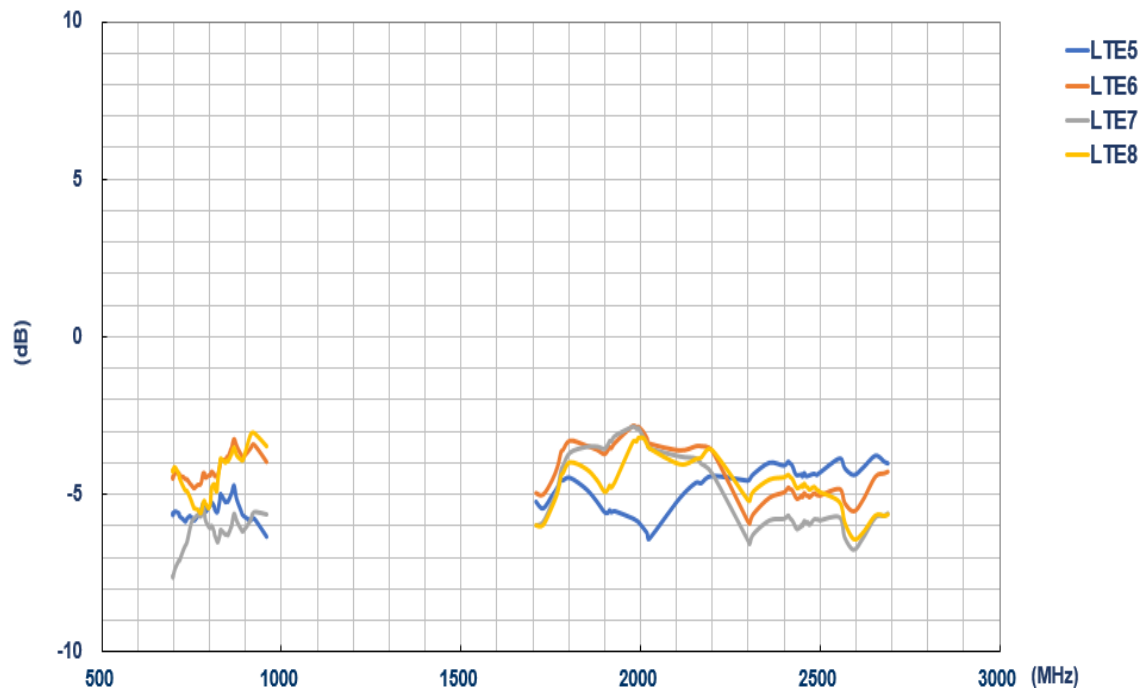
### 3.2.3 Efficiency



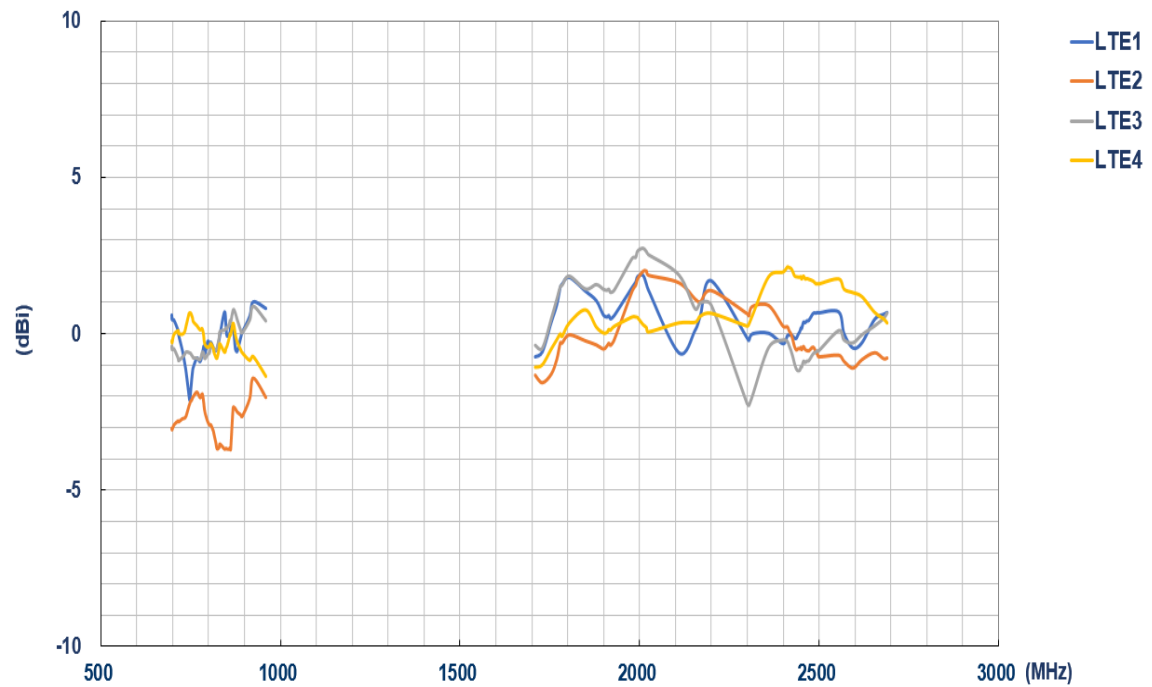


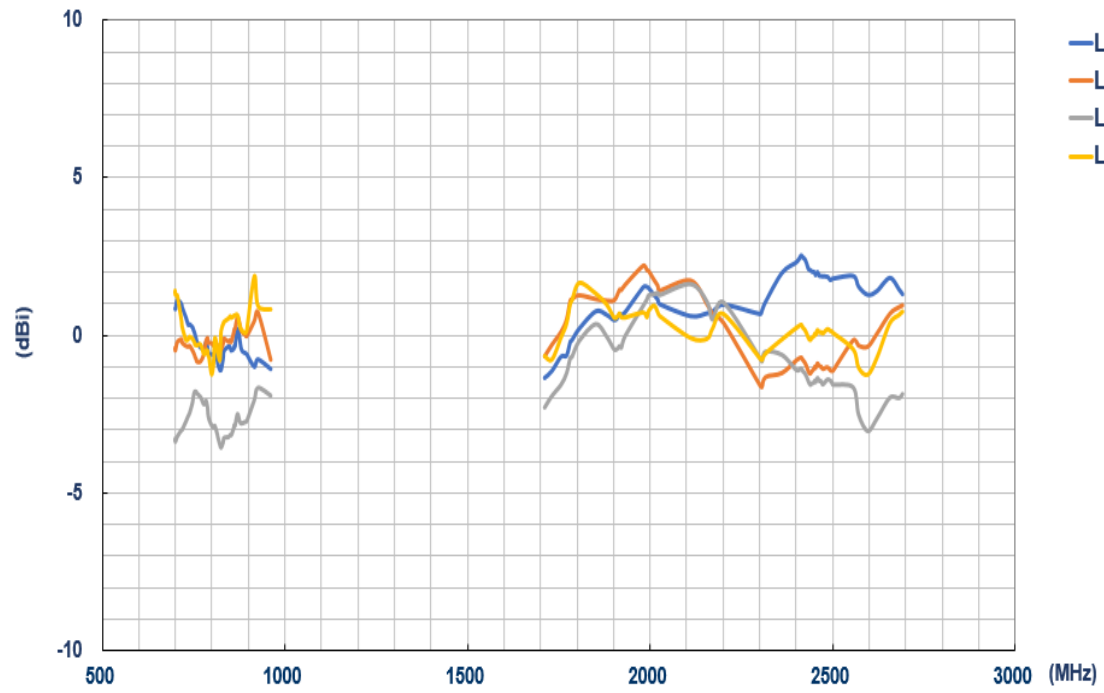
### 3.2.4 Average Gain





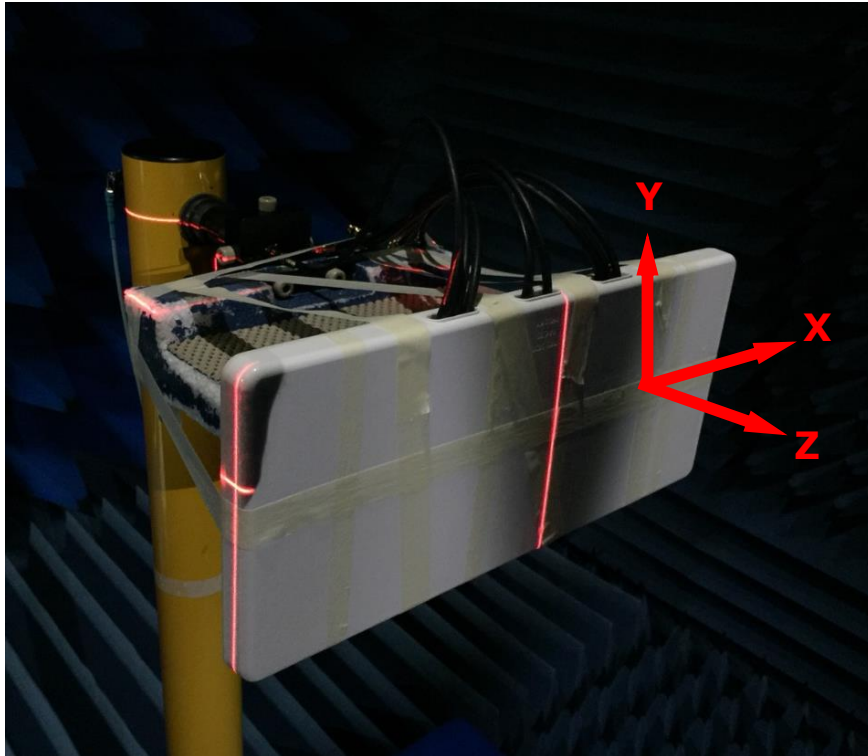
### 3.2.5 Peak Gain





## 4. Antenna Radiation Patterns

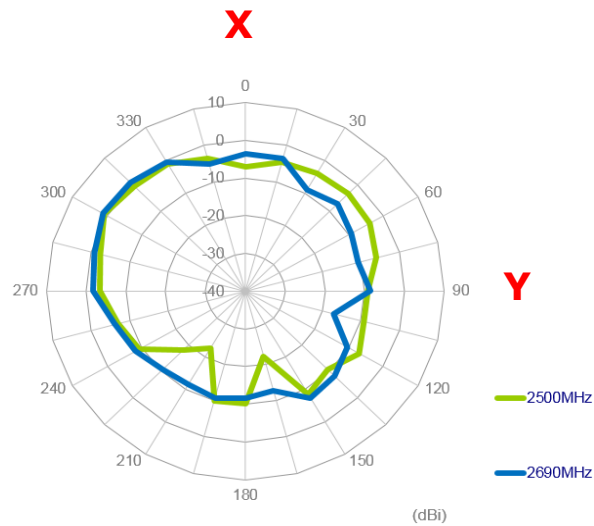
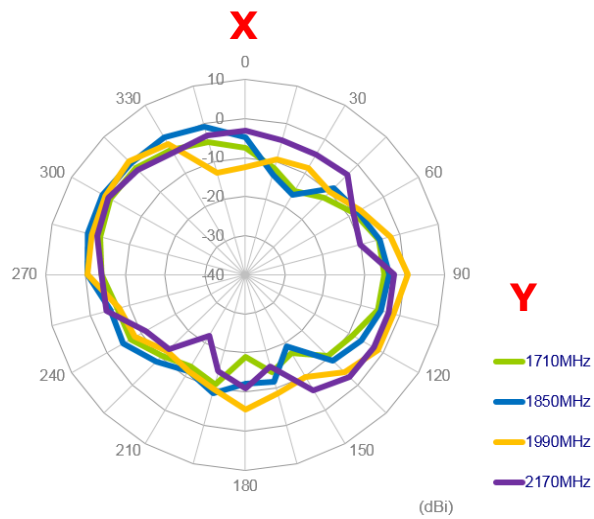
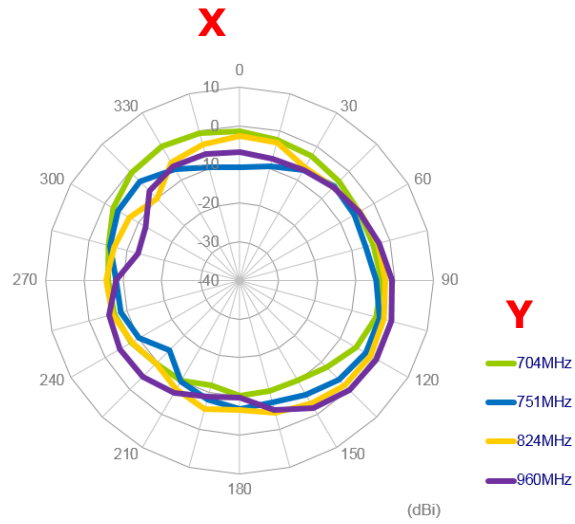
### 4.1 Antenna Setup (Antenna Test Setup in Anechoic Chamber)



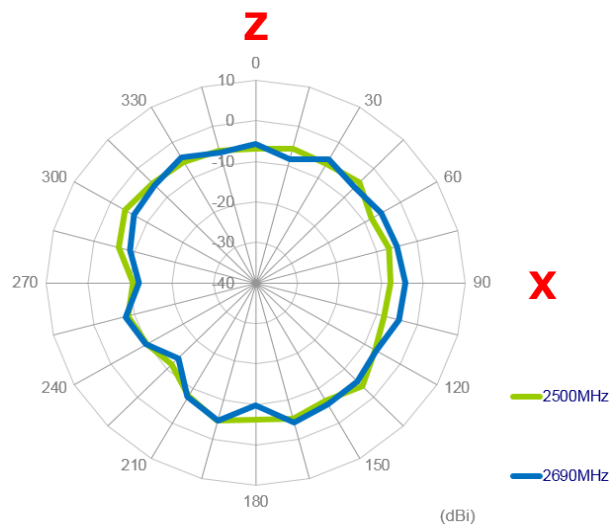
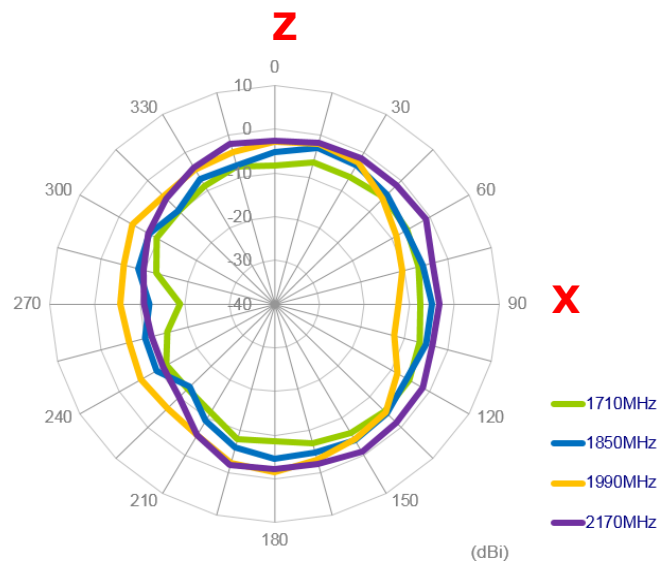
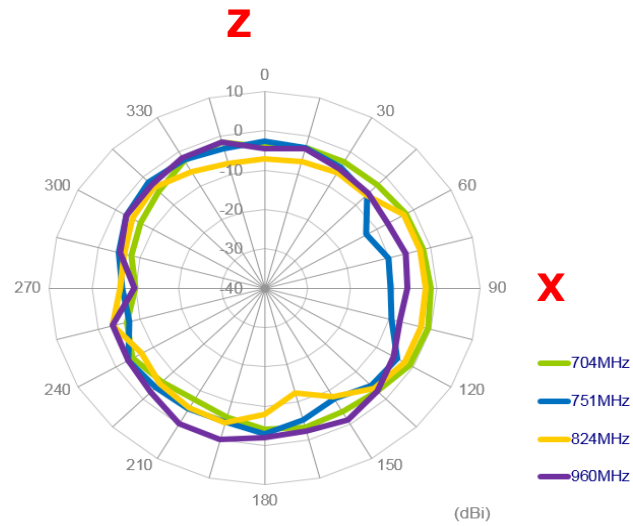
## 4.2 2D Radiation Patterns

### 4.2.1 LTE1

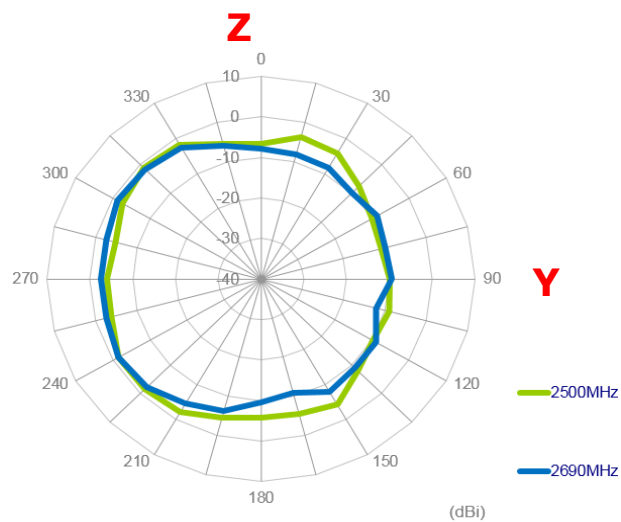
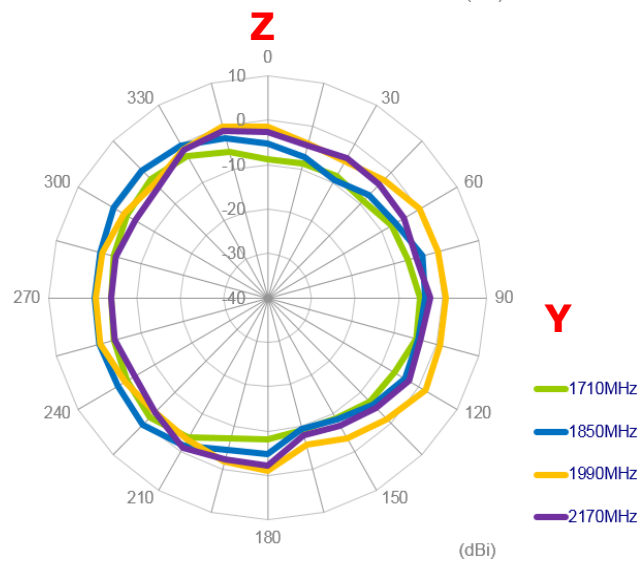
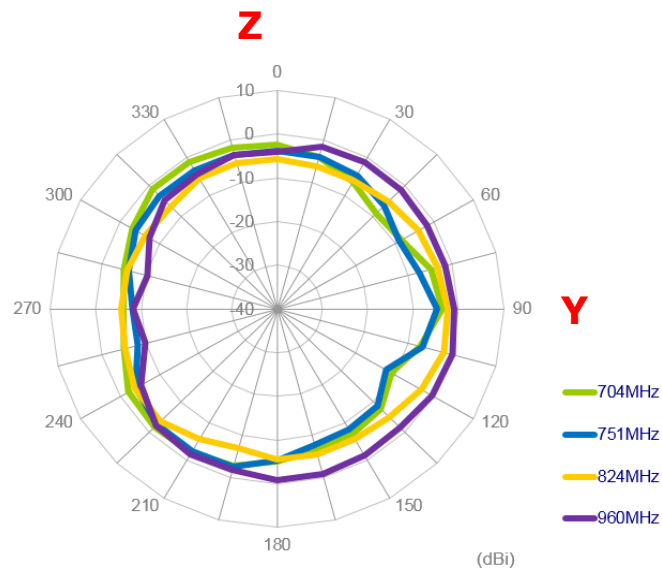
#### XY Plane



## XZ Plane

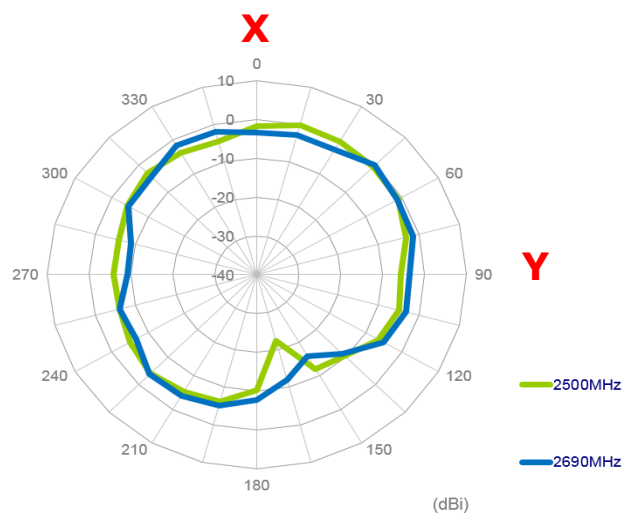
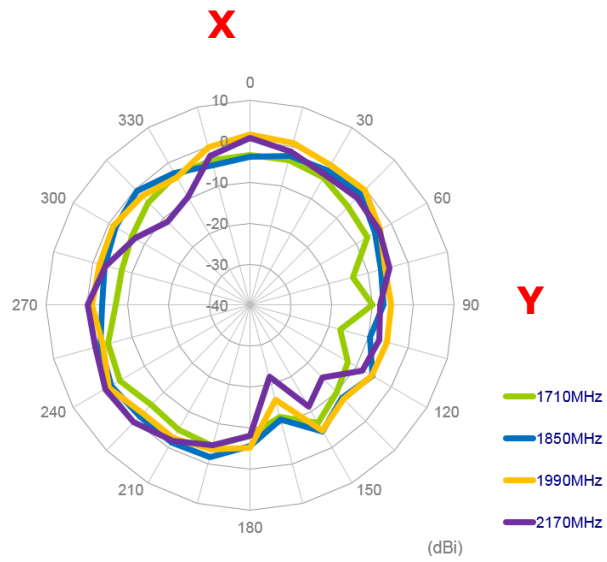
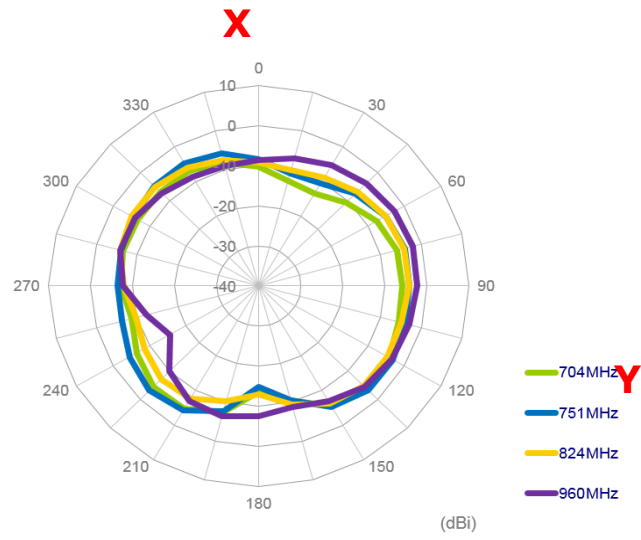


## YZ Plane

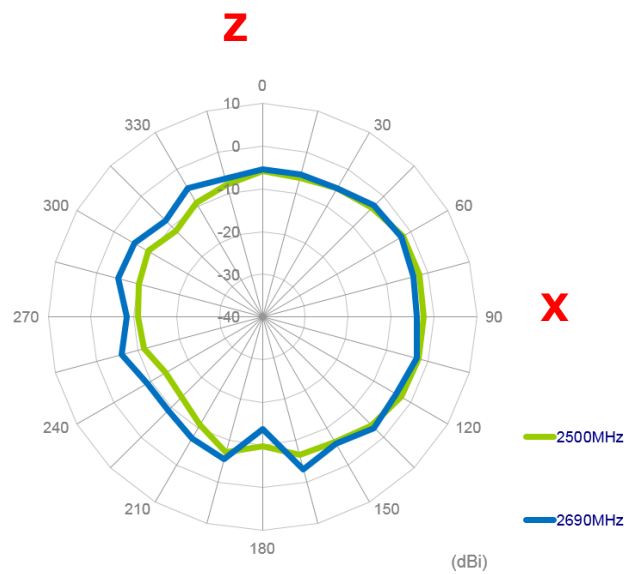
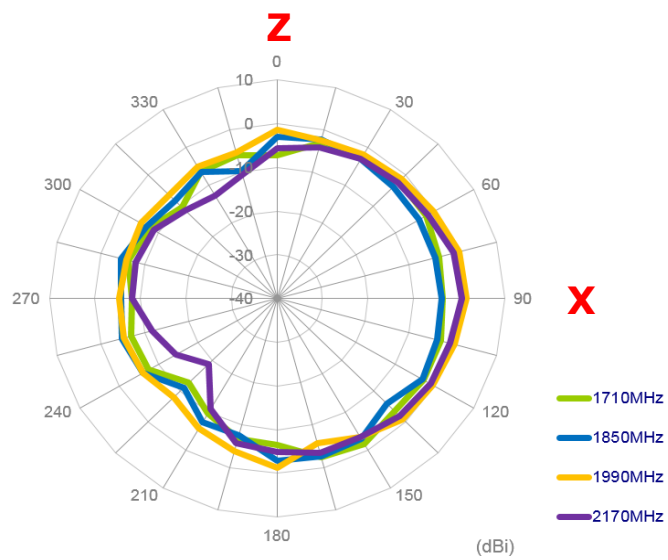
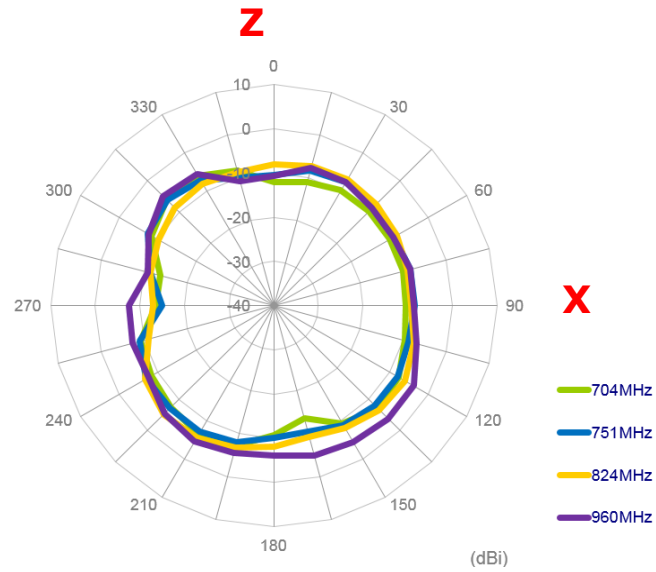


## 4.2.2 LTE2

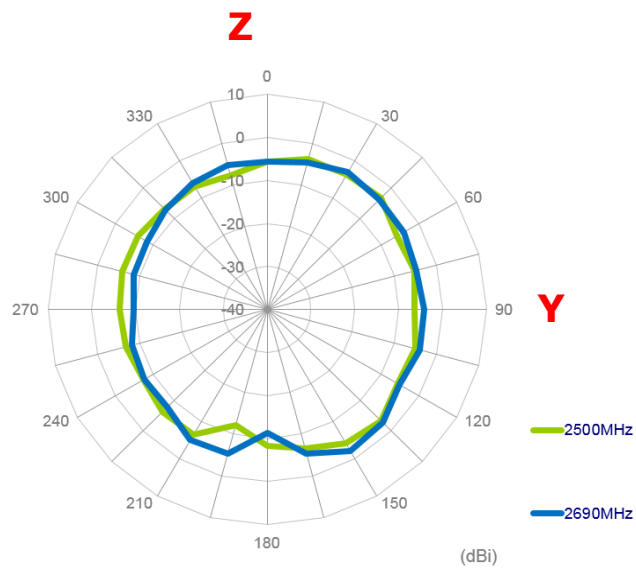
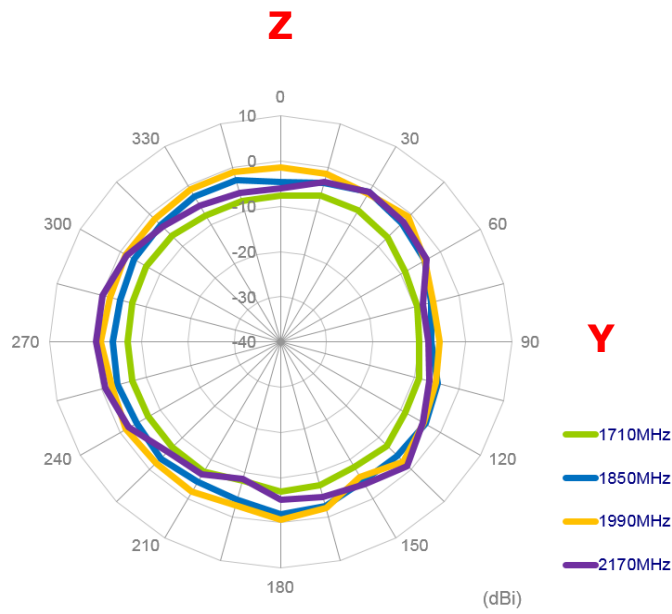
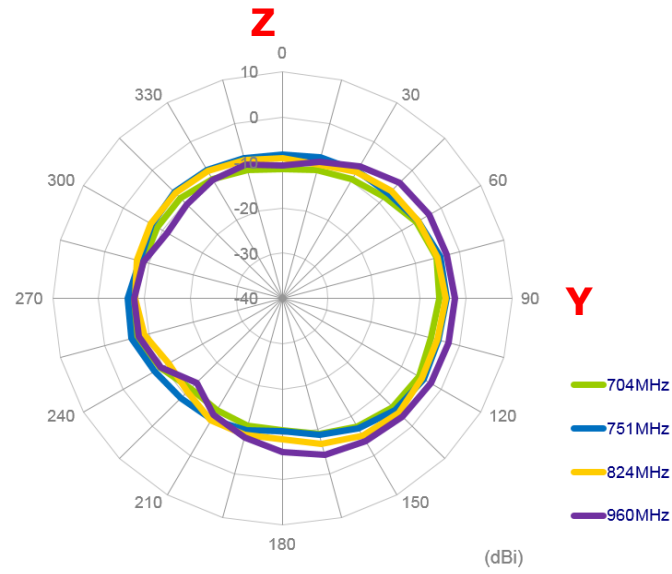
### XY Plane



## XZ Plane

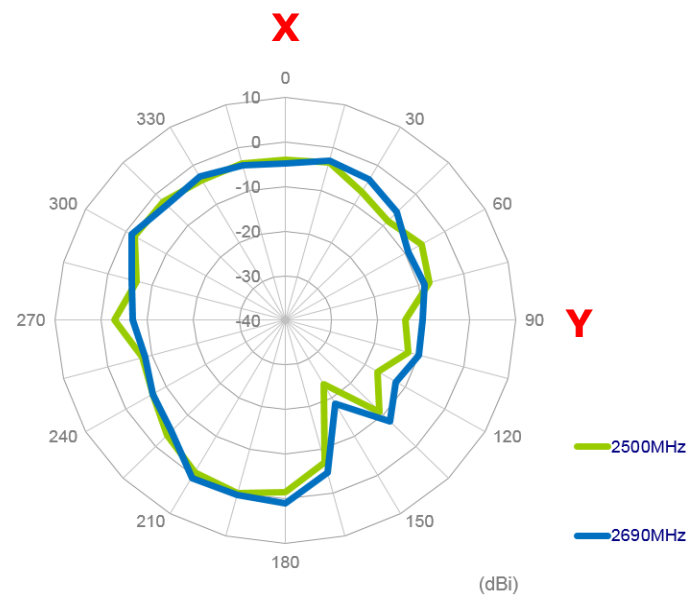
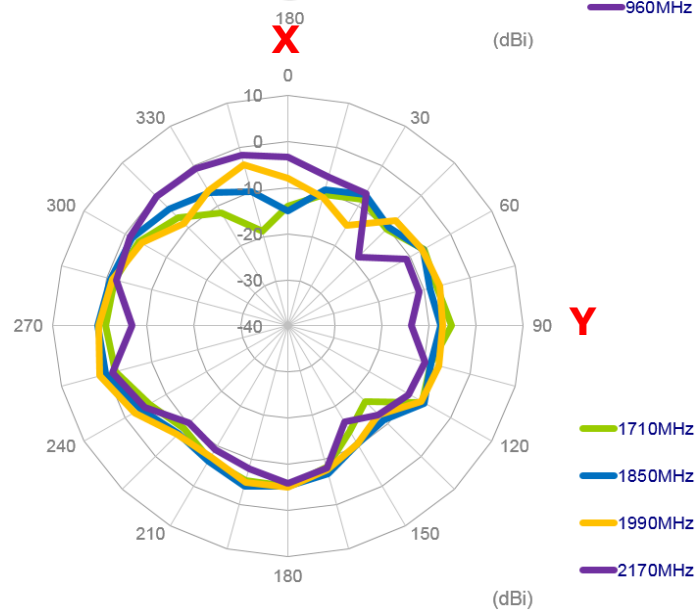
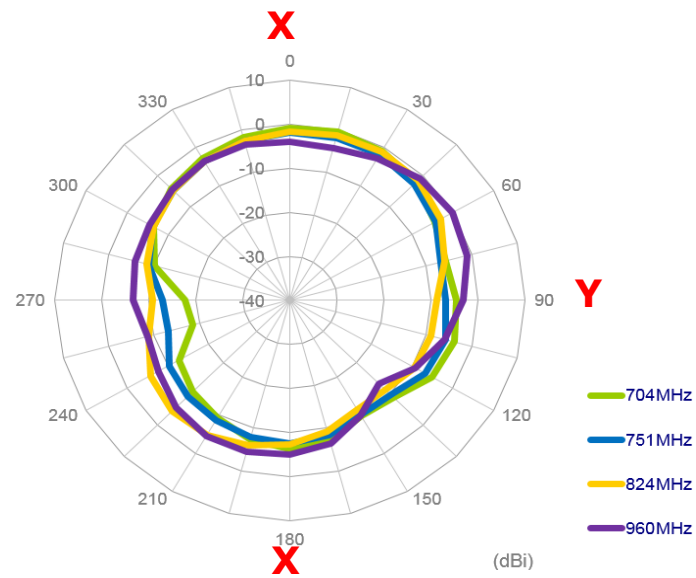


## YZ Plane

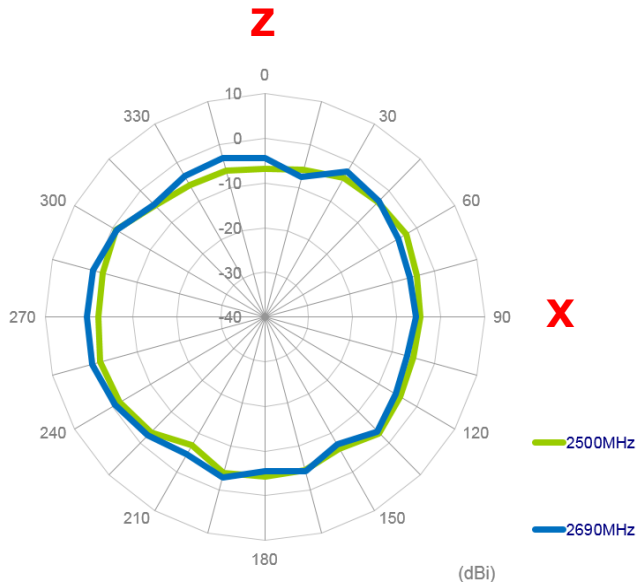
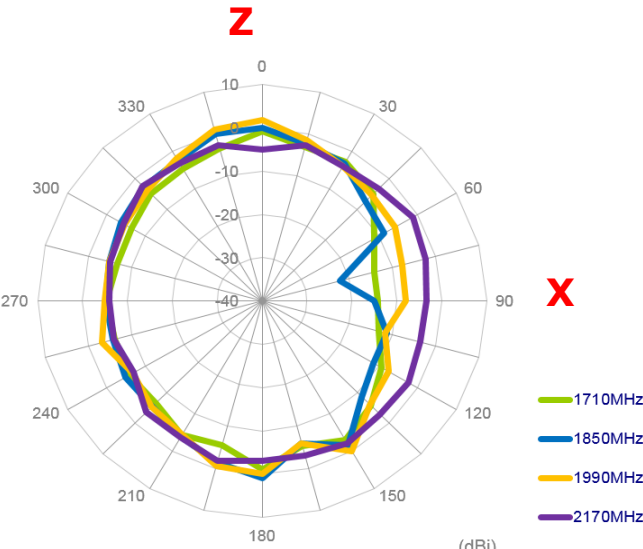
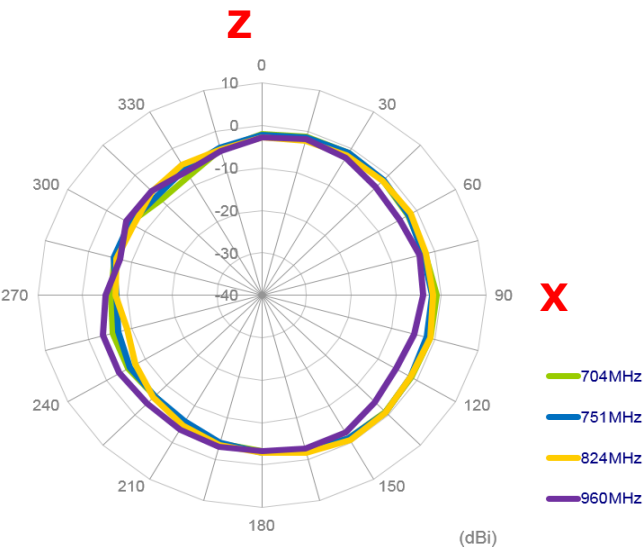


### 4.2.3 LTE3

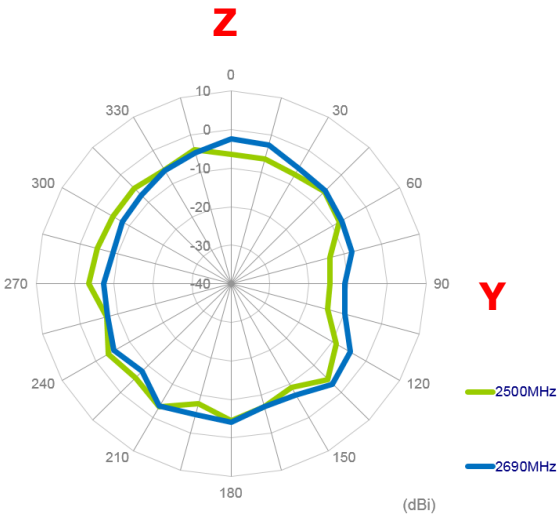
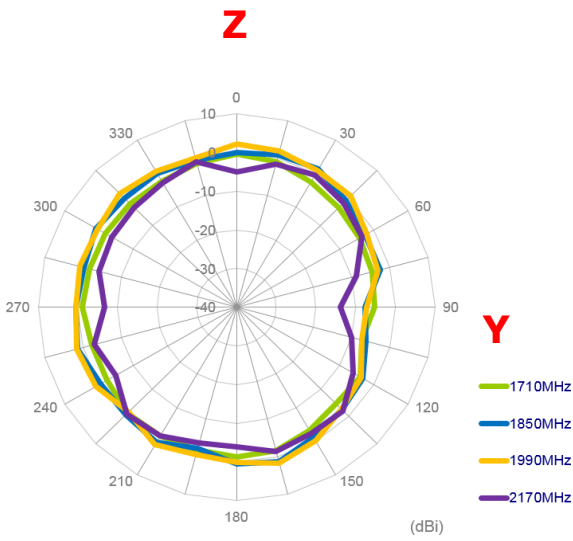
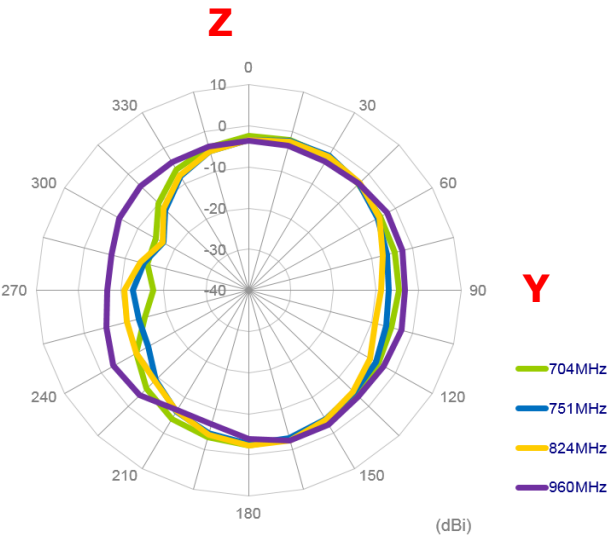
#### XY Plane



XZ Plane

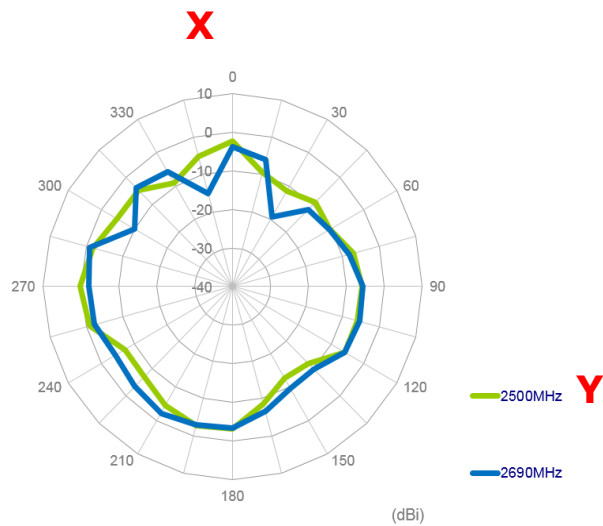
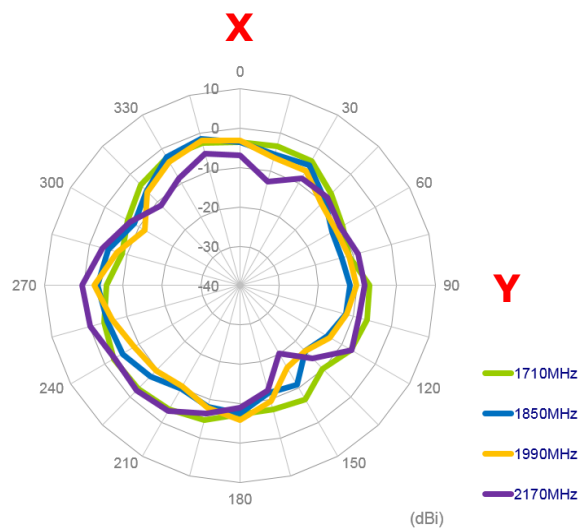
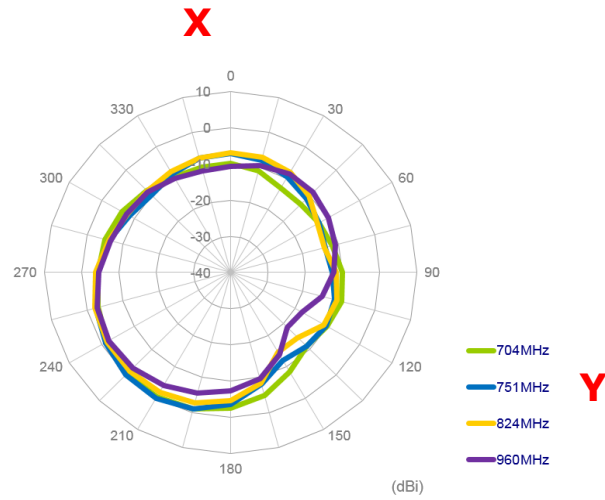


YZ Plane

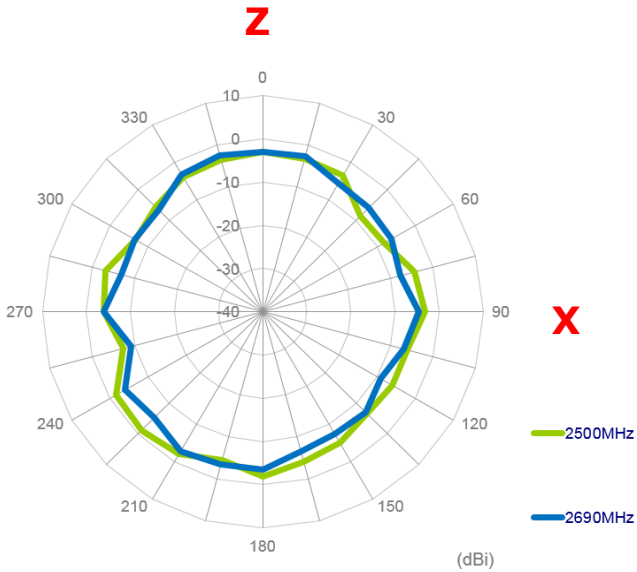
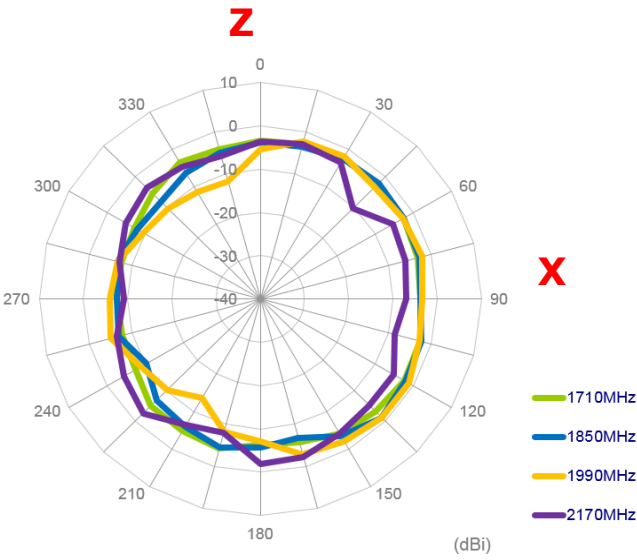
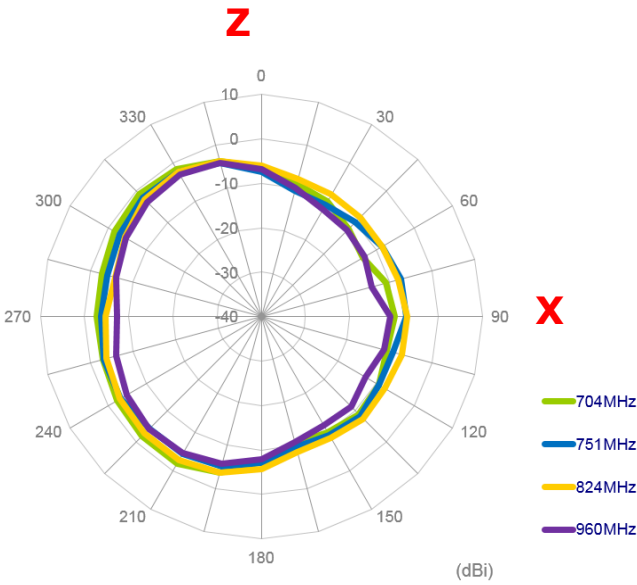


## 4.2.4 LTE4

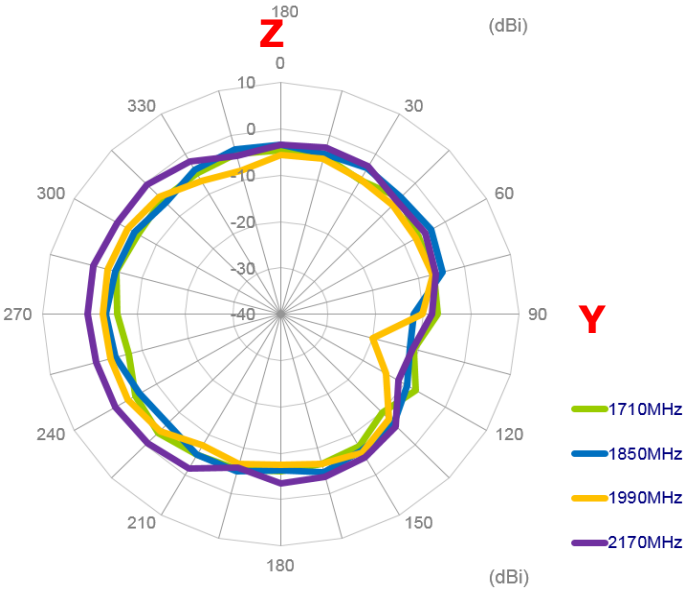
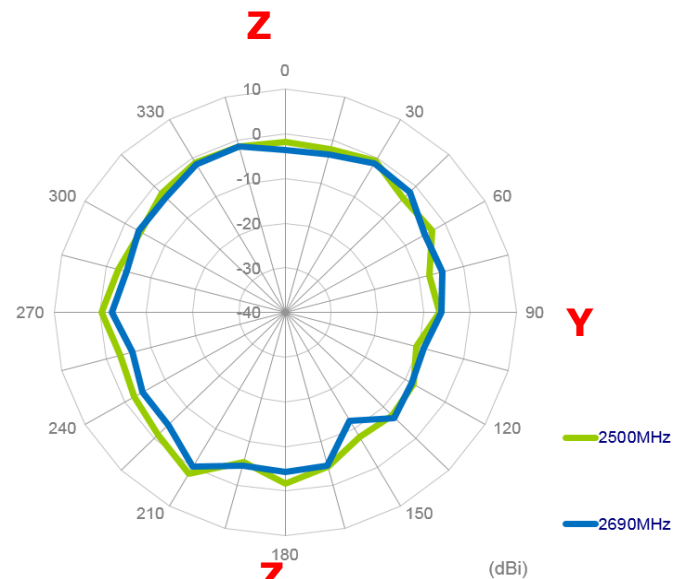
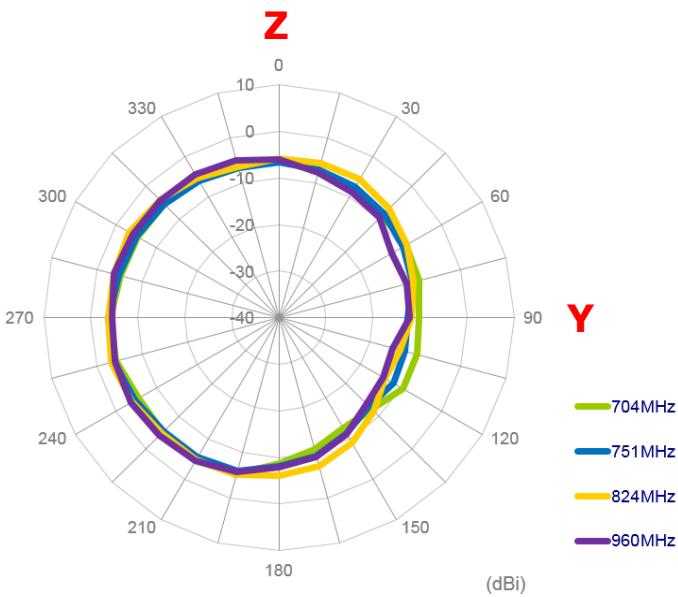
### XY Plane



XZ Plane

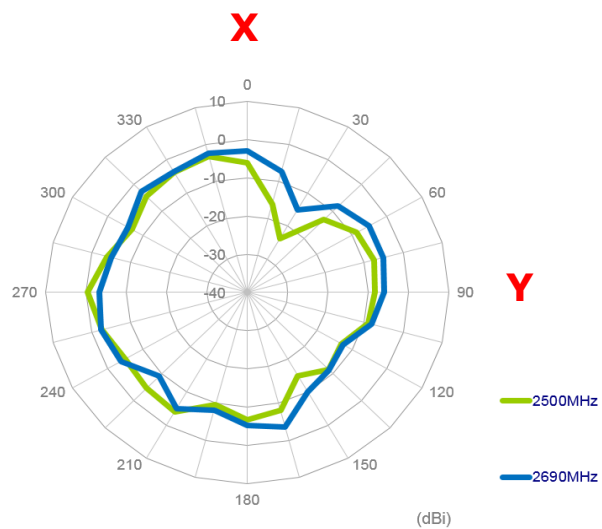
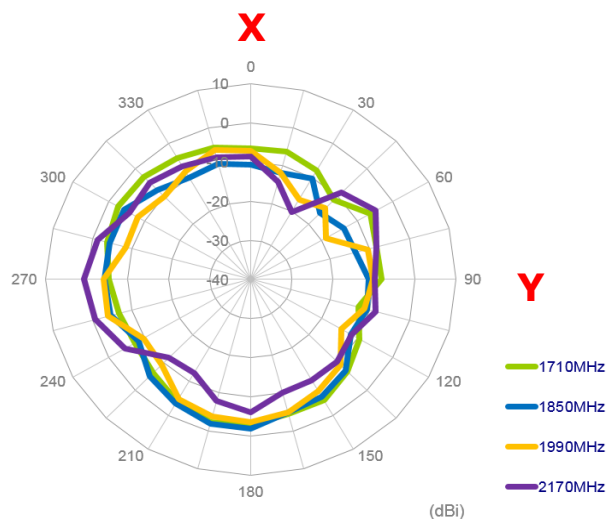
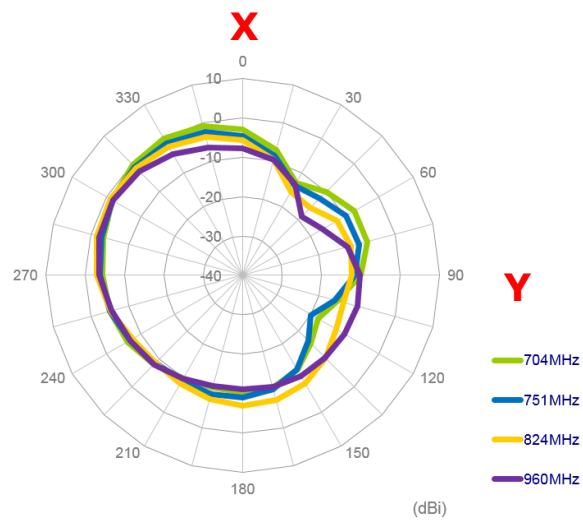


YZ Plane

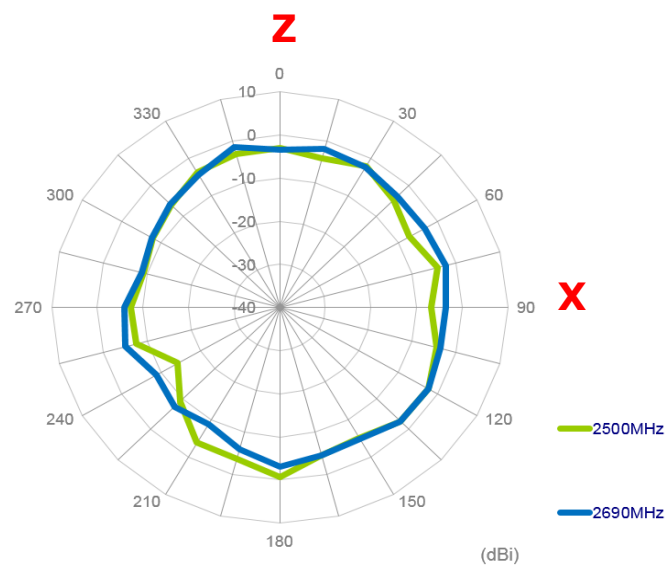
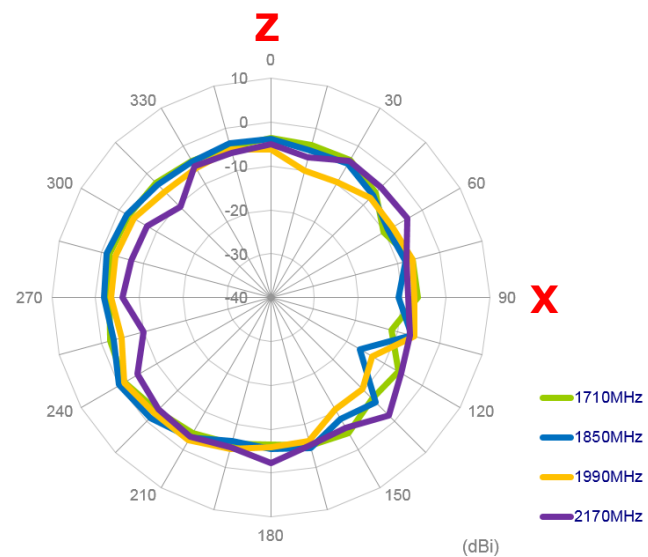
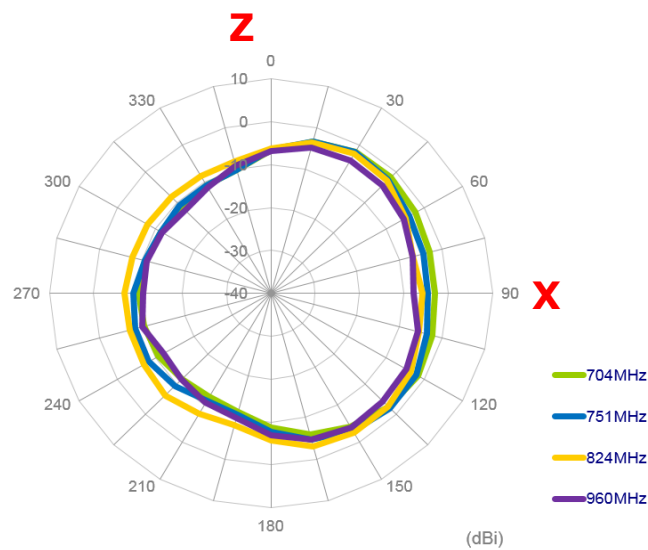


## 4.2.5 LTE5

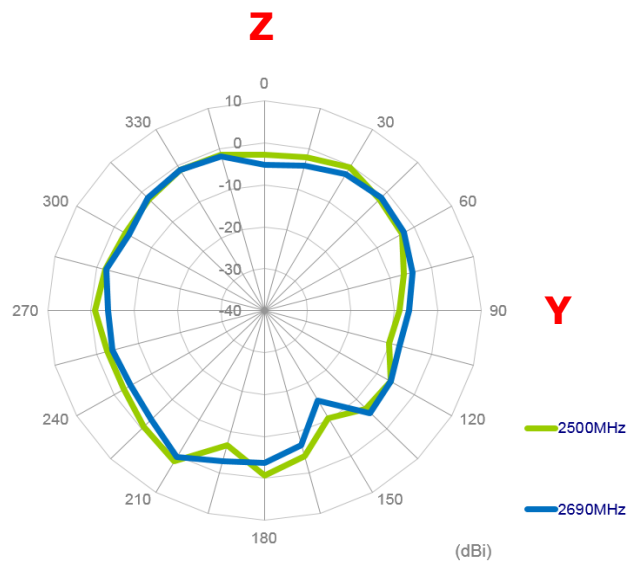
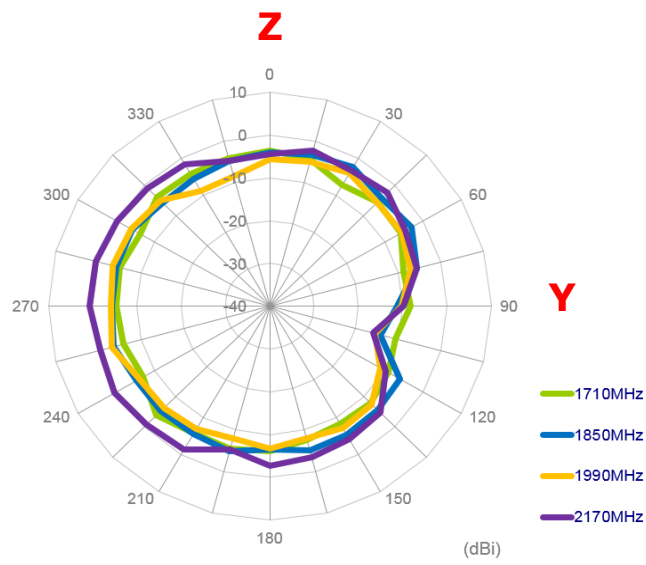
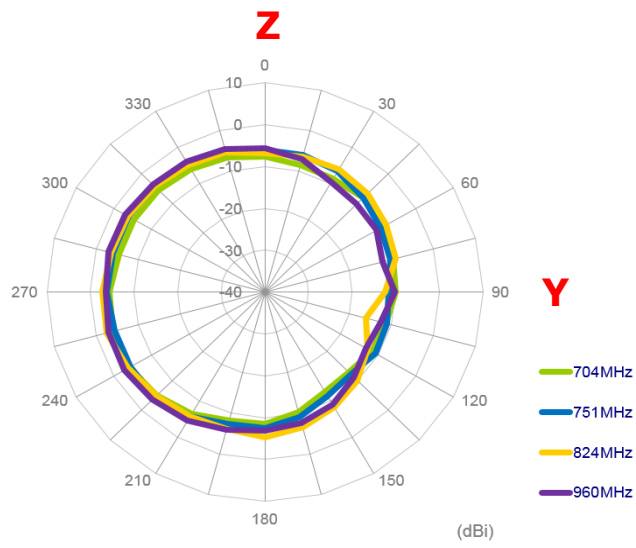
### XY Plane



Z-X Plane

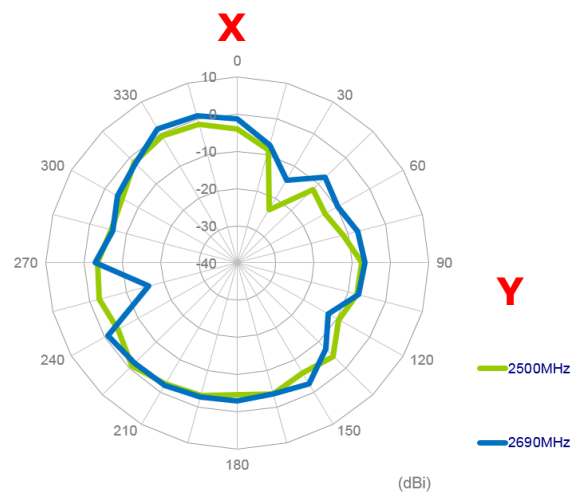
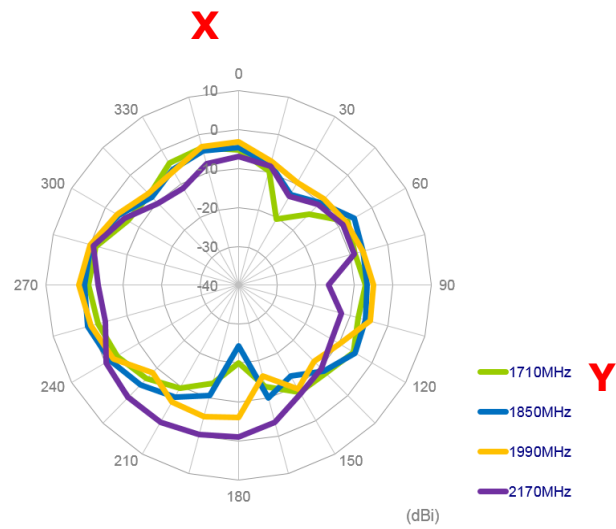
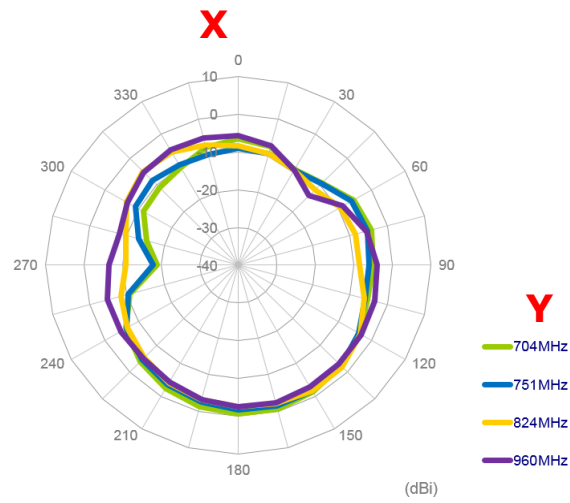


## YZ Plane

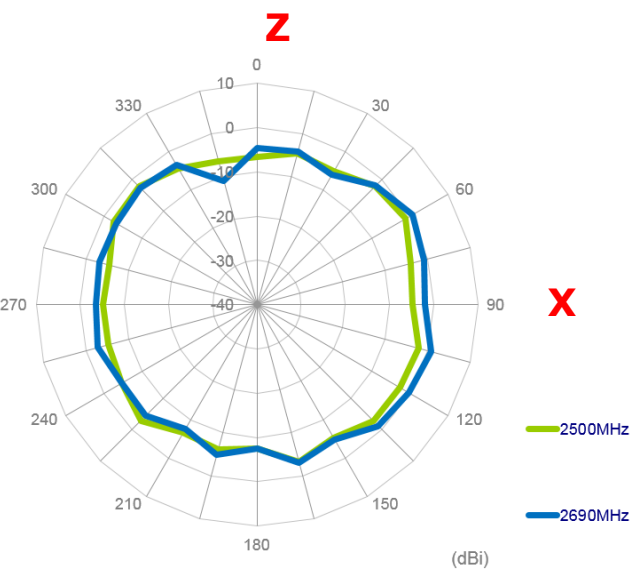
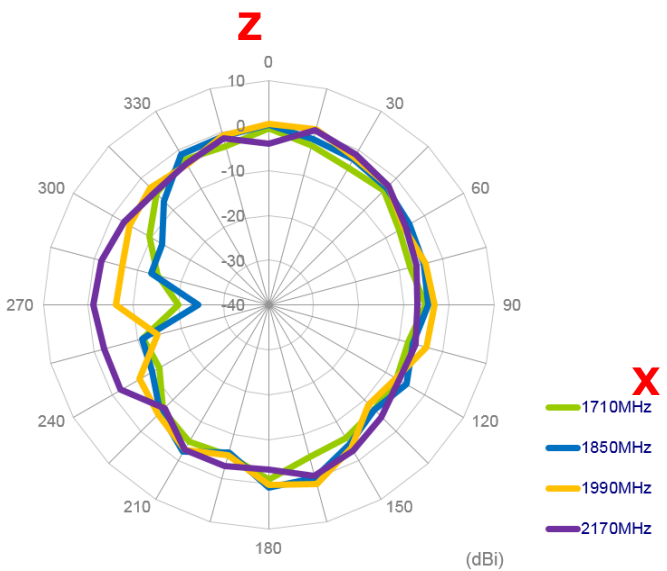
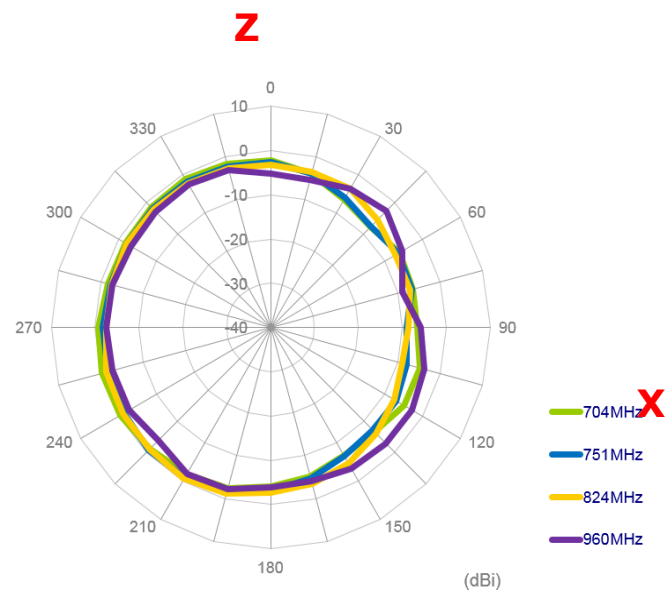


## 4.2.6 LTE6

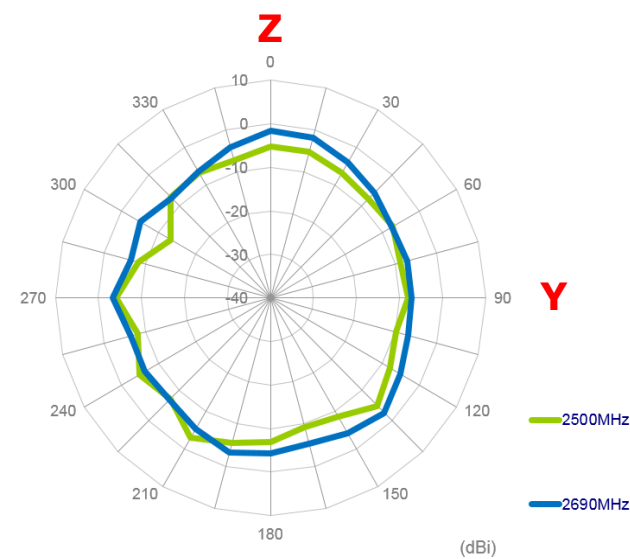
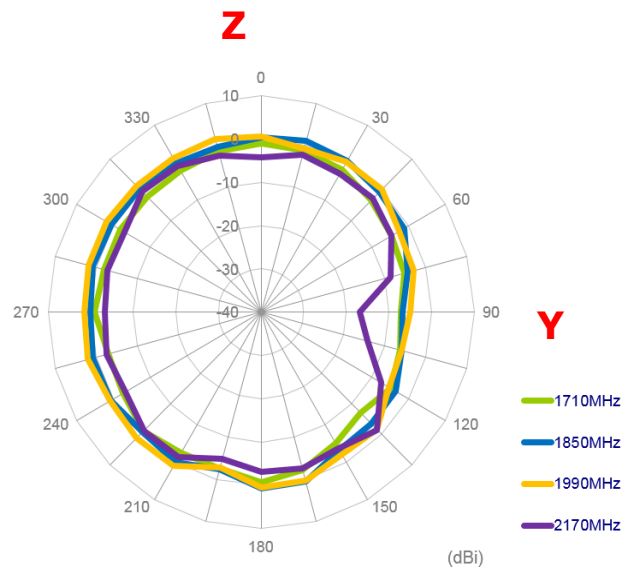
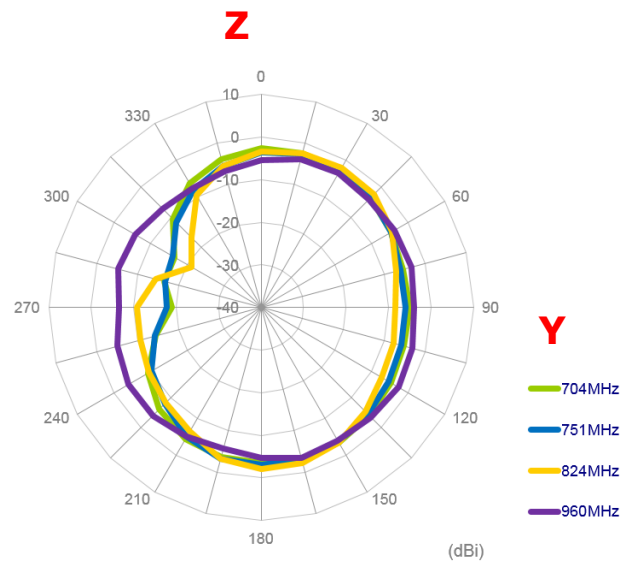
### XY Plane



XZ Plane

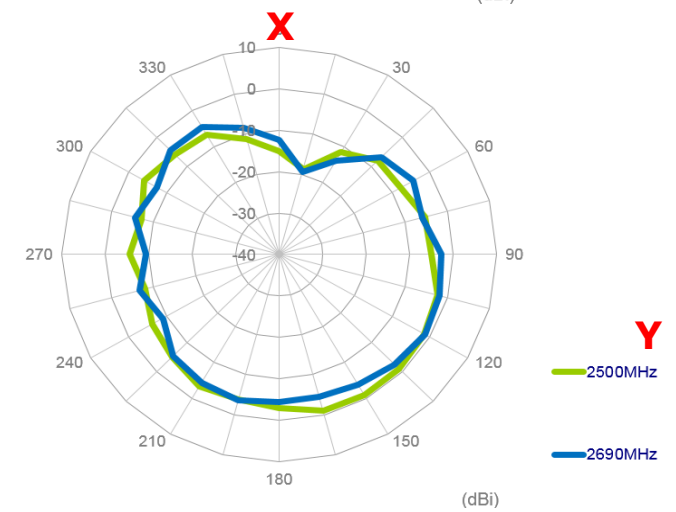
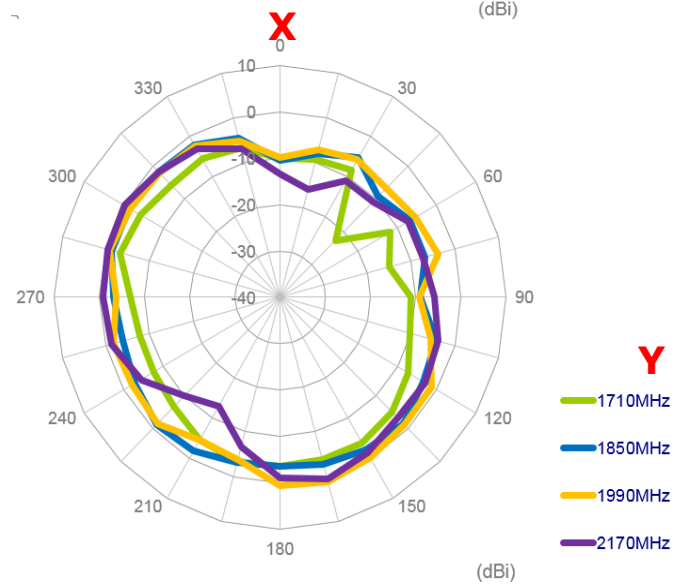
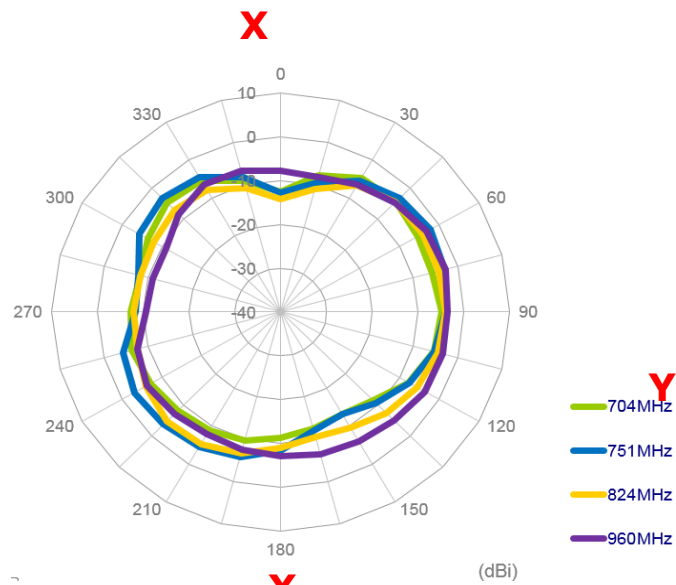


## YZ Plane

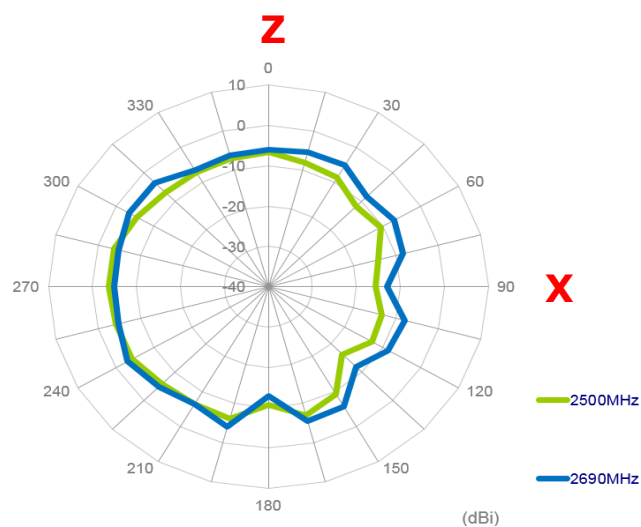
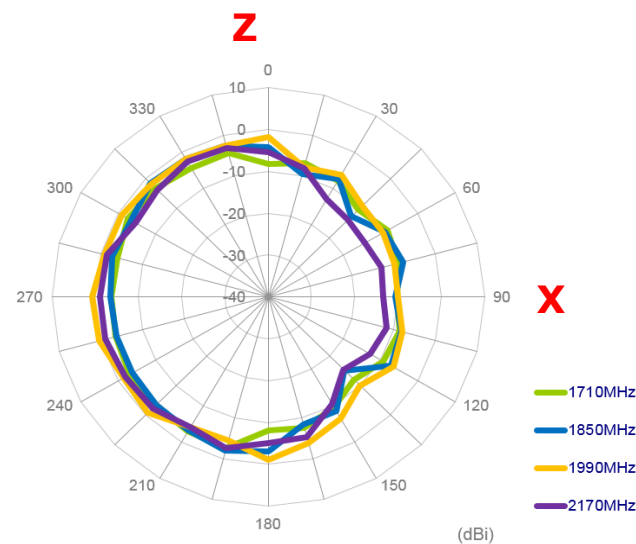
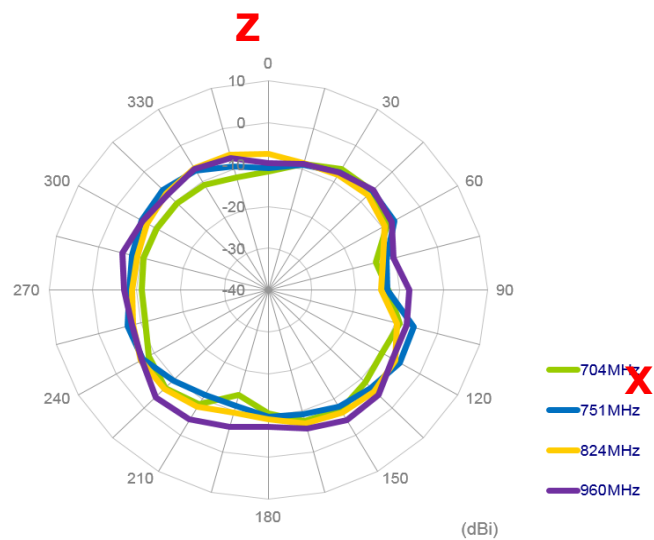


## 4.2.7 LTE7

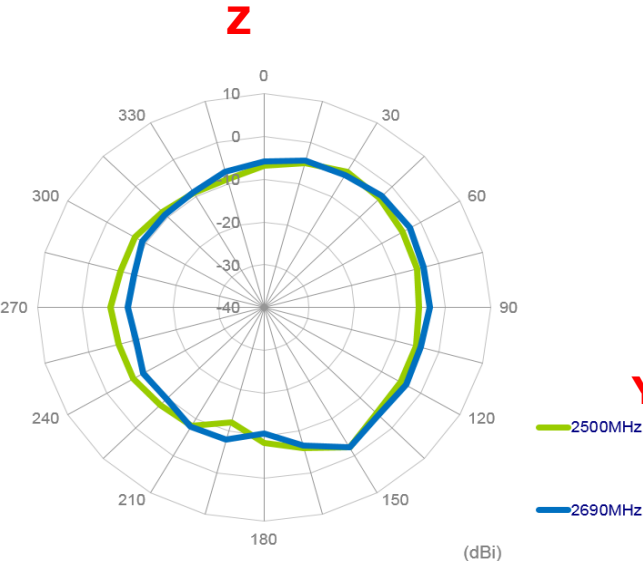
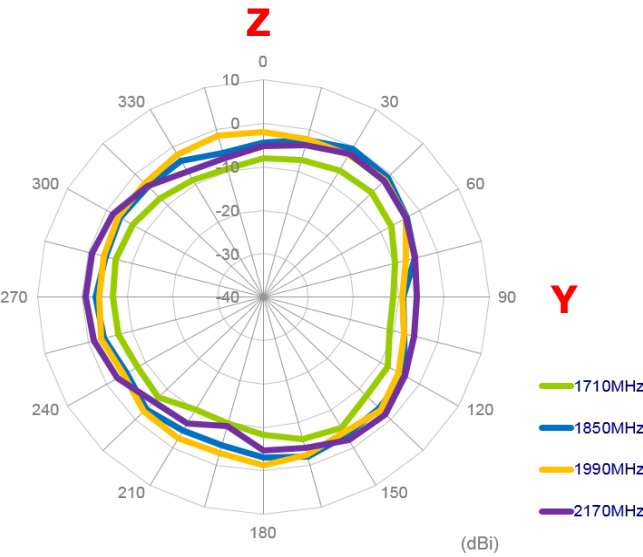
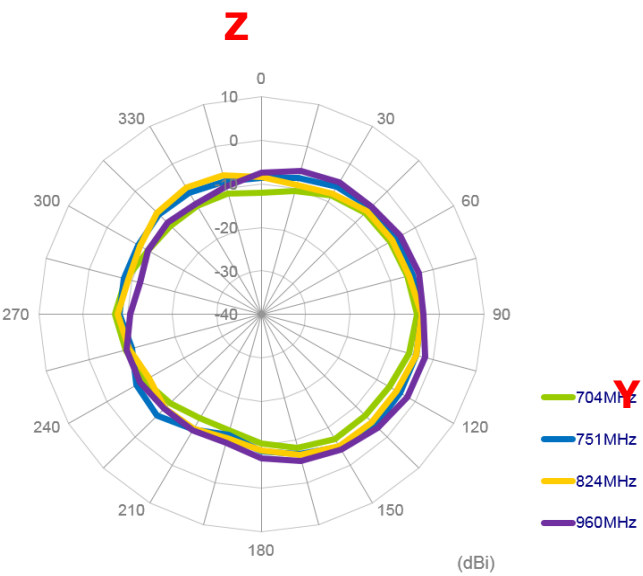
### XY Plane



XZ Plane

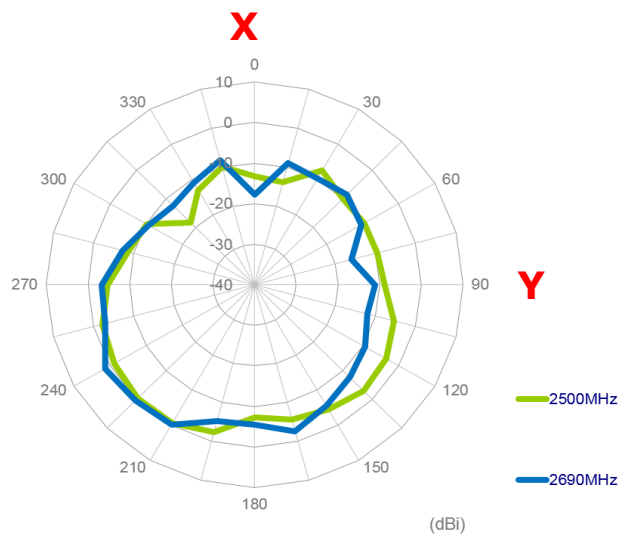
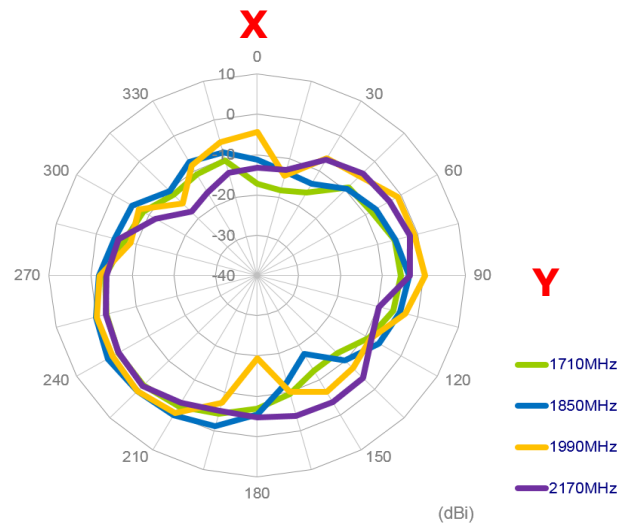
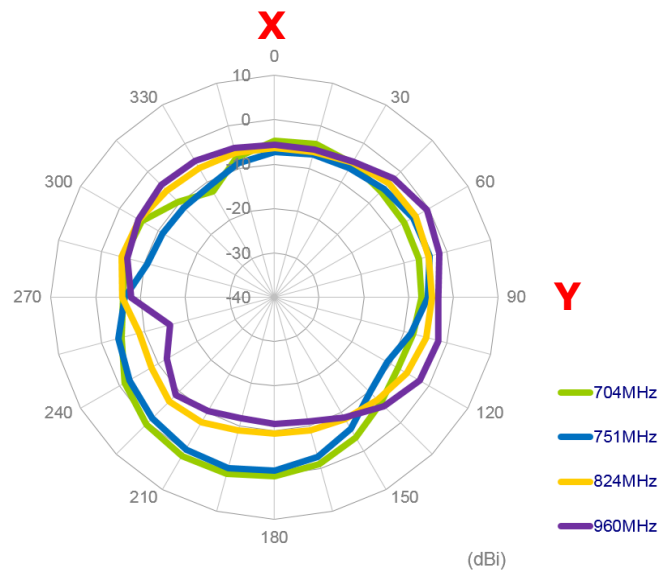


YZ Plane

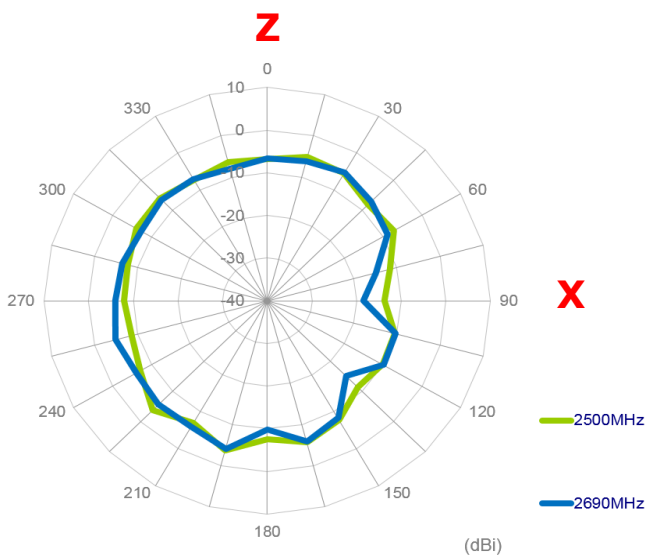
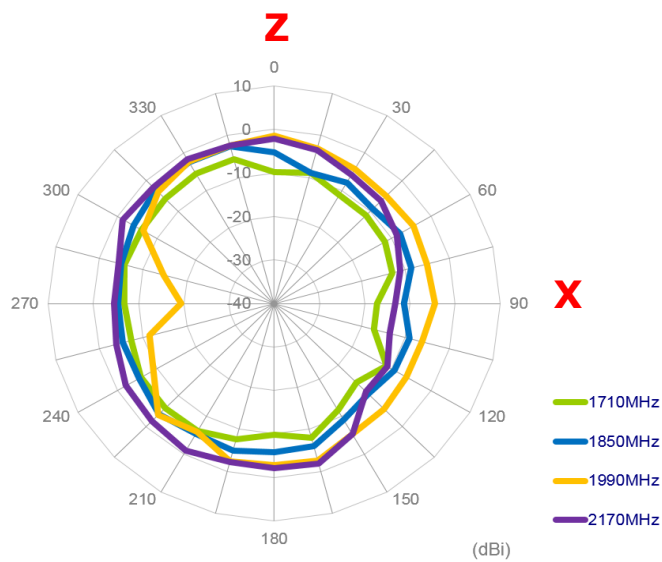
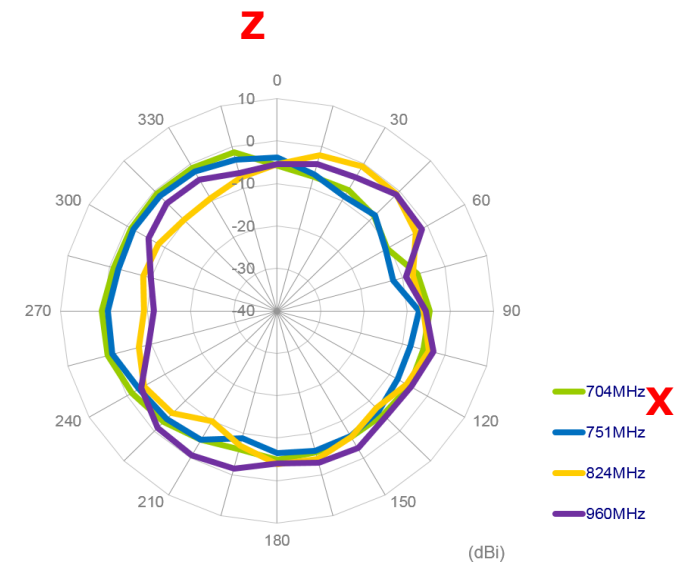


## 4.2.8 LTE8

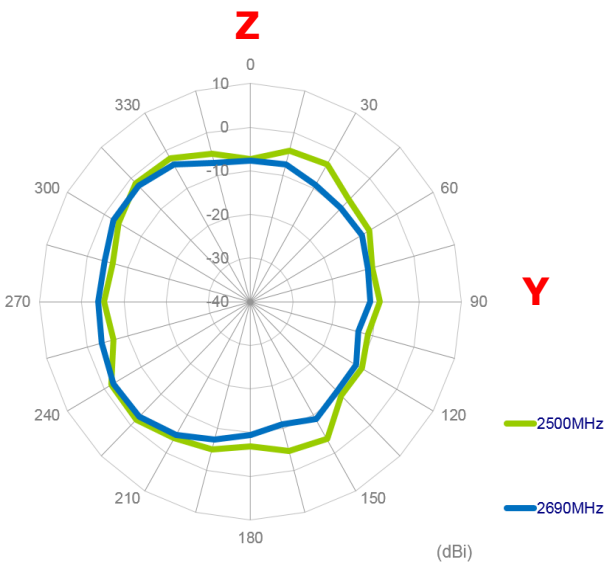
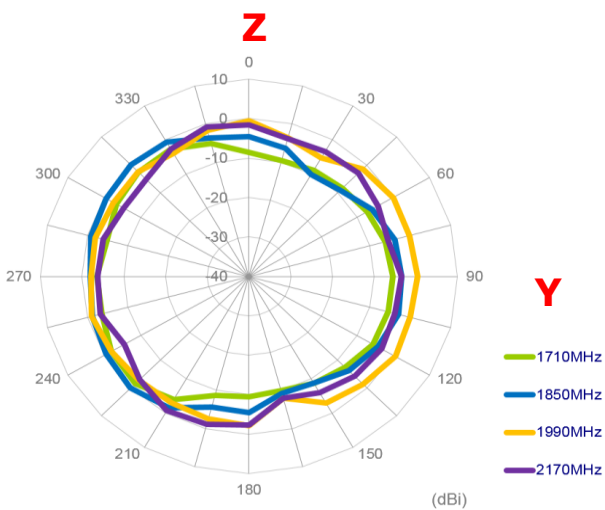
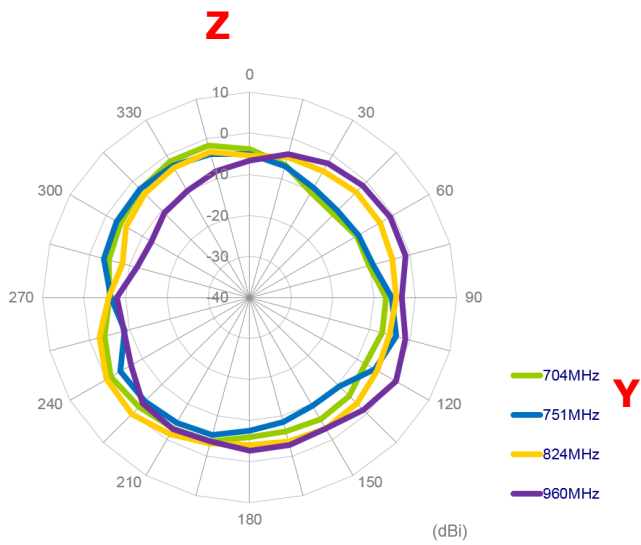
### XY Plane



XZ Plane

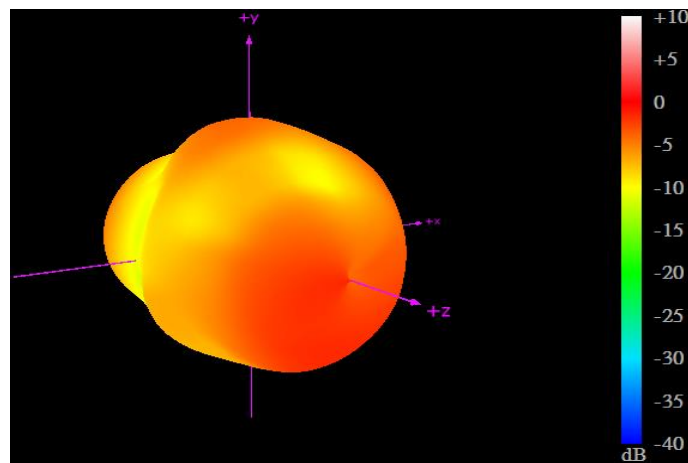


YZ Plane

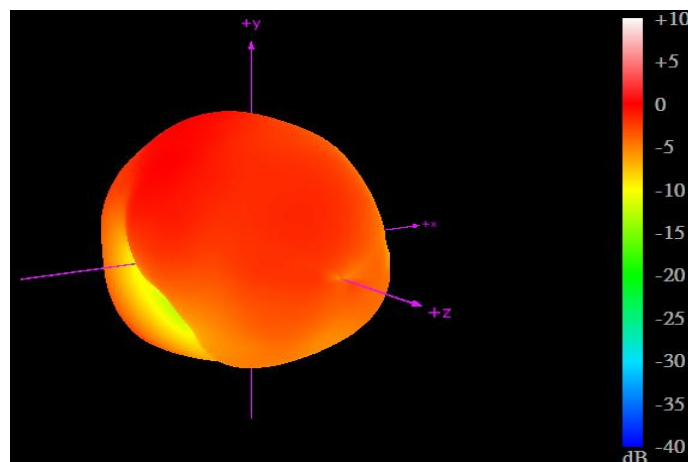


## 4.3 3D Radiation Patterns

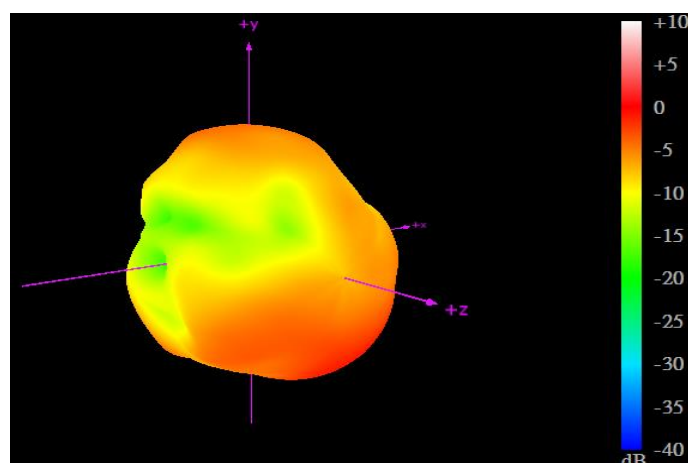
### 4.3.1 LTE1



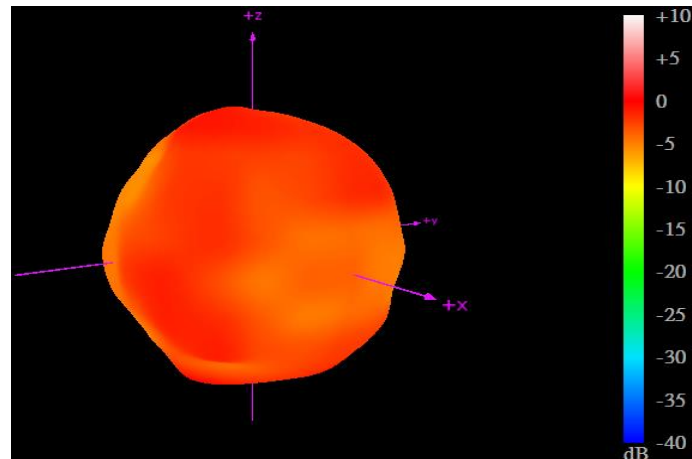
704MHz



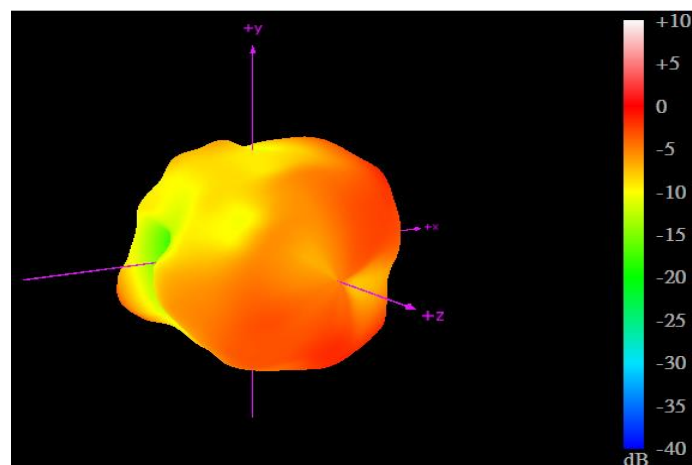
960MHz



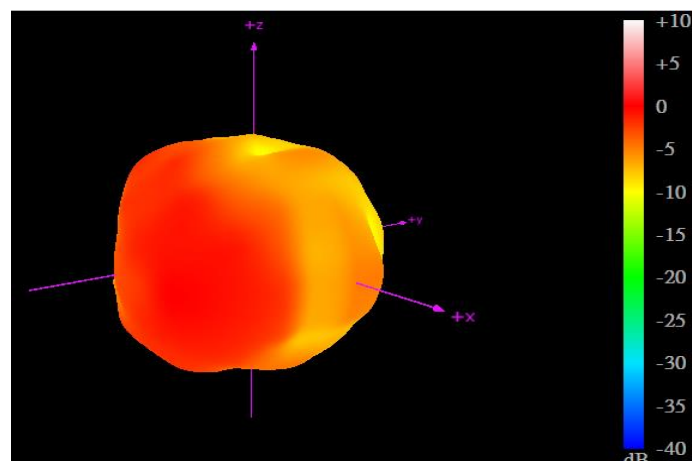
1710MHz



2170MHz

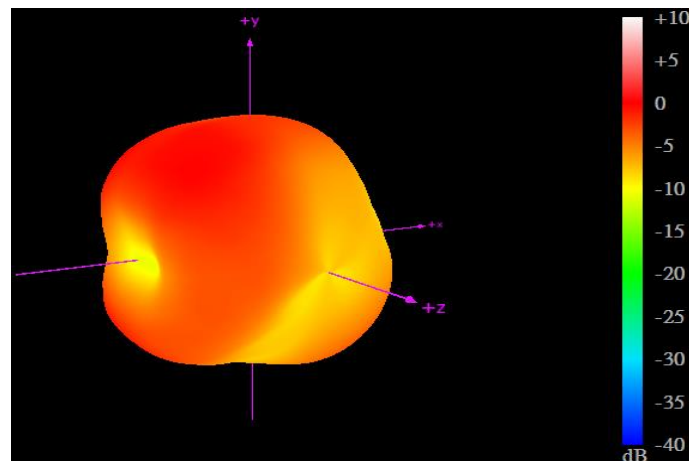


2300MHz

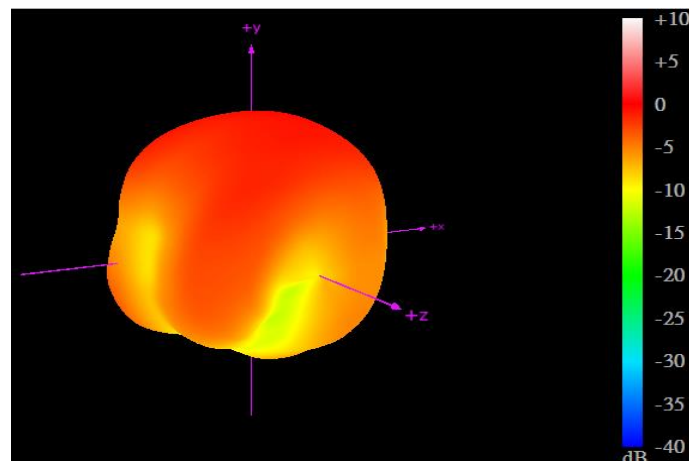


2690MHz

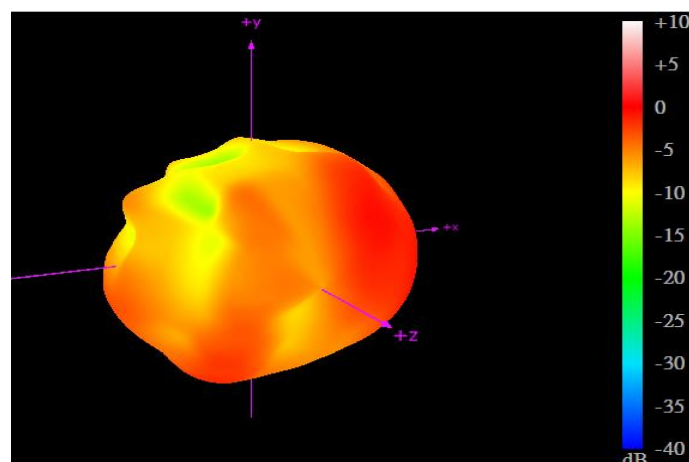
### 4.3.2 LTE2



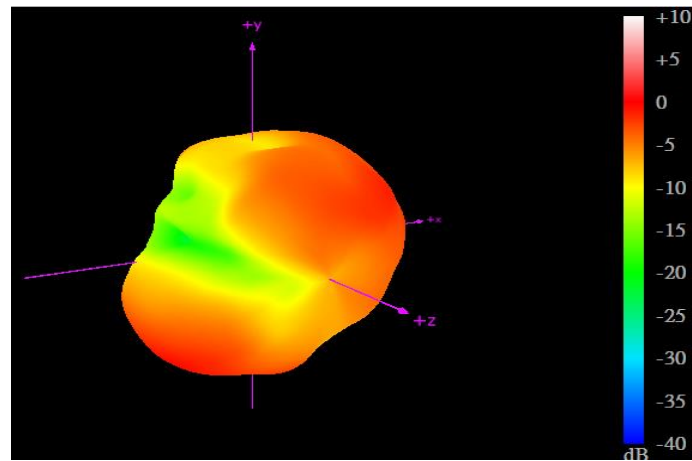
704MHz



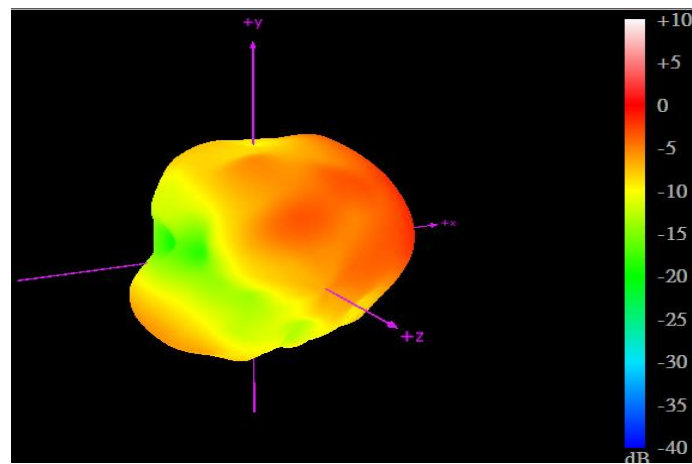
960MHz



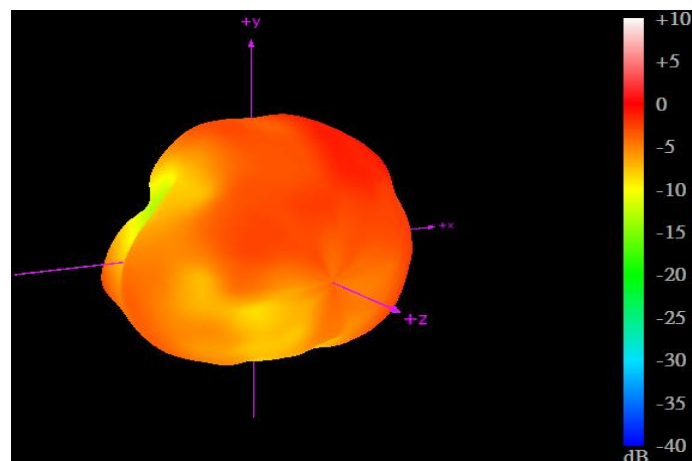
1710MHz



2170MHz

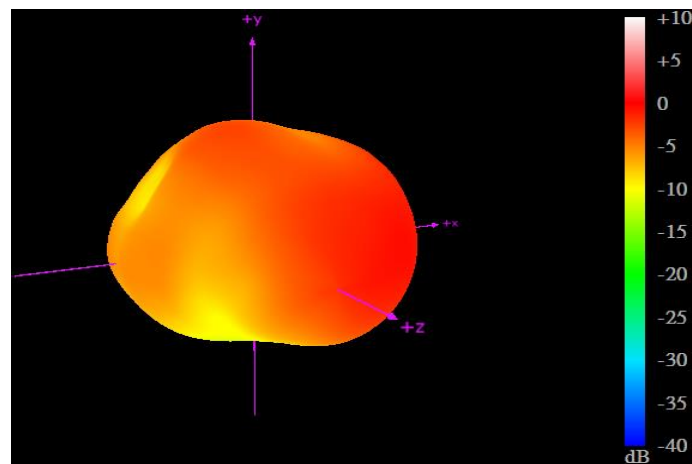


2300MHz

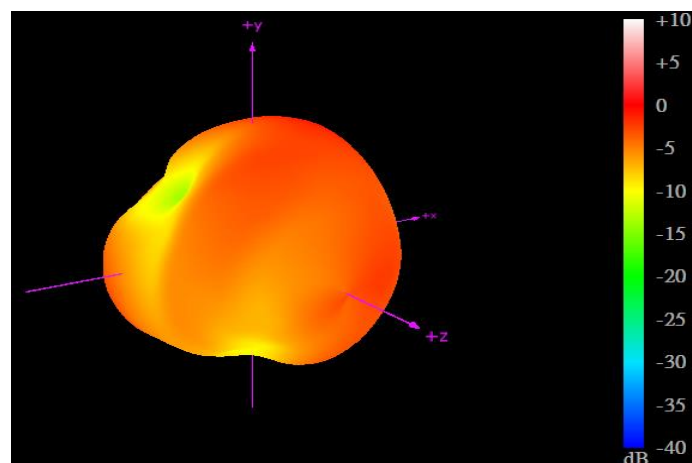


2690MHz

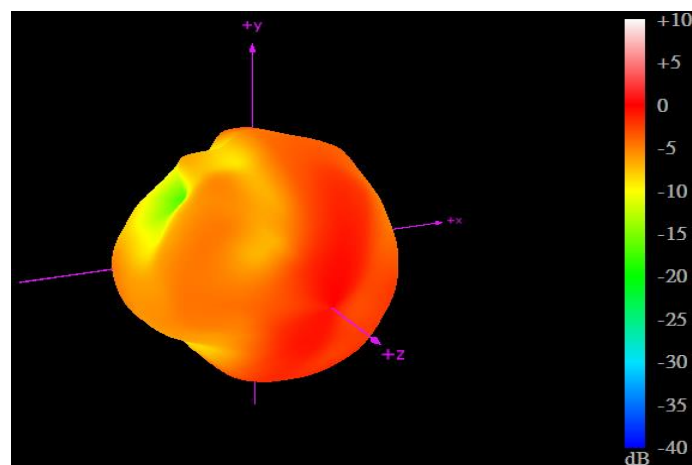
### 4.3.3 LTE3



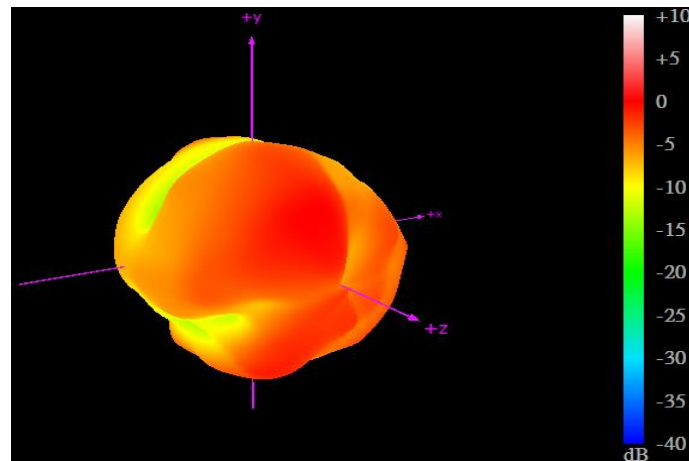
704MHz



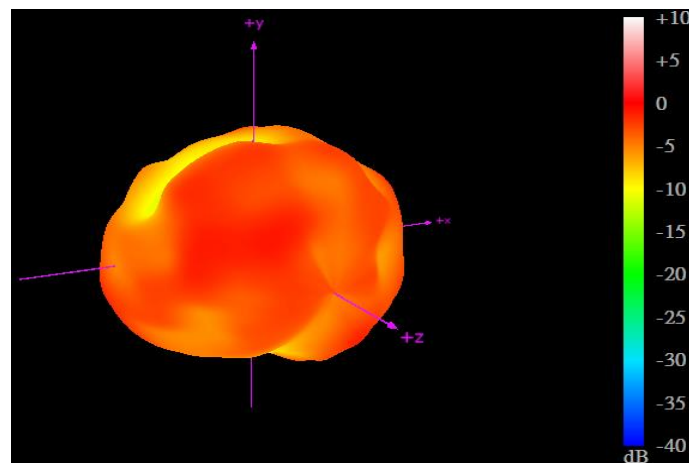
960MHz



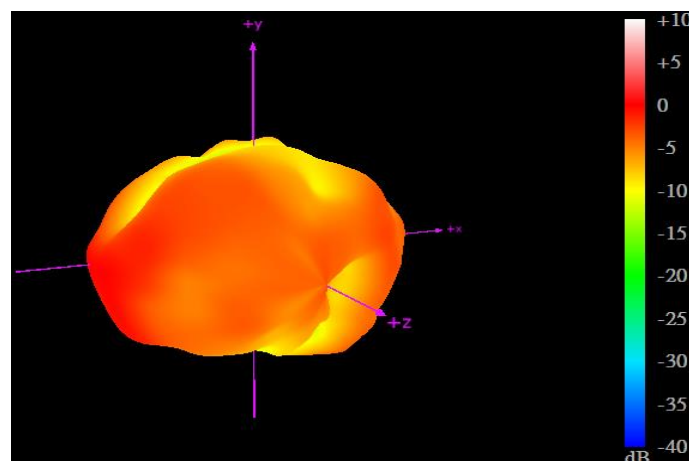
1710MHz



2170MHz

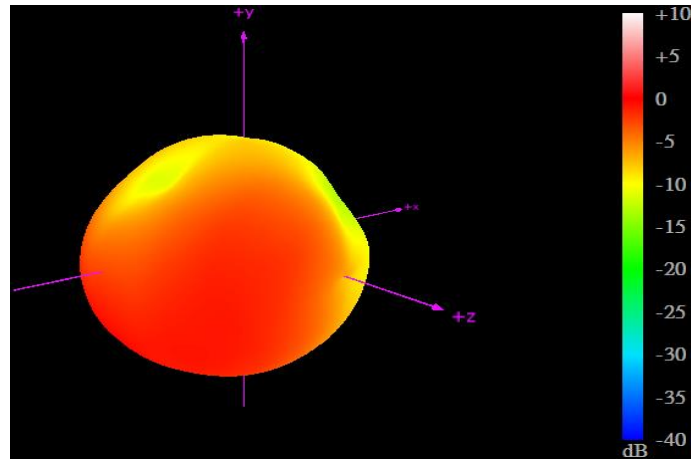


2300MHz

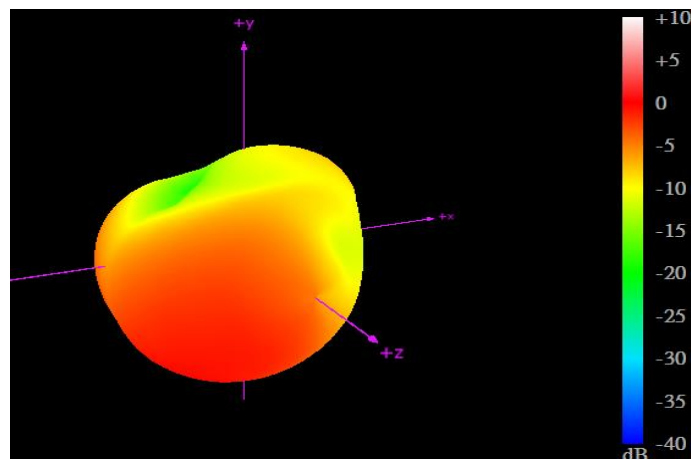


2690MHz

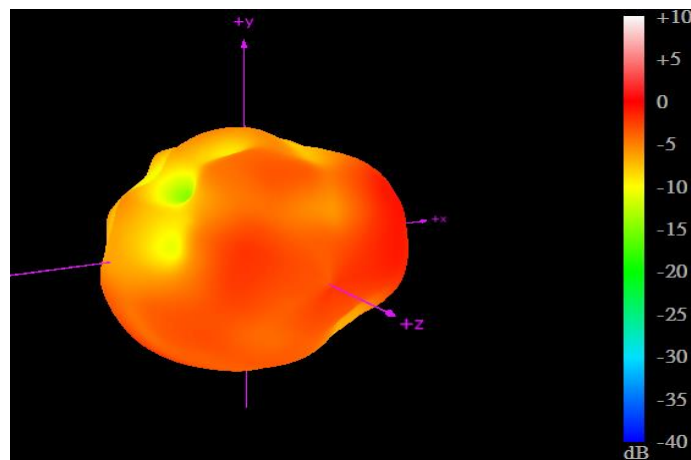
#### 4.3.4 LTE4



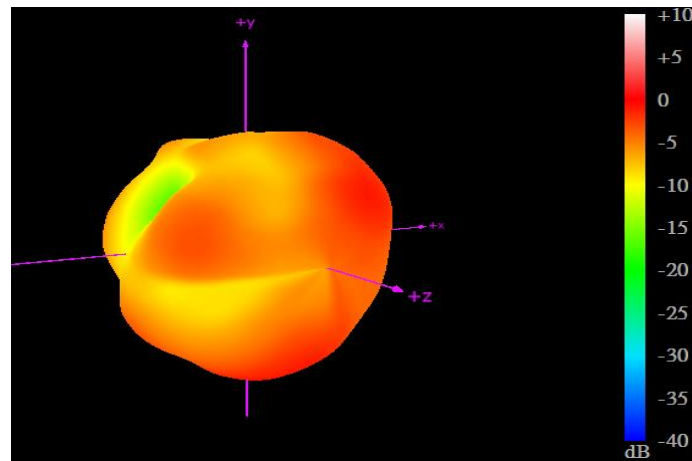
704MHz



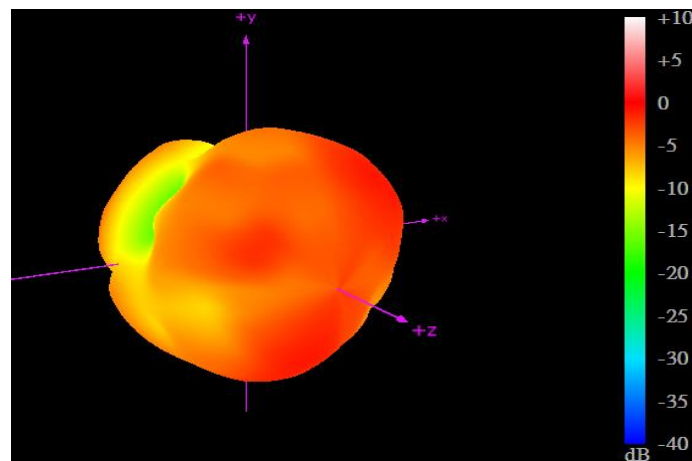
960MHz



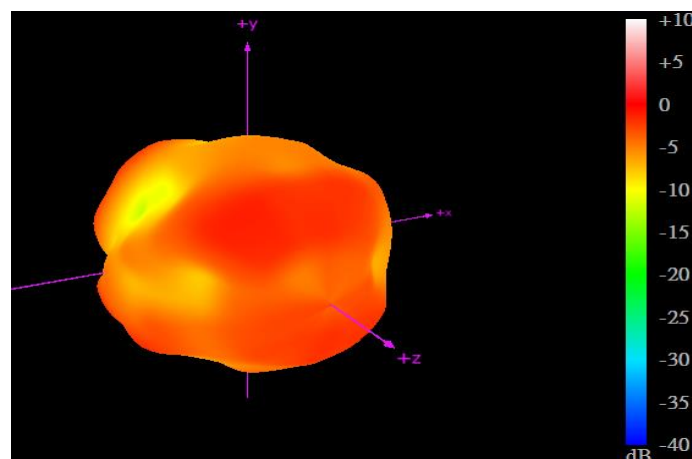
1710MHz



2170MHz

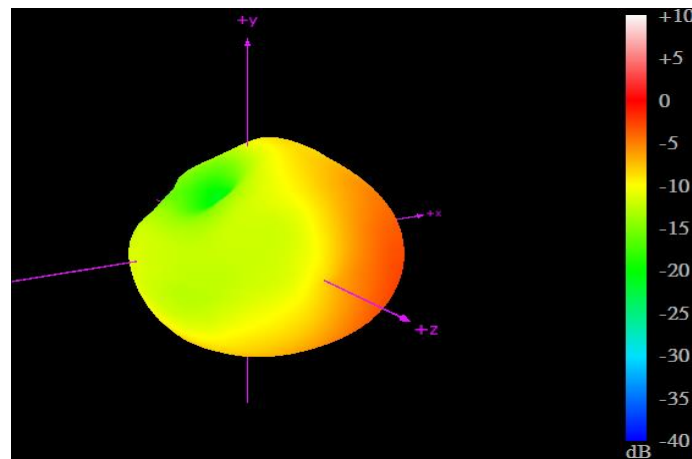


2300MHz

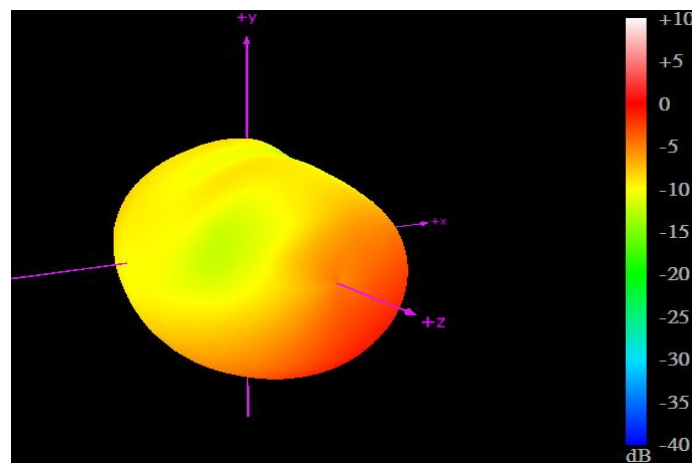


2690MHz

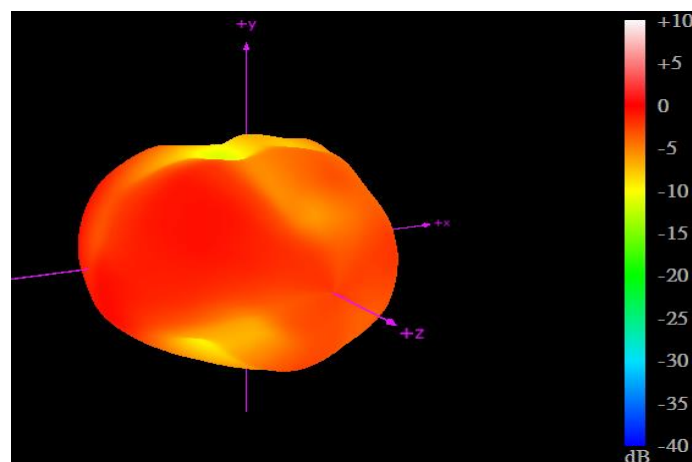
### 4.3.5 LTE5



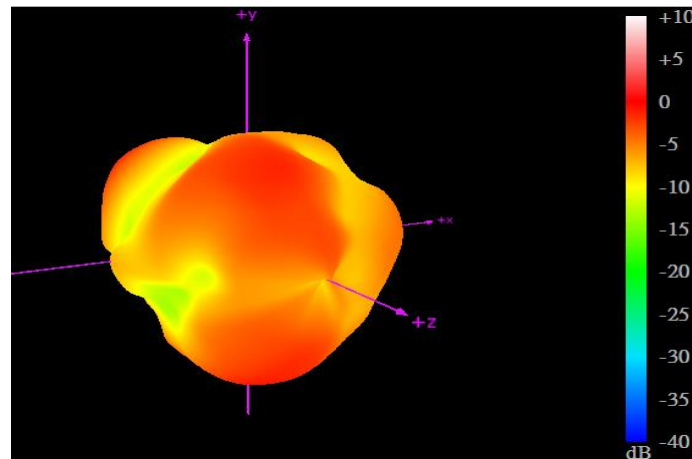
704MHz



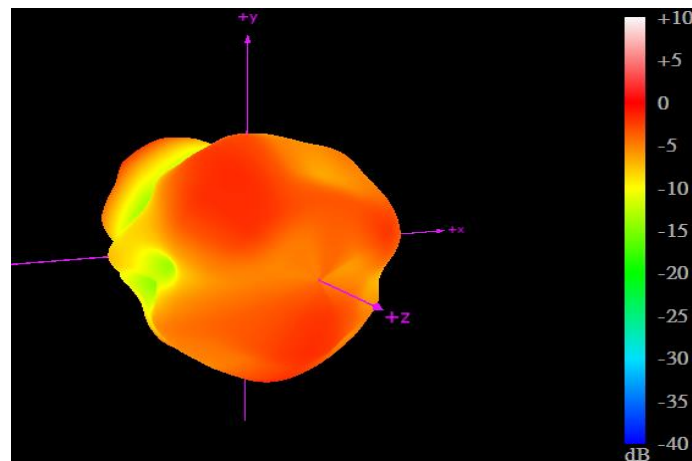
960MHz



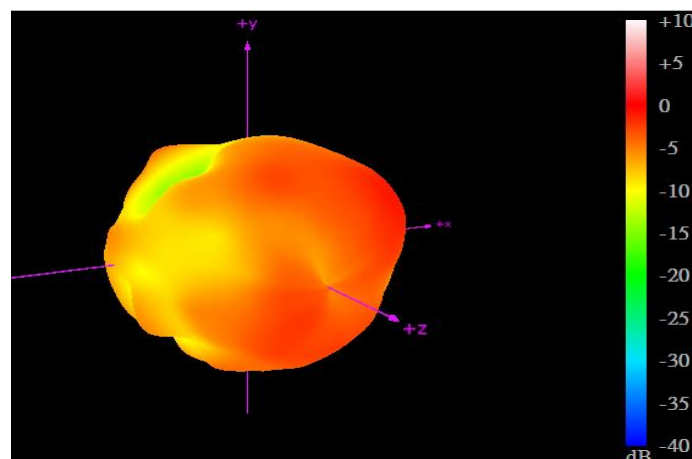
1710MHz



2170MHz

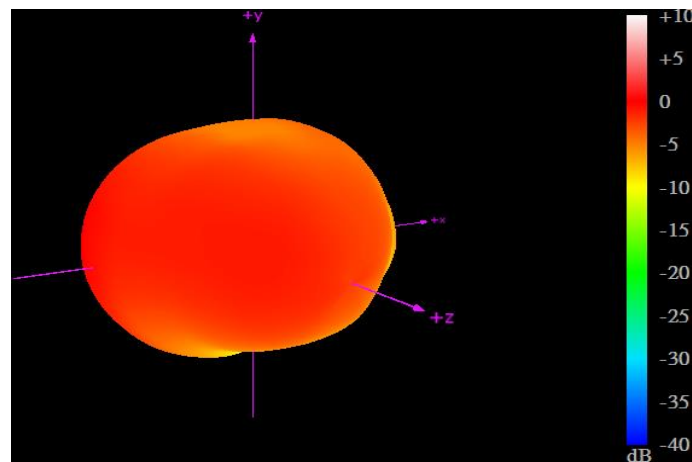


2300MHz

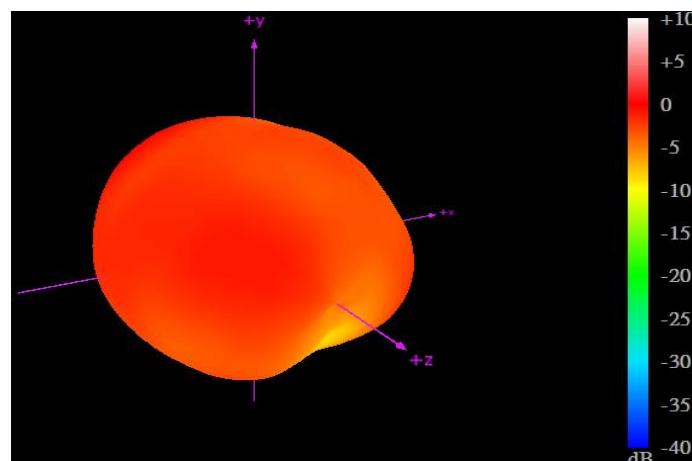


2690MHz

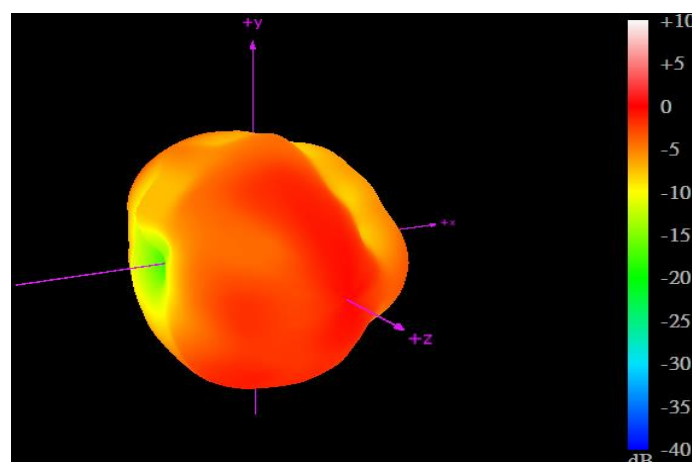
#### 4.3.6 LTE6



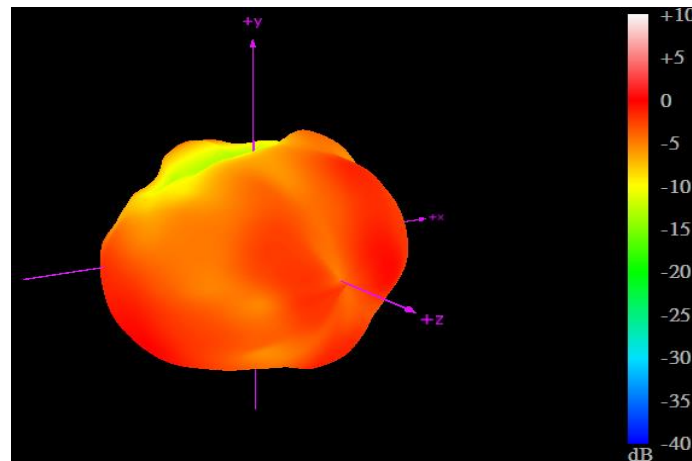
704MHz



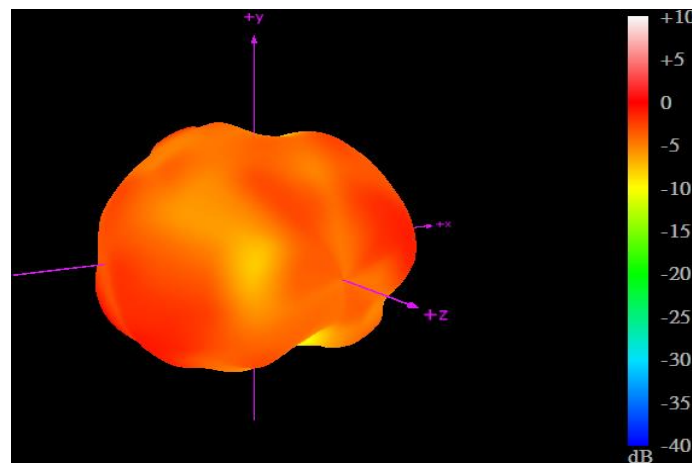
960MHz



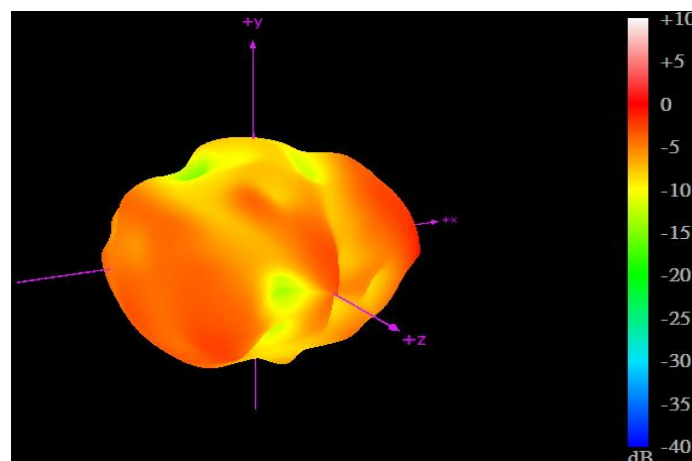
1710MHz



2170MHz

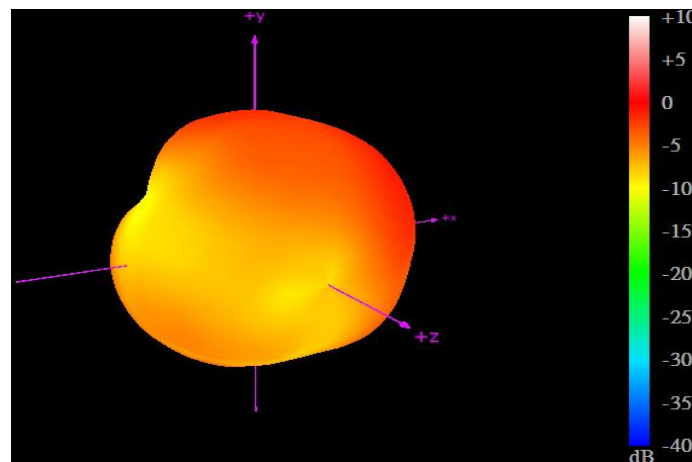


2300MHz

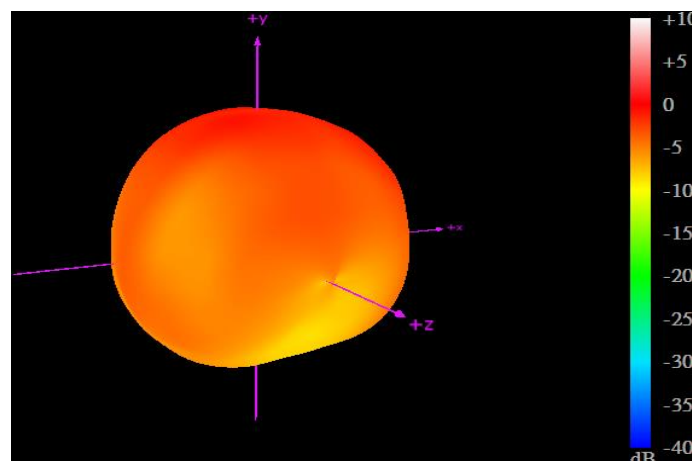


2690MHz

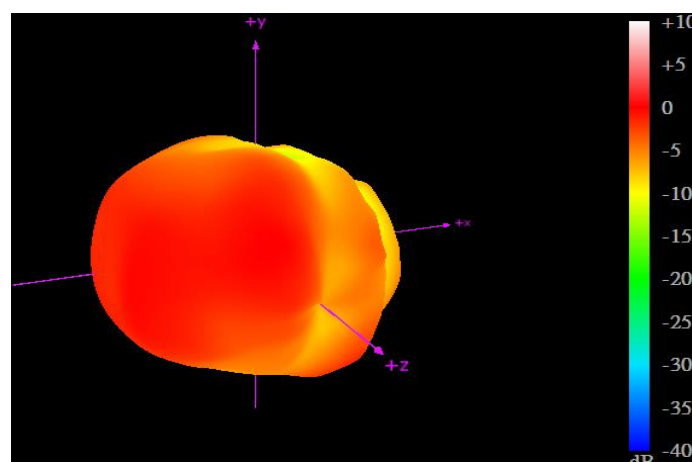
### 4.3.7 LTE7



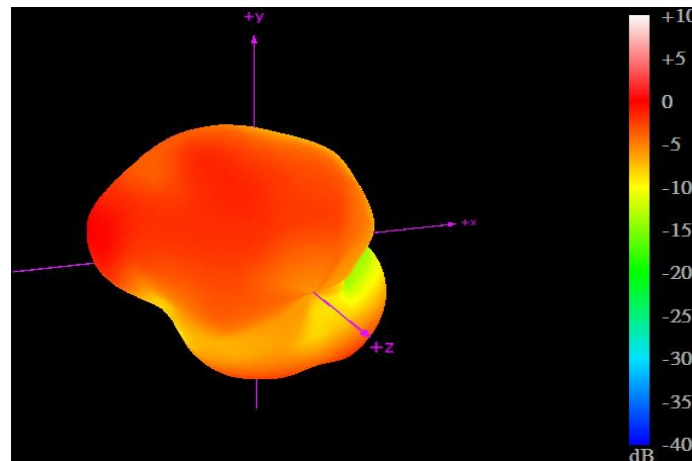
704MHz



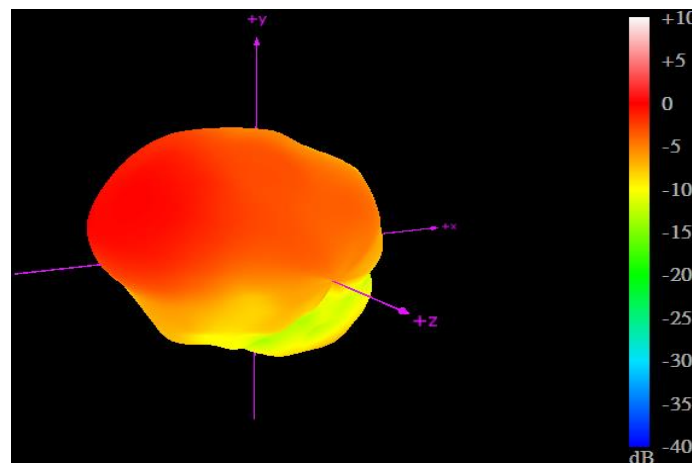
960MHz



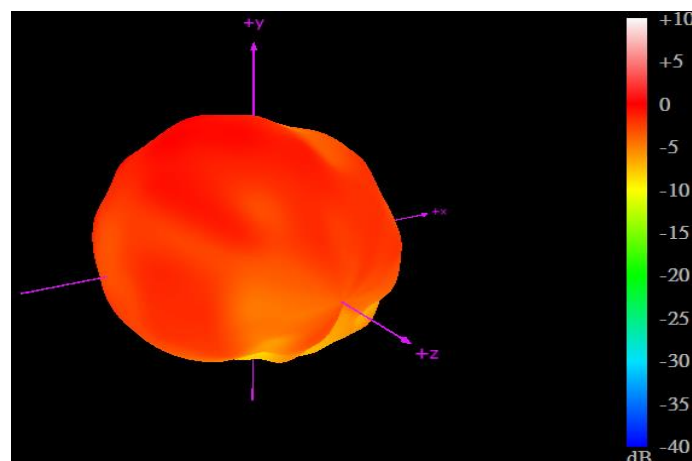
1710MHz



2170MHz

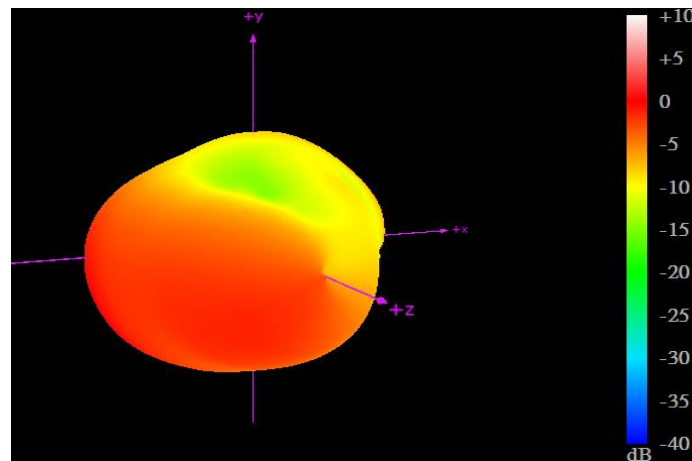


2300MHz

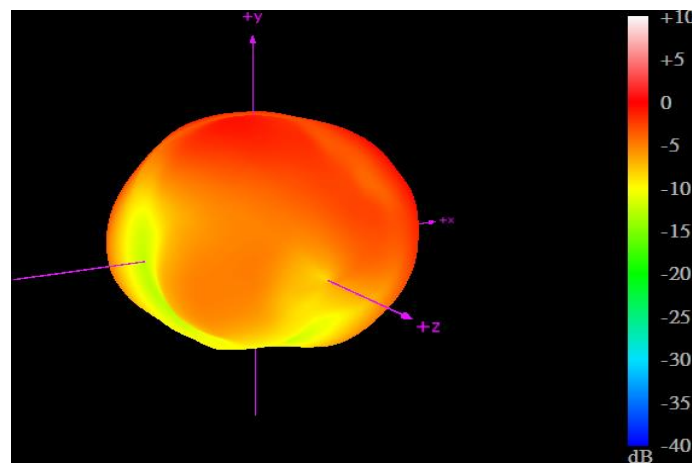


2690MHz

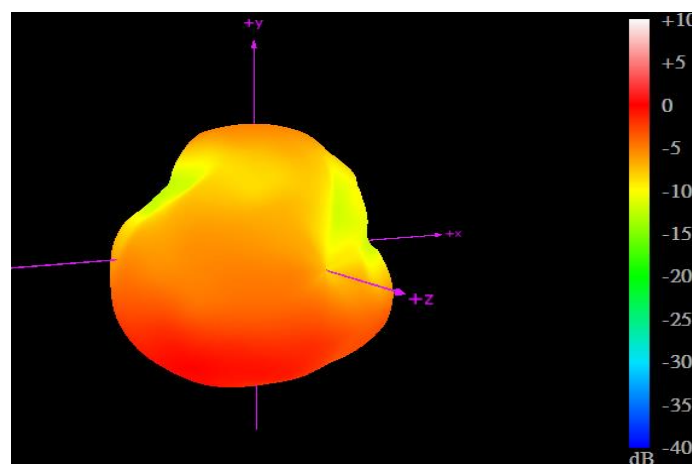
#### 4.3.8 LTE8



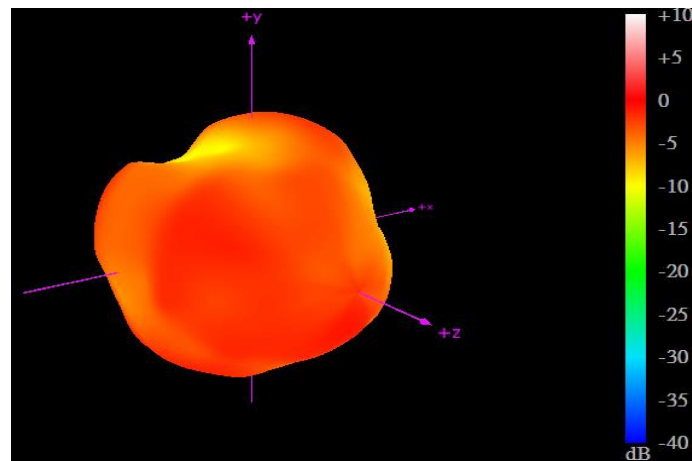
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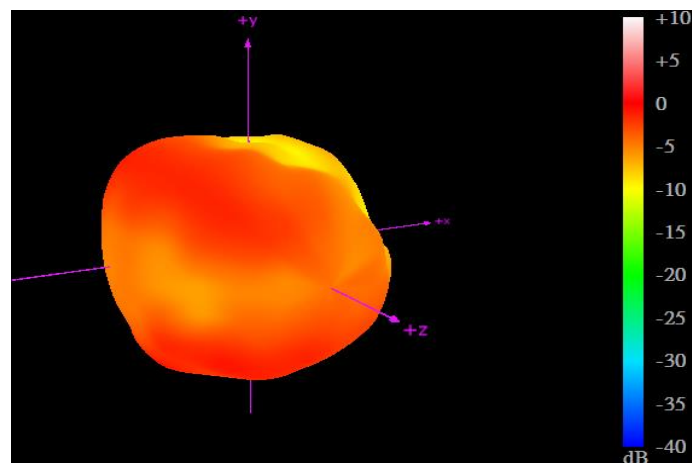
960MHz



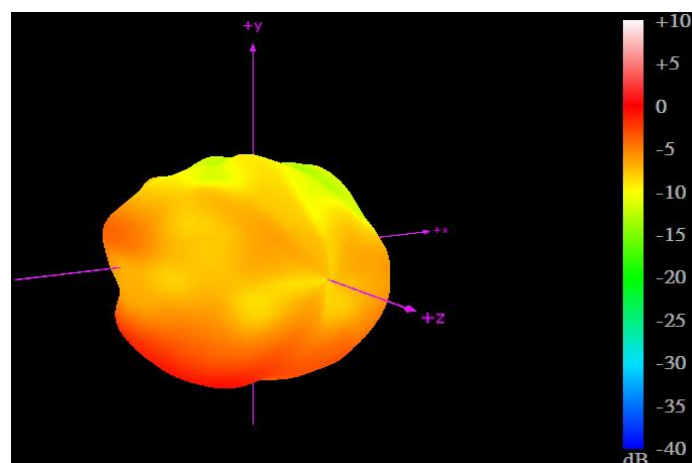
1710MHz



2170MHz



2300MHz



2690MHz

## **5. Mechanical Drawing (Unit: mm)**

## **6. Packaging**

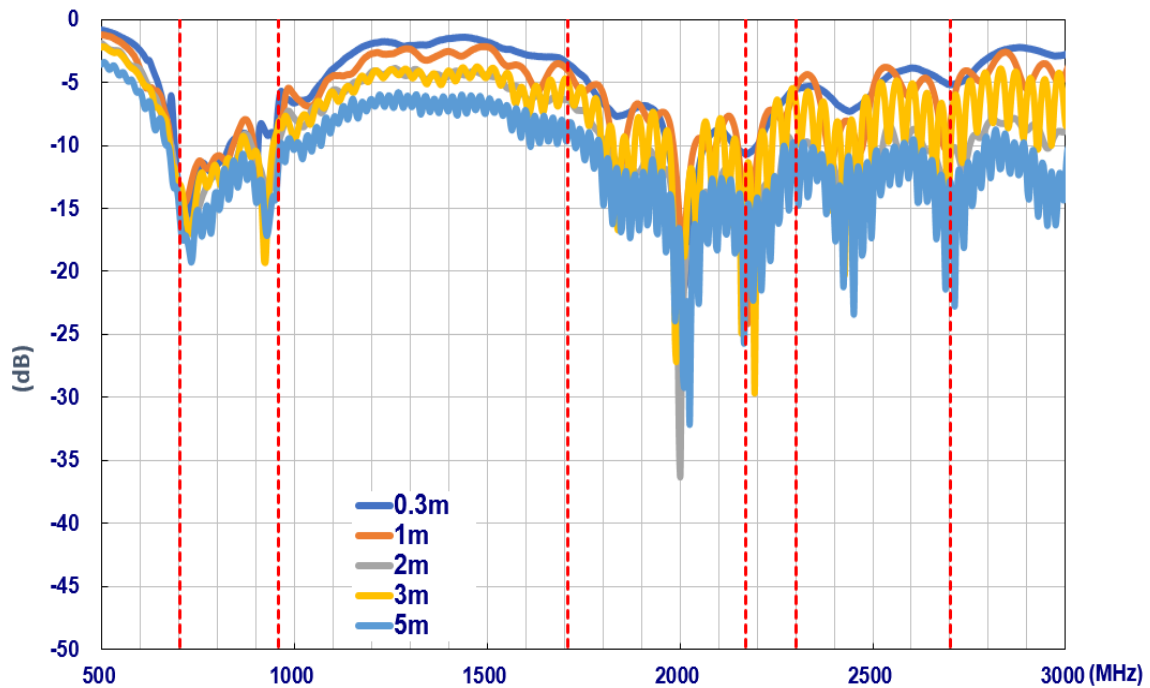
Packaging has been requested, will update when received.

## **7. Application Note**

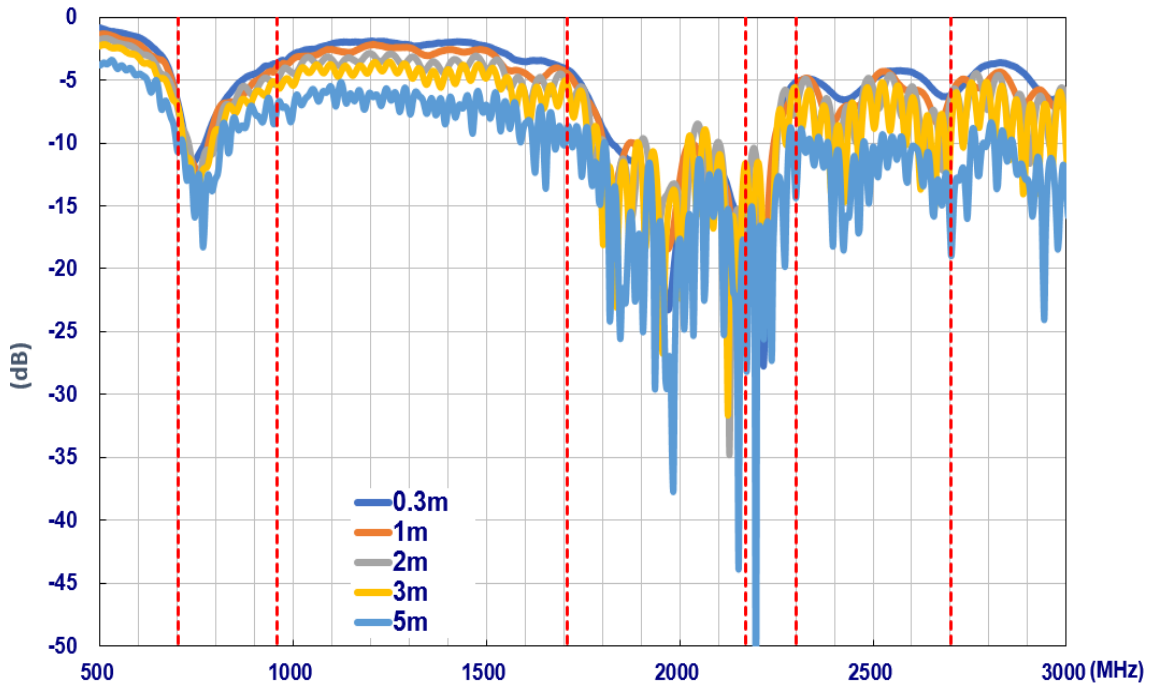
The MA9909 antenna performance with different cable lengths is shown below.

## 7.1. Return Loss

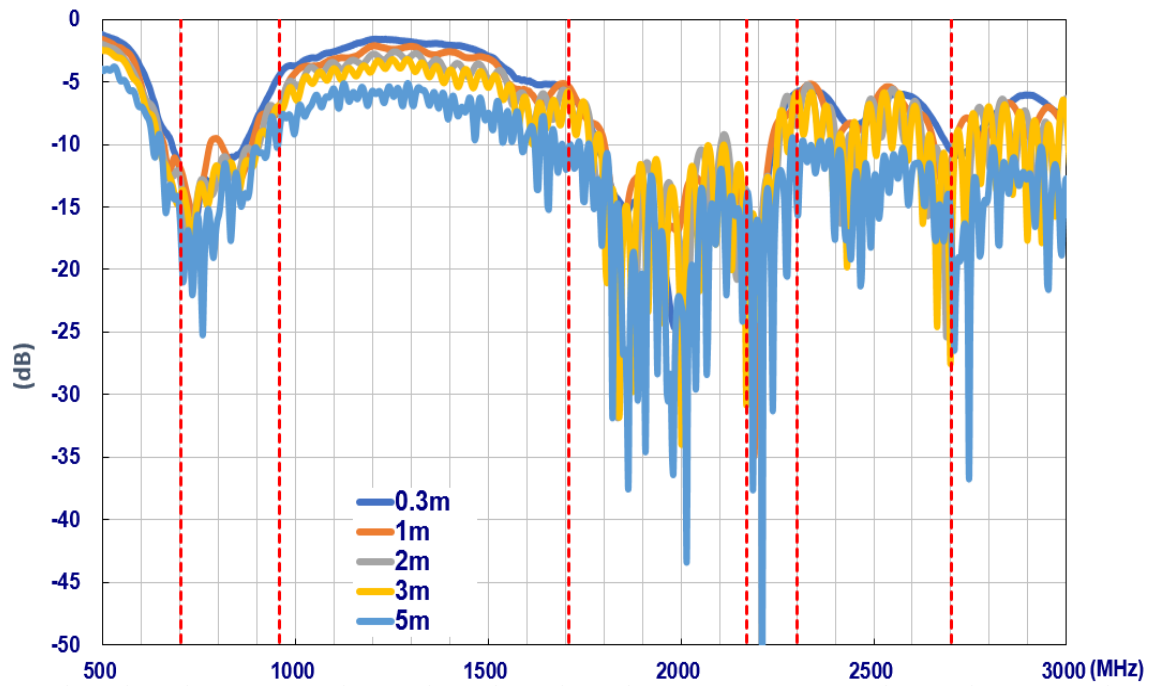
### 7.1.1 LTE1



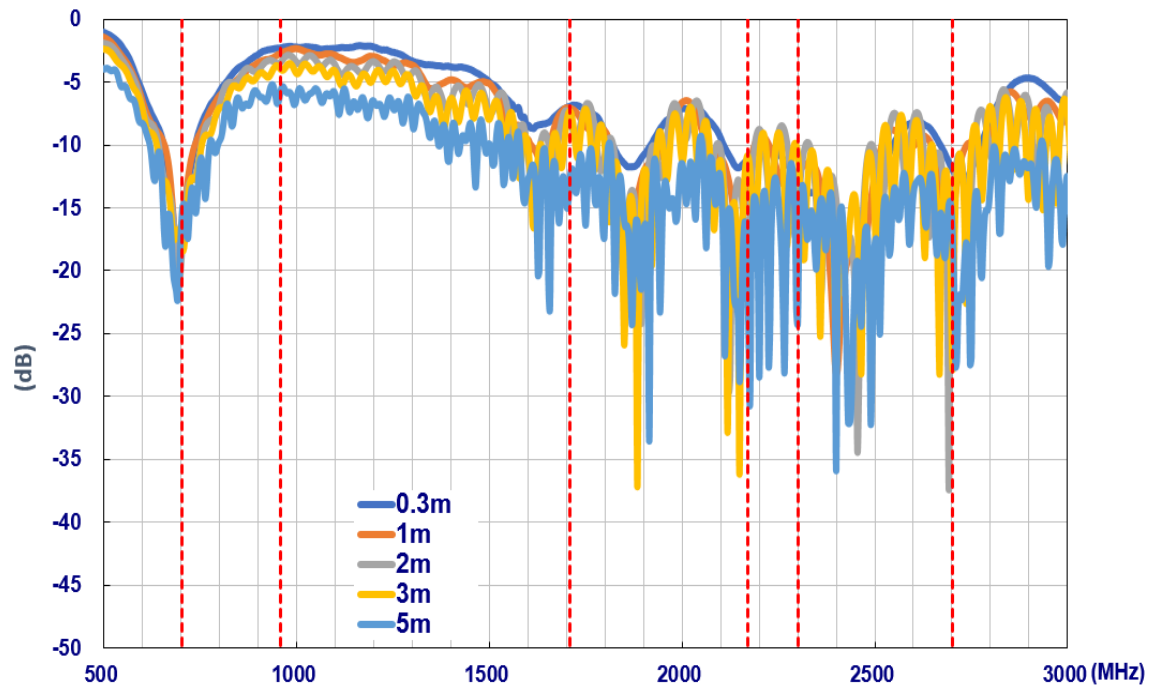
### 7.1.2 LTE2



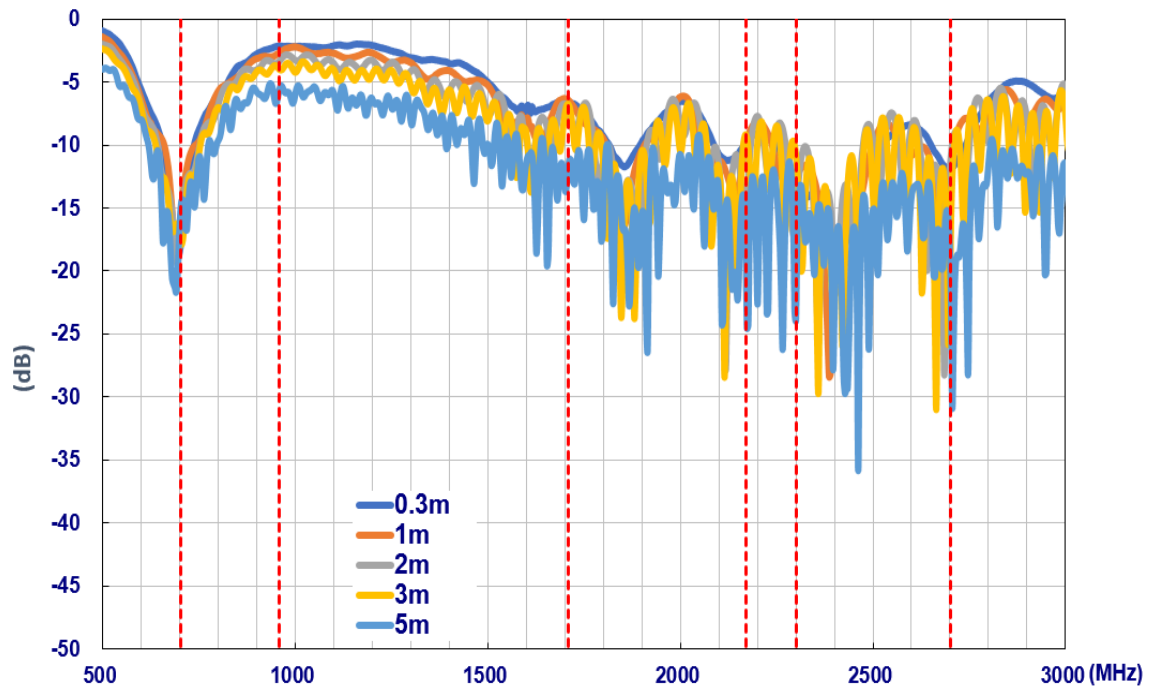
### 7.1.3 LTE3



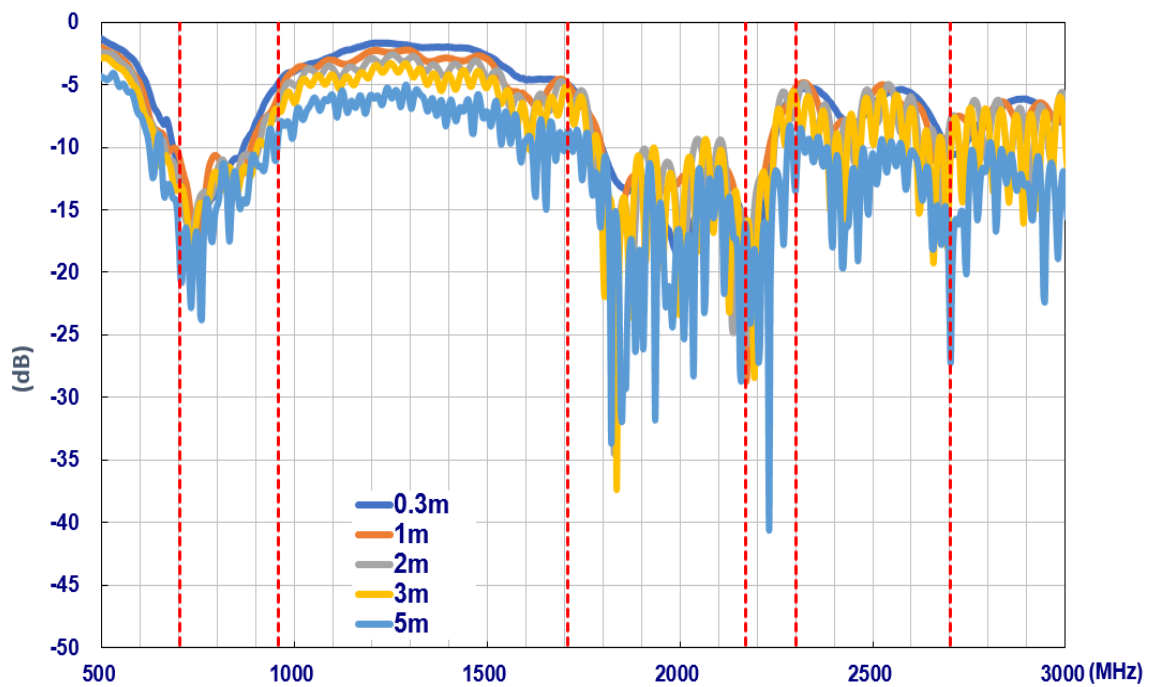
### 7.1.4 LTE4



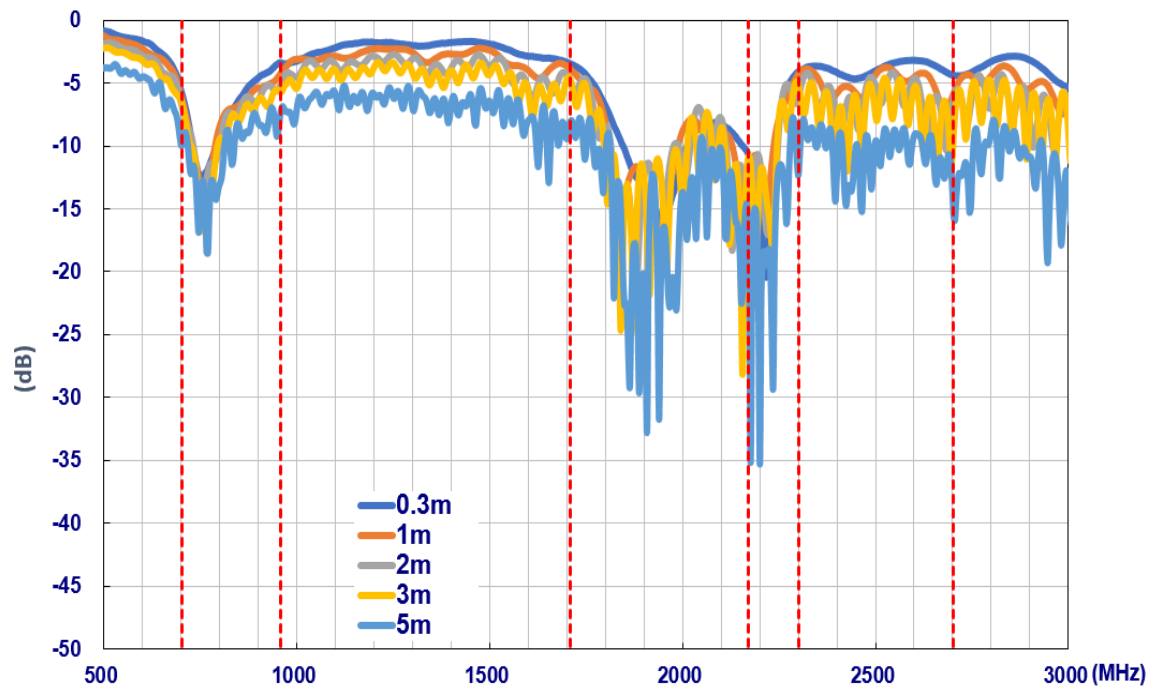
### 7.1.5 LTE5



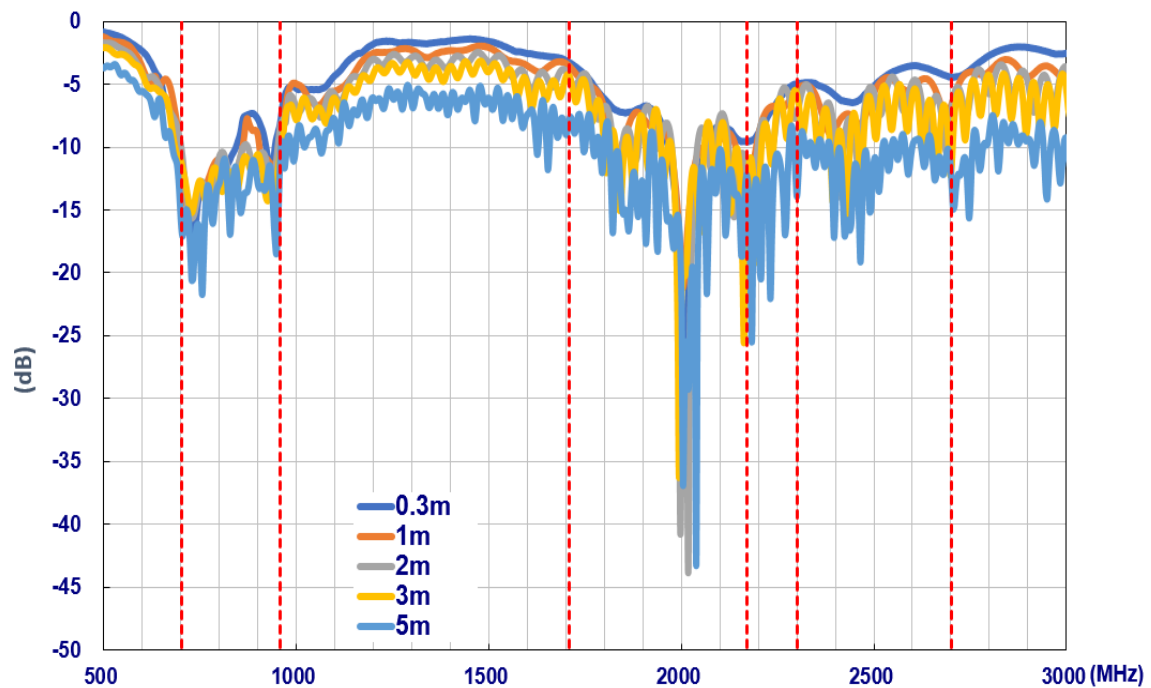
### 7.1.6 LTE6



### 7.1.7 LTE7

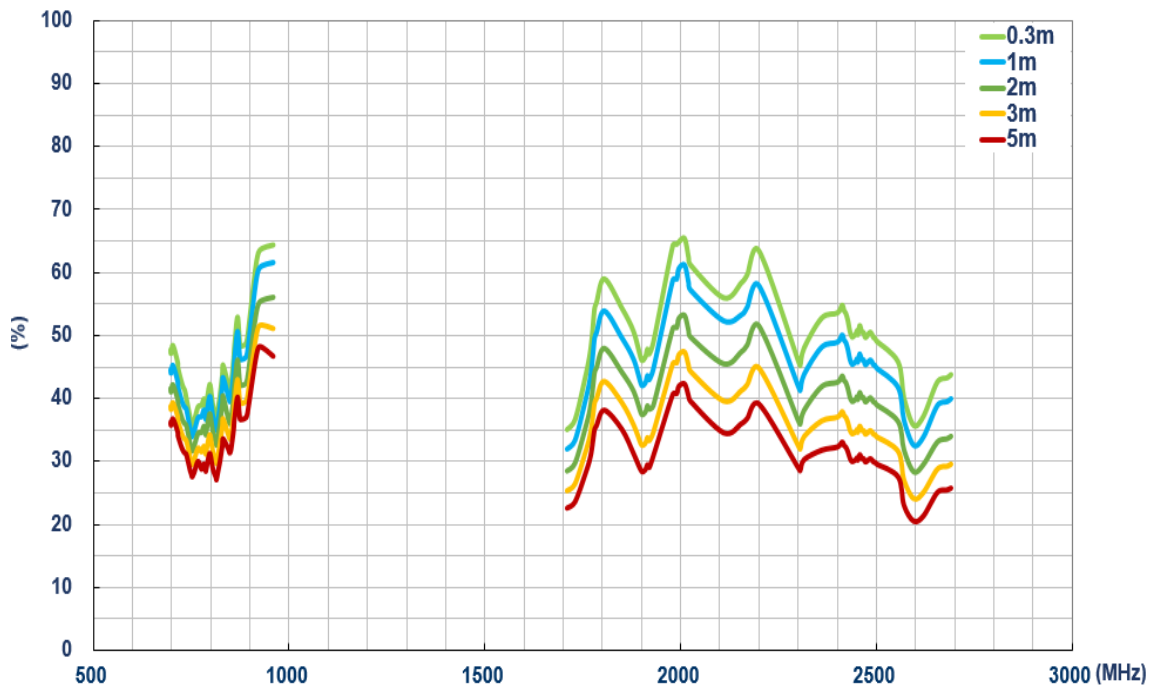


### 7.1.8 LTE8

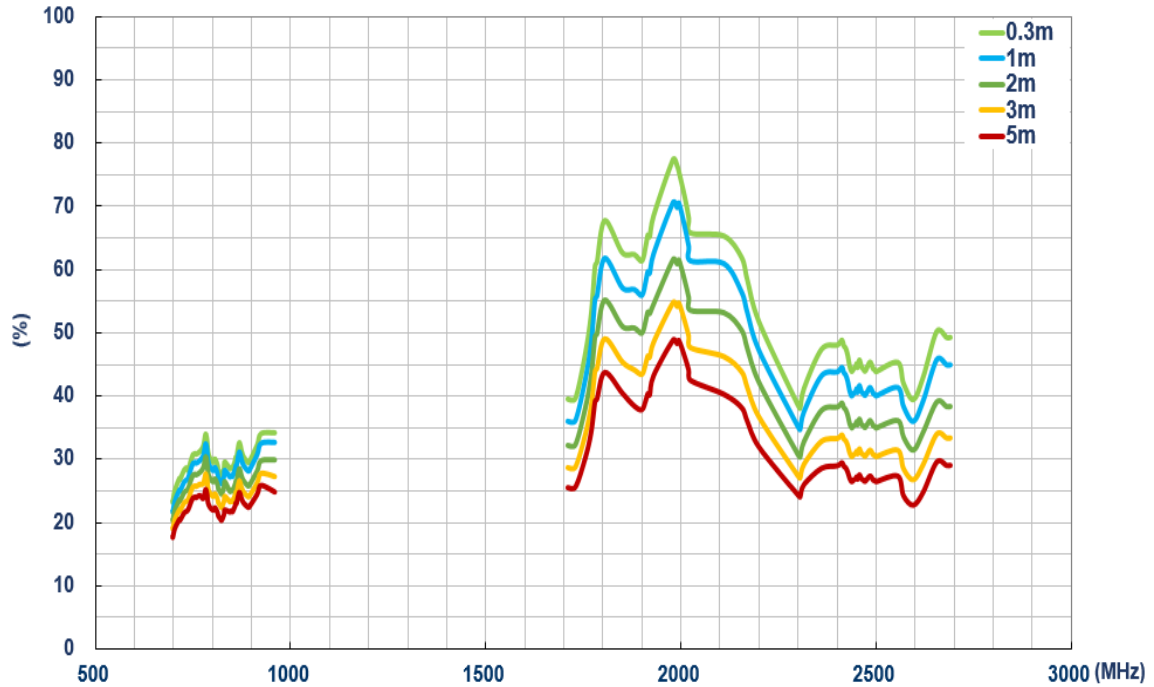


## 7.2. Efficiency

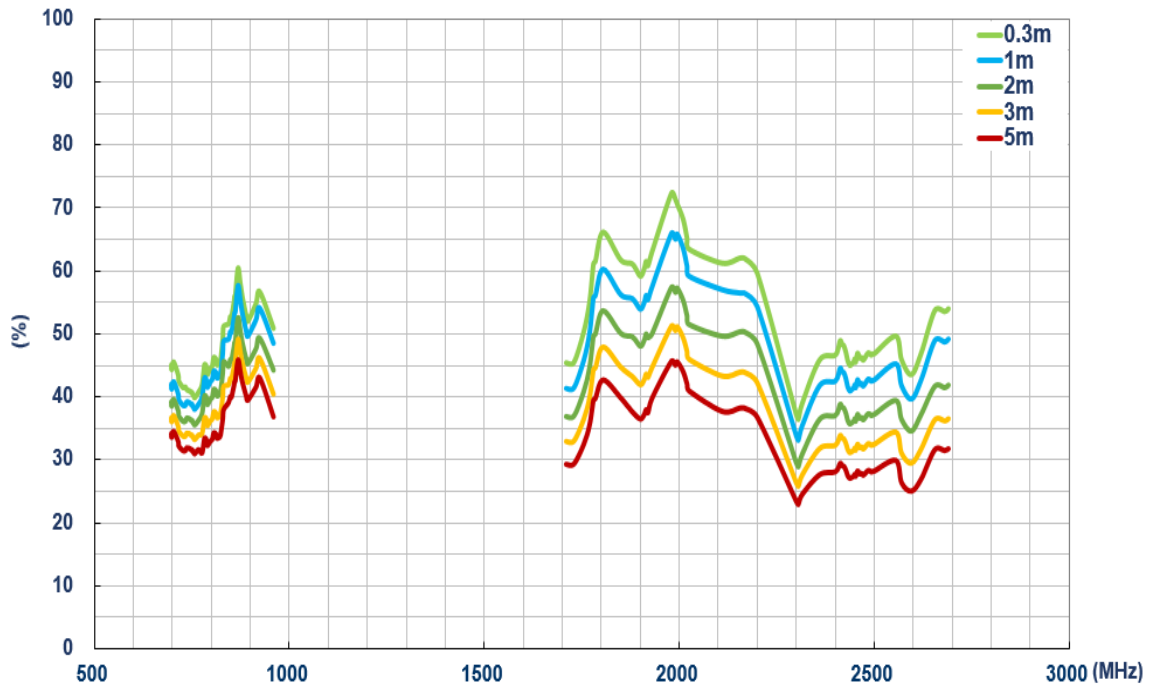
### 7.2.1 LTE1



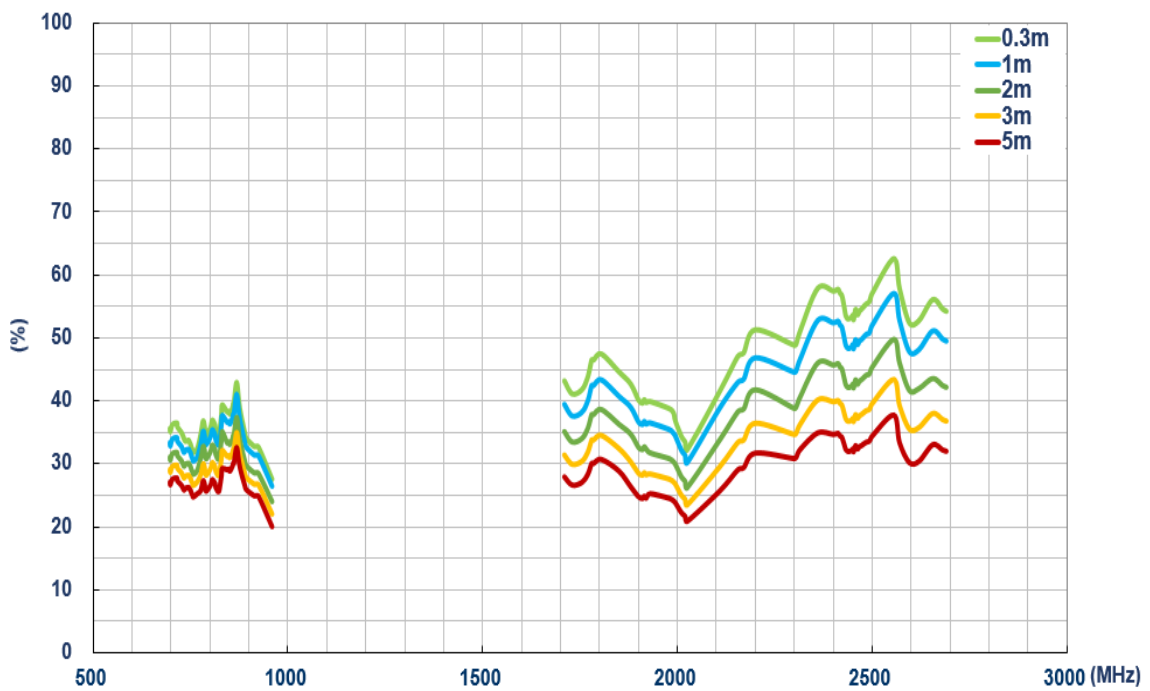
### 7.2.2 LTE2



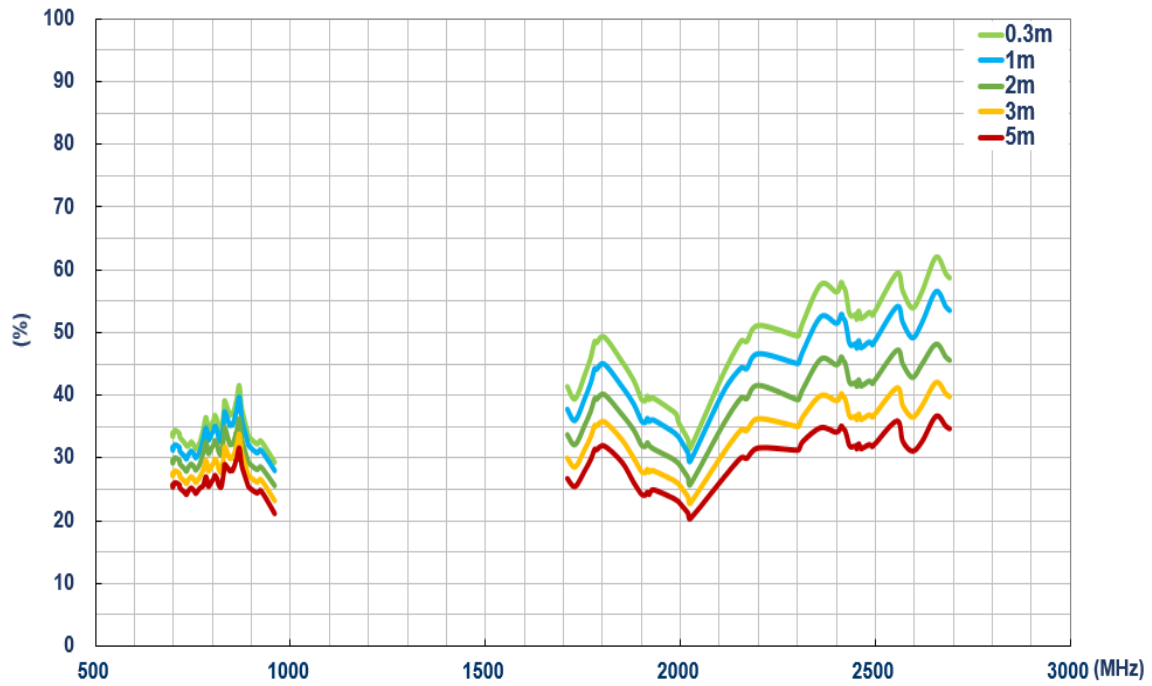
### 7.2.3 LTE3



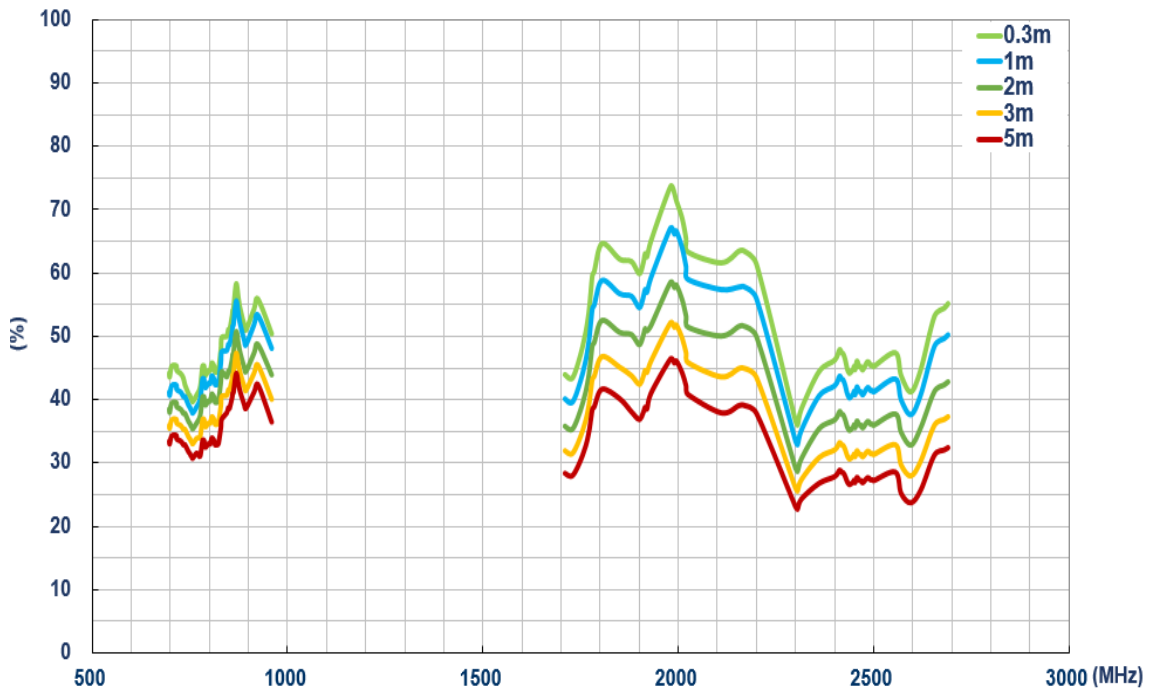
### 7.2.4 LTE4



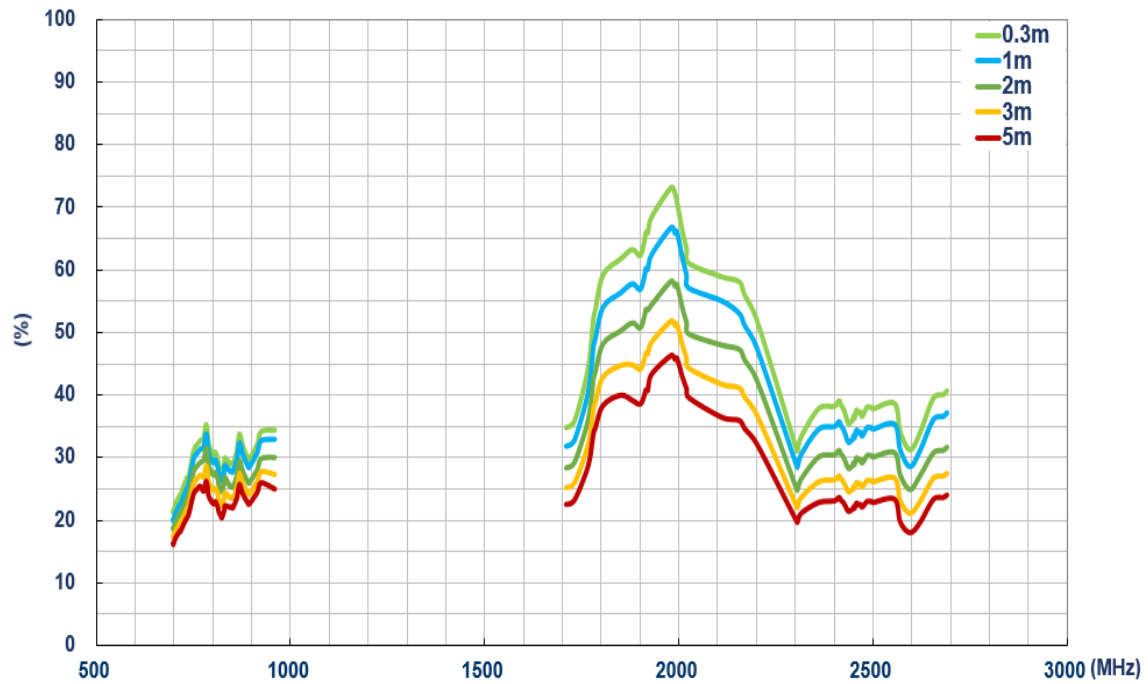
### 7.2.5 LTE5



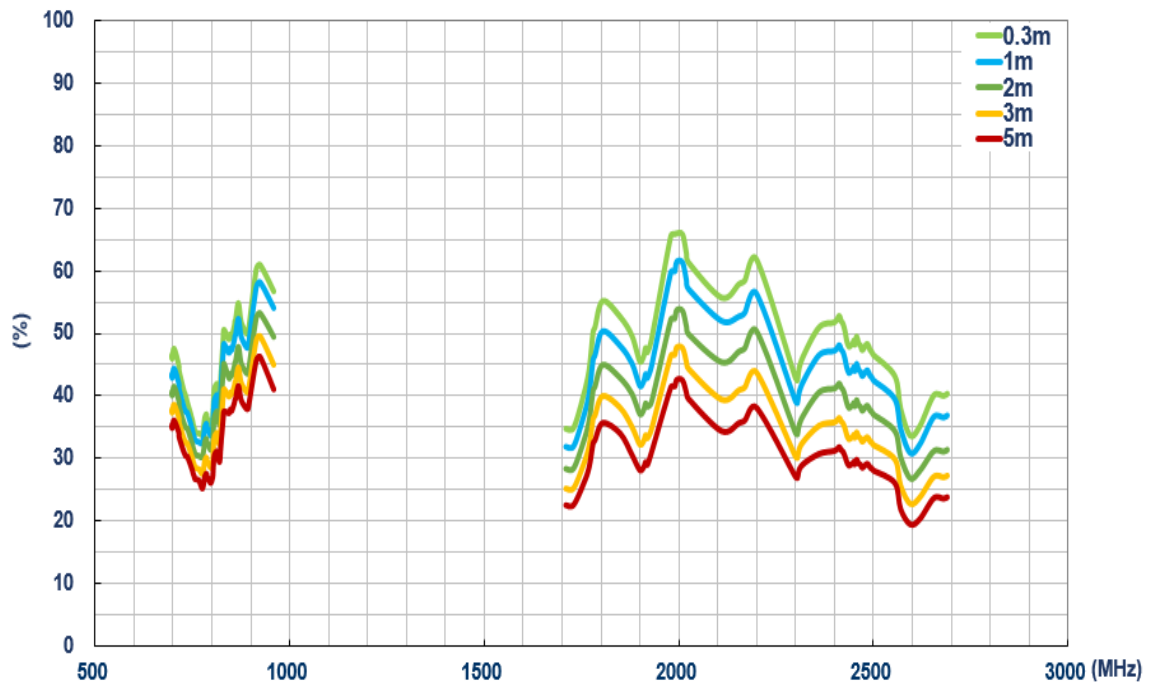
### 7.2.6 LTE6



## 7.2.7 LTE7

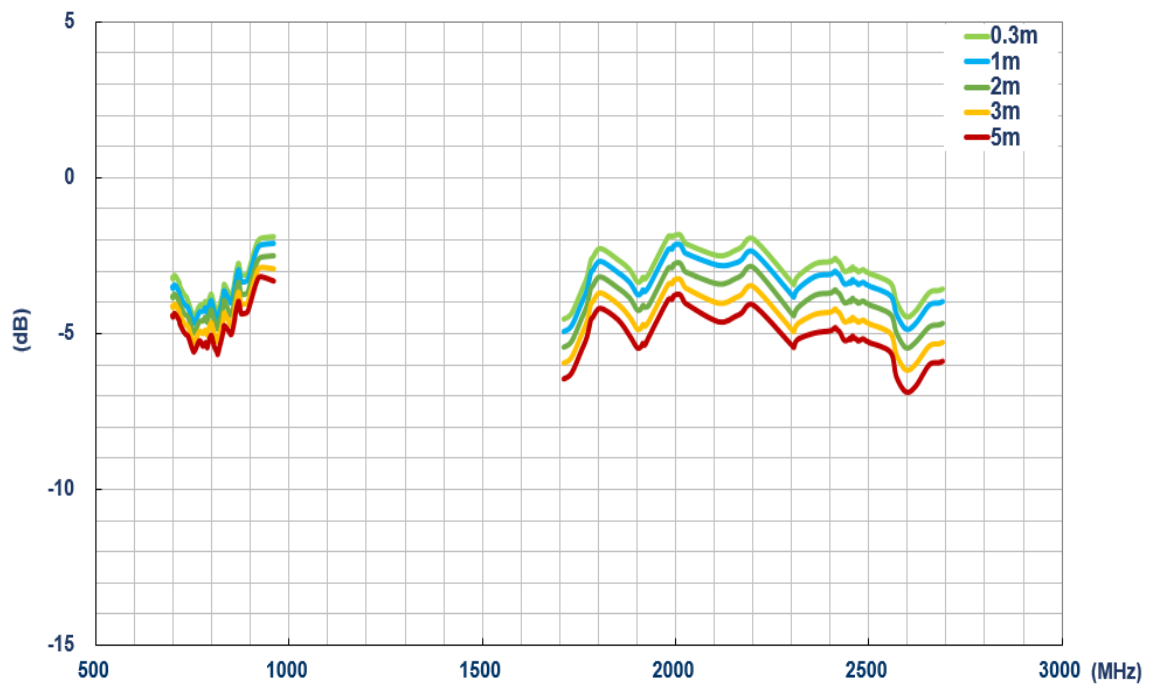


## 7.2.8 LTE8

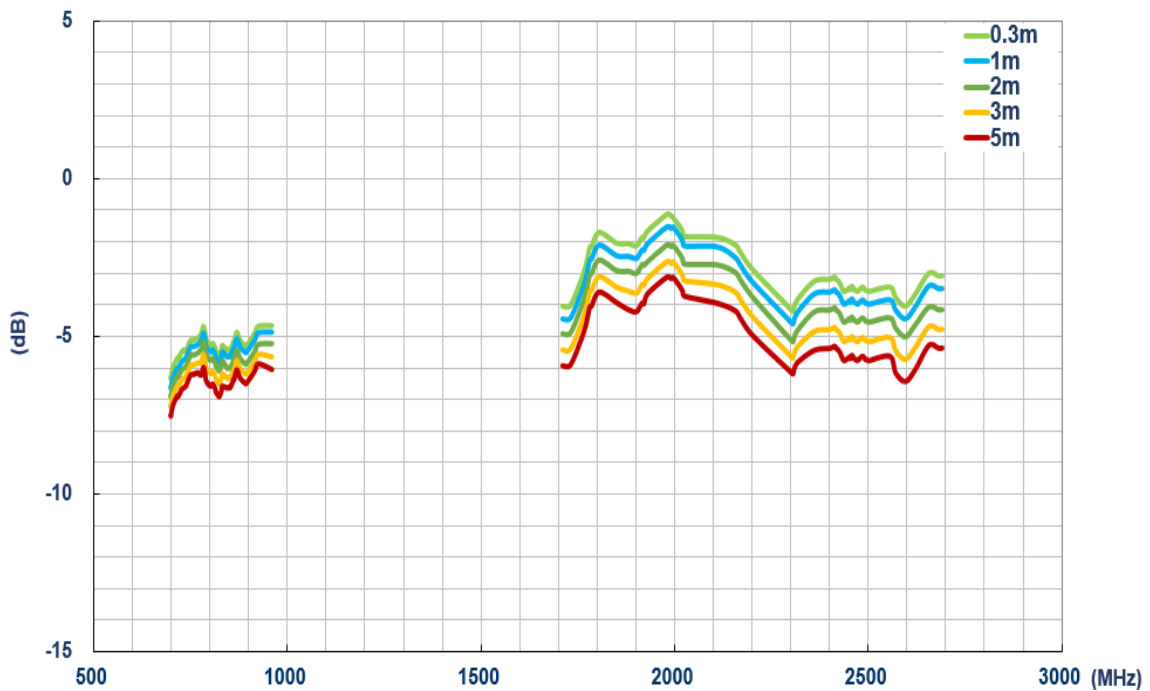


## 7.3. Average Gain

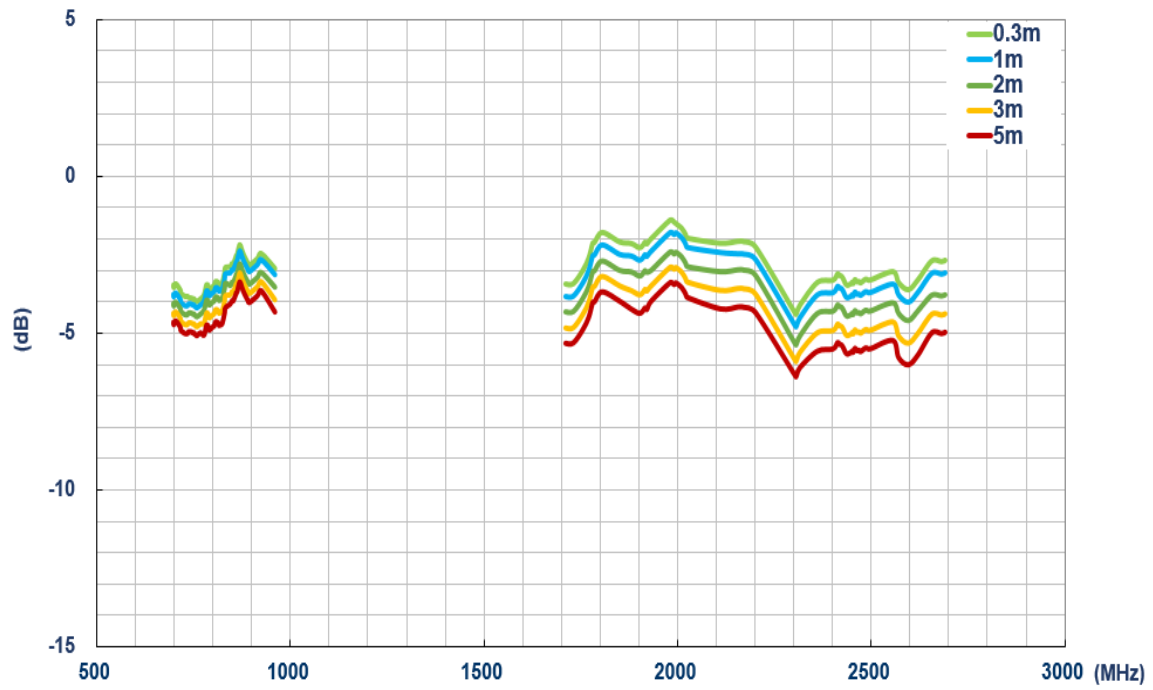
### 7.3.1 LTE1



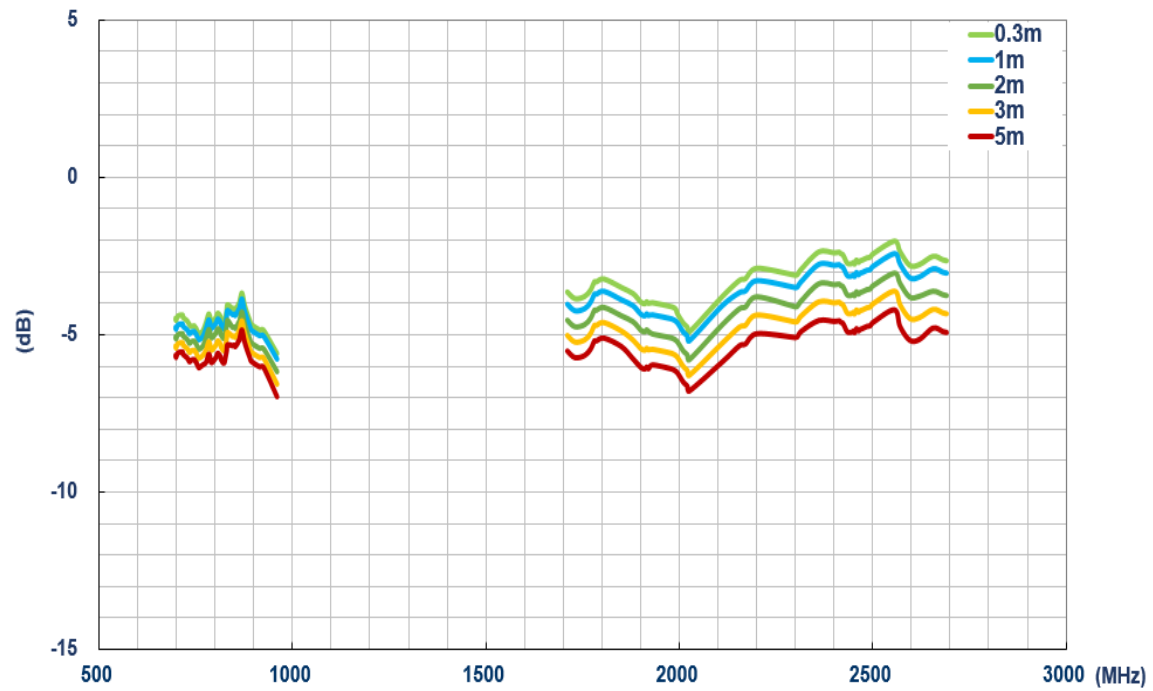
### 7.3.2 LTE2



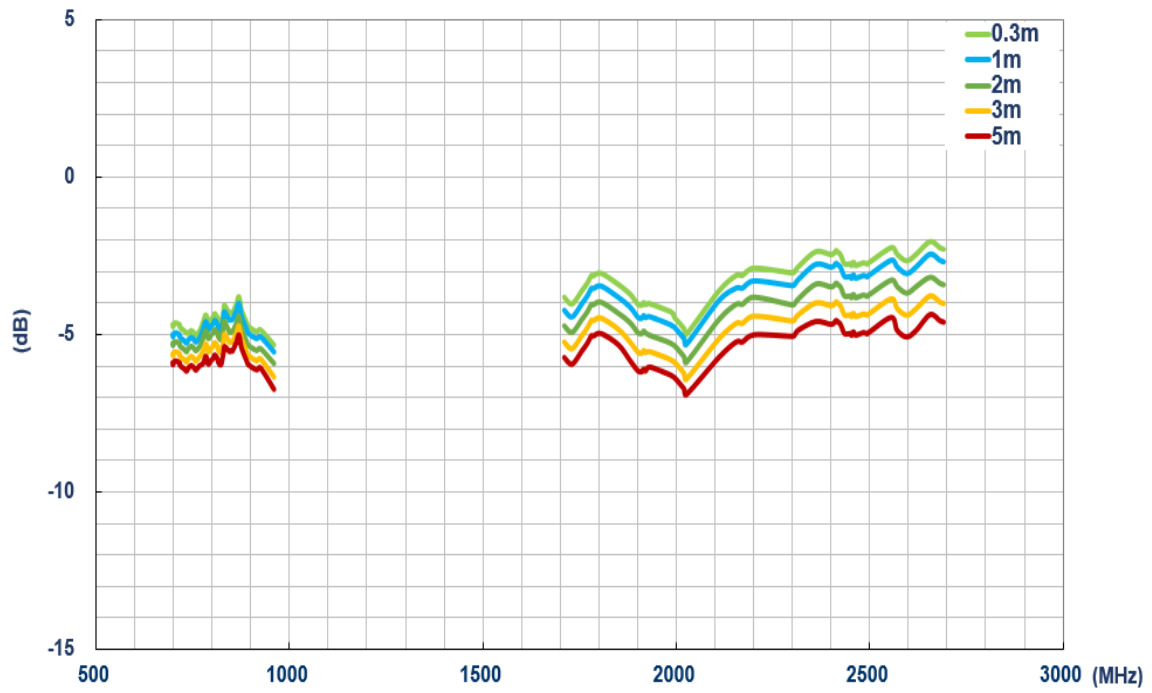
### 7.3.3 LTE3



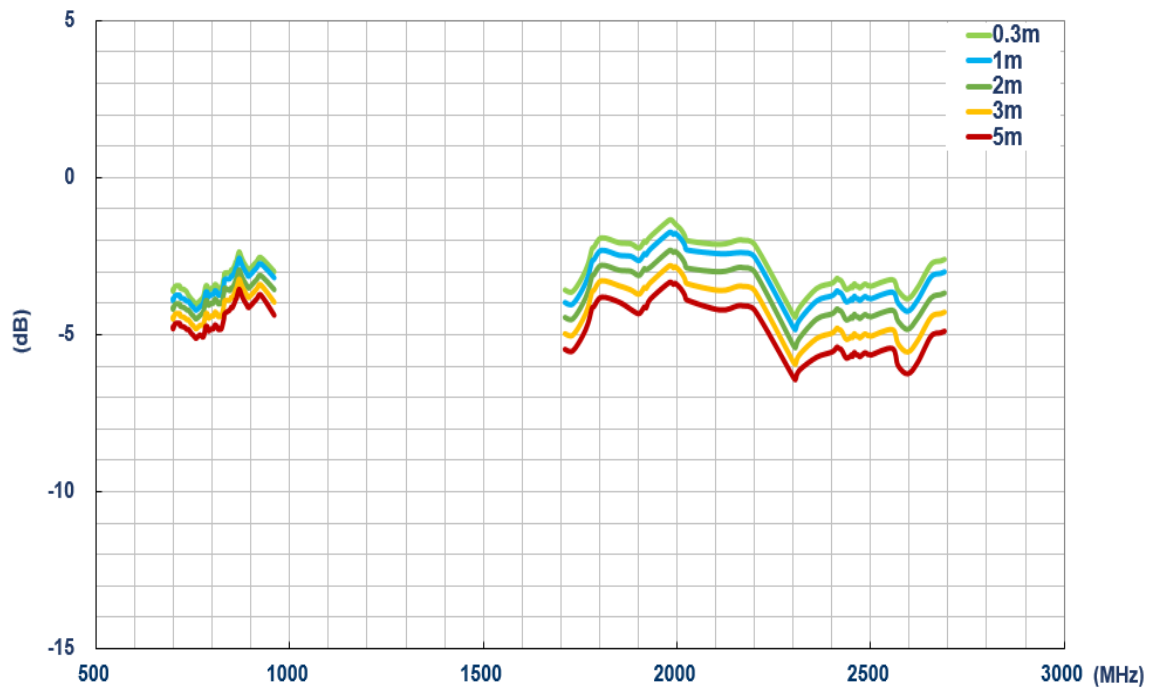
### 7.3.4 LTE4



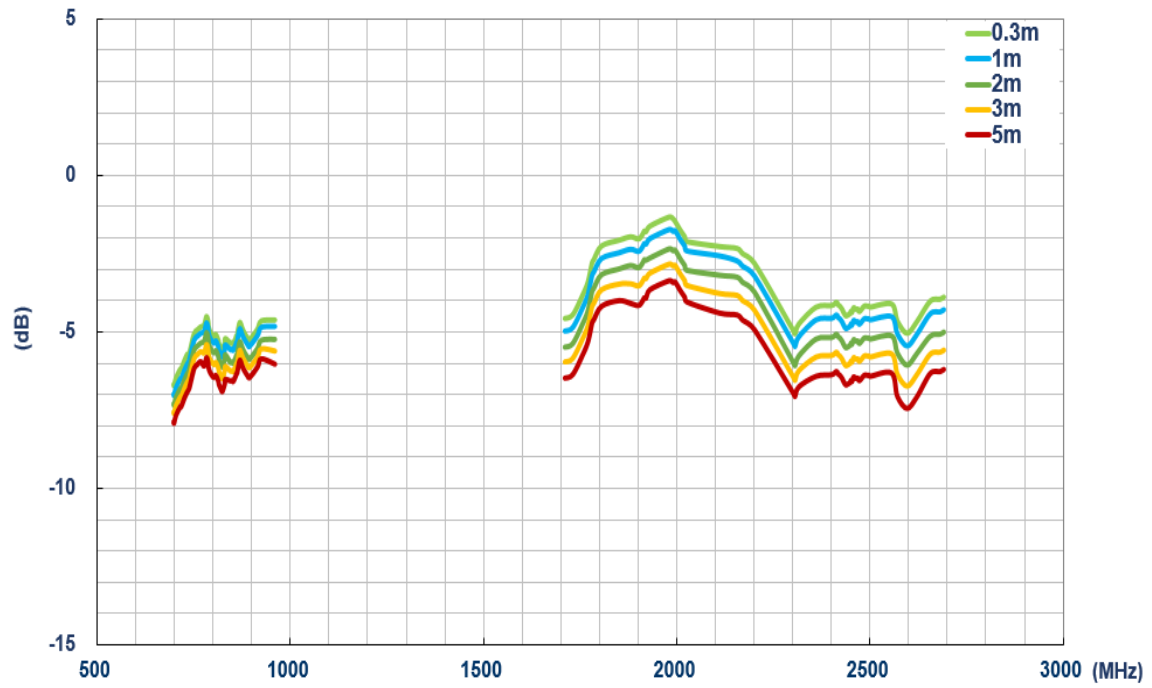
### 7.3.5 LTE5



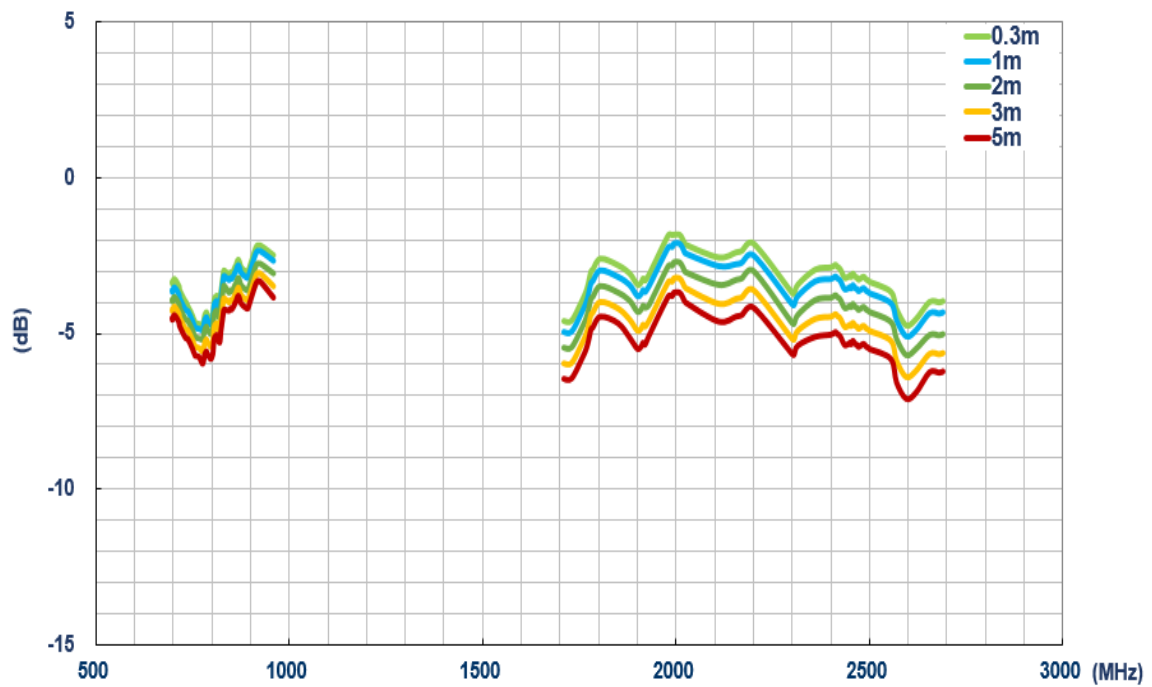
### 7.3.6 LTE6



### 7.3.7 LTE7

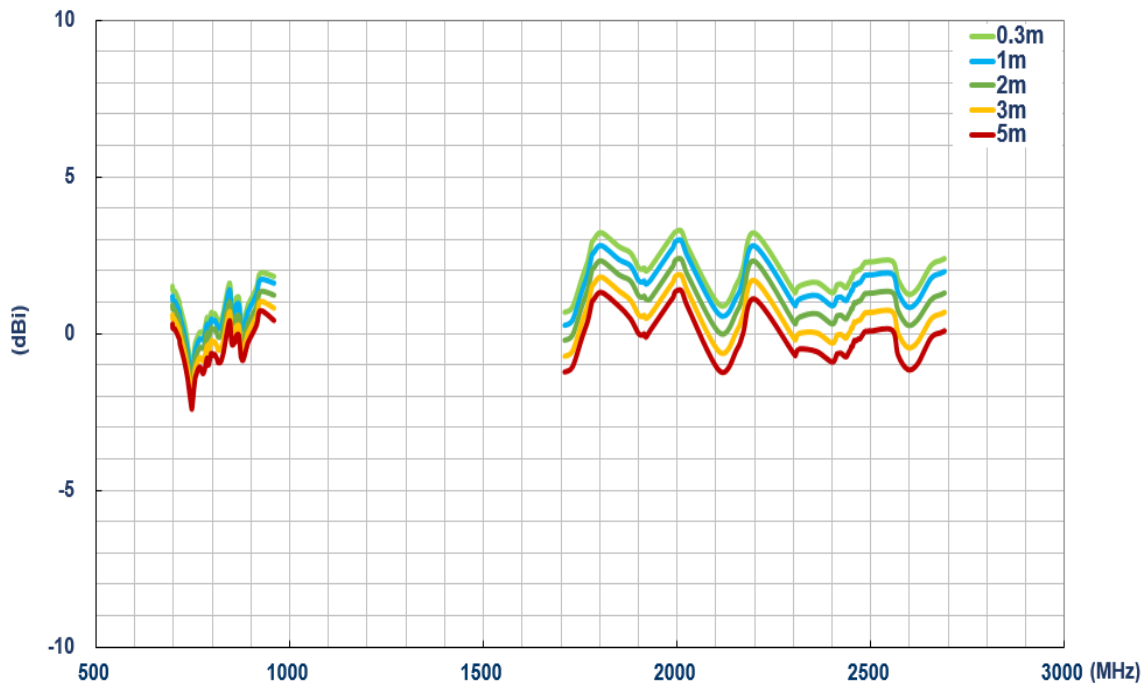


### 7.3.8 LTE8

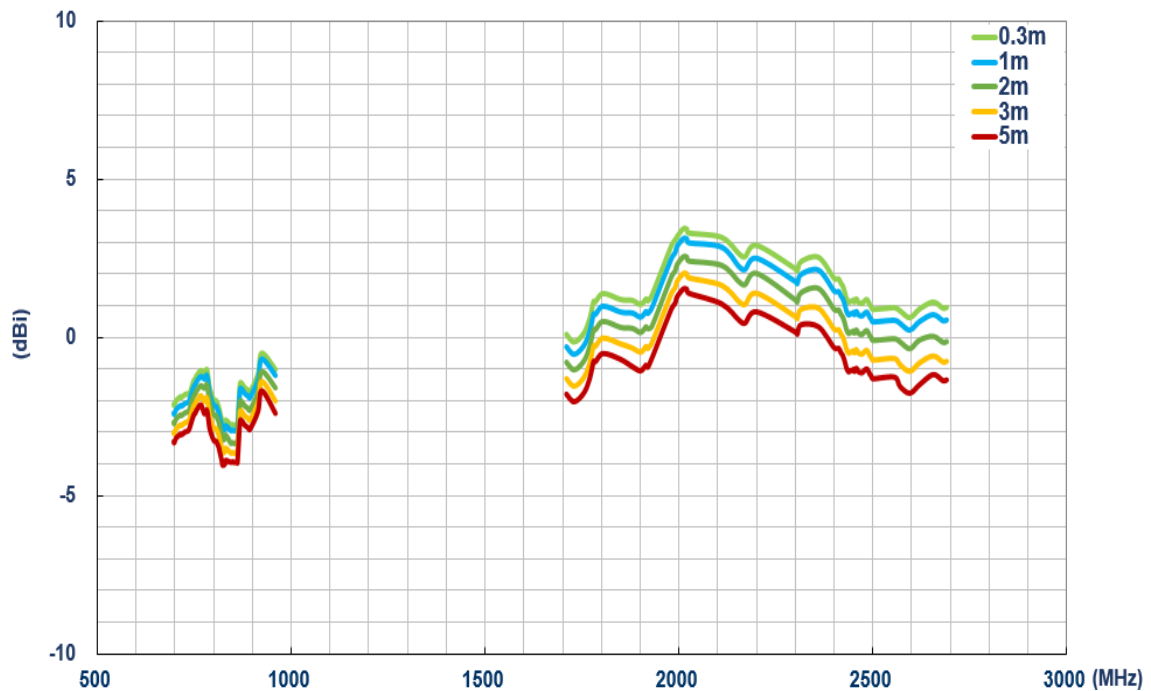


## 7.4. Peak Gain

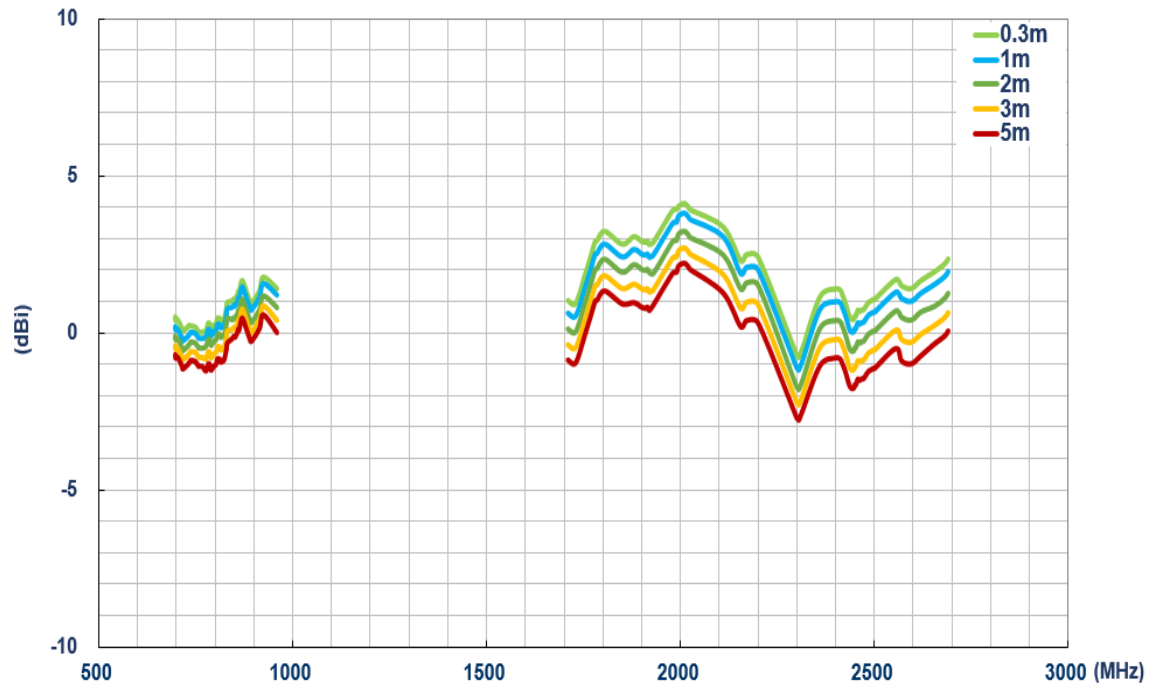
### 7.4.1 LTE1



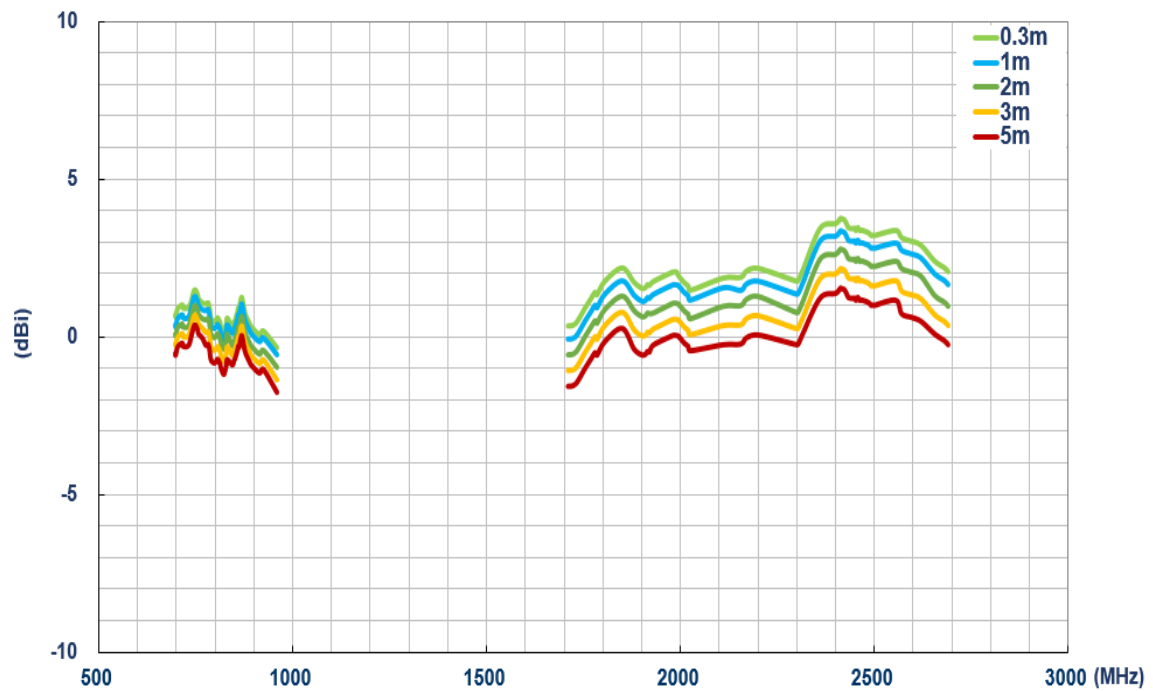
### 7.4.2 LTE2



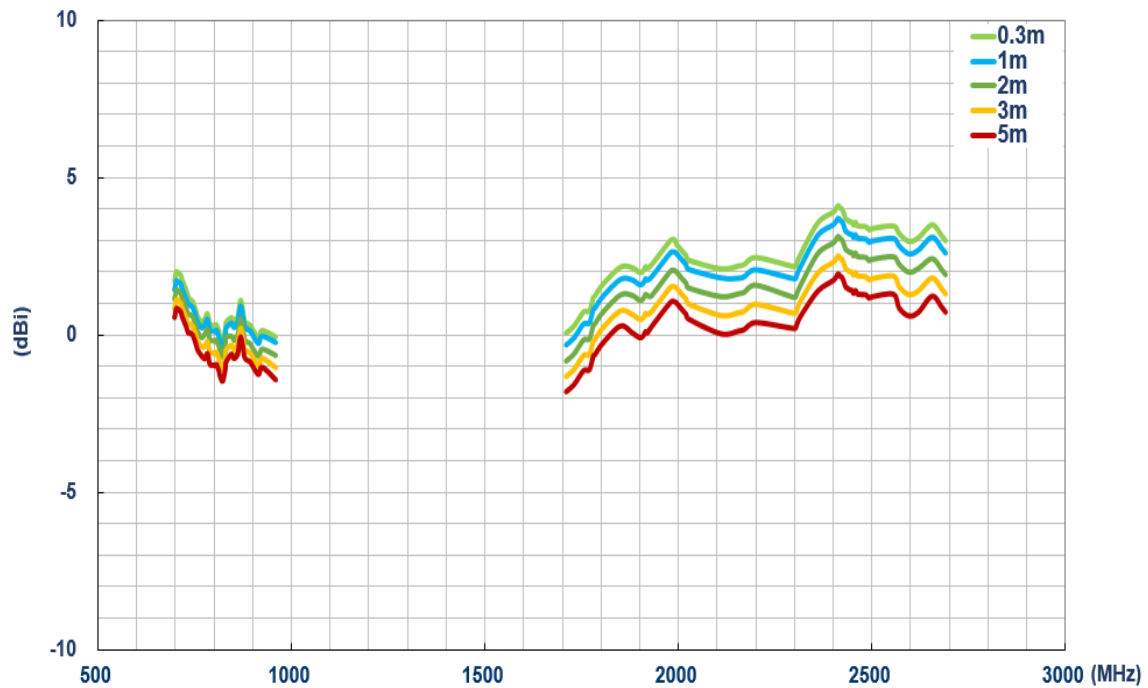
### 7.4.3 LTE3



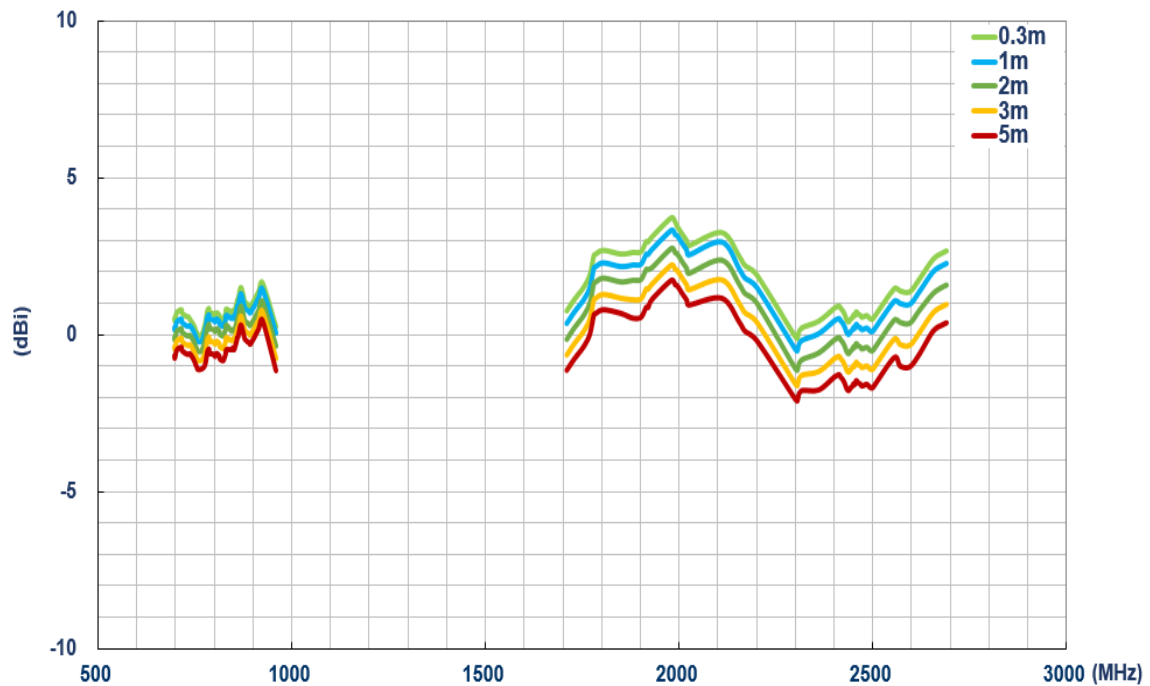
### 7.4.4 LTE4



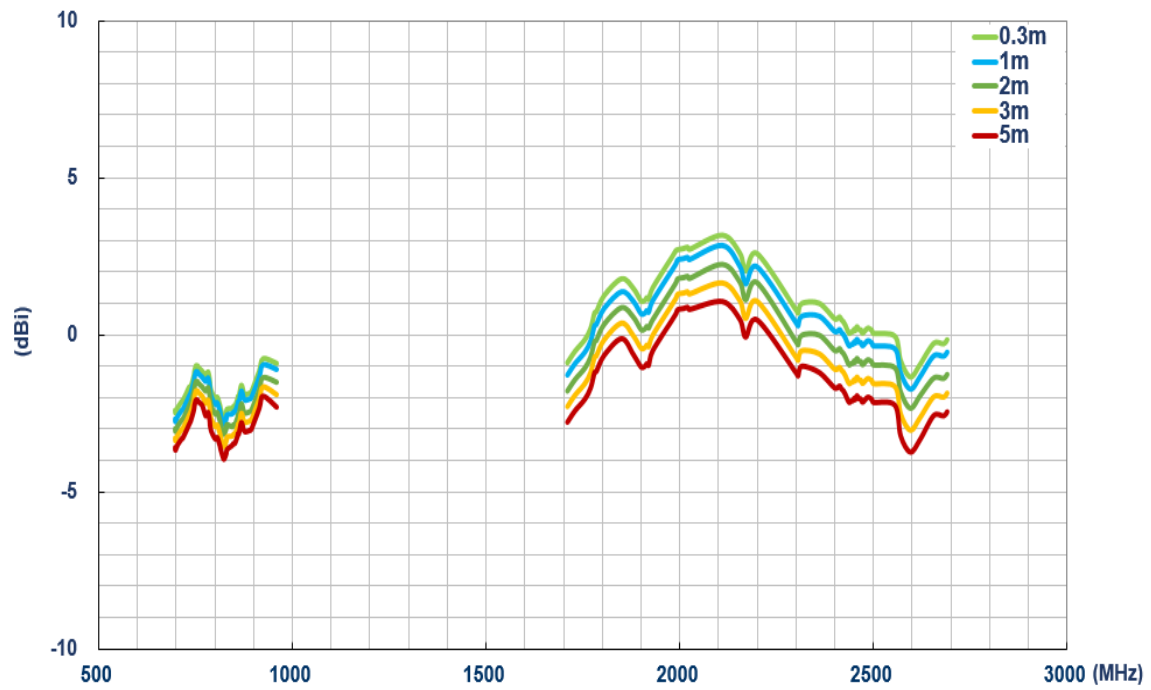
### 7.4.5 LTE5



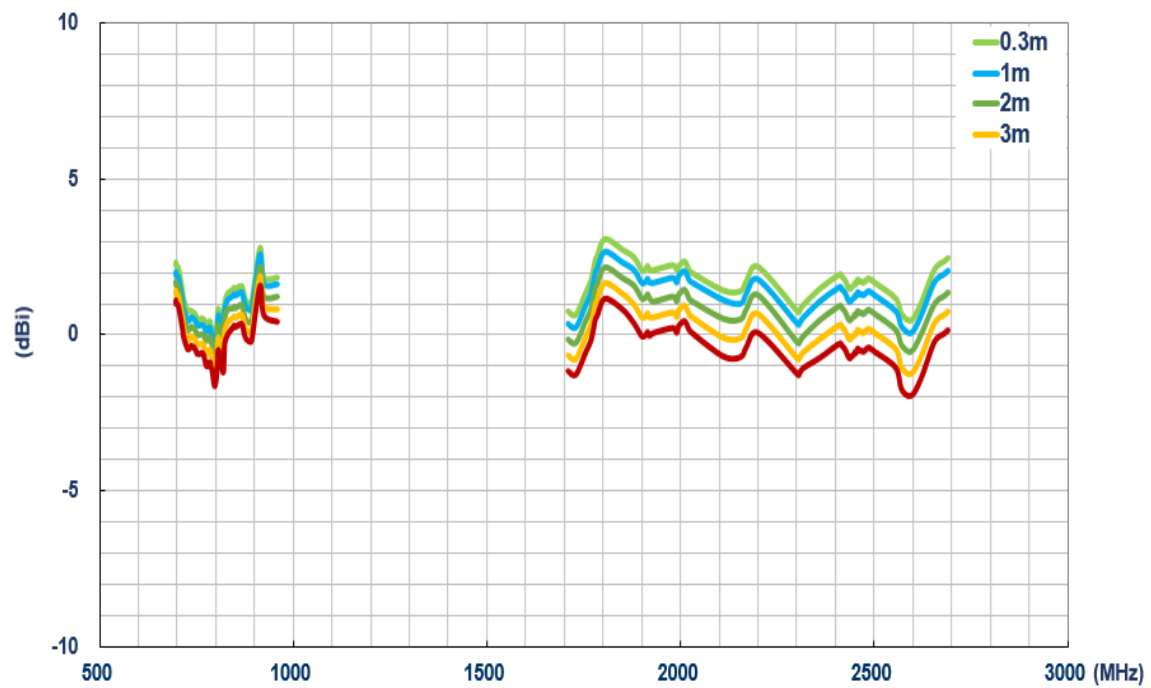
### 7.4.6 LTE6



### 7.4.7 LTE7



### 7.4.8 LTE8



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