

Winmate Inc.
Antenna Specification

Project :S101TG
Version :20220926
Issue Date : 2022/05/17

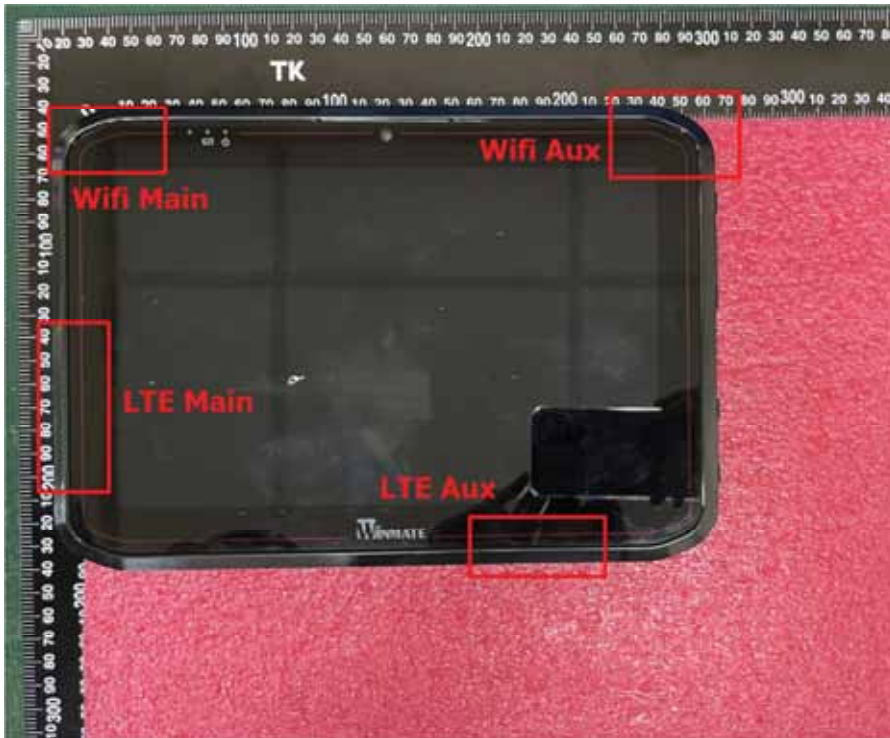
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1. Antenna Placement



2. Wi-Fi Main Antenna Specification

Winmate Part Number: 90RF0500001R

2.1. Electrical Characteristics

Frequency(MHz): 2400-2500 / 5150-6000

SWR: ≤ 1.70 @2400-2500MHz

≤ 2.31 @5150-6000MHz

Return Loss: ≤ -16.1 dB@2400-2500MHz

≤ -13.7 dB@5150-5850MHz

Peak Gain: 2.16dBi@2400-2500MHz

1.29dBi@5150-6000MHz

Impedance: 50ohm

Polarization: Linear

2.2. Mechanical Characteristics

Cable: 50 Ω φ 0.81 RF cable

Connector: MHF4

PCB: FR4 /Thickness 0.2mm

Type: Monopole

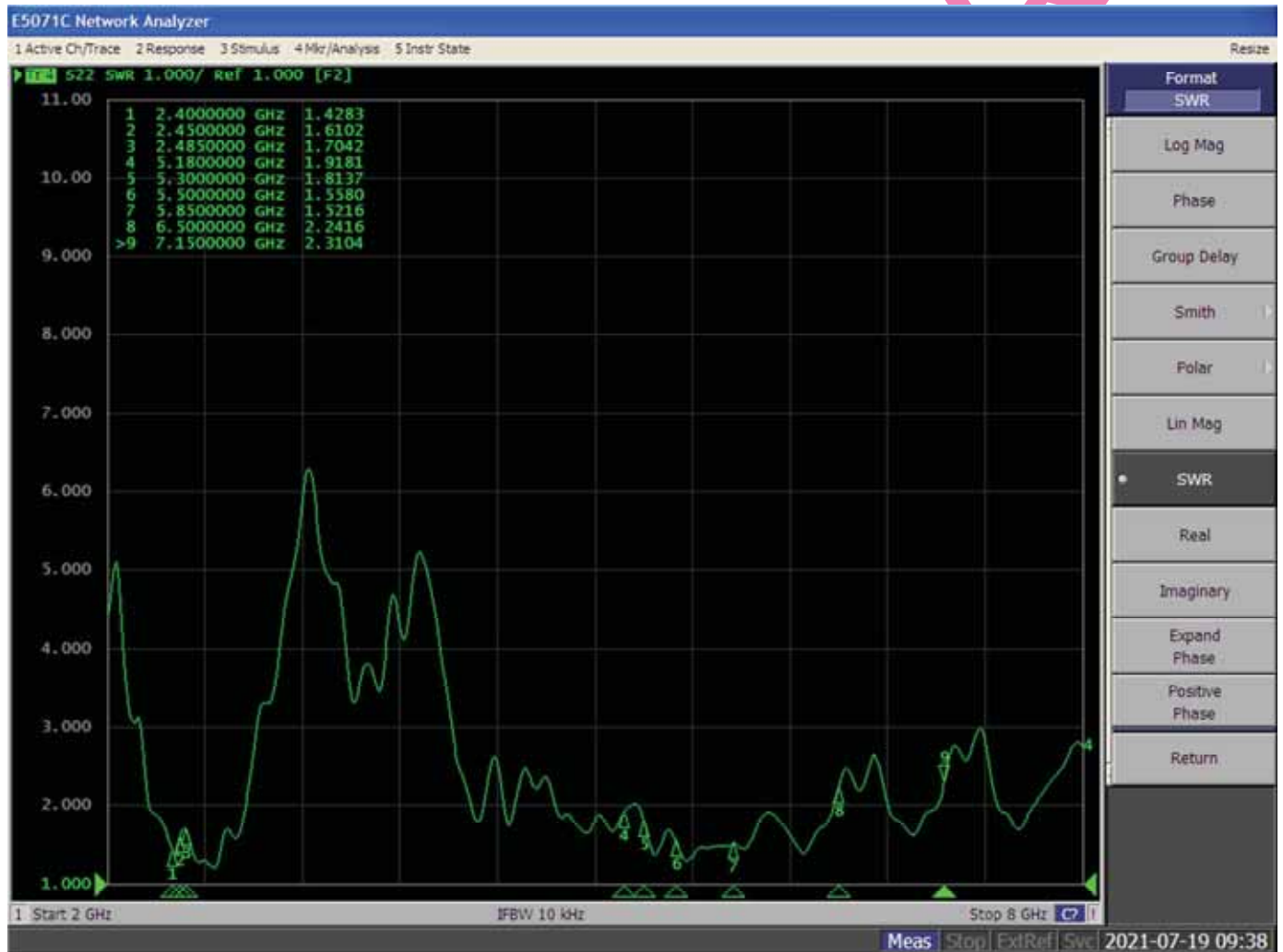
2.3. Environmental Characteristics

Operating Temperature: -30°C to 80°C

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2.4. RF Performance Characteristics

2.4.1. SWR



2.4.2. Return Loss



2.4.3. Gain / Efficiency

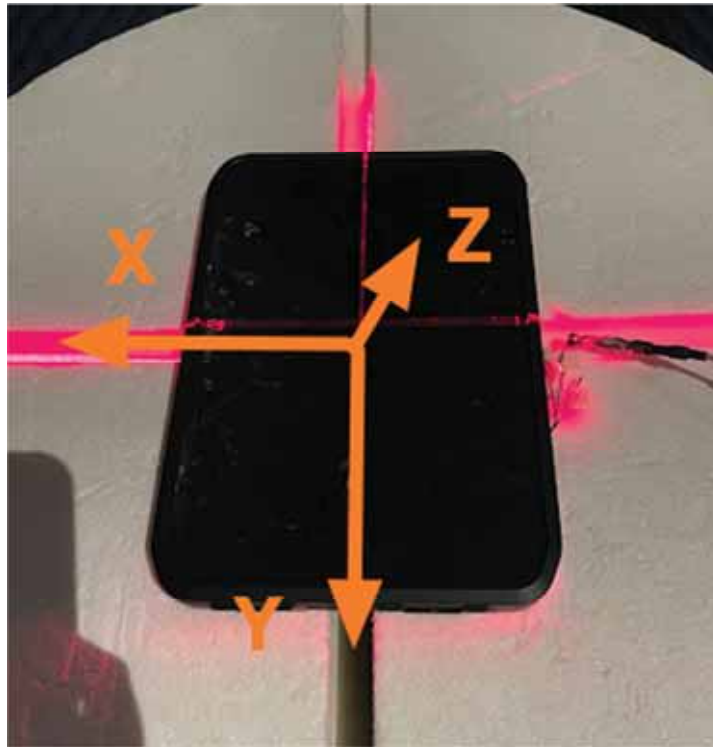
| Frequency | 2400 | 2427 | 2450 | 2472 | 2500 | 5150 | 5250 | 5350 | 5470 | 5540 |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Directivity (dBi) | 4.67 | 4.64 | 4.56 | 4.73 | 4.68 | 4.92 | 5.09 | 4.65 | 4.88 | 4.92 |
| Efficiency (dB) | -2.57 | -2.48 | -2.50 | -2.74 | -2.58 | -5.21 | -5.32 | -4.39 | -4.98 | -4.54 |
| Efficiency (%) | 55.34 | 56.45 | 56.29 | 53.19 | 55.26 | 30.16 | 29.39 | 36.41 | 31.77 | 35.15 |
| Peak Gain (dBi) | 2.10 | 2.16 | 2.07 | 1.99 | 2.11 | -0.29 | -0.23 | 0.26 | -0.10 | 0.38 |

| Frequency | 5600 | 5725 | 5850 | 5925 | 6000 | | | | | |
|-------------------|-------|-------|-------|-------|-------|--|--|--|--|--|
| Directivity (dBi) | 5.09 | 4.89 | 5.11 | 5.26 | 5.70 | | | | | |
| Efficiency (dB) | -4.14 | -4.43 | -4.62 | -4.54 | -4.41 | | | | | |
| Efficiency (%) | 38.53 | 36.02 | 34.48 | 35.19 | 36.25 | | | | | |
| Peak Gain (dBi) | 0.95 | 0.45 | 0.49 | 0.73 | 1.29 | | | | | |

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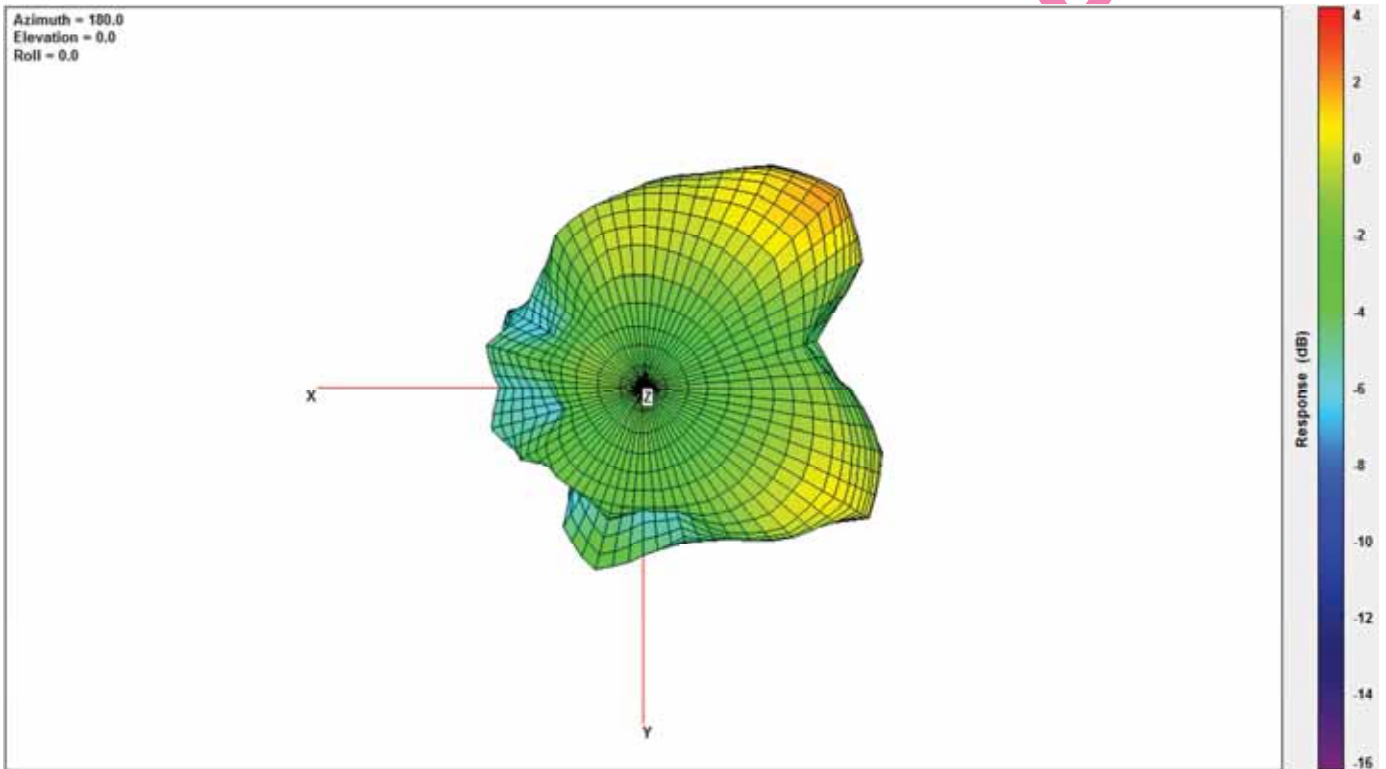
2.4.4. Radiation Patterns

2.4.4.1. Tets Setup

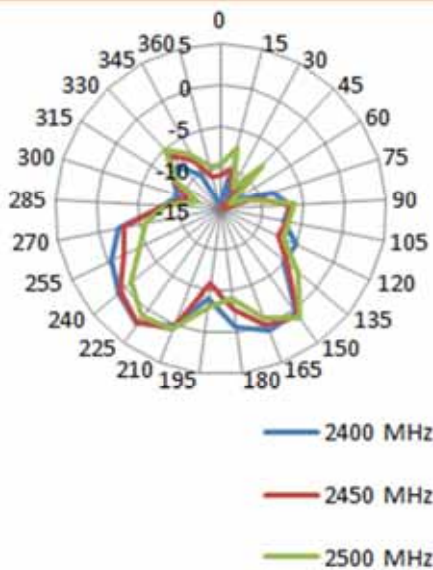


2.4.4.2. Straight 2D & 3D Radiation Patterns

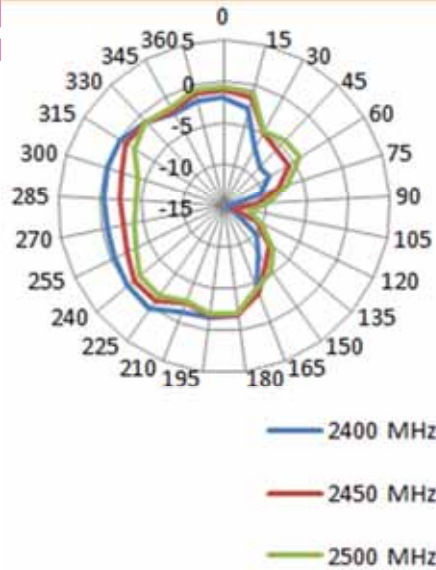
2450MHz



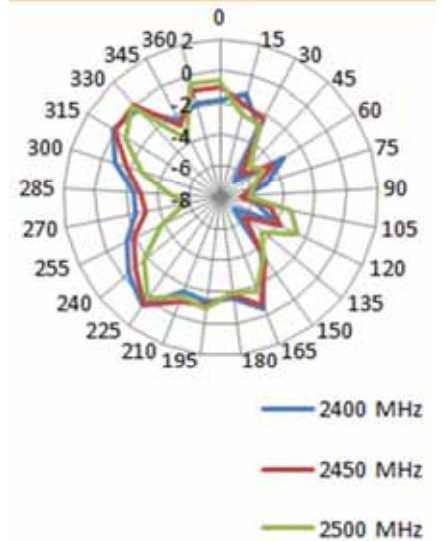
XY Plane



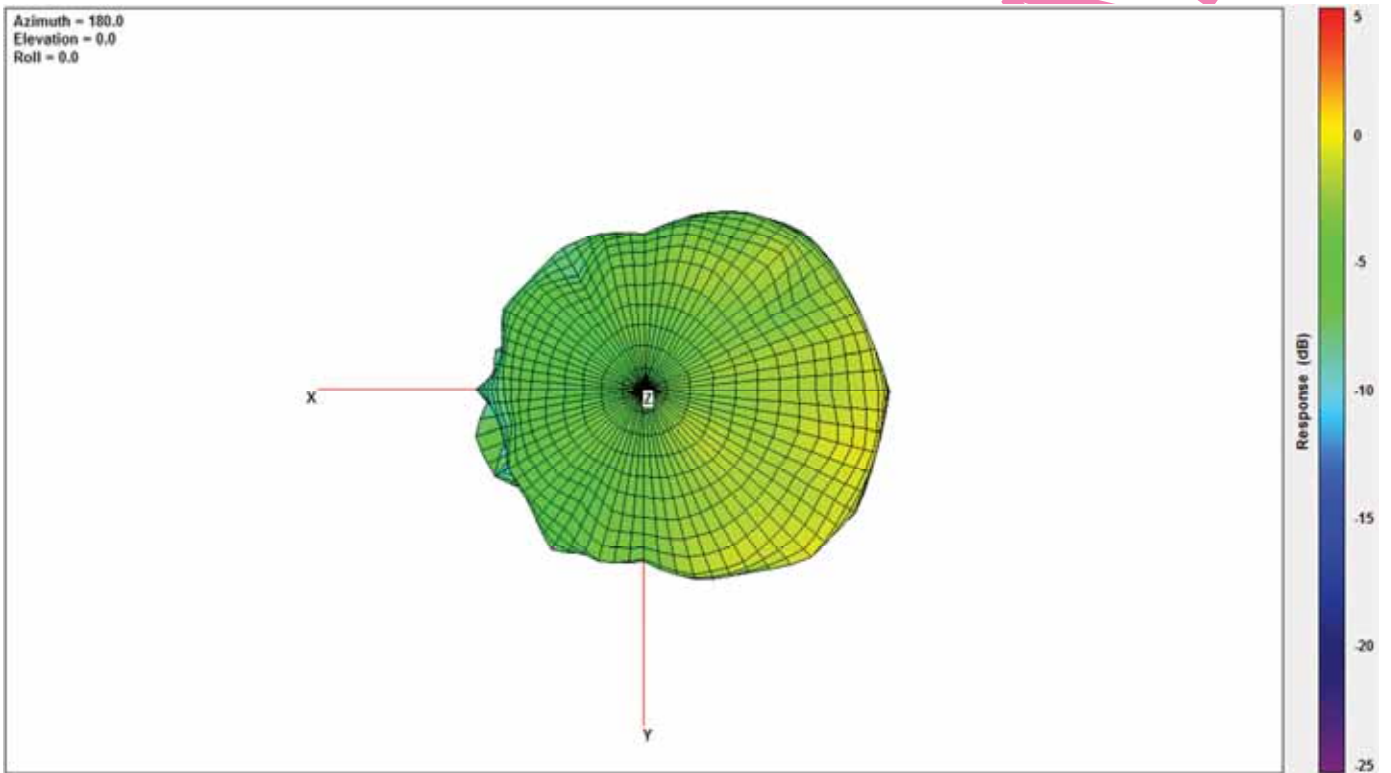
XZ Plane



YZ Plane



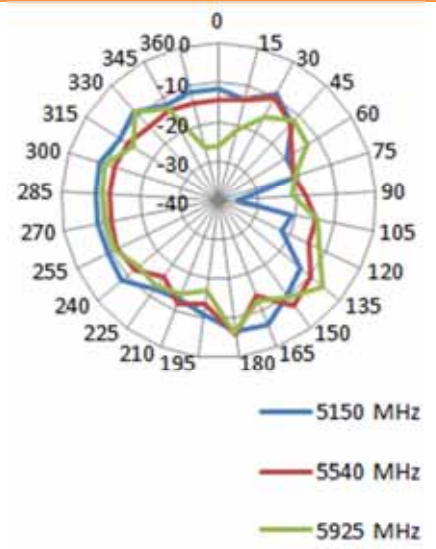
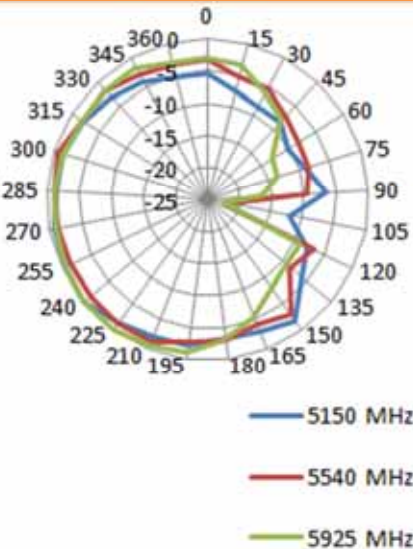
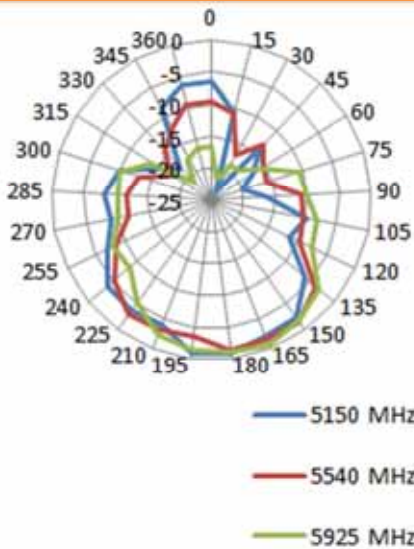
5540MHz



XY Plane

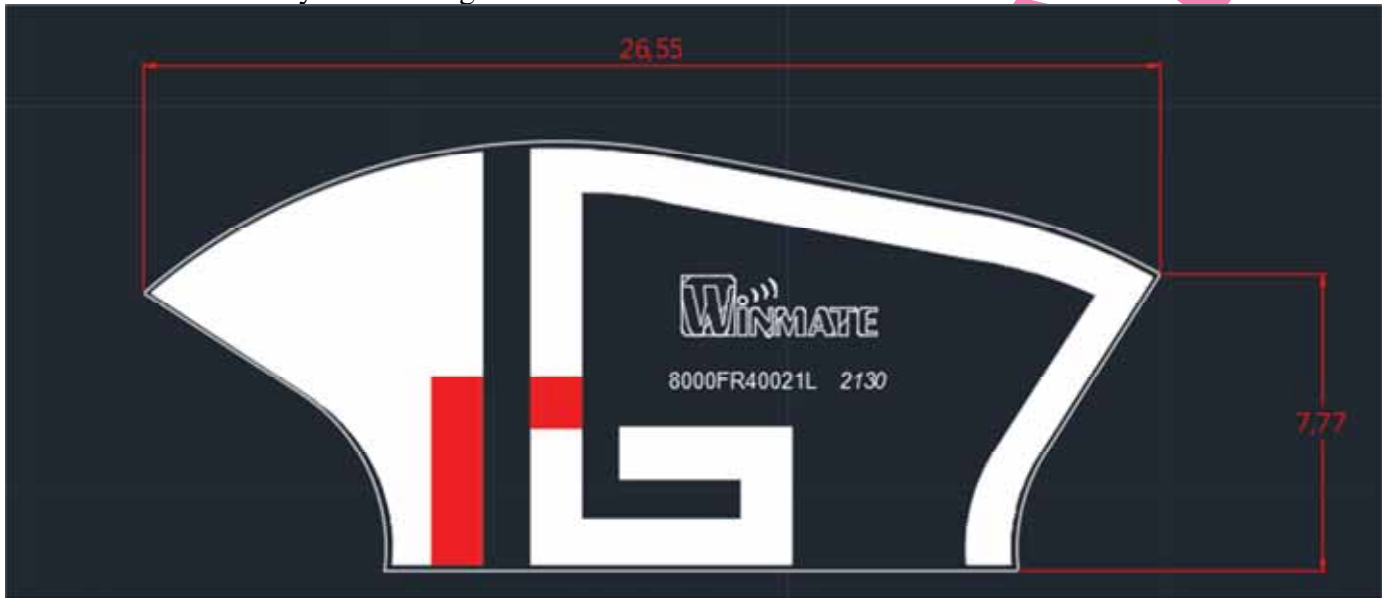
XZ Plane

YZ Plane

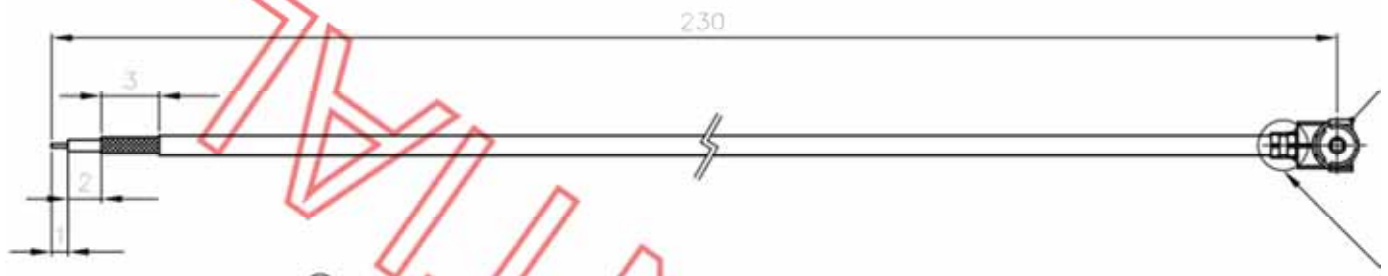


2.5. Drawing

WiFi Main Antenna Layout Drawing



RF cable Drawing



Antenna Assembly



Winmate Part Number: 90RF0500001R

3. WiFi Aux Antenna Specification

Winmate Part Number: 90RF0600001G

3.1. Electrical Characteristics

Frequency(MHz): 2400-2500 / 5150-6000

SWR: ≤ 1.66 @2400-2500MHz

≤ 1.87 @5150-6000MHz

Return Loss: ≤ -19.4 dB@2400-2500MHz

≤ -15.7 dB@5150-6000MHz

Peak Gain: 2.61dBi@2400-2500MHz

2.68dBi@5150-6000MHz

Impedance: 50ohm

Polarization: Linear

3.2. Mechanical Characteristics

Cable: 50 Ω φ 0.81 RF cable

Connector: MHF4

PCB: FR4 /Thickness 0.2mm

Type: Monopole

3.3. Environmental Characteristics

Operating Temperature: -30°C to 80°C

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3.4. RF Performance Characteristics

3.4.1 SWR



3.4.2 Return Loss



3.4.3. Gain / Efficiency

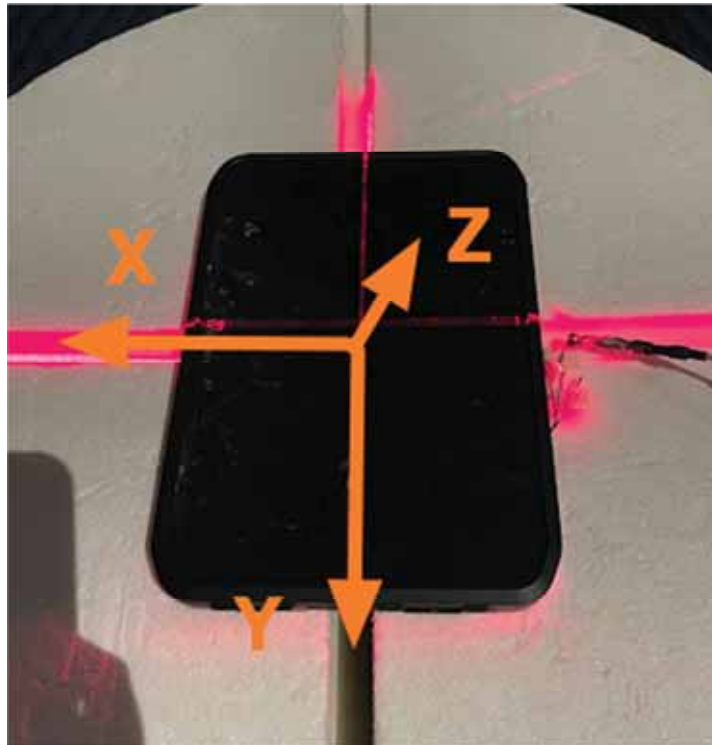
| Frequency | 2400 | 2427 | 2450 | 2472 | 2500 | 5150 | 5250 | 5350 | 5470 | 5540 |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Directivity (dBi) | 7.03 | 7.09 | 6.93 | 6.81 | 7.11 | 4.87 | 5.48 | 5.51 | 5.12 | 5.29 |
| Efficiency (dB) | -4.83 | -4.72 | -4.71 | -4.70 | -4.00 | -2.25 | -2.88 | -2.32 | -2.64 | -2.09 |
| Efficiency (%) | 32.87 | 33.76 | 33.84 | 33.89 | 39.78 | 59.57 | 51.47 | 58.67 | 54.48 | 61.75 |
| Peak Gain (dBi) | 2.19 | 2.38 | 2.22 | 2.11 | 2.61 | 2.62 | 2.60 | 2.39 | 2.48 | 2.20 |

| Frequency | 5600 | 5725 | 5850 | 5925 | 6000 | | | | | |
|-------------------|-------|-------|-------|-------|-------|--|--|--|--|--|
| Directivity (dBi) | 5.64 | 5.56 | 5.56 | 5.26 | 5.47 | | | | | |
| Efficiency (dB) | -1.75 | -2.38 | -2.45 | -2.47 | -2.55 | | | | | |
| Efficiency (%) | 66.81 | 57.81 | 56.89 | 56.56 | 55.59 | | | | | |
| Peak Gain (dBi) | 2.59 | 2.68 | 2.51 | 2.59 | 2.42 | | | | | |

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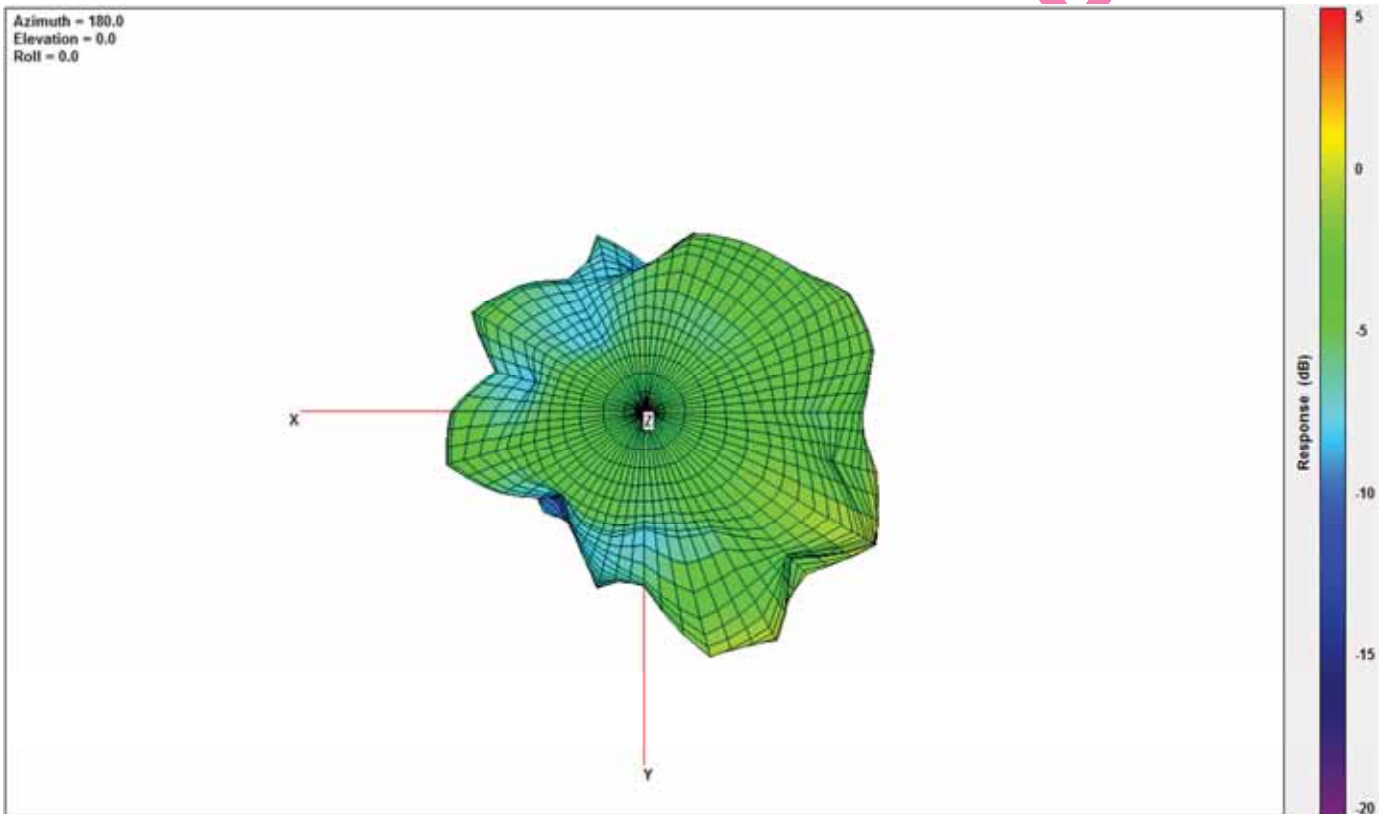
3.4.4. Radiation Patterns

3.4.4.1. Tets Setup



3.4.4.2. Straight 2D & 3D Radiation Patterns

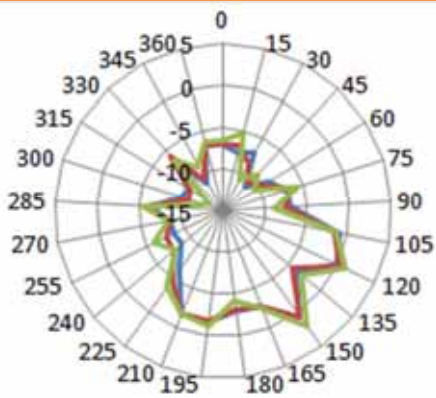
2450MHz



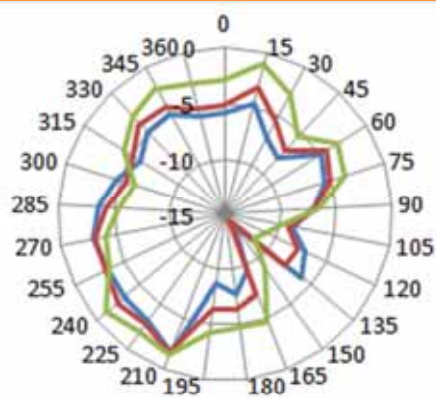
XY Plane

XZ Plane

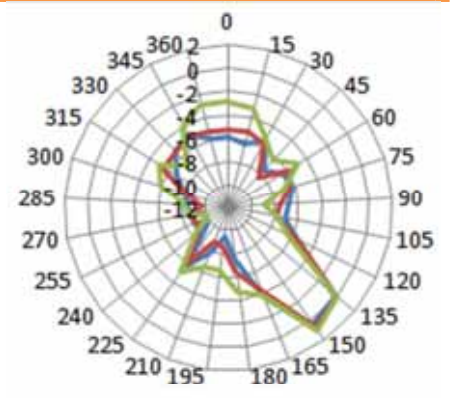
YZ Plane



— 2400 MHz
— 2450 MHz
— 2500 MHz

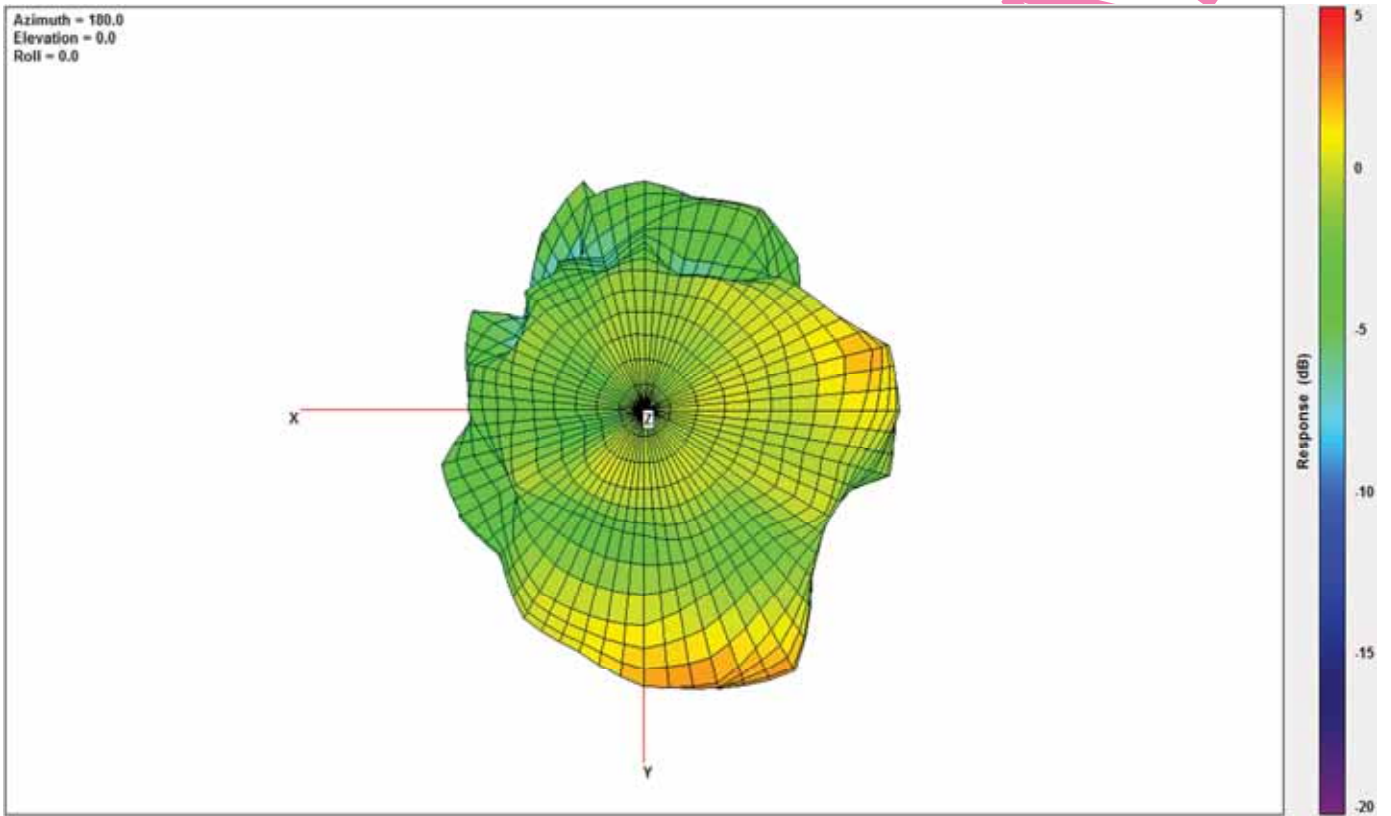


— 2400 MHz
— 2450 MHz
— 2500 MHz



— 2400 MHz
— 2450 MHz
— 2500 MHz

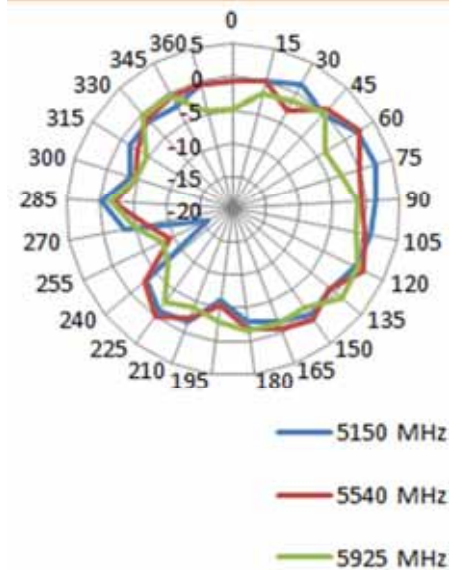
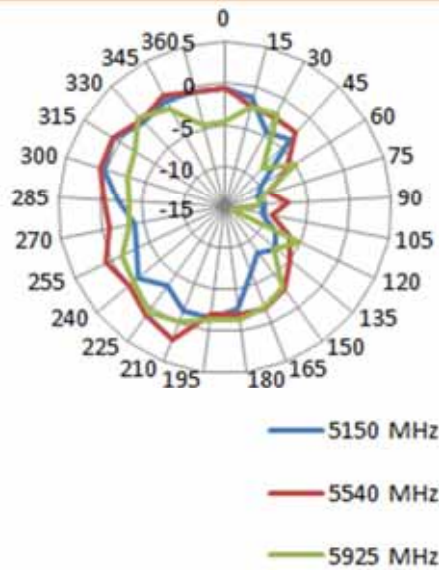
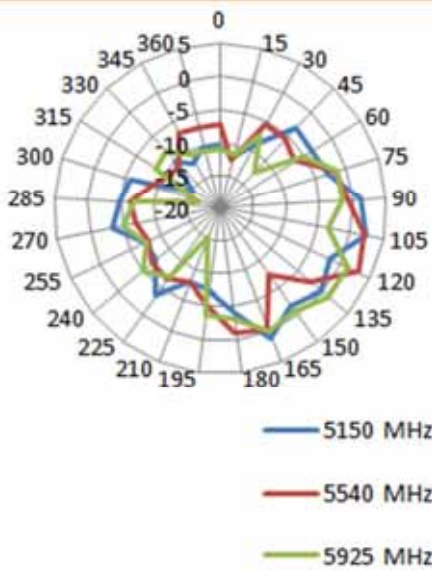
5540MHz



XY Plane

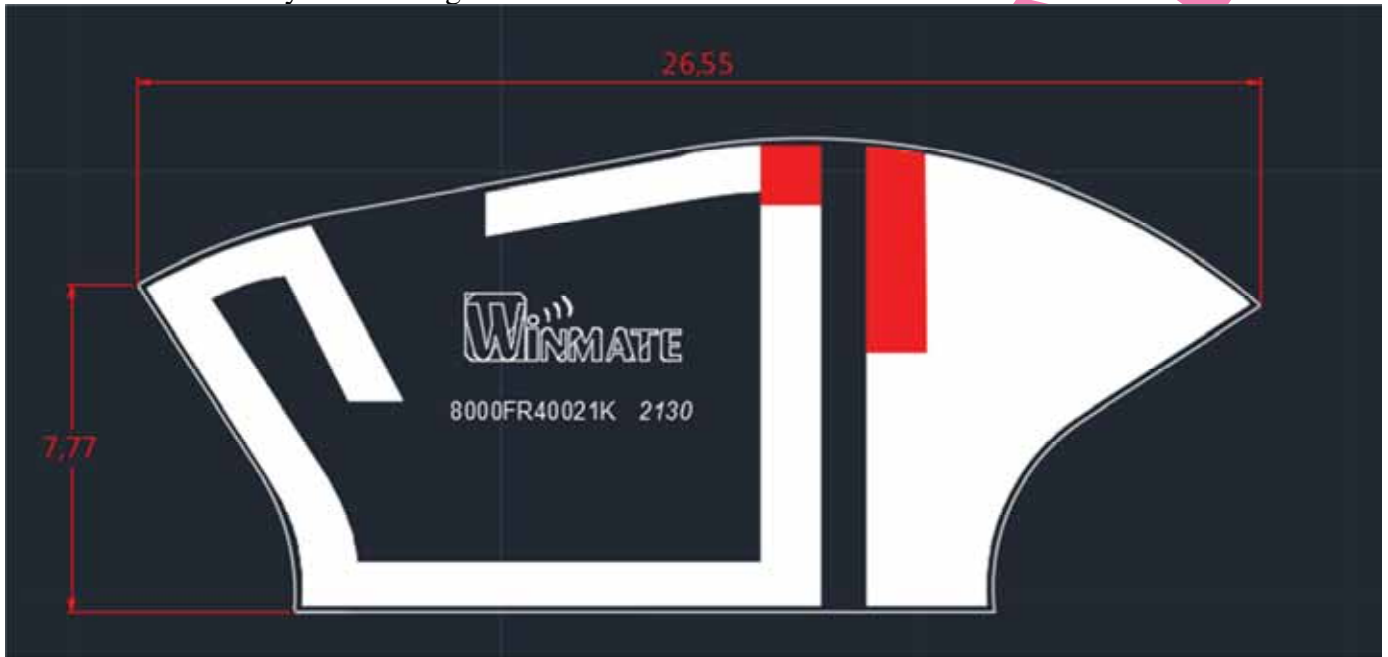
XZ Plane

YZ Plane

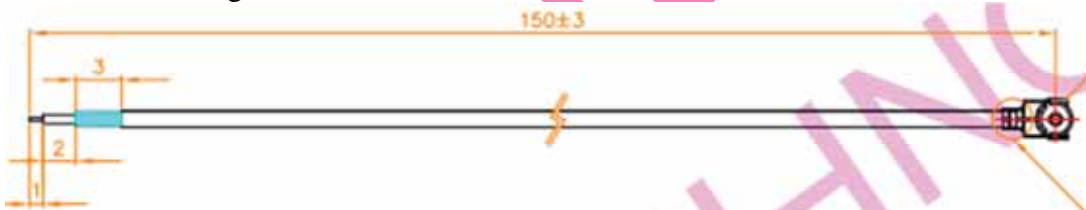


3.5. Drawing

WiFi Aux Antenna Layout Drawing



RF Cable Drawing



Antenna Assembly



Winmate Part Number: 90RF0600001G

4. LTE Main Antenna Specification

Winmate Part Number: 90RF0100001B

4.1. Electrical Characteristics

Frequency(MHz): 700-960 / 1710-2170 / 2500-2690

SWR: $\leq 3.53:1$ typ. (with Enclosure)

Peak Gain:2.30 dBi typ. (with Enclosure)

Impedance: 50ohm

Polarization: Linear

4.2. Mechanical Characteristics

Cable: 50Ω φ 0.81 RF cable

Connector: MHF 4

PCB: FPCB /Thickness 0.2mm

Type:PIFA

4.3. Environmental Characteristics

Operating Temperature: -30°C to 80°C

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4.4. RF Performance Characteristics

4.4.1. SWR



4.4.2. Return Loss



4.4.3. Gain / Efficiency

| Frequency | 699 | 707.5 | 716 | 729 | 737.5 | 746 | 751 | 777 | 782 | 787 |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Directivity (dBi) | 4.40 | 4.60 | 4.87 | 5.15 | 4.91 | 5.07 | 5.18 | 5.16 | 4.77 | 4.65 |
| Efficiency (dB) | -9.47 | -8.36 | -7.40 | -6.76 | -5.86 | -5.17 | -4.93 | -5.15 | -5.07 | -4.90 |
| Efficiency (%) | 11.29 | 14.59 | 18.22 | 21.10 | 25.97 | 30.39 | 32.14 | 30.56 | 31.15 | 32.38 |
| Peak Gain (dBi) | -5.07 | -3.76 | -2.53 | -1.61 | -0.94 | -0.11 | 0.25 | 0.02 | -0.29 | -0.25 |

| Frequency | 814 | 824 | 831.5 | 836.5 | 849 | 859 | 869 | 876.5 | 881.5 | 894 |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Directivity (dBi) | 3.64 | 3.70 | 3.80 | 3.76 | 3.53 | 3.60 | 3.57 | 3.55 | 3.57 | 4.10 |
| Efficiency (dB) | -3.16 | -2.91 | -2.87 | -2.79 | -3.02 | -3.15 | -3.38 | -3.44 | -3.49 | -3.69 |
| Efficiency (%) | 48.33 | 51.21 | 51.67 | 52.59 | 49.85 | 48.39 | 45.89 | 45.27 | 44.74 | 42.72 |
| Peak Gain (dBi) | 0.48 | 0.79 | 0.93 | 0.97 | 0.51 | 0.45 | 0.19 | 0.11 | 0.08 | 0.41 |

| Frequency | 1710 | 1732.5 | 1755 | 1850 | 1880 | 1882.5 | 1910 | 1915 | 1930 | 1960 |
|-------------------|-------|--------|-------|-------|-------|--------|-------|-------|-------|-------|
| Directivity (dBi) | 6.64 | 6.41 | 6.19 | 5.10 | 5.09 | 5.16 | 5.35 | 5.27 | 4.95 | 5.07 |
| Efficiency (dB) | -2.80 | -3.21 | -3.40 | -5.16 | -4.92 | -4.87 | -4.56 | -4.57 | -4.59 | -4.67 |
| Efficiency (%) | 52.52 | 47.76 | 45.72 | 30.51 | 32.25 | 32.59 | 34.97 | 34.88 | 34.72 | 34.12 |
| Peak Gain (dBi) | 2.14 | 2.20 | 2.30 | -0.06 | 0.17 | 0.29 | 0.78 | 0.70 | 0.35 | 0.40 |

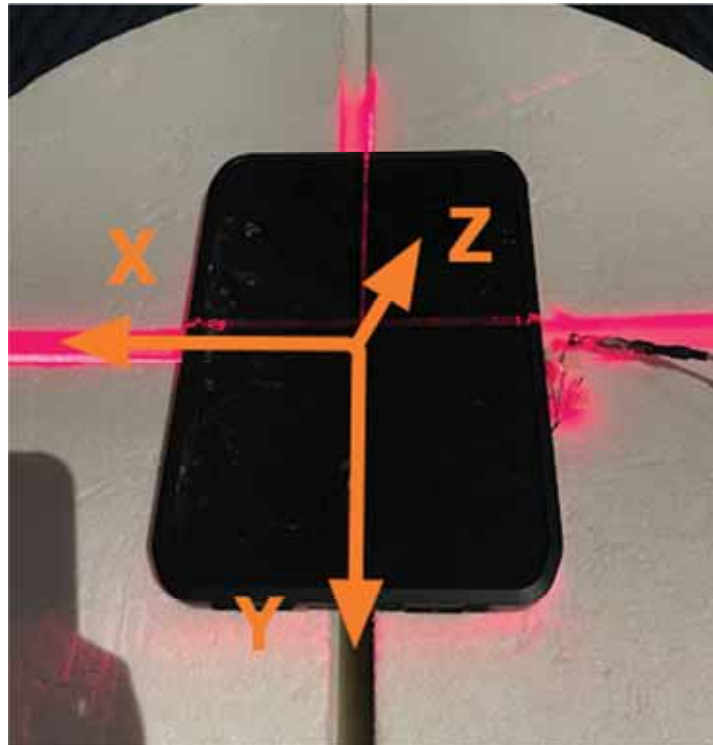
| Frequency | 1962.5 | 1990 | 1995 | 2110 | 2132.5 | 2155 | 2305 | 2310 | 2315 | 2350 |
|-------------------|--------|-------|-------|-------|--------|-------|-------|-------|-------|-------|
| Directivity (dBi) | 5.14 | 5.57 | 5.62 | 5.74 | 5.78 | 5.55 | 3.73 | 3.71 | 3.72 | 4.04 |
| Efficiency (dB) | -4.67 | -4.55 | -4.47 | -4.56 | -4.70 | -4.81 | -5.11 | -5.13 | -5.12 | -4.91 |
| Efficiency (%) | 34.15 | 35.09 | 35.75 | 34.97 | 33.87 | 33.01 | 30.83 | 30.71 | 30.75 | 32.30 |
| Peak Gain (dBi) | 0.47 | 1.02 | 1.15 | 1.18 | 1.08 | 0.73 | -1.38 | -1.41 | -1.40 | -0.87 |

| Frequency | 2355 | 2360 | 2496 | 2500 | 2535 | 2570 | 2593 | 2620 | 2655 | 2690 |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Directivity (dBi) | 4.10 | 4.20 | 5.04 | 4.98 | 5.15 | 5.13 | 5.51 | 5.36 | 5.74 | 5.80 |
| Efficiency (dB) | -4.87 | -4.82 | -5.55 | -5.52 | -5.66 | -5.79 | -5.98 | -6.22 | -6.71 | -6.60 |
| Efficiency (%) | 32.55 | 32.94 | 27.89 | 28.08 | 27.14 | 26.36 | 25.25 | 23.89 | 21.31 | 21.90 |
| Peak Gain (dBi) | -0.78 | -0.62 | -0.51 | -0.54 | -0.51 | -0.66 | -0.47 | -0.86 | -0.97 | -0.80 |

| Frequency | 3300 | 3550 | 3625 | 3700 | 3750 | 3800 | 4200 | 4400 | 4700 | 5000 |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Directivity (dBi) | 5.93 | 6.83 | 7.27 | 7.07 | 6.51 | 5.54 | 7.15 | 7.90 | 5.23 | 5.25 |
| Efficiency (dB) | -6.37 | -7.86 | -9.26 | -9.87 | -9.17 | -8.24 | -8.58 | -6.69 | -6.39 | -6.41 |
| Efficiency (%) | 23.07 | 16.38 | 11.85 | 10.30 | 12.10 | 14.99 | 13.88 | 21.42 | 22.95 | 22.85 |
| Peak Gain (dBi) | -0.44 | -1.02 | -1.99 | -2.80 | -2.66 | -2.70 | -1.42 | 1.20 | -1.16 | -1.16 |

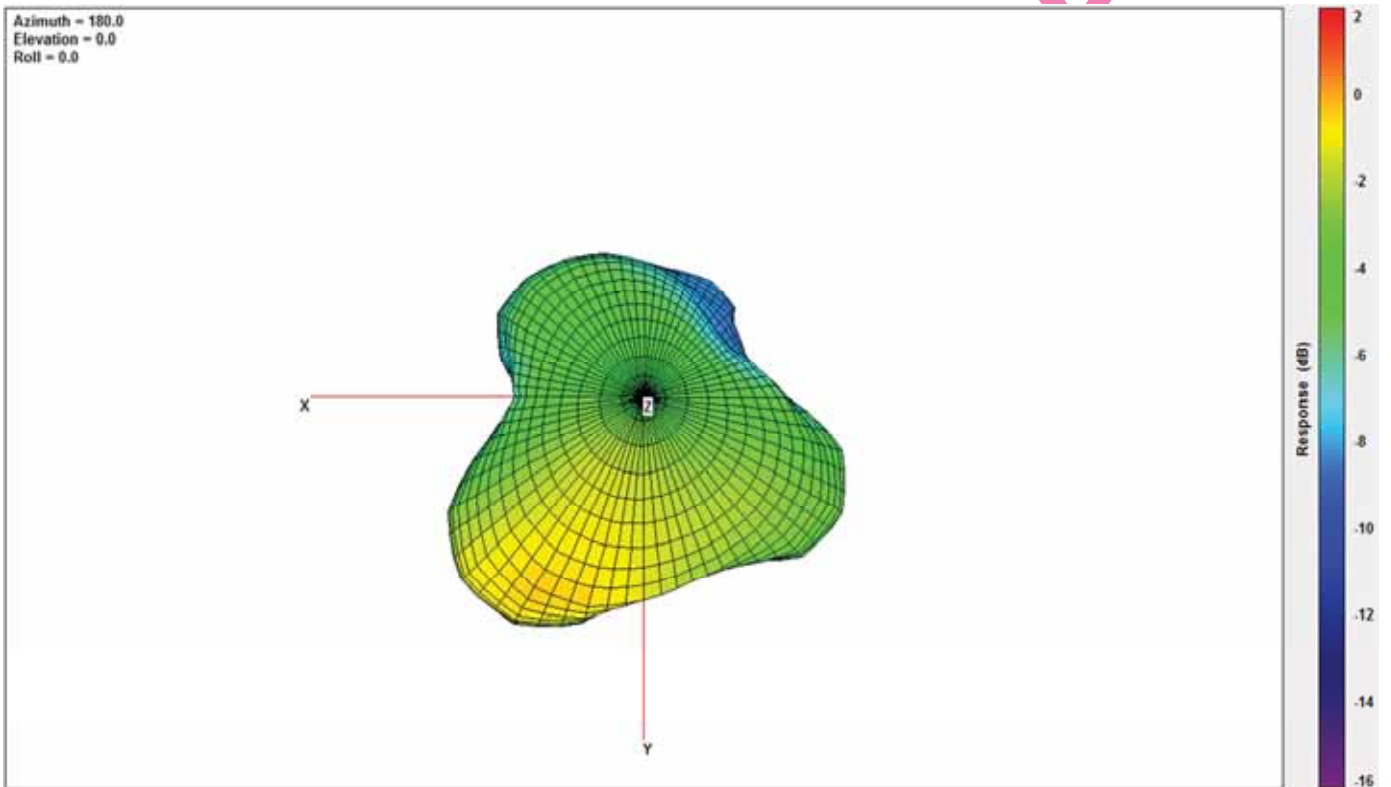
4.4.4. Radiation Patterns

4.4.4.1. Tets Setup



4.4.4.2. Straight 2D & 3D Radiation Patterns

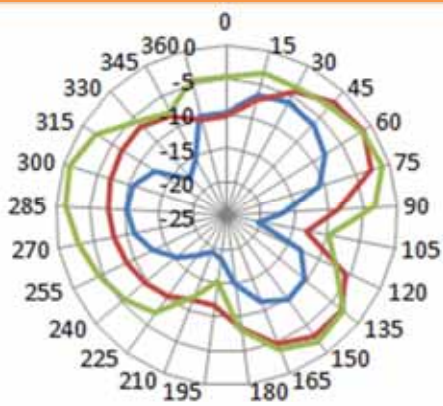
751MHz



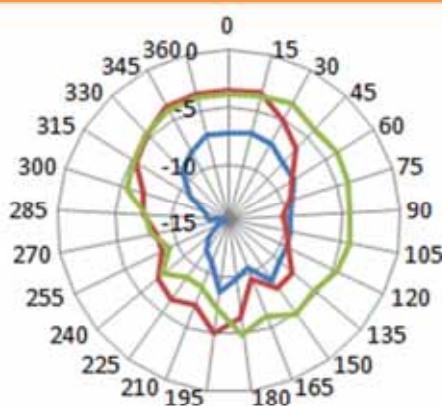
XY Plane

XZ Plane

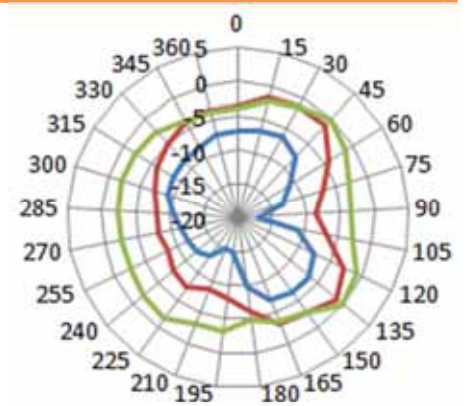
YZ Plane



— 699 MHz
— 751 MHz
— 814 MHz

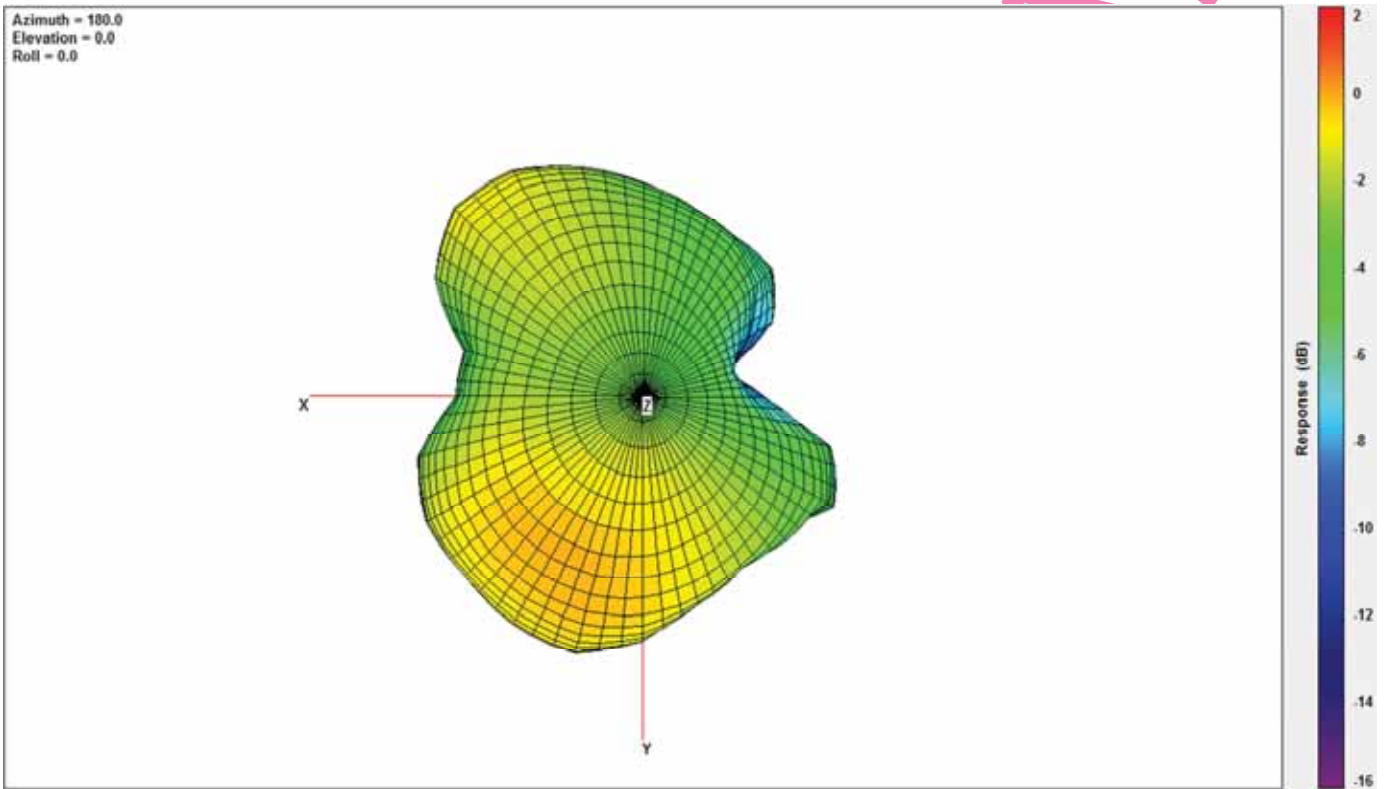


— 699 MHz
— 751 MHz
— 814 MHz



— 699 MHz
— 751 MHz
— 814 MHz

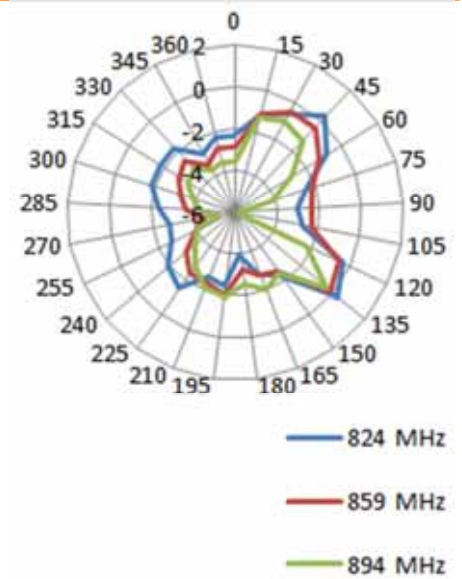
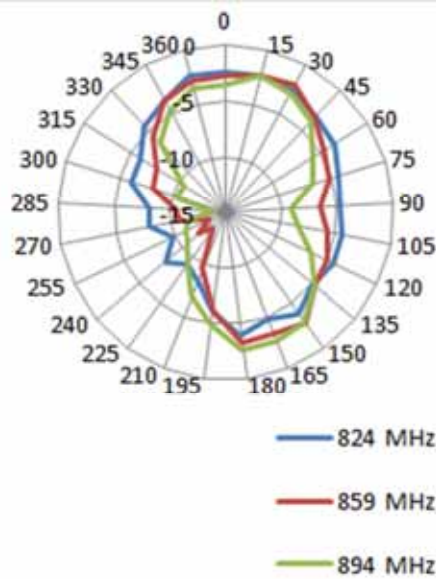
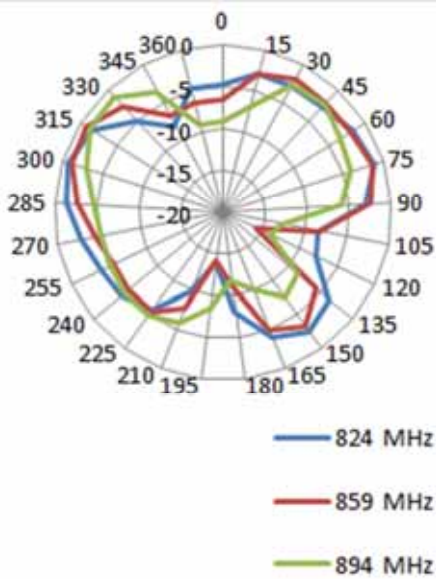
859MHz



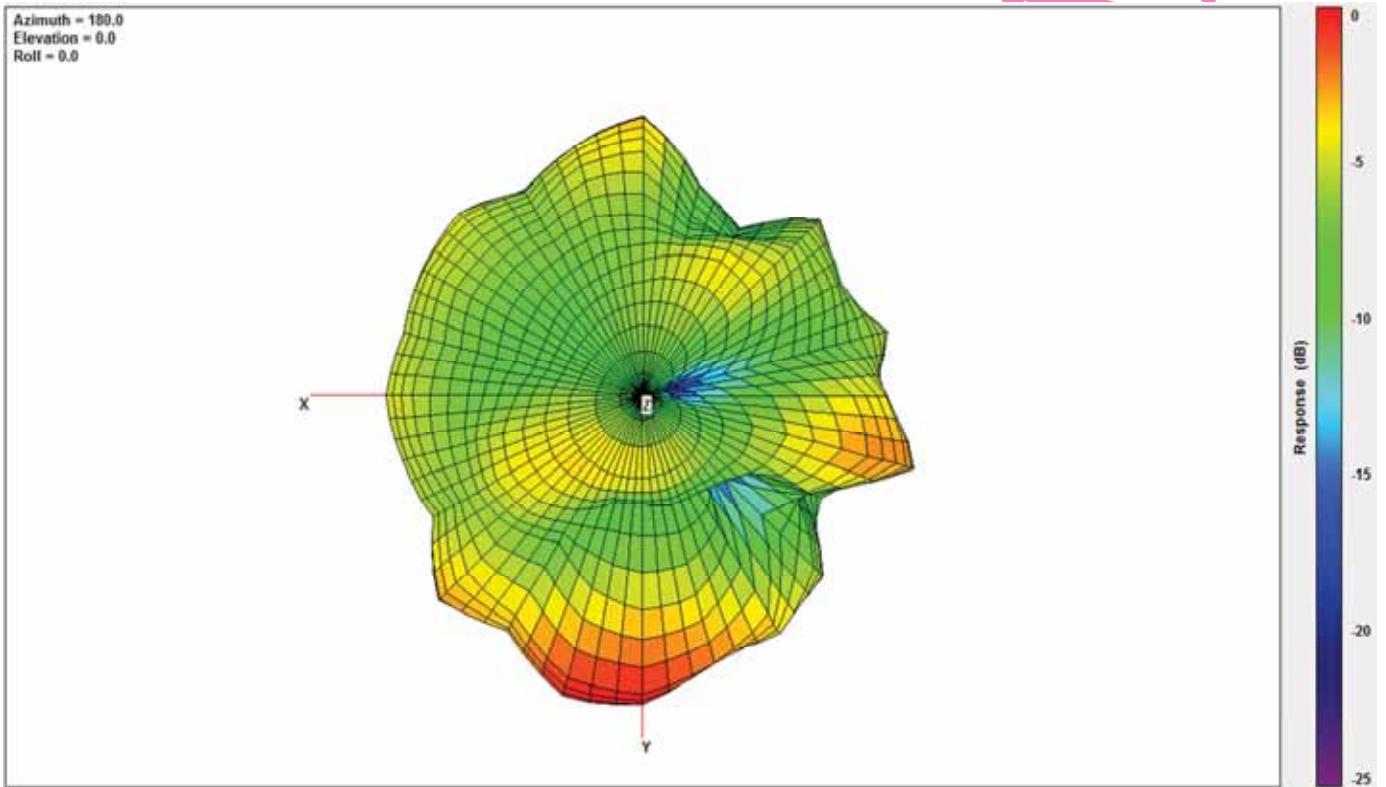
XY Plane

XZ Plane

YZ Plane



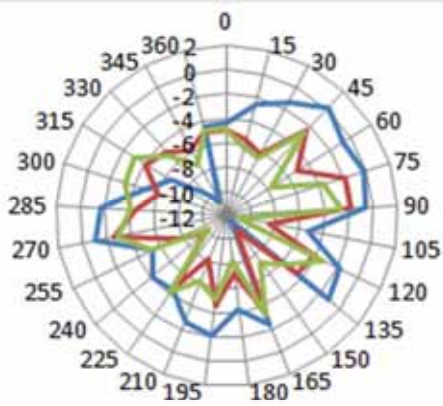
1850MHz



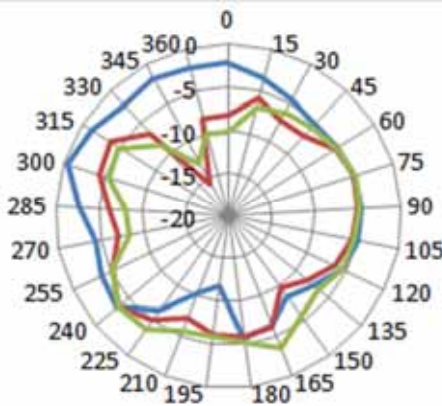
XY Plane

XZ Plane

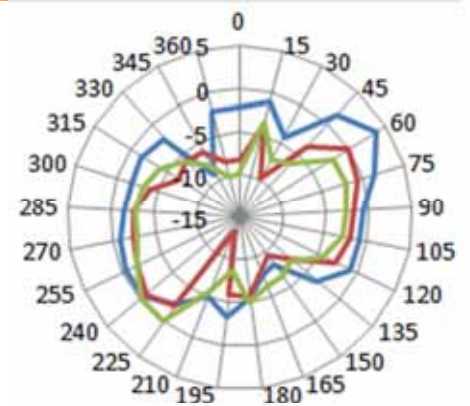
YZ Plane



- 1710 MHz
- 1850 MHz
- 1880 MHz

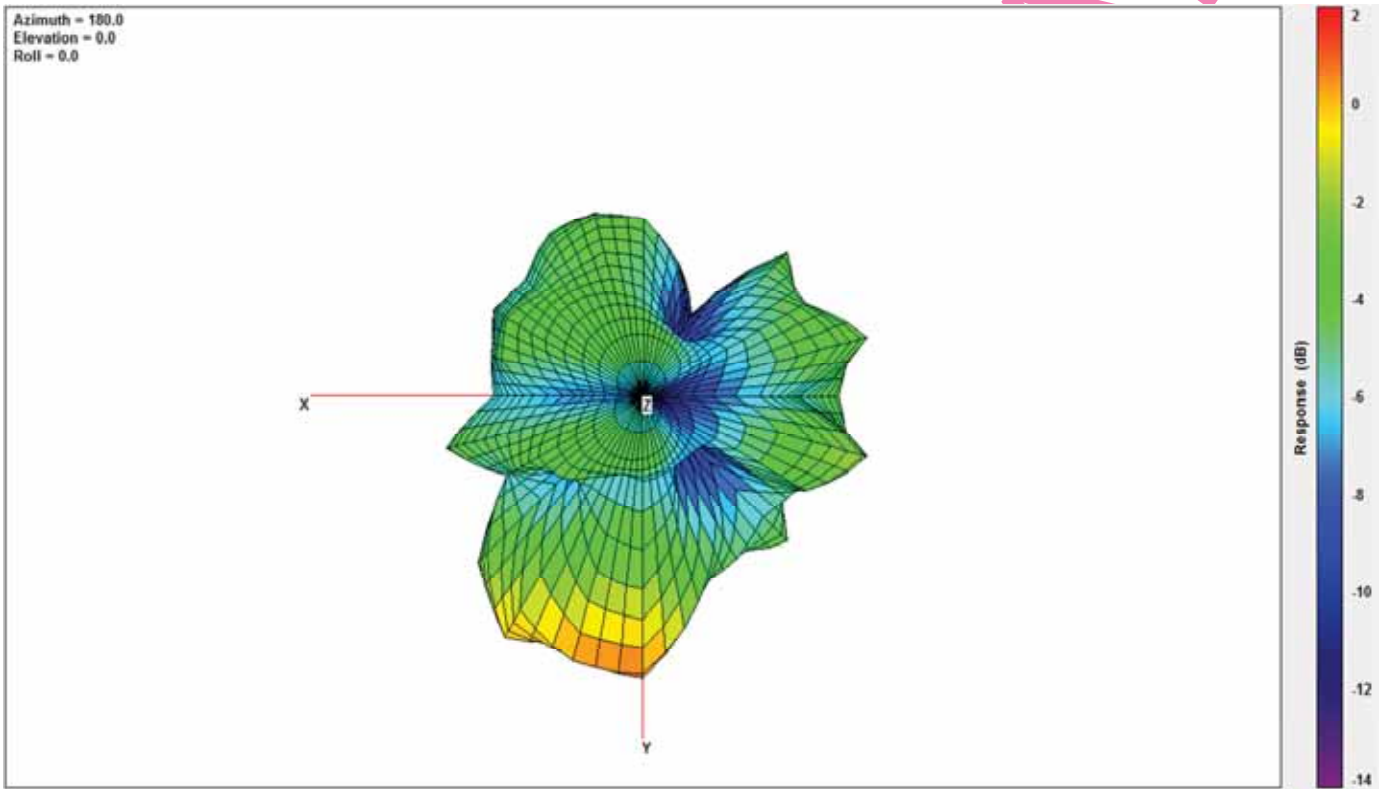


- 1710 MHz
- 1850 MHz
- 1880 MHz



- 1710 MHz
- 1850 MHz
- 1880 MHz

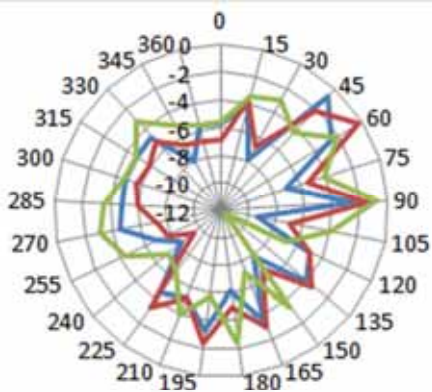
1990MHz



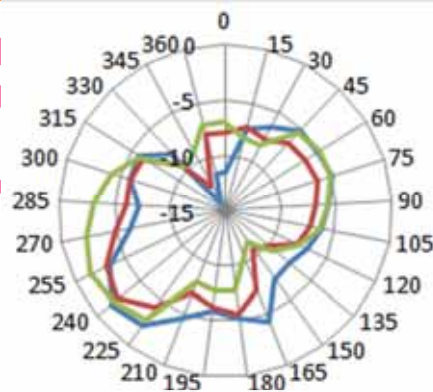
XY Plane

XZ Plane

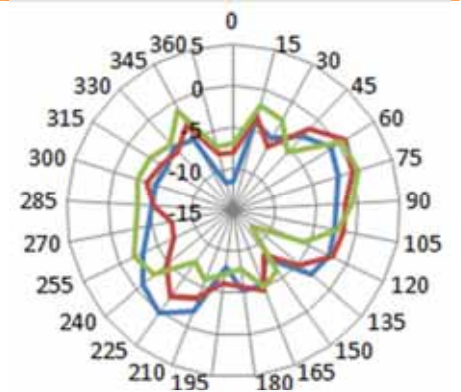
YZ Plane



— 1930 MHz
— 1990 MHz
— 2155 MHz

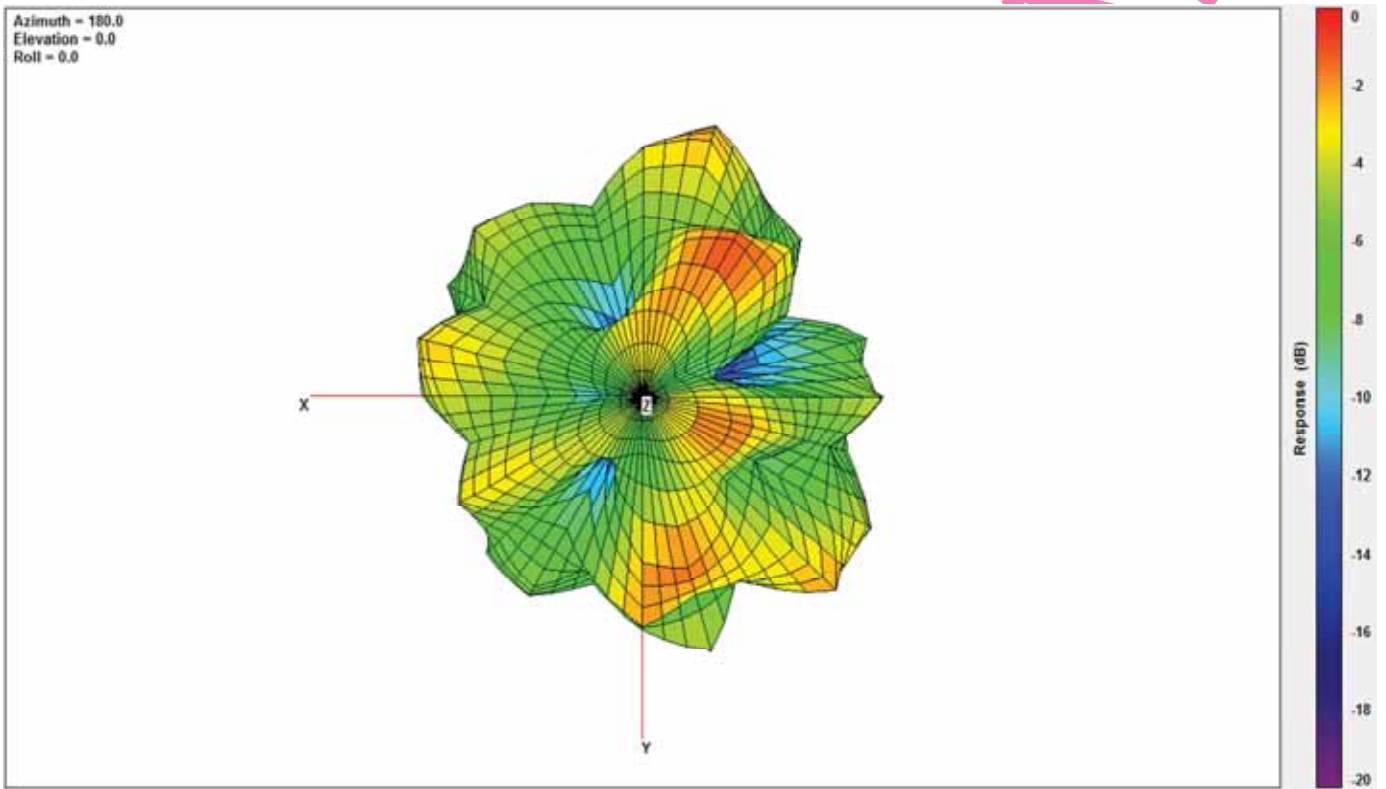


— 1930 MHz
— 1990 MHz
— 2155 MHz



— 1930 MHz
— 1990 MHz
— 2155 MHz

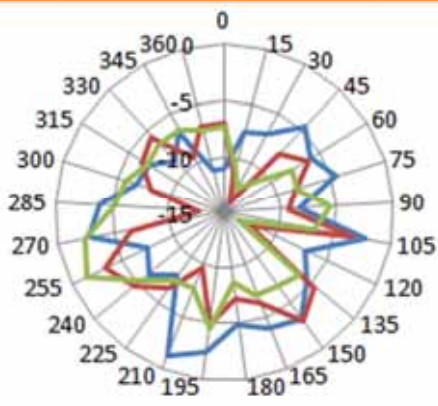
2593MHz



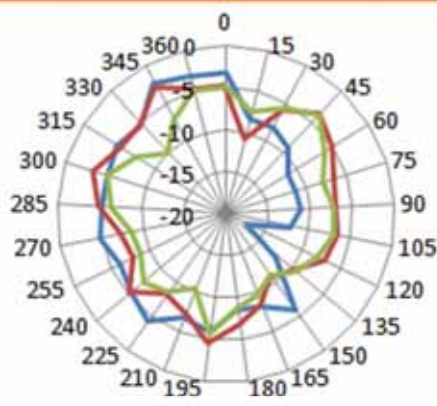
XY Plane

XZ Plane

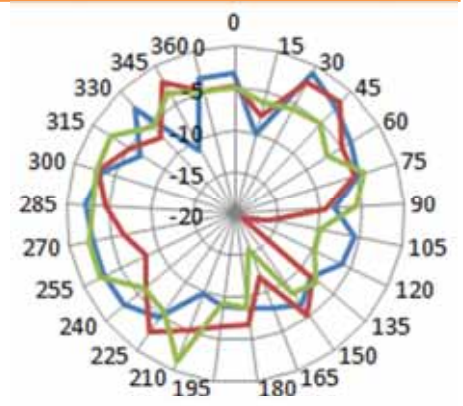
YZ Plane



- 2496 MHz
- 2593 MHz
- 2690 MHz

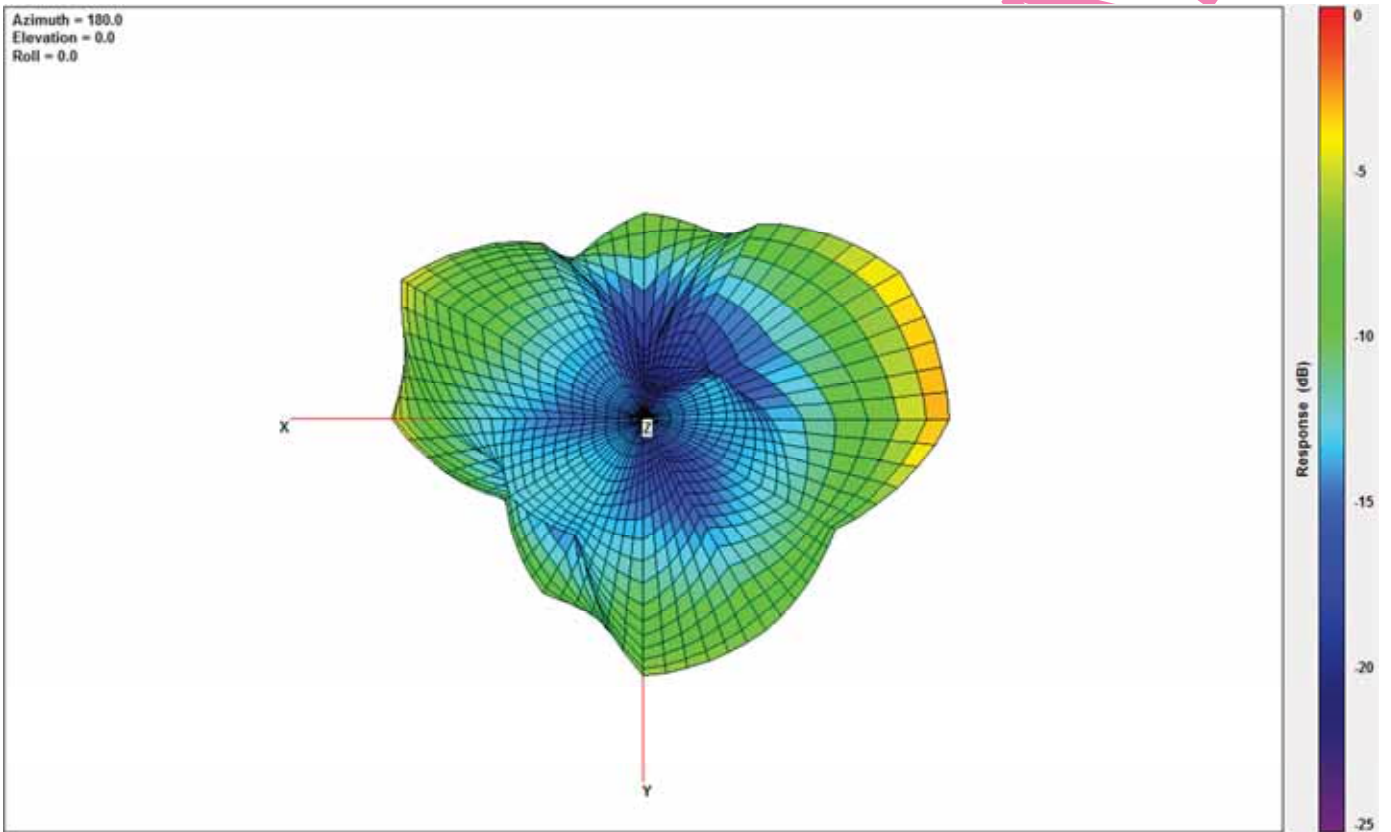


- 2496 MHz
- 2593 MHz
- 2690 MHz



- 2496 MHz
- 2593 MHz
- 2690 MHz

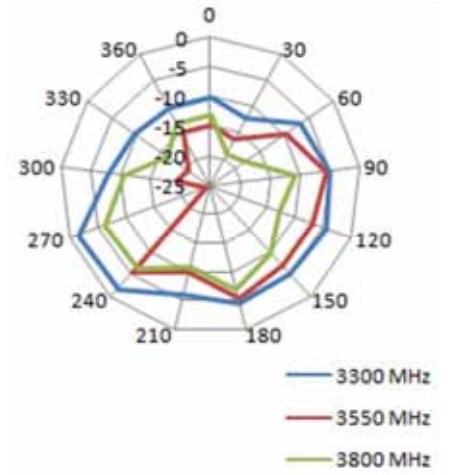
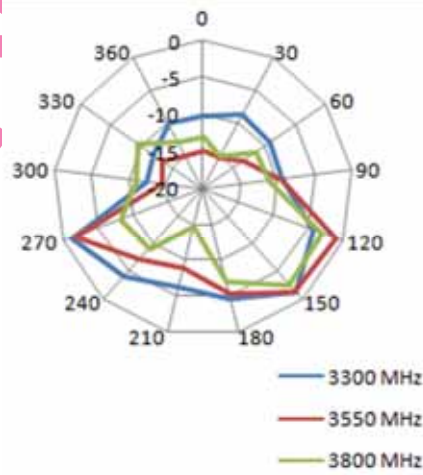
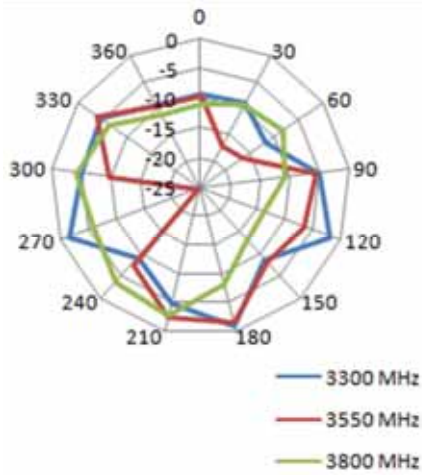
3550MHz



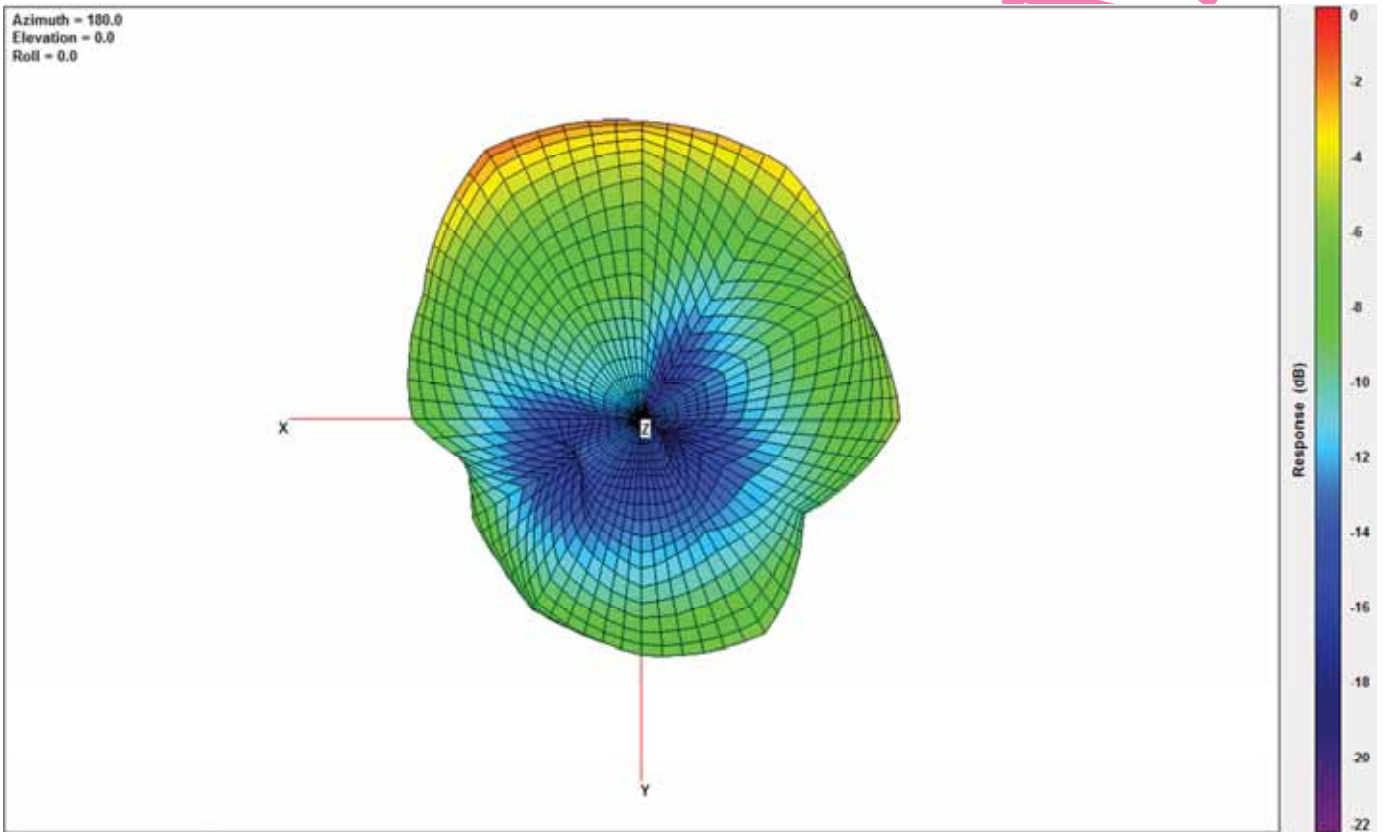
XY Plane

XZ Plane

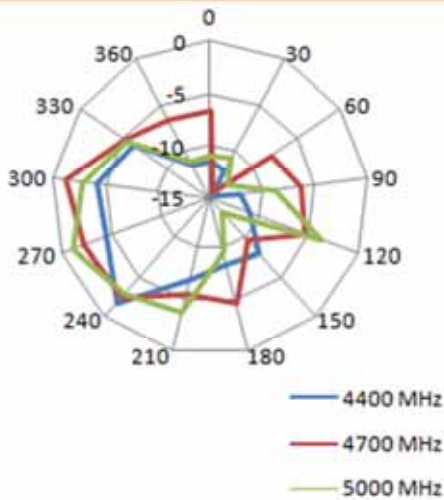
YZ Plane



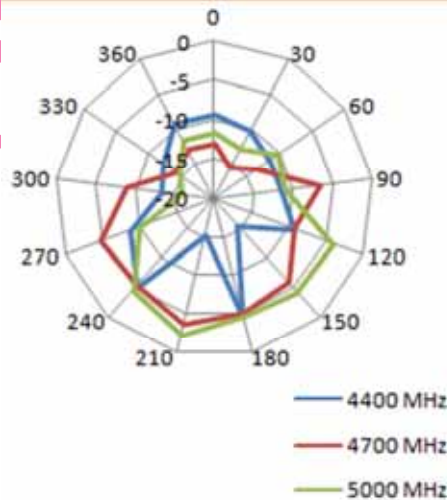
4700MHz



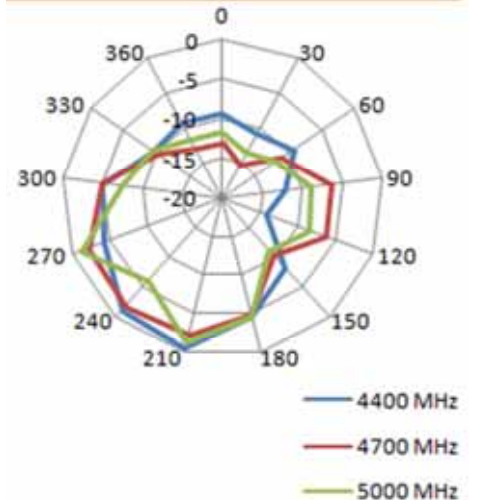
XY Plane



XZ Plane

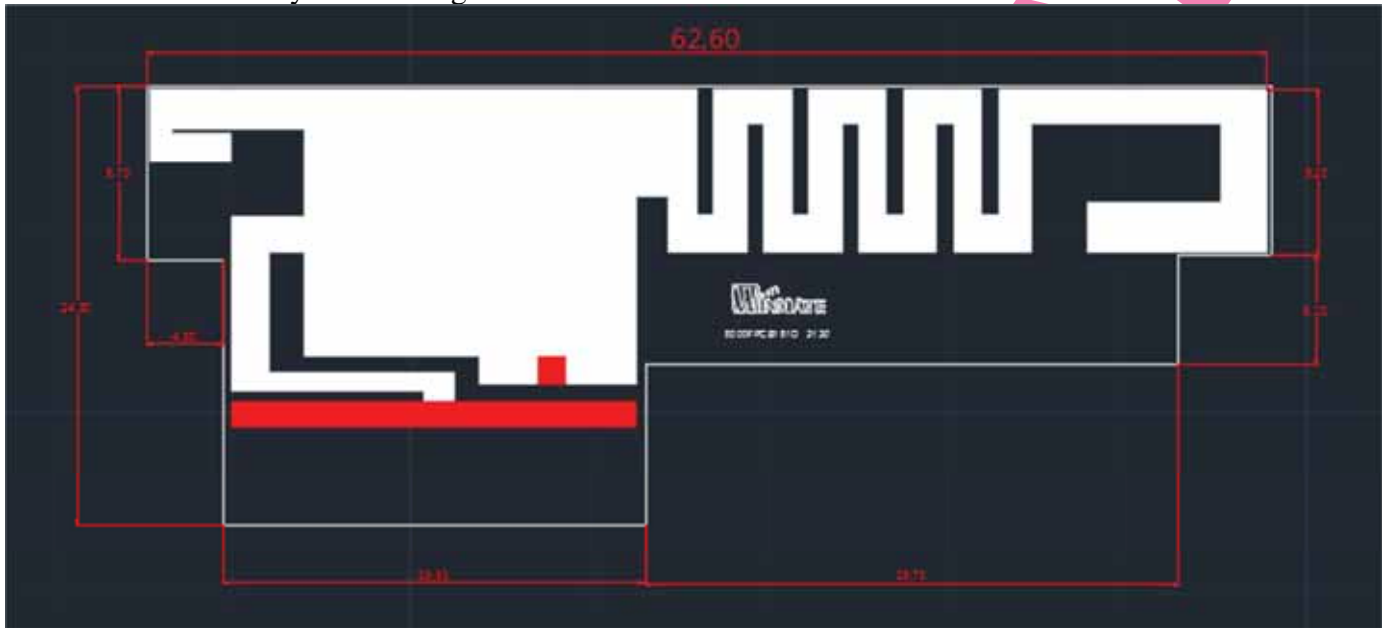


YZ Plane

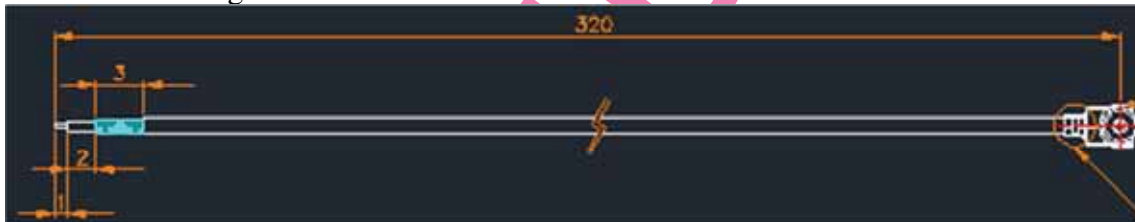


4.5. Drawing

LTE Main Antenna Layout Drawing



RF Cable Drawing



Antenna Assembly



Winmate Part Number: 90RF0100001B

5. LTE Aux Antenna Specification

Winmate Part Number: 90RF02000013

5.1. Electrical Characteristics

Frequency(MHz): 700-960 / 1710-2170 / 2500-2690

SWR: $\leq 3.43:1$ typ. (with Enclosure)

Peak Gain: 2.28dBi typ. (with Enclosure)

Impedance: 50ohm

Polarization: Linear

5.2. Mechanical Characteristics

Cable: 50Ω φ 0.81 RF cable

Connector: MHF 4

PCB: FPCB /Thickness 0.2mm

Type: Monopole

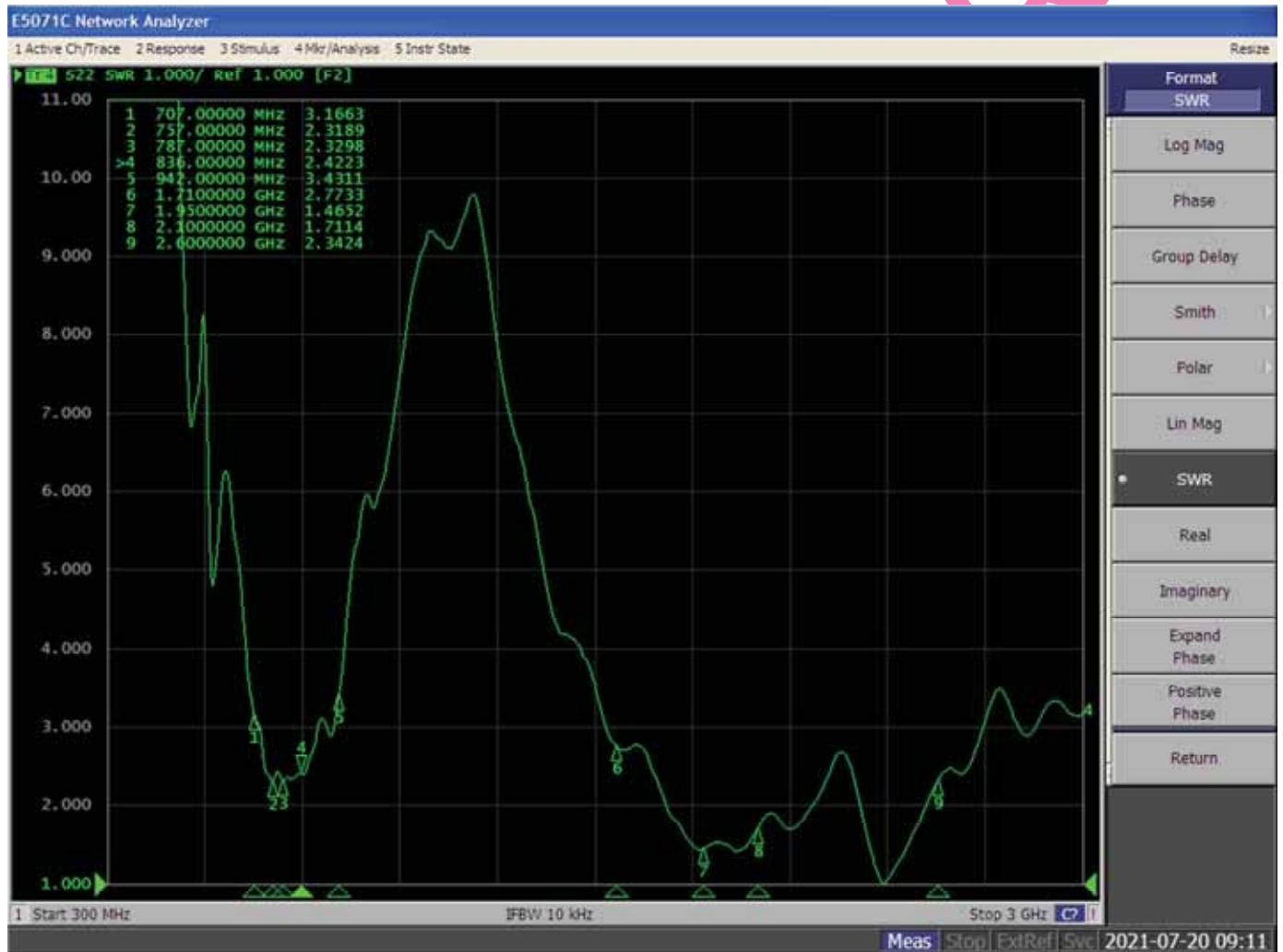
5.3. Environmental Characteristics

Operating Temperature: -30°C to 80°C

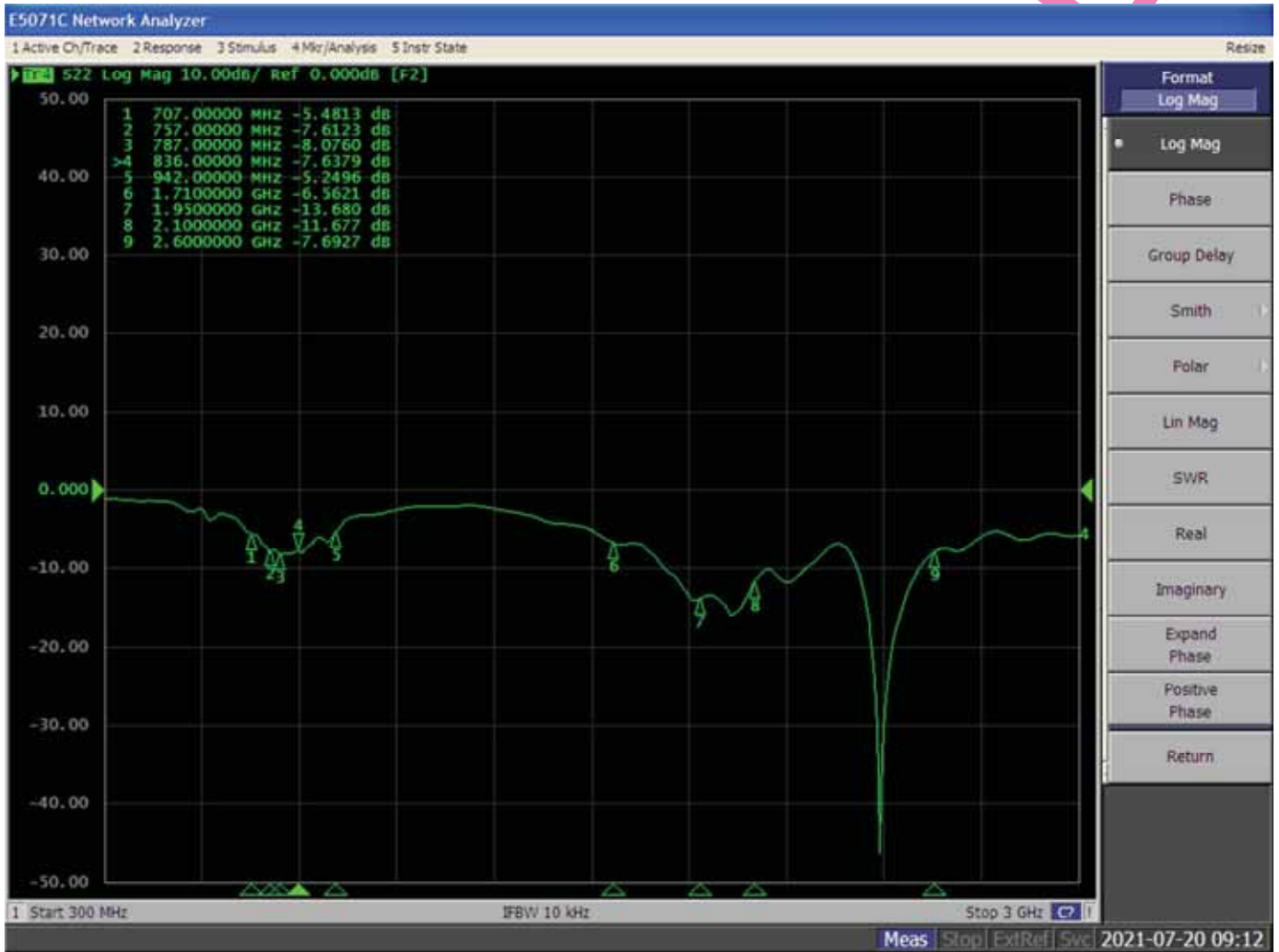
CONFIDENTIAL

5.4. RF Performance Characteristics

5.4.1. SWR



5.4.2. Return Loss



5.4.3. Gain / Efficiency

| Frequency | 699 | 707.5 | 716 | 729 | 737.5 | 746 | 751 | 777 | 782 | 787 |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Directivity (dBi) | 3.95 | 3.77 | 3.55 | 3.94 | 4.58 | 5.28 | 5.44 | 6.12 | 6.09 | 5.92 |
| Efficiency (dB) | -5.78 | -5.92 | -5.23 | -4.68 | -4.60 | -4.43 | -4.13 | -3.84 | -3.96 | -4.02 |
| Efficiency (%) | 26.45 | 25.61 | 30.02 | 34.08 | 34.70 | 36.08 | 38.61 | 41.34 | 40.21 | 39.67 |
| Peak Gain (dBi) | -1.83 | -2.15 | -1.68 | -0.73 | -0.01 | 0.85 | 1.30 | 2.28 | 2.13 | 1.91 |

| Frequency | 814 | 824 | 831.5 | 836.5 | 849 | 859 | 869 | 876.5 | 881.5 | 894 |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Directivity (dBi) | 5.34 | 5.80 | 5.61 | 5.15 | 5.62 | 6.34 | 6.97 | 7.17 | 7.16 | 6.96 |
| Efficiency (dB) | -4.27 | -4.70 | -5.11 | -5.30 | -5.92 | -6.44 | -7.19 | -7.50 | -7.59 | -7.95 |
| Efficiency (%) | 37.41 | 33.91 | 30.81 | 29.53 | 25.57 | 22.67 | 19.08 | 17.79 | 17.41 | 16.04 |
| Peak Gain (dBi) | 1.07 | 1.10 | 0.50 | -0.14 | -0.30 | -0.11 | -0.22 | -0.33 | -0.43 | -0.99 |

| Frequency | 1710 | 1732.5 | 1755 | 1850 | 1880 | 1882.5 | 1910 | 1915 | 1930 | 1960 |
|-------------------|-------|--------|-------|-------|-------|--------|-------|-------|-------|-------|
| Directivity (dBi) | 6.38 | 5.71 | 4.61 | 5.07 | 4.83 | 4.84 | 4.90 | 4.88 | 4.90 | 5.38 |
| Efficiency (dB) | -6.07 | -6.85 | -6.60 | -4.81 | -4.64 | -4.62 | -4.59 | -4.64 | -4.63 | -4.62 |
| Efficiency (%) | 24.73 | 20.67 | 21.89 | 33.03 | 34.38 | 34.55 | 34.73 | 34.35 | 34.41 | 34.48 |
| Peak Gain (dBi) | 0.31 | -1.14 | -1.99 | 0.26 | 0.20 | 0.22 | 0.31 | 0.24 | 0.27 | 0.76 |

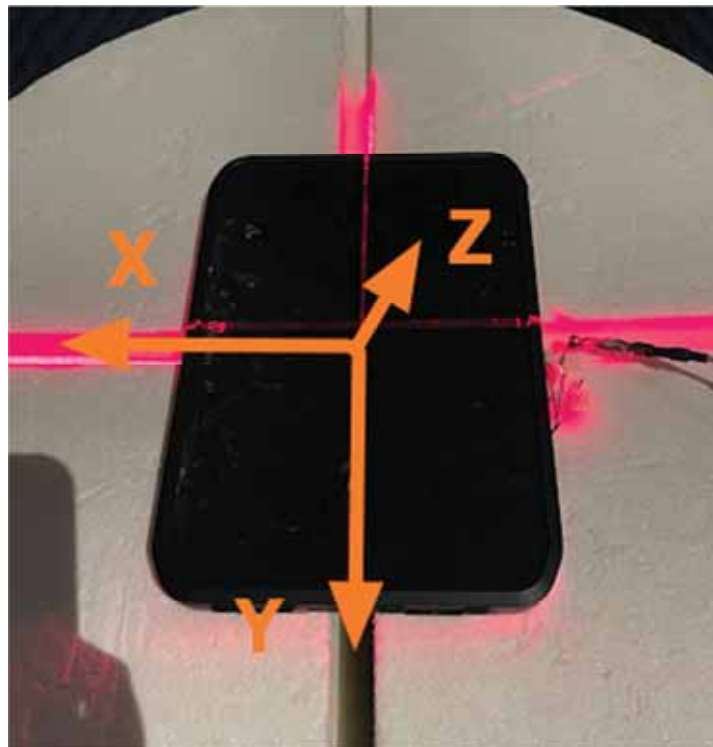
| Frequency | 1962.5 | 1990 | 1995 | 2110 | 2132.5 | 2155 | 2305 | 2310 | 2315 | 2350 |
|-------------------|--------|-------|-------|-------|--------|-------|-------|-------|-------|-------|
| Directivity (dBi) | 5.42 | 5.47 | 5.45 | 4.37 | 4.63 | 4.83 | 6.10 | 6.02 | 5.96 | 5.91 |
| Efficiency (dB) | -4.63 | -4.91 | -4.92 | -5.05 | -5.27 | -5.55 | -4.50 | -4.59 | -4.61 | -4.68 |
| Efficiency (%) | 34.40 | 32.29 | 32.24 | 31.25 | 29.73 | 27.85 | 35.48 | 34.76 | 34.60 | 34.01 |
| Peak Gain (dBi) | 0.78 | 0.56 | 0.53 | -0.68 | -0.64 | -0.72 | 1.60 | 1.43 | 1.36 | 1.23 |

| Frequency | 2355 | 2360 | 2496 | 2500 | 2535 | 2570 | 2593 | 2620 | 2655 | 2690 |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Directivity (dBi) | 6.01 | 6.05 | 4.64 | 4.60 | 4.33 | 4.45 | 4.48 | 4.84 | 5.56 | 5.56 |
| Efficiency (dB) | -4.69 | -4.66 | -4.45 | -4.41 | -4.62 | -4.71 | -4.93 | -5.38 | -5.79 | -5.42 |
| Efficiency (%) | 33.98 | 34.20 | 35.91 | 36.22 | 34.50 | 33.84 | 32.12 | 29.01 | 26.36 | 28.74 |
| Peak Gain (dBi) | 1.32 | 1.39 | 0.20 | 0.19 | -0.29 | -0.26 | -0.45 | -0.54 | -0.23 | 0.15 |

| Frequency | 3300 | 3550 | 3625 | 3700 | 3750 | 3800 | 4200 | 4400 | 4700 | 5000 |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Directivity (dBi) | 5.13 | 5.34 | 5.36 | 7.06 | 6.77 | 5.98 | 6.23 | 7.12 | 7.31 | 6.78 |
| Efficiency (dB) | -5.79 | -5.41 | -5.97 | -6.40 | -6.09 | -6.38 | -5.60 | -5.82 | -6.73 | -6.52 |
| Efficiency (%) | 26.35 | 28.77 | 25.27 | 22.92 | 24.62 | 23.02 | 27.53 | 26.20 | 21.21 | 22.30 |
| Peak Gain (dBi) | -0.66 | -0.08 | -0.61 | 0.67 | 0.68 | -0.40 | 0.63 | 1.30 | 0.58 | 0.26 |

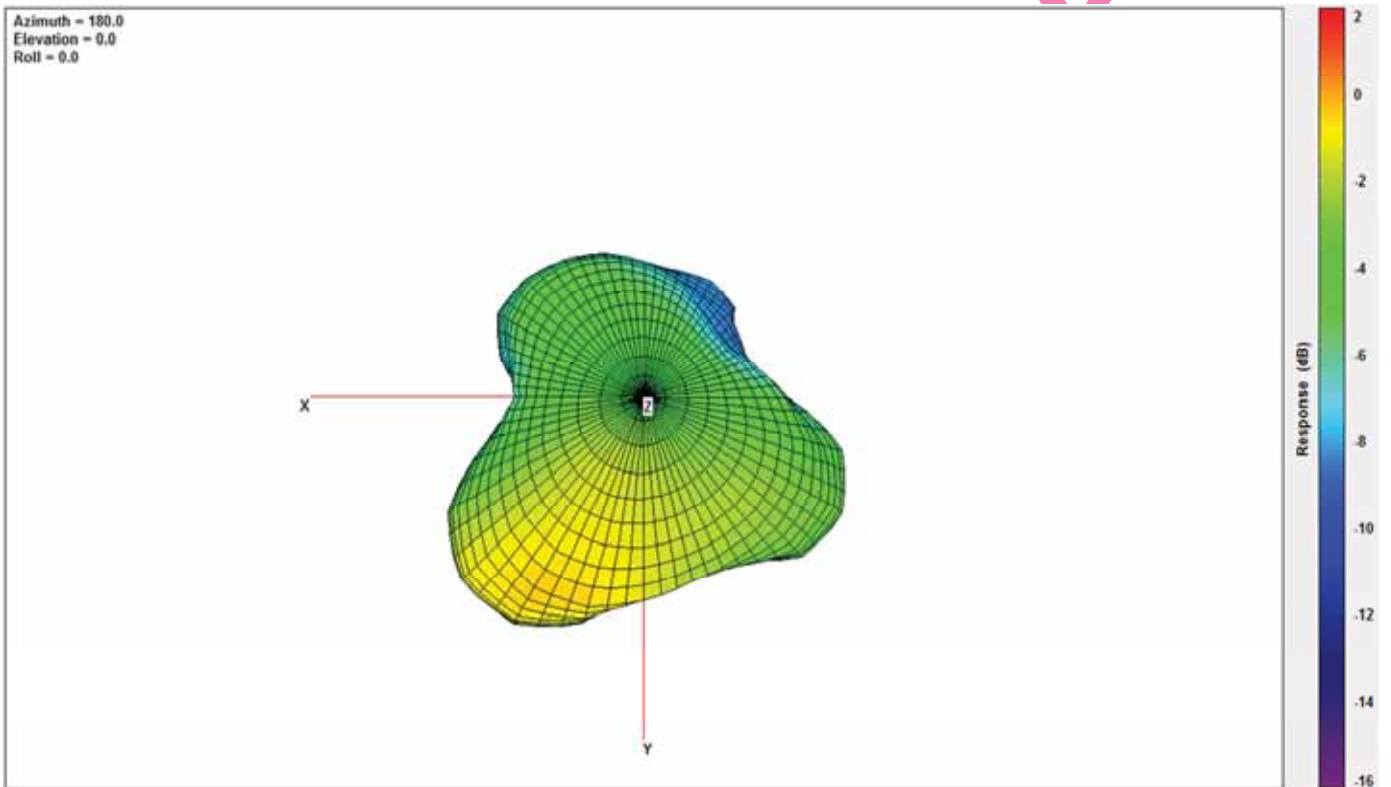
5.4.4. Radiation Patterns

5.4.4.1. Tets Setup



5.4.4.2. Straight 2D & 3D Radiation Patterns

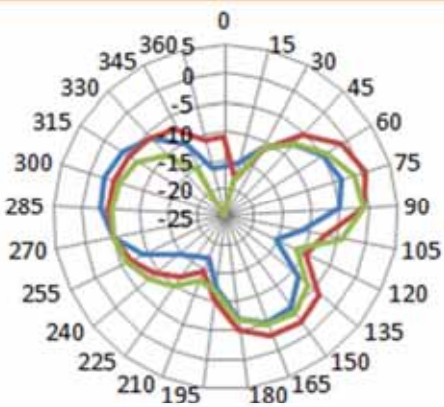
751MHz



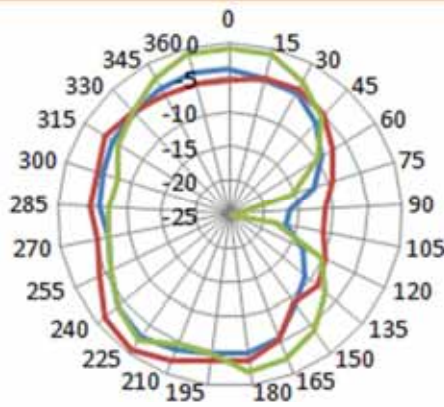
XY Plane

XZ Plane

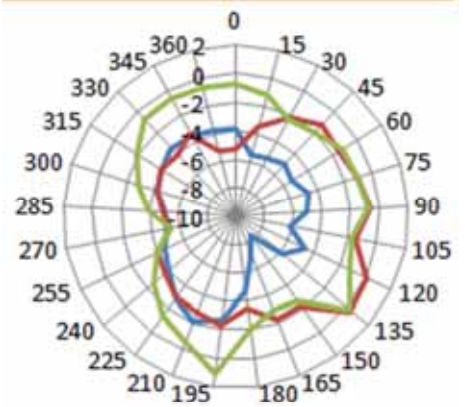
YZ Plane



- 699 MHz
- 751 MHz
- 814 MHz

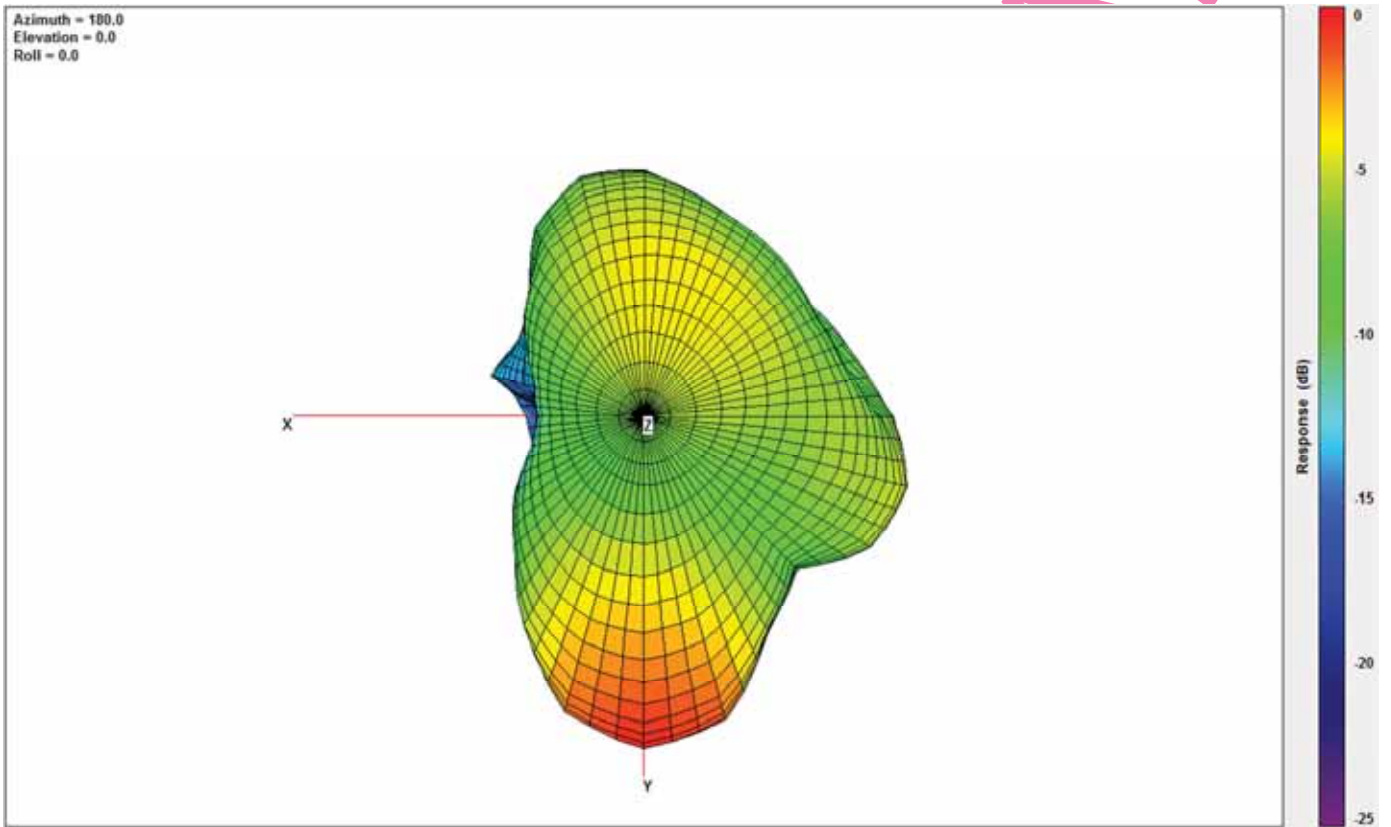


- 699 MHz
- 751 MHz
- 814 MHz



- 699 MHz
- 751 MHz
- 814 MHz

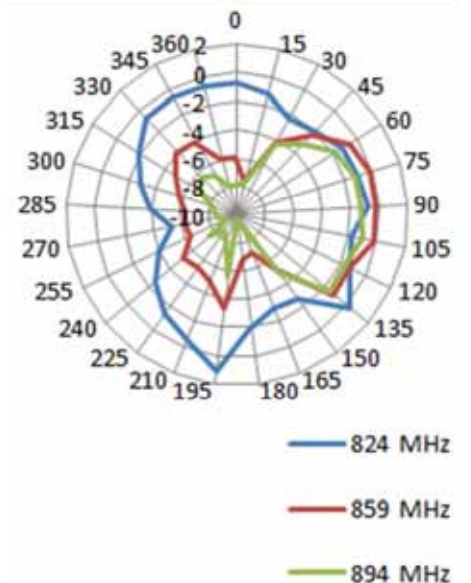
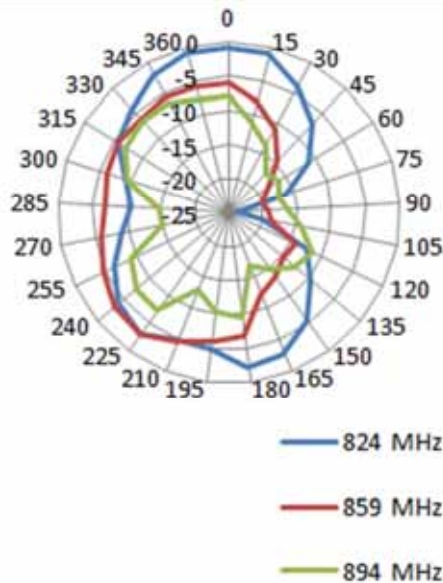
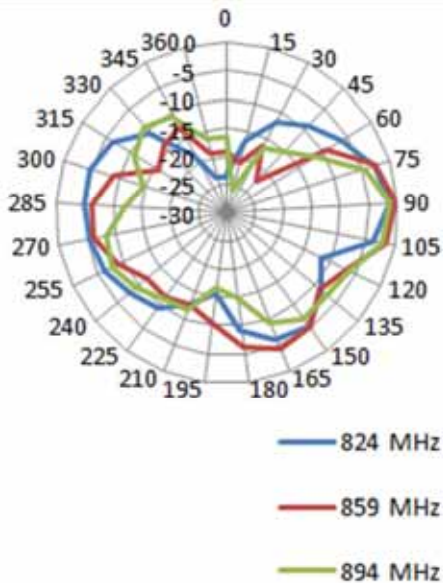
859MHz



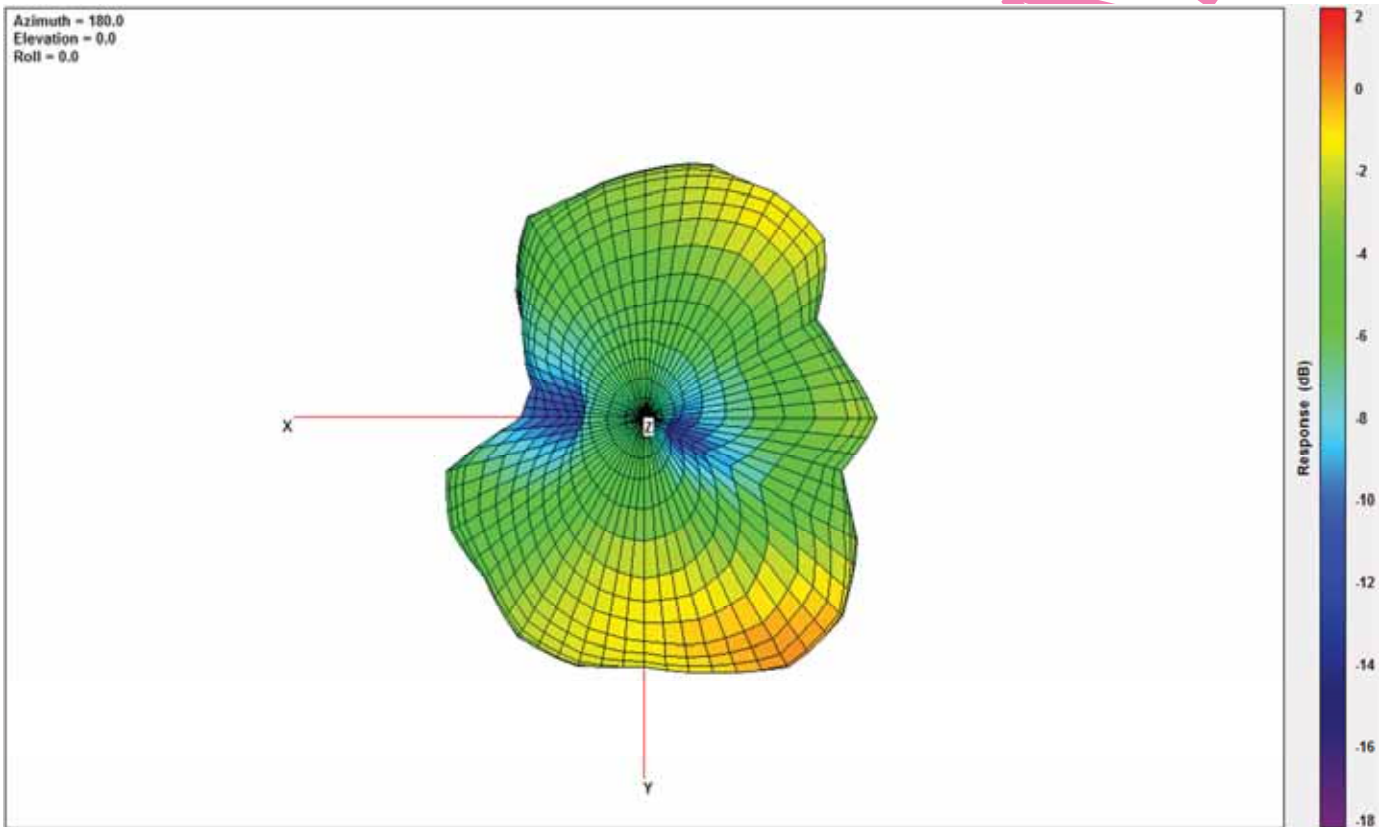
XY Plane

XZ Plane

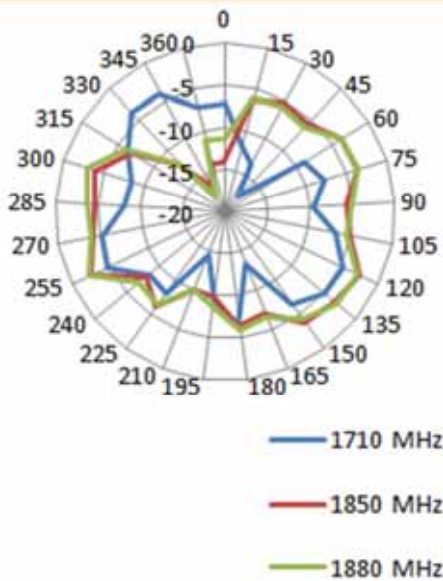
YZ Plane



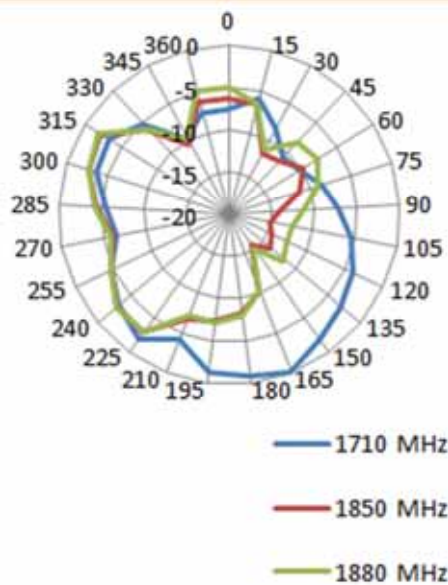
1850MHz



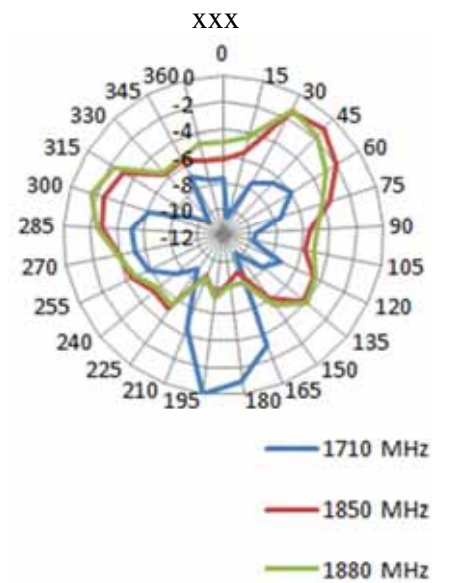
XY Plane



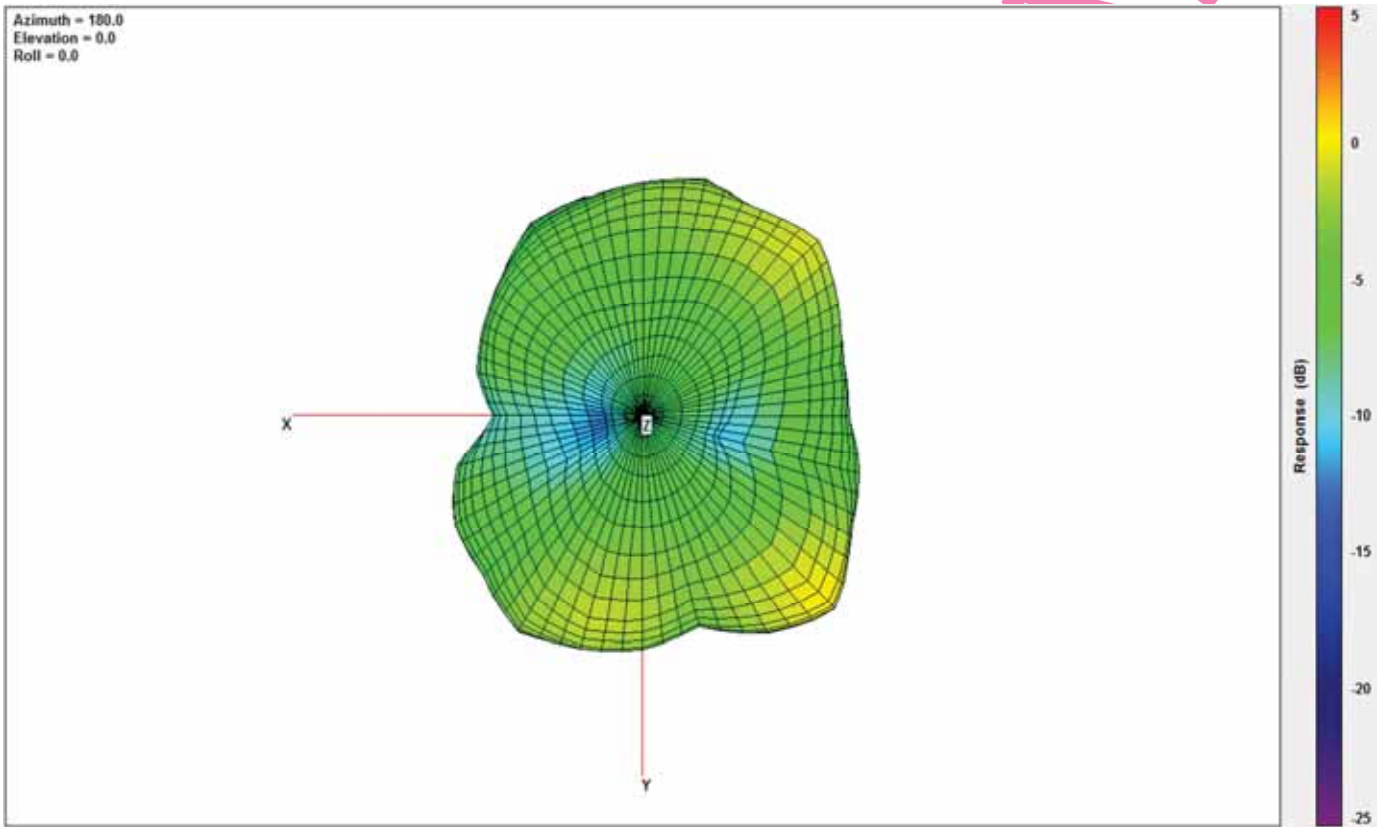
XZ Plane



YZ Plane



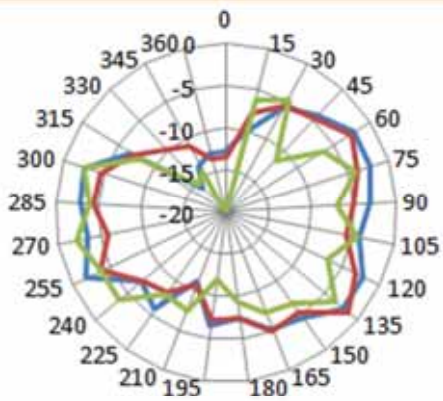
1990MHz



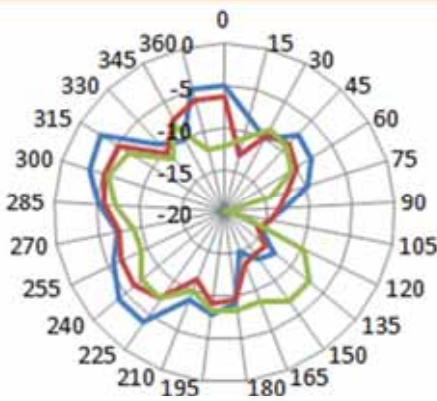
XY Plane

XZ Plane

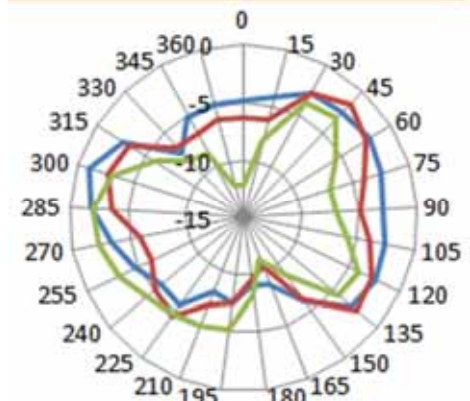
YZ Plane



- 1930 MHz
- 1990 MHz
- 2155 MHz

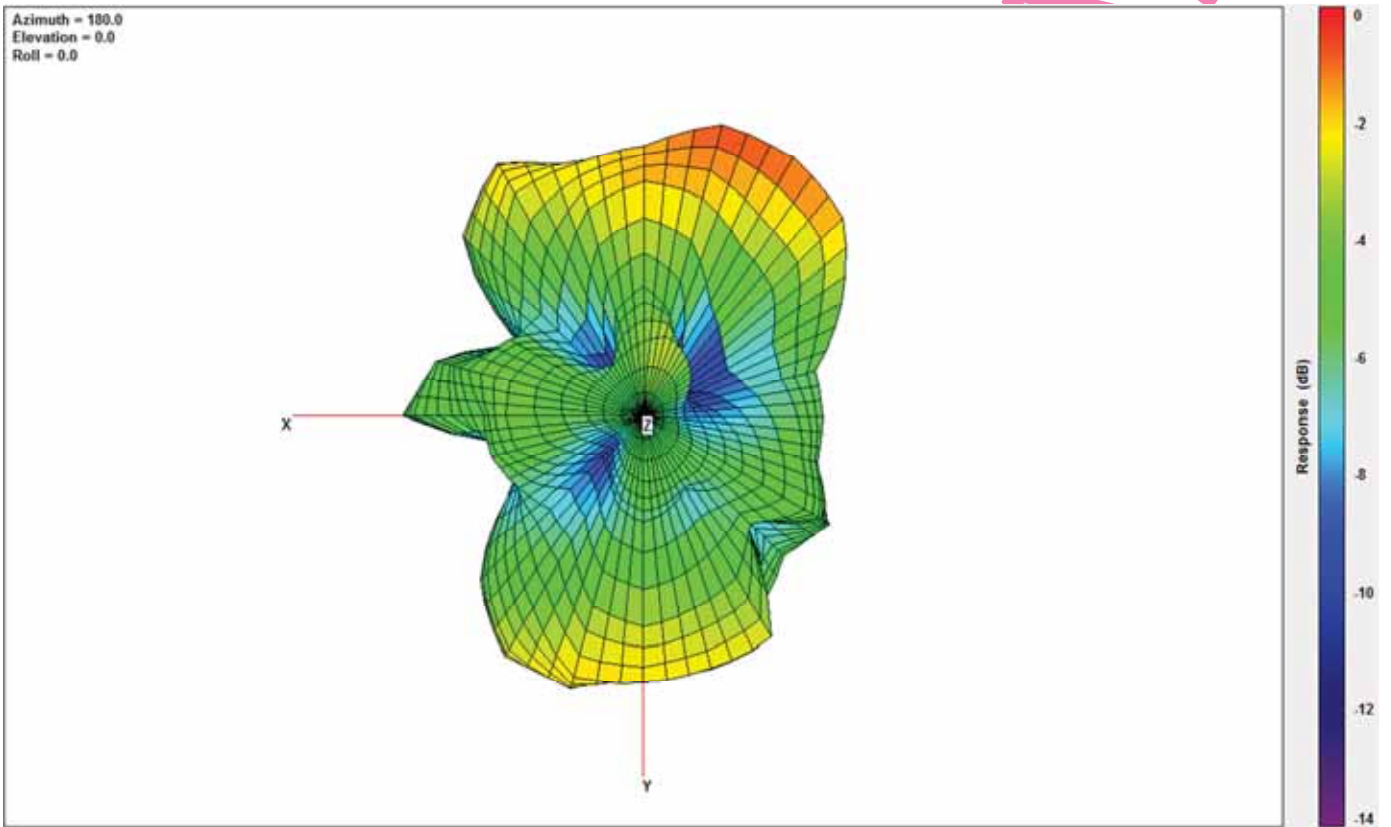


- 1930 MHz
- 1990 MHz
- 2155 MHz



- 1930 MHz
- 1990 MHz
- 2155 MHz

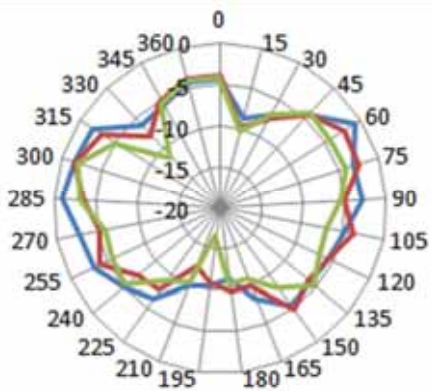
2593MHz



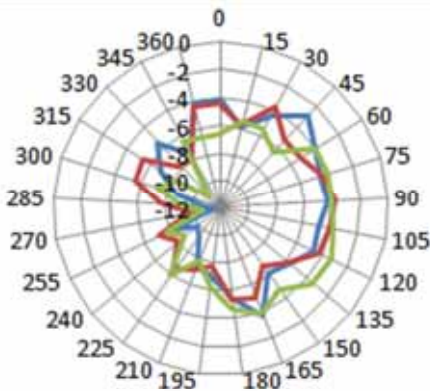
XY Plane

XZ Plane

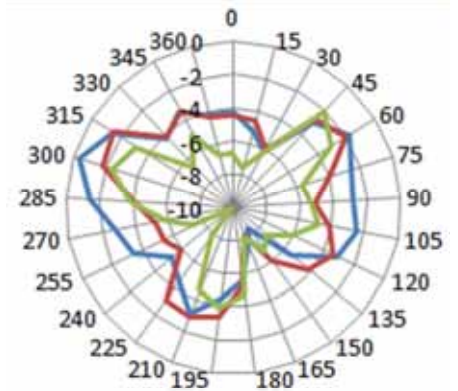
YZ Plane



- 2496 MHz
- 2593 MHz
- 2690 MHz

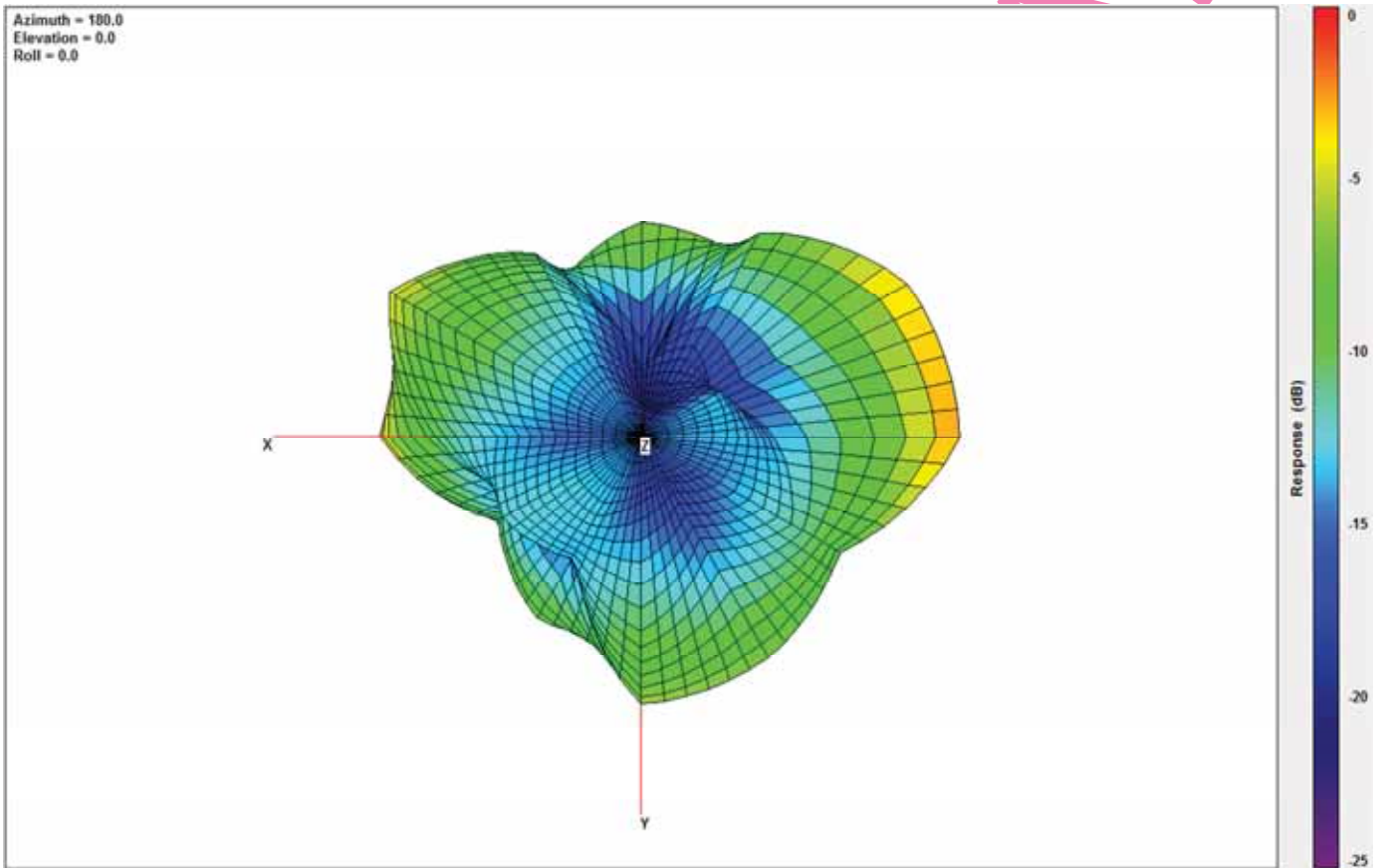


- 2496 MHz
- 2593 MHz
- 2690 MHz

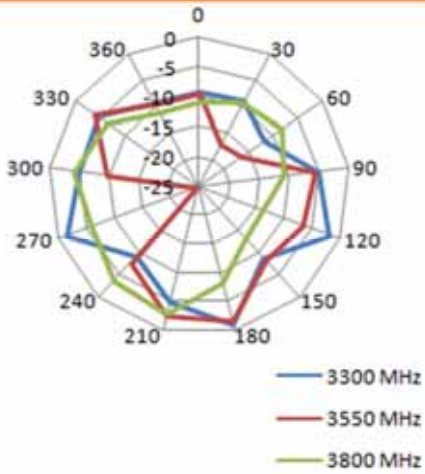


- 2496 MHz
- 2593 MHz
- 2690 MHz

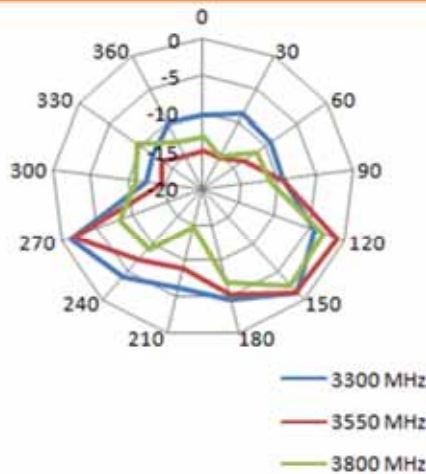
3550MHz



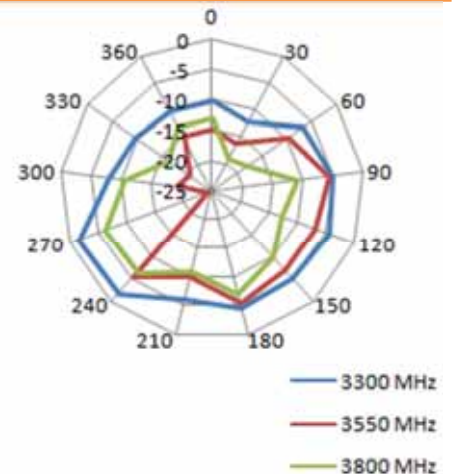
XY Plane



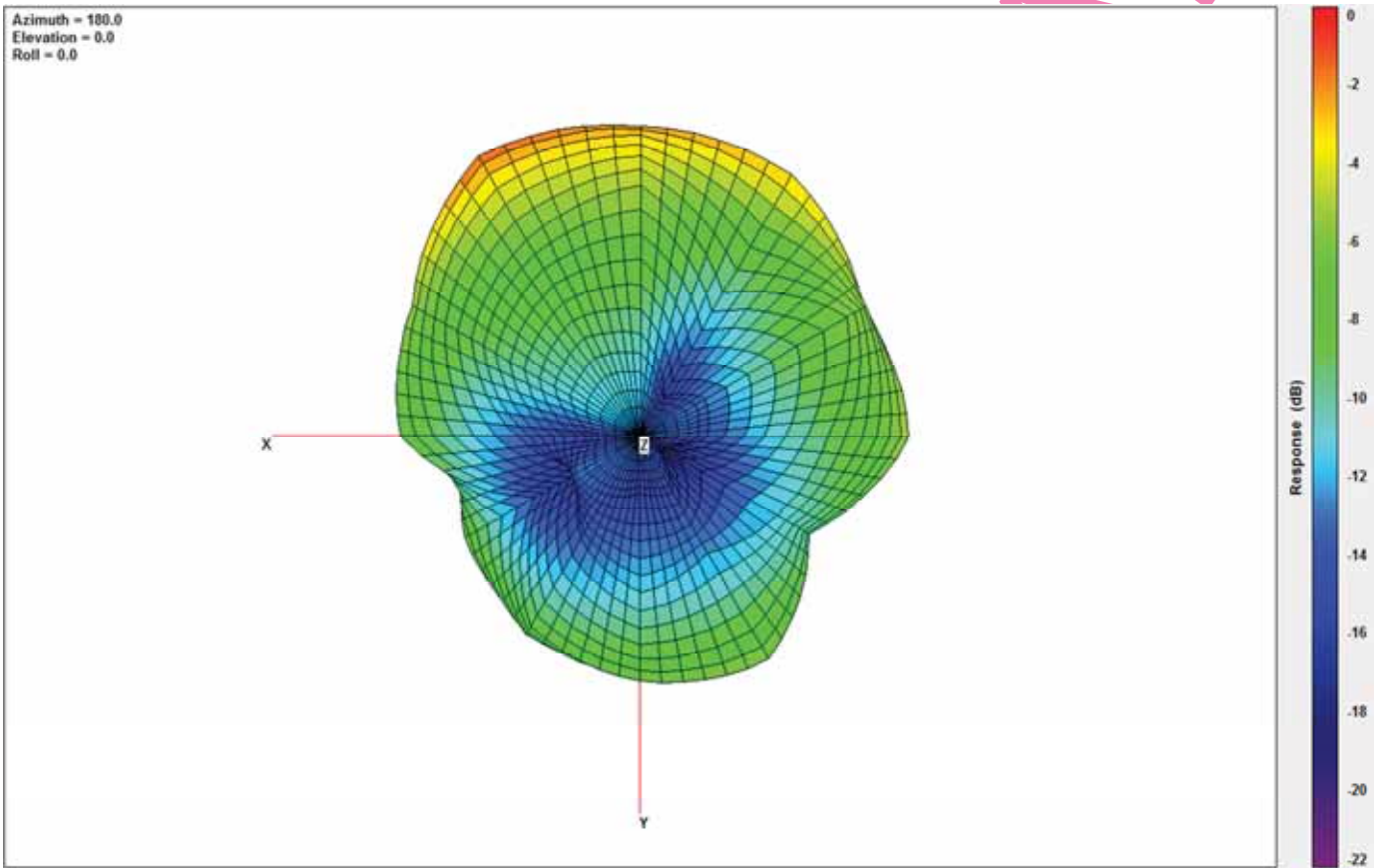
XZ Plane



YZ Plane



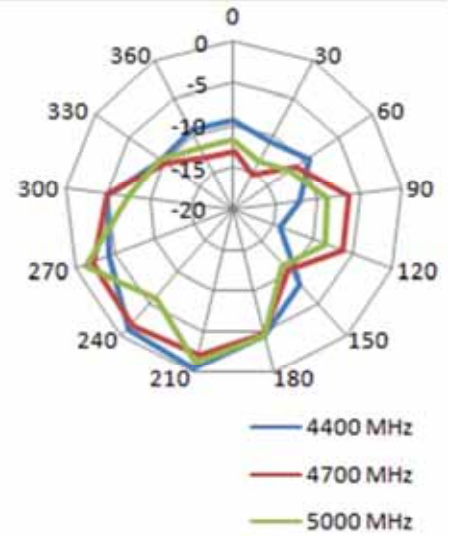
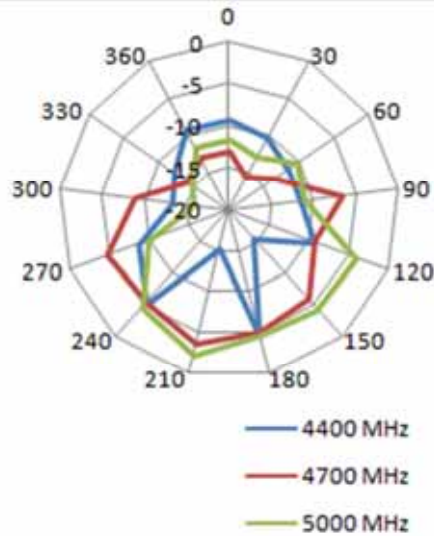
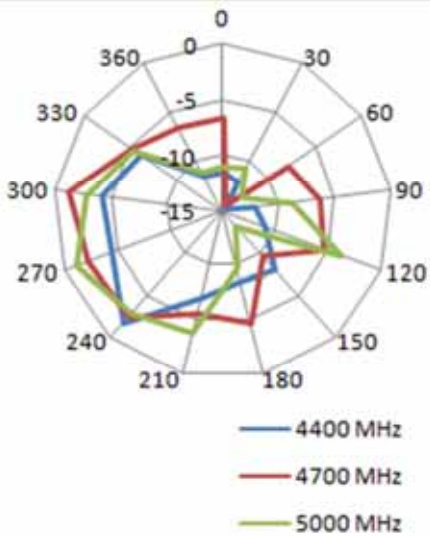
4700MHz



XY Plane

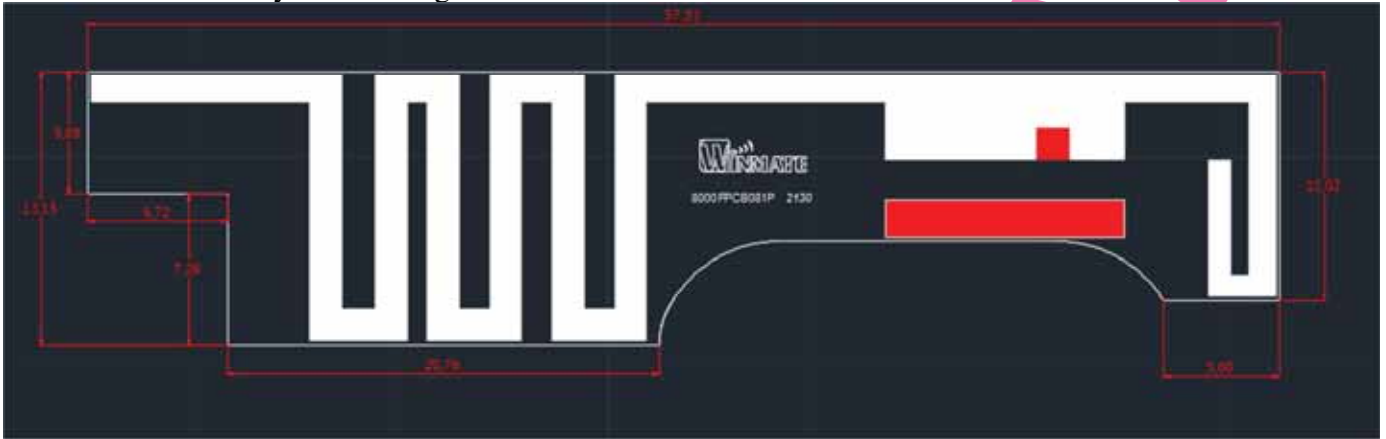
XZ Plane

YZ Plane

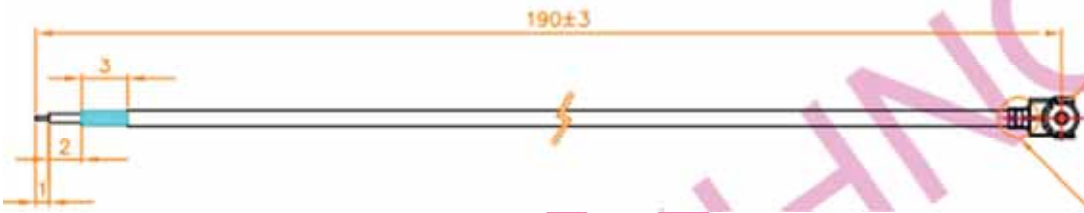


5.5. Drawing

LTE Aux Antenna Layout Drawing



RF Cable Drawing



Antenna Assembly



Winmate Part Number: 90RF02000013