Datasheet

JOYMAX
EnJOY MAX Wireless®

ZHX-713Acc4B

5G Cellular Blade antenna

The Joymax ZHX-713Acc4B antenna is a straight blade-style, IP67 rated, dipole antenna designed for use in 5G New Radio FR1, LTE, and Cellular IoT (LTE-M, NB-IoT) applications with broad bandwidth coverage from 617 MHz to 7125 MHz. The antenna also supports CBRS (3550 MHz to 3700MHz), Public Safety (4940 MHz to 4990 MHz), C-band (3700 to 4200MHz) and a growing number of Cellular 450 MHz band: LTE Band 31, Band 72, Band 73 applications.

The antenna attaches with an SMA plug (male pin) or RP-SMA Plug (female socket) connector.

Features

- Bandwidth 450 MHz to 7125 MHz
- Performance at 617 MHz to 698 MHz
    - VSWR: ≤ 2.4
    - Peak Gain: 2.1 dBi
    - Efficiency: 41%
- Omnidirectional radiation
- IP67 rated waterproof design
- SMA Plug (male pin) or RP-SMA Plug (female socket) connector

Applications

- 5G NR FR1, 4G, 3G, 2G
- Cellular IoT: LTE-M (Cat-M1), NB-IoT
- LTE 450 MHz band 31, 72, 73
- CBRS Private Network (3550 to 3700MHz)
- C-Band applications (3700 to 4200MHz)
- Public Safety networks (4940 to 4990MHz)
- Internet of Things (IoT) devices
- Gateways

Ordering Information

Part Number	Description
ZHX-713ASA4B	5G Cellular Straight Blade antenna with SMA Plug (male pin) connector
ZHX-713ARS4B	5G Cellular Straight Blade antenna with RP-SMA Plug (female socket) connector

Available from Joymax Inc. and select distributors and representatives.

Table 1: Electrical Specifications

ZHX-713Acc4B	5G NR / LTE Bands (MHz)						
Frequency Range	450	617~960	1710~2690	3300~4200	4400~5000	5150~5850	5925-7125
VSWR (Max)	2.0	2.4	2.0	1.9	1.9	1.6	1.7
Peak Gain (dBi)	0.7	2.1	3.7	2.7	2.8	3.6	3.9
Average Gain (dBi)	-4.3	-3.9	-3.1	-2.9	-2.5	-2.6	-2.8
Efficiency (%)	37	41	49	52	56	55	52
Polarization	Linear						
Radiation	Omni directional						
Max Power	1 W						
Wavelength	½-λ						
Electrical Type	Dipole						
Impedance	50 Ω						

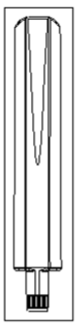
Electrical specifications and plots measured with the antenna hanging free in the space without ground plane.

Table 2: Mechanical Specifications

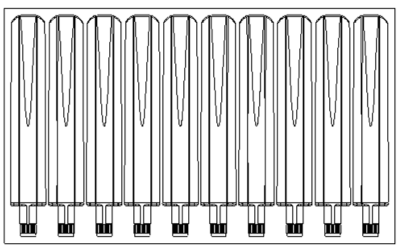
Parameter	Value
Connection	SMA Plug (male pin) or RP-SMA Plug (female socket) connector
Operating Temp.	-30˚C to +70˚C
Weight	24 g
Dimension	165 mm x 26 mm x 13 mm
Antenna Color	Black
Ingress Protection	IP67
Storage Temp.	-30˚C to +70˚C

Packaging Information

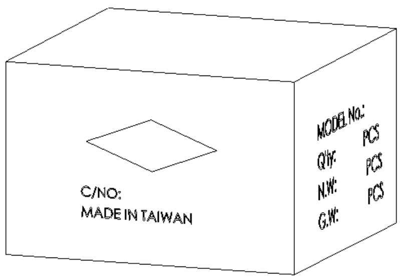
The ZHX-713Acc4B antennas are individually sealed in a clear plastic bag as shown in **Figure 1**. 300 pcs per carton, 390 mm x 260 mm x 330 mm (15.3 in x 10.2 in x 13.0 in.), total weight 8.5 kgs (18.7 lb). Distribution channels may offer alternative packaging options.



1 pce antenna/ 1 PE bag



50 pcs antenna/ 1 Bigger PE bag



300 pcs antenna/1 Carton

Figure 1. Antenna Packaging

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Product Dimensions

Figure 2 provides dimensions of the ZHX-713Acc4B in mm measurement unit. The antenna attaches with an SMA plug (male pin) or RP-SMA Plug (female socket) connector.

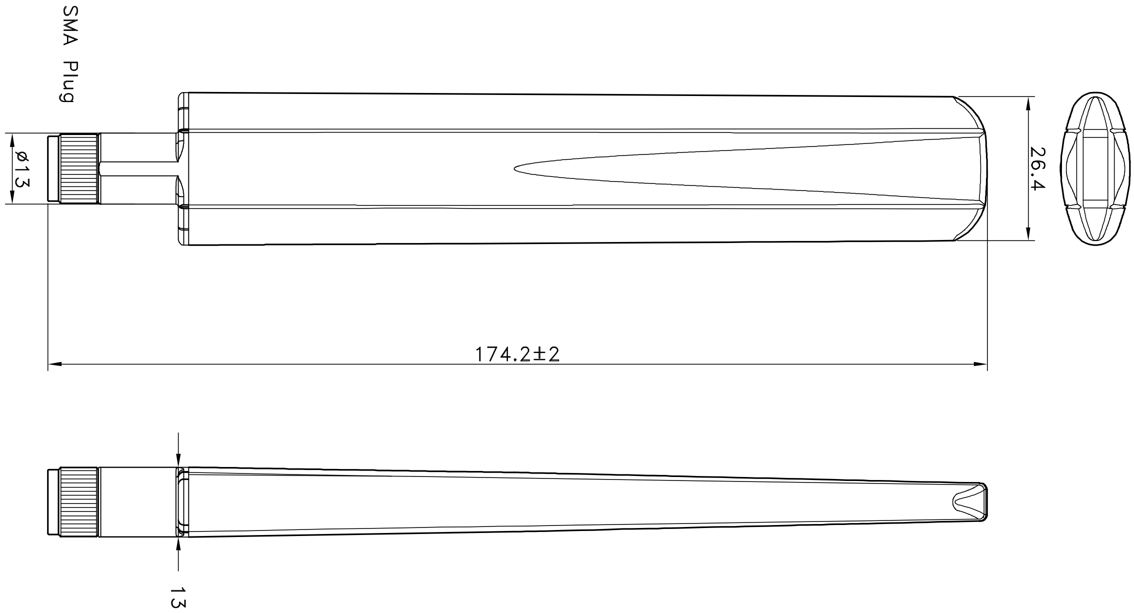
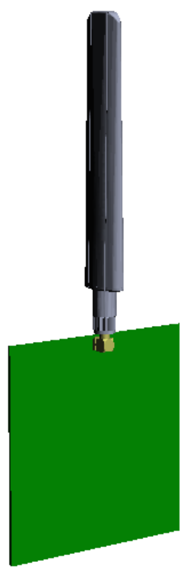


Figure 2. Antenna Dimensions

Antenna Test Orientation

The ZHX-713Acc4B antenna is characterized in an straight antenna orientations as shown in **Figure 3**. Although the antenna is a dipole not requiring a ground plane for function, characterization with an adjacent ground plane (120 mm x 120 mm) provides insight into antenna performance when attached directly to a printed circuit board mounted connector. The two orientations represent the most common end-product use cases.

Straight, hanging free without ground plane



On edge of ground plane

Figure 3. Antenna Test Orientation

STRAIGHT, WITHOUT GROUND PLANE

The charts on the following pages represent data taken with the antenna hanging free in the space without ground plane as shown in **Figure 4**.

Figure 4. Hanging free without ground plane

VSWR

Figure 5 provides the voltage standing wave ratio (VSWR) across the antenna bandwidth. VSWR is a function of the reflection coefficient, which describes the power reflected from the antenna back to the radio. A lower VSWR value indicates better antenna performance at a given frequency. Reflected power is also shown on the right-side vertical axis as a gauge of the percentage of transmitter power reflected back from the antenna.

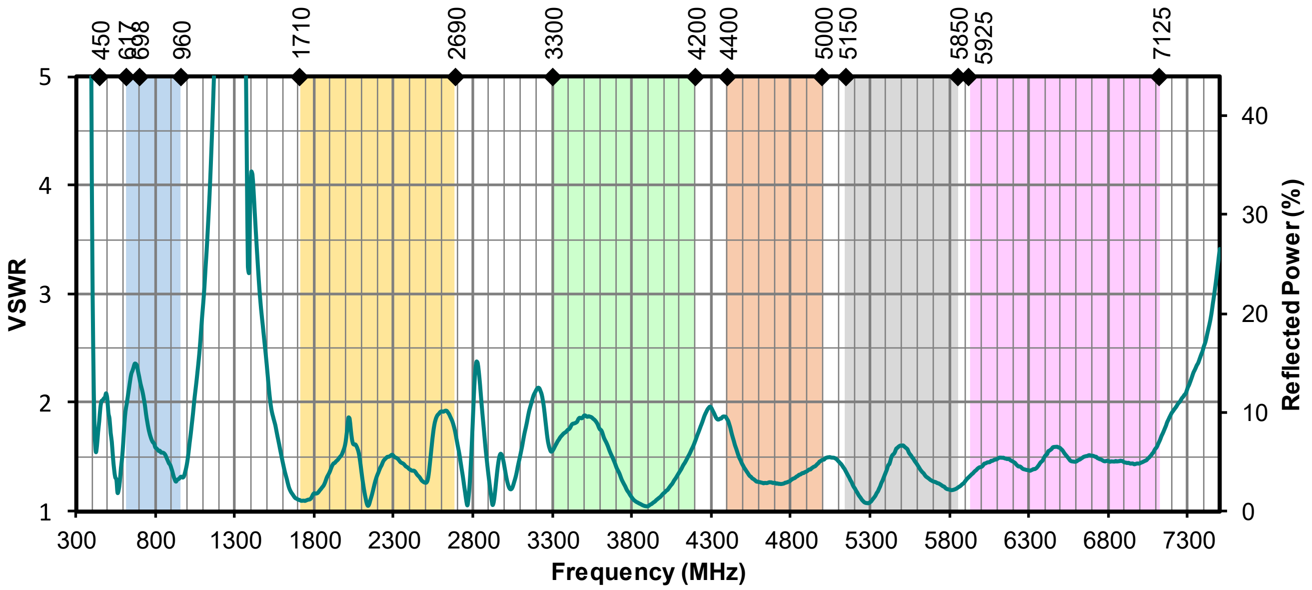


Figure 5. Antenna VSWR, Straight without ground plane

Return Loss

Return loss (**Figure 6**), represents the loss in power at the antenna due to reflected signals. Like VSWR, a lower return loss value indicates better antenna performance at a given frequency.

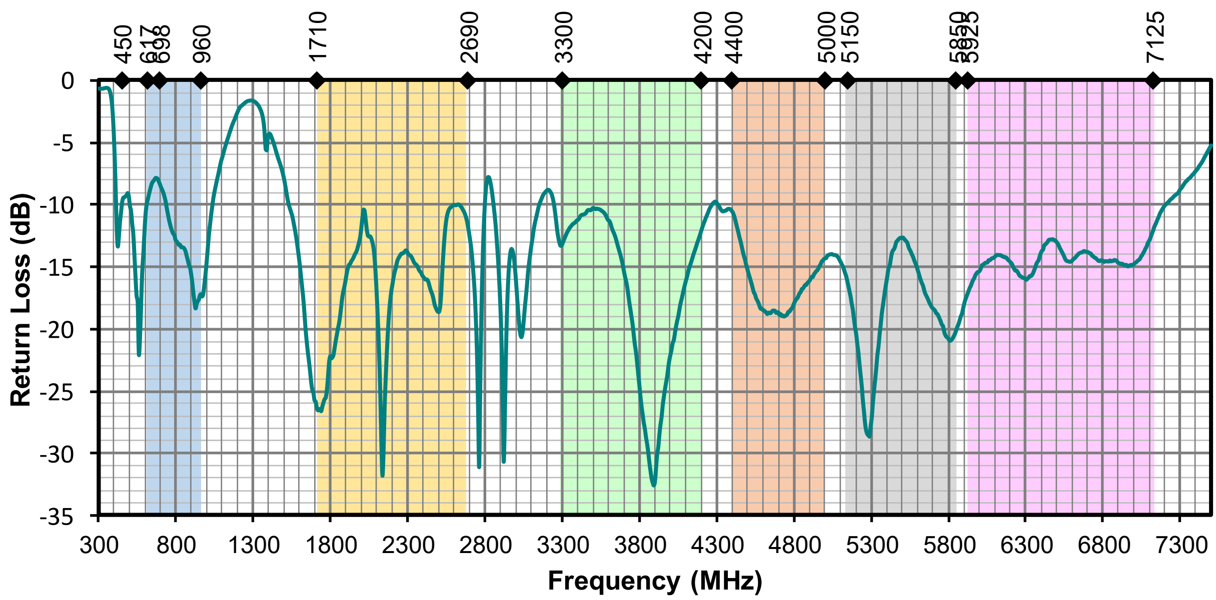


Figure 6. Antenna Return Loss, Straight without ground plane

Peak Gain

The peak gain across the antenna bandwidth is shown in **Figure 7**. Peak gain represents the maximum antenna input power concentration across 3-dimensional space, and therefore peak performance at a given frequency, but does not consider any directionality in the gain pattern.

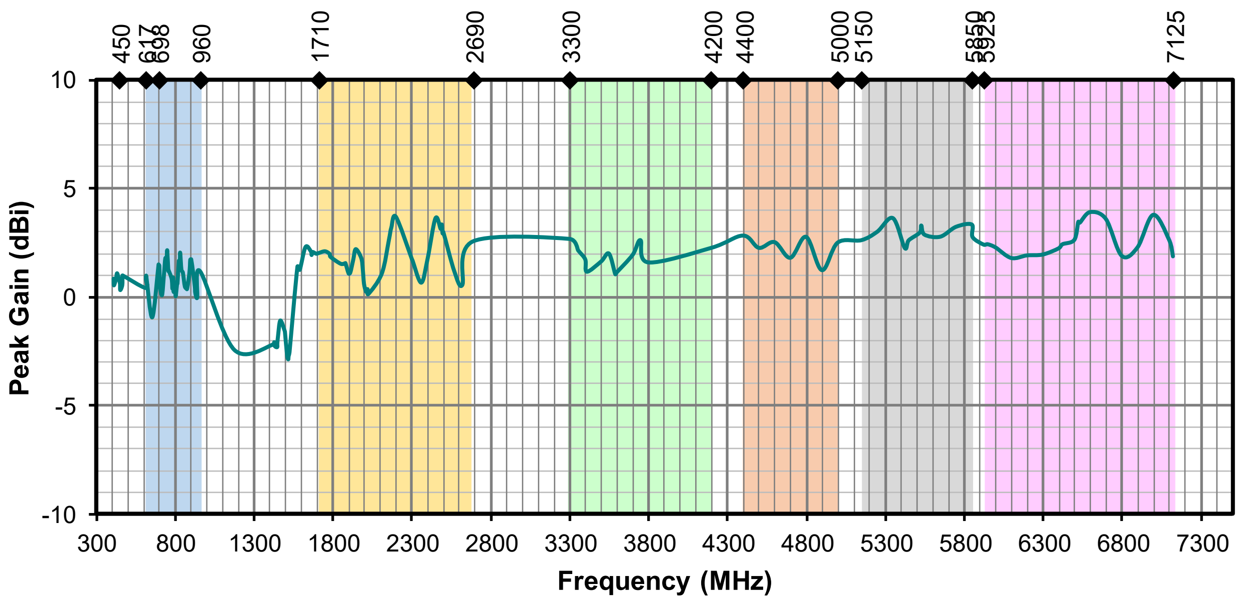


Figure 7. Antenna Peak Gain, Straight without ground plane

Average Gain

Average gain (**Figure 8**), is the average of all antenna gain in 3-dimensional space at each frequency, providing an indication of overall performance without expressing antenna directionality.

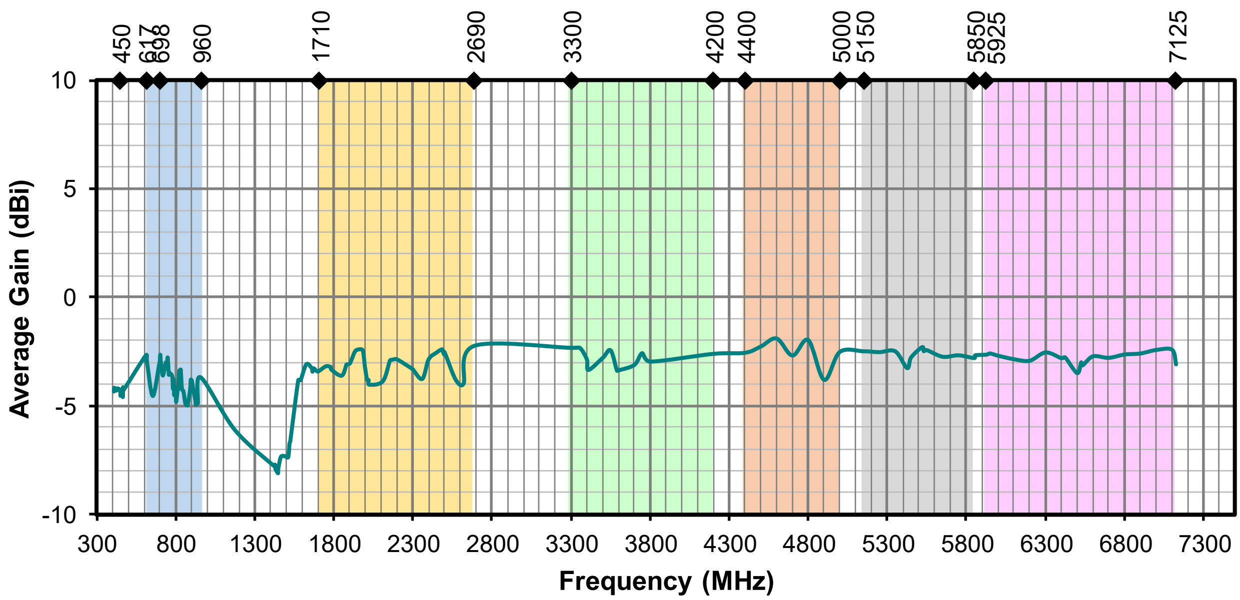


Figure 8. Antenna Average Gain, without ground plane

Radiation Efficiency

Radiation efficiency (**Figure 9**), shows the ratio of power radiated by the antenna relative to the power supplied to the antenna, expressed as a percentage, where a higher percentage indicates better performance at a given frequency. An ideal antenna has 100% efficiency. But in really world, usually an external antenna radiates only 50~60% of power supplied to it.

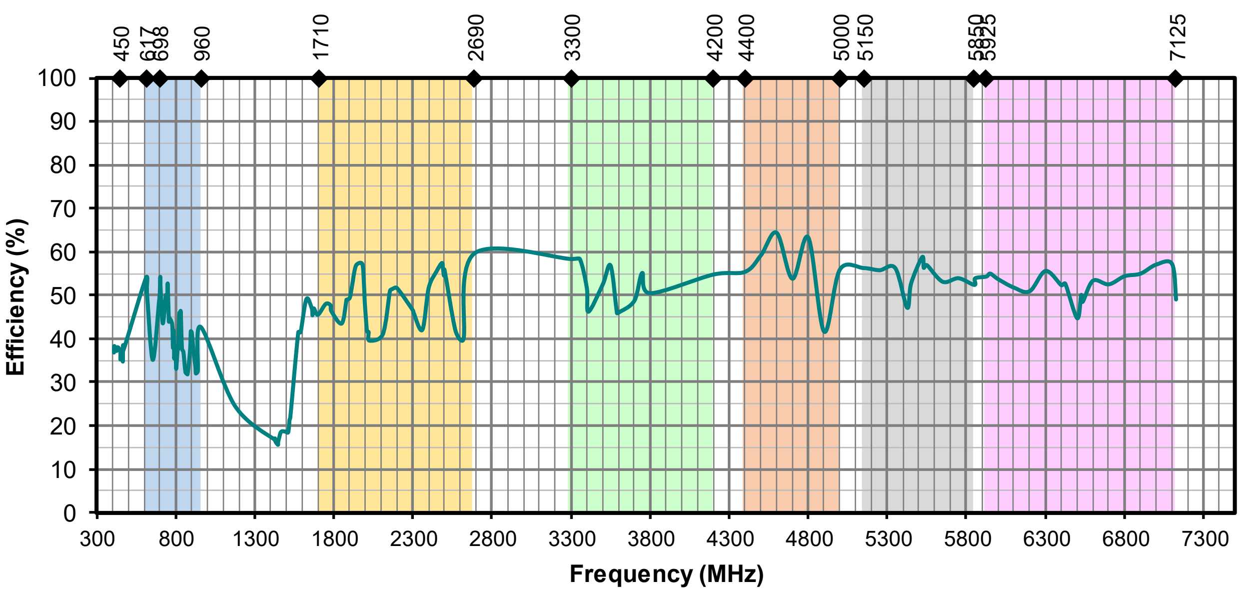
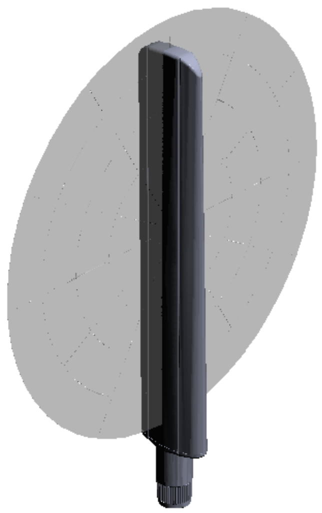


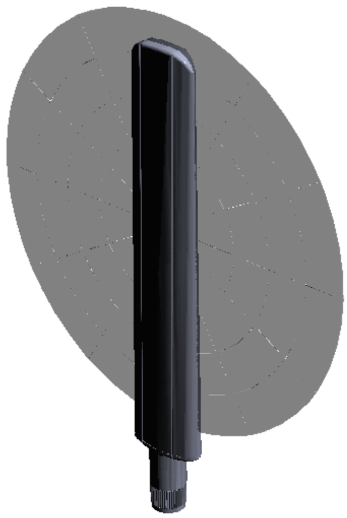
Figure 9. Antenna Efficiency, Straight without ground plane

Radiation Patterns

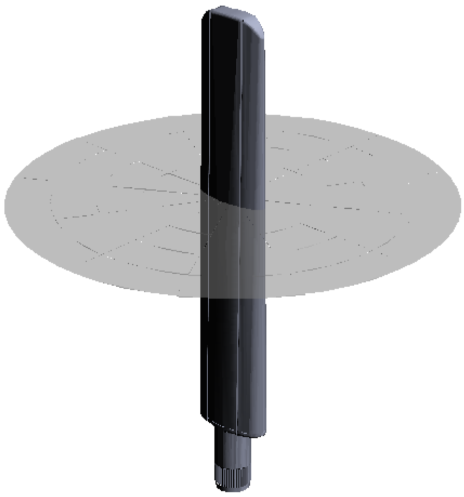
Radiation patterns provide information about the directionality and 3-dimensional gain performance of the antenna by plotting gain at specific frequencies in three orthogonal planes. Antenna radiation patterns for a straight orientation are shown in **Figure 10** using polar plots covering 360 degrees. The antenna graphic at the top of the page provides reference to the plane of the column of plots below it.



XZ-Plane Gain

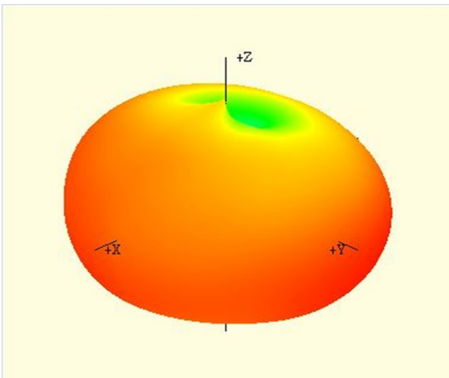


YZ-Plane Gain

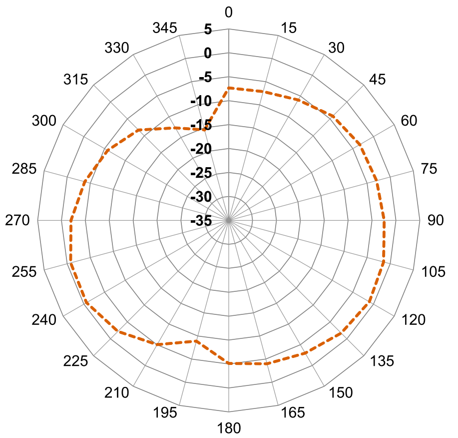


XY-Plane Gain

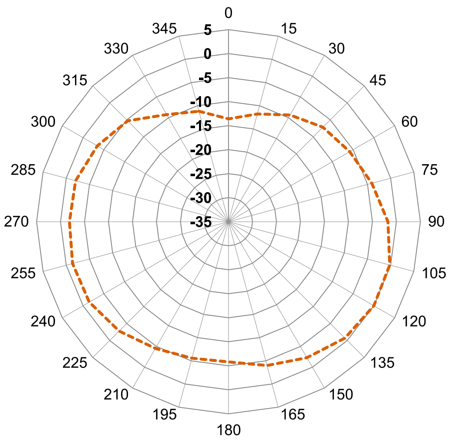
450 MHz



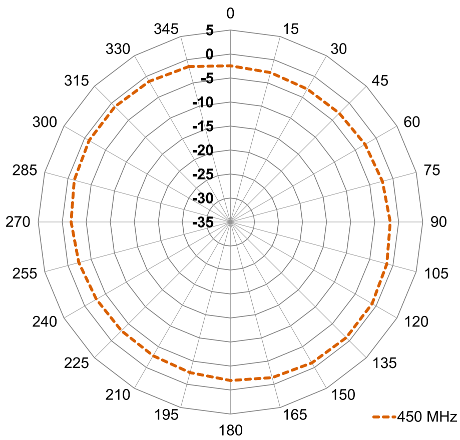
450 MHz



XZ-Plane Gain



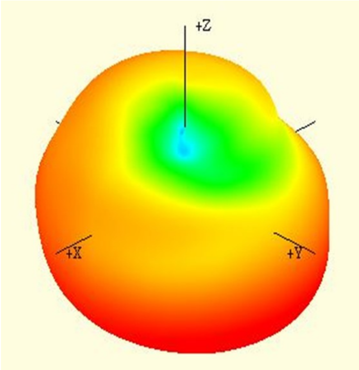
YZ-Plane Gain



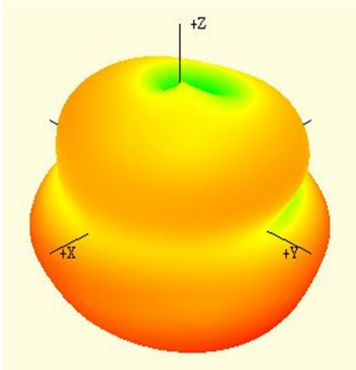
XY-Plane Gain

Figure 10. Antenna Radiation Patterns, Straight without ground plane

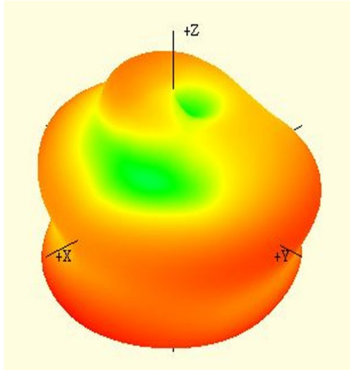
617 MHz to 960 MHz (778 MHz)



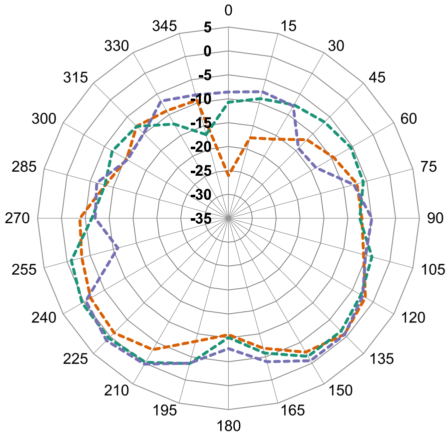
617 MHz



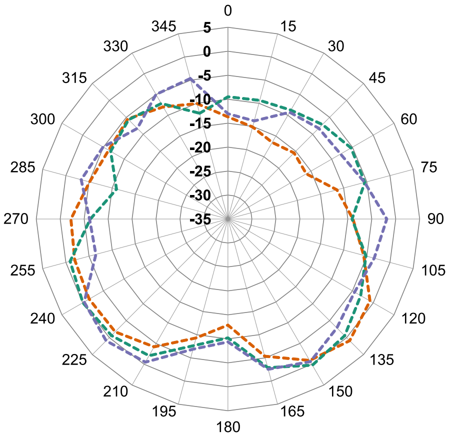
778 MHz



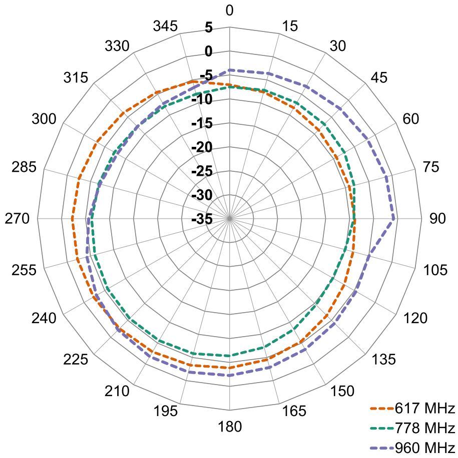
960 MHz



XZ-Plane Gain

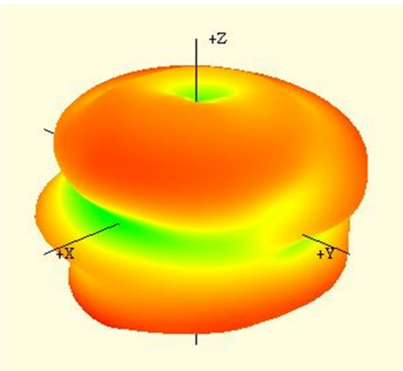


YZ-Plane Gain

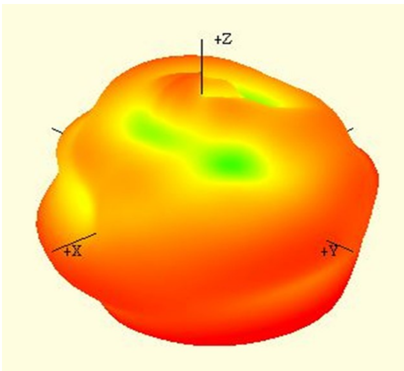


XY-Plane Gain

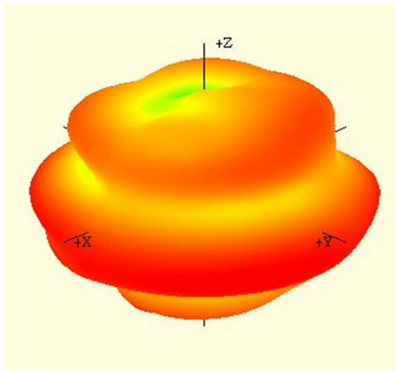
1710 MHz to 2690 MHz (2200 MHz)



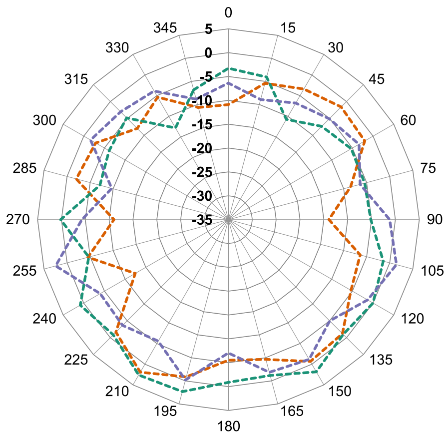
1710 MHz



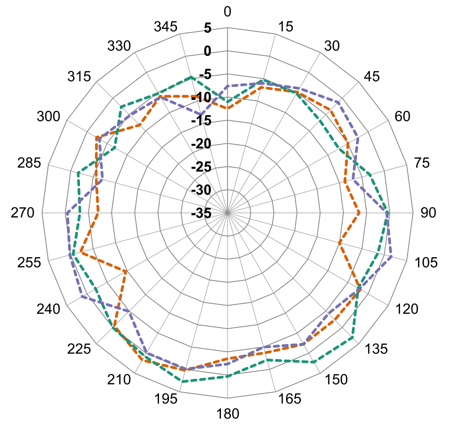
2200 MHz



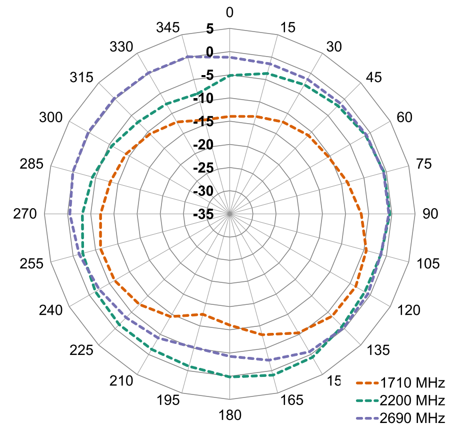
2690 MHz



XZ-Plane Gain



YZ-Plane Gain



XY-Plane Gain

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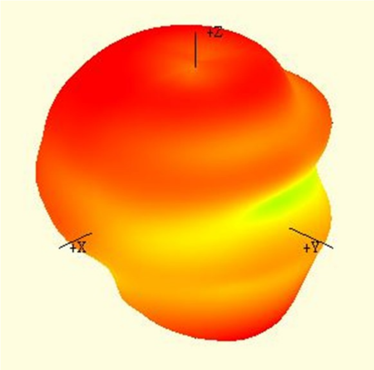
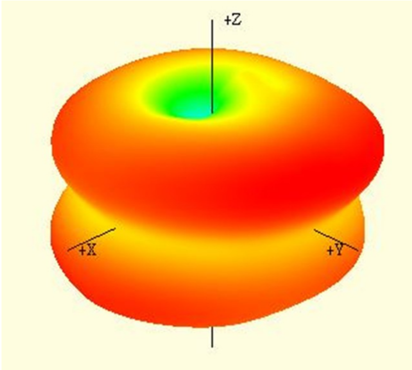
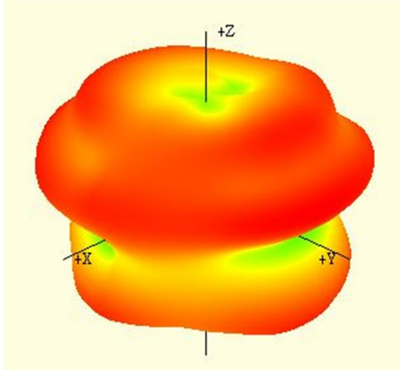
3300 MHz to 5000 MHz (4200 MHz)



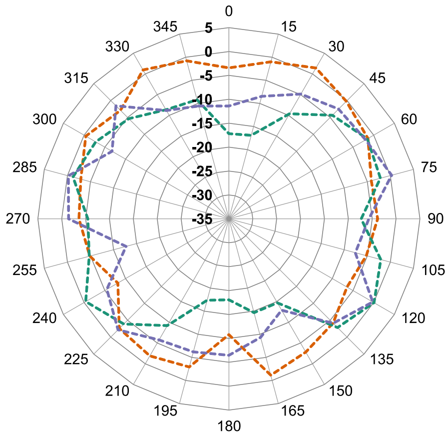
3300 MHz



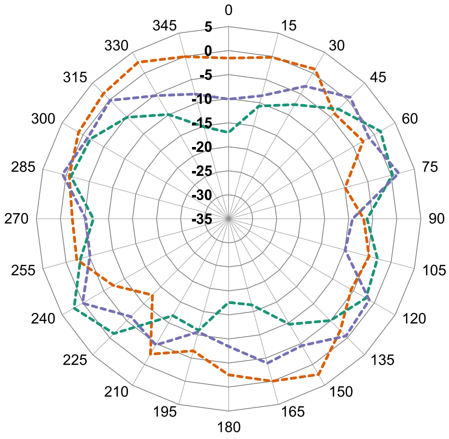
4200 MHz



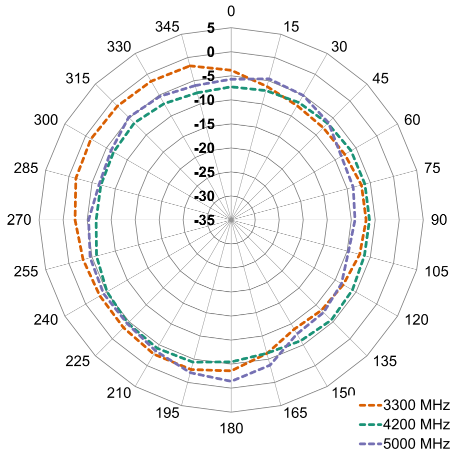
5000 MHz



XZ-Plane Gain

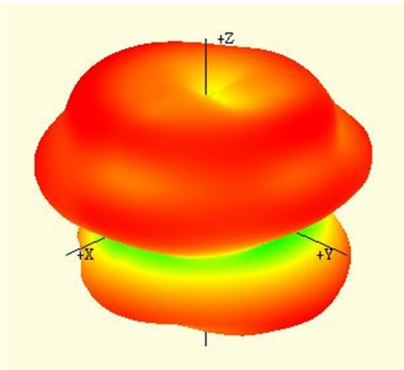


YZ-Plane Gain

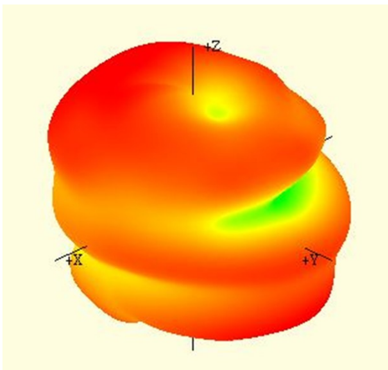


XY-Plane Gain

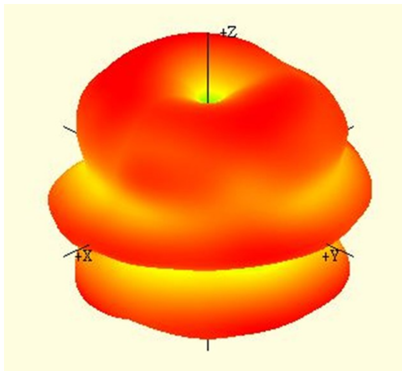
5150 MHz to 5850 MHz (5550 MHz)



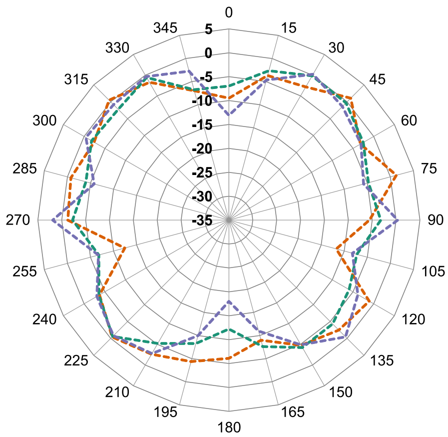
5150 MHz



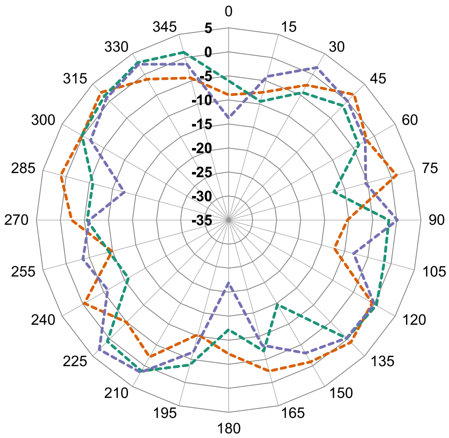
5550 MHz



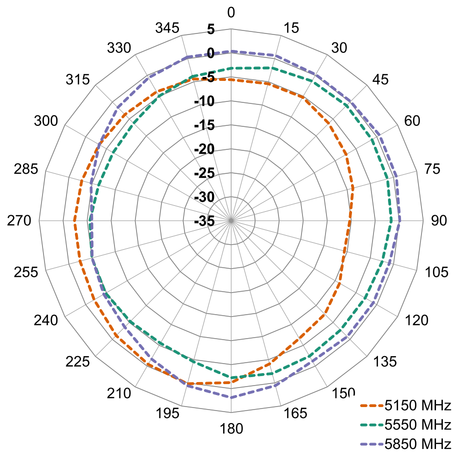
5850 MHz



XZ-Plane Gain

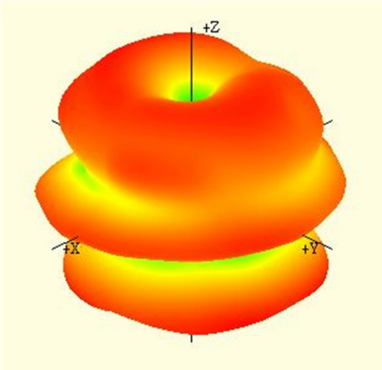


YZ-Plane Gain

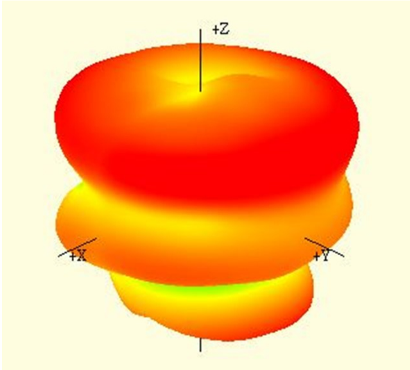


XY-Plane Gain

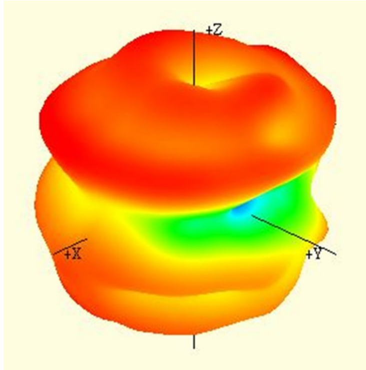
5925 MHz to 7125 MHz (6525 MHz)



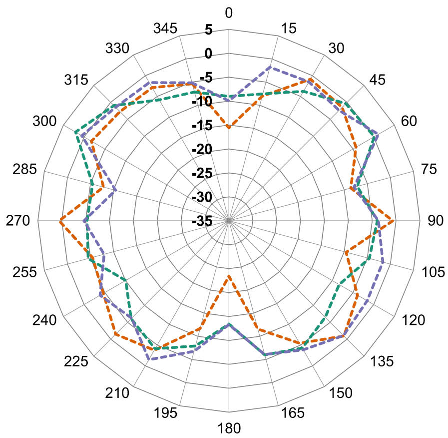
5925 MHz



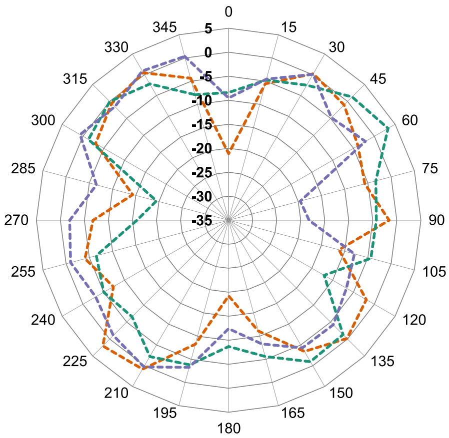
6525 MHz



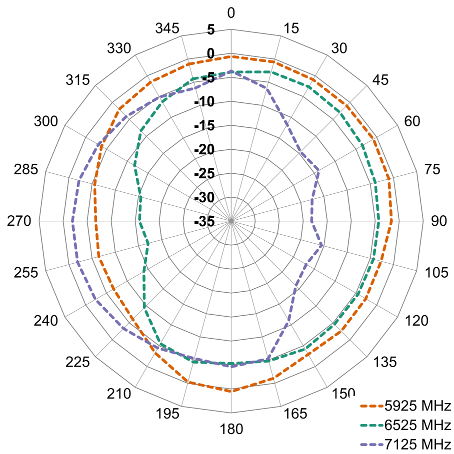
7125 MHz



XZ-Plane Gain



YZ-Plane Gain



XY-Plane Gain

STRAIGHT, WITHOUT GROUND PLANE

The charts on the following pages represent data taken with the antenna oriented at the edge of a 120 mm x 120 mm (4.72 in. x 4.72 in.) ground plane as shown in **Figure 11**.

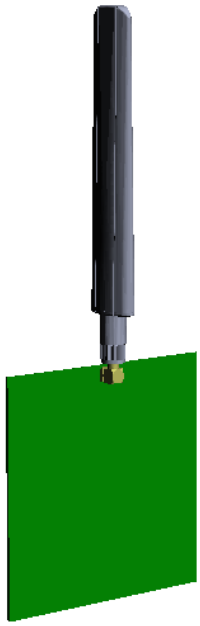


Figure 11. On edge of ground plane

VSWR

Figure 12 provides the voltage standing wave ratio (VSWR) across the antenna bandwidth. VSWR is a function of the reflection coefficient, which describes the power reflected from the antenna back to the radio. A lower VSWR value indicates better antenna performance at a given frequency. Reflected power is also shown on the right-side vertical axis as a gauge of the percentage of transmitter power reflected back from the antenna.

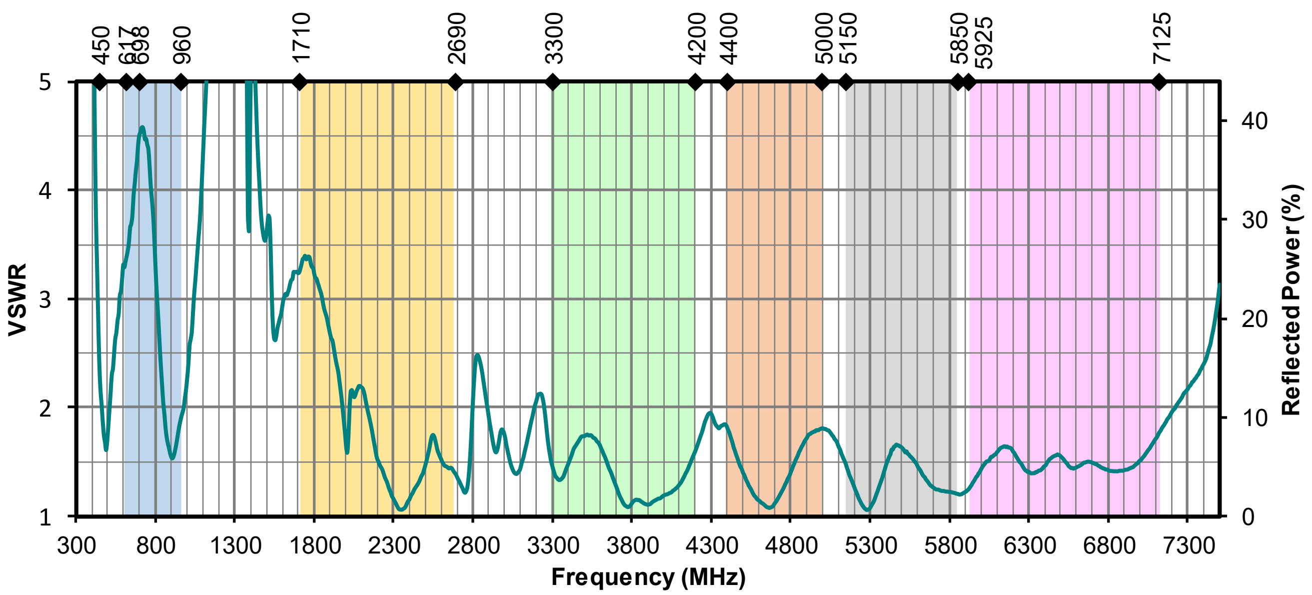


Figure 12. Antenna VSWR, with ground plane

Return Loss

Return loss (**Figure 13**), represents the loss in power at the antenna due to reflected signals. Like VSWR, a lower return loss value indicates better antenna performance at a given frequency.

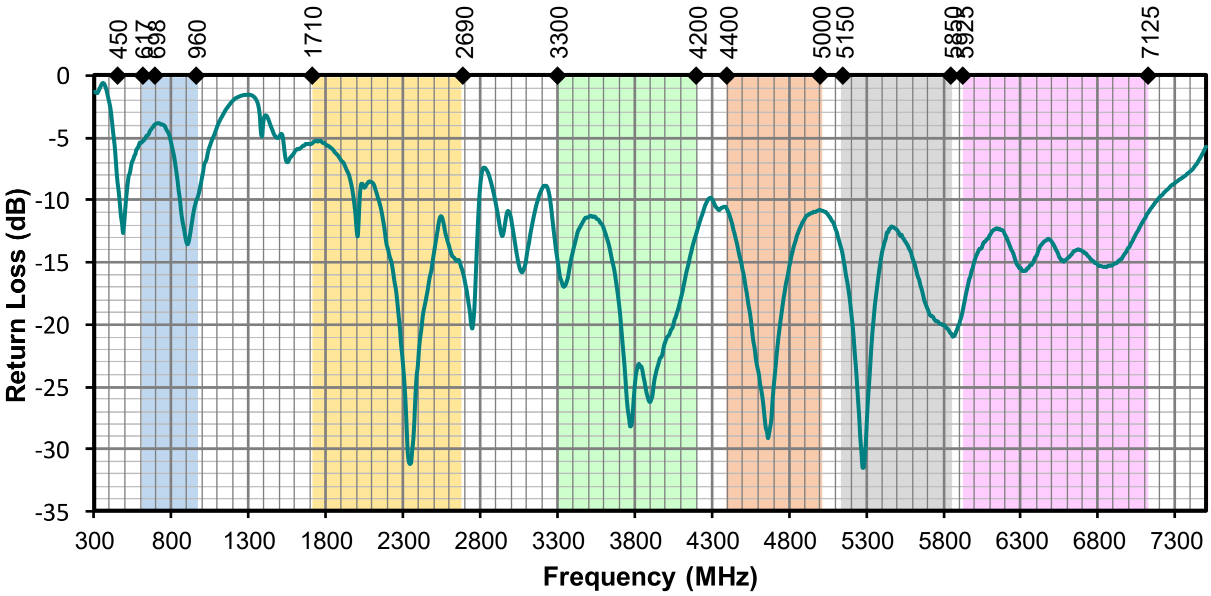


Figure 13. Antenna Return Loss, with ground plane

Peak Gain

The peak gain across the antenna bandwidth is shown in **Figure 14**. Peak gain represents the maximum antenna input power concentration across 3-dimensional space, and therefore peak performance at a given frequency, but does not consider any directionality in the gain pattern.

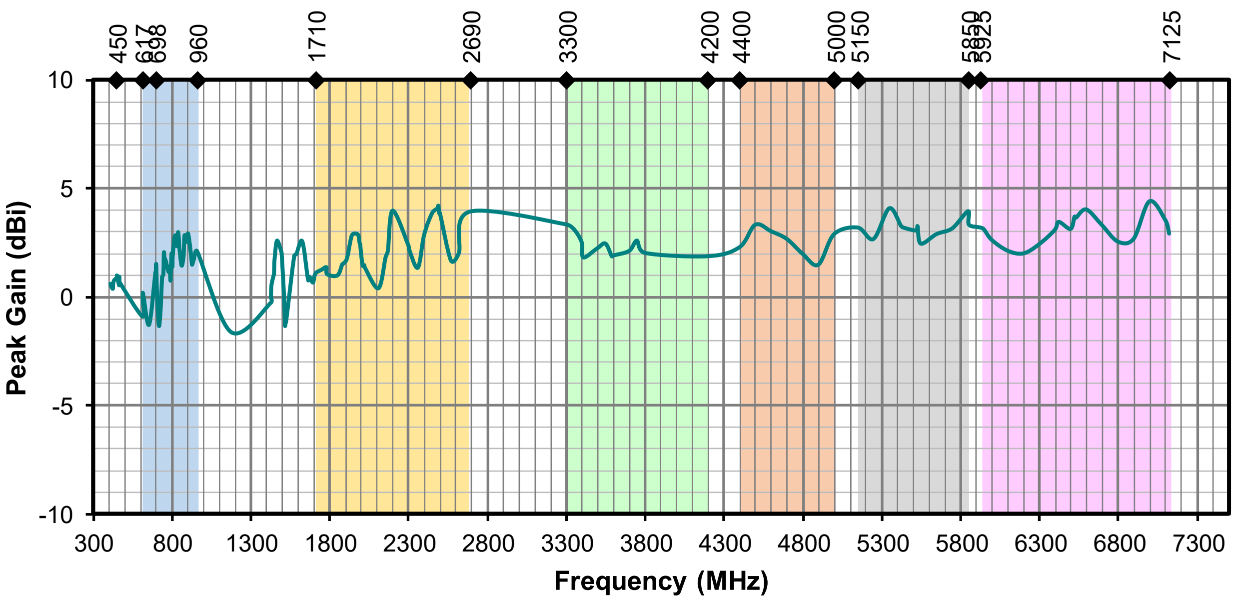


Figure 14. Antenna Peak Gain, with ground plane

Average Gain

Average gain (**Figure 15**), is the average of all antenna gain in 3-dimensional space at each frequency, providing an indication of overall performance without expressing antenna directionality.

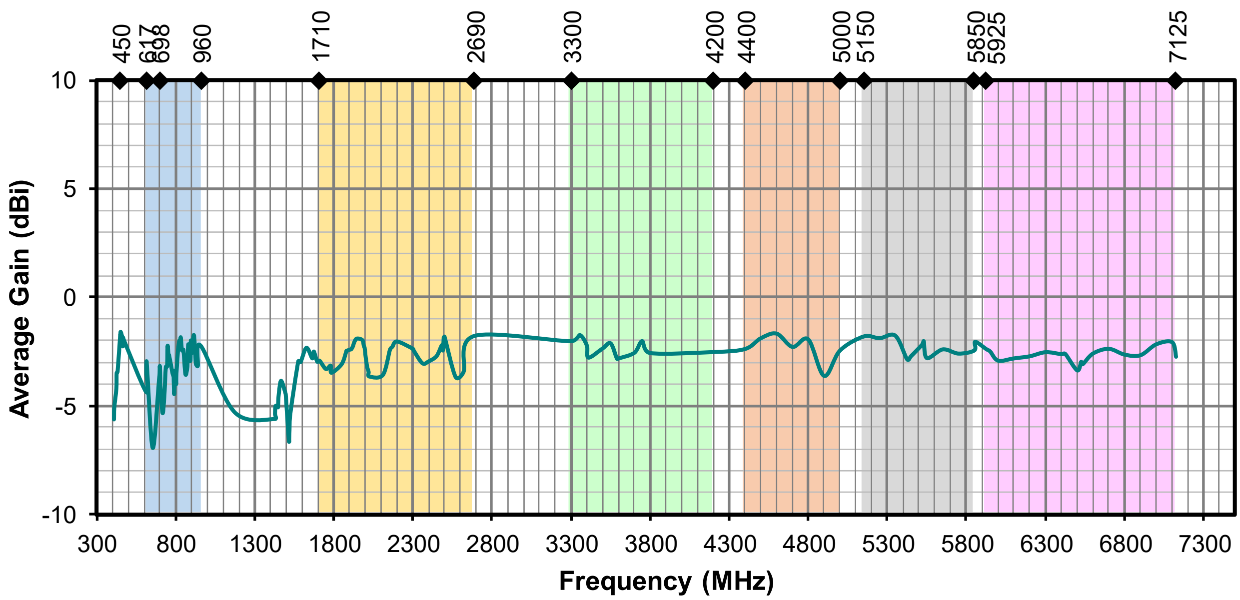


Figure 15. Antenna Average Gain, with ground plane

Radiation Efficiency

Radiation efficiency (**Figure 16**), shows the ratio of power radiated by the antenna relative to the power supplied to the antenna, expressed as a percentage, where a higher percentage indicates better performance at a given frequency. An ideal antenna has 100% efficiency. But in really world, usually an external antenna radiates only 50~60% of power supplied to it.

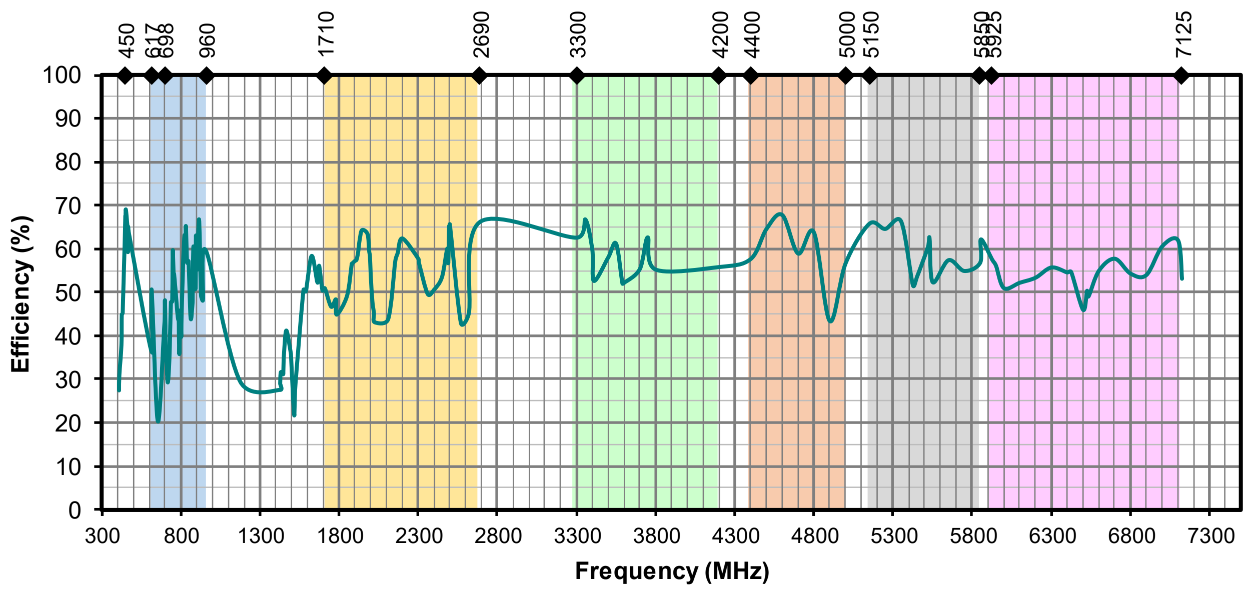
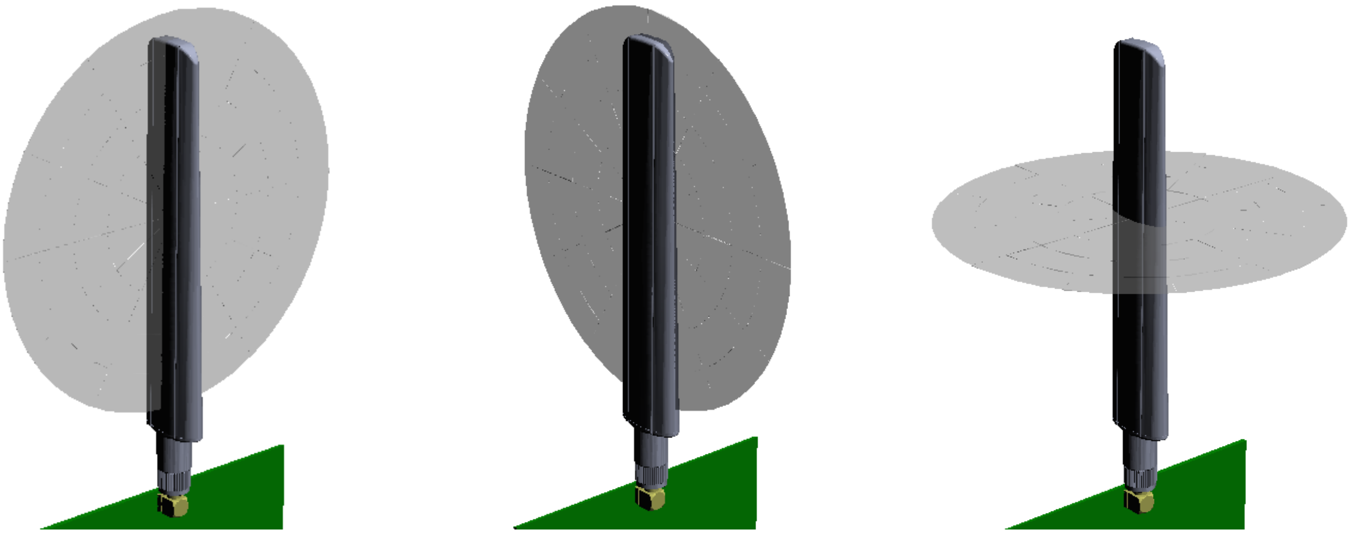


Figure 16. Antenna Efficiency, with ground plane

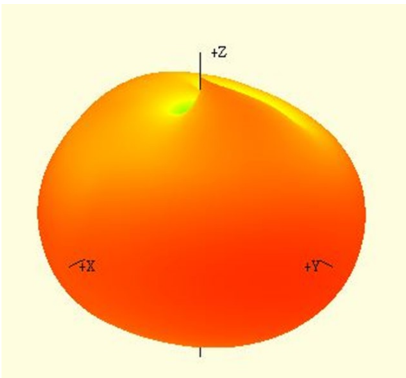
Radiation Patterns

Radiation patterns provide information about the directionality and 3-dimensional gain performance of the antenna by plotting gain at specific frequencies in three orthogonal planes. Antenna radiation patterns for a straight orientation are shown in **Figure 17** using polar plots covering 360 degrees. The antenna graphic at the top of the page provides reference to the plane of the column of plots below it.

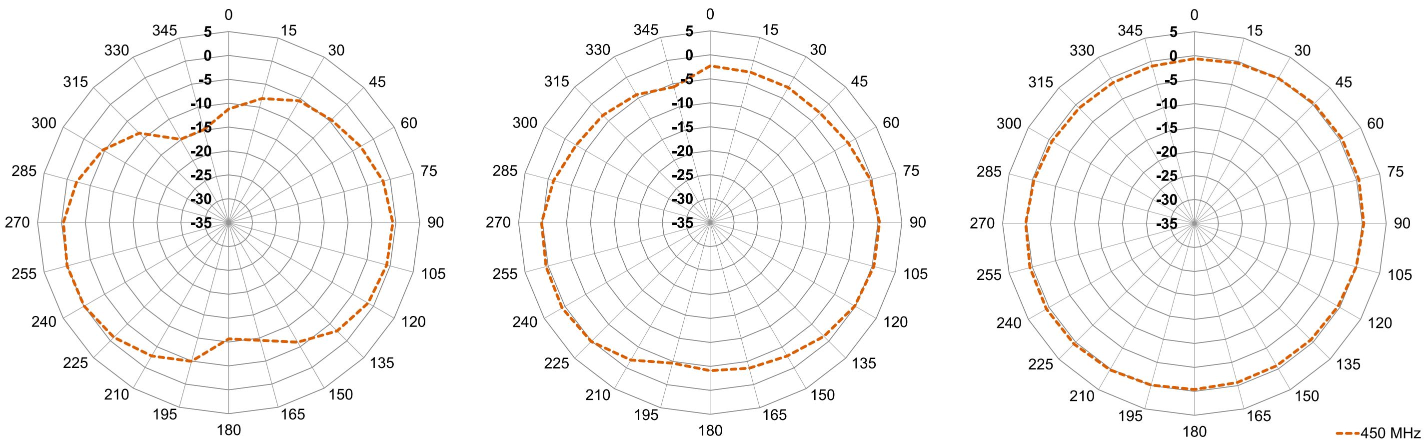


XZ-Plane Gain | YZ-Plane Gain | XY-Plane Gain

450 MHz



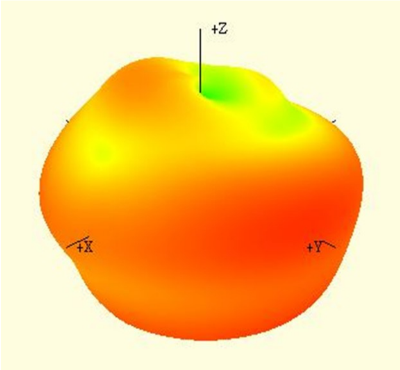
450 MHz



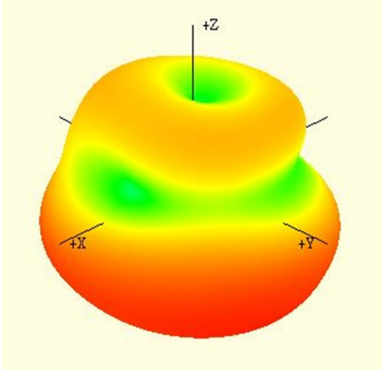
XZ-Plane Gain | YZ-Plane Gain | XY-Plane Gain

Figure 17. Antenna Radiation Patterns, with ground plane

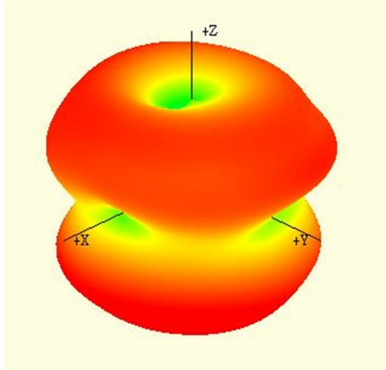
617 MHz to 960 MHz (778 MHz)



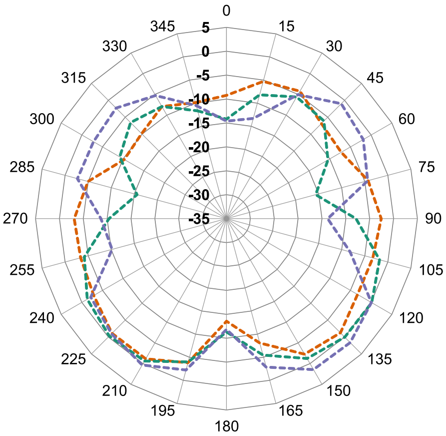
617 MHz



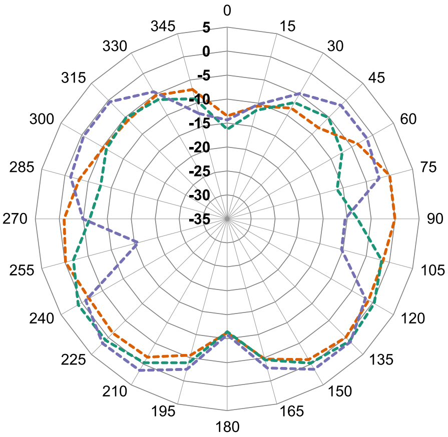
778 MHz



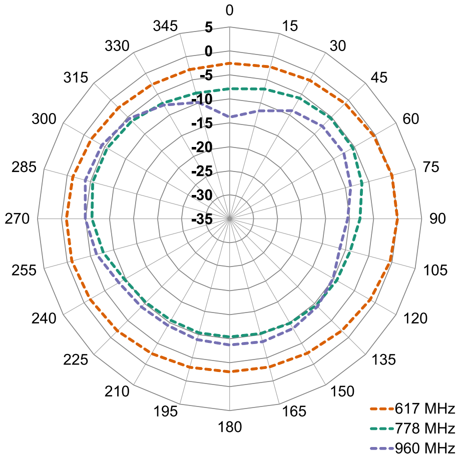
960 MHz



XZ-Plane Gain

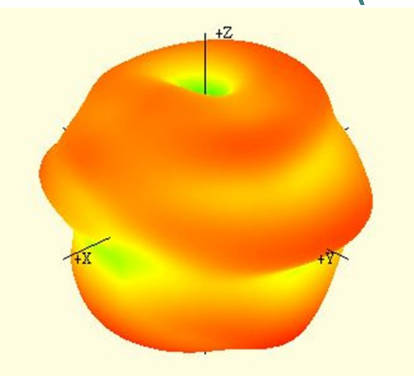


YZ-Plane Gain

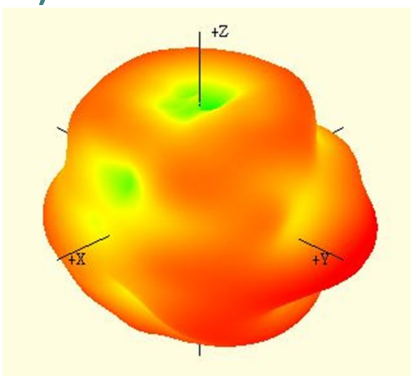


XY-Plane Gain

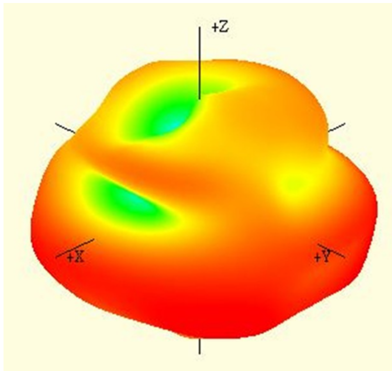
1710 MHz to 2690 MHz (2200 MHz)



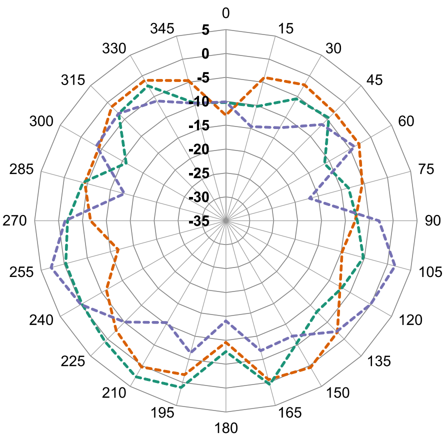
1710 MHz



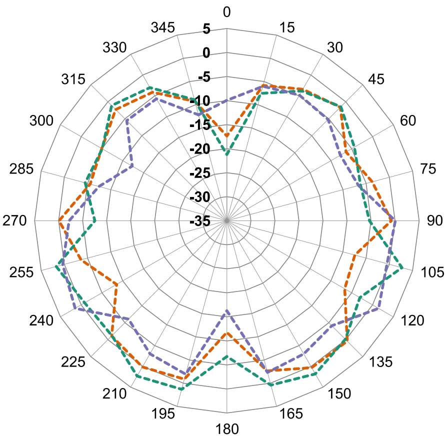
2200 MHz



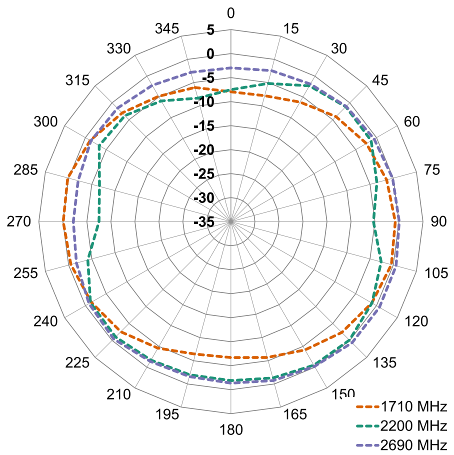
2690 MHz



XZ-Plane Gain

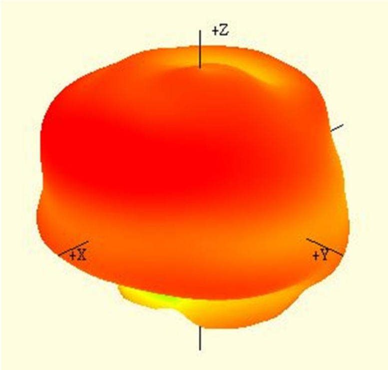


YZ-Plane Gain

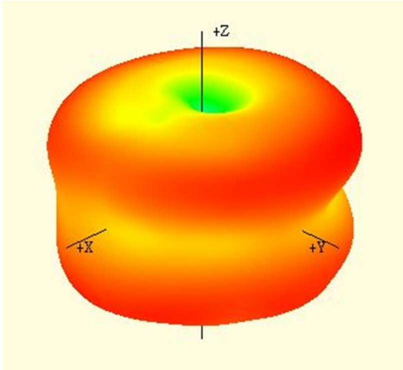


XY-Plane Gain

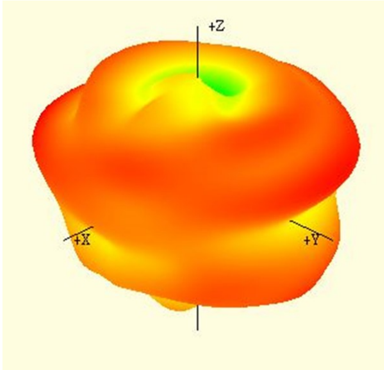
3300 MHz to 5000 MHz (4200 MHz)



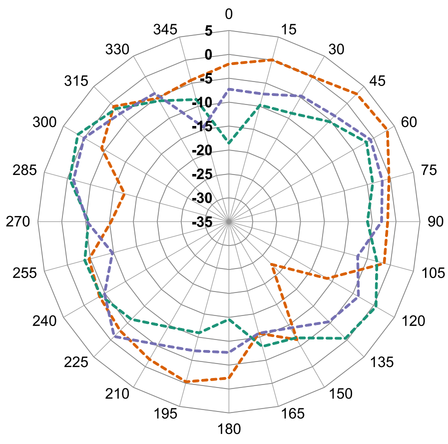
3300 MHz



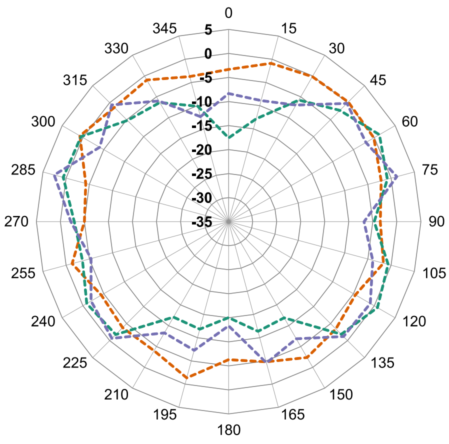
4200 MHz



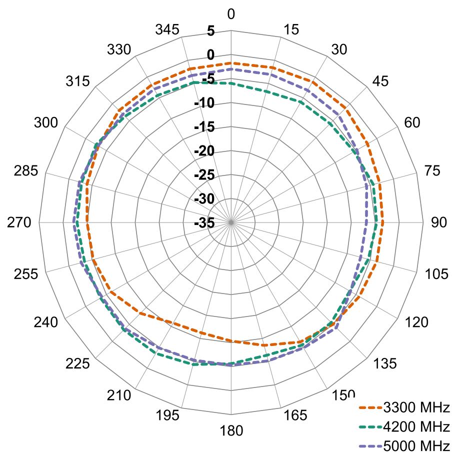
5000 MHz



XZ-Plane Gain

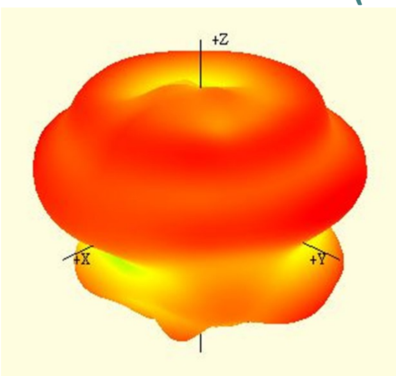


YZ-Plane Gain

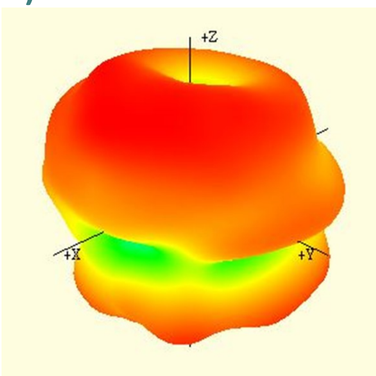


XY-Plane Gain

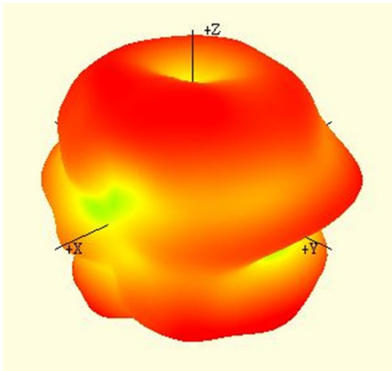
5150 MHz to 5850 MHz (5550 MHz)



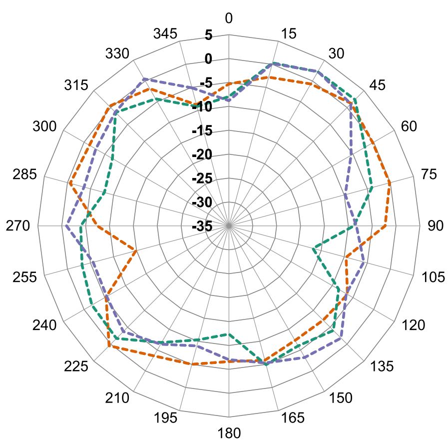
5150 MHz



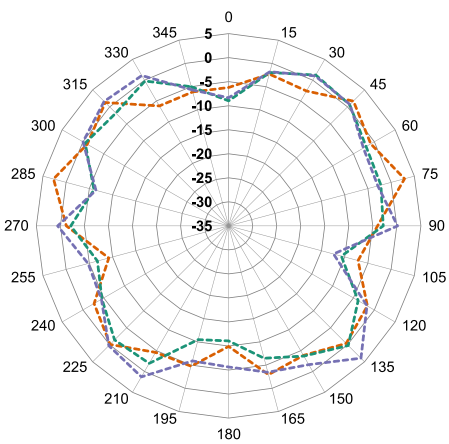
5550 MHz



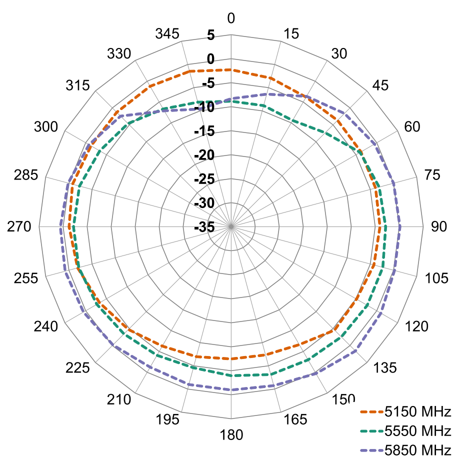
5850 MHz



XZ-Plane Gain

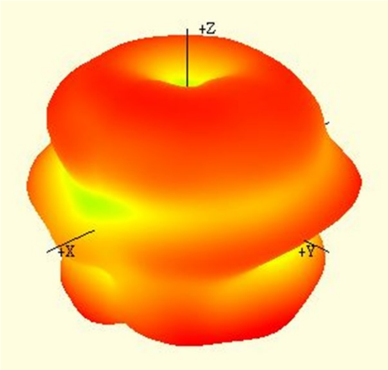


YZ-Plane Gain

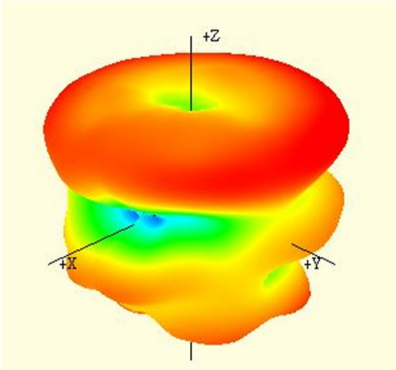


XY-Plane Gain

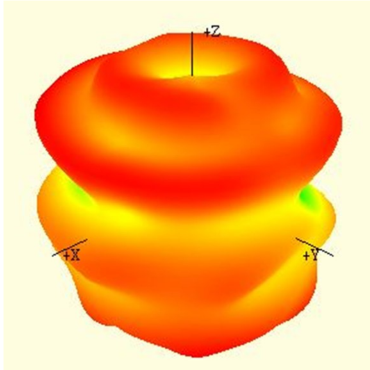
5925 MHz to 7125 MHz (6525 MHz)



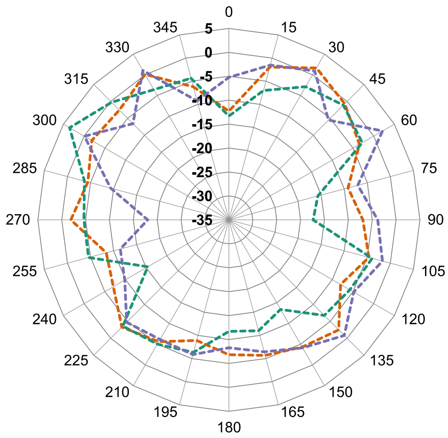
5925 MHz



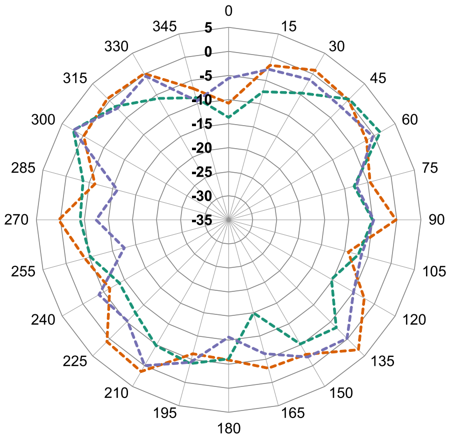
6525 MHz



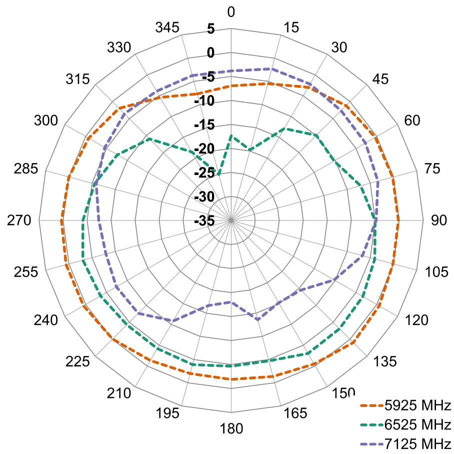
7125 MHz



XZ-Plane Gain



YZ-Plane Gain



XY-Plane Gain

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Antenna FAQs

Q: What is an antenna?

An antenna is used for transmission or reception of radio signals in wireless communication.

Q: How do antennas work?

Electricity flowing into the transmitter antenna makes electrons vibrate up and down it, producing radio waves. The radio waves travel through the air at the speed of light. When the waves arrive at the receiver antenna, they make electrons vibrate inside it.

Q: Does antenna size matter?

A bigger antenna, properly designed, will always have more **gain** than a smaller one. And it will be the best kind of **gain**, much better than using a small antenna and simply over-amplifying it, because a small antenna just won't pull in truly weak signals like this gigantic one will.

Q: What is the advantage of external antennas?

External antennas usually offer **better bandwidth** and **high performance** due to the nature of their larger size. This often results in a higher rated **gain** (dBi) than their internal counterparts. Due to its smaller size, an internal antenna would not function well to support lower frequencies.

Ease of integration – an external antenna requires fewer design resources and shorter time to integrate to allow for a more rapid time-to-market. An internal antenna's performance is influenced by device environment – PCB ground plane, nearby metal part, and enclosure. That would require much more effort such as impedance matching network to complete antenna design.

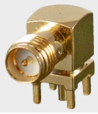
Q: Why is most antenna impedance 50 Ohm?

50 Ohm is an industry standard of coax cables and power amplifiers. It was chosen as a tradeoff between maximum power handling for the transmit coax and the copper losses. The optimum would have been anyway in the range of **30 to 100 ohm** with average at 50 Ohm.

Q: Why does GNSS require RHCP (Right-hand-circularly-polarized) antennas?

Satellite's signal has a low power density, especially after propagating through the **atmosphere** (**ionosphere** affect radio wave). Polarized waves oscillate in more than one direction, which deliver satellite's signal to receiver on Earth surface more effectively.

MATING COMPONENTS: RF COAXIAL CONNECTOR AND CABLE ASSEMBLY

Part Number	Image	Connector 1 (Receptacle)	Connector 2 (Plug)	Cable Length		Cable Diameter (mm)
				mm	Inch	
CX-SAS0MMPA1W0007		SMA Jack Female Socket Straight	MHF1	70	2.76	1.13
CT-SAB11X-006M		SMA Jack Female Socket Right Angle	N/A	N/A	N/A	N/A
CT-SAB41X		SMA Jack Female Socket Straight	N/A	N/A	N/A	N/A
CT-SAD11X-006M		RP-SMA Jack Male Pin Straight	N/A	N/A	N/A	N/A
CT-SAD12X-006M		RP-SMA Jack Male Pin Right Angle	N/A	N/A	N/A	N/A

Website: https://www.joymax.com.tw
Offices: 5, Dong-Yuan 2nd Road, Zhong-Li Dist., Tao-Yuan City 32063 Taiwan (R.O.C.)
Phone: +886 3 433 5698
E-MAIL: info@joymax.com.tw

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