Datasheet

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ZHF-3802cc3B

5G Panel-Mount Saltshaker antenna

The Joymax ZHF-3802cc3B series antennas are saltshaker-style, panel-mount, dipole antennas 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), and a growing number of C-band applications.

The dipole antenna provides a ground plane independent antenna solution to attach to device panel, roof, L bracket etc. Connection is made to the radio via a coaxial cable terminated in an SMA plug (male pin) connector.

Features

- Bandwidth 617 MHz and 7125 MHz
- Performance at 617 MHz to 960 MHz
  - VSWR: ≤ 3.3
  - Peak Gain: 2.8 dBi
  - Efficiency: 57%
- Ground plane independence dipole design
- Omnidirectional radiation
- IP67 rated waterproof design
- SMA plug (male pin) connector

Applications

- 5G NR FR1, 4G, 3G, 2G
- Cellular IoT: LTE-M (Cat-M1), NB-IoT
- CBRS Private Network (3550 to 3700MHz)
- C-Band applications (3700 to 4200MHz)
- Public Safety networks (4940 to 4990MHz)
- Low-power, wide-area (LPWA) applications
  - LoRaWAN®
  - Sigfox®
  - Weightless-P™
  - WiFi HaLow™ (802.11ah)

Ordering Information

Part Number	Description
ZHF-3802SA3B-Q100	5G Saltshaker Antenna with SMA Plug (male pin), RG58 coaxial cable, L=1000mm
ZHF-3802SA3B-Q200	5G Saltshaker Antenna with SMA Plug (male pin), RG58 coaxial cable, L=2000mm

Available from Joymax Electronics and select distributors and representatives.
Custom cable lengths are available for OEM volume inquiry.

Table 1: Electrical Specifications

ZHF-3802cc3B	5G NR / LTE Bands (MHz)					
Frequency Range	617~960	1710~2690	3300~4200	4400~5000	5150~5850	5925-7125
VSWR (Max)	3.3	2.3	3.3	2.4	2.7	2.8
Peak Gain (dBi)	2.8	3.2	3.2	3.6	5.7	3.4
Average Gain (dBi)	-2.5	-2.7	-4.6	-3.3	-3.6	-5.0
Efficiency (%)	57	55	35	47	44	32
Polarization	Linear					
Radiation	Omni directional					
Max Power	1 W					
Wavelength	½-λ					
Electrical Type	Dipole					
Impedance	50 Ω					

Electrical specifications and plots measured with a 350 mm x 350 mm (13.8 in. x 13.8 in.) reference ground plane and 1M RG58 cable.

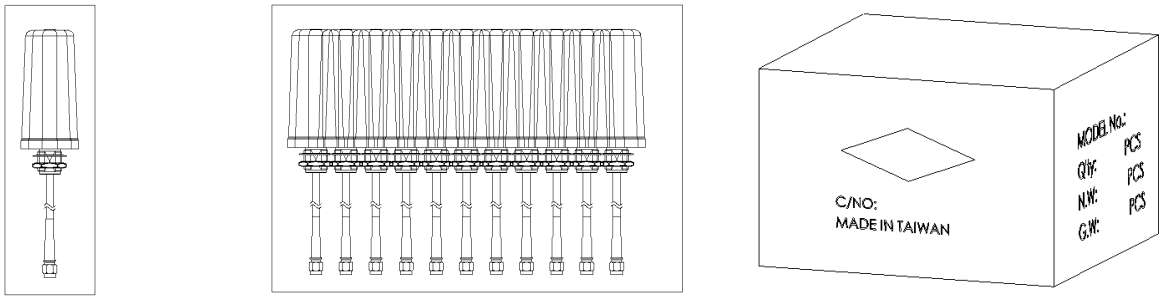
ATTENUATION FIGURES - 5 MM (0.195 INCH) DIAMETER CABLES									
Frequency Range (MHz)	698	960	1710	2650	3300	4400	5000	5850	7125
Cable Attenuation (dB/M)	< 0.4	< 0.5	< 0.6	< 0.8	< 0.9	< 1.1	< 1.2	< 1.3	< 1.7

Table 2: Mechanical Specifications

Parameter	Value
Connection	SMA Plug (male pin)
Operating Temp.	-40℃ to +85℃
Weight	1000mm cable—162g; 2000mm cable—195g
Dimension	⌀38.0 mm x 77.7 mm
Antenna Color	Black
Ingress Protection	IP67

Packaging Information

The ZHF-3802cc3B antennas are individually packed into a plastic bag as shown in **Figure 1**. 50 pcs per carton, 390 mm x 260 mm x 330 mm (11.4 in x 10.2 in x 12.9 in) with total weight 11 KGs (24.3 lb). Distribution channels may offer alternative packaging options.



1 pc antenna/ 1 bag | 10 pcs antenna/ 1 Bigger PE bag | 50 pcs antenna/ 1 Carton

Figure 1. Antenna Packaging

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Product Dimensions

Figure 2 provides dimensions of the ZHF-3802cc3B in mm measurement unit. The antenna permanently mounts through thread screws on roof, device panel, L bracket etc. Connection is made to the radio via a coaxial cable terminated in a SMA plug (male pin) connector. The standard antenna pack excludes L bracket.

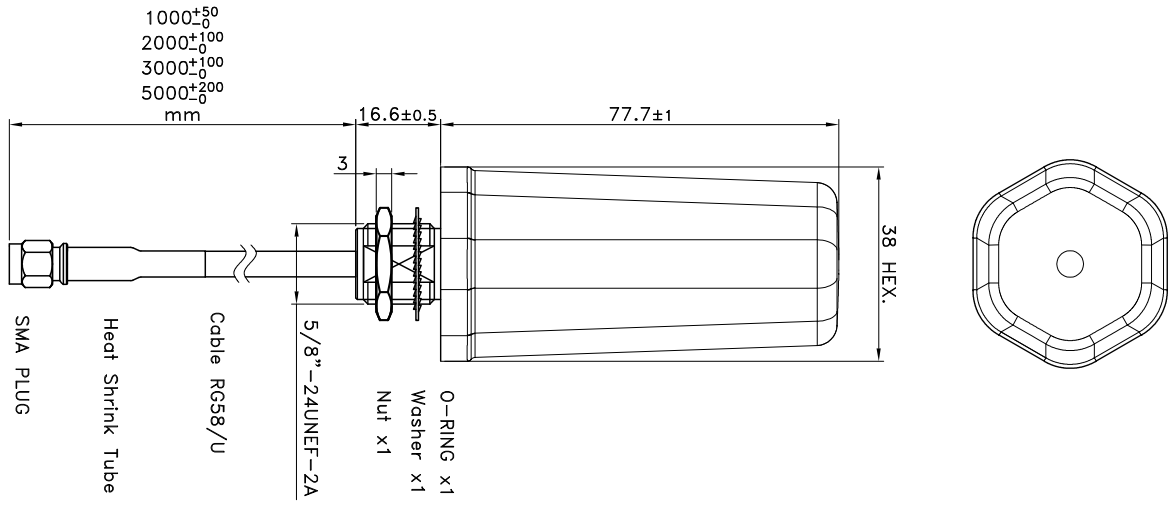

Figure 2. Antenna Dimensions

Antenna Test Setup

The ZHF-3802cc3B is characterized in two antenna setup as shown in **Figure 3**. Although the antenna is a dipole not requiring a ground plane for function, characterization with an adjacent ground plane (350 mm x 350 mm) provides insight into antenna performance when attached directly to metal plate of the device panel or roof. The two orientations represent the most common end-product use cases.

Hanging free without ground plane **Mount on 350 mm metal plate**

Figure 3. Antenna Test Setup

HANGING FREE, WITHOUT GROUND PLANE

The charts on the following pages represent data taken with the antenna hanging free 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.

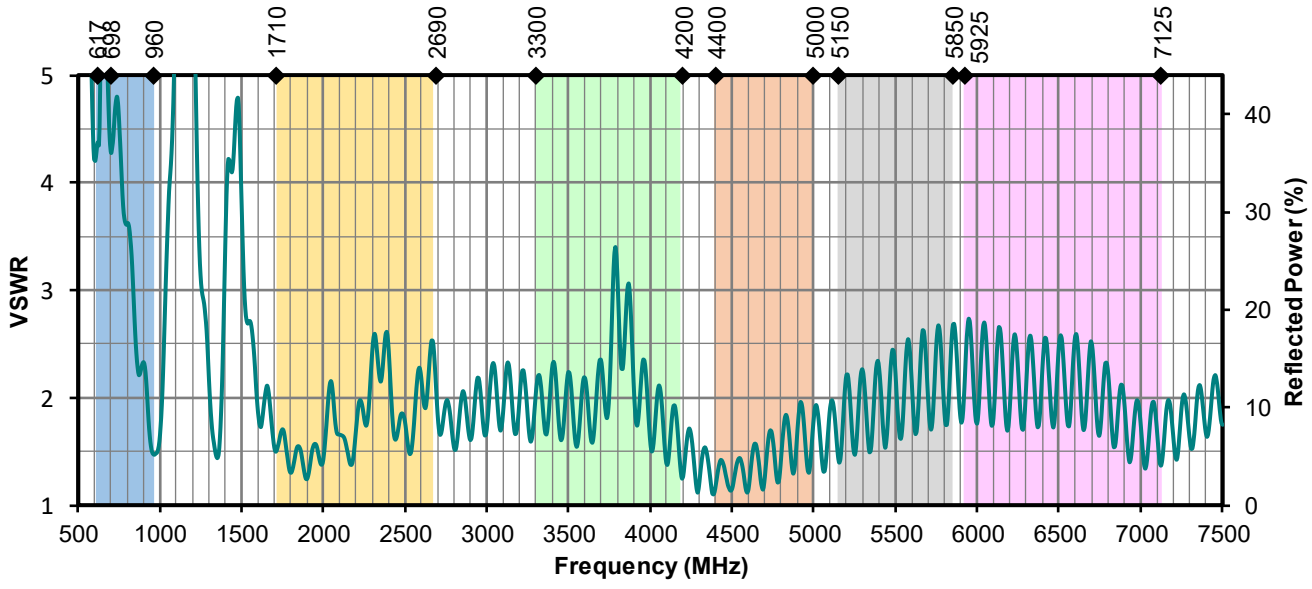

Figure 5. Antenna VSWR, hanging free with 1 Meter RG58 coax cable

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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.

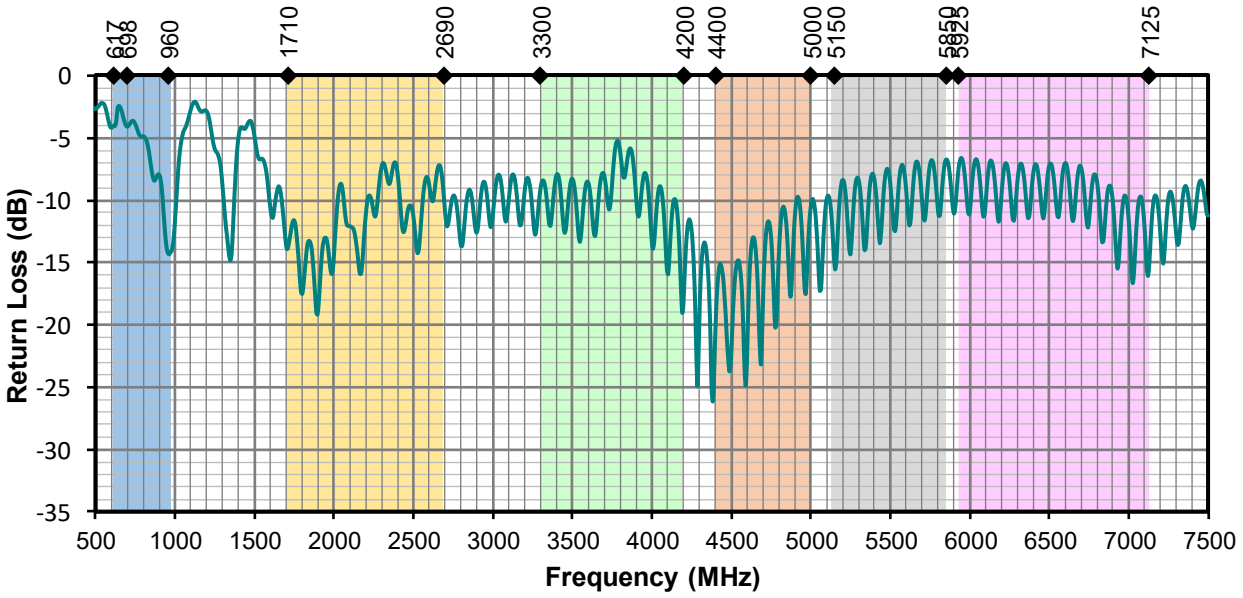

Figure 6. Antenna Return Loss, hanging free with 1 Meter RG58 coax cable

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.

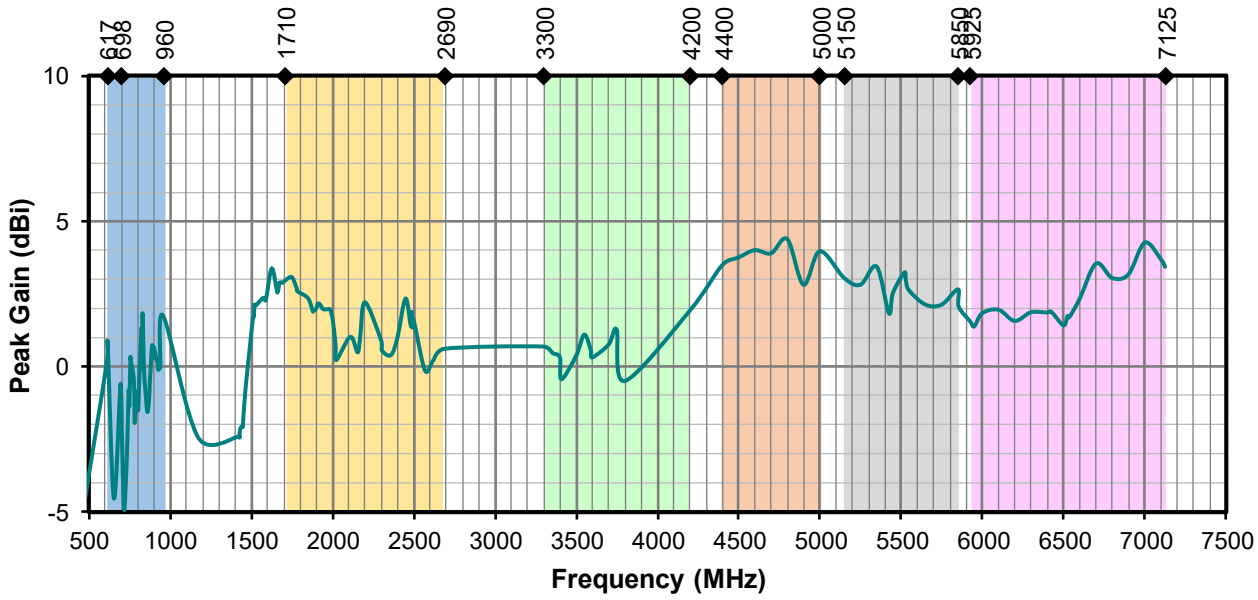

Figure 7. Antenna Peak Gain, hanging free with 1 Meter RG58 coax cable

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.

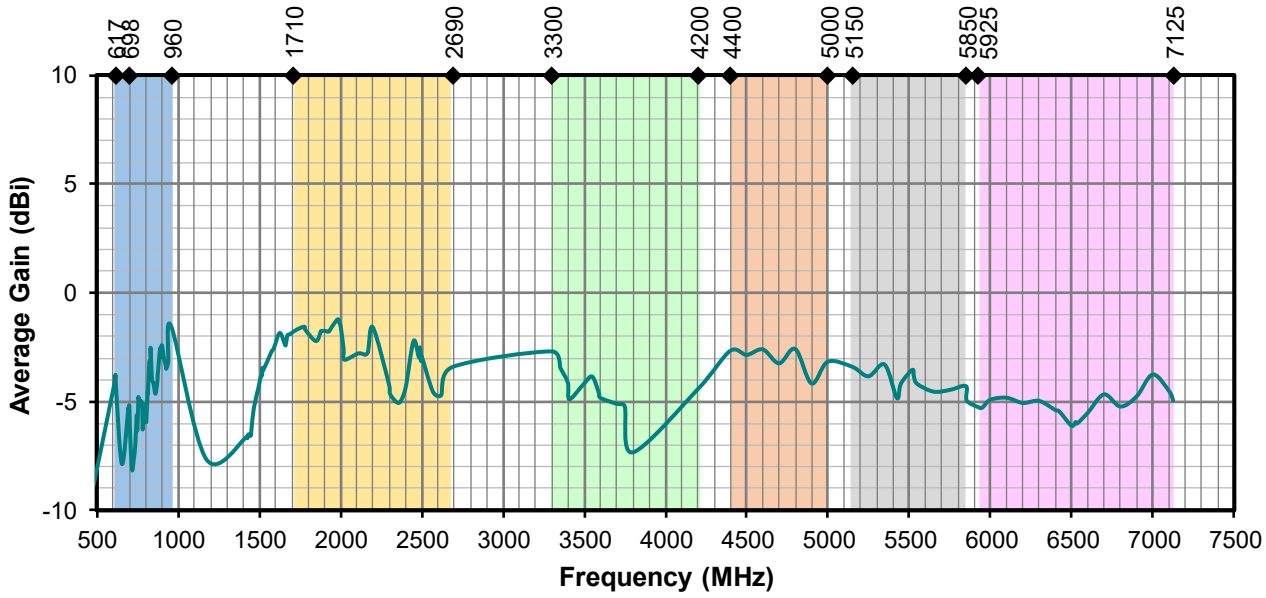

Figure 8. Antenna Average Gain, hanging free with 1 Meter RG58 coax cable

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.

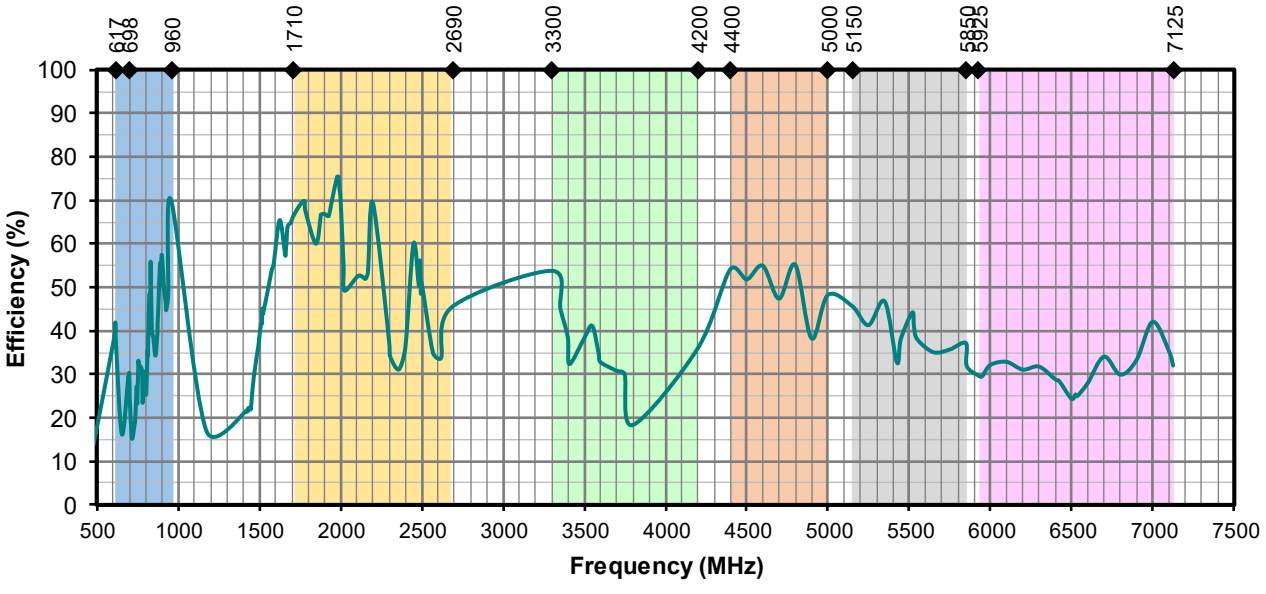

Figure 9. Antenna Efficiency, hanging free with 1 Meter RG58 coax cable

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Radiation Patterns

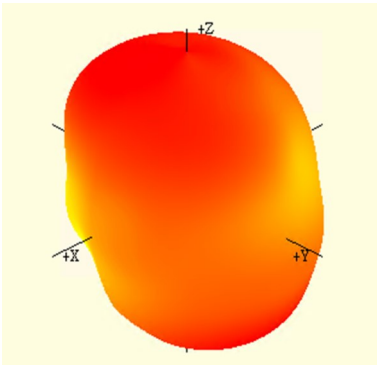
Radiation patterns provide information about the directionality and 3-dimensional gain performance of the antenna by plotting gain at specific frequencies in three orthogonal planes. The antenna radiation patterns for hanging free are shown in **Figure 10** using polar plots covering 360 degrees. The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

XZ-Plane Gain

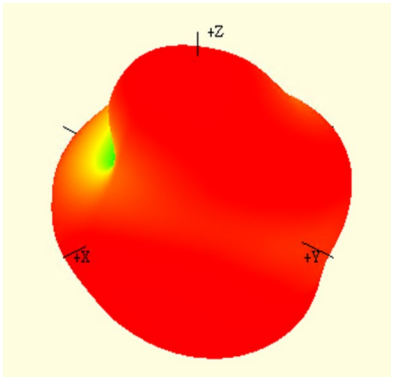
YZ-Plane Gain

XY-Plane Gain

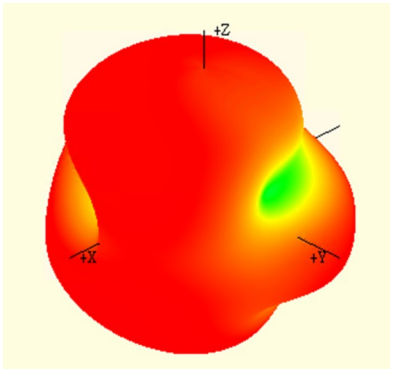
617 MHz to 960 MHz (778 MHz)



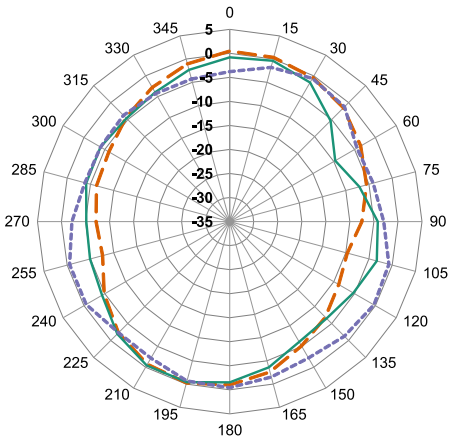
617 MHz



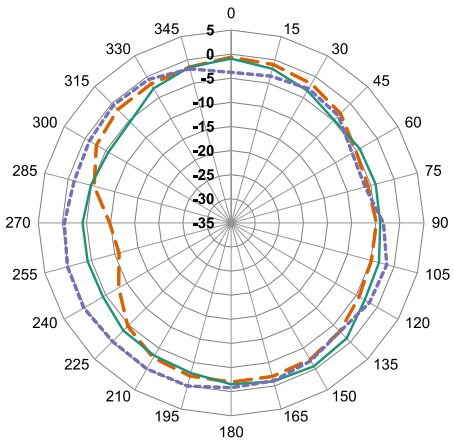
778 MHz



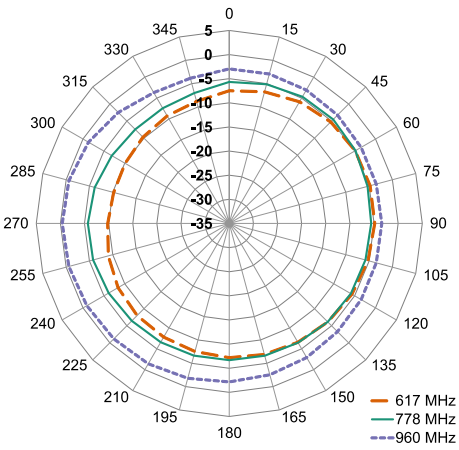
960 MHz



XZ-Plane Gain



YZ-Plane Gain



XY-Plane Gain

Figure 10. Antenna Radiation Patterns, hanging free with 1 Meter RG58 coaxial cable

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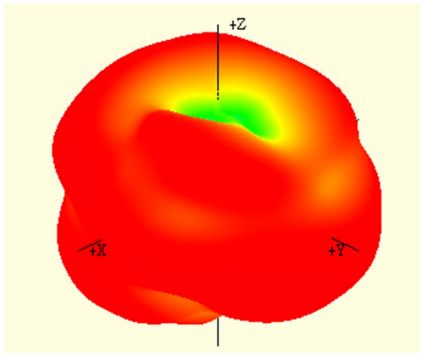
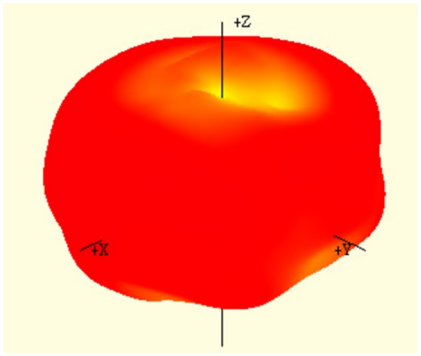
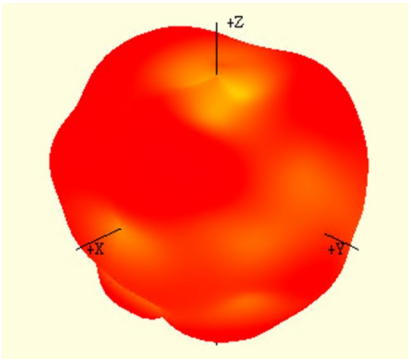
1710 MHz to 2690 MHz (2200 MHz)



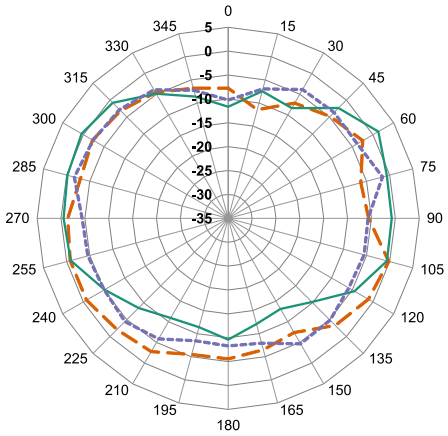
1710 MHz



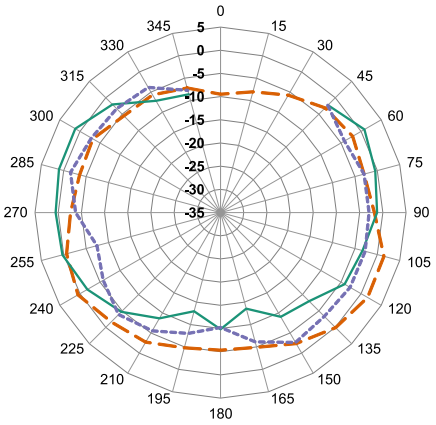
2200 MHz



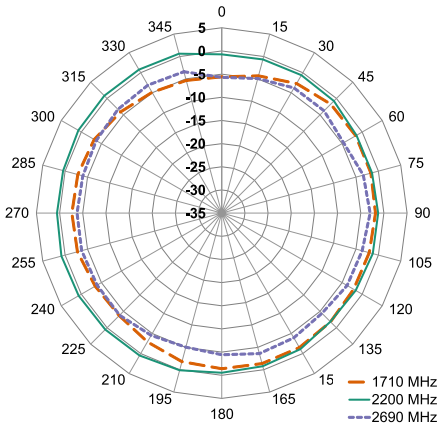
2690 MHz



XZ-Plane Gain

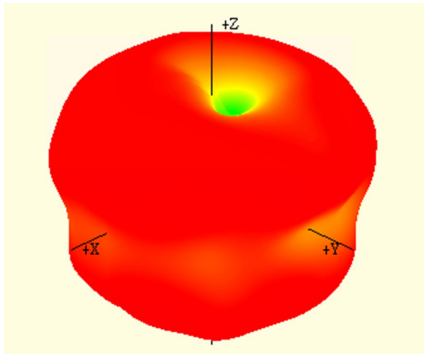


YZ-Plane Gain

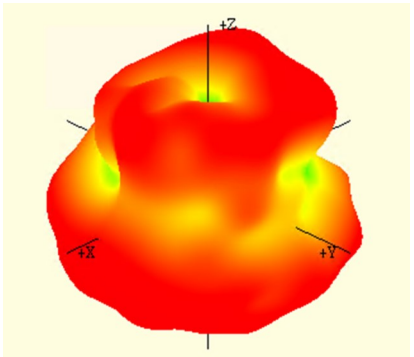


XY-Plane Gain

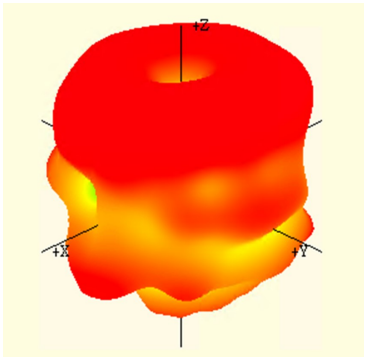
3300 MHz to 5000 MHz (4200 MHz)



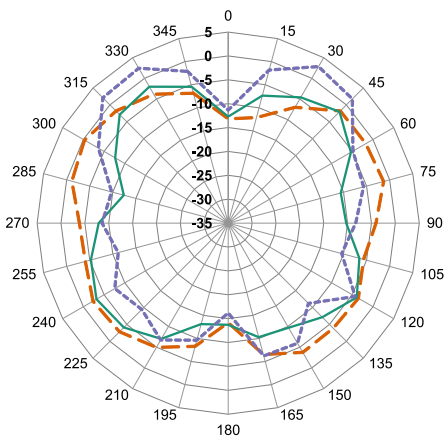
3300 MHz



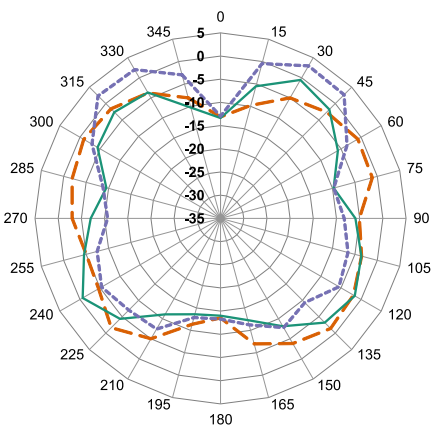
4200 MHz



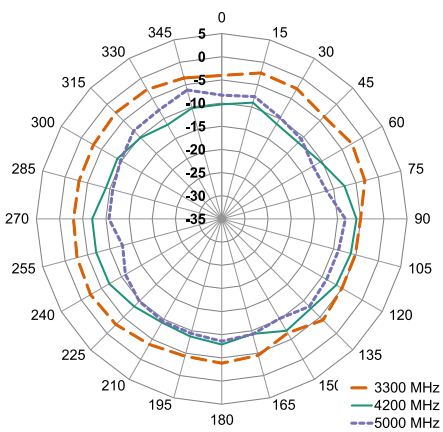
5000 MHz



XZ-Plane Gain



YZ-Plane Gain



XY-Plane Gain

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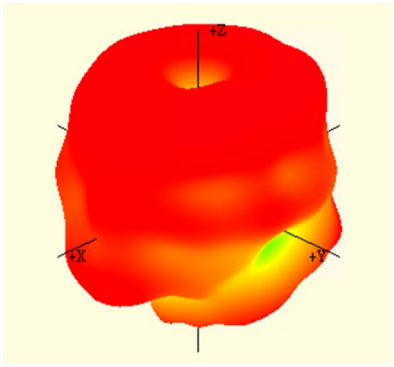
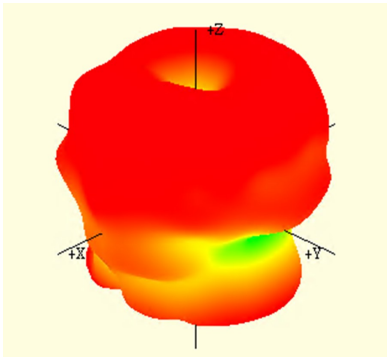
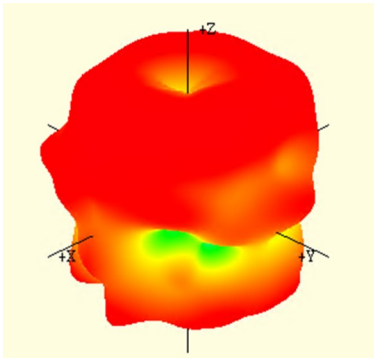
5150 MHz to 5850 MHz (5500 MHz)



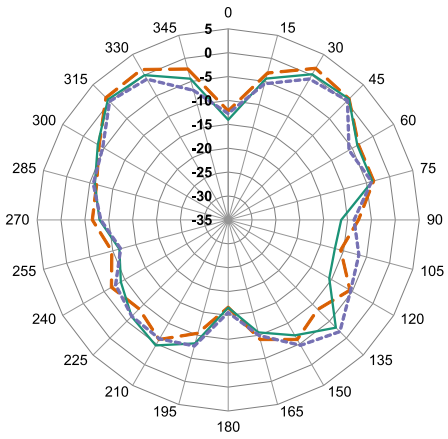
5150 MHz



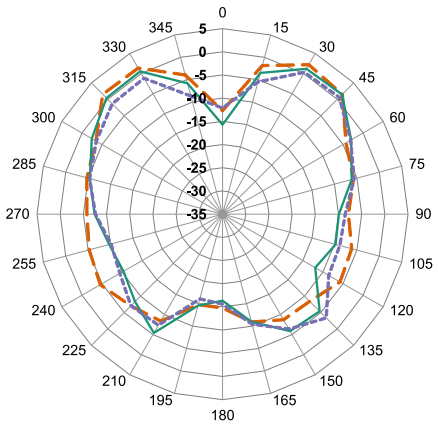
5500 MHz



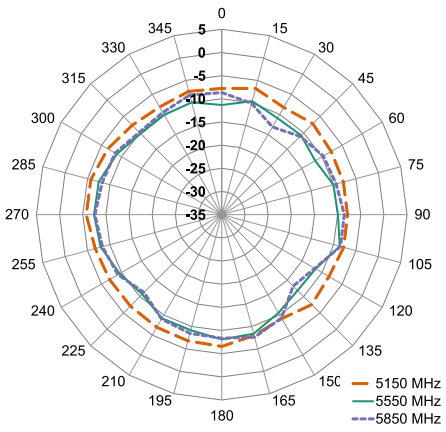
5850 MHz



XZ-Plane Gain

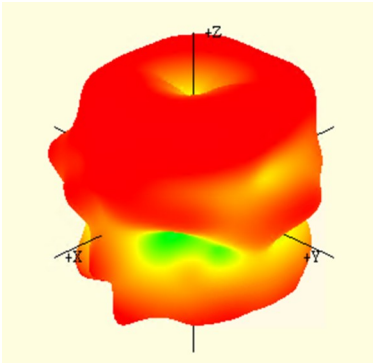


YZ-Plane Gain

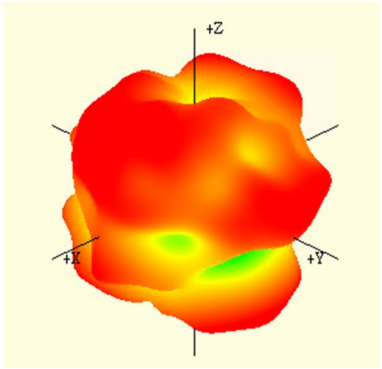


XY-Plane Gain

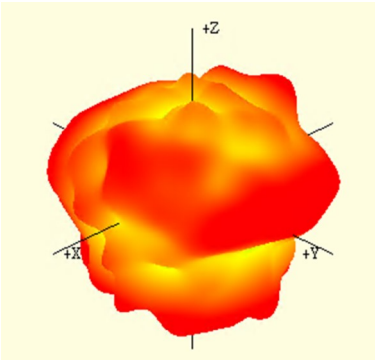
5925 MHz to 7125 MHz (6525 MHz)



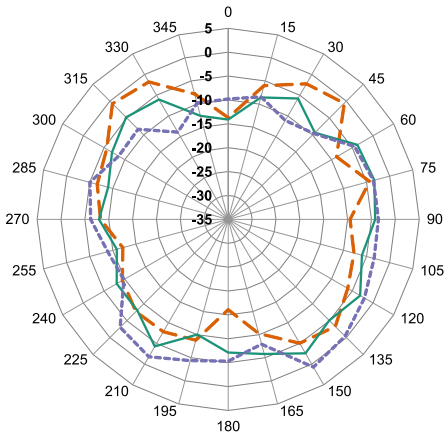
5925 MHz



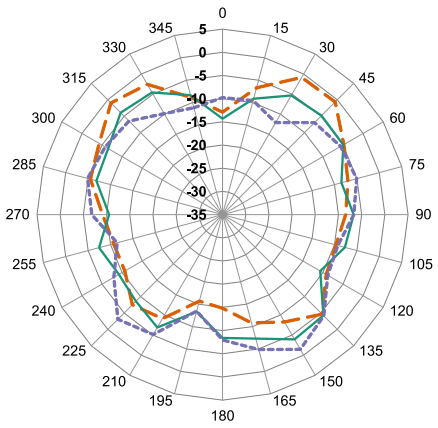
6525 MHz



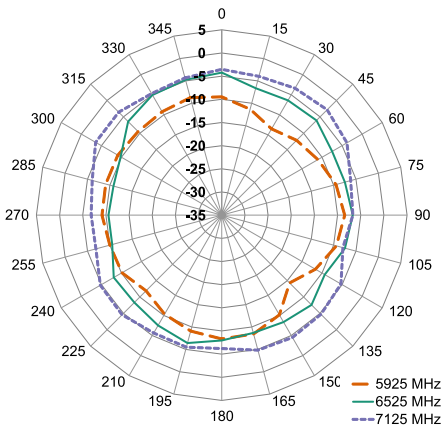
7125 MHz



XZ-Plane Gain



YZ-Plane Gain



XY-Plane Gain

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STRAIGHT, WITH GROUND PLANE

The charts on the following pages represent data taken with the antenna mount on a 350 mm x 350 mm (13.8 in. x 13.8 in.) metal ground plate as shown in **Figure 11**.

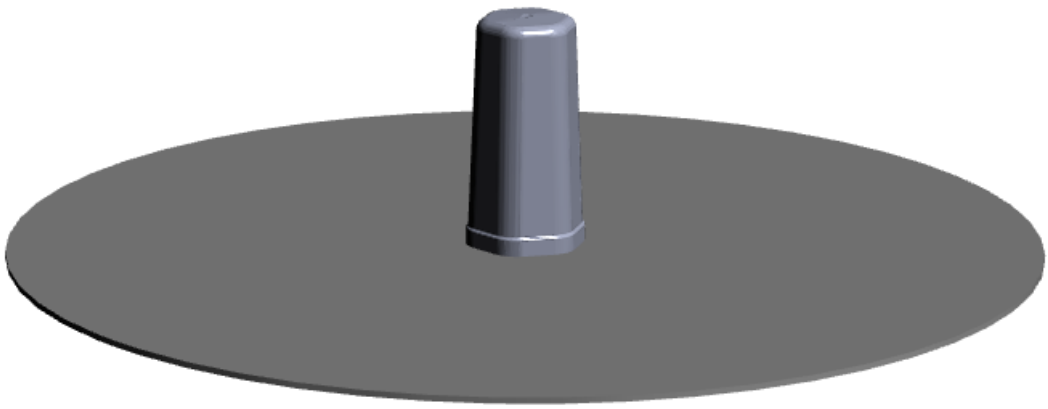

Figure 11. Mount on metal plate, with ground plane

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.

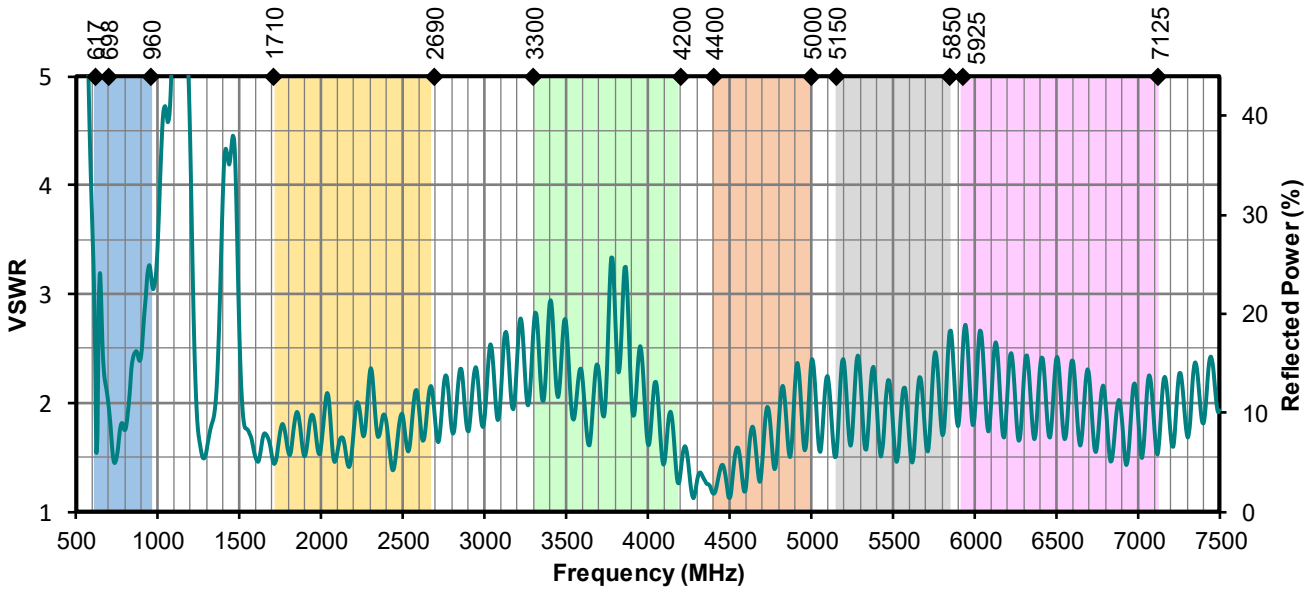

Figure 12. Antenna VSWR, on metal plate with 1 Meter RG58 coax cable

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.

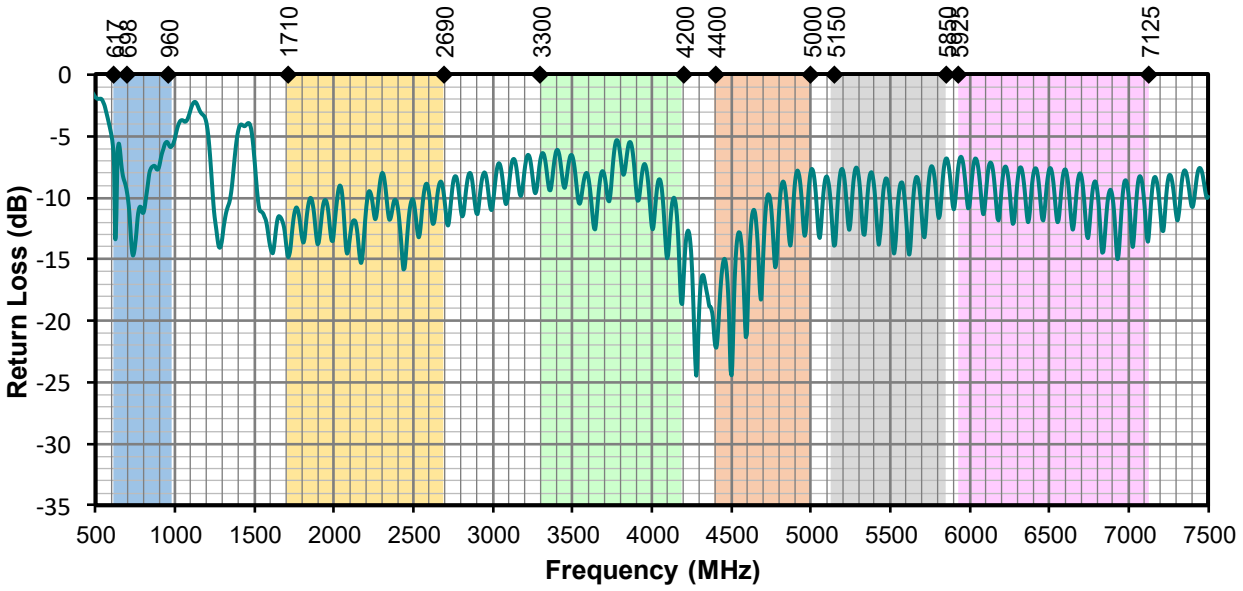

Figure 13. Antenna Return Loss, on metal plate with 1 Meter RG58 coax cable

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.

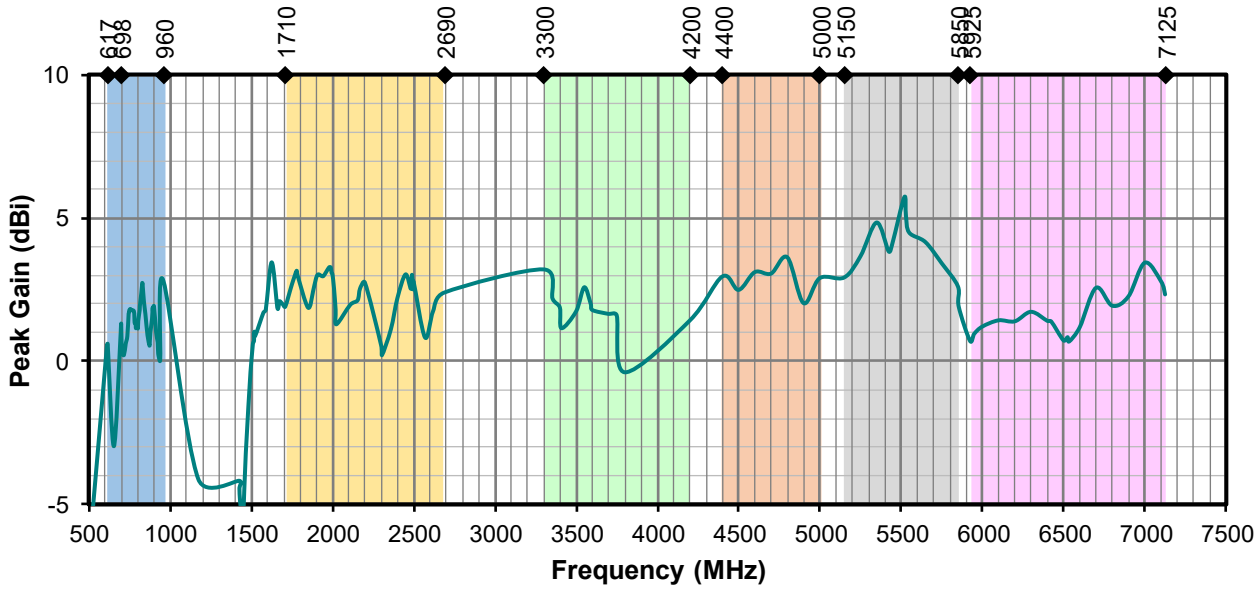

Figure 14. Antenna Peak Gain, on metal plate with 1 Meter RG58 coax cable

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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.

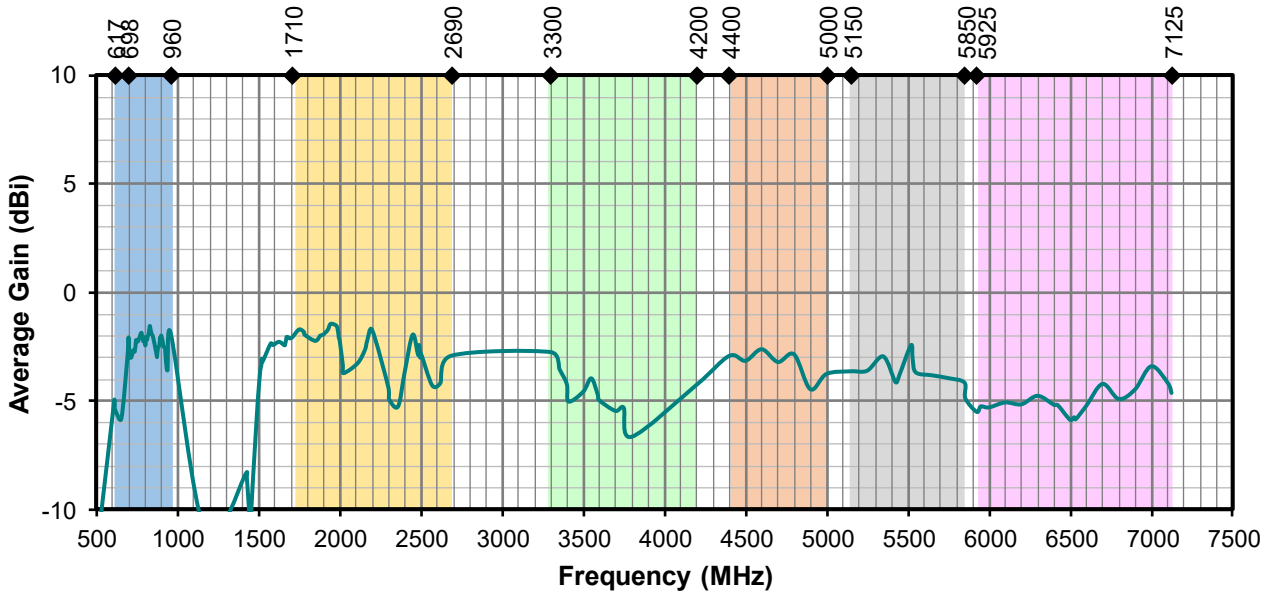

Figure 15. Antenna Average Gain, on metal plate with 1 Meter RG58 coax cable

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.

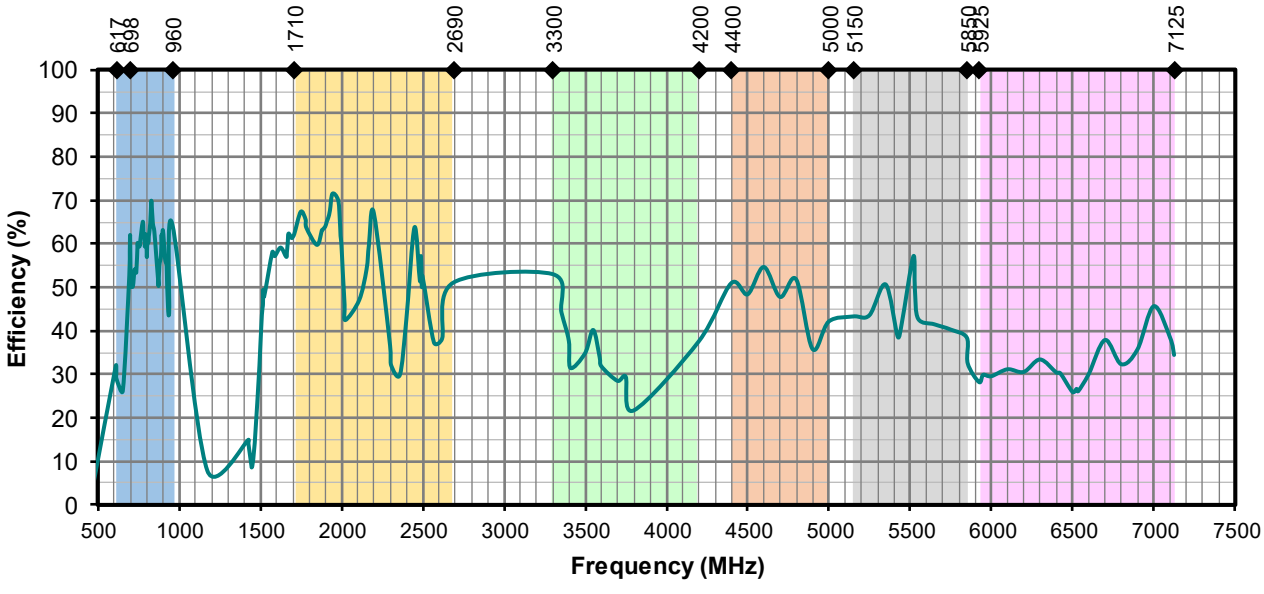

Figure 16. Antenna Efficiency, on metal plate with 1 Meter RG58 coax cable

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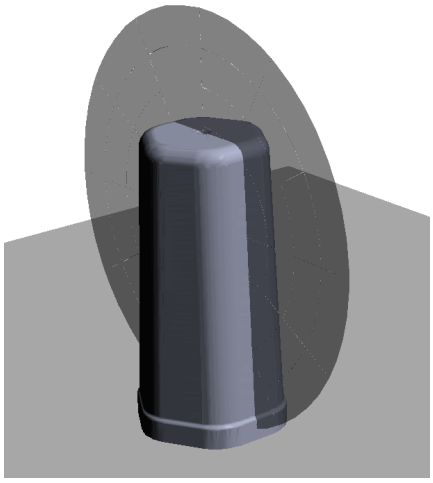
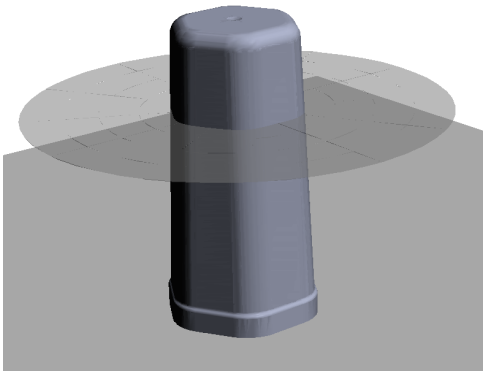
Radiation Patterns

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. The antenna radiation patterns with ground plane 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

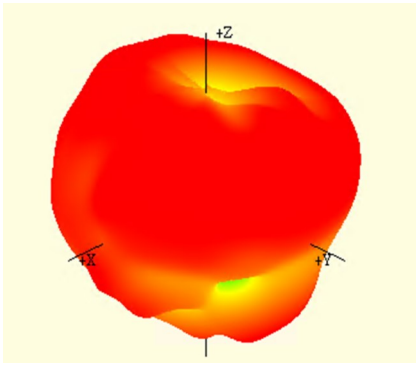


YZ-Plane Gain

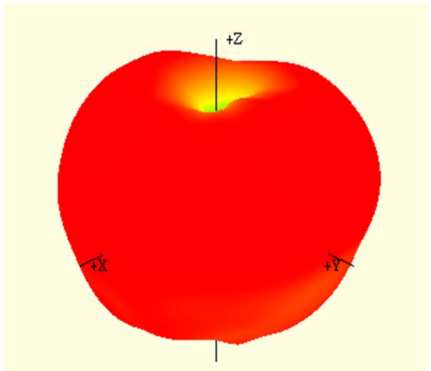


XY-Plane Gain

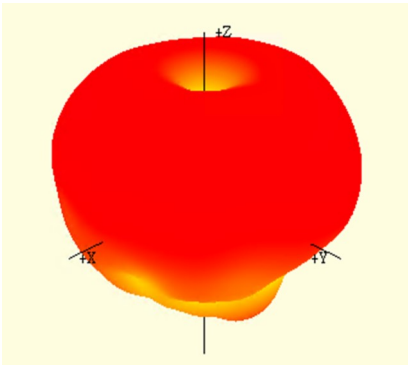
617 MHz to 960 MHz (778 MHz)



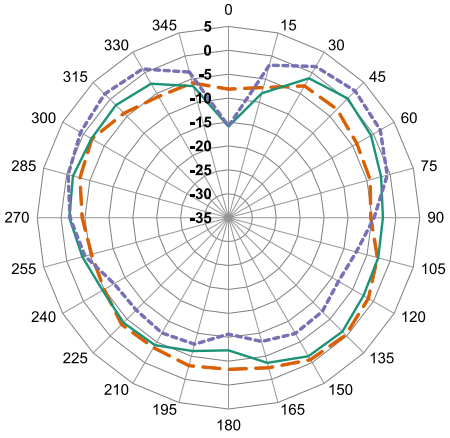
617 MHz



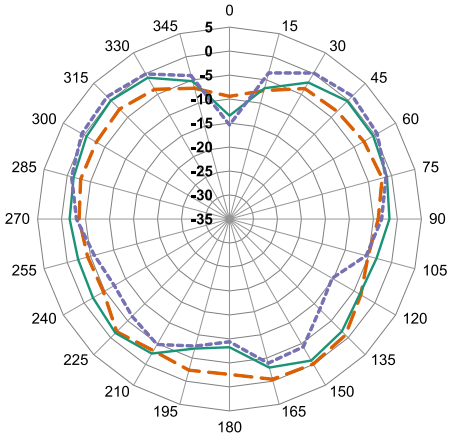
778 MHz



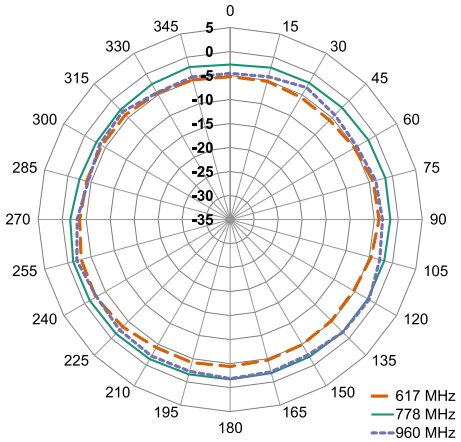
960 MHz



XZ-Plane Gain



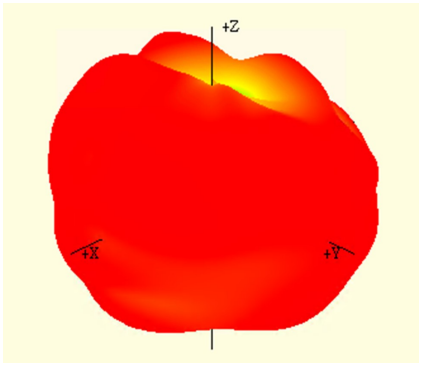
YZ-Plane Gain



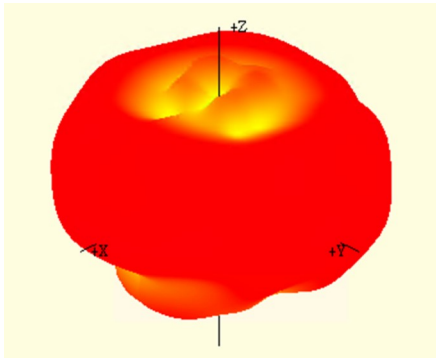
XY-Plane Gain

Figure 17. Antenna Radiation Patterns, on metal plate with 1 Meter RG58 coaxial cable

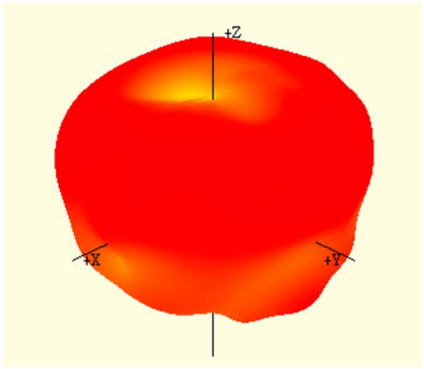
1710 MHz to 2690 MHz (2200 MHz)



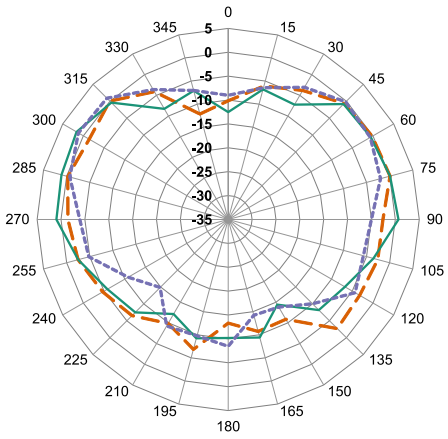
1710 MHz



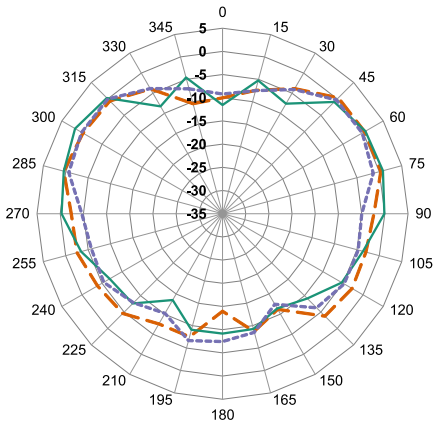
2200 MHz



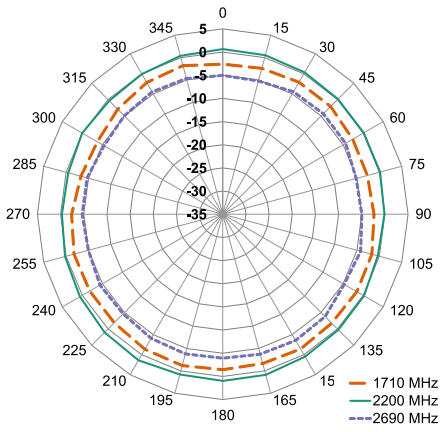
2690 MHz



XZ-Plane Gain

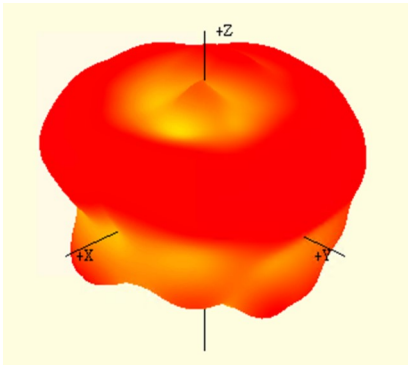


YZ-Plane Gain

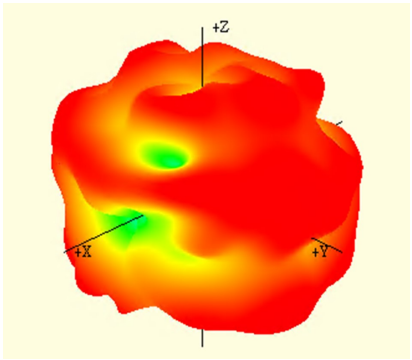


XY-Plane Gain

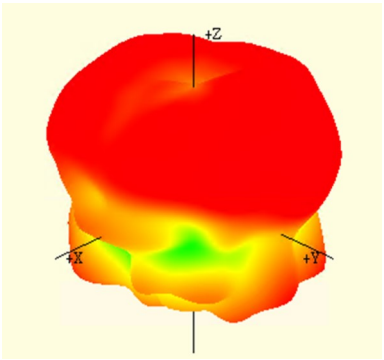
3300 MHz to 5000 MHz (4200 MHz)



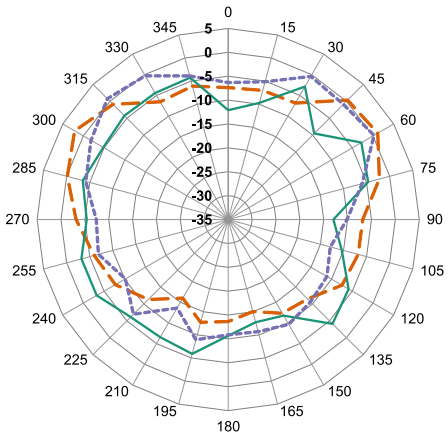
3300 MHz



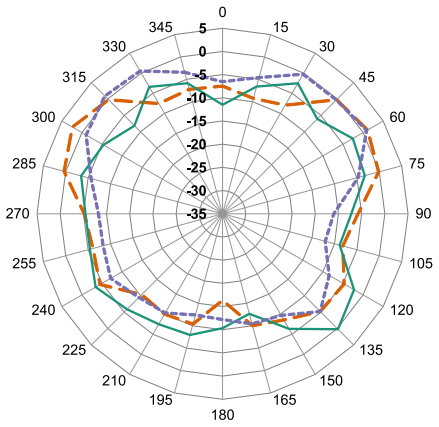
4200 MHz



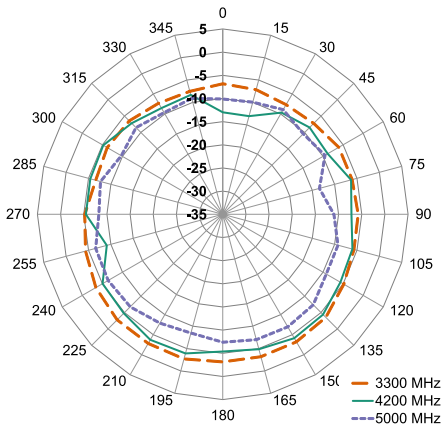
5000 MHz



XZ-Plane Gain



YZ-Plane Gain



XY-Plane Gain

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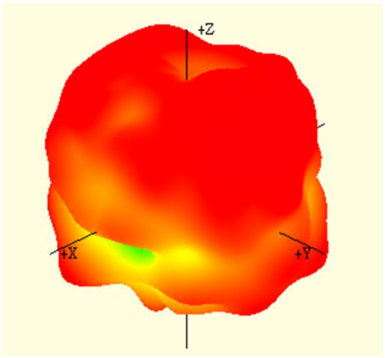
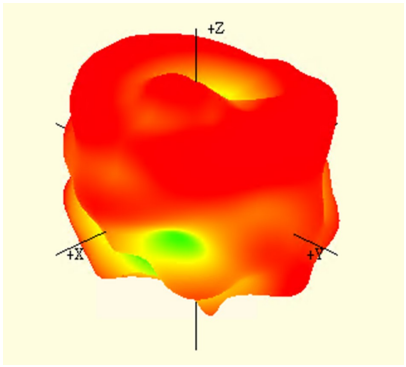
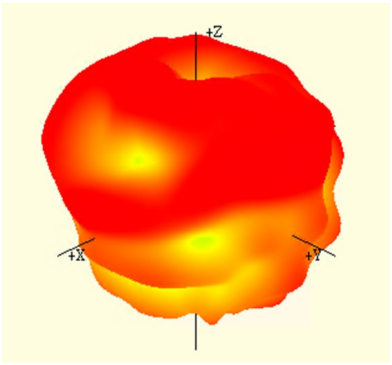
5150 MHz to 5850 MHz (5500 MHz)



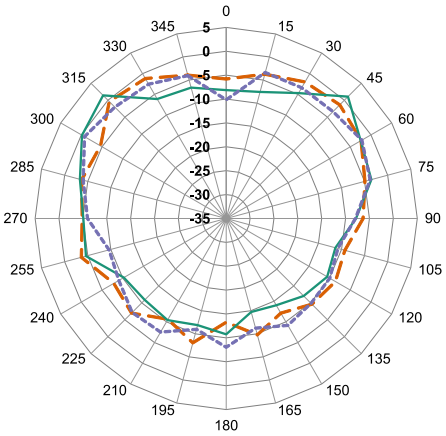
5150 MHz



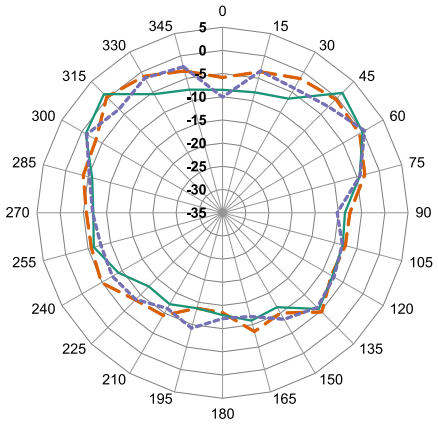
5500 MHz



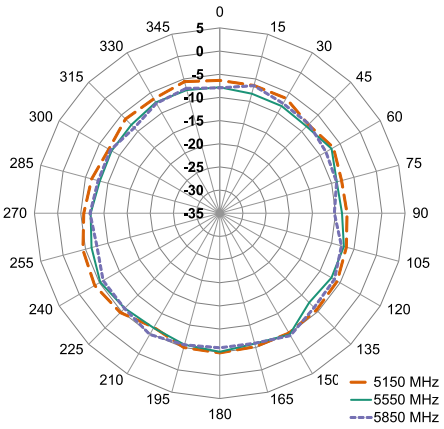
5850 MHz



XZ-Plane Gain

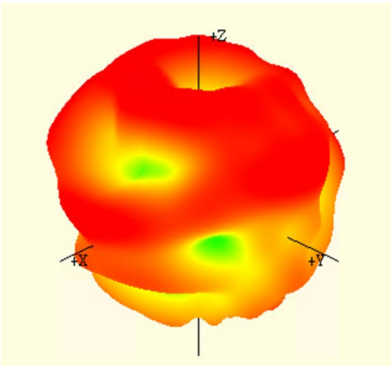


YZ-Plane Gain

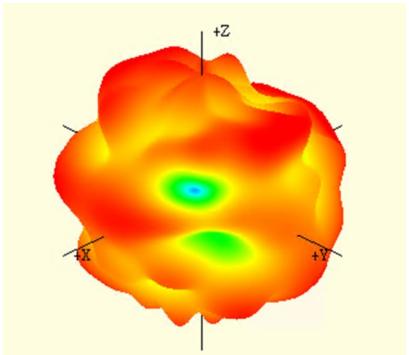


XY-Plane Gain

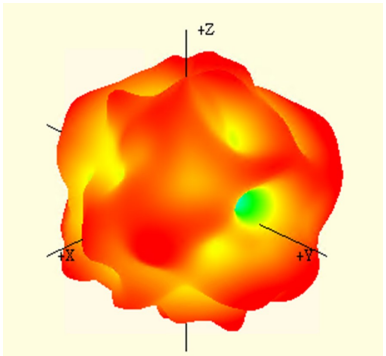
5925 MHz to 7125 MHz (6525 MHz)



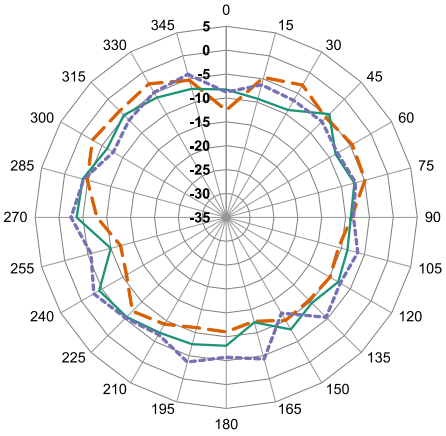
5925 MHz



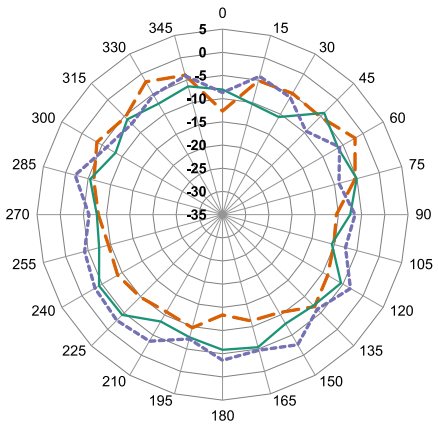
6525 MHz



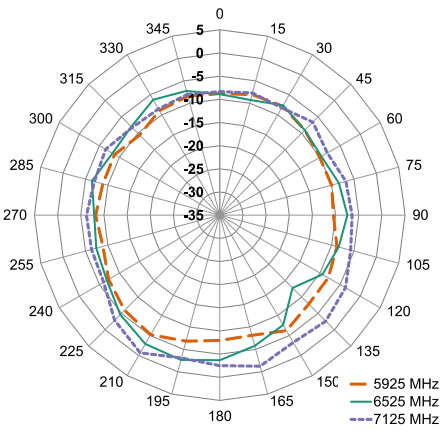
7125 MHz



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

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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