

EDGE OF GROUND PLANE, BENT 90 DEGREES

The charts on the following pages represent data taken with the antenna oriented at the edge of the ground plane, bent 90 degrees (Edge-Bent), as shown in **Figure 11**.

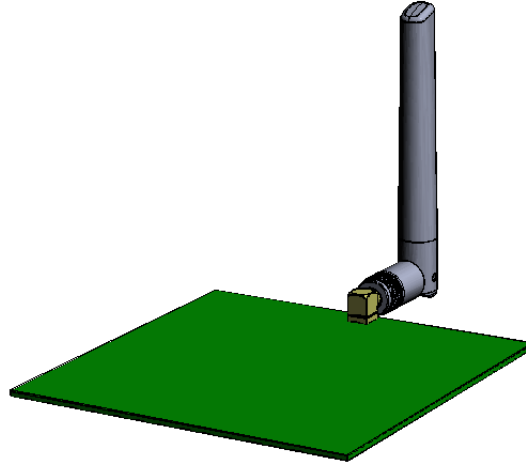


Figure 11. On edge of ground plane, Bent 90 Degrees

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.

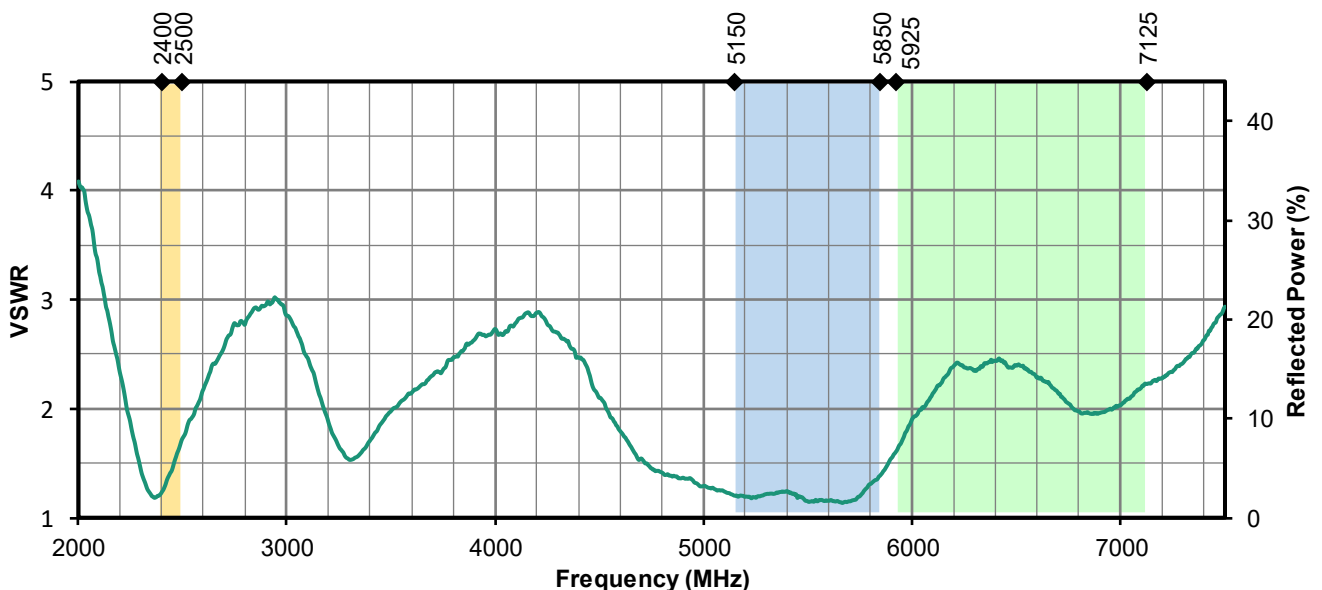


Figure 12. Antenna VSWR, Edge Bent 90 Degrees

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.

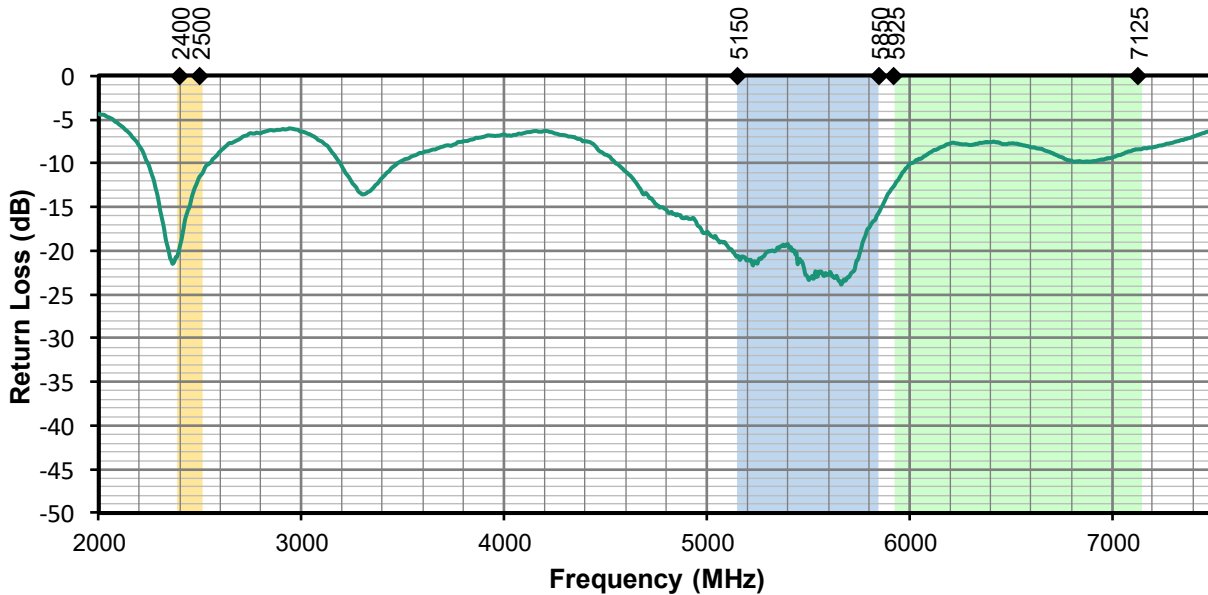


Figure 13. Antenna Return Loss, Edge Bent 90 Degrees

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.

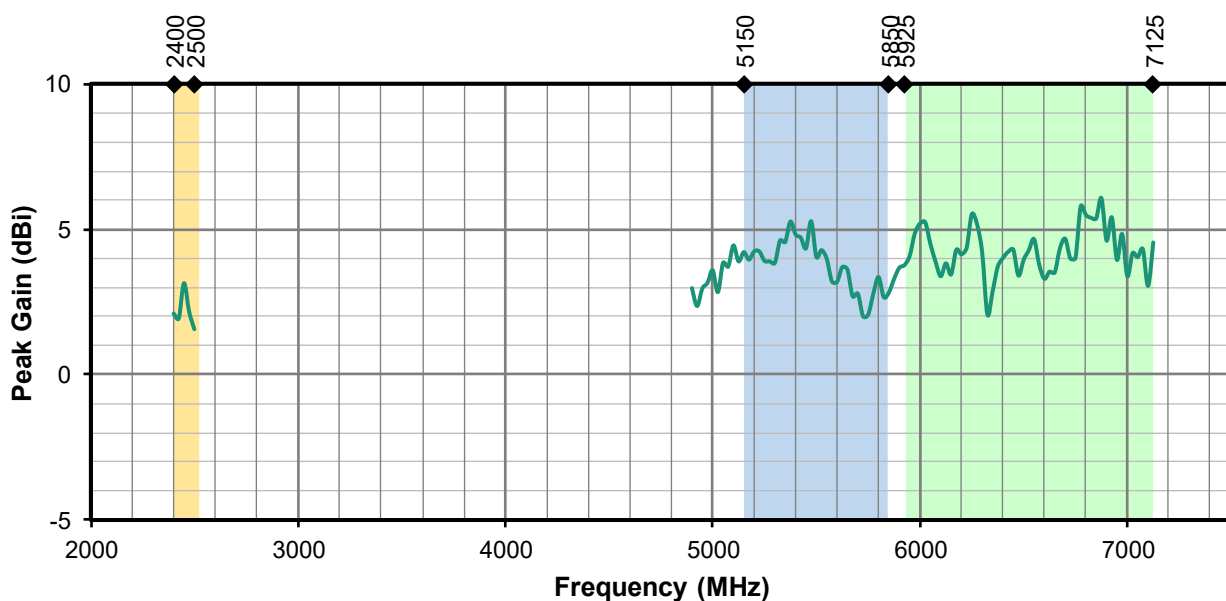


Figure 14. Antenna Peak Gain, Edge Bent 90 Degrees

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.

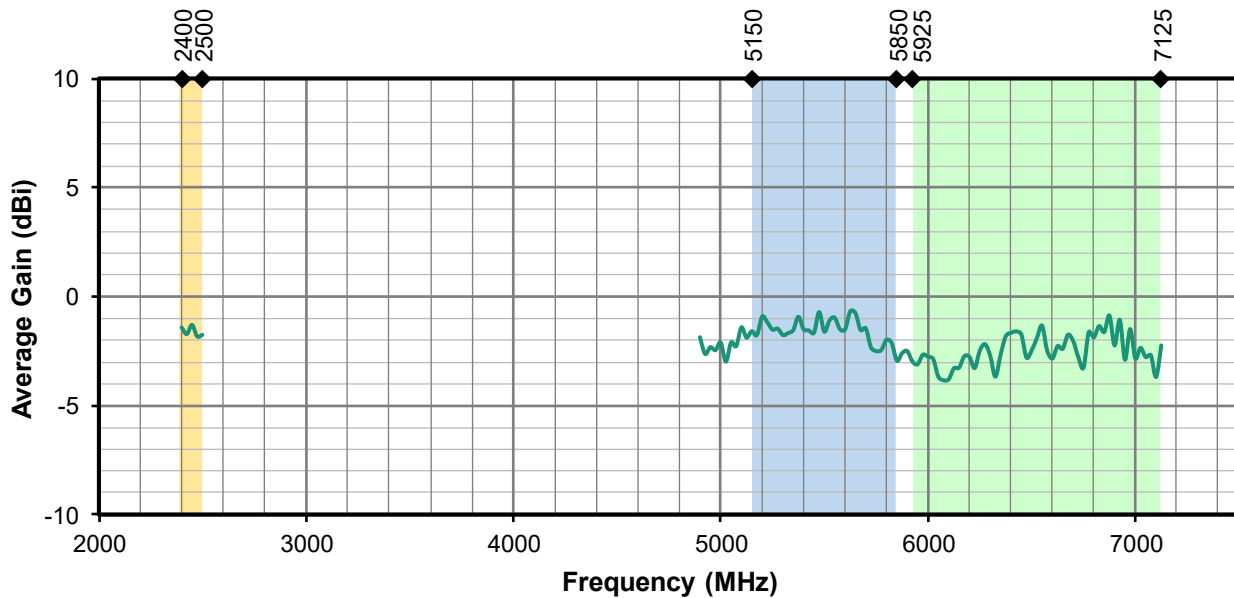


Figure 15. Antenna Average Gain, Edge Bent 90 Degrees

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.

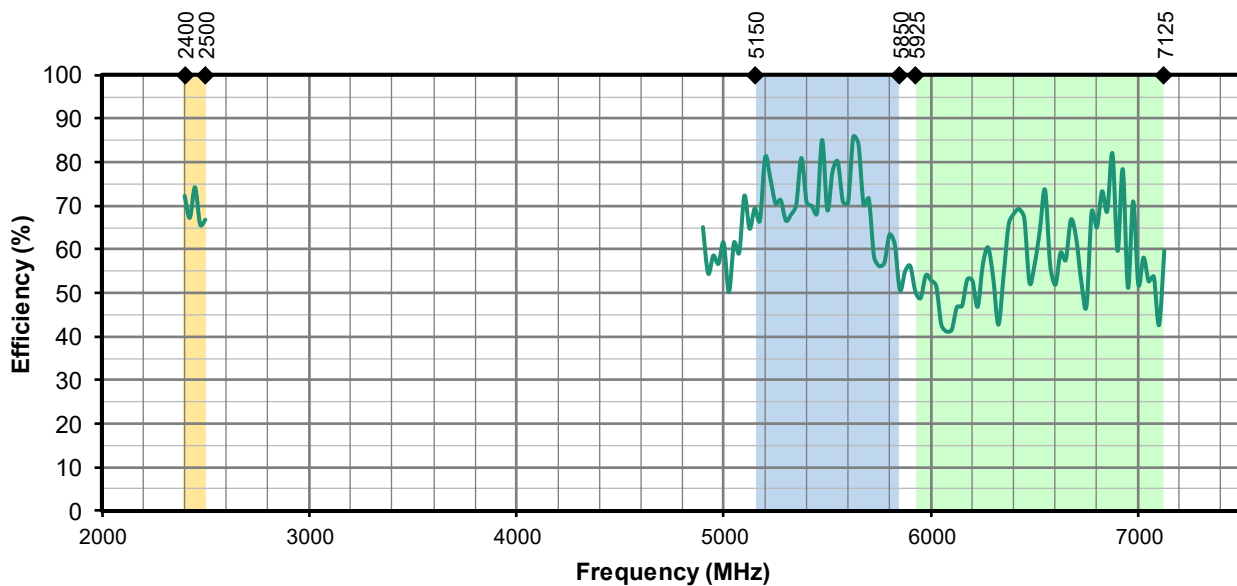
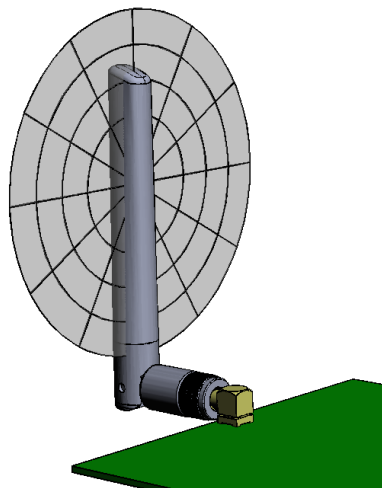


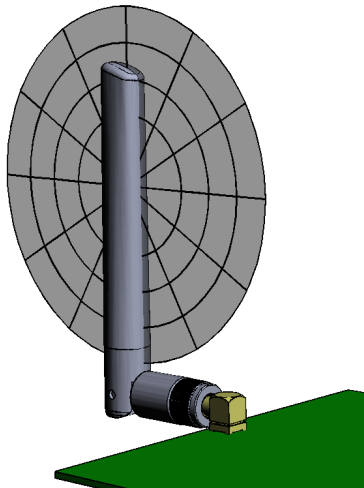
Figure 16. Antenna Efficiency, Edge Bent 90 Degrees

Radiation Patterns

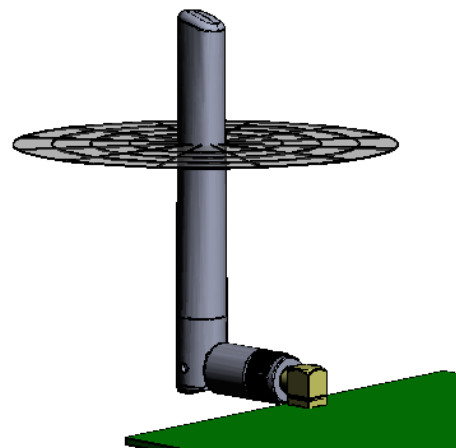
Radiation patterns provide information about the directionality and 3-dimensional gain performance of the antenna by plotting gain at specific frequencies in three orthogonal planes. Antenna radiation patterns for a straight orientation are shown in **Figure 17** using polar plots covering 360 degrees.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



XZ-Plane Gain

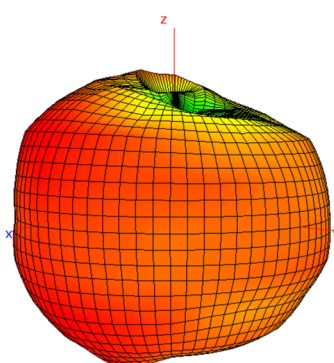


YZ-Plane Gain

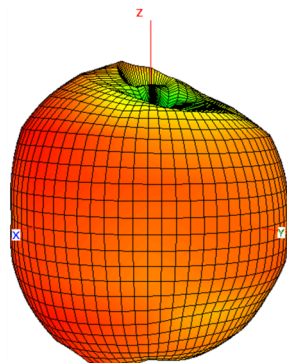


XY-Plane Gain

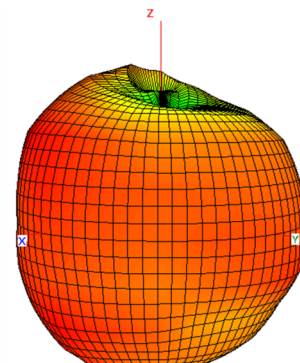
2400 MHz to 2500 MHz (2450 MHz)



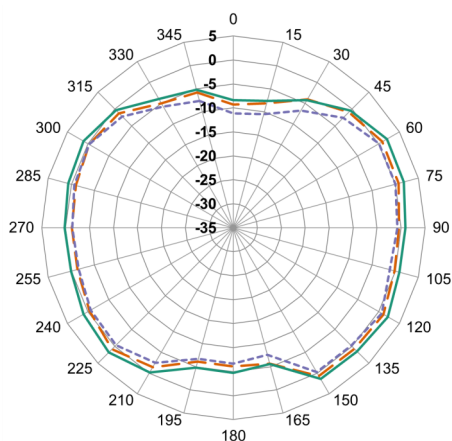
2400 MHz



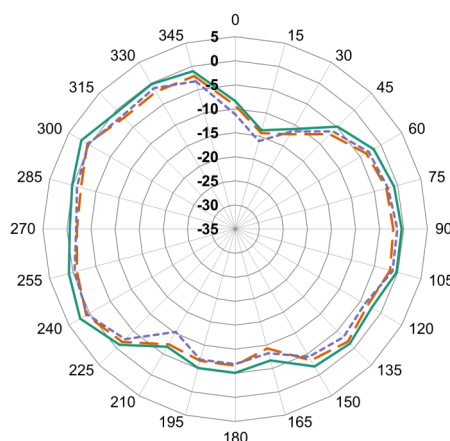
2450 MHz



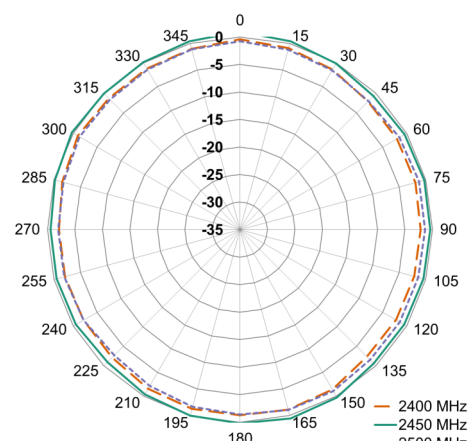
2500 MHz



XZ-Plane Gain



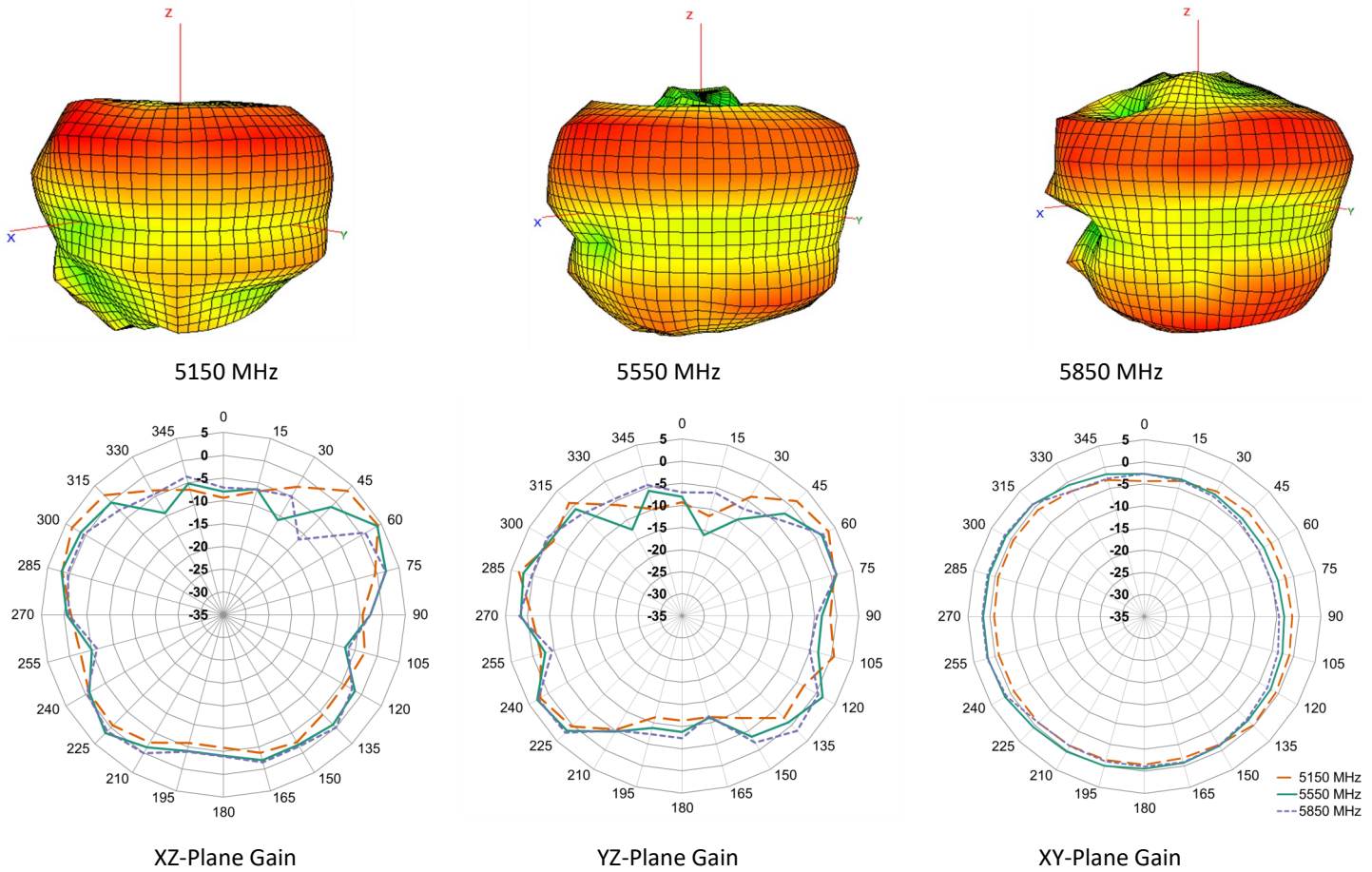
YZ-Plane Gain



XY-Plane Gain

Figure 17. Antenna Radiation Patterns, Edge Bent 90 Degrees

5150 MHz to 5850 MHz (5550 MHz)



5925 MHz to 7125 MHz (6525 MHz)

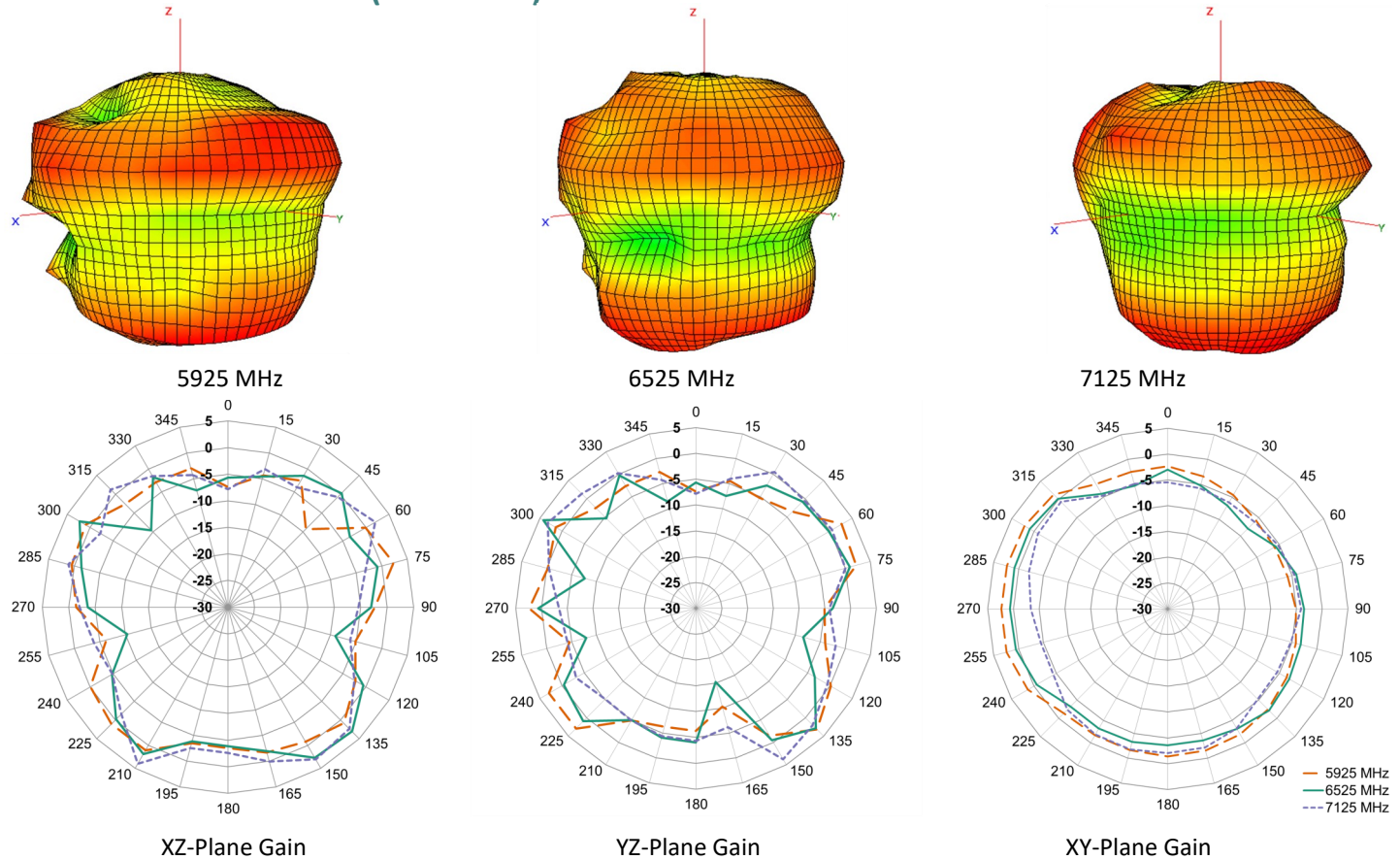


Figure 17-1. Antenna Radiation Patterns, Edge Bent 90 Degrees

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.

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