

GMX-221Acc3B

868/915 MHz LPWA Whip Antenna

The Joymax GMX-221Acc3B antenna is a whip-style, right-angle monopole antenna designed for use in Sub-1 GHz 868 MHz and 915 MHz frequency bands for low-power, wide-area (LPWA) applications such as LoRaWAN®, Sigfox®, Weightless-P®, and WiFi HaLow™ as well as ISM and remote control applications. The antenna features ultra low profile, ideal for IoT products requiring an ultra-compact, aesthetically pleasing antenna in a right angle form factor.

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



Features

- Bandwidth 862 MHz to 930 GHz
- Performance at 915 MHz
 - VSWR: ≤ 1.7
 - Peak Gain: 1.4 dBi
 - Efficiency: 69%
- Ultra-low profile to be easily integrated into small IoT devices
- SMA plug (male pin) or RP-SMA plug (female socket)

Applications

- Low-power, wide-area (LPWA) applications
 - LoRaWAN®
 - Sigfox®
 - Weightless-P®
 - WiFi HaLow™ (802.11ah)
- ISM applications
- Remote control
- Internet of Things (IoT) devices
- Networking routers / gateways

Ordering Information

Part Number	Description
GMX-221ASA3B	868/915 MHz Right-Angle Whip Antenna with SMA plug (male pin) Connector
GMX-221ARS3B	868/915 MHz Right-Angle Whip Antenna with RP-SMA plug (female socket) Connector

Available from Joymax Electronics and select distributors and representatives.

Table 1: Electrical Specifications

GMX-221Acc3B	Sub-1 GHz LPWA & ISM (MHz)	
Frequency Range	862~876 (868)	902~928 (915)
VSWR (Max)	2.4	2.0
Peak Gain (dBi)	1.1	1.8
Average Gain (dBi)	-2.6	-1.8
Efficiency (%)	55	66
Polarization	Linear	
Radiation	Omni directional	
Max Power	1 W	
Wavelength	$\frac{1}{4}\lambda$	
Electrical Type	Monopole	
Impedance	50 Ω	

Electrical specifications and plots measured with a 120 mm x 120 mm (4.72 in. x 4.72 in.) reference ground plane.

Table 2: Mechanical Specifications

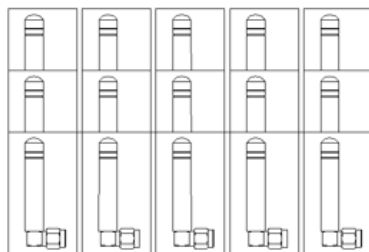
Parameter	Value
Connection	SMA Plug (male pin) or RP-SMA Plug (female socket)
Operating Temp.	-30°C to +70°C
Weight	6.5 g
Dimension	47 mm x \varnothing 8mm
Antenna Color	Black
Ingress Protection	N/A

Packaging Information

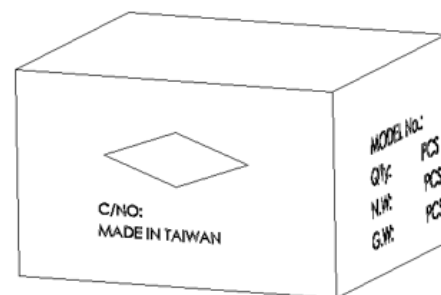
The GMX-221Acc3B antennas are individually sealed in a clear plastic bag. **Figure 1.** 1000 pcs per carton, 320 mm x 250 mm x 230 mm (12.5 in x 9.8 in x 9.0 in), total weight 7.2 kgs (15.87 lb). Distribution channels may offer alternative packaging options.



1 pc antenna/ 1 PE bag



50 pcs antenna/ 1 Bigger PE bag



1000 pcs antenna/ 1 Carton

Figure 1. Antenna Packaging

Product Dimensions

Figure 2 provides dimensions of the GMX-221Acc3B. Despite their tiny size, they are ruggedly constructed and able to withstand punishing environments just like our larger whips.

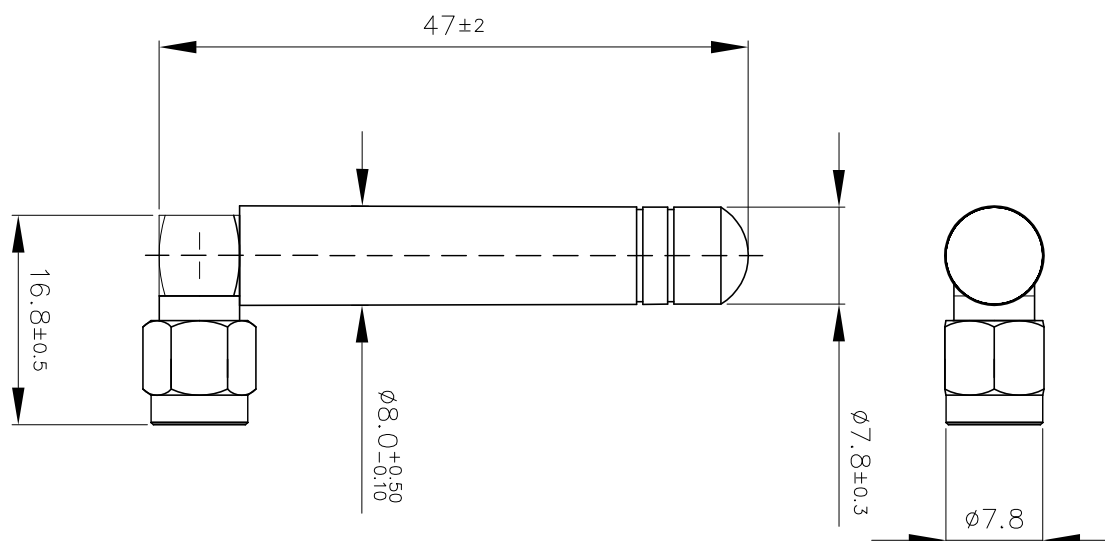


Figure 2. Antenna Dimensions

Antenna Orientation

The GMX-221Acc3B antenna is characterized in right-angle mount antenna orientations with an adjacent ground plane (120 mm x 120 mm) as shown in **Figure 3**. That provides reference insight into antenna performance when attached directly to a printed circuit board mounted connector. The antenna is a 1/4-wave monopole antenna requiring a ground plane to achieve high performance. The charts on the following pages represent data taken with the antenna oriented at the edge of the ground plane.

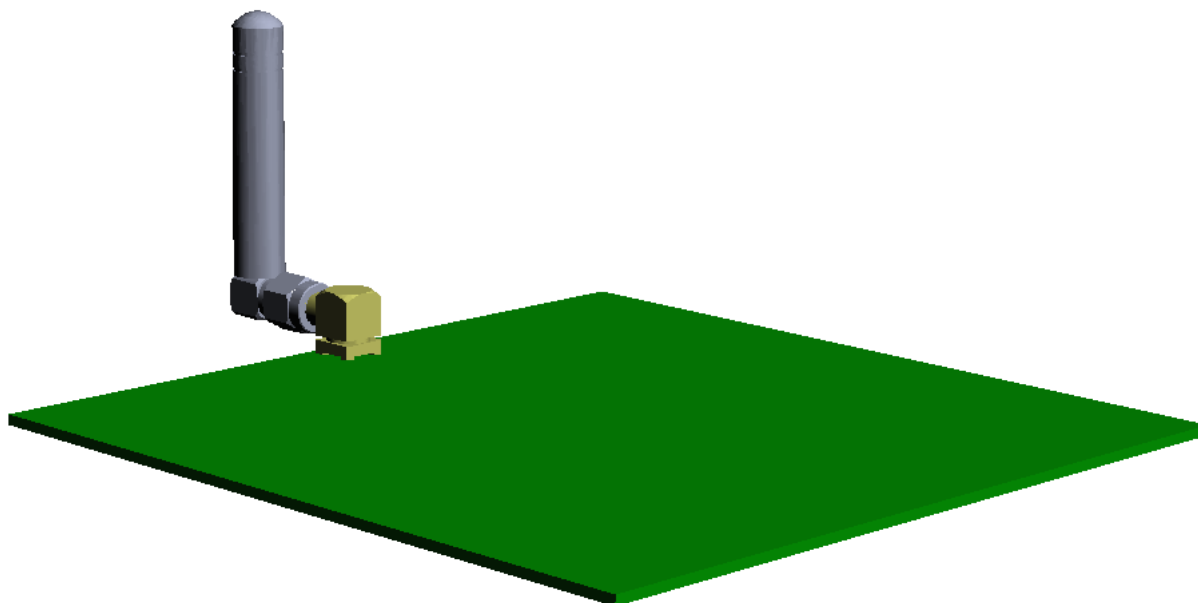


Figure 3. Antenna Test Orientation

VSWR

Figure 4 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.

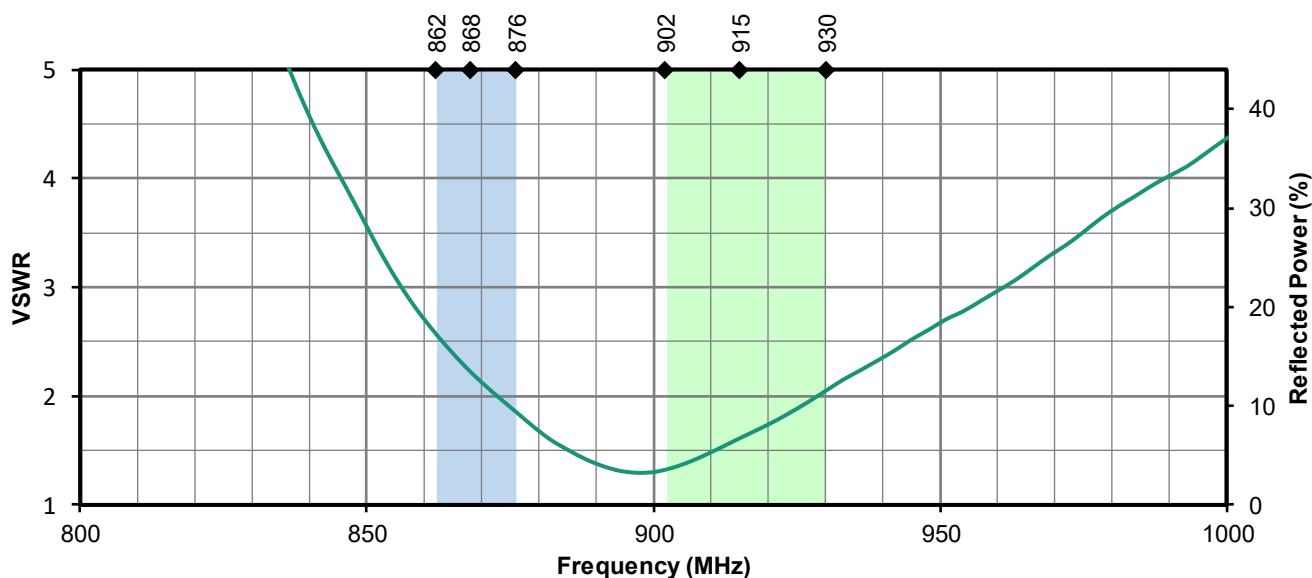


Figure 4. Antenna VSWR

Return Loss

Return loss (**Figure 5**), 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.

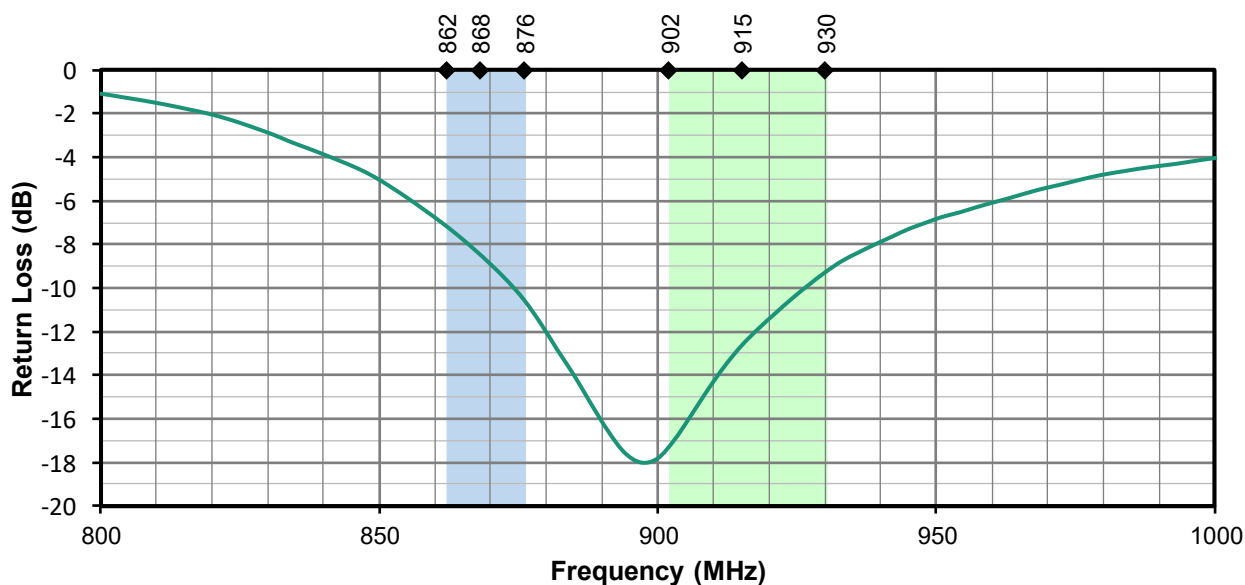


Figure 5. Antenna Return Loss

Peak Gain

The peak gain across the antenna bandwidth is shown in **Figure 6**. 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.

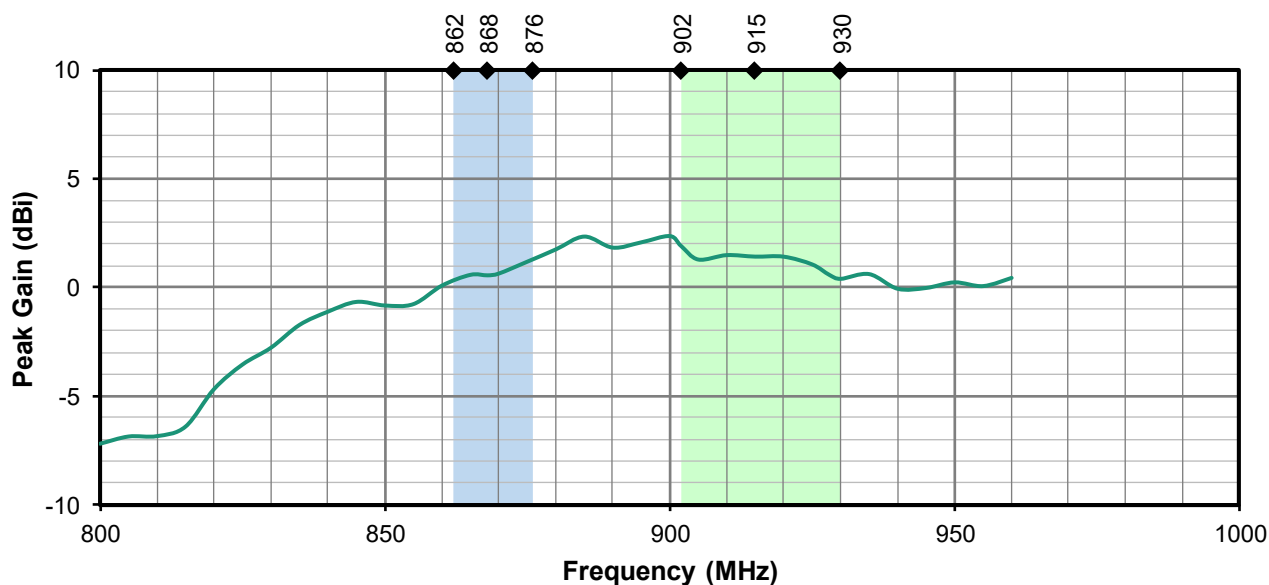


Figure 6. Antenna Peak Gain

Average Gain

Average gain (**Figure 7**), is the average of all antenna gain in 3-dimensional space at each frequency, providing an indication of overall performance without expressing antenna directionality.

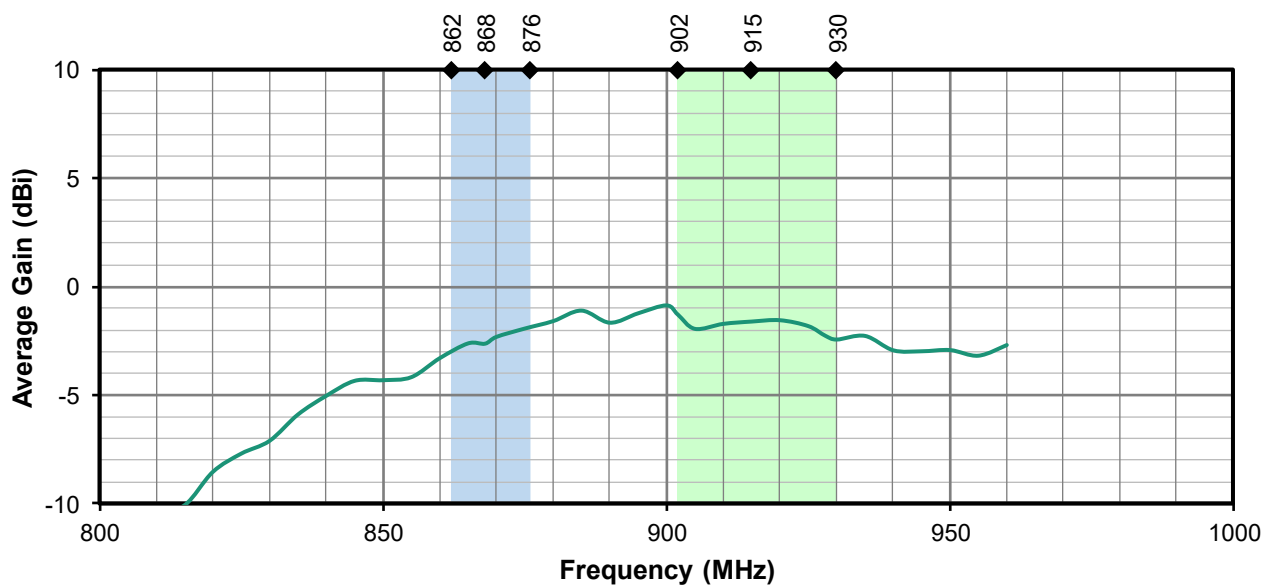


Figure 7. Antenna Average Gain

Radiation Efficiency

Radiation efficiency (**Figure 8**), 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.

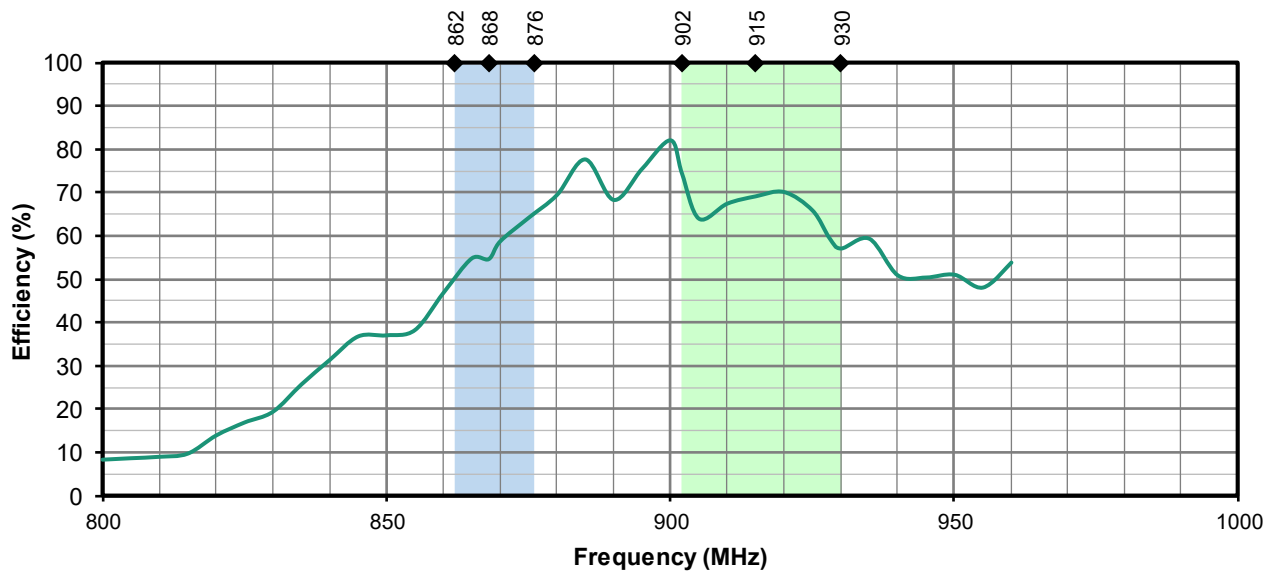
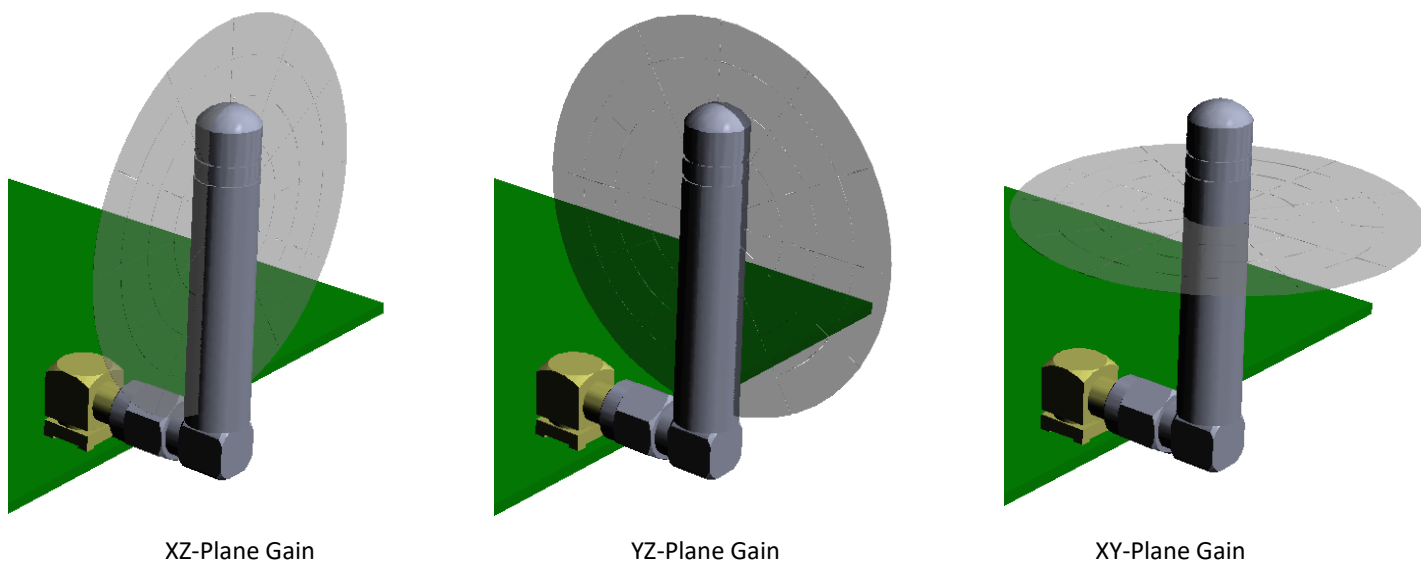


Figure 8. Antenna Efficiency

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 R/A orientation are shown in **Figure 9** 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.



862 MHz to 876 MHz (868 MHz)

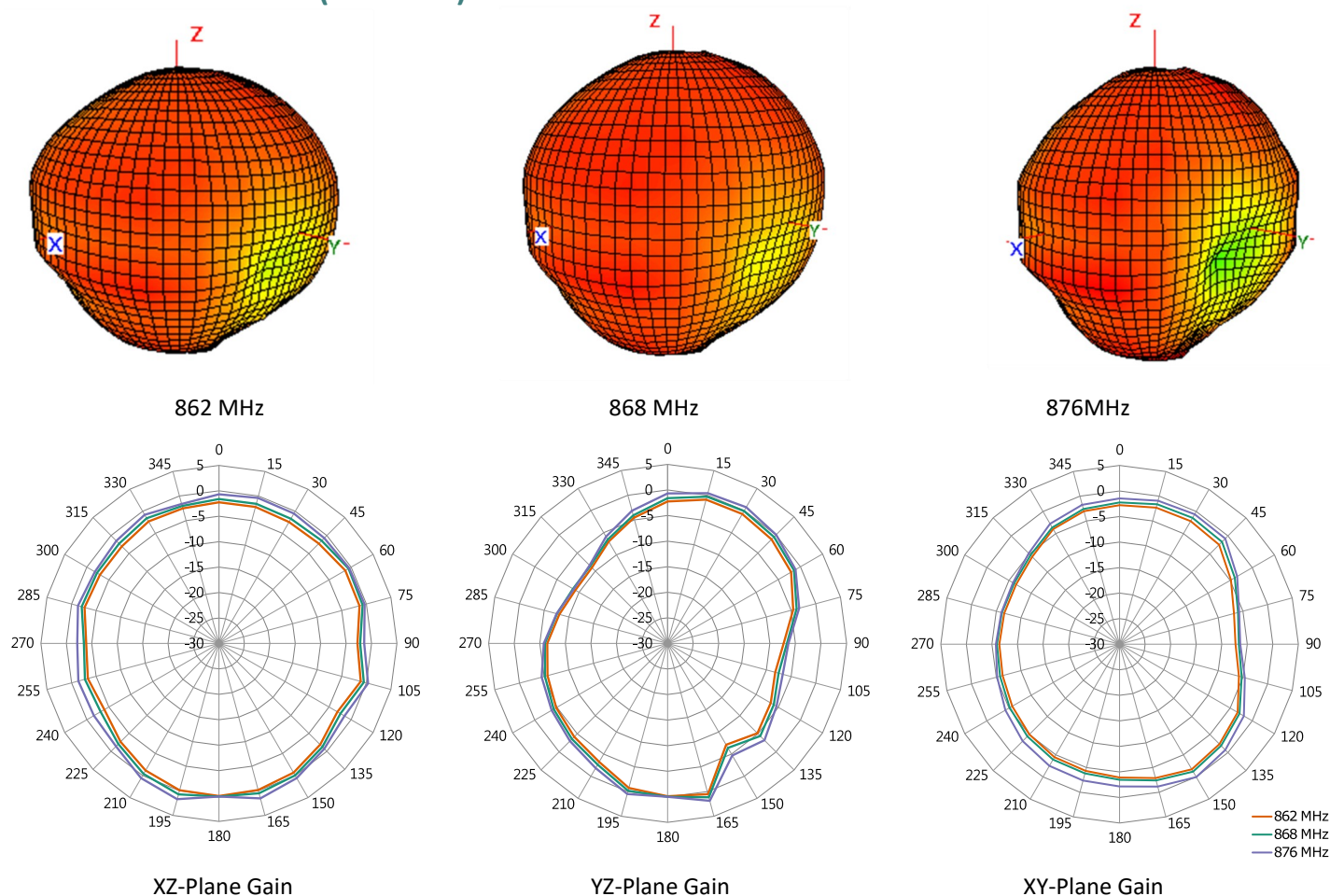


Figure 9. Antenna Radiation Patterns

902 MHz to 928 MHz (915 MHz)

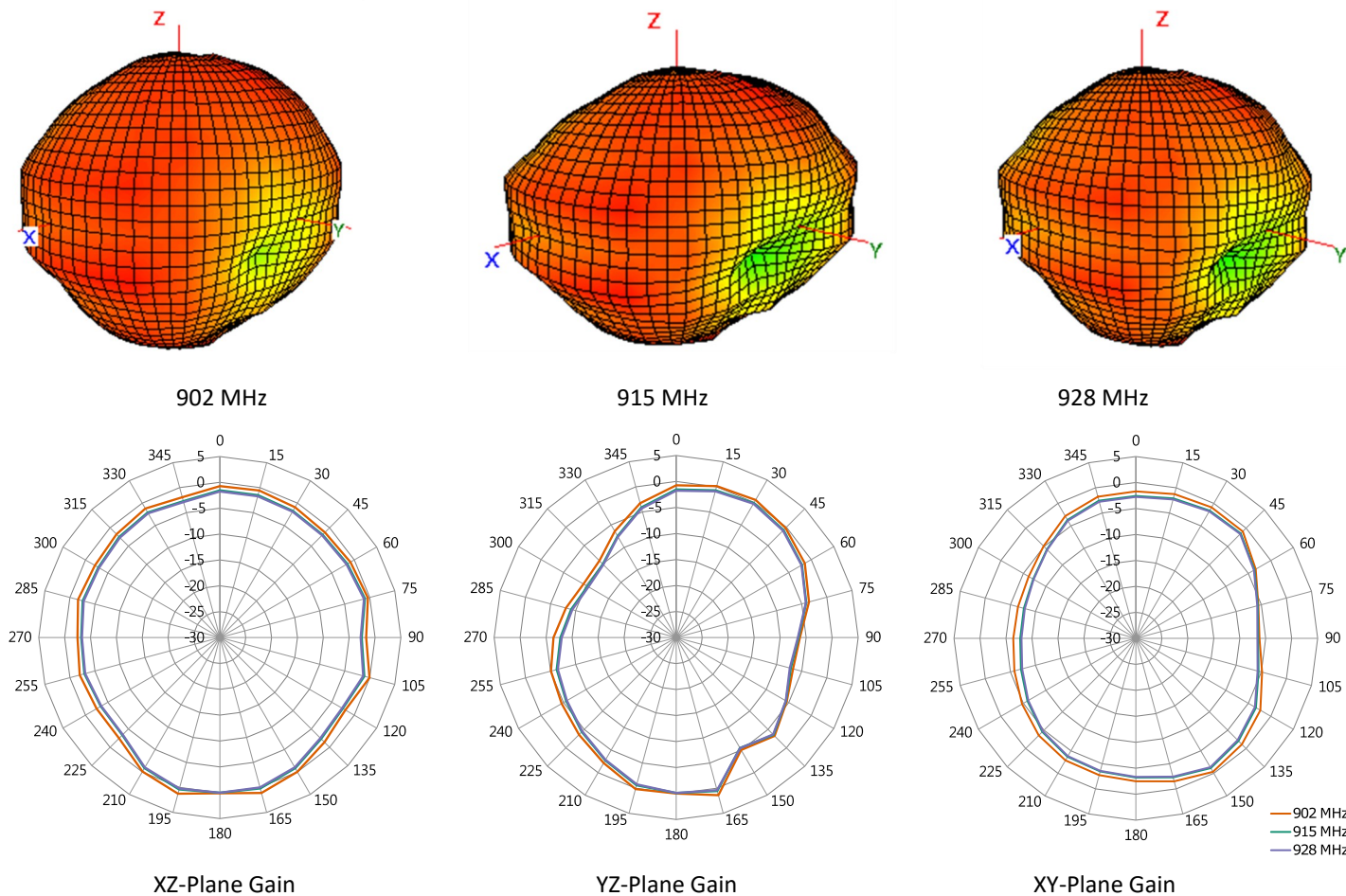


Figure 9-1. Antenna Radiation Patterns

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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