

AC31005

Global Navigation (GNSS) Embedded FPC Antenna

The AC31005 is a linearly polarized, flexible printed circuit (FPC) antenna that delivers robust, omnidirectional performance across all major global navigation systems, including GPS, GLONASS, BeiDou, and Galileo. Its multiband capability enables faster PPP (Precise Point Positioning) convergence, decimeter-level accuracy in positioning and improved resilience against multipath interference or jamming/spoofing.

The AC31005 delivers excellent efficiency and low VSWR in demanding GNSS applications like precision surveying, battery-powered devices or autonomous systems. Its flexible form factor and peel-and-stick adhesive backing simplify installation, making it easy to integrate into compact or uniquely shaped enclosures.

Connection to the radio module is provided via a 1.13 mm coaxial cable terminated with a U.FL-type plug connector, with multiple cable length options available (see Ordering Information).



AC31005-100UF
GNSS GPS Galileo GLONASS Beidou antenna

Features

- Performance at 1.164 GHz to 1.220 GHz
 - VSWR: 3.6
 - Peak Gain: 1.4 dBi
 - Efficiency: 67 %
- Performance at 1.220 GHz to 1.300 GHz
 - VSWR: 3.5
 - Peak Gain: 2.5 dBi
 - Efficiency: 67 %
- Performance at 1.559 GHz to 1.609 GHz
 - VSWR: 2.9
 - Peak Gain: 3.3 dBi
 - Efficiency: 72 %
- Compact T-shape form factor
 - 49.0 mm x 20.0 mm x 0.25 mm
- Linear polarization
- MHF1/U.FL compatible plug termination
- Ground plane independent
- Good out-of-band rejection

Applications

- Global Navigation (GNSS)
 - GPS L1/L2/L5
 - Galileo E1/E5/E6
 - GLONASS G1/G2/G3
 - Beidou B1/B2/B3
 - QZSS
- Timing and Synchronization Applications
- Professional Surveying and Geodesy
- Defense and Security
- OBD-II Modules
- IoT Applications
 - Asset Tracking
 - Smart Energy
 - M2M Industrial
 - Wearables/Healthcare
 - Autonomous systems (UAV/Drones, Delivery robots, Agricultural machinery)

Ordering Information

Part Number	Description	Cable Length	Connector
AC31005-050UF	GNSS L1/L2/L5 49 mm x 20 mm FPC Antenna	50 mm (1.97 in)	MHF1/U.FL-type plug (male)
AC31005-100UF	GNSS L1/L2/L5 49 mm x 20 mm FPC Antenna	100 mm (3.94 in)	MHF1/U.FL-type plug (male)
AC31005-150UF	GNSS L1/L2/L5 49 mm x 20 mm FPC Antenna	150 mm (5.91 in)	MHF1/U.FL-type plug (male)
AC31005-200UF	GNSS L1/L2/L5 49 mm x 20 mm FPC Antenna	200 mm (7.87 in)	MHF1/U.FL-type plug (male)

Electrical Specifications

Center Frequency	GNSS Bands	VSWR	Return Loss (dB)	Peak Gain (dBi)	Efficiency (%)
1176 MHz	GPS L5, Galileo E5a	3.6	-4.9	1.3	61
1207 MHz	GLONASS G3, Galileo E5b, Beidou B2	2.9	-6.1	1.4	67
1228 MHz/1248 MHz	GPS L2, GLONASS G2	2.7	-6.8	1.7	66
1269 MHz/1279 MHz	Beidou B3, Galileo E6	3.5	-5.0	2.5	61
1561 MHz/1575 MHz	Beidou B1, GPS L1, Galileo E1, GLONASS II L1, COMPASS C/II/Beidou B1-BOC, QZSS	2.5	-7.5	3.3	72
1601 MHz/1602 MHz	GLONASS I L1, GLONASS II L1	2.9	-6.3	3.3	62
Impedance	50 Ω				
Polarization	Linear				
Radiation Pattern	Omnidirectional				
Wavelength	$\frac{1}{2}$ -wave				
Max Power	2 W				
Electrical Type	Dipole				

Electrical specifications and plots measured with the antenna mounted on a 2 mm (0.08 in) thick sheet of ABS plastic.

Mechanical Specifications

Part Number	AC31005-050UF	AC31005-100UF	AC31005-150UF	AC31005-200UF
Weight	0.4 g (0.01 oz)	0.5 g (0.02 oz)	0.6 g (0.02 oz)	0.7 g (0.02 oz)
Coaxial cable, minimum inside bend radius	1.13 mm: 5.0 mm (0.20 in)			
Connection	MHF1/U.FL-type plug (male)			
Dimensions	49.0 mm x 20.0 mm x 0.25 mm (1.93 in x 0.79 in x 0.01 in)			
Operating Temp. Range	-40 °C to +85 °C (-40 °F to 185 °F)			
Recommended Storage Conditions	16° C - 27° C and 40% to 60% relative humidity			

Antenna Mounting

The AC31005 antenna is a flexible, adhesive-backed antenna that allows it to be permanently installed onto non-metallic surfaces. The adhesive backing is 3M 467MP™, which provides outstanding adhesion to high surface energy plastics. The adhesive delivers excellent shear strength to resist slippage and edge lifting, but can be repositioned before the adhesive cures, allowing for accurate positioning. This adhesive is highly resistant to solvents, humidity and moisture, as well as heat up to 204 °C (400 °F) for short periods.

The antenna should never be bent to the point of creating a crease or allowing the angle of the bend to fall below 90 degrees (i.e. become acute) as this will impair function and may cause permanent damage.

Antenna Dimensions

The dimensions for the AC31005 are shown below in Figure 1.

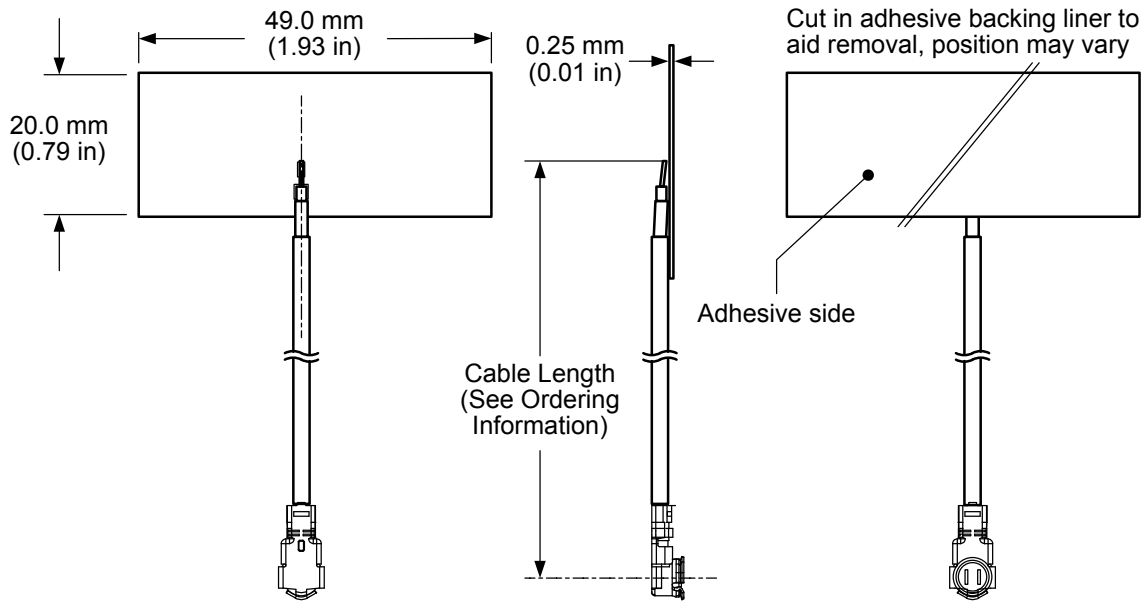


Figure 1. AC31005 Antenna Dimensions

VSWR

Figure 2 provides the voltage standing wave ratio (VSWR) across the antenna bandwidth. VSWR characterizes the power reflected from the antenna back to the transmitter. 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 measure of the percentage of transmitter power reflected back from the antenna.

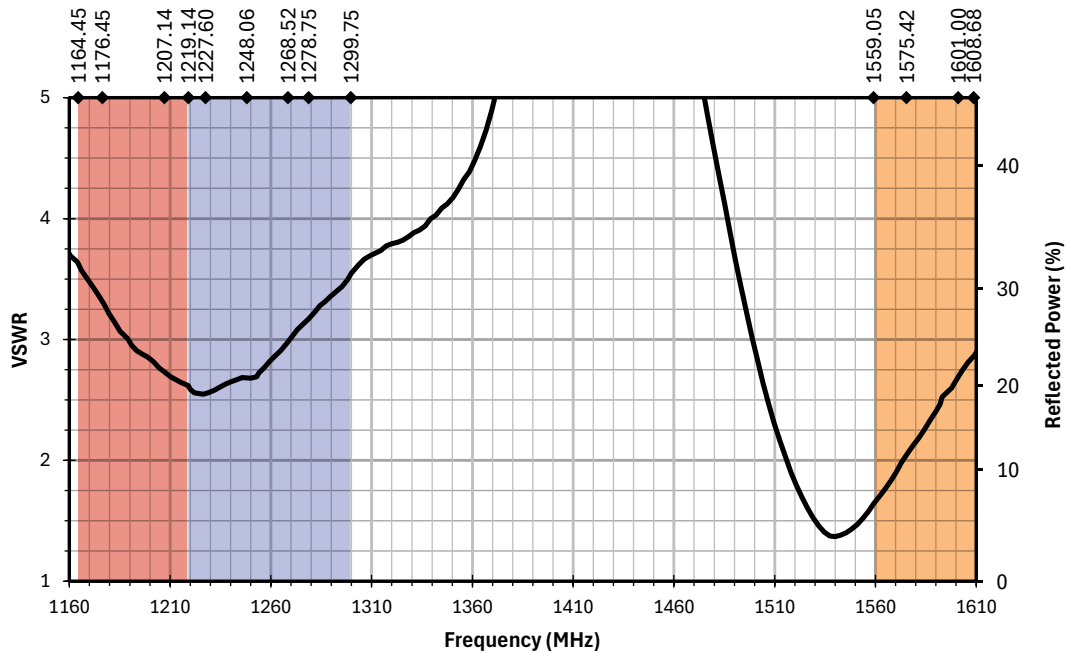


Figure 2. AC31005 Antenna VSWR with Frequency Band Highlights

Return Loss

Return loss (Figure 3) represents the loss in power at the antenna due to reflected signals. A higher magnitude return loss indicates better performance. Return loss is the negative of input reflection coefficient, in decibels (dB), and the two values are often used interchangeably.

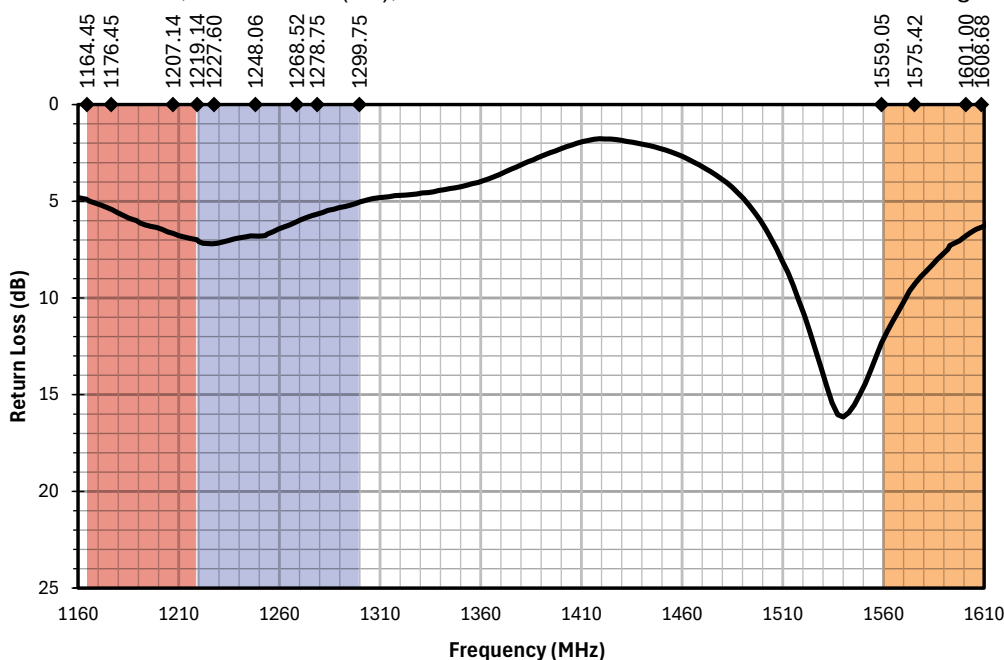


Figure 3. AC31005 Antenna Return Loss with Frequency Band Highlights

Peak Gain

Peak gain (Figure 4) provides a measure of the maximum conversion of antenna input power to radio waves at a given frequency. Peak gain does not account for the directionality of gain in 3-dimensional space.

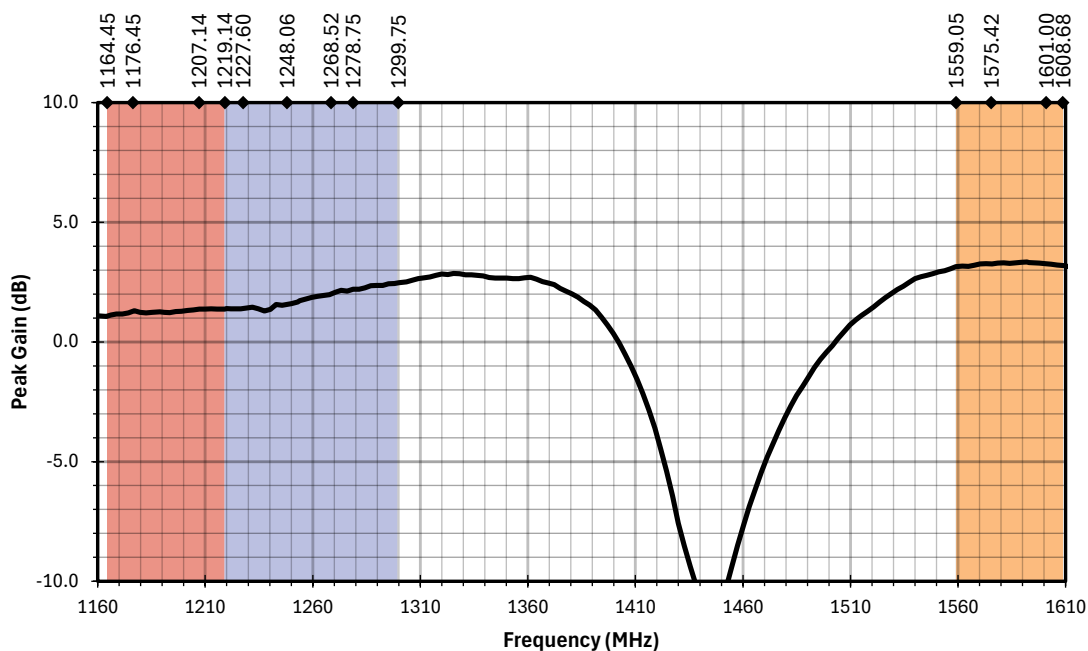


Figure 4. AC31005 Antenna Peak Gain with Frequency Band Highlights

Average Gain

Average gain (Figure 5) is the average of all antenna gain in 3-dimensional space at each frequency, providing an indication of overall performance without expressing antenna directionality.

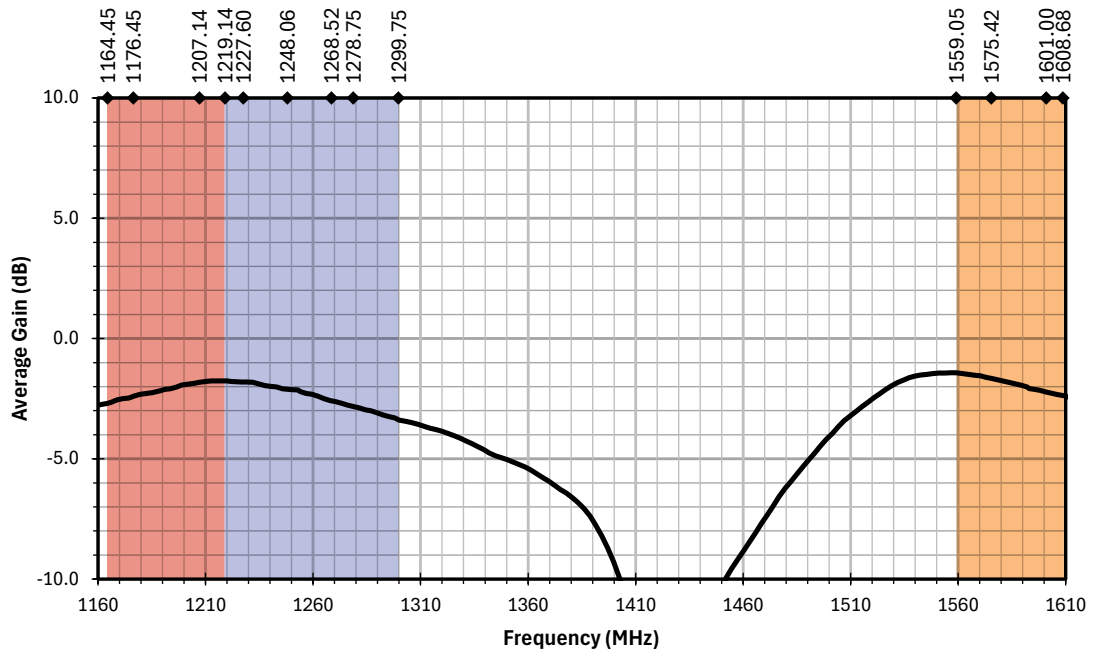


Figure 5. AC31005 Antenna Average Gain with Frequency Band Highlights

Efficiency

Efficiency (Figure 6) is the ratio of power delivered to the antenna relative to the power radiated at the antenna, expressed as a percentage, where a higher percentage indicates better performance at a given frequency.

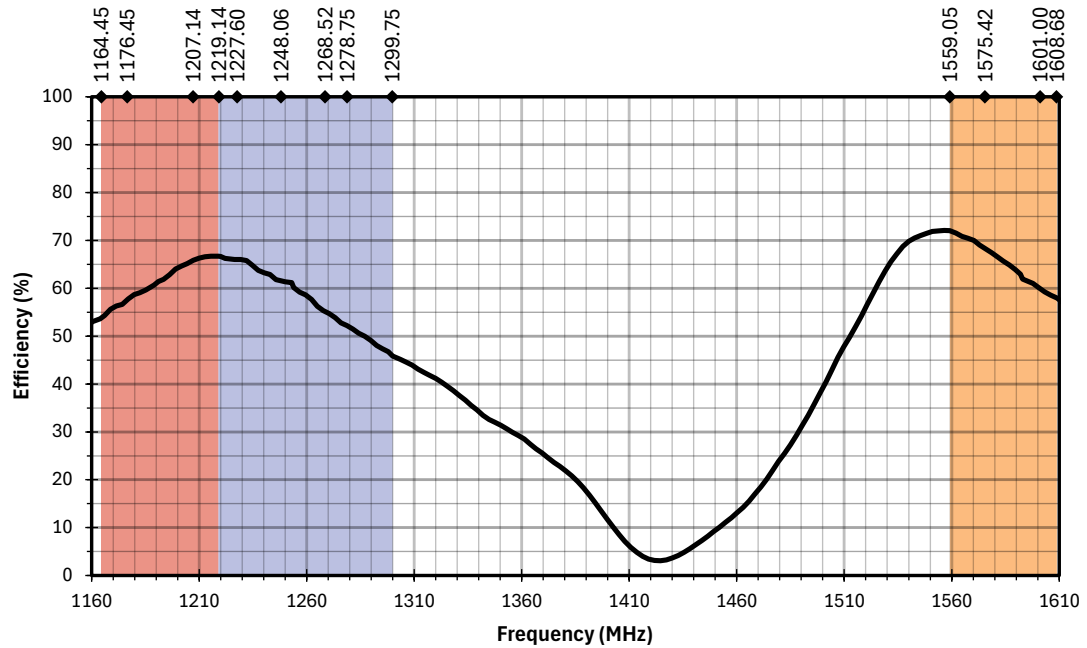
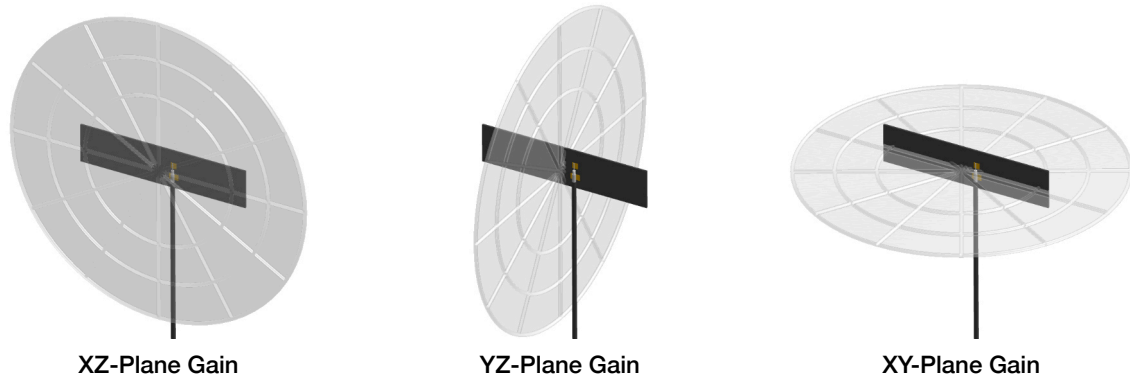


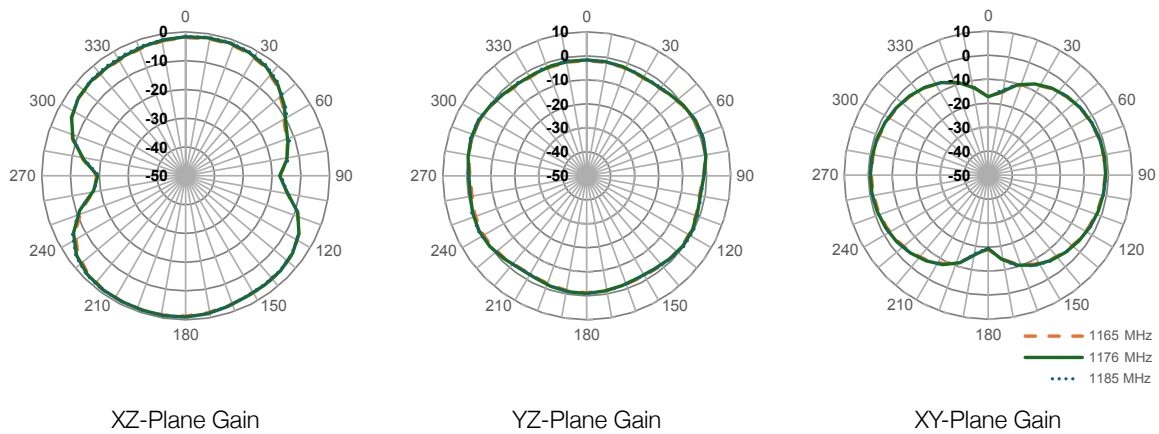
Figure 6. AC31005 Antenna Efficiency with Frequency Band Highlights

Radiation Patterns

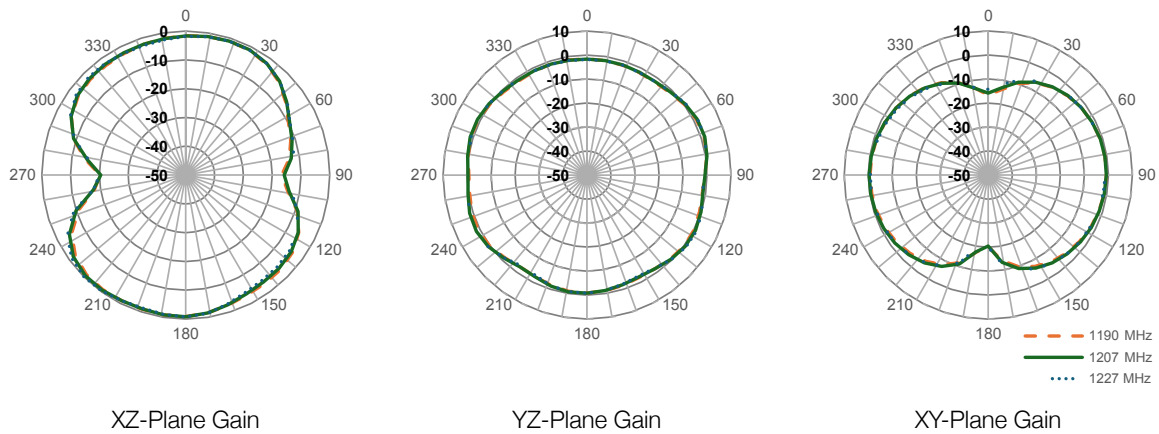
Radiation patterns provide information about the directional performance of the antenna by plotting gain in three orthogonal planes at the high-, low- and center-frequencies of an antenna frequency band. Antenna radiation patterns (Figure 7) are shown using polar plots covering 360 degrees with the plane of reference depicted above the plots. Note: when viewed with typical PDF viewing software, zooming into radiation patterns is possible to reveal fine detail.



1165 MHz to 1185 MHz (1176 MHz)

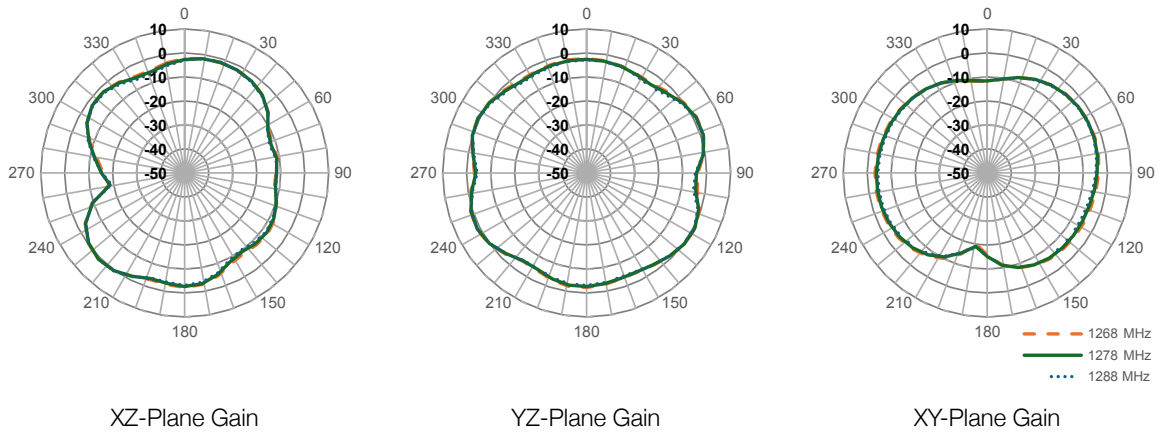


1190 MHz to 1227 MHz (1207 MHz)

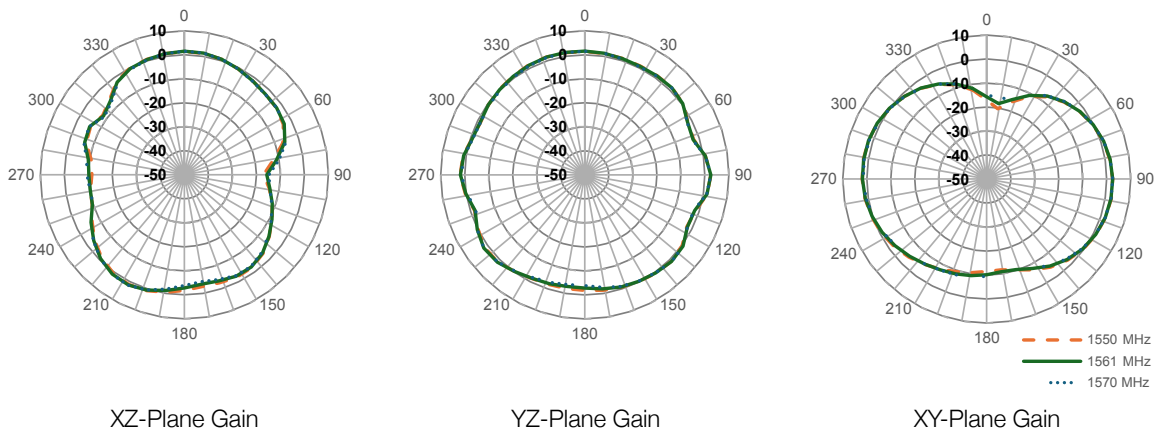


Radiation Patterns

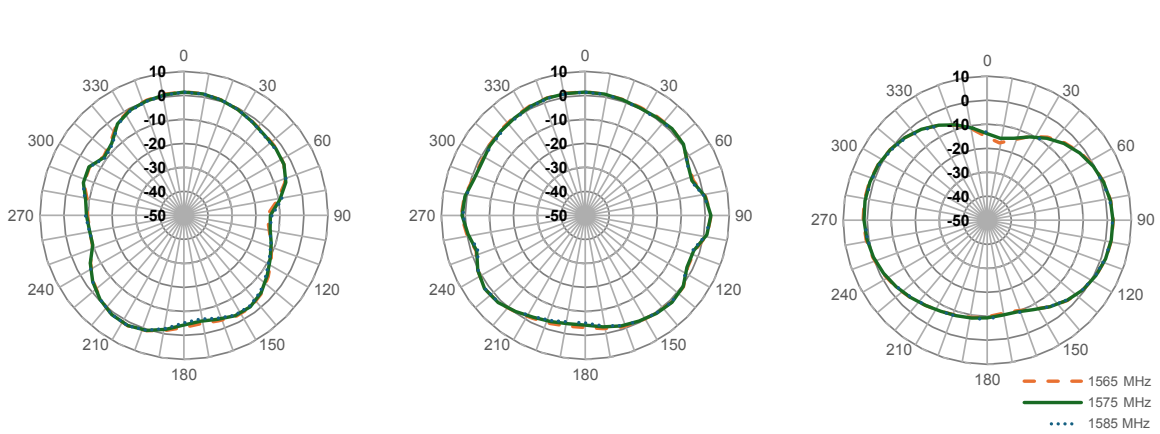
1268 MHz to 1288 MHz (1278 MHz)



1550 MHz to 1570 MHz (1561 MHz)



1565 MHz to 1585 MHz (1575 MHz)



1589 MHz to 1610 MHz (1601 MHz)

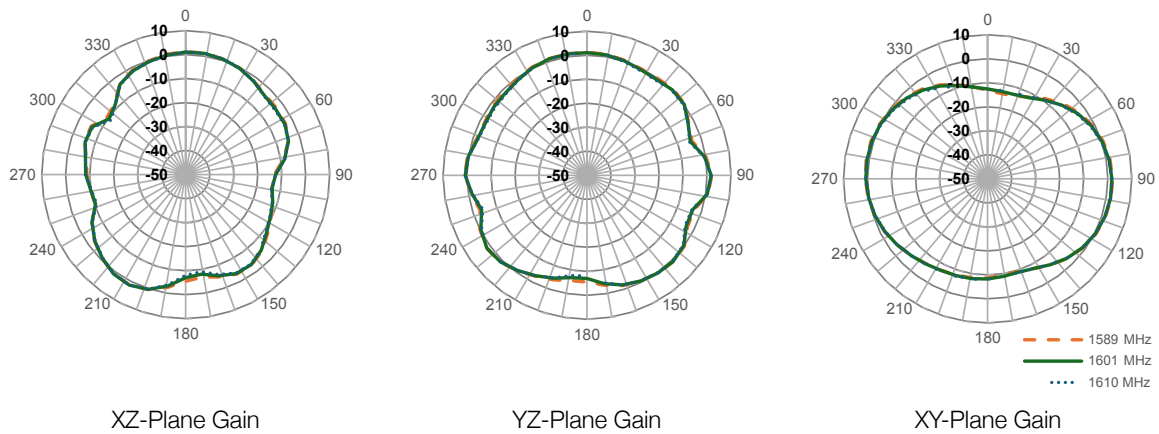


Figure 7. Radiation Patterns for AC31005 Antenna

Packaging Information

The AC31005 antenna is individually packaged in a labeled polyethylene bag and bulk packaged in a polyethylene bag in quantities of 50 pcs. Sealed bulk polyethylene bags are packed in cartons in quantities totaling 8000 pieces per carton. Carton dimensions are 340 mm x 340 mm x 200 mm (13.4 in x 13.4 in x 7.9 in).

Antenna Definitions and Useful Formulas

VSWR - Voltage Standing Wave Ratio. VSWR is a unitless ratio that describes the power reflected from the antenna back to the radio. A lower VSWR value indicates better antenna performance at a given frequency. VSWR is easily derived from Return Loss.

$$VSWR = \frac{10^{\left[\frac{\text{Return Loss}}{20}\right]} + 1}{10^{\left[\frac{\text{Return Loss}}{20}\right]} - 1}$$

Return Loss - Return loss represents the loss in power at the antenna due to reflected signals, measured in decibels. A larger magnitude return loss value indicates better antenna performance at a given frequency. Return Loss is easily derived from VSWR.

$$\text{Return Loss} = -20 \log_{10} \left[\frac{VSWR - 1}{VSWR + 1} \right]$$

Efficiency (η) - The total power radiated from an antenna divided by the input power at the feed point of the antenna as a percentage.

Total Radiated Efficiency - (TRE) The total efficiency of an antenna solution comprising the radiation efficiency of the antenna and the transmitted (forward) efficiency from the transmitter.

$$TRE = \eta \cdot \left(1 - \left(\frac{VSWR - 1}{VSWR + 1} \right)^2 \right)$$

Gain - The gain of an antenna is the ratio of its radiation intensity in a given direction (G) to the radiation intensity that would be obtained if the total power accepted by the antenna were radiated isotropically (identically in all directions). Realized gain is antenna gain accounting for input reflection and mismatch losses. Realized gain is typically labeled simply as “gain” in antenna datasheets.

$$G_{db} = 10 \log_{10}(G)$$

$$G_{dBd} = G_{dBi} - 2.51dB$$

Peak Gain - The highest antenna gain across all directions for a given frequency range. A directional antenna will have a very high peak gain compared to average gain.

Average Gain - The average gain across all directions for a given frequency range.

Maximum Power - The maximum signal power which may be applied to an antenna feed point, typically measured in watts (W).

Reflected Power - A portion of the forward power reflected back toward the amplifier due to a mismatch at the antenna port.

$$\left(\frac{VSWR - 1}{VSWR + 1} \right)^2$$

decibel (dB) - A logarithmic unit of measure of the power of an electrical signal.

decibel isotropic (dBi) - A comparative measure in decibels between an antenna under test and an isotropic radiator.

decibel relative to a dipole (dBd) - A comparative measure in decibels between an antenna under test and an ideal half-wave dipole.

Dipole - An ideal dipole comprises a straight electrical conductor measuring 1/2 wavelength from end to end connected at the center to a feed point for the radio.

Isotropic Radiator - A theoretical antenna which radiates energy equally in all directions as a perfect sphere.

Omnidirectional - Term describing an antenna radiation pattern that is uniform in all directions. An isotropic antenna is the theoretical perfect omnidirectional antenna. An ideal dipole antenna has a donut-shaped radiation pattern and other practical antenna implementations will have less perfect but generally omnidirectional radiation patterns which are typically plotted on three axes.

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Series: FPC.

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