

AC16502 2.4 GHz 30.5 mm Straight Whip Antenna

The Antenna Company AC16502 straight whip antennas provide a very compact omnidirectional 2.4 GHz antenna solution for all ISM applications including Bluetooth®, BLE and ZigBee®.

The 30.5 mm long straight whip (“rubber duck”) antenna performs adjacent to a ground plane or in free space including non-metallic enclosures. Additionally, the AC16502 supports IP65 ingress protection for wet and dusty applications.

The AC16502 whip antennas are available with SMA or reverse-polarity SMA (RP-SMA) plug (male) connector.



AC16502-SMA 2.4 GHz
Straight Whip Antenna

Features

- Very high efficiency
- IP65 ingress protection
- Dimensions: 30.5 mm x 8.0 mm
- Performance at 2.4 GHz to 2.485 GHz
 - VSWR: 1.8
 - Peak Gain: 7.8
 - Efficiency: 82
- SMA and RP-SMA termination options

Applications

- 2.4 GHz ISM applications
 - Bluetooth
 - Bluetooth Low Energy (BLE)
 - ZigBee
 - Wi-Sun
- Internet of Things (IoT) devices
- WLAN Gateways/Routers

Ordering Information

Part Number	Description
AC16502-SMA	SMA connector 2.4 GHz 30.5 mm straight whip antenna
AC16502-RPS	RP-SMA connector 2.4 GHz 30.5 mm straight whip antenna

Available from The Antenna Company (sales@antennacompany.com) and select distributors and representatives.

RF/Electrical Specifications

Parameter	Value
Frequency	2400 MHz to 2485 MHz
VSWR (max)	1.8
Peak Gain (dBi)	7.8
Average Gain (dBi)	-1.0
Average Efficiency (%)	79
Impedance	50 Ω
Polarization	Linear
Radiation Pattern	Omnidirectional
Wavelength	$\frac{1}{2}$ -wave
Max Power	10 W
Electrical Type	Dipole

Electrical specifications and plots measured with the antenna in free space.

Mechanical Specifications

Parameter	Value
Connection	SMA or RP-SMA
Ingress Protection	IP65
Weight	3.2 g (0.11 oz)
Dimensions	30.5 mm x 8.0 mm (1.20 in x 0.31 in)
Operating Temp. Range	-40 °C to +85 °C (-104 °F to 185 °F)
Operating Relative Humidity	10-95%
Ingress Protection	IP65

Antenna Dimensions

Figure 1 provides dimensions of the AC16502 antenna.

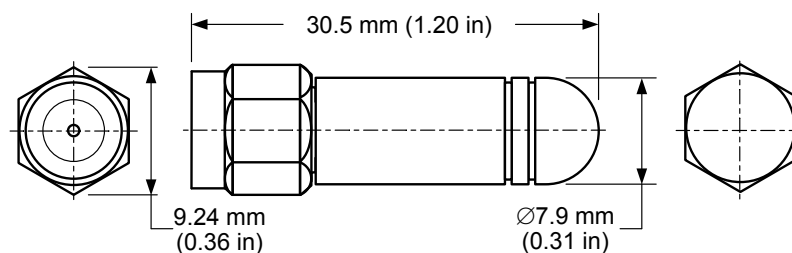


Figure 1. AC16502 Antenna Dimensions

Antenna Test Orientations

The AC16502 antenna is characterized in two antenna orientations as shown in Figure 2. Although the antenna does not require a ground plane to function, characterization on an adjacent ground plane (100 mm x 100 mm) provides insight into antenna performance when attached to a printed circuit board with ground plane. The antenna free space orientation characterizes use of an antenna attached to a non-metallic enclosure. These two orientations represent common end-product use cases.

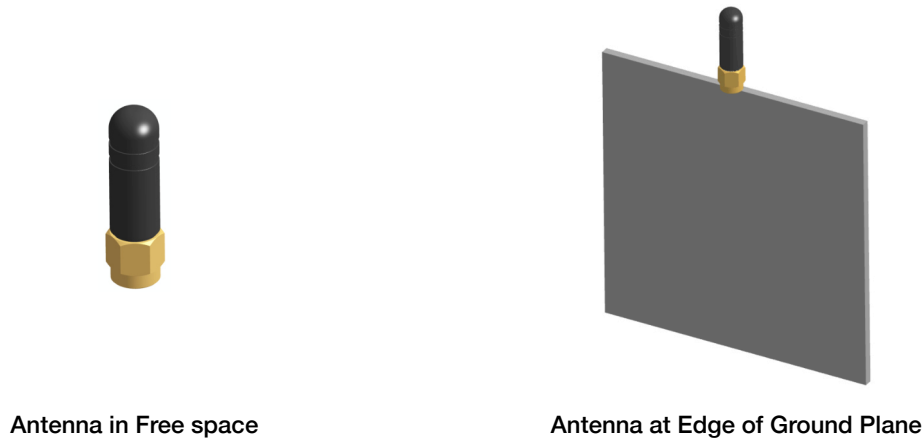


Figure 2. AC16502 Test Orientations

Free Space, No Ground Plane

The charts on the following pages represent data taken with the antenna in free space as shown in Figure 3.



Figure 3. AC16502 Antenna in Free Space

VSWR

Figure 4 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.

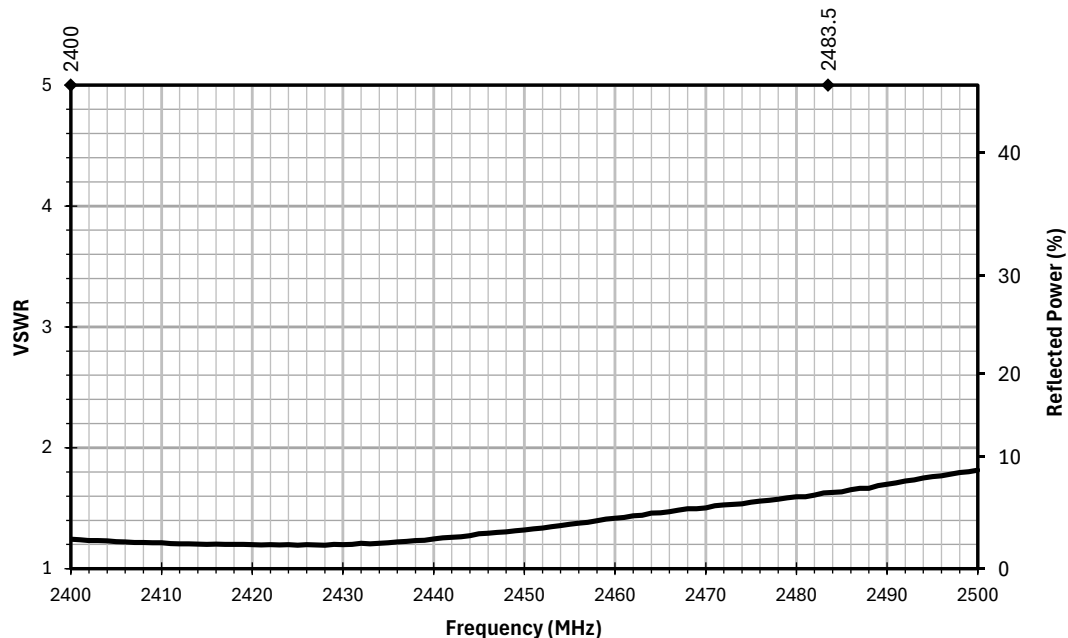


Figure 4. AC16502 Antenna VSWR, Free Space

Return Loss

Return loss (Figure 5) 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.

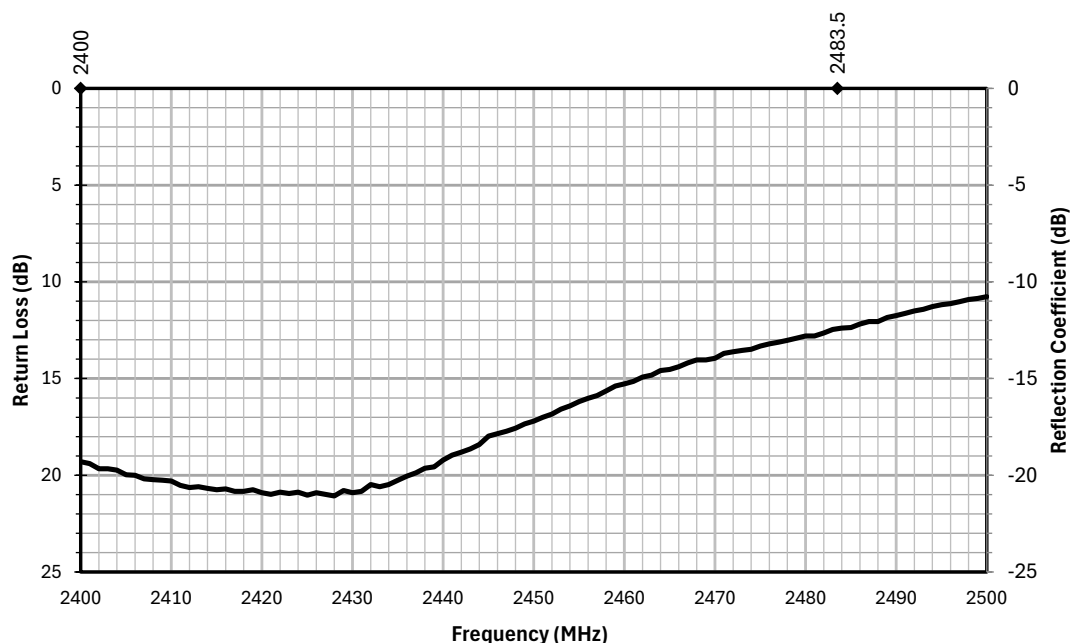


Figure 5. AC16502 Antenna Return Loss, Free Space

Peak Gain

Peak gain (Figure 6) 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.

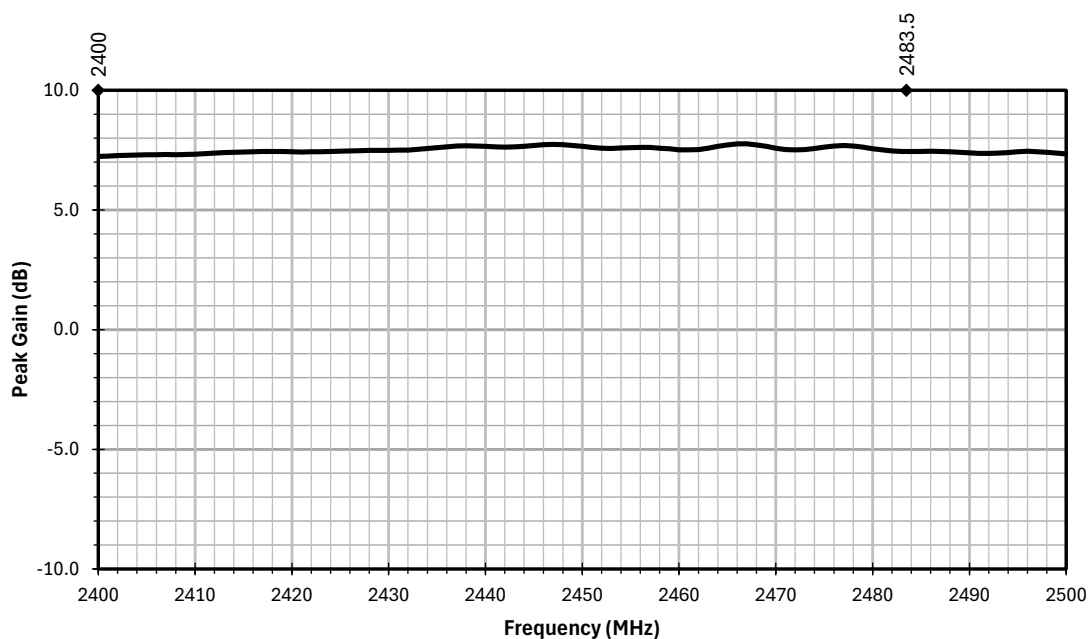


Figure 6. AC16502 Antenna Peak Gain, Free Space

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.

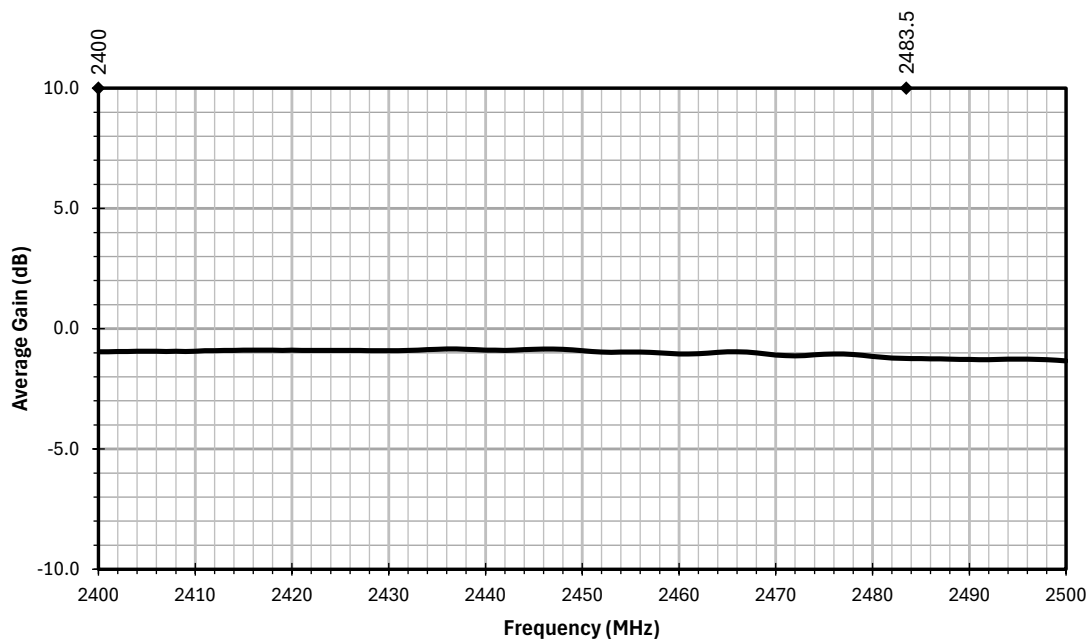


Figure 7. AC16502 Antenna Average Gain, Free Space

Efficiency

Efficiency (Figure 8) 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.

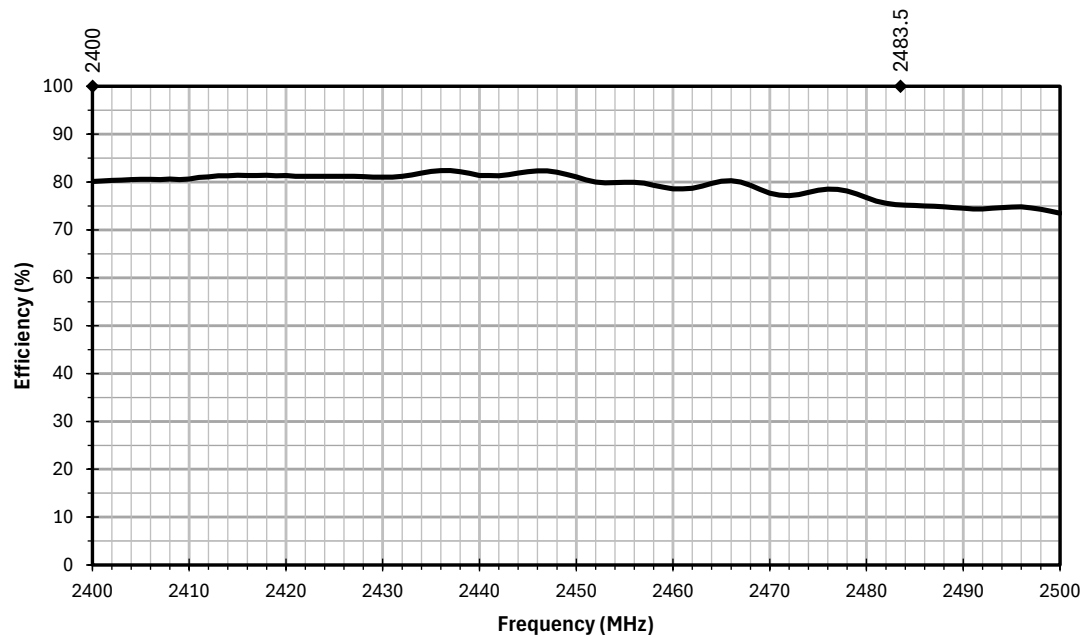
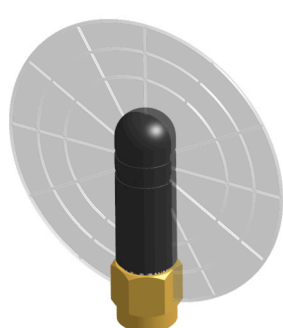


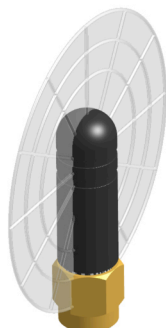
Figure 8. AC16502 Antenna Efficiency, Free Space

Radiation Patterns - Free Space

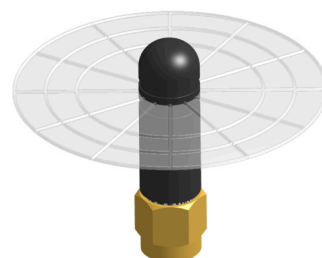
Radiation patterns provide information about the directional performance of the antenna by plotting gain in three orthogonal planes at the high-, low- and center-frequencies of an antenna frequency band. Antenna radiation patterns (Figure 9) are shown using polar plots covering 360 degrees with the plane of reference depicted above the plots. Note: when viewed with typical PDF viewing software, zooming into radiation patterns is possible to reveal fine detail.



XZ-Plane Gain

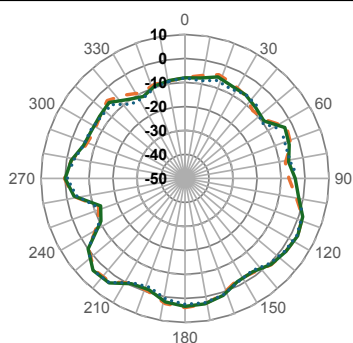


YZ-Plane Gain

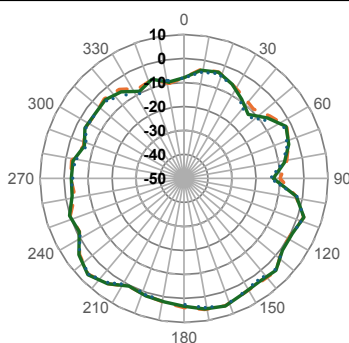


XY-Plane Gain

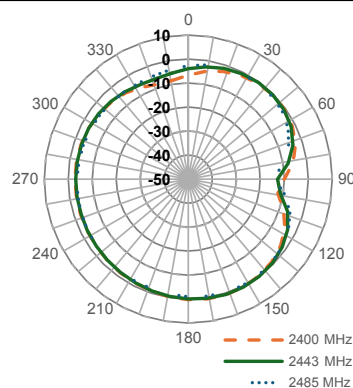
2400 MHz to 2485 MHz (2445 MHz)



XZ-Plane Gain



YZ-Plane Gain



XY-Plane Gain

Figure 9. Radiation Patterns for the AC16502 Antenna, in Free Space

Edge of Ground Plane

The charts on the following pages represent data taken with the antenna at the edge of a 100 mm x 100 mm ground plane as shown in Figure 10.

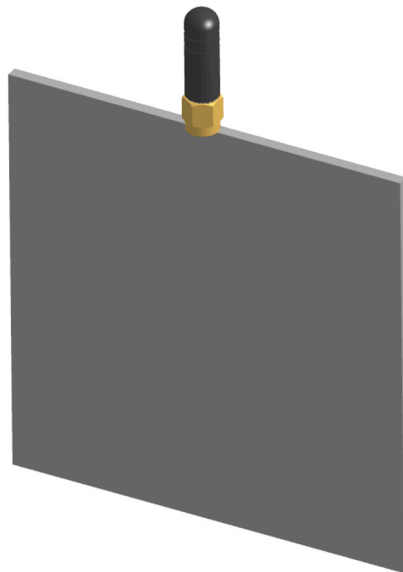


Figure 10. AC16502 Antenna at Edge of Ground Plane

VSWR

Figure 11 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.

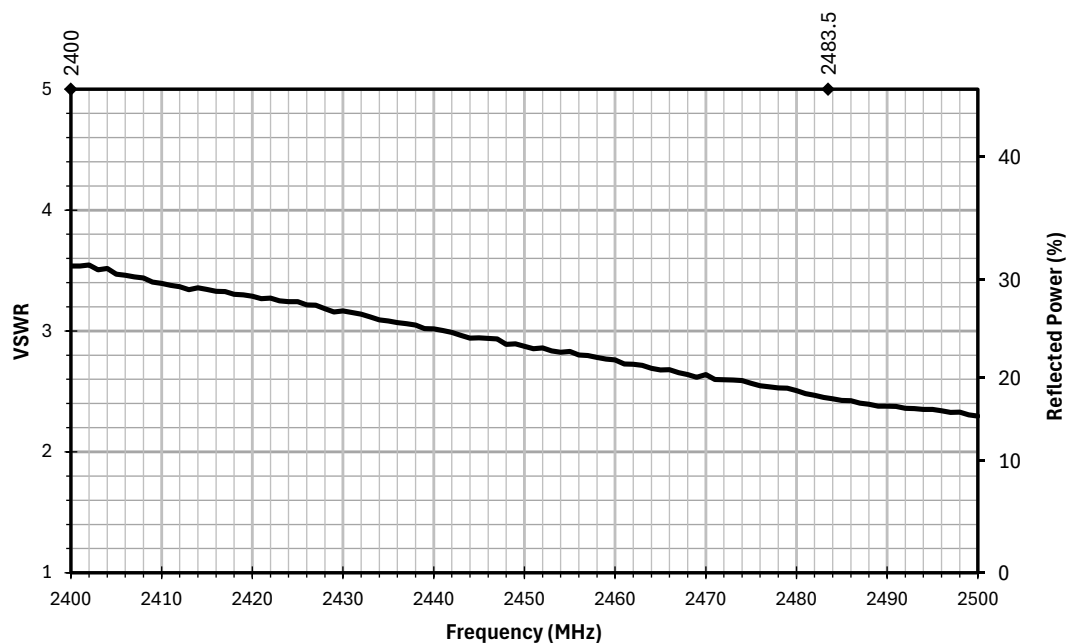


Figure 11. AC16502 Antenna VSWR at Edge of Ground Plane

Return Loss

Return loss (Figure 12) 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.

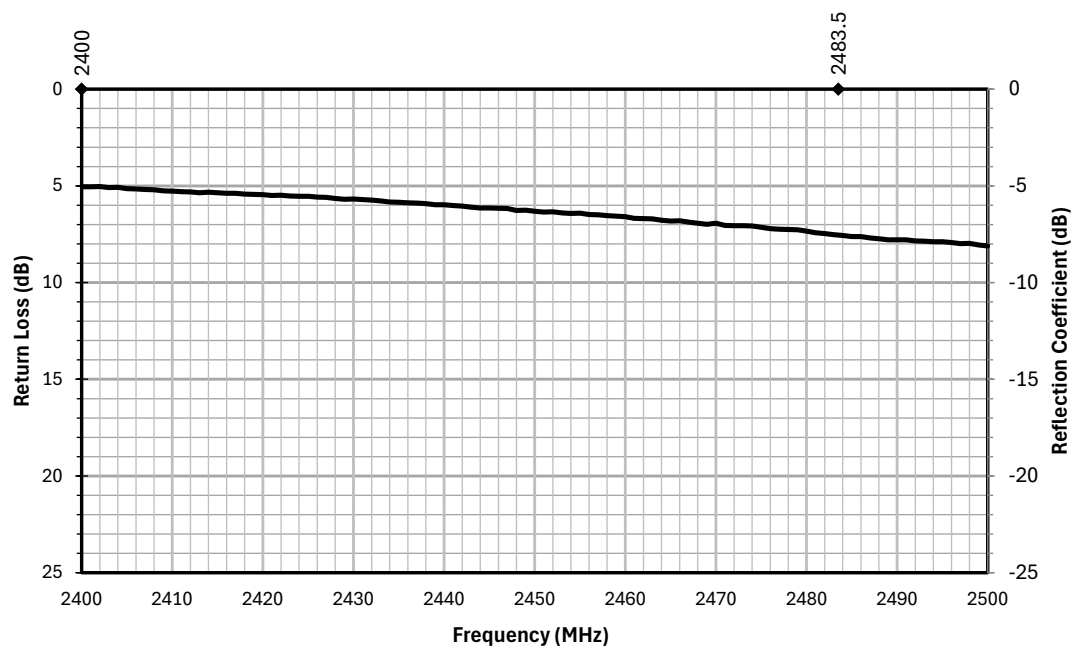


Figure 12. AC16502 Antenna Return Loss at Edge of Ground Plane

Peak Gain

Peak gain (Figure 13) 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.

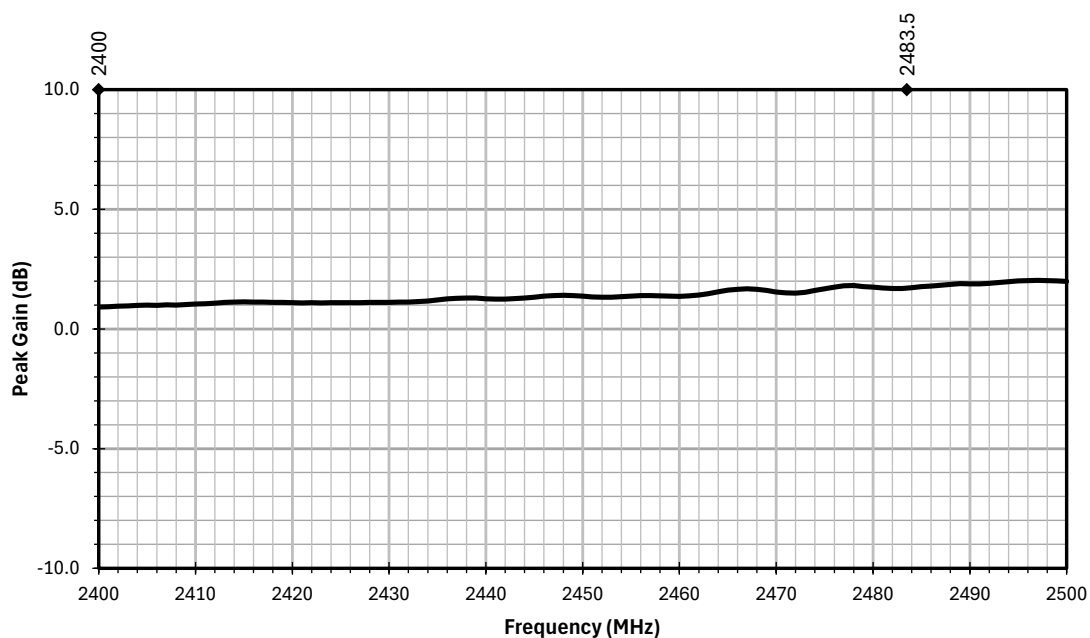


Figure 13. AC16502 Antenna Peak Gain at Edge of Ground Plane

Average Gain

Average gain (Figure 14) is the average of all antenna gain in 3-dimensional space at each frequency, providing an indication of overall performance without expressing antenna directionality.

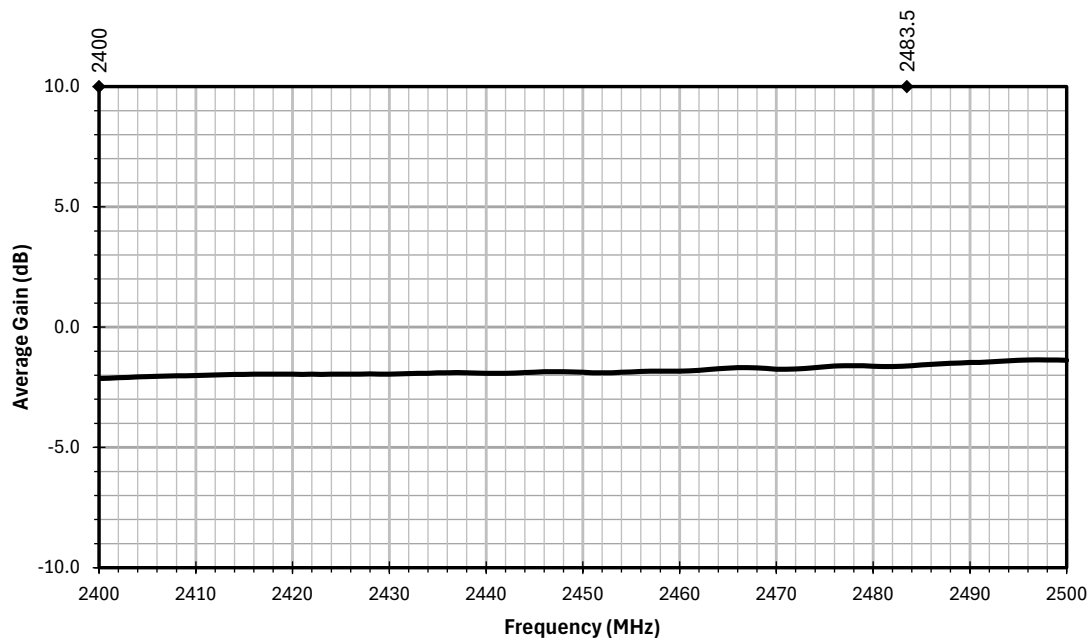


Figure 14. AC16502 Antenna Average Gain at Edge of Ground Plane

Efficiency

Efficiency (Figure 15) 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.

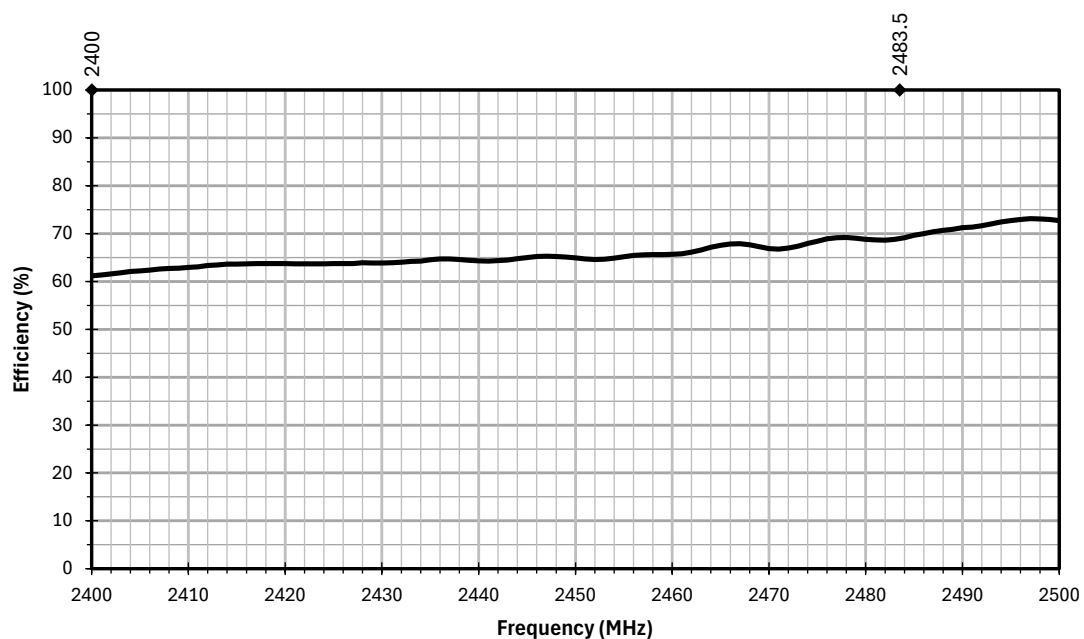
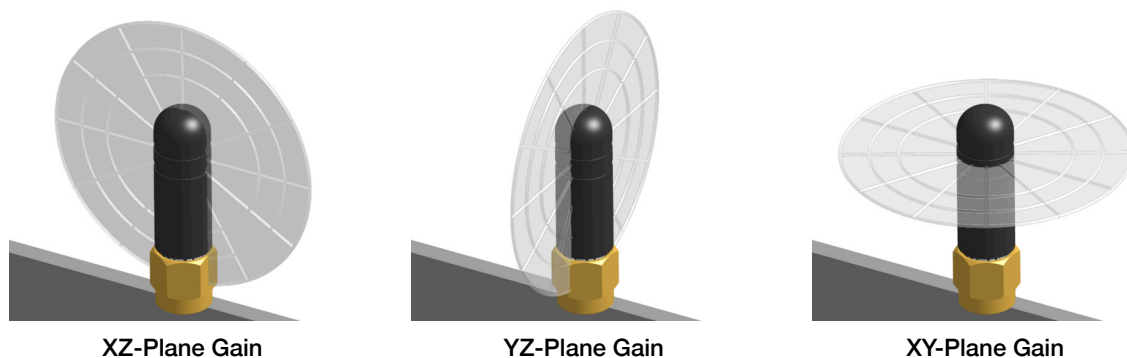


Figure 15. AC16502 Antenna Efficiency at Edge of Ground Plane

Radiation Patterns - Edge of Ground Plane

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 16) 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.



2400 MHz to 2485 MHz (2445 MHz)

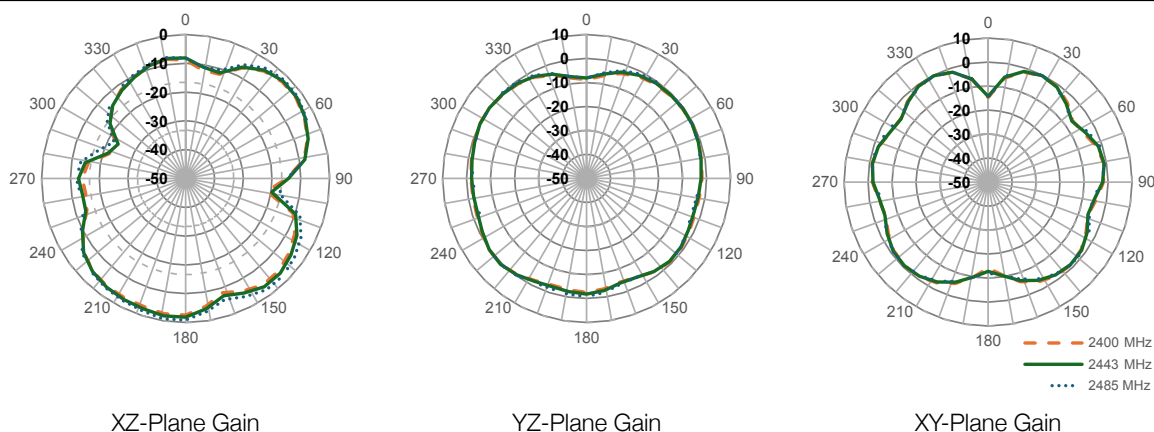


Figure 16. Radiation Patterns for the AC16502 Antenna

Packaging Information

The AC16502 antenna is individually packaged in a sealed polyethylene bag. 200 antennas in bags are placed in a large, sealed polyethylene bag. 10 sealed polyethylene bags are packaged in a carton totalling 2000 antennas. Carton dimensions are 360 mm x 280 mm x 260 mm (14.2 in x 11.0 in x 10.2 in).

Website: <http://www.antennacompany.com>
Offices: Eindhoven, The Netherlands
EMAIL: sales@antennacompany.com

The Antenna Company reserves the right to make changes to the product(s) or information contained herein without notice. No liability is assumed as a result of their use or application. No rights under any patent accompany the sale of any such product(s) or information.

Bluetooth is a registered trademark of Bluetooth SIG, Inc. ZigBee is a registered trademark of ZigBee Alliance, Inc. Other product and brand names may be trademarks or registered trademarks of their respective owners.

Copyright © 2026 The Antenna Company International N.V.

All Rights Reserved

DOC# DS26196-086ANT

