Datasheet

AC81014
Cellular Embedded FPC Antenna

The Antenna Company AC81014 is a compact, linearly polarized, flexible printed circuit (FPC) antenna that delivers robust, omnidirectional performance for cellular IoT applications including NB-IoT, Cat-M1/LTE-M, and 5G NR systems from 695 MHz to 6000 MHz. The flexibility and peel-and-stick adhesive backing make the AC81014 antenna easy to mount in unique and custom enclosures.

Connection is made to the radio via a 1.13 mm coaxial cable terminated in a U.FL-type plug connector. Various cable length options are available (See Ordering Information).

AC81014-100UF
Cellular FPC Antenna

Features

- Wideband coverage
  - 695 MHz to 6000 MHz
- High efficiency
- Ground plane independent
- Compact I-shape form factor
- 51.5 mm x 16.2 mm
- Linear polarization for use in varying orientations
- MHF1/U.FL compatible plug termination

Applications

- Worldwide 5G/4G/3G/2G cellular
- Cellular IoT
  - 5G NR/RedCap
  - 4G LTE
  - Cat-M1/LTE-M
  - NB-IoT
- Smart Metering
- M2M and Smart Utility Infrastructure
- Asset Management
- Tracking Devices
- Vending Machines
- Gateways/Routers/CPEs

Ordering Information

Part Number	Description
AC81014-050UF	Cellular wideband FPC antenna, 50 mm cable, U.FL-type plug
AC81014-100UF	Cellular wideband FPC antenna, 100 mm cable, U.FL-type plug
AC81014-150UF	Cellular wideband FPC antenna, 150 mm cable, U.FL-type plug
AC81014-200UF	Cellular wideband FPC antenna, 200 mm cable, U.FL-type plug

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

RF/Electrical Specifications

AC81014	VSWR (max)	Peak Gain (dBi)	Average Gain (dBi)	Average Efficiency (%)
695 MHz to 960 MHz	2.7	2.1	-2.9	52
1425 MHz to 1675 MHz	3.7	4.0	-2.4	59
1695 MHz to 2200 MHz	2.5	4.0	-1.4	73
2300 MHz to 2400 MHz	2.5	3.7	-1.9	65
2480 MHz to 2690 MHz	2.0	4.9	-1.5	71
3300 MHz to 5000 MHz	3.5	7.7	-2.5	57
5150 MHz to 5925 MHz	4.9	8.3	-3.2	50

Impedance	50 Ω
Polarization	Linear
Radiation Pattern	Omnidirectional
Wavelength	½-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	AC81014-050UF	AC81014-100UF	AC81014-150UF	AC81014-200UF
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	51.5 mm x 16.2 mm x 0.25 mm (2.03 in x 0.64 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 AC81014 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 AC81014 are shown below in Figure 1.

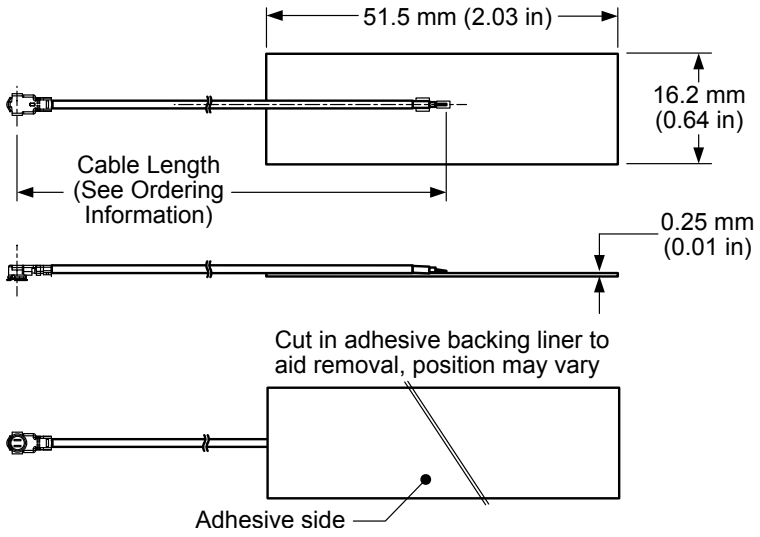


Figure 1. AC81014 Antenna Dimensions

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.

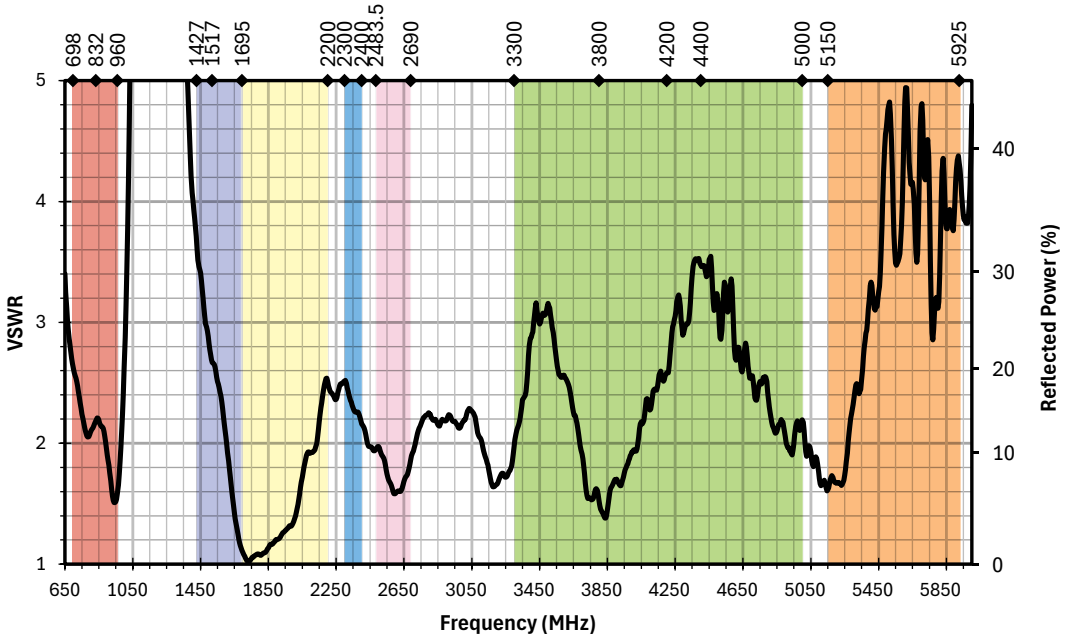


Figure 2. AC81014 Antenna VSWR

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.

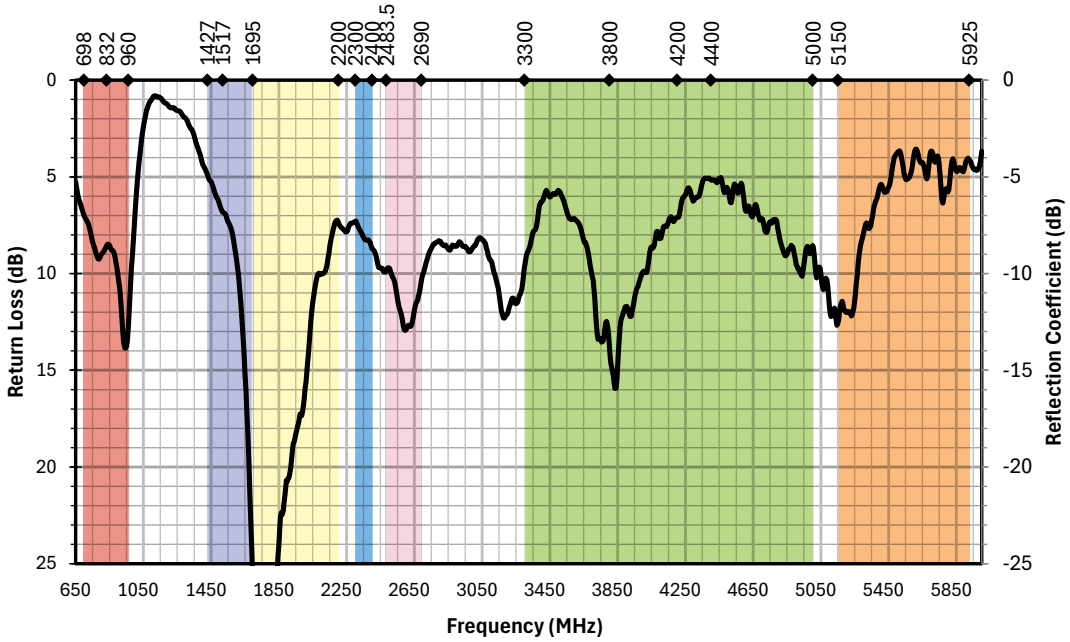


Figure 3. AC81014 Antenna Return Loss

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.

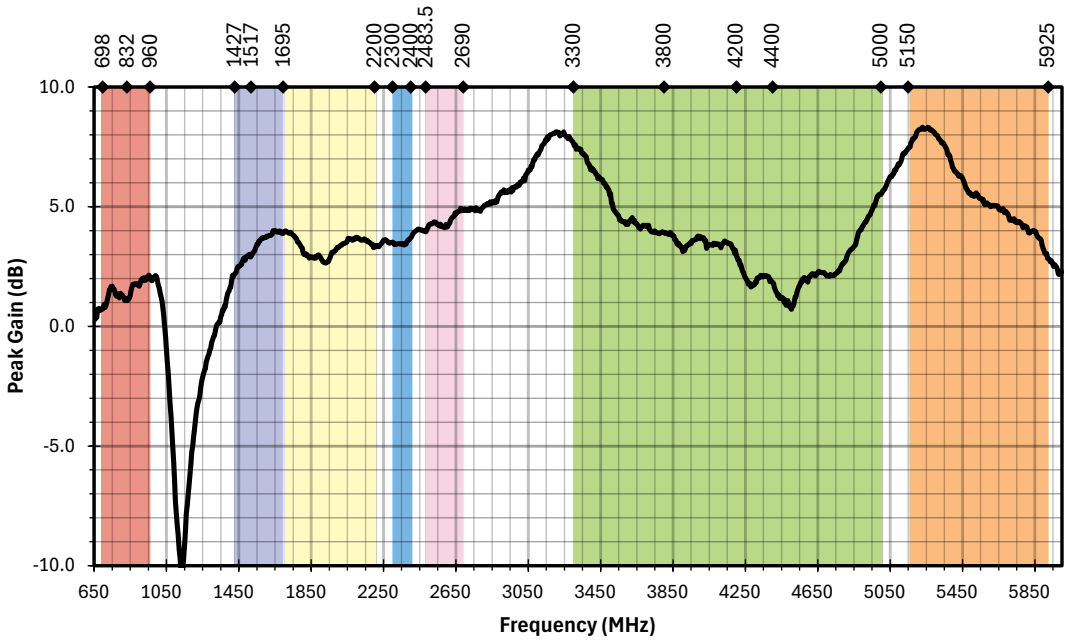


Figure 4. AC81014 Antenna Peak Gain

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.

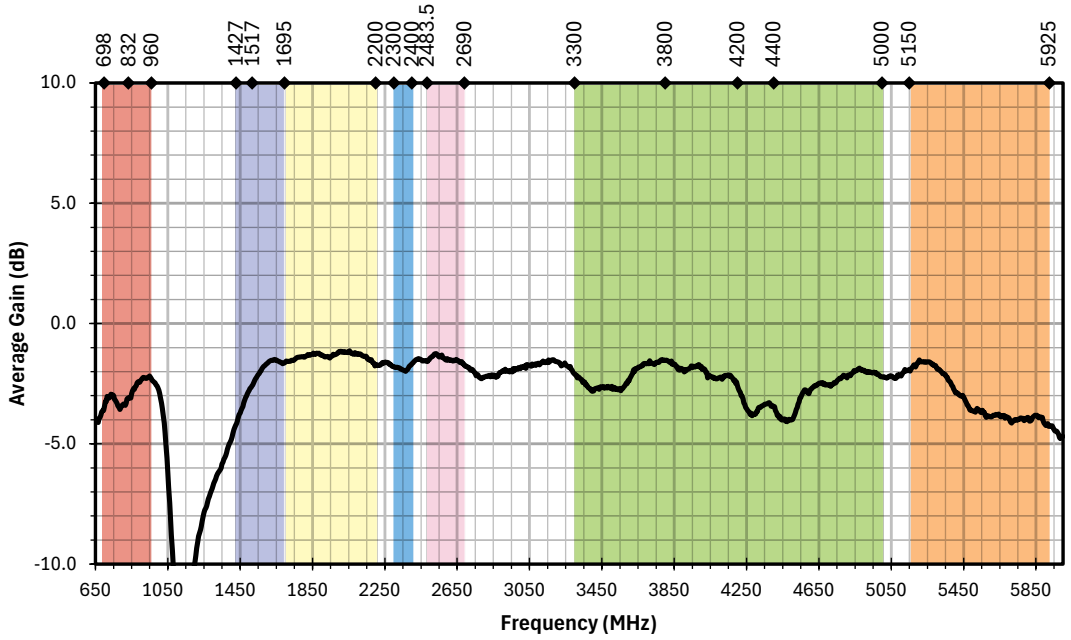


Figure 5. AC81014 Antenna Average Gain

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.

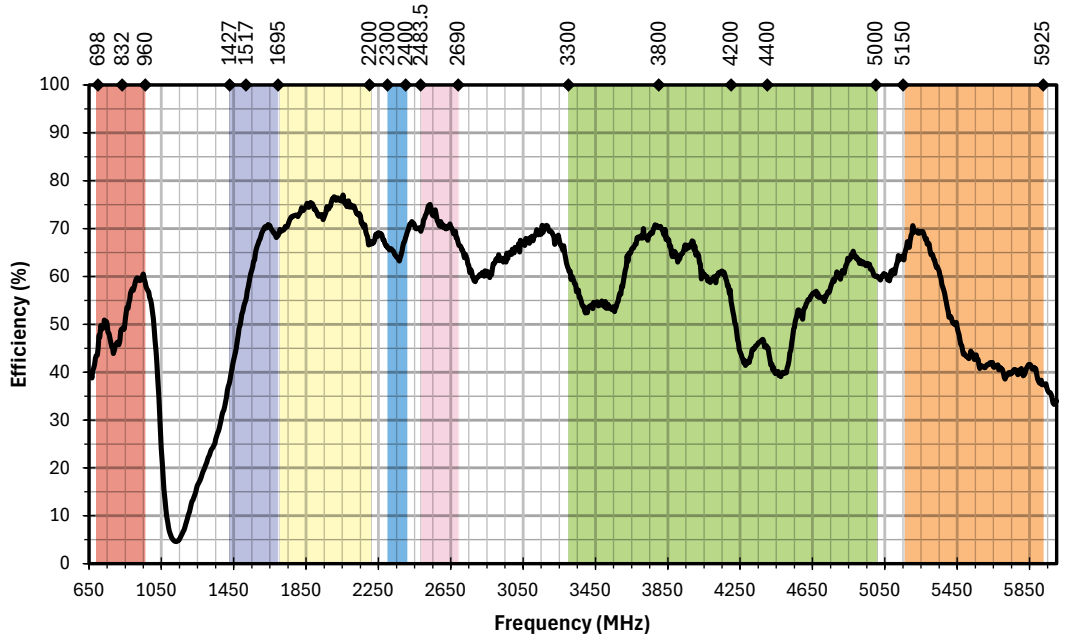
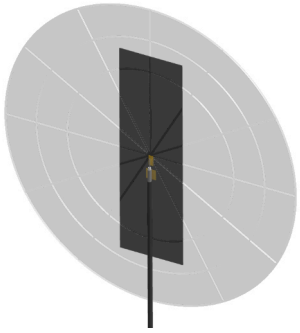


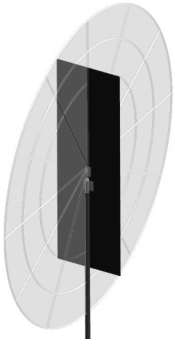
Figure 6. AC81014 Antenna Efficiency

Radiation Patterns

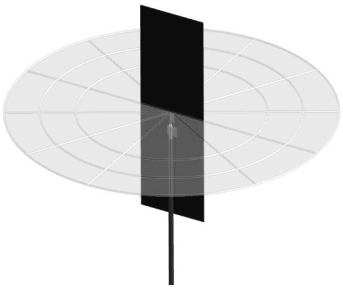
Radiation patterns provide information about the directional performance of the antenna by plotting gain in three orthogonal planes at the high-, low- and center-frequencies of an antenna frequency band. Antenna radiation patterns (Figure 7) are shown using polar plots covering 360 degrees with the plane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



XZ-Plane Gain

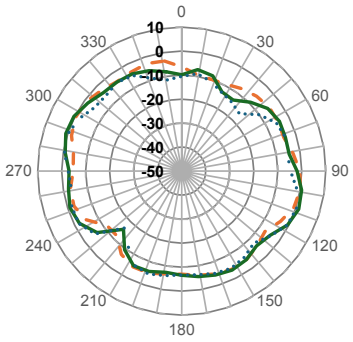


YZ-Plane Gain

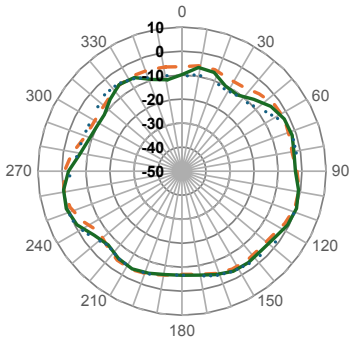


XY-Plane Gain

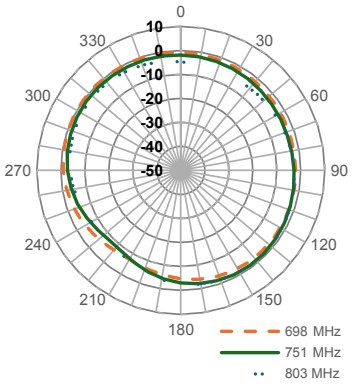
698 MHz to 803 MHz (751 MHz)



XZ-Plane Gain

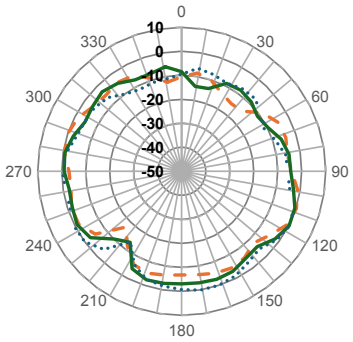


YZ-Plane Gain

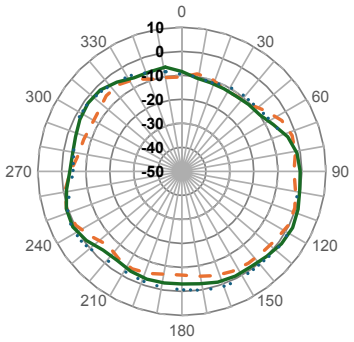


XY-Plane Gain

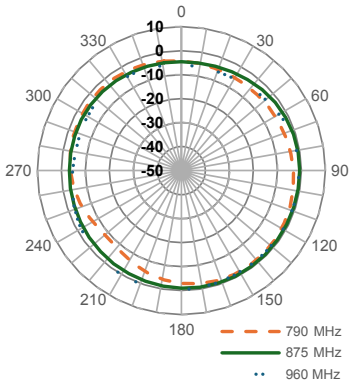
790 MHz to 960 MHz (875 MHz)



XZ-Plane Gain



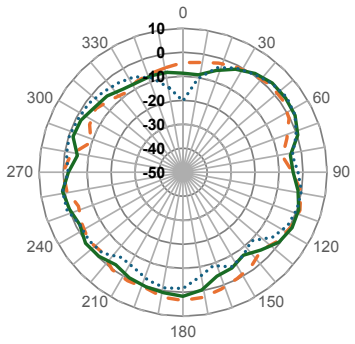
YZ-Plane Gain



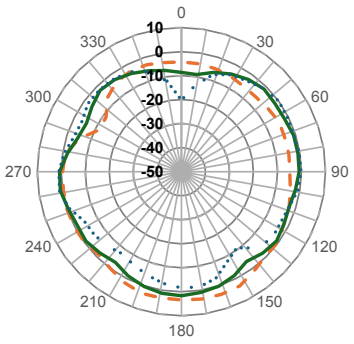
XY-Plane Gain

Radiation Patterns

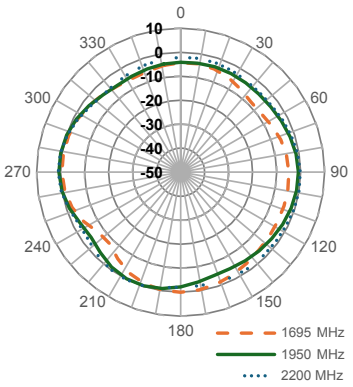
1695 MHz to 2200 MHz (1950 MHz)



XZ-Plane Gain

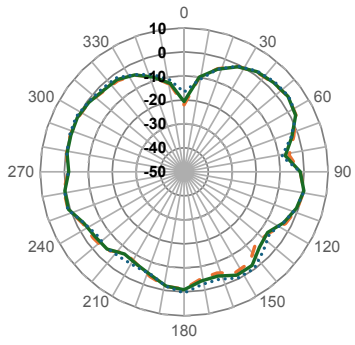


YZ-Plane Gain

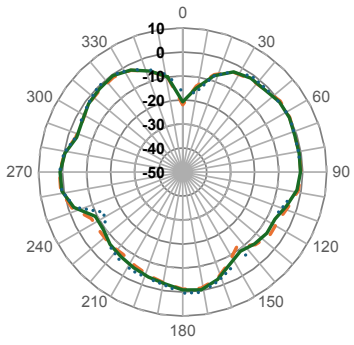


XY-Plane Gain

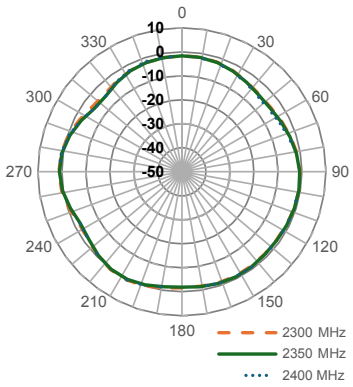
2300 MHz to 2400 MHz (2350 MHz)



XZ-Plane Gain

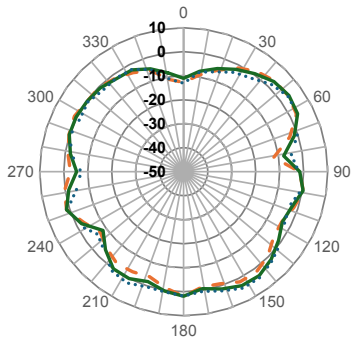


YZ-Plane Gain

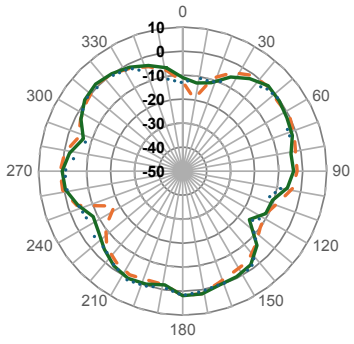


XY-Plane Gain

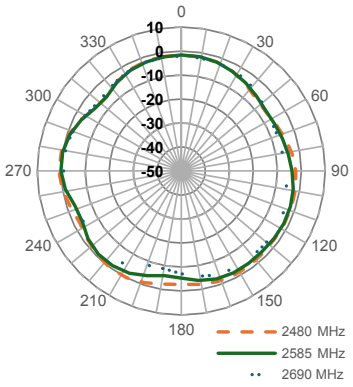
2480 MHz to 2690 MHz (2585 MHz)



XZ-Plane Gain



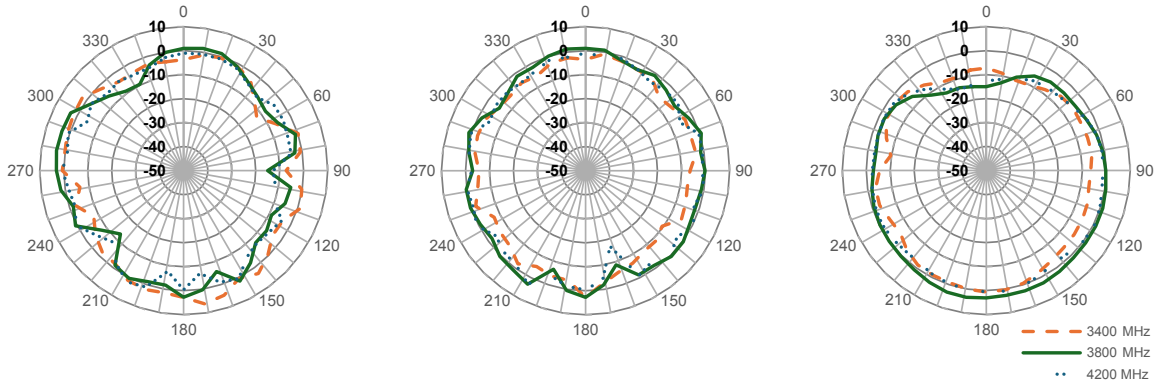
YZ-Plane Gain



XY-Plane Gain

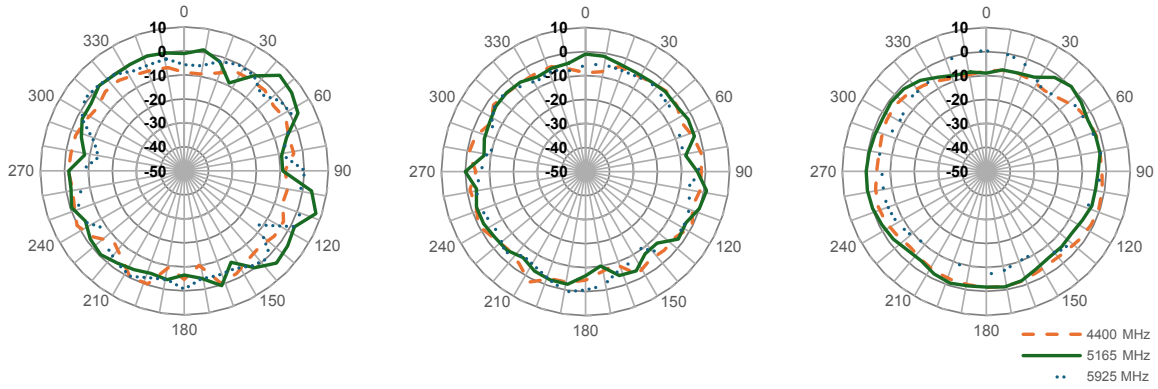
Radiation Patterns

3400 MHz to 4200 MHz (3800 MHz)



XZ-Plane Gain YZ-Plane Gain XY-Plane Gain

4400 MHz to 5925 MHz (5165 MHz)



XZ-Plane Gain YZ-Plane Gain XY-Plane Gain

Figure 7. Radiation Patterns for the AC81014 Antenna

Packaging Information

The AC81014 antenna is individually packaged in a labeled polyethylene bag and then bulk packaged in a polyethylene bag in quantities of 50 pcs. Sealed bulk polyethylene bags are packed in cartons in quantities of 160 yielding 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.

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

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.

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

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.

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

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.

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

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

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.

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

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.

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

Series: FPC

DOC# DS26175-084ANT