

Satellite IoT D2D Ready

TN & NTN Dual-Mode Antenna Satellite IoT Direct to Device Ready

Enhanced Low-Band LTE Connectorized Monopole Whip Antenna

Covering 4G/5G/Satellite Band 25

The L001267-01 direct to device (D2D) antenna is a compact rotatable hinged-whip antenna which offers optimized support for a wide range of cellular LTE and IoT applications.

L001267-01 provides excellent multiband cellular and cellular IoT performance. It offers better VSWR at the lower LTE frequency bands, including LTE Band 71 (617 MHz to 698 MHz), on a smaller ground plane than competitive products. This equates to better range in a smaller product design. The hinged design allows for the antenna to be positioned for optimum performance and reduces the potential for damage from impact compared to a fixed whip design.

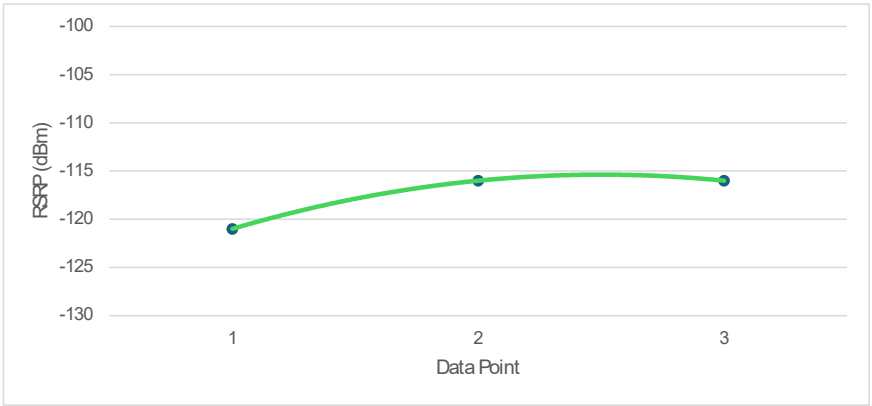
SATELLITE IOT D2D COMMUNICATIONS

Low Earth Orbit (LEO) satellites, positioned a few hundred km's above Earth, orbit rapidly and are ideal for IoT networks. A LEO satellite constellation can now support low data rate communications through specific LTE frequencies.

- Dual-mode capable - Supporting Terrestrial Networks (TN) and Non-Terrestrial Networks (NTN) from a single antenna
  - 698-3800 MHz terrestrial cellular coverage
  - Band 25 (1900 MHz) cellular satellite coverage
    - Testing available for other/future cellular satellite D2D frequency bands used by various network providers
- Enabling dual-mode communications via IoT devices
  - Prioritizing terrestrial networks but capable of automatically switching to satellite when the signal is weak or unavailable

REFERENCE SIGNAL RECEIVED POWER (RSRP) VALUES

The L001267-01 antenna was live-tested for receive signal strength. Data encompasses multiple satellite pass-overs, showing signal strength variation; exceeding the -120 dBm minimum for IoT devices.



An RSRP value of -120 dBm is generally the recognized minimum requirement suitable for the data rates of SMS, CAT-1, CAT-1 Bis connectivity.

RSRP can be susceptible to fluctuations for a variety of reasons. These can include: satellite elevation angle: antenna radiation patterns; solar flares; atmospheric conditions, and more.

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FEATURES

- Validated for use on satcom D2D networks
- Dual-Mode TN and NTN capable
- Enhanced low-band coverage (LTE B71)
  - Efficiency: 73%
  - VSWR: ≤ 3.3
  - Peak Gain: 3.4 dBi
- Covers all common LTE/4G/3G/2G bands
- Hinged for optimum positioning
- Small, unobtrusive profile, 78.7 mm long
- Extended temperature range to 130 °C
- SMA plug (male pin)

APPLICATIONS

- Non-Terrestrial and Terrestrial Networks
- Satellite IoT D2D (Direct to Device) applications
- Cellular IoT: LTE-M (Cat-M1) and NB-IoT
  - T-Mobile: band 71
  - AT&T: bands 12, 14, 17
  - Verizon: band 13
  - Europe: bands 8, 20
  - Latin America: bands 5, 28
  - Asia Pacific: bands 5, 8, 20, 28
- Worldwide LTE, UMTS and GSM
- Low-power, wide-area (LPWA) applications
  - LoRaWAN®
  - Sigfox®
- Citizens Broadband Radio Service (CBRS)
- ISM: Bluetooth® and ZigBee®
- FirstNet® Public Safety
- Internet of Things (IoT) devices
- Gateways

ELECTRICAL SPECIFICATIONS

Select Bands	Frequency Range	VSWR (max.)	Peak Gain (dBi)	Avg. Gain (dBi)	Efficiency (%)
LTE 71	617 MHz to 698 MHz	3.3	3.4	-1.5	73
LTE 12, 13, 14, 17, 26, 28, 29	698 MHz to 803 MHz	2.2	4.8	-0.7	90
LTE 5, 8, 20	791 MHz to 960 MHz	2.6	5.0	-1.1	90
LTE 1, 2, 3, 4, 25, 66	1710 MHz to 2200 MHz	3.2	3.9	-1.6	72
LTE 30, 40	2300 MHz to 2400 MHz	2.3	3.4	-1.2	77
LTE 7, 41	2496 MHz to 2690 MHz	1.9	4.1	-1.1	79
LTE 22, 42, 52, 43, 48, 49	3300 MHz to 3800 MHz	2.2	4.6	-2.4	64
ISM	2400 MHz to 2485 MHz	2.1	3.2	-1.4	74

Polarization	Linear	**Impedance**	50 Ω
Radiation	Omnidirectional	**Connection**	SMA Plug (male pin)
Max Power	10 W	**Weight**	10.0 g (0.35 oz)
Wavelength	1/4-wave	**Dimensions**	78.7 mm (3.1 in)
Electrical Type	Monopole	**Operating Temperature**	-40 °C to +130 °C

Electrical specifications and plots measured with a 102 mm x 102 mm (4.0 in x 4.0 in) reference ground plane, edge straight orientation.

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PRODUCT DIMENSIONS

Figure 1 provides dimensions of the L001267-01. The antenna whip can be tilted 180 degrees, and has detents every 45 degrees enabling the antenna to be oriented in any direction. The rotating base allows for continuous positioning through 360 degrees even while installed.

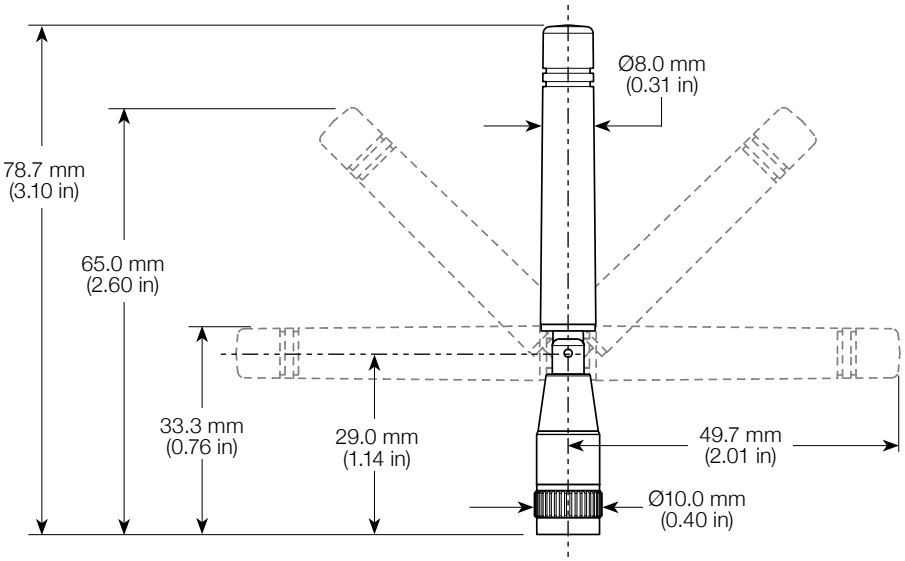
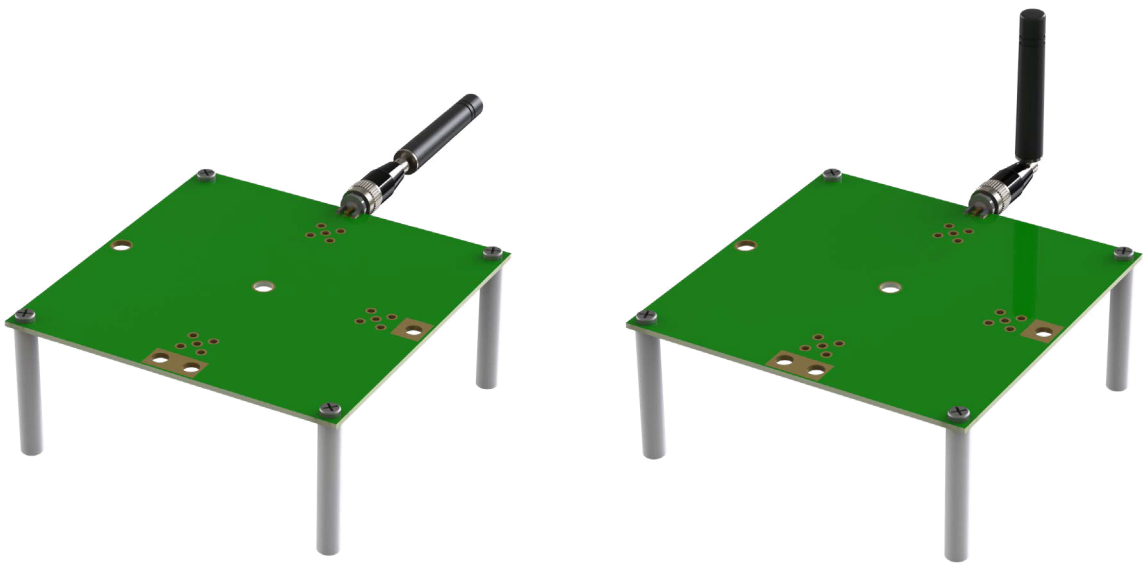


Figure 1: Antenna Dimensions

GROUND PLANE

1/4-Wave monopole antennas require an associated ground plane counterpoise for proper operation. The size and location of the ground plane relative to the antenna will affect the overall performance of the antenna in the final design. When used in conjunction with a ground plane smaller than that used to tune the antenna, the center frequency typically will shift higher in frequency and the bandwidth will decrease. The proximity of other circuit elements and packaging near the antenna will also affect the final performance.

For further discussion and guidance on the importance of the ground plane counterpoise, please refer to Linx Application Note, ***AN-00501: Understanding Antenna Specifications and Operation.***



On edge of ground plane, straight

On edge of ground plane, bent 90 degrees

Figure 2. L001267-01 on Evaluation PCB

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EDGE OF GROUND PLANE, STRAIGHT

The charts on the following pages represent data taken with the antenna oriented at the edge of the ground plane, straight (Edge-Straight), as shown in Figure 3.

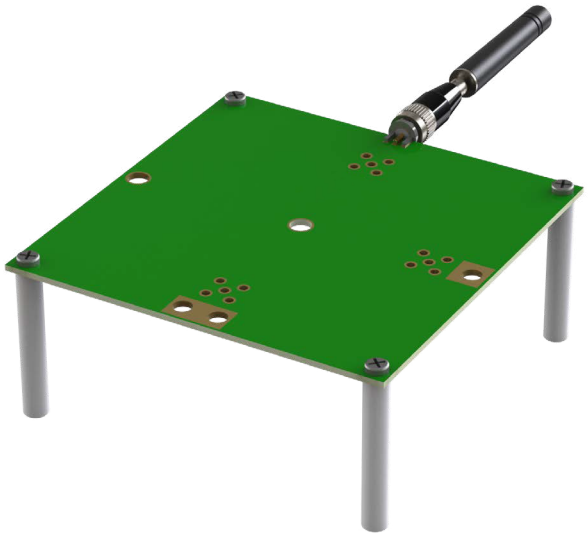


Figure 3. L001267-01 on Edge of Ground Plane, Straight (Edge-Straight)

VSWR

Figure 4 provides the voltage standing wave ratio (VSWR) across the antenna bandwidth. VSWR 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.

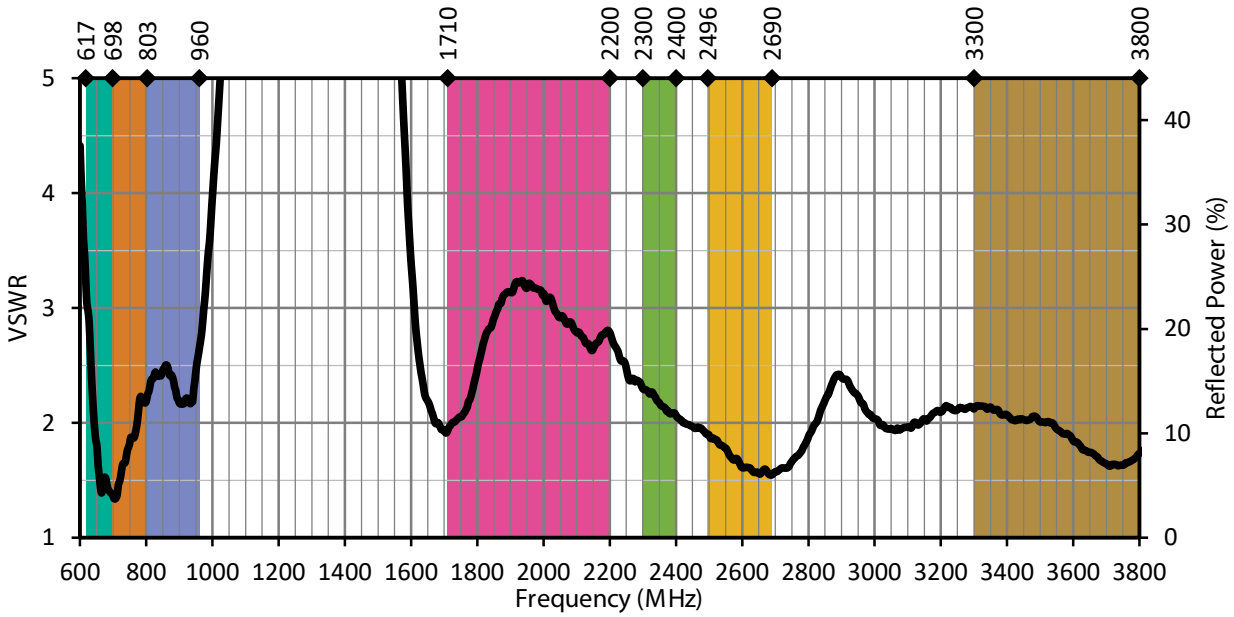


Figure 4. VSWR, Edge-Straight, with Frequency Band Highlights

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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.

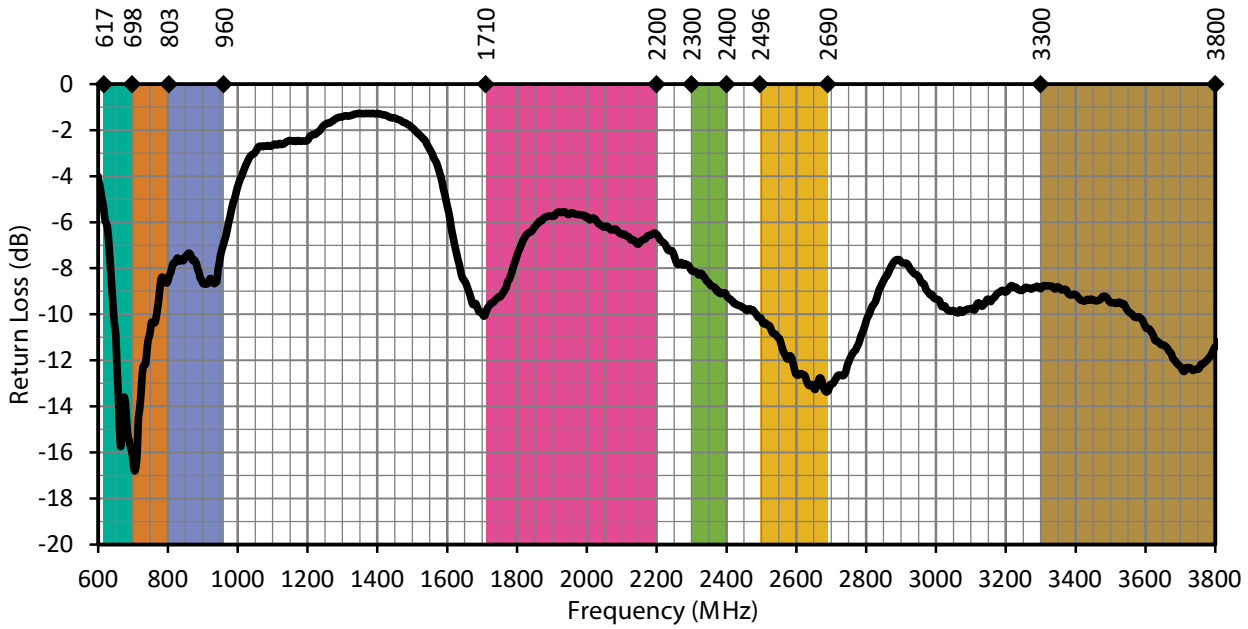


Figure 5. Return Loss, Edge-Straight, with Frequency Band Highlights

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.

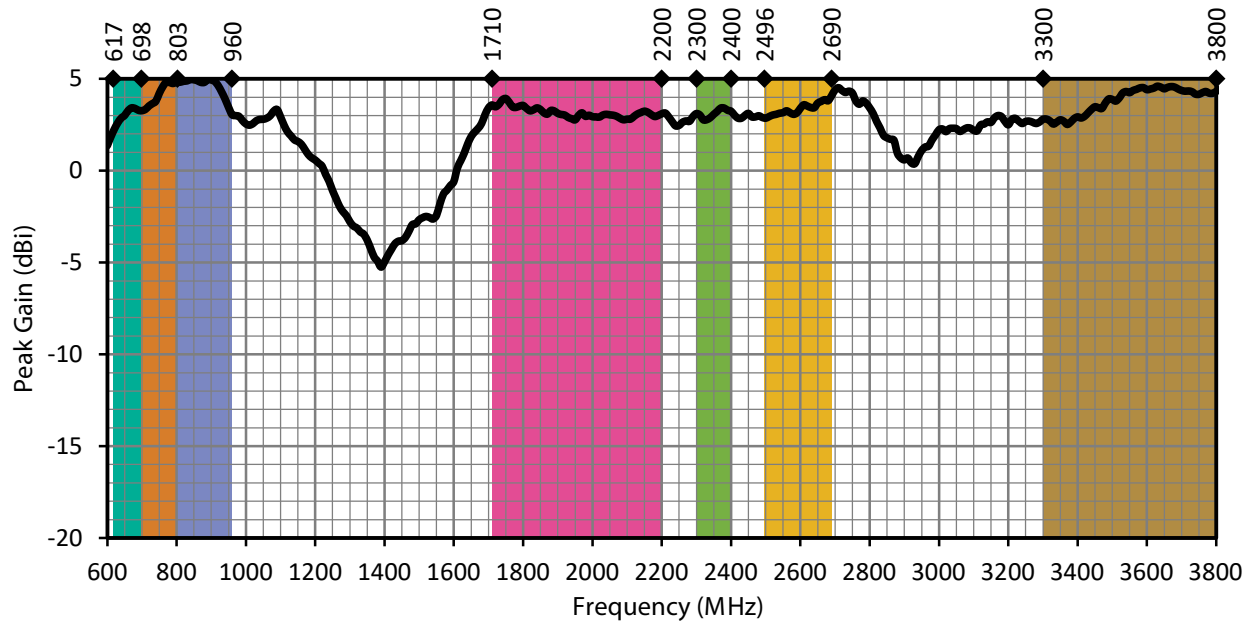


Figure 6. Peak Gain, Edge-Straight, with Frequency Band Highlights

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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.

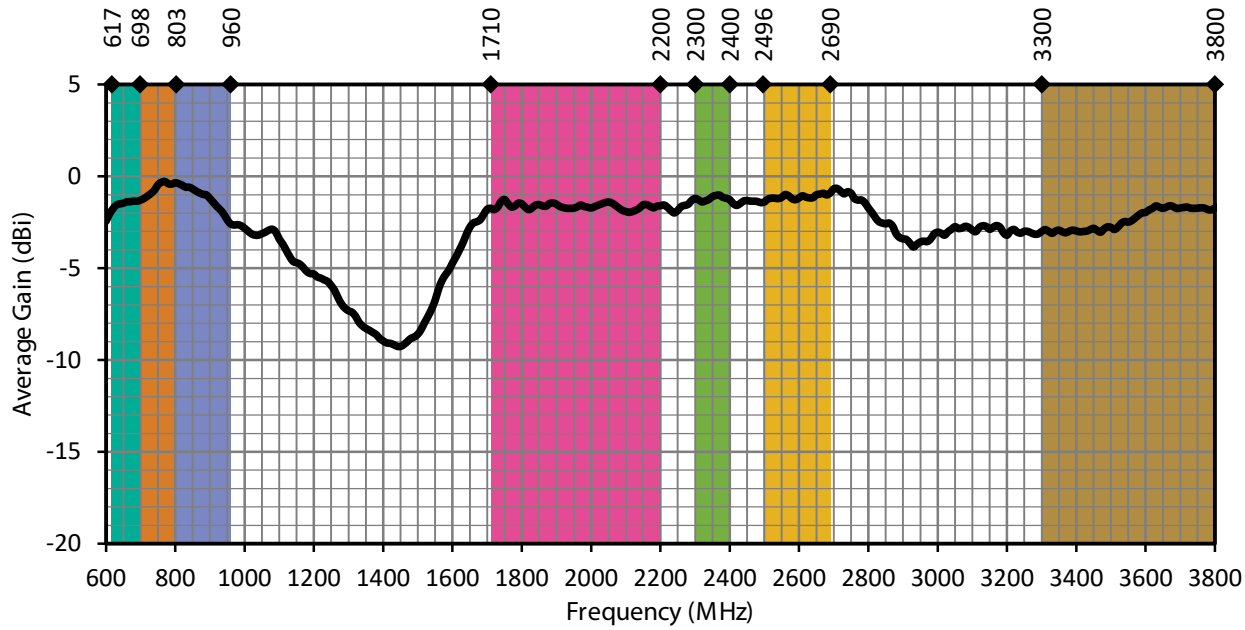


Figure 7. Antenna Average Gain, Edge-Straight, with Frequency Band Highlights

RADIATION EFFICIENCY

Radiation efficiency (Figure 8), shows 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.

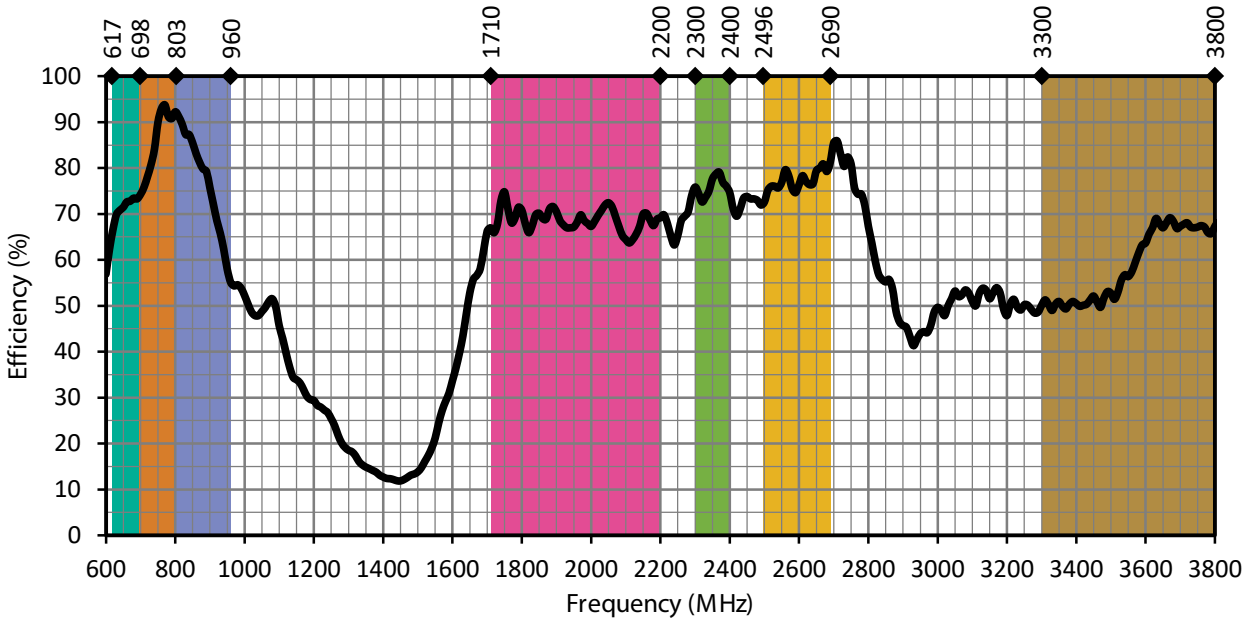


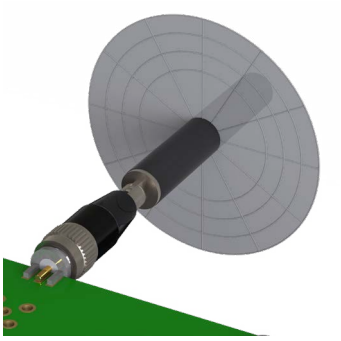
Figure 8. Antenna Radiation Efficiency, Edge-Straight, with Frequency Band Highlights

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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 an edge straight 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. Note: when viewed with typical PDF viewing software, zooming into radiation patterns is possible to reveal fine detail.

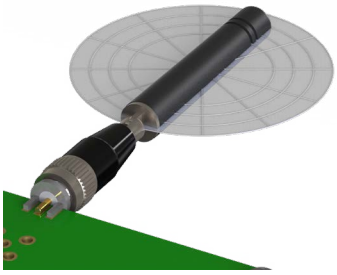
RADIATION PATTERNS - EDGE OF GROUND PLANE, STRAIGHT



XZ-Plane Gain

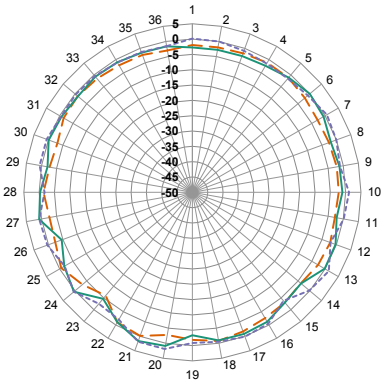


YZ-Plane Gain

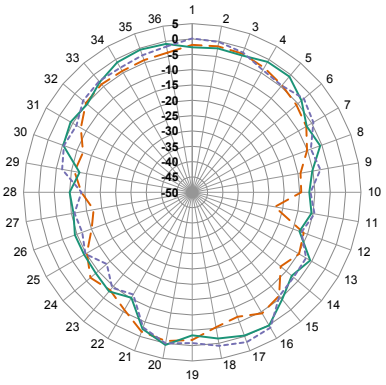


XY-Plane Gain

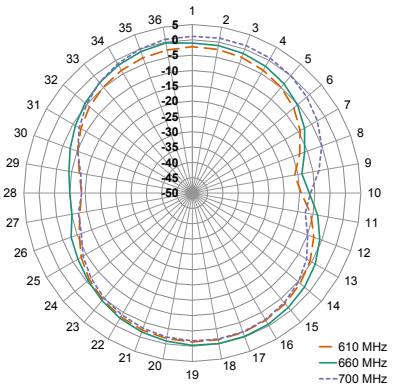
610 MHz TO 700 MHz (660 MHz)



XZ-Plane Gain

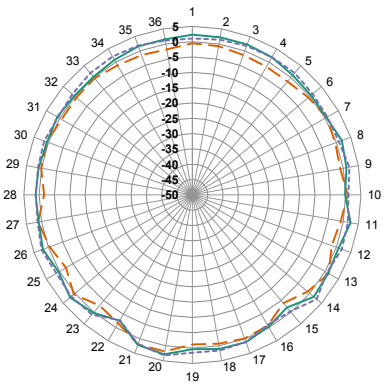


YZ-Plane Gain

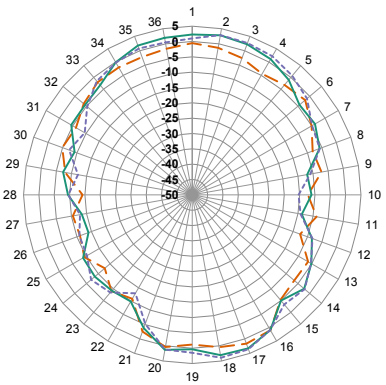


XY-Plane Gain

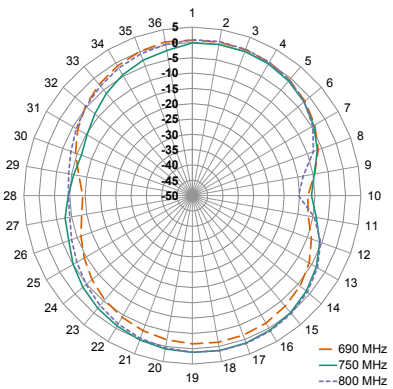
700 MHz TO 800 MHz (750 MHz)



XZ-Plane Gain



YZ-Plane Gain

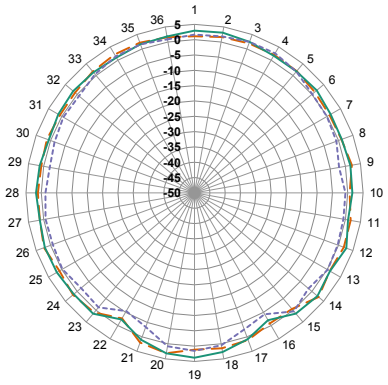


XY-Plane Gain

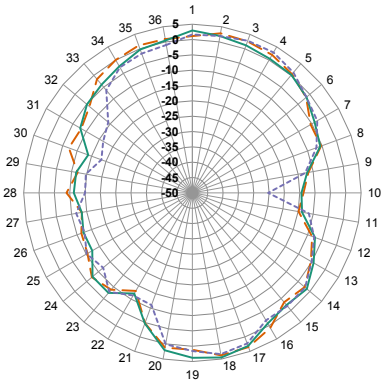
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RADIATION PATTERNS - EDGE OF GROUND PLANE, STRAIGHT

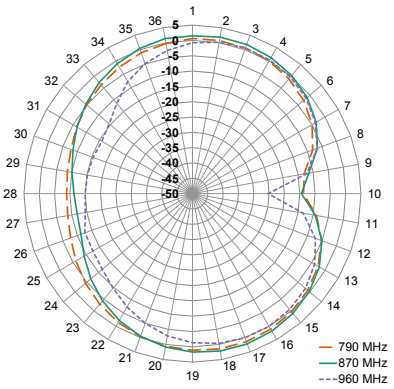
790 MHz TO 960 MHz (870 MHz)



XZ-Plane Gain

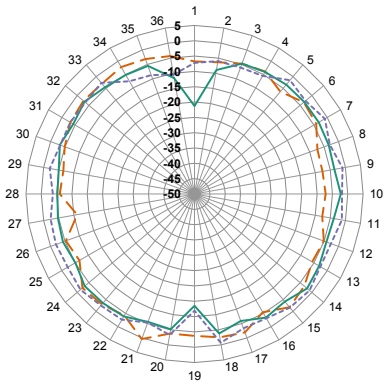


YZ-Plane Gain

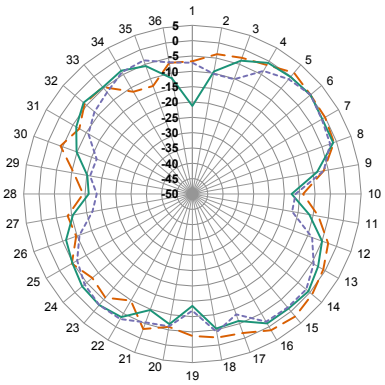


XY-Plane Gain

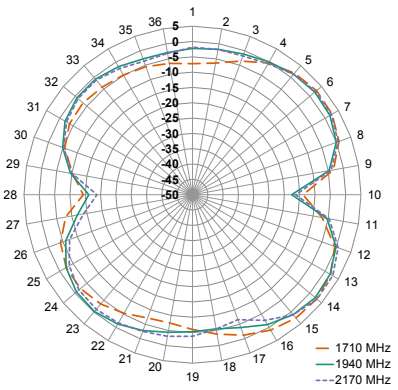
1710 MHz TO 2200 MHz (1940 MHz)



XZ-Plane Gain

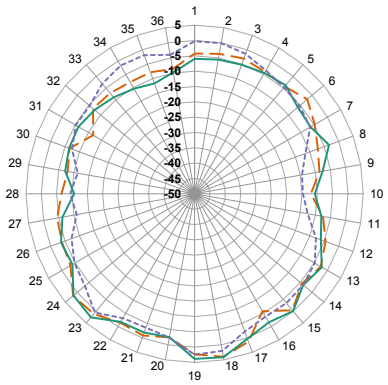


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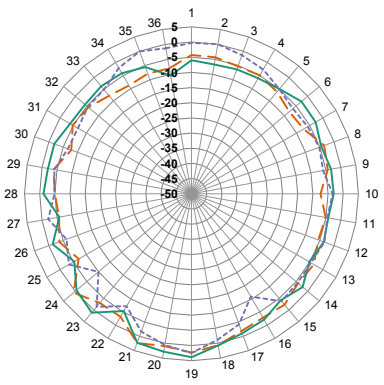


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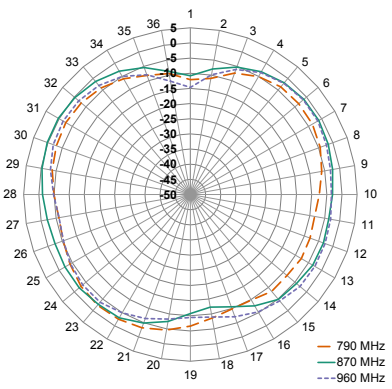
2300 MHz TO 2400 MHz (2350 MHz)



XZ-Plane Gain



YZ-Plane Gain

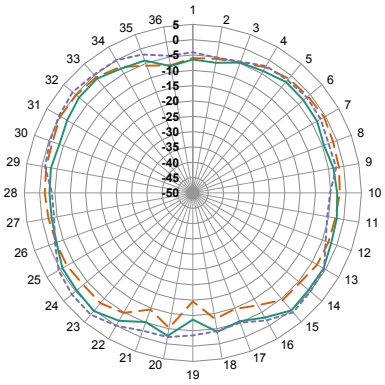


XY-Plane Gain

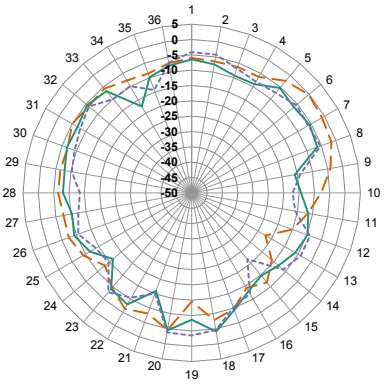
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RADIATION PATTERNS - EDGE OF GROUND PLANE, STRAIGHT

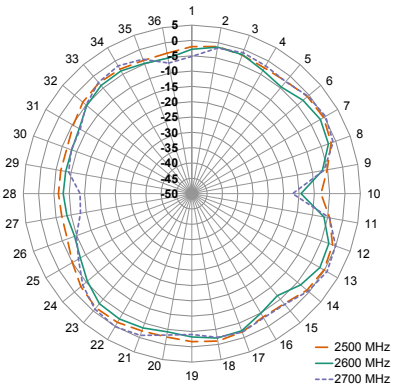
2496 MHz TO 2690 MHz (2450 MHz)



XZ-Plane Gain

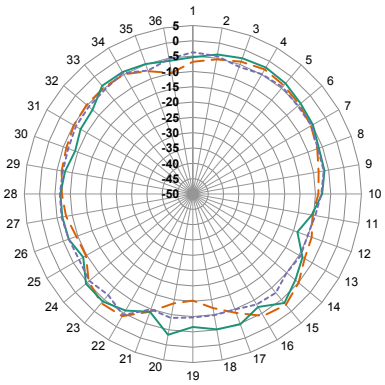


YZ-Plane Gain

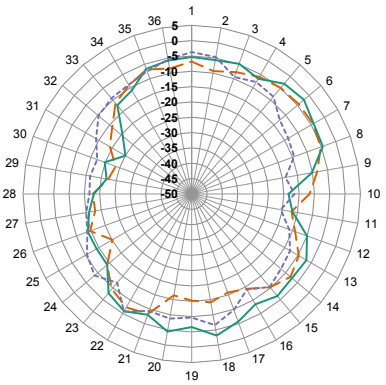


XY-Plane Gain

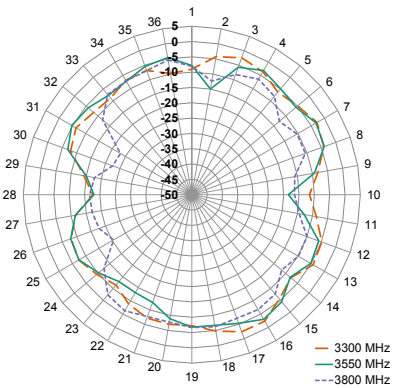
3300 MHz TO 3800 MHz (3550 MHz)



XZ-Plane Gain

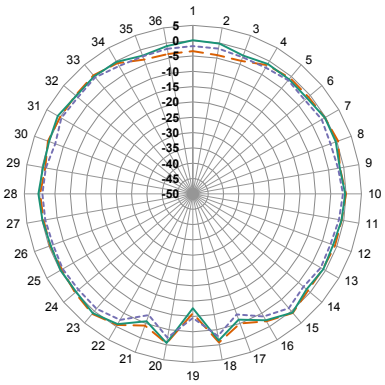


YZ-Plane Gain

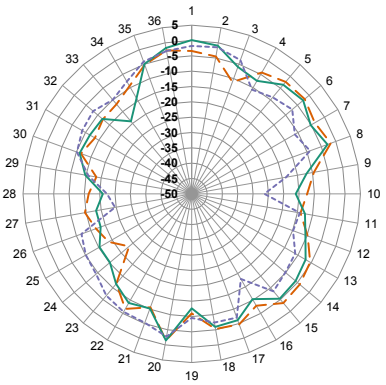


XY-Plane Gain

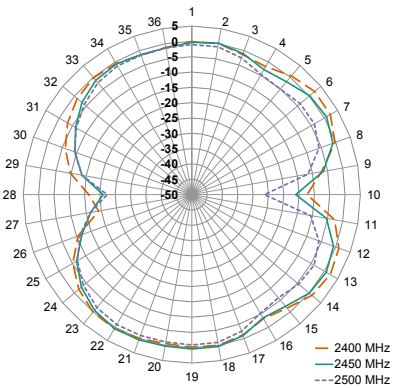
2400 MHz TO 2500 MHz (2450 MHz)



XZ-Plane Gain



YZ-Plane Gain



XY-Plane Gain

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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 10.

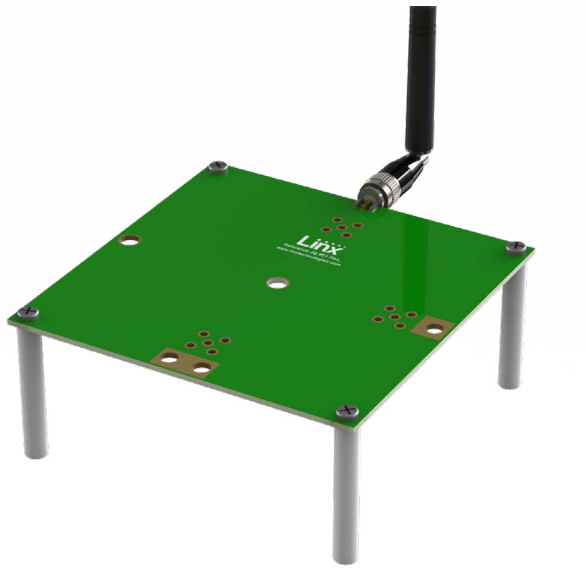


Figure 10. L001267-01 on Edge of Ground Plane, Bent 90 Degrees (Edge-Bent)

VSWR

Figure 11 provides the voltage standing wave ratio (VSWR) across the antenna bandwidth. VSWR 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.

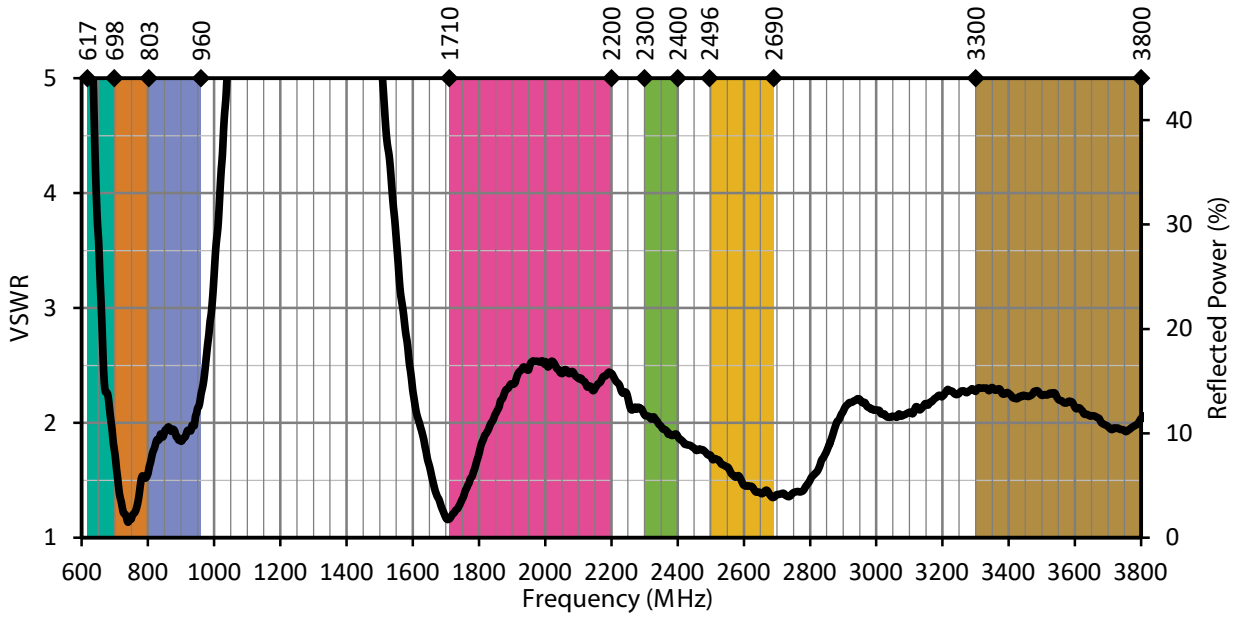


Figure 11. VSWR, Edge-Bent, with Frequency Band Highlights

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RETURN LOSS

Return loss (Figure 12), 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.

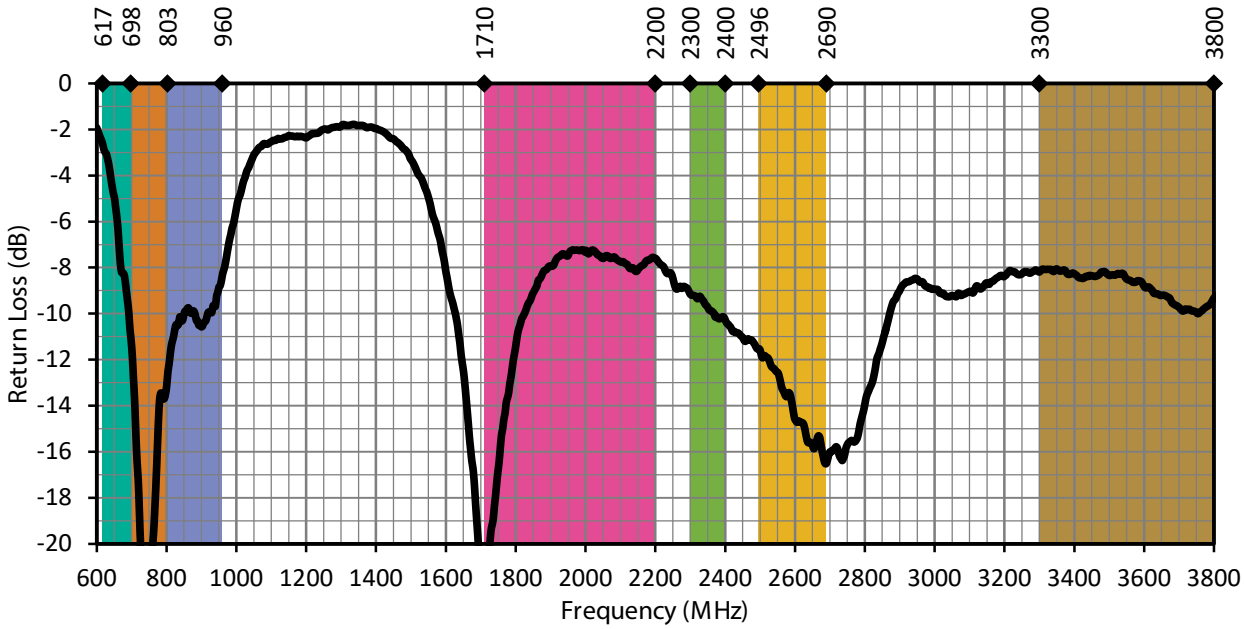


Figure 12. Return Loss, Edge-Bent, with Frequency Band Highlights

PEAK GAIN

The peak gain across the antenna bandwidth is shown in Figure 13. 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.

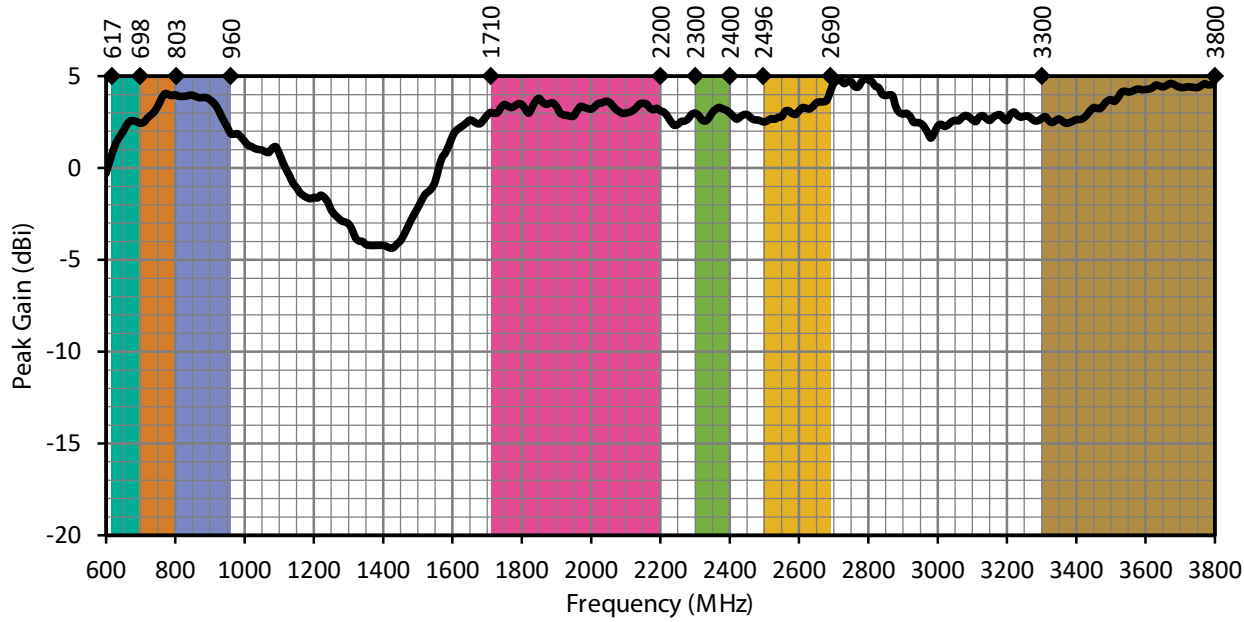


Figure 13. Peak Gain, Edge-Bent, with Frequency Band Highlights

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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.

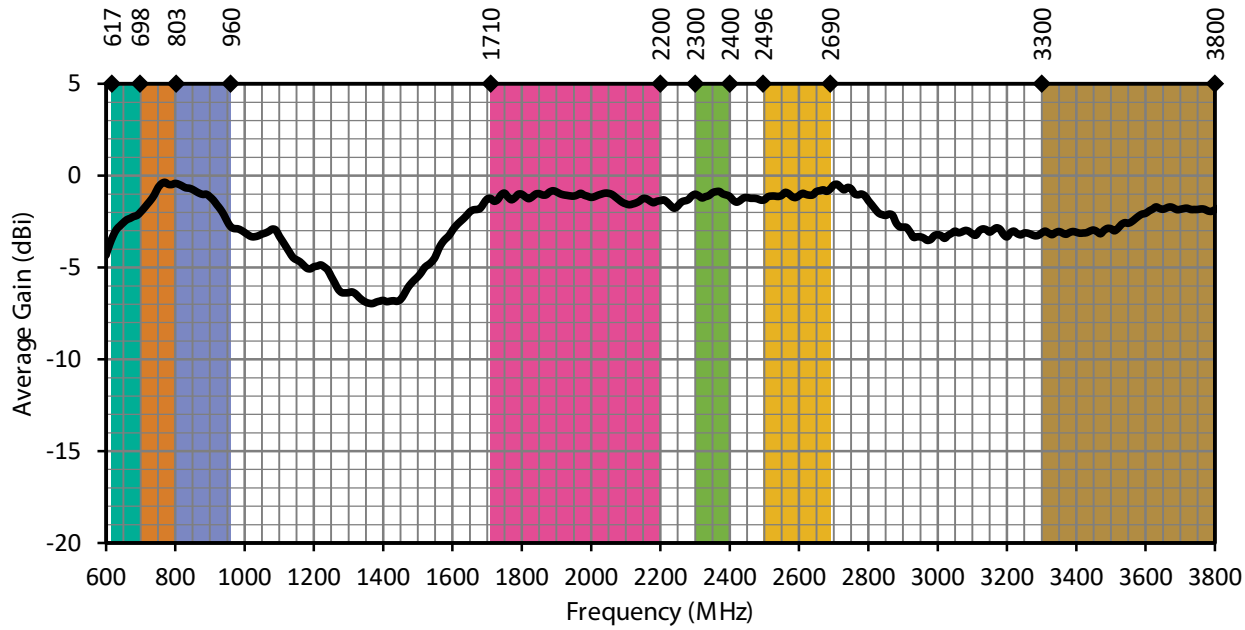


Figure 14. Antenna Average Gain, Edge-Bent, with Frequency Band Highlights

RADIATION EFFICIENCY

Radiation efficiency (Figure 15), shows 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.

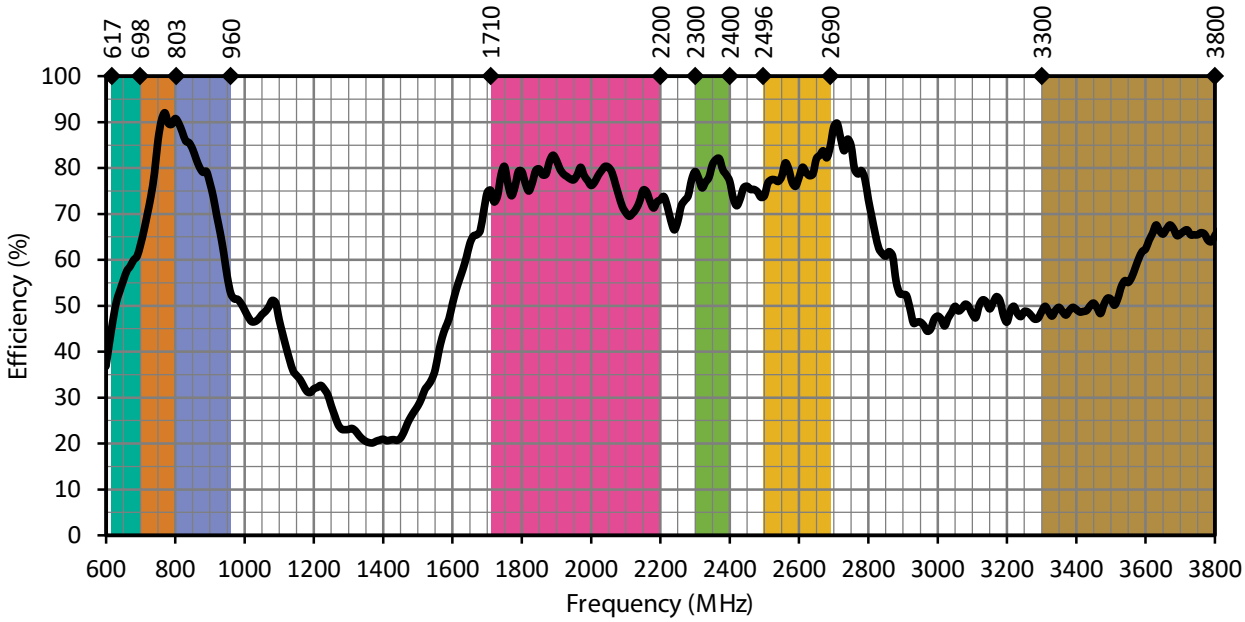


Figure 15. Antenna Radiation Efficiency, Edge-Bent, with Frequency Band Highlights

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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 bent 90 degree orientation are shown in Figure 16 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. Note: when viewed with typical PDF viewing software, zooming into radiation patterns is possible to reveal fine detail.

RADIATION PATTERNS - EDGE OF GROUND PLANE, BENT 90 DEGREES



XZ-Plane Gain

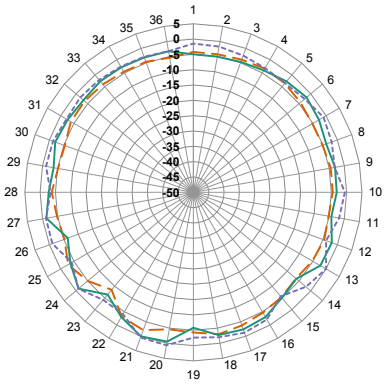


YZ-Plane Gain

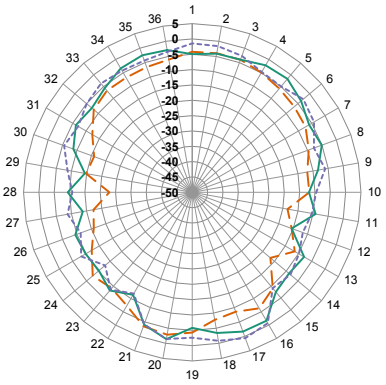


XY-Plane Gain

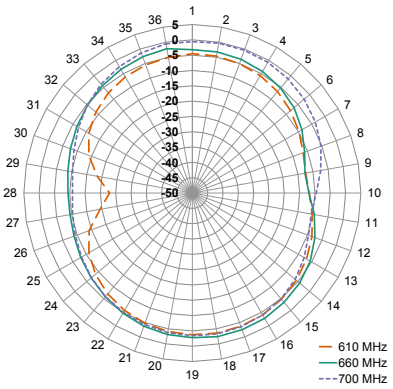
610 MHz TO 700 MHz (660 MHz)



XZ-Plane Gain

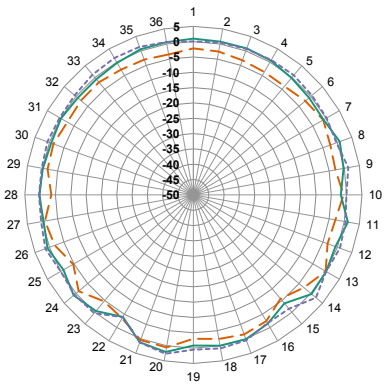


YZ-Plane Gain

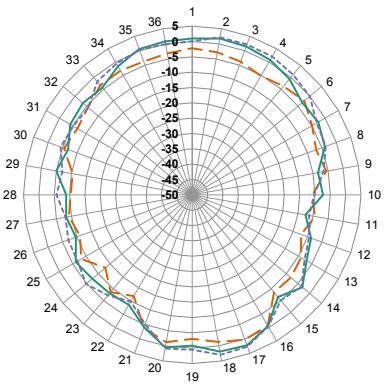


XY-Plane Gain

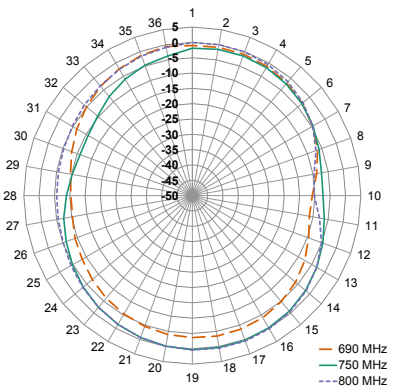
700 MHz TO 800 MHz (750 MHz)



XZ-Plane Gain



YZ-Plane Gain

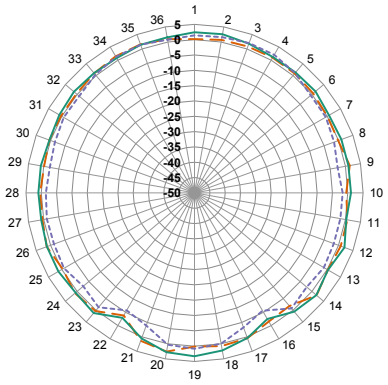


XY-Plane Gain

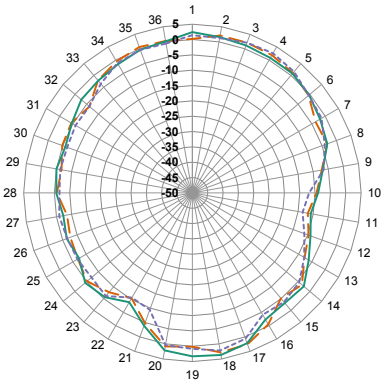
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RADIATION PATTERNS - EDGE OF GROUND PLANE, BENT 90 DEGREES

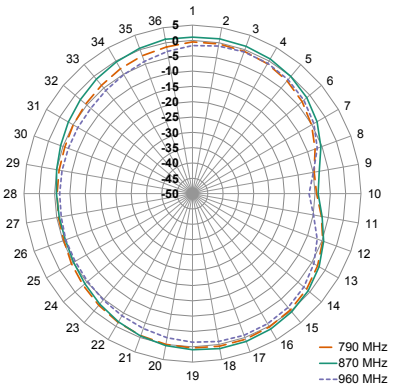
790 MHz TO 960 MHz (870 MHz)



XZ-Plane Gain

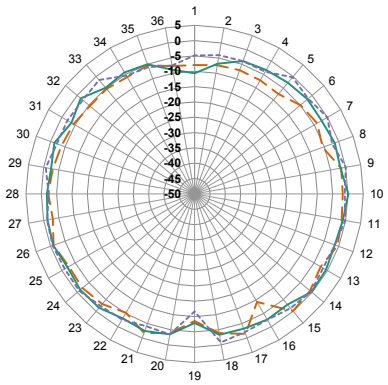


YZ-Plane Gain

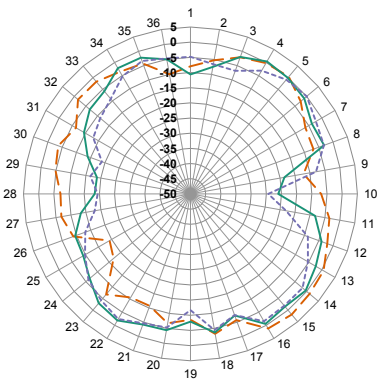


XY-Plane Gain

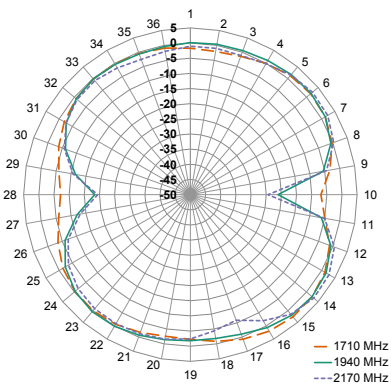
1710 MHz TO 2200 MHz (1940 MHz)



XZ-Plane Gain

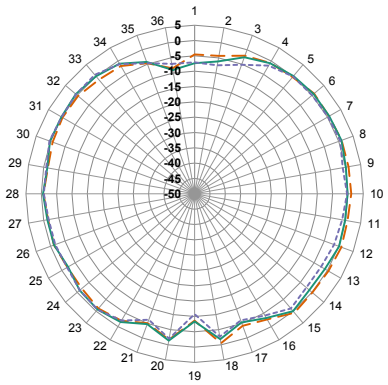


YZ-Plane Gain

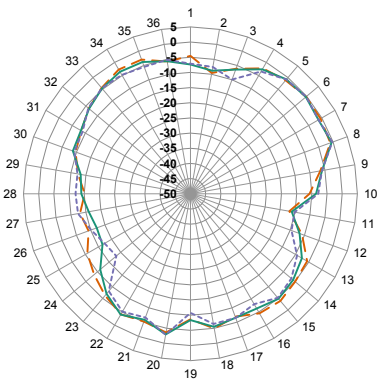


XY-Plane Gain

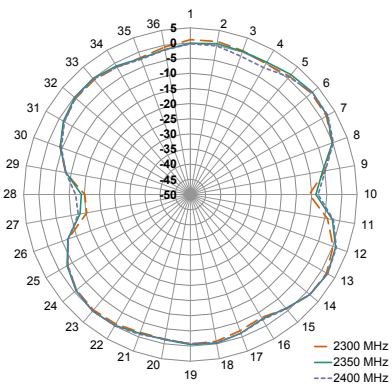
2300 MHz TO 2400 MHz (2350 MHz)



XZ-Plane Gain



YZ-Plane Gain

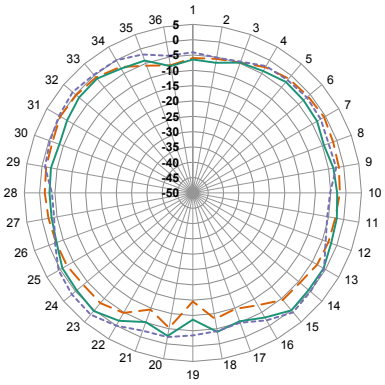


XY-Plane Gain

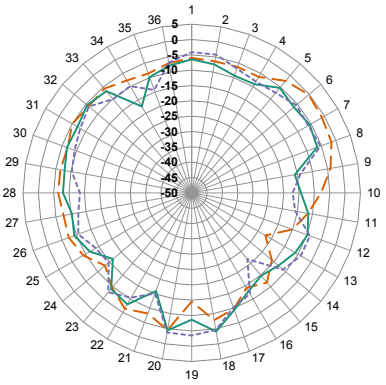
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RADIATION PATTERNS - EDGE OF GROUND PLANE, BENT 90 DEGREES

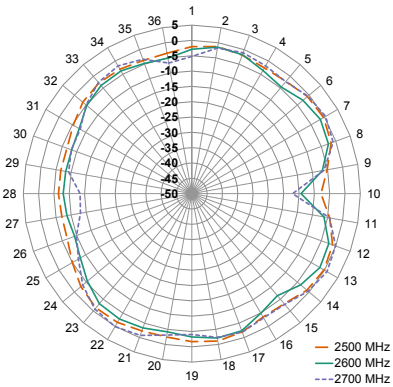
2496 MHz TO 2690 MHz (2600 MHz)



XZ-Plane Gain

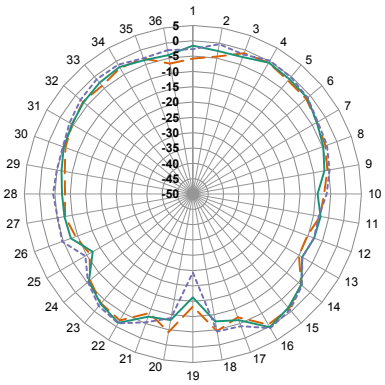


YZ-Plane Gain

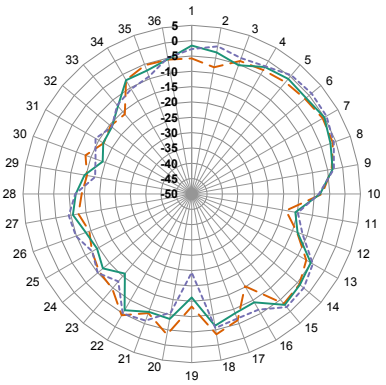


XY-Plane Gain

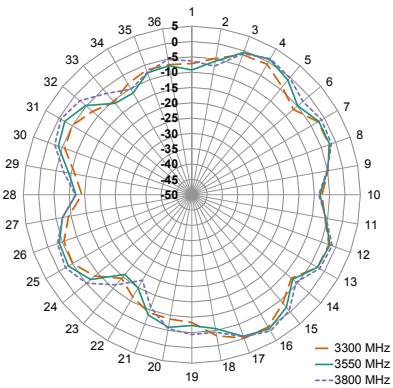
3300 MHz TO 3800 MHz (3550 MHz)



XZ-Plane Gain

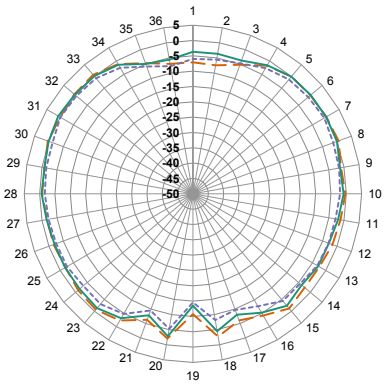


YZ-Plane Gain

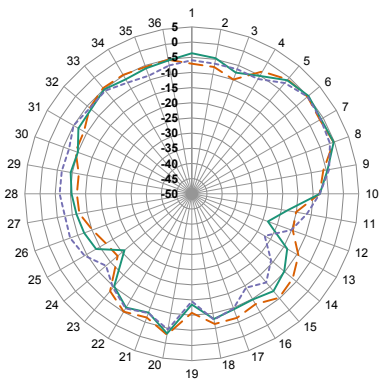


XY-Plane Gain

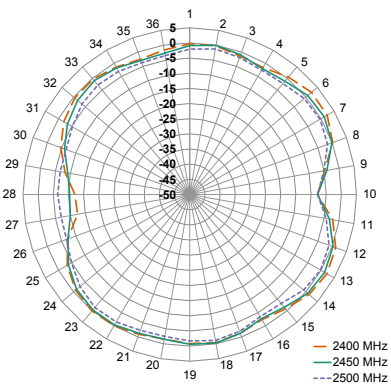
2400 MHz TO 2500 MHz (2450 MHz)



XZ-Plane Gain



YZ-Plane Gain



XY-Plane Gain

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