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INDUSTRY COMPARISON BARRACUDA VEHICULAR 6 PORT ANTENNA

This paper offers an RF performance comparison between the TE Connectivity's Barracuda antenna and another well-known industry antenna.

Introducing the Barracuda Antenna”

The TE Connectivity’s Barracuda antenna is a ruggedly reliable, low profile, multiport/ multiband, 5G-ready antenna that provides an exceptional solution for today’s high-tech public safety, transportation, and aftermarket fleet applications. The Barracuda antenna can turn vehicles into communication hubs and configured for ESN and FirstNet operation. The Barracuda antenna allows for single hole mounting which can reduce the risk of vehicle damage while also lowering installation costs. This antenna comes with a five-year product warranty

TE Connectivity’s Barracuda antenna has six ports that are configured for the following:

- Two port MIMO operation over the 3G/4G/5G/ ISM/CBRS bands
- Two-port MIMO operation over the low/high frequency Wi-Fi bands including Wi-Fi 6E
- Fifth port – Has options for a third Wi-Fi, UHF, or future VHF
- Sixth port – An additional port that provides an active antenna for enabling GNSS global navigation services

Key Features of the Barracuda Antenna

- 5G ready
- Low profile
- Configured for ESN and FirstNet operation
- IP67-rated, low profile, aerodynamic housing
- Multiband/MIMO operation with GNSS navigation
- Five-year product warranty

Performance Summary

While the following table displays the main performance differences between the TE Connectivity's Barracuda antenna and some other similar products, here are a few of the highlights where the Barracuda antenna excelled: Sixth port – An additional port that provides an active antenna for enabling
GNSS global navigation services

- Broad frequency coverage
- Excellent pattern performance/coverage
- Excellent isolation performance
- Low MSRP

✓ Competitive Strength

	Barracuda Antenna from TE Connectivity	Other Competing Antenna
Number of Ports	6	6
Port Configuration	2x LTE (includes 3G/4G/5G ISM/CBRS) 3x Wi-Fi 1 x GNSS	2x LTE 3x Wi-Fi 1 x GNSS
Frequency – MHz	✓ LTE Ports: 698-960/1690-3800 Wi-Fi Ports: 2400-2500/4900-6000 GNSS Ports: 1559- 1606	LTE Ports: 698-960/1710 2170/2500-3800 Wi-Fi Ports: 2400-2500/4900-6000 GNSS Ports: 1562-1612
Max Gain – dBi	LTE Ports: 2.5/7.4 Wi-Fi Ports: 4.0/6.4 GNSS Ports: 30.0 (dB)	LTE Ports: 2.0/5.0 Wi-Fi Ports: 4.0/6.0 GNSS Ports: 26.0 (dB)
Max VSWR	✓ LTE Ports: <2.5/<2.0 Wi-Fi Ports: <2.0:1 GNSS Ports: <2.0:1	LTE Ports: <2.5:1 Wi-Fi Ports: <2.0:1 GNSS Ports: <2.0:1
Isolation – dB	✓ LTE to LTE: >11 LTE to Wi-Fi: >14 Wi-Fi to Wi-Fi: >30	LTE to LTE: > 11 Wi-Fi to Wi-Fi: > 19
Power – Watts	30	25
Size – mm (L x W x H)	179 x 63 x 118 (w/whip) 179 x 63 x 48 (w/o whip)	172 x 61 x 118 (w/whip) 172 x 61 x 50 (w/o whip)
Mounting	Stud	Stud
Warranty – Years	✓ 5	3

Note: In the table above, LTE Ports refers to 3G/4G/5G/ISM/CBRS bands.

Performance Details

This section breaks down some of the focal points when it comes to assessing an antenna's performance.

Frequency, Gain and Radiation Patterns

Antenna gain indicates how well an antenna converts input power to radio waves or how strong a signal it can send in a specific direction. The higher the gain, the more directional it is. Higher gain does not, however, mean that the signal is amplified – but only that the signal has been focused into a narrower beam which brings with it increased range. To put it simply, it's a matter of taking RF power and redirecting it where you need it – same amount of power that is redistributed as needed.

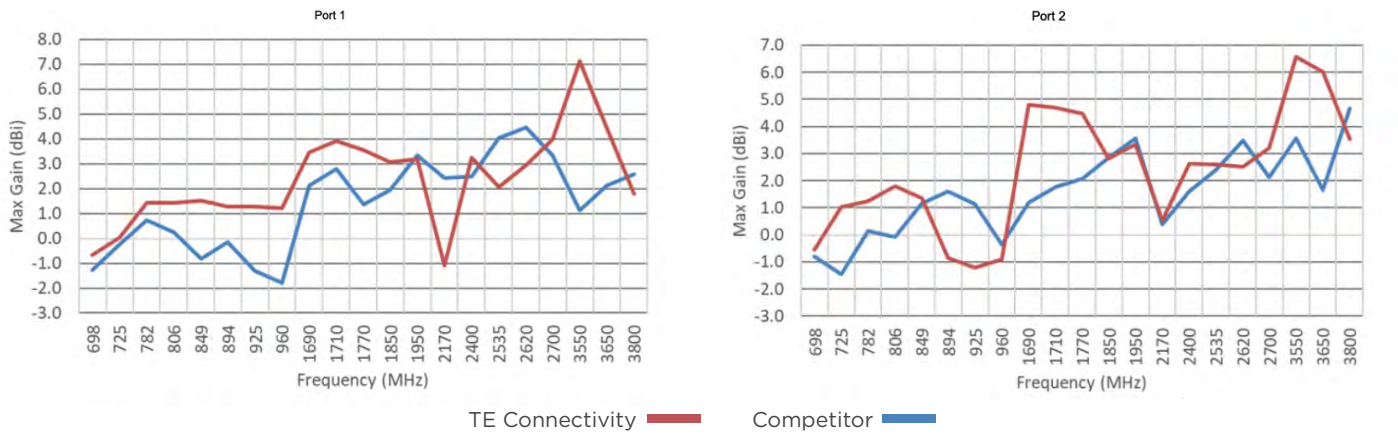
The following table displays the frequency coverage as well as the gain comparison between our antenna and some others.

Although both antennas show similar maximum gain with the Wi-Fi and GNSS ports, the Connectivity's Barracuda antenna seems higher when it comes to the LTE ports at this time. Refer to the following to view more detailed testing results.

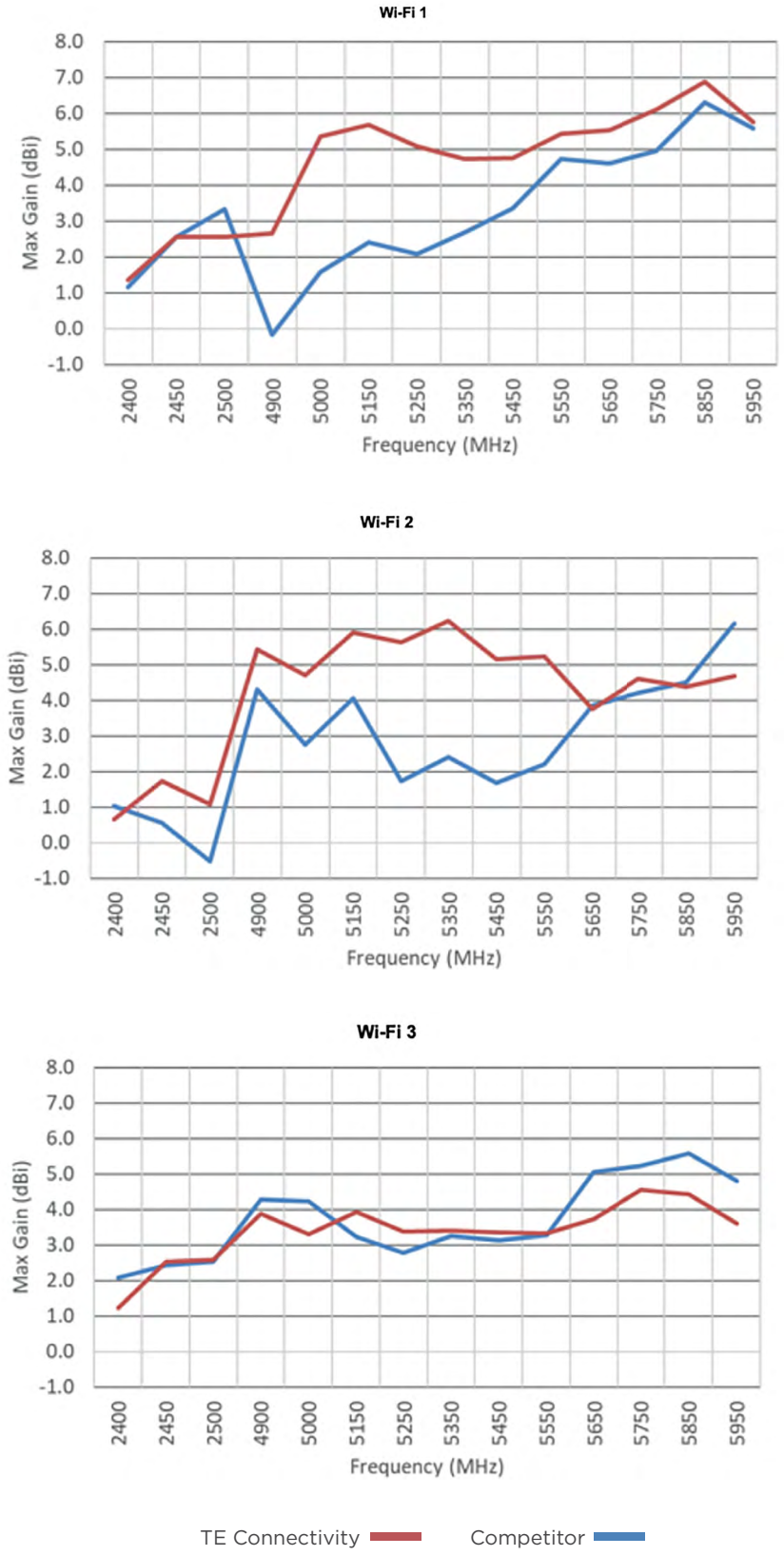
	Barracuda Antenna from TE Connectivity	Other Competing Antenna
Frequency – MHz	LTE Ports: 698-960/1690-3800 ✓ Wi-Fi Ports: 2400-2500/4900-6000 GNSS Ports: 1559- 1606	LTE Ports: 698-960/1710-2170/2500-3800 Wi-Fi Ports: 2400-2500/4900-6000 GNSS Ports: 1562-1612
Max Gain – dBi	✓ LTE Ports: 2.5/7.4 Wi-Fi Ports: 4.0/6.4 GNSS Ports: 30.0 (dB)	LTE Ports: 2.0/5.0 Wi-Fi Ports: 4.0/6.0 GNSS Ports: 26.0 (dB)

Note: LTE Ports refers to 3G/4G/5G/ISM/CBRS bands.

Maximum Gain Comparison – LTE Ports

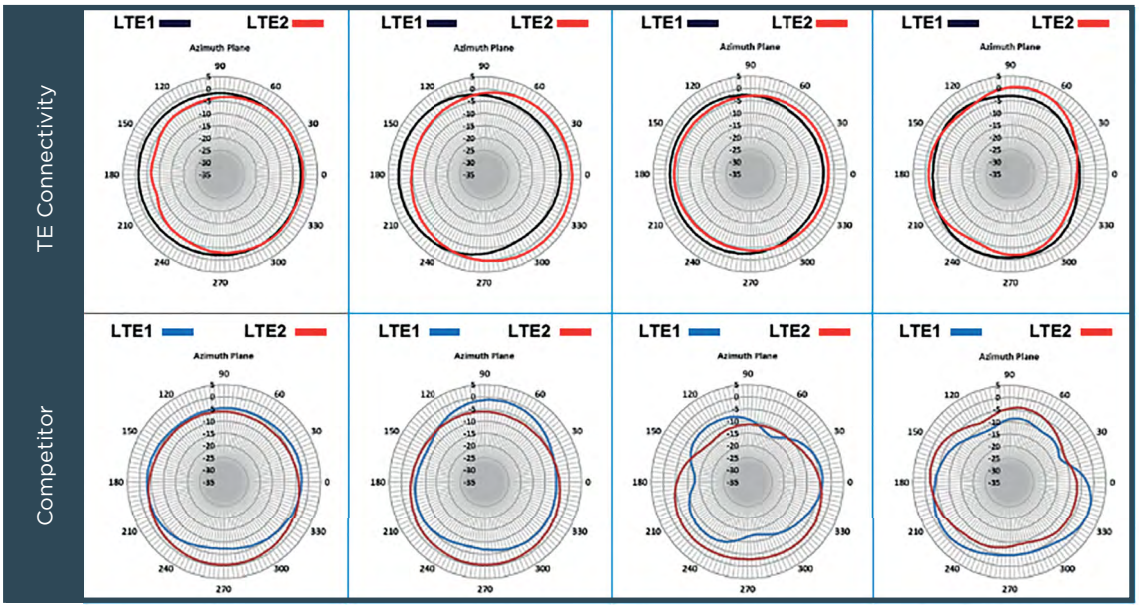


Maximum Gain Comparison – Wi-Fi Ports

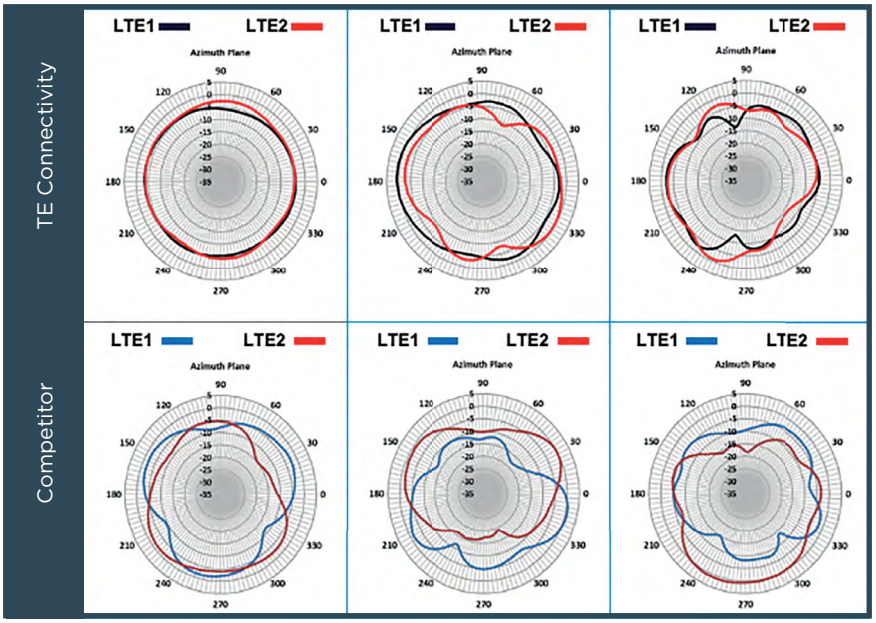


Radiation Pattern Comparison – LTE Port

698 MHz | 806 MHz | 960 MHz | 1690 MHz

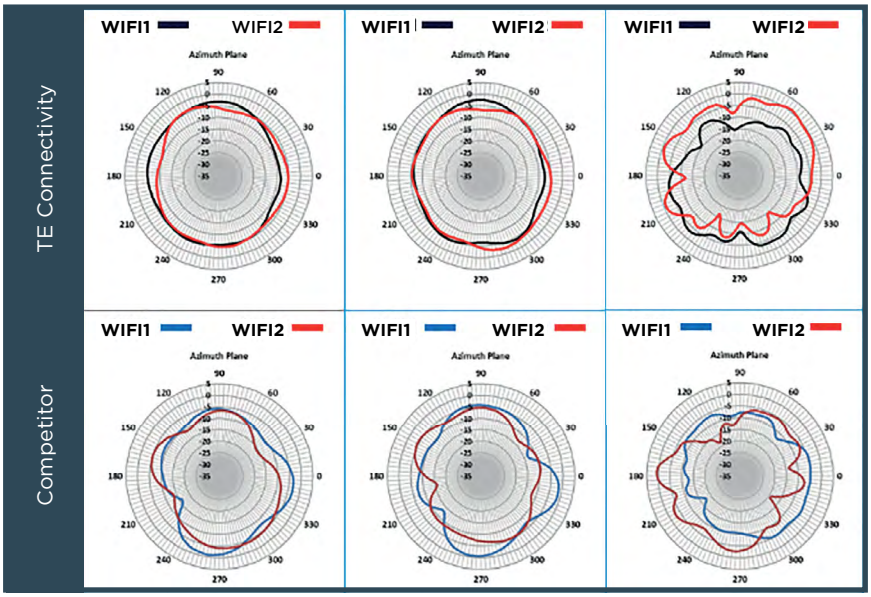


2170 MHz | 2700 MHz | 3700 MHz

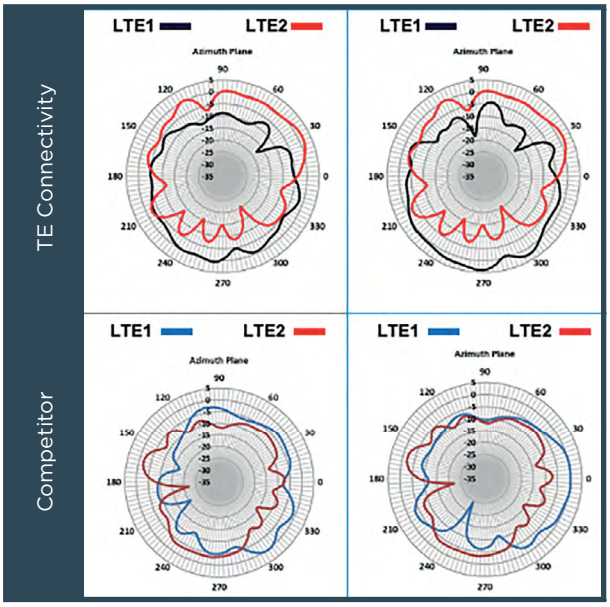


Radiation Patterns – Wi-Fi Ports

2400 MHz | 2500 MHz | 4900 MHz



5250 MHz | 5850 MHz



VSWR, Isolation and Power Handling

VSWR

Voltage Standing Wave Ratio (or VSWR) indicates how much of a divergence exists between an antenna and the transmission line to which its connected. VSWR values range from 1 to ∞ with a value below 2 generally considered acceptable.

Isolation

When multiple antennas are co-located or physically near each other, RF isolation decreases which can be an issue when one of the antennas is transmitting and the other one(s) are receiving or transmitting. Ideal isolation ensures uncorrelated transmissions for the antennas' radio signals. The higher the value (dB), the less interference of the radio signals and the better the performance of the associated antennas. Two methods to increase isolation is 1) to keep the antennas as far apart physically as possible and 2) adjust the antennas' polarization.

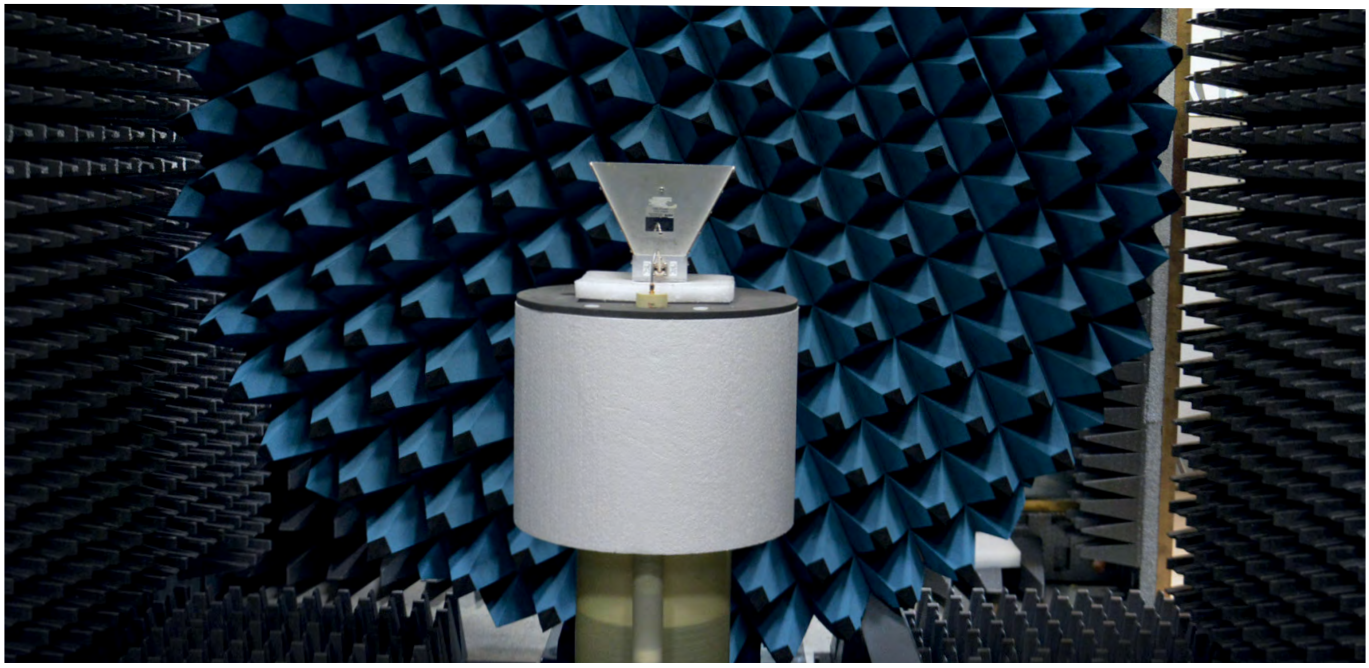
Power Handling

Power handling refers basically to the maximum amount of input power an antenna can manage and still properly function.

Performance Results

The following table displays the VSWR, isolation, and power handling comparisons between these two antennas.

	Barracuda Antenna from TE Connectivity	Other Competing Antenna
Max VSWR	LTE Ports: <2.5/<2.0 Wi-Fi Ports: <2.0:1 GNSS Ports: <2.0:1	LTE Ports: <2.5:1 Wi-Fi Ports: <2.0:1 GNSS Ports: <2.0:1
Isolation – dB	LTE to LTE: >11 LTE to Wi-Fi: >14 Wi-Fi to Wi-Fi: >30	LTE to LTE: > 11 Wi-Fi to Wi-Fi: > 19
Power – Watts	30	25



Test Setup

The following describes the test setup equipment and environment used for this performance comparison.

Radiation Pattern Testing

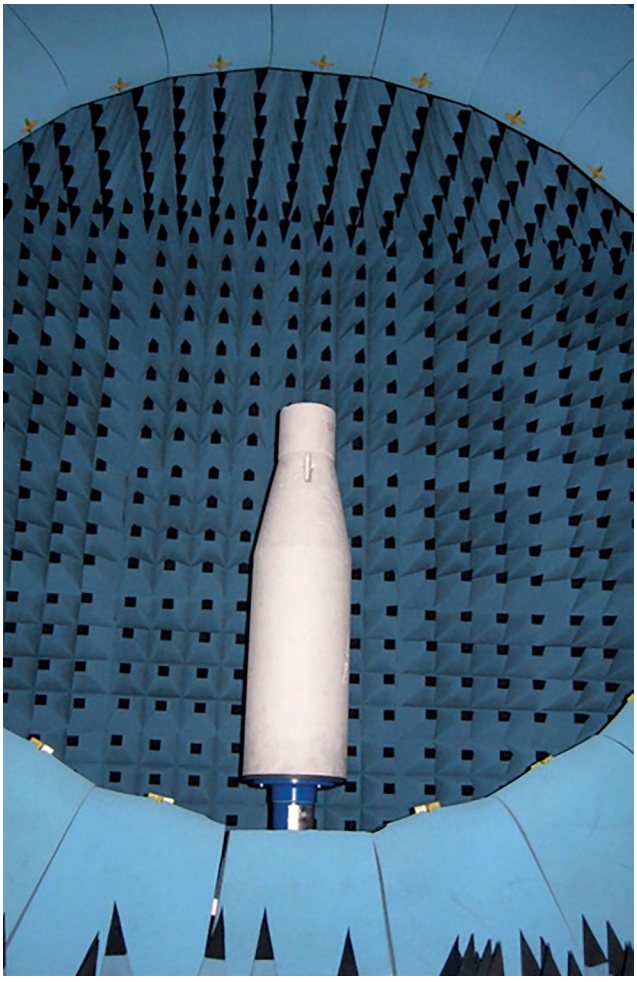
Radiation pattern testing was performed in a Satimo 3D Chamber SG24.

Chamber Specifications

External dimensions – m (ft.)	4.0 x 4.0 x 4.0 (13.12 x 13.12 x 13.12)
Shielding effectiveness, plane wave 800 MHz–6 GHz	100 dB
Pyramid absorber reflectivity	-30 dB @ 800 MHz

The SG24 has 23 probes, each spaced at 15° in elevation with an internal arch diameter of 2.4 meters.

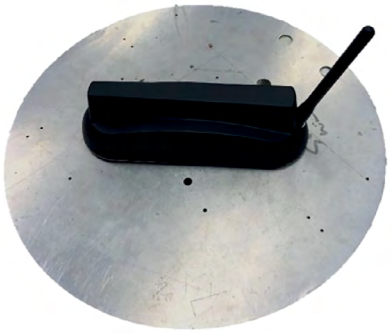
Passive antenna measurements are performed using a Vector Network analyzer and software.



VSWR and Isolation Testing

VSWR and isolation testing were performed with the VNA ENA5071B.

- The VNA was calibrated with the Keysight N4431B electronic calibration module
- The antenna performance was measured in a 3D chamber using a 30-centimeter ground plane at free space.



Performance Testing Parameters

The following outlines the testing parameters.

Operating Frequencies	• Two LTE ports: 698–960 MHz and 1690-3800 MHz • Two Wi-Fi ports: 2400–2500 MHz and 4900–5900 MHz • One Wi-Fi whip port: 2400–2500 MHz and 4900–5900 MHz • One GNSS port: 1559–1606 MHz
VSWR and Isolation	• Measurements were taken in free space on a one-foot diameter ground plane • Unused ports were terminated with 50-Ohm loads
Cable Details	LMR100 coaxial cable – one foot in length from the stub • Connector types: – LTE antenna – SMA connector – Wi-Fi antenna – RP-SMA connector RF test cable (VNA to antenna) – 220-millimeter coaxial cable RG402 with an N-type connector

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