

INTRODUCTION

Precise and reliable performance testing of wireless devices relies on a high-quality electromagnetic simulation test environment and standardized test software. These components are crucial for third-party certification labs and User Equipment (UE) Research and Development (R&D) departments to evaluate overall wireless device performance.

The RayZone 9000 (see images on the right and bottom), in adherence to 3rd Generation Partnership Project (3GPP), U.S. Cellular Telecommunications Industry Association (CTIA), and European Conformity (CE) certification standards, stands out as an exclusive OTA test system supplier with multiple CTIA-certified systems. Its design incorporates patented technologies, featuring innovations in electromagnetic environment design, measurement component optimization, test algorithm fine-tuning, and system software development.

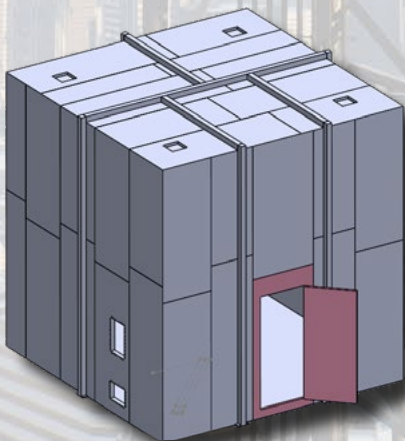
Key Advantages include:

- Multi-probe, spherical, multi-function, full-standard and fast OTA certification test system
- Frequency range: 0.4GHz–7.5GHz
- Test coverage: Antenna characteristics (antenna pattern, gain, efficiency), OTA performance (TRP/TIS/EIRP/EIS/Throughput)
- MIMO Test: MPAC/RTS methods, 2D/3D standard channel models and field environment simulation
- High accuracy: quiet zone reflection $\leq -32\text{dB}$, ripple SSD $< 0.6\text{dB}$
- Large DUT: quiet zone $\Phi > 50\text{cm}$ (SISO)/30cm (MIMO)
- Modular and lightweight design: Polygonal antenna frame and assembled shielding body, easy to construct and relocation

In this series, products feature wireless communication OTA test software on the Microsoft .NET framework platform, known for its comprehensive features, user-friendly interface, and ensuring high test accuracy and stability. Chambers are equipped with environmentally friendly EPP rigid foaming absorbers, ensuring resistance to moisture and a longer lifespan, preventing the impact of environmental changes on free-space range loss.

The RayZone 9000 multi-probe precision Over-The-Air (OTA) test system is tailored for 5G New Radio (NR) Multiple Input Multiple Output (MIMO) testing using the MPAC method. Compatible with the Radiated Two-Stage (RTS) method and encompassing all Single Input Single Output (SISO) measurement functions, it meets certification requirements by 3rd Generation Partnership Project (3GPP), Cellular Telecommunications

Industry Association (CTIA), and European Conformity (CE). It is the preferred choice for certification bodies, operators, device manufacturers, antenna suppliers, and design houses for reliable solutions in both certification and (R&D) testing.



COMPREHENSIVE DISTRIBUTED ANTENNA SYSTEM

The RayZone 9000 system features a modular multi-probe antenna structure, enhancing system flexibility. SISO and MIMO probe antennas are independently installed, simplifying system construction and improving installation accuracy. The distributed antenna system within the chamber includes horizontal and vertical rings. The horizontal rings, comprising upper, middle, and lower sections, are utilized for MPAC MIMO testing. The middle ring boasts 16 sets of dual-polarization probe antennas for 2D MIMO testing, while upper and lower rings each have 8 sets, enabling 3D MIMO testing when combined with the middle ring. Vertical antennas (see figures 1 & 2) consist of a full ring for SISO testing and a half ring for RTS MIMO testing. The full ring incorporates 23 sets of dual-polarization probes, and the half ring has 5 sets, offering selective installation based on configuration requirements.

RTS MIMO TESTING

The RayZone 9000 system facilitates RTS MIMO testing. During the RTS 4x4 MIMO test, the vertical ring's probe antennas initially measure the antenna pattern, capturing UE antenna amplitude and phase patterns. Subsequently, 4 antennas are chosen for the throughput test's second stage. To identify high isolation inverse matrix spatial positions, the RayZone 9000 introduces a half antenna ring orthogonal to the full vertical ring at a 90° angle. This half ring, featuring 5 spaced-out probe antennas at 30° intervals, enhances spatial combinations for 4 streams, aiding in the discovery of a higher isolation inverse matrix for the throughput test's second stage.

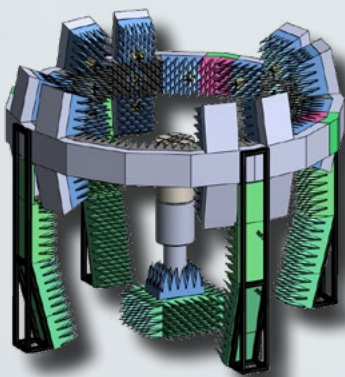


Figure 1: Horizontal Antenna Ring System

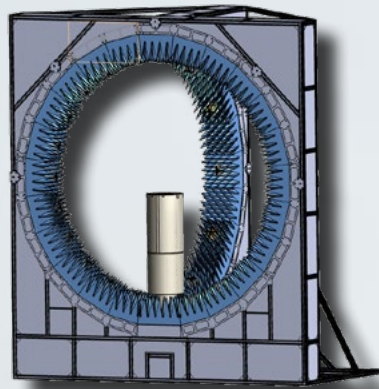


Figure 2: Vertical Antenna Ring System

WIDE-BAND LOW-RCS DUAL-POLARIZATION ANTENNA

The RayZone 9000 test antenna, known as MA-2800 (see figures 5&6), is a wideband, low Radar Cross Section (RCS), dual-polarization antenna. It serves purposes such as gain calibration, test probe usage, and generating wideband interference signals.

The antenna represent an innovation optimized for test chambers, featuring the integration of EPP materials (see figures 7&8) for the first time.

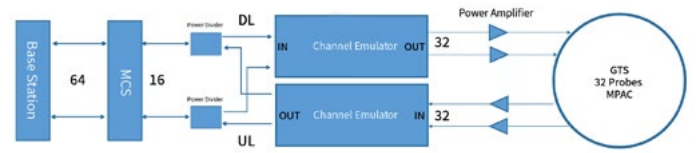


Figure 4: MIMO Test System Diagram Based on Actual Base Station

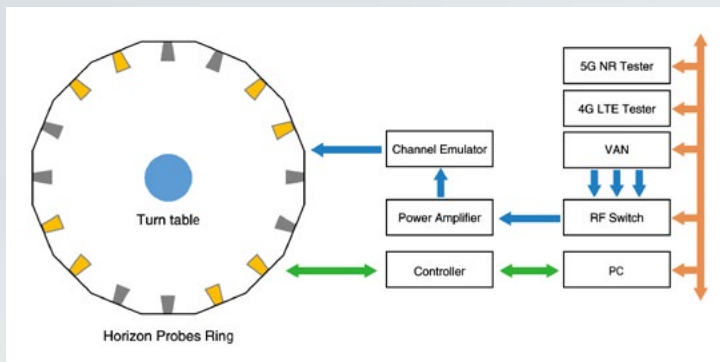


Figure 3: MIMO Test System Diagram Based on Wireless Test Set

This design minimizes antenna reflection to the environment, effectively suppresses coupling and reflection between probe antennas, reduces quiet zone reflection levels, enhances test accuracy, and decreases measurement uncertainty. In comparison to other antenna types, the MA-2800 series meets low RCS requirements while offering wide frequency band coverage, low Voltage Standing Wave Ratio (VSWR), low axial ratio (AR), flat in-band gain, and high cross-polarization isolation. Consequently, MA-2800 series antennas are well-suited for use in multi-probe measurement systems.

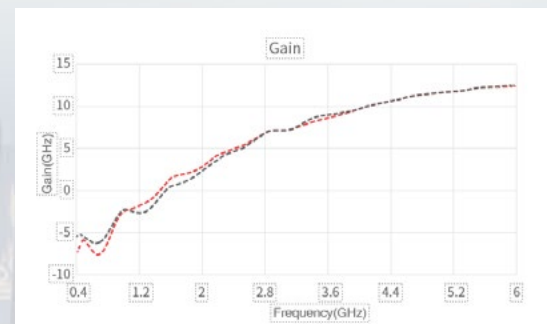
MPAC MIMO TESTING

The RayZone 9000 system supports two MIMO test plans: one based on a wireless test set (see figure 3) and the other on an actual base station (see figure 4).

The wireless test set plan involves evaluating UE downlink throughput performance using 8 or 16 probe antennas from the horizontal middle ring under 2D channel models. Alternatively, the upper and lower horizontal double rings' probe antennas can be included for the evaluation test under 3D channel models.

The actual base station plan incorporates uplink and downlink bidirectional channel simulation to assess UE bidirectional throughput performance. It utilizes 8 probe antennas from the middle ring for downlink simulation and another 8 for uplink simulation. These two sets of probe antennas are alternately distributed to achieve the reciprocity scenario of uplink and downlink. The upper and lower horizontal rings' probe antennas contribute to achieving the reciprocity scene under 3D channel models.

Additionally, the actual base station, with multiple output ports, can integrate phase-shifting network equipment for MIMO testing in the base station beamforming scenario.



Figures 5&6: MA-2800 Antenna

TECHNICAL SPECIFICATIONS

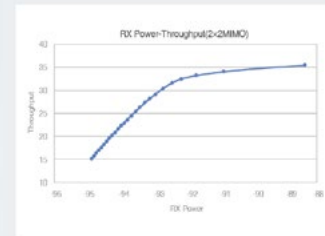
Frequency	0.4 ~ 7.5GHz
VSWR	< 2.5:1
Polarization	Dual Linear Polarization
Cross Polarization Isolation	25dB (typical)
Impedance	50 Ohms

POWERFUL TEST CAPABILITY

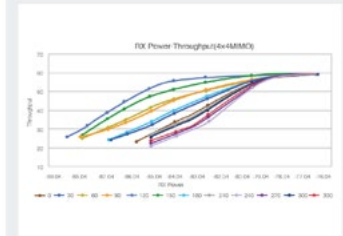
The hardware design of the RayZone 9000 OTA test system fully meets the far-field test requirements outlined in the latest "CTIA Test Plan for Mobile Station Over the Air Performance." It adheres strictly to the plan's calibration methods and test procedures, providing both passive and OTA test functions for various wireless communication standards.

1. Cellular 2G/3G/4G/5G FR1
2. Wi-Fi 802.11b/g/n/a/ac/ax
3. Bluetooth
4. GNSS navigation
5. 5G NR FR1 4x4 MPAC MIMO OTA throughput
6. 5G NR FR1 4x4 RTS MIMO OTA throughput

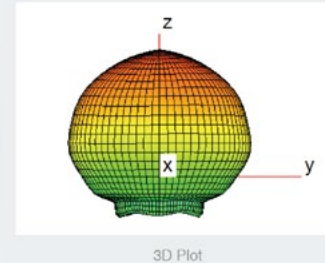
Furthermore, the RayZone 9000 can expand its capabilities to accommodate IoT product tests, including Zigbee, Lora, NB-IOT, etc., through the addition of test instruments and upgrades to the test software.



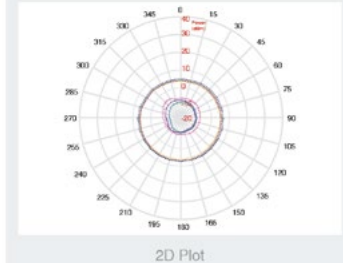
LTE 2x2 MIMO



LTE 4x4 MIMO



3D Plot

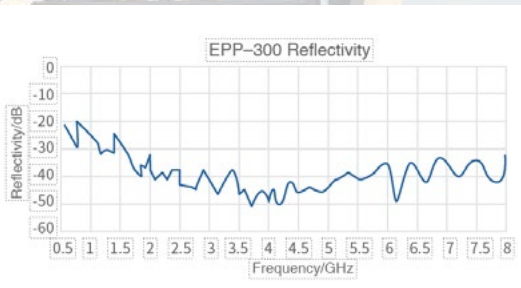


2D Plot

ANTENNA/OTA TEST SOFTWARE

The test software built on the .NET Framework 4.0, is a control and test automation software aligned with CTIA standards. It is regularly updated, offering diverse applications, flexible configurations, streamlined testing, and a user-friendly GUI. With stability throughout R&D, pre-certification, conformance, and QA in manufacturing, it meets varied test requirements across the entire product life cycle.

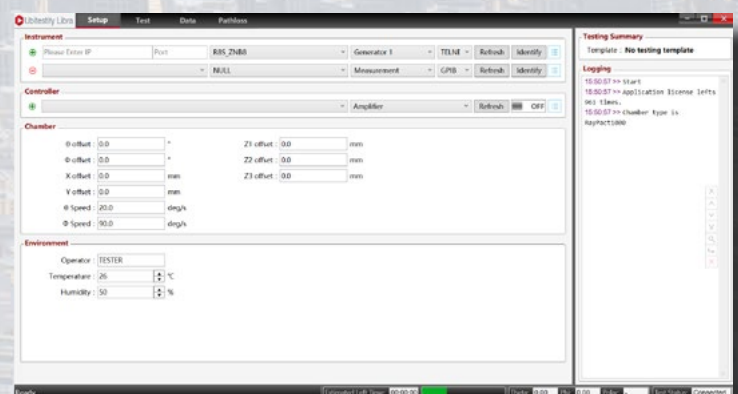
1. Facilitates 3D measurement, selectable 2D measurement, and single-point measurement
2. Allows user customization of test steps, angles, and configurations
3. Permits arbitrary selection of test points for comprehensive data review
4. Enhances testing processes with various assistant functions like anti-drop-call, auto-recall, and abnormal situation warnings, ensuring reliability and fluency
5. Manages comprehensive raw test data and log files with traceable and non-modifiable test processes
6. Supports batch processing for creating task lists, enabling continuous and automated unattended tests
7. Provides built-in templates and preconfigured parameters compatible with different instruments and test platforms, minimizing operational errors
8. Enables 3D display, arbitrary angle rotation of antenna patterns, and visual analysis tools for R&D engineers



Figures 7&8: EPP-300 Absorbing Foam

Using the provided wireless communication test software, the RayZone 9000 facilitates automated testing for the following items:

1. Antenna Gain
2. Antenna Directivity
3. Antenna Beam width
4. Cross Polarization Ratio
5. Antenna Efficiency
6. TRP
7. TIS
8. EIRP
9. EIS
10. NHPRP
11. NHPIS
12. 2D/3D Radiation Pattern
13. MIMO Antenna Correlation
14. MIMO Throughput



TECHNICAL SPECIFICATIONS

	Functions	RayZone 8000	RayZone 9000
General	Applications	- Antenna Test - SISO/MIMO OTA Test - CTIA SISO Certification Test	- Antenna Test - OTA Test - CTIA SISO/MIMO Certification Test
	Test methodologies	- Far-field conical cut method - RTS method	- Far-field conical cut method - MPAC method
	Frequency range	0.4GHz–7.5GHz	
	Dynamic range	60dB	
Shielding Room	Exterior dimensions (L x W x H)	4 × 4 × 4m (customizable)	5 × 5 × 5m (customizable)
	Shielding	>100dB	
	Door size (H x W)	2 x 1m	
Distributed Antenna Systems and Turn Table	Number of vertical ring antenna	23	23 (full ring)+5 (half ring)
	Antenna spacing of vertical ring	15°	
	Number of horizontal ring antenna	N/A	16+8+8
	Antenna spacing of horizontal ring	N/A	22.5°
	Azimuth turntable accuracy	0.1°	
	Azimuth turntable speed	30°/s	
	Turntable rotation range	0°–360°	
	Measurement distance	1.4m	1.6m
DUT	Max. size	50cm	
	Max. weight	50kg	
Quiet Zone	Dimensions (L × W × H)	0.5 × 0.5 × 0.5m	
	Reflection level	< -32dB (typical)	
Test Probe	Type	Low RCS Vivaldi antenna	Low RCS Vivaldi antenna
	Polarization	Dual-polarization	Dual-polarization
	Frequency 0.4GHz–7.5GHz	0.4GHz–7.5GHz	


TOYO TOYOTech

47623 Lakeview Blvd, Fremont, CA 94538

 Phone: 510-438-9548 | E-mail: info@toyotechus.com
<http://www.toyotechus.com>