

INTRODUCTION

The RayZone® 2800 (see Figure 1) is an all-in-one OTA testing system designed for 5G Sub-6GHz devices' antenna and SISO/MIMO OTA (Over-the-air) testing. RayZone 2800 is the world's first testing system which can execute the 4x4 MIMO OTA throughput test, with the process taking merely 40 mins^{1, 2}. The RayZone 2800 is an ideal testing tool for 5G devices.

The RayZone 2800 supports most wireless testing standards, including 2G/3G/4G/5G/Wi-Fi, SISO/MIMO, GNSS, as well as the NB-IoT/Cat-M testing. Furthermore, its testing software can be customized based on customer requirements.

With system level simulations, innovative absorbers, custom-designed antennas and cutting-edge testing algorithms, the GTS minimizes system testing error, pursues excellence in designing and manufacturing the test system. The RayZone 2800 system can provide a certified-level accuracy.

With a footprint of less than 3 cubic meters, the RayZone 2800 is suitable for typical offices and laboratories. Its modular design makes the system easy to be installed and relocated. The high quality EPP absorbers are environment-friendly, dust-free, moisture-proof and have a life-time-warranty.

With certified-level accuracy, all-in-one testing capability, fast measurement speed, the RayZone 2800 sets the new benchmark for the OTA test systems.

Other key features include:

- Comprehensive wireless standards: 2G/3G/4G/5G(FR1)/GNSS/A-GNSS/Wi-Fi/Bluetooth
- IoT standards: LTE Cat NB1(NB-IoT)/Cat-M1(e-MTC)
- SISO test: TRP/TIS/EIRP/EIS
- MIMO test: 2x2, 4x4 with 3D models, the world's first 4x4 MIMO system
- Passive antenna, Desense, ICS, CA (2CC/3CC/4CC)
- Frequency range: 400MHz, 600MHz-6GHz, expandable to 7.25GHz
- GTS MaxSign 100 test software for antenna/OTA test with visual data analysis
- Environment-friendly EPP rigid foam absorber, low RCS/high gain test antennas, customized fixture
- Certification level accuracy; fastest MIMO test speed
- Modular structure, compact size, fast assemble and re-location

CERTIFIED LEVEL ACCURACY, STABLE PERFORMANCE

The RayZone 2800's ripple test SSD specification is in full compliance with CTIA test plan, but MIMO OTA system demands higher standards of antenna coupling and isolation, as well as testing zone reflection. The reflection in QZ is less than -32dB and test error caused by reflection is less than 0.2dB.

Designed for MIMO OTA, the testing zone reflections in the RayZone 2800 reach -32dB, which is 10dB better than CTIA SISO standard. Therefore, the MIMO throughput testing error caused by internal reflection is less than 0.2dB. The accuracy of antenna measurements is shown in table 1.



Figure 1: RayZone 2800 (Front View)

We are the first company to introduce low RCS probe antennas in OTA testing system³, which can reduce the interference within multi-antennas. Moreover, for the 5G wide band signal, the probe antennas are optimized to make its gain fluctuation less than 0.5dB within 100MHz BW.

The RayZone 2800 is equipped with new-generation EPP absorbers⁴, characterized by moisture-proof, indeformable, durable and its absorbing rate unchanged with the environment humidity, which ensures the performance of the RayZone 2800 to be stable and consistent. MaxSign100 testing software integrates GTS expertise in MIMO testing⁵.

Characterized by the optimal hardware design, unique quick testing function and error elimination capability, the RayZone 2800 offers the certified-level accuracy with the fastest testing speed for MIMO OTA.

SPECIFICATION	FREQUENCY RANGE	TYPICAL VALUE
Peak Gain Accuracy	0.4 GHz ~ 0.6 GHz	±1.0 dB
	0.6 GHz ~ 0.9 GHz	±0.6 dB
	0.9 GHz ~ 6.0 GHz	±0.4 dB
Repeatability	0.4 GHz ~ 6.0 GHz	±0.2 dB
	0.4 GHz ~ 0.6 GHz	±2.0 dB
	0.6 GHz ~ 0.9 GHz	±0.8 dB
-10dB Sidelobes Accuracy	0.9 GHz ~ 6.0 GHz	±0.5 dB
	0.4 GHz ~ 0.6 GHz	±3.4 dB
	0.6 GHz ~ 0.9 GHz	±1.6 dB
-20dB Sidelobes Accuracy	0.9 GHz ~ 6.0 GHz	±1.0 dB
	0.4 GHz ~ 0.6 GHz	-
	0.6 GHz ~ 0.9 GHz	±2.7 dB
-30dB Sidelobes Accuracy	0.9 GHz ~ 6.0 GHz	±2.2 dB

Table 1: Antenna Measurement Accuracy

¹ 3GPP TS 37.544, User Equipment (UE) Over The Air (OTA) Performance Conformance Testing

² W. Yu, Y. Qi, K. Liu, Y. Xu, and J. Fan, "Radiated two-stage method for LTE MIMO User Equipment Performance Evaluation," TEMC, 2014

³ J. Wu, Y. Qi, W. Yu, L. Liu, and F. Li, "An Absorber-Integrated Taper Slot Antenna," TEMC, 2017

⁴ P. Gong, L. Liu, Y. Qi, W. Yu, F. Li, and Y. Zhang, "Multiphysics Analysis of Millimeter-Wave Absorber with High Power Handling Capability" IEEE EMC, 2017

⁵ P. Shen, Y. Qi, W. Yu, and F. Li, "Eliminating RSARP Reporting Errors in the RTS Method for MIMO OTA Test," TEMC, 2017

SUPPORTS 5G NR FR1, THE FIRST 4×4 MIMO OTA SYSTEM

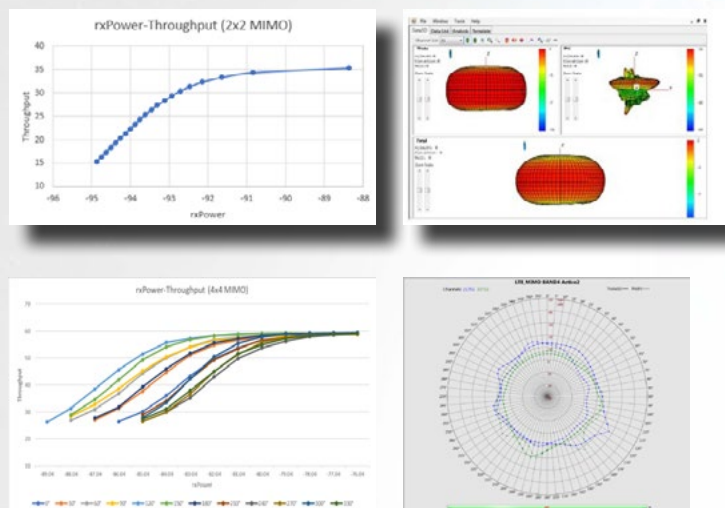
With 2D/3D channel model compatible, the RayZone 2800 is the first system that supports both 2x2 and 4x4 MIMO OTA testing in the world. In the beginning of 2018, the Radiated Two Stage (RTS) method was officially accepted by 3GPP and became a standard testing method for the MIMO OTA measurement^{1,2,7}. Near the end of 2018, GTS successfully completed the UE LTE 4x4 MIMO throughput OTA test in San Diego. This was the first time that the UE 4 streams full speed throughput result was obtained in the world.

The RayZone 2800's basic system configuration supports LTE 2×2 MIMO OTA throughput test. It can be upgraded to support LTE 4×4 MIMO/5G FR1 4x4 MIMO OTA with 3D channel model test^{6,7}.

The RTS MIMO OTA method has many benefits:

- Simple Hardware structure, cost-effective and simple maintenance
- Only testing instruments and system software upgrade is needed to allow for 4G to 5G tests or 2D to 3D channel models tests
- Fast testing speed
- Provides decomposition testing results to R&D engineers, assists with trouble shooting and MIMO performance optimizing

The RayZone 2800 solves the OTA testing challenge for 5G UE development as it is an ideal OTA testing tool. We keep track of the wireless standard's evolution, collect customers feedback, continuously update the testing software, and improve the system capability.



FAST AND ACCURATE OTA TEST

UE's OTA performance will impact user experience, but the OTA testing speed is slow. Typically, an UE 3D MIMO OTA throughput test will take more than 6 hours; displaying its impracticality. The ability to reduce the testing time becomes a critical point for wireless terminals and antenna development.

GTS invented the testing methods and algorithms, fundamentally solved the problem of low efficiency tests, greatly improved the SISO/MIMO testing speed without sacrificing the testing accuracy. RayZone2800 helps to improve 5G UE development efficiency and removes the possibility of OTA testing times stunting the R&D progress.

MINIATURIZED & MODULAR DESIGN; EASY TO INSTALL & RELOCATE

The RayZone 2800 is less than 3m in height, acceptable to standard office buildings and laboratories. The modular design block construction and light-weight concept make the whole system easily buildable and relocated. It can not only save the construction time, but also protects the customers' investment in expensive large test systems.

HARDWARE SIMULATION, DECOMPOSITION TEST; HW DESIGN & OPTIMIZATION ASSISTANCE

The antenna engineer would like to know the antenna's impact on the whole system performance. Usually, it has to be simulated via software. But with the RTS testing method, the antenna engineer can rapidly test the real antenna, automatically upload the antenna pattern to the system, then get the MIMO throughput result immediately. Furthermore, engineers can simulate an antenna pattern using software, upload the file to the system, then execute the real-time hardware simulation. With this tool, the hardware engineer can accurately evaluate different antennas' impact on the same RF communication module. It will greatly improve the hardware development and optimize the efficiency.

For the system engineer, the RayZone 2800 is an invaluable tool. The engineer could test the system's TPR/TIS/Throughput, and understand which factor impacts the whole system performance, which module needs improvement. The RayZone 2800 provides flexible testing tools, such as antenna pattern, ECC, and full band TIS fast sweep. The engineer can execute the decomposition test⁸, to comprehensively analyze each module's influences, and to improve the whole system performance.

ITEM(S)	MPAC (CTIA STANDARD) TEST TIME	RTS METHOD TEST TIME
2D MIMO OTA (UMi& UMa)	10 mins (pattern) +120 mins (TP)	10 mins (pattern) +30 mins (TP)
3D MIMO OTA (single channel model)	20 mins (pattern) +360 mins (TP)	20 mins (pattern) +40 mins (TP)

ITEM(S)	MPAC (CTIA STANDARD) TEST TIME	SMART TEST METHOD TEST TIME
SISO TIS 3Ch (GSM)	40 mins	6.5 mins
SISO TIS 3Ch (Wi-Fi)	160 mins	10 mins

⁶ P. Shen, Y. Qi, W. Yu, J. L. Drewniak, M. Yu and F. Li, "An RTS-Based Near-Field MIMO Measurement Solution--A Step Toward 5G," TMTT, 2018.

⁷ P. Shen, Y. Qi, W. Yu, and F. Li, "Inverse Matrix Auto-Search Technique for the RTS MIMO OTA Test—Part 1: Theory," TEMC, 2017

⁸ P. Shen, Y. Qi, W. Yu, J. Fan, Z. Yang and S. Wu, "A Decomposition Method for MIMO OTA Performance Evaluation," TVT, 2018

MAXSIGN 100 PROFESSIONAL ANTENNA/OTA TEST SOFTWARE

The MaxSign100 system's control and test automation software (see Figure 2) is compliant with CTIA test standards and is kept up to date with the latest specifications. The software provides a wide range of applications, flexible configurations, test processes as well as a simple to use but powerful GUI. It meets different test requirements and covers the entire product life cycle from R&D, pre-certification, and conformance to QA manufacturing.

Test supported include:

- Gain: EIS
- Directivity: NHPRP
- Beamwidth: NHPIS
- Sidelobe Level: ICS
- Efficiency: Radiation Pattern
- TRP: Desense
- TIS: Throughput
- EIRP

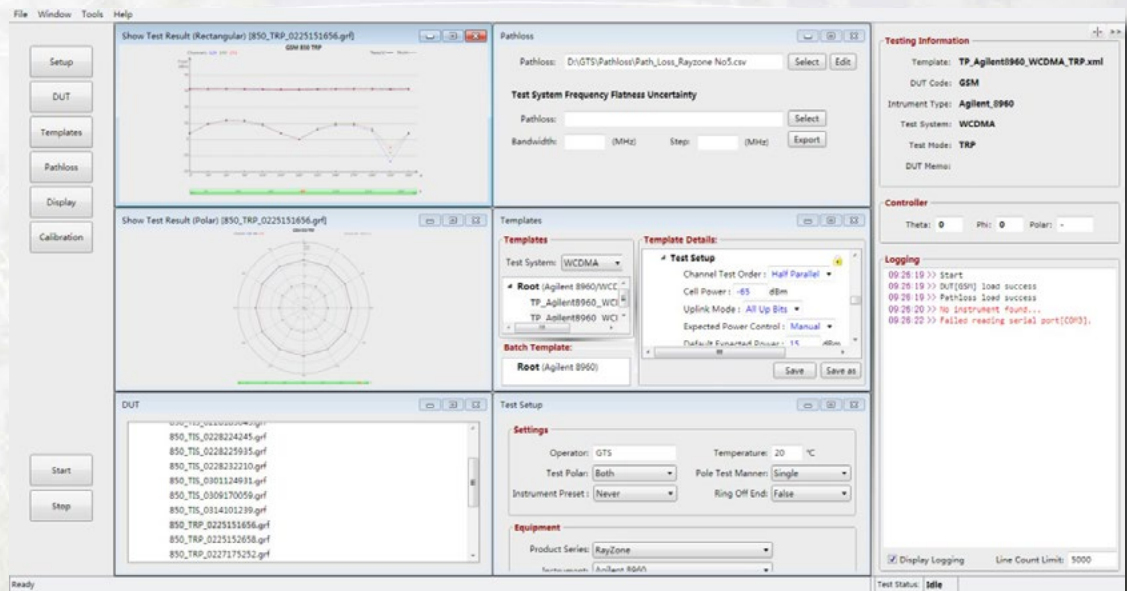


Figure 2: MaxSign Test Software

Other key features include:

- Supports 3D measurement, cut selectable 2D measurement, and single point measurements
- User-defined test step, test angle, and test configuration
- Arbitrary selection of test point to review all test data of it
- Wide variety of test assistant functions: anti-drop-call, auto-recall, and abnormal situation warnings. Improves the testing processes' reliability and fluency
- Comprehensive raw test data and log files management. Traceable and non-modifiable test process
- Batch processing function supports creating task lists for continuous and auto-mated unattended tests
- Resourceful built-in templates, preconfigured parameters compatible with different instruments and test platforms. Simple manipulations effectively prevent operational errors
- Supports 3D display, antenna pattern arbitrary angle rotation, viewing, and cutting to help R&D engineers to visually analyze and diagnose problems

RAYZONE 2800 SHIELDING ENCLOSURE

Hardware	Chamber, Shielding Door, Absorber, Dual Polarized Narrow Beam Probe Antennas, RF Switch Box, RF Cable, Positioner, System Controller and Turntable
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SYSTEM SPECIFICATIONS

Dimensions (L×W×H)	3.0 m × 3.0 m × 2.9 m
Max. DUT Size	Φ42 cm
Reflection Level (in QZ)	< -32 dB
Antenna Pattern Accuracy	±0.5 dB
Turn Table Max Load	15 kg
Turn Table Max Speed	40°/s
f-Resolution	0.5°
q-Resolution	15°
Door (H×W)	1900mm × 700mm
Shielding Effect	>100 dB (600 MHz - 6GHz)
Measurement Path	1.23 m
Number of Antennas	12+2
Power	AC 220/110 V
Control Interface	RS 232
Hardware Structure	On-site Assembly & Reassembly

INSTRUMENTS SUPPORTED (OPTIONAL)

Base station Emulator	Keysight UXM E7515A/B, Keysight 8960 (E5515C), R&S CMW500, CMX500, Anritsu MT8820C/8821, MT8862A, MT8000A, StarPoint SP6010
VNA	Keysight, R&S, Anritsu and etc
Signal Generator	Keysight E4438C, Keysight MXG N5182B, Spirent GSS6300/6560/6700/7000
Channel Emulator	Anite F32/F64, Spirent VR5/Vertex

RAYZONE SOFTWARE MODULES

MaxSign V2.1 Base Module	System Control/Instrument Drivers/ Passive Test
3D PatternPad	3D Data Viewer
GSM/GPRS/EGPRS/CDMA/CDMA 1xRTT	TRP/TIS/EIRP/EIS/ICS
WCDMA/CDMA 1xEVDO	TRP/TIS/EIRP/EIS/ICS
TD-SCDMA	TRP/TIS/EIRP/EIS/ICS
Wi-Fi (802.11 a/b/g/n/ac/ax etc.)	UE/AP TRP/TIS/Throughput
LTE SISO (FDD/TDD)	TRP/TIS/EIRP/EIS/ICS
5G FR1 SISO (NSA/SA)	TRP/TIS/EIRP/EIS/ICS
LTE/FR1 MIMO 2×2	Data Throughput
LTE/FR1 ECC	Passive ECC/Active ECC
GPS/A-GPS	C/No /EIS/TIS
BeiDou	TIS
Desense	Wi-Fi/Cellular/GPS
NB-IoT/Cat-M	TRP/TIS/EIRP/EIS

SERVICE & SUPPORT

System calibration	One free calibration at system delivery
Maintenance	Free for the first year
Software upgrade	Free for the first year



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