

General Test Systems Inc.

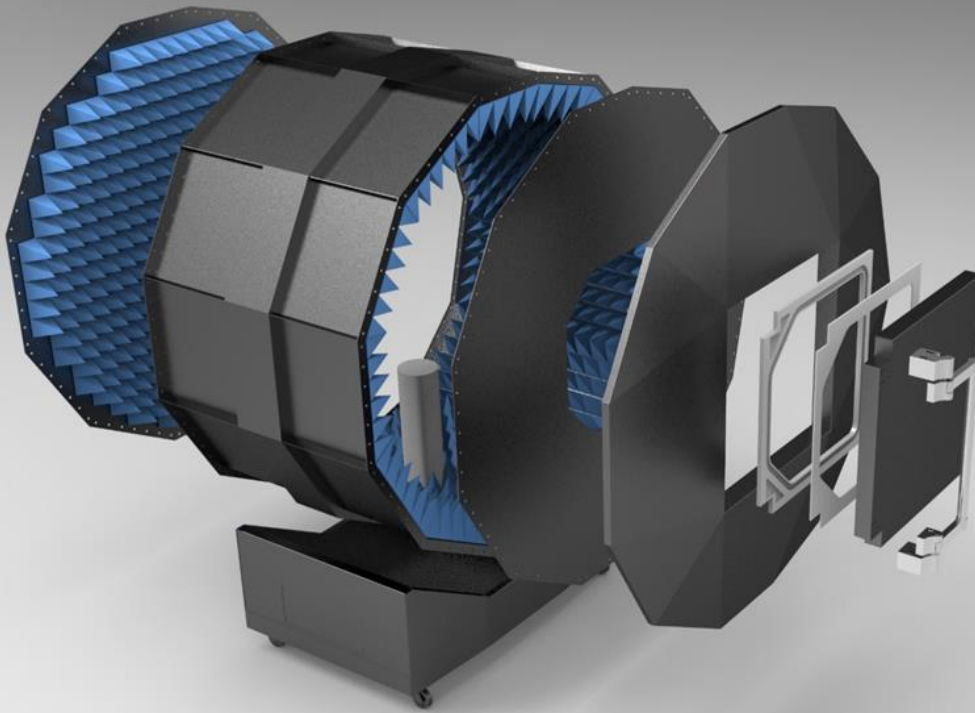
GTS RayZone® 1800 5G+

5G(FR1) SISO/MIMO Compact Antenna/OTA Test System



* Pictures are for reference only, please prevail in kind.

- Comprehensive wireless standards: 2G/3G/4G/5G(FR1)/GNSS/A-GNSS/Wi-Fi/Bluetooth/UWB
- IoT standards: LTE Cat NB1(NB-IoT)/Cat-M1(e-MTC)
- SISO TRP/TIS/EIRP/EIS testing, 2×2 MIMO throughput testing
- Passive antenna, Desense and ICS testing
- Frequency range: 600MHz-12GHz
- GTS MaxSign 100 test software for antenna/OTA test with visual data analysis
- Environment-friendly EPP rigid foam absorbers, low RCS/high gain antennas and customized fixture
- Fast MIMO testing, certified-level accuracy
- Integrated design, plug & play, simple maintenance



COMPLEX TO SIMPLE

Innovative Chamber Structure, Ingenuous Asymmetric 13-sided-polygon Design

Small structure changes, significant performance improvements

With the continuous miniaturization of mobile terminal (cellphone, laptop, and etc.), the testing of the built-in low-directionality antennas becomes critical in R&D testing. The weaknesses of large far-field chamber are shown in such terminal testing, such as being huge in size, slow in test, expensive and less cost-effective.

Based on the in-depth study of the near-field radiation, GTS proposed an innovative test theory: in the near-field radiation, the indicators that characterize the overall performance of the mobile terminal such as TRP, TIS and the peak of the antenna pattern are closely related. Through the careful structure design and probe antenna optimization, it is possible to make the accurate measurements for DUT's peak value and directionality, and the system measurement uncertainty can be similar to the far-field tests. RayZone1800 is an excellent implementation of the above theory with our engineering studying results.

RayZone1800's innovatively employed the asymmetric 13-sided polygon design. Through the 180 degree transformation of some sampling points, with only 12 test antennas, it provides a minimum angle of 15° sampling step as defined in the CTIA measurement. The asymmetric shape determines the irregular distribution of the test

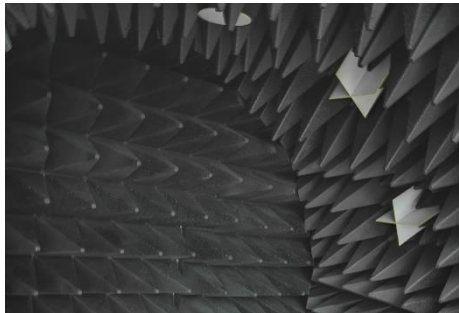
probes which maximizes the measurement distance within a small chamber. In addition, matching the antenna quantity with the antenna spacing helps to avoid the direct reflection and reduce the adjacent coupling between antennas.

RayZone1800 achieves the same measurement performance as a large certified chamber in one-fifth of the size.

- Based on the brand-new test theory, it realizes the effective near-field radiation test, and a unique asymmetric multi-probe system architecture is adopted according to the physical characteristics of the low directivity of the DUT antenna.
- The absorbers are directly adhered to the inner surface, which coincides with the electromagnetic wave propagation end surface. It ingeniously achieves the theoretical maximum-use efficiency of shielding space.
- The antennas are isolated from the absorbers to prevent any temperature and humidity changes from affecting the antenna performance and system stability.
- All RF cables and controlling mechanism of turntable are placed in external trunkings or the chamber base. Together with the wave-transparent fixture, RayZone1800 provides a pure test environment.

Pursue Perfection, Achieve Excellence in System Performance

High performance absorbers + Low RCS antennas



Frequency	400MHz	600MHz	700MHz	1GHz	3GHz	5GHz	12GHz
Absorber Reflection	-28 dB	-28 dB	-42 dB	-45 dB	-50 dB	-55 dB	-55 dB

RayZone1800's absorbing materials use full-band simulation and optimized designs to obtain the best absorbing performance structure, ensure excellent electromagnetic wave absorption performance :

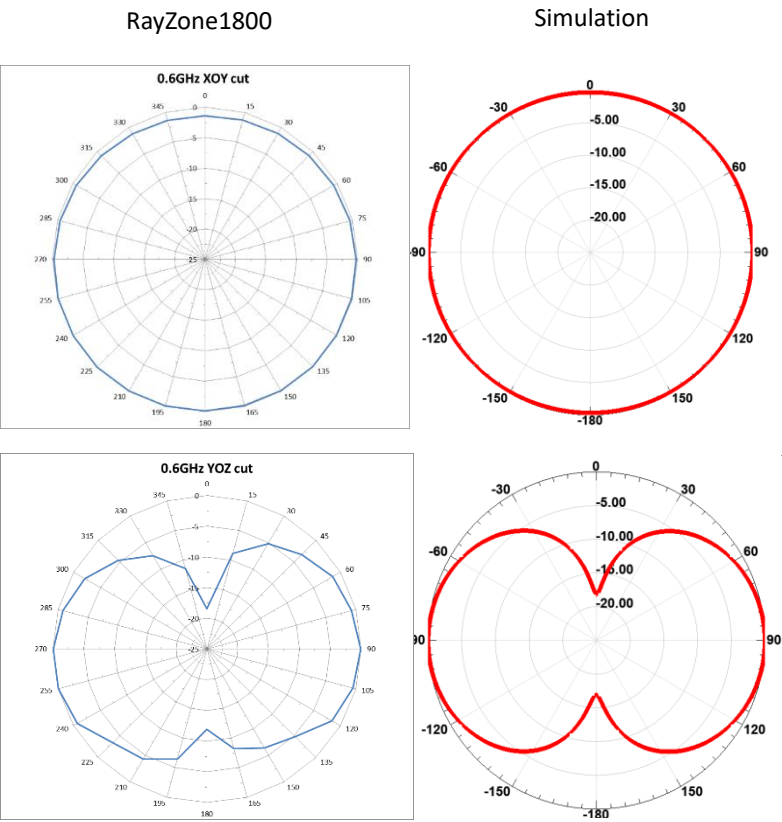
- Electric property: EPP has small dielectric constant, small surface reflection, sufficient internal attenuation, and good absorbing effect in the microwave frequency band.
- Fire resistance : meets UL94 HF-1 , GB8624 B2 standard.
- Limit Oxygen Index: no less than 27%
- Working temperature : long-term -50-100°C (short-term 120°C)
- Environment protection : non-toxic raw materials, odor-free, and no harmful gas released, no dust.
- Final product: meets RoHS standard.
- Physical Appearance: precise size, uniformity color.

Being a key part of the OTA test system, the customized and low RCS(radar cross-section) probe antennas are equipped in the RayZone1800 which help to obtain the best system testing accuracy.

- Working frequency range: 400MHz~12GHz
- Gain flatness within the whole working frequency $\leq \pm 0.25\text{dB}$
- Optimizing the antenna feed to improve the standing-wave-ratio
- Modular design ensures the performance consistency and simple maintenance of the antenna
- Compact size, being integrally designed with surrounding absorbers, achieving low RCS characteristic.

In order to pursue the test accuracy, GTS designed a variety of accessories for the use in the test systems.

We recognize the difficulty for engineers to measure and obtain the performance of the AUT itself due to the common current exists in the passive antenna measurement which has caused the RF connector and test cable to become undetachable part of the AUT. The common current's side-effect is particularly significant at low frequency. Therefore, GTS designed a special choke beads for the passive antenna measurement which can suppress the common current and reduce the external cable and connector's interference to the test result. RayZone1800 provides a perfect testing environment for the antenna engineers, in which the engineer can obtain the real and accurate antenna pattern of the small size AUT in very low frequency and different positions. The right figure shows a standard passive antenna's patterns from RayZone1800 and software simulation.



RayZone1800 passive test result vs. Simulations

From its external shape to the internal parts, RayZone1800's every design went through very strict system-level hardware simulations, it employed customized testing probes which are wide frequency, low RCS and low cross-polarization; the new generation EPP absorbers which are in-deformable, durable, moisture-proof and dust-free; Full wave-transparent and customizable fixture design can reduce the signal occlusion and improve the test accuracy. With all the great effort on improving the system, the RayZone1800 test results can be compared with a large far field test system. It can not only be consistent with lab simulations, but also provide full test capability of an expensive and large certified chamber. The measured results are as follows.

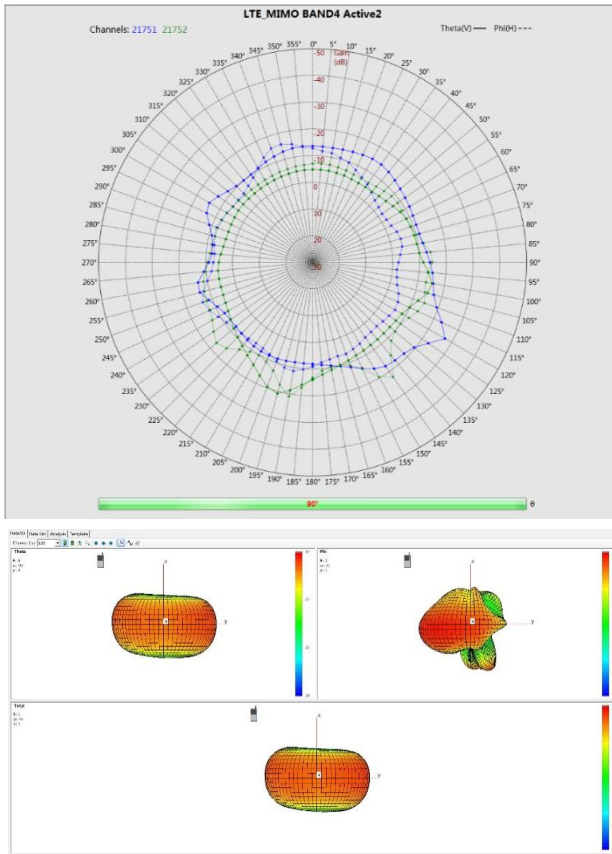
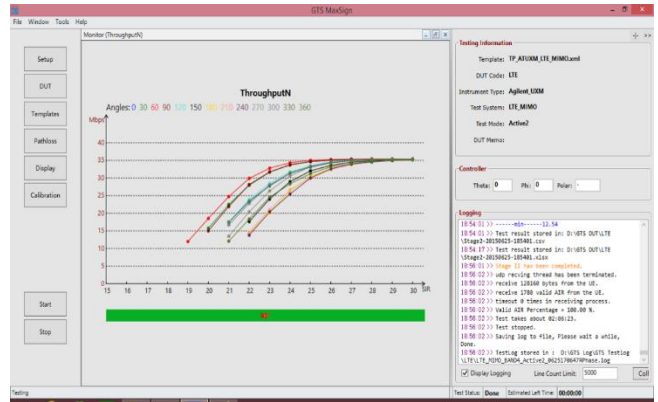
Band	TRP					TIS				
	Channel	Freq	RZ1800	Certified Lab	Difference	Channel	Freq	RZ1800	Certified Lab	Difference
GSM850	251	848.8	26.55	26.70	-0.15	251	893.8	-104.58	-104.60	-0.02
GSM900	124	914.8	26.95	26.40	0.55	124	959.8	-103.16	-102.40	0.76
GSM1800	885	1784.8	26.52	25.90	0.62	885	1879.8	-106.52	-106.30	0.22
GSM1900	810	1909.8	26.38	25.50	0.88	810	1989.8	-105.90	-105.50	0.40
LTE(B3)	19900	1780	20.31	19.90	0.41	1900	1875	-97.50	-97.40	0.10
LTE(B5)	20600	844	19.71	19.90	-0.19	2600	889	-96.52	-97.20	-0.68
LTE(B7)	21350	2560	20.16	20.30	-0.14	3350	2680	-94.74	-94.00	0.74
LTE(B17)	23800	711	17.14	17.80	-0.66	5800	741	-96.14	-96.80	-0.66
LTE(B40)	39550	2390	18.89	18.70	0.19	39550	2390	-93.25	-93.80	-0.55

RayZone1800 active test result vs. Certified chamber's

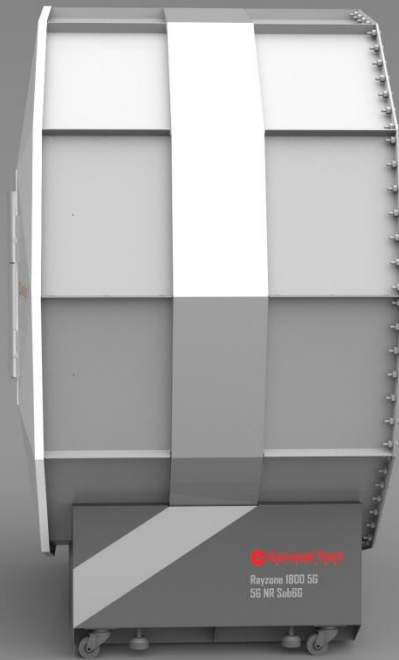
MaxSign100 Professional Antenna/OTA Test Software

User-Friendly, Extensible, Customizable

GTS MaxSign100 system's control and test automation software is based on the Net Framework 4.0 platform. It is fully complied with CTIA test standards and kept up to date with the latest specification. The MaxSign100 provides a wide range of applications, flexible configurations, smooth test processes, stable operation, as well as a simple but friendly GUI. It can meet different test requirements in different product stages and cover the whole product life cycle from R&D, pre-certification, conformance to QA in manufacturing.



- Supports 3D measurement, cut selectable 2D measurement and the single point measurement.
- 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, such as 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 list for continuous and automated 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 engineer to visually analyze and diagnose problem.

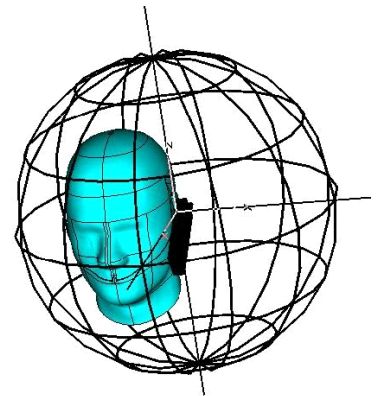


- Full wireless standards
- All standard test items
- Passive/active/phantom test
- 2D/3D pattern display
- Desense test
- Wide instruments selections
- Various debugging information for R&D
- Minimum 15° sampling resolution
- Auxiliary tool for DUT HW optimization

RayZone1800 is one of the RayZone series products that are electromagnetic environment simulation testing systems. It provides wide range applications, powerful functions and flexible configurations. Comparing to a certified chamber, RayZone1800 can achieve same level accuracy, but with faster test speed and better test repeatability. Based on the new testing theory and system design, RayZone1800 has a unique asymmetric polygon structure which ingeniously multiplies the DUT sampling points, achieving a good balance between compact size and comprehensive functions.

RayZone1800 fully supports SISO OTA throughput test, and RTS(Radiated Two-Stage) MIMO OTA test with only requirement in software upgrades. RayZone1800 is a cost-effective tool for the 4G/5G wireless pre- certified tests.

Due to its compact size and flexible mobility, the integrated and calibrated RayZone1800 can be transported to customer site as a whole. Without month-long installation and calibration process needed by a conventional chamber, our customer can dramatically save the time, space and human resource. To be an accurate, stable, simple, delicate, flexible, convenient and efficient test solution—RayZone1800 carries out GTS product concepts of “Accurate, Simple, Fast, Agile”. Every innovation comes from our persistence in creating more values for our customers.



RayZone1800 System Specifications

General	Functions	Passive/Active antenna test, OTA test
	Applications	-Antenna R&D test -Wireless terminal R&D test -Desense test -RF pre-certificated test -MIMO throughput test
	DUT types	Antenna, cellphone, tablet, laptop, CPE etc.
	Test methodologies	Multi-probe, Smart test and RTS method
	Frequency range	600MHz~7.5GHz
	Test items	-Antenna: 2D/3D Antenna pattern(amplitude, phase), Directivity, Gain, Efficiency, Beamwidth, Cross Polar Level, Sidelobe Level, -RF: EIRP, EIS, TRP, TIS, NHPRP, NHPIS, ICS, ECC, TWR(two way ranging), AoA(angle of arrival) -Others: Desense
	Shielding	> 80dB
	Measurement distance	80cm
DUT	Max. DUT size	25×25×25cm
	Max. DUT weight	20kg
	Com. ports	USB 3.0/RS232
QZ	Size	25cm×25cm×25cm (L×W×H)
	Reflections	< -25dB
Probe antenna	θ-resolution	15°
	Numbers	12+2
	10dB beam width	~60°
	Cross-polarization ratio	≤ -25dB
Absorber	Base material	EPP
	Height	22cm
	Power tolerance	≤0.75 kW/m ²
Turntable	Rotation range	Φ: 0°~360°
	Rotation speed	≤40°/s
	Φ-resolution	0.5°
Chamber	Exterior dimensions	195cm×183cm×110cm (H×W×D)
	Door size	57cm×57cm (W×H)
	Weight	350KG

Configuration & Ordering

RayZone1800 Shielding Enclosure	
H/W	Chamber,Shielding Door, Absorber, Dual Polarized Narrow Beam Probe Antennas,RF Switch Box, RF Cable, Positioner, System Controller,Turntable.
Services and Maintenance	
Calibration	Free for 1st Time
Maintenance	Free for 1st Year
S/W Upgrade	Free for 1st Year
Instruments Supported	
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

Max Sign 100 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
UWB	TRP/TIS/TWR/AoA

Headquarters

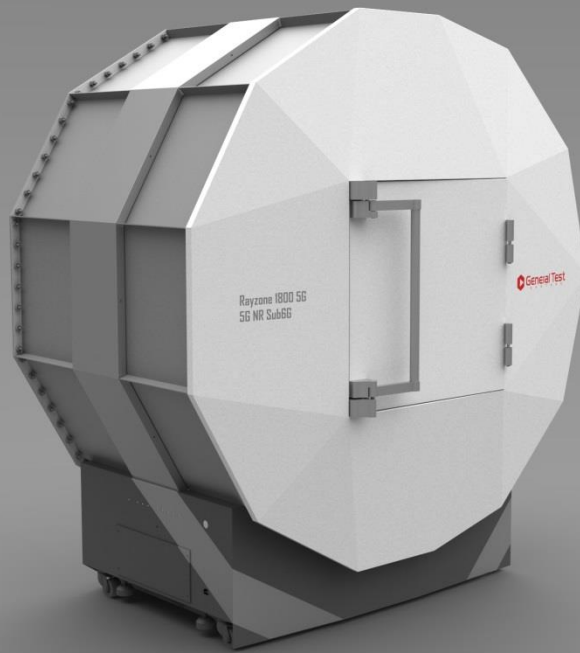
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Accurate • Simple • Fast • Agile