INTRODUCTION

The RP600 phased-array compact antenna test range (CATR) system is a platform designed for mmWave phased-array antennas and related products, catering to antenna and OTA performance testing. This system is characterized by rapid testing, a small footprint, quick delivery, and an open interface, ensuring high precision.

In the RP600 model, the scanning range covers the entire sphere of the Device Under Test (DUT) when placed vertically. However, if horizontal placement or cable tangling is a concern, the RP600Y model can be selected, with its scanning range primarily covering the upper hemisphere.

- For DUT size ≤350×350mm and frequency range 6 - 110 GHz.
- Simultaneously perform tests for multi-frequency, multi-channel, and multi-beam in a single scan
- Compact range field calibration technology eliminates probe movement time and achieves high calibration efficiency for phased-array antennas
- Compact design, three-cabinet assembly, transported as a whole, rapid delivery, fast integration
- Flexible hardware and software configuration, open interface, support user-defined functional upgrades

Figure 1: RP600 CATR Testing Series

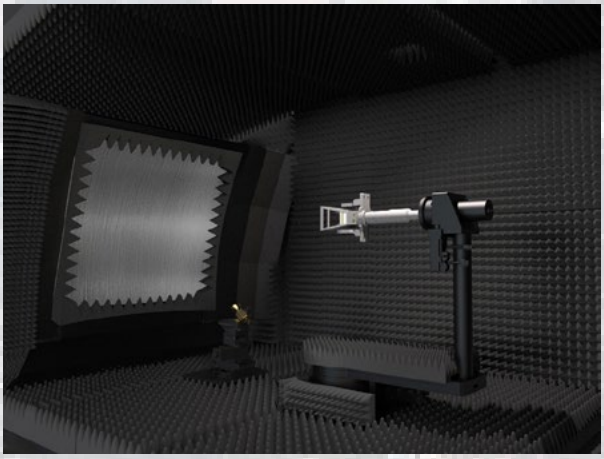

Figure 2: RP600 Interior View

TESTING FUNCTIONS

The RP600/RP600Y CATR testing system is compatible with a phased-array antenna with an aperture of up to 350mm, covering a frequency range of 6 - 110GHz. Its positioner and DUT fixtures are customizable, and the system's external dimensions can be flexibly adjusted to suit the user testing environment. Testing capabilities include phased-array antenna calibration, passive and active transmit/receive performance testing, and more (see *figures 3, 4 & 5*).

PASSIVE TESTING FUNCTIONS

- Antenna 1D/2D/3D Gain/Phase Patterns, Directivity,
- Efficiency, Cross-Polarization Ratio, Front-to-Back
- Ratio, Sidelobe levels, Null Filling, Beamwidth, Beam
- Pointing(Aim Error), Shaft Ratio, Phase Center, etc

ACTIVE TESTING FUNCTIONS

- Active Gain, G/T, EIRP, RF conformance, Protocol conformance

PHASED ARRAY ANTENNA CALIBRATION

- CATR Calibration Method, Rotating Vector Method

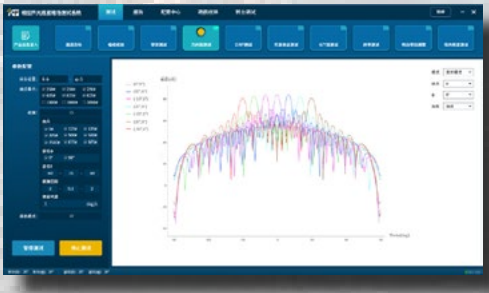

Figure 3: Antenna Pattern Testing

Figure 4: EIRP Test

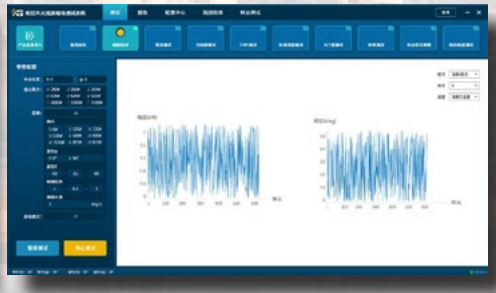

Figure 5: Phase/Amplitude Calibration

TESTING PERFORMANCE

The CATR systems place significant emphasis on quiet zone performance as a key specification. In particular, it excels with internationally leading quiet zone capabilities (see *figure 6*) backed by core technologies such as system simulation, feed horn, reflector, absorbers, positioner, and quiet zone validation devices.

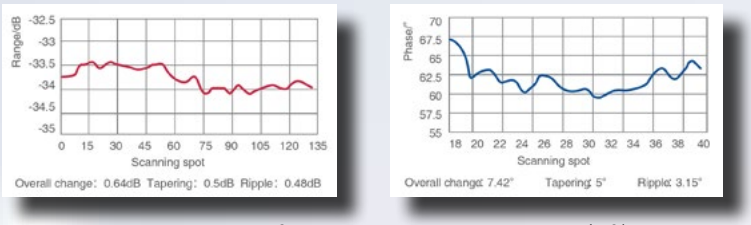

Figure 6: Measured Curves for 24GHz Quiet Zone Amplitude (left) / Phase (right) Performance

The exceptional efficiency of these testing systems is rooted in a deep understanding of user requirements and Device Under Tests (DUTs). We consistently improve testing efficiency (see *table 1*) while meeting precise customer requirements, aiming for a balance between test efficiency and accuracy.

TESTING EFFICIENCY			
	RP600	**Conventional Planar Near-Field System**	**Conventional CATR System**
DUT Supports Continuous Trigger Test	Yes	Yes	Yes
System Supports Continuous Trigger Test	Yes	No	No
System Supports The Automatic Loading And Unloading Of DUT	Yes	No	No
System Provides Quick-Connectors	Yes	No	No
One-Click Test	Yes	No	No
Dut Loading And Unloading Time (Take An Antenna With 900 Elements For Example)	~5 minutes	~20 minutes	~20 minutes
Calibration Time(For Example: 900 Elements, 64 Frequencies, Tx/Rx)	~5 minutes	~25 minutes	~5 minutes
Test Time (For Example: Single Cut, 180° Range, 9 Frequencies, 9 Beams Pattern)	~3 minutes	~300 minutes	~30 minutes

[1] Phased array antenna's element, frequency, and beam switching support continuous trigger.

Table 1: Testing Efficiency

UNIFORM-PHASE-CENTER FEED

Compared to traditional corrugated horn feeds, our CATR horn feeds exhibit excellent wide-angle cross-polarization performance, with phase center deviations on the E-plane and H-plane being less than 5°, and VSWR less than 1.5. In the whole system simulation, the accuracy of cross-polarization testing has improved nearly threefold, and the accuracy of phase testing has increased by approximately 20%.

Figure 6: Uniform-Phase-Center Corrugated Horn Antenna

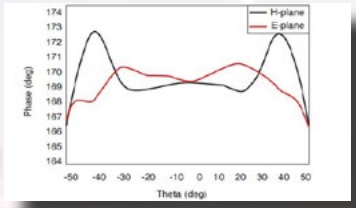

Figure 7: Wide-Angle Consistent-Phase Corrugated Horn

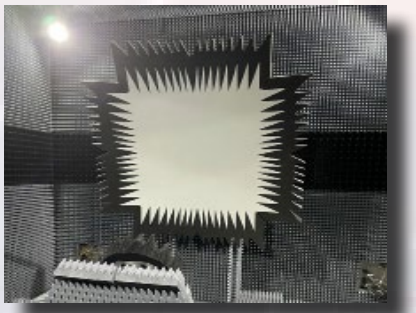

Figure 8: Absorber-Surrounding-Edge Reflector

Figure 9: Low-scattering High-precision Positioner

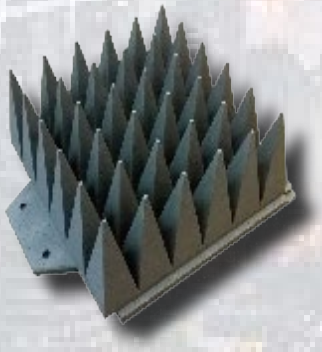

Figure 10: EPP High Performance Absorber

LOW EDGE SCATTERING REFLECTOR

Compared to conventional serrated or rolled-edge reflectors, the new absorber surrounding-edge reflectors effectively reduce electromagnetic wave scattering caused by pure metal edges. This reduction weakens the interference of scattered waves in the quiet zone, improving phase and amplitude uniformity. The measured quiet zone performance surpasses international standards, with a total phase variation of less than 8°. Furthermore, the new surrounded-edge reflector can create a larger quiet zone with a smaller metal reflector, reducing reflector size and weight.

LOW-SCATTERING HIGH-PRECISION POSITIONER

Leveraging expertise in precision electromechanical technology, we integrate full-wave system simulation, self-developed absorbing materials, and microsecond-level continuous triggering technology. This unique combination guarantees exceptional system mechanical precision, concurrently minimizing positioner interference in the test zone. The result is a zero accumulated error in bidirectional tests, effectively doubling testing efficiency. Additionally, we offer customization options for dimensions, precision, motor travel range, and load-bearing capacity of the positioner to meet specific requirements (see *figure 9*).

EPP HIGH PERFORMANCE ABSORBERS

The EPP absorbing material is developed, manufactured, and tested. It uses environmentally friendly and durable EPP (Expanded Polypropylene) as the base material. Through full-wave simulation and optimization design, it ensures the overall absorbing performance of the absorbers. The absorption rate testing technology, with ultra-wideband and multi-angle incidence, guarantees the excellent quality of each piece of absorber. It meets flame resistance standards (UL94 HF-1) and exhibits internationally leading absorption performance. The EPP absorber is dust-free and moisture-free, making it suitable for various environments, including outdoors, clean rooms, PIM chambers, OTA chambers, etc.

Figure 11: Thermal-insulation Wave-transparent Mask

THERMAL TESTING MODULE

The RP600 series is adaptable to include a thermal-insulation wave-transparent ball mask (see *figure 11*), facilitating high-low temperature shock and cyclic testing within the range of -10 to 55℃. This ball mask integrates with existing positioners, necessitating minimal system upgrades. Its installation and removal are straightforward, ensuring that the original testing functionality remains unaffected.

FULL FUNCTIONAL TESTING CONTROL SOFTWARE WITH HIGH INTELLIGENCE

We offer seamless testing with versatile phased-array antenna software. Supporting diverse instruments and Devices Under Test (DUTs), it integrates functions like calibration, PROM programming, validation, testing, recording, and data analysis upload. With a user-friendly open interface for one-click testing, it boosts efficiency in existing testing processes.

CONTINUOUS TRIGGERING CONTROLLER

The continuous triggering controller employs microsecond-level real-time continuous triggering technology, effectively synchronizing the intricate states and timing of the positioner, phased-array antenna, RF links, instruments, and software. This synchronization facilitates swift testing for multiple frequencies, multiple channels, and multiple beams.

COMPREHENSIVE ASSURANCE FOR PHASED-ARRAY ANTENNA TESTING

During the development phase of phased-array antennas, special requirements such as power supply, water cooling, and beam control are often necessary. With extensive experience in the field of phased-array antenna testing, we can customize comprehensive and reliable solutions for power supply, water cooling, and beam control based on customer requirements.

AUTOMATIC LOADING AND UNLOADING DUT

The integration of a robotic arm system, quick-mount fixture, and quick-connectors streamlines automatic device loading and unloading, enhancing overall testing efficiency and fault tolerance. This setup also contributes to reducing labor costs.

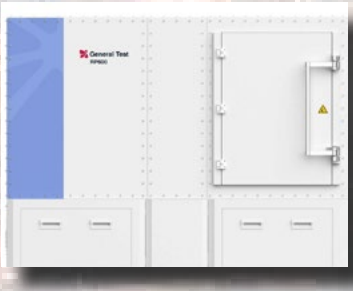

Figure 12: Device Automatic Loading/Unloading

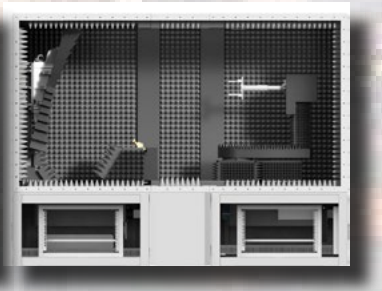

Figure 13: RP1200 Interior View

TECHNICAL SPECIFICATIONS		
Application	Antenna test, phased-array antenna calibration, phased-array antenna test, mm-wave OTA test, RF conformance test, protocol conformance test	
Frequency Range	6 - 110GHz	
Technology	CATR (compact antenna test range)	
Max Aperture Of Phased Array	350mm	
Orientation Of Phased Array Placement	Vertical	
Max Weight Of Phased Array	20Kg	
Measuring The Range Of Antenna Pattern	Theta: -180° to +180°	Phi: 0° to 360°
Testing Items	Passive	Antenna 1D/2D/3D Gain/Phase Patterns, Directivity, Efficiency, Cross- Polarization Ratio, front-to-back ratio, Sidelobe levels, Null Filling, Beamwidth, Beam Pointing (Aim Error), Shaft Ratio, Phase Center
	Active	Active Gain, G/T, EIRP, RF conformance, Protocol conformance
	Phased-array Calibration	CATR Calibration Method, Rotating Vector Method
Quiet Zone	Amplitude Variation	≤1.5dB
	Amplitude Taper	≤1dB
	Amplitude Ripple	≤±0.5dB
	Phase Variation	≤8°
	Phase Taper	≤3°
	Phase Ripple	≤±3°
	Cross-Polarization	≥28dB
Shielding	80dB	
Calibration Time (For Example: 900 Elements,64 Frequencies, Tx/Rx)	About 5 minutes[1]	
Test Time (For Example: Single Cut, 180° Range, 9 Frequencies, 9 Beams Pattern)	About 3 minutes[2]	
Exterior Dimensions (L x W x H)	2.2 × 1.6 × 1.8 meters	
Test Probe	Corrugated Horn, Dual-Polarization/Single-Polarization	
	VSWR	≤1.5 (Typical)
	Gain	≥8dBi
	Frequncy Range	6 - 8GHz; 8 - 12GHz; 12 - 18GHz; 18 - 26.5GHz; 26.5 - 40GHz; 40 - 60GHz; 60 - 90GHz; 90 - 110GHz
Absorber	EPP / Honeycomb (optional)	
	Height	300/100/60mm
	Absorbing Rate	≤-40dB
	Withstand Power	1.2kW/m2 (EPP)/ 10kW/m2 (Honeycomb)
Positioner	Rotation Axes	Azimuth, Polarization
	Rotation Range	Azimuth: -180° to +180°; Polariztion: 0 to 360°
	Rotation Accuracy	≤0.01° (Azimuth/Polarization)

[1] Phased array antenna's element switching supports continuous trigger
[2] Phased array antenna's frequency and beam switching support continuous trigger

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