



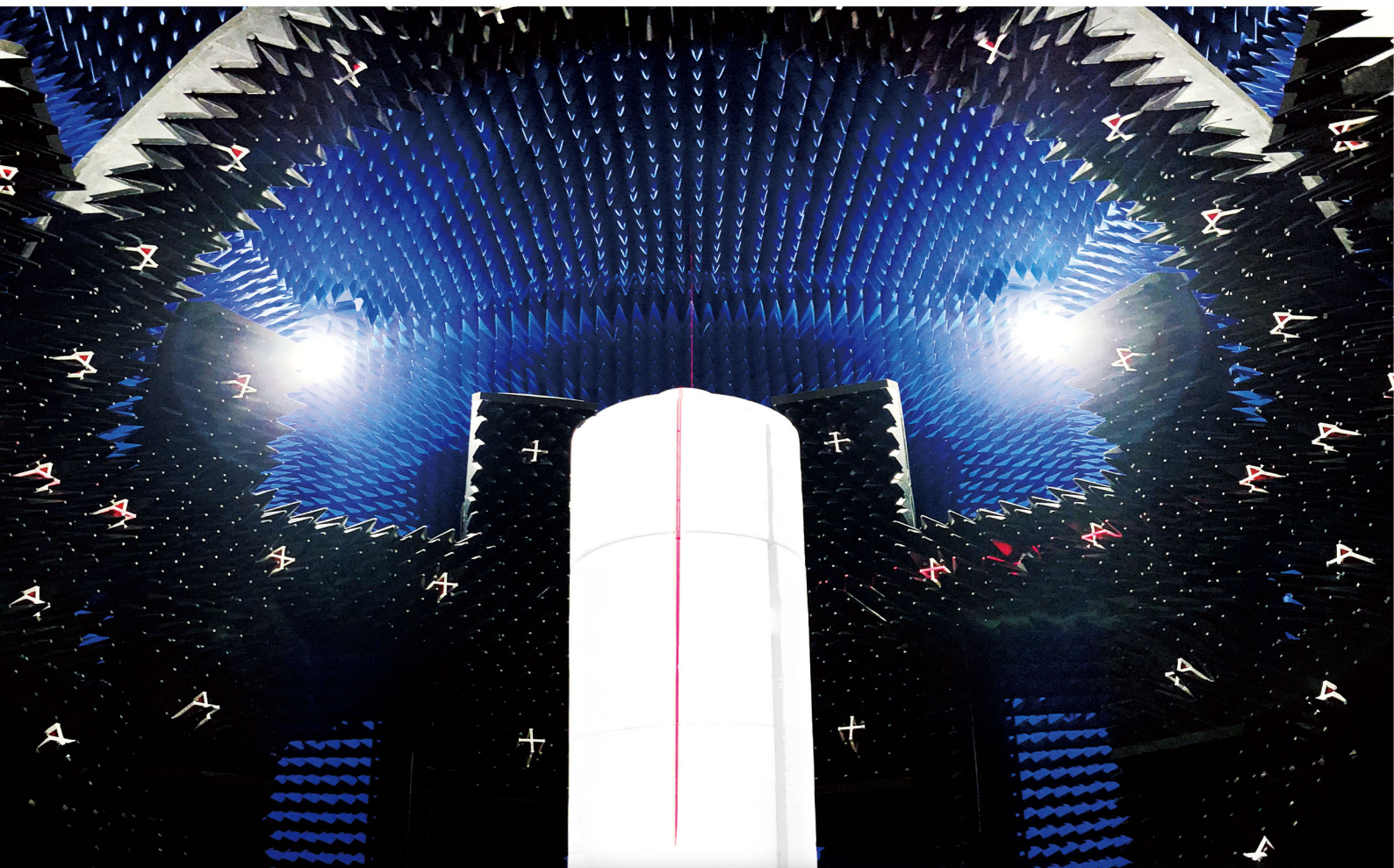
HWA-TECH
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Hwa-Tech WrlessLab Test System

Antenna Performance Test Expert Of IoT Terminals

New test solution for IoT product. In addition to the traditional antenna and active OTA testing, Desense test, multi-communication coexistence test, channel simulation test, and multi-user scenario application test are added.

Hwa-Tech WrlessLab



Functions



- Wireless Communication Formats: 2G/3G/4G/5G(FR1)/GNSS/A-GNSS/WiFi/Bluetooth
- IoT Communication Modes: LTE Cat NB1 (NB-IoT)/Cat-M1 (e-MTC)/Lora/Zigbee/UWB
- Test Frequency: 400MHz-7.5/11GHz
- SISO OTA: TRP/TIS/EIRP/EIS
- MIMO OTA 2×2/4×4 throughput test; the test system used to passed CTIA MIMO OTA multi-probe certification; 2D/3D channel model is supported.
- Passive Antenna Test, Desense Test, ICS, CA (2CC/3CC/4CC), and communication coexistence test are supported.
- The antenna ring use EPP hard material which is hard to deform, that ensures a long-term stable performance of antennas. The test system uses low insertion loss RF components, such as power amplifier and RF switch. Even in high temperature environment for 24 hours, the data variation of components could be lower than 0.1dB. The regular normalization test also makes sure the insertion loss variation of all 46 test paths in control.
- It has bigger test distance compare to other similar products in industry. With Hwa-Tech antennas which have better bandwidth, the system could have a test area that 30% larger than the general system.
- With self-dependence intellectual property, the Model B WiFi channel simulator and multi-communication interference generator make the test environment closer to the real environment.

WrlessLab Test System

WrlessLab multi-probe test system is the top-end test system of Hwa-Tech's OTA system. The system meet to the requirements of the OTA test specifications of 3GPP, CTIA, EU CE, CCSA and other standard organizations. The system could also provide a CTIA format report. Actually, the multi-probe MIMO test system provided by Hwa-Tech have passed the CTIA certification in September 2017, which is the third one in the world.

The traditional OTA test system is mostly designed for mobile phone products. It has smaller test quiet zone, and is more suitable for terminals with good omnidirectional antenna. With the development of the IoT industry, the equipment size is larger and the omnidirectional antenna is not necessary. Thus, the traditional test items like TRP and TIS are not completely suitable for some current IoT equipment. Hwa-Tech WrlessLab test system could provide larger test quiet zone than other OTA system in same chamber size. In addition, the software has a new performance evaluation system, which could help users to use the OTA test system better.

The stability of antenna ring could ensure the test result is reliable. WrlessLab test system improve antenna ring's stability in two ways: Firstly, antennas are installed in EPP hard absorbing material. Compare with polyurethane absorbing material, EPP material could have no deformation more than 15 years. That make the antennas perform as new in a long time. Secondly, the chamber uses clean absorbing material instead of normal Polyurethane absorbing material. Clean absorbing material doesn't drop carbon dust which usually contain in absorbing material itself. It could also maintain its performance over 15 years but avoid the brittleness of EPP material which is easy to be bumped and broken. These 2 ways make test area's electromagnetic characteristics of Hwa-Tech WrlessLab test system stay in a perfect condition.

WrlessLab test system could be compatible with SISO/MIMO test. In SISO test, 24 probes, 32 probes, 48 probes, 72 probes are optional. The MIMO test could also support 2D/3D channel model which have 16 probes and 32 probes respectively.



Basic Technical Specification of Chamber

According to different user sites, Hwa-Tech provides WrlessLab test systems with different size and specifications to maximize the use of user sites and provide more accurate test systems:

Technical Specification	Index					
	WrlessPro-15°	WrlessLab-24/32/48/72				
Dimension (W * H * D)	1.84m*1.98m*1.09m	3m*3m *3m	3.4m*3.4m *3.4m	4m*4m *4m	5m*5m *5m	6m*6m *6m
CTIA/CCSA Quiet Zone (Ripple)	25cm	35~40cm		40~50cm	50~65cm	
Shielding Performance	400MHz~11GHz >80dB	400MHz~12GHz >100dB				
Test distance (from antenna end face to turntable center)	0.65m	1.1m	1.3m	1.6m	2.1m	2.6m
Maximum weight of DUT	20kg	30kg/50kg/100kg/200kg				
Rotation speed (turntable)	30°/s					
Phi angular resolution (turntable)	0.1°					
Theta angular resolution (number of probes: 24/32/48/72)	15°	15°/10°/7.5°/5°				
Frequency range (test antenna)	400MHz-7.5GHz/11GHz					
Polarization isolation (test antenna)	>25dB					
Shelding door size (W * H)	0.8m*0.8m	1m * 2m double-knife three-spring screen door (manual/electric/pneumatic optional)				

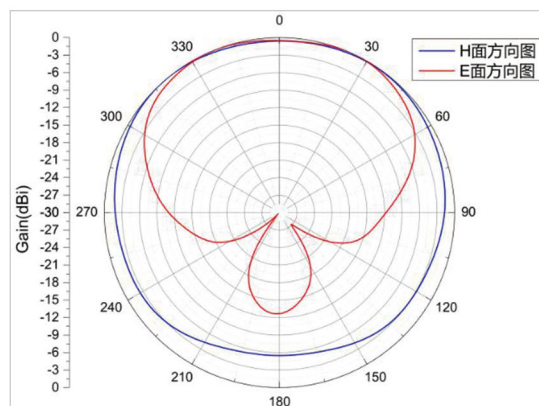


Main Features of WrlessLab System ①

■ Increase the Quiet Zone (Ripple) by 30%

01

Compared with the general probe, the large size and high roundness antenna developed by Hwa-Tech and used by WrlessLab has two characteristics. One is the integrated design of the probe and the EPP absorbing material, which ensures the consistency of the absorbing material loaded on each probe and reduces the RCS of the probe, thus to minimize the mutual interference between the probes. The other one is the high roundness of the probe emission pattern in the direction of use and the symmetry of the two-polarization pattern, which expands the field uniformity of the two-polarization radiation of the probe to the tested area, thus to expand the quiet zone.



02

It has larger test distance. Compared with the general OTA test system, the WrlessLab test system maximizes the size of the probe ring, thus to provide a larger test radius. Compared with the typical test system on the market, its test radius is expanded by 10%~40%, providing better quiet zone ripple test results. The following is the ripple test results in the 50cm quiet zone of 5m system:

Free-Space Test	Frequency (MHz)							
	722	836.5	1575.42	1732.5	1880	2132.5	2450	5500
Theta Axis Dipole SSD Max (dB)	0.35	0.52	0.47	0.49	0.58	0.46	0.48	0.39
Theta Axis Loop SSD Max (dB)	0.41	0.52	0.39	0.33	0.46	0.37	0.41	0.63
Phi Axis Dipole SSD Max (dB)	0.29	0.38	0.37	0.37	0.58	0.32	0.18	0.35
Phi Axis Loop SSD Max (dB)	0.26	0.33	0.28	0.32	0.26	0.20	0.24	0.35
Maximum SSD (dB)	0.41	0.52	0.47	0.49	0.58	0.46	0.48	0.63

Main Features of WrlessLab System ②

■ Adapt to Various IoT Terminal Tests



Accurate Measurement of Small Signal (Sidelobe Level)/Large Signal

Unlike mobile phones, IoT terminals often fail to cover the antenna pattern completely due to short antenna design period and special shell, resulting in the following problems in the OTA test process:

- ① DUT with poor antenna pattern often drops from call box easily.
- ② The transmission power is high enough. However, due to insufficient polarization coverage, the difference between small signal (poor direction/polarization) and large signal (good direction/polarization) is more than 40dB, which leads to test these big difference signal inaccuracy.
- ③ Only partial directional performance test is required, and all sphere directional diagram test is not required.

With unique multi-level signal amplifier design, the two problems ① and ② can be solved, so as to solve the accurate/smooth testing of the IoT terminals. With its unique software architecture design, WrlessLab system open the settings of test antenna, customer could define the test antenna angle.

Link Amplification	0.1dB Gain Variation Range
0dB	<20dBm@400MHz <20dBm@7.2GHz
14dB	<14dBm@400MHz <15dBm@7.2GHz
25dB	<-12dBm@400MHz <-11dBm@7.2GHz
39dB	<-13dBm@400MHz <-12dBm@7.2GHz
50dB	<-40dBm@400MHz <-38dBm@7.2GHz
64dB	<-41dBm@400MHz <-39dBm@7.2GHz



Complex Electromagnetic Environment Simulation

Different to the easy electromagnetic environment in chamber, in real scene various electromagnetic interferences are disorderly and complex. Even DUT itself may have several communication systems working at the same time. (Such as phone, we use 4G/ WiFi /BT at the same time). The coexistence scene is common. Hwa-Tech has developed a cost-effective interference simulation device, which can simulate all kinds of external interference signals or bring the interference source to the scene to record and playback the interference signals. It also provides standard interference signals for scene simulation, including Bluetooth, interference signals when microwave oven is working, WiFi, 2/3/4G, Lora, e-MTC, ZigBee, pulse, continuous wave and other user-defined interference waveforms.

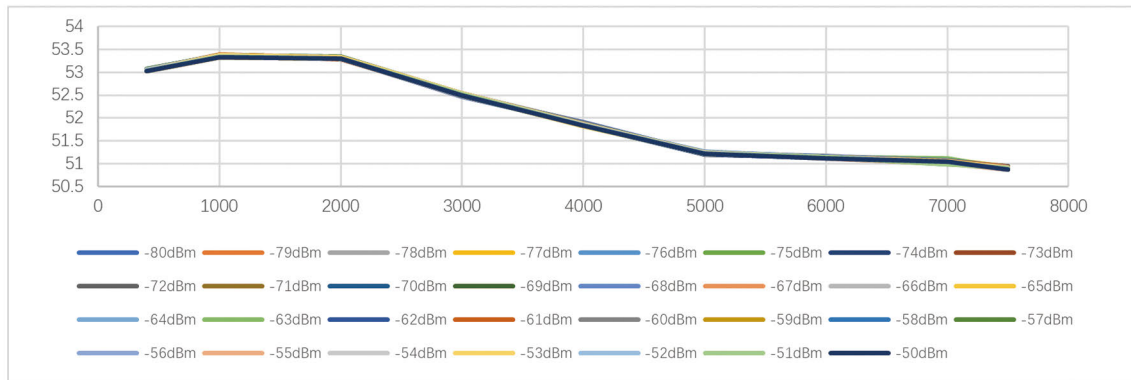


Main Features of WrllessLab System ③

Long-term Stable guarantee of the system

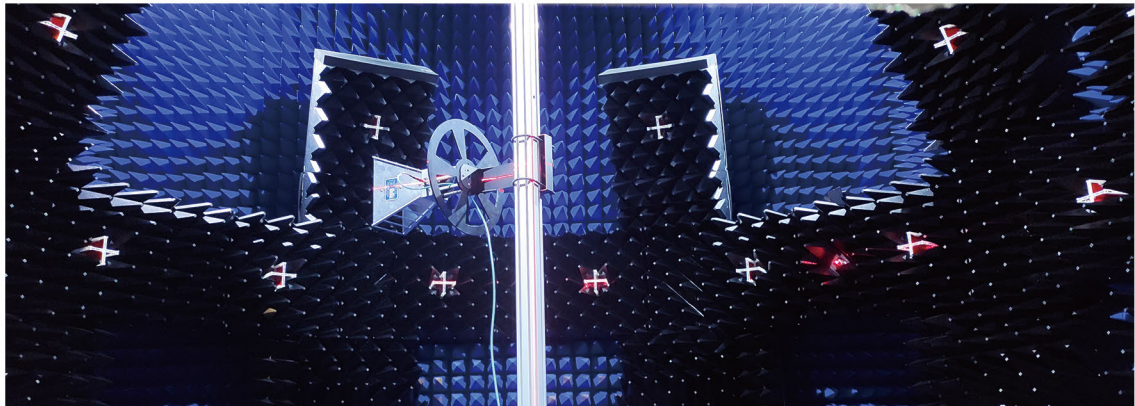
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Hwa-Tech provides military-grade RF devices with micro-package technology on the surface and gold wire interconnection. The high-speed switches adopt the control circuit built by triodes. The amplifier modules adopt eutectic. Molybdenum copper carrier is under the chip to increase heat dissipation and avoid module stability problems caused by solder paste patch welding. The following figure shows the amplifier test results. Within 7.5GHz, the flatness of the amplifier is better than $\pm 1.5\text{dB}$



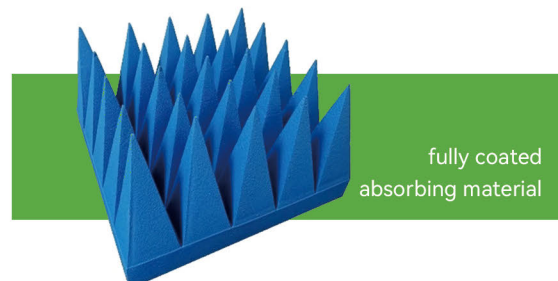
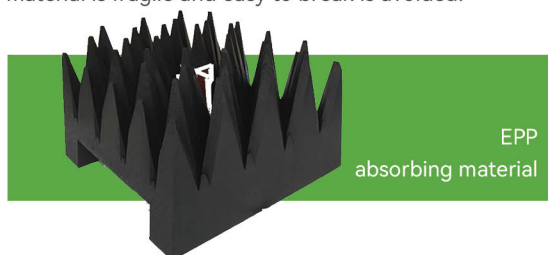
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Regular antenna ring calibration service is provided. To guarantee long-term stability of the darkroom, regular link antenna ring calibration is the key besides the stability of the devices used. At present, Hwa-Tech is the only manufacturer in China that provides on-site antenna ring calibration service. With antenna ring calibration every three years, the test system can be used as a new one for a long term. WrllessLab test system provide antenna ring calibration(calibration by Hwa-tech)and RF loss calibration(calibrate by customer) to calibrate all system.



03

EPP absorbing material + fully coated absorbing material. The EPP is a hard material and is not changed with time. The antenna ring of the WrllessLab test system adopts the integrated design of the EPP absorbing material and the probe, thus to ensure the long-term stability of the probe ring. The internal wall of the darkroom is pasted/hung with fully coated absorbing material. The service life of this material is up to 15 years. Furthermore, the long-term stability of the performance is guaranteed because the carbon powder does not fall off, and the problem that EPP absorbing material is fragile and easy to break is avoided.



Hwa-Tech Quick OTA Testing Software

Quick OTA testing software is independently developed by Hwa-Tech based on the C # platform. It owns the full intellectual property rights of the software, follows the CTIA and CCSA measurement specifications, and supports passive antenna test, active SISO OTA test, MIMO OTA test, application simulation test, and WiFIR-398 test functions.

Antenna test items

Antenna gain
Circular polarization gain
Directional pattern
Beam width
Cross polarization level
Antenna efficiency
Front-to-rear ratio
Axial ratio
2D/3D directional pattern
Antenna correlation coefficient (ECC)
Out-of-roundness
Gain synthesis

SISO active test items

Total isotropic radiation power (TRP)
Total isotropic receiving sensitivity (TIS)
Effective isotropic radiation power (EIRP)
Effective isotropic receiving sensitivity (EIRS)
Near horizontal plane radiated power (NHPRP)
Near horizontal plane receiving sensitivity (NHPIS)
Directional pattern
Channel sensitivity scanning in ICS

IoT application test items

Desense test (Desense)
Coexisting interference test
User-defined limit index conversion and communication distance simulation
Performance test in specified direction range
UWB AOA test
UWB TOF test
Zigbee/Lera/UWB signaling performance test

MIMO test items

2D/3D LTE 2 * 2/4 * 4
throughput vs power/signal-to-noise ratio
2D/3D 5G SA/NSA 2*2/4*4
throughput vs power/signal-to-noise ratio
2D/3D 5G SA/NSA UL/DL bidirectional
throughput vs power/signal-to-noise ratio
2D/3D 5G NSA NR+LTE DL
throughput vs power/signal-to-noise ratio
Throughput directional pattern test

WiFi test items

OFDMA test
Throughput vs interference
Throughput vs channel model (various large/small scale channel models)
Throughput vs distance
Throughput vs direction
DFS/ACS test
Data rate adaptation test
Multi-user test
Correlation stability test
Ultimate performance test
Terminal matching test
Time fairness test
Space fairness test
Wireshark packet capture
WiFi traffic playback
Roaming test
Mu-MIMO test

Accessories ①

■ Easytest



Easytest RF control unit can be added to the WrllessLab system to test non-standard communication systems, such as UWB/Lera/Zigbee/Wimax/user-defined protocol. This instrument has the function of separating the receiving/transmitting of single-port path to sepearate RF signal. It can control the path attenuation of the transmissio path independently, and cooperate with the user equipment to complete the performance test and signal capture.

■ RF Switch Box



Frequency range: 400MHz~12GHz

The adaptive power amplifier RF switch box developed by Hwa-Tech can adjust the power amplification level according to the received power, support real-time switching of 6-level amplification link, and provide a dynamic range of 90dB maximally, ensuring that the test signal strength is within the accuracy dynamic range of the system.

■ High-Speed Switch Box



Frequency range: 400MHz~12GHz

The high-speed switch box developed by Hwa-Tech is used for antenna switching at different angles and switching between different polarization of dual-polarized antennas, and supports hard trigger . All RF switches in the high-speed switch box are designed with high-performance semiconductor components, and the isolation of a single switch can reach more than 70dB,switch time within 50ns.

Accessories ②

■ Dipole Antenna



The standard dipole antenna developed by Hwa-Tech has higher gain accuracy, and its roundness can reach $\pm 0.1\text{dB}$. It is applicable for the calibration of active test or ripple test.

■ Standard Chamber WrlessLab



■ Compact Chamber WrlessPro-15°



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