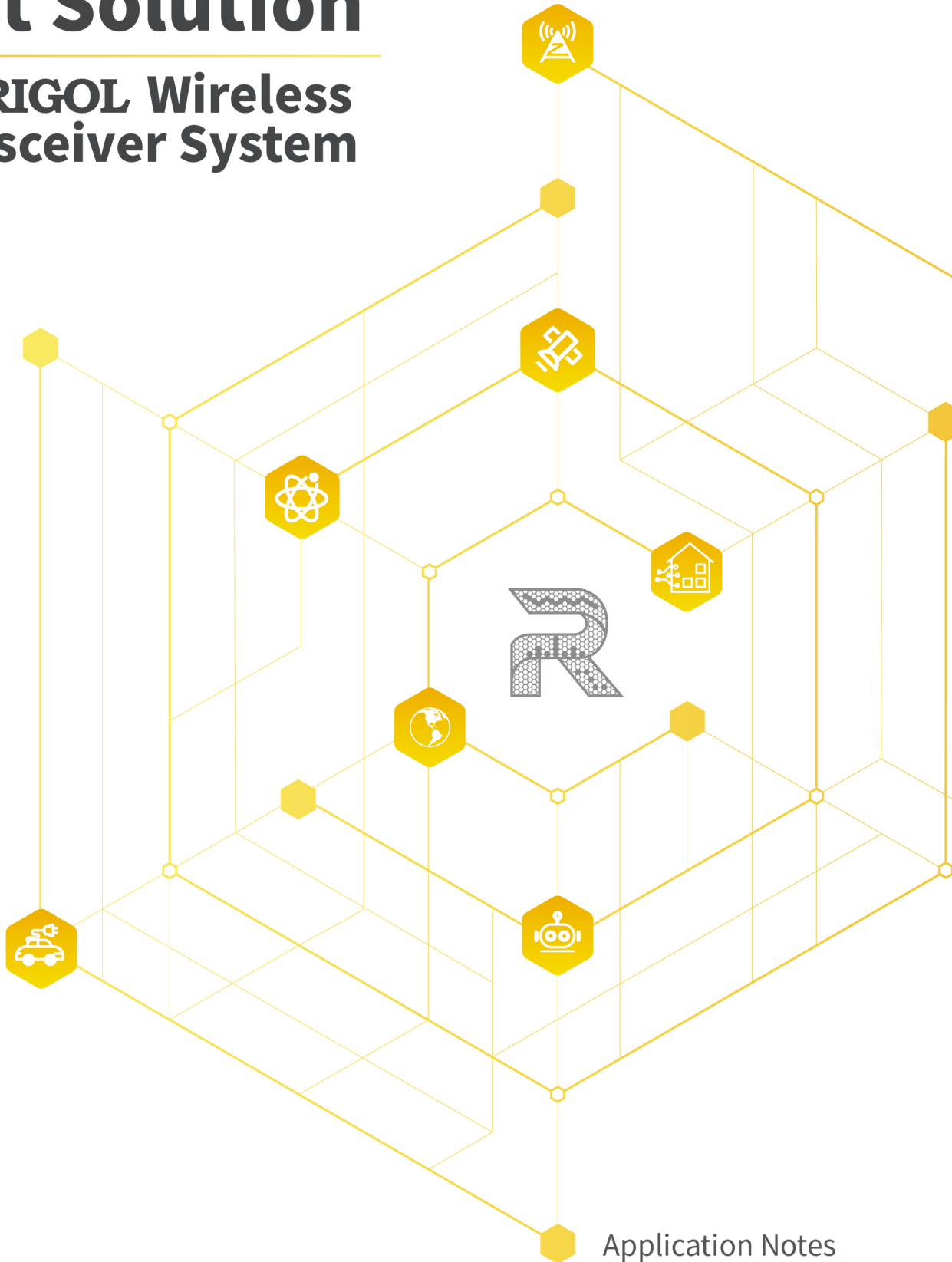




RIGOL

# Test Solution

## For RIGOL Wireless Transceiver System



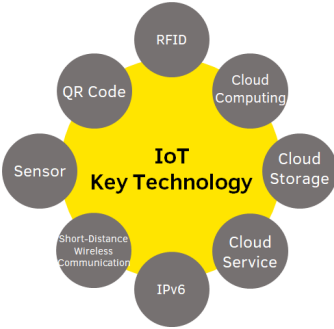
Application Notes

ANW01100-1220-0003



# 1 Introduction

In comparison with the wire communication, wireless communication boasts its low cost and high adaptability, without any medium or wiring distribution. Therefore, wireless transceiver systems are widely used in modern society and in various fields such as Internet of Things (IoT), wireless communication devices, remote control, smart home appliances, industrial automation, and medical devices. They provide people with more convenient and flexible means of communication and facilitate information exchange and connectivity between devices.



**Figure 1.1 Application Scenarios of Wireless Communication**

To avoid any errors in the emission, transmission, and receiving process, you need to perform several tests for the wireless system, such as transmitter test, receiver test, and antenna test. This document describes the application of RIGOL products in the wireless transceiver testing.

## 2 Wireless Transceiver Test

The wireless transceiver system test consists of three main parts:

1. Wireless signal transmitter test: a process of testing and evaluating the quality of the wireless signal transmitted by a device.
2. Wireless signal receiver testing: a process of testing and evaluating the capability of wireless devices to receive signals.
3. Antenna test.

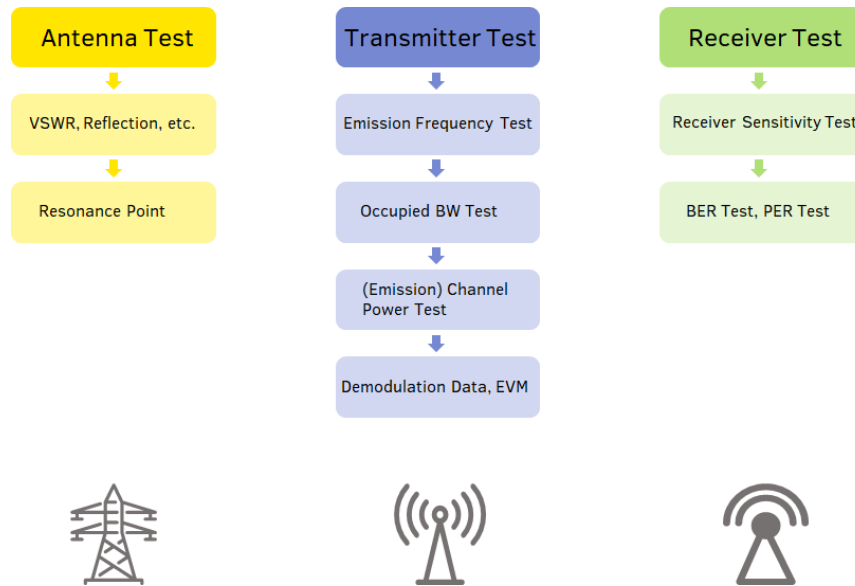


Figure 2.1 Wireless Transceiver System Test

### 3 Test and Challenges

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1. Modulation is an essential part of wireless transmission. Different products, environments and applications involve a wide variety of modulations. For example, analog modulations AM and FM are used for wireless radio stations; simple digital modulation ASK and FSK are used for remote control, remote key, ETC, parking toll collection systems, access control, wireless meter reading, etc. In addition, there are more complex digital modulations such as QAM, QPSK, OQPSK, 4FSK, etc., which are often used in standard communication protocols such as cell phone communication, Zigbee, Bluetooth, WiFi and etc.
2. Complex digital modulations are mostly transient signals, transmitted intermittently, and their active time is short, making the conventional swept spectrum analyzer difficult to capture all the signals completely.
3. Most complex modulations have their own unique protocols, such as Zigbee, Bluetooth, WiFi, etc, and the regular IQ modulation cannot simulate such signals.

## 4 Solutions

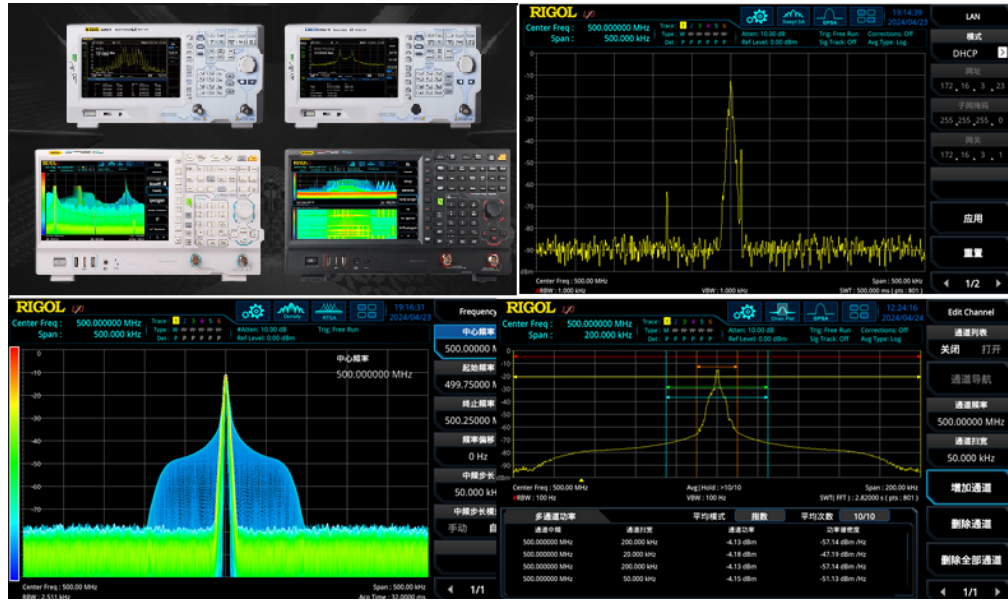
### 4.1 Transmitter Test

The transmitter test mainly consists of frequency, power, demodulation and other tests. The spectrum analyzer is the commonly used instrument to perform such kind of tests. Comparing the commonly used analog spectrum analyzer and swept spectrum analyzer, RIGOL's RSA series real-time spectrum analyzer whose frequency range is from 9 kHz to 6.5 GHz can better meet the application demands of emission tests.

**Table 4.1 Comparison of Swept Spectrum Analyzer and Real-Time Spectrum Analyzer**

| Normal Mode Test of the Swept Spectrum Analyzer                                                                                                                                                                                                                                                              | RTSA Mode Test of RIGOL Real-Time Spectrum Analyzer                                                                                                                                                                                                                                                                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. The signal cannot be 100% captured, and needs to be acquired several times, with max. hold enabled.</li> <li>2. The spectrum line cannot be fully displayed.</li> <li>3. The demodulation function is unavailable, unable to get modulation parameters.</li> </ol> | <ol style="list-style-type: none"> <li>1. Minimum signal duration of only 7.45 <math>\mu</math>s for 100% probability of intercept (POI).</li> <li>2. RTSA is good in capturing and displaying transient signals.</li> <li>3. For common AM, FM, ASK, FSK, QAM signals, it can demodulate the parameters or IQ symbol data.</li> </ol> |

By comparison, we can see that with the minimum signal duration of only 7.45  $\mu$ s for 100% probability of intercept (POI), RIGOL's real-time spectrum analyzer can well capture the transient signal of the wireless test, display the frequency distribution spectrum line in a real-time manner. Besides, it has many advanced measurement capabilities that allow for rapid testing of time-domain power (T-Power), adjacent channel power (ACP), multi-channel power (Multichan Pwr), occupied BW, emission bandwidth (EBW), C/N ratio (CNR), etc. to meet the needs of a wide range of specific parameter testing for wireless signals.



**Figure 4.1 GPsA, RTSA, and Advanced Measurement Function (AMK) of the Spectrum Analyzer**

The RIGOL real-time spectrum analyzer also includes ADM and VSA modes.

- The ADM mode provides the demodulation function which can demodulate and analyze the AM, FM and PM signals. By analyzing the parameters of the specified demodulation type, you can better judge the performance of the transmitter device.
- With the VSA function, it can demodulate the common IQ modulated signals, including ASK, FSK, PSK, QAM signal, so that some complex digital modulated signals can be analyzed. You can observe the parameters of the signal in a constellation graph or eye format to get the test results of demodulated data and EVM (error vector magnitude).

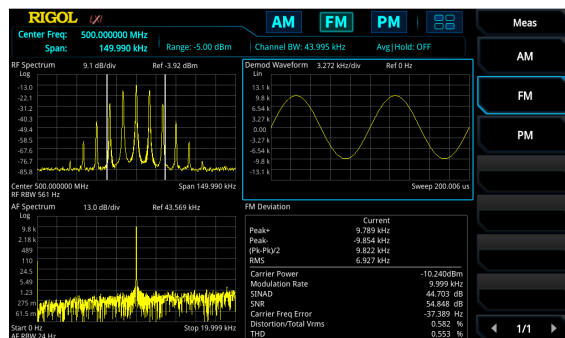




Figure 4.2 RIGOL Spectrum Analyzer Performs Signal Demodulation and Analysis

## 4.2 Receiver Test

Receiver sensitivity test is the most complex part of the test technology in the wireless system. Error-Rate Detector (ERD) is often used in the industry to do this test. However, limited to its test frequency range and modulation type, its cost is high. The following figure shows RIGOL's receiver sensitivity test solution.

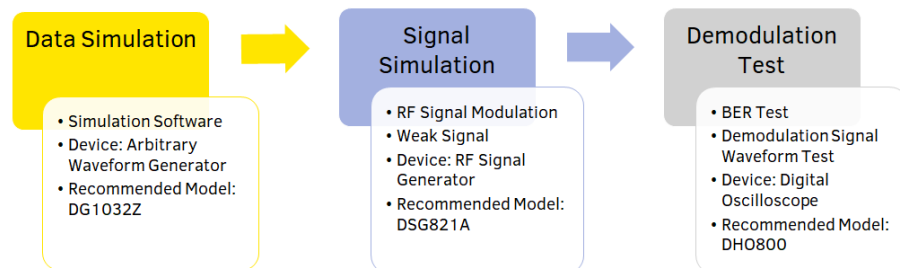


Figure 4.3 RIGOL's Test Solution for Receiver Sensitivity Test

This test solution has the following advantages:

- Deep memory depth. RIGOL's DG function/arbitrary waveform generator provides up to 512 Mpts memory depth. It can simulate the data rate of 100 Mbit/s for up to 50 ms, closer to true random sequence data.
- RF signal has a wide range of power and frequency values. The signal modulation in this case is mainly realized by RIGOL's DSG series products, with the frequency range from 1.5 GHz to 20 GHz; power as low as -130 dBm, covering most application scenarios.

- Multiple modulation types are available. RIGOL's RF signal generator can be equipped with IQ modulation option, allowing you to simulate complex modulated signals such as QAM, QPSK, OQPSK, 4FSK, and etc.
- Low cost. Take the FSK receiver sensitivity of 433MHz as an example. It is called the "smallest system". Its test cost is reduced by ten times comparing with the ERD test cost.

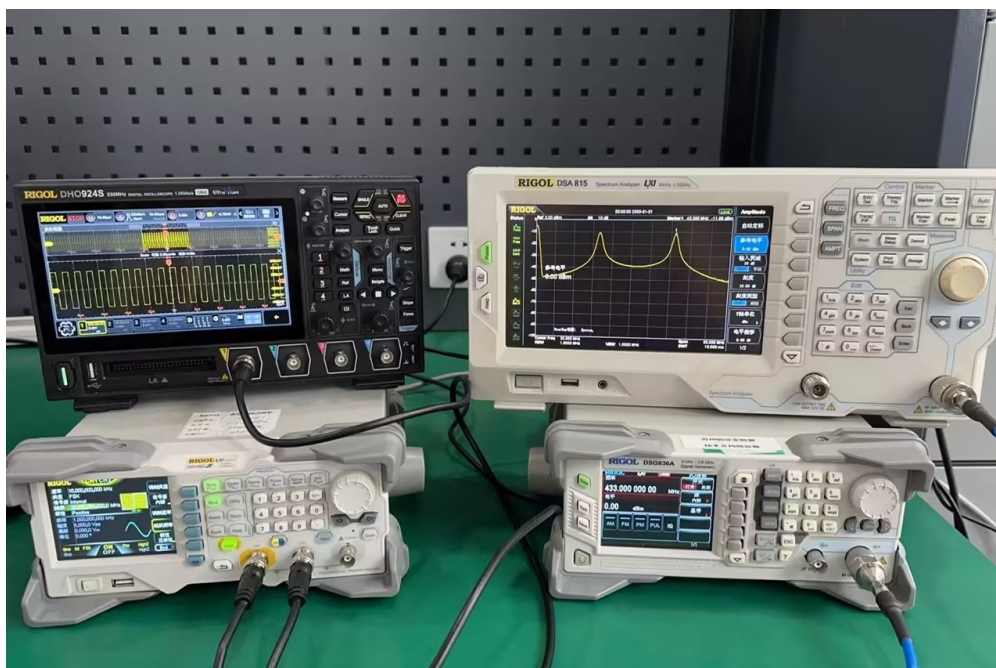
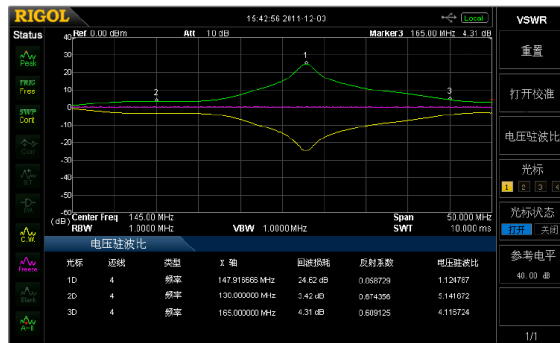
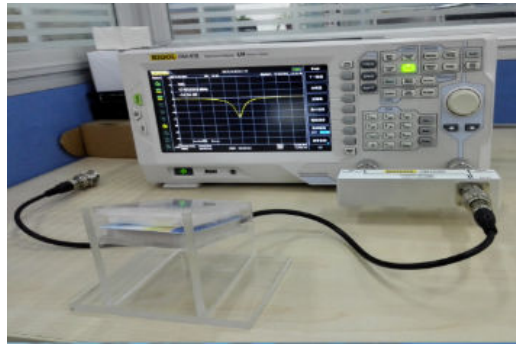


Figure 4.4 Minimum System Setup for the Receiver Sensitivity Test Scenario

## 4.3 Antenna Test

Antenna, as an important carrier in the radio transceiver system, plays an important role in transmitting and receiving signals. In the antenna test, the standing wave ratio (SWR) or VSWR is one of the most important test parameters. The antenna SWR or VSWR test is mostly done with a vector network analyzer, but the cost is high and the usage rate is low for VNA. RIGOL provides two solutions for testing VSWR.

- One is using the DSA-TG series spectrum analyzer with the VSWR bridge to complete the antenna VSWR test. This solution applies to the antenna measurement within the 7.5 GHz range.



**Figure 4.5 Use DSA and VSWR Bridge to Test the VSWR of the Antenna**

- The other is using the RSA5000N series real-time spectrum analyzer used in the transmitter test to complete the antenna VSWR test. The instrument not only can perform ADM demodulation, VSA demodulation in the transmitter test, but also is equipped with the VNA mode, which is capable of performing the antenna VSWR test in the 6.5 GHz frequency range. In comparison with the professional VNA instrument, these two solutions are cost-effective and capable of completing multiple tests.





Figure 4.6 RSA5065N VNA Mode for VSWR Test of the Antenna

## 5 Summary

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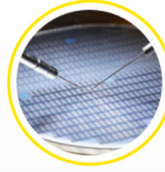
The wireless transceiver system is one of the basic modules of the wireless terminal device. RIGOL's test solution for the wireless transceiver system offers a wide range of power, frequency, and modulation options at an affordable price, effectively improving your production, R&D and test efficiency.

# Boost Smart World and Technology Innovation

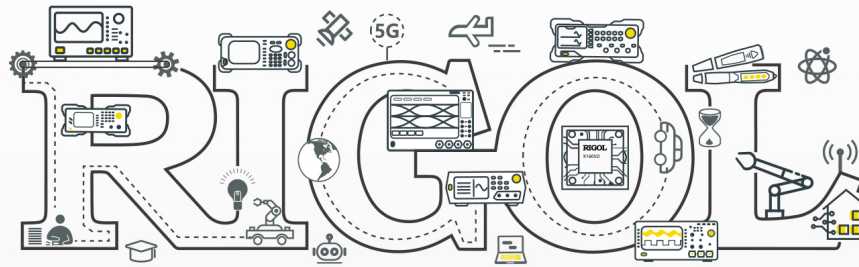
Industrial Intelligent  
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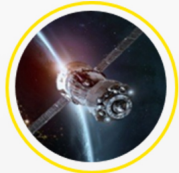


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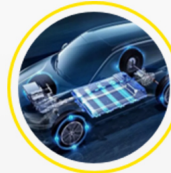


Communication

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