Application Note：
WT-200 Guide on Testing Telink BLE Module

AN-19032100-E2

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Brief：

This document is guide on how to use iTest WT-200 to test BLE Module based on Telink SoC.

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Information:

For further information on the technology, product and business term, please contact Telink Semiconductor Company (www.telink-semi.com).

For sales or technical support, please send email to the address of:

telinkcnsales@telink-semi.com

telinkcnsupport@telink-semi.com

Revision History

Version	Major Changes	Date	Author
1.0.0	Initial release	2019/3	XZG, LX, Cynthia
1.1.0	Update Section 3.2.4 Rx test	2019/3	XZG, LX, Cynthia, JF

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1 WT-200 Background Knowledge

The WT-200 of iTest, a general tester with support of multiple standards including Bluetooth, Zigbee, 802.11a/g, 802.11b, 802.11n, 802.11ac and etc., integrates VSA (Vector Signal Analyzer) and VSG (Vector Signal Generator).

By using the WT-200, the parameters of BLE module, such as Tx power, carrier frequency offset, carrier drift, modulation parameter, and Rx sensitivity, can be tested to evaluate the module's performance.

In this document, the test of Telink 8267 Dongle using WT-200, WLAN Meter and EMI Test Tool is taken as an example, to illustrate establishment of hardware environment and software setting for Bluetooth function test.

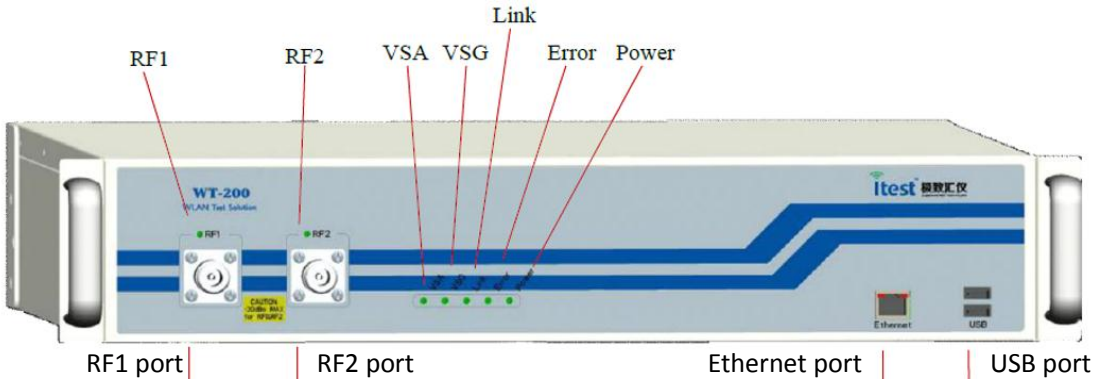

Figure 1 WT-200 front view

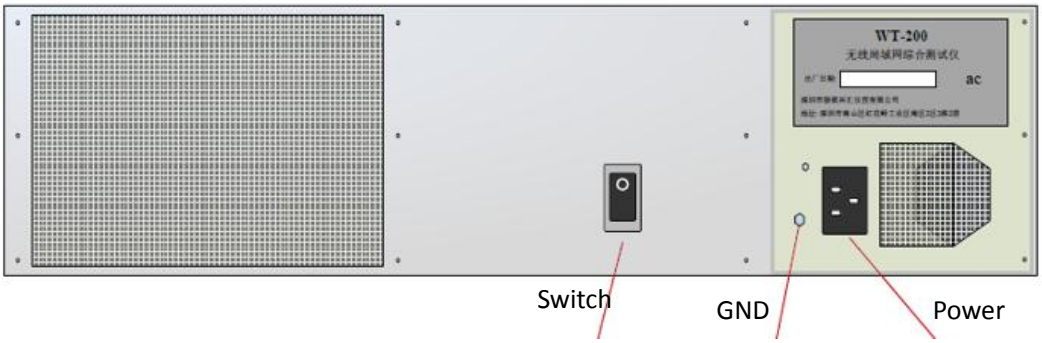

Figure 2 WT-200 back view

Table 1 Indicating lights on WT-200 front end

Light	Status	Indication
RF1	ON	WT-200 RF1 port is working.
	OFF	WT-200 RF1 port has already stopped working.
RF2	ON	WT-200 RF2 port is working.
	OFF	WT-200 RF2 port has already stopped working.
VSA	ON	WT-200 is processing signal reception.
	OFF	WT-200 has already stopped processing signal reception.
VSG	ON	WT-200 is processing signal transmission.
	OFF	WT-200 has already stopped processing signal transmission.
Link	ON	WT-200 has already been linked to Client.
	OFF	WT-200 is idle with no link to any Client.
Error	RED	WT-200 has error.
	OFF	WT-200 is normal.
Power	OFF	WT-200 power is abnormal or it's not powered on.
	RED	WT-200 power is normal, but it's not switched on yet.
	ORANGE	WT-200 is starting or shutting down. When it's starting, other indicating lights will blink due to self-detection of corresponding modules.
	GREEN	WT-200 has already been started.
	BLINK	WT-200 does not work normally due to malfunction.

Table 2 Ports

Location	Port	Description
Front end	RF1	RF Tx/Rx port 1
	RF2	RF Tx/Rx port 2
	Ethernet	When Ethernet connection is available, the working status light on the right is turned on; When 100Mbs network is detected, the status light is orange. When 1000Mbs network is detected, the status light is green. When the equipment is connected to software, the left status light starts blinking.
	USB	When WT-200 is started, the equipment's version info and network info will be written into the disk connected with USB port.
Back end	Power	Working voltage 100~240V AC
	Switch	Switch for WT-200: When the WT-200 is shut down, press the switch to start it. When the WT-200 is switched on, press the switch, the equipment will be shut down after 30s cooling.

	GND	Interface to connect WT-200 and GND

2 HW Environment Establishment

2.1 HW Requirement

The hardware resources below are needed.

- PC
- Burning EVK: TLSR8266BR56
- BLE Module: 8267 Dongle Module
- WT-200
- Network cable
- USB cable
- RF cable

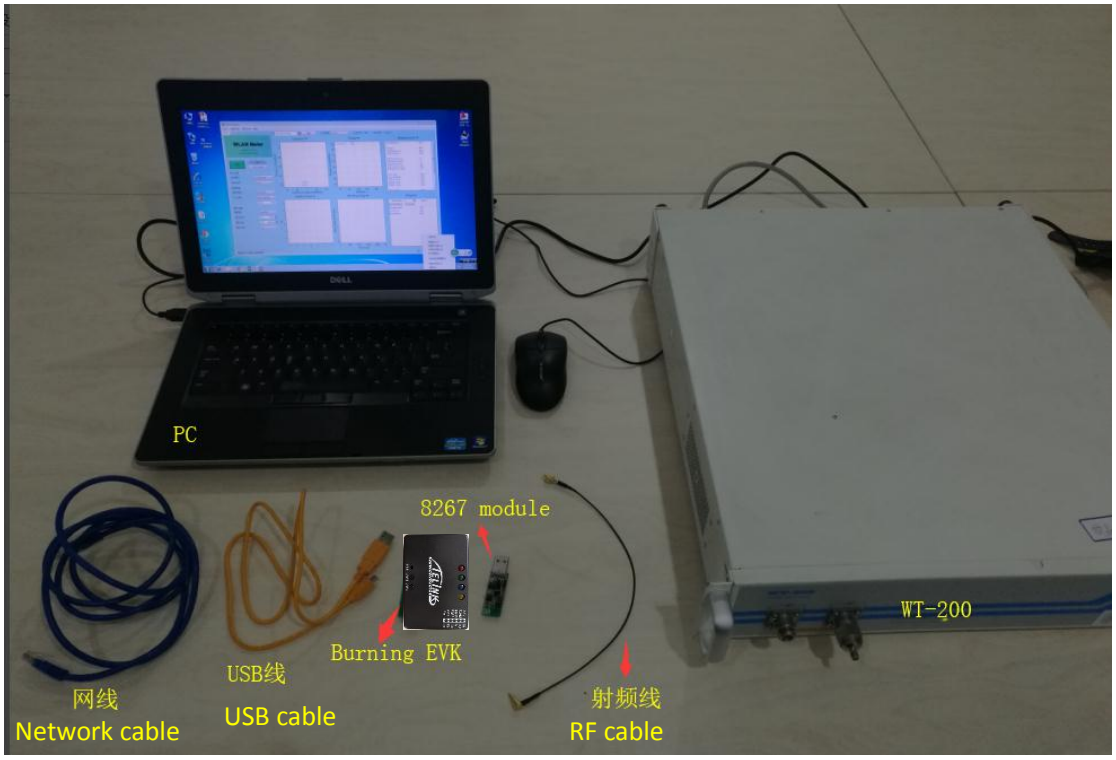

Figure 3 HW kit

2.2 HW connection

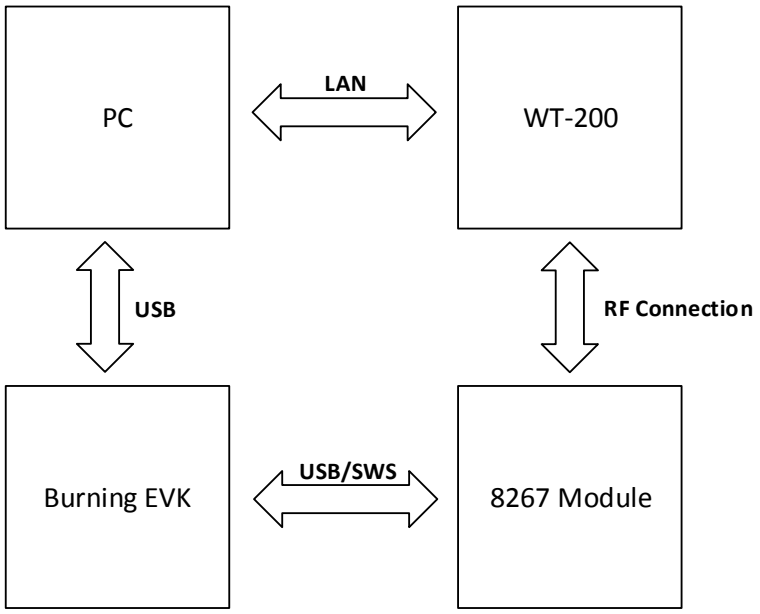

Figure 4 HW connection chart

2.2.1 Connect PC with WT-200

Use a network cable to connect LAN interface of PC with Ethernet port of WT-200, as shown below.

Figure 5 Connect PC with WT-200

Start the test software “WLAN Meter” on the PC side. User can switch language by clicking “Language” under the “Settings” menu.

The factory default IP address of WT-200 is available on the interface.

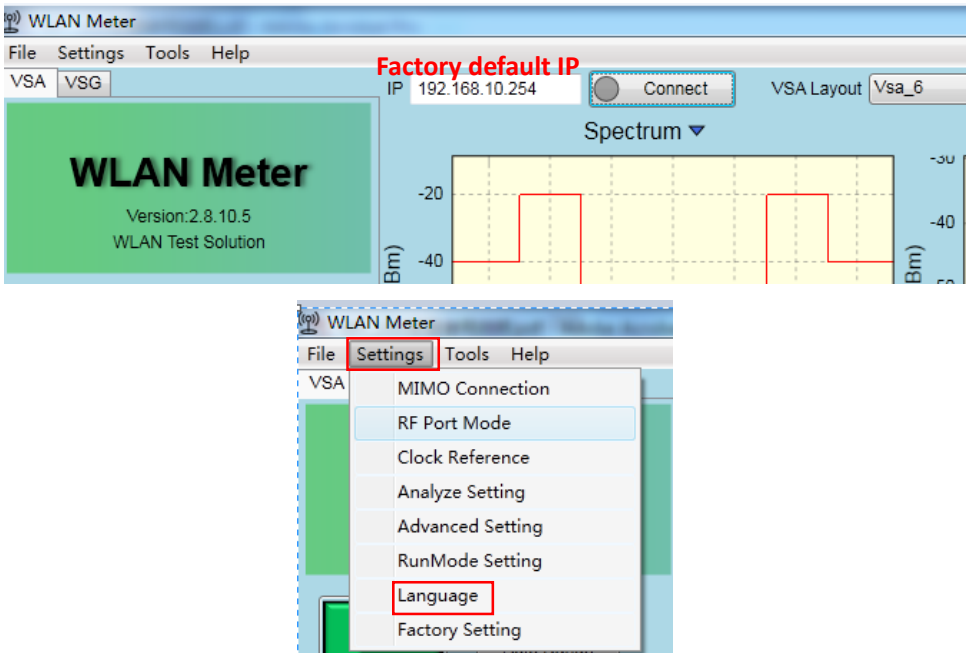

Figure 6 View default IP for WT-200

The IP address of PC should be set as “192.168.10.xxx”, to ensure the PC and the WT-200 are within the same sub-network.

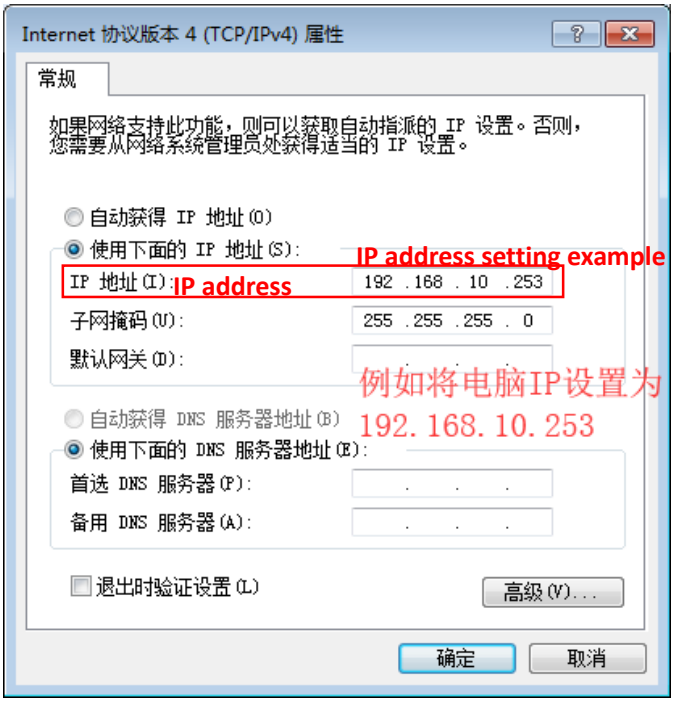

Figure 7 Set PC IP address

After setting PC IP address, click the “Connect” button next to IP address on the software “WLAN Meter”, to verify connection between the PC and the WT-200. The grey dot icon will turn green to indicate connection success, and the text of the button will turn to “Disconnect”, as shown below.

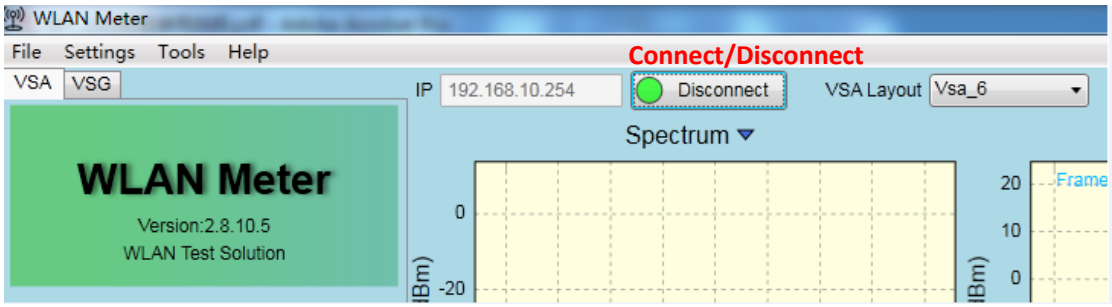

Figure 8 Connection success between PC and WT-200

2.2.2 Prepare 8267 Module

Before 8267 module is ready for use, it should be burned with corresponding EMI binary file.

1) Connect 8267 Module with Burning EVK (TLSR8266BR56) via USB method or Swire method, and connect miniUSB of the EVK with PC USB via a USB cable.

   For the guide of TLSR8266BR56, please refer to the document “***AN_18010500_User Guide for Telink Burning EVK TLSR8266BR56***”.

Figure 9 USB connection method

Figure 10 Swire connection method

2) Start the “Telink Burning and Debugging Tool (BDT)” tool on the PC side, and use the tool to download the target firmware into the 8267 Module.

   For the guide of BDT tool, please refer to the document “***AN-18101200_Telink Burning and Debugging Tool (BDT) User Guide***”.

2.2.3 Connect 8267 Module with WT-200

Use a RF cable to connect the RF interface of the 8267 Module with RF port (e.g. RF1) of the WT-200.

The software “WLAN Meter” can be used to set the two RF ports of the WT-200.

Click the “RF Port Mode” under the “Settings” menu to open the “RF port setting” window.

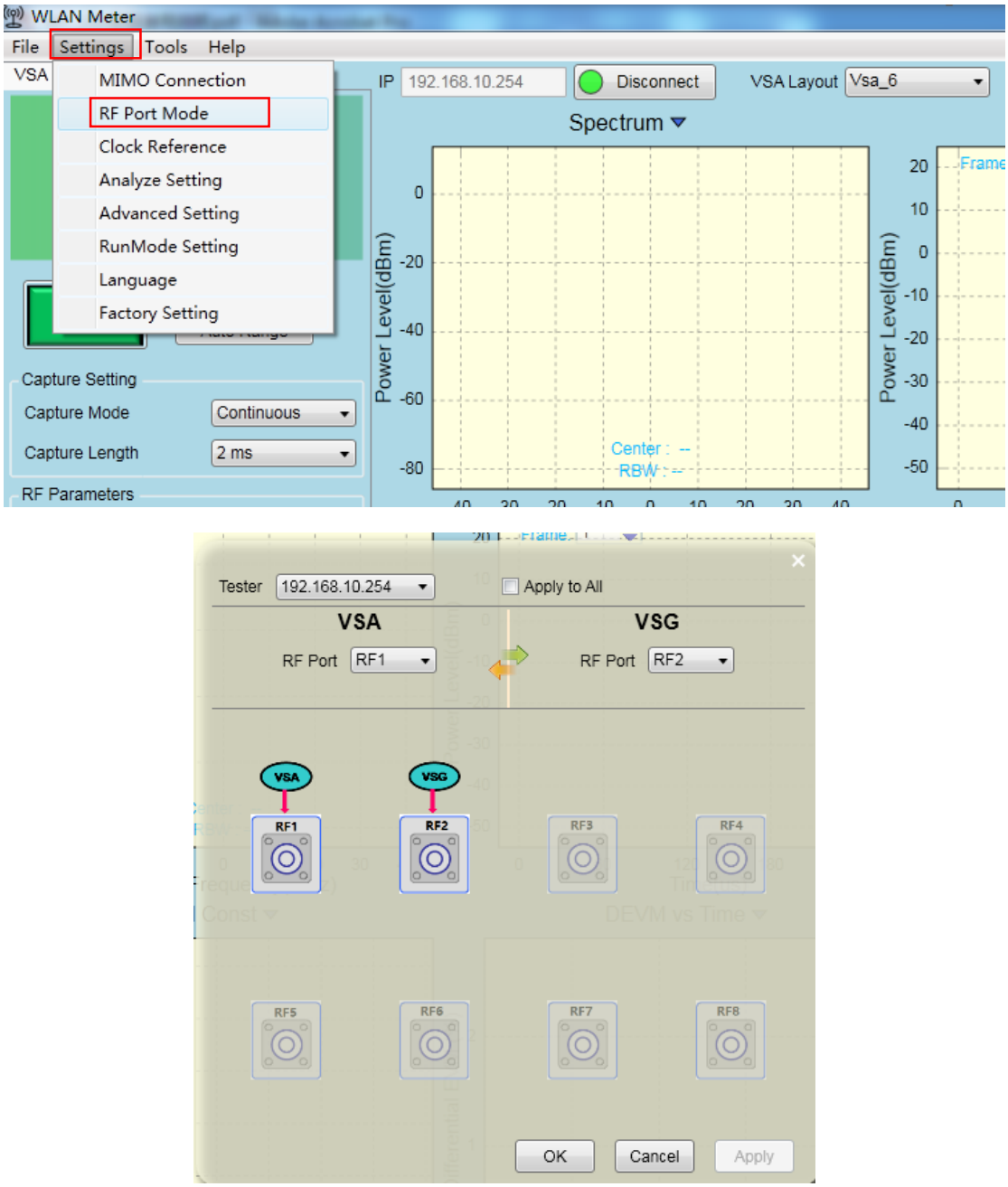

Figure 11 Open “RF port setting” window

On the “RF port setting” window, user can set the two RF ports as VSA input and VSG output. Herein RF1 is set as VSA input, and RF2 is set as VSG output. The 8267 Module can be connected to RF1 or RF2 as per test requirement.

Table 3 RF port setting

	Combination 1	**Combination 2**	**Combination 3**	**Combination 4**	**Combination 5**
RF1	VSA	VSA	VSG	VSG	OFF
RF2	VSG	OFF	VSA	OFF	OFF

3 SW Setting

In the demonstration, EMI Test Tool is used to control BLE Module, while VSA and VSG of the "WLAN Meter" are used to test transmission and reception of the Module.

3.1 Use VSA for Module Tx test

3.1.1 EMI Test Tool setting

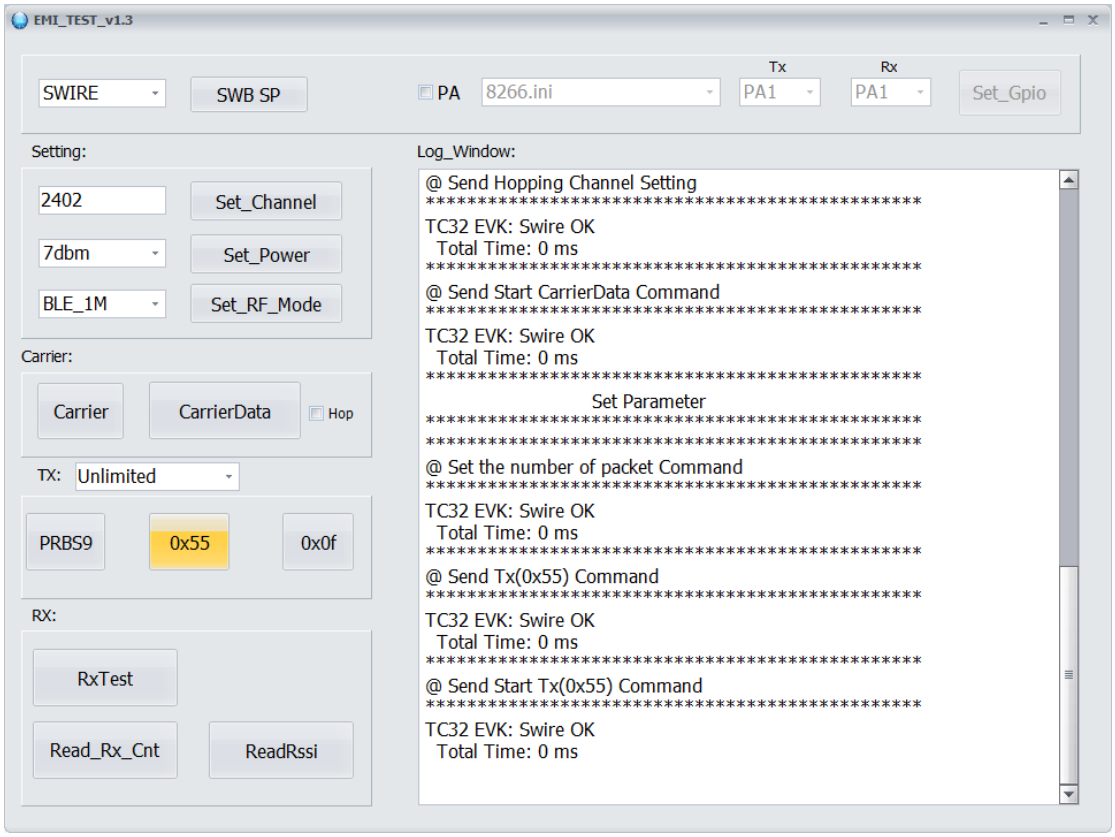

Figure 12 EMI Test Tool interface

On EMI Test Tool, it's needed to configure the following items: Module working frequency (Set_Channel), Tx power (Set_Power), working mode (Set_RF_Mode), single carrier mode (Carrier) / modulation mode (CarrierData), and carrier data format (PRBS9/0x55/0x0f). Corresponding setting is also needed on WLAN Meter.

Example: Working frequency - 2402MHz, Tx power - 7dBm, Working mode - BLE_1M (BLE mode, Data rate = 1Mbps), CarrierData mode, Data format - 0x55.

3.1.2 WLAN Meter setting

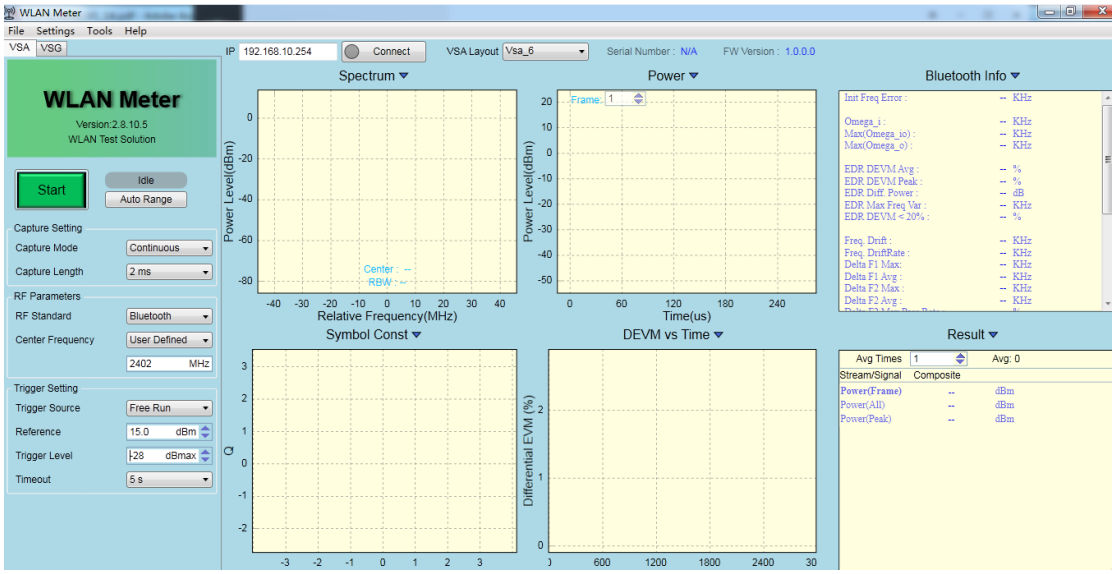

Figure 13 WLAN Meter VSA test interface

Parameter setting example:

- **Capture Setting**

✧ Capture Mode: Continuous

✧ Capture Length: 2ms

✧ RF Standard: Bluetooth

✧ Center Frequency: User Defined, 2402MHz

- **Trigger Setting**

✧ Trigger Source: Free Run

✧ Reference: 15dBm (Since Module Tx power is 7dBm, the reference level should be higher than the configured value.)

✧ Trigger Level: -28dBm

✧ Timeout: 5s (After test is started, the test will be stopped automatically if no signal is received within this timeout duration.)

After configuration is completed, click the “Start” button to enable the equipment to enter test. The text of the button will change to “Stop”, the interface will show current status indication, and the right “Test Result Window” will show test result in real time, as shown below.

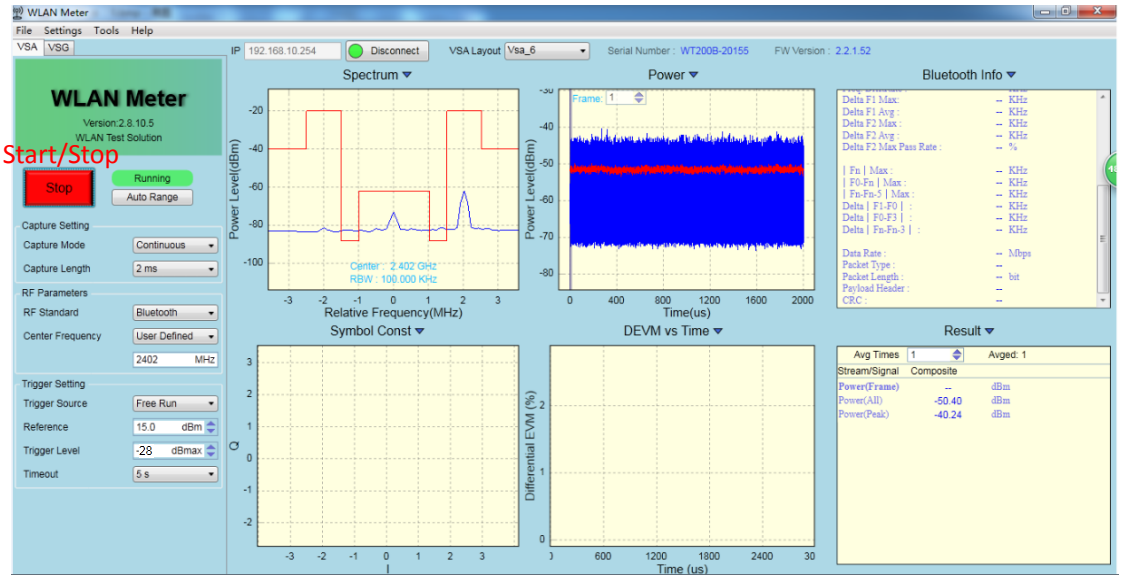

Figure 14 VSA test result

Via the drop-down menu “VSA Layout”, user can adjust VSA test result layout available on the “Test Result Window”. Several combinations are selectable, as shown below.

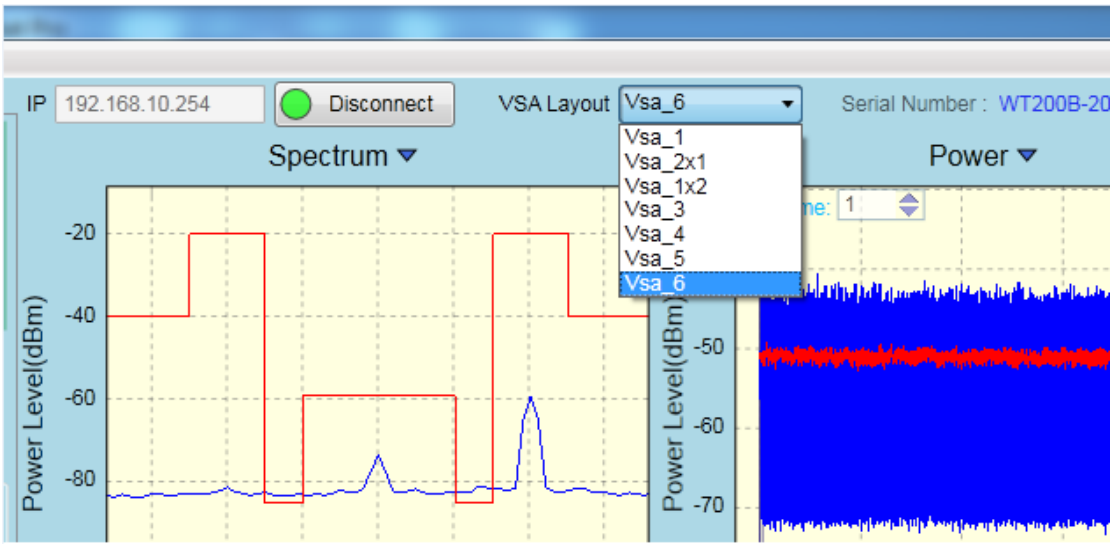

Figure 15 Adjust VSA test result window

To adjust the content of each sub-view in the “Test Result Window”, user can click the corresponding inverted triangle icon , and select test result items on the “SubType Selector” as needed.

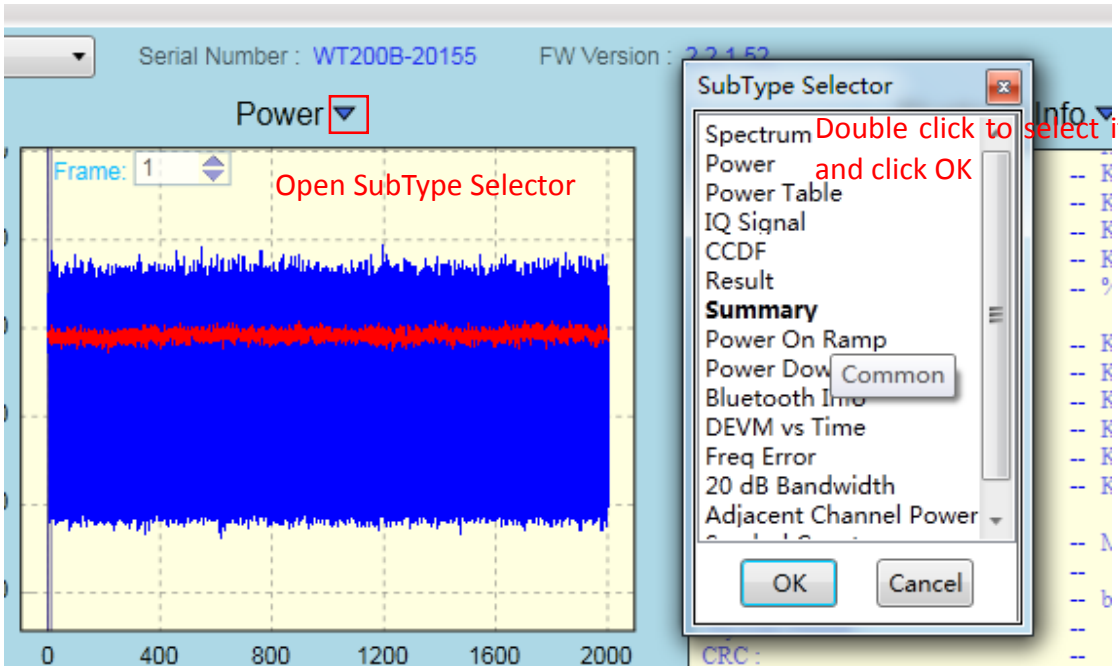

Figure 16 Adjust sub-view of test result window

3.2 Use VSG for Module Rx test

3.2.1 Use Wave Generator to generate wave file

The folder of the installed WLAN Meter also contains a sub-tool Wave Generator which serves to generate wave file needed for VSG output.

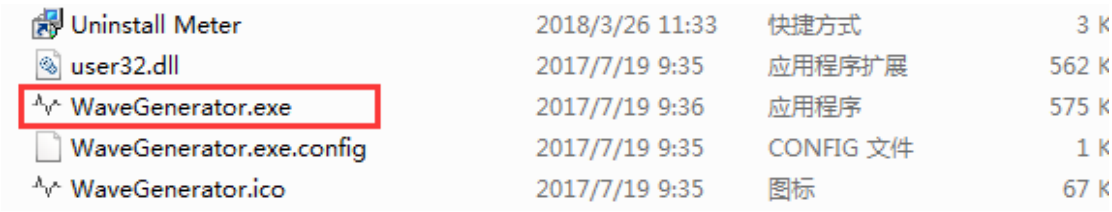

Figure 17 WaveGenerator tool

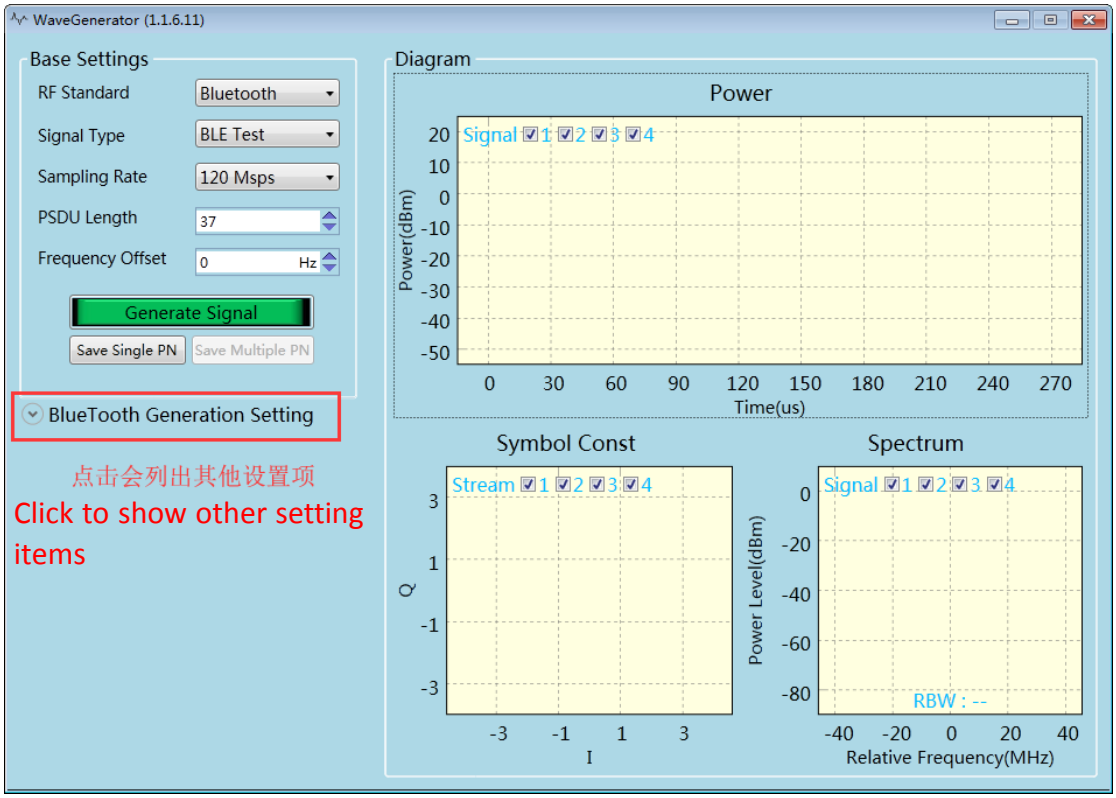

Figure 18 WaveGenerator interface

Base Settings:

- ✧ RF Standard: Bluetooth
- ✧ Signal Type: BLE Test
- ✧ Sampling Rate: 120Msps
- ✧ PSDU Length: 37 PSDU (Physical-layer Service Date Unit) packet length
- ✧ Frequency Offset: 0Hz

Click the “BlueTooth Generation Setting” to show other setting items. DO NOT modify the default setting of “LE Sync Word” under “LE Packet Settings”.

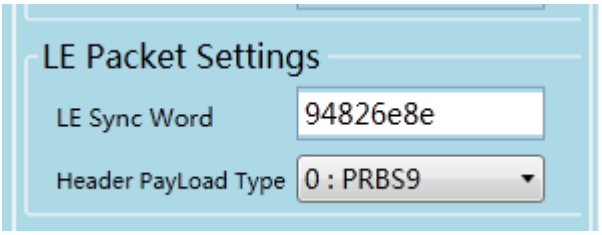

Figure 19 Check LE Sync Word

After the configurations above are completed, click the green “Generate Signal” button 

. When the right side shows corresponding wave spectrum figure and power figure, click the “Save Signal PN” button to save the generated signal as one “.bwv” file (wave file).

3.2.2 WLAN Meter SW setting

On the WLAN Meter interface, switch to the VSG tab, select the “Load VSG Signal” under the “File” menu and then import the generated wave file.

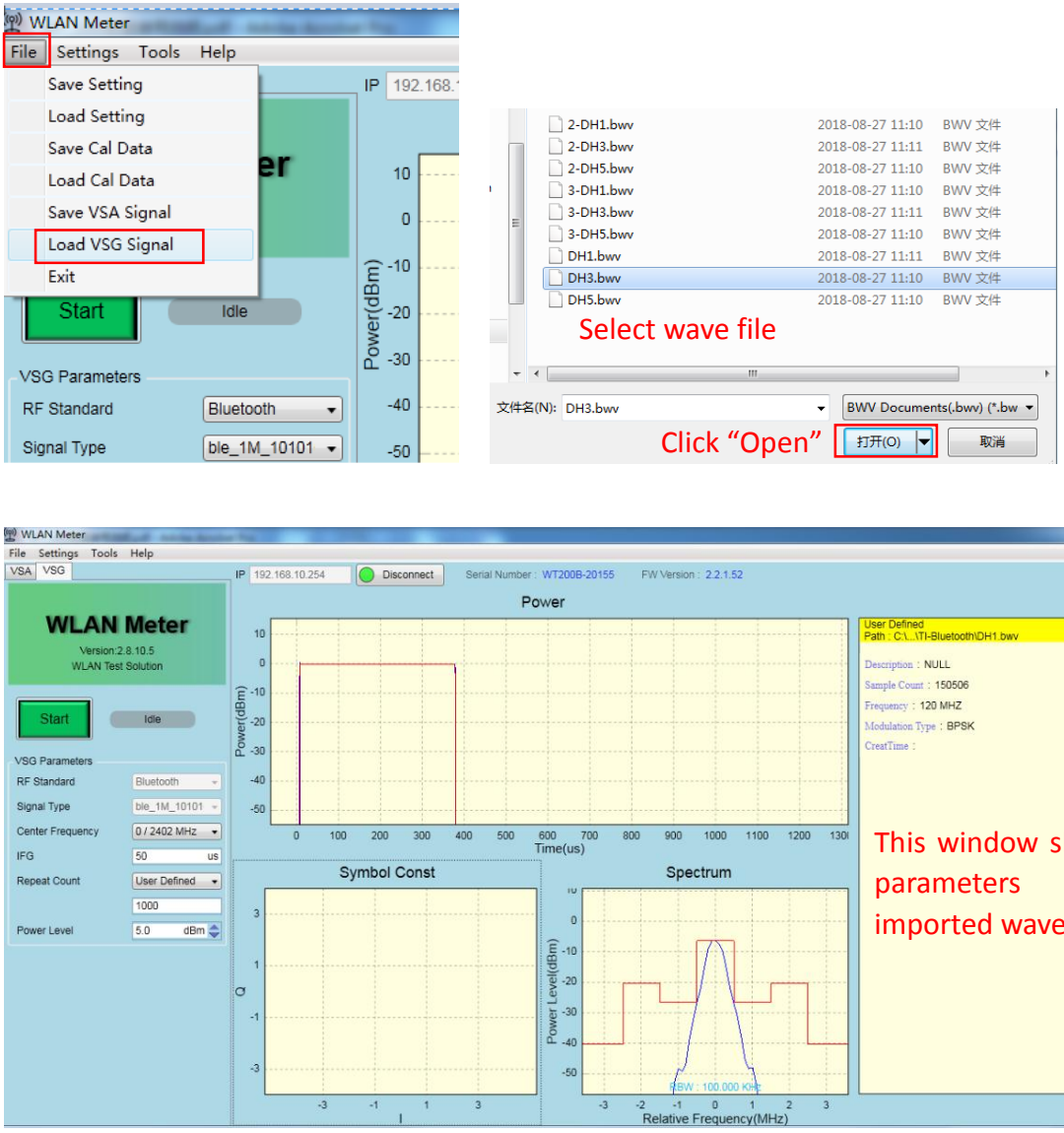

Figure 20 Import wave file

After importing the wave file, the right window will show some parameter information, and user only needs to configure Center Frequency, Tx Power Level, Tx interval (IFG, Inter-frame Gap), and the count number of repeat times (Repeat Count).

3.2.3 EMI Test Tool setting for Module Rx test

To test Rx performance of BLE Module, before VSG outputs signal to the Module, EMI Test Tool should be configured to enable the Module to enter Rx mode.

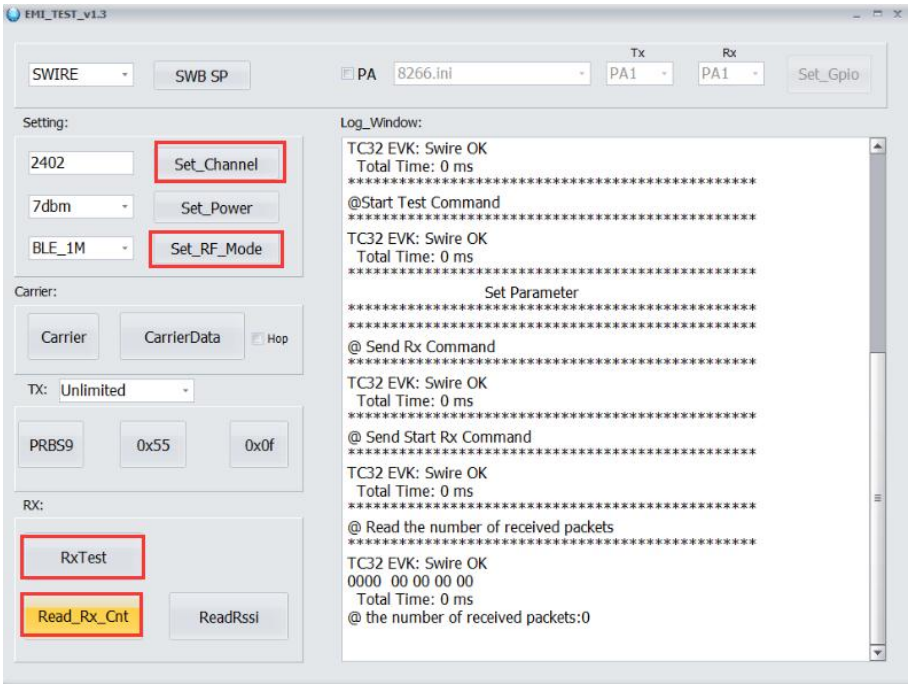

Figure 21 EMI Test Tool setting

***Notes:**

1) Frequency (Set_Channel) should be consistent with VSG Tx frequency.
2) Working mode (Set_RF_Mode) should be consistent with VSG Data Rate. Herein it's set as BLE_1M corresponding to 1Mbps data rate.
3) Before clicking the "RxTest" button to enter Rx mode, to calculate packet loss rate, it's suggested to click the "Read_Rx_Cnt" button to preview the number of packets that have been received.
   As shown in the Figure 21, the number of received packets is 0.

3.2.4 Rx test

On the WLAN Meter interface, click the “Start” button, so that the equipment can send packets as per the setting. The text of the button will change to “Stop”, and the status will be shown as “Running”.

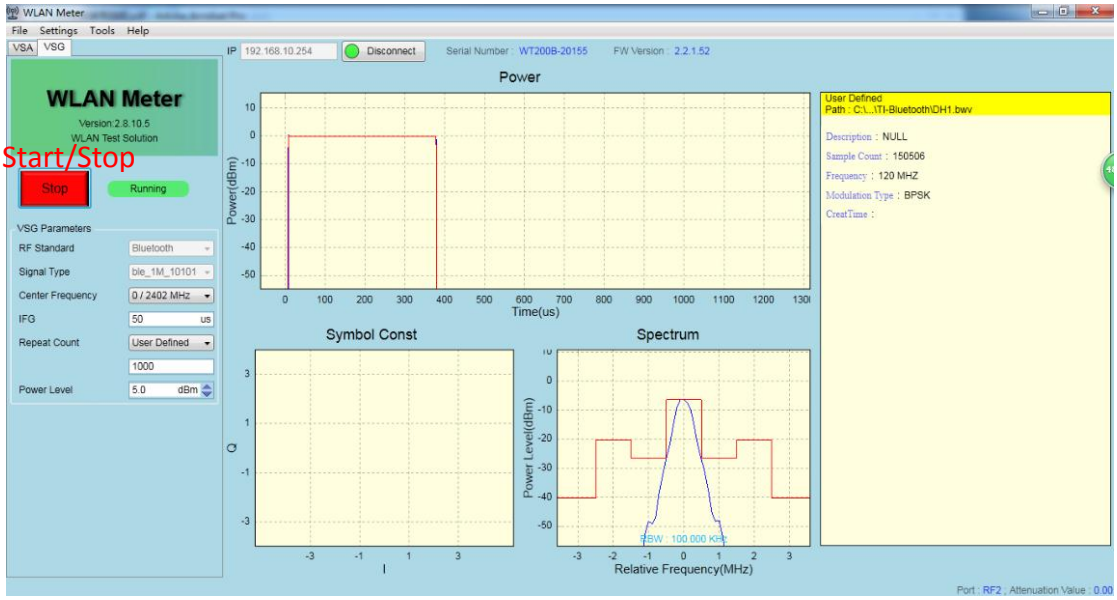

Figure 22 Data is being sent.

After all packets are sent as per the setting, the equipment will stop automatically, the text of the button will change to “Start” and the status will be shown as “Idle”.

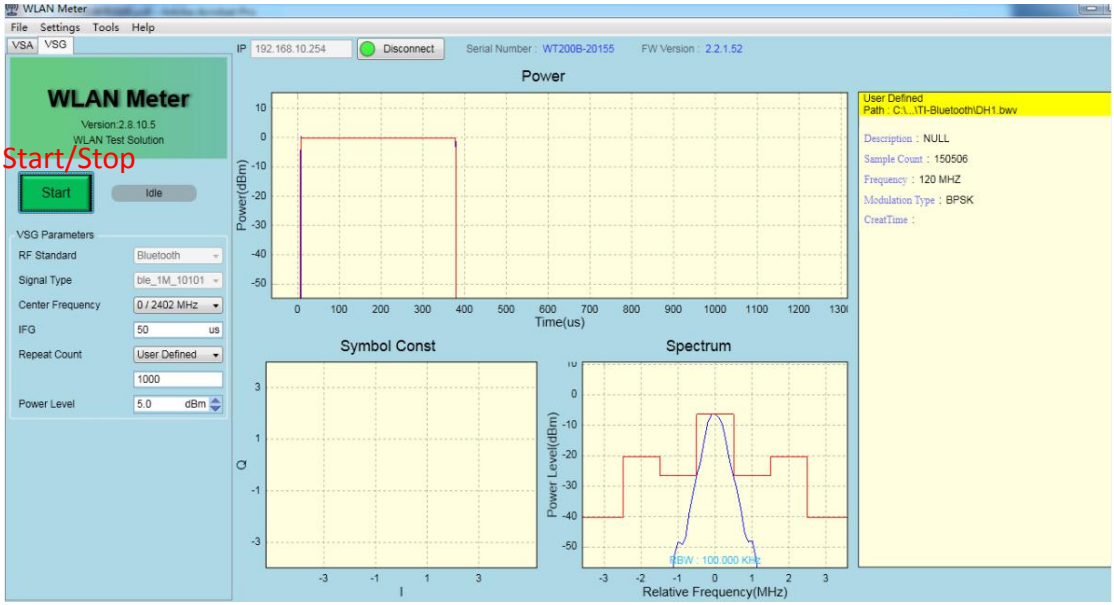

Figure 23 All data have been transmitted.

On the EMI Test Tool interface, click the “Read_Rx_Cnt” button again to view the number of packets that are received by the Module.

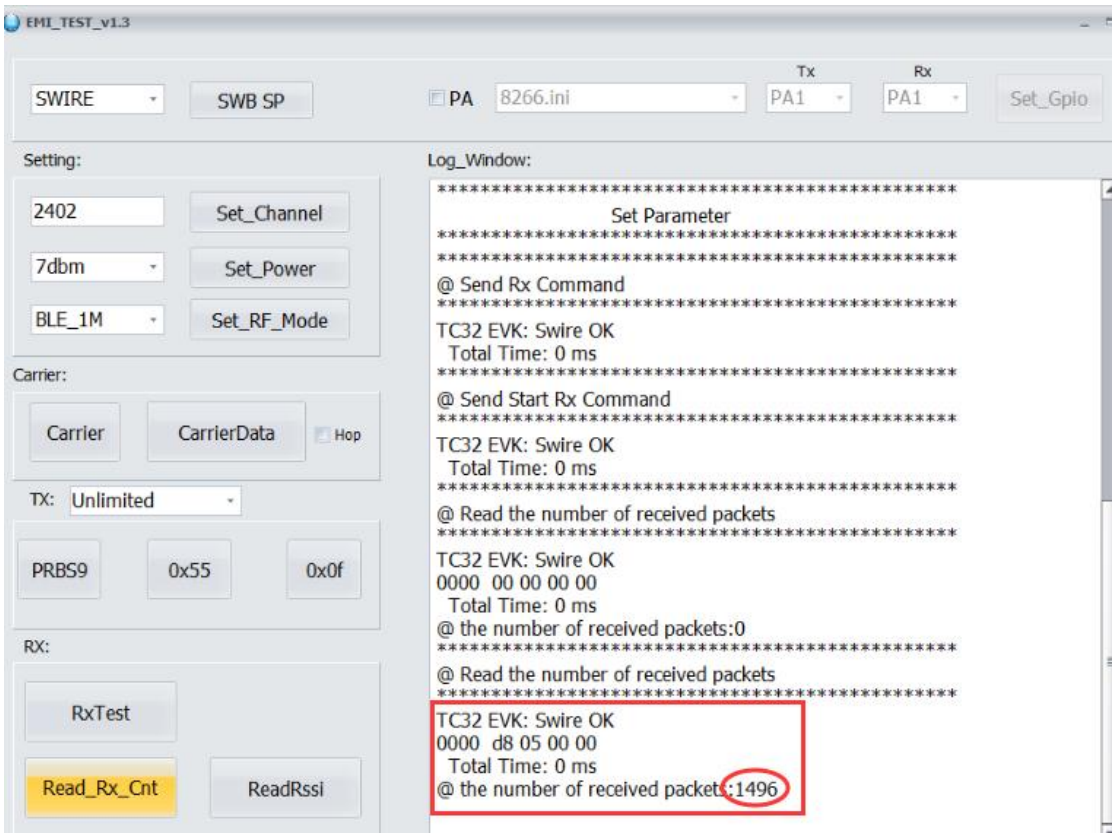

Figure 24 View the number of received packets

In this example, VSG sends 1500 packets, and the Module actually receives 1496 packets. Therefore, the PER (packet error rate) is (1500-1496)/1500 = 0.27%.

Adjust the Tx power of VSG until the PER of 8267 Module reaches 30.8% which is the critical point.

Thus, the **Module’s Rx sensitivity** corresponding to the current channel should equal **Tx power** minus **path loss**.

For example, suppose channel frequency is 2402MHz, VSG Tx power is -89dBm (marked as P1), the PER of 8267 Module reaches 30.8%, and the path loss from the Module to the WT-200’s RF port is 1dB.

Therefore, the 8267 Module’s Rx sensitivity @ 2402MHz = P1 - Loss = (- 89dBm) - 1dB = - 90dBm (BLE 1Mbps).