GigaDevice Semiconductor Inc.

GD32VW553 Throughput and Scenario-based Power Consumption Test Manual

Application Note
AN150

Revision 1.3

(Mar. 2025)

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1.　　Introduction

This test manual is mainly used to give instructions to clients to test transmission and reception throughput performance and various scenario-based power consumption performance of the Wi-Fi development board corresponding to the chips of GD32VW553 series in signaling mode. Chapter 2 introduces configuration of test systems, software and hardware of the development board. Chapter 3 introduces test methods of throughput performance. Chapter 4 introduces test methods of various scenario-based power consumptions. Chapter 5 introduces frequently-asked questions and solutions. Section 6 is version history.

2. Test preparation
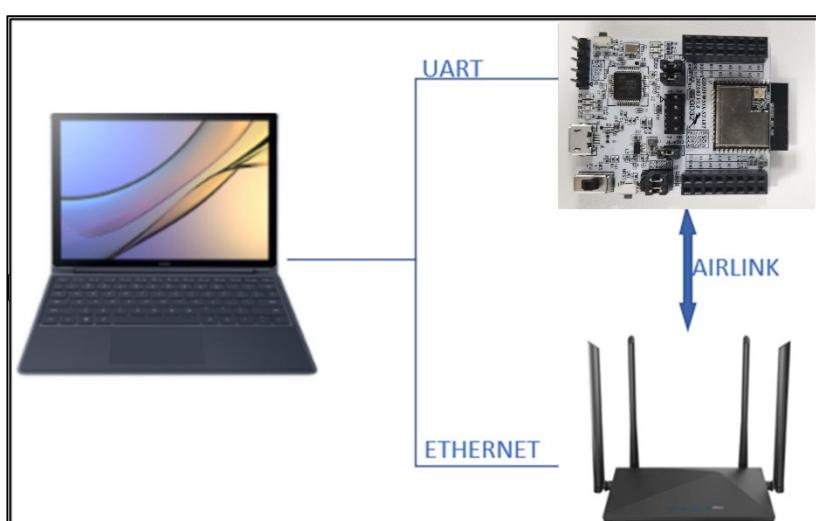
This chapter introduces the preparations for signaling test, including the building of the test system and software and hardware platforms, and the hardware configuration section includes the instructions for configuration of the GD development board (module).

2.1. System building

The signaling test system mainly includes three parts: PC, device under test (DUT), and wireless router (AP) *Figure 2-1. Signaling test system*:

The PC controls DUT and AP via UART (USB to UART) and Ethernet respectively for tests on throughput and power consumption performance of DUT. DUT and AP interact wirelessly.

Figure 2-1. Signaling test system

2.2. Hardware configuration

For **GD "Start" development board** (*Figure 2-2. Reference connection of GD development board*, mother board + module), Version 1.0 Start board use DAPLINK circuit as the communication circuit while Version 3.0 use GDLINK circuit. Below description is mainly based on Version 3.0 Start board.

1. UART&JLINK functions: The communication function of USB to UART and the firmware burning function of USB to JLINK are realized through the GDLINK circuit on the bottom board, and PC is connected to the USB port of the bottom board through a USB cable;
2. Serial port connection: Serial ports are connected to the bottom board J5.2/4 (main chip UART PIN) and J5.1/3 (GDLINK UART PIN)) respectively with jumpers.
3. JLINK connection: JLINK are connected to the bottom board J4.2/4/6/8 (main chip JLINK PIN) and J4.1/3/5/7 (GDLINK JLINK PIN)) respectively with jumpers.
4. Configuration of the main chip mode:

- ■ **"BOOT0"** of PIN should be at low level (boot from flash), which is realized by configuring the jumper caps **J3.3** and **J3.5** on the bottom board.
- ■ **"PU"** of PIN should be at high level, which is realized by "pressing" the switch **"SW3"** on the bottom board.
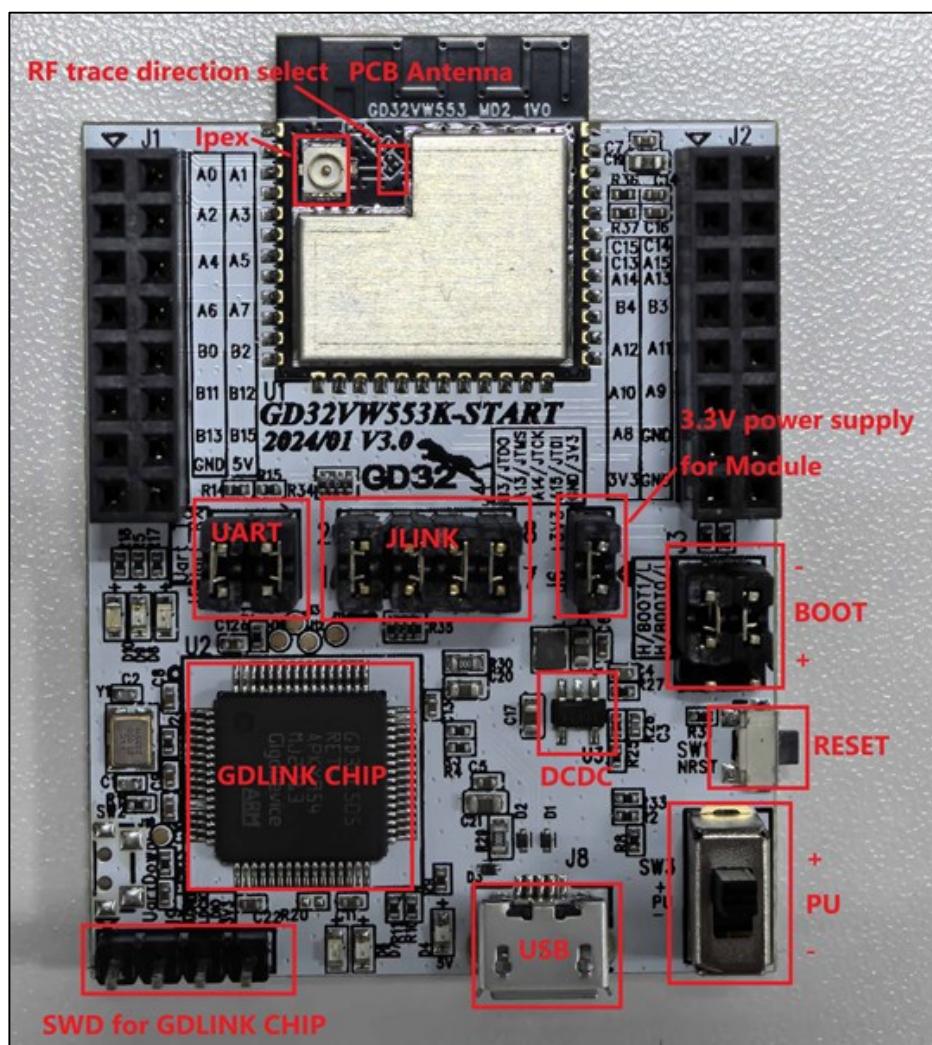
5. Module antenna switching:

- ■ Switch the position of the resistor by welding ***Figure 2-2. Reference connection of GD development board*** to select the RF signal path of DUT: When the left side of the resistor faces upward, the RF path leads to the PCB antenna and can only be used for radiation test; when the left side of the resistor faces downward, the RF path leads to the RF (Ipex) connector and is used for conduction test and radiation test of the external antenna. This document mainly targets **radiation test**.
- ■ Connect the RF test socket of DUT and the RF port of the instrument with the Ipex to SMA cable.

6. Module power supply: The DCDC circuit on the bottom board converts the 5V power input from the USB port into a 3V3 output, and the 3V3 output is connected to the 3V3 pad of the module through the jumper cap "J6". Disconnect this jumper (from external 3V3 output to J6.2) to test power consumption of the module.

Figure 2-2. Reference connection of GD development board
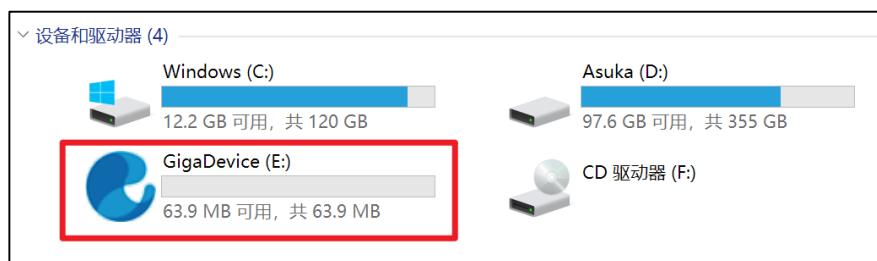
2.3. Software configuration

1. Drive installation: After the development board hardware and the test system are built, connect the two ends of the USB cable to the development board and PC respectively. For GDLINK, no driver is needed for WIN10 system but a corresponding driver should be installed for WIN7 system. For DAPLINK, Firstly install the DAPLINK driver "**mbedWinSerial_16466.rar**" on PC: After decompression, double-click the .exe file to start automatic installation. After installation, the serial port device and COM number *Figure 2-3. Installation of serial port drive* are displayed in the "**Device Manager**" on PC. It is recommended to install Windows 10/Windows 7 system on PC.

Figure 2-3. Installation of serial port drive

2. Firmware download: After the GDLINK driver is installed, a new diskette named "GigaDevice" *__Figure 2-4. GDLINK folder__* is displayed in the path of PC-"**Explorer**". Directly "drag and drop" (or copy and paste) to this drive letter the firmware named "**wifi_signaling_test**" provided by GD, and wait for a while to achieve firmware burning, and click **Reset** to restart the chip.

Figure 2-4. GDLINK folder

3. Starting the test: Use the serial port tool or the serial port command line to perform subsequent tests.

3. Throughput test
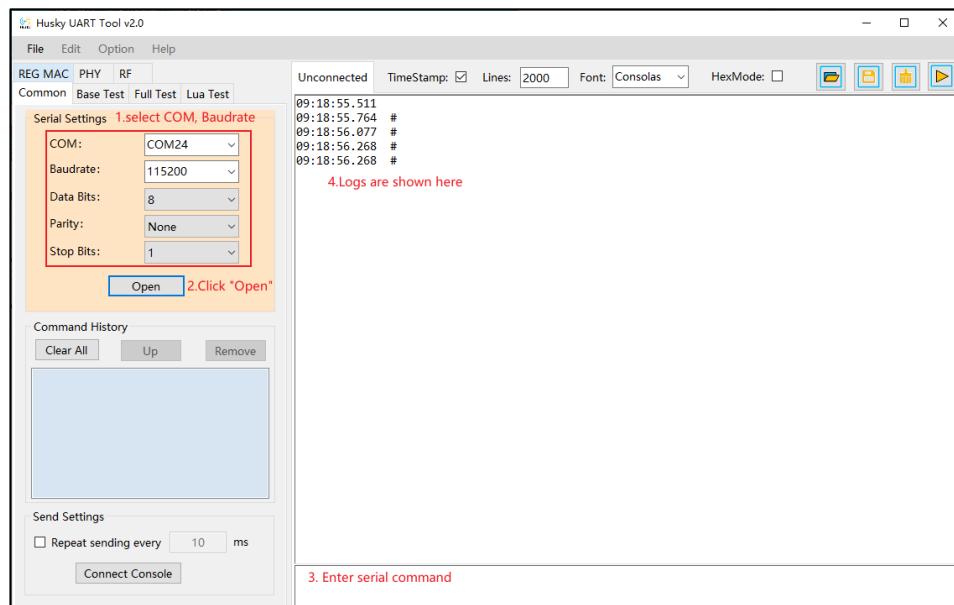
This chapter introduces how to test TCP TX/RX and UDP TX/RX performance in signaling mode with the serial port tool and commands. Considering that interferences at varying levels in the open environment might influence the test results, the test environment in the chapter is required to be a **shielded room environment**.

The test result in the chapter reflects throughput performance of GD32VW553 in regular mode. GD32VW553 also supports the mode with high throughput performance which can be tested with the firmware named "**image-all-high-performance.bin**". For the burning method, please refer to ***Software configuration***.

3.1. Serial port connection

1. After connecting DUT to PC, open the UART tool on PC (the serial port tool "**Husky UART Tool**" provided by GD is recommended), click the drop-down menu of **COM**, select the COM port of DUT, and click the button below to connect. The serial port configuration and the connection status are as shown in ***Figure 3-1. GD serial port tool***:

Figure 3-1. GD serial port tool

2. The serial port is connected. At this moment, short press **Reset** at the side of the DUT development board and release (namely short pull "resent" PIN of the chip), and the serial port output box will display the log information as shown in ***Figure 3-2. Serial port boot information***. Left-click in the serial port input box and press **Enter** on the keyboard, and the log displays "**#**":

Figure 3-2. Serial port boot information


```
# ALW: MBL: First print.
ALW: MBL: Boot from Image 0.
ALW: MBL: Validate Image 0 OK.
ALW: MBL: Jump to Main Image (0x0800a000).
Build date: 2024/01/10 11:11:31
This firmware is for WiFi signaling test.
=== RF initialization finished ===
=== WiFi calibration done ===
```

3.2. Preparations

Tests in Sections 3.3-3.6 require connecting DUT and PC to the same AP using the wireless and wired methods respectively. The serial port command used for connecting DUT to AP is as follows:

wifi_scan

Scan AP in the environment and print AP information such as SSID and encryption methods on the serial port tool.

wifi_connect <SSID> [PASSWORD]

Connect DUT to the corresponding AP. <SSID> in the command is the SSID of the AP. [PASSWORD] is password of the AP. If encryption of the AP is open, then [PASSWORD] is not required.

wifi_status

Check DUT connection information such as the IP address of DUT.

If the tests in the next chapter require installing iperf3 program at PC, you may download it from the official website: https://iperf.fr/iperf-download.php#windows. Please chooser version iPerf 3.1.2.

3.3. iPerf3 TCP TX Test

1. Run iPerf3 at PC and execute commands with CMD command line:
   iperf3 -s -p <port> -i <interval>

<Port> parameter is used to set a monitoring port at Server. <Interval> parameter is used to set the cycle of printed test results (namely the Interval line in *Figure 3-3. iperf3 TCP TX*) in units of seconds. Example:
   iperf3 -s -p 5002 -i 1

2. Serial port tool executes the command:

iperf3 -c <ip addr> -l <length> -p <port> -i <interval> -t <time>

<ip addr> parameter is IP address of PC. <Port> parameter should be the same as the parameter of the command at PC. <Interval> parameter can be different from the one at PC. <length> is the size of TCP package with unit of byte. **For TCP test, it is recommended to use 1460.** <Time> is the duration of data transmission. Example:

iperf3 -c 192.168.124.2 -l 1460 -p 5002 -i 1 -t 20

Note: Commands at PC need to be adjusted according to actual configuration. The same as below.

After the test starts, you may see the printed test results at the serial port tool as shown in *Figure 3-3. iperf3 TCP TX*.

Figure 3-3. iperf3 TCP TX

3.4. iPerf3 TCP RX Test

1. Serial port tool executes the command:

iperf3 -s -p <port> -i <interval>

Example (<port>=5005, <interval>=1):

iperf3 -s -p 5005 -i 1

2. Run iPerf3 at PC and execute commands with CMD command line:

iperf3 -c <ip addr> -l 1460 -p <port> -i <interval> -t <time>

Here, <ip addr> is the IP address of DUT. Example:

iperf3 -c 192.168.124.3 -l 1460 -p 5005 -i 1 -t 20

The printed test results at the serial port tool are as shown in **_Figure 3-4. iperf3 TCP RX_**.

Figure 3-4. iperf3 TCP RX

```
#
# iperf3 -s -p 5005 -i 1

Iperf3: start iperf3 server!
# iperf3 server:: -----------------------------------------------------------
iperf3 server:: Server listening on 5005
iperf3 server:: -----------------------------------------------------------
iperf3 server:: Accepted connection from 192.168.124.2, port 63874
iperf3 server:: [  9] local 192.168.124.3 port 5005 connected to 192.168.124.2 port 63875
iperf3 server:: [ ID] Interval           Transfer     Bandwidth
iperf3 server:: [  9]    0.00-1.00   sec  1.79 MBytes  15.0 Mbits/sec
iperf3 server:: [  9]    1.00-2.00   sec  1.86 MBytes  15.6 Mbits/sec
iperf3 server:: [  9]    2.00-3.00   sec  1.87 MBytes  15.7 Mbits/sec
iperf3 server:: [  9]    3.00-4.00   sec  1.90 MBytes  15.9 Mbits/sec
iperf3 server:: [  9]    4.00-5.00   sec  1.91 MBytes  16.1 Mbits/sec
iperf3 server:: [  9]    5.00-6.00   sec  1.92 MBytes  16.1 Mbits/sec
iperf3 server:: [  9]    6.00-7.00   sec  1.90 MBytes  15.9 Mbits/sec
iperf3 server:: [  9]    7.00-8.00   sec  1.88 MBytes  15.8 Mbits/sec
iperf3 server:: [  9]    8.00-9.00   sec  1.87 MBytes  15.7 Mbits/sec
iperf3 server:: [  9]    9.00-10.00  sec  1.92 MBytes  16.1 Mbits/sec
iperf3 server:: [  9]   10.00-11.00  sec  1.90 MBytes  15.9 Mbits/sec
iperf3 server:: [  9]   11.00-12.00  sec  1.92 MBytes  16.1 Mbits/sec
iperf3 server:: [  9]   12.00-13.00  sec  1.88 MBytes  15.8 Mbits/sec
iperf3 server:: [  9]   13.00-14.00  sec  1.90 MBytes  16.0 Mbits/sec
iperf3 server:: [  9]   14.00-15.00  sec  1.82 MBytes  15.3 Mbits/sec
iperf3 server:: [  9]   15.00-16.00  sec  1.86 MBytes  15.6 Mbits/sec
iperf3 server:: [  9]   16.00-17.00  sec  1.82 MBytes  15.3 Mbits/sec
iperf3 server:: [  9]   17.00-18.00  sec  1.91 MBytes  16.0 Mbits/sec
iperf3 server:: [  9]   18.00-19.00  sec  1.93 MBytes  16.2 Mbits/sec
iperf3 server:: [  9]   19.00-20.00  sec  1.79 MBytes  15.0 Mbits/sec
iperf3 server:: - - - - - - - - - - - - - - - - - - - - - - - - -
iperf3 server:: [ ID] Interval           Transfer     Bandwidth
iperf3 server:: [  9]    0.00-20.00  sec  37.7 MBytes  15.8 Mbits/sec         sender
iperf3 server:: [  9]    0.00-20.00  sec  37.6 MBytes  15.8 Mbits/sec         receiver
iperf3 server:: -----------------------------------------------------------
iperf3 server:: Server listening on 5005
iperf3 server:: -----------------------------------------------------------
```

3.5.   iPerf3 UDP TX Test

1. Run iPerf3 at PC and execute commands:

iperf3 -s -p <port> -i <interval>

Example (<port>=5002, <interval>=1):

iperf3 -s -p 5002 -i 1

2. Serial port tool executes the command:

iperf3 -c <ip addr> -l <length> -p <port> -i <interval> -t <time> -u –b <bandwidth>

Here, <ip addr> is the IP address of PC. **In UDP test, <length> is recommended to use 1472.** <Bandwidth> is used to set the upper limit of UDP band width in units of bits/sec. Example:

iperf3 -c 192.168.124.2 -l 1472 -p 5002 -i 1 -t 20 -u -b 50M

3.6. iPerf3 UDP RX Test

1. Serial port tool executes the command:
   iperf3 -s -p <port> -i <interval>

Example (<port>=5005, <interval>=1):
   iperf3 -s -p 5005 -i 1

2. Run iPerf3 at PC and execute commands:
   iperf3 -c <ip addr> -l 1472 -p <port> -i <interval> -t <time> -u –b 50M

Here, <ip addr> is the IP address of DUT. Example:
   iperf3 -c 192.168.124.3 -l 1472 -p 5005 -i 1 -t 20 -u –b 50M

4. Scenario-based power consumption test

This chapter introduces how to test power consumption in several typical scenarios in signaling mode. The test scenarios are described below:
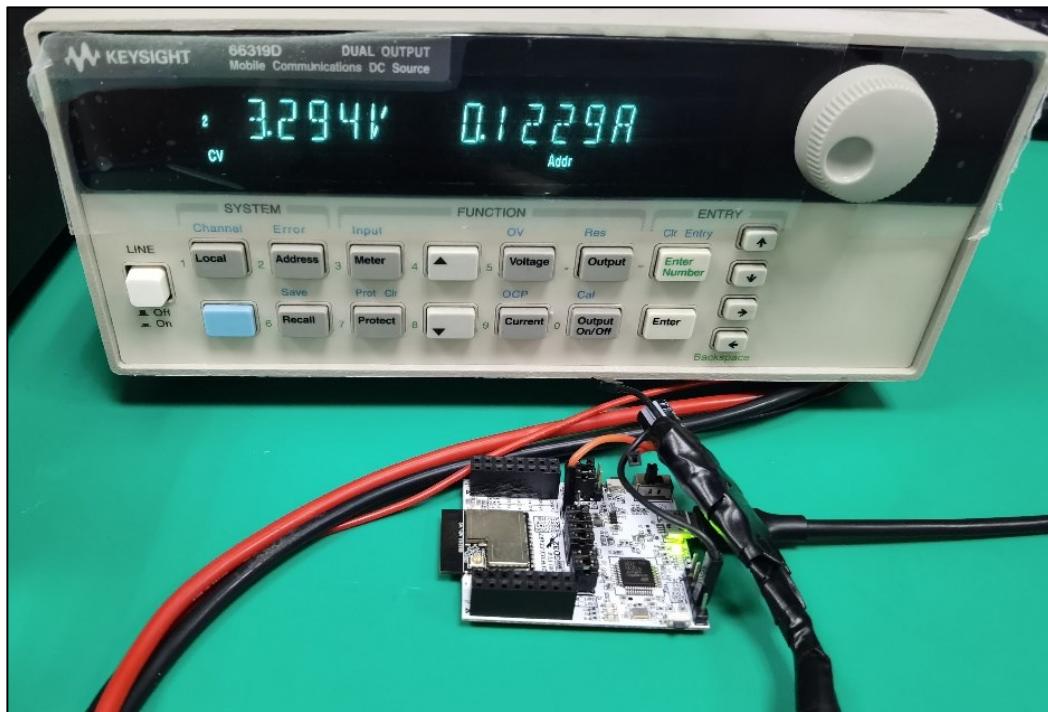
Table 4-1. Test Scenarios

Scenario	Scenario Description
Wi-Fi is off.	Connect AP. MCU operates while Wi-Fi is in sleep.
Connect AP+UDP TX	Connect AP, UDP TX data
Connect AP+UDP RX	Connect AP, UDP RX data
Connect AP+ power saving, DTIM=1	Connect AP. Both MCU and Wi-Fi are in power saving mode. DTIM=1

4.1. Test preparation

1. Test system: Based on *__Figure 2-1. Signaling test system__*, a DC power supply is required to supply power to the module and capture current data in real time, such as **Keysight 66319D** (This instrument is also used for the power consumption tests below).
2. Instrument configuration: It is mainly for the DC power supply, and the end of the power cable is welded with a Dupont wire for transfer. For stable output voltage, it is recommended to weld a large electrolytic capacitor (such as 100 uF)) at the end of the power supply cable. After the instrument is powered on, first set the output voltage of the instrument to 3.3 V, and then set the output state to **OFF**.
3. Hardware preparation: Use the GD development board as an example here. Please refer to *__Figure 2-2. Reference connection of GD development board__*. The DC-DC circuit on the bottom board converts a 5 V power input from the USB port into a 3.3 V output, and the 3.3 V output is connected to the 3.3 V pad with the jumper cap "J6". Disconnect the jumper cap "J6" and connect the 3.3 V and GND Dupont wire of the output terminal of the direct current power supply to pin J6.2 and any GND pin (jack) respectively. As shown in *__Figure 4-1. Power consumption test system__*, the 3.3 V and the GND Dupont wire are connected to J6.2 and J9.4 respectively.
4. Software preparation: The test firmware is the same as that used for throughput test mentioned above. Please refer to *__Software configuration__* for details.
5. Power-on sequence: First turn the output state of the DC power supply to **ON** to see a current change. Then connect the bottom board and PC with a USB cable. After the **Device Manager** of PC identifies the serial port number, you can use serial port command line to perform the power consumption test.

Figure 4-1. Power consumption test system

4.2.   Wi-Fi is off
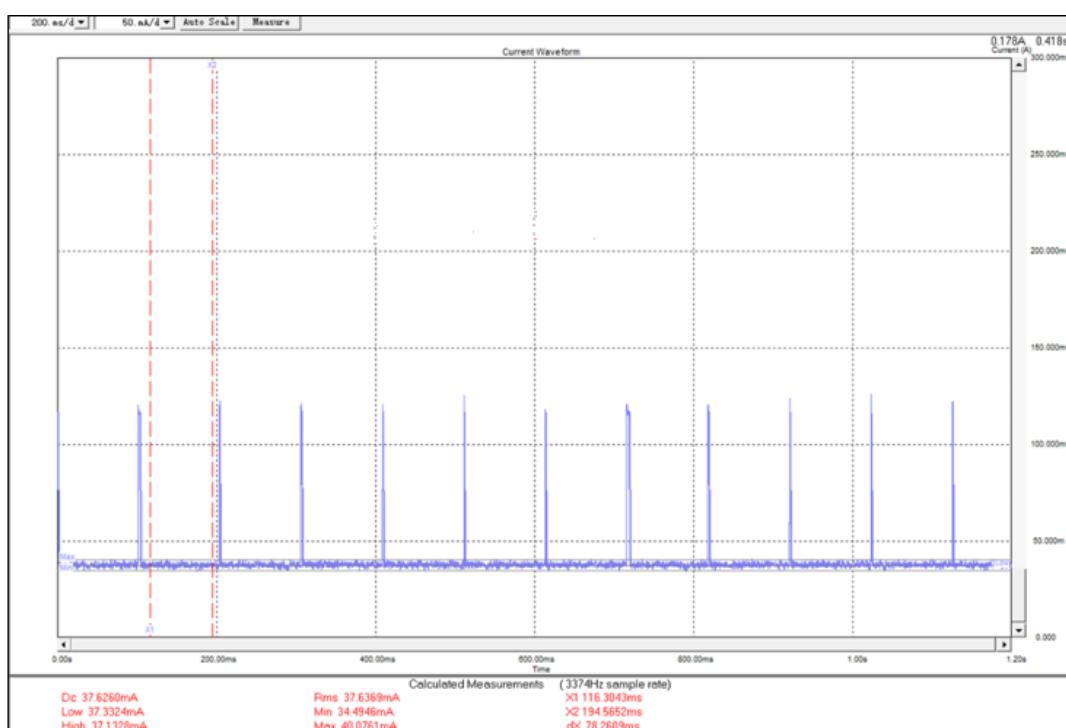
After the chip is powered on, the default status is that Wi-Fi is on. When testing scenario-based power consumption in this chapter, it is required to turn off Wi-Fi manually. After the test, Wi-Fi needs to be turned on manually for other tests.

1. Please refer to **_Preparations_** for how to connect AP.
2. The serial port tool executes the following commands in sequence to turn off some circuits in BLE and enter the Wi-Fi sleep mode:

    ble_disable

    wifi_ps 1
3. In Wi-Fi sleep mode, the direct current power supply can be used to capture power consumption data. Please note that bottom current data between beacons should be captured. Please refer to **_Figure4-2. Power consumption when "Wi-Fi is off"_**. At this moment, the average power consumption within the time window is 37.6 mA (the value in the "**DC**" field on the lower left side of the photo). Please note that at this time, uart is not off yet in the test. If it is off, the power consumption result will be lower.
4. After testing the power consumption, the serial port tool will execute the following command to exit the Wi-Fi sleep mode.

    wifi_ps 0
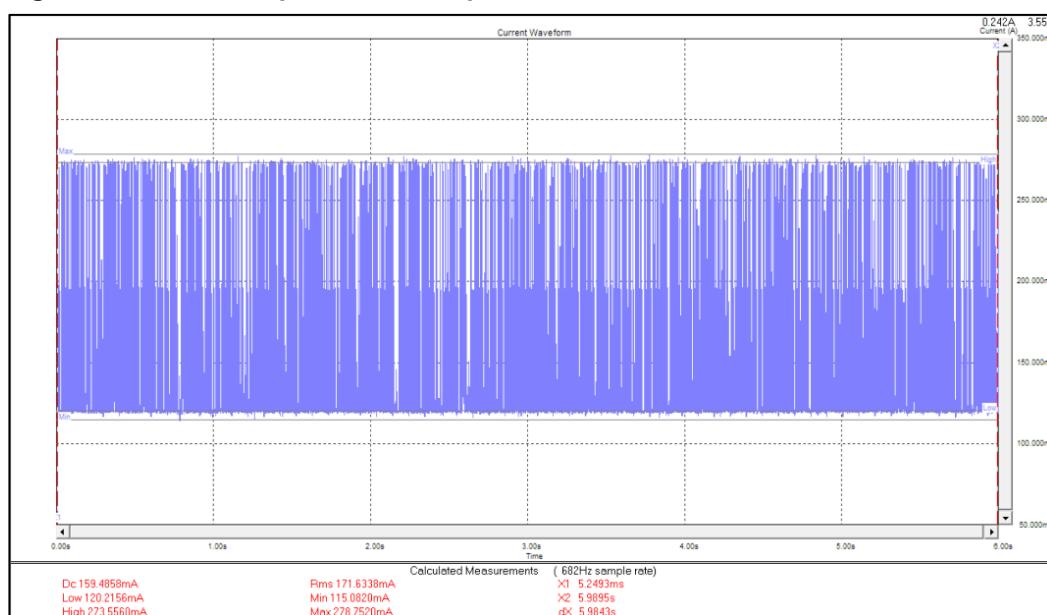
Figure4-2. Power consumption when "Wi-Fi is off"

4.3.   Connect AP+UDP TX

1. Please refer to ***Preparations*** for how to connect AP.
2. Referring to ***iPerf3 UDP TX Test***, start iPerf3 UDP TX test.
3. In UDP TX test, the direct current power supply is used to capture power consumption data. Please refer to ***Figure 4-3. "UDP TX" power consumption***. The average power consumption is 159.5 mA (the value in the "**DC**" field on the lower left side of the photo).
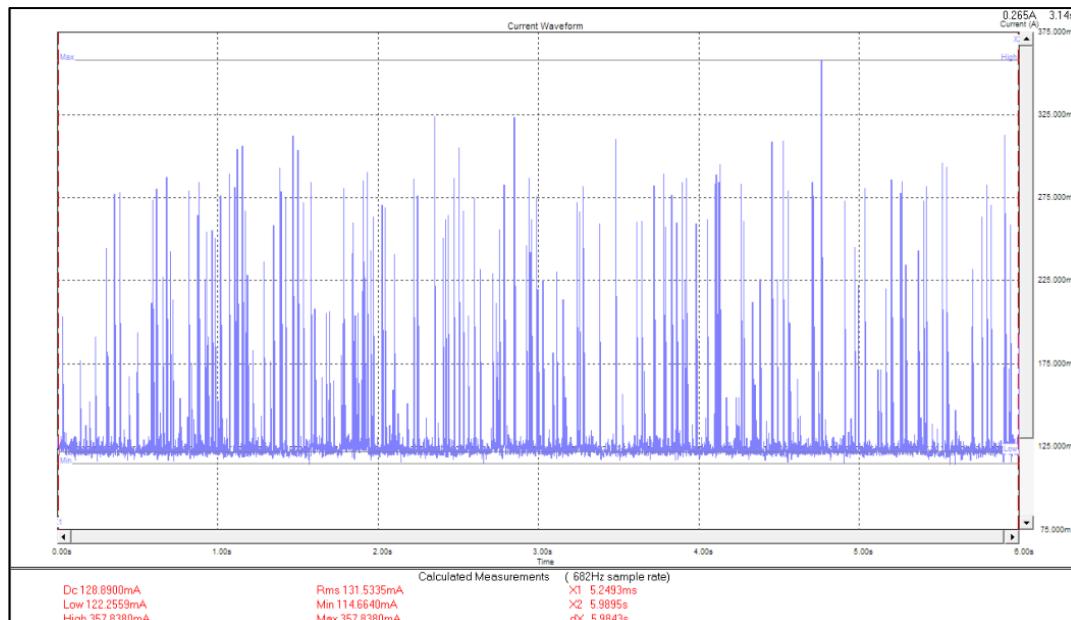
Figure 4-3. "UDP TX" power consumption

4.4.   Connect AP+UDP RX

1. Please refer to **_Preparations_** for how to connect AP.
2. Referring to **_iPerf3 UDP RX Test_**, start iPerf3 UDP RX test.
3. In UDP RX test, the direct current power supply is used to capture power consumption data. Please refer to **_Figure4-4. "UDP RX" power consumption_**. The average power consumption is 128.9 mA (the value in the "**DC**" field on the lower left side of the photo).

Figure4-4. "UDP RX" power consumption

4.5.   Connect AP+ power saving, DTIM=1

1. Currently, the DTIM parameter of AP on the market is 1 by default. If the DTIM is not 1, you may modify it on the configuration interface as shown in ***Figure 4-5. Modify DTIM***.
2. Please refer to ***Preparations*** for how to connect AP.
3. Execute the following serial port commands in sequence to turn off some circuits of the chip BLE to make the chip enter the power saving mode.

ble_disable
wifi_ps 2
sys_ps 1

In power saving mode, the direct current power supply is used to capture power consumption data. Please refer to ***Figure 4-6. "DTIM= 1" power consumption***. The average power consumption is **1.43 mA** (the value in the "**DC**" field on the lower left side of the photo).

Figure 4-5. Modify DTIM
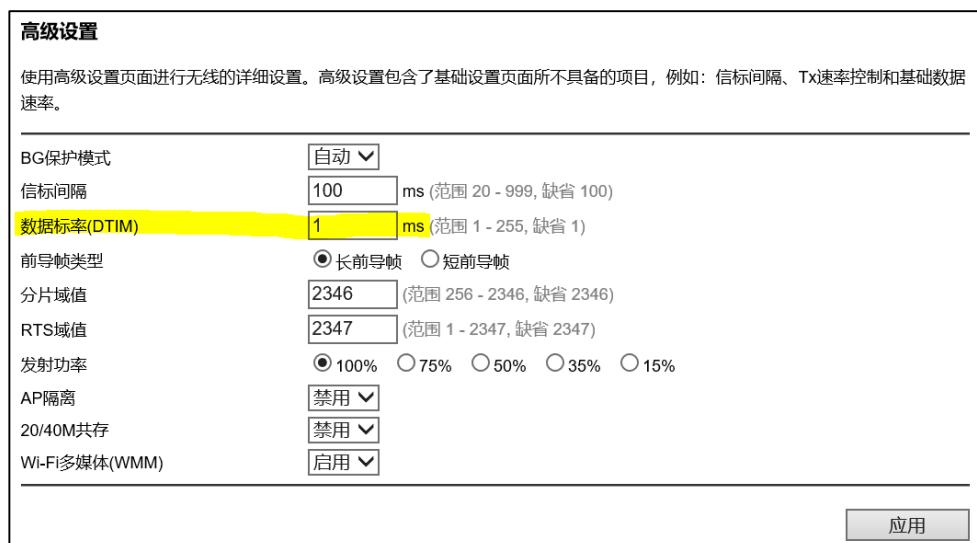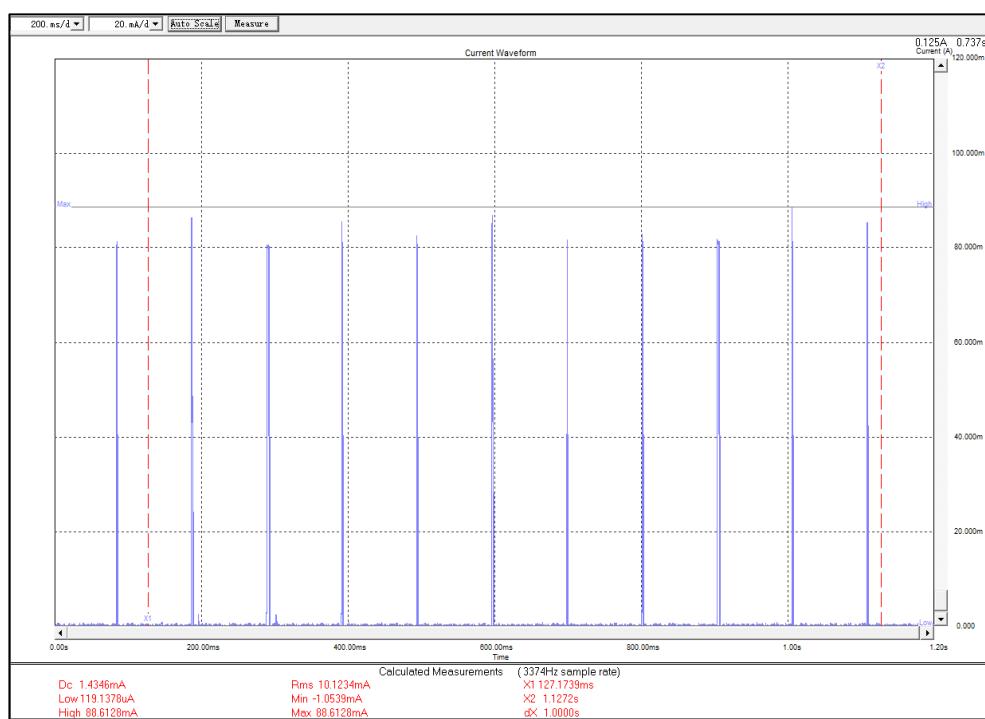
Figure 4-6. "DTIM= 1" power consumption

5. FAQ

1. Q: When the test is performed by entering the serial port command, no log is returned after the command is entered on the serial port tool.

   A: Try to turn off and on the serial port tool.
      Confirm the hardware configuration of DUT, and check whether the PIN (UART, NRST, PU, BOOT, 3V3, GND) are connected correctly.

2. Q: When the chip is initialized in the test tool, failure is displayed.
   A: Confirm whether the version of the firmware in DUT is correct. You may use Husky Tool to confirm whether the serial port communication is normal, and whether the commands such as input mode setting are valid.

6. Revision history

Table 6-1. Revision history

Revision No.	Description	Date
1.0	Initial release	Nov.01, 2023
1.1	Modify 2.3	Mar.01, 2024
1.2	Modify chapter 2	Jul.19, 2024
1.3	Modify Important Notice page content.	Mar.28, 2025

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