# E103-W14 Series User Manual

## WiFi+BLE5.2 low power WiFi serial port module

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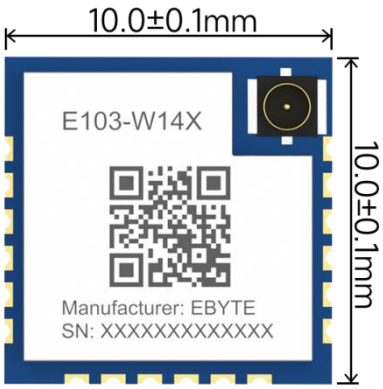
# 1 Overview

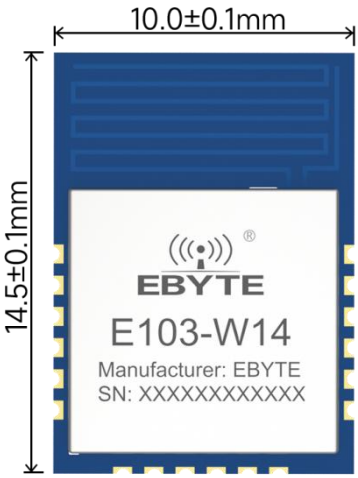
## 1.1 Introduction

The E103-W14 series is a low-power, cost-effective Wi-Fi & Bluetooth module developed by Chengdu Ebyte Electronics Co., Ltd. , which complies with Bluetooth 5.2 and IEEE 802.11b/g/n standard protocol. The module integrates the hardware and software resources required for complete Wi-Fi and Bluetooth applications, supports AP, STA, AP+STA 3 Wi-Fi working modes and low-power Bluetooth, and is very suitable for low-rate applications and data acquisition applications such as smart home and industrial control.

In terms of functions, the module supports IEEE802.11 b/g/n standards and Bluetooth BLE5.2 protocol . The module can work in STA and BLE slave modes at the same time , and supports multiple network transmission protocols such as TCP/UDP/HTTP/MQTT .




**E103-W14X**




**E103-W14**

## 1.2 Features

- Support IEEE802.11 /b/g/n standards and work in 2.4GHz frequency band;
- Support Bluetooth BLE5.2 protocol and operate in 2.4GHz frequency band;
- Support 3 working modes: AP, STA, and AP+STA;
- Support module STA and BLE slave to work simultaneously ;
- Support WPA2 WIFI security authentication method;
- Support multiple network communication protocols such as TCP/UDP/HTTP/MQTT;
- Support up to 6 socket connections;
- AP access point supports 3 -way STA device connection;
- Support SNTP network time acquisition (on the premise of Internet access);
- Support MQTT and MQTTS network protocols (Alibaba Cloud, Baidu Cloud, OneNet)
- Support HTTP Client;
- Support TCP SERVER/TCP CLIENT, UDP communication mode;

- Support AT command configuration;
- Support static IP address allocation and DHCP dynamic allocation;
- Support scanning nearby AP information;
- Support WIFI fast connection;
- Support automatic adjustment of Bluetooth packet length ;
- Support WiFi and Bluetooth slave mode switching;
- Maximum MTU is 244 bytes;

## 1.3 Application Scenario

-Medical and healthcare

- Multi-parameter patient monitor
- Electrocardiogram (ECG)
- Hospital electronic bed and bed control system
- Telemedicine system

- Building and home automation:

- HVAC systems and thermostats
- Video surveillance, video doorbells, and low-power cameras
- Building security systems and low-power electronic locks

- Smart appliances
- Smart Wear
- Asset tracking
- Factory Automation
- Grid infrastructure

# 2 Specifications

## 2.1 RF parameters

| RF parameters | unit | Model | | Remark |
|---|---|---|---|---|
| | | E103-W14X | E103-W14 | |
| WiFi Protocols | - | IEEE 802.11b/g/n | | |
| Bluetooth Protocol | - | BLE5.2 | | |
| Wi-Fi transfer rate | - | ● 802.11b: 1 Mbps, 2 Mbps, 5.5 Mbps, 11 Mbps<br>● 802.11g: 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps, 54 Mbps<br>● 802.11n: HT20 (MCS0~MCS7) | | |
| Antenna type | - | IPEX | PCB board antenna | Characteristic impedance is about 50 ohms |
| Reference distance | M | 500 | 200 | Antenna gain 5dBi, module |

| | | | | |
|---|---|---|---|---|
| | | | | communicates with device |
| Frequency band | GHz | 2.4 ( WiFi, Bluetooth ) | | Supports the global license-free ISM 2.4GHz frequency band |

## 2.2 Electrical parameters

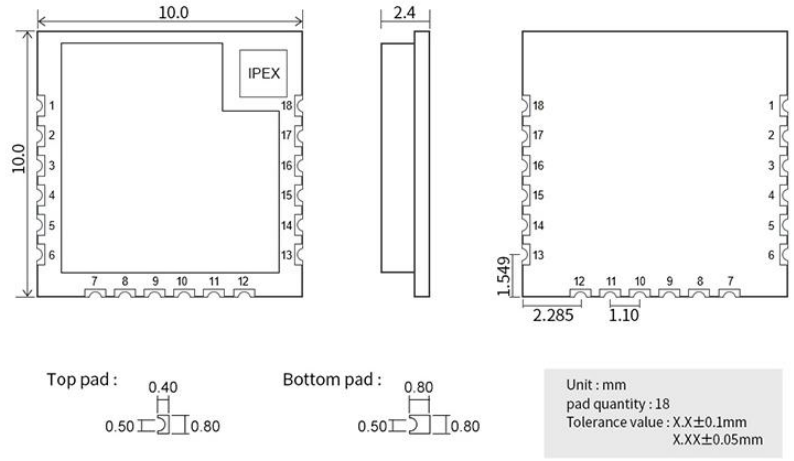
| RF parameters | | | unit | Model | | Remark |
|---|---|---|---|---|---|---|
| | | | | E103-W14X | E103-W14 | |
| Operating Voltage | | | V | 2. 7 -3.6V | | Over 3.6 V will permanently burn out the module |
| Communication level | | | V | 3.3 | | Using 5V TTL may burn out |
| Power consumption | Transmit power | | dBm | 18 | | |
| | Emission current | | mA | 200 | | |
| | Receiving current | | mA | 33 | | |
| | Sleep current | Sleep1 | uA | 3 | | In this mode, the clocks of the MCU and all digital peripherals are stopped, and the system has only a 32K clock. At this time, only some hardware modules are working, and only GPIO interrupts and AON counter interrupts can wake up the system to restore to normal voltage and continue running. |
| | | Sleep2 | uA | 0.5 | | In this mode, the system has only 32K clock, and only some hardware modules are working. Except for the AON module, other hardware modules are powered off. |
| Temperature | Operating temperature | | ℃ | -40～+85 | | Industrial Grade |
| | Storage temperature | | | -40～+ 95 | | |

## 2.3 Hardware Parameters

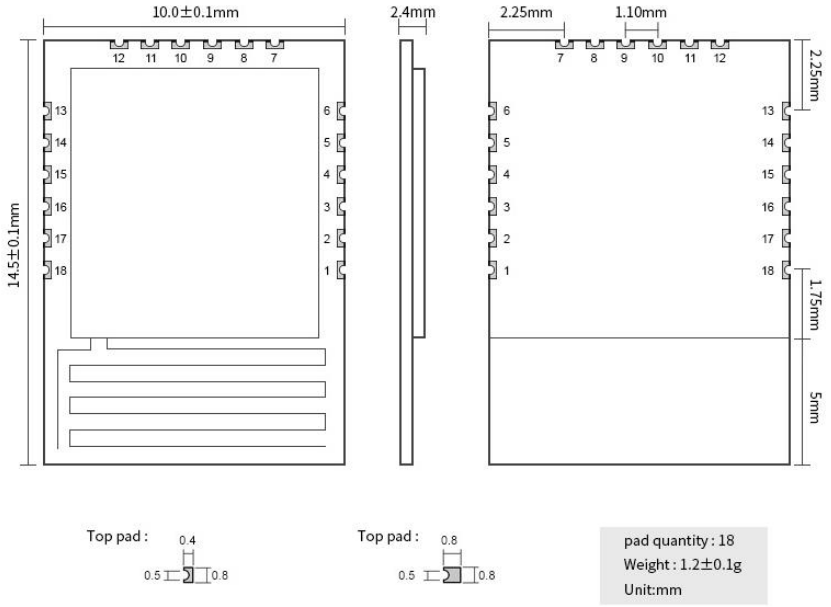
| Hardware Parameters | Model | | Remark |
|---|---|---|---|
| | E103-W14X | E103-W14 | |
| Flash | 2 MB | | |
| RAM | 256 KB | | |
| Frequency | 120MHz | | |
| Packaging | Patches | | |
| Size | 10*10mm | 14.5*10mm | The error size is ± 0.2 mm |
| Weight | 0.4±0.1g | 1.2±0.1g | The error is ±0.1g |

# 3 Mechanical dimensions and pin definition

## 3.1 E103-W14X Pin Diagram



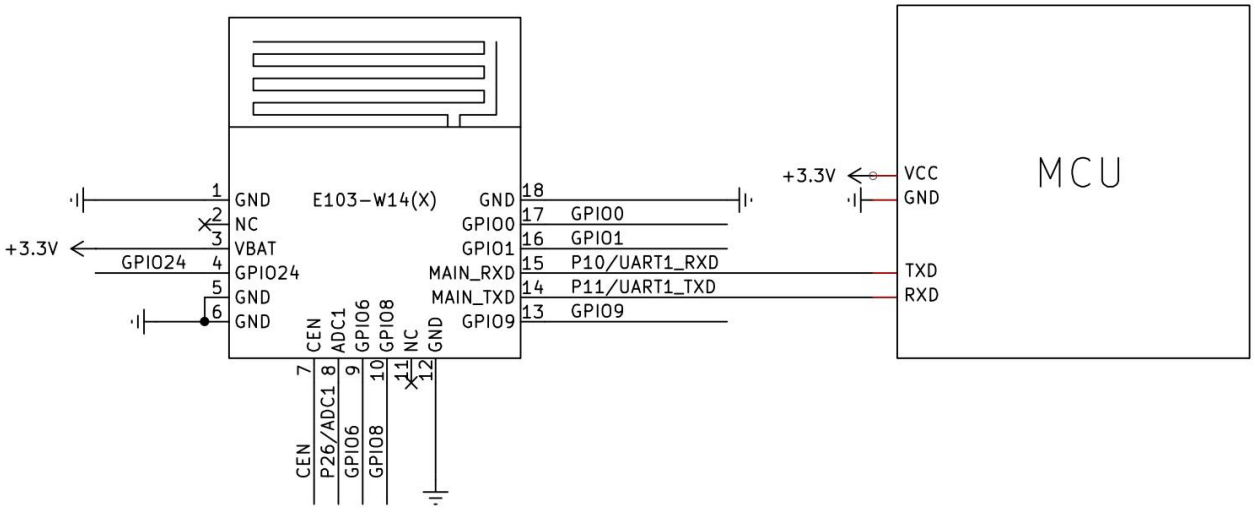

## 3.2 E103-W14 Pin Diagram



E103-W14&E103-W14X pin definition:

| Pin number | Pin Name | Pin Type | Pin Purpose |
|---|---|---|---|
| 1 | GND | - | Power Ground |
| 2 | NC | - | Empty feet |
| 3 | VBAT | - | VCC recommended 3.3v |
| 4 | GPIO24 | I/O | GPIO |
| 5 | GND | - | Power Ground |
| 6 | GND | - | Power Ground |
| 7 | CEN | - | The chip enable pin is valid at a high level (the module has an internal pull-up, and the customer can use this pin to implement the hardware reset pin function). |
| 8 | ADC1 | I | Analog input pin (no software function yet) |
| 9 | GPIO6 | I/O | GPIO |
| 10 | GPIO8 | I/O | GPIO |
| 11 | NC | - | Empty feet |
| 12 | GND | - | Power Ground |
| 13 | GPIO9 | I | Default SLEEP wake-up pin (rising edge or falling edge is valid, depending on the actual configuration of the customer) |
| 14 | TXD | O | Module serial port sending |
| 15 | RxD | I | Module serial port receiving |
| 16 | GPIO1 | I/O | GPIO |
| 17 | GPIO0 | I/O | GPIO |
| 18 | GND | - | GPIO |

# 4 Recommended connection diagram




Notice:

The power supply must be guaranteed to be between 2.7 V and 3.6 V. To ensure stable operation of the module, it is recommended to select an external LDO with a power supply capacity greater than 500 mA.

# 5 Function Description

This module can work in WiFi mode and ble mode through instructions. From the perspective of the WiFi layer, the module can work in AP, STA, STA+AP mode. From the perspective of the BLE layer, the module currently only supports the slave role. From the perspective of the network layer , the module supports TCP (server, client), TLS (server, client), UDP, HTTP, MQTT .

## 5.1 Working Mode

This section describes supported working mode.

## 5.2 Access Point (AP Mode)

Access Point is referred to as AP mode, which is similar to a router. It allows wireless devices to connect and establish server, client, and UDP communications based on TCP/IP. This mode supports connecting 3 stations and supports up to 6 TCP socket transmissions. Use the command AT+CWMSAP to configure the module to initialize AP.

## 5.3 Station (STA mode)

Station mode is referred to as STA. In this role, the module does not provide connection and can only connect to Access Point or router. This module supports TCP server, TCP client, UDP, and supports up to 6 sockets in the Station role. It also supports MQTT and HTTP client. The command AT+C WJAP enables the module to connect to AP as STA role.

## 5.4 SoftAP+STA mode

That is, it is in AP and STA mode at the same time. Use AT+CWSAP and AT+CWJAP commands to make the module work in SoftAP mode and STA mode at the same time. In this mode, it supports connecting to one AP at most and connecting to two STAs .

## 5.5 Internet function

This module supports TLS server TLS client TCP server, TCP client , UDP, MQTT, HTTP client and other functions. All network functions can be used at the same time, for example, you can open a TCP server and act as a TCP client to connect to other ones at the same time . ( **Note that in addition to the TLS function, since TLS will occupy a lot of resources, the TLS link can only be used alone** ) .

### 5.5.1TCP server

The module can initialize a TCP Server. In this mode, it can only connect to 5 SOCKETs at most. After the module initializes a server, the entire module shares 5 sockets in total. For example, after the server module connects to 5 clients, the server module can no longer connect to other server modules as a client. On the contrary, if the server module only connects to 4 clients, the module can still connect to a server as a client.

### 5.5.2TCP client

The module connects to other TCP servers. In single TCP client mode, up to 6 sockets can be connected .

### 5.5.3TLS Server

The module is initialized as a TLS server. In this mode, only one TLS encrypted socket can be connected. Supports TLS 1.2

### 5.5.4TLS Client

The module only supports tls single link. That is, if TLS Client mode is used, only one socket can be supported.

### 5.5.5UDP

You can use the udp mode of AT+CIPSTART to communicate with the remote UDP service that is listening. The module supports a maximum of 6 sockets. **( Note : This module does not support the UDP listening function.)**

### 5.5.6MQTT

In MQTT mode, the module supports IoT platforms such as Alibaba Cloud, Baidu Cloud, and OneNet. Simply enter the service parameters created on the platform into the module to start communication.

#### 5.5.6.1Ali Cloud

For network communication based on the Alibaba Cloud platform, you need to log in to Alibaba Cloud to obtain relevant parameters, mainly including product keys, device names, client IDs, and other information. For details, see Chapter 7 Alibaba Cloud Configuration Tutorial.

### 5.5.7 HTTP Client

When using this function, you only need to configure the corresponding server resource symbol URL and start a trigger request to obtain the server response resources. You do not need to worry about the complex HTTP protocol layer. For details, see the AT command manual

## 5.6 Low power consumption

This module has two low power modes
Low voltage sleep (AT+SLEEP=2) is a relatively power-saving sleep mode. In this mode, the clocks of the MCU and all digital peripherals are stopped, and the system has only 32K clocks; at this time, only some hardware modules are working, and only GPIO interrupts and AON counter interrupts can wake up the system to restore to normal voltage and continue to run .
Deep sleep (AT+SLEEP=1) is a relatively power-saving sleep mode. In this mode, the system has only 32K clocks, and only some hardware modules are working. Except for the AON module, other hardware modules have been powered off. When the GPIO interrupt or RTC timeout interrupt wake-up signal is triggered, the system exits the deep sleep state. ( **Note: Wake-up will reset the system.** )

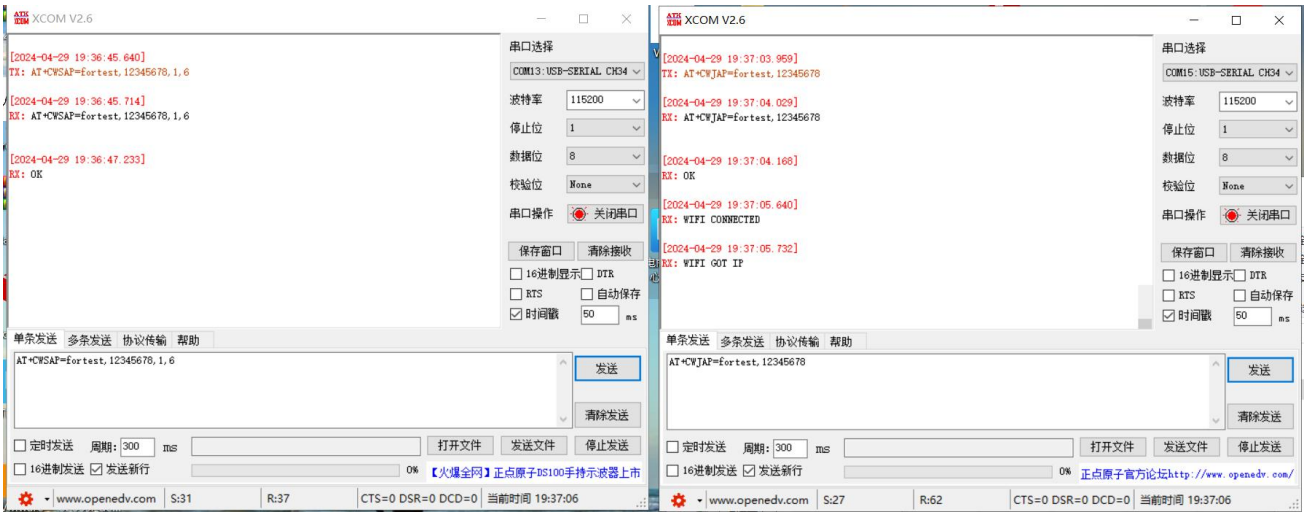
# 6 Tutorial

This module has many functions, and relevant parameters need to be configured before use so that it can work normally. In the following tutorials, the operations marked with * are required. Please set them according to your needs when using other modes.

## 6.1 Basic module WiFi connection

### 6.1.1WiFi connection between modules

This section mainly demonstrates the WiFi connection between modules
1） Module 1 uses AT+CWSAP=fortest,12345678,1,6 to enable the AP function of the module
2） After module 1 turns on AP, module 2 uses AT+CWJAP=fortest,12345678 to connect to module 1.
3） Module 2 returns OK, which means it has started to connect to AP, but the connection is not successful at this time. Wait for the module to return WIFI GOT IP, which means the connection is successful.
As shown in the figure below, the left side is module 1 and the right side is module 2.

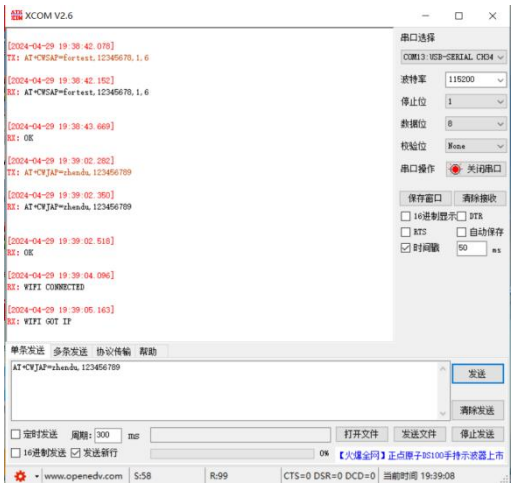



## 6.1.2The module works in both STA and AP modes

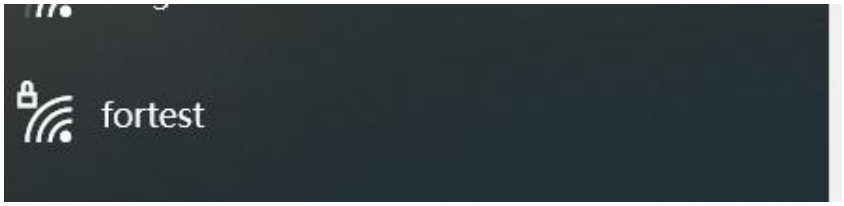
1） The module uses the command AT+CWSAP=fortest,12345678,1,6. Wait for the return OK.

2） The module uses the command AT+CWJAP=zhendu,123456789 ( **the AP information here should be replaced by the customer's own AP information** ). Connect to the AP generated by the router. Wait for the return of OK

3） Wait for the WIFI GOT IP to be returned, as shown in the figure




4） At the same time, you can use a computer or mobile phone to scan the AP generated by the module and connect to it.




## 6.2 Basic TCP/UDP data transmission

This section mainly demonstrates the module's TCP and UDP communications.

## 6.2.1TCP communication between modules

1) Module 1 AT+CWSAP=fortest,12345678,1,6 initialized as AP
2) Module 1 AT+CIPMUX=1 to open multiple links (if you want to open the server, you must first open multiple links)
3) Module 1 AT+CIPSERVER=1,4200 to start the server, listen to port 4200, and wait for the return of LISTENING to indicate successful start. At this point, the configuration of module 1 is complete
4) Module 2 AT+CWJAP=fortest,12345678. Connect module 1 WiFi
5) Wait for the return of WIFI GOIT IP
6) Module 2 AT+CIPSTART=TCP,192.168.100.1,4200 connects to the server of module 1
7) Wait for SOCKET CONNECTED:0 to return to indicate that the TCP connection is successful.
8) Both sides send data. Since module 1 is configured as multi-link, it needs to use AT+CIPSEND=<ID>,<LEN> to send data. Module 2 is not configured, so it uses AT+CIPSEND=<LEN> to send data, as shown below

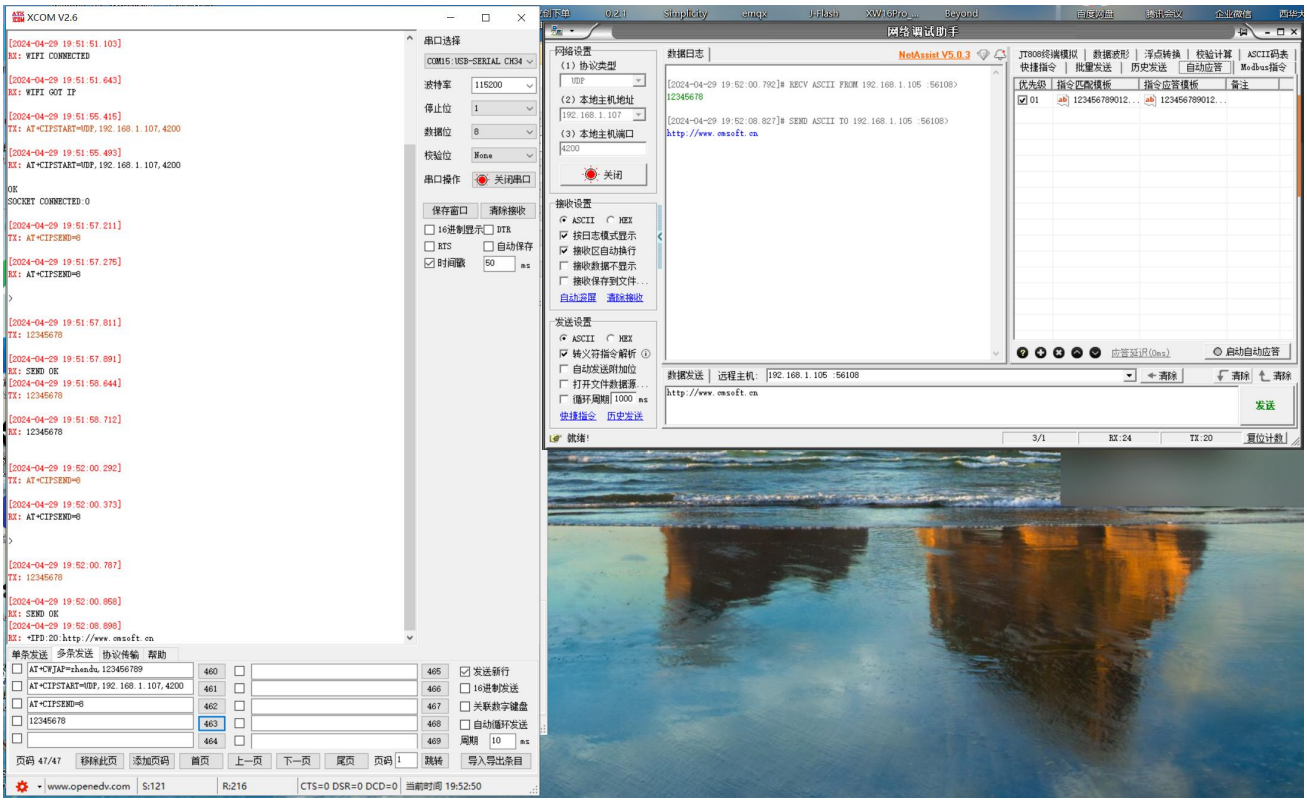

## 6.2.2 Module communicates with PC UDP (PC needs to enable monitoring)

1） The module and the computer are connected to the same WiFi, AT+CWJAP=zhendu,123456789 ( **the parameters here need to be replaced with the actual ones of the customer** )
2） Use the network debugging assistant tool on the PC and select UDP protocol to start monitoring
3） Module AT+CIPSTART=UDP,192.168.1.107,4200. Wait for the return of SOCKET CONNECT:0. At this time, the surface is created successfully
4） Use the command AT+CIPSEND=<LEN> to send data. If successful, it will return SEND OK
5） Since UDP is connectionless, the PC does not know the module's IP address, so the PC can only send data to the module after the module sends data to the PC. When the module receives the data, it will be displayed in the form of

+IPD:<LEN>,<DATA>. LEN indicates the data length, and DATA indicates the actual received data.

6） The whole process is shown in the figure below



## 6.2.3 TLS communication between modules

1） Module 1 AT+CWSAP=fortest,12345678,1,6 turns on the AP function.

2） Module 1 AT+CIPMUX =1 to enable multi-link ( this command must be used before enabling the server)

3） Module 1 AT+CIPSERVER=1,4200,TLS starts the tls server. Waiting for the return of LISTENING means that the TLS server is successfully started

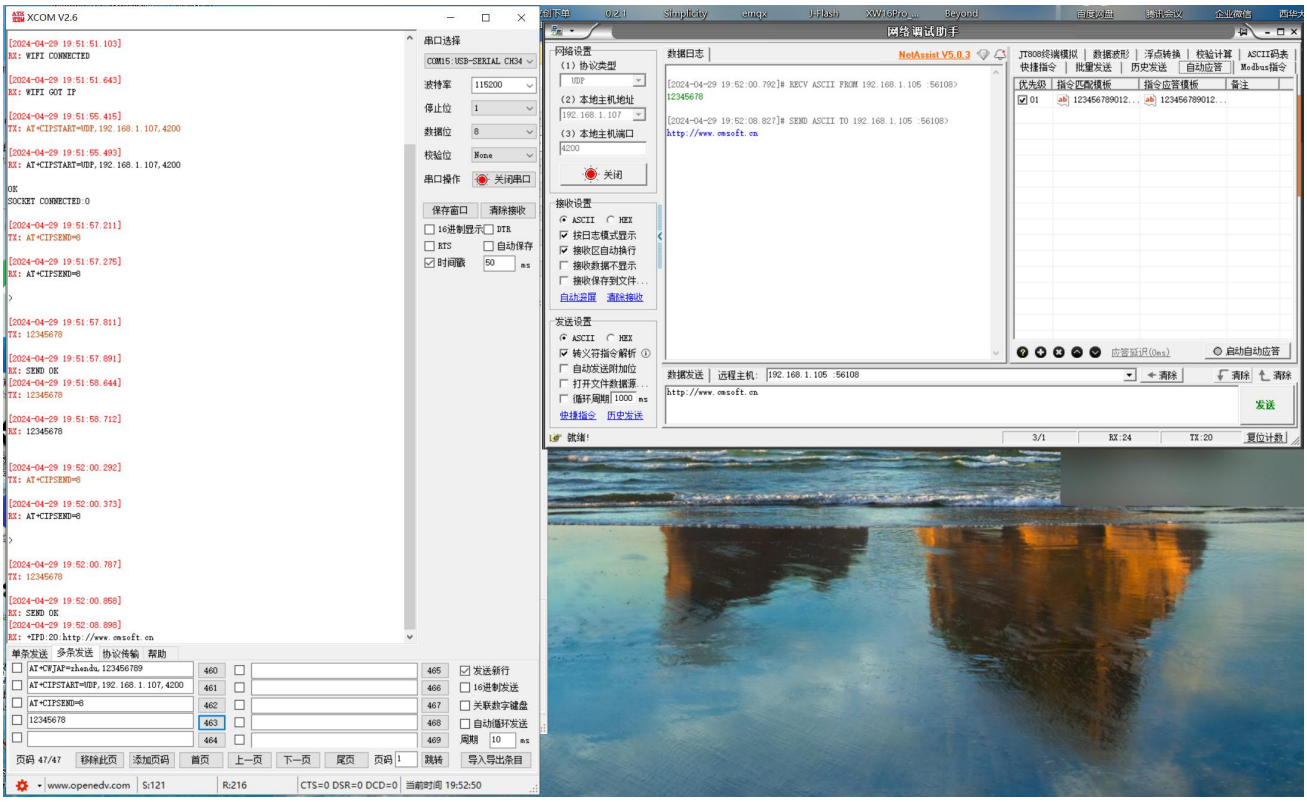
4） Module 2 AT+CWJAP= fortest,12345678 connects to the AP of module 1

5） Module 2 Waiting for WiFi GOT IP to be returned

6） Module 2 Use the command AT+CIPSTART=TLS,192.168.100.1,4200 and wait for the return SOCKET CONNECTED:0, which means the TLS connection is successful.

7） At this time, you can send data through the command AT+CIPSEND. For details, see the command manual.

8） The entire configuration process is shown in the figure below.




## 6.2.4 Transparent transmission description

1） The transparent transmission mode only supports a single connection, that is, only connection 0 is supported for data transparent transmission.

2） The server does not support transparent transmission.

3） The client can enter transparent transmission mode by using the AT+SAVETRANSLINK command, or by using AT+CIPMODE=1 after connecting, or by simply sending "AT+CIPSEND". After entering transparent transmission mode, all serial port data will be sent on socket link 0.

4） After entering the transparent transmission mode, you can exit the transparent transmission mode by sending +++. Note that unlike the command, which needs to end with a carriage return and line feed, when sending +++, you only need to send three characters +++.

# 6.3 HTTP Request

This section introduces how to make a simple HTTP request

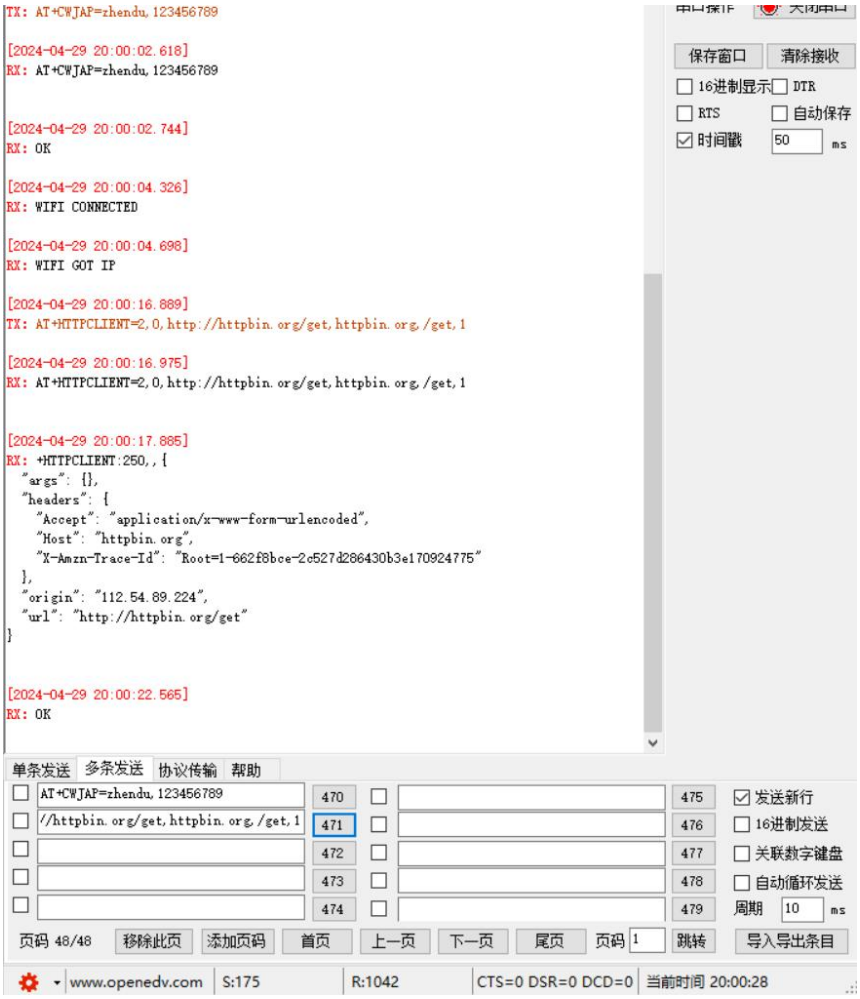
1） The module needs to connect to an AP that can access the Internet. AT+CWJAP=zhendu,123456789 (the WiFi information here needs to be replaced with the customer's actual information).

2） Waiting for the return of WIFI GOT IP

3） GET request (AT+HTTPCLIENT=2,http://httpbin.org/get,httpbin.org,/get,1) For command parameters, see the AT command manual. Note that the URL here must contain http:// or https://. Wait for OK to be returned. If there is data, the server's reply will be returned before OK is returned.

4） The process is shown in the figure below




## 6.4 MQTT

MQTT supports versions v3.1 and v3.1.1. Any cloud platform that supports these two versions of MQTT can be connected. This summary will use Alibaba Cloud as an example for demonstration.

### 6.4.1 Ali Cloud

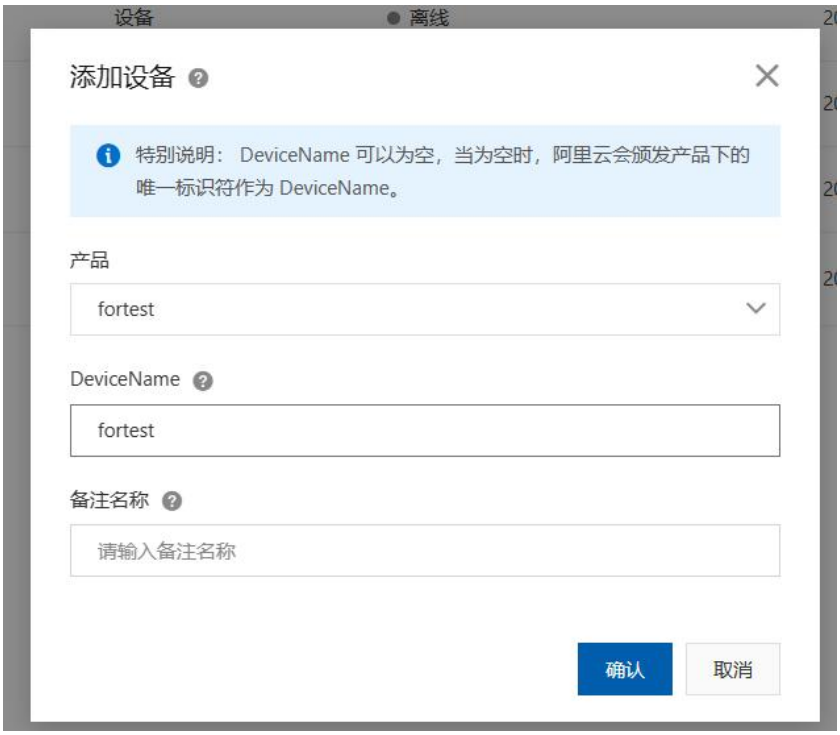
1） The module acts as a STA and is connected to a router that can access the external network.

2） Visit Alibaba Cloud IoT Platform, IoT Platform (aliyun.com) .

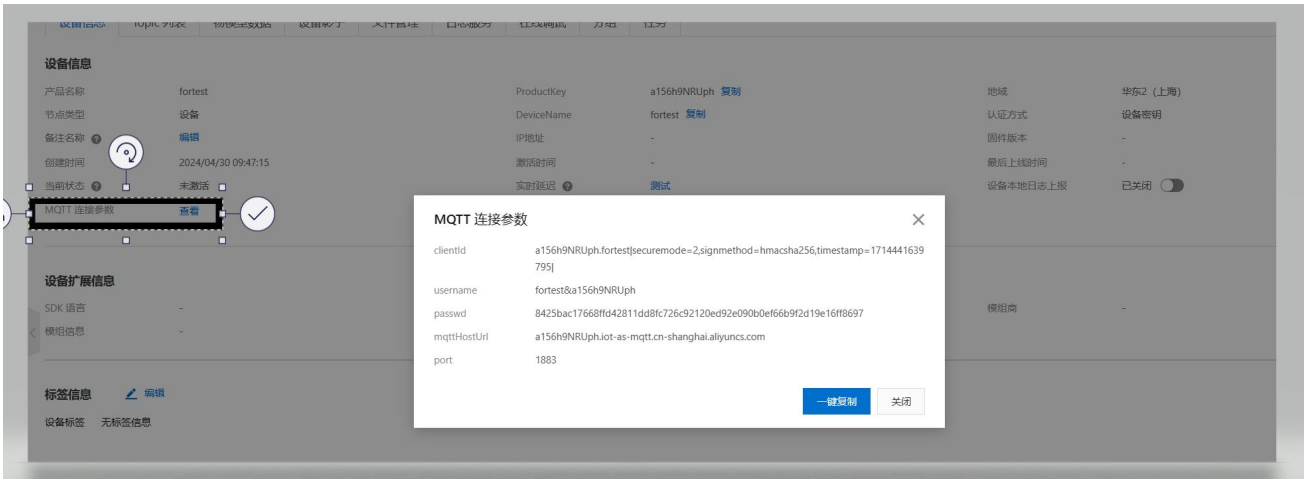
3） Click to enter the public example

4） Select "Product" on the left column and click Create Product


5） Select Device in the left column, click Add Device, and select the product you just created.




6） Click to view the information and get the necessary parameters for the connection (note that if there is a special character ',' in the parameter, please use a backslash to escape it. For example, if the parameter you want to enter is ", asd", you need to send "\, asd" when using the command.




7） Module sets user login information AT+MQTTUSERCFG=0,0,a156h9NRUph.fortest|securemode=2 \, signmethod=hmacsha256 \, timestamp=1714441911497|,fortest&a156h9NRUph,cc2a9489408d1b6c6843552e6c60a2409af224c2c4761badb0174c9d623cf5d2,0,0 ( **Note that the backslash marked in red is escaped** )

8） Set the connection parameters AT+MQTTCONNCFG=0,120,0,lwt,LWT,BYE,1,0

9） Initiate a connection AT+MQTTCONN=0, a156h9NRUph.iot-as-mqtt.cn-shanghai.aliyuncs.com,1883,0. Note that it may take a long time to wait after using this command

10） The module setting process is shown in the figure below


11） The device can also be seen online on Alibaba Cloud.


12） Note that Alibaba Cloud can only subscribe to physical models that it has designed.

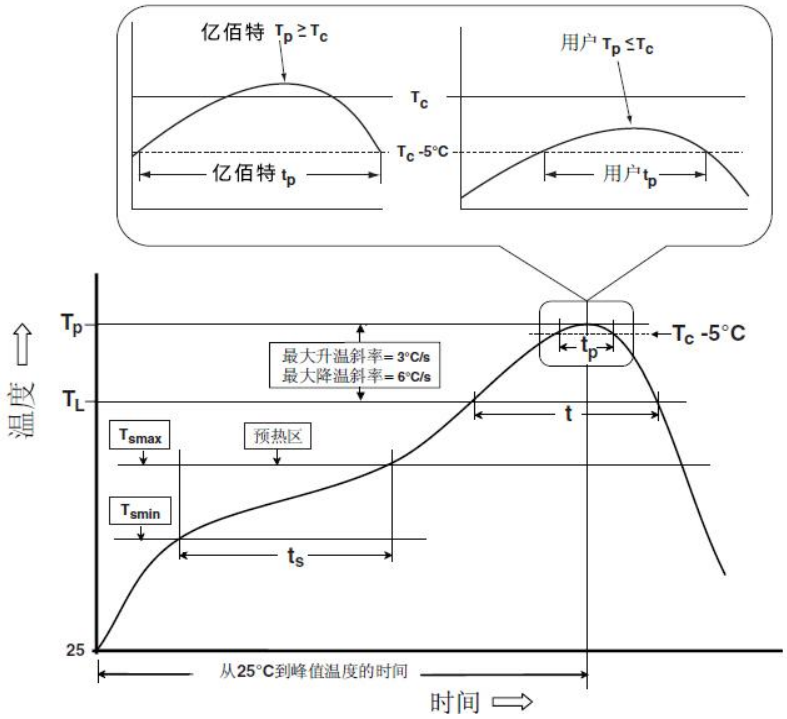
13） MQTT can only send data through commands (AT+MQTTPUB /AT+MQTTPUBRAW).

# 7 Welding work instructions

## 7.1 Reflow Temperature

| Reflow profile characteristics | | Leaded process assembly | Lead-free assembly |
|---|---|---|---|
| Preheating/keeping | Minimum temperature ( Tsmin ) | 100℃ | 150℃ |
| | Maximum temperature (T smax ) | 150℃ | 200℃ |
| | Time (T smin ~T smin ) | 60-120 seconds | 60-120 seconds |
| Heating slope (T L ~T p ) | | 3℃/sec, max. | 3℃/sec, max. |
| Liquidus temperature ( TL ) | | 183℃ | 217℃ |
| T L above the holding time | | 60~90 seconds | 60~90 seconds |
| Package peak temperature Tp | | Users must not exceed the temperature stated on the product's "Moisture Sensitivity" label. | Users must not exceed the temperature stated on the product's "Moisture Sensitivity" label. |
| p ) within 5°C of the specified classification temperature (Tc) is shown in the figure below. | | 20 seconds | 30 seconds |
| Cooling slope (Tp~T L ) | | 6℃/sec, max. | 6℃/sec, max. |
| Time from room temperature to peak temperature | | 6 minutes, longest | 8 minutes, longest |
| ※The peak temperature (Tp) tolerance of the temperature curve is defined as the upper limit of the user | | | |

## 7.2 Reflow Oven Curve




# 8 FAQ

## 8.1 The transmission distance is not ideal

- When there is a straight-line communication obstacle, the communication distance will be attenuated accordingly ;
- Temperature, humidity, and co-channel interference can increase the communication packet loss rate ;
- The ground absorbs and reflects radio waves, so the test results are poor when close to the ground ;
- Seawater has a strong ability to absorb radio waves, so the test effect at the seaside is poor ;
- If there are metal objects near the antenna, or the antenna is placed in a metal shell, the signal attenuation will be very serious ;
- The power register is set incorrectly, or the air rate is set too high (the higher the air rate, the closer the distance) ;
- The power supply voltage at room temperature is lower than the recommended value. The lower the voltage, the lower the power output .
- The antenna used does not match the module well or the antenna itself has quality issues.

## 8.2 Module is easily damaged

- Please check the power supply to ensure that it is within the recommended power supply voltage. If it exceeds the maximum value, the module will be permanently damaged .
- Please check the stability of the power supply. The voltage should not fluctuate greatly or frequently .

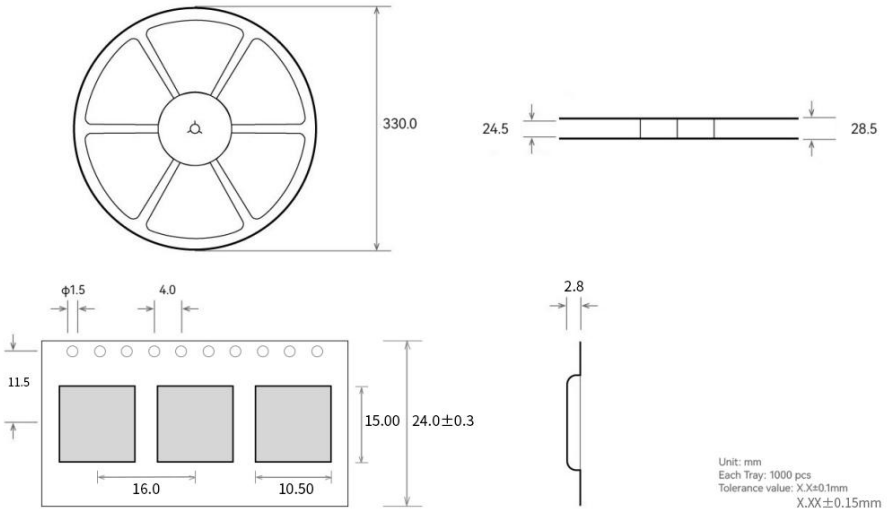
- Please ensure anti-static operation during installation and use, as high-frequency components are sensitive to static electricity ;
- Please ensure that the humidity is not too high during installation and use, as some components are humidity sensitive devices ;
- If there is no special requirement, it is not recommended to use it at too high or too low temperature.

## 8.3The bit error rate is too high

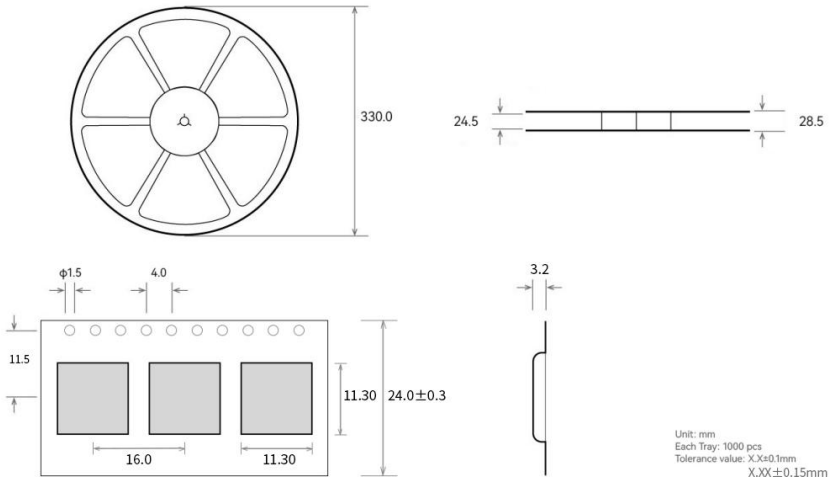
- There is interference from the same frequency signal nearby. Stay away from the interference source or change the frequency or channel to avoid interference.
- An unsatisfactory power supply may also cause garbled characters, so the reliability of the power supply must be ensured;
- Extension cables or feeder cables that are of poor quality or are too long can also cause a high bit error rate.

# 9 Bulk packaging method

## 9.1 E103-W14



## 9.2 E103-W14X




# 10 Revise history

| Version | Revision Date | Revision Notes | Maintenance man |
|---|---|---|---|
| 1.0 | 2023-10-31 | initial version | Hao |
| | | | |

# About us

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