

WiFi BLE Transparent Transmission Module

MS11SF1

Datasheet

V 1.1.0

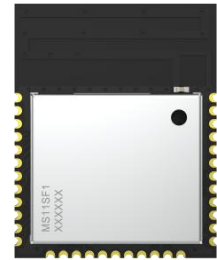
Applicable Product Model
MS11SF11

Version Note

Version	Details	Contributor(s)	Date	Notes
1.0.0	First edit	CoraL	2022.11.08	
1.1.0	Added SPI pin description	Vinle	2023.07.20	

MS11SF1-ESP32C3

Support 2.4G Wi-Fi4 (IEEE802.11 b/g/n) , support AP/STA/AP+STA Mode, Tiny size



MS11SF1 is a WIFI + BLE Soc combo module that supports WIFI 4 as well as BLE 5.0. This module supports Wi-Fi4 + BLE 5.0, equipped with RISC-V 32-bit single-core processor, the operating frequency up to 160MHz. MS11SF1 supports the use of AT commands to development, through the serial port to send AT commands to configure the Wi-Fi, BLE, to achieve the function of pass-through. BLE single packet can support up to 514 bytes to be sent, the chip wakes up BLE and BLE and WIFI start at the same time when the chip wakes up, WIFI is STA mode by default and BLE is broadcast mode.

■ Features

- Bluetooth 5.0
- Supports 2.4G Wi-Fi4 (IEEE802.11 b/g/n), backwards compatible
- Supports development using AT commands and ESP-IDF.
- Supports AP provisioning, SmartConfig provisioning, and BluFi provisioning

■ Application

- Smart Homes
- Consumer Electronics
- Intelligent wearable device
- Security Equipment
- Automotive Devices
- Smart Agriculture

■ Key parameter

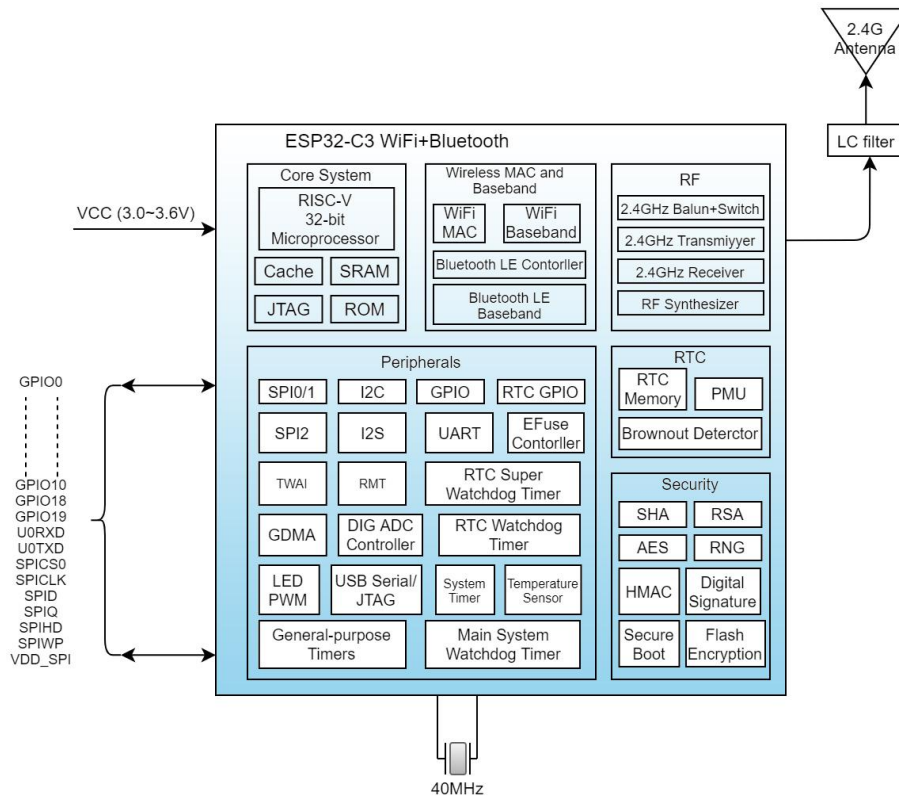
Chip Model	ESP32C3	Antenna	PCB/ ANT Pin
Module size	16.6×13.2×2.2mm	GPIO	22
Flash	4MB	RAM	400KB
Receiving Sensitivity	-97dBm	Transmission Power	BLE: -27 ~ +18dBm Wi-Fi: +10 ~ +20dBm
Current(TX)	278mA	Current(RX)	87mA
Firmware	AT Firmware		

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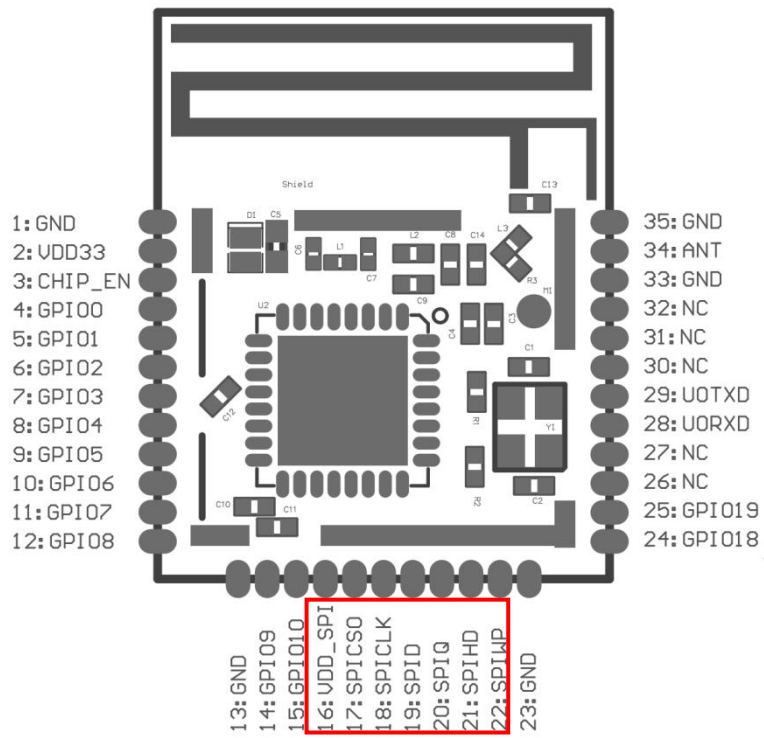
1 Block Diagram



2 Electrical Specification

Parameter	Values	Notes
Working Voltage	3.3V-3.6V	To ensure RF work, supply voltage suggest not lower than 3.3V
Power supply current	≥500mA	
Working Temperature	-40°C~+85°C	
BLE Broadcast Transmission Power	-27 ~ +18dBm	Configurable
WiFi RF Transmission Power	+10 ~ +20dBm	Configurable
Receiving Sensitivity	-97dBm	

3 Pin Description



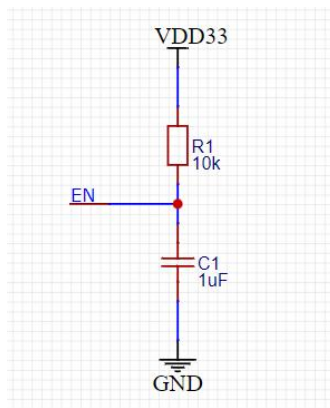
4 Pin Definition

Pin Number	Symbol	Type	Definition
1	GND	Grounded	
2	VDD33	Supply Power	
3	CHIP_EN	Sleep/Wake-up pin	High level: Chip operational Low level: Chip in sleep mode
4-8	GPIO0-GPIO4	IO	General-purpose IO (GPIO), firmware not utilized.
9	GPIO5	BLE CONN-IND	High level: Connected Low level: Not connected
10	GPIO6	Serial port RX	UART1
11	GPIO7	Serial port TX	UART1
12	GPIO8	IO	General-purpose IO (GPIO), firmware not utilized.
13	GND	Grounded	
14	GPIO9	IO	General-purpose IO (GPIO), firmware not utilized.
15	GPIO10	IO	General-purpose IO (GPIO), firmware not utilized.
16	VDD_SPI	Supply Power	VDD_SPI is typically used to provide power to the chip's built-in flash or external flash. It can only be used as GPIO11 when an external flash is connected and powered separately.
17-22	SPICS0-SPIWP	IO	General-purpose IO (GPIO) or SPI interface, firmware not utilized.
23	GND	Grounded	
24-25	GPIO18-GPIO19		General-purpose IO (GPIO) or built-in USB-to-JTAG interface.
26-27 30-32	NC	-	Not connected
28	U0RXD	RXD	Used for firmware debugging

29	U0TXD	TXD	Used for firmware debugging
34	ANT	RF	Antenna pin
35	GND	Grounded	

Notice:

1. The MS11SF1 has a total of 3 SPIs (SPI0, SPI1 and SPI2). SPI0 and SPI1 can be configured in SPI memory mode, and SPI2 can be configured in general SPI mode.
2. GPIO11-GPIO17 have been connected to the SPI Flash pins inside the module and are not recommended for other functions.
3. In order to ensure the regular power supply when the MS11SF1 module is used, an RC delay circuit needs to be added to the EN pin. The RC is usually recommended to be $R = 10\text{ k}\Omega$, $C = 1\text{ }\mu\text{F}$.



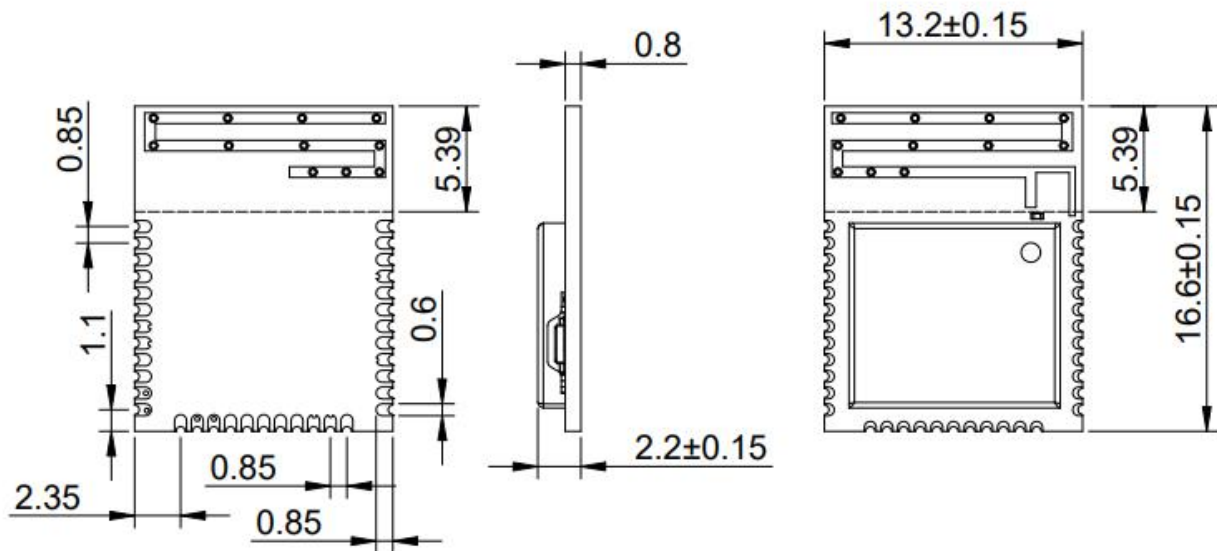
4.1 SPI data communication ports, as follows

MS11SF11	SPI	MCU-SPI
GPIO2	SPIQ/DO	MISO
GPIO6	SPICLK	SCLK
GPIO7	SPID/DI	MOSI
GPIO10	SPICS0	CS
GPIO3	HANDSHARE	HANDSHARE_EN

Notice:

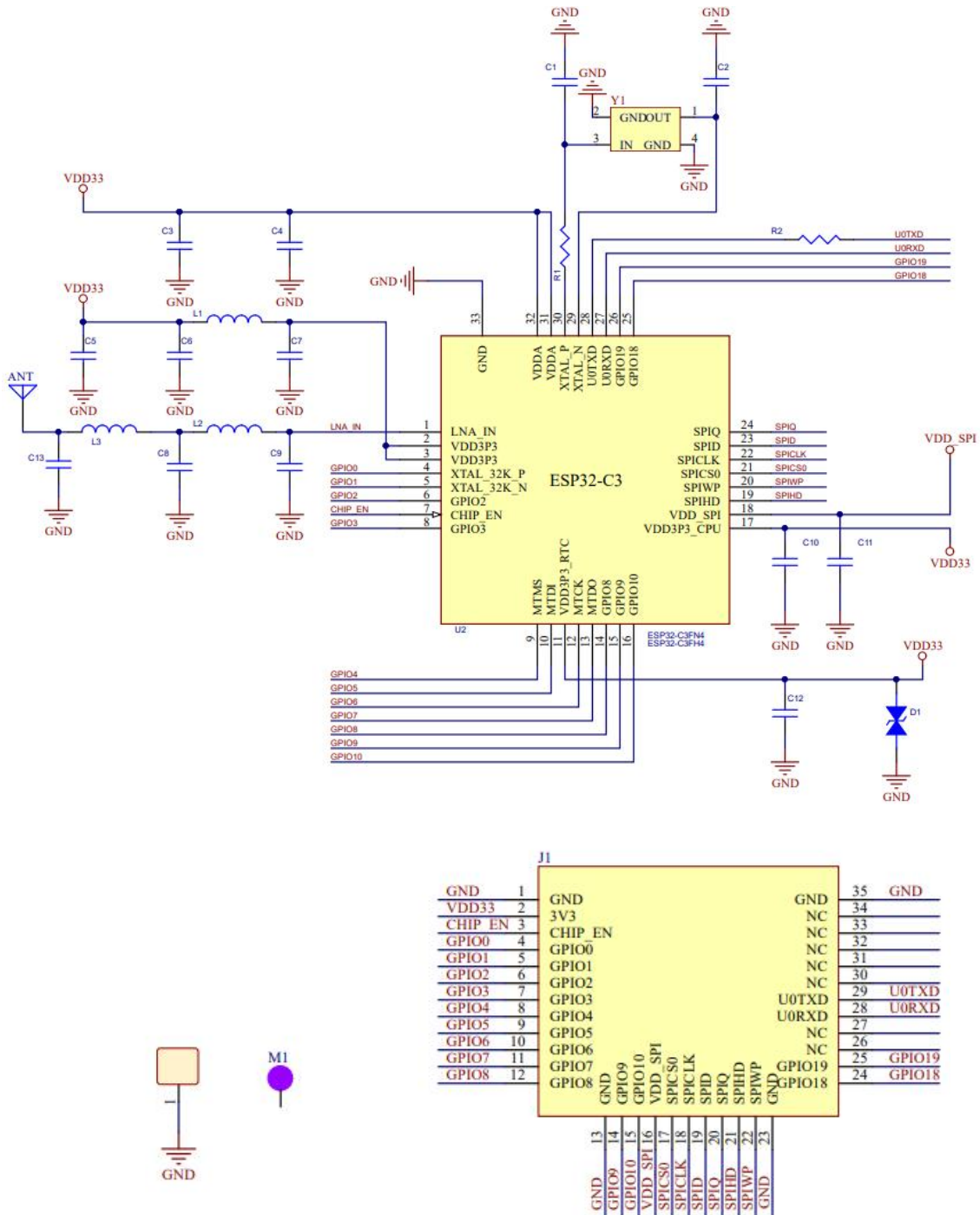
Where as the module pin-out diagram, SPI pins in the red box line, the above pins are not recommended for other functions. It is the data port connection between ESP32-C3 series chips and external flash chips.

5 Mechanical Drawing



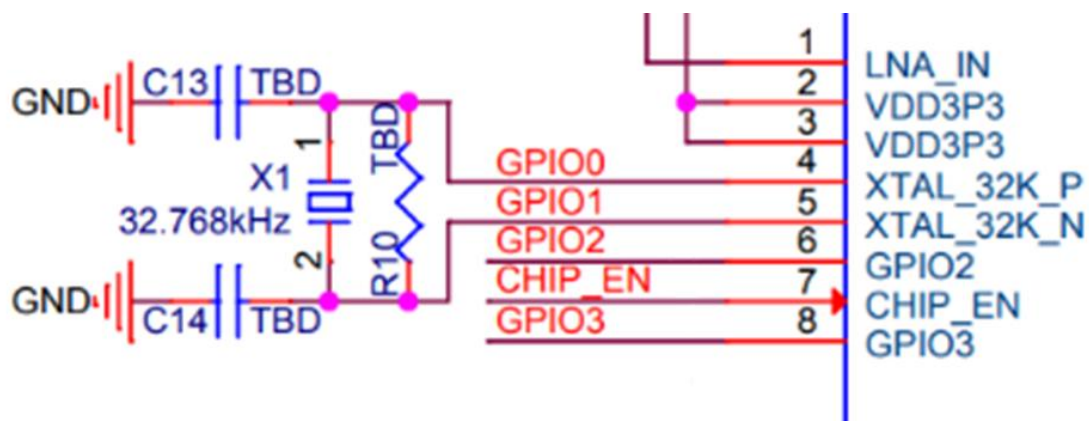
* (Default unit: mm Default tolerance: ±0.1)

6 Electrical Schematic



Notice: If you need to use an external antenna annoying please contact the salesman, need to internally modify the 0Ω resistor connection direction.

External RTC crystal oscillator circuit:



Notice:

- The 32.768kHz crystal oscillator selected requirements:
- -Equivalent Series Resistance(ESR)≤70kΩ
- -The load capacitance values at both ends are configured according to the specifications of the crystal oscillator
- Parallel resistor R10 is used for paranoid crystal oscillator, this resistor is usually NC.
- If can't the RTC CLK source, else Pin 4(XTAL_3K_P) and Pin5(XTAL_32K_N) can also be configured for GPIO port.

7 Transparent Transmission Function Description

This firmware includes BLE slave transponder, WIFI can be setted as AP or STA mode for data transfer. WIFI can be connected to a variety of cloud servers, such as Ali Cloud, Baidu Cloud, Amazon cloud, etc.. BLE and WiFi can be started at the same time, but when transmitting data, BLE has to exit instruction mode because of transmission through, and WIFI data transmission is through instruction control, so BLE and WiFi can not be carried out at the same time, data transmission.

In order to ensure the normal operation of the module, the module needs to provide a stable 3.3 V voltage, CHIP-EN pin pull up, the module will be awakened, into the BLE broadcast state and serial port will be opened. WIFI is not started, needs to be configured with instructions to start.

In the instruction mode, the basic parameters of the module, BLE parameter and WIFI parameter can be configured by AT instruction. See the MS11SF1-AT command set file for details.

7.1 BLE transparent transmission

The module ble defaults:

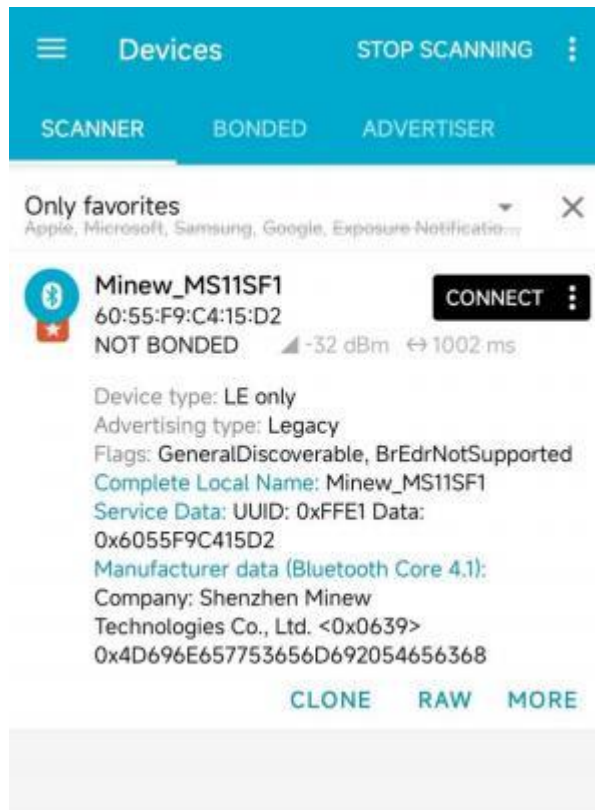
Broadcast name: Minew	broadcast time: 1s
Baud rate: 9600bps, 8N1	serial port parity bit: no parity
Connection interval: 20-40 ms	transmit power: 0 dbm
Service UUID: 0x0000FFF0-0000-1000-8000-00805F9B34FB	
Notify UUID: 0x0000FFF1-0000-1000-8000-00805F9B34FB	
Write UUID: 0x0000FFF2-0000-1000-8000-00805F9B34FB	
Custom broadcast data: Minewsemi Tech	

BLE broadcast, that is, instruction mode, all data sent through the serial port will be considered as an instruction; when connected, it will enter transmission mode

The transmitted serial port data is transmitted through the BLE CONN-IND pin to confirm whether the device is connected.

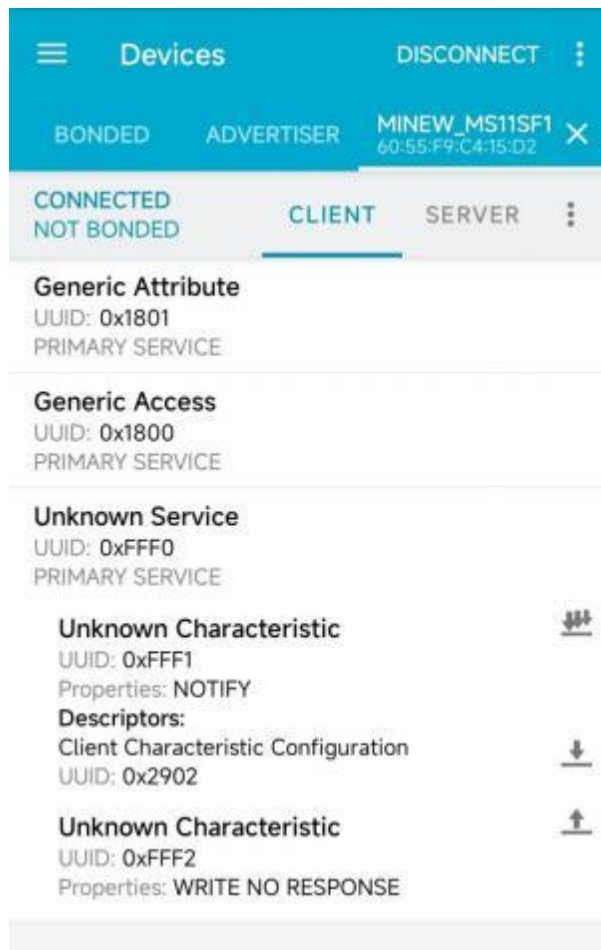
7.1.1 BLE instruction mode

After power-on correctly, the module will automatically turn on BLE broadcast, at this time all the data entered by the serial port are regarded as instructions. Instructions can be found in the Bluetooth Low Energy AT command set section of the MS11SF1-AT command set file, and can modify BLE's broadcast name, broadcast custom data, service UUID, broadcast interval, connection interval, and other parameters. If all parameters are set successfully, "OK R N" will be returned. If the setting fails, "Error r n" will be returned. Module Bluetooth broadcast, through the mobile app such as nrf connect (or Minew UART) scanning device, device default broadcast name is Minew_MS11SF1, broadcast data content as shown in the figure.

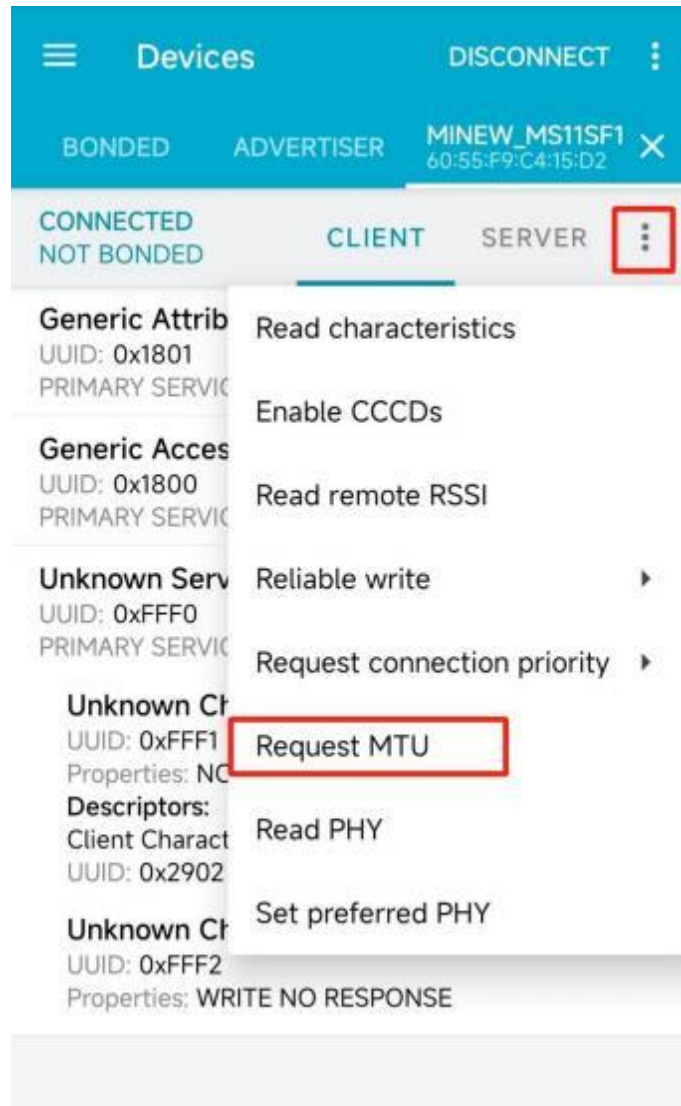


7.1.2 BLE transmission mode

When the device is connected by a host such as a mobile phone app, it will enter transmission mode, at this moment, all data entered by the serial port will be treated as Transparent transmission data, which is forwarded to the host via Bluetooth. The interface after the App connects is as shown, with both the default service UUID and the feature UUID is 16-bit, and the service UUID or feature UUID can be set to 128 bits by instruction in broadcast mode.



In addition, when the device is connected, the default MTU is 23 bytes, which means that a packet can only support sending up to 20 bytes. The maximum MTU supported by the device is 517 bytes, that is, a packet can send a maximum of 514 bytes. The MTU must be set after the APP is connected. Setting the MTU via NRF Connect is shown in the figure below.



7.2 WIFI transmission

WI-FI can be set to STA mode or Soft-AP mode, or you can use a combination of the two. In the default firmware, to reduce the power consumption of the command usage process, the radio frequency function of wi-fi is turned off, so before using WIFI normally, you need to enter the command AT + WIFI = 1 in command mode (A return key is required for line feed) , and then return OK, you can also use AT + NVS command to save WIFI's default RF state to FLASH. For more detailed WIFI instructions, refer to the WIFI command set section in the MS11SF1-AT command set file.

7.2.1 Soft-ap mode example

Soft-AP mode can be colloquially referred to as a base station, which other devices can connect to through the outgoing WIFI. Through a simple module as Soft-AP in UDP transmission UART WIFI transmission function example, to illustrate the basic usage of module AP mode. The sequence and response of serial port instruction are as follows:

① AT+WIFI=1

Return: OK

② AT+CWMODE=2

Return: OK

//turn on the RF function of WIFI

//set the WIFI Mode to Soft-AP mode

③ AT + CWSAP = "ESP32", "1234567890", 5,3 //set WIFI name and password in AP mode

Return: OK

The module establishes the UDP transmission of the fixed-end IP address and the port corresponding to the PC, and the remote IP address is 192.99. 168.4.2, the remote port is 8080, the local port is 2233, and the mode is 0.

④ AT+CIPSTART="UDP","192. 168.4.2",8080,2233,0

Return: Connect OK

⑤AT+CIPAP? //query module for IP Gateway Information

Return: + CIPAP: IP: "192.168.4.1"+ CIPAP: gateway: "192.168.4.1"

+CIPAP:netmask:"255.255.255.0"

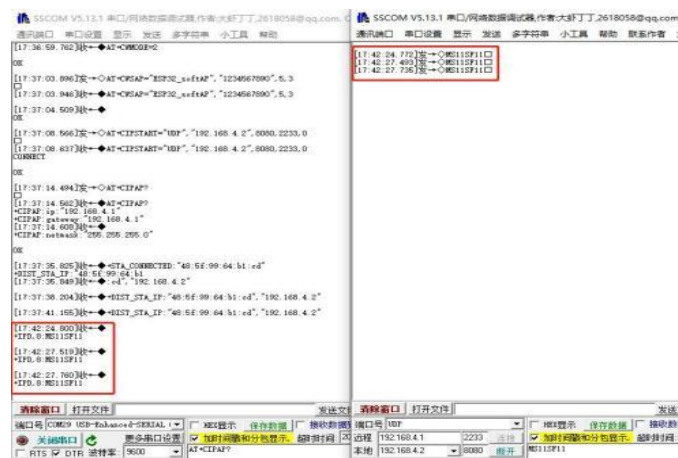
At this time the module has generated a WIFI named ESP32, now you can use the PC side to connect the AP, connect successfully, use the serial network data debugger, port selection UDP, create a UDP service transport. Local IP address, select 192.168.4.2, port written to 8080, remote IP address queried for 5 instruction gateway address 192.0.168.4.1, the port is ④ instructions to set the module port 2233, and finally click on the connection can be.



⑥AT+CIPMODE = 1 //entering UART WIFI transmit-receive mode

Return: OK

After entering the pass-through receiving mode, the PC can carry out WIFI transmission with the module, but only in one direction. Now the module is in command mode and can receive WIFI pass-through data sent from the PC.



⑦AT+CIPSEND//enter WIFI transmission mode to receive and send data

Return: OK

After the input of the instruction, you can achieve two-way through the function of the serial input of all data are through the data, if you want to exit the transmission mode, in the serial input + + + (no carriage return line wrap) can enter the normal instruction mode.

When you exit transmission mode with + + + , you are back to Passthrough receive mode, and the TCP connection is still valid. You can resume the Pass-through transmission mode by using the AT + CIPSEND command. Exit UART WIFI Passthrough receive mode using the command: AT + CIPMODE = 0 and close TCP connection command: AT + CIPCLOSE.

7.2.2 STA mode example

STA mode, is a module that can connect to hot spots from a router or mobile phone. Through example: a simple module as a TCP client in STA mode to achieve UART WIFI transmission function, to illustrate the basic use of STA mode module. The sequence and response of serial port instruction are as follows:

① AT+WIFI=1 //Enable the RF function of WIFI

Return: OK

② AT+CWMODE=1 //Set WIFI Mode to STA mode

Return: OK

③AT+CWJAP="MS11SF1", "1234567890" //name and password to connect to other device hotspots.

Return: WIFI CONNECTED Wifi GOT IP OK

The SSID and password you entered may be different from the above command. Please use your device SSID and password.

④AT + CIPSTA? //query the IP address of the device

Return: + CIPSTA: IP: "172.16.1.193"

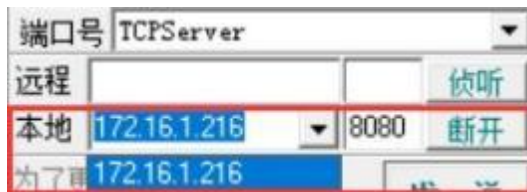
+CIPSTA:gateway:"172.16.0.1"

+CIPSTA:netmask:"255.255.254.0"

OK

Your query results may differ from the above returns

Then connect to the same hotspot as the device on the PC, use the serial port network data debugger on the PC, create a TCP server, select the local IP address 172.16.1.216, port 8080, and listen.



As a client, the module is connected to the TCP server through TCP. The IP address of the server is the local IP address 172.16.1.216 set by the debugger above, and the port is 8080. It can be connected through instructions.

⑤ AT+CIPSTART="TCP","172. 16. 1.216",8080

Return: Connect OK

⑥AT+CIPMODE=1//enter UART WIFI transmit and receive mode

Return: OK

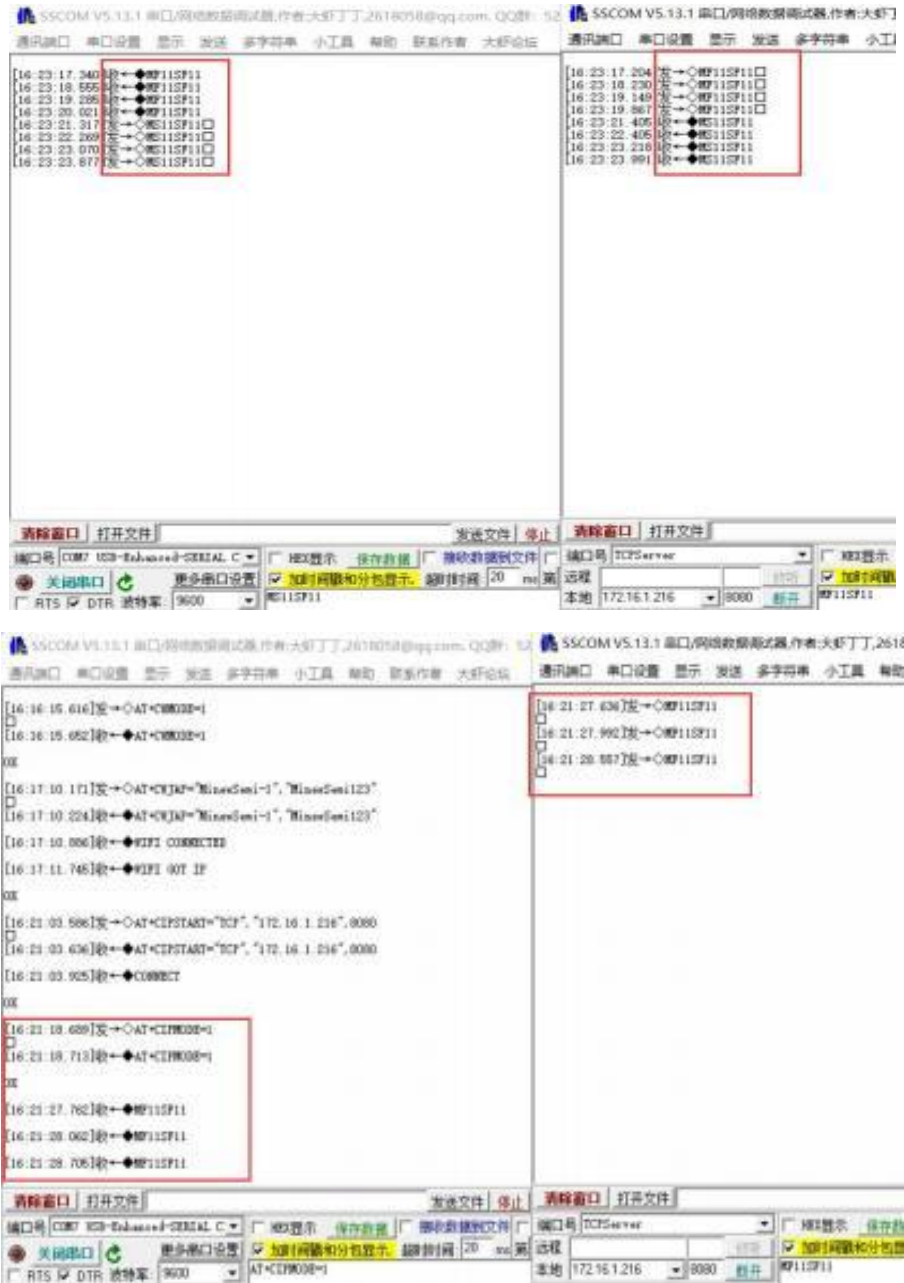
At this time the module will enter the transmission and instruction mode, can be carried out at the same time the instruction output and TCP server data reception.

⑦ AT+CIPSEND

Back to: OK >

After the input of the instruction, you can achieve two-way transmission function, all data input serial data are transmission data, if you want to exit, the transmission state, enter + + + (no carry out return) on the serial port to enter the normal instruction mode.

When you exit Passthrough mode with + + + , you are back to Pass-through receive mode, and the TCP connection is still valid. You can resume the Pass-through transmission mode by using the AT + CIPSEND command. To exit UART WIFI transmit Receive mode, use the command: AT + CIPMODE = 0, Close the TCP connection command: AT + CIPCLOSE.



7.2.3 Soft-ap + STA mixed mode example

Soft-AP + STA is a hybrid mode that allows modules to be connected to other devices and hot spots on other devices at the same time, but it does not support WIFI penetration on both devices at the same time, can achieve different connections at different times, the client or server to complete the function of transmission. To illustrate this pattern briefly with a basic hybrid example, the sequence and response of the serial instructions are as follows:

① AT+WIFI=1 //turn on the RF function of WIFI

Return: OK

② AT+CWMODE=3 //Set WIFI Mode to mixed mode

Return: OK

③ AT+CWSAP="ESP32", "1234567890", 5,3//set WIFI name and password in AP mode

Return: OK

④ AT+CWJAP="MS11SF1", "1234567890"//name and password to connect to other device hotspots

Return: WIFI CONNECTED Wifi GOT IP OK

```
[16:59:30.237]发->◇AT+CWMODE=3
□
[16:59:30.256]收<-◆AT+CWMODE=3
OK
[16:59:51.446]发->◇AT+CWSAP="ESP32_softAP", "1234567890", 5, 3
□
[16:59:51.495]收<-◆AT+CWSAP="ESP32_softAP", "1234567890", 5, 3
[16:59:52.062]收<-◆
OK
[17:00:37.546]发->◇AT+CWJAP="MinewSemi-1", "MinewSemi123"
□
[17:00:37.592]收<-◆AT+CWJAP="MinewSemi-1", "MinewSemi123"
[17:00:37.755]收<-◆WIFI CONNECTED
[17:00:38.299]收<-◆WIFI GOT IP
OK
[17:00:54.352]收<-◆+STA_CONNECTED:"26:92:6d:2d:ad:ea"
[17:00:54.575]收<-◆+DIST_STA_IP:"26:92:6d:2d:ad:ea", "192.168.4.2"
```

After completing the above instructions, the WIFI of the module is turned on and can be connected to other devices, and the WIFI hotspots of other devices are also connected, you can use the single-mode pass-through example above to create a connection to pass-through without doing so in this section. However, it should be noted that, for example, if you are doing a TCP client pass-through, you can not do any other pass-through AT the same time. You need to disconnect the TCP connection in instruction mode, which is AT + CIPCLOSE, it can turn off TCP/UDP/SSL single-or multiple-connection mode. For more detailed examples of TCP-IP, refer to the MS11SF1-AT Command set file for instructions, Examples, and AT command sets.

7.2.4 Connect the cloud server to the MQTT

MS11SF1 can communicate with cloud servers such as Ali Cloud, Baidu Cloud, Tencent Cloud, Amazon Cloud, etc. .Specific communication steps include related cloud connection documents, MQTT communication between MS11SF1 and PC client, Android client and IOS client, refer to the testing documents of MQTT communication between clients and modules, please contact us to provide.

8 Power Consumption Description

8.1 RF power consumption

The following power consumption figures are based on 3.3 V power supply, 25°C ambient temperature, and test results done at the RF interface.

Operating mode		Operating status	Peak value (mA)	Average value (mA)
RF Mode	TX	TX-802.11b, 1Mbps, @21dBm	371.18	354.53
		TX-802.11g,54Mbps, @19dBm	289.38	263.59
		TX-802.11n,HT20-MCS7, @18.5dBm	273.81	251.22
		TX-802.11n,HT40-MCS7, @18.5dBm	249	220.4
	RX	RX-802.11n,HT20-MCS7	95.38	83.88
		RX-802.11n,HT40-MCS7	102.87	86.36

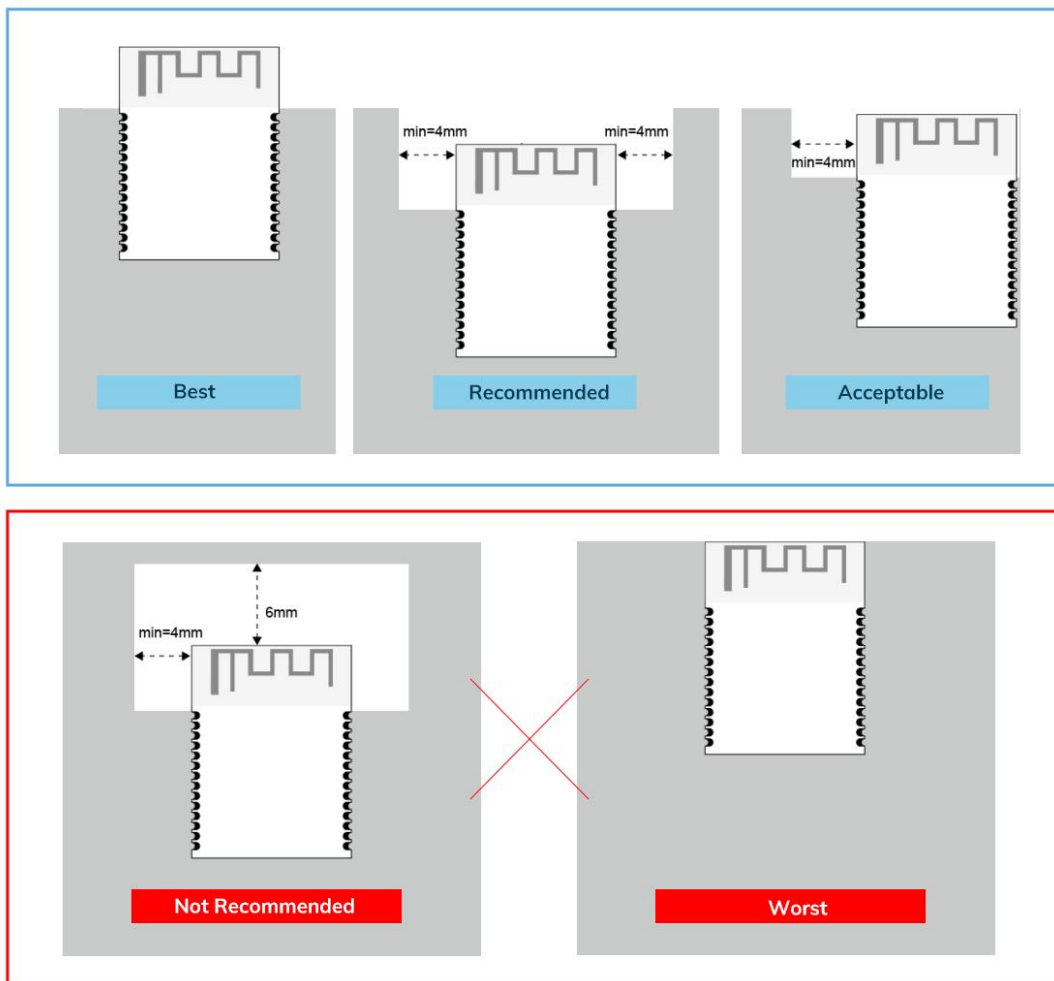
8.2 Power management

Operating mode	Operating status	Average value
Modem-sleep (Support)	CPU is powered on and clock frequency configurable; Wi-Fi, BLE baseband and RF off; Wi-Fi or BLE to stay connected.	25.04mA
Light-sleep	CPU is powered off; Host, MAC, RTC timer, external interrupt can wake up the chip; Wi-Fi or BLE to stay connected.	153µA
Deep-sleep	The RTC memory is in working state; The RTC memory is in working state; The RTC clock timer or RTC GPIO can wake up the chip.	5.74µA
Power off (Support)	The CHIP_EN pin is pulled low and the chip is turned off	0.31µA

9 PCB Layout

Module antenna area couldn't have GND plane or metal cross line, couldn't place components nearby. It is better to make hollow out or clearance treatment or place it on the edge of PCB board.

Notice: Refer to examples as below, and highly suggest to use the first design and the adjustment of modules antenna design according to the first wiring.



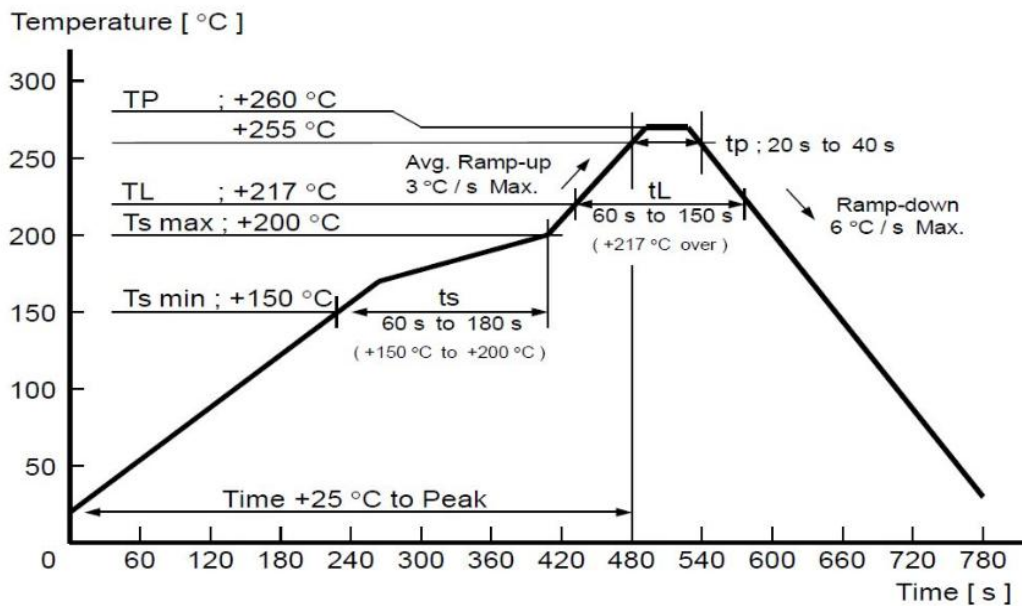
Layout notes:

- 1) Preferred Module antenna area completely clearance and not be prevented by metals, otherwise it will influence antenna's effect (as above DWG. indication).
- 2) Cover the external part of module antenna area with copper as far as possible to reduce the main board's signal cable and other disturbing.
- 3) It is preferred to have a clearance area of 4 square meter or more area around the module antenna (including the shell) to reduce the influence to antenna.
- 4) Device should be grounded well to reduce the parasitic inductance.
- 5) Do not cover copper under module's antenna in order to avoid affect signal radiation or lead to transmission distance affected.
- 6) Antenna should keep far from other circuits to prevent radiation efficiency reduction or affects the normal operation of other lines.
- 7) Module should be placed on edge of circuit board and keep a distance away from other circuits.
- 8) Suggesting to use magnetic beads to insulate module's access power supply.

10 Reflow and Soldering

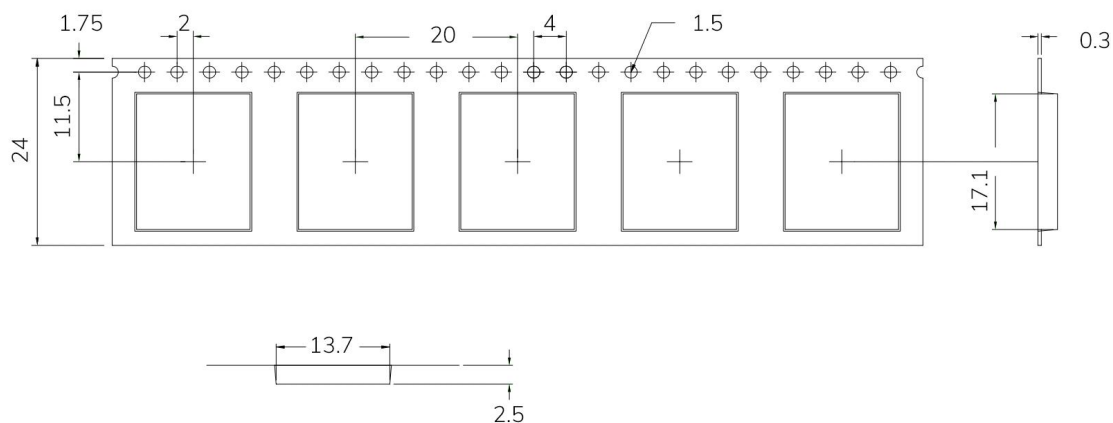
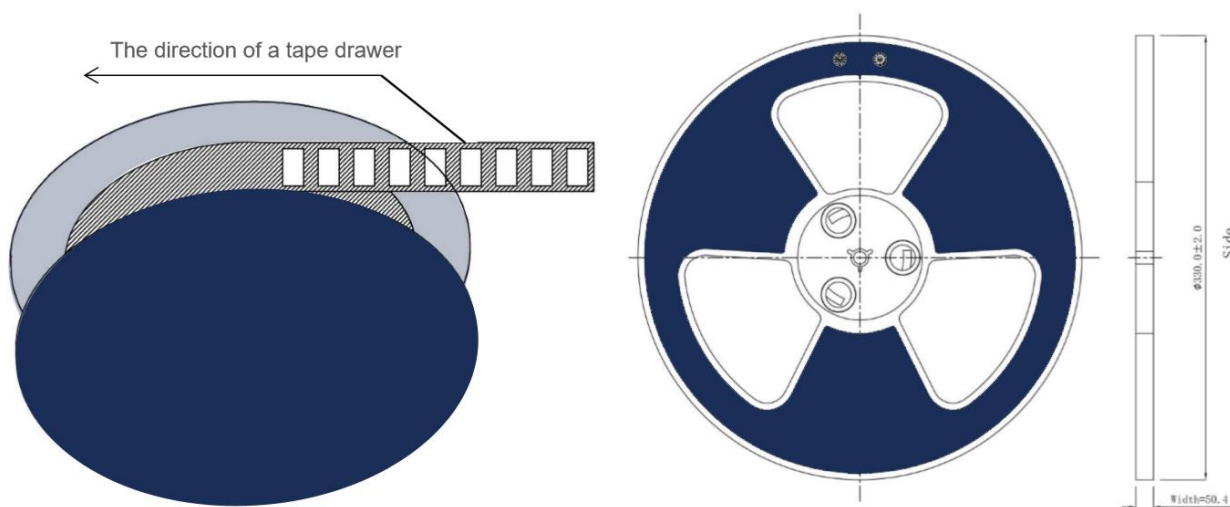
1) Do SMT according to above reflow oven temperature deal curve. Max. Temperature is 260°C;

Refer to IPC/JEDEC standard; Peak TEMP<260°C; Times: ≤2 times, suggest only do once reflow soldering on module surface in case of SMT double pad involved. Contact us if special crafts involved.



- 2) Suggesting to make 0.2mm thickness of module SMT for partial ladder steel mesh, then make the opening extend 0.8mm
- 3) After unsealing, it cannot be used up at one time, should be vacuumed for storage, couldn't be exposed in the air for long time. Please avoid getting damp and soldering-pan oxidizing. If there are 7 to 30 days interval before using online SMT, suggest to bake at 65-70 °C for 24 hours without disassembling the tape.
- 4) Before using SMT, please adopt ESD protection measure.

11 Package Information



* (Default unit: mm Default tolerance: ± 0.1)

Packing detail	Specification	Net weight	Gross weight	Dimension
Quantity	850PCS	680g	1150g	W=44mm, T=0.35mm

*** Note:** Default weight tolerance all are within 10g (except the special notes)

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Every product undergoes stringent testing, including transmit power, sensitivity, power consumption, stability, and aging tests. Our fully automated module production line is now in full operation, boasting a production capacity in the millions, capable of meeting high-volume production demands.

● Contact Us

Shenzhen Minewsemi Co., Ltd. is committed to swiftly delivering top-quality connectivity modules to our customers. For assistance and support, please feel free to contact our relevant personnel, or contact us as follows:

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