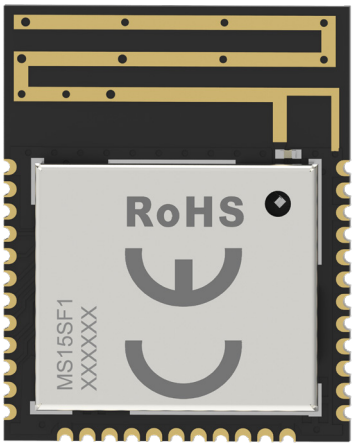
MINEWSEMI

WiFi Command Module
MS15SF1



Datasheet

V 1.0.0

Version Note

Version	Details	Contributor(s)	Date	Notes
1.0.0	First edit	Vincle, Leo	2024.09.06	

Part Number

Model	Hardware Code
MS15SF11	1N32AI

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https://en.minewsemi.com/file/MS15SF1-ESP32C6_Datasheet_M_EN.pdf

MS15SF1-ESP32C6

Multi-protocol, cost-effective, low-power, Wi-Fi 6 + BLE 5.3 module with full development resource support

MS15SF1 is a multi-protocol, high-performance, cost-effective wireless Wi-Fi 6+BLE 5.3 combo module based on ESP32-C6 SoC. The RISC-V single-core runs at a frequency of 160 MHz, with 320KB+4MB Flash program space, 512KB+16KB RAM, integrated 2.4 GHz transceiver, LNA, and other powerful resources for 2.4GHz WiFi/BLE connections. It is compatible with the MS11SF11 module and can withstand up to 80M voltages in actual high-interference conditions.

FEATURES

- Support 2.4G WiFi6 (802.11b/g/n ax) + BLE5.3, Zigbee and Thread (802.15.4) multi-protocols
- Support AP, STA, AP+STA Mode
- Support AT, ESP-IDF development
- Support IEEE 802.15.4-2015 protocol
- Support SDIO, I2S, UART and other interfaces
- Support OTA encryption upgrade

KEY PARAMETER

MS15SF1			
Chip Model	ESP32-C6FH4	**Antenna**	PCB
Module size	16.6x13.2x2.2mm	**GPIO**	22
Flash	4MB + 320KB	**RAM**	512KB+16KB
Receiving Sensitivity	BLE: -106dBm WiFi: -99.2dBm	**Transmission Power**	BLE: -34 ~ +21dBm WiFi: -24 ~ + 20dBm
Current(TX)	382mA	**Current(RX)**	82mA

APPLICATION

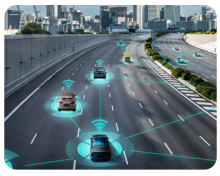
Smart Buildings

Consumer Electronics

Smart Healthcare

Security Equipment

Service Robot



Automotive Devices

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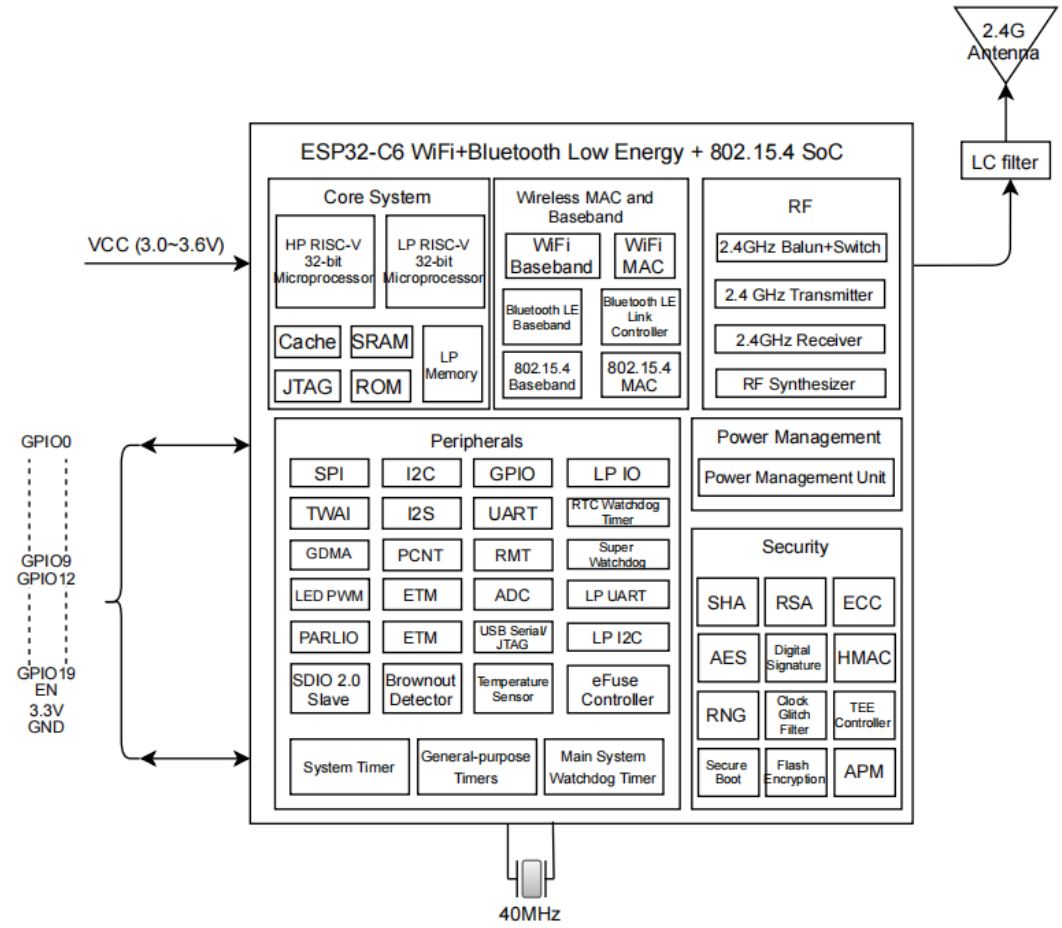
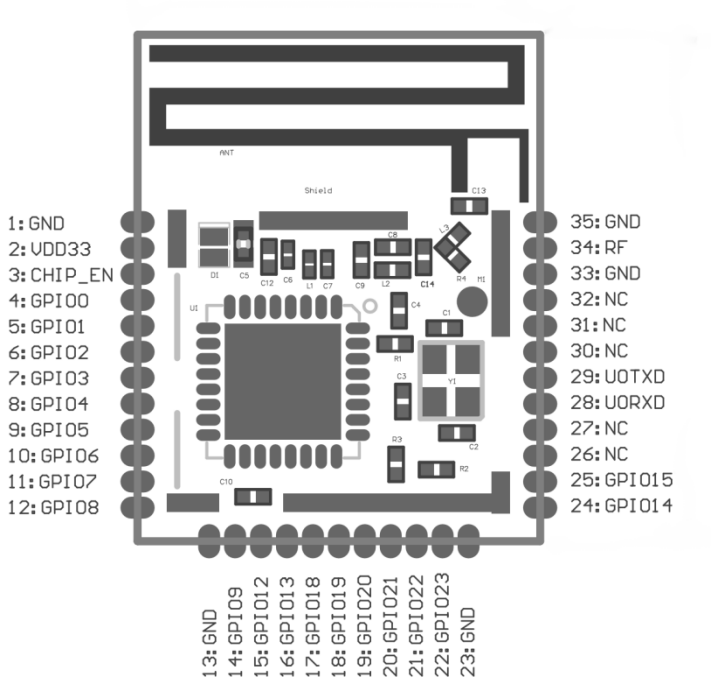
1 BLOCK DIAGRAM



2 ELECTRICAL SPECIFICATION

Parameter	Values	Notes
Working Voltage	3.0V-3.6V	To ensure RF work, supply voltage suggest not lower than 3.3V
Working Temperature	-40℃~+105℃	Storage temperature is -40℃~+125℃
Transmission Power	BLE: -34 ~ +21dBm WiFi: -24 ~ +20 dBm	Configurable
Current(RX)	82mA	RF Receive Current in Maximum Power Mode
Current(TX)	382mA	RF Receive Current in Maximum Power Mode
Module Dimension	16.6x13.2x2.2mm	
Quantity of IO Port	22	

3 PIN DESCRIPTION



（TOP View）

4 PIN DEFINITION

Symbol	Type	Definition
GND	Ground	Ground
VDD	Negativ power supply	Power supply：3.0 ~ 3.6V, with this pin
CHIP_EN	Enable	High: chip enable; Low: chip disable; Note: the EN pin should NC.
RF	-	External antenna pin
GPIO1 - GPIO9	GPIO	General IO port,
GPIO12 - GPIO15	GPIO	GPIO6 - Serial port RXD.
GPIO18 - GPIO23	GPIO	GPIO7 - serial port TXD.
U0TXD	I/O, TX	I/O pin firmware download UART TX
U0RXD	I/O, RX	I/O pin firmware download UART RX
NC	-	Not connected pin

5 POWER CONSUMPTION DESCRIPTION

5.1 Description

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

Operating mode		Working status	Peak
RF Mode	TX	802.11b, 1 Mbps, DSSS @ 20.5 dBm	382mA
		802.11g, 54 Mbps, OFDM @ 19.0 dBm	316mA
		802.11n, HT20, MCS7 @ 18.0 dBm	295mA
		802.11n, HT40, MCS7 @ 17.5 dBm	280mA
		802.11ax, MCS9 @ 15.5 dBm	251mA
	RX	802.11b/g/n, HT20	78mA
		802.11n, HT40	82mA
		802.11ax, HE20	78mA

5.2 Power management

Operating mode	Working status	Type value
Modem-sleep (Support by default)	80MHZ, CPU working, peripheral clock fully on	30mA
	80MHZ, CPU idle, peripheral clock fully on	25mA
Light-sleep	CPU, wireless communication module power off, peripheral clock off, all GPIOs set to high impedance state.	180μA
	CPU, wireless communication module, peripheral power off, all GPIOs set to high state.	35μA
Deep-sleep	RTC Timer and LP Memory Power Up	7μA
Power off (Support by default)	The CHIP_PU pin is pulled low and the chip is turned off.	1μA

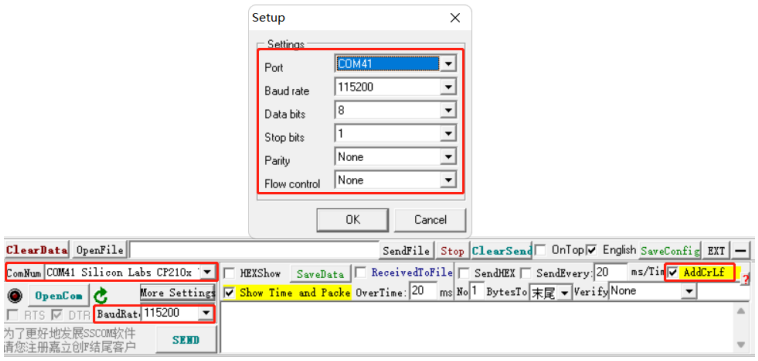
6 DESCRIPTION OF TRANSMISSION FUNCTIONS

This pass-through firmware includes BLE and WIFI pass-through, WIFI can be set as AP or STA mode for data transmission, WIFI can be connected to all kinds of cloud servers, such as AliCloud, BaiduCloud, AmazonCloud, etc. BLE and WIFI can be activated at the same time, but when transmitting data, BLE pass-through needs to exit the command mode to enter the pass-through mode, whereas the data transmission of WIFI is controlled by commands. BLE and WIFI can be activated at the same time, but when transmitting data, BLE needs to exit command mode to enter transmission mode, while WIFI data transmission is controlled by commands.

In order to ensure the normal operation of the module, it is necessary to provide a stable 3.3V voltage to the module, and the module will be woken up when the EN pin is pulled high, and the default mode is command mode, and the pass-through firmware has command mode as well as pass-through mode. In the command mode, the AT command can be used to configure the module's basic, BLE and WIFI parameters, please refer to the document of "ESP32-C6ESP-AT User Guide".

6.1 Serial Port Settings

Baud rate: 115200
Data bits: 8
Date bits: None
Stop bits: 1
Parity: None
Sends line feed settings:
CR&LF (\r\n) (Carriage Return Line Feed)
Send settings: ASCII
Receive setting: ASCII



6.2 WiFi Transmission

WIFI can be set to STA mode or Soft-AP mode, or a mixture of these two modes can also be achieved. under the default firmware, WiFi defaults to the open AP mode, which can directly search for SSIDs starting with ESP. in order to reduce the power consumption during the use of the commands, the RF function of the BLE is turned off, so you need to turn it on in the command mode before using the BLE normally. For more detailed description of WIFI commands, please refer to the WIFI Command section in the 《ESP32-C6ESP-AT User Guide》 document.

6.2.1 Soft-AP Mode Example

The Soft-AP mode can be commonly referred to as a base station, to which other devices can connect through the WIFI emitted by the module. The basic usage of the module in AP mode is illustrated by a simple example of the module as a Soft-AP implementing the UART WIFI pass-through function in UDP transmission. The sequence and response of the serial commands are as follows:

①AT+CWMODE? // Check WIFI mode

Return: OK

② AT+CWMODE=2 //Set WIFI mode to Soft-AP mode

Return: OK

③ AT+CWSAP="ESP32_softAP", "1234567890",5,3
//Set the WIFI name and password in AP mode.
Return: OK

The module establishes UDP transmission with a fixed peer IP address and port to the corresponding port of the PC, with the remote IP address 192.168.4.2, remote port 8080, local port 2233, and mode 0.

④ AT+CIPSTART="UDP", "192.168.4.2",8080,2233,0

Return: CONNECT OK

⑤ AT+CIPAP? //Query the IP gateway information of the module.

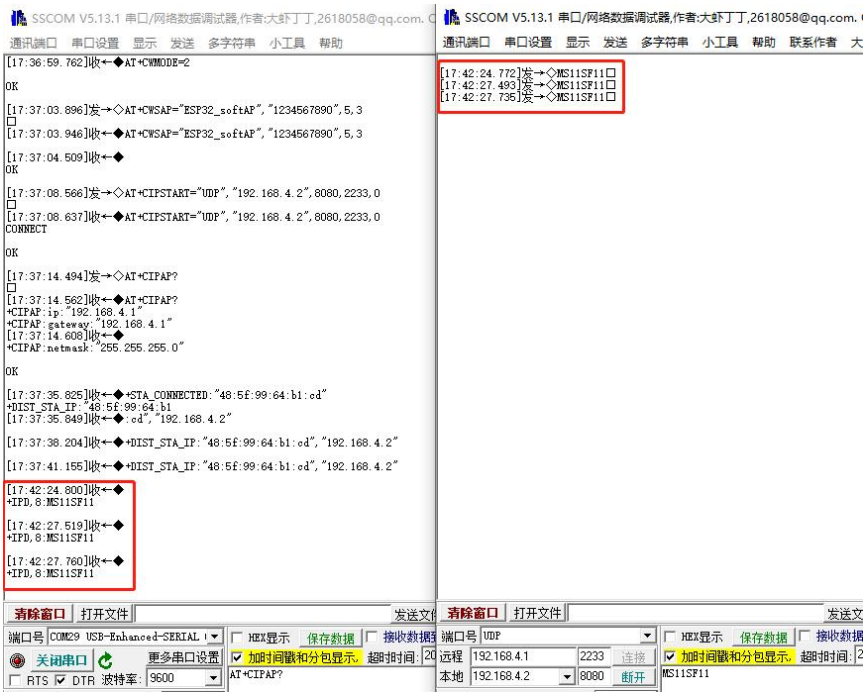
Return: +CIPAP:ip: "192.168.4.1" +CIPAP:gateway: "192.168.4.1"
+CIPAP:netmask: "255.255.255.0"

At this time, the module has generated a WIFI with the name of ESP32_xxxxxx(6-bit value after MAC), now you can use the PC to connect to the AP, after the connection is successful, use the Serial Network Data Debugger, select UDP for the port number, and create a UDP service transmission. Local IP address, select 192.168.4.2, port write 8080, remote IP address is 192.168.4.1 which is the gateway address queried by ⑤ command, port is 2233 which is the module port set by ④ command, and finally click connect.

⑥ AT+CIPMODE=1 //Enter UART WIFI Transparent Receiving Mode

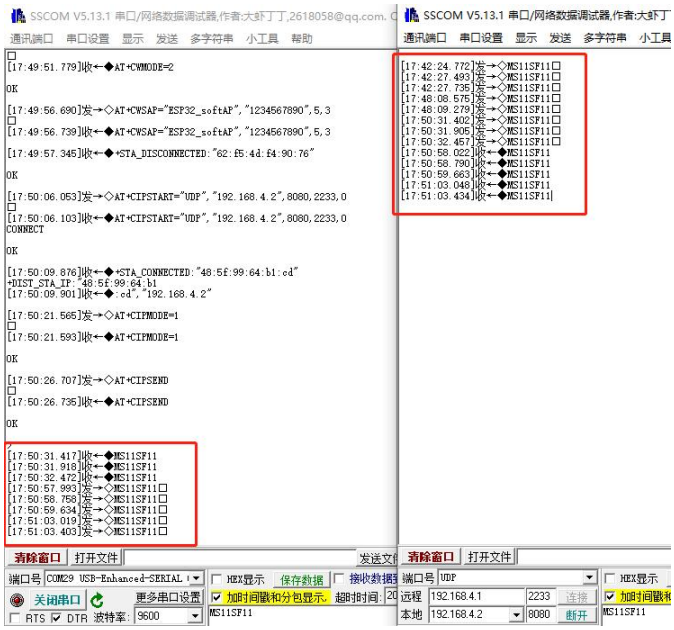
Return: OK

After entering the transmission receiving mode, the PC can transmit WIFI to and from the module, but only in one direction, the module is now in the command mode and receives the WIFI transmission data from the PC.



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

Return: OK
After inputting this command, you can realise the two-way pass-through function, all the data inputted from the serial port are pass-through data, if you want to exit the pass-through state, input ++++ (no carriage return line feed) in the serial port to enter the normal command mode.



When you exit the pass-through mode with ++++, you return to the pass-through receive mode and the TCP connection is still active. You can continue to use the AT+CIPSEND command to resume the pass-through mode. To exit the UART WIFI pass-through mode, use the command: AT+CIPMODE=0, and close the TCP connection: AT+CIPCLOSE.

6.2.2 STA Model Example

STA mode, in general terms, means that the module can connect to a hotspot issued by a router or a mobile phone. The basic use of STA mode is illustrated by a simple example of the module as a TCP client in STA mode to realise the UART WIFI pass-through function. The sequence of serial commands and responses are as follows:

①AT+CWMODE? //Check the WIFI. mode
Return: OK

②AT+CWMODE=1 //Set WIFI mode to STA mode
Return: OK

③AT+CWJAP="MS11SF1", "1234567890" //Name and password for connecting to other device hotspots

Return: WIFI CONNECTED WIFI GOT IP OK
The SSID and password you enter may be different from the commands above, so please use your device SSID and password.

④AT+CIPSTA? //Check 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

The result of your query may be different from the above returns
Then use the PC side to connect to the same hotspot as the device, and use the Serial Network Data Debugger on the PC to create a TCP server, select the local IP address 172.16.1.216, port 8080, and listen.

The module acts as a client to connect to the TCP server via TCP. The IP address of the server is the local IP address 172.16.1.216 set by the above debugger, and the port is 8080, so you can just connect via the command.

⑤ AT+CIPSTART="TCP", "172.16.1.216",8080

Return: CONNECT OK

⑥ AT+CIPMODE=1 //Enter UART WIFI Transmission Acceptance Mode

Return: OK

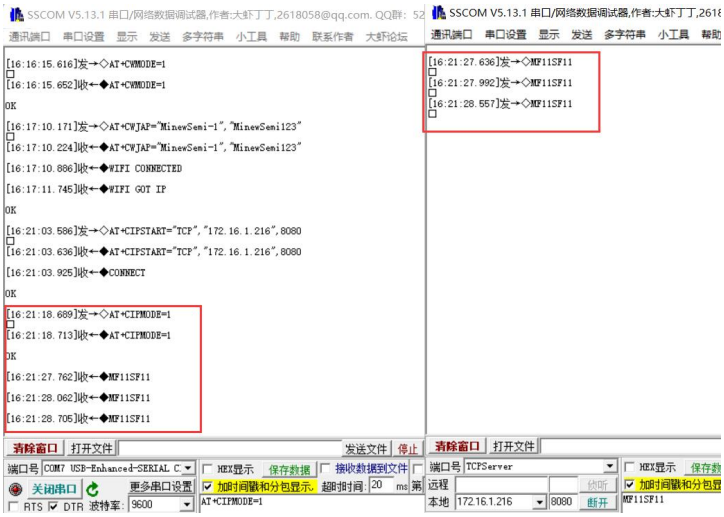
At this point the module enters the Transmission Receive and Command modes, allowing for simultaneous command output as well as data reception from the TCP server.

⑦ AT+CIPSEND

Return: OK >

After inputting this command, you can realise the two-way pass-through function, all the data inputted from the serial port are pass-through data, if you want to exit the pass-through state, input ++++ (no carriage return line feed) in the serial port to enter the normal command mode.

When you exit the pass-through mode with ++++, you return to the pass-through receive mode and the TCP connection is still active. You can continue to use the AT+CIPSEND command to resume the pass-through mode. To exit the UART WIFI pass-through mode, use the command: AT+CIPMODE=0, and close the TCP connection: AT+CIPCLOSE.



6.2.3 Soft-AP+STA Hybrid Mode Example

The mixed mode of Soft-AP+STA can support the module to be connected by other devices and connect to the hotspot of other devices at the same time, but in this mode, it does not support the WIFI throughput function with devices at both ends at the same time, and it can be realised to connect to different clients or servers at different times to complete the throughput function. This mode is briefly illustrated by a basic hybrid example, and the sequence of serial port commands and responses are as follows:

①AT+CWMODE? //Check the mode of WIFI.

Return: OK

② AT+CWMODE=3 //Set WIFI mode to Mixed mode

Return: OK

③ AT+CWSAP="ESP32_softAP", "1234567890",5,3 //
Set the WIFI name and password in AP mode.

Return: OK

④ AT+CWJAP="ESP32_softAP", "1234567890" //Name and password to connect to other device hotspot

Return: WIFI CONNECTED WIFI GOT IP OK

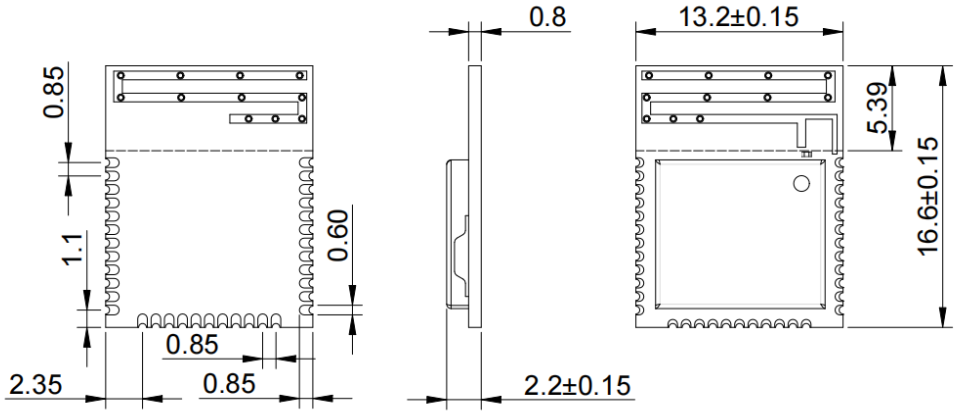
```
[16:59:30.237]发→◇AT+CWMODE=3
□
[16:59:30.256]收←◆AT+CWMODE=3

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 commands, the module's WIFI has been opened to be connected by other devices, and has also been connected to the WIFI hotspot of other devices, you can create a connection to do the pass-through through the single-mode passthrough example that has been described above, and will not repeat the instructions in this section. However, it should be noted that, for example, when doing a TCP client passthrough, you cannot do other passthroughs at the same time, and you need to disconnect the TCP connection in command mode, the command is AT+CIPCLOSE, which can turn off the single-connection mode or multiple-connection mode of TCP/UDP/SSL, please refer to the "MS13SF1-AT" file for more details on the TCP-IP example description. Command Set" file for more detailed TCP-IP examples, please refer to the "ESP32-C6ESP-AT User Guide" file for command examples and the AT Command Set section.

6.2.4 Connecting Cloud Servers to MQTT

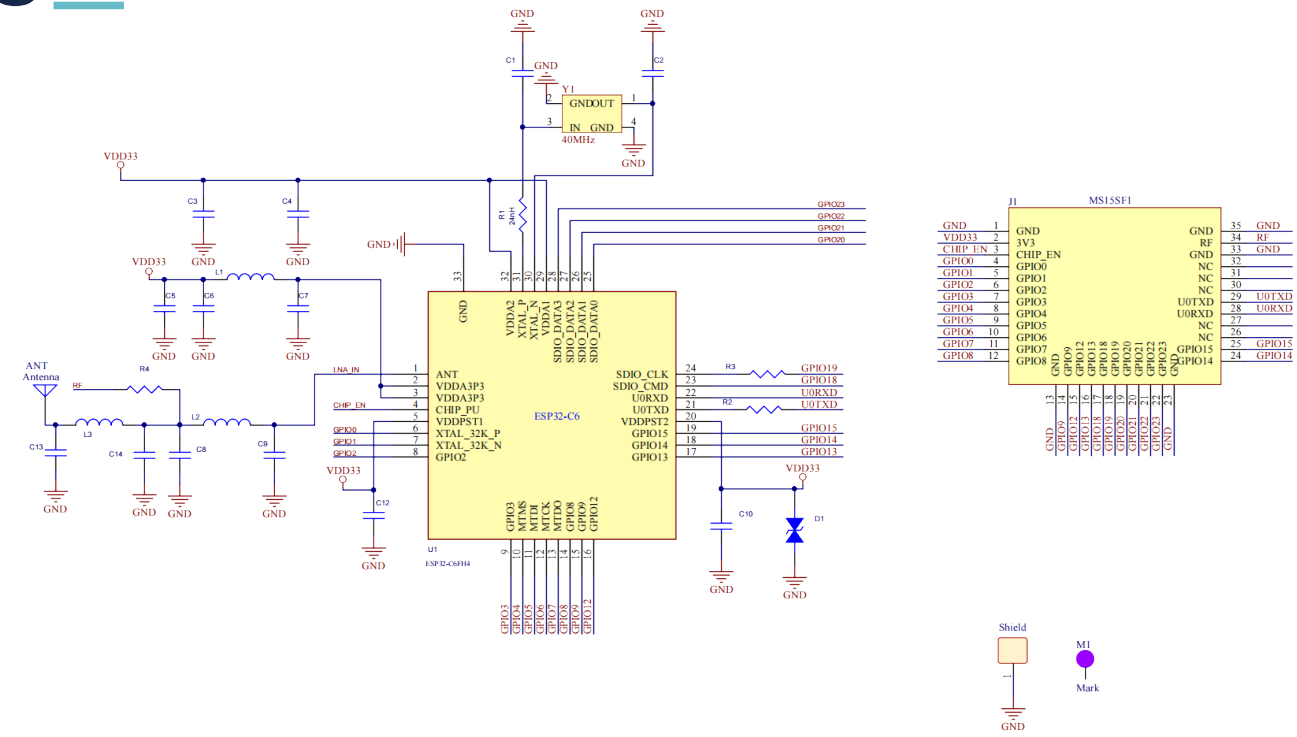
MS15SF1 can communicate with AliCloud, BaiduCloud, TencentCloud, AmazonCloud and other cloud servers, the specific communication steps have the relevant cloud connection documents, MS15SF1 with PC clients, Android clients and IOS clients for MQTT communication steps see the test document of MQTT communication between each client and module, please contact us to provide.

7 MECHANICAL DRAWING



Default unit: mm Default tolerance: ±0.15

8 ELECTRICAL SCHEMATIC



Notice: Before placing an order, please confirm the specific configuration required with the salesperson.

Notice: To ensure that the power supply to the ESP32-C6 chip is stable during power-up, it is advised to add an RC delay circuit at the EN pin. The recommended setting for the RC delay circuit is usually R = 10 kΩ and C = 1 μF. However, specific parameters should be adjusted based on the power-up timing of the module and the power-up and reset sequence timing of the chip.

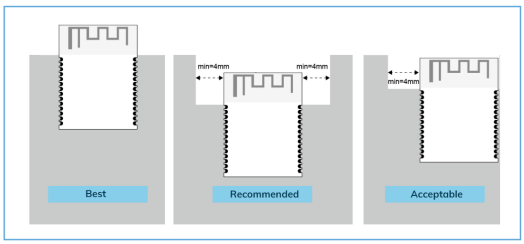
9 PCB LAYOUT

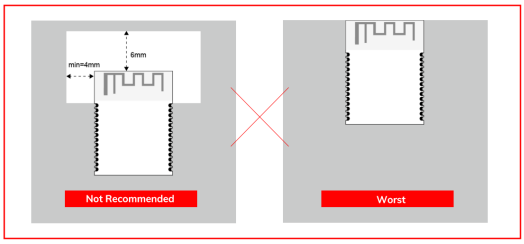
Module antenna area couldn't have GND plane or metal cross line, couldn't place components nearby. It is better to make hollow out or clearance treatment or place it on the edge of PCB board.

> 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.

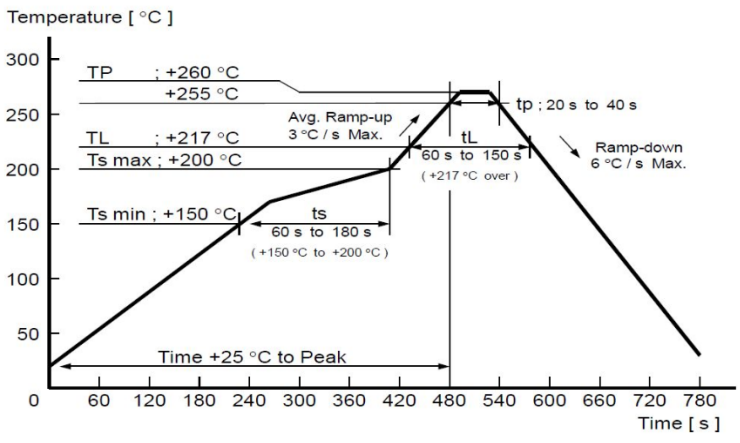




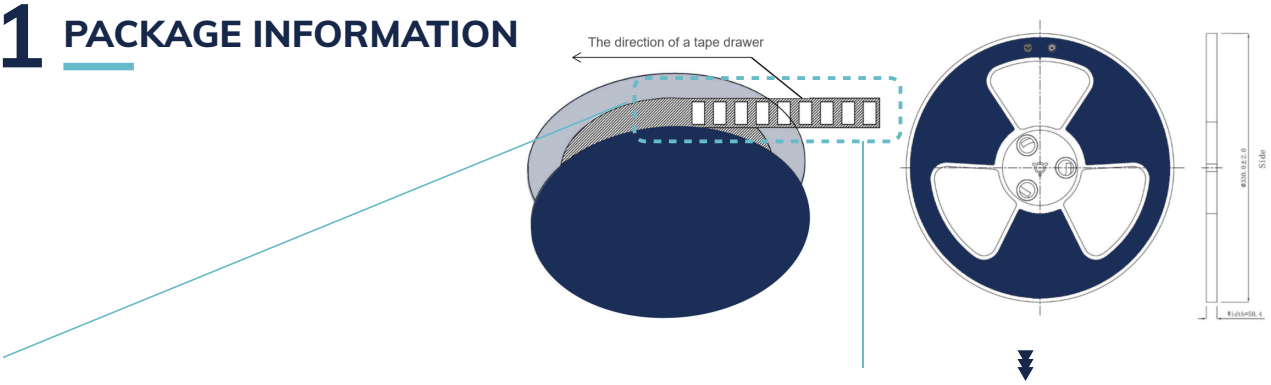
10 REFLOW AND SOLDERING

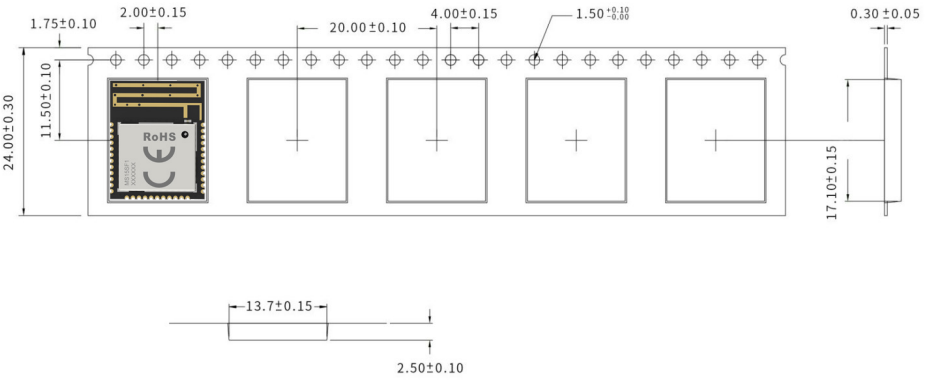
1) Do SMT according to above reflow oven temperature deal curve. Max. Temperature is 260℃;
Refer to IPC/JEDEC standard; Peak TEMP<260℃; Times: ≤2 times, suggest only do once reflow soldering on module surface in case of SMT double pad involved. Contact us if special crafts involved.

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 ℃ for 24 hours without disassembling the tape.
4) Before using SMT, please adopt ESD protection measure.



11 PACKAGE INFORMATION





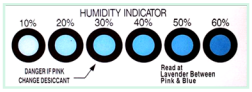
Inner carton(*8)
355*340*35mm，±5mm

Outer carton
370*358*350mm，±10mm

Remarks

General material list for FCL packaging:

Carrier tape packaging tray



Humidity Indicator
(1 pcs/bag)

Desiccant
(placed in a vacuum bag)

Vacuum bag

Inner carton(*8)
355*340*35mm，±5mm

Outer carton
370*358*350mm，±10mm

Other:

Moisture-proof label (attached to the vacuum bag)

Certification label (attached to the vacuum bag)

Outer box label

⚠ Default unit：mm Default tolerance：±0.1

Packing detail	Specification	Net weight	Gross weight	Dimension
MS15SF1	850PCS	-	-	W=24mm，T=0.35mm

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

12 STORAGE CONDITIONS

- **Please use this product within 6 months after signing the receipt.**
  - This product should be stored without opening the package at an ambient temperature of 5~35°C and a humidity of 20~70%RH.
  - This product should be left for more than 6 months after receipt and should be confirmed before use.
  - The product must be stored in a non-corrosive gas (Cl2, NH3, SO2, NOx, etc.).
  - To avoid damaging the packaging material, do not apply any excessive mechanical shocks, including but not limited to sharp objects adhering to the packaging material and product dropping.

- **This product is suitable for MSL2 (based on JEDEC standard J-STD-020).**
  - After opening the package, the product must be stored at ≤30°C/<60%RH. It is recommended to use the product within 3-6 months after opening the package.
  - When the color of the indicator in the package changes, the product should be baked before welding.

- **Baking is not required for one year if exposure is limited to <30°C and 60%RH. Refer to MSL2 for exposure criteria for moisture sensitivity level. If exposed to (≥168h@85°C/60%RH) conditions or stored for more than one year, recommended baking conditions.**
  1. 120 +5/-5°C, 8 hours, 1 time
  Products must be baked individually on heat-resistant trays because the materials (base tape, reel tape, and cover tape) are not heat-resistant, and the packaging material may be deformed at temperatures of 120℃;
  2、90℃ +8/-0℃，24hours，1times
  The base tape can be baked together with the product at this temperature. Please pay attention to the uniformity of heat.

13 HANDLING CONDITIONS

• Be careful in handling or transporting products because excessive stress or mechanical shock may break products.
• Handle with care if products may have cracks or damages on their terminals. If there is any such damage, the characteristics of products may change. Do not touch products with bare hands that may result in poor solder ability and destroy by static electrical charge.

14 QUALITY

Cognizant of our commitment to quality, we operate our own factory equipped with state-of-the-art production facilities and a meticulous quality management system. We hold certifications for ISO9001, ISO14001, ISO27001, OHSA18001, BSCI.

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.

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The company has the right to change the content of this manual according to the technological development, and the revised version will not be notified otherwise. Without the written permission and authorization of the company, any individual, company, or organization shall not modify the contents of this manual or use part or all of the contents of this manual in other ways. Violators will be held accountable in accordance with the law.

16 RELATED DOCUMENTS

- esp32-c6_Chip_Datasheet
  https://en.minewsemi.com/file/esp32-c6_Chip_Datasheet_EN.pdf
- MinewSemi_Product_Naming_Reference_Manual_V1.0
  https://en.minewsemi.com/file/MinewSemi_Product_Naming_Reference_Manual_EN.pdf
- MinewSemi_Connectivity_Module_Catalogue_V2.0
  https://en.minewsemi.com/file/MinewSemi_Connectivity_Module_Catalogue_EN.pdf

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