ESP-C3-M1-I Specification

Version V1.1.0

Document development/revision/revocation resume

Version	Date	Develop/revise content	Edition	Approve
V1.1.0	2021.10.08	First Edition	Shengxing Zou	Ning Guan

Content

1. Product Overview

ESP-C3-M1-I is a WiFi module developed by Shenzhen Ai-Thinker Technology Co., Ltd. The module's core processor chip ESP32-C3 is a highly integrated low-power WiFi and Bluetooth system-on-chip (SoC) designed for the Internet of Things (IoT), mobile devices, wearable electronic devices, and smart home applications, ect.

The ESP32-C3 chip has industry-leading low-power performance and radio frequency performance, and supports WiFi IEEE802.11b/g/n protocol and BLE 5.0. The chip is equipped with a RISC-V 32-bit single-core processor with an operating frequency of up to 160 MHz. Support secondary development without using other microcontrollers or processors. The chip has built-in 400 KB SRAM, 384 KB ROM, 8KB RTC SRAM, and built-in 4MB Flash. The chip supports a variety of low power consumption working states, which can meet the power consumption requirements of various application scenarios. The chip's unique features such as fine clock gating function, dynamic voltage clock frequency adjustment function, and RF output power adjustable function can achieve the best balance between communication distance, communication rate and power consumption.

The ESP-C3-M1-I module provides a wealth of peripheral interfaces, including UART, PWM, SPI, I2S, I2C, ADC, temperature sensor and up to 15 IO ports.

The ESP-C3-M1-I module has a variety of unique hardware security mechanisms. The hardware encryption accelerator supports AES, SHA and RSA algorithms. Among them, RNG, HMAC and digital signature (Digital Signature) modules provide more security features. Other security features include Flash encryption and secure boot (secure boot) signature verification. The perfect security mechanism enables the chip to be perfectly applied to various encryption products.

The ESP-C3-M1-I module supports low-power Bluetooth: Bluetooth5, Bluetooth mesh. Bluetooth rate support: 125Kbps, 500Kbps, 1Mbps, 2Mbps. Support broadcast extension, multi-broadcasting, channel selection.

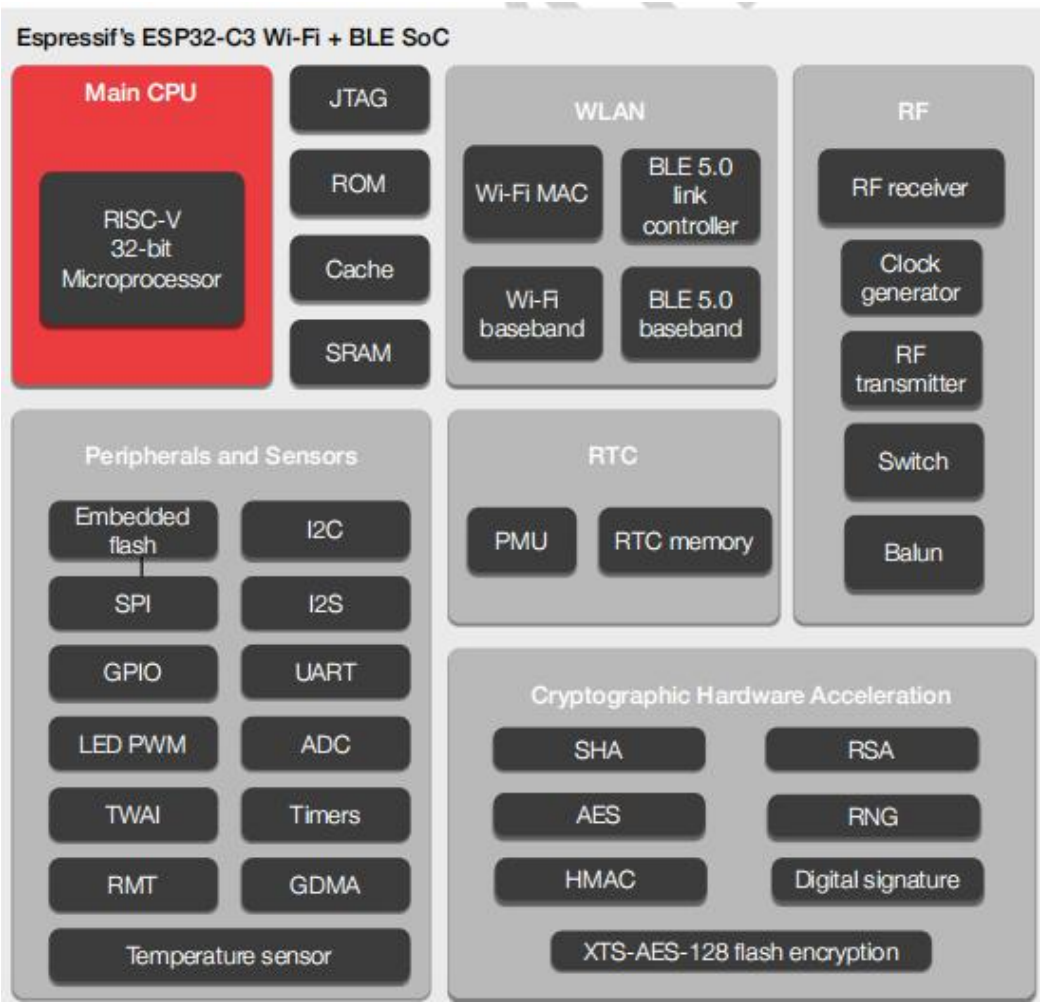

Figure 1 The main chip architecture diagram

1.1. Features

- Support WiFi 802.11b/g/n, 1T1R mode data rate up to 150Mbps
- Support BLE5.0, rate support: 125Kbps, 500Kbps, 1Mbps, 2Mbps
- RISC-V 32-bit single-core processor, supports a clock frequency of up to 160 MHz, has 400 KB SRAM, 384 KB ROM, 8KB RTC SRAM
- Support UART/GPIO/ADC/PWM/I2C/I2S/SPI interface, temperature sensor, pulse counter
- Using SMD-61 package
- Integrated WiFi MAC/BB/RF/PA/LNA/Bluetooth
- Support multiple sleep modes, deep sleep current is less than 5uA

- Serial port rate up to 5Mbps
- Support STA/AP/STA+AP mode and promiscuous mode
- Support Smart Config (APP)/AirKiss (WeChat) for Android and IOS one-click network configuration
- Support serial port local upgrade and remote firmware upgrade (FOTA)
- General AT commands can be used quickly
- Support secondary development, integrated Windows and Linux development environment
- About Flash: ESP-C3-M1-I chip has built-in 4MByte Flash by default

2. Main parameters

Table 1 Description of main parameters

Moduel Name	ESP-C3-M1-I
Package	SMD-61
Size	12.5*13.2*2.4(±0.2)mm
Antenna	IPEX interface
Frequency Range	2400 ~ 2483.5MHz
Operating Temperature	-40 ℃ ~ 85 ℃
Store Temperature	-40 ℃ ~ 125 ℃ , < 90%RH
Power supply range	Voltage 3.0V ~ 3.6V, Electrical current >500mA
Support Interface	UART/GPIO/ADC/PWM/I2C/I2S/SPI
IO	IO0, IO1, IO2, IO3, IO4, IO5, IO6, IO7, IO8, IO9, IO10, IO18, IO19, IO20, IO21
UART Rate	Support 110 ~ 4608000 bps , default 115200 bps
Bluetooth	BLE 5.0, Does not support traditional Bluetooth
Security	WEP/WPA-PSK/WPA2-PSK
SPI Flash	4MByte

2.1. Static electricity requirements

The ESP-C3-M1-I module is an electrostatic sensitive device, and special precautions must be taken when handling it.

Figure 2 ESD anti-static diagram

2.2. Electrical characteristics

Table 2 Electrical characteristics table

Parameters		Conditions	Min	Typical Values	Max	Unit
Supply voltage		VDD	3.0	3.3	3.6	V
I/O	V_{IL}/V_{IH}	-	-0.3/0.75VDD	-	0.25VDD/VDD+0.3	V
	V_{OL}/V_{OH}	-	N/0.8VIO	-	0.1VIO/N	V
	I_{MAX}	-	-	-	12	mA

2.3. WIFI RF performance

Table 3 WiFi RF performance table

Description	Typical values	Unit
Operating frequency	2400 - 2483.5	MHz
Output power		
11n mode HT40, PA output power	15±2	dBm
11n mode HT20, PA output power	15±2	dBm
11g mode, PA output power	16±2	dBm
11b mode, PA output power	18±2	dBm
Receiving sensitivity		
11b, 1 Mbps	≤-94	dBm
11b, 11 Mbps	≤-86	dBm
11g, 6 Mbps	≤-90	dBm

11g, 54 Mbps	≤-73	dBm
11n, HT20 (MCS7)	≤-71	dBm
11n, HT40 (MCS7)	≤-68	dBm

2.4. BLE RF performance

Table 4 BLE radio frequency performance table

Description	Typical Values	Unit
Output power		
Transmit power	9±2	dBm
Receiving sensitivity Low Energy consumption BLE: 1M		
Sensitivity@30.8%PER	≤-94	dBm

2.5. Power consumption

The following power consumption data is based on 3.3V power supply, 25° C ambient temperature, and measured with an internal voltage regulator.

- All measurements are done at the antenna interface without the SAW filter.
- All emission data is based on 100% duty cycle, measured in continuous emission mode.

Table 5 Power consumption table

Mode	Mix	Average value	Max	Unit
Tx 802.11b, DSSS 1Mbps, POUT=+20dBm	-	350	-	mA
Tx 802.11g, OFDM 54Mbps, POUT =+18dBm	-	290	-	mA
Tx 802.11n, MCS7, POUT =+17dBm	-	280	-	mA
Rx 802.11b, 1024 bit	-	90	-	mA
Rx 802.11g, 1024 bit	-	90	-	mA
Rx 802.11n, 1024 bit	-	93	-	mA
Modem-Sleep①	-	20	-	mA
Light-Sleep②	-	130	-	μA

Deep-Sleep③	-	5	-	μA
Power Off	-	1	-	μA

3. Appearance dimensions

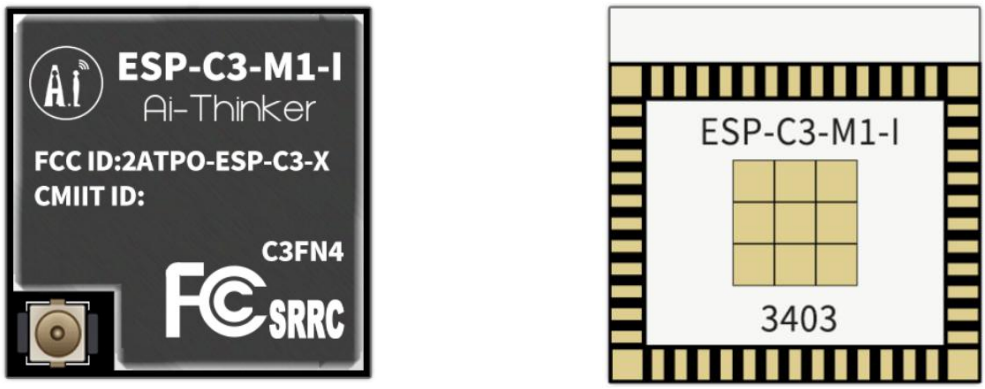

Figure 3 The appearance of the module (the rendering is for reference only, the actual product shall prevail)

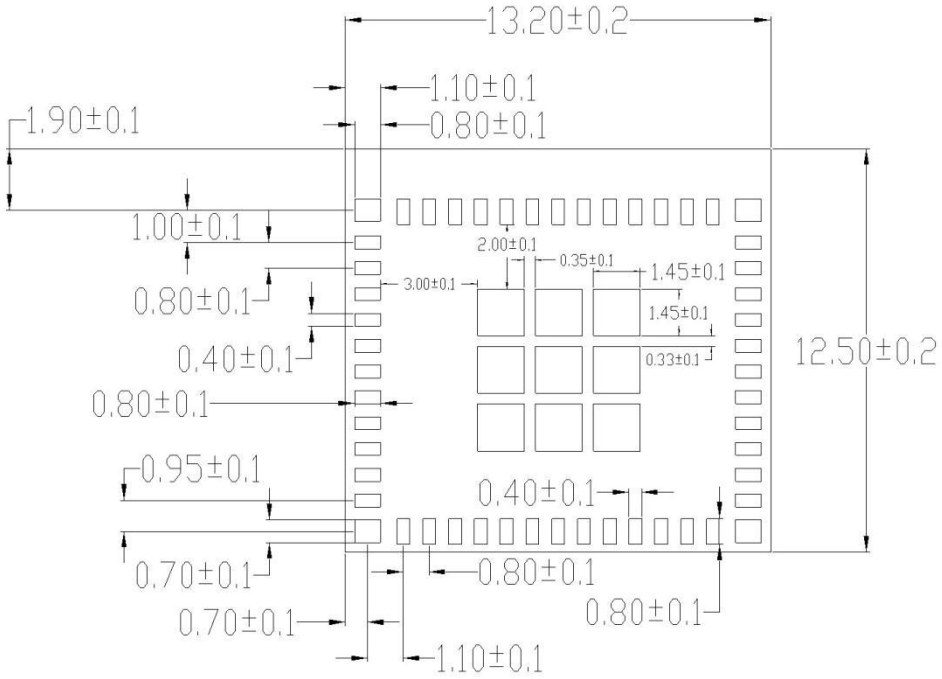

Figure 4 Module size diagram

4. Pin definition

The ESP-C3-M1-I module has a total of 61 pins. As shown in the pin diagram, the pin function definition table is the interface definition.

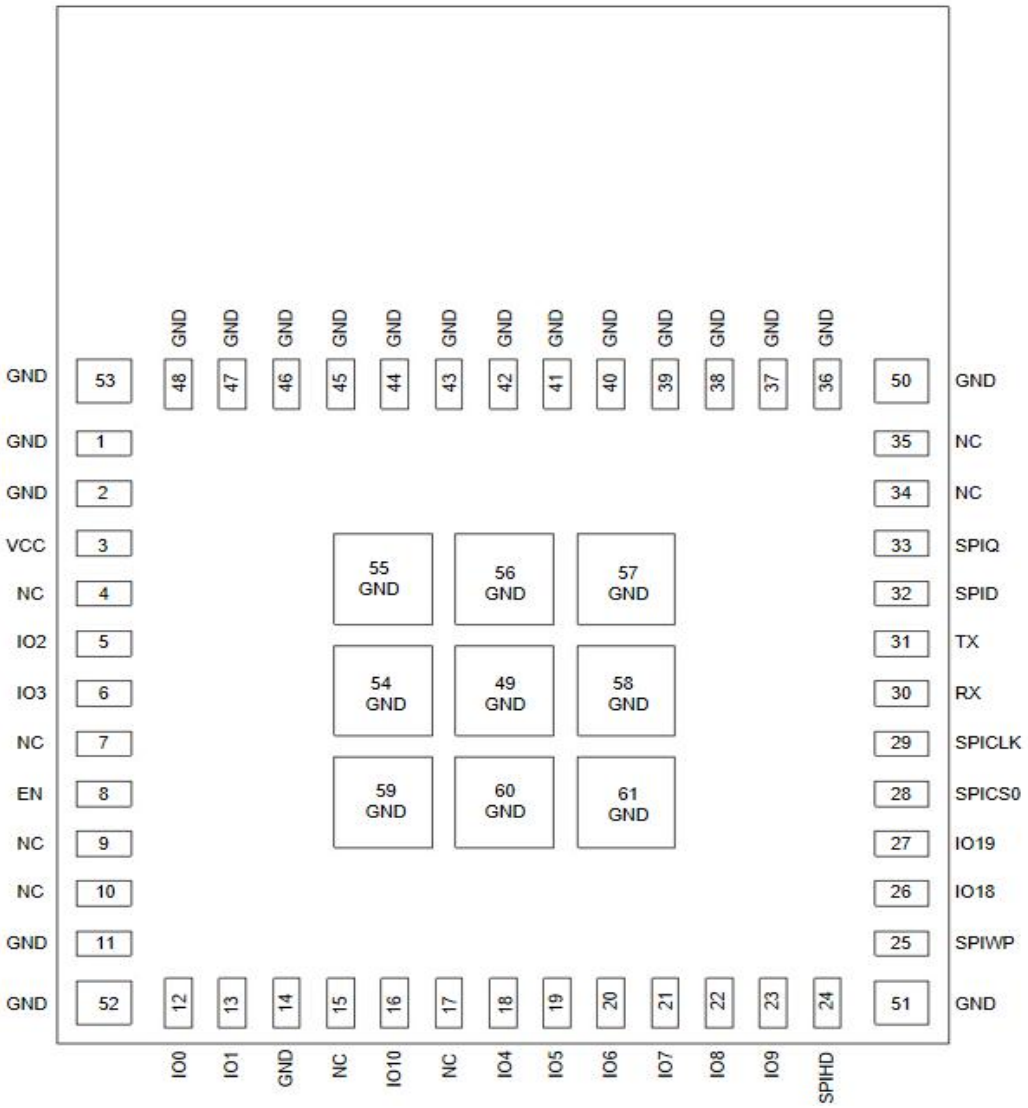

Figure 5 Schematic diagram of module pins (top view)

Table 6 Pin function definition table

No.	Name	Function
1, 2, 11, 14, 36-61	GND	Grounded Power negative
3	VCC	Power Power positive
4, 7, 9, 10 15, 17, 34, 35	NC NC	Empty Empty
5	IO2	GPIO2, ADC1_CH2, FSPIQ
6	IO3	GPIO3, ADC1_CH3
8	EN	High level: chip enabled; Low level: chip shutdown;
12	IO0	GPIO0, ADC1_CH0, XTAL_32K_P
13	IO1	GPIO1, ADC1_CH1, XTAL_32K_N
16	IO10	GPIO10, FSPICS0
18	IO4	GPIO4, ADC1_CH4, FSPIHD, MTMS
19	IO5	GPIO5, ADC2_CH4, FSPIWP, MTDI
20	IO6	GPIO6, FSPICLK, MTCK
21	IO7	GPIO7, FSPID, MTDO
22	IO8	GPIO8
23	IO9	GPIO9
24	SPIHD	NC, not recommended
25	SPIWP	NC, not recommended
26	IO18	GPIO18, USB_D-
27	IO19	GPIO19, USB_D+
28	SPICS0	NC, not recommended
29	SPICLK	NC, not recommended
30	RX	U0RXD, GPIO20
31	TX	U0TXD, GPIO21
32	SPID	NC, not recommended
33	SPIQ	NC, not recommended

Table 7 Module startup mode description

System start-up mode			
Pin	Default	SPI Start up mode	Download Start up Mode
IO8	Non	/	1
IO9	Pull up	1	0

Note: Some pins have been internally pulled up, please refer to the schematic.

5. Schematic diagrams

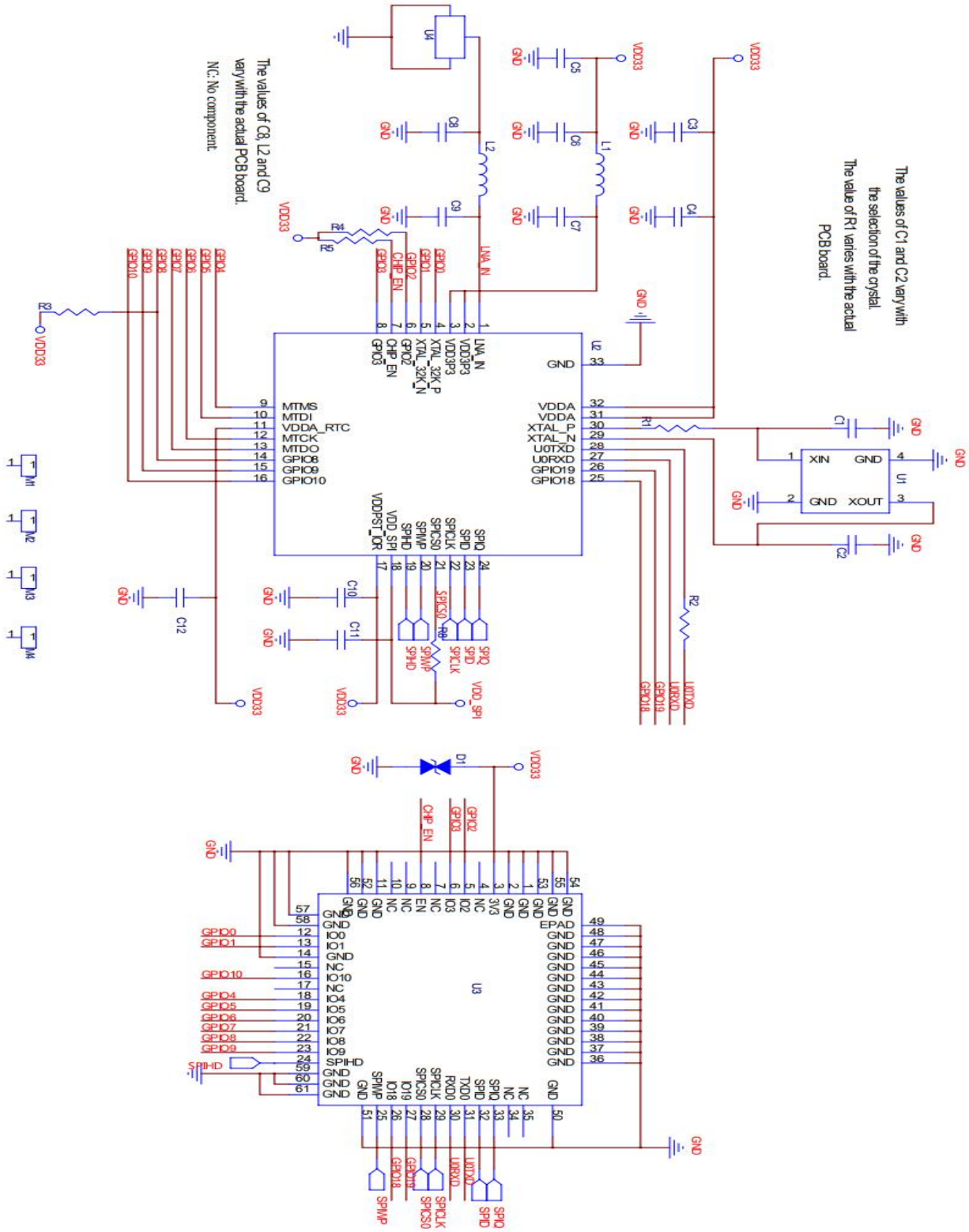

Figure 6 Module schematic diagram

6. Design guidance

6.1. Module application guidance circuit

(>= 500mA, it is recommended to use DC-DC or LDO independent power supply)

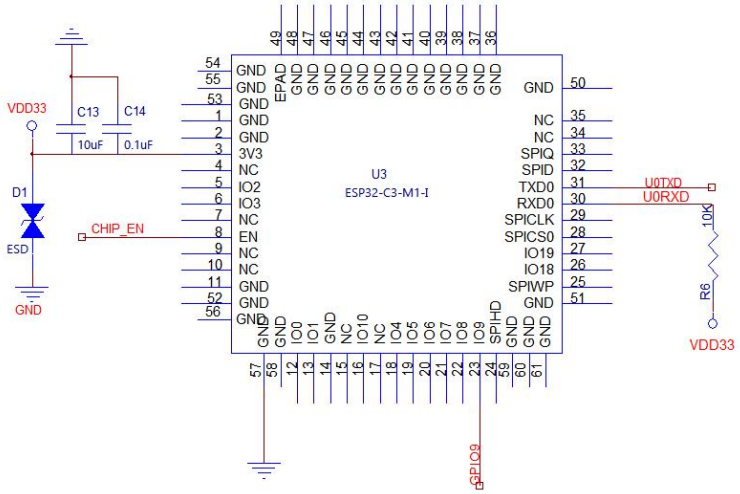

Figure 7 Application circuit diagram

Note:

- IO20 is used as U0RXD, and a pull-up resistor needs to be added externally.
- IO9 is the startup control pin, it is in normal working mode when high level, and it is in firmware programming mode when low level. The internal default high level of the chip.

6.2. Antenna interface

- The ESP-C3-M1-I module requires an external antenna, and a standard IPEX socket is attached to the module. The size chart of the IPEX seat is as follows:

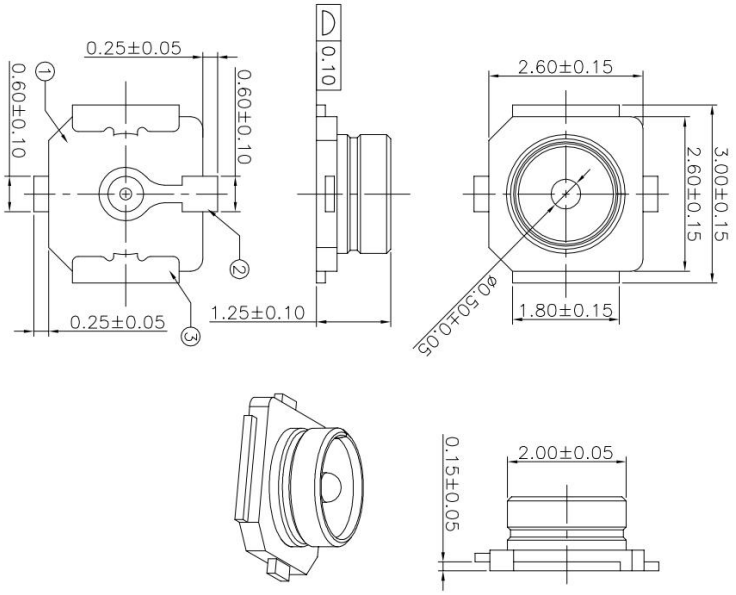

Figure 8 Dimensional drawing of the IPEX seat on the board end

6.3. Power supply

- Recommended 3.3V voltage, peak current above 500mA.
- It is recommended to use LDO for power supply; if using DC-DC, it is recommended that the ripple be controlled within 30mV.
- For the DC-DC power supply circuit, it is recommended to reserve a place for the dynamic response capacitor to optimize the output ripple when the load changes greatly.
- It is recommended to add ESD devices to the 3.3V power interface.

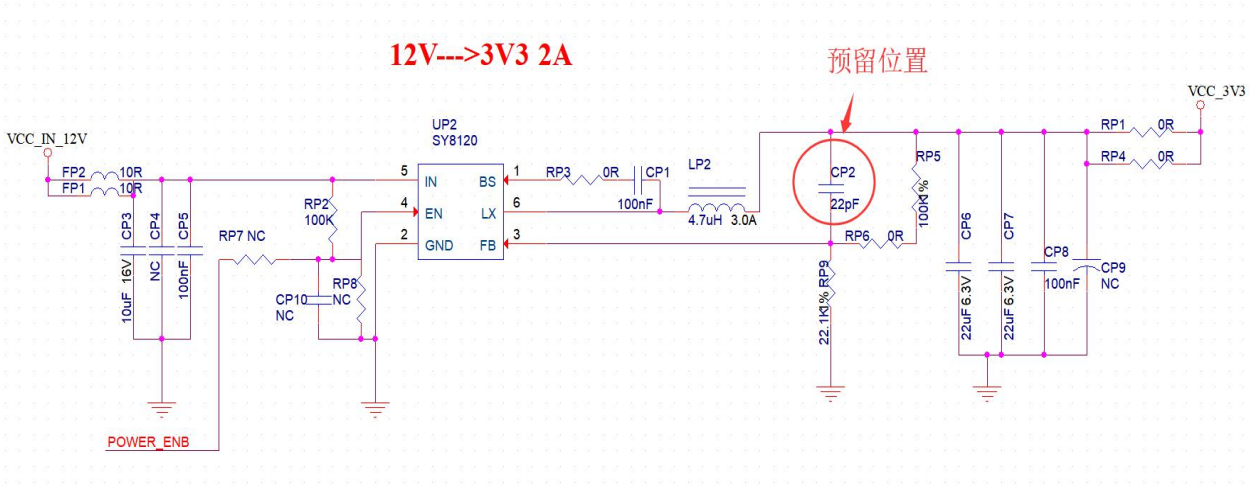

Figure 9 DC-DC step-down circuit diagram

6.4. The use of GPIO interface

- There are some IO ports on the periphery of the module. If you need to use it, it is recommended to connect a 10-100 ohm resistor in series with the IO port. This can suppress overshoot and make the levels on both sides more stable. It is helpful for EMI and ESD.
- For the pull-up and pull-down of special IO ports, please refer to the instructions in the specification. This will affect the startup configuration of the module.
- The IO port of the module is 3.3V. If the main control and the IO port level of the module do not match, a level conversion circuit is needed.
- If the IO port is directly connected to a peripheral interface, or a terminal such as a header, it is recommended to reserve an ESD device near the terminal when the IO port is routed.

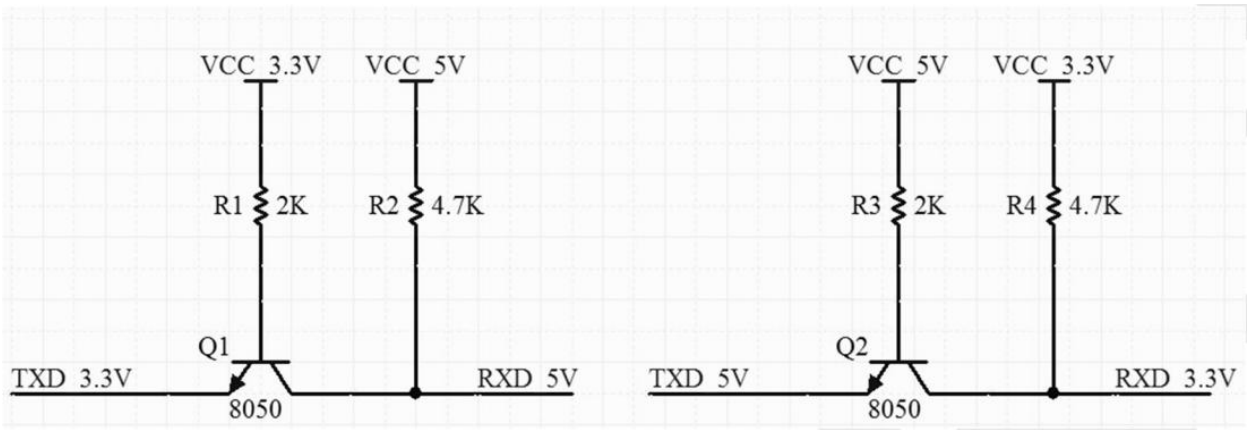

Figure 10 Level conversion circuit

7. Reflow soldering curve

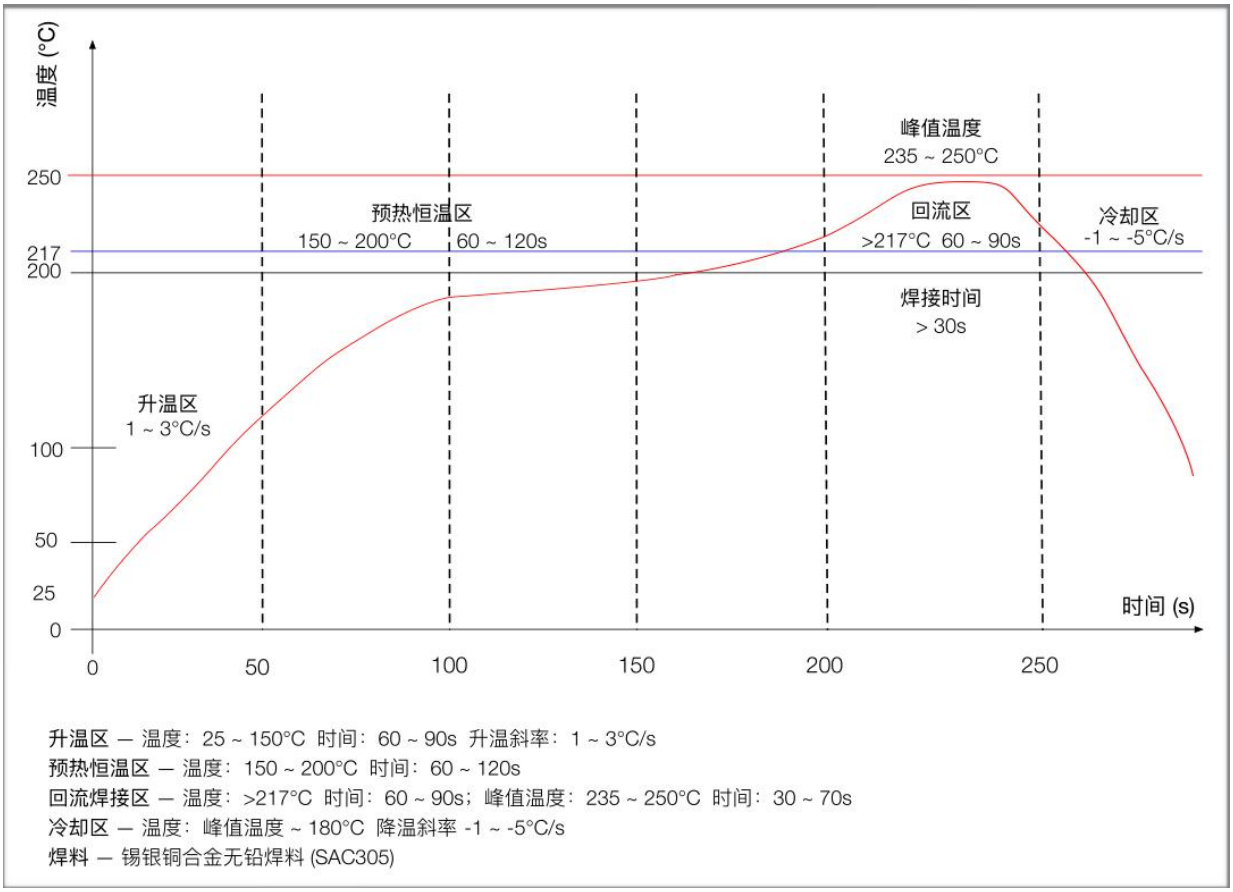

Figure 11 Reflow soldering curve

8. Product related models

Table 8 Product related model list

Model name	Main chip	Package	Size	Antenna interface
ESP-C3-12F	ESP32-C3	SMD-22	24.0*16.0*3.1(±0.2)mm	Onboard PCB antenna /IPEX socket compatible
ESP-C3-32S	ESP32-C3	SMD-38	25.5*18.0*3.1(±0.2)mm	Onboard PCB antenna /IPEX socket compatible
ESP-C3-13	ESP32-C3	SMD-18	20.0*18.0*3.1(±0.2)mm	Onboard PCB antenna /IPEX socket compatible
ESP-C3-13U	ESP32-C3	SMD-18	14.0*18.0*3.1(±0.2)mm	IPEX interface
ESP-C3-01M	ESP32-C3	DIP-18 Gold finger plug-in	18.0*18.0*2.8(±0.2)mm	Onboard PCB antenna
ESP-C3-M1	ESP32-C3	SMD-61	16.6*13.2*2.4(±0.2)mm	Onboard PCB antenna
Product related information: https://docs.ai-thinker.com				

9. Packaging information

The ESP-C3-M1-I module adopts taping packaging, 800pcs/reel. As shown below:

Figure 12 Packaging and taping diagram

10. Contact us

Official website: https://www.ai-thinker.com

Development DOCS: https://docs.ai-thinker.com

Official Forum: http://bbs.ai-thinker.com

Sample purchase: https://aithinker.tmall.com

https://Ai-Thinker.taobao.com

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