ESP32-C6-MINI series

User Manual

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Contents

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1. Functional Overview

1.1 Introduction

ESP32-C6-MINI-1 and ESP32-C6-MINI-1U are developed based on the built-in ESP32-C6 series chip solution .

ESP32-C6-MINI-1 and ESP32-C6-MINI-1U are universal Wi-Fi6 and Bluetooth Low Energy 5.3 (Bluetooth LE) modules with small size, rich peripheral interfaces, and 4MB embedded configuration Flash, equipped with RISC-V 32-bit single-core processor. The chip integrates a wealth of peripherals, including UART, I2C, I2S, infrared remote control module (remote control peripheral), LED PWM controller, general DMA controller, TWAI® controller, USB serial port/JTAG controller, temperature sensor and Analog /Digital converter, also has single-wire, dual-wire, and four-wire SPI interfaces.

It can be used in smart home, industrial automation, healthcare, consumer electronics and other fields.

ESP32- C6 -MINI-1

ESP32- C6 -MINI- 1U

1.2 Features and functions

- Works in the 2412~2484 MHz frequency band, 1T1R
- Support IEEE 802.11ax protocol ;
- Support Bluetooth Low Energy (Bluetooth LE): passed Bluetooth 5.3 certification;
- The Bluetooth part supports: Bluetooth mesh, broadcast extension, multi-broadcast, power control and other functions;
- 4MB embedded flash,
- Support AT commands;
- Support MQTT protocol;
- Support IPV6 network settings;
- Support HTTP protocol;
- Support low power consumption mode;
- Support AT commands;
- Support three role interchanges of AP, STA and AP+STA;
- Support serial communication and flow control. The baud rate supports up to 128000 ;
- Support automatic and manual networking

2. Electrical Characteristics

2.1 Absolute Maximum Ratings

symbol	parameter	minimum value	maximum value	unit
VDD33	Power pin voltage	–0.3	3.6	V
T *STORE*	Storage temperature	–40	85	°C

Chart 1 - 1Absolute Maximum Ratings

2.2 Recommended working conditions

symbol	parameter	minimum value	Typical value	maximum value	unit
VDD33	Power pin voltage	3.0	3.3	3.6	V
IVDD	Supply current from external power supply	0.5	—	—	A
T	Recommended operating temperature	–40	—	85	°C
Humidity	humidity	—	85	—	%RH
I	Transmitting current	251	—	400	mA
	Receiving current	—	78	—	
	Sleep current	14	—	38	

Chart 1 - 3 Recommended working conditions

2.3 Radio frequency characteristics

Module model		ESP32-C6-MINI-1	ESP32-C6-MINI-1U
Working channel center frequency range		**2412~2484MHz**	**2412~2484MHz**
Wi-Fi		Protocol IEEE802.11b/g/n	Protocol IEEE802.11b/g/n
Antenna type		PCB antenna	IPEX antenna
Distance	With router @Mercury MW305R	200m	180m
	between modules	200m	180 m

Chart 1 - 5 RF Characteristics

3. Hardware Description

3.1 Functional block diagram

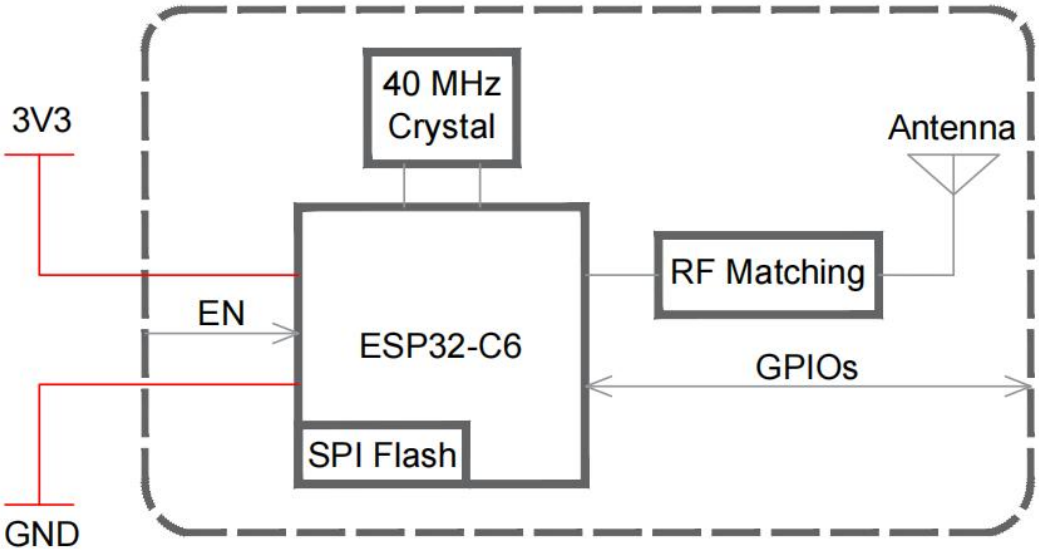


Figure 1 ESP32- C6 -WROOM-1 functional block diagram

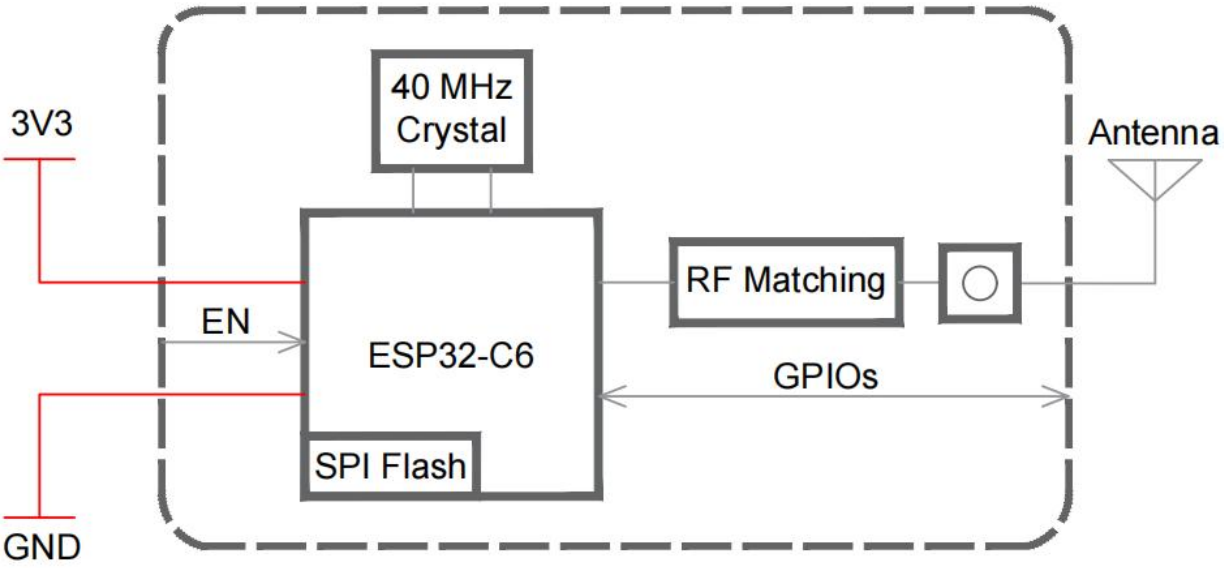


Figure 2 ESP32-C6-WROOM-1U functional block diagram

3.1 ESP32-C6-MINI-1 & ESP32-C6-MINI-1U pin definition

The pin layout diagram shows the approximate location of the pins on the module. Please refer to Figure 8.1 Module Dimensions for the actual layout drawn to scale.

Note that the pin layout of ESP32-C6-MINI-1U is the same as that of ESP32-C6-MINI-1, but there is no keepout zone.

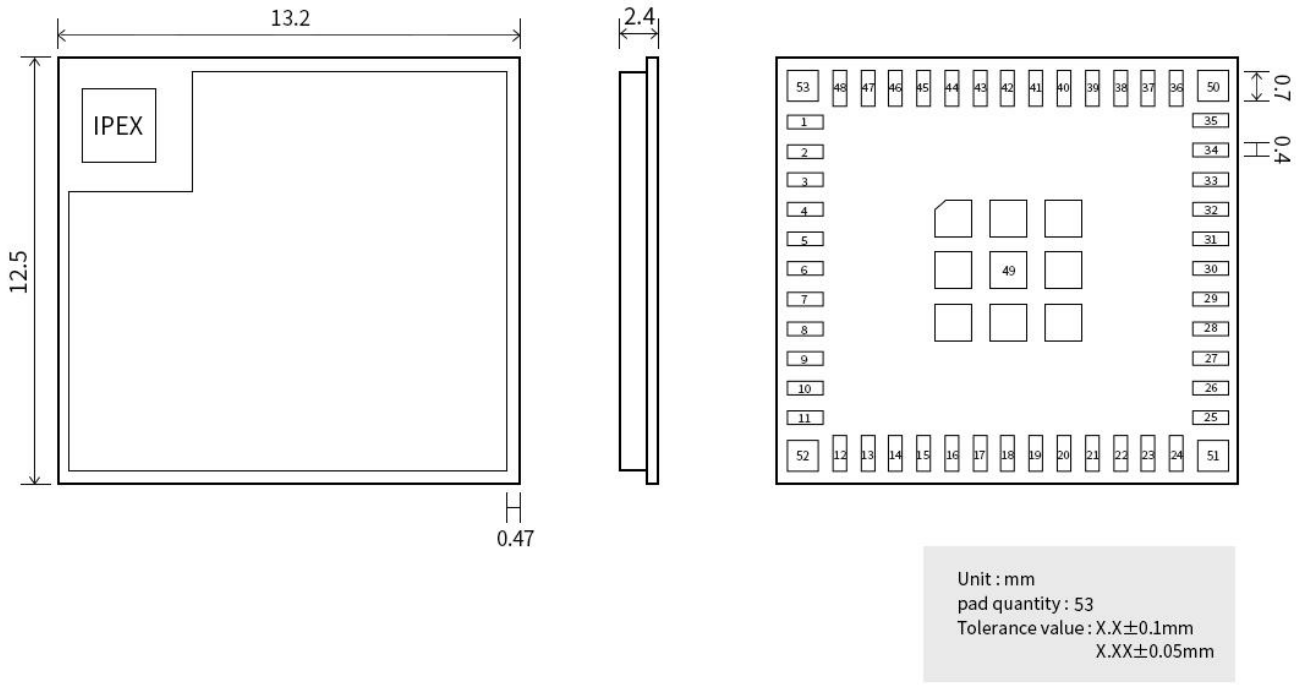


Chart 2- 1 Pin layout diagram (top view)

Name	Serial number	Type 1	Function
GND	1, 2, 11, 14, 36~53	P	Ground
3V3	3	P	Powered by
NC	4	—	Empty pin
IO2	5	I/O/T	GPIO2, LP_GPIO2, LP_UART_RTSN, ADC1_CH2, FSPIQ
IO3	6	I/O/T	GPIO3, LP_GPIO3, LP_UART_CTSN, ADC1_CH3
NC	7		Empty pin
EN	8	I	High level: chip enabled; low level: chip turned off; Be careful not to let the EN pin float.
IO4	9	I/O/T	MTMS, GPIO4, LP_GPIO4, LP_UART_RXD, ADC1_CH4, FSPIHD
IO5	10	I/O/T	MTDI, GPIO5, LP_GPIO5, LP_UART_TXD, ADC1_CH5, FSPIWP
IO0	12	I/O/T	GPIO0, XTAL_32K_P, LP_GPIO0, LP_UART_DTRN, ADC1_CH0
IO1	13	I/O/T	GPIO1, XTAL_32K_N, LP_GPIO1, LP_UART_DSRN, ADC1_CH1

IO6	15	I/O/T	MTCK, GPIO6, LP_GPIO6, LP_I2C_SDA, ADC1_CH6, FSPICLK
IO7	16	I/O/T	MTDO, GPIO7, LP_GPIO7, LP_I2C_SCL, FSPID
IO12	17	I/O/T	GPIO12, USB_D-
IO13	18	I/O/T	GPIO13, USB_D+
IO14	19	I/O/T	GPIO14
IO15	20	I/O/T	GPIO15
NC	21	—	Empty pin
IO8	22	I/O/T	GPIO8
IO9	23	I/O/T	GPIO9
IO18	24	I/O/T	GPIO18, SDIO_CMD, FSPICS2
IO19	25	I/O/T	GPIO19, SDIO_CLK, FSPICS3
IO20	26	I/O/T	GPIO20, SDIO_DATA0, FSPICS4
IO21	27	I/O/T	GPIO21, SDIO_DATA1, FSPICS5
IO22	28	I/O/T	GPIO22, SDIO_DATA2
IO23	29	I/O/T	GPIO23, SDIO_DATA3
RXD0	30	I/O/T	U0RXD, GPIO17, FSPICS1
TXD0	31	I/O/T	U0TXD, GPIO16, FSPICS0
NC	32		Empty pin
NC	33		Empty pin
NC	34	—	Empty pin
NC	35	—	Empty pin

P: power supply; I: input; O: output; T: can be set to high impedance.

Chart 2-2 pin definition list

3.2 Recommended schematic diagram

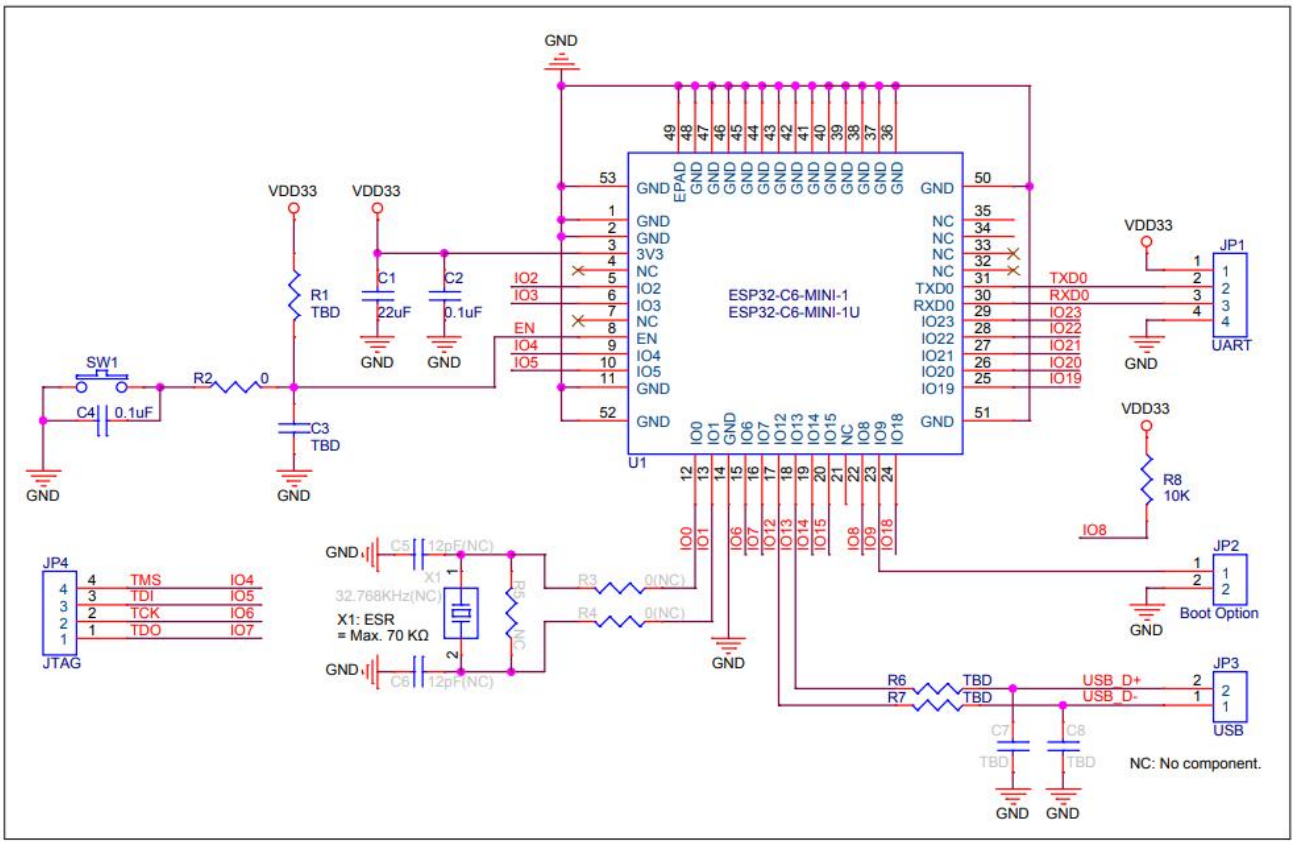


Chart 2 - 3 Recommended schematic

3.3 Module size

3.3.1 ESP32-C6-MINI-1 Dimensional Drawing

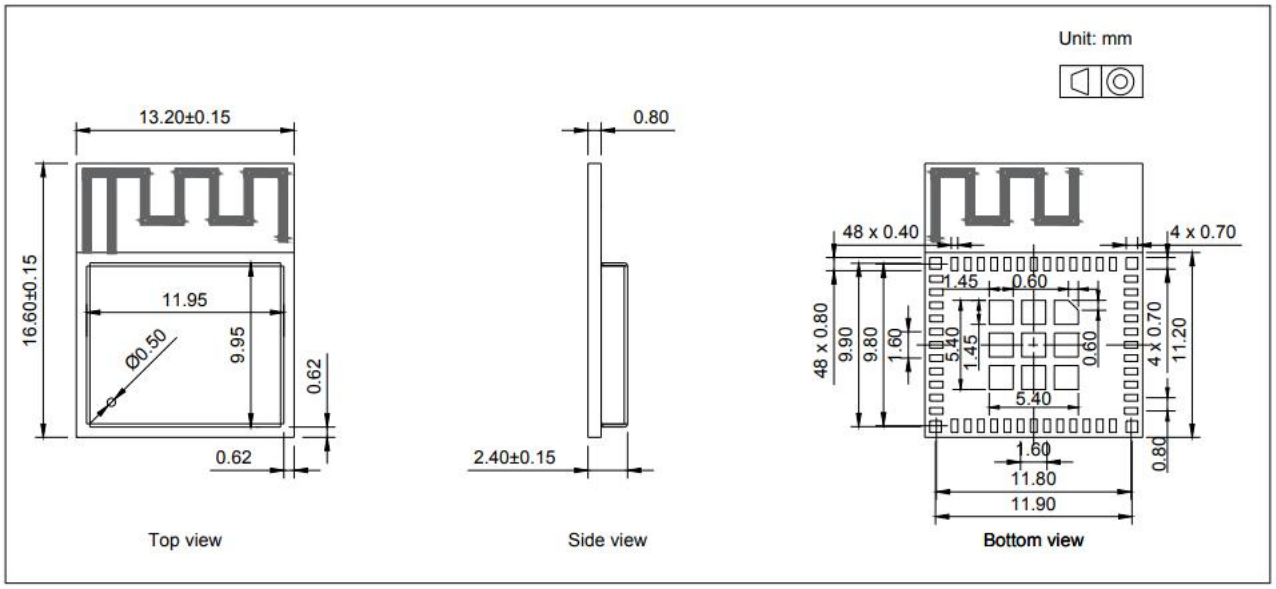


Chart 2- 4 module dimensions

3.3.2 ESP32-C6-MINI-1U Dimensional Drawing

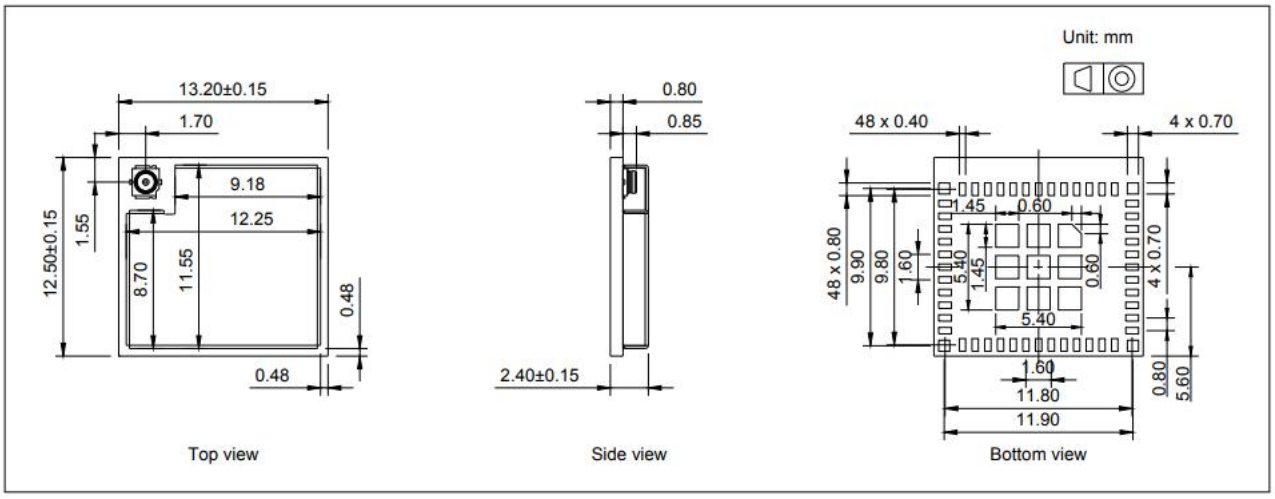


Chart 2- 5 module dimensions

3.4 PCB packaging graphics

3.4.1 ESP32-C6-MINI-1 Dimensional Drawing

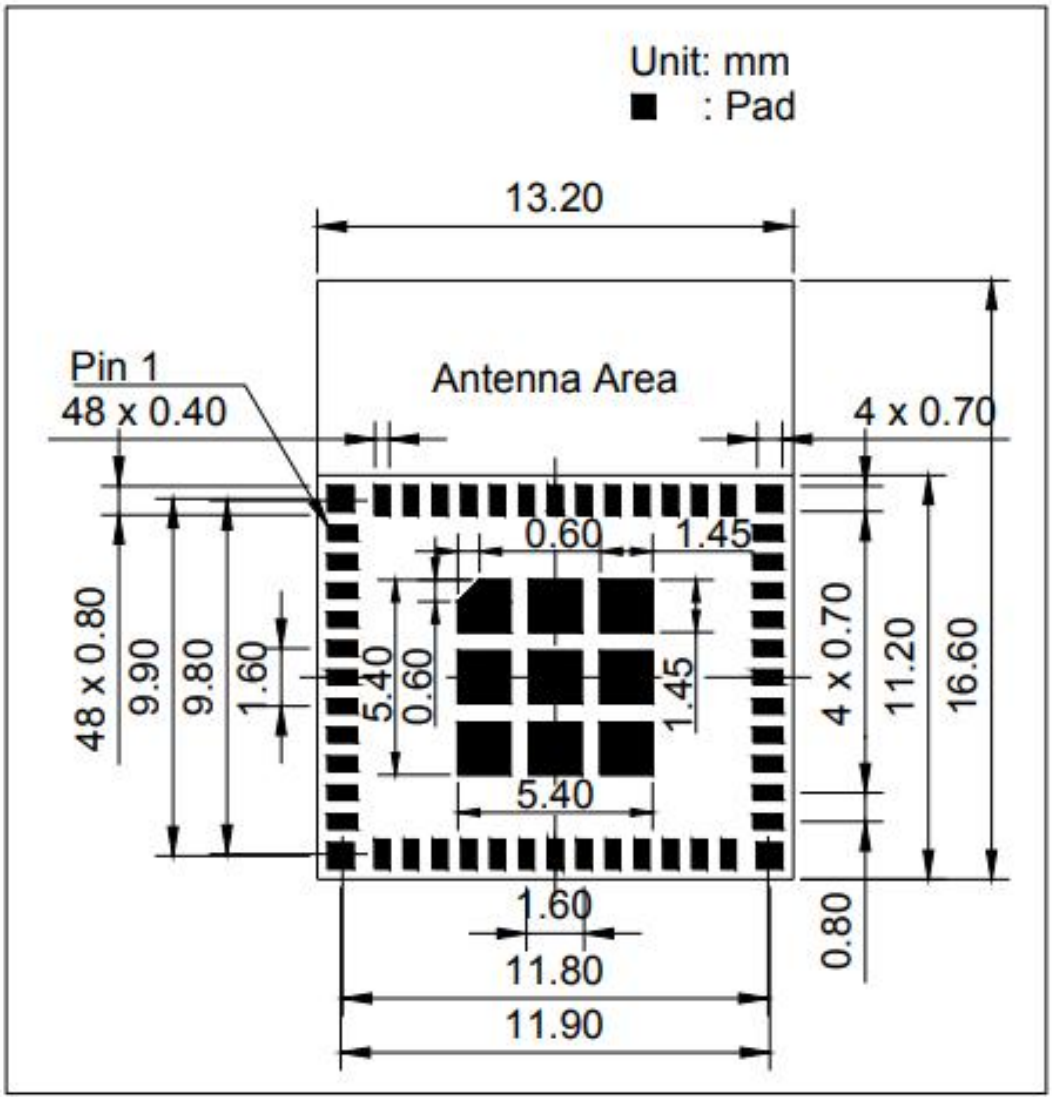


Chart 2- 6 PCB seal

3.4.2 ESP32-C6-MINI-1U Dimensional Drawing

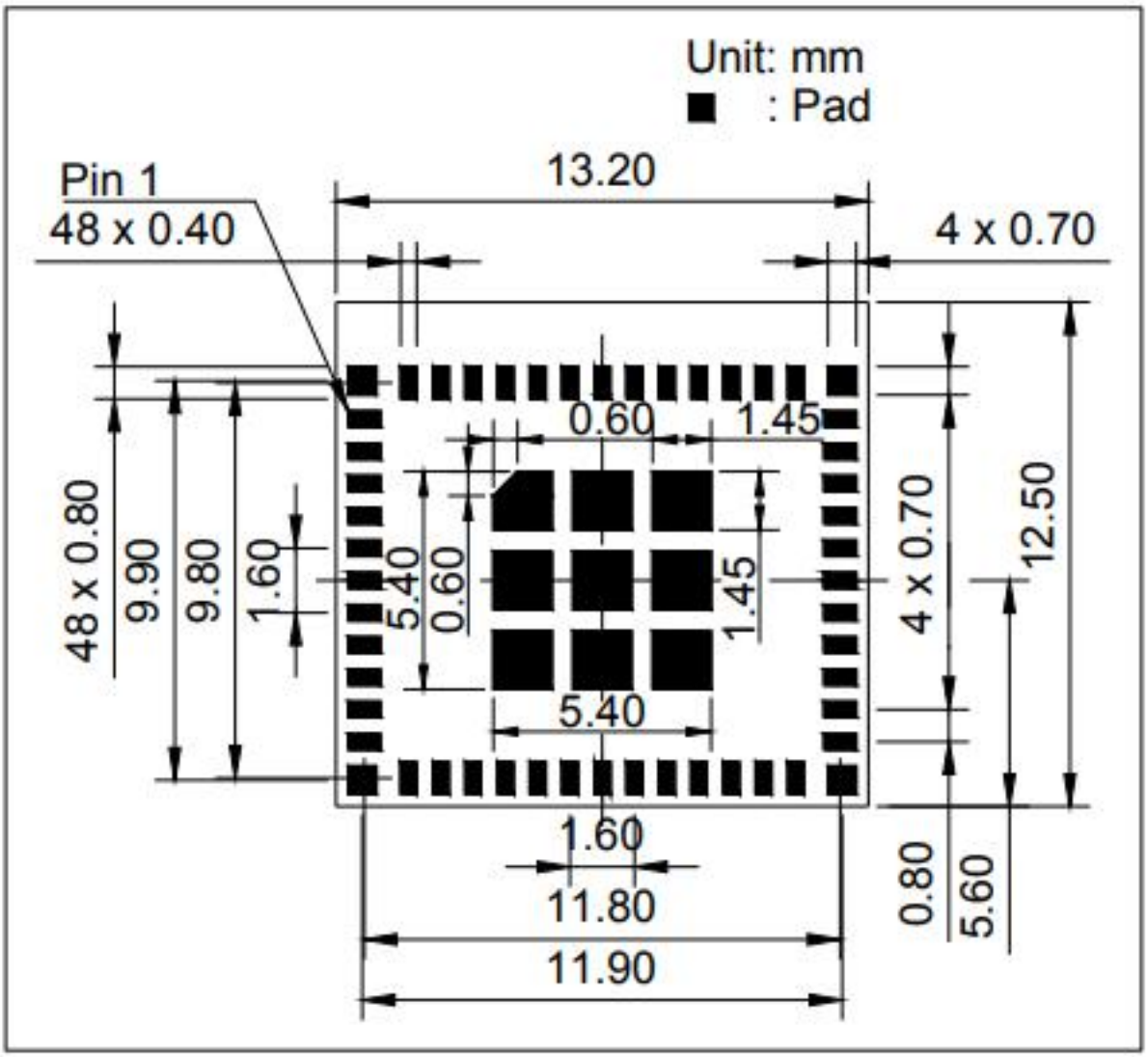


Chart 2- 7 PCB packaging

3.5 External antenna connector dimensions

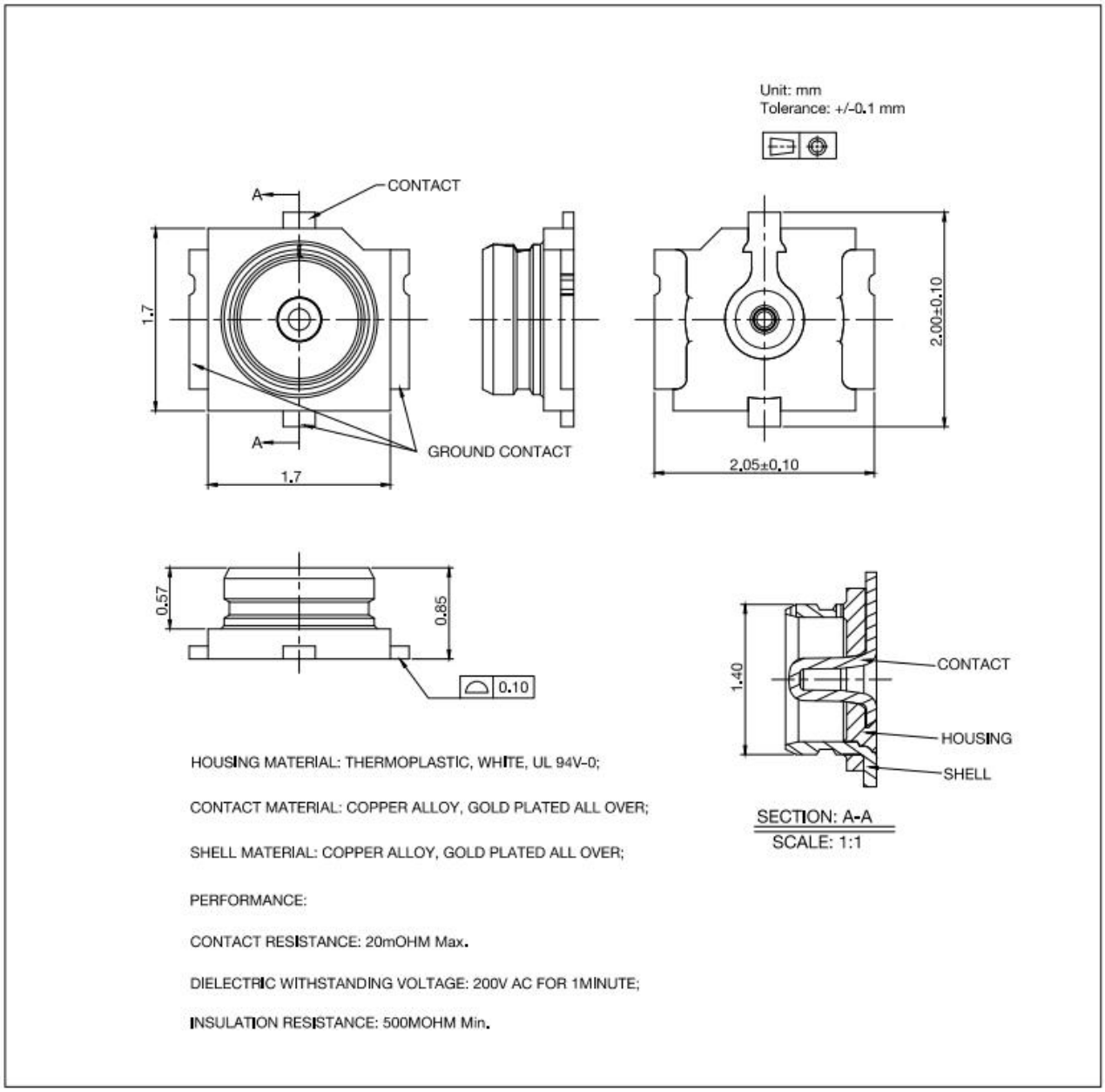


Chart 2- 8 External antenna connector dimensions

4. AT Commands

For details on AT commands, please see the download page "ESP32-C6-4MB-AT-V4.0.0.0"

5. Frequently Asked Questions

5.1 Transmission distance is not ideal

- When there are straight-line communication obstacles, the communication distance will be correspondingly attenuated;
- Temperature, humidity, and co-channel interference will cause the communication packet loss rate to increase;
- The ground absorbs and reflects radio waves, and the test effect is poor when close to the ground;
- Seawater has a strong ability to absorb radio waves, so the test results at the seaside are poor;
- If there are metal objects near the antenna, or if it is placed in a metal case, the signal attenuation will be very serious;
- The power register setting is wrong and the air rate is set too high (the higher the air rate, the closer the distance);
- The low voltage of the power supply at room temperature is lower than the recommended value. The lower the voltage, the smaller the power generated;

5.2 Modules are easily damaged

- Please check the power supply to ensure that it is within the recommended power supply voltage. If it exceeds the maximum value, it will cause permanent damage to the module;
- Please check the stability of the power supply. The voltage cannot fluctuate greatly and frequently;
- Please ensure anti-static operation during installation and use, as high-frequency devices are sensitive to static electricity;
- Please ensure that the humidity during installation and use should not be too high, as some components are humidity-sensitive devices;
- If there are no special needs, it is not recommended to use it at too high or too low temperature.

5.3 Bit error rate is too high

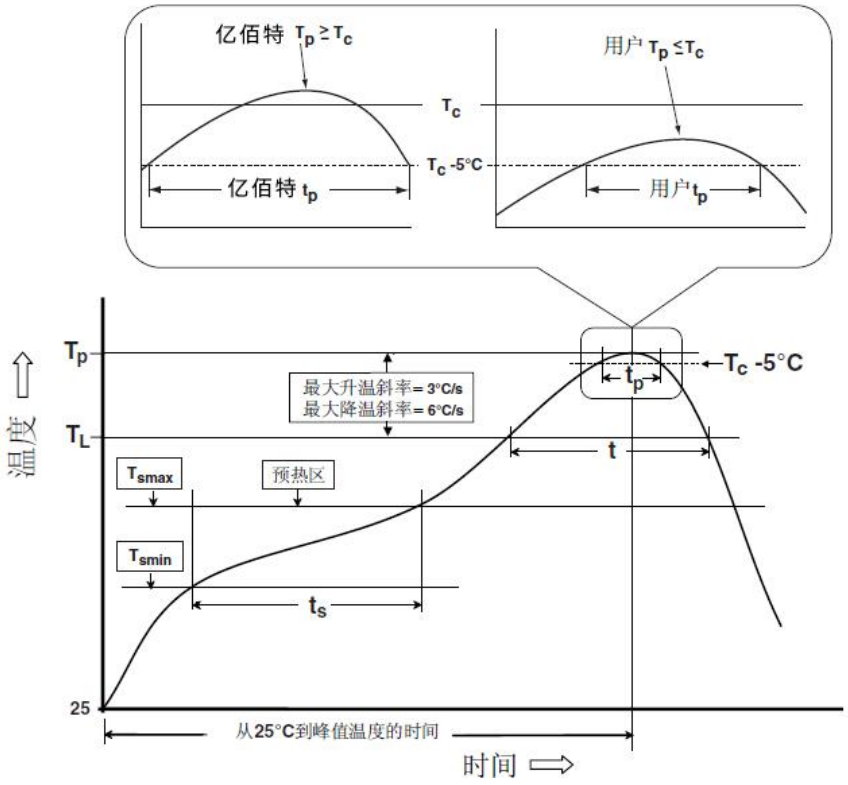
- If there is co-channel signal interference nearby, stay away from the interference source or modify the frequency or channel to avoid interference;
- The clock waveform on the UART is not standard, check whether there is interference on the UART line;
- Unsatisfactory power supply may also cause garbled code, so be sure to ensure the reliability of the power supply;

6. Welding Operation Guidance

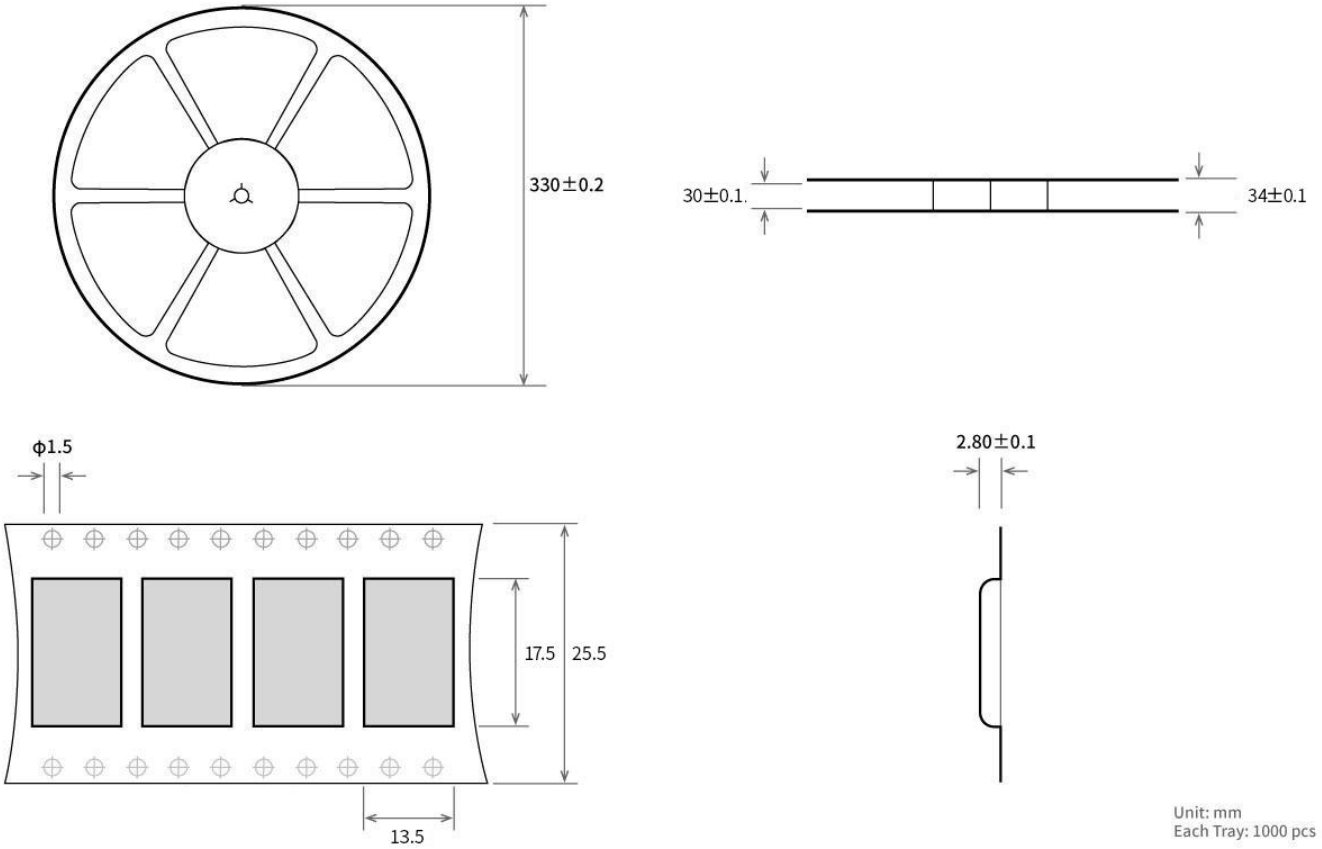
6.1 Reflow soldering temperature

Reflow soldering curve characteristics		Lead process assembly	Lead-free process assembly
Preheat/keep warm	Minimum temperature (T_{smin})	100℃	150℃
	Maximum temperature (T_{smax})	150℃	200℃
	Time (T_{smin} ~T_{smin})	60-120 seconds	60-120 seconds
Temperature rise slope (T_L ~T_P)		3℃/second, maximum	3℃/second, maximum
Liquidus temperature (T_L)		183℃	217℃
Holding time above T_L		60~ 90 seconds	60~ 90 seconds
Package peak temperature T_p		Users should not exceed the temperature indicated on the product's "Moisture Sensitivity" label.	Users should not exceed the temperature indicated on the product's "Moisture Sensitivity" label.
Time (Tp) within 5 ℃ of the specified grading temperature (Tc), see the figure below		20 seconds	30 seconds
Cooling slope (Tp ~T_L)		6℃/second, maximum	6℃/second, maximum
Time from room temperature to peak temperature		6 minutes, maximum	8 minutes, maximum
※The peak temperature (Tp) tolerance definition of the temperature curve is the upper limit of the user			

6.2 Reflow soldering curve



7. Packing



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Revise history

Version	Revision date	Revision Notes	Maintenance man
1.0	2024-4-2	initial version	Hao

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