ESPS3-32E

Product Specification

2.4GHz Wi-Fi & BLE5.0 Coexistence Module

Version: 1.0 Date: Feb.08, 2025

Features

- General
  - Chip: ESP32-S3 (S3RH2, S3R8) Series
  - Module Size:18mm x 19.2mm x 3mm
  - Xtensa®dualCore32-bit. LX7 microprocessor 240MHz
  - 384KB ROM
  - 512K SRAM
  - 16 KB RTC SRAM
- Wi-Fi Features
  - IEEE 802.11 b/g/n-compliant
  - Center frequency range of operating channel: 2412 ~ 2484 MHz
  - 1T1R mode with data rate up to 150 Mbps
  - TX/RX A-MPDU, TX/RX A-MSDU
  - Immediate Block ACK
- Bluetooth Features
  - Bluetooth® 5 (LE) Bluetooth mesh
  - Speed: 125 Kbps, 500 Kbps, 1 Mbps, 2 Mbps
  - Advertising extensions
  - Multiple advertisement sets
  - Channel selection algorithm #2
  - Coexistence of Wi-Fi and Bluetooth
- Peripheral Interfaces
  - GPIO * 36;
  - I2C;
  - I2S;
  - SDIO;
  - TWAI (CAN 2.0);
  - SPI;
  - EN ;
  - MCPWM;
  - ADC;
  - LED PWM;
- Working Temperature: -40℃~85℃

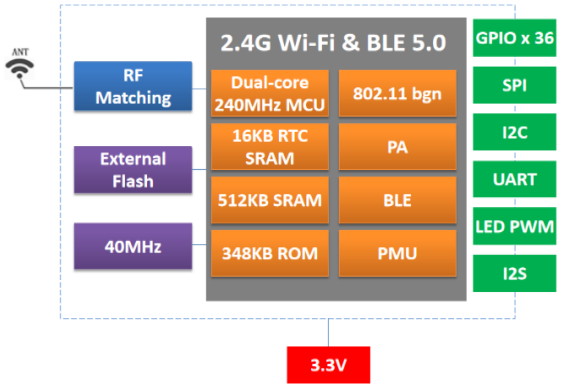
Applications

- Serial transparent transmission;
- Wi-Fi prober;
- Smart power plug/Smart LED light/Smart home;
- Camera product;
- Sensor networks;
- Over-the-top (OTT) devices;
- Wireless location system beacon;
- Industrial field bus;

Module Type

Model	Chip	Flash	PSRAM	Antenna
ESPS3-32E-N4	ESP32-S3	4MB	-	U. FL
ESPS3-32E-N8	ESP32-S3	8MB	-	U. FL
ESPS3-32E-N16	ESP32-S3	16MB	-	U. FL
ESPS3-32E-N16R2	ESP32-S3RH2	16MB	2MB	U. FL
ESPS3-32E-N16R8	ESP32-S3R8	16MB	8MB	U. FL

Module Structure



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Update Record

Date	Version	Update
2025-02-28	V1.0	First released

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1. Introduction

ESPS3-32E Wi-Fi and BLE coexistence Module is a highly integrated single-chip low power 802.11b/g/n Wireless LAN (WLAN) network controller. It combines a dual-core 240MHz CPU, WLAN MAC, a 1T1R capable WLAN baseband, RF, and Bluetooth in a single chip. It also provides a bunch of configurable GPIO, which are configured as digital peripherals for different applications and control usage.

ESPS3-32E integrates rich peripherals, including SPI, parallel IO, ADC,UART, I2C, I2S, RMT (TX/RX), LED pulse width modulation, USB2.0 serial port, JTAG controller, MCPWM, SDIO slave controller, GDMA, Twai ®controller, on-chip JTAG debugging function, event task matrix. And up to 36 GPIO and so on.

ESPS3-32E module use ESPS3-32E as Wi-Fi and BLE coexistence SOC chip.

ESPS3-32E module integrates internal memories for complete Wi-Fi protocol functions. The embedded memory configuration also provides convenient application developments.

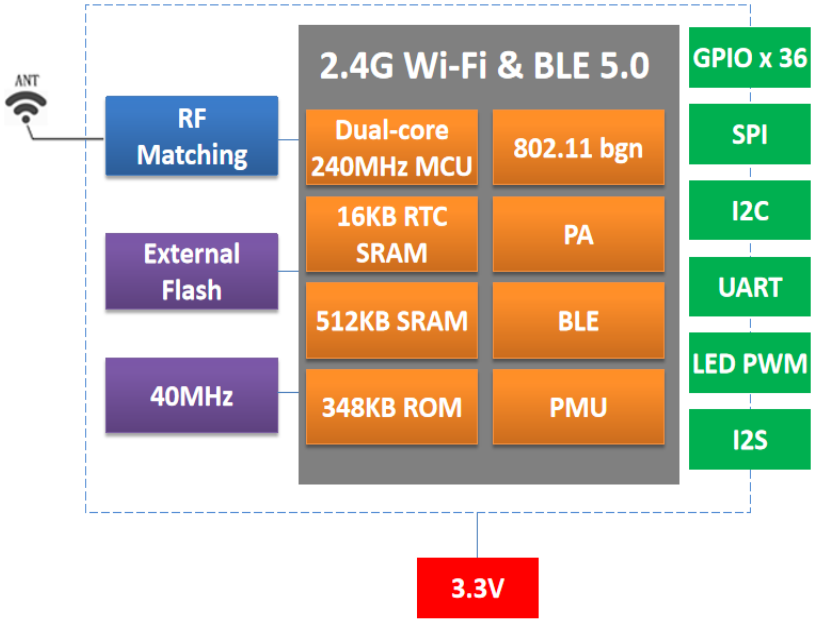


Fig.1.1 ESPS3-32E Module Structure

Technical parameters for ESPS3-32E are listed as follows.

Table.1.1 ESPS3-32E Parameters

Type	Item	Parameter
Wi-Fi	Frequency	2.4G~2.5G (2412M~2484M)
	Transmit power	802.11b: +19 dBm
		802.11g: +17 dBm
		802.11n: +14 dBm
	Receiver sensitivity	802.11b: -88 dBm (11Mbps)
		802.11g: -76 dBm（54Mbps）
		802.11n: -74 dBm（MCS7, HT20）
		802.11n: -71 dBm（MCS7, HT40）
	EVM	-24dB @802.11b,11Mbps @19dBm
		-27dB @802.11g,54Mbps @17dBm
		-29dB @802.11n,HT20,MCS7 @15dBm
		-29dB @802.11n,HT40,MCS7 @15dBm
		Optional printed circuit board antenna and IPEX1 base, default printed circuit board antenna
	Antenna	U.FL
BLE	RF power control range	-24~18dBm （2402 ~ 2480 MHz）
Hardware	CPU	Xtensa®dualCore32-bit.LX7microprocessor 240MHz
	Interface	UART/SDIO/SPI/I2C/GPIO
	Working voltage	3.0V ~ 3.6V(Standard 3.3V)
	Working temperature	-40°C ~ 85°C
	Environment temperature	-40°C ~ 105°C
	Shape	18mm x 19.2mm x 3mm
Software	Wi-Fi working mode	STA, Soft-AP and sniffer modes
	Security mode	WPS / WEP / WPA / WPA2 / WPA3
	Update firmware	UART Download/USB Download
	Software develop	SDK
	Network protocol	IPv4, TCP/UDP/HTTP/FTP/MQTT

2. Interface Definition

ESPS3-32E Wi-Fi & BLE module interface definition is shown as below。

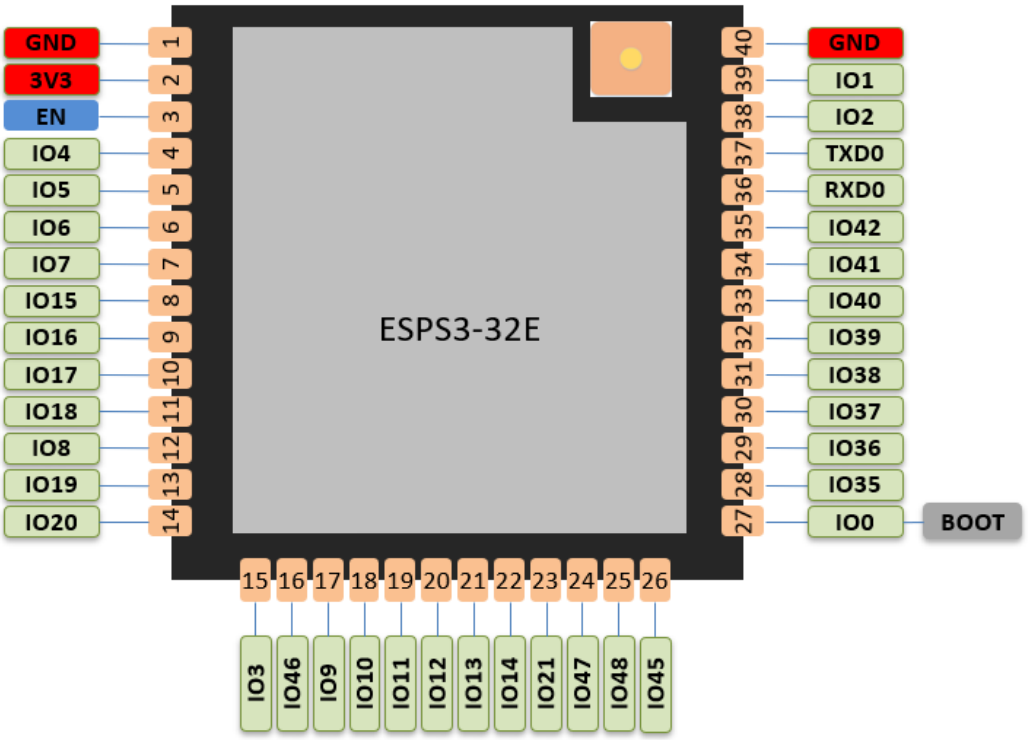


Fig.2.1 ESPS3-32E Pins Definition（Top view）

Working modes and pins function is shown in Table 2.1.

Table.2.1Working Mode

Mode	IO0 Voltage Level
UART Download Mode	LOW
Flash Boot Mode	HIGH (Default)

Table.2.2 Pins Function Definition

Num.	Pin Name	Type	Function
1	GND	P	Ground
2	3V3	P	Power supply

3	EN	I	Chip enable; Internal Pull-up. HIGH: enable the chip.
4	IO4	I/O	RTC_GPIO4, GPIO4, TOUCH4, ADC1_CH3
5	IO5	I/O	RTC_GPIO5, GPIO5, TOUCH5, ADC1_CH4
6	IO6	I/O	RTC_GPIO6, GPIO6, TOUCH6, ADC1_CH5
7	IO7	I/O	MTDO, GPIO7, LP_GPIO7, LP_I2C_SCL, FSPID
8	IO15	I/O	RTC_GPIO15, GPIO15, U0RTS, ADC2_CH4, XTAL_32K_P
9	IO16	I/O	RTC_GPIO16, GPIO16, U0CTS, ADC2_CH5, XTAL_32K_N
10	IO17	I/O	RTC_GPIO17, GPIO17, U1TXD, ADC2_CH6
11	IO18	I/O	RTC_GPIO18, GPIO18, U1RXD, ADC2_CH7, CLK_OUT3
12	IO8	I/O	RTC_GPIO8, GPIO8, TOUCH8, ADC1_CH7, SUBSPICS1
13	IO19	I/O	RTC_GPIO19, GPIO19, U1RTS, ADC2_CH8, CLK_OUT2, USB_D-
14	IO20	I/O	RTC_GPIO20, GPIO20, U1CTS, ADC2_CH9, CLK_OUT1, USB_D+
15	IO3	I/O	RTC_GPIO3, GPIO3, TOUCH3, ADC1_CH2
16	IO46	I/O	GPIO46
17	IO9	I/O	RTC_GPIO9, GPIO9, TOUCH9, ADC1_CH8, FSPIHD, SUBSPIHD
18	IO10	I/O	RTC_GPIO10, GPIO10, TOUCH10, ADC1_CH9, FSPICS0, FSPIIO4, SUBSPICS0
19	IO11	I/O	RTC_GPIO11, GPIO11, TOUCH11, ADC2_CH0, FSPID, FSPIIO5, SUBSPID
20	IO12	I/O	RTC_GPIO12, GPIO12, TOUCH12, ADC2_CH1, FSPICLK, FSPIIO6, SUBSPICLK
21	IO13	I/O	RTC_GPIO13, GPIO13, TOUCH13, ADC2_CH2, FSPIQ, FSPIIO7, SUBSPIQ
22	IO14	I/O	RTC_GPIO14, GPIO14, TOUCH14, ADC2_CH3, FSPIWP, FSPIDQS, SUBSPIWP
23	IO21	I/O	RTC_GPIO21, GPIO21
24	IO47	I/O	SPICLK_P_DIFF, GPIO47, SUBSPICLK_P_DIFF
25	IO48	I/O	SPICLK_N_DIFF, GPIO48, SUBSPICLK_N_DIFF
26	IO45	I/O	GPI45

27	IO0	I/O	RTC_GPIO0, GPIO0
28	IO35	I/O	SPIIO6, GPIO35, FSPID, SUBSPID
29	IO36	I/O	SPIIO7, GPIO36, FSPICLK, SUBSPICLK
30	IO37	I/O	SPIDQS, GPIO37, FSPIQ, SUBSPIQ
31	IO38	I/O	GPIO38, FSPIWP, SUBSPIWP
32	IO39	I/O	MTCK, GPIO39, CLK_OUT3, SUBSPICS1
33	IO40	I/O	MTDO, GPIO40, CLK_OUT2
34	IO41	I/O	MTDI, GPIO41, CLK_OUT1
35	IO42	I/O	MTMS, GPIO42
36	RXD0	I/O	U0RXD, GPIO44, CLK_OUT2
37	TXD0	I/O	U0TXD, GPIO43, CLK_OUT1
38	IO2	I/O	RTC_GPIO2, GPIO2, TOUCH2, ADC1_CH1
39	IO1	I/O	RTC_GPIO1, GPIO1, TOUCH1, ADC1_CH0
40	GND	P	Ground
41	EPAD	P	Ground

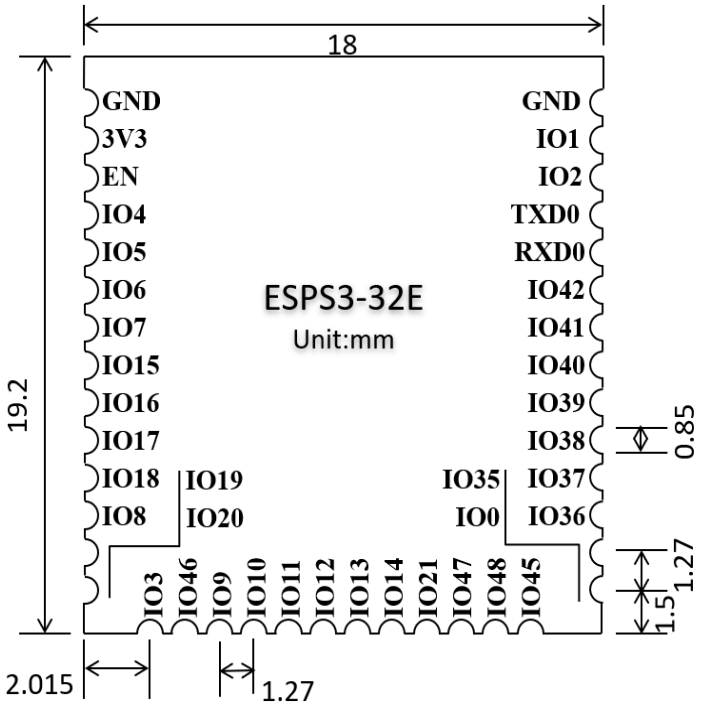
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3. Size and Layout

Size for ESPS3-32E can be shown as follows.



Fig.3.1 Shape for ESPS3-32E (Model in pic is ESPS3-32E-N16R8)



(a) （Top view）



(b) Side View

Fig.3.2 Size forESPS3-32E

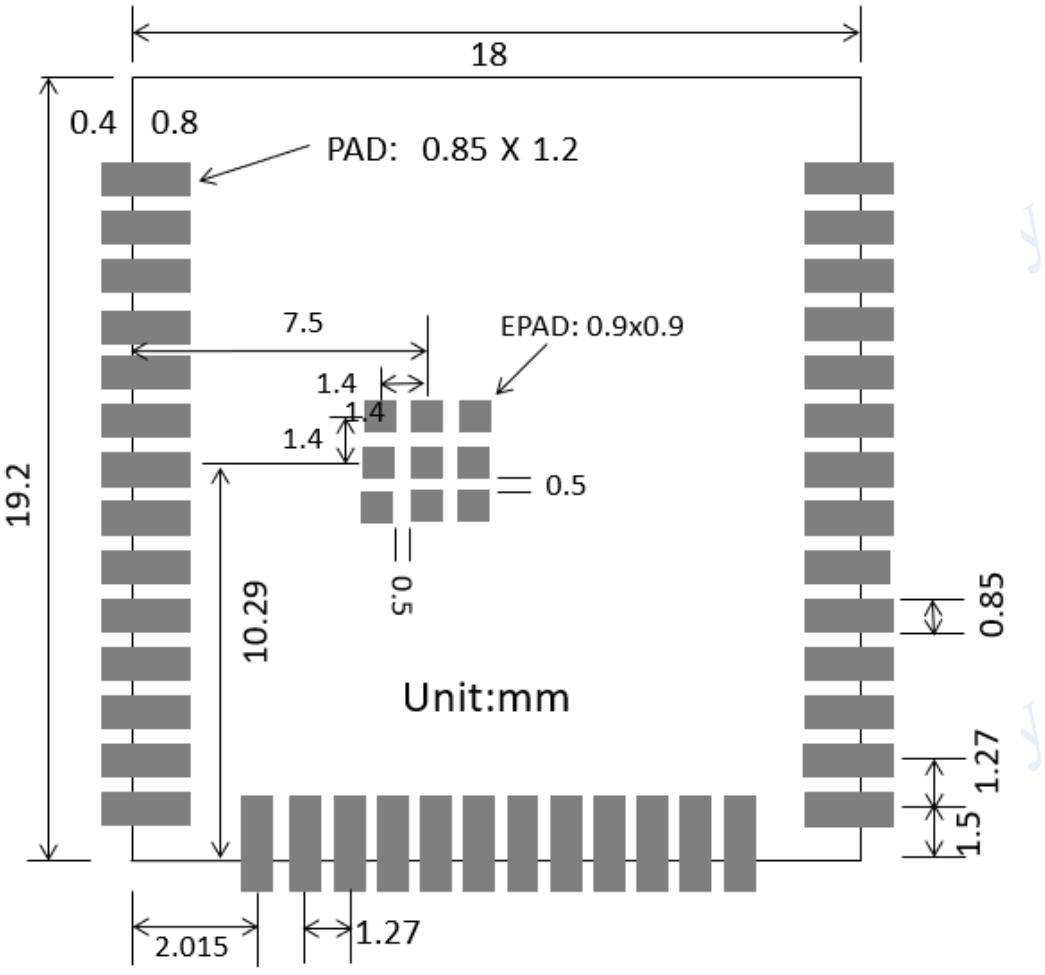


Fig. 3.3 PCB Layout for ESPS3-32E（Top view）

4. Electronica Characteristics

Table.4.1 Electronica Characteristics

Parameters	Condition	Min	Classical	Max	Unit
Store Temperature	-	-40	Normal	105	℃
Sold Temperature	IPC/JEDEC J-STD-020	-	-	260	℃

Working Voltage		-	3.0	3.3	3.6	V
I/O	V_{IL}	-	-0.3	-	0.25*VDD	V
	V_{IH}	-	0.75*VDD	-	VDD+0.3	
	V_{OL}	-	-	-	0.1*VDD	
	V_{OH}	-	0.8*VDD	-	-	
Electrostatic Release Quantity (Human model)		TAMB=25℃	-	-	2	KV
Electrostatic Release Quantity (Machine model)		TAMB=25℃	-	-	0.5	KV

5. Power Consumption

Table.5.1 Power Consumption

Parameters	Min	Classical	Max	Unit
RX 11n, HT20	-	-	88	mA
RX 11n, HT40	-	-	91	mA
TX 11b, 11Mbps @19dBm	-	-	326	mA
TX 11g, 54Mbps @17dBm	-	-	270	mA
TX 11n, HT20, MCS7, @15dBm	-	-	256	mA
TX 11n, HT40, MCS7, @15dBm	-	-	260	mA
Modem-sleep, CPU is powered on @40MHz	-	18	-	mA
Light-sleep	-	240	-	uA
Deep-sleep, RTC timer + RTC memory	-	7	-	uA
Power off, CHIP_PU is set to low level	-	1	-	uA

The peak current consumption of ESPS3-32E exceed 500mA when the module start work (RF calibration work consumes maximum current). Therefore, the recommended power supply is no less than 500mA.

Note:

1. Active Mode: CPU and RF are all turned on.

2. Modem-sleep Mode: CPU is turned on. RF and baseband are turned off, but the communication is still connected.

3. Light-sleep Mode: CPU is turned off. RTC/external interrupt/MAC can wake up the chip. The communication is still connected.

4. Deep-sleep Mode: Only RTC is turned on.

6. Wi-Fi RF Characteristics

The data in the following table is gotten when voltage is 3.3V in the indoor temperature environment.

Table.6.1 Wi-Fi TX Characteristics

Parameters	Min	Classical	Max	Unit
Input frequency	2412	-	2484	MHz
802.11b	-	19	-	dBm
802.11g,54Mbps	-	17		dBm
802.11n,MCS7	-	14	-	dBm

Table.6.2 Wi-Fi RX Sensitivity

Parameters	Min	Classical	Max	Unit
802.11b,1Mbps	-	-98	-	dBm
802.11b,11Mbps	-	-88	-	dBm
802.11g,6Mbps	-	-94	-	dBm
802.11g,54Mbps	-	-76	-	dBm
802.11n,HT20,MCS0	-	-93	-	dBm
802.11n,HT20,MCS7	-	-74	-	dBm
802.11n,HT40,MCS0	-	-90	-	dBm
802.11n,HT40,MCS7	-	-71	-	dBm

Table.6.3 Wi-Fi RX Characteristics

Parameters	Min	Classical	Max	Unit
ADJ Channel Rejection @11b, 1Mbps	-	35	-	dB
ADJ Channel Rejection @11b, 11Mbps	-	35	-	dB
ADJ Channel Rejection @11g, 6Mbps	-	31	-	dB

ADJ Channel Rejection @11g, 54Mbps	-	14	-	dB
ADJ Channel Rejection @11n,HT20,MCS0	-	31	-	dB
ADJ Channel Rejection @11n,HT20,MCS7	-	13	-	dB
ADJ Channel Rejection @11n,HT40,MCS0	-	19	-	dB
ADJ Channel Rejection @11n,HT40,MCS7	-	8	-	dB

7. Bluetooth LE Radio

Table.7.1 TX Transmitter General Characteristics（Bluetooth Radio 2402 ~ 2480 MHz）

Parameters	Min	Classical	Max	Unit
RF power control range	-24	4	10	dBm
ADJ channel Transmit Power @F-F0±2MHz	-	-37	-	dBm
ADJ channel Transmit Power @F-F0±3MHz	-	-42	-	dBm
ADJ channel Transmit Power @F-F0±>3MHz	-	-44	-	kHz
△f1avg	-	-	213	kHz
△f2max	196	-	-	kHz
ICFT	-	-10	-	kHz

Table.7.2 RX Transmitter General Characteristics（Bluetooth Radio 2402 ~ 2480 MHz）

Parameters		Min	Classical	Max	Unit
BLE	Sensitivity @30.8% PER	-92	-	-103	dBm
	Maximum received signal @30.8% PER	0	-	-	dBm
	Co-channel C/I	-	8	-	dB

8. Recommended Sold Temperature Curve

(1) Reflow Times <= 2 times (Max.)

(2) Max Rising Slope: 3℃/sec

(3) Max Falling Slope: -3℃/sec

(4) Over 217℃ Time: 60~120sec

(5) Peak Temp:240℃~250℃

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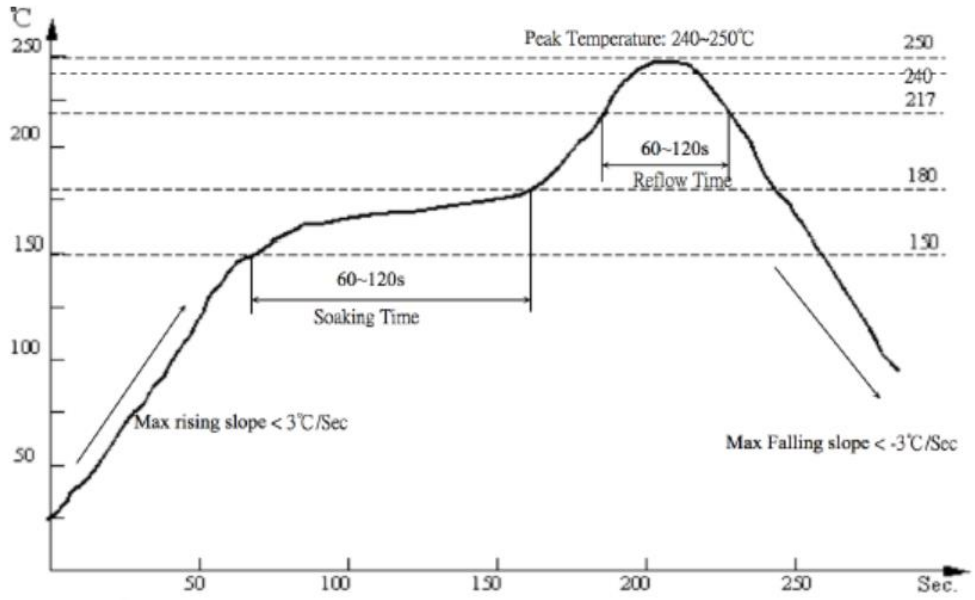


Fig.8.1 Recommended Reflow Profile

9. Minimum User System

This module can work just at 3.3V voltage condition:

Note:

(1) The working voltage for module is DC 3.3V;

(2) The max current from IO of this module is 40mA;

(3) Wi-Fi module is at download mode: IO0 is LOW level, then module reset to power;

(4) Wi-Fi module is connected to RXD of the other MCU, and TXD is connected to RXD of the other MCU.

10. U.FL RF Connector

ESPS3-32E module use U.FL type RF connector for external antenna connection. (IPEX V1.0).

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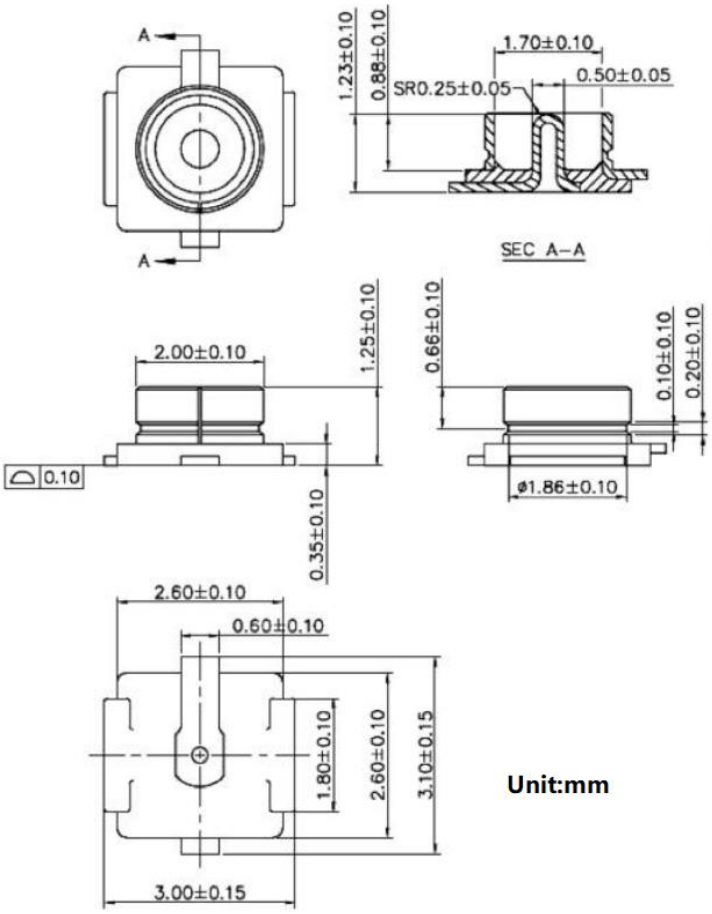


Fig.10.1 U.FL RF Connector

11. Peripheral Design Suggestion

Wi-Fi module is already integrated into high-speed GPIO and Peripheral interface, which may be generated the switch noise. If there is a high request for the power consumption and EMI characteristics, it is suggested to connect a serial 10~100 ohm resistance, which can suppress overshoot when switching power supply, and can smooth signal. At the same time, it also can prevent electrostatic discharge (ESD).

12. Product Handling

12.1 Storage Conditions

The products sealed in moisture barrier bags (MBB) should be stored in a non-condensing atmospheric environment of < 40 °C and 90%RH. The module is rated at the moisture sensitivity level (MSL) of 3. After unpacking, the module must be soldered within 168 hours with the factory conditions 25±5 °C and 60%RH. If the above conditions are not met, the module needs to be baked.

12.2 Electrostatic Discharge (ESD)

• Human body model (HBM): ±2000 V

• Charged-device model (CDM): ±500 V

13. Packing Instruction

The product is packed in a tray, as shown in the following figure.

The size of the single box is: 340 x 360 x 60mm, and 650 pieces module is in the box. And the outer box size is 355 x 375 x 325mm, including 5 single box which include 3250 pieces module.



Fig.13.1 Module Package

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