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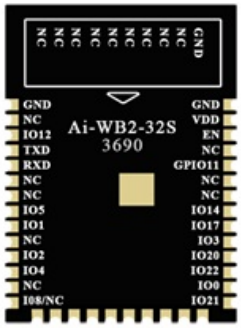
Ai-Thinker

Ai-Thinker Ai-WB2-32S Wi-Fi and BT Module



Product Usage Instructions

- Ai-WB2-32S is electrostatic sensitive, so handle with care to prevent damage.
- Follow ESD preventive measures as shown in the manual.
- Ensure the following electrical characteristics are maintained:
- The device operates in different modes with varying output power and receive sensitivity levels as outlined in the provided tables.
- For Bluetooth Low Energy performance, check the provided table for frequency range, rates, output power, and receive sensitivity.

Document resume

Version	Date	Develop/revise content	Edition	Approve
V1.0.0	2022.6.20	First Edition	NanNan Yuan	NingGuan
V1.0.1	2022.7.21	Update Rendering Figure	NanNan Yuan	NingGuan

Product Overview

- Ai-WB2-32S is a Wi-Fi& BT module developed by Shenzhen Ai-Thinker Technology Co., LTD.
- The module is equipped with BL602 chip as the core processor and supports the Wi-Fi 802.11b/ g/n protocol and the BLE 5.0 protocol.
- The BL602 chip has a low-power 32-bit RISC CPU, 276KB RAM, and a wealth of peripheral interfaces, including SDIO, SPI, UART, I2C, IR Remote, PWM, ADC, DAC, PIR, and GPIO.
- It can be widely used in the Internet of Things (IoT), mobile devices, wearable electronic devices, smart homes, and other fields.

Characteristic

- The package is SMD-38
- Support IEEE 802.11 b/g/n protocol
- Wi-Fi Security Support WPS/WEP/WPA/WPA2 Personal/WPA2 Enterprise/WPA3
- Supports 20MHz bandwidth, and the Max rate is 72.2 Mbps
- Bluetooth BLE 5.0, Bluetooth Mesh
- Support Station + BLE Station + SoftAP + BLE
- Support 32-bit RISC CPU 276KB RAM
- Secure startup, supports mirroring with ECC-256 signature
- Support QSPI/SPI Flash On-The-Fly AES Decryption, support AES 128 CTR
- Support AES 128/192/256-bit encryption engine
- Support SHA-1/224/256
- Support a true Random Number Generator (TRNG)
- Public key Accelerator (PKA) supports a large number of basic operations, software provides signature, verification, and other application program interfaces
- Support SDIO SPI UART I2C IR remote PWM ADC DAC PIR G PI, ,O etc
- Integrated Wi-Fi MAC/BB/RF/PA/LNA/BT
- Supports a variety of sleep modes, deep sleep current 12μA
- Universal AT instruction for quick start
- Support secondary development, an integrated Windows, Linux development environment

Main parameters

Table :1: Description of the main parameters

Model	Ai-WB2-32S
Package	SMD-38
Size	25.5*18.0*3.1(±0.2)mm
Antenna	on-board PCB antenna IPEX connector

Antenna Gain	on-board PCB antenna: 2.08dBi IPEX connector: FPC Antenna 3.44dBi
Frequency	2400 ~ 2483.5MHz
Package	SMD-38
Size	25.5*18.0*3.1(±0.2)mm
Antenna	on-board PCB antenna IPEX connector
Antenna Gain	on-board PCB antenna: 2.08dBi IPEX connector: FPC Antenna 3.44dBi
Frequency	2400 ~ 2483.5MHz
Operating temperature	-40℃ ~ 85℃
Storage temperature	-40℃ ~ 125℃, < 90%RH
Power supply	Support voltage 2.7V ~ 3.6V, supply current ≥500mA
Interface	UART/GPIO/ADC/PWM/I2C/SPI
IO	15
UART rate	Default 115200 bps
Security	WPS/WEP/WPA/WPA2 Personal/WPA2 Enterprise/WPA3
Flash	Default 4MByte MAX support 16MByte
Security	WPS/WEP/WPA/WPA2 Personal/WPA2 Enterprise/WPA3
Flash	Default 4MByte MAX support 16MByte

Static electricity requirement

- Ai-WB2-32S is an electrostatic sensitive device. Therefore, you need to take special precautions when carrying it.

Figure 2 ESD preventive measures

Electrical characteristics

Table 2: Electrical characteristics table

Parameters		Condition	Min.	Typical value	Max.	Unit
Voltage Supply		VDD	2.7	3.3	3.6	V
I/O	VIL	-	-	-	0.3*VDDIO	V
	VIH	-	0.7*VDDIO	-	-	V
	VOL	-	-	0.1*VDDIO	-	V
	VOH	-	-	0.9*VDDIO	-	V
	IMAX	-	-	-	15	mA

Wi-Fi RF Performance

Table 3: Wi-Fi RF performance table

Description	Typical value			Unit
Frequency range	2400 ~ 2483.5MHz			MHz
Output Power				
Mode	**Min.**	**Typical value**	**Max.**	**Unit**
11n Mode HT20， PA output power	-	16	-	dBm
11g Mode, PA output power	-	17	-	dBm
11b Mode, PA output power	-	19	-	dBm
Receive Sensitivity				
Mode	**Min.**	**Typical value**	**Max.**	**Unit**
11b， 1 Mbps	-	-98	-	dBm
11b, 11 Mbps	-	-90	-	dBm
11g, 6 Mbps	-	-93	-	dBm
11g， 54 Mbps	-	-76	-	dBm
11n， HT20 (MCS7)	-	-73	-	dBm

BLERF Performance

Table 4: BLE RF performance table

Description	Typical value			Unit
Frequency range	2400 ~ 2483.5MHz			MHz
Output Power				
Rate Mode	**Min.**	**Typical value**	**Max.**	**Unit**
1Mbps	-	9	15	dBm
Receive Sensitivity				
Rate Mode	**Min.**	**Typical value**	**Max.**	**Unit**
1Mbps sensitivity@30.8%PER	-	-96	-	dBm

Power

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

- All measurements are made at the antenna interface with a filter.
- All transmission data are based on a 100% duty cycle in continuous transmission mode.

Table 5 Power consumption

Mode	Min.	AVG	Max.	Unit
Tx 802.11b，11Mbps，POUT=+21dBm	-	260	-	mA
Tx802.11g，54Mbps，POUT =+18dBm	-	245	-	mA
Tx802.11n，MCS7，POUT =+17dBm	-	230	-	mA
Rx 802.11b,packet length 1024 byte	-	65	-	mA
Rx 802.11g,packet length 1024 byte	-	65	-	mA
Rx 802.11n,Packet length 1024 byte	-	65	-	mA
Deep-Sleep	-	12	-	μA

Appearance Dimensions

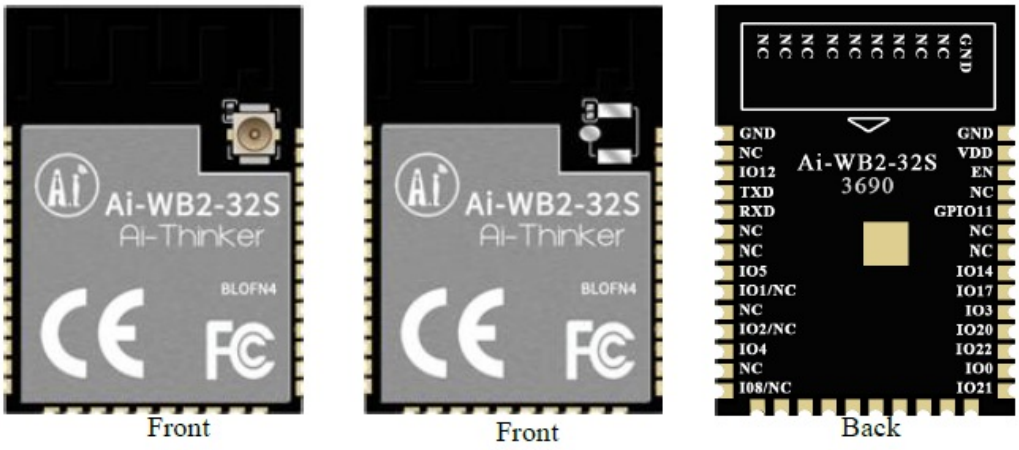


Figure 3 Appearance diagram (Rendering figure is for reference only,subject to physical objects)

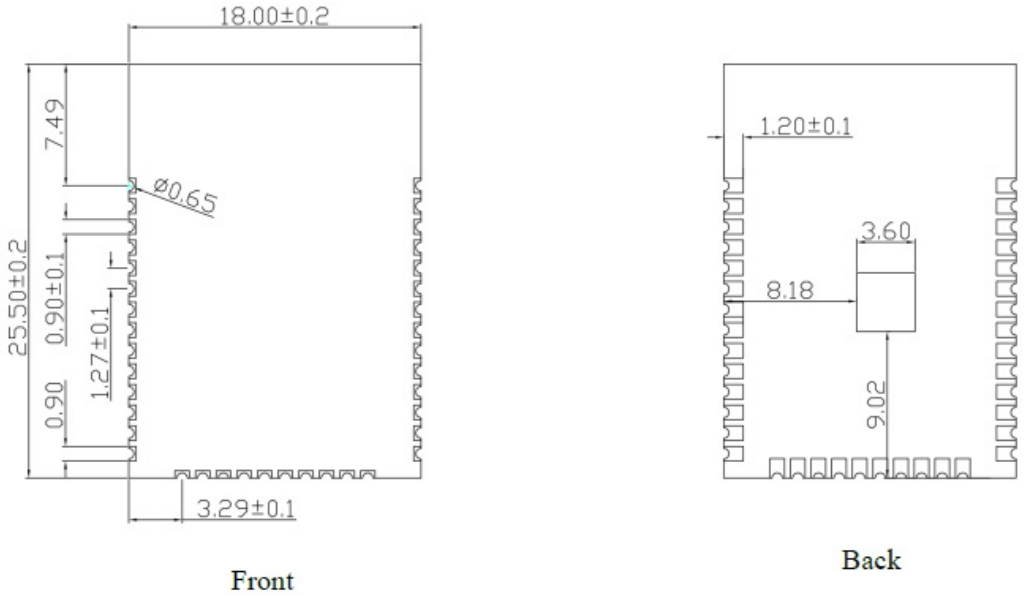


Figure 4 Dimension diagram

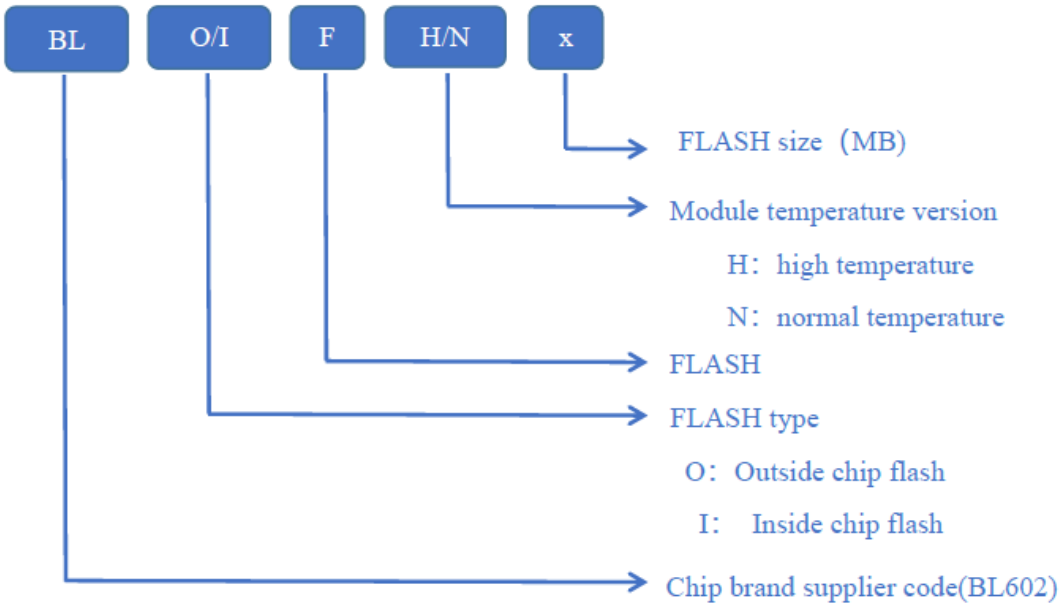


Figure 5 Shield printing information

Pin Definition

- Ai-WB2-32S module is connected with a total of 38 pins, as shown in the pin schematic diagram. The pin function definition table is the interface definition.

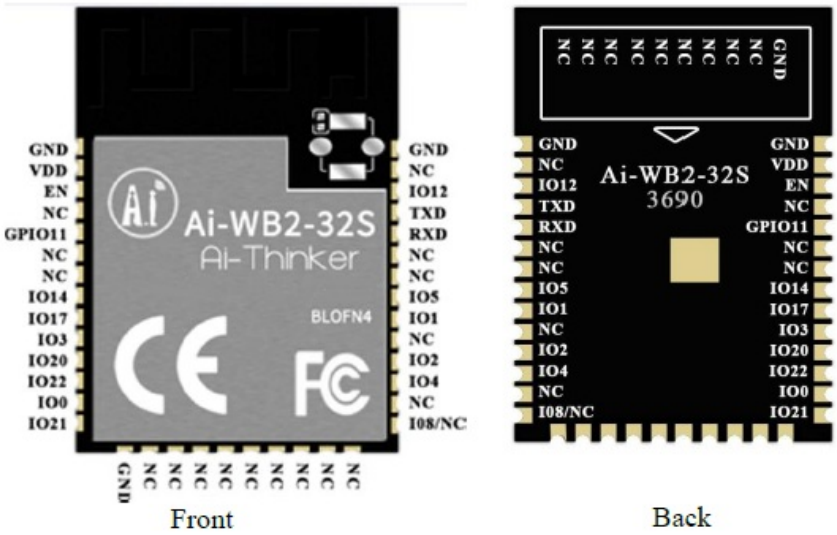


Figure 6 Schematic diagram of module pins

Table 6: Pin function definition table

No.	Name	Function
1,15,38	GND	Ground

2	VDD	3.3V power supply; It is recommended that the output current of the external power supply be higher than 500mA
3	EN	The default chip enable pin, active-high.
4,6,7,16-24,26,29,32,3	NC	NC is not available
5	GPIO11	GPIO11/SPI_SCLK/IIC_SDA/ADC_CH10/JTAG_TDI/TDO
8	IO14	GPIO14/SPI_SS/IIC_SCL/PWM_CH4/ADC_CH2/JTAG_TCK/TMS
9	IO17	GPIO17/SPI_MOSI/MISO/IIC_SDA/PWM_CH2/JTAG_TCK/TMS
10	IO3	GPIO3/SPI_SCLK/IIC_SDA/PWM_CH3/JTAG_TDO/TDI
11	IO20	It is not recommended to use. It is shared with the Flash in the module. If you need to use it, please contact Ai-Thinker. GPIO20/SPI_MOSI/MISO/IIC_SCL/PWM_CH0/JTAG_TMS/TCK
12	IO22	It is not recommended to use. It is shared with the Flash in the module. If you need to use it, please contact Ai-Thinker. GPIO22/SPI_SS/IIC_SCL/PWM_CH2/JTAG_TCK/TMS
13	IO0	It is not recommended to use. It is shared with the Flash in the module. If you need to use it, please contact Ai-Thinker. GPIO0/SDIO_CLK//SPI_MOSI/MISO/IIC_SCL/PWM_CH0/JTAG_TMS/TCK

14	IO21	It is not recommended to use. It is shared with the Flash in the module. If you need to use it, please contact Ai-Thinker. GPIO21/SPI_MOSI/MISO/IIC_SDA/PWM_CH1/JTAG_TDI/TDO
25	IO8/NC	Default NC, unavailable
27	IO4	GPIO4/SPI_MOSI/MISO/IIC_SCL/PWM_CH4/ADC_CH1
28	IO2	It is not recommended to use. It is shared with the Flash in the module. If you need to use it, please contact Ai-Thinker. GPIO2 /SPI_SS/IIC_SCL/PWM_CH2
30	IO1	It is not recommended to use. It is shared with the Flash in the module. If you need to use it, please contact Ai-Thinker. GPIO1/SPI_MOSI/MISO/IIC_SDA/PWM_CH1
31	IO5	GPIO5/SPI_MOSI/MISO/IIC_SDA/PWM_CH0/ADC_CH4/JTAG_TMS/TCK
34	RXD	RXD/GPIO7/SPI_SCLK/IIC_SDA/PWM_CH2/JTAG_TDO/TDI
35	TXD	TXD/GPIO16/SPI_MOSI/MISO/IIC_SCL/PWM_CH1/JTAG_TMS/TCK
36	IO12	GPIO12/SPI_MOSI/MISO/IIC_SCL/PWM_CH2/ADC_CH0/JTAG_TMS/TCK
9	IO17	GPIO17/SPI_MOSI/MISO/IIC_SDA/PWM_CH2/JTAG_TCK/TMS
10	IO3	GPIO3/SPI_SCLK/IIC_SDA/PWM_CH3/JTAG_TDO/TDI

11	IO20	It is not recommended to use. It is shared with Flash in the module. If you need to use it, please contact Ai-Thinker. GPIO20/SPI_MOSI/MISO/IIC_SCL/PWM_CH0/JTAG_TMS/TCK
12	IO22	It is not recommended to use. It is shared with the Flash in the module. If you need to use it, please contact Ai-Thinker. GPIO22/SPI_SS/IIC_SCL/PWM_CH2/JTAG_TCK/TMS
13	IO0	It is not recommended to use. It is shared with the Flash in the module. If you need to use it, please contact Ai-Thinker. GPIO0/SDIO_CLK//SPI_MOSI/MISO/IIC_SCL/PWM_CH0/JTAG_TMS/TCK
14	IO21	It is not recommended to use. It is shared with the Flash in the module. If you need to use it, please contact Ai-Thinker. GPIO21/SPI_MOSI/MISO/IIC_SDA/PWM_CH1/JTAG_TDI/TDO
25	IO8/NC	Default NC, unavailable
27	IO4	GPIO4/SPI_MOSI/MISO/IIC_SCL/PWM_CH4/ADC_CH1
28	IO2	It is not recommended to use. It is shared with Flash in the module. If you need to use it, please contact Ai-Thinker. GPIO2/SPI_SS/IIC_SCL/PWM_CH2
30	IO1	It is not recommended to use. It is shared with the Flash in the module. If you need to use it, please contact Ai-Thinker. GPIO1/SPI_MOSI/MISO/IIC_SDA/PWM_CH1

31	IO5	GPIO5/SPI_MOSI/MISO/IIC_SDA/PWM_CH0/ADC_CH4/JTAG_TMS/TCK
34	RXD	RXD/GPIO7/SPI_SCLK/IIC_SDA/PWM_CH2/JTAG_TDO/TDI
35	TXD	TXD/GPIO16/SPI_MOSI/MISO/IIC_SCL/PWM_CH1/JTAG_TMS/TCK
36	IO12	GPIO12/SPI_MOSI/MISO/IIC_SCL/PWM_CH2/ADC_CH0/JTAG_TMS/TCK

Design Guidance

Module application circuit

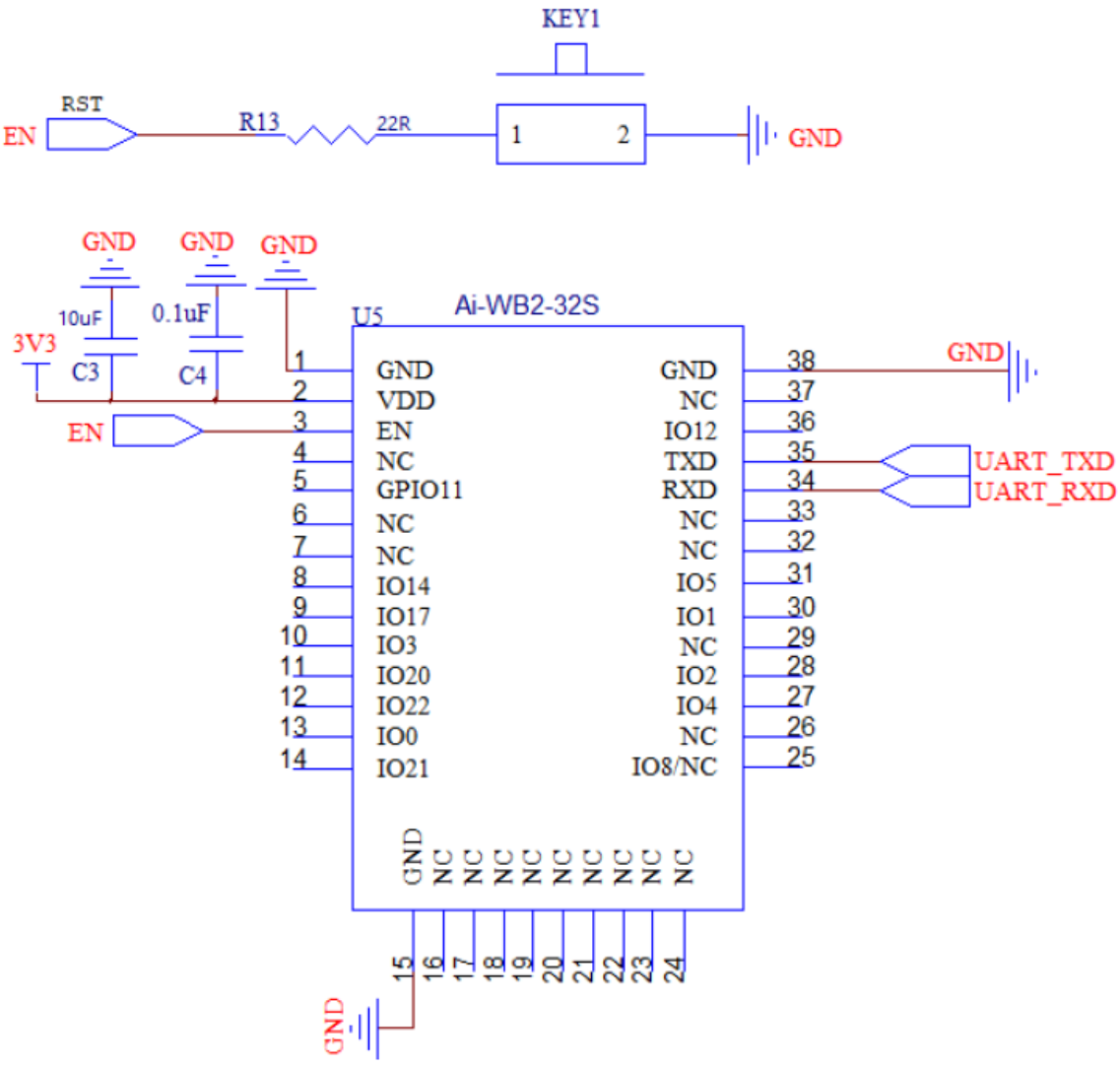
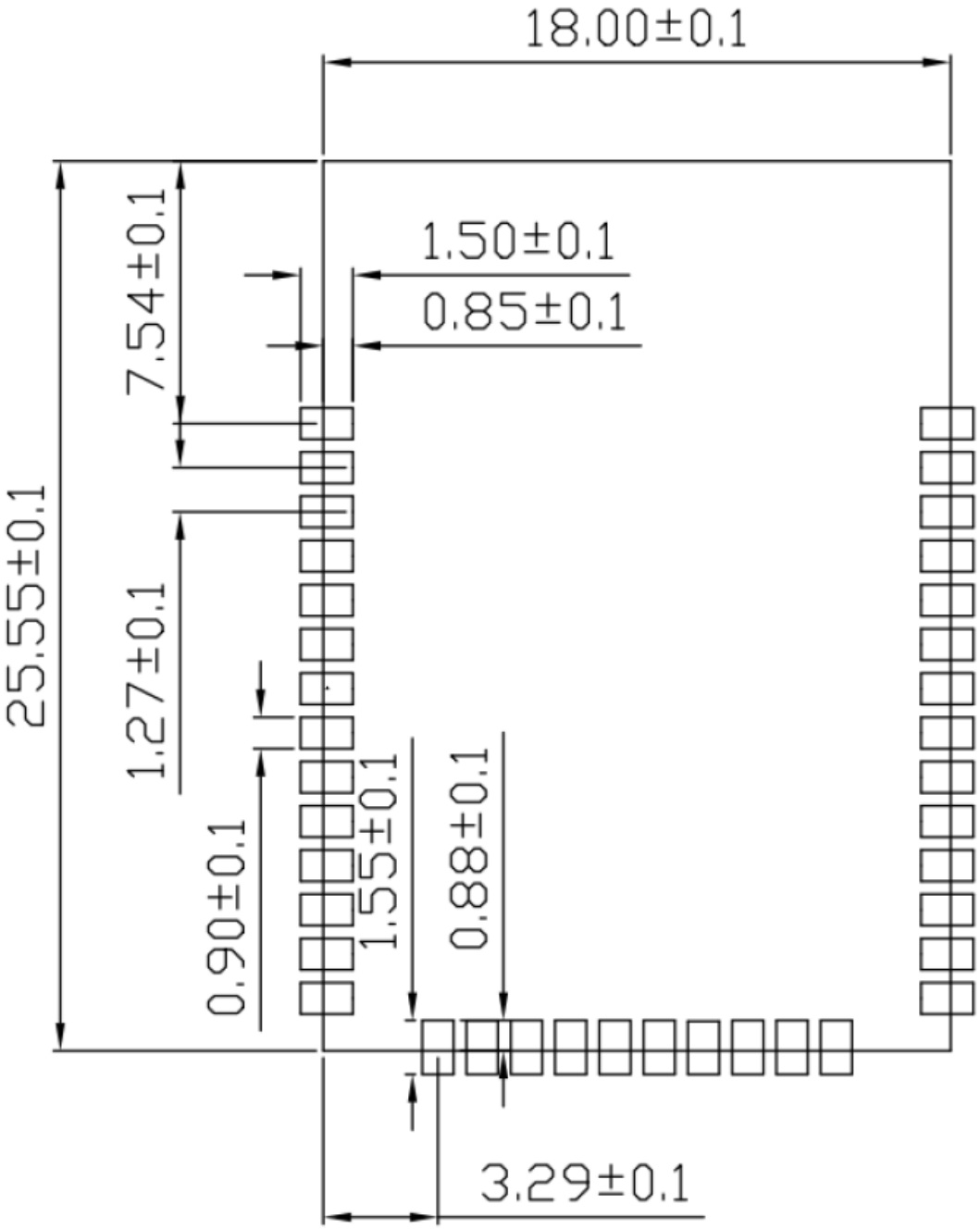


Figure 11 Application circuit diagram

- If the IO port is used as PWM, it is recommended to reserve a 4.7K pull-down resistor around the module. Especially in the application of light control, it can prevent the flashing light phenomenon at the moment of power-on start.
- The IO0/IO1/IO2/IO8/NC/IO20/IO21/IO22 pins are not available by default. If you need to use it, please contact Ai-Thinker.

Recommend PCB footprint size

Figure 12 Recommend PCB footprint size



Antenna layout requirements

- The following two methods are recommended for the installation position on the

mainboard:

- **Option 1:** put the module on the edge of the motherboard, and the antenna area extends out of the edge of the motherboard.
- **Option 2:** put the module on the edge of the motherboard, the edge of the motherboard at the antenna position, hollow out an area.

- In order to meet the performance of the onboard antenna, it is forbidden to place metal parts around the antenna and keep away from high-frequency devices.

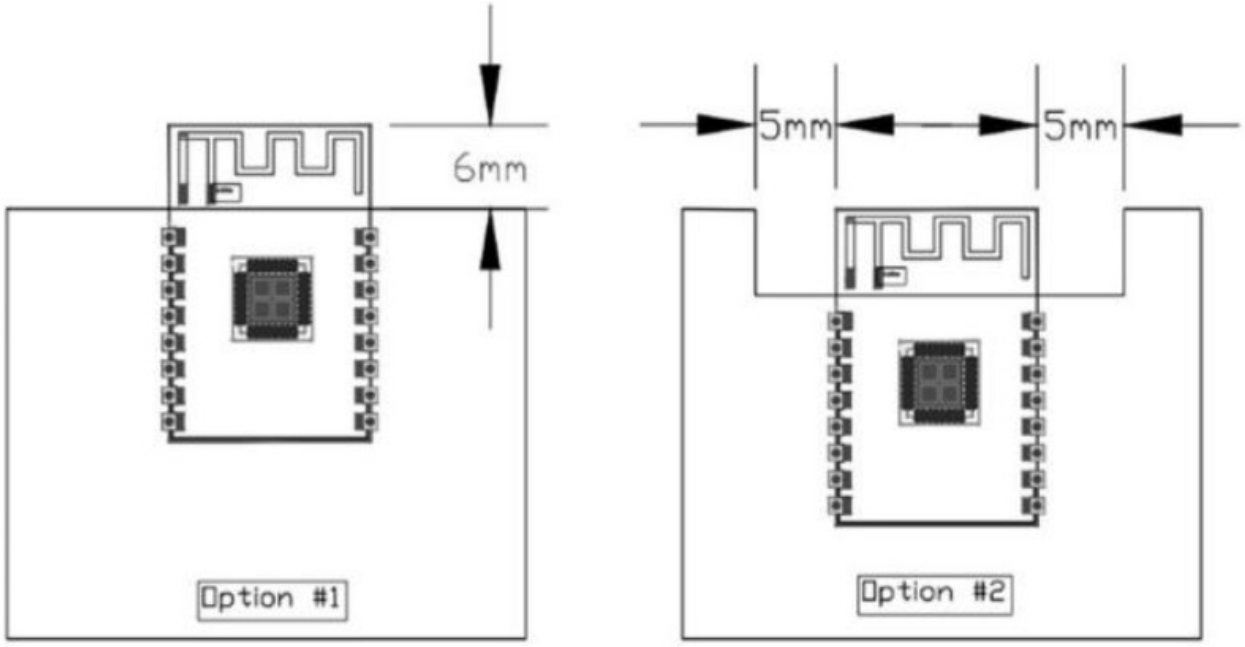


Figure 13 Antenna layout diagram

Power supply

- Recommended 3.3V voltage, peak current over 500mA.
- Power supply is recommended to use LDO; if the DC-DC is used, the ripple is recommended to be controlled within 30 mV
- DC-DC power supply circuit proposes to reserve the dynamic response capacitance to optimize the output ripple with large load changes.
- It is recommended to add ESD devices to the 3.3V power interface.

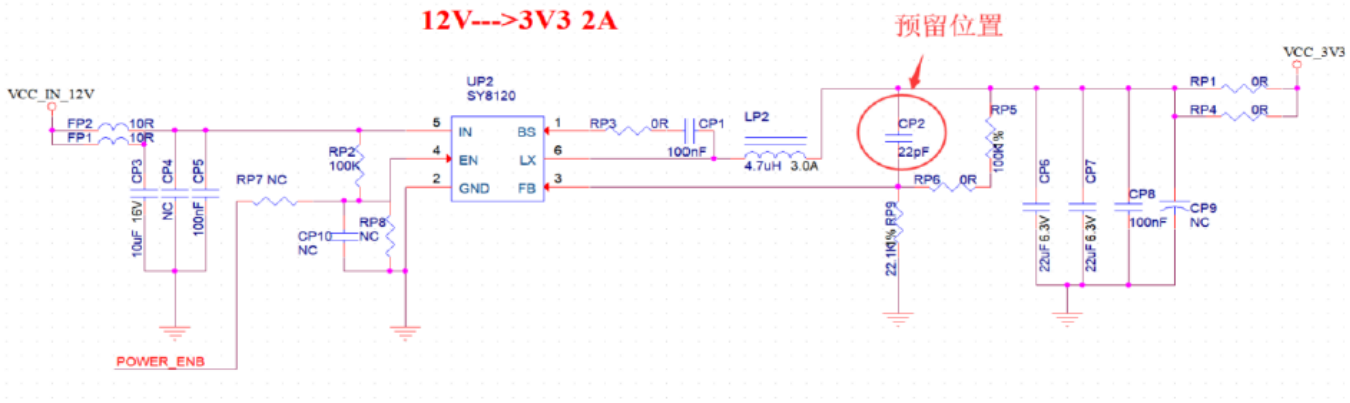


Figure 14 DC-DC step-down circuit diagram

GPIO

- 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 inhibits overshoot and makes both sides level more stable. It is helpful for EMI and ESD.
- For special I/O ports to be pulled up and down, refer to the usage instructions in the specifications, which may affect the module startup configuration.
- The IO port of the module is 3.3V. If the IO level of the main control and the module do not match, a level conversion circuit needs to be added.
- If the I/O port is directly connected to a peripheral port or terminals, for example, a pin row, reserve an ESD device near the terminal of the I/O cable.

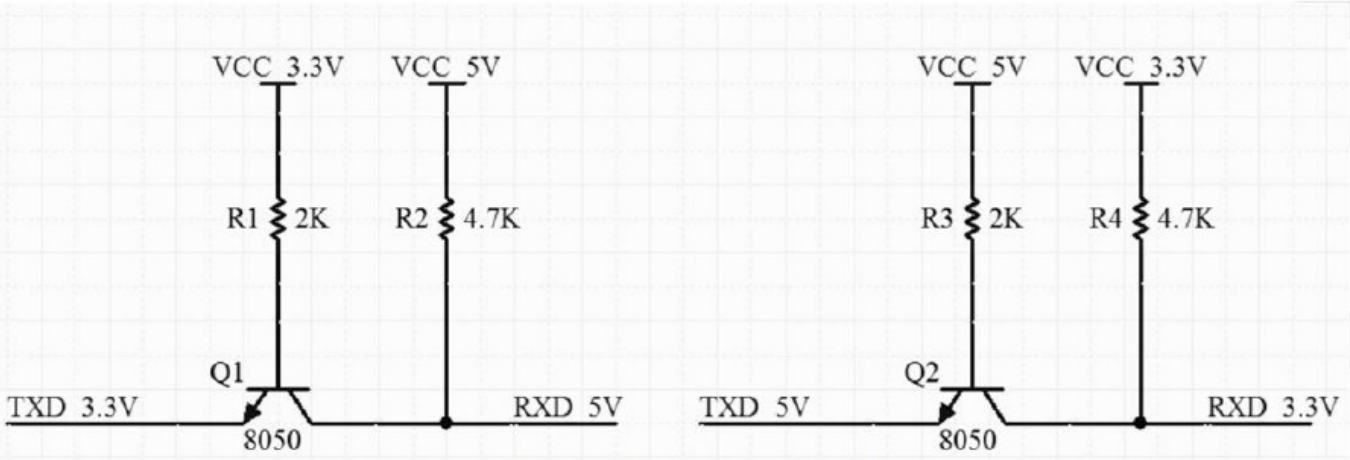


Figure 15 Level convert circuit

Storage conditions

- Products sealed in moisture-proof bags should be stored in a non-condensing atmosphere of <40 ° C /90% RH.

- The module has a moisture sensitivity rating of MSL 3.
- After the vacuum bag is opened, it must be used within 168 hours at 25±5℃/60%RH, otherwise it needs to be baked before it can be put on line again.

Reflow welding curve diagram

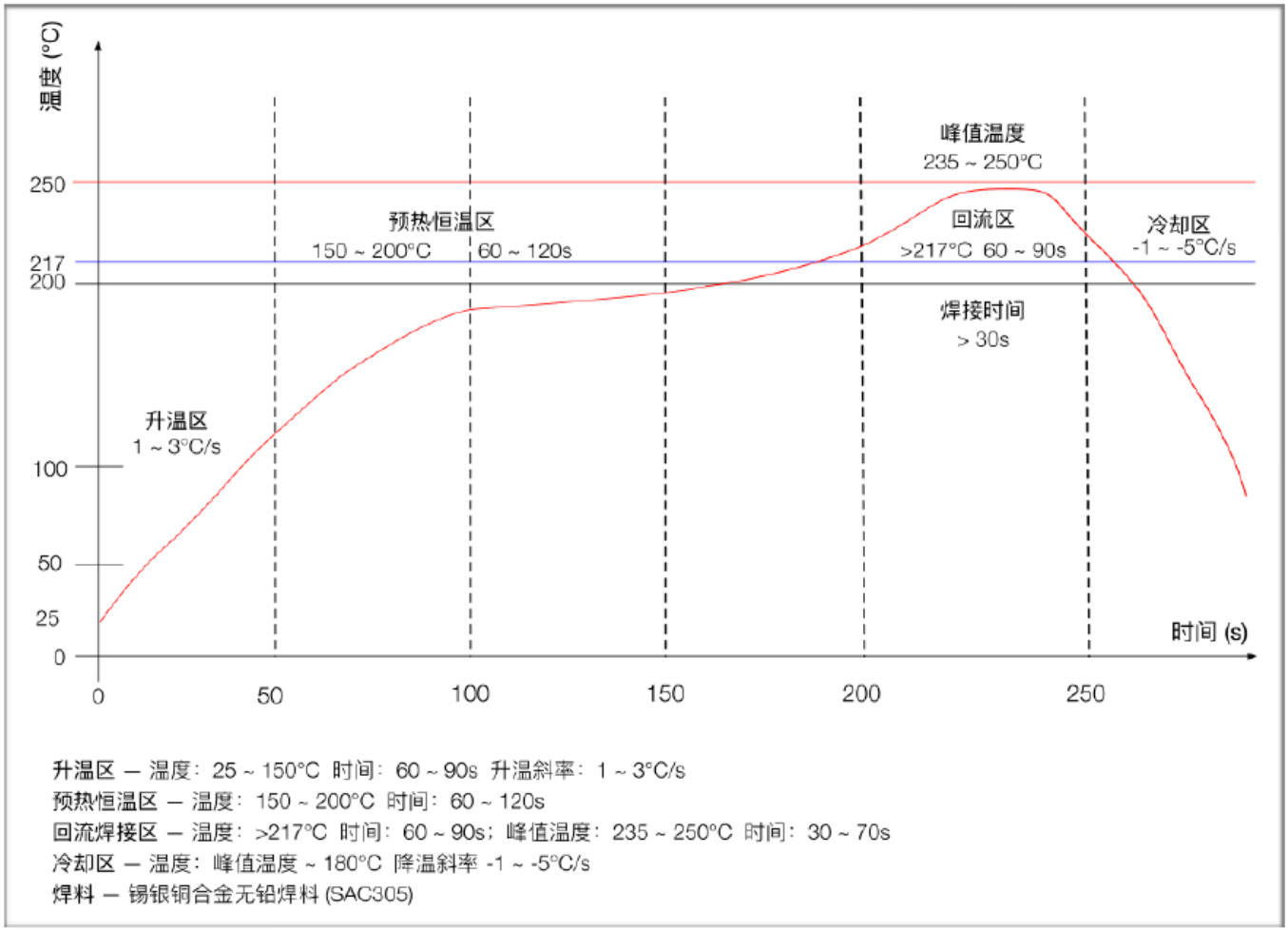


Figure 16 Reflow welding diagram

Product Packaging Information

- Ai-WB2-32S module was packaged in a tape, 800pcs/reel.As shown in the below image:

Figure 17 Package and packing diagram

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FCC STATEMENT

OEM/Integrators Installations

The module is limited to OEM installation only.
This product is mounted inside the end product only by professional installers, OEM. They use this module to change the power and control signal settings through the software of the end product within the scope of this application. The end user cannot change this setting. This device is intended only for OEM integrators under the following conditions:

1. The antenna must be installed such 20cm is maintained between the antenna and the users. This module may use two antennas, an on-board PCB antenna with a gain 2of .08dBi and an external FPC antenna with a gain of 3.44dBi through the IPEX connector. (Note: The two antennas cannot be used together.)
2. The transmitter module may not be co-located with any other transmitter or antenna.

As long as these two conditions are met, further transmitter test will not be required. However, integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.
The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user manual of the end product with integrates this module. The end user manual shall include all required regulatory information/warnings as shown in this manual.
If the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module.
This exterior label can use wording such as the following:

Contains Transmitter Module FCC ID: 2BMGHYR-WB2-32S”
When the module is installed inside another device, the user manual of this device must contain below warning statement:

Federal Communication Commission Interference Statement

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, according to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used under the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Radiation Exposure Statement:

- This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.
- This equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body.

Caution:

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment.

That separate approval is required for all other operating configurations, including portable configurations, to Part 2.1093 and different antenna configurations.

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- Ai-Thinker official website
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- Develop DOCS
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- Taobao shop
- Alibaba shop
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- Tel: +86-0755-29162996

WeChat mini program

WeChat official account

FAQ

- **Q: Is the Ai-WB2-32S compatible with Windows and Linux environments?**
  - **A:** Yes, the device supports secondary development and is integrated with Windows and Linux development environments.
- **Q: What are the typical power supply requirements for the Ai-WB2-32S?**
  - **A:** The device operates within a voltage supply range of 2.7V to 3.6V.

- **Q: How should I handle the Ai-WB2-32S to prevent damage due to static electricity?**
  - **A:** The Ai-WB2-32S is electrostatic sensitive; hence, follow ESD preventive measures as indicated in the manual to avoid damage while handling the device.

Documents / Resources

	Ai-Thinker Ai-WB2-32S Wi-Fi and BT Module [pdf] Owner's Manual 2BMGHYR-WB2-32S, 2BMGHYRWB232S, yr wb2 32s, Ai-WB2-32S Wi-Fi and BT Module, Ai-WB2-32S, Wi-Fi and BT Module, BT Module, Module

References

- User Manual

Ai-Thinker

2BMGHYR-WB2-32S, 2BMGHYRWB232S, Ai-Thinker, Ai-WB2-32S, Ai-WB2-32S Wi-Fi and BT Module, BT Module, Module, Wi-Fi And BT Module, yr wb2 32s

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