Ai-WV01-32S Specification

版本 V1.1.2

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Document Resume

Version	date	Develop/revise content	Formulate	Approved
V1.1.0	2025.7.30	First formulated	Qiao Rongxin	Guan Ning
V1.1.1	2025.8.26	Modify the serial port rate	Qiao Rongxin	Guan Ning
V1.1.2	2025.9.10	Add side dimension diagrams	Qiao Rongxin	Guan Ning

Content

1. Product Overview

Ai-WV01-32S is a Wi-Fi & BT & AIoT smart voice module developed by Shenzhen Ai-Thinker Technology Co., Ltd. The module is equipped with BL602 and VB6824 chips as core processors. Wireless support Wi-Fi The 802.11b/g/n and BLE 5.0 protocols are supported. For voice, the AI voice algorithm achieves enhanced noise reduction, highly reliable wake-up recognition rates, high-definition call quality, a richer range of offline voice control commands, faster response recognition times, and offline + online hybrid recognition capabilities . It can be widely used in AI voice products, audio and video multimedia, the Internet of Things (IoT), mobile devices, smart homes, and other fields.
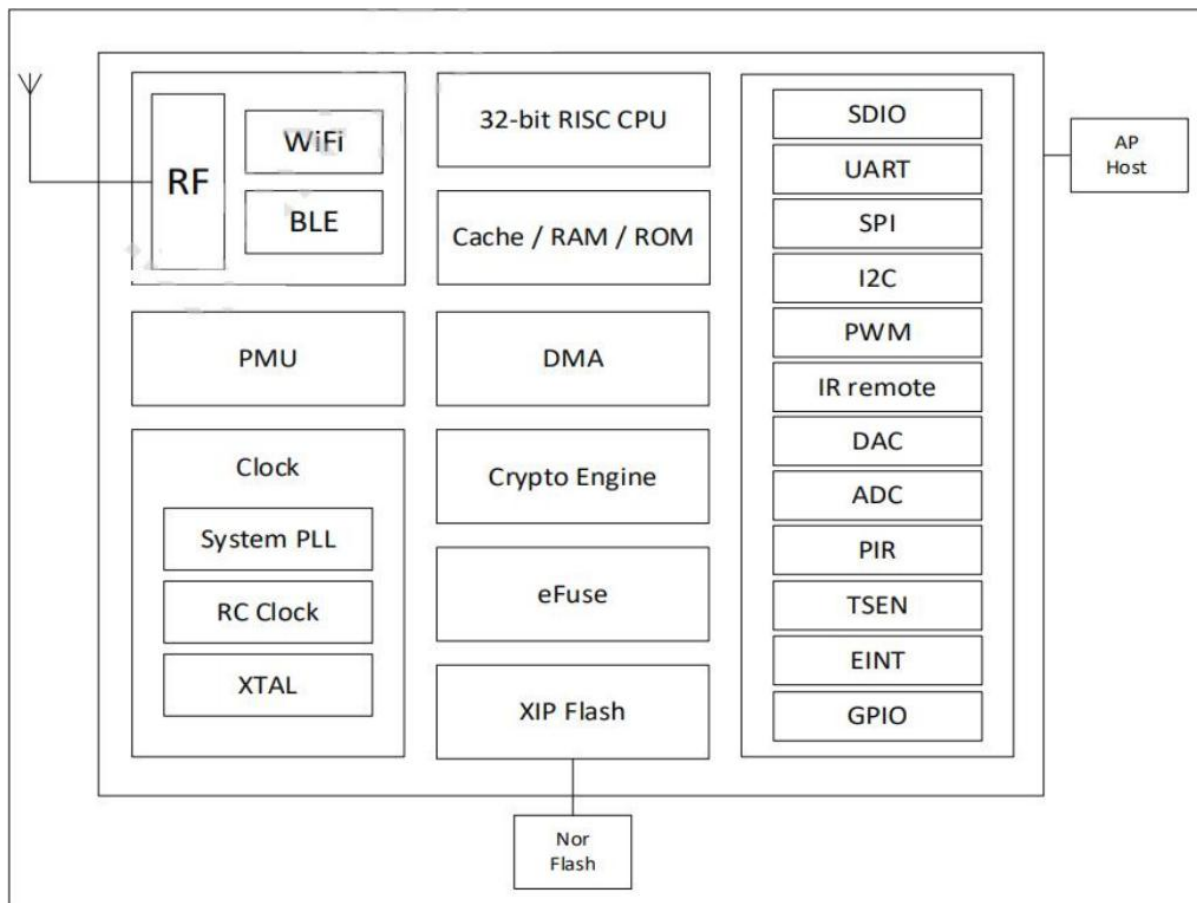

Figure 1 Main chip architecture diagram

1.1. Characteristic

■ SMD-40 package

■ Supports IEEE 802.11 b/g/n protocols

■ Wi-Fi security supports WPS/WEP/WPA/WPA2 Personal/WPA2 Enterprise/WPA3

■ Supports 20MHz bandwidth and a maximum rate of 72.2 Mbps

■ Bluetooth Low Energy 5.0, Bluetooth Mesh

■ Support Station + BLE mode, Station + SoftAP + BLE mode

■ Support 32-bit RISC CPU, 276KB RAM

■ Support SDIO, SPI, UART, I2C, IR remote, PWM, ADC, DAC, PIR , GPIO , etc.

■ Support QSPI/SPI Flash on-the-fly AES decryption (OTFAD), support AES 128 CTR
mode

■ Support AES 128/192/256-bit encryption engine

■ Support background noise suppression

■ Support speech recognition (ASR) algorithm

■ Support voice noise reduction algorithm

■ Support multiple sleep modes, deep sleep

■ Supports secondary development and integrates Windows and Linux development
environments

2. Main parameters

Table 1 Description of main parameters

Model	Ai-WV01-32S
Encapsulation	SMD-40
Size	25.5*18.0*3.1(mm)
Antenna type	Onboard antenna/IPEX
Spectrum range	2400 ~ 2483.5MHz
Operating temperature	-40℃ ~ 85℃
Storage Environment	-40℃ ~ 125℃, < 90%RH
Power supply	3V3 pin voltage 3.3 V, current ≥ 500mA ; 5V/DACR pin voltage 5V, current ≥ 1 A
Supported interfaces	UART/GPIO/ADC/PWM/I2C/SPI
Available IO	14
Serial port rate	Default 2000000 bps
Security	WPS/WEP/WPA/WPA2 Personal/WPA2 Enterprise/WPA3
Flash	The default value is 4MByte, and the maximum supported value is 16MByte.

2.1. Static electricity requirements

Ai-WV01-32S is electrostatic sensitive device and requires special precautions when handling.

Figure 2 ESD anti-static diagram

2.2. Electrical characteristics

Table 2 Electrical characteristics

Parameter		Pins	Minimum	Typical	Maximum	Unit
Supply voltage		3V3 pin	2.7	3.3	3.6	V
		5V/DACR pin	2.5	5	6	V
I/O	VIL		-	-	-	0.3*VDDIO	V
	VI H		-	0.7 *VDDIO	-	-	V
	VOL		-	-	0. 1*VDDIO	-	V
	VOH		-	-	0.9 *VDDIO	-	V
	IMAX		-	-	-	15	mA

2.3. Wi-Fi RF performance

Table 3 Wi-Fi RF performance

Describe	Typical values			Unit
Spectrum range	2400 ~ 2483.5MHz			MHz
Output power				
Model	Minimum	Typical	Maximum	unit
11n mode HT20, PA output power	-	16	-	dBm
In 11g mode, PA output power	-	17	-	dBm
In 11b mode, PA output power	-	19	-	dBm
Receive sensitivity				
Model	Minimum	Typical	Maximum	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

2.4. BLE RF performance

Table 4 BLE radio frequency performance

Describe	Typical values			Unit
Spectrum range	2400 ~ 2483.5MHz			MHz
Output Power				
Rate Mode	Minimum	Typical values	Maximu	Unit
1Mbps	-	9	15	dBm
Receive Sensitivity				
Rate Mode	Minimum	Typical values	Maximu	Unit
1Mbps Sensitivity@30.8%PER	-	-96	-	dBm

2.5. Power consumption

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

■ All transmit data is measured based on 100 % duty cycle in continuous transmit mode.

Table 5 Power consumption

Model	Minimum	Average	Maximum	Unit
Transmit 802.11b , 11 Mbps , POUT=+ 20	-	281	-	mA
Transmit 802.11g , 54Mbps , POUT = +1 8	-	252	-	mA
Transmit 802.11n , MCS7 , POUT = +1.7 dBm	-	266	-	mA
Receive 802.11b , packet length 1024 bytes	-	94	-	mA
Receive 802.11g , packet length 1024 bytes	-	94	-	mA
Receive 802.11n , packet length 1024 bytes	-	94	-	mA

3. Appearance dimensions

On-board front   IPEX front   Back
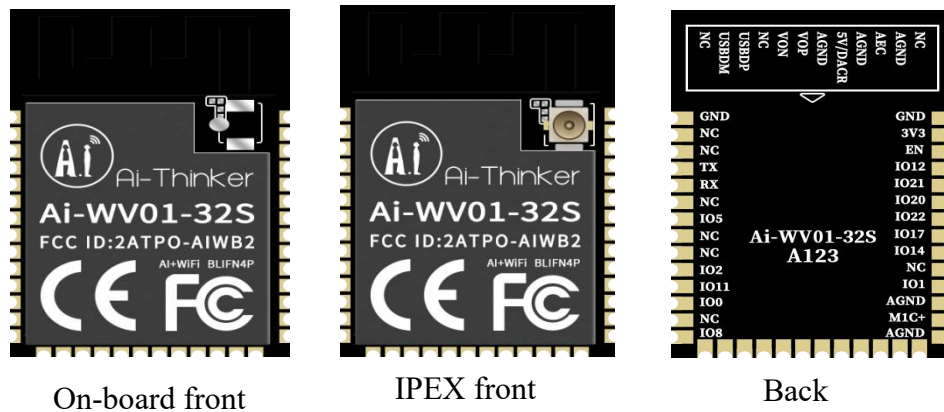
Figure 3 Appearance (rendering is for reference only, the actual product shall prevail)

Front   Side   Back

Figure 4 Dimensional drawing

BL	O/I	F	H/N	x	P

Module is equipped with an audio power amplifier

FLASH Size（MB）

Module temperature version

H: high temperature

N: normal temperature

FLASH

FLASH Type
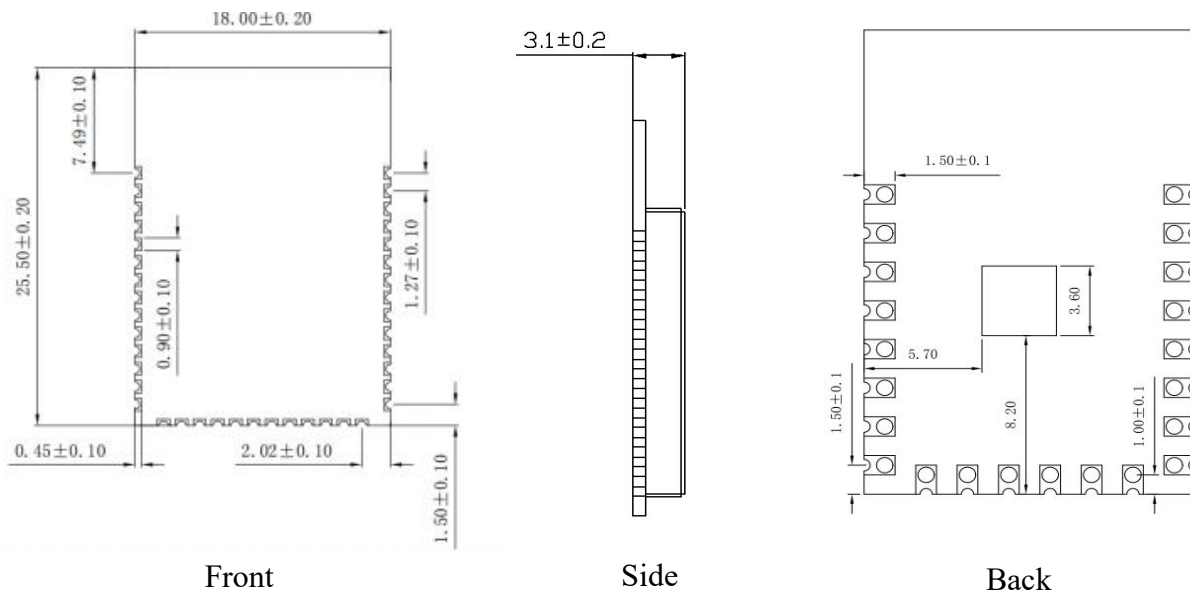
O:Chip external FLASH

I:Chip built-in FLASH
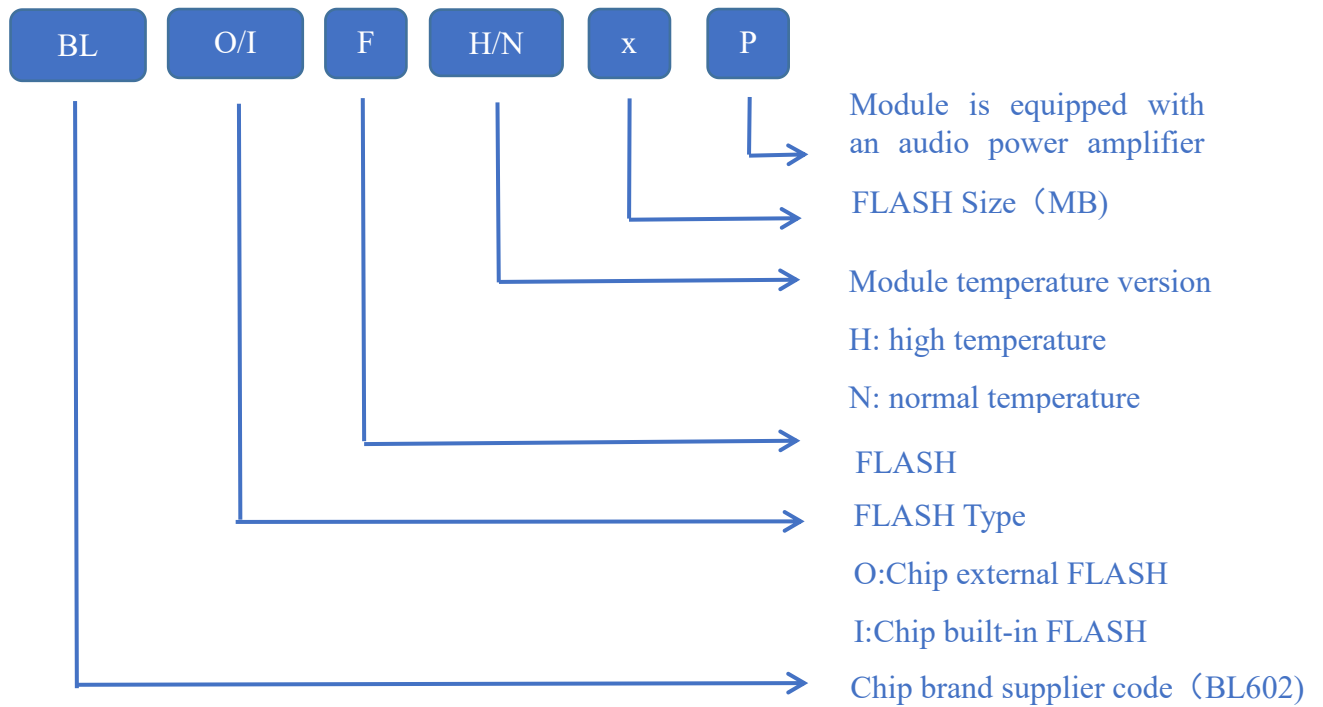
Chip brand supplier code（BL602）

Figure 5 Shielding cover silk screen representative information

4. Pin Definition

Ai-WV01-32S module has a total of 40 pins, as shown in the pin diagram. The pin function definition table is the interface definition.
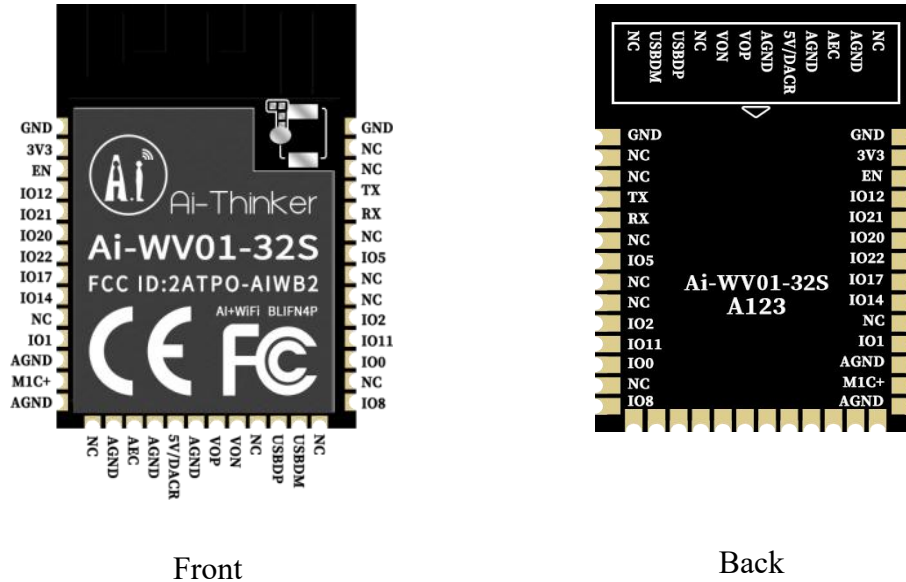

Front   Back

Figure 6 Pin diagram

Table 6 Pin function definition table

No.	Name	Function
1	GND	Grounding
2	3V3	Chip power supply pin, 3.3V power supply; external power supply current is recommended to be above 500mA
3	EN	The default is to enable the chip, high level is valid, and it cannot be used at the same time as RST
4	IO12	SPI_MOSI /I2C_SCL/PWM_CH2/ADC_CH0/SWGPIO12/TMS
5	IO21	SF1_CS/SF2_CS /SPI_MISO/I2C_SDA/PWM_CH1/SWGPIO21/TDI
6	IO20	GPIO20/SPI_MOSI/MISO/IIC_SCL/PWM_CH0/JTAG_TMS/TCK
7	IO22	GPIO22/SPI_SS/IIC_SCL/PWM_CH2/JTAG_TCK/TMS
8	IO17	GPIO17/SPI_MOSI/MISO/IIC_SDA/PWM_CH2
9	IO14	GPIO14/SPI_SS/IIC_SCL/PWM_CH4/ADC_CH2
10	NC	Dangling

11	IO1	GPIO1/SPI_MOSI/MISO/IIC_SDA/PWM_CH1
1 2	AGND	AGND; it is recommended to connect to the negative terminal of the microphone input
13	MIC+	Microphone input positive terminal
14	AGND	Analog Ground
15	NC	Dangling
16	AGND	Analog Ground
17	AEC	The default setting is NC. When the module is connected to an external amplifier, this pin can be used as an audio capture input.
18	AGND	Analog Ground
19	5V/DACR	The default is the power supply pin of the built-in amplifier, 5V power supply; the external power supply current is recommended to be above 1A When the module is connected to an external amplifier, this pin is used as the audio DAC output
20	AGND	Analog Ground
21	VOP	The module has a built-in amplifier output P. When the module is connected to an external amplifier, this pin can be left floating.
22	VON	The module has a built-in amplifier output N. When the module is connected to an external amplifier, this pin can be left floating.
23	NC	Dangling
24	USBDP	Default USB Negative Data (pull down) for the VB6824 chip Other functions (UART1RXD: Uart1 Data In(D); SPI2DOB: SPI2 Data Out (B); IIC_SDA_A: IIC SDA(A); (pull down)
25	USBDM	Default USB Positive Data (pull down) for the VB6824 chip Other functions (UART1TXD: Uart1 Data Out(D); SPI2CLKB: SPI2 Clock (B); IIC_SCL_A: IIC SCL(A); ADC12: ADC Input Channel 12)
26	NC	Dangling

27	IO8	As a bootstrap, when it is high at the moment of power-on, the module enters the burning mode; when it is low at the moment of power-on, the module starts normally.
28	NC	Dangling
29	IO0	GPIO0/SDIO_CLK/SPI_MOSI/MISO/IIC_SCL/PWM_CH0/JTAG_TMS/TCK
30	IO11	GPIO11/SPI_SCLK/IIC_SDA/ADC_CH10
31	IO2	GPIO2/SPI_SS/IIC_SCL/PWM_CH2
32	NC	Dangling
33	NC	Dangling
34	IO5	GPIO5/SPI_MOSI/MISO/IIC_SDA/PWM_CH0/ADC_CH4
35	NC	Dangling
36	RX	RXD/GPIO7/SPI_SCLK/IIC_SDA/PWM_CH2/JTAG_TDO/TDI
37	TX	TXD/GPIO16/SPI_MOSI/MISO/IIC_SCL/PWM_CH1/JTAG_TMS/TCK
38	NC	Dangling
39	NC	Dangling
40	GND	Grounding

Annotation:

1. This module has a built-in audio amplifier by default. If an external amplifier is required, please contact Anxinke for a customized BOM. In addition, when an external amplifier is installed, the functions of some pins will change. See the pin definitions in this table for details.

2. GPIO8 is used as the Bootstrap pin. When it is high at the moment of power-on, the module enters the programming mode. When it is low at the moment of power-on, the module starts normally.

3. In PWM lighting control applications, the IO pins generating PWM must maintain a stable state (typically low) during power-up to avoid flickering. During or after power-up, GPIOs 0-2, 5, 7, 14, and 20-22 may have a weak pull-up, resulting in a high level. These pins can be pulled down by adding a 4.7k Ω resistor to maintain a low level.

4. The default function of GPIO11 is JTAG TDO. It may output a high level during power-on and is not recommended for PWM light control.
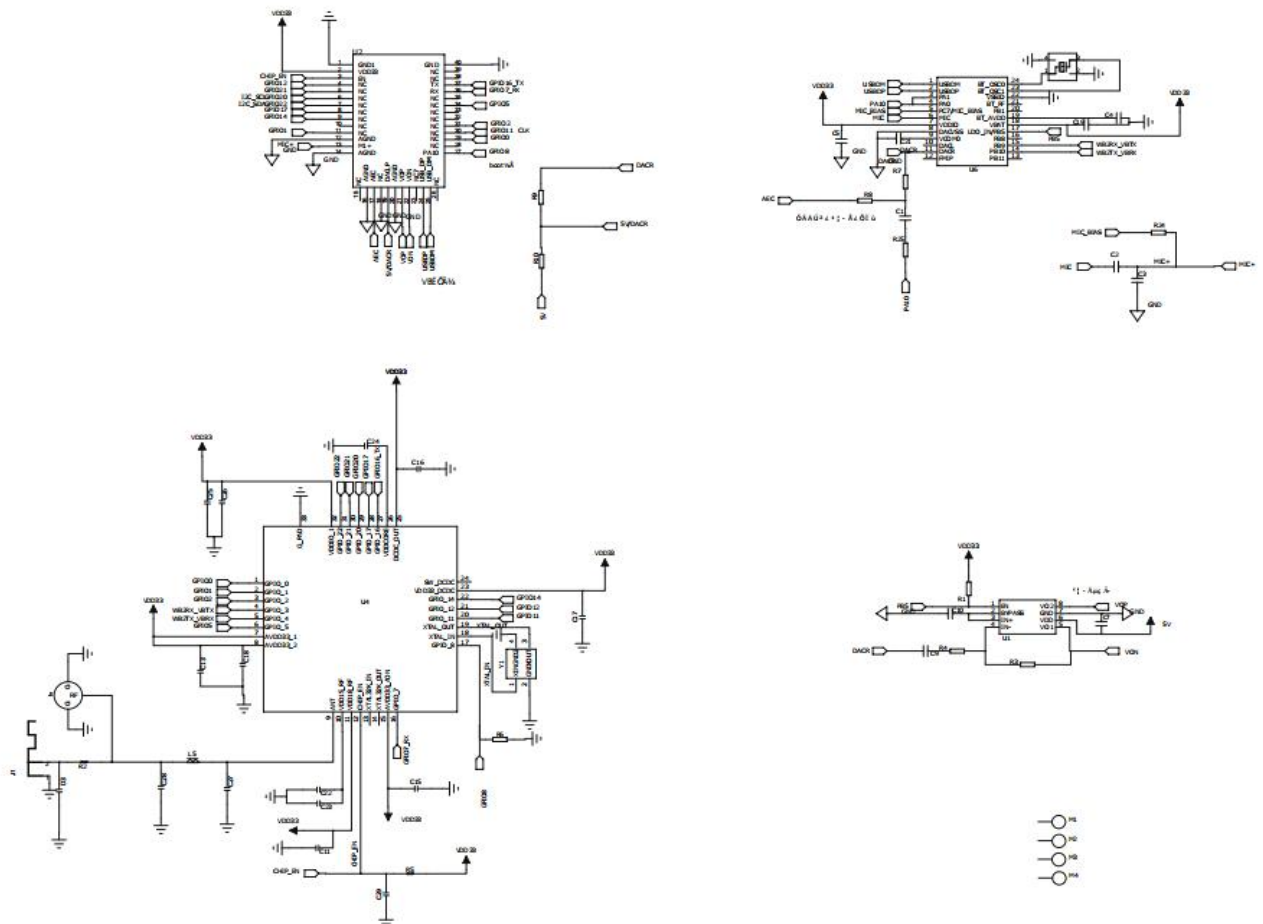
5. Schematic

Figure 7 Schematic diagram

6. Antenna parameters

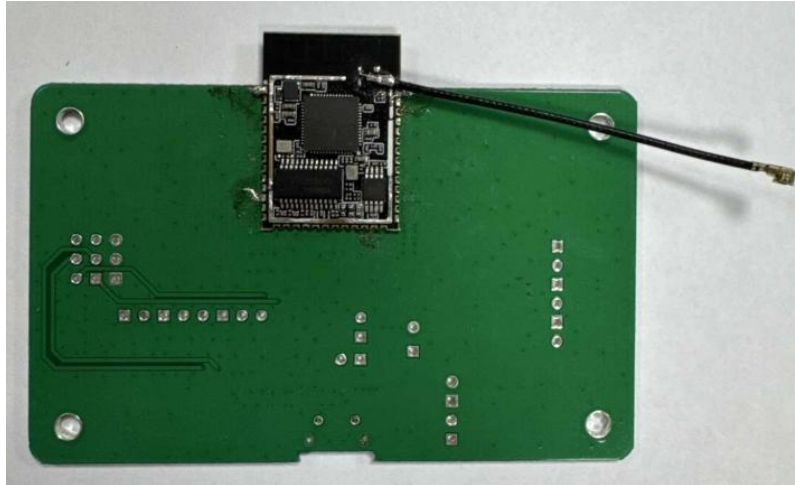## 6.1. Antenna test prototype illustration

Figure 8   Antenna test prototype reference diagram antenna
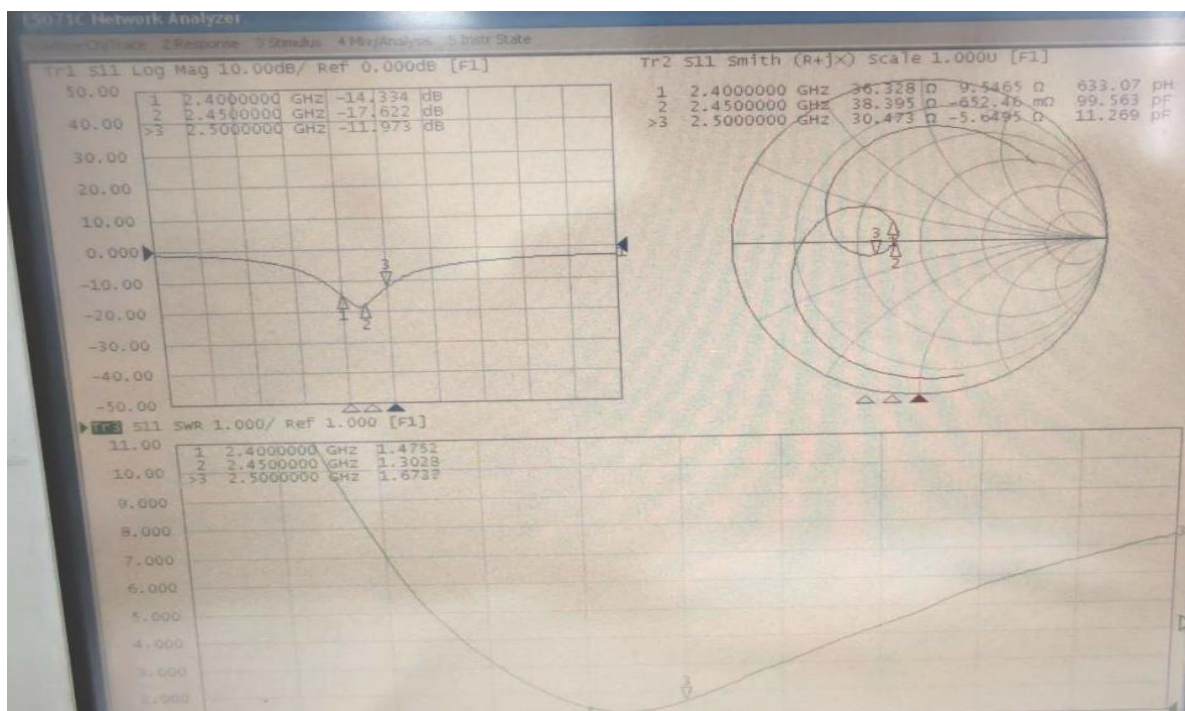
6.2. Antenna S parameters

Figure 9 Antenna S parameters

6.3. Antenna gain and efficiency

Table 7 Antenna gain and efficiency

Frequency ID	1	2	3	4	5	6	7	8	9	10	11
Frequency(MHz)	2400	2410	2420	2430	2440	2450	2460	2470	2480	2490	2500
Gain (dBi)	1.08	1.11	1.17	1.15	1.27	1.40	1.34	1.24	1.07	0.95	0.86
Efficiency (%)	59.86	61.01	62.17	62.33	62.33	63.00	62.19	61.43	60.41	60.20	58.28

6.4. Antenna pattern
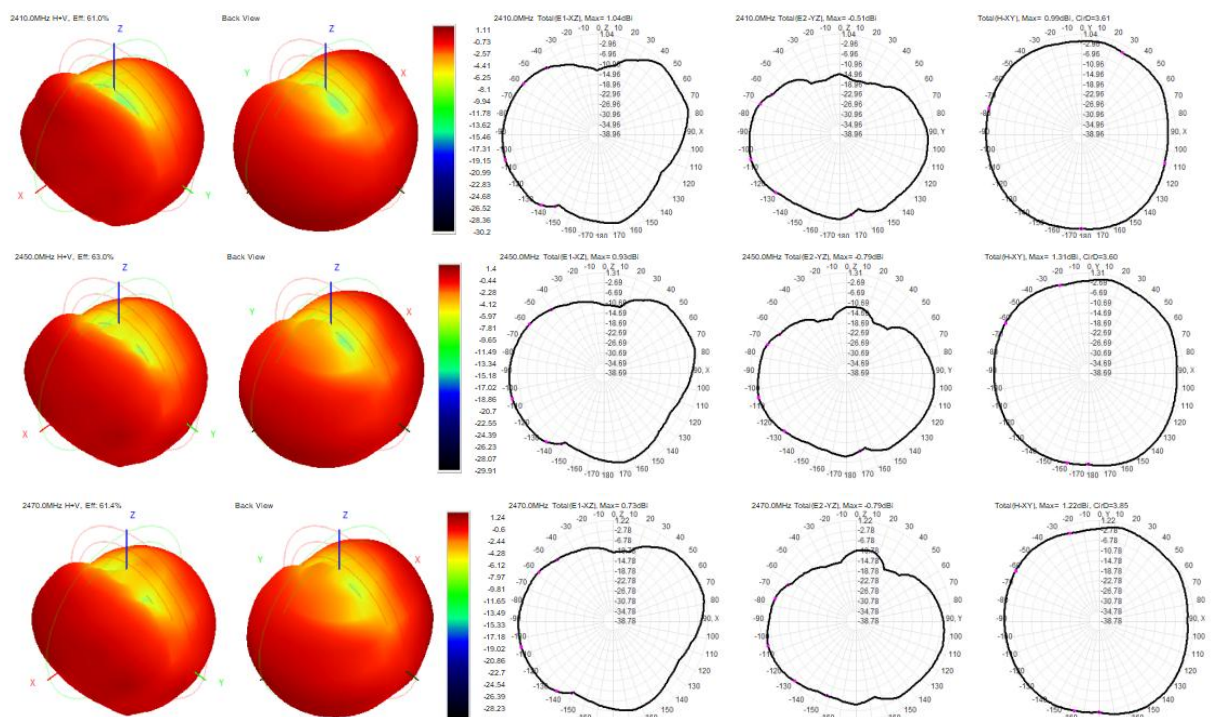
Figure 10 Antenna pattern

7. Design Guidance

7.1. Application Guidance Circuit

Figure 11 Application guidance circuit

- ■ USB_DM and USB_DP are the default programming pins of the module.

- ■ TX and RX are the default main serial ports of the module.

- ■ M1+ is connected to the positive terminal of the microphone, and an electret microphone is required.

- ■ VOP, VON connect to speakers. 4R3W, 8R2W speakers are recommended.

7.2. Recommended PCB package size
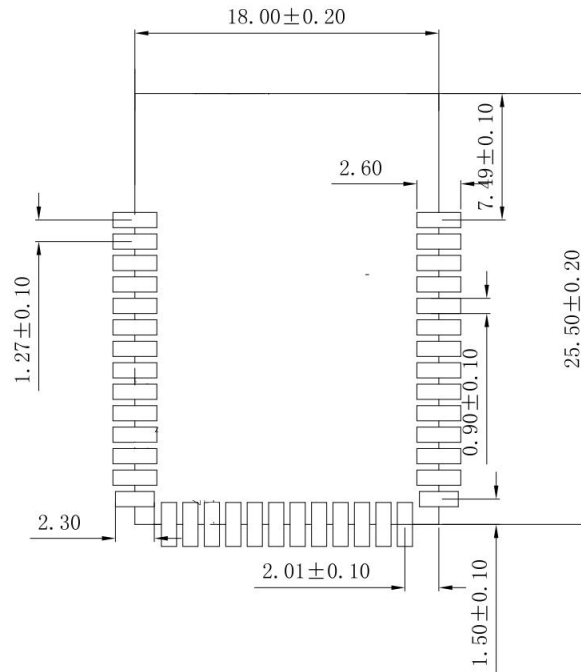
Figure 12 Recommended PCB package dimensions

7.3. Antenna layout requirements

■ The following two methods are recommended for the installation position on the motherboard:

Solution 1: Place the module on the edge of the motherboard, with the antenna area extending beyond the edge.

Solution 2: Place the module on the edge of the motherboard and hollow out an area on the edge of the motherboard where the antenna is located.

■ To ensure the performance of the onboard antenna, no metal parts should be placed around the antenna, and it should be kept away from high-frequency devices.
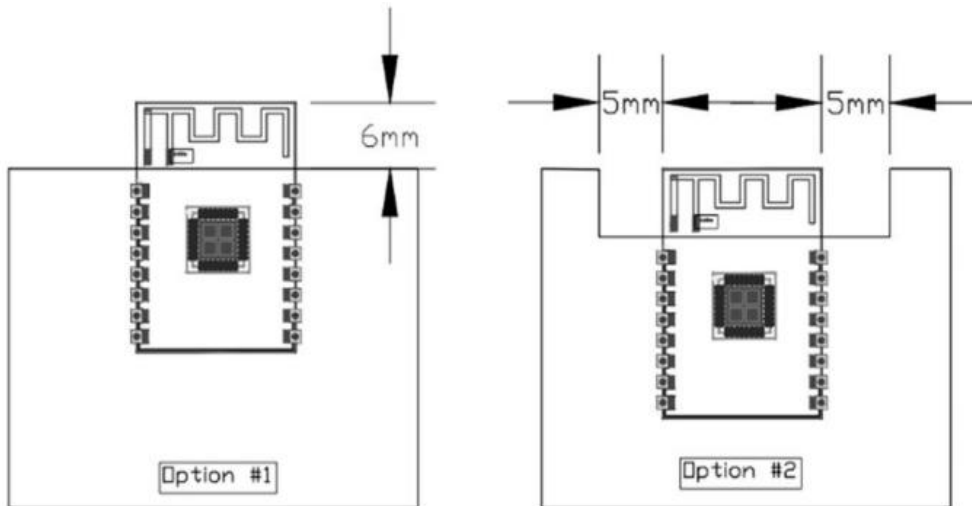
Figure 13 Antenna layout diagram

7.4. Power supply

■ Recommended chip uses a 3.3V voltage and a peak current of more than 500mA .

■ It is recommended that the built-in PA use a 5V voltage and a peak current of more than 1A .

■ If using a DC-DC converter, it is recommended that the ripple be controlled within 3 % .

■ It is recommended to reserve space for dynamic response capacitors in the DC-DC power supply circuit to optimize the output ripple when the load changes greatly.

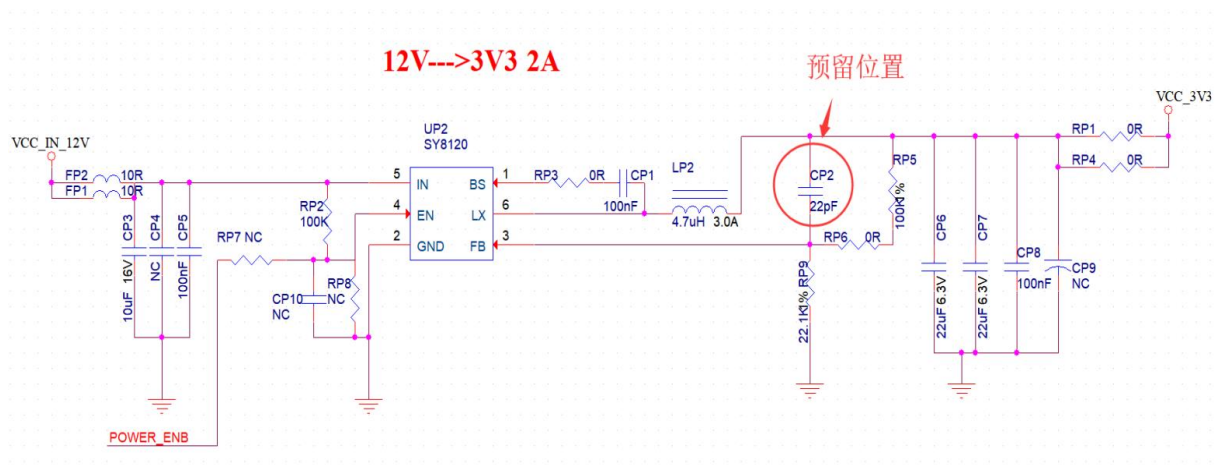■ It is recommended to add ESD devices to the power interface.

Figure 14 DC-DC buck reference circuit diagram

7.5. GPIO

■ The module has some external IO ports. If you need to use them, it is recommended to connect a 10-100 ohm resistor in series with the IO port. This can suppress overshoot and make the voltage level on both sides more stable. It also helps with EMI and ESD.

■ For the pull-up and pull-down functions of special IO ports, please refer to the instructions in the datasheet, as this will affect the startup configuration of the module.

■ The IO port of the module is 3.3V. If the voltage levels of the main control and module IO ports do not match, a level conversion circuit needs to be added.

■ If the IO port is directly connected to a peripheral interface, or terminals such as a pin header, it is recommended to reserve ESD devices near the terminals where the IO port is routed.
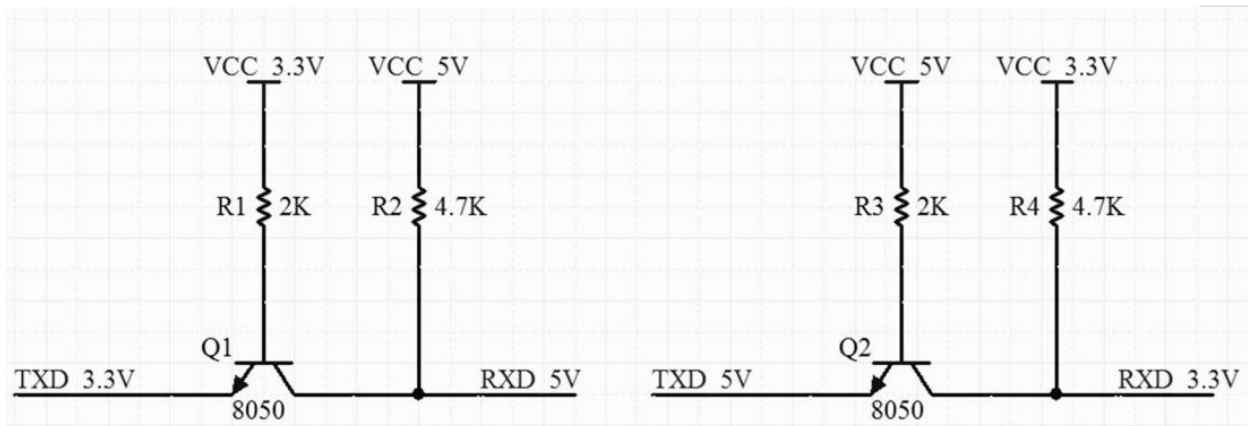

Figure 15 Level conversion circuit

8. Storage conditions

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

The module's moisture sensitivity level MSL is level 3.

After the vacuum bag is unsealed, it must be used within 168 hours at 25±5℃/60%RH. Otherwise, it needs to be baked before it can be used again.
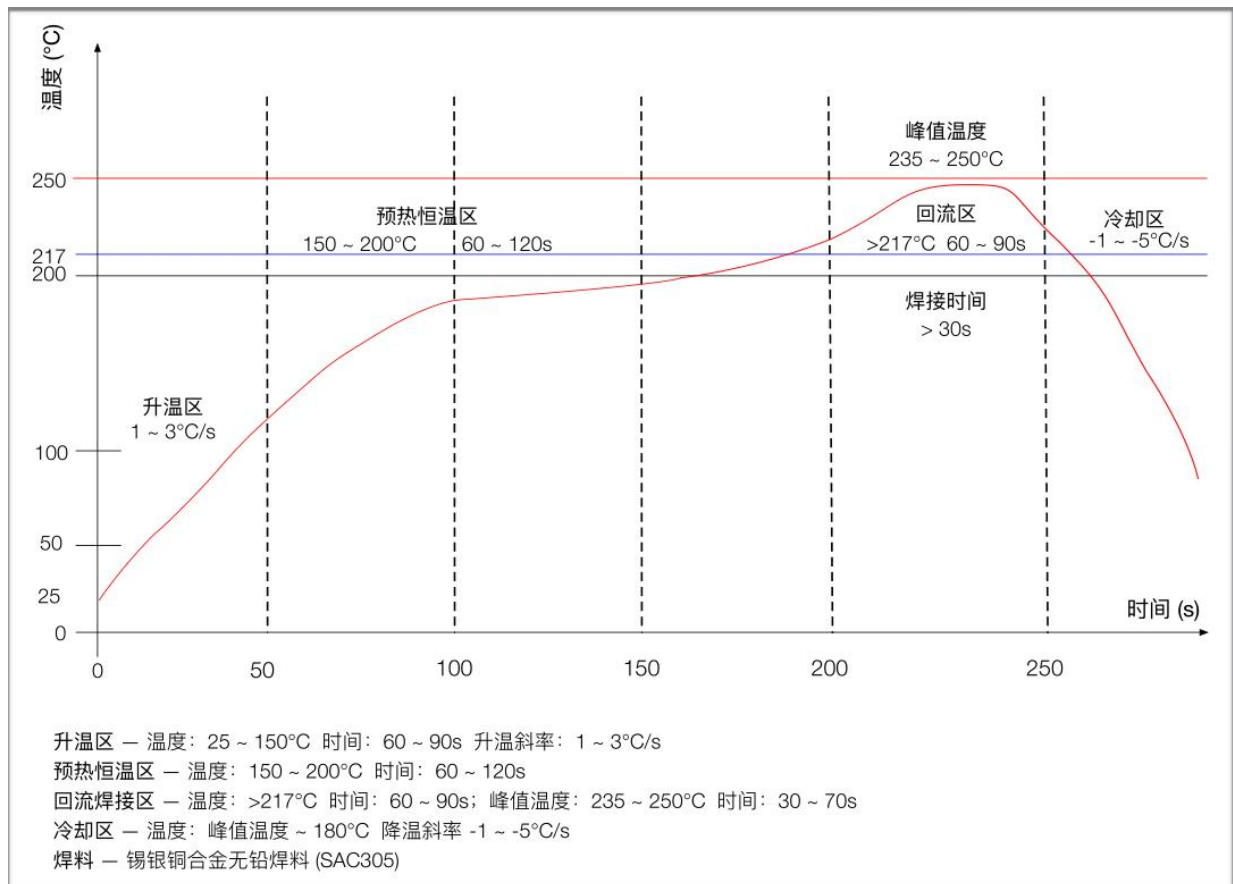
9. Reflow Oven Profile

Figure 16 Reflow soldering curve

10. Product packaging information

Ai-WV01-32S module is packaged in tape, 800 pcs/reel. As shown below:

Figure 17 Packaging Taping Diagram

11. Contact Us

Ai-Thinker official website   Office forum   Develop DOCS

LinkedIn   Tmall shop   Taobao shop   Alibaba shop

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Domestic business cooperation：sales@aithinker.com

Overseas business cooperation：overseas@aithinker.com

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