Rd-03L_V2 Specification

Version V2.0.0

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文件履历表

Version	Date	Develop/revise content	Edition	Approv
V2.0.0	2025.04.22	V2 First Edition	RongXin Qiao	Ning Guan

Content

1. Product Overview

Rd-03L_V2 is a battery-powered ultra-low power radar module developed by Shenzhen Ai-Thinker Technology Co., LTD. This module includes simplified 24GHz millimeter-wave sensor hardware and low-power human presence detection intelligent algorithm firmware.

Rd-03L_V2 version is equipped with the AIoT millimeter-wave sensor SoC ICL1112, a high-performance 24GHz - transmitting and receiving antenna and peripheral circuits. ICL1112 is an industry-leading μA-level 24G single-transmit and single-receive millimeter-wave sensor chip, featuring ultra-low power consumption and outstanding long-range exploration capabilities. It operates in the K-band at 24 GHz and uses the FMCW frequency-modulated continuous wave to detect targets within the set space. Rd-03L_V2 version can achieve precise perception of moving, slightly moving and standing human bodies. The low-power human presence detection algorithm firmware can be applied in indoor scenarios to sense whether there are moving or slightly moving human bodies in the area in a low-power mode and refresh the detection results in real time.

The maximum sensing distance ofthe Rd-03L_V2 version for the moving human body is 8 meters. The sensing distance range, trigger and hold thresholds in different intervals, the reporting frequency of the human body existence state and the target human body distance, as well as the time when no one reports can be easily configured. Rd-03L_V2 version supports GPIO and UART interface, plug and play, flexible application in the intelligence of different scenarios and end products.

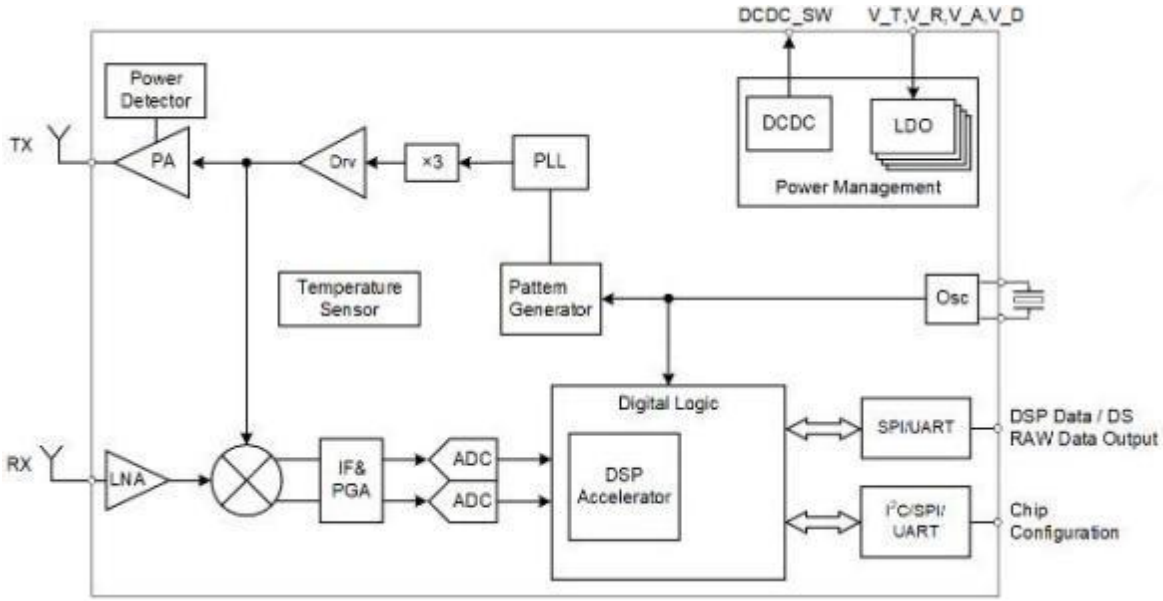


Figure 1 Architecture diagram of ICL1112 chip

1.1. Characteristic

- DIP package, standard 2.54mm pin
- Ultra-small module size: 17.5*19mm, plug and play
- Radar supports the 24GHz ISM frequency band
- The radar antenna supports 1 reception and 1 transmission. The antenna beam is narrow, the resolution is high, the frequency band is wide, and the anti-interference ability is strong
- The maximum sensing distance of the radar can reach up to 8 meters
- The radar has a wide detection Angle and a coverage range of ±60 degrees
- The detection targets are moving, slightly moving and stationary human bodies
- Accurate identification within the radar range, supports the division of the sensing range, and shields interference outside the range
- The average operating current is less than the reported frequency of 80uA@1Hz
- Close-range 0.35m sensing, with no blind spots in detection
- Report the detection results in real time
- Provide visualization tools to support the configuration of detection distance intervals and target disappearance delay times
- The intelligent parameter adjustment of the radar can be achieved through the serial port, which is convenient and fast
- Support IAP online upgrade
- Supports wall-mounted installation
- Support UART
- Typical application scenarios

✓ Human body sensor light control
✓ Human body sensing wake-up for devices such as advertising screens
✓ Life safety protection
✓ Smart home appliances
✓ Smart Security
✓ Smart lighting
✓ New energy charging/parking monitoring facilities

2. Main parameters

Table 1 Main parameters

Model	Rd-03L_V2
Package	DIP-5
Size	17.5*19.0(±0.2)mm
Antenna	On-board antenna
Frequency	24G ~24.25GHz
Operation temperature	-40℃~ 85℃
Storage environment	-40℃~ 125℃, < 90%RH
Power supply	The power supply voltage is 3.0V to 3.6V, and the power supply current is ≥200mA
Interfaces	UART
UART rate	Default 256000 bps

2.1. Static electricity requirements

Rd-03L_V2 is an electrostatic sensitive device and special preventive measures need to be taken during handling.

Figure 2 ESD anti-static diagram

2.2. Electrical characteristics

Table 2 Electrical Characteristics Table

Parameter		Conditio	Min.	Typical value	Max.	Unit
Power supply		VDD	3.0	3.3	3.6	V
I/O	VIL	-	0	-	0.3*VDD	V
	VIH	-	0.7*VDD	-	VDD	V
	VOL	-	0	-	0.5	V
	VOH	-	VDD -0.5	-	-	V

2.3. Radar sensing range

Table 3 Radar induced range

Installation	Min.	Typical	Max.	Unit
Wall-mounted method (±60。 range)	-	8	-	m

Notice:

- The above sensing distance is measured based on the open space ofAnxinke, for reference only.
- The radar sensing distance is greatly affected by surrounding walls, ceilings, large-sized objects, and installation methods. The actual measurement data ofthe installation environment shall prevail.

2.4. Power

The following power consumption data are based on a 3.3V power supply, an ambient temperature of25 ° C, and radar parameters measured in Figure 3.

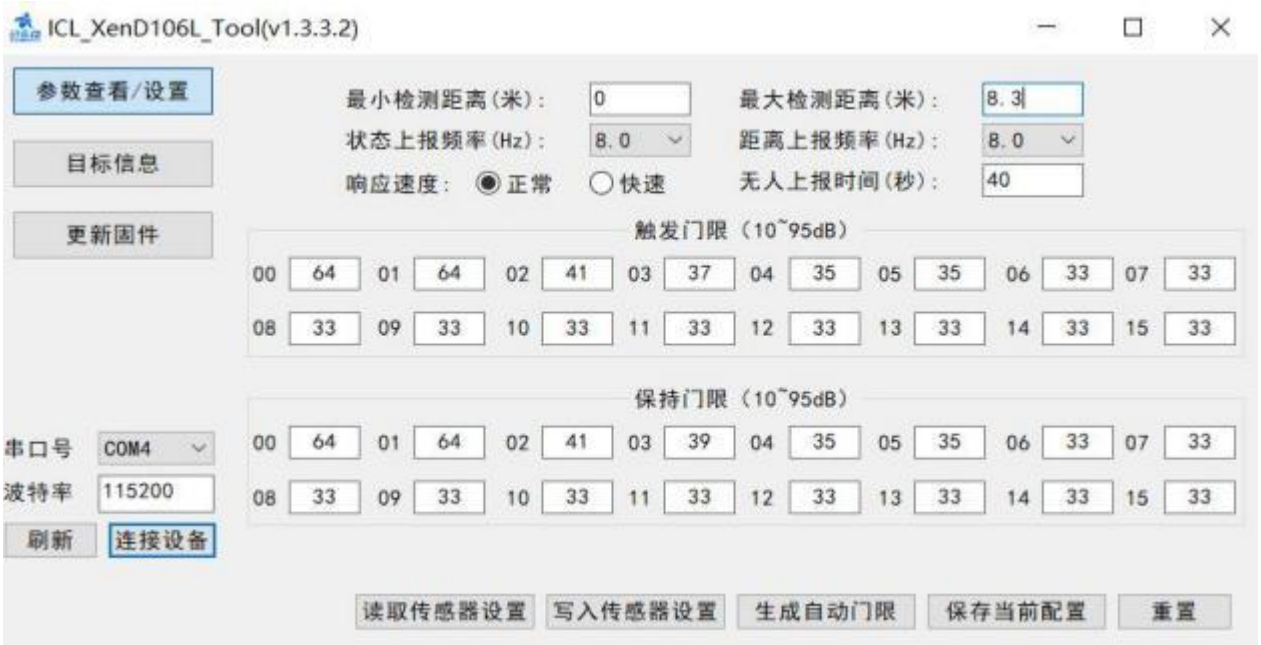
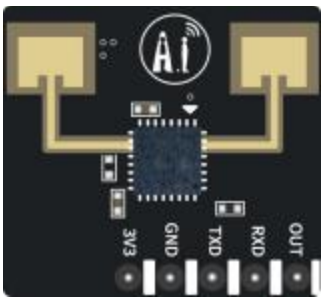


Figure 3 Radar setting parameter diagram

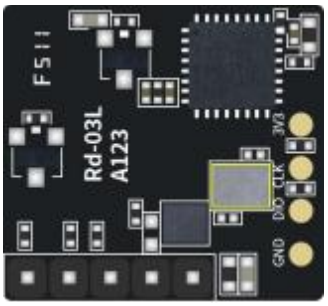
Table 4 Power Consumption Table

Power current			
Work reporting frequency (unit: Hz)	**Distance reported frequency (unit: Hz)**	**Test the average**	**Unit**
1	1	73.322	uA
2	2	144.708	uA
3	3	165.111	uA
4	4	271.132	uA
5	5	336.190	uA
6	6	395.625	uA
7	7	457.393	uA
8	8	491.944	uA

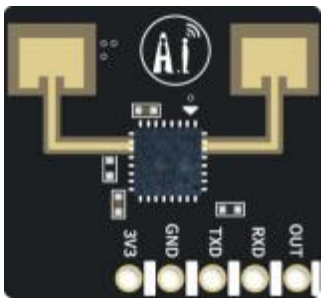
3. Appearance size



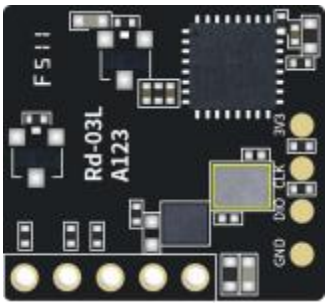
Front (with stitch plate)



Back (with stitch plate)

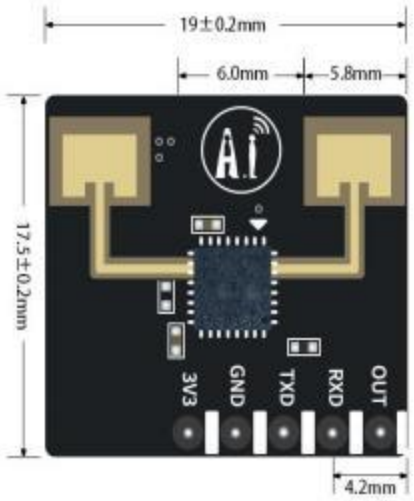


Front (without stitch plate)



Back (without stitch plate)

Figure 4 Appearance drawing (The rendering is for reference only. The actual product shall prevail.)

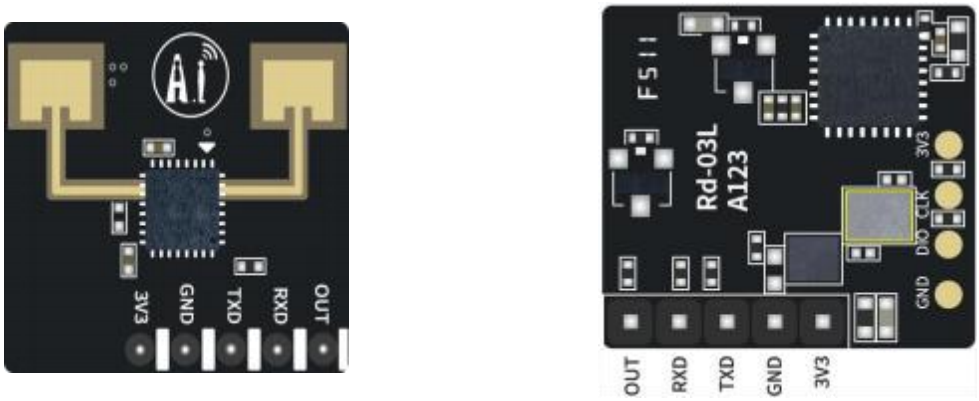


Front

Figure 5 Dimension drawing

4. Pin definition

Rd-03L_V2 module has a total of 5 pins connected out. As shown in the pin diagram, the pin function definition table is the interface definition.



Front Back

Figure 6 Pin diagram

Table 5 Definition table of pin functions

No.	Name	Function
1	3V3	Input power
2	GND	Ground
3	TX	UART_TX
4	RX	UART_RX
5	OT2	The detection result output: a high level is output when sensing and a low level is output when not sensing

5. Schematic diagram

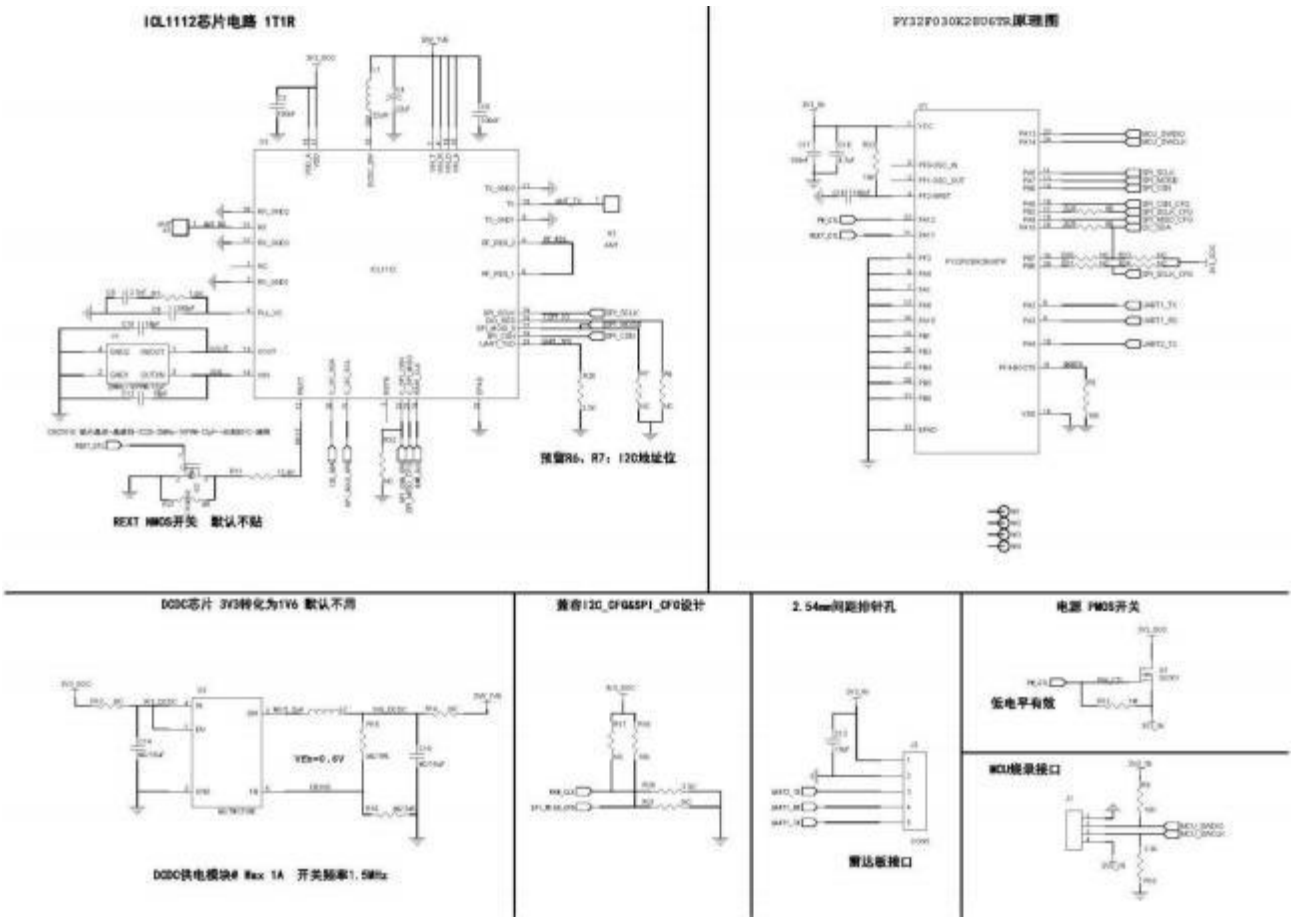


Figure 7 Schematic diagram

6. Design guidance

6.1. Application guide circuit

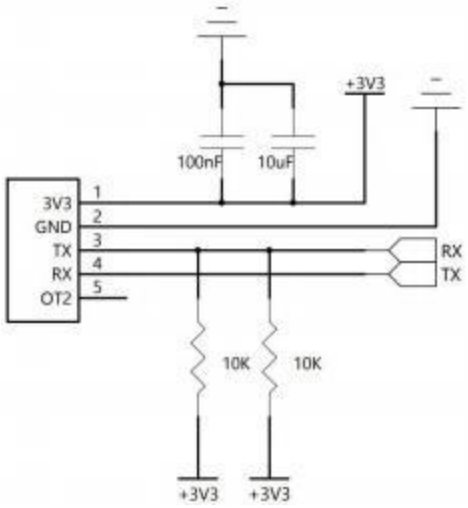


Figure 8 Application guidance Circuit

6.2. Recommended PCB package size

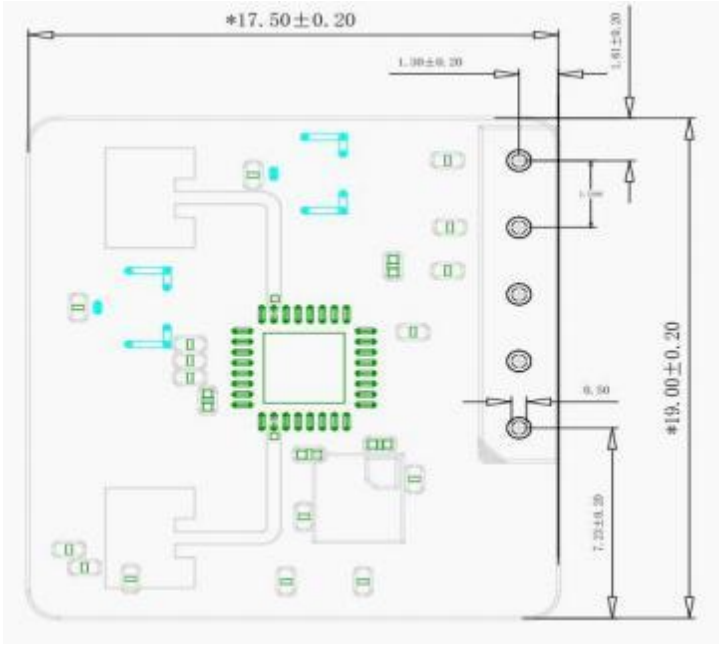


Figure 9 Recommended PCB package size

Notice:

- Rd-03L_V2 module adopts a standard pin header interface with a pitch of 5 pins -2.54mm

6.3. Precautions for radar installation

■ The installation positions on the motherboard are recommended in the following ways:

✓ Try to ensure that the radar antenna is directly facing the area to be detected and that the area around the antenna is open and unobstructed.

✓ It is necessary to ensure that the radar is installed firmly and stably. The shaking of the radar itself will affect the detection effect.

✓ It is necessary to ensure that there is no movement or vibration of objects on the back of the radar. Because radar waves are penetrating, the back lobe of the antenna signal may detect moving objects on the back of the radar. Metal shielding covers or metal backplates can be used to shield the radar backplate, reducing the impact caused by objects on the back of the radar.

✓ Due to the differences in the target's size, state, RCS, etc., the distance accuracy of the target will fluctuate. Meanwhile, the farthest distance will also fluctuate slightly.

✓ When there are multiple radars in the 24GHz band, please do not have their beams directly facing each other. Try to install them as far away as possible to avoid possible mutual interference.

■ To meet the performance requirements of the onboard antenna, no metal parts are allowed to be placed around the antenna, and it should be kept away from high-frequency devices.

■ The input voltage range of the power supply is 3.0V-3.6V. The power supply ripple should be within 100kHz without obvious frequency peaks. Users need to consider the corresponding ESD and lightning surge and other electromagnetic compatibility designs.

6.4. Installation environment requirements

This product needs to be installed in a suitable environment, if used in the following environments, the detection effect will be affected:

■ There are continuously moving non-human objects in the sensing area, such as animals, constantly swinging curtains, large green plants directly facing the air outlet, etc.

■ There are large areas of strong reflectors in the sensing area. Strong reflectors directly facing the radar antenna will cause interference.

■ When wall-mounted, external interference factors such as air conditioners and electric fans on the indoor ceiling need to be taken into consideration.

6.5. Installation mode and induction range

■ Wall-mounted installation method

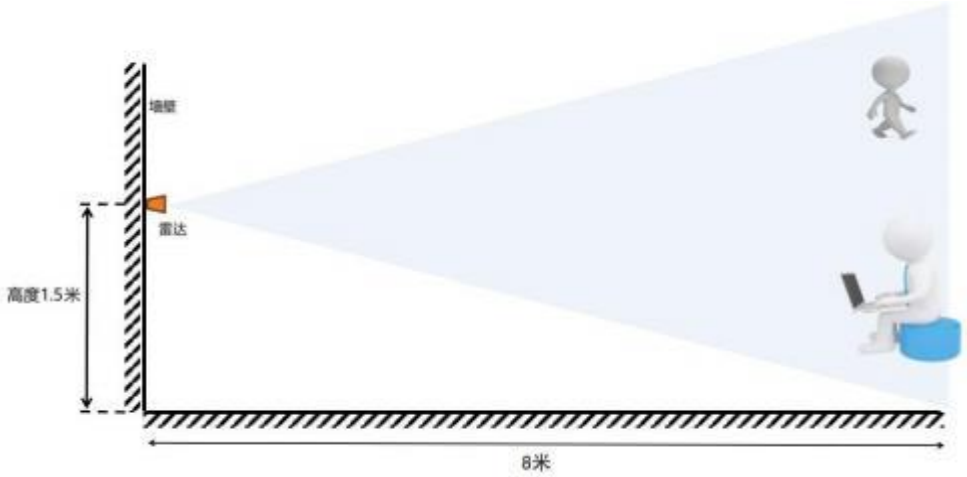


Figure 10 Schematic diagram of wall-mounted installation

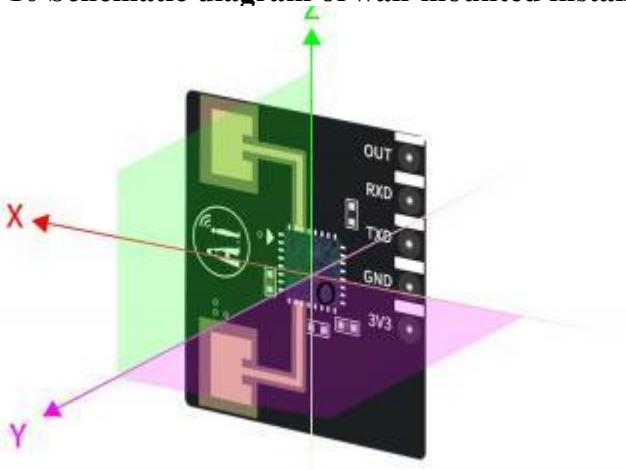


Figure 11 Schematic diagram of the wall-hanging direction

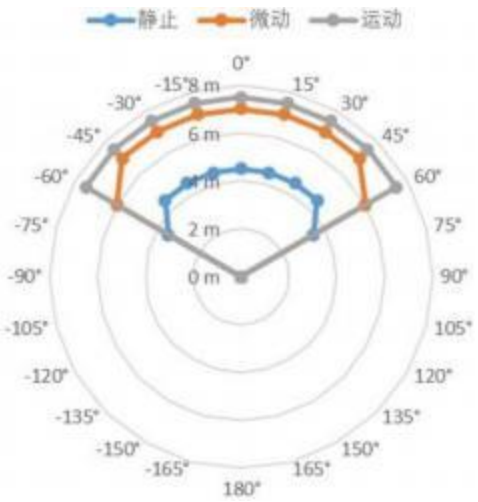


Figure 12 Wall-mounted radar map

6.6. Power Supply

- Recommended voltage is 3.3V and the peak current is above 200mA.
- It is recommended to use LDO power supply; If DC-DC is used, it is recommended that the ripple be controlled within 1000mV.
- It is recommended to reserve the position of the dynamic response capacitor in the DC-DC power supply circuit, which can optimize the output ripple when the load changes greatly.
- 3.3V power supply interface increases ESD device is recommended.

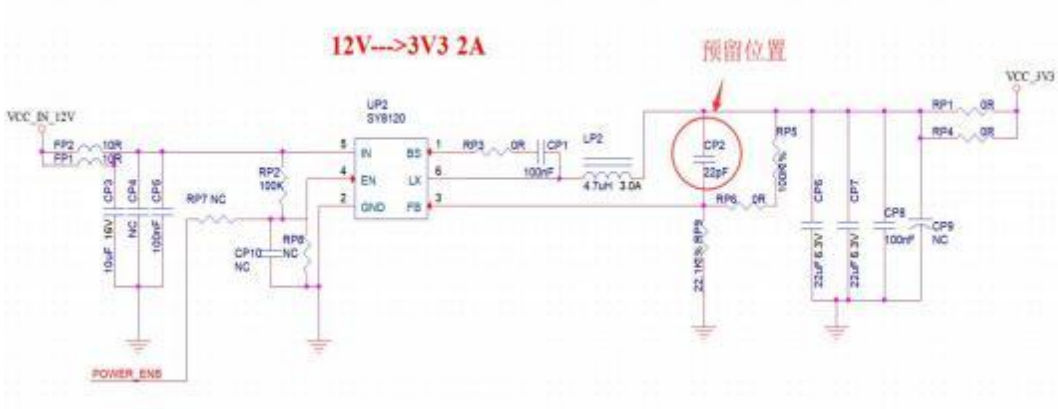


Figure 13 DC-DC step-down circuit diagram

6.7. GPIO

- Some IO ports are led out from the periphery of the module. If you need to use them, it is recommended to connect a resistor of 10 to 100 ohms in series with the IO ports. This can suppress overshoot and make the levels on both sides more stable. It is helpful for both EMI and ESD.
- For the up and down pulling of special IO ports, please refer to the usage instructions in the specification sheet. This will affect the startup configuration of the module.
- The IO port of the module is 3.3V. If the level of the main control and the IO port of the module does not match, a level conversion circuit needs to be added.
- If the IO port is directly connected to the peripheral interface or pin headers and other terminals, it is recommended to reserve ESD devices near the IO port traces.

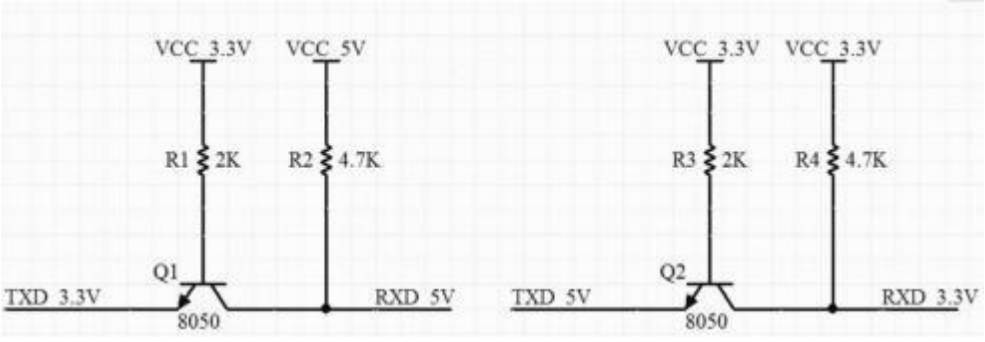


Figure 14 Level Conversion Circuit

7. Storage conditions

Products sealed in moisture-proofbags should be stored in a non-condensing atmosphere at <40℃/90%RH.

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

After the vacuum bag is unwrapped, 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.

8. Reflow welding curve diagram

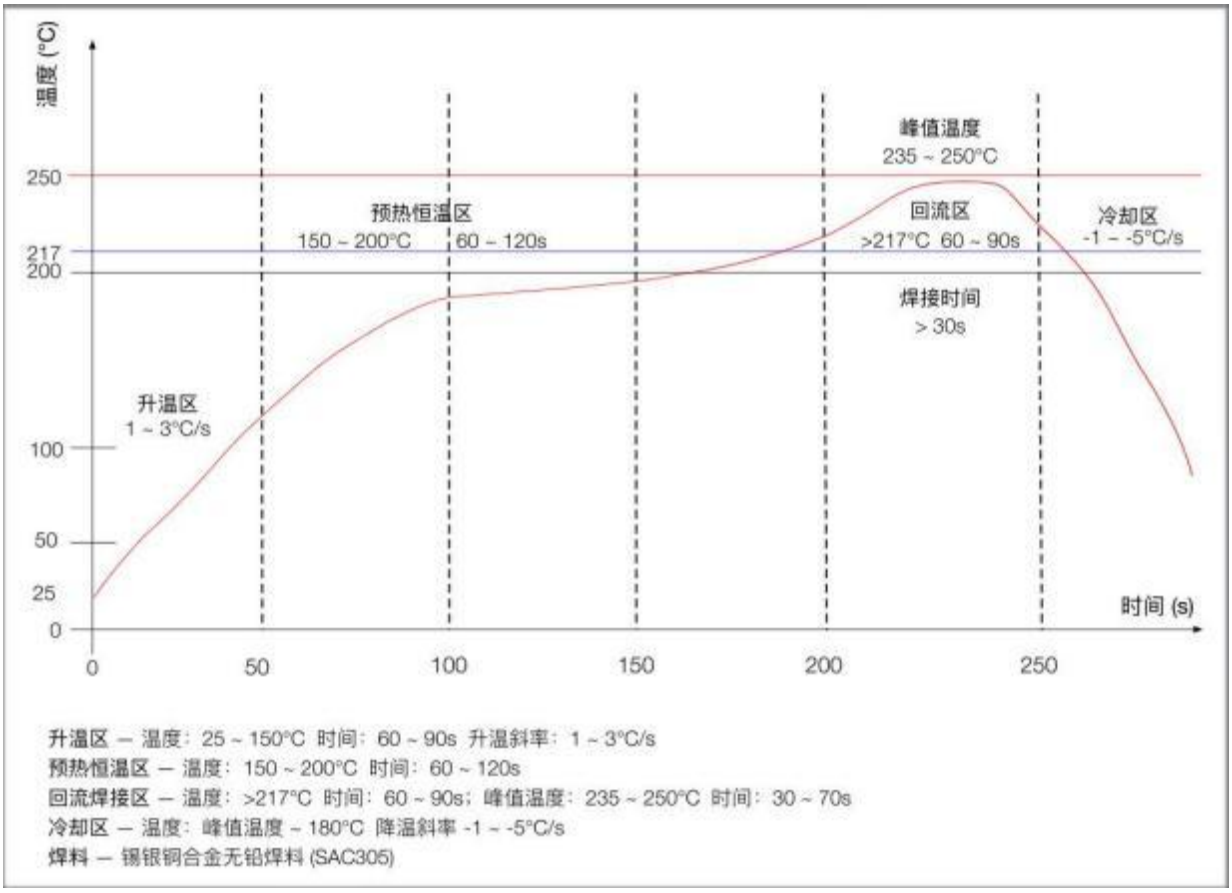


Figure 15 reflow soldering curve

9. Product package information

Rd-03L_V2 module is packaged in tape at 200 pcs /reel. As shown in the figure below:

Figure 16 Packaging tape drawing

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