Rd-03L Specification

Version V1.0.0

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Document resume

Version	Date	Develop/revise content	Edition	Approve
V1.0.0	2023.12.27	First Edition	Pengfei Dong	Ning Guan

Content

1. Product Overview

Rd-03L is a battery-powered ultra-low power radar module developed by Shenzhen Ai-Thinker Technology Co., Ltd. The module includes extremely simplified 24GHz millimeter wave sensor hardware and low-power Human Presence sensing intelligent algorithm firmware.

Rd-03L is equipped with AIoT millimeter wave sensor SoC ICL1112, high-performance 24GHz-receiver antenna and peripheral circuit. ICL1112 is an industry-leading μA-Class 24g single-transmit single-receiver millimeter wave sensor chip, which has ultra-low power consumption (55 μA) and ultra-high remote exploration capability. It works in the K-band of 24 GHz, and uses FMCW frequency modulation continuous wave to detect targets in the set space. Rd-03L adopts millimeter wave sensor distance measurement technology and ICL1112 chip advanced proprietary radar signal processing and low power consumption control technology to realize accurate perception of motion, micro motion and standing human body. Low-Power Human body presence induction algorithm firmware is mainly used in indoor scenes. It detects whether there is moving or micro-moving human body in the area in a low-power mode, and refreshes the detection results in real time.

The maximum sensing distance of the Rd-03L to the moving human body is 8 meters. It is easy to configure the sensing distance range, trigger and maintenance thresholds in different intervals, the status of the human body, the frequency of reporting the distance from the target human body, and the time when no one reports. Rd-03L supports GPIO and UART interfaces, plug and play, and can be flexibly applied to different intelligent scenarios and terminal products.

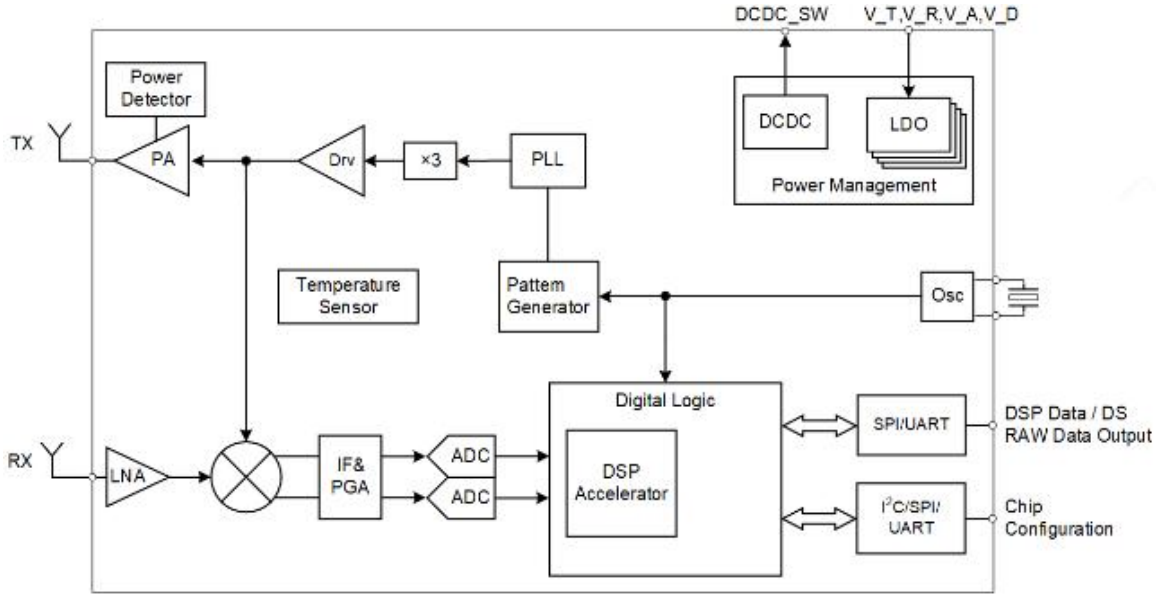


Figure 1 ICL1112 chip architecture

1.1. Characteristic

- DIP package, standard 2.54mm pin
- Ultra-small module size: 20*20mm, Plug and Play
- Radar supports 24GHz ISM frequency bands
- The radar antenna supports 1 receive and 1 transmit, with narrow antenna beam, high resolution, wide frequency and strong anti-interference capability
- The farthest induction distance of radar can reach 8 meters
- Radar Detection angle is large, coverage can reach ± 60 degrees
- The detection targets are motion, micro motion and static human body
- Accurate identification within radar intervals, support induction range division, and shield out-of-range interference
- Average working current less than 100uA @ 1Hz reporting frequency
- Proximity 0.2m induction, no detection blind area
- Report detection results in real time
- Provides visualization tools to configure the probe distance interval and the target disappearance delay time
- Intelligent parameter tuning of radar can be realized through serial port, which is convenient and fast
- Support IAP online upgrade
- Support wall mounting
- Support for UART
- Typical application scenarios

✓ Human body induction light control

✓ Human body induction wake-up of devices such as advertising screens

✓ Life Safety Protection

✓ Smart home appliances

✓ Intelligent Security

✓ Intelligent lighting

✓ New energy charging/parking monitoring facilities

2. Main parameters

Table 1 main parameters

Model	Rd-03L
Package	DIP-5
Size	20.0*20.0(±0.2)mm
Antenna	On-board antenna
Frequency	24G ~24.25GHz
Operation temperature	-40℃~ 85℃
Storage environment	-40℃~ 125℃, < 90%RH
Power supply	Support voltage 3.0V ~ 3.6V，power supply current ≥200mA
Interfaces	UART
UART rate	Default 256000 bps

2.1. Static electricity requirements

Rd-03L is an electrostatic sensitive equipment, special precautions should be taken during handling.

Figure 2 ESD anti-static diagram

2.2. Static electricity requirements

Table 2 Electrical Characteristics Table

Parameter		Condition	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 value	Max.	Unit
Wall hanging mode (±60° range)	-	8	-	M

Notice:

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

2.4. Power

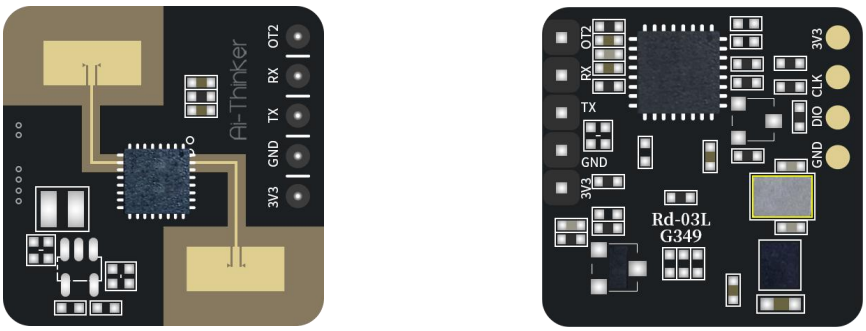
The following power consumption data are measured based on 3.3V power supply, 25°C ambient temperature and radar parameters in figure 3.

Figure 3 radar setting parameter diagram

Table 4 power consumption table

Power consumption current			
Work reporting frequency（Unit: Hz)	**Distance reporting frequency（Unit: Hz)**	**Test average current**	**Unit**
0.5	0.5	46.54	uA
1	1	85.76	uA
1.5	1.5	123.36	uA
2	2	161.84	uA
2.5	2.5	200.93	uA
3	3	237.38	uA
3.5	3.5	272.90	uA
4	4	313.04	uA
4.5	4.5	355.20	uA
5	5	390.56	uA
5.5	5.5	423.31	uA
6	6	471.94	uA
6.5	6.5	519.51	uA
7	7	544.29	uA
7.5	7.5	575.02	uA
8	8	592.88	uA

3. Appearance size



Front Back

Figure 4 external view (rendering is for reference only, subject to the actual object)

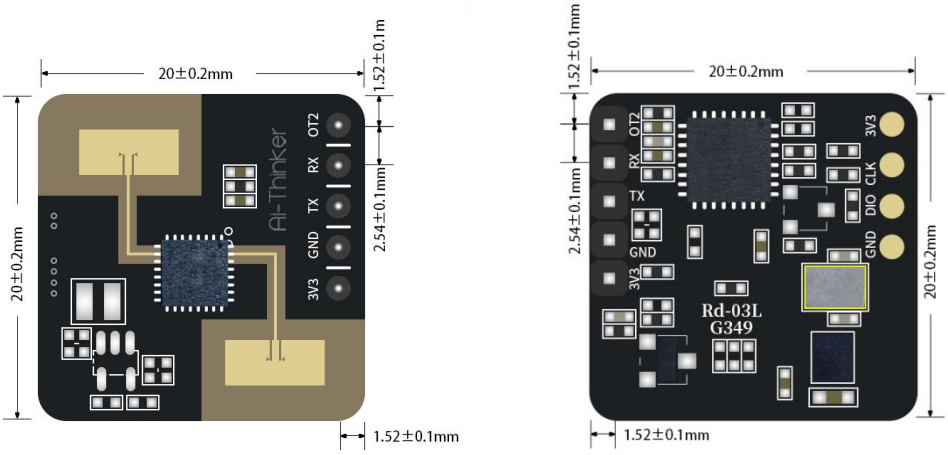


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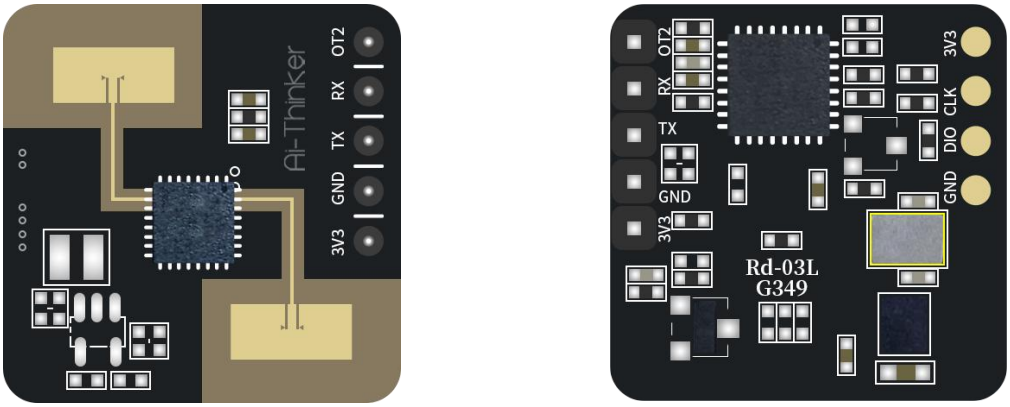
Figure 5 Dimension Diagram

4. Pin definition

Rd-03L module connects 5 pins, for example, the pin function definition table is the interface.



Front Back

Figure 6 pin diagram

Table 5 definition table of pin functions

No.	Name	Description
1	3V3	Input power supply
2	GND	Conductive earth
3	TX	UART_TX
4	RX	UART_RX
5	OT2	Output of detection results, high level output when sensing, low level output when not sensing

5. Schematic diagram

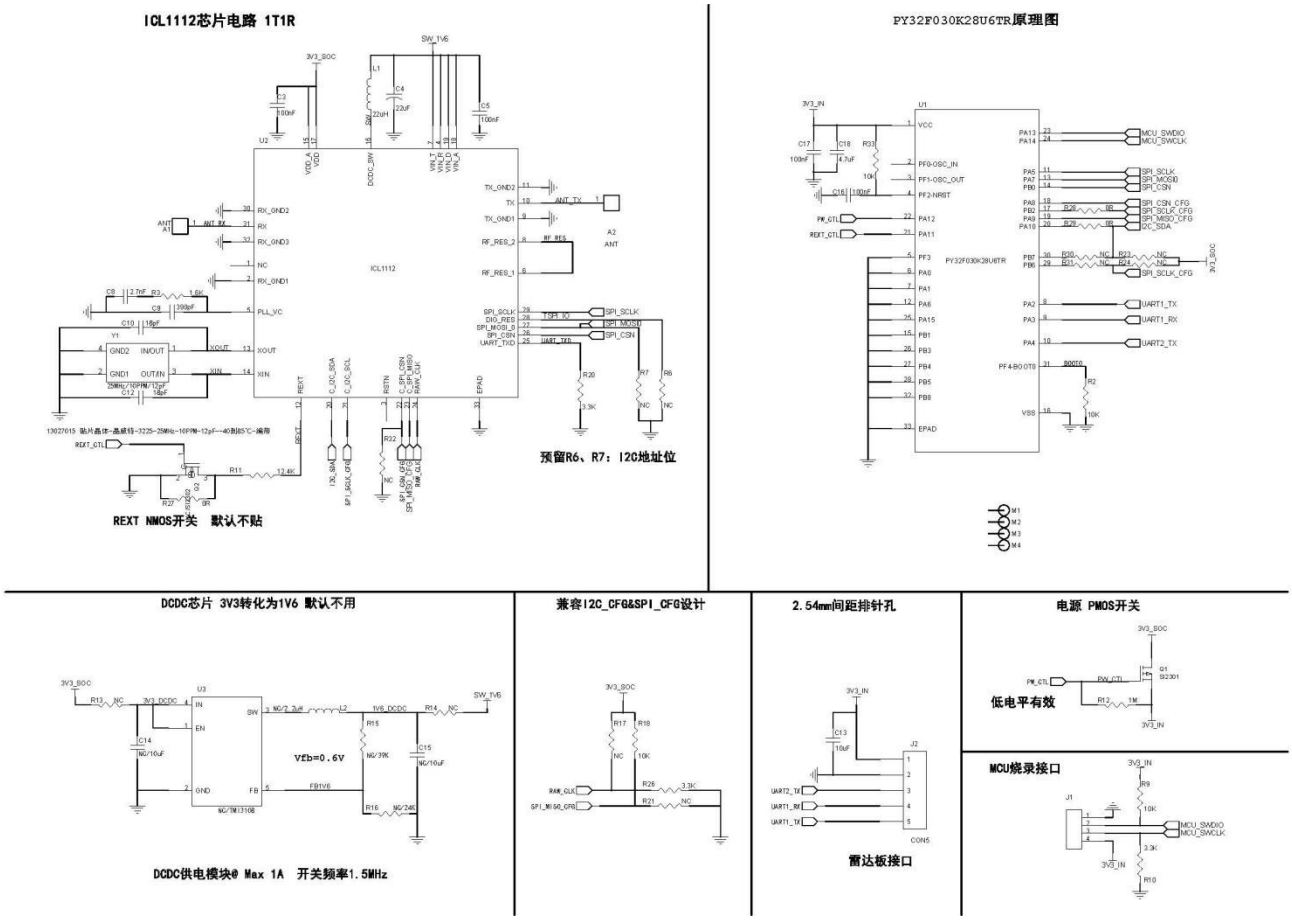


Figure 7 schematic diagram

6. Design Guide

6.1. Application Guide circuit

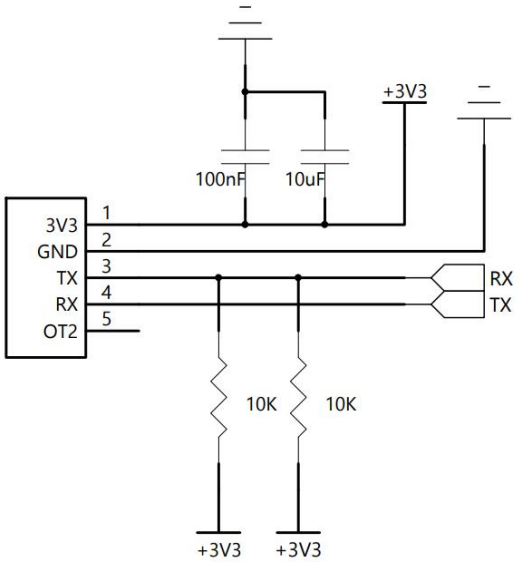


Figure 8 application guidance circuit

6.2. Recommend PCB package size

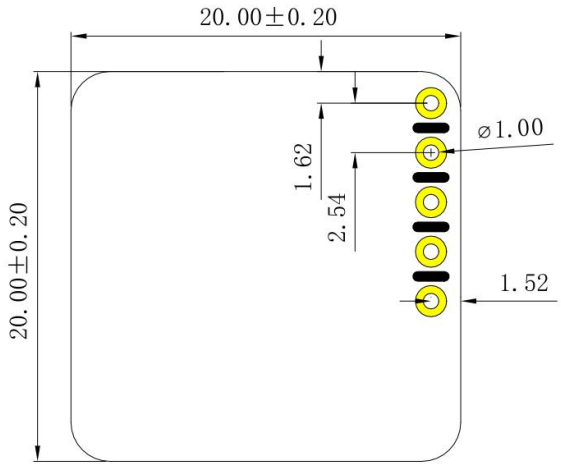


Figure 9 recommend PCB package size

Note:

- The Rd-03L module adopts a standard pin connector with a spacing of 5pin-2.54mm

6.3. Radar installation precautions

- The installation position on the motherboard is recommended in the following ways:

- ✓ Try to ensure that the radar antenna is facing the area to be detected, and the antenna is open and unobstructed.
- ✓ To ensure that the radar installation position is firm and stable, the shaking of the radar itself will affect the detection effect.
- ✓ Make sure that there is no movement or vibration of objects on the back of the radar. Due to the penetrability of radar wave, the back flap of antenna signal may detect moving objects on the back of radar. Metal Shield or metal back plate can be used to shield the back flap of radar and weaken the influence caused by the objects on the back of radar.
- ✓ Due to the different shape, state and RCS of the target, the distance accuracy of the target will fluctuate; At the same time, the longest distance will also fluctuate slightly.
- ✓ When there are multiple 24GHz band radars, please do not align the beam and try to stay away from installation to avoid possible mutual interference.

- ■ In order to meet the performance of the on-board antenna, it is forbidden to place metal parts around the antenna and keep away from high-frequency devices.
- ■ The input voltage range of the power supply is 3.0 V-3.6 V, and the ripple of the power supply is required to have no obvious frequency peak within 100kHz. Users should consider the corresponding EMC designs such as ESD and lightning surge.

6.4. Installation environment requirements

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

- ■ There are non-human objects that keep moving in the sensing area, such as animals, curtains that keep swinging, large plants and green plants facing the air outlet, etc.
- ■ There are large areas of strong reflectors in the induction area, which will cause interference to the radar antenna.
- ■ When installing wall hanging, external interference factors such as air conditioner and electric fan on the top of the room should be considered.

6.5. Installation method and sensing range

■ Wall mounting method

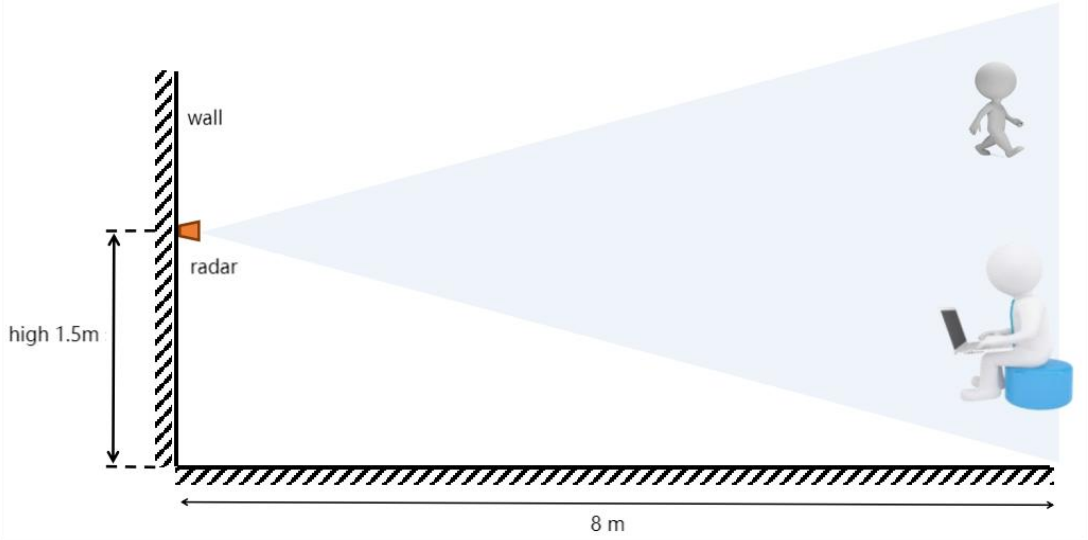


Figure 10 wall mounting diagram

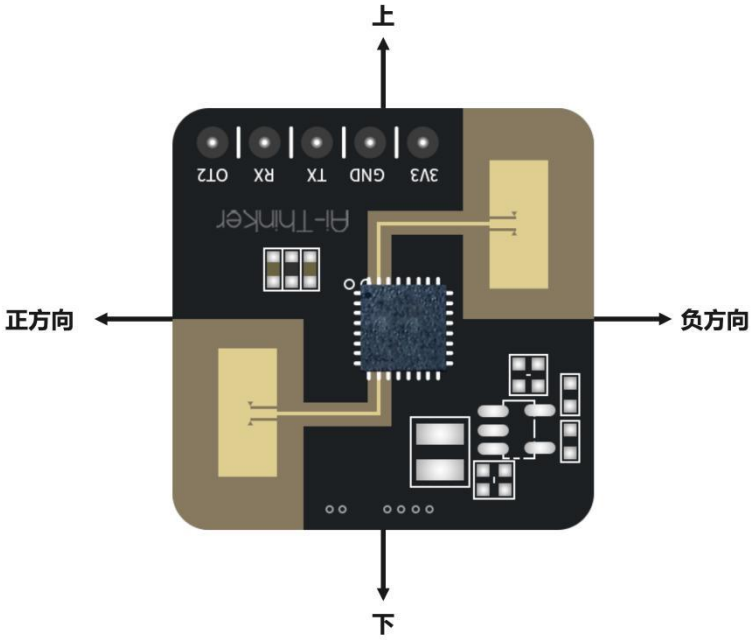


Figure 11 schematic diagram of wall hanging direction

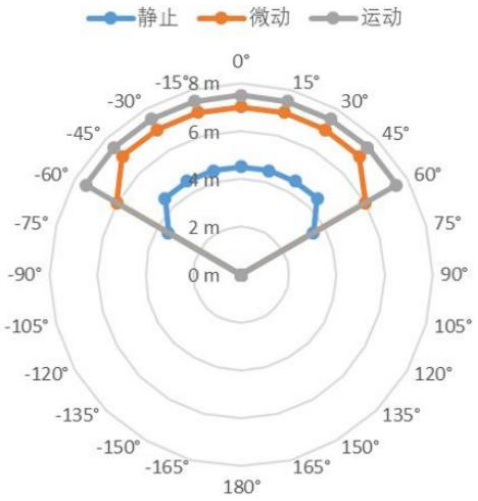


Figure 12 wall-mounted radar diagram

6.6. Power supply

- Recommend a voltage of 3.3V with a peak current of over 200mA.
- We recommend that you use LDO for power supply. If you use DC-DC, we recommend that you control the ripple within 1000mV.
- DC-DC power supply circuit is recommended to reserve the position of dynamic response capacitor, which can optimize the output ripple when the load changes greatly.
- We recommend that you add ESD devices to the 3.3V power interface.

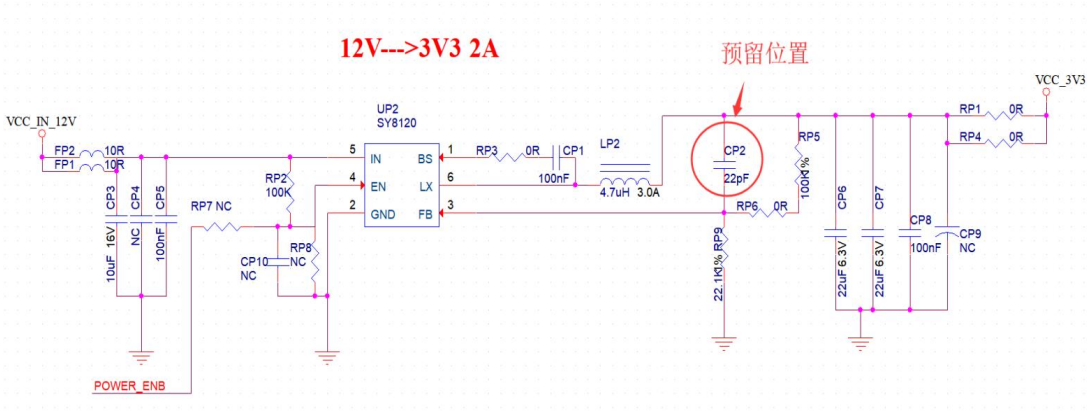


Figure 13 DC-DC step-down circuit diagram

6.7. GPIO

- Some IO ports are introduced outside the module. If you need to use them, we recommend that you connect 10-100 ohms of resistance to the IO ports in series. In this way, overshoot can be suppressed and the levels on both sides can be more stable. It is helpful for both

EMI and ESD.

- For the pull-down of special I/O ports, please refer to the instructions in the specification, which will affect the startup configuration of the module.
- The I/O port of the module is 3.3V. If the main control does not match the I/O port level of the module, a level conversion circuit needs to be added.
- If the IO port is directly connected to the peripheral interface, or the terminal such as the pin, it is recommended to reserve ESD devices near the terminal of the IO port.

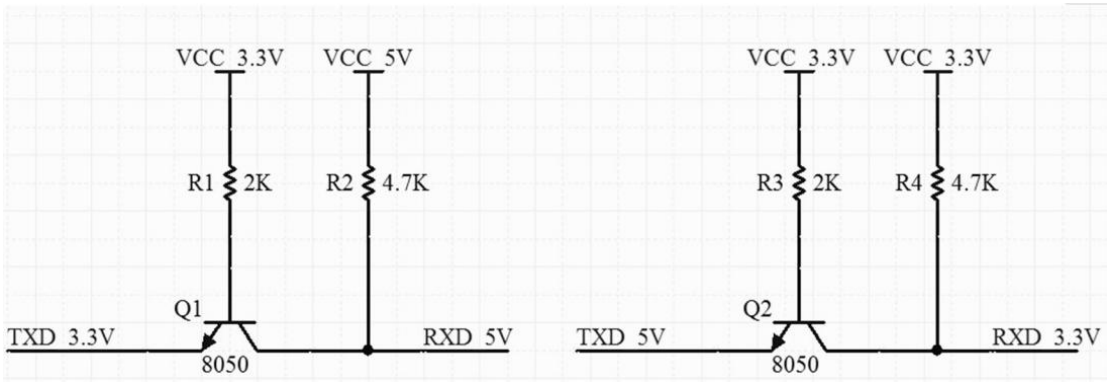


Figure 14 level conversion circuit

7. Storage Conditions

Products sealed in moisture-proof bags shall be stored in a non-condensing atmospheric environment of <40℃/90% RH.

The humidity sensitivity level MSL of the module is Level 3.

After the vacuum bag is unpacked, it must be used up within 168 hours at 25±5℃/60%RH, otherwise it can be put on line again after baking.

8. Reflow welding curve diagram

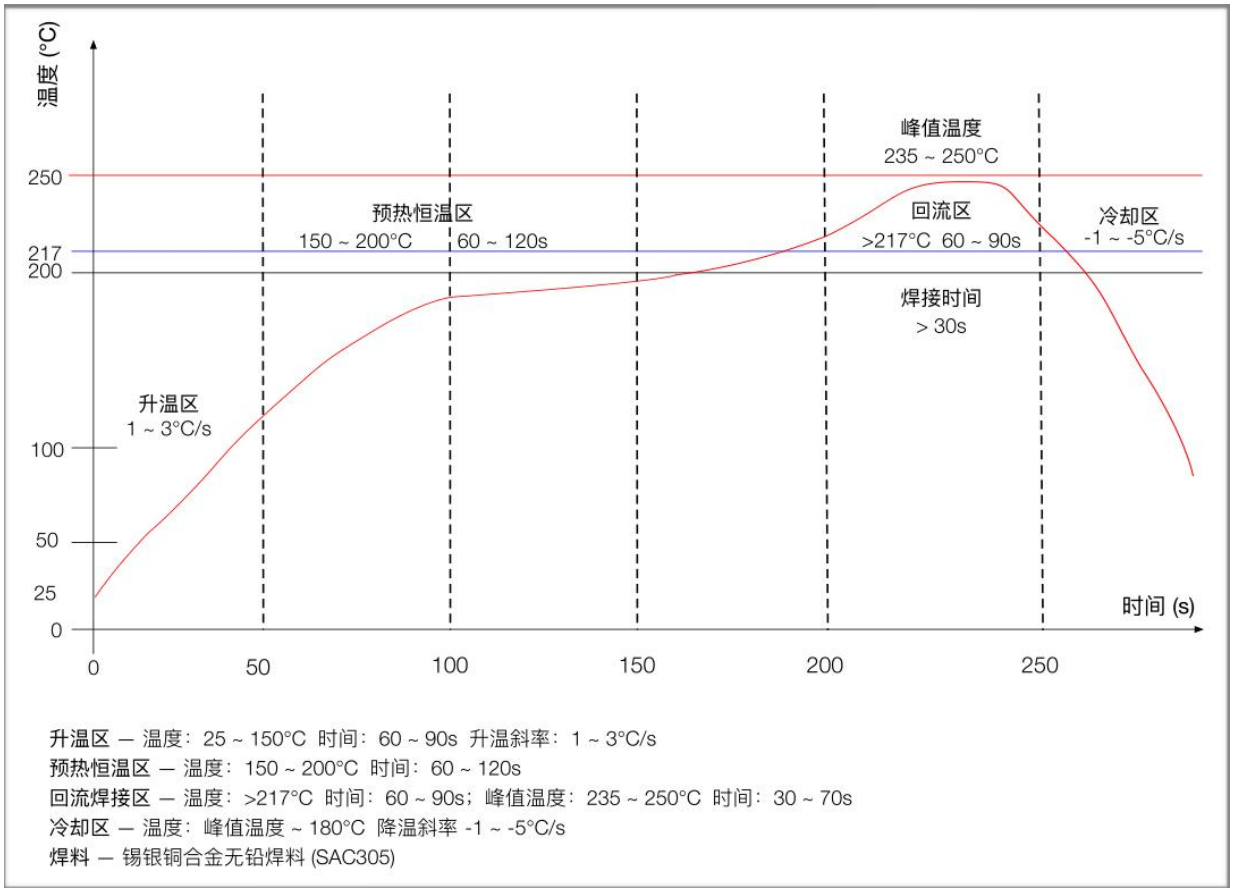


Figure 15 Reflow welding curve

9. Product package information

Rd-03L module adopts braided packaging, 200pcs/disk. As shown in the following figure:

Figure 16 packing ribbon diagram

10.Contact us

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