Rd-03D Specification

Version V1.0.0

Copyright ©2023

Document resume

Version	Date	Develop/revise content	Edition	Approve
V1.0.0	2023.08.31	First Edition	Pengfei Dong	Ning Guan

Content

1. Product overview 4
1.1. Characteristic 5
2. Main parameters 6
2.1. Static electricity requirement 6
2.2. Electrical characteristics 6
2.3. Radar sensing range 7
2.4. Power 7
3. Appearance size 8
4. Pin definition 9
5. Schematic diagram 10
6. Design guidance 10
6.1. Application guide circuit 10
7. Precautions for radar installation 11
7.1. Installation environment requirements 11
7.2. Installation mode and induction range 12
7.3. Power Supply 13
7.4. GPIO 14
8. Storage conditions 14
9. Reflow welding curve diagram 15
10. Product package information 15
11. Contact us 16
Disclaimer and copyright notice 17
Notice 17
Statement 18

1. Product overview

Rd-03D is a radar module developed by Shenzhen Ai-Thinker Technology Co., LTD, which is equipped with the S5KM312CL chip. S5KM312CL is an integrated microcontroller millimeter wave sensor SoC based on FMCW radar transceiver technology. It works in 24 GHz K-band with a maximum sweep bandwidth of 0.25GHz. The module adopts the advanced signal processing technology of FMCW waveform and S5 series chip, combined with MCU's radar signal processing and built-in intelligent positioning and tracking algorithm, can detect multiple targets in the specified area and report the results in real time, and users can quickly develop the corresponding target positioning and tracking products.

Rd-03D module accurately senses human body and regional motion state, carries intelligent algorithm to realize motion trajectory recognition and tracking, and realizes speed measurement and ranging of targets in the region, with faster recognition speed and lower power consumption. The module can be configured quickly and is suitable for all kinds of public publicity facilities. It can intelligently distinguish the human body in the form of movement, micro-movement and rest, and control the switch of equipment. The module has good resistance to external interference and is not affected by wireless signals such as WIFI.

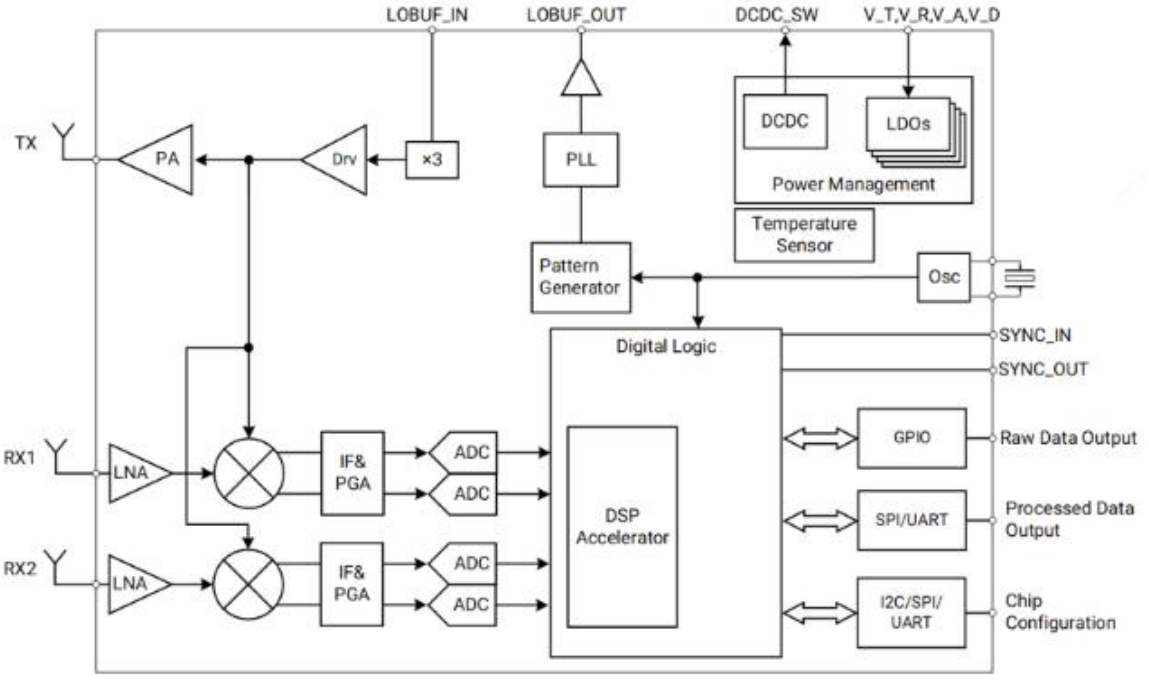


Figure 1 S5KM312CL architecture diagram

1.1. Characteristic

- Adopts standard 1*4P-1.25mm socket connector
- Radar support 24 GHz ISM frequency band
- High performance 1T2R antenna
- Accurate target positioning and tracking
- MAX sensing distance is 8m
- The range resolution is 0.75m, the ranging accuracy is 0.15m
- Detection range azimuth Angle ±60°, pitch Angle ±30°
- Wall mounting
- Provides a visual tool to configure the tracking detection range, data reporting interval, and target retention time
- Ultra-small module size: 15*44mm
- Automatically loads default configuration, plug and play
- Support UART, you can use the serial port to realize radar intelligent parameter adjustment, convenient and fast
- 5V single power supply
- Typical application scenarios:
  - ✓ Smart home
  - ✓ Smart business
  - ✓ Bathroom
  - ✓ Smart lighting

2. Main parameters

Table 1 Main parameters

Model	Rd-03D
Package	Standard 1*4P-1.25mm socket connector
Size	15.0*44.0(±0.2)mm
Antenna	on-board PCB antenna
Frequency	24G ~24.25GHz
Working temperature	-40℃ ~ 85℃
Storage temperature	-40℃ ~ 125℃, < 90%RH
Power supply	Support voltage 5V, supply current ≥200mA
Interface	UART
UART rate	Default 256000 bps

2.1. Static electricity requirement

Rd-03D is an electrostatic sensitive device. Therefore, you need to take special precautions when carrying it.

Figure 2 ESD preventive measures

2.2. Electrical characteristics

Table 2 Electrical characteristics table

Parameters		**Condition**	**Min.**	**Typical value**	**Max.**	**Unit**
Voltage Supply		VDD	-	5	-	V
I/O	VIL	VDD	-0.3	-	0.3*VDD	V
	VIH	VDD	0.7*VDD	-	VDD+0.3	V
	VOL	VDD	-	-	0.33	V
	VOH	VDD	2.7	-	-	V

2.3. Radar sensing range

Table 3 Radar sensing range

Installation Method	Min.	Typical	Max.	Unit
Installation wall mount	-	8	-	m

Note:

- The above induction distance is based on Ai-Thinker open field measurement, for reference only
- The radar sensing distance is greatly affected by surrounding walls, ceilings, large-size objects, and installation methods. The specific data in the installation environment shall prevail

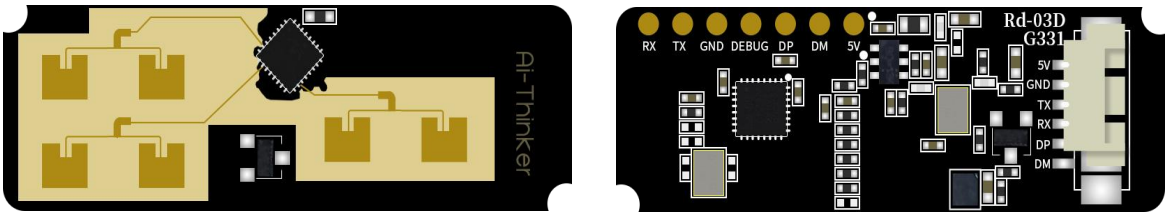
2.4. Power

The following power consumption data is based on a 5V power supply and an ambient temperature of 25° C.

Table 4 Power consumption

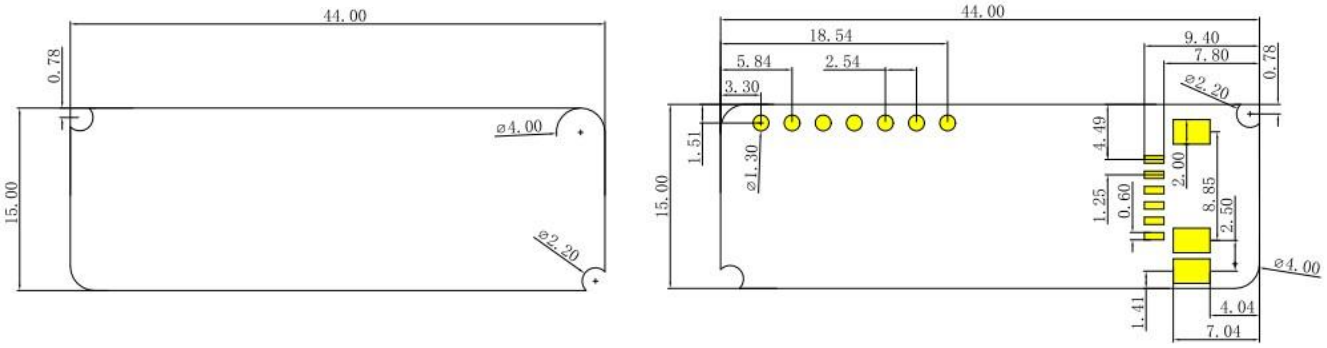
Mode	Min.	AVG	Max.	Unit
Working status	-	92	-	mA

3. Appearance size



Front Back

Figure 3 Appearance diagram (rendering diagram is for reference only, subject to the actual object）

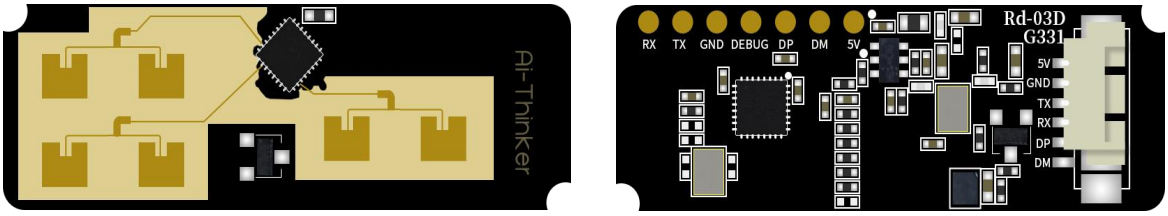


Front Back

Figure 4 Size chart

4. Pin definition

Rd-03D module is connected with four pins, such as the pin diagram, and the pin function definition table is the interface definition.



Front Back

Figure 5 Pin diagram

Table 5 Definition table of pin functions

No.	Name	Function
1	5V	Input power
2	GND	Ground
3	TX	UART_TX
4	RX	UART_RX

5. Schematic diagram

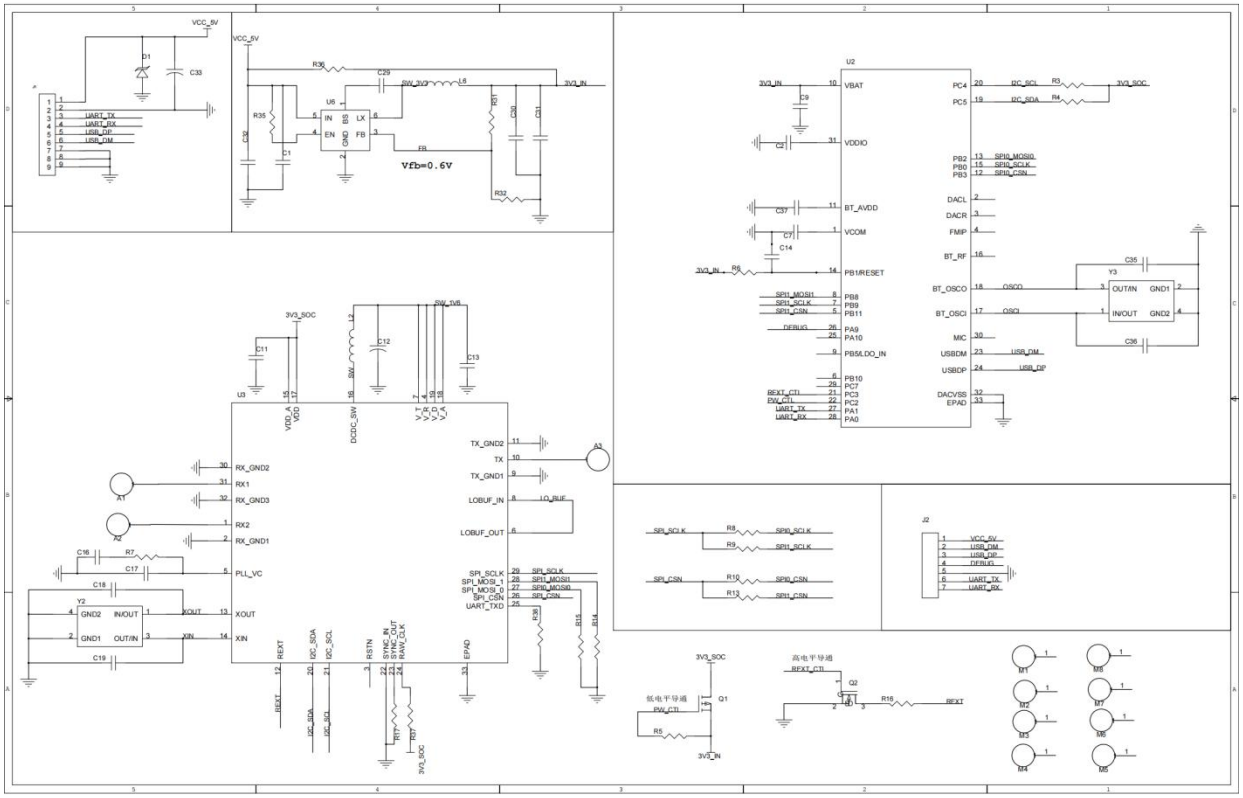


Figure 6 Schematic diagram

6. Design guidance

6.1. Application guide circuit

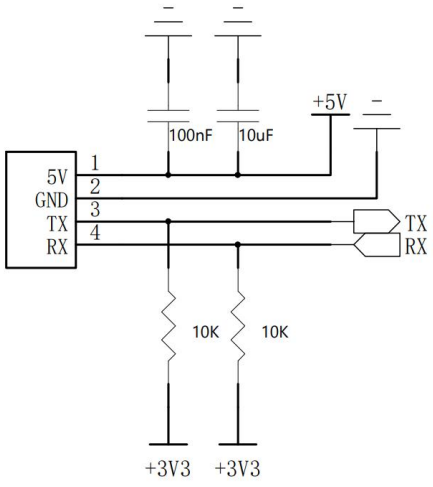


Figure 7 Application guide circuit

7. Precautions for radar installation

- In motherboard installation position, it is recommended that the following several ways:
  - ✓ As far as possible to ensure that the radar antenna is opposite to test area, and the antenna around open without sunscreen.
  - ✓ Ensure that the radar installation position is firm, stable, shaking will influence the effect of detection of radar itself.
  - ✓ Make sure there is no movement or vibration on the back of the radar. Due to the penetrating nature of radar waves, the back lobe of the antenna signal may detect moving objects on the back of the radar. A metal shield or metal backplane can be used to shield the radar back lobe to reduce the impact of objects on the back of the radar.
  - ✓ The range accuracy of the target will fluctuate due to the different size, state, RCS, etc.; And the farthest distances fluctuate slightly.
  - ✓ If there are multiple radars in the 24GHz band, do not beam correctly and install them as far away as possible to avoid possible mutual interference.
- To meet the performance of the onboard antenna, do not place metal parts around the antenna, far away from high-frequency devices.
- The power input voltage range is 5V, and the power ripple is required to be controlled within 100mV. Users need to consider the corresponding ESD and lightning surge EMC design.

7.1. 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 non-human objects in continuous motion in the sensing area, such as animals, curtains that continue to swing, and large green plants facing the air outlet.
- There is a large area of strong reflectors in the sensing area, which will cause interference to the radar antenna.
- When mounting the wall, it is necessary to consider the external interference factors such as air conditioning and electric fans at the top of the room.

7.2. Installation mode and induction range

■ Hanging roof installation

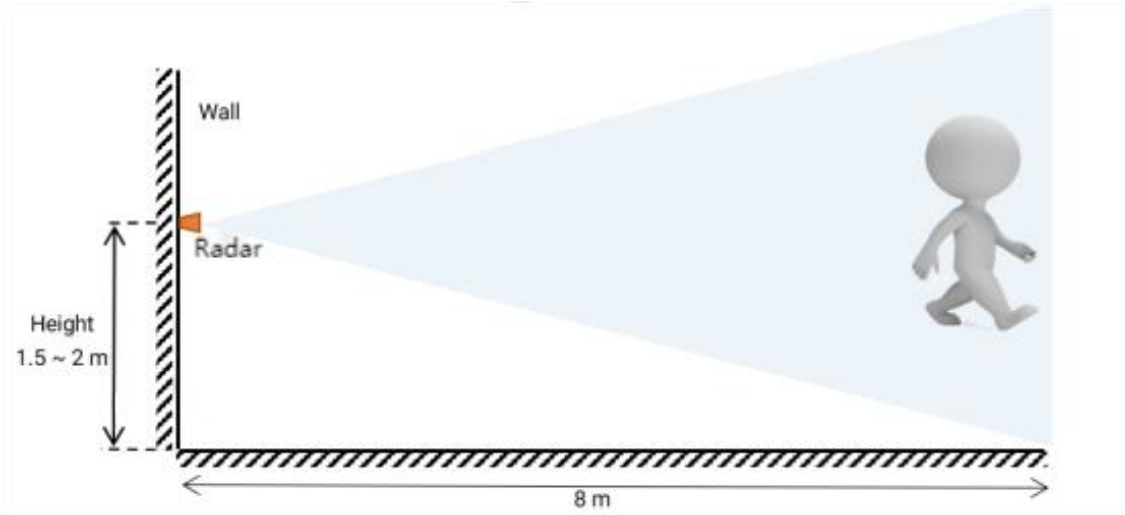


Figure 8 Wall mounting diagram

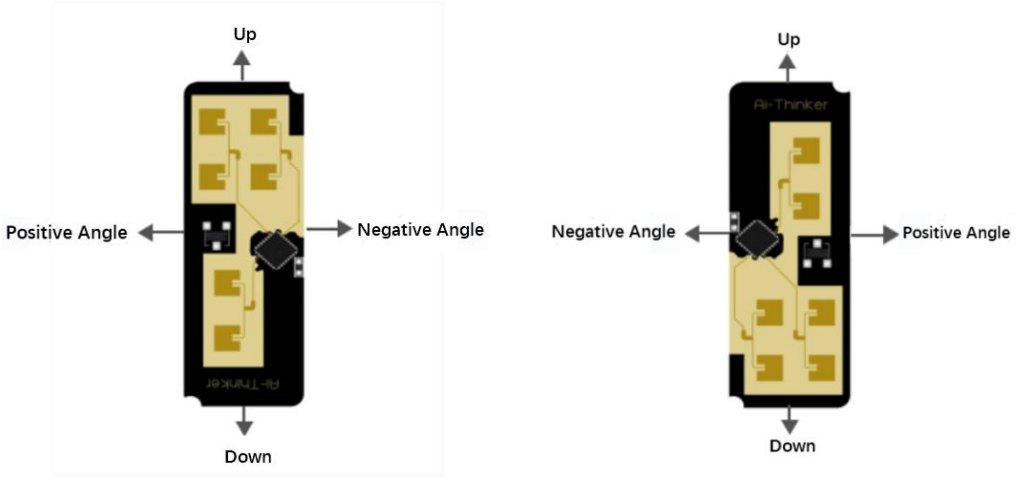


Figure 9 Schematic diagram of detection range of hanging wall

Note: It is recommended that the radar installation azimuth is shown in Figure 10 (a) or (b), positive and negative directions are azimuth angles, up and down directions are pitch angles, and the radar antenna plane normal direction is 0°

- Detection range Azimuth Angle ±60°, pitch Angle ±30°, the maximum detection distance in the normal direction is 8m

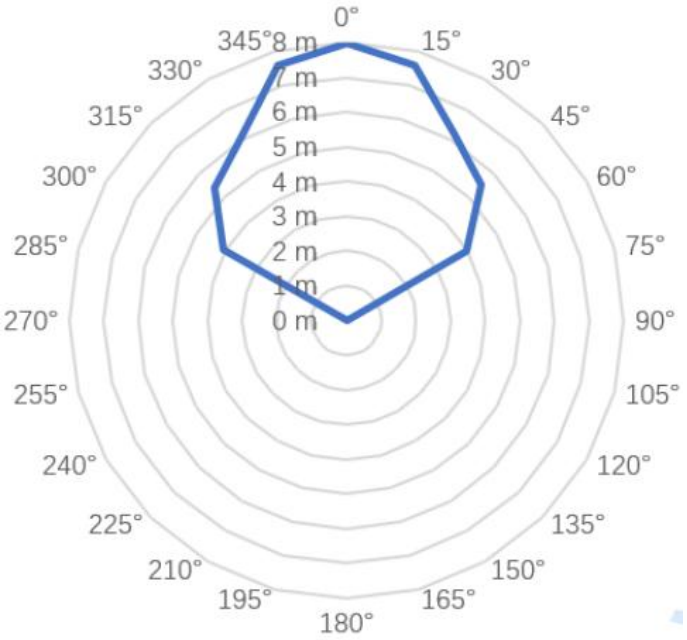


Figure 10 Schematic diagram of tracking range of wall mounting

7.3. Power Supply

- Recommended 5V voltage, peak current above 200mA.
- LDO power supply is recommended; If DC-DC is used, it is recommended to control the ripple within 100mV.
- DC-DC power supply circuit It is recommended to reserve a dynamic response capacitor to optimize output ripple when the load changes greatly.
- ESD devices are recommended for the 5V power port.

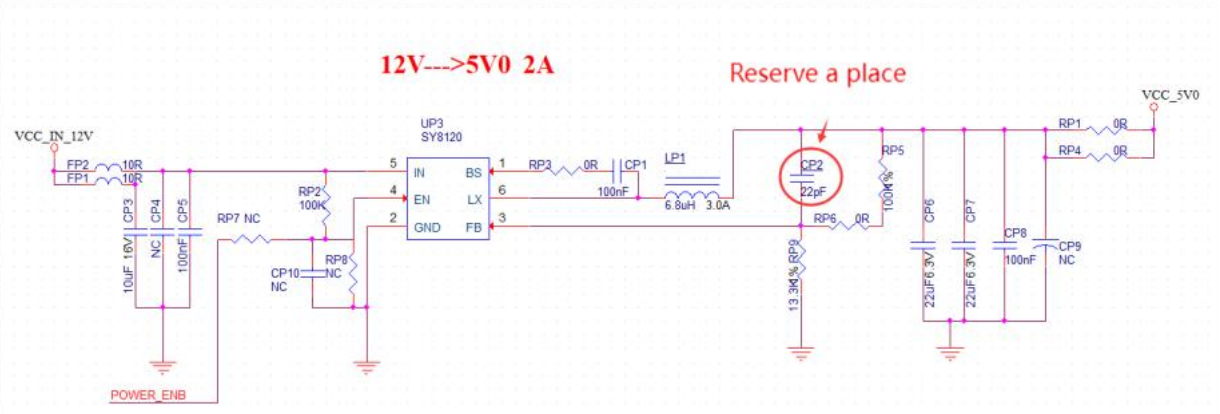


Figure 11 DC-DC buck circuit diagram

7.4. GPIO

- Some IO ports are drawn from the periphery of the module. If necessary, it is recommended to use 10-100Ω in series resistance on the IO port. This suppresses overshoot and makes both sides smoother. Helps with both EMI and ESD.
- For pulling up and down special IO ports, see the usage instructions in the specifications. This affects the startup configuration of the module.
- The IO port of the module is 3.3V. If the level of the master control does not match that of the IO port of the module, a level conversion circuit needs to be added.
- If the IO port is directly connected to the peripheral interface or a pin bar terminal, reserve an ESD device near the IO port cable to the terminal.

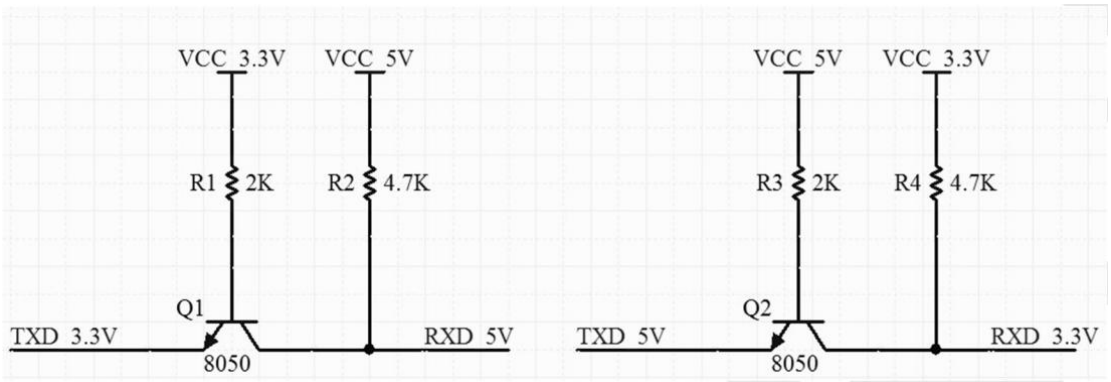


Figure 12 Level switching circuit

8. Storage conditions

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

The module has a moisture sensitivity level MSL of 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 put on line again.

9. Reflow welding curve diagram

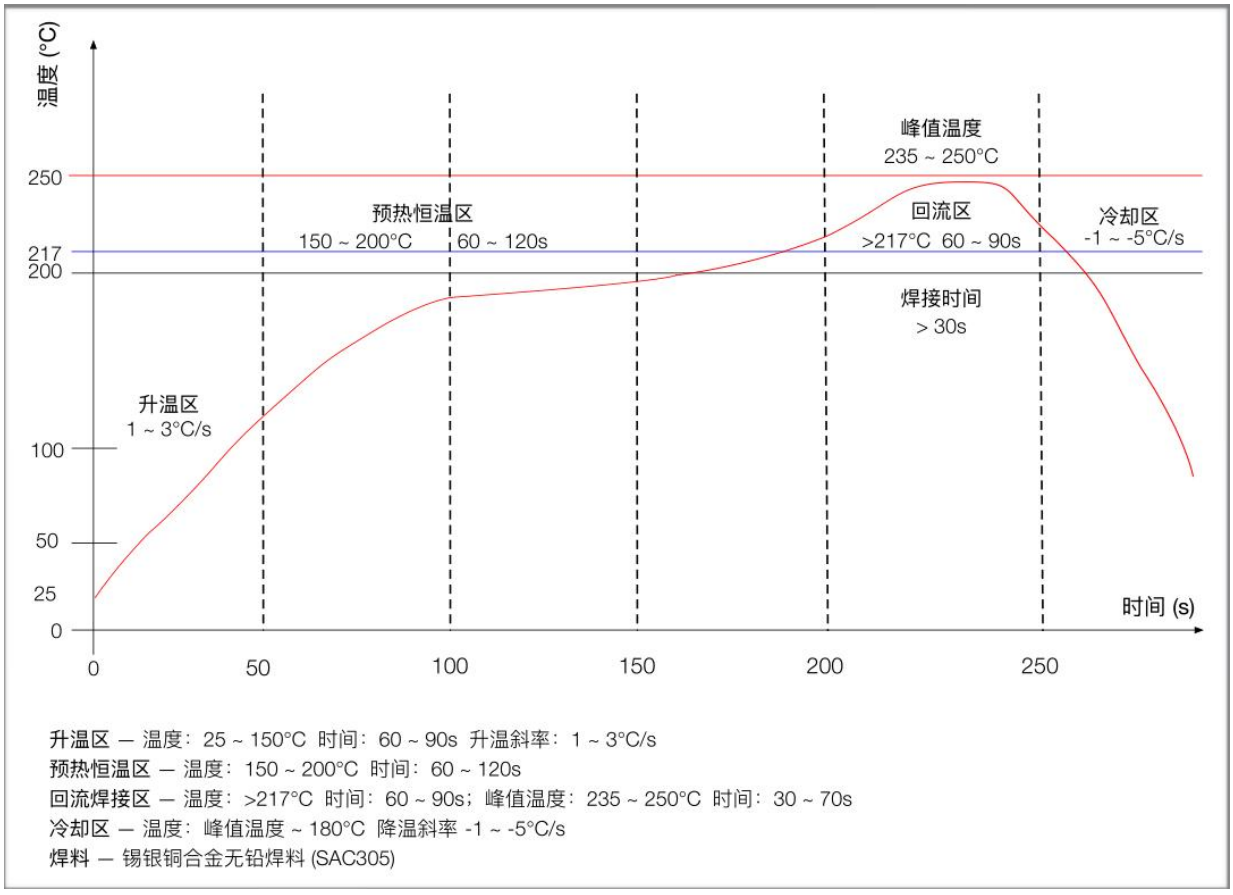


Figure 13 Reflow welding diagram

10. Product package information

Rd-03D module adopts braid packaging, 500pcs/reel. As shown in the picture below:

Figure 14 Packaging braid diagram

11.Contact us

Ai-Thinker official website Official Forum Develop DOCS LinkedIn

Tmall shop Taobao shop Alibaba shop

Technical support Email: support@aithinker.com

Domestic business cooperation: sales@aithinker.com

Overseas business cooperation：overseas@aithinker.com

Company address: Room 403,408-410, Block C, Huafeng Smart Innovation Port, Gushu 2nd Road, Xixiang, Baoan District, Shenzhen.

Tel: 0755-29162996

WeChat mini

WeChat official

Disclaimer and copyright notice

The information in this article, including the URL address for reference, is subject to change without notice.

The document is provided "as is" without any guarantee responsibility, including any guarantee for merchantability, suitability for a specific purpose, or non-infringement, and any guarantee mentioned elsewhere in any proposal, specification or sample. This document does not bear any responsibility, including the responsibility for infringement of any patent rights arising from the use of the information in this document. This document does not grant any license for the use of intellectual property rights in estoppel or other ways, whether express or implied.

The test data obtained in the article are all obtained from Ai-Thinker's laboratory tests, and the actual results may vary slightly.

All brand names, trademarks and registered trademarks mentioned in this article are the property of their respective owners, and it is hereby declared.

The final interpretation right belongs to Shenzhen Ai-Thinker Technology Co., Ltd.

Notice

Due to product version upgrades or other reasons, the contents of this manual may be changed.

Shenzhen Ai-Thinker Technology Co., Ltd. reserves the right to modify the contents of this manual without any notice or prompt.

This manual is only used as a guide. Shenzhen Ai-Thinker Technology Co., Ltd. makes every effort to provide accurate information in this manual. However, Shenzhen Ai-Thinker Technology Co., Ltd. does not guarantee that the contents of the manual are completely free of errors. All statements and information in this manual. And the suggestion does not constitute any express or implied guarantee.

Statement

Ai-Thinker may provide technical and reliability data (including data sheets), design resources (including reference designs), application or other design recommendations, network tools, safety information and other resources (the "Resources") "as is" without warranties of any kind, express or implied. Including, but not limited to, express or implied warranties of suitability, fitness for a particular use, or non-infringement of any third party's intellectual property rights.And specifically declares that it is not liable for any necessary or incidental losses, including but not limited to, arising from the application or the use of any of our products and circuits.

Ai-Thinker reserves the right to release information in this document (including but not limited to metrics and product descriptions) and any changes to our products without prior notice. This document automatically supersedes and replaces all information provided in previous versions of the same document number file.

These resources are available to skilled developers who design with Ai-Thinker products. You are solely responsible for: (1) Selecting the appropriate Ai-Thinker products for your application; (2) Design, validate, and run your application and product throughout its life cycle; (3) Ensure that your application meets all applicable standards, codes and laws, as well as any other functional security, information security, regulatory or other requirements.

Ai-Thinker may authorize you to use these resources only for the development of applications of Essence Products described in this Resource. Without the permission of Ai-Thinker, any unit or individual shall not extract or copy part or all of these resources, and shall not be transmitted in any form. You are not entitled to use any other Ai-Thinker intellectual property rights or any third party intellectual property rights. You shall indemnify you in full for any claims, damages, costs, losses and liabilities arising against Ai-Thinkeror its representatives in connection with the use of these resources, for which Ai-Thinker is not liable.

The products offered by Ai-Thinker are subject to the terms of sale of Ai-Thinker or other applicable terms attached to Essence's products. Essence's availability of these resources does not extend or otherwise change the warranties or warranties disclaimers applicable to product releases.