



# Rd-03 Specification

Version V1.1.1

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## Document resume

Version	Date	Develop/revise content	Edition	Approve
V1.1.0	2023.05.11	First Edition	Jiye Yang	Ning Guan
V1.1.1	2023.05.31	Change the packaging	Jiye Yang	Ning Guan

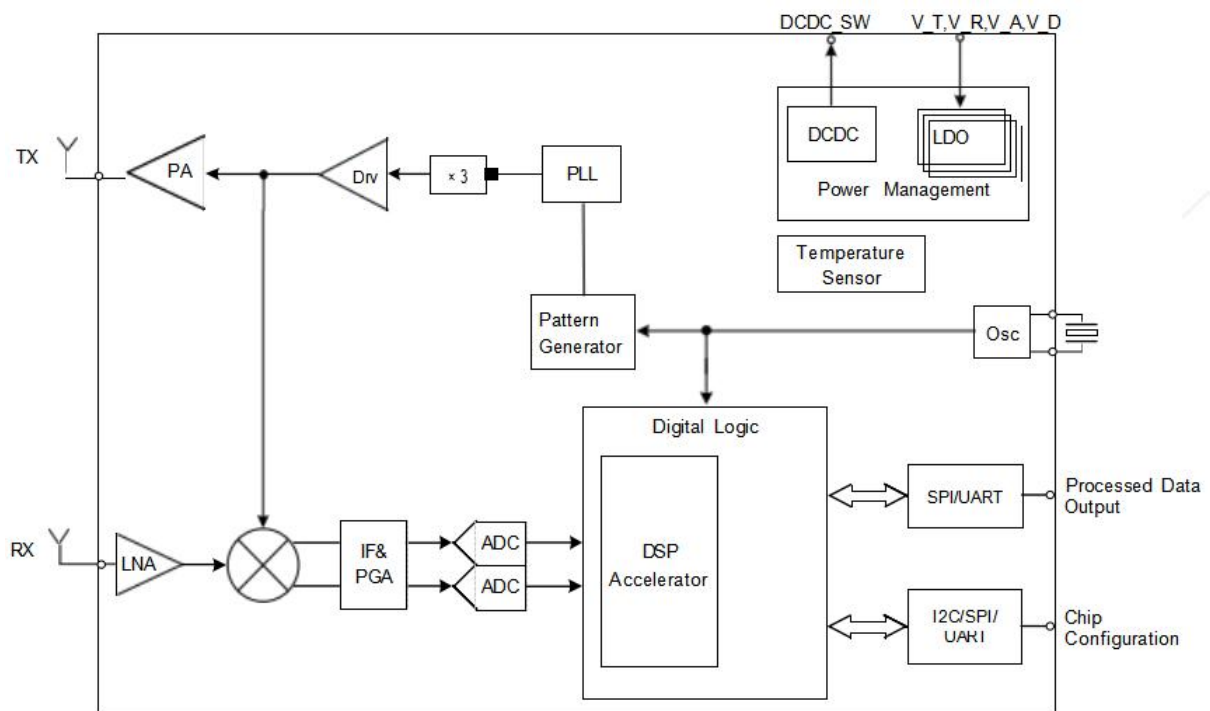
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## 1. Product Overview

Rd-03 is a radar module developed by Shenzhen Ai-Thinker Technology Co., LTD. It equipped with silicon micro-S3KM1110 chips. S3KM1110 is an integrated single-chip millimeter-wave sensor SoC based on FMCW radar transceiver technology. Operates in 24 GHz K-band with up to 1 GHz modulation bandwidth per frequency. FMCW continuous wave is used to detect the target in the set space. Combined with radar signal processing and accurate human body sensing algorithm, high sensitivity human presence state sensing can be realized to recognize human body in motion and static state.

The Rd-03 module can sense whether there is a moving or micro-moving human body in the area, and realize real-time detection results. A visual configuration tool is provided to easily configure the sensing distance range, sensing sensitivity in different intervals and unmanned delay time, etc.



**Figure 1 S3KM1110 architecture diagram**

## 1.1. Characteristic

- DIP package, standard 2.54mm pin
- Radar support 24 GHZ ISM frequency band
- The radar antenna supports 1 receive and 1 transmit, antenna beam narrow, high resolution, frequency bandwidth, strong anti-interference
- The radar's max sensing range is up to 5 meters
- Radar angle is big, range of  $\pm 60$  degrees
- Radar range and accurate recognition, support induction range, shielding range outside interference
- Ultra-small size: 20\*20mm, Plug and play, real-time reporting of detection results
- The intelligent adjustment of radar parameters can be realized through the serial port, which is convenient and fast
- Support various installation methods such as ceiling and wall
- Support UART
- Typical application scenarios
  - ✓ Human sensor light control
  - ✓ Human body induction wake-up of advertising screen and other equipment
  - ✓ life safety protection
  - ✓ Smart Appliances
  - ✓ Smart Security
  - ✓ smart lighting
  - ✓ New energy charging/parking monitoring facilities

## 2. Main parameters

**Table 1 main parameters**

<b>Model</b>	Rd-03
<b>Package</b>	DIP-5
<b>Size</b>	20.0*20.0( $\pm 0.2$ )mm
<b>Antenna</b>	On-board antenna
<b>Frequency</b>	24G ~24.25GHz
<b>Operation temperature</b>	-40℃ ~ 85℃
<b>Storage environment</b>	-40℃ ~ 125℃, < 90%RH
<b>Power supply</b>	Support voltage 3.0V ~ 3.6V, power supply current $\geq 200$ mA
<b>Interfaces</b>	UART
<b>UART rate</b>	Default 115200 bps

### 2.1. Static electricity requirements

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



**Figure 2 ESD anti-static diagram**

### 2.2. Electrical characteristics

**Table 2 Electrical Characteristics Table**

<b>Parameter</b>		<b>Conditio</b>	<b>Min.</b>	<b>Typical value</b>	<b>Max.</b>	<b>Unit</b>
Power supply		VDD	3.0	3.3	3.6	V
I/O	VIL	-	0	-	0.8	V
	VIH	-	2.3	-	VDD	V
	VOL	-	0	-	0.45	V
	VOH	-	2.45	-	VDD	V

## 2.3. Radar sensing range

**Table 3 Radar induced range**

Installation	Min.	Typical	Max.	Unit
Wall hanging mode ( $\pm 60^\circ$ range)	-	10	-	m
Ceiling method (3m hanging height), circular projection radius	-	5	-	m

**Notice:**

- The above sensing distance is measured based on the open space of Anxinke, 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.

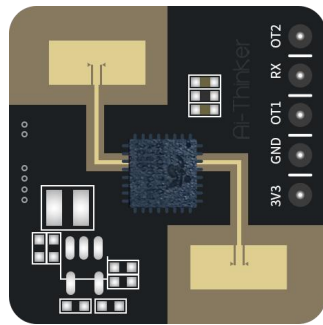
## 2.4. Power

The following power consumption data is based on a 3.3V power supply and an ambient temperature of 25° C

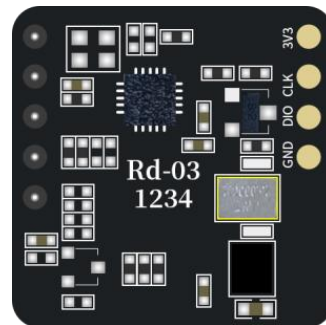
**Table 4 Power Consumption Table**

Model	Min.	AVG	Max.	Unit
working status	-	50	-	mA

### 3. Appearance size

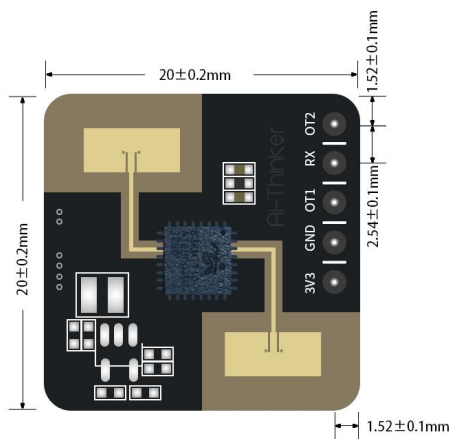


Front

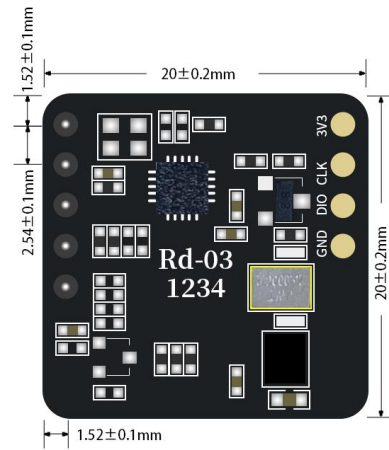


Back

**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-03 connects to a total of 5 interfaces, for example, the pin diagram, the pin function definition table is the interface definition

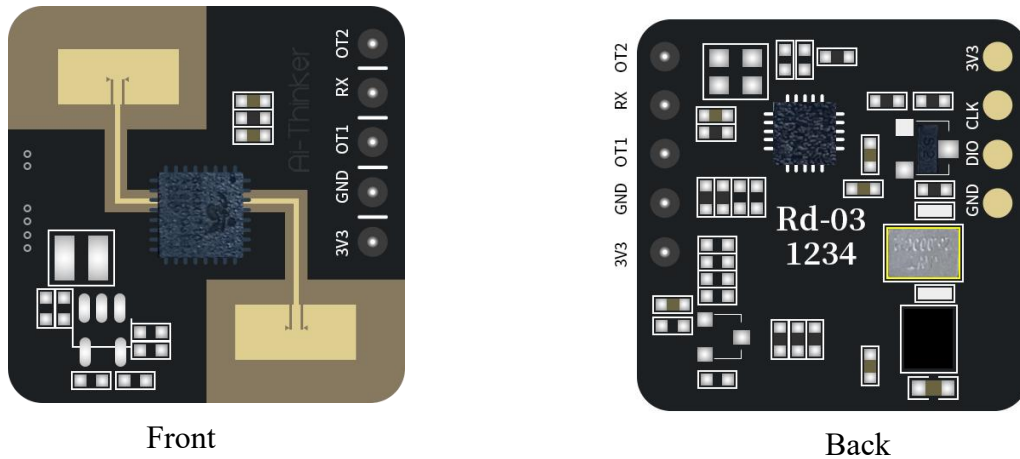


Figure 5 Pin diagram

Table 5 Definition table of pin functions

No.	Name	Function
1	3V3	input power
2	GND	Ground
3	OT1	UART_TX
4	RX	UART_RX
5	OT2	Detection result output, output high level when sensing, output low level when not sensing

## 5. Schematic diagram

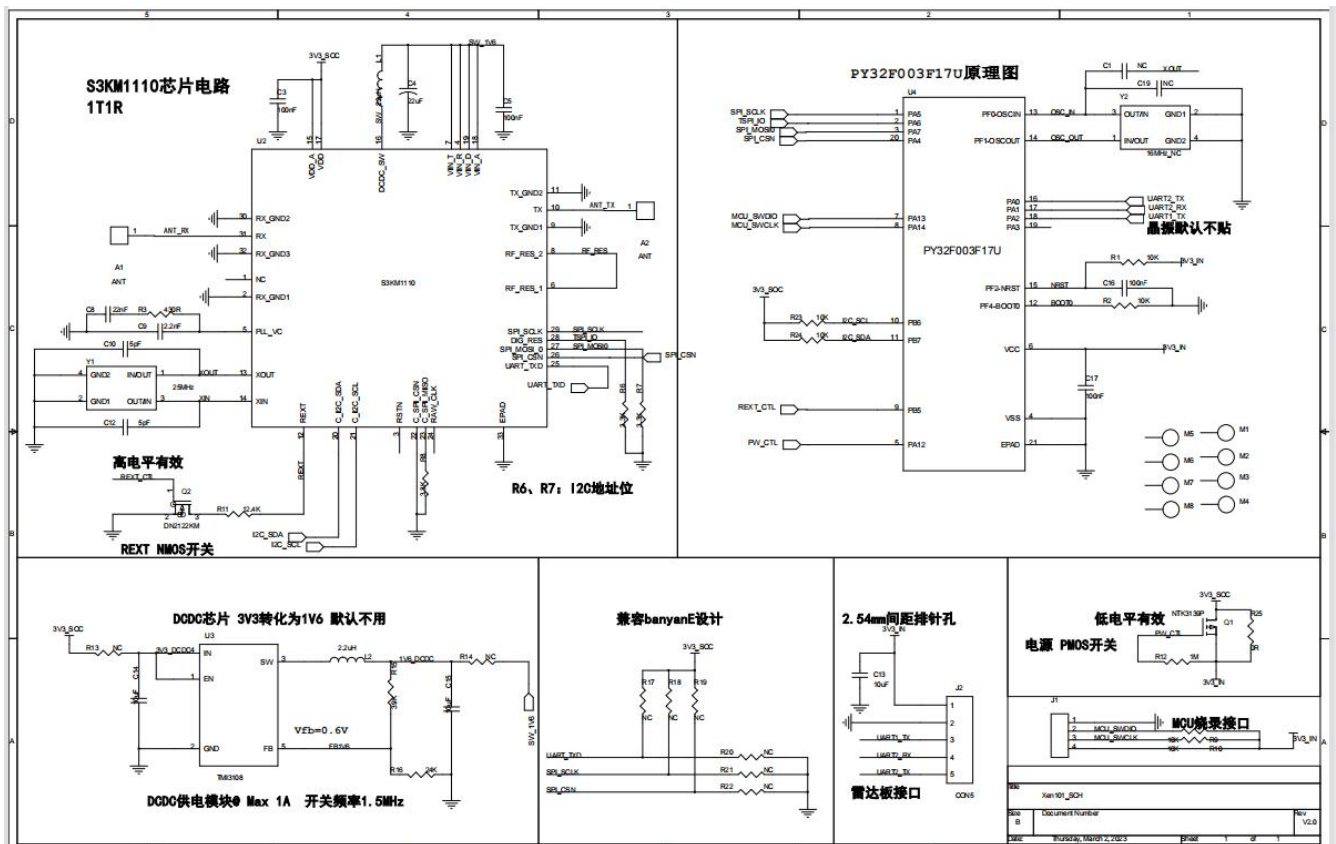


Figure 6 Schematic diagram

## 6. Design guidance

### 6.1. Application guide circuit

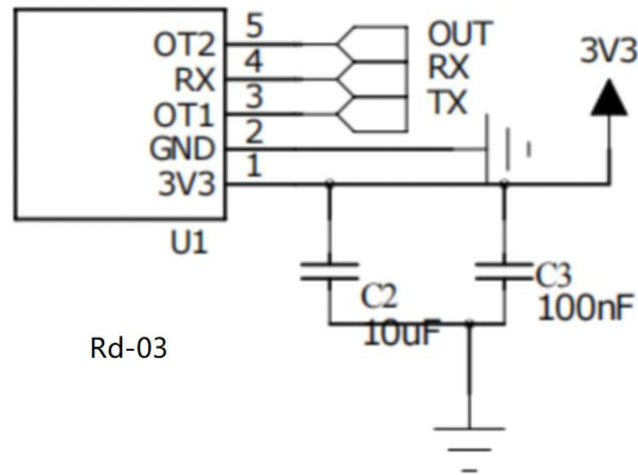


Figure 7 Application guide circuit

### 6.2. Recommended PCB package size

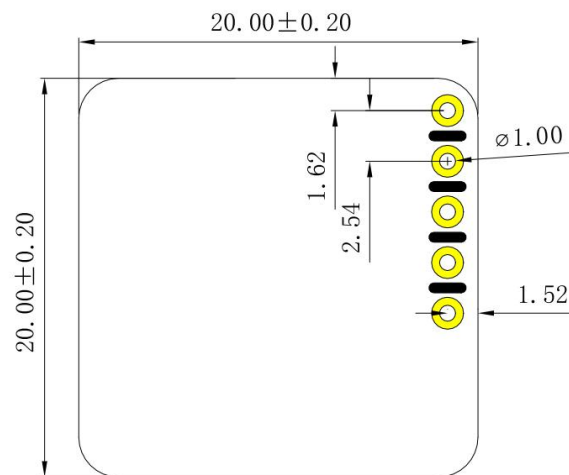


Figure 8 Recommended PCB package size

Note::

- Rd-03 module adopts standard pin header interface with 5pin-2.54mm spacing

### 6.3. 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.
- ✓ ensure that there won't be on the back of radar object movement or vibration. Due to the penetrating nature of radar waves, the antenna signal back lobe may detect moving objects on the back of the radar. A metal shield or metal backplane can be used to shield the radar back flap to weaken the influence of objects on the back of the radar.
- ✓ The theoretical range accuracy of radar is obtained by special algorithm on the basis of the physical resolution of 0.75m. As target size, condition, different, such as RCS target distance accuracy will fluctuate; And the farthest distances fluctuate a little bit.
- In order to meet the performance of on-board antenna, antenna surrounding prohibited, metal pieces, far away from the high frequency components.

### 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:

- Induction of continuous movement in the area of nonhuman objects, such as animals, sustained oscillation of the curtain, is the outlet of the large strain of green plant, etc.
- induction area exists the strong reflector of large area, strong reflector is of the radar antenna can cause interference.
- When mounting the wall, need to consider the top of the indoor air conditioning, electric fan etc. External interference factors.

## 6.5. Installation mode and induction range

### ■ Hanging roof installation

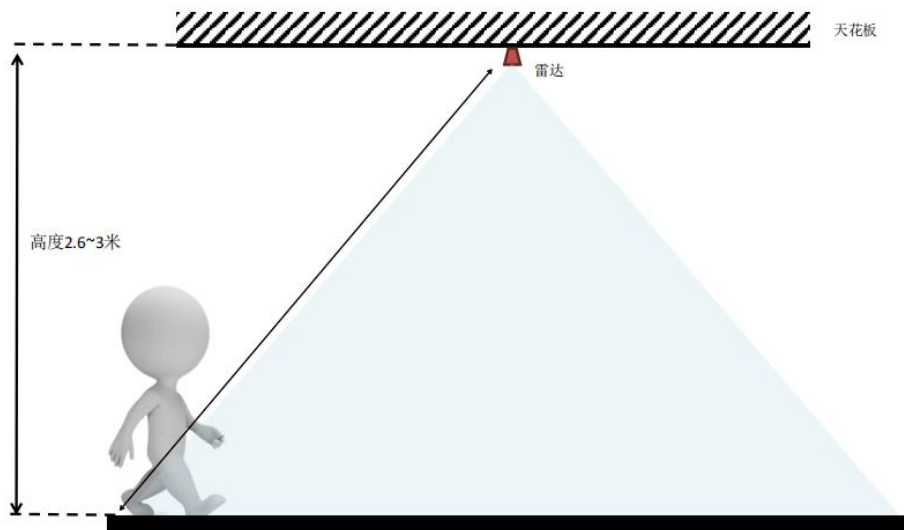


Figure 9 Schematic diagram of mounting the roof

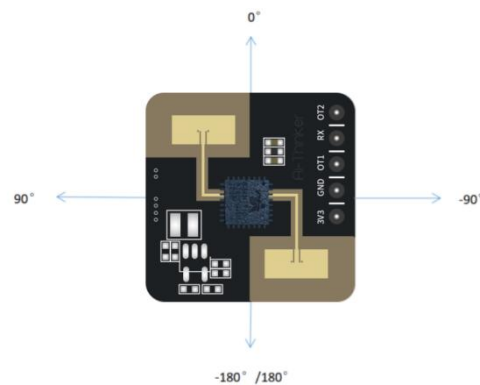


Figure 10 Schematic diagram of the direction of the ceiling

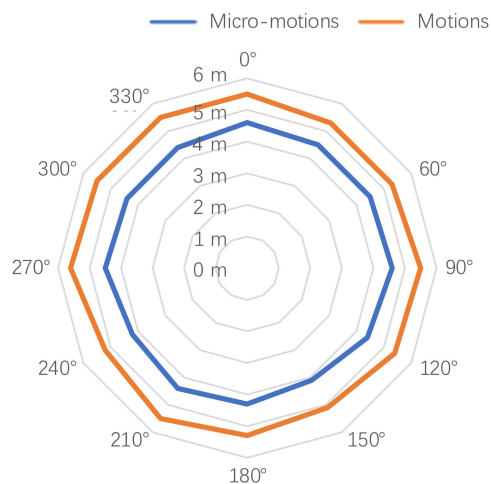
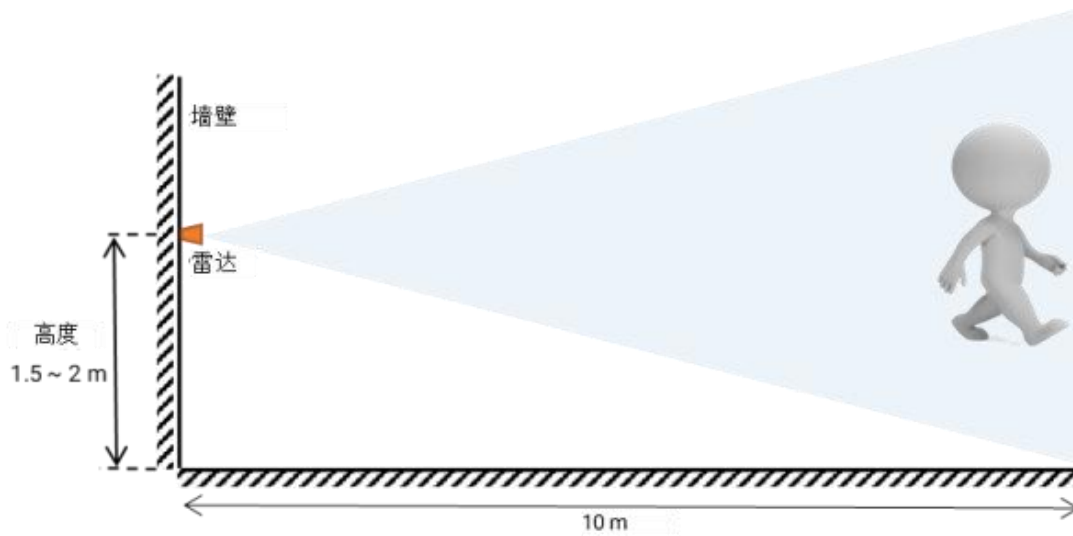
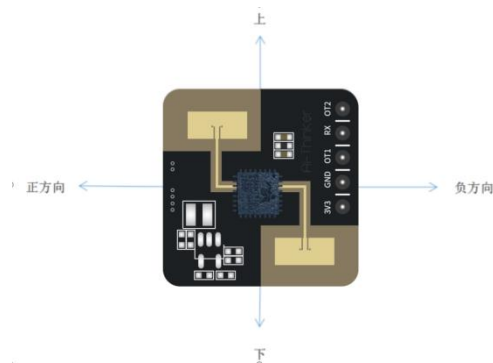


Figure 11 Radar map of the ceiling

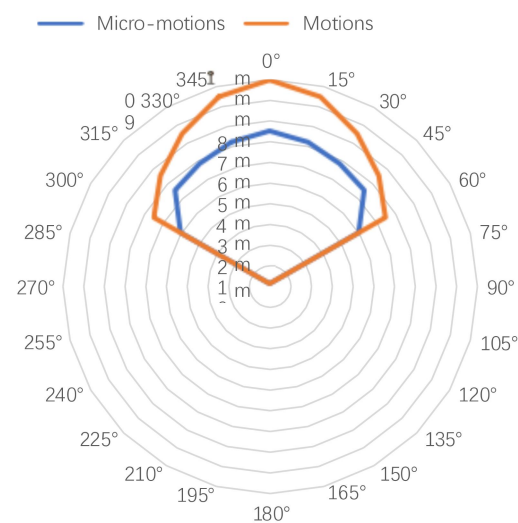
## ■ Wall mounting mode



**Figure 12 Schematic diagram of wall mounting**



**Figure 13 Schematic diagram of wall-mounting direction**



**Figure 14 Wall-mounted radar char**

## 6.6. Power Supply

- Recommended voltage is 3.3V and the peak current is above 200mA.
- Recommended to use LDO as power supply ; If using DC-DC, it is recommended to control ripple within 30mV.
- DC - DC power supply circuit suggested the reserved capacitance position, dynamic response can be large changes in load and optimize the output ripple.
- 3.3V power supply interface increases ESD device is recommended.

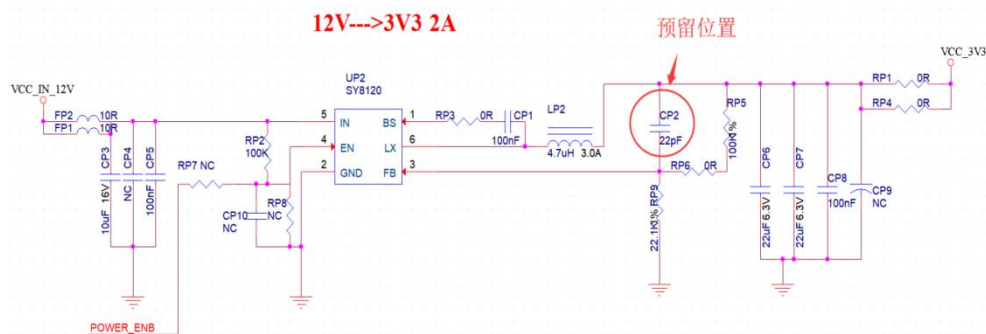


Figure 15 DC-DC step-down circuit diagram

## 6.7. GPIO

- Some IO ports are drawn from the periphery of the module. If necessary, it is recommended to use 10-100 ohm resistors in series on the IO ports. It can suppress overshoot, so make level both sides more smoothly. It helps EMI and ESD.
- Special IO mouth pull up or down, need to refer to instructions on the use of the specification, here will affect the launch configuration module.
- Module IO port is 3.3 V if the master IO mouth level does not match with module, need to increase the level conversion circuit.
- If IO mouth directly connected to the peripheral interface, or terminal, such as row needles, and Suggestions on the IO mouth line near the terminal obligate ESD device.

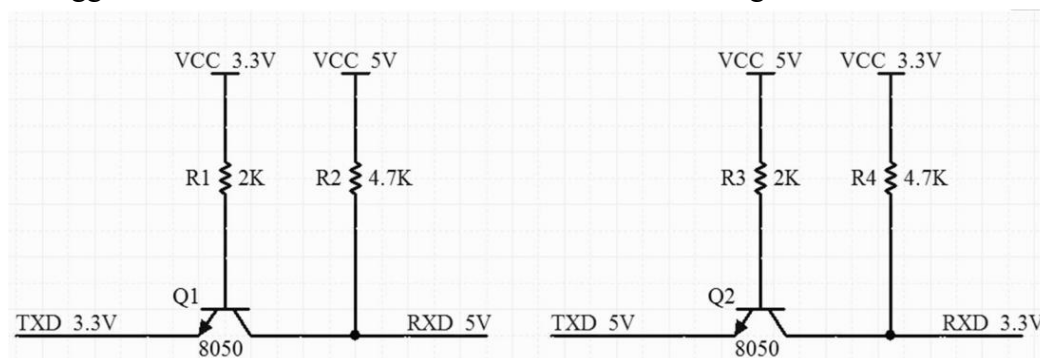


Figure 16 Level switching circuit

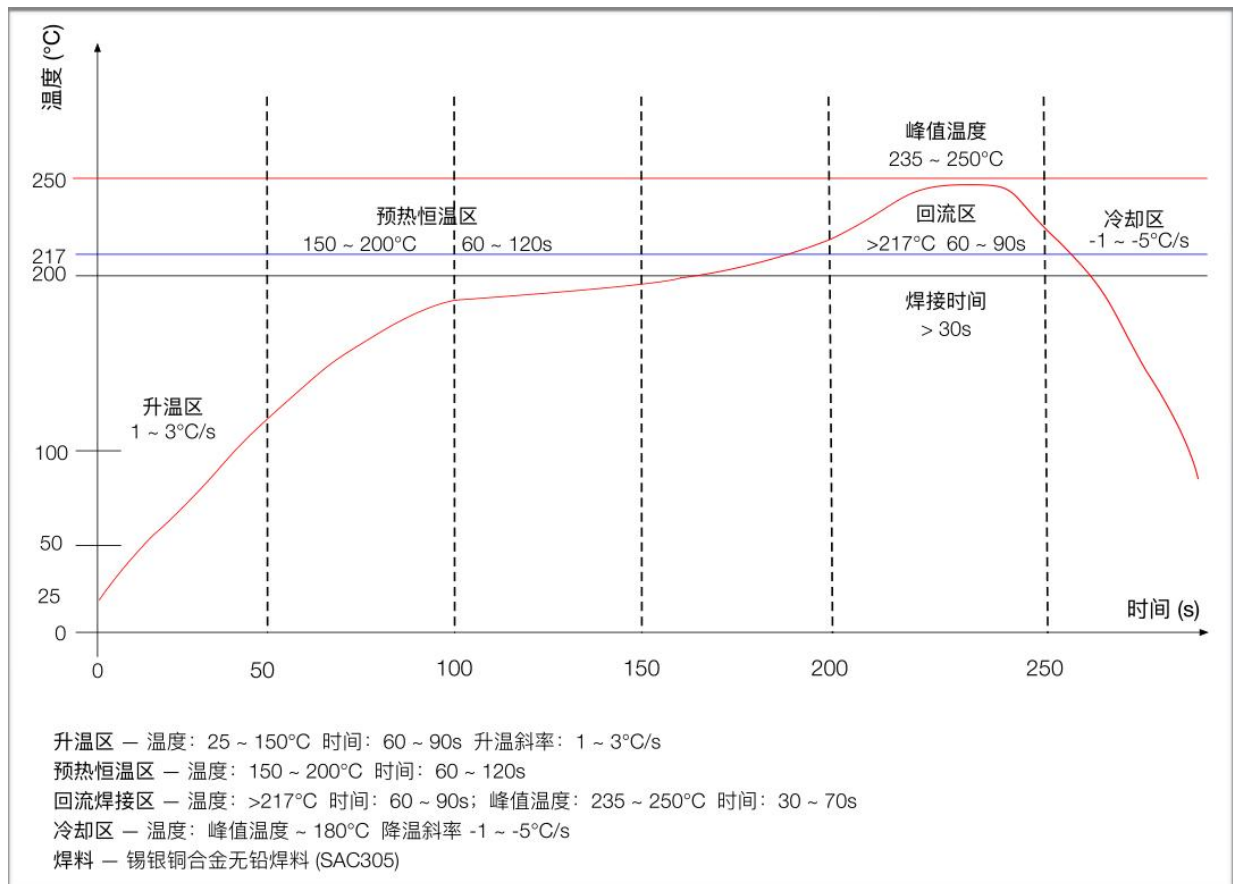
## 7. Storage conditions

Products sealed in moisture-proof bags should be stored in a non-condensing atmosphere at  $<40^{\circ}\text{C}/90\%\text{RH}$ .

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

After the vacuum bag is unwrapped, it must be used within 168 hours at  $25 \pm 5^{\circ}\text{C}/60\%\text{RH}$ . Otherwise, it needs to be baked before it can be put on line again.

## 8. Reflow welding curve diagram



**Figure 17 Reflow welding curve**



## 9. Product package information

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



Figure 18 Packaging packing diagram

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

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant 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 in accordance with 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 into 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.

To maintain compliance with FCC's RF Exposure guidelines, This equipment should be installed and operated with minimum 20cm distance between the radiator and your body: Use only the supplied antenna.