Rd-04 Specification

Version V1.1.0

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Document resume

Version	Date	Develop/revise content	Edition	Approve
V1.1.0	2023.05.12	First Edition	Jiye Yang	Ning Guan

Content

1. Product overview

Rd-04 is a motion sensing module based on X-band radar developed by Shenzhen Ai-Thinker Technology Co., LTD. The module uses Phosense's XBR818 chip, and center frequency is 10.525GHz. The module design adopts fixed frequency, directional transmitting and receiving antenna (1T1R), integrates the functions of medium frequency demodulation, signal amplification and digital processing, and has the ability of delay setting and adjustable perception range. The module has the advantages of no wall penetration, anti-interference, small size, good suppression effect of clutter and high harmonic, high stability and consistency. In the module pulse power supply mode, the power consumption is in the micro-ampere level. The module is mainly aimed at low-cost and low-power consumption applications.

The module is suitable for embedded concealed installation, not affected by temperature / humidity, lampblack, water mist, etc., can be widely used in all kinds of lamps, such as bulb lamp, downlight, ceiling light, etc.; low power application, such as visual doorbell, cat eye, door lock, low power camera, intelligent litter box, pet feeder, etc.
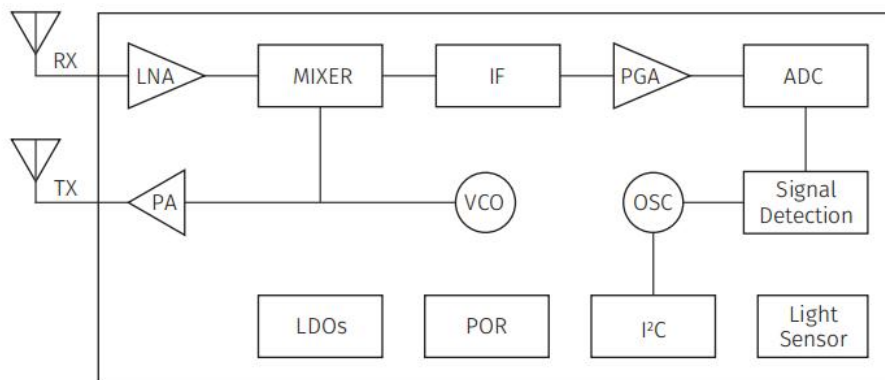

Figure 1 XBR818 chip architecture diagram

1.1. Characteristic

■ DIP package, standard 2.0mm pin header.

■ The radar supports the 10.525G frequency band.

■ Integrated digital signal detection and processor, real-time output of moving target detection results.

■ Support IIC bus configuration

■ Support pulse power supply mode

■ Support integrated photosensitive drive

■ Support a variety of installation methods such as top hanging and wall hanging.

■ The longest radar induction range is up to 6.5 meters

■ The radar detection Angle is large, and the coverage range can reach ± 50 degrees

■ Typical application scenarios

    ✓ Human sensor light control

    ✓ Human senseing awakening of advertising screen and other equipment

    ✓ Life safety protection

    ✓ Smart home appliances

    ✓ Intelligent security

2. Main parameters

Table 1 Description of main parameters

Model	Rd-04
Package	DIP
Size	15.0*15.0mm
Antenna	On board PCB antenna
Frequency range	10.275-10.775GHz
Operating temperature	-40°C ~ 85°C
Storage environment	-40°C ~ 125°C, < 90%RH
Power supply range	The power supply voltage is 3.0V ~ 3.6V, and the power supply current is ≥100mA.
Support interface	IIC
Available IO quantity	2

2.1. Electrostatic requirements

Rd-04 is electrostatic sensitive equipment, so special precautions should be taken during handling

Figure 2 ESD antistatic diagram

2.2. Electrical specification

Table 2 Table of Electrical Characteristics

Parameter		Condition	Min. value	Typical value	Max. value	un
supply voltage		VDD	3.0	3.3	3.6	V
I/O	VIL	-	-	-	0.3*VDDIO	V
	VIH	-	0.7*VDDIO	-	-	V
	VOL	-	-	0.1*VDDIO	-	V
	VOH	-	-	0.9*VDDIO	-	V
	IMAX	-	-	-	15	m

2.3. Radar sensing distance

Table 3 Radar Induction Distance

Installation mode	Min. value	Typical value	Max. value	Unit
Wall hanging mode （radial direction ）	-	6.5	-	meters
Top hanging mode (3m hanging height), circular projection radius	-	2.5	-	meters

2.4. Power consumption

The following power consumption data are based on a power supply of 3.3V and an ambient temperature of 25 C. The hardware configurations of constant power supply and pulse power supply are different.

Table 4 Power consumption table

Mode	Min. value	Typical value	Max.value	Unit
Constant power supply mode	-	16	-	mA
Pulse power supply mode	-	110	-	uA

3. Appearance size

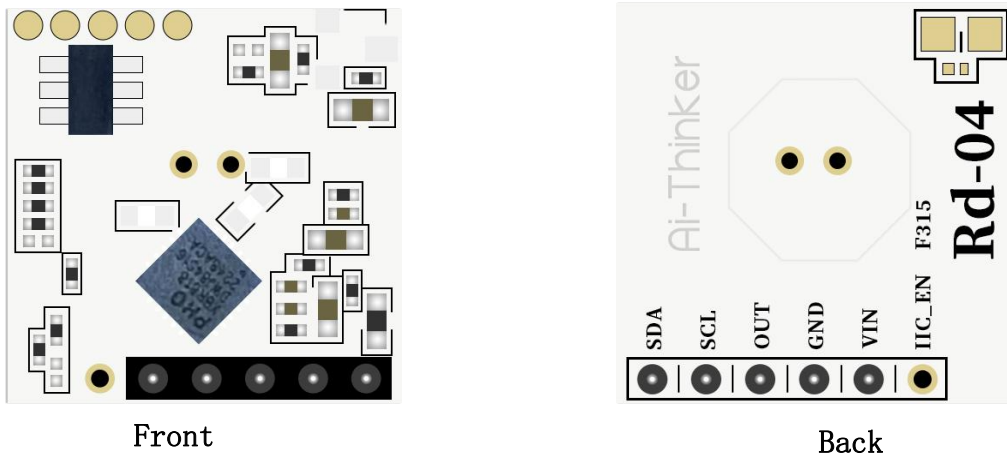Front   Back

Figure 3 Appearance diagram (Rendering figure is for reference only,subject to physical objects)
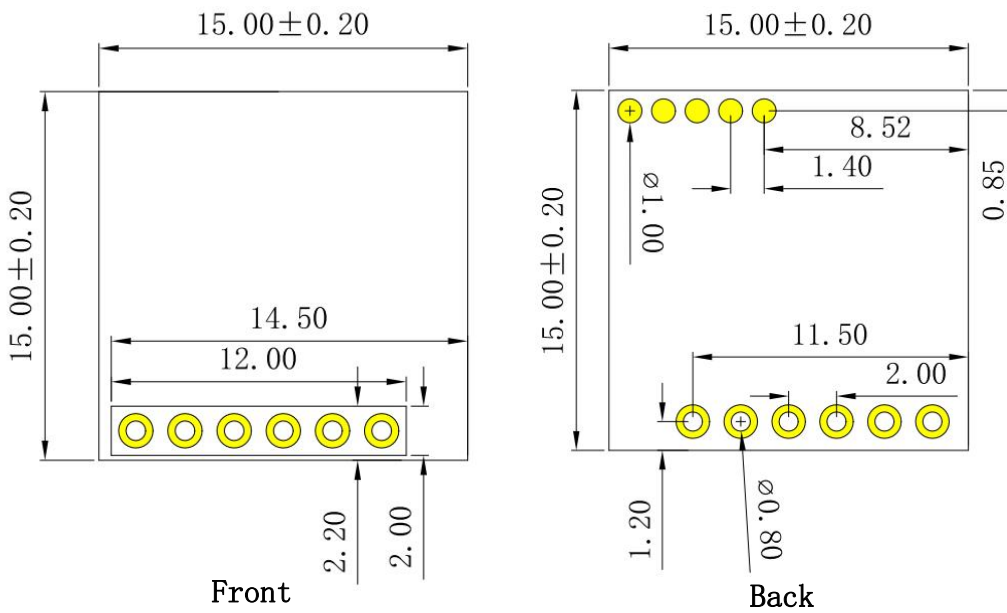

Front   Back

Figure 4 Dimension diagram

4. Pin definition

The Rd-04 module has 6 pins, such as the pin schematic diagram, and the pin function definition table is the interface definition.
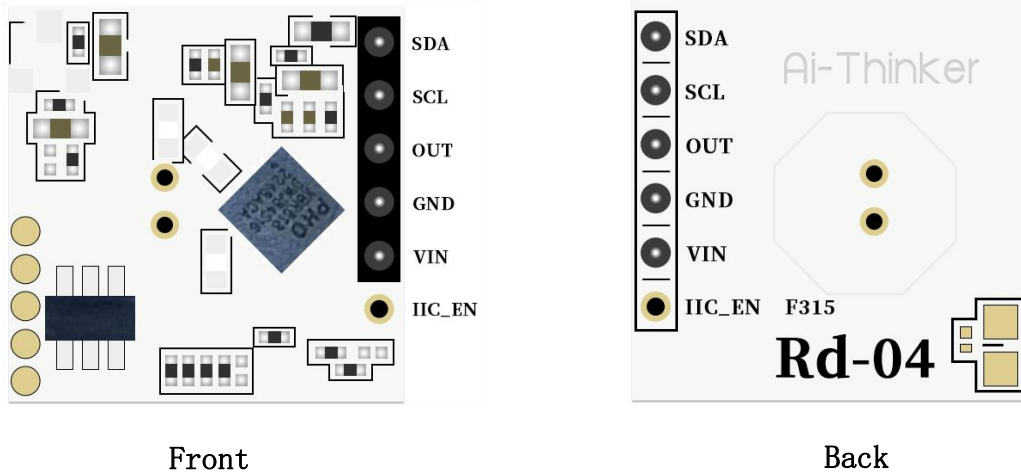

Front   Back

Figure5 Pin schematic diagram

Table 5 Pin Function definition table

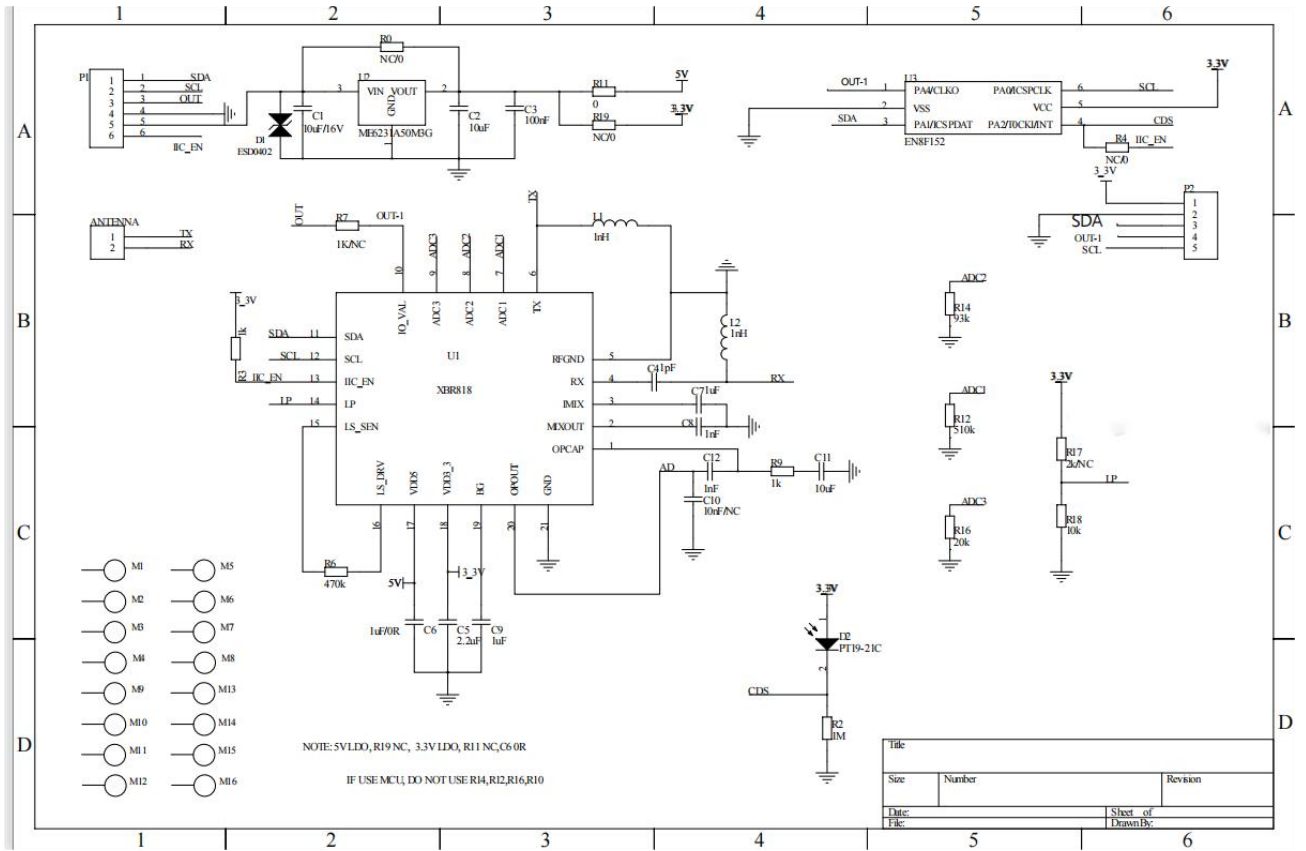| No.	Name	Function
1	SDA	IIC data line
2	SCL	IIC clock line
3	OUT	Output of detection results, high level during induction, and low level without induction
4	GND	Ground
5	VIN	3.3V input power supply
6	IIC_EN	IIC enable, when configure Rd-04 mode with external MCU, this pin is connected to the IO port of the external MCU for low power consumption

5. Schematic diagram

Figure 6 Schematic diagram
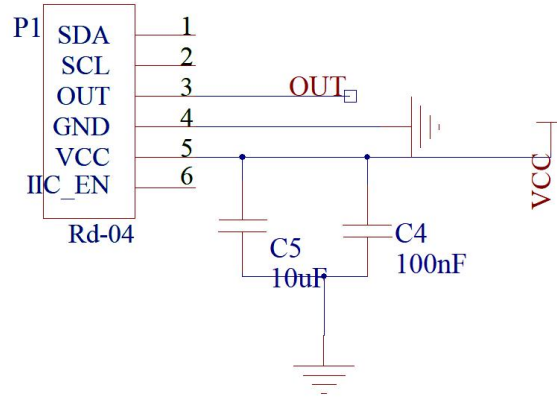
6. Design guidance

6.1. Application circuit guidance

Figure 7Application circuit guidance

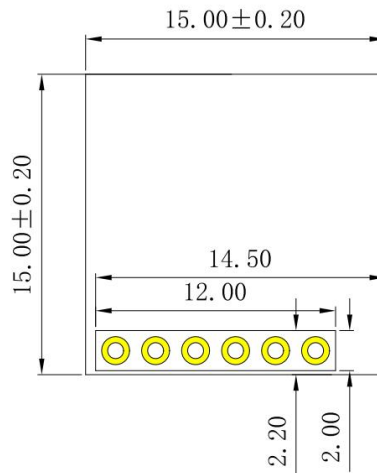## 6.2. Recommend PCB package size

Figure 8 Recommend PCB package size

Note：

■ The Rd-04 module supports a standard pin header interface with 2.0mm spacing

6.3. Attention in testing and using radar module

■ In the installation position on the motherboard, the following ways are recommended:

✓ Try to ensure that the radar antenna is facing the area to be detected, and the antenna is open without shielding;

✓ To ensure that the radar installation position is firm and stable, the shaking of the radar itself will affect the detection;

✓ In the case of walls or obstacles reflecting microwave, the perceived distance and perceived Angle will have gain;

✓ In the case of open around, the perception distance and Angle will be attenuation; because the microwave antenna can change detection, so please protect the antenna, the surface without metal objects (such as solder wire), to avoid affecting the perception distance;

✓ The radar module maintains an independent use space, and the surrounding space maintains a free space interval of more than 2mm;

✓ About 15s initialized noise analysis time after power-on, during which it is abnormal perception work;

✓ During production line testing and aging operation, if a large number of radar modules are stacked to a block, there may be self-excitation phenomenon may occur. Please ensure that a safe distance of more than 50cm is maintained between the powered radar modules.

■ In order to meet the performance of onboard antenna, it is forbidden to place metal parts around the antenna, away from high-frequency devices.

6.4. Attention in application and installation of devices with built-in radar modules

✓ Equipped with radar module components, the installation position should be far away from the ventilation pipe, fire pipe, drainage pipe, mechanical vibration or large metal equipment and other strong vibration objects;

✓ Charge operation is strictly prohibited, so as to avoid action error, connection error, burn out the circuit or electric shock;

✓ Avoid installation in the sun and rain, to prevent damage and affect the service life;

✓ The device must be installed away from the electromagnetic field to avoid electromagnetic interference and misoperation; it should also be installed away from objects fixed rotating or swinging (such as electric fan, swaying leaves, drying clothes in the wind, etc.) to avoid misoperation;

✓ When the devices of several built-in radar modules are fixed and installed, the spacing

between each device shall be 0.5m;

✓ The antenna surface of the radar microwave module is recommended to be 3~5mm away from the product shell, otherwise it will affect the perception distance;

Figure 9 Distance between antenna surface and product shell

✓ After the built-in radar module, it is recommended to place it horizontally or vertically. Within the effective perception range, try to avoid installing two or more built-in radar modules face to face;

✓ If the device using the built-in radar module (such as lamps) is always working (always bright) and cannot be turned on and off according to the moving target detection, the radar module may be disturbed by moderate frequency, causing the module to be judged to have a moving target moving within the perception range. At this time, the power supply should be turned off to check whether the power supply state of the power board is normal and whether the module space distance changes;

✓ If the above problems cannot be solved, please power off and observe the situation around the installation position, and eliminate the influence of environmental interference factors; after starting the power supply, if still have problems, then consider to replace the drive power panel or radar module.

6.5. 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, and large green plants facing the air outlet.

■ There is a large area of strong reflector in the sensing area, which will interfere with the radar antenna.

■ When installing on wall, external interference factors such as air conditioner and electric fan at the top of the room should be considered.

6.6. Installation mode and induction range
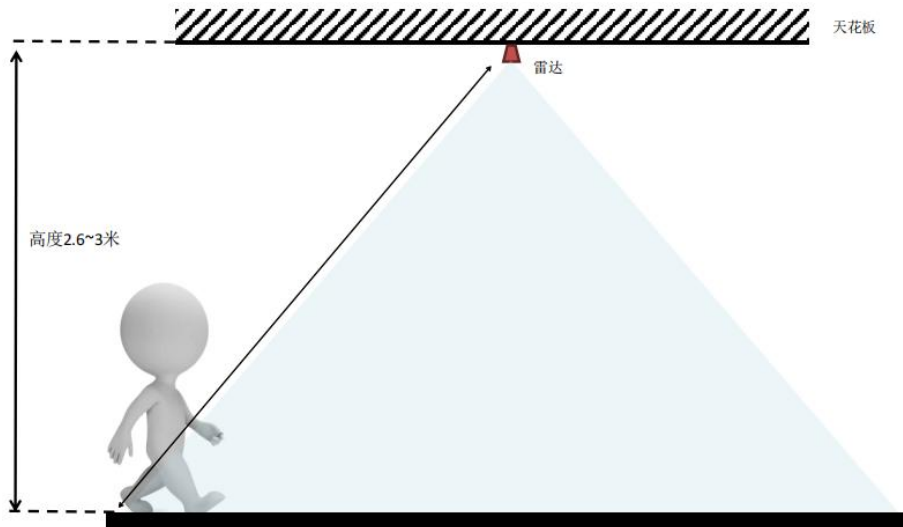
■   Top-hanging installation mode

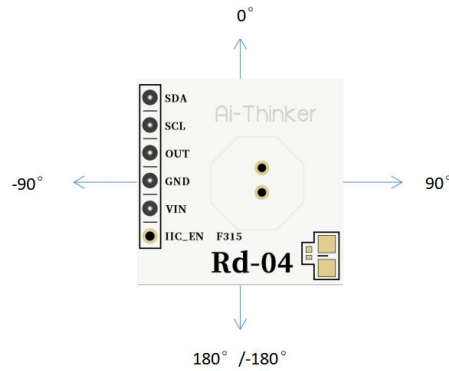**Figure 10 Schematic diagram of the top-hanging installation**

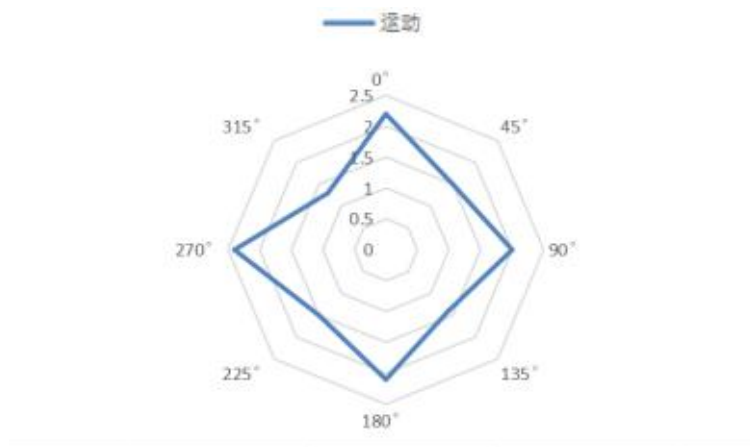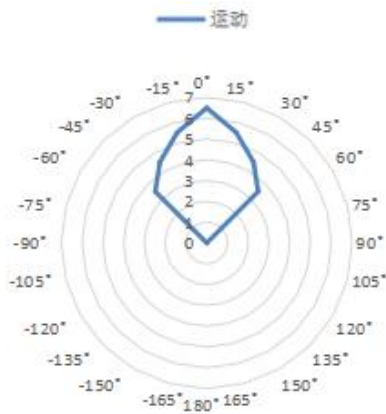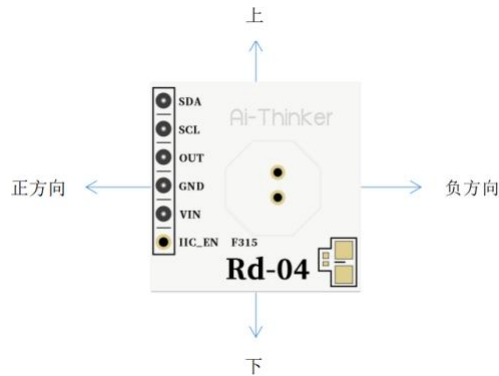**Figure 11 Direction diagram of the module for top-hanging**

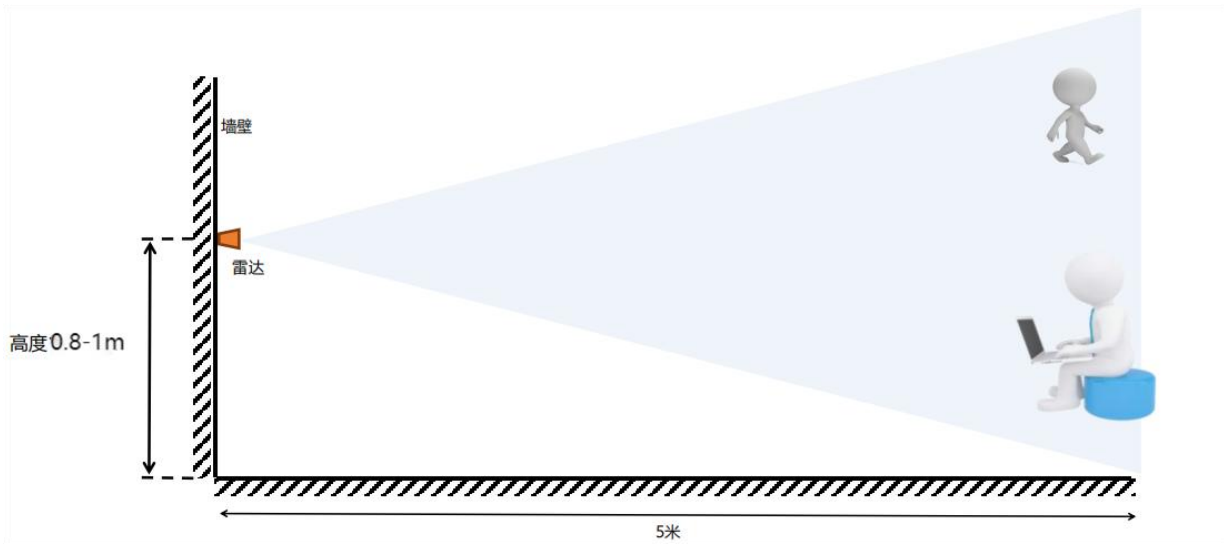**Figure 12 Top-hanging radar diagram**

■   Wall-hanging installation mode

Figure. 13 Schematic diagram of wall-hanging installation

Figure 14 Direction diagram of the module forwall-hanging

Figure 15 Wall-hanging radar diagram(± 50 degrees)

6.7. Supply electricity

- Recommended voltage is 3.3V, and peak current is above 100mA.

- It is recommended to use LDO for power supply; If DC-DC is used, it is recommended to control the ripple within 30mV.

- DC-DC power supply circuit suggests to reserve the position of dynamic response capacitor, which can optimize the output ripple when the load changes greatly.

- It is suggested to add ESD devices to the 3.3V power interface.
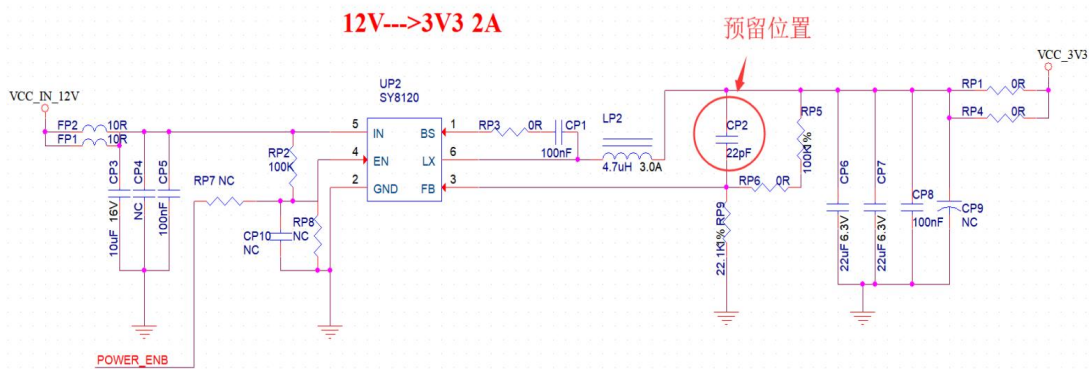

Figure16   DC-DC reduction voltage circuit diagram

6.8. GPIO

- The periphery of the module introduces some IO ports and, if necessary, uses the recommended series resistance of 10-100 ohms on the IO ports. This can suppress the overshoot and make the level on both sides more stable. For both EMI and ESD.

- For the up and down of the special IO port, refer to the instructions of the specification, which will affect the startup configuration of the module.

- The IO port of the module is 3.3V. If the main control does not match the IO port level of the module, the level conversion circuit should be added.

- If the IO port is directly connected to the peripheral interface or terminals, it is recommended to reserve ESD devices at the IO port line near the terminal.
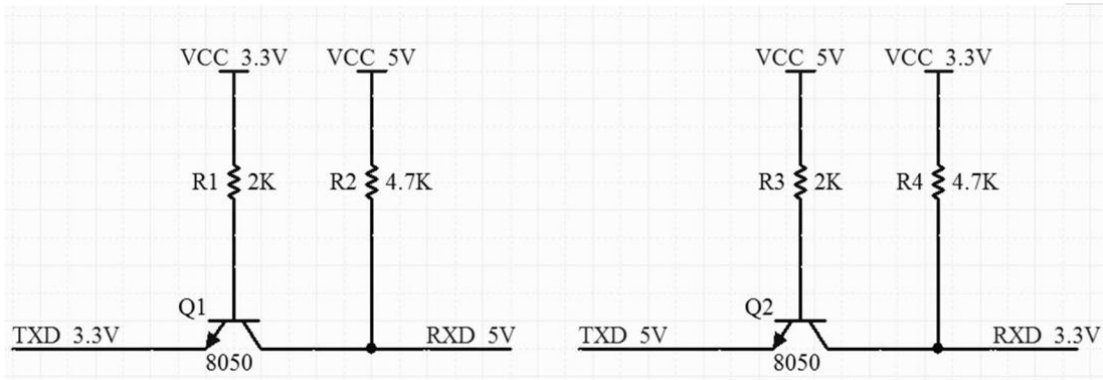
Figure 17 Level conversion circuit

7. Storage condition

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

The moisture sensitivity level MSL of the module is level 3.

After the vacuum bag is unpacked, it must be used within 168 hours at 25 5℃/60% RH, otherwise it will need to be baked before it can be put on the line again.
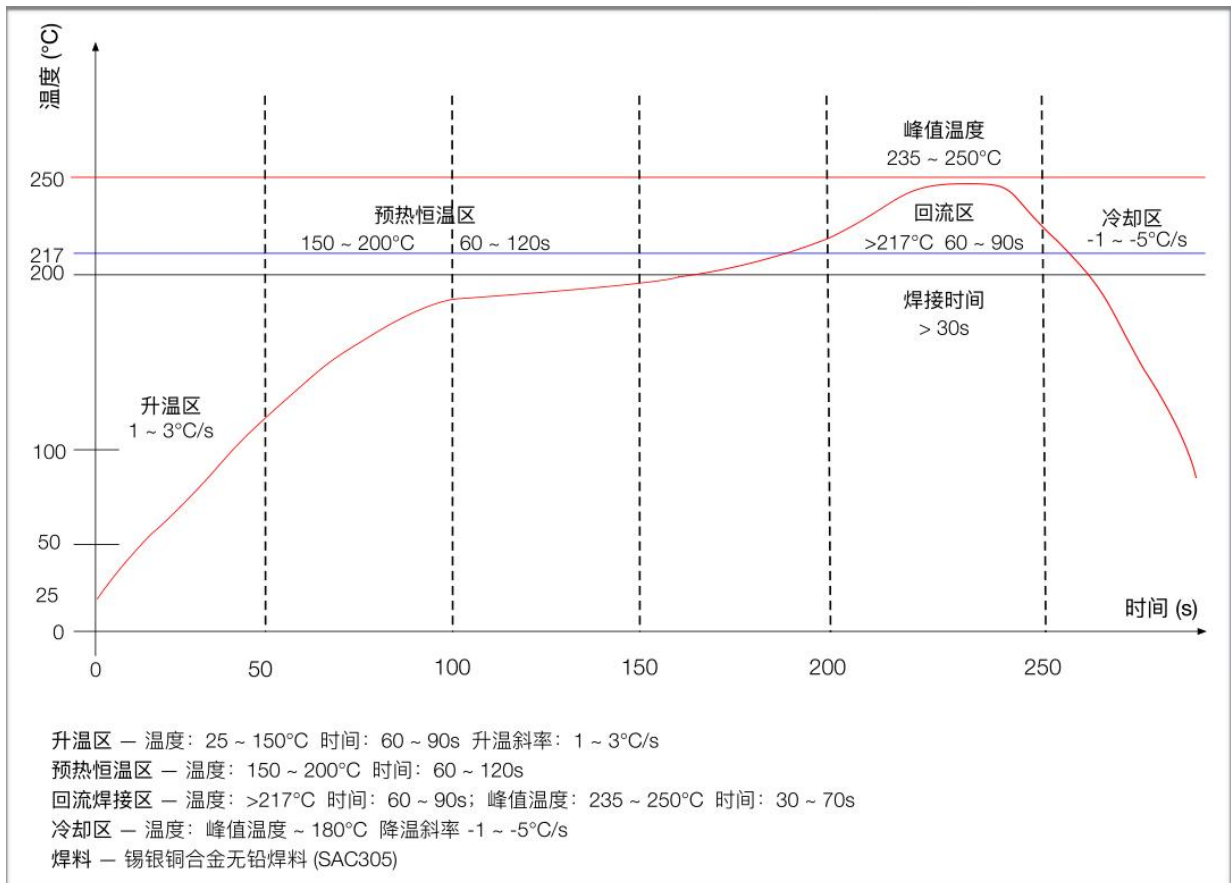
8. Reflow welding curve

Fugure18 Reflow Soldering Curve

9. Product package information

Table6 Package information table

Package list	Package methord	Qity/bag（Electrostatic bag）	Quantity per pack (sealing bag)
Rd-04	Bubble cotton +	1pcs	50pcs

10. Contact us

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