Rd-60 Specification

Version V2.0.0

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Document resume

Version	Date	Develop/revise content	Edition	Approved by
V2.0.0	2025.01.09	First Edition	Pengfei Dong	Ning Guan

Content

1. Product overview

Rd-60 is a low-power radar module developed by Shenzhen Anxinke Technology Co., Ltd. It integrates 60 GHz FMCW carrier AiP millimeter wave radar system and multi-protocol wireless connection, including BLE5.3/802.15.4/Thread/Matter. The module integrates 1T3R AiP radar antenna array and 2.4GHz wireless transceiver antenna, crystal and Flash, which can satisfy developers' rapid application development of the module. The module contains four low-power management modes: power off, standby, idle, and working. It not only has low power consumption in standby mode, but also has low power consumption for the fast and burst engine and high-performance RF transceiver. The flexible configuration of these modes allows for the power consumption of the entire module to meet a variety of stringent application requirements. Its configuration and data acquisition are implemented through the UART / SPI / 12C digital interface. The module is divided into four subsystems:

- mmWave RF and BB subsystems: This module includes all high-performance radar RF/analog and baseband digital signal circuits. It also comprises a linear frequency-modulated pulse generator and a Tx-to-Rx state machine.
- Wireless RF and BB subsystem: This module includes a complete multi-protocol wireless RF, modulation/demodulation, baseband protocol, and data interacts with the application CPU via the internal data bus.
- Processing and application subsystem: including a 32-bit RISC CPU and a radar hardware accelerator (HWA) for various application processing and task management. Our proprietary HWA IP is used for processing specific radar computations (such as FFT, CFAR, etc.), compression, and moving target detection and localization.
- Power and clock subsystems: A complex single-chip SoC with a multifunctional system, we use the integrated PMU system and clock subsystem within the chip for centralized management.

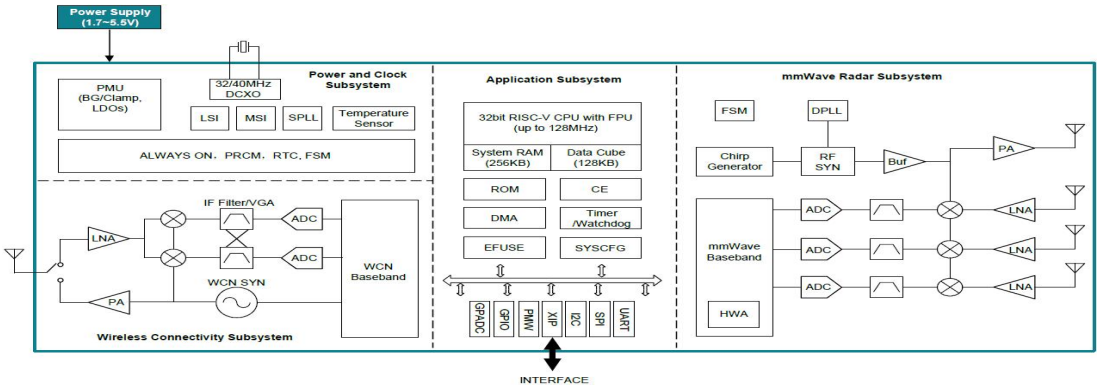


Figure 1 Main Chip Architecture Diagram

1.1. Characteristics

- With the SMD package, compatible with 1.27mm pin header
- The radar spectrum range is 58G ~64GHz, and the continuous sweep band width is 6GHz
- The radar antenna supports 1T3R, realizing different configuration modes of 1T1R, 1T2R and 1T3R
- Equivalent omnidirectional radiation power (EIRP)17.5dBm
- The radar detection angle is large, the coverage is horizontal FOV 120° and vertical FOV 120°
- The maximum induction distance of the radar is 8 meters (depending on the size of the detection target RCS)
- The nearest induction distance of radar is 0.01 m (reference human target)
- Ultra-small module size: 22.5*18.5mm
- Support protocol: Physical layer supports BLE 5, 802.15.4; protocol layer supports BLE 5.3 protocol
- Bluetooth LE PHY: 1Mbps, 2Mbps, long-distance S2 (500 Kbps), S8 (125 Kbps)
- Bluetooth transmit power 4 dBm @ BLE 1dBm, receiving sensitivity-95 dBm @ BLE 1dBm
- Typical application scenarios

It can be widely used in the typical scenes of AIOT intelligent perception represented by intelligent home appliances, intelligent security, intelligent health care, intelligent cockpit, etc., to realize the high precision and high sensitivity detection of the movement and micro-motion of human body and objects:

- ✓ Human body movement / presence detection
- ✓ Human body tracking and counting
- ✓ Human breathing and heartbeat detection
- ✓ Gesture recognition
- ✓ Visible doorbell
- ✓ Web camera
- ✓ Air conditioner
- ✓ Refrigerator
- ✓ Television

2. Main parameters

Table 1 Description of the main parameters

Model	Rd-60
Package	SMD24 compatible DIP-24
Size	22.5*18.5*5.8(±0.2)mm（with pin header） 22.5*18.5*1.6(±0.2)mm（without pin header）
Antenna	Radar:AiP antenna Bluetooth:On-board pcb antenna or pin welding antenna
Frequency	Radar:58G ~64GHz; Bluetooth:2400 ~ 2483.5MHz
Operating temperature	-40℃ ~ 85℃
Storage environment	-40℃ ~ 125℃, < 90%RH
Power supply range	Supply voltage 1.7V ~ 5.5V，typical value 3.3V，supply current ≥500mA
Support interface	UART/IIC
Serial port rate	The UART is compatible with the 16550 industrial standard and supports a port rate of up to 3Mbps. Default: 115200.

2.1. Electrostatic requirements

Rd-60 is a static-sensitive device that requires special precautions during handling.

Figure 2 ESD ESstatic diagram

2.2. Electrical character

Table 2 Electrical characteristics table

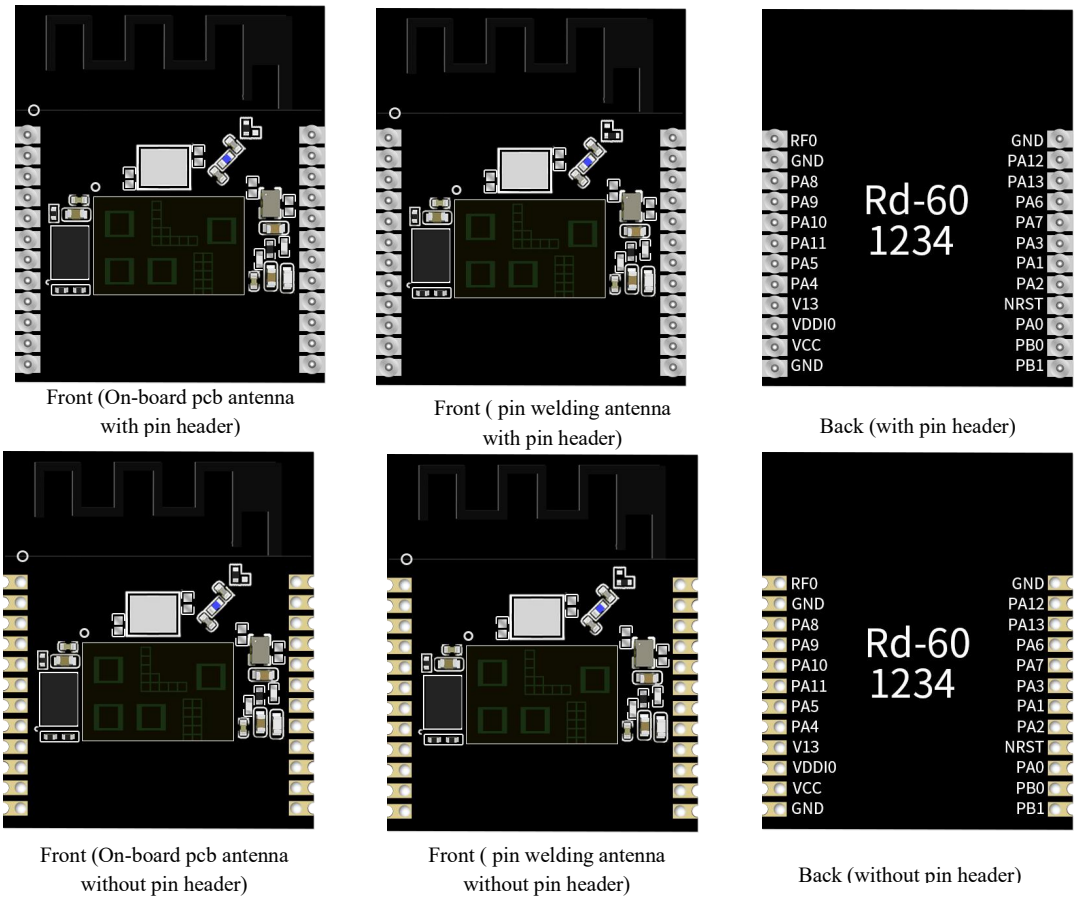
Parameter		Condition	Minimum value	Typical value	Maximum value	Unit
Supply voltage		VCC	1.7	3.3	5.5	V
		VDDIO	1.7	3.3	3.6	V
		V13	1.2	1.3	2.5	V
I/O	VIL	-	-0.3	-	0.35*VDDIO	V
	VIH	-	0.65*VDDI	-	1.1*VDDIO	V
	VOL	-	-0.3	-	0.1*VDDIO	V
	VOH	-	0.9*VDDIO	-	1.1*VDDIO	V

2.3. BLE radio-frequency performance

Table 4 BLE RF Performance Table

Describe	Typical value			Unit
Frequency range	2400 ~ 2483.5MHz			MHz
Output power				
Rate mode	**Minimum value**	**Typical value**	**Maximum value**	**Unit**
1Mbps	-	3	-	dBm
2Mbps	-	3		dBm
Receiving sensitivity				
Rate mode	**Minimum value**	**Typical value**	**Maximum value**	**Unit**
1Mbps sensitivity@30.8%PER	-	-94	-	dBm
2Mbps sensitivity@30.8%PER	-	-91	-	dBm

3. Appearance size



Front (On-board pcb antenna with pin header)

Front (pin welding antenna with pin header)

Back (with pin header)

Front (On-board pcb antenna without pin header)

Front (pin welding antenna without pin header)

Back (without pin header)

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

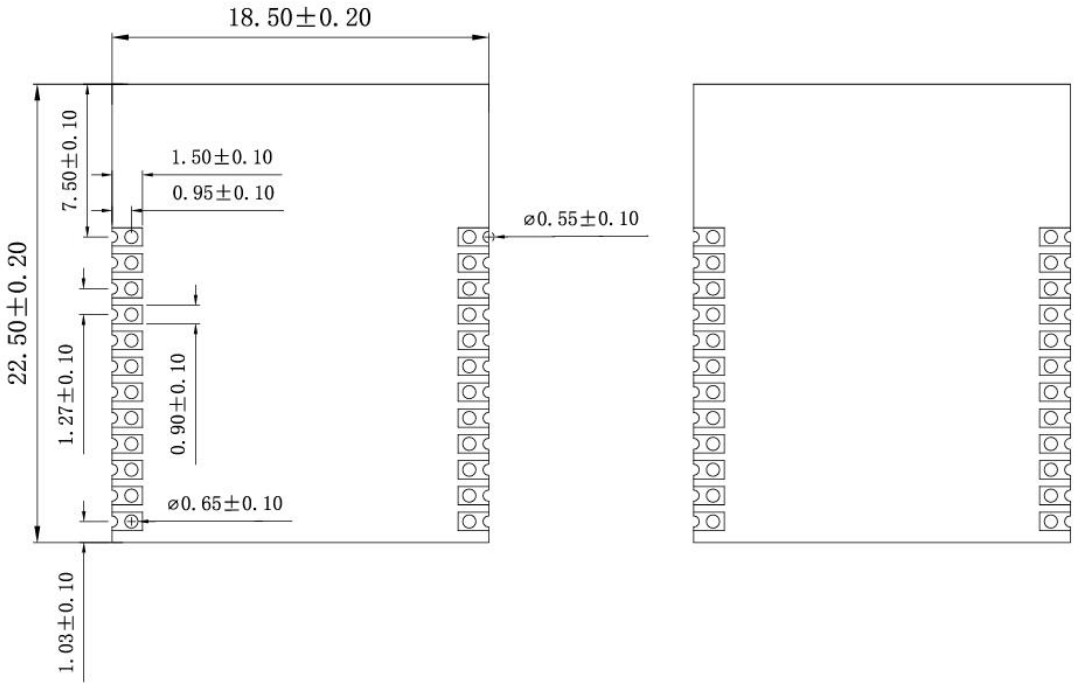
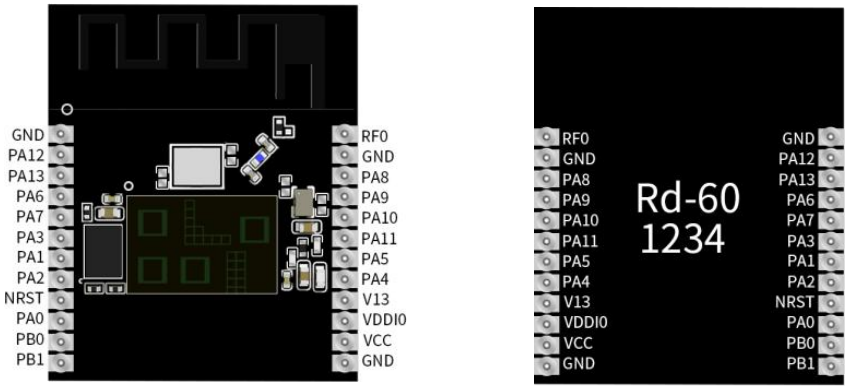


Figure 4 Size diagram

4. Pin definition



Front Back

The Rd-60 module is connected with 24 pins, refer to the pin schematic diagram, and the pin function definition table is the interface definition

Figure 5 Pin schematic diagram

Table 5 Pin function definition table

No	Name	Function description
1	GND	(G), connect to ground
2	PA12	(IO/WUP),PA12,WIO12,UART2-RX,UART1-RTS,PWM4,GPADC4
3	PA13	(IO/WUP),PA13,WIO13,UART2-TX,MCO-CLK,PWM4,GPADC4
4	PA6	(IO/WUP),PA6,WIO6,UART1-RTS,UART2-TX,I2C1-SDA,PWM6,GPADC6
5	PA7	(IO/WUP),PA7,WIO7,UART1-CTS,UART2-RX,I2C1-SCL,PWM7,GPADC7
6	PA3	(IO),PA3,WIO3,SPI0-MISO,UART1-CTS,I2C0-SCL,UART2-RX,PWM3
7	PA1	(IO),PA1,WIO1,SPI0-CLK,UART1-RX,PWM1
8	PA2	(IO),PA2,WIO2,SPI0-MOSI,UART1-RTS,I2C0-SDA,UART2-TX,PWM2
9	NRST	(IO), external reset, low level effective, default high level
10	PA0	(IO),PA0,WIO0,SPI0-CS,UART1-TX,PWM0,MCO-CLK
11	PB0	(IO/WUP),PB0,WIO16,UART0-TX,S-SWD-TMS,PWM0
12	PB1	(IO/WUP),PB1,WIO17,UART0-RX,S-SWD-TCK,PWM
13	GND	(G), connect to ground

14	VCC	(PI), module power supply 1.7V~5.5V， default input 3.3V
15	VDDIO	(PI), module IO power supply1.7~3.6V， default input3.3V
16	V13	(PI),Analog power supply input voltage 1.2V~2.5V， the default is 1.3V, and see the precautions for the power supply mode
17	PA4	(IO),PA4,WIO4,SPI0-HOLD,I2C0-SDA,PWM4
18	PA5	(IO),PA5,WIO5,SPI0-WP,I2C-SCL,PWM5
19	PA11	(IO/WUP),PA11,WIO11,I2C1-SCL,S-SWD-TCK,PWM3,GPADC3
20	PA10	(IO/WUP),PA10,WIO10,I2C1-SDA,S-SWD-TMS,PWM2,GPADC2
21	PA9	(IO/WUP),PA9,WIO9,UART1-RX,I2C1-SDA,PWM1,GPADC1
22	PA8	(IO/WUP),PA8,WIO8,UART1-TX,I2C1-SCL,PWM0,GPADC0
23	GND	(G), connect to ground
24	RFO	Bluetooth RF output port, the default is suspended

Notice：

- The PI represents the input power supply;
- PO represents the output power supply;
- 3IO represents the general digital function pin;
- WUP represents the standby (standby) mode can maintain the state or wake up the digital pin of the system, where WIOx refers to the sequential number of WUP type IO;
- The periphery of millimeter wave radar module includes power supply and 16 GPIO. VCC is the main power supply of the module and VDDIO is the power supply of GPIO. When the power supply voltage does not exceed 3.6V, VCC and VDDIO can be directly short connected when applied. The V13 can be powered by an internal VINT or an external DCDC, and the module can achieve lower power consumption if powered by an external DCDC.

5. Schematic diagram

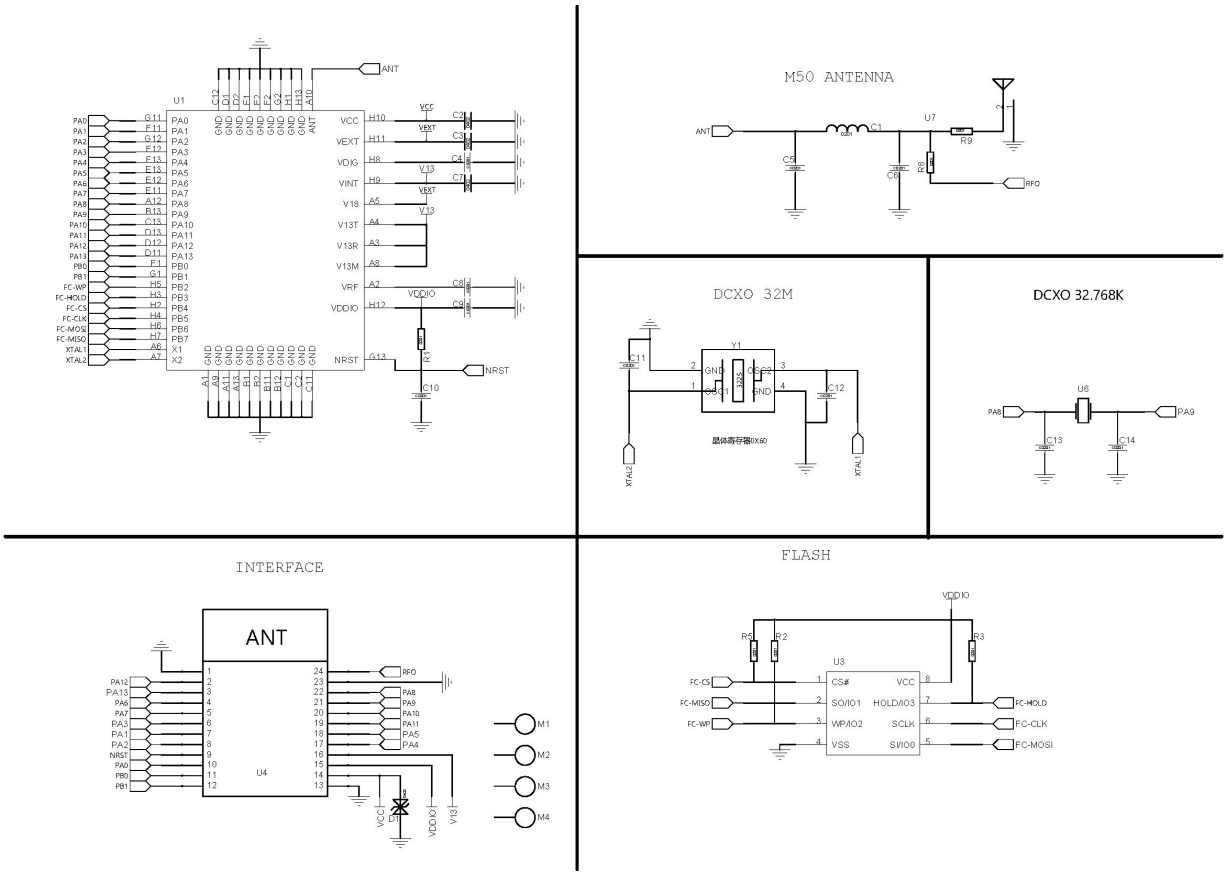


Figure 6 Schematic diagram

6. Design guide

6.1. Application circuit guide

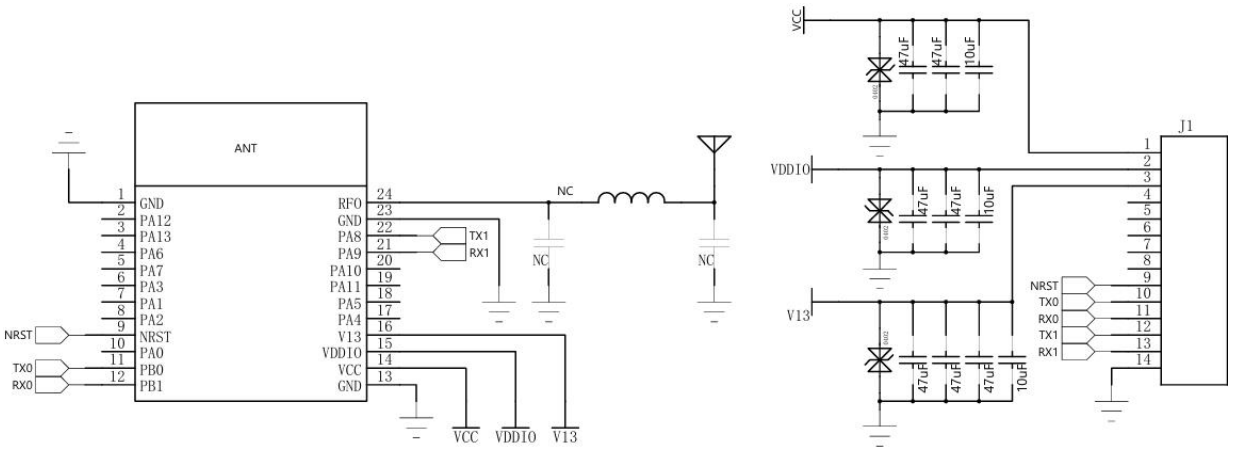


Figure 7 Application circuit guide

- There is a difference between V13 external 1.3V and the low power current using the chip internal VINT. Table 6 shows the current difference comparison table using the maximum detection distance 5 m / radar report frequency 0.5Hz

Table 6 Comparison table of current differences

Parameter	Low power lining current (uA)	Average current in the unmanned state (uA）
V13 for 1.3V supply from an external DCDCVDDIO=VCC=3.3V	10.42	28.49
The V13 is powered by the internal chip VINTVDDIO=VCC=3.3V	16.9	45

- In the ultra-low power consumption scenario, providing the V13pin of the module with 1.3V power supply can further reduce the power consumption. For V13 external power supply of 1.3V DCDC, note the following:

✓ The selection of DCDC requires minimal static current, recommended to be less than 1 uA;

✓ Power supply current of DCDC is> 500 mA;

- The serial port 0 (PB 0 / PB 1) receives the radar command, and the serial port 1 (PA8 / PA9) outputs the radar data.
- Use serial port 0 (PB 0 / PB 1). PB 0 is boot foot, and when the moment PB 0 is low level, the module enters the burning mode; when the moment PB 0 is high level.

6.2. Recommended PCB package size

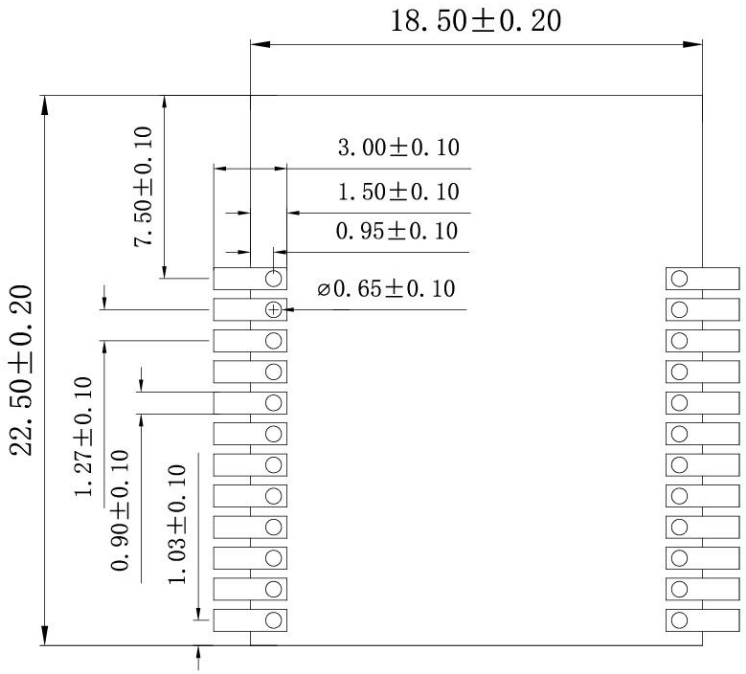


Figure 8 Recommended PCB package size

Notice:

- The Rd-60 module uses SMD 24 package standard needle interface compatible with DIP24-1.27mm spacing

6.3. Precautions for radar installation

- 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 installation position of the radar is firm and stable, the shaking of the radar itself will affect the detection effect.

✓ Make sure that there is no movement or vibration on the back of the radar. Due to the penetration of radar waves, the antenna signal back flap may detect moving objects on the back of the radar. Metal shield or metal backplane can be used to shield the radar back flap and weaken the impact of the radar back object.

✓ Due to the target size, state, RCS, etc., the target distance accuracy can also fluctuate slightly.

- ✓ When there are multiple 60GHz band radars, do not beam directly and keep far away from installation to avoid possible mutual interference.
- ■ In order to meet the performance of on-board antenna, metal parts are prohibited around the antenna, away from high-frequency devices.
- ■ The power input voltage range is 1.7V-5.5V, requiring the power ripple within 100 kHz. Users should consider the corresponding electromagnetic compatibility design such as ESD and lightning surge.

6.4. Installation environment requirements

The product needs to be installed in the suitable environment, if used in the following environment, the test effect will be affected:

- ■ There are non-human objects with continuous movement in the induction 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 induction area, which can cause interference to the radar antenna.
- ■ When installing the hanging wall, it is necessary to consider the external interference factors such as the air conditioning and electric fan on the top of the room.

6.5. Power supply

- ■ Recommended 3.3V voltage, peak current above 500 mA.
- ■ Recommended 3.3V voltage, peak current above 500 mA.
- ■ The DC-DC power supply circuit suggests to reserve the position of the dynamic response capacitor, which can optimize the output ripple when the load change is large.
- ■ In the 3.3V power interface, it is recommended to add ESD devices.

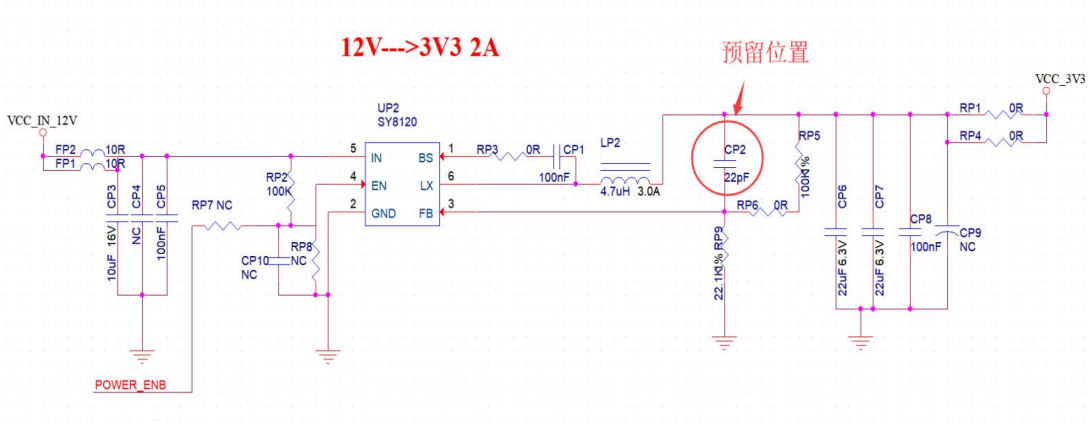


Figure 9 DC-DC buck circuit diagram

6.6. GPIO

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

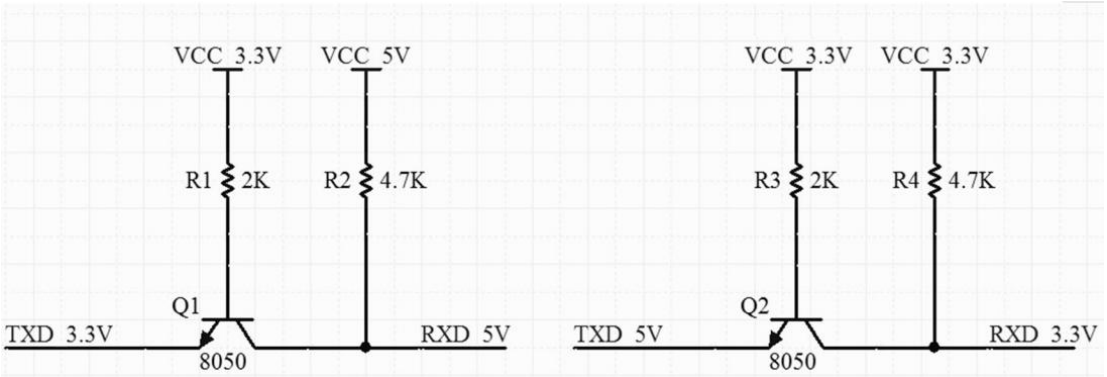


Figure 10 The level conversion circuit

7. Storage condition

Products sealed in a moisture-proof bag shall be stored in a non-condensing atmosphere of <40℃ / 90% RH. The moisture sensitivity grade MSL of the module is 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 the secondary launch.

8. Reflow welding curve diagram

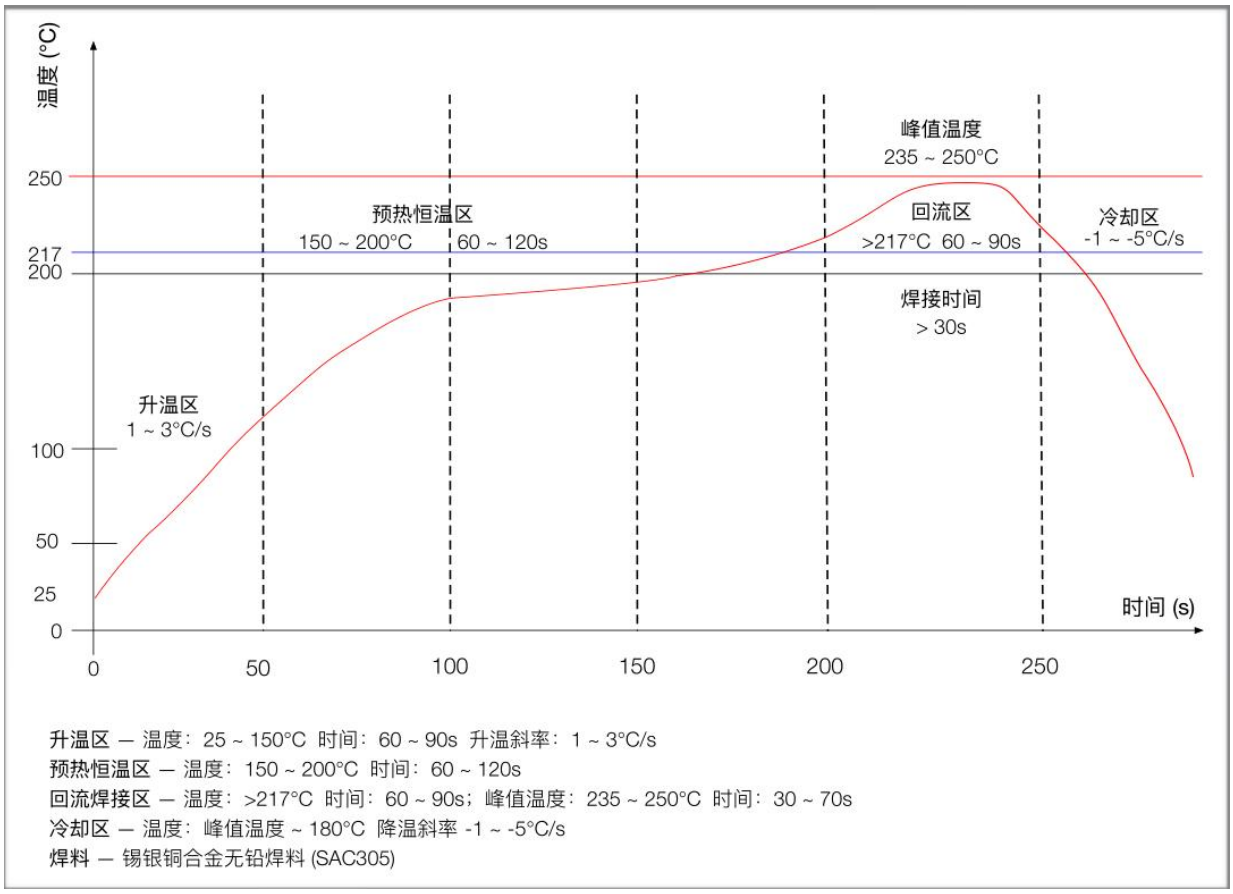


Figure 11 Reflow welding curve diagram

9. Product packaging information

The Rd-60 module is packaged in a tape at 400 pcs / reel. As shown in the figure below:

Figure 12 Packaging diagram

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Linkedin Tmall shop Taobao shop Alibaba shop

Technial suppot 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

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