



Rd-01 Specification

Version V1.1.1

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Document Revision History

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1. Product Overview

The Rd-01 is a radar module developed by Shenzhen Ai-Thinker Technology Co., Ltd., which supports Wi-Fi and BLE.

The radar section is equipped with the S3KM111L chip from IClegend Micro. The S3KM111L is an integrated single-chip single-waveform sensor SoC based on FMCW radar technology. It operates in the 24GHz K-band and provides a modulation bandwidth of up to 1GHz per chirp. It detects targets within a defined space using FMCW. Combined with radar signal processing and a precise human-presence detection algorithm, it provides highly sensitive human-presence sensing and identifies both moving and stationary human bodies.

The Wi-Fi and BLE section uses the BL602 chip as its core processor. It supports the Wi-Fi 802.11b/g/n protocols and the BLE 5.0 protocols. The BL602 integrates a low-power 32-bit RISC CPU, 276KB RAM, and a wide range of peripheral interfaces, including SPI, UART, I2C, PWM, ADC, and GPIO.

The Rd-01 module can detect whether a moving or micro-moving person is present within the sensing area and transmits the detection result in real time via Wi-Fi and BLE. A visual configuration tool is provided for easy configuration of the sensing-distance range, sensing sensitivity in different zones, no-person delay time, and other parameters. The module also supports wireless configuration of radar parameters via Wi-Fi and BLE, greatly improving installation and maintenance efficiency and offering convenience and efficiency.

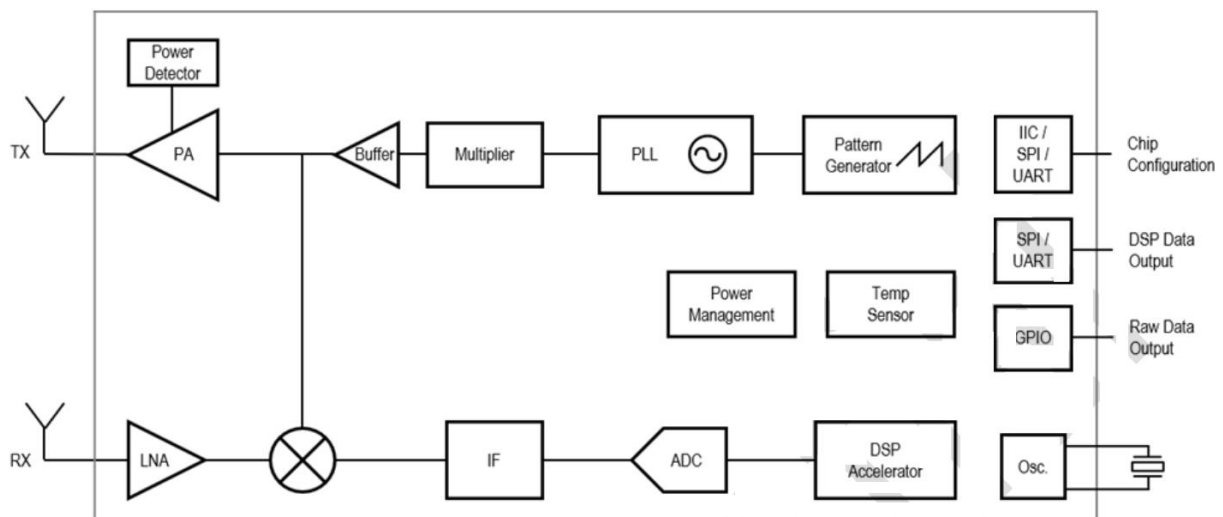


Figure 1 S3KM111L Chip Architecture Diagram

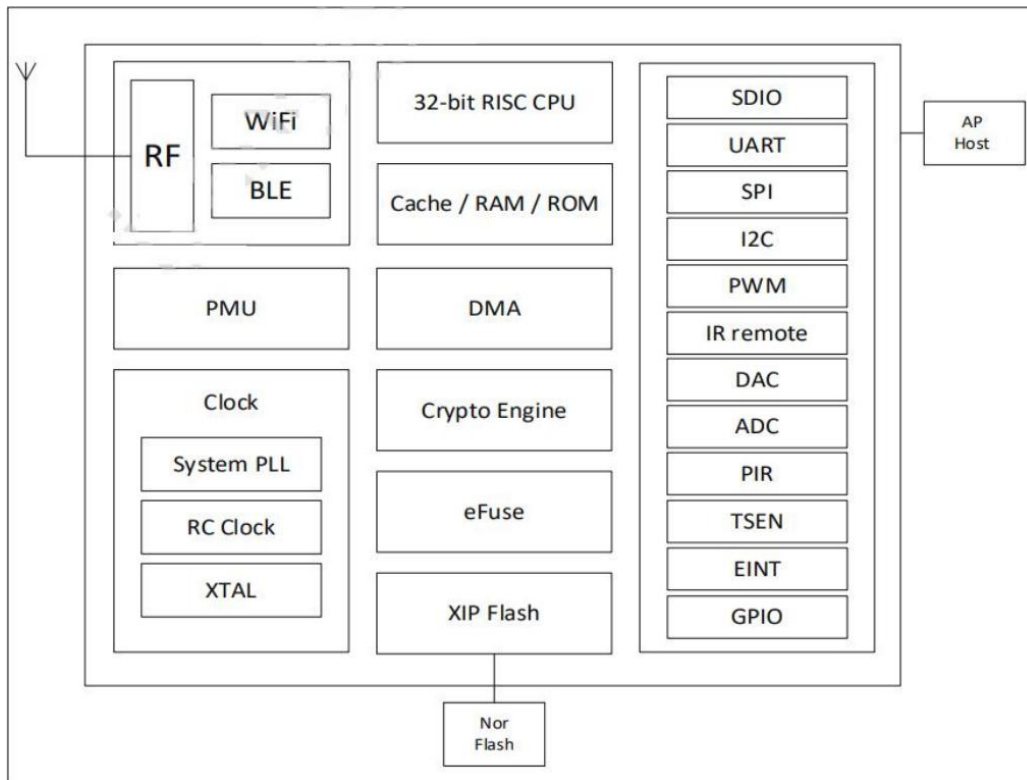


Figure 2 BL602 Chip Architecture Diagram

1.1. Features

- SMD-12 package, compatible with standard sockets or pin headers
- Radar supports the 24GHz ISM band
- Maximum radar sensing distance of up to 5 meters
- Wide radar detection angle, with coverage of up to $\pm 60^\circ$
- Accurate detection within radar zones; supports sensing range partitioning to shield interference outside the zones
- Intelligent radar parameter adjustment via Bluetooth, offering convenience and efficiency
- Supports ceiling-mounted, wall-mounted, and other installation methods
- Supports IEEE 802.11 b/g/n protocols
- Wi-Fi security supports WPS/WEP/WPA/WPA2 Personal/WPA2 Enterprise/WPA3
- Supports 20MHz bandwidth, with a maximum data rate of 72.2Mbps.
- Bluetooth Low Energy 5.0 and Bluetooth Mesh
- Supports Station + BLE mode, Station + SoftAP + BLE mode

- Supports 32-bit RISC CPU with 276KB RAM
- Secure boot; supports images signed with ECC-256
- Supports on-the-fly AES decryption (OTFAD) for QSPI/SPI Flash and AES 128 CTR mode
- Supports AES 128/192/256-bit encryption engine
- Supports SHA-1/224/256
- Support for True Random Number Generator (TRNG)
- Public Key Accelerator (PKA), supporting basic large-number arithmetic; software provides APIs for signing, verification, and other applications
- Supports SPI, UART, I2C, PWM, ADC, and GPIO
- Integrated Wi-Fi MAC/BB/RF/PA/LNA/BT
- Supports multiple sleep modes
- Supports secondary development, with integrated Windows and Linux development environments
- Flexible assembly options; compatible with SMD, pin headers and sockets
- Typical applications scenarios
 - ✓ Body induction light control
 - ✓ Human-presence wake-up for devices such as advertising displays
 - ✓ Life-safety protection
 - ✓ Smart appliances
 - ✓ Smart security systems

2. Key Specifications

Table 1 Key Specifications

Model	Rd-01
Package	SMD-12, compatible with SMD, pin headers, sockets, and other assembly methods
Dimensions	35.0*18.0 (mm)
Antenna Type	Radar: onboard antenna Wi-Fi & BLE: IPEX connector
Frequency Range	Radar: 24G – 24.25GHz Wi-Fi: 2400 – 2483.5MHz
Operating Temperature	-40°C – 85°C
Storage Conditions	-40°C – 125°C, < 90% RH
Power Supply	Supply voltage 3.0V – 3.6V, supply current $\geq 500\text{mA}$
Supported Interfaces	UART/GPIO/ADC/PWM/I2C/SPI
Available I/Os	8
Baud Rate	115200bps by default
Security	WPS/WEP/WPA/WPA2 Personal/WPA2 Enterprise/WPA3
Flash	2MByte by default

2.1. Electrostatic Requirements

Rd-01 is an ESD-sensitive device and requires special precautions during handling.



Figure 3 ESD Protection Diagram

2.2. Electrical Characteristics

Table 2 Electrical Characteristics

Parameter	Condition	Min	Typ	Max	Unit
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	mA

2.3. Radar Detection Range

Table 3 Radar Detection Range

Installation Method	Min	Typ	Max	Unit
Wall-mounted ($\pm 60^\circ$)	-	5	-	m
Ceiling-mounted	-	3.5	-	m

2.4. Wi-Fi RF Performance

Table 4 Wi-Fi RF Performance

Description	Typ			Unit
Frequency Range	2400 – 2483.5			MHz
Output Power				
Mode	Min	Typ	Max	Unit
11n HT20, PA	-	16	-	dBm
11g, PA	-	17	-	dBm
11b, PA	-	19	-	dBm
Receiver Sensitivity				
Mode	Min	Typ	Max	Unit
11b, 1Mbps	-	-98	-	dBm
11b, 11Mbps	-	-90	-	dBm
11g, 6Mbps	-	-93	-	dBm

11g, 54Mbps	-	-76	-	dBm
11n, HT20 (MCS7)	-	-73	-	dBm

2.5. BLE RF Performance

Table 5 BLE RF Performance

Description	Typ			Unit
Frequency Range	2400 – 2483.5			MHz
Output Power				
Data Rate Mode	Min	Typ	Max	Unit
1Mbps	-	9	15	dBm
Receiver Sensitivity				
Data Rate Mode	Min	Typ	Max	Unit
1Mbps Sensitivity @30.8% PER	-	-96	-	dBm

2.6. Power Consumption

The following power consumption data are measured under a 3.3V power supply and 25°C ambient temperature.

- Under the test conditions, all transmit power measurements are performed at the antenna interface.
- All transmission data are measured at 100% duty cycle in continuous transmit mode.

Table 6 Power Consumption

Mode	Min	Avg	Max	Unit
TX 802.11b, 11Mbps, POUT = +21dBm	-	260	-	mA
TX 802.11g, 54Mbps, POUT = +18dBm	-	245	-	mA
TX 802.11n, MCS7, POUT = +17dBm	-	230	-	mA
RX802.11b, Packet Length 1024 bytes	-	65	-	mA
RX 802.11g, Packet Length 1024 bytes	-	65	-	mA
RX 802.11n, Packet Length 1024 bytes	-	65	-	mA
Radar Sensing Status	-	90	-	mA

3. Appearance and Dimensions

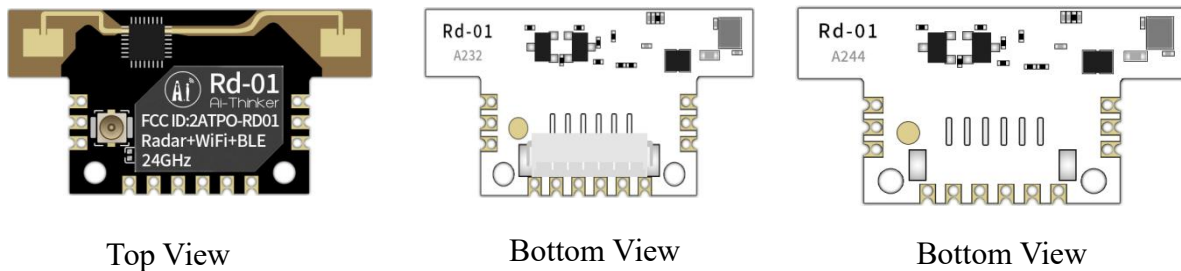


Figure 4 Module Appearance

(Rendering is for reference only; the actual product shall prevail.)

Note: The Rd-01 module is available in versions with or without a socket.

- The socket-equipped version can be connected to the mainboard using a cable, allowing flexible installation. The socket uses a standard $1 \times 6P$ interface with a 1.25mm pitch. The positioning holes on the module can be used for screw fastening.
- The socket-less version can be mounted on the mainboard using SMD, which helps improve assembly efficiency.

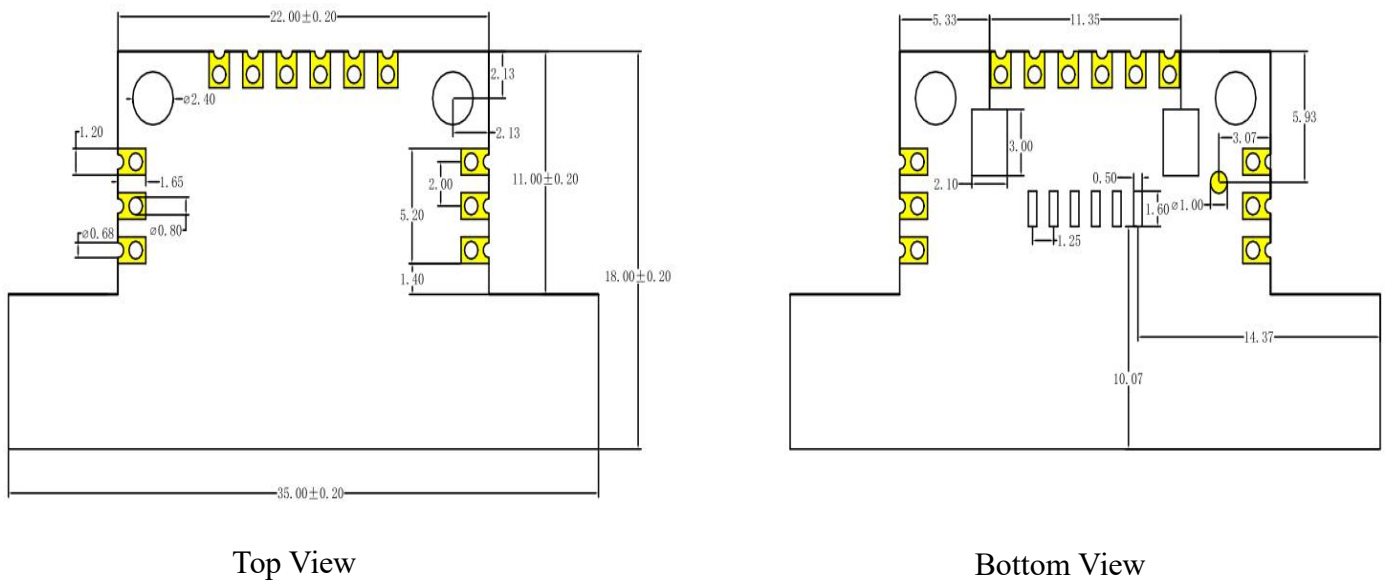


Figure 5 Module Dimensions (Unit: mm)

4. Pin Definition

The Rd-01 module exposes a total of 12 pins, as shown in the pin diagram. The pin function definition table provides the detailed interface specifications.

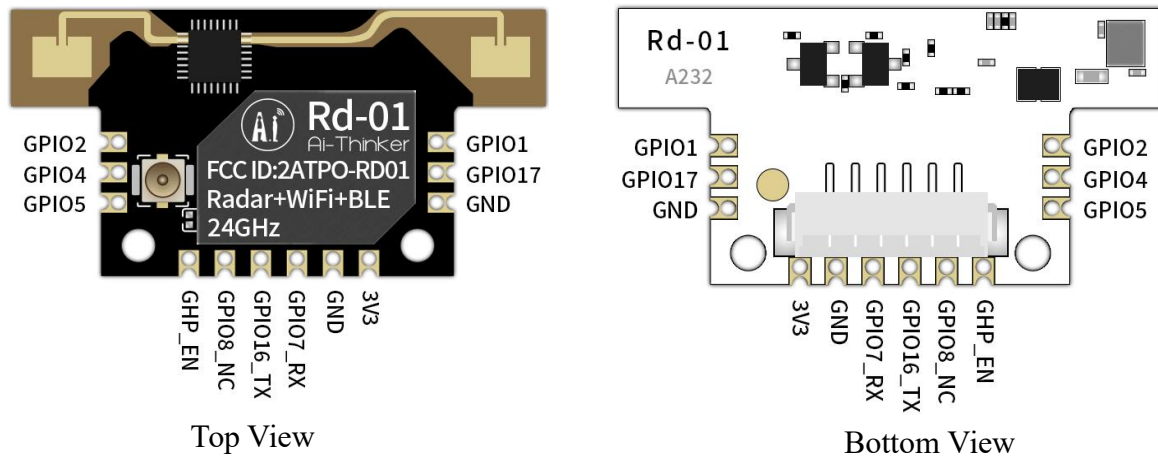


Figure 6 Pin Diagram

Table 7 Pin Function Definition

No.	Name	Function
1, 11	GND	Ground
2	GPIO17	GPIO17/SPI_MOSI/MISO/IIC_SDA/PWM_CH2/JTAG_TCK/TMS
3	GPIO1	GPIO1/SPI_MOSI/MISO/IIC_SDA/PWM_CH1
4	GPIO2	GPIO2/SPI_SS/IIC_SCL/PWM_CH2
5	GPIO4	GPIO4/SPI_MOSI/MISO/IIC_SCL/PWM_CH4/ADC_CH1
6	GPIO5	GPIO5/SPI_MOSI/MISO/IIC_SDA/PWM_CH0/ADC_CH4/JTAG_TMS/TCK
7	CHIP_EN	Default as chip enable, active high
8	GPIO8	Bootstrap/GPIO8/SPI_MOSI/MISO/IIC_SCL/PWM_CH3
9	GPIO16	TXD/GPIO16/SPI_MOSI/MISO/IIC_SCL/PWM_CH1/JTAG_TMS/TCK
10	GPIO7	RXD/GPIO7/SPI_SCLK/IIC_SDA/PWM_CH2/JTAG_TDO/TDI
12	3V3	3.3V power supply, current recommended to be above 500mA

Note: GPIO8 serves as Bootstrap. When it is at a high level at the moment of power-on, the module enters programming mode; when it is at a low level at the moment of power-on, the module boots normally.

5. Schematic

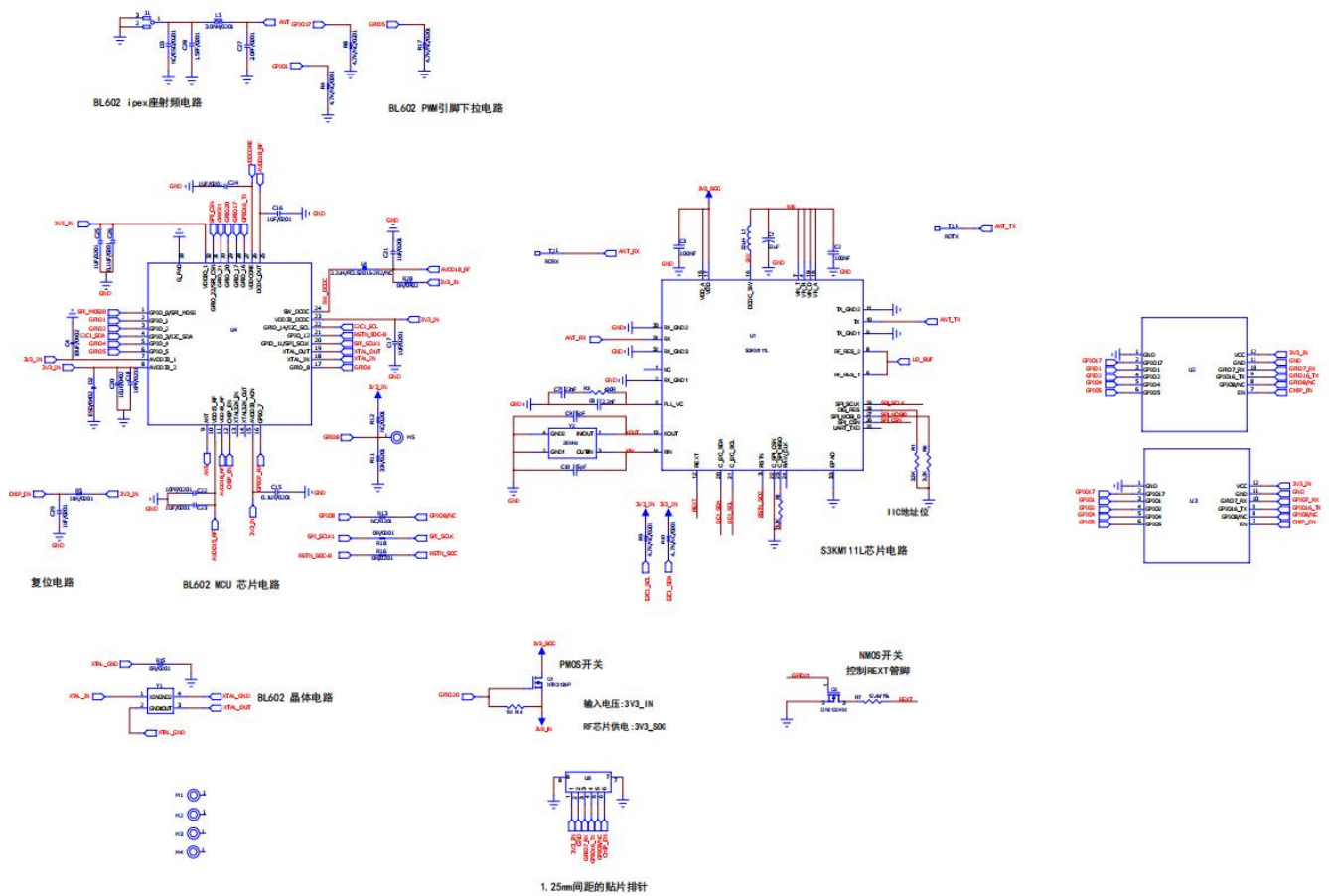


Figure 7 Schematic

6. Design Guide

6.1. Application Reference Circuit

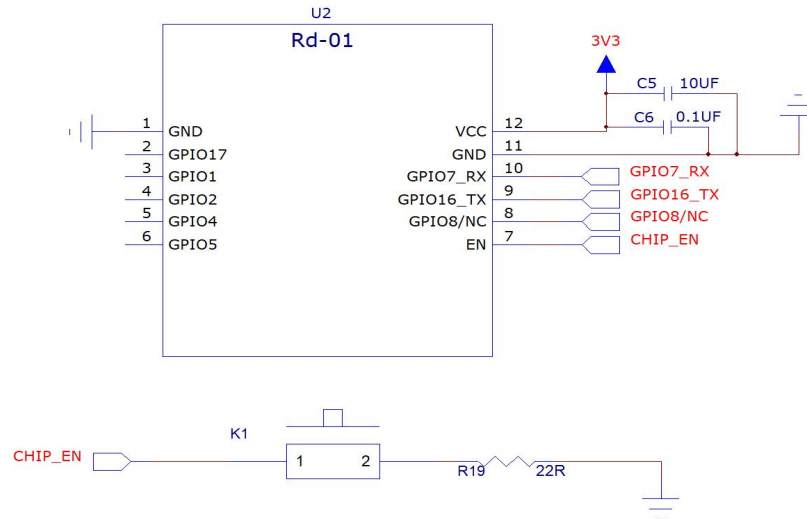


Figure 8 Application Reference Circuit

Note: When an I/O port is used as PWM, it is recommended to reserve a 4.7k Ω pull-down resistor around the module. This is especially important for lighting-control applications to prevent flashing during power-on and startup.

6.2. Recommended PCB Footprint Dimensions

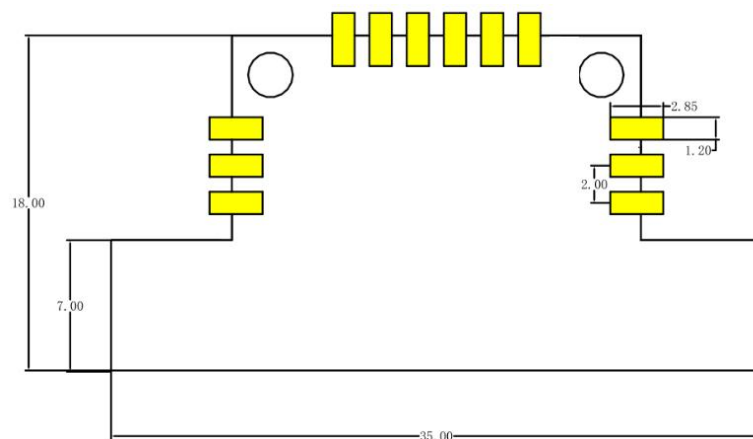


Figure 9 Recommended PCB Footprint Dimensions (Unit: mm)

Note: The Rd-01 module is compatible with multiple interfaces, including a 6-pin standard socket with 1.25mm pitch, standard pin headers with 2.0mm pitch, and castellated-pad SMD soldering.

- When adopting SMD mounting, components on the backside of the radar antenna of the module require clearance.

6.3. Radar Installation Precautions

- For the installation position on the mainboard, the following methods are recommended:
 - Ensure that the radar antenna faces the area to be detected and that the area around the antenna is open and free of obstructions.
 - Ensure that the radar is installed firmly and securely. Movement or vibration of the radar itself will affect detection performance.
 - ✓ Ensure that no objects move or vibrate behind the radar. Because radar waves are penetrable, the antenna's back lobe may detect moving objects behind the radar. A metal shield or metal backplate can be used to shield the radar back lobe and reduce the influence of objects behind the radar.
 - ✓ The theoretical range accuracy of the radar is obtained via special algorithm processing on the basis of a physical resolution of 0.75m. Due to differences in target size, state, RCS, and other factors, the target distance accuracy may fluctuate, and the maximum detection distance may also vary slightly.
- To ensure performance of the onboard antenna, metal objects must not be placed near the antenna, and the antenna should be kept away from high-frequency devices.

6.4. Installation Environment Requirements

This product must be installed in a suitable environment. Detection performance may be affected when the product is used in the following environments:

- Continuously moving non-human objects exist within the sensing area, such as animals, continuously swinging curtains, or large plants directly facing an air outlet.
- Large-area, strongly reflective objects exist within the sensing area. The strongly reflective objects facing the radar antenna may cause interference.
- For wall-mounted installation, external interference sources such as indoor ceiling-mounted air conditioners and electric fans must be considered.

6.5. Installation Method and Sensing Range

■ Ceiling-mounted Installation

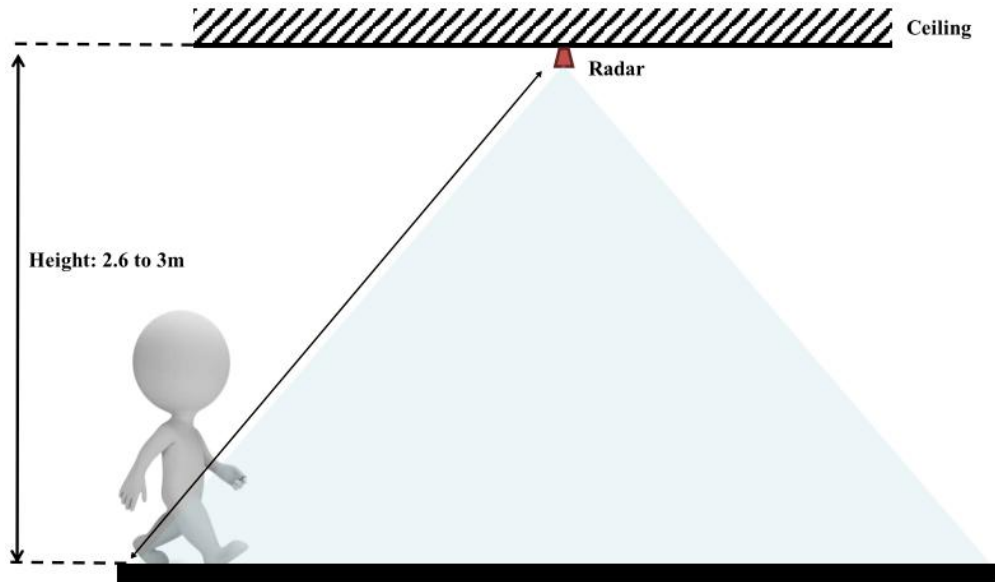


Figure 10 Ceiling-Mounted Installation Diagram

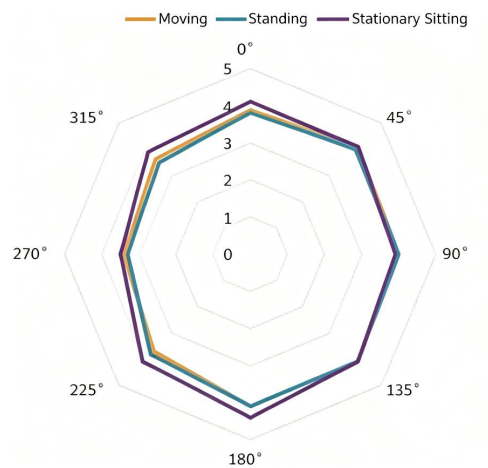
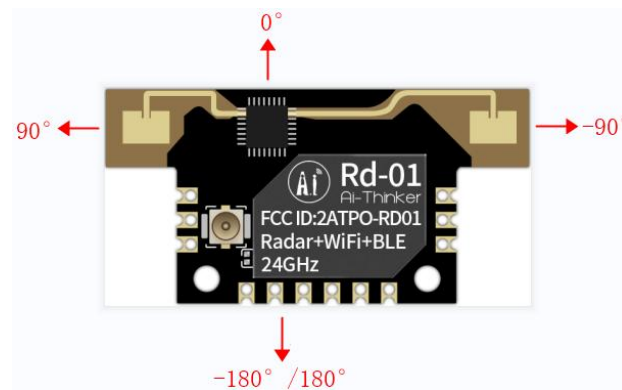


Figure 11 Detection Range for Ceiling-Mounted Installation

■ Wall-mounted Installation

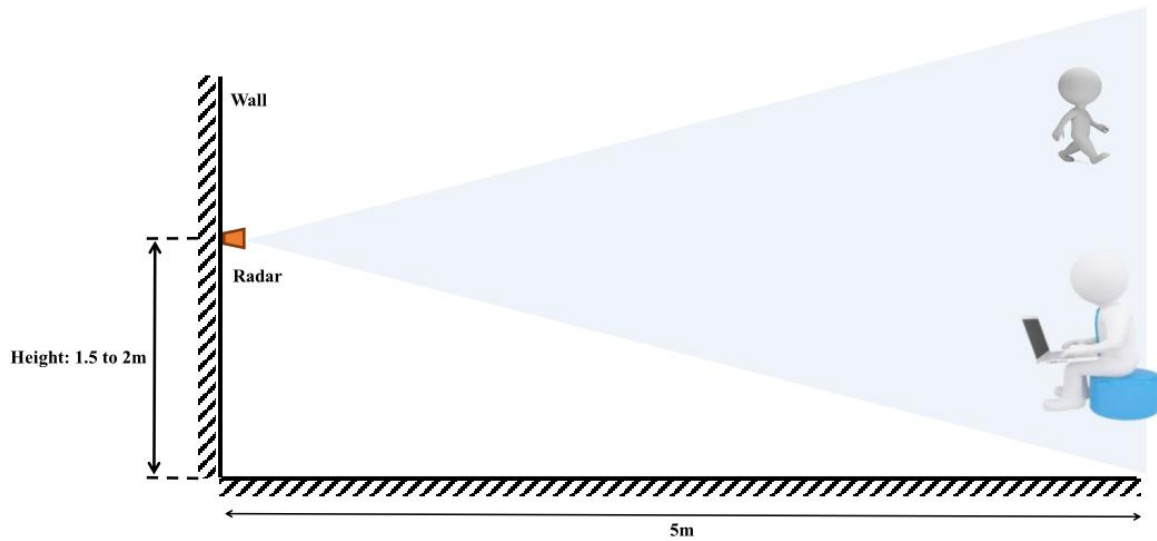


Figure 12 Wall-Mounted Installation Diagram

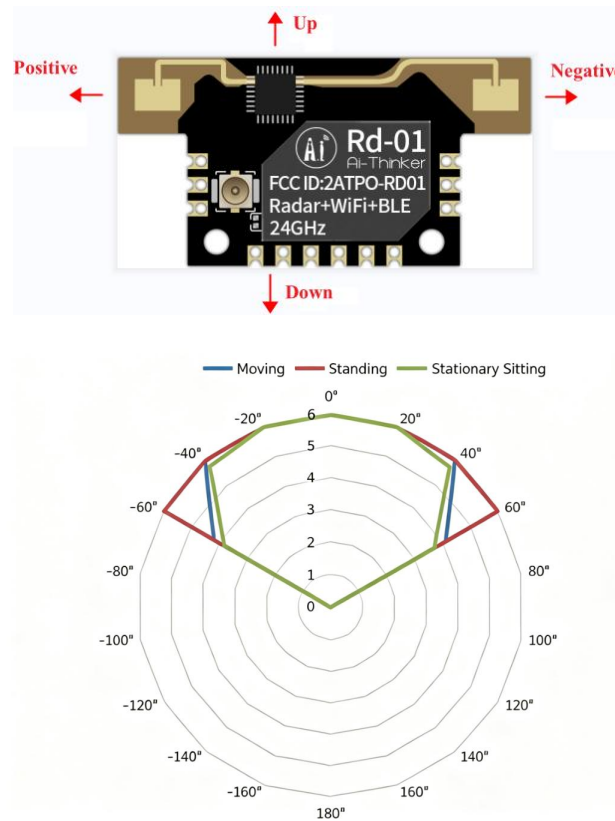


Figure 13 Detection Range for Wall-Mounted Installation

6.6. Power Supply

- A 3.3V supply voltage is recommended, with current above 500mA.
- An LDO is recommended for power supply; if using DC-DC, the ripple should be controlled within 30mV.
- For the DC-DC power supply circuit, it is recommended to reserve space for dynamic response capacitors to optimize output ripple under large load transients.
- It is recommended to add ESD protection devices to the 3.3V power interface.

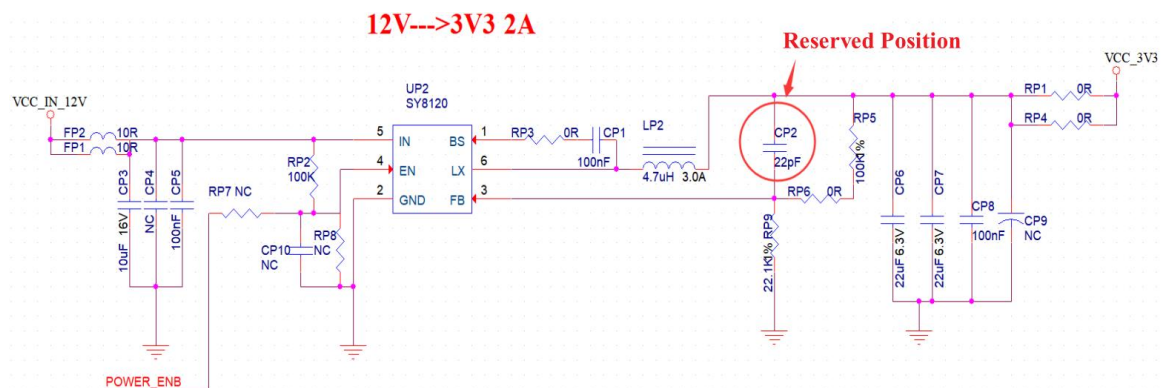


Figure 14 DC-DC Buck Circuit

6.7. GPIO

- Some I/O pins are exposed on the module periphery. To use these I/O pins, it is recommended to connect a 10-100Ω resistor in series with each I/O pin. This helps suppress overshoot, stabilize signal levels, and benefits both EMI and ESD protection.
- The pull-up or pull-down configuration for special I/O pins must follow the guidelines in the specification, as it affects the module's boot configuration.
- The module's I/O pins operate at 3.3V. If the I/O voltage level of the main controller and the module do not match, a level-shifting circuit must be added.
- If an I/O pin is directly connected to a peripheral interface or pin headers, it is recommended to reserve space for an ESD protection device near the connector on the I/O trace.

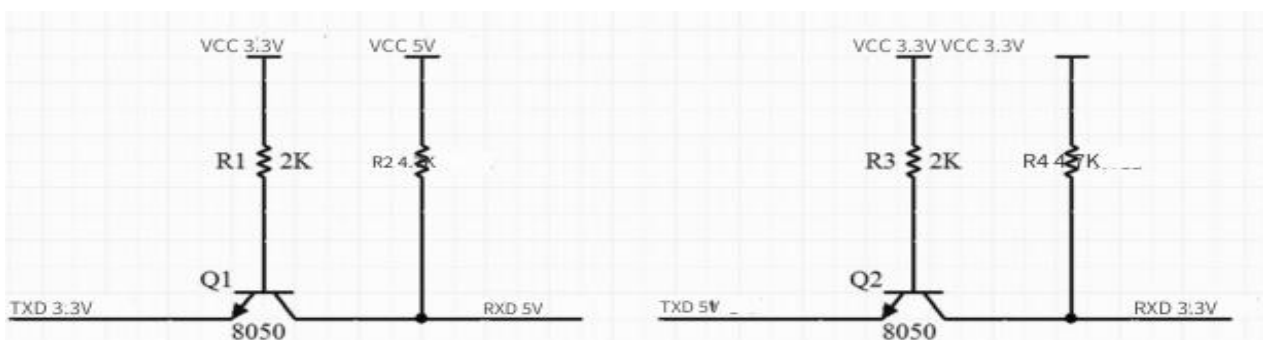


Figure 15 Level-Shifting Circuit

7. Storage Conditions

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

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

The module must be used within 168 hours after vacuum bag removal under conditions of $25\pm 5^{\circ}\text{C}$ and 60% RH. Otherwise, the module requires baking before being returned to production.

8. Reflow Soldering Profile Figure

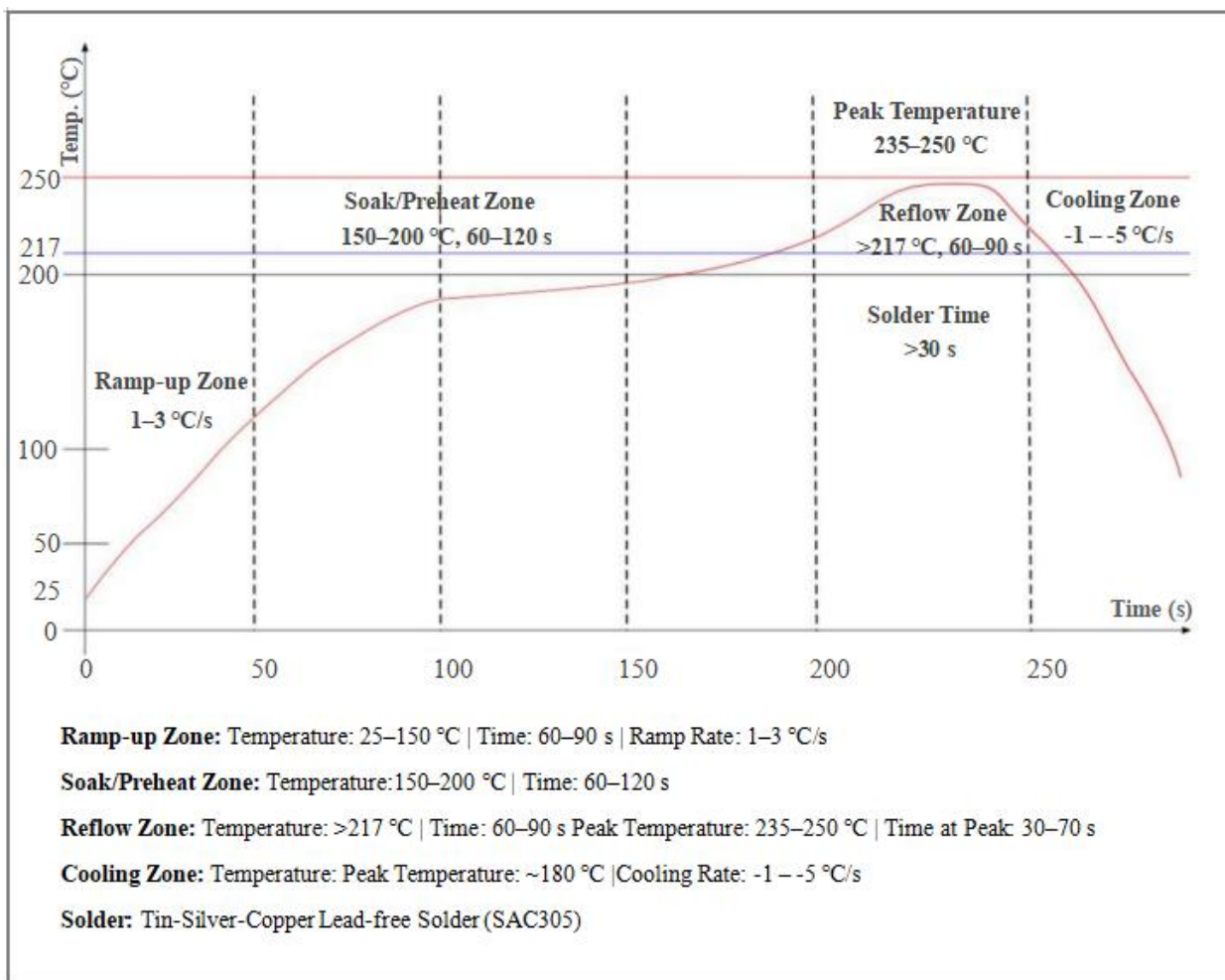


Figure 16 Reflow Soldering Profile

9. Packaging Information

The Rd-01 module (without socket) is packaged in anti-static tape and reel, 550 pcs/reel, as shown in the figure below.



Figure 17 Tape and Reel Packaging Diagram

Table 8 Packaging Information

Packing List	Packaging Method	Quantity per Tray (Tray)
Rd-01 module (with socket)	Anti-static transparent PET tray	25pcs

10.Contact Us

[Official Website](#)

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