Shenzhen Hi-Link Electronic Co.,Ltd

HLK-LD2420 User Manual

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Content

1. Product Description

HLK-LD2420 is a high performance 24 GHz radar module with one transmitter and one receiver antenna. Its human sensing algorithm uses millimeter wave radar distance measurement technology and the advanced proprietary signal processing technology of S3 series chips to achieve accurate sensing of moving, micro-movement and standing human bodies.

HLK-LD2420 is mainly used in indoor scenes to sense whether there is a moving or slightly moving human body in the area and refresh the detection results in real time. It has a maximum sensing distance of 8 m and can be easily configured to sense the distance range, sensitivity and refresh time in different zones.It supports GPIO and UART interface, which is plug-and-play and can be flexibly applied to different smart scenarios and end products.

1.1. Main Features

- Single-chip smart millimeter wave sensor SoC and smart algorithm firmware on board
- Ultra-small module size: 20 mm × 20 mm
- Load default body sensor configuration, plug and play
- 24 GHz ISM band with FCC, CE, and Commission-free spectrum regulatory approvals
- 3.3 V power supply, supports 3.0 V ~ 3.6 V wide voltage range
- Average operating current 50 mA
- Detection target for motion, micro-motion human body
- Real-time reporting of detection results
- Provide visualization tools to support the configuration of the detection distance interval, sub-interval setting sensitivity and results reporting time
- Support induction range division, completely shielding any interference outside the zone
- Proximity 0.2 m sensing, no blind detection zone
- Motion body sensing distance up to 8 m
- Large detection angle, covering a range of ±60°
- Support a variety of installation methods, such as hanging the top, hanging wall
- Independent configuration of trigger and hold states, strong anti-interference capability

1.2.Application Scenarios

HLK-LD2420 human body sensing sensor can detect and identify moving, standing and stationary human bodies, and is widely used in various AIoT scenarios, covering the following types.

Smart Home

It senses the presence and distance of the human body and reports the detection results for intelligent control of home appliances by the main control module.

Smart Business

Recognizes the human body approaching or moving away within the set distance interval; lights up the screen in time to keep the device on in the presence of the human body.

Smart Security

Induction access control, building intercom, electronic cat's eye, etc.

Smart Lighting

Identify and sense human body, precise position detection, can be used in public place lighting equipment (sensor lamp, bulb lamp, etc.).

2. System Description

HLK-LD2420 is an intelligent and accurate human sensor based on Hylink S3 series millimeter wave sensor chip. The sensor uses FMCW FM continuous wave, combined with radar signal processing and built-in intelligent human sensing algorithm to detect human targets in a set space and update the detection results in real time. Using Haling Technology's intelligent millimeter wave sensor reference solution, users can quickly develop their own accurate body sensing products.

The hardware part of HLK-LD2420 is composed of a fully integrated Hylink Smart Millimeter Sensor SoC, a 24 GHz transmitter-receiver antenna and a host MCU; the software part is equipped with firmware and visual configuration tools released by Hylink to realize human body sensing functions with flexible configuration of sensing distance, sensitivity and reporting time.

The HLK-LD2420 specification parameters are shown in Table 2-1.

Parameters	Remarks	Minimum	Typical	Maximum	Unit
Hardware Specifications					
Supported Bands	Comply with FCC, CE, Commission-free certification standards	24	-	24.25	GHz
Support maximum sweep bandwidth		-	0.25	-	GHz
Maximum equivalent omnidirectional radiated power		-	11	-	dBm
Supply voltage		3.0	3.3	3.6	V
Size		-	20×20	-	mm2
Ambient temperature		-40	-	85	°C
System Performance					
Distance detection range (wall mounted)	Exercise human target	-	8	-	m
	Micromotion human target	-	6	-	m
Distance detection range (hanging top)	Exercise human target	-	5	-	m
	Micromotion human target	-	4	-	m
Distance detection accuracy	Moving targets within 8m of the radar line	-	±0.35	-	m
Average operating current		-	50	-	mA
Data refresh rate		-	10	-	Hz

3. Hardware Description

The picture below shows the front and back of the module. The module is equipped with 5 pin holes (factory does not come with pins) called J2 for power supply and communication; J1 is the SWD J1 is the SWD interface, which is used for MCU program burning and debugging.

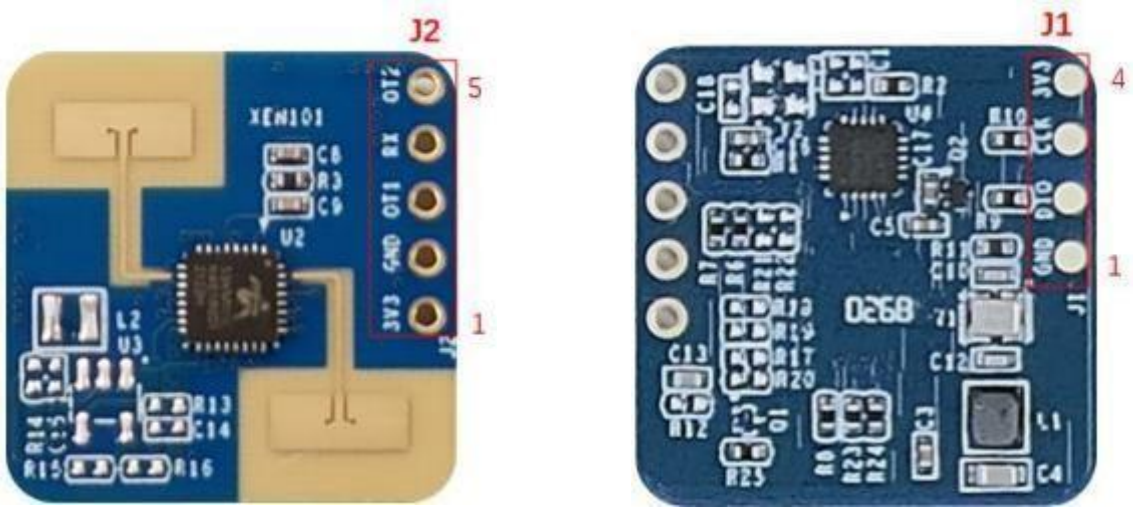


Figure 3-1 Physical drawing of the front and back of the module

Table 3-1 J1 Pin Description

J#PIN#	Name	Function	Description
J1Pin1	GND	Grounding	
J1Pin2	DIO	SWD Interface Data Cable	0 ~ 3.3 V
J1Pin3	CLK	SWD Interface clock line	0 ~ 3.3 V
J1Pin4	3V3	Power input	3.0 V ~ 3.6 V，Typ.3.3V

Table 3-2 J2 Pin Description

J#PIN#	Name	Function	Description
J2Pin1	3V3	Power input	3.0 V ~ 3.6 V，Typ.3.3 V
J2Pin2	GND	Grounding	
J2Pin3	OT1	UART_TX	0 ~ 3.3 V
J2Pin4	RX	UART_RX	0 ~ 3.3 V
J2Pin5	OT2	IO for reporting detection status: high for occupied, low for unoccupied	0 ~ 3.3 V

Note: J1, J2 interface pin spacing 2.54 mm.

4. Software Description

This chapter introduces the firmware debugging of HLK-LD2420 and the use of the upper computer tools.

The HLK-LD2420 is shipped with burned-in system firmware, the firmware version is detailed in the module package. Hailing Technology provides visualization and configuration software for HLK-LD2420 hardware, which is convenient for developers to configure HLK-LD2420 parameters according to the usage scenarios and optimize the sensing effect.

4.1. Firmware Configuration

This section describes how to debug the HLK-LD2420 radar module firmware.

Step 1、The USB to TTL serial adapter board is used to connect the host computer to the radar module, and the pin connections are shown in Table 4-1 and Figure 4-1. shown in Table 4-1 and Figure 4-1.

Table 4-1 Correspondence of pins when connecting the radar to the USB serial adapter board

Radar Module	Serial port adapter board
RX	TXD
O_T1	RXD
3V3	VCCIO
GND	GND

Figure 4-1 Connection between HLK-LD2420 hardware and USB serial port adapter board

Step 2、Open the Device Manager of the host computer and check the serial number of the serial port where the radar module is located.

Step 3、Open the serial port tool, select the serial port number of the radar module, set the serial port baud rate to 115200, and then click the "Open Serial Port" button to view the current radar detection results on the output side of the tool interface.

4.2. Upper computer use

This section introduces the use of the HLK-LD2420 module's upper computer tool to help users understand the meaning of the relevant parameters and how to obtain them.

Step 1: Obtain the HLK-LD2420's companion host computer tool "HLK-LD2420_TOOL" from Hailing Technology's website.

Step 2: Use the serial adapter board to connect the radar module and the host computer according to Figure 4-1.

Step 3: Open the host computer tool, select the serial port number of the radar module, input the baud rate 115200, and click the "Connect Device" button to read and write the parameters (Note: the serial port tool and the host computer tool cannot be used at the same time).

4.2.1. Parameter Setting

The interface of the upper computer tool is shown in Figure 4-2.

Figure 4-2 HLK-LD2420_TOOL interface

The explanation of the parameters involved in the upper computer tool interface is detailed in Table 4-2.

Table 4-2 Explanation of the parameters of the upper computer tool interface

Parameter Name	Explanation	Parameter Range
Minimum Distance	Used to set the minimum distance gate for radar detection. The resolution of the distance gate is 70 cm.	0~15
Maximum distance	Used to set the maximum distance gate for radar detection. The resolution of the distance gate is 70 cm.	0~15 (need not be less than the minimum distance)
Target disappearance Delay time	The target state is switched from occupied to unoccupied with a delay of T: during this time, if an occupied state is detected, the timing of this period is restarted. The radar will only switch to unoccupied and report unoccupied if it detects unoccupied for a full T time.	0~65535
Trigger Threshold	It is recommended to set the sensitivity from unoccupied to occupied, which is more than 5 times the noise level. Please refer to 4.2.2 and 4.2.3 for bottom noise scanning and data viewing.	0~65535
Maintain threshold	The sensitivity for detecting human micro-movements and maintaining the presence of a person is recommended to be set at 2~5 times the noise level. Please refer to 4.2.2 and 4.2.3 for the scanning and data viewing of the bottom noise.	0~65535

4.2.2. Bottom noise scanning

The Uplink Bottom Noise Scan page is shown in Figure 4-3. Scanning the bottom noise through the Uplink is divided into three steps:

Step 1: Set the scan interval and scan duration.

Step 2: Set the path to save the data files.

Step 3: Click "Start Scan".

The noise data is stored as a folder in the set file path with a timestamp added to the folder name suffix for differentiation. No one is kept in the scan area during the scan noise.

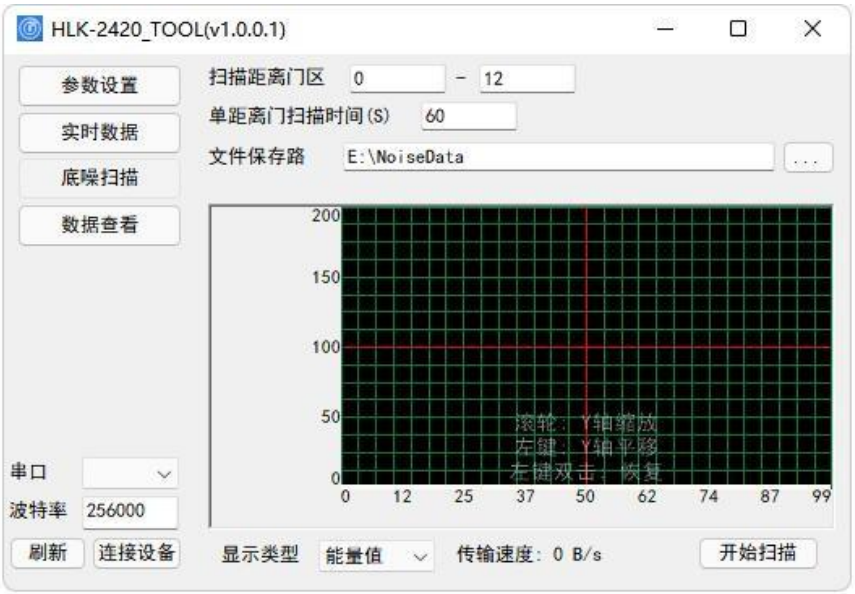


Figure 4-3 Upper computer bottom noise scanning page

4.2.3. Bottom noise data view

The view page of the bottom noise data from the host computer is shown in Figure 4-4, and the bottom noise data from the host computer is viewed in two steps.

Step 1: Select the folder where the viewed data is located.

Step 2: Select the distance gate to be viewed.

The underside noise data of the viewed distance gate will appear in the waveform window, where the horizontal axis is the time and the vertical axis is the Peak value. The mouse hover position will display the Peak value of the horizontal coordinate.

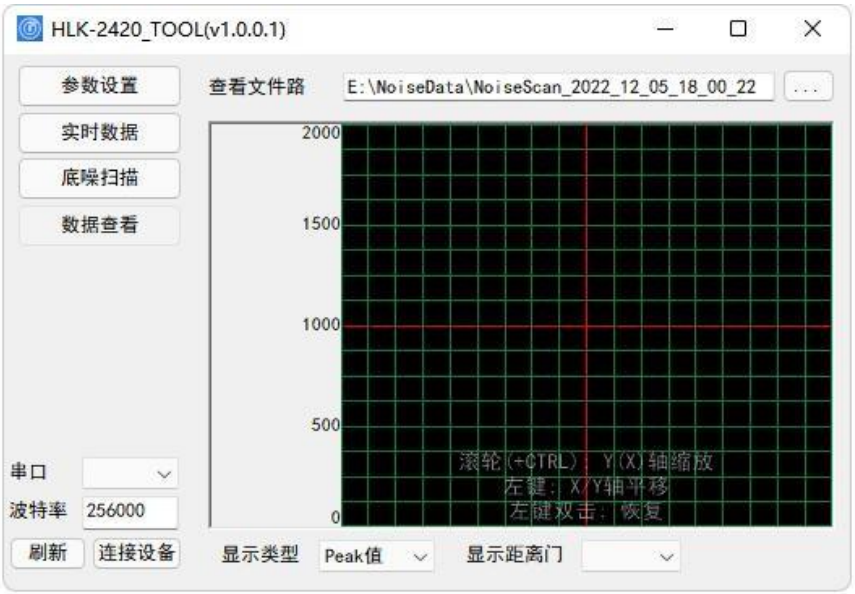


Figure 4-4 Upper computer data view page

5. Installation and detection range

The HLK-LD2420 supports both ceiling and wall mounting, and the recommended method is ceiling mounting.

The orientation of the radar is shown in Figure 5-1. The Y-axis is 0°, the X-axis is 90°, and the Z-axis is perpendicular to the X-Y plane (also called the normal direction).

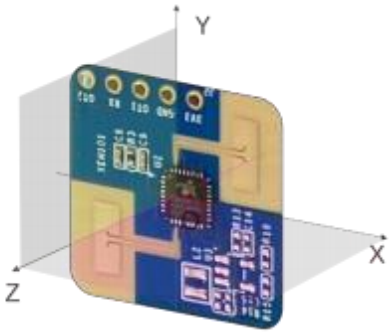


Figure 5-1 Radar module orientation diagram

5.1. Ceiling Mount

The recommended ceiling mounting height is 2.7~3 m. The maximum motion sensing range of the HLK-LD2420 radar module in the default configuration is a conical three-dimensional space with a bottom radius of 5 m, as shown in Figure 5-2.

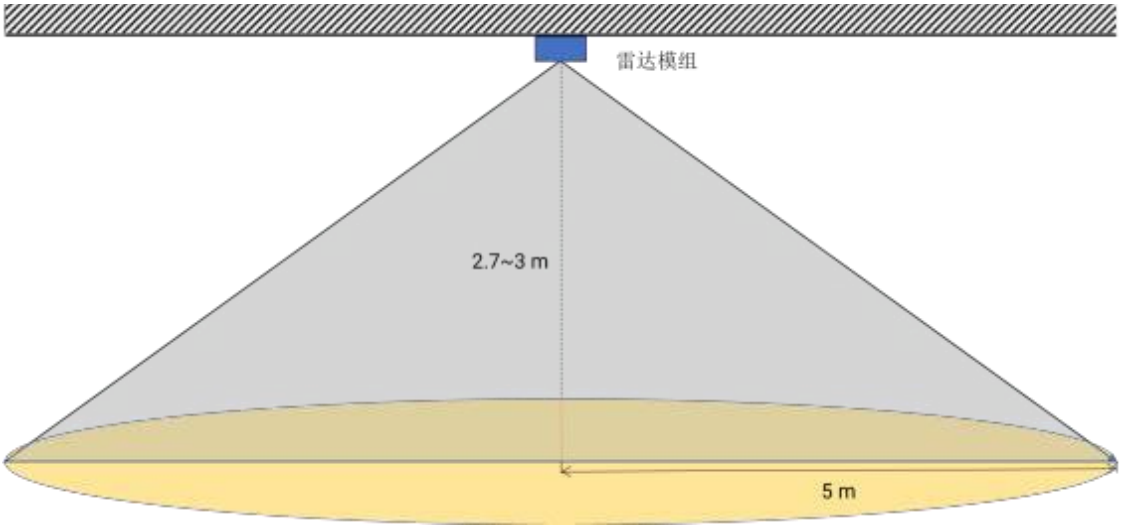
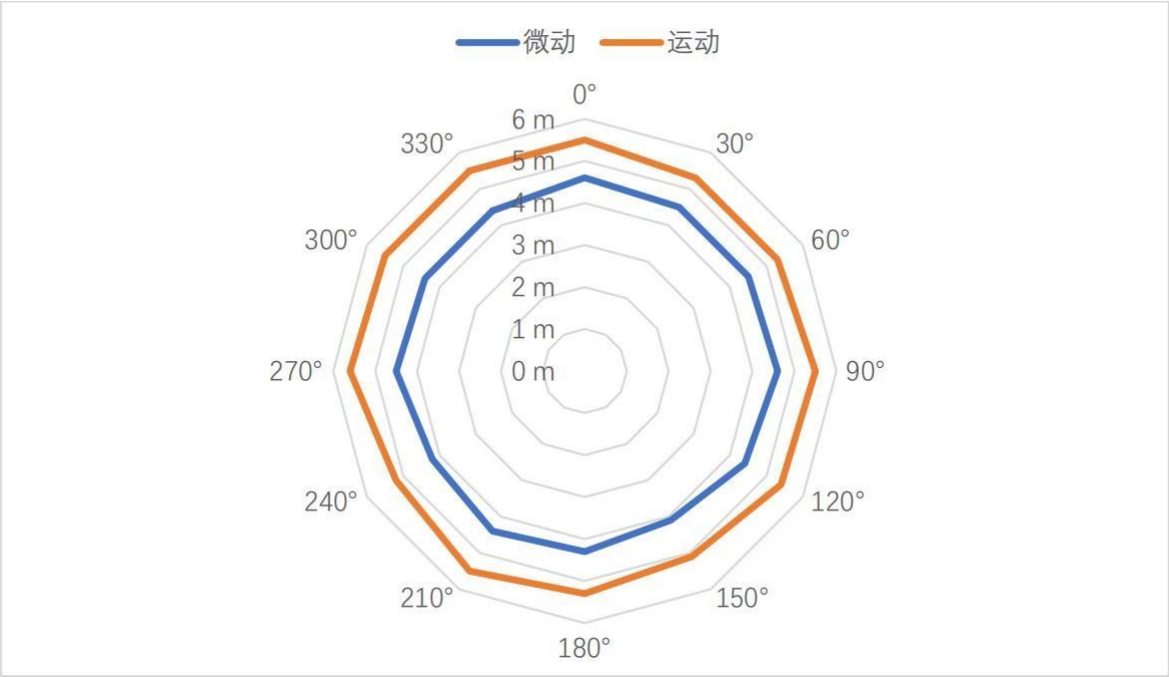


Figure 5-2 HLK-LD2420 radar module detection range diagram (hanging top) Hanging top installation height

The motion and micro-motion detection range of this reference scheme at 2.7m is shown in Figure 5-3.



5-3 Hanging ceiling mount induction range

5.2. Wall Mounted

The recommended wall mounting height is 1.5~2 m. For wall mounting, the X-axis of the radar module (refer to Figure 5-1) points to the horizontal direction, the Y-axis points upward, and the Z-axis points to the detection area. The maximum motion sensing range of the wall-mounted HLK-LD2420 radar module in the default configuration is a three-dimensional sector with a radius of 8 m and an angle of ±45° in the horizontal and pitch directions, as shown in Figure 5-4.

The detection range of this reference solution for a wall mounting height of 1.5 m is shown in Figure 5-5.

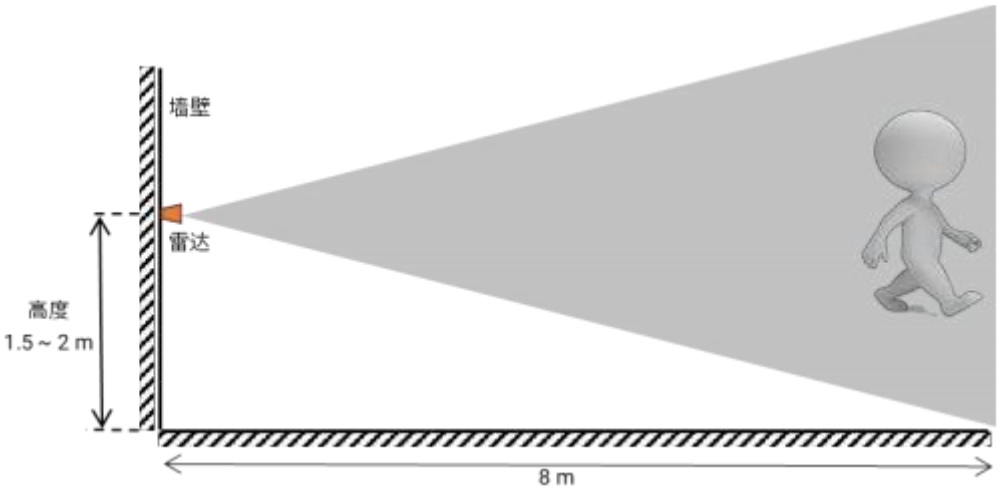


Figure 5-4 HLK-LD2420 radar module detection range diagram (wall mount)

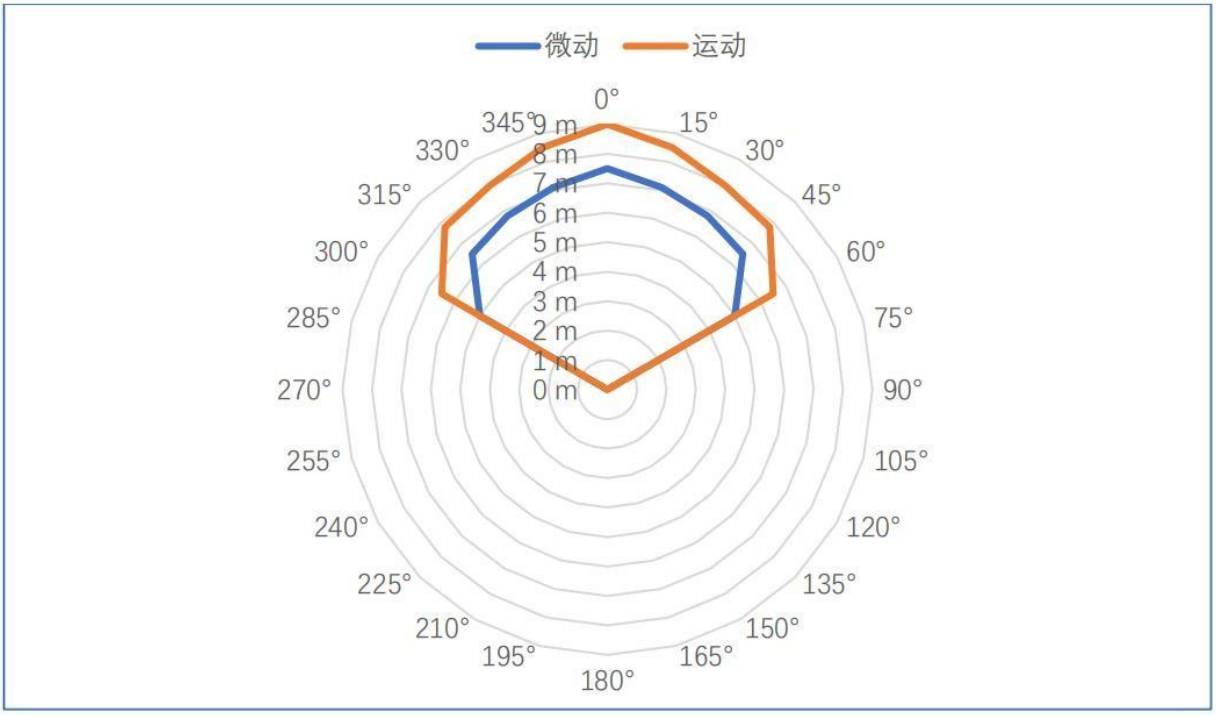


Figure 5-5 Sensing range for wall mounting

5.3. Detection range test

The test methods for radar triggering and holding detection range are described separately as follows.

Trigger range:

The target human body approaches the radar from a distance when no one is reported on the radar, and stops advancing when the radar starts to report that someone is present, and the current position is the boundary of the radar trigger detection range; the area enclosed by the detection boundary in each direction is the radar trigger detection range.

Holding range:

The target human body keeps a small movement in the position to be measured in the state of radar reported as occupied, such as shrugging shoulders, raising hands, if the radar within 60 s

Always reported as occupied, the current position is within the radar hold detection range; otherwise, the detection position is outside the hold detection range.

6. Mechanical size

Figure 6-1 shows the mechanical dimensions of the module, all units are in mm mm. the plate thickness of the module is 1.2 mm with a tolerance of ±10%.

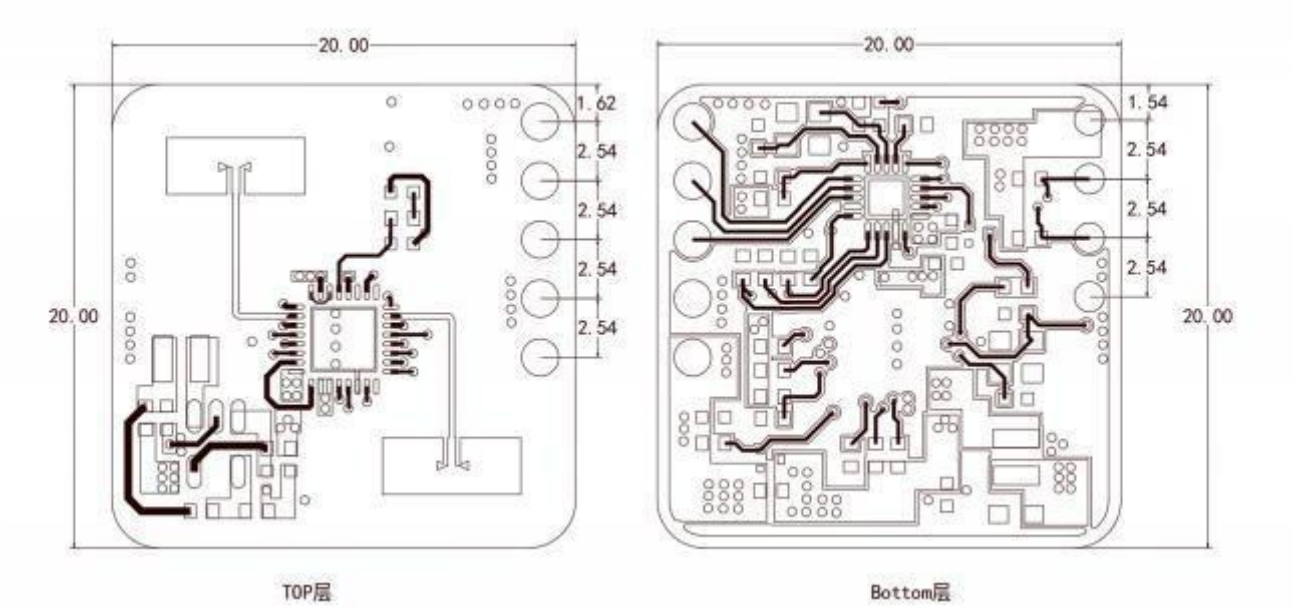


Figure 6-1 Hardware Mechanical Dimensions

7. Installation Instructions

Radar housing requirements

If the radar requires a housing, the housing must have good wave transmission characteristics in the 24 GHz band and must not contain metal or materials that shield electromagnetic waves.

materials that have a shielding effect on electromagnetic waves. See the Millimeter Wave Sensor Radome Design Guide for additional considerations.

Installation environment requirements

This product needs to be installed in a suitable environment, if used in the following environment, the detection effect will be affected：

There are non-human objects in the sensing area that are in constant motion, such as animals, continuously swinging curtains and large green plants facing the wind vents.

There is a large area of strong reflective plane in the sensing area, and strong reflectors are causing interference to the radar antenna.

When wall-mounted, you need to consider the interference factors from outside such as air conditioners and electric fans on top of the room.

Precautions for installation

Try to ensure that the radar antenna is facing the area to be detected, and the antenna is open and unobstructed around.

To ensure that the sensor installation position is solid and stable, the radar itself shaking will affect the detection effect.

It is ensured that there are no objects moving or vibrating on the back side of the radar. Due to the penetrating nature of radar waves, the antenna back flap may detect moving objects at the back of the radar. A metal shield or a metal back plate can be used to shield the radar backside flap to reduce the effect of objects on the backside of the radar.

When multiple 24 GHz band radars are present, do not install them in direct beam alignment, but as far away from each other as possible to avoid possible mutual interference.

Power Supply Notes

The power supply input voltage range is 3.0 V~3.6 V, and the power supply ripple has no obvious spectral peaks within 100 kHz, this solution is a reference design, users need to consider the corresponding ESD and lightning surge and other EMC design.

8. Cautions

Maximum detection distance

The maximum range of the radar is 8 m. Within the range, the radar reports the straight-line distance of the target from the radar. The radar can only output distance information for moving bodies within 8 m. It does not support proximity ranging for stationary bodies at this time.

Maximum distance and accuracy

Theoretically, the radar range accuracy of this reference solution is 0.35 m. Due to the different body size, status and RCS of human targets, the range accuracy may fluctuate, and the maximum detection distance may also fluctuate.

Target disappearance delay time

When the radar module detects no human presence in the target area, it does not immediately report the "unoccupied" status of the area, but delays it.

The delayed reporting mechanism is: once no human target is detected within the test range, the radar module will start a timer, the duration of which is the unoccupied duration, and if no one is detected within the timer, the "unoccupied" status will be reported at the end of the timer; if someone

is detected within this time period, the timer will be ended and updated immediately, and the target information will be reported.

9. Version History

Versions	Time	Change content
V1.0	2023/2/15	Initial draft.
V1.1	2023-2-24	Modify some errors