



Shenzhen Hailingke Electronics Co., Ltd.

HLK-LD2420 User Manual

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1. product introduction

HLK-LD2420 is a high-performance 24GHz A radar module with a send-and-receive antenna. Its human body sensing algorithm uses millimeter wave

Radar distance measurement technology and S3. The advanced proprietary signal processing technology of the series chips realizes the precise perception of motion, micro-movement and standing human body.

HLK-LD2420 is mainly used to detect whether there is a moving or slightly moving human body in the indoor scene perception area, and refresh the detection results in real time. It's right

The farthest sensing distance of moving human body is 8 meters, can easily configure the sensing distance range, sensing sensitivity and refresh time in different intervals, support

GPIOs and UART interface, plug and play, flexibly applied to different intelligent scenarios and terminal products.

1.1. main features

- Equipped with a single-chip smart millimeter wave sensor SoC and smart algorithm firmware
- Ultra-small module size: 20 mm x 20 mm
- Load the default human sensor configuration, plug and play
- 24 GHz ISM frequency band, through FCC, CE, No committee spectrum regulation certification
- 3.3V power supply, support 3.0V ~ 3.6V wide voltage range
- Average working current 50 mA
- The detection target is movement and micro-movement of the human body
- Real-time reporting of detection results
- Provides visualization tools to support the configuration of detection distance intervals, setting sensitivity and result reporting time between partitions
- Support the division of sensing range, completely shield any interference outside the range
- close range 0.2m induction, no detection blind zone
- The furthest distance of motion human body induction 8 meters
- The detection angle is large, and the coverage reaches $\pm 60^\circ$
- Support various installation methods such as ceiling hanging and wall hanging
- Independent configuration of trigger and hold state, strong anti-interference ability

1.2.Application Scenario

HLK-LD2420The human body induction sensor can detect and identify the moving, standing and stationary human body, and is widely used in variousAIoT

Scenarios, covering the following types:

smart home

Perceive the existence and distance of the human body, and report the detection results for the main control module to intelligently control the operation of home appliances.

Smart business

Identify the approach or distance of the human body within the set distance interval; light up the screen in time, and keep the device always on when the human body is present.

Smart Security

Induction access control, building intercom, electronic peephole, etc.

Smart lighting

Recognize and sense the human body, accurately detect the position, and can be used for lighting equipment in public places (sensing lights, bulb lights, etc.).

2.System specification

HLK-LD2420is based on HilinkS3An intelligent and precise human body sensing sensor developed by a series of millimeter wave sensor chips. sensor

useFMCWFM continuous wave, combined with radar signal processing and built-in intelligent human body sensing algorithm, detects human targets in the set space

And update the detection results in real time. Using Hilink's intelligent millimeter wave sensor reference solution, users can quickly develop their own accurate human body sensing products

Taste.

HLK-LD2420The hardware part is mainly composed of the fully integrated Hilink intelligent millimeter wave sensorSoC,24GHzOne send one receive antenna and main control

MCUComposed; the software part is matched with the firmware and visual configuration tool released by Hailingke to realize the flexible configuration of sensing distance, sensitivity and

Human body sensing function for reporting time.

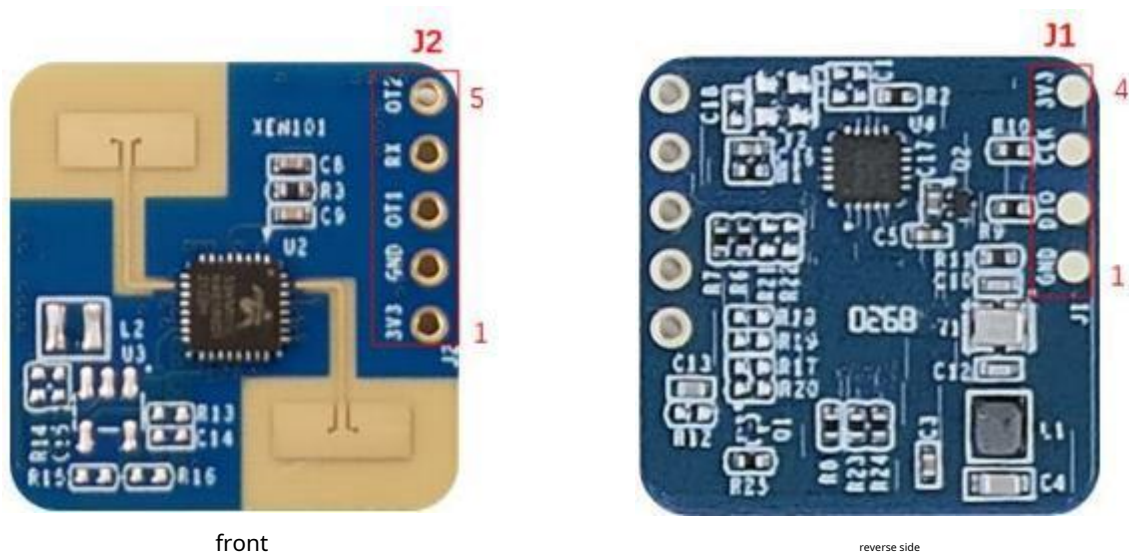
HLK-LD2420The specification parameters are shown in the table2-1shown.

parameter	Remark	the smallest	typical	maximum	unit
hardware specification					
Support frequency band	Comply with FCC, CE, non-committee certification standards	twenty four	-	24.25	GHz
Support maximum sweep bandwidth		-	0.25	-	GHz
Maximum equivalent isotropic radiated power		-	11	-	dBm
supply voltage		3.0	3.3	3.6	V
size		-	20 x 20	-	mm ²
ambient temperature		- 40	-	85	°C
system performance					
Distance detection range (wall-mounted)	Sports Human Target	-	8	-	m
	micro-motion human target	-	6	-	m
Distance detection range (ceiling)	Sports Human Target	-	5	-	m
	micro-motion human target	-	4	-	m
Distance Detection Accuracy	Moving targets within 8m of the straight-line distance from the radar	-	±0.35	-	m
Average working current		-	50	-	mA
data refresh rate		-	10	-	Hz

3.hardware description

The picture below shows the front and back photos of the module. Module reserved 5A pin hole (the factory does not match the pin) is called J2, for power supply and communication; J1 for

SWD interface for MCU Program burning and debugging.



picture3-1The physical picture of the front and back of the module

surface3-1 J1Pin Description

J#PIN#	name	Function	illustrate
J1Pin1	GND	grounding	-
J1Pin2	DIO	SWD interface data cable	0 ~ 3.3V
J1Pin3	CLK	SWD interface clock line	0 ~ 3.3V
J1Pin4	3V3	power input	3.0V ~ 3.6V, Typ.3.3V

surface3-2 J2Pin Description

J#PIN#	name	Function	illustrate
J2Pin1	3V3	power input	3.0 V ~ 3.6 V, Typ.3.3 V
J2Pin2	GND	grounding	-
J2Pin3	OT1	UART_TX	0 ~ 3.3V
J2Pin4	RX	UART_RX	0 ~ 3.3V
J2Pin5	OT2	IO, used to report the detection status: high level means there are people, low level means no one	0 ~ 3.3V

illustrate:J1,J2Interface pin spacing2.54 mm.

HLK-LD2420supportKeil 5 IDEburninghexfile or source code project, you can useJ-Link (V9above version),

CMSIS-DAPWait for the programmer to download the program. Please make sure it is installed before burningPuya.PY32F0xx_DFP.1.1.0.pack.

4. Software Description

Introduction to this chapter HLK-LD2420 Firmware debugging and the use of PC tools.

HLK-LD2420 The system firmware has been burned at the factory, and the firmware version is detailed in the module packaging. Hailingke provides for HLK-LD2420 hardware

Visual host computer configuration tool software, which is convenient for developers to configure HLK-LD2420 Configure parameters to optimize the sensing effect.

4.1. firmware configuration

This section introduces HLK-LD2420 Debugging method of radar module firmware.

step one, pass USB change TTL The serial port adapter board is connected to the upper computer and the radar module, and the pin connection method is as shown in the table 4-1 and diagram 4-1

shown.

surface 4-1 radar with USB Correspondence between the pins when the serial port adapter board is connected

radar module	Serial adapter board
RX	TXD
O_T1	RXD
3V3	VCCIO
GND	GND



Figure 4-1 The connection method between HLK-LD2420 hardware and USB serial port adapter board

step two, Open the device manager of the host computer, and check the serial port number of the serial port where the radar module is located.

step three, Open the serial port tool, select the serial port number of the radar module, and set the serial port baud rate 115200, and then click "Open Serial Port"

button to view the current radar detection results at the output end of the tool interface.

4.2.Host computer use

This section introduces the use of the upper computer tools that are matched with the HLK-LD2420 module, to help users understand the meaning of relevant parameters and related parameters method of obtaining .

step one, Obtain the upper computer tool "HLK-2420_TOOL.exe" supporting HLK-LD2420 from the official website of HLK-LD2420.

Step two,According to the method in Figure 4-1, use the serial port adapter board to connect the radar module and the host computer.

Step three,Open the host computer tool, select the serial port number of the radar module, and enter the baud rate**115200**, click the "Connect Device" button to

Read and write parameters (note: the serial port tool and the host computer tool cannot be used at the same time).

4.2.1.parameter settings

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



Figure 4-2 HLK-LD2420_Tool interface

See Table 4-2 for the explanation of the parameters involved in the host computer tool interface.

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

parameter name	explain	parameter range
shortest distance	Used to set the minimum range gate for radar detection. The resolution of the range gate is 70 cm.	0~15
maximum distance	Used to set the maximum range gate for radar detection. The resolution of the range gate is 70 cm.	0~15 (not less than the minimum distance)
target disappears delay	It takes a period of time T to switch the target state from occupied to unattended: during this period, if a person is detected, the timing of this period of time will be restarted. The radar will switch to the unmanned state and report unmanned only after detecting that the unmanned state lasts for a complete T time.	0~65535
trigger threshold	It is used to set the sensitivity from unoccupied to occupied state. It is recommended to set it at more than 5 times of the energy. For energy scanning and data viewing, please refer to 4.2.2 and 4.2.3.	0~65535
hold threshold	It is recommended to set the sensitivity at 2 to 5 times of the noise floor for detecting human micro-movement and maintaining the human state. For energy scanning and data viewing, please refer to 4.2.2 and 4.2.3.	0~65535

4.2.2. energy scan

The host computer energy scanning page is shown in Figure 4-3, and the energy scanning through the host computer is divided into three steps: .

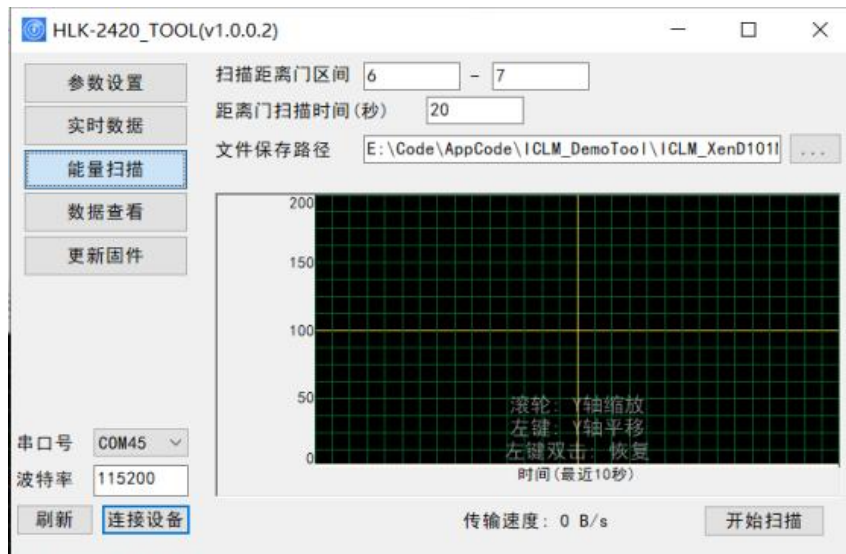
step one, Set the scan interval and scan duration.

Step two, Set the data file save path.

Step three, Click "Start Scan".

The energy data will be stored in the set file path in the form of a folder, and a time stamp is added to the suffix of the folder name for distinction.

Keep the scan area clear of people during the energy scan.



picture4-3Host computer energy scan page

4.2.3. Energy data viewing

The host computer energy data viewing page is shown in Figure 4-4. There are two steps to view energy data through the host computer:

step one, Select the folder where the data to be viewed is located.

Step two, Select the range gate for viewing.

The energy data of the range gate being viewed will appear in the waveform window, where the horizontal axis is time and the vertical axis is Peak value. The mouse hover position can be displayed

Display the Peak value on the abscissa.

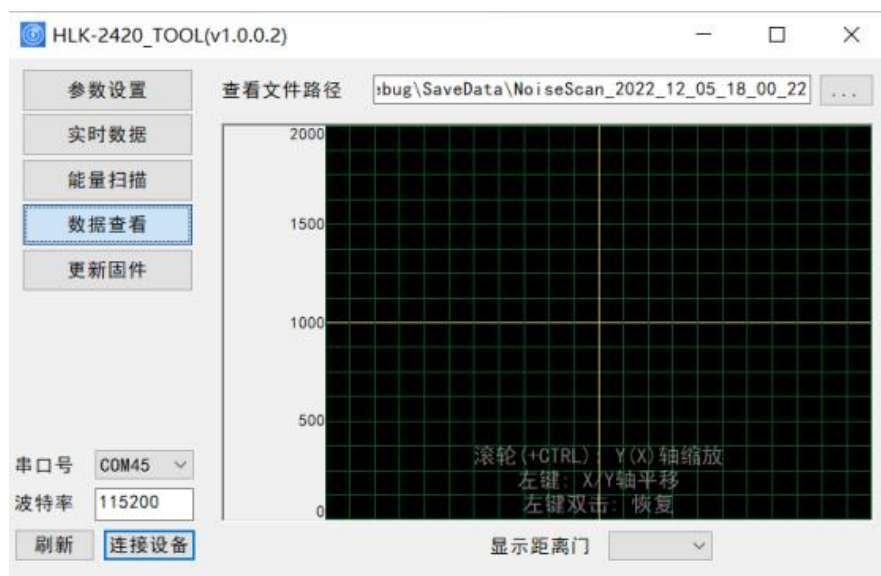


Figure 4-4 PC data view page

5. Installation and Detection Range

HLK-LD2420 supports both ceiling and wall installation methods, and the recommended method is ceiling installation.

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

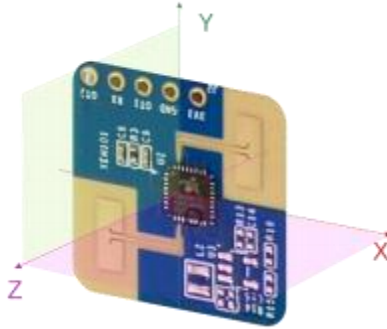


Figure 5-1 Schematic diagram of radar module orientation

5.1. Ceiling installation

The recommended ceiling installation height is 2.7 to 3 m. The maximum motion sensing range of the ceiling-mounted HLK-LD2420 radar module in the default configuration is

A conical three-dimensional space with a bottom radius of 5m, as shown in Figure 5-2.

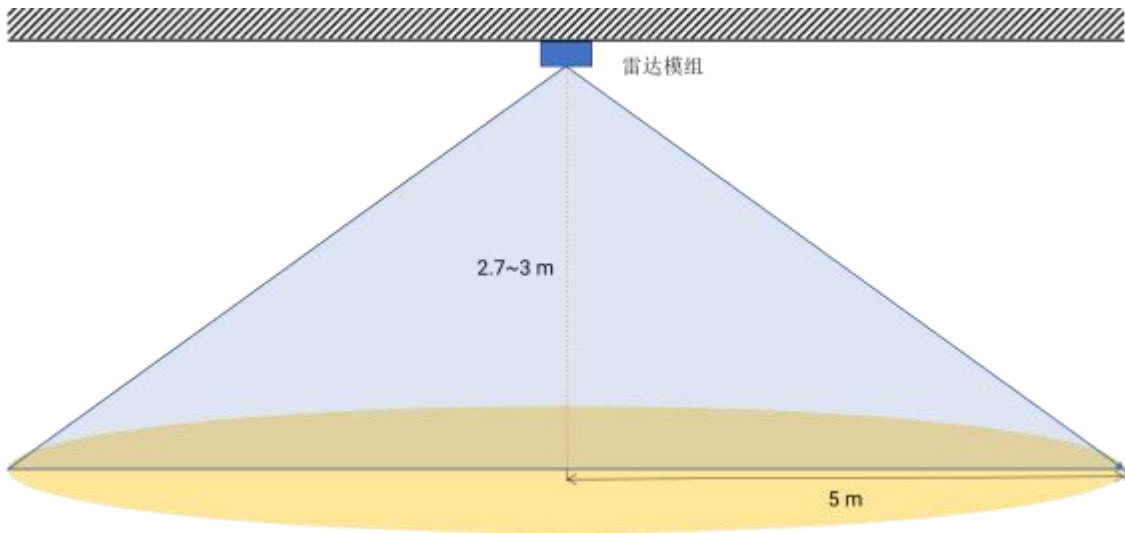
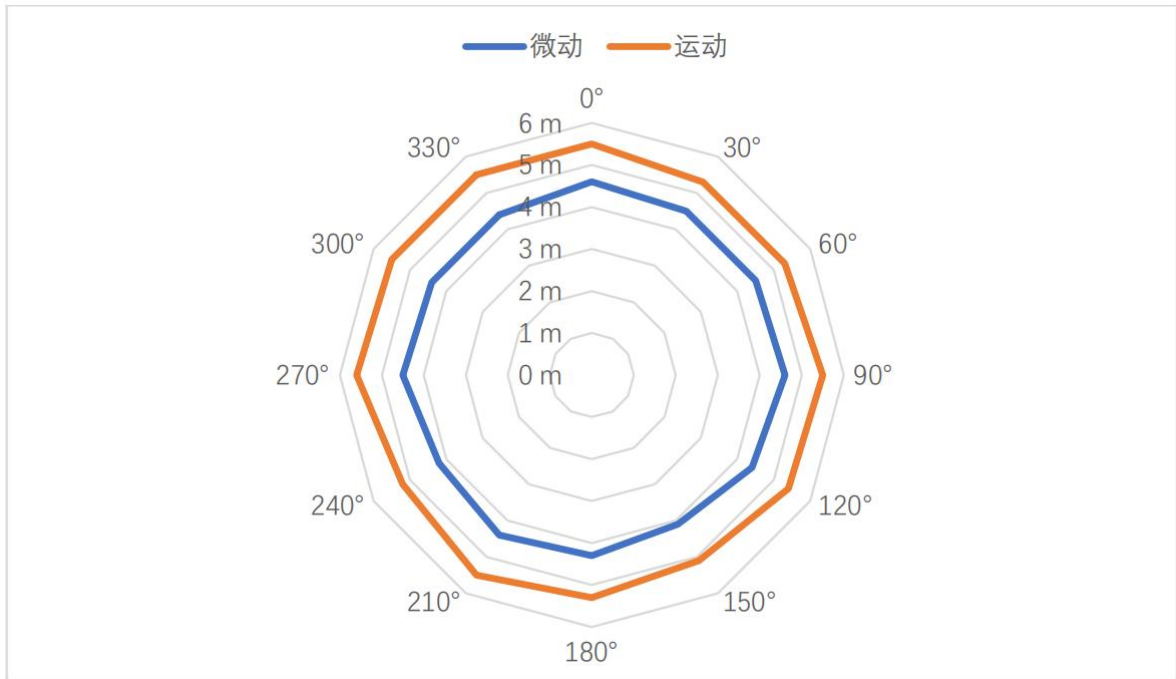


Figure 5-2 Schematic diagram of the detection range of the HLK-LD2420 radar module (on the ceiling)

When the ceiling installation height is 2.7m, the schematic diagram of the motion and micro-motion detection range of this reference solution is shown in Figure 5-3.



5-3 Ceiling installation sensing range

5.2.wall mount

The recommended wall mounting height is 1.5 to 2 m. When wall-mounted, the X-axis of the radar module (refer to Figure 5-1) points to the horizontal direction, and the Y-axis points upwards.

The Z axis points to the detection area. The HLK-LD2420 radar module mounted on the wall has a maximum motion sensing range of 8 m in radius and horizontal

A three-dimensional fan-shaped space with an included angle of $\pm 45^\circ$ with the pitch direction, as shown in Figure 5-4.

Figure 5-5 shows the detection range of this reference solution when the wall-mounted installation height is 1.5 m.

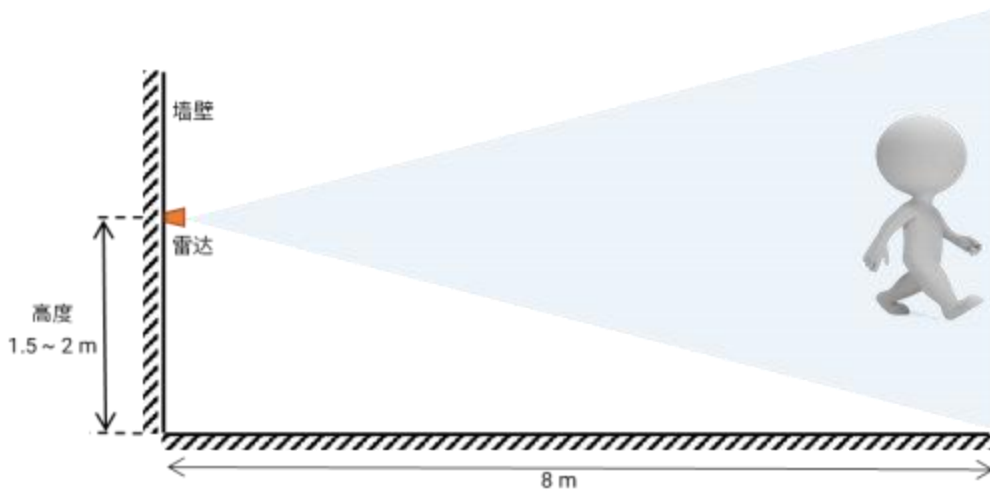


Figure 5-4 Schematic diagram of detection range of HLK-LD2420 radar module (wall-mounted)

6. Mechanical Dimensions

Figure 6-1 shows the mechanical dimensions of the module, all units are mm. The plate thickness of the modules is 1.2 mm with a tolerance of $\pm 10\%$.

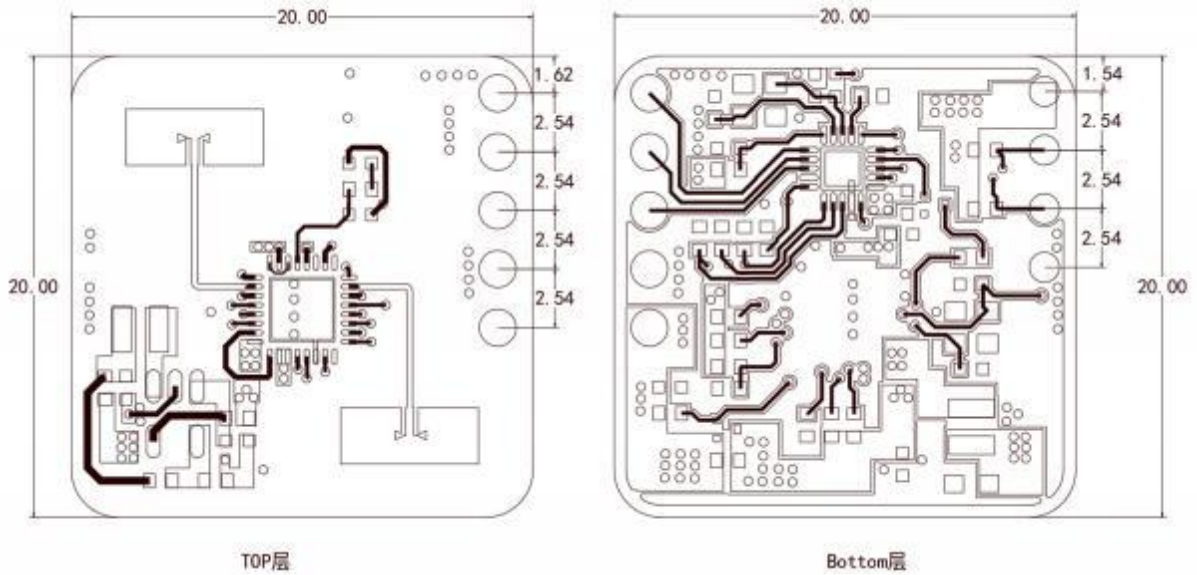


Figure 6-1 Hardware mechanical dimensions

7. Installation Notes

Radar Enclosure Requirements

If the radar requires an enclosure, the enclosure must have good wave-transmitting properties in the 24 GHz band and must not contain metal or be sensitive to electromagnetic waves.

wave shielded

The material of action. See the mmWave Sensor Radome Design Guidelines for more considerations.

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 are continuously moving in the sensing area, such as animals, continuously swinging curtains, and large green plants facing the air outlet.
- There are large areas of strong reflection planes in the sensing area, and strong reflectors facing the radar antenna will cause interference.
- When installing on the wall, it is necessary to consider external interference factors such as air conditioners and electric fans on the top of the room.

Precautions during installation

- Try to ensure that the radar antenna is facing the area to be detected, and the surrounding area of the antenna is open and unobstructed.
- To ensure that the installation position of the sensor is firm and stable, the shaking of the radar itself will affect the detection effect.
- Make sure there is no movement or vibration on the back of the radar. Due to the penetrating nature of radar waves, the antenna backlobe may detect the surface moving objects. Metal shields or metal backplanes can be used to shield the radar back lobe and reduce the impact caused by objects on the back of the radar. into the impact.
- When there are multiple 24 GHz frequency band radars, please do not face the beam directly, and install them as far away as possible to avoid possible mutual interference.

Power Notes

- The power supply input voltage range is 3.0 V~3.6 V, and the power supply ripple has no obvious spectral peak within 100 kHz. This scheme is a reference design. Users need to consider the corresponding electromagnetic compatibility design such as ESD and lightning surge.

8.Precautions

Maximum detection distance

The maximum range for the radar to detect targets is a radial distance of 8 m. Within the detection range, the radar will report the straight-line distance between the target and the radar. radar

Within 8 m, it can only output the distance information of a moving human body, and does not support the short-distance ranging function of a stationary human body for the time being.

Firmware baud rate change

The default serial port baud rate of the radar is 256000, and developers can modify it in the project directory \platform\py32\inc\py32_uart.h

USART0_BAUDRATE macro definition to modify the baud rate.

Maximum distance and accuracy

Theoretically, the radar ranging accuracy of this reference scheme is 0.35 m. Due to the differences in the size, state and RCS of human targets, the ranging accuracy

There will be fluctuations, and the farthest detection distance will also fluctuate to a certain extent.

Target disappear delay time

When the radar module detects that there is no human body in the target area, it will not immediately report the "no one" status in the area, but will be delayed.

The mechanism for delayed reporting is: once no human target is detected within the test range, the radar module will start timing, and the duration is the time when no one continues

If no one is continuously detected within the time period, the "no one" status will be reported after the end of the time; if no one is detected within this time period

If it is, it will end immediately and update the timing, and report the target information.

9.version history

Version	time	change content
V1.0	2023/2/15	initial draft.
V1.1	2023/3/23	The pin function of the module is changed, the default baud rate is changed to 115200, and the version of the host computer is updated

important statement

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