Shenzhen Hailingke Electronics Co., Ltd.

HLK-LD2420 User Manual

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1. Product Introduction

HLK-LD2420 is a high-performance 24 GHz radar module with a transmit-receive antenna from Hilink. Its human body sensing algorithm uses millimeter wave

Radar distance measurement technology and the S3 series chip's advanced proprietary signal processing technology enable accurate perception of motion, micro-movement and standing human bodies.

HLK-LD2420 is mainly used in indoor scene sensing to see if there is a moving or slightly moving human body in the area, and to refresh the detection results in real time.

The maximum sensing distance of a moving human body is 8 m. The sensing distance range, sensing sensitivity in different intervals and refresh time can be easily configured.

GPIO and UART interfaces are plug-and-play and can be flexibly applied to different smart scenarios and terminal products.

1.1. Main features

ÿ Equipped with single-chip intelligent millimeter wave sensor SoC and intelligent algorithm firmware

ÿ Ultra-small module size: 20 mm × 20 mm

ÿ Load the default human body sensing configuration, plug and play

ÿ 24 GHz ISM band, can pass FCC, CE, and RF spectrum regulations certification

ÿ 3.3 V power supply, supports 3.0 V ~ 3.6 V wide voltage range

ÿ Average operating current 50 mA

ÿ Detection target is moving or slightly moving human body

ÿ Report detection results in real time

ÿ Provides visualization tools to support configuration of detection distance intervals, setting sensitivity within intervals and result reporting time

ÿ Supports sensing range division, completely shielding any interference outside the range

ÿ Short distance sensing of 0.2 m, no blind spot

ÿ Maximum distance of human motion sensing: 8 m

ÿ Large detection angle, coverage range up to ±60°

ÿ Support various installation methods such as ceiling hanging and wall hanging

ÿ Trigger and hold states are configured independently, with 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

Sense the presence and distance of human body and report the detection results for the main control module to intelligently control the operation of home appliances.

Smart Business

Identify when a person is approaching or moving away within the set distance range; light up the screen in time and keep the device lit when a person is present.

Smart Security

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

Smart Lighting

Identify and sense the human body, accurately detect the position, and can be used for lighting equipment in public places (induction lamps, bulbs, etc.).

2. System Description

HLK-LD2420 is an intelligent and accurate human body sensing sensor developed based on the Hilink S3 series millimeter wave sensor chip.

Use FMCW frequency modulated continuous wave, combined with radar signal processing and built-in intelligent human body sensing algorithm to detect human targets in the set space

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

Product.

The hardware of HLK-LD2420 is mainly composed of the fully integrated Hilink intelligent millimeter wave sensor SoC, 24 GHz one-transmit-one-receive antenna and main control

MCU; the software part is equipped with firmware and visual configuration tools released by Hilink, which can flexibly configure the sensing distance, sensitivity and

Human body sensing function for reporting time.

The specifications of HLK-LD2420 are shown in Table 2-1.

parameter	Remark	Minimum Typical	maximum	unit
Hardware specifications				
Supported frequency bands	Comply with FCC, CE, and NFPA certification standards	24	24.25	GHz
Supports maximum sweep bandwidth		0.25		GHz
Maximum equivalent isotropic radiated power		11		dBm
Supply voltage		3.0 3.3	3.6	In
size		20 × 20		mm²
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 mounted)	Moving human target (diameter)	5		m
	Micro-motion human target (diameter)	4		m
Distance detection accuracy	Moving targets within 8m of the radar straight line distance -	±0.35		m
Average operating current		50		m.a.
Data refresh rate		10		Hz

3. Hardware Description

The following figure shows the front and back of the module. The module has 5 reserved pin holes (not equipped with pins when leaving the factory) called J2, which is used for power supply and communication; J1 is

SWD interface, used for MCU program burning and debugging.

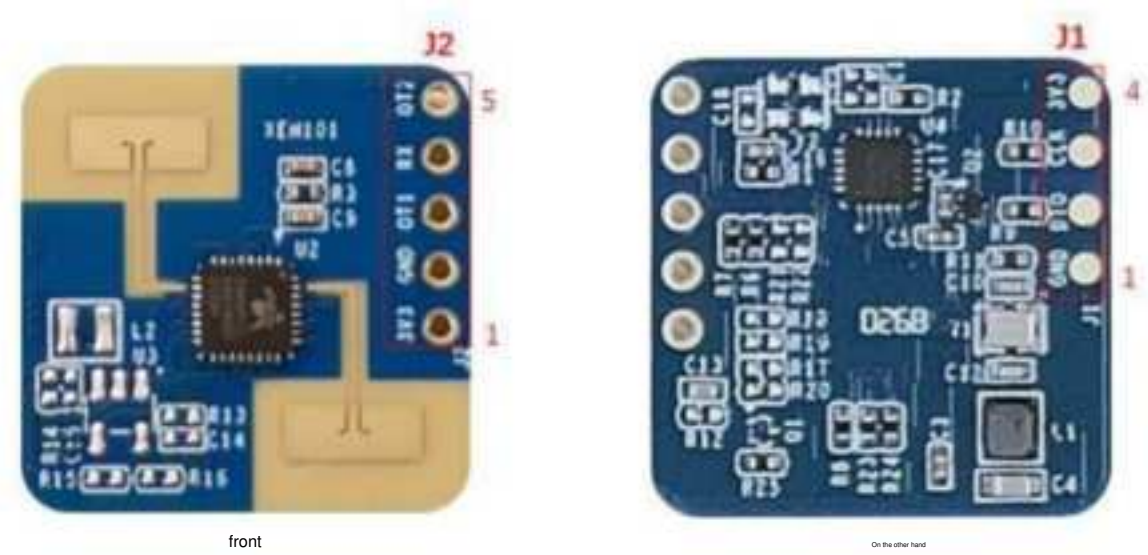


Figure 3-1 Module front and back pictures

Table 3-1 J1 pin description

J#PIN# Name		Function	illustrate
J1Pin1	GND	Grounding	
J1Pin2	PART	SWD interface data cable	0 ~ 3.3V
J1Pin3	CLK	SWD interface clock line	0 ~ 3.3V
J1Pin4	3V3	power input	3.0V ~ 3.6VўTyp.3.3V

Table 3-2 J2 pin description

J#PIN#	name	Function	illustrate
J2Pin1	3V3	Power Input	3.0V ~ 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 detection status: high level means someone is there, low level means no one is there	0 ~ 3.3V

Note: The pin spacing between J1 and J2 interfaces is 2.54 mm.

4. Software Description

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

HLK-LD2420 has been pre-installed with system firmware. For details on the firmware version, please refer to the module packaging.

The visual host configuration tool software makes it convenient for developers to configure the parameters of HLK-LD2420 according to the usage scenarios and optimize the sensing effect.

4.1. Firmware Configuration

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

Step 1: Connect the host computer and radar module through the USB to TTL serial port adapter board. The pin connection method is shown in Table 4-1 and Figure 4-1.

shown.

Table 4-1 The corresponding relationship between the pins when the radar is connected to the USB serial port 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 port number of the radar module.

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.

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

4.2.Use of host computer

This section introduces the use of the host computer tool that comes with the HLK-LD2420 module to help users understand the meaning of related parameters and related parameters.

Method of obtaining .

Step 1: Get the host computer tool "HLK-2420_TOOL.exe" for HLK-LD2420 from the official website of Hilink .

Step 2: Use the serial port 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, enter the baud rate 115200, and click the "Connect Device" button.

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

4.2.1. Parameter settings

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

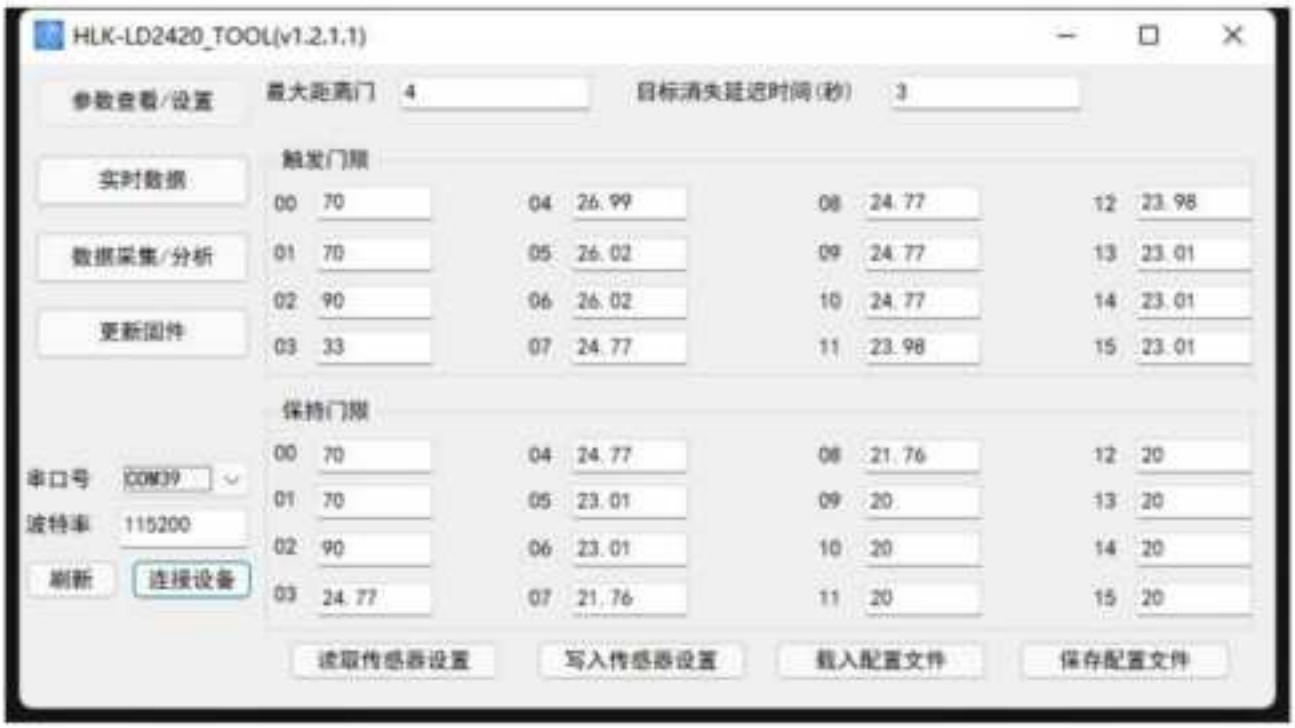


Figure 4-2 HLK-LD2420_Tool interface

Figure 4-3 After the device is connected

For detailed explanation of the parameters involved in the host computer tool interface, please see Table 4-2.

Table 4-2 Parameter explanation of the host computer tool interface

Parameter name	explain	Parameter range
Minimum distance	Used to set the minimum distance gate for radar detection. The resolution of the range gate is 70 cm.	0~15
Maximum distance	Used to set the maximum distance gate for radar detection. The resolution of the range gate is 70 cm.	0~15 (must be no less than the minimum distance)
Target disappears Delay time	The target state needs to be switched from occupied to unoccupied for a period of time T: during this period, if If a person is detected, the timer for this period will be restarted. The state of no one will switch to no one after it lasts for a full T time. Human status, report no one.	(Corresponding to the host computer setting) 0-90 (Corresponding to serial port configuration) 0~1000000000
Trigger threshold	Used to set the sensitivity from no-man to manned state. It is recommended to set it at 5 times the energy. For energy scanning and data viewing, please refer to 4.2.2 and 4.2.3.	(Corresponding to the host computer setting) 0-90 (Corresponding to serial port configuration) 0~1000000000
Keep Threshold	The sensitivity used to detect human micro-movement and maintain the status of people is recommended to be set at 2~5 times the background noise. For energy scanning and data viewing, please refer to 4.2.2 and 4.2.3ÿ	(Corresponding to the host computer setting) 0-90 (Corresponding to serial port configuration) 0~1000000000

Threshold parameter description: Assume that N is the parameter configured by the host computer and M is the parameter configured by the serial port.

The parameter conversion relationship is N = (10 ÿ log10) M = $\sqrt[N]{10}$ 10, for example, the serial port configuration distance gate 0 threshold value is 65536,

The host computer should be (10 ÿ log10 65536 ÿ ÿ 48.16. For example, if the host computer parameter is 70, the corresponding serial port configuration

The parameter is $\sqrt[70]{10}$ ÿ 10000000, the instruction converts to hexadecimal, with the little end first: 0x80969800

4.2.2 实时数据

上位机“实时数据”页面如图 4-4 所示，其功能页面介绍如下：

- 左上角的彩灯图标表示探测区域内有人/无人情况：雷达检测到人体存在时，彩灯为红色；没有检测到人体存在时，彩灯为绿色；
- 彩灯后方的文本显示框显示雷达检测到的目标人体与雷达的径向距离；
- “开始/暂停”切换按钮用于开启和暂停雷达的检测；
- “生成门限”按钮用于扫描环境噪声并计算各个距离门的“触发门限”和“保持门限”；
- “应用门限”按钮用于将“生成门限”功能中得到的“触发门限”和“保持门限”发送给雷达；
- “相对功率 VS 距离门”折线图用于实时显示各个距离门的运动能量值（绿色折线），触发门限值（红色折线）和保持门限值（黄色折线）；黑色背景表示该距离门为有效探测范围，灰色背景表示该距离门为无效探测范围；
- “距离 VS 时间”折线图用于实时显示雷达检测到的目标人体在过去 60 秒内的距离变化；灰色背景区域表示雷达在该时间段检测到目标人体，黑色背景区域表示雷达在该时间段没有检测到目标人体。

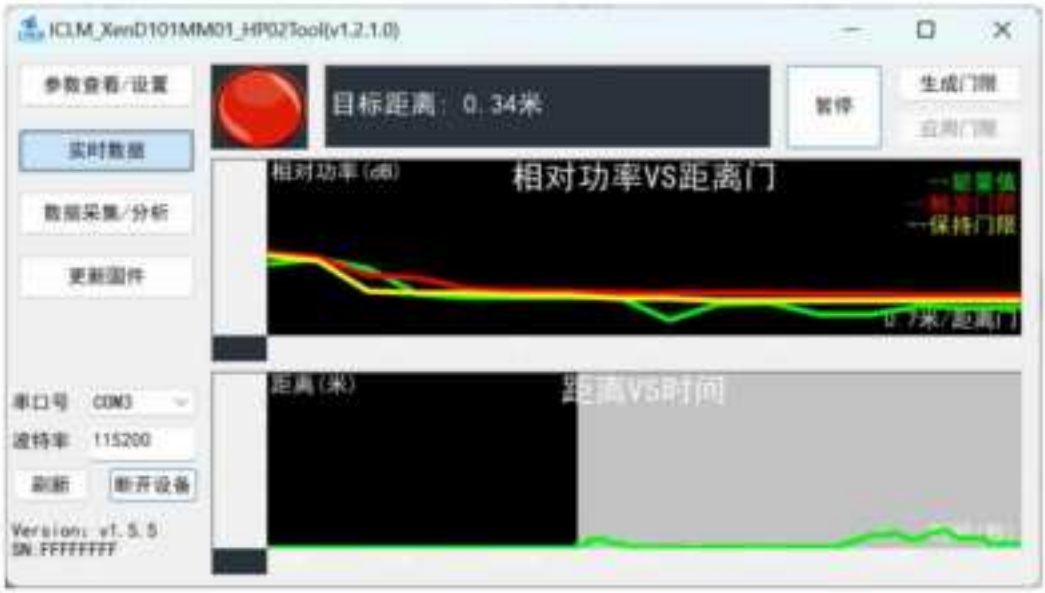


图 4-4 实时数据页面

通过上位机查看实时数据的步骤如下：

步骤一、在连接 HLK-LD2420 模组与上位机工具之后，点击“实时数据”按钮切换至该功能页面，此时上位机工具自动开启雷达的检测功能，“开始/暂停”切换按钮显示“暂停”，上位机功能页面的两个折线图开始显示相应实时数据信息；

步骤二、点击“开始/暂停”切换按钮可暂停雷达的检测功能，功能页面的彩灯变为绿色，目标距离显示“0.00

米”，下方的两个折线图停止更新。

通过上位机生成/应用门限的步骤如下：

步骤一、在“实时数据”页面的“开始/暂停”按钮显示“暂停”时，点击“生成门限”按钮，上位机工具弹出“门限采集”信息窗口，上方的表格实时展示各个距离门的触发能量和保持能量数值，下方的进度条显示扫描进度，如图 4-5 所示；

步骤二、点击“取消”按钮可终止采集；如果用户想要保存并应用采集的数据，待数据采集完成后点击“确定”；

步骤三（可选）、如果步骤二中用户选择了“确定”，则页面上的“应用门限”按钮由灰色的不可点击状态变为可点击状态，点击“应用门限”按钮，上位机工具把步骤二中计算得到的门限数据发送给雷达，并弹出“门限设置成功”的提示窗口。

应用了生成的门限后，用户可以在“参数查看/设置”页面查看最新的雷达门限参数值。

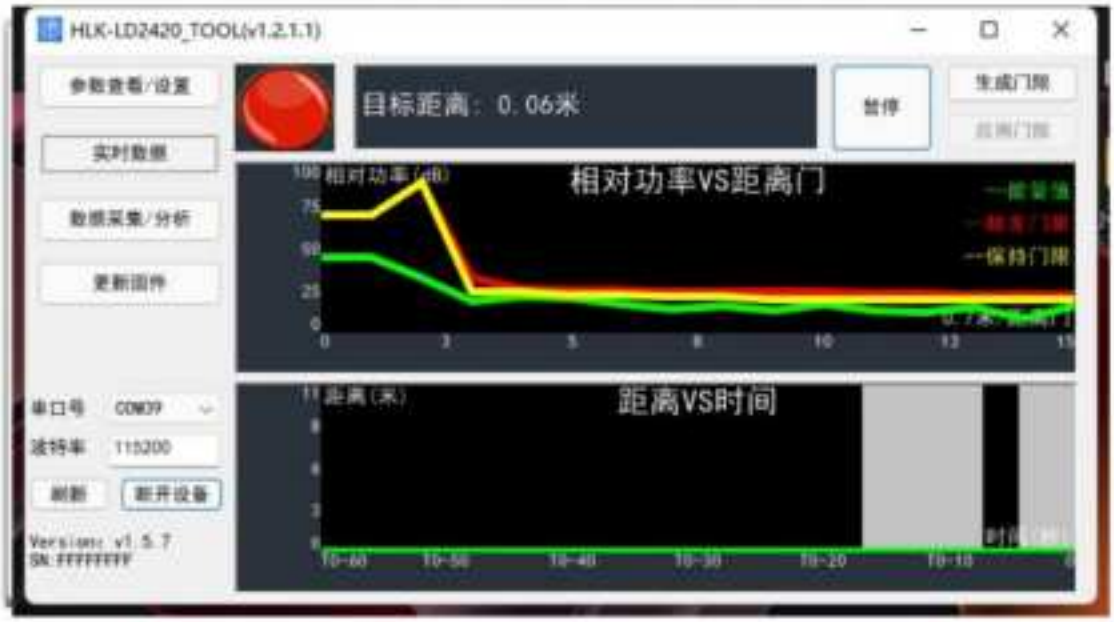


图 4-5 门限采集页面

4.2.3 数据采集/分析

上位机的“数据采集/分析”页面如图 4-6 所示，其功能页面介绍如下：

- “距离门扫描时间（秒）”：用于设置每个距离门的环境噪声扫描时长，默认 20 s，取值范围为 0~65535；
- “文件保存路径”：用于设置采集到的数据的保存路径；
- “选择显示距离门”：用于选择需查看的距离门，可选范围为 0~15；
- “采集数据/停止采集”切换按钮：用于开始和停止数据采集，停止数据采集后，用户可在设置的文件保存路径下看到文件名以 RadarData 开头、时间戳结尾的.dat 类型文件；
- “载入数据”按钮：用于打开已保存的雷达扫描数据，供用户查看和分析；

- “能量信息”折线图：用于显示用户选择的距离门上的扫描能量值，触发门限，和保持门限，横轴为时间，纵轴为相对功率表示的能量信息；
- “距离信息”折线图：用于显示雷达检测范围内检测到的人体目标的距离信息，横轴为时间，纵轴为距离。

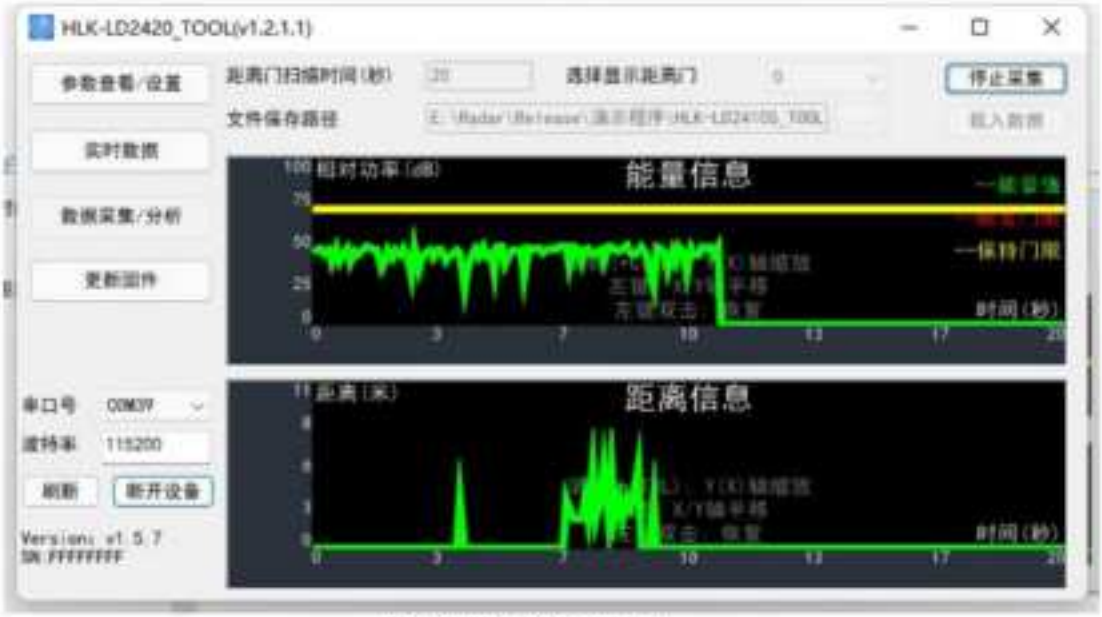


图 4-6 采集/分析数据页面

通过上位机采集能量数据的步骤如下：

步骤一、在连接 HLK-LD2420 模组与上位机工具之后，点击“数据采集/分析”功能按钮切换至该功能页面；

步骤二、输入“距离门扫描时间”，设置“文件保存路径”[2]，确保雷达检测范围在一个扫描周期内无人后，点击“采集数据/停止采集”切换按钮，开始采集数据；

步骤三、开始采集数据后，用户可以等待上位机工具在扫描完成后自动停止采集，也可以点击“采集数据/停止采集”切换按钮提前停止数据采集；这两种情况下，采集到的数据都会存放在步骤二中设置的文件保存路径下；

通过上位机分析能量数据的步骤如下：

步骤一、在连接 HLK-LD2420 模组与上位机工具之后，点击“数据采集/分析”功能按钮切换至该功能页面；

步骤二、点击“载入数据”按钮，选择需要查看的数据；

步骤三、选择需要查看的距离门，用户即可在两个折线图上看到该数据文件中、该距离门的能量信息和距离信息；

步骤四、如需查看曲线上某一点的具体数据，将鼠标光标放在曲线上感兴趣的位置，光标附件会出现悬浮框显示该处的能量值或距离信息，如图 4-7 所示。

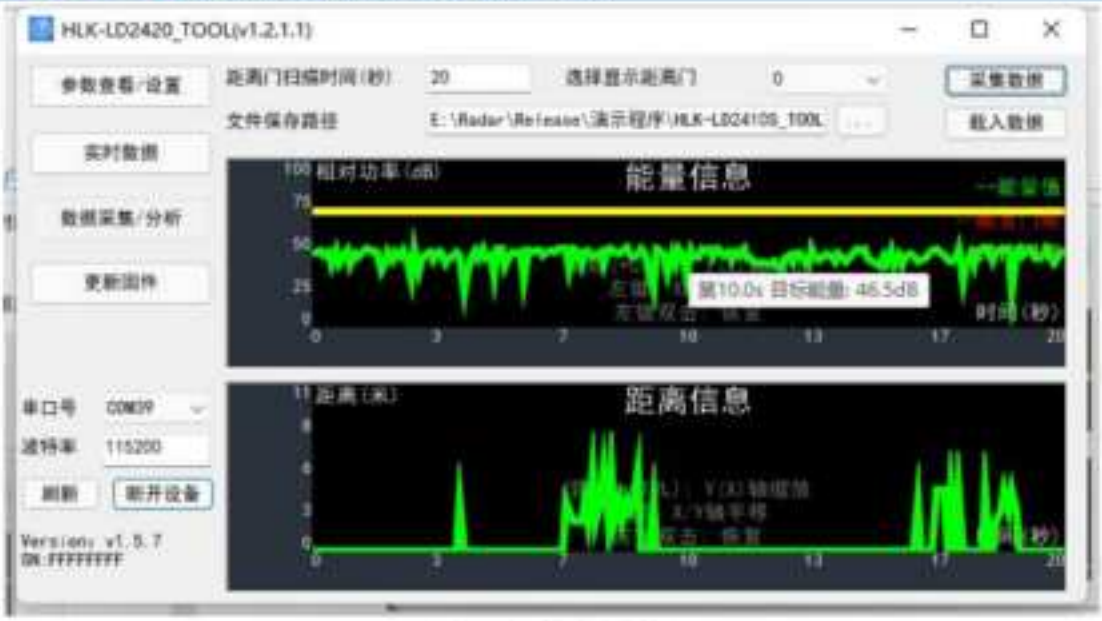


图 4-7 数据查看页面

在查看数据时，用户可以对折线图进行缩放、平移和恢复操作：

- 缩放横坐标：鼠标光标放在图形画布上，按下键盘上 Ctrl 键同时滚动鼠标的滚轮可以在横坐标上放大（向上滚动鼠标滚轮）和缩小（向下滚动鼠标滚轮）图形；
- 平移数据图形：鼠标光标放在图形画布上，按下鼠标左键并移动鼠标，可以相应地移动图形，横纵坐标也会同步变化；
- 恢复图形：鼠标光标放在图形画布上，双击鼠标左键可以将图形恢复为默认的显示设置。

4.2.4 更新固件

上位机“更新固件”页面如图 4-8 所示。通过上位机更新雷达模组固件的步骤如下：

步骤一、在连接 HLK-LD2420 模组与上位机工具之后，点击“更新固件”功能按钮切换至该功能页面；

步骤二[1]、在功能页面点击“获取固件信息”按钮，右侧提示信息框中会显示当前设备的 ID 信息；

步骤三、点击“选择 bin 文件路径”按钮，选择需要的.bin 文件，点击“下载”按钮开始升级固件，右侧提示信息框会实时显示下载结果，下方显示 bin 文件信息和当前的下载进度。

[1] 此步骤为必需，用户在使用上位机界面更新固件时不可跳过此步骤。

图 4-8 固件升级页面

固件升级成功后，页面提示信息框中会显示“下载成功！”。固件升级失败时，提示信息框中会显示相应出错信息。

5. 通信协议

本通信协议主要供需脱离可视化工具进行二次开发的用户使用。XenD101MM 通过串口（TTL 电平）与外界通信。雷达的数据输出与参数配置命令均在本协议下进行。雷达串口默认波特率为 115200 1 停止位，无奇偶校验位。

本章主要从三个部分介绍此通信协议：

- 协议格式：包括协议数据格式和命令帧格式；
- 配置命令包格式：包括命令包格式和命令返回包格式；
- 上传数据帧格式：包括调试模式的上传数据帧格式和上报模式的上传数据帧格式。

使用命令进行参数配置的基本流程是：

1. 进入命令模式；
2. 配置参数命令/获取参数命令；
3. 退出命令模式。

5.1 协议格式

5.1.1 协议数据格式

HLK-LD2420 数据通信使用小端格式，以下表格中所有数据均为十六进制。

5.1.2 命令协议帧格式

协议定义的雷达配置命令和 ACK 命令格式如表 5-1 和表 5-3 所示。

表 5-1 发送命令协议帧格式

帧头	帧内数据长度	帧内数据	帧尾
FD FC FB FA	2 字节	见表 5-2	04 03 02 01

表 5-2 发送帧内数据格式

命令字（2 字节）	命令值（N 字节）

表 5-3 ACK 命令协议帧格式

帧头	帧内数据长度	帧内数据	帧尾
FD FC FB FA	2 字节	见表 5-4	04 03 02 01

表 5-4 ACK 帧内数据格式

发送命令字（2 字节）	命令执行状态（2 字节）	返回值（N 字节）

5.2 发送命令与 ACK

5.2.1 读取固件版本命令

此命令读取雷达固件版本信息。

命令字：0x0000

命令值：无

返回值：版本号长度（2 字节）+ 版本号字节串

发送数据：

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9 ~ 12
FD FC FB FA	02 00	00 00	04 03 02 01

雷达 ACK(成功)：

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9, 10	Byte 11, 12	Byte 13~18	Byte 19 ~ 24
FD FC FB FA	0C 00	00 01	00 00	06 00	76 31 2E 35 2E 35	04 03 02 01

5.2.2 使能配置命令

对雷达下发的任何其他命令必须在此命令下发后方可执行，否则无效。

命令字: 0x00FF

命令值: 0x0001

返回值: 2 字节 ACK 状态（0 成功，1 失败）+ 2 字节协议版本（0x0002）+ 2 字节缓冲区大小（0x0020）

发送数据：

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9, 10	Byte 11 ~ 14
FD FC FB FA	04 00	FF 00	01 00	04 03 02 01

雷达 ACK(成功)：

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9, 10	Byte 11, 12	Byte 13, 14	Byte 15 ~ 18
FD FC FB FA	08 00	FF 01	00 00	02 00	20 00	04 03 02 01

5.2.3 结束配置命令

结束配置命令，执行后雷达恢复工作模式。如需再次下发其他命令，需要先发送使能配置命令。

命令字：0x00FE

命令值：无

返回值：2 字节 ACK 状态（0 成功，1 失败）

发送数据：

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9 ~ 12
FD FC FB FA	02 00	FE 00	04 03 02 01

雷达 ACK(成功)：

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9, 10	Byte 11 ~ 14
FD FC FB FA	04 00	FE 01	00 00	04 03 02 01

5.2.4 读取序列号命令

此命令读取雷达的序列号。

命令字：0x0011

命令值：无

返回值：2 字节 ACK 状态（0 成功，1 失败）

发送数据：

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9 ~ 12
FD FC FB FA	02 00	11 00	04 03 02 01

雷达 ACK(成功)：

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9, 10	Byte 11, 12	Byte 13, 14	Byte 15 ~ 18
FD FC FB FA	08 00	11 01	00 00	02 00	CD AB	04 03 02 01

5.2.5 写入序列号命令

此命令写入雷达的序列号。

命令字：0x0010

命令值：SN 长度（2 字节）+ SN 字节串

返回值：2 字节 ACK 状态（0 成功，1 失败）

发送数据：（示例）

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9~12	Byte 9 ~ 12
FD FC FB FA	06 00	10 00	02 00 CD AB	04 03 02 01

雷达 ACK(成功)：

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9, 10	Byte 11 ~ 14
FD FC FB FA	04 00	10 01	00 00	04 03 02 01

5.2.6 读取雷达寄存器命令

此命令读取雷达的寄存器。

命令字：0x0002

命令值：2 字节芯片地址 +（2 字节地址）* N

返回值：（2 字节数据）* N

发送数据：

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9 ~ 12	Byte 13 ~ 16
FD FC FB FA	06 00	02 00	40 00 40 00	04 03 02 01

雷达 ACK(成功)：

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9, 10	Byte 11, 12	Byte 13 ~ 16
FD FC FB FA	06 00	02 01	00 00	07 02	04 03 02 01

5.2.7 配置雷达寄存器命令

此命令写入雷达的寄存器。

命令字：0x0001

命令值：2 字节芯片地址 +（2 字节地址）* N

返回值：2 字节 ACK 状态（0 成功，1 失败）

发送数据：

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9, 10	Byte 11 ~ 14	Byte 15 ~ 18
FD FC FB FA	08 00	01 00	40 00	40 00 07 42	04 03 02 01

雷达 ACK(成功):

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9, 10	Byte 11 ~ 14
FD FC FB FA	04 00	01 01	00 00	04 03 02 01

5.2.8 读取雷达参数配置命令

此命令可以读取雷达当前的配置参数。

命令字：0x0008

命令值：（2 字节参数 ID）* N

返回值：（4 字节参数值）* N

发送数据：（示例）

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9, 10	Byte 11 ~ 14
FD FC FB FA	04 00	08 00	01 00	04 03 02 01

雷达 ACK：（成功，最大距离门 12）

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9, 10	Byte 11 ~ 14	Byte 15 ~ 18
FD FC FB FA	08 00	08 01	00 00	0C 00 00 00	04 03 02 01

5.2.9 配置雷达参数命令

此命令设置雷达模组的参数。具体参数字请参考表 5-5。

表 5-5 协议参数表

参数名称	参数字	参数范围
最小距离门	0x0000	0~15
最大距离门	0x0001	0~15
目标消失延迟	0x0004	0~65535 单位秒
触发门限	0x0010 ~ 0x001F	0~232 - 1，为模值平方
保持门限	0x0020 ~ 0x002F	0~232 - 1，为模值平方

命令字：0x0007

命令值：（2 字节参数 ID + 4 字节参数值）* N

返回值：2 字节 ACK 状态（0 成功，1 失败）

发送数据：最大距离门 12，最小距离门 2

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9, 10	Byte 11, 12	Byte 13, 14	Byte 15 ~ 18
FD FC FB FA	08 00	07 00	01 00	12 00	00 00	04 03 02 01

雷达 ACK（成功）：

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9, 10	Byte 11 ~ 14
FD FC FB FA	04 00	07 01	00 00	04 03 02 01

5.2.10 配置系统参数命令

此命令可以配置雷达系统参数。

命令字：0x0012

命令值：（2 字节参数 ID + 4 字节参数值）* N

返回值：2 字节 ACK 状态（0 成功，1 失败）

发送数据：

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9, 10	Byte 11 ~ 14	Byte 15 ~ 18
FD FC FB FA	08 00	12 00	00 00	04 00 00 00	04 03 02 01

雷达 ACK（成功）：

Byte 1 ~ 4	Byte 5, 6	Byte 7, 8	Byte 9, 10	Byte 11 ~ 14
FD FC FB FA	04 00	12 01	00 00	04 03 02 01

5.3 雷达上报数据

HLK-LD2420 出厂固件正常的工作模式通过串口输出检测结果，输出的结果是 ON/OFF 的字符串及目标距离门。在特殊的模式下，上位机会获取雷达处理过程中的数据，因此在命令行模式下固件提供额外的两种传输格式，分别为调试模式和上报模式。

在命令行模式中，通过调整命令包中的工作模式参数，可控制串口上报的数据格式。图 5-1 展示了一个命令包示例。

图 5-1 命令包格式示例

在该命令包中，命令参数的参数值可决定雷达的工作模式：0x0000 为调试模式，0x0004 为上报模式，0x0064 为正常模式。

表 5-6 展示了调试模式的数据帧格式。调试模式下传出的 RDMAP 模值数据，按照每个 chirp 的所有距离门的数据进行发送，即先发送第 1 个 chirp 的 16 个距离门的模值数据，再发送第 2 个 chirp 的 16 个距离门的模值数据，以此类推。

表 5-6 调试模式的数据帧格式

帧头	数据	帧尾
AA, BF, 10, 14	RDMAP：20（多普勒）*16（距离门）*4（模值平方）	FD, FC, FB, FA

表 5-7 上报模式的数据帧格式

帧头	长度	检测结果	目标距离	各距离门能量值	帧尾
F4, F3, F2, F1	2 字节，检测结果、目标距离和各距离门能量值的总字节数	1 字节， 00 无人 01 有人	2 字节	32 字节 16（距离门总数）* 2 字节	F8, F7, F6, F5

图 5-2 展示了上报模式时串口传出的一帧数据帧示例。

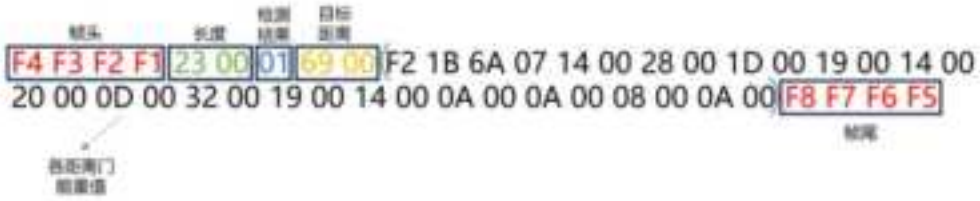


图 5-2 上报模式的数据帧示例

示例中，各部分数据含义如下：

长度字段：表示上报检测结果+目标距离+各距离门能量值所占的总字节数；

检测结果：表示当前场景中是否有目标；

目标距离：表示场景中目标相距雷达的距离；

各距离门能量值：表示从 0~15 距离门，每个距离门的能量值大小。

因此图 2 中数据帧解析举例如下：

长度：0023，表示上报检测结果+目标距离+各距离门能量值所占的总字节数 = 35

检测结果：01，表示当前检测到场景中有人

目标距离：0069，表示目标距离 = 105 cm

各距离门能量值：

距离门 0 能量 = 1BF2

距离门 1 能量 = 076A

距离门 2 能量 = 0014

距离门 3 能量 = 0028

距离门 4 能量 = 001D

距离门 5 能量 = 0019

距离门 6 能量 = 0014

距离门 7 能量 = 0020

距离门 8 能量 = 000D

距离门 9 能量 = 0032

距离门 10 能量 = 0019
距离门 11 能量 = 0014
距离门 12 能量 = 000A
距离门 13 能量 = 000A
距离门 14 能量 = 0008
距离门 15 能量 = 000A

6. Installation and detection range

HLK-LD2420 supports two installation methods: ceiling-mounted and wall-mounted. The recommended method is ceiling-mounted installation.

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 XY plane (also called the line direction).

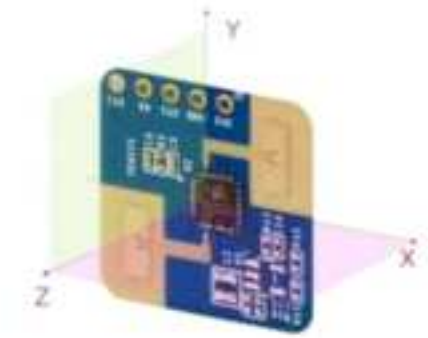


Figure 5-1 Radar module orientation diagram

6.1. Ceiling installation

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

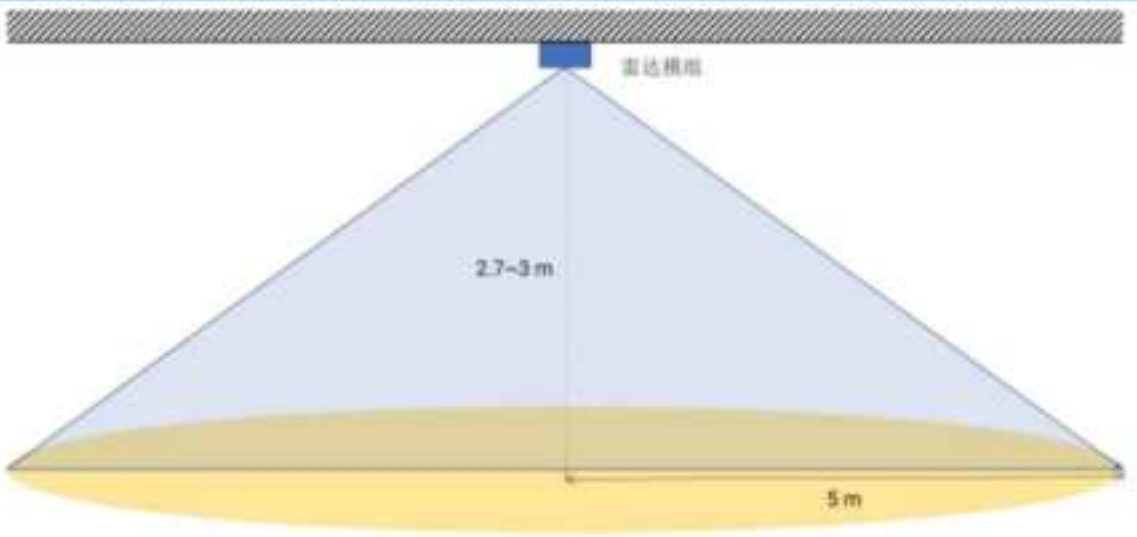
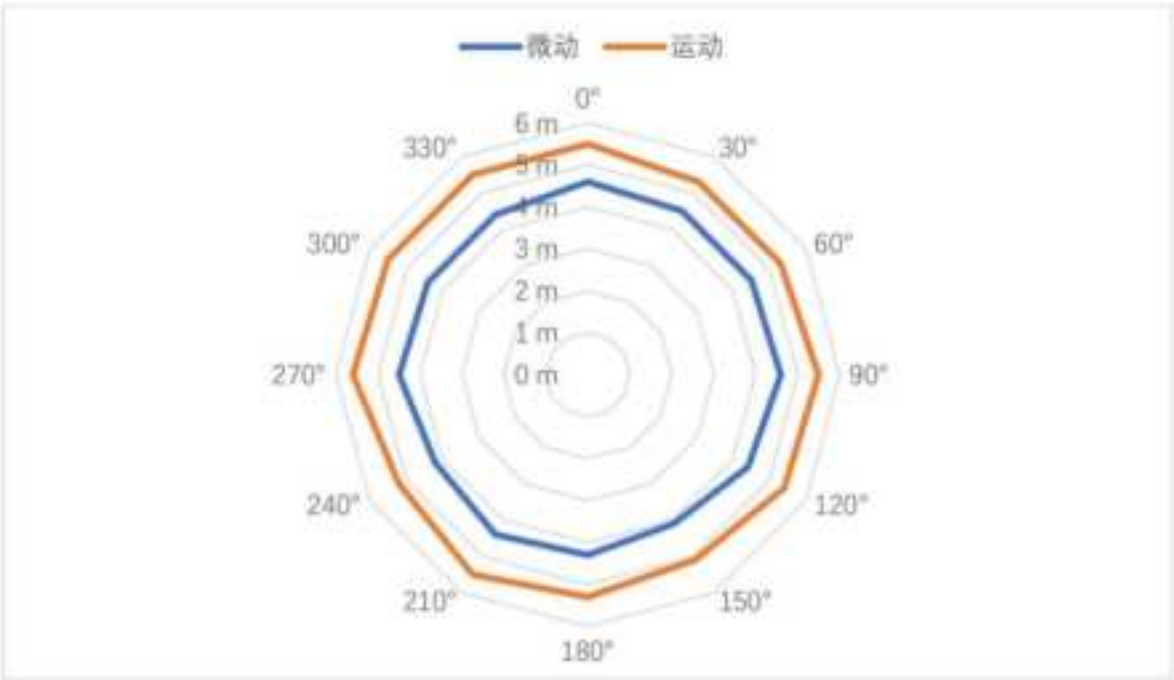


Figure 5-2 Schematic diagram of the detection range of the HLK-LD2420 radar module (ceiling mounted)

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



5-3 Ceiling Mounting Sensing Range

6.2. Wall Mounting

The recommended wall-mounted installation height is 1.5~2 m. When mounted on the wall, the X-axis of the radar module (see Figure 5-1) points horizontally and the Y-axis points upward.

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 8 m in radius and horizontal

A three-dimensional fan-shaped space with an angle of ±60° with the pitch direction, as shown in Figure 5-4.

The detection range diagram of this reference solution when the wall-mounted installation height is 1.5 m is shown in Figure 5-5.

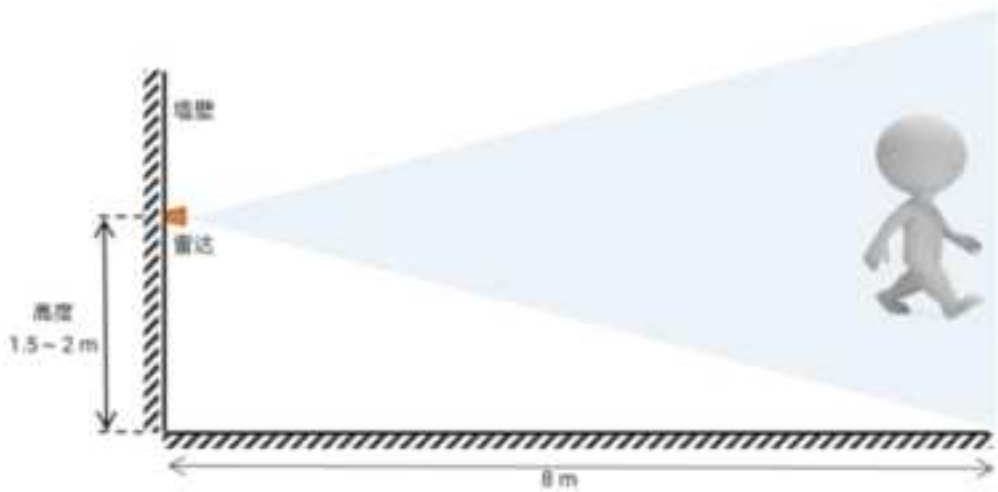


Figure 5-4 Schematic diagram of the detection range of the HLK-LD2420 radar module (mounted on the wall)

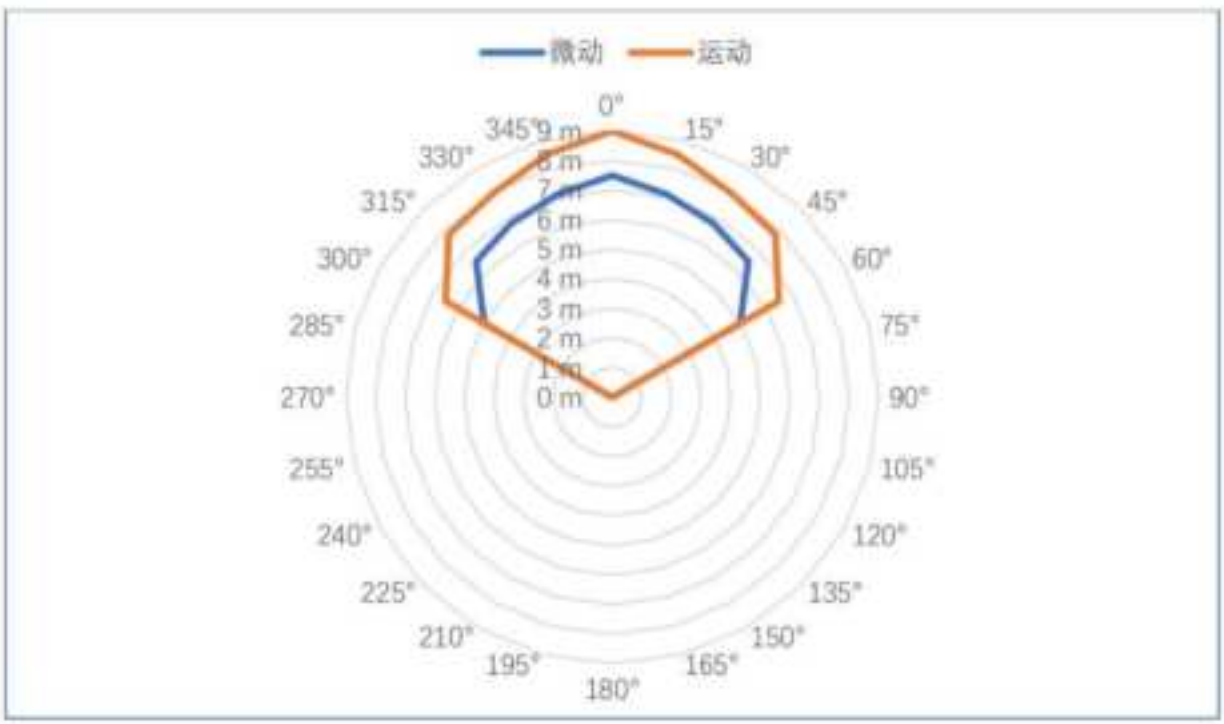


Figure 5-5 Wall-mounted sensing range

6.3. Detection range test

The test methods for radar triggering and maintaining detection range are introduced as follows:

ÿ Trigger range:

The target person approaches the radar from a distance when the radar reports no person. When the radar starts to report that there is a person, it stops moving forward. The current position is

The boundary of the radar trigger detection range; the area enclosed by the detection boundaries in all directions is the radar trigger detection range.

ÿ Keep range:

When the target person keeps a small movement at the position to be detected, such as shrugging or raising his hand, the radar will detect the person within 60 seconds.

If there is someone reported all the time, the current position is within the radar detection range; otherwise, the detection position is outside the detection range.

7. Mechanical dimensions

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

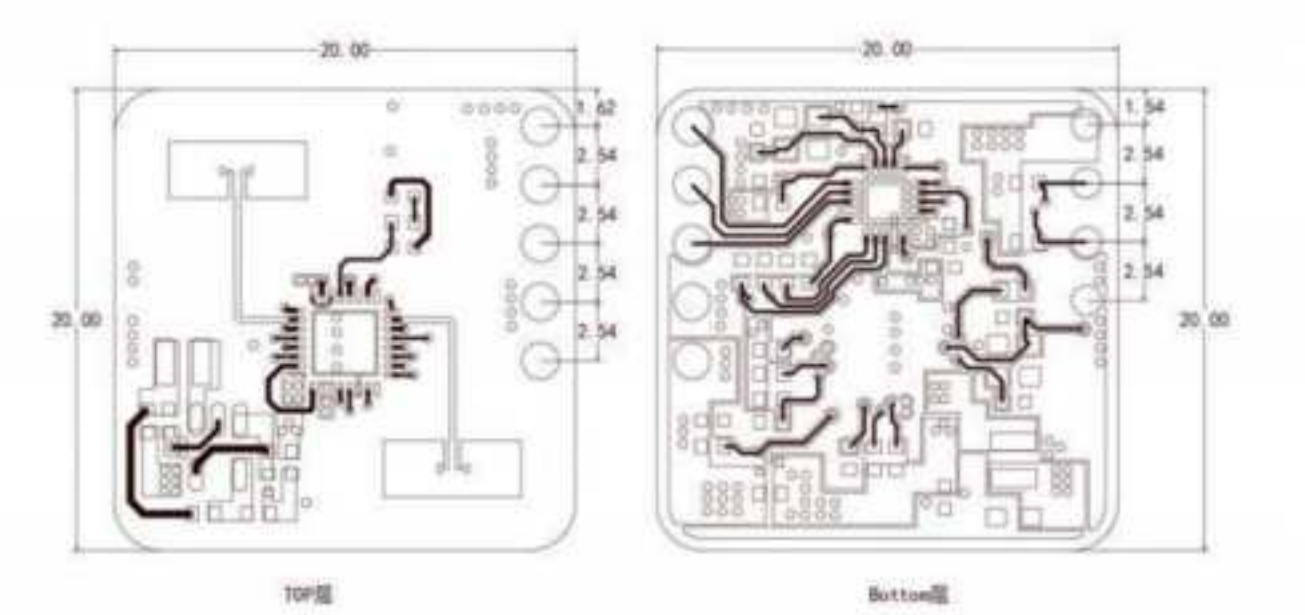


Figure 6-1 Hardware mechanical dimensions

8. Installation Instructions

Radar enclosure requirements

If the radar needs to be installed in a housing, the housing must have good wave-transmitting properties in the 24 GHz band and must not contain metal or electromagnetic

Wave shielding

For more information, see the mmWave Sensor Radome Design Guide.

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:

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

ÿ There is a large area of strong reflective plane in the sensing area. Strong reflective objects facing the radar antenna will cause interference.

ÿ When wall-mounted, external interference factors such as air conditioners and electric fans on the ceiling of the room need to be considered.

Notes on installation

ÿ Try to ensure that the radar antenna is facing the area to be detected and that there is an open area around the antenna.

ÿ Ensure that the sensor is installed firmly and stably. The shaking of the radar itself will affect the detection effect.

ÿ Ensure that there is no movement or vibration behind the radar. Since radar waves are penetrating, the antenna back lobe may detect the radar back.

A metal shield or metal back plate can be used to shield the radar back lobe and reduce the impact of objects behind the radar.

The impact of the.

ÿ When there are multiple 24 GHz frequency band radars, please avoid direct beam alignment and install them as far away as possible to avoid possible mutual interference.

Power Supply Considerations

ÿ The power input voltage range is 3.0 V~3.6 V, and the power ripple has no obvious spectrum peak within 100 kHz. This solution is a reference design.

Users need to consider the corresponding electromagnetic compatibility design such as ESD and lightning surge.

9. Notes

Maximum detection distance

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

It can only output the distance information of moving human bodies within 8 m, and does not currently support the close-range distance measurement function of stationary human bodies.

Maximum distance and accuracy

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

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

Target disappearance delay

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

The delayed reporting mechanism is: once no human target is detected within the test range, the radar module will start counting, and the duration is the duration of no one

If no one is detected during the timing, the "no one" status will be reported after the timing ends; if someone is detected during this time period

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

10. Version History

Version time		Changes
V1.0	2023/2/15	Initial draft.
V1.1	2023/3/23 The pin function of the module has changed, the default baud rate has changed to 115200, and the host computer version has been updated	
V1.2	2023/8/15	Added serial port description, new version host computer usage instructions, serial port command protocol
V1.3	2023/12/11	Modify parameter description
V1.3.1	2024/3/21	Modify parameter description
V1.3.2 2024/11/22		Modify parameter description

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