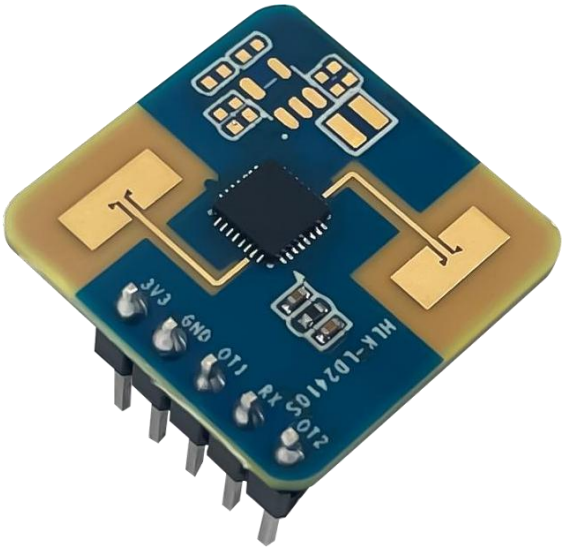
Shenzhen Hi-Link Electronic Co., Ltd.

HLK-LD2410S

Low Power Human Presence Sensor Module

User manual



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Content

1. Introduction of HLK-LD2410S

HLK-LD2410S is LD2410S series of battery-powered ultra-low power human presence millimeter wave sensor developed by Hi-Link, including extremely simplified 24 GHz millimeter wave sensor hardware LD2410S and **low power** human presence sensing intelligent algorithm firmware.

The hardware LD2410S is equipped with AIoT millimeter wave sensor, high performance 24 GHz one-and-receive antenna and peripheral circuit; The low power intelligent human body sensing algorithm uses millimeter wave sensor distance measurement technology and ICL1112 chip advanced proprietary radar signal processing and low power control technology to achieve accurate perception of moving, micromotion and standing human body. The low-power human presence sensing algorithm firmware is mainly used in indoor scenarios. It detects whether there is a moving or fretting human body in the area in low-power mode and refreshes the detection results in real time.

The maximum sensing distance of HLK-LD2410S to the moving human body is **10 m**, and the triggering and holding thresholds of different intervals, the human presence state, the reporting frequency of the target human distance, and the reporting time of no one. HLK-LD2410S supports GPIO and UART interfaces, plug and play, flexibly applied to different intelligent scenarios and end products.

HLK-LD2410S main features are as follows:

- Equipped with single-chip smart millimeter wave sensor SoC and intelligent algorithm firmware
- Ultra-small sensor size:20 mm × 20 mm
- Loads the default sensing configuration, plug and play
- 24 GHz ISM frequency band, can be certified by FCC, CE, and non-commission spectrum regulations
- 3.3 V power supply, Supports a wide voltage range of 3.0 V to 3.6 V
- Average working current 0.1 mA@1 Hz Reporting frequency
- Detection targets are moving, micromoving and stationary human bodies
- Report detection results in real time
- Provides visualization tools for configuring detection range intervals and target disappearance delay
- Support induction range division, completely shield any interference outside the range
- Close range 0.2m sensing, no detection blind area
- The maximum sensing distance of the moving human body is 10 m
- The detection angle is large, and the horizontal covering angle is ±60° when mounting the wall
- Supports wall mounting
- Support API online upgrades

HLK-LD2410S battery-powered ultra-low power consumption human body millimeter wave sensors can detect and identify moving, micro-moving and stationary human bodies, widely used in various AIoT scenarios, covering the following types:

- **Smart home**

Sensing the presence and distance of moving objects such as human body, and reporting the detection result, so that the main control module can intelligently control the operation of household appliances.

- **Smart Business**

Identify the proximity or distance of the human body within the set distance interval; Light the screen in time to keep the device bright when the human body is present.

- **Smart security**

Intelligent door lock, induction access control, building intercom, digital door viewer, etc.

- **Intelligent lighting**

Recognition and perception of the human body, accurate position detection, can be used in public lighting equipment (induction lights, bulb lights, etc.).

2. System description

HLK-LD2410S is a battery-powered ultra-low-power millimeter-wave sensor based on Hi-Link's millimeter-wave sensor chip. The sensor uses FMCW FM continuous wave, radar signal processing and built-in intelligent low-power body sensing algorithm to detect the human body target in the set space and update the detection results in real time. With this millimeter-wave sensor reference solution, users can quickly develop their own precise, low-power body sensing products.

The hardware LD2410S is mainly composed of a fully integrated intelligent millimeter wave sensor SoC, a 24 GHz antenna and a main control MCU. The software part is combined with the low-power human presence sensing algorithm firmware and visual configuration tool released by Hi-Link to realize the human body sensing function that can flexibly configure sensing distance, trigger and hold thresholds, unreported time and data refresh rate.

Table 2-1 lists the specifications of HLK-LD2410S:

Table 2-1 HLK-LD2410S specification

Parameter	Min	Typ	Max	Unit	Remark
HLK-LD2410S Hardware specifications					
Supported frequency band	24	-	24.25	GHz	Comply with FCC, CE, no committee Certification standard
Maximum scanning bandwidth supported	-	0.25	-	GHz	-
Maximum equivalent omnidirectional radiated power	-	10	-	dBm	-
Power supply	3.0	3.3	3.6	V	-
Size	-	20 × 20	-	mm^2	-
Ambient temperature	-40	-	85	℃	-
HLK-LD2410SSystem performance					
Range detection range	-	10	-	m	Moving human object detection
(Wall hanging, 1.5 meters high)	-	4	-	m	Stationary human target detection
Average working current	0.04	0.12	0.6	mA	Office scene
Data refresh cycle	1	40	60	s	Configurable

Power consumption of each parameter

Medium refresh rate power consumption: average 349 uA

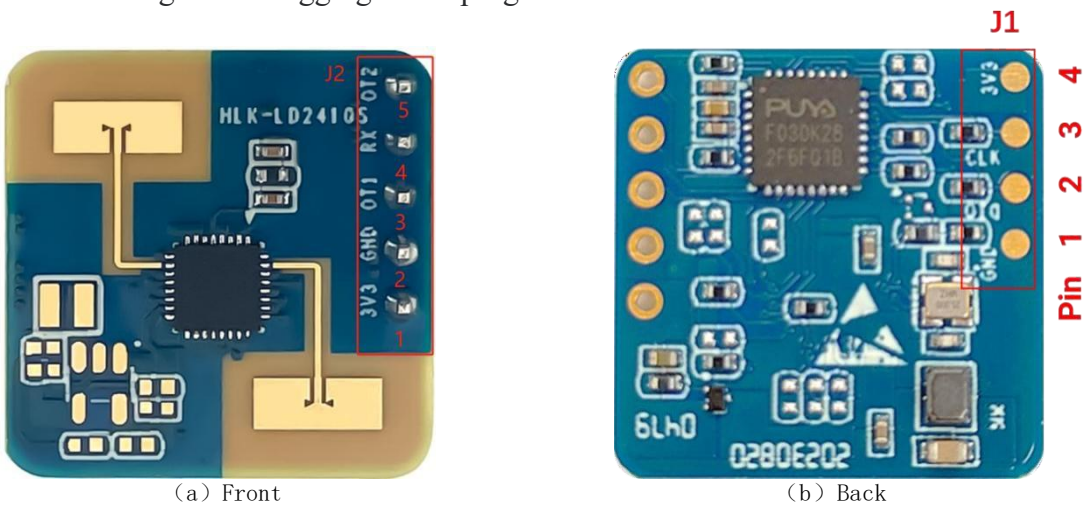
Maximum refresh rate power consumption: average 446 uA

Minimum refresh rate power consumption: average 45 uA

3. Hardware description

3.1. Hardware LD2410S

Figure 3-1 shows both sides of the hardware LD2410S. The hardware LD2410S reserve five pin holes (factory supplied pins) called J2 for power supply and communication. J1 is the SWD interface for burning and debugging MCU programs.



(a) Front (b) Back

Figure 3-1 Front and rear of the hardware LD2410S

For details about the pins of J1 and J2, see Table 3-1 and Table 3-2.

Table 3-1 J1 pin description

J#PIN#	Name	Function	Remark
J1Pin1	GND	Grounding	-
J1Pin2	DIO	SWDInterface data cable	0~3.3V
J1Pin3	CLK	SWDInterface clock line	0~3.3V
J1Pin4	3V3	Power input	3.0V~3.6V, Typ. 3.3V

Table 3-2 J2 pin description

J#PIN#	Name	Function	Remark
J1Pin1	3V3	Power input	3.0V~3.6V, Typ. 3.3V
J1Pin2	GND	Grounding	-
J1Pin3	OT1	UART_TX	0~3.3V
J1Pin4	RX	UART_RX	0~3.3V
J1Pin5	OT2	IO, which is used to report the detection status: the high level is manned, and the low level is unmanned	0~3.3V

4. Software description

This chapter introduces the firmware debugging of HLK-LD2410S and the use of upper computer tools. When commissioning or using a millimeter wave sensor, the upper computer can be powered by the USB serial port adapter. At the same time, TX, RX, and GND of the millimeter wave sensor can be connected to the corresponding ports on the USB serial port adapter board. (For details about the pin connection between the sensor and the USB serial port adapter, see Table 4-1.) The user can also use the panel power supply, and connect the TX, RX and GND of the panel to the corresponding interface of the USB serial port adapter board (the TX, RX and GND of the panel are connected to the corresponding pins of the sensor with the same name). Because the connection modes of the two power supply modes are similar, this chapter only describes the method of using the upper computer power supply.

HLK-LD2410S factory has burned low-power human presence sensor algorithm firmware, firmware version see the sensor packaging. Hi-Link provides visual upper computer configuration tool software for hardware LD2410S, which is convenient for developers to configure parameters of HLK-LD2410S according to the use scenario and optimize the induction effect.

4.1. Firmware Configuration

This section describes the way to debug the sensor HLK-LD2410S firmware using a third-party serial port tool.

Step 1. Connect the host computer to the millimeter wave sensor through the USB-to-TTL serial port adapter board. Table 4-1 and Figure 4-1 show the pin connections;

Table 4-1 Pins mapping between a millimeter wave sensor and a USB serial port adapter

Millimeter wave sensor	Serial adapter board
RX	TXD
OT1	RXD
GND	GND
3V3	VCCIO

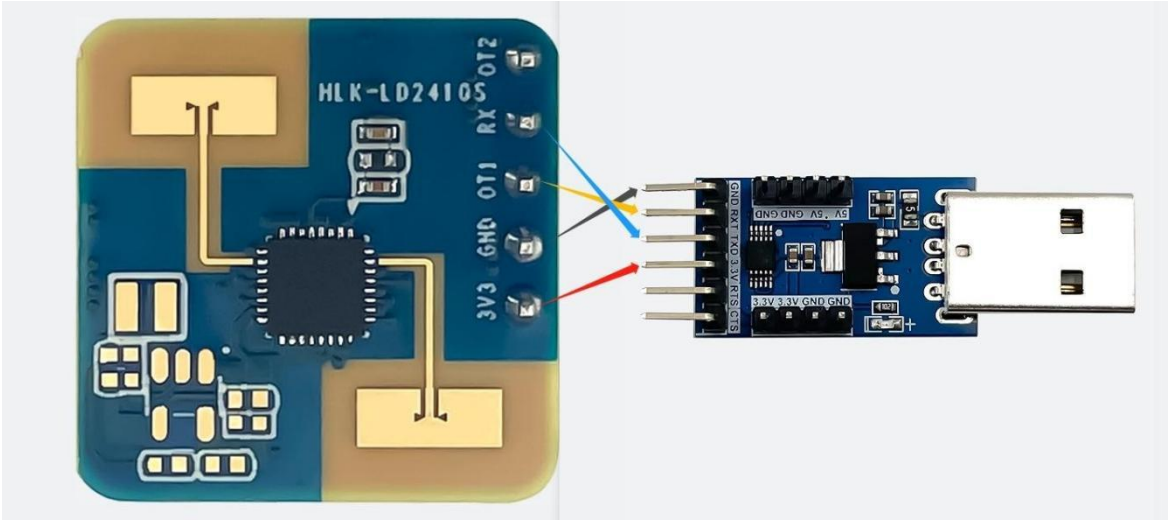


Figure 4-1 Connection between the hardware LD2410S and the USB serial port board

Step 2. Open the device manager of the upper computer and obtain the serial port number of the serial port where the millimeter wave sensor is located;

Step 3. Open the third-party serial port tool, select the serial port number of the millimeter wave sensor, set the serial port baud rate to 115200, and then click "Open Serial port".

(or the same function) button to view the detection result of the current sensor at the output end of the tool interface.

4.2. Upper computer tool description

This section describes the use of the upper computer tool for HLK-LD2410S to help users understand the meaning of related parameters and how to obtain related parameters.

Note: Host tools and third-party serial tools cannot be used at the same time!

Before using the functions of the upper computer tool, the user should first connect HLK-LD2410S with the upper computer tool, the steps are as follows:

Step 1. Obtain the upper computer tool "HLK-LD2410S_TOOL" supporting HLK-LD2410S from the official website of Hi-Link;

Step 2. Connect the mmwave sensor to the host using the serial port adapter, as shown in Figure 4-1.

Step 3. Open the host tool, click Refresh button, select the serial port number of the MMwave sensor from the Serial Port drop-down list, and confirm that Baud rate is 115200. Then click Connect Device to connect the host computer to the sensor.

(a)Before device connection

(b)After device connection

Figure 4-2 HLK-LD2410S_TOOL

As shown in Figure 4-2(a), the upper computer tool interface can be divided into three areas: Device operation area (Zone1), function button area (Zone2), and function page area (Zone3).

After the host tool is successfully connected to the MMwave sensor, the sensor firmware version and sensor Serial Number (serial number) are displayed in the Zone1 area of the interface. The default SN of the sensor is 12345678. The current parameter values of the millimeter wave sensor are displayed in the View/Set Parameters area, as shown in Figure 4-2(b).

4.3. View/set parameters

On the page shown in Figure 4-3, you can view the current parameters of the MMwave sensor and modify the parameters to meet the requirements of specific application scenarios.

The steps to read the parameters of the millimeter wave sensor using the upper computer tool are as follows:

- After connecting HLK-LD2410S to the upper computer tool, click the "Read sensor Settings" button in the "Parameter view/Setting" function page, the page will pop up the "Read

parameters successfully" prompt window, and display all the current parameter values of the millimeter wave sensor, click "OK" to close the prompt window.

Figure 4-3 Page for reading sensor parameters on the host

The steps to change one or more sensor parameters using the host tool are as follows:

Step 1: After connecting HLK-LD2410S with the host computer tool, enter new parameter values for all parameters that need to be changed in the "Parameter view/Setting" function page;

Step 2. Click the "Write sensor Settings" button on the current page, and the upper computer will write the parameter values in the current interface to the sensor. After success, a "Write parameter successfully" prompt window will pop up on the page, and click "OK" to complete the parameter setting.

If you need to restore the parameter Settings of the sensor to the default Settings, click "Reset" on the "Parameter View/Setting" function page. The upper computer tool will send the default parameters to the sensor and update the parameters on the "Parameter View/Setting" function page.

Table 4-2 describes the parameters on the Parameter View/Set page of the host tool.

Table 4-2 Describes the parameters on the host tool page

Name of parameter	Function of parameter	Range of parameter	Unit
Minimum detection distance	Minimum effective detection distance of the sensor	0~11.20	m
Maximum detection distance	Maximum effective detection distance of the sensor	0~11.20	m
Status reporting frequency	Frequency at which the sensor reports a manned/unoccupied state	0.5~8	Hz

Range reporting frequency	The frequency at which the sensor reports the distance to the target when it's manned	0.5~8	Hz
Response speed	The sensor detects the response speed of an unoccupied area	Normal/Fast	-
Report time when no one was there	The delay time required for the target state reported by the sensor to change from human to non-human	0~120	s
Trigger threshold	Absolute threshold of energy value of 0-7 distance gate when no one to man state	10~95	dB
Trigger SNR threshold	The SNR relative threshold of the distance gate from 8 to 15 when no one is in the occupied state	5~63	dB
Holding threshold	Absolute threshold of energy value of 0~7 distance gates for detecting human micromotion and maintaining human state	10~95	dB
Maintain the SNR threshold	The SNR relative threshold of 8~15 distance gate for detecting human micromotion and maintaining human presence	5~63	dB

4.4. Target information

The "Target Information" page of the upper computer tool shows the human body sensor detection results and real-time data, and provides related operations to save the detection data of the millimeter wave sensor.

As shown in Figure 4-4, the function page of the “Target Information” page can be divided into four areas:

- a Target result display area;
- b Function button area;
- c Real-time data display area;
- d Data save operation area.

Figure 4-4 Target Information page of the host

Table 4-3 describes the areas on the “Target Information” page.

Table 4-3 describes the functions of each area on the Target Information page

Page area		Function	Description
a	Lantern icon	The color of the light indicates the movement/micro-movement/absence of the human target in the detection area	Green means no one; Red means someone; Blue means there is a person and the body is at rest.
	Target information text box	Displays the detected target information	Displays whether there is a human target and its motion state, and between the human body and the sensor Straight line distance (m).
b	"Playback/Stop" toggle button	Plays back/stops displaying the specified detection data	"Start/Stop" switch button when "Start" is displayed, this button can be clicked, otherwise this button is gray and cannot be clicked.
	"Start/Stop" toggle button	Turn on/pause the sensor for human presence sensing detection	-
c	"Distance VS time" real-time detection data display	Real-time display of unmanned information detected by the sensor in the last 60 seconds and the distance information of the detected human target	The color progress bar above the coordinates displays the presence/absence of people in the detection area in real time: green indicates no one, red indicates someone; Blue means there is a person and the body is at rest. The red curve at the bottom of the coordinate chart shows the historical straight-line distance between the target and the sensor in the last 60 s.

d	Save data	You can choose whether to save the detection data and set the path for saving the detection data	This area can only be operated when the text of the "Start/Stop" button in Zone b displays "Start"; After checking the "Data save" option, you can select the saving path of detection data by clicking the "Select path" button. If no path is selected, the detection data is saved in the directory where the host software resides.

The steps for viewing the target information detected by the millimeter wave sensor using the upper computer tool are as follows:

Step 1. After connecting HLK-LD2410S with the upper computer tool, click the "Target Information" button to switch to the functional page. At this time, the upper computer tool automatically starts the detection function of the millimeter wave sensor, the "Start/Stop" switch button in section b of the page displays "Stop", and the corresponding target information begins to be displayed in real time in areas a and c of the page.

Step 2. Click the "Start/Stop" switch button again to pause the detection of the millimeter wave sensor.

The steps to save the test data using the upper computer tool are as follows:

Step 1. After connecting HLK-LD2410S with the upper computer tool, click the "Target Information" button to switch to the function page, and then the upper computer tool automatically opens the detection function of the millimeter wave sensor;

Step 2. Click the "Start/Stop" switch button to stop the detection function of the sensor. The text of the button switches to "Start", and the function control of saving data in d area becomes operational;

Step 3. Click the check box before "Save data" to enable the function of saving data;

Step 4 (Optional). Click the "Select Path" button to select a path to save the detection data.

The steps to play back the test data using the upper computer tool are as follows:

Step 1. After connecting HLK-LD2410S with the upper computer tool, click the "target information" button to switch to the function page, and the upper computer tool will automatically open the detection function of the sensor;

Step 2. Click the "Start/Stop" switch button to stop the sensor detection function. The text of the button changes to "Start", and the "Playback/Stop" button becomes clickable;

Step 3. Click the "Playback/Stop" button and select the path where the test data to be played is located. After the completion, the function page of the upper computer tool will start to play the test data, and the text of the "Playback/Stop" button will be changed to "Stop";

Step 4 (Optional). Click the "Playback/Stop" switch button to stop data playback; Users can also wait for the playback process to complete before proceeding with other operations.

4.5. Update the firmware

Figure 4-5 shows the Firmware Update page for the host. The steps to update the firmware of the MMwave sensor using the upper computer tool are as follows:

Step 1. After connecting HLK-LD2410S with the host computer tool, click the "Update Firmware" function button to switch to the function page;

Step 2. Click the "Get Firmware Information" button. The ID and firmware information of the current device will be displayed below and to the right of the button.

Step 3. Click the "Select bin file path" button to select the required.bin file;

Step 4. Click the "Burn" button to update the firmware. The prompt box on the right will display the download result in real time, and the bin file information and the current download progress will be displayed at the bottom.

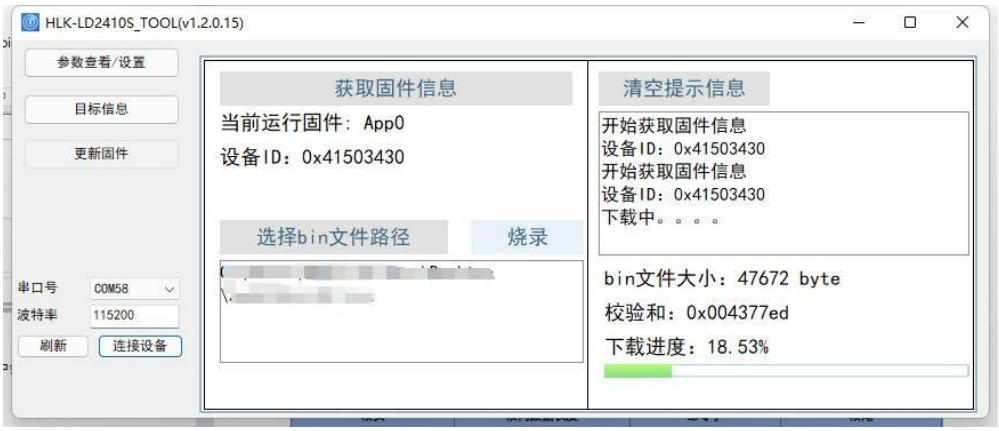


Figure 4-5 Firmware upgrade page for the host

After the firmware is successfully upgraded, the message "Download succeeded!" is displayed. When the firmware upgrade fails, an error message is displayed in the information box.

5. Communication protocol

This communication protocol is mainly used by users who need to do secondary development without visual tools. HLK-LD2410S battery-powered Ultra-low power consumption The human body has a millimeter-wave sensor to communicate with the outside world through a serial port (TTL level). Sensor data output and parameter configuration commands are carried out under this protocol. The default baud rate of the serial port on the sensor is 115200. The port has 1 stop bit and no parity bit.

5.1. Use commands to set parameters

Basic procedure:

1.Enter the command mode.

2.Set parameter commands or obtain parameter commands.

3.Exit the command mode.

HLK-LD2410S data communication uses a small-endian format, and all data in the following table is hexadecimal.

5.2. Format of reported data

Table 5-1 describes the formats of the data reported by sensors.

Table 5-1 Reported data formats

Frame head	Intra-frame data length	Target state	Object distance	Reserved Bits	Frame end
F4F3F2F1	2 bytes	1 byte（0/1 indicates no one; 2/3 Indicate someone）	2 bytes （unit：cm）	34 bytes	F8F7F6F5

5.3. Send commands and ACK

5.3.1. Read the firmware version command

This command reads the sensor firmware version.

Command word：0x0000

Command value：None

Returned value： 2 bytes major version number + 2 bytes minor version number + 2 bytes patch version number

Send data:

Frame head	Intra-frame data length	Command word	Frame end
FDFCFBFA	0200	0000	04030201

ACK (Success) :

Frame head	Intra-frame data length	Command word	Equipment type	Version type	Major version	Minor version	Patch version	Frame end
FD FC FB FA	0E 00	00 01	00 00 00 80	00 00	01 00	01 00	00 00	04 03 02 01

5.3.2. Enable configuration command

Any other command sent to the sensor can be executed only after this command is sent. Otherwise, it is invalid.

Command word: 0x00FF

Command value: 0x0001

Frame head	Intra-frame data length	Command word	Command value	Frame end
FD FC FB FA	0400	FF00	0100	04030201

Return value: 2-byte protocol version（0x0001）

Send data：

ACK（Success）：

Frame head	Intra-frame data length	Command word	Enable	Protocol version number	buffer size	Frame end
FD FC FB FA	0800	FF01	0000	0300	8000	04030201

5.3.3. End configuration command

This command enables the sensor to stop the parameter configuration mode and resume the working mode. If you want to run other commands again, you need to send the enable configuration command first.

Command word：0x00FE

Command value：None

Return value：2-byte ACK status (0 succeeded, 1 failed)

Send data:

Frame head	Intra-frame data length	Command word	ACK	Frame end
FDFCFBFA	0400	FE01	0000	04030201

ACK(Success):

Frame head	Intra-frame data length	Command word	Frame end
FDFCFBFA	0200	FE00	04030201

5.3.4. Write Serial number command

This command writes the sensor serial number.

Command word: 0x0010

Command value: 2 bytes serial number length + 8 bytes serial number

Return value: 2-byte ACK status (0 succeeded, 1 failed)

Send data: (for example： SN is 12345678)

Frame head	Intra-frame data length	Command word	Serial number length	Serial number	Frame end
FD FC FB FA	0C00	10 00	0800	31 32 33 34 35 36 37 38	04 03 02 01

ACK(Success):

Frame head	Intra-frame data length	Command word	ACK	Frame end
FD FC FB FA	0400	1001	0000	04030201

5.3.5. Read serial number command

This command reads the sensor serial number.

Command word：0x0011

Command value：None

Return value： 2-byte ACK status (0 succeeded, 1 failed) + 2-byte serial number length + 8-byte serial number

Send data:

Frame head	Intra-frame data length	Command word	Frame end
FDFCFBFA	0200	1100	04030201

Sensor ACK： （Success, serial number: 12345678）

Frame head	Intra-frame data length	Command word	ACK	Serial number length	Serial number	Frame end
FDFCFBFA	0E00	1101	0000	0800	3132333435363738	04030201

5.3.6. Write generic parameter commands

This command is used to set the general parameters of a sensor.

Command word: 0x7000

Command value: (2-byte parameter word + 4-byte parameter value)*N

Return value: 2-byte ACK status (0 succeeded, 1 failed)

Send data: (For example： "Detect farthest distance gate" =12; "Detect nearest distance gate" = 0; "No one delay time (seconds)" = 40; "Status reporting Frequency" = 0.5 Hz. "Distance reporting frequency" = 0.5Hz; "Response Speed" = Normal）

Frame head	Intra-frame data length	Command word	Detect the farthest distance gate	Detect the nearest distance gate
FDFCFBFA	2600	7000	05000C000000	0A0000000000

Unattended delay time (s)	Frequency of status reporting	Frequency of distances reporting	Respond speed	Frame end
060028000000	020005000000	0C0005000000	0B0005000000	04030201

ACK（Success）：

Frame head	Intra-frame data length	Command word	ACK	Frame end
FD FC FB FA	04 00	70 01	00 00	04 03 02 01

Table 5-2 describes the parameters and value ranges of common parameters.

Table 5-2 The definition of Parameter word and value range of the common parameter

Name of parameter	Parameter word	Range of value	Unit
Detect the farthest distance gate	05	1~16	-
Detect the nearest distance gate	0A	0~16	-
Unmanned delay time	06	10~120	s
Trigger refresh rate	0B	0.5~8（0.5 step）	Hz
Maintain the refresh rate	0C	0.5~8（0.5 step）	Hz
Response speed	0B	5(Normal)/ 10(Fast)	-

5.3.7. Read common parameter commands

This command reads the configuration parameters of the sensor.

Command word：0x7100

Command value: (2 bytes parameter word)*N

Return value: (4bytes parameter word)*N

Send data:

Frame head	Intra-frame data length	Command word	Detect the farthest distance gate	Detect the nearest distance gate
FD FC FB FA	0E 00	71 00	05 00	0A 00
Unattended delay time (s)	**Frequency of status reporting**	**Frequency of distances reporting**	**Respond speed**	**Frame end**
06 00	02 00	0C 00	0B 00	04 03 02 01

ACK: (Successful example:

"Detect farthest distance gate" = 12; "Detect nearest distance gate" = 0; "No one delay time (seconds)" = 40; “Status reporting Frequency” = 0.5 Hz. "Distance reporting frequency" = 0.5Hz; “Response Speed” = Normal)

Frame header	Intra-frame data length	Command word	ACK	Detects the farthest distance gate	Detects the nearest distance gate
FD FC FB FA	1A 00	71 01	00 00	0C 00 00 00	00 00 00 00
Unattended delay time (s)	**Frequency of status reporting**	**Frequency of distances reporting**		**Respond speed**	**Frame end**
28 00 00 00	05 00 00 00	05 00 00 00		05 00 00 00	04 03 02 01

5.3.8. Write threshold parameter command

This command is used to set trigger and hold threshold parameters for the distance gate 0 to 7 of a sensor.

Command word: 0x7200

Command value: (2-byte parameter word+ 4-byte parameter value)*N

Return value: 2-byte ACK status (0 succeeded, 1 failed)

Send data: (For example:

0 Distance gate trigger threshold = 50; 1 Distance gate trigger threshold = 46;
2 Distance gate trigger threshold = 34; 3 Distance gate trigger threshold = 32;

4 Distance gate trigger threshold = 32; 5 Distance gate trigger threshold = 32;
6 Distance gate trigger threshold = 32; 7 Distance gate trigger threshold = 32;

0 Distance gate keeping threshold=50; 1 Distance gate keeping threshold=46;
2 Distance gate keeping threshold=32; 3 Distance gate keeping threshold=30;

4 Distance gate keeping threshold=30; 5 Distance gate keeping threshold=30;
6 Distance gate keeping threshold=30; 7 Distance gate keeping threshold=30)

Frame head	Intra-frame data length	Command word	0 distance gate Trigger threshold	1 distance gate Trigger threshold	2 distance gate Trigger threshold	3 distance gate Trigger threshold
FDFCFB FA	6200	7200	000032 000000	01002E 000000	02002E 000000	030020 000000
4 distance gate Trigger threshold	5 distance gate Trigger threshold	6 distance gate Trigger threshold	7 distance gate Trigger threshold	0 distance gate Holding threshold	1 distance gate Holding threshold	2 distance gate Holding threshold
040020 000000	050020 000000	060020 000000	070020 000000	080032 000000	09002E 000000	0A0020 000000
3 distance gate Holding threshold	4 distance gate Holding threshold	5 distance gate Holding threshold	6 distance gate Holding threshold	7 distance gate Holding threshold	Frame end	
0B001E 000000	0C001E 000000	0D001E 000000	0E001E 000000	0F001E 000000	04030201	

ACK(Success):

Frame head	Intra-frame data length	Command word	ACK	Frame end
FDFCFBFA	0400	7201	0000	04030201

Table 5-3 describes the trigger and hold threshold parameters word for the distance gate 0 to 7 of the sensor.

Table 5-3 the definition of trigger and hold threshold parameters word

Parameter name	Parameter word
Trigger threshold (0~7 distance gate)	0~7
Holding threshold (0~7 distance gate)	8~15

5.3.9. Read threshold parameter command

This command is used to read the trigger and hold thresholds of the distance gate 0 to 7 of the sensor.

Command word: 0x7300

Command value: (2-byte parameter word) * N

Ruturn value: (4-byte parameter value) * N

Send data:

Frame head	Intra-frame data length	Command word	0 distance gate Trigger threshold	1 distance gate Trigger threshold	2 distance gate Trigger threshold	3 distance gate Trigger threshold
FDFCFB FA	2200	7300	0000	0100	0200	0300
4 distance gate Trigger threshold	5 distance gate Trigger threshold	6 distance gate Trigger threshold	7 distance gate Trigger threshold	0 distance gate Holding threshold	1 distance gate Holding threshold	2 distance gate Holding threshold
0400	0500	0600	0700	0800	0900	0A00
3 distance gate Holding threshold	4 distance gate Holding threshold	5 distance gate Holding threshold	6 distance gate Holding threshold	7 distance gate Holding threshold	Frame end	
0B00	0C00	0D00	0E 00	0F00	04030201	

ACK(Success): (For example:

0 Distance gate trigger threshold =50;	1Distance gate trigger threshold=46;	2 Distance gate trigger threshold=34;	3 Distance gate trigger threshold=32;
4 Distance gate trigger threshold=32;	5 Distance gate trigger threshold=32;	6 Distance gate trigger threshold=32;	7 Distance gate trigger threshold=32;
0 Distance gate holding threshold=50;	1 Distance gate holding threshold=46;	2 Distance gate holding threshold=32;	3 Distance gate holding threshold=30;
4 Distance gate holding threshold=30;	5 Distance gate holding threshold=30;	6 Distance gate holding threshold=30;	7 Distance gate holding threshold=30;)

Frame head	Intra-frame data length	Command word	ACK	0 distance gate Trigger threshold	1 distance gate Trigger threshold	2 distance gate Trigger threshold
FDFCFB FA	4400	7301	0000	32000000	2E000000	22000000
3 distance gate Trigger threshold	4 distance gate Trigger threshold	5 distance gate Trigger threshold	6 distance gate Trigger threshold	7 distance gate Trigger threshold	0 distance gate Holding threshold	1 distance gate Holding threshold

20000000	20000000	20000000	20000000	20000000	32000000	2E000000
2 distance gate Holding threshold	3 distance gate Holding threshold	4 distance gate Holding threshold	5 distance gate Holding threshold	6 distance gate Holding threshold	7 distance gate Holding threshold	Frame end
20000000	1E000000	1E000000	1E000000	1E000000	1E000000	04030201

5.3.10. Write the SNR parameter command

This command is used to set the trigger and hold SNR parameters of the sensor.

Command word: 0x7400

Command value: (2-byte parameter word + 4-byte parameter value) * N

Return value: 2-byte ACK status (0 succeeded, 1 failed)

Send data: (example:

08 Distance gate trigger SNR =15; 09 Distance gate trigger SNR = 15; 10 Distance gate trigger SNR = 15;

11 Distance gate trigger SNR = 15: 12 Distance gate trigger SNR = 15; 13 Distance gate trigger SNR = 15;

14 Distance gate trigger SNR = 15; 15 Distance gate trigger SNR = 15;

08 Distance gate hold SNR = 09; 09 Distance gate hold SNR = 09; 10 Distance gate hold SNR = 09;

11 Distance gate hold SNR = 09; 12 Distance gate hold SNR = 09; 13 Distance gate hold SNR = 09;

14 Distance gate hold SNR = 09; 15 Distance gate hold SNR = 09)

Frame head	Intra-frame data length	Command word	8 Distance gate trigger SNR	9 Distance gate trigger SNR	10 Distance gate trigger SNR	11 Distance gate trigger SNR
FDFCFB FA	6200	7400	00000F 000000	01000F 000000	02000F 000000	03000F 000000
12 Distance gate trigger SNR	13 Distance gate trigger SNR	14 Distance gate trigger SNR	15 Distance gate trigger SNR	8 Distance gate hold SNR	9 Distance gate hold SNR	10 Distance gate hold SNR
04000F 000000	05000F 000000	06000F 000000	07000F 000000	080009 000000	090009 000000	0A0009 000000

11 Distance gate hold SNR	12 Distance gate hold SNR	13 Distance gate hold SNR	14 Distance gate hold SNR	15 Distance gate hold SNR	Frame end
0B0009 000000	0C0009 000000	0D0009 000000	0E0009 000000	0F0009 000000	04030201

ACK(Success):

Frame head	Intra-frame data length	Command word	ACK	Frame end
FDFCFBFA	0400	7401	0000	04030201

Table 5-4 describe the definition of 8 to 15 range gate trigger and hold SNR parameter name.

Table 5-4 Definition of trigger and hold SNR parameter word

Parameter name	Parameter word
Trigger SNR（8~15 distance gate）	0~7
Hold SNR（8~15 distance gate）	8~15

5.3.11. Read the SNR parameter command

This command is used to read the trigger and hold SNR parameters of the sensor.

Command word: 0x7500

Command value: (2-byte parameter word) * N

Return value: (4-byte parameter value) * N

Send data:

Frame head	Intra-frame data length	Command word	8 Distance gate trigger SNR	9 Distance gate trigger SNR	10 Distance gate trigger SNR	11 Distance gate trigger SNR
FDFCFBFA	2200	7500	0000	0100	0200	0300
12 Distance gate trigger SNR	13 Distance gate trigger SNR	14 Distance gate trigger SNR	15 Distance gate trigger SNR	8 Distance gate hold SNR	9 Distance gate hold SNR	10 Distance gate hold SNR
0400	0500	0600	0700	0800	0900	0A00
11 Distance gate hold SNR	12 Distance gate hold SNR	13 Distance gate hold SNR	14 Distance gate hold SNR	15 Distance gate hold SNR	Frame end	
0B00	0C00	0D00	0E 00	0F00	04030201	

ACK(Success): (Example:

08 Distance gate trigger SNR =15; 09 Distance gate trigger SNR = 15; 10 Distance gate trigger SNR = 15;

11 Distance gate trigger SNR = 15: 12 Distance gate trigger SNR = 15; 13 Distance gate trigger SNR = 15;

14 Distance gate trigger SNR = 15; 15 Distance gate trigger SNR = 15; 08 Distance gate hold SNR = 09;

09 Distance gate hold SNR = 09; 10 Distance gate hold SNR = 09; 11 Distance gate hold SNR = 09;

12 Distance gate hold SNR = 09; 13 Distance gate hold SNR = 09; 14 Distance gate hold SNR = 09;

15 Distance gate hold SNR = 09)

Frame head	Intra-frame data length	Command word	ACK	8 distance gate Trigger threshold	9 distance gate Trigger threshold	10 distance gate Trigger threshold
FDFCFB FA	4400	7501	0000	0F000000	0F000000	0F000000
11 distance gate Trigger threshold	12 distance gate Trigger threshold	13 distance gate Trigger threshold	14 distance gate Trigger threshold	15 distance gate Trigger threshold	8 distance gate Holding threshold	9 distance gate Holding threshold
0F000000	0F000000	0F000000	0F000000	0F000000	09000000	09000000
10 distance gate Holding threshold	11 distance gate Holding threshold	12 distance gate Holding threshold	13 distance gate Holding threshold	14 distance gate Holding threshold	15 distance gate Holding threshold	Frame end
09000000	09000000	09000000	09000000	09000000	09000000	04030201

6. Installation and detection range

The recommended installation method of HLK-LD2410S is wall mounting. Figure 6-1 shows the position of the millimeter wave sensor when it is mounted on a wall. Where the X-axis direction is 0°, the Z-axis direction is 90°, and the Y-axis is perpendicular to the X-Z plane (also called the normal line direction).

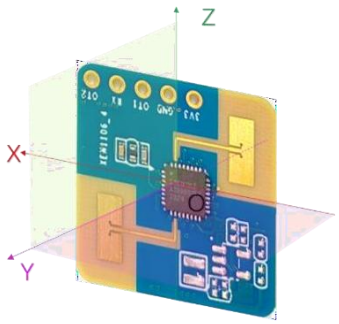


Figure 6-1 Sensor orientation diagram

The recommended wall mounting height is 1.5 to 2 m. In this case, the maximum motion sensing range of the HLK-LD2410S in the default configuration is a conical space with a normal direction of 8 m and an Angle of ±60° between the horizontal and pitching directions, as shown in Figure 6-2.

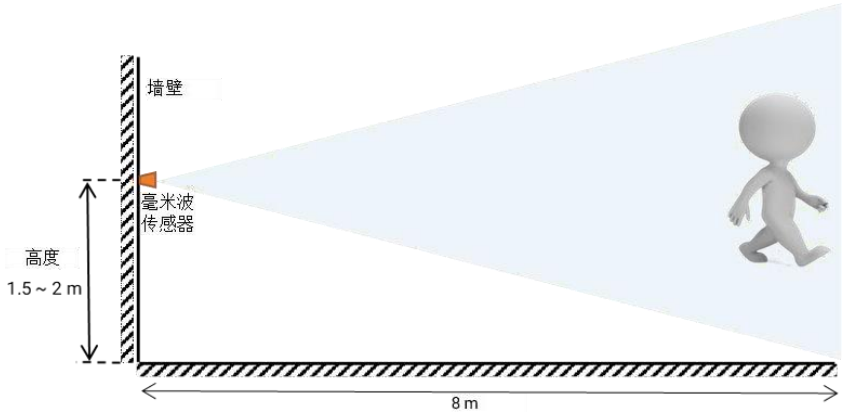


Figure 6-2 Schematic diagram of HLK-LD2410S detection range (wall hanging)

When the mounting height is 1.5 m, Figure 6-3 shows the detection range of the HLK-LD2410S for the stationary, micro-moving, and moving human body in all directions.

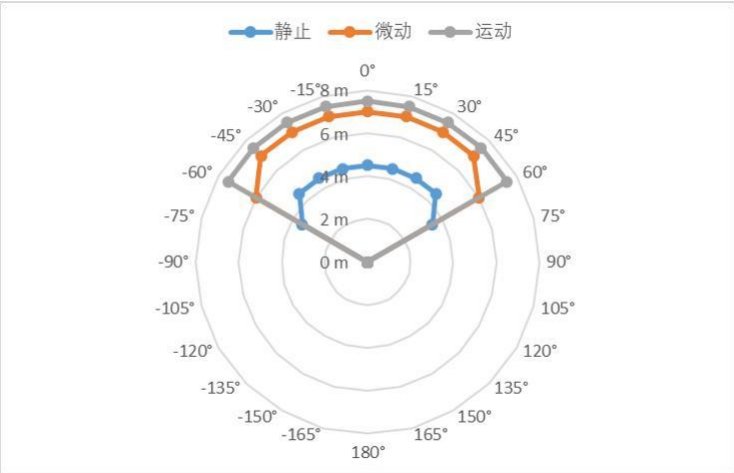
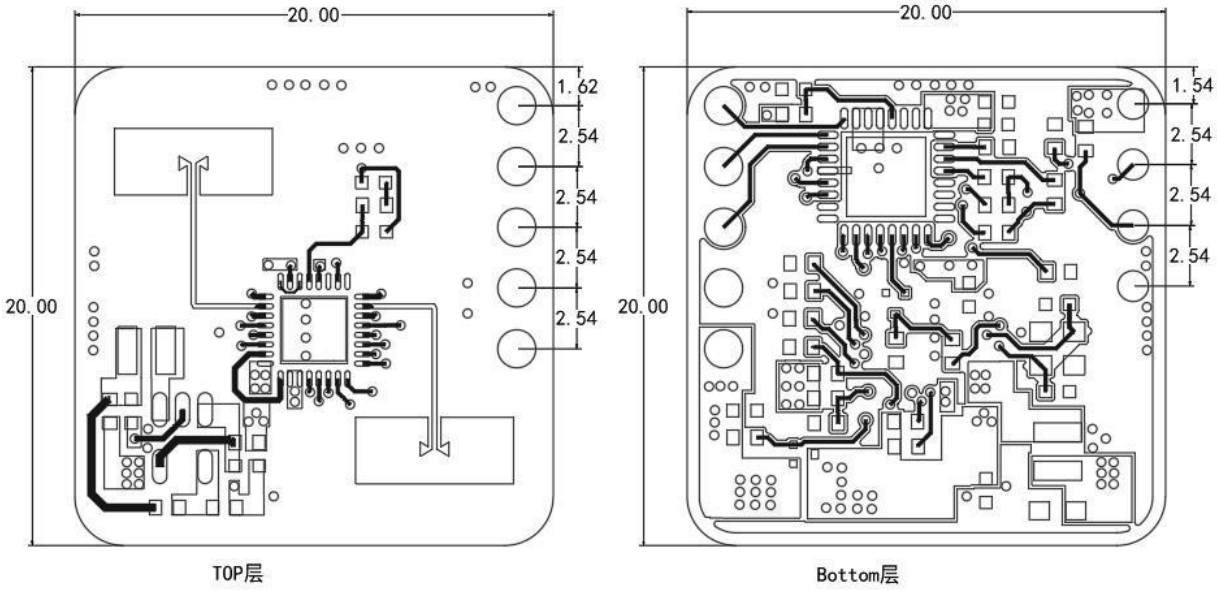


Figure 6-3 Sensing range for wall mounting

7. Mechanical dimensions

Figure 7-1 shows the mechanical dimensions of the hardware LD2410S. All units are mm. The LD2410S has a plate thickness of 1.2mm with a tolerance of ±10%.



单位：毫米

Figure 7-1 Hardware LD2410S Mechanical dimensions

8. Installation instructions

Millimeter wave sensor housing requirements

If the millimeter wave sensor needs to be installed with a housing, the housing must have good transmittance in the 24 GHz band and must not contain metals or materials that shield electromagnetic waves. For more precautions, please refer to《 MMWAVE Sensor Radome Design Guide_Hi-Link》.

Installation environment requirements

- This product needs to be installed in a suitable environment, if used in the following environments, the detection effect will be affected;
- There are non-human objects in continuous motion in the sensing area, such as animals, curtains that continue to swing and large green plants facing the tuyere;
- There is a large area of strong reflection plane in the sensing area, and the strong reflection will cause interference to the sensor antenna;
- When mounting 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 that the antenna is open around it.
- To ensure that the installation position of the millimeter wave sensor is firm and stable, the shaking of the sensor itself will affect the detection effect.
- Ensure that there is no movement or vibration on the back of the millimeter wave sensor. Due to the penetrating nature of millimeter waves, the antenna back lobe may detect moving objects on the back of the sensor. A metal shield or a metal backplane can be used to shield the antenna back flap to reduce the impact of objects on the back of the sensor.
- When there are multiple millimeter wave sensors in the 24 GHz band, do not beam correctly and install them as far away as possible to avoid possible mutual interference.

Power supply precautions

The input voltage range of the power supply is 3.0V ~ 3.6V, 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 ESD and lightning surge electromagnetic compatibility design.

9. Precautions

Maximum detectable range

The maximum detection range of the sensor HLK-LD2410S is 8 m radial distance. Within the detection range, the sensor reports the straight-line distance between the target and the sensor.

Maximum distance and accuracy

Theoretically, the measuring error of the sensor in this reference scheme is ± 0.35m; Due to the different body type, state and RCS of the human target, the ranging accuracy will fluctuate, and the farthest detection distance will also fluctuate.

Target disappearance delay time

When the millimeter wave sensor detects that there is no human body in the target area, it will not immediately report the "no one" state in the area, but a delay. The delayed reporting mechanism is as follows: once no human target is detected within the test range, the sensor will turn on the timing, which is the duration of no one. If no one is detected continuously during the timing, the state of "no one" will be reported after the end of the timing. If someone is detected during this time period, the timer ends immediately, updates the timer, and reports the target information.

10. Version history

Version	Time	Modification
1.00	2023/10/12	First edition
1.1	2023/10/21	Modify some parameter descriptions
1.2	2023/10/31	Modify the connection graph error description

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