Human presence sensing moduleSerial communication protocol

LD2410

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1 Introduction to Communication Interfaces

1.1 Pin Definitions

Figure 1 Module pin definition diagram

Pin	Symbol	Name	Function
1	Out	Target status output	Human presence detected:output high level
2	UART_Tx	Serial Tx	Serial port Tx pin
3	UART_Tx	Serial Tx	Serial port Tx pin
4	GND	GND	GND
5	VCC	Power input	Power input 5V

Table 1 Pin definition table

1.2 Use and Configuration

1.2.1 Typical Application Circuit

The LD2410 module directly outputs the detected target state (high level for someone, low level for no one) directly through an I0 pin, and can also output the detection result data through the serial port according to the specified protocol. The serial port output data includes: Target status and distance auxiliary information, etc, users can use flexibly according to specific application scenarios.

The power supply voltage of the module is 5V, and the power supply capacity of the input power supply is required to be greater than 200mA.

The module I0 output level is 3.3V. The default baud rate of the serial port is 57600, 1 stop bit, and no parity bit.

1.2.2 The Role of Configuration Parameters

Users can modify the configuration parameters of the module through the serial port of LD2410 to adapt to different application requirements.

The configurable radar detection parameters include the following:

- **Farthest detection distance**

✓ Set the farthest detectable distance, only human targets that appear within this farthest distance will be detected and output the result.

✓ Set in units of distance gates, and each distance gate is 0.75m.

✓ Including the farthest door for motion detection and the farthest door for static detection, the setting range is 1 to 8. For example, if the farthest door is set to 2, only if there is a human body within 1.5m will it effectively detect and output the result.

- **Sensitivity**

✓ Only when the detected target energy value (range 0~ 100) is greater than the sensitivity value will it be determined that the target exists, other wise it will be ignored.

✓ The sensitivity value can be set from 0 to 100. The sensitivity of each range gate can be independently set, so that the detection in different distance ranges can be precisely adjusted, local accurate detection or filtering of interference sources in specific areas.

✓ In addition, if the sensitivity of a certain distance gate is set to 100, the effect of not recognizing the target under the distance gate can be achieved. For example, if the sensitivity of distance gate 3 and distance gate 4 is set to 20, and the sensitivity of other distance gates is set to 100, it is possible to detect only the human body within the range of 2.25-3.75m from the distance module.

- **No-one duration**

✓ When the radar outputs the result from man to no man, it will report man for a period of time.

If there is no man in the radar test range during this time period, the radar will report no man; if the radar detects man during this time period, it will be refreshed again. This time, in seconds. It is equivalent to the unmanned delay time. After the person leaves, the output state will be unmanned only after the person has left the system for more than this duration.

1.2.3 Visual Configuration Tool Description

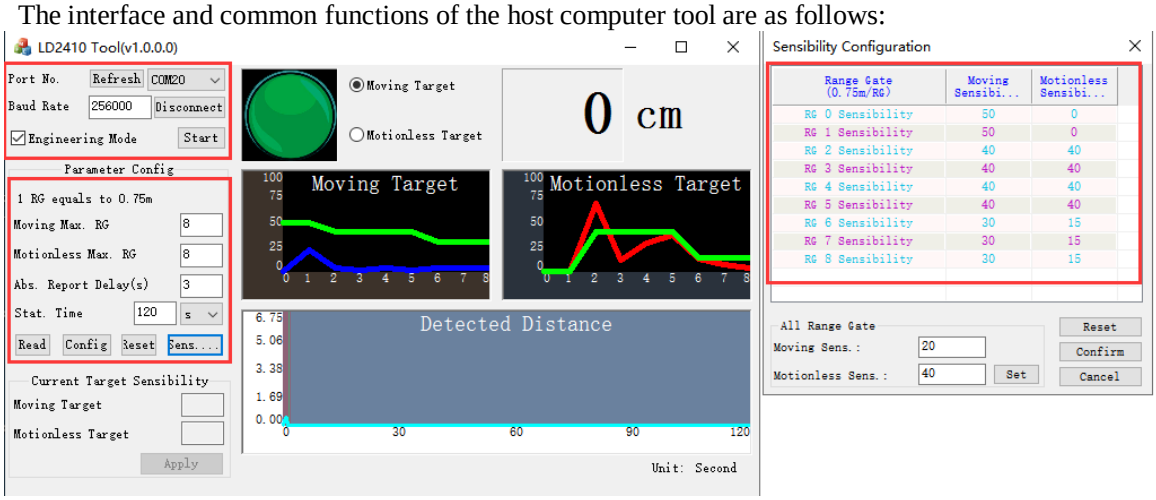
In order to facilitate the user to test and configure the module quickly and efficiently, a PC configuration tool is provided. The user can use this tool software to connect the serial port of the module, read and configure the parameters of the module, and receive the detection results reported by the. module. Data, and real-time visual display, which greatly facilitates .the use of users.

How to use the host computer tool:

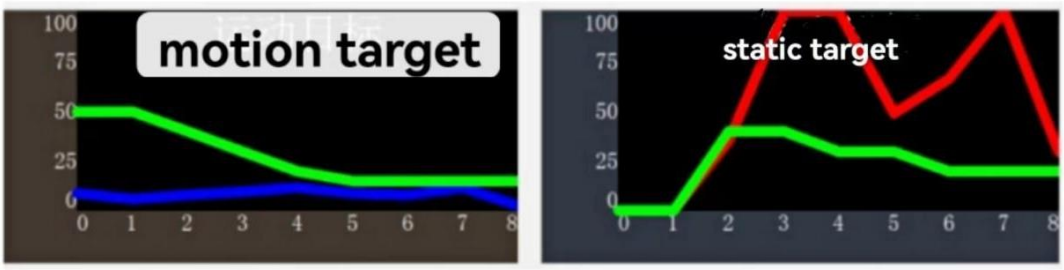
1. Use the USB to serial port tool to connect the module serial port correctly
2. Select the corresponding serial port number in the host computer tool, set the baud rate to 57600, select the engineering mode, and click to connect the device
3. After the corresponding is successful, click the start button, the right graphical interface will display the test results and data
4. After connecting, if the start button is not clicked, or click stop after starting,the mode parameter information can be read or set

Note:The parameters cannot be read and configured after clicking start, and configuration can only be performed after stopping.

The interface and common functions of the host computer tool are as follows:



The ball is the target state output indication: red means that there is a moving target, and purple means that there is a stationary target:,Green means no one



red line:the energy value of each stationary target on the distance door
green line:set sensitivity
blue line:the energy value of the moving object on each distance gate

2 Letter of Agreement

This communication protocol is mainly used by users who need to do secondary development without visual tools.LD2410 communicates with the outside world through the serial port(TTL level). The data output and parameter configuration commands of the radar are all carried out under this protocol. The default baud rate of the serial port is 57600, 1 stop bit, and no parity bit.

2.1 Protocol Format

2.1.1 Protocol Data Format

The format of the radar configuration command and ACK command defined by the protocol is shown in Table 1 to Table 4.

Table 2 Send command protocol frame format

Frame header	Frame data length	frame data	MFR
FD FC FB FA	2bytes	See table 3	04 03 02 01

Table 3 Transmit frame data format

Command word(2 bytes)	Command value(N bytes)

Table 4 ACK command protocol frame format

Frame header	Frame data length	Frame data	MFR
FD FC FB FA	2 bytes	See table 5	04 03 02 01

Table 5 ACK frame data format

Send command word& 0x0100(2bytes)	Return value (N bytes)

2.2 Send Command Word & ACK

2.2.1 Enable Configuration Command

And other command issued to the radar must be executed after this command is issued, otherwise it will be invalid.

Command word:0x00FF

Command value:0x0001

Return value:2 bytes status (0 success, 1 failure)+2 bytes protocol version(0x0001)+2 bytes buffer size(0x0040)

Send data:

FD FC FB FA	0400	FF00	0100	04 03 02 01

RADAR ACK(success):

FD FC FB FA	08 00	FF01	00 00	01 00	40 00	04 03 02 01

2.2.2 End Configuration Command

End the configuration command, and the radar will return to working mode after execution. If you need to issue other commands again, you need to send the enable configuration command first.

Command word:0x00FE

Command value:none

Return value:2 bytes ACK status(0 success, 1 failure)

Send data:

FD FC FB FA	02 00	FE 00	04 03 02 01

Radar ACK(success):

FD FC FB FA	04 00	FE 01	00 00	04 03 02 01

2.2.3 Maximum Distance Gate and Unmanned Duration Parameter Configuration Command

The command sets the radar's maximum detection range gate(moving & stationary)(configuration range 2~8), and the parameter of unmanned duration(configuration range 0~65535 seconds). For specific parameter words, please words, please refer to table5-5. This configuration value is not lost when power off.

Command word:0x0060

Command value:2 bytes maximum moving distance door word+4 bytes maximum moving distance door parameter+2 bytes maximum static distance door word+4bytes maximum static distance door parameter+2 bytes no-person duration word + 4 words Section unattended duration parameter.

Return value:2 bytes ACK status(0 success, 1 failure)

0x0060 Protocol parameter word:

Parameter name	Parameter word
Maximum moving distance gate	0x0000
Maximum resting distance door	0x0001
No-one duration	0x0002

Sending data:maximum distance gate8(movement& stillness), unmanned duration 5 seconds

FD FC FB FA	1400	60 00	00 00	08 00 00 00	01 00	08 00 00 00	02 00	05 00 00 00	04 03 02 01

Radar ACK(success):

FD FC FB FA	04 00	60 01	00 00	04 03 02 01

2.2.4 Read Parameter Command

This command can read the current configuration parameters of the radar.

Command word:0x0061

Command value:none

Return value:2 bytes ACK status(0 success, 1 failure)+ header(0xAA)+maximum distance gate N(0x08)+configure maximum moving distance gate+ configure maximum static gate + distance gate 0 motion sensitivity(1 byte)+...+Distance Gate N Motion Sensitivity(1 byte)+ Distance Gate 0 Rest sensitivity 1 Byte) +..+ Distance Gate N Rest Sensitivity(1 byte)+ No Time Duration(2 Bytes).

Send data:

FD FC FB FA	61 00	04 03 02 01

Radar ACK:(success, max range gate 8, configure moving range gate 8, static range gate 8, 0~8 motion sensitivity 20, 0~8 static sensitivity 25, unmanned duration 5 seconds)

Byte1~4		Byte 5.6	Byte 7.8	Byte 9.10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte 16	Byte 17	Byte18
FD FC FB FA		18 00	61 01	00 00	AA	08	08	08	14	14	14	14
Byte 19	Byte20	Byte 21	Byte 22	Byte 23	Byte 24	Byte 25	Byte 26	Byte 27	Byte 28	Byte 29	Byte 30	
14	14	14	14	14	19	19	19	19	19	19	19	
Byte 31	Byte 32											
19	19											

2.2.5 Enable Engineering Mode Command

This command turns on radar engineering mode. After the engineering mode is turned on, the energy value of each range gate will be added to the date reported by the radar. For the detailed

format, please refer to 2.3.2 target data composition. After the module is powered on, the engineering mode is disabled by default, and this configuration value is lost when the power is turned off.

Command word:0x0062

Command value:none

Return value:2bytes ACK status(0 success, 1 failure)

Send data:

FD FC FB FA	02 00	62 00	04 03 02 01

Radar ACK(success):

FD FC FB FA	04 00	62 01	00 00	04 03 02 01

2.2.6 Close Engineering Mode Command

This command turns off radar engineering mode. After closing, please refer to 2.3.2 target data composition for the data format reported by radar.

Command word:0x0063

Command value:none

Return value:2 bytes ACK status(0 success, 1 failure)

Send data:

FD FC FB FA	02 00	63 00	04 03 02 01

Radar ACK(success):

FD FC FB FA	04 00	63 01	00 00	04 03 02 01

2.2.7 Range Gate Sensitivity Configuration Commands

This command configures the sensitivity of the distance gate, and the configuration value will not be lost after power failure. Its supports not only the individual configuration of each distance gate, but also the simultaneous configuration of all distance gates to a unified value. If you set the sensitivity of all distance gates to the same value at the same time, you need to set the distance

gate value to 0xFFFF.

Command word:0x0064

Command value:2bytes distance gate word + 4 bytes distance gate value + 2 bytes motion sensitivity word + 4 bytes motion sensitivity value + 2 bytes static sensitivity word + 4 bytes static sensitivity value.

Return value:2 bytes ACK status(0 success, 1 failure)

0x0064 Protocol parameter word

Parameter name	Parameter word
Distance gate	0x0000
Motion sensitivity	0x0001
Static sensitivity word	0x0002

Send data:configure the motion sensitivity of distance gate 3 to 40, and the static sensitivity of 40

FD FC FB FA	04 00	00 00	04 03 02 01

Radar ACK(success):

FD FC FB FA	14 00	64 00	00 00	FF FF 00 00	01 00	28 00 00 00	02 00	28 00 00 00	04 03 02 01

Send data: configure the motion sensitivity of all distance gates to 40, and the static sensitivity to 40.

FD FC FB FA	14 00	64 00	00 00	FF FF 00 00	01 00	28 00 00 00	02 00	28 00 00 00	04 03 02 01

Radar ACK (success):

FD FC FB FA	04 00	64 01	00 00	04 03 02 01

2.2.8 Read Firmware Version Command

This command reads radar firmware version information

Command word:0x00A0

Command value:none

Return value: 2 bytes ACK status(0 success, 1 failure) + 2 bytes firmware type (0x0000) + 2 bytes major version number + 4 bytes minor version number.

Send data:

FD FC FB FA	02 00	A0 00	04 03 02 01

Radar ACK(success):

FD FC FB FA	**0B 00**	**A0 01**	**00 00**	**00 00**	**02 01**	**16 24 06 22**	**04 03 02 01**

The corresponding version number is V1.02.22062416

2.2.9 Set Serial Port Baud Rate

This command is used to set the baud rate of the serial port of the module. The configuration value will not be lost after power failure. The configuration value will take effect after restarting the module.

Command word:0x00A1

Command value:2 bytes ACK status(0 success,1 failure)

Return value:2 bytes ACK status (0 success,1 failure)

Table 6 serial port baud rate selection

Baud rate selection index value	Baud rate
0x0001	9600
0x0002	19200
0x0003	38400
0x0004	57600
0x0005	115200
0x0006	230400
0x0007	256000
0x0008	460800

The factory default value is 0x0004, which is 57600

Send data:

FD FC FB FA	**04 00**	**A1 00**	**04 00**	**04 03 02 01**

Radar ACK(success):

FD FC FB FA	**04 00**	**A1 01**	**00 00**	**04 03 02 01**

2.2.10 Factory Reset

This command is used to restore all configuration values to their original values, and the configuration values will take effect after restarting the module.

Command word:0x00A2

Command value:none

Return value:2 bytes ACK status (0 success, 1 failure)

Send data:

FD FC FB FA	**02 00**	**A2 00**	**04 03 02 01**

Radar ACK(success):

FD FC FB FA	**04 00**	**A2 01**	**00 00**	**04 03 02 01**

The factory default configuration values are as follows:

Table 7 factory default value

Configuration item	defaults
Maximum moving distance gate	8
Maximum resting distance door	8
No-one duration	5
Serial port baud rate	57600

Configuration item	defaults	Configuration item	defaults
Motion sensitivity for distance gate 0	50	Rest sensitivity for distance gate 0	(cannot be set)
Motion sensitivity for distance gate 1	50	Rest sensitivity for distance gate 1	(cannot be set)
Motion sensitivity for distance gate 2	40	Rest sensitivity for distance gate 2	40
Motion sensitivity for distance gate 3	30	Rest sensitivity for distance gate 3	40
Motion sensitivity for distance gate 4	20	Rest sensitivity for distance gate 4	30
Motion sensitivity for distance gate 5	15	Rest sensitivity for distance gate 5	30
Motion sensitivity for distance gate 6	15	Rest sensitivity for distance gate 6	20
Motion sensitivity for distance gate 7	15	Rest sensitivity for distance gate 7	20
Motion sensitivity for distance gate 8	15	Rest sensitivity for distance gate 8	20

2.2.11 Restart the Module

When the module receives this command, it will automatically restart after the response is sent.

Command word:0x00A3

Command value:none

Return value:2 bytes ACK status (0 success, 1 failure)

Send data:

FD FC FB FA	**02 00**	**A3 00**	**04 03 02 01**

Radar ACK(success):

FD FC FB FA	**04 00**	**A3 01**	**00 00**	**04 03 02 01**

2.3 Radar Data Output Protocol

The LD2410 outputs the radar detection results through the serial port, and outputs the basic information of the target by default, including the target state, motion energy value, static energy value, motion distance, static distance and other information. If the radar is configured in engineering mode, the radar will additionally output the energy value of each range gate(moving & stationary). Radar data is output in the specified frame format.

2.3.1 Reporting Data Frame Format

The format of the radar report message frame defined by the protocol is shown in table and table 9. In normal working mode and engineering mode, the definition of the reported data type value is shown in table 10.

Table 8 report data frame format

Frame header	Frame data length	Frame data	MFR
F4 F3 F2 F1	2 bytes	See table9	F8 F7 F6 F5

Table 9 data frame format

Type of data	Head	Target data	Tail	Check
1 byte	0xAA	See table11,table 13	0x55	0x00

Table 10 data type description

Data type value	illustrate
0x01	Engineering mode data
0x02	Target data composition

2.3.2 Target Data Composition

The content of the target data reported by the radar will change according to the working mode of the radar. In the normal working mode, the radar outputs the basic information data of the target by default; when configured in the engineering mode, the radar will add the energy value information of each range gate after the basic information data of the target. Therefore, the basic information of the target will always be output in the data reported by the radar, and the energy value information of the range gate will only be output after the command is enabled.

In normal working mode, the composition of the target data reported by the radar is shown in Table 11, and the definition of the target state value is shown in Table 12. The composition of the target data frame in the engineering mode is shown in Table 13, and some data are added based on the data reported in the normal working mode.

Table 11 target data frame composition

Target state	Movement target distance (cm)	Exercise target energy value	Stationary target distance (cm)	Stationary target distance (cm)	Detection distance (cm)
1 byte (see table 12)	2 bytes	1 byte	1 byte	1 byte	1 byte

Table 12 target state value description

Target state value	illustrate
0x00	No target
0x01	Sports target
0x02	Stationary target
0x03	Stationary & stationary targets

Table 13 target data (engineering mode) frame composition

...	Detection distance(cm)	Maximum moving distance gate N	Maximum static distance gate N	Movement distance gate 0 energy value	...	Movement distance gate N energy value	Static distance gate 0 energy value	...	Static distance gate N energy value	Retain data, store additional information
...	2 bytes	1 byte	1 byte	1 byte	..	1 byte	1 byte	...	1 byte	M bytes

Data data:

Report data in normal working mode:

Frame header	Frame data	Frame data	MFR
F4 F3 F2 F1	0D 00	02 AA 02 51 00 00 00 00 3B 00 00 55 00	F8 F7 F6 F5

Report data in engineering mode:

Frame header	Frame data length	Frame data	MFR
F4 F3 F2 F1	23 00	01 AA 03 1E 00 3C 00 00 39 00 00 08 08 3C 22 05 03 03 04 03 06 05 00 00 39 10 13 06 06 08 04 03 05 55 00	F8 F7 F6 F5

2.4 Radar Command Configuration Mode

2.4.1 Radar Command Configuration Steps

The process of the LD2410 radar executing a configuration command indudes two links: the host computer “send command” and the radar “reply command ACK”. If the radar has no ACK reply or fails to reply ACK., it means that the radar fails to execute the configuration command.

As mentioned before, sending any other commands to the radar, the developer needs to send the “enable configuration” command first, and then send the configuration command within the

specified time. After the command configuration is completed, send the “end configuration” command to inform the radar configuration has ended.

For example, if you want to read the radar configuration parameters, first the host computer sends the “enable configuration” command, after receiving the radar ACK successfully, it sends the “read parameters” command; after receiving the radar ACK successfully, it finally sends the “end” command. “configure” command; after the radar ACK is successful, it indicates that the complete reading of parameters is over.

The radar command configuration process is shown in the figure below

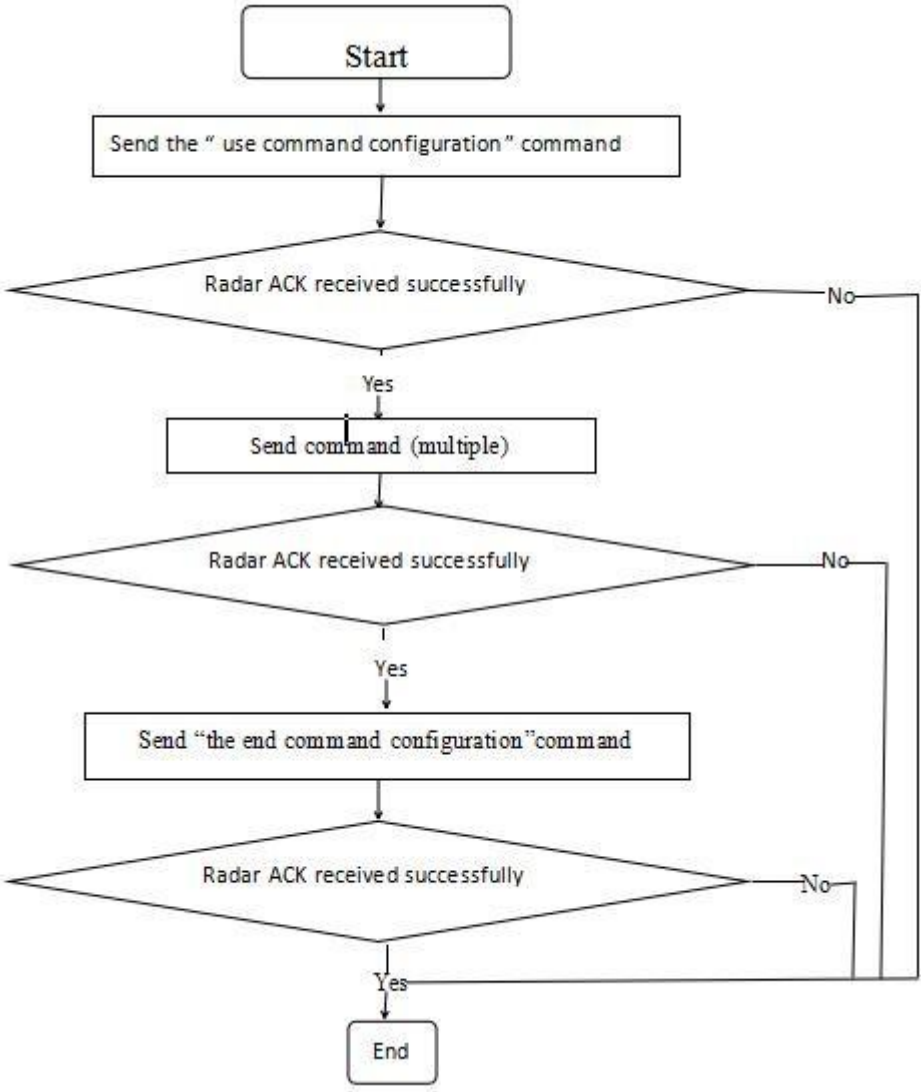


Figure 2 radar command configuration flow

3 Revision records

Data	Version	Modify the content
2022-12-19	1.02	Initial version
2023-3-22	1.03	Update the default Potter rate is 57600