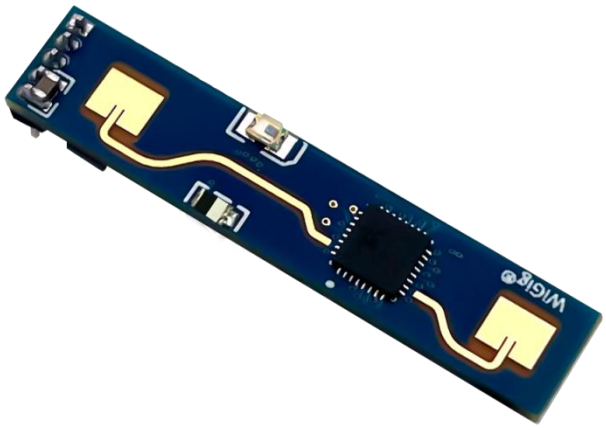
Shenzhen Hailingke Electronics Co., Ltd.

HLK-LD2410BB

Human presence sensor module

Serial communication protocol



Version: V1.05 Modification date: 2022-9-20

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chart index

1 Introduction to communication interface

1.1 Pin definition

Figure 1 Module pin definition diagram

pin	symbol	name	Features
1	out	target state output	Human presence detected: output high level No human presence: output low level
2	UART_Tx	Serial Tx	Serial port Tx pin
3	UART_Rx	Serial Rx	Serial port Rx pin
4	GND	power ground	power ground
5	VCC	power input	Power supply input 5V

Table 1 Pin definition table

1.2 Use and configuration

1.2.1 Typical Application Circuit

The LD2410B module directly outputs the detected target state through an IO pin (high level for someone, low level for no one), 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 flexibly use 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 IO output level is 3.3V. The default serial port baud rate is 256000, 1 stop bit, 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 LD2410B to meet different application requirements.

Configurable radar detection parameters include the following:

The furthest detection distance

Set the farthest detectable distance, only the human targets appearing within this farthest distance will be detected and the result will be output. Set it in units of distance gates, each distance gate is 0.75m.

Including the longest distance door for motion detection and the longest distance door for static detection, the range can be set from 1 to 8. For example, if the longest distance door is set to 2, only when there is a human body within 1.5m can it be effectively detected and the result output.

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, otherwise it will be ignored.

The sensitivity value can be set from 0 to 100. Sensitivity can be set independently for each range gate, which can precisely adjust the detection in different distance ranges, local accurate detection or filter interference sources in specific areas.

In addition, if the sensitivity of a range gate is set to 100, the effect of not recognizing the target under this range gate can be achieved. For example, if the sensitivities of range gate 3 and range gate 4 are set to 20, and the sensitivities of other range gates are set to 100, then only the human body within the range of 2.25-3.75m from the module can be detected.

Duration of no one

When the radar outputs the results from someone to no one, it will report people for a period of time. If there is no one in the radar test range during this time period, the radar will report no one; if the radar detects people during this time period, it will be refreshed. This time, in seconds. It is equivalent to the unoccupied delay time. After the person leaves, the output state will be unoccupied only after keeping no one for more than this duration.

1.2.3 Description of Visual Configuration Tool

In order to facilitate users to quickly and efficiently test and configure the module, a PC-side PC configuration tool is provided. Users can use this tool software to connect to the serial port of the module, read and configure the parameters of the module, and also 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 upper computer tools:

1. Correctly connect the module serial port with the USB to serial port tool;

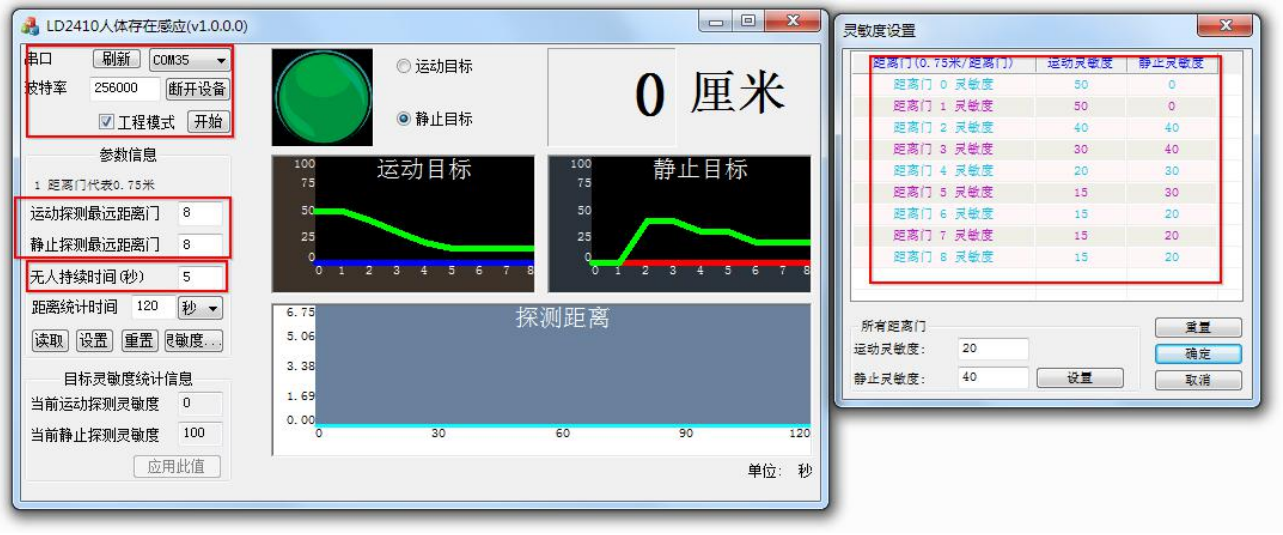
2. Select the corresponding serial port number in the upper computer tool, set the baud rate to 256000, select the engineering mode, and click to connect the device;

3. After the connection is successful, click the start button, and the graphical interface on the right will display the test results and data;

4. After connecting, when the start button is not clicked, or click stop after starting, the mode parameter information can be read or set;

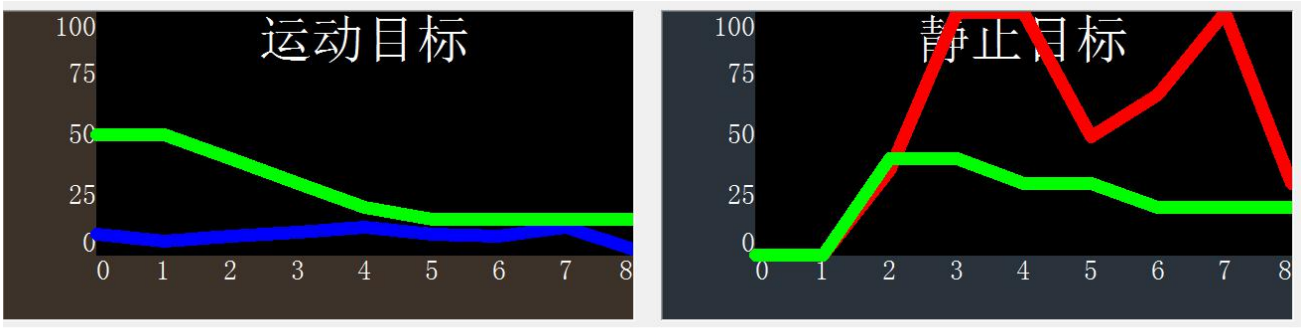
Note: After clicking start, the parameters cannot be read and configured, and the configuration can only be performed after stopping.

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



The ball is the output indicator of the target state: red represents a man-made moving target, and purple represents a man-made stationary target;

Green means no one



绿色线：设置的灵敏度　　蓝色线：每个距离门上的运动目标能量值　　红色线：每个距离门上的静止目标能量值

2 letter of agreement

This communication protocol is mainly used by users who need to do secondary development without visualization tools.LD2410Bvia the serial port (TTLlevel) to communicate with the outside world. The data output and parameter configuration commands of the radar are carried out under this agreement. The default baud rate of the radar serial port is256000,1 Stop bit, no parity bit.

2.1 Protocol format

2.1.1 Protocol data format

LD2410BThe serial port data communication of the device uses little endian format, and all the data in the following table are in hexadecimal.

2.1.2 Command protocol frame format

Protocol-defined radar configuration commands andACKThe command format is as shown in the table1to table4shown.

Table 2 Send command protocol frame format

frame header	Intra-frame data length	Intra frame data	end of frame
FD FC FB FA	2byte	see table3	04 03 02 01

Table 3 Send data format in the frame

Command word(2byte)	command value (Nbyte)

Table 4 ACK command protocol frame format

frame header	Intra-frame data length	Intra frame data	end of frame
FD FC FB FA	2byte	see table5	04 03 02 01

Table 5 ACK frame data format

Send command word |0x0100(2byte)	return value(Nbyte)

2.2 Send command and ACK

2.2.1 Enable configuration command

Any 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:2byteACKstate(0success,1fail) +2byte protocol version (0x0001) +2Byte buffer size (0x0040)

send data:

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

radarACK(success):

FD FC FB FA	**08 00**	**FF 01**	**00 00**	**01 00**	**40 00**	**04 03 02 01**

2.2.2 End configuration command

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

Command word:0x00FE

Command value: none

return value:2byteACKstate(0success,1fail)

send data:

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

radarACK(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

This command sets the radar maximum detection range gate (moving & stationary) (configuration range2~8), and the unoccupied duration parameter (configurable range0~65535 Second). For specific parameters, please refer to the table5- 5. This configuration value will not be lost when power off.

Command word:0x0060

Command value:2byte max motion distance gate word +4byte max motion distance gate parameter +2Byte Maximum Static Distance Gate Word +4Character Knot maximum static distance gate parameter +2byte no duration word +4byte no-duration parameter

return value:2byteACKstate(0success,1fail)

0x0060protocol parameter word

parameter name	parameter word
Maximum Movement Distance Gate	0x0000
Maximum static distance door	0x0001
Duration of no one	0x0002

Sending Data: Maximum Range Gate8(motion & stillness), unoccupied duration5Second

FD FC FB FA	**14 00**	**60 00**	**00 00**	**08 00 00 00**	**01 00**	**08 00 00 00**	**02 00**	**05 00 00 00**	**04 03 02 01**

radarACK(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:2byteACKstate(0success,1fail) + head(0xAA) + maximum distance gateN(0x08) +Configure maximum motion distance gate + configure maximum rest distance gate + distance gate0motion sensitivity (1bytes) + ... + range gateN motion sensitivity (1bytes) + range gate0static sensitivity1bytes) + ... + range gateNstatic sensitivity (1byte)

+ Unoccupied Duration (2byte)

send data:

FD FC FB FA	**02 00**	**61 00**	**04 03 02 01**

radarACK:(success, max distance gate8, configure the motion range gate8, the rest distance gate8,0~8motion sensitivity20, 0~8 static sensitivity25, the duration of no one5Second)

Byte 1~4		Byte 5, 6	Byte 7, 8	Byte 9, 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte 16	Byte 17	Byte 18
FD FC FB FA		1C 00	61 01	00 00	AAA	08	08	08	14	14	14	14
Byte 19	Byte 20	Byte 21	Byte 22	Byte twenty three	Byte twenty four	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	Byte 33, 34	Byte 35~38									
19	19	05 00	04 03 02 01									

2.2.5 Enable engineering mode command

This command turns on the radar engineering mode. After turning on the engineering mode, the energy value of each range gate will be added to the data reported by the radar. For the detailed format, please refer to2.3.2target data composition . After the module is powered on, the engineering mode is disabled by default, and this configuration value will be lost when the module is powered off.

Command word:0x0062

Command value: none

return value:2byteACKstate(0success,1fail)

send data:

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

radarACK(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 the radar reporting data format2.3.2target data composition .

Command word:0x0063

Command value: none

return value:2byteACKstate(0success,1fail)

send data:

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

radarACK(success):

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

2.2.7 Range Gate Sensitivity Configuration Command

This command configures the sensitivity of the range gate, and the configured value will not be lost when the power is turned off. It not only supports the individual configuration of each range gate, but also supports the simultaneous configuration of all range gates to a unified value. If you set all range gate sensitivities to the same value at the same time, you need to set the range gate value to0xFFFF.

Command word:0x0064

Command value:2byte distance gate word +4byte distance gate +2byte motion sensitivity word +4byte motion sensitivity value +2byte static Sensitivity word +4byte static sensitivity value

return value:2byteACKstate(0success,1fail)

0x0064protocol parameter word

parameter name	parameter word
range gate	0x0000
motion sensitivity word	0x0001
static sensitivity word	0x0002

Send data: configure range gate3motion sensitivity40, static sensitivity40

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

radarACK(success):

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

Send Data: Configure motion sensitivity for all range gates40, static sensitivity40

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**

radarACK(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 the radar firmware version information.

Command word:0x00A0

Command value: none

return value:2byteACKstate(0success,1fail) +2byte firmware type (0x0001) +2byte major version number +4byte times

version number

send data:

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

radarACK(success):

FD FC FB FA	**0C 00**	**A0 01**	**00 00**	**00 01**	**07 01**	**16 15 09 22**	**04 03 02 01**

The corresponding version number isV1.07.22091615

2.2.9 Set the 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 when the power is off, and the configuration value will take effect after restarting the module.

Command word:0x00A1

Command value:2byte baud rate selection index

return value:2byteACKstate(0success,1fail)

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 is0x0007,Right now256000

send data:

FD FC FB FA	**04 00**	**A1 00**	**07 00**	**04 03 02 01**

radarACK(success):

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

2.2.10 Restore factory settings

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

Command word:0x00A2

Command value: none

return value:2byteACKstate(0success,1fail)

send data:

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

radarACK(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 Configuration Values

configuration item	Defaults
Maximum Movement Distance Gate	8
Maximum static distance door	8
Duration of no one	5
Serial baud rate	256000

configuration item	Defaults	configuration item	Defaults
range gate0motion sensitivity	50	range gate0static sensitivity of	-(not settable)
range gate1motion sensitivity	50	range gate1static sensitivity of	-(not settable)
range gate2motion sensitivity	40	range gate2static sensitivity of	40
range gate3motion sensitivity	30	range gate3static sensitivity of	40
range gate4motion sensitivity	20	range gate4static sensitivity of	30
range gate5motion sensitivity	15	range gate5static sensitivity of	30
range gate6motion sensitivity	15	range gate6static sensitivity of	20
range gate7motion sensitivity	15	range gate7static sensitivity of	20
range gate8motion sensitivity	15	range gate8static sensitivity of	20

2.2.11 Restart the module

After receiving this command, the module will automatically restart after sending the response.

Command word:0x00A3

Command value: none

return value:2byteACKstate(0success,1fail)

send data:

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

radarACK(success):

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

2.2.12 Bluetooth settings

This command is used to control the bluetooth on or off, the bluetooth function of the module is turned on by default

After receiving this command, the function will take effect after restarting

Command word:0x00A4

Command value:0x0100turn on bluetooth0x0000turn off bluetooth

return value:2byteACKstate(0success,1fail)

Send data: (turn on bluetooth)

FD FC FB FA	04 00	A4 00	01 00	04 03 02 01

radarACK(success):

FD FC FB FA	04 00	A4 01	00 00	04 03 02 01

2.2.13 Get mac address

This command is used to queryMACaddress

Command word:0x00A5

Command value:0x0001

return value:2byteACKstate(0success,1fail) +1byte fixed type (0x00)+3byteMACaddress (address is big-endian sequence)

send data:

FD FC FB FA	04 00	A5 00	01 00	04 03 02 01

radarACK(success):

FD FC FB FA	0A 00	A5 01	00 00	8F 27	2E B8	0F 65	04 03 02 01

Inquiredmacaddress is:8F 27 2E B8 0F 65

2.2.14 Obtain Bluetooth permission

This command is used to obtain Bluetooth permission, and can be used after successful acquisitionappObtain device information and debugging parameters via Bluetooth

Command word:0x00A8

Command value:6bytes of password value (per2byte little endian)

return value:2byteACKstate(0success,1fail)

The default password is "HiLink", then the corresponding value is0x4869(hi)0x4c69(Li)0x6e6b(nk)

send data:

FD FC FB FA	08 00	A8 00	48 69	4c 69	6e 6b	48 69	04 03 02 01

radarACK(success):

FD FC FB FA	04 00	A8 01	00 00	04 03 02 01

Note: This response only responds to Bluetooth, not to the serial port

2.2.15 Set Bluetooth password

This command is used to set the password for Bluetooth control

Command word:0x00A9

Command value:6bytes of password value (each byte is little-endian)

return value:2byteACKstate(0success,1fail)

send data:

FD FC FB FA	08 00	A9 00	48 69	4c 69	6e 6b	04 03 02 01

radarACK(success):

FD FC FB FA	04 00	A9 01	00 00	04 03 02 01

2.2.16 Distance resolution setting

Set the distance resolution of the module, that is, how far each distance gate represents. The configuration value will not be lost when the power is turned off, and the configuration value will take effect after restarting the module.

It can be configured as 0.75m or 0.2m for each range gate, and the maximum number of supported range gates is 8.

Command word:0x00AA

Command value:2byte distance resolution selection index

return value:2byteACKstate(0success,1fail)

Table 8 Selection of distance resolution

Distance resolution selection index value	Range resolution (distance represented by each range gate)

0x0000	0.75m
0x0001	0.2m

The factory default is0x0001,Right now0.75m

send data:

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

radarACK(success):

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

2.2.17 Query distance resolution setting

Query the current range resolution setting of the module, that is, how far each range gate represents.

Command word:0x00AB

Command value: none

return value:2byteACKstate(0success,1fail) +2byte distance resolution selection index

The return value is defined the same as**Table 8 Selection of distance resolution**

send data:

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

radarACK(success):

FD FC FB FA	**06 00**	**AB 01**	**00 00**	**01 00**	**04 03 02 01**

The distance resolution representing the current setting is0.2m

2.3 Radar data output protocol

LD2410BThe radar detection results are output through the serial port, and the basic information of the target is output by default, including target status, motion energy value, rest energy value, motion distance, rest distance and other information. If the radar is configured as engineering mode, the radar will additionally output the energy value of each range gate (moving & static). The radar data is output according to the specified frame format.

2.3.1 Report data frame format

The radar report message frame format defined by the protocol is shown in the table8and table9shown. In normal working mode and engineering mode, the definition of the reported data type value is shown in the table10shown.

Table 8 Reporting data frame format

frame header	Intra-frame data length	Intra frame data	end of frame
F4 F3 F2 F1	2byte	see table9	F8 F7 F6 F5

Table 9 Intra-frame data frame format

type of data	head	target data	tail	check
1bytes (see table10)	0xAA	see table11,surface13	0x55	0x00

Table 10 Data Type Description

data type value	illustrate
0x01	Engineering Mode Data
0x02	Target basic information data

2.3.2 Composition of target data

The target data content reported by the radar will change according to the working mode of the radar. In normal working mode, the radar outputs the basic information data of the target by default; when configured in 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, while the energy value information of the range gate needs to be enabled by the command before it can be output.

In normal working mode, the target data reported by the radar consists of the following table11As shown, the definition of the target state value is shown in the table12shown. The composition of the target data frame in engineering mode is shown in the table13As shown, some data are added to the data reported in the normal working mode.

Table 11 Composition of target basic information data

target state	moving target distance (cm)	Sports goal energy value	stationary target distance (cm)	stationary target energy value	Detection distance (cm)
1bytes (see table12)	2byte	1byte	2byte	1byte	2byte

Table 12 Description of target state value

target state value	illustrate
0x00	no target
0x01	sport goal
0x02	stationary target
0x03	Moving & Stationary Targets

Table 13 Composition of engineering mode target data

Add the following data after the target basic information data in Table 11

...	maximum exercise range gateN	maximum static range gateN	Movement distance leave the door0 Energy value	...	Movement distance leave the doorN Energy value	Static distance leave the door0 Energy value	...	Static distance leave the doorN Energy value	Reserved number According to, store extra information
...	1byte	1byte	1byte	...	1byte	1byte	...	1byte	mbyte

Report data instance:

Report data in normal working mode:

frame header	Intra-frame data length	Intra frame data	end of frame
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	Intra-frame data length	Intra frame data	end of frame
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 method

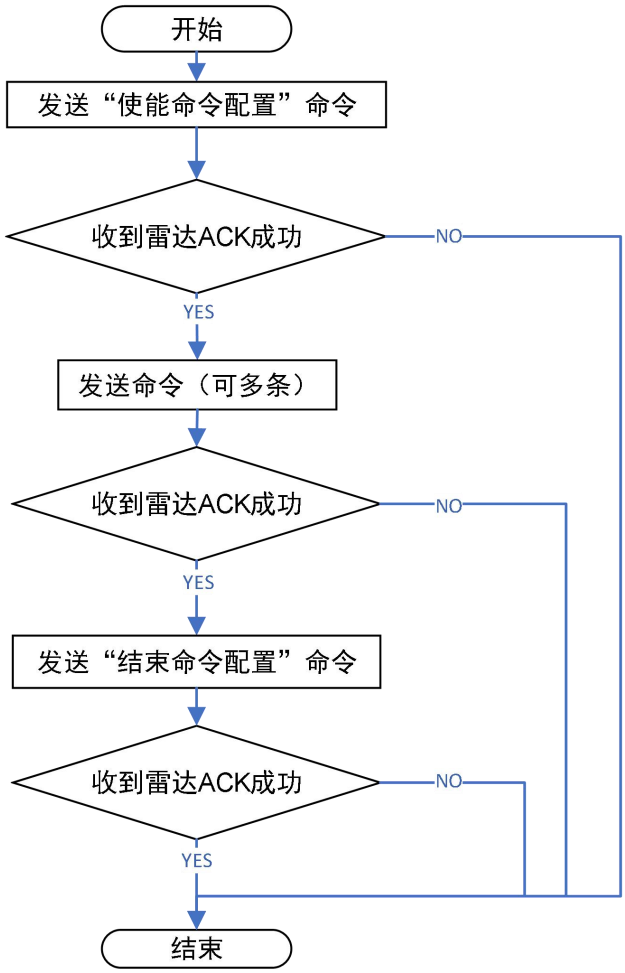
2.4.1 Radar command configuration steps

LD2410BThe process of the radar executing a configuration command includes the host computer "send command" and the radar "reply command".ACK"Two links. If the radar does not haveACKreply or replyACKIf it fails, it means that the radar failed to execute the configuration command.

As mentioned before, 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 that the configuration has ended.

For example, if you want to read the radar configuration parameters, first the host computer sends the "enable configuration" command;ACKAfter success, send the "read parameter" command; wait for the radar to be receivedACKAfter success, finally send the "end configuration" command; wait for the radarACKAfter success, it indicates that the complete read parameter action is over.

The radar command configuration process is shown in the figure below.



picture2Radar command configuration process

3 Revision History

date	Version	Modify content
2022-6-24	1.01	initial version
2022-7-1	1.02	Fixed some error descriptions, added restart and factory reset commands
2022-7-19	1.03	Correct the length value of some command instances
2022-8-22	1.04	Increase the protocol of the bluetooth part
2022-9-20	1.05	Increase the protocol of the bluetooth part, increase the resolution protocol, and correct version number agreement
2022-11-02	1.06	Modify company address
2022-12-6	1.07	Modify the sending command of Bluetooth control password

4 Technical support and contact information

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