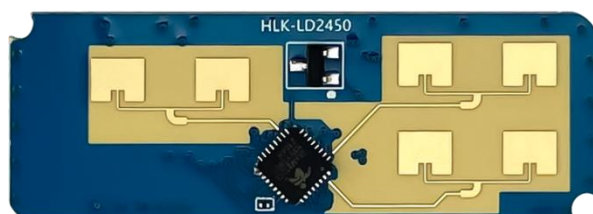**Shenzhen Hailingke Electronics Co., Ltd.**

HLK-LD2450

Moving target detection and tracking module

Serial communication protocol

| Version: V1.02 | Modification date: 2023-9-7 | Copyright@Shenzhen Hailingke Electronics Co., Ltd. |

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1 Introduction to communication interface

1.1 Pin definition

Figure 1 Module pin definition diagram

Pin name	Function
5V	Power supply input 5V
GND	power ground
Tx	Serial port Tx pin
Rx	Serial Rx pin

Table 1 Pin definition table

1.2 Use and configuration

1.2.1 Typical application circuit

The LD2450 module directly outputs detection result data through the serial port according to the specified protocol. The serial port output data contains information such as the

position and speed of up to three targets, and users can flexibly use it according to specific application scenarios.

The module power supply voltage 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 baud rate of the serial port is 256000, 1 stop bit, and no parity bit.

1.2.2 Visual host computer tool description

Our company provides LD2450 visual host computer demonstration software to facilitate users to intuitively experience the positioning and tracking effect of the radar module on targets. **How to use the host computer tools:**

1. Use the USB to serial port tool to correctly connect the module serial port. Please check the module pin description.Table 1 Pin definition table;

2. Open the ICLM_MTT.exe PC tool software, click the Detect Device button, and the PC software will automatically search for the LD2410 module through the serial port;

after detecting the module, the PC software will prompt as shown below
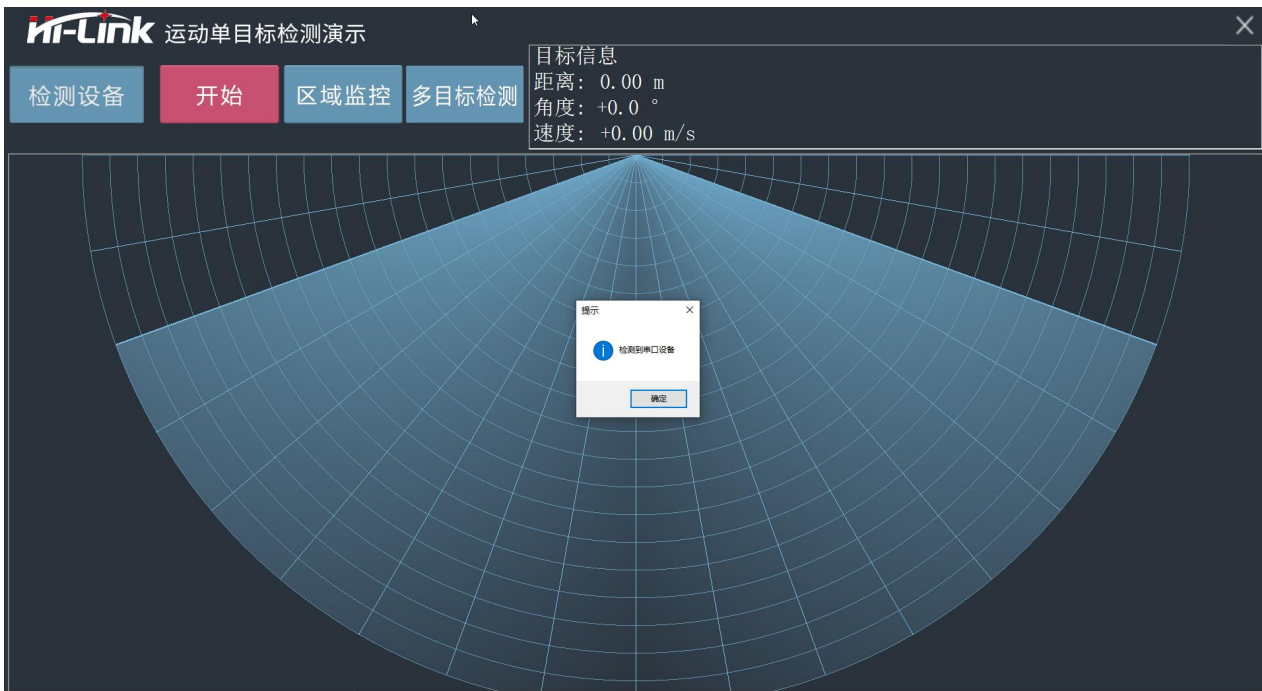
4. Then click the start button. The host computer software will receive the detection data reported by the LD2450 module and display it on the software surface in real time.
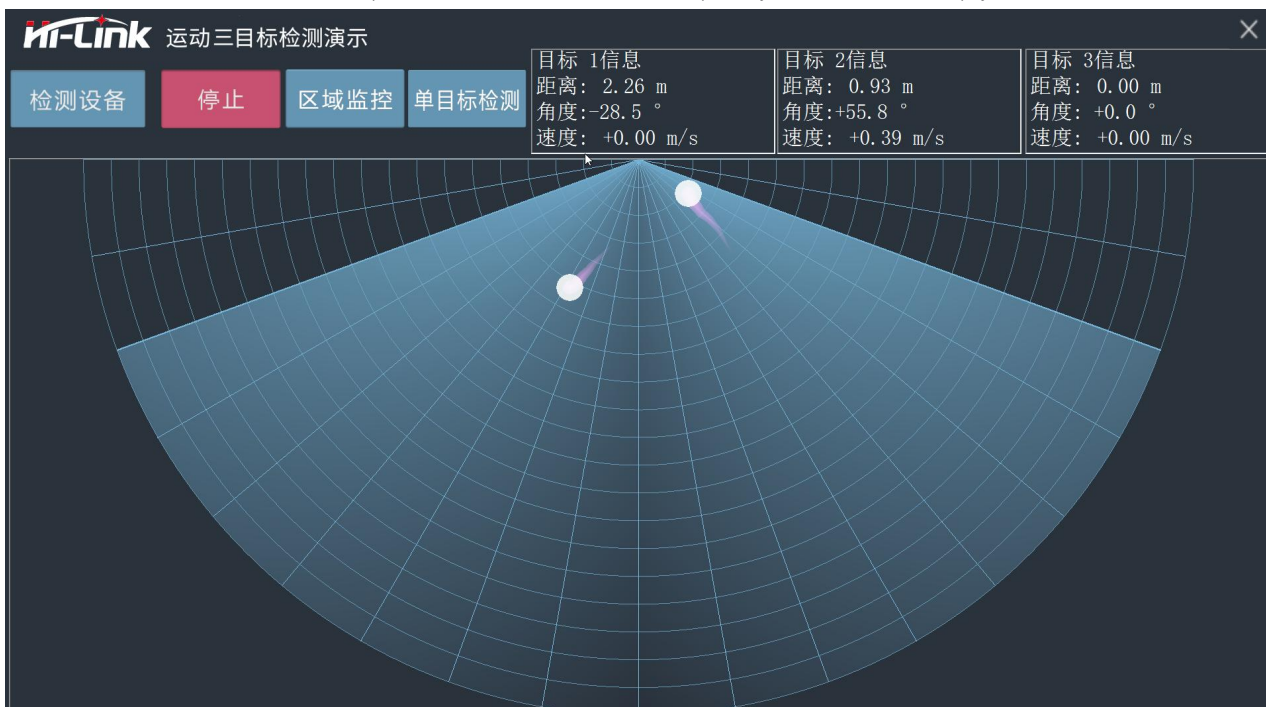
The display includes: the real-time position of up to three targets on the sector chart, and the distance, angle and speed information of each target.

2   letter of agreement

This communication protocol is mainly used by users who need to conduct secondary development without visualization tools.LD2450via serial port (TTLlevel) to communicate with the outside world. The data output and parameter configuration commands of the radar are all performed under this agreement. Radar serial port default baud rate256000,1Stop bits, no parity bits.

2.1 Protocol format

2.1.1 Protocol data format

LD2450The serial port data communication uses little endian format, and all data in the following tables are in hexadecimal.

2.1.2 Command protocol frame format

protocol-defined radar configuration commands andACKThe command format is as shown in the table1To the table4shown.

Table 2 Send command protocol frame format

Frame header	Intraframe data length	intraframe data	end of frame
FD FC FB FA	2byte	See table3	04 03 02 01

Table 3 Transmit intraframe data format

Command word(2byte)	command value (Nbyte)

Table 4 ACK command protocol frame format

Frame header	Intraframe data length	intraframe data	end of frame
FD FC FB FA	2byte	See table5	04 03 02 01

Table 5 ACK intra-frame data format

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

2.2 Send command and ACK

2.2.1 Enable configuration commands

Any other commands issued to the radar must be executed after this command is issued, otherwise they will be invalid.

Command word:0x00FF

Command value:0x0001

return value:2byteACKstate(0success,1failed) +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 returns 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: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 Single target tracking

Set to single target tracking, and the default is multi-target tracking when the module is started.

Command word:0x0080

Command value: None

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

send data:

FD FC FB FA	02 00	80 00	04 03 02 01

radarACK(success):

FD FC FB FA	04 00	80 01	00 00	04 03 02 01

2.2.4 Multiple target tracking

Set to multi-target tracking, the default is multi-target tracking when the module is started.

Command word:0x0090

Command value: None

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

send data:

FD FC FB FA	02 00	90 00	04 03 02 01

radarACK(success):

FD FC FB FA	04 00	90 01	00 00	04 03 02 01

2.2.5 Read firmware version command

This command reads radar firmware version information.

Command word:0x00A0

Command value: None

return value:2byteACKstate(0success,1failed) +2Byte Firmware Type (0x0000) +2Byte major version number +4Bytes

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 00	02 01	16 24 06 22	04 03 02 01

The corresponding version number isV1.02.22062416

2.2.6 Set serial port baud rate

This command is used to set the baud rate of the module's serial port. 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: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 value 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

2.2.7 Restore factory settings

This command is used to restore all configuration values to their non-factory values. 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 items	default value
Serial port baud rate	256000
Bluetooth switch	open

2.2.8 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: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

2.2.9 Bluetooth settings

This command is used to control the turning on or off of Bluetooth. The Bluetooth function of the module is turned on by default. The configuration values will not be lost when the power is off, and the configuration values will

take effect after restarting the module.

Command word:0x00A4

Command value:0x0100Turn on Bluetooth0x0000Turn off Bluetooth

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

send data:

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

Indicates turning on Bluetooth

radarACK(success):

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

2.2.10 Get mac address

This command is used to queryMACaddress

Command word:0x00A5

Command value:0x0001

return value:2byteACKstate(0success,1failed)+1Byte fixed type (0x00)+3byteMACAddress (big endian)

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

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

2.2.11 Query the current regional filtering configuration

This command is used to query the current area filtering configuration of the module

Command word:0x00C1

Command value: None

return value:2byteACKstate(0success,1failed)+2Byte area filter type+twenty fourByte area coordinate configuration

Area filter type	Area one coordinate setting	Area 2 coordinate settings	Regional coordinate settings
signed int16 type 0 Turn off regional filtering 1 Only detect the set area 2 Does not detect the set area	set upThe coordinate values of the two diagonal vertices of the rectangular area; Each vertex is represented by x and y coordinates respectively, and the coordinate value grid The formula is signed int16 type, unit mm; All coordinate values are 0, indicating that this area is not used;	The format of the setting value is the same as that of the region Format	The format of the setting value is the same as that of the region Format

Table 8 Regional filtering configuration value format

send data:

FD FC FB FA	02 00	C1 00	04 03 02 01

radarACK(success):

FD FC FB FA	1E 00	C1 01	00 00	01 00	E803 E803 18FC 8813	0000 0000 0000 0000	0000 0000 0000 0000	04 03 02 01

Represents the current configuration content: only detects targets in the rectangular area delineated by two diagonal vertex coordinates (1000,1000) and

(-1000,5000)

2.2.12 Set regional filtering configuration

This command is used to set the regional filtering configuration of the module. The configuration value will not be lost after power failure. It will take effect immediately after setting.

Command word:0x00C2

Command value:26Bytes of area filtering configuration value, see the value formatTable 8 Regional filtering configuration value format table

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

send data:

FD FC FB FA	1C 00	C2 00	02 00	E803 E803 18FC 8813	0000 0000 0000 0000	0000 0000 0000 0000	04 03 02 01

The representative setting is: do not detect targets in the rectangular area delimited by the two diagonal vertex coordinates (1000,1000) and (-1000,5000).

radarACK(success):

FD FC FB FA	04 00	C2 01	00 00	04 03 02 01

2.3 Radar data output protocol

The LD2450 module communicates with the outside world through the serial port and outputs the detected target information, including the x coordinate, y coordinate in the area, and the speed value of the target.

The default baud rate of the radar serial port is 256000, 1 stop bit, and no parity bit. The data format reported by the radar is as shown in the table below, and is reported at 10 frames per second.

Frame header	intraframe data	end of frame
AA FF 03 00	Target 1 Information Target 2 Information Target 3 Information	55cc

Table 9 Report data frame format

The specific information contained in a single target is shown in the following table

Target X coordinate	target y coordinate	target speed	distance resolution
signed int16 type, highest Bit 1 corresponds to positive coordinates, bit 0 corresponds to Negative coordinate, unit mm	signed int16 type, highest Bit 1 corresponds to positive coordinates, bit 0 corresponds to Negative coordinate, unit mm	signed int16 type, 1 pair of highest bits Should be positive speed, 0 corresponds to negative speed, The other 15 bits correspond to the speed, in cm/s	uint16 type, single pitch Size from door, unit: mm

Table 10 Intra-frame data format

Data example:

AA FF 03 00 **0E 03 B1 86 10 00 40 01** **00 00 00 00 00 00 00 00** **00 00 00 00 00 00 00 00** **55cc**

This set of data indicates that the radar is currently tracking a target, namely target 1 (blue field in the example). Target 2 and target 3 (corresponding to the red and black fields in the example respectively) do not exist, so their corresponding data segments are 0x00. The process of converting target 1 data into relevant information is shown below: Target 1 x coordinate: 0x0E + 0x03 * 256 = 782

0 - 782 = -782 mm Target 1 y coordinate: 0xB1 + 0x86 * 256 = 34481

34481 - 2^15 = 1713 mm

Target 1 speed: 0x10 + 0x00 * 256 = 16

0 -16 =-16 cm/s

Target 1 distance resolution: 0x40 +0x01* 256 = 320 mm

2.4 Radar command configuration method

LD2450The process of the radar executing a configuration command includes the host computer "sending the command" and the radar "replying the command".ACK"Two links. If there is no radarACKreply 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, developers need 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; after receiving the radarACKAfter success, send the "read parameters" command again; wait until the radarACKAfter success, finally send the "end configuration" command; wait for the radarACKAfter success, it indicates that the complete action of reading parameters is completed.

The radar command configuration process is shown in the figure below.
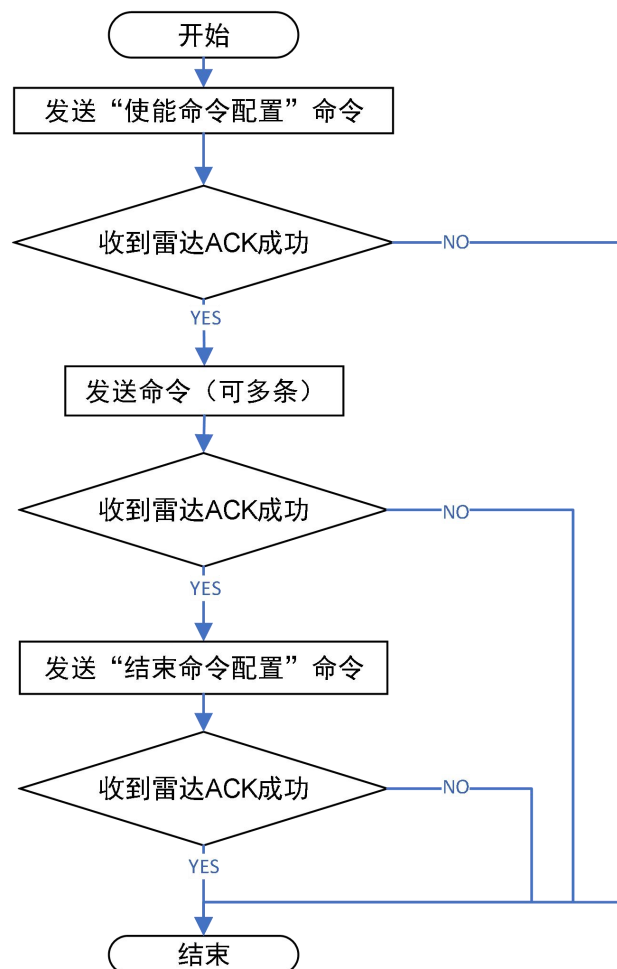
picture2Radar command configuration process

3 Revision history

date	Version	Modify content
2023-8-2	1.01	initial version
2023-9-7	1.02	Added configuration commands related to regional filtering function

4 Technical support and contact information

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