

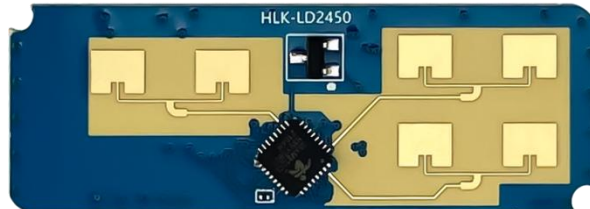


Shenzhen Hi-Link Electronic Co.,Ltd

HLK-LD2450

Motion Target Detection and Tracking Module

Serial Communication Protocol



Content

1 Communication Interface Introduction	4
1.1 Pin definitions	4
1.2 Use and configuration	4
1.2.1 Typical application circuit	4
1.2.2 Visualization upper tool description	4
2 Communications Protocol	6
2.1 Protocol format	6
2.1.1 Protocol data format	6
2.1.2 Command protocol frame format	6
2.2 Send command with ACK	7
2.2.1 Enable configuration commands	7
2.2.2 End configuration commands	7
2.2.3 Single target tracking	7
2.2.4 Multi target tracking	8
2.2.5 Query target tracking mode	8
2.2.6 Read firmware version command	8
2.2.7 Setting the serial port baud rate	9
2.2.8 Restore factory setting	9
2.2.9 Restart module	10
2.2.10 Bluetooth setup	10
2.2.11 Get mac address	10
2.2.12 Query the current zone filtering configuration	11
2.2.13 Setting up regional filtering configurations	12
2.3 Radar data output protocol	12
2.4 Radar command configuration method	13
3 Revision History	14
4 Technical Support and Contact	14

Chart Index

Table 1	Pin definition	4
Table 2	Send command protocol frame format	6
Table 3	Transmit in-frame data format	6
Table 4	ACK command protocol frame format	6
Table 5	ACK intra-frame data format	6
Table 6	Serial baud rate selection	9
Table 7	Factory default configuration values	9
Table 8	Regional filtering configuration value format	11
Table 9	Reported data frame format	12
Table 10	In-frame data format	12
Figure 1	Module pin definition diagram	4
Figure 3	Illustration of the effect of zone filtering configuration	11
Figure 3	Radar command configuration flow	13

1 Communication Interface Introduction

1.1 Pin definitions

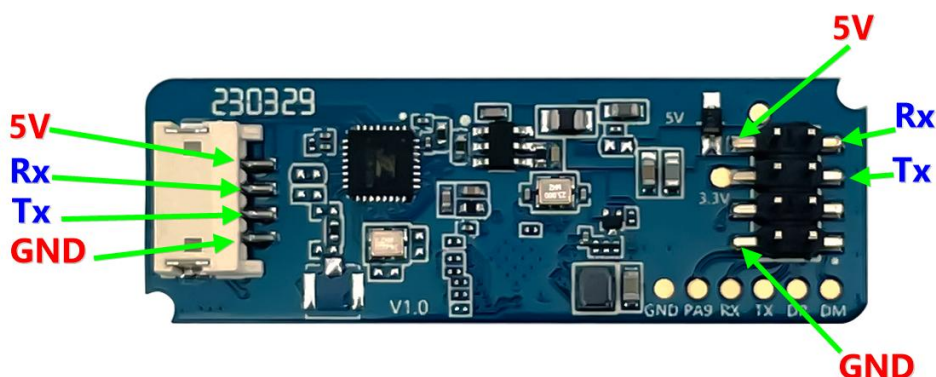


Figure 1 Module Pin Definition Diagram

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

Table 1 Pin Definition

1.2 Use and configuration

1.2.1 Typical application circuit

LD2450 module directly through the serial port in accordance with the prescribed protocol for the detection of the results of the data output, the serial port output data contains up to three target position and speed and other information, the user can be flexible according to the specific application scenarios.

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

The module IO output level is 3.3 V. The default baud rate of the serial port is 256000, 1 stop bit, no parity bit.

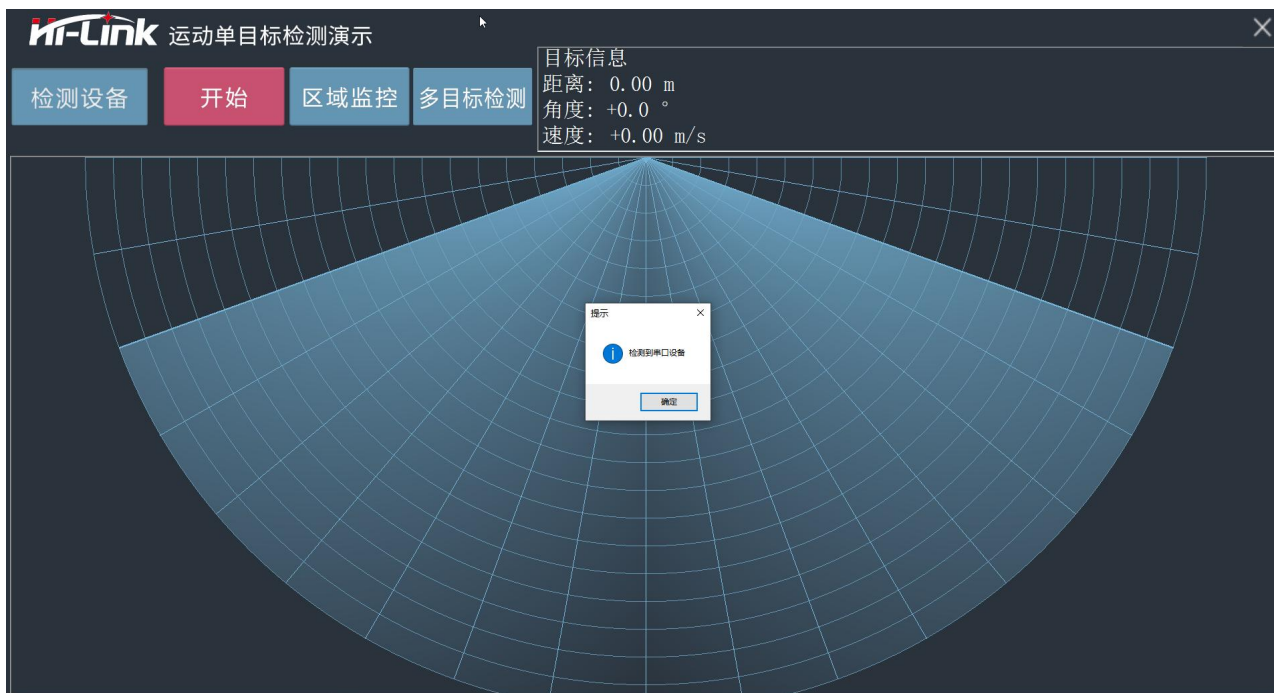
1.2.2 Visualization upper tool description

Our company provides the visualization of LD2450 upper computer demonstration software, which is convenient for users to intuitively experience the positioning and tracking effect of the radar

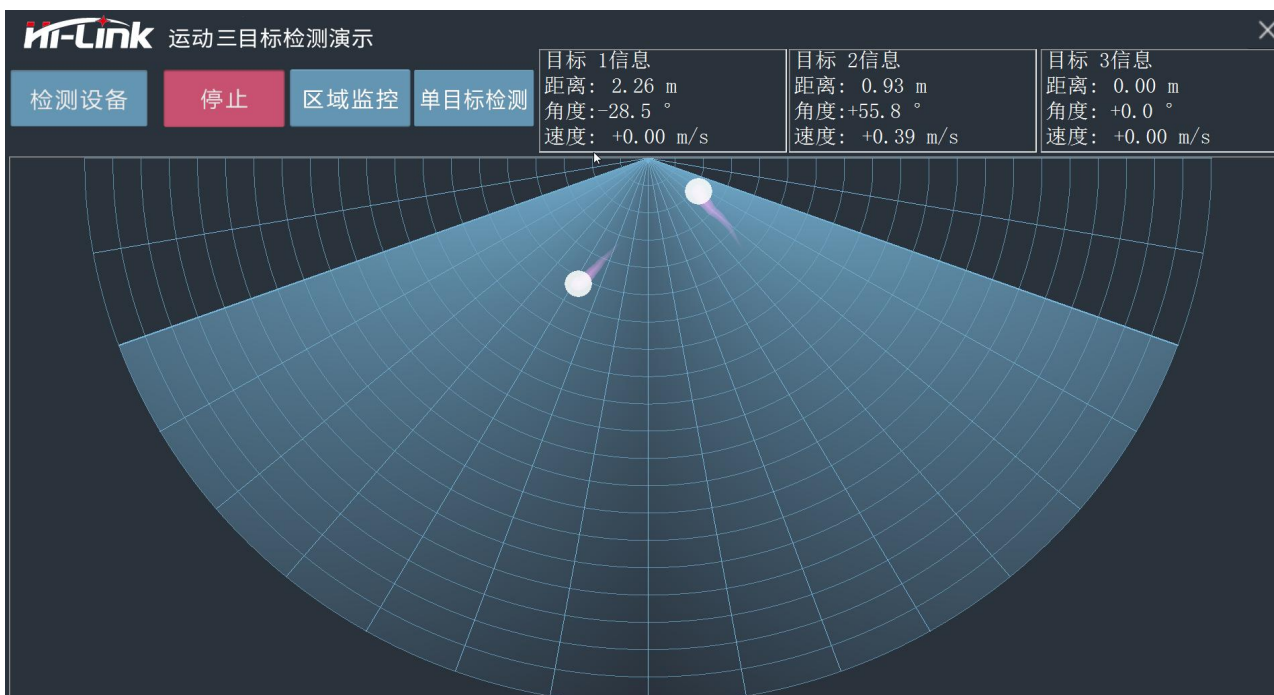
module on the target.

How to use the upper tool:

1. Use the USB to Serial tool to connect the module serial port correctly, please refer to Table 1 Pin Definition Table for the module pin description;
2. Open ICLM_MTT.exe PC tool software, click the Detect Device button, the PC software automatically searches for the LD2410 module through the serial port; after the module is detected, the PC software will have a prompt as follows.



3. Then click the start button, the upper 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 positions of up to three targets on a sector map, with distance, angle and speed information for each target.

2 Communications Protocol

This communication protocol is mainly for users who need to do secondary development away from the visualization tool. the LD2450 communicates with the outside world through a serial port (TTL level). Radar data output and parameter configuration commands are carried out under this protocol. The default baud rate of the radar serial port is 256000, 1 stop bit, no parity bit.

2.1 Protocol format

2.1.1 Protocol data format

The LD2450's serial data communication uses the little-end format, and all data in the following tables are in hexadecimal.

2.1.2 Command protocol frame format

The protocol-defined radar configuration commands and ACK command formats are shown in Tables 1 through 4.

Table 2 Send command protocol frame format

Header	In-frame data length	In-frame data	End of frame
FD FC FB FA	2 bytes	See Table 3	04 03 02 01

Table 3 Transmit in-frame data format

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

Table 4 ACK command protocol frame format

Header	In-frame data length	In-frame data	End of frame
FD FC FB FA	2 bytes	See Table 5	04 03 02 01

Table 5 ACK intra-frame data format

Send Command Word 0x0100 (2 bytes)	Return value (N bytes)
--------------------------------------	------------------------

2.2 Send Command with ACK

2.2.1 Enable configuration commands

Any other orders issued to the radar must be issued after this order or they are invalid.

Command word: 0x00FF

Command value: 0x0001

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

Send data:

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

Radar ACK(success):

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

2.2.2 End configuration commands

End Configuration command, the radar restores the 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 byte 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 Single target tracking

Set to single target tracking

Command word: 0x0080

Command value: none

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

Send data:

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

Radar ACK(success):

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

2.2.4 Multi target tracking

Set to multi-target tracking

Command word: 0x0090

Command value: none

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

Send data:

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

Radar ACK(success):

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

2.2.5 Query target tracking mode

Queries the current target tracking of the module, the default value is multi-target tracking.

Command word: 0x0091

Command value: none

Return Value: 2 bytes ACK status (0 success, 1 failure) + 2 bytes tracking mode value (0x0001 single target tracking, 0x0002 multi-target tracking)

Send data:

FD FC FB FA	02 00	91 00	04 03 02 01
-------------	-------	-------	-------------

Radar ACK(success):

FD FC FB FA	06 00	91 01	00 00	01 00	04 03 02 01
-------------	-------	-------	-------	-------	-------------

The return value 0x0001 means that it is currently in single-target tracking mode.

FD FC FB FA	06 00	91 01	00 00	02 00	04 03 02 01
-------------	-------	-------	-------	-------	-------------

The return value of 0x0002 means that it is currently in multi-target tracking mode.

2.2.6 Read firmware version command

This command reads the 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	0C 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.

2.2.7 Setting the serial port baud rate

This command is used to set the baud rate of the serial port of the module, the configured value is not lost when power down, and the configured value takes effect after restarting the module.

Command Word: 0x00A1

Command value: 2-byte baud rate selection index

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

Table 6 Serial 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 0x0007, which is 256000.

Send data:

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

Radar ACK(success):

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

2.2.8 Restore factory setting

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

Command Word: 0x00A2

Command value: none

Return Value: 2 byte 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 configuration values

Configuration item	Default value
Serial port baud rate	256000
Bluetooth switch	Turn on
Tracking mode	Multi-target tracking
Area filtering function	Turn off

2.2.9 Restart module

The module receives this command and will automatically reboot after the answer 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
-------------	-------	-------	-------	-------------

2.2.10 Bluetooth setup

This command is used to control the Bluetooth on or off, the Bluetooth function of the module is on by default. The configured value is not lost when power down, and the configured value takes effect after restarting the module.

Command word: 0x00A4

Command value: 0x0100 turn on bluetooth 0x0000 turn off bluetooth

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

Send data:

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

Indicates Bluetooth is turned on.

Radar ACK(success):

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

2.2.11 Get mac address

This command is used to query the MAC address

Command word: 0x00A5

Command value: 0x0001

Return Value: 2 bytes ACK status (0 success, 1 failure) + 1 byte fixed type (0x00) + 3 bytes MAC address (big end sequence)

Send data:

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

Radar ACK(success):

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

The queried mac address is: 8F 27 2E B8 0F 65

2.2.12 Query the current zone filtering configuration

This command queries the current zone filtering configuration of the module

Command word: 0x00C1

Command value: none

Return: 2 bytes ACK status (0 success, 1 failure) + 2 bytes area filter type + 24 bytes area coordinate configuration

Type of regional filtering	Regional 1-coordinate setting	Regional 2-coordinate setting	Regional 3-coordinate setting
signed int16 type 0 Disable region filtering 1 Detect only the set region 2 Do not detect the set area	Setting the coordinate values of the diagonal two vertices of the rectangular region; Each vertex is represented by X and Y coordinates, respectively, and the format of the coordinate values is of type signed int 16 in mm; All coordinate values of 0 means this area is not used.	The format of the setting value is the same as the format of the area 1 setting.	The format of the setting value is the same as the format of the area 1 setting.

Table 8 Regional filtering configuration value format

Send data:

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

Radar ACK(success):

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

Represents the current configuration: only detect targets in the rectangular area delineated by two diagonal vertices with coordinates (1000,1000) and (-1000,5000), corresponding to the detection range of the red box area as follows.

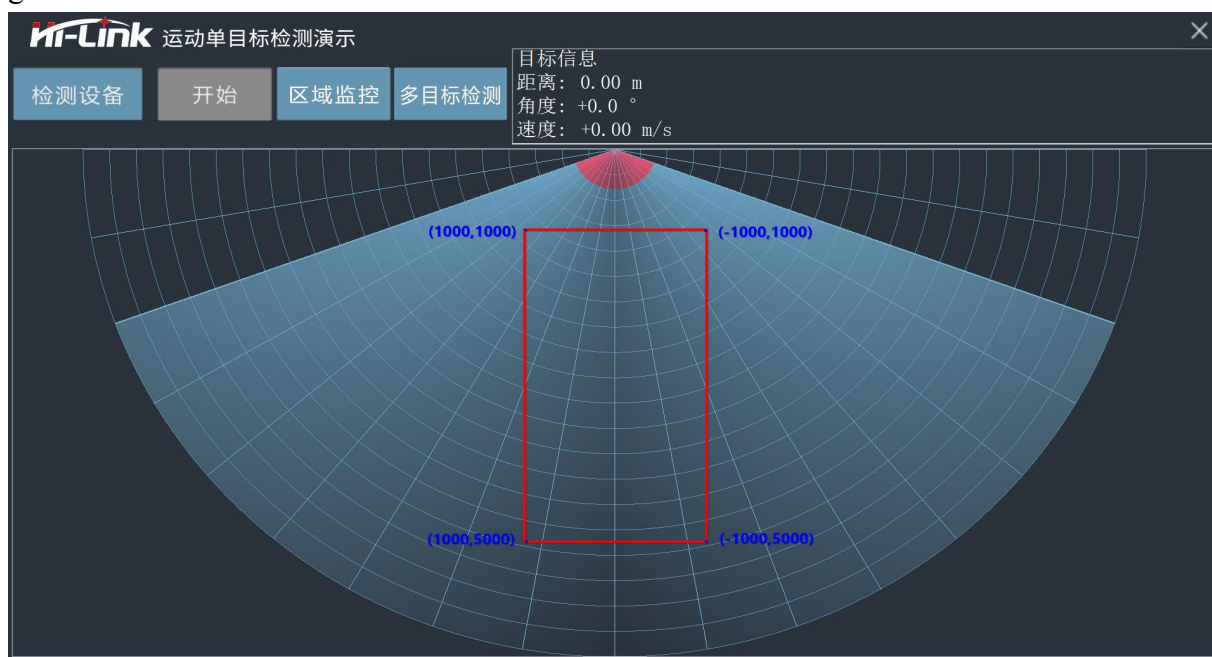


Figure 3 Illustration of the effect of zone filtering configuration

2.2.13 Setting up regional filtering configurations

This command is used to set the region filtering configuration of the module, the configuration value will not be lost when power down, and it takes effect immediately after setup.

Command word: 0x00C2

Command value: 26 bytes of region filtering configuration value, see Table 8 Region filtering configuration value format.

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

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
----------------	----------	----------	----------	------------------------	------------------------	------------------------	----------------

Represents the setting of not detecting targets in the rectangular area delimited by the coordinates of the two diagonal vertices (1000,1000) and (-1000,5000).

Radar ACK(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 information about the detected target, including the x-coordinate and y-coordinate in the area, as well as the velocity value of the target.

The default baud rate of the radar serial port is 256000, 1 stop bit, no parity bit.

The data format reported by the radar is shown in the table below, 10 frames per second.

Header	In-frame data	End of frame
AA FF 03 00	Goal 1 information Goal 2 information Goal 3 information	55 CC

Table 9 Reported data frame format

The specific information contained in the individual targets is shown in the table below

Target X coordinate	Target Y coordinate	Target speed	Distance resolution
signed int 16 type, the highest bit 1 corresponds to positive coordinates, 0 corresponds to negative coordinates, unit: mm	signed int 16 type, the highest bit 1 corresponds to positive coordinates, 0 corresponds to negative coordinates, unit: mm	signed int 16 type, the highest bit 1 corresponds to the positive speed, 0 corresponds to the negative speed, and the other 15 bits correspond to the speed in cm/s.	uint16 type, individual distance gate size in mm

Table 10 In-frame data format

Example of data:

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 55 CC

This set of data indicates that the radar is currently tracking a target i.e. target 1 (blue field in the example), and target 2 and target 3 (corresponding to the red and black fields in the example respectively) do not exist, so their corresponding data segment is 0x00. The process of converting the

data of target 1 into relevant information is demonstrated as follows:

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

The process of LD2450 radar executing a configuration command consists of two parts: the upper computer "sends command" and the radar "replies to command ACK". If the radar does not reply with ACK or fails to reply with ACK, it means that the radar fails to execute the configuration command.

As mentioned above, 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 been completed.

For example, if you want to read the radar configuration parameters, firstly, 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 sends the "end configuration" command at last. After receiving the successful radar ACK, then send the "read parameters" command; after receiving the successful radar ACK, finally send the "end configuration" command; after the successful radar ACK, it indicates that the complete action of reading parameters is finished.

The radar command configuration flow is shown below.

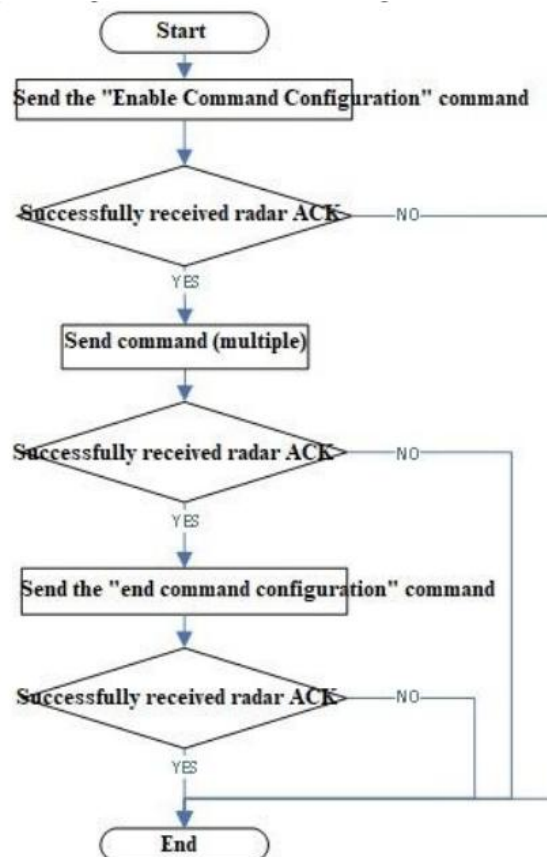


Figure 3 Radar command configuration flow

3 Revision History

Data	Version	Contents of the modification
2023-8-2	1.01	Initial version
2023-9-7	1.02	Configuration commands related to adding zone filtering
2023-10-17	1.03	Add tracking mode query command Optimize default value description

4 Technical Support and Contact



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