

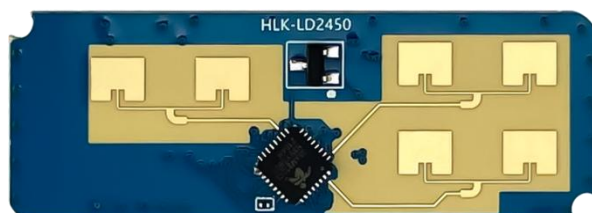


Shenzhen Hi-Link Electronic Co., Ltd.

HLK-LD2450

Motion target detection and tracking module

Serial communication protocol



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1. Introduction to communication interfaces

1.1 Pin definition

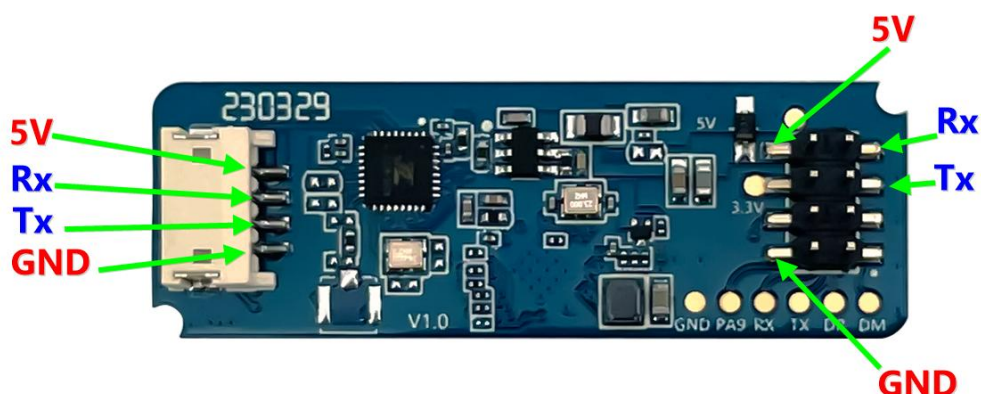


Figure 1 Module pin definition diagram

Pin name	Function
5V	Power supply input 5V

Pin name	Function
GND	Power Ground
Tx	Serial Tx pin
Rx	Serial Rx Pin

Table 1 Pin definition table

1.2 Usage and Configuration

1.2.1 Typical application circuit

The LD2450 module outputs the detection result data directly through the serial port according to the specified protocol. The serial port output data contains the location and speed information of up to three targets, which can be flexibly used according to the specific application scenario.

The power supply voltage of the module is 5V, and the power supply capability of the input power supply is greater than 200mA.

Module IO output level is 3.3V. The serial port has a default baud rate of 256000, 1 stop bit and no parity bit.

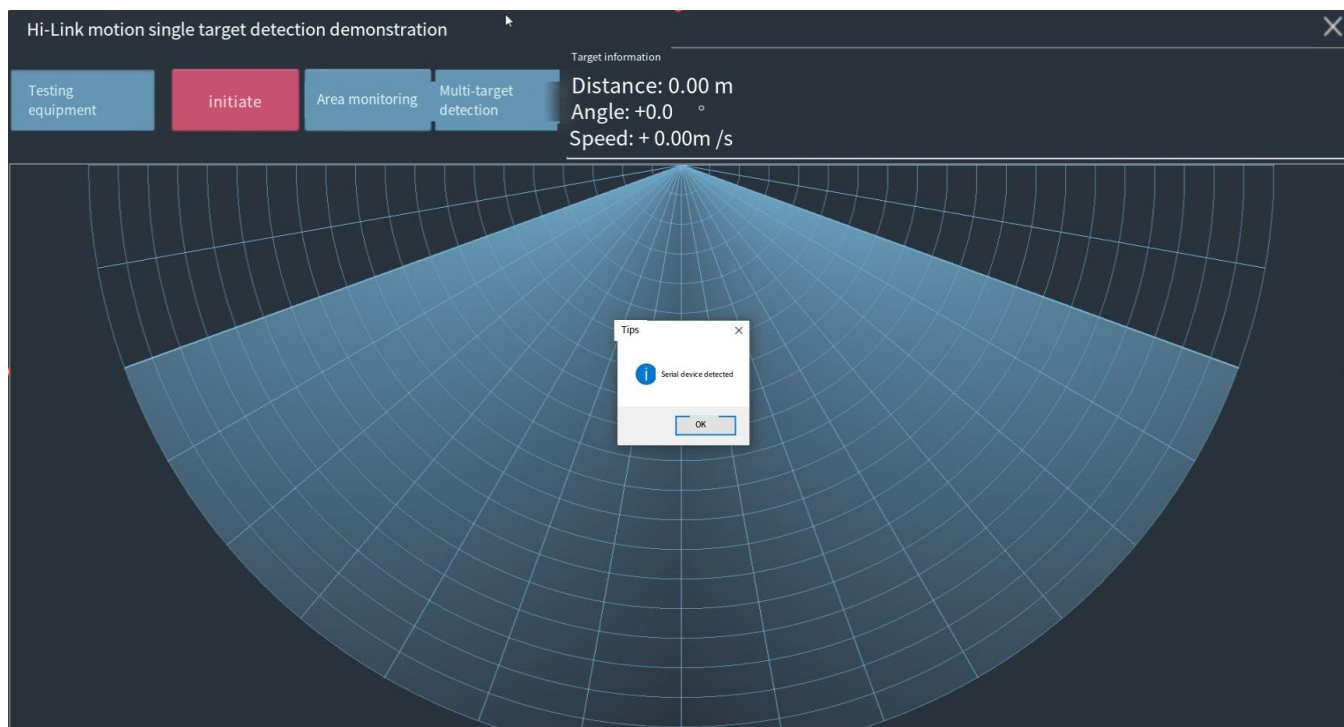
1.2.2 Visual upper computer tool description

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

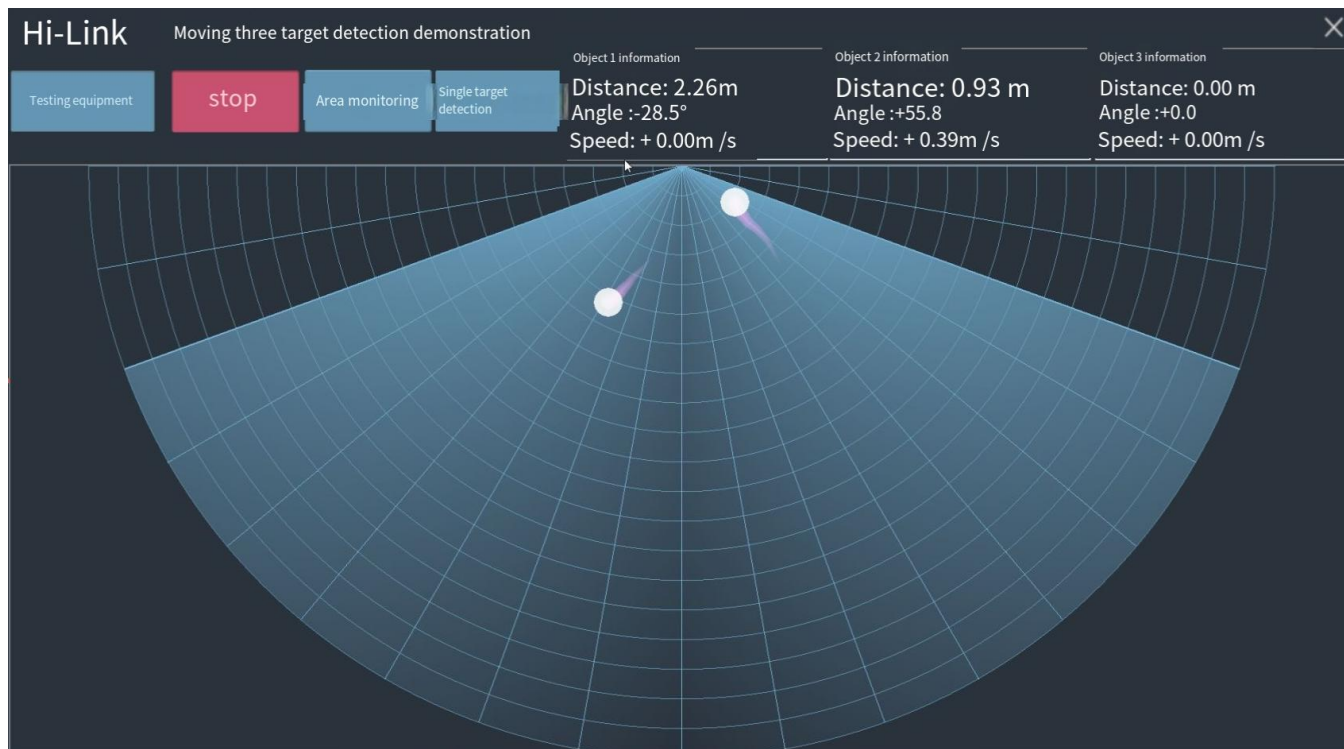
How to use the upper computer tool:

1. Use the USB-to-serial port tool to correctly connect the serial port of the module. For module pin descriptions, see [Figure 1 Module pin definition diagram](#)

2. Open the ICLM_MTT.exe tool software on the upper computer, click the detection device button, and the upper computer software automatically searches the LD2410 module through the serial port; After the module is detected, the upper computer software will prompt as shown in the following figure:



3. Then click the Start button, and 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 position of up to three targets on the fan chart, and distance, Angle, and speed information for each target.

2. Communication Protocols

This communication protocol is mainly used by users who are separated from visual tools for secondary development. 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 agreement. The radar serial port has a default baud rate of 256000, 1 stop bit and no parity bit.

2.1 Protocol Format

2.1.1 Protocol data format

Serial port data communication of LD2450 uses the small-end format.

All data in the following table is hexadecimal.

2.1.2 Frame Format of the command protocol

The radar configuration command and ACK command formats defined by the protocol are shown in [Table 2](#) to [Table 5](#).

Table 2 Transmit command protocol frame format

Frame header	Intra-frame data length	Intra-frame data	Frame end
FD FC FB FA	2 bytes	See Table 3	04 03 02 01

Table 3 Format of sending intra-frame data

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

Table 4 ACK command protocol frame format

Frame header	Intra-frame data length	Intra-frame data	Frame end
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)	Returned value (N byte)
-------------------------------------	-------------------------

2.2 Sending Commands and ACK

2.2.1 Enable the configuration command

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

Command word: 0x00FF

Command value: 0x0001

Returned value: 2-byte ACK status (0 succeeded, 1 failed) + 2-byte protocol version (0x0001) + 2-byte buffer size (0x0040)

Send data

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

Radar ACK(successful) :

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 configuration command, radar returned to operational mode after execution. If you want to run other commands again, you need to send the enable configuration command first.

Command word: 0x00FE

Command value: None

Returned value: 2 bytes ACK status (0 succeeded, 1 failed)

Send data:

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

Radar ACK(successful) :

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

2.2.3 Single target tracking

Set it to single target tracking

Command word: 0x0080

Command value: None

Returned value: 2 bytes ACK status (0 succeeded, 1 failed)

Send data:

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

Radar ACK(successful) :

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

2.2.4 Multiple target tracking

Set up multi-target tracking

Command word: 0x0090

Command value: None

Returned value: 2 bytes ACK status (0 succeeded, 1 failed)

Send data:

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

Radar ACK(successful) :

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-byte ACK status (0 successful, 1 failed) + 2-byte trace

mode value (0x0001 Single target Trace, 0x0002 Multiple target trace)

Send data:

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

Radar ACK(successful) :

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

The return value 0x0001 indicates the current single-target tracking mode.

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

The return value 0x0002 represents the current 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

Returned value: 2-byte ACK status (0 succeeded, 1 failed) + 2-byte firmware type (0x0000) + 2-byte major version number + 4-byte minor version number.

Send data:

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

Radar ACK(successful) :

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 Set the Baud Rate of the serial Port

Using this command, you can set the baud rate of the serial port on a module. The value does not lose after a power failure. The value takes effect after the module is restarted.

Command word: 0x00A1

Command value: 2 bytes Baud rate selection index

Returned value: 2 bytes ACK status (0 succeeded, 1 failed)

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 0x0007, that is, 256000.

Send data:

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

Radar ACK(successful) :

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

2.2.8 Restore factory setting

Using this command, you can restore all configuration values to their default values. The configuration values take effect after the module is restarted.

Command word: 0x00A2

Command value: None

Returned value: 2 bytes ACK status (0 succeeded, 1 failed)

Send data:

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

Radar ACK(successful) :

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

The factory default values are as follows:

Table 7 Factory default configurations

Configuration item	Default value
Serial baud rate	256000
Bluetooth switch	Switch on
Tracking mode	Multiple target tracking
Zone filtering function	Off

2.2.9 Restart module

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

Command word: 0x00A3

Command value: None

Returned value: 2 bytes ACK status (0 succeeded, 1 failed)

Send data:

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

Radar ACK(successful) :

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

2.2.10 Bluetooth setting

This command is used to enable or disable Bluetooth. The Bluetooth function of the module is enabled by default. The configuration value is not lost after a power failure. The configuration value takes effect after the module is restarted.

Command word: 0x00A4

Command value: 0x0100 Enabling Bluetooth 0x0000 Disabling Bluetooth

Returned value: 2 bytes ACK status (0 succeeded, 1 failed)

Send data:

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

Represent turn on bluetooth.

Radar ACK(successful) :

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

2.2.11 Obtaining a mac Address

This command is used to query the MAC address.

Command word: 0x00A5

Command value: 0x0001

Returned value: 2-byte ACK status (0 succeeded, 1 failed) + 1-byte fixed type (0x00) + 3-byte MAC address (big-endian)

Send data:

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

Radar ACK(successful) :

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 area filtering configuration

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

Command word: 0x00C1

Command value: None

Returned value: 2-byte ACK status (0 succeeded, 1 failed) + 2-byte area filter type + 24-byte area coordinate configuration

Area filter type	Region 1 coordinate Setting	Region 2 coordinate Setting	Region 3 coordinate Setting
signed int16 type 0 Disable the area filtering function 1 Only the set area is detected 2 The set area is not detected	Sets the coordinate values of the two diagonal vertices of the rectangular area; each vertex is represented in x and y coordinates, and the coordinate value is in signed int16 format, in mm; if all coordinates are 0, the region is not used.	The format of the setting value is the same as that of region 1	The format of the setting value is the same as that of region 1

Table 8 Format of area filtering configuration values

Send data:

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

Radar ACK(successful) :

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

Representing the current configuration content is: only two targets in the rectangular area delimited by the coordinates of two diagonal vertices (1000,1000) and (-1000,5000) are detected, and the corresponding detection range is in the red box area as shown below:

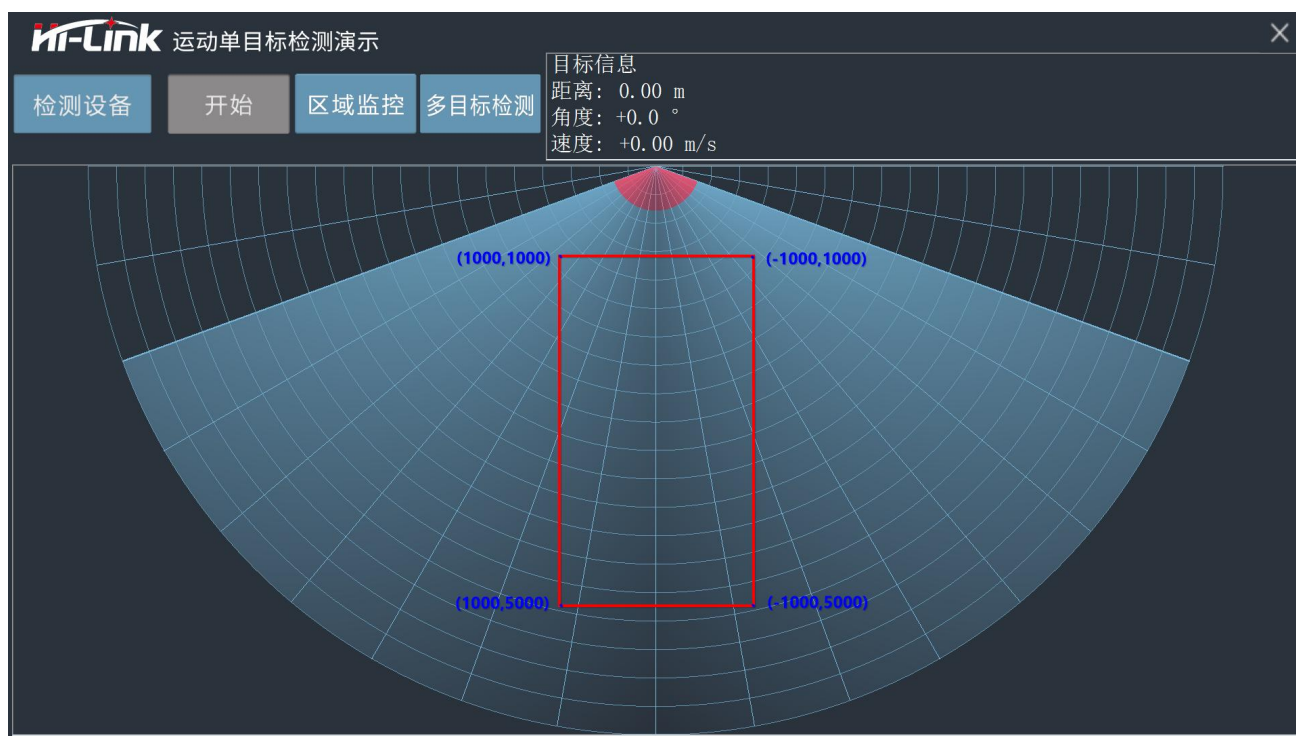


Figure 2 Zone filtering configuration effect diagram

2.2.13 Set the area filtering configuration

This command is used to set the area filtering configuration of a module. The configuration value does not lose after power failure and takes effect immediately

Command word: 0x00C2

Command value: The value is a 26-byte area filtering configuration.

Value format see [Table 8 Format of area filtering configuration values](#)

Returned value: 2 bytes ACK status (0 succeeded, 1 failed)

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

Represent set to: do not detect two targets in a rectangular area delimited by two diagonal vertex coordinates (1000,1000) and (-1000,5000)

Radar ACK(successful) :

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 in the area, the y coordinate, and the speed value of the target.

The radar serial port has a default baud rate of 256000,1 stop bit and no parity bit.

The radar reports data in the format shown in the table below, at 10 frames per second.

Frame Header	Intra-frame data	Frame end
AA FF 03 00	Target 1 information Target 2 information Target 3 information	55 CC

Table 9 Format of reported data frames

The following table shows the specific information for a single target:

Table 10 Intra-frame data format

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 00 00 00 55 CC

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

2.4 Radar command configuration mode

The process of executing a configuration command by the LD2450 radar includes two steps: "send command" by the host computer and "reply command ACK" by the radar. If the radar does not respond with an ACK or fails to respond with an ACK, it indicates that the radar fails to execute the configuration command.

As mentioned earlier, before sending any other commands to the radar, the developer needs to send the "enable configuration" command, and then send the configuration command within the specified time. After the command configuration is complete, send the "End configuration" command to inform the radar that the configuration is complete.

For example, to read the radar configuration parameters, the host computer first sends the "enable configuration" command; After receiving the radar ACK successfully, send the "Read parameters" command. After receiving the radar ACK successfully, send the End configuration command. After the radar ACK succeeds, it indicates that the complete parameter reading operation is complete.

The radar command configuration process is shown in the following figure:

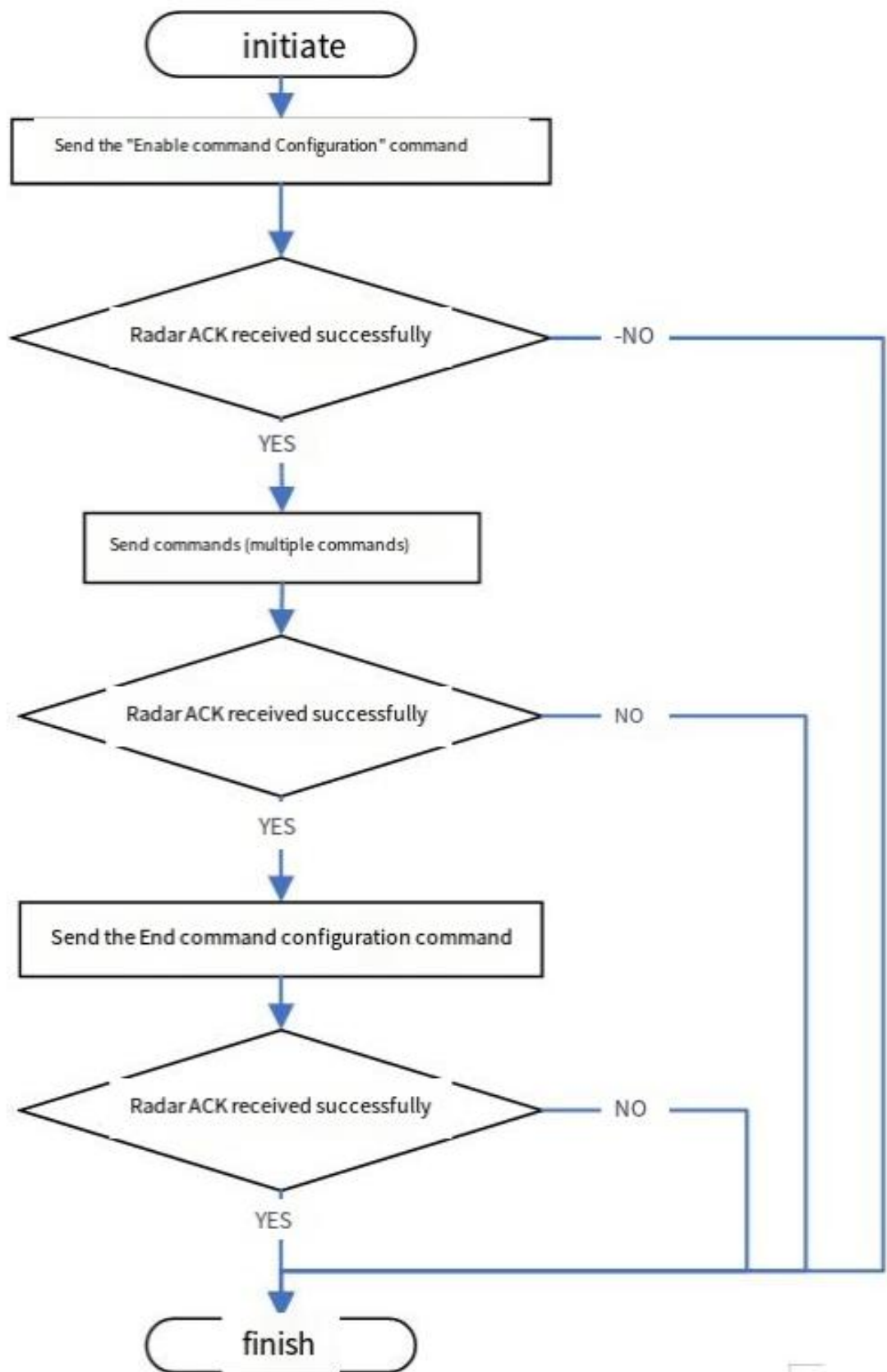


Figure 3 Radar command configuration process

3. Revision Records

Date	Version	Revise content
2023-8-2	1.01	Initial version
2023-9-7	1.02	Added commands related to area filtering
2023-10-17	1.03	Added trace mode query command Optimized the description of default values

4. Technical support and contact information



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