WitMotion WT-VL53L1 Laser Ranging Sensor User Manual

Contents

WitMotion WT-VL53L1 Laser Ranging Sensor

Product Information

Tutorial Link

[Google Drive]

Link to instructions DEMO:

[WITMOTION Youtube Channel]

If you have technical problems or cannot find the information that you need in the provided documents, please contact our support team. Our engineering team is committed to providing the required support necessary to ensure that you are successful with the operation of our AHRS sensors.

Contact

[Technical Support Contact Info]

Application

- Robot
- UAV
- Intelligent Device

Specifications

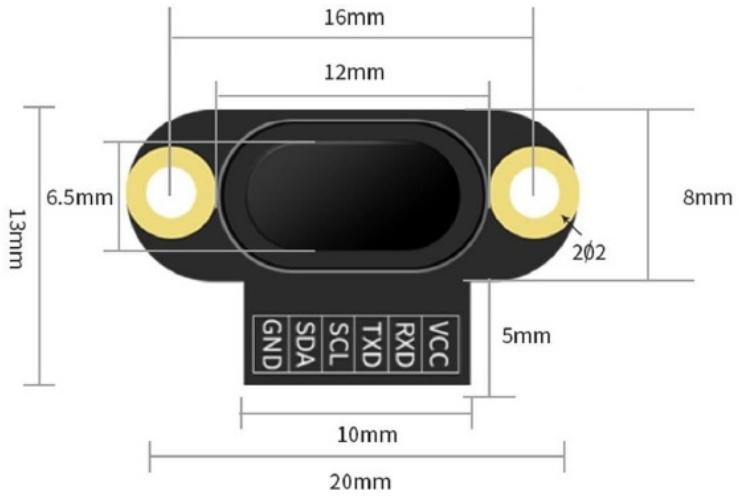
- **Voltage:** 3.3V-5V
- **Current:** Not specified
- **Size:** Not specified
- **Fixed Hole:** Not specified
- **Return Rate:** Not specified
- **Measuring Distance:** Not specified
- **Interface:** Serial, Modbus, IIC
- **Baud Rate:** Not specified
- **Ranging Error:** Not specified

Overview
The VL53L1 Laser Ranging Sensor is designed with a voltage stabilization circuit and is compatible with 3.3V embedded systems. It supports serial, Modbus, and IIC modes. The sensor has two kinds of digital interfaces – serial port and IIC, with the latter being directly connected to the chip. The data output rate can be adjusted from 0.1Hz to 100Hz (default 100Hz). The sensor features a 2-layer PCB board process, making it thinner, smaller, and more reliable. It also includes a metal shielding cover to prevent static interference. By default, it operates in short-distance mode with a maximum measurement distance of 2 meters. When measuring distances beyond 4 meters, it switches to long-distance mode.

- With voltage stabilization circuit, working voltage 3.3V~5V, compatible with 3.3V embedded system.

- Supports serial, Modbus, and IIC modes.
- Two kinds of digital interface serial port and IIC, IIC is directly connected to the chip.
- Data output rate up to 100Hz. 0.1~100Hz (default 100Hz) can be adjusted.
- 2-layer PCB board process, thinner, smaller and more reliable. Metal shielding cover to prevent static interference.
- Default short-distance mode (the longest measurement distance is 2 meters), when measuring 4 meters, change to the long-distance mode.

Product Size
The size of the VL53L1 Laser Ranging Sensor is not specified in the user manual.



Parameter

Parameter	Voltage	Current	Size	Fixed Hole	Return Rate	Measuring Distance	Interface	Baud Rate	Ranging Error
Specification	3.3V-5V	Not specified	Not specified	Not specified	Not specified	Not specified	Serial, Modbus, IIC	Not specified	Not specified

Parameter	Specification
Ø Voltage	3.3V-5V
Ø Current	<33mA
Ø Size	20mm x13mm x6.2mm 0.787″ x 0.511″ x0.244″
Ø Fixed Hole	Spacing 16mm, hole radius 1mm Spacing 0.630″, hole radius 0.039″
Ø Return Rate	0.1 100HZ default 10Hz
Ø Measuring Distance	40mm-4000mm (4000mm without optical cover) 1.575″-157.480″ (157.480″without optical cover)
Ø Interface	Level TTL
Ø Baud Rate	Supports 2400-921600, default 115200
Ø Ranging Error	±20mm (±0.787″)

Pin Instruction

Pin Explanation

Number	Pin	Explanation
1	VCC	3.3V-5.0V power output
2	RXD	Serial port receiving pin (TTL level, not directly connected to RS232 level) can be connected to the TXD of the microcontroller
3	TXD	Serial port sending pin (TT level, not directly connected to RS232 level) ca n be connected to the RXD of the microcontroller
4	SCL	IIC communication clock pin (need to enter IIC mode)
5	SDA	IIC communication data pin (need to enter IIC mode)
6	GND	Ground

Hardware Connection

PC Connection

To connect with a computer, a serial port module with USB to TTL level is required.

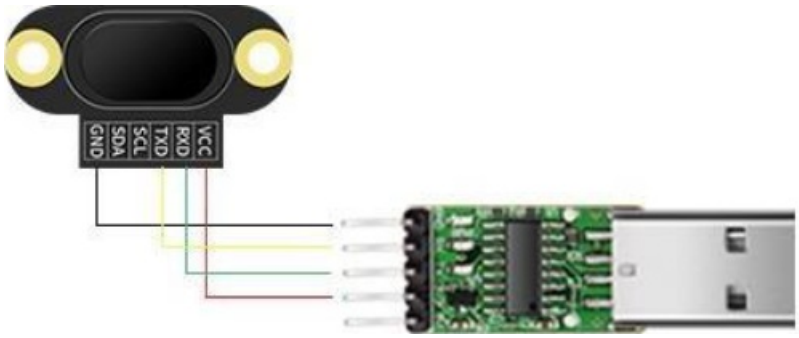
We recommend the following two USB to serial modules:

3-in-1 serial converter

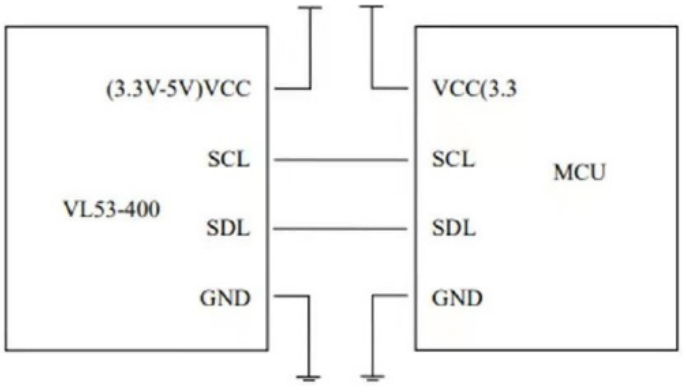
6-in-1 serial converter

Step 1. Connect the sensor with a serial converter
PIN Connection:
VCC – 5V
TX – RX
RX – TX
GND – GND
Step 2. Plug it into computer.

PC-serial module connection diagram:



IIC Connection



Notice:

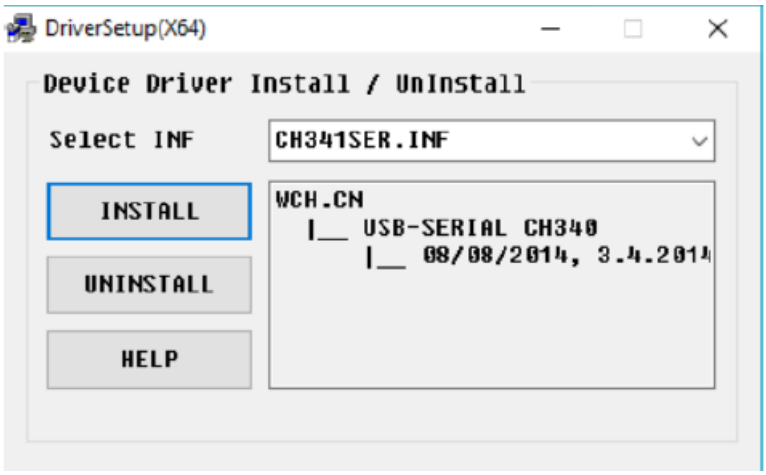
1. The sensor and the measured object should be as parallel as possible. If there is a deviation, the angle cannot be greater than the laser emission angle.
2. To detect fast-moving objects, the sampling frequency should be adjusted (VL53L1 sets the timing preset time and measurement time interval).
3. The laser light source is an invisible beam to the naked eye (the laser can be seen with a mobile phone camera). Obstacles in the emission angle of the light source will affect the ranging effect.
4. The module is affected by natural light. In general, the stronger the natural light, the greater the impact. That is, the ranging distance becomes shorter, the accuracy becomes worse, and the fluctuation becomes larger. Under strong light (such as sunlight), it is generally recommended to be used in close-range detection scenarios.

Use Instructions with PC

Serial Connection
Step 1. Connect the sensor with offered Type-C wire.
(**Warm Reminder:** If you wanna use a longer cable, it should be a standard Type-C data cable)
Step 2. Unzip the software and install the driver CH340

- Software and driver download

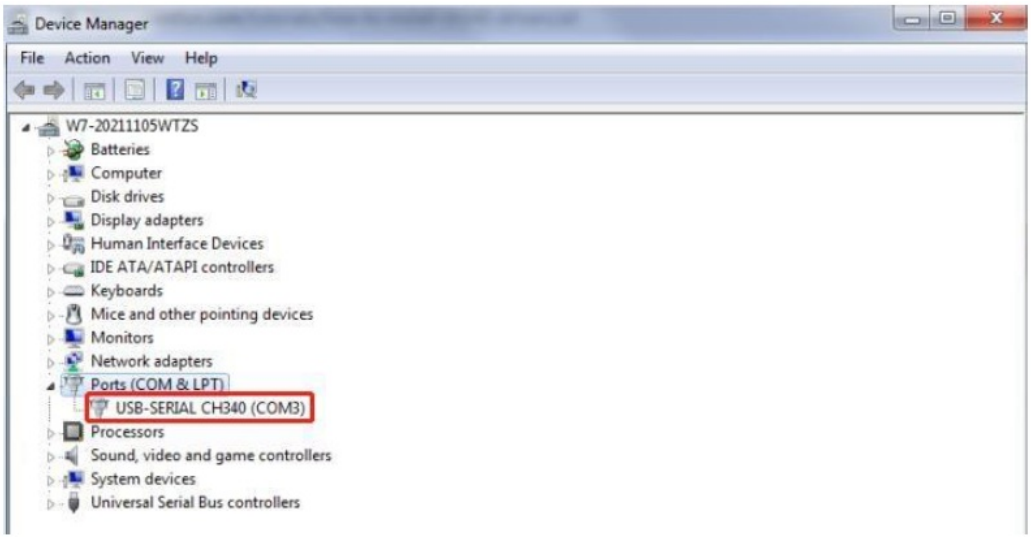
How to Install and update the CH340 driver
Click e “Uninstall” button first. Then click on the “Install” button.



How to verify your driver is working

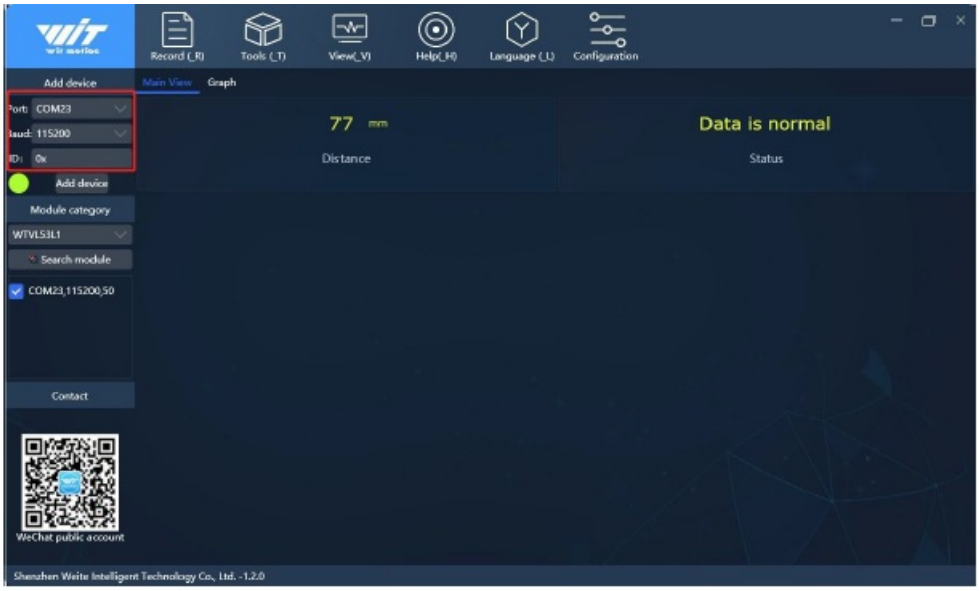
1. To check that the CH340 enumerates to a COM port, you can open the device manager. You can click the Start or ⊞ (Windows) button and type “device manager to quickly search for the application.

2. After opening the device manager, you will need to open the Ports (COM & LPT) tree. The CH340 should show up as USB-SERIAL CH340 (COM##). Depending on your computer, the COM port may show up as a different number.



Data View

Step 1. Open the computer, click the corresponding serial. (Default baud rate: 115200)



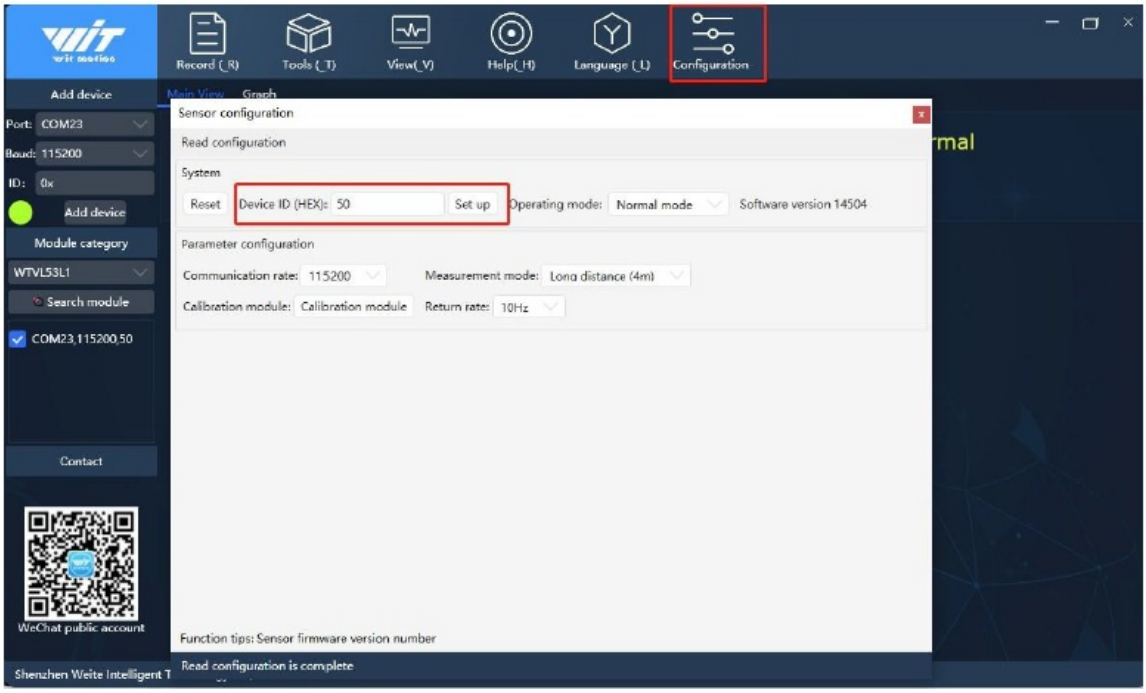
Step 2. Click “Search Device” then view the data, as follows:

ID

When there are multiple Modbus connections, need to set different Modbus IDs read data normally. After setting the ID, the data can be read normally only when the computer is used to search for the device again. The device ID is saved after power off.

Step 1. Click “Configuration” to select the corresponding device and enter the configuration interface.

Step 2. Entering “Device ID” click “Set up”. ID can be set in the range 0x00~0x7F.

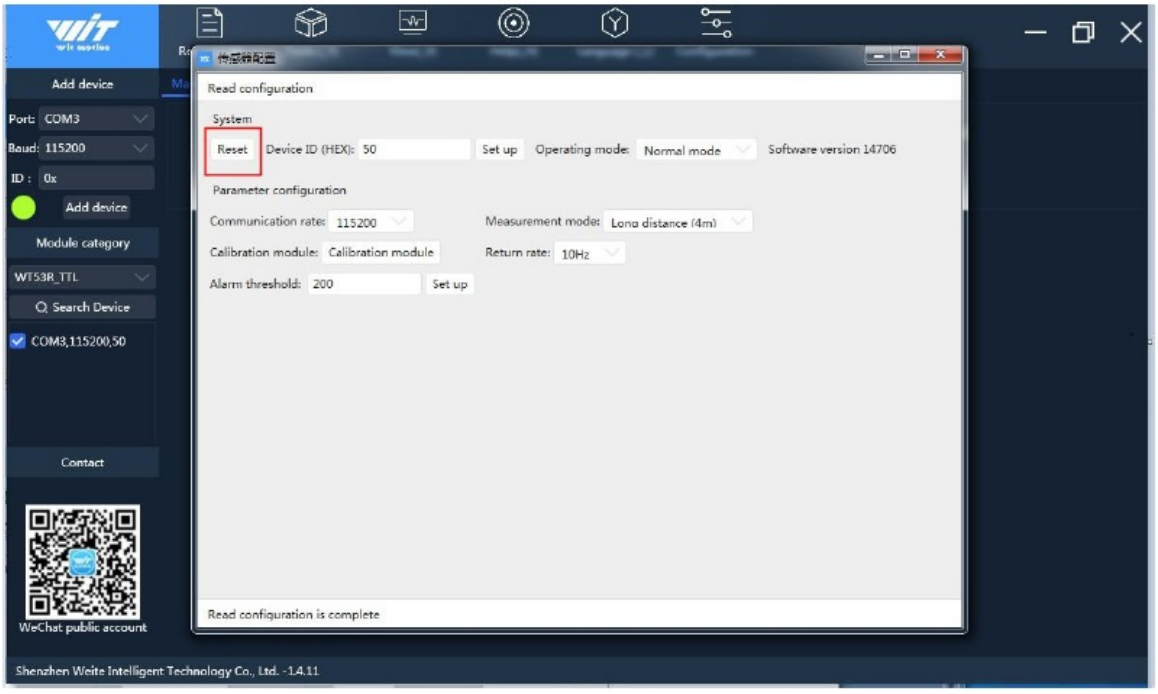


Reset

Reset will restore all user setting parameters to the default state.

Step 1. After connecting the sensor normally, click “Configuration” to enter the configuration interface.

Step 2. Click “Reset”, If the baud rate or ID is not the default setting (default baud rate: 115200, ID: 0X50), search for the device again.

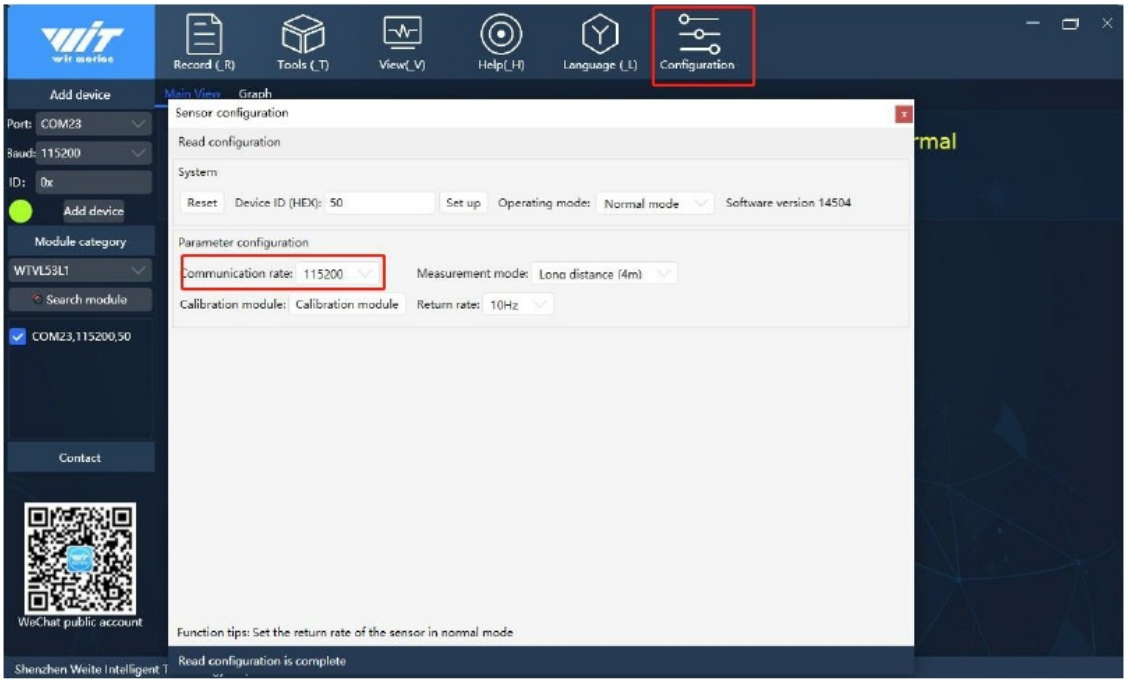


Baud Rate

After the normal connection, the baud rate can be modified on the computer.

Step 1. Click “Configuration” to select the corresponding device and enter the configuration interface.

Step 2. Click “Communication rate”, select the baud rate.

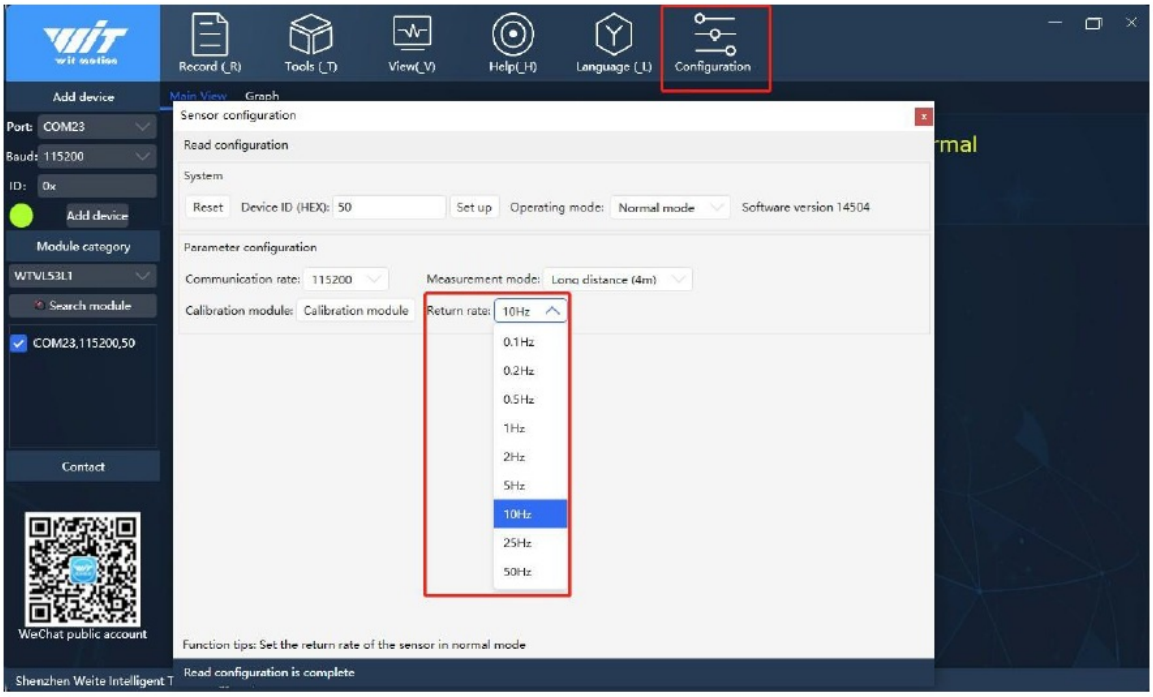


Return Rate

The sensor can set the automatic return speed of 0.1~100Hz (due to the influence of the measurement distance, the time is not absolutely accurate, and the return rate is useless in Modbus mode.)

Step 1. After connecting the sensor normally, click “Configuration” to select the corresponding device and enter the configuration interface.

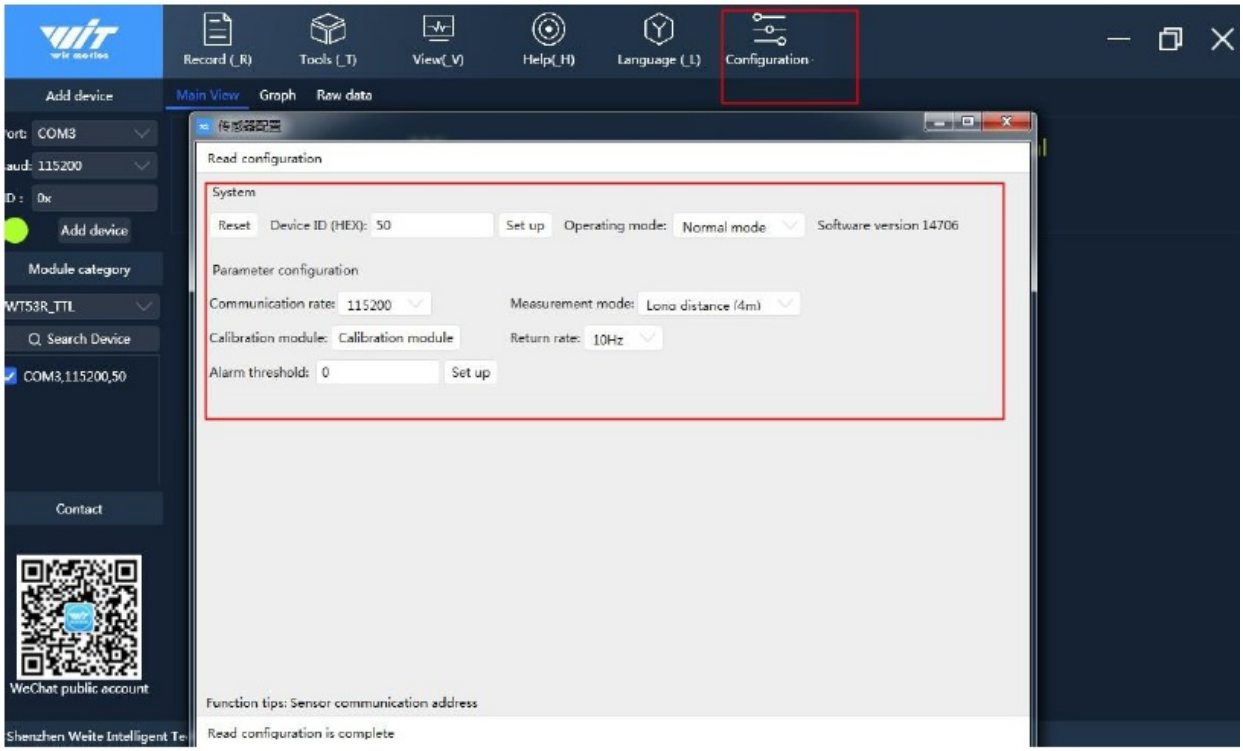
Step 2. Click “Return rate”.



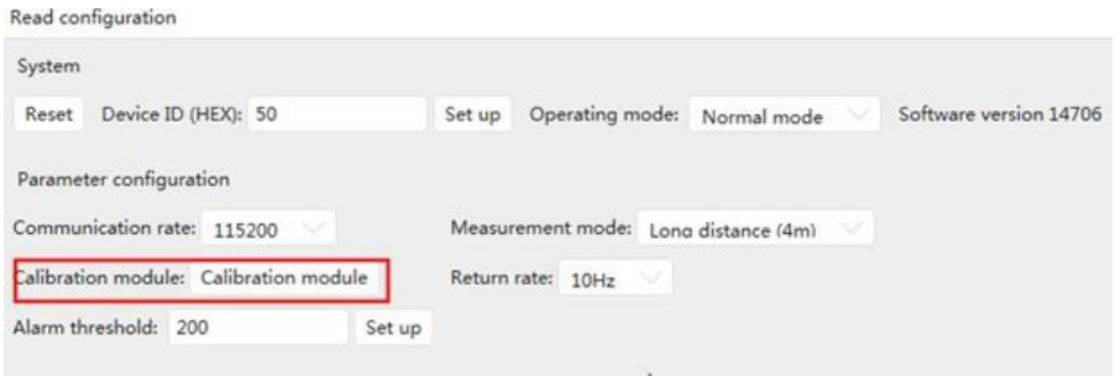
Calibration Module

The sensor can be calibrated manually, fix the sensor, place a white object at a distance of 14cm (5.512″) in front of the sensor and click to calibrate.

Step 1. After connecting the sensor normally, click “Configuration” to select the corresponding device and enter the configuration interface.



Step 2. Fix the sensor and calibration object, click “Calibration module”.

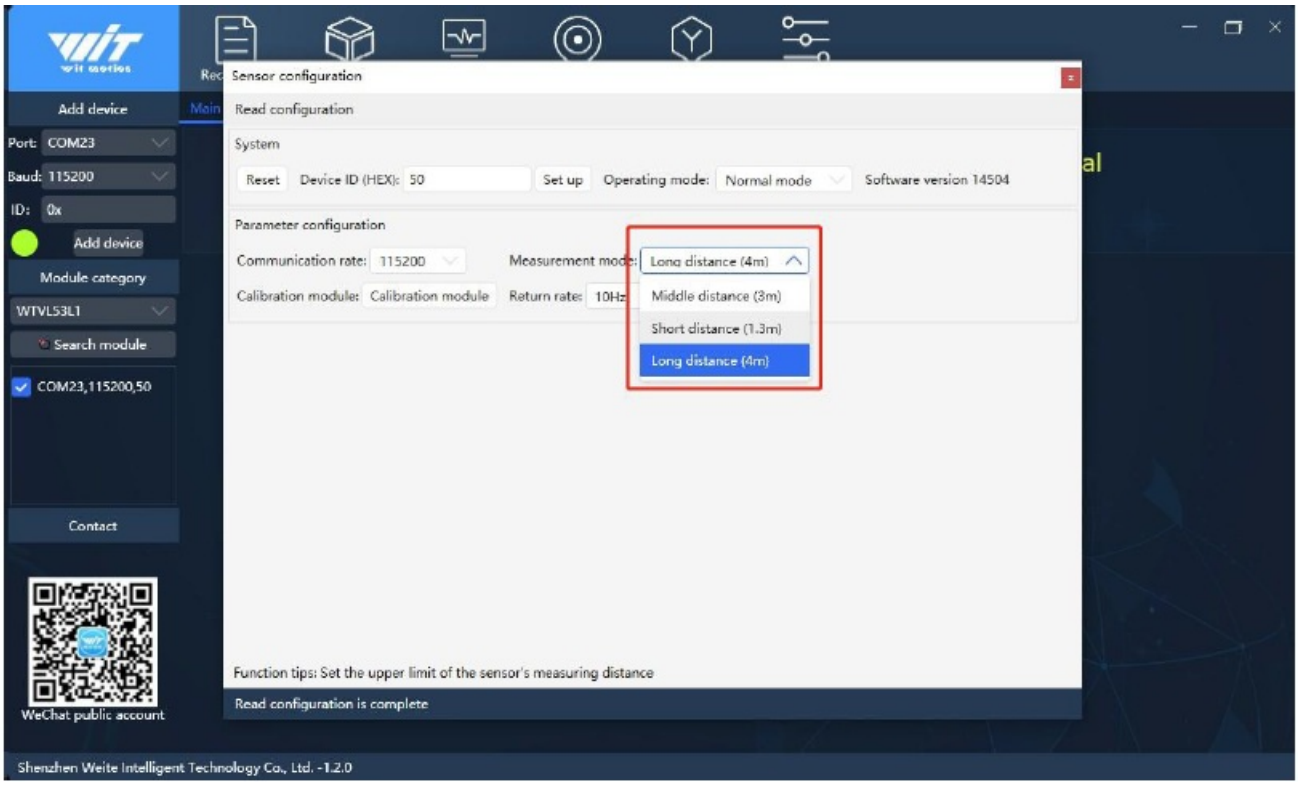


Measurement Mode

The laser ranging module can set three distance modes, the short-distance mode has a maximum measurement distance of 1.3 meters, the medium-distance mode has a maximum measurement distance of 3 meters, and the long-distance mode has a maximum measurement distance of 4 meters. The default setting is long-distance mode.

Step 1. After connecting the sensor normally, click “Configure” to select the corresponding device and enter the configuration interface.

Step 2. Click “Measurement mode”.



Notice:
When changing the measurement mode, the computer automatically changes the setting values of the two registers, 0x07 (timing preset time) and 0x08 (measurement interval) according to the mode selection.

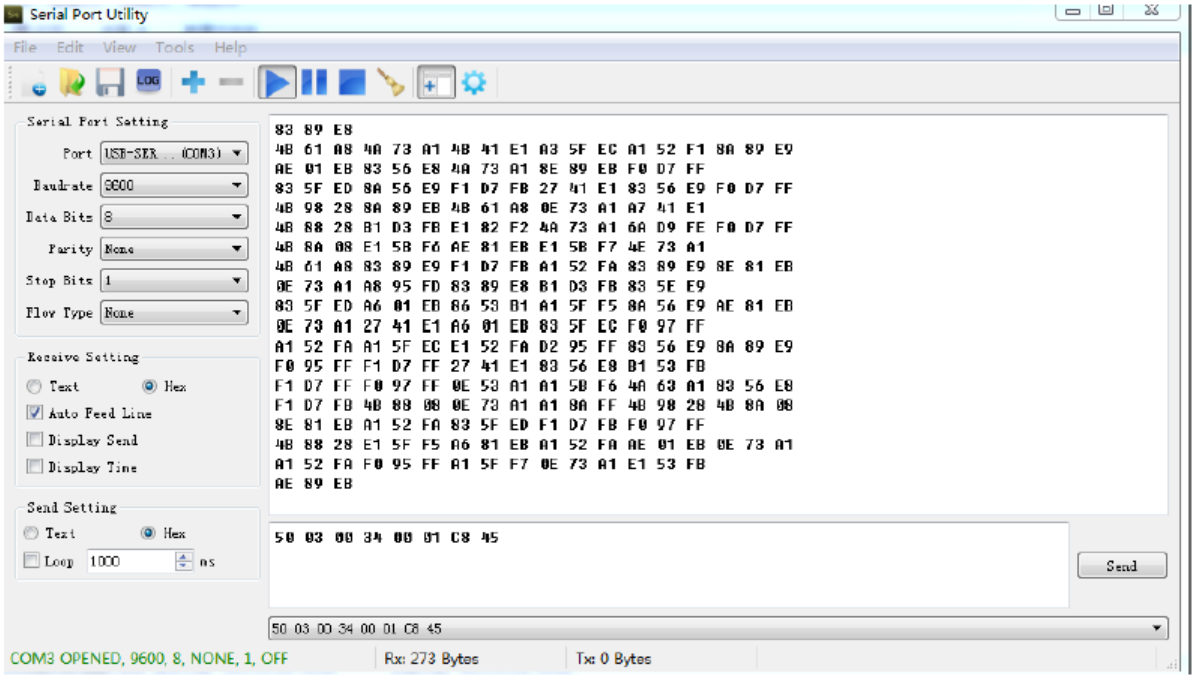
The setting values of the computer are as follows:
Example of serial:

Measurement Mode	Timing Preset Time 0x07	Measurement Interval 0x08
Default	20	1
Short-distance	20	1
Medium-distance	250	50
Long-distance	250	50

MODADDR 06 00 07 00 14 CRCH CRCL Time delay100ms // Set 7 register is 20
MODADDR 06 00 08 00 01 CRCH CRCL Time delay100ms // Set 8 register is 1
MODADDR 06 00 36 00 01 CRCH CRCL // Set to short-distance

Communication Protocol

Serial Mode
The data returned by the sensor is as follows:



For example:
d: 490mm 19.291″
State: 7, No Update
d: 490mm 19.291″ means measuring distance
State: 7, No Update indicates the status bit of the measurement data

Modbus Protocol
The sensor adopts the industrial standard Modbus protocol, the reading and writing format is as follows:
Modbus communication, the command number is divided into two kinds of read command and write command, 0x03 (read command) reads the corresponding register data, 0x06 (write command) writes data to the corresponding register.

The computer sends the data frame:

ID	Sign	Register high byte	Register low byte	Read length high byte	Read length low byte	CRC Check high byte	CRC Check low byte
ID	CMD	RegH	RegL	LenH	LenL	CRCH	CRCL

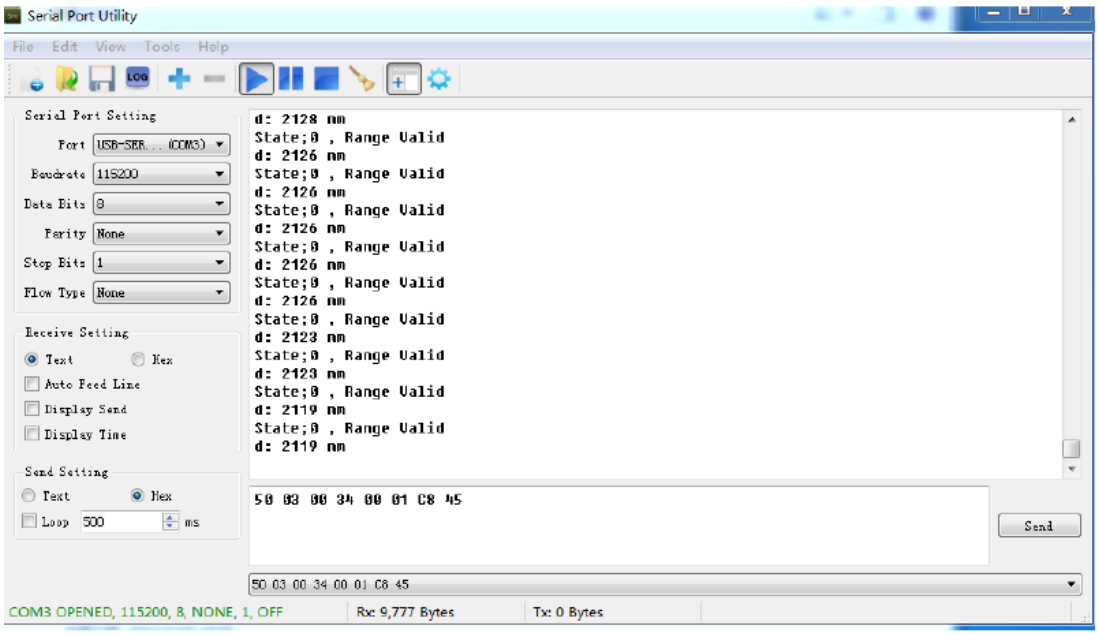
For example:
the module address is 0x50 (default), the read command is 0x03, the register 0x34 (measurement distance), and the length is one byte.
Command: 50 03 00 34 00 01

Module response frame:

ID	Sign	Data length	Data bit 1 byte	Data bit 1 byte		CRC Check high byte	CRC Check low byte
ID	CMD	LenH	DataH	DataL	…..	CRCH	CRCL

For example:
the module address is 0x00, the read command is 0x03, and the length is 2 bits.
Command: 50 03 02 00 1C 44 41

As follows: Read the measured distance



Send command: 50 03 00 34 00 01 C8 45
Accept data: 50 03 02 07 0B 06 7F
Data analysis: 0x50 is the Modbus address, 0x03 is sign, 0x02 is the data length, 0x07 0x0B measurement data corresponds to 0x070B is decimal 1803mm (710.079″), the measurement distance is 18036mm (710.079″), and 0x06 0x7F is the CRC check byte.

Modbus Register

Name	Address	Format	Explanation
System Restore	0x00	MODADDR 06 00 00 00 01 CRCH CRCL	Write 0x01, restore default
Return Rate	0x03	MODADDR 06 00 03 00 00 CRCH CRCL	Write 0x00, return speed 0.1Hz
		MODADDR 06 00 03 00 01 CRCH CRCL	Write 0x01, return speed 0.2Hz
		MODADDR 06 00 03 00 02 CRCH CRCL	Write 0x02, return speed 0.5Hz
		MODADDR 06 00 03 00 03 CRCH CRCL	Write 0x03, return speed 1Hz
		MODADDR 06 00 03 00 04 CRCH CRCL	Write 0x04, return speed 2Hz
		MODADDR 06 00 03 00 05 CRCH CRCL	Write 0x05, return speed 5Hz
		MODADDR 06 00 03 00 06 CRCH CRCL	Write 0x06, return speed 10Hz
		MODADDR 06 00 03 00 07 CRCH CRCL	Write 0x07, return speed 20Hz
		MODADDR 06 00 03 00 08 CRCH CRCL	Write 0x08, return speed 50Hz
		MODADDR 06 00 03 00 09 CRCH CRCL	Write 0x09, return speed 100Hz
Baud Rate Setting	0x04	MODADDR 06 00 04 00 00 CRCH CRCL	Write 0x00, baud rate 2400
		MODADDR 06 00 04 00 01 CRCH CRCL	Write 0x01 baud rate 4800
		MODADDR 06 00 04 00 02 CRCH CRCL	Write 0x02 baud rate 9600
		MODADDR 06 00 04 00 03 CRCH CRCL	Write 0x03 baud rate 19200
		MODADDR 06 00 04 00 04 CRCH CRCL	Write 0x04 baud rate 38400
		MODADDR 06 00 04 00 05 CRCH CRCL	Write 0x05 baud rate 57600
		MODADDR 06 00 04 00 06 CRCH CRCL	Write 0x06 baud rate 115200

		MODADDR 06 00 04 00 07 CRCH CRCL	Write 0x07 baud rate 230400
		MODADDR 06 00 04 00 08 CRCH CRCL	Write 0x08 baud rate 460800
		MODADDR 06 00 04 00 09 CRCH CRCL	Write 0x09 baud rate 921600
VL53-400 Timing preset time (Better not to change , default 20MS)	0x07	MODADDR 06 00 07 TIMEBUDGETH	TIMEBUDGET: 20-1000 MS can be changed 0x0014-0x03e8
VL53-400 Interval (Better not to change , default 1MS)	0x08	MODADDR 06 00 08 PERIODH PERIODL CRCH CRCL	PERIOD 1-1000 MS can be changed 0x0001-0x03e8
ID settings	0x1A	MODADDR 06 00 1a 00 MODADDRL CRCH CRCL	Write 0x00~0xFE
Data	0x34	MODADDR 03 00 34 00 01 CRCH CRCL	Read, distance high 8 byte and distance low 8 byte
Output state	0x35	MODADDR 03 00 35 00 01 CRCH CRCL	Read: 0x07, Sensor No Update
			Read:0x00 Sensor Range Valid
			Read:0x01 Sensor Sigma Fail
			Read:0x02 Sensor Signal Fail
			Read:0x03 Sensor Min Range Fail
			Read:0x04 Sensor Phase Fail
			Read:0x05, Sensor Hardware Fail
Model	0x36	MODADDR 06 00 36 00 01 CRCH CRCL	Write 0x00, short distance (up to 1.3 m, better environmental immunity)
		MODADDR 06 00 36	Write 0x01, medium distance

		00 02 CRCH CRCL	(up to 3 meters)
		MODADDR 06 00 36 00 03 CRCH CRCL	Write 0x02, long distance mode (up to 4 meters)
Calibration	0x37	MODADDR 06 00 37 00 04 CRCH CRCL	Write 0x04 to enter calibration
		MODADDR 03 00 37 00 01 CRCH CRCL	Read: 0x01, start calibration
			Read: 0x02, calibration failed
			Read: 0x03, calibration complete
System mode	0x38	MODADDR 06 00 38 00 00 CRCH CRCL	Write 0x00, sensor normal mode, automatic return

IIC Mode
When set to IIC mode, the MCU releases the IIC bus of the VL53-400. SDA and SCL are directly connected to the sensor (the internal 10K resistors of SDA and SCL are pulled up). For specific data reading, please refer to the VL53-400 data sheet.
Setting method: send MODADDR 06 00 38 00 02 CRCH CRCL
For example, if the module address is 50, then IIC mode needs to send 50 06 00 38 00 02 84 47 After entering the IIC mode, the serial port of the module will output “IICMODE” characters.

Product Usage Instructions

Installation
To use the VL53L1 Laser Ranging Sensor, follow the steps below:

1. Ensure that the working voltage is between 3.3V and 5V.
2. Choose the appropriate digital interface (serial port, Modbus, or IIC) for your application.
3. If using the IIC interface, connect it directly to the chip.
4. If required, adjust the data output rate from 0.1Hz to 100Hz.
5. Mount the sensor securely, ensuring that the metal shielding cover is in place to prevent static interference.
6. If you need to measure distances beyond 4 meters, change the sensor to long-distance mode.

Usage
Once the VL53L1 Laser Ranging Sensor is installed, you can use it as follows:

1. Ensure that the sensor is powered on and connected properly to the device.
2. Send commands or queries to the sensor using the chosen digital interface (serial port, Modbus, or IIC) to initiate measurements or retrieve data.
3. Based on your application requirements, interpret the received data accordingly.
4. Handle any errors or exceptions that may occur during usage.

Maintenance
The VL53L1 Laser Ranging Sensor does not require specific maintenance. However, it is recommended to periodically check the connections and ensure that the sensor is clean and free from any obstructions. If any issues arise, refer to the troubleshooting section of the user manual or contact technical support.

Warnings
Ensure that the working voltage remains within the specified range (3.3V-5V) to prevent damage to the sensor. Avoid exposing the sensor to extreme temperatures or humidity. Handle the sensor with care to avoid physical damage.

FAQ

1. **Q: What is the power supply voltage range for the VL53L1 Laser Ranging Sensor?**
   A: The sensor operates with a voltage range of 3.3V-5V.
2. **Q: Can I adjust the data output rate of the sensor?**
   A: Yes, the data output rate can be adjusted from 0.1Hz to 100Hz, with the default value set at 100Hz.
3. **Q: How far can the VL53L1 Laser Ranging Sensor measure distances?**
   A: The maximum measuring distance is not specified in the user manual. Please refer to the product specifications or contact technical support for more information.

4. **Q: How do I switch the sensor to long-distance mode?**

   A: By default, the sensor operates in short-distance mode. When measuring distances beyond 4 meters, the sensor automatically switches to long-distance mode.

5. **Q: Where can I find additional support or documentation for the VL53L1 Laser Ranging Sensor?**

   A: You can visit the official website at www.wit-motion.com or contact the support team at support@wit-motion.com.

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- **Website:** www.wit-motion.com
- **Email:** support@wit-motion.com

Documents / Resources

	WitMotion WT-VL53L1 Laser Ranging Sensor [pdf] User Manual WT-VL53L1 Laser Ranging Sensor, WT-VL53L1, Laser Ranging Sensor, Ranging Sensor, Sensor

References

- Accelerometer, Gyroscope, 6050 Mpu, Ahrs Sensor, Mpu-6050 Supplier
- Accelerometer, Gyroscope, 6050 Mpu, Ahrs Sensor, Mpu-6050 Supplier
- User Manual