Laser Distance Meter

Modbus RTU

Communication protocols

V1.2

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1、Introduction to Communication Protocol

1.1 Communication physical parameters

- Baud rate: (default) 115200, the common baud rates that can be used are: 2400, 4800, 9600, 14400, 19200, 38400, 57600, 76800, 115200.
- Parity: (default) no parity, can choose to use odd parity or even parity.
- Stop bit: 1 bit
- Data bits: (default) 8 bits, data length is 9 when parity is used

1.2 Protocol format

Adopt MODBUS, RTU mode, CRC16-bit check.

Note: Add H after the number to indicate the hexadecimal data format, such as 03H, which indicates 03 in hexadecimal.

(1) Function code 03H--Query the contents of the slave device register (read operation)

Table 1 Master device message format

slave address	function code	Initial register address	Number of registers(n)	CRC check
1 byte	（03H）1 byte	2 bytes	2 bytes	2 bytes

Table 2 Slave device message format

slave address	function code	Number of bytes in the data area(n)	data area	CRC check
1 byte (01H-F7H)	1 byte (03H)	1 byte	n*2 bytes	2 bytes

(2) Function code 06H--set the contents of a single register of the slave device (write operation)

Table 3 Master device message format

slave address	function code	Register address	data to be written	CRC check
1 byte	1 byte	2 bytes	2 bytes	2 bytes

Table 4 Slave device message format

slave address	function code	Register address	written data	CRC check
1 byte (01H-F7H)	1 byte （06H）	2 bytes	2 bytes	2 bytes

Note

- The whole packet of data must be sent continuously, and the two data packets must be sent at an interval of 3.5 characters of quiescent time, otherwise parsing errors will occur.
- The valid slave device address range is 0-247 (decimal), among which device address 0 is the broadcast address, which can be received by all slaves; 1-247 is the addressing range of the slave.
- The function codes used in this protocol are 03 (read), 06 (single register write)
- If the 16-bit or 32-bit data contained in the address and data is sent, the high byte is first, and the low byte is at the back.
- The CRC check data is two bytes, with the lower 8 bits being first, and the higher 8 bits being at the back. The check data is calculated by the device address, function code and data through the CRC calculation formula in 1.2.1. The receiving device recalculates the CRC of the received message and compares it with the value in the received CRC field. It indicates that an error occurs if the two values are different.

1.3 Sample code of CRC16 (C language)

```
// Calculate CRC check value
        unsigned short CRC16 ( unsigned char *arrbuff ,int len)
        {
          unsigned short    crc = 0xFFFF;
          int i, j;
          for ( j=0; j<len;j++)
          {
             crc=(unsigned short)(crc ^arrbuff[j]);
             for ( i=0; i<8; i++)
           {
                 if ((crc & 1) > 0)
                 {
                       crc = (unsigned short)(crc >> 1);
                       crc = (unsigned short)(crc ^ 0xa001);
                 }
                 else
                 {
                       crc = (unsigned short)(crc >> 1);
                 }
             }
          }
          return (crc);
        }
```

2、Register description

2.1 Basic function register

Table 4 definition table of basic function register

register address decimal (HEX)	register content	Number of registers	register status	Description
0(0000H)	measurement fault code	1	read-write	=0 no fault >0 There is a fault, please refer to Table 11 for the specific error code Write 0 to clear the fault code
1(0001H)	Operating status	1	read-write	0= idle state,stop measurement 1 = laser on 2 = measuring
2(0002H)	measuring distance value	2	read only	4-byte unsigned integer data, high-order first, low-order last, unit 0.1mm, 0 is invalid data
3(0003H)	device address	1	read-write	Valid range 1-247
4(0004H)	serial communication parameters	2	read-write	The upper 8 bits are the verification parameters: 00 no verification 01 odd check 02 even check The lower 24 bits are baud rate: Valid range: 2400-11520 4=14400，5=19200，6=38400，7=57600，8=76800，9=115200
5(0005H)	distance offset	1	read-write	Signed integer, unit 0.1mm
6(0006H)	software version number	1	read only	Current version number, high 8-bit hardware version, low 8-bit software version
7(0007H)	measurement frequency	1	read-write	0 = Single 1 = 5Hz 2 = 10Hz 3 = 20Hz 4 = 30Hz
8(0008H)	internal temperature	1	read only	Unit 0.1℃
9(0009H)	serial number	2	read only	Unique serial number, 32-bit unique code

Note: distance value = (measured value + distance offset)

2.2 Extended Function Register

Table 5 Definition table of extended function register

Register address decimal (HEX)	register content	Number of registers	register status	Description
10(000AH)	Analog output mode	1	read-write	Analog output function =0 off =1 0-5V =2 0-10V =3 4-20mA =4 0-20mA =5 0-24mA
11(000BH)	Minimum range of analog output	2	read-write	Valid data range 0-900000
12(000CH)	Maximum range of analog output	2	read-write	Valid data range 0-900000
13(00DH)	Switch value output 1 high level distance value	2	read-write	Valid data range 0-900000
14(000EH)	Switch value output 1 low level distance value	2	read-write	Valid data range 0-900000
15(00FH)	Switch value output 2 high level distance value	2	read-write	Valid data range 0-900000
16(0010H)	Switch value output 2 low level distance value	2	read-write	Valid data range 0-900000
17(0011H)	switch input function	1	read-write	=0 disable =1 float or high level to start measurement, low level to stop measurement =2 floating or high level to stop measurement, low level to start measurement

20(0014H)	CAN communication frame mode	1	read-write	=0 standard frame =1 extended frame
21(0015H)	CAN communication baud rate	1	read-write	Unit KHz, valid data are: 20, 50, 80, 100, 125, 250, 500, 600, 800, 1000
22(0016H)	CAN communication send ID	2	read-write	Standard frame mode, valid range of ID is 0-7FFH, extended frame mode ID valid range is 0-1FFFFFFFH
23(0017H)	CAN communication receiving ID	2	read-write	Standard frame mode, valid range of ID is 0-7FFH, extended frame mode ID valid range is 0-1FFFFFFFH
24(0018H)	Parameter saving	1	write	Store the set parameters in the memory and save them after power off
25(0019H)	Get multiple measurements	6	read	Obtain measured distance, signal strength and internal temperature . This three parameters are 4-byte length Integer.
40(0028H)	maximum range	2	read	Get the farthest measurement distance of the device
41(0029H)	minimum range	2	read	Obtain the latest measured distance of the device

2.3 Error codes and solutions

Table 6 Definition table of error code

error codes	implication	solution
220	Internal communication failure	Restarting the sensor
252	Temperature is too high(55℃)	Cool the sensor to the operating temperature range
253	temperature is too low (-20℃)	Warm the sens, or to the operating temperature range
254	The target distance is out of range	Please use within measurable range
255	The signal reflected by the target is weak or out of range	Please increase the reflectivity of the target surface
256	The signal reflected by the target is too strong	Please reduce the reflection intensity of the target surface
257	Ambient light is too strong	Use under appropriate ambient light intensity

3、Usage details and examples of register

The device is the Laser Distance Meter Sensor, and the host is the controller such as PC or PLC. The following takes the device address = 01H (1 in decimal) as an example

3.1 Read distance

direction	Data	Meaning
host -> device	01 03 00 02 00 02 65 CB	Read the current distance value
Device -> host	01 03 04 00 00 38 5C E9 CA	The unit is 0.1mm. The measurement result is 0000385CH, and the result is 1.4428m when converted into decimal
	01 03 04 00 00 00 00 FA 33	Error, result is 0

3.2 Read multiple measurements

direction	Data	Meaning
host -> device	01 03 00 19 00 06 14 0F	Start reading from the first register and read 6 registers consecutively
Device -> host	01 03 0C 00 00 07 A0 00 00 88 17 00 00 01 81 71 D6	0000 no error 000007A0H, distance 1952 00008817H, signal strength 34839 0000181H, the current temperature is 38.5℃

3.3 Set switch parameter value

direction	Data	Meaning
host -> device		Set switching value
	01 06 00 0D 00 00 07 00 C8 36	output 1 high level distance
	01 06 00 0E 00 00 03 ED 4E BB	output 1 low level distance
	01 06 00 0F 00 00 03 E3 F2 BF	output 2 high level distance
	01 06 00 10 00 00 03 ED E6 B9	output 2 low level distance
Device -> host	01 06 00 0D 00 00 07 00 C8 36 01 06 00 0E 00 00 03 ED 4E BB 01 06 00 0F 00 00 03 E3 F2 BF 01 06 00 10 00 00 03 ED E6 B9	set successfully

3.5 Set analog parameters

direction	Data	Meaning
host -> device		Set DAC out value
	01 06 00 0A 00 03 E9 C9	DAC out mode 4-20mA
	01 06 00 0B 00 00 00 00 42 06	Minimum range

	01 06 00 0C 00 09 27 C0 3C 64	Maximum range
Device -> host	01 06 00 0A 00 03 E9 C9 01 06 00 0B 00 00 00 00 42 06 01 06 00 0C 00 09 27 C0 3C 64	set successfully

3.6 Set CAN communication parameters

direction	Data	Meaning
host -> device		Set CAN conmunication para
	01 06 00 14 00 00 C9 CE	frame mode
	01 06 00 15 00 7D 58 2F	baud rate
	01 06 00 16 00 7D 00 00 3E 1C	Send ID
	01 06 00 17 00 00 02 86 13 06	Receive ID
Device -> host	01 06 00 14 00 00 C9 CE 01 06 00 15 00 7D 58 2F 01 06 00 16 00 7D 00 00 3E 1C 01 06 00 17 00 00 02 86 13 06	set successfully

Appendix A: How to test Modbus Using modScan32

A.1 Serial port settings

Using the serial port of the computer connected to the sensor.

Communication parameters: 115200, 8-bit data length, 1-bit stop bit, no parity

communication mode： RTU

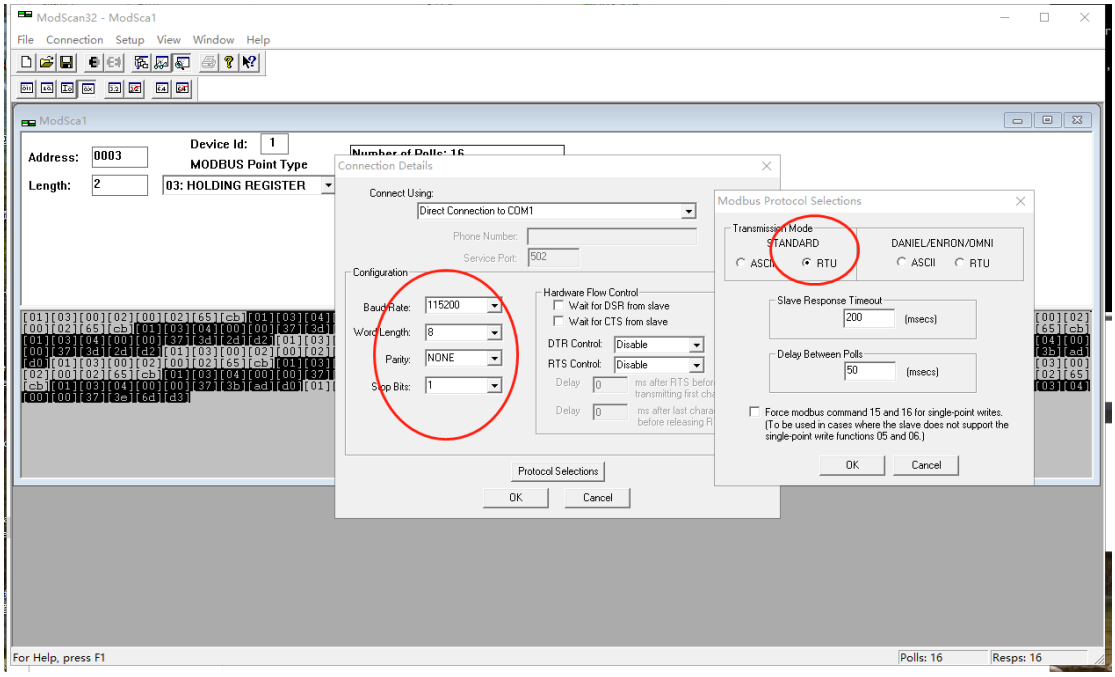

Figure A.1 Configuration interface after modscan is enabled

A.2 Parameter settings of register

Device id： Secondary address of the device

Register address, modscan will automatically reduce the register address by 1 before sending, so when reading the distance parameter register 2, you need to fill in the Address as 3.

Length: the length of the register, the data is the length of the data sent back by the sensor/2.

Select 03, HOLDING REGISTER. Read distance data

Menu: setup->display Options->show traffic displays the following data

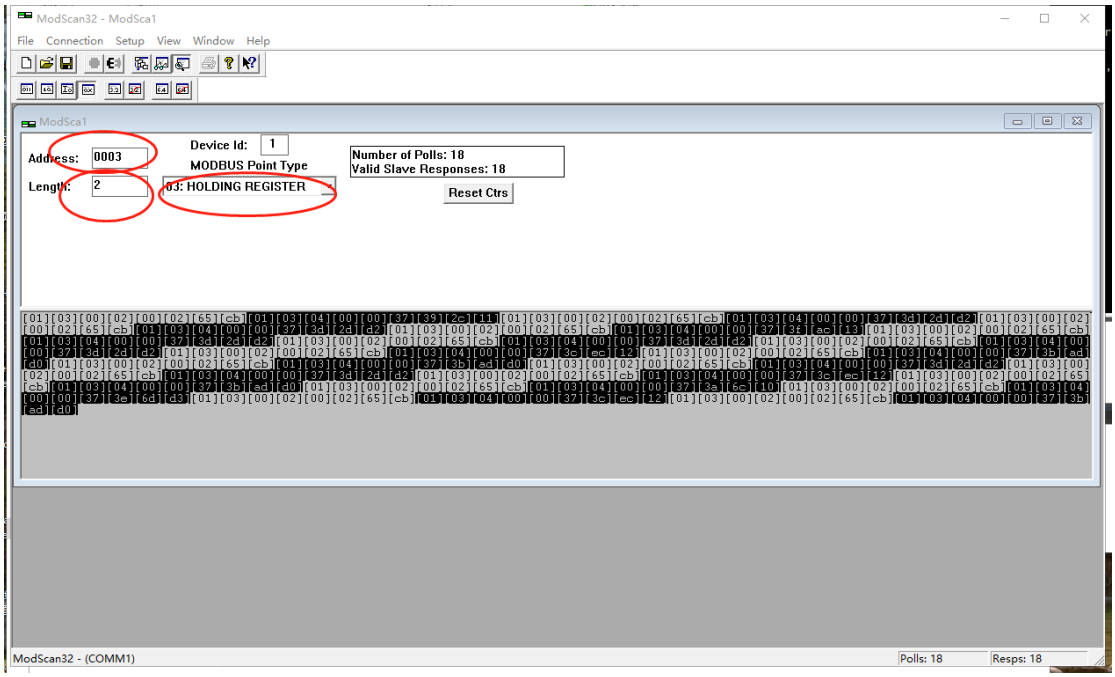

Figure A.2 modscan function code, register start and length setting interface

Menu: setup->display Options->show Data displays the following data, the interface is the result of automatic analysis, and 14139 is the distance value.

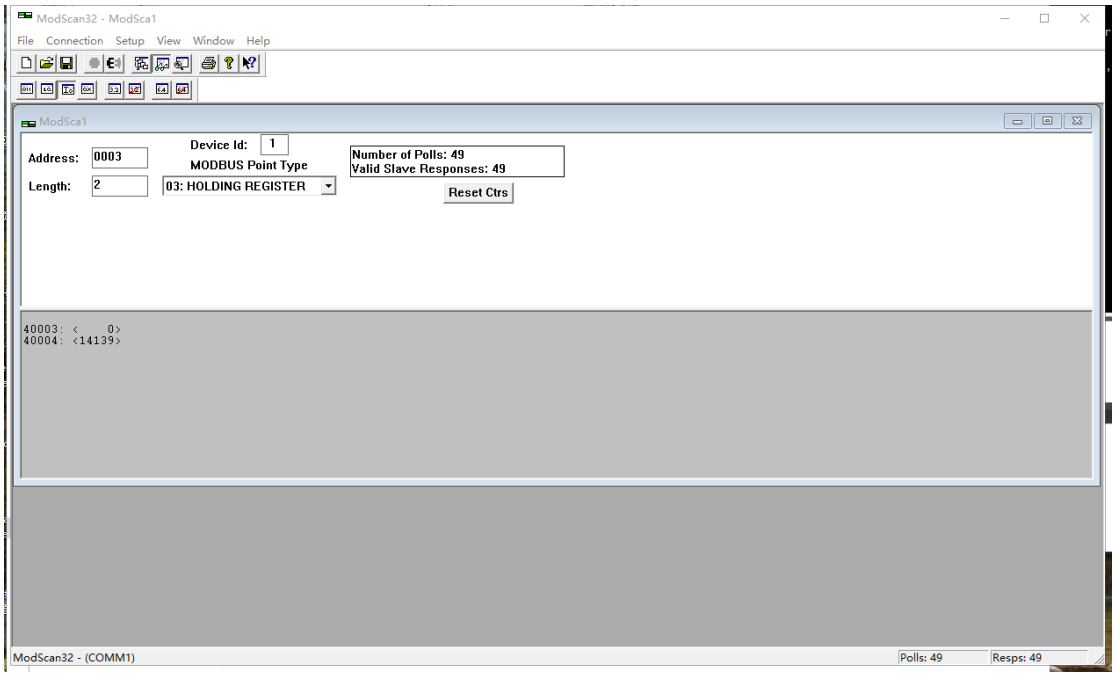

Figure A.3 modscan data analysis interface

Appendix B: User guide to Modbus RTU test tools software

The tool software “Modbus RTU test tools” is specially designed and developed for the OLEI laser single-point ranging sensor. It fully realizes all the supported modbus register setting and reading functions. Through the visual interface operation, it is more convenient and quick to familiarize and test the function and performance of the sensor.

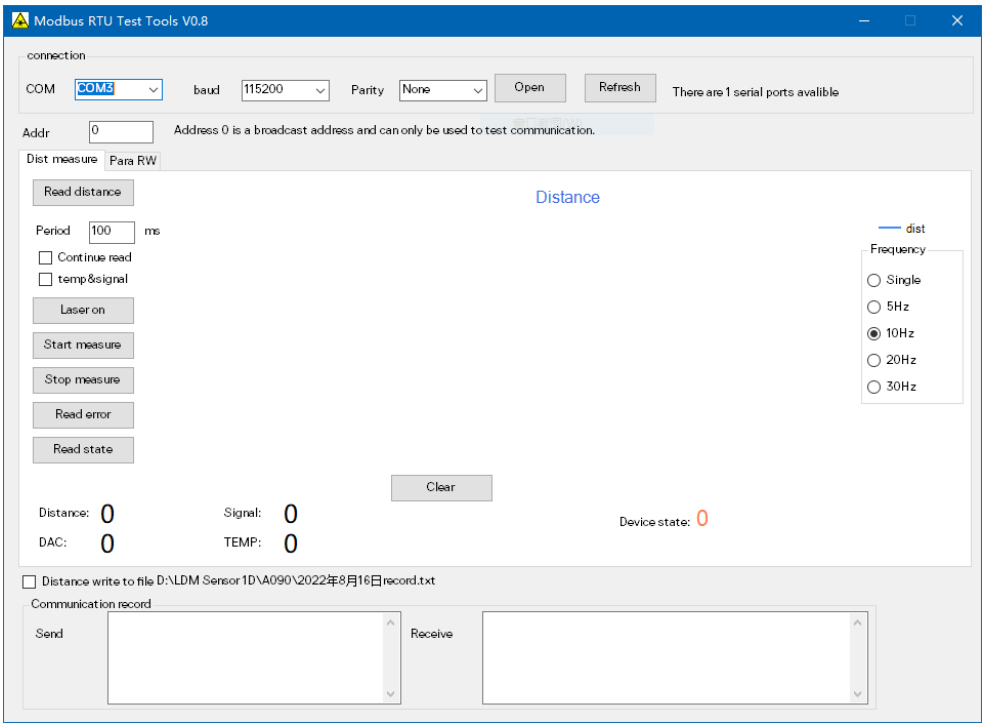

Figure B.1 Initial interface after startup

The software automatically searches for all local serial ports and adds them to the serial port list after startup. The default baud rate is 115200, no parity.

If a new serial port is added after the software is enabled, click the refresh button to search all serial ports again.

Select the correct serial port in the drop-down option of serial port number, click the Open button, if the serial port is connected successfully, the following interface is displayed.

The interface automatically displays the internal information read from the sensor.

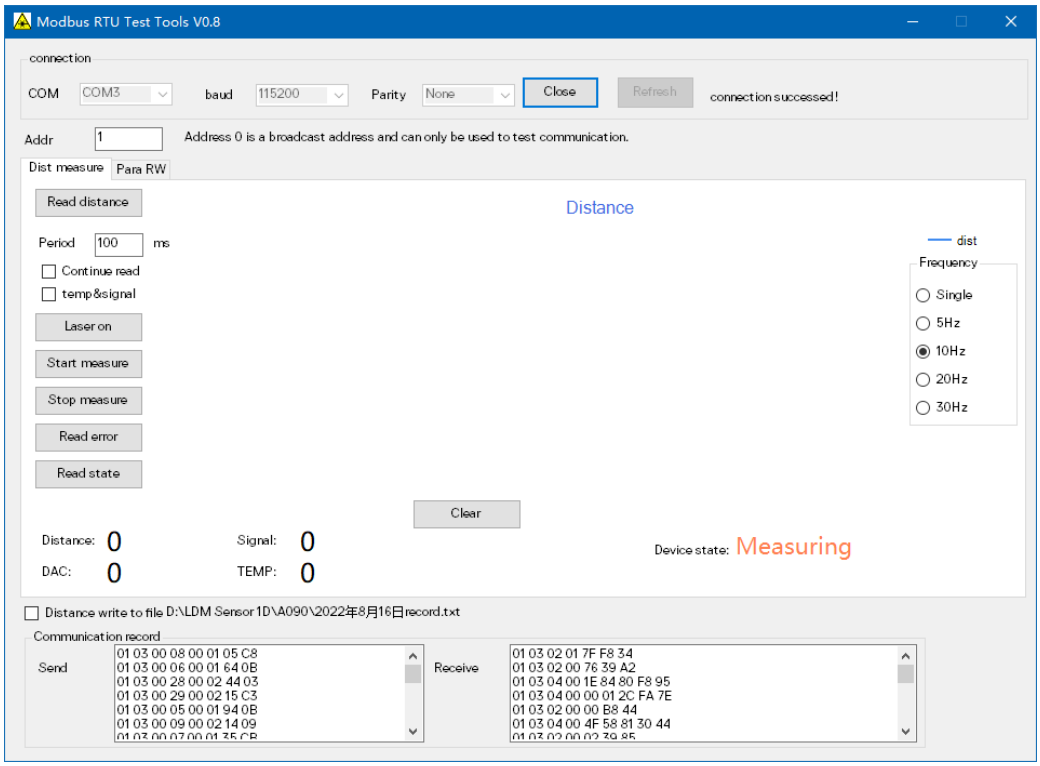

Figure B.2 Interface of successful connection

Check the temp&single as well as continuous reading check boxes, all results of continuous measurement at 10HZ can be obtained. The button on the left can control the start and stop of the measurement, as well as the reading of the status, and the frequency selection area on the right can switch the measurement frequency of the current sensor.

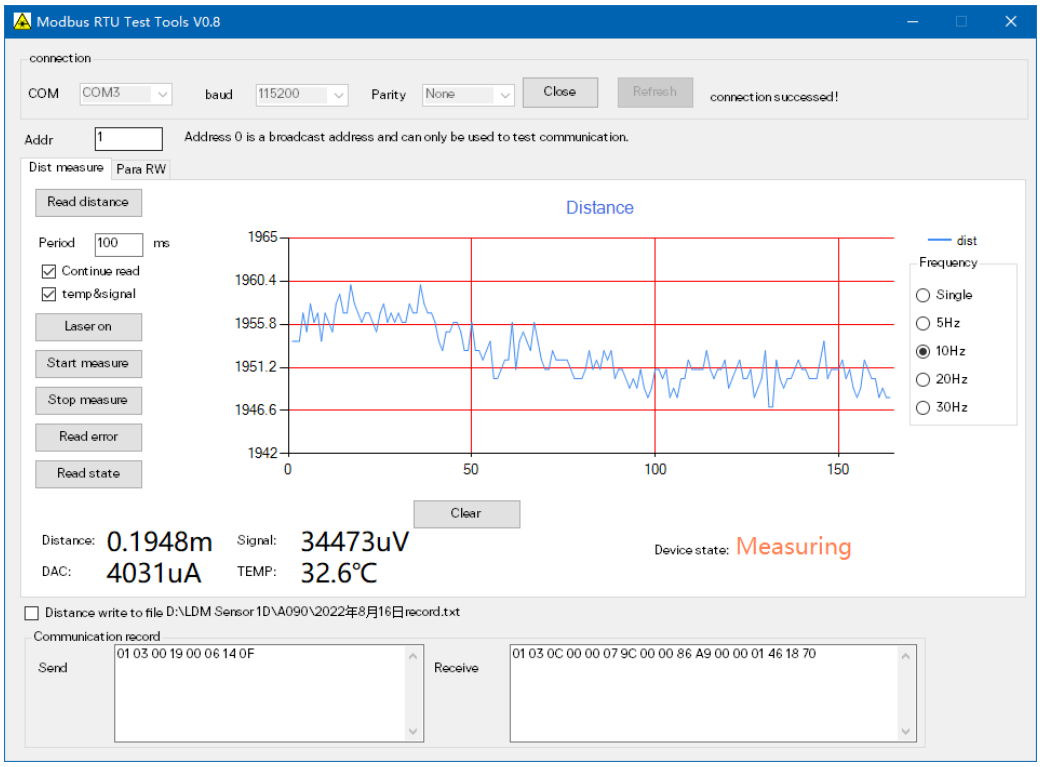

Figure B.3 Distance measurement interface

Switch to the Para RW page, you can read and set parameters. To read parameters, use the Read All Parameters button on the left. To set parameters, you can use the Write Device button on each parameter page to write the modified parameters to the sensor.

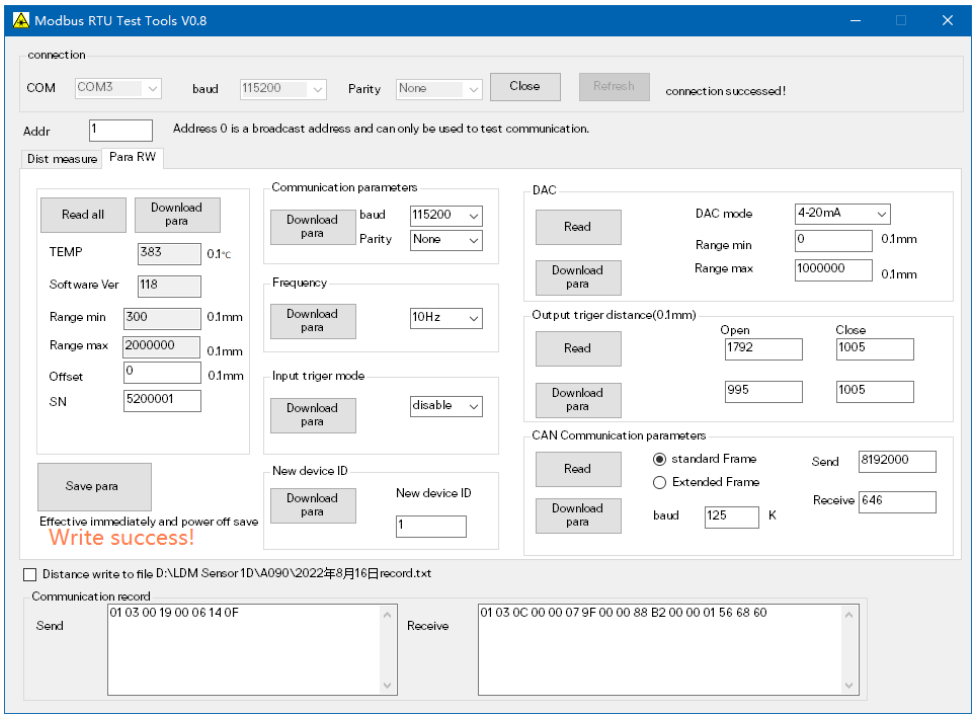

Figure B.4 Para RW page