4-in-1 oil online monitoring sensor

Test Guidebook

(first edition)

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Preparatory work

1. Test tool;
2. Configuration connection;
3. Communication protocols and commands;
4. Test example.

1. Test tool

1.1 Hardware tool

① 1 laptop or desktop computer with USB port；

② Sensor 1；

③ Test 1 oil sample；

④ 1 communication cable；

⑤ 1 USB-RS485 converter；

⑥ +24V DC power supply 1.

⑦ One USB-RS485 communication cable.(If you use this cable, you do not need to ④ ⑤ ⑥ , you can apply when purchasing)

1.2 Software tool

① USB-RS485 converter driver (if 1.1 (7) USB-RS485 communication cable is selected, install the driver as PL2303)

PL2303_Prolific_DriverInstaller_v110.rar

② Serial communication software

ModbusPollV3.60.rar

Serial debugging assistantV2.2.rar

2. Configuration connection

2.1 Install the serial port driver and serial port software

Double-click the software tool icon in 1.2 and install it as prompted. You are advised to close the antivirus software on the PC before installing the software. Otherwise, an error or file loss may occur, resulting in an installation failure.

2.1.1 Installing the Serial Driver

Users need to install the corresponding driver according to the type of USB-RS485 converter used. After the driver is installed, you can view the installation result in the Computer -> Administration -> Device Manager -> Ports directory. The interface after successful installation is shown in Figure 1:

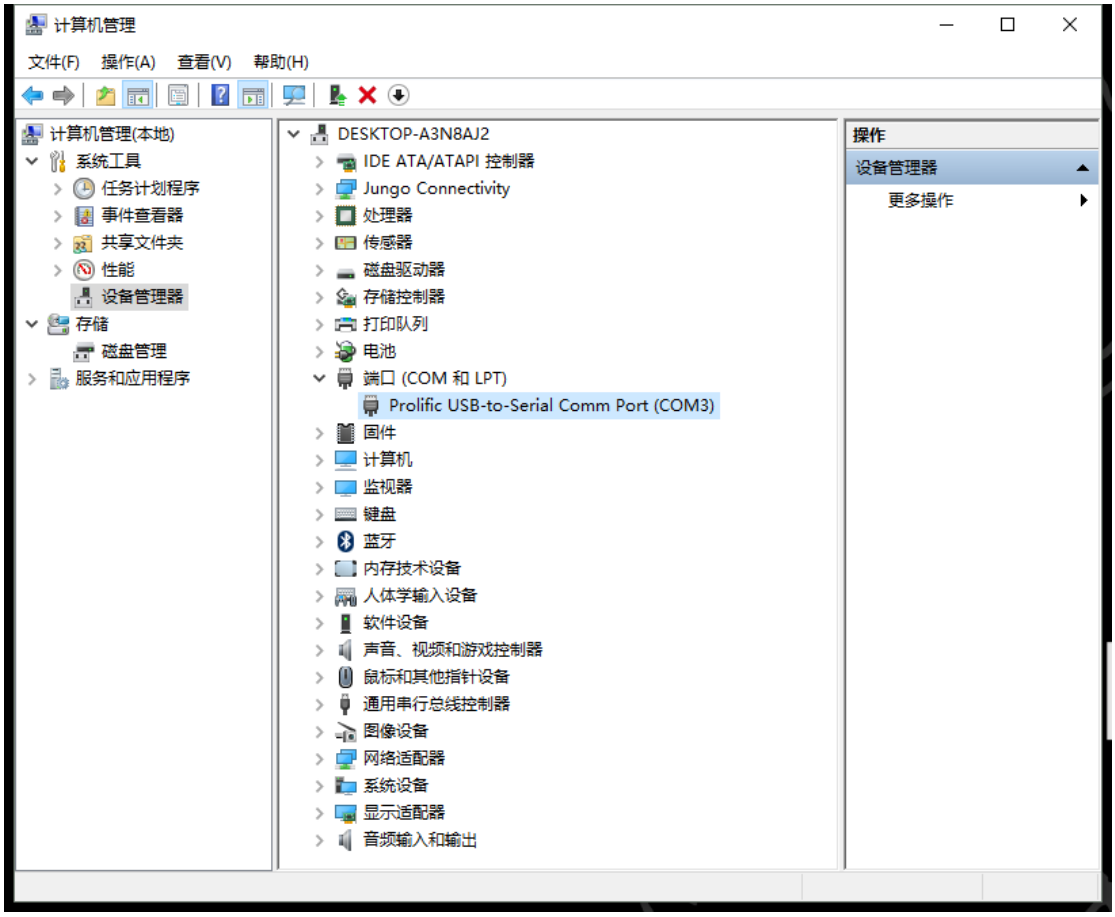


Figure 1 The serial port driver is successfully installed

2.1.2 Installing serial Port Software

（1）Serial debugging assistant software

Directly decompress the software to the computer desktop and you can use it. The normal use interface of the software is shown in Figure 2:

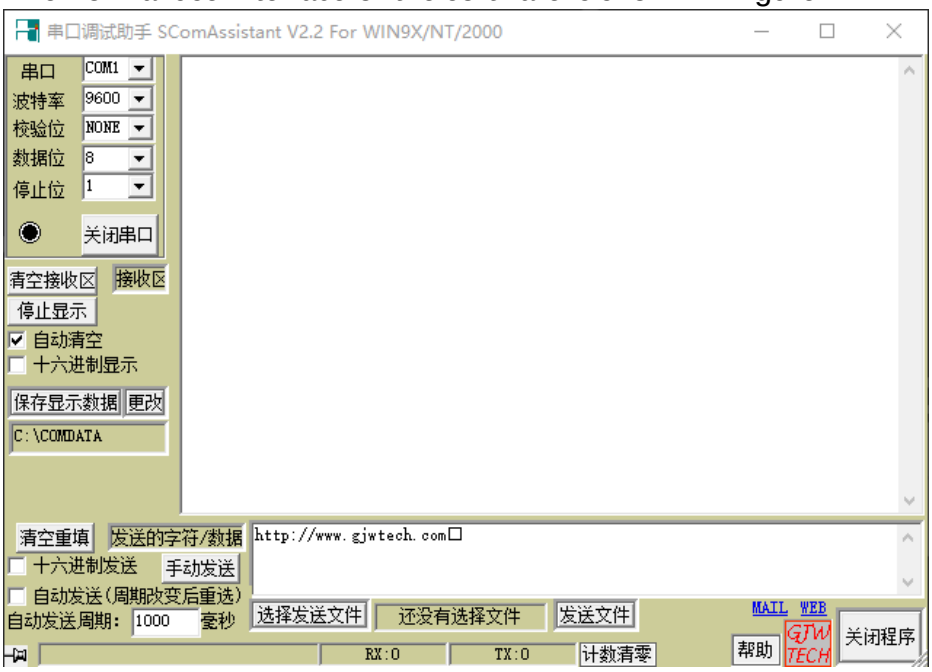


Figure2 Serial assistant software interface

（2）Modbus POLL software

The decompressed software package contains the following three files:

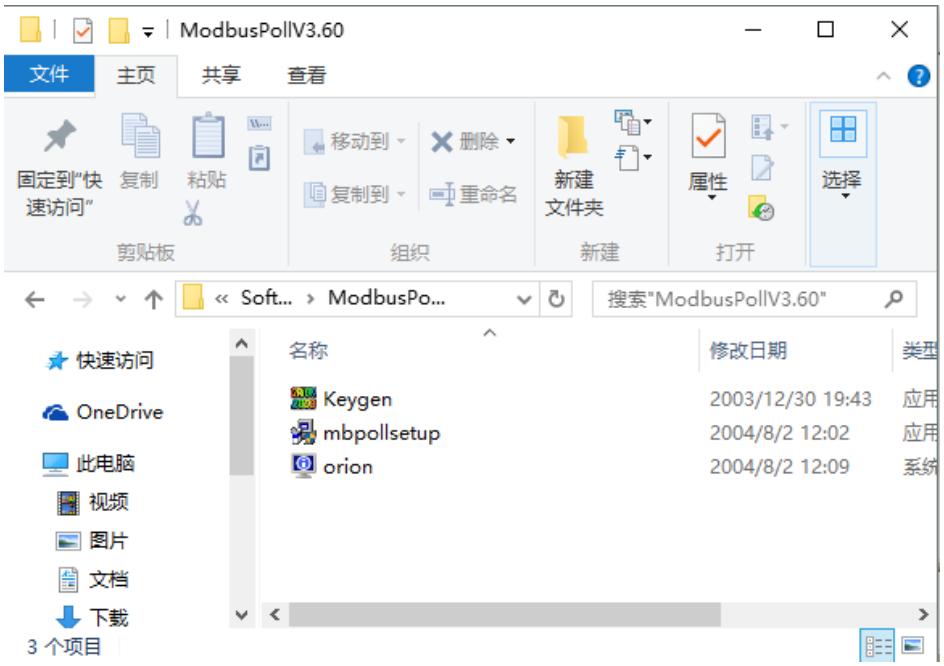
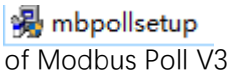


Figure3 Modbus Poll V3.60 Decompression interface

Double-click or run the icon 

as administrator to access Modbus Poll. V3.60 The installation screen of Modbus Poll V3.60 is shown in Figure 4.

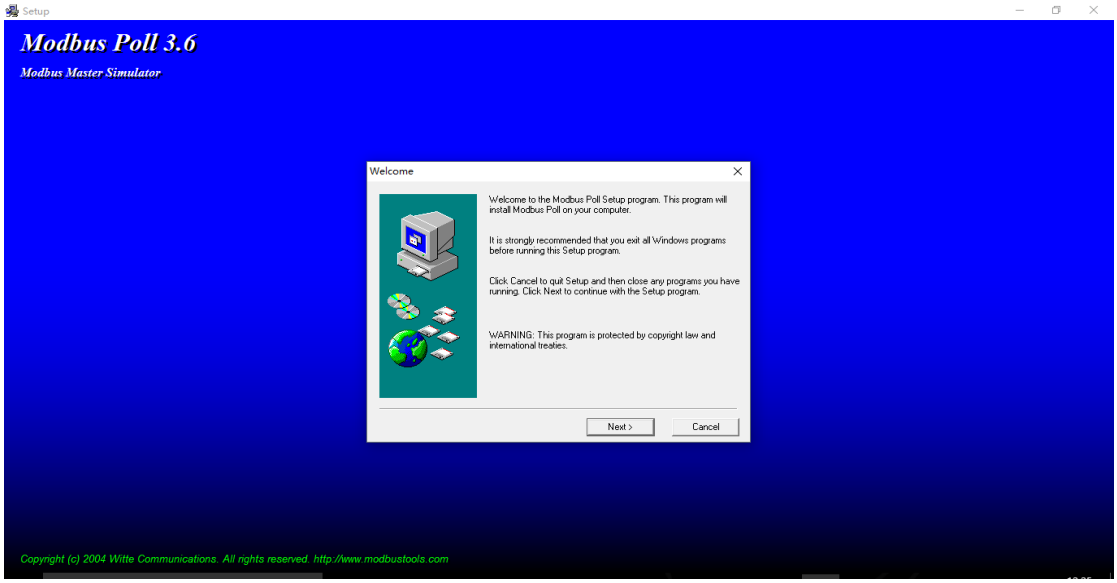


Figure4 Modbus Poll V3.60 Installation interface

Follow the software installation instructions step by step. The interface after the software installation is complete is shown in Figure 5:

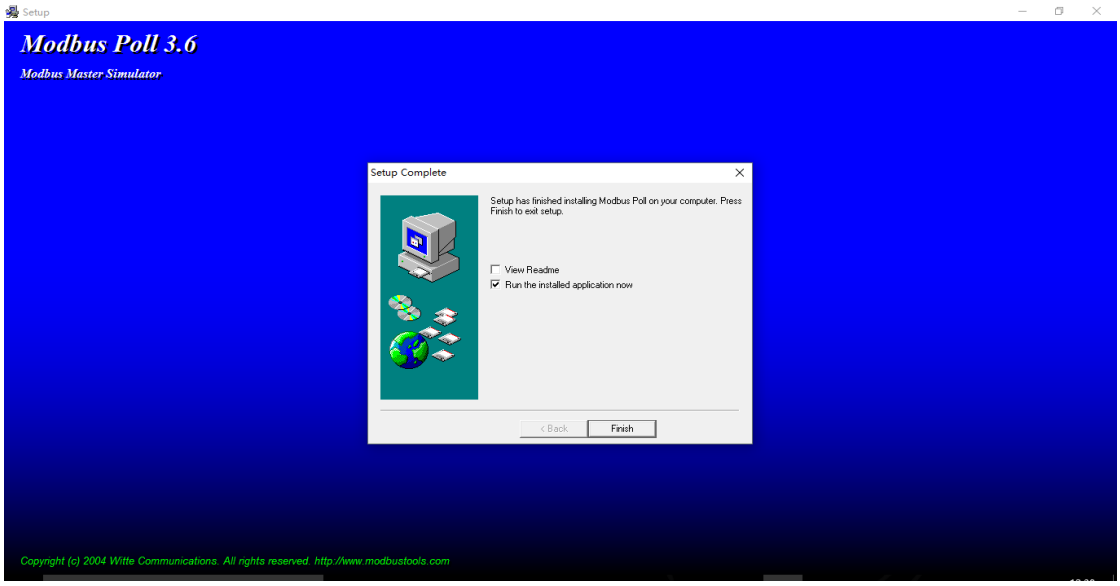
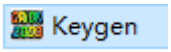


Figure 5 Modbus Poll V3.60 Installation completionscreen

tap Finish, If it is the first time to install and use, it will automatically switch to the registration interface dialog box shown in Figure 6:

Figure 6 Registration interface dialog box:

Double-click or run the icon as an administrator 

, Open the Registry dialog box in Figure 7:

Figure7 Registry dialog box

Copy the contents of the registry in Figure 7 to the corresponding location of the registration interface dialog box in Figure 6, and it can be used normally after registration. The normal operation interface is shown in Figure 8:

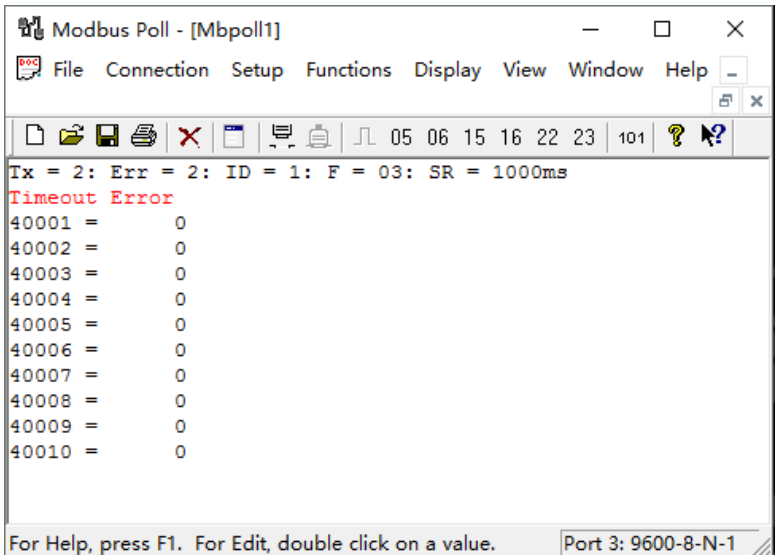


Figure8 Modbus Poll Software interface

2.2 Test line connection

Connect the test line as shown in Figure 9. Measurement results can be read normally about 15s after the power is switched on. The sensor body is equipped with self-diagnostic function: during operation, when the sensor probe is completely exposed to the air, the viscosity and density will be displayed as invalid characters, which does not mean that there is a malfunction; when the measurement environment index exceeds the measurable range of the parameter, the viscosity and density will be displayed as the upper limit or lower limit of the default setting, and the output data will not be updated; when the measurement environment index is restored within the measurable range, the sensor will automatically start the measurement and update the output data. When the measurement environment returns to within the measurable range, the sensor will automatically start the measurement and update the output data.

Special attention is paid to the test or normal use of the sensor probe must be completely submerged in the oil, otherwise the measurement results can not characterise the current condition of the oil sample.

Figure 9 Test Line Connection Diagram

3. Communication protocols and commands

The sensor adopts MODBUS RTU communication protocol, half-duplex working mode. The serial transmission rate is 9600 bps. Frame format: 1 bit start, 8 bits data, 1 bit stop, no parity bit. Command return delay time is about 10 milliseconds. The transmission distance is about 1200 metres.

In a complete online monitoring system, the master device acts as a host and the sensors act as slaves. Each communication handshake is always an access request from the master and a response from the slave.

3.1 MODBUS RTU Description of the data frame structure

Each data frame consists of the following:

——address
——function code
——amount of data
——date 1
——...
——date n
——CRC16 calibration

Frame format (10-bit):

starting position	D0	D1	D2	D3	D4	D5	D6	D7	stop bit

3.2 Transmission format

(1)Command Message Format

Host sends read data command:

address	function code	Data start address high bit	Data start address low bit	High number of data	Low number of data	CRC16 Checksum Low	CRC16 checksum high

The sensor sends a read data command back:

address	function code	byte length	Data 1 input	...	Data n input	CRC16 Checksum Low	CRC16 checksum high
			highs are ahead				

The host sends a write data command:

address	function code	Data start address high bit	Data start address low bit	High number of data	Low number of data	CRC16 Checksum Low	CRC16 checksum high

The sensor sends a write data command back:

address	function code	Data start address high bit	Data start address low bit	High number of data	Low number of data	CRC16 Checksum Low	CRC16 checksum high

(2)Exception Answer Returns

The sensor returns no abnormal answer.

3.3 Sensor Commands and Instructions

The sensor operable registers are described below:

modulus	function code	data home address	data length	byte count	Read/ Write	data type	define
V	03H	0000H	2	4	Read	floating point	Read viscosity measurements
D	03H	0002H	2	4	Read	floating point	Read density measurements
DC	03H	0004H	2	4	Read	floating point	Read dielectric constant measurements
T	03H	0006H	2	4	Read	floating point	Reading temperature measurements

Table 1 Registers available in Modbus RTU mode

(1) Reading temperature measurements

Example of reading sensor temperature measurement [sensor with address number 1, temperature T = 25.4843 ° C]:

apply		responsive	
domain name	(hexadecimal)	domain name	(hexadecimal)
address	01	address	01
function code	03	function code	03
data home address Hi	00	data byte length	04
data home address Lo	06	Temperature measurement	41
data item Hi	00		CB
data item Lo	02		E0
CRC16 Lo	24		03
CRC16 Hi	0A	CRC16 Lo	96
		CRC16 Hi	30

Table 2 Example of reading sensor temperature measurements

(2) Read viscosity, density, dielectric constant and temperature measurements

Example of reading sensor viscosity, density and temperature measurements [sensor with address number 1, viscosity V = 48.3878 cp, density D = 855.6719 kg/m3, dielectric constant DC = 2.2142, temperature T = 25.6093 °C].

apply		responsive	
domain name	(hexadecimal)	domain name	(hexadecimal)
address	01	address	01
function code	03	function code	03
data home address Hi	00	byte count	10
data home address Lo	00	viscosity measurements	42
data item Hi	00		41
data item Lo	08		8D
CRC16 Lo	44		23
CRC16 Hi	0C	density measurements	44
			55
			EB
			00
		dielectric constant measurements	40
			0D
			B5
			74
		temperature measurements	41
			CC
			E0
			03
		CRC16 Lo	18
		CRC16 Hi	04

Table 3 Examples of reading sensor viscosity, density, dielectric constant and temperature measurements.

4. Test Example

4.1 interface definition

The sensor has an M8 1*6 connector (male) at the end of the sensor with the following port definitions:

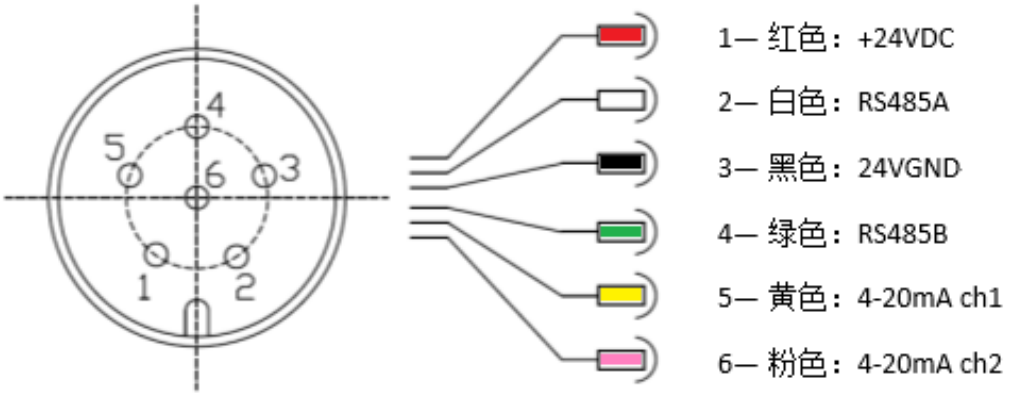


Figure 10 Sensor Interface Definition

4.1.1 RS485 Output

RS485 Communication connection schematic:

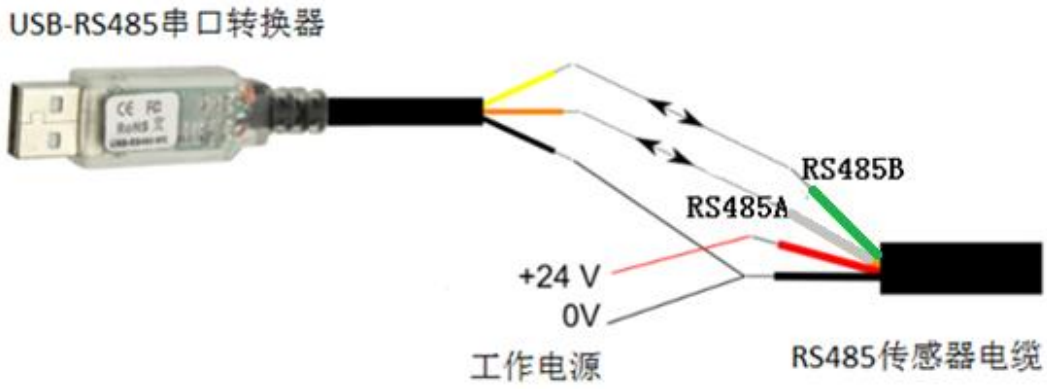


Figure 11 RS485 Communication Connection Diagram

4.1.2 4-20mA Output

(1) 4-20mA Output Channel Definition

Ch1 is the temperature T (°C)

Ch2 is the density D (kg/m3)

(2) 4-20mA Range Definition

Iout	4mA	12mA	20mA
Ch1	-40.0 ℃	40.0 ℃	80.0 ℃
Ch2	600.0 kg/m3	925.0 kg/m3	1250.0 kg/m3

Note: Depending on the customer's order, ch1 and ch2 ranges can be selected flexibly, the above table is an example.

Table 4 4-20mA Range Definitions

(3) 4-20mA Output Connection

The DAVIS uses a 3-wire 4-20mA current loop analogue output, wired as follows:

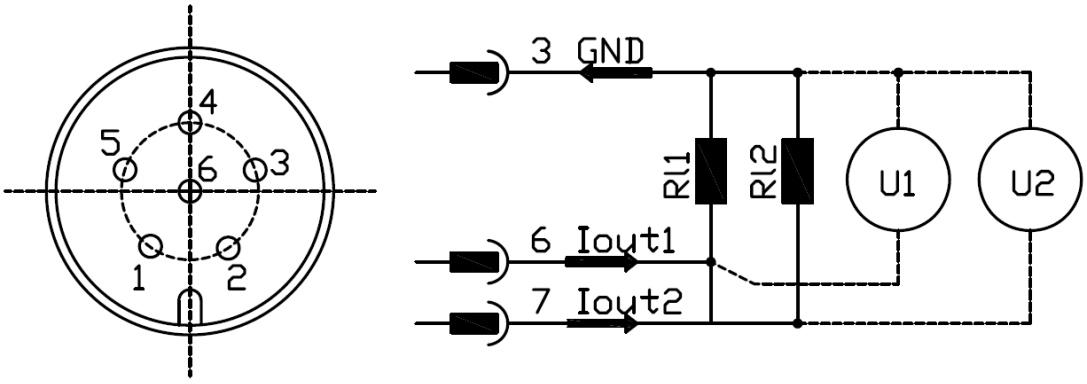


Figure 12 4-20mA Current Loop Connection Diagram

In order to achieve the rated operating characteristics of the sensor, the load resistance R1 and R2 should be ≤ 500Ω, we recommend that the user We recommend that the user select a 250Ω high-precision, low-temperature-drift sampling resistor. At this point, the sensor can work normally under 9V-28V DC external power supply.external power supply.

Note: If the user needs to use 500Ω or more sampling resistor, please specify when ordering.

(4) 4-20mA Output conversion formula

norm	measurement range	formulas
temp T	-40.0 … 80.0 ℃	T = (Iout – 4) * 120 / (20 – 4) - 40
density D	600.0 … 1250.0kg/m3	W = (Iout – 4) * 650 / (20 – 4) + 600

Note: The above measurement ranges are examples for the convenience of the customer's understanding and are subject to modification as agreed in the order.

Table 5 4-20mA conversion formula

4.2 Communication Port Configuration

The sensor's factory default serial port configuration is as follows:

parametric	value
address	1
baud	9600
data bit	8
parity bit	无
stop bit	1

Table 6 Serial communication parameter configuration

4.3 Communication software settings

4.3.1 MODBUS POLL Software Setting

(1) Double-click the Modbus Poll software shortcut on your computer desktop.

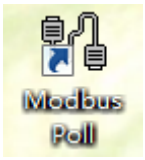


Figure 13 Modbus Poll Software Shortcut

(2) Open the Modbus Poll software, the interface is shown in Figure 14.

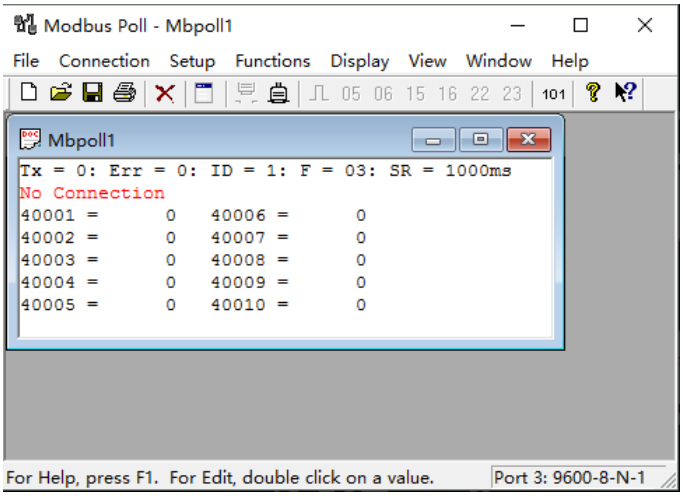


Figure 14 Modbus Poll Software Interface

(3) Click "Connect" in the menu and set the parameters as shown in Fig. 15. The port number is determined by the actual port used by the user.

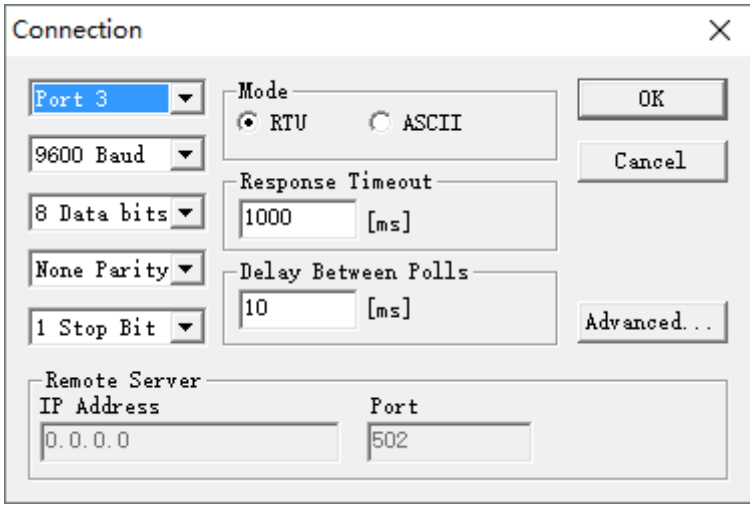


Figure 15 Connection Setting

(4) Click the "OK" button. Then click the "Setup" item in the menu, select the Poll Definition option in the drop-down box, and the dialogue box shown in Figure 16 will appear.

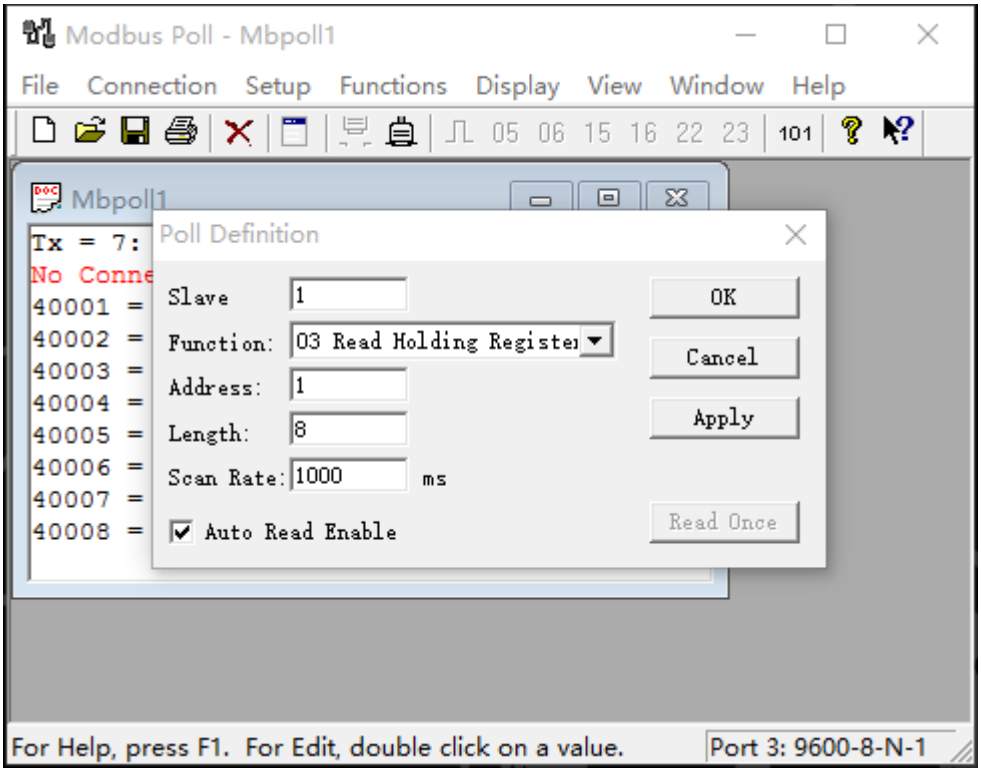


Figure 16 Poll Definition Setting

(5) Click the "OK" button. Then click the "Display" item in the menu, and select "Float" and "PLC Addresses (Base 1)" in the drop-down box, as shown in Figure 17. Figure 17

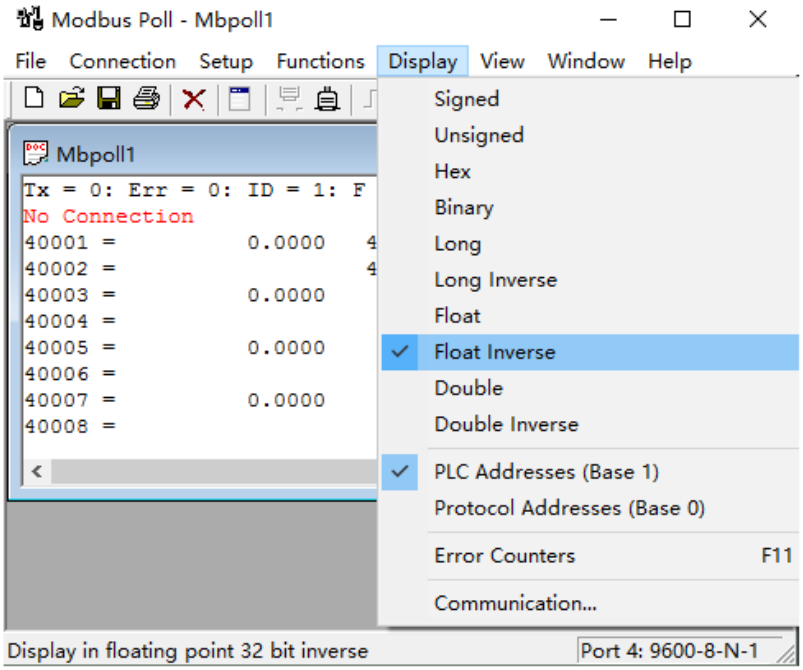


Figure 17 Display Setting

(5) The setup is complete, and the normal communication interface is shown in Fig. 18. Viscosity 66.2338 cp, density 886.7139kg/m3, dielectric constant 2.2314, temperature 21.3438 ℃.

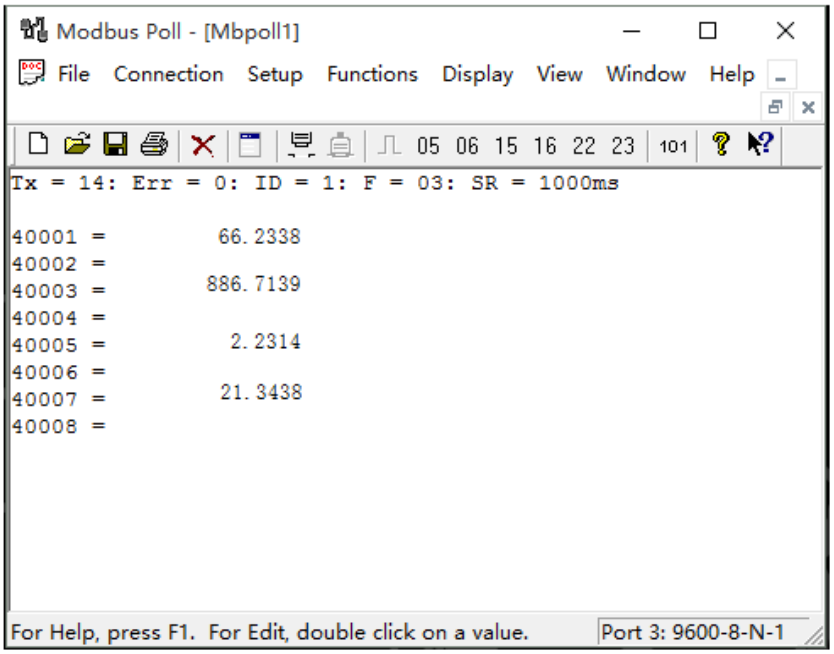


Figure 18 Normal Communication Interface

4.3.2 Serial Assistant Software Setting

The normal communication interface of the serial port debugging assistant is as follows:

Figure 19 Normal communication interface of serial port debugging assistant

4.5 Test Steps

Step 1: Install the relevant drivers and test software on the test machine and connect the test line according to Figure 9.

Step 2: Set up the communication software and test whether the communication connection of the whole line is normal. If it is normal, step 3 will be executed; if it is not normal, the line connection will be carefully checked and troubleshooting will be done.

Step 3: Clean the sensor probe with petroleum ether (or alcohol) until there is no obvious oil stains on the surface of the probe electrode, and blow it dry with the instrument air source. This step must be performed before the sensor is used.

Step 4: 25ml or a larger capacity measuring cup to take an appropriate amount of oil samples, oil level to just submerged sensor probe parts appropriate, the probe parts can not have obvious bubbles. As shown in Figure 25.

Step 5: Connect the sensor, power on the test.