KTH2-RM & KTH2-R-PE & KTH2-R-PVC

RS485 communication

Probe-type temperature and humidity sensor

U s e r M a n u a l



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1 Product Overview

The KTH2-R series probe-type RS-485 temperature and humidity transmitter uses a high-precision integrated temperature and humidity sensor as the signal measurement unit, featuring a compact structure and small size. The KTH2-R series adopts an RS-485 communication interface, follows the standard ModBus-RTU communication protocol, supports flexible settings for communication address and baud rate, and has a maximum communication distance of up to 1200 meters.

The KTH2-R series products have the following features:

1. Standard RS-485 communication, following the standard ModBus-RTU communication protocol;
2. Typical temperature measurement accuracy is <0.2 ℃ ;
3. Wide voltage power supply, supports DC 8-28V input.

The detailed parameters of the KTH2-R series will be described below.

1.1 Product Parameters

The basic parameters of the KTH2-R product are shown in Table 1-1 below.

Table 1-1 Basic Product Parameters

Item		parameter	Precautions
Operating voltage		DC 8-28 V	
Static power		24V 10mA	
Process media		Air	
accuracy	temperature	±0.2 ℃	
	humidity	±2 %RH	
resolution	temperature	0.1 ℃	
	humidity	0.1%RH	
stability	temperature	<±0.03 ℃ /year	
	humidity	<±0.25 %RH/year	
Temperature range for collection		-40℃~85℃	It must not be used in highly polluted or dusty environments.
Relative humidity range		<100%	Non-condensing
Storage temperature		-40℃~105℃	
Operating Temperature		-40℃-85℃	
Communication methods		RS-485 communication	Slave address 1-254
size		65*46*29mm	
Installation method		Standard DIN rail mounting	
Shell material		ABS engineering plastic	

1.2 Product dimensions and interfaces

The KTH2-R series has three models: KTH2-RM (metal casing), KTH2-R-PVC (thermoplastic casing), and KTH2-R-PE (thermoplastic PE casing). The dimensions of the three models will be introduced below.

1.2.1 Product Dimensions

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The dimensions of the KTH2-RM product are shown in Figure 1-1 below. The total dimensions of the transmitter are 56*14mm, and the temperature measuring unit is 31mm long.

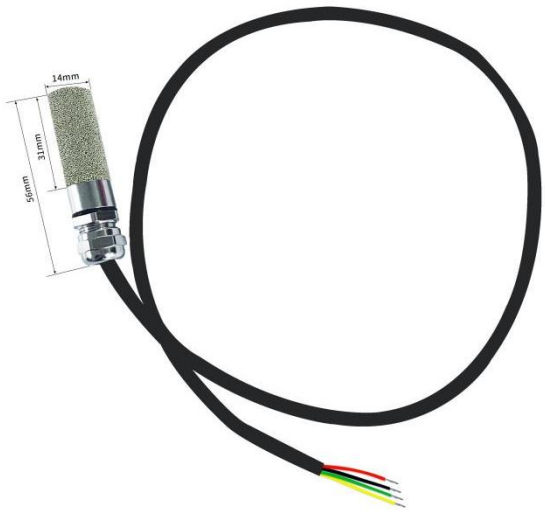


Figure 1-1 Dimensional diagram of KTH2-RM product

The dimensions of the KTH2-R-PVC product are shown in Figure 1-2 below. The total dimensions of the transmitter are 68*16mm, and the length of the temperature measuring unit is 47.5mm.



Figure 1-2 Dimensional diagram of KTH2-R-PVC product

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The dimensions of the KTH2-R-PE product are shown in Figure 1-3 below. The total dimensions of the transmitter are 75.5*16mm.



Figure 1-3 Schematic diagram of KTH2-R-PE product dimensions

1.2.2 Product external interfaces

The product's external interface diagram is shown in Figure 1-4 below.

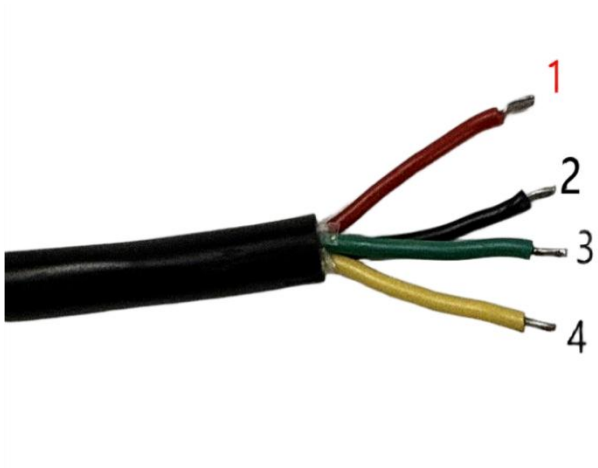


Figure 1-4 Product Interface Diagram

The product's external interface functions are shown in Table 1-2 below.

Table 1-2 Product Interface Description Table

Serial Number	Port naming	Port Function	illustrate	Cable color
1	VCC	Positive power supply	DC 8-28V, positive power input	red

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2	GND	negative terminal of power supply	Negative power supply terminal, GND	black
3	A	485 communication interface A	RS485 A	green
4	B	485 communication interface B	RS485 B	yellow

1.3 Product internal structure diagram

The KTH2-R series products are composed of three main functional modules: temperature measurement unit, main control unit, and communication unit, as shown in Figure 1-5 below.

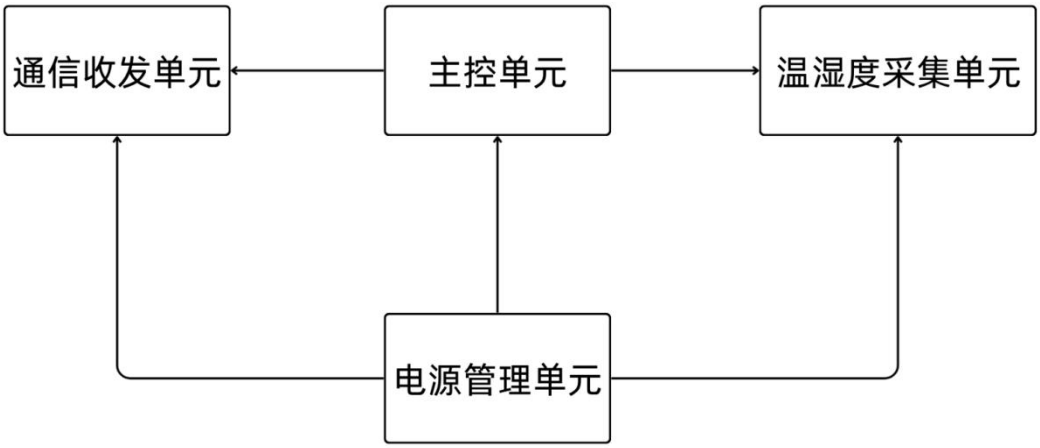


Figure 1-5 Internal Structure Diagram of the Product

1.4 Product Wiring

The KTH2-RI product will collect temperature and humidity data through a temperature and humidity sensor once powered on, and output the data in the form of analog current. Its wiring should be as shown in Figure 1-6 below.

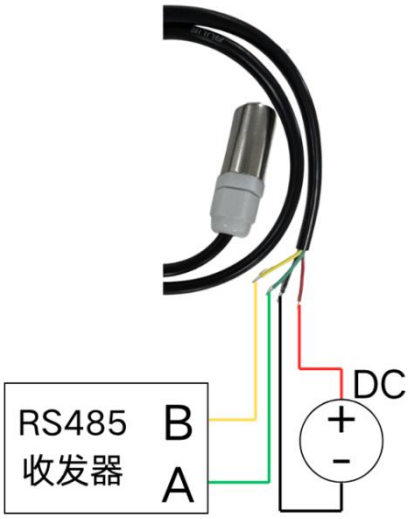


Figure 1-6 Wiring diagram of KTH2-R series products

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2 ModBus RTU Communication Protocol and Register Description

2.1 Introduction to ModBus RTU Communication Protocol

ModBus RTU (Remote Terminal Unit) is a master-slave based serial communication protocol. Its physical layer typically uses the RS-485 electrical standard and is suitable for data exchange between industrial field devices. This protocol employs a compact binary data encoding method, with each data frame containing an address field, function code, data field, and CRC cyclic redundancy check field. It features high transmission efficiency and strong anti-interference capabilities. In typical applications, a single master station can poll multiple slave devices, supporting register read/write operations. Communication distance and speed must comply with the RS-485 physical layer specification.

2.2 Function Codes and Register List

2.2.1 Function Codes

The KTH2-R series products support read-only function codes and write function codes. The corresponding function codes are shown in Table 2-1 below.

Table 2-1 Function Code Table

Function code		Function Description	Operable register address
Decimal (0d)	Hexadecimal (0x)		
3	03	Read a single register	0x00 - 0x0E 0x300 - 0x301
16	10	Write multiple registers	0x0C - 0x0E
06	06	Write a single register	0x0C - 0x0E

2.2.2 Register List

The register list of the main control unit for the KTH2-R series products is shown in Table 2-2 below.

Table 2-2 Register List for KTH2-R Series Products

Register address	Configuration address	quantity	significance	state	Data range
0x00	40001	1	Equipment Model	Read-only	
0x01	40002	1	Device software version	Read-only	
0x02	40003	10	Equipment Name	Read-only	
0x0C	40013	1	Device address	Reading and writing	0~0xFF
0x0D	40014	1	Serial port baud rate	Reading and writing	0: 1200bps 1:2400bps 2: 4800 bps

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					3: 9600 bps (factory default) 4: 19200 bps
0x0E	40015	1	Serial port verification	Reading and writing	Serial port verification: 0 : No verification (factory default) 1 : Odd parity 2: Even parity
0x0300	40769	1	Temperature value	Read-only	0~0xFFFF
0x0301	40770	1	Humidity value	Read-only	0~0xFFFF

2.3 Explanation and Analysis of Commonly Used Function Codes

When communicating using the ModBus-RTU protocol, the following format should be used: "ModBus address + function code + operation register address + operation register value + CRC16 checksum". The following will describe the sending and receiving of commonly used operations.

2.3.1 Reading Temperature

Note: The physical quantity "temperature" is a signed number and will be displayed using two's complement in the design. The two's complement of a positive number is the original number, and the two's complement of a negative number is the one's complement of the original number plus 1. Unless otherwise specified, all numbers in the following tables are hexadecimal numbers.

Definition: Least significant bit (LSB) = 0.1°C or 0.1%RH

The function code for read-only temperature is 03, and the register address to be operated on is 0x03 00.

send	ModBus address	Function code	Operate register address	Manipulate register values	CRC16 checksum
	01	03	03 00	00 01	84 4E

① Assume the temperature is 15.0°C.

take over	ModBus address	Function code	Number of bytes returned	Register contents	CRC16 checksum
	01	03	02	00 96	38 2A

The received response was "01 03 02 00 96 38 2A", and the process of converting it into the actual temperature is as follows:

0x00 96 = 0d150 = 150 * 1LSB = 15.0°C

② Assume the temperature is -21.7°C.

take over	ModBus address	Function code	Number of bytes returned	Register contents	CRC16 checksum
	01	03	02	FF 27	B9 AE

The received response was "01 03 02 FF 27 B9 AE", and the process of converting it into the actual temperature is as follows:

0xFF 27 two's complement = 0x80 D9 = 0d(-217) = -217 * 1 LSB = -21.7°C

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2.3.2 Reading Humidity

The function code for read-only humidity is 03, and the register address to be operated on is 0x03 01.

send	ModBus address	Function code	Operate register address	Manipulate register values	CRC16 checksum
	01	03	03 01	00 01	D5 8E

Assume the humidity is 41.3%RH at this time.

take over	ModBus address	Function code	Number of bytes returned	Register content value	CRC16 checksum
	01	03	02	01 9D	78 7D

The received reply was "01 03 02 01 9D 78 7D", and the process of converting it into actual humidity is as follows:

0x01 9D = 0d413 = 413 * 1LSB = 41.3%RH

2.3.3 Simultaneously read temperature and humidity

send	ModBus address	Function code	Operate register address	Manipulate register values	CRC16 checksum
	01	03	03 00	00 02	C4 4F

take over	ModBus address	Function code	Number of bytes returned	Register content value	CRC16 checksum
	01	03	04	01 02 02 88	5B 09

The received response was "01 03 04 01 02 02 88 5B 09". The process of converting it into actual temperature and humidity values is as follows:

0x01 02 = 0d258 = 258 * 1LSB = 25.8°C;

0x02 88 = 0d648 = 648 * 1LSB = 64.8%RH.

2.3.4 Setting Serial Port Parameters

This example will demonstrate how to use function code 0x10 to change the baud rate to 9600bps.

send	address	Function code	Register address	Number of registers	length	data	CRC16 checksum
	01	10	00 0D	00 01	02	00 03	E7 4C

take over	ModBus address	Function code	Register address	Number of registers	CRC16 checksum
	01	10	00 0D	00 01	90 0A

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2.3.5 Setting the ModBus Address

This example will demonstrate how to use function code 0x10 to change the default address 0x01 to address 0x0A.

send	address	Function code	Register address	Number of registers	length	data	CRC16 checksum
	01	10	00 0C	00 01	02	00 0A	26 9B

take over	ModBus address	Function code	Register address	Number of registers	CRC16 checksum
	01	10	00 0C	00 01	C1 CA

2.3.6 Broadcast method query module address

If you forget to configure the ModBus address of a module, you can use the broadcast method to query the address of a single module. For example, if the module address is changed to 0x0A in section 2.3.5 above, you can use the following command to query the address of the module.

send	ModBus address	Function code	Operate register address	Manipulate register values	CRC16 checksum
	00	03	00 0C	00 01	45 D8

take over	ModBus address	Function code	Number of bytes returned	Return value	CRC16 checksum
	0A	03	02	00 0A	9D 82

The ModBus address received at this time is the address of this module.

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3 Host computer user manual

This chapter will introduce three methods for using the host computer (temperature and humidity host computer, Modbus poll, Modbus scan).

3.1 Host computer driver installation

If you have not used a USB to 485 (USB to TTL) adapter before or your computer does not have the CH340 driver, you need to install the driver first; if you have the CH340 driver, you can ignore section 3.1 .

The installation steps for the host computer driver are as follows:

1. Locate the CH340 driver, click "Download Materials," and obtain the product information.
   CH340 Driver - Chengdu Kejiexun Electronic Technology Co., Ltd.



Figure 3-1 CH340 driver storage location

2. After downloading and extracting, open the folder and select the corresponding driver.

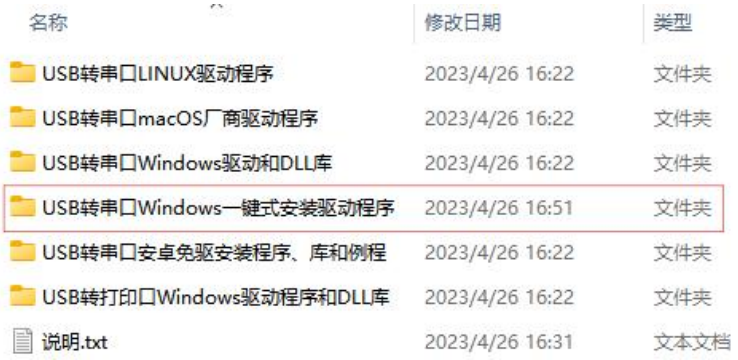


Figure 3-2 Driver Directory

3. After opening, double-click CH341SER.EXE;

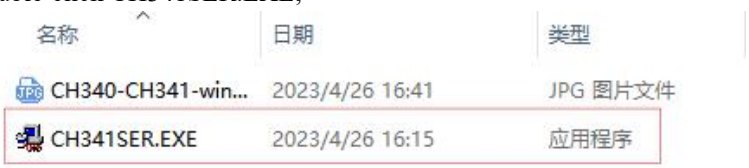


Figure 3-3 Application Content

4. Click to install;

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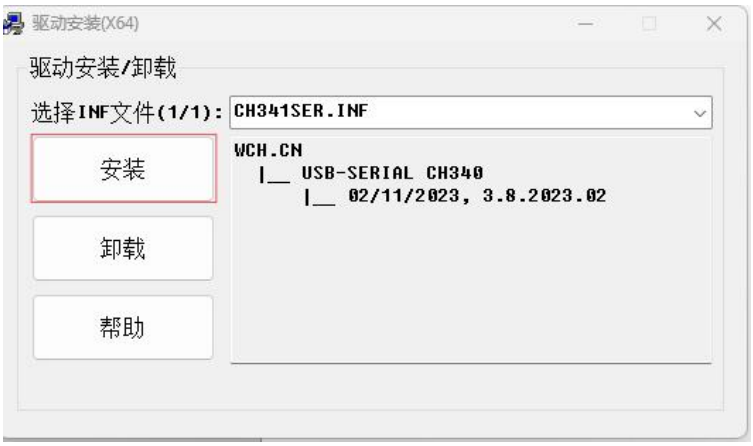


Figure 3-4 Driver installation interface

5. The following message will be displayed after successful installation;

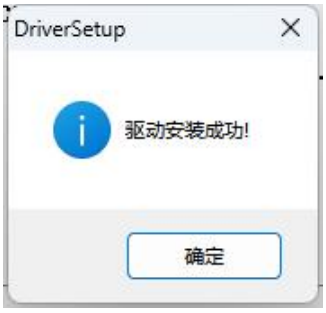


Figure 3-5 Driver installation success message

6. After connecting the USB to 485 device to the computer, open Device Manager, and the host computer will automatically recognize the port.

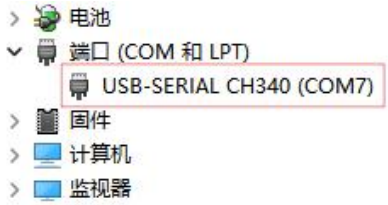


Figure 3-6 Host computer port directory

3.2 Temperature and humidity host computer software instructions

3.2.1 Preparation before use

Before using the host computer, the external hardware must be connected and the corresponding serial port driver must be installed on the host computer. This chapter will not provide a detailed explanation of the hardware connection. (For specific hardware connections, please refer to "Chapter 1.2.2")

The interface and operation of the temperature and humidity host computer will be explained next.

3.2.2 Interface Description

For serial communication, the corresponding serial port parameters need to be set, as shown in Figure 3-7 below.

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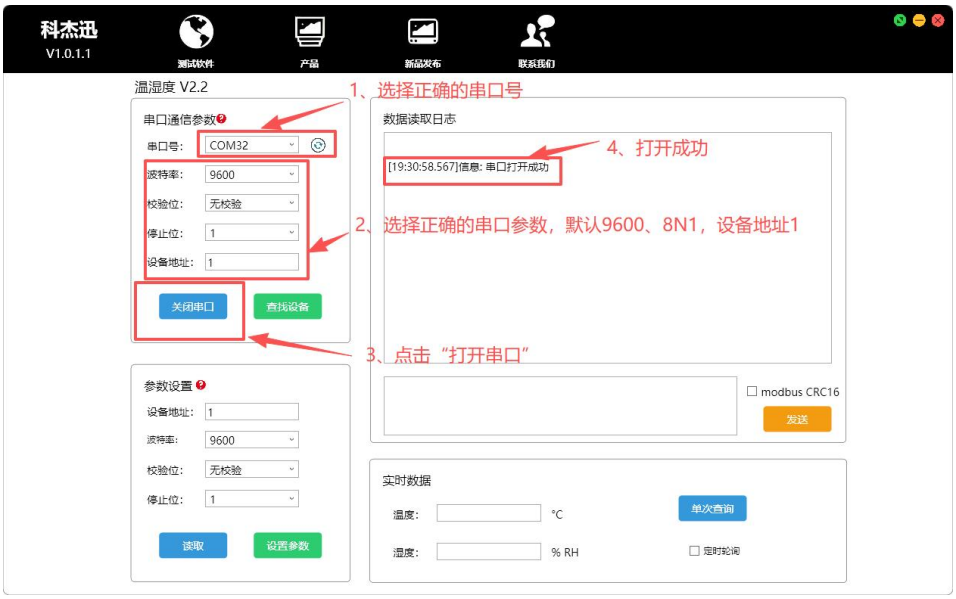


Figure 3-7 Temperature and Humidity Host Computer Interface

3.2.3 Instructions for modifying address and serial port parameters

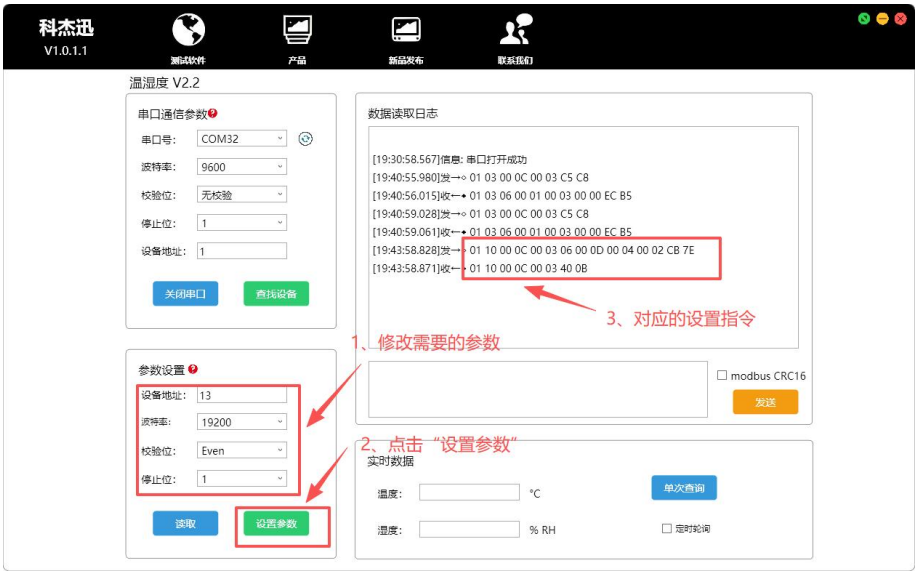


Figure 3-8 Address and serial port parameter modification interface

3.2.4 Temperature and humidity reading instructions

As shown in Figure 3-9 below, its timed polling cycle is approximately 250ms per read.

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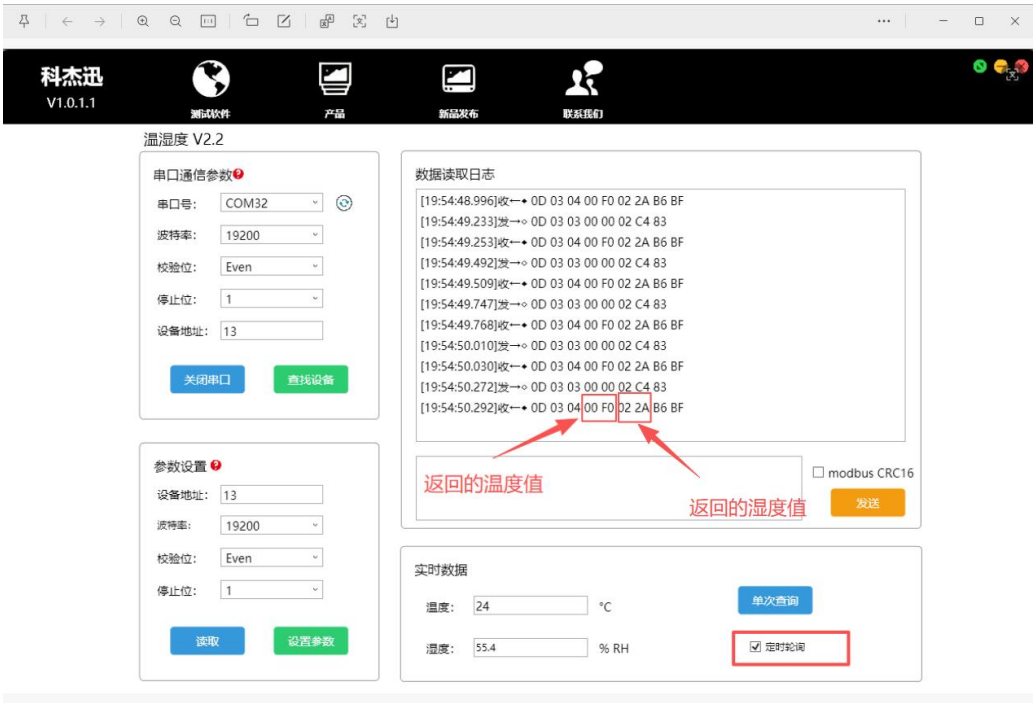


Figure 3-9 Temperature and humidity reading interface

Temperature calculation: (resolution 0.1℃)

Hexadecimal 0x00F0 => Decimal 240 => 240 * 0.1℃ = 24.0℃

Humidity calculation: (resolution 0.1%RH)

Hexadecimal 022A => Decimal 554 => 554 * 0.1%RH = 55.4%RH

3.3 ModBus poll software description

3.3.1 Preparation before use

Before use, prepare the following: ModBus poll software installation, hardware connection (refer to section 1.2.2), USB to 485 module, and CH340 driver installation on the host computer. This will not be elaborated further in this section.

3.3.2 Software Interface Description

Open the Modbus Poll software, click Connection to enter the connection settings. In the area shown in the image below, select Serial Port, select the serial port number to insert (COM13 for example), select the baud rate of 9600, data bits 8, parity bits None, and stop bits 1. On the right, select RTU communication mode, and then click OK.

See Figure 3-10.

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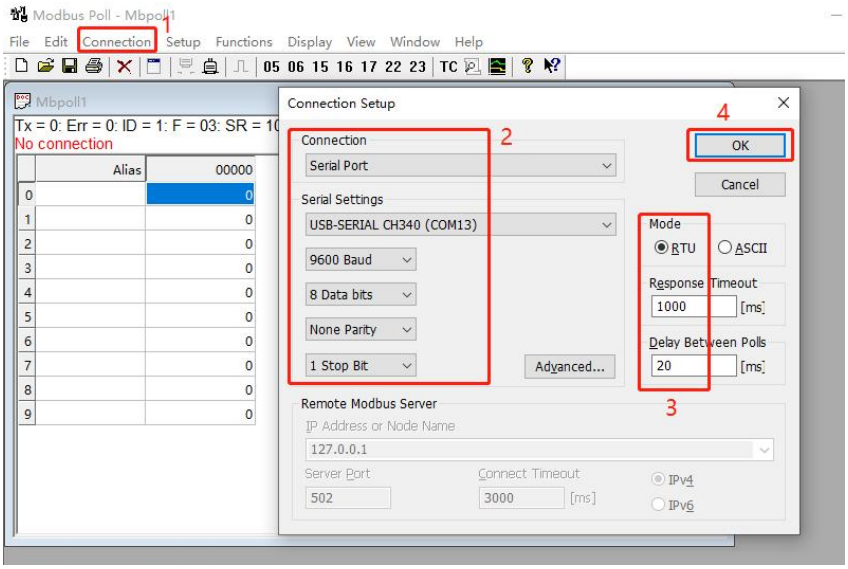


Figure 3-10 Modbus Poll software configuration interface

3.3.3 Reading Interface Description

Click setup to enter the settings, enter the station address and slave ID (default is 1), select the corresponding function code (default is 03), enter the corresponding register start address (see the table below, default is 0x0300, corresponding to decimal 768), read 2 registers (temperature, humidity), the reading time is 1000 milliseconds by default, click apply on the right, and then click OK.

See Figure 3-11.

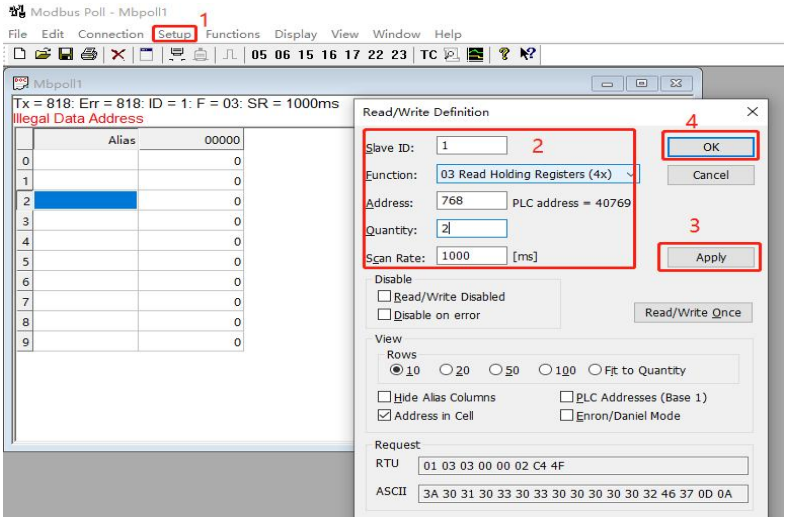


Figure 3-11 Modbus poll settings interface

At this point, the host computer has no red error messages, indicating that communication with the module has been successful. In the software, register address 768 corresponds to the temperature value, and register address 769 corresponds to the humidity value. The output value multiplied by 0.1 is the specific temperature and humidity value (temperature = 269 * 0.1 = 26.9℃) (humidity = 678 * 0.1 = 67.8%RH).

Figure 3-12 shows the reading interface after the settings are completed.

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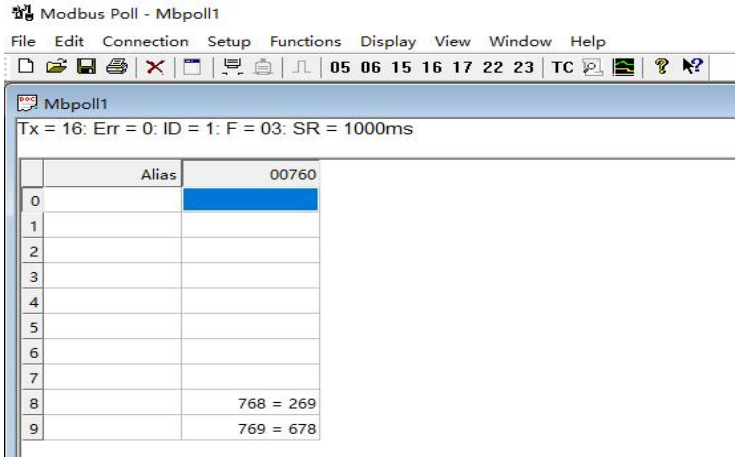


Figure 3-12 Modbus poll reading interface

3.4 ModBus Scan Software Description

3.4.1 Preparation before use

Before use, prepare the following: ModBus Scan software installation, hardware connection (refer to section 1.2.2), USB to 485 module, and CH340 driver installation on the host computer. This section will not elaborate further.

3.4.2 Software Interface Description

Open the Modbus Scan software, click Connection Settings in the menu bar, then click Connect. A detailed connection dialog box will appear. Select the corresponding serial port (COM13 for example), set the baud rate to 9600 and the data bits to 8 (i.e., word length), set the parity to none and the stop bits to 1, click Protocol Selection, select the RTU protocol, and finally click OK to close the dialog box.

See Figures 3-13 and 3-14 below.



Figure 3-13 Modscan software connection interface

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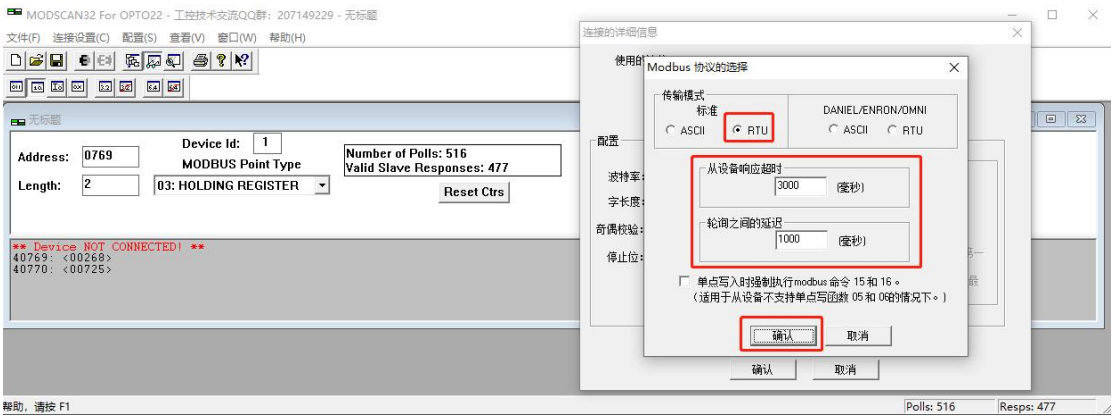


Figure 3-14 Modscan software protocol settings interface

3.4.3 Reading Interface Description

Enter the station address of the temperature and humidity module (default is 01), enter the starting address of the register 769, enter the read length as 2, select function code 03, and it will automatically connect and update the data after selection.

See Figure 3-15 below .



Figure 3-15 Modscan reading interface

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