



HWR350 Series Trace Moisture Sensor User Manual

(v5.1.1)



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Announcement

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This manual explains how to use the HWR350 series trace moisture sensor (hereinafter referred to as the HWR350) and consists of the following four sections:

1. Test the tool;
2. Configuration connections;
3. Communication protocols;
4. Test instructions.

1 Test Tools

1.1 Hardware Tool

- ① PC with USB interface;
- ② HWR350 sensor;
- ③ Test oil sample;
- ④ M8 6-pole cable;
- ⑤ USB-RS485 converter;
- ⑥ +24V DC power supply.

1.2 Software tool

- ① USB-RS485 Converter Driver



PL2303_Prolific_DriverInstaller_v110.rar

- ② serial communications software



ModbusPoll6.3.rar

If users need, related software can be obtained from our technical staff.

2 Configuring Connections

2.1 Installation of serial drivers and serial communication software

It is recommended that you close the antivirus software on your computer before installing the software, otherwise it may report errors or lose files and cause the installation to fail.

2.1.1 Installing the serial port driver

Install the corresponding driver according to the serial communication software used. After the driver is installed, you can check the installation result under Computer->Management->Device Manager->Port Catalogue.

Management->Device Manager->Ports directory to view the installation results, the interface after successful installation is shown in Figure 1:

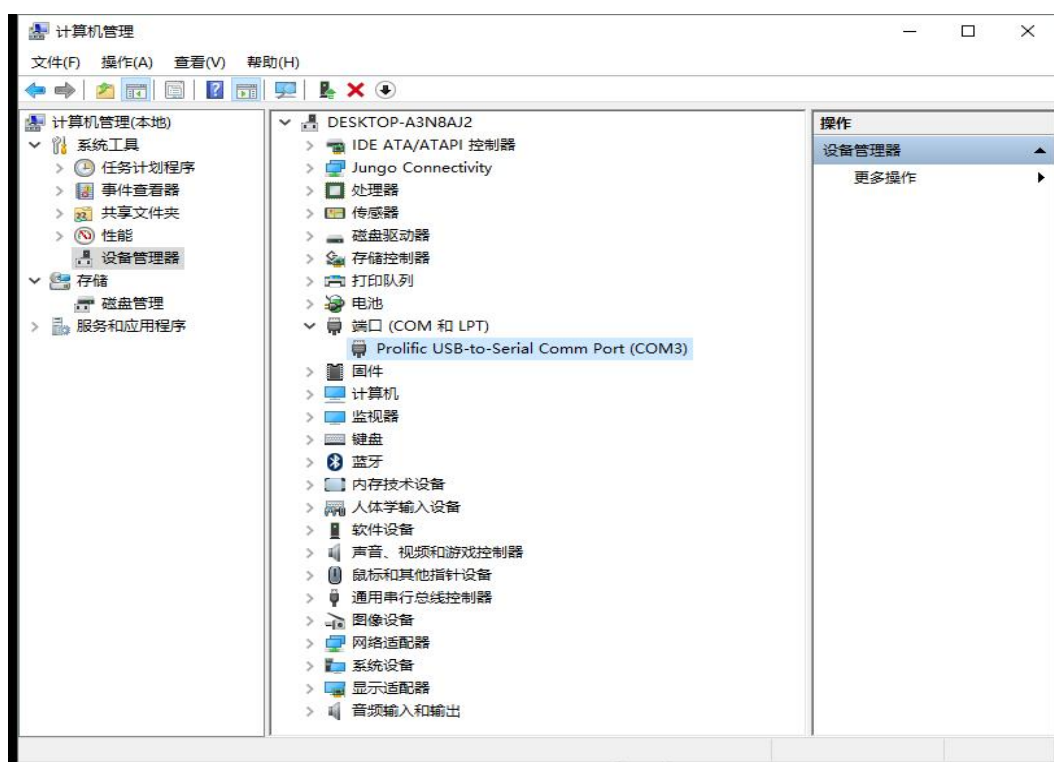


Figure 1 Serial Driver Installation Successful Interface

2.1.2 Installation of serial communication software

Follow the Modbus Poll software prompts for installation and setup.

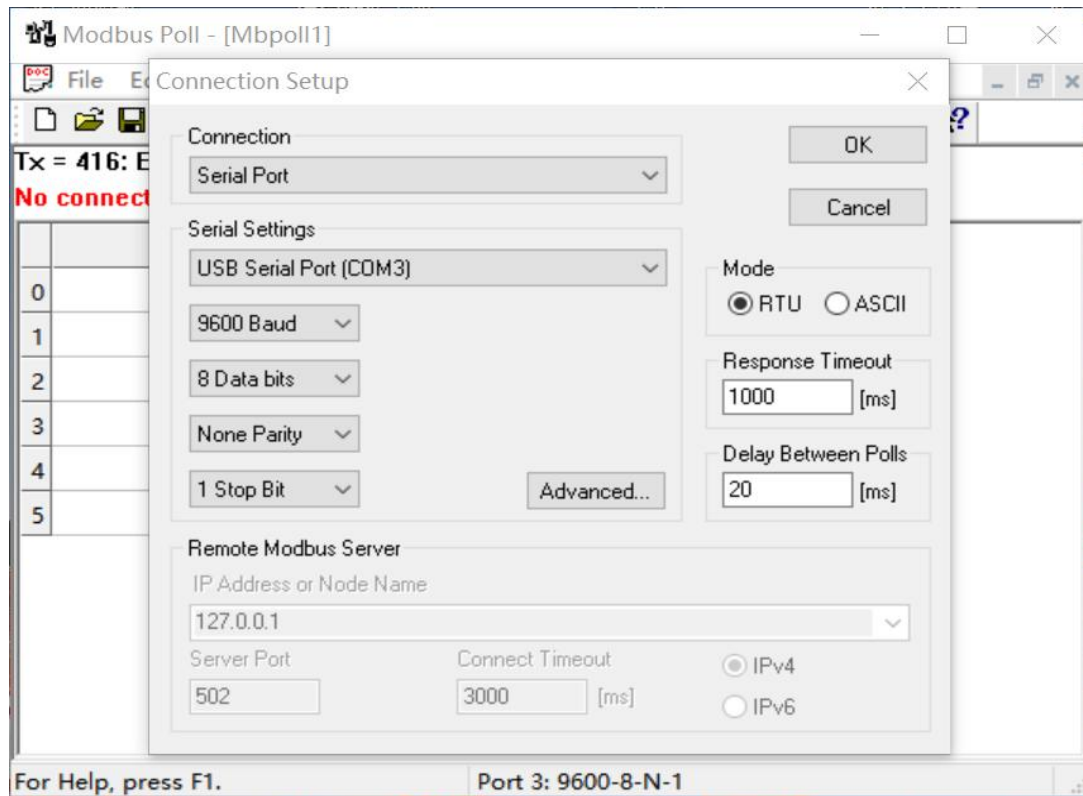


Figure 2 Modbus Poll Software Serial Port Settings

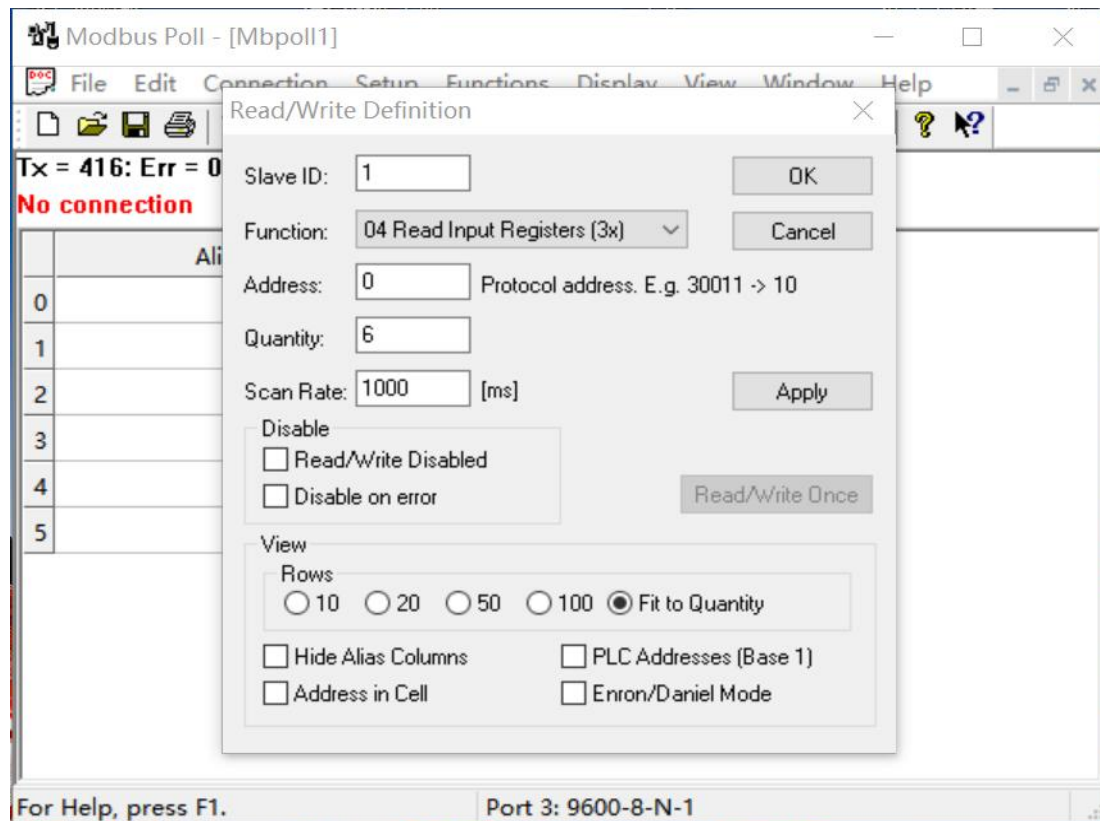


Figure 3 Modbus Poll Software Read/Write Settings

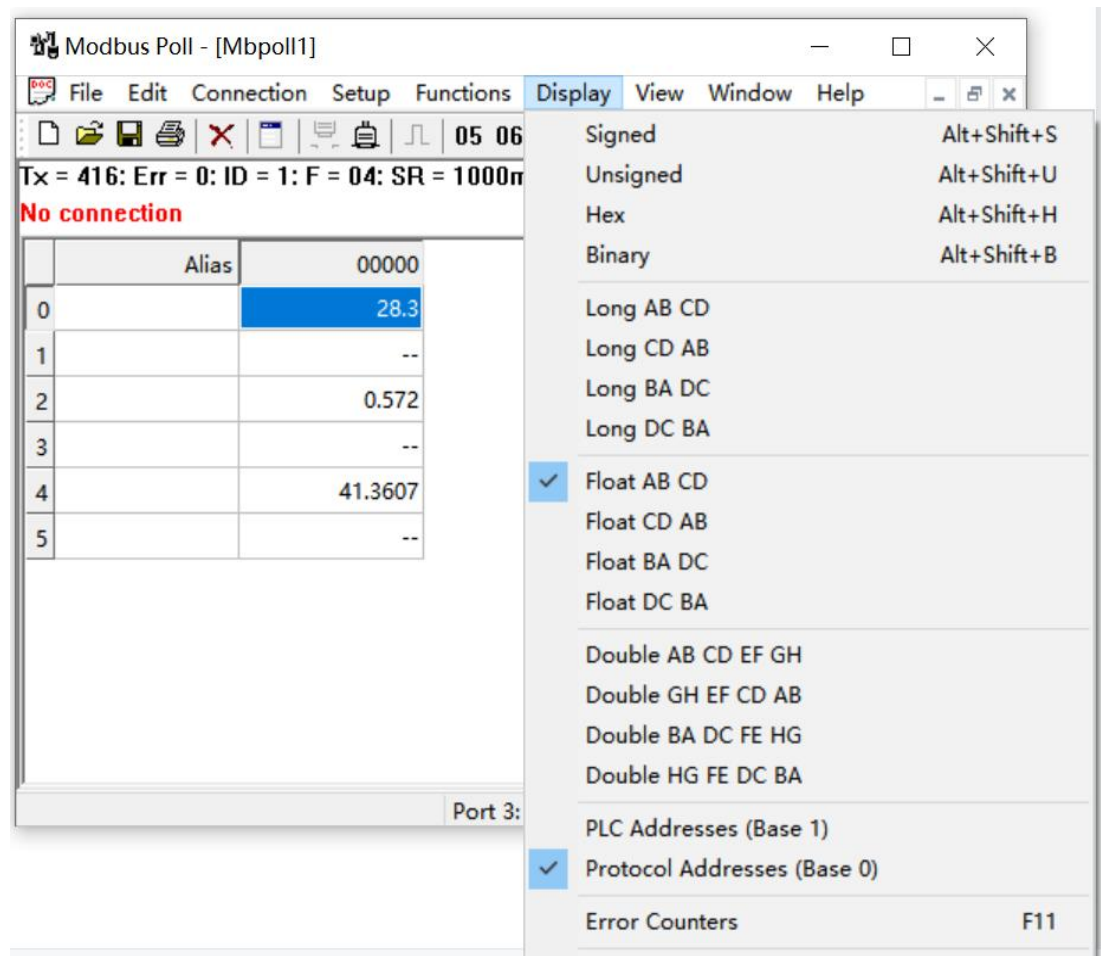


Figure 4 Modbus Poll Software Data Display Settings

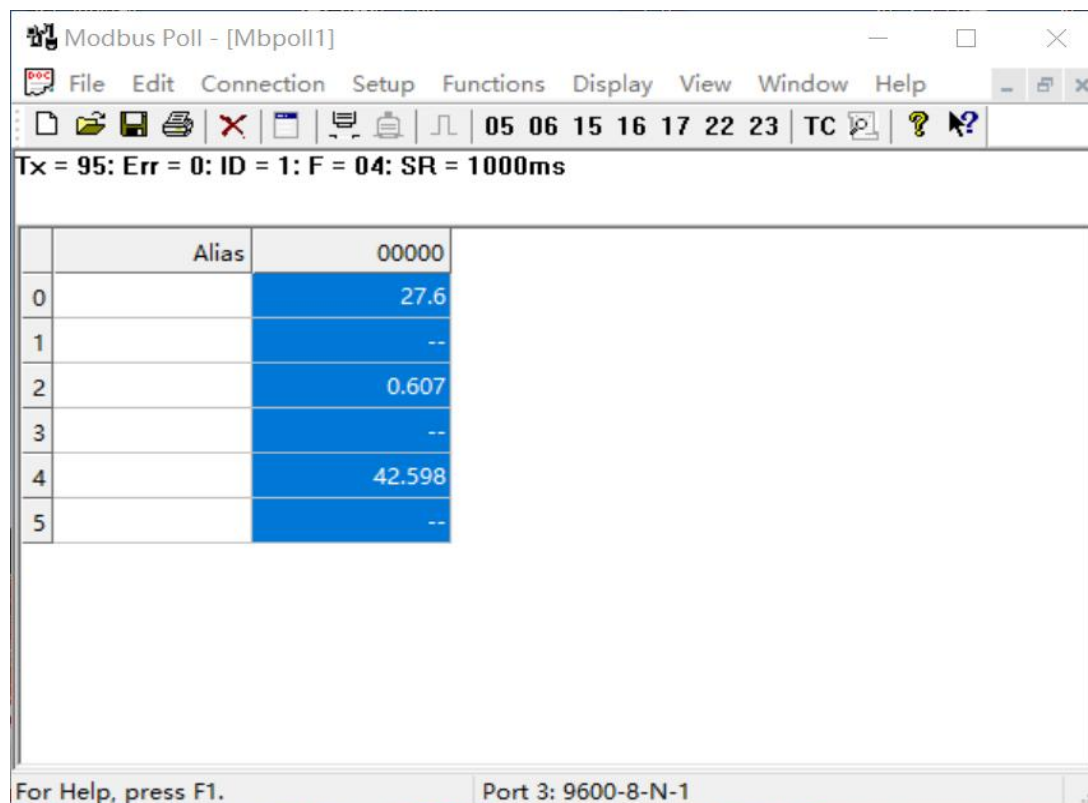


Figure 5 Modbus Poll Software Communication Interface

Fig. 5 shows data indicating: temperature 27.6 ° C, water activity 0.607 aw, water content 42.598 ppm.

2.2 Communication Line Connection

Connect the communication lines as shown in Figure 6. Measurement results can be read normally about 3 seconds after the power is switched on. It is important that the HWR350 probe is fully immersed in the oil (no air bubbles in the probe's air holes) during testing or normal use, otherwise the measurement results will not characterise the current condition of the oil sample.



Fig. 6 Schematic diagram of communication line connection

3 Communication protocol

HWR350 provides a standard RS485 or RS232 communication interface to communicate with the host using Modbus RTU protocol. In a complete online monitoring system, the master control device acts as the host and HWR350 acts as the slave. Each communication handshake always consists of an access request from the master and a response from the slave.

Use of specification standards: "GB/T19582-2008 Modbus protocol-based industrial automation network specification".

3.1 Data format

3.1.1 Data frame format

The format of each byte (frame) sent by HWR350 completely follows the MODBUS communication protocol of GB/T19582-2008 standard, and the function codes support reading, writing, batch writing, etc. The CRC checksum: (CRC-16/MODBUS $x_{16}+x_{15}+x_{2+1}$) starts from the "address code" to the "data" end. The CRC checksum: (CRC-16/MODBUS $x_{16}+x_{15}+x_{2+1}$) starts from "address code" to the end of "data". The data frame contains start bit, information bit and stop bit, total 10 bits, as shown in Figure 7.

Frame format (10-bit):

Threshold	D0	D1	D2	D3	D4	D5	D6	D7	Stop-bit
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Figure 7 Data frame format

The specific definitions are as follows:

Bit 1: Start bit ("0" valid);

Bits 2 to 9: Information bits;

Bit 10: Stop bit ("1" valid);

3.1.2 Message format

The format of each message received and sent by the system is as follows:

--address

--Function code

--Data number

--Data 1

--...

--Data n

--CRC16 checksum

3.2 Communication parameters

3.2.1 Serial port settings

Parametric	Causality
baud	9600
data bit	8-bit
parity check	no checksum
stop bit	1-bit

Table 1 Serial Port Settings

3.2.2 Modbus function code

function code	define
04 (0x04)	Read Input Register
06 (0x06)	Write Single Register
16 (0x10)	Write multiple registers

Table 2 Modbus Function Codes

3.2.3 Modbus operable register

no.	start address	function code	word length	Store content	instruction
1	0x0000	0x04	2	temp	data type: float ABCD ; unit: °C
2	0x0002		2	water activity	data type: float ABCD ; unit: aw
3	0x0004		2	moisture content	data type: float ABCD ; unit: ppm
4	0x9000	0x04	1	address	data type: unsigned int
		0x06			

Note: float Single-precision floating-point data, compliant with IEEE754 standard.

Table 3 Modbus Operable Registers

3.3 Data retrieval

Example of reading HWR350 data message [HWR350 address is 1, temperature 27.6 ° C, water activity 0.607 aw, water content 42.598 ppm].

apply		response	
domain name	(hexadecimal)	domain name	(hexadecimal)
address	01	address	01
function code	04	function code	04
data home address Hi	00	data byte count	0C
data home address Lo	00	temperature	41
number of data word Hi	00		DC
number of data word Lo	06		CC
CRC16 Lo	70		CD
CRC16 Hi	08	water activity	3F
			1B
			64
			5A
		moisture content	42
			2A
			64
			5A
		CRC16 Lo	14
		CRC16 Hi	79

Table 4 Example of reading HWR350 data message

3.4 Address Setting

HWR350 The factory default address is 1. The address setting range is 1 to 100, and 0 is the broadcast address.

3.4.1 Enquiry Address

Example of a query address message [HWR350 Current address is 1.]

apply		response	
domain name	(hexadecimal)	domain name	(hexadecimal)
broadcast address	00	broadcast address	00
function code	04	function code	04
start address Hi	90	data byte count	02
start address Lo	00	current address Hi	00
data word count Hi	00	current address Lo	01
data word count Lo	01	CRC16 Lo	45
CRC16 Lo	1D	CRC16 Hi	30
CRC16 Hi	1B		

Table 5 Example of query HWR350 address message

3.4.2 Change address

Example of a Modify Address Message [HWR350 address changed from 1 to 2.]

apply		response	
domain name	(hexadecimal)	domain name	(hexadecimal)
current address	01	current address	01
function code	06	function code	06
data home address Hi	90	data home address Hi	90
data home address Lo	00	data home address Lo	00
Setup Address Hi	00	Setup Address Hi	00
Setup Address Lo	02	Setup Address Lo	02
CRC16 Lo	25	CRC16 Lo	25
CRC16 Hi	0B	CRC16 Hi	0B

Table 6 Example of Modify HWR350 Address Message

3.5 4-20mA analogue output

3.5.1 4-20mA Output Channel Definition

Ch1 is the temperature ($^{\circ}\text{C}$)

Ch2 is water activity (aw) or water content (ppm)

3.5.2 4-20mA Range Definition

Iout	4mA	12mA	20mA
Ch1	-40.0 $^{\circ}\text{C}$	40.0 $^{\circ}\text{C}$	120.0 $^{\circ}\text{C}$
Ch2	0 ppm	500 ppm	1000 ppm

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

Table 7 4-20mA Range Definitions

3.5.3 4-20mA output connection

The HWR350 uses a 3-wire 4-20mA current loop analogue output, wired as follows.

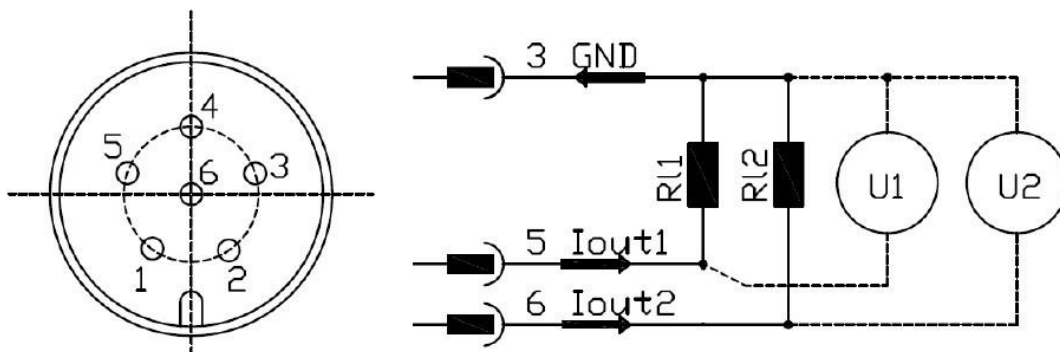


Figure 8 4-20mA Current Loop Connection Diagram

Attention:

- 1) The red wire (corresponding to pin 1 of M8 connector) connects to DC24V;
- 2) The black wire (corresponding to pin 3 of M8 connector) is connected to GND; 3) The HWR350 has two 4-20mA three-wire analogue outputs.
- 3) HWR350 has two 4-20mA 3-wire analogue outputs, channel 1 for temperature and channel 2 for water content (or as required by order);
- 4) Yellow wire (corresponds to pin 5 of M8 connector) connects to the user's 4-20mA sampling module input positive terminal; at the same time, the output negative terminal of this loop connects back to the black wire GND, constituting a 4-20mA current loop; this channel represents temperature;
- 5) Orange wire (or old blue wire, corresponding to pin 6 of M8 connector) is connected to the positive input terminal of the 4-20mA sampling module of the user's other way; at the same time, the negative output terminal of this circuit is connected back to the black wire GND, constituting a 4-20mA current loop; this channel represents the water content;
- 6) Special Note: Users need to confirm whether the 4-20mA loop load resistors RL1 and RL2 are included in the user's 4-20mA acquisition module. 6) Special note: Users need to confirm whether the 4-20mA loop load resistors RL1 and RL2 are included in the user's 4-20mA acquisition module, or in the PLC 4-20mA input channel, and should not connect an ammeter in series to the loop to measure the 4-20mA current value directly without any load;

7) load resistance (RL1, RL2)

In order to achieve the rated operating characteristics of the HWR350, the load resistors RL1 and RL2 should be $\leq 500\Omega$ and $\geq 100\Omega$, and we recommend that users choose 500Ω high-precision, low-temperature-drift sampling resistors. At this point, HWR350 can work normally under 22V-28V DC external power supply.

3.5.4 4-20mA Output conversion formula

norm	range	formulas
temp	-40.0 ... 120.0 °C	$T = (I_{out} - 4) * 160 / (20 - 4) - 40.0$
moisture content	0 ... 1000 ppm	$W = (I_{out} - 4) * 1000 / (20 - 4) + 0$

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 8 4-20mA conversion formula

3.5.5 DDU intelligent meter

The HWR350 can be equipped with an optional DDU intelligent display meter for your convenience in the field.

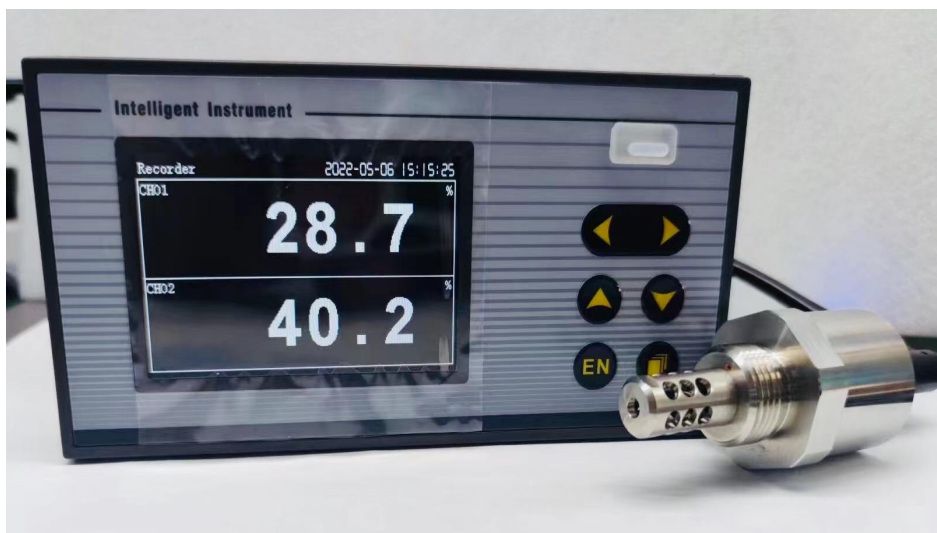


Figure 9 DDU Smart Meter

The instrument comes with +24VDC power output (P+, P- terminals), HWR350 does not need external power supply. The power supply ground (P- terminal) is not common to the analogue input signal ground (C terminal) and needs to be shorted with a shielded wire.



Fig. 10 Connection of instrument terminals to HWR350 cable

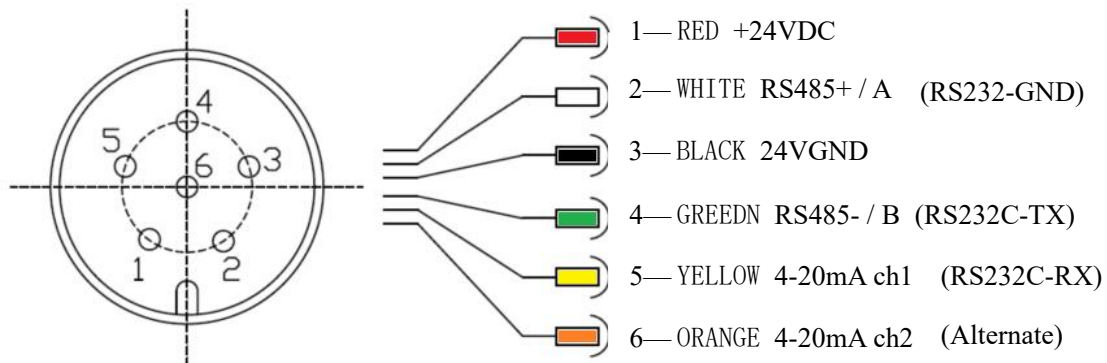


Warning: Please make sure to check the above wiring sequence is correct and operate with caution, otherwise the instrument may be damaged due to short-circuit, over-voltage, etc. caused by wrong wiring, resulting in no communication.

4 Test Description

4.1 Wiring Definition

The HWR350 has an M8 1*6 connector (male) on the tail with the following interface definition:



Note: Wiring definitions in parentheses are for RS232 communication mode.

Figure 11 Connector Interface Definition

4.2 Test step

Step 1: Connect the test line according to Figure 6.

Step 2: Set up the communication software and test whether the communication connection of the whole line is normal. If it is normal, perform step 3; If not, double-check the line connections and troubleshoot the problem.

Step 3: Clean the HWR350 probe with petroleum ether until there is no obvious oil stains on the probe surface, and blow it dry with the instrument air source.

This must be done before using the HWR350.

Step 4: Use a 25mL or larger measuring cup to take an appropriate oil sample, with the oil level just submerged in the HWR350 mounting tube screw. The level of the oil should be just enough to submerge the threads of the HWR350 mounting tube, and there should not be any obvious air bubbles in the air holes of the probe.

Step 5: Connect the HWR350 and power up for testing.

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