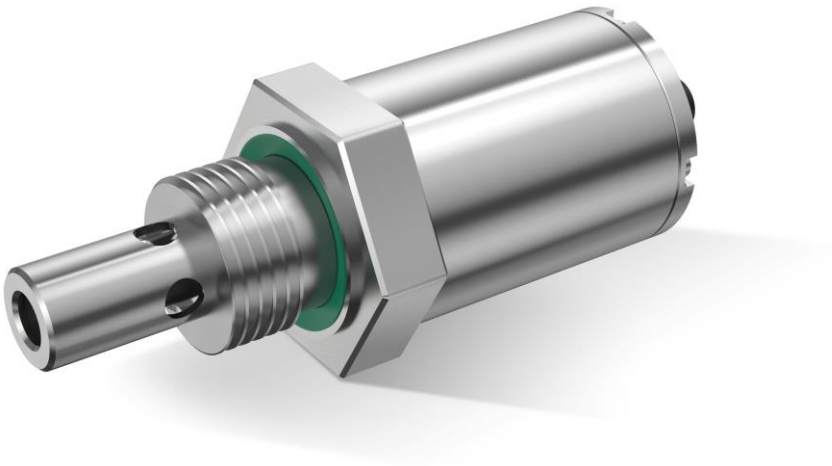
HWR-580MOil Characterisation Sensor

user manual

（v1.0.1）



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Representations

This manual explains how to use the HWR-580M Oil Characteristics Sensor (hereinafter referred to as the HWR-580M), and consists of the following four sections:

1. testing tools;
2. configuration connections;
3. communication protocols;
4. test instructions.

1 Test Tools

1.1 Hardware Tools

① PC with USB interface;

② HWR-580M sensor;

③ Test oil sample;

④ M8 6-core cable;

⑤ USB-RS485 converter;

⑥ +24V DC regulated 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

Users should install the corresponding driver according to the serial port communication software used. After the driver is installed, you can check the installation result under Computer->Management->Device Manager->Port Directory, and the interface after successful installation is shown in Figure 1:

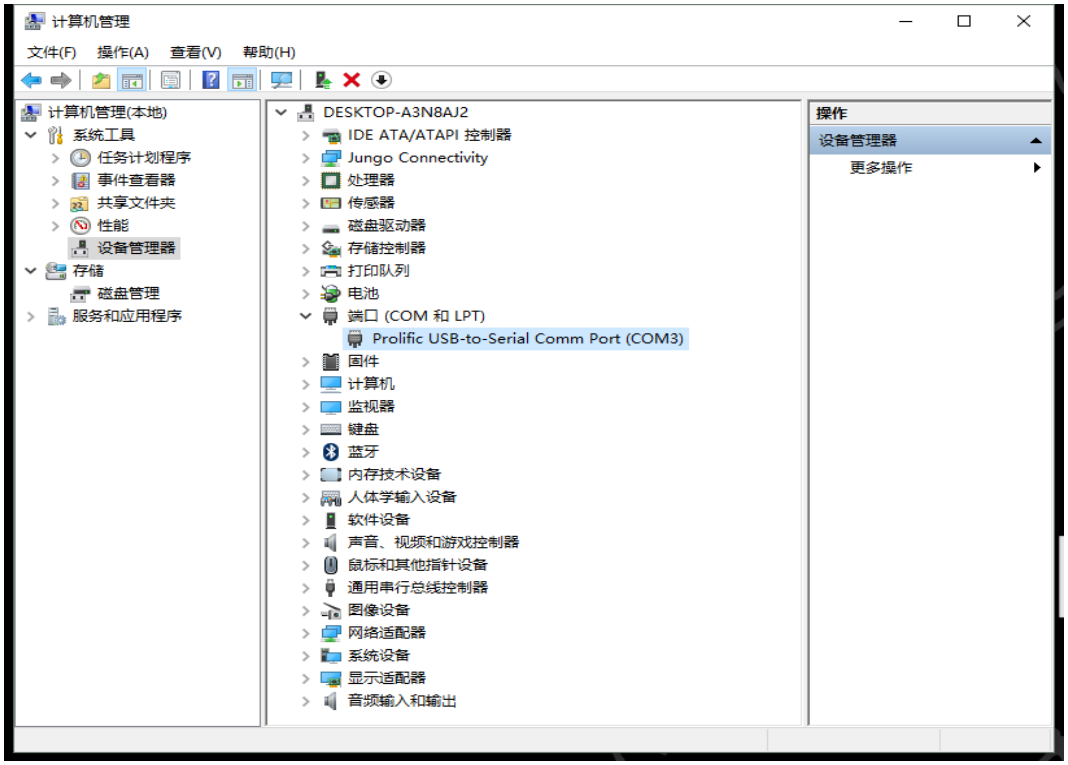


Figure 1 Serial Driver Installation Successful Interface

2.1.2 Installation of serial communication software

Follow the Modbus Poll software prompts for installation and setup.

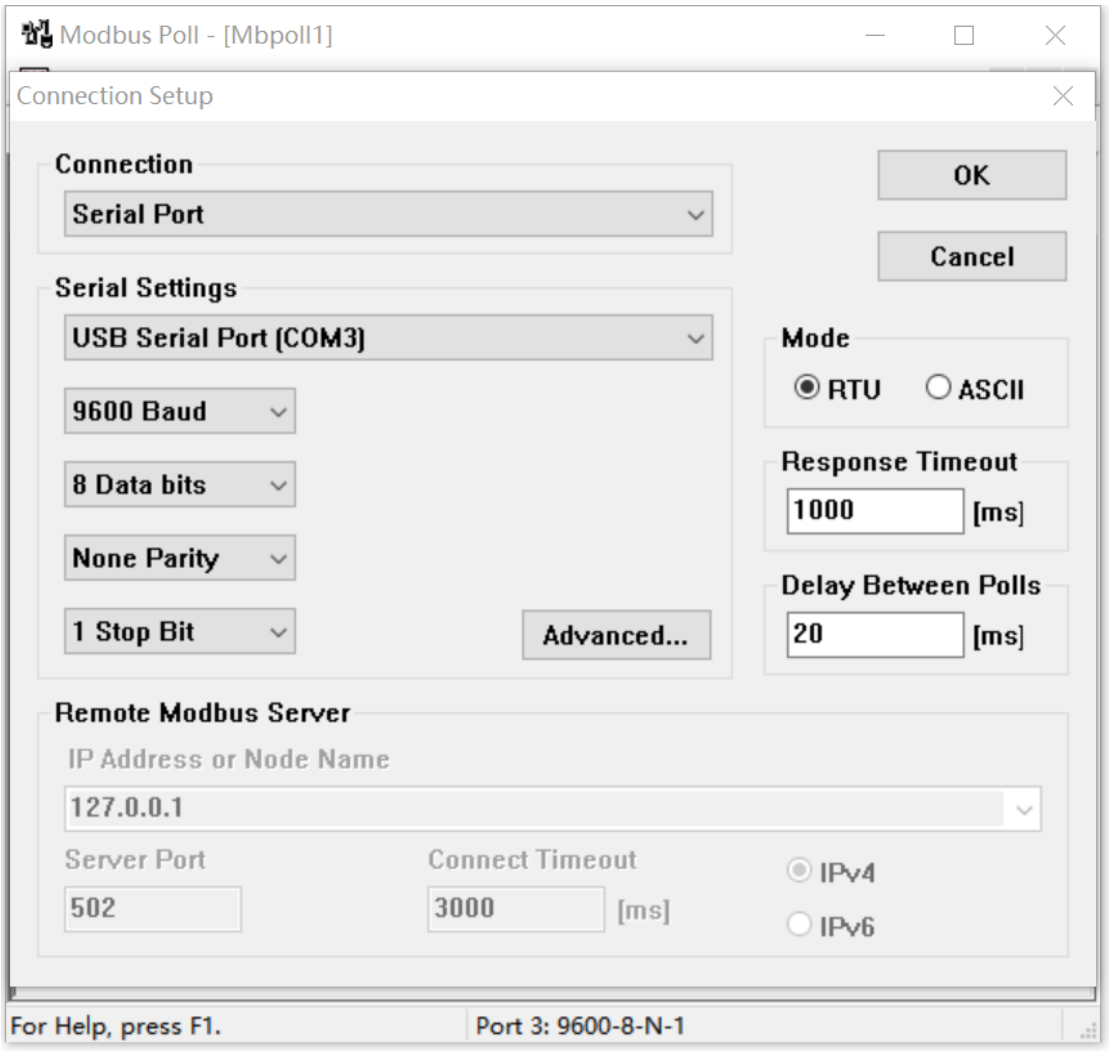


Figure 2 Modbus Poll Software Serial Port Settings

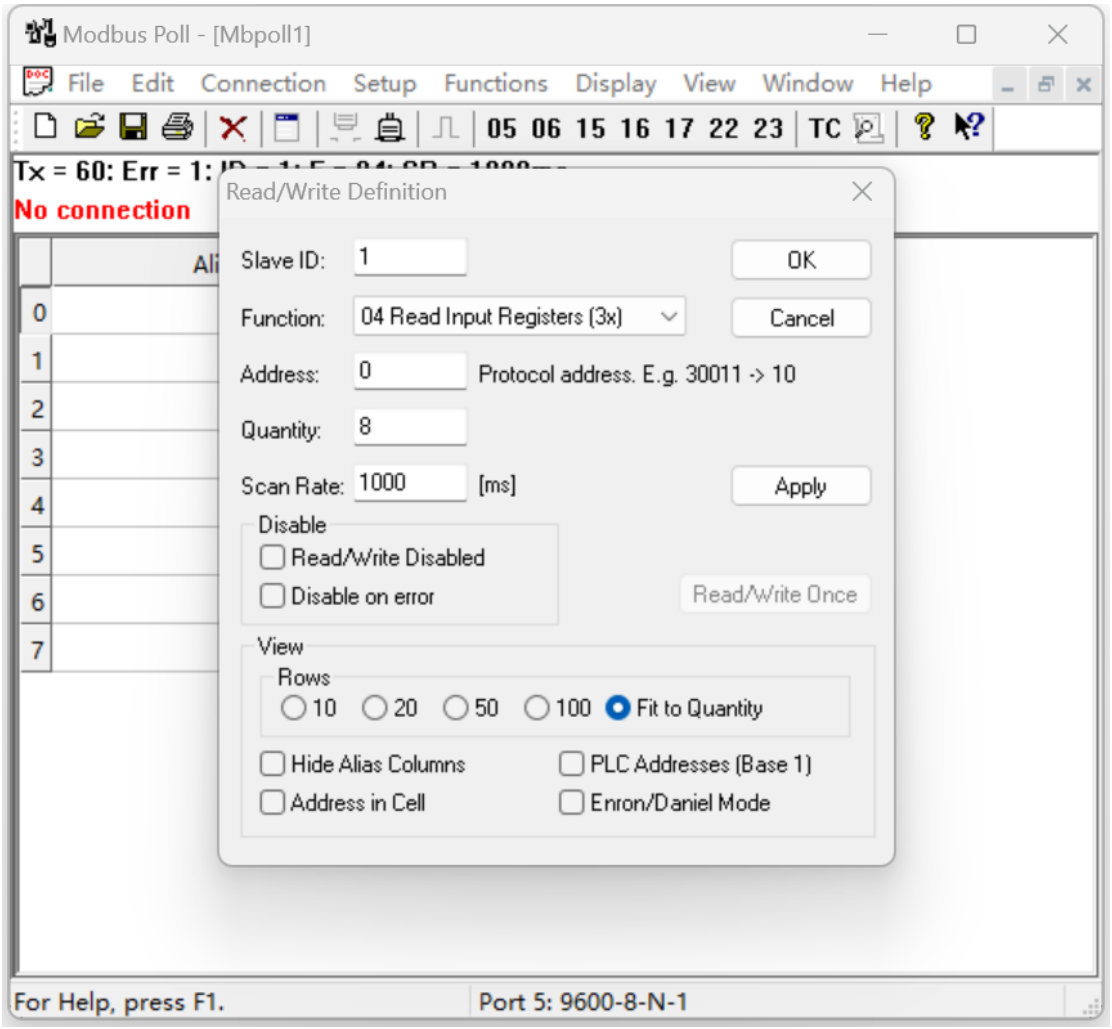


Figure 3 Modbus Poll Software Read/Write Settings

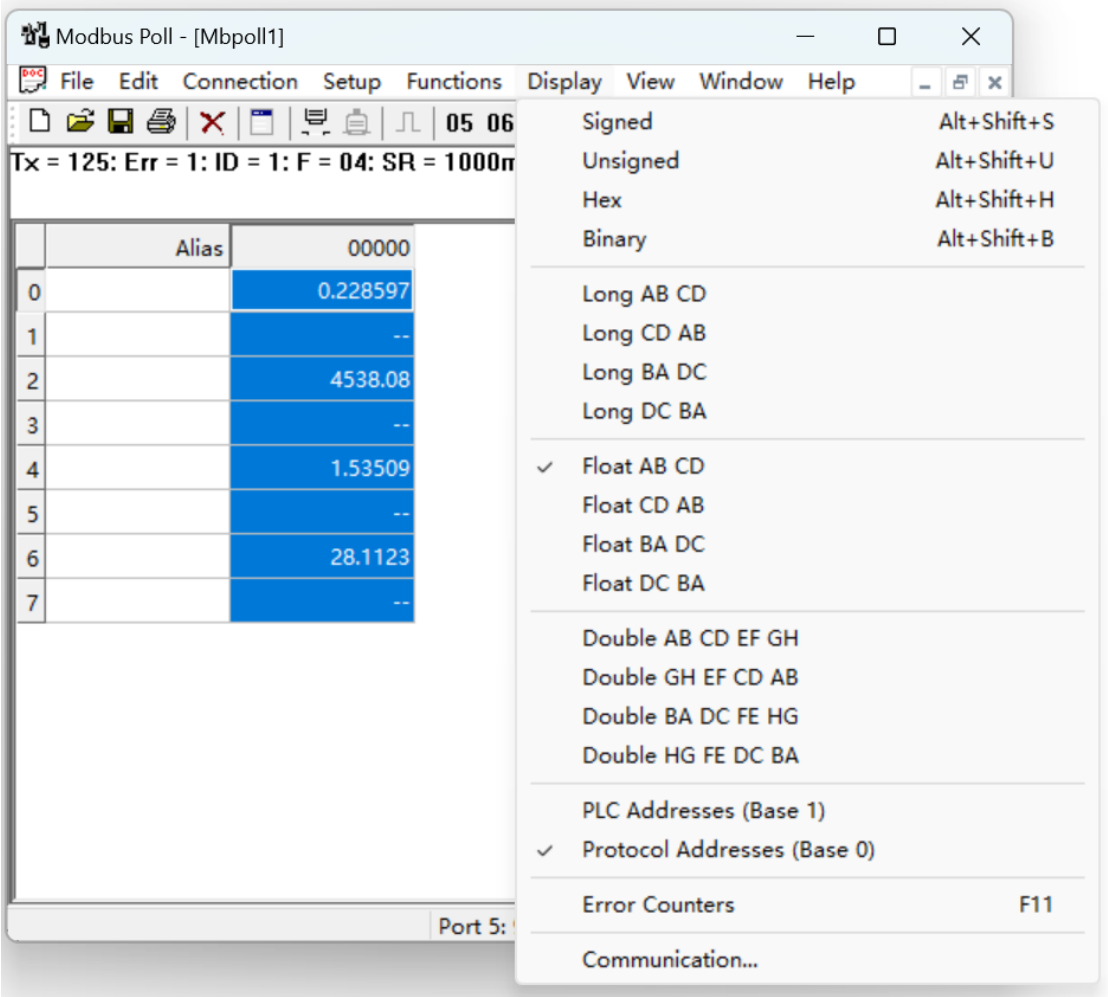


Figure 4 Modbus Poll Software Data Display Settings

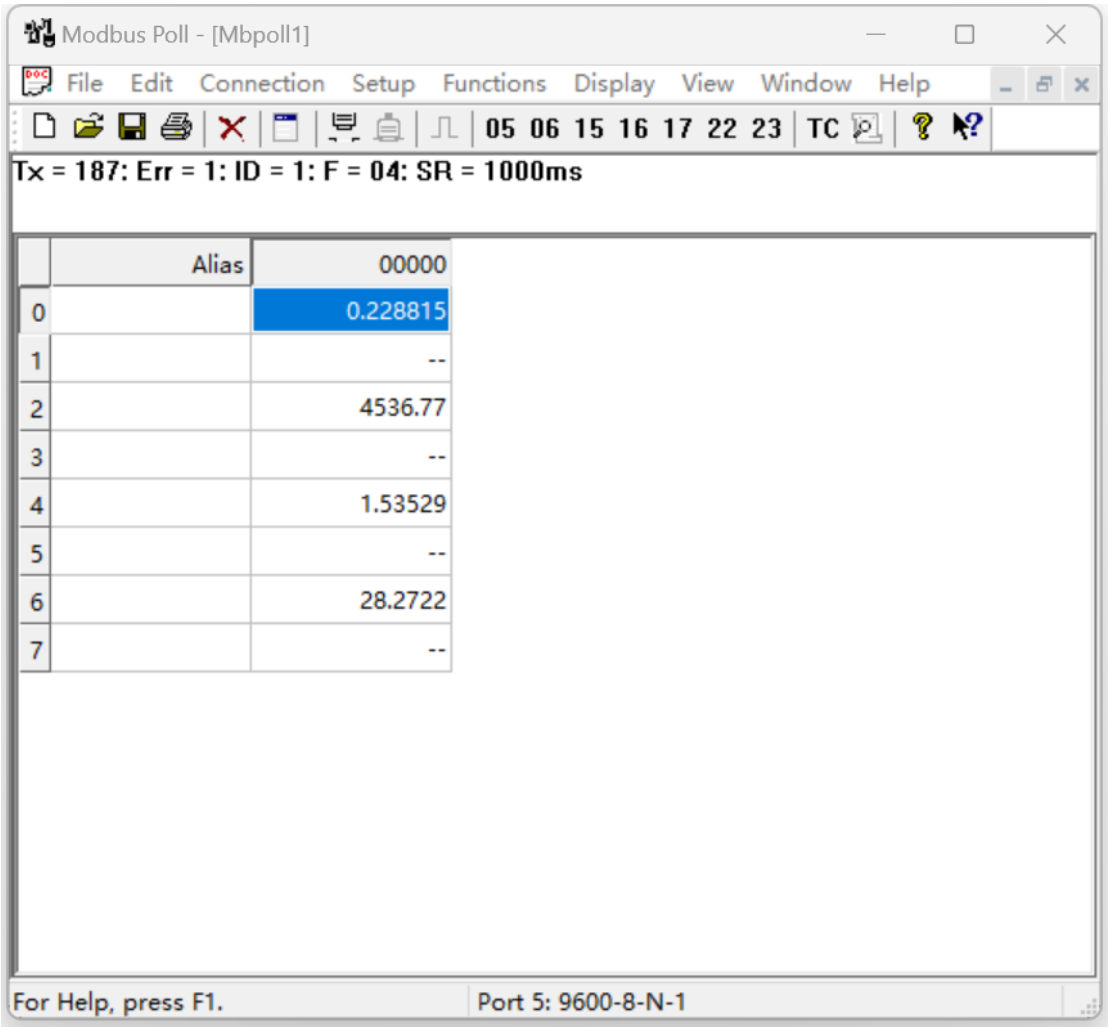


Figure 5 Modbus Poll Software Communication Interface

Fig. 5 shows data indicating: acid value 0.228815 mgKOH/g, resistivity 4536.77 × 109 Ω-cm, dielectric loss voltage 1.53529 V, and temperature 28.2722 ℃.

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 turned on. Special attention should be paid to the fact that the HWR-580M probe must be completely submerged in the oil (no air bubbles at the probe's air holes) during testing or normal use, otherwise the measurement results will not be able to characterise the current condition of the oil sample.

Figure 6 Schematic diagram of communication line connection

3 Communication protocol

HWR-580M provides standard RS485 communication interface externally and uses Modbus RTU communication protocol to communicate with the host. In a complete online monitoring system, the master control device acts as the host and HWR-580M acts as the slave. Each communication handshake is always an access request from the host and a response from the slave.

Use specification standard: 'GB/T19582-2008 Industrial Automation Network Specification Based on Modbus Protocol'.

3.1 Data format

3.1.1 Data frame format

HWR-580M sends each byte (frame) format fully comply with the GB/T19582-2008 standard MODBUS communication protocol, function code support read, write, batch write and so on. The CRC check: (CRC-16/MODBUS x16+x15+x2+1) starts from 'address code' to 'data'. The data frame contains start bit, information bit and stop bit, a total of 10 bits, as shown in Figure 7.

Frame format (10-bit):

start bit	D0	D1	D2	D3	D4	D5	D6	D7	stop bit

Figure 7 Data frame format

The specific definitions are as follows:
Bit 1: start bit ('0' is 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 calibration

3.2 Communication parameters

3.2.1 Serial port settings

parametric	causality
baud	9600
data bit	8 place
parity check	uncalibrated
stop bit	1 place

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 Modbusoperable register

No.	starting address	function code	word length	Stored content	clarification
1	0x0000	04	2	acid value	data type：float ABCD；unit：mgKOH/g
2	0x0002		2	resistivity	data type：float ABCD；unit：$10^9\Omega\cdot cm$
3	0x0004		2	Dielectric Loss Voltage	data type：float ABCD；unit：V
4	0x0006		2	temp	data type：float ABCD；unit：℃
5	0x9000	0x04 0x06	1	address	data type：unsigned int

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

Table 3 Modbus operable registers

3.3 Data retrieval

Example of reading HWR-580M data message [HWR-580Maddress is 1, acid value 0.2292956 mgKOH/g, resistivity 4533.868×10^9 Ω·cm, Dielectric Loss Voltage 1.535723 V, temp 28.91157 ℃。]

request		responsive	
domain name	(hexadecimal)	domain name	(hexadecimal)
address	01	**address**	01
function code	04	**function code**	04
data home address Hi	00	**Number of data bytes**	10
data home address Lo	00	**acid value**	3E
Number of data words Hi	00		6A
Number of data words Lo	08		CC
CRC16 Lo	F1		78
CRC16 Hi	CC	**resistivity**	45
			8D
			AE
			F2
		Dielectric Loss Voltage	3F
			C4
			92
			95
		temp	41
			E7
			4A
			E4
		CRC16 Lo	E3
		CRC16 Hi	9E

Table 4 Example of reading HWR-580M data message

3.4 Address Settings

The factory default address of HWR-580M 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 [HWR-580M current address is 1.]

request		responsive	
domain name	(hexadecimal)	domain name	(hexadecimal)
broadcast address	00	**broadcast address**	00
function code	04	**function code**	04
start address Hi	90	Number of data bytes	02
start address Lo	00	**current address** Hi	00
Number of data words Hi	00	current address Lo	01
Number of data words Lo	01	CRC16 Lo	45
CRC16 Lo	1D	CRC16 Hi	30
CRC16 Hi	1B		

Table 5 Example of query HWR-580M address message

3.4.2 Change address

Example of a Modify Address Message [HWR-580M address changed from 1 to 2.]

request		responsive	
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
Setting the address Hi	00	Setting the address Hi	00
Setting the address Lo	02	Setting the address Lo	02
CRC16 Lo	25	CRC16 Lo	25
CRC16 Hi	0B	CRC16 Hi	0B

Table 6 Example of Modifying the HWR-580M Address Message

3.5 4-20mA analogue output

3.5.1 4-20mA Output Channel Definition

Ch1 is the temperature (°C)

Ch2 is the acid value (mgKOH/g)

3.5.2 4-20mA Range Definition

Iout	4mA	12mA	20mA
Ch1（℃）	-40.0	40.0	120.0
Ch2（mgKOH/g）	0.0	0.5	1.0

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

Table 7 4-20mA Range Definitions

3.5.3 4-20mA output connection

HWR-580M adopts 3-wire 4-20mA current loop analogue output, the wiring schematic is as follows.

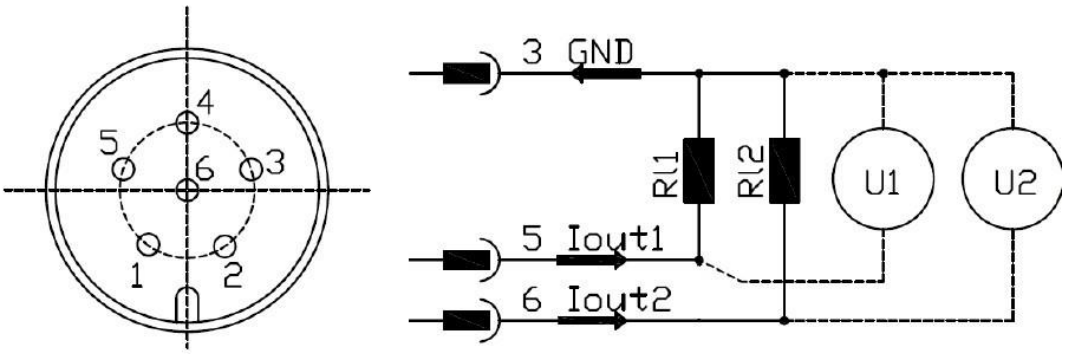


Figure 8 Schematic diagram of 4-20mA current loop connection

Attention:

1） The red wire (corresponding to pin 1 of M8 connector) is connected to DC24V;

2） Black wire (corresponding to M8 connector 3 pins) connects to GND; 3) HWR-580M has two 4-20mA three-wire analogue outputs.

3） HWR-580M has two 4-20mA 3-wire analogue outputs, channel 1 for temperature and channel 2 for acid value (or as per order);

4） The yellow wire (corresponding to pin 5 of the M8 connector) is connected to the positive

input terminal of the user's 4-20mA sampling module; at the same time, the negative output terminal of this loop is connected back to the black wire GND, constituting a 4-20mA current loop; this channel represents the temperature;

5） The orange wire (corresponding to M8 connector pin 6) connects to the user's input positive terminal of the other 4-20mA sampling module; at the same time, the output negative terminal of the loop is connected back to the black wire GND, constituting a 4-20mA current loop; this channel represents the acid value;

6） **Special Note: Users need to make sure that the 4-20mA circuit 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 circuit to measure the 4-20mA current value without any load;**

7） Load resistance (RL1, RL2)

In order to achieve the rated operating characteristics of the HWR-580M, the load resistors RL1 and RL2 need to be ≤500Ω and ≥100Ω, and we recommend that users choose 500Ω high-precision, low-temperature-drift sampling resistors. At this point, HWR-580M can work normally under 22V-28V DC external power supply.

3.5.4 4-20mA Output conversion formula

norm	Measurement range	formulas
temp	-40.0 … 120.0 ℃	T = (Iout – 4) * (120.0-(-40.0)) / (20 – 4) - 40.0
acid value	0.0 … 1.0 mgKOH/g	A = (Iout – 4) * (1.0-0.0) / (20 – 4) + 0.0

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 Equation

3.5.5 LWDDU Smart Meter

For the convenience of users on-site use, HWR-580M can be equipped with LWDDU intelligent display meter.

Figure 9 LWDDU Smart Meter

The instrument comes with +24VDC power output (P+, P- terminals), HWR-580M does not need to be connected to an external power supply. The power supply ground (P- terminal) and analogue input signal ground (C terminal) are not common ground, and need to be shorted with a shielded wire.

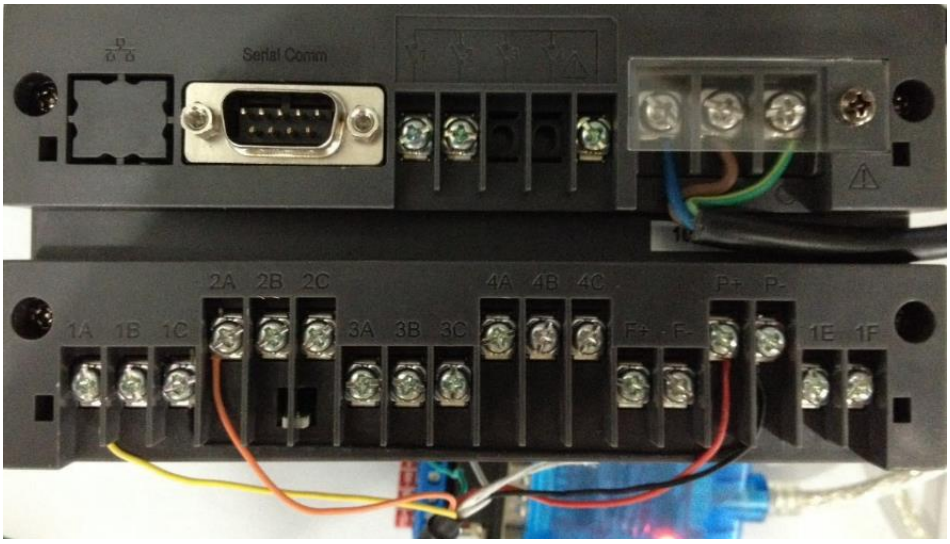


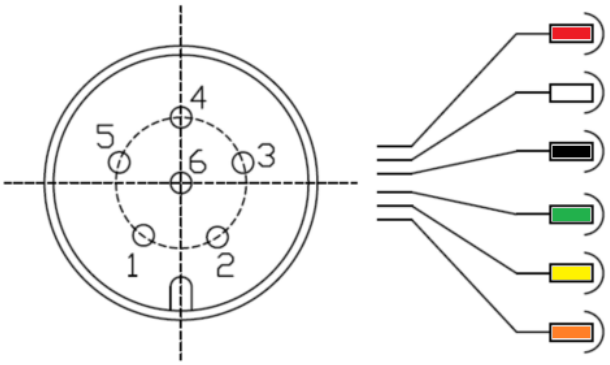
Figure 10 Instrument terminal and HWR-580M cable connection diagram

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 Definitions

The HWR-580M has an M8 1*6 connector (male) on the end with the following interface definition:



1— red +24VDC

2— white RS485+ / A

3— black 24VGND

4— green RS485- / B

5— yellow 4-20mA ch1

6— orange 4-20mA ch2

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 whole line communication connection is normal. If it is normal, perform step 3; If not normal, double-check the line connection and troubleshoot the problem.
Step 3: Clean the HWR-580M probe with petroleum ether until there are no visible oil stains on the probe surface, and blow it dry with the instrument air source. this step must be performed before the HWR-580M is used.
Step 4: Use a 25mL or larger capacity measuring cup to take an appropriate amount of oil samples, the oil level to just submerge the HWR-580M mounting pipe threads as appropriate, the probe air hole parts can not have obvious air bubbles.
Step 5: Connect the HWR-580M, power on the test.