S1000 Series 3-Parameter Oil Characterisation Sensor User's Manual

user manual

（3.0.1 版）

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Representations

This manual explains the S1000 series three-parameter oil characterisation sensor (hereinafter referred to as the S1000) in relation to the use of the following four sections:

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

1 Test Tools

1.1 Hardware Tools

① PC with USB interface;

② S1000 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:

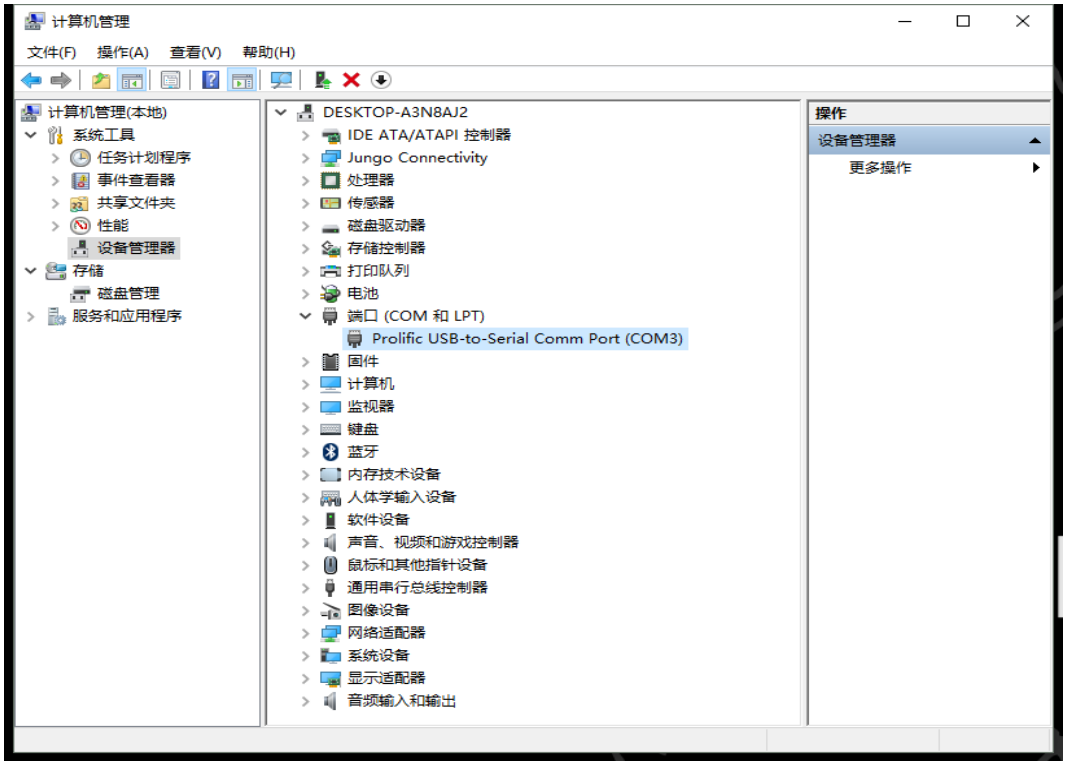

Figure 1 Serial Driver Installation Successful Interface

2.1.2 Installation of serial communication software

Follow the Modbus Poll software prompts for installation and setup.

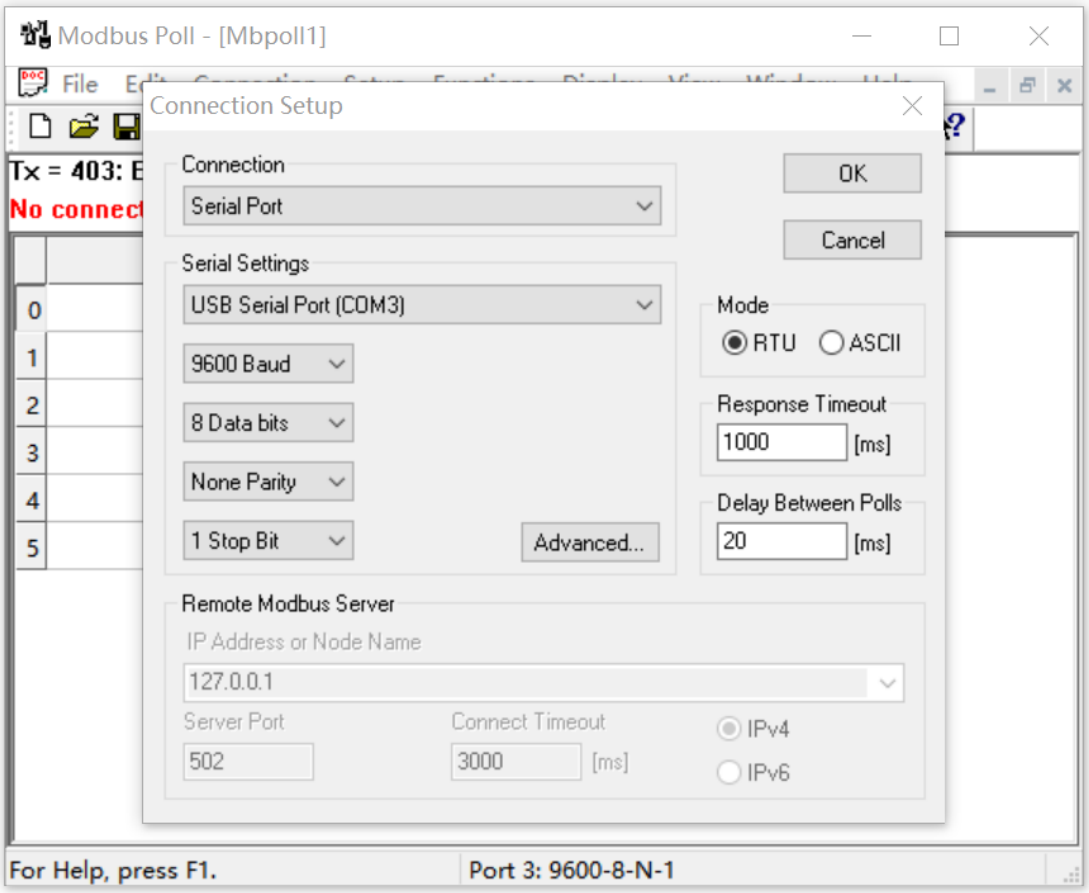

Figure 2 Modbus Poll Software Serial Port Settings

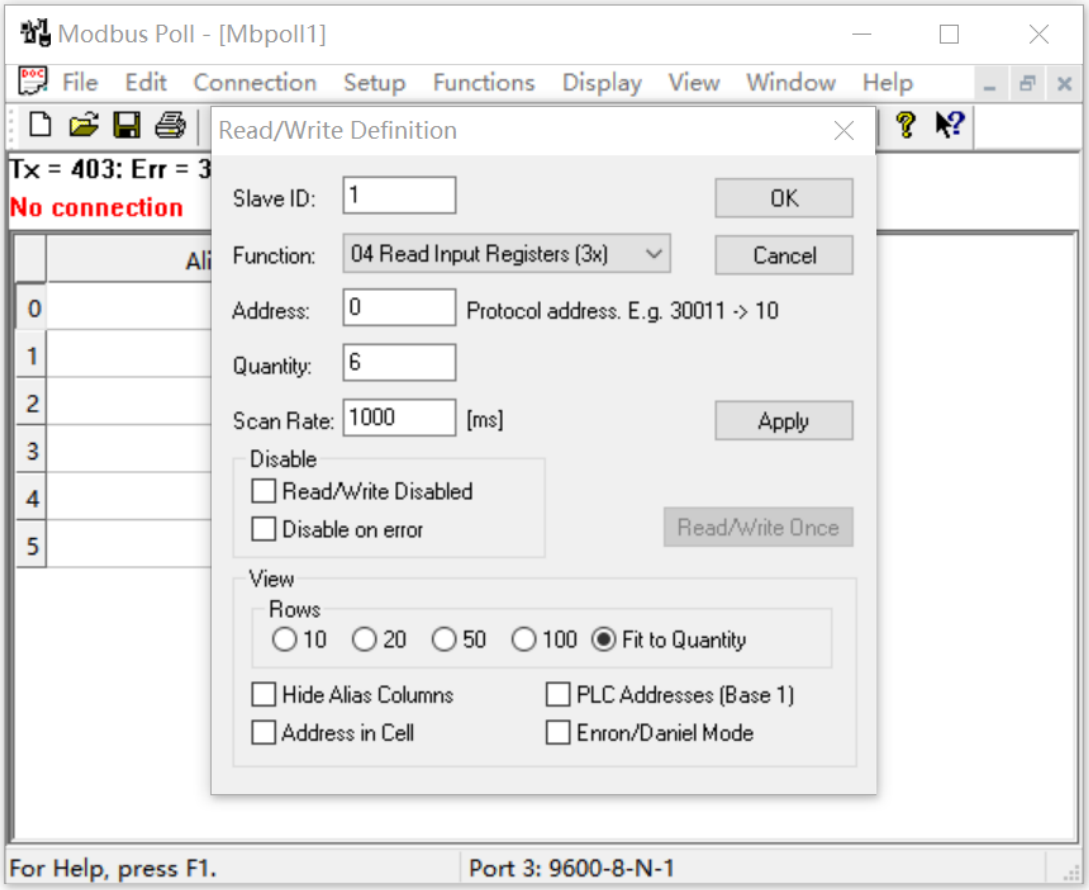

Figure 3 Modbus Poll Software Read/Write Settings

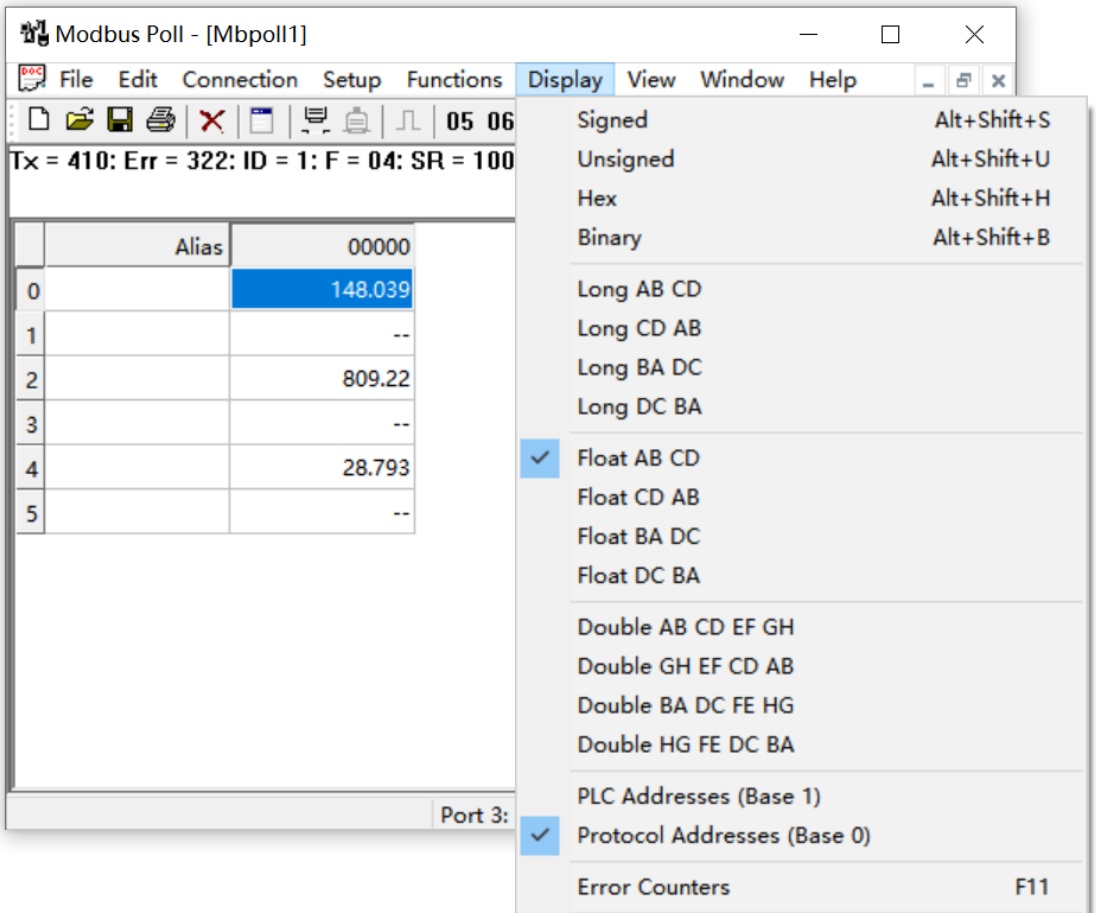

Figure 4 Modbus Poll Software Data Display Settings

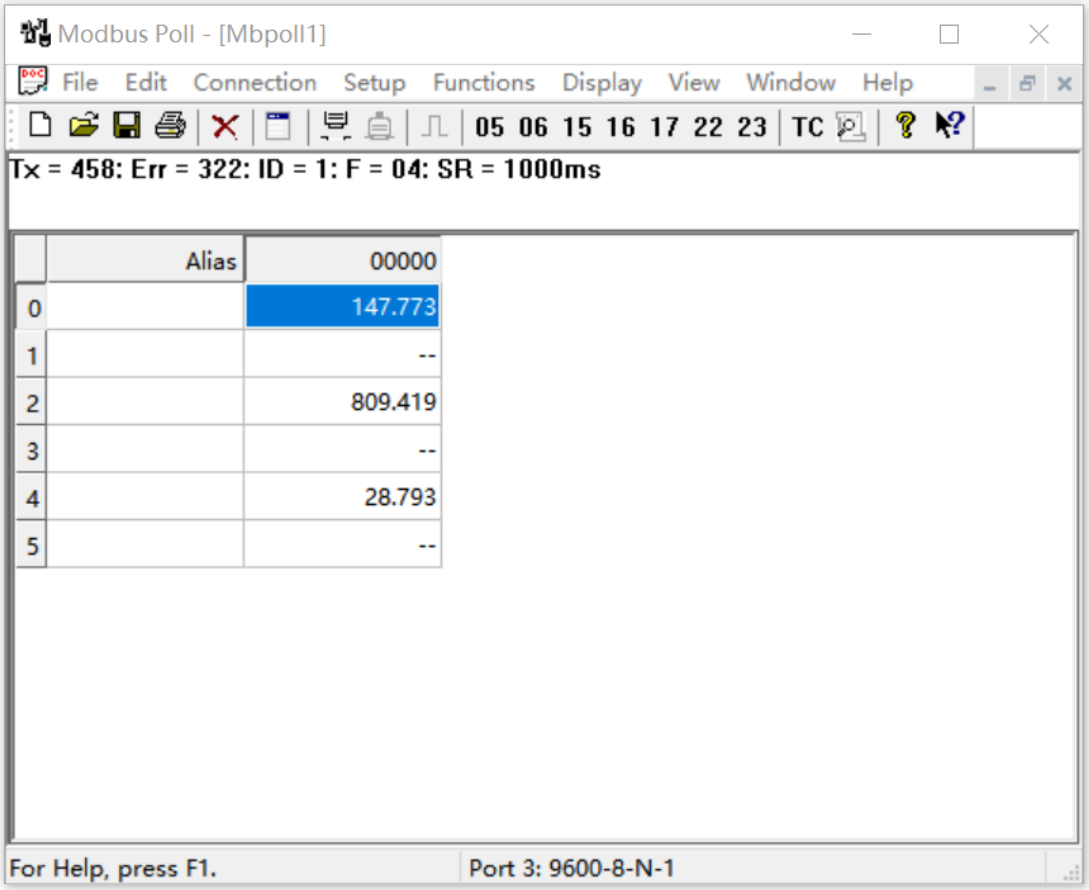

Figure 5 Modbus Poll Software Communication Interface

Figure 5 displays data indicating: viscosity 147.773 cP (cSt), density 809.419 kg/cm3, temperature 28.793 ℃.

2.2 Communication line connection

Connect the communication line as shown in Figure 6. The measurement results can be read normally about 15s after the power is turned on. Special attention should be paid to the fact that the S1000 probe must be completely submerged in the oil (no air bubbles at the position of 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

S1000 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 S1000 acts as the slave. Each communication handshake is always an access request from the host and a response from the slave.

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

3.1 Data frame format

S1000 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
03（0x03）	Read Holding Register
04（0x04）	Read Input Register
06（0x06）	Write Single Register
16（0x10）	Write multiple registers

Table 2 Modbus function codes

3.2.3 Modbus Modbus operable register

No.	starting address	function code	word length	Stored content	clarification
1	0x0000	0x04	2	viscosity	data type ： Float ABCD ； unit ： cP(cSt)
2	0x0002		2	density	data type ： Float ABCD ； unit ： kg/m^3
3	0x0004		2	temp	data type ： Float ABCD ； unit ： ℃
4	0x9000	0x04 0x06	1	address	data type ： U16

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

Table 3 Modbus operable registers

3.3 Data retrieval

Example of reading S1000 data message [S1000 address is 1, viscosity 48.3878 cP (cSt), density 855.6719 kg/m3, temperature 25.6093 ° C].

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**	0C
data home address Lo	00	viscosity	42
Number of data words Hi	00		41
Number of data words Lo	06		8D
CRC16 Lo	70		23
CRC16 Hi	08	density	44
			55
			EB
			00
		temp	41
			CC
			E0
			03
		CRC16 Lo	ED
		CRC16 Hi	4E

Table 4 Example of Reading S1000 Measurement Result Message

3.4 Address Settings

The factory default address of S1000 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 [S1000 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	01
Number of data words Hi	00	current address Lo	01
Number of data words Lo	01	CRC16 Lo	44
CRC16 Lo	1D	CRC16 Hi	A0
CRC16 Hi	1B		

Table 5 Sample Query S1000 Address Message

3.4.2 Change address

Example of a Modify Address Message [S1000 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 Setting S1000 Address Message

3.5 4-20mA analogue output

3.5.1 4-20mA Output Channel Definition

Ch1 is the temperature（℃）

Ch2 is the density（kg/m^3）、viscosity（cP 或 cSt）

3.5.2 4-20mA Range Definition

Iout	4mA	12mA	20mA
Ch1	-40.0 ℃	40.0 ℃	120.0 ℃
Ch2	600.0 kg/m^3	925.0 kg/m^3	1250.0 kg/m^3

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

S1000 adopts 3-wire 4-20mA current loop analogue output, the wiring schematic is as follows.

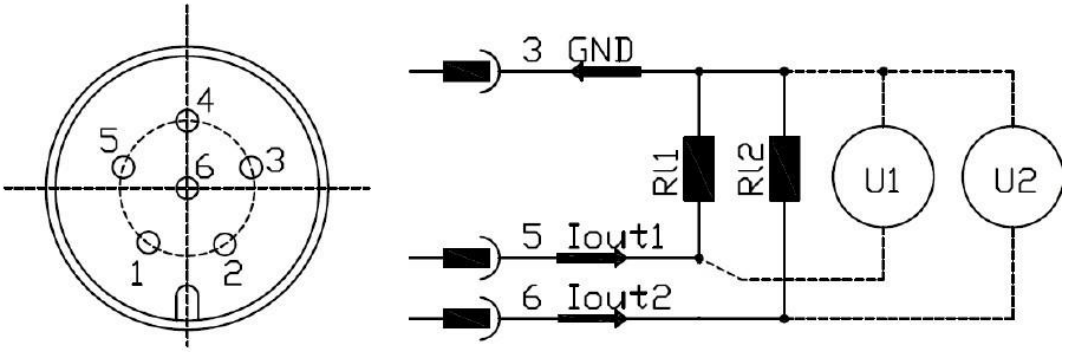

Fig. 8 Schematic diagram of 4-20mA current loop connection

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） OCC330 has two 4-20mA 3-wire analogue outputs, channel 1 for temperature and channel 2 for viscosity (or as per order);

4） The yellow wire (corresponding to the M8 connector pin 5) connects to the user's 4-20mA sampling module input positive terminal; 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 temperature;

5） Orange wire (or the old blue wire, corresponding to the M8 connector 6 pins) is connected to the user's other way 4-20mA sampling module input positive terminal; at the same time, the negative output terminal of the circuit is connected back to the black wire GND, constituting a 4-20mA current loop; this channel represents the power viscosity;

6） Special Note: Users need to check whether the 4-20mA loop load resistors RL1 and RL2 are included in the user's 4-20mA acquisition module or the PLC 4-20mA input channel, and should not connect an ammeter in series to measure the 4-20mA current value directly in the loop without any load;

7） Load Resistance (RL1, RL2)

In order to achieve the rated operating characteristics of the S1000, the load resistance RL1 and RL2 need to be ≤ 500Ω and ≥ 100Ω, we recommend that the user choose 500Ω high-precision, low-temperature-drift sampling resistor. At this time, S1000 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) * 160 / (20 – 4) - 40.0
viscosity	1.0 … 400.0 cp	Dv = (Iout – 4) * 399 / (20 – 4) + 1.0

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

4 Test Description

4.1 Wiring Definitions

The S1000 has an M8 6-pole connector (male) on the tail with the following interface definitions:

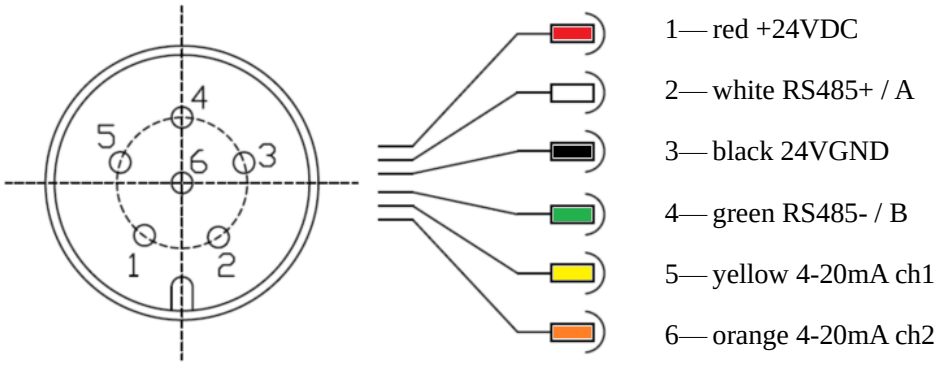

Figure 11 Connector Interface Definition

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 it is not normal, check the line connection carefully and troubleshoot the problem.

Step 3: Clean the S1000 probe with petroleum ether until there is no obvious oil stains on the surface of the probe, and blow it dry with the instrument air source. this step must be performed before using the S1000.

Step 4: Use 50mL or a larger capacity measuring cup to take an appropriate amount of oil samples, the height of the oil level to just submerge the S1000 mounting pipe threads as appropriate, the probe air hole parts can not have obvious bubbles.

Step 5: Connect the S1000, power on the test.