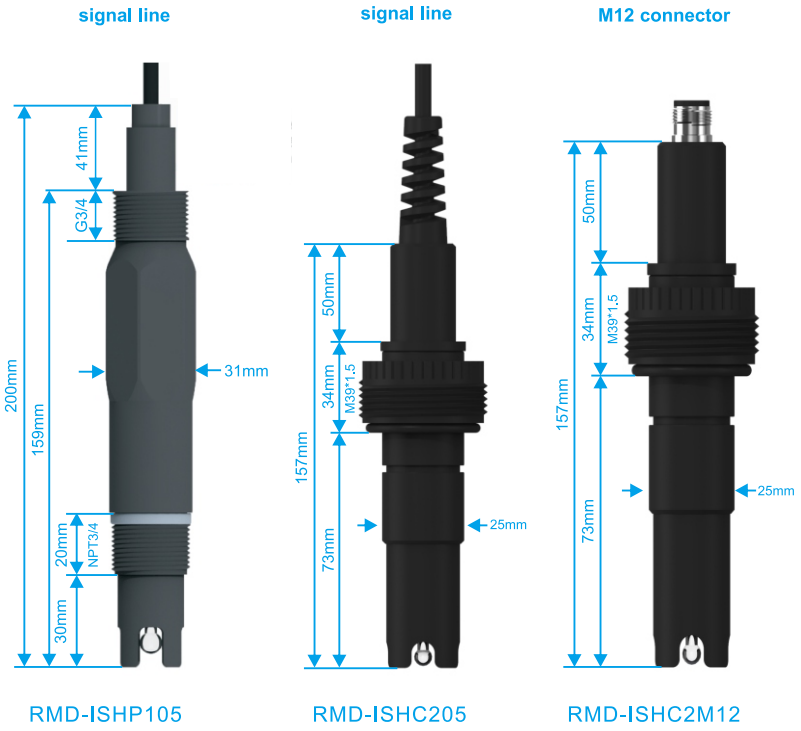
1. Technical data

PH range	0...14pH
Resolution	0.01pH
Accuracy	±0.02pH
PH balance	7.00±0.25
Temperature range	0.0...60℃
Resolution	0.1℃
Accuracy	±0.3℃
Temperature compensation	Automatic
Slope	≥96%
Output	RS485;4...20mA
Power supply	DC9-30V(Recommend 12V)
Pressure range	0...3bar
Shell material	PPS, ABS
Liquid junction	PTFE
Pipe thread	3/4,M39*1.5
Cable length	5m or customized
Protection grade	Ip68



2. Sensor use

2.1 Please read this instruction carefully before use.

2.2 Sensor bulb is fragile and cannot be repaired after damaged.

2.3 In the measurement process, if there is dirt, adhesive or scale on the sensor bulb, the measured value will be inaccurate or fluctuate. It should be cleaned and calibrated in time.

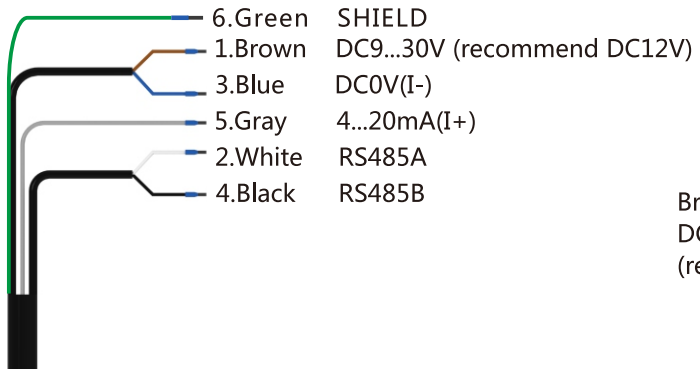
2.4 If there is bubble in the bulb, the measured value will be inaccurate or fluctuate. You can gently shake the sensor bulb to remove the bubble.

3. Sensor wiring

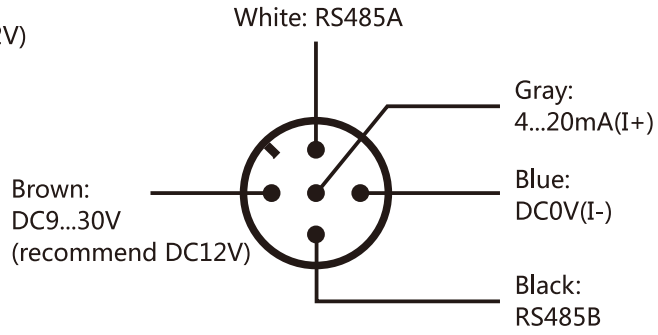
3.1 Please follow the instructions carefully, the wrong wiring will damage the product completely.

3.2 Please carefully check all the wiring in the system and confirm that the wiring is complete right before switch on the power.

3.3 Note: RS485A line and RS485B line are strictly forbidden to contact with the power supply line, otherwise the communication of the sensor will be permanently damaged.



Sensor outlet



M12 connector

4. Sensor activation

4.1 The sensor should be activated in 3 M KCL solution.

4.2 Dry sensor must be activated before use.

5. Sensor calibration

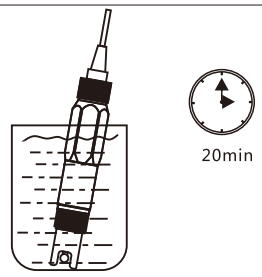
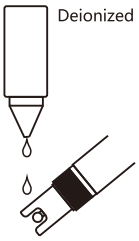
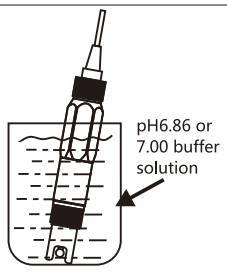
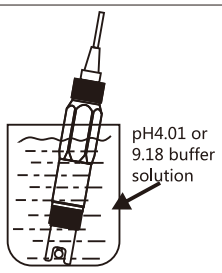
5.1 The sensor has been calibrated before shipment, and the user can directly use it.

5.2 It is recommended to use the two-point method for calibration, usually with pH6.86 or pH7.00 buffer solution calibrate the zero point, then the slope is determined with the buffer solution of pH4.01 or pH9.18.

5.3 The sensor should be calibrated in fresh buffer solution. If the solution to be tested is acidic, the pH of the buffer solution should be less than the solution to be tested; if the solution to be tested is alkaline, the pH of the buffer solution should be greater than the solution to be tested.

5.4 Users are recommended to calibrate the sensor every 1 to 2 months.

5.5 The calibrating steps are as follows:

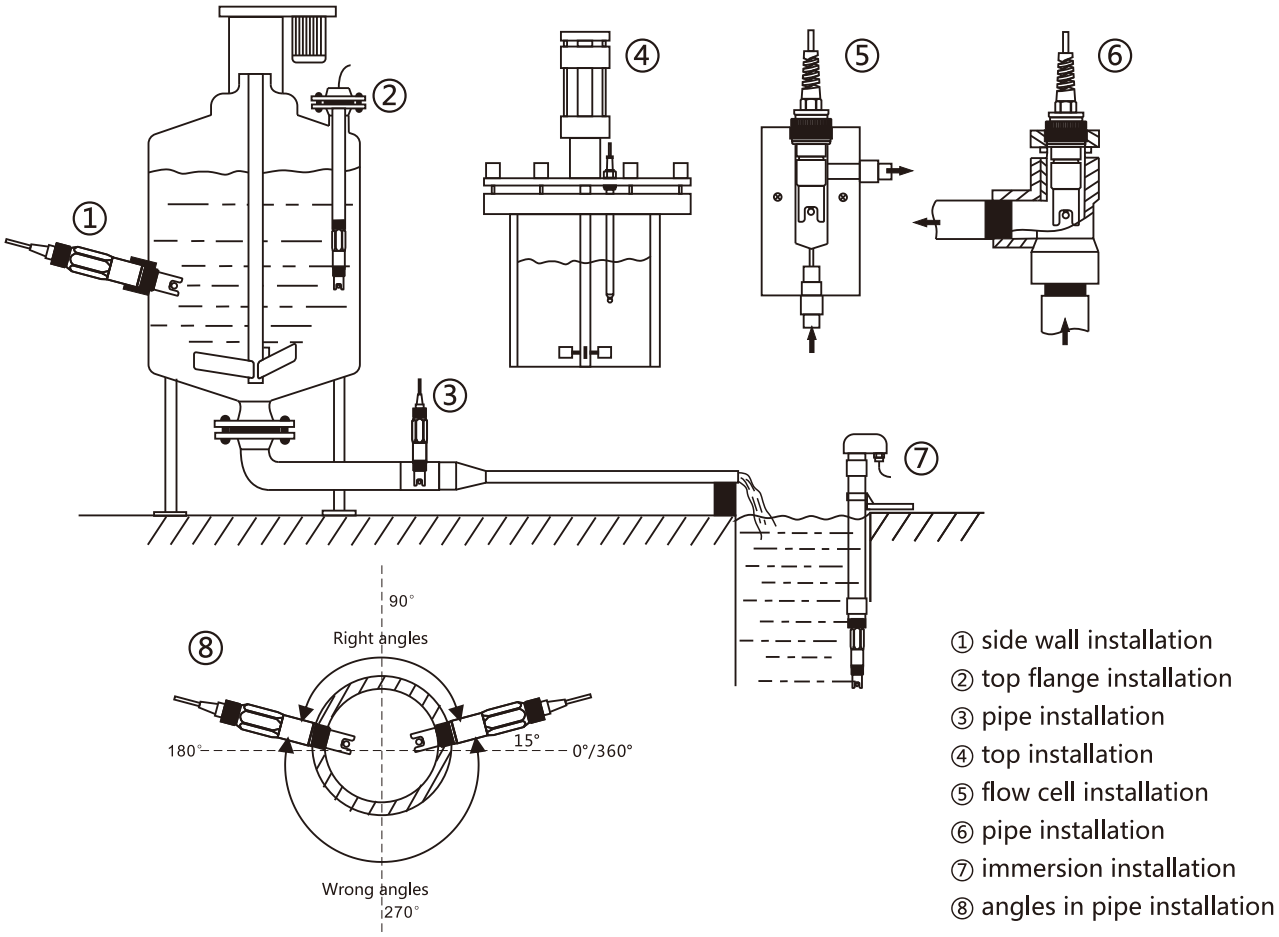
			
1. Put the sensor into the buffer solution of pH4.01 and soak for 10 minutes, and then soak in buffer solution of pH 6.86 for 10 minutes.	2. Rinse the sensor with distilled water or deionized water and dry it with a paper towel.	3. Put the sensor in pH 6.86 or 7.00 buffer solution and wait until the value is stable, calibrate the first point . Then take the sensor out of the buffer solution, rinse and dry it with a paper towel.	4. Put the sensor in pH 4.01 or 9.18 buffer solution and wait until the value is stable, calibrate the second point . Then take the sensor out of the buffer solution rinse and dry it with a paper towel.

6. Sensorinstallation

6.1 PH sensor is recommended to be installed in the flow cell for more stable and accurate measurement.

6.2 If installing sensor in the pipe, the right angle should be 15°~165°.

6.3 Installation method.



① side wall installation
② top flange installation
③ pipe installation
④ top installation
⑤ flow cell installation
⑥ pipe installation
⑦ immersion installation
⑧ angles in pipe installation

Pay attention to the immersion installation:

1. In this installation, there will be dirt on the sensor frequently, it needs to be cleaned regularly.
2. Measuring value is not stable.
3. Different insertion depths will affect the measured value.
4. The position of the sensor must be above the sediment.

7. Sensor communication

7.0 Default communication instructions:

Note: 1. Data starting at 0x represents hexadecimal;

2. The check code is 16CRC, the low byte is in the front and the high byte is in the back;

3. Floating point number occupy four bytes;

7.1 Communication description (factory default):

Factory default	
baud rate	9600(default)
data bit	8
stop bit	1
check bit	no
address	1 (default)

7.2 Host computer transmission format:

	Data type	Description	Remarks
Integer	16 bit integer	The high and low bytes of the word component are not reversed	Example: 0x 0032 to decimal number is 50
Floating point number	(CDAB) 3412	The high-low word of the double-byte component is reversed, but the high-low byte of the word is not reversed.	Example: 72 37 41 DB transfer to floating point number, CDAB change order is ABCD, ie 41 DB 72 37 transfer to floating point is 27.4

7.3 Function code description

7.3.1 This product supports 03,06,16 and other common function codes

7.3.2 The output register uses 16 function codes when writing double word data or writing multiple data in batches

03	Read single or multiple registers
06	Write single register
16	Write multiple registers

7.4 Read floating point number

7.4.1 Host computer transmission format:

	ID address	Function code	Register start address		Qty of registers		CRC16	
			High byte	Low byte	High byte	Low byte	Low byte	High byte
Example 1 Read measured value	0x 01	0x 03	0x 00	0x 01	0x 00	0x 02	0x 95	0x CB
Example 2 Read Temp value	0x 01	0x 03	0x 00	0x 03	0x 00	0x 02	0x 34	0x 0B

7.4.2 Slave computer response format:

	ID address	Function code	Qty of registers	Read register data in hexadecimal floating point number				CRC16	
				C	D	A	B	Low byte	High byte
Example 1 Measured value return	0x 01	0x 03	0x 04	0x 2C	0x 81	0x 40	0x 91	0x 52	0x E7
Example 2 Temp value return	0x 01	0x 03	0x 04	0x 72	0x 37	0x 41	0x DB	0x 20	0x 8E

Note: 72 37 41 DB transfer to floating point number, CDAB change order is ABCD, ie 41 DB 72 37 transfer to floating point is 27.4

7.5 Read integer

7.5.1 Host computer transmission format:

	ID address	Function code	Register start address		Qty of registers		CRC16	
			High byte	Low byte	High byte	Low byte	Low byte	High byte
Example 1 Read warning status	0x 01	0x 03	0x 00	0x 07	0x 00	0x 01	0x 35	0x CB

7.5.2 Slave computer response format:

	ID address	Function code	Qty of registers	Read register data in hexadecimal integer		CRC16	
				A	B	Low byte	High byte
Example 1 Warning status return	0x 01	0x 03	0x 02	0x 00	0x 00	0x B8	0x 44

7.6 Write floating point number

7.6.1 Host computer transmission format:

	ID address	Function code	Register start address		Qty of registers		Qty of bytes	Write register data in hexadecimal floating point number				CRC16	
			High byte	Low byte	High byte	Low byte		C	D	A	B	Low byte	High byte
Example 1 Write Measured value offset	0x 01	0x 10	0x 00	0x 12	0x 00	0x 02	0x 04	0x 00	0x 00	0x 3F	0x 80	0x 63	0x 2A

7.6.2 Slave computer response format:

	ID address	Function code	Register start address		Qty of registers		CRC16	
			High byte	Low byte	High byte	Low byte	Low byte	High byte
Example 1 Measured value offset return	0x 01	0x 10	0x 00	0x 12	0x 00	0x 02	0x E1	0x CD

Note: the measured value is offset by 1.00, floating point number 1.00 converts to hexadecimal 0X3F800000, transpose the high and low positions 0X00003F80 and write 0X0012.

7.7 Write integer

7.7.1 Host computer transmission format:

	ID address	Function code	Register start address		Write register data in hexadecimal integer		CRC16	
			High byte	Low byte	A	B	Low byte	High byte
Example 1 Write device address	0x 01	0x 06	0x 00	0x 19	0x 00	0x 02	0x D9	0x CC

7.7.2 Slave computer response format:

	ID address	Function code	Register start address		Write register data in hexadecimal integer		CRC16	
			High byte	Low byte	A	B	Low byte	High byte
Example 1 Device address return	0x 01	0x 06	0x 00	0x 19	0x 00	0x 02	0x D9	0x CC

Note: change the local computer address 1 to address 2 and write the hexadecimal number 0x 00 02 into register 0x 00 19.

7.8 Calibrating instructions

7.8.1 Before calibration

Write the value of zero calibration (that is, the value of the first point) and the value of slope calibration (that is, the value of the second point) to the sensor before calibration;

If the zero calibration value is 6.86pH, write the data 0x01 to register 0x36;

Send command: 01 06 00 36 00 01 A8 04;

If the slope calibration value is 4.01pH, write the data 0x01 to register 0x38;

Send command: 01 06 00 38 00 01 C9 C7.

7.8.2 Start calibration

First step：

Clean and dry the sensor ,put the sensor in the solution 6.86 of zero point calibration;

Send command: 01 03 00 66 00 01 64 15;

After the measured ADC value is stable, read the ADC value in the 0x66 register;

Write the instruction to confirm the calibration to the 0x 3E register;

Send command: 01 06 00 3E 00 FF A8 46.

Second step：

Clean and dry the sensor, put the sensor in the solution 4.01 of slope calibration;

Send command: 01 03 00 66 00 01 64 15;

After the measured ADC value is stable, read the ADC value in the 0x66 register;

Write the instruction to confirm the calibration to the 0x 3F register;

Send command: 01 06 00 3F 00 FF F9 86.

7.9 Address description

Name	Hosting number	Data type	Length	Read/write	Description
Measurements	0X 00 01	floating point	2	read	Storage location for measured value
Temperature measurement	0X 00 03	floating point	2	read	Storage location for measured temperature
Current output value	0X 00 05	floating point	2	read	Output current based on PH/ORP measurements
Warning	0X 00 07	Integer	1	read	00: Normal 01: Measurement exceeds the upper limit; 02: Measurement exceeds the lower limit; 03: Temperature exceeds the upper limit; 04: Temperature exceeds the lower limit
Measure mode	0X 00 08	Integer	1	read/write	00: pH ; 01: ORP
Upper limit of measurement	0X 00 0A	floating point	2	read/write	Upper limit of measured value (20mA corresponding value)
Lower limit of measurement	0X 00 0C	floating point	2	read/write	Lower limit of measurement value (4mA corresponding value)
Upper temperature limit	0X 00 0E	floating point	2	read/write	Upper temperature limit
Lower temperature limit	0X 00 10	floating point	2	read/write	Lower temperature limit
Measured value offset	0X 00 12	floating point	2	read/write	Adjust measurement
Temperature offset	0X 00 14	floating point	2	read/write	Adjust temperature value
Damping coefficient	0X 00 16	Integer	1	read/write	0-10
Device address	0X 00 19	Integer	1	read/write	1-255
Baud rate	0X 00 1A	Integer	1	read/write	0=2400 , 1=4800 , 2=9600 3=19200 , 4=38400
Restore factory	0X 00 1B	Integer	1	write	
ORP calibration value	0X 00 30	floating point	2	read/write	
Calibrating slope	0X 00 34	Integer	2	read	-0.1984
Zero point calibration solution	0X 00 36	Integer	1	read/write	0=7.00, 1=6.86
Slope calibration solution	0X 00 38	Integer	1	read/write	0=1.68 , 1=4.01 , 2=9.18 3=10.1 , 4=12.45
Manual temperature	0X 00 3A	floating point	2	read/write	25℃
Zero confirmation	0X 00 3E	Integer	1	write	
Slope confirmation	0X 00 3F	Integer	1	write	
Measured ADC	0X 00 66	Integer	1	read	

7.10 Common instruction examples

	Function	Send command	Return command	Remarks
1	Read measured value	01 03 00 01 00 02 95 CB	01 03 04 2C 81 40 91 52 E7	The 2C814091 change order to 40912C81 and its floating point is 4.53
2	Read temperature measurement	01 03 00 03 00 02 34 0B	01 03 04 72 37 41 DB 20 8E	The 723741DB change order to 41DB7237and its floating point is 27.4
3	Read current output value	01 03 00 05 00 02 D4 0A	01 03 04 00 00 41 40 CB 93	The 00004140 change order to 41400000 and its floating point is 12.00
4	Read warning	01 03 00 07 00 01 35 CB	01 03 02 00 00 B8 44	0000 is the current state
5	Write measurement mode	01 06 00 08 00 01 C9 C8	01 06 00 08 00 01 C9 C8	Set to ORP mode
6	Write upper limit of measurement	01 10 00 0A 00 02 04 00 00 41 20 42 58	01 10 00 0A 00 02 61 CA	The upper measurement limit is set to 10.00
7	Write lower limit of measurement	01 10 00 0C 00 02 04 00 00 3F 80 E3 AA	01 10 00 0C 00 02 81 CB	The lower measurement limit is set to 1.00
8	Write upper temperature limit	01 10 00 0E 00 02 04 00 00 42 C8 43 15	01 10 00 0E 00 02 20 0B	The upper temperature limit is set to 100.00
9	Write lower temperature limit	01 10 00 10 00 02 04 00 00 40 A0 C3 1B	01 10 00 10 00 02 40 0D	The lower temperature limit is set to 5.00
10	Write measured value offset	01 10 00 12 00 02 04 00 00 3F 80 63 2A	01 10 00 12 00 02 E1 CD	Set to 1.00
11	Write temperature offset	01 10 00 14 00 02 04 00 00 3F 80 E3 00	01 10 00 14 00 02 01 CC	Set to 1.00
12	Write damping coefficient	01 06 00 16 00 01 A9 CE	01 06 00 16 00 01 A9 CE	Set to 1
13	Write device address	01 06 00 19 00 02 D9 CC	01 06 00 19 00 02 D9 CC	Set to 2
14	Write baud rate	01 06 00 1A 00 00 A8 0D	01 06 00 1A 00 00 A8 0D	Set to 2400
15	Write restore factory	01 06 00 1B 00 FF B9 8D	01 06 00 1B 00 FF B9 8D	Factory default values are restored once sent
16	Write ORP calibration value	01 10 00 30 00 02 04 00 00 42 AC C0 66	01 10 00 30 00 02 41 C7	Write ORP standard liquid value 86mV
17	Read calibration slope	01 03 00 34 00 02 85 C5	01 03 04 CC CD 3E 4C 45 09	The CCCD3E4C change order to 3E4CCCD and its floating point is 0.2
18	Write zero point calibration solution	01 06 00 36 00 01 A8 04	01 06 00 36 00 01 A8 04	Set to 6.86
19	Write slope calibration solution	01 06 00 38 00 01 C9 C7	01 06 00 38 00 01 C9 C7	Set to 9.18
20	Write manual temperature	01 10 00 3A 00 02 04 00 00 41 A0 40 EC	01 10 00 3A 00 02 61 C5	Set to 20.0
21	Write zero calibration	01 06 00 3E 00 FF A8 46	01 06 00 3E 00 FF A8 46	Confirm to calibration zero
22	Write slope calibration	01 06 00 3F 00 FF F9 86	01 06 00 3F 00 FF F9 86	Confirm to calibration slope
23	Read measured ADC	01 03 00 66 00 01 64 15	01 03 02 2E E0 A4 6C	2EE0 turns to integer 12000

8. Maintenance and storage

8.1 After washing the sensor, only use soft paper towel to absorb the water. Do not rub the sensitive bulb.

8.2 when the sensor is stored, the protective cover must be put on, and the protective cover must contain the immersion fluid to keep the moister of the sensor bulb.

8.3 If there is white potassium chloride crystal on the sensor, this salty substance will not affect the use. It is only necessary to rinse the sensor with distilled water to remove the crystal and then dry it.

8.4 Cable connector must be kept clean and free of moisture or water.

8.5 The sensor should not be placed in the air for long periods of time. Put on the protective cover when it is not in use.

9. Troubleshooting

9.1 The failure rate of the sensor is low, When the sensor is inaccurate, mainly because the pH sensor has changed, so it is necessary to check whether the pH sensor is in good condition. If the bubble damaged, it should be timely replaced.

9.2 If the value of the sensor is too large, too small or no change, check whether the electrolyte is dry, missing or contaminated. If the above conditions occur, re-add the electrolyte; Check whether the electrode is in good connection with the instrument.

9.3 Modbus troubleshooting:

Problem	Possible reason	Solution
Modbus no response	The baud rate, or stop bit does not match the Modbus master settings	Verify that the Settings match the Modbus master device Settings, and verify that the Modbus master device parity check is set to None
	Rs232 or RS485 cable is faulty	Replace/repair cables
	No network offsets and terminations, or network offsets and terminations are not suitable.	Check the termination or offset Settings for all network devices.Only the endpoints of the network should be turned on and terminated, and there should be only a point on the network to provide an offset.
	The slave address is incorrect, or the slave address is the same as the address of another bus device	Verify that all addresses are unique and are between 1 and 247.
Modbus abnormal response	Register not supported	Verify that the register is supported
	Incorrect data type	Verify that the requested register data type matches the Modbus master device request; for example, you cannot access a floating point data using 2-byte integer data. When a floating point data (2 registers / 4 bytes) is requested, two registers must be requested at the same time.