SZ616-B SZ516-C
Oil-in-water Sensor
User Manual

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Catalogue

Preface **3**

1 Overview **4**

1.1 Introduction 4

1.2 Wire Definition 5

1.3 Technical Specifications 6

2 Installation **7**

2.1 Configuration table 7

2.2 Sensor Installation 7

3 Calibration **7**

3.1 Brief description 7

3.2 Standard solution configuration 8

4 Maintenance schedule and methods **8**

4.1 Maintenance cycle 8

4.2 Maintenance methods 9

4.3 Attention 9

5 Trouble Shooting **9**

6 Quality Assurance **10**

7 Communication protocols **11**

7.1 Reading data 11

7.2 Writing data 12

7.3 Calculating CRC Checksum 12

7.4 Register Table 13

7.5 Conversion algorithms for floating point numbers 14

Preface

Dear customer:

Thank you for using our product. Reading the entire manual before use is highly recommended for operation and maintenance the instrument and out of unnecessary trouble.

Please observe the operating procedures and precautions in this manual.

To make sure the effective after-sales protection provided by the instrument, please do not use any operation or maintenance other than which mentioned in the manual.

Due to non-compliance with the precautions specified in this manual, any fault and loss caused shall not be covered by the warranty, and the manufacturer shall not bear any relevant responsibility. If you have any questions, please contact our after-sales service department or representative.

Carefully unpack the instrument and accessories from the shipping container, and inspect for possible damage during shipping. Check received parts with items on the packing list. If any parts or materials are damaged or missing, please contact our customer service or the authorized distributor immediately.

Save all packing materials until you are sure that the instrument functions properly. Any damaged or defective items must be returned in their original packaging materials.

1 Overview

Online OIW sensor use the principle of ultraviolet fluorescence technique with high sensitivity. Compared with other methods, the fluorescence method is proven to be more efficient, fast and repeatable. which can be used to detect solubility and emulsification. It is suitable for oil field monitoring, industrial circulating water,condensate water, wastewater treatment, surface water station and many other water quality measurement scenes.

Sensor features:

RS - 485 output, Modbus protocol compatible;

With automatic cleaning wiper, eliminate influence of oil on the measurement;

Reduce contamination without interference by the light interference from the outside world;

Not affected by particles of suspended matter in water.

1.1 Introduction



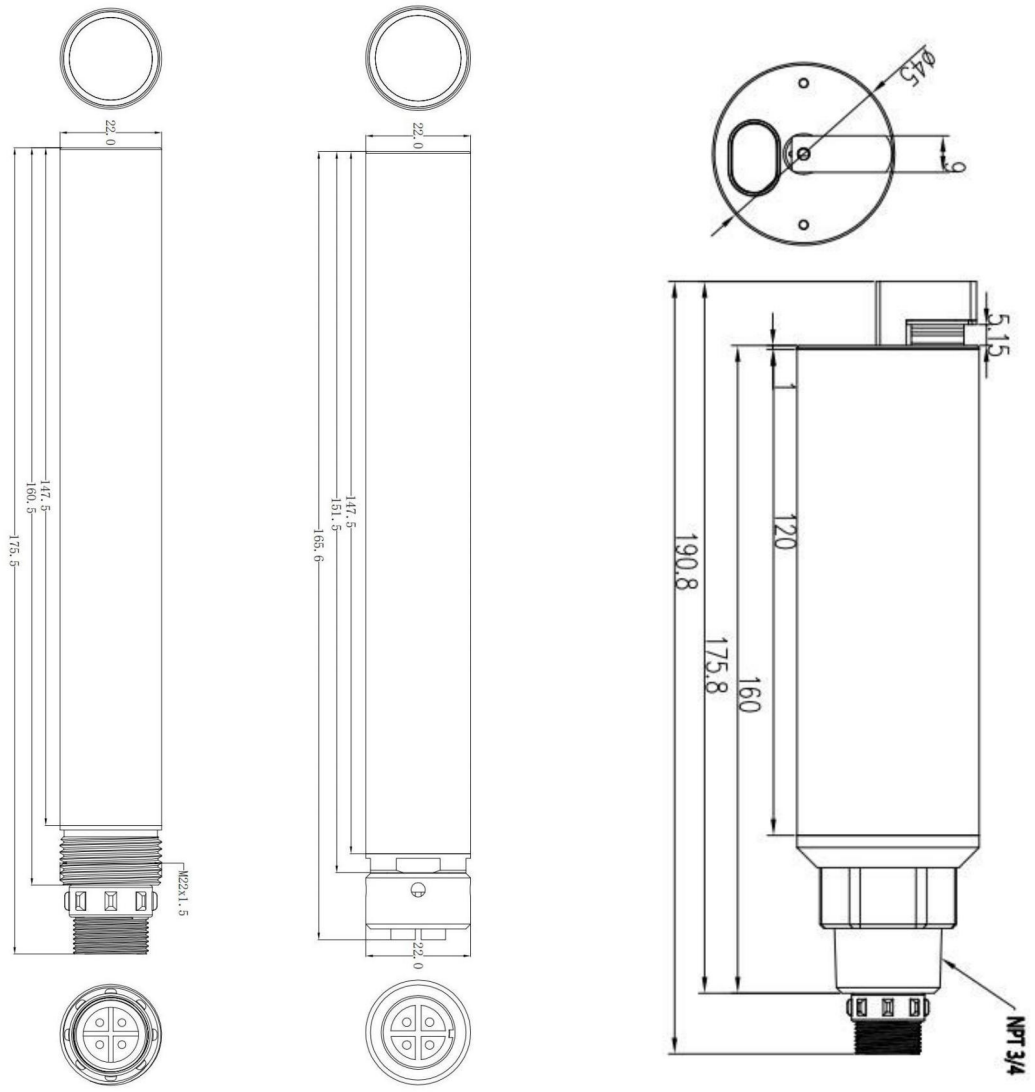
▲OIW Sensor



▲OIW Sensor （multiparameter）



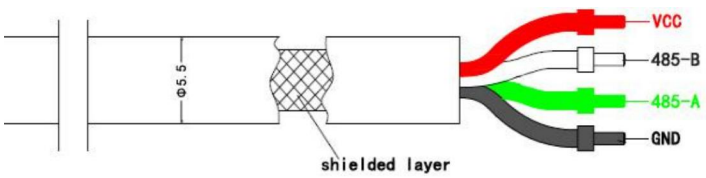
▲Self-cleaning OIW Sensor



▲OIW size ▲OIW size （multiparameter） ▲Self-cleaning OIW size

1.2 Wire Definition

4 wire AWG-24 or AWG-26 shielding wire. OD=5.5mm



1, Red—Power (VCC)
2, White—485 Date_B (485_B)
3, Green—485 Date_A (485_A)
4, Black—Ground (GND)

1.3 Technical Specifications

Name	OIW Sensor	OIW Sensor (multi-parameters)	self-cleaning OIW size
Principle	Ultraviolet fluorescence method		
Range	0-50ppm（optional 0-150ppm）		
Detection limit	Determined by actual oil sample		
Resolution	0.01ppm		
Linearity	$R^2 > 0.999$		
Housing IP Rating	IP68		
Maximum	6bar	6bar	3bar
Temperature	0-50℃		
Interface	Supports RS-485, MODBUS protocol		
Power	0.2W（Suggested power supply: DC 9-24V,current>50mA）		0.2W（non wiping）0.6W（wiping）; suggested power supply: DC 5-12V,>500mA
Sensor Size	Φ22mm*175.5mm	Φ22mm*165.6mm	Φ45mm*190.8mm
Self-cleaning System	Null	Null	One-piece self-cleaning brush
Construction	M22*1.5 (optional accessories can betransferred, NPT3/4 thread)	Multiple parameters with our company's sensor	3/4 inch NPT, Drop-in installation
Probe cable	10m (default), customizable		
Sensor material	Ti		316L(Optional titanium alloy)
Calibrate	Zero-point, one-point or two-points calibration		

Note:

The above technical parameters are all data under laboratory standard liquid environment.

Sensor life and maintenance calibration frequency are related to actual field conditions.

2 Installation

2.1 Configuration table

Standard configuration	Number	Remarks
OIW Sensor	1	
Cable	1	10m

2.2 Sensor Installation

(1) Wiring and power supply

① Do not use the sensor cable to pull the sensor! It is required to install sensor in a secure and stable mounting bracket.

② The female and male connector of sensor cable should be screwed tightly to avoid moisture incursio.



③ Make sure power supply voltage is correct before power on.

(2) Sensor installation

① It is recommended to install the sensor vertically with electrodes facing down.

② In consideration of the fluctuation of water level, install the sensor below water level of 30cm, and try to install it in the position where there are no bubbles in the water;

③ Considering the basic principles of optics, Please keep the sensorThe end of the light window is not less than 10cm from the bottom of the container/related device!

3 Calibration

3.1 Brief description

OIW Sensor supports zero-point、one-point or two-points calibration. The calibration tool can be used with our Smart PC software or according to sensor communication protocol. For our Smart PC software, please can the QR code on the right to get it. Customers can also develop by themselves according to the communication protocol.

SmartPC User Manual:

（1） Open the SmartPC and select "Language" in the title bar: English.

（2） Select the correct port and click "Connect".

（3） Check calibration to perform calibration operation. Press F1 to get the help document. Find the calibration instructions for the OIW probe.

（4） You can also use the tool to measure and record data, referring to the help documentation.

3.2 Standard solution configuration

(1) Mother solution configuration

Take 0.1g of qunine sulfate（CAS：6119-70-6）and dissolve in 0.05mol/L sulfuric acid, fixed capacity to 1L (used 0.05mol/L sulfuric acid). At this time, 1000ppm qunine sulfate standard solution is prepared;

(2) 44ppm OIW standard solution configuration

Take 0.5mL of 1000ppm qunine sulfate standard solution (step1) and dissolve in 0.05mol/L sulfuric acid, fixed capacity to 1L (used 0.05mol/L sulfuric acid). At this time, the 44ppm OIW standard solution is prepared.

(3) The remaining concentrations can be diluted proportionally, and the prepared solution is best used within 24 hours.

Notes:

① The test should be performed in a brown light-proof bottle, and attached bubbles should be avoided to the light window during probe inserting and reading;

② The distance between the end face of sensor window and the bottom of container is ≥ 10cm.

4 Maintenance schedule and methods

4.1 Maintenance cycle

Cleanliness of the measuring window is very important to maintain accurate readings.It is recommended to clean the sensor light Windows and dry them with a clean cloth before testing.

Maintenance task	Recommended maintenance frequency	
	OIW Sensor	Self-cleaning OIW Sensor
Sensor cleaning	Cleaning every 2 to 3 weeks	Cleaning every 3 to 4 weeks
Calibration sensor	Every 3 to 4 weeks	
Maintenance and inspection of self-cleaning brush	Null	It is recommended to replace the brush skin every three months (depending on the specific working conditions).

4.2 Maintenance methods

(1) Clean the sensor surface： Wash the outer surface of sensor with tap water, if there is still residue, using soft brush for stubborn dirt. Detergent can be added in tap water to clean.

(2) Window surface: clean the outer surface of the sensor with tap water. For some stubborn dirt, traditional detergent and soft cloth can be used to clean it. It is forbidden to scrape the window surface with hard objects.

(3) Check the cable： inspect the sensor cable if there is damage.

(4) Check whether the sensor shell is damaged due to corrosion or other reasons. Check whether the sensor's cleaning brush is damaged, excessive wear leads to less than the light window and other abnormalities.

4.3 Attention

(1) Probe contains sensitive optical components and electronic components. Ensure that the probe far away from severe mechanical impact.

(2) Self-cleaning OIW sensor cleaning brush is internally provided with a reduction motor.Under no circumstances shall external force be used to rotate the cleaning brush or hinder the rotation of the cleaning brush (except for replacing the cleaning brush).Large external force factors can cause damage to the deceleration motor.

5 Trouble Shooting

Table 5-1 lists the symptoms, possible causes, and recommended solutions for common problems encountered with the OIW sensor. If your symptom is not listed, or if none of the solutions solves your problem, please contact us.

ERROR	POSSIBLE CAUSE	SOLUTION
Communication abnormal	Power supply or wiring issues	Check whether the power supply and wiring are correct according to the instruction
	Interface or protocol issues	1.Use our SmartPC upper computer software to check whether the communication is normal. 2.Check according to the supporting communication protocol of the product.
No change in reading	Abnormal cleaning brush	1.Check whether the brush is entangled by foreign matter, if so, please remove the foreign matter; 2.Turn on the power again and observe whether the brush rotates. If it cannot rotate or rotates abnormally, please contact customer service.
		Check whether the power supply meets the requirements, to avoid the low power supply can not drive the brush rotation.
	Software and hardware anomalies	Contact customer service
Measured value is too high, Too Low or instability	Sensors are seriously contaminated	Clean sensor body, special light window table
	Sensor's brush is worn	Change brush
	Calibration is required	Perform user calibration
Other errors	Contact customer service	

Table 5-1 List of frequently asked questions

6 Quality Assurance

(1) The warranty period is 1 year.

(2) This quality assurance does not cover the following cases.

① Due to force majeure, natural disasters, social unrest, war (declared or undeclared), terrorism, the War or damage caused by any governmental compulsion.

②damage caused by misuse, negligence, accident or improper application and installation.

③ Freight charges for shipping the goods back to our company.

④ Freight charges for expedited or express shipping of parts or products covered by the warranty.

⑤ Travel to perform warranty repairs locally.

(3) This warranty includes the entire contents of the warranty provided by our company with respect to its products.

① This warranty constitutes a final, complete and exclusive statement of the terms of the warranty, and no person or The agent is authorized to establish other warranties in the name of our company.

② The remedies of repair, replacement, or return of payment as described above are exceptional cases that do not violate this warranty, and the remedies of replacement or return of payment are for our products themselves. Based on strict liability or other legal theory, our company shall not be liable for any other damage caused by a defective product or by negligent operation, including any subsequent damage that is causally related to these conditions.

7 Communication protocols

The RS485 communication protocol uses MODBUS communication protocol, and the sensors are used as slaves.

Data byte format.

Baud rate	**9600**
Starting position	1
Data bits	8
Stop bit	1
Check digit	N

Read and write data (standard MODBUS protocol)

The default address is 0x01, the address can be modified by register

7.1 Reading data

Host call (hexadecimal)

01 03 00 00 00 01 84 0A

Code	**Function Definition**	**Remarks**
01	Device Address	
03	Function Code	
00 00	Start Address	See register table for details
00 01	Number of registers	Length of registers (2 bytes for 1 register)
84 0A	CRC checksum, front low and back high	

Slave answer (hexadecimal)

01 03 02 00 xx xx xx xx

Code	Function Definition	Remarks
01	Device Address	
03	Function Code	
02	Number of bytes read	
XX XX	Data (front low and back high DCBA)	See register table for details
XX XX	CRC checksum, front low and back high	

7.2 Writing data

Host call (hexadecimal)

01 10 1B 00 00 01 02 01 00 0C C1

Code	Function Definition	Remarks
01	Device Address	
10	Function Code	
1B 00	Register Address	See register table for details
00 01	Number of registers	Number of read registers
02	Number of bytes	Number of read registers x2
01 00	Data (front low and back high DCBA)	
0C C1	CRC checksum, front low and back high	

Slave answer (hexadecimal)

01 10 1B 00 00 01 07 2D

Code	Function Definition	Remarks
01	Device Address	
10	Function Code	
1B 00	Register Address	See register table for details
00 01	Returns the number of registers written	
7D 2D	CRC checksum (front low and back high)	

7.3 Calculating CRC Checksum

(1) Preset one 16-bit register as hexadecimal FFFF (i.e., all 1s) and call this register the CRC register.

(2) Iso-oring the first 8-bit binary data (both the first byte of the communication information frame) with the lower 8 bits of the 16-bit CRC register and placing the result in the CRC register, leaving the upper 8 bits of data unchanged.

(3) Shift the contents of the CRC register one bit to the right (toward the low side) to fill the highest bit with a 0, and check the shifted-out bit after the right shift.

(4) If the shifted out bit is 0: repeat step 3 (shift right one bit again); if the shifted out bit is 1, CRC register and polynomial A001 (1010 0000 0000 0001) for the iso-or.

(5) Repeat steps 3 and 4 until the right shift is made 8 times so that the entire 8-bit data is processed in its entirety.

(6) Repeat steps 2 through 5 for the next byte of the communication information frame.

(7) Exchange the high and low bytes of the 16-bit CRC register obtained after all bytes of this communication information frame have been calculated according to the above steps.

(8) The final CRC register content is obtained as follows: CRC code.

7.4 Register Table

Start address	Command Description	Number of registers	Data format (hexadecimal)
0x0700H	Get Software and Hardware Rev	2	4 bytes in total 00 ~ 01: hardware version 02 ~ 03: software version For example, reading 0101 represents 1.1
0x0900H	Get SN	7	14 bytes in total 00: reserved 01 ~ 12: serial number 13: Reserved The 12 bytes of the serial number are translated according to ASCII code, i.e. the factory serial number
0x1100H	User calibration K/B (read/write)	4	Total 8 bytes 00~03: K 04~07: B To read K for example, read out as 4 bytes of data (low bit in front, DCBA format, need to convert this data to floating point, see below for conversion method) To write k, for example, we need to convert k to 32-bit floating point and write it in (DCBA

			format)
0x1B00H	Brush power-on startup settings	1	2 bytes in total 00~01: 0x0000 does not start on power 0x0100 Power on and self-start
0x2600H	Temperature value/OIW value acquisition	4	8 bytes in total 00~03: Temperature value 04~07: OIW value The reading temperature value/OIW value is 4 bytes of data. (The low position is in the front, DCBA format, and this data needs to be converted to a change floating point number. The conversion method is shown below)
0x3000H	Device address (read and write)	1	2 bytes in total 00~01: Device address The range can be set from 1~254 For example, the data obtained is 02 00 (If the low position is in the front, it means that the address is 2) Take address 15 as an example, then 0F 00 Write the corresponding address (low in front) When the current device address is unknown, you can use FF as a common device address to ask for the current
0x3100H	Brush startup (write only)	0	Send a write command with a write length of 0
0x3200H	Brush repeated start time setting (read and write)	1	2 bytes in total 00~01: Time Take the reading value 1E 00 (default) as an example, the actual value is 0x001E, that is, 30 minutes. For example, if you need to write for 60 minutes, convert it to 3C 00 for writing.

7.5 Conversion algorithms for floating point numbers

7.5.1 Converting floating point numbers to hexadecimal numbers

Step 1: Convert the floating point representation of 17.625 to binary floating point

First find the binary representation of the integer part

$17 = 16 + 1 = 1\times2^4 + 0\times2^3 + 0\times2^2 + 0\times2^1 + 1\times2^0$

So the binary representation of the integer part 17 is 10001B

Then find the binary representation of the fractional part

0.625 $= 0.5 + 0.125 = 1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3}$

So the binary representation of the decimal part 0.625 is 0.101B

So the floating point number in binary form for 17.625 expressed in floating point form is 10001.101B

Step 2: Shift to find the exponent.

Shift 10001.101B to the left until there is only one place left before the decimal point to get 1.0001101B, and

10001.101B = 1.0001101 B x 2^4 . So the exponential part is 4, which, when added to 127, becomes 131, whose binary representation is 10000011B

Step 3: Calculate the end number

Removing the 1 before the decimal point of 1.0001101B gives the trailing number 0001101B (because the 1 before the decimal point must be 1, the IEEE specifies that only the one after the decimal point should be recorded). An important note for 23-bit trailing numbers: the first bit (i.e. the hidden bit) is not compiled. The hidden bit is the bit to the left of the separator, which is usually set to 1 and suppressed.

Step 4: Symbol bit definition

A positive number has a sign digit of 0 and a negative number has a sign digit of 1, so 17.625 has a sign digit of 0.

Step 5: Convert to floating point

1 digit sign + 8 digits exponent + 23 digits mantissa

0 10000011 00011010000000000000000B (corresponding to 0x418D0000 in hexadecimal)

7.5.2 Converting hexadecimal numbers to floating point numbers

Step 1: Convert hexadecimal number 0x427B6666 to binary floating point number 0100 0010 0111 1011 0110 0110 0110 0110B into sign, exponent and mantissa bits

0 10000100 11110110110110011001100110b

1 digit sign + 8 digits exponent + 23 digits mantissa

Sign bit S: 0 表示正数

Index bit E: 10000100B = 1× 2^7 +0× 2^6 +0× 2^5 +0× $2^4 + 0 \times 2^3$ +1× 2^2 +0× 2^1 +0× 2^0

=128+0+0+0+0+0+4+0+0=132

Last digit M: 11110110110011001100110B = 8087142

Step 2: Calculating floating point numbers

D = $(-1)^S$ × $(1.0 + M/2^{23})$ × 2^{E-127}

= $(-1)^0$ × $(1.0 + 8087142/2^{23})$ × $2^{132-127}$

= 1 x 1.964062452316284 x 32

= 62.85