SUCH

Digital Inductive Conductivity Sensor

User Manual



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Product introduction

It is widely used to online monitor the conductivity value in liquid for high measure range and special liquid solutions of high Temperature, by using high-performance CPU chip and SMT chip technology to complete conductivity and temperature measurement, temperature compensation, , high precision, good repeatability. It is widely used in continuous monitoring of conductivity value in solutions such as thermal power, chemical fertilizer, metallurgy, environmental protection, pharmaceutical, biochemical, food.

1. Main features

- ✧ This product is digital conductivity sensor, which can directly output RS485 signal and 4~20mA signal.
- ✧ High precision, high stability and preferable anti-jamming ability.
- ✧ The shell is made of polytetrafluoroethylene (PTFE) material, which has excellent chemical stability, corrosion resistance, electrical insulation and good anti-aging endurance. For most chemicals and solvents, it shows inertia and can resist strong acid and alkali, as well as various organic solvents.
- ✧ High temperature cable is made of tinned Teflon material, high temperature resistant up to 200 degrees, almost insoluble in any organic solvents, resistant to acids and alkalis, decomposers, petrol, oil and many other chemical media. Resistant to high voltage, low high-frequency loss and high insulation resistance.
- ✧ Applications: Widely used in seawater, sewage monitoring, power

plants and food pipeline cleaning, chemical production in highly polluted environments, as well as continuous monitoring of acid and alkali concentrations.

- ✧ No need controller, can directly connect to computers, PLC and other devices with RS485/4-20mA signal interface for data acquisition and maintenance. It's convenient for users to integrate data measured by sensors into the industrial control environment, such as host computer system and IOT.
- ✧ Collecting data, debugging and maintaining sensors through wired (485 to USB module), or relying on DTU devices to realize wireless networks (such as WIFI, GPRS and other wireless networks).
- ✧ The sensor can be set with RS485 communication for its slave address, baud rate, online calibration, factory reset, 4-20mA output corresponding range, coefficient of proportionality, incremental compensation and other settings.
- ✧ Power off protects > 10 years.

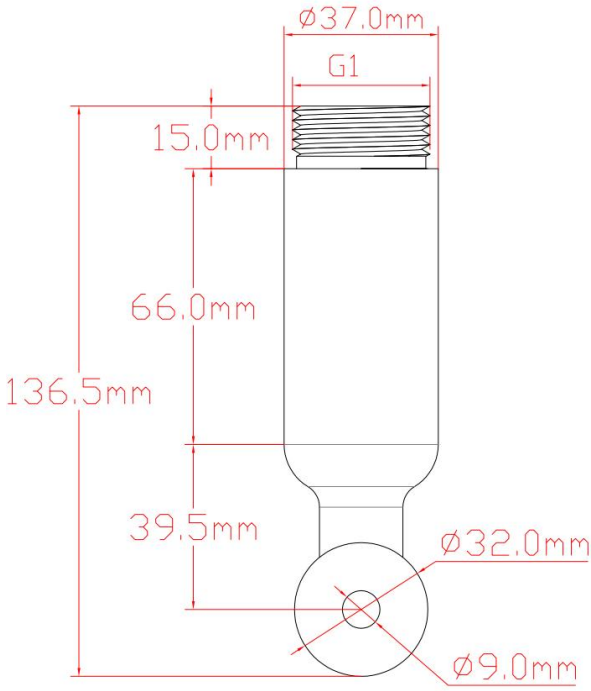
2. Technical indicators

- ✧ Measuring range: 0-1000mS/cm、0-2000mS/cm(other ranges can be customized)
- ✧ Resolution: 0.1mS/cm, 0.1℃
- ✧ Accuracy: ±2％FS，±0.5℃
- ✧ Automatic temp. compensation: 0-60℃ or 0-100℃, NTC 10K
- ✧ Output: Support RS48(Modbus-RTU protocol) & 4-20mA output
- ✧ Working conditions:0~60℃ or 0-100℃(Optional)

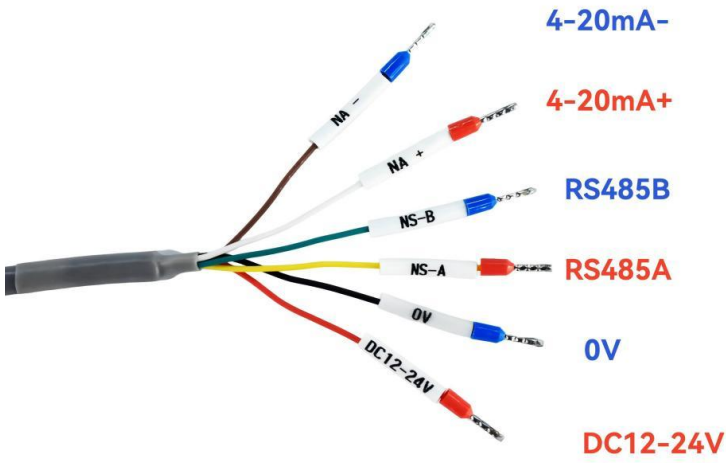
- ✧ Output load: <500Ω 4-20mA (optional)
- ✧ Working voltage:DC12V
- ✧ Protection level: IP68

3. Electrode diagram

Sensor Specification:



Wiring Instruction:



DC 12-24V+ , 0V : connect to **DC 12-24V** power supply.
NS-A, NS-B: connect to RS485 interface
NA+, NA-: connect to 4-20mA interface

4. Communication Protocol

MODBUS-RTU	
Baud rate	9600（default）
Device No	1（default）
Data bit	8 digits
Odd-even calibration	NO
Stop bit	1 digits

4.1 Register Setting

Register name	Address	type of data	Length	Read/ Write	Note
Display value	R0	unsigned	1	R	Default 1 decimal
Temperature	R1	unsigned	1	R	2 decimal
4mA output display value	R2	unsigned	1	R	Default 1 decimal
20mA output display value	R3	unsigned	1	R	Default 1 decimal
Range lower limit	R4	unsigned	1	R	Default to 0
Range upper limit	R5	unsigned	1	R	Default 1 decimal
Scale factor	R6	unsigned	1	R	1 decimal
Increment	R7	signed	1	R	Default 1 decimal
Resolution	R8	signed	1	R	Default to 1
Product identification	R9	signed	1	R	Default to 12
Slave address	R10	unsigned	1	R	Range between 1-247

Baud rate	R11	unsigned	1	R	1200 2400 4800 9600 19200 38400 57600
Function calls	R12	unsigned	1	W	Find parameter settings for more details
Parameter1	R13	unsigned	1	W	Find parameter settings for more details
Parameter2	R14	unsigned	1	W	Find parameter settings for more details

4.2 MODBUS Instruction format

This sensor is compatible with 0x03, 0x06, 0x10 function codes of MODBUS protocol.

0x03 Command Format：

Definition	Address	Function Code	Initial Address	Number of Register	CRC calibration
Data	ADDR	0x03	Rstart	Rnum	CRC 16

Number of Bytes	1	1	2	2	2

0x03 Return Format：

Definition	Address	Function Code	Number of Data	Data	CRC calibration
Data	ADDR	0x03	Rnum*2	Data	CRC 16
Number of Bytes	1	1	1	Rnum*2	2

0x06 Command Format (same as command)：

Definition	Address	Function Code	Register Address	Data	CRC calibration
Data	ADDR	0x06	Raddr	Data	CRC 16
Number of Bytes	1	1	2	2	2

0x06 Return Format(same as command format)：

Definition	Address	Function Code	Register Address	Data	CRC calibration
Data	ADDR	0x06	Raddr	Data	CRC 16
Number of Bytes	1	1	2	2	2

0x10 Command Format：

Definition	Add	Function Code	Initial Add	Number of Register	Number of Data	Data	CRC calibration
Data	ADDR	0x10	0x000C	0x0003	0x06	Data	CRC 16
Number of Bytes	1	1	2	2	1	6	2

0x10 Return Format

Definition	Address	Function Code	Initial Address	Number of Register	CRC calibration
Data	ADDR	0x10	0x000C	0x0003	CRC 16
Number of Bytes	1	1	2	2	2

4.3 Data reading

This sensor data is read by the 0x03 function code of the MODBUS protocol.

Example: Reading EC value and temperature value

Send command: 01 03 00 00 00 02 C4 0B

Return: 01 03 04 1A CC 09 C4 3A D7

The data part is**:** 1A CC 09 C4

EC Value: Data 0x1ACC, converted to decimal in 6860, EC value is 686.0uS/cm, reserved 1 decimal.

Temperature Value: Data 0x09C4, converted to decimal 2500, temperature value is 25.00, reserved 2 decimal.

4.4 Parameter adjustment

1. Parameter adjustment of the sensor adopt 0x06 or 0x10 function code of MODBUS protocol.

2. It's divide into 3 steps in using using 0x06 function code to adjust parameters:

    1) Write parameter 1 into register R13

    2) Write parameter 2 into register R14

    3) Write the function number into register R12

3. Use the 0x10 function code, and write the function number, parameter 1, and parameter 2 to the three registers starting from R12. It has same effect with write step by step.

4. When the function call is successful, the R12, R13, and R14 registers are all reset to 0. If the function call fails or the parameters are incorrect, the R14 register will display -1.

4.5 Function call parameter list

Function	Parameter 1	Parameter 2	Function number
Zero Calibration	Zero Cal*10	1	1

Slope Calibration	Slope Cal *10	2	1
Temperature Correction	Temperature value*100	Any value	2
Change 4-20mA output range (customized）	4mA Output representative value	20mA representative value	3
Change Correction Factor	Scale factor	Display value increment	5
Change slave configuration	New slave number	New baud rate	6
Restore Factory Setting	Password 20034	Arbitrary value	7

Example: EC value calibration (using 0x10 function code)

Zero calibration: Standard liquid of conductivity is 73.0mS/cm, 73.0*10=730, convert to 16 band is 0x02DA. Therefore, function number is 0x0001, parameter 1 is 0x02DA, parameter 2 is 0x0001.

The data part is**:** 00 01 02 DA 00 01

Send command: 01 10 00 0C 00 03 06 00 01 02 DA 00 01 FA FC

Return**:** 01 10 00 0C 00 03 40 0B

Slope calibration: Standard liquid of conductivity is 1413.0mS/cm, 1413.0*10=14130, convert to 16 band is 0x3732. Therefore, function number is 0x0001, parameter 1 is 0x3732, parameter 2 is 0x0002.

The data section is: 00 01 37 32 00 02

Send command: 01 10 00 0C 00 03 06 00 01 37 32 00 02 35 05

Return: 01 10 00 0C 00 03 40 0B

Common Commands

Slave 1 reads all data: 01 03 00 00 00 0F 05 CE

Slave 2 reads all data: 02 03 00 00 00 0F 05 FD

Slave 3 reads all data: 03 03 00 00 00 0F 04 2C

Modify slave number to 2: 01 10 00 0C 00 03 06 00 06 00 02 25 80 14 4F

Modify slave number to 3:01 10 00 0C 00 03 06 00 06 00 03 25 80 45 8F

Restore factory settings: 01 10 00 0C 00 03 06 00 07 4E 43 00 00 75 83

CRC16 calculation function (C language)

```
Function: Calculate CRC16 check digit
Parameters.
    buf:Array of bytes needed to calculate the CRC len:Array length
Return: CRC code
*/
uint16_t CRC16(uint8_t buf[],int len){
    int i , j;
    uint16_t CRCreg = 0xffff;       //modbus CRC16 initial value
    uint16_t DXS = 0xA001;          //modbus CRC16 polynomial
    for (i=0;i<len;i++){
        CRCreg = CRCreg ^ buf[i];
```

```
            for (j=0;j<8;j++) {
                if((CRCreg & 1) == 1)
                    CRCreg = (CRCreg >> 1) ^ DXS;
                else
                    CRCreg = CRCreg >> 1;
            }
        }
        return CRCreg;
}
```

Attention and maintenance

1. Before the sensor is powered on, the wiring needs to be checked again to avoid damage to the sensor due to incorrect or reverse connection.
2. The sensor should be kept as still as possible during the measurement and the temperature of the solution needs to be kept relatively stable.
3. If the sensor has been powered off for a long time, wait 5-15 minutes for the measurement to stabilize when it is powered on again.
4. Due to the sensor's temperature complement being built-in and not directly in contact with the solution, when accurate temperature measurement is required, the built-in temperature complement NTC10k should not be used as a temperature sensing device for the measurement. If temperature compensation or temperature calibration is to be performed, it is necessary to wait until the electrode and solution temperatures are equal. This process may take about 10 minutes due to the difference in temperature between the two.
5. If the sensor is not used, please place it in a light-proof, dry and ventilated environment for storage.
6. Sensor heads are precision parts and must not be disassembled, the shape and size of the probe cannot be changed, and it cannot be cleaned with strong acid or alkali to avoid the accuracy of the measurement.
7. The measuring cable is special cable and cannot be replaced.
8. When measuring, the sensor should be cleaned in distilled water (or deionized water) first, and the filter paper should be used to absorb moisture to prevent impurities from being introduced into the liquid to be tested. Check if the terminal is dry. If there is dirt, please use absolute alcohol. Wipe, use after drying.
9. The sensor is used for a long time, and when a measurement error occurs,

it’s necessary to calibrate the sensor for accurate measurement.

10. When the calibration and measurement cannot be performed while maintaining and maintaining the sensor in the above manner, the sensor has failed. Please replace the it.