ORP10

Oxidation Reduction Potential (ORP) Transmitter

User Manual

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1 Customer Support

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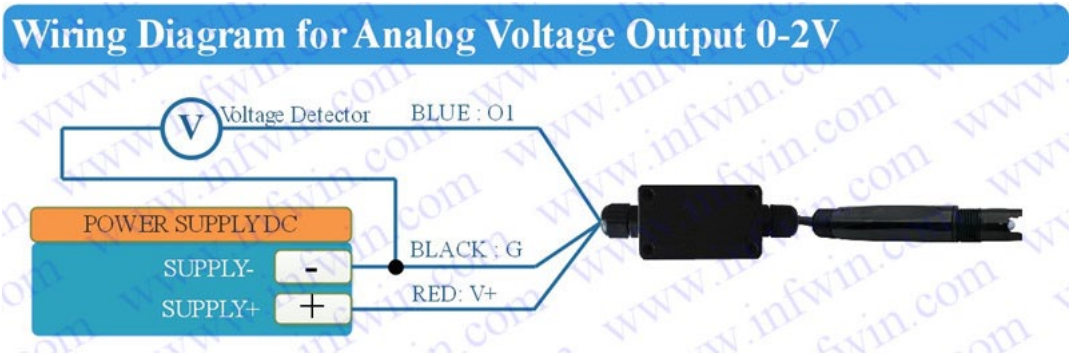
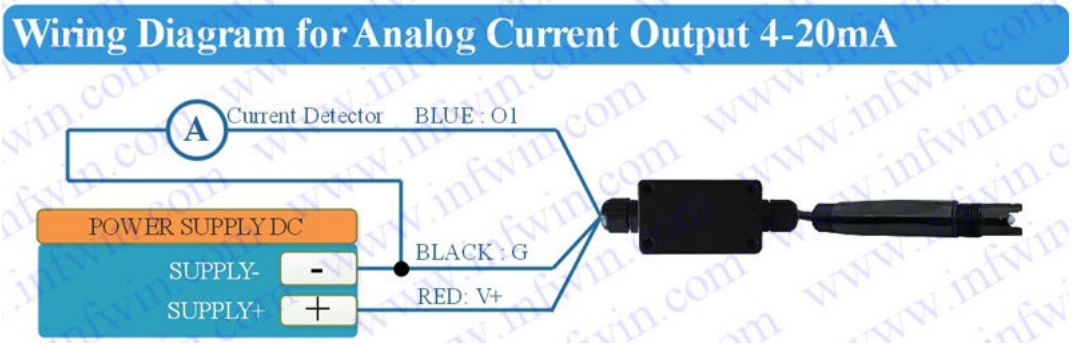
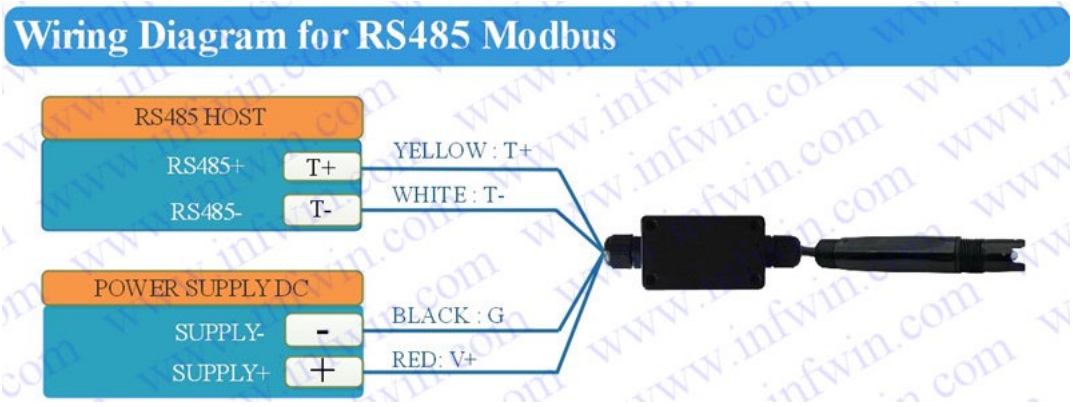
2 Introduction

Oxidation Reduction Potential (ORP) is a measurement of sanitizer effectiveness in water. ORP is an electronic measurement in millivolts (mV) of the ability of a chemical substance to oxidize or reduce another chemical substance. The output signal can be RS485, Analog Voltage or Analog Current. The sensor is applicable for industrial, water processing, sewerage system, irrigation, smart agriculture etc.

- ORP measurement
- Output Interface with RS485, Voltage, Current
- High accuracy with excellent stability
- Reverse power protection and Built-in TVS/ESD protection

Specifications			
Output Interface	Analog Voltage 0-2V (Output resistance ~0ohm)	Analog Current 4-20mA (Load Resistor<500ohm)	RS485 Modbus-RTU
Power Supply	3.9-30V/DC	12-30V/DC	3.9-30V/DC
Power Consumption	10mA@24V DC	30mA@24V DC (with 20mA output signal)	10mA@24V DC
ORP Measurement	Range:+/-2000mV,Resolution:1mV,Accuracy:±2%		
IP Ratings	Electrode:IP68 Transmitter:IP65		
Operating Temperature	-40~85℃		
Installation	Electrode:3/4"NPT screw threads Transmitter:Mounting hole		
Cable Length	Power and Signal Cable:2 meters or Customize Electrode Cable:5 meters		
Dimension	Electrode:3/4"NPT screw threads Transmitter:128*70*42mm		

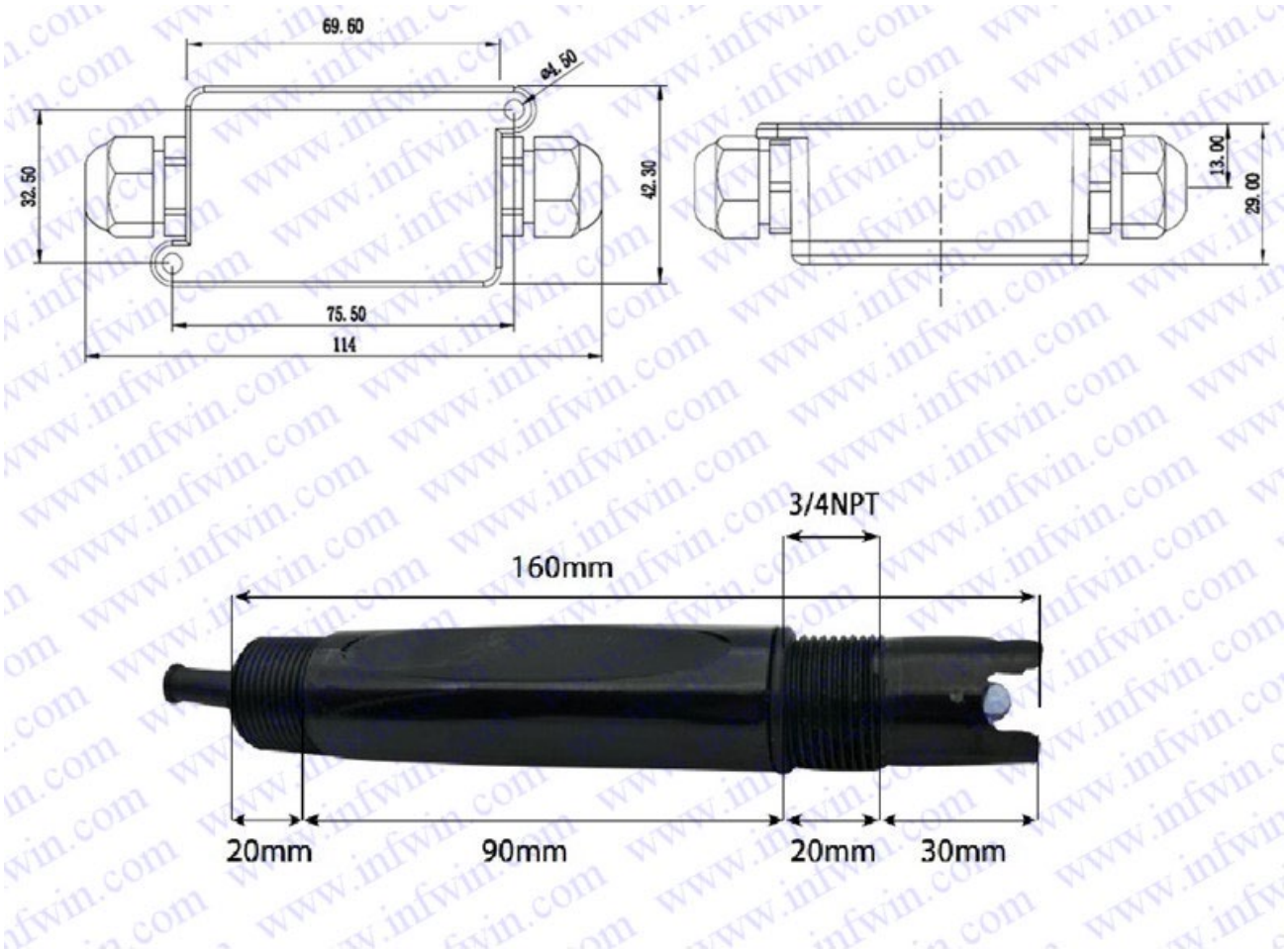
3 Wiring diagrams

Type	Wiring diagram
Analog Voltage Output	Red (V+): Power Supply + Black (G): Power Supply - Blue (O1): Analog Output 
Analog Current Output	Red (V+): Power Supply + Black (G): Power Supply - Blue (O1): Analog Output 
RS485 Modbus	Red (V+): Power Supply + Black (G): Power Supply - Yellow (T+): RS485+/A/T+ White (T-): RS485-/B/T- 

	ALL RS485 communication parameters (Mosbus Slave Address, baudrate, parity, databits, stopbits) are set in internal register and can be saved when power down, the factory setting is ADDRESS=1, BAUDRATE=9600bps,PARITY=NONE, DATABITS=8bits, STOPBITS=1bit; Sometimes you may FORGET the communication settings, In this case, you can open the shield module and press the SET button for more that 3 seconds, then all the communication parameters reset to factory setting, then communicating with the sensor using the factory setting to set your desired settings. Please re-power up the sensor to make the settings effective.

4 Dimension and Ordering Infomation

4.1 Dimension



Unit: mm

4.2 Ordering Infomation

Parameters	Code	Comments
Code 1: Product Series	ORP10	ORP10 transmitter
Code 2: Power Supply	A B	3.9-30V DC 3.3-16V
Code 3: ORP Range	A B C	+/-2000mV +/-1000mV Customize
Code 4: Output Interface	A B C D E F G	Analog Voltage 0-2V Analog Current 4-20mA RS485,Modbus-RTU RS485,Modbus-RTU & Analog Voltage 0-2V RS485,Modbus-RTU & Analog Current 4-20mA SDI-12 Customize
Code 5: Cable Length	002 XXX	Electrode Cable:5 meters , Power and Signal Cable:2 meters Electrode Cable:5 meters , Power and Signal Cable:xxx meters
Ordering Code Example: ORP10 transmitter Power Supply 3.9-30V DC, ORP Range +/-2000mV, Output Interface RS485, Modbus-RTU, Power and Signal Cable Length 5 meters. Ordering Code is : ORP10 - A A C 005		

5 Installation and maintenance

5.1 Installation

Installation locations of Electrodes will vary depending on the system design. The key is to monitor a good representative sample of the whole solution directly after introduction of chlorine. The installation location must allow for complete contact of the scrubber liquid with the probes. Some example installation locations for Electrodes include the following:

- Outlet of packed tower
- Outlet of recycle pump
- Pump bypass line
- Heat Exchanger bypass line

5.2 Maintenance

Under normal conditions, electrodes can last anywhere from several months to several years depending on the type of operation, rate of production, strength of product, and quality of the raw materials used in the process. Because each application is different, there is no average life expectancy.

Because the pH responsive glass bulb or flat surface is relatively thin, care should be taken so that the bulb does not become scratched or broken. It is also important that ORP measuring surfaces are not scratched or gouged. The suggestions in this sheet are intended to help avoid these problems. Coating of an electrode's measuring surface can lead to erroneous readings including shortened span and slow response times. The type of coating determines the type of cleaning technique. Soft Coatings can be removed by vigorous stirring, by use of a squirt bottle or, very carefully, by gently wiping with a soft, clean non-abrasive paper or cloth. Hard Coatings should be chemically removed. The chemical used to remove the coating should be the least harsh chemical that dissolves the coating in 1 or 2 minutes and does not attack the electrode's materials of construction. For example, a calcium carbonate coating might be removed with 5% HCl (muriatic acid). Oily or Organic Coatings are best removed with detergents or an appropriate solvent that does not attack the electrode's materials of construction. For example, isopropyl alcohol might be used but acetone should be avoided if the electrode's body is made of CPVC.

6 Output Signal Conversion

Output Interface	Parameters Range	Conversion Formula
Analog Voltage Output 0-2V	ORP Range:-2000mV~+2000mV	ORP=2000*(VOLTAGE-1).When VOLTAGE=2.0V,then ORP=2000*(2-1) = 2000mV.
	ORP Range:-1000mV~+1000mV	ORP=1000*(VOLTAGE -1).When VOLTAGE=2.0V,then ORP=1000*(2-1) = 1000mV.
Analog Current Output 4-20mA	ORP Range:-2000mV~+2000mV	ORP= 4000 *(CURRENT-12)/16.When CURRENT=4mA,then ORP=4000 *(4-12)/16=-2000mV.
	ORP Range:-1000mV~+1000mV	ORP= 2000 *(CURRENT -12)/16.When CURRENT 4mA,then ORP=2000 *(4-12)/16=-1000mV.
RS485 Modbus-RTU	ORP Range:-2000mV~+2000mV	EC=(REGISTER VALUE).When REGISTER VALUE=1568,then EC= 1568mV
Customize	Contact support for customized sensor interface	

NOTE: The unit of VOLTAGE is (V), The unit of CURRENT is (mA).

NOTE: VWC is Volumetric Water Content, EC is Electrical Conductivity.

7 RS485 Modbus Protocol

7.1 Modbus Protocol

Modbus Protocol is widely used to establish master-slave communication between intelligent devices or sensors. A MODBUS message sent from a master to a slave contains the address of the slave, the function code (e.g. 'read register' or 'write register'), the data, and a check sum (LRC or CRC).

The sensor is RS485 interface with Modbus protocol. The default serial communication settings is slave address 1, modbus rtu, 9600bps, 8 databits and 1 stop bit. All communication settings can be changed with modbus command, and take effective after re-power up the sensor.

Following modbus function code are supported by sensor.

Modbus Function Code 0x03 : used for reading holding register.

Modbus Function Code 0x04 : used for reading input register.

Modbus Function Code 0x06 : used for writing single holding register.

Modbus Function Code 0x10: used for writing multiple holding register.

7.2 Modbus Register

Parameters	Register Addr. (HEX/DEC)	Data Type	Modbus Function Code(DEC)	Range and Comments	Default Value
TEMPRATURE	0x0000 /0	INT16 RO	3/4	-4000-8000 for -40.00~80.00℃.	N/A
ORP	0x0001 /1	UINT16 RO	3/4	-2000~+2000 for -2000mV~+2000mV	N/A
ORPRAWAD	0x0002 /2	UINT16 RO	3/4	-2000~2000 for -2000~2000	N/A
TEMPCOMPENSATEEN	0x0020 /32	UINT16 R/W	3/6/16	0: Enabled 1: Disabled	0
ORPCALIBRAWAD0 ORP calibration point for -2000mV	0x0030 /48	UINT16 R/W	3/6/16	-2000~2000 for -2000~2000	N/A
ORPCALIBRAWAD1	0x0031 /49	UINT16 R/W	3/6/16	-2000~2000 for -2000~2000	N/A

ORP calibration point for 0mV					
ORPCALIBRAWAD2 ORP calibration point for 2000mV	0x0032 /50	UINT16 R/W	3/6/16	-2000~2000 for -2000~2000	N/A
SLAVEADDRESS	0x0200 /512	UINT16 R/W	3/6/16	0-255	1
BAUDRATE	0x0201 /513	UINT16 R/W	3/6/16	0-6 0:1200bps 1:2400bps 2:4800bps 3:9600bps 4:19200bps 5:38400bps	3:9600bps
PROTOCOL	0x0202 /514	UINT16 R/W	3/6/16	0-1 0:Modbus RTU 1:Modbus ASCii	0:Modbus RTU
PARITY	0x0203 /515	UINT16 R/W	3/6/16	0-2 0:None 1:Even 2:Odd	0:None Parity
DATABITS	0x0204 /516	UINT16 R/W	3/6/16	1 1:8 databits	1:8 databits
STOPBITS	0x0205 /517	UINT16 R/W	3/6/16	0-1 0:1 stopbit 1:2 stopbits	0:1 stopbit
RESPONSEDELAY	0x0206 /518	UINT16 R/W	3/6/16	0-255 for 0-2550 milliseconds	0
ACTIVEOUTPUTINTERVAL	0x0207 /519	UINT16 R/W	3/6/16	0-255 for 0-255 seconds.	0

NOTE: UINT16:16 bit unsigned integer, INT16:16bit signed integer

NOTE: RO: Register is Read Only, R/W: Register is Read/Write

NOTE: HEX is Hexadecimal (data with 0x/0X prefix), DEC is Decimal

7.3 Modbus Register Detail Descripton

TEMPERATURE		
Data Range	-4000-8000 For -40.00~80.00℃	Default: N/A
Power Down Save	N/A	

Note:Temperature value (Binary complement).

Example:When REGISTER = 0x0702 (HEX format), then

VALUE=(0x07*256+0x02)/100=17.94℃.When REGISTER=FF05H (HEX format),then

VALUE=((0xFF*256+0x05)-0xFFFF-0x01)/100 =(0xFF05-0xFFFF-0x01)/100=-2.51℃.

ORP		
Data Range	-2000~+2000 for -2000mV~+2000mV	Default: N/A
Power Down Save	N/A	

Note: ORP value

Example:When REGISTER = 0x02BC (HEX format), then VALUE=(0x02*256+0xBC)=700mV

ORPCALIBRAWAD		
Data Range	-2000~+2000 for -2000mV~+2000mV	Default: N/A
Power Down Save	N/A	

Note:ORP raw AD value

Example:When REGISTER = 0x02BC (HEX format), then VALUE=(0x02*256+0xBC)=700

TEMPCOMPENSATEEN		
Data Range	0: Enable 1: Disabled	Default: 0
Power Down Save	YES	

Note: Temperature compensation

SLAVEADDRESS --- Modbus Slave Address		
Data Range	0-255	Default: 1
Power Down Save	YES	

Note: Please re-power on the sensor to take effective after set.

BAUDRATE --- Serial Comm Baudrate		
Data Range	**0-5** **0:**1200bps **1:**2400bps **2:**4800bps **3:**9600bps **4:**19200bps **5:**38400bps	Default: 3

Power Down Save	YES	

Note: Please re-power on the sensor to take effective after set.

PROTOCOL --- Serial Comm Protocol		
Data Range	0-1 0:Modbus RTU 1:Modbus ASCii	Default: 0
Power Down Save	YES	

Note: Please re-power on the sensor to take effective after set.

PARITY --- Serial Comm Parity		
Data Range	0-2 0:NONE 1:EVEN 2:ODD	Default: 0
Power Down Save	YES	

Note: Please re-power on the sensor to take effective after set.

DATABITS --- Serial Comm Databits		
Data Range	1 1:8 databits	Default: 1
Power Down Save	YES	

Note: Please re-power on the sensor to take effective after set.

STOPBITS --- Serial Comm Stopbits		
Data Range	0-1 0:1 stopbit 1:2 stopbits	Default: 0
Power Down Save	YES	

Note: Please re-power on the sensor to take effective after set.

RESPONSEDELAY --- Serial Comm Response Delay		
Data Range	0-255 for 0-2550 milliseconds, 0 for disabled	Default: 0
Power Down Save	YES	

Note: Please re-power on the sensor to take effective after set.

Note: Sensor will delay a period before response to master request command.

Example: When set to 5 and receive a request from master device, then sensor will delay 5*10ms=50ms, then response to master.

ACTIVEOUTPUTINTERVAL --- Serial Comm Active Output Interval time		
Data Range	0-255 for 0-255 seconds, 0 for disabled	Default: 0
Power Down Save	YES	

Note: Please re-power on the sensor to take effective after set.

Note: Sensor will output the data actively without any master request command.

Note:Only ONE sensor should be on RS485 network, or there will be data collision and corrupt the data on line.

Note:Refer to SETTING mode to exit the Active Output Mode.

Example: When set to 5 then sensor will output the data every 5 seconds without any master request command.

7.4 Modbus Function Code

For description below, data started with 0X/0x means that it's in HEX format.

7.4.1 Function Code 3 Protocol Example

Master Request:AA 03 RRRR NNNN CCCC

AA	1 byte	Slave Address,0-255
0x03	1 byte	Function Code 3
RRRR	2 byte	Starting Register Addr
NNNN	2 byte	Quantity of Register to read
CCCC	2 byte	CRC CHECKSUM

Slave Response:AA 03 MM VV0 VV1 VV2 VV3… CCCC

AA	1 byte	Slave Address,0-255
0x03	1 byte	Function Code 3
MM	1 byte	Register Data Byte Count
VV0,VV1	2 byte	Register Value (High8bits first)
VV2,VV3	2 byte	Register Value (High8bits first)

…	…	Register Value (High8bits first)
CCCC	2 byte	CRC CHECKSUM

Example:Read register 0x0200-0x0201,that is slave address and baudrate.

Master Request:01 03 0200 0002 C5B3

Slave Addr.	1 byte	0x01
Function Code	1 byte	0x03
Starting Register Addr.	2 byte	0x0200
Quantity of Register to read	2 byte	0x0002
Checksum	2 byte	0xC5B3

Slave Response:01 03 04 00 01 00 03 EB F2

Slave Addr.	1 byte	0x01
Function Code	1 byte	0x03
Register Data Byte Count	1 byte	0x04
Register Value: Address	2 byte	0x00(HIGH 8 Bits)
		0x01(LOW8 Bits)
Register Value: Baudrate	2 byte	0x00(HIGH 8 Bits)
		0x03(LOW8 Bits)
Checksum	2 byte	0xEBF2

7.4.2 Function Code 4 Protocol Example

Master Request:AA 04 RRRR NNNN CCCC

AA	1 byte	Slave Address,0-255
0x04	1 byte	Function Code 4
RRRR	2 byte	Starting Register Addr
NNNN	2 byte	Quantity of Register to read
CCCC	2 byte	CRC CHECKSUM

Slave Response:AA 04 MM VV0 VV1 VV2 VV3… CCCC

AA	1 byte	Slave Address,0-255
0x04	1 byte	Function Code 4
MM	1 byte	Register Data Byte Count
VV0,VV1	2 byte	Register Value (High8bits first)
VV2,VV3	2 byte	Register Value (High8bits first)
…	…	Register Value (High8bits first)
CCCC	2 byte	CRC CHECKSUM

Example:Read register 0x0000-0x0002,that is temperature, ORP value.

Master Request: 01 04 0000 0002 71CB

Slave Addr.	1 byte	0x01
Function Code	1 byte	0x04
Starting Register Addr.	2 byte	0x0000
Quantity of Register to read	2 byte	0x0002
Checksum	2 byte	0x71CB

Slave Response: 01 04 04 08C3 029E 8910

Slave Addr.	1 byte	0x01
Function Code	1 byte	0x04
Register Data Byte Count	1 byte	0x04
Register Value: Temperature	2 byte	0x08(HIGH 8 Bits)
		0xC3(LOW8 Bits)
Register Value: ORP	2 byte	0x02(HIGH 8 Bits)
		0x9E(LOW8 Bits)
Checksum	2 byte	0x8910

Temperature =(0x08*256+0xC3)/100=2243/100=22.43 ℃
ORP=0x02*256+0x9E=670mV

7.4.3 Function Code 6 Protocol Example

Master Request:AA 06 RRRR VVVV CCCC

AA	1 byte	Slave Address,0-255
0x06	1 byte	Function Code 6
RRRR	2 byte	Register Addr (High8bits first)
VVVV	2 byte	Register Value (High8bits first)
CCCC	2 byte	CRC CHECKSUM

Slave Response:AA 06 RRRR VVVV CCCC

AA	1 byte	Slave Address,0-255
0x06	1 byte	Function Code 6
RRRR	2 byte	Register Addr (High8bits first)
VVVV	2 byte	Register Value (High8bits first)
CCCC	2 byte	CRC CHECKSUM

Example:Write Register 0x0020,that is set temperature compensation

Request: 01 06 0020 0000 8800

Slave Addr.	1 byte	0x01
Function Code	1 byte	0x06
Register Addr.	2 byte	0x0020 (High8bits first)
Register Value	2 byte	0x0000 (High8bits first)
Checksum	2 byte	0x8800

Response:01 06 0021 0001 1800

Slave Addr.	1 byte	0x01
Function Code	1 byte	0x06
Register Addr.	2 byte	0x0020 (High8bits first)
Register Value	2 byte	0x0000 (High8bits first)
Checksum	2 byte	0x8800

7.4.4 Function Code 16 Protocol Example

Master Request:AA 10 RRRR NNNN MM VVVV1 VVVV2 …CCCC

AA	1 byte	Slave Address,0-255
0x10	1 byte	Function Code 0x10
RRRR	2 byte	Starting Register Addr

NNNN	2 byte	Quantity of Register to write
MM	1 byte	Register Data Byte Count
VVVV1	2 byte	Register Value(High8bits first)
VVVV2	2 byte	Register Value(High8bits first)
…	…	Register Value(High8bits first)
CCCC	2 byte	CRC CHECKSUM

Slave Response:AA 10 RRRR NNNN CCCC

AA	1 byte	Slave Address,0-255
0x10	1 byte	Function Code 0x10
RRRR	2 byte	Starting Register Addr
NNNN	2 byte	Quantity of Register to write
CCCC	2 byte	CRC CHECKSUM

Example:Write Register 0x0200-0x0201,that is set slave address to 1,and baudrate to 19200bp.

Master Request:01 10 0200 0002 04 0001 0004 BACC

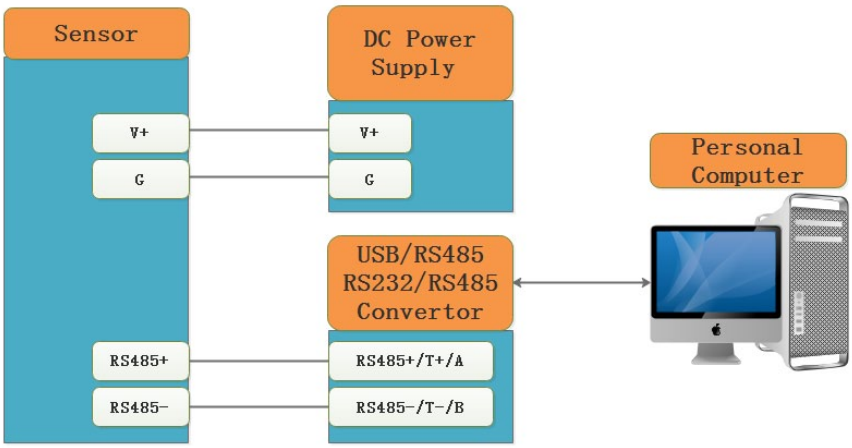
0x01	1 byte	Slave Addr.
0x10(HEX)	1 byte	Function Code 0x10
0x0200	2 byte	Starting Register Addr
0x0002	2 byte	Quantity of Register to write
0x04	1 byte	Register Data Byte Count
0x0001	2 byte	Register Value: Slave Address 1
0x0004	2 byte	Register Value: Baudrate 19200bps
0xBACC	2 byte	CRC CHECKSUM

Salve Response:01 10 0200 0002 4070

0x01	1 byte	Slave Addr.
0x10(HEX)	1 byte	Function Code 0x10
0x0200	2 byte	Starting Register Addr(High8bits first)
0x0002	2 byte	Quantity of Register to write(High8bits first)
0x4070	2 byte	CRC CHECKSUM

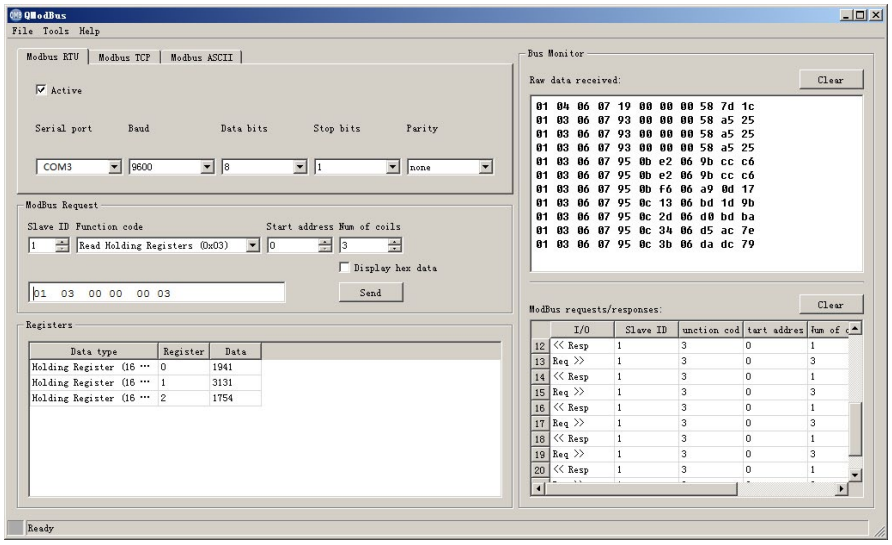
8 Software Configuration Utility

8.1 Hardwar Setup



8.2 Universal Modbus Comm Utility

You can use software listed below to try reading/writing the register of sensor, https://github.com/ed-chemnitz/qmodbus/releases



8.3 SensorOneSet Configuration Utility

SensorOneSet is a configuration utility to read/set sensor config for all of our serial communication sensor products. Please contact us if you need the English version.

Appendix

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Version Control

Date	Version	Comment	Updated by
2017-04-23	V1.0	Initial Creation	fg49597