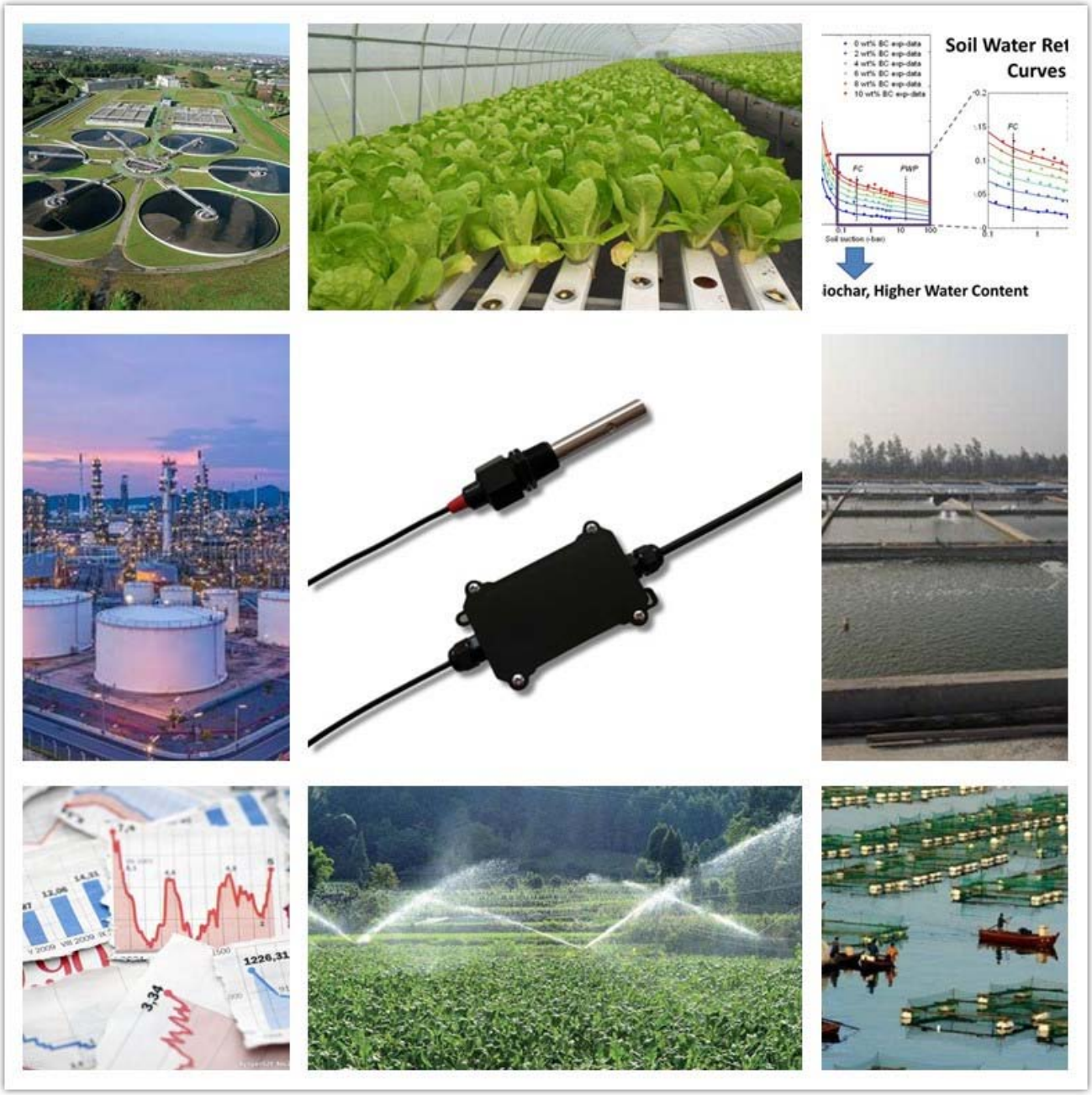
ECTDS10-ISO

Isolated Solution Conductivity Transmitter

User Manual



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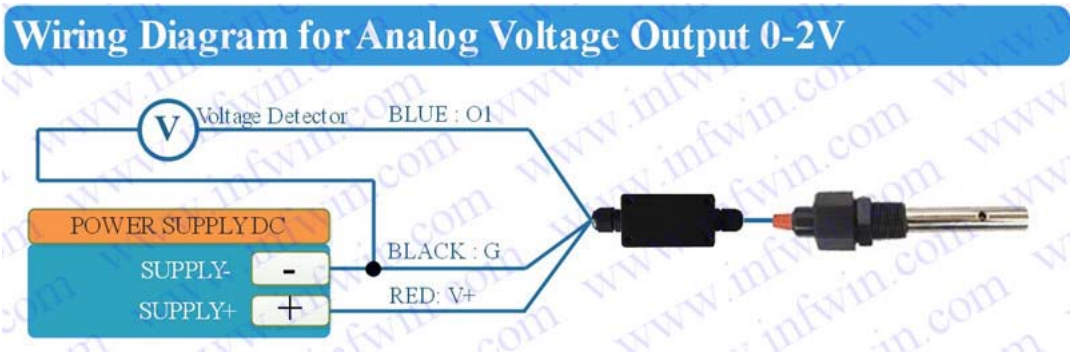
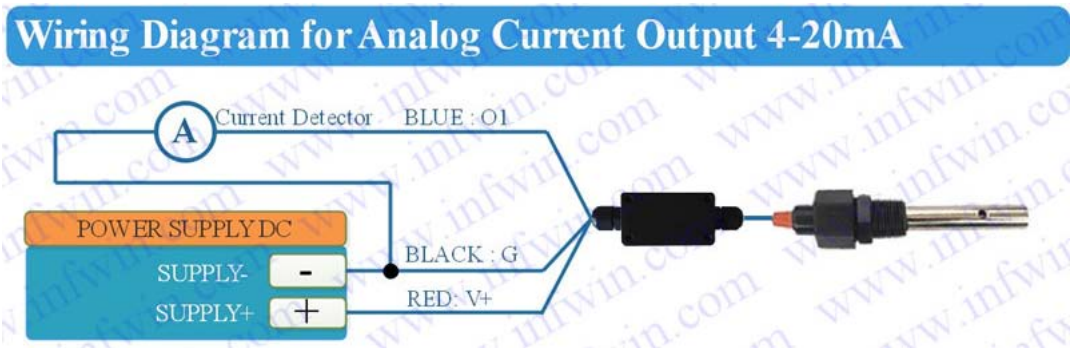
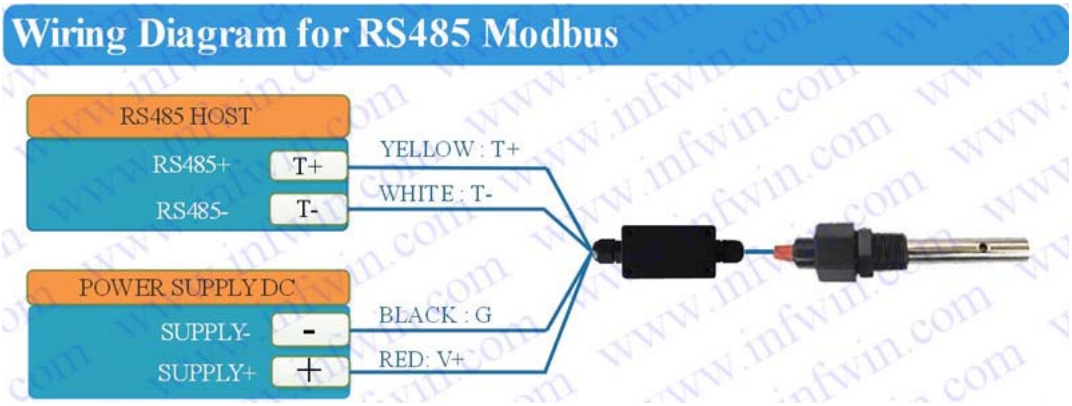
2 Introduction

ECTDS10-ISO measures Conductivity, Salinity, TDS with temperature compensation. 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.

- Conductivity, Salinity and TDS measurement with temperature compensation
- Isolated Sensor Input
- With ABS or Stainless steel electrode
- 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(Idle)	40mA@24V DC	40mA@24V DC (with 20mA output signal)	40mA@24V DC
Power Consumption(Max)	80mA@24V DC	100mA@24V DC (with 20mA output signal)	80mA@24V DC
Start-up time	< 2 seconds		
EC Measurement	Isolated Sensor Input, Range: 0-5000us/cm, 10000us/cm, 20000us/cm Resolution: 0-10000us/cm, 10us/cm; 100000-20000us/cm, 50us/cm Accuracy: 0-10000us/cm, ±3%; 10000-20000us/cm, ±5% EC temperature compensation: 0-50°C		
Temperature Measurement	Range: -40~80°C, Resolution:0.1°C, Accuracy:±0.5°C		
IP Ratings	Electrode:IP68; Transmitter:IP65		
Operating Temperature	-40~85°C		
Installation	Electrode:1/2"NPT screw threads; Transmitter:Mounting hole		
Cable Length	Power and Signal Cable:2 meters or Customize; Electrode Cable:5 meters		
Dimension	Electrode:1/2"NPT screw threads; Transmitter:128*70*42mm		

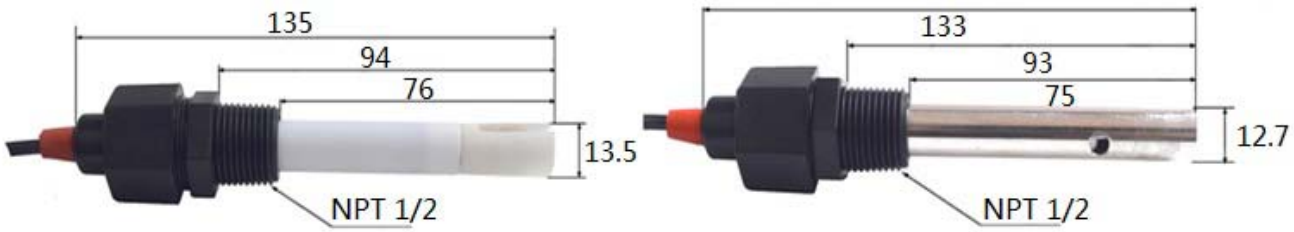
3 Wiring diagrams

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- 

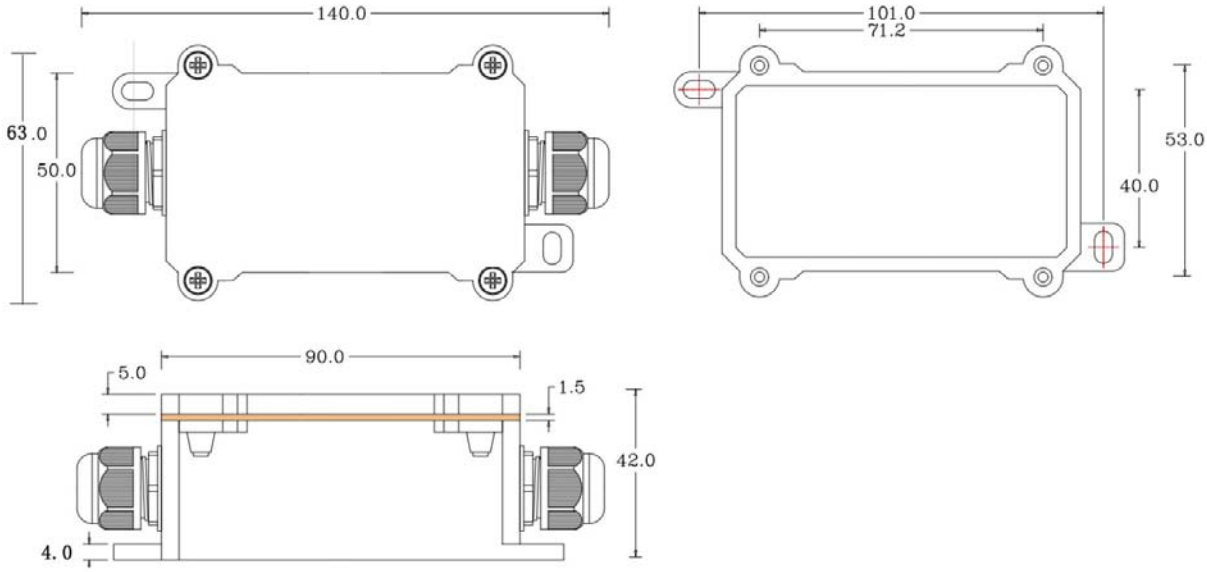
4 Dimension and Ordering Infomation

4.1 Dimension

Electrode(mm)



Transmitter(mm)



4.2 Ordering Infomation

Parameters	Code	Comments
Code 1: Product Series	ECTDS10-ISO	ECTDS10-ISO isolated conductivity transmitter
Code 2: Measuring Parameters	A	Conductivity, Salinity and TDS
Code 3: Electrode	A B C	ABS electrode Stainless steel electrode Customize
Code 4: EC Range	A B C D E	0-20000us/cm 0-10000us/cm 0-5000us/cm 0-2000us/cm Customize

Code 5: Power Supply	A B	3.9-30V DC (applicable for RS485 and 0-2V output) 12-30V DC (applicable for 4-20mA output)
Code 6: 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 7: 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: ECTDS10-ISO isolated conductivity transmitter, ABS electrode, Conductivity Range 20000us/cm, Power Supply 3.9-30V DC, Output Interface RS485, Modbus-RTU, Power and Signal Cable Length 5 meters. Ordering Code is : ECTDS10-ISO-A A A A C 005		

5 Installation Maintenance and Calibration

5.1 Installation

1/2"NPT screw threads installation. Please refer to the dimensions.

5.2 Installation Guide

Should following the common requirements for conductivity electrode installation.

5.3 Key button Function

There are 3 buttons on the transmitter board.

Button	Functionality	Comment
SW1-SET	Reset the serial communication parameters to factory default value	Factory default value: Slave Address 1,9600,N,8,1,Modbus-RTU
SW2-CALL	Short Press:Calibrate 1413us/cm Press for 3+ seconds:Restore 1413us/cm calibration value to factory default value	Immerse the electrode into 1413us/cm solution and wait until the reading value being stable, then Short Press the button to calibrate
SW3-CALH	Short Press:Calibrate 12880us/cm Press for 3+ seconds:Restore 12880us/cm calibration value to factory default value	Immerse the electrode into 12880us/cm solution and wait until the reading value being stable, then Short Press the button to calibrate

5.4 Conductivity Calibration

When performing the EC calibration, you should guarantee the temperature of the standard EC calibration solution is around 25°C. And wait for a while for temperature and EC equilibrium after immersing the sensor into the standard solution.

5.4.1 Calibrate by Key Button

1) Immerse the electrode into 1413us/cm solution and wait until the reading value being stable,then press SW2-CALL key to calibrate.
2) Immerse the electrode into 12880us/cm solution and wait until the reading value being

stable,then press SW3-CALH key to calibrate.
3) Verify the sensor output value.

5.4.2 Perform EC calibration by command

1) Immerse the electrode into 1413us/cm solution and wait until the reading value being stable,then write 0xFFFF to modbus register 0x0030(ECCALIB_1413 EC calibration point for 1413us/cm)to calibrate.
2) Immerse the electrode into 12880us/cm solution and wait until the reading value being stable,then write 0xFFFF to modbus register 0x0031(ECCALIB_12880 EC calibration point for 12880us/cm)to calibrate.
3) Verify the sensor output value.

6 Output Signal Conversion

Output Interface	Parameters Range	Conversion Formula
Analog Voltage Output 0-2V	EC range: 0-2000us/cm	EC=1000*VOLTAGE。When VOLTAGE=0.3V，then EC=1000*0.3=300us/cm
	EC range: 0-5000us/cm	EC=2500*VOLTAGE。When VOLTAGE=0.3V，then EC=2500*0.3=750us/cm。
	EC range: 0-10000us/cm	EC=5000*VOLTAGE。When VOLTAGE=0.3V，then EC=5000*0.3=1500us/cm。
	EC range: 0-20000us/cm	EC=10000*VOLTAGE。When VOLTAGE=0.3V，then EC=10000*0.3=3000us/cm。
Analog Current Output 4-20mA	EC range: 0-2000us/cm	EC= 125 *(CURRENT-4)。When CURRENT=6.4mA，则 EC= 125 *(6.4-4)=300us/cm
	EC range: 0-5000us/cm	EC= 312.50 *(CURRENT-4)。When CURRENT=6.4mA，then EC= 312.50*(6.4-4)=750us/cm
	EC range: 0-10000us/cm	EC= 625 *(CURRENT-4)。When CURRENT=6.4mA，then EC=625*(6.4-4)=1500us/cm
	EC range: 0-20000us/cm	EC= 1250 *(CURRENT-4)。When CURRENT=6.4mA，then EC=1250*(6.4-4)=3000us/cm
RS485 Modbus-RTU	EC range: All	EC=(REGISTER VALUE)。When REGISTER VALUE=1568，then EC= 1568us/cm。
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°C.	N/A
RESERVED	0x0001 /1	UINT16 RO	3/4	0	0
EC-Electrical Conductivity	0x0002 /2	UINT16 RO	3/4	0-20000 for 0-20000us/cm	N/A
SALINITY	0x0003 /3	UINT16 RO	3/4	EC*SALINITYCOFF Unit：mg/L or ppm	N/A
TDS	0x0004 /4	UINT16 RO	3/4	EC*TDSCOFF Unit：mg/L or ppm	N/A
RESERVED	0x0005 /5	UINT16 RO	3/4	0	0
RESERVED	0x0006 /6	UINT16 RO	3/4	0	0
RESERVED	0x0007 /7	UINT16 RO	3/4	0	0

ECRAWAD	0x0008 /8	UINT16 RO	3/4	0-4000	N/A
RESERVED	0x0009 /9	UINT16 RO	3/4	0	0
TEMPCOMPENSATEEN	0x0020 /32	UINT16 R/W	3/6/16	0: External Temperature Sensor 1: Onboard temperature sensor 2: Disabled	0
RESERVED	0x0021 /33	UINT16 R/W	3/6/16	N/A	0
ECTEMPCOFF	0x0022 /34	UINT16 R/W	3/6/16	0-100 for 0.0%-10.0%	20(2%)
SALINITYCOFF	0x0023 /35	UINT16 R/W	3/6/16	0-100 for 0.00-1.00	55(0.55)
TDSCOFF	0x0024 /36	UINT16 R/W	3/6/16	0-100 for 0.00-1.00	50(0.5)
ELECTRODECONSTANT	0x0025 /37	UINT16 R/W	3/6/16	500-1500 for 0.500-1.500	1000(1.000)
ECCALIB_1413 EC calibration point for 1413us/cm	0x0030 /48	UINT16 R/W	3/6/16	Immerse the electrode in 1413us/cm solution for a while and write 0xFFFF into the register to calibrate.	N/A
ECCALIB_12880 EC calibration point for 12880us/cm	0x0031 /49	UINT16 R/W	3/6/16	Immerse the electrode in 12880us/cm solution for a while and write 0xFFFF into the register to calibrate.	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 0:Modbus RTU	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°C	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°C.When REGISTER=FF05H (HEX format),then VALUE=((0xFF*256+0x05)-0xFFFF-0x01)/100 =(0xFF05-0xFFFF-0x01)/100=-2.51°C.

EC ---Electrical Conductivity		
Data Range	0-20000 For 0-20000us/cm	Default: N/A
Power Down Save	N/A	

Note:Electrical Conductivity.

Example:When REGISTER = 0x0702 (HEX format), then VALUE=(0x07*256+0x02)=1794us/cm

SALINITY--- Salinity		
Data Range	0-20000 For 0-20000mg/L or ppm	Default: N/A
Power Down Save	N/A	

Note:**SALINITY**

Example:When REGISTER = 0x0702 (HEX format), then VALUE=(0x07*256+0x02)=1794mg/L or ppm, Salinity is derived by EC, SALINITY=EC* SALINITYCOFF, in which SALINITYCOFF is a coefficient, please refer to SALINITYCOFF.

TDS---Total Dissolved Solid		
Data Range	0-20000 For 0-20000mg/L or ppm	Default: N/A
Power Down Save	N/A	

Note:Total Dissolved Solid

Example:When REGISTER = 0x0702 (HEX format), then VALUE=(0x07*256+0x02)=1794mg/L or ppm, TDS is derived by EC, TDS=EC* TDSCOFF, in which TDSCOFF is a coefficient, please refer to TDSCOFF.

ECRAWAD		
Data Range	0-32767	Default: N/A
Power Down Save	N/A	

Note: Conductivity raw AD value

Example:When REGISTER = 0x0702 (HEX format), then VALUE=(0x07*256+0x02)=1794

TEMPCOMPENSATEEN		
Data Range	0: External Temperature Sensor 1: Onboard temperature sensor 2: Disabled	0
Power Down Save	YES	

Note: Temperature compensation

ECTEMPCOFF---EC Temperature Compensation Coefficient		
Data Range	0-100 for 0.0%-10.0%	Default: 20(2%)
Power Down Save	YES	

Note:EC Temperature Compensation Coefficient

SALINITYCOFF---Salinity Coefficient		
Data Range	0-100 for 0.00-1.00	Default: 55(0.55)
Power Down Save	YES	

Note:Salinity Coefficient.

TDSCOFF---TDS Coefficient

Data Range	0-100 for 0.00-1.00	Default: 50(0.50)
Power Down Save	YES	

Note:TDS Coefficient.

ELECTRODECONSTANT		
Data Range	500-1500 for 0.500-1.500	Default: 1000(1.000)
Power Down Save	YES	

Note: Electrode constant provided by the electrode manufactor

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 0:Modbus RTU	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	Default: 0

	2:ODD	
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: Use key button to restore the serial comm parameters factory value 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, reserved, and EC.

Master Request:01 04 0000 0003 B00B

Slave Addr.	1 byte	0x01
Function Code	1 byte	0x04
Starting Register Addr.	2 byte	0x0000
Quantity of Register	2 byte	0x0003

to read		
Checksum	2 byte	0xB00B

Slave Response: 01 04 06 08 16 00 00 05 78 2B 6A

Slave Addr.	1 byte	0x01
Function Code	1 byte	0x04
Register Data Byte Count	1 byte	0x06
Register Value: Temperature	2 byte	0x08(HIGH 8 Bits)
		0x16(LOW8 Bits)
Register Value: Reserved	2 byte	0x00(HIGH 8 Bits)
		0x00(LOW8 Bits)
Register Value: EC	2 byte	0x05(HIGH 8 Bits)
		0x78(LOW8 Bits)
Checksum	2 byte	0xD257

Temperature =(0x08*256+0x 16)/100=2070/100=20.70 °C
EC=0x05*256+0x78=5*256+120 =1400 us/cm

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

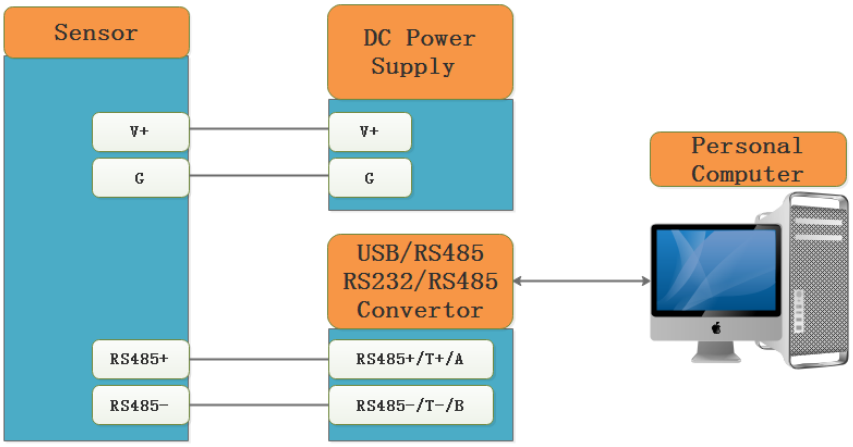
0x01	1 byte	Slave Addr.
0x10(HEX)	1 byte	Function Code 0x10
0x0200	2 byte	Starting Register Addr
0x0002	2 byte	Quantity of Register to write
0x04	1 byte	Register Data Byte Count
0x0001	2 byte	Register Value: Slave Address 1
0x0004	2 byte	Register Value: Baudrate 19200bps
0xBACC	2 byte	CRC CHECKSUM

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

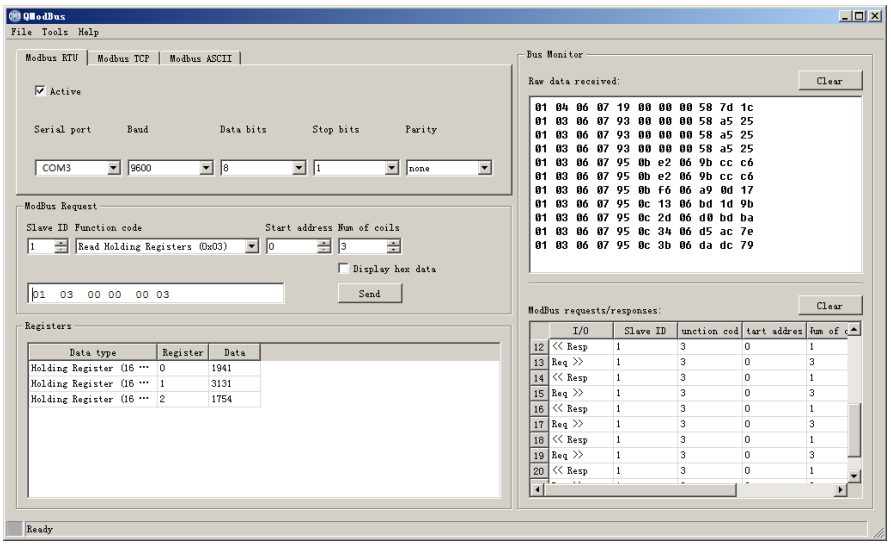
8 Software Configuration Utility

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

Copyright and Trademark

Version Control

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