DigiPHORP
Digital PH&ORP Sensor (RS485 Interface)
Digital PH&ORP Sensor (SDI-12 Interface)
User Manual

Index

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2 Introduction

DigiPHORP integrates PH and ORP electrodes and transmission circuits, and has a small size. The sensor is applicable for industrial, water processing, sewerage system, irrigation, smart agriculture etc.

The SDI-12 output provides universal compatibility with any SDI-12-enabled data logger and low power applications, or use a RS485 physical interface for applications that require long cable runs or many sensors.

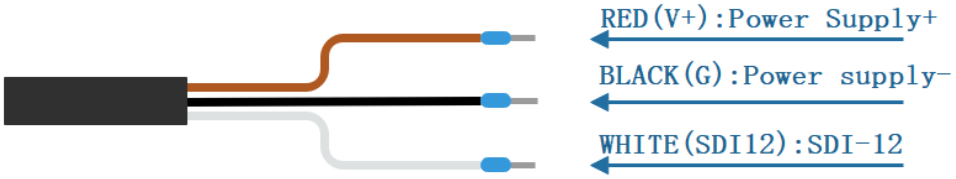
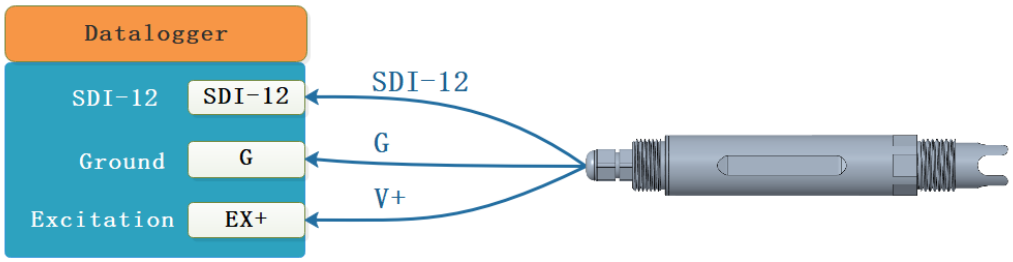
Features:

- Integrated PH and ORP electrode and transmitter circuit, IP68 protection grade
- High precision, fast response, good interchangeability
- Small in size, low power consumption
- 3/4 NPT is convenient for submersible installation or installation in pipelines and tanks
- RS485 or SDI-12 communication interface with surge protection
- Low power consumption can be used in battery-powered systems
- Reverse power protection and Built-in TVS/ESD protection
- ODM/OEM

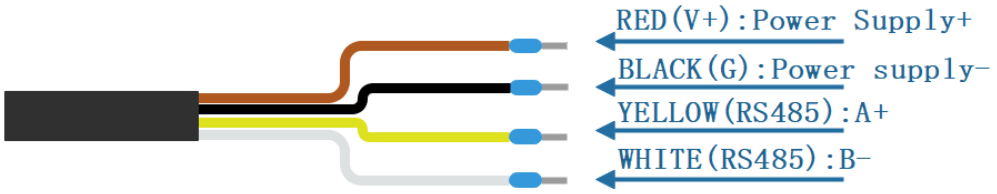
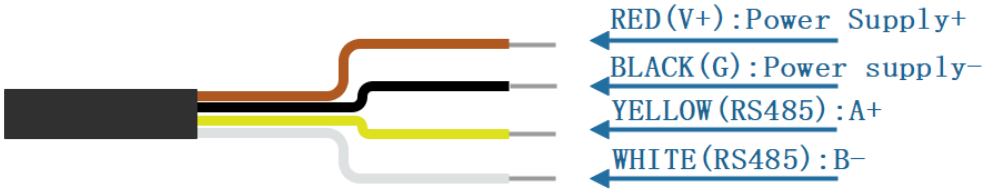
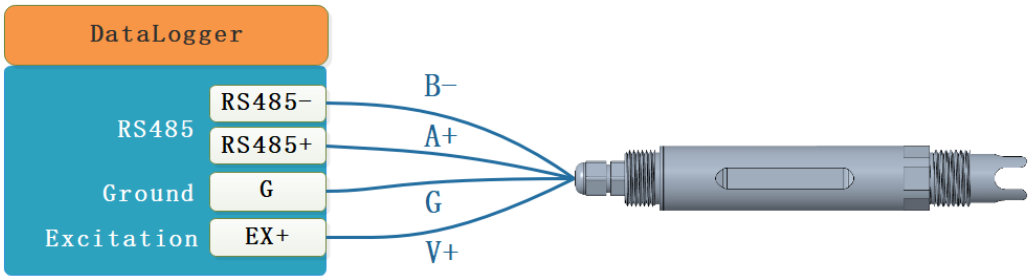
Specifications	
Output Interface	Optional: SDI-12, V1.3 Optional: RS485, Modbus-RTU
Power Supply	4.5-28V DC
Power Consumption	SDI-12 Interface: Quiescent <10uA@ 12V DC; Measuring <10mA @ 12V DC RS485 Interface: Quiescent <8mA@ 12V DC; Measuring <10mA @ 12V DC
PH	Range: 0~14PH, Resolution: 0.01PH, Accuracy: +/-0.1PH; Response Time < 10 s
ORP	Range: -2000.0~2000.0mV, Resolution: 0.1mV, Accuracy: +/-20mV; Response Time < 30 s
Temperature	Range: -40~80°C, Resolution: 0.1°C, Accuracy: +/-0.5°C
IP Ratings	IP68
Operating	Temperature: 0~80°C, Humidity: 0~100%, Pressure: ≤0.2 MPa
Storage	Temperature: -5~65°C, Humidity: 0~90%
Cable Length	2 meters or Customize
Dimension	207*30 mm (Length*Diameter), 3/4 NPT screw threads

3 Wiring diagrams

3.1 SDI-12 Interface

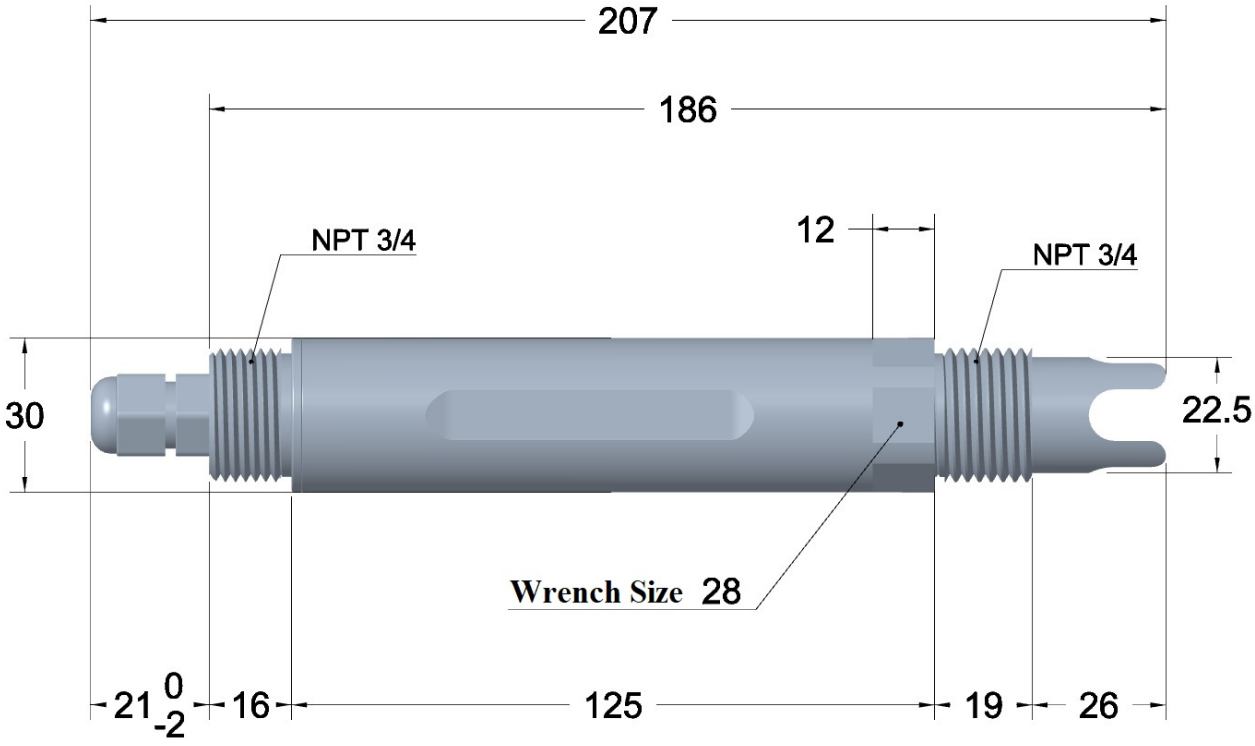
Type	Wiring diagram
SDI-12 Interface	Cold pressed terminal  Tinned lead wires 
Connections	Wiring Diagram 

3.2 RS485 Interface

Type	Wiring diagram
RS485 Interface	Cold pressed terminal  Tinned lead wires 
Connections	Wiring Diagram 

4 Dimension and Ordering Information

4.1 Dimension



Unit: mm Tolerance: ±0.5mm

4.2 Ordering Infomation

Ordering Information		
Parameters	**Code**	**Comments**
Code 1: Product Series	DigiPHORP	DigiPHORP Sensor
Code 2: Shell Material	A	ABS+PC
Code 3: Electrode Type	A	PH and ORP Electrode (Built-in Temperature Compensation Sensor)
Code 4: Power Supply	C	4.5-28V DC
Code 5: Output Interface	C F	RS485, Modbus-RTU SDI-12
Code 6: Cable Length	002 XXX	2 meters xxx meters
Ordering Code Example: DigiPHORP - A A C C 002 Product Series: DigiPHORP Sensor Shell Material: ABS+PC Electrode Type: PH and ORP Electrode (Built-in Temperature Compensation Sensor) Power Supply: 4.5-28V DC Output Interface: RS485, Modbus-RTU Cable Length: 2 meters		

5 Installation & Maintenance

5.1 PH Electrode Maintenance

Important Note: Typical lifespan is 1-2 years; replace more frequently under harsh conditions.

Installation Notes:

(1) Avoid damaging the membrane: Handle gently during installation. Do not touch the glass/antimony membrane at the electrode tip.

(2) Maintain vertical positioning: Tilting may cause uneven reference electrolyte diffusion, reducing accuracy.

(3) Ensure proper hydration: Soak new or dried electrodes in 3M KCl for 24 hours before use.

Operational Guidelines:

(1) Avoid extreme conditions: Prolonged exposure to pH <2 or >12 solutions accelerates aging. Temperatures >80°C may crack the glass membrane.

(2) Prevent reference contamination: Rinse with deionized water after measuring proteins, sulfides, or organic solvents.

(3) Regular calibration: Calibrate monthly with pH buffers (daily for high-precision applications).

Cleaning procedures:

(1) Protein fouling: Soak in 0.1M HCl + pepsin solution for 30 mins.

(2) Inorganic deposits: Clean with 0.1M EDTA solution.

Proper storage:

(1) Short-term: Store in 3M KCl solution.

(2) Long-term: Use a dry storage cap to prevent electrolyte crystallization.

Troubleshooting:

Issue	Solution
Slow response	Check for fouling or aging
Drifting readings	replace electrode
Calibration failure	Clean membrane & check buffer expiry

5.2 ORP Electrode Maintenance

Important Note: Typical lifespan is 1-3 years (replace annually in harsh environments like industrial wastewater).

Installation Notes:

(3) Avoid physical impact: Handle gently during installation. Do not touch the platinum/gold sensing surface.
(4) Maintain vertical positioning: Tilting may cause uneven reference electrolyte diffusion.
(3) Initial activation: Soak new electrodes in ORP standard solution (e.g., ZoBell solution) for 30 minutes before first use.

Operational Guidelines:

(4) Avoid corrosive media: Rinse immediately with deionized water after measuring sulfides, cyanides, or strong oxidizers.
(5) Prevent reference contamination: Regularly check the electrolyte filling port for crystallization or leakage.
(6) Monthly verification: Validate electrode response with ORP standard solution (+258mV @25°C). Clean or replace if deviation exceeds ±30mV.

Cleaning procedures:

(3) Organic fouling: Soak in 0.1M HCl for 5 minutes.
(4) Sulfide contamination: Clean with 10% thiourea solution.

Proper storage:

(3) Short-term: Store in 3M KCl solution.
(4) Long-term: Use a dry storage cap to prevent electrolyte crystallization.

Troubleshooting:

Issue	Solution
Slow response	Clean sensing surface with specialized solution
Drifting readings	Check temperature compensation or replace electrode
Calibration failure	Replace ORP standard solution and verify slope

6 SDI-12 Communication

The sensor has SDI-12 interface and protocol. The description and terms used within this chapter are listed in table below:

Parameters	Unit	Description
±	-	Sign of the value
a	-	SDI-12 address
n	-	Number of measurements (fixed width of 1)
nn	-	Number of measurements with leading zero if necessary (fixed width of 2)
ttt	Seconds	Maximum measurement time (fixed width of 3)
tttt	Seconds	Maximum measurement time (fixed width of 4)
<TAB>	-	Tab character
<SAPCE>	-	Space character
<CR>	-	Carriage return character
<LF>	-	Line feed character
<Checksum>	-	SUM Checksum
<CRC_ADI>		ADI protocol CRC Checksum
<CRC>	-	SDI-12 protocol CRC Checksum
<VERIFY_STATUS>	-	Sensor Verification status
<±Temperature>	℃ ℉	Temperature Original, the value is output according to the temperature unit setting.
<±TemperatureCalibed>	℃ ℉	Temperature Calibed, the value is output according to the temperature unit setting.
<±TOffset>	℃ ℉	Temperature Offset, the value is output according to the temperature unit setting. <±TemperatureCalibed> = <±Temperature> + <±TOffset>
<TemperatureUnit>	-	Temperature Unit, Range: C: ℃ F: ℉
<±PH>	-	PH Value(Temperature Compensation)
<±PHTx>	-	PH Value(No Temperature Compensation)
<±PHVolt>	mV	The millivolt value corresponding to PH value (Temperature Compensation)
<±PHVoltTx>	mV	The millivolt value corresponding to PH value (No Temperature Compensation)
<±ORP>	-	ORP Value(Temperature Compensation)
<±ORPTx>	-	ORP Value(No Temperature Compensation)
<±ORPVolt>	mV	The millivolt value corresponding to ORP value (Temperature Compensation)
<±ORPVoltTx>	mV	The millivolt value corresponding to ORP value (No

		Temperature Compensation)
<TemperatureCompensateEn>	-	PH Temperature Compensation Enable/Disable: Range: 0: Enable PH temperature compensation (to 25℃); 1: Disable PH temperature compensation;
<SensorType>	-	Sensor Type, Range: 2: PH and ORP
<PHCalibGroup>	-	PH Calibrate Group, Range: 0: Group 0, use PH=4.00, 7.00, 10.01 for PH calibration and subsequent PH calculation. 1: Group 1, use PH=4.00, 6.86, 9.18 for PH calibration and subsequent PH calculation.
<PHCalibPointIndex>	-	PH Calibration Point, Range: When <PHCalibGroup>=0: 0: Calibrate with PH=4.00 Standard Buffer Solution; 1: Calibrate with PH=7.00 Standard Buffer Solution; 2: Calibrate with PH=10.01 Standard Buffer Solution; When <PHCalibGroup>=1: 0: Calibrate with PH=4.00 Standard Buffer Solution; 1: Calibrate with PH=6.86 Standard Buffer Solution; 2: Calibrate with PH=9.18 Standard Buffer Solution;
<PHElectrodeMilliVolt>	mV	The milli-voltage output of PH electrode in PH standard buffer solution
<ORPTCompCoef>	mV/℃	ORP Temperature Compensation Coefficient. Range: 0.00~1.00
<ORPStandardMV>	mV	The nominal milli-voltage value of ORP standard buffer solution
<ORPMeasuredMV>	mV	The milli-voltage output of ORP electrode in ORP standard buffer solution

The following error value will be responded as measurement value when there is error:

Error Value	Description
-9999	Sensor Broken
-9996	Not supported value (Invalid Value)

6.1 SDI-12 Interface

Please refer to SDI-12 standard user manual V1.3.

6.2 Protocol

Request	Response	Comment
a!	a<CR><LF>	**Acknowledge Active** a: Sensor address **Example:** Request: 0! Response: 0<CR><LF>
aI!	allccccccccmmmmmmvvvxxxxxxxxxxxxx<CR><LF>	**Send Identification** a: Sensor address ll: SDI-12 Version Number cccccccc: 8 characters' vendor identification mmmmmm: 6 characters specifying the sensor model number vvv: 3 characters specifying the sensor version xxxxxxxxxxxxx: 13 characters' serial number <CR><LF>: terminates the response **Example:** Request: 0I! Response:013INFWIN DigiPO3.02507230000002<CR><LF>
?!	a<CR><LF>	**Sensor Address Query** a: Sensor address **Example:** Request: ?! Response: 0<CR><LF>
aAb!	b<CR><LF>	**Change Sensor address** a: Current Sensor address

		b: New Sensor address **Example:** Request: 0A1! Response: 1<CR><LF>
aM!, aMC! aM1!, aMC1!	a0013<CR><LF> a: Sensor address 001: Measurement data will be ready in 001 seconds 3: Number of measurement data returned by aD0! <CR><LF>: terminates the response aD0! Response data format: a<±PH><±ORP><±TemperatureCalibed>[<CRC>]<CR><LF>	**PH Value(Temperature Compensation), ORP Value(Temperature Compensation) and Temperature Calibed Measurement** **Example:** Request: 0M! Response: 00013<CR><LF> Response: 0<CR><LF> Request: 0D0! Response: 0+8.87+256.1+20.61<CR><LF>
aM2!,aMC2!	a0014<CR><LF> a: Sensor address 001: Measurement data will be ready in ttt seconds 4: Number of measurement data returned by aD0! <CR><LF>: terminates the response aD0! Response data format: a<+SensorType><±PH><±ORP><±TemperatureCalibed>[<CRC>]<CR><LF> Note: <SensorType>=2 indicates that the sensor is PH and ORP.	**Sensor Type, PH Value(Temperature Compensation), ORP Value(Temperature Compensation) and Temperature Calibed Measurement** **Example :** Request: 0M2! Response: 00014<CR><LF> Response: 0<CR><LF> Request: 0D0! Response: 0+2+8.92+256.1+19.76<CR><LF>
aM3!, aMC3!	a0015<CR><LF> a: Sensor address 001: Measurement data will be ready in 001 seconds 5: Number of measurement data	**PH Value(Temperature Compensation), ORP Value(Temperature Compensation), Temperature Calibed, Millivolt value corresponding to PH value (Temperature Compensation), Millivolt value corresponding to ORP value (Temperature**

	returned by aD0! <CR><LF>: terminates the response aD0! Response data format: a<±PH><±ORP><±TemperatureCalibed><±PHVolt><±ORPVolt>[<CRC>]<CR><LF>	**Compensation) Measurement** **Example:** Request: 0M3! Response: 00015<CR><LF> Response: 0<CR><LF> Request: 0D0! Response: 0+7.03+256.1+23.51-1.9+256.1<CR><LF>
aM4!, aMC4!	a0015<CR><LF> a: Sensor address 001: Measurement data will be ready in 001 seconds 5: Number of measurement data returned by aD0! <CR><LF>: terminates the response aD0! Response data format: a<±PHTx><±ORPTx><±TemperatureCalibed><±PHVoltTx><±ORPVoltTx> [<CRC>]<CR><LF>	**PH Value(No Temperature Compensation), ORP Value(No Temperature Compensation), Temperature Calibed, Millivolt value corresponding to PH value (No Temperature Compensation), Millivolt value corresponding to ORP value (No Temperature Compensation) Measurement** **Example:** Request: 0M4! Response: 00015<CR><LF> Response: 0<CR><LF> Request: 0D0! Response: 0+7.03+256.1+23.51-1.9+256.1<CR><LF>
aM5!, aMC5!	a0012<CR><LF> a: Sensor address 001: Measurement data will be ready in 001 seconds 2: Number of measurement data returned by aD0! <CR><LF>: terminates the response aD0! Response data format: a<±TemperatureCalibed><±Temperature>[<CRC>]<CR><LF>	**Temperature Calibed and Temperature Original Measurement** **Example (<±TOffset>=0.00):** Request: 0M5! Response: 00012<CR><LF> Response: 0<CR><LF> Request: 0D0! Response: 0+23.53+23.53<CR><LF>
aC!,aCC! aC1!,aCC1! aC2!,aCC2! aC3!,aCC3!	This command set has the same data format as aM!, aMC!, aMx!, aMCx! (x=1-9), refer to the corresponding command.	This command set has the same data format as aM!, aMC!, aMx!, aMCx! (x=1-9), refer to the corresponding command.

aC4!,aCC4! aC5!,aCC5! aC6!,aCC6! aC7!,aCC7! aC8!,aCC8! aC9!,aCC9!		The only difference is that data response has no SDI-12 service request output compared to aM!, aMC!, aMx!, aMCx! Command.
aV!	a0011<CR><LF> a: Sensor address 001: Measurement data will be ready in 001 seconds 1:Number of measurement data <CR><LF>: terminates the response aD0! Response data format: a<VERIFY_STATUS><CR><LF>	**Sensor Verification Command** **Example:** Request: 0V! Response: 00011<CR><LF> Response: 0<CR><LF> Request: 0D0! Response: 0+0<CR><LF> "+0" indicates sensor normal. "None-Zero" indicates sensor error.
aD0! aD1! aD2!	[<svvvv><svvvv><svvvv>…][<CRC>]<CR><LF> [<svvvv>]: data value [<CRC>]: Optional 3 characters CRC checksum, <CR><LF>:terminates the response	Send Data since the last aM, aMC, aC, aCC, aV command, The data returned depends on the command sent most recently.
aR0!, aRC0! aR1!, aRC1!	Response data format: a<±PH><±ORP><±TemperatureCalibed>[<CRC>]<CR><LF>	**PH Value(Temperature Compensation), ORP Value(Temperature Compensation) and Temperature Calibed Measurement** **Example:** Request: 0R0! or 0R1! Response: 0+8.87+256.1+20.61<CR><LF>
aR2!,aRC2!	Response data format: a<+SensorType><±PH><±ORP><±TemperatureCalibed>[<CRC>]<CR><LF> Note: <SensorType>=2 indicates that the sensor is PH and ORP.	**Sensor Type, PH Value(Temperature Compensation), ORP Value(Temperature Compensation) and Temperature Calibed Measurement** **Example :** Request: 0R2!

		Response: 0+2+8.92+256.1+19.76<CR><LF>
aR3!, aRC3!	Response data format: a<±PH><±ORP><±TemperatureCalibed><±PHVolt><±ORPVolt>[<CRC>]<CR><LF>	**PH Value(Temperature Compensation), ORP Value(Temperature Compensation), Temperature Calibed, Millivolt value corresponding to PH value (Temperature Compensation), Millivolt value corresponding to ORP value (Temperature Compensation) Measurement** **Example:** Request: 0R3! Response: 0+7.03+256.1+23.51-1.9+256.1<CR><LF>
aR4!, aRC4!	Response data format: a<±PHTx><±ORPTx><±TemperatureCalibed><±PHVoltTx><±ORPVoltTx> [<CRC>]<CR><LF>	**PH Value(No Temperature Compensation), ORP Value(No Temperature Compensation), Temperature Calibed, Millivolt value corresponding to PH value (No Temperature Compensation), Millivolt value corresponding to ORP value (No Temperature Compensation) Measurement** **Example:** Request: 0R4! Response: 0+7.03+256.1+23.51-1.9+256.1<CR><LF>
aR5!, aRC5!	Response data format: a<±TemperatureCalibed><±Temperature>[<CRC>]<CR><LF>	**Temperature Calibed and Temperature Original Measurement** **Example (<±TOffset>=0.00):** Request: 0R5! Response: 0+23.53+23.53<CR><LF>
aXR_TUNIT!	aTUNIT=<TemperatureUnit> <TemperatureUnit> is temperature unit: C: degrees centigrade F: degrees fahrenheit	**Query temperature unit** **Example:** Request: 0XR_TUNIT! Response: 0TUNIT=C<CR><LF>
aXW_TUNIT_<TemperatureUnit>!	aTUNIT=<TemperatureUnit>	**Configure temperature unit** **Example:** Request: 0XW_TUNIT_C!

		Response: 0TUNIT=C<CR><LF>
aXR_TOFFSET!	aTOFFSET=<±TOffset> <±TOffset>: temperature offset value between -10.00~10.00, it will be effective when issuing a new measurement command.	**Query temperature offset value** **Example:** Request: 0XR_TOFFSET! Response: 0TOFFSET=+1.00<CR><LF>
aXW_TOFFSET_<±TOffset>!	aTOFFSET=<±TOffset>	**Configure temperature offset value** **Example:** Request: 0XW_TOFFSET_+1.00! Response: 0TOFFSET=+1.00<CR><LF>
aXR_SN!	aSN=<ssssssss> <ssssssss> is 8-digits serial number	**Query serial number** **Example:** Request: 0XR_SN! Response: 0SN=12345678<CR><LF>
aXW_SN_<ssssssss>!	aSN=<ssssssss>	**Configure serial number** **Example:** Request: 0XW_SN_ABCDEFGH! Response: 0SN=ABCDEFGH <CR><LF>
aXR_TCOMPEN!	aTCOMPEN=<TemperatureCompensateEn><CR><LF> <TemperatureCompensateEn>: PH Temperature Compensation Enable/Disable, Range: 0: Enable PH temperature compensation (to 25℃); 1: Disable PH temperature compensation;	**Query PH Temperature Compensation Enable/Disable** **Example:** Request: 0XR_TCOMPEN! Response: 0TCOMPEN=0<CR><LF>
aXW_TCOMPEN_<TemperatureCompensateEn>!	aTCOMPEN=<TemperatureCompensateEn><CR><LF>	**Configure PH Temperature Compensation Enable/Disable** **Example:** Request: 0XW_TCOMPEN_0! Response: 0TCOMPEN=0<CR><LF>
aXW_PHCALGROUP_<PHCalibGroup>!	aPHCALGROUP=<PHCalibGroup><CR><LF> <PHCalibGroup>:PH Calibrate	**Configure current PH calibration group** **Example:** Request: 0XW_PHCALGROUP_0!

	Group, Range: 0: Calibration Group 0, use PH=4.00, 7.00, 10.01 for PH calibration and subsequent PH calculation. 1: Calibration Group 1, use PH=4.00, 6.86, 9.18 for PH calibration and subsequent PH calculation.	Response: 0PHCALGROUP=0<CR><LF>
aXR_PHCALGROUP!	aPHCALGROUP=<PHCalibGroup><CR><LF>	**Query current PH calibration group** **Example:** Request: 0XR_PHCALGROUP! Response: 0PHCALGROUP=0<CR><LF>
aXW_PHCAL<PHCalibPointIndex>!	aPHCAL<PHCalibPointIndex>=<PHElectrodeMilliVolt><CR><LF> <PHCalibPointIndex>: PH Calibration Point, Range: When <PHCalibGroup>=0: 0: Calibrate with PH=4.00 Standard Buffer Solution; 1: Calibrate with PH=7.00 Standard Buffer Solution; 2: Calibrate with PH=10.01 Standard Buffer Solution; When <PHCalibGroup>=1: 0: Calibrate with PH=4.00 Standard Buffer Solution; 1: Calibrate with PH=6.86 Standard Buffer Solution; 2: Calibrate with PH=9.18 Standard Buffer Solution; <PHElectrodeMilliVolt>:The milli-voltage output of PH electrode in PH standard buffer solution.	**Calibrate the sensor in the PH standard buffer solution of the current calibration group (<PHCalibGroup>)** **Example1: When <PHCalibGroup>=0, use PH=4.00, 7.00, 10.01 for PH calibration and subsequent PH calculation.** Use PH=4.00 standard buffer solution: Request: 0XW_PHCAL0! Response: 0PHCAL0=-177.6<CR><LF> Use PH=7.00 standard buffer solution: Request: 0XW_PHCAL1! Response: 0PHCAL0=0<CR><LF> Use PH=10.01 standard buffer solution: Request: 0XW_PHCAL2! Response: 0PHCAL0=-177.6<CR><LF> **Example2: When <PHCalibGroup>=1, use PH=4.00, 6.86, 9.18 for PH calibration and subsequent PH calculation.** Use PH=4.00 standard buffer solution:

		Request: 0XW_PHCAL0! Response: 0PHCAL0=-177.6<CR><LF> Use PH=6.86 standard buffer solution: Request: 0XW_PHCAL1! Response: 0PHCAL0=8.3<CR><LF> Use PH=9.18 standard buffer solution: Request: 0XW_PHCAL2! Response: 0PHCAL2=-129.0<CR><LF>
aXR_PHCAL<PHCalibPointIndex>!	aPHCAL<PHCalibPointIndex>=<PHElectrodeMilliVolt><CR><LF>	**Query the PH calibration data of the current calibration group (<PHCalibGroup>)** **Example:** Request: 0XR_PHCAL0! Response: 0PHCAL0=-177.6<CR><LF> Request: 0XR_PHCAL1! Response: 0PHCAL1=0<CR><LF> Request: 0XR_PHCAL2! Response: 0PHCAL2=-177.6<CR><LF>
aXW_RESETCALIBPH!	aRESETCALIBPH=0<CR><LF> Reset the PH calibration data of Calibration Group 0 and 1 to the factory default value.	**Reset PH calibration to factory default value** **Example:** Request: 0XW_RESETCALIBPH! Response: 0RESETCALIBPH=0<CR><LF>
aXW_ORPCAL_<ORPStandardMV>!	aORPCAL=<ORPStandardMV>,<ORPMeasuredMV><CR><LF> <ORPStandardMV>:The nominal milli-voltage value of ORP standard buffer solution. <ORPMeasuredMV>:The milli-voltage output of ORP electrode in ORP standard buffer solution.	**Calibrate in ORP standard buffer solution** **Example:** Request: 0XW_ORPCAL_420! Response: 0ORPCAL=420,400<CR><LF>
aXR_ORPCAL!	aORPCAL=<ORPStandardMV>,<ORPMeasuredMV><CR><LF>	**Query the ORP calibration data** **Example:** Request: 0XR_ORPCAL!

		Response: 0ORPCAL=420,400<CR><LF>
aXR_ORPTCOMPCOEF!	aORPTCOMPCOEF=<ORPTCompCoef > <ORPTCompCoef>: ORP Temperature Compensation Coefficient, Range: 0.00-1.00	**Query ORP Temperature Compensation Coefficient.** **Example:** Request: 0XR_ORPTCOMPCOEF! Response: 0ORPTCOMPCOEF=+0.20<CR><LF>
aXW_ORPTCOMPCOEF_<ORPTCompCoef>!	aORPTCOMPCOEF=<ORPTCompCoef>	**Configure ORP Temperature Compensation Coefficient.** **Example:** Request: 0XW_ORPTCOMPCOEF_+0.20! Response: 0ORPTCOMPCOEF=+0.20<CR><LF>
aXW_RESETCALIBORP!	aRESETCALIBORP=0<CR><LF> Reset the ORP calibration data to the factory default value.	**Reset ORP calibration to factory default value** **Example:** Request: 0XW_RESETCALIBORP! Response: 0RESETCALIBORP=0<CR><LF>
aXW_RESETSYSTEM!	aRESETSYSTEM=0<CR><LF>	**Restart the sensor (equivalent to powering on)** **Example:** Request: 0XW_RESETSYSTEM! Response: 0 RESETSYSTEM=0<CR><LF>

7 RS485 Communication

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 effect after the sensor is powered on again.

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 (HEX/DEC)	Data Type	Modbus Function	Range and Comments	Default Value
Temperature Calibed TEMPERATURE_CALIBED	0x0000 /0	INT16 RO	3/4	-4000-8000 mapping to -40.00-80.00 (℃); -4000-17600 mapping to -40.00-176.00 (℉)	N/A
PH (Temperature Compensation) PH	0x0001 /1	INT16 RO	3/4	0-1400 mapping to 0.00-14.00	N/A
ORP (Temperature Compensation) ORP	0x0002 /2	INT16 RO	3/4	-20000~20000 mapping to -2000.0~2000.0mV	N/A
The millivolt value corresponding to PH value (Temperature	0x0003 /3	INT16 RO	3/4	-20000~20000 mapping to -2000.0~2000.0mV	N/A

Compensation) PH_VOLT					
PH Value(No Temperature Compensation) PH_TX	0x0004 /4	INT16 RO	3/4	0-1400 mapping to 0.00-14.00	N/A
The millivolt value corresponding to PH value (No Temperature Compensation) PH_VOLT_TX	0x0005 /5	INT16 RO	3/4	-20000~20000 mapping to -2000.0~2000.0mV	N/A
The millivolt value corresponding to ORP value (Temperature Compensation) ORP_VOLT	0x0006 /6	INT16 RO	3/4	-20000~20000 mapping to -2000.0~2000.0mV	N/A
ORP Value(No Temperature Compensation) ORP_TX	0x0007 /7	INT16 RO	3/4	-20000~20000 mapping to -2000.0~2000.0mV	N/A
The millivolt value corresponding to ORP value (No Temperature Compensation) ORP_VOLT_TX	0x0008 /8	INT16 RO	3/4	-20000~20000 mapping to -2000.0~2000.0mV	N/A
Temperature Original TEMPERATURE	0x0009 /9	INT16 RO	3/4	-4000-8000 mapping to -40.00-80.00 (℃); -4000-17600 mapping to -40.00-176.00 (℉)	N/A
Reserved RESERVED	0x000A /10	INT16 RO	3/4	Reserved	0
Reserved RESERVED	0x000B /11	INT16 RO	3/4	Reserved	0
Reserved RESERVED	0x000C /12	INT16 RO	3/4	Reserved	0
Reserved RESERVED	0x000D /13	INT16 RO	3/4	Reserved	0

Reserved RESERVED	0x000E /14	INT16 RO	3/4	Reserved	0
Reserved RESERVED	0x000F /15	INT16 RO	3/4	Reserved	0
Temperature Unit TEMPUNIT	0x0020 /32	UINT16 R/W	3/6/16	0:℃ 1:℉	0
Temperature Offset TOFFSET	0x0021 /33	INT16 R/W	3/6/16	-1000～1000 mapping to -10.00～10.00	0
PH Temperature Compensation Enable/Disable TEMPCOMPENSATEEN	0x0022 /34	UINT16 R/W	3/6/16	0: Enable PH temperature compensation (to 25℃); 1: Disable PH temperature compensation;	0
Floating Point Register Byte Order FLOATBYTEORDER	0x0023 /35	UINT16 R/W	3/6/16	Configure floating point register byte order. 0: Big-endian [ABCD] 1: Little-endian[DCBA] 2: Big-endian byte swap [BADC] 3: Little-endian byte swap[CDAB]	3
PH&ORP Value Filter Strength FILTERSTRENGTH	0x0024 /36	UINT16 R/W	3/6/16	PH&ORP Value Filter Strength. The larger the value, the more stable the data. 0-15, 0 is disabled.	2
PH User Calib Point 0 PHUSERCALIB0	0x0030 /48	INT16 R/W	3/6/16	Write 0x7FFF for automatic calibration. During automatic calibration: ● When the PHCALIBGROUP register is 0, calibrate using a standard solution with PH=4.00; ● When the PHCALIBGROUP register is 1, calibrate using a standard solution with PH=4.00.	N/A
PH User Calib Point 1 PHUSERCALIB1	0x0031 /49	INT16 R/W	3/6/16	Write 0x7FFF for automatic calibration. During automatic	N/A

				calibration: ● When the PHCALIBGROUP register is 0, calibrate using a standard solution with PH=7.00; ● When the PHCALIBGROUP register is 1, calibrate using a standard solution with PH=6.86;	
PH User Calib Point 2 PHUSERCALIB2	0x0032 /50	INT16 R/W	3/6/16	Write 0x7FFF for automatic calibration. During automatic calibration: ● When the PHCALIBGROUP register is 0, calibrate using a standard solution with PH=10.01; ● When the PHCALIBGROUP register is 1, calibrate using a standard solution with PH=9.18;	N/A
PH Calib Group PHCALIBGROUP	0x0033 /51	UINT16 R/W	3/6/16	Set calibration group for user calibration: 0: Use PH standard solutions 4.00, 7.00, and 10.01 for user calibration; 1: Use PH standard solutions 4.00, 6.86, and 9.18 for user calibration	0
ORP Temperature Compensation Coefficient ORPTCOMPCOEF	0x0040 /64	INT16 R/W	3/6/16	ORP Temperature Compensation Coefficient. Range: 000~100 mapping to 0.00~1.00mV/℃	20
The nominal millivolt value of the ORP standard solution ORPSTANDARDMV	0x0041 /65	INT16 R/W	3/6/16	Range: -2000 to 2000 When calibrating the ORP electrode, the written data is the nominal millivolt value of the standard solution used. The read data is the nominal millivolt value of the standard solution used in	256

				the last calibration of the ORP electrode	
The millivolt value output by the ORP electrode in the standard solution ORPMEASUREDMV	0x0042 /66	INT16 RO	3/6/16	The read data represents the millivolt value output by the ORP electrode in the standard solution during the last calibration	256
Reset PH calibration to the factory Settings RESETCALIB	0x0050 /80	UINT16 R/W	3/6/16	The read value is 0. Write 0: Reset the calibration data of PH calibration group 0 and PH calibration group 1 to factory Settings. Write 1: Reset the ORP calibration data to the factory Settings. Write 0xFFFF: Reset PH and ORP calibration data.	N/A
Restart the sensor SYSTEMRESET	0x0051 /81	UINT16 R/W	3/6/16	The read value is 0; Writing 0xFFFF to restart the sensor (equivalent to repowering on).	N/A
Modbus Slave Address ADDRESS	0x0200 /512	UINT16 R/W	3/6/16	0-255	1
RS485 baudrate BAUDRATE	0x0201 /513	UINT16 R/W	3/6/16	0-5 0: 1200bps 1: 2400bps 2: 4800bps 3: 9600bps 4: 19200bps 5: 38400bps	3: 9600bps
RS485 Protocol PROTOCOL	0x0202 /514	UINT16 R/W	3/6/16	0 0: Modbus RTU	0: Modbus

					RTU
RS485 parity PARITY	0x0203 /515	UINT16 R/W	3/6/16	0-2 0: NONE 1: EVEN 2: ODD	0: NONE
RS485 data bits DATABITS	0x0204 /516	UINT16 R/W	3/6/16	1 1: 8 bits	1: 8 bits
RS485 Stopbits STOPBITS	0x0205 /517	UINT16 R/W	3/6/16	0-1 0: 1 stopbit 1: 2 stopbits	0: 1 stopbit
Reserved RESERVED	0x0206 /518	UINT16 R/W	3/6/16	Reserved	0
Reserved RESERVED	0x0207 /519	UINT16 R/W	3/6/16	Reserved	0
User Defined Serial Number USERSN	0x0220 /544 0x0221 /545 0x0222 /546 0x0223 /547	UINT16 R/W	3/16	0x0000000000000000- 0xFFFFFFFFFFFFFFFF Those four registers should be read/write in one command.	N/A
Temperature Calibed TEMPERATURE_CALIBED_FLOAT	0x1000 /4096	FLOAT RO	3/4	-40.00-80.00 (℃); -40.00-176.00 (℉)	N/A
PH (Temperature Compensation) PH_FLOAT	0x1002 /4098	FLOAT RO	3/4	0.00-14.00	N/A
ORP (Temperature Compensation) ORP_FLOAT	0x1004 /4100	FLOAT RO	3/4	-2000.0~2000.0mV	N/A
The millivolt value corresponding to PH value (Temperature Compensation) PH_VOLT_FLOAT	0x1006 /4102	FLOAT RO	3/4	-2000.0~2000.0mV	N/A
PH Value(No Temperature	0x1008 /4104	FLOAT RO	3/4	0.00-14.00	N/A

Compensation) PH_TX_FLOAT					
The millivolt value corresponding to PH value (No Temperature Compensation) PH_VOLT_TX_FLOAT	0x100A /4106	FLOAT RO	3/4	-2000.0~2000.0mV	N/A
The millivolt value corresponding to ORP value (Temperature Compensation) ORP_VOLT_FLOAT	0x100C /4108	FLOAT RO	3/4	-2000.0~2000.0mV	N/A
ORP Value(No Temperature Compensation) ORP_TX_FLOAT	0x100E /4110	FLOAT RO	3/4	-2000.0~2000.0mV	N/A
The millivolt value corresponding to ORP value (No Temperature Compensation) ORP_VOLT_TX_FLOAT	0x1010 /4112	FLOAT RO	3/4	-2000.0~2000.0mV	N/A
Temperature Original TEMPERATURE_FLOAT	0x1012 /4114	FLOAT RO	3/4	-40.00-80.00 (℃); -40.00-176.00 (℉)	N/A
Reserved RESERVED_FLOAT	0x1014 /4116	FLOAT RO	3/4	Reserved	0
Reserved RESERVED_FLOAT	0x1016 /4118	FLOAT RO	3/4	Reserved	0
Reserved RESERVED_FLOAT	0x1018 /4120	FLOAT RO	3/4	Reserved	0
Reserved RESERVED_FLOAT	0x101A /4122	FLOAT RO	3/4	Reserved	0
Reserved RESERVED_FLOAT	0x101C /4124	FLOAT RO	3/4	Reserved	0

Reserved RESERVED_FLOAT	0x101E /4126	FLOAT RO	3/4	Reserved	0

UINT16:16 bit unsigned integer

INT16:16bit signed integer

RO: Register is Read Only

R/W: Register is Read/Write

HEX: Hexadecimal (data with 0x/0X prefix)

DEC: Decimal

FLOAT: Floating point register, the byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register. Please refer to “Modbus Register Detail Descripton” for more details.

The register value will be set as following when there is sensor error:

Error Value	Register Address	Error
-32768	Measurement Value	sensor broken
-32765	Measurement Value	Not supported value (Invalid Value)

7.3 Modbus Register Detail Description

TEMPERATURE_CALIBED: Temperature Calibed, INT16		
Range	-4000-8000 mapping to -40.00-80.00 (Temperature Unit set to ℃); -4000-17600 mapping to -40.00-176.00 (Temperature Unit set to ℉)	Default: N/A
Parameter Save	N/A	

Note: Temperature measurement value calibrated by TOFFSET register.

TEMPERATURE_CALIBED_FLOAT: Temperature Calibed, FLOAT		
Range	-40.00-80.00 (Temperature Unit set to ℃); -40.00-176.00 (Temperature Unit set to ℉)	Default: N/A
Parameter Save	N/A	

Note: Temperature measurement value calibrated by TOFFSET register. The byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register.

TEMPERATURE: Temperature Original Value, INT16		
Range	-4000-8000 mapping to -40.00-80.00 (Temperature Unit set to ℃); -4000-17600 mapping to -40.00-176.00 (Temperature Unit set to ℉)	Default: N/A
Parameter Save	N/A	

Note: Temperature original value.

TEMPERATURE_FLOAT: Temperature Original Value, FLOAT		
Range	-40.00-80.00 (Temperature Unit set to ℃); -40.00-176.00 (Temperature Unit set to ℉)	Default: N/A
Parameter Save	N/A	

Note: Temperature original value. The byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register.

PH: PH (Temperature Compensation) , INT16		
Range	0-1400 mapping to 0.00-14.00	Default: N/A
Parameter Save	N/A	

Note: PH (Temperature Compensation to 25℃).

PH_FLOAT: PH (Temperature Compensation), FLOAT		
Range	0.00-14.00	Default: N/A
Parameter Save	N/A	

Note: PH (Temperature Compensation to 25℃). The byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register.

PH_VOLT: The millivolt value corresponding to PH value (Temperature Compensation), INT16		
Range	-20000~20000 mapping to -2000.0~2000.0mV	Default: N/A
Parameter Save	N/A	

Note: The millivolt value corresponding to PH value (Temperature Compensation to 25℃).

PH_ VOLT_FLOAT: The millivolt value corresponding to PH value (Temperature Compensation), FLOAT		
Range	-2000.0~2000.0mV	Default: N/A
Parameter Save	N/A	

Note: The millivolt value corresponding to PH value (Temperature Compensation to 25℃). The byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register.

PH_TX: PH (No Temperature Compensation) , INT16		
Range	0-1400 mapping to 0.00-14.00	Default: N/A
Parameter Save	N/A	

Note: PH (No Temperature Compensation).

PH_TX_FLOAT: PH (No Temperature Compensation), FLOAT		
Range	0.00-14.00	Default: N/A
Parameter Save	N/A	

Note: PH (No Temperature Compensation). The byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register.

PH_VOLT_TX: The millivolt value corresponding to PH value (No Temperature Compensation), INT16		
Range	-20000~20000 mapping to -2000.0~2000.0mV	Default: N/A
Parameter Save	N/A	

Note: The millivolt value corresponding to PH value (No Temperature Compensation).

PH_ VOLT_TX_FLOAT: The millivolt value corresponding to PH value (No Temperature Compensation), FLOAT		
Range	-2000.0~2000.0mV	Default: N/A
Parameter Save	N/A	

Note: The millivolt value corresponding to PH value (No Temperature Compensation). The byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register.

ORP: ORP (Temperature Compensation) , INT16		
Range	-20000~20000 mapping to -2000.0~2000.0mV	Default: N/A
Parameter Save	N/A	

Note: ORP (Temperature Compensation to 25℃).

ORP_FLOAT: ORP (Temperature Compensation), FLOAT		
Range	-2000.0~2000.0mV	Default: N/A
Parameter Save	N/A	

Note: ORP (Temperature Compensation to 25℃). The byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register.

ORP_VOLT: The millivolt value corresponding to ORP value (Temperature Compensation), INT16		
Range	-20000~20000 mapping to -2000.0~2000.0mV	Default: N/A
Parameter Save	N/A	

Note: The millivolt value corresponding to ORP value (Temperature Compensation to 25℃).

ORP_ VOLT_FLOAT: The millivolt value corresponding to ORP value (Temperature Compensation), FLOAT

Range	-2000.0~2000.0mV	Default: N/A
Parameter Save	N/A	

Note: The millivolt value corresponding to ORP value (Temperature Compensation to 25℃). The byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register.

ORP_TX: ORP (No Temperature Compensation) , INT16		
Range	-20000~20000 mapping to -2000.0~2000.0mV	Default: N/A
Parameter Save	N/A	

Note: ORP (No Temperature Compensation).

ORP_TX_FLOAT: ORP (No Temperature Compensation), FLOAT		
Range	-2000.0~2000.0mV	Default: N/A
Parameter Save	N/A	

Note: ORP (No Temperature Compensation). The byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register.

ORP_VOLT_TX: The millivolt value corresponding to ORP value (No Temperature Compensation), INT16		
Range	-20000~20000 mapping to -2000.0~2000.0mV	Default: N/A
Parameter Save	N/A	

Note: The millivolt value corresponding to ORP value (No Temperature Compensation).

ORP_ VOLT_TX_FLOAT: The millivolt value corresponding to ORP value (No Temperature Compensation), FLOAT		
Range	-2000.0~2000.0mV	Default: N/A
Parameter Save	N/A	

Note: The millivolt value corresponding to ORP value (No Temperature Compensation). The byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register.

TEMPUNIT: Temperature Unit, UINT16		
Range	0: ℃ 1: ℉	Default: 0
Parameter Save	YES	

Note: Temperature Unit.

TOFFSET: Temperature Offset, INT16

Range	-1000～1000 mapping to -10.00～10.00℃	Default: 0
Parameter Save	YES	

Note: Temperature Offset.

TEMPRATURE_CALIBED = TEMPRATURE + TOFFSET;

TEMPRATURE_CALIBED_FLOAT = TEMPRATURE_FLOAT + TOFFSET / 100.00;

TEMPCOMPENSATEEN: PH Temperature Compensation Enable/Disable, UINT16		
Range	0: Enable PH temperature compensation (to 25℃); 1: Disable PH temperature compensation;	Default: 0
Parameter Save	YES	

Note: PH Temperature Compensation Enable/Disable. After disabling temperature compensation, the following PH-related register values will not be temperature-compensated:

Register PH, PH_FLOAT, PH_VOLT, PH_VOLT_FLOAT

FLOATBYTEORDER: Floating Point Register Byte Order, UINT16		
Range	0: Big-endian [ABCD] 1: Little-endian[DCBA] 2: Big-endian byte swap [BADC] 3: Little-endian byte swap[CDAB]	Default: 3
Parameter Save	YES	

Note: Configure floating point register byte order.

Example: The 123456.00 in IEC754 is 0x47F12000 (A=47, B=F1, C=20, D=00), then

0: Big-endian [ABCD]

1: Little-endian[DCBA]

2: Big-endian byte swap [BADC]

3: Little-endian byte swap[CDAB]

FILTERSTRENGTH: PH&ORP Value Filter Strength, UINT16		
Range	PH&ORP Value Filter Strength. The larger the value, the more stable the data. 0-15, 0 is disabled.	Default: 2
Parameter Save	YES	

Note: Configure PH&ORP Value Filter Strength.

PHCALIBGROUP: PH Calibration Group, UINT16		
Range	Set calibration group for user calibration:	Default: 0

	0: Use PH standard solutions 4.00, 7.00, and 10.01 for user calibration; 1: Use PH standard solutions 4.00, 6.86, and 9.18 for user calibration	
Parameter Save	YES	

Note: PH Calibration Group. After setting the calibration group, please use the PHUSERCALIB0, PHUSERCALIB1, and PHUSERCALIB2 registers to perform the PH value calibration operation.

PHUSERCALIB0:PH User Calib Point 0, INT16		
Range	Write 0x7FFF for automatic calibration. During automatic calibration: ● When the PHCALIBGROUP register is 0, calibrate using a standard solution with PH=4.00; ● When the PHCALIBGROUP register is 1, calibrate using a standard solution with PH=4.00;	Default: N/A
Parameter Save	YES	

Note: PH User Calib Point 0.

PHUSERCALIB1:PH User Calib Point 1, INT16		
Range	Write 0x7FFF for automatic calibration. During automatic calibration: ● When the PHCALIBGROUP register is 0, calibrate using a standard solution with PH=7.00; ● When the PHCALIBGROUP register is 1, calibrate using a standard solution with PH=6.86;	Default: N/A
Parameter Save	YES	

Note: PH User Calib Point 1.

PHUSERCALIB2:PH User Calib Point 2, INT16		
Range	Write 0x7FFF for automatic calibration. During automatic calibration: ● When the PHCALIBGROUP register is 0, calibrate using a standard solution with PH=10.01; ● When the PHCALIBGROUP register is 1, calibrate using a	Default: N/A

	standard solution with PH=9.18;	
Parameter Save	YES	

Note: PH User Calib Point 2.

ORPTCOMPCOEF: ORP Temperature Compensation Coefficient, INT16		
Range	0~100 mapping to 0.00～10.00	Default: 20
Parameter Save	YES	

Note: ORP Temperature Compensation Coefficient.

ORPSTANDARDMV: The nominal millivolt value of the ORP standard solution, INT16		
Range	Range: -2000 to 2000 When calibrating the ORP electrode, the written data is the nominal millivolt value of the standard solution used. The read data is the nominal millivolt value of the standard solution used in the last calibration of the ORP electrode	Default: 256
Parameter Save	YES	

Note: The nominal millivolt value of the ORP standard solution.

ORPMEASUREDMV: The millivolt value output by the ORP electrode in the standard solution, INT16		
Range	The read data represents the millivolt value output by the ORP electrode in the standard solution during the last calibration	Default: 256
Parameter Save	YES	

Note: The millivolt value output by the ORP electrode in the standard solution.

RESETCALIB: Reset PH calibration to the factory Settings,UINT16		
Range	The read value is 0. Write 0: Reset the calibration data of PH calibration group 0 and PH calibration group 1 to factory Settings. Including the following registers: PHUSERCALIB0, PHUSERCALIB1, PHUSERCALIB2; Write 1: Reset the ORP calibration data to the factory Settings. Including the following registers: ORPTCOMPCOEF, ORPSTANDARDMV,	Default: N/A

	ORPMEASUREDMV; Write 0xFFFF: Reset PH and ORP calibration data	
Parameter Save	N/A	

Note: Reset PH and ORP calibration to the factory Settings

SYSTEMRESET: Restart the sensor, UINT16		
Range	The read value is 0; Writing 0xFFFF to restart the sensor (equivalent to repowering on).	Default: N/A
Parameter Save	N/A	

Note: Restart the sensor

SLAVEADDRESS: Modbus Slave Address, UINT16		
Data Range	0-255	Default: 1
Parameter Storage	YES	

Note: Please power up the sensor to take effective after set.

BAUDRATE: Serial Comm Baudrate, UINT16		
Data Range	0-5 0:1200bps 1:2400bps 2:4800bps 3:9600bps 4:19200bps 5:38400bps	Default: 3
Parameter Storage	YES	

Note: Please power up the sensor to take effective after set.

PROTOCOL: Serial Comm Protocol, UINT16		
Data Range	0:Modbus RTU	Default: 0
Parameter Storage	YES	

Note: Please power up the sensor to take effective after set.

PARITY: Serial Comm Parity, UINT16		
Data Range	0:NONE	Default: 0

	1:EVEN 2:ODD	
Parameter Storage	YES	

Note: Please power up the sensor to take effective after set.

DATABITS: Serial Comm Databits, UINT16		
Data Range	1:8 databits	Default: 1
Parameter Storage	YES	

Note: Please power up the sensor to take effective after set.

STOPBITS: Serial Comm Stopbits, UINT16		
Data Range	0:1 stopbit 1:2 stopbits	Default: 0
Parameter Storage	YES	

Note: Please power up the sensor to take effective after set.

USER_SN--- User Serial Number		
Data Range	0x0000000000000000-0xFFFFFFFFFFFFFFFF User Serial Number. These four registers should be read and write together from start address 0x0220 with quantity 4.	Default: N/A
Parameter Storage	YES	

8 Calibration

8.1 PH Calibration

The sensor is calibrated using PH standard buffer solution, which supports two sets of PH standard buffer solutions. Users can use one of these two commonly used buffer solutions for PH calibration as needed.

Calibration Group	PH standard buffer
0	PH=4.00; PH=7.00; PH=10.01
1	PH=4.00; PH=6.86; PH=9.18

8.1.1 PH Calibration Procedure for SDI-12 Sensor

Use the command to set the required calibration group (**the calibration group Settings are stored after power failure and can be set only once**), then immerse the sensor in the corresponding standard buffer solution and send the instructions for calibration, where "a" is the SDI-12 address of the sensor:

Calibration Group <PHCalibGroup>	PH standard buffer	Calibration Command
0	(1) Set the calibration group expected to be used (2) Immerse the sensor in PH=4.00 buffer solution (3) Immerse the sensor in PH=7.00 buffer solution (4) Immerse the sensor in PH=10.01 buffer solution	aXW_PHCALGROUP_0! aXW_PHCAL0! aXW_PHCAL1! aXW_PHCAL2!
1	(1) Set the calibration group expected to be used (2) Immerse the sensor in PH=4.00 buffer solution (3) Immerse the sensor in PH=6.86 buffer solution (4) Immerse the sensor in PH=9.18 buffer solution	aXW_PHCALGROUP_1! aXW_PHCAL0! aXW_PHCAL1! aXW_PHCAL2!

The following example uses the buffer of calibration group 0 (<PHCalibGroup>=0), that is, PH=4.00, PH=7.00, PH=10.01 to calibrate the transmitter, the calibration process is as follows:

Steps	**Description**	**Command**
1	Set the calibration group to 0, that is, use PH=4.00,	Request: aXW_PHCALGROUP_0!

	PH=7.00, PH=10.01 buffer for electrode calibration.	
2	Rinse the electrodes with deionized water. Immerse the electrode in the PH=4.00 standard buffer, stir the electrode moderately, and wait for the PH reading to stabilize, and wait for the electrode temperature (if any) to balance with the standard buffer, then send the calibration command.	Request: aXW_PHCAL0!
3	Rinse the electrodes with deionized water. Immerse the electrode in the PH=7.00 standard buffer, stir the electrode moderately, and wait for the PH reading to stabilize, and wait for the electrode temperature (if any) to balance with the standard buffer, then send the calibration command.	Request: aXW_PHCAL1!
4	Rinse the electrodes with deionized water. Immerse the electrode in the PH=10.01 standard buffer, stir the electrode moderately, and wait for the PH reading to stabilize, and wait for the electrode temperature (if any) to balance with the standard buffer, then send the calibration command.	Request: aXW_PHCAL2!
5	Rinse the electrodes with deionized water. Verify the measured values.	Request: Data measurement command
6	If calibration fails, use the command to reset the PH calibration value to the factory setting. The calibration data of calibration group 0 and calibration group 1 are restored to factory Settings.	Request: aXW_RESETCALIB!

8.1.2 PH Calibration Procedure for RS485 Sensor

Use the command to set the required calibration group (**the calibration group Settings are stored after power failure and can be set only once**), then immerse the sensor in the corresponding standard buffer solution and send the instructions for calibration:

Calibration Group <PHCalibGroup>	PH standard buffer	Calibration Command
0	(1) Set the calibration group expected to be used (2) Immerse the sensor in PH=4.00 buffer solution	Write 0 to register PHCALIBGROUP Write 0x7FFF to register PHUSERCALIB0

	(3) Immerse the sensor in PH=7.00 buffer solution (4)Immerse the sensor in PH=10.01 buffer solution	Write 0x7FFF to register PHUSERCALIB1 Write 0x7FFF to register PHUSERCALIB2
1	(1) Set the calibration group expected to be used (2) Immerse the sensor in PH=4.00 buffer solution (3) Immerse the sensor in PH=6.86 buffer solution (4) Immerse the sensor in PH=9.18 buffer solution	Write 0 to register: PHCALIBGROUP Write 0x7FFF to register PHUSERCALIB0 Write 0x7FFF to register PHUSERCALIB1 Write 0x7FFF to register PHUSERCALIB2

The following example uses the buffer of calibration group 0 (PHCALIBGROUP=0), that is, PH=4.00, PH=7.00, PH=10.01 to calibrate the transmitter, the calibration process is as follows:

Steps	Description	Command
1	Set the calibration group to 0, that is, use PH=4.00, PH=7.00, PH=10.01 buffer for electrode calibration.	Write 0 to register PHCALIBGROUP
2	Rinse the electrodes with deionized water. Immerse the electrode in the PH=4.00 standard buffer, stir the electrode moderately, and wait for the PH reading to stabilize, and wait for the electrode temperature (if any) to balance with the standard buffer, then send the calibration command.	Write 0x7FFF to register PHUSERCALIB0
3	Rinse the electrodes with deionized water. Immerse the electrode in the PH=7.00 standard buffer, stir the electrode moderately, and wait for the PH reading to stabilize, and wait for the electrode temperature (if any) to balance with the standard buffer, then send the calibration command.	Write 0x7FFF to register PHUSERCALIB1
4	Rinse the electrodes with deionized water. Immerse the electrode in the PH=10.01 standard buffer, stir the electrode moderately, and wait for the PH reading to stabilize, and wait for the electrode temperature (if any) to balance with the standard buffer, then send the calibration command.	Write 0x7FFF to register PHUSERCALIB2
5	Rinse the electrodes with deionized water. Verify the measured values.	Data measurement command
6	If calibration fails, use the command to reset the PH calibration value to the factory setting. The calibration data of calibration group 0 and calibration group 1 are	Write 0xFFFF to register RESETCALIB

	restored to factory Settings.	

8.2 ORP Calibration

The sensor is calibrated using ORP standard buffer, and the user can choose ORP standard buffer (e.g. 256mV, 420mV) to calibrate the sensor.

8.2.1 ORP Calibration Procedure for SDI-12 Sensor

The following example uses 420mV ORP standard buffer to calibrate the transmitter, the calibration process is as follows:

Steps	Description	Command
1	Rinse the electrodes with deionized water. Immerse the electrode in the 420mV standard buffer, stir the electrode moderately, and wait for the ORP reading to stabilize before sending calibration instructions.	Request: aXW_ORPCAL_420!
2	Rinse the electrodes with deionized water. Verify the measured values.	Request: Data measurement command
3	If calibration fails, use the command to reset the ORP calibration value to the factory setting.	Request: aXW_RESETCALIB!

8.2.2 ORP Calibration Procedure for RS485 Sensor

The following example uses 420mV ORP standard buffer to calibrate the transmitter, the calibration process is as follows:

Steps	Description	Command
1	Rinse the electrodes with deionized water. Immerse the electrode in the 420mV standard buffer, stir the electrode moderately, and wait for the ORP reading to stabilize before sending calibration instructions.	Write 420 to register ORPSTANDARDMV
2	Rinse the electrodes with deionized water. Verify the measured values.	Data measurement command
3	If calibration fails, use the command to reset the ORP calibration value to the factory setting.	Write 0xFFFF to register RESETCALIB

Appendix A SDI-12 Sensor Testing and Settings

The user can test the communication or set the parameters with the SDI-12 sensors in the following method.

■ Use any kind of master device that supports the SDI-12 interface (such as data acquisition device, data logger, etc.) to communicate with the sensor or set the parameters.

■ Use a computer to communicate with the sensor through the SDI-12 converter (such as the SDI12ELF20 converter) and to set the parameters.

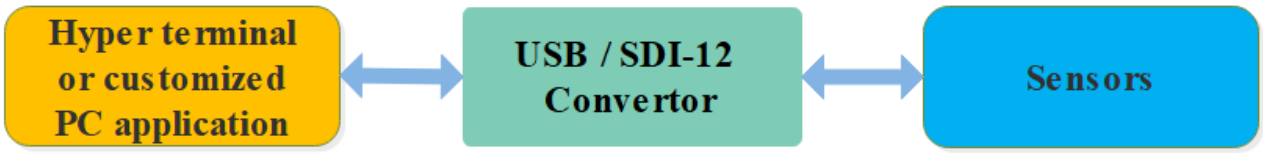
This chapter mainly introduces the communication or parameter setting on a computer for sensor through the SDI-12 converter (SDI12ELF20).

A.1 Testing SDI-12 Sensors with SDI12ELF20 Converter

SDI12ELF20 is a communication converter between USB master device and SDI-12 sensor. It supports bidirectional transparent transmission of SDI-12 communication data and is used to control or test SDI-12 compatible sensors or devices. The USB master device can be a computer, Raspberry PI and other hosts that support USB interface.

SDI12ELF20 Converter User Manual
https://www.infwin.com/sdi12elf20-sdi-12-to-usb-converter/

In this example, a computer is used as a USB host to connect the sensor through the SDI12ELF20 converter for SDI-12 communication test.



Installation steps:

■ Install USB Virtual COM port driver on PC, laptop or other USB master device. The converter uses the CH340C as the USB bridge chip. Download and install the CH340C driver and install it. After the converter is connected to the PC, a COM port is added to the system port. Use this port number in the debugging software to debug the communication with the converter.

Driver Download
https://www.infwin.com/resource-usb-to-serial-port-driver-ch340-series

■ Connect the converter to a PC, laptop or other USB master device through USB port

■ Connect the sensor of the SDI-12 port to the converter

■ The sensor can be powered by the power output that comes with the converter or by an external power supply which has common POWER GROUND with the converter power supply

■ Users can use any serial communication software for SDI-12 communication, such as Terminal or HyperTerminal, The default communication parameters of SDI12ELF20 is 9600bps, none parity, 8 data bits, 1 stop bit. Please use ASCII mode to send and receive data.

Testing Software Download	
Terminal (universal serial port debugging tool)	https://www.infwin.com/resource-serial-port-com-development-tool/
HyperTerminal (universal serial port debugging tool)	https://www.infwin.com/resource-serial-port-com-development-tool/
SensorOneSetSDI12 (SDI-12 sensor configuration utility)	https://www.infwin.com/resource-sensoronesetsdi12-configuration-utility-for-sdi-12-sensors/

A.2 Testing Example

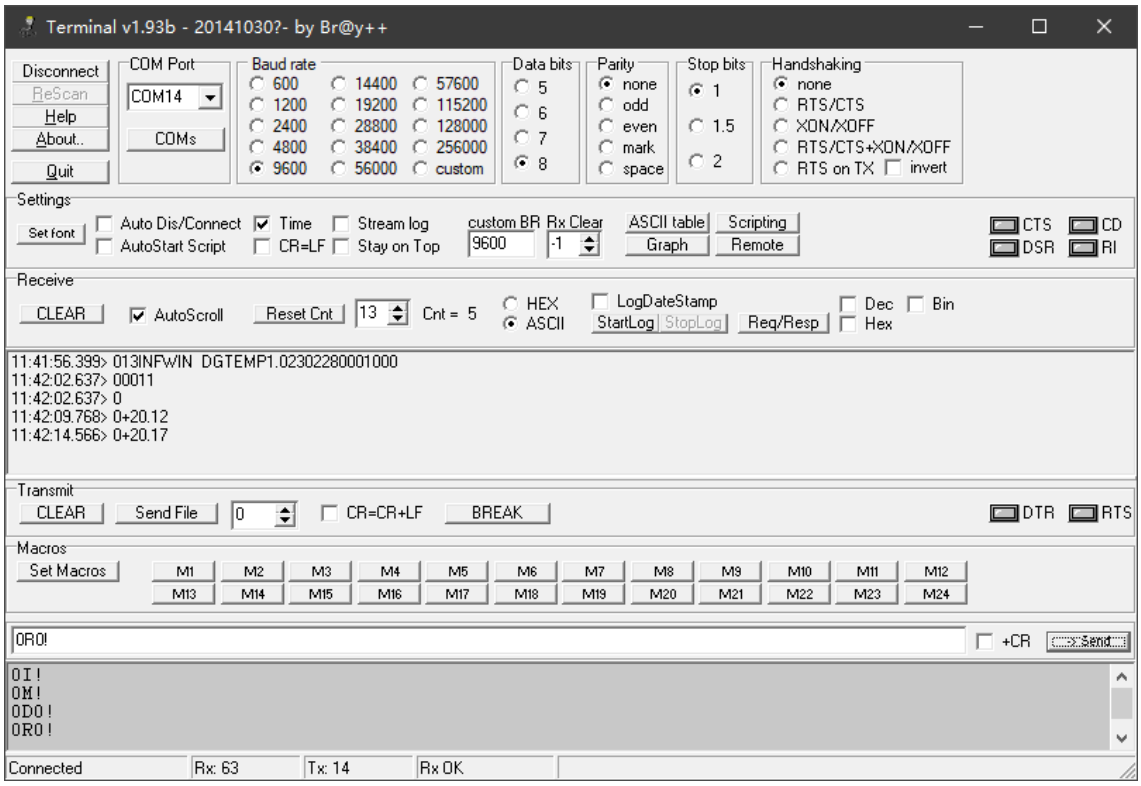
In this example, we use the SDI12ELF20 converter to communicate between a computer and the rugged temperature sensor DigiTEMP, The power supply of DigiTEMP is also provided by SDI12ELF20.

DigiTEMP Rugged Temperature Sensor User Manual
https://www.infwin.com/digitemp-rugged-digital-temperature-sensor-sdi12-rs485-modbus/

■ **Connections**

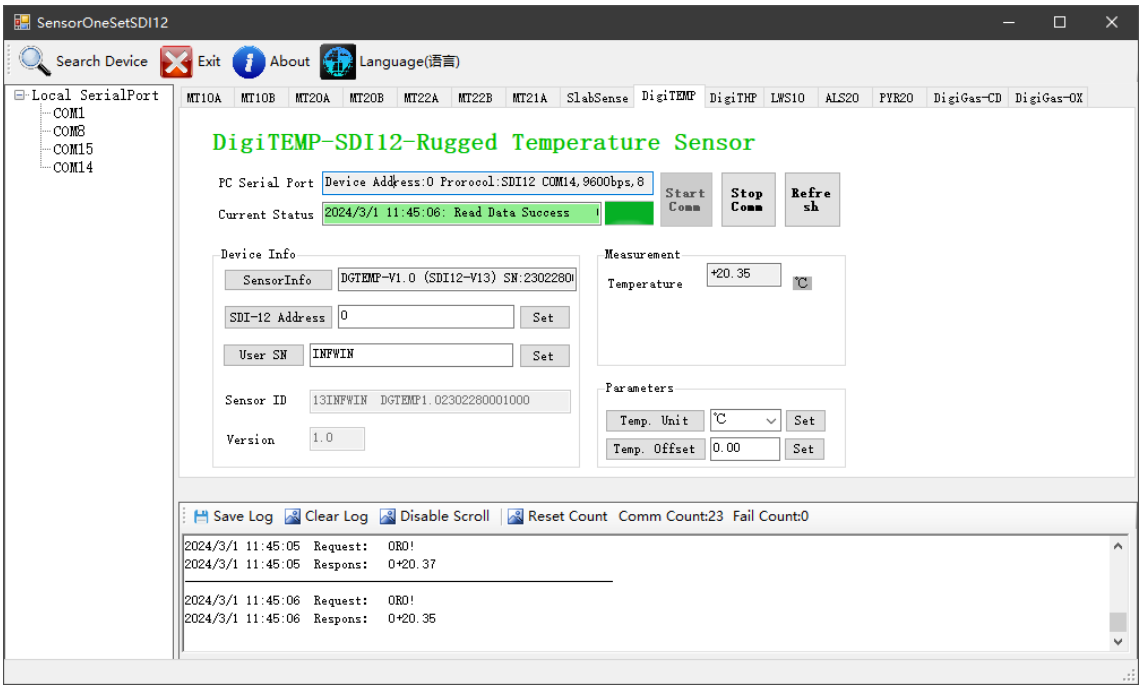
■ Testing with serial port utility “Terminal”

Take “Terminal” as an example, when debugging, please select the corresponding serial port number, baudrate is set to 9600bps, none parity, 8 data bits, 1 stop bit (the default communication Settings of SDI12ELF20), open the serial port and input the SDI-12 command and send. Please note that the ASCII format should be used for data communication.



■ Testing with SDI-12 sensor configuration utility “SensorOneSetSDI12”

Start up the application, select the corresponding product page DigiTEMP, click "start communication" and choose the proper serial port number, 9600bps, none parity, 8 data bits, 1 stop bit (SDI12ELF20 default communication Settings) and start communication.



Appendix B RS485 Sensor Testing and Settings

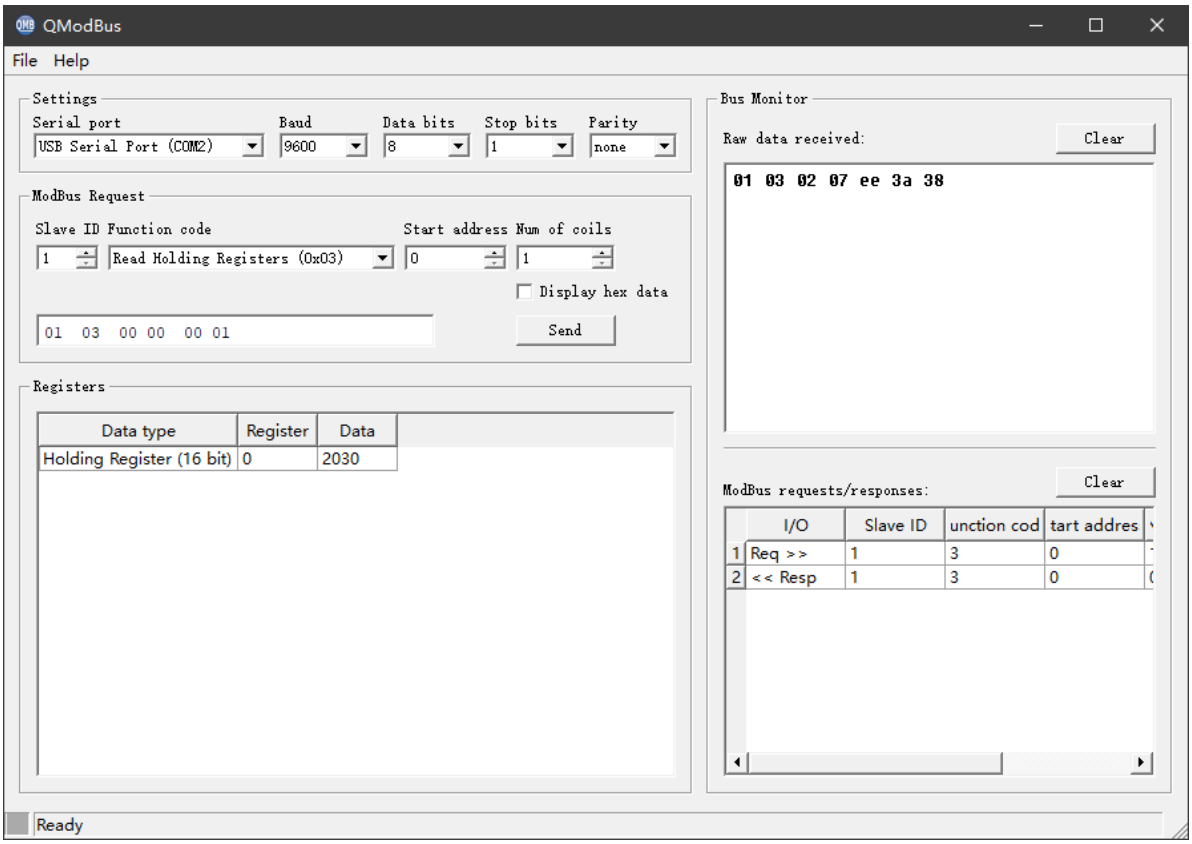
In this example, we use the USB/RS485 converter to communicate between a computer and the rugged temperature sensor DigiTEMP, The power supply of DigiTEMP is also provided by USB/RS485 converter.

DigiTEMP Rugged Temperature Sensor User Manual
https://www.infwin.com/digitemp-rugged-digital-temperature-sensor-sdi12-rs485-modbus/

Connections

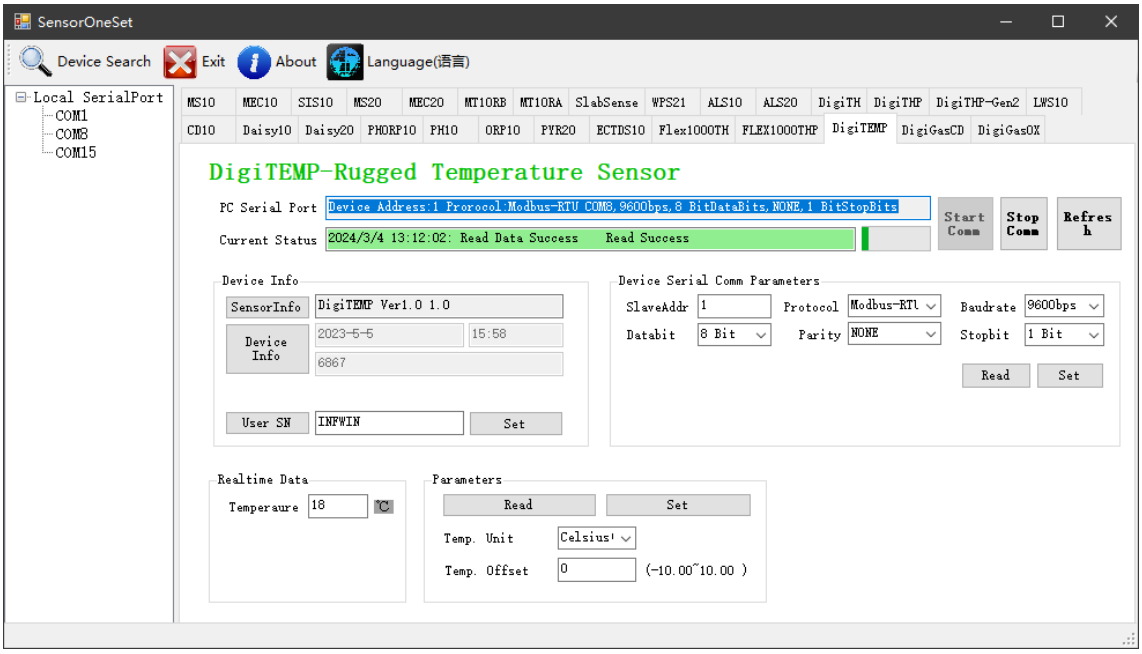
Testing with serial port utility “QModbus”

Take “QModbus” as an example, when debugging, please select the corresponding serial port number, baudrate is set to 9600bps, none parity, 8 data bits, 1 stop bit (the default communication Settings of DigiTEMP), open the serial port and input the Modbus-RTU command and send.



■ Testing with RS485 sensor configuration utility “SensorOneSet”

Start up the application, select the corresponding product page DigiTEMP, click "start communication" and choose the proper serial port number, 9600bps, none parity, 8 data bits, 1 stop bit (DigiTEMP default communication Settings) and start communication.


SensorOneSet
Device Search
Exit
About
Language(语言)
Local SerialPort
COM1
COM3
COM15
MS10 MEC10 SIS10 MS20 MEC20 MT10RB MT10RA SlabSense WPS21 ALS10 ALS20 DigiTH DigiTHP DigiTHP-Gen2 LWS10
CD10 Daisy10 Daisy20 PHORP10 PH10 ORP10 PYR20 ECTDS10 Flex1000TH FLEX1000THP DigiTEMP DigiGasCD DigiGasOX
DigiTEMP-Rugged Temperature Sensor
PC Serial Port
Device Address:1 Prorocol:Modbus-RTU COM3,9600bps,8 BitDataBits,NONE,1 BitStopBits
Current Status
2024/3/4 13:12:02: Read Data Success Read Success
Start Comm
Stop Comm
Refres h
Device Info
SensorInfo
DigiTEMP Ver1.0 1.0
Device Info
2023-5-5
15:58
6867
User SN
INFWIN
Set
Device Serial Comm Parameters
SlaveAddr
1
Protocol
Modbus-RTU
Baudrate
9600bps
Databit
8 Bit
Parity
NONE
Stopbit
1 Bit
Read
Set
Realtime Data
Temperaure
18
℃
Parameters
Read
Set
Temp. Unit
Celsius
Temp. Offset
0
(-10.00~10.00)

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Version Control

Date	Version	Comment	Updated by
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