PHORP10

PH / ORP Transmitter (SDI-12 Interface)

User Manual

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2 Introduction

PHORP10 transmitter measures the PH/ORP of solution or semi-solid substrate. The transmitter 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.

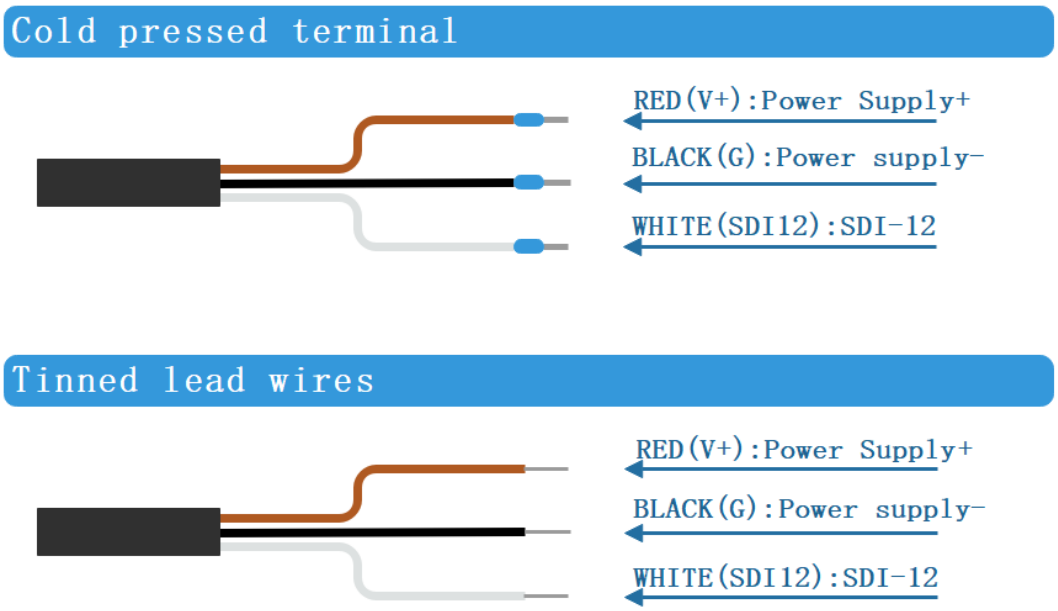
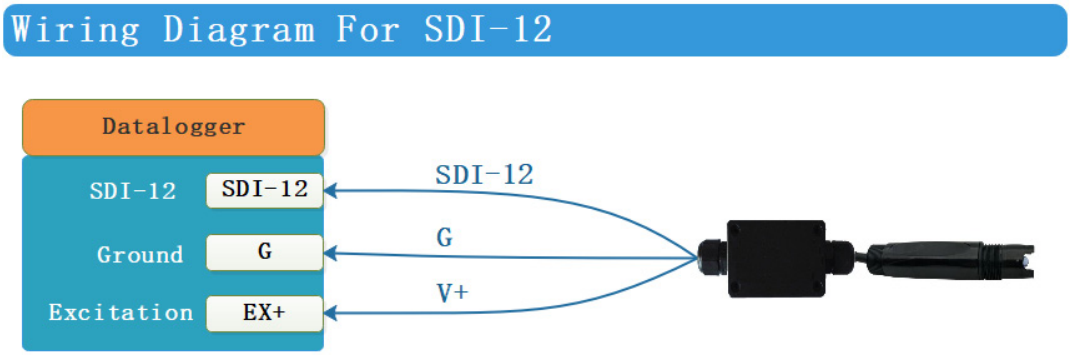
Features:

- PH or ORP measurement
- SDI-12 Output Interface with low power design
- High impedance and isolated electrode input
- High accuracy with excellent stability
- Reverse power protection and Built-in TVS/ESD protection

Specifications	
Output Interface	Optional: SDI-12, V1.3
Power Supply	4.5-28V/DC
Power Consumption	SDI-12 Interface: Quiescent Current : <10uA Measuring Current : <10mA @ 12V DC
PH Measurement	High impedance and isolated input; Range: 0-14PH, Resolution: 0.01PH, Accuracy: +/-0.1PH; Circuit Response Time < 1 second
ORP Measurement	High impedance and isolated input ; Range: +/-2000mV, Resolution: 0.1mV, Accuracy: +/-1mV; Circuit Response Time < 1 second
Temperature Measurement(Optional)	Range: -40~80°C, Resolution: 0.1°C, Accuracy: +/-0.5°C; Circuit Response Time < 1 second
IP Ratings	Electrode: IP68; Transmitter: IP65
Operating	Temperature: -40~80°C, Humidity: 0-100%
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: Width*Diameter 160*30mm; 3/4"NPT screw threads Transmitter: 140mm*65mm*50mm

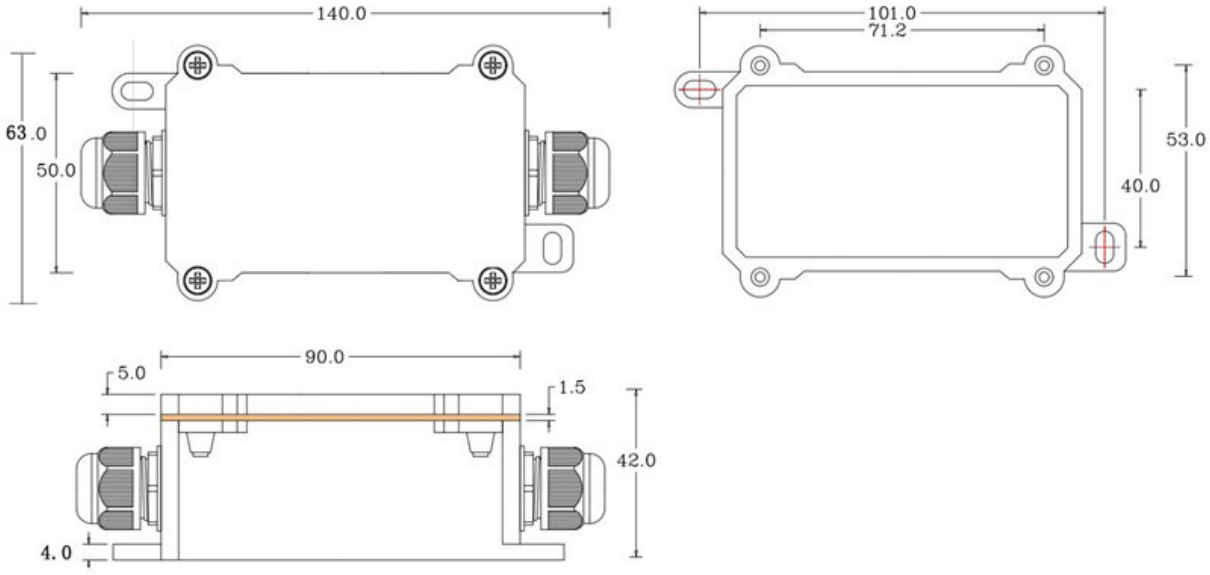
3 Wiring diagrams

3.1 SDI-12 Interface

Type	Wiring diagram
SDI-12 Interface	
Connections	

4 Dimension and Ordering Infomation

4.1 Dimension



Unit: mm

4.2 Ordering Infomation

Parameters	Code	Comments
Code 1: Product Series	PHORP10	PHORP10 transmitter
Code 2: Electrode Selection	A B C D E	PH Electrode (No Built-in Temperature Compensation Sensor) PH Electrode (With Built-in Temperature Compensation) ORP Electrode (No Built-in Temperature Compensation Sensor) ORP Electrode (With Built-in Temperature Compensation) Transmitter Only (No PH /ORP Electrode)
Code 3: Power Supply	C	4.5-28V DC
Code 4: Output Interface	F	SDI-12
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: PHORP10-A C F 002 PHORP10: PHORP10 transmitter A: PH Electrode (No Built-in Temperature Compensation Sensor) C: Power Supply 4.5-28V DC F: Output Interface SDI-12 002: Electrode Cable:5 meters , Power and Signal Cable:2 meters		

5 Safety ,Care and Installation

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 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. The value depends on the settings of <TemperatureSensorSelection>.
<±TemperatureCalibed>	℃ ℉	Temperature Calibed, the value is output according to the temperature unit setting. The value depends on the settings of <TemperatureSensorSelection>.
<±TOffset>	℃ ℉	Temperature Offset, the value is output according to the temperature unit setting. <±TemperatureCalibed> = <±Temperature> + <±TOffset>
<TemperatureUnit>	-	Temperature Unit, Rnage: C: ℃ F: ℉
<±PH>	-	PH Value(Temperature Compensated)
<±PHTx>	-	PH Value(Non Temperature Compensated)
<±ORP>	Milli-Voltage	ORP Value(Calibrated Value)
<±ORPOrig>	Milli-Voltage	ORP Value(Original Value Output by Electrode)
<±ElectrodeMilliVolt>	Milli-Voltage	Electrode Output Voltage
<+WarmUpTime>	Seconds	Warm Up Time, The sensor measurement circuit will be powered on for a period of time specified by

		<+WarmUpTime> upon receiving the measurement command, then make a measurement. Range:1-60 (Seconds)
<LedEnable>	-	LED indicator on PCB, Range: 0: Disabled, the indicator light will be off regardless of whether the transmitter is working or not. 1: Enabled, the indicator will be off during sleep and on to indicate that the transmitter is working.
<TemperatureSensorSelection>	-	Temperature Sensor Selection, Range: 0: External Temperature Sensor (NTC 10K, 3950), -40℃ if unconnected; 1: Temperature fixed at 25℃; 2: Onboard Temperature Sensor;
<SensorType>	-	The electrode transmitter connected, Rnage: 0: PH Electrode 1: ORP Electrode
<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>	Milli-Voltage	The milli-voltage output of PH electrode in PH standard buffer solution
<ORPStandardMV>	Milli-Voltage	The nominal milli-voltage value of ORP standard buffer solution

<ORPMeasuredMV>	Milli-Voltage	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 and Protocol

6.1.1 SDI-12 Interface

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

6.1.2 Protocol

Request	Response	Comment
a!	a<CR><LF>	**Acknowledge Active** a: Sensor address **Example:** Request: 0! Response: 0<CR><LF>
aI!	allccccccccmmmmmmvvvxxxxxxxxxxxxxx<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 PHORP 8.1PHORP10-00012<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!	attt2<CR><LF> a: Sensor address ttt: Measurement data will be ready in ttt seconds, which equals to <+WarmUpTime> 2: Number of measurement data returned by aD0! <CR><LF>: terminates the response aD0! Response data format: a<±PH><±TemperatureCalibed>[<CRC>]<CR><LF>	**PH and Temperature Measurement** **Example:** Request: 0M! Response: 00012<CR><LF> Response: 0<CR><LF> Request: 0D0! Response: 0+8.87+20.61<CR><LF>
aM1!, aMC1!	attt2<CR><LF> a: Sensor address ttt: Measurement data will be ready in ttt seconds, which equals to <+WarmUpTime> 2: Number of measurement data returned by aD0! <CR><LF>: terminates the response aD0! Response data format: a<±ORP><±TemperatureCalibed>[<CRC>]<CR><LF>	**ORP and Temperature Measurement** **Example:** Request: 0M1! Response: 00012<CR><LF> Response: 0<CR><LF> Request: 0D0! Response: 0+208.8+20.58<CR><LF>
aM2!,aMC2!	attt3<CR><LF> a: Sensor address ttt: Measurement data will be ready in ttt seconds, which equals to <+WarmUpTime> 3: Number of measurement data	**PH / ORP and Temperature Measurement** **Example 1:** <SensorType>=0（PH Electrode） Request: 0M2! Response: 00013<CR><LF> Response: 0<CR><LF>

	returned by aD0! <CR><LF>: terminates the response aD0! Response data format: a<+SensorType><±PH/ORP><±TemperatureCalibed>[<CRC>]<CR><LF> Note: When <SensorType>=0(PH Electrode), The <±PH/ORP> value will be set as PH value; When <SensorType>=1(ORP Electrode), The <±PH/ORP> value will be set as ORP value;	Request: 0D0! Response: 0+0+8.92+19.76<CR><LF> **Example 2:** <SensorType>=1（ORP Electrode） Request: 0M2! Response: 00013<CR><LF> Response: 0<CR><LF> Request: 0D0! Response: 0+1+429.50+19.73<CR><LF>
aC!,aCC!	attt02<CR><LF> a: Sensor address ttt: Measurement data will be ready in ttt seconds, which equals to <+WarmUpTime> 02: Number of measurement data returned by aD0! <CR><LF>: terminates the response aD0! Response data format: a<±PH><±TemperatureCalibed>[<CRC>]<CR><LF>	**PH and Temperature Measurement** **Example:** Request: 0C! Response: 000102<CR><LF> Request: 0D0! Response: 0+8.87+20.61<CR><LF>
aC1!,aCC1!	attt02<CR><LF> a: Sensor address ttt: Measurement data will be ready in ttt seconds, which equals to <+WarmUpTime> 02: Number of measurement data returned by aD0! <CR><LF>: terminates the response aD0! Response data format: a<±ORP><±TemperatureCalibed>[<CRC>]<CR><LF>	**ORP and Temperature Measurement** **Example:** Request: 0C1! Response: 000102<CR><LF> Request: 0D0! Response: 0+208.8+20.58<CR><LF>

aC2!,aCC2!	attt03<CR><LF> a: Sensor address ttt: Measurement data will be ready in ttt seconds, which equals to <+WarmUpTime> 3: 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: When <SensorType>=0(PH Electrode), The <±PH/ORP> value will be set as PH value; When <SensorType>=1(ORP Electrode), The <±PH/ORP> value will be set as ORP value;	**PH / ORP and Temperature Measurement** **Example 1:** <SensorType>=0（PH Electrode） Request: 0C2! Response: 000103<CR><LF> Request: 0D0! Response: 0+0+8.92+19.76<CR><LF> **Example 2:** <SensorType>=1（ORP Electrode） Request: 0C2! Response: 000103<CR><LF> Request: 0D0! Response: 0+1+429.50+19.73<CR><LF>
aV!	attt1<CR><LF> a: Sensor address ttt: Measurement data will be ready in ttt seconds, which equals to <+WarmUpTime> 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. “+1” 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!	Response data format: a<±PH><±TemperatureCalibed>[<CRC>]<CR><LF>	**PH and Temperature Measurement** **Example:** Request: 0R0! Response: 0+8.87+20.61<CR><LF>
aR1!,aRC1!	Response data format: a<±ORP><±TemperatureCalibed>[<CRC>]<CR><LF>	**ORP and Temperature Measurement** **Example:** Request: 0R1! Response: 0+208.8+20.58<CR><LF>
aR2!,aRC2!	Response data format: a<+SensorType><±PH/ORP><±TemperatureCalibed>[<CRC>]<CR><LF> Note: When <SensorType>=0(PH Electrode), The <±PH/ORP> value will be set as PH value; When <SensorType>=1(ORP Electrode), The <±PH/ORP> value will be set as ORP value;	**PH / ORP and Temperature Measurement** **Example 1:** <SensorType>=0（PH Electrode） Request: 0R2! Response: 0+0+8.92+19.76<CR><LF> **Example 2:** <SensorType>=1（ORP Electrode） Request: 0R2! Response: 0+1+429.50+19.73<CR><LF>
aR9!,aRC9!	Response data format: a<±Temperature><±TemperatureCalibed><±PHTx><±PH><±ORPOrig><±ORP><±ElectrodeMilliVolt>[<CRC>]<CR><LF>	Temperature Original**,** Temperature Calibed**,** PH Value(Non Temperature Compensated)**,** PH Value(Temperature Compensated)**,** ORP Value(Original Value Output by Electrode)**,** ORP Value(Calibrated Value)**,**Electrode Output Voltage measurement. **Example**: Request: 0R9! Response: 0+19.60+19.60+8.77+8.94-9996.00-9996.00-112.19<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. The temperature display value equals to the original sensor measurement value added with the temperature offset value.	**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_WUT!	aWUT=<+WarmUpTime><CR><LF> <+WarmUpTime>: Warm Up Time, The sensor measurement circuit will be powered on for a period of time specified by <+WarmUpTime> upon receiving the measurement command, then make a measurement. Range:1-60 (Seconds)	**Query Warm Up Time** **Example:** Request: 0XR_WUT! Response: 0WUT=+10<CR><LF>
aXW_WUT_<+WarmUpTime>!	aWUT=<+WarmUpTime><CR><LF>	**Configure Warm Up Time** **Example:** Request: 0XW_WUT_10! Response: 0WUT=+10<CR><LF>
aXR_LEDENABLE!	aLEDENABLE=<LedEnable><CR><LF> <LedEnable>: LED indicator on PCB, Range: 0: Disabled, the indicator light will be off regardless of whether the	**Query Led Indicator Enable** **Example:** Request: 0XR_LEDENABLE! Response: 0LEDENABLE=1<CR><LF>

	transmitter is working or not. 1: Enabled, the indicator will be off during sleep and on to indicate that the transmitter is working.	
aXW_LEDENABLE_<LedEnable>!	aLEDENABLE=<LedEnable><CR><LF>	**Configure Led Indicator Enable** **Example:** Request: 0XW_LEDENABLE_1! Response: 0LEDENABLE=1<CR><LF>
aXR_TSENSOR!	aTSENSOR=<TemperatureSensorSelection><CR><LF> <TemperatureSensorSelection>: Temperature Sensor Selection Range: 0:External Temperature Sensor (NTC 10K, 3950), -40℃ if unconnected; 1:Temperature fixed at 25℃; 2:Onboard Temperature Sensor;	**Query Temperature Sensor Selection** **Example:** Request: 0XR_TSENSOR! Response: 0TSENSOR=0<CR><LF>
aXW_TSENSOR_<TemperatureSensorSelection>!	aTSENSOR=<TemperatureSensorSelection><CR><LF>	**Configure Temperature Sensor Selection** **Example:** Request: 0XW_TSENSOR_0! Response: 0TSENSOR=0<CR><LF>
aXR_SENSORTYPE!	aSENSORTYPE=<SensorType><CR><LF> <SensorType>: 0: PH Electrode 1: ORP Electrode	**Query Electrode Type** **Example:** Request: 0XR_SENSORTYPE! Response: 0SENSORTYPE=0<CR><LF>
aXW_SENSORTYPE_<SensorType>!	aSENSORTYPE=<SensorType><CR><LF>	**Configure Electrode Type** **Example:** Request: 0XW_SENSORTYPE_0! Response: 0SENSORTYPE=0<CR><LF>
aXW_PHCALRESET!	aPHCALRESET<CR><LF>	**Reset PH calibration to factory default value** **Example:** Request: 0XW_PHCALRESET! Response: 0PHCALRESET<CR><LF>
aXW_PHCALGROUP_<PHCalibGroup>!	aPHCALGROUP=<PHCalibGroup><CR><LF> <PHCalibGroup>:PH Calibrate Group, Range: 0: Group 0, use PH=4.00, 7.00, 10.01 for PH calibration and subsequent PH	**Configure current PH calibration group** **Example:** Request: 0XW_PHCALGROUP_0! Response: 0PHCALGROUP=0<CR><LF>

	calculation. 1: Group 1, use PH=4.00, 6.86, 9.18 for PH calibration and subsequent PH calculation.	
aXR_PHCALGROUP!	aPHCALGROUP=<PHCalibGroup><CR><LF>	**Query current PH calibration group** **Example:** Request: 0XR_PHCALGROUP! Response: 0PHCALGROUP=0<CR><LF>
aXW_PHCAL<PHCalibGroup><PHCalibPointIndex>!	aPHCAL<PHCalibGroup><PHCalibPointIndex>=<PHElectrodeMilliVolt><CR><LF> <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;	**Calibrate in ORP standard buffer solution** **Example1: When <PHCalibGroup>=0, use PH=4.00, 7.00, 10.01 for PH calibration and subsequent PH calculation.** PH=4.00: Request: 0XW_PHCAL00! Response: 0PHCAL00=-177.6<CR><LF> PH=7.00: Request: 0XW_PHCAL01! Response: 0PHCAL00=0<CR><LF> PH=10.01: Request: 0XW_PHCAL02! Response: 0PHCAL00=-177.6<CR><LF> **Example2: When <PHCalibGroup>=1, use PH=4.00, 6.86, 9.18 for PH calibration and subsequent PH calculation.** PH=4.00: Request: 0XW_PHCAL10! Response: 0PHCAL00=-177.6<CR><LF> PH=6.86: Request: 0XW_PHCAL11! Response: 0PHCAL00=8.3<CR><LF> PH=9.18: Request: 0XW_PHCAL12! Response: 0PHCAL00=-129.0<CR><LF>

	<PHElectrodeMilliVolt>:The milli-voltage output of PH electrode in PH standard buffer solution.	
aXR_PHCAL<PHCalibGroup><PHCalibPointIndex>!	aPHCAL<PHCalibGroup><PHCalibPointIndex>=<PHElectrodeMilliVolt><CR><LF>	**Query the PH calibration data** **Example:** Request: 0XR_PHCAL00! Response: 0PHCAL00=-177.6<CR><LF> Request: 0XR_PHCAL01! Response: 0PHCAL01=0<CR><LF> Request: 0XR_PHCAL02! Response: 0PHCAL02=-177.6<CR><LF>
aXW_ORPCALRESET!	aORPCALRESET<CR><LF>	**Reset ORP calibration to factory default value** **Example:** Request: 0XW_ORPCALRESET! Response: 0ORPCALRESET<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>

7 Calibration

7.1 PH Calibration

The transmitter is calibrated using PH standard buffer, it supports two sets of PH standard buffers, and by setting <PHCalibGroup>, the transmitter can be calibrated using each of these common sets of buffers.

When <PHCalibGroup>=0, the transmitter should be calibrated with PH=4.00, PH=7.00, PH=10.01, and the PH value is calculated using this calibration data;

When <PHCalibGroup>=1, the transmitter should be calibrated with PH=4.00, PH=6.86, PH=9.18, and the PH value is calculated using this calibration data;

Calibration Group <PHCalibGroup>	PH standard buffer	Calibration Command
0	PH=4.00 PH=7.00 PH=10.01	aXW_PHCAL00! aXW_PHCAL01! aXW_PHCAL02!
1	PH=4.00 PH=6.86 PH=9.18	aXW_PHCAL10! aXW_PHCAL11! aXW_PHCAL12!

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.	Request: aXW_PHCALGROUP_0!
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_PHCAL00!
3	Rinse the electrodes with deionized water. Immerse the electrode in the PH=7.00 standard buffer, stir the	Request: aXW_PHCAL01!

	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.	
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_PHCAL02!
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_PHCALRESET!

7.2 ORPCalibration

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

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 PH calibration value to the factory setting.	Request: aXW_ORPCALRESET!

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.

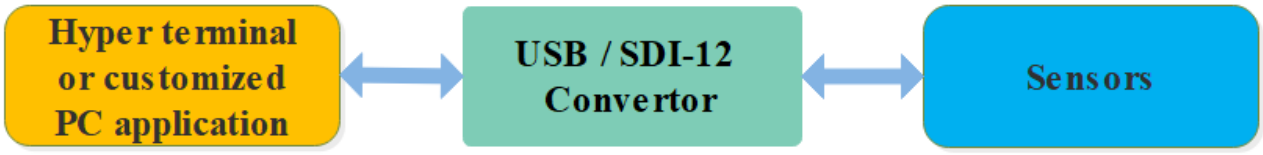
This chapter mainly introduces the communication or parameter setting on a computer for sensor through the SDI-12 converter (SDI12ELF20).

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, 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.

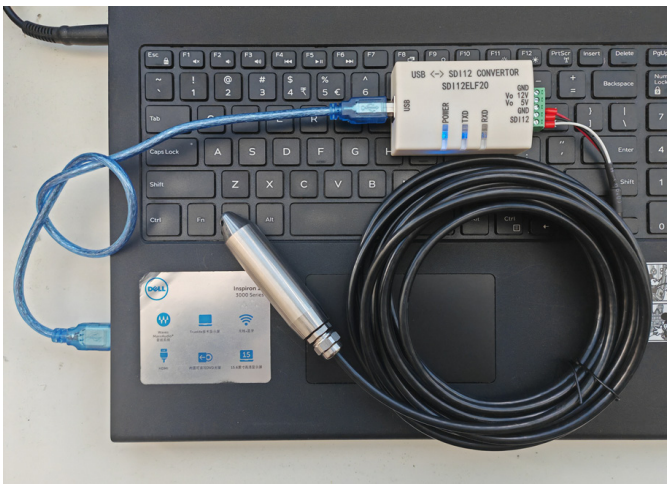
Testing Software Download	
Terminal (universal serial port debugging tool)	https://www.infwin.com/resource-serial-port-com-development-tool/
SensorOneSetSDI12 (SDI-12 sensor configuration utility)	https://www.infwin.com/resource-sensoronesetsdi12-configuration-utility-for-sdi-12-sensors/

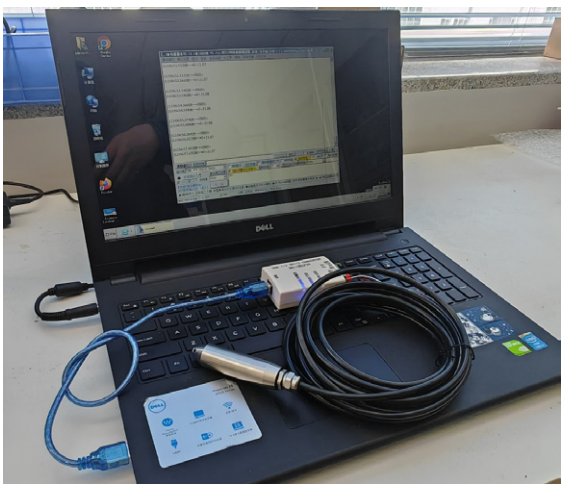
A.2 Testing Example

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/

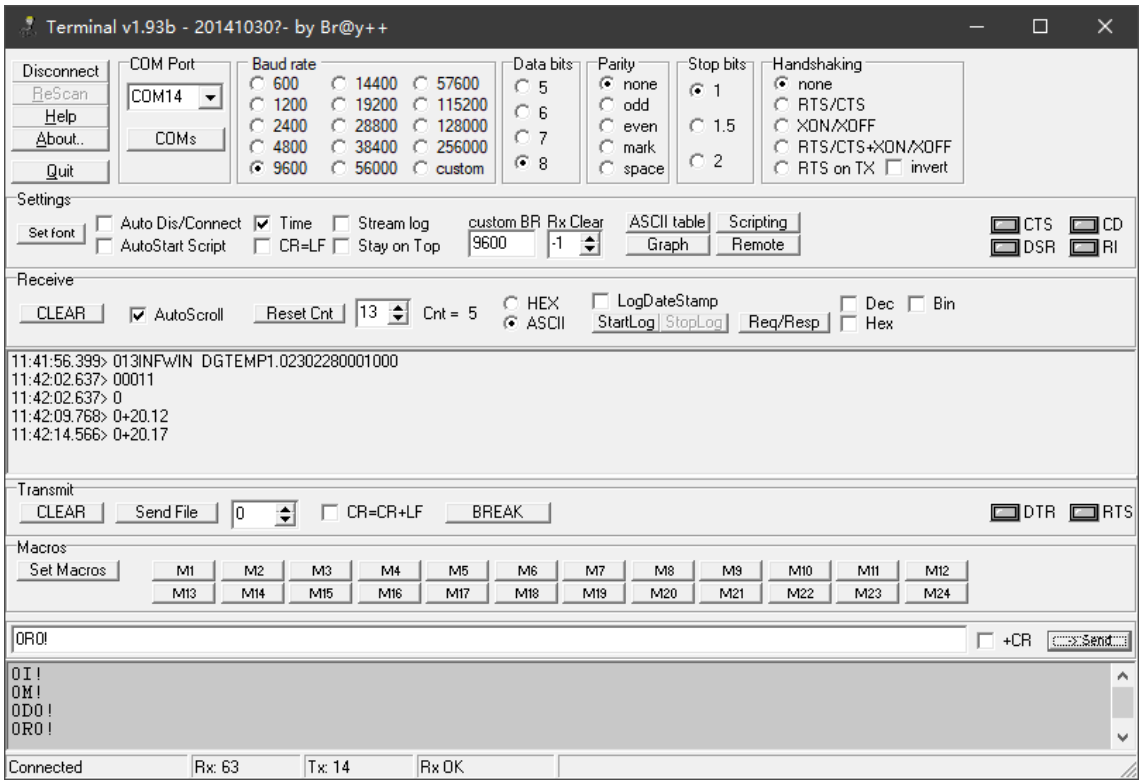
■ **Connections**





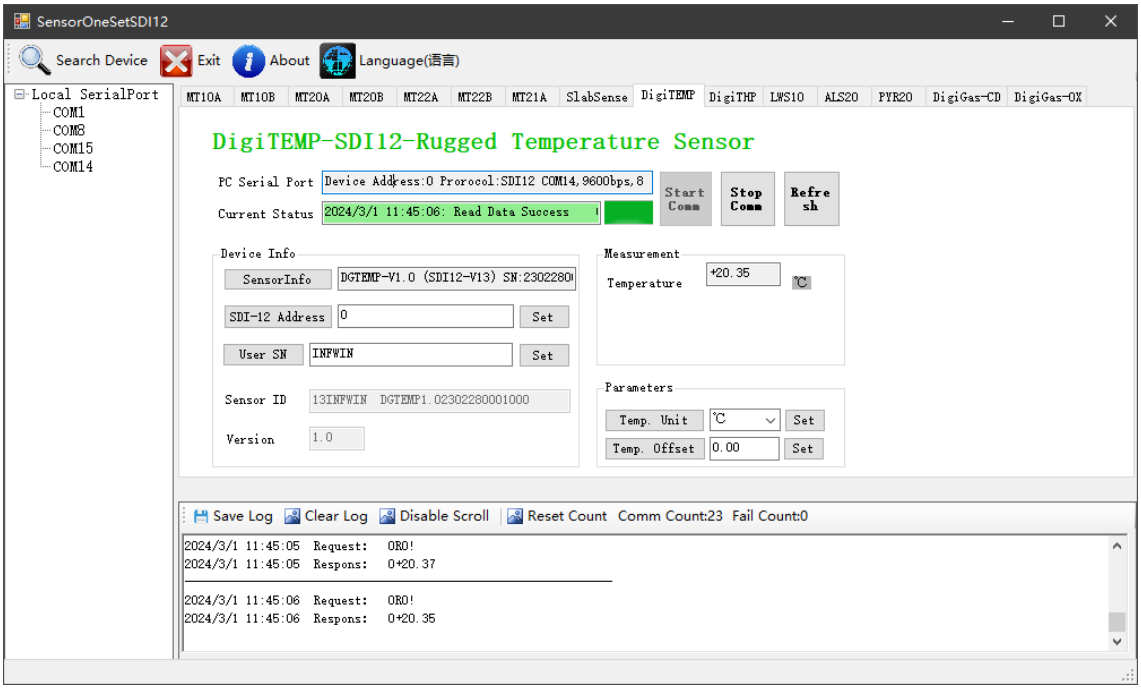
■ **Testing with serial port utility "Terminal"**

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.


SensorOneSetSDI12
Search Device
Exit
About
Language(语言)
Local SerialPort
COM1
COM3
COM15
COM14
MT10A MT10B MT20A MT20B MT22A MT22B MT21A SlabSense DigiTEMP DigiTHP LWS10 ALS20 PYR20 DigiGas-CD DigiGas-OX
DigiTEMP-SDI12-Rugged Temperature Sensor
PC Serial Port
Device Address:0 Prorocol:SDI12 COM14,9600bps,8
Current Status
2024/3/1 11:45:06: Read Data Success
Start Comm
Stop Comm
Refresh
Device Info
SensorInfo
DGTEMP-V1.0 (SDI12-V13) SN:2302280
SDI-12 Address
0
Set
User SN
INFWIN
Set
Sensor ID
13INFWIN DGTEMP1.02302280001000
Version
1.0
Measurement
Temperature
+20.35
℃
Parameters
Temp. Unit
℃
Set
Temp. Offset
0.00
Set
Save Log
Clear Log
Disable Scroll
Reset Count
Comm Count:23 Fail Count:0
2024/3/1 11:45:05 Request: 0R0!
2024/3/1 11:45:05 Respons: 0+20.37
2024/3/1 11:45:06 Request: 0R0!
2024/3/1 11:45:06 Respons: 0+20.35

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Version Control

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2024-02-11	V1.0	Initial Creation	sl51930