pH Sensor

pH1200

Version 1.05

User Manual

Greenspan Customer Service
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Technical Support When You Need It

The correct choice of sensor should be supported by professional advice to ensure long term success in the field. **Greenspan Technical Services** is dedicated to customer support and provides assistance in the selection, installation, deployment and commissioning of sensors with a full range of consulting services.

A full technical support and field advice service can be accessed by ringing **Customer Service** on +61 7 4660 1888 between 8am - 6pm, 5 days a week.

All requests for information will be serviced within 24 hours.

All Greenspan products are designed, developed and manufactured in Australia and can be supplied at short notice.

Warranty Details

Greenspan warrants all new Greenspan products against defects in materials and workmanship for **12 months** from the date of invoice. During the warranty period, we will repair or, at our option, replace at no charge a product that proves to be defective provided that it is returned, shipping prepaid, to Greenspan Technology Pty Ltd.

Greenspan's liability and obligations in connection with any defects in materials and workmanship are expressly limited to repair or replacement, and the sole and exclusive remedy in the event of such defects shall be repair or replacement. Greenspan's obligations under this warranty are conditional upon it receiving prompt written notice of claimed defects within the warranty period and its obligations are expressly limited to repair or replacement.

This warranty does not apply to products or parts thereof which have been altered or repaired outside of the Greenspan factory or other authorised service centre, or products damaged by improper installation or application, or subjected to misuse, abuse neglect or accident. This warranty also excludes items such as reference electrodes and Dissolved Oxygen membranes that may degrade during normal use.

Greenspan Technology Pty Ltd will not be liable for any incidental or consequential damage or expense incurred by the user due to partial or incomplete inoperability of it's products for any reason whatsoever or due to inaccurate information generated by its products.

All Warranty service will be completed as soon possible. If delays are unavoidable customers will be contacted immediately.

The sensors should not be dismantled unless under instruction from Greenspan. Incorrect handling will void the warranty.

Contents

1. Introduction to the pH1200 Sensor

1.1 Overview

The Greenspan SDI-12 sensor range has been designed to allow connection to the SDI-12 serial / digital network widely used in the hydrological and field monitoring industry.

SDI-12 allows multiple connection of sensors to a single data-logging recorder, transmitting at 1200 baud over distances up to 60 metres (200 feet) between each sensor and the data logger.

The pH1200 includes complete linearity correction and temperature correction over a wide range, thereby maintaining its factory accurate calibration while in the field. Each sensor is individually calibrated over span and temperature. The pH1200 conforms to SDI-12 version 1.2 protocol.

2. Packaging

Media compatibility should be checked before using the sensor and advice sought from Greenspan if any doubt exists. The 316 stainless body can be used in the majority of situations, but care should be taken against possible corrosion in high Chloride or Ferric solutions.

The body should always be totally immersed under the water to ensure the electronic module is at water temperature and also to avoid any possible anodic / cathodic action taking place on the stainless body at the water-air interface due to oxygen differences across the boundary. It has also been noticed at some sites that clamps used to support the sensors made of dissimilar metal to the 316 stainless body have occasionally caused spot corrosion due to electrolysis action.

An optional Delrin plastic body is available if there is concern with the suitability of the 316 stainless steel.

3. Unpacking Your pH1200 Sensor

Here are the items you should have received.

1. Greenspan pH1200 sensor with polyurethane cable.

2. This User Manual*

3. SDI-12 Command Calibration Reference*

Check the cable is long enough to reach from the depth selected to the data recorder.

* This item can be ordered separately from Greenspan or can be downloaded from http://www.greenspan.com.au/manuals.htm

4. Checking the Model Number and Range

Before installing your Greenspan SDI-12 sensor check the information on the label is correct to confirm you have received the instrument you have ordered. The label will look like this.

MODEL pH1200

RANGE 0-14 pH/0-50°C

OUTPUT SDI-12

S/N 001243

5. Testing Your System

Before installing your Greenspan SDI-12 sensor you may wish to familiarise yourself with its operation. Placing the sensor in a bucket of water and observing your data recorders readings can do this. This has the added advantage of easy access to a telephone if any questions arise.

6. General Methods of Installation

There are many ways of installing sensors in the field in order to ensure the continuous gathering of data and the safety of the device. Consideration needs to be given to the possibility of vandalism, animal damage, theft and extreme weather conditions. Sensor should always be deployed with the stainless steel drop cable, or damage will result.

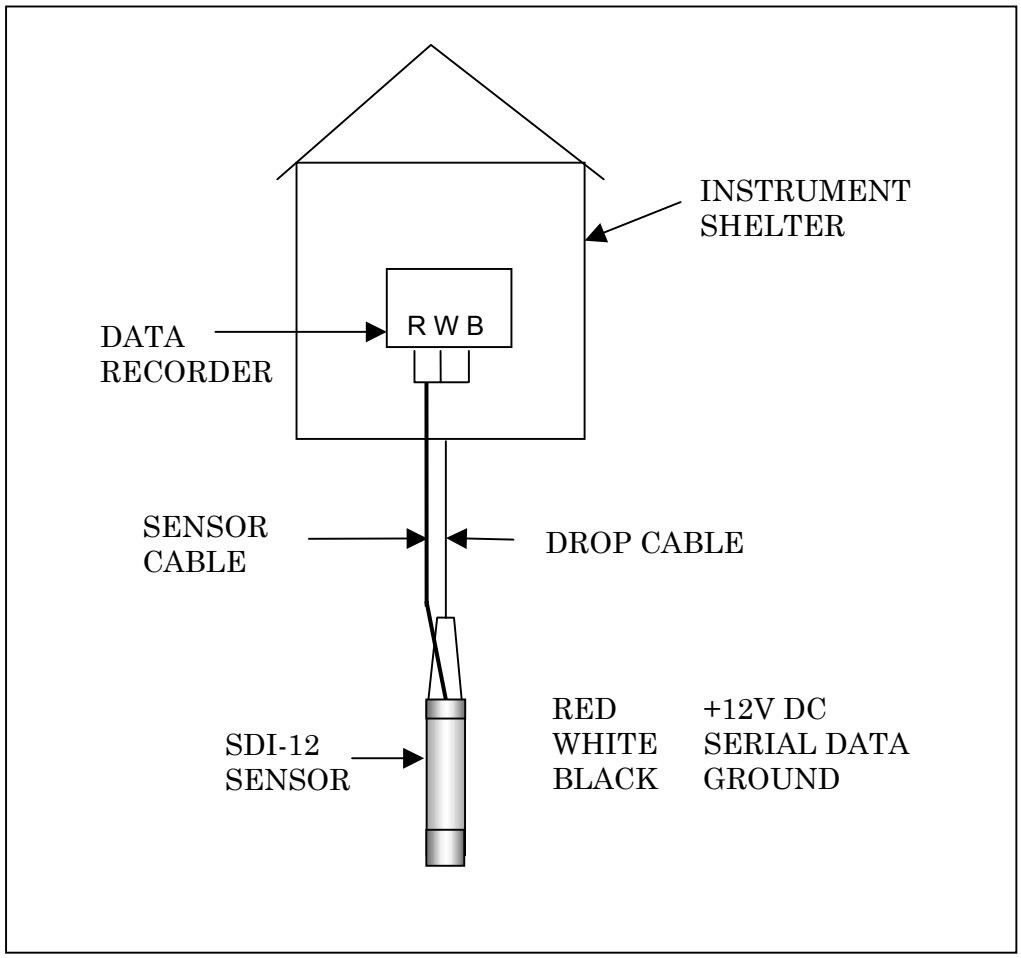


Figure 1. Installation

Note: Additional SDI-12 sensors are wired in parallel to the data recorder.

* Greenspan does not supply the stainless steel drop cable.

Some methods commonly used are:

1. Suspended sensor attached to a guide wire and winch board, which is useful for profiling applications.

2. Fly wire across stream or river, tether the sensor to the fly wire and fully immerse.

3. Installed in PVC conduit with sensor protruding from immersed end.

4. Sealed waterproof, self contained vessel including batteries and continuous logging equipment. Excellent for concealment.

5. Strapped to a pylon or post in areas that become submersed, cabled to bank.

6. Hand operation for spot readings.

6.1 Typical Locations

1. Suspended above bore hole via drop cable

2. Edge of a river, stream or lake embankment.

3. Side of a boat or vessel.

4. Mounted within a stilling well.

5. Mounted within drainage channels or pipes.

6. Suspended from dam walls.

7. Sensor anchored to bed of lake or stream

6.2 Field Installation Instructions

The Greenspan Range of Pressure Sensors and Water Quality Sensors can be installed into a variety of applications including:

- Rivers, Lakes and streams
- Bore Hole and groundwater wells
- Tanks and Reservoirs
- Wet Wells for Water and Sewer Systems

In all field applications, mechanical, electrical and physical protection of the Sensor, cabling and associated fittings must be provided.

Field Installation must ensure:

- The sensor is anchored or held in position or located so it is not subject to any movement during normal operations.
- Sensor is protected from direct sunlight to avoid high temperature fluctuations
- Sensor is protected against high turbulence and possible debris loading during flow events

6.3 Option 1: Non Turbulent Conditions

Where there is no possibility of the sensor being affected by turbulence it can be suspended into the water body using a stainless steel hanger cable. For example where the sensor is installed into a large water storage tank. The sensor will hang vertically into the tank and not be subject to movement from water movements. The stainless steel wire prevents loading of the sensor cable.

In Sewer Wet Well and Water Tank applications where high turbulence and debris loading may affect the sensor, the following minimum installation standards must be followed:

6.4 Option 2: High Turbulent Conditions

Where turbulence and water movement will act on the sensor it is recommended to mount the sensor in a stilling well or mounting cradle attached to the side of the well. This could simply be a length of PVC pipe bolted to the well wall in which the sensor is located or could be an extension pole with a sensor cradle at the lower end. Potential ragging and debris build up on the sensor & cable should be overcome by extending the stilling well to above the high water level or by cable tying the sensor cable up the cradle mounting arm. The movement of the sensor must be eliminated such that the sensor is not subject to twisting motion from swirling water during pumping, or from sideways movement due to ragging of the sensor.

In all sewer wet well applications regardless of the mounting system used it is recommended to also utilise a stainless steel hanger wire to prevent loading the sensor cable during installation, removal and maintenance. The stainless steel wire must be securely connected to the sensor using the hanger hook and the sensor cable should be cable tied at regular intervals up the stainless wire. An outer sheath of hose or tubing can be fitted over both cables to reduce ragging and debris build up on the cables. At the top of the well the stainless wire can be attached to a bolt or mounting point.

The stainless steel suspension hanger cable can be provided by Greenspan. (Part No 7SK-100)

Warning:
Under no circumstances must the sensor be installed such that it can collide with the sides of the well, or other solid objects within the well. Sensor installation under these circumstances will lead to sensor damage that will not be covered under our normal warranty conditions. In these cases the sensor must be mounted into a cradle or stilling well as per Option 2.

6.5 Other Considerations

When installing the sensor, ensure that the pH electrode cap is removed. To do this, pinch the tip of the pH electrode cap with the fingers and pull. A slight twisting action may help if it is tight.

After removing the sensor from deployment it is recommended the pH electrode cap is filled with pH4 solution and replaced to prevent the pH electrode from drying out.

Environmental compatibility should be checked before using the sensors and advice sought from Greenspan if any doubt exists. The 316 stainless body can be used in a majority of situations but care should be taken against possible corrosion in high Chloride, Sulphate or Ferric solutions.

The body should always be totally immersed under the water to ensure that the sensor is at water temperature and to also avoid any possible anodic/cathodic action taking place on the stainless body at the water-air interface. At some sites it has also been noticed that clamps used to support the sensor made of a dissimilar metal to the 316 stainless body can cause spot corrosion due to electrolysis.

6.6 Unit Range

The Greenspan pH sensor has been designed to operate to a maximum range of pH 14.

7. Sensor Maintenance

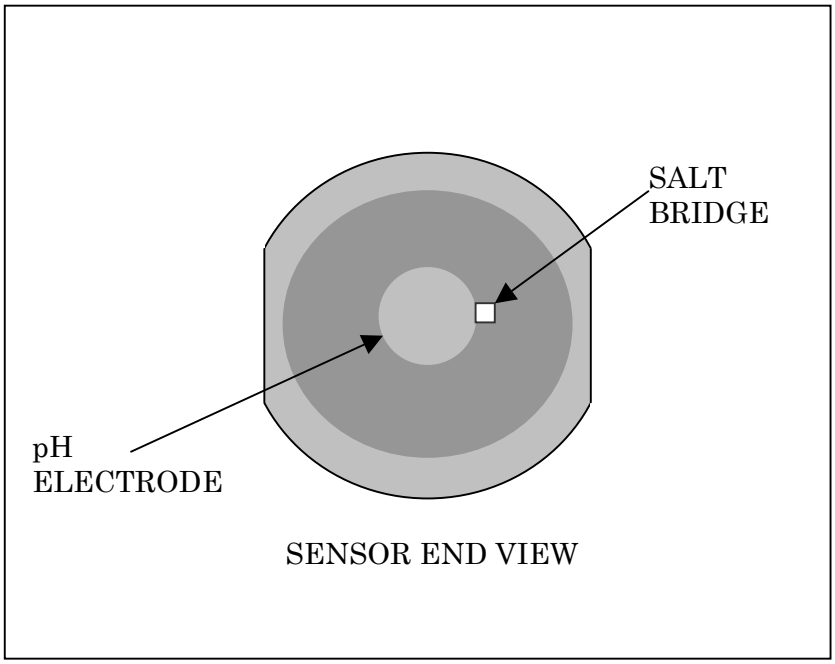
The sensor electrode should always be stored in de-ionised water or pH4 solution. The pH electrodes are shipped from Greenspan with a plastic electrode cover filled with pH4 solution. The plastic cap must be carefully removed prior to field installation of the sensor. The cap should be retained for future use if the sensor needs to be removed from site and stored, or moved to another location. (Refer section 6.5)

If the electrode is not kept moist it may dry out over a 36-hour period and cause erroneous readings. Restoration may be possible by soaking the sensor in pH4 or KCL solution for several hours.

Both the electrode and salt bridge must be kept reasonably clean at all times. Do not allow fats, oils, or proteins to dry on the electrode or salt bridge.

The electrode may be cleaned with mild solvent or detergent. Abrasive materials must not be used, a wash bottle or cotton bud is recommended. After cleaning, wash well with tap water and soak before use.

The gel filled electrode has distinct advantages for long term field applications, but has a limited lifetime. It is recommended that the electrode be replaced as recommended in section "Field Considerations".



8. pH Field Considerations

For sensors installed in difficult conditions, experience has shown that the Greenspan pH sensor usually requires 1-2 monthly visits to ensure that the electrode membrane is clean.

A common approach is to take a standard pH buffer into the field so that the pH sensor can be dipped into the solution and checked for conformity against manufacturers specifications. If it fails, the sensor should be withdrawn from service for recalibration and/or pH bulb replacement.

The expected lifespan of the gel type pH transducers in good field conditions is from 2-3 years, in poor conditions this may reduce to 12-18 months.

If performance is deteriorating or calibration is not being maintained, and the sensor is of age, then replacement of the transducer may be required. The sensor will need to be returned to Greenspan or one of its agents for transducer replacement and recalibration.

9. Operation

The Greenspan pH1200 combines robust, sealed construction with ease of use. Due to its low power consumption it can be operated from remote power sources for extended periods.

The advantage of incorporating a microprocessor is the ability to control both the offset and full scale settings. The main purpose for this is to make fine adjustments when required, as part of regular maintenance. These features are implemented with the extended SDI-12 commands.

10. Extended Commands

Please refer to the SDI-12 Command Calibration Reference for further information on the following commands.

10.1 User Gain

The User Gain command enables re-scaling when calibrating the sensor.

10.2 User Offset

The User Offset command allows the user to modify the offset of the sensor.

10.3 Zero Channel

The Zero Channel command will allow an automatic zero calibration. This command can also be used while the sensor is in place to reference the zero reading to where to sensor is located.

10.4 Reading data from the Greenspan pH1200

Your selected data recorder must be able to read SDI-12 signals. Since data recorders differ widely, you must follow the manufacturers' instructions when reading data. User requirements also differ, so the data recorders need to be programmed individually.

Detailed operation of the SDI-12 standard can be found in the document "A Serial-Digital Interface Standard for Microprocessor-Based Sensors" version 1.2 at web address.

http://www.sdi-12.org.

11. Calibration

11.1 pH Calibration

This procedure assumes laboratory standards are available.

To re-calibrate the pH channel:

1. Ensure sensor is connected to power and computer.

2. Calibration of pH requires a 2 point Gain and Offset Calibration.

3. Set current user *Offset Correction* to 0 *eg: 0XU0W030!* (Uoffset). Refer to Table 1 in Appendix of SDI-12 Command Manual for channel value.

4. Set current user *Gain Correction* to 1 *eg: 0XU1W031!* (Ugain). Refer to Table 1 in Appendix of SDI-12 Command Manual for channel value.

5. Remove the plastic cap from the pH bulb, if present. Spray clean the pH bulb with distilled water from a dispensing bottle. Gently dry with anti-static cloth.

6. Partly fill a pre-cleaned cap with fresh pH7 buffer and place onto pH bulb. Allow to stabilise for two minutes.

7. Obtain the measurement for pH Std 1 using *Start Measurement* command for pH7. *eg: 0M!* (Meas1). Wait for time out, then use the *Send Data* command *0D0!* to display reading.

8. Remove the cap from the pH bulb, spray clean the pH bulb and cap with distilled water. Gently dry with anti-static cloth.

9. Partly fill the pre-cleaned cap with fresh pH4 or pH10 buffer depending on the intended field use of the sensor and place onto pH bulb. Allow to stabilise for two minutes.

10. Obtain the measurement for pH Std 2 using *Start Measurement* command for pH4 or pH10. *eg: 0M!* (Meas2). Wait for time out, then use the *Send Data* command *0D0!* to display reading.

11. To re-calibrate the sensor, calculate the new user gain:

$$\text{new Ugain} = \frac{\text{pH Std 2} - \text{pH Std 1}}{\text{Meas2} - \text{Meas1}}$$

for example:
If measured pH10 value (Meas2) is 9.98, measured pH7 is 6.89 (Meas1), pH10 Std 2 is 10.06 and pH7 Std 1 is 6.88

$$\text{new Ugain} = \frac{10.06 - 6.88}{9.98 - 6.89}$$

$$= \mathbf{1.029126}$$

12. Calculate new User Offset correction:

    new Uoffset =pH Std2 – (Ugain x Meas2)

    for example:
    If pH10 measurement is 9.98pH and pH Std2 is 10.06 and Ugain is 1.03

    new Uoffset = 10.06 – (1.029126 x 9.98)
    = **- 0.27**

13. Write new *User Offset Correction* (*eg: 0XU0W03-0.27!)* Refer to Table 1 in Appendix of SDI-12 Command Manual for channel value.

14. Write new *User Gain Correction.* (*eg: 0XU1W031.029126!)* Refer to Table 1 in Appendix of SDI-12 Command Manual for channel value.

15. If using pH10 buffer, clean bulb as before and replace cap with pH4 for storage.

16. The pH channel is now re-calibrated and ready for use.

It is recommended calibration is checked every six months.

11.2 Temperature Calibration

The temperature calibration is factory set, it is strongly recommend this channel is not re-calibrated by the customer due to difficulties involved in setting up accurate, stable temperature standards.
The method presented here is included for completeness and assumes an accurate temp reference bath.

1. Ensure sensor is connected to power and computer.

2. Set up a low temperature stable bath (0-10°C)

3. Immerse the sensor in the bath (sensor should be completely covered) and allow two hours for sensor to stabilise to bath temperature.

4. Temperature calibration requires a 2 point Gain and Offset Calibration.

5. Set current *User Offset Correction* to 0 *eg: 0XU0W040!* (Uoffset). Refer to Table 1 in Appendix of SDI-12 Command Manual for channel value.

6. Set current *User Gain Correction* to 1 *eg: 0XU1W041!* (Ugain). Refer to Table 1 in Appendix of SDI-12 Command Manual for channel value.

7. Obtain the low point using *Start Measurement* command for temperature. *eg: 0M!* (Meas1). Wait for time out, then use the *Send Data* command *0D0!* to display reading.

8. Immerse the temp sensor in the hot water bath, (approx. 40- 50°C). Allow two hours for temperature to stabilise. Most sensors have the temperature reference device mounted internally and therefore require the airspace around them to equilibrate to case temperature.

9. Obtain the high point using *Start Measurement* command for temperature. *eg: 0M!* (Meas2). Wait for time out, then use the *Send Data* command *0D0!* to display reading.

10. To re-calibrate the sensor, calculate the new user gain:

$$\text{Ugain} = \frac{\text{Full Scale}}{\text{Meas2} - \text{Meas1}}$$

where: Full Scale = 50°C

for example:
If measured temperature (Meas2) is 45°C and measured low value (Meas1) is 5°C

new Ugain = $\frac{50}{45 - 5}$
= **1.25**

11. Calculate new *User Offset Correction*:

    new Uoffset = Full Scale - (Ugain x Meas2)

    for example:
    If Full Scale is 50°C and measured temperature is 45°C

    new Uoffset = 50 - (1.25 x 45)
    = **-6.25**

12. Write new *User Offset Correction, eg: 0XU0W04-6.25!*. Refer to Table 1 in Appendix of SDI-12 Command Manual for channel value.

13. Write new *User Gain Correction, eg: 0XU1W041.25!*. Refer to Table 1 in Appendix of SDI-12 Command Manual for channel value.

14. The Temperature channel is now re-calibrated and ready for use.

It is recommended calibration is checked every six months.

12. Specifications

Specification		Model pH1200
Range	pH Temp	0-14 pH 0 –50°C
Operating Temperature		0 to +50°C
Baud Rate		1200 baud
Address Range		00 to 09 A to Z
pH Accuracy		± 0.2 pH
Temperature Accuracy		± 1°C
Output		SDI-12
Supply Voltage		11-14VDC
Standby Current Comms Current Measurement Current		<200uA <15mA <50mA
Reading Time		2 seconds
Cable		Polyurethane outer-sheath Maximum length 60 metres
Dimensions:	Length Diameter	390mm 44mm Stainless Steel 47mm Delrin
Weight (potted)		680g Delrin 810g Stainless Steel
Wetted materials		Passivated 316 Stainless Steel, Delrin, Polyurethane