Pressure Sensor

PS100

Version 1.05

User Manual

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Greenspan Customer Service

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 it 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.

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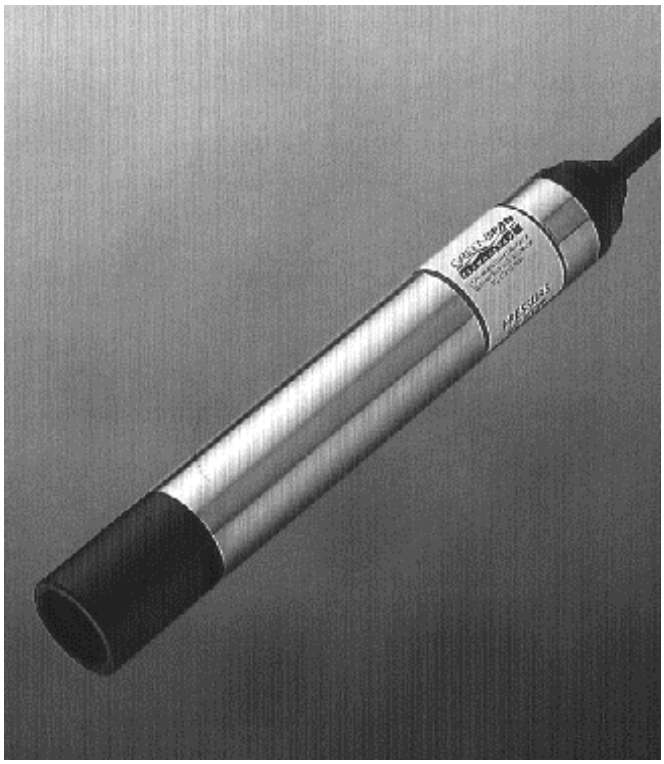
INTRODUCTION 1

Overview

The GREENSPAN Pressure Sensor, model number PS100 is a single output sensor designed for two wire connection.

The instrument is packaged in a durable, robust, Delrin or stainless steel housing fully sealed against moisture penetration and is hardwired to either vented or non vented cable supplied by Greenspan. A number of connection options are available for the cable that are customer selected.

The transducer consists of a ceramic disk that changes its capacitance linearly with applied pressure. This variation is measured by an electronic circuit and converted into a current ranging from 4mA at low pressure to 20mA at full scale. The sensor can be supplied in a variety of standard ranges.



PS100 Pressure Sensor

PRESSURE MEASUREMENT 2

Background

There are traditionally numerous ways to monitor depth readings of water bodies and they vary from floats and pulleys attached to chart recorders, capacitance tubes, acoustic reflection devices and pressure sensors attached to data loggers. The choices are dependent upon cost, accuracy and physical limitations of the measurement system devices and environmental constraints.

Techniques for Measuring Pressure

Several technologies have evolved in recent years to measure pressure in fluids. They include simple strain gauge silicon or stainless steel diaphragm sensors to more sophisticated capacitance ceramic resonant quartz sensors.
There has been a similar evolvement with the electronic circuits that monitor the physical change of the sensing technology. This can include basic temperature compensation or more sophisticated microprocessor controlled sensors which manage both temperature compensation and linearity connection.

Specific Characteristics of Pressure and Depth

Pressure sensors, which are used in the water industry, are calibrated to provide an output in metres or feet of water level. The sensors can be ordered as Gauge or Absolute or referenced to one atmosphere. A Gauge sensor will have one face of the pressure diaphragm exposed to the measuring fluid or air pressure and the other face exposed to atmospheric air pressure.
A gauge sensor removes measurement errors due to changing atmospheric pressure conditions. For example, if a 2 metre sensor is reading full scale and the atmospheric pressure changes from 1000 millibar to 1020 millibar both faces of the sensor experience the same pressure equivalent to approximately 200mm depth thus the sensor will continue to read 2 metres.

Gauge sensors utilise a vent tube to the surface to ensure that the reverse face of the pressure sensor experiences the atmospheric pressure. Vent tubes are generally encased in the sensor cable that connects the pressure sensor to the measuring instrument on the surface. The use of vent tubes is a very practical means of balancing atmospheric changes but care should be observed with their deployment. (See field deployment)

Absolute sensors have their reverse face enclosed and fixed at zero pressure whereas others can be referred to one-standard atmosphere. These have an advantage that a vent tube is not necessary but the disadvantage, in shallow depths, that the atmospheric pressure must be independently and accurately monitored to compensate for the significant errors due to atmospheric changes. It tends to be more of a problem when longer term monitoring is being considered as atmospheric pressures are unlikely to change during, quick, on the spot depth readings.

Water Density and Gravity

When pressure sensors are used for depth readings of any fluid the fluid density becomes an important parameter. In Australia a standard describes the relationship between force and water depth:

Australian Standard AS1376-1973 *

1kPa = 102.15 mm of pure water. @20degC

There is a difference in the density between pure water and seawater that may be of the order of three percent. This difference should be considered when particular measurement accuracies are required.

Another factor affecting calibration accuracy is gravity. The departure from standard gravity in Warwick, Qld is –0.17%. at latitude 27.973 deg, height 458m above sea level.
All Greenspan sensors are corrected for gravity as part of their calibration.

**For conditions, see Clause 1.3.8.3 Australian Standard AS1376*

HARDWARE 3

Sensor Design

The Greenspan PS100 pressure sensor consists of the following primary elements:

- Ceramic capacitance pressure transducer (sensing element)
- Signal conditioning and output circuit
- Data cable with/without vent tube
- Stainless Steel and Delrin packaging

Transducer

A transducer or transmitter provides a means of transferring one physical parameter to another i.e. pressure to electrical current or F (force) to I (current). The pressure transducer is a capacitive type. Pressure variations on a front plate are detected relative to a second plate and amplified to produce a signal that is linear over a fixed range. The transducers are available in various ranges. The Over Range Pressure is rated up to x40 times the full-scale value depending on range, (see Appendix 1, page 13).
The sensor face is made of a ceramic material (96% Aluminum Oxide, a highly resistant surface for many aggressive gases and liquids).

Signal Conditioning Circuit

This unit performs the following tasks:

- Provides a constant voltage to drive the ceramic sensor capacitance circuit.
- Monitors the output voltage from the ceramic sensor.
- Provides 4-20mA or voltage output suitable for data acquisition or process control.
- Accepts any supply voltage between 8-30V to provide a stable internal operating voltage.

The electronics are assisted by the highly stable nature of the transducer ceramic and its repeatability.

The sensor requires two seconds from power on to ensure full accuracy of reading.

Data Cable and Vent Tube

The data cable consists of the following:

- Outer sheath of wall thickness 1.2 +/-0.3mm, Polyurethane.
- Eight inner cores of 7 strand x 0.2mm copper, PVC sheathed.
- Vent tube of approximately 3mm nylon for atmospheric pressure equilibration
- Aluminium earth shield and drain wire

The cable has a resistance of 9 ohms per 100m of conductor. There are two conductors in a two wire system. Therefore, if 25m of cable is used with a 4-20mA sensor the total voltage drop across the cable at full scale is:

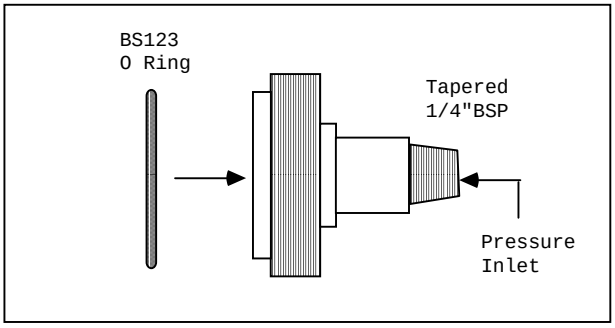
= (Full scale x 25 x 0.09) x 2

= 20mA x 2.25 x 2 = 90 millivolts

Therefore to ensure that the minimum voltage at the sensor is at least 8 volts a supply voltage of 8 + 0.090 = 8.09V is required.

Brass Pressure Fitting

The pressure sensor is available with an optional brass pressure fitting for use in process control applications. It is provided with an 'O' ring seal for mating against the sensor bulkhead and a $^1/_4$" BSP tapered pressure fitting. The brass fitting should be screwed into the sensor to lightly compress the 'O' ring.



Protection

The sensors are protected against reverse voltage connection and transient voltages up to 2KV such as may occur during lightning storms. However, if using in areas prone to lightning activity it is recommended that lightning arresters be fitted to all input cables.

Pressure Venting System

When vented pressure sensors are deployed, there is usually a difference between the atmospheric temperature and the temperature of the sensor at depth. This temperature differential causes a pumping effect to occur whereby moist air from the surface is drawn into the sensor through the vent line. This moisture can condense on sensitive electronic components due to warm surface air cooling inside the sensor.

This effect, however has been reduced to the absolute minimum by ensuring that the vent tube accesses the pressure transducer only and is isolated from the electronics compartment.

Sealing the system against exposure to the atmosphere and conditioning the existing air prior to entering the vent tube will alleviate this problem. Silicon desiccant crystals easily absorb moisture thereby drying the air and are used in the CVS-001 closed venting system. It is highly recommended that CVS-001 be installed on all Greenspan vented sensors.

The effectiveness of the closed venting method is compromised if the system is disassembled. Therefore, once installed or reassembled, some time is required for trapped air to become dry again. One advantage of this method is that the volume of air being dried is always constant therefore the desiccant crystal will not become saturated. Replacement of breather bags should not be necessary unless they are physically damaged.

MODEL CVS-001

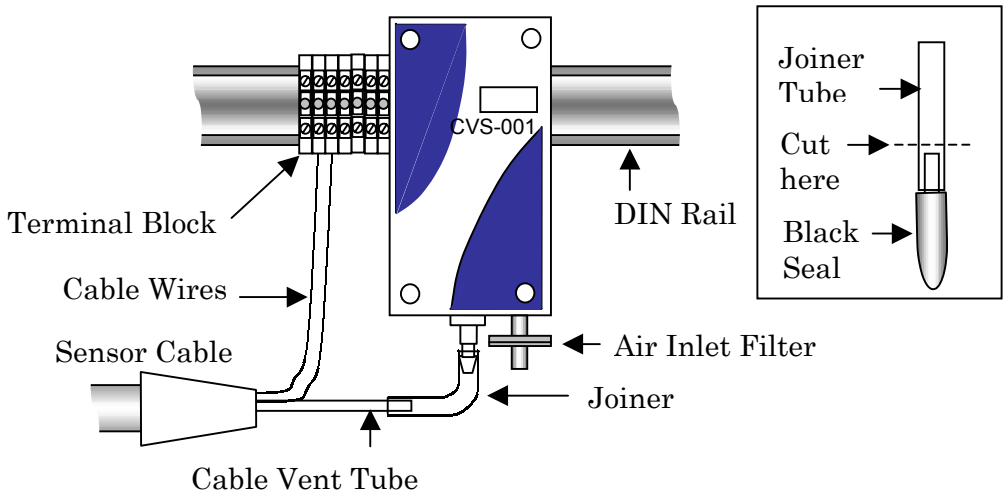


Figure 1. Single Installation, (Suggestion Only)

Remove the seal by cutting the end of the joiner tube with a sharp knife prior to connection. See inset, figure 1.

Figure 1 shows one arrangement possible for fitting CVS-001 to the sensor. A single CVS-001 is designed to handle sensor cable lengths up to **70 metres**. Multiple units may be connected together to increase the capacity.

Setup

The CVS-001 is shipped with a protective seal on the air entry hole, please ensure that this seal is cut off and removed when installing.

For correct operation of the desiccant system it is necessary to partially inflate the breather bag inside the CVS-001 to enable it to expand and contract with atmospheric pressure changes.

1. Remove joiner tube from cable vent tube. See Figure 1.

2. Attach 60ml syringe to joiner tube and withdraw all air from breather bag.

3. Remove syringe, recharge, and apply 60ml, remove syringe, recharge and repeat for a further 60ml (total 120ml).

4. Re-connect joiner tube to cable vent tube.

5. If multiple units are being used the volume of air required for priming must increase by approximately120ml for every unit connected.

   Note: Only remove the seal on the CVS–001 inlet when ready to install sensor vent tube. If dismantling the system ensure that the unit is sealed.

SENSOR MANUFACTURE 4

Quality Control Procedures

The following describes the quality process Greenspan implements to ensure that the documented specifications are consistently met.

- Each ceramic sensor is visually inspected before use.
- The sensor is assembled and calibrated.
- The sensor is tested on the dead weight calibrator to check linearity.
- All results are documented according to ISO9002 requirements (license N0:QEC3067).
- The instrument is visually inspected, marked and labeled.
  The complete sensor calibration record is archived for reference, and batch number information is kept on file for statistical analysis.
- The instrument is checked by an independent technician (Quality Control) to ensure correct operation of the sensor/system prior to shipment.
- An individual Certificate of Conformance is issued to the customer.

INSTALLATION 5

Connection

The sensor is connected to the data logger as follows:

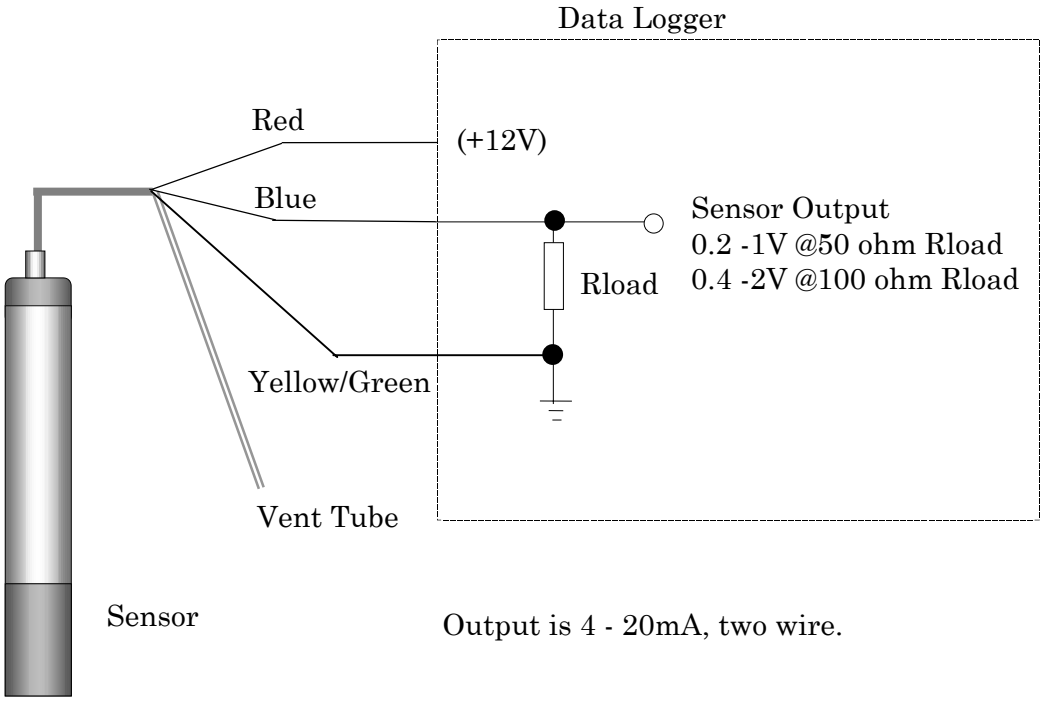


Diagram 1. Connection

Maximum load resistor: Rload = 200 ohms @ 8 Volts
Rload = 1000 ohms @ 27Volts

Typical loading for 12V is 50 - 100 ohms

The red (+12V) and blue (output), wires supply power to the PS100 sensor and provide the current loop for 4-20mA.

The Yellow/Green earth wire is for connection to a known earthing point as protection from induced electromagnetic disturbances.

General Methods of Installation

There are many ways of positioning 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.

Some methods commonly in use are:

1. Installed in PVC conduit with sensor emerging from the immersed end.

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

3. Hand operation for spot readings.

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

Typical Locations

1. Edge of river/stream/lake embankment.

3. Mounted within a stilling well off stream from the main flow.

4. Sensor anchored to bed of lake/stream

5. Suspended from dam walls.

6. Mounted within drainage channels/pipes

Media 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. Also to 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.

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

Note if the sensor is fitted with Delrin body it is recommended that the sensor is clamped or weighted with a copper nose cone to prevent buoyancy problems.

CLEANING AND MAINTENANCE 6

The sensor may be cleaned using a soft cloth and warm water, encrustation's or barnacle growth may have to be removed with a scraping action. Care is required when cleaning the head as the transducer gold plating must not be damaged or scratched.

Greenspan recommends calibration is checked every six to twelve months.

Greenspan offers a re-calibration service if required.

TROUBLESHOOTING 7

1. If output readings appear incorrect, disconnect the pressure sensor from the logger and connect a milliammeter in series with the supply and the pressure sensor output. In air, with zero pressure applied and with the sensor head vertically oriented, the reading should be 4.00mA. If the readings are still incorrect and other causes have been eliminated contact Greenspan.

2. If there appears to be no output from the pressure sensor channel, check external connections are correct, (see connection diagram) and that power is 12V and turned on.

3 Excessive algal growth may be reduced by installing a copper nose cone, which inhibits algal growth. These are available from Greenspan and are easily installed by screwing into the threaded portion of the sensor head.

APPENDIX 8

SPECIFICATIONS*

Specification	Model PS100
Standard Ranges available	0-1m, 0-2.5m, 0-5m, 0-10m, 0-20m 0-40m, 0-75m, 0-100m, 0-200m
Operating Temperature (compensated)	-5 to +60°C
Linearity (Combined Linearity, Hysteresis and Repeatability)	± 0.5% FS
Temperature Stability	± 0.25% FS (over range 0-50°C
Accuracy	± 0.75% FS (over range 0-50°C)
Supply Voltage	8-30VDC Reverse polarity protected Surge protected to 2kV
Zero Offset (Maximum Variation)	± 0.02mA
Quiescent Current	4 mA
Warm up time to stable reading	2 Seconds
Output	4-20mA
Dimensions	length 275 mm, S/S body 44 mm OD Delrin body 47 mm OD
Wetted Materials	316 Passivated Stainless Steel, Delrin, Ceramic,Viton, Polyurethane
Output Load (min-max)	0-1000 ohms at 27V 0-200 ohms at 8V
Storage Temperature	- 20 to +60°C

Over Range Pressure

Range (m)	Max. Over Range (m)	Range (m)	Max. Over Range (m)
1	40	40	250
2.5	60	75	400
5	60	100	400
10	100	200	400
20	180		

Specifications subject to change

PRESSURE SENSOR

22 Palmerin Street, Warwick 4370 Qld Australia.
Tel: 0746 601888 Fax: 0746 601800

CERTIFICATE of CONFORMANCE

Model No. **PS100**

Customer:

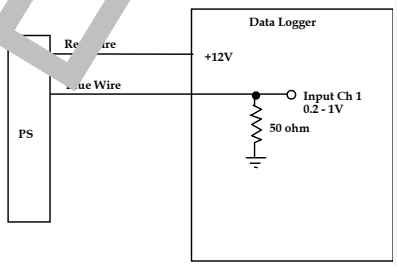
Ref:

Product Information

Serial No.		**001234**	**Cable Length**		20 metres
Range		0 - 10 m H2O	**Supply Voltage**		8- 30 VDC
Output	**FS**	20.00 mA	**Connection**	**+ve**	Red
	Zero	4.00 mA		**Gnd**	Blue
Linearity*		+/- 0.5 % of FS		**Shield**	Yellow/Green
Accuracy		+/- 0.75% FS (over 0-50°C)	**Connection Code**		BW2
Sensor Type		Gauge	For connection detail please refer to **Connector Chart** supplied.		

User Notes

1. Australian Standard AS1376 is used to convert kPa to metres of water (1kPa = 102.15 mm water).
2. Do not attempt to disassemble the sensor as this will void the warranty. Contact your agent for technical advice.
3. The sensor is protected against reverse polarity connection..
4. High range sensors utilise a 1/4” or 1/8" Tapered BSP thread.



5. *Combined Linearity, Hysteresis and Repeatability

Inspected By : ..... / /