



AQUAMONIX
Measure. Monitor. Master.

OPERATION AND CONFIGURATION MANUAL

ORP-1000 OXYGEN REDUCTION POTENTIAL SENSOR

Version 2.1 (Issued June 2017)

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1 Introduction

1.1 System Description

Thank you for purchasing the Greenspan ORP Sensor Model ORP1000. This manual provides a guide to the configuration, operation and maintenance of the sensor to provide long term reliable and accurate monitoring.

The ORP1000 probe uses a combination, Platinum ORP and reference electrode in the one body. This electrode is field replaceable by the user. Electrodes made of platinum are most commonly used for Eh measurements. The standard hydrogen reference electrode is fragile and impractical for routine field use. The Greenspan ORP1000 uses a silver:silver-chloride electrode and these are commonly used.

The reference consists of a specially coated wire in a salt filled cavity. This cavity makes electrical contact with the outside aqueous solution through a small porous wick. A common cause for premature ORP sensor failure is the chemical or biological contamination or fouling of the wick or salt filled cavity. Added protection for the reference electrode is provided by a reference protection ring constructed of porous PTFE that is impregnated with a special conductive gel. It is placed over the reference wick and should prevent most contaminants from reaching the wick, while still allowing good electrical contact with the sample. If the low cost protection ring is contaminated or fouled it can be simply replaced, extending the life of the combination electrode.

Designed for applications where an analogue output is required. The sensor provides a 3 wire 4-20mA output. The sensor requires power from a stable DC source between 11 and 13.2 Volts.

The Sensor is packaged in an Acetal body, with double o-ring seals for the cable and sensor head. This fully submersible sensor design is rugged and well proven and can withstand the harsh conditions found in remote field applications including groundwater, salty or acidic water conditions.

1.2 How to Use the Manual

Along with this manual, there are several other documents that may assist in the successful configuration and operation of the Greenspan ORP1000 Sensor. These should be maintained on file as a permanent reference as to the features, applications and use of the ORP1000.

Greenspan ORP1000 – Specifications Brochure

Greenspan ORP1000 – Certificate of Conformance

Greenspan ORP1000 – Quick Start Guide

1.3 Certification

The ORP probes are assembled and tested in accordance with Greenspan's ISO 9001 Quality Certified System. Each Sensor is individually manufactured and certified against a traceable Standard

Following calibration the sensors undergo a range of additional control processes to ensure that all specifications are consistent and documented.

- *The instrument is visually inspected, marked and labelled.*
- *The complete sensor calibration record is archived for reference, and batch number information is kept on file for statistical analysis.*
- *An individual Certificate of Conformance is issued to the customer.*

1.4 Unpacking and Inspection

All Greenspan Sensors are made to order and are individually calibrated and inspected. This ensures that they leave the factory in a working condition. On receipt, the customer should inspect the packaging and contents for any signs of damage during transportation. The customer should also check that all items on the delivery note have been received.

Please contact the factory in case anything is missing or damaged. A full set of documentation including Certificate of Conformance, Quick Start Guide, and User Manual will be provided with all equipment – either in hard copy format or in electronic format on the USB shipped with the goods.

1.5 Serial Number

Checking the Model Number and Range

Before installing your Greenspan ORP1000 sensor check the information on the label is correct to confirm you have received the instrument you have ordered. The label will look similar to this.

MODEL ORP1000

RANGE ±1000mV

S/N 012345

The customer is advised to keep a record of the serial numbers in case the sensor is lost or the label damage. Greenspan keeps records of all sensors sold including a calibration history.

1.6 Warranty Policy

Greenspan warrants all new products against defects in materials and workmanship for **12 months** from the date of invoice. Products that prove to be defective during the warranty period will be repaired or replaced at the discretion of Greenspan.

Under Greenspan warranty conditions; it is the responsibility of the customer to cover shipping charges back to the factory. Upon repair/replacement Greenspan will cover the return shipping charges to the customer.

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 will not be liable for any incidental or consequential damage or expense incurred by the user due to partial or incomplete operability of its 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.

Any sensor should not be dismantled unless under instruction from Greenspan Technical Service staff. Incorrect handling will void the warranty.

1.7 Factory Service & Repair

The correct choice of sensor and assistance with field installation can be provided by Greenspan and their sales offices. A correct choice of equipment, together with technical advice and field experience should result in 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. All Greenspan products are designed, developed and manufactured in Australia and can be supplied at short notice.

If for some reason sensors are required to be returned to our factory or your sales representative, please note the model and serial number, Describe the problem, including how and under what conditions the instrument was being used at the time of malfunction. Clean the product and cable. Decontaminate thoroughly if used in toxic or hazardous environment. Carefully pack product in original packaging if possible & include a statement certifying product and cable have been decontaminated with supporting information. Products returned for repair must be accompanied by a completed GRA (Goods Return Advice) form. All sensors returned for service and repair work must be properly decontaminated prior to return. A cleaning charge may be applied to sensors that require further decontamination. Service work will not commence until the quotation has been accepted by the customer. A purchase order for all repair and service work will be required before work is carried out.

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2 Sensor Overview

2.1 Theory of Measurement

The ORP1000 probe uses a combination, Platinum ORP and reference electrode in the one body.

The principle means of detection is by measuring the difference in potential between an inert indicator electrode and a reference electrode. At redox equilibrium, the potential difference between the ideal indicator electrode and the reference electrode equals the redox potential of the system.

2.2 Applications

Applications in which the Greenspan ORP1000 can be used include:

- Monitoring of streams and rivers.
- Monitoring of water storage bodies including stratification studies.
- Intermediate and final effluent treatment monitoring.
- Hydrological run off studies.
- Ground and bore water analysis.
- Drinking water filtration efficiency.
- Industrial process monitoring.
- Sludge and dredge monitoring.

2.3 Instrument Details

2.3.1 Sensor Design

The Greenspan ORP Sensor consists of the following primary elements:

- Field replaceable ORP electrode (fitted with reference protection ring)
- Protective Shrouds (removable for cleaning)
- Temperature compensated electronics with 4-20mA output
- Acetal Body
- Moulded cable entry
- Fitted cable

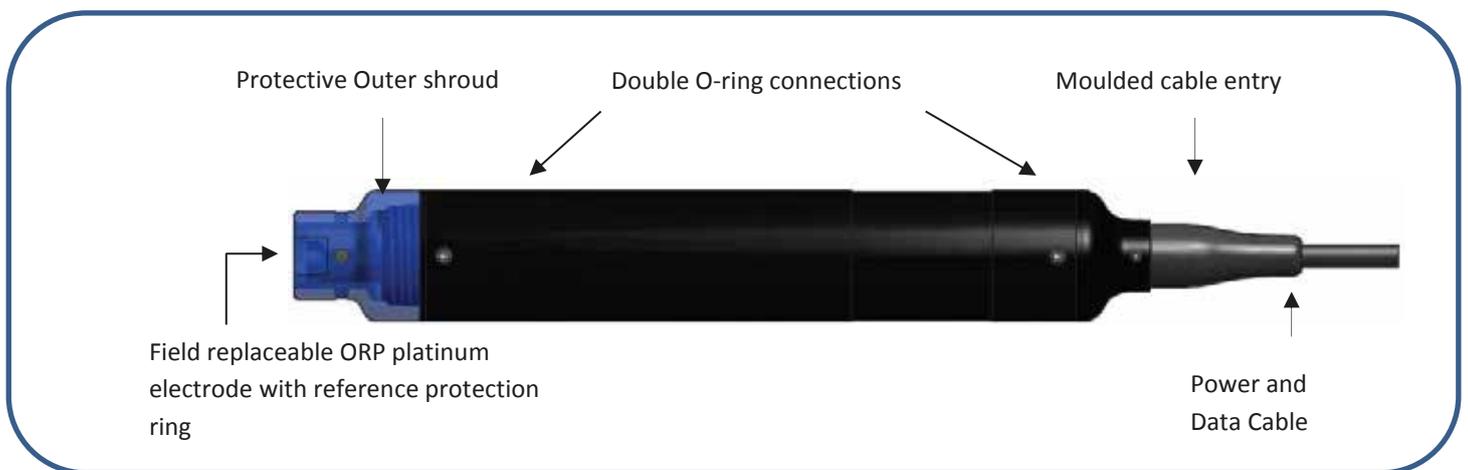
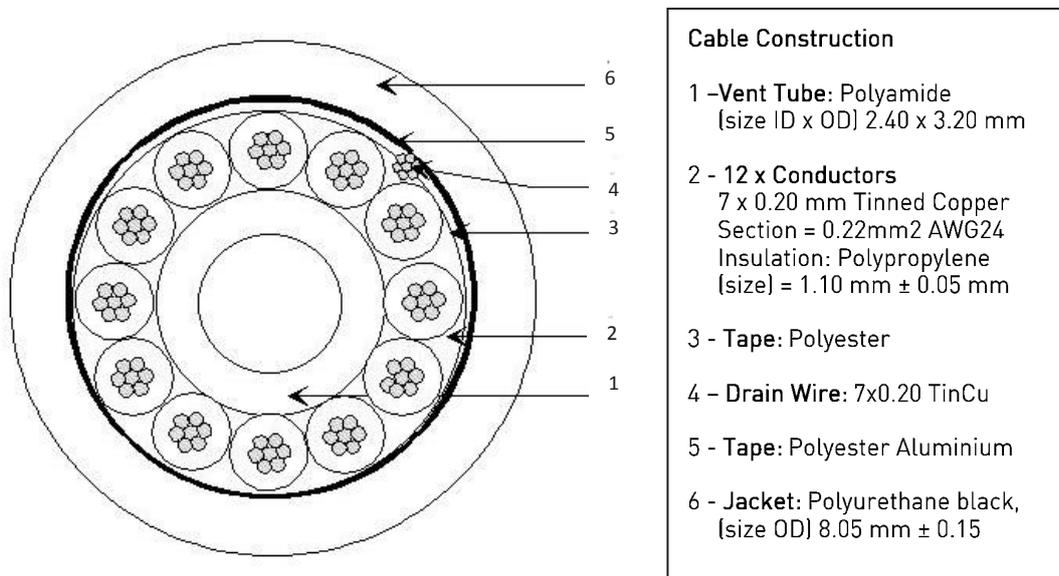


Figure 1 – ORP1000 Primary Elements

2.4 Cable Details

All Greenspan Sensors utilise a specially designed Polyurethane Cable. The cable contains 12 x conductors, 1 x drain wire, and an internal vent tube. The outer jacket is made from UV stabilized Polyurethane and is suitable for all external, underwater or harsh environment applications. This common cable construction is utilized for vented and non-vented sensors and all Greenspan Water Quality Sensors. Cables are generally factory fitted at time of manufacture in specified lengths. Cables can be joined or repaired in the field providing a waterproof connection can be maintained. Alternatively, cables can be terminated in waterproof junction boxes where cabling to other devices or longer cable runs are required.



2.4.1 Mechanical Specifications

- Specially Manufactured Greenspan Cable with 12 cores and Internal Vent
- High chemical resilience and abrasive resistance
- Conductor cross section : AWG 24,
- Electrical Resistance 9 ohm per 100m (per conductor)
- Operating temperature: 85°C (max.),
- Bending radius (static) : 6 ,
- Bending radius (dynamic) 12.
- Max Operating voltage : 250V
- Jacket Printing (white colour each meter)
- Conductor colour codes : green, yellow, white, black, brown, turquoise, violet, pink, red, blue, grey
- Tensile Strength is sufficient to self-suspend the Greenspan Sensor to depths of 300m.
- Long term creep due to temperature effects or tensile loading is negligible.

The moulded cable is fitted to the sensor using a double o ring seal and located using 2 x grub screws. The length of the cable is not critical to the long term calibration and operation of the sensor (provided the electrical requirements such as minimum supply voltage are maintained).

2.5 Options and Accessories

2.5.1 Cable Options

The sensor in its standard configuration is supplied with a fixed moulded cable and bare wire terminal connection. Special connectors can be fitted to the cables to suit specific applications, by request. Please contact your sales agent for pricing and further information.

2.5.2 Replacement Electrode Kit (Part #570-0240)

A kit containing a replacement combination electrode and spare reference protection ring is available. Contact your Greenspan sales representative for pricing and details.

2.5.3 Spare Reference Protection Ring (Part # 671-9123)

Spare reference protection rings are available. Contact your Greenspan sales representative for pricing and details.

2.5.4 Copper Inner Shroud (Part # 092-1034)

A protective copper inner shroud (*Greenspan Part # 092-1034*) can be fitted to inhibit biological or marine growth on the sensor electrode. Contact your Greenspan sales representative for pricing and details.

3 Sensor Operation

3.1 Wiring & Connections

The ORP1000 is a 3 wire, 4-20mA output sensor.

The following diagram illustrates the typical wiring arrangement for the ORP1000

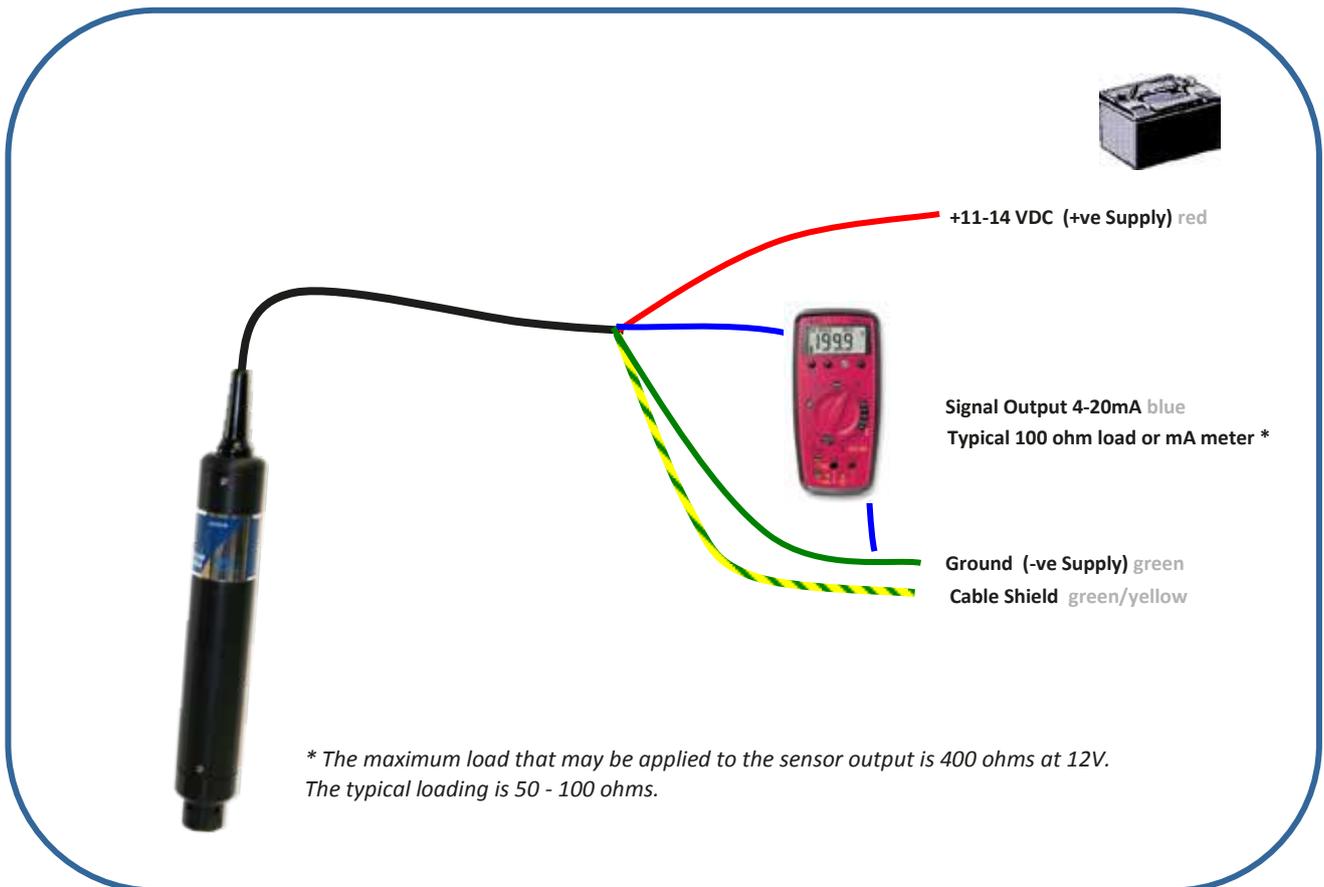


Figure 2 – ORP1000 Sensor Connection

4 Calibration & Maintenance

It is not possible to calibrate Eh electrodes over a range of redox potentials (as is done with pH electrodes). Instead standard solutions that are stable with known redox potentials for specific indicator electrodes are used to check response.

There are two main solutions used for measuring redox potentials, Light's solution and Zo Bell's solution.

The table below shows the theoretical potential of platinum ORP electrodes using two different common reference electrodes in the ORP standard Light's solution and Zo Bell's solution. The actual potential of the Greenspan ORP electrode in Light's solution is specified as 465mV+/- 10mV.

4.1.1 Comparison Table

Reference	Standard Hydrogen Electrode (SHE)	Greenspan Ag/AgCl Electrode
Light's Solution	+675mV	+465mV, +/-10mV
ZoBell's Solution	-	+229mV Saturated KCL

To determine the Eh of a sample relative to the hydrogen electrode, measure Eh of both sample and standard solution at the same temperature. Then calculate the Eh of the sample:

$$E_{\text{system}}^{\text{Eh}} = E_{\text{observed}}^{\text{E}} + E_{\text{Light's vs SHE}}^{\text{Eh}} - E_{\text{Light's Observed}}^{\text{Eh}}$$

Where: $E_{\text{observed}}^{\text{E}}$ = measured potential of sample

$E_{\text{Light's vs SHE}}^{\text{Eh}}$ = Potential of Light's versus SHE (675mV),

$E_{\text{Light's Observed}}^{\text{Eh}}$ = measured potential of Light's solution,
(465+/-10mV)

Reference

1. *Standard Methods 19th ED. 1995, 2-76, Oxidation and Reduction Potential Measurement in Clean Water.*

If the readings obtained are outside the expected values the electrode should be cleaned and/or replaced. Sensors may be returned to an authorised Greenspan agent for re-calibration.

Greenspan recommends calibration is checked every six to twelve months. Greenspan offers a re-calibration service if required.

4.2 Guidelines for cleaning sensor



The sensor and electrode may be cleaned using a soft cloth, mild detergents and warm water. If the sensor shows signs of marine growth a light biocide can be used to clean and kill any biological growth on the sensor. Sensors are supplied with a removable shroud that provides added protection for the electrode. This shroud unscrews for cleaning.

The sensor must be cleaned with the electrode in place. The sensor will be damaged by the ingress of water or other solutions into the electrode cavity. The electrode should only be removed when it is to be replaced. For heavy scaling or contamination a cleaner that contains some abrasive can be used. Rinse the electrode in clean water prior to installing sensor or checking calibration.

5 Installation

5.1 Shipping and Storage Cap



The ORP1000 sensor is shipped with a rubber cap covering the ORP electrode. This cap contains a small amount of 3M KCl solution and is in place to prevent the electrode from drying out during shipping and storage. **This cap must be removed prior to installation.** The cap should be retained so that it can be placed back on the electrode if the sensor is to be removed.

5.2 Field Deployment Considerations

The sensor should always be completely submerged and positioned such that the possibility of air bubbles becoming entrapped on the electrode is minimised. Trapped bubbles may cause errors in the output. The sensor should be periodically inspected for fouling, and can be cleaned with fresh water and damp cloth. In marine environments crustaceans may need removal at regular intervals.

The sensor should always be fully immersed under the water to ensure the electronic module is at water temperature. Sensors should generally be installed such that they can be easily and safely removed for cleaning and servicing. For environmental applications the sensor can often be mounted inside a section of PVC or steel pipe that enters the water body. The sensor can then be slid down inside the pipe until the sensor head just protrudes into the water body. This provides a high degree of protection for the sensor from environmental (sunlight, heat, flood debris etc) as well as from other influences such as cattle, vandalism etc. Most sediment transport occurs during storm events and flood conditions. Protection from floating debris damage is an important consideration along with adequate tethering of sensors.

Another widespread application is to hang the sensors in the water body from a fixed structure or a floating buoy or pontoon. Generally in lakes or estuary applications the sensor can hang on its own cable, and be easily retrieved for routine servicing.

5.2.1 Cabling Considerations

Care should be taken with installation and field servicing to ensure the cable is not subjected to persistent pulling, snagging or severe compression. Cyclic loading of the cable should also be avoided through careful sensor deployment. Additional stilling wells or mounting brackets may be required to prevent sensor movement. Where cable runs are required which may be subject to environmental influence (heat, water movement, sunlight, flood debris etc) it is advisable to protect the sensor cable inside a slightly larger diameter conduit such as PVC, steel or polyethylene. This also allows the sensor cable to be pulled out – should a sensor change-over be required at the site. Maximum cable runs up to several hundred meters are possible without affecting electrical signals.

5.2.2 Typical Sensor Installations

1. Edge of river/stream/lake embankment.
2. Side of boat/vessel.
3. Mounted within a stilling well off stream from main flow.
4. Mounted within drainage channels/pipes.
5. Suspended from dam walls or floating pontoon.
6. Sensor anchored to bed of lake/stream.

5.2.3 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
- The rubber storage cap is removed from the electrode

5.2.4 Other Considerations

Environmental compatibility should be checked before using the sensors and advice sought from Greenspan if any doubt exists. The sensor utilises some 316 stainless components that are suitable in a majority of situations but care should be taken against possible corrosion in high Chloride, Sulphate or Ferric solutions. The sensor 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 components at the water-air interface. If using clamps to mount the sensor – these should be of a type that evenly clamps the sensor body without excessive loading that could damage the sensor body.

5.3 Replacing Reference Protection Ring



The reference protection ring can be removed and/or replaced (with the electrode still in place in the sensor) by unscrewing the plastic shroud on the end of the electrode. The white protection ring can be slid off the platinum electrode.

5.4 Electrode storage



ORP electrodes should be stored in such a way to prevent the electrode from drying out. A rubber cap is provided with the electrode for this purpose. A small amount of liquid should be placed in this cap prior to the cap being placed over the electrode. 3M KCl is the preferred storage solution however, tap water should be used if not available.

5.5 Electrode replacement

IMPORTANT NOTE: Applying power with no electrode fitted may damage sensor electronics. Always remove power from the sensor prior to removal of an electrode



ORP electrodes will require periodic replacement. How long they last is dependent on the environment and to a lesser extent the cleaning and maintenance. In a typical environment, electrode life between 1 and 3 years is quite possible. The electrode is sealed in its mount with 2 o-rings on the electrode body. The electrode is removed by unscrewing it from the housing. Spanner flats are machined on the electrode to assist.

Take care when handling the ORP electrode, that it is not handled by the gold contacts. Contamination of this area may degrade the performance and expected life of the electrode.

Prior to removal of an electrode the sensor must be thoroughly cleaned and dried. Care must be exercised to ensure that no liquids or other contaminants enter the electrode cavity. The ORP1000 sensor should not be stored or transported without an electrode. Immersion of an ORP1000 without an electrode will likely cause damage to the sensor.

With the old electrode removed the electrode cavity should be carefully inspected. A small ring of contamination may be present at the mouth of the cavity. If present, this contamination should be removed with a clean cloth in such a way so that the contamination is not pushed inside the cavity. Do not flush the cavity with water or other cleaning solvents as damage to the electronics inside the sensor could occur.

Once clean, a new electrode can be screwed into the electrode mount. It is recommended that the calibration of the new electrode be checked prior to re-deployment.



6 Appendix A -Additional Information

6.1 ORP1000 Specifications

Measurement technique	Platinum electrode with internal reference
Sensor range (factory calibrated)	+/- 500mV, +/-1000mV, 0-1000mV
Sensor output	Analogue 4-20mA
Accuracy	+/-20mV (+/- 0.2mA)
Cable type	Polyurethane sheathed cable, OD 8mm, Aramid reinforced, moulded entry, bare wire connection
Cable lengths	10, 20, 30, 50, 100, 150 m (32, 65, 100, 165, 325, 490 ft)
Non-standard cable lengths	Yes (Extra cable moulding time may be required)
Power supply	11-13.2 VDC (at sensor)
Reverse polarity protection	Yes
Surge current protected	To 2kV
Warm up time to stable reading	2 sec
Current consumption	10mA to 30mA while turned on
Operating temperature	0-50°C
Storage temperature	-5°C - +60°C
Depth rating (water column)	100m
Weight	500g plus cable weight (665g per 10m length)
Dimensions (L x OD)	364.20mm x 47mm (14.35" x 1.85")
Wetted materials	Platinum, Acetal, 316 passivated Stainless Steel, polyurethane, viton



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