GREENSPAN

ODO-1000L

DISSOLVED OXYGEN LOGGING SENSOR

PRODUCT USER MANUAL

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CONTENTS

1 Introduction

1.1 System Description

Thank you for purchasing a Greenspan ODO-1000L Sensor. This manual provides a guide to the configuration, operation and maintenance of your sensor to provide long term reliable and accurate monitoring.

The sensor includes an internal data logger to provide long term data collection at remote sites. A large memory capacity (4 Mb) allows the ODO-1000L Sensor to store data over long periods before being downloaded either locally or remotely by your preferred communications method.

Communication with the ODO-1000L Sensor is user selectable RS232 or RS422/485. Set up, data collection and other user functions are simple to access using the supplied software package. Additionally key sensor information and control is available via MODBUS. Sensors are also compatible with the optional SDI-12 adapter.

The ODO-1000LSensor can be powered using external batteries (via the sensor cable) or with Greenspan's optional Lithium battery pack, which can be fitted as an extension to the sensor body, making it a fully self-contained measurement and logging system.

1.2 Certification

The ODO-1000L sensors 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.

1.3 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. They are packed in new cartons for shipping. 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 has been damaged or missing. 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 flash memory device shipped with the goods.

The sensor is fitted with an Acetal body which provides superior corrosion protection in a wide range of chemically active waters.

Because an individual sensor may be used in a variety of locations, media compatibility should be checked before installing and advice sought from Greenspan if any doubt exists.

1.4 Serial Number

Checking the Model Number and Range

Before installing your Greenspan ODO-1000L 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.

1.5 Warranty Policy

Greenspan warrants all new Greenspan 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 inoperability 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 Service staff. Incorrect handling will void the warranty.

1.6 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 GRN (Goods Return Notification) 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.

2 Sensor Overview

2.1 Optical Dissolved Oxygen

The optical dissolved oxygen (ODO) sensor uses a robust, solid state, fluorescence based transducer for field monitoring in a variety of environments. Fluorescence based sensors are inherently reliable and low maintenance, with no need for replaceable membranes or electrolyte. No Oxygen is consumed during operation making the sensor suitable for low flow applications. The sensor also responds quickly to changes in Oxygen levels.

2.1.1 Principal of Operation

- The emitter sends light, at ~475 nm, to the back side of the sensing element.
- The wetted side of the sensing element consists of a thin layer of a hydrophobic sol- gel material. A ruthenium complex is trapped in the solgel matrix, effectively immobilized and protected from water.
- The light from the LED excites the ruthenium complex immobilized in the sensing element.
- The excited ruthenium complex fluoresces, emitting energy at ~600 nm.
- If the excited ruthenium complex encounters an oxygen molecule, the excess energy is transferred to the oxygen molecule in a non-radiative transfer, decreasing or quenching the fluorescence signal (see Fluorescence Quenching below). The degree of quenching correlates to the level of oxygen concentration in contact with the sensing element.

2.1.2 Fluorescence Quenching

Oxygen is able to efficiently quench the fluorescence and phosphorescence of certain luminophores. This effect (first described by Kautsky in 1939) is called "dynamic fluorescence quenching." Collision of an oxygen molecule with a fluorophore in its excited state leads to a non-radiative transfer of energy. The degree of fluorescence quenching relates to the frequency of collisions, and therefore to the concentration of the oxygen- containing media.

3 Applications

Applications in which the Greenspan ODO-1000L sensors can be used include:

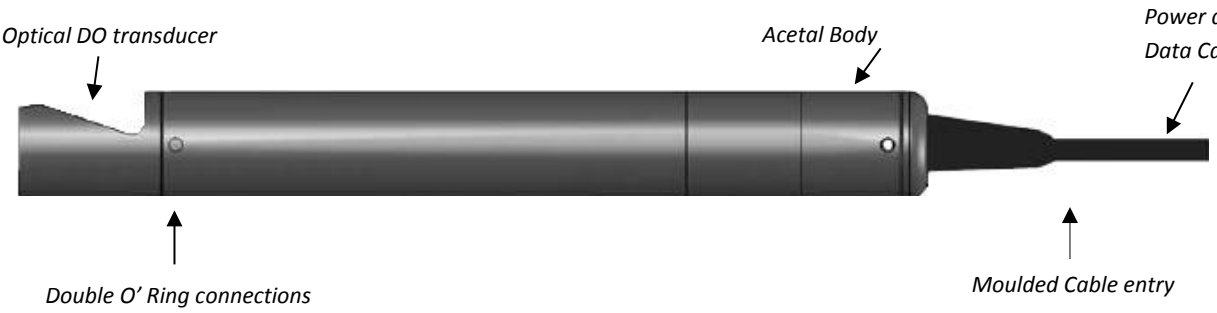
- Monitoring of streams and rivers.
- Monitoring of water storage bodies including stratification studies.
- Intermediate and final effluent treatment monitoring.
- Hydrological run off studies.
- Ground and bore water analysis.
- Drinking water filtration efficiency.
- Industrial process monitoring.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

4 Instrument Details

4.1.1 Sensor Design

The Greenspan ODO-1000L Sensor consists of the following primary elements:

- Microprocessor controlled signal conditioning and logging device
- Stainless steel or Acetal Body Material
- Data cable or Battery Pack option

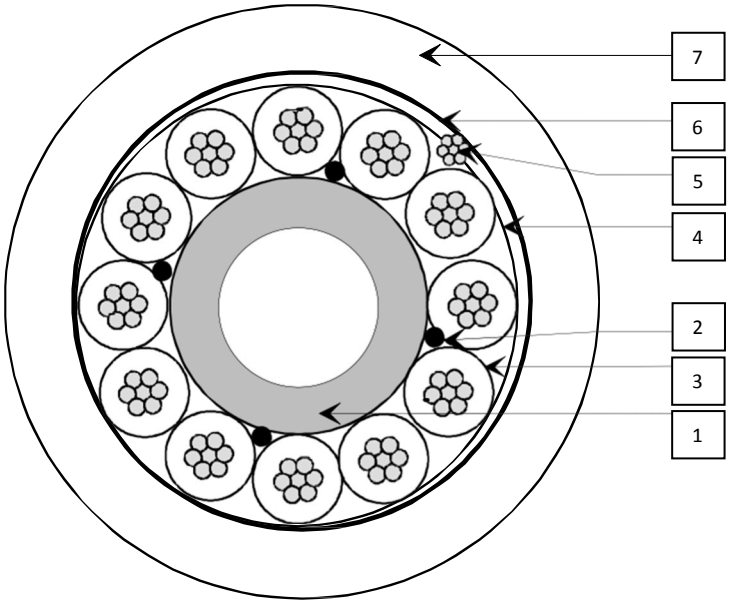


ODO-1000L Primary Elements

4.1.2 Cable Details

All Greenspan sensors utilise a specially designed Polyurethane Cable. The cable is reinforced with Aramid fibres which provide superior tensile strength and low stretch properties. Changes in temperature have little effect on the overall length of the cable. This feature provides users with the benefit of self-suspending the sensor to depths of 300m without additional strain relief.

The cable contains 12 x conductors, 1 x drain wire, an internal vent tube and Aramid fibres. 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 Greenspan sensors. Cables are generally factory fitted at time of manufacture in specified lengths.



Cable Construction

*1 –**Vent Tube:** Polyamide*
(size ID x OD) 2.40 x 3.20 mm

*2 – **Aramid Fibre***

*3 - **12 x Conductors***
7 x 0.20 mm Tinned Copper
Section = 0.22mm2 AWG24
Insulation: Polypropylene
(size) = 1.10 mm ± 0.05 mm

*4 - **Tape:** Polyester*

*5 – **Drain Wire:** 7x0.20 TinCu*

*6- **Tape:** Polyester Aluminium*

*7 - **Jacket:** Polyurethane black,*
(size OD) 8.05 mm ± 0.15

4.1.3 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

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).

4.2 Options and Accessories

4.2.1 Communication Cables

A communication cable is required to connect the sensor to a PC.

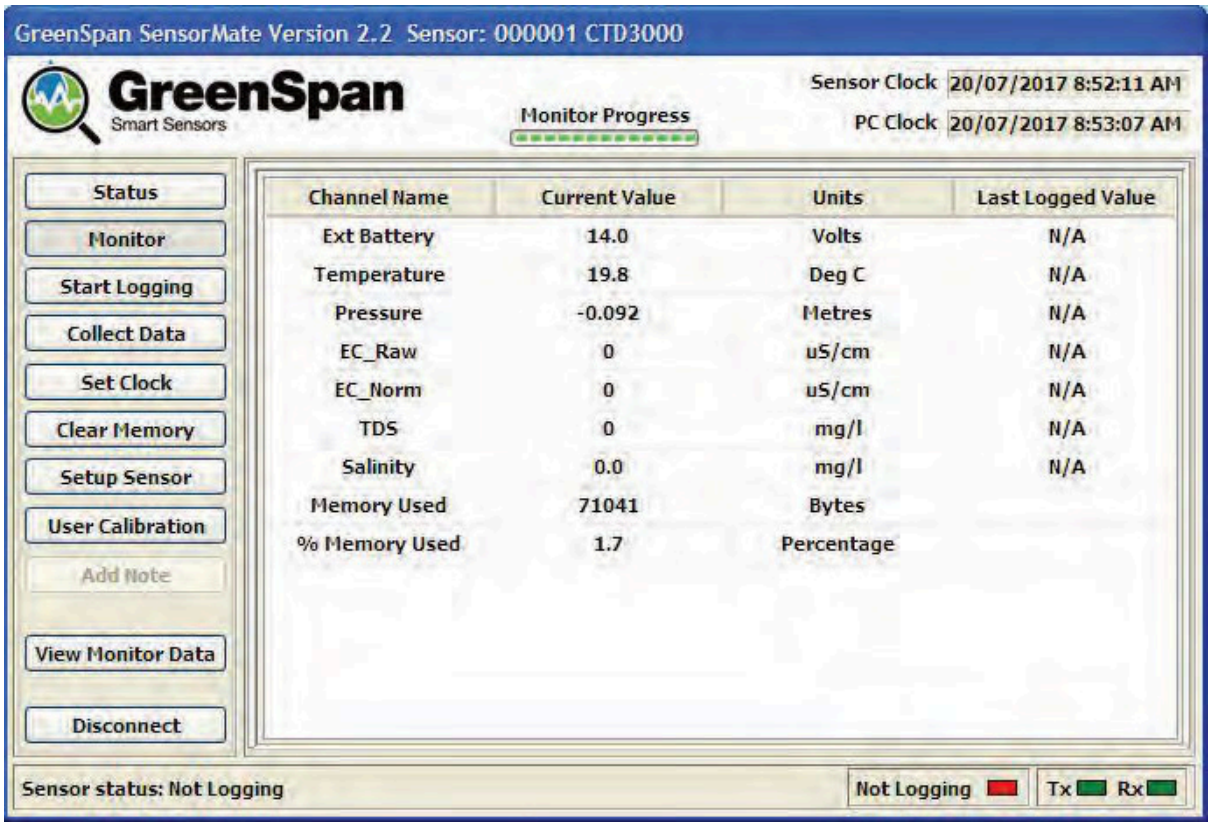
- The standard cable has a 7 socket Hirschman connector on one end and a USB on the other end. For connection to PC and laptops via USB port.
- 7 socket Hirschman connector on one end and DB9 on the other end. For connection to PC and laptops via serial ports.
- 7 socket Hirschman connector on one end and bare wires on the other end. For connection to TLC, dataloggers etc.
- 9 pin Conxall to D connector for serial ports. To connect a sensor with battery pack only to a PC or laptop via a serial port.

4.2.2 Optional Serial Output – SDI Adapter Unit

The ODO-1000L Sensor provides on board data logging of all data and serial output via RS232 to a Laptop or PC using the supplied *SensorMate* software.

A feature of the sensor is the ability to also provide serial output in SDI12 format using a small SDI Adapter unit connected to the end of the sensor cable. The SDI12 Adapter unit provides a standard 3 wire SDI12 output for connection to a third party Data Logger or Process Controller.
The ODO-1000L Sensor can simultaneously provide on-board data logging, as well as act as a standard SDI12 sensor.

When data is requested via SDI-12 the sensor will wake up and take a new set of readings for all channels that are enabled in the sensor. The sensor will then go into a low power, sleep mode. The user can enable or disable channels using SensorMate.



The easiest way to confirm which channels are enabled and what order the data will be returned via SDI-12 is to view the SensorMate monitor screen. By default, the data returned via SDI-12 will be the same channels and in the same order as what is displayed in the SensorMate monitor screen.

NOTE: Memory Used and Memory Used % is not returned via SDI-12.

4.3 On Board Battery Housing

The ODO-1000L Sensor may be factory fitted with a non-rechargeable long-life battery pack. This enables the sensor to be deployed at remote sites completely independent of above surface power supplies (no cable connection) and allows for discreet applications.

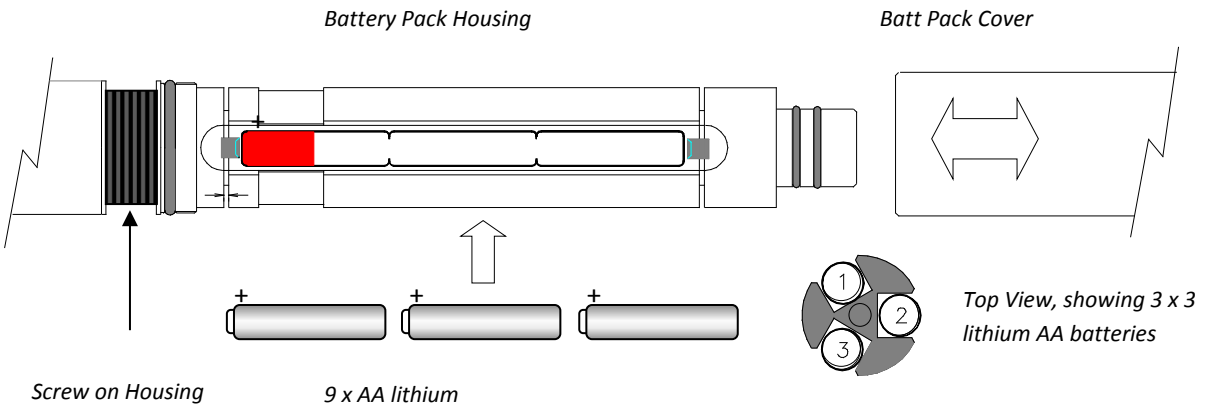
It also functions as a backup power supply in the event of a surface disturbance to the main supply. The unit is designed to allow easy access to the battery compartments for battery changeover and is housed in a cylindrical body of approximately the same dimensions as the sensor housing, thus doubling the length of the sensor.

Sensor with Battery Pack Cover Ready to Deploy

4.3.1 Battery Replacement

Batteries are removed by unscrewing the housing cover, as indicated below and gently levering the battery cells until they slip out. Replacement batteries must be inserted correctly or damage to batteries may occur. Align the +ve on the battery cells with the red indicator on the housing and push batteries in. Batteries are subject to leakage after depletion. The leakage is Thionyl Chloride, a toxic, corrosive non-flammable liquid that can cause damage to equipment and personal injury if in contact with the skin or eyes. Please replace batteries when depleted.

When installing replacement batteries within the battery housing it is necessary to push firmly on the cover until it clicks home over the O rings, after this it can be easily tightened on the thread by hand.



Optional Battery Pack

4.3.2 Important Battery Information

The type of battery used in the battery pack is Li/Mn02, Lithium Thionyl Chloride 3.6V AA cells. A total of nine batteries are required for each sensor battery pack. This configuration supplies a maximum 10.8 volts at 5.2A/Hr and a useful field life, depending on sensor type and logging frequency, of up to 12 months.

Replacement batteries are available from Greenspan.

Note: Standard AA lithium batteries (Duracell or Energiser Type) are NOT suitable for use in the sensor.

4.3.3 Battery Warnings:

- Do not dispose of batteries in fire, dispose of in appropriate manner.
- Do not short circuit
- Do not expose to water
- Do not crush or puncture
- Do not charge
- Do not over-discharge

To maintain the maximum possible life of the cells before replacement it is strongly recommended that an external power supply is connected to the sensor when downloading data. The power drawn when downloading is at its greatest level, therefore battery depletion will be much more rapid.

Battery life will depend on the battery type as well as the frequency of logging. Connection to a computer will drain the battery supply more quickly due to the higher current imposed by the RS232 serial data communications and will considerably reduce battery life. An additional internal lithium battery maintains logger data at all times but does not sustain the logging state. This battery is not user accessible and will maintain data for up to 10 years.

If the sensor is fitted with on board internal battery pack option and is to be placed in storage it is recommended that the logger be powered down and lithium batteries in the battery pack be removed. To turn off the logger after exiting from SensorMate, disconnect the communications cable and unscrew the battery cover. This exposes the battery compartment to allow removal of the batteries. Removing power will not affect any data remaining in storage so sensors could be downloaded away from the site if required.

4.4 Sensor Factory Calibration

Optical DO Sensors:

- Sensors are calibrated in a stirred, aerated DI water bath for 100% saturated and an aqueous Sodium Sulphate solution for zero.

All Sensors:

- An extensive range of final calibration and inspection tests, including tests in solutions of known standards, are carried out on every sensor.
- The sensor is visually inspected and packed ready for despatch.
- The complete calibration records, sensor history and batch number are placed on file and archived.
- The sensor is visually inspected and packed ready for despatch.

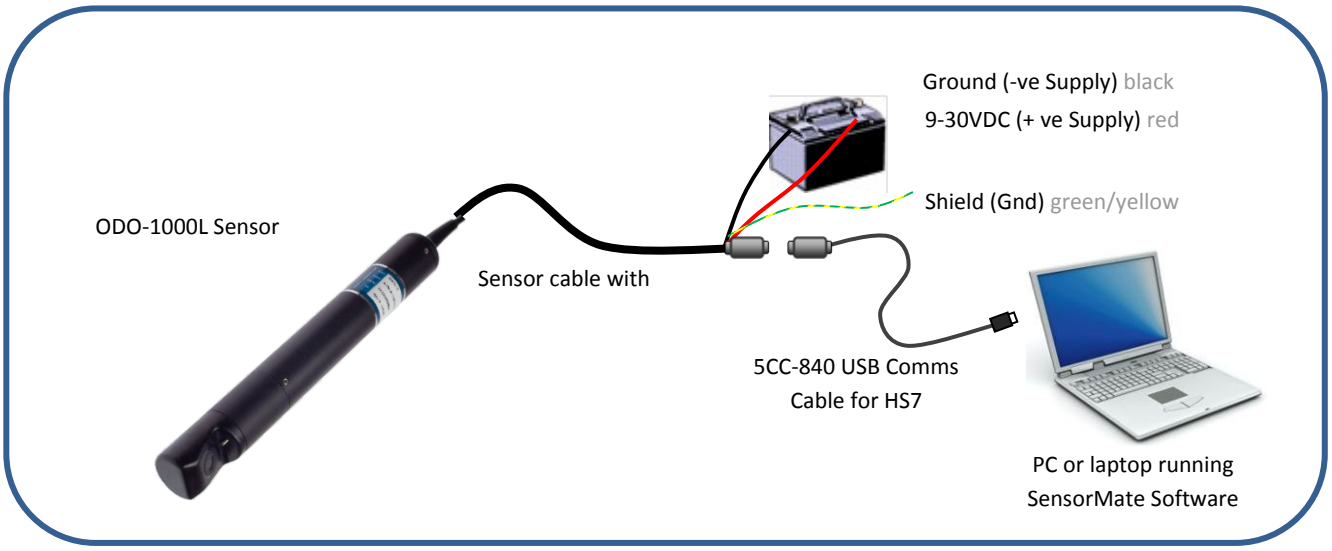
5 Sensor Wiring & Connections

5.1 Standard Connections

The ODO-1000L sensors are designed as a self-contained data logging sensor. It is normally powered by a 12-24V DC power supply – which can be battery, solar or Mains Plug Pack.

The logger has a large memory capacity and can operate for long periods between field visits. Typically the logged data is collected via laptop using the supplied SensorMate software.

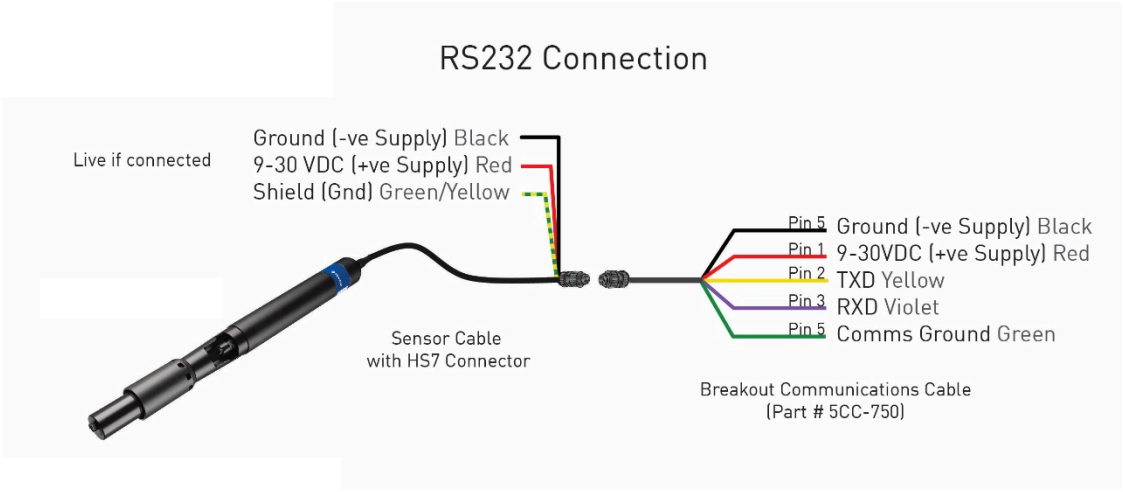
The following diagram illustrates the typical wiring arrangement for the ODO-1000L Sensor.

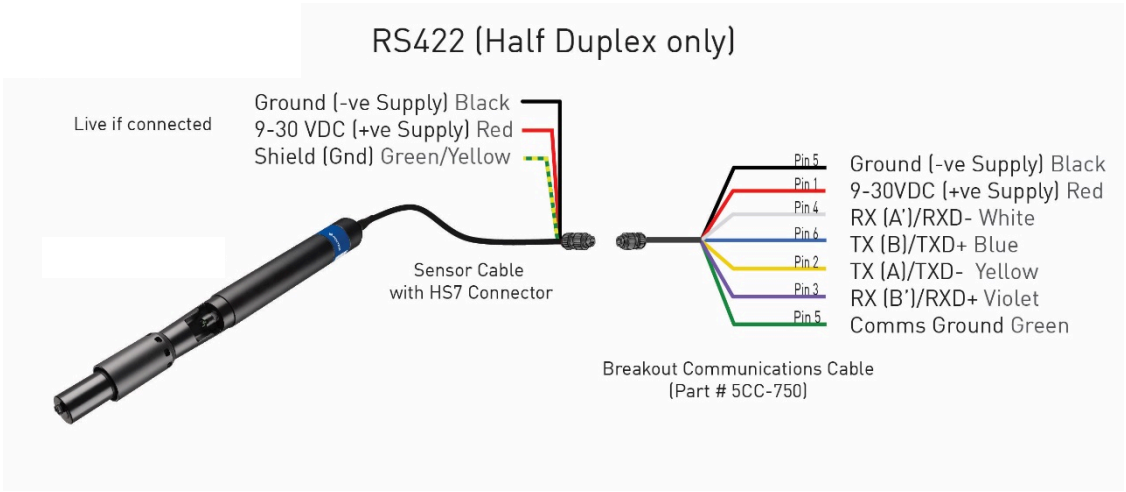


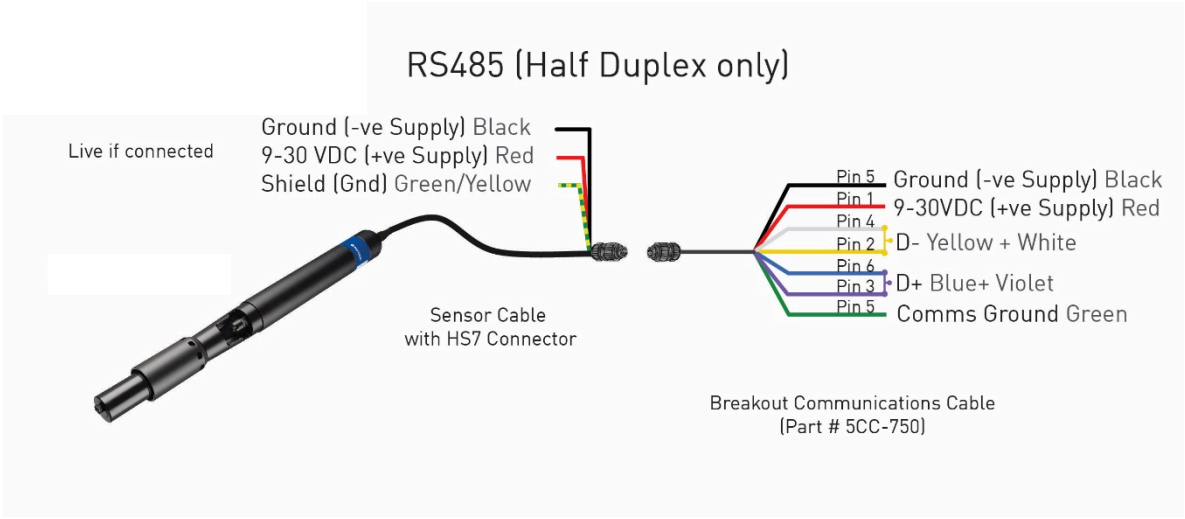
The SensorMate software provides for configuration of the data logger, collection of logged data, and all other functions. For further information, please refer to the SensorMate User Manual.

5.2 Wiring Diagrams

A Breakout Communication Cable is available if a bare wire connection is more suitable for an application. The Greenspan ODO-1000L Sensor CommsMode Utility contains wiring information for the various modes of serial communication.







6 Serial Communication (RS232, RS422/485)

Communication to the ODO-1000L sensors is via a serial link. The user can select RS232 (default setting) or RS422/485. The Greenspan ODO-1000L Sensor CommsMode Utility is a software tool that provides a simple method for selecting communication modes, non-standard baud rates and Modbus settings.

NOTE: SensorMate software uses the default settings.

	Function	5CC-750 Wire Colour
RS232	Ground (-ve Supply)	Black
	9-30 VDC (+ve Supply)	Red
	TxD	Yellow
	RxD	Violet
	Comms Ground	Green
RS422 Half Duplex	Ground (-ve Supply)	Black
	9-30 VDC (+ve Supply)	Red
	Rx (A')/RxD-	White
	TX (B)/TxD+	Blue
	Tx (A)/TxD-	Yellow
	Rx (B')RxD+	Violet
	Comms Ground	Green
RS485 Half Duplex	Ground (-ve Supply)	Black
	9-30 VDC (+ve Supply)	Red
	D-	Yellow + White
	D+	Blue + Violet
	Comms Ground	Green

NOTE: Full Duplex, where data is sent and received at the same time, is not supported.

6.1 Waking sensor

MP Sensors are designed to wake on receiving any commands on its communication lines. Although it wakes quickly, it may miss the first few characters of a command. Most generic Modbus communication programs will re-try if no valid response is received so this usually causes no problems. All in house programs send a “Null” command to wake the sensor prior to any subsequent commands.

Communication circuits will switch to a low powered, listening mode (sleep) if there has been no communication activity for 60 seconds.

7 Field Deployment Considerations

For applications in harsh environments it is recommended that the optional Acetal casing be specified.

The sensor head 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 body should always be fully immersed under the water to ensure the electronic module is at water temperature and to avoid any possible anodic/cathodic action taking place on the stainless body due to the oxygen difference across the boundary.

It is recommended that Acetal body sensors be used if clamping.

Sensors should generally be installed such that they can be easily and safely removed for cleaning, servicing. For environmental applications the sensor can often be mounted inside a section of PVC or steel pipe which 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.

7.1 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 which may cause long term cable movement. Where cable runs are required which may be subject to environmental effects (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.

7.2 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.

8 Maintenance (by Parameter)

8.1 Optical Dissolved Oxygen

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. It is important to take care when cleaning around the sensor optics – do not scratch the sensor lens.

The sensor will be damaged by the ingress of water or other solutions into the electronics cavity and Warranty will be voided if disassembled. Rinse the electrode in clean water prior to installing sensor or checking calibration.

9 User Calibration and Testing

The factory supplied Certificate of Conformance will provide detailed information regarding the sensor ranges and specifications; this document should be retained for future reference.

9.1 ODO

To maintain high quality control over monitoring programs, it is recommended ODO calibration is checked every 3-6 months. The MP Sensor has a user calibration facility in SensorMate.

The sensor can be checked by use of known standards.

Quick Check Method:

1. Remove the sensor from the water, ensure the sensor is clean.
2. Provide power to the sensor, connect sensor to a PC with appropriate communication cable.
3. Run SensorMate.
4. Place the sensor into a container with Sodium Sulphite solution (2 tea spoons Sodium Sulphite per 1 litre of water) for at least 10 minutes to allow the sensor to stabilise.
5. Once connected, the monitor screen will display the readings. The DO% Sat reading displayed, should be ±1% of 0% .
6. Remove the sensor from the container and rinse the sensor with clean water.
7. Place the sensor into a container of full scale solution (tap water aerated by an air pump and circulated using a water pump) and allow the sensor to stabilise for at least 10 minutes..
8. Check the reading on the monitor screen, the DO % sat should be ±1% of 98%.
9. This confirms that the sensor electronics has remained stable and no further action should be required if the sensor is within +/- 1% of these readings in different conditions.

Re-Calibration Method Using Calibration Solutions

1. Ensure the sensor is clean and dry.

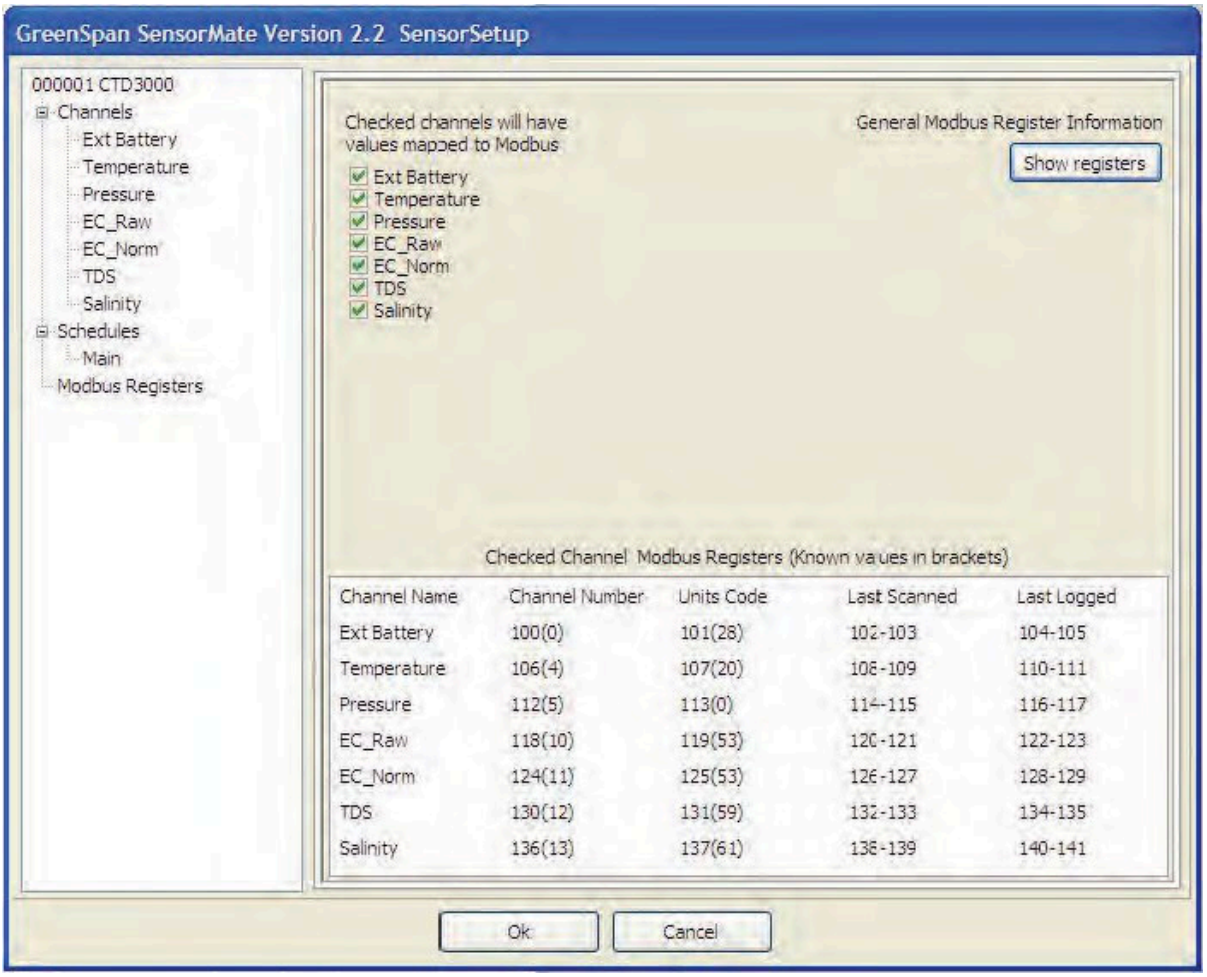
2. There are 2 steps to complete the calibration for an MP sensor with Optical DO:
   - the 1 Point Offset (zero calibration) and,
   - the 1 Point Span (full scale calibration)
3. Connect the sensor with the appropriate communication cable and turn on the DC power.
4. Run SensorMate.
5. In SensorMate, select User Calibration from the SensorMate main menu.
6. Select the calibration channel – ODO
7. Perform the zero calibration by selecting 1 Point offset in the Calibration Type.
8. Place the sensor into a Sodium Sulphite solution and allow 10 minutes to stabilise. Ensure the ODO head is fully submerged.
9. Click on the Calibrate Channel button.
10. The screen should display a window to allow entry of the new low value, type in 0 and click OK once the value has been entered.
11. Remove the sensor from the container and rinse it with clean water.
12. Perform full scale calibration by selecting 1 Point Span
13. Place the sensor into an aerated full scale and allow to stabilise for at least 10 minutes. Ensure the ODO head is fully submerged.
14. Click on the Calibrate Channel button.
15. The screen should display a window to allow entry of the new high value. Enter the new value e.g. 98% for the full scale value and click OK
16. Click on Monitor to verify the readings on the screen.

10 Modbus notes

10.1 Holding Registers

Sensor information can be mapped to Modbus holding registers. This provides an easy transfer of data to the many devices that support Modbus. The user can select Modbus RTU (default) or Modbus ASCII.

SensorMate V2.1 software has a feature to assist with setting up Modbus holding registers. When “Modbus Registers” is clicked in the Sensor Setup tree, a list of available channels will be displayed with a selection box. Selecting a Sensor channel will allocate 6 holding registers for channel information. A table will update and display the holding registers allocated. The **Ok** button must be pressed to send this setup to the sensor.



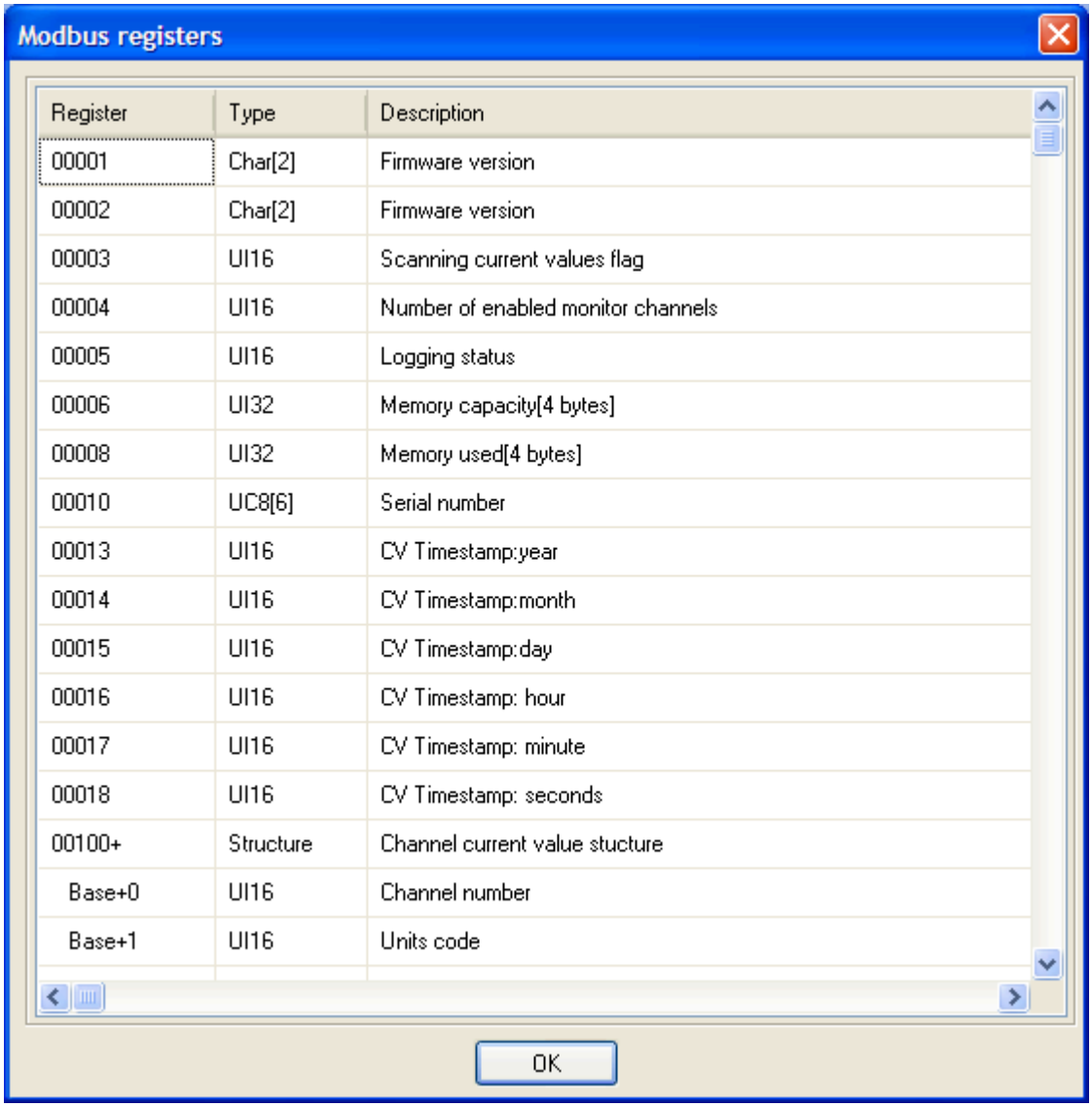
Each channel mapped to Modbus take 6 registers starting from 100 (see table below).

Address decimal	R	Type	Description
001xx + 0	✓	UC8	Channel number
001xx + 1	✓	UC8	Units code
001xx + 2	✓	Float	Last Scanned Value
001xx + 4	✓	Float	Last Logged Value

The sensor's configuration file contains the information of which channels are mapped to these Modbus registers.

10.2 Show registers button

There is also a "Show registers" button that provides other information that is also written to holding registers.



10.3 Codes and Terminology

The following list of codes, abbreviations and terms may be used in the software coding of these structures:

Bool	8 bit character used to represent TRUE and FALSE
UC8	Unsigned 8 bit character
UI16	unsigned 16 bit integer
SI16	signed 16 bit integer
UI32	unsigned 32 bit integer
SI32	signed 32 bit integer
F32	IEEE754 single precision floating point 32 bit value.
Cal	Calibration
Config	Configuration
CV	Current Values
HO	High order – upper 8 bits of a 16 bit word
LO	Low order – lower 8 bits of a 16 bit word.

10.4 Integer and Floating Point Values

The Modbus protocol specifies that the order of bytes is sent as low order first. For example, when sending a value of 0x1234, the first byte sent is 0x12 followed by the value 0x34.

10.5 32 Bit Values

The Modbus registers for 32 bit integer and floating point values are aligned on even register numbers and must be read and written in a single function call. For example, to read a 32 bit value from registers 00102/00103, call function code 03, start register 00102 and read two register values. An attempt to read register 00103 will result in an exception response.

10.6 Floating Point

All floating-point variables (denoted as type F32) are IEEE754 Floating Point format (single precision 32 bit). Example:

```
Read registers 00100 and 00101: flow velocity which has a value of 51.392.
The Modbus registers return 0x424d and 0x9225 from addresses 0100 and 0101.
This data corresponds to 0x25924d42 (low byte first) which is the same as
51.3297.  See test code below:

      /* PC code example */
       c[0] = 0x25;           /* last byte from register read */
       c[1] = 0x92;
       c[2] = 0x4d;
       c[3] = 0x42;      /* first byte from register read */

        t = *((float*) &c[0]);

       printf("%f", t);    /* value printed is 51.392 */
```

10.7 Updating Register Data

As per the Modbus protocol, data contained in registers is immediately sent on request. This may mean that the data sent may not be recent. To allow the user to obtain the most current data possible, using only Modbus commands, a request for data also starts the "Get Current Values" routine in the sensor, where all parameters that are set up in the monitor screen are read.

Get Current Values for a typical MP sensor would be complete within 6 seconds (5 second warm-up time + <1 second process time). When complete the "Last Scanned Values" are updated. To get the most current data a user can read the registers, wait until the sensor has a chance to get current values, and read registers again.

Alternatively, if the sensor's logging schedule is on, the data in the "Last Scanned Value" registers will be updated according to this schedule (e.g. if a 3 minute scan time is set, the data in the Last Scanned Value registers will be no older the 3 minutes when read).

10.8 Command Set – Modbus Function Codes

Func Code	Modbus Function Description	Uses for 3000 Series
03	Read multiple registers	Read current values, calibration data, basic calibration data and confguration data.
16	Write registers - multiple	Write current values, calibration data, basic calibration data and confguration data. Initiate a scan.
65-69	User commands	See following section

10.9 Command Set – User Function Codes

Function Code	User Function Description	Uses for 3000 Series
65	Set Date and Time	Future use
66	Start Logging	Future use
67	Stop Logging	Clears totals, as per flags sent as command parameters.
68	Wipe now	Enter passcode to gain level 0, 1 or 2 access and to log out.
69	Read Channel Name	Returns a text string for a given channel number

10.10 Exception Responses

Exception Code	Description	Uses for 3000 Series
01	Illegal Function	The received function code is not a valid
02	Illegal Data Address	The address in the data field is not valid
03	Illegal Data Value	The value in the data field is outside limits
05	ACK Acknowledge	The function is valid and is being processed
06	Busy, message rejected	The message was received without error but the 3000 Series cannot perform the operation. Retry later.
07	NAK	Access denied – operation cannot be performed

11 Specification

OPTICAL DO	Measurement Technique	Oxygen fluorescence detection method
	Sensor Range	0–200% saturation (0-20 ppm)
	Resolution	0.1%,
	Accuracy	Oxygen 1% of reading or 0.02 ppm whichever is greater
	Response Time	90% of DO change within 60 seconds
TEMP	Measurement Technique	Integrated precision thermistor
	Operating ranges	0–50°C
	Overall Accuracy (combined linearity, hysteresis and repeatability)	0.2 Deg
	Sensor Outputs	Internal Data Logger – serial data via SensorMate software Optional adaptor provides SDI12 serial output (3 wire)
	Storage Temperature	–5 Deg C – +60 Deg C
	Cable type	Polyurethane sheathed cable, OD 8 mm, with 3 mm vent tube, moulded entry, HS7 connector for serial connection.
	Standard 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	8 to 30 V DC (at sensor), or on-board battery pack (option)
	Power ESD protection	2000 volts
	Current consumption	Sleep ± 0.2 mA, logging 20 mA, communicating 30 mA (consumption rates vary depending on parameters selected)
	Sensor warm up time	Up to 5 seconds
	On-board battery pack (option)	Housing screws to sensor size (OD × L) 47 mm × 250 mm
	Battery capacity	9 × Lithium AA (3.6Volt) – Total capacity 5.2 Ah @ 10.8 v
	Typical field life (battery pack)	Over 12 month's remote operation @ 15 minute data logging.
	Internal data logger	Non-volatile, battery backed RAM with real time clock
	Memory size	4 Mb capacity, with user selectable wrap function
	Measuring units	User definable (Metric and Imperial US units)
	Data storage	250,000 readings. (Typically 5 minute data for >12 months)
	Logging frequency	User selectable from 1 second up to once per day
	Dimensions (L × OD)	ODO-1000L – 355 mm × 47 mm (14″ × 1.78″), MP65 – 355 mm × 65 mm (14″ × 2.5″) – Optional End Mount Batt Pack – 300 mm × 47 mm
	Weight	ODO-1000L – 550 g plus cable weight (665g per 10m length) MP 65 – 650 g (plus cable weight (665g per 10 m length)
	Wetted materials	Acetal, ceramic, polyurethane, viton

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