

# **P4** Lumi4 DO / TGP Probe

*Optical DO / Total Gas Pressure*



Serial Number

Software Rev



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# Warranty



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## WARRANTY AND CONDITIONS

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Point Four Systems Inc. warrants its equipment under normal use against any and all defects from the date of purchase for a period of one (1) year from the date of purchase. Any failure resulting from defective parts or faulty workmanship, as determined during evaluation by Point Four Systems Inc., will be repaired or replaced under warranty.

Point Four Systems Inc.'s obligation under the warranty is conditional upon:

- a) such equipment being installed, consistently used and maintained in accordance with Point Four Systems Inc.'s written instructions, specifications and safeguards.
- b) the defect(s) not being the result of misuse, neglect, accident or improper application nor of any user attempts at modification or repair.
- c) the purchaser reporting to Point Four Systems Inc. any defect within seven (7) days of its occurrence. Point Four Systems Inc. may request that the equipment in question be returned to Point Four Systems Inc.'s premises at the purchaser's cost within two (2) weeks of notification. Point Four may also require a written report by the purchaser of the circumstances in which the defect occurred.
- d) the purchaser certifies acceptance of the warranty as set out.

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## LIMITS OF LIABILITY

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Point Four Systems Inc.'s obligations specifically exclude any liability whatsoever for claims by the purchaser or user or any other persons or parties:

- a) in respect of merchantability or fitness for a particular purpose.
- b) for any special, indirect, incidental or consequential damages resulting from the use, or as a result of a malfunction of the equipment.
- c) for personal injury or any medical or disability claims or for compensation arising therefrom.

This warranty and the conditions, limitations and exclusions is accepted by the purchaser as the only authorized and applicable warranty and that there are no other warranties or conditions, oral or written, expressed or implied.

# Overview

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The Lumi4 DO/TGP probe allows users to simultaneously measure multiple parameters - Total Dissolved Gas Pressure (TGP), Dissolved Oxygen (DO) and temperature with a single probe. Increasing water temperatures, injection of air in water, algal blooms, or pumping can result in gas supersaturation. This may lead to bubble trauma or sub-lethal toxicological problems for aquatic life. The TGP probe provides an accurate measurement of total dissolved gas pressure. With the addition of an oxygen probe, the user can determine the percentage of TGP attributed to nitrogen & other gases.

- The oxygen sensor in the Lumi4 DO/TGP probe has many advantages over previous electro-chemical sensors. The optical dissolved oxygen sensor in the Lumi4 does not consume oxygen, and doesn't require stirring or regular calibration. The design of the optical DO sensor eliminates the need for electrolyte and membranes which can easily be damaged and require frequent servicing. The Lumi4 utilizes a tough, scratch resistant silicon sensing cap that extends the reliability of the sensor under adverse conditions, and is expected to last for approximately one year under normal operating conditions.

- The unique design of the TGP cartridge in the Lumi4 DO/TGP probe allows for quick, and reliable cartridge changes in the field. Simply unscrew the protective cover, and slide on a low cost replacement TGP cartridge.



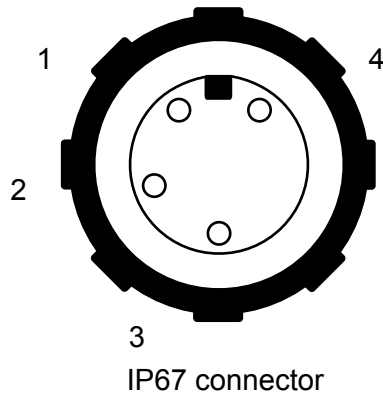
# Operation

The Lumi4 TGP/DO probe has been designed to work exclusively with Point Four Systems' family of monitoring & control systems, as well as being configured for direct connection to a PC.

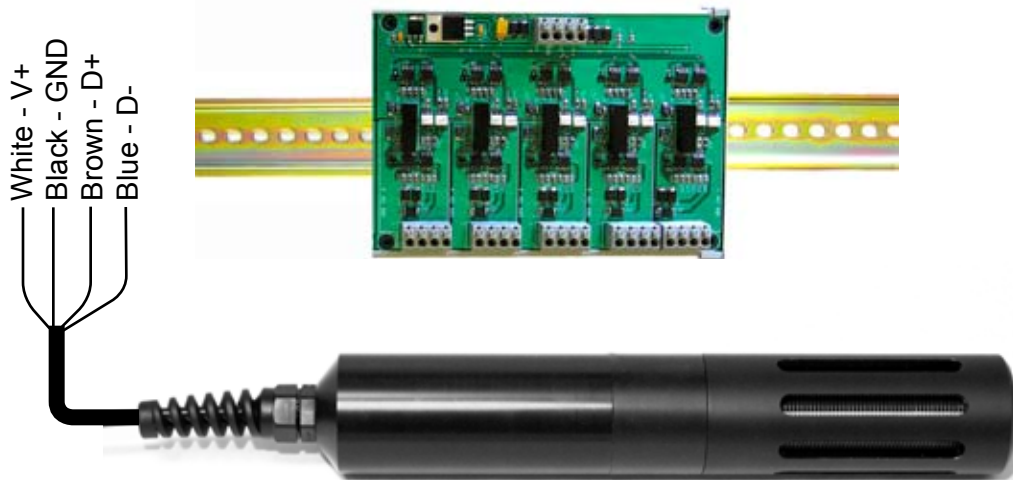
## PT4 ION:

The PT4 ION is a 10 probe multi channel display/controller unit. Its main function is to read and display information transmitted on the ION databus as well as provide control information to the ROC10 card. The main controller has two communication ports that allow it to transfer data from the main databus to a PC, a touch panel display, or through satellite communication.

Depending on system configuration, the Lumi4 connects either directly to the main unit or to the supplied junction box. Traditional galvanic isolation is not required.



Pin 1	Blue	D-
Pin 2	Brown	D+
Pin 3	Black	GND
Pin 4	White	V+

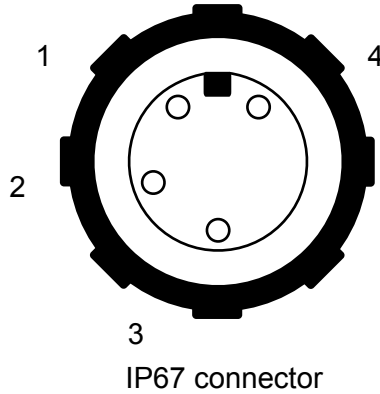


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**PT4 Tracker:**

The PT4 Tracker is a single probe handheld portable display unit, capable of displaying up to 10 probe variables simultaneously. The unit is powered via a rechargeable NimH battery system and includes a programmable built-in datalogger.

The Lumi4 connects directly to the Tracker's right probe port via an IP67 water tight connector.



Pin 1	Blue	D-
Pin 2	Brown	D+
Pin 3	Black	GND
Pin 4	White	V+

**PC Connectivity:**

The Lumi4 DO/TGP probe can be directly connected to a PC via RS232 communication. Point Four Systems can provide various connection systems and customized software.



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## Using RS485 Modbus on Point Four Systems' Smart Probes

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A Modbus Map is provided for each specific Sensor. The Modbus map contains all the probe information such as variables, units, calibration data and serial numbers. This information is held in various registers throughout the map. For simplicity sake, the key registers have been illustrated below:

### Communication Settings:

COM Port should be configured as follows:

Baud Rate = 9600  
Data Bits = 8  
Parity = Even  
Stop Bits = 1  
Flow Control = None

### Supported Modbus Commands:

Read Holding Registers (Floating Point, Integer)  
Preset Multiple Registers (Floating Point, Integer)  
Force Coil (Numeric Value)

### Key Registers:

\*\*\* Some programs require subtraction from 40001 to get register value \*\*\*

40048 Oxygen PV measured in % Sat	Mem Qty 2, Floating Point
40050 Oxygen PV measured in mg/l	Mem Qty 2, Floating Point
40042 Temperature PV measured in Deg C	Mem Qty 2, Floating Point
40046 Salinity Compensation for mg/l in ppt	Mem Qty 2, Floating Point
40019 Modbus Node Address (1-32)	Mem Qty 1, Integer

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## Taking Measurements

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Follow proper sampling procedures when using this probe:

- Sensor must be below 1 foot below surface for in-situ measurement
- Avoid water back eddies in streams or “dead spots” in tanks
- Insure probe placement does not hinder operation of the DO sensor located at the tip of the probe (avoid mud or gravel)
- Although the Lumi4 does not require water movement, a flow of water past the TGP membrane sensor will decrease response time, producing a faster reading.
- Avoid strain and stress on cable and cable entry to probe.
- Avoid physical damage to the TGP membrane cartridge (sticks and snags).
- To avoid moisture build-up within the TGP cartridge, it must be swapped or dried out after MAX. 1 MONTH of continuous use.

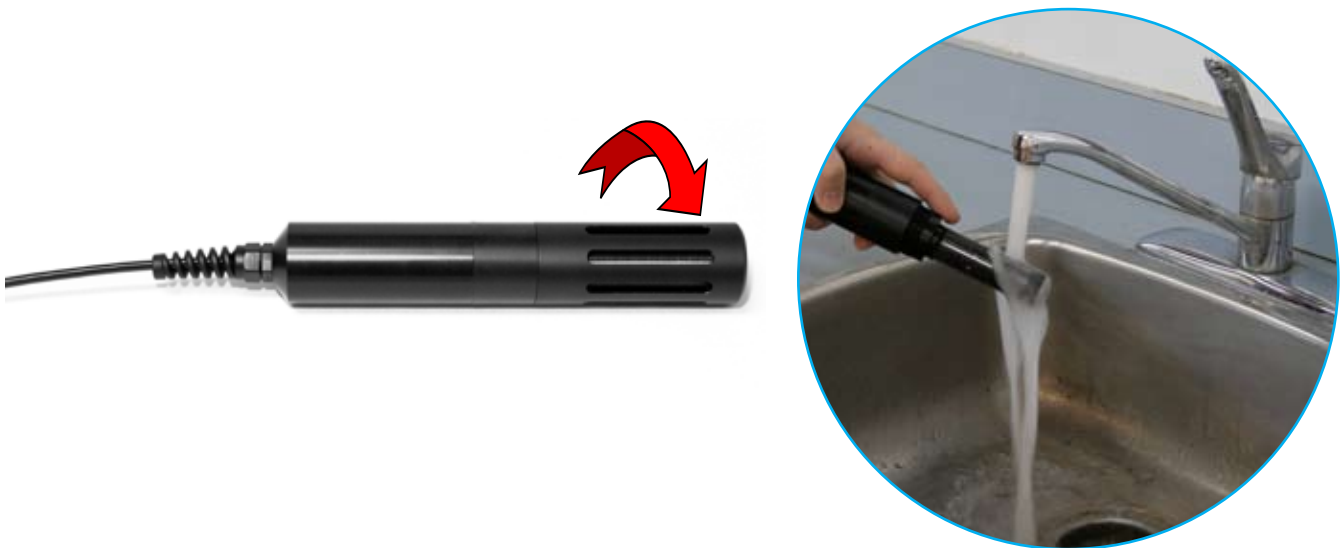


# SERVICE PROCEDURE

## Normal Periodic Use

After each measurement session:

- Remove the probe from the water, rinse clean straight away before any form of fouling dries on the membrane tubing.
- Unscrew the protective lower probe shield.
- Rinse off the membrane tubing with clean fresh water and gently shake the probe dry.
- Allow about 4 hours for the TGP cartridge to dry out (\*more time might be required in cold damp environments).
- If time is of the essence, have a spare cartridge available, and swap out the cartridges.
- Store dry at room temperature.



## Continuous Use

In some applications the TGP probe is left continuously submerged in water. Under such circumstances, water vapour eventually condense as small droplets on the internal walls of the tubing. As these droplets grow in size, they will eventually coalesce resulting in “cross-bridging”. With several such bridges present, the pressure detected by the sensor will produce a difficult-to-define average of the actual TGP, and menisci forces related to the contact angle at the juncture of the cross bridges and the silicon rubber tubing. The more cross bridges, the greater the error, ranging from a few mmHg to 20 or 30 mmHg.

With cross-bridging of bulk water, a step-change in readings will instantly result, then stabilize over time until the next cross-bridging occurs. Excess water in the tubing can damage the pressure transducer if actual contact is made with the pressure sensitive wafer.

The time taken for such a condition to arise is inversely proportional to water temperature.

In summary, the frequency of probe maintenance is site and condition specific.

As a guideline, the probe should be removed from the water on a routine basis every three weeks for cleaning and drying.

\* Refer to section NORMAL PERIODIC USE for maintenance procedures.



### A Simple Check for a Damaged or Broken Membrane Tube

If the membrane tube is compromised in any way, TGP readings will be wrong. A simple way to check the integrity of the tubing is to observe the TGP readings as the probe is steadily immersed in water. A fast increase (several mmHg per second) in displayed values indicates a damaged or broken membrane tube. Replace the cartridge and recalibrate.



- Inspect the tubing for any visible signs of bridging. If damaged or broken, replace the cartridge. Otherwise leave the probe in air until there is no sign of water present in the tubing.
- Re-calibrate if necessary.

Note: A need for an unusual degree of calibration correction could mean that the pressure sensor has been damaged by the bulk water.

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## Changing The TGP Cartridge

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Occasion may arise where the membrane tubing becomes damaged resulting in erroneous readings. The membrane cartridge must be replaced, or returned to Point Four Systems for reconditioning.

1. Unscrew the lower probe body to remove the membrane cartridge.



2. Pinch the head of the membrane tube; carefully separate the membrane tubing from the sensor port and set the now completely detached membrane assembly aside.

Be careful not to damage or stress the fine membrane tube, which connects to the pressure sensor in the electronics housing.



3. Align the hole on the new membrane cartridge with the sensor port rod, and reassemble the TGP probe in the reverse order of disassembly.

Note: Apply silicone grease on the lower probe body threads to avoid the plastic body from seizing in future disassembly.



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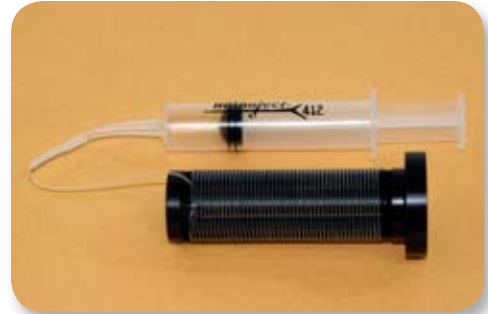
## TGP Membrane Cartridge Syringe Test

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The TGP Syringe Test is a simple and effective test to determine if the Silastic tubing within the TGP cartridge is damaged and needs to be replaced.

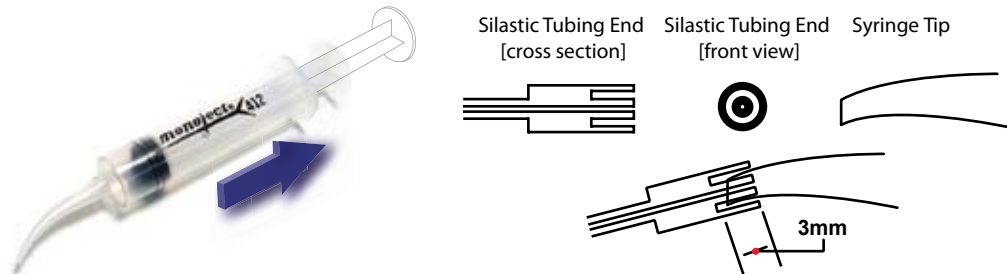
Begin this procedure by disconnecting the TGP cartridge from the probe body.

Disconnect the Silastic tubing from the probe sensor by pinching the end of the tubing and gently sliding it off.



Draw the plunger of the syringe half way back and then attach the cartridge tubing to the end of the syringe.

Note: Do not slide the tubing more than 3mm onto the end of the syringe as this will block the cartridge opening



Place the cartridge in a container of water and GENTLY apply pressure to the plunger.

If resistance is felt in the syringe when pressed and no bubbles appear from the cartridge when placed underwater, there are no holes in the Silastic tubing.

This indicates that the unit is good.

If bubbles appear from the cartridge when placed underwater, there are holes in the Silastic tubing.

This indicates that the unit needs to be replaced.

Contact supplier for a replacement TGP Cartridge



Note: When reassembling apply silicone grease on the lower probe body threads to avoid the plastic body from seizing in future disassembly. When assembled, check down the inside of the membrane cartridge to ensure that the tubing is not kinked.

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## Changing the DO Cap

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Unscrew the old sensor caps (counter-clockwise direction) from the shaft.  
Note: If the sensor cap is very firmly attached, then a silicone tube between finger and metal may supply a good grip.

Examine the small O-ring that seals the sensor cap against the sensor shaft. Replace it if traces of wear are observed.

Screw the new sensor cap again on the sensor shaft.  
Make sure that the gap between the shaft and the cap is closed, and therefore that the sealing effect of the O-ring under it is effective.



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## Calibration: When to Calibrate the Probe?

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Under ideal conditions (in air) the probe can keep its calibration for many months. In water, the actual conditions (e.g. the nature of deposit build-up) and the desired accuracy will dictate calibration frequency. To determine if calibration is necessary, perform the following steps:

1. Remove the probe from its measuring medium (i.e. water or gas).
2. Gently wipe the membrane with a soft cloth or tissue to remove any biofouling or debris.
3. Inspect the membrane for punctures, air bubbles, or scratches. If any of these are present, the DO cap must be replaced (refer to the “Changing the DO Cap” section).
4. The meter should now read 101% saturation, plus or minus 2%. If the reading is above or below this expected value, calibration is necessary.

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## Dissolved Oxygen Calibration

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5. Using the keypad, press “MENU”.
6. Select “Calibrate”, press “ENTER”.  

For the PT4 ION, select the correct ID# for the Lumi4 DO probe you wish to calibrate, press “ENTER”.
7. Select [Oxy %Sat], then press “ENTER”.
8. Select [1 Pt Cal], press “ENTER”.
9. Use navigation arrows to set %Sat to 101.0, then press “ENTER”.
10. “CALIBRATION OK” will be displayed for a moment. Calibration is now complete.
11. You can select another probe for calibration (PT4 ION only), or press “MENU” to return to the primary display.

According to the standards, the sensor can be calibrated in air or in an oxygen free environment (zero point). This is rarely necessary for most applications. If there are already displacements of measuring values of only a few percent within a few days, then damage to the luminophore due to measuring medium and cleaning medium has to be expected. In this case, you must consider whether a more frequent exchange of the sensor cap can be accepted or whether another measuring principle (e.g. with a classical oxygen sensor should be used).

Note: The sensor needs a preheating time of 10-15 minutes after switching on. During this phase, measurements are already possible. However, for an optimal calibration it is recommended that the probe be allowed to warm up completely.

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## Barometric Pressure (BP) Compensation:

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The PT4 ION controller and the PT4 Tracker meter contain a barometric pressure sensor. This sensor is automatically linked to each probe that requires a barometric pressure input. This eliminates the need for altitude compensation.

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## Temperature Calibration

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What is needed:

- Large bucket of water
- Certified thermometer (Deg C)

1. Fully submerge probe & thermometer in a bucket of water
2. Press [Menu] on ION or Tracker
3. Select [Calibration] & press [Enter]

For the PT4 ION, select the correct ID# for the Lumi4 TGP/DO probe that requires temperature compensation, press "ENTER".

4. Select [Temp Deg C] & press [Enter]
5. Select [1 Point Cal] & press [Enter]
6. Enter the value from the thermometer reading using the [navigation arrows]
7. Stir water with probe
8. Press [Enter]
9. Calibration screen reads [CALIBRATION OK]

\* If screen displays [UNSUCCESSFUL] then repeat from step 4.



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## Salinity Compensation (if required):

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Note that salinity compensation only affects dissolved oxygen readings in mg/L (ppm)

1. Use a refractometer, salinity meter, etc. to obtain the salinity (ppt) of the sampling medium.
2. Using the keypad on the PT4 ION or PT4 Tracker, press “MENU”.
3. Select “External Channels”, press “ENTER”.

For the PT4 ION, select the correct ID# for the Lumi4 DO/TGP probe that requires salinity compensation, press “ENTER”.

4. Select “Sal ppt”, press “ENTER”.
5. Use the navigation arrows, enter the value obtained from the salinity meter (in ppt), then press “ENTER”.
6. You can select another probe for calibration (PT4 ION only), or press “MENU” to return to the primary display.

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## TGP 1 Point Calibration & Check

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1. Remove the probe from water and allow for membrane cartridge to dry.

In air the probe should read 100% Sat. TGP +/- 0.2 %. If this is the displayed reading, then the probe is properly calibrated and there is no need to continue this procedure.

2. If after an hour the probe is still not reading accurately in air, remove the TGP cartridge from the probe and see if the reading changes to equal 100% Sat TGP.
3. If the reading is still not reading 100% then take a note as to what the Barometric Pressure is in mmHg and press [Menu]
4. Select [Calibration] and press [Enter]. (if you are using an ION you will have to select the probe ID you are working on, and then press [Enter]. )
5. Select [TGP mmHg] and press [Enter].
6. Select [1pt Cal.] and enter the value of mmHg from the BP reading you have already noted in step 3, then press [Enter].
7. The 1pt Calibration is complete.
8. Press [Menu] to return to the main display screen. The TGP probe should be reading 100% Sat. TGP.
9. To test the probe's response, re-attach the TGP cartridge to the probe and observe the readings.

The value should increase and then slowly drop back down to 100% Sat TGP in under 15min.

If the TGP values remains high at this point, then a new cartridge may be needed as the membrane may be damaged or plugged

\*Note: the TGP cartridge may be washed with a light detergent to remove biofouling, yet be careful that you do not let any water get into the tubing.

# Specification

## Measurements & Dimensions

Measured	Measurement Range	Resolution	Accuracy
Total Gas Pressure [mmHg]	0 -1550 mmHg	1.0 mmHg	+/- 2.0 mmHg
Dissolved Oxygen [%Sat]	0 - 300% Sat	0.1 % Sat	+/- 1.0 % Sat
Temperature [°C]	0 - 50 °C	0.1 °C	+/- 0.2 °C
Barometric Pressure [mmHg]	0 - 1550 mmHg	1.0 mmHg	+/- 2.0 mmHg
Derived			
Total Gas Pressure [% SAT]	0 to 200%	0.1%	+/- 4.0 % Sat
ΔP (Delta P) [mmHg]	+/- 1500 mmHg	1.0 mmHg	+/- 4.0 mmHg
Dissolved Oxygen [mg/L]	0 - 25 mg/L @ 20°C	0.1 mg/L	+/- 0.2 mg/L
Salinity Compensation [ppt]	0 - 50 ppt	1.0 ppt	

Probe Properties	
Measurement Principal	TGP (Membrane Diffusion) O2 (Optical Phase Angle)
Response Time Dissolved Oxygen	~ 95% @ 30 seconds
Response Time Total Gas Pressure	~ 95% @ 5 minutes
Max. Operating Depth	60m [200 ft]
Operating Temperature	0 - 50 °C
Max. Operating Deployment Time	1 month (TGP cartridge service necessary)
Material	Delrin, Silicon, 316 Stainless Steel
Power	5 - 14 VDC, 50mA Nom, 80 mA Peak
Output	Digital RS485 (Modbus Protocol)

Length	Diameter	Weight
24.6 cm [9.69"]	4.34 cm [1.71"]	0.7 kg [1.5 lbs] w/ 5m of cable

## Spare Parts

Part No	
1SSP050	Lumi4 Oxygen /TGP/Temp Probe with 5m cable
1SSP070	Lumi4 Replacement DO Cap
1SSP080	Lumi4 Replacement TGP Cartridge
1OXPA012	Extra Probe Cable, 6 Cond PolyU [\$m/\$ft]

\* Subject to Change without Notice