
# Dissolved Oxygen Controller
# Quick Start Guide

BD-DO-2020-VER1

# Contents

## Experimental Setup

1. Aquaria should be set up as shown in Figure 1: Experimental Setup
2. Regulating Nitrogen
    a. Nitrogen must be regulated coming from the tank
    b. Pressure from regulator should be adjusted to provide adequate flow to reduce DO to required levels while using a minimum amount of Nitrogen.
    c. Typical Pressure ranges from 3-5 psi for proper operation in a 20 gallon aquarium
    d. Pressure must not exceed 10 psi from the regulator
3. Connect Air Line
    a. Connect line from nitrogen tank to “IN” port on the DO Controller
    b. Connect line from “OUT” port on DO Controller to Tank
4. Circulation pump should be placed in the tank near the Nitrogen Outlet Tube
    a. Circulation pump should provide minimum 60 ml/min of flow over DO Probe Tip
5. Connect DO Probe to DO Probe port on DO Controller
6. Connect Temp Probe to Temp Probe port on DO Controller
7. Insert Temp and DO Probe into Aquarium
    a. Both Probes should be suspended in the water column – not lying on the bottom of the aquarium
    b. Probes should be located away from Nitrogen Outlet tube to ensure probe is reading values in thoroughly mixed water
8. Cover Air/Water interface with Styrofoam or Aquarium Lid
9. Insert Micro SD Card Into Micro SD Card Slot – Card will extend out from face of housing when fully inserted see Figure 2: MicroSD Card Shown Fully Inserted.
10. Connect 12VDC transformer to port on DO Controller and plug into electrical wall socket that has GCFI protection

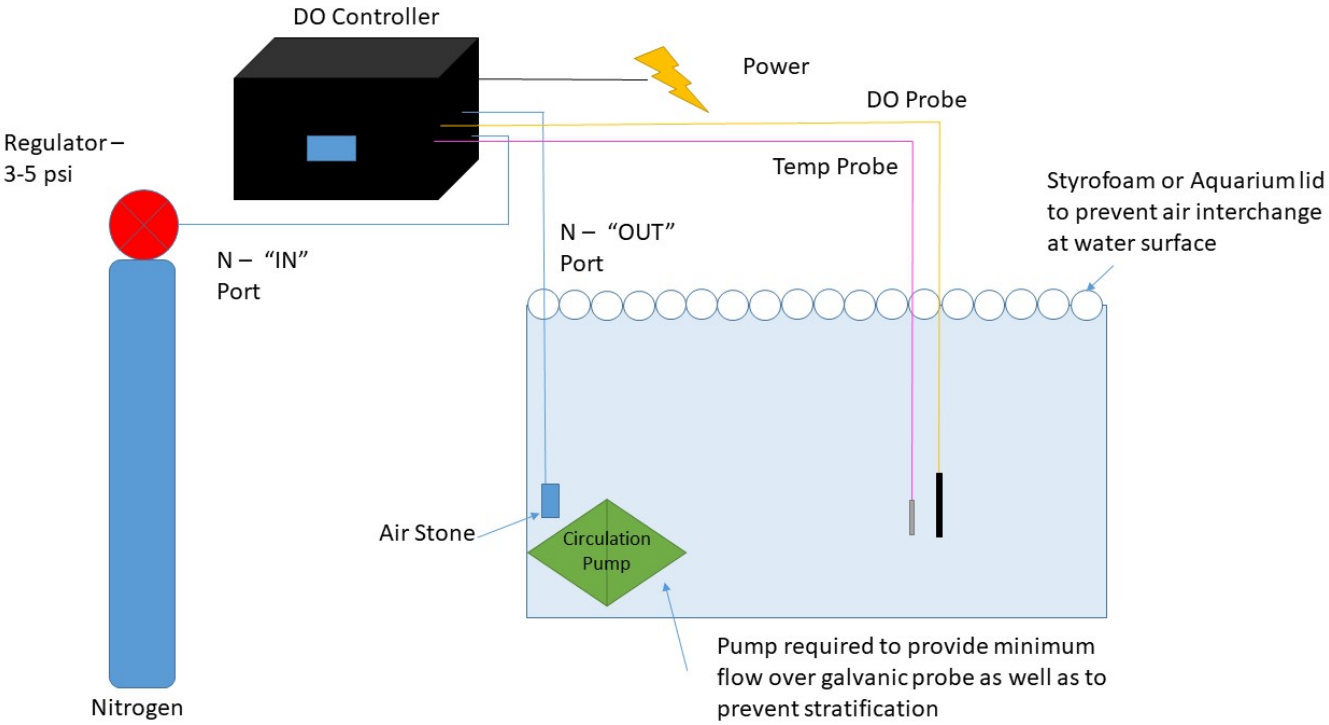



*Figure 1: Experimental Setup*


*Figure 2: MicroSD Card Shown Fully Inserted*

## Start Up

- Upon Startup system requires 10-20 seconds to boot up the processor and populate the home screen
- During Startup do not interact with screen until all fields are populated

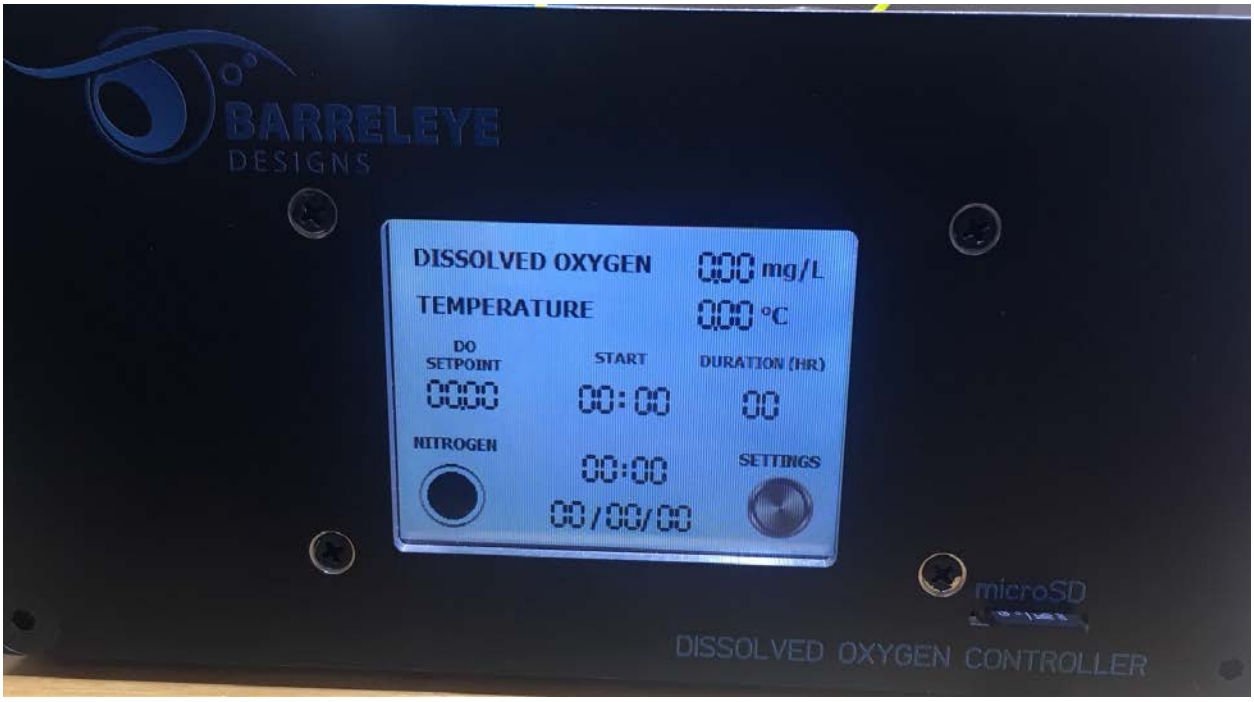



*Figure 3: Home Screen on Startup - No Fields Populated*

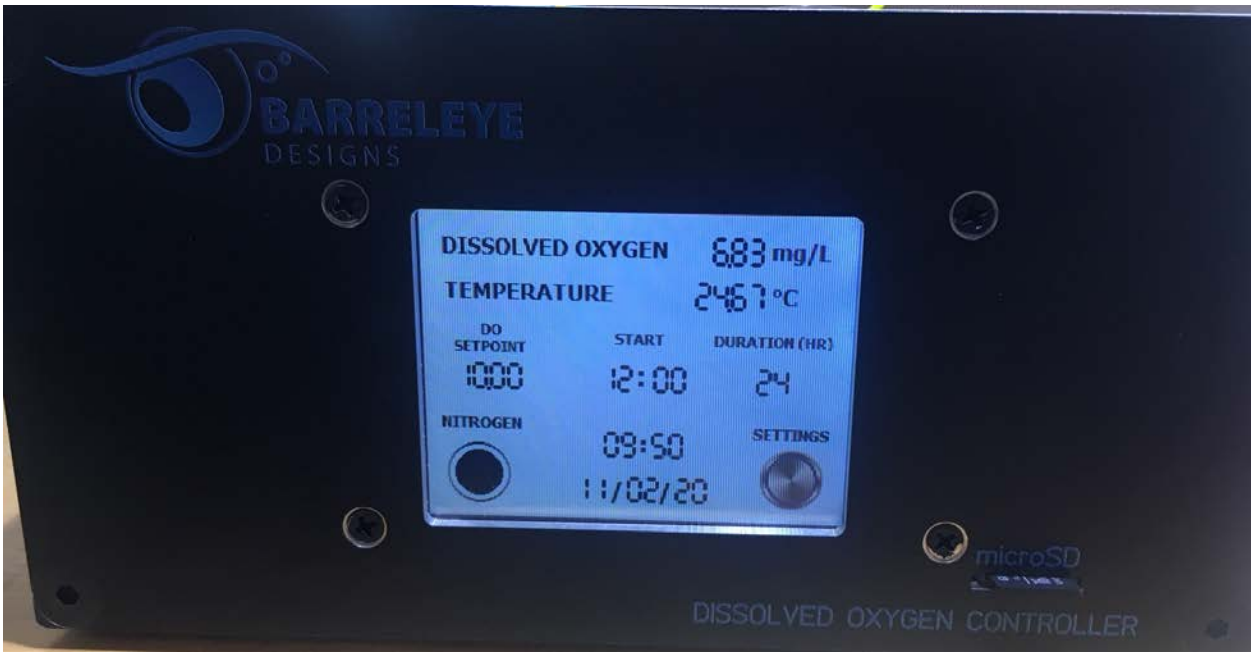



*Figure 4: Home Screen on Start Up - Fields Populated*

# Home Screen

## Fields

- Dissolved Oxygen
  - Current DO Level In Tank – Reading updated once per second
- Temperature
  - Current Temperature in Tank – Reading updated once per second
- DO Setpoint – Target DO in tank – User selected Value
- Start – Start time using a 24 hour clock, user selected value
- Duration – Run Time Duration based upon a 24 hour clock, user selected value
  - Example: Duration 24 Hours – Nitrogen will be controlled and adjusted for 24 hours per day - start time is not relevant in this scenario
  - Example: Start timer 12:00, Duration 3 Hours – Nitrogen will be controlled and adjusted for 3 hours from 12:00 to 15:00
  - Example: Start timer 20:00, Duration 6 Hours – Nitrogen will be controlled and adjusted for 20 hours from 20:00 to 02:00.
- Nitrogen – This button turns on/off the control of the nitrogen
  - Nitrogen “off” - will not flow into tank
  - Controller will measure and record Temp and DO Data


*Figure 5: Nitrogen Off*

  - Nitrogen “on” - will flow into tank to control DO levels
  - Controller will measure and record Temp and DO Data


*Figure 6: Nitrogen On*

- Settings – Progess thru the screens to access user input values
  - DO Setpoint
  - Start and Runtime Setpoints
  - Salinity Setpoint
  - Time and Date Set
  - Calibrate DO Probe

## DO Setpoint

The Dissolved Oxygen level that the DO Controller will maintain within the aquarium.

The level can be adjusted in 0.10 increments.

Once adjusted this value is immediately input as the setting for DO Control


### Fields

- Select – This button toggles between adjusting the hole number value or the decimal value, this the user to cycle thru the DO Values more efficiently
- Up – This increases the hole number by 1 or the decimal by .01 depending upon which value is selected
- Down – This decreases the hole number by 1 or the decimal by .01 depending upon which value is selected
- Next – Move to the Salinity Selection Screen
- Home – Return to the Home Screen

## Salinity

This is the salinity level is used by the DO Probe to calculate the DO in the tank.

The level can be adjusted in 0.10 increments.

Once adjusted this value is immediately input as the setting for DO Calculations


### Fields

- Select – This button toggles between adjusting the hole number value or the decimal value, this the user to cycle thru the Salinity values more efficiently
- Up – This increases the hole number by 1 or the decimal by .01 depending upon which value is selected
- Down – This decreases the hole number by 1 or the decimal by .01 depending upon which value is selected
- Next – Move to the Start/Duration Selection Screen
- Home – Return to the Home Screen

## Start/Duration Selection

This screen is used to select both the start time and duration using a 24 hour clock.


### Fields

- Start Time – This button adjust the start time in increments of 1 hour using a 24 hour clock.
- Run Time Duration– This button adjust the run time duration by increments of 1 hour. When set to 24 hours the Controller will maintain the DO Setpoint Level Continuously
- Next – Move to the Date-Time Set Screen
- Home – Return to the Home Screen

#### Examples

- Example: Duration 24 Hours – Nitrogen will be controlled and adjusted for 24 hours per day - start time is not relevant in this scenario
- Example: Start timer 06:00, Duration 9 Hours – Nitrogen will be controlled and adjusted for 9 hours daily from 06:00 to 15:00
- Example: Start timer 20:00, Duration 6 Hours – Nitrogen will be controlled and adjusted for 20 hours daily from 20:00 to 02:00.

## Date – Time Set

This screen is used to set the Date and Time.

Time Format – 24 hour clock

Date Format – MM/DD/YY


### Fields

- Select – This button toggles between which value to adjust
    - A Red Led will illuminate below field to indicate which field is to be adjusted
- Up – This increases the field by 1
- Down – This decreases the hole number by 1
- Set – When this button is pressed values on the screen will be sent and the clock will be adjusted
    - To verify the update return to the home screen and ensure that the Date Time indicated on the home screen is accurate
- Next – Advance to the DO Probe Calibration Screen
- Home – Return to the Home Screen

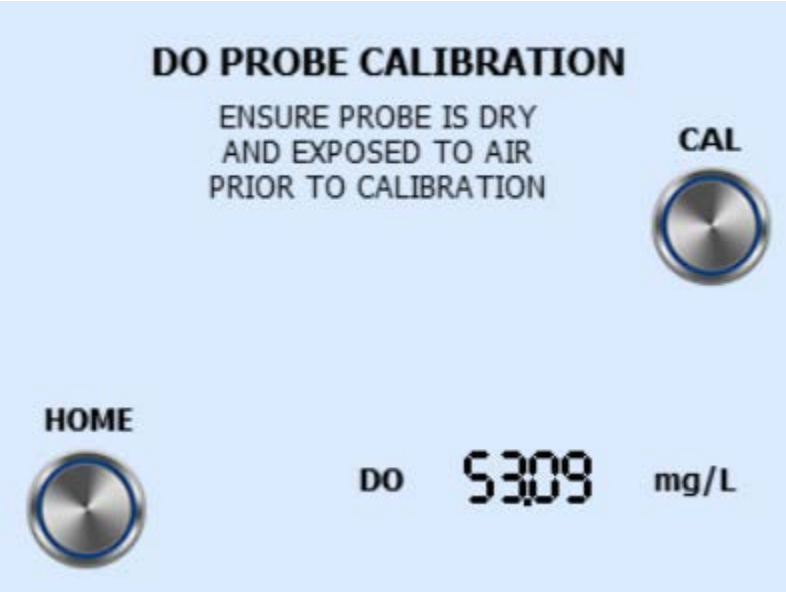
## DO Probe Calibration

This screen is used to calibrate the DO Probe.

Calibration will take up to 1 minute to complete. Do not power down the system or make further adjustments when calibration is taking place.

Calibration is not required frequently, please refer to Atlas Scientific Data Sheet in Appendix.

Prior to calibrating the probe ensure that the probe is dry and exposed to air.




### Fields

- CAL – This button initializes the calibration process
- Status-

  *Calibration in Process – Stabilizing Readings*
  - Controller has sent default values to probe and has begun taking readings
  - *Readings will be taken once per second for 30 seconds until readings stabilize*

  *Calibration in Process – Calibrating*
  - Controller is sending Calibration Command to DO Probe and analyzing the result

  *Calibration Complete*
  - Calibration was successful
  - Please allow up to 30 seconds for readings to stabilize once calibration is complete

  *Calibration Failed – Please Recalibrate*
  - Calibration Failed, run calibration again
- Home – Return to the Home Screen

## Screen Saver

After 5 minutes the controller will enter screen saver mode.

To exit screensaver mode press the button in the bottom left corner of the screen.

### Fields

- Button – This button exits screensaver and returns to the home screen.

## Data Retrieval – MicroSD

Data is stored in a text file on the MicroSD one time per minute.

The Data fields are:

| Date | Time | DO (mg/L) | Temperature (°C) | DOSetpoint (mg/L) |
|---|---|---|---|---|
| MM/DD/YY | 24:MM | X.XX | XX.XX | X.XX |

You can remove the memory card with the system powered down (preferred) or the system running.

System Powered Down

- Remove Power Plug from electrical outlet
- Remove MicroSD card from DO Controller
- Download data from MicroSD card to Computer
- Reinsert MicroSD Card
- Reinsert power plug into electrical outlet
    - If error appears on home screen "SD Card Error"
        i. Power Down System
        ii. Remove and reinsert MicroSD ensuring it is inserted correctly
        iii. Power Up System
        iv. If problem persists try a new MicroSD Card – (Must be less than 16 GB)

System Running

- Remove MicroSD card from DO Controller
    - If MicroSD Card is removed for more than 1 minute and error will appear on the home screen - "SD Card Error"
- Download data from MicroSD card to Computer
- Reinsert MicroSD Card
    - Wait up to 1 minute for "SD Card Error" to clear from home screen
    - If error does not clear from home screen after 1 minute
        i. Power Down System
        ii. Remove and reinsert MicroSD ensuring it is inserted correctly
        iii. Power Up System
        iv. If problem persists try a new MicroSD Card – (Must be less than 16 GB)

## Errors

If system is showing errors or screen data look corrupted power system down for a minimum of 10 seconds and then restart.

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V 4.3
Revised 7/20

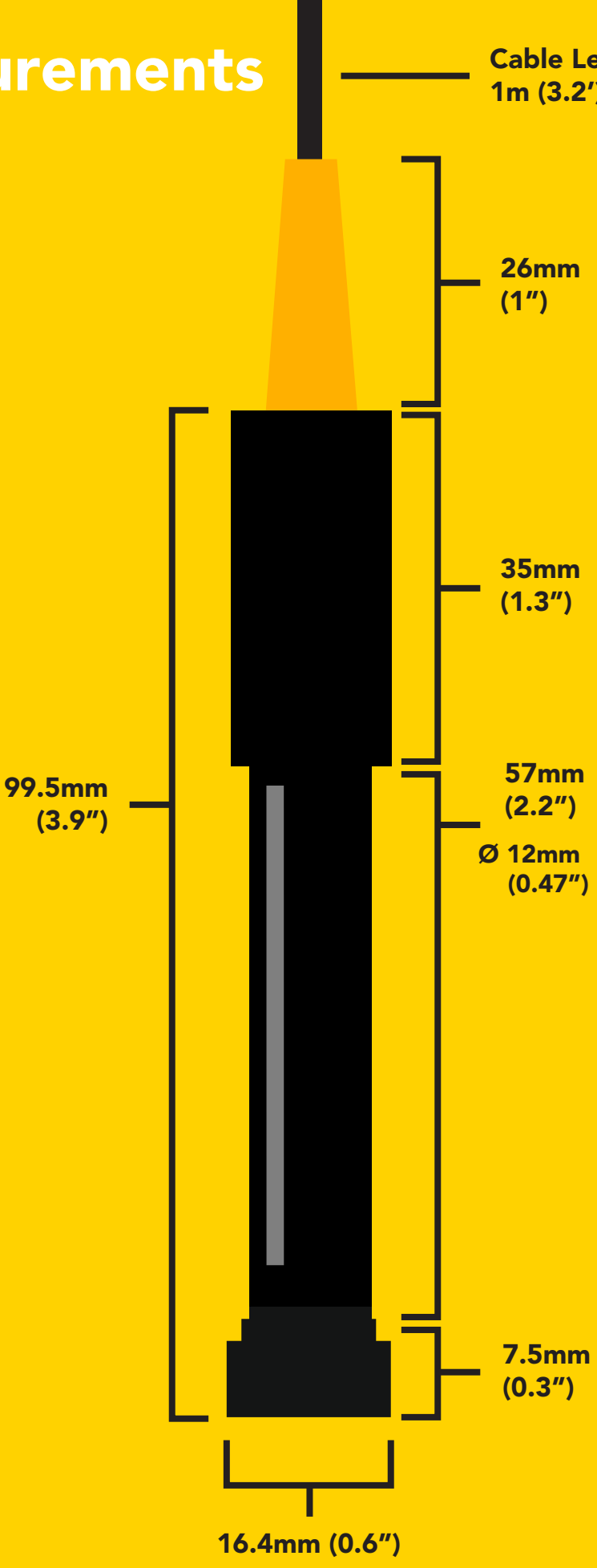
Gen 2

# Lab Grade D.O. Probe

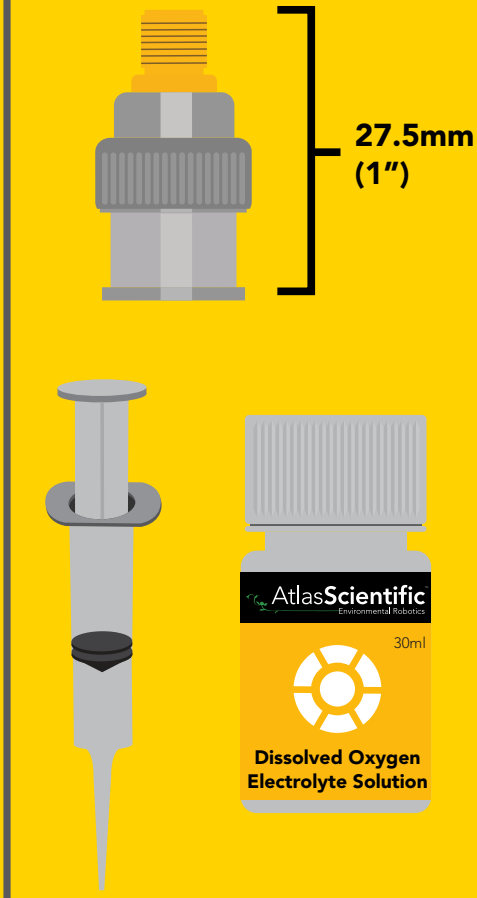
| | |
|---|---|
| Reads | **Dissolved Oxygen** |
| Range | **0 – 100 mg/L** |
| Accuracy | **+/– 0.05 mg/L** |
| Response time | **~0.3 mg/L/per sec** |
| Temperature range °C | **1 – 60 °C** |
| Max pressure | **3,447 kPa (500 PSI)** |
| Max depth | **343 Meters (1,125 ft)** |
| Connector | **Male SMA / Male BNC** |
| Cable length | **1 meter** |
| Internal temperature sensor | **No** |
| Time before recalibration | **~1 Year** |
| Life expectancy | **5 Years +** |
| Maintenance | **~18 Months** |

RoHS COMPLIANT

# Measurements




## Included with probe







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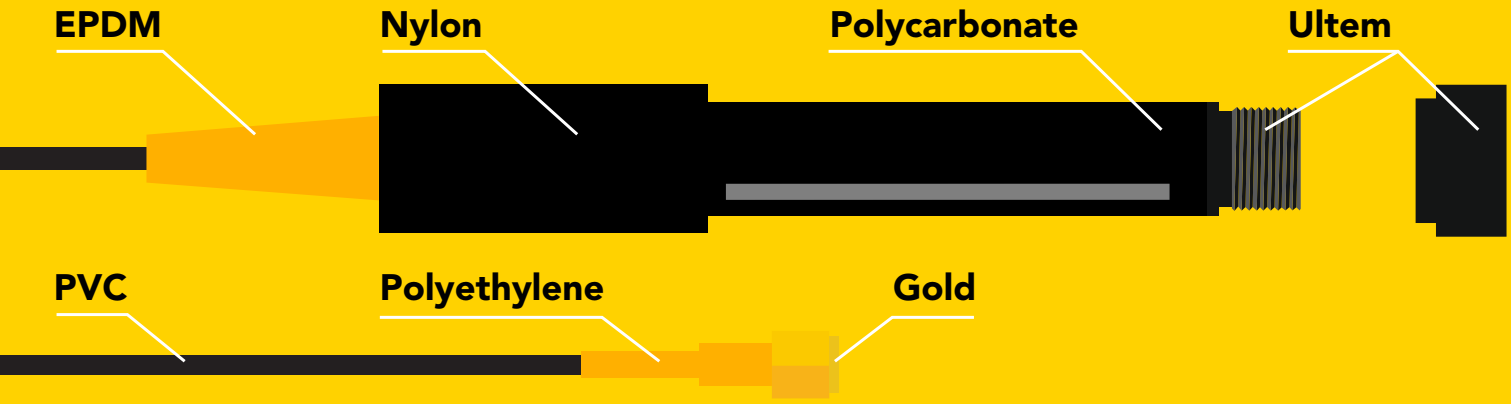
# Specifications

| | |
|---|---|
| Max depth | **343 meters (1,125 ft)** |
| Cable length | **1 meter** |
| Weight | **52 grams** |
| Speed of response | **~0.3 mg/L/per sec** |
| Dimensions | **16.5mm x 124mm (0.5" x 4.9")** |
| SMA connector | **Male** |
| Membrane type | **PTFE** |
| Sterilization | **Chemical only** |
| Food safe | **Yes** |
| Included with probe | **SMA to BNC adapter** |

# Materials




**This Dissolved Oxygen probe can be *fully submerged* in fresh or salt water, up to the SMA connector *indefinitely*.**

# Typical applications

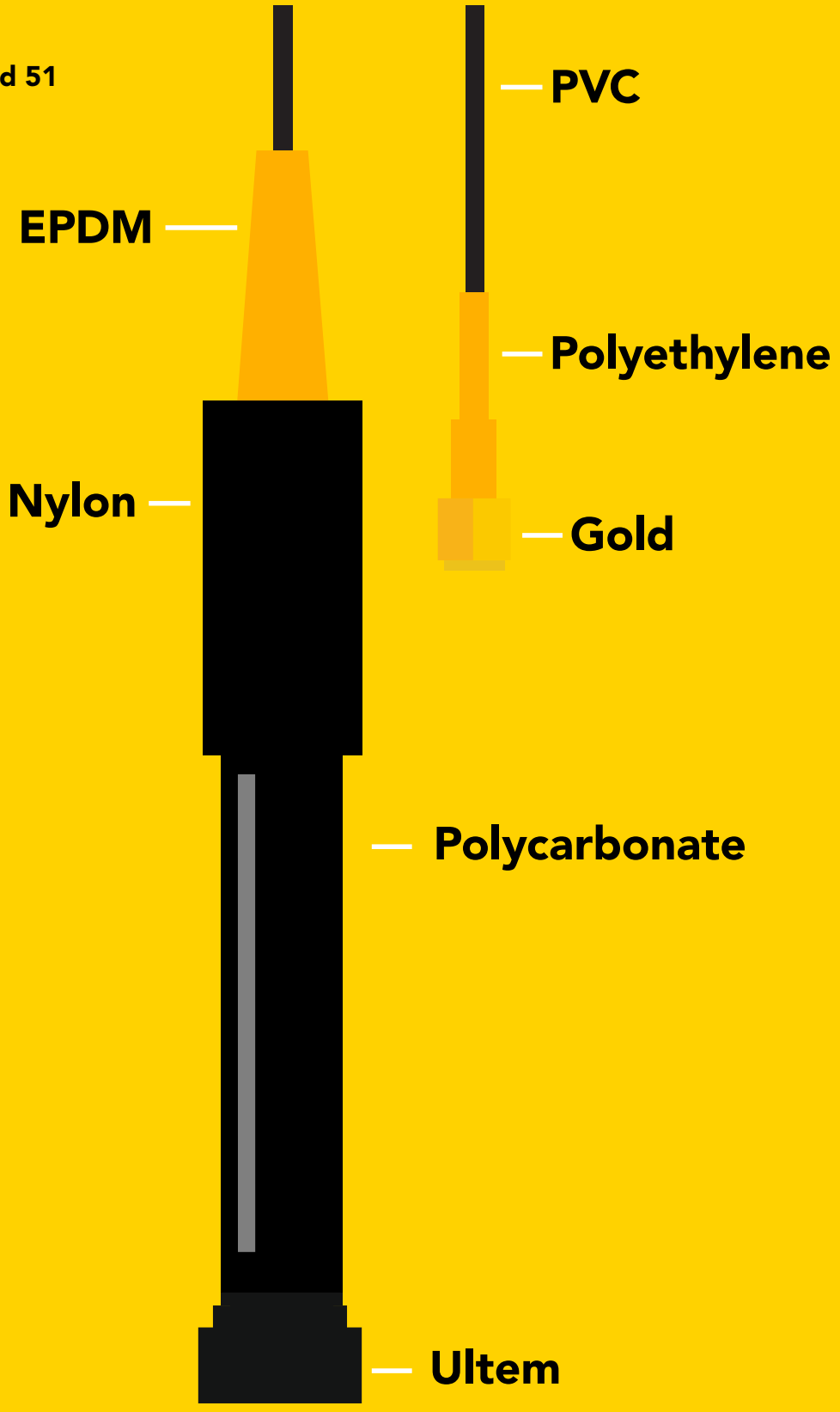
- Standard Lab use
- Field use
- Hydroponics
- Fish keeping
- Wine making
- Environmental monitoring

# NSF/ANSI 51 Compliant

**Atlas Scientific LLC, hereby certifies that,**

**Dissolved Oxygen Probe**
***Part # ENV-40-DOX***

**Complies with NSF/ANSI Standard 51**




- **PVC** NSF-51 Compliant
- **Gold** NSF-51 Compliant
- **Ultem** NSF-51 Compliant
- **Nylon** NSF-51 Compliant
- **EPDM** NSF-51 Compliant
- **Polyethylene** NSF-51 Compliant
- **Polycarbonate** NSF-51 Compliant

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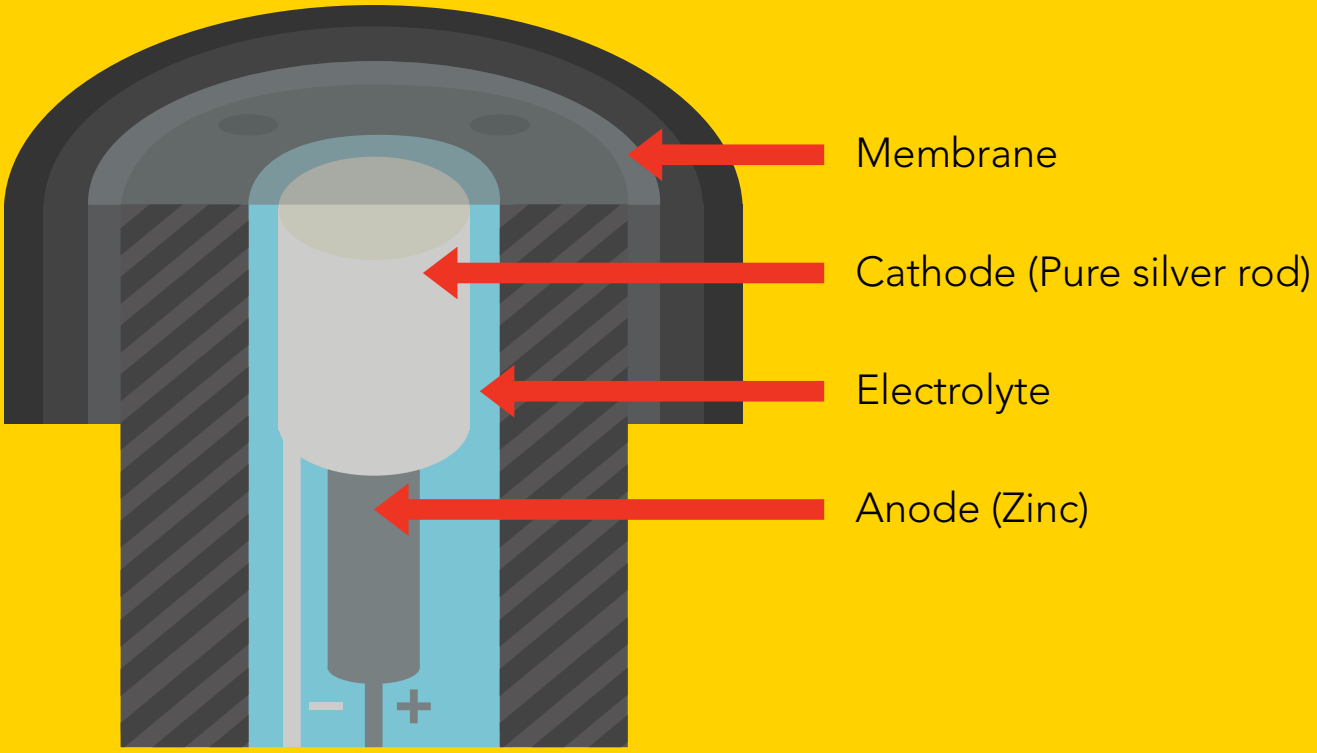
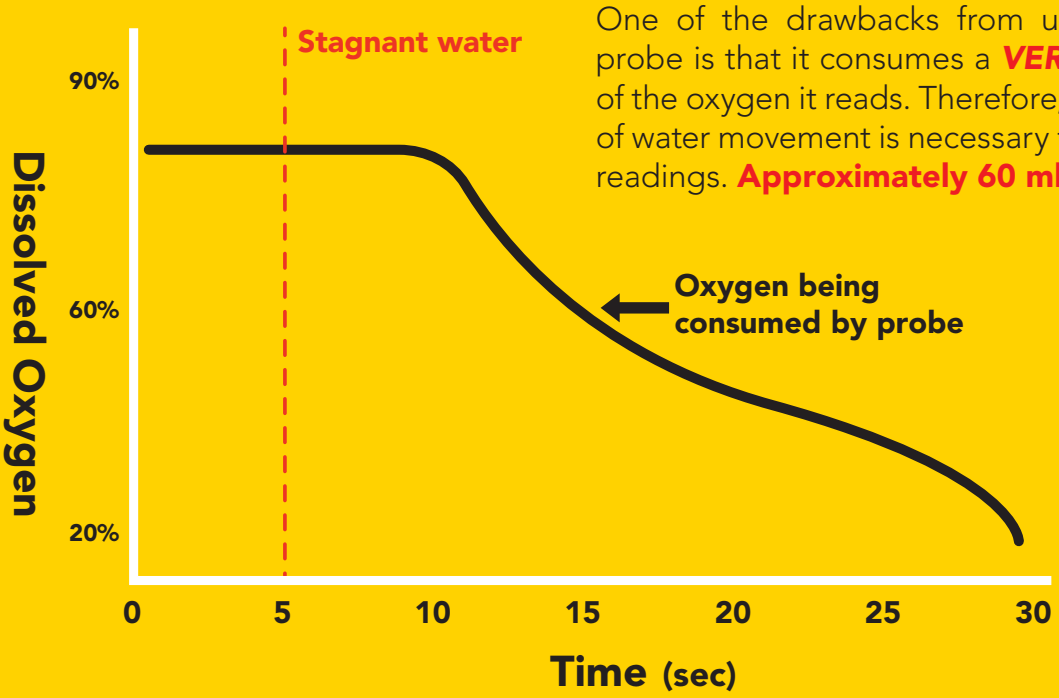
# Operating principle

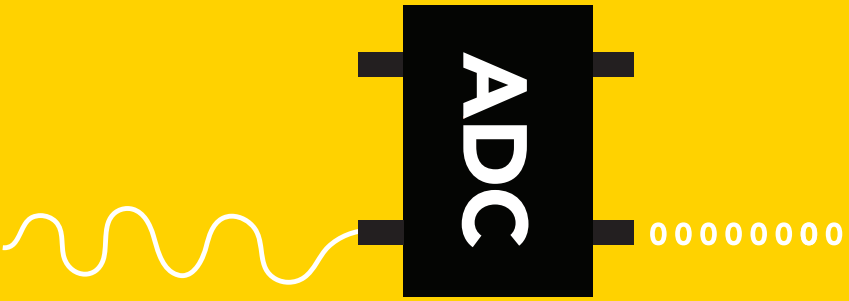
A galvanic dissolved oxygen probe consists of a PTFE membrane, an anode bathed in an electrolyte and a cathode. Oxygen molecules defuse through the probes membrane at a constant rate (without the membrane the reaction happens to quickly). Once the oxygen molecules have crossed the membrane they are reduced at the cathode and a small voltage is produced. If no oxygen molecules are present, the probe will output 0 mV. As the oxygen increases so does the mV output from the probe. Each probe will output a different voltage in the presence of oxygen. The only thing that is constant is that **0mV = 0 Oxygen**.




One of the drawbacks from using a galvanic probe is that it consumes a ***VERY*** small amount of the oxygen it reads. Therefore, a small amount of water movement is necessary to take accurate readings. **Approximately 60 ml/min**.

This galvanic dissolved oxygen probe is a passive device that generates a small voltage from 0mv – 60+ mv depending on the oxygen saturation of the PTFE sensing membrane. This voltage can easily be read by a multimeter or an analog to digital converter.




**Can be read with Multimeter**

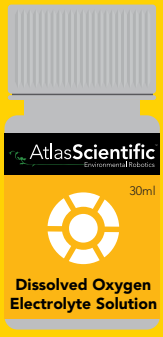
**Can be read with ADC**

# How often do you need to recalibrate a dissolved oxygen probe?

Because every use case is different, there is no set schedule for recalibration.

The dissolved oxygen probe reacts with oxygen in the water, the more oxygen it reacts with the more the probe is depleted of its electrolyte solution. Typically a dissolved oxygen probe will last ~2 years before the electrolyte is depleted *(results will vary)*. When the electrolyte is depleted, the probe will read very low numbers. Best practice is to replace the electrolyte solution and PTFE membrane every 1 – 2 years.

**The Gen 2 Dissolved Oxygen probe comes with:**




**30ml Dissolved Oxygen Electrolyte Solution**

**Syringe**

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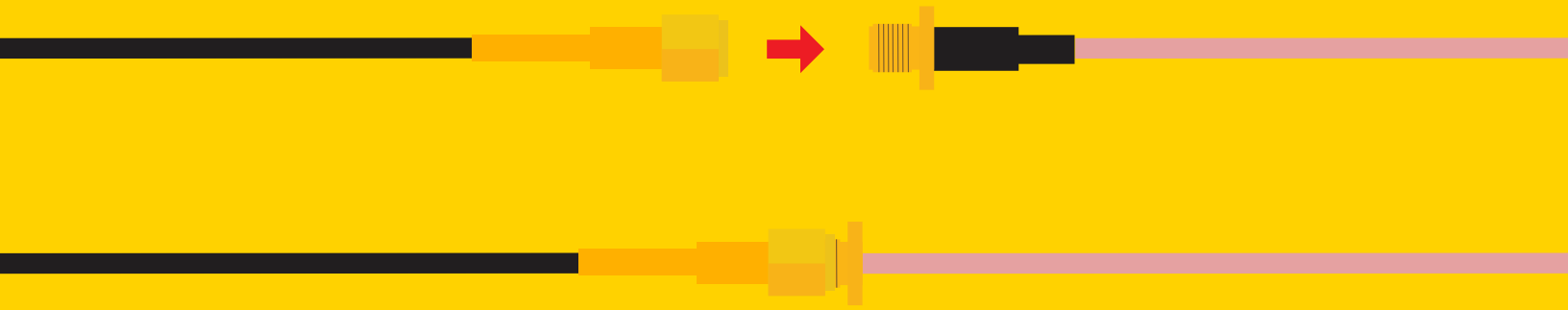
# Extending the probe cable length

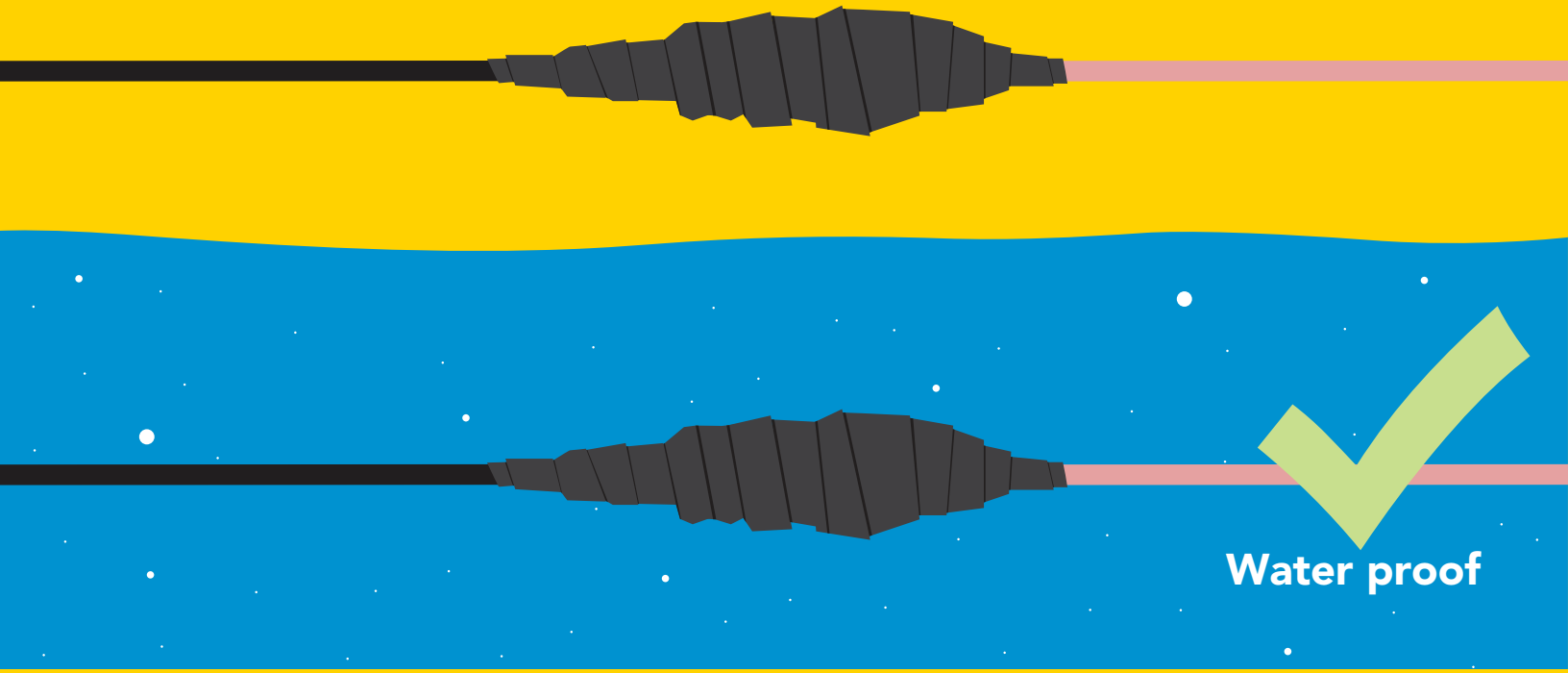
You can extend the cable to greater than 100 meters with no loss of signal. Atlas Scientific has tested up to 300 meters without a problem, however you run the risk of turning your D.O. probe into an antennae, picking up noise along the length of your cable.

If you want to extend your cable, we recommend that you use proper isolation, such as the ***Basic EZO™ Inline Voltage Isolator***, or ***Tentacle Shield***. Be sure to calibrate your probe with the extended cable.

Extending a probe cable can be easily done with our ***SMA Extension Cable***. Simply connect the SMA end of the probe to the Extension cable, and you are all set.



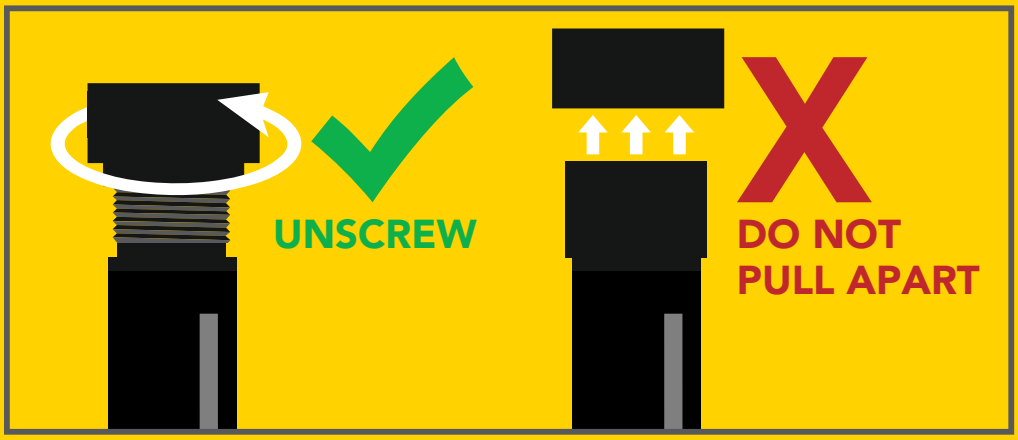
If you need to water proof a SMA connection, we highly recommend using a product like ***Coax-Seal*** to safely cover and prevent any water damage that may occur.



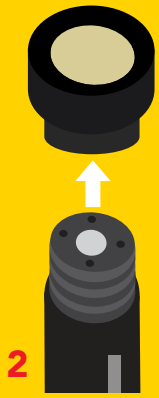
# How to recondition the lab grade dissolved oxygen probe

During usage, a small amount of electrolyte solution within the dissolved oxygen probe will deplete. In this case, you will need to add more solution into the probe.

**To add more electrolyte solution:** Carefully unscrew the probes membrane cap. Using the supplied syringe, withdraw 2ml – 5ml of electrolyte solution. Insert the syringe into one of the four holes surrounding the silver cathode. Inject solution until it leaks out one of the fill holes. Make sure the silver cathode has a drop of electrolyte on it, after filling the probe. Screw membrane cap back onto probe.









Withdraw
2ml – 5ml


Fill to
overflow


Make sure the silver cathode has a drop of electrolyte on it, after filling the probe




Rinse probe

# Probe cleaning

Over time dissolved oxygen probes can become dirty and covered in chemical deposits. Soft coatings can be removed by lightly brushing around the sides of the probe and membrane cap. If the probes membrane is in need of cleaning, use a mild bleach mixture to gently wash away any deposits.

**DO NOT USE A BRUSH TO CLEAN THE MEMBRANE**

If the probes membrane is ripped it must be replaced, as it will cause irregular readings.

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V 1.7

Revised 7/20

# PT-1000
## Temperature Probe

| | |
|---|---|
| Reads | **Temperature** |
| Probe type | **Class A platinum, RTD** |
| Range | **-200˚C to 850˚C** |
| Accuracy | **+/- (0.15 + (0.002*t))** |
| Reaction Time | **90% in 13s** |
| Cable length | **81cm (2.6')** |
| Connector | **Male BNC** |
| Output | **Resistance (Analog)** |
| Life expectancy | **15 years** |

RoHS COMPLIANT

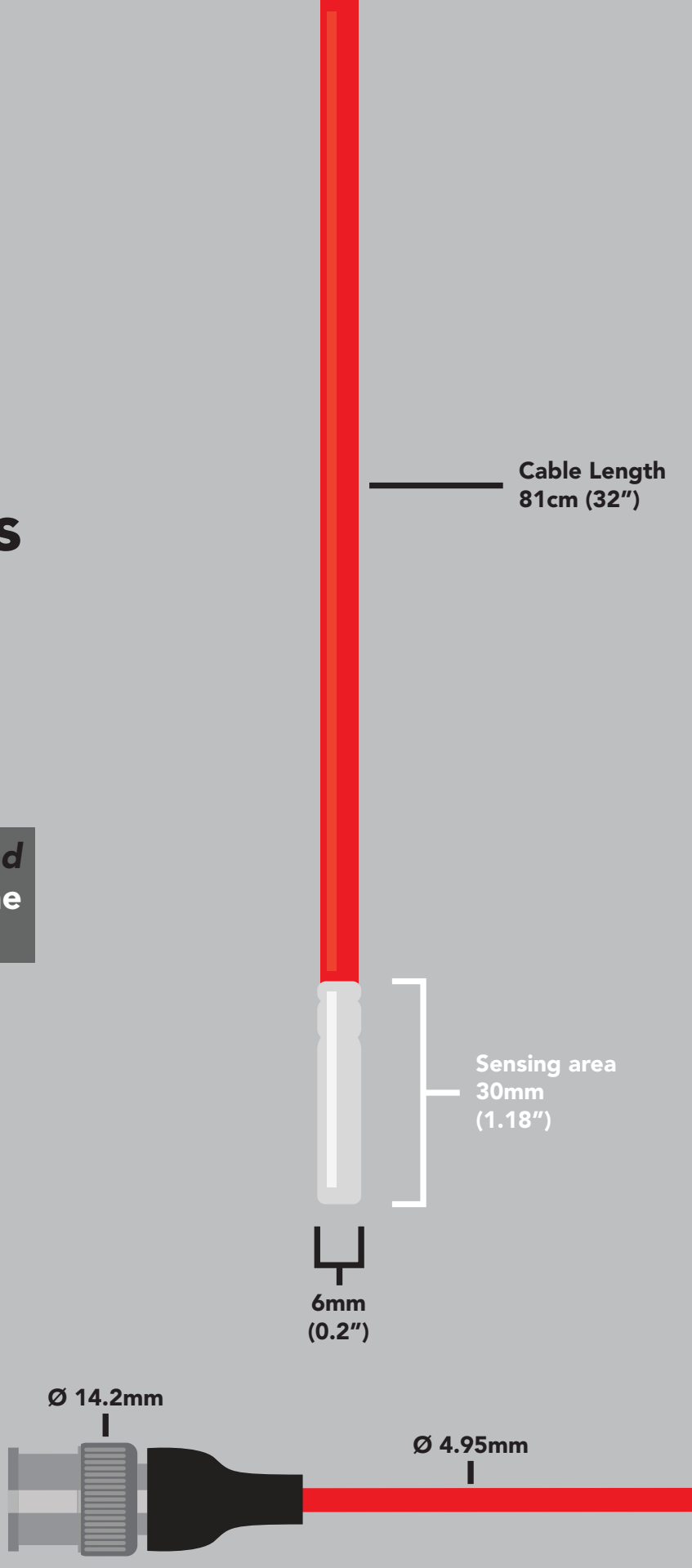
# Specifications

| | |
|---|---|
| Cable length | **81cm (32")** |
| Weight | **40 grams** |
| Min cable temp | **-55°C** |
| Max cable temp | **125°C** |
| Sensing material | **304 SS** |
| Dimensions | **6mm x 81cm (0.2" x 32")** |
| BNC connector | **Male** |
| Sterilization | **Chemical / Autoclave** |
| Food safe | **Yes** |

# Typical Applications

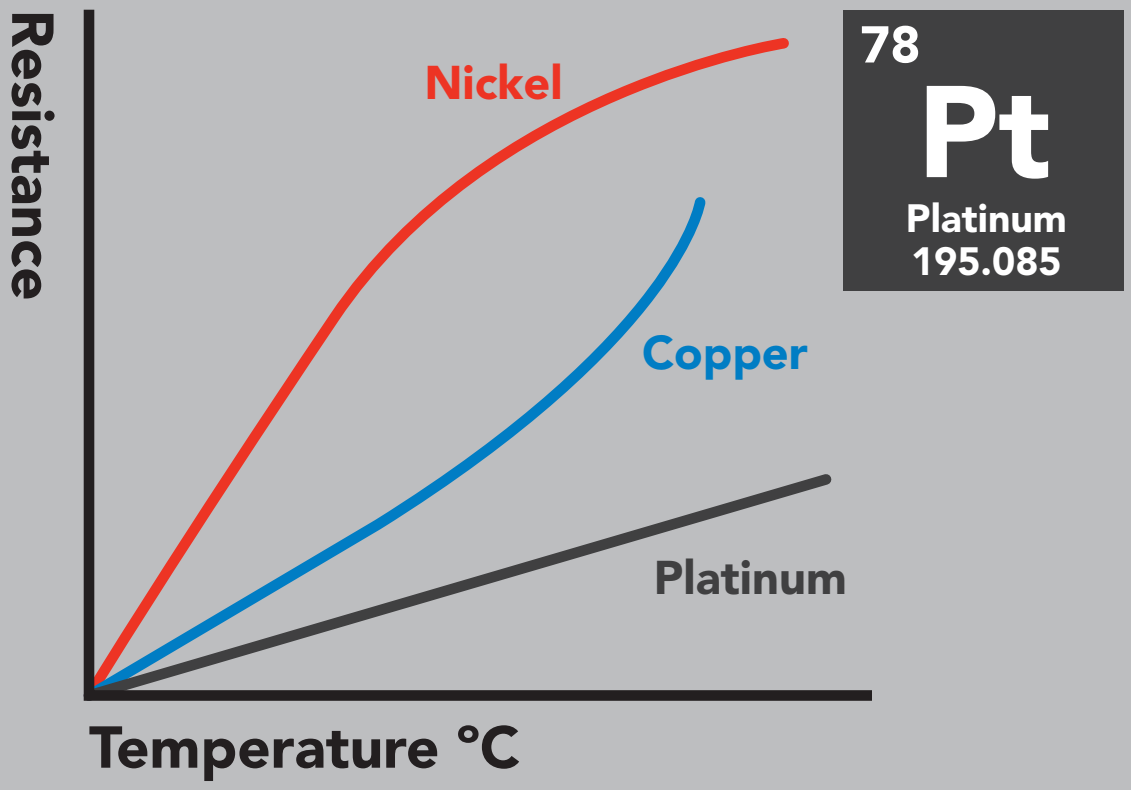
- Standard lab use
- Field use
- Soil
- Hydroponics / aquaponics
- Beer, wine and other liquor

**The PT-1000 can be *fully submerged* in fresh water or salt water, up to the BNC connector *indefinitely*.**

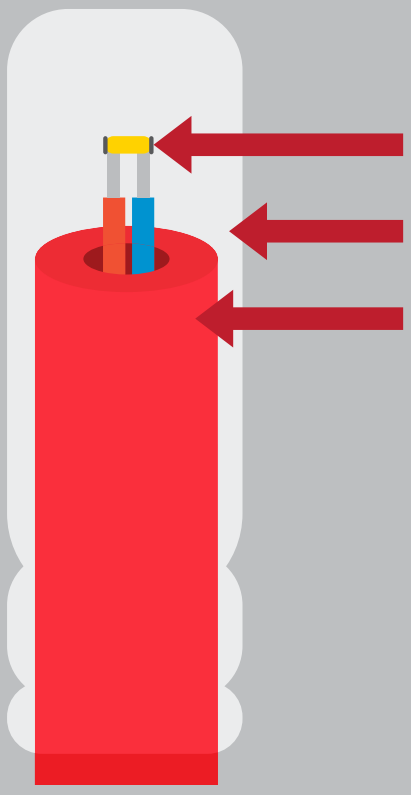


# Operating principle

Unlike any other material, platinums correlation between resistance and temperature seems to be woven into the fabric of the universe. It is for this reason, that the platinum RTD temperature sensor is the industrial standard for temperature measurement.




78
Pt
Platinum
195.085



Platinum resistor

304 stainless steel

Silicon rubber jacket

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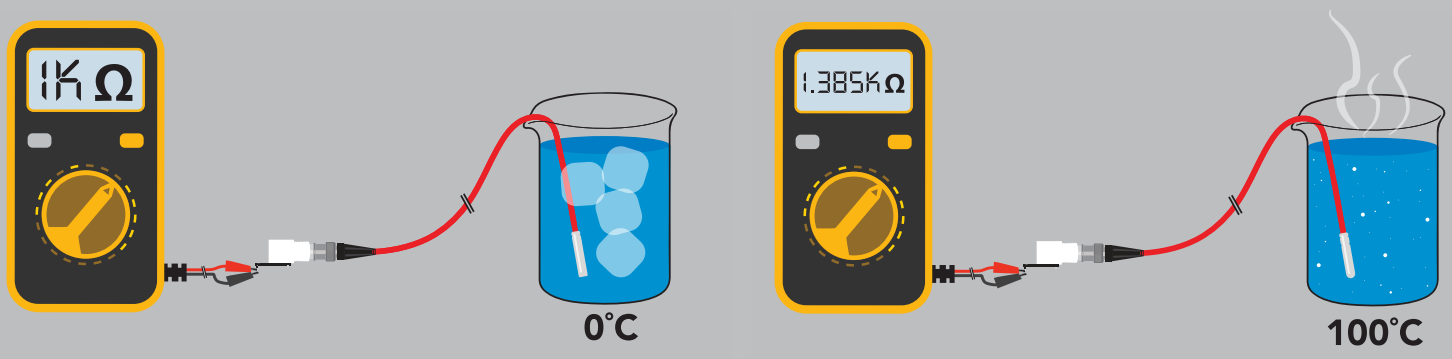
The PT-1000 temperature probe is a resistance type thermometer. Where PT stands for platinum and 1000 is the measured resistance of the probe at 0˚C in ohms (1k at 0˚C). As the temperature changes the resistance of the platinum changes.




To convert the resistance of the probe to temperature, use the following simplified equation:

$$T = -\frac{\sqrt{(-0.00232(R) + 17.59246)} - 3.908}{0.00116}$$

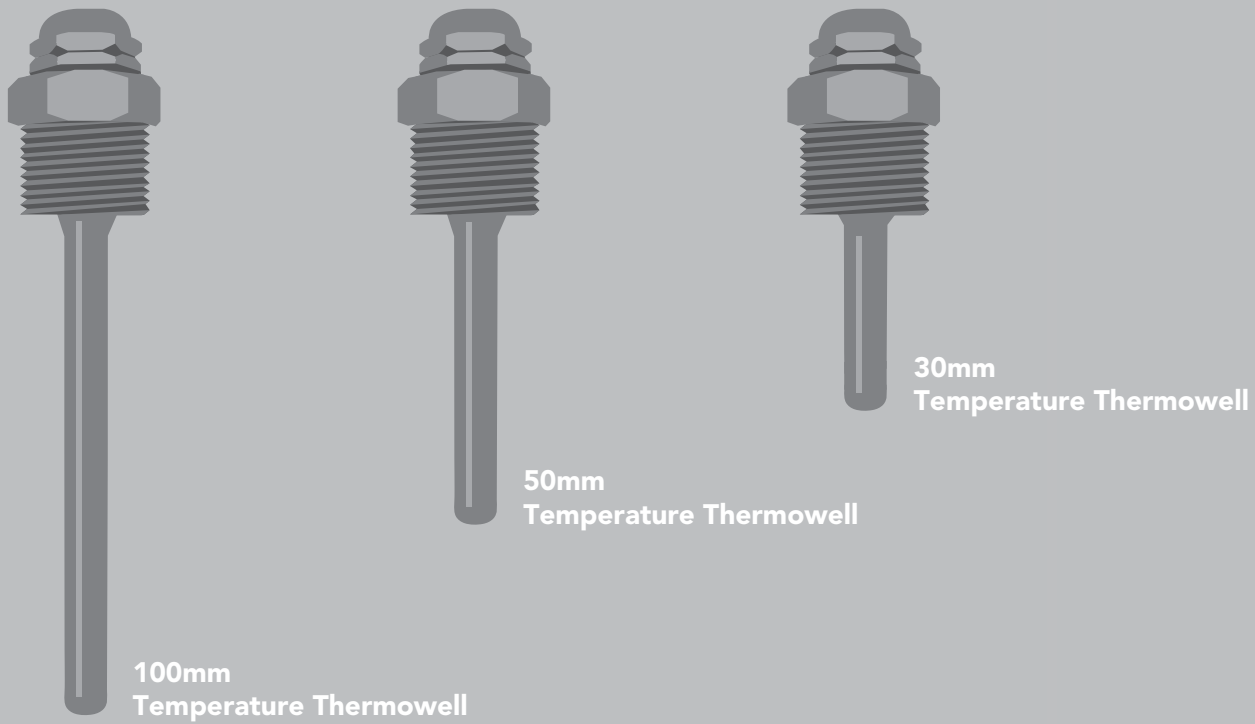
***T*** = Degrees Celsius
***R*** = Resistance measured from PT-1000 temperature probe

Below is a small table of temperatures and resistances, to help insure the above equation has been properly embedded into your code.

| ˚C | Ω | ˚C | Ω | ˚C | Ω |
|---|---|---|---|---|---|
| -10 | 960.9 | 7 | 1027.3 | 24 | 1093.5 |
| -9 | 964.8 | 8 | 1031.2 | 25 | 1097.3 |
| -8 | 968.7 | 9 | 1035.1 | 26 | 1101.2 |
| -7 | 972.6 | 10 | 1039 | 27 | 1105.1 |
| -6 | 976.5 | 11 | 1042.9 | 28 | 1109 |
| -5 | 980.4 | 12 | 1046.8 | 29 | 1112.8 |
| -4 | 984.4 | 13 | 1050.7 | 30 | 1116.7 |
| -3 | 988.3 | 14 | 1054.6 | 31 | 1120.6 |
| -2 | 992.2 | 15 | 1058.5 | 32 | 1124.5 |
| -1 | 996.1 | 16 | 1062.4 | 33 | 1128.3 |
| 0 | 1000 | 17 | 1066.3 | 34 | 1132.2 |
| 1 | 1003.9 | 18 | 1070.2 | 35 | 1136.1 |
| 2 | 1007.8 | 19 | 1074 | 36 | 1139.9 |
| 3 | 1011.7 | 20 | 1077.9 | 37 | 1143.8 |
| 4 | 1015.6 | 21 | 1081.8 | 38 | 1147.7 |
| 5 | 1019.5 | 22 | 1085.7 | 39 | 1151.5 |
| 6 | 1023.4 | 23 | 1089.6 | 40 | 1155.4 |

# Extended temperature range

In order to read temperatures that are above or below the max cable temperature **(-55°C to 125°C)** additional probe housing or **thermowells**, are needed to protect the cable from any temperature related damage.

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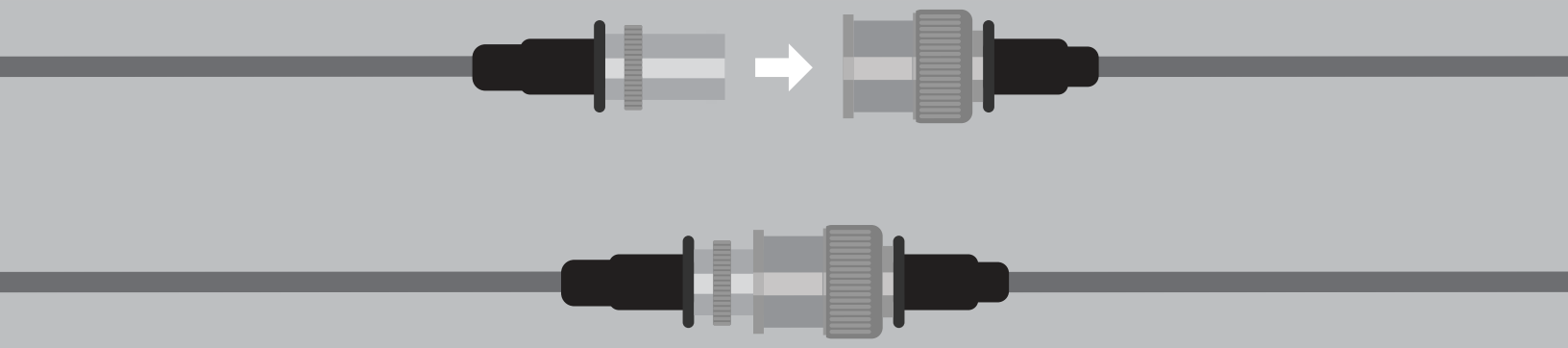

If you need to water proof a BNC connection, we highly recommend using a product like ***Coax-Seal*** to safely cover and prevent any water damage that may occur.