

# RBR COMPACT INSTRUMENTS

RBR *solo*<sup>3</sup>

RBR *duet*<sup>3</sup>



# INSTRUMENT GUIDE

[rbr-global.com](http://rbr-global.com)

# Table of contents

1	Compact instruments .....	4
1.1	RBR <i>solo</i> <sup>3</sup> .....	5
1.2	RBR <i>duet</i> <sup>3</sup> .....	7
2	Physical specifications.....	8
3	Sensor specifications .....	10
3.1	Pressure (D) .....	10
3.2	Temperature (T) .....	11
3.3	Radiometers (PAR, rad).....	11
3.4	Dissolved oxygen (ODO, DO).....	14
3.5	Turbidity .....	15
4	Derived parameters .....	16
4.1	Sea pressure .....	16
4.2	Depth .....	16
4.3	Oxygen concentration .....	17
4.4	Oxygen saturation.....	17
5	Hardware .....	18
5.1	Opening and closing a compact instrument .....	18
5.2	Instrument interface .....	20

6	Maintenance.....	21
6.1	Support kits.....	21
6.2	Replacing the O-rings.....	22
6.3	Replacing the battery.....	24
6.4	Replacing the desiccant capsule.....	25
6.5	Coupling the turbidity sensor.....	26
6.6	Connecting the cabled PAR sensor (LI-COR).....	28
6.7	Cables and connectors .....	29
6.8	RBR ODO sensor care and maintenance.....	30
6.9	OxyGuard DO sensor care and maintenance.....	31
6.10	Cleaning the instrument.....	32
6.11	Calibrating the instrument .....	33
6.12	Repairs.....	33
7	Revision history.....	34

# 1 Compact instruments

RBR manufactures two types of compact instruments, the RBRsolo<sup>3</sup> and RBRduet<sup>3</sup>.

The RBRsolo<sup>3</sup> is a family of single-channel instruments, whereas the RBRduet<sup>3</sup> instruments are dual-channel. Both are small, lightweight, stable, and provide highly accurate measurements during long deployments. Low power consumption, large memory, and ability to endure harsh conditions make them a perfect choice for many oceanographic applications. Only one software tool, Ruskin, is required to operate them. See Ruskin User Guide: Compact Instruments<sup>3</sup> for more information.

All RBR compact instruments support the following features:

- High accuracy
- Long deployments
- Compact and lightweight
- One AA battery
- Up to 32Hz sampling\*
- USB-C download

\* Select from several | fast sampling variants, such as | fast8, | fast16, | fast32, | tide16, and | wave16, depending on your needs.

**i** In most cases, standard, | slow, and | fast sampling variants look identical. The only exception is RBRsolo<sup>3</sup> T | deep | slow, which has an embedded thermistor.

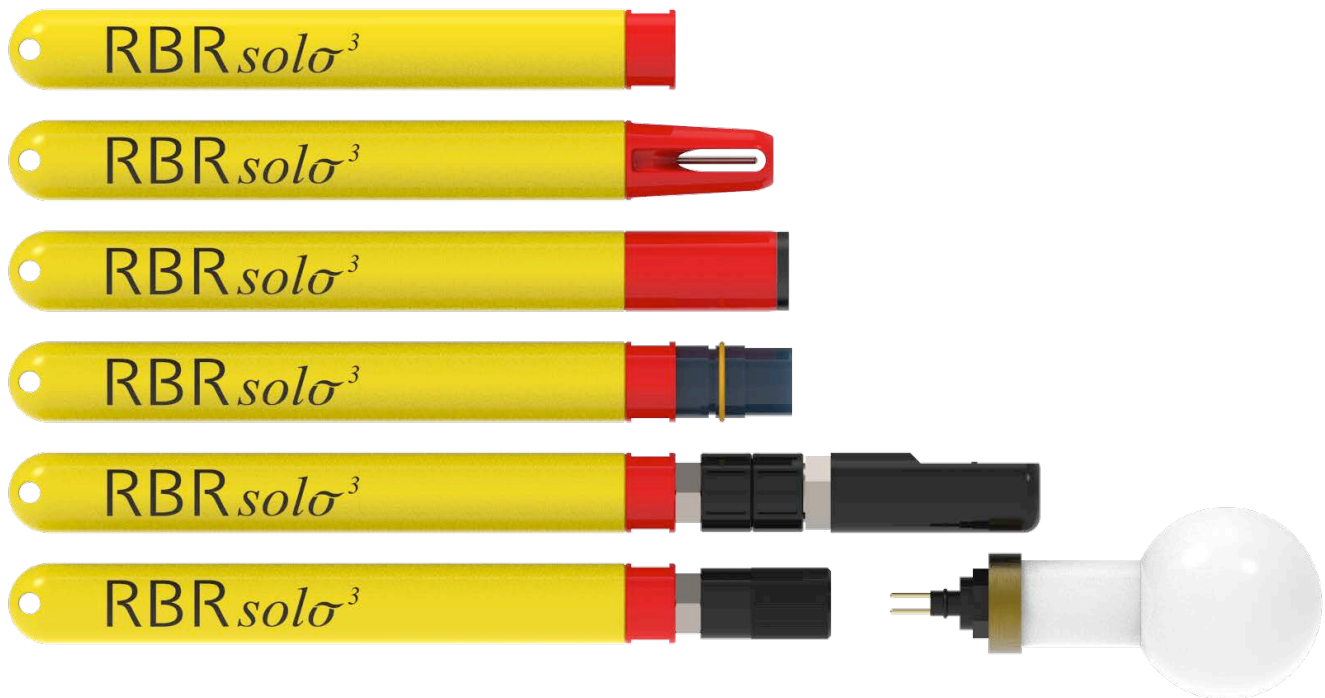
Some compact instruments are also available in titanium housing, which resists all forms of marine corrosion and is suitable for deepwater applications (| deep). All RBR instruments within the | deep family provide accurate and stable measurements in the most challenging environments. Several configurations are rated for the full ocean depth, thus being deployable as deep as the bottom of the Marianas Trench.



## 1.1 RBRsolo<sup>3</sup>

The RBRsolo<sup>3</sup> is a family of small single-channel, long-autonomy instruments which come in several variants:

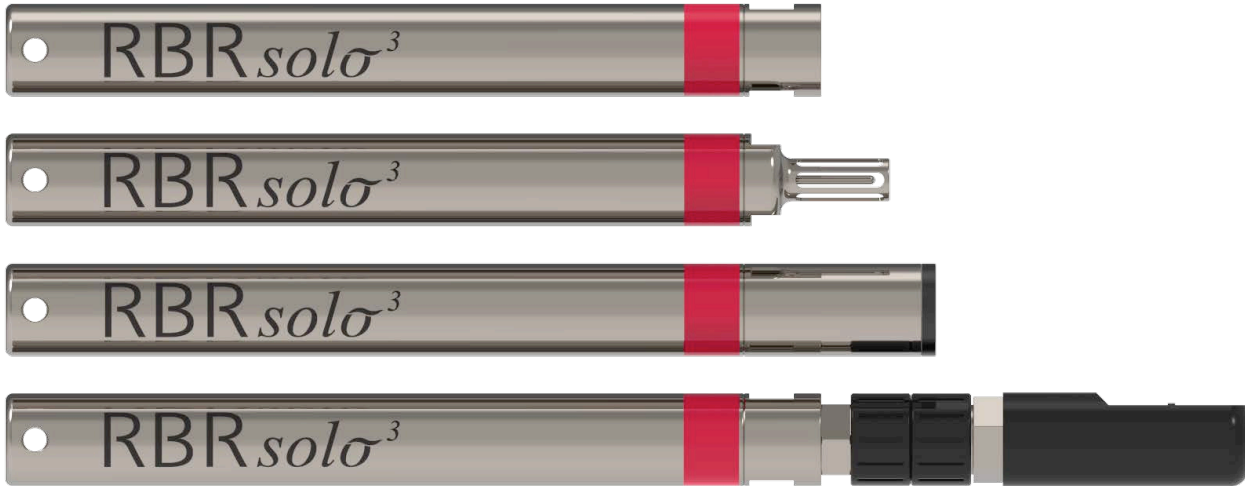
- RBRsolo<sup>3</sup> D - depth
- RBRsolo<sup>3</sup> T - temperature
- RBRsolo<sup>3</sup> PAR - photosynthetically active radiation
- RBRsolo<sup>3</sup> rad - narrow-band light radiation
- RBRsolo<sup>3</sup> DO - dissolved oxygen (with the OxyGuard® DO sensor)
- RBRsolo<sup>3</sup> Tu - turbidity (with the Seapoint® Tu sensor)
- RBRsolo<sup>3</sup> PAR (LI-COR) - photosynthetically active radiation (with the LI-COR® PAR sensors, cosine or spherical)



The RBRsolo<sup>3</sup> PAR and RBRsolo<sup>3</sup> rad look identical, third instrument from top.

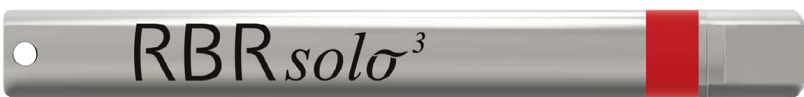
Several configurations are also available in titanium housing for deepwater applications (| deep), designed to endure harsh conditions:

- RBR*solo*<sup>3</sup> D | deep - depth
- RBR*solo*<sup>3</sup> T | deep - temperature
- RBR*solo*<sup>3</sup> PAR | deep - photosynthetically active radiation
- RBR*solo*<sup>3</sup> rad | deep - narrow-band light radiation
- RBR*solo*<sup>3</sup> Tu | deep - turbidity (with the Seapoint Tu sensor)



The RBR*solo*<sup>3</sup> PAR | deep and RBR*solo*<sup>3</sup> rad | deep look identical, third instrument from top.

In most cases, standard, | slow, and | fast sampling variants of the same instrument look identical, with the exception of RBR*solo*<sup>3</sup> T | deep | slow, which has an embedded thermistor:

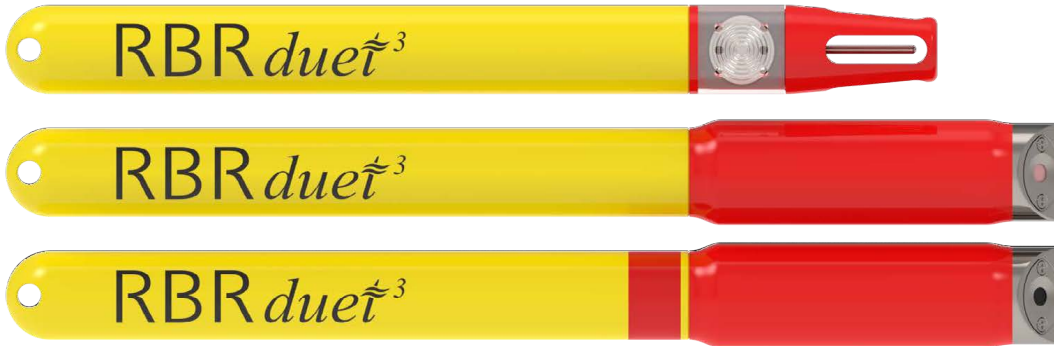


**i** RBR offers cabled versions of the RBR*solo*<sup>3</sup> D, T, PAR, rad, DO, and PAR (LI-COR) under the brand name of "RBR*coda*<sup>3</sup>". Sensor specifications are the same between the two lines of instruments.

## 1.2 RBRduet<sup>3</sup>

The RBRduet<sup>3</sup> is a family of small dual-channel, long-autonomy instruments which can be configured with either of the two options:

- RBRduet<sup>3</sup> T.D - temperature and depth
- RBRduet<sup>3</sup> T.ODO - temperature and optical dissolved oxygen



For the RBRduet<sup>3</sup> T.D, standard, | slow, and | fast sampling variants look identical.

For the RBRduet<sup>3</sup> T.ODO, standard and | fast variants look identical (second instrument from top), while RBRduet<sup>3</sup> T.ODO | slow has a red band (third instrument from top).

Both variants are also available in titanium housing for deepwater applications (| deep):

- RBRduet<sup>3</sup> T.D | deep - temperature and depth
- RBRduet<sup>3</sup> T.ODO | deep - temperature and optical dissolved oxygen



For the RBRduet<sup>3</sup> T.D | deep, standard, | slow, and | fast sampling variants look identical.

For the RBRduet<sup>3</sup> T.ODO | deep, standard and | fast variants look identical (second instrument from top), while the RBRduet<sup>3</sup> T.ODO | deep | slow has an extra red band (third instrument from top).

**i** RBR offers cabled versions of the RBRduet<sup>3</sup> T.D and T.ODO under the brand name of "RBRcoda<sup>3</sup>". Sensor specifications are the same between the two lines of instruments.


## 2 Physical specifications

### RBRsolo<sup>3</sup> and RBRduet<sup>3</sup> common specifications

Parameter	Value
Storage	~130 million readings
Power*	One AA-type cell
Communication	USB-C
Clock drift**	±60 seconds per year
Housing diameter	25.4mm (plastic), 25mm (Ti)
Housing length without the sensor end-cap	195.7mm (plastic), 200mm (Ti)

\*See [Ruskin User Guide: Compact Instruments<sup>3</sup>](#) for suitable battery chemistries.

\*\*The realtime clock is not maintained when there is no power.

 Lithium thionyl chloride batteries are only recommended for T, D, and T.D instruments. Other sensors will not work correctly on this type of battery.

### RBRsolo<sup>3</sup> weight, length, and depth rating

Instrument	Weight	Total length	Depth rating
RBRsolo <sup>3</sup> D	130g in air, 30g in water	211mm	1000m
RBRsolo <sup>3</sup> D   deep	330g in air, 230g in water	221mm	10000m
RBRsolo <sup>3</sup> T	120g in air, 20g in water	242mm	1700m
RBRsolo <sup>3</sup> T   deep	320g in air, 220g in water	240mm   fast, 225mm   slow	10000m
RBRsolo <sup>3</sup> DO (OxyGuard)	150g in air, 30g in water	249mm	1700m
RBRsolo <sup>3</sup> PAR	140g in air, 15g in water	248mm	1000m
RBRsolo <sup>3</sup> PAR   deep	320g in air, 195g in water	252mm	2000m
RBRsolo <sup>3</sup> Tu (Seapoint)	220g in air, 70g in water	327mm	1700m
RBRsolo <sup>3</sup> Tu   deep	420 in air, 270g in water	333mm	6000m
RBRsolo <sup>3</sup> PAR (with LI-192)	420g in air, 200g in water	261mm, cable 0.6m	560m
RBRsolo <sup>3</sup> PAR (with LI-193)	200g in air, 60g in water	261mm, cable 0.6m	350m

### RBRduet<sup>3</sup> weight, length, and depth rating

Instrument	Weight	Total length	Depth rating
RBRduet <sup>3</sup> T.D	150g in air, 30g in water	266mm	1000m
RBRduet <sup>3</sup> T.D   deep	350g in air, 240g in water	266mm	10000m
RBRduet <sup>3</sup> T.ODO	200g in air, 40g in water	303mm	1000m
RBRduet <sup>3</sup> T.ODO   deep	400g in air, 240g in water	307mm	6000m



### RBRsolo<sup>3</sup> deployment estimates for select sampling rates

Instrument	Speed	Time	Number of samples
RBRsolo <sup>3</sup> D	32Hz	24 days	65 million
	2Hz	58 days	10 million
RBRsolo <sup>3</sup> T	32Hz	48 days	130 million
	2Hz	140 days	24 million
RBRsolo <sup>3</sup> DO	32Hz	36 days	100 million
	2Hz	59 days	10 million
RBRsolo <sup>3</sup> PAR (LI-COR)	32Hz	29 days	81 million
	2Hz	42 days	7 million
RBRsolo <sup>3</sup> PAR, RBRsolo <sup>3</sup> rad	2Hz	7 days	1 million
	1Hz	14 days	1 million
RBRsolo <sup>3</sup> Tu	10s	9 days	81 thousand
	30s	27 days	77 thousand

### RBRduet<sup>3</sup> deployment estimates for select sampling rates

Instrument	Speed	Time	Number of samples
RBRduet <sup>3</sup> T.D	32Hz	16 days	44 million
	2Hz	53 days	9 million
RBRduet <sup>3</sup> T.ODO	2Hz	2 days	346 thousand
	30s	26 days	75 thousand

**i** Deployment times above are estimated for instruments with the highest capacity battery available for each variant. For deployment estimates specific for your configuration and sampling options, use Ruskin autonomy engine. See [Ruskin User Guide: Compact Instruments<sup>3</sup>](#) for details.  
Note that deployment estimates are the same for shallow and deep variants.

### 3 Sensor specifications

Most RBR compact instruments have only one channel (RBRsolo<sup>3</sup>), but some include two (RBRduet<sup>3</sup>). While temperature and pressure remain the most popular choices, specialised sensors are available to meet various requirements. Refer to the following subsections for more information.

Please contact the RBR sales team to discuss your needs and to select the perfect configuration for your applications.

#### 3.1 Pressure (D)

The RBRsolo<sup>3</sup> D and RBRduet<sup>3</sup> T.D instruments (including their | deep, | fast, | tide, and | wave variants) use the piezoresistive pressure sensor. The sensor is protected by a clear plastic guard. During deployments, always orient it downwards to reduce debris collecting on the membrane of the pressure sensor.



RBRsolo<sup>3</sup> D

**i** | tide16 and | wave16 variants take averages of pressure readings over extended periods of time, providing accurate tide level data.  
| wave16 instruments can also obtain wave characteristics and detect infrequent phenomena, like boat wakes.

Parameter	Value
Range*	20 / 50 / 100 / 200 / 500 / 1000dbar (plastic) 1000 / 2000 / 4000 / 6000 / 10000dbar (Ti)
Initial accuracy	±0.05% full scale
Resolution	<0.001% full scale
Typical stability	±0.05% full scale / year
Time constant	<10ms

\* Recommended depth for wave measurements is less than 50m.

## 3.2 Temperature (T)

The RBR*solo*<sup>3</sup> T and RBR*duet*<sup>3</sup> T.D (including their | deep, | fast, | tide, and | wave variants) use the same thermistor-type temperature sensor.



**RBR*solo*<sup>3</sup> T**

Parameter	Value
Range*	-5°C to 35°C
Initial accuracy	±0.002°C
Resolution	<0.00005°C
Typical stability	±0.002°C / year
Time constant	<0.1s   fast, <1s standard, <15s   slow

\*A wider temperature range is available upon request. Contact [RBR](#) for more information.

## 3.3 Radiometers (PAR, rad)

RBR offers PAR radiometers and narrow-band radiometers with a fixed channel width. Additionally, we support PAR sensors from LI-COR.

PAR sensors measure intensity of visible light at frequencies associated with photosynthesis. Narrow-band radiometers are available in a variety of wavebands.

### **RBR radiometers**

The RBR*solo*<sup>3</sup> PAR and RBR*solo*<sup>3</sup> rad instruments look identical and share several specifications.



**RBR*solo*<sup>3</sup> PAR**

The RBR*solo*<sup>3</sup> PAR and RBR*solo*<sup>3</sup> PAR | deep use the cosine photosynthetically active radiation sensors which can measure light within one hemisphere.

The RBR*solo*<sup>3</sup> rad and RBR*solo*<sup>3</sup> rad | deep use radiometers measuring narrow-band light with a fixed channel width, available in a variety of wavebands. Both centre wavelength and channel width are factory-configured.

### Optical radiometry

Parameter	Value
Dynamic range	>5.5 decades (nominal)
Absolute calibration*	±2%
Linearity	±1%
Operating temperature range	-5°C to 35°C
Cosine response error (water)	±5% at 0-60°C, ±10% at 61-82°C
Azimuth error (water)	±1.5% at 45°C
Out-of-band rejection**	>25dB (typical), OD 2.5

\* RBR calibrates radiometers with NIST traceable references.

\*\* Out-of-band rejection is wavelength-dependent for narrow-band radiometers.

### PAR


Parameter	Value
Wavelength range	400nm to 700nm
Full scale range	0 to 5000µmol/m <sup>2</sup> /s (minimum)
Resolution	±0.010µ mol/m <sup>2</sup> /s

### Narrow-band channels

Parameter	Value
Centre wavelengths (CWL)*	413 / 445 / 475 / 488 / 508 / 532 / 560nm
Full width at half-maximum (FWHM)	10nm (25nm for CWL 475nm)
Full scale range	0 to 400µW/cm <sup>2</sup> /nm (minimum)
Resolution**	±0.001µW/cm <sup>2</sup> /nm

\* Other CWL options within the 400-1100nm range are available upon request. Contact [RBR](#) for more information.

\*\* Resolution is wavelength-dependent for narrow-band radiometers.

 Dark offset is internally temperature-compensated.

## PAR (LI-COR)

The RBR*solo*<sup>3</sup> PAR (LI-COR) instruments use cabled cosine (one hemisphere, LI-192) or spherical (omnidirectional, LI-193) PAR sensors.



### Spherical PAR sensor



### RBR*solo*<sup>3</sup> PAR (LI-COR) variants

Parameter	Value
Wavelength range	400 to 700nm
Calibrated range	0 to 10000 $\mu$ mol/m <sup>2</sup> /s
Initial accuracy	$\pm$ 2%

## 3.4 Dissolved oxygen (ODO, DO)

### Optical dissolved oxygen (ODO)

The RBRduet<sup>3</sup> T.ODO, and RBRduet<sup>3</sup> T.ODO | deep use the optical dissolved oxygen sensor. During deployments, always orient the sensor downwards to reduce debris collecting on the sensing foil and minimise direct sunlight. Store the sensor in the dedicated storage cap, included with the instrument. Rehydrate for five days before deployment. See [RBR ODO sensor care and maintenance](#) for more information.



RBRduet<sup>3</sup> T.ODO

Parameter	Value
Measurement range	0-1000µmol/L
Calibrated range	
Concentration	0-500µmol/L
Saturation	0-120%
Temperature	1.5°C to 30°C
Initial accuracy	
For   fast	Maximum of ±8µmol/L or ±5%
For standard,   slow	Maximum of ±2µmol/L or ±1.5%
Resolution	
For   fast	<1µmol/L (saturation 0.4%)
For standard	<0.5µmol/L (saturation 0.2%)
For   slow	<0.1µmol/L (saturation 0.04%)
Time constant	<1s   fast, <8s standard, or <30s   slow

**⚠** Optical dissolved oxygen measurements require pressure correction for highest accuracy. Enter the known absolute pressure value manually in the table under the **Parameters** tab in Ruskin.

## Dissolved oxygen (DO)

The RBRsolo<sup>3</sup> DO uses the OxyGuard galvanic dissolved oxygen sensor. The sensor consumes oxygen from the environment and thus produces most accurate measurements when in a stirred environment. During deployments, always orient the sensor downwards to reduce debris collecting at the membrane. Store the sensor in the dedicated storage cap, included with the instrument.



**RBRsolo<sup>3</sup> DO (OxyGuard)**

Parameter	Value
Range	0 to 600%
Initial accuracy	±2% oxygen saturation
Resolution	1% of saturation
Response time	~10s, 90% step change at 20°C

## 3.5 Turbidity

The RBRsolo<sup>3</sup> Tu and RBRsolo<sup>3</sup> Tu | deep use the Seapoint turbidity sensor which detects light scattered by solid particles suspended in water. During deployments, minimise direct sunlight.



**RBRsolo<sup>3</sup> Tu**

Parameter	Value
Light source wavelength	880nm
Sensing distance	<5cm from windows
Time constant	0.1s
Measurement range	0-4000FTU
Linearity	<2% deviation for 0-1250FTU range*

\* Response becomes non-linear above 1250FTU.

## 4 Derived parameters

Ruskin software calculates the derived parameters.

You can select alternative derivation options for some parameters in the **Parameters** tab.

See [Ruskin User Guide: Compact Instruments<sup>3</sup>](#) for details.

### 4.1 Sea pressure

Sea pressure is the difference between the pressure measured underwater by your RBR instrument and atmospheric pressure. The units of measurement are **dbar** (decibars).

$$\text{Sea pressure} = \text{absolute pressure} - \text{atmospheric pressure}$$

where pressure (in dbar) is the value measured directly by your RBR instrument.

Enter atmospheric pressure (in dbar) manually in the table under the **Parameters** tab in Ruskin. See [Ruskin User Guide: Compact Instruments<sup>3</sup>](#). If not entered, a default value of 10.1325dbar will be used.

### 4.2 Depth

Depth is a function of sea pressure and seawater density. The units of measurement are **m** (metres).

$$\text{Depth} = \frac{\text{sea pressure}}{\text{density} \cdot g}$$

where seawater density is in  $\text{g/cm}^3$  and sea pressure is in dbar, and  $g$  is the acceleration of gravity and equals  $9.8\text{m/s}^2$ .

[Sea pressure](#) is also a derived parameter:

$$\text{Sea pressure} = \text{absolute pressure} - \text{atmospheric pressure}$$

Enter atmospheric pressure (in dbar) and seawater density (in  $\text{g/cm}^3$ ) manually in the table under the **Parameters** tab in Ruskin. See [Ruskin User Guide: Compact Instruments<sup>3</sup>](#). If not entered, default values of 10.1325dbar and  $1.0281\text{g/cm}^3$  will be used.



## 4.3 Oxygen concentration

The RBR*solo*<sup>3</sup> DO supports a third-party DO sensor from OxyGuard, which measures dissolved oxygen saturation.

When a sensor measures oxygen saturation, we derive oxygen concentration using the Weiss equation. See [The solubility of nitrogen, oxygen and argon in water and seawater](#) by R.F. Weiss for details.

The units of measurement may be **μMol/L**, **mg/L**, or **mL/L**.

The Weiss equation requires values for absolute temperature (in °K) and salinity, which are derived from measured temperature and conductivity. As your instrument does not measure conductivity, a default value of 35PSU will be used. Alternatively, enter conductivity manually in the table under the **Parameters** tab in Ruskin. See [Ruskin User Guide: Compact Instruments](#)<sup>3</sup>.

## 4.4 Oxygen saturation

The RBR*duet*<sup>3</sup> T.ODO measures dissolved oxygen concentration.

When a sensor measures oxygen concentration, we derive oxygen saturation using the Garcia and Gordon equation. See [Oxygen solubility in seawater: better fitting equations](#) by F. H. Garcia and I. I. Gordon for details.

The units of measurement are %.

The Garcia and Gordon equation requires values for absolute temperature (in °K) and salinity, which are derived from measured temperature and conductivity. As your instrument does not measure conductivity, a default value of 35PSU will be used. Alternatively, enter conductivity manually in the table under the **Parameters** tab in Ruskin. See [Ruskin User Guide: Compact Instruments](#)<sup>3</sup>.

## 5 Hardware

### 5.1 Opening and closing a compact instrument

**⚠** RBR compact instruments have two O-rings. Remember to keep the O-rings clean and avoid scratching the O-ring mating surfaces. Carefully inspect the O-rings before deploying the instrument.

#### Opening the instrument

1. Hold the instrument with the sensor end-cap up.
2. Unscrew the sensor end-cap, counterclockwise.
3. Once fully unscrewed, slide the housing away from the sensor end-cap to reveal the sensor carriage. The sensor carriage contains the battery compartment, desiccant holder, and USB-C port.



**Opening a compact instrument**

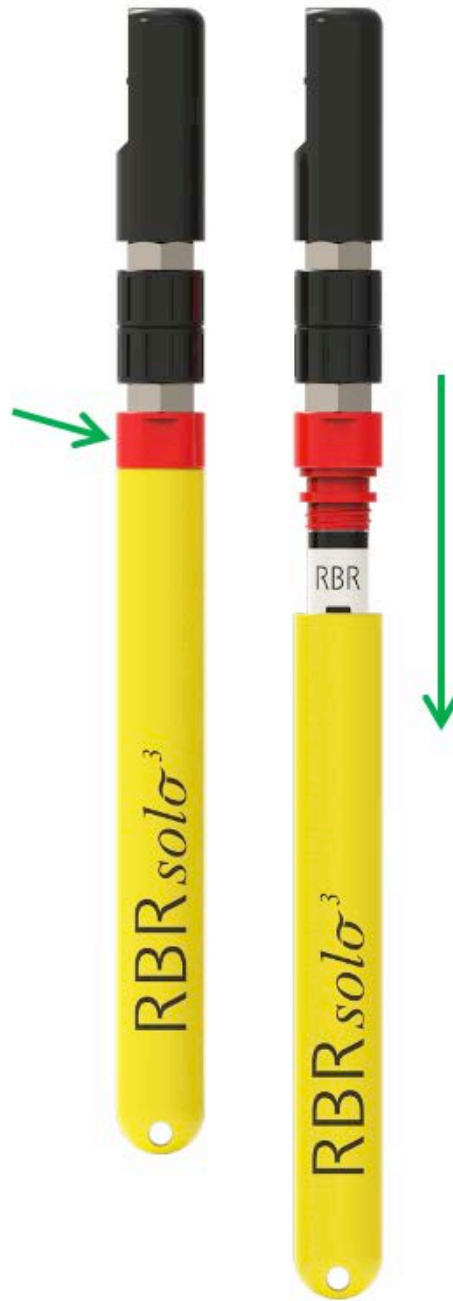


**Sensor carriage**

#### Closing the instrument

1. Insert the sensor carriage into the housing.
2. Screw the sensor end-cap back on, clockwise.

⚠ When opening the RBRsolo<sup>3</sup> Tu, make sure to unscrew the end-cap at the red ring. The black coupler is part of the turbidity sensor end-cap and should stay intact. See [Coupling of the turbidity sensor](#).



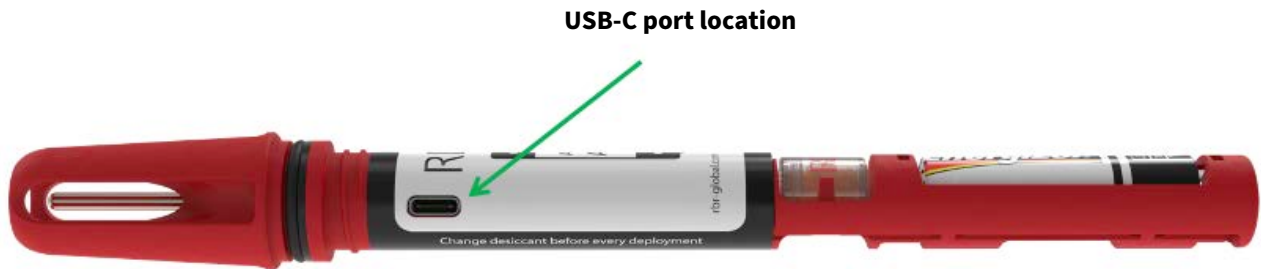
**Opening RBRsolo<sup>3</sup> Tu**

## 5.2 Instrument interface

 Refer to [Opening and closing a compact instrument](#) for details on accessing connection ports.

### USB-C port

RBR compact instruments provide an internal USB-C port.



The RBR [support kit](#) includes a USB-C data cable, which will connect the instrument to your computer.

### Deployment

- Connect the instrument to your computer using the USB-C cable
- Find the instrument on Ruskin
- Review the settings and click "Enable"

### Data download

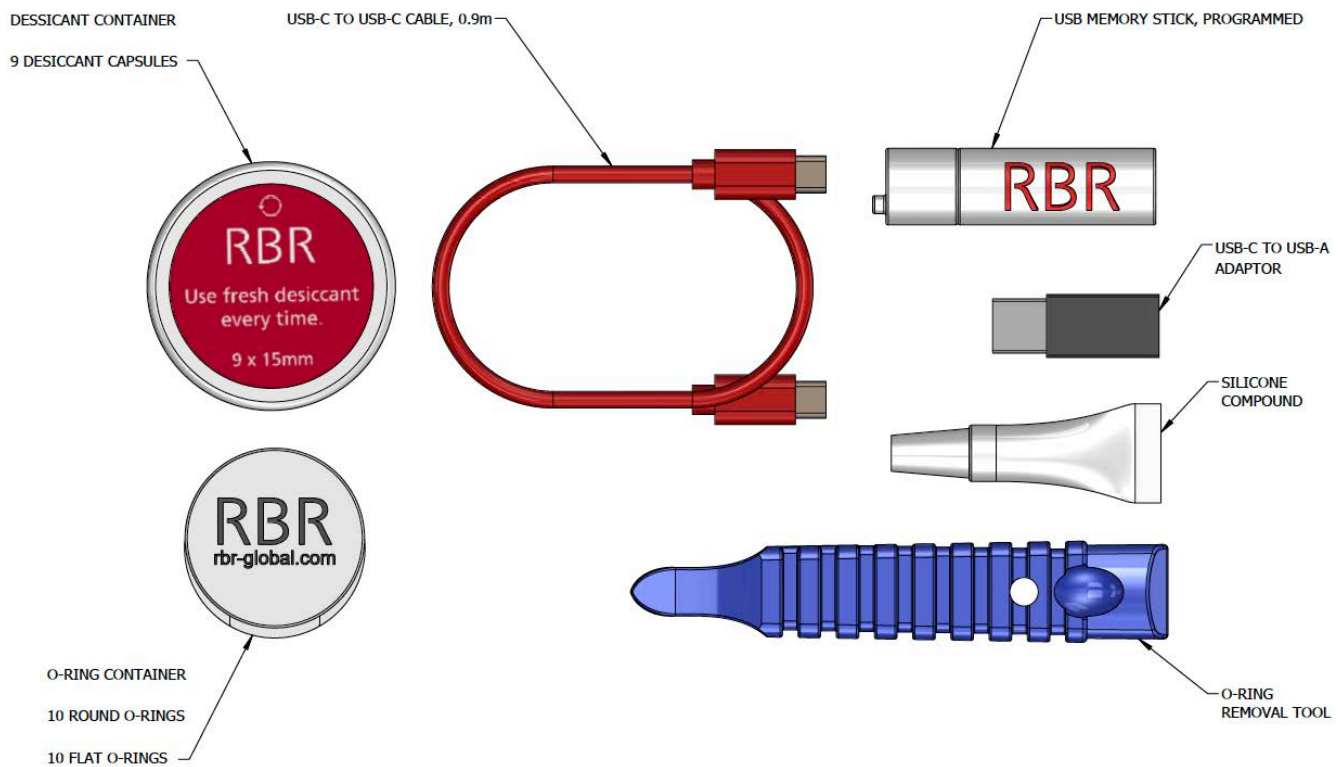
- Connect the instrument to your computer using the USB-C cable
- Find the instrument on Ruskin
- Click "Download..." and select a location to save the measurements

## 6 Maintenance

### 6.1 Support kits

RBR provides one support kit per every three instruments ordered. If you need more units, contact RBR.

The RBR support kit for compact instruments contains an assortment of basic accessories and spare parts.



#### **RBR support kit for compact instruments**

The RBR support kit for compact instruments includes the USB-C desktop cable. This cable is used to download data from the instrument's internal port to a computer.

RBR offers an OxyGuard sensor support kit in addition to the support kit for compact instruments. See [OxyGuard DO sensor care and maintenance](#).

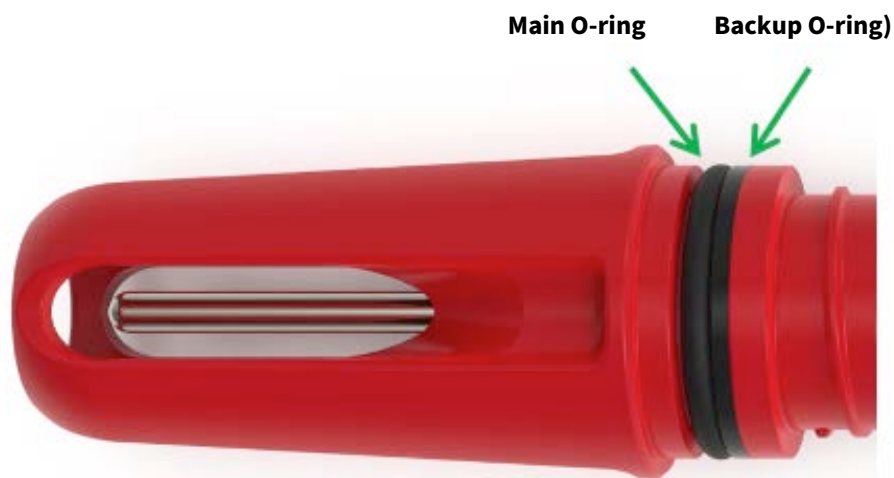
## 6.2 Replacing the O-rings

**i** Refer to [Opening and closing a compact instrument](#) for details on accessing the O-rings. The O-ring removal tool and silicone compound are available in the [support kit](#).

Care for the O-rings is the single most important item of maintenance on any submersible RBR instrument. A water leak can damage the circuit board beyond repair and cause complete data loss. Every instrument's seal depends upon its O-rings, and proper O-ring maintenance is crucial.

**i** The O-rings may lose elasticity over time, even when the instrument is not deployed. RBR strongly recommends replacing the O-rings regularly.

RBR compact instruments use two O-rings. One is the main O-ring, and the other is the backup. Both are required to protect the instrument from flooding.



**Location of the O-rings**

To access the O-rings, [open the instrument](#).

## Inspecting the O-rings and mating surfaces

Visually inspect the O-rings, paying attention to the following areas:

- The surface of the O-ring itself should be smooth and free of nicks or damage
- The mating surface on the inside of the case between the threads and the open end
- The groove in the end-cap where the O-ring sits



When handling the O-rings:

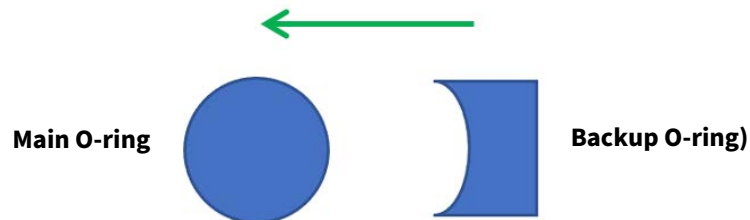
- Avoid using any object that could scratch the O-ring or any of its mating surfaces.
- If dirt is present in the O-ring groove, remove the O-ring as described below and thoroughly clean the groove.
- Do not return this old O-ring to the instrument! If you remove the O-ring from the instrument for any reason, always replace it with a new one.
- If the surfaces of the O-ring groove are scratched, pitted, or damaged, contact [RBR](#) for advice.

## Replacing the O-rings

Correct placement and orientation of the two O-rings are critical to maintaining depth rating integrity.

The main O-ring has a round profile. It must be installed first.

The backup O-ring is flat on one side, and concave on the other. When installed, the concave side must face the main O-ring.



**Orientation of the O-rings**

1. Use the plastic O-ring tool (included with the [support kit](#)) to remove the O-rings from the groove. The O-ring may need to stretch quite a bit as it is pushed off; this requires some effort but can be done by hand.
2. Clean the groove thoroughly using a soft, lint-free cloth and compressed air if necessary.
3. Select the proper O-rings and inspect them for damage.
4. Lubricate with a very light film of silicone grease (included in the [support kit](#)).
5. Install the main O-ring by sliding it over the electronic housings and popping it into its groove.
6. Install the backup O-ring, ensuring that the concave side is facing toward the main O-ring.
7. Once in place, inspect the O-rings once more for scratches and debris, and wipe away any silicone compound deposited on the carriage.
8. Once the inspection is complete, close the instrument.

## 6.3 Replacing the battery

**i** Refer to [Opening and closing a compact instrument](#) for details on accessing the battery.

RBR ships new instruments with fresh, highest capacity batteries included. Replace the batteries before each deployment to maximise the operational time, and prevent data loss.

Ruskin software estimates the remaining battery life during deployment by tracking power consumption in mAh. When setting up your deployment on Ruskin, check "Fresh" to indicate that new batteries are installed.

If using the same batteries for a subsequent deployment, do not check "Fresh" and power tracking will continue from the previously recorded level.

See [Ruskin User Guide: Compact Instruments](#)<sup>3</sup> for more information on predicting battery life.

**!** If using the same battery for a subsequent deployment, do not check "Fresh" on Ruskin.

### Replacing the battery

1. [Open the instrument](#) and pull out the sensor carriage.
2. Push the battery out of its holder using your finger or a blunt tool.
3. Insert a new AA-type battery into the holder.
4. Check for correct battery polarity.
5. Insert the sensor carriage into the housing and [close the instrument](#).



**Push the old battery out**



**Insert a new battery, ensuring correct polarity**

**!** Always remove the battery from your instrument during long-term storage! Doing so will prevent internal damage due to battery leakage and/or corrosion.



## 6.4 Replacing the desiccant capsule

**i** Refer to [Opening and closing a compact instrument](#) for details on accessing the desiccant.

Replace the desiccant capsule before each deployment.

Fresh desiccant will keep the instrument compartment dry and prevent malfunction. Water damage may occur if condensation forms inside the instrument.

As a preventative measure, RBR recommends servicing the instrument in a cool, dry place (when possible).

### Replacing the desiccant capsule

1. [Open the instrument](#) and pull out the sensor carriage.
2. Push the desiccant capsule out of its holder using your finger or a blunt tool.
3. Insert a new desiccant capsule into the holder.
4. Insert the sensor carriage into the housing and [close the instrument](#).



**Push the desiccant capsule out**

All instruments ship with fresh reusable desiccant capsules. They use a cobalt-free colour changing indicator dye. Orange indicates fresh desiccant, while green indicates it is saturated (about 15% water by weight). Once exhausted, the capsules can be replaced with new ones (available from RBR), or refreshed.



**Fresh (orange) and saturated (green) desiccant capsules**

## Refreshing the desiccant

Follow the steps below to refresh the desiccant.

1. Remove the saturated silica beads from their capsule.
2. Place them in the oven and heat at 120°C (250°F) for about two hours.

⚠ Always remove the beads from their capsule before refreshing!  
The capsule will deform if heated to 120°C.

3. Take the refreshed beads out of the oven and return them to the capsule.

⚠ Return the refreshed beads to the capsule immediately after reheating!  
If left outside the capsule, the desiccant will trap moisture and go back to green.

4. Wait until the silica beads cool down. Once cool, the desiccant is ready to be reused.

## 6.5 Coupling the turbidity sensor

The turbidity sensor in the RBR*solo*<sup>3</sup> Tu is connected to the instrument via a coupler. The instrument has a custom-made female connector, which fits the male connector of the sensor. The coupler has two flanges with opposing threads. New instruments are shipped with the coupler securely tightened, making this connection watertight.

Typically, you will never need to disconnect the sensor from the instrument. However, before deploying the RBR*solo*<sup>3</sup> Tu, it is important to verify that the coupler has not become loose. If that happens, you will see a small gap between the sensor and the coupler, or between the coupler and the base of the connector. Gently tighten the flanges to protect your instrument during deployment.



**Coupler on the RBR*solo*<sup>3</sup> Tu**

In rare instances, it may become necessary to disconnect and reconnect the turbidity sensor. Follow the steps below.



### RBRsolo<sup>3</sup> Tu, with the sensor disconnected

Step	Description
1	<p>Disconnect the sensor</p> <ol style="list-style-type: none"> <li>1. Take the instrument in your left hand and hold it horizontally, with the sensor oriented to the right.</li> <li>2. With your left index finger and thumb, prevent the left flange from moving.</li> <li>3. With your right hand, hold the sensor tightly.</li> <li>4. With your right index finger and thumb, twist the right flange clockwise until loose.</li> <li>5. The sensor will drop into your hand.</li> </ol>
2	<p>Access the female connector</p> <ol style="list-style-type: none"> <li>1. Twist the left flange counterclockwise.</li> <li>2. Remove the coupler.</li> </ol>
3	<p>Lubricate the female connector (see <a href="#">Cables and connectors</a>)</p>
4	<p>Reconnect the sensor</p> <ol style="list-style-type: none"> <li>1. Place the coupler back on the instrument.</li> <li>2. Twist clockwise until tight.</li> <li>3. Very carefully mate the sensor to the instrument (the pins on the sensor must be aligned with the corresponding holes).</li> <li>4. Press the sensor into the instrument to make sure the pins are inserted.</li> <li>5. Continue to hold the instrument with your left hand.</li> <li>6. With your right hand, hold the sensor tightly.</li> <li>7. With your right index finger and thumb, twist the right flange counterclockwise while slightly pushing the sensor in with your palm.</li> <li>8. Verify the tightness of both flanges.</li> </ol> <div style="border: 1px solid orange; padding: 5px; margin-top: 10px;"> <p><b>⚠</b> Occasionally, the left flange may begin to loosen while you are tightening the right one. It usually means that the pins did not mate properly. Carefully align the pins again and press harder. Wiggle the sensor gently to make sure the pins are inserted.</p> </div>

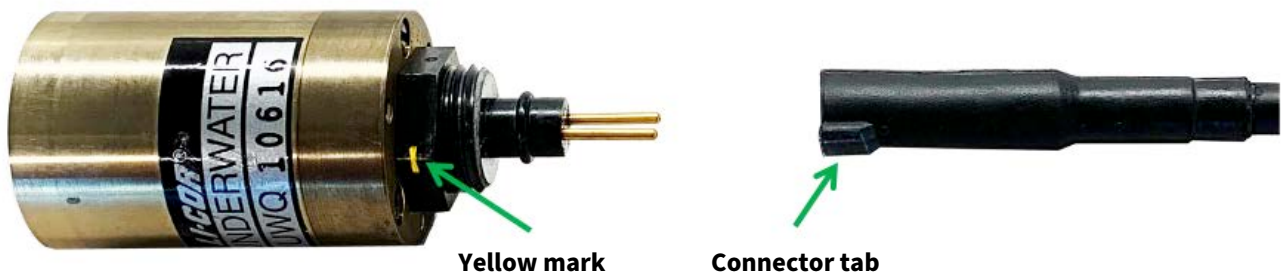
## 6.6 Connecting the cabled PAR sensor (LI-COR)

Proper connection between the PAR sensors (LI-COR) and their cable is crucial for deployment success.

Both LI-192 and LI-193 have a two-pin connector with a small yellow mark on the side.



Always align this yellow mark with the tab on the side of the cable connector when connecting the sensor to its cable.



### Orientation

After connecting the cable to the PAR sensor, confirm that the yellow mark and the connector tab are aligned, and then put the white locking sleeve in place. The sensor is ready for deployment.

⚠ Ensure proper orientation of the yellow mark and the tab before each deployment. Inverted connection of your PAR sensor will result in incorrect or lost data.

## 6.7 Cables and connectors

The RBRsolo<sup>3</sup> PAR with a spherical sensor (LI-193) includes a customised cable, which connects the PAR sensor to the instrument. This cable has two connectors, which need to be lubricated any time when they are disconnected and reconnected. Similarly, the female connector in the RBRsolo<sup>3</sup> Tu needs to be lubricated whenever the turbidity sensor is disconnected and reconnected.

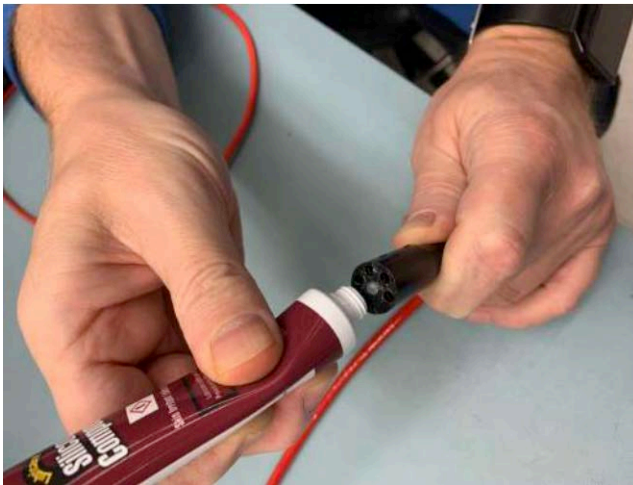
### Cable bend radius

The smallest bend radius for RBR supplied cables is 15cm.

### Lubricating the connectors

Lubrication improves watertight sealing, prevents corrosion, and reduces the force required to de-mate the connector. Use the silicone compound provided with your instrument.

- Apply the silicone compound to all female connectors before every mating
- Ensure each connector hole is filled with approximately 30% lubricant



**Lubricating a connector**

### Reducing mechanical stress

- Do not pull on the cable
- Hold onto the connector to pull out the cable
- Disconnect by pulling straight out, not at an angle
- Avoid sharp bends at the point where the cable enters the connector
- Avoid angular loads on the connector

## 6.8 RBR ODO sensor care and maintenance

The RBR optical dissolved oxygen sensors have an oxygen-sensitive substrate that requires special care. Any damage will permanently affect performance.

- ⚠️ Avoid direct sunlight.  
Never touch the sensitive element while cleaning or handling.  
Use the storage cap when the sensor is not in use.

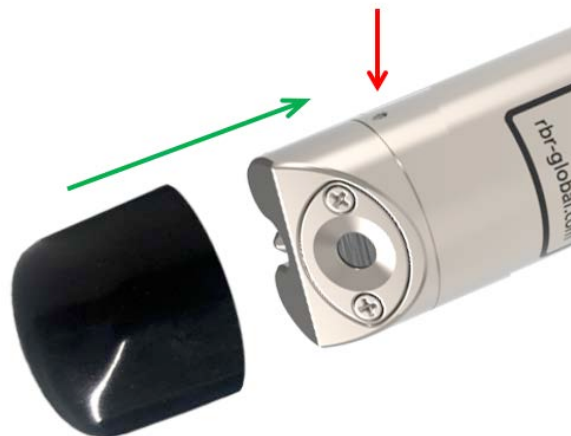
### Storage

Store the RBR optical dissolved oxygen sensor in the dedicated storage cap to protect it from damage.

Storage caps are provided with the instrument. Contact [RBR](#) if a replacement is needed.

- **Short-term storage (three weeks or less)**

1. Fill the storage cap with clean water until about 50% full.
2. Place the cap on the sensor and gently push it past the locking pin.
3. Refill the water periodically during storage. The cap is semi-watertight and will leak overtime.



**Push the storage cap past the locking pin**

- **Long-term storage (more than three weeks)**

- ⚠️ For longer storage periods, store your sensor dry. Rehydrate for **five** days before deployment.

1. Place an empty cap on the sensor and gently push it past the locking pin.
2. Before deployment, fill the storage cap with clean water like for short-term storage, place it on the sensor, and rehydrate for **five** days.

- ⚠️ It takes up to five days for a dry ODO sensor to equilibrate after being placed in water. Insufficient hydrating time before deployment may lead to unreliable data.



**RBRduet<sup>3</sup> T.ODO ready for storage**

### **First deployment**

RBR ships the RBRduet<sup>3</sup> T.ODO instruments with a hydrated storage cap on, so that the instrument is ready for its first deployment.

However, long transportation times and low cabin pressure may cause the water to evaporate. Verify that the storage cap is still wet. If not, rehydrate the sensor for **five days** before deployment.

### **Calibration**

Check your sensor calibration before each deployment in saturated fresh water. If the readings are not within 1% of 100% saturation, recalibrate the instrument using a one-point calibration. Typically, | fast instruments may need recalibration more often than standard or | slow. See [Ruskin User Guide: Compact Instruments<sup>3</sup>](#) for user calibration instructions.

## **6.9 OxyGuard DO sensor care and maintenance**

### **Storage**

Store the OxyGuard dissolved oxygen sensor in the dedicated storage cap to minimise fluid loss. Storage caps are provided with the instrument. Contact RBR if a replacement is needed.

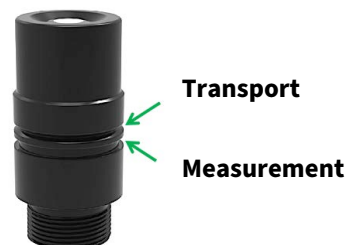


### **O-ring**

The red O-ring of the OxyGuard sensor serves two purposes:

- To retain the electrolyte during storage
- To balance pressure during deployments

There are two positions for O-ring on the OxyGuard sensor, "Transport" and "Measurement".



During transportation or storage, move the red O-ring of the Oxyguard sensor to the "Transport" position, closing off the port on the side of the cell.

Before deployment, move the O-ring to the "Measurement" position to maintain the pressure balance.

After deployment, return the O-ring to the "Transport" position.



### Support kit

RBR offers an OxyGuard sensor support kit that includes:

- Membrane tool
- Electrolyte solution (250ml)
- Fast response membranes
- Replacement O-rings
- Oxyguard Support Kit and Refurbishment Guide

Check the state of your DO sensor before deployment. Look for any damage to the membrane, cloudiness of the electrode, and buildup on the anode. If you find any damage, refurbish and recalibrate the sensor.

Refer to Oxyguard Support Kit and Refurbishment Guide, included with the support kit, for instructions on refurbishing your sensor. See Ruskin User Guide for instructions on calibration.

## 6.10 Cleaning the instrument

Clean the instrument after each extended deployment to remove deposits that may have accumulated.

⚠ Do not use an ultrasonic bath to clean your instruments! Ultrasonic vibrations can break the wire bonding inside the transducers.

Type	Procedure	Notes
General/biofouling	To clean the exterior, soak in a mild detergent, then scrub the instrument with a soft brush.	Avoid scratching the plastic (scratches make future cleaning more difficult).
Calcification, encrustation	Soak in vinegar for six hours, then scrub the surface using a soft brush.	Soaking in vinegar for more than 24 hours may damage the O-ring and increase the chances of a leak.

### Cleaning the pressure sensor

⚠ Avoid touching the diaphragm when cleaning the sensor! Any deformation will permanently affect performance.



1. Unscrew the sensor guard using a coin or a large flathead screwdriver. Do not apply excessive force, especially when using the screwdriver.
2. Rinse the area under running water. If this fails to remove the deposits, try soaking in vinegar.
3. If unsuccessful, contact RBR.

### **Cleaning PAR, rad, ODO, and turbidity sensors**

When dirty, carefully wipe the sensors with a soft cloth. To remove encrustation, soak in water until soft. It may take hours or days, depending on the severity.

- ❗ Do not use abrasive cloths as scratched faces can affect calibration.  
Do not use solvents or cleaners as these could affect optical properties of the window.

## **6.11 Calibrating the instrument**

Factory calibration coefficients are calculated for each sensor, and the coefficients are stored on the instrument.

RBR calibration certificates contain calibration equations, coefficients, and residuals for each sensor.

Calibration certificates are available for download:

- If using Ruskin, connect your instrument and go to the “Information” tab, then click “Download” at the bottom
- For OEM instruments, go to <https://oem-lookup.RBR-global.com>, middle tab, and search by the serial number and authorisation key

RBR recommends calibrating your instrument before any critical deployment, periodically once a year, or if you suspect the readings to be out of specifications.

Discuss your calibration requirements with RBR. In some cases, the instrument will need to be returned to RBR to have it checked and recalibrated.

Please contact [RBR](#) for our current calibration fees.

## **6.12 Repairs**

RBR supports all our products. Contact us immediately at [support@rbr-global.com](mailto:support@rbr-global.com) or via the [RBR website](#) if there are any issues with your instrument. Please have the model and the serial number of the unit ready. Our support team will work to resolve the issue remotely. In some cases, you may have to return your instrument to RBR for further servicing.

- ❗ There are no user-repairable parts of the instrument. Any attempt to repair without prior authorisation from RBR will void the warranty. Refer to the [RBR warranty statement](#).

To return a product to RBR for an upgrade, repair, or calibration, please contact our [support team](#) to obtain a return merchandise authorisation code (RMA) and review the detailed shipping information on the [RBR website](#).

## 7 Revision history

Revision No.	Release date	Notes
A	30-November-2021	Original
B	28-February-2022	Updated storage capacity to 130 million readings. Added MCBH pinout to Specifications, description of the PAR sensor (LI-COR) connector to Hardware, care instructions for the DO sensor (OxyGuard) to Maintenance.
C	30-November-2022	Improved page hierarchy for Specifications. Updated the link to Ruskin User Guide. Updated instructions for refreshing the desiccant. Added the Derived parameters section.
D	31-March-2023	Added a note on battery chemistries to and removed the MCBH pinout from Physical specifications. Added storage instructions for the ODO sensor to Maintenance. Moved Connecting instructions for Tu and PAR sensors from Hardware to Maintenance. Updated cleaning instructions for optical sensors in Cleaning.
E	30-April-2023	Updated the RBR ODO sensor subsections in Sensor specifications and Maintenance.
F	31-July-2023	Added a warning to the Replacing the battery section.
G	31-January-2024	Added a note about   tide and   wave variants to the Pressure (D) page. Updated the Radiometers section for RBR radiometer specifications. Updated the Dissolved oxygen subsection for ODO specifications and pressure correction note.
H	30-June-2024	Added a warning to Physical specifications regarding battery types. Updated the RBR <i>coda</i> <sup>3</sup> T.ODO specifications for accuracy and resolution. Added a warning against using the ultrasonic bath to the Cleaning section.
J	15-August-2024	Included a note about the RBR <i>duet</i> <sup>3</sup> T.ODO   slow variants in the introduction. Added images of the RBR <i>duet</i> <sup>3</sup> T.ODO   slow and RBR <i>duet</i> <sup>3</sup> T.ODO   deep   slow to the RBR <i>duet</i> <sup>3</sup> section.
K	30-November-2024	Updated the Radiometers section for initial accuracy. Updated the Calibration section for downloading instructions.
L	31-December-2024	Updated deployment estimates in Physical specifications.

