RBR SENSORS

RBR*coda*^{3} RBR*quadrante* RBR*tridente*

INSTRUMENT GUIDE

rbr-global.com

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1 RBR sensors

The RBR small smart sensors are a family of cabled instruments with high accuracy, low power consumption, and ability to endure harsh conditions. These realtime streaming sensors are easy to integrate into any RBR multi-parameter instrument, or connect directly via RS-232. Attach an MCIL connector with serial and power lines, and the data will stream.

The RBR sensors are a perfect choice for many oceanographic and limnology applications where realtime steaming of data is desired, such as borehole monitoring, remotely operated underwater vehicles, stream gauging, or harbour water levels. These completely sealed units are available in plastic or titanium housings to accommodate shallow or deep deployments. Select from several | fast sampling variants, such as | fast8, | fast16, | fast32, and | tide16, depending on your needs.

> RBR*coda*^{3} D | tide16 and RBR*coda*^{3} T.D | tide16 take averages of pressure readings over extended periods of time, providing accurate tide level data.

Shallow variants

- RBR*coda*^{3} D - pressure (depth)
- RBR*coda*^{3} T - temperature
- RBR*coda*^{3} T.D - temperature and pressure (depth)
- RBR*coda*^{3} DO (OxyGuard®) - dissolved oxygen
- RBR*coda*^{3} PAR - photosynthetically active radiation
- RBR*coda*^{3} rad - narrow-band light radiation
- RBR*coda*^{3} PAR (LI-COR®) - photosynthetically active radiation

Deep variants

- RBR*coda*^{3} D | deep - pressure (depth)
- RBR*coda*^{3} T | deep - temperature
- RBR*coda*^{3} T.D | deep - temperature and pressure (depth)
- RBR*coda*^{3} T.ODO | deep - temperature and optical dissolved oxygen
- RBR*coda*^{3} PAR | deep - photosynthetically active radiation
- RBR*coda*^{3} rad | deep - narrow-band light radiation

Multi-channel sensor packages

- RBR*tridente* - chlorophyll a, fDOM, phycocyanin, phycoerythrin, backscatter, turbidity
- RBR*quadrante* - photosynthetically active radiation, narrow-band light radiation

2 Specifications

The RBR smart realtime sensors have highly competitive specifications. They are designed for streaming data via RS-232 cable and thus have no onboard memory. Most have only one channel, but some include two, three, or four. Refer to the individual pages for the RBR*coda*^{3} D, RBR*coda*^{3} T, RBR*coda*^{3} T.D, RBR*coda*^{3} T.ODO, RBR*coda*^{3} PAR / RBR*coda*^{3} rad, RBR*tridente*, and RBR*quadrante*, as well as our instruments with third-party sensors, the RBR*coda*^{3} DO (OxyGuard) and the RBR*coda*^{3} PAR (LI-COR®).

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

2.1 RBR*coda*^{3} D

The RBR*coda*^{3} D and RBR*coda*^{3} D | deep use the piezoresistive pressure sensors.

The sensor is protected by a clear plastic guard. During deployments, always orient the sensor downwards to reduce debris collecting in the housing.

RBR*coda*^{3} D and RBR*coda*^{3} D | deep

Pressure

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

Physical

Parameter	Value
Housing	Plastic or titanium
Diameter	~25mm
Length	~200mm (~235mm with connector)
Weight	170g in air, 70g in water (plastic) 370g in air, 270g in water (Ti)
Depth rating	Up to 1000m (plastic) Up to 6000m (Ti)
Sampling rate	2Hz standard 8Hz | fast8 16Hz | fast16, | tide16 32Hz | fast32

Power

Parameter	Value
Supply voltage	6V to 18V (12V nominal)
Power	10mA/120mW at 12V

2.2 RBR*coda*^{3} T

The RBR*coda*^{3} T and RBR*coda*^{3} T | deep use the same thermistor-type temperature sensor. The thermistor on the RBR*coda*^{3} T | slow | deep is embedded, making the sensor extremely robust and deployable in the most challenging environments, such as boreholes and industrial settings.

RBR *coda*^{3} T, RBR*coda*^{3} T | deep, and RBR*coda*^{3} T | slow | deep

Temperature

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.

Physical

Parameter	Value
Housing	Plastic or titanium
Diameter	~25mm
Length	~210mm (~245mm with connector) ~195mm (~230mm with connector) | slow | deep
Weight	160g in air, 60g in water (plastic) 390g in air, 280g in water (Ti)
Depth rating	Up to 1700m (plastic) Up to 6000m (Ti)
Sampling rate	1Hz | slow 2Hz standard 8Hz | fast8 16Hz | fast16 32Hz | fast32

Power

Parameter	Value
Supply voltage	6V to 18V (12V nominal)
Power	10mA/120mW at 12V

2.3 RBR*coda*^{3} T.D

The RBR*coda*^{3} T.D and RBR*coda*^{3} T.D | deep use the thermistor-type temperature sensors and piezoresistive pressure sensors. The pressure sensor is protected by a clear plastic guard.

RBR*coda*^{3} T.D and RBR*coda*^{3} T.D | deep

Temperature

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

*A wider temperature range is available upon request. Contact RBR for more information.

Pressure

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

Physical

Parameter	Value
Housing	Plastic or titanium
Diameter	~25mm
Length	~265mm (~300mm with connector)
Weight	190g in air, 70g in water (plastic) 390g in air, 280g in water (Ti)
Sampling rate	2Hz standard 8Hz | fast8 16Hz | fast16, | tide16 32Hz | fast32

⚠ The depth rating of the RBR*coda*^{3} T.D and RBR*coda*^{3} T.D | deep instruments is determined by the depth rating of the pressure sensor installed.
For example, the RBR*coda*^{3} T.D in plastic housing with a 200dbar pressure sensor cannot be used at depths greater than 200m, even though the temperature sensor is rated at 1700m.

Power

Parameter	Value
Supply voltage	6V to 18V (12V nominal)
Power	10mA/120mW at 12V

2.4 RBR*coda*^{3} T.ODO

The RBR*coda*^{3} T.ODO uses the optical dissolved oxygen sensor. During deployments, always orient the sensor downwards to reduce debris collecting at the aperture 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.

RBR*coda*^{3} T.ODO

Dissolved oxygen

Parameter	Value
Measurement range	0-1000µmol/L
Calibrated range Concentration Saturation Temperature	 0-500µmol/L 0-120% 1.5°C to 30°C
Initial accuracy For | fast For standard, | slow	 Maximum of ±8µmol/L or ±5% Maximum of ±2µmol/L or ±1.5%
Resolution For | fast For standard For | slow	 <1µmol/L (saturation 0.4%) <0.5µmol/L (saturation 0.2%) <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. When installed on an instrument with a pressure sensor, this correction is done automatically.
If deployed as a standalone sensor or installed on a moored instrument with no pressure sensor, enter the known absolute pressure value manually in the table under the **Parameters** tab in Ruskin.

Temperature

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	<1s

*A wider temperature range is available upon request. Contact RBR for more information.

Physical

Parameter	Value
Housing	Titanium
Diameter	~28mm
Length	~125mm, ~160mm (with connector)
Weight	180g in air, 110g in water
Depth rating	Up to 6000m
Sampling rate	24hr to 1Hz

Power

Parameter	Value
Supply voltage	7V to 15V (12V nominal)
Power	10mA for 300ms (36mJ/sample) | fast 10mA for 300ms (36mJ/sample) standard 10mA for 500ms (60mJ/sample) | slow
Sleep current	60µA

Output values

• Temperature (°C)

• Dissolved O_2 concentration (µmol/L)

• Dissolved O_2 concentration (salinity compensated, µmol/L)

• Dissolved O_2 saturation (%)

• Dissolved O_2 phase (°)

2.5 RBR*coda*^{3} PAR, RBR*coda*^{3} rad

The RBR*coda*^{3} PAR and RBR*coda*^{3} rad instruments look identical and share several specifications.

The RBR*coda*^{3} PAR and RBR*coda*^{3} PAR | deep use the cosine photosynthetically active radiation sensors which can measure light within one hemisphere.

The RBR*coda*^{3} rad and RBR*coda*^{3} rad | deep use radiometers measuring narrow-band light with a fixed channel width, available in various 10nm- and 25nm-wide channels. Both centre wavelength and channel width are factory-configured.

RBR*coda*^{3} PAR and RBR*coda*^{3} PAR | deep

Optical radiometry

Parameter	Value
Dynamic range	>5.5 decades (nominal)
Absolute calibration*	±5%
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^2/s (minimum)
Resolution	±0.010µ mol/m^2/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^2/nm (minimum)
Resolution**	±0.001µW/cm^2/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.

Physical

Parameter	Value
Housing	Plastic or titanium
Diameter	~25mm
Length	~235mm (~270mm with connector)
Weight	170g in air, 40g in water (plastic) 330g in air, 200g in water (Ti)
Depth rating	Up to 1000m (plastic) Up to 2000m (Ti)
Sampling rate	Up to 16Hz

Power

Parameter	Value
Supply voltage	6-18V (12V nominal)
Power	77mJ per sample (1Hz or slower) 15mA/180mW (2Hz or faster)

2.6 RBR*quadrante*

The RBR*quadrante* is a four-channel radiometer, capable of measuring multiple wavebands simultaneously, including PAR. It uses the same cosine PAR sensors and narrow-band radiometers as the RBR*coda*^{3} PAR and RBR*coda*^{3} rad instruments.

RBR*quadrante*

Optical radiometry

Parameter	Value
Dynamic range	>5.5 decades (nominal)
Absolute calibration*	±5%
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^2/s (minimum)
Resolution	±0.010µ mol/m^2/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 ≥200µW/cm^2/nm (full sun)
Resolution**	±0.001µW/cm^2/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.

Physical

Parameter	Value
Diffuser	Acrylic
Housing	Titanium
Diameter	63mm
Length	57mm, 93mm (with connector)
Weight	400g (in air), 210g (in water)
Depth rating	Up to 2000m
Sampling rate	Up to 32Hz

Power

Parameter	Value
Supply voltage	4.5V to 30V (12V nominal)
Power	4mJ per sample (4Hz or slower) 3mA/36mW (8Hz or faster)
Sleep current	10µA

2.7 RBR*tridente*

The RBR*tridente* is an optical sensor with three channels, capable of making multiple fluorescence and backscatter or turbidity measurements simultaneously. Its standard depth rating is 6000m.

RBR*tridente*

Optical

Parameter	Value
Centroid angle	120°
Sensing volume	~1.3mL
Linearity, R^2	0.99
Calibration accuracy	5%

Chlorophyll *a*

Parameter	Value
Channel wavelength (excitation/emission)	470nm/695nm
Calibrated range*	0-50µg/L
Detection limit*	0.01µg/L

* Scaled to the fluorescence response from a monoculture of *Thalassiosira weissflogii*.

fDOM*

Parameter	Value
Channel wavelength (excitation/emission)	365nm/450nm
Calibrated range	0-500ppb
Detection limit	0.03ppb

* fDOM can be used as a proxy for cDOM.

Phycocyanin

Parameter	Value
Channel wavelength (excitation/emission)	620nm/654nm
Calibrated range	0-5000µg/L
Detection limit	0.2µg/L

Phycoerythrin

Parameter	Value
Channel wavelength (excitation/emission)	525nm/600nm
Calibrated range	0-6000µg/L
Detection limit	1.5µg/L

Backscatter

Parameter	Value
Channel wavelength	470/525/650/700nm
Calibrated range*	0-0.05$m^{-1}sr^{-1}$
Detection limit	1x10^{-6}$m^{-1}sr^{-1}$

* Response becomes non-linear above 0.05$m^{-1}sr^{-1}$.

Turbidity

Parameter	Value
Channel wavelength	700nm
Calibrated range*	0-500FTU
Detection limit	0.001FTU

* Response becomes non-linear above 500FTU.

Physical

Parameter	Value
Housing	Titanium
Diameter	63mm
Length	57mm, 93mm (with connector)
Weight	400g (in air), 210g (in water)
Depth rating*	Up to 6000m
Sampling rate	Up to 32Hz

* Standard depth rating is 2000m. 6000m is available upon request. Contact RBR for more information.

Power

Parameter	Value
Supply voltage	4.5V to 30V, 32mA (12V nominal)
Power	20mJ/sample (4Hz or slower) 384mW (8Hz or faster)
Sleep current	10µA

2.8 RBR*coda*^{3} DO (OxyGuard)

The RBR*coda*^{3} 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 aperture and minimise direct sunlight. Store the sensor in the dedicated storage cap, included with the instrument.

RBR*coda*^{3} DO (OxyGuard)

Dissolved Oxygen

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

Physical

Parameter	Value
Housing	Plastic
Diameter	~25mm
Length	~125mm (~160mm with connector)
Weight	190g in air, 70g in water
Depth rating	Up to 1700m
Sampling rate	2Hz

Power

Parameter	Value
Supply voltage	6V to 18V (12V nominal)
Power	10mA/120mW at 12V

2.9 RBR*coda*^{3} PAR (LI-COR)

The RBR *coda*^{3} PAR (LI-COR) instruments use cabled cosine (one hemisphere, LI-192) or spherical (omnidirectional, LI-193) PAR sensors.

Cosine PAR sensor

Spherical PAR sensor

RBR*coda*^{3} PAR (LI-COR) variants

PAR

Parameter	Value
Wavelength range	400 to 700nm
Calibrated range	0 to 10000µmol/m^2/s
Initial accuracy	±2%

Physical

Parameter	Value
Housing	Plastic
Diameter	~25mm
Length	~265mm (~300mm with connector) cable 0.6m
Weight	460g in air, 240g in water (cosine) 400g in air, 100g in water (spherical)
Depth rating	Up to 560m (cosine) Up to 350m (spherical)
Sampling rate	2Hz

Power

Parameter	Value
Supply voltage	6V to 18V (12V nominal)
Power	10mA/120mW at 12V

3 Derived parameters

The RBR realtime smart sensors stream the data already calibrated, with all the parameters derived.

See Ruskin User Guide: RBR Sensors for instructions on configuring your instrument.

3.1 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).

$$Sea\,pressure = absolute\,pressure - atmospheric\,pressure$$

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

Enter atmospheric pressure (in dbar) manually in the table under the **Parameter** tab in Ruskin. See Ruskin User Guide: RBR Sensors. If not entered, a default value of 10.1325dbar will be used.

3.2 Depth

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

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

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

Sea pressure is also a derived parameter:

$$Sea\,pressure = absolute\,pressure - atmospheric\,pressure$$

Enter atmospheric pressure (in dbar) and seawater density (in g/cm^3) manually in the table under the **Parameter** tab in Ruskin. See Ruskin User Guide: RBR Sensors. If not entered, default values of 10.1325dbar and 1.0281g/cm^3 will be used.

3.3 Oxygen concentration

The RBR*coda*^{3} DO supports a third-party DO sensor from OxyGuard, which measures dissolved oxygen saturation.

When a sensor measures oxygen saturation, we can 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 **Parameter** tab in Ruskin. See Ruskin User Guide: RBR Sensors.

3.4 Oxygen saturation

The RBR*coda*^{3} 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.

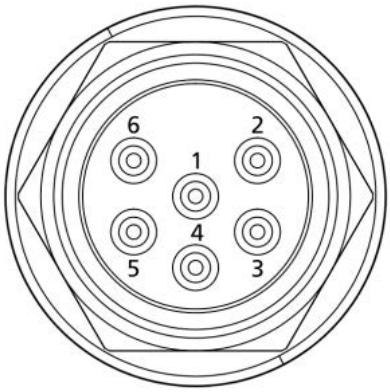
The units of measurement are **%**.

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 **Parameter** tab in Ruskin. See Ruskin User Guide: RBR Sensors.

4 Connector pinouts

4.1 MCBH connectors

All RBR smart sensors have an **MCBH-6-MP** connector to connect to your computer or to use for integrations with the RBR standard instruments. The data will stream via a patch cable (ordered separately).



Pin No.	RS-232
1	Ground
2	Power
3	From the sensor (Tx)
4	Into the sensor (Rx)
5	N/C
6	N/C

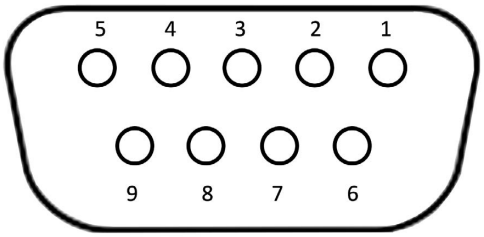
RBR*quadrante* with an MCBH connector

4.2 DB9 connectors

RBR smart sensors use RS-232 patch cables for connecting to your computer and power supplies. Depending on the ordered configuration, your patch cable may have an embedded converter and either a USB connector or a **DB9-F** connector.

Refer to RBR Cable Guide for available options.

Patch cable DB9-F connector pinout



Pin No.	RS-232
1	N/C
2	From the instrument (Tx)
3	Into the instrument (Rx)
4	N/C
5	Drain/Ground
6	Ground
7	Auxiliary
8-9	N/C

RBR*coda*^{3} D with an RS-232 cable, DB9-F connector

5 Maintenance

5.1 Deployment

The RBR smart realtime sensors are robust and reliable, but there are several things to keep in mind when deploying them. Proper deployment will ensure faultless operation and preserve your data.

⚠ Stress due to improper mounting may cause the RBR sensors to leak, resulting in the loss of valuable data or permanent damage to the electronics.
Any type of clamp or bracket which concentrates the stress on the housing is not recommended for use in mooring, mounting, and/or other deployment.
Contact RBR for proper mooring and mounting clamps suited to your specific application.

Precautions

1. Do not exceed the maximum depth rating.

⚠ All RBR sensors are individually rated to a maximum depth in meters, as indicated on the label.

2. Do not apply physical stress to the housing.

⚠ Stress due to improper mounting may cause the RBR sensors to leak, resulting in the loss of valuable data or permanent damage to the electronics.
Any type of clamp or bracket which concentrates the stress on the housing is not recommended for use in mooring, mounting, and/or other deployment.
Contact RBR for proper mooring and mounting clamps suited to your specific application.

3. Do not attempt to open the sensor.

⚠ All RBR sensors are sealed and cannot be opened by the user. Any attempt to do so will damage the sensor.

5.2 Cables and connectors

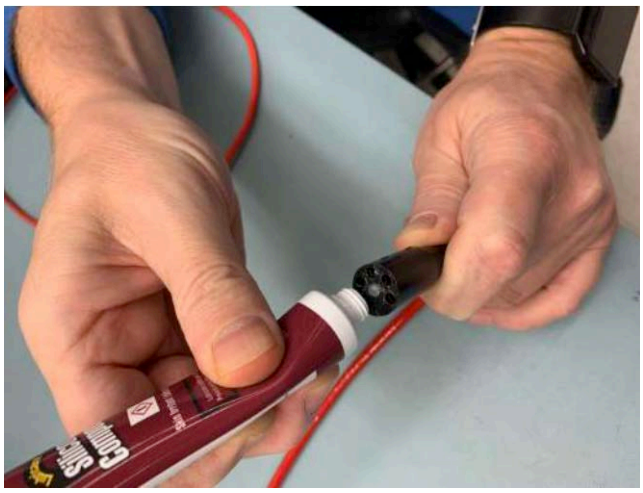
Cable bend radius

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

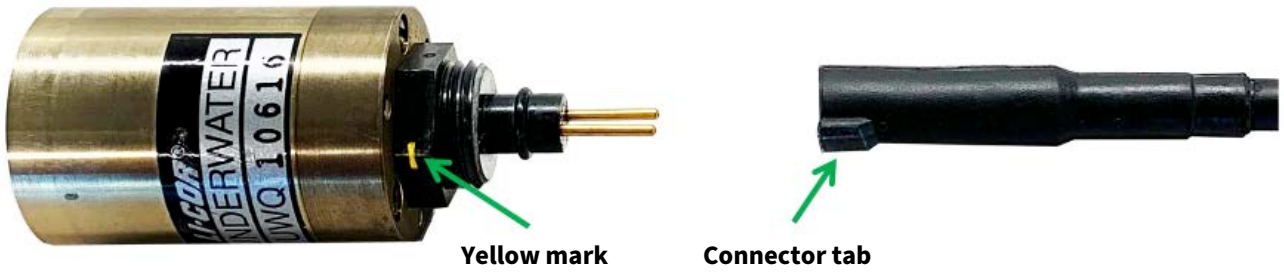
- Do not pull on the cable
- Hold onto the connector to pull out the cable
- Disconnect by pulling straight out, not at an angle
- Avoid sharp bends at the point where the cable enters the connector
- Avoid angular loads on the connector

5.3 PAR sensor (LI-COR) connector alignment

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.

5.4 DO sensor (OxyGuard) care and maintenance

Storage

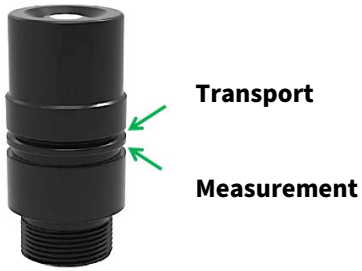
Store the OxyGuard dissolved oxygen sensor in the dedicated storage cap to minimise fluid loss. Storage caps are provided with the instrument. Contact RBR if a replacement is needed.

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 re-calibrate 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: RBR Sensors for instructions on calibration.

5.5 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.

RBR*coda*^{3} T.ODO ready for storage

Storage cap variants

RBR ODO sensors intended for vehicle integration are shipped with a specialised storage cap, designed for a sensor mounted inside the glider. This storage cap has an opening for refilling the water with a syringe. See the quick start guide provided with your sensor for more information.

RBR*coda*^{3} T.ODO for vehicle integration

First deployment

RBR ships the RBR*coda*^{3} 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 result in the loss of water. Verify that the storage cap is still wet. If not, rehydrate the sensor for **five days** before deployment.

5.6 RBR*tridente* sensor safety precautions

For fDOM measurements, the RBR*tridente* uses UV LEDs (ultraviolet light emitting diodes) and should be handled with care.

Ultraviolet radiation is invisible so it may not be obvious when the instrument is active. Exercise caution to avoid any associated health risks for the eyes.

> Wear approved safety glasses with side protection and UV filter lenses.
> Avoid looking at the LEDs.

Storage cap

Whenever possible, keep the storage cap on your fluorometers.

RBR*tridente* with its storage cap on

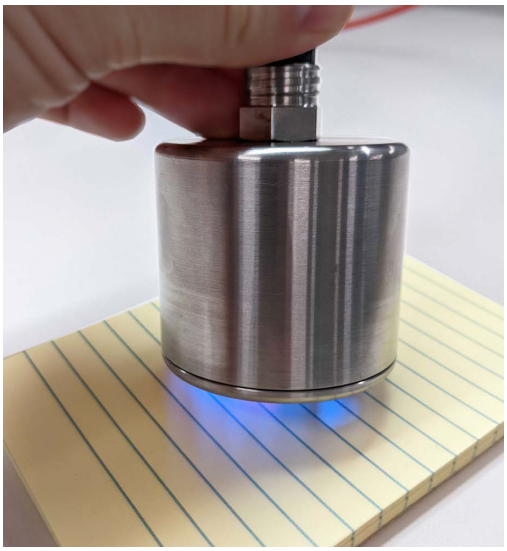
Eye protection

If the storage cap is removed, use protective eyewear. RBR recommends UV-blocking safety glasses of the highest available rating.

Safe operation

Never look at the LEDs as their optical power (ultraviolet and visible) can be hazardous to eyes.

Whenever handling an active fluorometer, place the unit face down on a non-abrasive surface to avoid shining the light into the eyes.



RBR*tridente* facing down

RBR realtime sensors continue streaming data as long as power is provided. When the fluorometer does not need to be active, disconnect it from the power supply.

5.7 Cleaning

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, and ODO 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.

Cleaning RBR*tridente*

RBR*tridente* design makes it resilient to corrosion and thus allows for more rigorous handling than other fluorometers.

See the table above for cleaning procedures.

5.8 Calibration

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. Hard copies are provided with each shipment. RBR can replace lost or misplaced calibration certificates upon request.

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.

5.9 Repairs

RBR supports all our products. Contact us immediately at 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.

6 Revision history

Revision No.	Release date	Notes
A	30-November-2021	Original
B	28-February-2022	Corrected pressure rating (from 10000dbar to 6000dbar), added maintenance instructions for the OxyGuard DO sensor.
C	15-March-2022	Added MCBH pinout and description of the PAR sensor (LI-COR) connector to Specifications.
D	15-September-2022	Added RBR*tridente* to the list of sensors and Specifications. Added sampling rates to Specifications. Moved description of the PAR sensor (LI-COR) connector to Maintenance. Added Deployment to Maintenance.
E	31-October-2022	Improved page hierarchy for Specifications. Added RBR*quadrante* to the list of sensors and Specifications. Added the Derived parameters section. Added RBR*tridente* sensors safety precautions to Maintenance.
F	31-May-2023	Updated the name of the document to RBR Sensors. Restructured Specifications, categorising them by instrument. Updated the *RBRtridente* and ODO specifications. Improved connector pinout tables. Added ODO sensor storage instructions to Maintenance. Updated cleaning instructions for optical sensors and added RBR*tridente* to Cleaning.
G	31-July-2023	Added a note about the depth rating of the RBR*coda*^{3} T.D. Updated the specifications for the RBR*coda*^{3} PAR, RBR*coda*^{3} rad, and RBR*quadrante*.
H	31-January-2024	Added information about | fast and | tide variants to the introductory page. Updated the RBR*coda*^{3} T.ODO section for specifications and pressure correction note. Updated the RBR*coda*^{3} PAR, RBR*coda*^{3} rad, RBR*quadrante*, and RBR*tridente* specifications.
J	30-June-2024	Added phycocyanin and phycoerythrin to the RBR*tridente* options in the Introduction. Updated the RBR*coda*^{3} T.ODO specifications for accuracy and resolution, RBR*quadrante* specifications for wavelength options, and RBR*tridente* specifications for new parameter options and depth rating. Added a warning against using the ultrasonic bath to the Cleaning section.