# RBR SENSORS


# RBR*coda*
# RBR*coda*$^3$

# INSTRUMENT GUIDE

rbr-global.com

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# 1 RBR sensors

The RBR*coda* and RBR*coda*$^3$ small smart sensors (Fig. 1), as well as multi-channel sensors RBR*tridente* and RBR*quadrante*, 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.

The 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.

The RBR*quadrante*, RBR*tridente,* and RBR*coda* Tu support aggregate sampling mode, where measurement bursts are taken over a selected period.

**Shallow variants**

- RBR*coda*$^3$ D - pressure (depth)
- RBR*coda*$^3$ T - temperature
- RBR*coda*$^3$ T.D - temperature, pressure
- RBR*coda* DO (OxyGuard®) - dissolved oxygen
- RBR*coda* PAR - photosynthetically active radiation
- RBR*coda* rad - narrow-band light radiation
- RBR*coda* 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, pressure
- RBR*coda* T.ODO - temperature, optical dissolved oxygen
- RBR*coda* Tu - turbidity
- RBR*coda* chl-*a* - chlorophyll-*a*
- RBR*coda* PAR | deep - photosynthetically active radiation
- RBR*coda* rad | deep - narrow-band light radiation


*Fig. 1. The RBRcoda and RBRcoda$^3$ small smart sensors*

The RBR*coda* T.ODO, RBR*coda* chl-*a* and RBR*coda* Tu are only available as a deep variant in titanium housing.

For multi-channel sensor variants, see the dedicated RBR*tridente* and RBR*quadrante* Instrument Guide.

# 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* T.ODO, RBR*coda* PAR / RBR*coda rad, and* RBR*coda* Tu, as well as our instruments with third-party sensors, the RBR*coda* DO (OxyGuard) and the RBR*coda* PAR (LI-COR®).

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

## 2.1 RBRcoda$^3$ D

The RBR*coda*$^3$ D and RBR*coda*$^3$ D | deep (Fig. 2) 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.


*Fig. 2. RBRcoda$^3$ D and RBRcoda$^3$ D | deep*

**Pressure**

| Parameter | Value |
|---|---|
| Range | 20 / 50 / 100 / 200 / 500 / 1000dbar (plastic)<br>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)<br>370g in air, 270g in water (Ti) |

| Parameter | Value |
|---|---|
| Depth rating | Up to 1000m (plastic)<br>Up to 6000m (Ti) |
| Sampling rate | 2Hz standard<br>8Hz \| fast8<br>16Hz \| fast16, \| tide16<br>32Hz \| fast32 |

**Power**

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

## 2.2 RBRcoda$^3$ 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. Fig. 3 illustrates the three models.


*Fig. 3. RBR coda$^3$ T, RBRcoda$^3$ T | deep, and RBRcoda$^3$ T | slow | deep with embedded thermistor*

**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)<br>~195mm (~230mm with connector) \| slow \| deep |
| Weight | 160g in air, 60g in water (plastic)<br>390g in air, 280g in water (Ti) |
| Depth rating | Up to 1700m (plastic)<br>Up to 6000m (Ti) |
| Sampling rate | 1Hz \| slow<br>2Hz standard<br>8Hz \| fast8<br>16Hz \| fast16<br>32Hz \| fast32 |

**Power**

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

## 2.3 RBRcoda$^3$ T.D

The RBR*coda*$^3$ T.D and RBR*coda*$^3$ T.D | deep (Fig. 4) use the thermistor-type temperature sensors and piezoresistive pressure sensors. The pressure sensor is protected by a clear plastic guard.


*Fig. 4. RBRcoda$^3$ T.D and RBRcoda$^3$ T.D | deep*

**Temperature**

| Parameter | Value |
|---|---|
| Range* | -5°C to 35°C |
| Initial accuracy | ±0.002°C |
| Resolution | <0.00005°C |

| Parameter | Value |
|---|---|
| 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)<br>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)<br>390g in air, 280g in water (Ti) |
| Sampling rate | 2Hz standard<br>8Hz \| fast8<br>16Hz \| fast16, \| tide16<br>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 RBRcoda T.ODO

The RBR*coda* T.ODO (Fig. 5) uses the optical dissolved oxygen sensor, with three time constant options available: 1s, 8s, and 30s. The | fast (1s time constant) variant is well suited for profiling applications. The | slow (30s time constant) version has a protective layer to facilitate automated cleaning by a wiper to keep it free from biofouling during long-term moored deployments.

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.


*Fig. 5. RBRcoda T.ODO | fast and RBRcoda T.ODO | slow*

**Dissolved oxygen**

| Parameter | Value |
|---|---|
| Measurement range | 0-1000µmol/L |
| Calibrated range<br><br>Concentration<br>Saturation<br>Temperature | <br><br>0-500µmol/L<br>0-120%<br>1.5°C to 30°C |
| Initial accuracy<br><br>For \| fast<br>For standard, \| slow | <br><br>Maximum of ±8µmol/L or ±5%<br>Maximum of ±2µmol/L or ±1.5% |
| Resolution<br><br>For \| fast<br>For standard<br>For \| slow | <br><br><1µmol/L (saturation 0.4%)<br><0.5µmol/L (saturation 0.2%)<br><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<br>10mA for 300ms (36mJ/sample) standard<br>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 RBRcoda PAR, RBRcoda rad

The RBR*coda* PAR *and RBRcoda* rad instruments (Fig. 6) look identical and share several specifications.

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

The RBR*coda* rad and RBR*coda* 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.


*Fig. 6. RBRcoda PAR and RBRcoda PAR | deep*

**Optical radiometry**

| Parameter | Value |
|---|---|
| Dynamic range | >5.5 decades (nominal) |
| Initial accuracy* | ±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/m²/s (minimum) |
| Resolution | ±0.010µ mol/m²/s |

**Narrow-band channels**

| Parameter | Value |
|---|---|
| Centre wavelengths (CWL)* | 380 / 413 / 445 / 475 / 488 / 508 / 532 / 560nm |
| Full width at half-maximum (FWHM) | 10nm (25nm for CWL 475nm) |
| Full scale range | 0 to 400µW/cm²/nm (minimum) |
| Resolution** | ±0.001µW/cm²/nm |

* Other CWL options within the 300-1100nm 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)<br>330g in air, 200g in water (Ti) |
| Depth rating | Up to 1000m (plastic)<br>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)<br>15mA/180mW (2Hz or faster) |

## 2.6 RBRcoda Tu

The RBR*coda* Tu (Fig. 7) is a real-time turbidity sensor with two independent optical channels for optimising linearity and sensitivity. Its high dynamic range permits exposure to full sunlight with very low detection limits, while power consumption and depth rating have been tailored for use in a wide variety of applications.

The turbidity channel of the RBR*coda* Tu ensures high sensitivity in the low range (0-1000FTU), while the optical backscatter channel is designed for high-turbidity applications (up to 20000FTU). RBR calibrates the optical backscatter channel to ensure the highest accuracy around and above 1000FTU, thus achieving alignment between these two channels through their intended measurement conditions.

All optical components of the RBR*coda* Tu are robust and durable, selected to minimise aging due to UV/sunlight exposure, and thus show no change in properties over extended deployments. Its sapphire windows facilitate automated cleaning by a wiper to keep them free of biofouling during long-term moored deployments.

> When used as a standalone sensor, the RBR*coda* Tu has the additional capability to sample in aggregate mode. See Ruskin User Guide: Sensors for details.


*Fig. 7. RBRcoda Tu*

**Turbidity**

| Parameter | Value |
|---|---|
| Channel wavelength | 880nm |
| Centroid angle | 90° |
| Linearity, $R^2$ | 0.99 |
| Initial accuracy | 5% |
| Calibrated range | 0 - 1000FTU |
| Measurement range* | 0 - 1500FTU |
| Detection limit | 0.005FTU |

* Response becomes non-linear above 1000FTU.

**Turbidity (optical backscatter)**

| Parameter | Value |
|---|---|
| Channel wavelength | 880nm |
| Centroid angle | 135° |
| Linearity, $R^2$ | 0.99 |
| Initial accuracy | 5% |
| Calibrated range | 1000 - 4000FTU |
| Measurement range* | 0 - 20000FTU |
| Detection limit | 2.0FTU |

* Response is linear between 500 and 15000 FTU

**Physical**

| Parameter | Value |
|---|---|
| Housing | Titanium |
| Diameter | 25mm |
| Length | ~70mm (~105mm with connector) |
| Weight | 110g in air, 70g in water |
| Depth rating | Up to 6000m |
| Sampling rate | Up to 32Hz |

**Power**

| Parameter | Value |
|---|---|
| Supply voltage | 4.5V to 30V (12V nominal) |
| Power | 2.3mJ/sample (4Hz or slower)<br>42mW (8Hz or faster) |
| Sleep current | 10µA at 12V |

## 2.7 RBRcoda chl-a

The RBR*coda* chl-*a* is a 6000m capable real-time chlorophyll-a sensor designed to ensure sensitivity to low concentrations across the measurable range (0-500µg/L). Its compact design, fast sampling rates, low power consumption, and high depth rating have been designed for use in a wide variety of applications.This dedicated chlorophyll-*a* fluorometer brings laboratory grade precision to the ocean environment while maintaining the ruggedness, reliability, and compact design required for field deployments.

All optical components of the RBR*coda* chl-*a* are robust and durable, selected to minimize aging due to UV/sunlight exposure, and thus show minimal change in properties over extended deployments. Its sapphire windows facilitate automated cleaning by a wiper to keep them free of biofouling during long-term moored deployments.

Deploy the RBR*coda* chl-*a* with the detection window facing down and the connector end cap pointing upwards to avoid unnecessary exposure to direct sunlight.


*Fig. 8. The RBRcoda chl-a*

**Physical**

| Parameter | Value |
|---|---|
| Connector | MCBH-6-MP |
| Communications | RS-232 |
| Housing | Titanium |
| Depth rating | 6000m |
| Diameter | 25mm |
| Length | 68mm (104mm with connector) |
| Weight | 110g in air,<br>70g in water |
| Operating temperature range | -5°C to +35°C |
| Sampling rate | Up to 32Hz |

**Power**

| Parameter | Value |
|---|---|
| Supply voltage | 4.5V to 30V (12V nominal) |
| Power | 6.5mJ/sample @ 12V (4Hz or slower)<br>180mW @ 12V (32Hz) |
| Sleep current | 10µA at 12V |

**Optical**

| Parameter | Value |
|---|---|
| Linearity, R2 | 0.99 |
| Initial accuracy | 5% |

**Chloropyll-*a***

| Parameter | Value |
|---|---|
| Wavelength | 470nm/695nm (excitation/emission) |
| Calibrated range* | 0-50µg/L |
| Measurement range | 0-500µg/L |
| Detection limit* | 0.010µg/L |

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

## 2.8 RBRcoda DO ( OxyGuard)

The RBR*coda* DO (Fig. 9) 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.

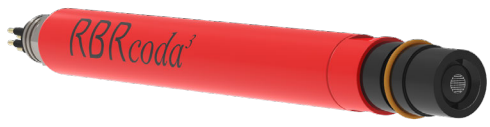



*Fig. 9. RBRcoda DO (OxyGuard)*

**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 RBRcoda PAR (LI-COR)

The RBR *coda* PAR (LI-COR) instruments (Fig. 10) use cabled cosine (one hemisphere, LI-192) or spherical (omnidirectional, LI-193).

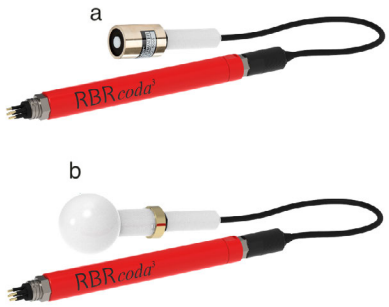



*Fig. 10. RBRcoda PAR (LI-COR) variants. (a) Cosine PAR sensor. (b) Spherical PAR sensor*

**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)<br>cable 0.6m |
| Weight | 460g in air, 240g in water (cosine)<br>400g in air, 100g in water (spherical) |
| Depth rating | Up to 560m (cosine)<br>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).

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

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).

$$\text{Depth} = \frac{\text{absolute pressure - atmospheric pressure}}{\text{density} \cdot \text{g}}$$

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:

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

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* 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[1]. 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* 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 **%**.

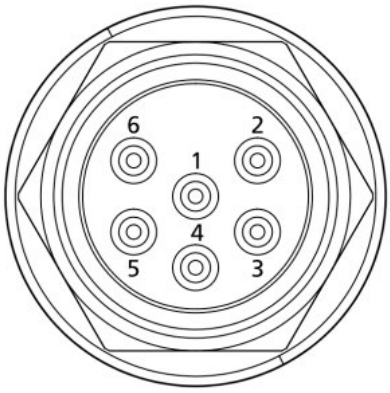
The Garcia and Gordon equation requires values for absolute temperature (in °K) and salinity, which are derived from measured temperature and conductivity. As your instrument does not measure conductivity, a default value of 35PSU will be used. Alternatively, enter conductivity manually in the table 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 (see Fig. 11) 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).


*Fig. 11. RBRcoda Tu with an MCBH connector*




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

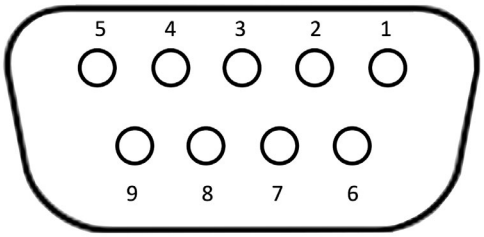
## 4.2 DB9 connectors

RBR smart sensors use RS-232 patch cables (see Fig. 12) 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.


*Fig. 12. RBRcoda$^3$ D with an RS-232 cable, 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 |

# 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.

**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. See Fig. 13.


*Fig. 13. Maximum depth rating 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 and void all warranty.

## 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

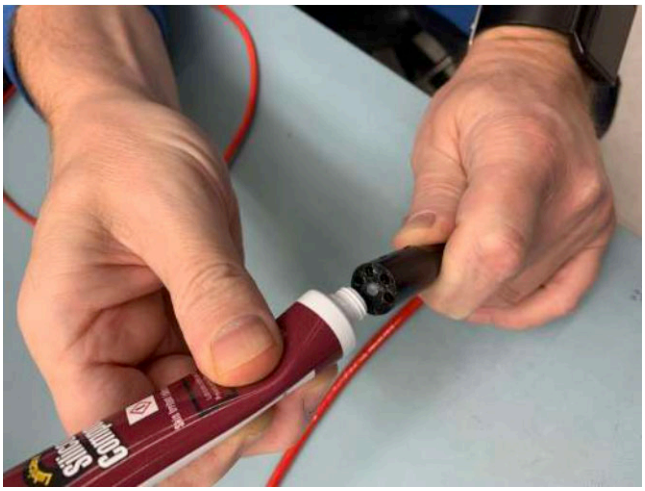


*Fig. 14. Applying silicone compound to the female connectors.*

*Fig. 15. Cross section of a connector with 30% lubricant fill.*

**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 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.


*Fig. 16. The RBR T.ODO with storage cap, note the red arrow showing the location of 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.


*Fig. 17. RBRcoda 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* T.ODO for vehicle integration

**First deployment**

RBR ships the RBR*coda* 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.

**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: Sensors for user calibration instructions.

## 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.

*Fig. 18. Storage cap*

**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".

*Fig. 19. Transport and Measurement positions*

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.

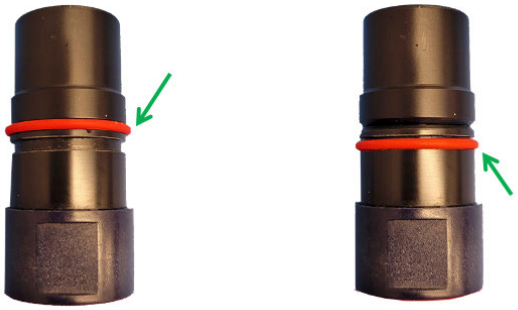


*Fig. 20. Transport position (left), measurement position (right)*

**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.

## 5.5 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.


*Fig. 21. The LI-COR PAR sensor, note the Yellow mark*

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


*Fig. 22. The orientation of the yellow mark and the connector tab*

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.

## 5.6 Cleaning

These instructions are for RBR sensors only, for 3rd party sensors refer to the manufacturers best practices for 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 the RBR*coda* T.ODO**

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 the RBR*coda* Tu and RBR*coda* chl-*a***

Clean the optical face of the sensor with a lint-free cloth and isopropyl alcohol.

⚠ Ensure you are wearing gloves, oil from finger prints easily soils the windows.

*Fig. 23. Dirty*

*Fig. 24. Clean*

## 5.7 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.

Calibration certificates are available for download:

- If using Ruskin, connect your instrument and go to **Information**, then click the **Download** button at the bottom
- For OEM instruments, go to https://oem-lookup.RBR-global.com, select **OEM lookup by serial number**, 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.

## 5.8 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-H | 2021-2023 | Various |
| 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, and to include the \| slow variant in the image. Updated the RBR*quadrante* specifications for wavelength options, and RBR*tridente* specifications for new parameter options, depth rating, and OEM variant. Added a warning against using the ultrasonic bath to the Cleaning section. |
| K | 15-August-2024 | Added the \| slow variant to the image in the RBR*coda*$^3$ T.ODO section. Updated the RBR*tridente* section for the OEM variant, wavelengths, weight specifications. |
| L | 15-November-2024 | Added a note on aggregate mode to the introduction. Updated specifications for the RBR*coda*$^3$ PAR, RBR*coda*$^3$ rad. Removed the RBR*quadrante* and RBR*tridente* sections (now available as a dedicated instrument guide). Added the RBR*coda* Tu section. Updated the Calibration section for downloading instructions. |
| M | | Added UV to Narrow-band wavelength specs table<br>Updated length of Tu sensor housing<br>Added RBR*coda* chl-*a* to sensor specifications section<br>Updated cleaning section |

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