RBR COMPACT INSTRUMENTS

RBR*solo*³
RBR*duet*³

INSTRUMENT GUIDE

rbr-global.com

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1 Compact instruments

RBR manufactures two types of compact instruments, the RBR*solo*^{3} and RBR*duet*^{3}.

The RBR*solo*^{3} is a family of single-channel instruments, whereas the RBR*duet*^{3} 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^3 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.

> In most cases, standard, | slow, and | fast sampling variants look identical.
> Exceptions are the RBR*solo*^{3} T | deep | slow, which has an embedded thermistor, and | slow variants of the RBR*duet*^{3} T.ODO, which feature an extra red band.

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.

Fig. 1 . The RBR compact instruments^3 family

1.1 RBRsolo³

The RBR*solo*³ is a family of small single-channel, long-autonomy instruments which come in several variants:

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

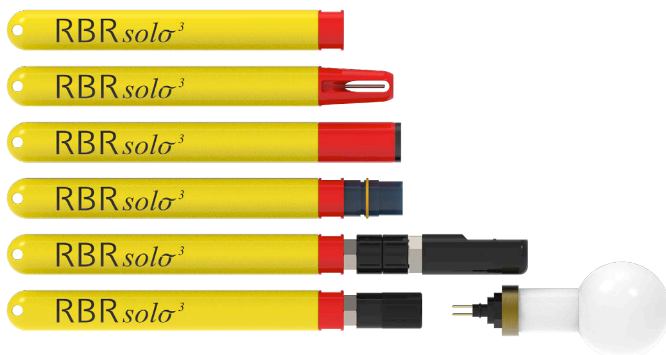


Fig. 2 . The RBRsolo³ shallow instruments

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

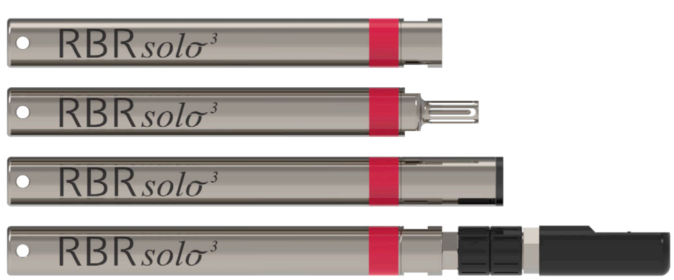


Fig. 3 . The RBRsolo³ | deep variants

The RBR*solo*^{3} PAR | deep and RBR*solo*^{3} 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*^{3} T | deep | slow, which has an embedded thermistor:

Fig. 4 . The RBRsolo^3 T | slow with embedded thermistor

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

1.2 RBRduet^3

The RBR*duet*^{3} is a family of small dual-channel, long-autonomy instruments which can be configured with either of the two options:

- RBR*duet*^{3} T.D - temperature and depth
- RBR*duet*^{3} T.ODO - temperature and optical dissolved oxygen

Fig. 5 . The RBRduet^3 shallow instruments

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

- RBR*duet*^{3} T.D | deep - temperature and depth
- RBR*duet*^{3} T.ODO | deep - temperature and optical dissolved oxygen

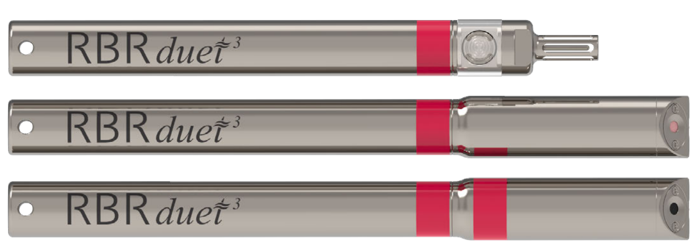


Fig. 6 . The RBRduet^3 | deep variants

Most RBR*duet*^{3} variants look identical except the RBR*duet*^{3} T.ODO | slow which has an extra red band (bottom instrument in Fig. 5 and Fig. 6).

RBR offers cabled versions of the RBR*duet*^{3} T.D and T.ODO under the brand name of "RBR*coda*^{3}". Sensor specifications are the same between the two lines of instruments.

2 Physical specifications

RBR*solo*[3] and RBR*duet*[3] 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[3] 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.

RBR*solo*[3] weight, length, and depth rating

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

RBR*duet*³ weight, length, and depth rating

Instrument	Weight	Total length	Depth rating
RBR*duet*³ T.D RBR*duet*³ T.D | deep	150g in air, 30g in water 350g in air, 240g in water	266mm 266mm	1000m 10000m
RBR*duet*³ T.ODO RBR*duet*³ T.ODO | deep	200g in air, 40g in water 400g in air, 240g in water	303mm 307mm	1000m 6000m

RBR*solo*³ deployment estimates for select sampling rates

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

RBR*duet*³ deployment estimates for select sampling rates

Instrument	Speed	Time	Number of samples
RBR*duet*³ T.D	32Hz	16 days	44 million
	2Hz	53 days	9 million
RBR*duet*³ T.ODO	2Hz	2 days	346 thousand
	30s	26 days	75 thousand

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[3] 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 (RBR*solo*[3]), but some include two (RBR*duet*[3]). 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 RBR*solo*[3] D and RBR*duet*[3] 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.

Fig. 7 . RBRsolo[3] D with piezoresistive pressure sensor

> |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*^{3} T and RBR*duet*^{3} T.D (including their | deep, | fast, | tide, and | wave variants) use the same thermistor-type temperature sensor.

Fig. 8 . RBRsolo^3 T with thermistor-type temperature sensor

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
Power	7-15V, 3mA (RBR*coda*^{3} T.ODO)

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

Fig. 9 . RBRsolo^3 PAR - PAR sensor

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

The RBR*solo*^{3} rad and RBR*solo*^{3} 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)
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.

PAR (LI-COR)

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

Fig. 10 . Cosine PAR sensor

Fig. 11 . Spherical PAR sensor

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

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

3.4 Dissolved oxygen (ODO, DO)

Optical dissolved oxygen (ODO)

The RBR*duet*^{3} T.ODO, and RBR*duet*^{3} 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.

Fig. 12 . RBRduet^3 T.ODO with an optical dissolved oxygen sensor.

Parameter	Value
Measurement range	0-1000µmol/L
Calibrated range Concentration Saturation Temperature	 0-500µmol/L 0-120% 1.5°C to 30°C

Parameter	Value
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. Enter the known absolute pressure value manually in the table under the **Parameters** tab in Ruskin.

Dissolved oxygen (DO)

The RBR*solo*^{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 membrane. Store the sensor in the dedicated storage cap, included with the instrument.

Fig. 13 . RBRsolo^3 DO with a galvanic dissolved oxygen sensor (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 (Tu)

The RBR*solo*[3] Tu and RBR*solo*[3] Tu | deep use the Seapoint turbidity sensor which detects light scattered by solid particles suspended in water. During deployments, minimise direct sunlight.

Fig. 14 . RBRsolo[3] Tu with a Seapoint turbidity sensor

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*
Depth rating	6000m

* 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[3] 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).

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

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

.

Enter atmospheric pressure (in dbar) manually in the table under the **Parameters** tab in Ruskin. See Ruskin User Guide: Compact Instruments[3]. 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).

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

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 **Parameters** tab in Ruskin. See Ruskin User Guide: Compact Instruments[3]. If not entered, default values of 10.1325dbar and 1.0281g/cm^3 will be used.

4.3 Oxygen concentration

The RBR*solo*[3] 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[3].

4.4 Oxygen saturation

The RBR*duet*[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 **Parameters** tab in Ruskin. See Ruskin User Guide: Compact Instruments[3].

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.

Closing the instrument

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

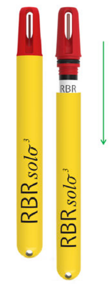


Fig. 15 . Opening a compact instrument

The sensor carriage contains the battery compartment, desiccant holder, and USB-C port.

⚠ When opening the RBR*solo*^{3} 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.

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.

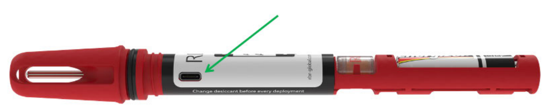


Fig. 16 . An RBR compact instrument battery carriage: note the location of USB-C port

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

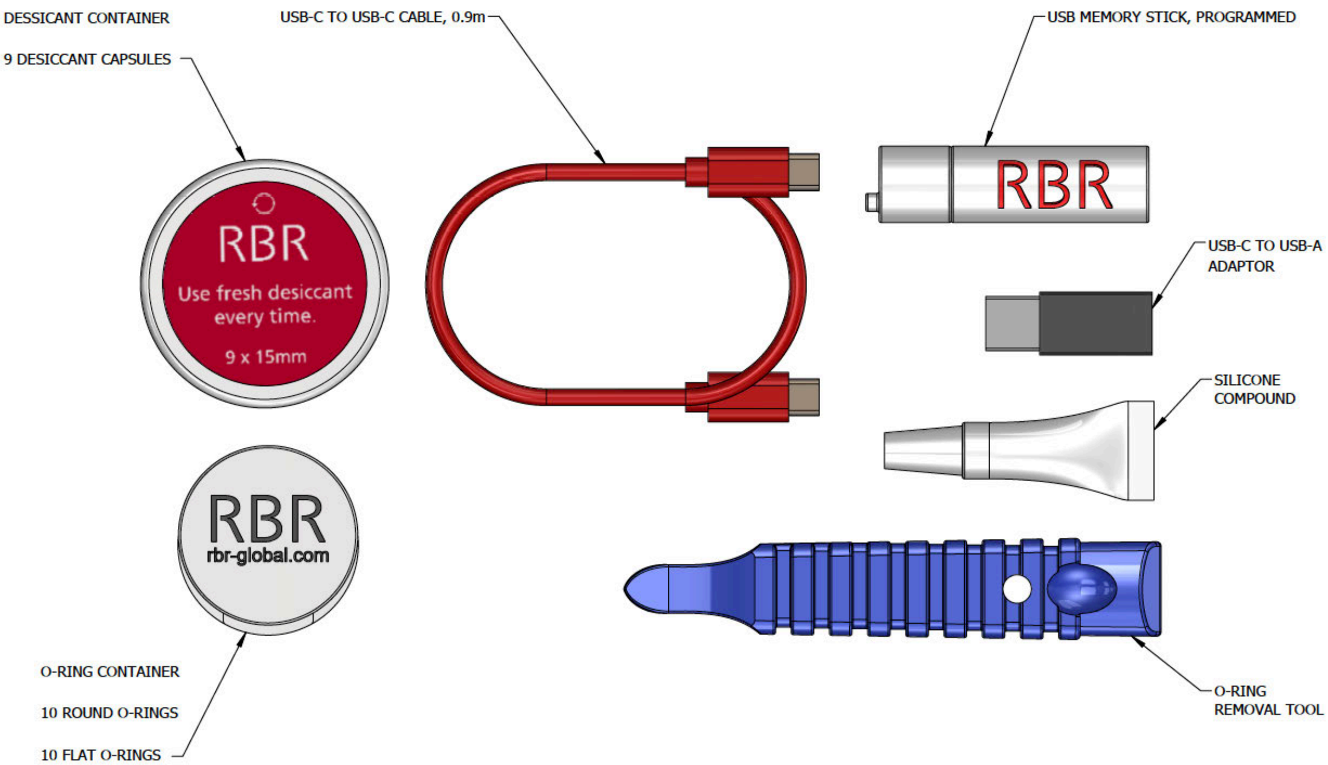
- Connect the instrument to your computer using the USB-C cable
- Find the instrument on Ruskin
- Click **Download...** and select a location to save the measurements

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

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 seal depends upon its O-rings; therefore, proper O-ring maintenance is crucial.

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.

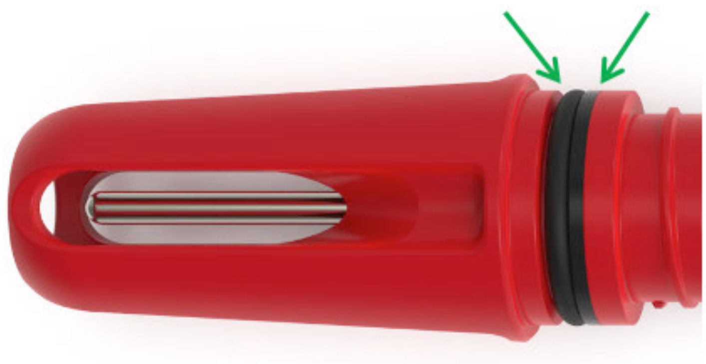


Fig. 17 . Location of the O-rings: main O-ring (left), backup O-ring (right)

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.

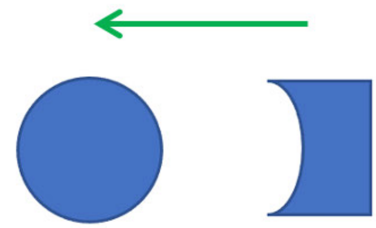


Fig. 18 . Orientation of the O-rings: main O-ring (left), backup O-ring (right)

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 out; 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

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 can estimate battery life based on chemistry and deployment parameters. See Ruskin User Guide: Compact Instruments[3] for more information on predicting battery life.

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.

Fig. 19 . An RBRsolo[3] T battery carriage: note the direction of removal

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

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.

Fig. 20 . Desiccant location and direction of removal

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.

Fig. 21 . 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.
3. Take the refreshed beads out of the oven and return them to the capsule.
4. Wait until the silica beads cool down. Once cool, the desiccant is ready to be reused.

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

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.

6.5 Coupling the turbidity sensor

The turbidity sensor in the RBR*solo*^{3} 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.

Fig. 22 . RBRsolo^3 Tu, with the sensor disconnected

Typically, you will never need to disconnect the sensor from the instrument. However, before deploying the RBR*solo*^{3} 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.

Fig. 23 . Coupler on the RBRsolo^3 Tu

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

Step	Description
1	Disconnect the sensor 1. Take the instrument in your left hand and hold it horizontally, with the sensor oriented to the right. 2. With your left index finger and thumb, prevent the left flange from moving. 3. With your right hand, hold the sensor tightly. 4. With your right index finger and thumb, twist the right flange clockwise until loose. 5. The sensor will drop into your hand.
2	Access the female connector 1. Twist the left flange counterclockwise. 2. Remove the coupler.
3	Lubricate the female connector (see Cables and connectors)

Step	Description
4	Reconnect the sensor 1. Place the coupler back on the instrument. 2. Twist clockwise until tight. 3. Very carefully mate the sensor to the instrument (the pins on the sensor must be aligned with the corresponding holes). 4. Press the sensor into the instrument to make sure the pins are inserted. 5. Continue to hold the instrument with your left hand. 6. With your right hand, hold the sensor tightly. 7. With your right index finger and thumb, twist the right flange counterclockwise while slightly pushing the sensor in with your palm. 8. Verify the tightness of both flanges.

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.

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.

Fig. 24 . The LI-COR PAR sensor: note the location of 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. 25 . 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.

6.7 Cables and connectors

The RBR*solo*^{3} 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 they are disconnected and reconnected. Similarly, the female connector in the RBR*solo*^{3} 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

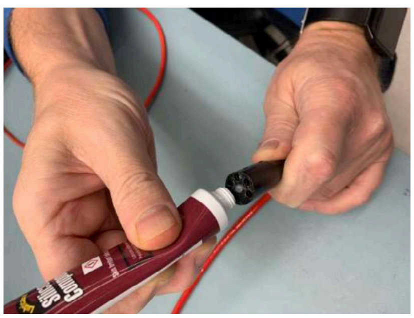


Fig. 26 . Applying silicone compound to the female connectors.

Fig. 27 . Cross-sectional view 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

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.

Fig. 28 . 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 as 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. 29 . RBRduet^3 T.ODO ready for storage

First deployment

RBR ships the RBR*duet*^{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 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^3 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.

Fig. 30 . 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. 31 . Location of the transport (top) and measurement (bottom) 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.

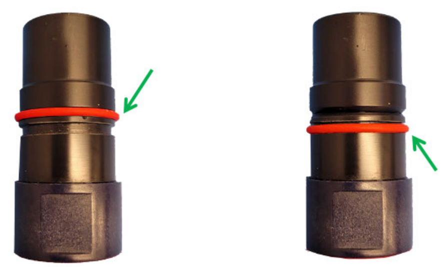


Fig. 32 . Transport position (left), measurement position (right)

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 the 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 risk 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 **Information**, then select **Download**.
- 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.

6.12 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.

7 Revision history

Revision No.	Release date	Notes
A - K	2021 - 2024	Various
L	31-December-2024	Updated deployment estimates in Physical specifications.
M	12-March-2026	UV wavelength added to Narrow-band table Updated Ruskin information on Replacing the battery page