RBR*quartz³* BPR
INSTRUMENT GUIDE

rbr-global.com

Table of contents

1 RBR*quartz*^{3} BPR

The RBR*quartz*^{3} BPR (Bottom Pressure Recorder) uses an integrated Paroscientific Digiquartz® pressure sensor for the best-in-class initial accuracy, resolution, and low drift performance. This instrument is intended for long-term autonomous or realtime observations of water level, tides, and tsunamis in deep water.

High resolution and accuracy of the quartz pressure sensor enable full ocean depth water level observations.

Continuous measurements allow the RBR*quartz*^{3} BPR to be used for tsunami detection and early-warning systems when connected to a cabled realtime network. Flexible measurement schedules and configurable integration times permit applications for tide and sea level measurements when powered on internal batteries. A high-accuracy marine temperature sensor records temperature data with each pressure measurement.

Realtime data applications are enabled via USB, RS-232, RS-485, or Ethernet communication. Data transmission to a surface buoy can be performed inexpensively and reliably using the RBR MLM inductive modem system. Innovative canister design allows for easy access to the battery compartment and fast data download via USB-C. Datasets can be read directly in Matlab, or exported to Excel, OceanDataView®, or text files.

Key features of the RBR*quartz*^{3} BPR are:

- High accuracy
- Quartz stability
- Long deployments

The RBR*quartz*^{3} BPR may include an optional built-in tilt sensor (accelerometer).

For a detailed description of Ruskin software and its use for the RBR *quartz* ^{3} BPR, refer to the Ruskin User Guide: Standard loggers[3] .
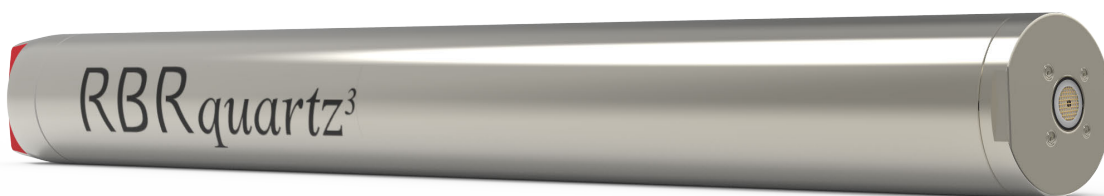
RBR*quartz*^{3} BPR

2 Specifications

Instrument

Specification	Description
Storage	240 million
Power	8 AA-type cells
External power	4.5 to 30V
Communications	Internal: USB-C External: USB and RS-232/RS-485, or Ethernet
Clock drift	±60 second/year
Maximum depth rating	7000m
Housing	Titanium
Diameter	60mm
Length	540mm
Weight	~3.3Kg in air, ~1.7Kg in water

Temperature sensor

Specification	Description
Range	-5 to 35°C*
Initial accuracy	±0.002°C
Resolution	0.00005°C
Typical stability	±0.002°C/year
Time constant	~30s (embedded)

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

Pressure sensor

Specification	Description
Range	4000 / 7000dbar
Initial accuracy	±0.01% full scale
Resolution	10ppb (at 1Hz sampling rate)

Power supply selection

If connected, an external power supply will be used preferentially over the internal batteries as long as the voltage remains 4.5V or greater. If it drops below 4.5V or complete disconnection occurs, the system automatically switches to the internal batteries.

Clock

The instrument's clock is maintained during brief disconnections. This time is usually sufficient to change batteries. If the clock is lost, synchronise with the computer again.

USB-C power
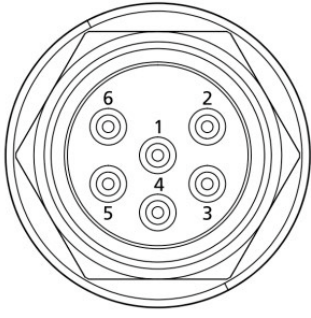
The USB-C cable provides power sufficient for configuration or data download. However, the instrument requires an internal or external power supply to perform sampling.

Deployment estimates

Deployment times are estimated for lithium thionyl chloride batteries based on both memory and internal battery capacity.

Speed	Time	# of samples
16Hz	~58 days	~48 million
2s	~65 days	~1.5 million
10s	~322 days	~1.5 million
60s	~5 years	~1.5 million

External MCBH-6-MP connector pinout

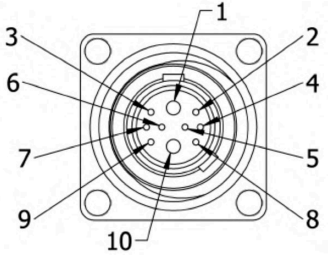| Pin No.	USB	RS-232	RS-485	Ethernet
1	Ground			
2	Power 4.5V to 30V			
3	N/C	Data output from the instrument (Tx)	TD (A)-	Data output from the instrument (Tx-)
4	VUSB +5V	Data input into the instrument (Rx)	RD (B)+	Data input into the instrument (Rx+)
5	D-	N/C	RD (A)-	Data input into the instrument (Rx-)
6	D+	N/C	TD (B)+	Data output from the instrument (Tx+)

External MINK-10-FCR connector pinout

Pin No.	RS-232	RS-485	Ethernet
1	Power 4.5V to 30V		
2	N/C	RD(A)	Data output from the instrument (Tx+)
3	N/C	N/C	Data input into the instrument (Rx+)
4	Data output from the instrument (Tx)	RD(B)+	Data output from the instrument (Tx-)
5	Ground		
6	Data input into the instrument (Rx)	TD(B)+	N/C
7	N/C	N/C	Data input into the instrument (Rx-)
8	N/C		
9	N/C	TD(A)-	N/C
10	Ground		

3 Hardware

3.1 Opening and closing the instrument

> ⚠ 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 with a standard end-cap
1. Twist the battery end-cap counterclockwise.
2. Once fully unscrewed, pull the end-cap away from the housing.

Closing the instrument with a standard end-cap
1. Place the end-cap back on the instrument.
2. Twist the end-cap clockwise until aligned with **PAUSE**.

Open instrument with a standard end-cap

Opening the instrument with a connectorised end-cap
1. Twist the battery end-cap counterclockwise.
2. Once fully unscrewed, pull the end-cap away from the housing.
3. For instruments with connectorised end-caps, unplug the umbilical cable.

Closing the instrument with a connectorised end-cap
1. Plug the mini-display port connector into the instrument as shown.
2. Twist the end-cap counterclockwise two full rotations to unwind the umbilical cable.
3. Place the end-cap back on the instrument.
4. Twist the end-cap clockwise until aligned with **PAUSE**.

Open instrument with a connectorised end-cap

3.2 RBR*quartz³* BPR interface

The RBR*quartz³* BPR instrument provides an internal USB-C port and several external communication options. Select from USB, RS-232, RS-485, and Ethernet at the time of order, and RBR will wire the battery end-cap to support your preferred external connection.

> ⓘ Patch cables and underwater extension cables are sold separately.

> ⓘ Refer to Opening and closing the instrument for details on accessing connection ports.
> Refer to Specifications for the external MCBH-6-MP and MINK-10-FCR connector pinout diagrams.
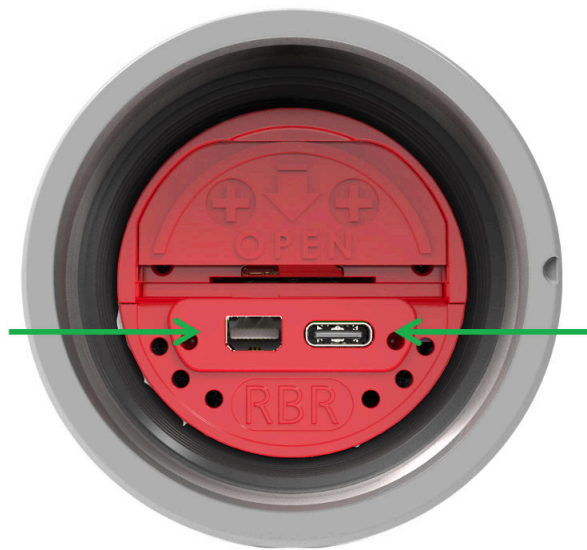
Left: Mini-display port, right: USB-C port

USB-C connection

Remove the battery end-cap to access the USB-C port located inside the instrument body.

A USB-C desktop cable is supplied in the instrument support kit. Use this cable to download data from the instrument to your computer.

Mini-display port

The mini-display port is located next to the USB-C port. This is the port to use for the umbilical cable from the connectorised end-cap.

End-cap types

RBR standard loggers are compatible with three different end-caps. These end-caps are interchangeable between instruments.

Standard end-cap

Connectorised end-cap

Right-angle connectorised end-cap

MCBH connectors

Only connectorised battery end-caps have the external MCBH-6-MP connector. Depending on your needs, they may be wired to support the USB, RS-232, or RS-485 communication (selected at the time of order).

ⓘ Patch cables and underwater extension cables are sold separately.

3.3 Orientation and datum location

The datum of the RBR*quartz³* BPR is located at the centre of the pressure sensor port. RBR performs an offset adjustment with the sensor facing downwards, as shown in the first image. It is recommended to deploy the instrument vertically to match the way it was calibrated. It is acceptable to deploy horizontally if necessary.

> ⚠ Avoid deploying the instrument vertically with the sensor facing up! Such orientation will affect performance of the pressure sensor due to increased build-up of sediment.

Recommended orientation:

sensors facing down
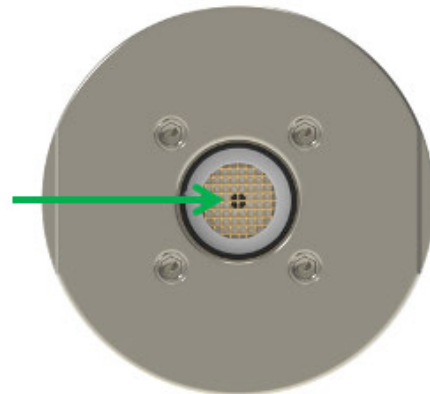
Datum location

3.4 Twist activation

Twist activation allows you to start or pause the instrument without the need to connect to a computer. All RBR Generation[3] standard instruments are equipped with twist activation as a standard feature. See Ruskin User Guide: Standard Loggers[3].

When you select "Twist activation" in Ruskin, the instrument starts to sample based on the twist on/off position rather than a schedule. To start sampling, first click "Enable" in Ruskin to enable logging. The status will then become "Paused". Turn the battery end-cap to the **RUN** position. The instrument will vibrate with one long pulse and start sampling. To pause it, turn the battery end-cap to the **PAUSE** position. The instrument will vibrate with three short pulses to indicate it has stopped logging.
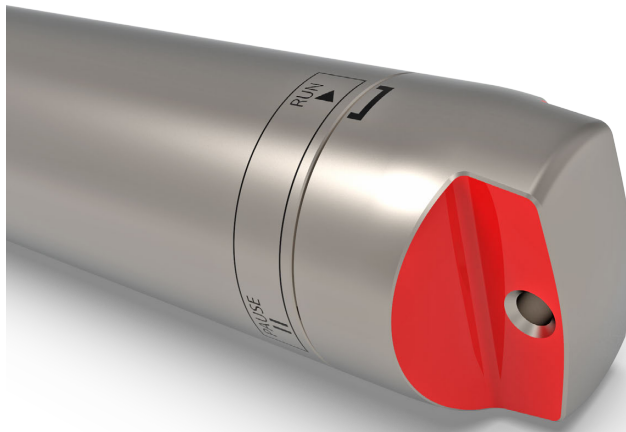
Twist activation mode: RUN
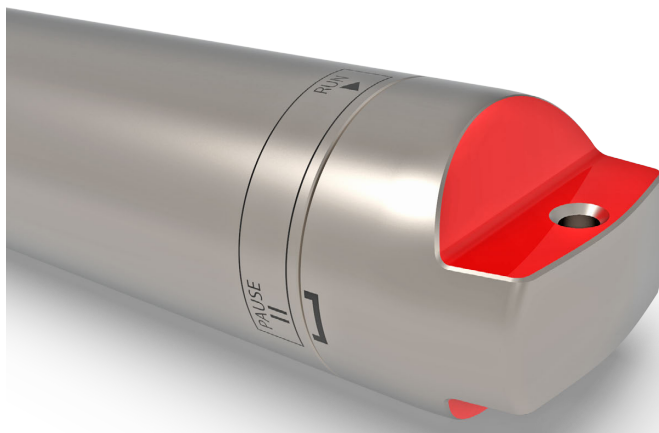
Twist activation mode: PAUSE

4 General maintenance

4.1 Support kit

RBR support kit

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

The RBR support kit contains an assortment of basic accessories and spare parts, as presented below.

RBR*quartz*³ support kit diagram
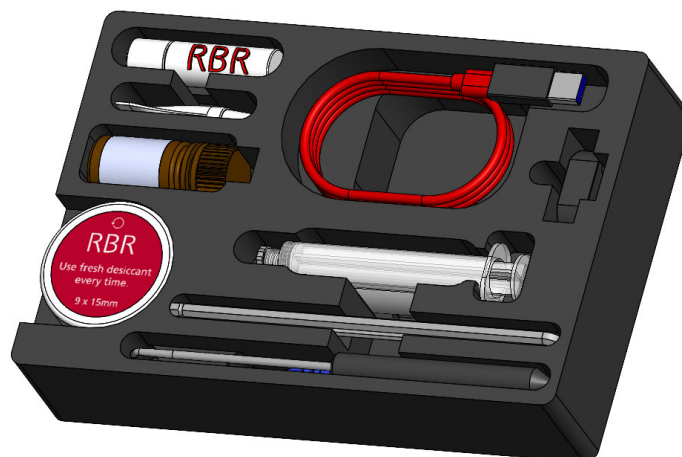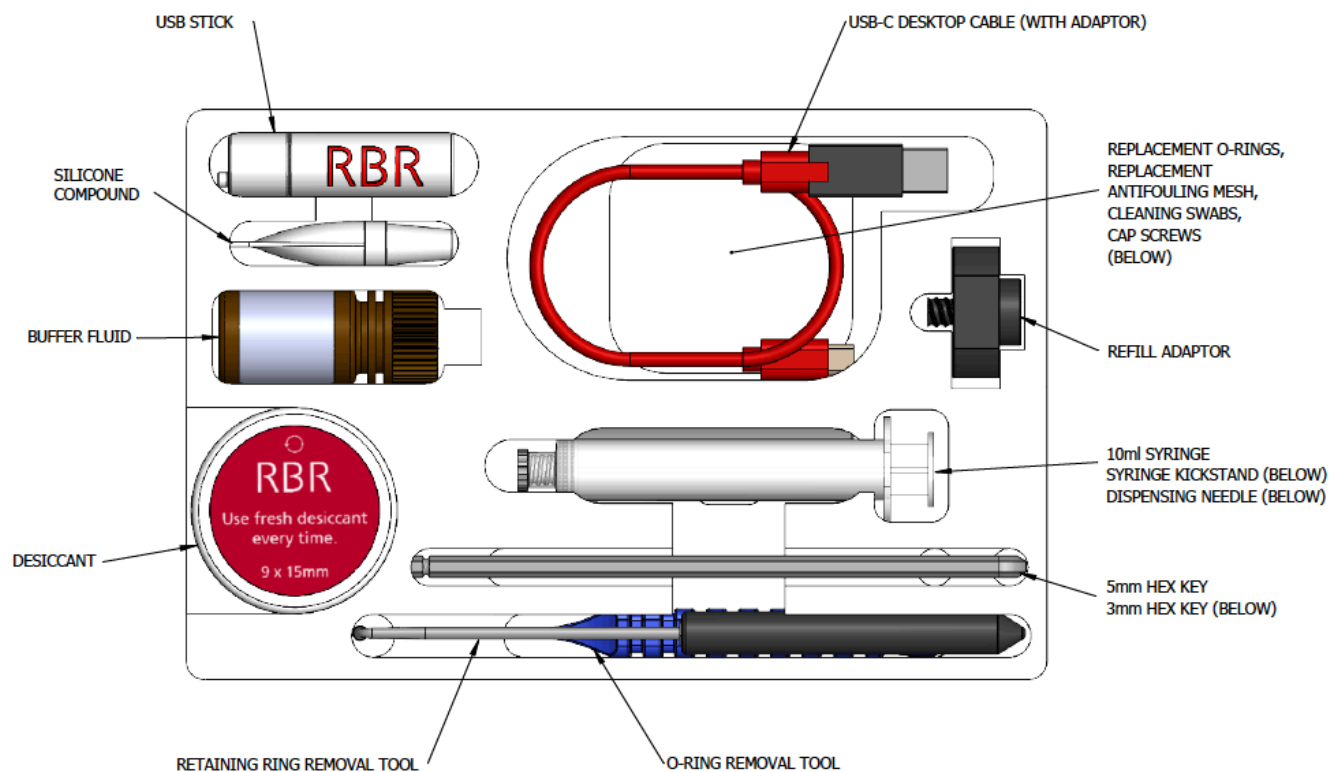
4.2 Replacing the O-rings

> ⓘ Refer to Opening and closing the instrument for details on accessing the O-rings.
> The O-ring removal tool and silicone compound are available in the support kit.

Care for the O-rings is the single most important item of maintenance on any submersible RBR instrument. A water leak can damage the circuit board beyond repair and cause complete data loss. Every instrument's seal depends upon its O-rings, not the end-cap tightness. Therefore, proper O-ring maintenance is crucial.

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

O-rings on the BR*quartz*³ BPR

The BR*quartz*³ BPR 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. To access the O-rings, open the instrument.

Main O-ring   **Backup O-ring)**
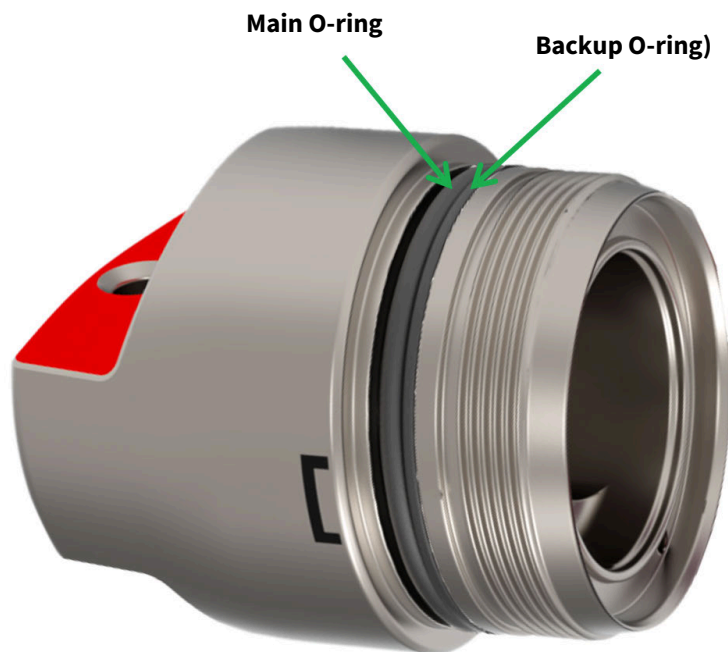
Location of the O-rings

Inspecting the O-rings

Visually inspect each new O-ring for nicks and scratches before installing it. Pay attention to the following areas:

- The surface of the O-ring itself
- 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.

Main O-ring   Backup O-ring)

Orientation of the O-rings
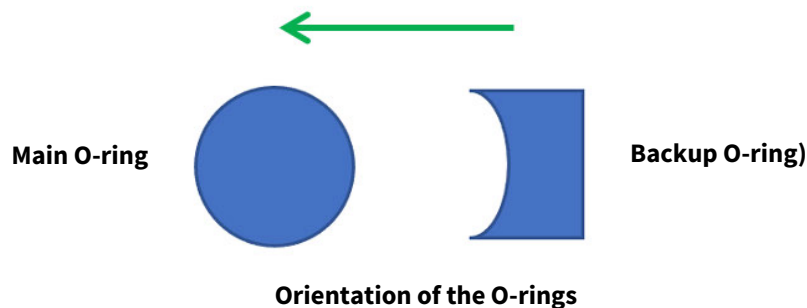
> 🛑 Do not use metal screwdrivers or any other metal tool! They may scratch the O-ring groove and render the end-cap useless.

1. Use the plastic O-ring removal tool (included in the support kit) to remove the old O-ring from its groove. The O-ring may need to stretch quite a bit as it is pushed off. This requires some effort, but can be done by hand.
2. Clean the groove thoroughly with a soft, lint-free cloth and compressed air, if necessary.
3. Select a new O-ring and inspect it for damage.
4. Lubricate with a very light film of silicone compound (included in the support kit).
5. Install the main O-ring by pushing it into place and popping it into its groove.
6. Install the backup O-ring, making sure the concave side is facing 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 end-cap.
8. Close the instrument.

4.3 Replacing the batteries

RBR ships new instruments with lithium thionyl chloride batteries included. Replace the batteries before each deployment to maximise the operational time and prevent data loss.

Ruskin software allows users to estimate the remaining battery life during deployment (assuming fresh batteries) by tracking power consumption in mAh. See Ruskin User Guide: Standard Loggers[3] for more information on predicting battery life.

RBR*quartz*[3] BPR with batteries removed

Replacing the batteries

1. Remove the battery end-cap.
2. Using both thumbs, press down on the "+" symbols on the battery cover and slide in the direction of the arrow.
3. Remove the eight old batteries from the battery carriage.
4. Insert eight new batteries.
5. Check for correct battery polarity.
6. Put the end-cap back on the logger and twist clockwise until aligned with **PAUSE**.

4.4 Replacing the desiccant capsules

Replace desiccant capsules 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 desiccant capsules
1. Remove the battery end-cap.
2. Remove the used desiccant capsules from their sockets.
3. Insert fresh desiccant capsules into their sockets, face out.
4. Once all the capsules are secured, place the battery end-cap back in its place.
5. Put the end-cap back on the logger and twist clockwise until aligned with **PAUSE**.

Location of the desiccant capsules   **Direction of insertion**

4.5 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
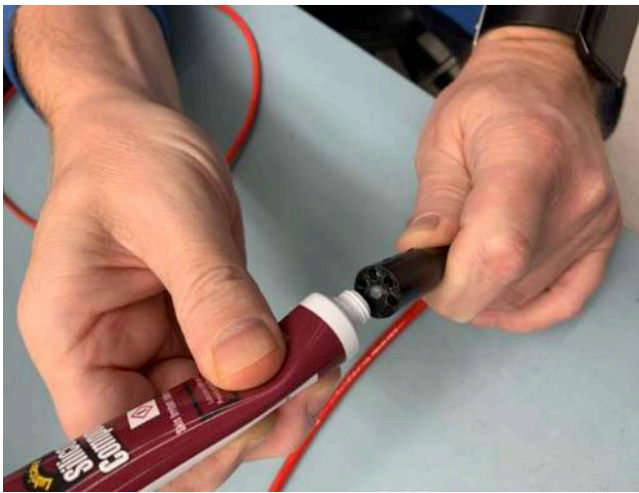
Lubricating a connector

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

4.6 Cleaning the instrument

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

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).
Sensor antifouling mesh	Scrub the antifouling mesh with a soft brush. Replace the antifouling mesh if needed.	See instructions on removing the antifouling mesh for more information.
Calcification	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.

4.7 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. 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 re-calibrated.
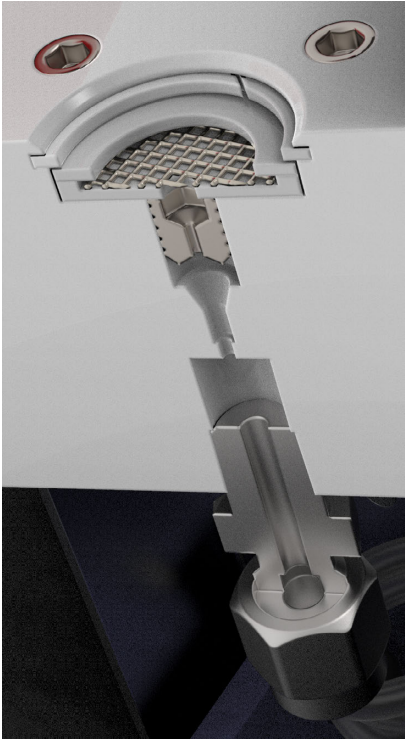
Please contact RBR for our current calibration fees.

5 Pressure sensor maintenance

5.1 Removing the antifouling mesh assembly

Removing the antifouling mesh assembly may be necessary for a variety of reasons, such as cleaning the instrument and its buffer tube, or installing the external pressure adaptor. Follow the steps below.

1. Remove the retaining ring using the removal tool. Hook the split in the ring at the opening and pull it out of the recess in the sensor end-cap.
2. The upper mesh insulator disk, nickel-copper mesh, and the lower mesh insulator disk will come out easily once the retaining ring is removed.

Item No.	Description	Part image	Assembled antifouling mesh	Buffer tube interface assembly
1	Lower mesh insulator disk			
2	Nickel-copper mesh			
3	Upper mesh insulator disk			
4	Retaining ring			

> ⓘ Replacement parts are available in the support kit.

5.2 Filling the syringe and de-gassing the buffer oil

ⓘ All required materials for this procedure are provided in the support kit.

It is important to remove all gases from the system as they can form bubbles and cause anomalies in the data. Refill the system with de-gassed oil any time when cleaning it, or if it has had an oil leak for any reason.

Required materials
- Buffer fluid
- Syringe with a stopper and needle
- Syringe kickstand

Recommended handling materials
- Latex or nitrile gloves
- Lint-free tissues
- Protective coat

⚠ Buffer oil is not a hazardous substance, but it is recommended to practice good industrial hygiene and safety practices, and to use this material in a well-ventilated space.

Filling the syringe

Step	Description
1	Remove the stopper from the syringe.
2	Install the needle.
3	Draw 1-2ml of the oil into the syringe.

De-gassing the buffer oil

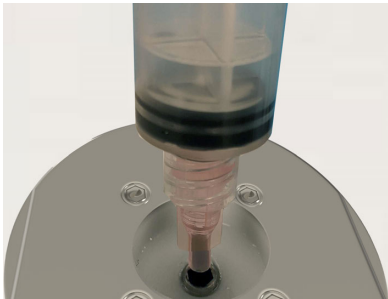| Step	Description	Image
1	Invert the syringe so that the needle is facing up and pull any remaining oil out of the needle into the syringe.	
2	Remove the needle.	
3	Gently push the plunger to purge the air from the syringe.	
4	Install the stopper.	
5	Reverse the syringe so that the stopper is facing down.	
6	Draw out the plunger of the syringe past the 10ml point.	
7	Install the syringe kickstand so that it cups the plunger and supports it in the drawn-out position. The syringe will brace against the flange on the plunger and the barrel.	
8	Leave the syringe in the reverse position for about an hour.	
9	Remove the kickstand.	
10	Invert the syringe so that the tip is facing up.	
11	Remove the stopper.	
12	Purge any air from the syringe	

5.3 Cleaning the buffer tube

ⓘ All required materials for this procedure are provided in the support kit.

Required materials

- Buffer fluid
- Syringe with a stopper and needle
- Syringe kickstand

Cleaning the buffer tube by aspirating the buffer oil

Step	Description	Images
1	Remove the antifouling mesh assembly	
2	Clean the buffer tube assembly 1. Insert the needle into the buffer tube assembly, all the way 2. Draw out the plunger of the syringe past the 10ml point 3. Install the syringe kickstand so that it cups the plunger and supports it in the drawn-out position; the syringe will brace against the flange on the plunger and the barrel ⚠ The syringe will draw up oil and any particles until the assembly is empty, and then, it will draw air.	
3	Refill the buffer tube assembly	

Cleaning the buffer tube by purging with buffer oil

Debris can be removed from the buffer tube assembly by purging the assembly with buffer oil. This method will consume more oil, but it may be more effective in some situations.

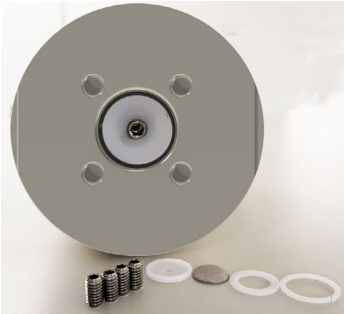| Step	Description
1	Prepare the instrument and the syringe 1. Remove the antifouling mesh assembly 2. Remove the instrument from the foam stand and lay it on its side 3. Fill the syringe and de-gas the buffer oil
2	Clean the buffer tube assembly 1. Insert the needle into the buffer tube assembly, all the way 2. Depress the plunger and flush the buffer tube assembly 3. With the syringe still in the pressure port, stand the instrument with the port up 4. While depressing the plunger, remove the syringe
3	Refill the buffer tube assembly

5.4 Refilling the buffer oil

ⓘ All required materials for this procedure are provided in the support kit.

Required materials

- 3mm and 5mm hex keys
- O-ring
- Silicone compound
- Buffer fluid
- Syringe with a stopper and needle
- Syringe kickstand
- Refill adaptor
- Four socket head cap screws

Refilling the buffer oil

Step	Description	Images
1	Prepare the instrument 1. Remove the antifouling mesh assembly (see Removing the antifouling mesh assembly) 2. Remove the four set screws around the pressure port using the 3mm hex key	
2	Prepare the refill adaptor 1. Apply a thin film of silicone compound to the O-ring of the refill adaptor 2. Install the O-ring into the refill adaptor as shown in the image	

Step	Description	Images
3	Fill the buffer tube with oil 1. Remove the stopper from the syringe 2. Install the needle 3. Invert the syringe so that the needle is point up 4. Purge the air from the needle by depressing the plunger until a drop of oil comes out 5. Insert the needle into the buffer tube assembly and fill it with oil to the top of the set screw 6. When extracting the needle, continue to apply pressure to the plunger to maintain the oil level 7. Draw the oil out of the needle and remove the needle	
4	Refilling the oil 1. Install the refill adaptor to the syringe 2. Invert the syringe so that the refill adaptor is pointing up 3. Purge the air from the refill adaptor by depressing the plunger until a drop of oil sits at the adaptor opening ⚠ Ideally, the meniscus at the air-oil interface should be convex to minimise the air in the final assembly.	
5	Install the refill adaptor 1. Mate the refill adaptor to the pressure port 2. Install the four cap screws with the 5mm hex key ❗ Do not apply pressure to the plunger when the syringe is installed on the pressure port! Doing so may exceed the pressure rating of the sensor.	

Step	Description	Images
6	De-gas the system 1. Draw the plunger of the syringe just past the 10ml mark 2. Install the syringe kickstand so that it cups the plunger and supports it in the drawn-out position; the syringe will brace against the flange on the plunger and the barrel ⚠ Bubbles will be coming out of the system through the oil into the syringe, drawn into the rarefied air. The rate of bubbles coming out should quickly start to reduce. If it is not happening, tighten the syringe to the refill adaptor and tighten the four cap screws. 3. Leave the syringe in this position for about an hour 4. Remove the kickstand, while keeping the syringe in place ⚠ The plunger will drop back, almost to the surface of the oil, due to low pressure inside the syringe. 5. With everything still attached, draw the plunger of the syringe just past the 10ml mark again 6. Very gently pump the plunger up and down approximately 10 times, until no bubbles come out of the system after drawing the plunger .	
7	Clean up and reassemble 1. Remove the refill adaptor 2. Remove excess oil from the pressure port with a tissue or swab 3. Once cleaned, install the lower mesh insulator disk with the recess facing up 4. Place the nickel-copper mesh in the recess of the lower mesh insulator disk 5. Place the upper lower mesh insulator disk on top of the lower mesh insulator disk and nickel-copper mesh assembly 6. Open the split on the retaining ring and ease its middle into the sensor end-cap recession 7. Hold the retaining ring in place with one finger and feed the the rest of the ring into the sensor end-cap recession	

6 External pressure adaptor

The external pressure adaptor is designed for the RBR*quartz³* instruments and can be used to verify or recalibrate the Paroscientific Digiquartz® pressure sensor.

RBR provides the RBR*quartz³* pressure adaptor kit with each instrument. It is not included in the RBR support kit and needs to be ordered separately. You can choose to receive this separate kit at the same time as the instrument, or to request it separately at a later date.
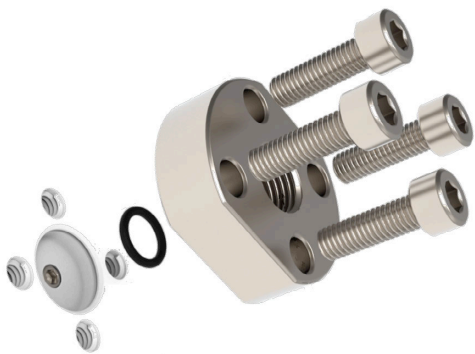
RBR*quartz³* pressure adaptor kit includes:

- pressure adaptor
- four socket head cap screws
- 3mm and 5m hex keys
- five replacement O-rings

Pressure adaptor kit

Installing the adaptor

Step	Description	Image
1	Remove the antifouling mesh.	
2	Apply a thin layer of silicon compound to the O-ring.	
3	Install the O-ring into the O-ring groove of the external pressure adaptor.	
4	Position the external pressure adaptor over the exposed pressure port of the instrument.	
5	Install the four screws with a 5mm hex key and tighten them to 1/4 turn past snug (max 10 Nm torque).	

ⓘ Refer to Removing the antifouling mesh assembly for required materials and steps.
Refer to Replacing the O-rings for additional instructions.

7 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.

8 Revision history

Revision No.	Release date	Notes
A	31-March-2022	Original

CE