# RBR CT|uv and CTD|uv INSTRUMENTS


RBRconcerto3

RBRduo3

# INSTRUMENT GUIDE

rbr-global.com

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# 1 RBR*duo*³ C.T | uv and RBR*concerto*³ C.T.D | uv

> This guide focuses on CT and CTD instruments with active antifouling.
> For information on other sensors and instruments, refer to the RBR Instrument Guide: Standard Instruments³.

RBR offers two standard instruments with active antifouling:

- RBR*duo*³ C.T | uv - conductivity and temperature
- RBR*concerto*³ C.T.D | uv - conductivity, temperature, and pressure

> The RBR*duo*³ C.T | uv and RBR*concerto*³ C.T.D | uv use UV LEDs (ultraviolet light emitting diodes) and should be handled with care.
> Wear approved safety glasses with side protection and UV filter lenses.
> Avoid looking at the LEDs. See Safety precautions.


**RBR*concerto*³ C.T.D | uv**

The RBR*duo*³ C.T | uv and RBR*concerto*³ C.T.D | uv offer the same features as their CT and CTD counterparts, plus active antifouling. They are uniquely designed to determine salinity by measuring the conductivity and temperature of water. Their rugged inductive cell is not affected by surface contaminants or freezing conditions.

Equipped with a piezoresistive pressure channel, the RBR*concerto*³ C.T.D | uv provides more accurate salinity data when the instrument is sampling at varying depths.

The active antifouling system helps maintain high accuracy of measurements during extended deployments in the photic zone. It uses an array of active UV LEDs to illuminate critical sensor surfaces and reduce biofouling on the conductivity cell. The RBR*duo*[3] C.T | uv and RBR*concerto*[3] C.T.D | uv are perfect for moored applications, such as on surface buoys, seafloor observatories, and cabled realtime monitoring systems, and are recommended for operation depths less than 200m.

**Four UV LEDs illuminating the CT cell**

All RBR standard instruments support the following features :

- High accuracy
- Extended deployments
- Large memory
- Flexible schedules
- Twist activation
- USB-C download
- Realtime communication
- Wi-Fi

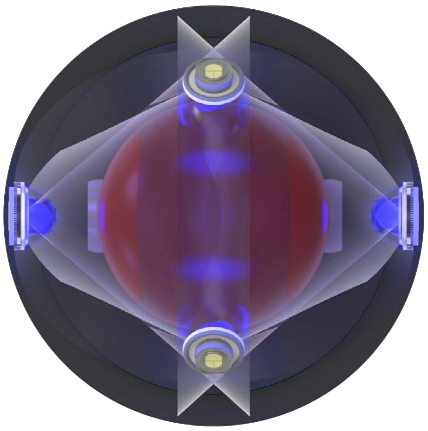
The RBR*duo*[3] C.T | uv and RBR*concerto*[3] C.T.D | uv instruments are equipped with connectorized end-caps designed to connect to external battery canisters or cabled power. Backup internal batteries ensure uninterrupted sampling through sporadic power disruptions. Stream your realtime data through RS-232/485, or download a complete dataset at the end of your deployment using USB-C. A dedicated holder makes it simple to replace desiccant before each deployment. The calibration coefficients are stored on the instrument, and only one software tool, Ruskin, is required to operate it. Datasets can be read directly in Matlab, or exported to Excel, OceanDataView®, or text files. The instruments come with a Wi-Fi module and twist activation.

For a detailed description of using the Ruskin software, see Ruskin User Guide: Standard Instruments[3].

# 2 Antifouling

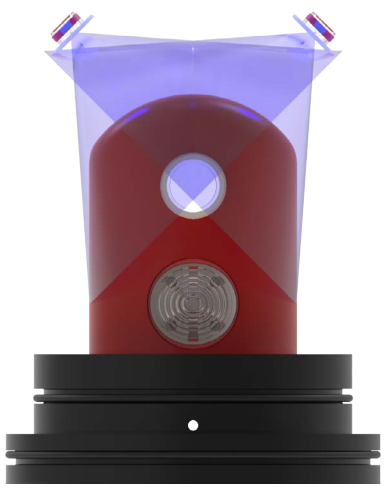
The RBR*duo*[3] C.T | uv and RBR*concerto*[3] C.T.D | uv ship with the UV schedule disabled. See Ruskin User Guide: Standard Instruments[3] for details on configuring the antifouling cycle.

The RBR*duo*[3] C.T | uv and RBR*concerto*[3] C.T.D | uv use ultraviolet radiation to reduce biofouling of the conductivity cell and thus improve accuracy of measurements during long-term deployments in epipelagic environment. Four UV LEDs installed on the inside of the guard illuminate critical sensor surfaces at one-minute intervals, slowing any biological growth.

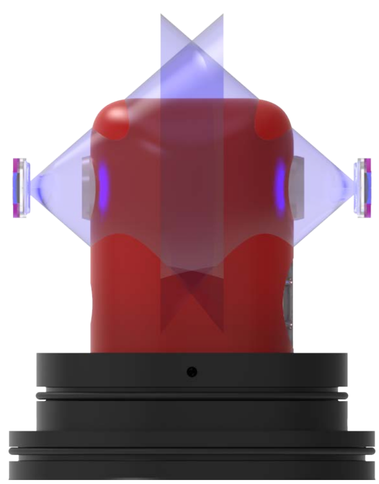


**Four UV LEDs illuminating the CT cell**

When active, the two upper UV LEDs emit ultraviolet radiation at the top sensor surfaces, while the two UV LEDs located on the spine of the guard illuminate the white ceramic tube inside of the CT cell where the bulk of the conductivity measurements occurs. As a result, the instruments with the active antifouling show a considerably lower salinity drift, compared with no-UV units.



**Upper UV LEDs**



**UV LEDs located on the spine**

The UV LEDs will activate immediately after you enable the deployment. See Safety precautions.

# 3 Physical specifications

**Instrument**

| Specification | Description |
|---|---|
| Max number of readings | 240 million |
| Power | 8 AA-type cells (alkaline or lithium iron)* |
| External power | 4.5 to 30V |
| Communications | Internal: USB-C<br>External: USB and RS-232 / RS-485 |
| Clock drift | ±60 seconds/year |
| Housing | Plastic |
| Diameter | 63.3mm housing, 100mm guard |
| Length | 470mm |
| Weight | ~1.7kg in air, ~0.25kg in water |
| Depth rating | Up to 200m |
| Sampling rate | 1min or 30s |

* Internal batteries are used only as a backup during power interruptions. See Ruskin User Guide: Standard Instruments[3] for suitable battery chemistries.

RBR recommends using an external power supply with the RBR*duo*³ C.T | uv and RBR*concerto*³ C.T.D | uv. Instruments with active antifouling tend to consume more power than a regular RBR*duo*³ or RBR*concerto*³ and thus will quickly drain the batteries if the instrument is not connected to an external power source.

**Antifouling**

| Parameter | Value |
|---|---|
| Illumination type | UV-C light (275nm) |
| Peak power consumption | 3.0W (250mA at 12V), low power level<br>3.6W (300mA at 12V), standard power level |
| Average power consumption | 260mW (22mA at 12V), low power level<br>750mW (63mA at 12V), standard power level |
| UV interval | 60s |
| Duty cycle | 25% (15s) |


**RBR *concerto*³ C.T.D | uv**

#### 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.

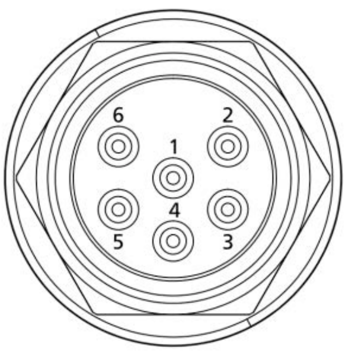
#### Clock

The instrument clock is maintained during brief disconnections. This time is usually sufficient to change batteries. If the clock is lost, the time will revert to January 2000. In this case, check the power supply and 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.

#### External MCBH-6-MP connector pinout




| Pin No. | USB | RS-232 | RS-485 |
|---|---|---|---|
| 1 | Ground | | |
| 2 | Power +4.5 to +30V | | |
| 3 | N/C | From the instrument (Tx) | From the instrument (Tx-) |
| 4 | +5V | Into the instrument (Rx) | Into the instrument (Rx+) |
| 5 | D- | N/C | Into the instrument (Rx-) |
| 6 | D+ | N/C | From the instrument (Tx+) |

ⓘ For deployment estimates specific for your instrument configuration and sampling options:

- Go to Ruskin and click the "Instruments" tab
- Select "Simulate an instrument...", find your logger under "Standard instruments", and click "OK"
- Adjust variable parameters under "Configuration" to match your needs
- Ruskin autonomy engine will calculate the **End** date and indicate when your deployment is likely to stop

Note that RBR instruments with the antifouling system typically rely on the external power supply during deployments, so the only gating condition will be the memory.

# 4 Sensor specifications

The RBR*duo*[3] C.T | uv instruments use conductivity and temperature sensors.

The RBR*concerto*[3] C.T.D | uv instruments use conductivity, temperature, and pressure sensors.

## 4.1 Conductivity (C)

RBR CT | uv and CTD | uv instruments use integrated inductive conductivity sensors which measure the ability of seawater to conduct electric current.

| Parameter | Value |
|---|---|
| Range | 0 to 85mS/cm |
| Initial accuracy | ±0.003mS/cm |
| Resolution | <0.0001mS/cm |
| Typical stability* | ±0.010mS/cm/year |
| Max depth rating | 200m |

* For a clean cell with no biofouling.


**CTD | uv cell, transparent view**

The CT cell is rugged and durable. It is not affected by surface contaminants or freezing conditions, and can be frozen into ice.

While 80% of its volumetric measurements happens inside the cell, they also extend up to 15cm away and thus may be affected by conductive and non-conductive objects within this distance. RBR calibrates conductivity sensors to account for static objects, such as cages, guards, and other sensors.

✔ To maintain optimal accuracy, deploy your instrument at least 15cm away from other objects.

Conductivity measurements are temperature compensated.

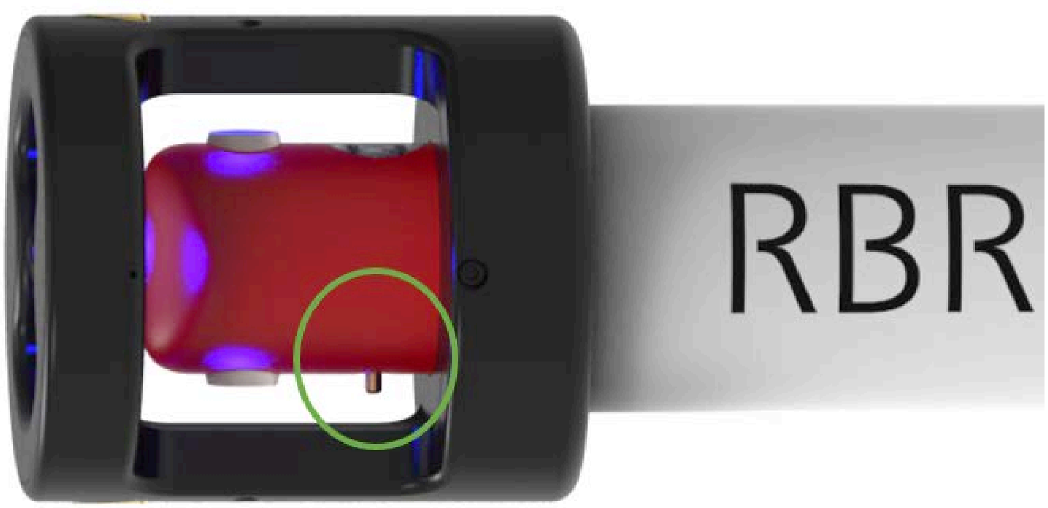
## 4.2 Temperature (T)

RBR CT and CTD instruments use the thermistor-type temperature sensors.

While RBR thermistors are rated for depths up to 10km, the C.T | uv and C.T.D | uv instruments operate at depths up to 200m.

| 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 | <20s |

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



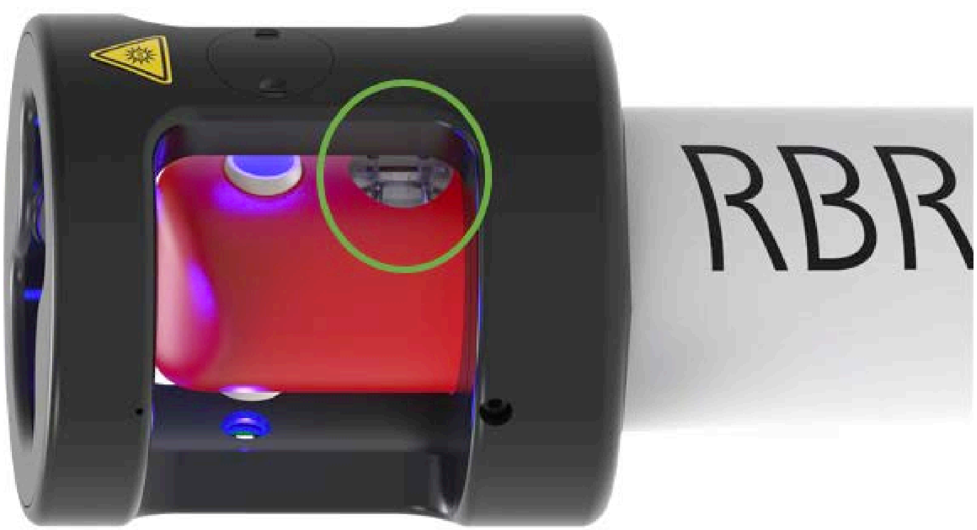

**CTD | uv cell, with thermistor circled**

## 4.3 Pressure (D)

RBR CTD | uv instruments use piezoresistive pressure (depth) sensors.

The sensor is protected by a clear plastic guard. During moored deployments with sediment in the environment, avoid orientations with the pressure sensor facing directly upwards.

| Parameter | Value |
|---|---|
| Range | 20 / 50 / 100 / 200dbar |
| Initial accuracy | ±0.05% full scale |
| Resolution | <0.001% full scale |
| Typical stability | ±0.05% full scale / year |
| Time constant | <10ms |




**CTD | uv cell, with pressure sensor circled**

# 5 Derived parameters

Calculate derive parameters using Ruskin software or on the RBR instrument itself, depending on how it is configured. Both routes use the same equations and produce identical results.

### Calculation on Ruskin

All derived parameters will be calculated on Ruskin:

- when the data storage format is set to **Desktop** and **Realtime** is set to **None**

As a result, the RSK file will only store raw data. This option enables post-processing on Ruskin, with the flexibility of changing the variables.

To obtain derived parameters, download the dataset to your laptop and open it on Ruskin, then input physical parameters into the **Parameters** tab. Furthermore, Ruskin has alternative derivation options for some parameters, which you can also select in the **Parameters** tab. See Ruskin User Guide: Standard Instruments[3] for details.

> ⚠ The **Desktop** storage format is a preferred option. Having the raw data keeps more options open in the long term.
> However, when you are managing your deployments using a smartphone, it is more efficient to derive parameters in realtime than post-process a large RSK file with raw data, due to limited capabilities of mobile devices.

### Calculation on the instrument

All derived parameters will be calculated on the instrument:

- when the data storage format is set to **Mobile**
  or
- when the data storage format is set to **Desktop** and **Realtime** is set to **Serial** or **USB**

As a result, the RSK file will store the data with calibration coefficients already applied and derived parameters already calculated.

CT measurements allow for deriving salinity, specific conductivity, speed of sound, and density anomaly.

CTD measurements allow for deriving salinity, specific conductivity, speed of sound, density anomaly, sea pressure, and depth.

## 5.1 Salinity

Salinity is defined as the ratio of the mass of dissolved material to the mass of seawater. It is impossible to measure absolute salinity directly. However, we can derive practical salinity from measurable properties: electrical conductivity, temperature, and pressure, obtained by your RBR*concerto*[3] C.T.D | uv. The units of measurement are **PSU** (dimensionless Practical Salinity Units).

RBR uses the algorithm recommended by PSS78, the world standard for practical salinity calculation. It enables calculation of practical salinity in a range 2 to 42PSU from conductivity S (mS/cm) measured at temperature T (ºC) and hydrostatic pressure p (dBar). Refer to Practical Salinity Scale of 1978 (PSS78) for more details.

The RBR*duo*[3] C.T | uv will calculate salinity if you enter depth in the table under the **Parameters** tab in Ruskin. See Ruskin User Guide: Standard Instruments[3].

⚠ If the PSS78 calculation generates an error, the instrument will report a salinity of 0. This might occur when, in air, the conductivity report a small negative value. This does not apply if one of the measured parameters is already flagged as an error.

## 5.2 Specific conductivity

Specific conductivity is a function of conductivity and temperature. This parameter is mostly applicable in studies of freshwater and brackish water. The units of measurement are **µS/cm** (microsiemens per centimetre).

RBR uses the algorithm described in Standard Methods for the Examination of Water and Wastewater by L.S. Clesceri et al, which yields specific conductivity normalised to 25°C.

$$Specific\ conductivity = \frac{0.001 \cdot conductivity}{1 + 0.0191(temperature - 25)}$$

where conductivity in mS/cm and temperature in °C are values measured by your RBR instrument, and 0.0191 is the default specific conductivity coefficient.

The specific conductivity coefficient is defined as the change in conductivity (in %) per 1°C. Its default value corresponds to an increase in conductivity of 1.91%. However, it depends on temperature and ionic composition of the water, ranging between 0.0175 and 0.0214 for natural lakes and rivers. You may be able to find the value specific to your body of water in literature or experimentally. In this case, adjust the specific conductivity coefficient manually in the table under the **Parameters** tab in Ruskin. See Ruskin User Guide: Standard Instruments[3].

This method enables calculation of specific conductivity in a range 0 to 6000µS/cm and is valid in the temperature range -2°C to +35°C.

## 5.3 Speed of sound

Speed of sound in seawater is a function of salinity, temperature and pressure. The units of measurement are **m/s** (metres per second).

It is not always possible to measure the speed of sound in seawater directly. However, we can derive it from measurable properties: electrical conductivity, temperature, and pressure, obtained by your RBR*concerto*[3] C.T.D | uv.

The RBR*duo*[3] C.T | uv will calculate the speed of sound if you enter depth in the table under the **Parameters** tab in Ruskin. See Ruskin User Guide: Standard Instruments[3].

We derive salinity first, via the PSS78 method, and then use it in the algorithm, often referred to as the UNESCO equation. See Speed of sound in seawater as a function of salinity, temperature, and pressure by G.S.K. Wong and S. Zhu for more details.

In the oceans, the speed of sound varies between 1450 and 1570m/s. It increases about 1.3m/s per each 1PSU increase in salinity, 4.5m/s per each 1°C increase in temperature, and 1.7m/s per each 1dbar increase in pressure.

## 5.4 Density anomaly

Density anomaly, or negative thermal expansion, is the paradoxical tendency of water to expand during cooling. This behaviour manifests in anomalous decrease in water density when the temperature drops below 4°C. The units of measurement are **kg/cm³** (kilograms per cubic centimetre).

It is not possible to measure the density anomaly directly. However, we can derive it from measurable properties: electrical conductivity, temperature, and pressure, obtained by your RBR*concerto*[3] C.T.D | uv. The RBR*duo*[3] C.T | uv will calculate density anomaly if you enter depth in the table under the **Parameters** tab in Ruskin. See Ruskin User Guide: Standard Instruments[3].

We derive salinity first, via the PSS78 method, and then use it in the algorithm, often referred to as the UNESCO equation of state:

$$Density\ anomaly = \left(\frac{1}{V(S,t,p)}\right) - 1000kg/m^3$$

where V (S, t, p) is specific volume of seawater derived from salinity, temperature and pressure and $1000kg/m^3$ is density of freshwater.

See UNESCO (1981), Tenth report of the joint panel on oceanographic tables and standards for details.

> ⚠ The UNESCO equation of state is applicable within these ranges: 2 < practical salinity < 42, −2°C< temperature < 35°C.
> If salinity values are lower than 2PSU (freshwater), density anomaly values will not be accurate.

## 5.5 Sea pressure

Sea pressure is the difference between the pressure measured underwater by your RBR*concerto*[3] C.T.D | uv 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: Standard Instruments[3]. If not entered, a default value of 10.1325dbar will be used.

## 5.6 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: Standard Instruments[3]. If not entered, default values of 10.1325dbar and 1.0281g/cm$^3$ will be used.

# 6 Hardware

## 6.1 Opening and closing the instrument

> ⚠ Remember to keep the O-ring clean and avoid scratching the O-ring mating surfaces. Carefully inspect the O-ring before deploying the instrument.

**Opening the instrument**

1. Twist the battery end-cap counterclockwise.
2. Once fully unscrewed, pull the end-cap away from the housing.
3. Unplug the umbilical cable.


**RBR*concerto*³ C.T.D | uv, open**

**Closing the instrument**

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. Twist the end-cap clockwise back on the instrument until aligned with **PAUSE**.

## 6.2 Instrument interface

The RBR standard instruments provide an internal USB-C port and, depending on the end-cap type, an external MCBH-6-MP connector.

> Refer to Opening and closing the instrument for details on accessing connection ports.
> Refer to Physical specifications for the external MCBH-6-MP connector pinout diagram.


### 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

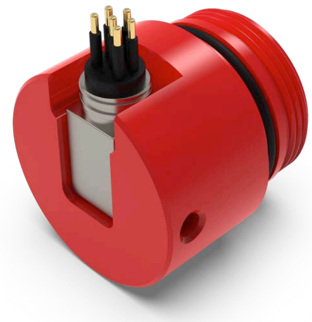
The mini-display port is located next to the USB-C port. This is the port to use for the umbilical cable from the connectorised end-cap.

**End-cap types**

RBR standard instruments 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).

**MCBH connector**

ⓘ Patch cables and underwater extension cables are sold separately. See RBR Cable Guide for details.

⚠ RBR recommends using only connectorised end-caps with the RBR*duo*³ C.T | uv and RBR*concerto*³ C.T.D | uv. Instruments with active antifouling tend to consume more power than a regular RBR*duo*³ or RBR*concerto*³ and thus will quickly drain the batteries if the instrument is not connected to an external power source.

## 6.3 Twist activation

All RBR Generation$^3$ standard instruments are equipped with twist activation as a standard feature. See Ruskin User Guide: Standard Instruments[3].

**Sampling**

Twist activation allows you to start or pause the instrument without the need to connect to a computer.

When you select "Twist activation" in Ruskin, the instrument starts to sample based on the twist **PAUSE**/**RUN** 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 paused logging.


**Twist activation mode**

**Left: PAUSE, right: RUN**

**Wi-Fi**

Twist activation allows you to connect to the instrument over the Wi-Fi when using a mobile device.

See Wi-Fi module for details.

## 6.4 Wi-Fi module

RBR instruments with the WI-FI READY icon on the end-cap are equipped with a Wi-Fi module. Contact RBR if you have any questions about this feature.


Use the Wi-Fi module on your instrument to download the realtime data and process them while still at sea. There is no need to open the instrument, and no need to be close to the shore as your instrument will be the router point.

When activated, the instrument will create its own SSID network which will appear under Wi-Fi networks on your device. Your device will switch to this network and connect to the instrument. If set to **Auto-download**, Ruskin will start downloading the data.

There are two ways to activate the Wi-Fi on RBR instruments: twist activation and pressure switch.

#### Twist activation

Activate the Wi-Fi by twisting the end-cap in either direction. The WI-Fi will stay on for 60 seconds, waiting for you to connect. The instrument needs to be close enough for you to reach it and turn it on.

> ⚠ The Wi-Fi is disabled after 60s of inactivity. Twist the end-cap to **RUN** or **PAUSE** to re-activate the Wi-Fi.

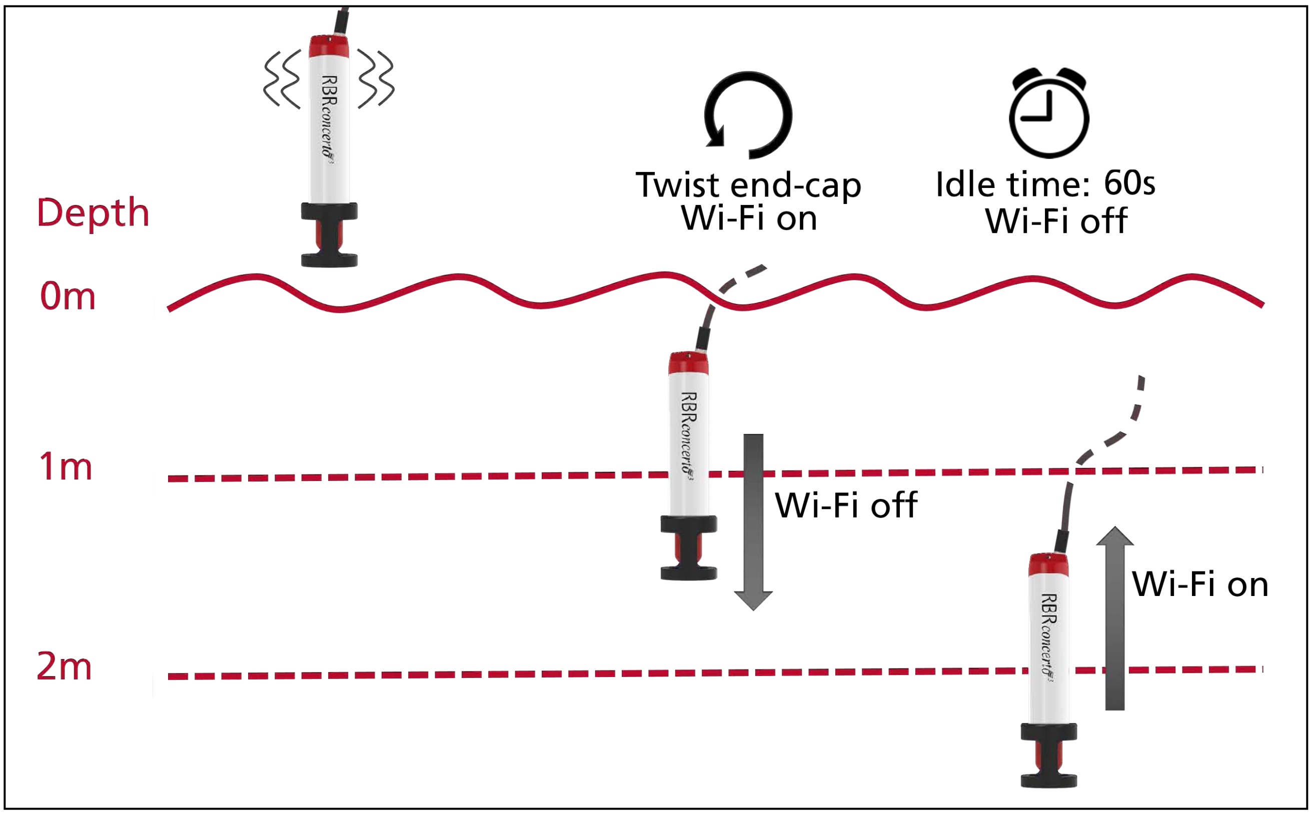
> ⚠ Twisting the end-cap to the **RUN** or **PAUSE** position will activate the Wi-Fi. However, twisting to the **PAUSE** position will also pause the instrument, as described above. Twist the end-cap back to **RUN** before continuing with deploying your instrument.

**Pressure switch**

When your instrument goes underwater, the Wi-Fi will go off at the depth of 1-2m because the signal cannot get through. However, even if the instrument stays on the surface, the Wi-Fi will go off after 60s of inactivity. Thus, there will be no connection to the instrument while it is in the downcast phase.

During the upcast, the instrument will detect the drop in pressure and automatically switch on the Wi-Fi at about 2m below the surface. The Wi-Fi will stay on for 60s. If your laptop is within reach during this time, Ruskin will reconnect to the instrument and start downloading the dataset.

⚠ This feature does not apply to shallow deployments (2m or less).




⚠ The nominal Wi-Fi range for instruments in plastic housing is 30m, but it may be shorter in real life due to challenging physical environments.

⚠ If the Wi-Fi connection is lost in the middle of the download, Ruskin will continue from where it left off next time it detects the instrument again, appending the original RSK file.

# 7 Maintenance

## 7.1 Safety precautions

The RBR*duo*$^3$ C.T | uv and RBR*concerto*$^3$ C.T.D | uv use UV LEDs (ultraviolet light emitting diodes) and should be handled with care. Ultraviolet radiation is invisible so it may not be obvious when the instrument is active. Exercise caution to avoid any associated health risks for the eyes.

The instruments ship with the UV schedule disabled, so it is safe to unpack them. However, going forwards, RBR recommends following protective measures at all times.

**Eye protection**

Use protective eyewear when handling the RBR*duo*$^3$ C.T | uv and RBR*concerto*$^3$ C.T.D | uv instruments. RBR recommends UV-blocking safety glasses of the highest available rating.

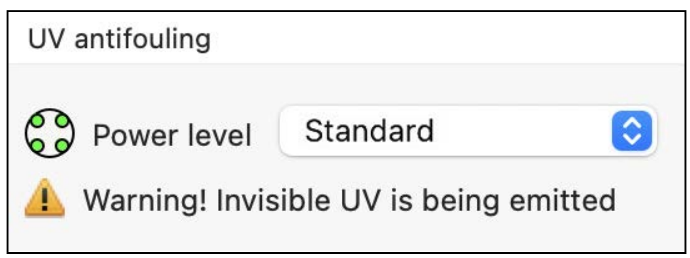
**Safe operation**

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

Whenever handling an active instrument, hold it with the guard facing down to avoid shining the light into the eyes.

> The instrument begins to emit ultraviolet radiation as soon as a deployment starts, whether it is by twist activation or when the start time is set to "Now".

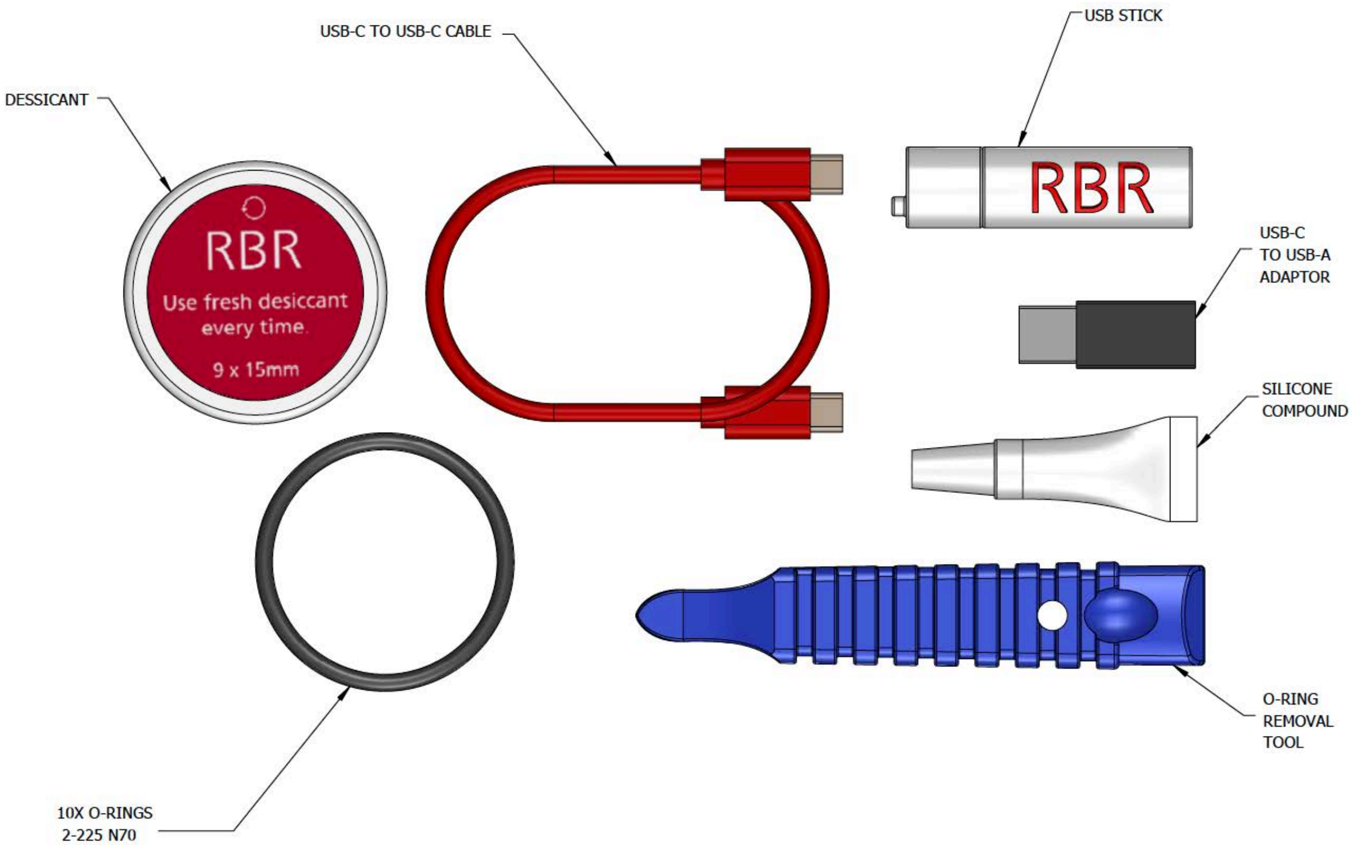
When the UV LEDs are active, Ruskin will display a warning and the red dots on the UV power icon will turn green. See Ruskin User Guide: Standard Instruments[3] for more information.

## 7.2 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.



## 7.3 Replacing the O-ring

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

Care for the O-ring 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-ring, 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.


**Location of the O-ring**

To access the O-ring, open the instrument.

**Inspecting the O-ring**

Visually inspect the 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-ring**

> 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 new O-ring by pushing it into place and popping it into its groove.
6. Once in place, inspect it once more for scratches and debris, and wipe away any silicone compound deposited on the end-cap.
7. Close the instrument.

## 7.4 Replacing the batteries

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

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

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

See Ruskin User Guide: Standard Instruments[3] for more information on predicting battery life.

**RBR standard instrument 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 instrument and twist clockwise until aligned with **PAUSE**.

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

## 7.5 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 instrument and twist clockwise until aligned with **PAUSE**.

**Location of the desiccant capsules**


**Direction of insertion**

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


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

### Refreshing the desiccant

Follow the steps below to refresh the desiccant.

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

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

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

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

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

## 7.6 Cables and connectors

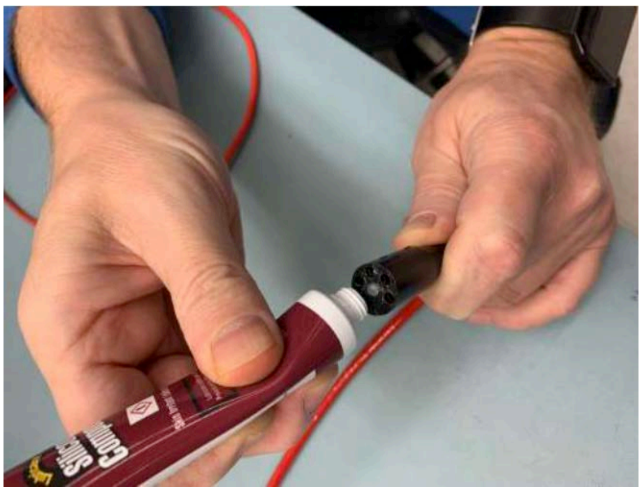
**Cable bend radius**

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

## 7.7 Cleaning the instrument

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

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

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

#### Cleaning the pressure sensor

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

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

#### Cleaning the CT cell

> Typically, the white ceramic tube inside the CT cell does not need cleaning because the UV radiation protects it from biofouling. If some cleaning is still required, use a very thin cloth. Feed it throw the tube and floss back and forth.

1. Feed the cloth through the guard and remove the biofouling from all surfaces.
2. Rinse the area under running water.
3. If unsuccessful, contact RBR.

#### Cleaning the housing

Scrub the surface using a soft brush.

## 7.8 Calibrating the instrument

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

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

Calibration certificates are available for download:

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

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

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

Please contact RBR for our current calibration fees.

## 7.9 Repair

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-October-2023 | Original |
| B | 15-July-2024 | Updated the Physical specifications section for new power specifications and new images.<br>Updated the Sensor specifications sections for conductivity specifications (resolution) and new images.<br>Added a warning against using the ultrasonic bath to the Cleaning section. |
| C | 30-November-2024 | Updated the Wi-Fi module section for free Wi-Fi availability.<br>Updated the Calibration section for downloading instructions. |