

# RUSKIN USER GUIDE

RBR*solo* $\sigma^3$

RBR*duet* $\hat{\tau}^3$



[rbr-global.com](http://rbr-global.com)

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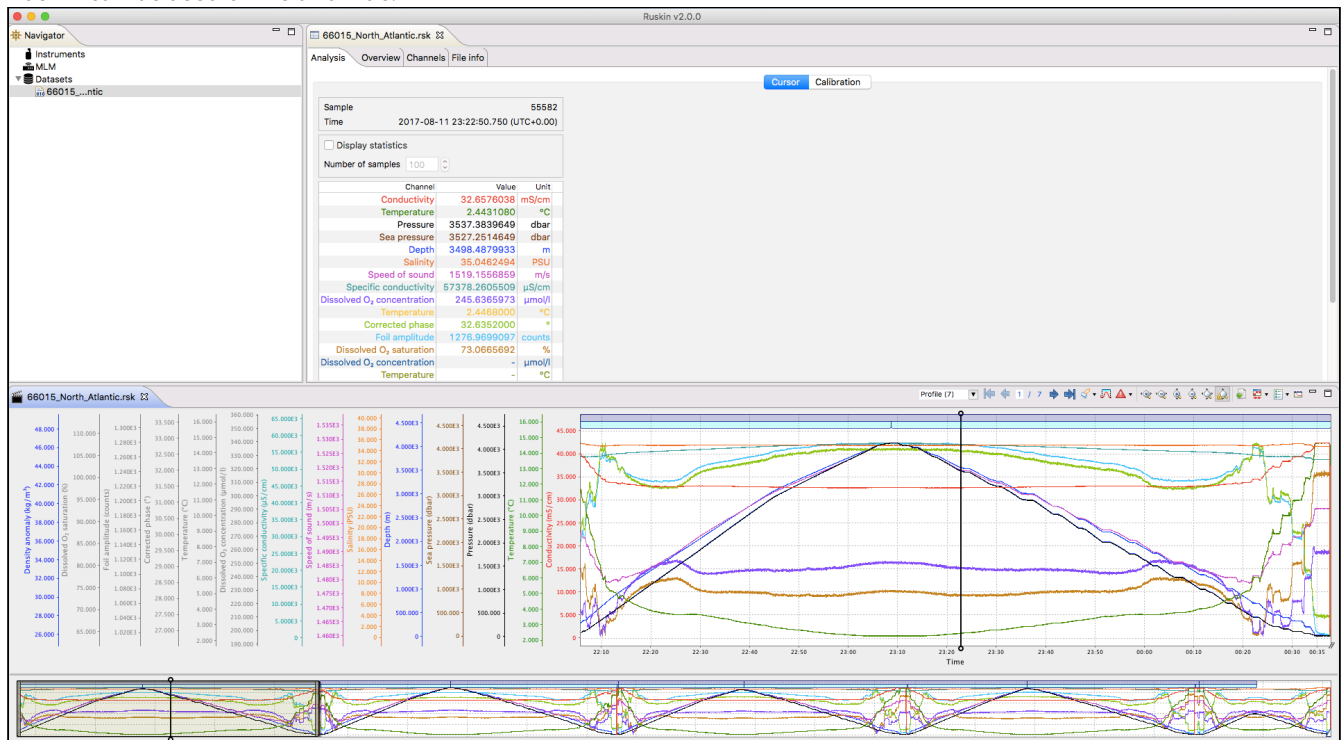
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## 2 Ruskin

Ruskin is the RBR software that manages your RBR loggers to provide all the data necessary to do your work. Ruskin provides a graphical user interface that makes using the loggers easy. You can use Ruskin to do the following:

- configure, schedule and enable multiple loggers
- download data after logging
- graphically view data sets
- export data in various formats
- change the calibration coefficients for your logger

Ruskin can be used on PC and Mac.



### 3 Revision history

Revision No.	Release Date	Notes
A	12-Feb-2018	First release

CE

## 4 Warranty statement

**All data loggers manufactured by RBR Ltd. are warranted against defects in workmanship or original parts and materials for one year.** Third party sensors (not manufactured by RBR) are limited to the warranty provided by the original manufacturer.

Units suffering from such defects will be repaired or replaced at the discretion of RBR Ltd., provided that the problem has appeared during normal use of the instrument for the purpose intended by us. The liability of RBR Ltd. extends only to the replacement cost of the instrument. The customer will bear all costs of shipment to us for repair; all other costs, including return shipment, will be borne by RBR Ltd.

This warranty does not cover consumables or normal wear and tear, nor does it cover damage caused by negligent use or mishandling. Attempted modification or repair of any unit without the prior consent of RBR Ltd. will immediately void any warranty in force.

Users are expected to maintain a regular program of calibration.

**We reserve the right to grant or refuse warranty repairs at our discretion if we consider that there are reasonable grounds for doing so.**

## 5 Introduction

This document introduces you to Ruskin and helps you to use it effectively from the start. It is specifically written for the RBR*solo*<sup>3</sup> and RBR*duet*<sup>3</sup> loggers - our smallest one and two channel loggers.

You can access the Ruskin User Guide on the USB data stick provided when you purchase a logger, from the Help menu in Ruskin, and on the RBR web site, at [www.rbr-global.com](http://www.rbr-global.com).

Release notes are automatically displayed each time you install an updated version of Ruskin. The most recent release notes are also available from the Help menu in Ruskin. For information about operating and maintaining your data logger, see the Logger Hardware section. It helps explain how to change the battery and change desiccant, including other useful information, such as inspecting and replacing O-rings.



## 6 Installation

### 6.1 Install Ruskin on a PC

You can install Ruskin on a PC that runs the Windows 7, 8, 8.1, or 10 operating system.


The minimum requirements for Ruskin are:

- OS = Windows 7
- Processor speed = 1.4GHz
- RAM required = 1GB
- Display resolution = 1024x768 recommended
- HDD space for installation = 300MB


#### Steps

1. Connect the data stick included with your instrument to a USB port.
2. Navigate to the folder Ruskin Installation and double click on the file `RuskinSetup.exe`.
3. Follow the installation wizard. By default, Ruskin will be installed to `C:\RBRRuskin`.
4. The logger uses a USB interface to communicate with Ruskin.


At the end of the installation, a prompt will appear asking, "Would you like to install the logger driver at this time?"

 Realtime sensors will not require USB drivers to operate, they are only required for our loggers.

5. Click **Yes** to install the drivers.

 You may need to run the setup application as an administrator to install the driver correctly.

A shortcut to Ruskin appears on the desktop and in a **Start** menu folder called RBRRuskin.

 Please note that the most recent version of Ruskin can be found at <https://rbr-global.com/products/software>

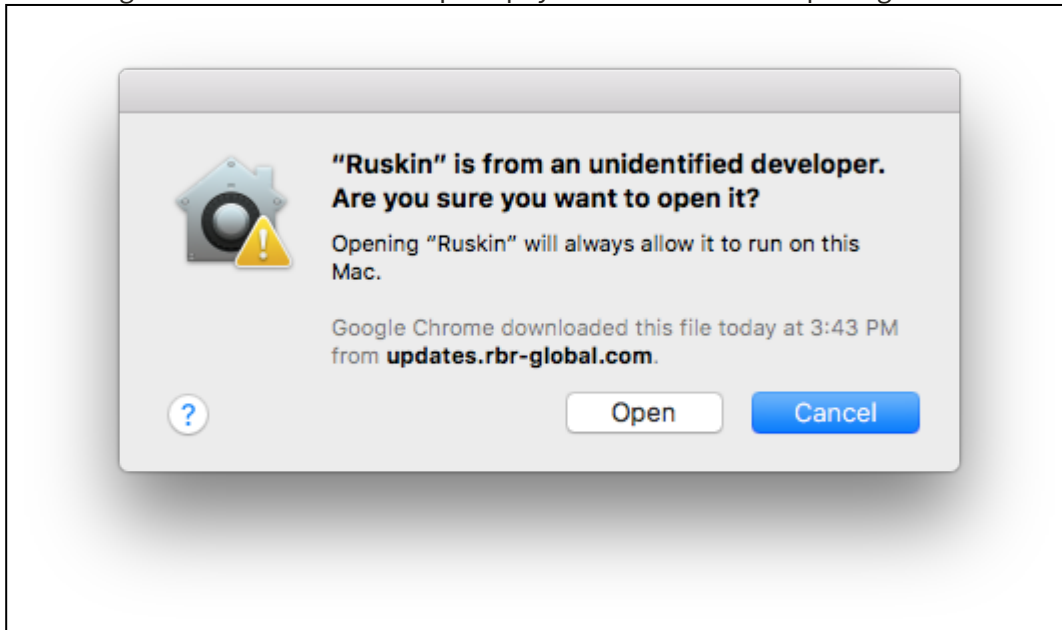
### 6.2 Install Ruskin on a Mac

You can install Ruskin on a Mac running OS X 10.5 (Leopard) or later.

#### Steps

1. Insert the USB data stick in the appropriate USB port.
2. Navigate to the folder OSX and double click on the file `Ruskin.dmg`.
3. When the disk image window opens, drag the Ruskin icon into the applications directory and wait for the copy to complete.

4. To open Ruskin for the first time navigate to your applications directory, locate Ruskin, right click on the icon, and select **Open**.
5. The dialogue box shown below will prompt you to authorize the opening of Ruskin.



It may be required that you navigate to **System Preferences > Security & privacy** to allow apps downloaded from “**Anywhere**” to complete the installation.



Although you can specify a different folder for the working directory for the software, we recommend that you use the default **Applications** folder.

A folder named RBRRuskin appears in the **Applications** folder.

You may want to drag the Ruskin.app application to the **Dock**.

## 6.3 Update Ruskin

To take advantage of new features and bug fixes, ensure that you are using the most recent version of Ruskin.

It is not necessary to uninstall an older version of Ruskin before installing a newer version. The installation program deletes the older files before installing the newer ones. It does not delete any Ruskin data files or log files.

The most recent version of Ruskin is always available on the RBR website ([www.rbr-global.com](http://www.rbr-global.com)). However, if you already have an older version of Ruskin installed, Ruskin automatically notifies you that a newer version is available when you start Ruskin. You can check to see if a new version is available from within Ruskin navigating to the menu **Help > Check for updates**. If you have a broadband connection, we recommend that you follow the installation instructions that appear on your computer. Otherwise, request a USB stick from RBR.



If you do not have a broadband connection and/or are unable to install the Ruskin updates, update notifications are available via email. To receive these notifications, send an email to: [support@rbr-global.com](mailto:support@rbr-global.com) subject: "Ruskin update request".

## 6.4 Uninstall Ruskin

If you no longer need to manage RBR instruments from your computer, you can uninstall Ruskin.



Removing Ruskin will not delete your data files or your diagnostic logs.

It is not necessary to uninstall an older version of Ruskin before installing a newer version. The installation program deletes the older files before installing the newer ones. For more information, see [Update Ruskin](#).

### **Windows 7, 8, 8.1, or 10**

Go to **Start > Control Panel > Programs**, and under **Programs and Features**, click **Uninstall a program**. In the list, locate **Ruskin** – click **Ruskin** to highlight it, and then click **Uninstall**.

### **OS X 10.5 or later**

Move the RBRRuskin folder from **Applications** to the **Trash**.

## 7 Provide your feedback

You can get in touch with RBR in several different ways:

- Send us an email. For a technical question, write to [support@rbr-global.com](mailto:support@rbr-global.com). For general inquiries, use [info@rbr-global.com](mailto:info@rbr-global.com).
- Send us a bug report from within Ruskin itself. Use the **Help** menu > **Comment on Ruskin**. This allows you to include the diagnostic logs, and any other files (RSK datasets, screenshots) that will help us reproduce the problem and help you as quickly as possible.

### Steps

1. From the **Help** menu, click **Comment on Ruskin**.  
The Feedback to RBR dialog box appears.
2. Enter your identification information, for example, email address and name, and then summarize your comments.
3. Provide a detailed description and add any attachments, if required.
4. Click **Submit** to submit the report.

## 8 Quick start

### 8.1 Deploy an instrument

Before you begin using your RBR loggers, you may want to experiment with the simulated loggers that are included in Ruskin. For instructions on simulating a logger, see [Simulating an RBRsolo/duet](#).

When you are ready to use your own RBR loggers, we recommend that you follow the following steps to ensure that you measure exactly what you want on the first attempt.

#### Steps

- To establish communication between the RBR*solo*<sup>3</sup> or RBR*duet*<sup>3</sup> and a computer, open the instrument (see [Opening and closing the logger](#)) and remove the housing. There is a USB-C connector located on the back side of the logger. The supplied interface USB-C cable is plugged into this connector and the other end is attached to the USB port on your computer.
- The logger should appear in the **Navigator** view after a few seconds.
- If you are using the logger for the first time, you can use either the default preferences or specify your preferences to apply to all your loggers. For more information, see [Preferences](#). You can change these preferences at any time.
- Click the logger that you want to use. Ensure that it contains the sensors you expect to find on the logger by viewing the **Information** tab in the **Properties** view on the right side of the Ruskin window. For more information, see [View information about a logger](#).

If you want to see live data sampled every few seconds but not saved, select the **Fetching** button in the toolbar located above the **Plot** view. The **Plot** view is located at the bottom of the Ruskin window.



You must specify your preferences regarding these features before you enable the schedule. For more information, see [Configure a logger](#).

- If you want to view or modify calibration coefficients, click the **Calibration** tab. For more information, see [Calibration tab](#).
- Click the **Configuration** tab > **Sampling** section to schedule the logger to take samples when and as often as you want within the limits of your logger. For more information, see [Scheduling a RBRsolo/duet](#).

Ruskin prevents you from enabling a schedule that exceeds the memory capacity of the logger. Ruskin also shows the estimated battery usage required to use your logger as scheduled. You should seriously consider this information before you enable the schedule.


- If you want to download data, click the **Download** tab to download all the data saved since your schedule was enabled. For more information, see [Download](#). The focus changes to the new dataset in the **Navigator** view, and the static data appears in the **Plot** view. You can now export the downloaded data to a file in Excel or text. You can also save the image as a PDF or PNG file for viewing outside Ruskin.


## 8.2 Batteries

RBR dataloggers can use any chemistry of AA battery.

We estimate the deployment time based on a capacity calculated from the nominal voltage and miliamp hours.

Name	Chemistry	Voltage (V)	mAh
Lithium thionyl chloride	LiSOCL <sub>2</sub>	3.7	2400
Lithium	Li-FeS <sub>2</sub>	1.5	3500
Alkaline	Zn-MnO <sub>2</sub>	1.5	2500
Li-ion	LiNiMnCo	3.6	750
NiMH	NiMH	1.2	2400

 The different chemistries affect the deployment time, so ensure you have selected the appropriate chemistry in the [battery life calculator](#) to get the most accurate deployment estimate.

 Mixing batteries of different chemistries, brands, and age will reduce performance and potentially damage the instrument. Batteries that are not matched properly can become overheated, causing them to leak and potentially explode.

## 8.3 Simulating an RBRsolo/duet

Ruskin can simulate most logger types that RBR produces, including the RBR*solo*<sup>3</sup> and RBR*duet*<sup>3</sup>. We recommend that you experiment with your type of simulated logger before enabling a schedule for your actual RBR logger. This practice will probably save you time in the long run by ensuring you are familiar with the options available.

### Steps

1. From the **Instruments** menu, click **Simulate instrument**. The Configure Simulated Instrument dialog box appears.
2. Under Logger type, select the **Compact Instruments** tab and select the appropriate options.
3. Click **OK**. The simulated logger appears under Instruments in the **Navigator** window.

- Click the new simulated logger. You can work with this logger the same way as you work with a real RBR logger, including: configuring, calibrating, logging, and downloading data. Multiple loggers, both real and simulated, are listed in your **Navigator** window.

✓ If you want to remove a simulated logger, right-click it and click **Remove simulated instrument**. You can also use the Instruments menu.

## 8.4 View information about a logger

You can view static information about a logger at any time as follows:

In the **Navigator** view, click the appropriate logger.

The **Information** tab in the **Properties** window on the right side of Ruskin identifies the logger, its logger details such as model, serial number, generation, firmware version and battery status.

The screenshot shows the 'Properties' window with the 'Information' tab selected. The window is divided into two main sections: 'Logger details' on the left and 'Channels' on the right.

**Logger details:**

- Model: RBRduet<sup>3</sup>
- Generation: Late 2017
- Serial: 902917
- Firmware: 1.000
- Link: USB

**Power:**

- Source: Internal
- Internal: 3.6V
- External: 0.0V

**Channels:**

#	Parameter	Units	Ranging
1	Temperature	°C	None
2	Pressure	dbar	None
(3)	Temperature	°C	None
4	Sea pressure	dbar	None
5	Depth	m	None

## 8.5 Recover an instrument and download data

When the deployment is complete recover your instrument and follow these steps to download your data.

⚠ Flooded loggers may be under pressure and opening a logger may be dangerous - take precautions when opening a logger

### Steps

- Start Ruskin

- Carefully open the logger by unscrewing the pressure housing
- Insert the USB-C connector into the logger and connect cable to your computer
- The logger appears in the navigator window and select the **Download** tab and select **Download...** (see [Download](#))
- Save the file to a preferred location
- Evaluate your data (see [Analysis](#))



## 9 Configure a logger

Before you enable a logger schedule, you can configure the logger to suit your requirements.

The instructions to configure a |tide or |wave logger are different than the standard loggers and can be found in [Tides and waves](#).

If your logger schedule is already enabled when you decide to change the configuration you must stop running the schedule, make your changes, and enable the schedule again. However, any data stored so far on the logger will be lost.



You can preserve the data by downloading it to a file before you enable the schedule again.

The **Configuration** tab contains the **Enable**, and **Use last setup** buttons. When you click **Enable**, the logger setup parameters are stored to the logger and the schedule is enabled. **Use last setup** is intended for configuring multiple loggers using the same schedule. For example, to set up three |tide loggers with exactly the same parameters, set one logger up and enable it; connect the second and third logger and when you click **Use last setup** button, these two loggers will be set up with the same parameters as the first logger. This includes the logger clock time, start and end logging times, sampling period (or rate), gating condition, and tide or wave sampling parameters for |tide or |wave loggers.

### 9.1 Scheduling a RBRsolo<sup>3</sup>/duet

You can schedule your RBRsolo<sup>3</sup> or RBRduet<sup>3</sup> to start at a specified time and sampling rate. Ruskin indicates any unattainable conditions in the defined schedule at the bottom of the **Configuration** tab, and the **Enable** button is grayed out.

#### Steps

1. Connect your logger locally to computer's USB port. The logger should appear in the **Navigator** view after a few seconds.
2. While the logger you want is highlighted in the **Navigator** view, click the **Setup** tab in the **Properties** view.

3. Click either **UTC sync** to synchronize the logger with Coordinated Universal Time, or **Local sync** to synchronize the logger with your local PC clock.
4. In the **Start** boxes, specify the date and time that you want to start running the schedule or select the **Now** check box to populate the current date and time.

✓ If you select and then clear the **Now** check box, you can then manually modify the current date and time instead of the original values.

5. Specify the interval between samples using the **Speed** option. If the **Rate** box is not selected you have the ability to set the sampling interval in units of seconds. The **Rate** option allows you to select between 2,4,8,16,24 and 32 Hz frequencies.

⚠ All profiling loggers (known as |fast) have the ability to sample faster than 2Hz. For example |fast32 loggers sample at rates of 2,4,8,16,24 or 32Hz. All |tide loggers can average at rates of 2,4,8 or 16Hz. All |wave loggers can sample at rates of 2,4,8 or 16Hz

6. An estimated end logging is shown at the bottom of the **Configuration** tab based on the sampling interval set. Check to ensure this date is beyond the end date of your planned deployment. The green and red bars next to the End date shows whether memory or battery is the limiting factor for the deployment. For the above instrument, it can log for 16.3 days based on memory, with a further 34.4 days of battery capacity remaining.
7. If the logger you are scheduling has had a fresh battery inserted, select the **Fresh battery** box. Ruskin has the capability to calculate the remaining battery life available for a used battery based on the number of samples that have been taken. The RBR*solo*<sup>3</sup> and RBR*duet*<sup>3</sup> keep track of the number of previously stored samples to determine the battery use. Selecting and deselecting the **Fresh Battery** check box allows you to see the difference between a fresh battery and a used battery.


⚠ If you select the **Fresh battery** box and enable the logger the previously stored sample count is reset. In this case it is assumed that a fresh battery is installed.

8. To enable the logger to start sampling immediately or in the future click **Enable**. A message appears informing you that the memory will be erased.
9. Select **Cancel** if you need to download the previously sampled data or press **Erase and enable logging** to enable the logger.

### 9.1.1 Battery life calculator

#### When to replace the batteries

Compared to the cost of deployment, the cost of a new set of batteries is close to negligible. We highly recommend that the batteries be replaced before every deployment unless there is no doubt that they have sufficient capacity. Battery voltage does not decrease linearly and is therefore not an accurate indicator of battery capacity. However, if the logger software indicates a yellow or red battery icon on the setup screen, the batteries should be replaced.

 When in doubt, replace the batteries

#### Predicting battery life

Battery life prediction is a complicated issue. In RBR loggers, battery life is a strong function of the type of logger, the type and number of sensors attached, the sampling scheme (sampling period and the use of: thresholding, real-time data collection and averaging), and the temperature of the water during the deployment. Manufacturers' data for the batteries do not provide information that can be directly related to way the batteries are used in RBR loggers.

The Ruskin software calculates the expected battery usage (in mA hours - mAh) for the logger during setup. The nominal capacity of each type of battery is described in the [battery section](#) and is given in mAh at room temperature. The software will warn the user if the expected battery usage for a particular deployment scenario is approaching the theoretical potential mAh. The software will not prevent a logger from being started even if a warning is given. In tests at RBR Ltd. of multiple examples of various brands of batteries at 6°C, all examples were able to provide the threshold capacity defined in our [battery section](#). The user should view these predictions and further de-rate the batteries if the expected deployment is in cold water.


RBR continues to characterize battery life in its loggers and will continue to improve the battery life calculator in future versions of Ruskin.

## 9.2 Stop logging

Logging stops on its own when one of the following occurs:


- The end logging time is reached.
- The power is removed.
- The logger memory is filled.
- The logger battery is depleted.

To manually stop the logger In the **Properties** view, click **Configuration** tab and select **Stop logging**.

 Whether or not you make any changes to the schedule or the configuration, before running the schedule again, a warning appears that the contents of memory will be erased. If you want to save the data stored so far on the logger, you must download the data to a file before proceeding. You can do this from **Properties** view > **Configuration** tab and select **Download**. For more information about downloading a file, see [Download](#).

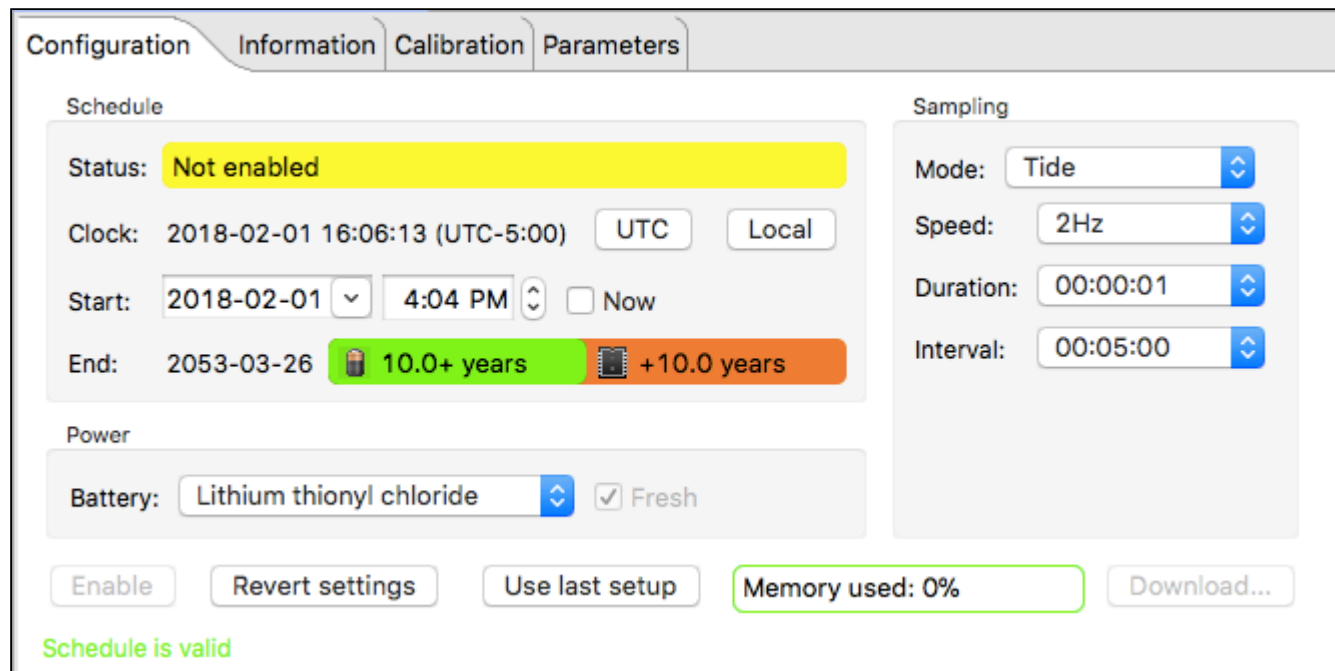
## 9.3 Waves and tides RBRsolo/duet

### 9.3.1 Tides

 This section applies to the RBRsolo<sup>3</sup> D |tide and |wave and RBRduet<sup>3</sup> T.D |tide and |wave loggers

|tide loggers use averaging to remove wave data from the pressure measurements. |wave loggers can be set up to operate like |tide loggers.

From the **Configuration** tab select the mode **Tide** to enable the tide measuring regime.




The screenshot shows the 'Configuration' tab of the RBR logger interface. It is divided into two main sections: 'Schedule' and 'Sampling'. The 'Schedule' section includes a 'Status' field set to 'Not enabled', a 'Clock' field showing '2018-02-01 16:06:13 (UTC-5:00)' with 'UTC' and 'Local' buttons, a 'Start' field with a date picker set to '2018-02-01' and a time picker set to '4:04 PM', and an 'End' field with a date picker set to '2053-03-26' and two buttons for '10.0+ years'. The 'Sampling' section includes a 'Mode' dropdown set to 'Tide', a 'Speed' dropdown set to '2Hz', a 'Duration' dropdown set to '00:00:01', and an 'Interval' dropdown set to '00:05:00'. Below these sections is a 'Power' section with a 'Battery' dropdown set to 'Lithium thionyl chloride' and a 'Fresh' checkbox. At the bottom, there are buttons for 'Enable', 'Revert settings', 'Use last setup', a 'Memory used: 0%' indicator, and a 'Download...' button. A green status message 'Schedule is valid' is displayed at the bottom left.

- In **Sampling** specify how fast you want pressure readings to be taken. Select in **Speed** either a period of 1s or slower or a rate for sub-second sampling rates.
- In **Sampling** specify the tidal averaging **Duration** (how long to average) and specify the tidal measurement **Interval** (the interval between averages).

In the above example the averaging rate is set to 2Hz and the averaging duration is 1 minute and this measurement is repeated every 5 minutes.

## 9.3.2 Waves

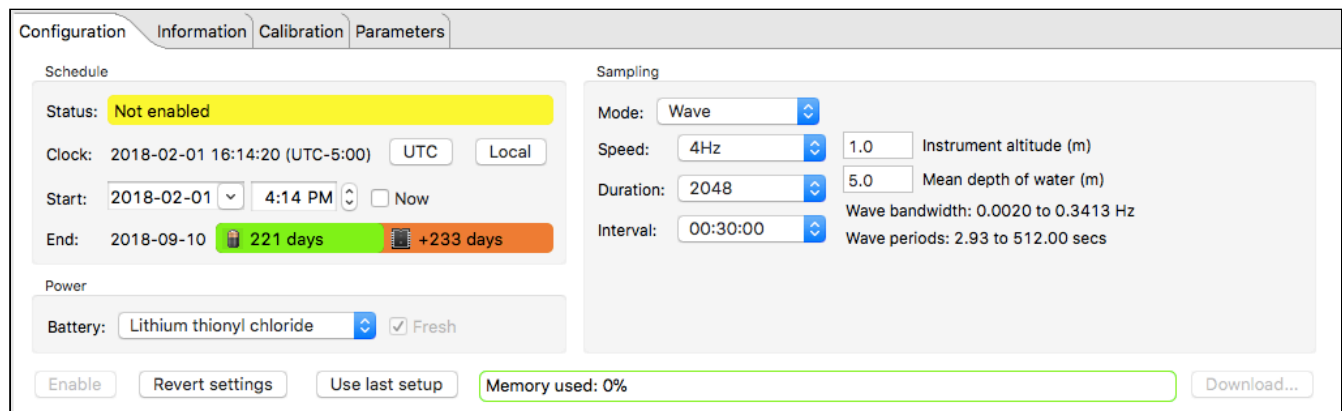
 This section applies to the RBR*solo*<sup>3</sup>D |wave and RBR*duet*<sup>3</sup>T.D |wave

A |wave logger records both wave and tide information, and the configuration is different from other loggers. For additional information on planning a wave deployment, please refer to [Appendix D - |wave deployment planning](#).



All |wave loggers automatically calculate tide data by averaging the wave burst data. There is no setup required to determine tide information with the wave logger.

From the **Configuration** tab select **Wave** as the mode to enable the wave measuring regime.



- In **Sampling**, specify how fast you want pressure readings to be taken. Select in **Speed** either a period of 1s or slower or a rate for sub-second sampling rates.
- In **Duration (samples)**, select the number of samples that you want to take during a wave burst. The range is between 512 and 32768 samples.
- In **Interval**, enter the interval between the bursts for the wave measurement period.
- In **Instrument altitude (m)**, enter the number of meters above the sea or river bed where the logger will be secured in place. This value is used when making wave bandwidth estimates.
- In **Mean depth of water (m)**, enter the total expected depth of the water where the logger will be deployed. This value is used to estimate the range of wave frequencies and periods that can be resolved. Ruskin calculates the actual depth from the measured pressure data post-deployment.

## 9.3.3 RBR*solo*/*duet* |wave deployment planning

The following provides a guideline to establish a coherent deployment for |wave loggers.

The |wave logger should be fixed to a suitable support below the surface of the water, such as a dock or other rigid mooring. The logger must not be able to move in the water. The figure below offers a view of the logger fixed to a dock with a definition of the different water heights.

- Mean depth of water: an estimate of the average water depth, used for the initial prediction of expected wave frequencies that can be detected. Ruskin will use the actual depth measured by the logger for its calculations.
- Instrument altitude: The actual height of the logger above the seabed. This is defined by the deployment, and the logger must be physically affixed at this height during the installation.

Given the height of the logger above seabed and the depth of logger as measured during the deployment, the total depth of water can be calculated.

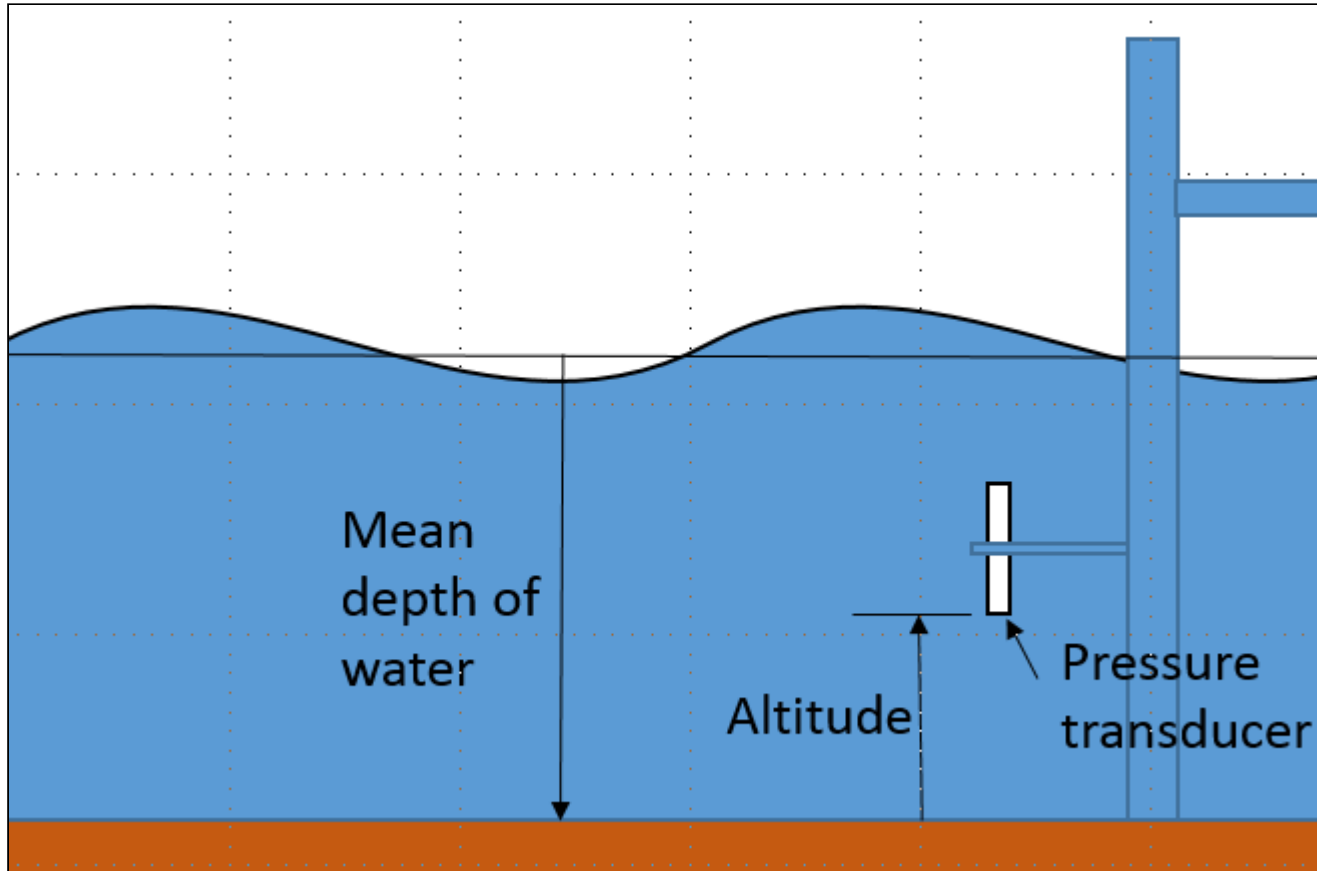


Figure 1. Logger positioning

### |wave logger positioning

For deployment planning, refer to Figure 1. Ruskin needs to know the expected mean depth of water (in metres) and the expected altitude (height) of the logger above the seabed to provide an estimate of the frequencies and periods of the wave that the logger is be able to measure. The logger measures water depth/pressure by means of a pressure transducer. The physics of what a pressure transducer can 'see' at depth depends on the height of water above the transducer *as well as* the amount of water below the transducer. High frequencies attenuate very quickly with depth. Figure 2 shows the attenuation with depth as a function of wave period in seconds ( $period = 1/frequency$ ). This graph demonstrates that the placement of the logger is critical in determining frequencies/periods of the wave data to be captured by the logger. The pressure transducer may be placed in any orientation.

**The basic rule is to place the logger as close to the surface of the water without the possibility that the logger will emerge from the water either because of large waves or low tides.**

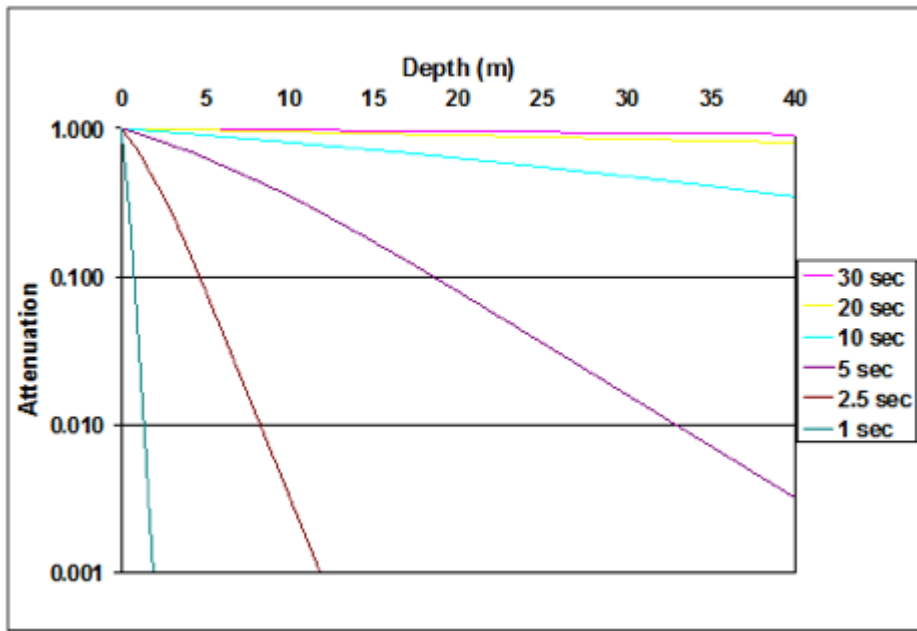


Figure 2. Wave attenuation as a function of depth for various wave periods.

This step in the deployment configuration requires that the 'expected mean depth of water', that is the total depth of water known from experience with the measurement site, and the 'expected altitude of the logger above seabed', a definition to be given to the diver, be entered. Note that on data retrieval the second value will be added to the measured depth of water above the logger when performing all wave calculations.

When waves are enabled, the logger takes multiple pressure readings in a burst which allows for the reconstruction of the surface wave time series. There are three parameters which define the wave data:

1. Measurement speed: this defines the sampling rate or period for individual pressure readings used.
  - a. The rate possibilities are 2Hz, 4Hz, 8Hz, and 16Hz
  - b. The sampling rate defines several elements of the data capture:
    - i. The highest possible frequency visible in the data is limited to  $\frac{1}{2}$  the sampling frequency. However, this mathematical limit can not usually be achieved because of the attenuation characteristics shown above.
    - ii. The sampling frequency defines the resolution of the frequency spectrum which can be calculated from the wave data.
    - iii. The sampling frequency, together with the burst length, define the lowest frequency which can be assessed in a wave burst.
2. Wave measurement period: this defines how often wave bursts are collected.
3. Burst Length: this defines the number of samples in a wave burst. It must be a power of 2 and is chosen from the list: 512, 1024, 2048, 4096, 8192, 16384, and 32768. The longest wave period to be assessed is defined by: burst length/sampling frequency

The wave parameters work together to define the range of wave information which can be calculated as well as the memory and battery usage.

## 9.4 Autoranging and fixed gain

Turbidity sensors are capable of autoranging. The logger can change the gain setting on the front-end amplifiers in order to select the most appropriate range based on the environment being measured. The logger can also set the gain on the sensor to a fixed value selected by the user, rather than allowing the logger to select the gain as it measures.

From the **Configuration** tab under logger details there is a drop down menu where the **Range** of the sensor can be specified. Seapoint turbidity sensors are capable of autoranging (automatic gain setting) or having a fixed range of 2500, 500, 125 or 25 NTU.

The screenshot shows the 'Configuration' tab of a logger interface. It features several sections: 'Schedule' with status 'Not enabled', clock settings, and start/end dates; 'Sampling' with mode 'Continuous' and speed '2Hz'; 'Power' with battery type 'Lithium thionyl chloride' and a 'Fresh' checkbox; and 'Ranging sensors' with a 'Range' dropdown menu open, showing options 'Auto', '2500 NTU', '500 NTU', '125 NTU', and '25 NTU'. At the bottom, there are buttons for 'Enable', 'Revert settings', 'Use last setup', and a 'Memory used: 0%' indicator. A green message 'Schedule is valid' is displayed at the bottom left.

Range change events are displayed in the **Plot** view when the **Display diagnostic** is selected from the **Events** button,



, located in the **Plot** view toolbar. Range change events are displayed as RANGE XX Units where XX indicates the current range and units are the units of the sensor – typically NTU for turbidity sensors and  $\mu\text{g/l}$  for fluorometers. For fast sampling where the change may be occurring over a number of samples the event is displayed as RANGE CHG and is followed by the final range event.

## 9.5 Deployment

Once you have ensured that the batteries are fresh, inspected the O-rings and programmed the logger (see [Configure a logger](#)), the instrument is ready to be deployed.

There are four precautions you should take to avoid damaging the logger and maximise the deployment autonomy:

1. Pay attention to the maximum pressure rating. All loggers with pressure sensors are individually rated to a maximum depth/pressure. This is indicated by the label which is placed on the logger's sensor end cap. Loggers which do not have a pressure sensor do not have this label, but are limited by the maximum depth/pressure rating of either the logger housing itself or of the sensors.



2. Avoid physical stress to the logger. Any type of clamp or bracket which concentrates the stress to the logger body is not recommended for use in logger mooring, mounting, and/or other deployment. Stress due to improper mounting may cause the logger to leak, resulting in the loss of valuable data or permanent damage to the electronics. RBR can provide proper mooring and mounting clamps suited to your specific application.
3. Use desiccant. If the logger is closed up in a warmer environment than the deployment environment, internal condensation can result. Since condensation may cause the circuitry to malfunction, the installation of desiccant prior to deployment is strongly advised.
4. Orientation on a mooring. Due to battery capacity potentially being sensitive to cell orientation, it is best to mount the logger with the sensor end facing down when deployed. Even if batteries that are minimally sensitive to cell orientation are used (e.g. Tadiran), it is always good practice to mount the loggers in this manner in the event that any brand of battery is employed.

## 10 Download

### 10.1 Download data from the logger

You can download data from a logger at any time. If you stop running a schedule, you must download the data before you restart the schedule to prevent the data stored so far from being lost. It is not possible to start logging without erasing the memory contents.

#### Steps

1. From the **Configuration** tab select **Download**.  
The **Save as RSK** dialog box appears.
2. Specify a location and a name for the data file.  
By default, the RSK file name uses the Ruskin file naming convention. For more information about the naming convention, see File naming convention below.
3. The name of the new dataset appears and is highlighted automatically in **Navigator** view > **Datasets**. The **Properties** view changes to the new dataset and contains the following tabs: **Analysis**, **Overview**, **Channels**, and **File Info**. All the data that was stored on the logger at the time of the download is automatically plotted in the **Plot** view.



Downloading data again while the same schedule continues to run, picks up the same data plus any data stored since the last download.

You can add a comment after downloading a dataset.

### 10.2 File naming convention

In Ruskin, by default, the name of a data file is composed of the following information:

- The first six digits represent the logger serial number.
- The next eight digits represent the current year, month, and day.
- The next four digits represent the current time to the minute.
- The file extension indicates the file format and should not be changed. If you change it, the file extension that you specify becomes part of the name, and the required extension is appended.

For example, the file named 911936\_20090522\_1613.rsk contains data for a logger with a serial number of 911936 whose data was downloaded in 2009 on May 22 at 4:13 pm.

## 11 Calibration tab

The **Calibration** tab displays the calibration coefficients for each parameter (sensor) present and the date and time of the last calibration. Selecting the sensor from the dropdown menu **Parameter** toggles between the calibrations for the different sensors on the unit.

Configuration Information **Calibration** Parameters

Parameter 1: Temperature

Calibration date: 2018-02-01 13:37:27

Label	Value
C0	3.5000000E-03
C1	250.00000E-06
C2	2.7000000E-06
C3	23.000000E-09

Store calibration Revert calibration ☒ Check calibration expiry Request calibration quote

You can request a calibration quote for your logger by selecting **Request calibration quote** and sending the information directly to RBR Ltd. In the **Calibration** tab, click **Request calibration quote**, and when the **Request calibration** dialog box appears, enter the appropriate information. Make sure to verify that all information is correct before sending the request. You can edit any of the coefficients and use **Store calibration** to save the new coefficients to the logger. Use **Revert calibration** to recover to the original coefficients if you have not already selected **Store calibration**.

Calibration coefficients are calculated for each sensor, and the coefficients are stored in the logger. Calibration certificates are provided for each sensor and contain both the calibration equation and the coefficients. Hard copies are provided with each shipment, and the documents are contained inside the shipping box. Please refer to the calibration certificates for the coefficients and residuals. RBR can replace lost or misplaced calibration certificates.

## 12 Update firmware

Instrument firmware upgrades can be performed from within Ruskin on a Windows-based computer without having to return the instrument to the factory. Ruskin automatically checks to see if a newer version of firmware is available and displays a message in the **Information** tab.

The screenshot shows the 'Setup' window for an RBRsolo 075529 instrument. The window has two tabs: 'Setup' and 'Calibration'. The 'Setup' tab is active and contains two main sections: 'Logger details' and 'Schedule'.

**Logger details:**

- Model: RBRsolo T
- Generation: Late 2012
- Serial: 075529
- Firmware: 1.100
- Battery:

**Schedule:**

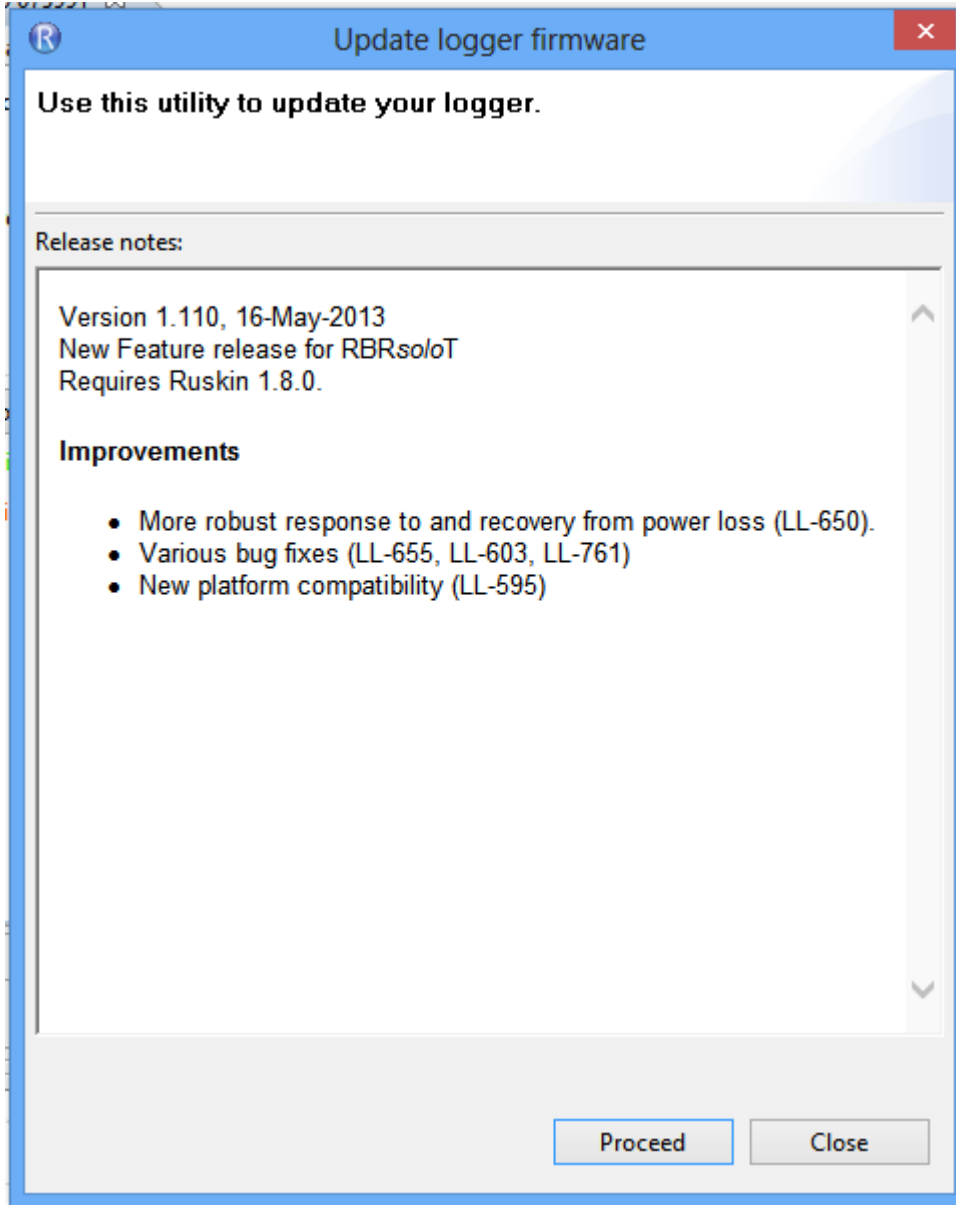
- Logger status: **Not enabled** (highlighted in yellow)
- Logger clock: 22/Sep/2014 13:00:51 (with 'UTC sync' and 'Local sync' buttons)
- Start logging: 7/ 9/2014 (calendar icon) 2:32 PM (time spinner)
- Sampling: ☐ Period ☒ Rate 2Hz (dropdown)
- End logging: 09/Dec/2014 (Estimated)
- ☐ Start immediately
- ☐ Fresh battery

At the bottom of the 'Schedule' section, there are three buttons: 'Enable logging', 'Use last setup', and 'Download...'. A green box highlights the 'Memory used: 0%' text.

Below the buttons, a green message states: 'Schedule is valid'.

At the bottom of the window, an orange message states: 'A newer firmware version is available. Please update to ensure full compatibility.' To the right of this message is an 'Update firmware' button.

Click the **Update firmware** button to upgrade the logger firmware. The following screen will appear:



⚠ Do not disconnect the logger until the process is fully completed. Disconnecting the logger during this process may render the logger inoperable.

If for some reason RBR needs to supply a version of firmware, the following method is used to manually update the logger firmware.

⚠ Contact RBR for instructions before proceeding. This method of updating the firmware should only be attempted with the assistance of RBR.

Click the **Instruments** menu > **Update logger firmware**.



❗ Do not use the HID port to upgrade your logger firmware. Use the COM port instead.

### Steps

1. In the **Instruments** menu, click **Update logger firmware**.  
The Update logger firmware dialog box will appear.
2. Click **Select file** and browse to the location of the firmware update file provided by RBR.  
The file will have the extension .rbrfw.
3. Use the drop down list to select the COM port of the logger.  
If you have multiple instruments connected and do not know the correct COM port to use, in the **Navigator** view click **L Instruments**. The **Connections** view appears and you can see the port being used in the Port column of the table. To close the **Connections** view, select the X.
4. Click **Proceed** to start the firmware upgrade.  
A progress bar shows the status of the upgrade. Once the firmware upgrade is complete, the message *Update completed successfully* appears at the top of the dialog box.
5. If the upgrade doesn't complete successfully, click **Proceed** again to retry until successful.

⚠ Occasionally the upgrade will succeed but the logger disappears from the **Navigator** view. If this occurs, disconnect your logger from the USB port and then reconnect to re-establish communication.

6. Click **Close**.

## 13 Datasets

### 13.1 Open a stored dataset

You can open any stored dataset to explore its contents.

#### Steps

1. Click **File** menu > **Open dataset**.
2. Double-click the .rsk file that contains the data that you want to view.
3. The name of the dataset appears and is highlighted automatically in the **Navigator** view. The **Properties** view changes to the dataset. The data in the file is automatically plotted in the **Plot** view.

✔ To close a dataset, right-click its name in the **Navigator** view and click **Close dataset**. Or use **File > Close dataset**

⚠ **Ruskin performs an integrity check that is intended to make sure that older data files are compatible with newer versions of Ruskin software. This information is displayed in [File info](#). If the file requires updating the message indicates the issue with the file, and how long an update will take.**

**RBR strongly recommends that all files that have issues be updated.**

### 13.2 Analysis

The **Analysis** tab contains information and settings for configuring the calibration information and to display statistical information. You must already have an open dataset to view and configure these settings. For information about how to open a dataset, see [Download](#).

#### 13.2.1 Cursor tab

When a file is selected and plotted, the **Analysis** tab can be selected to display information about the dataset channels and their values.

Analysis
Overview
Channels
File info

Sample
143

Time
2018-02-02 10:53:33.231 (UTC-5:00)

☐ Display statistics

Number of samples
100

Channel	Value	Unit
Temperature	14.5291477	°C
Pressure	15.1366514	dbar
Sea pressure	5.0041514	dbar
Depth	4.9633444	m

Copy selection

This table reports the value at each sample number when selected in the plot referenced to the vertical black cursor.

The sample number and time of the sample are displayed.

Selecting **Display statistics** gives you the ability to determine the average value and standard deviation over a range of samples. Change the number of samples in the average by using the spin buttons. The grey bar that appears on the plot view is the range of the samples in the average.

Analysis
Overview
Channels
File info

Sample
43 - 143

Time
2018-02-02 10:51:52.979 - 2018-02-02 10:53:33.231 (UTC-5:00)

☒ Display statistics

Number of samples
100

Channel	Value	Avg	Std	Unit
Temperature	14.5291477	15.4602618	11.8524012112	°C
Pressure	15.1366514	15.3513438	8.3280118742	dbar
Sea pressure	5.0041514	5.2188438	8.3280118742	dbar
Depth	4.9633444	5.1762860	8.2600999221	m

Copy selection



## 13.2.2 Calibration tab

When a file is selected and plotted for re-calibration the **Calibration** tab can be selected to assist with calculating calibration coefficients, see [User calibration](#) .

## 13.3 Overview

When a file is selected and plotted the **Overview** tab can be selected to display general information about the dataset.

The screenshot shows the 'Overview' tab of a software interface. At the top, there are four tabs: 'Analysis', 'Overview' (which is selected), 'Channels', and 'File info'. Below the tabs, the 'File name' is displayed as '/Users/afergusson/Desktop/102769\_20180129\_1513T.rsk'. The main content area is divided into three columns: 'Dataset', 'Logger', and 'Deployment'. The 'Dataset' column contains four rows: '# of samples:' with value '26011', '# of events:' with '0', '# of diagnostics:' with '0', and '# of errors:' with '0'. The 'Logger' column contains three rows: 'Model:' with 'RBRsolo³', 'Serial:' with '102769', and 'Firmware:' with '1.000'. The 'Deployment' column contains seven rows: 'Gate:' with 'none', 'Time zone:' with 'UTC-5:00', 'Deployment start time:' with '2018-01-26 09:58:06', 'First sample time:' with '2018-01-26 09:58:16', 'Last sample time:' with '2018-01-29 10:13:16', 'First event time:' with '2018-01-26 09:58:16', and 'Last event time:' with '2018-01-29 10:13:22'. Below these columns is a 'Period:' row with the value '00:00:10'. At the bottom of the form, there is a 'Comment' section with a large text input area and a 'Save comment' button.

Dataset	Logger	Deployment
# of samples: 26011	Model: RBRsolo³	Gate: none
# of events: 0	Serial: 102769	Time zone: UTC-5:00
# of diagnostics: 0	Firmware: 1.000	Deployment start time: 2018-01-26 09:58:06
# of errors: 0		First sample time: 2018-01-26 09:58:16
		Last sample time: 2018-01-29 10:13:16
		First event time: 2018-01-26 09:58:16
		Last event time: 2018-01-29 10:13:22
		Period: 00:00:10

Comment

Save comment

This is also the form on which you can enter a comment for the dataset and then press **Save comment** to save it.

## 13.4 Channels

The **Channels** tab displays three additional tabs: **Information**, **Calibration**, and **Parameters**.

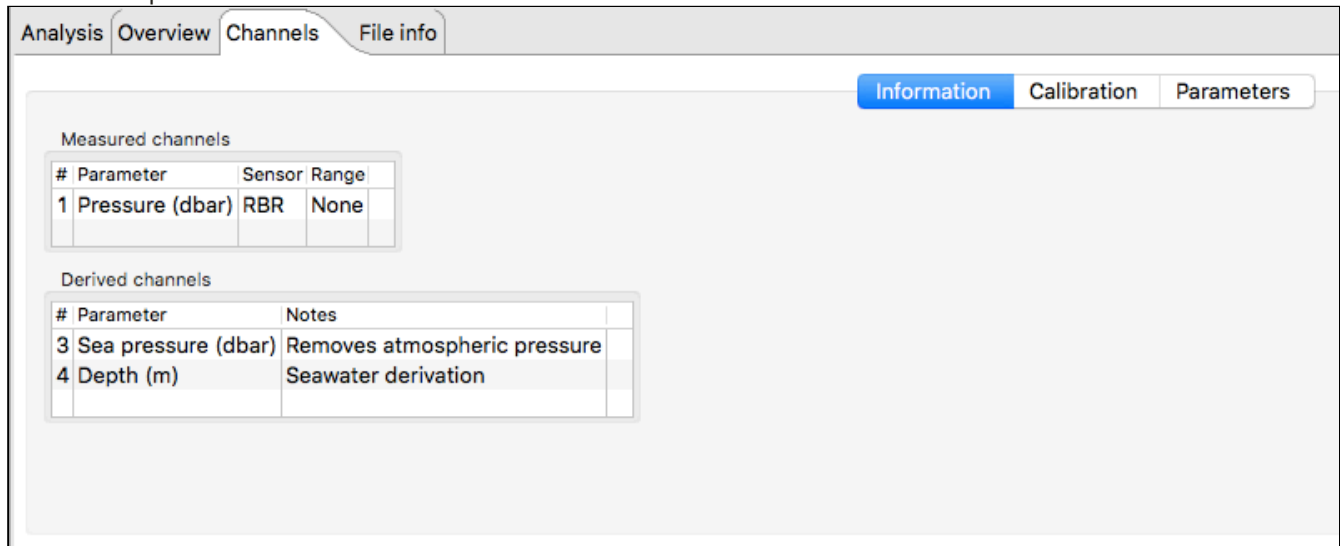
The **Information** tab displays the measured parameter, the sensor manufacturer and the range setting. The type of derived channels and how it is calculated is displayed in a separate table.

The **Calibration** tab displays the calibration coefficients for each sensor.

The **Parameters** tab displays the values of the parameters, default values if other required parameters are required and the method used to calculate the derived channels.

### 13.4.1 Information tab

The **Information** tab displays the measured parameters, the sensor manufacturer and the range setting (if applicable). It also shows any derived channels that are available, and a description of the methodology used in the calculation of that derived parameter.



The screenshot shows a software interface with a top navigation bar containing 'Analysis', 'Overview', 'Channels', and 'File info'. Below this, there are three sub-tabs: 'Information' (which is active and highlighted in blue), 'Calibration', and 'Parameters'. The 'Information' tab displays two tables. The first table, titled 'Measured channels', has columns for '#', 'Parameter', 'Sensor', and 'Range'. It contains one row: '# 1', 'Pressure (dbar)', 'RBR', and 'None'. The second table, titled 'Derived channels', has columns for '#', 'Parameter', and 'Notes'. It contains two rows: '# 3', 'Sea pressure (dbar)', and 'Removes atmospheric pressure'; and '# 4', 'Depth (m)', and 'Seawater derivation'.

#	Parameter	Sensor	Range
1	Pressure (dbar)	RBR	None

#	Parameter	Notes
3	Sea pressure (dbar)	Removes atmospheric pressure
4	Depth (m)	Seawater derivation

### 13.4.2 Calibration tab

The **Calibration** tab displays the calibration coefficients and temperature correction coefficients (as applicable) for each channel (sensor) and the date and time of the last calibration.

Analysis
Overview
Channels
File info

Information
Calibration
Parameters

Time	Parameter	C0	C1	C2	C3
2016 Oct 26 12:08:23	Temperature	3.4634530E-03	-252.84080E-06	2.4384370E-06	-86.558024E-09
2016 Oct 27 15:07:39	Pressure	9.6950392E+00	90.428560E+00	-734.87665E-03	3.2094721E+00

Store and recompute data
Revert calibration
☐ Use deployment calibrations

Analysis
Overview
Channels
File info

Information
Calibration
Parameters

Time	Parameter	C0	C1	C2	C3
2016 Oct 26 12:08:23	Temperature	3.4634530E-03	-252.84080E-06	2.4384370E-06	-86.558024E-09
	Pressure	9.6950392E+00	95.000000E+00	-734.87665E-03	3.2094721E+00

Store and recompute data
Revert calibration
☐ Use deployment calibrations

You can edit any of the coefficients and use **Store and recompute data** to recalculate the dataset. Use **Revert calibration** to recover to the original coefficients if you have not already selected **Store and recompute data**. To recover the original calibration coefficients edit one of the values and click in another cell. The **Use deployment calibrations** check box then becomes active and unchecked. Check this checkbox to restore the coefficients used by the logger and then press **Store and recompute data** to save the coefficients.

### 13.4.3 Parameters tab

When a file is selected and plotted, the **Parameters** tab can be selected to display the parameters used to calculate any applicable derived channels.

The tab reports the relevant derived channel information for the sensors on the logger. The parameters can be edited to change the derived channel calculation. Once a parameter is modified, the **Update and recompute** and **Revert settings** buttons become active.

**Revert settings** rereads the RSK file and populates the form with the parameters from the file. **Update and recompute** writes the new parameters to RSK file and re-displays newly calculated data.

The following example is for a CTD and dissolved oxygen logger where you can change the calculation parameters to calculate the derived channels:

The screenshot shows the 'Parameters' tab within the 'Channels' section of the software. It features two radio buttons: 'Simplified depth derivation' (selected) and 'Seawater derivation'. Below these are four input fields: 'Atmospheric pressure (dbar)' with the value 10.132501, 'Density (g/cm³)' with 1.0260206, 'Latitude (degrees)' with 0.0, and 'Speed of sound type' with a dropdown menu set to 'UNESCO'. At the bottom are two buttons: 'Update and recompute' and 'Revert settings'.

Selecting the **Seawater derivation** in the **Parameters** tab results in a depth calculation based on UNESCO Technical paper 44.

The depth derivation equations can be found under the menu item **Options** menu > **Preferences** > **Derived Channels** > **Depth** tab.

For wave loggers you can change the wave calculation by adjusting how the depth is calculated and by adjusting the instrument altitude.

## 13.5 File info

When a file is selected and plotted the **File info** tab can be selected to display information about the file.

The screenshot shows the 'File info' tab. It displays the following information: 'File name: /Users/jtaylor/Desktop/RBR\_Desktop/Data/cast data/060163\_20140715\_1516.rsk', 'Version: 1.8.9', 'Structure: full', and 'Size: 78.266 MB'. Below this, a message states: 'A new version of the RSK file format is available. The anticipated update duration is 04:22'. At the bottom is an 'Update' button.



There are two formats of RSK file: full and EP. EP stands for Easy Parse (mobile compatible format that is typically used with WiFi enabled loggers). Only EP format files can be displayed on a mobile device. EP format files have calibration coefficients that cannot be edited, hence you cannot recalculate EP format files.

❗ Files created by older versions of Ruskin must be updated to ensure compatibility. Failing to do so may result in odd graphical display and incorrect reporting of the sample values.


If the message *A new version of the RSK file format is available.* appears, click **Update**. The update process may take some time, however, Ruskin does estimate the time with the message *The anticipated update duration is <time period>.*

## 13.6 Plot view

You can use the **Plot** view to view a graphical display of data in datasets or live data. When viewing live data, the logger must still be attached.

A toolbar at the top of the **Plot** view contains various buttons to help you customise, explore, and export the graphical display.

Each channel appears as a different colour in the graphical display. These colours are specified for all graphical displays in **Options** menu > **Preferences** > **Plotting** and can be changed only there. You can also change other defaults affecting the **Plot** view in **Preferences**. For information, see [Specifying plotting preferences](#)

⚠ Scaling of the data is based on the on the minimum and maximum value sampled for each channel - sometimes there are erroneously high or low values that may make the real data appear incorrect. Use the vertical zoom  to increase the scale of the data displayed.

You can click a particular time (location) in the plot to view each channel value and related statistics at that time. A vertical black line marks the place. The **Cursor** tab panel above displays the channel values, units, the sample number, and the time that the data was measured.

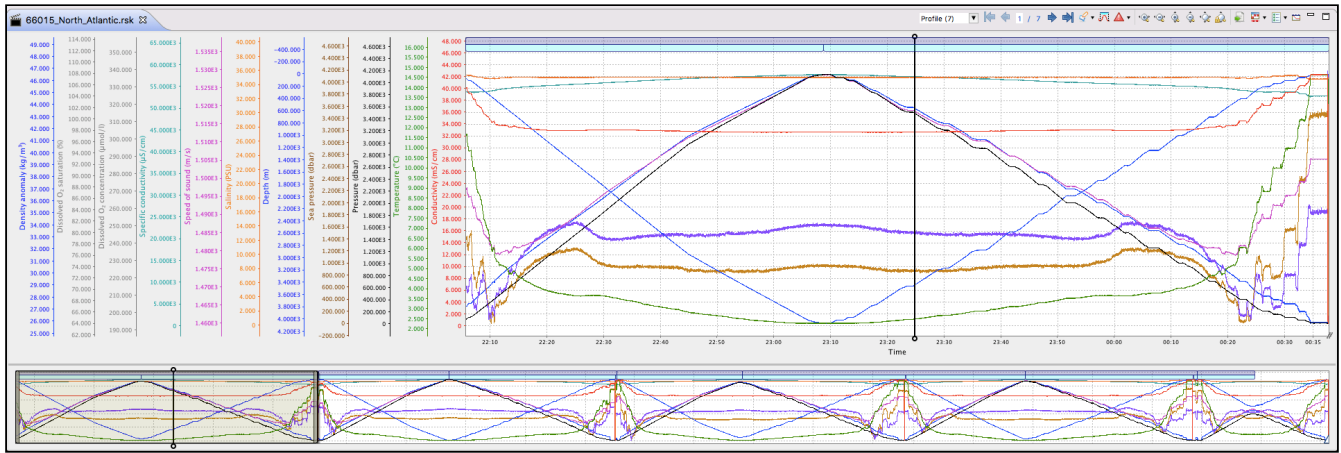
For datasets only, you can select the **Display statistics** check box to view the average value and standard deviation for each channel based on the number of samples that you specify.

If you want to copy the data to the clipboard and then paste it into another application, select a row, a column, a cell or click on the word channel for the entire table and then click **Copy**.

The graphical display for each dataset appears on its own tab in the **Plot** view. The dataset file name appears at the top of the tab. The icons differentiate at a glance the live data from the datasets.

### 13.6.1 Thumbnail view

Large data sets can take a long time to display on older systems, and to facilitate data viewing, large files may be down sampled and displayed in a thumbnail view. This view is presented below the main **Plot** view and contains a sliding window. The data within the window is displayed in the **Plot** view. This window may be repositioned by using the next and previous keyboard arrow keys, or dragging it using the mouse, or double-clicking to position the window in the appropriate location in the thumbnail view. The sliding window reports the date and time at the center of the window when selected and moving.



## 13.6.2 Live data

You can use the **Plot** view to view a graphical display of samples being fetched at the default speed for your logger type. The graphical display for live data for each logger appears on its own tab in the **Plot** view. The logger model and serial number appear at the top of the tab. The icons differentiate at a glance the live data from the datasets.

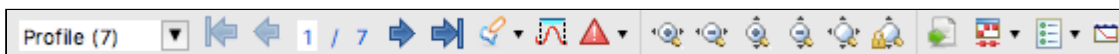
- ✓ If a graphical display does not appear, click the **Start live plot** or **Resume live plot** button. If the graphical display still does not appear, click the **Line style** button and ensure that either **Draw lines** or **Draw markers** is selected.

## 13.6.3 Plot tools

Live data toolbar





Dataset toolbar







## Tools for datasets and live data

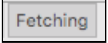
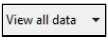

Button	Purpose	Use
	Zoom control	Zoom in/out horizontally, vertically, and reset zoom to display the maximum extent of each axis

Button	Purpose	Use
	Auto-ranging	<p>Toggles the auto-ranging of the channel axis</p> <div>  Disabling the auto-ranging of the axis can be useful for looking at trends in data </div>
	Data rendering type	Choose lines, shapes, or lines and markers for the trace lines
	Toggle channel visibility	<p>Turn on or off channels to be visible in the plot view</p> <p>Toggle on raw values removes the calibration equation from the sensor value</p>
	Event visibility	Turn on and off visibility of the various levels of events (error warning diagnostic)
	Delete the data in the Plot view	<p>Click the button if you want to delete all the data in the <b>Plot</b> view for all channels.</p> <p>Note: Any data stored on the logger is preserved.</p>
	Minimize the Plot view	<p>Click the button to place the <b>Plot</b> view as an unopened view in the margin of the Ruskin window.</p> <p>Tip: To restore the <b>Plot</b> view to its former size, click the restore button in the margin.</p>
	Maximize the Plot view	<p>Click the button to expand the <b>Plot</b> view to the full size of the Ruskin window.</p> <p>Tip: To restore the <b>Plot</b> view to its former size, click the <b>Restore</b> button in any margin that contains an unopened view.</p>

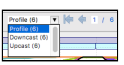
## Tools for live data



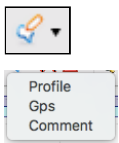




Button	Purpose	How to use
Show legend /Hide legend 	Show or hide a legend in the plot	Click this button to toggle between showing and hiding a legend at the bottom of the plot.
Export plot 	Save an image of the graphical display to a file	Click the button and then specify a file type ( <b>PDF</b> or <b>PNG</b> ), location, and name for the file that will contain an image of the graphical display currently in the <b>Plot</b> view. If you want the legend to be included, first click the show legend button.
Show/ hide axes 	Show or hide axes	Click the button to toggle between showing and hiding the vertical axes to the left of the plot.
	Show or hide data panel	Click to hide the tab called <b>Main</b> that is referred to as the <b>Data panel</b> . This tab shows how many samples the logger has collected, the time and date, and a table that helps to easily view the information collected. If you select a row in the table, you can copy that row using the <b>Copy row</b> button. The row is saved to the clipboard where you can then paste the row into a text editor or word processing program.  If you want to copy just one cell, click the cell you want to copy, and click the <b>Copy cell</b> button.  Note: The <b>Copy row</b> button changes to <b>Copy cell</b> when you select a cell in the table.




Button	Purpose	How to use
Live plot mode 	Start, stop, or restart the flow of data in the Plot view at the default speed and viewing streamed data	The logger supports either streaming or fetching data. Fetching is the action of asking the logger to take a reading and report it. Ruskin displays the fetched data every 1-2 seconds. Fetching is disabled if the logger is enabled. In streaming mode, Ruskin receives streamed data from the logger at the sampling rate set during the logger configuration.
View all data 	View chart display by time or all data	Click the button to display a drop down list of time span options to display the data by time period. For example, display 2 minutes of data. You can also choose to display all of the data collected.
Clear plot 	Delete the data in the Plot view	Click the button if you want to delete all the data in the <b>Plot</b> view for all channels. Note: Any data stored on the logger is preserved.

## Tools for datasets

Button	Purpose	Use
	Filter	Changes the type of annotation for the navigation buttons <ul style="list-style-type: none"> <li>• If an annotation is selected, switching filters zooms the view to the newly selected annotation.</li> <li>• If no annotation is selected and switching filter from one profiling annotation type to another (profile, upcast, downcast), the view does not change.</li> <li>• If no annotation is selected and switching filter between categories (profile, upcast, downcast to any other non-profiling annotation type, or any non-profiling annotation type to any other annotation type), the view moves to the first annotation of the new category.               <ul style="list-style-type: none"> <li>• Comment → Profile moves to first profile</li> <li>• Profile → Comment moves to first comment</li> <li>• Comment → Downcast moves to first downcast</li> <li>• Profile → Downcast does not move.</li> </ul> </li> </ul>

Button	Purpose	Use
	Move to first, previous, next, and last	Move to the first, previous, next, and last annotation of the filter type If annotation is selected also moves selection
	Index	The current annotation index, which can be edited  Blue text if annotation selected or time domain extent matches annotation extent  Red otherwise  Click middle of index (the / ) to zoom to annotation
	Create annotation	Select type of annotation to create  After selection click and drag on main plot to create annotation  Profiles or geodata cannot overlap the same type - new annotations will fill the available space between existing profiles  <div>  Only available in time domain </div>
	Cast detection	Runs a cast detection algorithm based on depth and conductivity to automatically generate profiles and casts  <div>  Overwrites logger generated cast events and profiles </div>
	Export plot	Exports the current view of the main plot to pdf or png

Button	Purpose	Use
	Plot by depth	<p>Toggles between plot by time and plot by depth</p> <div> <p><b>i</b> If there is no depth channel the plot would then use the next pressure or pressure derived channel starting from the bottom of the channel list</p> </div>

### 13.6.4 Keyboard Shortcuts

To navigate in the plot a number of keyboard shortcuts are available.

- Move to the next sample: Arrow Right (Next arrow)
- Move to the previous sample: Arrow Left (Previous arrow)
- Zoom in around data cursor: Up arrow
- Zoom out around data cursor: Down arrow
- Double click to zoom in to the range of the annotation
- Zoom a region: Press and hold shift key and then click the left mouse button and drag the window that appears.
- Pan: Press and hold the Ctrl key and then click the left mouse button and drag the mouse left or right or up or down across the plot.
- Shift arrow moves by a minimum of 10 samples or 10% of the current displayed data

To navigate in the thumbnail view

- Anywhere you click you will centre the master overlay
- You can click and drag from the centre of the master to pan
- If you click on the edge of the master overlay the cursor will change and you can resize the window
- Scroll to zoom the master overlay
- Your data cursor will show up in the thumbnail view, but it can only be updated from the main plot

## 13.7 Exporting datasets

You may want to share your data with others or analyse your data using other software. You can export data as a text file, which can then be imported into many applications, or export it in a particular format for analysis in Microsoft Excel, Matlab MAT or OceanDataView.

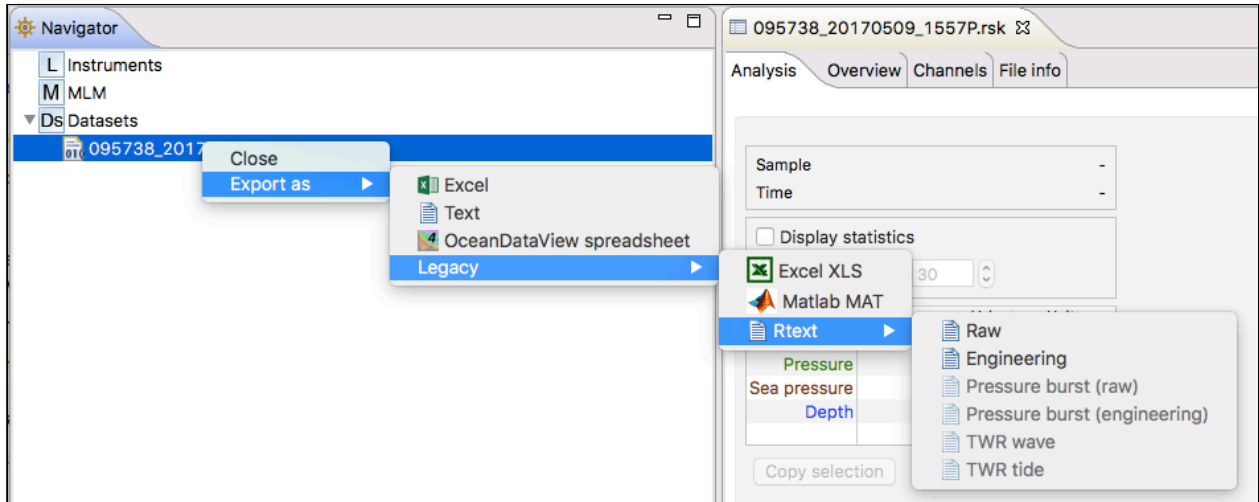
The Raw, Engineering and Pressure burst file format depends on the logger type and sensors in use.

The Raw format contains decimal voltage ratios with un-calibrated readings. The Engineering format contains the data in the units of the sensor; these are calibrated sensor readings. The Pressure burst is the file of pressure burst readings and is only applicable to |wave loggers. The Engineering file contains all the data presented in the **Plot** view and in the case of |wave loggers the wave analysis data as well. In a |wave Engineering file there are two parts to this file – the plot view data and the wave analysis.

You must already have downloaded the data to a dataset or opened an existing dataset.

## Steps

1. Right-click the dataset whose data you want to export, and hover to **Export as** to open a submenu, or use **File** menu > **Export dataset**.



2. Select the appropriate export format (Excel, Text, OceanDataView or one of our Legacy formats). Under the Legacy formats you will find exports for Excel, Matlab, and Rtext files (**Raw**, **Engineering** or **Pressure burst**). TWR file formats apply to the older loggers and are not available for Logger2 and newer generations.

❗ Exports to Matlab may fail if the RSK file size exceeds 20MB. Alternatively, an RSK file can be imported directly into Matlab with our toolkit [RSKtools](http://www.rbr-global.com) that is available for download from our website at [www.rbr-global.com](http://www.rbr-global.com). The RSK file is a single file database based on SQLite that allows us to have very large files with high-speed access to any part of the dataset.

⚠ Large files may not export completely into any of these formats. Large files should be converted to .txt and processed after the fact. The Excel export is limited to 65000 rows

3. Specify a location and a name for the data file.
4. Click **Save**.

## 14 User calibration

Calibration coefficients are calculated for each sensor and the coefficients are stored in the logger. Calibration certificates are provided for each sensor and contain both the calibration equation and the coefficients. Hard copies are provided with each shipment and the documents are contained inside the shipping box. Please refer to the calibration certificates for the coefficients and residuals. RBR can replace lost or misplaced calibration certificates.

### 14.1 Change calibration coefficients

Sensors such as the dissolved oxygen sensor that can be field calibrated will require you to update the calibration coefficients for these channels periodically. You may also need on occasion to manually enter new coefficients, although this is not recommended for factory calibrated sensors (for example T or D) unless instructed by RBR. **Steps**

You can view static information about an instrument at any time as follows:

1. In the **Navigator** view, under the **Instruments** list, click the appropriate logger.
2. Click **Analysis** tab > **Calibration** tab to show the current calibration coefficients.
3. To manually change a coefficient, click on the appropriate entry in the table (C1, C2, C3, etc.). The current entry will be highlighted, and the new value can be typed.
4. If a two point calibration has been performed, and calculated coefficients have been copied, right click on either the **Time** or **Parameter** entry for the parameter you wish to modify. Select **Paste to selected row** from the drop down menu.
5. Click **Store calibration** to write the calibration coefficients to the logger.
6. If you need to revert to previous coefficients, click **Revert calibration**.



If you do not click **Store calibration**, the coefficients will not be written to the instrument, and will be lost once your session is closed.

### 14.2 N-Point calibration

Sensors such as Dissolved Oxygen ([Oxyguard](#)) or [turbidity](#) generate a voltage output that is proportional to the value of the parameter being measured. To calibrate these sensors, Ruskin offers an N-point calibration method to generate calibration coefficients.

### 14.3 Oxyguard DO calibration



The Oxyguard DO sensor has a true zero point and therefore it can be calibrated using the single-point calibration method using a reading at 100% oxygen concentration only. The 100% calibration should be performed at the expected temperature and salinity of the deployment environment.

If the logger has a pH/ORP sensor and Oxyguard DO sensor, it is advisable to ensure that the pH/ORP and Reference sensors are submerged in the water during measurement.

## Equipment

1. Two Large mouth beakers
2. Sodium sulphite  $\text{Na}_2\text{SO}_3$
3. Aquarium air pump
4. Magnetic stirrer

## Preparing solutions

Reference Point 1 solution – Oxygen saturated solution at expected temperature and salinity of deployment environment

1. Fill the large beaker with 2 L of water. And install magnetic stirrer.
2. Bubble air through the water using an air pump (an aquarium air pump would work).
3. Switch ON the air-pump and the magnetic stirrer.

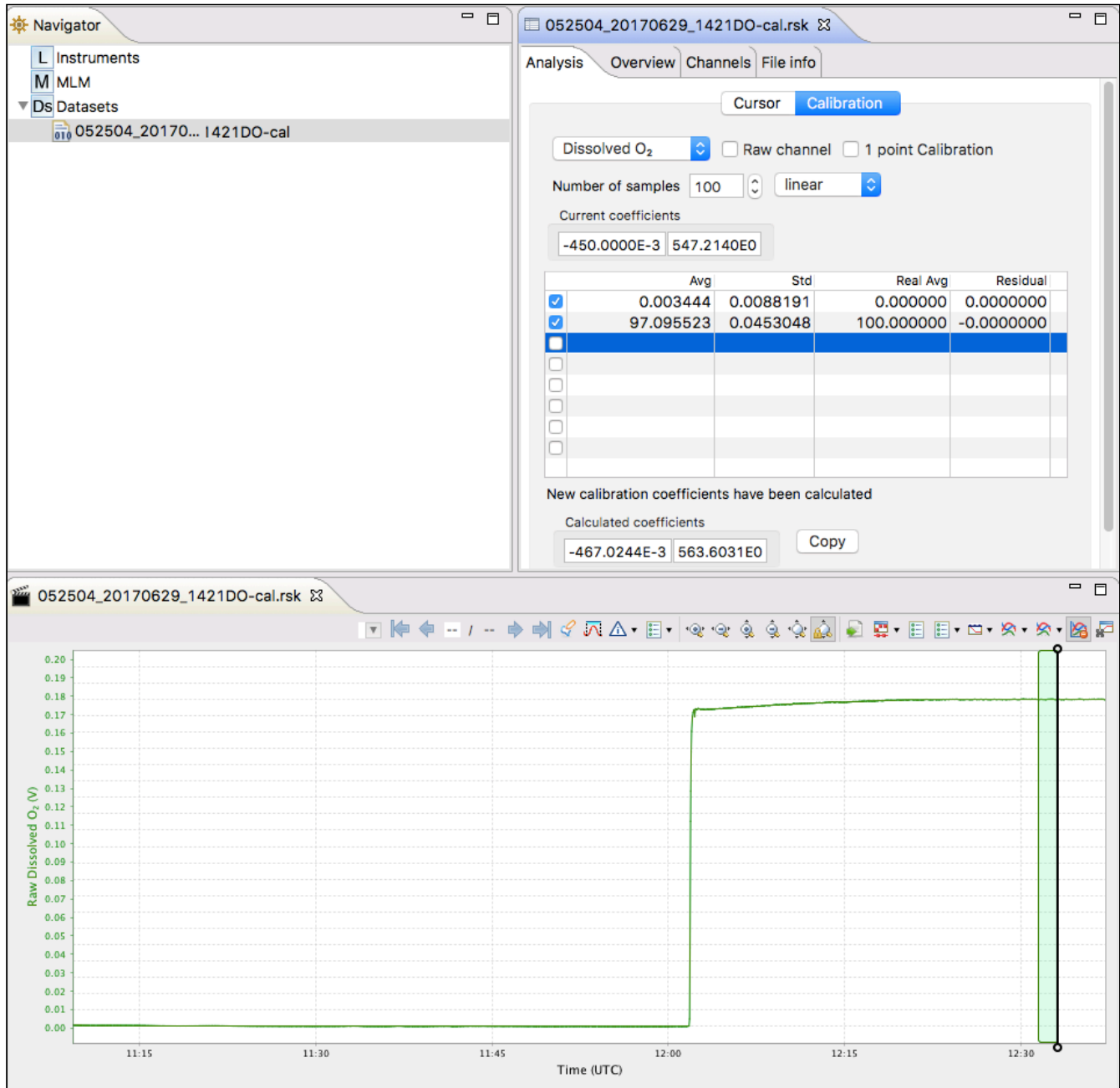
Reference Point 2 solution – Dissolved oxygen concentration of zero

1. In a beaker, dissolve approximately 5 tsp of sodium sulfite ( $\text{Na}_2\text{SO}_3$ ) into 500 mL tap water.
2. Mix the solution thoroughly with a magnetic mixer. The solution will be oxygen-free after 15 minutes.

## Steps

1. In Ruskin, configure the instrument to sample at a fast rate, between 6 Hz and 3 seconds.
2. Use **Sync to PC** to ensure the logger clock is synchronized to the PC clock, and ensure the end time is set so that the logger will keep sampling until calibration is complete.
3. Submerge the dissolved oxygen sensor in the Reference Point 1 solution for at least 15 minutes near the stirrer so that it is in the best mixed area of the bath.
4. Take sample readings for at least 15 minutes for the 100% calibration point, making note of the time that the sample is being measured.
5. Submerge the dissolved oxygen sensor in the Reference Point 2 solution for at least 15 minutes for the 0% calibration point, making note of the time that the sample is being measured.
6. Retrieve the data from the data logger as per the steps in [Download](#).
7. The calibration data should now be displayed in the **Plot** view. In the **Properties** view, go to **Analysis** tab > **Calibration** tab.
8. Select the dissolved oxygen sensor type from the drop down list.
9. The **Number of Samples** spinner box is automatically set to **100**.  
This value is the number of sample points Ruskin will average the calibration coefficients for the sensor. Typically, this value should be in the range of 50 to 100 samples.
10. Click on a stable point in the **Plot** view corresponding to 100% oxygen. In the table in the first row, under **Real Avg**, enter 100 and press enter.

11. Select the check box in the second row in the table, then click on a stable point in the **Plot** view corresponding to 0% oxygen. In the table in the second row, under **Real Avg**, enter 0 and press enter.
12. Ruskin automatically calculates the calibration coefficients, and these values appear in **Calculated coefficients**. Clicking the **Copy** button saves the new calibration coefficients to the clipboard.
13. Follow the steps in [Change calibration coefficients](#) to update the coefficients for this sensor in the data logger.



## 14.4 Turbidity calibration

The Seapoint turbidity sensor is calibrated by RBR with a two-point calibration technique. We recommend to do a two point calibration performed under fluorescent lighting.

Alternatively, one can do a single point calibration. If doing a single "0" point calibration in distilled water the calibration will only correct the coefficients for an offset. If only a single non zero point is performed the calibration will recompute the slope coefficient. We recommend to only perform a "0" point calibration unless you are confident on your non zero standard.

### 14.4.1 Two-point calibration

#### Equipment (entire logger submerged)

- 4000-FTU Formazin standard – 500 ml
- Distilled water – 5 L
- Black-walled, wide-mouth container (large enough to hold the logger)
- Volumetric flask 1000 ml, class A
- Volumetric flask 200 ml, class A
- Stir stick



If you plan to submerge only the sensor, you can decide on the container volume and adjust the solution volumes appropriately.

#### Steps (preparing solutions)

1. In Ruskin, configure the data logger to sample using a 10 second sampling interval and set the sensor to autoranging - see [Autoranging and fixed gain](#).
2. Use **Sync to PC** to ensure the logger clock is synchronised to the PC clock, and ensure the end time is set so that the logger will keep sampling until calibration is complete.
3. Flush the sensor, container and glassware with distilled water and dry them.
4. Fill the black wall container with 5000 ml distilled water using the large volumetric flask.
5. Set the sensor in the container until the sensor is fully submerged in the distilled water.



The distance from the sensor's windows to the container wall must be at least 20 cm. If possible, place a dark cover on the calibration container and avoid direct light on the container.

6. Record the data in distilled water for five minutes.  
This is the zero-turbidity calibration point.
7. Fill the 500 ml volumetric flask with Formazin Standard. Remember to gently shake the bottle before opening the Formazin solution.
8. Add 500 ml Formazin Standard to the black wall container with distilled water, and gently mix the solution with a stirring stick.



9. Calculate the value of the standard turbidity solution at calibration point according to following formula:



Calculating dilution

$$Tu_{STD} = Tu_{STK} * V_{TOT} / (V_{DW} + V_{TOT}) = 363.63 \text{ FTU}$$

Where:

$Tu_{STD}$  = turbidity of the standard solution (FTU)

$Tu_{STK}$  = 4000 FTU – turbidity of the stock solution

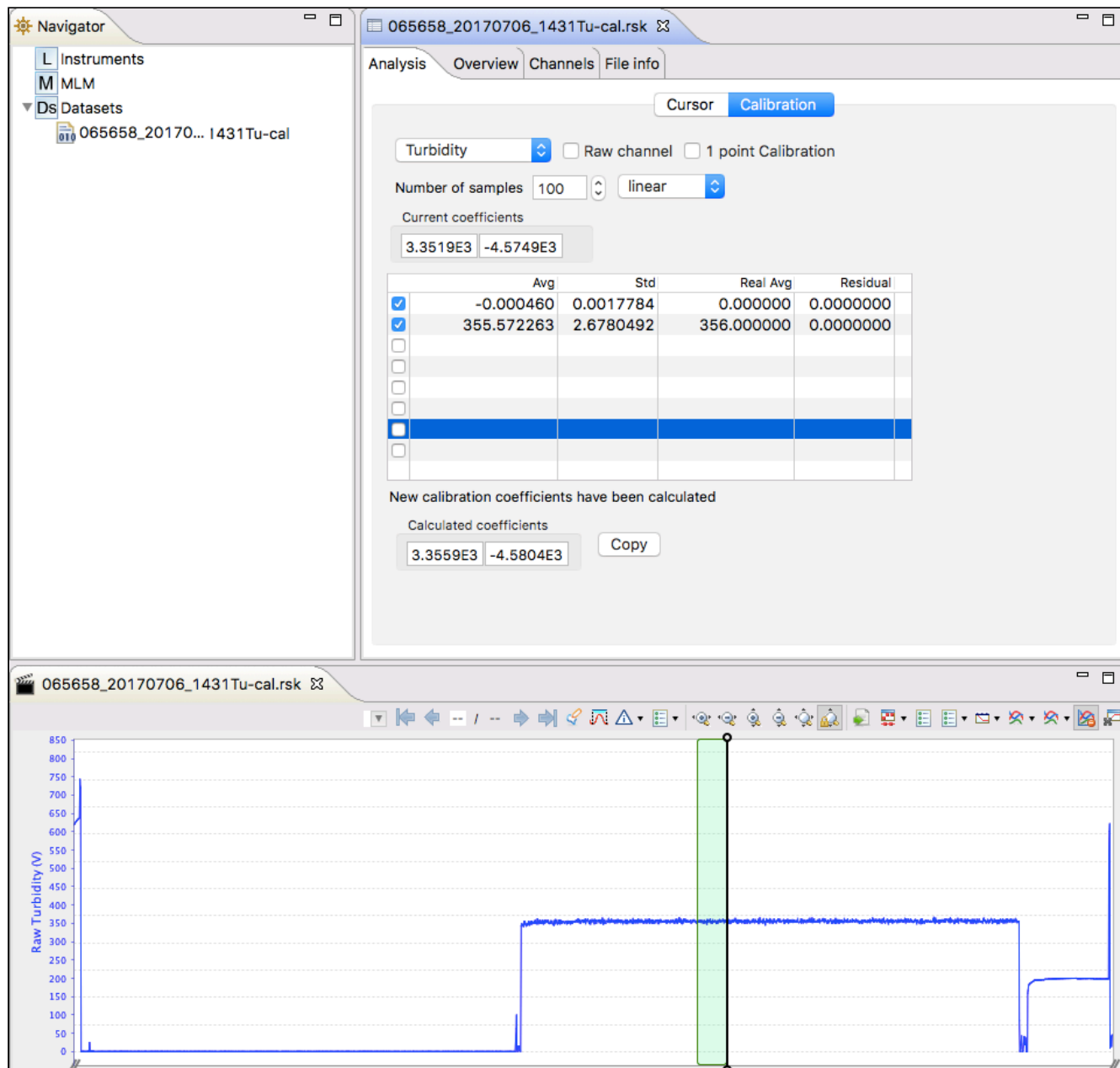
$V_{TOT}$  = 500 ml volume of stock solution at calibration point (ml)

$V_{DW}$  = 5000 ml - initial volume of distilled water

10. After five minutes, remove the logger from the calibration container and wash the sensor head under regular tap water.
11. Retrieve the data from the data logger as per the steps in [Download](#).
12. The calibration data should now be displayed in the **Plot** view. In the Properties view, go to **Analysis** tab > **Calibration** tab.
13. Select the **Tu sensor** type from the drop down list.
14. The **Number of Samples** field is automatically set to **100**.  
This value is the number of sample points Ruskin will average calculate the calibration coefficients for the sensor. Typically, this value should be in the range of 50 to 100 samples.
15. Click on a stable point in the **Plot** view corresponding to 0 NTU. In the table in the first row, under **Real Avg**, enter 0 and press enter.
16. Select the check box in the second row in the table, then click on a stable point in the **Plot** view corresponding to reading of your turbidity solution. In the table in the second row, under **Real Avg**, enter the value of your turbidity solution and press enter.
17. Ruskin automatically calculates the calibration coefficients, and the values appear in **Calculated coefficients**. Clicking the **Copy** button saves the new calibration coefficients to the clipboard.
18. Follow the steps in [Change calibration coefficients](#) to update the coefficients for this sensor in the data logger.



By using the above formula and changing the volume of distilled water and Formazin solution, you can prepare different calibration points or different volumes for checking linearity of the turbidity sensor or getting close to real turbidity value of standard turbidity solution.



## 14.4.2 One-point calibration

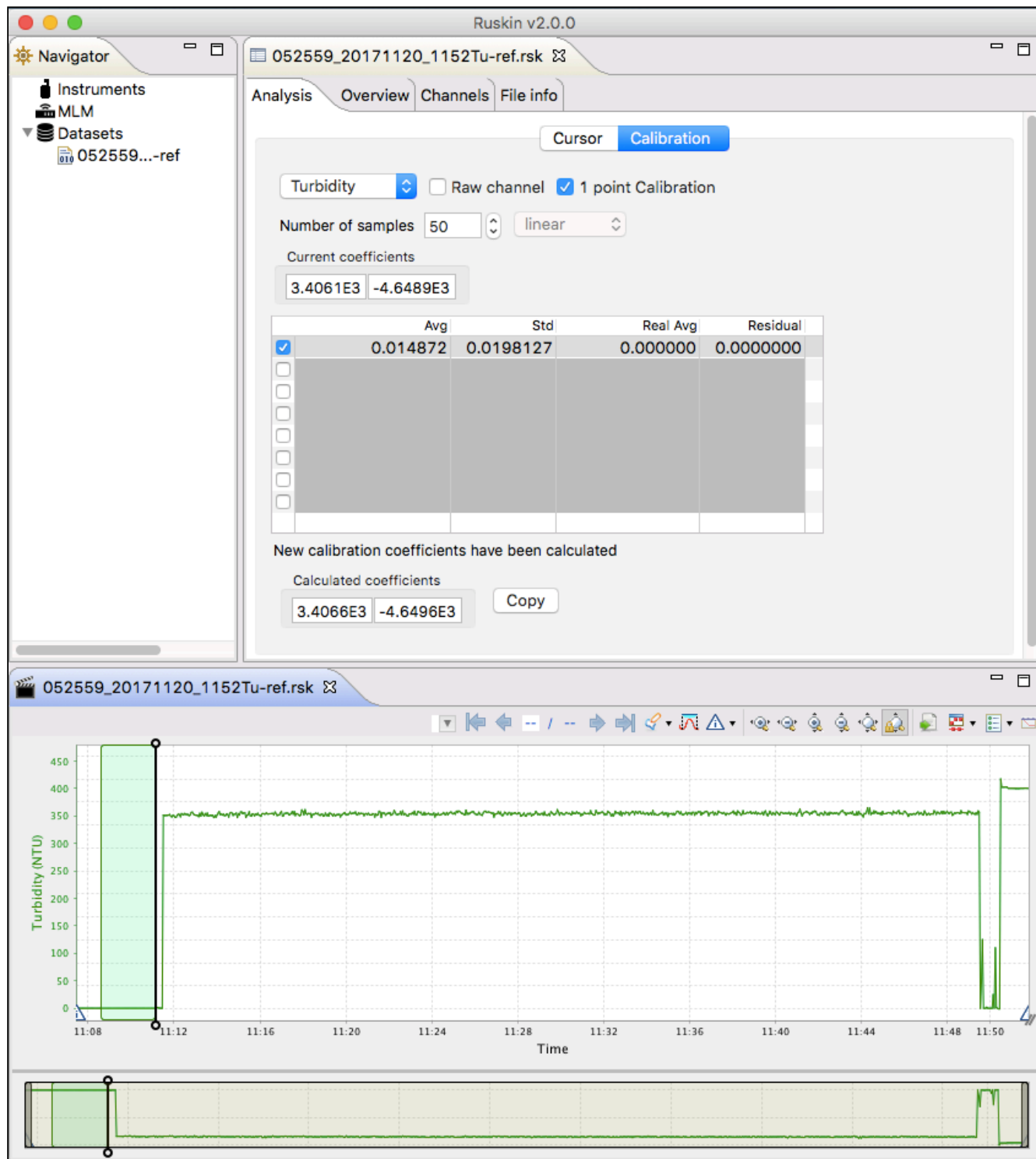
Using the same procedure as in the 2-point calibration, one can use only the distilled water or formazin standard to generate new coefficients from a single point.

RBR suggests to use the one point calibration for establishing a new "0" value only, as unless one is very confident on their non zero point they may put the unit out of specification.

After you have generated a dataset of your single point as described in the procedure above follow the setps below:

1. Retrieve the data from the data logger as per the steps in [Download](#).

2. The calibration data should now be displayed in the **Plot** view. In the Properties view, go to **Analysis** tab > **Calibration** tab.
3. Select the **Tu sensor** type from the drop down list.
4. The **Number of Samples** field is automatically set to **100**.  
This value is the number of sample points Ruskin will average calculate the calibration coefficients for the sensor. Typically, this value should be in the range of 50 to 100 samples.
5. Click on a stable point in the **Plot** view corresponding to 0 NTU. In the table in the first row, under **Real Avg**, enter 0 and press enter.
6. Ruskin automatically calculates the calibration coefficients, and the values appear in **Calculated coefficients**. Clicking the **Copy** button saves the new calibration coefficients to the clipboard.
7. Follow the steps in [Change calibration coefficients](#) to update the coefficients for this sensor in the data logger.



## 15 Preferences

Ruskin sets global preferences that require no changes in many situations. However, as you learn more about what Ruskin can do, you may want to change some of these defaults to better suit your requirements. The global preferences include:

- where to store output files
- plotting preferences
- configuring derived channels
- calculating derived channels when sensors are missing

You can change these preferences at any time.

### 15.1 Specify location for log files

You can control where log files are stored by default. Specify these locations before downloading any data.

#### Steps

1. From the **Options** menu, click **Preferences**.
2. In the list on the left side, click **General**.
3. In **File location**, type a directory name in the **Directory for log files** text box, or click **Browse** to locate the directory where you want to store log files.



Log files are used when you request RBR support.

4. Click **Apply** or **OK**.

You can change where future log files are stored by default at any time. The change takes effect immediately.

### 15.2 Specify Language selection

#### Steps

1. From the **Options** menu, click **Preferences**.
2. In the list on the left side, click **General**.
3. In **Language selection**, select a language from the list.
4. Click **Apply** or **OK**.

### 15.3 Using advanced sampling controls

#### Steps

1. From the **Options** menu, click **Preferences**.
2. In the list on the left side, click **General**.
3. In **Sampling control**, select **Enable advanced sampling controls** check box to change from the simple control.
4. Click **Apply** or **OK**.



Simple control: provides a default list of fixed values.

Advanced control: provides the user the ability to enter any values.

## 15.4 Derived channels RBRsolo/duet



Ruskin calculates all the possible derived channels for that specific logger.

The RBRsolo<sup>3</sup>D and RBRduet<sup>3</sup>T.D measure pressure and from that sea pressure and depth is derived. The RBRsolo<sup>3</sup>DO measures percent dissolved oxygen saturation and from that dissolved oxygen concentration may be derived.

### 15.4.1 Depth channel

To set up the initial values to derive depth and sea pressure select the menu item **Options**, then select **Preferences**, then select **Derived channels** and select the **Depth** tab. Enable the depth channel and select the appropriate calculation methods and edit the default parameters.

Enter the average expected Atmospheric pressure and the expected density of the water (default values are populated). There are two methods to calculate depth - select the appropriate method using the radio buttons. Sea Pressure is calculated by subtracting the Atmospheric pressure.



For downloaded files, use the dataset [Parameters tab](#) to edit the parameters to derive the channel.

### 15.4.2 Dissolved Oxygen concentration

To set up the initial values to derive dissolved oxygen concentration select the menu item **Options**, then select **Preferences**, then select **Derived channels** and select the **Dissolved O2** tab. Enable the Dissolved Oxygen channel and select the desired concentration units (μMol/L, mg/L or mL/L) from the drop down list.

Derived Channels

Enable and configure derived channels

Depth

Conductivity - Salinity

Dissolved O2

No sensor values

☒ Enable Dissolved Oxygen Channel
 

Any logger using an Oxyguard DO sensor

☒ Derive concentration using the Weiss equation

Use the following unit
 

mL/L

⚠ For downloaded files, use the dataset [Parameters tab](#) to edit the parameters to derive the channel.

## 15.5 Specifying plotting preferences

You can specify how you want the graphical display in the **Plot** view to behave by default. With the exception of choosing colours for each channel, these preferences can be overridden for a particular graphical display in the **Plot** view.

✓ You can click **Apply** to save your changes without closing the dialog box.

### 15.5.1 Channel visibility tab

The **Channel visibility** tab displays many options to hide or show specific information in the **Plot** view. These settings are applied when displaying a dataset in the **Plot** view. Some information in this tab is enabled by default. When you select any of the check boxes in this tab, the action is immediate.

**Channel visibility** tab with default settings

Plotting

Manage default plotting behavior

Channel visibility

Channel colours

☒ By default, hide any measured channel underlying a simple derived channel  
☐ Show dataset events by default  
☒ Show dataset errors by default  
☐ Automatically save live data to a file  
☐ By default, hide all measured channels

☐ Hide temperature channels
☐ Hide conductivity channels
☐ Hide pressure channels
☐ Hide distance channels
☐ Hide dissolved O2 channels
☐ Hide fluorometry channels
☐ Hide pH channels
☐ Hide PAR channels
☐ Hide ORP channels
☐ Hide BPR channels
☐ Hide transmittance channels
☐ Hide turbidity channels
☐ Hide voltage channels

☐ By default, hide all derived channels

☐ Hide salinity channels
☐ Hide depth channels
☐ Hide distance channels
☐ Hide specific conductivity channels
☐ Hide density anomaly channels
☐ Hide pressure channels
☐ Hide speed of sound channels
☐ Hide dissolved O2 channels

## Steps

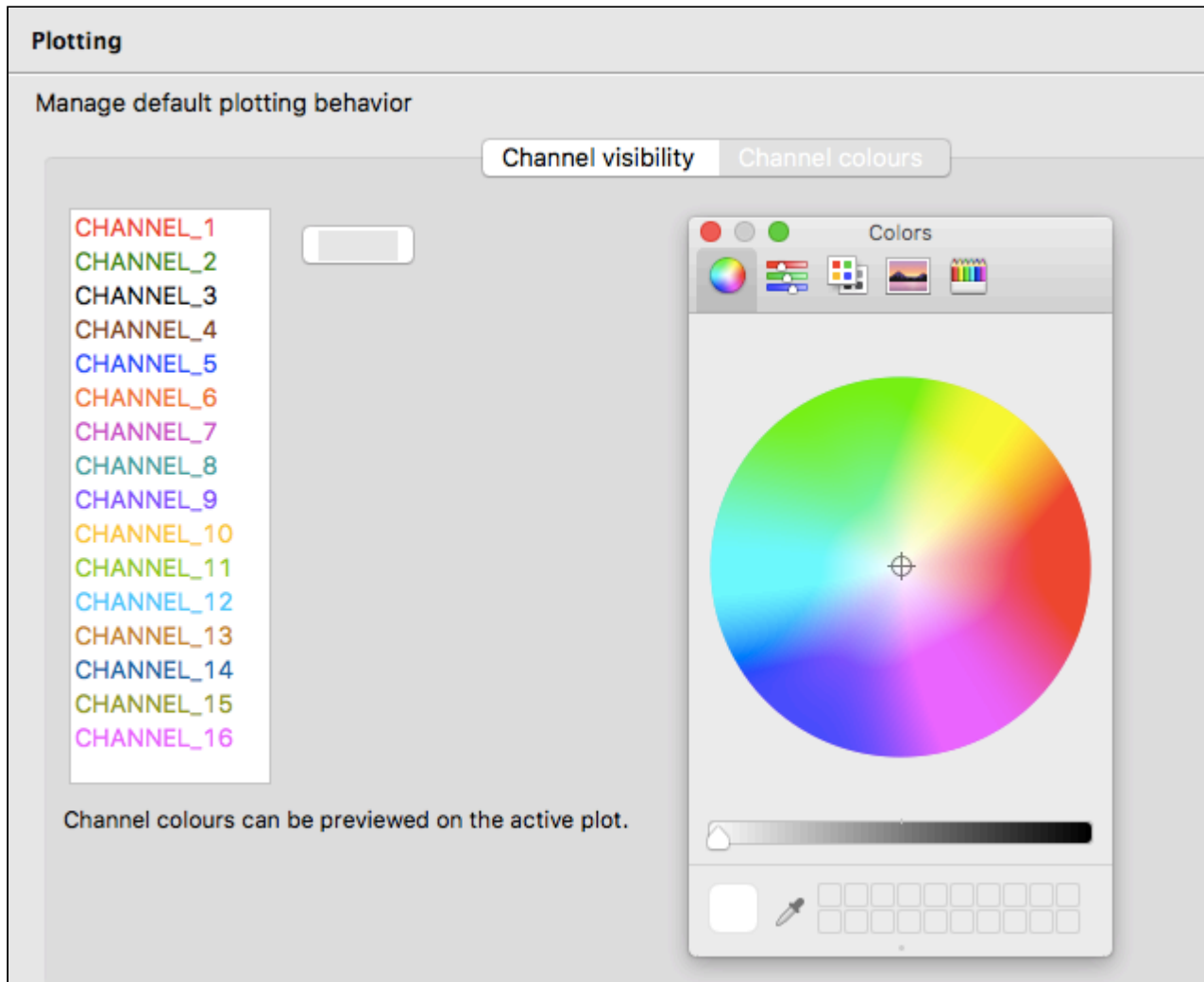
1. From the **Options** menu, click **Preferences**.
2. In the list on the left side, click **Plotting**.
3. On the **Channel visibility** tab, select the check box for the information you want hidden.  
Events appear at the x-axis as a vertical grey line with brief text to indicate the type of event, such as STP for a stop event in a dataset. Refer to [Appendix A - Event and error stamps](#) for a list of the event types.
4. To hide all measured channels, select **By default, hide all measured channels** check box.
5. To hide all derived channels, select **By default, hide all derived channels** check box.
6. To show information, clear the check box beside the information you want shown.

## 15.5.2 Channel colours tab

The **Channel colours** tab allows you to choose a different colour for each channel that is shown for information currently running in **Plot** view, or from an opened dataset. If there is no colour available that you like, you can create your own colour. When you select a colour, the new colour is immediately updated by Ruskin.

**Channel colours** tab with the **Colour** dialog box to customize a colour for a channel





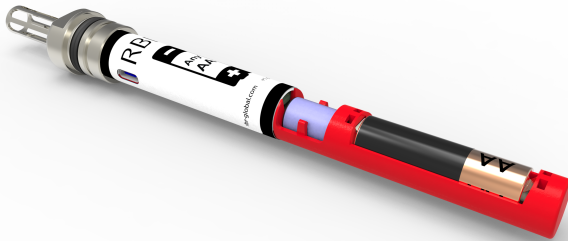
### Steps

1. From the **Options** menu, click **Preferences**.
2. In the list on the left side, click **Plotting**.
3. Click the **Channel colours** tab.
4. In the channels listed, click the channel you want to change the colour for.
5. Click the colour box that appears beside the channel list.
6. With the colour dialog box open, select a colour from the **Basic colour** area.
7. Select **OK** to apply the colour to the channel.
8. To create a custom colour:
  - a. Repeat steps 4 and 5.
  - b. Click **Define Custom Colours** and then choose a colour.
  - c. Click **Add to Custom Colours** to add the new colour to **Custom colours**.
  - d. Click **OK** to apply the new custom colour to the channel.

## 16 Logger hardware

### 16.1 Opening and closing the logger RBRsolo/duet

To open an RBR*solo*<sup>3</sup> or RBR*duet*<sup>3</sup> logger unscrew the sensor end counter-clockwise while holding on to the yellow housing. Once fully unscrewed, the housing can be carefully slid away from the sensor end cap, revealing the sensor carriage. The sensor carriage contains the battery compartment, desiccant holder and USB-C port.



Closing the logger is exactly the reverse of opening it. Remember to keep the O-rings clean and avoid scratching the O-ring mating surfaces. Carefully inspect the O-rings before deploying the logger. Do not use excessive force when tightening the end sensor end; hand-tight is quite sufficient, as the seal depends upon the O-rings, not the end cap tightness.

### 16.2 Changing the batteries RBRsolo/duet

RBR*solo*<sup>3</sup> and RBR*duet*<sup>3</sup> data loggers are powered by one (1) AA size 3.6V battery of any kind.

To remove the battery, use either your finger or a blunt tool to push the battery from its holder using the keyhole opening on the back of the carriage.



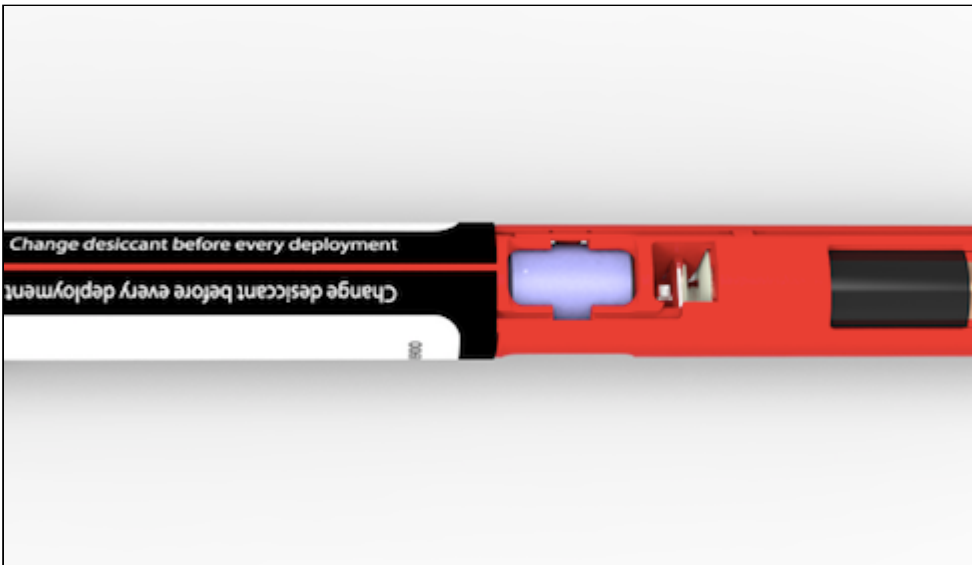
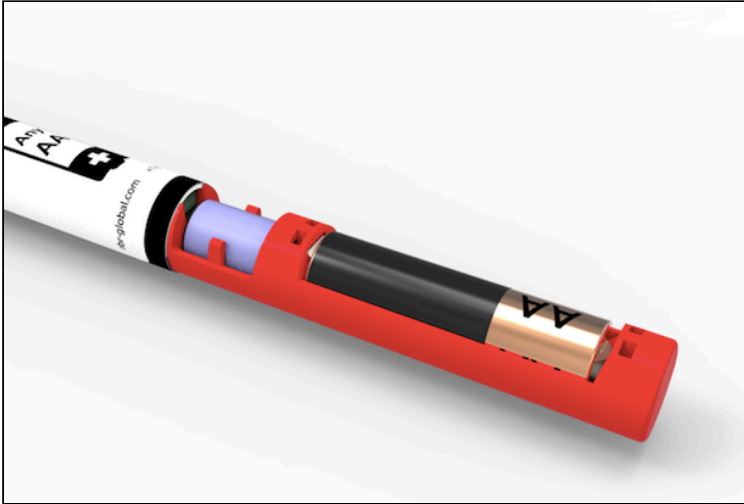
To insert the battery, press the battery into the battery holder, ensuring it is correctly oriented with the negative terminal placed towards the electronics. The label in the logger indicates proper battery placement.



## 16.3 Installing desiccant RBRsolo/duet

The RBR*solo*<sup>3</sup> and RBR*duet*<sup>3</sup> has a dedicated location for placement of desiccant in the sensor carriage, which will accommodate one (1) Dricap desiccant capsule (part # 02-01207AG35).

To remove the desiccant, use your finger or a pen to push through the small hole in the carriage and eject the desiccant.



Insert a fresh desiccant capsule into the desiccant holder, ensuring that it is secure.

## 16.4 Maintenance and repairs

### 16.4.1 Instrument calibration

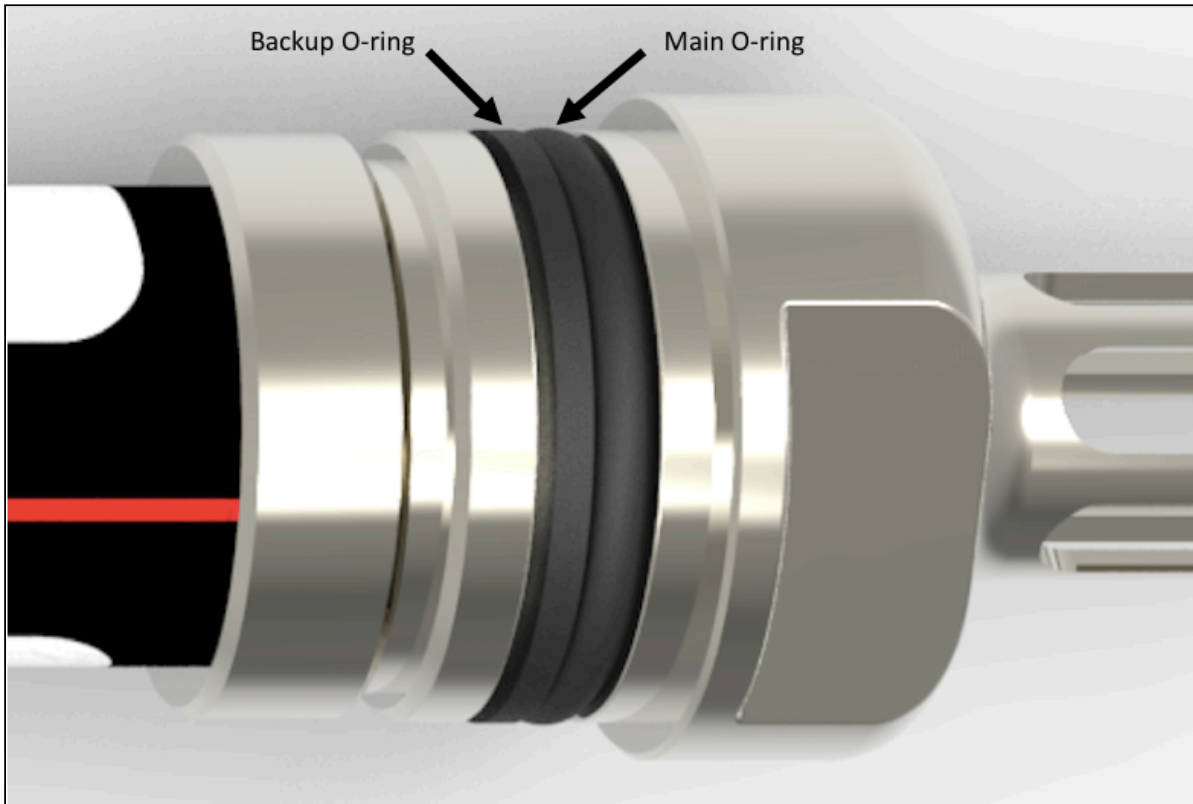
We recommend that you verify the calibration of your data logger before any critical deployment, periodically once a year, or if you suspect the calibration to be out of specifications. Discuss your calibration needs with RBR. In some cases, you will be recommended to return the instrument to RBR to have it checked and re-calibrated. Please contact us for our current calibration fees.

### 16.4.2 O-rings RBRsolo/duet

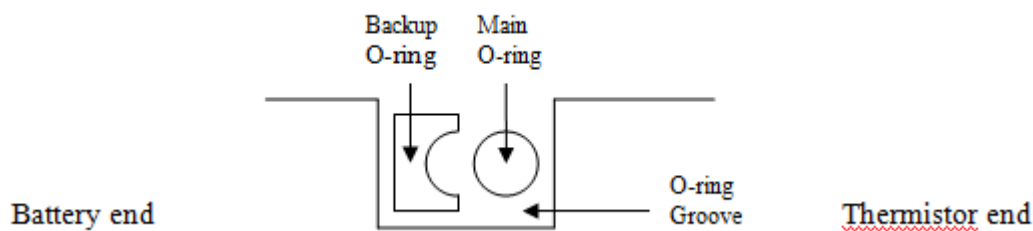
The single most important item of maintenance on any RBR submersible data logger is care of the O-rings. Any kind of water leak can damage the circuitry beyond repair and cause complete data loss. Every logger's seal depends upon its O-rings, not the end cap tightness. Proper O-ring maintenance, therefore, is crucial. The RBRsolo<sup>3</sup> and RBRduet<sup>3</sup> use

two O-rings. One is the main O-ring and the other is the backup O-ring. Both O-rings are required to ensure that the logger does not become flooded. The correct placement and orientation of the two O-rings is critical to maintaining depth rating integrity.

The backup O-ring is flat on one side, and cupped on the other. When installing, the grooved side must be located towards the main O-ring.



Before you remove the O-rings from the RBRsolo or RBR*duet*, make yourself familiar with their orientation and location. Inspect the new O-rings provided in the loggers support kit – there are two types. The back-up O-ring is a flat O-ring with a concave channel on one side. The main O-ring is round.



### Inspecting O-rings

Give particular 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 inner surfaces of the groove in the end cap where the O-ring sits

Any dirt present should be removed by wiping thoroughly with a soft, lint-free cloth. When cleaning, never use any material or tool which could scratch the O-ring or any of its mating surfaces. If any dirt is present in the O-ring groove,

then the O-ring should be removed as described below to allow thorough cleaning of the groove. If an O-ring needs to be removed for any reason, it should be replaced.

If the O-ring is scratched, cut, distorted, perished or defective in any other way it must be replaced. If any of the surfaces of the O-ring groove are scratched, pitted or otherwise damaged, the logger may need to be returned to RBR for refurbishment: please contact us for advice [support@rbr-global.com](mailto:support@rbr-global.com).

### Replacing an O-ring

1. Lever the O-ring from its groove. Use a soft plastic or wood tool; do not use a metal screwdriver or any other tool which may scratch the surfaces of the O-ring groove: doing so will probably render the end cap useless. Slide the O-ring out of its groove and off the logger. 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. Thoroughly clean the O-ring groove, taking great care not to scratch or damage it in any way. Inspect it carefully, and contact us for advice if it appears damaged. Apply a light film of silicone grease to all three inside surfaces of the groove, being careful not to trap any dirt, hairs or lint.
3. Select the proper O-ring and make sure it is not damaged. Lubricate it with a very light film of silicone grease to ease its installation. The correct order and orientation is as follows (assuming the o-rings have been removed): Install the main O-ring first by sliding it over the electronics housing (it is too small to fit over the sensor cap). Install the back up o-ring making sure that the concave part faces toward the sensor end and will mate with the main o-ring. The flat part of the backup o-ring must mate flat with the O-ring backing wall. Make sure there are no twists in either O-ring.
4. When the new O-ring is in place, inspect it once more for scratches and dirt, and wipe away any silicone grease deposited on the end cap.

Many experienced users of oceanographic equipment replace all O-rings before every deployment as a matter of routine. The cost of an O-ring is negligible compared with the cost of the instrument and its deployment. Routine replacement of O-rings, therefore, is cheap insurance.

RBR*solo* and RBR*duet*: #2-115 N70 O-ring, 8-115 N90 backup ring

## 16.4.3 Repairs

We support all instruments and software that we manufacture. First line support is always available by phone, fax or e-mail. Please contact us immediately if you are experiencing problems with your RBR product. It is very important to contact us before returning your instrument, as some difficulties can be easily solved on-site by the user. Please have the model and serial number of the unit handy when you contact us at [support@rbr-global.com](mailto:support@rbr-global.com).

There are no user-repairable parts of the logger. Any attempt at repair, whether successful or not, without prior authorization from RBR Ltd. will void the warranty. If it is necessary to return the product to RBR for an upgrade, repair, or calibration; please review the detailed shipping information on our website [www.rbr-global.com](http://www.rbr-global.com) before returning the unit.

In the unlikely event of an instrument requiring service at RBR, contact us for an RMA number and please use the following shipping address:

RBR Ltd  
95 Hines Road Unit 5  
Kanata, Ontario  
CANADA K2K 2M5

Telephone +1 (613) 599-8900

For those who are shipping from outside of Canada, you will need to clearly mark the waybill and any other customs paperwork with the following:

"Canadian goods being returned to manufacturer for repair. NOT A SALE."

Please state the instrument value on the waybill as closely as possible to the current market value based on the original purchase price less depreciation. Please contact RBR if you have any questions about the instrument value. Send the unit using your own preferred method (prepaid). However, we suggest that you do not use Ground Service, since customs brokerage charges will be billed incorrectly.

Units repaired under warranty will be returned prepaid by RBR. Warranty repairs are decided on a case by case basis.

#### **Standard Repair Charges (Non-warranty)**

Our minimum repair charge is \$150 CAD. This charge covers a comprehensive initial check, including verification calibration and sensor functionality. Minor repairs are also covered by this basic fee. If further repair work or re-calibration is necessary, a quotation will be issued to the customer. Once we have received authorization to proceed, the repair shall be completed and the instrument returned as soon as possible. Please note that any units returned with low (or no) batteries will have new batteries installed and the costs will be added to the repair invoice.

#### **16.4.4 Support kits**

To simplify maintenance of your data logger, RBR sells support kits with enough O-rings, and silicone grease for 5 deployments. Please contact RBR for more information or to place an order.

## 17 Appendices

### 17.1 Appendix A - Event and error stamps

The following is a list of event/error stamps that may be displayed in the data set.

**TIMESTAMP** - Time synchronization event, is used to ensure timing synchronization, whenever there is a possibility that the actual date/time of a sample according to the logger's internal calendar/clock does not match what is expected in the normal sampling sequence.

**USER STOP** - Sampling stopped by user, is used to indicate that a command to stop sampling occurred.

**UNKNOWN** - An unknown error has occurred, is used to indicate that the error has occurred in the logger and the cause of the error is unknown.

**ERROR ##** - Change event (system restart where logger clock is no longer valid), is used to indicate an internal error has occurred in the logger.

**RESTART ##** - Warm startup event (clock and programmed parameters are valid/unharmd), indicates a system restart, in which all programmed parameters are valid.

**GAIN###** - gain change event

Below is a description of all the different event stamp types ## which could be encountered. Some of these are quite common, while others indicate very rare fault conditions. Some may also occur together in various combinations, with no sample data between them.

Error##	code	comment
00	eDATA_ERROR_CATCH_ALL	generic/unknown/unexpected error
01	eDATA_ERROR_EOC	A/D *EOC bit was set (should always = 0)
02	eDATA_ERROR_DMY	A/D *DMY bit was set (should always = 0)
03	eDATA_ERROR_MODULE_ADDR	invalid address used for RBR channel
04	eDATA_ERROR_OVERFLOW	too much data to send to front end
05	eDATA_ERROR_BUS_BUSY	access to internal bus denied



06	eDATA_ERROR_TX_FAIL	timeout sending command
07	eDATA_ERROR_RX_TIMEOUT	timeout receiving response
08	eDATA_ERROR_PARSING	generic failure to interpret response
09	eDATA_ERROR_NO_SAMPLE	no sample was started
10	eDATA_ERROR_IN_PROGRESS	sample acquisition still in progress
11	eDATA_ERROR_FAILED	sample process failed somewhere
12	eDATA_ERROR_AVERAGE	average computation error (no valid samples)
13	eDATA_ERROR_REPLY_SHORT	front end reply contains fewer characters than expected
15	eDATA_ERROR_UNABLETOCOMP UTE	unable to compute derived/cross channel