RUSKIN
USER GUIDE

RBR*virtuoso³* RBR*duo³*

RBR*concerto³* RBR*maestro³*

rbr-global.com

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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
1.0	7-Oct-2011	Original
2.0	15-Oct-2012	Adding RBRvirtuoso and RBRconcerto, and new features
2.1	28-Jan-2013	Adding thresholding and AMT pH calibration, editing autoranging, thumbnail view, parameters tab, file export, event button, and calibration
3	26-Jun-2013	Initial controlled release, new part #, no other changes
4	22-Jul-2013	Ruskin v1.8.3 additions
5	02-Sep-2014	Migrated to new editing system, updated for Ruskin v1.8.20
6	22-Dec-2014	Added auxiliary controls
7	12-Jan-2015	Added bursting controls
B	12-Sept-2017	Final revision for standard loggers
C	02-Feb-2018	Logger 3 features
D	12-Dec-2018	Updated installation details, updated screenshots, added auto-deploy features
E	13-Mar-2019	Updated plotting information, firmware upgrades, and screenshots

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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 written specifically for the RBR*virtuoso^3*, RBR*duo^3*, RBR*concerto^3*, and RBR*maestro^3* 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.

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:\RBR`.
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?"
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 Ruskin.

> ⚠ 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.

An application named Ruskin 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). 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 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 Ruskin application 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. For general inquiries, use 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 Using a simulated logger.

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 logger and a computer, remove the battery end cap and locate the USB-C connector, just below the battery cover. The supplied interface cable is plugged into this connector. The USB-C connector can be inserted with either side facing up.
- 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.

- Click the **Configuration** tab to specify streaming**.**

> ✅ 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 Schedule a logger.

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.

- On the **Configuration** tab, click **Enable** to take samples according to the schedule that you specified. If you enabled streaming data, you will see the data appear immediately once the logger is enabled in the **Plot** view toolbar.

- If you want to download data, click the **Download** button from the **Configuration** 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 Using a simulated logger

Ruskin can simulate most logger types that RBR produces. We recommend that you experiment with your type of simulated logger before enabling a schedule for your actual RBR logger. This practice helps you become more familiar with how an RBR data logger interacts with Ruskin and how to configure the settings and features within Ruskin.

Configuring a simulated logger

1. From the **Instruments** menu, click **Simulate instrument**.
   The **Configure Simulated Instrument** dialog box appears.
2. Click on the tab that correlates to your logger's family type.

   For example, if simulating an RBR*virtuoso*^{3}, you would select the **Standard Instruments** tab.
3. Select from the information provided within the logger's tab.
4. Click **OK**.
   The simulated logger appears under **Instruments** in the **Navigator** view.
5. Go to the **Navigator** view and click the new simulated logger to see the general information and configuration settings in the **Properties** window.

You can now work with this logger the same way as you work with a real RBR logger, including: configuring, calibrating, and fetching data. Currently simulated instruments cannot be enabled or downloaded. For more information, see Deploy an instrument.

Multiple loggers, both real and simulated, can be listed in your **Navigator** window.

> ✅ If you want to remove a simulated logger, in the **Navigator** window, right-click the logger and click **Remove simulated instrument**. You can also use the **Instruments** menu.

8.3 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 general information such as model, serial number, generation, firmware version, battery status, and the channels.

Logger details					
Model: RBRmaestro³	**Channels**				
Generation: Late 2017	#	Parameter	Units	Sensor	Ranging
Serial: 907011	1	Conductivity	mS/cm	Marine	None
Firmware: 1.099	2	Temperature	°C	Marine	None
Link: USB	3	Pressure	dbar	RBR	None
	4	Temperature	°C	RBRcoda T.ODO	None
Power	5	Dissolved O₂ concentration	µmol/l	RBRcoda T.ODO	None
	6	Voltage	V	0v to +5v	None
Source: USB	7	Turbidity	NTU	Seapoint	Auto
Internal: 12.0V	8	Sea pressure	dbar	derived	None
External: 0.0V	9	Depth	m	derived	None
	10	Salinity	PSU	derived	None
	11	Specific conductivity	uS/cm	derived	None

8.4 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 battery end cap of the logger
- Insert the USB-C connector into the logger and connect the cable to your computer
- The logger appears in the navigator window and select the **Configuration** tab and select **Download...** (see Download)
- Save the file to a preferred location
- Evaluate your data (see Analysis)

8.5 Data format

Data can either be streamed from an instrument (requires a deployment to be enabled) or it can be fetched from the instrument.

Realtime data can be formatted in a limited number of formats as described below. Each format is listed alongside and an example output for an RBR*concerto*³ C.T.D:

Output format option	Instrument setting	Example data
Standard resolution	caltext01	`2018-12-10 13:06:38.000, 0.0005, 22.9536, 10.1149`

Output format option	Instrument setting	Example data
Standard resolution (units)	caltext02	2018-12-10 13:06:38.000, 0.0005 mS/cm, 22.9536C, 10.1149 dbar
Highest resolution (RBRquartz)	caltext03	2018-12-10 13:06:38.000, 0.000525642944, 22.939636, 10.1149120
Engineering	caltext04	2018-12-10 13:06:38.000, 525.642944e-006, 22.9396360e+000, 10.1149120e+000

The output format can be changed in Ruskin from the instrument's **Configuration** tab. There is a drop down menu item called **format** in the **Options** section.

- **Standard resolution**
  - All data values are shown to 4 decimal places
- **Standard resolution (units)**
  - All data values are shown to 4 decimal places
  - Following the value, and separated from it by a space, is a short string representing the units of measurement.
- **Highest resolution (RBRquartz)**
  - All values are shown with enough significant digits ensuring no loss of resolution.
- **Engineering**
  - All values are shown in 'engineering-notation' floating point (same as scientific notation except that the exponents are constrained to be multiples of three) with enough significant digits ensuring no loss of resolution.

The values following the timestamp are all the enabled channels. To identify which channels are enabled and their order in the string you can use the command **outputformat channellist**.

Example:

>> outputformat channelslist

<< utputformat channelslist = conductivity(mS/cm)|temperature(C)|pressure(dbar)

8.6 Ruskin Mobile

8.6.1 Connecting over Wi-Fi to a mobile device
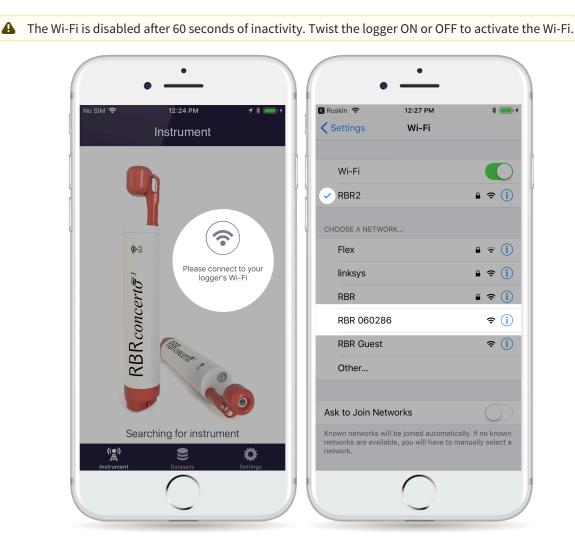
Install the Ruskin App on your mobile device by going to the Apple App store or Google Play.

Steps

1. Twist ON/Off on the logger end cap to activate the Wi-Fi.
   You may need to Twist the logger either to the ON position or OFF position to activate the Wi-Fi, but remember to twist to the OFF position to pause the logger.

> ✓ The twist activation is intended to start sampling or pause sampling, however twisting ON or OFF also enables the Wi-Fi module to transmit. This is the method to activate the Wi-Fi if it is not active.

2. The Android app will automatically scan Wi-Fi networks for any instruments. On iOS you must connect to the instrument in your Wi-Fi settings. There is a convenience button on the landing page as shown below. The logger should appear automatically under "Choose a network..." The name appears as the RBR serial number of the logger. Tap it to connect to the instrument. Please allow your iPhone to connect before you exit the Settings screen, i.e. that a blue check mark appears to the left of the Wi-Fi network.

> ⚠ The Wi-Fi is disabled after 60 seconds of inactivity. Twist the logger ON or OFF to activate the Wi-Fi.

3. Exit Settings to return to the Home screen.
4. From the Home screen, tap the Ruskin App (the App will automatically search for the logger and connect to it).
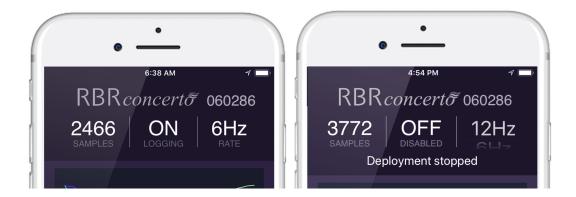
After connecting to the logger, you are automatically in the **Instrument** view of the app. The different views you can go to are **Instrument**, **Datasets** and **Settings**, located at the bottom of the screen. Tap **Datasets** to view a list of local datasets, and (optionally) remote datasets you have stored in your Dropbox account. This is also how you can share/upload and view your data, explained more later.

8.6.2 Instrument Tab
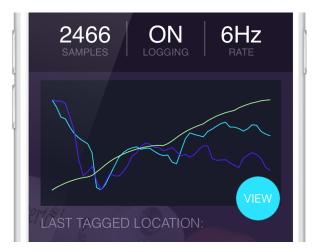
When connected to an instrument, the top of the Instrument tab shows the status of the logger indicating whether it is currently logging samples, how many samples have been taken, and what the sampling rate is set to. The sampling rate can only be changed when the deployment has been stopped as shown below - note that the right most frequency indicator has become a picker.

The logging state (ON/OFF) in the example below, controlled by twisting the instrument end cap to an ON or OFF position, should not be confused with starting / stopping a deployment, controlled using the red START / STOP button in the lower right corner of the Instrument tab. This is explained more later.

Real-time Data
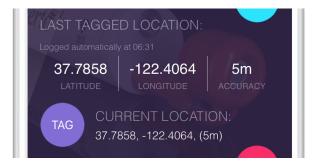
A sparkline chart shows the last 50 readings for each of the measured channels (or the last 150 readings when using a tablet). These are typically out-of-water samples and serve to provide real-time feedback from the instrument. To view charts of the full deployment, tap the light blue "VIEW" button beneath the sparkline.

Geotagging

Your logger does not have a GPS - location information for the logger is gathered using your phone / tablet's location capabilities.

The "LAST TAGGED LOCATION" in the center of the Instrument tab, indicates when the last GPS coordinates were added to the dataset. Whenever the mobile app connects to an instrument it automatically logs the location in the dataset. The location is taken at the time of connection, so should a download take several minutes and the boat be moving, the initial location is captured. Should a more accurate location fix be attained within the first minute after connection, those coordinates are used instead.

As the app uses GPS, a clear view of the sky will typically lead to a more accurate waypoint, rather than downloading inside a ship cabin for example. To conserve the battery life of your phone, GPS tracking only occurs when the Ruskin app is open, but this means that sometimes it can take a few moments to get an accurate location fix.

A GPS waypoint fix can also be manually added at any time by tapping on the purple "TAG" button. The last tagged location will be updated to indicate the coordinates and accuracy of the manual waypoint.

Channels

Scrolling to the bottom of the Instrument tab reveals the instrument's Measured and Derived Channel lists along with their units of measurement. The colored circle to the left of each channel indicates the sparkline color used to represent the latest readings from that channel.

8.6.3 Starting or Stopping a Deployment

The red button in the bottom right corner reads either START or STOP. If a deployment has been started the STOP button ends that deployment, and likewise, if a deployment has been stopped, the button reads START to begin a new deployment.

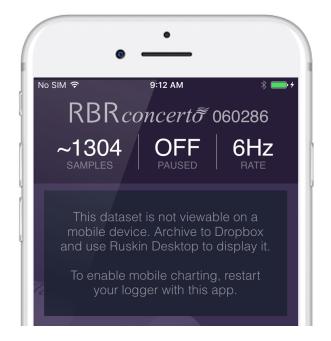When a new deployment is started, the data on the instrument will be erased. Also, once a deployment has been stopped, it can not be resumed - a new deployment must be started, wiping the data on the instrument.

One dataset is created for each deployment. Deployments are typically long running, consisting of many sampling periods (by twisting the end cap to ON) and paused periods (by twisting the end cap to OFF).

While a deployment is stopped, the sampling rate can be adjusted as described earlier. A deployment can only have one sampling period, thus once the deployment begins, the sampling rate picker in the top right corner of the Instrument tab can no longer be changed.

Whilst the deployment is stopped, twisting the instrument to either ON or OFF will activate the Wi-Fi, but the instrument will not buzz as the instrument is not sampling.

From Ruskin Desktop, when you start a deployment, you are given the option to do so in an "EasyParse (mobile) compatible" mode, or in a more complex mode where calibration data is segregated. If the existing deployment is not in the EasyParse (mobile) mode, the mobile app can still download the data, but the app will not display a sparkline, nor will users be able to view charts.
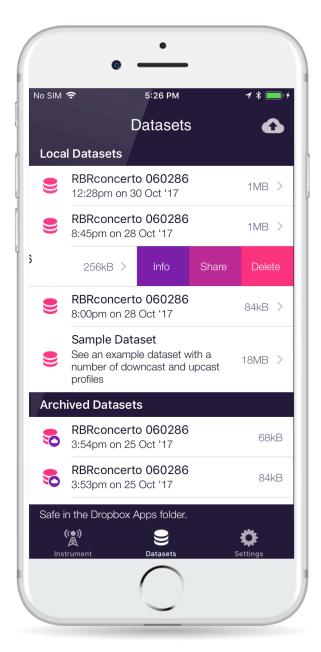
When starting a new deployment from the mobile app, the new deployment is always set to the EasyParse (mobile) mode, regardless of the previous deployment's mode.

Clock Sync

When you start a deployment, you can automatically set the instrument's time. The time is taken from your phone / tablet. As the instrument has a clock but no concept of time zones, you may choose to use **UTC** or **local** time, or you may choose to set no time at all. Note that should you leave the logger without batteries for more than a few seconds, the clock will reset (back to the epoch). Starting a new deployment with this setting enabled provides a convenient way to correct the clock.
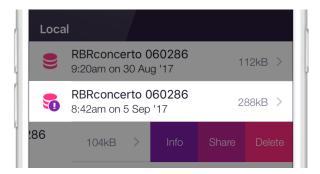
8.6.4 Accessing Datasets

Datasets are separated into 2 lists - datasets that are locally stored on your device (from instrument downloads performed on this phone / tablet), and "Archived Datasets" that are stored on Dropbox. If you have not set-up Dropbox, the second list will not appear. Note that there are a number of ways datasets can be uploaded from your device - you do not necessarily need to use Dropbox. Setting-up Dropbox and using other means of sharing datasets is explained later.

A sample dataset, captured from a real deployment, is also available to demonstrate features of the app.
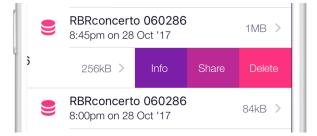
If an instrument deployment was started from Ruskin Desktop, and the user opted not to use the EasyParse (mobile) mode, the dataset icon will include an exclamation mark.

You can view charts for datasets stored locally on your device. You can NOT view charts for datasets that have been archived to Dropbox and removed from your device. For this reason you may or may not choose to automatically remove local datasets once you have uploaded them (explained in the Dropbox section).

Uploading and Sharing Datasets

On iOS, swiping to the left on an item in the Datasets list will reveal some operations that can be performed on that dataset. On Android, long-pressing the item reveals the equivalent context menu.

The "Share" option shows a context menu of the available share options for that dataset. These are only available for local datasets. What these are, depends on the apps you have installed on your phone, but a number of options come without additional apps. On iOS these include sharing by email, AirDrop, and save to Files (as of iOS 11). If you would like to see your cloud drive (Google Drive, Baidu, Box, Microsoft OneDrive, iCloud, Dropbox etc.) you need to install that app, after which it should be available as a share destination.
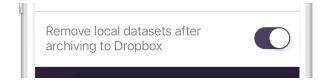
Dropbox

There are additional features available for Dropbox sharing, that incidentally don't require the Dropbox app to be installed. You can bulk upload your Datasets to Dropbox. To enable Dropbox integration, you must sign in to Dropbox. The option for this is at the top of the Settings tab.

Once signed in to Dropbox you can press the cloud button in the top right corner of the Datasets tab to bulk upload all your local datasets. As the datasets upload, the icon will transition from an upwards arrow to a check-mark.

	RBRconcerto 060286 9:19am on 22 Jun '17	76kB	>
	RBRconcerto 060286 9:29am on 22 Jun '17	76kB	>
	RBRconcerto 060286 9:37am on 22 Jun '17	76kB	>
	RBRconcerto 060286 9:38am on 22 Jun '17	76kB	>
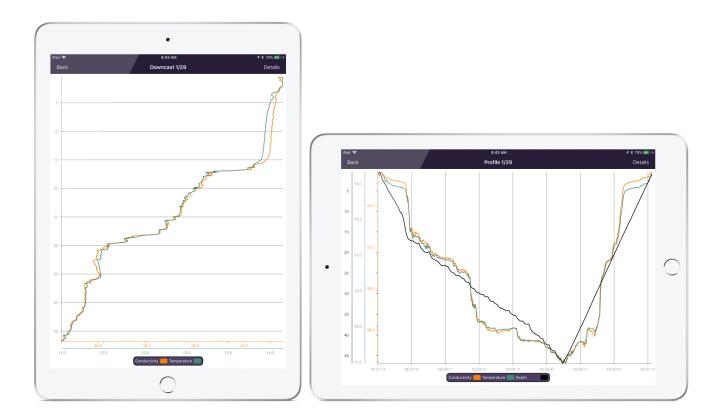
You can choose to automatically delete the datasets from your device once they have been uploaded. The preference for this, which by default is set to delete the local copy, can be found in the Settings tab.

Remove local datasets after archiving to Dropbox

8.6.5 Charting

Selecting the blue "VIEW" button under the Sparkline will show charts for the connected instrument's existing deployment. Charts for any local datasets can also be viewed by tapping on that dataset in the Datasets list. The charts are separated into casts, that is, each time the instrument descends and ascends again is considered to be a cast, and one chart is created for each cast.

In the example below, there are 29 casts (pages). Swipe left and right to view the chart for each cast. Note that when testing the out-of-water samples, there will only be one chart as the instrument determines the start and end of casts by depth (pressure) readings.
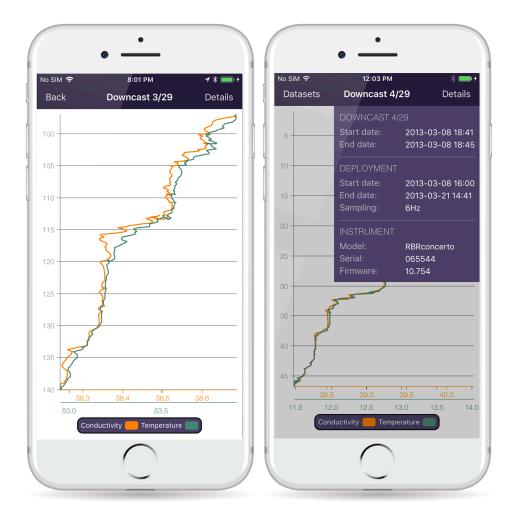
In portrait orientation, channel data is plotted by depth. Only downcast data is plotted - the upcast data is omitted. As the instrument sensors face downwards, the downcast provides the most accurate data - upcast data can be subtly impacted by the turbulence from the leading instrument housing on the ascent.

When viewing out of water samples, the Downcast chart will appear like a random plot. Only once used in a real cast will the true usefulness of this plot become apparent, as illustrated above.

In landscape orientation, the channel data is plotted by time. Depth is inverted so the bottom reading on the chart intuitively represents the bottom of the cast.

Pinch-to-zoom in on data. The chart axes adjust relative to each other on zooming and panning around the chart so that all chart series occupy the full height or width of the chart and can be easily compared side-by-side.

The Details drawer, shown by tapping the top-right corner, reveals data about the displayed cast and the deployment. The deployment data is also available in the "Info" context menu of the Datasets list.

You can set some chart viewing preferences. In the Settings tab you can opt to have your charts plot temperature by Celsius (default) or Fahrenheit, and whether depth is plotted as metres (default), feet or fathoms. This is purely a viewing preference for your phone / tablet and in no way changes the units in which the data is captured in the dataset.

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.

Within the **Configuration** tab the **Enable**, **Revert settings,** and **Use last setup** buttons are found. When you click **Enable**, the logger setup parameters are stored to the logger and the schedule is enabled. When you click **Revert settings**, you set the logger configuration back to previous settings.

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 Overview of the Configuration tab

Group	Field	Explanation
Schedule		You can configure multiple settings that include when the logger starts and stops logging, what type of sampling regime takes place, and the type of measurements speed. For more information about scheduling a logger, see Schedule a logger.
	Status	Indicates the loggers current state (Not enabled, Logging in progress, Paused).
	Clock	The loggers current clock. Buttons for syncing to the computers clock or to the computers clock adjusted to UTC.
	Start/End	The programmed start time and the estimated end time based on available memory or power.

Group	Field	Explanation
	Realtime	For more information about real time data configuration, see Fetching and streaming date.
	Format	You can configure settings for obtaining real time data from your logger (provided it is equipped with an external data port). You can select one of the four live data output formats.
	Serial	You can specify the Baud rate for serial communication.
	Mode	Serial communication protocol.
Power	Internal	You can specify the type of internal battery used for the deployment estimator. The logger tracks how many samples have been taken since the Fresh box has been checked and estimates based on the remaining potential samples.
	External	You can specify the type of external power supply used for the deployment estimator.
	Extended battery endcap	You can specify if this instrument is configured with an extended battery endcap in order to get more accurate autonomy figures for the sampling regime specified.
Sampling	Mode	You can toggle between Continuous, Average or Burst sampling. See Averaging or Bursting.
	Speed/ Rate	Sampling speed is >1sec or check the Rate box to select <1sec sampling.
	Gate	For information about enabling twist action, see Twist Activation. For information about wet switch settings, see wet switch.

Group	Field	Explanation
Options	Realtime	You can enable streaming data on either a USB or Serial connection
	Format	The format of realtime data
	Serial	You can specify the Baud rate for serial communication.
	Mode	Serial communication protocol.
	Storage	The standard format is Desktop, however, to improve the download speed over WiFi enabled loggers select Mobile.
	Wi-Fi	You can toggle on or off the Wi-Fi module to save power.
Voltage sensors	Channel	The index of voltage channel
	Latency	The time (ms) required to wait after power up for the sensor to settle in order to take a reading
	Current	The amount of current (mA) the sensor requires to operate
Ranging sensors	Sensor	The name of the sensor
	Range	The gain level used on the specified sensor for the deployment. Either a fixed gain or auto range setting

9.2 Schedule a logger

You can schedule when your loggers start logging readings and specify the sampling rate. Ruskin indicates any unattainable conditions in the defined schedule at the bottom of the **Configuration** tab, and the **Enable** button is greyed out.

Before you enable your logger, you should verify the available settings found in the groups: **Schedule, Sampling, Options, Voltage sensors, Ranging sensors, and Power**.

> ⚠ The display of the above tabs are based on the logger capability. Not all tabs are visible.

Steps

1. While the logger you want is highlighted in the **Navigator** window, click the **Configuration** tab.
2. Click **Local sync** to set the logger time to your computer time, or select **UTC sync** to adjust your computer time to UTC time.
3. Under **Start**, specify the date and time you want to start running the schedule, or select the **Now** check box.

   > ✅ 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.

   > ⚠ If the gating condition is other than **None**, then the **Start** date and time cannot be set.

4. Under **End**, the date the logger will exhaust either the batteries or memory is specified.

   > ✅ The **Battery** bar shows how long the instrument will run based on the selected battery chemistry or capacity, the **Start logging** (date and time) and the **Measurement speed**.
   > The **Memory** bar shows how long the instrument will run based on the memory capacity, the **Start logging** (date and time) and the **Measurement speed**.
   > The bar is shown in Red if the end time is not limited by this factor, if in Green it is the limiting factor. It is best to tune your **Measurement speed** and battery chemistry to optimize for these factors.

5. In **Sampling mode** select the type of sampling required, **Continuous**, **Average**, **Burst, Directional, Tide** or **Wave** (as applicable).

   > ✅ Average, Tide and Wave sampling are set from their respective tabs.

6. In **Measurement speed** select either a period (one second or longer) or a rate (rate is for |fast loggers only).
7. Click **Enable** configure the logger to sample.

> ✅ If the battery bar indicator is green but shows that you are close to capacity and you know that your logger will be operating under very cold conditions, you may want to lower the demands on the battery by lengthening your sampling period or opting for a different battery chemistry.

> ⚠ An error message appears at the bottom of the **Configuration** tab if the sampling period is too fast for your logger. This typically means that one of the sensors has a long latency.

> ⚠ If the **Enable** button is grayed out, an error message appears.
> If you enable the logger, and it is not your first schedule, you will see the warning *The contents of memory will be erased!* Before proceeding, you should download the data from the logger (see Download). If you are sure that the information is stored, then click **Erase and enable logging**.

9.2.1 Profiling |fast

All profiling loggers (known as |fast) have the ability to sample faster than one second, as well as sample in an average or burst mode.

Selecting **Rate** for a **Sampling speed** enables sampling speeds of 1 Hz or faster.

9.3 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.

9.4 Averaging

To set up a logger to average at sub-second rates (Hz) or with periods one second or greater, click **Configuration** tab > **Sampling** section, and then select **Average** in the **Mode** drop down menu.

There are two versions of the **Average Sampling** section that can be used, either simple or advanced. This option can be set in Preferences.

Simple form:

In the simple form only pre-defined selections can be made. A more complex setup can be set by using the advanced version as follows.

Advanced mode:

To set how fast the individual samples are taken for the averaging calculation, select **Period** to enter a sampling period equal to one second or greater; or the **Rate** button for periods less than one second. If a sub-second sampling speed is to be used, select the required rate from the **Rate** drop down list. To set the length of time of the averaging, enter the value in the **Duration** spin box.

To set how often the average reading is calculated, enter the value in the **Interval** spin box.

In the example above, 1 minute of 2 Hz (2 times a second) readings are taken and averaged, with the cycle repeating every 5 minutes and the average values are reported every 5 minutes.

9.5 Bursting

All loggers support the ability to sample in a burst mode.

To set up a logger to burst at sub-second rates (Hz) or with periods one second or greater, click **Configuration** tab > **Sampling** section, and then select **Burst** in the **Mode** drop down menu.

There are two versions of the **Burst Sampling** section that can be used, either simple or advanced. This option can be set in Preferences.

Simple form:

In the simple form only predefined selections can be made. A more complex setup can be set by using the advanced version as follows.

Advanced mode:

To set how fast the individual samples are taken in the burst, select **Period** to enter a sampling period equal to one second or greater; or the **Rate** button for periods less than one second. If a sub-second sampling speed is to be used, select the required rate from the **Rate** drop down list. To set the length of the burst in samples, enter the value in the **Duration** spin box.

To set the interval between burst measurements, enter the value in the **Interval** spin box.

9.6 Tides and Waves

9.6.1 Tides

Tide loggers use averaging to remove wave data from the pressure measurements, and the method for setting up the logger is the same as described for Averaging.

In the **Sampling** section of the **Configuration** tab, the tide parameters can be configured:

There are two versions of the **Tide Sampling** section that can be used, either simple or advanced. This option can be set in Preferences.

Simple form:

Advanced form:

9.6.2 Waves

A |wave logger records wave and tide information, and the configuration is different from other loggers. For additional information on planning a wave deployment, please refer to |wave deployment planning.

If your logger is already logging data when you decide to change the configuration, you must stop logging, make your changes, and then start logging 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 restart the logger.

> ⚠️   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.

In the **Sampling** section of the **Configuration** tab, the wave parameters can be configured:

There are two versions of the **Wave Sampling** section that can be used, either simple or advanced. This option can be set in Preferences.

Simple form:

- In **Speed**, specify how fast you want pressure readings to be taken. In the simple form, you can select from the options in the drop-down list. In the advanced form, you can either set the period in multiples of seconds, or you can set a sub-second rate.
- 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.
- 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 parameter calculations.
- 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 calculate the range of wave frequencies that can be measured, and those values will be displayed, in both bandwidth and period. Ruskin will calculate the actual depth from the measured pressure data post-deployment.

To configure advanced settings for wave sampling, go to **Options** menu > **Preferences**, and select **General**. On the **General** page, select the **Enable advanced sampling controls** check box under **Sampling control** – make sure to click **OK**.

Advanced form - sampling at one second or slower:

Advanced form - sampling at 2, 4, 8, and 16 Hz

- In **Speed**, specify how fast you want pressure readings to be taken. In the simple form, you can select from the options in the drop-down list. In the advanced form, you can either set the period in multiples of seconds, or you can set a sub-second rate, depending on the check box selection.
- 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.
- 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 parameter calculations.
- 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 calculate the range of wave frequencies that can be measured, and those values will be displayed, in both bandwidth and period. Ruskin will calculate the actual depth from the measured pressure data post-deployment.

> ✔ The timestamp of the burst for both a Tide and Wave datasets is the beginning of the burst.

9.6.3 |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.
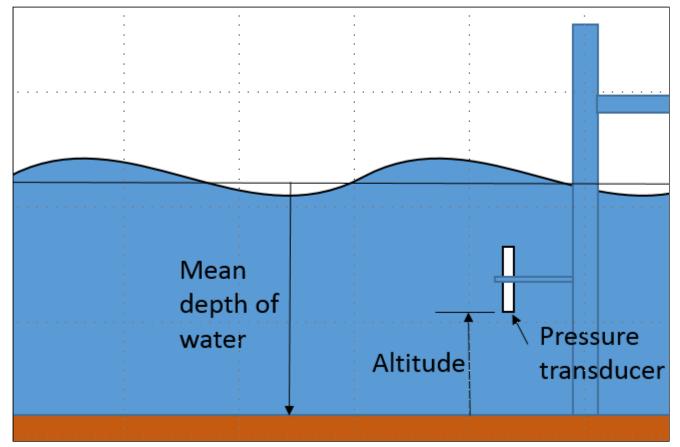
Figure 1. Logger positioning

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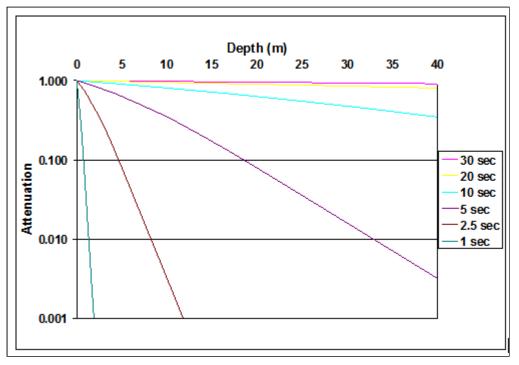
Figure 2. Wave attenuation as a function of depth for various wave periods.

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:
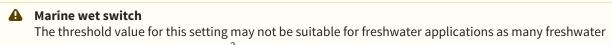
1. Measurement speed: this defines the sampling rate or period for individual pressure readings used.
   a. The rate possibilities are 2Hz, 4Hz, 8Hz, and 16Hz
   b. The sampling rate defines several elements of the data capture:
      i. The highest possible frequency visible in the data is limited to ½ 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.

9.7 Gate Condition

Gating is a method to enable the logger based on a condition that may not be time based. The logger can be made to start and stop sampling based either on the conductivity sensor measurement (Marine wet switch) or by a mechanical activation (twist activation).

The Marine wet switch turns on the sensors to check the value of the conductivity sensor every 15 seconds. If the value exceeds 1 mS/cm^2 logging will start until the conductivity values decrease below this threshold.

> ⚠ **Marine wet switch**
> The threshold value for this setting may not be suitable for freshwater applications as many freshwater sources would not exceed 1 mS/cm^2.

For more information about how the twist activation works, see Twist Activation.

If the gating option is available on your logger select the appropriate option from the drop down menu. To enable the logger based on contact with water, select **Marine wet switch**. To enable the logger by twist activation select **Twist activation**. If the logger is to be enabled based on a specific start time, which is set in the **Configuration** tab, select **None**.

9.7.1 Twist Activation

If this option is available and selected, the logger starts or stops sampling based on the action of closing or opening the battery end cap.

When this option is selected, the logger starts to sample based on the Twist ON/OFF position rather than a schedule. To start sampling first click enable logging, the logger status will then become "paused" until the battery end cap is closed to the ON position. To pause the sampling, turn the battery end cap to the OFF position. The logger will vibrate to indicate if it is sampling or paused. A long vibration indicates that the logger is sampling and three short vibrations indicate that the logger is paused.

9.8 Fetching and streaming data

The logger is capable of fetching measurements from the logger when connected over USB from the internal port, or, if an external connector is available, over USB or RS-232/485.

If you are still connected to the logger via USB, you can click **Fetching** in the **Plot** view toolbar. A graphical display appears of the samples fetched from the logger at the default speed for the logger type rather than of the samples that are scheduled and being stored on the logger.

> ⚠️ If you have an underwater RS-232 interface, select **Serial** from the **Realtime** drop down menu and **RS232** from the **Mode** drop down menu.

Steps

1. Under the **Options** section of the **Configuration** tab, select **Serial** from the **Realtime** drop down menu.
2. If you have an RS-232 interface, select **RS232** from the **Mode** drop down menu. If you have an underwater USB interface or RS485, select **USB** or **RS485** from the **Realtime** drop down menu.
3. For an RS-232 or RS485 connection, select a connection speed from the **Serial** drop down list.

If you are interfacing to an external system that requires a control signal input, such as a modem with a DTR input, you will need to configure the parameters for the auxiliary output control signal from the datalogger.

After the logger setup is complete and the schedule is enabled, the logger will automatically output as sample reading at the set sampling rate.

9.9 Mobile settings

If you have a mobile device, you can use it to configure, download, and view data from a WiFi-capable data logger. The Ruskin app is available on the Apple App Store and Google Play Store.

If you intend to use the Ruskin app you are advised to enable EasyParse (mobile) compatible data storage on the logger. Do not enable it for non-WiFi capable loggers. For additional information about the WiFi module, see WiFi module.

With EasyParse (mobile) compatible data storage selected, the logger data is parsed differently so that the download is faster over WiFi and a feature called cast detection is activated. The cast detection feature separates each profile into groups of down and up casts to make viewing of the profiles easier on the mobile device.

To enable compatible storage for mobile devices in Ruskin, connect the data logger to a computer running Ruskin (not a mobile device) and go to the **Options** section of the **Configuration** tab and select **Mobile** from the **Storage** drop down menu.

9.10 Autoranging and fixed gain

Certain sensors, specifically turbidity and fluorometer 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.

Steps

1. Under the **Ranging sensors** section of the **Configuration** tab.
2. Any sensors present capable of autoranging are shown in **Sensor**. Select the sensor you want to configure from the list provided.
3. Select the required gain value from the available selections in **Range**.
4. Repeat the above steps for the next available autoranging sensor.

Fixed gain:

Autoranging (Automatic gain setting):

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 µg/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.

9.11 Voltage channel parameters

In the **Voltage sensors** section of the **Configuration** tab, you can set the sensor parameters for the sensor attached to the voltage channel. Select the appropriate voltage channel and enter the sensor latency and the sampling current. These parameters are used in the deployment time calculation (battery use) and for determining minimal sampling intervals.

> ⚠ You must enter these parameters for sensors not supplied by RBR.

9.12 Derived channel parameters

When configuring your logger, you can change the default values of parameters that are used to calculate derived channels. These values are stored in the logger itself and are used in place of the values in **Options** menu > **Preferences** > **Derived channels**.

In the **Parameters** tab, you can configure the parameters to calculate derived channels on a logger that supports derived channels.

9.13 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 three precautions you should take to avoid damaging the logger and maximize 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.

9.14 Automatic Tasks

When working with a large number of similar instruments, Ruskin offers various automatic tasks, which can be toggled on and off from the Instruments menu, or by right-clicking the "Instruments" group in the navigator view. Icons indicating the current state will be displayed on the "Instruments" group. Since these tasks can change the state of the logger, the on/off state defaults to off each time Ruskin is run.
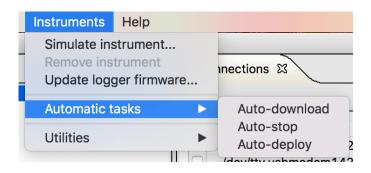
Figure 1. Instruments menu showing automatic tasks options. If a task is enabled, it will show a check mark.

Figure 2. Right-clicking on the "Instruments" group of the navigator view will show the automatic tasks. If a task is enabled, it will show a check mark.

Figure 3. "Instruments" group of the navigator view with icons indicating that auto-download and auto-deploy are enabled.

9.14.1 Auto-Download

When an instrument is detected, it will automatically start a download process and store the file using the common logger download naming scheme (serial number, date and time of download) in the last "save to" directory chosen. Other than possibly creating unwanted files, this option is safe since it does not alter the state of the logger.

9.14.2 Auto-Stop

When an instrument is detected, it will automatically stop the instrument if the instrument was previously enabled. If auto-download is not also selected, a warning will be displayed about downloading the instrument data. It is not possible to re-enable the instrument without erasing the instrument's memory, so it is advised to also use the auto-download feature at the same time, or ensure that the data is downloaded prior to re-enabling the instrument.

9.14.3 Auto-Deploy

When an instrument is detected, the instrument will be stopped and then reprogrammed with the last known configuration settings. It is highly recommended to also use auto-download with this setting since the instrument memory will be erased during the deployment set up. To use this feature, first connect an instrument that will act as the model and configure that instrument with the desired settings and then turn on auto-deploy. Each instrument connected, if it supports the same capabilities of the model instrument, will be configured to match the scheduling of the model instrument. Auto-deploy implies auto-stop since the instrument must be stopped to update it with the new schedule information.

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.

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 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.

| Configuration | Information | ⚠ Calibration | Parameters |

Logger details

Model:	RBRmaestro^3
Generation:	Late 2017
Serial:	200003
Firmware:	1.099
Link:	USB

Channels

#	Parameter	Units	Sensor	Ranging	
1	Conductivity	mS/cm	Marine	None	
2	Temperature	°C	Marine	None	
3	Pressure	dbar	RBR	None	
4	Sea pressure	dbar	derived	None	
5	Depth	m	derived	None	
6	Salinity	PSU	derived	None	
7	Speed of sound	m/s	derived	None	
8	Specific conductivity	µS/cm	derived	None	

Power

Source:	USB
Internal:	0.0V
External:	0.0V

A newer firmware version is available. Please update to ensure full compatibility.   [Update firmware]

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

Update logger firmware

Use this utility to update your logger.

Release notes

Version 1.094, 19-Nov-2018
Maintenance release for RBR*virtuoso*^{3}, RBR*duo*^{3}, RBR*concerto*^{3}, RBR*maestro*^{3}, RBR*brevio*^{3} (late 2017)
Requires Ruskin 2.6.0

Bug fixes

- Protect from loss of channel configuration and calibration memory (L3-567).
- Protect from loss of general configuration memory (L3-575).
- Threshold function now works properly with deep conductivity cell (L3-548).
- Prevent unresponsive state following battery removal (L3-562).
- Data download using small packet sizes is now reliable (L3-563).
- Prevent excessive WiFi power-on/off events at high sample rates (L3-568).
- Setting of alarm time for next sample is now more robust (L3-572).
- Eliminate risk of logger failing on entering deep sleep (L3-580).
- Firmware changes to OEM units can now be locked out (L3-558).
- Corrections to DO2 concentration to saturation equation (L3-582).

[Close]   [Proceed]

> ⚠ 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**.

Steps

1. In the **Instruments** menu, click **Update logger firmware.**
   The Update logger firmware dialog box will appear.
2. Click the instrument drop down to select the instrument you wish to upgrade.
   a. A default firmware image will be selected for your instrument.
   b. If RBR supplied a firmware file click the **Select file** button and browse to the location of the firmware update file provided. The file will have the extension .rbrfw.
3. 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.
4. If the upgrade doesn't complete successfully, click **Proceed** again to retry until successful.

> ⚠️ Occasionally the logger will not reappear in the **Navigator** view following a successful upgrade. If this occurs, disconnect your logger from the USB port and then reconnect to re-establish communication.

5. 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

13.2.1 Analysis tab

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.

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.

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.

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.

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.

> ⚠️ **T-string**
> Thermistor strings have channel 1 referring to the node at the end of the string and the last channel being the node closest to the connector.

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.

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:

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.

⚠ 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 "double lollipop" vertical black line marks the place. The **Cursor** tab panel above (or on the side of the plot for live data) displays the channel values, units, the sample number, and the time that the data was measured.
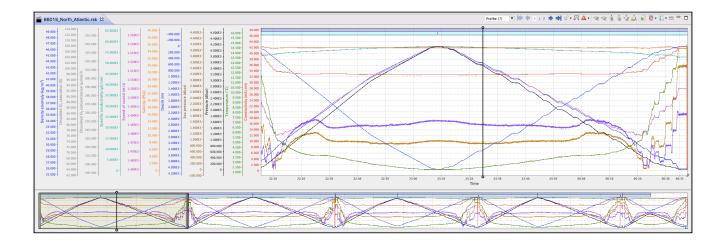
For datasets only, you can select the **Display statistics** check box to view the average value and standard deviation for each channel based on the number of samples that you specify.

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.

13.6.1 Thumbnail view

A downsampled representation of the dataset appears in a thumbnail view, along with an indicator of the current plotted time range. The indicator can be positioned on the thumbnail view by clicking on the thumbnail view or dragging the indicator. The indicator can be resized by dragging the edges, which will zoom the plot along the time domain to match the new indicator size. The thumbnail always shows time-domain data, even if the plot is switched to depth-domain mode.

13.6.2 Live data

You can use the **Plot** view to view a graphical display of logger sampling. The data can come from one of two sources: fetching or streaming. Fetching can be used on a logger that is either not enabled, or enabled without a streaming option. Streaming can be used on a logger that has been enabled. If fetching is used on a logger with streaming selected and the logger is enabled, the current file used for the fetching data will be closed and a new file started for the streaming data; fetching will be disabled.

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.

> ⬦ Live data collection support in Ruskin is intended for debugging, development, and schedule trial purposes only and is not intended as a robust data collection solution. Performance will degrade significantly if large (>50-100K samples, depending on hardware) data collections are performed, especially if there are a large number of events being reported.

13.6.3 Plot Tools

Dataset toolbar

Live plot toolbar

The live plot toolbar appears to the right of the dataset toolbar.

Tools for datasets and live data

Button	Purpose	Use

	Filter	Changes the type of annotation for the navigation buttons
		
		• If an annotation is selected, switching filters zooms the view to the newly selected annotation.
		• If no annotation is selected and switching filter from one profiling annotation type to another (profile, upcast, downcast), the view does not change.
		• 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.
		    • Comment → Profile moves to first profile
		    • Profile → Comment moves to first comment
		    • Comment → Downcast moves to first downcast
		    • Profile → Downcast does not move.

	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. If the currently selected annotation matches the time domain extent the text will appear blue, otherwise the text will be red Click middle of index (the '/') to zoom to the annotation.

Button	Purpose	Use
Profile Gps Comment	Create annotation	Select type of annotation to create. After selection, click and drag left/right on main plot to create the annotation. When the click is released the annotation will be created as a temporary annotation, selected, and show its editable tooltip. Profiles or geodata cannot overlap the same type - new annotations will fill the available space between existing profiles. ⚠ The annotation must be **edited** (such as adding a title or description, or, in the case of profiles, by adding an up or down cast) and **saved** (press ENTER/Return, or click the green check mark on the tooltip) before it will be saved in the RSK file. ⚠ Only available in time domain
	Cast detection	Runs a cast detection algorithm based on depth and conductivity to automatically generate profiles and casts ❗ Overwrites logger generated cast events and profiles
	Event visibility	Turn on and off visibility of the various levels of events (error, warning, information, and diagnostic)
	Zoom control	Zoom in/out horizontally, vertically, and reset zoom to display the maximum extent of each axis Zooming the range will center the data on the currently selected sample.

Button	Purpose	Use
	Auto-ranging	Toggles the auto-ranging of the channel axes
		ⓘ Disabling the auto-ranging of the axis can be useful for looking at trends in data
? Unknown Attachment	Export plot	Exports the current view of the main plot to pdf or png
? Unknown Attachment	Data rendering type	Choose lines, shapes, or lines and markers for the trace lines
		✅ If no data appears in the **Plot** view, try changing the rendering to "Display Markers". Time spans that are larger than expected will cause breaks between data points and lines will not be drawn connecting those points, whereas markers draw at each individual point.
? Unknown Attachment	Toggle channel visibility	Turn on or off channels to be visible in the plot view
		Toggle on raw values removes the calibration equation from the sensor value
? Unknown Attachment	Plot by depth	Toggles between plot by time and plot by depth
		ⓘ 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

Tools for live data

Button	Purpose	How to use
	Toggle the side data panel	The side data panel appears beside the charts and shows the file location that will be used to capture samples, the number of samples collected, the values of the last received sample, and the currently selected sample. The side panel can be toggled on and off with this button.
	Live plot time range selection	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.
	Start or pause fetching	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 and has streaming turned on.

13.6.4 Shortcuts / Controls

- Data cursor:
    - Click on the main plot to set the data cursor (double lollipop indicator).
    - Move to the previous/next data sample: Left/Right Arrow Key
        - To move by hundreds of samples, use Shift - Arrow
        - To move by ten thousands of samples, use Alt - Arrow
        - To move by millions of samples, use Shift - Alt - Arrow
- Annotations
    - Double click on an annotation bar to zoom in to the range of the annotation.
    - Click and drag on the edge of an annotation bar to resize the annotation, if the annotation is resizeable (CELL GPS annotations are not).
    - Click and drag on the annotation bar to move the annotation, if the annotation is moveable (CELL GPS annotations are not).
- Main Plot
    - Double click on the plot to reset to fully zoomed out.
    - Shift-click and drag on the plot to select a zoom region. The zoom region will be denoted by a rectangle. Make sure to press shift before clicking.
    - Control-click and drag on the plot to pan the plot. Make sure to press control before clicking.
    - Mouse wheel will zoom the plot in/out based on the current mouse position.
- Main Plot Axes

- Double-click on an axis to set the axis to auto-range (show the full range of data).
- Click and drag an axis to pan the axis.
- Shift-click and drag an axis to zoom the axis in or out.
- Mouse wheel will zoom the axis in/out based on the current mouse position.
- Thumbnail
  - To resize the viewable range, click and drag on the handles (gray bars) on or use the mouse wheel within the viewable range indicator.
  - Click and drag the viewable range indicator to pan
  - Click on a region not covered by the viewable range indicator to center the viewable range at that location.
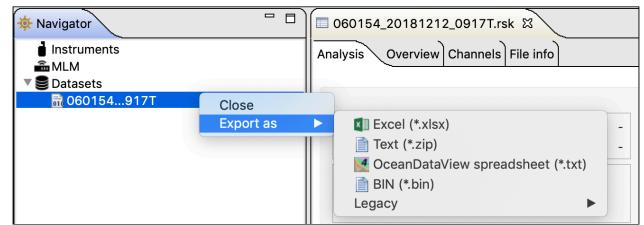
13.7 Exporting datasets

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 such as Microsoft Excel or OceanDataView.

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 Bin). The exports found under the Legacy formats are not appropriate for newer instruments and so are not discussed here.

> ⊘ 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 that is available for download from our website at 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 legacy 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.

Change calibration coefficients

Sensors such as dissolved oxygen, turbidity and pH 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 C, 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.

14.1 N-Point calibration

Sensors such as pH, Dissolved Oxygen (Oxyguard or Rinko) 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.

14.2 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 Na_2SO_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 (Na2SO3) 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.

14.3 Rinko optode calibration

The Rinko optode can be calibrated using Ruskin N-point calibration.

Equipment

1. Two Large mouth beakers
2. Sodium sulphite Na_2SO_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
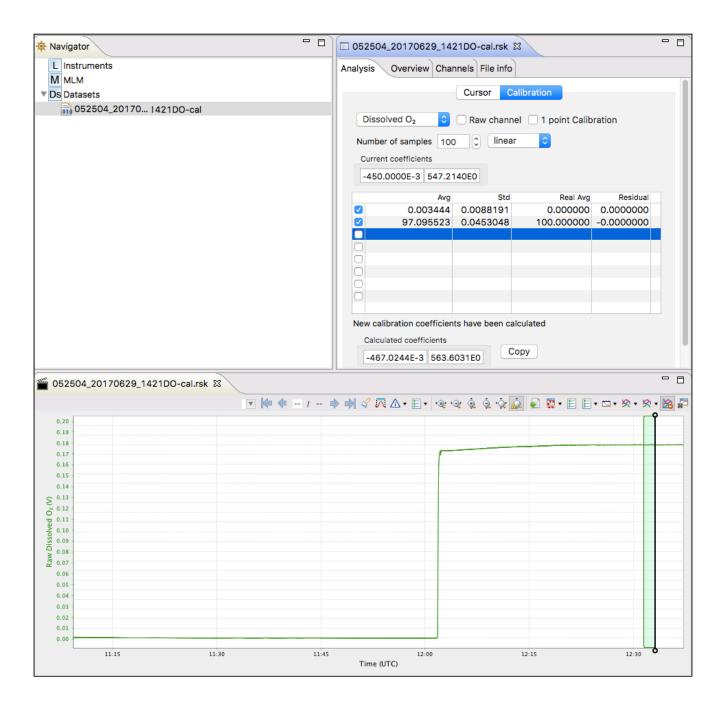
1. Fill the large beaker with water 2 L, and install magnetic stirrer.
2. Bubble air through the water using an air pump (an aquarium air pump would work).
3. Switch ON the air-pump and the magnetic stirrer.

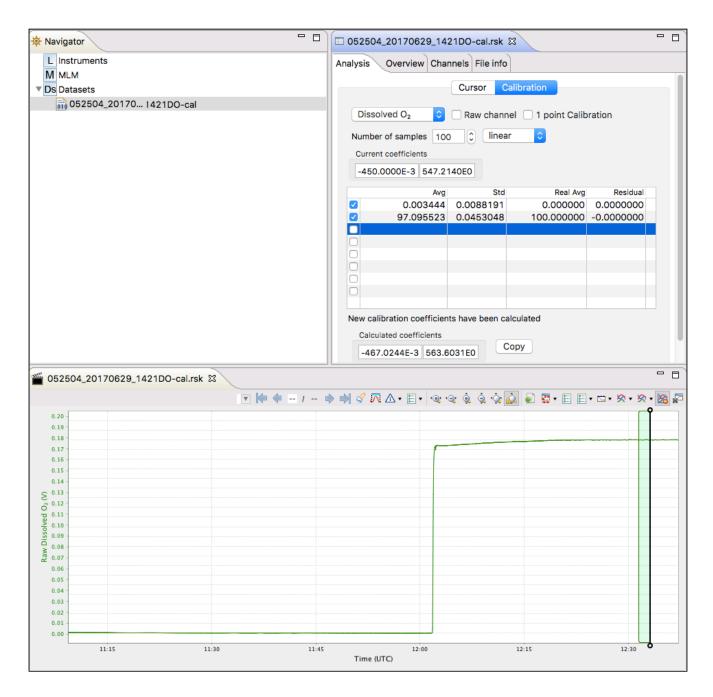Reference Point 2 solution – Dissolved oxygen concentration of zero

- In a beaker, dissolve approximately 5 tsp of sodium sulphite (Na_2SO_3) into 500 mL tap water. Mix the solution thoroughly with a magnetic mixer. The solution will be oxygen-free after 15 minutes.

Steps

1. In Ruskin, configure the logger to sample at a fast rate, between 6 Hz and 3 seconds.
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. 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 calculate 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 the values appear in **Calibration 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 disstilled water the calibration will only correct the coefficients for an offset. If only a single non zero point is performed the callibration 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 submerse only the sensor, you can decide on the container volume and adjust the solution volumes appropriately.

Steps (preparing solutions)
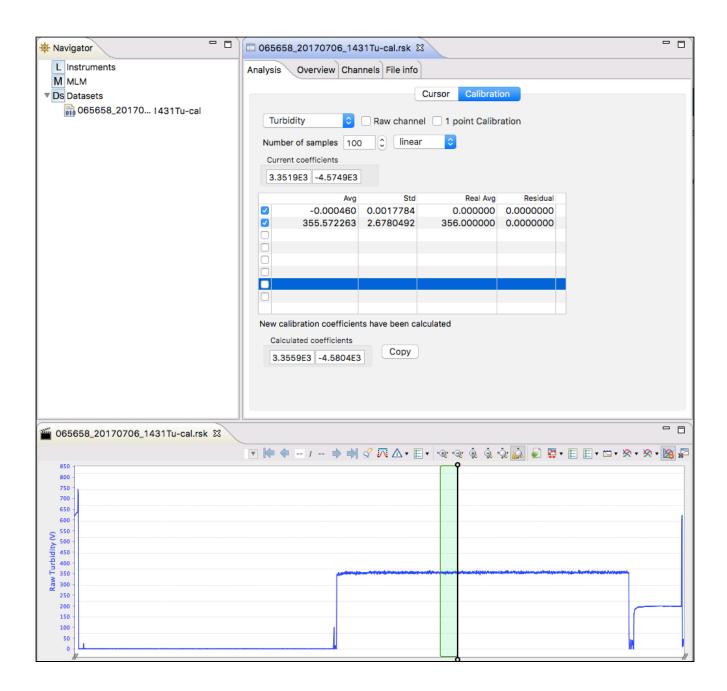
1. In Ruskin, configure the data logger to sample using a 10 second sampling interval and set the sensor to autoranging - see Autoranging and fixed gain.
2. Use **Sync to PC** to ensure the logger clock is synchronised to the PC clock, and ensure the end time is set so that the logger will keep sampling 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
   > $Tu_{STD} = Tu_{STK} * V_{TOT}/(V_{DW}+V_{TOT}) = 363.63$ FTU
   > Where:
   > Tu_{STD} = turbidity of the standard solution (FTU)
   > Tu_{STK} = 4000FTU – 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
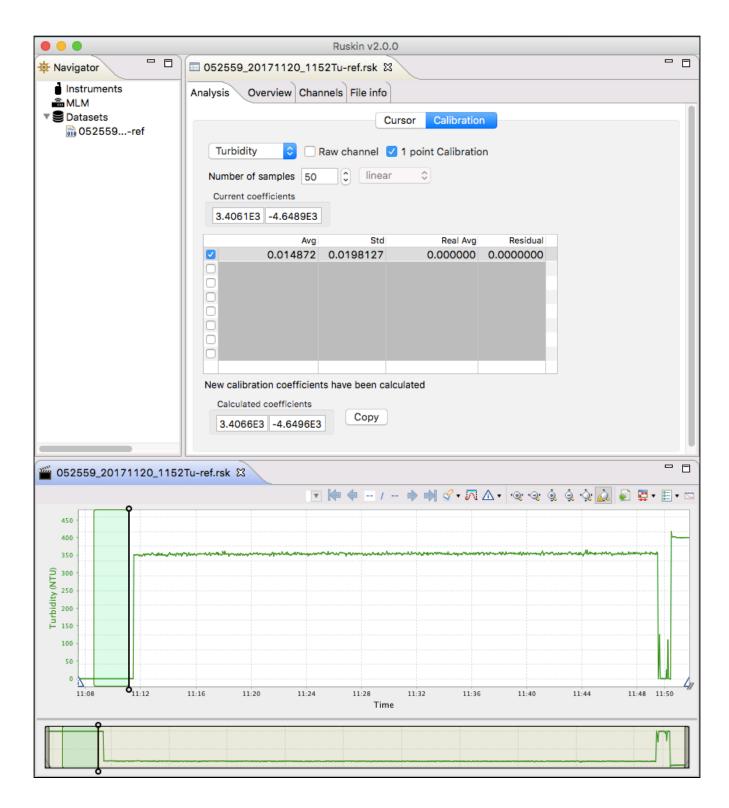
Using the same procedure as in the 2-point calibration, one can use only the distilled water or formazin standard to generate new coefficients from a single point.

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.
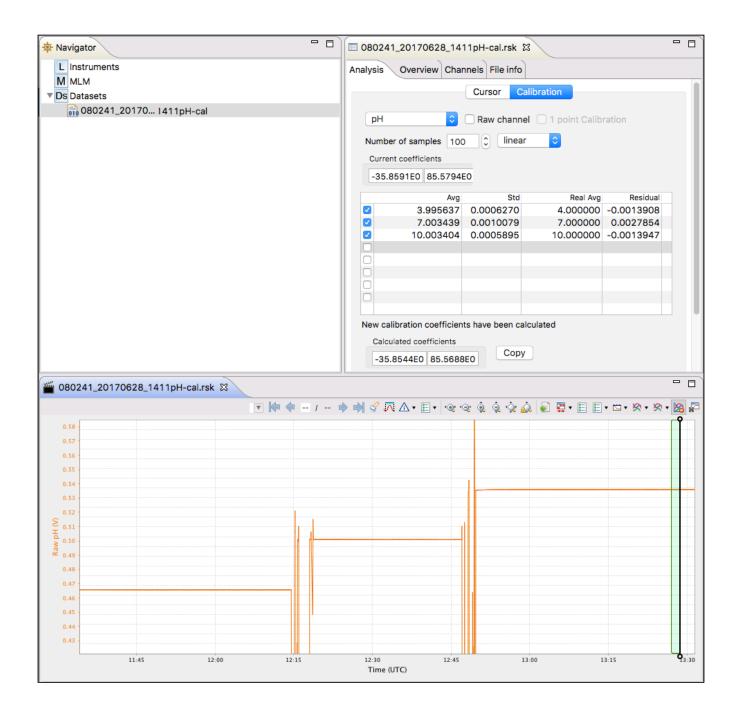
2. The calibration data should now be displayed in the **Plot** view. In the Properties view, go to **Analysis** tab > **Calibration** tab.
3. Select the **Tu sensor** type from the drop down list.
4. The **Number of Samples** field is automatically set to **100**.
   This value is the number of sample 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.

14.5 Idronaut pH calibration

Calibration of the pH sensor should use two or more pH buffers, and should be carried out every day that the electrode is used for optimum accuracy. It is recommended that a pH 7 buffer be used to check the zero point and an acid and an alkaline buffer used to set the slope. RBR uses pH 4 and pH 10 to measure the slope.

Steps

1. In Ruskin, configure the logger to sample at a fast rate, between 6 Hz and 3 seconds.
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. Submerge the pH sensor in the pH 4 buffer solution for at least 15 minutes near the stirrer so that it is in the best mixed area of the bath.

> ⚠ Ensure that the pH sensor is rinsed with clean water between each sample reading to avoid contamination between buffer values.
> Ensure that both the pH and Reference electrode are submerged in the same solution.
> If the logger has a pH/ORP sensor and an Oxyguard DO sensor, it is advisable to ensure that the DO sensor is submerged in the buffer during measurement.

4. Submerge the pH sensor in the pH 7 buffer solution for at least 15 minutes near the stirrer so that it is in the best mixed area of the bath.
5. Submerge the pH sensor in the pH 10 buffer solution for at least 15 minutes near the stirrer so that it is in the best mixed area of the bath.
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 pH 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 the pH 4. In the table in the first row, under **Real Avg**, enter 4 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 pH 7. In the table in the second row, under **Real Avg**, enter 7 and press enter.
12. Select the check box in the third row in the table, then click on a stable point in the **Plot** view corresponding to pH 10. In the table in the third row, under **Real Avg**, enter 10 and press enter.
13. 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.
14. Follow the steps in Change calibration coefficients to update the coefficients for this sensor in the data logger.

L Instruments
M MLM
Ds Datasets
080241_20170... l411pH-cal

080241_20170628_1411pH-cal.rsk

Analysis | Overview | Channels | File info

Cursor | Calibration

pH | Raw channel | 1 point Calibration

Number of samples 100 | linear

Current coefficients

-35.8591E0 | 85.5794E0

	Avg	Std	Real Avg	Residual
☑	3.995637	0.0006270	4.000000	-0.0013908
☑	7.003439	0.0010079	7.000000	0.0027854
☑	10.003404	0.0005895	10.000000	-0.0013947
☐				
☐				
☐				
☐				
☐				

New calibration coefficients have been calculated

Calculated coefficients

-35.8544E0 | 85.5688E0 | Copy

080241_20170628_1411pH-cal.rsk

Raw pH (V)

0.58
0.57
0.56
0.55
0.54
0.53
0.52
0.51
0.50
0.49
0.48
0.47
0.46
0.45
0.44
0.43

11:45   12:00   12:15   12:30   12:45   13:00   13:15   13:30

Time (UTC)

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 data files

You can control where data 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 RSK files** text box, or click **Browse** to locate the directory where you want to store data files.
4. Click **Apply** or **OK**.

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

15.2 Specify location for realtime data files

You can control where realtime files are stored by default. Specify these locations before connecting any instrument.

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 realtime RSK files** text box, or click **Browse** to locate the directory where you want to store data files.
4. Click **Apply** or **OK**.

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

> ⚠ Realtime files are generated when a connected instrument is streaming or when the user enables fetching mode on the instrument.

15.3 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.

15.4 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**.

15.5 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.

15.6 Using advanced calibration controls

Steps

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

> ⚠ Simple control: provides the user the ability to view and edit the main coefficients (C) for any channel.
> Advanced control: provides the user the ability to view and edit all main and dependency calibration coefficients (C,X) for all channels.

15.7 Derived channel preferences

> ⚠️ The derived channels settings in **Preferences** was originally intended for XR(X),1060, 2050, and 1050 RBR data loggers. It does not apply to newer generations.
> Newer generations calculate all the possible derived channels for that specific logger.
> Use the Parameters tab to set up initial derived channel parameters.
> For downloaded files, use data set Parameters tab.

Derived channels contain calculated data based on data from measured channels. In the **Derived Channels** section of the **Preferences** dialog box, you can choose additional channels derived from measured channels. You can also set the salinity, pressure, and temperature values used to calculate the derived channels when a sensor is not available.

> ⚠️ If you suspect that the derived channel value is incorrect check to make sure that the **no sensor present** values are correct. For example, if a Dissolved Oxygen saturation measurement is made in lake at 8 degrees but the **no sensor present** salinity value is 35 and temperature is 15 degrees the concentration reported will be incorrect. Adjust the **no sensor present** values and re-compute.

Derived channels are included by default in the **Plot** view and in datasets.

15.7.1 Add depth as a derived channel

If your logger has a pressure channel, you can use its measurements to derive a depth channel. The data calculated for this derived channel appears along with measured channels in the **Plot** view and in datasets.

Steps

1. From the **Options** menu, click **Preferences**.
2. In the list on the left side of the **Preferences** dialog box, click **Derived Channels**.
3. On the **Depth** tab, select the **Enable Depth Channel** check box.
   For new loggers, all derived channels are calculated regardless of the check box status.
4. In the **Atmospheric Pressure** box, type a deciBar value for the atmospheric pressure on the logger or use the default value. This value corrects the pressure measurements during the depth calculation.
5. Click either **Simplified calculation** or **Seawater calculation**, which is a calculation based on a UNESCO technical paper:
   a. If you want to use the simplified calculation, type the actual water density or use the default value. Note that for freshwater, the density should be set to 1.0.
   b. If you want to use the UNESCO seawater calculation, specify the latitude of the data collection in degrees and minutes.

15.7.2 Add dissolved oxygen as a derived channel

You can derive a dissolved oxygen channel that measures the oxygen saturation as a percentage. The data calculated for this derived channel appears along with measured channels in the **Plot** view and in datasets.

Steps

1. From the **Options** menu, click **Preferences**.
2. In the list on the left side of the **Preferences** dialog box, click **Derived Channels**.
3. Click the **Dissolved O2** tab and select the **Enable Dissolved Oxygen Channel** check box.
   For new loggers, all derived channels are calculated regardless of the check box status.

4. If any of your loggers use the Oxyguard DO sensor to measure oxygen saturation and you want to use the Weiss equation, select the **Calculate concentration using the Weiss equation** check box and select the output unit, one of µMol/L, mg/L or mL/L.
   The Weiss equation requires values for temperature and salinity. If your logger does not measure these things, you can specify standard values on the **No sensor values** tab.
5. If any of your loggers use the Aanderaa Optode DO sensor to measure oxygen concentration, select the **Calculate concentration** check box and select the output unit, either mg/l or ml/l.
6. If any of your loggers use the Aanderaa Optode DO sensor to measure oxygen saturation, select the **Calculate saturation using the Garcia and Gordon equation** check box.
   The Garcia and Gordon equation requires values for temperature and salinity. If your logger does not measure these things, you can specify standard values on the No sensor values tab.

15.7.3 Calculate derived channels when sensors are missing

When your sensors do not provide the salinity, pressure, or temperature values needed to calculate derived channels, you can specify actual values to use instead.

Steps

1. From the **Options** menu, click **Preferences**.
2. In the list on the left side of the **Preferences** dialog box, click **Derived Channels**.
3. Click the **No sensor values** tab.
4. In the boxes provided, specify the values that you want to use when actual values are not provided by your sensors.

15.8 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.

15.8.1 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 fluorometery 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 C - 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.

15.8.2 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.

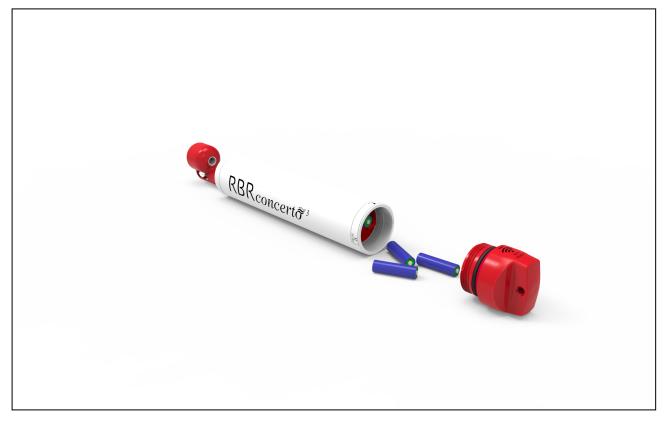**Channel colours** tab with the **Colour** dialog box to customize a colour for a channel

Plotting

Manage default plotting behavior

Channel colours can be previewed on the active plot.

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

Loggers have two end caps: the sensor end cap houses the sensors, and the battery end cap covers the data port and battery cover plate. Access to the data port and the battery cover is gained by removing the end cap opposite the sensor end of the logger. It may be unscrewed by hand or by using a rod inserted into the mooring line hole for leverage. The end cap does not unscrew completely until the O-ring is clear of its mating surface in the body. This ensures that it will not eject at high speed should the interior of the logger become pressurised.
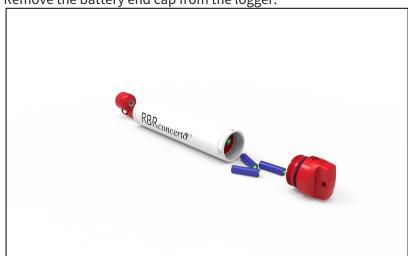
Closing the logger is exactly the reverse of opening it. Remember to keep the O-rings clean and avoid scratching the O-ring mating surfaces. Carefully inspect the O-rings, as described in the Inspecting the O-rings section, before deploying the logger. Do not use excessive force when tightening the end cap; hand-tight is quite sufficient, as the seal depends upon the O-rings, not the end cap tightness.

16.2 Changing the batteries
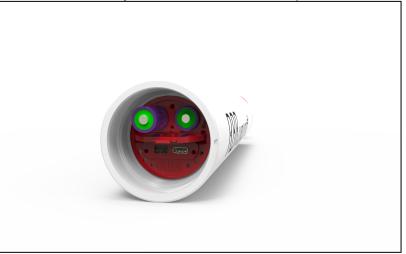
Loggers are powered by eight AA size cells. These can be almost any chemistry with only a few restrictions depending on the sensors ordered. Check your loggers compatibility in Ruskin to see if your instrument has a restriction.

Steps

1. Remove the battery end cap from the logger.

2. Using both thumbs, press down on the "+" symbols on the battery cover and slide in the direction of the arrow. The battery cover can then be folded up.
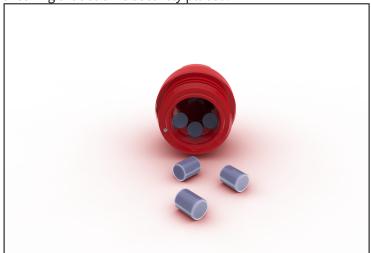
3. Invert the logger to allow the batteries to slide out of the battery carriage.
4. Insert fresh batteries into the battery carriage with the negative terminals pointing inwards, four (4) batteries per channel.
5. Close the battery cover by folding down and then pressing with both thumbs on the "+" symbols and sliding in the opposite direction of the arrow.
6. Replace the battery end cap.

16.3 Installing desiccant

The logger has a dedicated location for placement of desiccant in the battery end cap, which will accommodate three (3) Dricap desiccant capsules (part # 0003240 (qty9), or 0005668 (qty100)).

Steps

1. Remove the battery end cap from the logger - see Opening and closing the logger.
2. Inside the battery end cap, there are 3 recessed sockets. Insert a desiccant capsule into each socket, ensuring that each is securely placed.
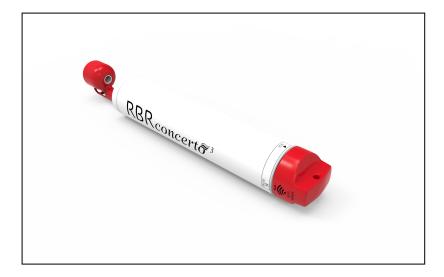
3. Replace battery end cap.

16.4 Twist activation option
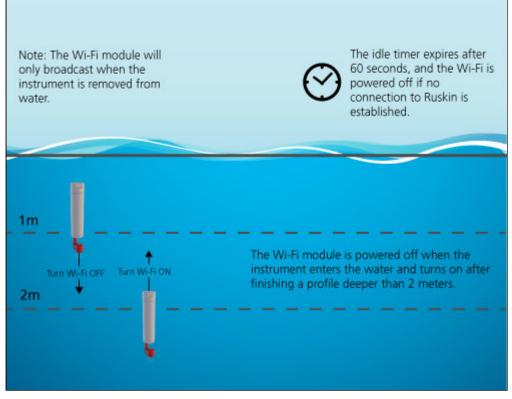
Loggers purchased with this option can be enabled without a schedule by activating **Twist Activation** (see Gating Condition). You must first enable this mode and enable the logger. Closing the battery end cap enables the logger. When enabled by twist activation the logger will vibrate for a few seconds. To stop the logger, open the battery end cap one quarter turn. When the logger is stopped it will vibrate for a few seconds to provide positive feedback.

16.5 Wi-Fi module

The Wi-Fi module will be powered for 60 seconds whenever the battery end cap is turned to the on or off position regardless of whether logging has been enabled or not, allowing for connection to Ruskin, downloading data, and programming the deployment. See image below for an example use case:

Note: The Wi-Fi module will only broadcast when the instrument is removed from water.

The idle timer expires after 60 seconds, and the Wi-Fi is powered off if no connection to Ruskin is established.

1m

Turn Wi-Fi OFF   Turn Wi-Fi ON

The Wi-Fi module is powered off when the instrument enters the water and turns on after finishing a profile deeper than 2 meters.

2m

If you have a Wi-Fi-capable logger and a mobile device, you can connect and view data from the logger on the mobile device. The following explains how to set up your logger, connecting to the mobile device using Wi-Fi, and what information you can view from the mobile device. You must install the Ruskin app from the App store in order to view the logger's information.

> ⚠️ You can connect to a Wi-Fi logger with Ruskin (not Ruskin App) on your computer by connecting to the logger Wi-Fi network. Ruskin will automatically detect the logger. Many of the details discussed below are applicable to communicating with you logger over Wi-Fi with Ruskin

16.5.1 Setting up your logger

You must set up your data logger first, before connecting it to the mobile device.

The **Configuration** tab contains the **Enable**, **Revert settings** and **Use last setup** buttons. When you click **Enable**, the logger setup parameters are stored to the logger and the schedule is enabled. When you click **Revert settings**, you automatically revert the logger configuration back to previous settings.

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 exact same parameters as the first logger.

Steps

1. Connect the logger to the computer and then open Ruskin.
2. In the **Configuration** tab's **Sampling** section, select **Twist activation** from the **Gate** drop down menu.
3. In the **Configuration** tab's **Options** section, select **Mobile** from the **Storage** drop down menu for EasyParse (mobile) compatible data storage.

4. In the **Configuration** tab's **Sampling** section, set the sampling regime and measurement speed. See Schedule a logger.
5. Click **Enable**.
6. Disconnect the logger from your computer.
7. Insert the Wi-Fi module.
8. Close the battery end cap.

> ⚠ If you don't want the logger to sample immediately turn the battery end cap to the Off position. See Twist Activation for more details.
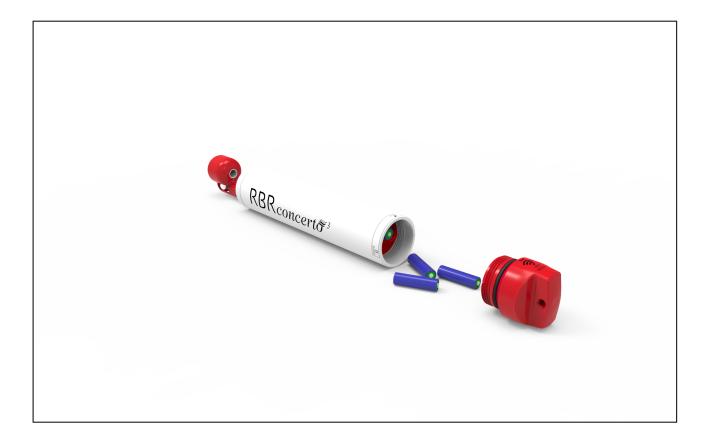
16.6 Maintenance and repairs

16.6.1 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.

16.6.2 O-rings

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.

> ❗ O-rings may lose elasticity over time due to pressure, even when the logger is not deployed. We strongly suggest that the O-rings be replaced regularly, for example, before every deployment, or after a change of batteries, or at least once a year.

Inspecting O-rings

Pay attention to the following areas:

- The surface of the O-ring itself
- The mating surface on the inside of the case between the threads and the open end
- The 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.

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, see part numbers below, and make sure it is not damaged. Lubricate it with a very light film of silicone grease to ease its installation.
4. Install the new O-ring by pushing it into place and popping it into its groove.
5. 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.

Most experienced users of oceanographic equipment replace all O-rings before every deployment as a matter or 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.

Plastic bodies: #2-225 N70 O-ring

Titanium bodies: #2-225 N70 O-ring, #8-225 N90 backup ring

16.6.3 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.

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 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.

16.6.4 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.

16.7 Internal and External Power draw

RBR loggers may be powered by an external source with a voltage range from 4.5-30V.

16.7.1 Order of power draw

When an external power supply is present, the logger will preferentially draw power from this source and not consume the internal batteries. For a logger that is powered by an external source, the internal batteries serve as backup power in the event the external source fails.
The logger is powered by the external power source as long as the voltage is greater than 4.5V. If the external voltage drops below 4.5V, the system switches on the internal batteries.

16.7.2 Paused

Twisting the battery end cap toggles the logger between the "Play" and "Paused" states. When the instrument is in the "Paused" state the power draw is truly 0, so it is not necessary to stop the logger if it will remain in this state for an extended period of time.

16.7.3 USB Power

When connected, USB preferentially powers the logger during configuration or data download, however, if sampling occurs while connected via USB the internal batteries are used during the sample.

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/unharmed), 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_UNABLETOCOMPUTE	unable to compute derived/cross channel