Software Manual for RTS-1&RTS-1C

Riga © 02– September– 2019

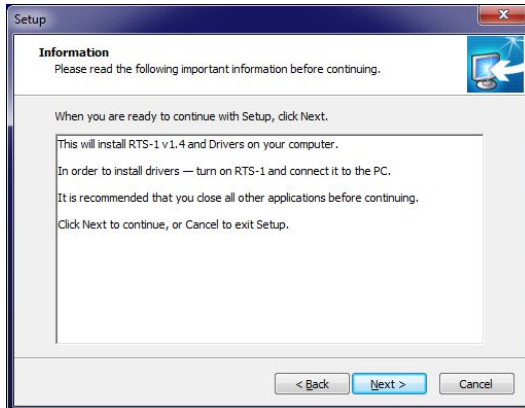*Written by: Pavel Bankovsky, Alex Zhukov (software@biosan.lv)*

Installation Instructions

Standard software installation process, you must agree to the terms of use of the software and follow all the steps of installation.
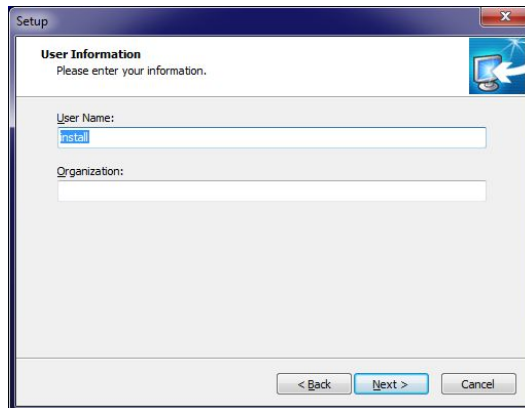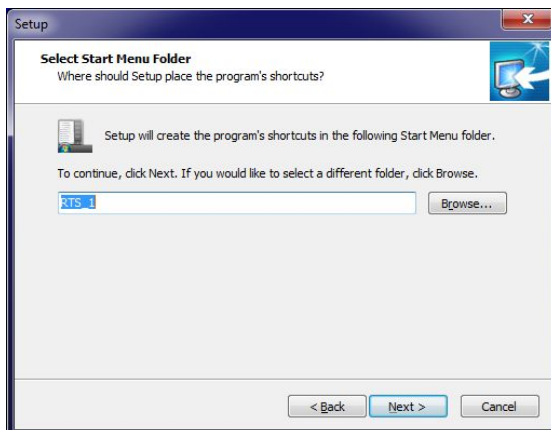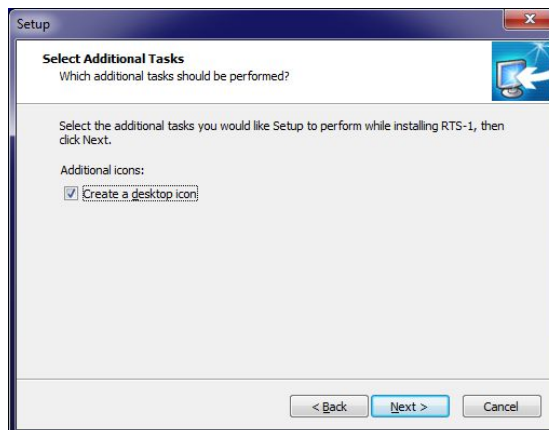
Welcome Window

Information window   *User information window*
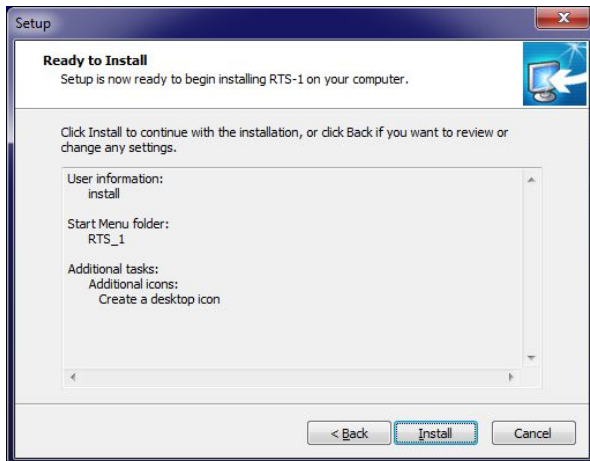

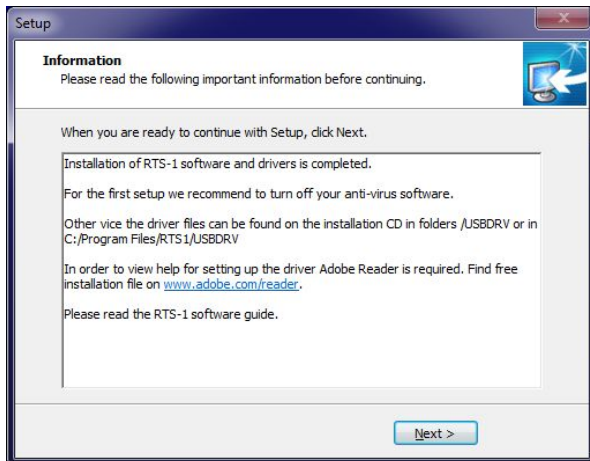*Installation path window*   *Advanced Settings*
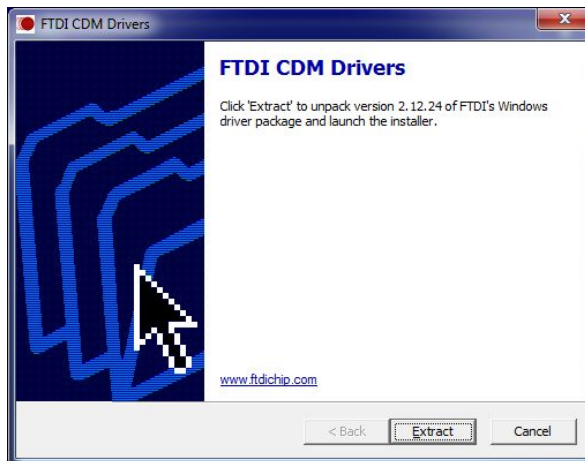
Installation   *The installation process*

Setup

Ready to Install
Setup is now ready to begin installing RTS-1 on your computer.

Click Install to continue with the installation, or click Back if you want to review or change any settings.

User information:
    install

Start Menu folder:
    RTS_1

Additional tasks:
    Additional icons:
        Create a desktop icon

< Back   Install   Cancel

Setup

Installing
Please wait while Setup installs RTS-1 on your computer.

Extracting files...
C:\Program Files (x86)\RTS1\rts.exe

Cancel

Installation finish   *FTDI installation*

Setup

Information
Please read the following important information before continuing.

When you are ready to continue with Setup, click Next.

Installation of RTS-1 software and drivers is completed.

For the first setup we recommend to turn off your anti-virus software.

Other vice the driver files can be found on the installation CD in folders /USBDRV or in C:/Program Files/RTS1/USBDRV

In order to view help for setting up the driver Adobe Reader is required. Find free installation file on www.adobe.com/reader.

Please read the RTS-1 software guide.

Next >

FTDI CDM Drivers

FTDI CDM Drivers

Click 'Extract' to unpack version 2.12.24 of FTDI's Windows driver package and launch the installer.

www.ftdichip.com

< Back   Extract   Cancel

Setup

Completing the RTS-1 Setup Wizard

Setup has finished installing RTS-1 on your computer. The application may be launched by selecting the installed shortcuts.

Click Finish to exit Setup.

☑ Run the RTS-1 software
☐ Move custom user calibration files to new location

< Back   Finish

Program is ready to be launched. Select Move custom calibration files to new location if you have your custom calibrations and you need them to be moved. If you are unsure about this feature, just leave it unchecked.

Instructions for running the program

## Connecting devices to the program:

1. Turn on the device(s) **RTS-1C** and connect to a PC **USB 2.0** with a provided USB cable.
2. Launch the program.
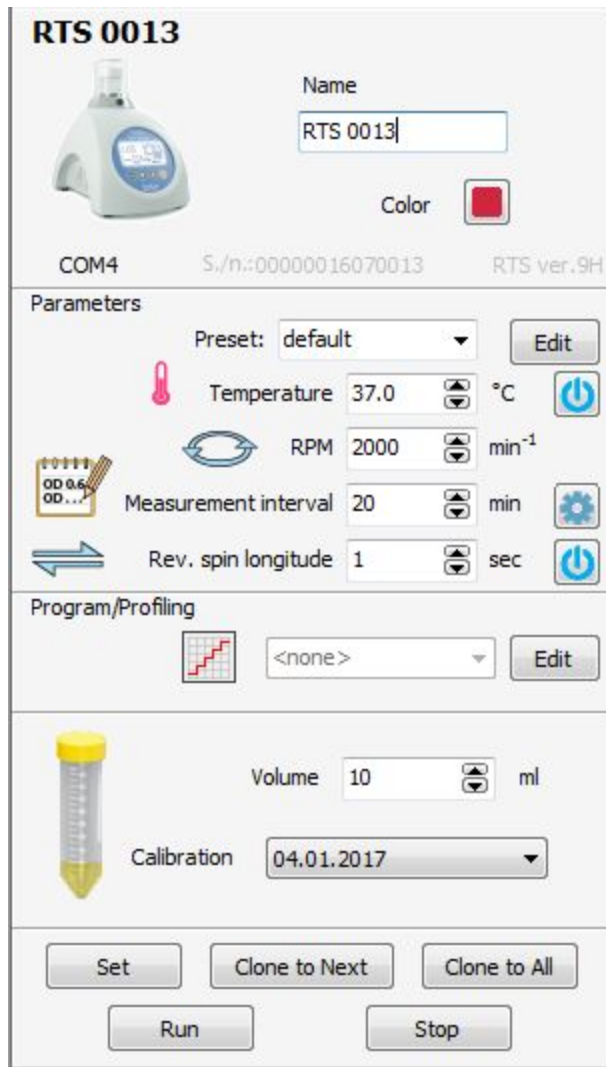3. Wait for the devices to be found
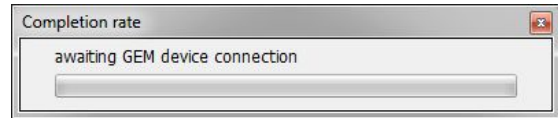
Sequence these actions can take place in any order, as the software automatically finds the device connected.

Setting the RTS-1C
To get familiar with all the elements on this tab, please see chapter "Tab: Setup".
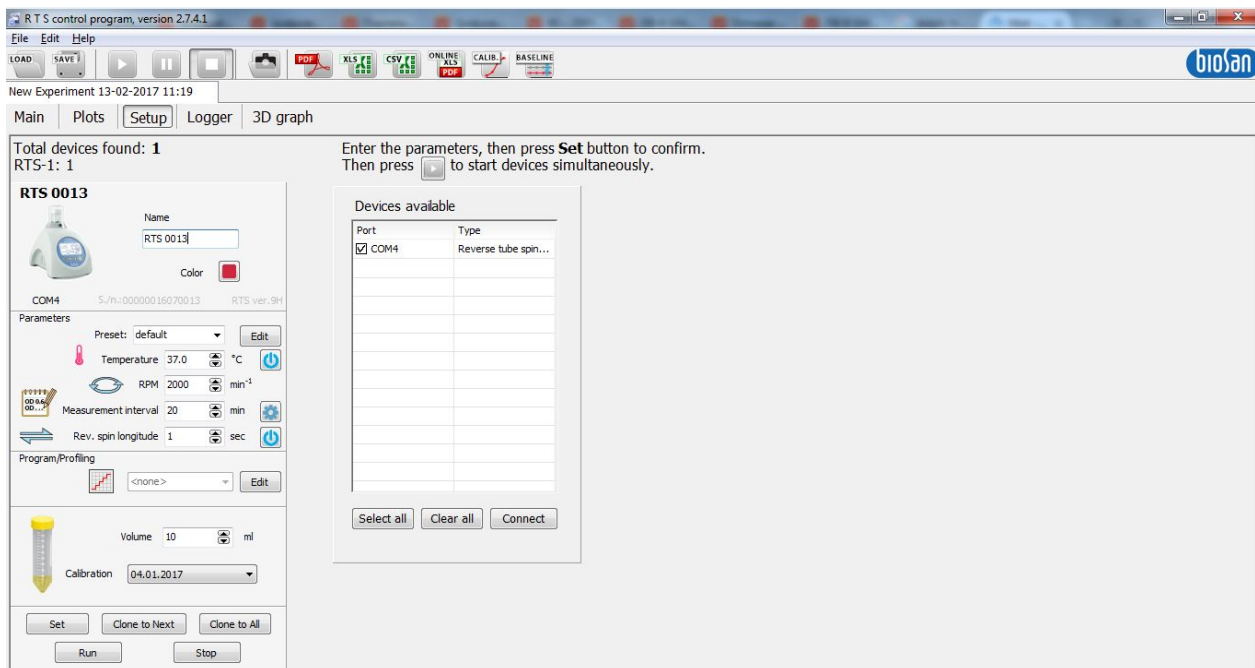
Setting parameters of RTS-1C

To set parameters press button "Set".

It is important to specify the correct volume as it determines correct OD measurements. To launch the device click Run.

Toolbar

This button launches all devices and cycling programs at the same time

This button pauses the experiment

This button stops the experiment

This button saves the experiment or choose File / Save dialogue tree

This button loads any saved experiment or choose the File / Load or dialogue tree

This button opens the folder in which you made the last plot/graph shots

Pressing the button pops up a dialog box "Save file to ... ", where you can select the format and the path of the saved file.

This button provides a report in .csv file.
Pressing the button pops up a dialog box" Save as ... ", where you can choose the path of the saved file

This button provides a report in Adobe PDF file.
Pressing the button pops up a dialog box" Save as ... ", where you can choose the path of the saved file

This button exports the reports online and backs up your data

This button opens calibrations window

This button opens baseline module

Tab: Main

Graph

The graph displays the OD kinetics over time where each device is represented with a different color.

On the right side of the graph, user can find devices' names and their corresponding plot colors.

Button "Auto-Scale" automatically changes the scale so that all points fit into the area.

"Screenshot" button will save the picture of the current chart in the

<\Users\Public\Documents\RTS\ScreenShots\<Date>

Scroll mouse wheel up to increase scale.

Scroll mouse wheel down to decrease the scale.

Panning occurs while holding left mouse button and dragging the mouse around the graph
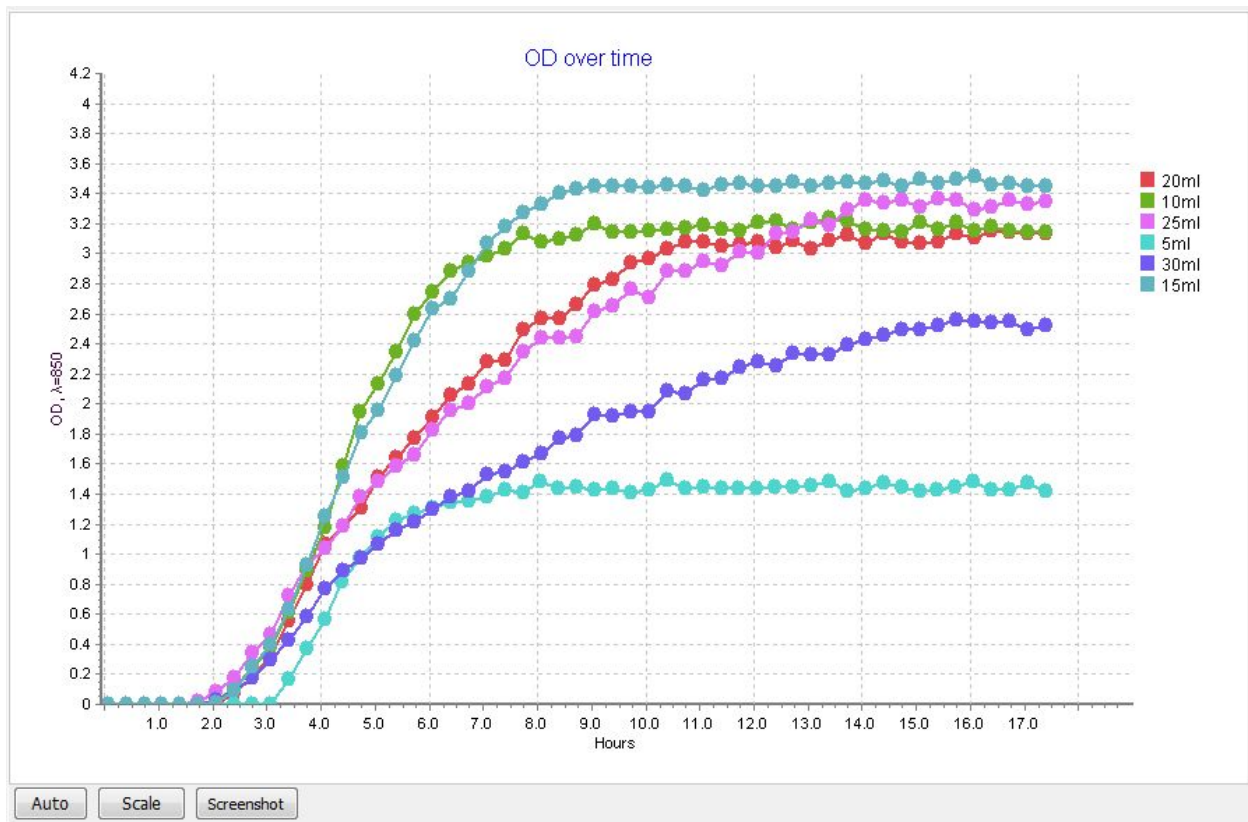
Button "Scale" allows you to fine-tune the scaling region.

Fields Min. time / Max. time represents the scale on the axis X.

Fields Min. OD, λ= 850/Max. OD, λ= 850 represents the scale on the axis Y.
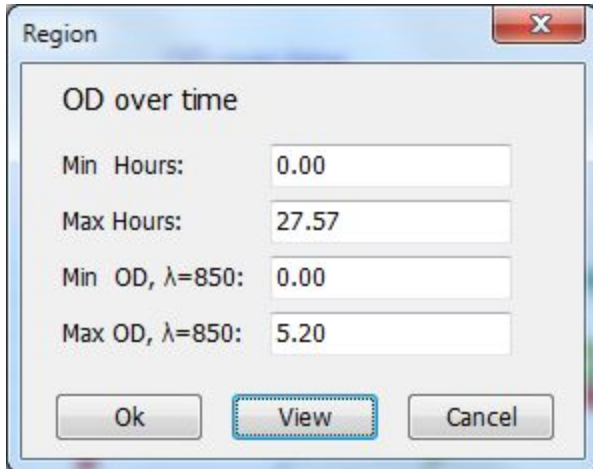
In the field "Experiment name" you can enter the name of the experiment (the default field is filled with "New experiment" + current date and time.)
In the field "Operator name" specify the name of the operator who performs the experiment.

Experiment details:

Experiment name   E.Coli Growth 28-05-2013 11:58

Operator name   P. Bankovsky

Tab "Devices" is a list of connected devices.
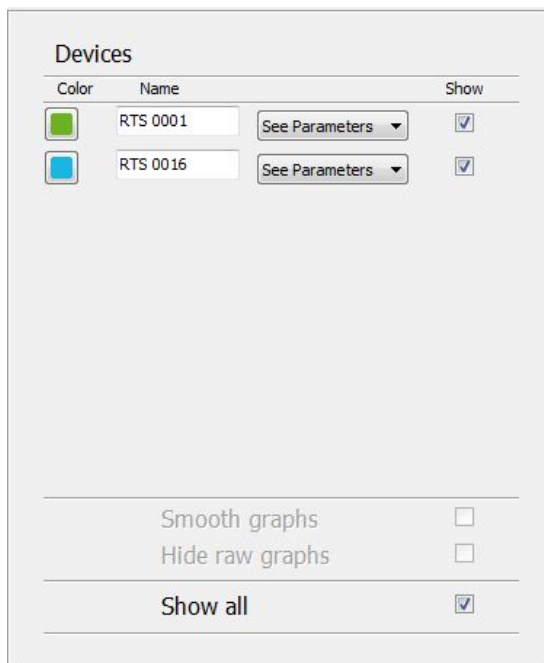
Click "See Parameters" drop list to see current device setting

RTS 0016

Port= COM23
Run time= 01:08 hh:mm
λ= 0nm
RPM= 0/2000
RS period= 0 sec
Temp= 22.1/0.0°C
Status= Ready
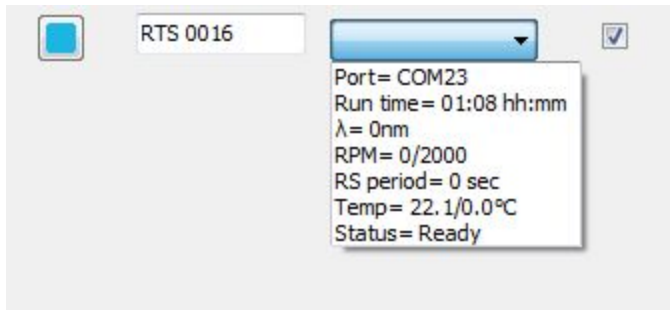
Example: loaded experiment with 6 RTS-1C:
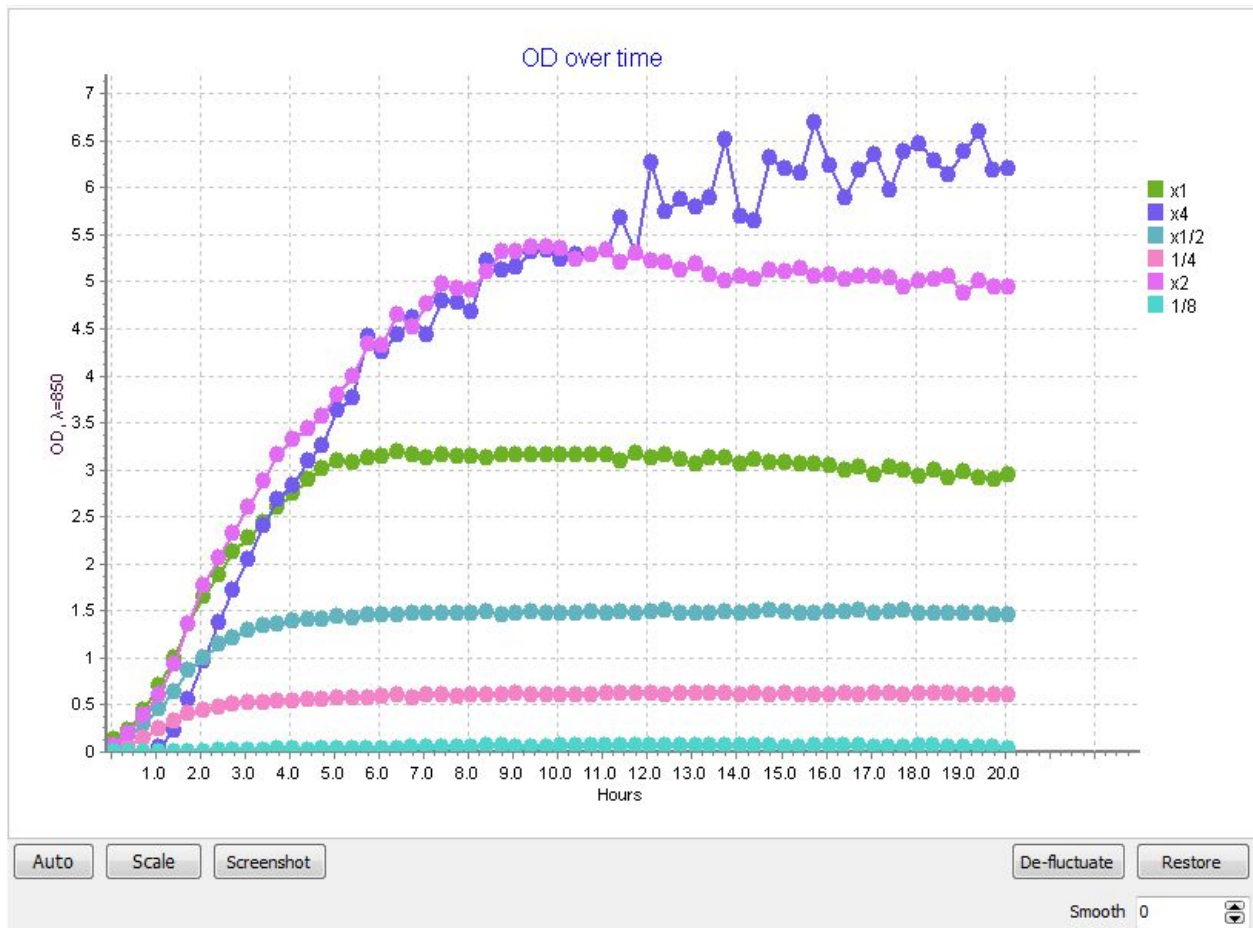
Curve Smoothing

The following buttons are available only when loading a saved experiment.

De-fluctuate Restore Smooth 0	De-fluctuate button removes accident fluctuations; Smooth factor smooths the graph curves (from 0 to 99); Restore button returns the raw data; **Example of graphs smoothing :**

The smoothing function is available in loaded experiments only.

The experiment is available at the following path <RTS-1C folder>/Experiments at Biosan / LB_conc_effect_on_biomass_yield.bsn

Click De-fluctuate, then indicate smooth factor 4, see the result on the picture below:
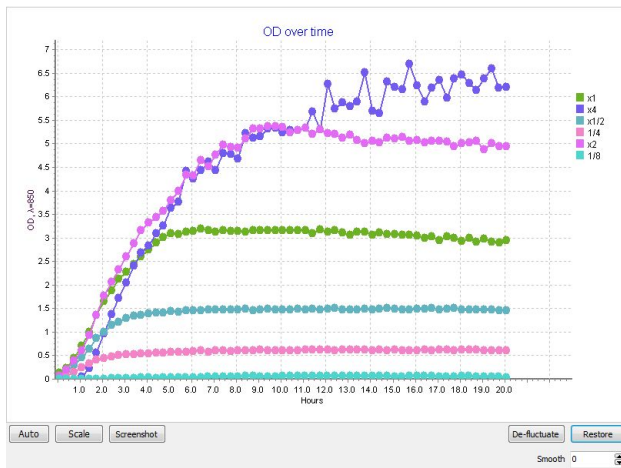
Before smoothing   *After smoothing*
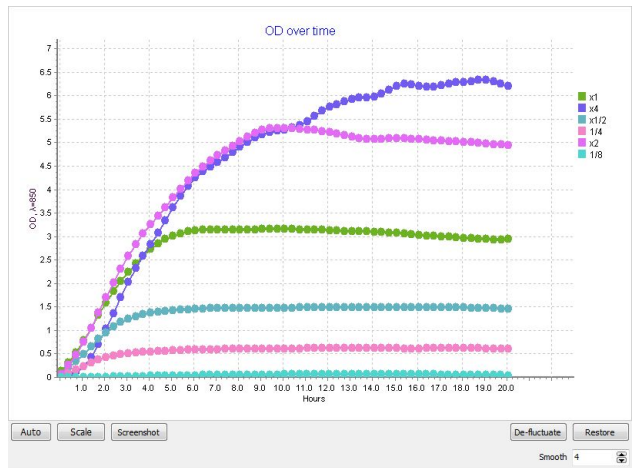
Note that excessive smoothing can lead to distortion of the experimental results

Devices

Here is given the list of connected devices.
By clicking on the name tab, you can rename a device.
By clicking see parameters dropbox you can see the set parameters of a device.

Port= COM6
Run time= 00:02 hh:mm
λ= 850nm
RPM= 1621/2000
RS period= 1 sec
Temp= 27.1/27.0°C
Status= Delayed start

By ticking/unticking a "Show" box a corresponding device will be hidden/shown on the plots.
By ticking/unticking "Show All" box, all devices will be shown/hidden on the plots.

Smooth graphs and Hide raw graphs features has been disabled as one can use the de-fluctuate and smooth graph options in the loaded experiments only.

Devices tab in a new experiment   *Devices tab in a loaded experiment*

Devices

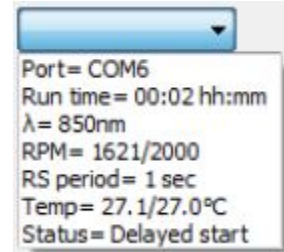| Color	Name		Show
	RTS-0001	See Parameters ▼	☑
	RTS-0002	See Parameters ▼	☑
	RTS-0003	See Parameters ▼	☑
	RTS-0004	See Parameters ▼	☑
	RTS-0005	See Parameters ▼	☑
	RTS-0006	See Parameters ▼	☑

Smooth graphs	☐
Hide raw graphs	☐
Show all	☑

Devices

Color	Name		Show
	63C	See Parameters ▼	☑
	67C	See Parameters ▼	☑
	K+	See Parameters ▼	☑
	68C	See Parameters ▼	☑
	K-	See Parameters ▼	☑
	65C	See Parameters ▼	☑
	66C	See Parameters ▼	☑
	69C	See Parameters ▼	☑
	64C	See Parameters ▼	☑

Smooth graphs	☐
Hide raw graphs	☐
Show all	☑

Tab: Logger

Logger tab displays data obtained from the RTS-1C devices.

"Show Device" table displays devices used in the experiment.
To hide / show data from a specific RTS-1C tick/untick appropriate box.

Data types can be identified by different colors:

Button "Hide All" hides the data from all devices in the table.

Button "Show All" button unhides the data in the table.

Tab: Plots (Charts)

Plots tab displays graphs of the different values versus time:

    1. Figure "OD over time" - shows the dependence of the optical density (OD) versus time.

    2. Figure "Growth rate" shows the dependence of growth rate (first derivative) of versus time.

    3. Figure "Temperature" shows a temperature change versus time.
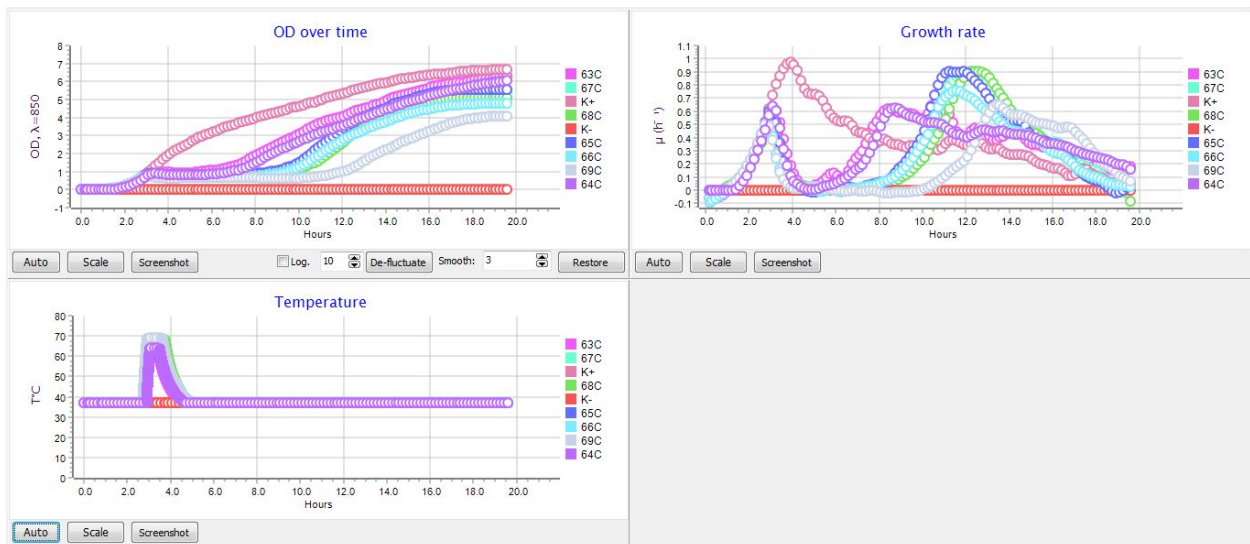
 Button "Auto" automatically sets the scale;

 Button "Scale" allows to set the desired scale on the chart;

 Will do a screenshot of a graph in a following folder <Users\Public\Documents\RTS\ScreenShots\<Date>

Following buttons are available only in loaded experiments:

De-fluctuate button removes random fluctuations;
Smooth — curves smoothing factor(from 0 to 99);
Restore button returns graph to default state

Tab: 3D Graph

Switches between displaying the optical density and the growth rate versus time

The names of all RTS-1C devices are shown in the left column.
The relative positions on X axis are shown in the right column.

Device Position

Device	Position
30s	0
4s	1
1s	2
16s	3
2s	4
8s	5

Default sort ▼

[Set]
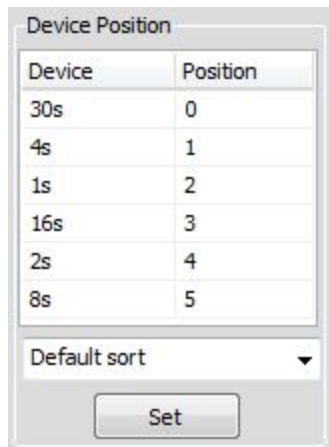
Clicking on "Set" button will do the sorting.
A sorting method can be selected from the list:
1. Manual sort - Allows you to manually set the position of each Device.
2. Default sort - Devices and numbers from 0 to N.
3. Volume sort - Sets the position depending on the volume.
4. Temperature sort - Sets the position depending on the temperature.
5. Speed sort - Sets the position depending on the rotational speed.
6. RS Frequency sort - sort the devices depending on the frequency of reverse spinning.
7. Average sort - sort the devices depending on the average OD or $\wedge$ OD / $\wedge$ t.

This option turns on / off the following parameters:
- **Outlines only** - leaves only the outline of the plot.
- **Web** - draws the contour of the web in the form of a mesh.
- **Surface only** - shows only the surface.
- **Origin** - display XYZ origin.
- **Autocolor** - By default, all points above 4 OD are painted with red. This function automatically adjusts the color palette, where only the highest point will be red.

☑ Outline only
☐ Web
☐ Surface only
☐ Origin
☐ Autocolor
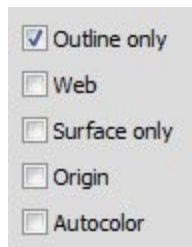
Buttons "+", "−" allow you to scale the graph. Button "B" restores the graph to its original position. Buttons with Arrows will rotate the graph in the shown direction.

Button "Rotate" animates the rotation on the graph.
Arrow buttons move the graph in the direction indicated on the button.

Button "Take Screenshot" takes a picture of the 3D graph. It is saved under following path <Users\Public\Documents\RTS\ScreenShots\<Date> .
Button "Open Screen Folder" opens the folder where the latest screenshot was taken to.
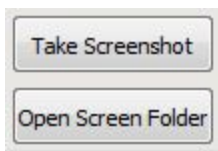
Field to enter the name of the X axis.

X axis name:
Manual sort
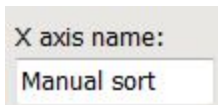
Change the transparency of the surface.

Transparency:
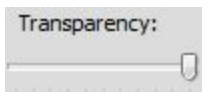
Changing the font size.

Text Size:
1.10
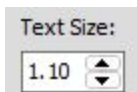
Chart scaling of the axes XYZ.
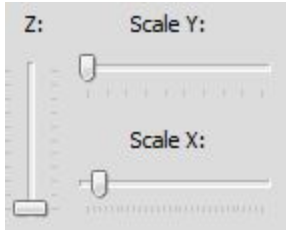
Example of a program that is loaded experiment with 6 devices RTS-1:
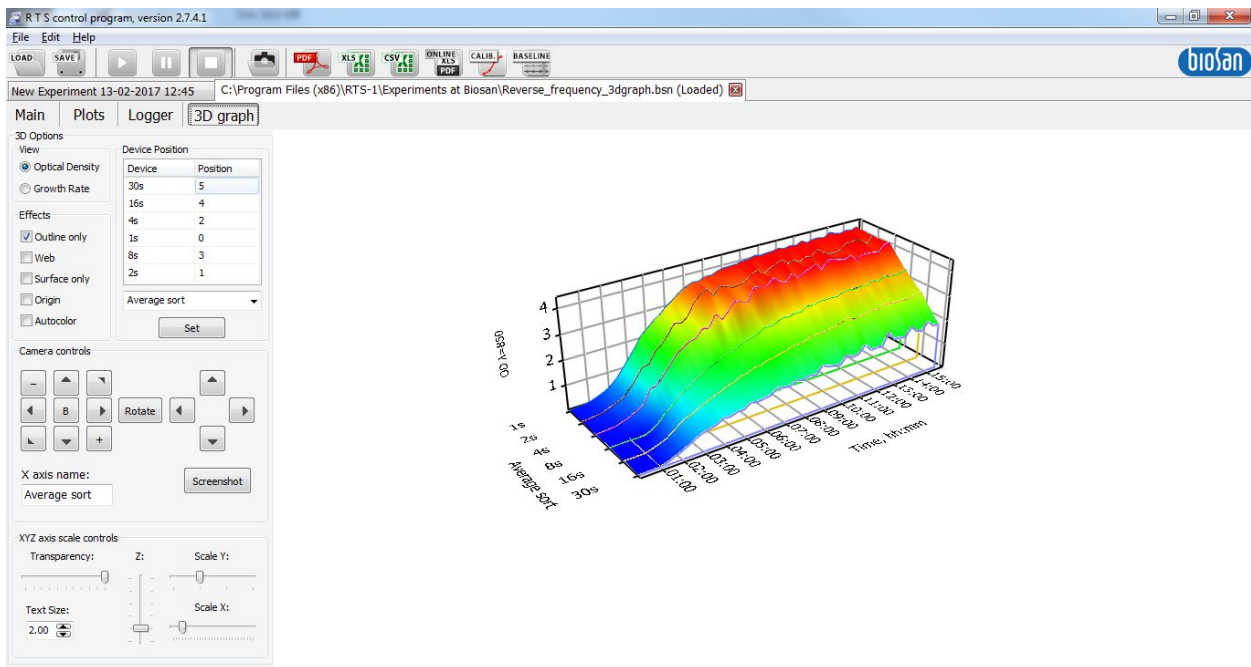
Tab: Setup

In the tab "Setup" you can set the parameters of each connected device

- Name: the name of the device
- COM#: Port number of the connected device
- s/n 00000016070013: Serial number of the device
- RTS ver.9H : Version of the hardware
- Color: the color of a curve on a plot representing the device
- Preset: You can choose a ready-made template with saved parameters
- Temperature: temperature in °C
- RPM: the speed of rotation per minute
- Measurement interval: How often will measurement be carried out, also user can enter the advanced measurement option by clicking on the toothed gear icon.
- Rev.spin period: the frequency of changing the direction of Reverse Spin
- Profiling: To set cycles and profiling (see Profiling chapter for more details)
- Volume: volume of the sample
- Calibration: selects the calibration for measurement

Button "Set" - will set the parameters on a referred device.
Button "Clone to Next" - will set the parameters to the next device that is located in the program.
Button "Clone to All" - will set the parameters to all connected devices.
Button "Run" - will run a device separately
Button "Stop" - will stop a device separately

The table below shows a list of all connected devices.
Device can be disconnected by unticking the appropriate box.
Button "Select all" connects all found RTS-1 devices.
Button "Clear all" disconnects all devices.
Button "Connect" will connect or disconnect a selected device.
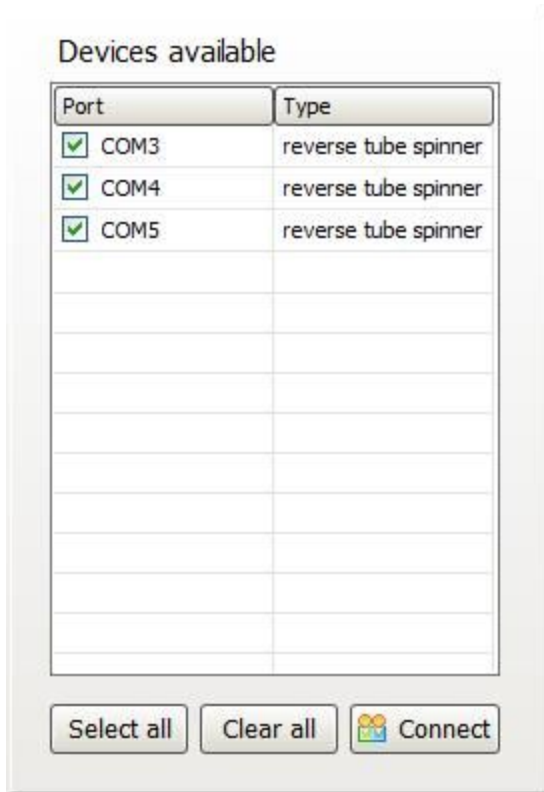
Presets

Menu Edit-> Presets user can create / modify parameters templates.
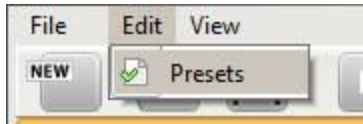
Commands panel (in order):
- Top of the list.
- previous pattern.
- following template .
- The end of the list.
- Remove the template.
- Edit Template.
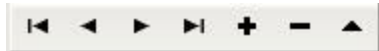
Template consists of six fields:

1. Name:the name of the device.
2. Temperature: Temperature.
3. Measure: how often frequent to measure.
4. Velocity: the speed of rotation per minute.
5. RS period: the frequency of changing the direction of Reverse Spin mixing.
6. Volume: volume.

"Save" button saves all changes.
"Close" button closes the window templates.

Name	Temperature	Measure	Velocity	RS period	Volume
3s	29	1	500	2	12.5
2s	28	1	250	3	10
1s	30	1	2000	4	7
default	37	10	1700	5	10
simple	25	10	750	0	10
4s	27	1	1000	1	5
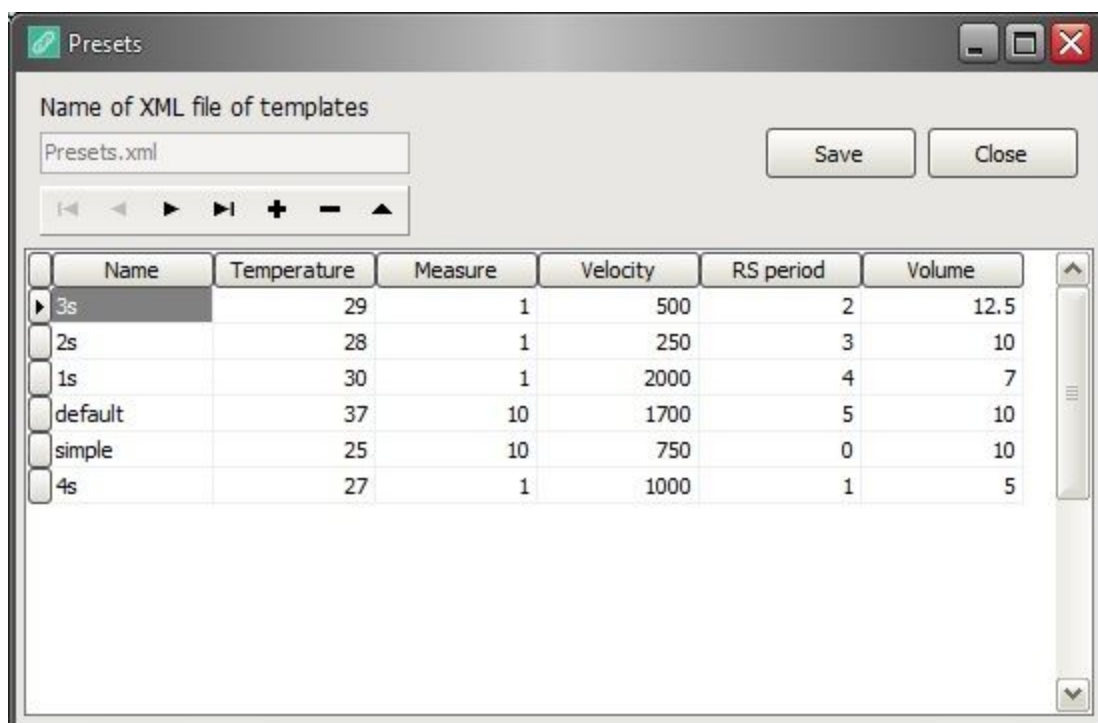
Advanced measurement
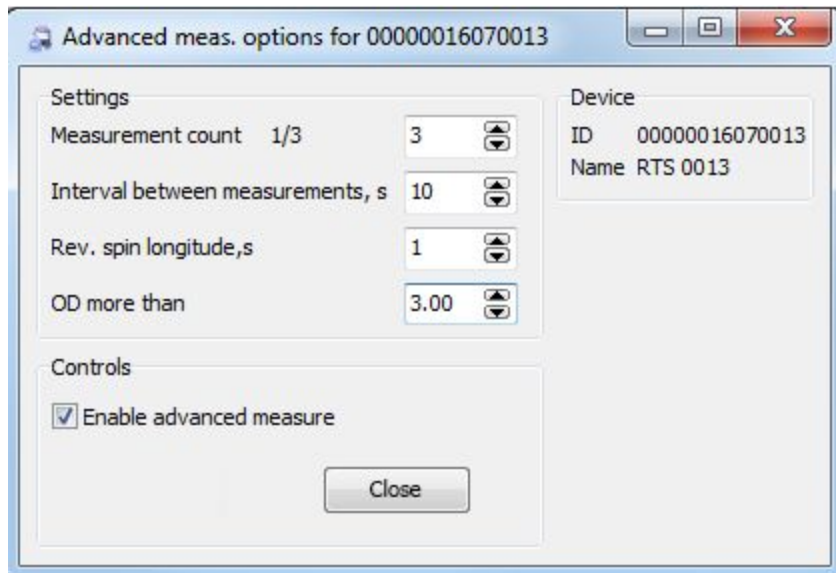
This function is designed to implement greater accuracy of measurement for dense samples. The maximum and minimum values will be ignored and the average of the remaining will be calculated.
This function is set separately for each instrument.

Here is a short guide how to use it:

1. Set the total number of measurements to make
2. Set the interval between measurements in seconds
3. Set the reverse spin longitude in seconds
4. Set the OD value, above which the advanced measurement options will take place

In the controls, tick the Enable advanced measure.

Press Set button to apply the settings, stop to cancel the settings.

Online Report

This option is made to enable remote monitoring process of the experiment in real time. Option is created via using a third-party free-of-charge application Google Drive.
To use this application should register a google account (see below)

By clicking "Online report" window appears to create reports.
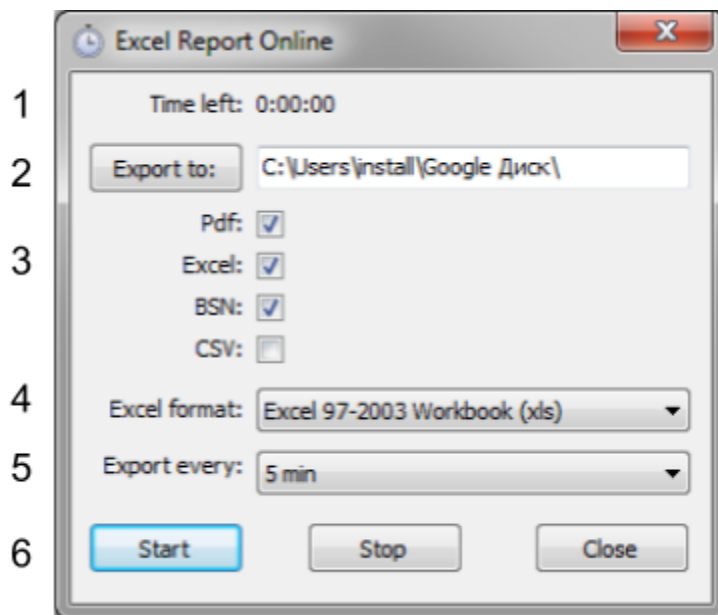
1. The time till next report will be created.
2. The path to save reports. (If the "Google Drive" is installed. The default path will be the folder of "Google Drive",).
3. Exporting PDF, Excel, BSN (back up), CSV reports.
4. Selecting an Excel file format.
5. The frequency of reports generations.
6. Start / stop button.

When you turn on the online report, a special animation appears in the toolbar.

Google Drive installation manual (Cited):

1. Go to http://drive.google.com ⬚ .
2. Click the **Download Google Drive** for your PC button.
3. Open **googledrivesync.exe** to automatically install and start Google Drive on your PC. (You may receive a warning that Google Drive is an application downloaded from the Internet. Click the **Open** button.)
4. Enter your **Google Account username** and **password** in the window that opens. This will be the account associated with Google Drive for your PC.
5. Complete the installation package instructions.
6. Launch Google Drive for your PC from the Start menu. Drag files and folders into your Google Drive folder to begin syncing items to **My Drive** (part of Google Drive on the web).

If the instruction above does not work, go to
https://support.google.com/drive/answer/2375078?hl=en for the latest information.

To use the Online Report option: Google Drive should be installed both on the device where experiment is running and on the device where user wants to monitor the experiment. Same login can be used, or if user wishes to use different accounts — a folder can be created and shared using Google Drive services.

If your organization do not accept working with third-party applications, you can always choose the path for exporting reports to an internal secure server to which a remote access is possible.

In the same way you can create online reports on other types of cloud-services, but this manual covers only the use with Google Drive.

Profiling / Cycling

Next feature allows you to program cycles.

Profiling:

Step	Command	Value	Unit	Go to step	Repeat	True	Else
1	Stop						
2	Hold for	10	min				
3	Set RS longitude	1	sec				
4	Set speed	2000	rpm				
5	Start						
6	Hold for	15	sec				
7	Measure OD						
8	Hold for	1	sec				
9	Set speed	0	rpm	1			
10							

Set current step: 1

Add row Blank Set

Experiment Save

No mixing, OD meas ▾ Load Delete

Start Stop Apply and Hide

Status:
Time left: 0:00:00
Device ID: 00000000000010
Name: RTS 0010

2.5
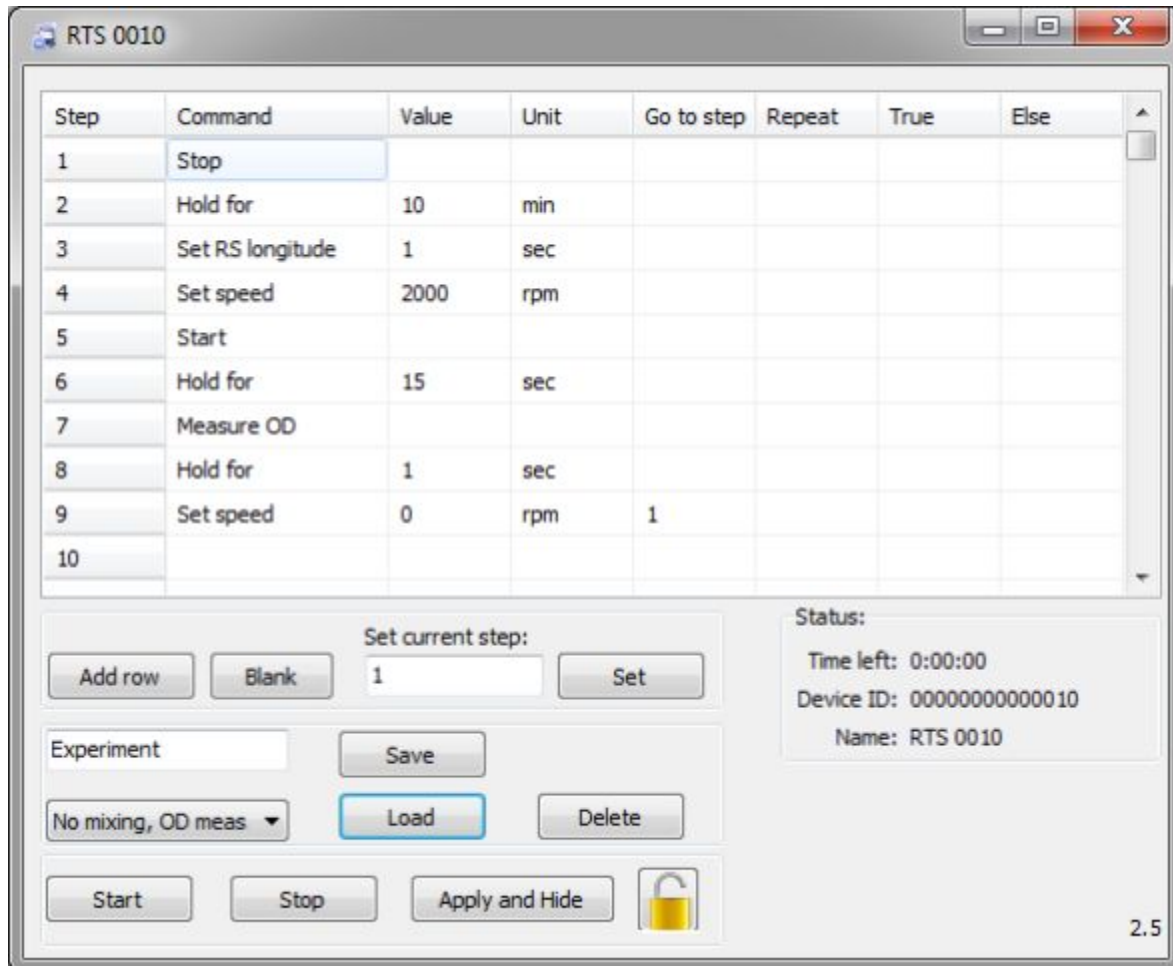
Button "Add row" - Adds an empty line at the end of the table
button "Start" - Starts the profiling (Can be activated also by **Play** button in the toolbar)
button "Stop" - Stops the profiling.
button "Load" - Loads the saved program from the list (e.g. "No mixing, OD meas").
button "Save" - Saves the current program (e.g. "Experiment").
button "Set" - Changes the current program step if you want to move to the desired program step (press "Stop" button).
button "Apply and Hide" - Applies profiling program and hides the window
button "Blank" - Clears the entire table

Clicking the right mouse button opens a menu.

Insert row before - add a blank line before the current line.
Clear current row - Clear the current line.
Clear all - Clear the entire table .
Delete current row - Deletes the current line.

Commands List:
- Start - Runs the RTS1
- Set temperature - Sets the temperature
- If OD - Waiting to achieve a certain value of optical density
- Measure OD - Forced OD measurement
- Hold for - Start timer, at the end of which program will go to the next step. Indicate the time and select the units sec / min / hour
- Fast set temperature - Sets the temperature with overcooling / overheating
- Set meas. time - frequency optical density measurements
- Stop - Fully stops the RTS1
- Set speed - sets the rotational speed of the tube
- Set RS longitude - sets the frequency of rotation direction change
- Set volume - Sets the volume of the sample
- Pause - Pause the operation of RTS1
- Sound Alarm - will sound an alarm, to stop the alarm go to Setup tab and click button

Step	Command	Value	Unit
1	Start		
2	Set temperature	27	°C
3	Measure OD	▼	
4		>	
5		< >=	
6		<= =	

Step	Command	Value	Unit	G
1	Start			
2	Set temperature	27	°C	
3	Measure OD	=	0.4	
4	Hold for	30	▼	
5			sec min	
6			hrs	

Step	Command	Value	Unit	Go to step	Repeat	True	Else
1	Start						
2	Set temperature	27	°C				
3	Measure OD	=	0.4				
4	Hold for	30	min				
5	Fast set temperature	37	°C				
6	Set meas. time	10	min				
7	Stop						

For "Set temperature", " Hold for"," Fast set temperature"," Set meas. time ", etc. go to and repeat functions are available

- Go to - At the end of the current step program jumps to the step indicated in this field.
- Repeat - Number of iterations, at the end will go to the next step.

"If OD" is a conditional "go to" function with true/else values
For example, using this example

Step	Command	Value	Unit	Go to step	Repeat	True	Else
1	Start						
2	If OD	>	1			3	1
3	Set temperature	4	°C				
4	Stop						
5	Sound Alarm!						

if OD = 0.9 at the moment, it will jump to the step number 1, because the condition was not met

and if the current reading will be 1.1 OD, program will jump to step 3. If nothing is indicated in True / Else fields, then if the condition is not met, the transition will not be done, and when the condition will be met, program will jump to the next step.
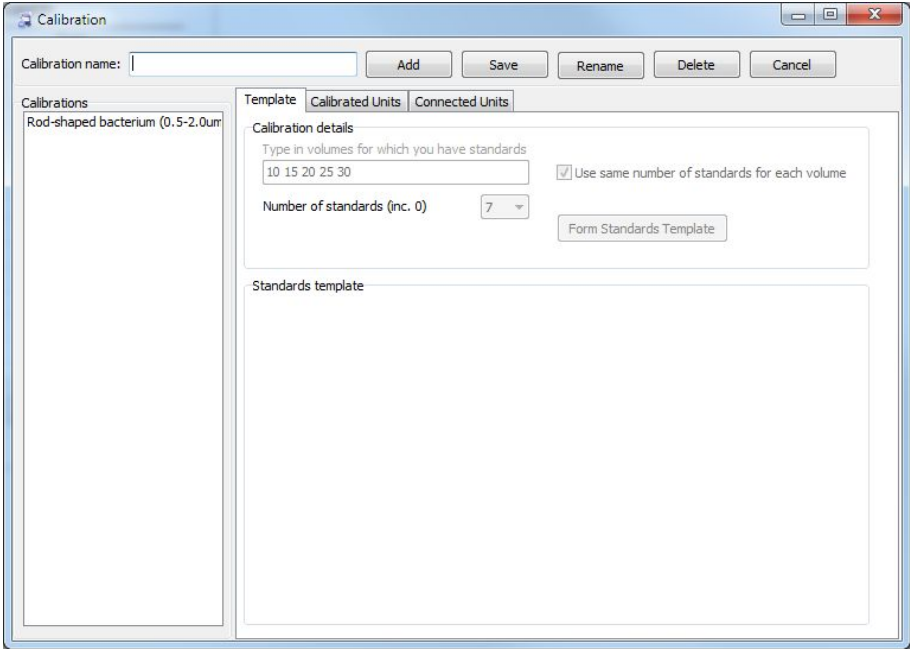
Calibration

This section describes a manual calibration procedure. User can create his own calibrations

Click on the Calib. button [CALIB.] located on the toolbar
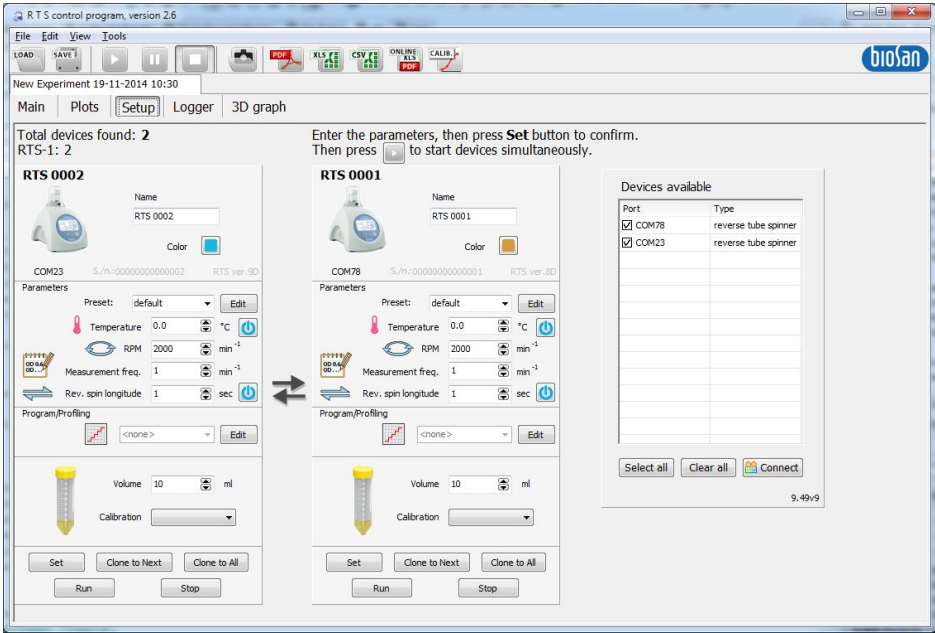
Following window will appear:

To create new calibration — type in the name in "Calibration name" field (e.g. Test calibration) and press "Add" button:

Calibration name: Test calibration   [Add]

For example you have following calibration setup:
Std in this table stands for Standard.

Std 0	Std 1	Std 5	Std 7
10 ml	10 ml	10 ml	10 ml
0 OD	1 OD	5 OD	7 OD

Std 0	Std 0.5	Std 1	Std 4
20 ml	20 ml	20 ml	20 ml
0 OD	1 OD	5 OD	7 OD

Std 0	Std 0.5	Std 1	Std 4
30 ml	30 ml	30 ml	30 ml
0 OD	1 OD	5 OD	7 OD

10, 20, 30 volumes, each of the volume has 4 different OD, where Std 0 is blank (e.g. media, dH2O).

To set parameters enter volumes in calibration details and set number of standards to 4 (if you have less or more standards between volumes you can edit standards template further)

Calibration details
Type in volumes for which you have standards
10 20 30   ☑ Use same number of standards for each volume

Number of standards (inc. 0) [4 ▾]   [Form Standards Template]

Note: Volumes must be separated by **single spaces** only!

> Click on "Form Standards Template" button

Calibrations' list will be updated:

Now fill in the standards' OD values (that have been quantified beforehand in e.g. spectrophotometer) in Standards template for each of the volume.

If you have exactly the same amount of standards and their OD values are the same in each volume, press "Copy Standards ODs to All Volumes" button.

If you have different amount of standards for any of the volumes, indicate it by selecting a volume corresponding tab, set the number of standards and press Set button.

Std #	Std OD
0	0
1	
2	
3	

Tabs: 10 ml | 30 ml

Copy Standard ODs to All Volumes

Number of standards 3 ▼   Set

Dropdown: 3, 4, 5, 6

Save your settings by pressing "Save" button. If everything works correctly, following window will appear. If not, follow a guidance written in such windows.

asrts

Successfully saved.

OK
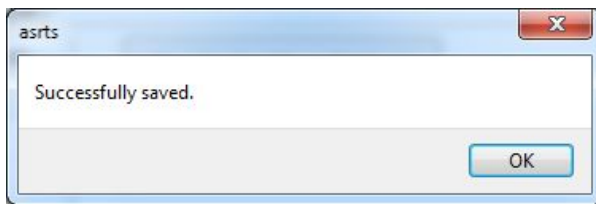
If you select Calibrated Units tab, it should appear empty as none of the units carries your calibration.

Tabs: Template | Calibrated Units | Connected Units
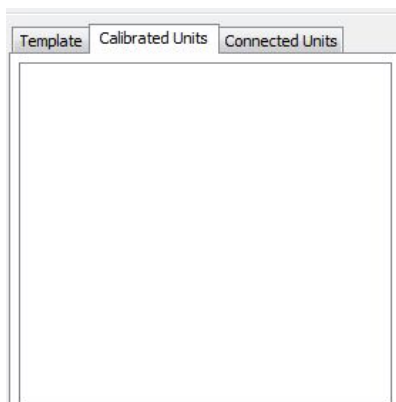
Go to Connected Units to begin calibration measurements

Here is a window representing a calibration setup:

- RTS 0013 -- is the name of the unit
- 00000016070013.stdb -- is the units filename in the calibration
- RTS ver. 9H -- is the version of the hardware
- S./n 00000016070013 -- is the serial number of the unit
- COM4 -- is the connection port; not calibrated -- means that the unit is not yet calibrated.
- Volume, ml -- is the volume of the standard that is inserted
- Standard # -- is the number of the standard that is inserted (in this example it is the blank standard)
- Min: θ -- the minimum value acquired after measurement, it will not be recorded
- Max: θ -- the maximum value acquired after measurement, it will not be recorded
- Average: 0 -- the remaining of the measurement values are going to be averaged, this value will be recorded.

33

- Progress 3/5: 3 is current measure, 5 is total measurements (when all measurements completes, there will be a sound)
- Last acquired value -- this shows the last measured value
- Measure button -- measures a standard
- Stop button -- stops the measurement
- Curve button -- opens mathematical module for calculation of the model to fit your calibration setup
- Show Hz button -- show a window with volumes that has to be yet inserted

Calibration setup

Select a volume of the standard that is inserted

Select a number of the standard that is inserted

Following command enables you to specify how many measurements you want to perform (min 3, recommended 5), mixing time before 1st measurement (recommended 30sec), Mixing time between measurements (recommended 15 seconds)

Measure all button -- starts measurement in all connected devices simultaneously
Stop all button -- stops all measurements
Swap button -- for example you have a following (see picture bellow) calibration setup. For example when you finish measuring standards 0, 1, 5 and 7 of Volume 10 ml and units in the Connected Units window are located as on the picture (RTS 0001, RTS 0002, RTS 0003, RTS 0004)
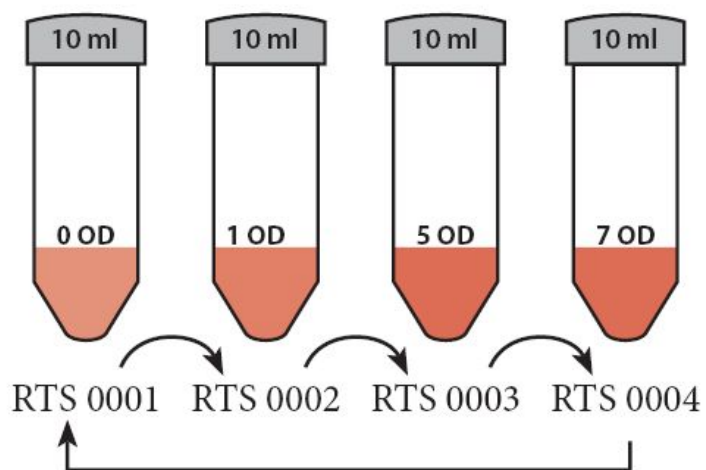
After pressing Swap button, standards will be relocated as follows:
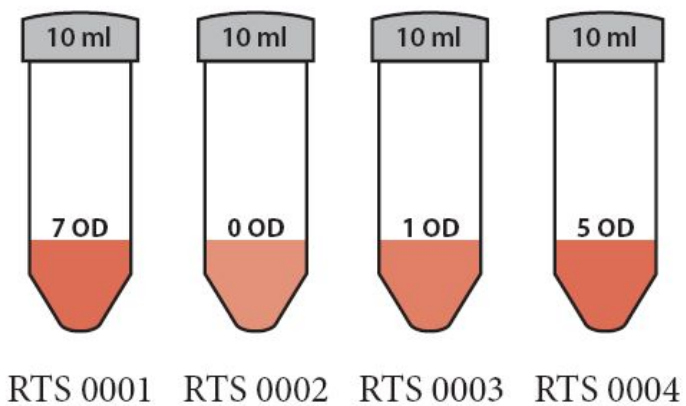
>Click on the Show Hz button, to check which standards are yet to be measured
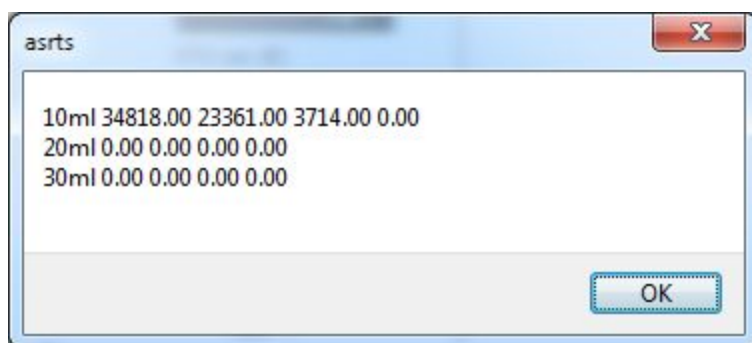
If you press Curve button before entering all values, such window will appear


```
asrts                                              X

This standards are not calibrated:
10ml 0.00
10ml 1.00
10ml 5.00
10ml 7.00
20ml 0.00
20ml 1.00
20ml 5.00
20ml 7.00
30ml 0.00
30ml 1.00
30ml 5.00
30ml 7.00

                                          OK
```
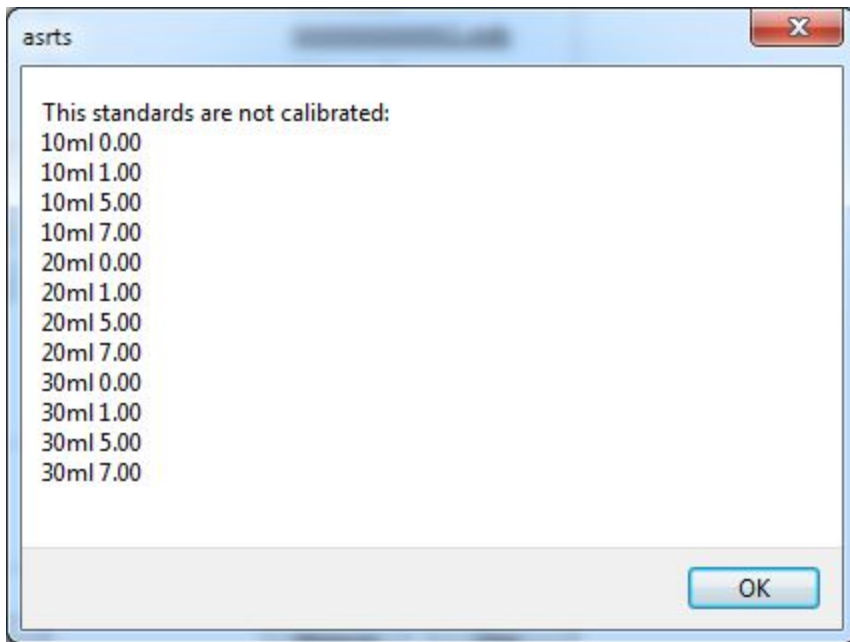
When you fill all the volumes press Show Hz to check if all standards were measured


```
asrts                                              X

10ml 34818.00 23421.00 3714.00 1205.00
20ml 34990.00 23364.00 3714.00 1205.00
30ml 34874.00 23457.00 3713.00 1204.00

                                  OK
```
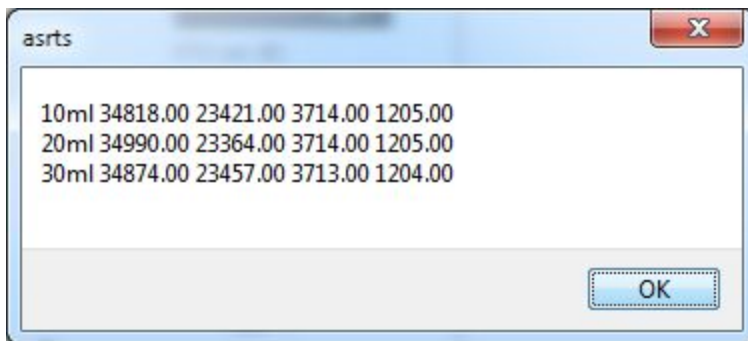
Click on Curve button to proceed for mathematical calculation of model fitting using your calibration setup. Following window will appear after you press Curve button. Software automatically selects the best model for you, but you can select any of the models.
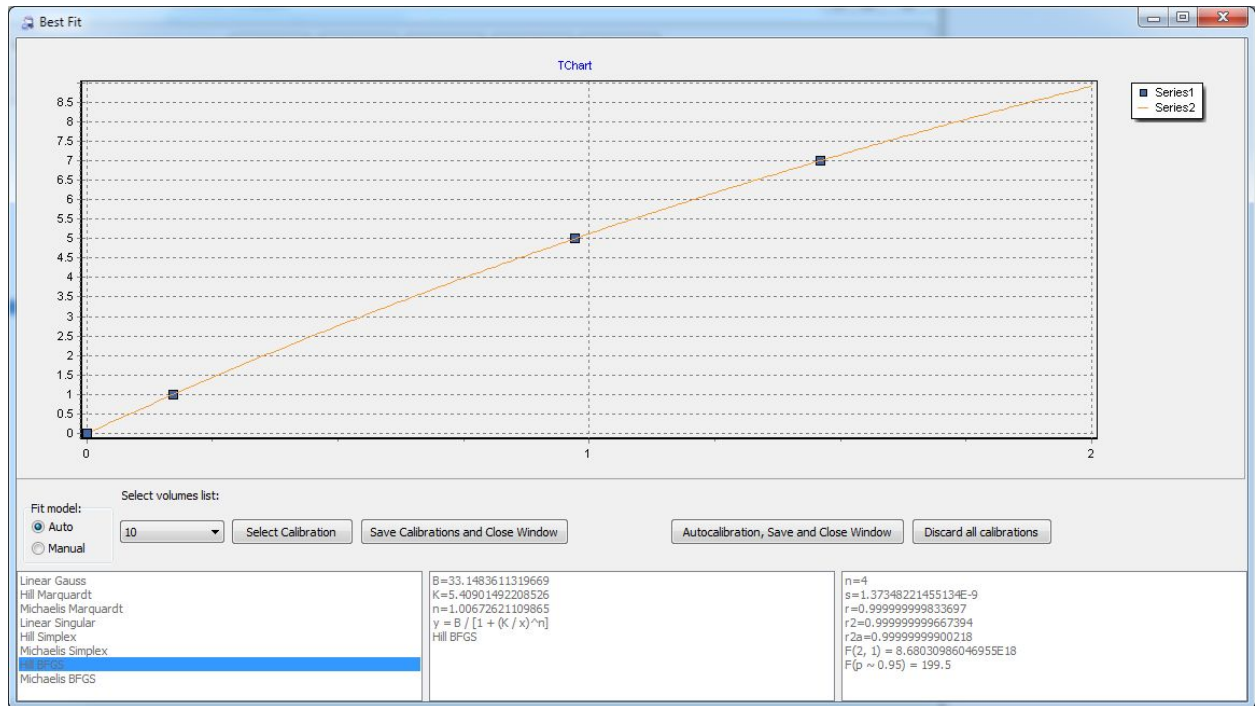
Here is given a description of tools available:
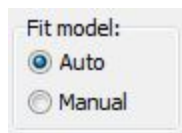
Fit model: Auto or Manual -- Set Manual if you want to select other than the best fit model.
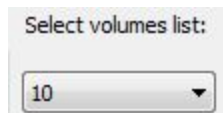
Select volumes list -- Select a volume to see what calibration curve to select.
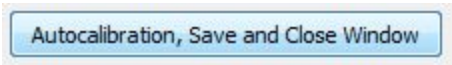
If you are satisfied with best fit selection press

Here is given a list of models and algorithms used for determining the equation coefficients and parameters

Here is given a list of calculated equation coefficients for Hill's model using BFGS determination algorithm

```
B=33.1483611319669
K=5.40901492208526
n=1.00672621109865
y = B / [1 + (K / x)^n]
Hill BFGS
```

Here is given a list of equation parameters.

```
n=4
s=1.37348221455134E-9
r=0.999999999833697
r2=0.999999999667394
r2a=0.99999999900218
F(2, 1) = 8.68030986046955E18
F(p ~ 0.95) = 199.5
```

Where:
Number of observations is n
Residual error is s
Coefficient of correlation is r
Coefficient of determination is r2
Adjusted coeff. of determination is r2a
Variance ratio (explained/resid.) is F(1, 3)
Critical variance ratio is F(p = 0.95)

If you are satisfied with your new selected calibration Select Calibration button
When you have selected all the satisfiable calibration press Save Calibrations and Close Window button:

| Select Calibration | Save Calibrations and Close Window |

To discard all selected models and return to Best fit calibration press Discard all calibrations button:

| Discard all calibrations |
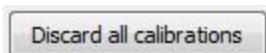
When you have saved the calibration, the status of the units should change to calibrated

RTS 0001
00000000000001.stdb
RTS ver.8D
S./n.: 00000000000001
COM78   calibrated

To see calibration curves, go to Calibrated Units and click on the unit of interest

| Template | Calibrated Units | Connected Units |

00000000000001.stdb
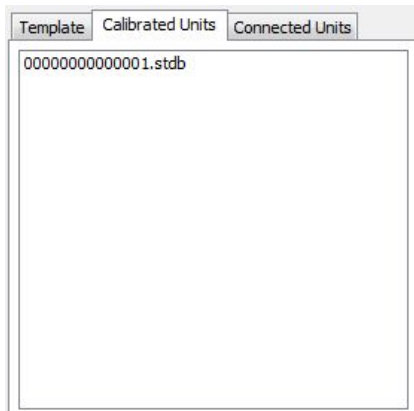
Here you will see the calculated models and intermediates between them.

Hill BFGS y = B / [1 + (K / x)^n]
B=33.1483611319669
K=5.40901492208526
n=1.00672621109865

Std#	Std OD	Unit OD
0	0	0
1	1	0.17219838
2	5	0.97196192
3	7	1.46081677
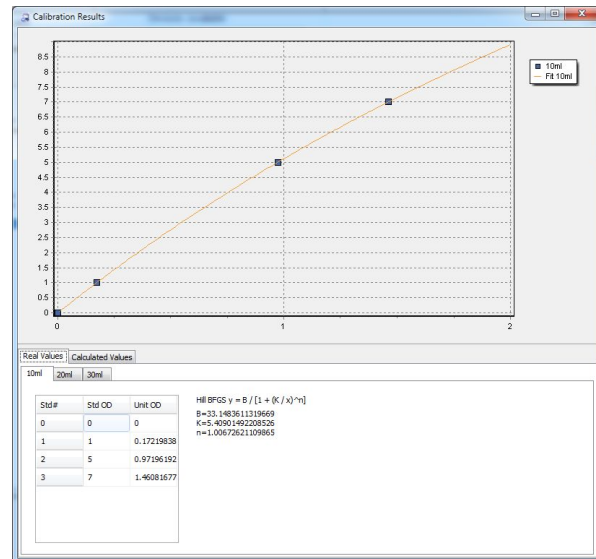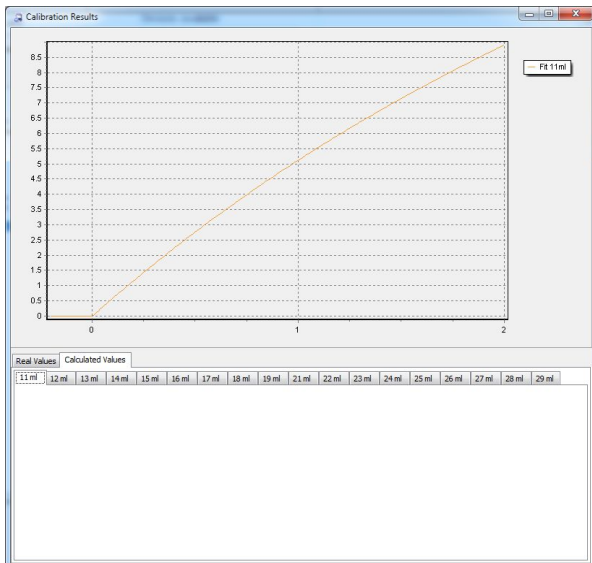
Now to use your calibration you have to choose it for each unit or:
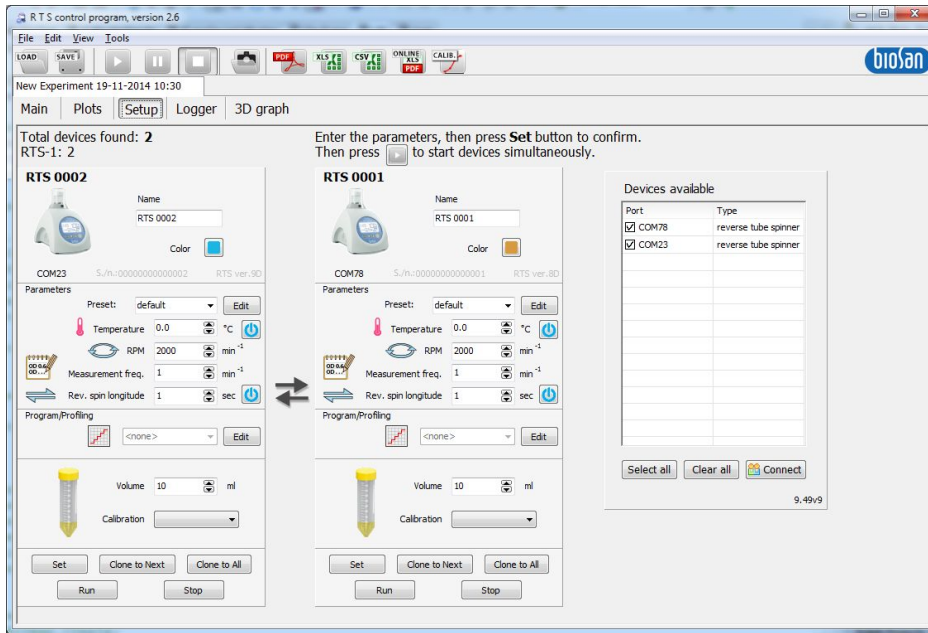
You can press Run button for all units and following window will appear if one or more units will not have selected calibration:
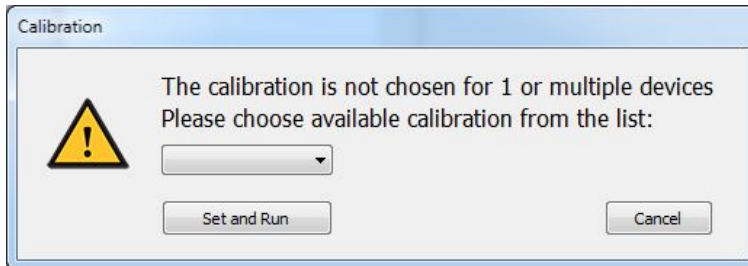
Select your new calibration and press Set and Run button:
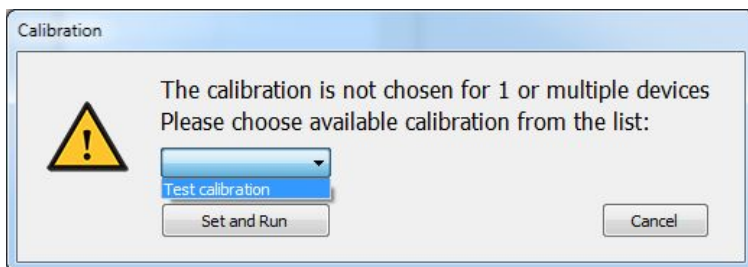
Calibration Results

In order to see the parameters of the calibrations, do the following:

Open Calibration module: CALIB.

Choose the Calibration, click on Calibrated Units tab and double click on a needed calibrated unit's ID, on which you want to change the calibration parameters (eg. Rod-shaped bacterium (0.2-2.0um3) and 00000016070011.stdb):
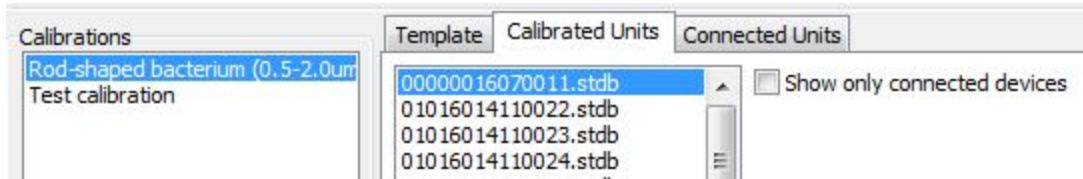
Double click on the unit's ID.

In this window you can observe the calibration parameters:
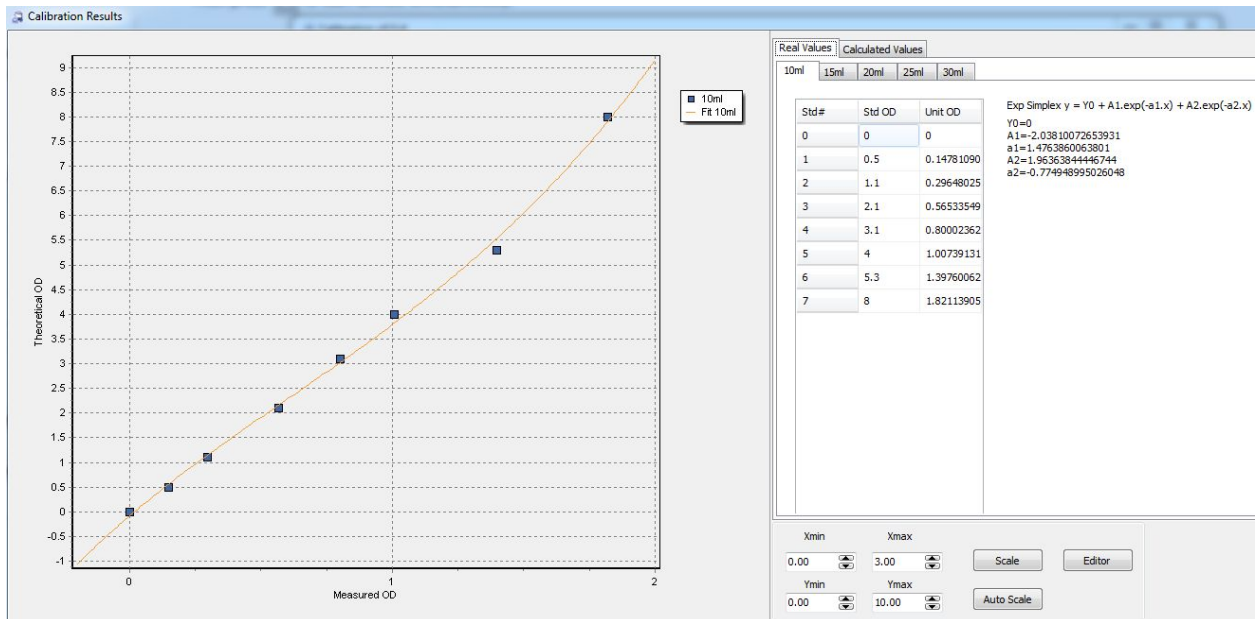
This graph shows the Theoretical OD vs Measured OD calibration curve:
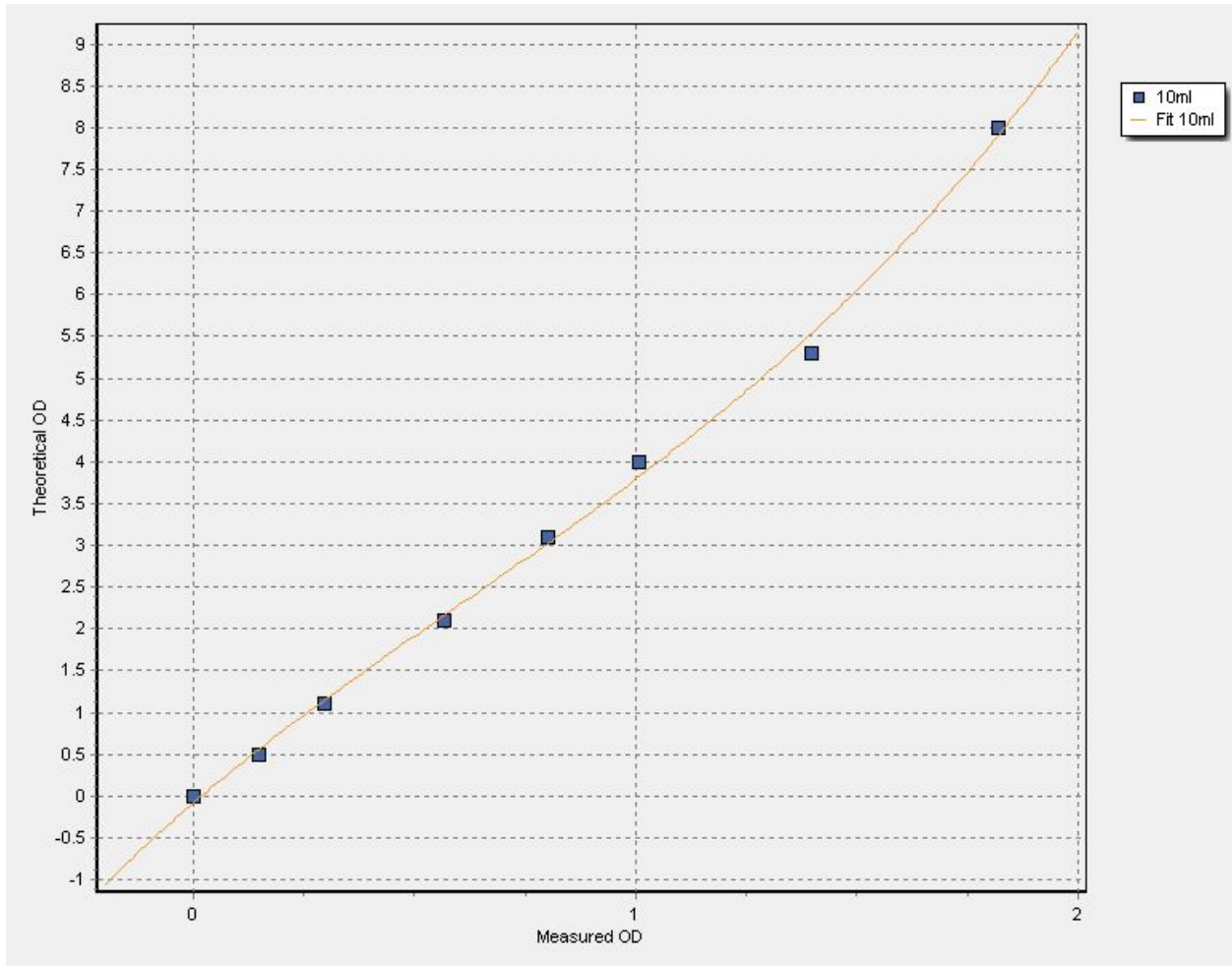
Button "Scale" allows you to fine-tune the scaling region.
Fields Xmin / Xmax represents the scale on the X axis.
Fields Ymin / Ymax represents the scale on the Y axis.

Button "Auto Scale" automatically adjusts the scaling in order to fit all points.

Tabs "Real Values" shows the table of calibrated volumes (e.g. 10ml, 15ml, 20ml, 25ml, 30ml)

Real Values Calculated Values

| 10ml | 15ml | 20ml | 25ml | 30ml |

Std#	Std OD	Unit OD
0	0	0
1	0.5	0.14781090
2	1.1	0.29648025
3	2.1	0.56533549
4	3.1	0.80002362
5	4	1.00739131
6	5.3	1.39760062
7	8	1.82113905

Exp Simplex $y = Y0 + A1.exp(-a1.x) + A2.exp(-a2.x)$

Y0=0
A1=-2.03810072653931
a1=1.4763860063801
A2=1.96363844446744
a2=-0.774948995026048

The calibrated volume's table consists of following columns:
- Std# -- Number of the standard
- Std OD -- Theoretical OD of the standard
- Unit OD -- Measured OD on the unit

On the right you can see the calibration equation of the selected volume

Exp Simplex $y = Y0 + A1.exp(-a1.x) + A2.exp(-a2.x)$

Y0=0
A1=-2.03810072653931
a1=1.4763860063801
A2=1.96363844446744
a2=-0.774948995026048
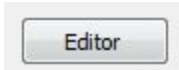
In order to edit the parameters of the calibration -- press on the "Editor" button   Editor
It will open the Editor module, for more information please check the Editor chapter in this manual.

In "Calculated Values" tab you can see how the software calculates the models between calibrated volumes

Real Values	Calculated Values														
11 ml	12 ml	13 ml	14 ml	16 ml	17 ml	18 ml	19 ml	21 ml	22 ml	23 ml	24 ml	26 ml	27 ml	28 ml	29 ml

Editor

If you want to edit the parameters of a calibration -- open the Editor module (Calibrations > Select a Calibration > Calibrated Units tab > Double click on a unit's ID > Click on the "Editor" button)
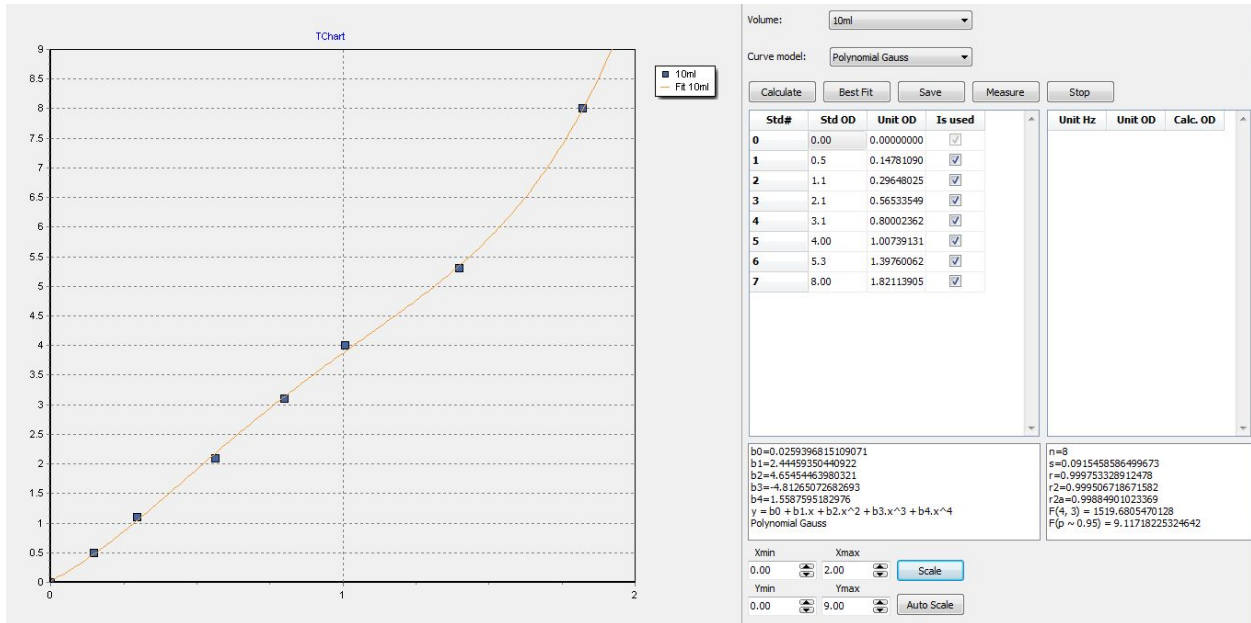
This graph shows the Theoretical OD vs Measured OD calibration curve:
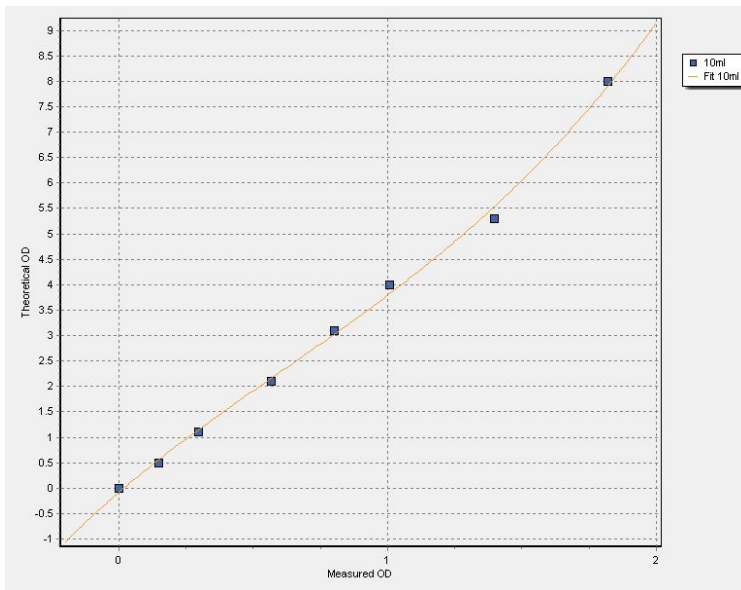
Button "Scale" allows you to fine-tune the scaling region.
Fields Xmin / Xmax represents the scale on the X axis.
Fields Ymin / Ymax represents the scale on the Y axis.
Button "Auto Scale" automatically adjusts the scaling in order to fit all points.

Using "Volume" drop list, you can select the needed calibrated volume.

Using "Curve model" drop list, you can select the needed model for fitting the calibration data. The list is generated automatically and depends on the number of standard points. The first part of the name shows what fitting model is being used, the second part of the name shows what fitting algorithm is being used (e.g. Polynomial is the model and Gauss is the algorithm).

Here is the Editor's Command Toolbar, Calibration Table and Current Measurements Table .

Calculate	Best Fit	Save	Measure	Stop				

Std#	Std OD	Unit OD	Is used		Unit Hz	Unit OD	Calc. OD	
0	0.00	0.00000000	✓					
1	0.5	0.14781090	✓					
2	1.1	0.29648025	✓					
3	2.1	0.56533549	✓					
4	3.1	0.80002362	✓					
5	4.00	1.00739131	✓					
6	5.3	1.39760062	✓					
7	8.00	1.82113905	✓					

Button "Calculate" -- Fits a new best model based on the values in the calibration table, if the check box in the "Is used" table is not checked, this function excludes the standard from fitting.

The "Best fit" method chooses the best model by its coefficient of determination (R^2) value.

Button "Save" -- Saves current parameters of the calibration.

Button "Measure" -- Performs a measurement, the measured values are indicated in the table on the right. Following values are outputted:

Unit Hz -- Measured frequency (for manufacturer's use).

Unit OD -- Measured OD The value can be copied by right clicking on it and choosing to "Copy".
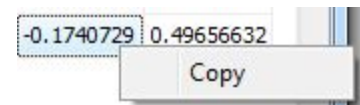
Calc. OD -- Calculated OD. Calculation is based on the currently selected model. The value can be copied by right clicking on it and choosing to"Copy".

Button "Stop" -- stops the measurements.

Command list for the calibration table.

Std#	Std OD	Unit OD	Is used
0	0.00	0.00000000	✓
1	0.5	0.14781090	✓
2	1.1	0.29648025	✓
3	2.1	0.56533549	✓
4	3.1	0.80002362	✓
5	4.00	1.00739131	✓
6	5.3	1.39760062	✓
7	8.00	1.82113905	✓

▲ Insert row before
▼ Insert row after
🖌 Clear current row
✖ Delete current row

By right clicking on the value under columns "Std OD", "Unit OD", "Is used", you can add additional standards (except for Std# 0) by clicking on "Insert row before" / "Insert row after" and then entering the "Std OD" and "Unit OD" values manually. Do not forget to check the box under "Is used" column.

To clear the row from the inputted values, click on the "Clear current row" option.

To delete a row, click on the "Delete current row" option.

Here is given a list of calculated model coefficients eg. for Polynomial model using Gauss determination algorithm.

```
b0=0.0259396815109071                      n=8
b1=2.44459350440922                        s=0.0915458586499673
b2=4.65454463980321                        r=0.999753328912478
b3=-4.81265072682693                       r2=0.999506718671582
b4=1.5587595182976                         r2a=0.99884901023369
y = b0 + b1.x + b2.x^2 + b3.x^3 + b4.x^4   F(4, 3) = 1519.6805470128
Polynomial Gauss                           F(p ~ 0.95) = 9.11718225324642
```

Where:

Number of observations is n

Residual error is s

Coefficient of correlation is r

Coefficient of determination is r2

Adjusted coeff. of determination is r2a

Variance ratio (explained/resid.) is F(1, 3)

Critical variance ratio is F(p = 0.95)

Baseline function

Baseline function will subtract the measured or inputted OD value from following measured OD values.

1. Press "Baseline" button in the toolbar to open the Baseline window.

2. Baseline window (on the right) will appear.
   a) Column ID: here is written the ID of the device
   b) Column Name: here is written the name of the device
   c) Column Baseline: here is written the measured or inputted OD value, which will be subtracted from the following measured OD values. It is also possible to type in the value via keyboard.
   d) Column Select: here is indicated for which devices the "Measure" button will work.
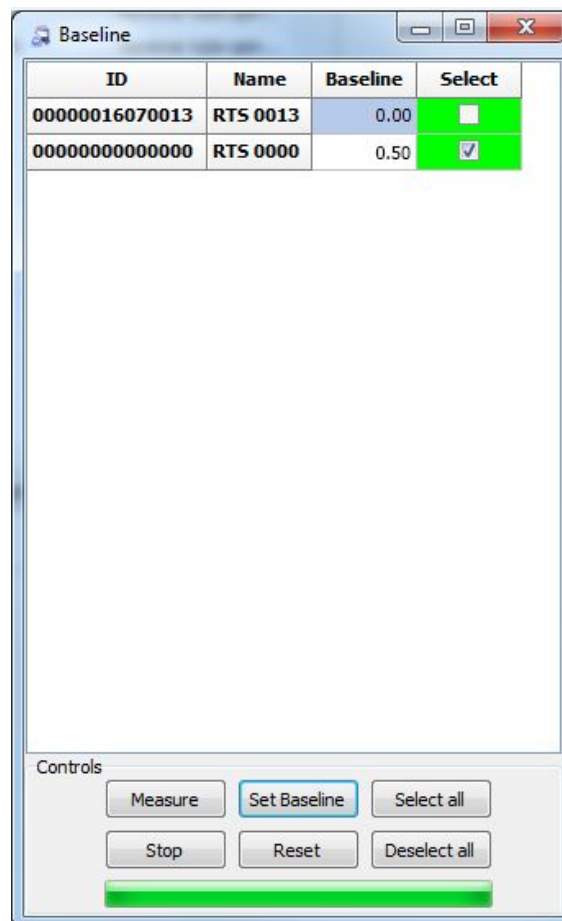
3. Button "Measure" will measure the baseline value for the selected units.
4. Button "Select all" will select all devices
5. Button "Deselect all" will deselect all devices
6. Button "Set Baseline" will subtract the baseline values from the following measured OD values. This will work for **all** connected devices.
7. Button "Reset" will set 0.00 in the "Baseline" column.
8. To close the window, click on the [X] button.

Operation Outline:

Press the "Measure" button, and wait until the unit will get the OD value or enter the baseline value via keyboard.

During the measurement step, the device will mix the solution for ~10 seconds and then perform the measurement.

When you receive the value, press "Set Baseline" button.

All OD values measured **before and after** the baseline measurement will be affected.

Note: double check that all the devices have launched for baseline measurement, if not then please run measurement on the stuck device separately.

#	Name	Port	hh:mm	Hours	Volume	t°C	OD	Gr.r	Dev. sta	Port stat	λ,n	Event	Device ID	Baseline
1		COM28	08.feb 2017 17:05	0.0	10	28.8	0		Stop	Ready	0	connect	00000000000000	0.15
2		COM4	08.feb 2017 17:05	0.0	10	28.8	0		Stop	Ready	0	connect	00000016070013	0.2
3	RTS 0013	COM4	08.feb 2017 17:06	0.0	10	28.8	0		Stop	Ready	0	status	00000016070013	0.2
4	RTS 0000	COM28	08.feb 2017 17:06	0.0	10	28.8	0		Stop	Ready	0	status	00000000000000	0.15
5	RTS 0000	COM28	08.feb 2017 17:06	0.0	10	28.8	0		Run	Running	0	status	00000000000000	0.15
6	RTS 0013	COM4	08.feb 2017 17:06	0.0	10	28.8	0		Run	Running	0	status	00000016070013	0.2
7	RTS 0013	COM4	08.feb 2017 17:07	0.0	10	28.8	0.03		Run	Running	850	data	00000016070013	0.2
8	RTS 0000	COM28	08.feb 2017 17:07	0.0	10	28.8	0		Run	Ready	0	connect	00000000000000	0.15
9	RTS 0013	COM4	08.feb 2017 17:08	0.1	10	28.8	0	1.342	Run	Running	850	data	00000016070013	0.2
10	RTS 0000	COM28	08.feb 2017 17:09	0.1	10	28.8	0		Run	Ready	850	data	00000000000000	0.15
11	RTS 0013	COM4	08.feb 2017 17:10	0.1	10	28.8	0.04	0.622	Run	Running	850	data	00000016070013	0.2
12	RTS 0013	COM4	08.feb 2017 17:11	0.1	10	28.8	0.01	0.816	Run	Running	850	data	00000016070013	0.2
13	RTS 0013	COM4	08.feb 2017 17:12	0.1	10	28.8	0.01	0.553	Run	Running	850	data	00000016070013	0.2
14	RTS 0000	COM28	08.feb 2017 17:13	0.1	10	28.7	0		Run	Ready	850	connect	00000000000000	0.15
15	RTS 0000	COM28	08.feb 2017 17:13	0.1	10	28.7	0.01	0.196	Run	Ready	850	data	00000000000000	0.15
16	RTS 0013	COM4	08.feb 2017 17:13	0.1	10	28.8	0.02	0.307	Run	Running	850	data	00000016070013	0.2
17	RTS 0013	COM4	08.feb 2017 17:14	0.2	10	28.8	0	0.437	Run	Running	850	data	00000016070013	0.2
18	RTS 0000	COM28	08.feb 2017 17:15	0.2	10	28.7	0.01	0.201	Run	Ready	850	data	00000000000000	0.15
19	RTS 0013	COM4	08.feb 2017 17:16	0.2	10	28.8	0.03	0.06	Run	Running	850	data	00000016070013	0.2
20	RTS 0013	COM4	08.feb 2017 17:17	0.2	10	28.8	0.01	0.294	Run	Running	850	data	00000016070013	0.2
21	RTS 0000	COM28	08.feb 2017 17:17	0.2	10	28.7	0	0.027	Run	Ready	850	data	00000000000000	0.15
22	RTS 0013	COM4	08.feb 2017 17:18	0.2	10	28.8	0.02	0.044	Run	Running	850	data	00000016070013	0.2
23	RTS 0013	COM4	08.feb 2017 17:19	0.2	10	28.8	0.01	0.212	Run	Running	850	data	00000016070013	0.2
24	RTS 0000	COM28	08.feb 2017 17:19	0.2	10	28.7	0.01	0.04	Run	Ready	850	data	00000000000000	0.15
25	RTS 0013	COM4	08.feb 2017 17:21	0.3	10	28.8	0.02	0.015	Run	Running	850	data	00000016070013	0.2
26	RTS 0000	COM28	08.feb 2017 17:22	0.3	10	28.7	0	0.047	Run	Ready	850	data	00000000000000	0.15

Tabs: OD | Growth Rate | Temperature | **Logger**

After the export, the Baseline value on the moment of measurement will be stored in the Baseline column in the Logger tab.

Temporary saves

By default software autosaves a running experiment each 15 minutes.
Experiment can be found in "Users\Public\Documents\RTS\Temporary saves"

This feature autosaves up to 10 experiments, if you have 10 experiments already, then the first experiment from the list will be overwritten.

Troubleshooting

World practice shows that software vendors in the case of software malfunctioning indicate that user have accepted of the license agreement by which the software was provided as is or/and the shortcomings of operating system compatibility with the PC hardware, which leads to errors of or reduced productivity of the program. Unfortunately, we state that this practice model is the best for us (considering our modest budget) and we have to stick to it. But, we would be grateful if you send captured errors [software@biosan.lv,](mailto:software@biosan.lv) so that we can identify the cause and, possibly, make the program better.

1. - When I open up the program, a message appears that the last experiment was not saved, but I definitely saved it.
    - We know about this issue and trying to solve it.

2. - The device can not connect to the computer.
    - Try restarting your devices/software/computer, if it does not help, then reinstall the software and the drivers.

3. - The program can not close, says that the experiment is still going, but I stopped it.
    - Try pressing the Play button on the toolbar (to start the experiment), and click on the Stop button, wait 5 seconds and then try to close it. If this does not work, open Task Manager (Ctrl + Shift + Esc) and close all processes "rts.exe"

4. - Device does not respond to the program
    - Try to turn on or off the device, if necessary, try to plug it off and then on.

5. - Drivers can not be installed
    - 1. Try to give administrator rights to the user who installs the program
    - 2. If previous step did not help, try the following:
    Go to Control Panel/Device Manager
    Expand the Other devices line:
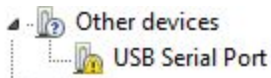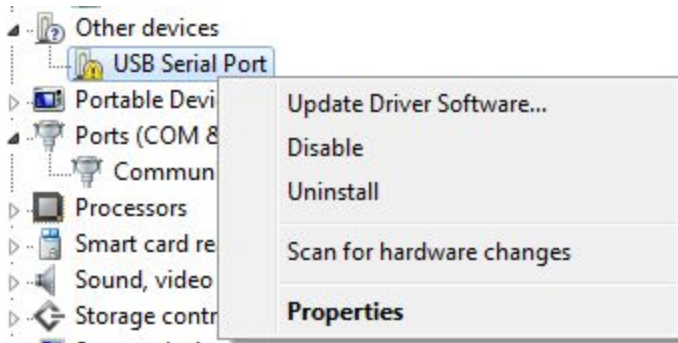
Click on Properties, Select Driver tab, click on the Update Driver:
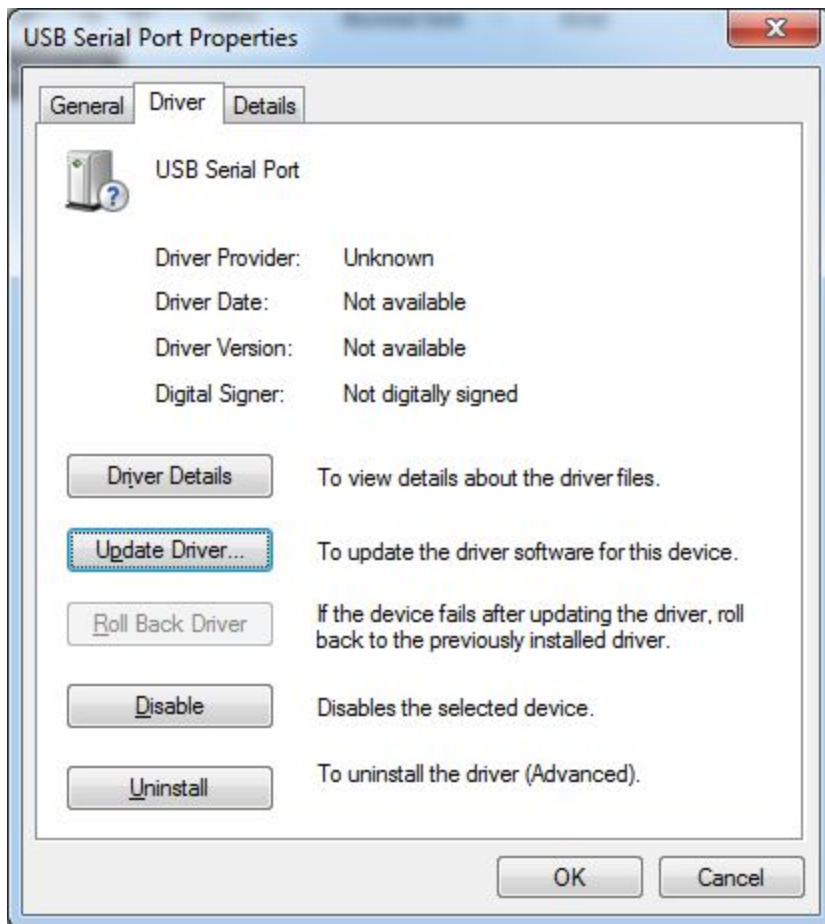
Select Search automatically for updated driver software (you should have internet connection on)

➜ Search automatically for updated driver software
Windows will search your computer and the Internet for the latest driver software
for your device, unless you've disabled this feature in your device installation
settings.

After installing the driver, following message should appear:

Windows has successfully updated your driver software

Windows has finished installing the driver software for this device:

USB Serial Port

If you do not have internet connection, please use computer with internet to download latest drivers from: http://www.ftdichip.com/Drivers/VCP.htm under "Available as setup executable". Then transfer and install the driver on the computer where the units are connected.

If it did not help, please try to find a solution here:
https://support.microsoft.com/en-us/help/2654149/error-usb-device-not-recognized-when-you-try-to-access-a-usb-external-hard-drive.

6. - My problem is not described here.
    -While working with the program a problem that is not described here may arise. There is an universal solution: reboot the computer and / or reinstall the program. Check the website for the latest software updates

7. - I have connected the devices to USB 2.0 SS (super speed) terminals and my computer shuts down constantly, indicating that there is some sort of an error with FTDI driver.
    - Please avoid connecting to USB 2.0 SS, connect the devices to the standard USB 2.0. Data for connecting to USB 3.0 terminals is yet not available.
8. - The online report does not export any more.
    - One of the reasons could be that you have run out of space on the server.

9. - My laptop can not export results online after 20-30 minutes.
    - Most likely your laptop is configured with hard disk saving mode, to change this go to Control Panel / Choose when to turn off the display / Change advanced power settings / Hard Disk> Turn off hard disk after> put "Never" everywhere

10. - First, we would need to identify if the problem is with the unit or with the hub. Download latest drivers from: http://www.ftdichip.com/Drivers/CDM/CDM21216_Setup.exe or the latter. Then install the driver on the computer where the units are connected. Connect one of the units without the hub directly to the computer. If it is connected, then check if the problem is with the hub.
    Connect the hub to the computer, wait until it will be recognized by operating systems, connect one of the units and wait until the operating systems will recognize the devices. If after some time (5-10 min) it is not recognized, the problem may be with the hub. If the

usb hub was not sold by us (BS-010158-BK, USB 2.0 Hub 10 × ports), then we cannot guarantee its operation, please check for solutions with the hub's manufacturer. But usually the reasons are following:

    a. The hub is powered only from the usb, but the ones that we sell and recommend should be connected to the main.

    b. The hub drivers are out of date. Please check the latest drivers on the manufacturer's website.

    c. Please check that the hub is not extended by another hub.

    d. Windows update cannot install the needed drivers, for that reason we recommend to turn the internet off, restart the computer and then install the unit's and hub's drivers.

    e. If everything that you tried above does not solve your issue: try to install everything on a different computer and check for the repeatability of the issue.

    f. **Also we highly recommend that troubleshooting should be performed by an IT specialist.**

11. -When I try to start the devices, the software asks me about the calibrations, but the listbox is empty.

    -The reason could be following:

    a. The user did not install the software provided on the usb drive with the unit, as the provided software has calibration files for new units.
Reinstall the software provided on the usb drive or
download the newest software installation file from this folder below:
http://biosan.info/Software/1%20RTS-1/

12. -I have installed version 2.7.4.1 or above and my custom created calibrations are not loading, what should I do?
-The calibration folder has been moved to "Public Documents" instead of user specific ones. Use the MoveTool.exe located in the installation path of RTS-1 software. To move the files click on the MoveTool.exe. The reason for that is to avoid situations when one PC has multiple accounts with different access levels. Before 2.7.4.1 there were numerous situations when Admin users were installing the software and the calibrations were saved under his "My Documents" folder and other users could not access those installed calibrations.
Use the Move and Replace settings.
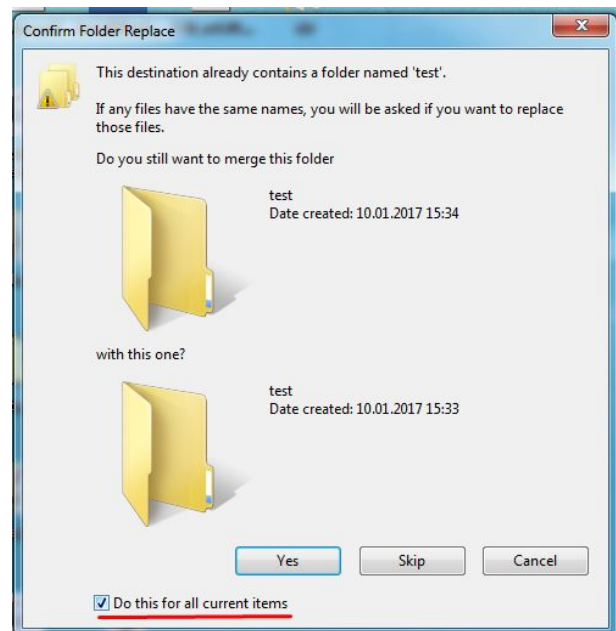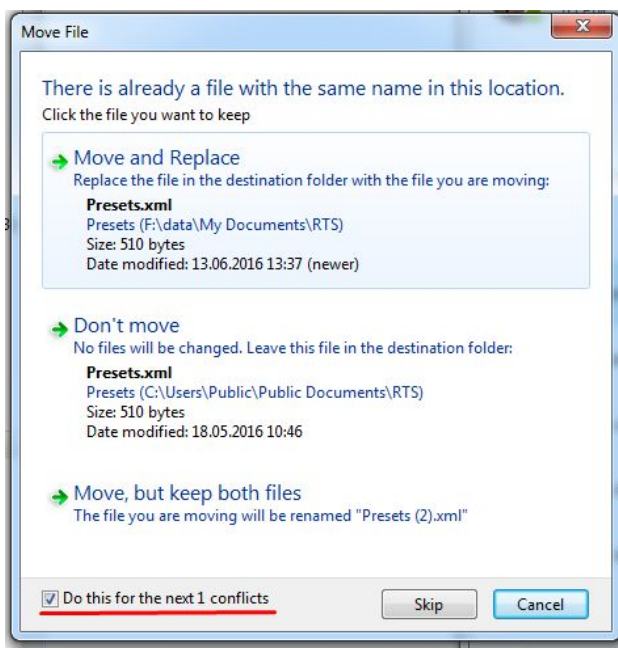
Disclaimer

1. Program is provided "as is", as it was stated in the license agreement.
2. This documentation may not coincide with the latest version of the program. In this case, we are sorry and hope for your understanding, and we would be grateful if you could send us corrections, also we hope that the interface is really intuitive and does not require thorough explanation.