



Elveflow® Smart Interface

USER GUIDE

November 2014



READ THIS MANUAL CAREFULLY BEFORE USING THE SOFTWARE

This manual must be read by any person who is or will be responsible for using the Elveflow Smart Interface (ESI).

Due to the continual development of the products, the content of this manual may not correspond to the new software. Therefore, we retain the right to make alterations without prior notification.

Important ESI safety notices:

1. The ESI gives the user complete control over the Elveflow products. Beware of pressure limits for containers, chips and other parts on your setup. They might be damaged if the applied pressure is too high.
2. Use a computer with enough power for the ESI to avoid software freezing and damaging the setup.

IF THESE CONDITIONS ARE NOT MET, THE USER IS EXPOSED TO DANGEROUS SITUATIONS AND THE INSTRUMENT CAN UNDERGO PERMANENT DAMAGE. ELVESYS AND ITS PARTNERS CANNOT BE HELD RESPONSIBLE FOR ANY DAMAGE RELATED TO THE INCORRECT USE OF THE INSTRUMENTS.

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Description

The Elveflow[®] Smart Interface (ESI) enables interactive control of all Elveflow[®] instruments. Up to 16 instruments can be controlled independently and simultaneously on the same window with a set of functions dedicated to the instrument type, but can also work together within microfluidic projects.

Thanks to an intuitive interface, this application allows microfluidicists to use Elveflow[®] products from the simplest command for beginners to complex manipulations for experts.

Where to find the ESI

You can find the Elveflow Smart Interface in the **USB key** that was shipped with your Elveflow instrument.

We are always improving the ESI and adding new features to make it more powerful and more intuitive. If you want to be sure you have the latest version, visit our **webpage**:

www.elveflow.com/elveflow-software

You can also find SDKs for LabVIEW, MATLAB and C in the zip files available at the download section.

Minimum system requirements

- Window XP SP3* or later - both 32 and 64-bit versions are supported;
- USB 2.0 port or faster;
- 1 GB RAM;
- 3.0 GHz Pentium 4;
- 1 GB of free hard disk space.

* The Elveflow instruments have integrated components that require specific libraries. These libraries are incompatible with Windows XP SP2 and older, Mac OS and Linux.

Installation

1. Plug the Elveflow[®] USB flash drive to the computer.
2. Open the Elveflow folder.
3. Run Install.exe.
4. Follow the instructions presented by the installation assistant.
5. **Restart your computer** when prompted to finish the installation process.

Getting started

The following sections will guide you through the steps for adding a new instrument, exploring its basic and advanced features and using it with other instruments to automate your experiment.

Specific guides for the Elveflow instruments

User guides are available for every Elveflow instrument. Check the dedicated guides for correctly setting up your experiment before using the Elveflow Smart Interface.

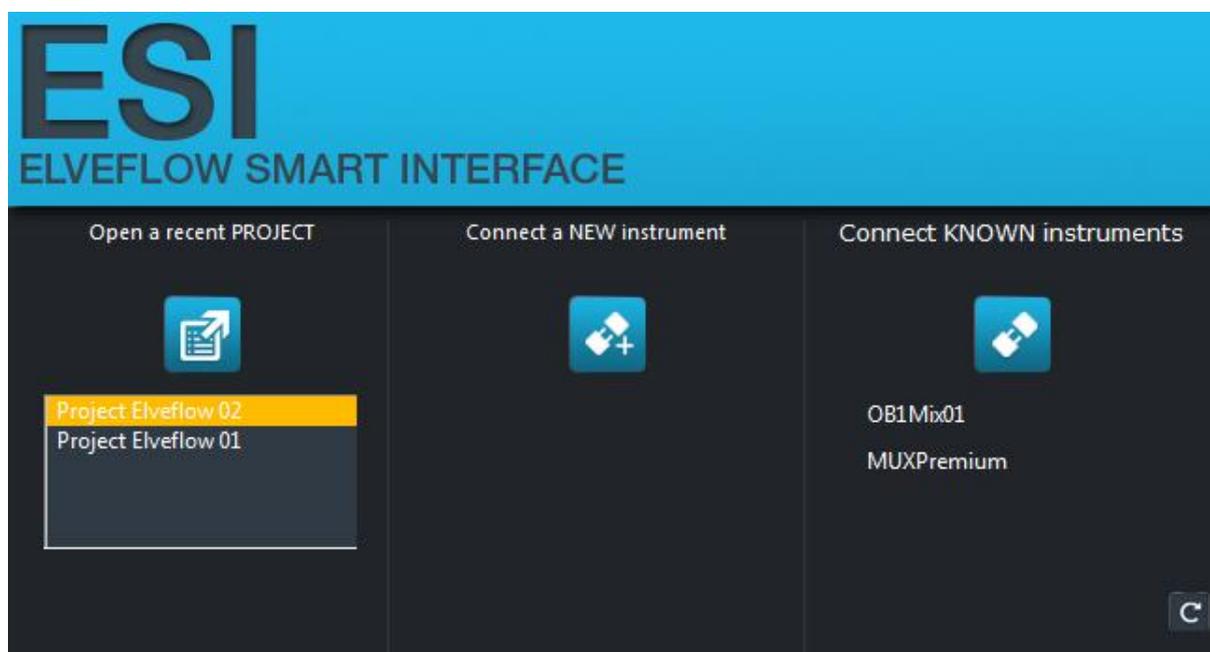
Launching the Elveflow Smart Interface

Nothing simpler than double-clicking the ESI icon that was added to your desktop during software installation!



You can also find a shortcut to the software on “Start menu > Programs > Elveflow > Elveflow Smart Interface”.

Once the software is launched you will see the start menu window similar to this one:



There are three options available:

1. Open a recent project

As soon as you start using the software and find the best configuration for your experiment, you will find useful to save your parameters to use them later. This button allows you to load the previously saved parameters so that you can quickly start experimenting.

2. Connect a new instrument

Here you can add instruments that are being connected for the first time. Once an instrument is added, it will appear in the “known instruments” list the next time you launch the ESI. This part will be covered in the next section.

3. Connect know instruments

All the instruments that have already been added by the user and are presently connected to the computer are listed here. Click the button to launch the listed instruments. If an added instrument is not listed here, check the USB connection and click the refresh button.



Connecting a new instrument

Your instrument is plugged to the computer and you clicked the “Connect a new instrument” button. Here is what you see:



1. Choose the type of your instrument and click “Next”.

Where is the Flow Sensor? Flow Sensors are indirectly connected to the computer. First add or load a host instrument (AF1, OB1 or Flow Reader), then connect and configure the flow sensor in the host’s “Preferences” menu, as described further in this User Guide.

2. Give your new instrument a name and click “Next”.
3. Depending on the type of instrument you have added, a different window will appear.

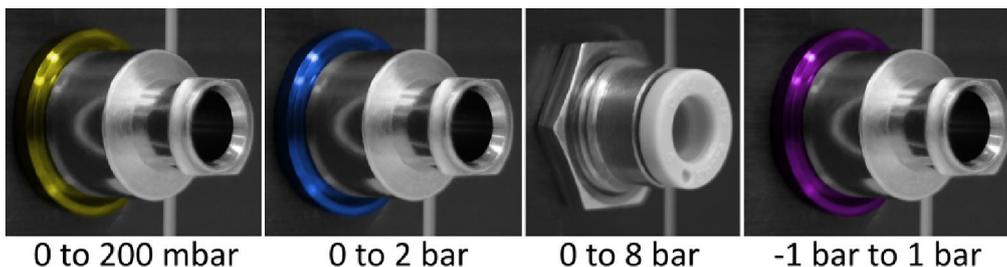
AF1

Choose the pressure range* of your AF1: 200 mbar, 2 bar or -1 to 1 bar.

OB1

Choose the pressure ranges* for each channel of your OB1: 200 mbar, 2 bar, 8 bar or -1 to 1 bar.

* If you are not sure of the pressure ranges you have in an AF1 or OB1, check the ring on its outlet(s).



MUX

Choose the MUX model: Standard 2/2, Standard 3/2 or Premium. You must also choose the number of valves in your MUX Standard 2/2: 4, 8, 12 or 16 valves.

Flow Reader

Choose the Flow Sensors you have connected to the Flow Reader. You can easily modify this later.

Click “Next”.

Important! Have you chosen a wrong pressure range on an AF1 or OB1, a wrong MUX type or number of valves? Click on “Preferences > Hardware > Reset” and connect your instrument again as if it was new.

Common instrument features

The main window for each instrument is different due to their basic functionalities. However they all share a common toolbar - which is available at the upper part of the main window – and a common menu bar.

The toolbar



From left to right:

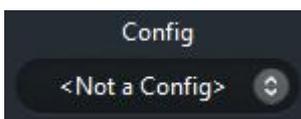
- The **parameters** shortcut allows the user to access all the advanced features of the instrument.



- The **instruments list** presents all the connected and active Elveflow instruments. Switch easily between instruments using this list.



- The **configurations list** presents the pre-programmed configurations which are available in the memory. It allows the user to quickly switch between whole instrument configurations for fast control.



- The **main switch** is a virtual power button. It shows and controls all the pressure/vacuum outlets (for AF1s and OB1s) or valves (for MUXs) at once.



- The **add step** button creates a new step in the programmable script.



- The **script/instrument switch** allows fast switch between the main instrument window and the script window.



The following sections present the instrument-specific aspects of the main window and the instruments' advanced features.

Parameters menu

Clicking the Parameters button on any instruments Main window gives access to the Parameters menu. Some of the options discussed below are available for all instruments. Others are feature-dependent and are available for selected instruments.

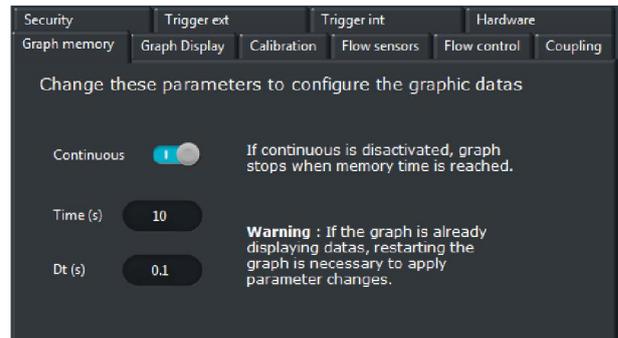
- **Graph memory**

Configure how much data – in time - is held in memory during the experiment. This time can be much longer than that displayed by the graph and can be exported eventually.

When **Continuous** is activated, data is saved in permanence, whereas in the deactivated state the software stops saving data when the memory time is reached.

Time [s] and **Dt [s]** refer to for how and at which intervals of time the data will be saved.

Restart the graph to apply these parameters.



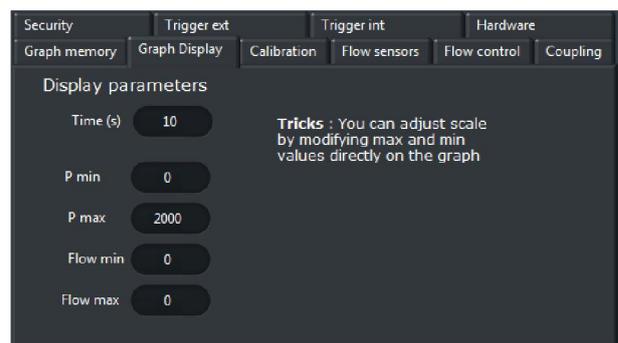
- **Graph display**

Configure the data displayed by the graph.

Time [s] refers to how many seconds are displayed.

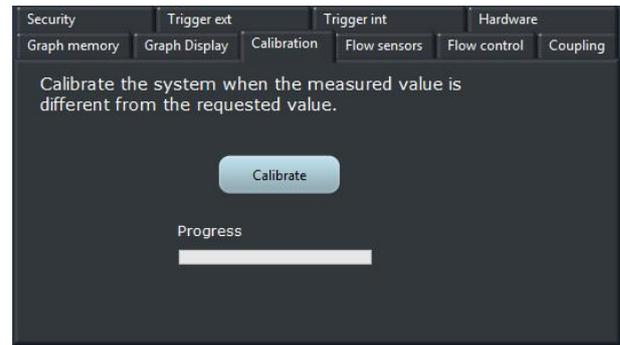
P min and **P max** are the limits in pressure on the left axis of the graph, while **Flow min** and **Flow max** are the flow rate limits, on the right axis. You can also modify the limits directly on the graph.

On the graph, right-click an axis and choose autoscale to have the ranges adapted automatically.



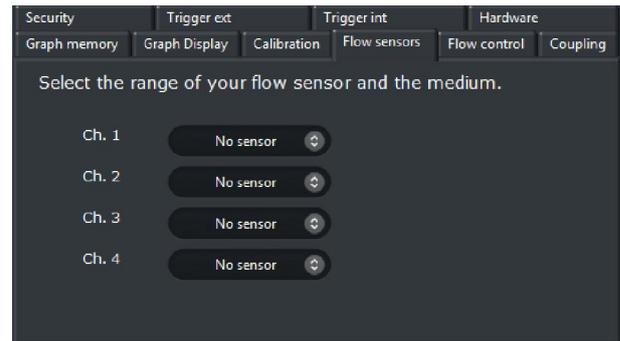
- **Calibration**

Perform a calibration of the instrument when the measured pressure value differs from the requested value. When an instrument is connected for the first time, it is recommended to perform a calibration. Please note that to perform the calibration, the instrument has to be power supplied, the switch on its front side has to be pushed in and the outputs must be blocked. The calibration lasts around 20 min.



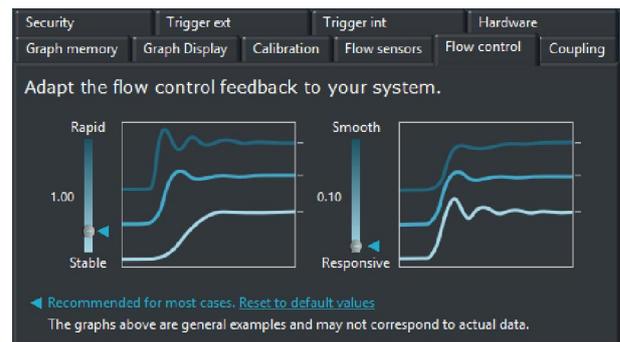
- **Flow sensors**

Select or modify the ranges of the flow sensors connected to your instrument. For OB1 Pressure Controllers you can also select a reservoir type and the amount of fluid to be handled.



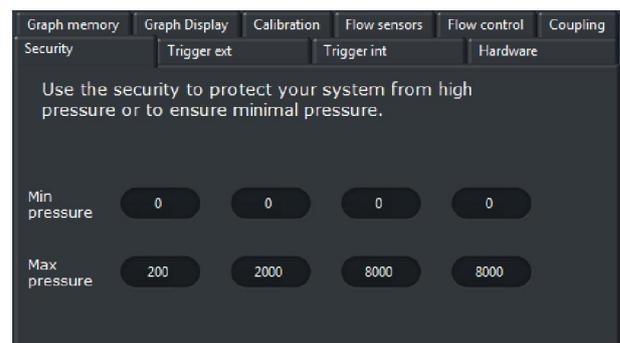
- **Flow control**

Adjust the parameters of the flow/pressure feedback loop to obtain the smoothest and fastest flow rate switch. These values will highly depend on the setup, so they should be examined carefully.



- **Security**

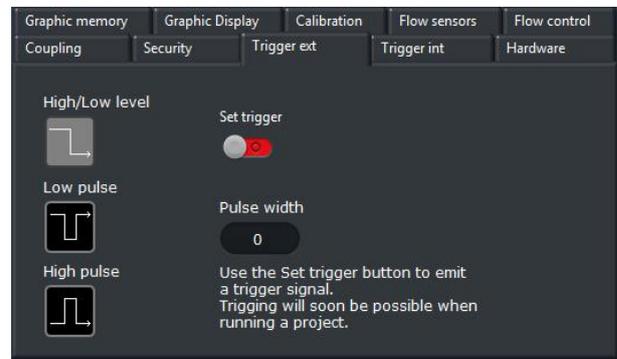
Protect your system or microfluidic chip from high pressure or ensure minimal pressure in a channel.



- **External trigger**

The instrument can also emit signals to trigger actions in other devices. You can configure the mode (level change, low pulse and high pulse) and the pulse width.

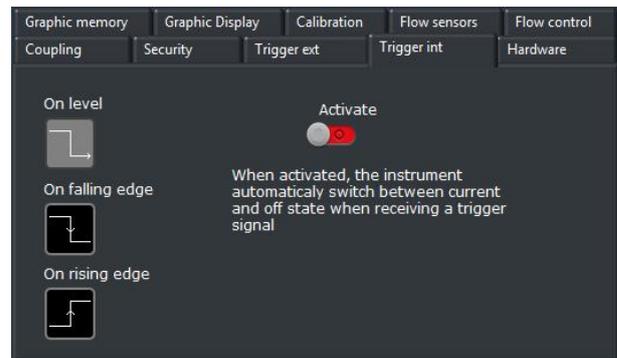
The synchronization is used with the sequence mode, discussed further in this guide.



- **Internal trigger**

This trigger is used to synchronize an action of your instrument with a signal coming from another device. It can work in three distinct ways: level change, falling edge and rising edge.

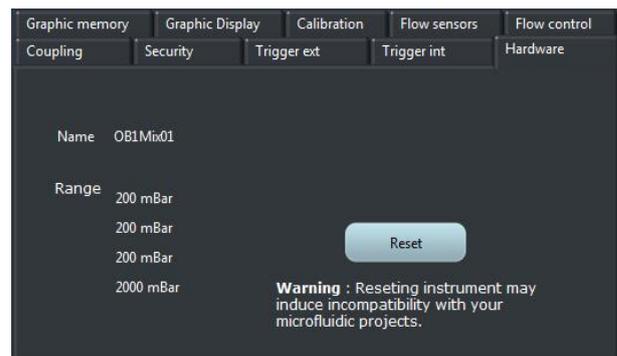
The synchronization is used with the sequence mode, discussed further in this guide.



- **Hardware**

The name and main characteristics of your instruments are displayed in this tab. If by any reason you want to change its name or any feature, Reset the instrument and add it once again when launching the ESI.

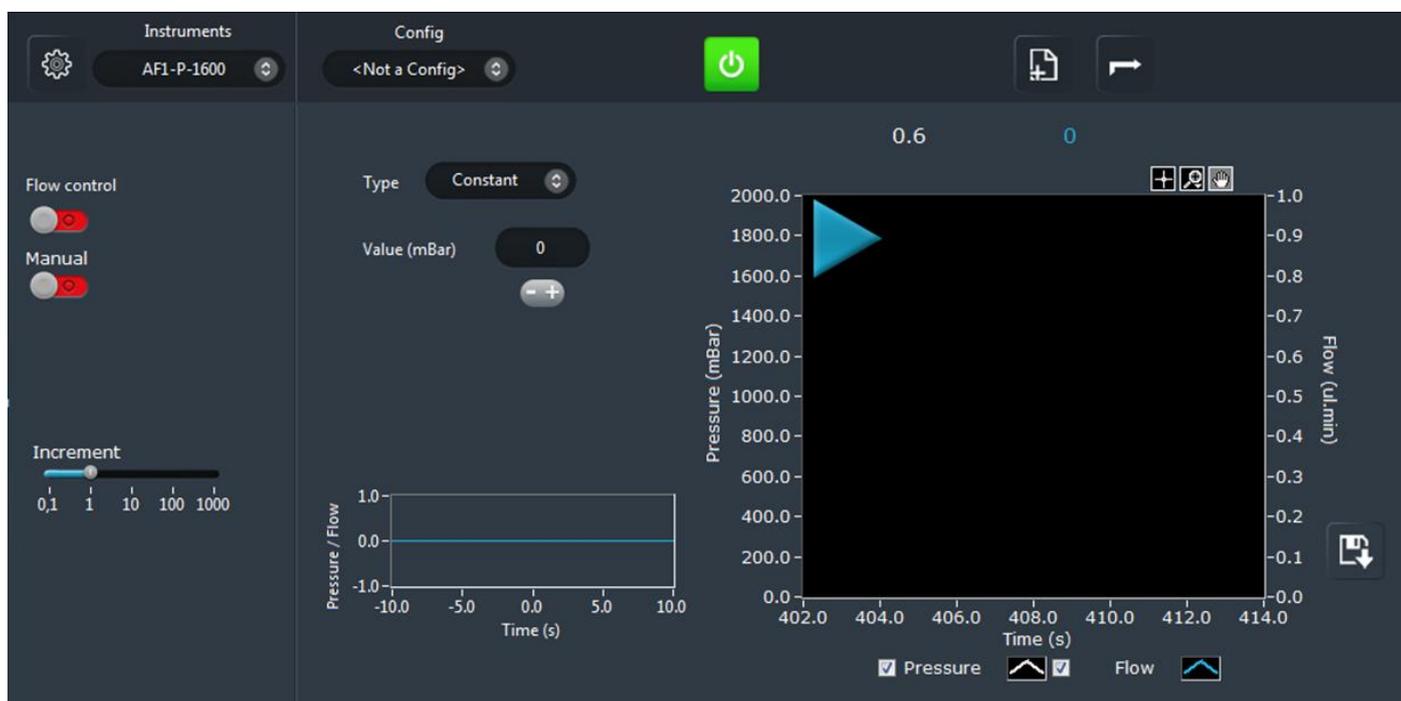
Note that changing these features can induce incompatibility with previously saved projects.



AF1 features

The AF1 Premium and AF1 Dual are pressure generators and controllers that have a single pressure outlet. The AF1 Dual can also generate and regulate vacuum.

Main window



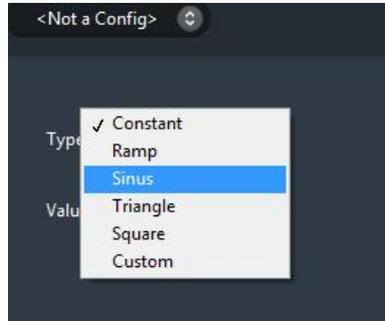
In the main AF1 window you will find information about the current state of your instrument, controls and configurable parameters.

On the left side:

- **Flow control** activates the feedback loop which automatically adjusts the pressure so that the specified flow rate is obtained.
- **Manual** switches between control via the ESI (switch OFF) and via the knob on the front side of the AF1 (switch ON).
- **Increment** shows of how much the set pressure/flow will increase or decrease if the user clicks the “+” and “-” buttons, respectively. The value can also be changed with “arrow up” and “arrow down”.

On the right side:

- **Type** shows how the pressure/flow is applied. A stable value is applied when type is set as “constant”. Functions such as sine, square and ramps can be used choosing the respective type. Custom curves can also be imported from CSV files by choosing “custom” and clicking load. The parameters of the curves can be adjusted: maximum and minimum value, period, phase and dissymmetry.

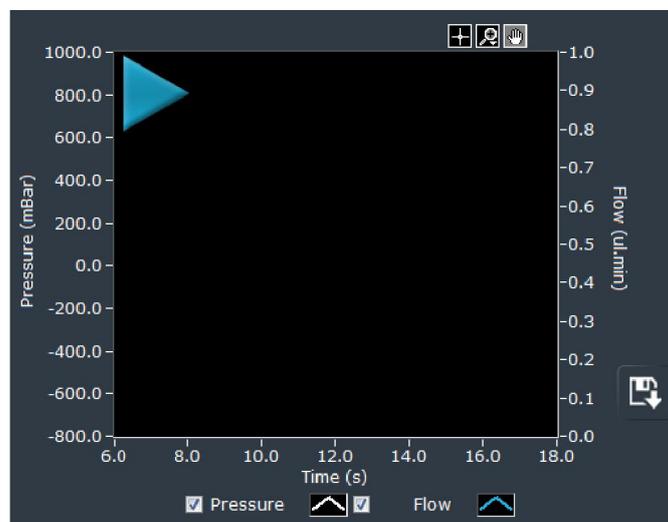


Note: by changing the dissymmetry parameters, square and triangle functions can be easily transformed into pulse or sawtooth functions.

- **Value** indicates how much pressure is applied or the flow rate to be reached if the flow control is activated. Type the value directly or use the plus/minus buttons and up/down arrows to increase/decrease the value.
- The **small graph** below the value shows in real time the pressure/flow rate profile applied to the channel.
- Above the main graph, the real-time display shows the **pressure (white) and flow rate (blue)** values.



- The **main graph** shows in real time the measured pressure and flow rate values.



Click the play/pause button to launch and stop de graph. The graph parameters can be configured in the “Parameters” menu, “Graph display” section.

- **Export and save graph data** to text or Excel format. The amount and intervals of data exported is related to the parameter chosen in the “Graph memory” section of the “Parameters” menu.



Parameters menu

The “Parameters” menu can be accessed by clicking the dedicated shortcut on the common instrument toolbar.

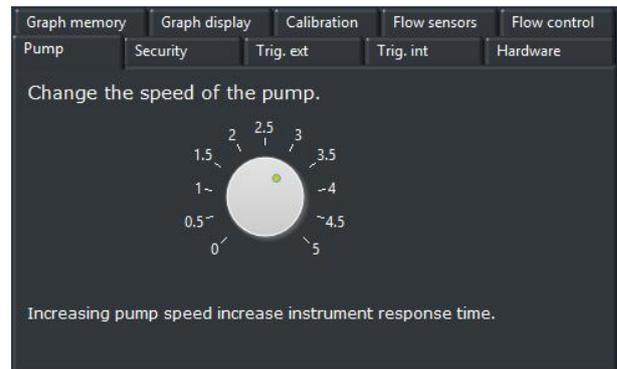


Most of the parameters that can be found in this menu were already described in the previous Common instrument features section, since they are shared by more than one instrument. Refer to that section if the information you are looking for is not described below.

- **Pump**

Adjust the pump power depending on your experiment requirements. Increasing the pump speed can increase the response time, but also increase the noise generated by the pump.

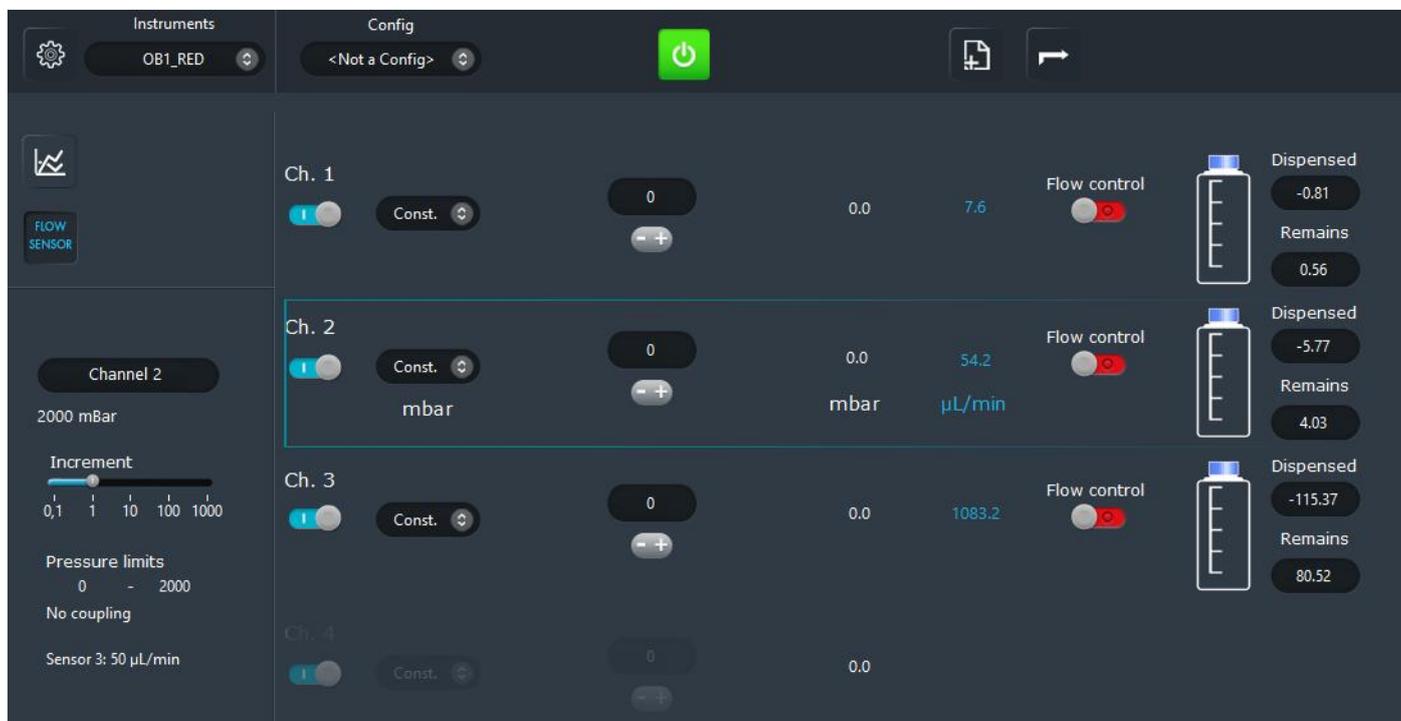
Note: this function is only available for the second version of the AF1.



OB1 features

The OB1 is a pressure controller that has up to four pressure outlets. It can control both positive and negative pressure.

Main window



In the main OB1 window you will find information about the current state of your instrument, controls and configurable parameters.

On the left side:

- The **Graph** button opens a new window where the user can observe in real time the pressures and flow rates on each one of the OB1 channels.



- The **Flow Sensor** button opens a dialog where the user can choose the ranges of the flow sensors connected to the OB1.



- Below these two buttons is displayed the currently **selected channel** with information concerning its **range**, its **pressure limits**, its **coupling** with other channels and the **flow sensor** connected to it.

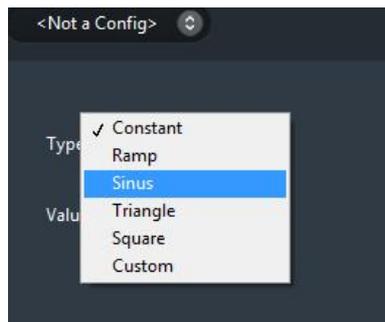
- **Increment** shows of how much the set pressure/flow will increase or decrease if the user clicks the “+” and “-“ buttons, respectively. The value can also be changed with “arrow up” and “arrow down”.

On the right side, from left to right:

- The **switches** allow the user to quickly switch each channel ON and OFF, i.e., to completely remove the pressure in a channel or apply it again.



- **Type** shows how the pressure/flow is applied. A stable value is applied when type is set as “constant”. Functions such as sine, square and ramps can be used choosing the respective type. Custom curves can also be imported from CSV files by choosing “custom” and clicking load. The parameters of the curves can be adjusted: maximum and minimum value, period, phase and dissymmetry.



Note:by changing the dissymmetry parameters, square and triangle functions can be easily transformed into pulse or sawtooth functions.

- **Value** indicates how much pressure is applied or the flow rate to be reached if the flow control is activated. Type the value directly or use the plus/minus buttons and up/down arrows to increase/decrease the value.
- The value can be replace by **asmall graph**if a type different than “Constant” is chosen. It willshow in real time the pressure/flow rate profile applied to the channel.
- The real-time display shows the **pressure (white) and flow rate(blue)** values.



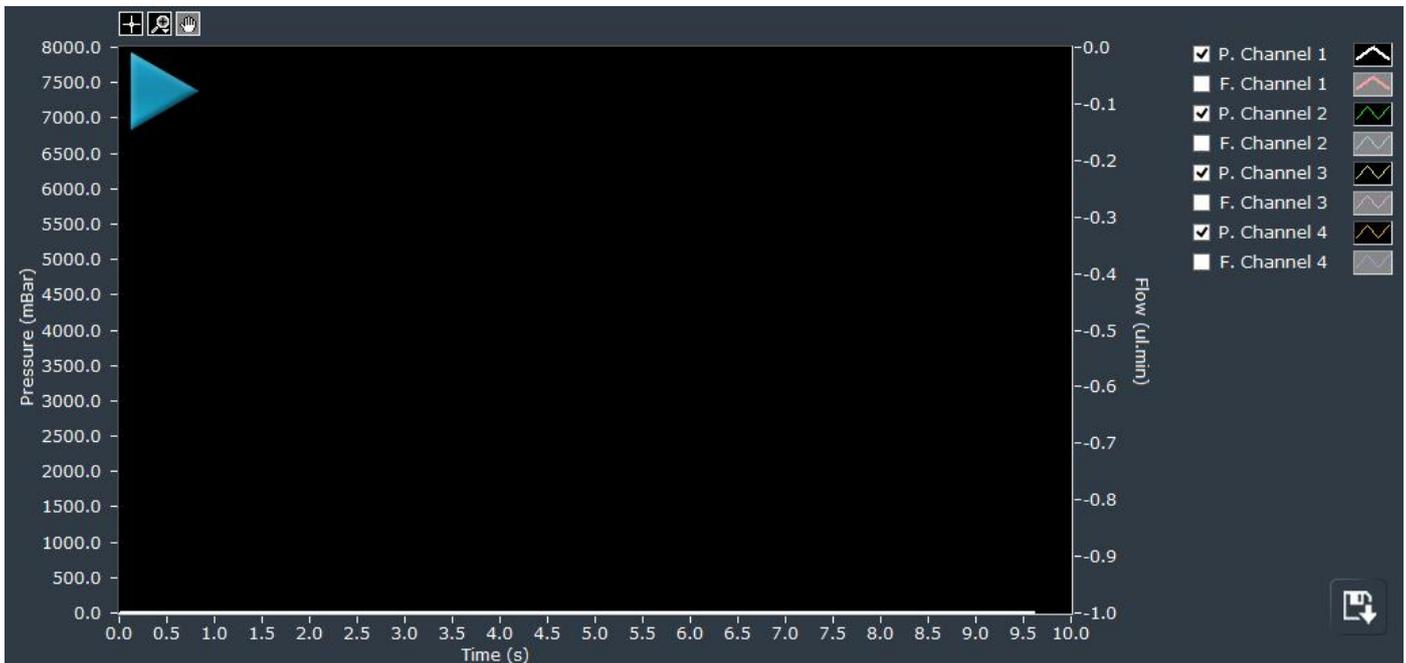
- **Flow control** activates the feedback loop that automatically adjusts the pressure so that the specified flow rate is obtained.

- The **reservoir** can be configured to show in real time the amount of **fluid remaining** in the user's reservoir and the amount that was already **dispensed**.



Graph window

Clicking the Graph button on the Main window activates the Graph window.



Click the play/pause button to launch and stop the graph. The graph parameters can be configured in the "Parameters" menu, "Graph display" section.

- The pressure and flow rate curves displayed by the graph can be selected by clicking the corresponding **checkboxes** on the right-hand side of the window.
- Export and save graph data** to text or Excel format. The amount and intervals of data exported is related to the parameter chosen in the "Graph memory" section of the "Parameters" menu.



Parameters menu

The “Parameters” menu can be accessed by clicking the dedicated shortcut on the common instrument toolbar.



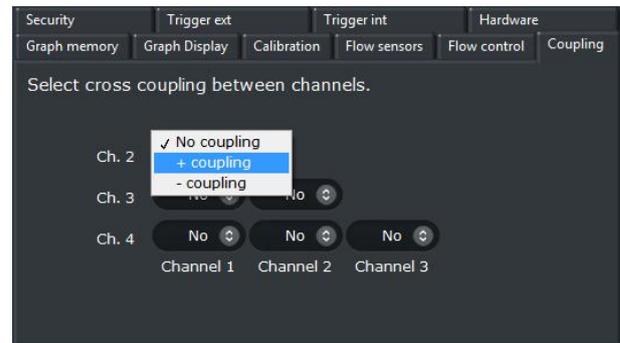
Most of the parameters that can be found in this menu were already described in the previous Common instrument features section, since they are shared by more than one instrument. Refer to that section if the information you are looking for is not described below.

- **Coupling**

Couple the pressures between two or more channels.

When two or more channels are **coupled positively**, any variation in pressure in one of the channels induces the same variation in the others.

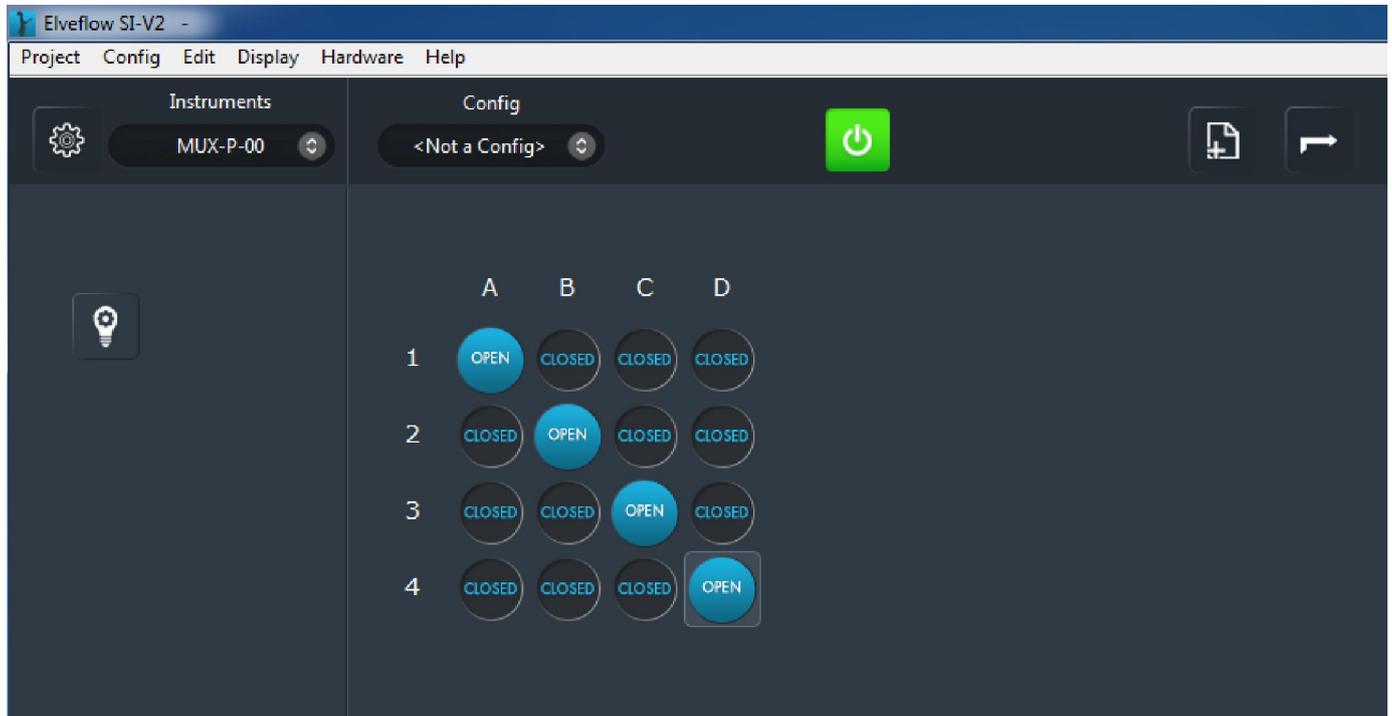
If the channels are **coupled negatively**, a variation in one channel induces an inverse variation in the others, i.e., an increase in pressure in the first channel yields a decrease in pressure in the other channels.



MUX Standard features

The MUX is a valve matrix that can be use either to block/let flow a fluid (MUX Flow Switch Matrix) or to distribute a fluid from an inlet to a selected outlet (MUX Quake Valve and Cross Chip).

Main window



In the main MUX window you will find information about the current state of each valve in the instrument and its main controls.

On the right side:

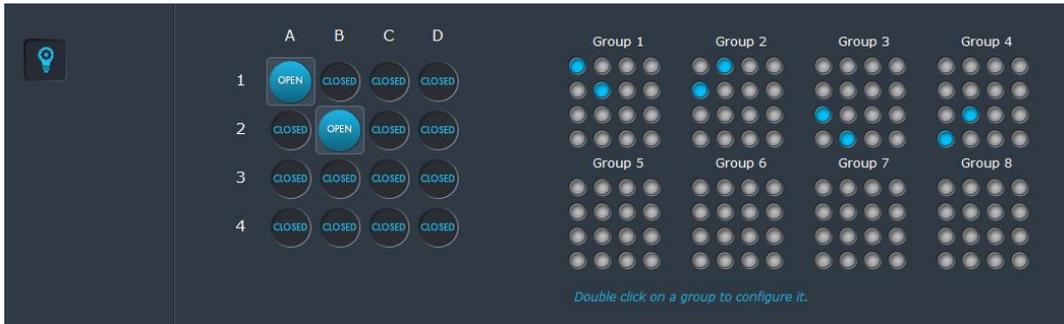
- The **valve switches** allow the user to control each valve independently.

On the left side:

- The **Advanced tools** button opens a side bar were the user can configure groups of valves for quick switching.



Display groups:



Click on a group to activate or deactivate it. Double click a group of valves to configure it. Note that a valve cannot be part of two distinct groups.

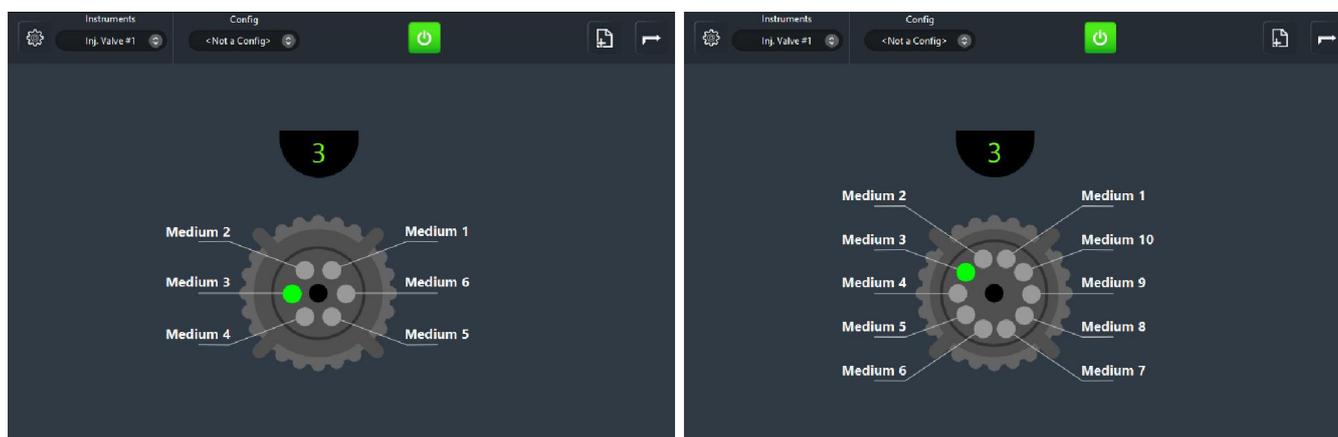


- **Selected valves:** This tab allows selecting the valves that will belong to the group. Please notice that one valve cannot belong to more than one group.
- **Off state:** This tab allows setting a state (open or closed) when the group is disabled.
- **On state:** This tab allows setting a state (open or closed) when the group is enabled.
- **Use multi step:** Enable this function in order to program a short sequence that will be repeated continuously. Click on the “add step” button to add the number of steps you want to be repeated. Click on the “delete step” button to delete a step. For each step you can set a determined length in seconds.

MUX Distributor features

The MUX Distributor is a rotative injection valve allowing a single inlet/outlet to be connected to up to 10 different reservoirs/chips for selective injection.

Main window



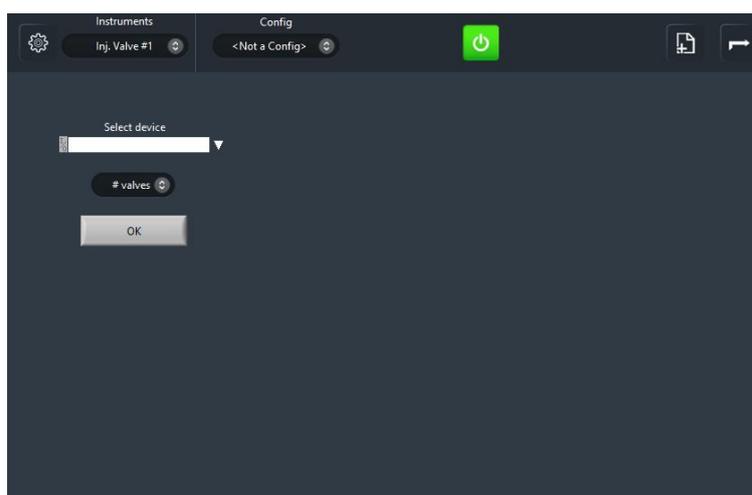
Main window for Rheodyne valves – six and ten inputs/outputs

In the main MUX Distributor valve window you will find information about the current state of your instrument, a control for the valve position and the names of the used media.

The connected device and type of valve are selected on the **Parameters menu**, at instrument launch or any time any of these parameters need to be changed.



The menu appears in the main window, as show below



Select the device and the **number of valves** and click “OK”. If no device appears in the list, click on Refresh and/or check the USB connection and power supply.

The **valve position** is selected by clicking the green/gray buttons on the main instrument window. The **media name** can also be modified by clicking on the actual name and typing the new name.

Coupling with a flow sensor

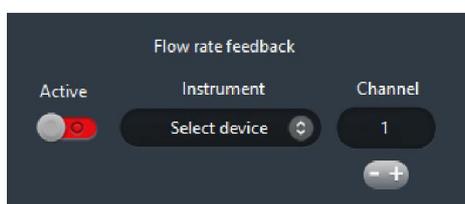
The MUX Distributor can be couple to a flow sensor in order to compute the volume flowing into or out of reservoirs according to the valve position. In order to use this feature another Elveflow instrument to which a flow sensor can be connected has to be available. Such instruments are the OB1 Pressure

The procedure for coupling the MUX Distributor to a flow sensor is the following:

1. Connect both the MUX Distributor and the flow sensor host to the Elveflow Smart Interface;
2. In the MUX Distributor main window, click on Parameters.



3. Select the flow sensor host in the Instrument list and choose the flow sensor channel. Activate the flow rate feedback and click OK.



4. A new sidebar will appear in the MUX Distributor main window showing a volume corresponding to each valve position.

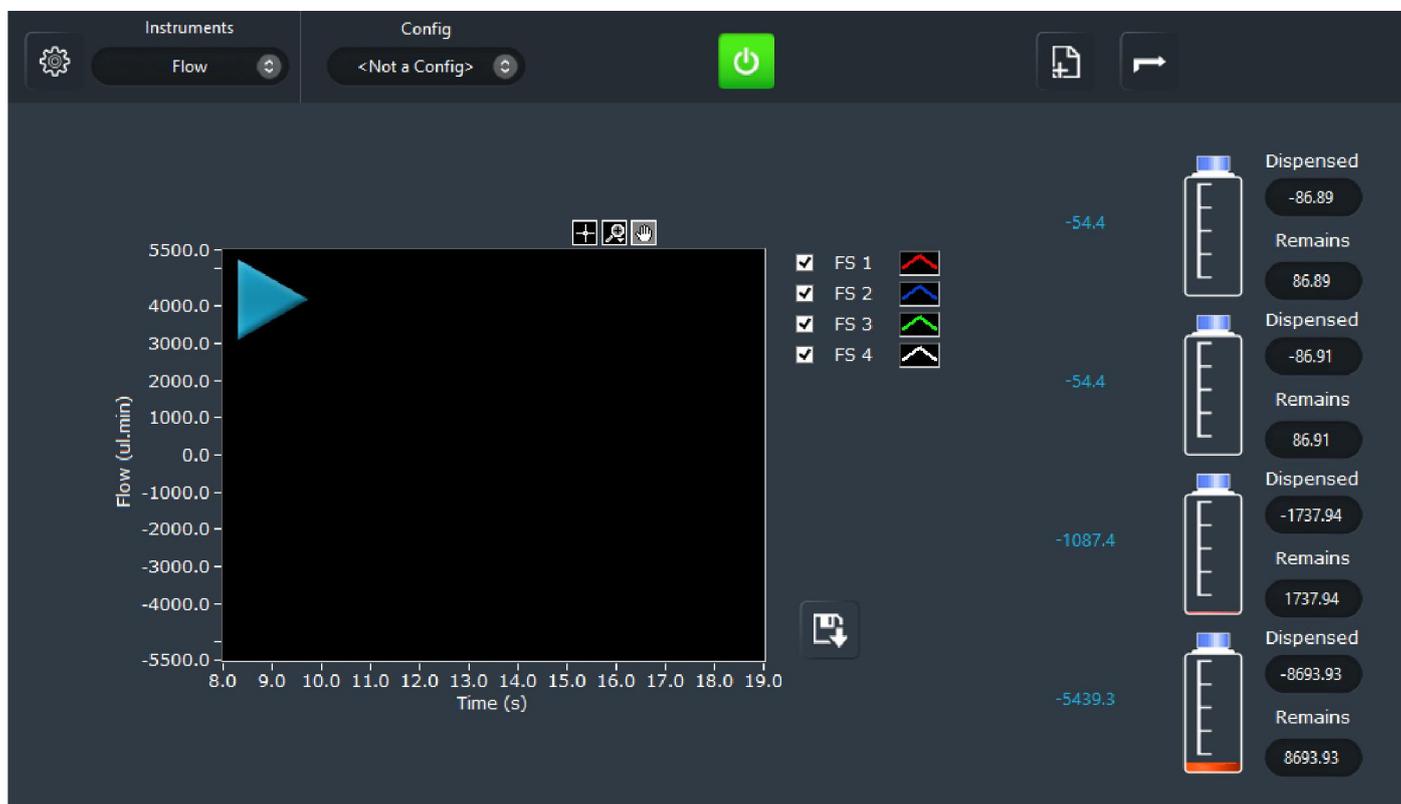
	Volume (μ l)	
Medium 1	0	Reset all
Medium 2	0	
Medium 3	0	
Medium 4	0	
Medium 5	0	
Medium 6	0	
Medium 7	0	
Medium 8	0	
Medium 9	0	
Medium 10	0	

5. The volume flowing through the selected flow sensor is added/subtracted from the values shown in the sidebar. Each volume can be reset individually to any value directly on its indicator. All the values can also be reset to zero at once by clicking the “Reset all” button.

Flow Reader features

The Flow Reader is a host module for up to four Flow sensors of any model.

Main window



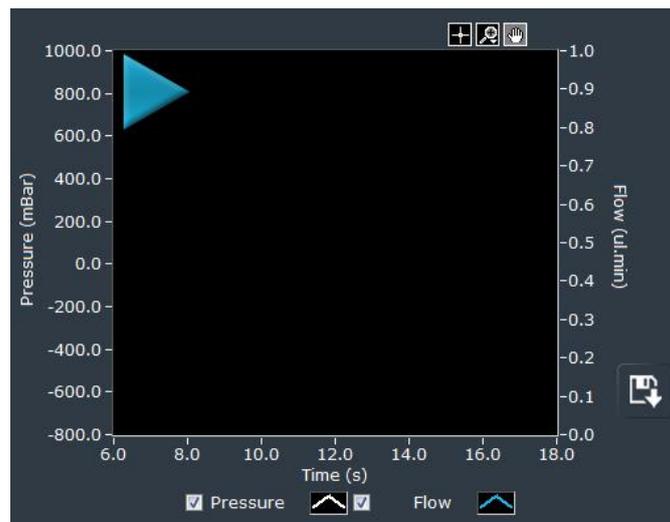
In the main Flow Reader window you will find information about the current state of your instrument, controls and configurable parameters.

The flow sensors connected to the Flow Reader are selected on the **Parameters menu**.



On the left side:

- The **graph** shows in real time the measured flow rate values.



Click the play/pause button to launch and stop the graph. The graph parameters can be configured in the “Parameters” menu, “Graph display” section.

- **Export and save graph data** to text or Excel format. The amount and intervals of data exported is related to the parameter chosen in the “Graph memory” section of the “Parameters” menu.

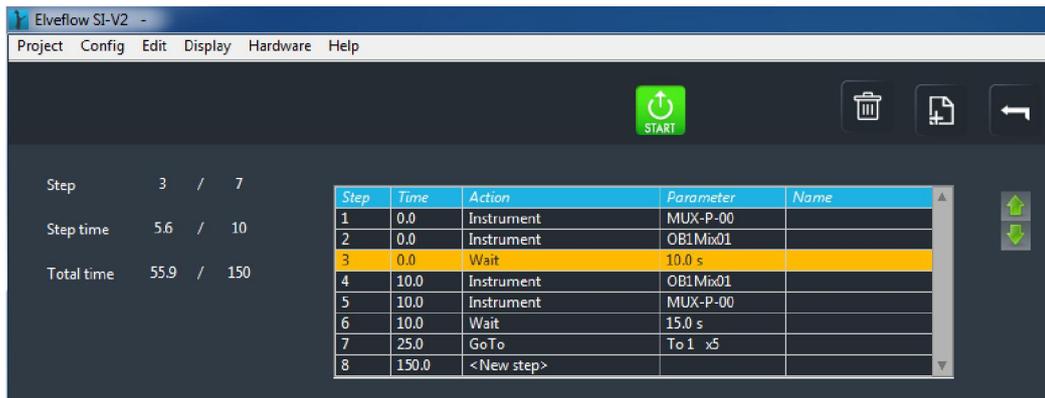


On the right side:

- The **reservoirs** can be configured to show in real time the amount of **fluid remaining** in the user’s reservoirs and the amount that was already **dispensed**.



Project window



1. Add new step to project schedule

a) Add instrument configurations:

In order to add an instrument configuration as a new step on the project schedule, click on the “add step to project” button placed on the top right corner of every **instrument main window**. A window prompts to enter the desired step number and name.



b) Add actions:

In order to add an action as a new step on the project schedule, click on the “add step to project” button placed on the top right corner of the **project window**. A window prompts to select one of the three different actions:



➤ Wait:

This action allows setting the time length the instruments are going to perform the configurations listed immediately above on the project schedule. For each wait step, select the step number, name (optional) and the time length in seconds.

➤ Trigger:

This action allows configuring determined trigger signals on your project schedule.

For each trigger step, select step number and name (optional), the instrument involved, the type of trigger (internal or external) and the time out. For internal trigger, the time out option enables defining a maximum waiting duration before continuing the execution of the sequence. Set time out to «Inf» to set an infinite waiting. Note that when an internal signal is awaited, every instrument keeps waiting for the signal in its current state.

The trigger signal parameters for each instrument have to be configured on the preference menu.

➤ Go to:

This action allows repeating a determined sequence of steps on your project schedule. For each loop, select the step number and name, the step to start the loop and the number of times to repeat it. `

c) Copy-Paste steps:

In order to copy and paste steps on the project schedule, press “Ctrl” on your keyboard, click on the step to be copied, drag and drop at the desired position.

2. Start

Click the «start» button to launch the automatic execution of the defined series of sequences.



3. Delete step(s)

Click the «delete step» button to delete a determined step from the project.



4. See instrument main window

Click the «see instrument» button to go back to the instrument main window.



Menu access

1. File

- a) New project:
It saves a new project as a file .LVflow for later use.
- b) Open project:
It prompts the user to open an .LVflow project file.
- c) Save project:
It saves the current project configuration.
- d) Save project as:
It prompts the user to save the current project with a different name or path.

2. Config

- e) New config:
It saves a new config as a file for later use.
- f) Open config:
It prompts the user to open a config file.
- g) Save config:
It saves the current config.
- h) Save config as:
It prompts the user to save the current config with a different name or path.
- i) Save all configs:
It prompts the user to save all the configs.

3. Display

- j) Current instrument:
It shows the instrument main window.
- k) Project:
It shows the project window.
- l) Start menu:
It shows the start menu window.

4. Hardware

- m) Check connection:
It shows an informative window with instrument connection status.
- n) Restart instrument:
It reconnects an instrument when communication has been lost and needs to be restarted.

5. Help

- o) About:
It shows the Elveflow[®] Smart Interface version.