ELVE FLOW
PLUG & PLAY MICROFLUIDICS

VALVES RANGE & MUX WIRE

VALVES & VALVE CONTROLLER V3

User Guide

DOCUMENT REF: UGVRMW-081222

SYMBOLS USED IN THIS DOCUMENT

IMPORTANT INFORMATION. Disregarding this information may risk equipment damage and personal injuries or degrade your user experience.

HELPFUL INFORMATION. This information facilitates the use of the instrument and contributes to its optimal performance.

ADDITIONAL INFORMATION is available on the internet or from your Elveflow representative

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Introduction

This user guide explains the version 3 (V3) of the valves range and MUX Wire valve controller. The MUX Wire valve controller allows you to control up to eight valves in your setup through Elveflow's software interface or in standalone mode.

The Elveflow's **MUX Wire V3 valve controller** (Fig 1) works perfectly with all of Elveflow's microfluidic valves and devices through the same software interface. It is equipped with internal and external trigger connectors that **synchronize it with the other equipment in the setup**, such as microscopes or analytical instruments.

Fig 1. *The MUX Wire valve controller can control up to eight microfluidic valves.*

The **Elveflow valves V3 range** has been carefully selected for their convenience and performance to suit most microfluidic applications. Our valves provide **20ms or less switching time, low internal volume, high chemical compatibility, and no disruption flow** (Fig 2).

Fig 2. *A closeup of a microfluidic valve that can be controlled by the MUX Wire valve controller (in the background).*

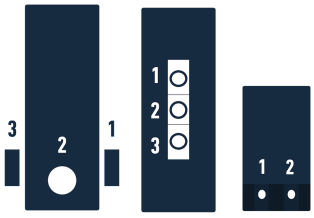
Definitions:

Below, find the specific terms used in this user guide to facilitate your understanding.

MUX Wire valve controller

The MUX Wire can control up to eight valves in your setup. The valves can be independently or simultaneously controlled through the Elveflow Smart Interface (ESI) or in standalone mode.

Valve range - models and types



The combination of valve models and types provide different possibilities for specific setup requirements (Table 1).

The **valve model** relates to the supported pressure - high pressure (until 6 bars), low pressure (until 3 bars), and low volume (for low internal volume requirements).

The **valve type** indicates the flow path (2/2 or 3/2) and the normally open (NO) or normally closed (NC) state of the valve. The V3 range offers three types of valves: 2/2 NO, 2/2 NC, and 3/2 valves. The NO or NC refer to their normal states when a power supply is <u>not</u> applied.

2/2 NO Valve

A normally open (NO) valve is *open by default* and remains open until a power supply is applied. When powered, the coil inside closes the valve, *preventing* liquid or gas from flowing through it.

Default state of 2/2 NO Valve

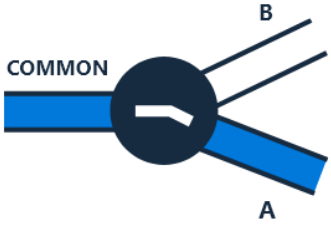
2/2 NC Valve

A normally closed (NC) valve is *closed by default* and remains closed until a power supply is applied. When powered, the coil inside opens the valve, *allowing* liquid or gas to pass through it.

Default state of 2/2 NC Valve

3/2 Valve

A 3/2 valve has one inlet and two outlets, making them ideal for diverting flow from one path (way A) to another (way B). Thus, 3/2 valves provide bidirectional control (unlike 2/2 valves).



Default state of 3/2 Valve

Table 1. *The three available valve V3 models and the possible valve types combination.*

VALVE MODEL	VALVE TYPE		
High-pressure valve	2/2 normally open (NO) [1]	2/2 normally closed (NC) [1]	3/2 valve
Low-pressure valve	2/2 normally open (NO) [1]	2/2 normally closed (NC) [1]	3/2 valve
Low volume	2/2 normally closed (NC)		

Fig 3. *An example of three valve types and models: a 3/2 high-pressure (left), a 2/2 low-pressure (port 2 is closed) (center), and a 2/2 low volume (right).*

HELPFUL INFORMATION.

- Note that although the casing for the 3 high-pressure valve types - 3/2, 2/2 NC, and 2/2 NO - is the same, some come with a closed port.
- The 3/2 valve can also be used to choose between two inlets (A or B) and one outlet (Fig 13).

[1] with a closed port

Instruments Description

Note: The serial number of each device is found under the instrument.

MUX Wire V3 valve controller

The MUX Wire can independently or simultaneously control up to eight microfluidic valves through the Elveflow Smart Interface (ESI). The LED indicator on top of the valve controller displays each valve's type and state, facilitating the use, visualization, and control of all the valves in your setup.

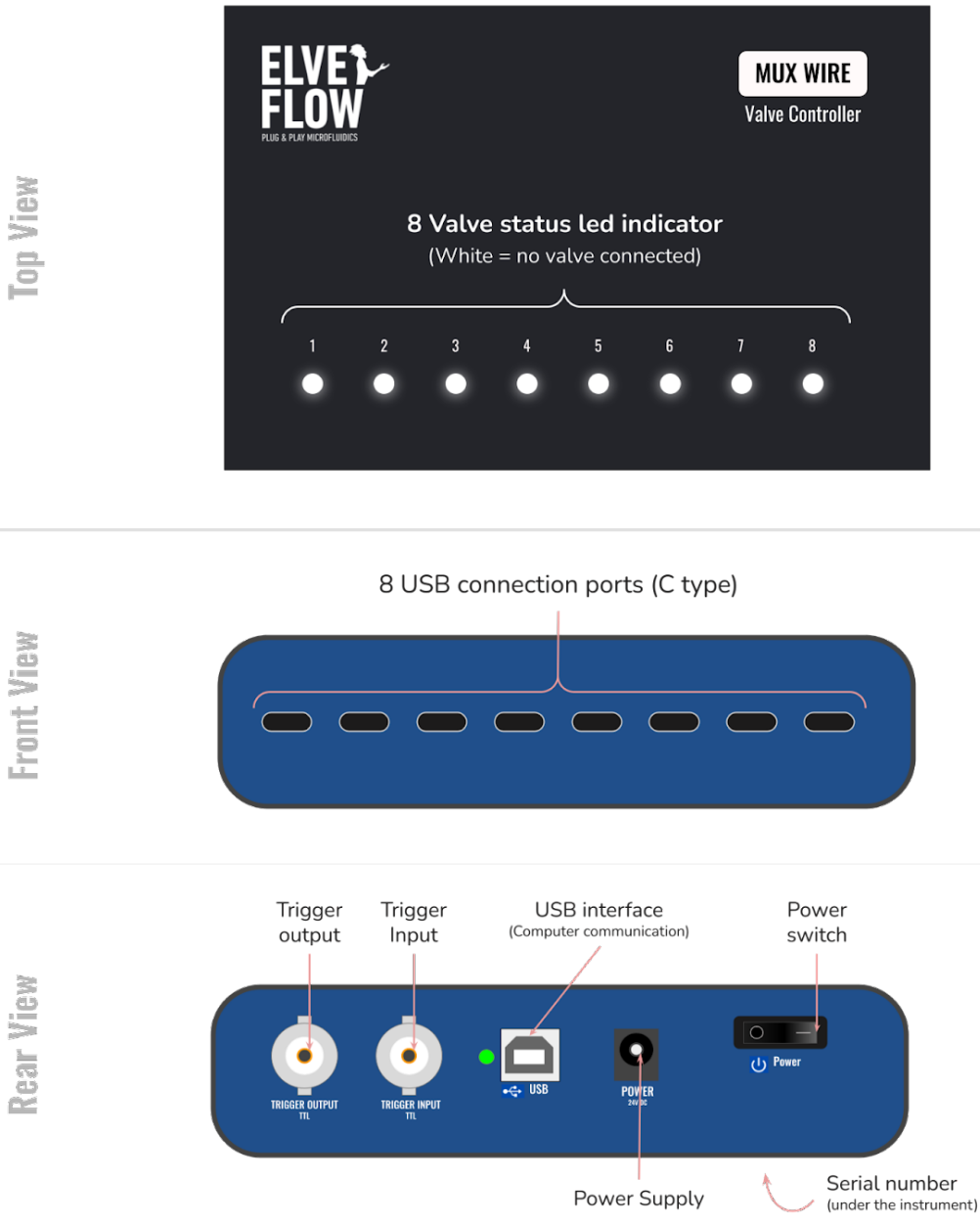
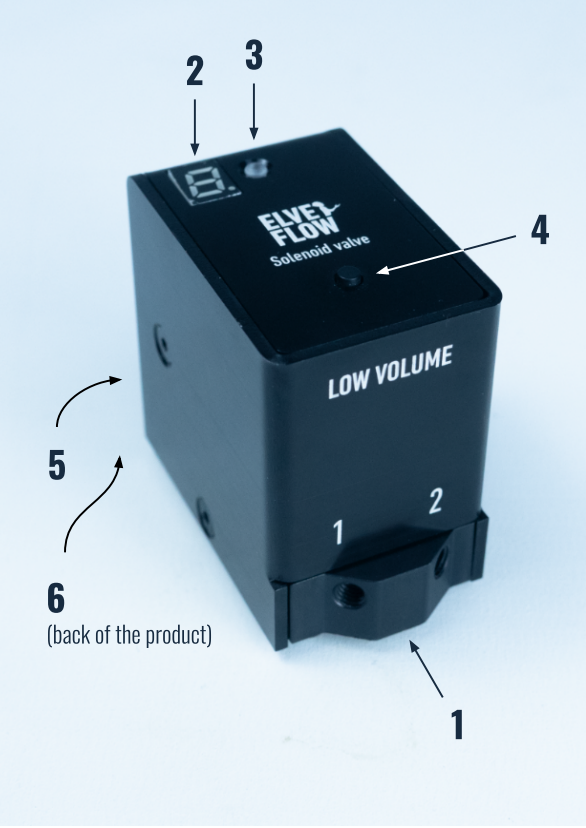


Fig 4. *Top, front, and rear view of the MUX Wire valve controller.*

Valves V3



1. Manifold - fluidic connection
2. Channel number display
3. LED valve state indicator
4. Valve activation button
5. USB-C port
6. Serial number label

Fig 5. *Details of a valve V3 used with the MUX Wire valve controller.*

Valve state & color codes

Each MUX wire valve controller controls up to eight valves. The color of the LED (on top of the MUX Wire) displays the state and the type of each connected valve. This is an easy and quick way to differentiate the valves - when powered or by default - in your setup (Table 2).

For the 2/2 valves (NC and NO), a steady green LED indicates the valve is open, while a steady red LED indicates the valve is closed (Fig 7).

For the 3/2 valve, a steady blue LED indicates the valve will divert the flow through the first flow path (way A), and a purple LED indicates the flow will follow the second flow path (way B).

Table 2. *The LED on top of the MUX Wire valve controller uses a color code to display each valve type (2/2 or 3/2) and state (open or closed for 2/2 and way A or way B for 3/2). Green and Red indicate the state of the 2/2 valves, while blue and purple indicate the 3/2 valves' state.*

VALVE TYPE	DEFAULT STATE	ACTIVATED STATE	NOT CONNECTED
2/2 normally open (NO)	**GREEN** (open)	**RED** (closed)	**WHITE**
2/2 normally closed (NC)	**RED** (closed)	**GREEN** (open)	**WHITE**
3/2 valve	**BLUE** (way A)	**PURPLE** (way B)	**WHITE**

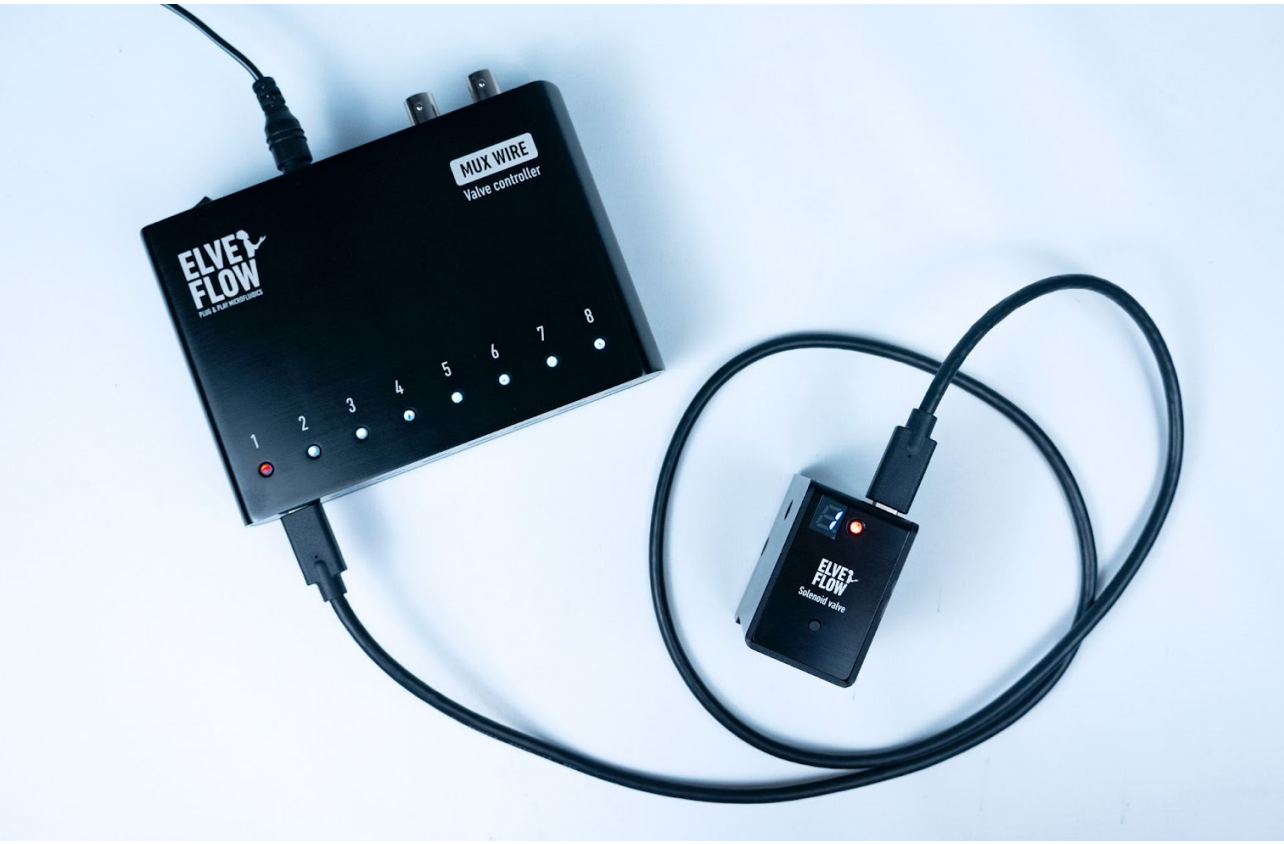


Fig 7. *Example of a 2/2 normally closed (NC) valve connected to the first slot of the MUX Wire valve controller and shown on the LED display slot 1 (red). The red light on the MUX Wire and the valve indicate that the valve is in a "closed"* position.

Additional Elements

The MUX Wire valve controller and valves are supplied with specific elements according to users' requests and needs. Thus, please check the package content upon receiving your order.

Each MUX Wire valve controller has a USB cable to connect it to a computer and a power supply. The valves are accompanied by a USB C-type cable to connect them to the MUX wire.

In addition to the above items, the user should have the necessary fluidic accessories (tubing, additional fittings, etc.) to connect the inlets/outlets to the rest of the setup.

IMPORTANT INFORMATION.
If your package is missing an item from your order, please notify us **within one month** by emailing customer@elveflow.com.

Installation & Use

Fluidic connections

The following Table describes the fittings required to connect the valves to the flow path. The connectors are designed for 1/16" OD tube or 3/32" ID tubing (2.5mm). Still, they can also be adjusted to other tubings using sleeves or adaptors.

Table 3. *The fluidic connectors to be used with each type of valve.*

	Low-pressure valve	High-pressure valve	Low volume valve
Fitting type	fitting ¼-28 unf	fitting 10-32	fitting 10-32
Visual			

Electrical connections

The MUX Wire valve controller must be plugged into the power supply provided with the product (see **Additional Elements** session). Connection to the computer is made via the supplied USB cable.

Each valve connects to the MUX Wire via the provided C-type USB cables (one cable per valve).

Compatibility of previous valve versions with the MUX Wire V3

It is possible to use the Mux Wire V3 with a prior version of the valve. However, the cable that connects the valve and MUX Wire V3 must be a USB-C. Hence, you will need a USB-C cable and a Micro USB adaptor to connect a non-V3 valve to the MUX Wire V3.

Fig 8. *Using a USB-C to connect a previous valve version (not a V3) to the MUX Wire V3 through a Micro USB adaptor.*

ESI software installation

1. Plug the Elveflow® USB flash drive into your computer, or download the latest version from the Elveflow website.
2. Open the Elveflow® folder.
3. Locate the ESI software zip file.
4. Copy the installation zip file to a location of your choice (e.g., desktop) and unzip the file.
5. Run setup.exe and follow the instructions displayed by the installation assistant.
6. When ready, restart your computer to finish the installation process.

- Ensure your ESI version is up to date before implementing the solutions described in this guide.
- Do not install the ESI software directly from the Zip file or the USB key.
- Always copy the ESI.zip source to your computer and unzip it before launching the installation process.

Download the latest version of the Elveflow® Smart Interface anytime from the Elveflow website. Two links for the same file are provided to facilitate access to the installation files. The mirror link is the same file hosted on another server, so you have an accessible version 24/7.

Using the MUX Wire and valves in standalone mode

Connect your MUX Wire to the power supply

Connect the power adapter to the instrument (24V DC indication) and the adapter to an electric socket (country-specific adapters provided) (Fig 9).

A green LED switches ON once the MUX is powered and ON (with a 24V DC jack plugged in).

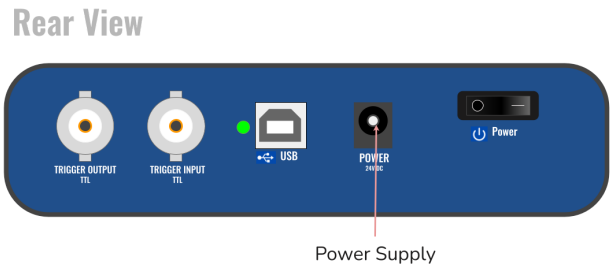


Fig 9. *Connecting the MUX Wire to a power supply.*

Connecting a valve to use in standalone mode

You can power a valve by connecting it to your MUX Wire V3 using a USB connection (see Technical Specifications Table).

Upon connecting the valves to the valve controller, you can manually activate or deactivate them via the push button on top of the valve. This way, the system works in a *standalone* mode without needing the ESI or a computer.

Pushing a valve button will switch the valve state from default to active state, meaning:

- A Normally Open (NO) valve will close upon pressing the push button.
- A Normally Closed (NC) valve will open upon pressing the push button.
- A 3/2 way valve will divert the flow from one path (way A) to another (way B) upon pressing the push button.

Using the MUX Wire and valves with a computer and the ESI

Connecting the MUX Wire to a computer and power supply

Connect the valve controller to the computer using the USB cable (USB indication) (Fig 10).

Next, connect the power adapter to the instrument (24V DC indication) and the adapter to an electric socket (country-specific adapters provided).

A green LED switches ON once the MUX is powered and ON (with a 24V DC jack plugged in).

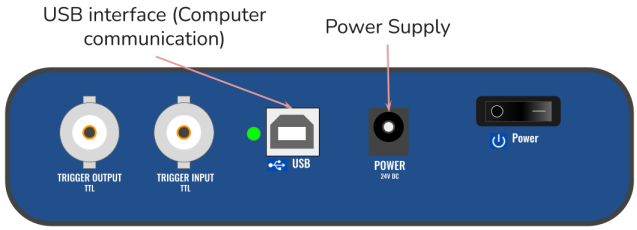


Fig 10. *The USB connection is required to use the MUX wire controller with a computer.*

Using the MUX Wire and valves in ESI

As an additional feature, the new ESI-MUX interface offers detailed information about the type and state of the valves connected to the instrument (Fig 11). The ESI displays the following information on each connected valve:

- the corresponding associated channel number.
- the valve type (2/2 NO, 2/2 NC, or 3/2)
- the valve state (open, closed, way A, or way B)

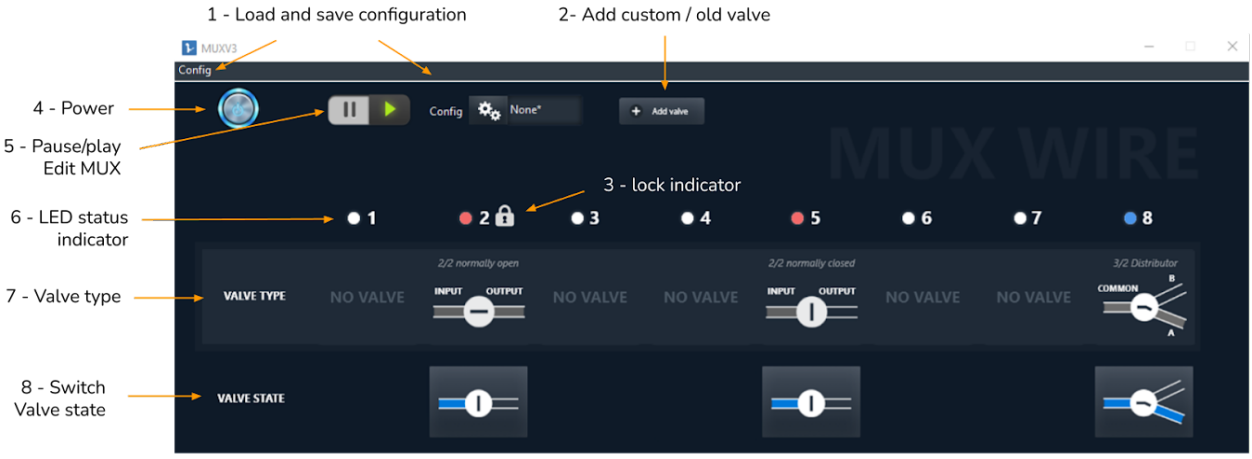


Fig 11. *Description of the MUX Wire and valves interface in the ESI.*

You can load and save a configuration to record a valve type and state (Fig 11.1).

The connected valves V3 are automatically recognized by the ESI. However, a custom or previous valve version is not automatically recognized, so you must add them using the “Add valve” button (Fig 11.2).

The MUX Wire V3 allows you to activate your valves in two ways:

1. using the switch function - Valve State - in the ESI MUX Wire V3 interface (Fig 11.8).
2. manually via the push button of valve V3 (valve activation button) (Fig 5.4).

A lock indicator is displayed in the ESI if you manually activate a valve using the push button (Fig 11.3). To unlock and deactivate the valve, press the valve push button again. Note that if you activate a valve through the ESI instead of manually, you must use the same step to deactivate it (i.e., click on the valve state icon again).

Clicking on the Power button (Fig 11.4) disables every connected valve and changes the state of several valves at once. If you wish to hold the valve state as it is and not turn it off, click the Pause button (Fig 11.5).

The LED state indicator in the ESI interface shows the valve type and state (Fig 11.6) according to the MUX Wire LED color code (see Table 2). The valve type indicator (Fig 11.7) displays the valve type.

Finally, clicking the "Valve State" button will change the valve state indicated at the bottom of the screen (Fig 11.8).

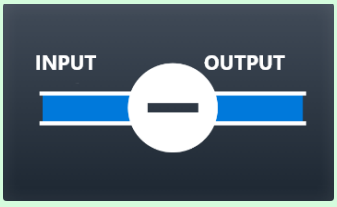
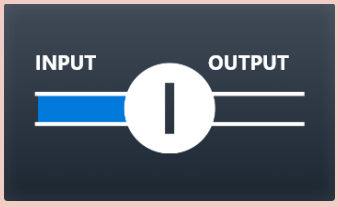
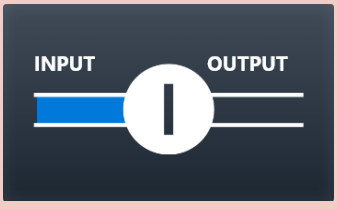
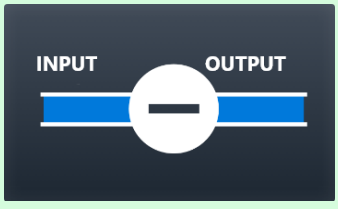
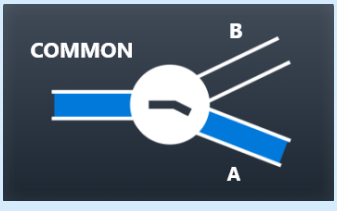
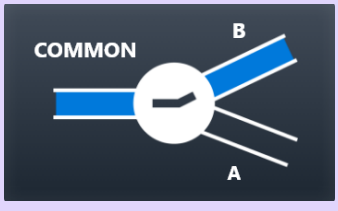
Deactivating a valve: to deactivate a valve, you must use the same path used to activate it. For example:

- If you activate a given valve via the software, you can only deactivate it through the software.
- If you activate a given valve manually via the valve button, you can only deactivate it manually by pressing the valve button again.

ESI valve icons

The ESI displays several icons for quick and easy reading of a valve type and state (Table 4).

Table 4. *The icons describe the valve type and state shown by the ESI. The colors (red, green, blue, and purple) refer to the previously described color codes (see Table 2).*

VALVE TYPE	DEFAULT STATE	ACTIVATED STATE
2/2 normally open (NO)		
2/2 normally closed (NC)		
3/2 valve		

Automation of MUX Wire configurations using the sequencer in the ESI

Automate your experiment and switch from one configuration to another through the ESI Sequencer (Fig 12).

Fig 12. *Automation of MUX Wire configurations in the ESI using the sequencer. Open the Sequencer (a), select the MUX from the list of available functions (b), and load the configuration you would like to apply (c).*

Open the sequencer from the main window (Fig 12a) to access a whole range of functions and select the MUX from the list of available functions (Fig 12b). To add a MUX Wire step, the ESI will ask you to specify the instrument. At this stage, you can load the configuration of your choice (Fig 12c). Note that it is also possible to determine the period during which you wish to apply the selected configuration.

Using the MUX Wire and valves with Elveflow SDK

The Software Development Kit (SDK) user manual explains how to control the MUX Wire, among other features. Before starting a new experiment involving the SDK, please read the user manual to save time and effort, and reach the best results.

Applications

The valves V3 provide total and precise flow control over fluid or gas.

Using the MUX Wire V3 with Elveflow **2-way (2/2) microfluidic valves** enables or blocks liquid or gas flow at precise points in the flow path where the valve is installed. The **Elveflow 3-way (3/2) valves** provide directional control to orient, and switch flows at specific locations (Fig 13).

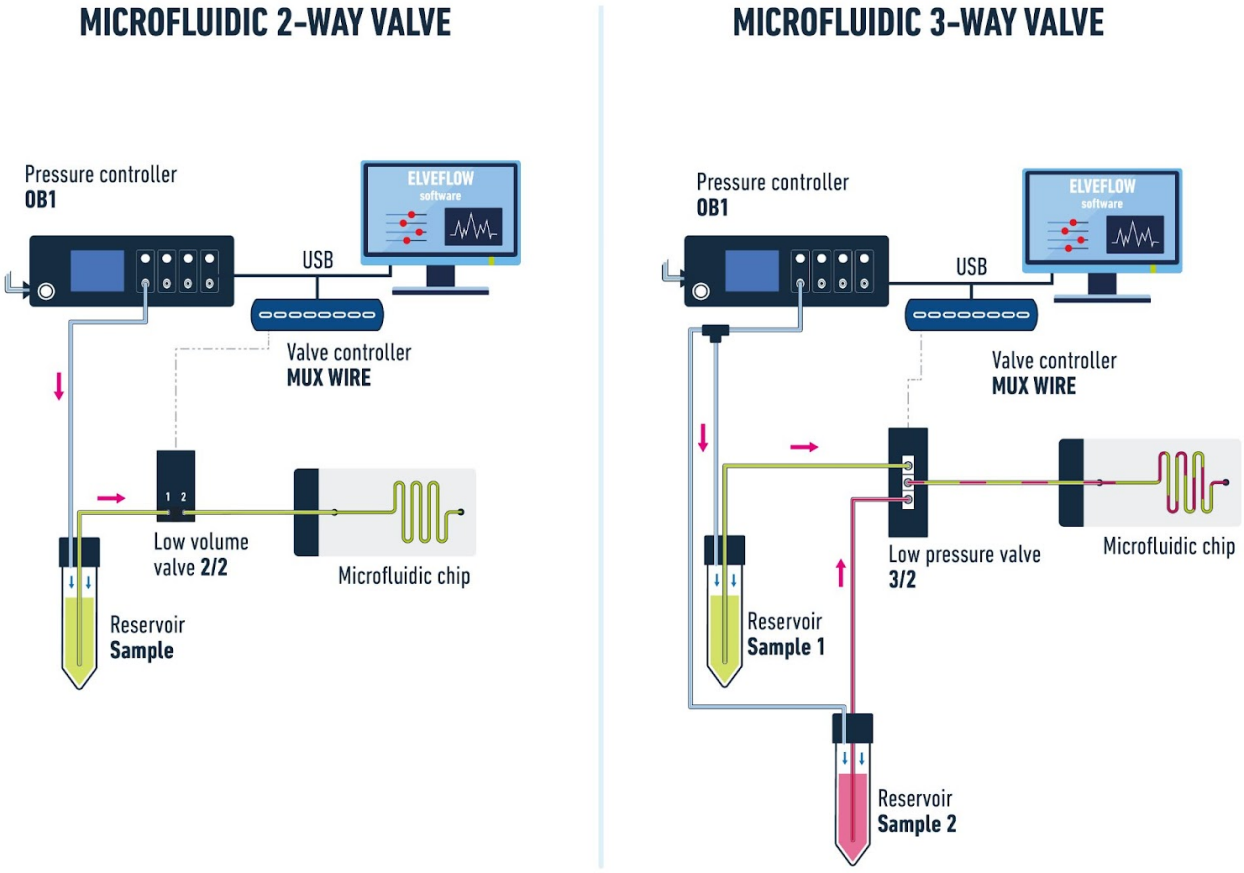


Fig 13. *Combining the MUX Wire V3 valve controller with Elveflow 2/2 (left) or 3/2 (right) microfluidic valves V3 is ideal for blocking, allowing, or diverting the flow at critical points in a microfluidic setup.*

The MUX Wire V3 controller and valves are ideal for the following applications:

- Fast medium switching (e.g., drug testing, dynamic cell cultures, long-term experiments)
- On-chip peristaltic pump
- Sequential sample injection
- Cell/particle sample screening
- Medium perfusion switch for cell biology
- Diffusion studies
- Unidirectional recirculation
- Organ-on-chip experiments
- Tissue culture and engineering
- Cell culture

Technical Specifications

MUX Wire V3

PERFORMANCES	
Number of controlled valves	**8**
ELECTRICAL	
Input voltage range, AC	**100V** to **240VAC**
AC supply frequency	**50 Hz** to **60 Hz**
Input current, AC	**0.8A**
Power supply, DC	**18-24, 1.5A**
Max current consumption	**1.5A** peak
Power consumption (max)	**36W**
Max valve power	**10W**
Connection type	**USB**
MECHANICAL SPECIFICATIONS	
Valve connectors	**USB-C**
Operating temperature	**5-50°C**
Dimensions (without connectors)	**140x96x35 mm**
Weight	**0.374kg**
SOFTWARE	
Computer specifications	**USB 2.0 port, Intel Pentium II 500 MHz, I Go Hard Disk space, 2 Go RAM Windows XP and newer, 32/64 bit.** - LabVIEW® 2011 is required when using LabVIEW® libraries. - ESI installation is required to use SDK.
Provided software	**Elveflow Software Interface**
Software development kit	**C++, Python, MATLAB® and LabVIEW® libraries**

Valves V3

	LOW PRESSURE	HIGH PRESSURE	LOW VOLUME
PERFORMANCES			
Switching time (ms)	<10	15	20
Max recommended pressure (bar)	3	6	5
Internal diameters	0,6 mm	1,6 mm	0,4 mm
Available type	2/2 NO | 2/2 NC | 3/2	2/2 NO | 2/2 NC | 3/2	2/2 NC
Internal volume [1]	25 µl | 25 µl | 32 µl	55,5 µl | 55,5 µl | 58,25 µl	14,7 µl
Dead volume [3]	None	None	None
Wetted materials [4]	FKM/PEEK	FKM/PEEK	FFKM/PEEK
ELECTRICAL			
Command voltage, DC	24V	24V	24V
Connection type	USB-C 3.1 Gen2 (cable included)		
MECHANICAL SPECIFICATIONS			
Fluidic connectors	Standard ¼-28 UNF, flat-bottom	10-32	10-32
Operating temperature	5-50°C	5-50°C	5-50°C
Dimensions (without connectors)	52x34x80 mm	52x34x80 mm	57x34x51 mm
Weight	0.132kg	0.158kg	0.108kg

[1] Volume inside the system from the entrance to exit

[2] Volume of liquid to be mixed with the next liquid.

[3] Volume trapped in the system (dead end), not fully removed, and relies on diffusion to clear out.

[4] Always make sure your fluid is compatible with the wetted materials before starting any experiment.

Customer Support

Find all the information you need about our product range at the Elveflow Support Portal (https://support.elveflow.com/support/solutions). Most likely, the answers you're looking for can be found there. However, if you still have questions or need further clarification, contact us at customer@elveflow.com.

Troubleshooting information

By providing the information described below, the Elveflow Support team will be ready to help you:

The elements usually required for troubleshooting are:

1. the serial number of the Elveflow device(s) (found under each instrument).
2. the ESI Report and the ESI initialization file (see how to create an ESI report in the next section)
3. the screenshots of the error messages, if applicable.
4. pictures or movies of your setup. You can use WeTransfer to send us large files up to 2Go; just make sure to add the download link to your reply.

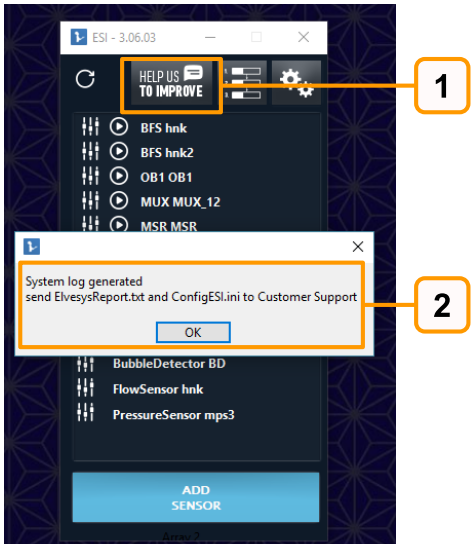
Generating and sending ESI reports

ESI reports create a snapshot of the software configuration used in your system. The Elveflow Support expert will use the report to provide you with the proper assistance.

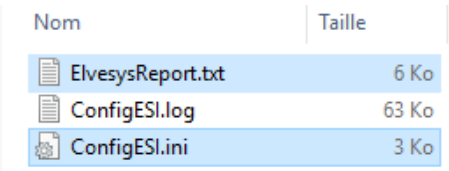
To generate a report, follow these steps:

1- Open ESI software

2- Click on "Help us to improve" (1) on the ESI main window to generate the report (2)



3- Click OK to open the ESI data folder. They are usually located in C: \ Users \ Public \ Documents \ Elvesys \ ESI \ data.



4- Add these 2 files to your email at customer@elveflow.com:

- ElvesysReport.txt
- ConfigESI.ini

ELVE FLOW

PLUG & PLAY MICROFLUIDICS

Technical support

customer@elveflow.com

General information

contact@elveflow.com

+33(0).184.163.807

ELVESYS - Microfluidics innovation center

172 Rue de Charonne,
75011 Paris, FRANCE

www.elveflow.com

MAY THE FLOW BE WITH YOU