

# ESS™ PLATFORM

Easy Switch Solutions™



## User Manual

**ESS™ platform: SWITCHBOARD, M-SWITCH™ and 2-SWITCH™**

Version November 2014



<b>1. INTRODUCTION</b>	<b>4</b>
<b>2. USING A 2-SWITCH™ VALVE</b>	<b>5</b>
<b>2.1 Fluidic principle</b>	<b>5</b>
<b>2.2 Description</b>	<b>6</b>
2.2.1 2-SWITCH™ Front	6
2.2.2 2-SWITCH™ Back	7
2.2.3 2-SWITCH™ Top and Bottom faces	8
<b>2.3 Connection</b>	<b>9</b>
2.3.1 Fluidic connection	9
2.3.2 Electric connection	12
<b>2.4 Positioning</b>	<b>13</b>
<b>3. USING AN M-SWITCH™ VALVE</b>	<b>16</b>
<b>3.1 Fluidic principle</b>	<b>16</b>
<b>3.2 Description</b>	<b>17</b>
3.2.1 M-SWITCH™ Front and top	17
3.2.2 M-SWITCH™ Back	18
3.2.3 M-SWITCH™ Bottom face	18
3.2.4 M-SWITCH™ Side face	18
<b>3.3 Connection</b>	<b>19</b>
3.3.1 Fluidic connection	19
3.3.2 Electric connection	22
<b>3.4 Positioning</b>	<b>23</b>
<b>4. USING THE SWITCHBOARD</b>	<b>25</b>
<b>4.1 Description</b>	<b>25</b>
<b>4.2 Connection</b>	<b>26</b>
<b>5. HOW TO USE THE 2-SWITCH™ AND M-SWITCH™ WITH GAS</b>	<b>28</b>
<b>6. HOW TO START WORKING WITH THE ESS™</b>	<b>30</b>
<b>7. FLUIDIC CIRCUITS EXAMPLES</b>	<b>31</b>
<b>8. FREQUENTLY ASKED QUESTIONS</b>	<b>32</b>
<b>9. SPECIFICATIONS</b>	<b>33</b>

### WARNINGS:



- Do never open SWITCHBOARD, 2-SWITCH™ and M-SWITCH™ devices. Refer all servicing to after-sales service department (support@fluigent.com).



- Prevent any objects or liquids from entering the SWITCHBOARD, this may cause a short-circuit failure or other malfunction. Failing to respect this advice would:
  - Expose you to direct current/voltage in case the device is under voltage which may lead to severe damages
  - Void device's warranty
  - Discharge our company from any liability regarding physical or device damages



- Do not place the product in an unstable location, place the device in a location with a level surface and a strong and stable support.
- Do not use other power supply than the one provided with the ESS™. The power supply provided with the ESS™ has been carefully selected to meet the power requirements of the ESS™ in all configurations and to comply with all safety standards.
- If you are using the ESS™ platform with other flow control systems, please check that the pressure in your fluidic system does not exceed 100 psi

## 1. Introduction

The **Easy Switch Solutions™ platform (or ESS™)** provides solutions for path selection in microfluidics. The Easy Switch Solutions™ platform enables you to implement two (2) different kinds of valves in your microfluidic circuit.

- ⇒ The **2-SWITCH™** is a 3-port / 2-position solenoid valve: two (2) ports can alternatively be connected to a third one. The 2-SWITCH™ is fully described in §2.
- ⇒ The **M-SWITCH™** is an 11-port / 10-position rotary valve: ten (10) peripheral ports can alternatively be connected to a central one. The M-SWITCH™ is fully described in §3.
- ⇒ The third element of the Easy Switch Solutions™ platform is the **SWITCHBOARD**: this device hosts up to four (4) M-SWITCH™ and eight (8) 2-SWITCH™ and provides them power supply. The SWITCHBOARD is also the link between the connected 2-SWITCH™ and M-SWITCH™ and the controlling software ESS™ Control (cf. ESS™ Control User Manual). The SWITCHBOARD is fully described in §4.

Combining the 2-SWITCH™ and M-SWITCH™ valves thanks to the SWITCHBOARD will give you new possibilities to easily design and build even the most complex microfluidic circuits. It is also a powerful tool to simplify your chip design and automate your experiments.

The **ESS™ platform has been designed to work at its best performances with FLUIGENT flow control solutions** (MFCS™ and Flow-Rate Platform). It is however possible to use the ESS™ platform with other flow control systems provided that the pressure applied to the ESS™ devices **does not exceed 100 psi**.

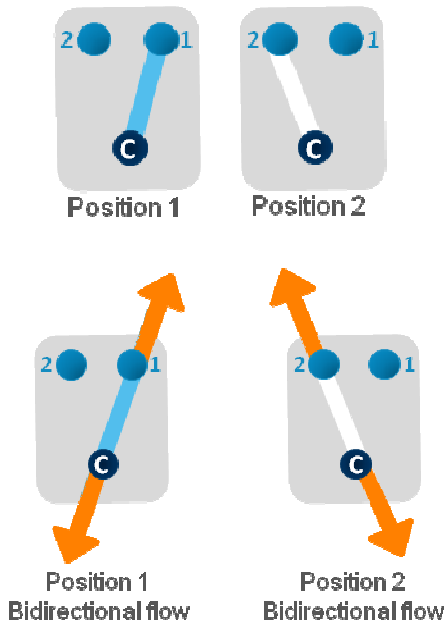
The ESS™ user manual will show you how to use the ESS™ elements for your daily work. It will describe all the ESS™ functionalities that will help you to rationalize your microfluidic circuits and automate your experiments. You will also find examples of applications using the ESS™ and answers to the frequently asked questions about the ESS™. With these elements you will be able to exploit the full performances of the Easy Switch Solutions™ platform for your application.

## 2. Using a 2-SWITCH™ valve

### 2.1 Fluidic principle

The 2-SWITCH™ is a 3-port / 2-position valve. This means that three (3) ports can be connected with fittings and tubings to your application, and that it is possible to choose between two (2) positions linking the ports in two (2) different manners.

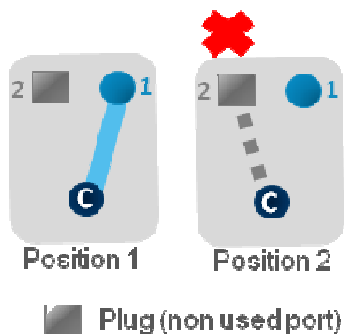
#### Fluidic 2-way switch



Here is the fluidic diagram of a 2-SWITCH™. The dark blue “C” port at the bottom of the 2-SWITCH™ is the **common port**: it can be either connected to port #1 or to port #2 depending on the chosen position.

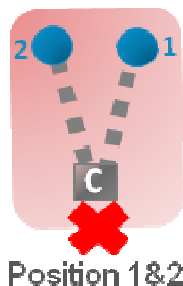
- ▶ **Position 1** connects the common port to port #1 and **Position 2** connects the common port to port #2. The 2-SWITCH™ enables you to switch between these two positions.
- ▶ The **Default position of the 2-SWITCH™** when the 2-SWITCH™ is not powered is **Position 1**.
- ▶ The 2-SWITCH™ is a **bidirectional valve**: the fluid can flow in both directions inside the 2-SWITCH™ i.e. from the common port to port #1 / port #2 **AND** from port #1 / port #2 to the common port.

#### Fluidic on/off switch



Another possibility for using the 2-SWITCH™ is to connect a plug to either port #1 or port #2. This way, one of the positions of the 2-SWITCH™ (Position 1 for port #1 or Position 2 for port #2) becomes a closed position, and the 2-SWITCH™ acts as a fluidic “on/off” switch.

- ▶ *Example:* A plug (gray square) is connected to port #2. Position 2 is thus closed. In Position 1 fluids can flow through the valve between the common port and port #1, whereas in Position 2 the fluidic path is closed between the common port and port #2.

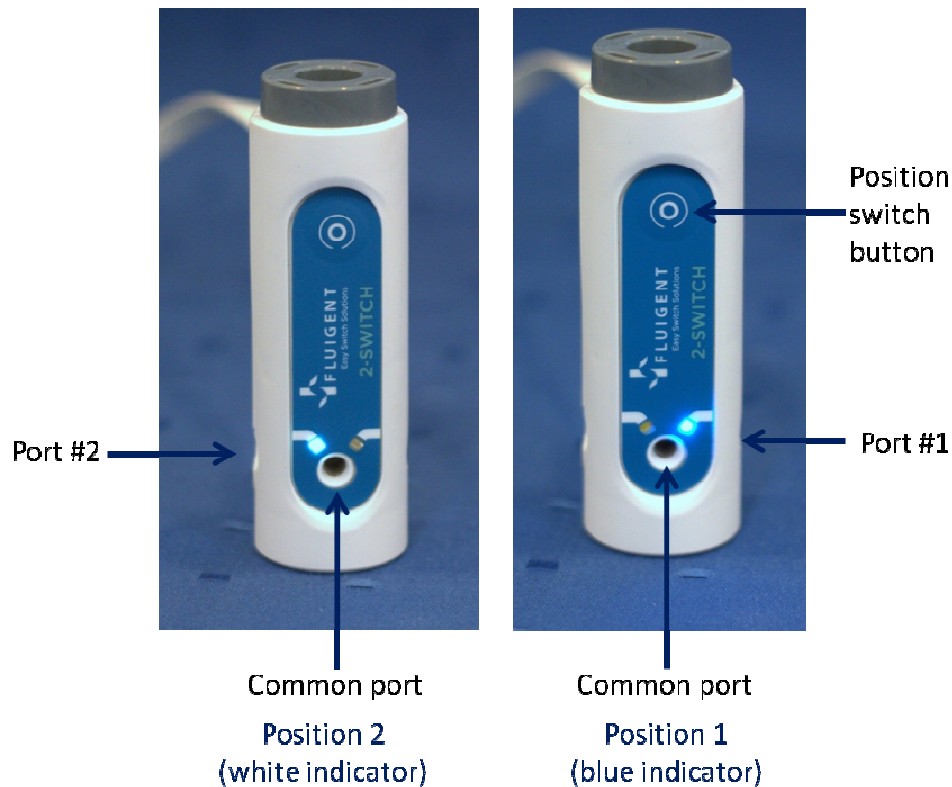


**Warning:** The fluidic “on/off” switch configuration only works if port #1 or port #2 is connected with a plug. **If the common port is plugged then no flow can circulate through the 2-SWITCH™** (bottom diagram).

FAQ: Should I fill with liquid the plugged path inside the 2-SWITCH™ before screwing the plug? (cf. §8)

## 2.2 Description

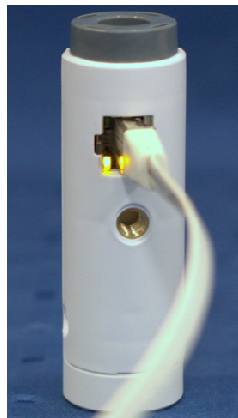
### 2.2.1 2-SWITCH™ Front



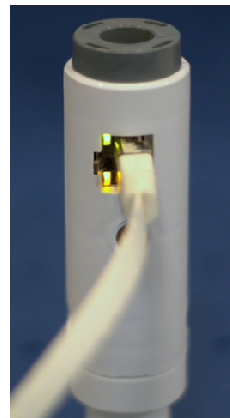
Here is a picture of the front of a 2-SWITCH™.

- ▶ The 3 fluidic ports are at the bottom part of the device. The **common port** is the **central port**, included in the device front. When looking at the front of the 2-SWITCH™, **port #1** is the **right port** and **port #2** is the **left one**.
- ▶ Two light indicators on the front show the current activated position of the 2-SWITCH™:
  - A **blue indicator** (right) for Position 1 linking the common port to port #1 (right).
  - A **white indicator** (left) for Position 2 linking the common port to port #2 (left).
- ▶ The front of the 2-SWITCH™ also includes a push button at the top to manually switch between Position 1 and Position 2.

## 2.2.2 2-SWITCH™ Back



Orange indicator  
(Power ok)



Orange + green indicator  
(Power ok – Check connection)

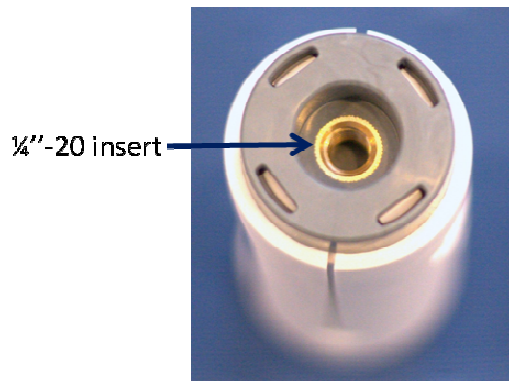
Here is a picture of the back of a 2-SWITCH™.

- ▶ Port #1 is now at the left and port #2 is at the right.
- ▶ At the centre of the back, a **UNC 1/4"-20" thread is inserted** to enable the user to fasten the 2-SWITCH™ to the provided base or to any 1/4"-20" screw-mounted device (as further explained in §2.4).
- ▶ At the top of the device we can see the RJ45 port to connect electrically the 2-SWITCH™ to the SWITCHBOARD. Two light indicators are associated with the RJ45 port.
  - The **orange indicator** lights up when the 2-SWITCH™ is powered.
  - The **green indicator** lights up if a "Check connection" identification has been requested for the 2-SWITCH™ from the SWITCHBOARD (cf. §4.2) or from the ESS™ Control software (cf. ESS™ Control User Manual).

**Warning:** Please note that **only straight-through wired RJ45 cables are compatible with the ESS™** (to connect the 2-SWITCH™ with the SWITCHBOARD). Other types of cable can damage the ESS™, and reciprocally, the cables provided with the ESS™ should not be used for other applications. FLUIGENT advises to only use the cables provided with the ESS™ for ESS™ operation.

### 2.2.3 2-SWITCH™ Top and Bottom faces

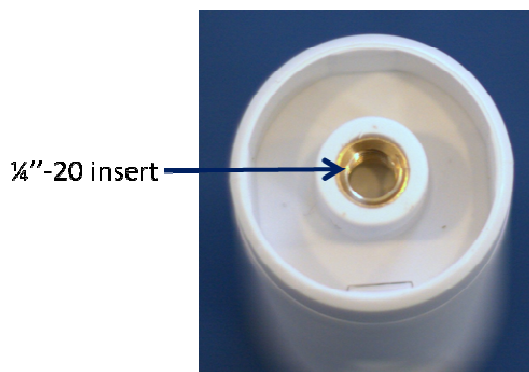
#### Top face



2-SWITCH™ top

Here is a picture of the top face of a 2-SWITCH™. A **UNC 1/4-20" thread is inserted** in the centre of the top face so that the 2-SWITCH™ can be fastened to the provided base or to any 1/4-20" screw-mounted device (as further explained in §2.4).

#### Bottom face



2-SWITCH™ bottom

Here is a picture of the bottom face of a 2-SWITCH™. A **UNC 1/4-20" thread is inserted** in the centre of the bottom face so that the 2-SWITCH™ can be fastened to the provided base or to any 1/4-20" screw-mounted device (as further explained in §2.4).

The **bottom face and the top face of the 2-SWITCH™ are complementary**: two 2-SWITCH™ can be assembled together by inserting the top face of one 2-SWITCH™ in the bottom of another 2-SWITCH™. Please see §2.4 for more details.



## 2.3 Connection

### 2.3.1 Fluidic connection

#### Description of the fittings and tubings



A 2-SWITCH™ has three (3) fluidic ports, described in §2.1 as “Common port”, “Port #1” and “Port #2”.

- ▶ The characteristics of those three (3) ports are:
  - Thread-size: 10-32.
  - Flat-bottom type (FB).
  - Compatible with tubings of 1/16'' external diameter (1/16'' OD).
- ▶ To get started, FLUIGENT provides you with:
  - Five (5) 10-32 FB fittings for 1/16'' OD tubings: including a nut (with the thread) and a ferrule.
  - Three (3) plugs: 10-32 FB plugs.
  - Two (2) meters of 1/16'' OD FEP tubing with 250µm internal diameter.  
**NB:** There is a wide variety of materials and internal diameters available with 1/16'' tubing from fittings suppliers to suit your application.

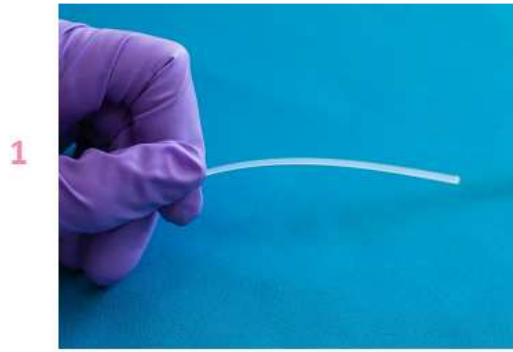
**Warning:** These fittings have been **specifically selected by FLUIGENT to ensure good 2-SWITCH™ operation**. FLUIGENT advises you to **use only these fittings** on the 2-SWITCH™.

**Warning:** Please note that **only tubings of 1/16'' external diameter should be used with the 2-SWITCH™**. FLUIGENT does not recommend the use of other tubings sizes with or without tubing sleeves, as it can damage the 2-SWITCH™ and give non-tight fluidic connection.

**NB:** When the 2-SWITCH™ is not used or stored, FLUIGENT advises you to **connect plugs to all ports** to protect the fluidic ports from dust.

**FAQ:** How can I make a junction between a 2-SWITCH™ and tubings with external diameters different from 1/16''? (cf. §8)

## Connecting a 1/16" OD tubing to the 2-SWITCH™



1. Cut the 1/16" OD tubing to the desired length, leaving a square-cut face.

2. Slide the **nut** over the tubing with the nut thread facing the tubing end being connected.

3. Slip the **ferrule** over the tubing, with the **tapered portion of the ferrule facing the nut**. **NB: the nuts and ferrules are specifically designed to work together.** FLUIGENT advises you to only associate the provided ferrules with the provided nuts and vice-versa.

4. Insert the assembly into the receiving port, and while **holding the tubing firmly** against the bottom of the port, **tighten the nut finger tight.**

5



5. To check the tightness of your connection, you may pull gently on the tubing: it must stay fitted in the ferrule and nut.

### Connecting a plug to the 2-SWITCH™



1. Simply screw the plug in port #1 or port #2 finger-tight.



Fully connected 2-SWITCH™ in fluidic on/off configuration. Position 1 is plugged and Position 2 is opened.

### 2.3.2 Electric connection



- ▶ Simply plug one connector of the RJ45 cable provided with the 2-SWITCH™ in the female RJ45 plug at the back of the 2-SWITCH™. The other connector should be connected to the SWITCHBOARD as explained in §4.2.
- ▶ If the 2-SWITCH™ is connected to a powered SWITCHBOARD, the orange indicator on the female RJ45 connector lights up.

**Warning:** Please note that **only straight-through wired RJ45 cables are compatible with the ESS™** (to connect the 2-SWITCH™ with the SWITCHBOARD). Other types of cable can damage the ESS™, and reciprocally, the cables provided with the ESS™ should not be used for other applications. FLUIGENT advises to only use the cables provided with the ESS™ for the ESS™.

## 2.4 Positioning

There are several possibilities to set the 2-SWITCH™ up. Please note that the 2-SWITCH™ device does not have any imposed mounting orientation. The 2-SWITCH™ can be used in any spatial configuration.

### Setting-up with the provided base



Vertical positioning  
with base

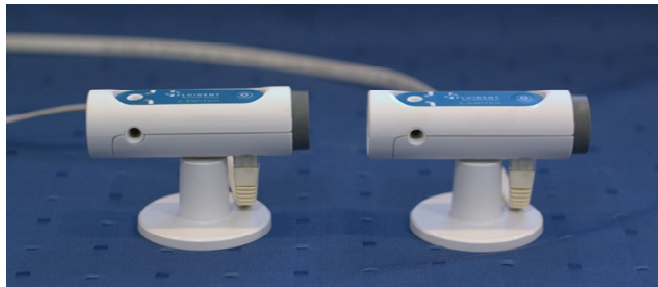


Horizontal positioning  
with base

- ▶ The base provided with the 2-SWITCH™ can be screwed to any of its ¼-20" inserts.
- ▶ Mainly, the 2-SWITCH™ can be set-up **vertically** on the base by fastening the base into the ¼-20" insert of the bottom face or **horizontally** when fastening the base into the ¼-20" insert of the back.

**NB:** It is easier to first connect the RJ45 cable on the 2-SWITCH™ before screwing the base on the back face for horizontal positioning.

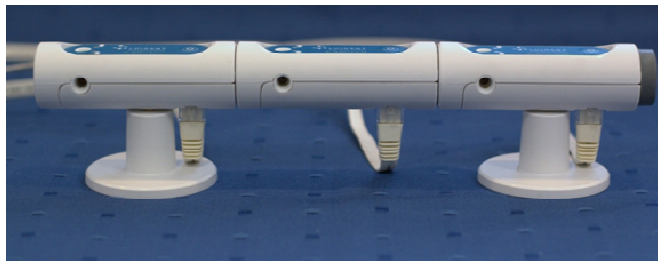
## Assembling several 2-SWITCH™ together using the complementary faces



- ▶ The top and bottom faces of the 2-SWITCH™ devices are complementary: you can assemble them together by inserting the top face of one 2-SWITCH™ into the bottom face of another 2-SWITCH™.



- ▶ As many 2-SWITCH™ as you need can be assembled together horizontally, and meanwhile can be set-up on their base fastened into their back insert.



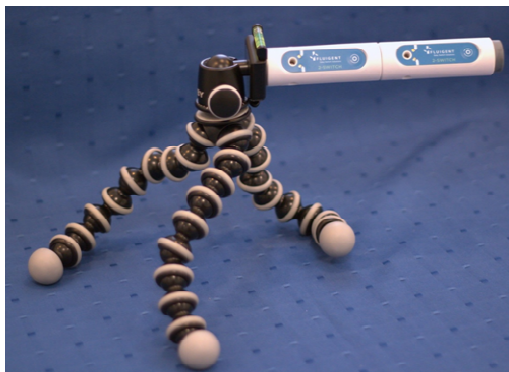
- ▶ 2-SWITCH™ devices can also be assembled vertically. FLUIGENT advises not to assemble more than two 2-SWITCH™ together vertically.



## Other possible setting-up



- ▶ The three ¼-20" inserts of the 2-SWITCH™ can be used to mount the 2-SWITCH™ on any frame or support equipped with ¼-20" pins such as a flexible rod as shown here (not provided with the 2-SWITCH™).

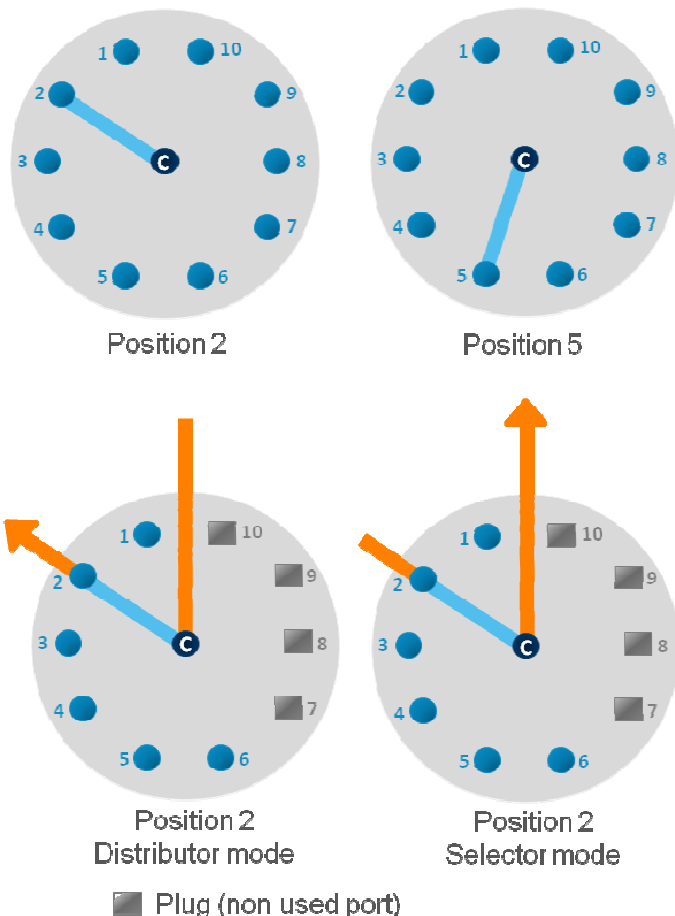


- ▶ ¼-20" thread is also the standard for all photographic equipment. You can use for example a tripod for cameras and screw a 2-SWITCH™ on it (not provided with the 2-SWITCH™).

### 3. Using an M-SWITCH™ valve

#### 3.1 Fluidic principle

The M-SWITCH™ is an 11-port / 10-position valve. This means that eleven (11) ports can be connected with tubings, and that it is possible to choose between ten (10) positions linking one of the ten (10) external ports to the central port of the valve.



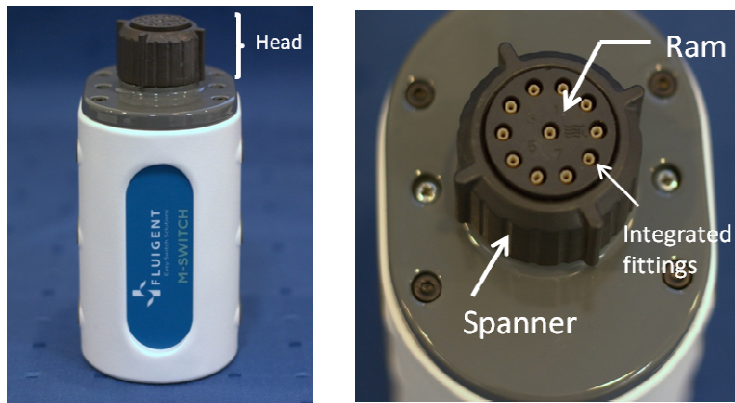
Here is the fluidic diagram of an M-SWITCH™. The dark blue port at the centre of the M-SWITCH™ is the **central port**. The light blue ports are the **external ports**. The central port can be connected in turns to each external port, from port #1 to port #10 depending on the chosen position (respectively from Position 1 to Position 10).

- ▶ The **Default position of the M-SWITCH™** when the M-SWITCH™ is not powered is the **last actuated position**.
- ▶ The M-SWITCH™ is a **bidirectional valve**, meaning that the fluid can flow inside the M-SWITCH™ in both directions:
  - **Distributor mode**: fluid flows from the central port to one external port (according to the selected position).
  - **Selector mode**: fluid flows from one of the external ports (according to the selected position) to the central port.
- The **non used ports must be closed with plugs** (gray squares on the diagram) to preserve the M-SWITCH™ good operation. In the same way as the 2-SWITCH™, it is possible to use a plugged position to close a fluidic path.



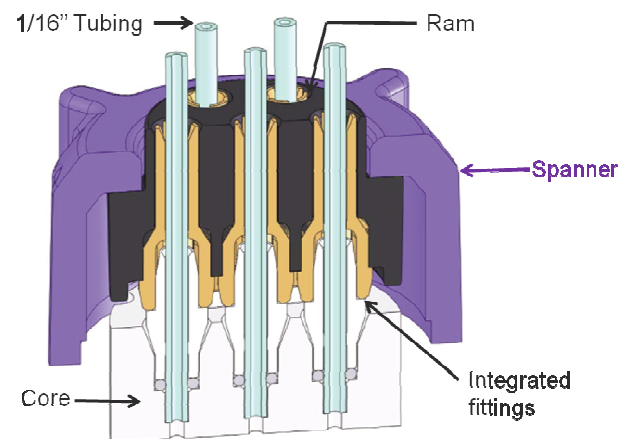
## 3.2 Description

### 3.2.1 M-SWITCH™ Front and top

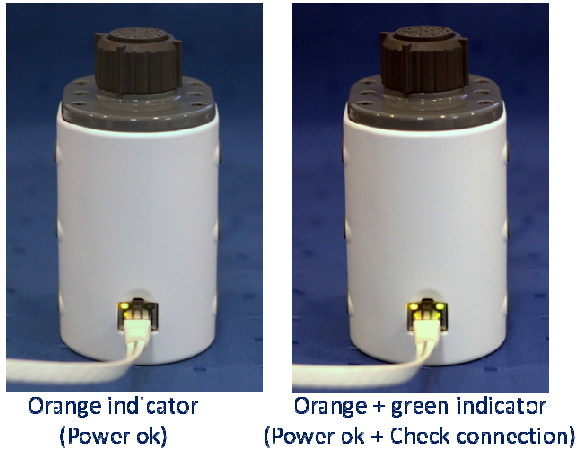


Here is a picture of the front of an M-SWITCH™.

- ▶ At the top of the picture, the fluidic head of the device can be seen. The head holds the fluidic ports.
- ▶ The head of the M-SWITCH™ is made up of the **Ram** which holds the integrated fittings and the **Spanner**, which is tightened around the Ram to clench the integrated fittings and make tight fluidic connections. The method to connect tubings to the M-SWITCH™ is detailed in §3.3.1.



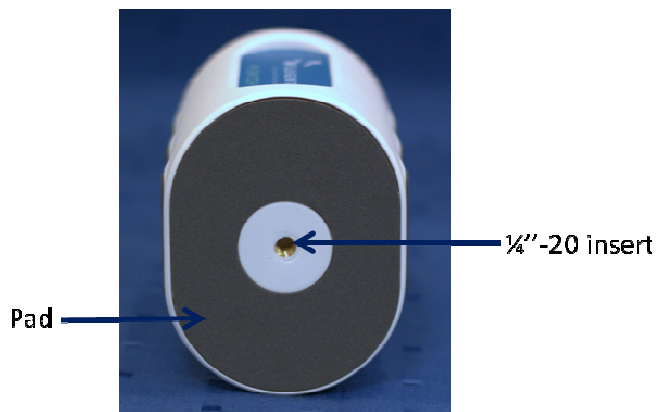
### 3.2.2 M-SWITCH™ Back



Here are pictures of the back of an M-SWITCH™.

- ▶ At the bottom of the device we can see the RJ45 port to connect electrically the M-SWITCH™ to the SWITCHBOARD. Two light indicators are associated with the RJ45 port.
  - The **orange indicator** lights up when the M-SWITCH™ is powered.
  - The **green indicator** lights up if a “Check connection” identification has been requested for the M-SWITCH™ from the SWITCHBOARD (cf. §4.2) or from the ESS™ Control software (cf. ESS™ Control User Manual).

### 3.2.3 M-SWITCH™ Bottom face



Here is a picture of the bottom face of an M-SWITCH™.

- ▶ A pad covers the bottom face to ensure a good gripping of the M-SWITCH™ to the surface where it is placed in vertical position.
- ▶ A **UNC 1/4-20" thread is inserted** in the centre of the bottom face so that the M-SWITCH™ can be fastened to any 1/4-20" screw-mounted device (as further explained in §3.4).

### 3.2.4 M-SWITCH™ Side face



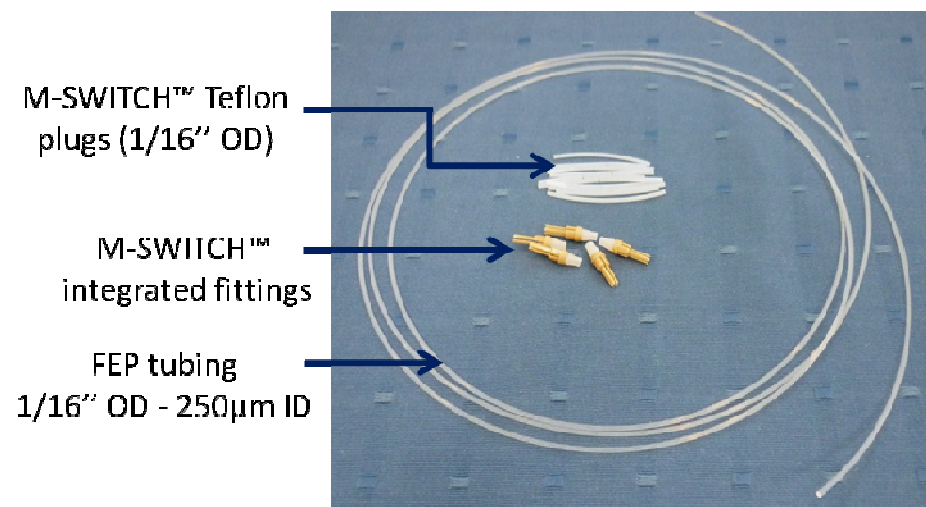
Here is a picture of the side face of an M-SWITCH™.

- ▶ Several pads are integrated on each side of the M-SWITCH™ to ensure a good gripping to the surface where it is placed in horizontal position.

### 3.3 Connection

#### 3.3.1 Fluidic connection

##### Description of the fittings and tubings



An M-SWITCH™ has eleven (11) fluidic ports, described in §3.1 as one (1) “Central port”, and ten (10) “External ports”.

- ▶ The M-SWITCH™ has **integrated fittings**, whose ferrules are visible at the surface of the Ram. These ferrules are **compatible with tubings of 1/16'' external diameter** (1/16'' OD).
- ▶ **Warning:** All ports should have a piece of 1/16'' OD tubing or a plug inserted during operation.
- ▶ To get started, FLUIGENT provides you with:
  - Five (5) replacement integrated fittings additionally to the ten already fitted in the M-SWITCH™.
  - Ten (10) Teflon plugs: 1/16'' OD Teflon rods.
  - Two (2) meters of 1/16'' OD FEP tubing with 250µm internal diameter.  
**NB:** There is a wide variety of materials and internal diameters available with 1/16'' tubing from fittings suppliers to suit your application.

**Warning:** These fittings have been **specifically selected by FLUIGENT to ensure good M-SWITCH™ operation**. FLUIGENT advises you to **use only these fittings** on the M-SWITCH™.

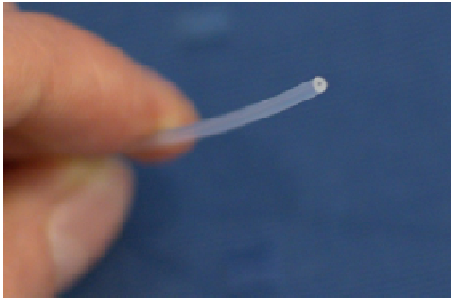
**Warning:** Please note that **only tubings of 1/16'' external diameter should be used with the M-SWITCH™**. FLUIGENT does not recommend the use of other tubings sizes with or without tubing sleeves, as it can damage the M-SWITCH™ and give non-tight fluidic connection.

**NB:** When the M-SWITCH™ is not used or stored, FLUIGENT advises you to **connect plugs to all ports** to protect the fluidic ports from dust.

FAQ: How can I make a junction between an M-SWITCH™ and tubings with external diameters different from 1/16''? (cf. §8)

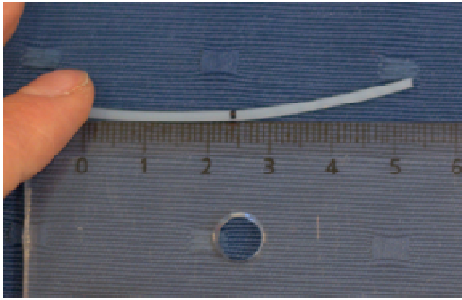
## Connecting a 1/16" OD tubing or plug to the M-SWITCH™

1



1. Cut the 1/16" OD tubing to the desired length, leaving a square-cut face. For connecting a plug, take one of the plugs provided by Fluigent.

2



2. **Mark each piece of tubing or plug 24mm from the end** (it will be an indicator to ensure that the tubing is fully seated).

3

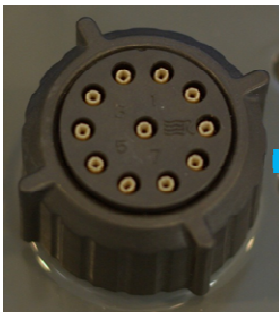


Tightened spanner

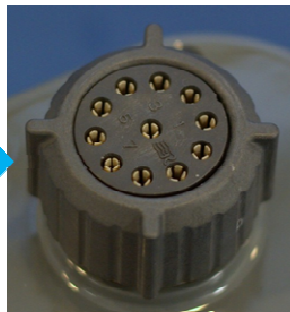


Loosened spanner

3. Loosen the Spanner adequately to release the ferrules of the integrated fittings. **NB:** it is better to do the fluidic connections with the M-SWITCH™ in vertical position (see §3.4).

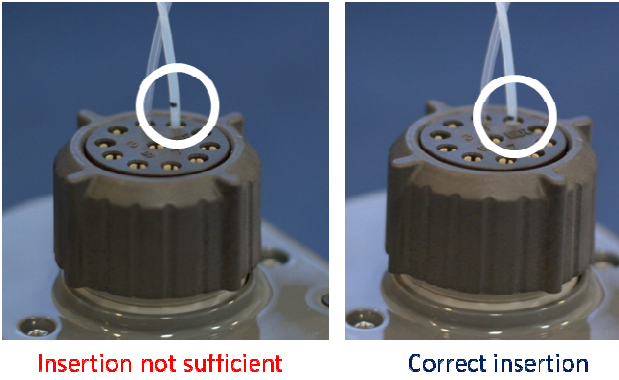


Tightened fittings

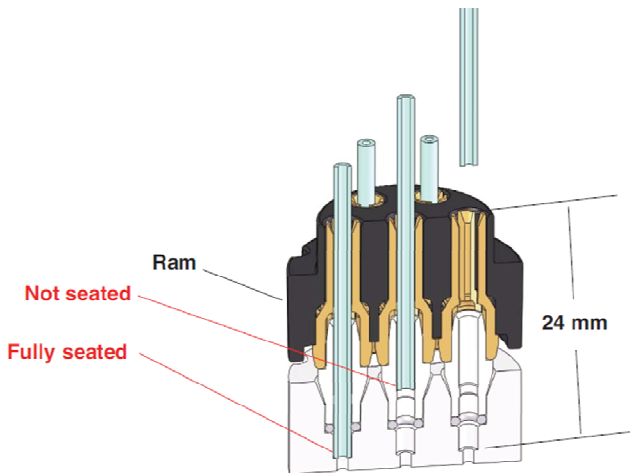


Loosened fittings

4



4. Insert the piece of tubing or plug in one port and push it all the way to the bottom of the port. The mark made at step 2 should be approximately flush with the top of the Ram when tubing is fully seated.



5



Tightened spanner

5. Once tubings or plugs have been inserted in all ports, tighten the Spanner to clench the fittings around tubings and plugs and have a tight connection.
6. To check the tightness of you connection, you may pull gently on the tubings and plugs: they must stay fitted in the integrated fittings.

### 3.3.2 Electric connection



- ▶ Simply plug one connector of the RJ45 cable provided with the M-SWITCH™ in the female RJ45 plug at the back of the M-SWITCH™. The other connector should be connected to the SWITCHBOARD as explained in §4.2.
- ▶ If the M-SWITCH™ is connected to a powered SWITCHBOARD, the orange indicator on the female RJ45 connector lights up.

**Warning:** Please note that **only straight-through wired RJ45 cables are compatible with the ESS™** (to connect the M-SWITCH™ with the SWITCHBOARD). Other types of cable can damage the ESS™, and reciprocally, the cables provided with the ESS™ should not be used for other applications. FLUIGENT advises to only use the cables provided with the ESS™ for the ESS™.

### 3.4 Positioning

There are several possibilities to set the M-SWITCH™ up. Please note that the M-SWITCH™ device does not have any imposed mounting orientation. The M-SWITCH™ can be used in any spatial configuration.

#### Vertical position



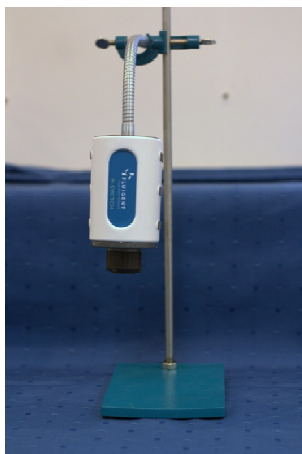
- ▶ The M-SWITCH™ can be set up vertically. As explained in §3.2.3, a pad covers the bottom face to ensure a good gripping of the M-SWITCH™ to the surface where it is placed in vertical position.

#### Horizontal position

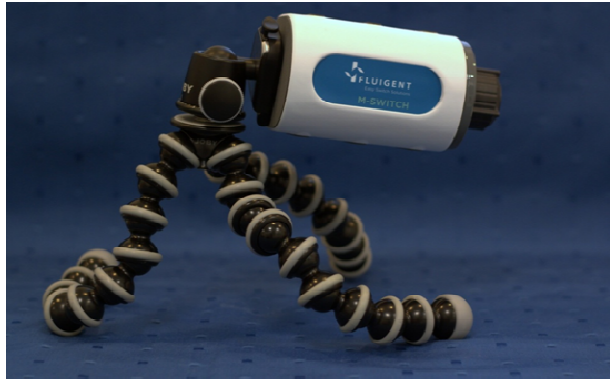


- ▶ The M-SWITCH™ can also be set up horizontally. As explained in §3.2.4, several pads are integrated on each side of the M-SWITCH™ to ensure a good gripping to the surface where it is placed in horizontal position.

#### Other possible setting-up



- ▶ The ¼-20'' insert on the bottom face of the M-SWITCH™ can be used to mount the M-SWITCH™ on any frame or support equipped with ¼-20'' pins such as a flexible rod as shown here opposite (not provided with the M-SWITCH™).



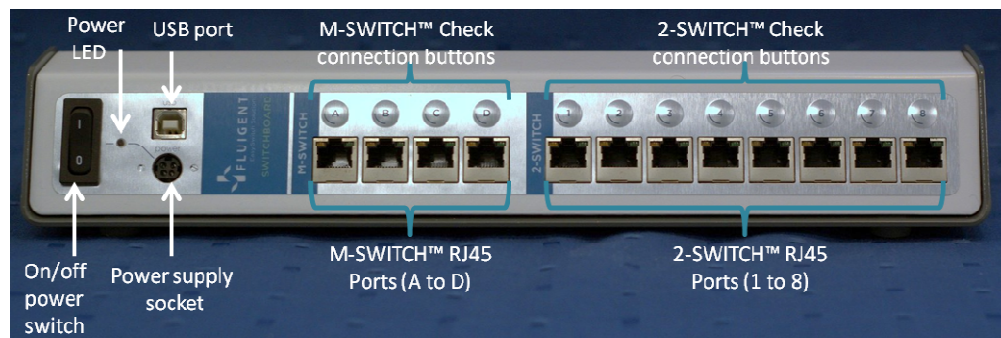
- ▶ ¼-20" thread is also the standard for all photographic equipment. You can use for example a tripod for cameras and screw an M-SWITCH™ on it (not provided with the M-SWITCH™).



## 4. Using the SWITCHBOARD

The SWITCHBOARD is absolutely necessary to operate the ESS™. This device hosts up to four (4) M-SWITCH™ and eight (8) 2-SWITCH™ and provides them power supply. The SWITCHBOARD is also the link between the connected 2-SWITCH™ and M-SWITCH™ and the controlling software ESS™ Control (cf. ESS™ Control User Manual).

### 4.1 Description



- ▶ An **on/off power switch** enables to choose to power the SWITCHBOARD (and consequently all the connected M-SWITCH™ and 2-SWITCH™) or not while leaving the power supply plugged to the SWITCHBOARD.
  - Power switch on the “O” position: power off.
  - Power switch on the “I” position: power on.
- ▶ A **green indicator (power LED)** lights up when the SWITCHBOARD is powered.
- ▶ A **USB port (type B)** links the SWITCHBOARD to a computer for software control. It is labeled “usb” on the front panel of the SWITCHBOARD.
- ▶ Below the USB port is the **power supply socket** to power the SWITCHBOARD and all connected 2-SWITCH™ and M-SWITCH™. It is labeled “power” on the front panel of the SWITCHBOARD.
- ▶ Then there are two groups of RJ45 ports:
  - A first group of four RJ45 ports to connect up to four (4) M-SWITCH™.
  - A second group of eight RJ45 ports to connect up to eight (8) 2-SWITCH™.
- ▶ Two light indicators are associated with each RJ45 ports:
  - The **orange indicator** lights up when an M-SWITCH™ or a 2-SWITCH™ is connected to the port.
  - The **green indicator** lights up if a “Check connection” identification has been requested for the device connected to the port from the corresponding **Check connection push button** on the SWITCHBOARD or from the ESS™ Control software (cf. ESS™ Control User Manual).

## 4.2 Connection

### Power supply connection

1



- ▶ The on/off power switch is on position O (off).
- ▶ Connect the plug of the power supply provided with the ESS™ into the socket on the front of the SWITCHBOARD labeled “power”. The flat side of the power supply plug must face upwards to enter the socket on the SWITCHBOARD.

2



3



- ▶ You can now actuate the on/off power switch to turn the SWITCHBOARD on and off.

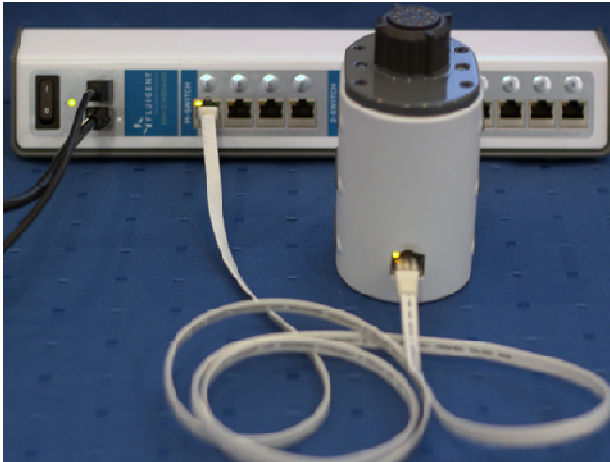
**Warning:** Please note that the power supply provided with the ESS™ has been carefully selected to meet the power requirements of the ESS™ in all configurations and to comply with all safety standards. FLUIGENT advises to only use the power supply provided with the ESS™ for the ESS™.

### USB connection



- ▶ Connect the type B plug of the USB cable provided with the ESS™ into the type B USB port on the front of the SWITCHBOARD labeled “usb”.
- ▶ Connect the other end of the USB cable (type A standard plug) to the computer where the ESS™ Control software is installed (cf. ESS™ Control User Manual).

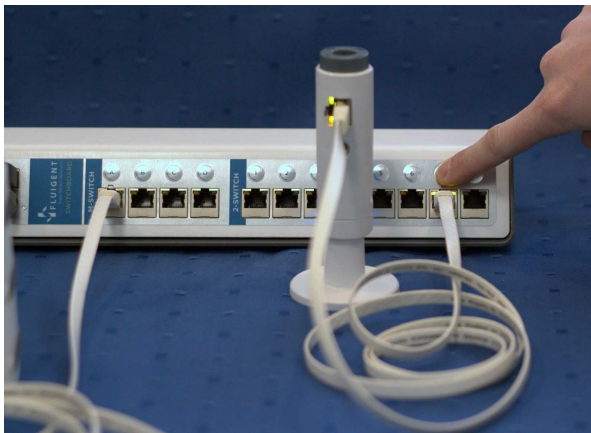
## M-SWITCH™ connection



► To connect an M-SWITCH™ to the SWITCHBOARD, plug one end of a RJ45 cable provided with the ESS™ to one of the four (4) M-SWITCH™ RJ45 ports on the SWITCHBOARD, and the other end to the RJ45 port of the M-SWITCH™ (cf. §3.3.2). When the SWITCHBOARD is powered (cf. §4.2) the orange indicators of the linked RJ45 ports on the SWITCHBOARD and the M-SWITCH™ light up, indicating a good electric connection.

► **Check connection feature:** To check the communication between the M-SWITCH™ and the SWITCHBOARD, push the button located above the used RJ45 port on the SWITCHBOARD. If the communication is good, the green indicators of the linked RJ45 ports on the SWITCHBOARD and the M-SWITCH™ light up while the push button is pressed. **This is also a tool to identify RJ45 ports that are linked on the SWITCHBOARD and an M-SWITCH™.**

## 2-SWITCH™ connection



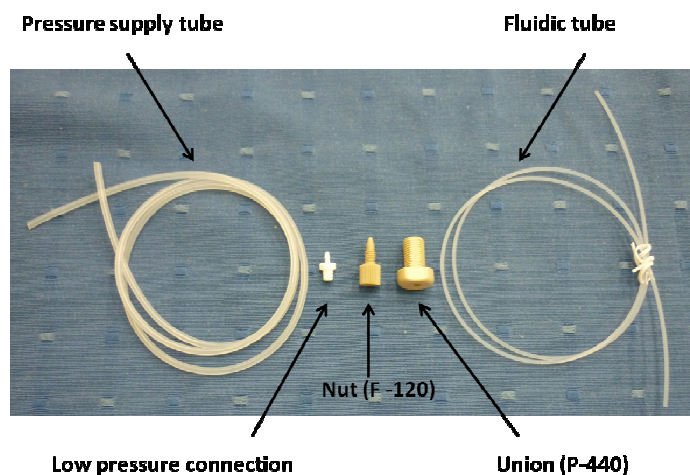
► To connect a 2-SWITCH™ to the SWITCHBOARD, plug one end of a RJ45 cable provided with the ESS™ to one of the eight (8) 2-SWITCH™ RJ45 ports on the SWITCHBOARD, and the other end to the RJ45 port of the 2-SWITCH™ (cf. §2.3.2). When the SWITCHBOARD is powered (cf. §4.2) the orange indicators of the linked RJ45 ports on the SWITCHBOARD and the 2-SWITCH™ light up, indicating a good connection.

► **Check connection feature:** To check the communication between the 2-SWITCH™ and the SWITCHBOARD, push the button located above the used RJ45 port on the SWITCHBOARD. If the communication is good, the green indicators of the linked RJ45 ports on the SWITCHBOARD and the 2-SWITCH™ light up while the push button is pressed. **This is also a tool to identify RJ45 ports that are linked on the SWITCHBOARD and a 2-SWITCH™.**

## 5. How to use the 2-SWITCH™ and M-SWITCH™ with gas

Here is an example of how you can use the 2-SWITCH™ or M-SWITCH™ with gas. We present the fittings and tubes and describe how to use it to connect in air the MFCS™-EZ to the 2-SWITCH™/M-SWITCH™.

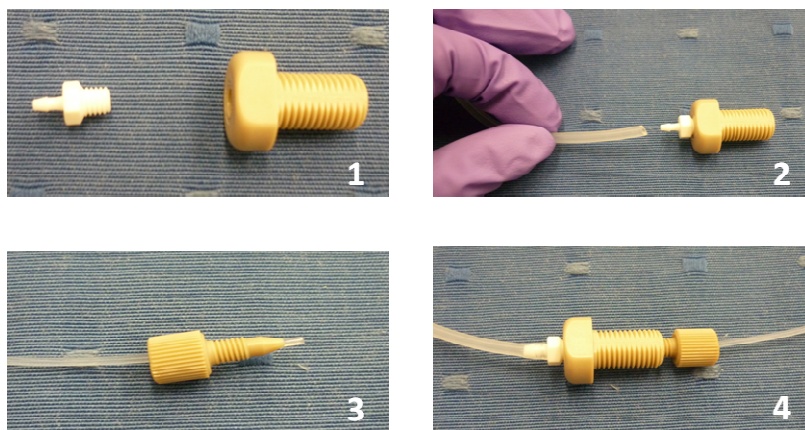
### Description of the fittings and tubes



In this example we use:

- A pressure supply tube provided with the MFCS™-EZ and its pressure connection (X210-1 from Promepla)
- A fluidic tube OD 1/16'' and its fluidic connection : a nut (F-120 from Idex Health and Science)
- A union (P-440 from Idex Health and Science) to connect fluidic tube to pressure tube

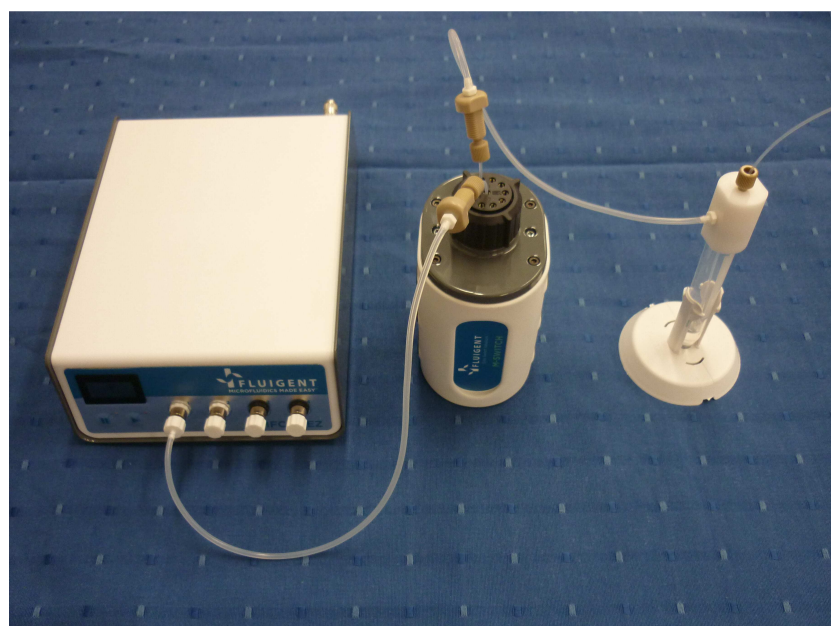
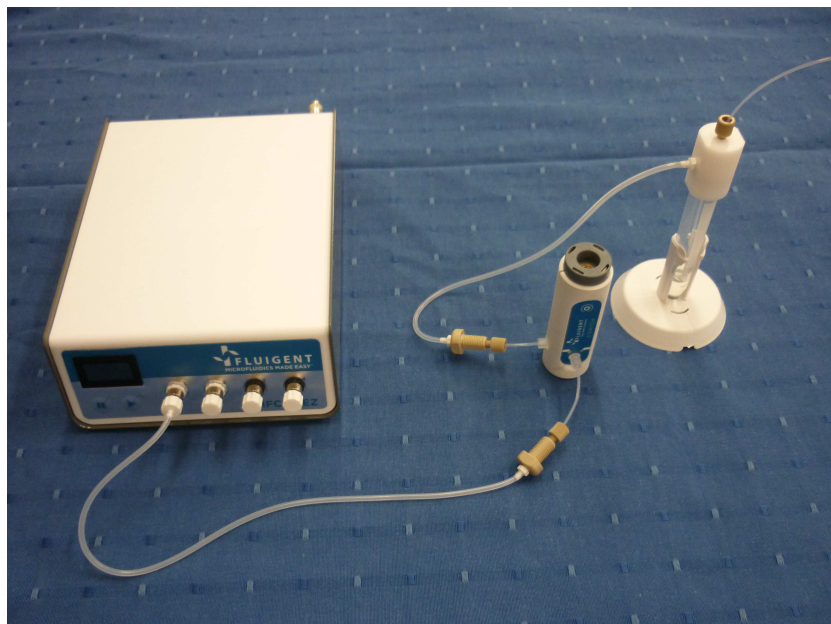
### Connecting pressure tube to fluidic tube



1. Insert the low pressure connection into the union (P-440)
2. Insert the assembly in the pressure tube
3. Slide the **nut** over the fluidic tube
4. Insert the assembly into the union (P-440)

## Connecting the reservoir to the MFCS™-EZ via the 2-SWITCH™ and the M-SWITCH™

Once the connection has been done between the fluidic tube and the pressure tube, you can use the assembly to connect the 2-SWITCH™/M-SWITCH™ to the MFCS™-EZ and the 2-SWITCH™/M-SWITCH™ to the reservoir, as described on the images below.



### Warning:

- Do not forget to wash your M-SWITCH™ and 2-SWITCH™ with distilled water after your experiment, to avoid any clogging in the fluidic parts that could damage the device and cause malfunction.
- The use of M-SWITCH™ and /or 2-SWITCH™ with gas reduces the lifetime of the valves and can lead to a premature aging.

## 6. How to start working with the ESS™

Here is a quick-setup guide to remind you of the main steps to get your ESS™ platform up and running:

1. Firstly, you may want to do the required fluidic connections on the 2-SWITCH™ and M-SWITCH™ that you want to use:
    - See §2.3.1 for the 2-SWITCH™ fluidic connection how-to.
    - See §3.3.1 for the M-SWITCH™ fluidic connection how-to.
  2. Then, position your devices as you reckon the most practical for your application.
    - See §2.4 for the different 2-SWITCH™ mounting options.
    - See §3.4 for the different M-SWITCH™ positioning options.
  3. Connect your devices RJ45 ports with the provided flat RJ45 cables.
  4. Connect your SWITCHBOARD to the power supply as explained in §4.2 and then connect your devices RJ45 cables on appropriate SWITCHBOARD RJ45 ports.
  5. If you wish to use the ESS™ Control software provided with your devices, do not forget to connect a USB cable from the SWITCHBOARD to the computer where ESS™ Control is installed (cf. §4.2 and the ESS™ Control User Manual).
- ⇒ You can now use your ESS™ platform for your application.
- ⇒ **Warning:** do not forget to rinse your M-SWITCH™ and 2-SWITCH™ with distilled water after your experiment, to avoid any clogging in the fluidic parts that could damage the device and cause malfunction.

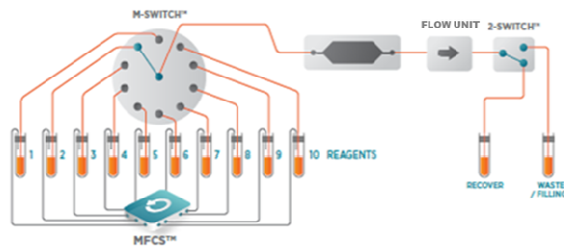
FAQ: I do not remember which device is connected to a SWITCHBOARD RJ45 port (cf. §8)

## 7. Fluidic circuits examples

### SEQUENTIAL INJECTIONS

Up to 10 liquids are selected and injected sequentially inside the 1-channel chip by the M-SWITCH™. The samples at the outlet are then sorted by the 2-SWITCH™. All steps can be automated by the ESS™ control software.

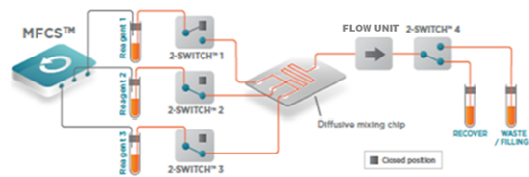
- Cell analysis
- Cell lysis and DNA extraction for PCR or NGS (Next Gen Sequencing) analysis
- Drug testing
- Calibration curve, etc



### SELECTIVE MIXING

Several samples are injected simultaneously or separately within a Y-shape chip by applying the adequate position to the 2-SWITCH™. The samples at the outlet are then sorted by the 2-SWITCH™ 4. All steps can be automated by the ESS™ control software or controlled manually .

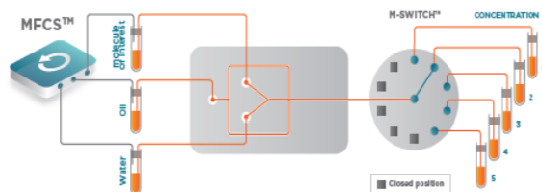
- Chemical mixing reactions
- Stoichiometry study, etc



### SAMPLES SEPARATOR AND COLLECTOR

Different proportions of the molecule of interest are injected in the chip, generating droplets of different concentrations. These droplets are then sorted at the outlet by the M-SWITCH™ depending on their concentrations. All steps can be automated by the ESS™ control software.

- Molecules synthesis in droplets with sorting by concentration



## 8. Frequently Asked Questions

### §2.1 With a fluidic “on/off” switch configuration, should I fill with liquid the plugged path inside the 2-SWITCH™ before screwing the plug?

If you are planning to use a 2-SWITCH™ as a fluidic on/off switch, you will need to plug either port #1 or port #2 on the 2-SWITCH™.

For example if you plug port #2, when in Position 2 the common port will be connected to the plug inside the 2-SWITCH™. As there is still some internal volume inside the 2-SWITCH™ (12µL per position), it is better to fill the 2-SWITCH™ in Position 2 with distilled water before connecting the plug to close the position. This way, during the experiment when the valve is actuated in Position 2 to close a path, there will be minimal liquid displacement in the Position 2 internal volume, as it will have already been filled with liquid.

### §2.3.1 How can I make a junction between a 2-SWITCH™ and tubings with external diameters different from 1/16”?

The 2-SWITCH™ device can only be connected with **1/16” OD tubing and the provided fittings**, as explained in §2.3.1. There is a wide variety of materials and internal diameters available with 1/16” tubing to suit your application. However, if you have constraints on your fluidic setup that force you to use tubings of other external diameters than 1/16”, a wide range of **adaptors and unions** are available from the fittings suppliers, to make a junction between your specific tubing and the 2-SWITCH™ tubing.

**Warning:** Please note that **sleeves cannot be used directly in the 2-SWITCH™ fluidic ports** (risks of trapping the smaller tubing and possible non-tight connection).

### §3.3.1 How can I make a junction between an M-SWITCH™ and tubings with external diameters different from 1/16”?

The M-SWITCH™ can only be connected with 1/16” OD tubing, as explained in §3.3.1. The same strategy as for the 2-SWITCH™ can be followed if it is needed to use tubing with other external diameters on the fluidic setup (read above).

**Warning:** Please note that **sleeves cannot be used directly in the M-SWITCH™ fluidic ports** (risks of trapping the smaller tubing and possible non-tight connection).


### §5 I do not remember which device is connected to a SWITCHBOARD RJ45 port.

To identify the linked SWITCHBOARD RJ45 ports and devices, you can use the **Check connection feature** by pushing the corresponding Check connection buttons on the SWITCHBOARD (one for each RJ45 port, see §4.2). This will light up the green RJ45 indicators on the associated SWITCHBOARD RJ45 port and on the RJ45 port of the device connected to it.

Other methods are applicable if using the ESS™ Control software (see the ESS™ Control User Manual).



## 9. Specifications

<b>2-SWITCH™</b>		
Pressure rating	100 psi	Please note that the ESS™ platform have been optimized to work with FLUIGENT flow control devices. <b>If you are using the ESS™ platform with other flow control systems, please check that the pressure in your fluidic system does not exceed 100 psi.</b>
Internal volume	12 µL for each position	
Wetted materials	PTFE	
Mechanical response time	20 ms	
Size	30.44 x 96.37 mm 60 x 42.5 mm (base)	Diameter x height Diameter x height
Weight	70 g 18 g (base)	
<b>M-SWITCH™</b>		
Pressure rating	100 psi	Please note that the ESS™ platform have been optimized to work with FLUIGENT flow control devices. <b>If you are using the ESS™ platform with other flow control systems, please check that the pressure in your fluidic system does not exceed 100 psi.</b>
Internal volume	11.6 µL for each position	
Wetted material	RPC-7 polymer	
Mechanical response time	280 ms port-to-port	
Size	92 x 71.2 x 138.4 mm	Length x width x height
Weight	419 g	
<b>SWITCHBOARD</b>		
Input	24V  6.67A 160W max	
Size	343 x 99.4 x 58.35 mm	Length x width x height
Weight	1228 g	



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