

# PPS5 Peristaltic Perfusion System Manual

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Printed: 16.09.2016

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# 1 Important Information and Instructions

## 1.1 Operator's Obligations

The operator is obliged to allow only persons to work on the device, who

- are familiar with the safety at work and accident prevention regulations and have been instructed how to use the device;
- are professionally qualified or have specialist knowledge and training and have received instruction in the use of the device;
- have read and understood the chapter on safety and the warning instructions in this manual and confirmed this with their signature.

It must be monitored at regular intervals that the operating personnel are working safely.

Personnel still undergoing training may only work on the device under the supervision of an experienced person.

## 1.2 Guarantee and Liability

The *General conditions of sale and delivery* of Multi Channel System MCS GmbH always apply. The operator will receive these no later than on conclusion of the contract.

Guarantee and liability claims in the event of injury or material damage are excluded when they are the result of one of the following.

- Improper use of the device.
- Improper installation, commissioning, operation or maintenance of the device.
- Operating the device when the safety and protective devices are defective and / or inoperable.
- Non-observance of the instructions in the manual with regard to transport, storage, installation, commissioning, operation or maintenance of the device.
- Unauthorized structural alterations to the device.
- Unauthorized modifications to the system settings.
- Inadequate monitoring of device components subject to wear.
- Improperly executed and unauthorized repairs.
- Unauthorized opening of the device or its components.
- Catastrophic events due to the effect of foreign bodies or Acts of God.

## 1.3 Important Safety Advice



Warning: Make sure to read the following advice prior to install or to use the device and the software. If you do not fulfill all requirements stated below, this may lead to malfunctions or breakage of connected hardware, or even fatal injuries.



Warning: Obey always the rules of local regulations and laws. Only qualified personnel should be allowed to perform laboratory work. Work according to good laboratory practice to obtain best results and to minimize risks.



Warning: Be very careful with the rotating parts of the pump! Do not clamp something in between neither long hair nor a cravat, for example.

The product has been built to the state of the art and in accordance with recognized safety engineering rules. The device may only

- be used for its **intended purpose**;
- be used when in a **perfect condition**.
- Improper use could lead to serious, even fatal injuries to the user or third parties and damage to the device itself or other material damage.



Warning: The device and the software are **not** intended for medical uses and **must not** be used on humans.

Malfunctions which could impair safety should be rectified immediately.

### Requirements for the installation and operation

- Do not use the PPS5 peristaltic pump for perfusion with flammable or aggressive (corrosive) liquids.
- Do not store flammable materials nearby during operation.
- Check in regular intervals that the PPS5 pump does not overheat.

## 2 Installation and Operation

### 2.1 Welcome to the PPS5 Peristaltic Perfusion System



The **peristaltic pump PPS5** with **software control** is developed for the perfusion of biological samples. The pumps are driven by stepper motors providing a very long lifetime without maintenance. The durable brushless motors are extremely reliable, show very constant rotation speed, are vibration free and have low electromagnetic emission. These characteristics make the PPS5-System an ideal choice for electrophysiological experiments.

The device consists of five independent peristaltic pumps, four perfusion (inlet) pump for delivering perfusion solution to the sample, and one waste (outlet) pump to remove dispensable solution. The droplet isolator chambers avoid pulsation artifacts and allow optical fluid control.

If you need more than five channels you can connect several PPS5-Systems in serial. Each pump can still be controlled separately.

The flow rate of the pumps vary between 0 to 30 ml/minute. Other flow rates are available on demand, please contact MCS.

## 2.2 Setting Up and Connecting the PPS5 Pump



**Warning:** Do not start the perfusion until you have double-checked that the perfusion lines are set up properly and that the inflow and outflow rate are matching. Spilled liquid may irreversibly damage electronic instruments.

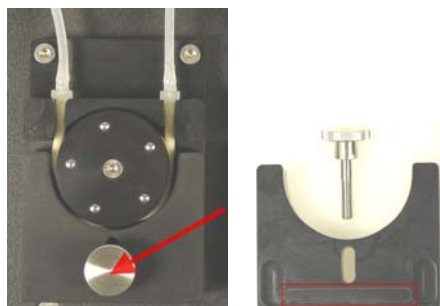
The PPS5 consists of five independent peristaltic pumps, which are rotating counterclockwise. The left one is intended for perfusion inlet, the right one for perfusion outlet. It is of course also possible to use both pumps as independent perfusion inlet pumps, and to use for example a vacuum pump for suction. This manual will focus on the intended function as inlet and outlet pumps. Each inlet pump cycle contains a droplet isolator. The outlet pump is additionally equipped with a bubble detector.

### Connecting the Tube Set

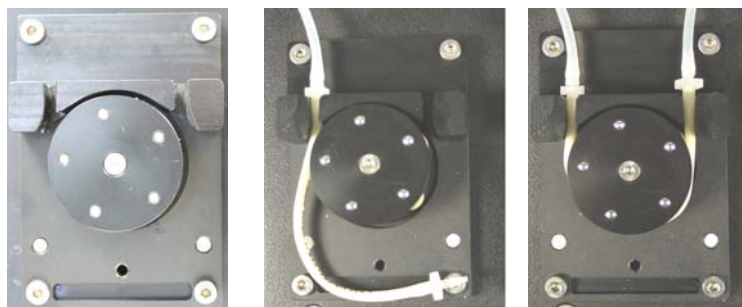
The following tubes are used:

- Identical Pharmed ® BPT (Saint-Gobain) tubes with an inner diameter of 1.65 mm and an outer diameter of 3.35 mm around the pump revolver and for the connection between outlet droplet isolator chamber and outlet pump, where the sensor of the bubble detector is located.
- A PVC tube with larger inner diameter is used for the tube to the waste bottle.
- Silicon tubing is used for all other connections.

The specified tubing must be used for the pump revolvers to ensure that the volumes set in the software are correct. Other tubing can be used for all other connections as well. Sets of ten tubes for replacement are available from Multi Channel Systems (For example: PPRT1.65-10 tubes: Pharmed ® BPT, ID: 1.65 mm, OD: 3.35 mm). Additionally you can order a replacement set for all fluidic components PPS5-Set-F. Please see section "Ordering Information" in the Appendix.



For connecting or changing the tubes, please open the screw and remove the bracket of the pump revolver. Insert the provided tube and fix it with the luer tube connectors in the denoted way. To remount the bracket, take care to insert the bar of the bracket into the corresponding socket on the pump housing. Fix the screw firmly.



If you do not need the droplet isolator, please use the circllet and connect the heads of the tube with a luer adapter.

### 2.2.1 Use of Droplet Isolators



The droplet isolators can be used to disrupt the direct liquid column from the pump to the sample. This can help to remove low frequency noise originating from the pulsation of the pump head. On the other hand, the droplet isolators make the flow speed inaccurate, and cause a continued flow even after the pump is stopped. If the flow rate is high (approximate  $> 6 - 8$  ml/min) the droplet isolators will fill up over time and might even overflow.

The suggested procedure is to start working without the droplet isolators, and use them only in case unacceptable fluctuations caused by the pump occur in the recordings which cannot be removed otherwise, for example by using a 10 Hz high pass filter.



**Warning:** The droplet isolators remove pulsation artifacts, but also cause a continuing flow even some time after the pumps are stopped. To avoid flooding, please use hose clamps to stop the flow. Do not forget to open the clamps when you restart the pump.

### Bubble Detector

The bubble detector can be used as an alarm system to prevent flooding of the recording equipment.

The bubble detector connected to the outlet detects the amount of bubbles in the outlet tube. A low number of bubbles can indicate that the perfusion outlet cycle is not working properly, so the bubble detector can be used as an alarm system to prevent flooding of the recording equipment.

The bubble detector connected to the waste pump tube detects insufficient flow in the waste tube. This can be an indicator for a problem with the perfusion. A light barrier detects the changes of fluid to air in the outlet tube and measures whether this event takes place at least once every ten seconds or not. More than one bubble per 10 seconds is considered okay, less is considered as an indicator that the fluid flow in the outlet is too low. The LED is constantly on without tube, when the fluid flow is not correct it flashes fast, with correct flow the LED flashes slowly. When the bubble detector detects too low fluid flow in the outlet tube, the inlet perfusion pumps will be stopped automatically. The waste pump runs continuously to prevent overflow.



The sensor of the bubble detector is on the left side of the LED, the short Pharmed ® BPT tube has to be guided through the bubble detector as shown on the picture. The LED indicates the fluid flow: The LED is constantly on without tube, when the fluid flow is not correct it flashes fast, with correct flow the LED flashes slow. Please pay attention to the LED.



### Rear Panel



1. Connect the PPS5 pump with the provided power supply cable to the power supply.
2. Connect the PPS5 pump with an USB cable (type A – B) to an USB 2.0 port.
3. Use the “I/O” switch to switch the PPS5 on and off.

It is possible to connect several PPS5 devices via USB hub to one computer to be controlled by the same software.

### 2.3 Software

The PPS5 perfusion system can be controlled via USB connection by the provided software PPS5 from Multi Channel Systems MCS GmbH.

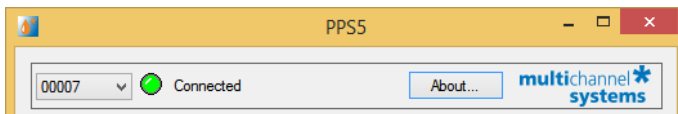
#### Operation of the Perfusion Peristaltic Pump with PPS5 Software

PPS5 software is running on Microsoft Windows ® systems Windows 10, 8.1, 7 or XP.

#### Main Window

##### Connection

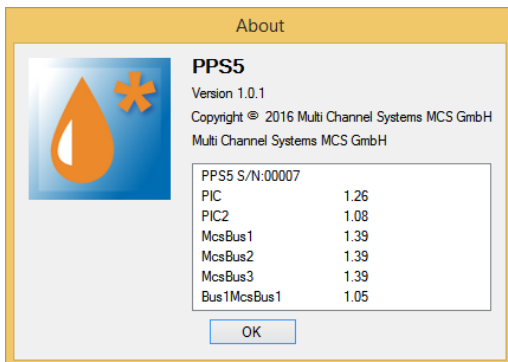
If the PPS5 is setup and connected correctly, the LED symbol is green.



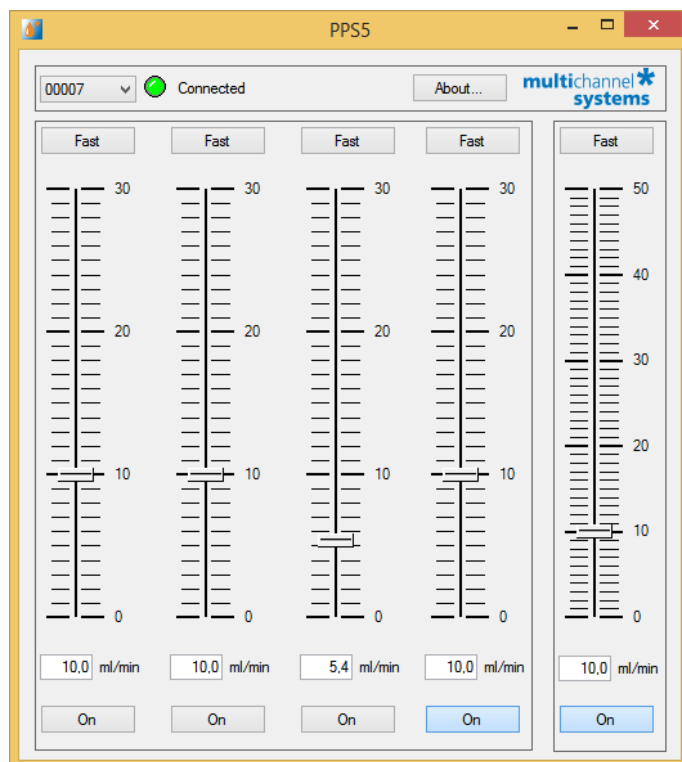
When using more than one PPS5-System, connected via USB cable, please select the serial number of the devices from the drop down menu. The pumps can be operated independently from each other.

##### About

Click the "About" button to see the software version. Free software updates will be available on the MCS web site. Please check <http://www.multichannelsystems.com/downloads/software>.



## Main Window of PPS5 Software



The intended use for the PPS5-System is the perfusion of a biological sample with different compounds and the aspiration of the waste solution. To avoid flooding of the amplifier, the flow rate of the outlet must always be higher than the flow rate of the inlet. Please choose the relation between the velocity of the waste and the perfusion pump via slider.

With the sliders, the speed of the left four **Perfusion** (inlet tube) pump, and the right **Waste** (outlet tube) pump can be controlled. The unit is milliliter per minute, the maximum is 30 ml/min for the inlet and 50 ml/min for the drain, if no relation between both parameters is selected. Alternatively, type the desired value into the text box below the slider. The resolution is 100  $\mu$ l/min. Click the button "On" to start the pump of your choice and the button above will turn to green. Click "Off" to stop the pump and the button above turns to grey. It is possible to change the velocity via slider or by writing into the window while the pump is running. Clicking the button "Fast" sets the pump speed to maximum as long as the button is pressed. The yellow color indicates the "Fast" mode. This feature can be used for rinsing the tubes, for example.

## 2.4 Cleaning and Maintenance

To clean the peristaltic pump system after use, flush all tubes with distilled water for a few minutes and then quickly with 70 % Ethanol (EtOH). Suck the tubes dry. Disconnect all tube connectors and unscrew the caps of the compound or waste bottle. Empty the bottles and wash them out. Take care not to mistake the tubing when reconnecting.



**Warning:** Make sure no liquid is sucked into the pump revolvers! This can lead to irreversible damage. Empty the bottle after each experiment. Avoid remaining liquid in the bottle and tubing, this can result in contamination.

## 3 Appendix

### 3.1 Technical Specifications

<b>General Information</b>	
Operating temperature	10 °C to 40 °C
Storage temperature	10 °C to 50 °C
Dimensions (H x W x D)	260 x 385 x 180 mm
Weight	7.8 kg
Number of perfusion pump inlets	4
Number of perfusion pump outlets	1
Maximum perfusion rate inlet	30 ml per minute
Maximum perfusion rate outlet	50 ml per minute
Bubble detector	optical fluid flow control
<b>Power Supply</b>	
Type	FSP 150-AAA N1
Voltage range @ frequency	100 to 240 VAC @ 47 to 63 Hz
Power consumption	10 W
<b>Software Control</b>	
Connection to the computer	USB 2.0 High Speed (cable type A – B)
Operating system	Microsoft Windows ® 10, 8, 7, Vista or XP with NTFS, English and German version

## 3.2 Ordering Information

### 3.2.1 Scope of Delivery

- 1 PPS5 main device
- 1 PPS5 CD (Software and Manual)
- 1 PPS5 power *supply* (FSP 150-AAA N1)
- 1 power cord, country-specific
- 1 USB 2.0 cable (A – B)
- Replacement tubes for PPS5
- Bottles for reservoir and waste

### 3.2.2 Replacement

#### Peristaltic Pump PPS5 Replacement Tube Set

**PPRT1.65-10:** Unit of 10 peristaltic pump tubes: Pharmed ® BPT (Saint-Gobain), (ID = 1.65 mm, OD = 3.35 mm, L = 90 mm)

**PPRT22.9-10:** Unit of 10 peristaltic pump tubes: Pharmed ® BPT (Saint-Gobain), (ID = 22.9 mm, OD = 3.99 mm, L = 90 mm)

## 3.3 Contact Information

#### Local retailer

Please see the list of official MCS distributors on the MCS web site.

#### User forum

The Multi Channel Systems MCS GmbH User Forum provides the opportunity for you to exchange your experience or thoughts with other users worldwide.

#### Mailing list

If you have subscribed to the Mailing List, you will be automatically informed about new software releases, upcoming events, and other news on the product line. You can subscribe to the list on the contact form of the MCS web site.

[www.multichannelsystems.com](http://www.multichannelsystems.com)