multichannel systems
An Affiliate of Harvard Bioscience, Inc.

Peristaltic Perfusion System PPS5

USER MANUAL

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Imprint

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GENERAL INFORMATION

Important Safety Advice

Warning: Make sure to read the following advice prior to installation or use of 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: Always obey 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: The device and the software are not intended for medical uses and must not be used on humans.
MCS assumes no responsibility in any case of contravention.

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.

Malfunctions which could impair safety should be rectified immediately.

Grounding

This product is grounded through the grounding conductor on the power cord. To avoid electric shock, the grounding conductor must be connected to earth.

Orient the Equipment Properly

Do not orient the equipment so that it is difficult to manage the disconnection device.

High Voltage

Electrical cords must be properly laid and installed. The length and quality of the cords must be in accordance with local provisions.

Only qualified technicians may work on the electrical system. It is essential that the accident prevention regulations and those of the employers' liability associations are observed.

Each time before starting up, make sure that the power supply agrees with the specifications of the product. Check the power cord for damage each time the site is changed. Damaged power cords should be replaced immediately and may never be reused. Check the leads for damage.

Damaged leads should be replaced immediately and may never be reused. Do not try to insert anything sharp or metallic into the vents or the case. Liquids may cause short circuits or other damage. Always keep the device and the power cords dry. Do not handle it with wet hands.

Requirements for the Installation

Make sure that the device is not exposed to direct sunlight. Do not place anything on top of the device, and do not place it on top of another heat producing device, so that the air can circulate freely.

Explanation of the Symbols used

 Caution / Warning

 DC, direct current

Guarantee and Liability

The general conditions of sale and delivery of Multi Channel Systems MCS GmbH always apply. They can be found online at https://www.multichannelsystems.com/sites/multichannelsystems.com/files/documents/Terms%20and%20Conditions.pdf

Multi Channel Systems MCS GmbH makes no guarantee as to the accuracy of any and all tests and data generated by the use of the device or the software. It is up to the user to use good laboratory practice to establish the validity of his / her findings.

Guarantee and liability claim 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.

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.

Terms of Use for PPS5

You are free to use the software for its intended purpose. You agree that you will not decompile, reverse engineer, or otherwise attempt to discover the source code of the software.

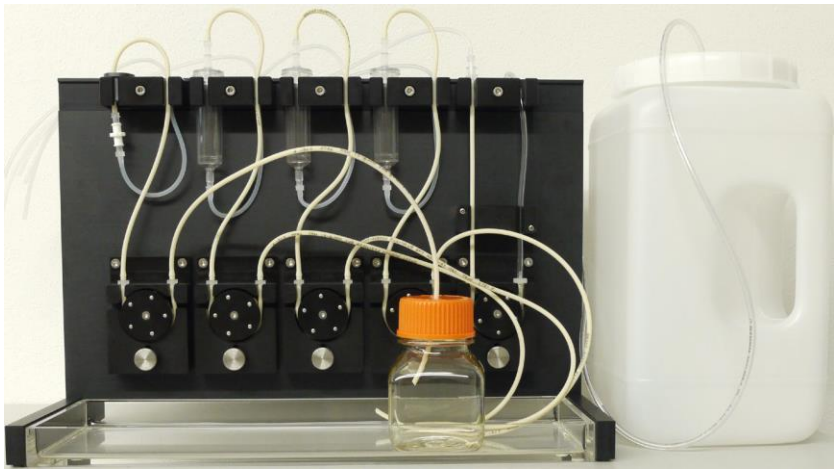
Limitation of Liability

Multi Channel Systems MCS GmbH makes no guarantee as to the accuracy of any and all tests and data generated by the use the software. It is up to the user to use good laboratory practice to establish the validity of his findings.

To the maximum extent permitted by applicable law, in no event shall Multi Channel Systems MCS GmbH or its suppliers be liable for any special, incidental, indirect, or consequential damages whatsoever (including, without limitation, injuries, damages for data loss, loss of business profits, business interruption, loss of business information, or any other pecuniary loss) arising out of the use of or inability to use the program or the provision of or failure to provide Support Services, even if Multi Channel Systems MCS GmbH has been advised of the possibility of such damages.

INSTALLATION AND OPERATION

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.

Synchronize each pump individual with peripheral devices via TTL signals.

If you need more than five channels you can connect several PPS5-Systems. Each pump can still be controlled separately. The flow rate of the pumps vary between 0 to 30 ml/minute for the four inlet pumps and 0 to 50 ml / minute for the outlet pump. Other flow rates are available on demand, please contact MCS.

Additional analog and digital inputs allow to operate the PPS5 pump via external inputs, for example from a stimulus generator STG.

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. The four pumps on the left side are intended for perfusion inlet, which are rotating clockwise. The right one is for perfusion outlet and is rotating counterclockwise. Each inlet pump cycle contains a droplet isolator. The outlet pump is additionally equipped with a bubble detector.

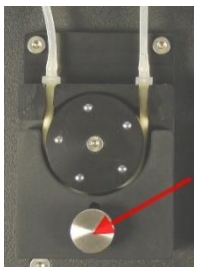
Connecting the Tube Set

The following tubes are used:

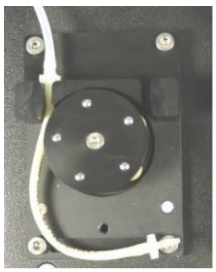
• A PVC tube with an inner diameter of 2.0 mm and an outer diameter of 4.0 mm is used for the tube to the waste bottle.

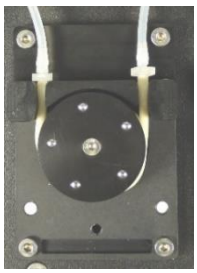
• Pharmed BPT and Silicone tubing is used for all other connections.

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 and PPRT2.29-10 tubes, ID: 2.29 mm, OD: 3.99 mm). Please see section “Replacement” 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.





Use with Drip Chamber

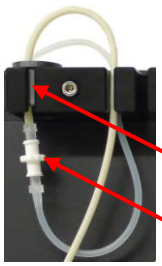

Drip chamber

The drip chamber (droplet isolator) 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.

Use without Drip Chamber


Luer adapter and circlet

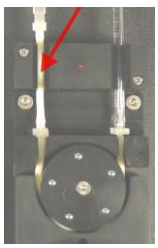
If you do not need the drip chamber, please use the circlet and connect the heads of the tube with a luer adapter.

Bubble Detector

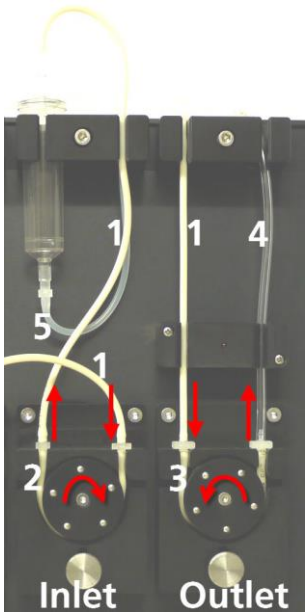
The bubble detector can be used as an alarm system to prevent flooding of the recording equipment. The bubble detector connected to the outlet detects the amount of bubbles in the outlet tube. A low number of bubbles can indicate that the perfusion outlet cycle is not working properly, so the bubble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

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.



Replacement of the Tubes



1 Pharmed BPT: ID 1.65 OD 3.35
2 Pharmed BPT: ID 1.65 OD 3.35 (Replacement: PPRT 1.65 – 10)
3 Pharmed BPT: ID 2.29 OD 3.99 (Replacement: PPRT 2.29 – 10)
4 PVC: ID 2.0 OD 4.0
5 Silicone: ID 1.0 OD 3.0

Rear Panel

1. Connect the provided power supply to the “24 VDC” connector.
2. Connect the PPS5 pump with an USB cable (type A – B) to an USB 2.0 port of the computer.
3. Optional: Connect the BNC input connectors “P1” to “P4” (inlet) and “W” (outlet) to receive TTL pulses from peripheral devices for synchronization.
4. Use the “Power” switch (I/O) 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.

SOFTWARE PPS5

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

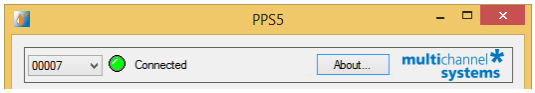
Operation of the Perfusion Peristaltic Pump with PPS5 Software

PPS5 software is running on Microsoft Windows ® systems Windows 11, 10, and 8.1.

Main Window

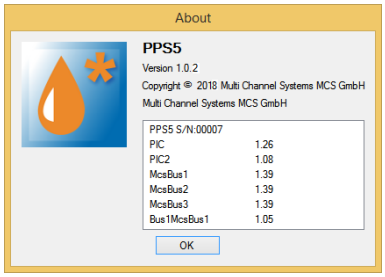
Connection

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



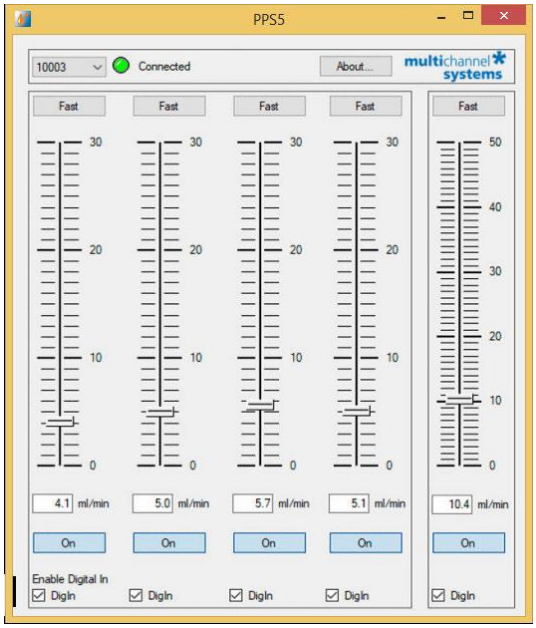
When using more than one PPS5-System, connected via USB cable, please select the serial number of the devices from the drop down menu. The pumps can be operated independently from each other.

About



Click the “About” button to see the software version. Free software updates will be available on the MCS web site. Please check https://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 overspill solution to the waste. To avoid flooding of the amplifier, the flow rate of the outlet must always be higher than the flow rate of the inlet.

With the sliders, the speed of the left four **Perfusion** (inlet tube) pumps 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. Alternatively, type the desired value into the text box below the slider. The resolution is 100 µl/min. Click the button "**On**" to start the pump of your choice. Click the "**On**" button again to stop the pump. 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 feature "**Fast**" mode can be used for rinsing the tubes, for example.

Enable the digital inputs via "**Enable Digital In**" check boxes to allow TTL signals from peripheral devices for synchronization. Please switch the respective pump to "On", which should receive the digital pulse and choose a velocity, otherwise the TTL signal has no effect.

All five TTL inputs are galvanically separated and each of them has its own ground.

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.

APPENDIX

Technical Specifications

General Information	
Operating temperature	10 °C to 40 °C
Storage temperature	10 °C to 50 °C
Dimensions (H x W x D)	260 mm x 385 mm 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
Number of digital input BNC connectors	5
Configuration of the BNC input connectors	Outer ring: Ground Center: TTL signals from min. + 3 V to max. + 5 V
Power Supply	
Type	FSP 150-AAA N1
Voltage range @ frequency	100 to 240 VAC @ 47 to 63 Hz
Power consumption	10 W
Software Control	
Connection to the computer	USB 2.0 High Speed (cable type A – B)
Operating system	Microsoft Windows ® 11, 10 or 8, English and German version
PPS5	Version 1.0.2

ORDERING INFORMATION

Scope of Delivery

- 1 PPS5 main device
- 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
- 1 storage tray for the bottles
- 10 m silicone tube, ID 1.0 mm, OD 3.0 mm
- 5 tube fitting luer slip male // barb 1/16”
- 5 hose clamp
- 4 circlets
- 4 fitting luer-lock female to luer-lock female (luer adapter)

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)

PPRT2.29-10: Unit of 10 peristaltic pump tubes: Pharmed ® BPT (Saint–Gobain), (ID = 2.29 mm, OD = 3.99 mm, L = 90 mm)

Drip Chamber: Unit of 5 drip chambers (891308)

PPS5-Set-F: Set of fluidic devices for the Peristaltic Pump PPS5

- 4 supply tubes (Pharmed BPT, L=400 mm)
- 4 interconnection tubes (Pharmed BPT, L=250 mm)
- 1 sample tube for self-made (Silicone, L=10 000 mm)
- 1 detector tube (Pharmed BPT, L=140 mm)
- 1 waste tube (PVC, L=1000 mm)
- 5 fitting luer-slip male to barb 1/16"
- 4 fitting luer-lock female to luer-lock female (luer adapter)

Number of Articles for Multi Channel Systems MCS GmbH:

- PPRT1.65-10 890769
- PPRT2.29-10 890770
- Drip Chamber 891308
- PPS5-Set-F 891342

CONTACT INFORMATION

Local retailer

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

Mailing list

If you have subscribed to the Newsletter, 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.

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