

# Sensapex uMc-PPC automated pressure control products

## Operating manual

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## Disclaimer

Best efforts have been made to ensure that information contained in this manual is accurate. Latest version of this manual is available at: [www.sensapex.com/support](http://www.sensapex.com/support). We accept no responsibility for any errors or omissions, and we reserve the right to modify specifications, design, characteristics and products at any time without obligation.

## The Sensapex products are designed to be used for research applications.

- Product is not a medical device. It should be used only for non-human research.
- Any misuse will be the sole responsibility of the user/owner. Sensapex assumes no implied or inferred liability for direct or consequential damages from this product.

## Safety warnings

- Use only the power supplier and cables provided by Sensapex. Always use grounded mains supply.
- Do not expose the product to liquid spills or moisture to prevent fire or shock hazard.
- This instrument contains no user-serviceable parts or components. Do not try to open or attempt to repair the instrument.

## Precautions

Failure to comply with any of the following precautions may damage the product.

- Products are sensitive research instruments. Handle and operate them according to instructions in this manual and with care to avoid damage.
- Do not operate if there is any obvious damage to the product.
- Do not operate near flammable materials or expose them to corrosive materials. Use of any hazardous materials with the product is not recommended and is the sole responsibility of the user.
- Retain the original packaging for possible future transport of the product.
- To clean the products, gently wipe them with a clean and dry or slightly water dampened cloth. Do not submerge in water or other cleaners or solvents.

## Environmental ratings

- Products are designed for typical laboratory conditions.
- The products should be operated only in the temperature range of 15 °C to 40 °C. The maximum allowed relative humidity is 80 % at 5 °C to 31 °C and decreasing linearly from 80 % to 50 % between 31 °C and 40 °C.
- Mains supply-voltage must not fluctuate more than  $\pm 10\%$ . The presence of typical transients on the mains supply, e.g. those of installation or overvoltage, are category II.
- Pollution degree II

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## 1 General

### 1.1 Introduction

Sensapex uMc-PPC automated pressure control products provide integrated and compact high-precision pressure control solution for cell research and other applications where precision and ease of use are important. Different product variants are available to cover commonly required pressure ranges and channel counts.

The uMc pressure control products can be operated by Sensapex uMp-TSC2 touch screen controller or by computer using Sensapex open-source software development kit (SDK). Productized automation features, such as automated pipette cleaning, are available at the uMp-TSC2 when using the uMc products together with uMp micromanipulators.



Figure 1. Left, uMc pressure control products. Right, uMp-TSC2 touch screen controller.

## 1.2 Warranty

Sensapex products have two (2) years' limited warranty. The limited warranty terms that supersede any other terms are defined in the Sensapex general sales terms available at our website:

- USA: <https://www.sensapex.com/sensapex-terms-and-conditions-us/>
- Rest of the world: <https://www.sensapex.com/sensapex-terms-and-conditions/>

## 1.3 Arrival inspection

**Please store the original packaging in case it ever becomes necessary to ship products again. Improper packaging is a form of abuse and will void the warranty for possible shipping damage.**

- Contact Sensapex or your local representative immediately if outside of the package is damaged or if you otherwise have any concerns regarding possible shipping damage.
- Carefully unpack all items and verify that you have received all the products ordered.
- Contact Sensapex or your local representative if any of the ordered parts are missing.

## 1.4 No self-repairs allowed

Do not dismantle, loosen, or remove any of the screws or parts that are not indicated in this manual to be operated by the customer during normal use. Doing so will void the warranty and may damage products.

# 2 Installation

**Handle the products with care. Do not drop the products or otherwise cause impacts, which may cause permanent damage to the product requiring factory service.**

**Please see also the installation video of the uMc-PPC pressure controller that is available at Sensapex YouTube channel: <https://www.youtube.com/watch?v=8H-nMAXnG0c>**

## 2.1 Installing uMc-PRF-VAC

Sensapex uMc-PRF-VAC (Figure 2) generates vacuum and high-pressure air supplies according to the uMc-PPC pressure controller requirements from a standard compressed air source.

**Ensure that air supply to the uMc-PRF-VAC is free from oil, water and excessive particles.**

To install uMc-PRF-VAC (Figure 2):

1. Close the input valve by turning its handle perpendicular to the *PHIGH in* port.
2. Connect min. 500 kPa (5 bar) pressure supply to *PHIGH in* port using 6 mm OD hard tubing. First, unscrew the nut from the *PHIGH in* port and slide it to the tubing.
3. Push tubing all the way to the *PHIGH in* port and secure it in place by tightening the nut to the port. Finger tight is sufficient - do not use tools.
4. Connect 6 mm tubing to the *PVAC out* port following the similar procedure as for the *PHIGH in* port.
5. Connect 6 mm tubing to the *PHIGH out* port following the similar procedure as for the *PHIGH in* port.
6. Connect the provided power supplier to the *PWR* connector.

7. Open the input valve of the *PHIGH in* by turning its handle parallel to the port after the uMc-PPC is connected to the *PVAC out* and *PHIGH out* ports (or tubing connected to output ports are otherwise pinched close to prevent leaking).
8. Switch ON the power from the PWR switch. It is normal that some sound is produced intermittently while the uMc-PRF-VAC is generating vacuum pressure.
9. In case continuous sound occurs, close the *PHIGH in* valve and re-install tubing according to the instructions.
10. It is possible to re-adjust the *PVAC out* and *PHIGH out* pressure output if needed (see chapter 8).



Figure 2. uMc-PRF-VAC

## 2.2 Installing uMc-PPC

***In case uMc-PRF-VAC is not used, ensure that the high-pressure and vacuum air supplies meet the specifications of the uMc-PPC products. Air supply must be clean from oil, water and particles to avoid malfunctioning or damaging the products.***

***Automated pressure control products are designed for pressure control applications with zero or very small air flows. Proper pressure regulation requires that the output ports are connected to closed pressure lines or lines with a very small leak.***

To install and validate uMc-PPC functionality (Figure 3):

1. Connect the 6 mm OD tubing from uMc-PRF-VAC *PHIGH out* (or from other pressure source) to the uMc-PPC *Phigh* input port similarly as for the uMc-PRF-VAC.
2. Connect the 6 mm OD tubing from uMc-PRF-VAC *PVAC out* (or from other pressure source) to the uMc-PPC *Pvac* input port similarly as for the uMc-PRF-VAC.
3. Turn on air supply to the uMc-PRF-VAC and power it ON as instructed in 2.1.



Figure 3. Top, uMc-PPC-2 from the front and back. Below, uMc-PPC-8 from the back.

4. Connect short 1/32-inch soft tubing to the *Pout* ports. Pinch them closed or tie into a knot for no leak.
5. Confirm that uMc-PPC is powered OFF.
6. To control with uMp-TSC2 or computer, confirm that *DAQ mode on/off* button is OFF (=not pressed).
7. Connect the provided power supplier to the uMc-PPC.
8. Connect ethernet cable from uMc-PPC to uMp-TSC2 or computer (directly or via network switch).
9. Power ON the uMc-PPC. It becomes available for control by the uMp-TSC2 or computer. This can be verified by live *Pout* pressure values that uMc-PPC provides.

To connect to the other experimental instruments:

1. Connect the uMc-PPC *Pout* port to the application specific pipette holder, injector or other instrumentation using the 1/32-inch soft tubing.
2. User/ATM ports can be left unconnected for the ATM reference pressure, used for manual pressure application (e.g. suction with mouthpiece) or chained to another uMc-PPC *Pout* port to allow quickly multiplexing between two automatically regulated pressure values.

### 3 uMc-PPC pressure controller operation

#### 3.1 uMp-TSC2 touch screen interface

The uMp-TSC2 provides real-time pressure information and quick buttons for the most used features. This manual includes instructions for the uMp-TSC2 that are specific for the uMc-PPC products. Please review uMp micromanipulation system and uMs microscope system operating manuals for further information on other uMp-TSC2 features.

Layout and functionalities of the main user interface view (Figure 4):

- Some of the user interface symbols have dual functionality available by pressing longer than 2s.
- Left white part of the display shows Sensapex products that are connected to the uMp-TSC2.
  - Area can be hidden and recovered by the orange arrow symbol.
  - The cogwheel under the device opens its *Settings* menu (settings specific for that device).
- *Main menu* can be accessed from the symbol at top right corner.
- Each of the channels of the connected uMc-PPC pressure controllers are listed in the main view and their output pressure is shown in real-time based on measurement from the *Pout* port with high accuracy pressure sensor.
- Main view provides quick buttons to set the control pressure for individual channels, as well as buttons to change the output valve mode between the *User/ATM* and *Pout* port.
- Cog wheel symbols open view to set and save quick buttons for specific control pressures.
- The emergency stop symbol at the bottom left corner will turn red whenever any of the Sensapex products connected to the system is moving. Pressing the symbol immediately stops all products.

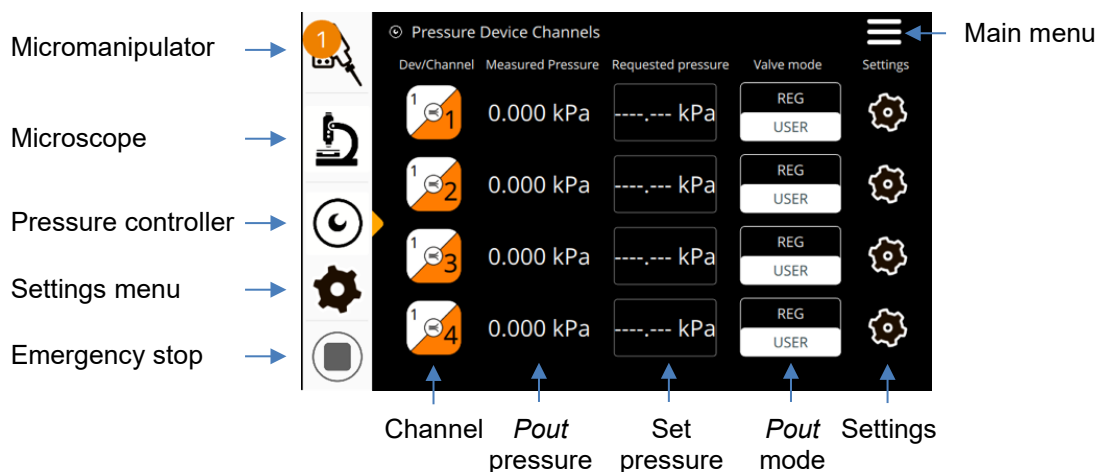


Figure 4. uMp-TSC2 UI main view when the uMc-PPC pressure controller is selected

uMp-TSC2 *Main menu* can be entered by tapping the menu symbol from top right corner of the main view. *Main menu* structure is shown in Figure 5 (items that are not specific to uMc-PPC are grayed out).

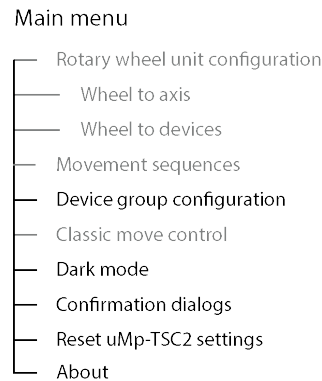


Figure 5. uMp-TSC2 Main menu

### 3.1.1 Device group configuration

Sensapex systems are based on a network control architecture that allows adding unlimited number of products (devices) to the same system with a single control interface.

*Device group configuration* can be used to configure specific Sensapex products to specific local area network group to prevent unintentional control across different systems (Figure 6).

1. Start by tapping Scan all groups, which will list all the Sensapex products connected in the same network. List shows serial numbers of each product.
2. If the list includes products that are not part of the same setup, change the uMp-TSC2 group to a different and unused group by tapping Change own group button.
3. Select the Sensapex products that are connected to your setup and press Move to own group button. This will move them to the control group of your setup and uMp-TSC2.
4. Restart by power off-on the products that were re-configured (3.1).
5. For PC control, define the same group for the controller products (if other than default group A).

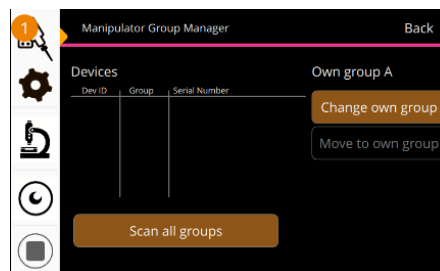


Figure 6. Device group configuration.

### 3.1.2 Dark mode

*Dark mode* setting only impacts the LED light around the uMp-TSC2 front panel button when used with the uMc-PPC products.

### 3.1.3 Confirmation dialogs

*Confirmation dialogs* setting determines if notification pop-ups are displayed when operating uMp-TSC2 (does not disable confirmation dialogs).

### 3.1.4 Reset uMp-TSC settings

*Reset uMp-TSC settings* enables resetting the uMp-TSC2 software settings to the factory default values. It does not impact on the uMc-PPC device settings.

### 3.1.5 About

*About* provides information about the uMp-TSC2 product. Of special interest are the current firmware version and the LOCAL IP address (bolded below) that is required information for the firmware update tool.

```

version 1.2.1.4-9 (c) Sensapex
Product info
HNAME uMpTCU-11202201
SNO 11202001
PRODATE 08.11.2022
HWID 2.0
DHCP N/A
LOCAL 169.254.50.113
Sensapex RWx 1.22.39.400 325F36503439
Proxy settings
    
```

## 3.2 Pressure control operation with uMp-TSC2

**Please note that the uMc-PPC may generate some sound and consumes air during its normal operation even in the case of zero leak application. Pressurized air tank might not be an optimal pressure source.**

uMc-PPC has the following functionalities for each channel, which can be operated with the uMp-TSC2 or with the computer using SDK:

- Accurately set and maintain the output pressure within the product specifications.
- Quickly change the *Pout* valve mode between the controlled and *User / ATM* pressure.
- Measure the pressure of the *Pout* output port using the integrated high accuracy pressure sensor

### 3.2.1 Setting the *Pout* Valve mode

Tap the *Valve mode* button for the channel of interest to toggle its mode (Figure 7). Default is USER, corresponding to routing the *User/ATM* to the *Pout* port. REG mode will route the set control pressure to the *Pout* port. Measured pressure of the *Pout* port will follow the commanded control pressure within the specifications.

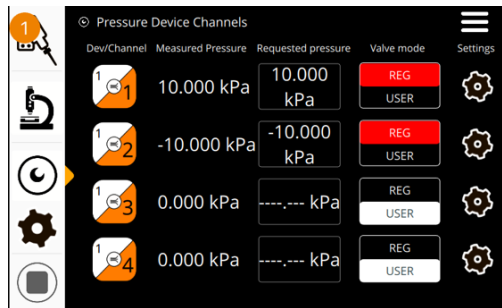


Figure 7. Pressure device view with two channels control Pout pressure according to set values.

### 3.2.2 Setting the control pressure value

Tap the *Requested pressure* button (Figure 7) and set the pressure in kPa in the pop-up window. Tap *Accept* button to confirm (Figure 8).

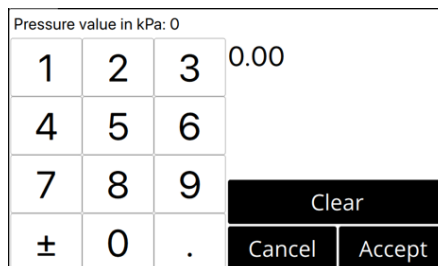


Figure 8. Pressure setting window.

### 3.2.3 Save and operate with preset pressure settings

Press the cog wheel symbol of the channel of interest (Figure 7) to save different control pressure and output valve combinations to the quick buttons. To configure, define the control pressure and the valve mode, and tap *Save pressure to quick button* (Figure 9). Quick buttons will appear accordingly.

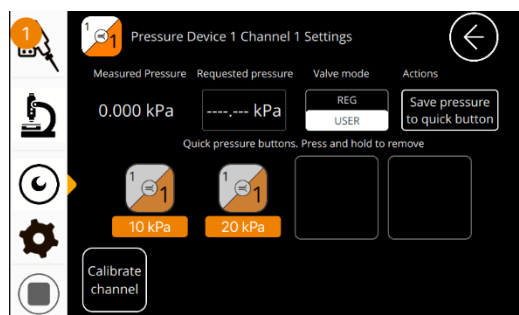


Figure 9. Quick button view for preset pressure and Pout valve mode combinations.

### 3.3 uMp-TSC2 stand-by mode and powering off

Stand-by mode can be activated by pushing the uMp-TSC2 front panel push button briefly. It will dim the display without impacting uMc-PPC functionalities. Pushing the button again will return to normal operating mode. Long press will power off the uMp-TSC2.

## 4 uMc-PPC settings

*uMc pressure controller settings* menu can be entered from the uMp-TSC2 main view cogwheel symbol below the product symbol. Settings are specific to the uMc-PPC product and need to be configured to each of them separately. *uMc pressure controller settings* menu structure is shown in Figure 10.

uMc pressure controller settings

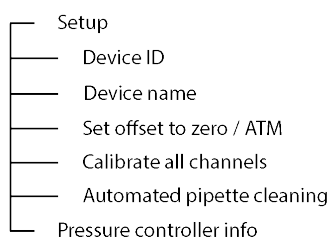


Figure 10. uMc pressure controller settings menu

### 4.1 Setup

#### 4.1.1 Device ID

Each Sensapex product that is controlled by the uMp-TSC2 or SDK for PC control needs to have unique *Device ID*, which is used to identify and communicate with that product.

In case more than one uMc-PPC is connected to the same system, connect them to the uMp-TSC2 one at the time and configure them with unique *Device ID*. Use numbers between 30-39, which are reserved for the uMc-PPC products.

#### 4.1.2 Device name

*Device name* allows providing the uMc-PPC a nick name (not used as identity for the control purposes).

#### 4.1.3 Set offset to zero / ATM

The high accuracy pressure sensors that measure the *Pout* pressure have in-built feature to zero the pressure offset to the current ambient environment connected to the *User / ATM* port. To Calibrate with the uMp-TSC2:

- Confirm that the *Pout* port is connected to experimental instrumentation as during the use and that there is no significant air leak
- Calibration will be done as reference to *User / ATM* port, which should be left open to the air if that is the preferred calibration reference.
- Tap the *Set offset to zero / ATM* and wait ca. 10 seconds for calibration to complete

Use `umc_reset_sensor_offset()` function of the SDK to calibrate with the computer.

#### 4.1.4 Calibrate all channels

*Calibrate all channels* function is used to calibrate linearity of the closed-loop pressure regulators against the pressure sensors that measure the *Pout* output pressure. The corresponding function in the software development kit is `umc_pressure_calib()`. This calibration is not recommended unless advised by the Sensapex support, because it may also reduce the performance if not performed under optimal conditions. Contact Sensapex at [support@sensapex.com](mailto:support@sensapex.com) if you have concerns on the pressure control accuracy.

#### 4.1.5 Automated pipette cleaning (see chapter 5)

### 4.2 Pressure controller info

*Pressure controller info* provides information about the uMc-PPC hardware and software. Of specific relevance are the firmware version and the serial number that are bolded in the example below.

```

uMv_v1.23.39.100
IP: 169.254.254.30
MAC: 70:B3:D5:45:DC:0F
SN: 11700038
HW: 3
DOM: 20230114

```

## 5 Automated pipette cleaning

Automated pipette cleaning feature that is available in the uMp-TSC2 requires a system with Sensapex uMc-PPC pressure controller and uMp micromanipulator products. Sensapex uMc-SLC recording chamber provides integrated cleaning and rinsing wells according to the described cleaning process.

### 5.1 Pipette cleaning process

Sensapex has commercialized the automated pipette cleaning technique developed in the Prof. Craig Forest laboratory at the Georgia tech. It is based on flushing the Tergazyme cleaning solution through the pipette tip, followed by the rinsing and flushing out all the residues of the cleaning solution. The original publications from the Forest lab and further validations e.g. from the Prof. Jörg Geiger laboratory in Charite have proven that the technique is effective and safe to the cells with no significant physiological side-effects.

Once configured, the automated pipette cleaning can be performed by quick button available at the uMp-TSC2 main menu (Figure 3). It will be executed by the currently selected manipulator / pipette after confirming the pop-up dialog.

The pipette cleaning process consists of the following steps (Figure 11), which are configured in the uMp-TSC2 wizard (see 5.2):

1. Patch-clamp recording or its attempt is finished, and user wants to record from next cell.
2. Pipette is moved to the Safe position that is typically above the sample with the tip in the recording media. Automation sequence:
  - Retract x-axis / diagonal (pipette axis) to Safe X
  - Move vertical z-axis to Safe Z
  - Move y-axis to Safe Y.
3. Pipette is moved to Cleaning position and the tip is cleaned in Tergazyme. Automation sequence:
  - Retract x-axis / diagonal (pipette axis) to Clean X

- Move y-axis to Clean Y
  - Lower z-axis to Clean Z
  - Apply sequence of negative and positive pressure pulses to flush tip with Tergazyme.
4. Pipette is moved to Rinsing position, typically recording media, and rinsed. Automation sequence:
- Move z-axis to Safe Z
  - Move y-axis to Rinse Y
  - Move x-axis to Rinse X
  - Move z-axis to Rinse Z
  - Apply negative pressure pull rinsing solution to the tip, followed by long positive pressure pulse to expel rinsing solution and some pipette internal solution to ensure no cleaning solution remains in the tip.
5. Pipette is moved to the Safe position to be ready for next recording attempt. Automation sequence:
- Move z-axis to Safe Z
  - Move x-axis / diagonal (pipette axis) to Safe X
  - Move y-axis to Safe Y

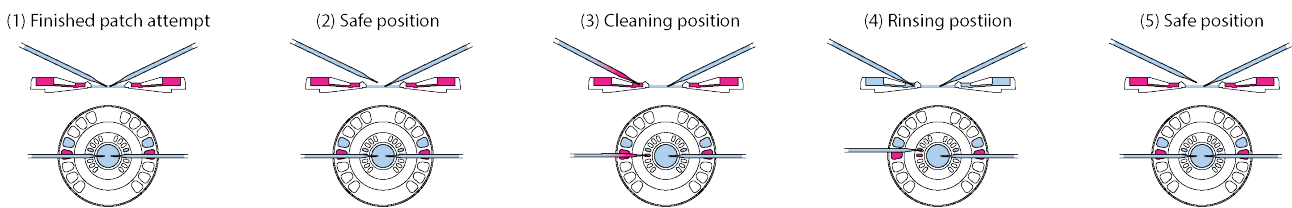


Figure 11. Pipette cleaning process

## 5.2 Pipette cleaning configuration

**Always validate the automated cleaning sequence first with mock-up use in safe conditions to reduce risk for collisions and damage to other instruments.**

uMp-TSC2 provides a configuration wizard to set the required pipette position and pressure sequences according to the automated cleaning process described in 5.1. Cleaning and rinsing pressure sequences as defined in the original publication are used as default, but those are also freely configurable.

1. Enter the pipette cleaning configuration view (Figure 12) by long-pressing the pipette cleaning symbol in the uMp-TSC2 main view (Figure 3).
2. Automated cleaning is based on the *Pipette Devices*, which link the specific micromanipulator that is physically holding the pipette with the specific pressure controller channel that is connected to that pipette. Typically *Pipette Device* number follows the *Device ID* of the corresponding micromanipulator.
3. To configure a *Pipette Device*, tap cogwheel at its row to open the *Pipette Settings* menu (Figure 12).

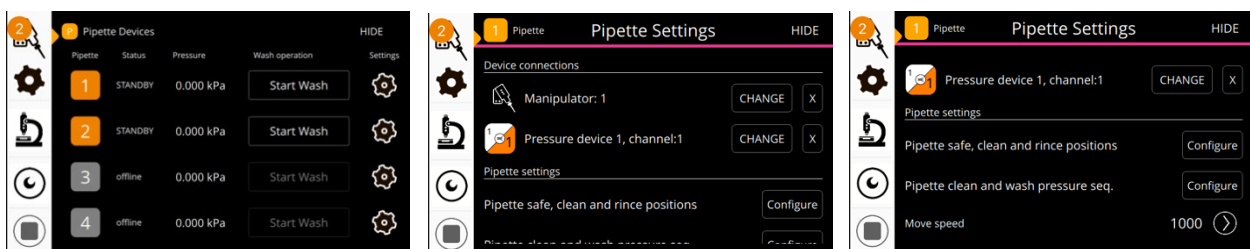


Figure 12. *Pipette Devices* list and *Pipette Settings* menu.

4. Configure *Manipulator* holding the pipette by tapping the *Change* button and selecting the manipulator from the *Select Device* list. Press the *X* button next to the *Change* button to remove the currently defined micromanipulator and to reconfigure.
5. Configure *Pressure device* and its channel by tapping the *Change* button and selecting the uMc-PPC and its channel from the *Select Device* list. Press the *X* button next to the *Change* button to remove the currently defined *Pressure device* and its channel, and to reconfigure

6. Configure *Pipette Safe, Clean and Rinse positions* by tapping the *Configure* button (Figure 12).
7. Set the *Pipette Safe Position* by first pressing *Reset* button (Figure 13). Move the pipette tip to the *Safe Position* and press *Save* button. Confirm with pop-up dialog.

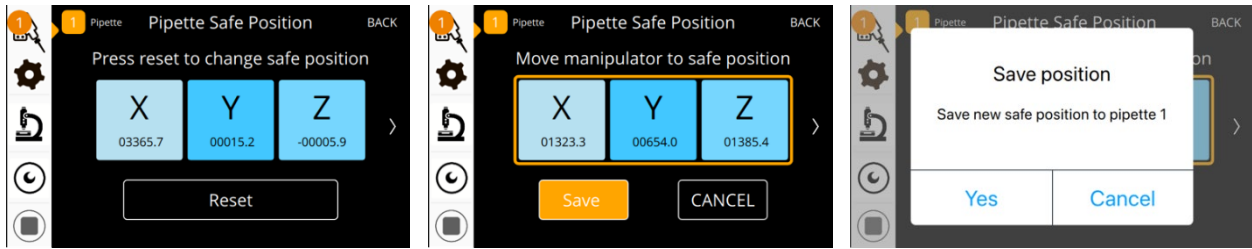


Figure 13. Pipette Safe Position.

8. Set the *Pipette Clean Position* by first pressing *Reset* button (Figure 14). Move the pipette tip to the *Clean Position* and press *Save* button. Confirm with pop-up dialog.

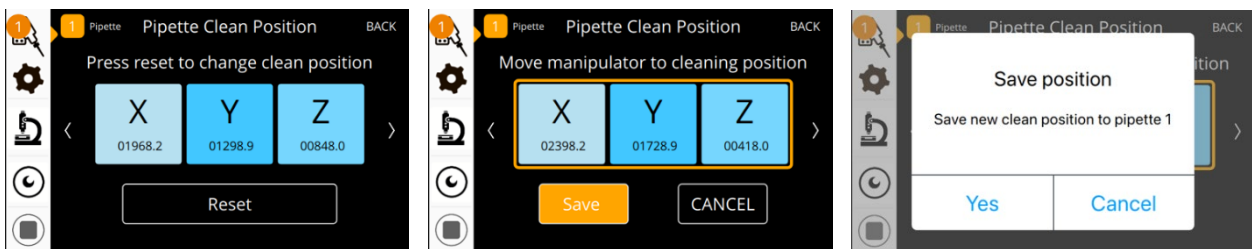


Figure 14. Pipette Clean Position.

9. Set the *Pipette Rinse Position* by first pressing *Reset* button (Figure 15). Move the pipette tip to the *Rinse Position* and press *Save* button. Confirm with pop-up dialog.

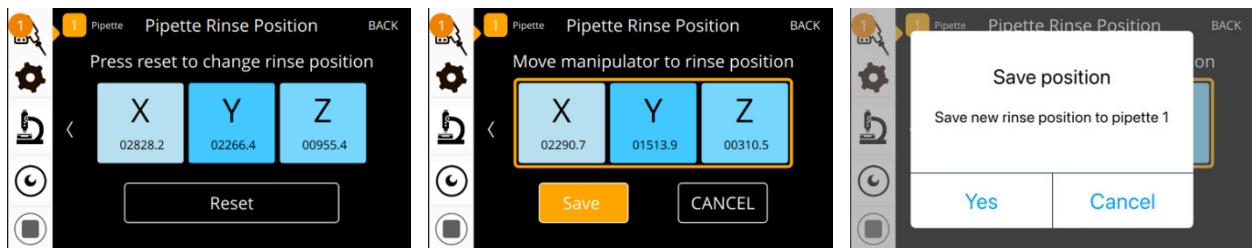


Figure 15. Pipette Rinse Position.

10. To configure *Pipette Clean and Rinse Pressure Sequences*, tap the *Configure* button in the *Pipette settings list* (Figure 12).
11. Configure *Cleaning pressure* sequence by tapping the *Change* button to open the protocol generator (Figure 16). The original published protocol is used by default (recoverable by *DEFAULT* button). To generate a new sequence:
  - a. Remove button will remove the last step in the protocol
  - b. Add button will add another step in the protocol according to: (1) defined *Pressure*, (2) *Delay* that defines the step duration in milliseconds and (3) output *Valve* mode.
  - c. Remove / add steps until the desired protocol is ready
  - d. Save button will save the configured protocol
  - e. Cancel button will leave the sequence generator without saving the changes.

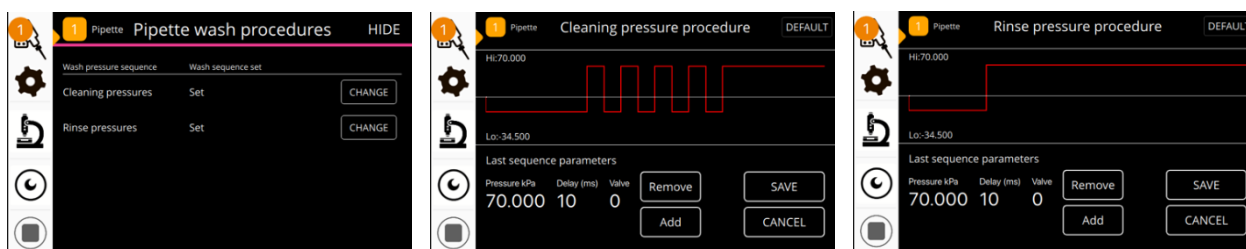


Figure 16. Cleaning and Rinse pressure sequences.

12. Configure *Rinse pressure* sequence by tapping the Change button to open the protocol generator (Figure 16). The original published protocol is used as default (recoverable by *DEFAULT*). Follow instructions provided in 11. to generate a new protocol.

### 5.3 uMc-SLC recording chamber

uMc-SLC recording chamber (Figure 17) is an integrated low profile recording chamber for brain slices with dedicated cleaning and rinsing wells for up to 8 pipettes. Consult Sensapex at [support@sensapex.com](mailto:support@sensapex.com) for alternatives in case uMc-SLC is not suitable for your experiments.

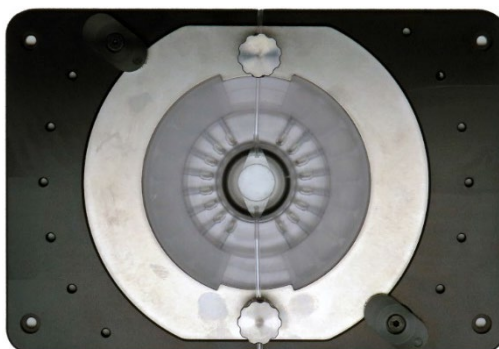


Figure 17. uMp-SLC chamber for automated pipette cleaning.

## 6 DAQ mode (coming soon)

DAQ mode is used when, instead of uMp-TSC2 or SDK, a data acquisition system with digital and analog IO ports is used to control the uMc-PPC (Figure 3).

Control in DAQ mode is based on a combination of digital IO to select the uMc-PPC channel and analog IO to control or read the pressure. Number of the required digital IO lines depends on the number of channels in the uMc-PPC. Use the cable with SMA connectors to connect the uMc-PPC to the data acquisition system.

**Note that pressure and Pout valve mode cannot be controlled by the uMp-TSC2 or computer when the DAQ mode is ON. It is still possible to read the pressure values.**

To used DAQ mode (Figure 18):

1. Set uMc-PPC to the *DAQ mode* by pressing the mode selection button down. Yellow indicator LED will turn on to confirm that the device is in *DAQ mode*.
2. Connect digital output from the data acquisition system to *TrigIN* connector to control the *Pout* valve mode between the control pressure and *User/ATM*. Low state (0 V) corresponds to the *User / ATM* mode and high state (3.3 – 5 V) corresponds to the control pressure mode.
3. Connect analog 0 - 10V output from data acquisition system to *ADC\_IN* connector to control the pressure. 0 V – 10 V range corresponds to -70 kPa - 70 kPa range.
4. Connect analog 0 - 10V input from data acquisition system to *ADC\_OUT* connector to read the measures *Pout* pressure. 0 V – 10 V range corresponds to -70 kPa - 70 kPa range.

5. Connect digital outputs from data acquisition system to the IOsel connector(s) to select which one of the uMc-PPC channels is controlled at the time.
  - a. For the uMc-PPC2, low state defines channel 1 and high state defines channel 2.
  - b. For the uMc-PPC4, IO line state vs. channel selection logic is:

00	1
01	2
10	3
11	4

- c. For the uMc-PPC8, IO line state vs. channel selection logic is:

000	1
001	2
010	3
011	4
100	5
101	6
110	7
111	8



Figure 18. DAC mode IO connectors.

## 7 Updating firmware

**We recommend updating firmware regularly to enjoy new features introduced at the times. Please let us know if you observe software bugs so that we can fix them promptly.**

uMc-PPC and uMp-TSC2 firmware can be updated using a dedicated software update tool. Follow the step-by-step instructions on how to update the firmware:

[https://sensapex.com/wp-content/uploads/downloadable-files/2023/08/uMx-firmware-update-tool\\_v2.2.pdf](https://sensapex.com/wp-content/uploads/downloadable-files/2023/08/uMx-firmware-update-tool_v2.2.pdf)

A troubleshooting guide is available to help with possible issues in detecting the Sensapex products with a computer: <https://sensapex.com/wp-content/uploads/2023/07/PC-connection-quick-sheet-v2.pdf>

## 8 uMc-PRF-VAC output pressure re-adjustment

**The uMc-PRF-VAC is adjusted at the factory to provide vacuum and high pressure according to the uMc-PPC requirements. Please consult Sensapex at [support@sensapex.com](mailto:support@sensapex.com) to discuss your possible re-adjustment needs before doing so.**

To re-adjust the uMc-PRF-VAC

1. Open the cabin by turning the four large screws by 90 degrees.
2. Review and adjust the first stage high-pressure regulator that supplies the vacuum ejector. Default value is 450 kPa for optimal vacuum generation efficiency. Do not exceed 550 kPa.

3. Adjust the second stage high-pressure regulator. Default value is 100 kPa for the uMc-PPC. Do not exceed 120 kPa.
4. Vacuum generating ejector is pre-set to produce -80 kPa vacuum. It is possible to adjust the vacuum pressure and its control settings from the ejector push buttons. Default values are 5 kPa for H1 and 1 kPa for H2. Contact Sensapex at [support@sensapex.com](mailto:support@sensapex.com) for further instructions.

## 9 Maintenance and troubleshooting

***This instrument contains no user serviceable parts or components. Disassembling the product or attempting self-repair is prohibited and will void the warranty. Contact Sensapex or your local representative to arrange a service.***

***It is recommended to update the firmware regularly. Please let us know if you observe software bugs.***

Please review the common issues and their solutions. If it does not help, contact your local representative or Sensapex support for further instructions: [support@sensapex.com](mailto:support@sensapex.com). Please include the respective product serial number(s), a brief description of the issue, possible circumstances leading to it and a picture of the installation to help the troubleshooting.

### 9.1 Solution has entered inside the uMc-PPC from *Pout* or *User/ATM ports*

- In case the solution is distilled water or other solution that is not expected to leave any particles or residues after drying, remove tubing from the output ports, set positive control pressures and output valve modes so that there is air flow through the ports. NOTE that this will consume air supply.
- In case the solution is saline or some other solution that will leave particles or other residues when drying, contact Sensapex at [support@sensapex.com](mailto:support@sensapex.com). Product is likely to need service due to very small orifices used in the uMc-PPC for regulating the pressure.

### 9.2 Hissing sound

- Some sound during operation is normal. In case continuous hissing occurs, locate the source of the leak and re-install tubing to fix it.

### 9.3 uMc-PPC is not found by the uMp-TSC2 or computer

- Confirm that the uMc-PPC is connected to the uMp-TSC2 or computer directly or via ethernet switch. Each ethernet connector should have indicator LEDs blinking when physical connection is established.
- Confirm that the DAQ mode is set OFF, i.e. mode push button at the back of device is not pressed.
- Confirm that uMp-TSC2 or computer are using the device group as the uMc-PPC (see 3.1.1).

### 9.4 Output pressure does not follow the commanded control pressure

- Confirm that the uMc-PPC is installed according to the instructions (2.2) and receiving the specified high pressure and vacuum supply. uMc-PPC requires ~10 % larger supply pressure than the control pressure. Smaller supply is not harmful, but it will limit the available pressure control range accordingly.
- Confirm that there is no significant leak in pressure lines connected to the *Pout* port.
- Compare the possible errors in measured pressure vs. commanded control pressure to the product specifications for repeatability and accuracy. Note that Pascal is a very small quantity and small deviations within the uMc-PPC repeatability and accuracy specifications are often not significant to the application.
- In case there is constant off-set error in the pressure value regardless of the commanded control pressure, perform *Set offset to zero / ATM* calibration (see 4.1.3).

## 10 Specifications

### **uMc-PPC-2**

Channel number:	2
Pressure supply tubing:	6 mm OD, rigid or semi-rigid
High pressure supply:	80 - 120 kPa (11.6 -17.4 PSI)
Input vacuum pressure:	min. -80 kPa (-11.6 PSI)
Output pressure ports:	1/32 inch soft tubing
Output pressure range:	±70 kPa / ±10.2 PSI
Resolution:	0.01 kPa
Repeatability:	±0.28 kPa
Accuracy:	±0.53 kPa
Control interface:	Ethernet, RJ45
DAQ interface:	SMA connectors
Power supply (provided):	24 VDC, 3.54 A
Dimensions:	140 x 140 x 74 mm
Weight:	1.3 kg

### **uMc-PPC-4 | 8**

Channel number:	4   8
Pressure supply tubing:	6 mm OD, rigid or semi-rigid
High pressure supply:	80 - 120 kPa (11.6 -17.4 PSI)
Input vacuum pressure:	min. -80 kPa (-11.6 PSI)
Output pressure ports:	1/32 inch soft tubing
Output pressure range:	±70 kPa / ±10.2 PSI
Resolution:	0.01 kPa
Repeatability:	±0.28 kPa
Accuracy:	±0.53 kPa
Control interface:	Ethernet, RJ45
DAQ interface:	SMA connectors
Power supply (provided):	24 VDC, 6.25 A
Dimensions:	310 x 250 x 95 mm
Weight:	2.8 kg   3.4 kg

### **uMc-PRF-VAC**

Tubing size:	6 mm OD, rigid or semi-rigid
Input high pressure:	500 kPa / 72.5 PSI
Output high pressure:	100 kPa / 14.5 PSI
Output vacuum pressure:	-80 kPa / -11.6 PSI
Dimensions:	350 x 120 x 300 mm
Weight:	8.5 kg

### **uMp-TSC2**

Capacitive touch screen display	
Connects up to two uMp-RW3 4	
Two Ethernet ports to connect Sensapex devices or PC	
Power supply (provided):	24 VDC, 3.54 A
Dimensions:	125x95x127 mm
Weight:	680 g