Sensapex uMs microscope system

Operating manual

Rev 1.1
17th March 2025

Sensapex Oy
Teknologiantie 13
Email: support@sensapex.com
www.sensapex.com

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. 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 uMs microscope 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 ±10%. The presence of typical transients on the mains supply, e.g. those of installation or overvoltage, are category II.
- Pollution degree II

1 General

1.1 Introduction

Sensapex uMs microscope system is based on proprietary motion control technology and innovative engineering to achieve high accuracy, stability and low vibrations even during fast movements.

Sensapex stand-alone uMp-TSC2 touch screen controller and uMp-RW3 rotary wheel control interfaces are intuitive and provide many automated features, such as parfocal objective change. Single set of controllers can control all Sensapex devices, such as uMp micromanipulators and uMc automated pressure controllers, for fully integrated user experience. The microscope system is designed for Nikon optics and accessories.

Figure 1 provides an overview of the uMs microscope system, including typical configuration options for Sensapex micromanipulators, Nikon products and other 3rd party manufacturers products.

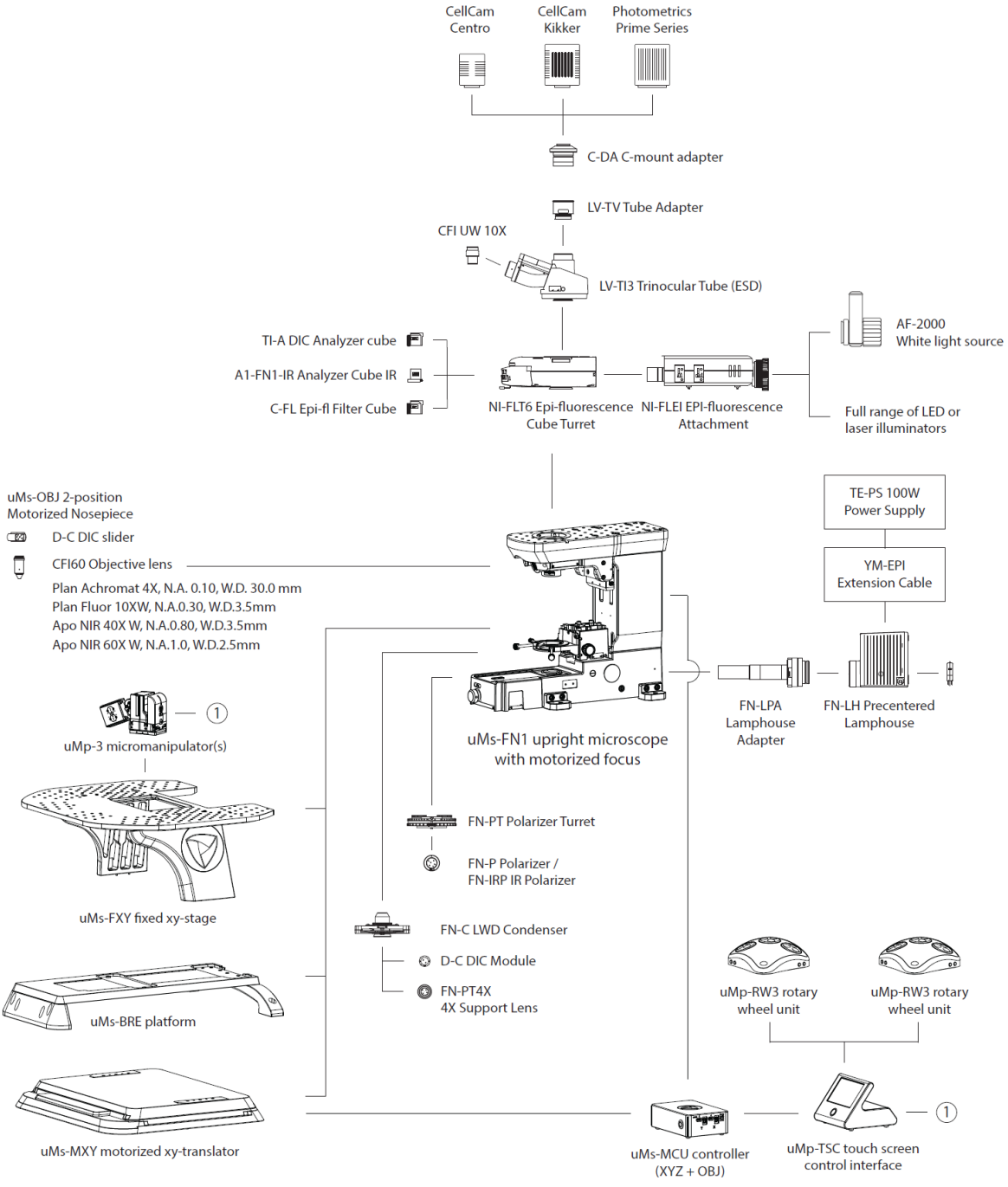


Figure 1. Sensapex uMs microscope system overview.

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, which are 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.

- Please notify Sensapex or your local distributor immediately if the outside of the package is damaged.
- Carefully unpack all the 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 or if you have any concern regarding possible shipping damage.

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 require returning the product to Sensapex for service.

1.5 General installation recommendations

- Sensapex uMs microscope system is designed to install upright on an anti-vibration table, which provides stable, flat, and clean surface with 25 mm or ¼" thread pattern.
- Handle the products with care, considering that products may be heavy. Do not drop the products or otherwise cause any impacts, which may cause permanent damage and require factory service.
- The room should be temperature controlled and no air drafts should affect the system or otherwise significant thermal drifts may occur that compromise stability.
- For electrophysiology experiments, ground the Sensapex products to the main ground of the experimental setup. We recommend using the high-quality grounding cables provided by Sensapex, which are optimized for low electrical resistance while maintaining flexibility.

2 uMs microscopy system installation

Step-by-step installation video of the uMs microscope system, incl. typical Nikon products, is available at Sensapex YouTube channel: https://www.youtube.com/watch?v=8H-nMAXnG0c

This document provides instructions on how to install Sensapex products. Please review carefully operating manual of 3rd party manufacturers' products that may be included in the system.

uMs microscope system main products are shown in Figure 2:

1. uMs-MXY motorized xy-translator
2. uMs-FN1 motorized upright microscope
3. uMs-FXY fixed stage. uMs-MXY and uMs-FXY are called together as xy-stage in this manual.
4. uMs-BRE microscope bridge
5. uMs-MCU microscope motor controller
6. uMp-TSC2 touch screen control interface
7. uMp-RW3 rotary wheel unit
8. Nikon long working distance universal condenser
9. Nikon epi-fluorescence illuminator and filter turret
10. Nikon trinocular tube and eyepieces
11. Sensapex uMp-3 micromanipulator (see micromanipulator operating manual)

Figure 2. uMs microscope system products.

2.1 Installing uMs-MXY xy-translator

uMs-MXY xy-translator is a heavy product (16.9 kg). Do not lift or handle it alone. Do not drop the uMs-MXY or permanent damage is likely to follow, which will require a non-warranty factory repair.

Follow these instructions to install uMs-MXY on antivibration table (Figure 3, see also installation video):

1. Open the shipment box and lift the smaller product cardboard box on a sturdy table. Save and store the shipment box and corner cushions.
2. Open the cardboard box and peel the plastic bag to access areas around the transport brackets.
3. Attach the temporary handles to the M6 threads at the top of the uMs-MXY, one to each side.
4. Lift the uMs-MXY using handles and remove plastic bag and cardboard box (store to shipment box).
5. Place the uMs-MXY on the antivibration table so that its side is over the edge just sufficiently enough to allow access to the transport bracket also from the bottom of the uMs-MXY.
6. Loosen 4 pcs of screws and remove the transport bracket.
7. Lift and re-position the uMs-MXY using handles so that its opposite side is just sufficiently enough over the edge to access the second transport bracket also from bottom.
8. Loosen 4 pcs of screws and remove the transport bracket. Store transport brackets and screws in the shipment box.
9. Lift and place the uMs-MXY in the position where the microscope system will be installed. It is recommended to place it as front as possible on the table, while leaving at least three rows of threads in front of it to fit the uMs-BRE. This will provide good access to the microscope and sample, while maximizing space behind it for the light source and possible imaging equipment.

Figure 3. uMs-MXY from front and top

10. X-axis of the uMs-MXY needs to be moved during the installation process to access the mounting holes. Unpack the uMs-MCU microscope controller. Typically uMs-MCU is placed on a shelf under the antivibration table or on the rack next to it. Place the uMs-MCU during the installation in a location that provides easy access to the connectors while allowing moving it later to its final position without reworking the cabling. It is recommended to keep on organizing the cables throughout the installation.
11. **Always ensure that the uMs-MCU is powered off before connecting or disconnecting cables.**
12. Attach the gray motor and black sensor cables between the uMs-MXY and the uMs-MCU according to the laser engraved markings for x and y-axes (Figure 4). Cables will only fit in correct orientation.

Figure 4. uMs-MXY motor and sensor cable connections.

13. Connect the uMs-MCU to its power supply.
14. Unpack uMp-TSC2 touch screen controller and uMp-RW3 rotary wheel unit.
15. Connect the ethernet cable from the uMs-MCU to the uMp-TSC2.
16. Connect uMp-RW3 to uMp-TSC2 with the provided USB cable.
17. Connect the uMp-TSC2 to its power supply.
18. Power ON the uMs-MCU and the uMp-TSC2.
19. Tap the uMs microscope symbol at the uMp-TSC2 main view to select it for the control (Figure 5).
20. Confirm that the uMs-MXY has room to move over its whole 120x85 mm range without collisions. Move the uMs-MXY all the way to left from the uMp-RW3 x-axis wheel.

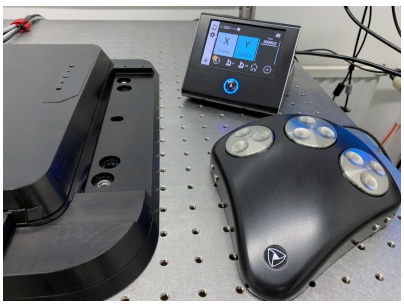


Figure 5. uMs-MXY is selected for control by uMp-TSC2 and uMp-RW3 and moved to left.

21. uMs-MXY has kinematic adjustment feet to compensate for uneven mounting surface, which could otherwise reduce the motion quality. First, lift the adjustment feet up by rotating them so that they are not in contact with the table (use T50 torx bit). Gently slide the uMs-MXY on the antivibration table to align the fixed mounting hole at the center and the two adjustment feet through-holes with the table thread pattern (Figure 6, metric thread pattern). **NOTE! Imperial thread pattern has its own fixed mounting holes and kinematic feet positions. The kinematic feet can be screwed all the way out and moved between the metric and imperial mounting positions.**

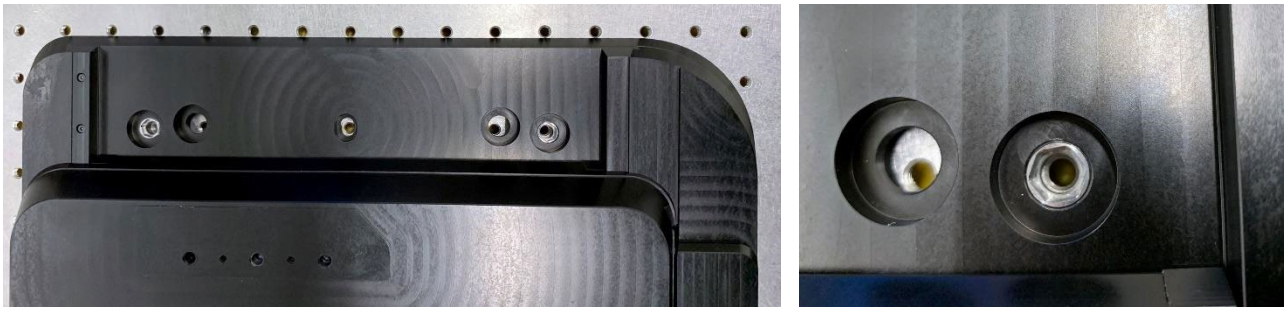


Figure 6. uMs-MXY kinematic adjustment feet centering

22. Move the x-axis all the to the right using the uMp-RW3 x-axis wheel.
23. Lift the kinematic adjustment foot up so that it is not in contact with the table. Gently slide and/or rotate the uMs-MXY if needed to align the two fixed mounting holes and the adjustment foot through-holes with the table thread pattern.
24. Attach the uMs-MXY to the table by using the two fixed screw holes and M6x16 socket head screws. Do not fully tighten to allow slight re-adjusting of the uMs-MXY orientation if needed.
25. Move x-axis all the way to the left using the uMp-RW3 x-axis wheel.
26. Confirm that the fixed screw mounting hole and two adjustment feet through holes align with the table thread patter. Attach the uMs-MXY to the table through fixed mounting hole and tighten the M6 screw firmly.
27. Lower the adjustment feet to be just in contact with the table. **Tighten only until reliable contact; overtightening cause stress to the uMs-MXY impacting its motion quality and lifetime.**
28. Use the uMp-RW3 to move the x-axis all the way to right.
29. Firmly tighten the two fixed mounting screws.
30. Lower the adjustment foot to be just in contact with the table. **Tighten only until reliable contact; overtightening cause stress to the uMs-MXY impacting its motion quality and lifetime.**
31. Place the M6x20 countersunk screws with special cup washer through the adjustment foot and tighten firmly (Figure 7).
32. Use the uMp-RW3 to move the x-axis all the way to left.
33. Place two M6x20 countersunk screws with special cup washers through the two adjustment feet and tighten firmly.

Figure 7. uMs-MXY adjustment foot screw with special cup washer.

2.2 Installing uMs-FXY fixed stage

uMs-FXY is a fixed stage designed to provide maximum stability and a large installation platform for electrophysiology and other experiments that involve complex instrumentation around the sample. It provides pre-configured installation positions for up to 10 uMp-3 micromanipulators and has a K-frame size opening for the sample holder. Standard Sensapex accessories include uMs-KSA adapter that is designed for the uMc-

SLC slice chamber with integrated pipette cleaning and uMc-STA adapter for the Warner PM-1 perfusion chamber platform.

Step-by-step instructions on how to install uMs-FXY to the uMs-MXY for motorized xy-stage solution are provided below (see also installation video). **NOTE that uMs-FXY can be also installed directly on the antivibration table with 25 mm or ¼" thread pattern when used as stand-alone fixed stage.**

1. Place the four dowel pins that are provided with the uMs-FXY to the uMs-MXY leg mounting areas (Figure 8, left). Place uMs-FXY legs to the uMs-MXY so that they are leaning inward. Dowel pins will guide them in the right positions (Figure 8, right).

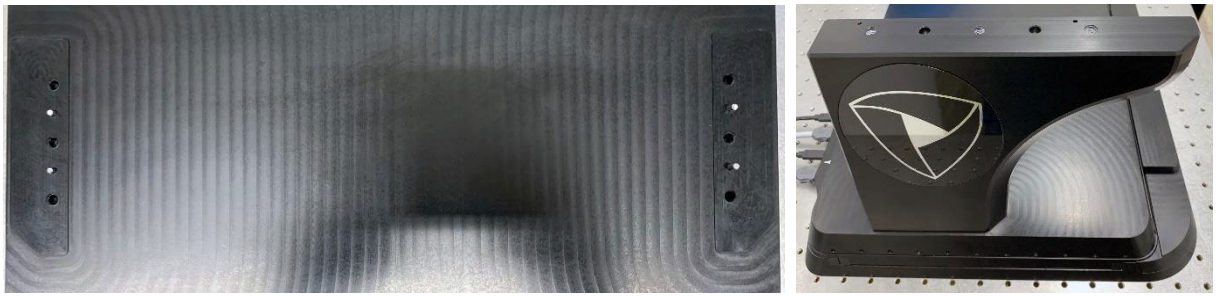


Figure 8. Left, uMs-FXY dowel pins placed on the uMs-MXY. Right, uMs-FXY leg placed on the uMs-MXY.

2. Mount the uMs-FXY legs to uMs-MXY using three M6x16 screws. Ball head hex tool makes the initial tightening easier (Figure 9). Use the provided washers to ensure firm attachment.

Figure 9. uMs-FXY leg mounting

3. Add spacers on the top and centered with the legs to adjust the stage height to be right for a given installation. Use the 15 mm spacer with the Sensapex uMs-FN1 microscope. Being higher than what is sufficient is not recommended, because it will reduce the effective Z-focus range that is available for the experiments (more is better allowing to clear the objective further away from sample/pipettes).
4. Place the uMs-FXY stage top over the legs and spacers so that the six mounting holes align with the legs threads (Figure 10). Different length M6 screws are provided with the uMs-FXY to accommodate different spacer heights. Place the screws through the mounting holes and to the threads at the legs. Adjust the stage top position, while keeping spacers in place until all six screws are aligned with the threads. Gradually tighten the screws until they are all firmly tightened.

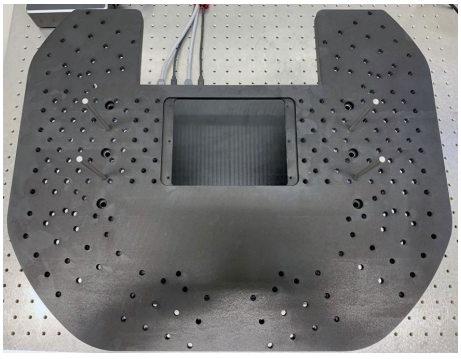


Figure 10. uMs-FXY stage top installation placed on legs

2.3 Installing uMs-FN1 microscope with uMs-BRE

Objective changer is installed to the uMs-FN1 and carefully aligned in the factory. Please do not disassemble or remove it from the microscope or misalignment may follow.

Please lift and handle the uMs-FN1 from its upper shelf or other parts of the main microscope stand. Lifting or handling from the objective changer may cause misalignment or damage.

uMs-BRE is used to integrate an upright microscope with the Sensapex xy-stage solution. uMs-BRE has recess and mounting threads tailored for the uMs-FN1 microscope (or standard Nikon FN1 microscope). Sensapex provides uMs-BRE and uMs-FXY variants for the Evident BX51WI and Zeiss AxioExaminer.

Step-by-step installation instructions on how to install uMs-FN1 with the uMs-BRE (see also installation video):

1. Place the uMs-BRE over the uMs-MXY and center it (Figure 11). There should be ca. 20 mm gap between the uMs-MXY front edge and the uMs-BRE front foot.
2. Confirm that the uMs-BRE mounting holes are aligned with the table threads. Use four M6x16 screws, two in front and two at the back, for mounting the uMs-BRE in place. Note that there are dedicated mounting holes in the front for the metric and imperial thread patterns. Gently pull the uMs-BRE towards you to guide it straight against the screws before firmly tightening them.

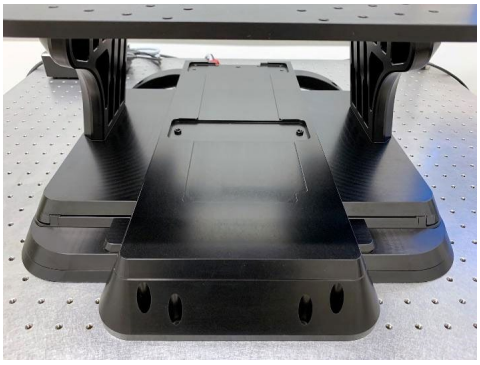


Figure 11. uMs-BRE placed and centered over the uMs-MXY

3. To install uMs-FN1 on the bridge, first attach the four mounting brackets to the uMs-FN1 microscope stand using the provided M6 screws (two for each bracket). Tighten the screws and then loosen up enough to allow brackets to move slightly.
4. Place the uMs-FN1 on the recess of the uMs-BRE (Figure 12, left). Confirm that the microscope settles well in the recess. Attach the uMs-FN1 to the uMs-BRE using the four M6x20 screws and washers (Figure 12, right). Gradually tighten the screws between the brackets and the microscope stand, as well as between the brackets and uMs-BRE until all screws are firmly tightened.

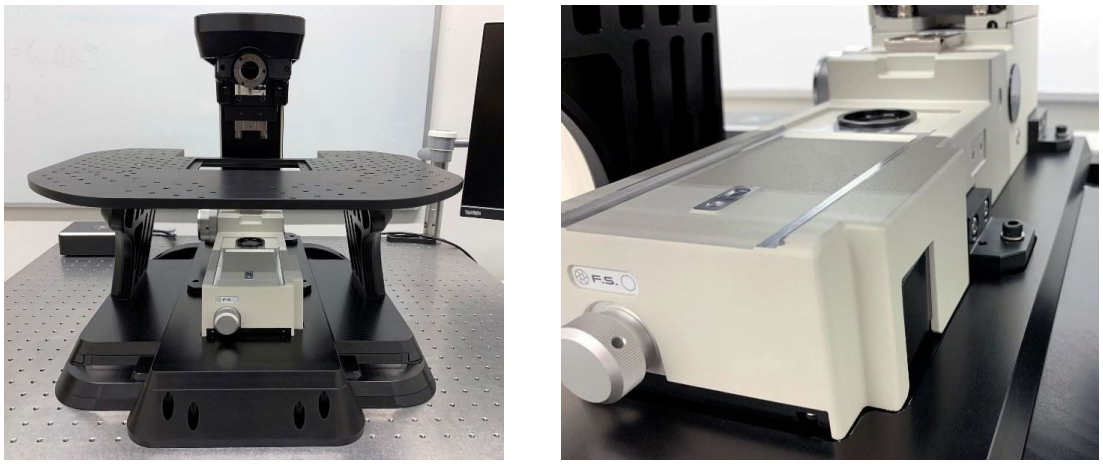


Figure 12. Installing uMs-FN1 to the uMs-BRE

5. Power OFF the uMs-MCU microscope controller.
6. Attach the gray motor and black sensor cables between the uMs-FN1 microscope and the uMs-MCU motor control according to laser engraved markings for the focus and the objective changer (Figure 13). Connectors will fit only in their correct orientation.

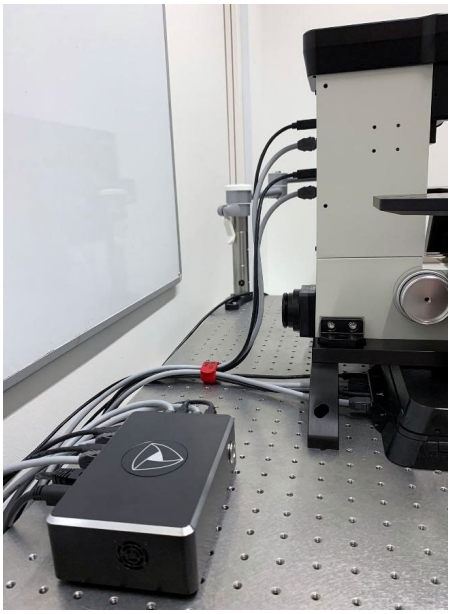


Figure 13. Connecting the uMs-FN1 to the uMs-MCU

7. Power ON the uMs-MCU. Microscope system should re-appear at the uMp-TSC2 display. Tap the microscope symbol to select it for control. You should see live coordinates for the xy-stage and for the z-focus, as well as objective symbols for the objective changer.
8. Confirm by operating the uMs-MXY and uMs-FN1 with the uMp-RW3 wheels that it can move its whole range without collisions.
9. Perform *Calibrate zero position* from microscope settings menu (see 5.1.3). The calibration sequence: (1) Move the z-focus all the way up, (2) move the y-axis all the way to the front and (3) move the x-axis all the way to the left. After calibration xy-axes and focus return to their home positions (re-configurable, see 3.5).
10. Configure the *Lift before change* to both objectives to ensure safe change without collisions (5.2.2).

2.4 Installing Nikon and other 3rd party products

Please note that large movement range of the uMs-MXY and uMs-FN1, as well as tilting objective changer may cause collisions. Always lift the focus first before changing the objective. Operate the system first in safe conditions to establish what is the safe operation range in your system and familiarize yourself with the basic use.

Review Nikon and 3rd party manufacturers operating manuals carefully before continuing installation.

Quick guide to install typical Nikon products and camera to the microscope system (see also installation video):

1. Install the condenser holder to the uMs-FN1 and lower it to its lowest height.
2. Slide the condenser to the holder and lock in place with the mounting screw (Figure 14, left).
3. In case DIC contrast is used, lift the condenser higher in focus and slide in the polarizer turret.
4. When the sample is at the uMs-FXY stage top plane and Koehler illumination is properly set, the condenser lens should not collide with the xy-stage. ***Carefully move the uMs-MXY over its range with the uMp-RW3 to confirm there is no collision risk with the condenser.***

Figure 14. Left, Installing the condenser. Right, Installing the polarizer turret for DIC.

5. Install the transmitted light lamphouse to the interface at the back of the uMs-FN1 (Figure 15).

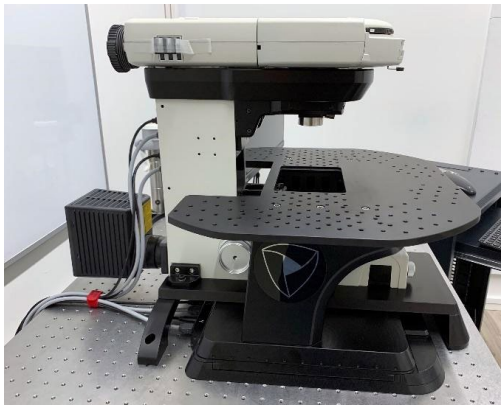


Figure 15. Installing transmitted light lamphouse and epifluorescence illumination parts.

6. Install the filter cube turret and reflected light illuminator on top of the uMs-FN1 (Figure 15).
7. Install the trinocular head and camera c-mount adapters to the filter turret or directly on the uMs-FN1 in case filter turret is not included in the system (Figure 16).

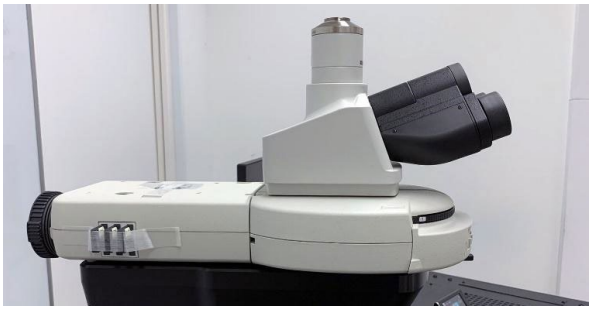


Figure 16. Installing the trinocular tube and c-mount camera adapter.

8. Install the camera to the c-mount and eyepieces to the trinocular tube (Figure 17).

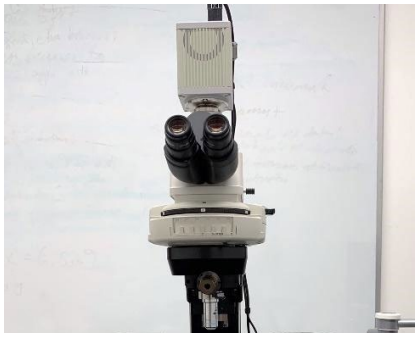


Figure 17. Installing the camera and eyepieces.

9. Install objectives to the objective changer. **Place the physically bigger objective (typically higher magnification) to the front position of the changer to reduce risk of collisions with the microscope stand (=pointing towards you when not in use).** The Objective changer is designed for the Nikon CFI60 physiology objectives. Consult Sensapex or your local representative in case you plan to use any other objectives with it.
10. Confirm that the *Lift before change* (5.2.2) setting is lifting objective high enough from the stage and sample before change to avoid collisions.
11. *Calibrate offsets* between the two objectives (5.2.3) for the parfocal objective change.
12. Organize and secure camera cables to avoid drag and vibrations that may otherwise them. Consult Sensapex or your local representative for special camera support in case you have issues with camera fan induced vibrations.

2.5 Grounding

Ground the uMs-FN1 microscope from its dedicated grounding point marked to the stand. This will ground the microscope and the objective changer, reducing a possible noise that could otherwise couple to the recordings.

2.6 Connecting other Sensapex products to the same system

Install uMp micromanipulators and uMc automated pressure controllers according to their operating instructions manuals. Connect all Sensapex products to the same network switch with the Ethernet cables. All products will be available for control through the uMp-TSC2 touch screen controller and rotary wheel units.

uMs microscope system, like all other Sensapex products, can be controlled by the computer using the open-source software development kit. More information on the computer control and software development kit can be found from Sensapex website: https://sensapex.com/support/umx-software/

3 uMs microscope system control

3.1 Powering ON – OFF the system

It is important to power off the uMs microscope system by first powering off the uMp-TSC2, which will save the current absolute coordinates to the uMs-MCU microscope controller's permanent memory. After that the uMs-MCU can be powered off from its power button.

Correct powering off sequence avoids the need to re-do *Calibrate zero position*.

3.2 uMp-RW3 rotary wheel unit

Each wheel of the uMp-RW3 rotary wheel unit (Figure 2) controls the xy-stage or microscope z-focus. Two uMp-RW3 can be connected to the uMp-TSC2. This is a typical configuration to support operating the xy-stage and z- focus with a dedicated uMp-RW3 while controlling the uMp micromanipulators with a second uMp-RW3.

- Rotary wheels move the corresponding axis back-forth with speed defined by current speed setting.
- A pair of buttons on the left side increase or decrease speed setting.
- A pair of buttons on the right side allow cycling through different Sensapex products that are connected to the same system (e.g. between the microscope and micromanipulators).

3.3 uMp-TSC2 touch screen controller

The uMp-TSC2 provides real-time position information and quick buttons for the most used features. It also includes configuration options to customize the usability according to the user preferences.

Layout and functionalities of the main user interface view (Figure 18):

- Many of the user interface symbols have further functionalities available by pressing the symbol for longer than 2 seconds.
- Left white part of the display shows Sensapex products that are connected to the uMp-TSC2 (in this case uMp micromanipulators, uMs microscope system and uMc pressure controller).
    - Area can be hidden and recovered by 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.
- Selected uMp-RW3 is indicated at top left corner (in case more than one is connected).
- Real-time position of the xy-stage and z-focus are shown in micrometers.
- The bottom area provides quick buttons to speed setting, objective change and programmable memory positions (Home and Targe).
- 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.

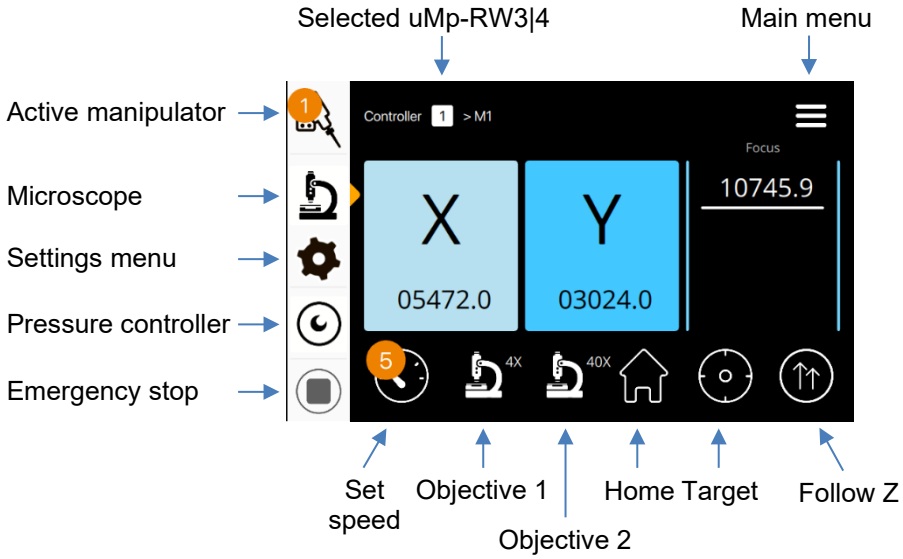


Figure 18. uMp-TSC2 main view with Microscope device selected.

3.4 Basic operation

- Use rotary wheels of the uMp-RW3 to move the xy-stage or z-focus.
  - The wheel – axis configurations and positioning directions are customizable (see 4.1).
- Use uMp-RW3 push buttons on the right side or press the microscope symbol in the uMp-TSC2 main view to select the uMs microscope system for control
- Use uMp-RW3 push buttons on the left side or press the speed selection symbol in the uMp-TSC2 main view to change the speed setting
- Turning the wheel slower than a certain threshold will cause undesired start-stop movement
  - Switch to a smaller speed setting and rotate the wheel faster for smooth movement

3.5 Setting and using Home and Target positions

- Tap *Home* or *Target* symbol shortly to drive xy-stage and z-focus to pre-set home or target positions.
- Long press *Home* or *Target* position symbol to save the current position as a new memory position.
- A pop-up dialog enables defining the positioning speed and confirming execution (Figure 19).

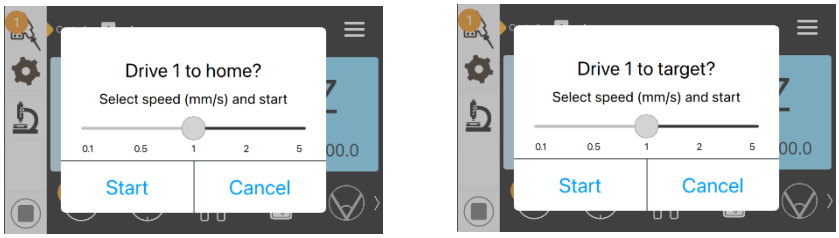


Figure 19. *Home* and *Target* memory positions

3.6 Changing between absolute and relative coordinates

Tap any of the axis display areas to toggle between absolute and relative coordinates:

- Relative position mode is indicated by an open circle at the top right corner of the axis
- In case relative position mode is entered first time, it will reset coordinates to zero.
- If the relative position is set earlier, the position relative to that earlier set position is shown
- To reset the relative position reference (i.e. to re-zero), long-press the open circle symbol

3.7 Changing the objective

Configure the Lift before change 5.2.2 and Calibrate offsets 5.2.3 to ensure safe objective change.

Objective can be changed by tapping its quick button at the uMp-TSC2 main view (Figure 18, magnification of the objective is indicated in the symbol). Objective change process:

1. Z-focus is raised according to the *Lift before change* setting.
2. Objective changer tilts the selected objective to the working position.
3. Z-focus returns to same position as before the change, incl. *Calibrate offsets* corrections.
4. Optionally, in case *Dip after change* parameter is configured for a water immersion objective (5.2.2), the z-focus is briefly dropped below the final focus position to pull the water column.

3.8 uMp-TSC2 Sleep mode

Sleep mode can be activated by pushing the push button at the uMp-TSC2 front panel. Pushing button again will return to normal operating mode. Sleep mode dims the display and disables the rotary wheels to avoid unintended operation.

3.9 Updating firmware

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

uMs-MCU 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

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

4 uMp-TSC2 Main menu

uMp-TSC2 *Main menu* can be entered by tapping the menu symbol from the top right corner of the main view. *Main menu* structure is shown in Figure 20.

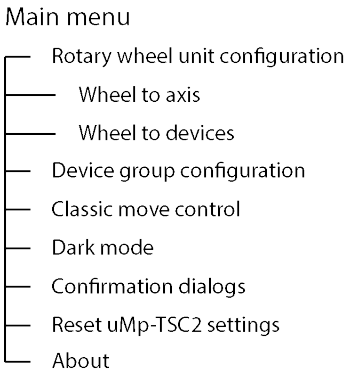


Figure 20. uMp-TSC2 Main menu

4.1 Rotary wheel unit configuration

Enter *Rotary wheel unit configuration* menu. *Wheel to axis* configurator defines which wheel of the uMp-RW3 is operating which xy-stage or z-focus axis, as well as movement vs. wheel rotation direction (Figure 21).

- Tap different configuration alternatives for wheel-to-axis mapping.
- Tap wheel symbols to reverse movement vs. wheel rotation direction.

Wheel to devices configurator defines which Sensapex devices are controlled by which uMp-RW3 in case more than one uMp-RW3 is connected to the system (Figure 21). Follow the user interface instructions.

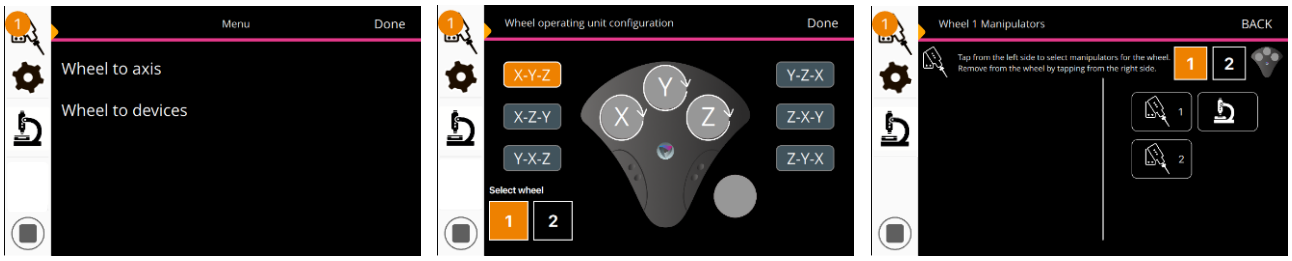


Figure 21. Rotary wheel unit configuration

4.2 Device group configuration

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

Device group configuration setting can be used to configure specific Sensapex products to specific local area network group to prevent unintentional control across different systems (Figure 22).

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).

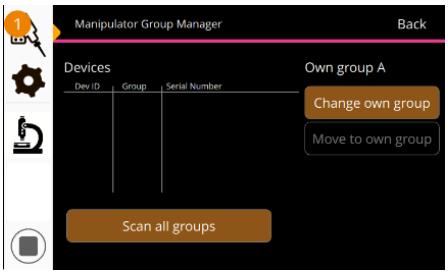


Figure 22. Device group configuration.

4.3 Classic move control

Classic move control defines if the uMp-RW3 wheel rotation speed affects the movement speed.

- *Classic move control* is disabled by default. In this configuration, the movement speed varies based on how fast the wheel rotates, which is typically considered to be intuitive.
- Enabling *Classic move control* sets the movement speed constant for a given speed setting, regardless of how fast the wheel is rotated.
- Regardless of the mode, always move to slower speed setting in case the movement does not remain continuous due to too slow wheel rotation.

4.4 Dark mode

Dark mode setting defines if the LED light around the uMp-TSC2 button and the indicator LEDs at the back of the possibly connected uMp micromanipulators get turned on. Please note that the red LEDs inside the manipulator axes that relate to optical encoders are not dimmed by this.

4.5 Confirmation dialogs

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

4.6 Reset uMp-TSC settings

Reset uMp-TSC settings enables resetting the uMp-TSC2 defined software settings to factory default values. It does not impact settings saved to the microscope, micromanipulators or automated pressure controllers.

4.7 About

About menu provides information of the uMp-TSC2 product. Of special interest are the current firmware version and the LOCAL IP address (bolded below), which 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

5 Microscope settings menu

Microscope settings menu can be accessed from the uMp-TSC2 main view's cogwheel symbol located below the microscope symbol. The *Microscope settings* menu structure is shown in Figure 23.

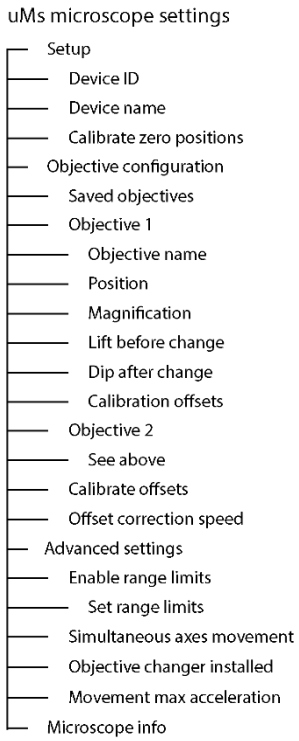


Figure 23. Microscope settings menu

5.1 Setup

5.1.1 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. It is unusual to have more than one uMs-MCU microscope controller in the same system and, thus, the *Device ID* is rarely a consideration with the uMs microscope products.

Please see the uMp micromanpulator operation manual in case of the manipulator connectivity issues.

5.1.2 Device name

Device name allows naming the microscope (not used to identify the device for control purpose).

5.1.3 Calibrate zero position

Microscope xy-stage and and z-focus have large movement ranges. Always ensure that all axes can travel their full range during the Calibrate zero position without collisions. We recommend to move the xy-stage and z-focus first with uMp-RW3 rotary wheels to the end of their ranges that are visited during the Calibrate zero function while carefully observing risk for possible collisions.

Calibrate zero position will drive the xy-stage and z-focus against their limit switches to establish the zero points of the absolute coordinate system. It is important that absolute position information is always correct because e.g. programmable memory positions are addressed in the absolute coordinate system. Re-doing *Calibrate zero position* is not needed when following correct power-off sequence (see 3.1).

Perform the *Calibrate zero position* from the *Microscope settings* menu. The calibration sequence:

1. Lift the z-focus all the way up
2. Move the y-axis all the way front and the x-axis all the way left
3. Return all axes to their *Home* positions

5.2 Objective configuration

5.2.1 Saved objectives

Saved objectives shows the objectives that are currently configured for the microscope system.

5.2.2 Objective 1 | 2 settings

- ***Objective name*** allows giving the objective a preferred name.
- ***Position*** defines the physical position of the objective in the objective changer. Configure the objectives to have positions according to their physical installation to the objective changer.
- ***Magnification*** setting can be used to define the magnification of the objective, which is also shown together with the objective change quick buttons in the uMp-TSC2 main view (Figure 18).
- ***Lift before change*** defines distance in micrometers that the z-focus is raised before the objective change. We recommend lifting the focus all the way up before change to minimize the risk of collisions. In case the defined value is beyond the maximum range, the focus is lifted to its highest position.
- ***Dip after change*** setting defines in micrometers distance that the z-focus will transiently visit below the final focus position after change to automatically pull the water column when using water immersion objective. Test the safe and sufficient dipping distance specific to your installation.
- ***Calibration offsets*** show the parfocality correction vs. reference objective (see 5.2.3).

5.2.3 Calibrate offsets

Calibrate offsets feature allows automated parfocality adjustment between the two objectives. Calibration can be done with step-by-step wizard that starts by selecting the *Calibration offsets* feature (Figure 24). Use microscope test slide or pipette tips as reference targets for the calibration and ensure that only the microscope xy-stage and z-focus are moved during the procedure (e.g. not the calibration target).

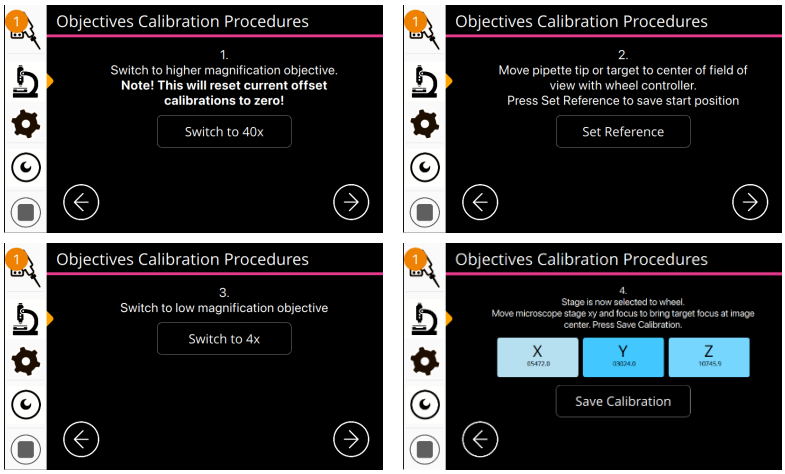


Figure 24. Objective offset calibrations wizard

5.2.4 Offset correction speed

Offset correction speed defines the movement speed used during the parfocality calibration adjustments.

5.3 Advanced settings

5.3.1 Enable range limits

Enable range limits feature allows limiting the active positioning range to be less than the full range. This may be helpful, for example, to prevent collision to the dish bottom with the objective or to the manipulators. Enabling the feature reveals *Set range limits* setting, which is a configurator to set the limits (Figure 25):

1. Min and Max limits are set to each axis one at a time. The current axes coordinates are displayed.
2. Tap the specific limit that you want to configure.
3. Use uMp-RW3 to move the selected axis to the position where a specific limit should be set.
4. Tap Set button. Repeat for each limit.
5. Tap Reset button to reset all limits for re-configuration.

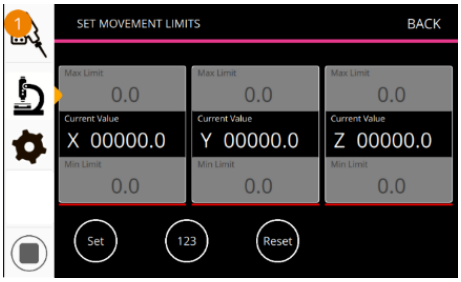


Figure 25. Range limit configuration

5.3.2 Simultaneous axes movement

Enabling *Simultaneous axes movement* setting will move the xy-stage and z-focus simultaneously during the memory position functions like *Home* and *Target* (and with PC control). This may increase collision risk, which is why the setting is disabled by default.

5.3.3 Objective changer installed

Objective changer installed setting defines if the 2-position objective changer is included in the system.

5.3.4 Movement max acceleration

Movement max acceleration setting defines the maximum acceleration in µm/s^2 when moving the xy-stage and z-focus with the uMp-RW3 wheel unit or PC. Default is 10000 µm/s^2, which can be adjusted to adjust positioning dynamics.

5.4 Microscope info

Microscope info provides specific information about the uMs-MCU motion controller. Of specific relevance are the firmware version and serial number that are bolded in the example below.

uMs_v1.23.39.102
IP: 169.254.48.16
MAC: 70:B3:D5:45:DC:0F
SN: 11500016
HW: 3
DOM: 20201214

6 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. Please include the respective product serial number, a brief description of the issue, possible circumstances leading to it and a picture of the installation to help the troubleshooting.

6.1 Microscope system or some of its axes are not recognized by the uMp-TSC2

- Review the device group settings in the uMp-TSC2 to confirm that the microscope system and uMp-TSC2 are in the same group (see 4.2).
- In case specific axis of the xy-stage or z-focus axes is not detected, confirm that the cabling is done according to the installation instructions.
- Check that the Objective changer installed setting is enabled in case the objective changer quick symbols are not displayed in the uMp-TSC2 main view (see 5.3.3). Restart uMp-TSC2 and select the microscope device again if configuration is correct but quick symbols don't show up.

6.2 Microscope xy-stage or z-focus do not move or move only over partial range

- Confirm that there is no physical collision that is preventing the movement. Typically, this is easy to notice due to large forces that the xy-stage or focus will impose on the colliding objects.
- Check if the *Enable range limits* is enabled and if the underlying settings are limiting the range.

6.3 Xy-stage or z-focus positioning is not smooth or accurate

- Confirm that all the installation steps were completed according to the instructions, all mounting screws are firmly tightened and that the installation surface is stable, flat and clean. E.g. incorrect settings for the uMs-MXY kinematic mounting feet may lead to vibrations and/or damage.

6.4 Products got exposed to accidental liquid spill

- In case a small spill occurs, the products should be immediately cleaned using damp cloth.
- In case a major spill occurs, which may cause liquid ingress into the products, power off and unplug power suppliers from the system immediately. Contact your local representative or Sensapex for further instructions.

7 Specifications

uMs-FN1

Focus range:	40 mm, encoded
2-position nosepiece:	tilting, motorized
Resolution:	4 nm
Repeatability:	100 nm
Max. speed:	20 mm/s
Dimensions:	428 x 170 x 351 mm
Weight:	10.0 kg

uMs-MXY

X-Y range:	120 x 85 mm, encoded
Resolution:	4 nm
Repeatability:	100 nm
Max. speed:	20 mm/s
Dimensions:	445 x 380 x 50 mm
Weight:	16.9 kg

uMs-MCU

Controls uMs-FN1 and uMs-MXY
Closed-loop control
Ethernet connection to uMp-TSC2 or PC

Power supply (provided):	24 VDC, 3.54 A
Dimensions:	150 x 74 x 49 mm
Weight:	570 g

uMs-FXY

Adjustable height:	183 – 213 mm
Foot print of single leg:	32 x 113 mm
Dimensions:	500 x 419 mm
Weight:	7.8 kg

uMs-BRE

Dimensions:	503 x 400 x 66 mm
Weight:	5.1 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

uMp-RW3 rotary wheel interface

3 rotary wheels
Push buttons for speed and device selection

USB connection to uMp-TSC2:	5 VDC, 0.2 A
Dimensions:	170x53x170 mm
Weight (uMp-RW3):	1050 g

EU Declaration of Conformity

1. **Manufacturer**

   Sensapex Oy

   Teknologiantie 13

   90590 Oulu

2. **This declaration of conformity is issued under the sole responsibility of the manufacturer**

3. **Object of the declaration**

Brand name:	Sensapex
uMs microscope system:	uMp-TSC2, uMp-RW3, uMs-FN1, uMs-MXY, uMs-MCU

4. **The object of the declaration is in conformity with the following directives**

2014/30/EU	Electromagnetic Compatibility Directive (EMC)
2011/65/EU	Restriction of Hazardous Substances (RoHS) Directive
2006/42/EC	Machinery Directive (MD)

   and harmonised standards / technical specifications

   EMC **EN IEC 61326-1:2021**

   Emission requirements: EN 55011:2006, EN 61000-3-2:2019, EN 61000-3-3:2013

   Immunity requirements according to Table 2 for equipment intended to be used in an industrial electromagnetic environment: Electrostatic discharge (ESD), Electromagnetic field, Power frequency magnetic field, Burst, Surge, Voltage dips & Short interruptions, Conducted RF

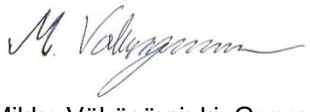
   RoHS EN IEC 6300 Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

   MD EN ISO 12100 Safety of Machinery. General Principles for Design. Risk Assessment and Risk Reduction

5. **Signed for and on behalf of:**

   Oulu 28.8.2024

   Sensapex Oy

   Mikko Vähäsöyrinki, General Manager