SN-PZ-50 Micromanipulator

For use with SI-CTS200 Cell Tester System

INSTRUCTION MANUAL

Serial No._____

100413

World Precision Instruments

Other Popular WPI Products

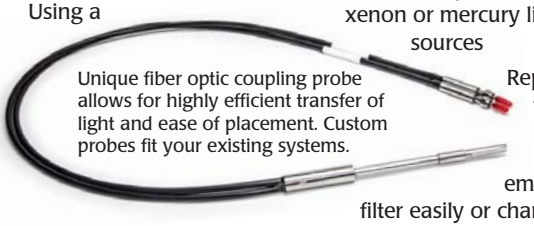
Biofluorometer

Now more reliable, simplified and affordable

The new SI-BF100 is an LED-based fluorometer for life science applications. It is ideally suited for ratiometric calcium detection (FURA-2) and ATPase detection (via NADH fluorescence). With up to seven LED modules (wavelengths), the **SI-BF100** covers many fluorometric applications in neuroscience and cell biology.

Recent advancements in optics and LED technology simplify ratiometric calcium imaging, making this equipment more affordable. A breakthrough in WPI patented technology allows the **SI-BF100** to use wavelengths below 380nm and produce more light in those spectra. This technology significantly cuts the cost of photometric calcium imaging without sacrificing resolution or quality.

- LED light sources require less power, give off less heat and are more compact and affordable
- Sampling rates up to 1kHz (1,000 ratios/second maximum). At lower speeds, signal averaging is used for noise reduction.
- Two auto ranging photomultiplier inputs allow you to monitor multiple wavelengths from a single emission output that can be comprised of any wavelength of light for which an LED module is available
- Using a separate reference channel, ultra-stable, continuous ratio calculations automatically compensate for LED intensity drift. This ensures less noise and produces more accurate measurements.
- Application-specific probes are available for existing tissue baths and cuvette systems.
- Ratio noise is <0.05 peak to peak, drift is less than 0.1 unit/hour
- The warm up time of less than one minute is a dramatic improvement over the common 20–60 minutes required by xenon or mercury light sources
- Replace the emission filter easily or change the LED modules to transform the SI-BF100 into a general purpose fluorometer for many other applications


Unique fiber optic coupling probe allows for highly efficient transfer of light and ease of placement. Custom probes fit your existing systems.

www.wpiinc.com/CTS200

CONTENTS

Based on: Sensapex SMX-series Operating Manual
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ABOUT THIS MANUAL

The following symbols are used in this guide:

This symbol indicates a CAUTION. Cautions warn against actions that can cause damage to equipment. Please read these carefully.

This symbol indicates a WARNING. Warnings alert you to actions that can cause personal injury or pose a physical threat. Please read these carefully.

NOTES and TIPS contain helpful information.

Fig. 1—These micromanipulators are made for positioning microelectrodes, micropipettes or microtools in three-dimensional space with sub-micrometer resolution over distances of millimeters.

INTRODUCTION

The **SN-PZ-50** micromanipulator is compact device that offers a full range of positioning and motion control features. Because of its drift-free positioning mechanism and small size that permits close installation to the target, the manipulator has outstanding stability. Additionally, the small size allows multiple micromanipulators to be used on applications in confined spaces.

The concept of this micromanipulator is designed in cooperation with scientists to maximize its usability and productivity in research. The micromanipulators are typically used in biomedical research to position microelectrodes, micropipettes or miniature sensors. The micromanipulator is also suitable for many other applications where high precision positioning is required.

The micromanipulator is based on the latest piezo-technology, which is used in combination with integrated linear position sensors and closed-loop control to provide high precision positioning. The mechanical design is built with aerospace-quality aluminum alloys for optimal stiffness to weight ratio. It provides a full

grounding skeleton throughout the manipulator. High precision stainless-steel, crossed roller bearings are used to ensure accurate linear movement.

To ensure high quality, the micromanipulators are produced according to certified ISO9001 and ISO13485 quality system management. The manipulators come with a two (2) year warranty when you register your product within 30 days from shipping. Otherwise, a one year warranty applies.

This manual provides information on how to install and operate the micromanipulation system on the WPI **SI-CTS200 Cell Tester** system. It also includes a trouble-shooting guide. Updated manuals covering more general usages of this micromanipulation system are available from the **Sensapex** website: www.sensapex.com.

Notes and Warnings

The **SN-PZ-50** micromanipulation system is designed for positioning microelectrodes, micropipettes or microtools in three-dimensional space, over millimeters of distance with sub-micrometer resolution. The positioning of devices should always be performed while using a microscope to observe the target, as well as the probe, within the microscope's field of view. No other use for this micromanipulation system is recommended.

- This product is not a medical device. Use it only for non-human research.
- Do not open or attempt to repair the instrument to avoid risk of injury from electrical shock.

Safety warnings

CAUTION: Use the charger only with properly grounded mains supply that meets the product specifications.

CAUTION: To prevent fire or shock hazard, do not expose the product to liquid spills or moisture.

CAUTION: Use only the cables provided by the manufacturer to comply with CE electromagnetic immunity and interference standards and to minimize electrical noise to other equipment in the laboratory.

CAUTION: Position the equipment so that it is easy to operate the on/off switch or disconnect the system.

CAUTION: Do not attempt to replace the battery inside the control unit.

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

- The product is designed for operation in a laboratory environment at room

temperature.

- Operate this product only according to the instructions included in this manual.
- Do not operate if there is any obvious damage to the product.
- Do not operate near flammable materials or expose the manipulators to corrosive materials. Use of any hazardous materials with the product is not recommended and is your sole responsibility.
- Do not attempt to use any other charger than the one provided.
- Protect yourself against injury from microelectrodes or micropipettes. Note that pressure injections may cause a pipette to shoot off the holder. Use safety glasses and other protection.
- Retain the original packaging for possible future transport of the product
- Handle and operate the micromanipulator with care to avoid cable damage.
- This instrument contains no user-serviceable parts or components. Do not try self-repair. This product should be serviced and repaired only by the manufacturer.

CAUTION: To clean the micromanipulation system components, gently wipe them with a clean, dry cloth. The cloth may be slightly dampened with water. Do not submerge the product in water or any other cleaners or solvents.

Environmental Ratings

The micromanipulation system is designed for indoor use. If the system is used outdoors, it must be protected from rain, snow and other contaminants. The system has been tested for use up to 2000m elevation. The system should be operated only in the temperature range of 5°C to 40 °C. The maximum allowed relative humidity is 80% between 5°C to 31°C. The maximum allowable humidity decreases linearly from 80% to 50% between 31°C and 40°C. The voltage of the power source should not fluctuate more than ±10%. Typical voltage fluctuations on the power source are categorized as Type II (installation or overvoltage). Pollution degree II.

Parts List

The piezo micromanipulator system is comprised of stand-alone battery operated control unit and plug-and-play micromanipulators that are ready when the controller is connected.

After unpacking, verify that there is no visible damage to the system. Verify that all items are included:

Fig. 2—The SI-CTS200 Cell Tester is a dual micromanipulator system wtih the control unit and two micromanipulators (left- and right-handed versions). The force transducer and the nanomotor are attached to the manipulators.

The micromanipulation system comes assembled for plug-and-play installation. It consists of:

- Micromanipulator(s) configured according order specification. The connector hub is included for systems with more than two manipulators.
- Control unit
- Charger and power cord
- USB cable

NOTE: One left-handed micromanipulator and one right-handed micromanipulator are provided with the complete version of the **SI-CTS200** Cell Tester. The transducer and the nanomotor are mounted on these micromanipulators at a steep, fixed approach angle to optimize the effectiveness of these devices while still maintaining an open light path.

Fig. 3—(Left) Charger and power cord

Fig. 4—(Right) USB upgrade cable.

CAUTION: Please keep the original packaging, and use it to transport the micromanipulation system to another location, when necessary. Improper packaging is a form of abuse and can void the warranty if shipping damage is sustained because of the packaging.

Unpacking

Upon receipt of this instrument, make a thorough inspection of the contents and check for possible damage. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed damage should be reported at once to the carrier and an inspection requested. Please read the section entitled "Claims and Returns" on page 35 of this manual. Please contact WPI Customer Service if any parts are missing at 941.371.1003 or customerservice@wpiinc.com.

Returns: Do not return any goods to WPI without obtaining prior approval (RMA # required) and instructions from WPI's Returns Department. Goods returned (unauthorized) by collect freight may be refused. If a return shipment is necessary, use the original container, if possible. If the original container is not available, use a suitable substitute that is rigid and of adequate size. Wrap the instrument in paper or plastic surrounded with at least 100mm (four inches) of shock absorbing material. For further details, please read the section entitled "Claims and Returns" on page 35 of this manual.

INSTALLATION

General Recommendations

NOTE: Your product is inspected and tested before the shipment. If there are any unexpected problems that cannot be solved by actions recommended in the troubleshooting guide, please contact WPI. We will promptly answer your request and organize repair or replacement service, if needed.

Before the micromanipulators are mounted on the **SI-CTS200 Cell Tester**, the surfaces of the mounting pedestals and the adapters for the transducer and nanomotor should be checked for cleanliness. For stability, make sure the microscope and the cuvette base are also mounted to a rigid surface.

The micromanipulators are built with corrosion-resistant materials for tolerance against corrosive substances, such as saline solutions. However, the micromanipulators should be immediately and carefully cleaned, if they are exposed to corrosive fluids or aerosols. Care should also be taken to avoid introducing particles to the bearings, which may prevent normal function. WPI assumes no responsibility for damage caused by a failure to comply to these recommendations.

CAUTION: Do not dismantle, loosen or remove any of the screws or parts, unless you are directed to do so in this manual. Doing so voids the warranty

and may require returning the product to WPI for service.

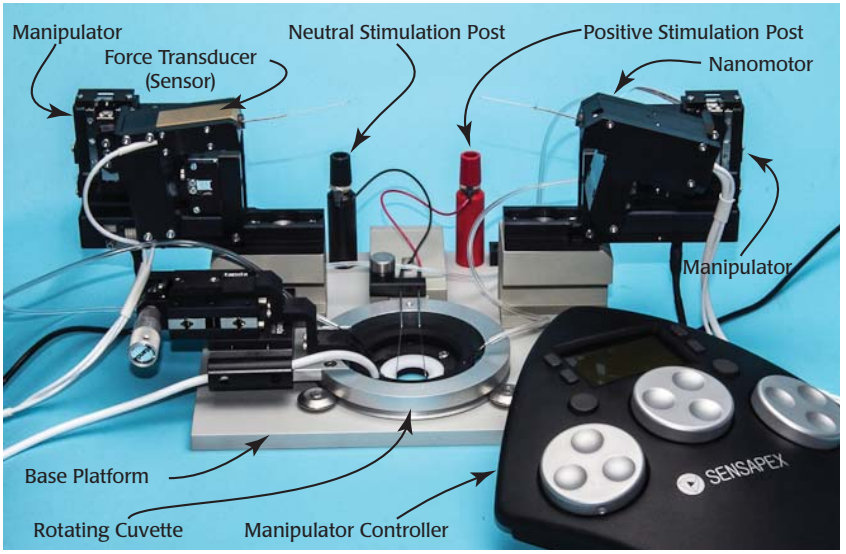


Fig. 5—An assembled **SI-CTS200** *Cell Tester system*

Micromanipulator Mounting on SI-CTS200 Base

CAUTION: Use great care when handling the force transducer and the nanomotor assemblies. The microtweezers and glass fiber mount tips are extremely delicate and easily damaged.

1. To assembly your **SI-CTS200**, position the base platform on a solid surface.
2. Install the manipulators.
   A. Remove the manipulators from their packaging.
   B. The manipulators are built on a hinged platform. Open the hinged platform to reveal the screw holes (Fig. 6).

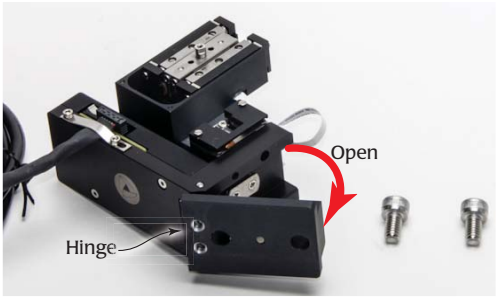
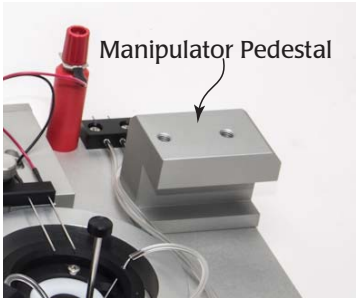


Fig. 6—(Right) Open the hinged platform on the bottom of the manipulator.

   C. Place two M6 screws into the holes on the base of the manipulator and line up the screws with the holes on the base platform manipulator pedestals (Fig. 7). Use a hex wrench and tighten the screws (Fig. 9).



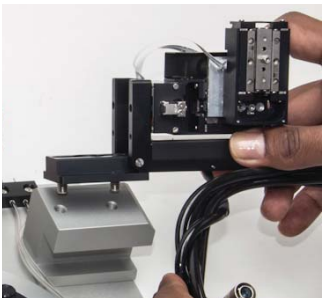


Fig. 7—(Left) The base platform has two manipulator pedestals on the back side.
Fig. 8—(Center) Line up the screws with the holes in the pedestals.
Fig. 9—(Right) Tighten the screws.

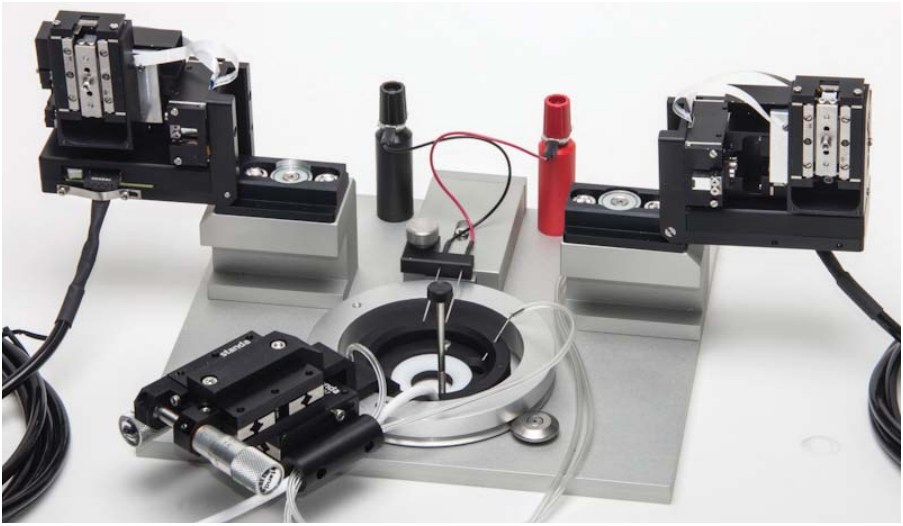


Fig. 10—Both manipulators are mounted and tilted back as far as they can go.

3. Mount the nanomotor to the micromaniplator on the right side of the base platform.

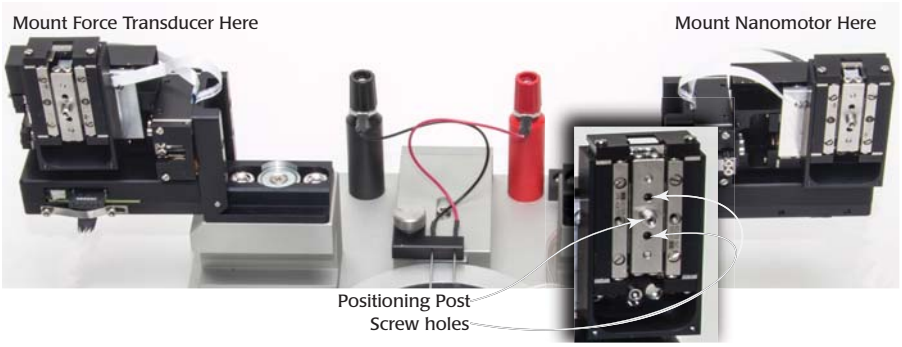


Fig. 11—The force transducer must be mounted on the left and the nanomotor on the right side.

CAUTION: To avoid damaging the microtweezers, flip the two micromanipulators all the way back before installing the nanomotor and sensor (Fig. 10).

A. Place the two screws into the screw holes on the nanomotor (Fig. 12).
B. There is a small post on the micromanipulator to help position the nanomotor. Slide the nanomotor over the post and line up the screws with the holes on the micromanipulator.
C. Use a small hex wrench to tighten both screws securely.

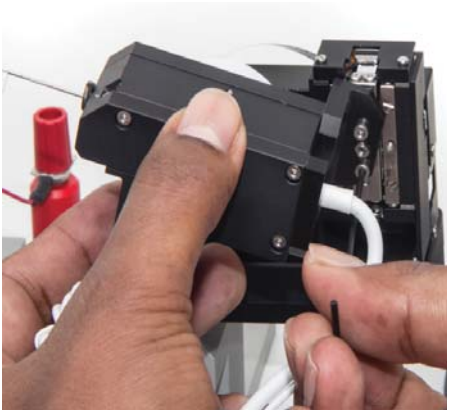


Fig. 12—(Left) The screw holes are labeled.

Fig. 13—(Right) Secure the nanomotor to the micromanipulator on the right side of the base platform

4. Mount the force transducer to the micromanipulator on the left side of the base platform in the same way that you mounted the nanomotor to the right side

micromanipulator.

Fig. 14—The force transducer is mounted on the left side and the nanomotor on the right side.

Connecting Micromanipulators to the Control Unit

The cables on each micromanipulator terminate with precision, multi-pin plugs. These plugs need to be inserted into matching sockets on the back of the control unit. These sockets are on one side of the controller, and the power plug and the ON/OFF button are on the opposite side of the controller.

CAUTION: To prevent damage to these connectors, make sure the plug and the socket are aligned properly before pushing the two together. If aligned properly, the connectors will lock together automatically. If the sleeve around the plug is retracted properly, the plug can easily be removed from the socket.

The **SN-PZ-50** micromanipulator system is pre-programmed so that the odd-numbered device ID addresses (1, 3, 5…) are configured for the right-handed micromanipulators, like the one that supports the nanomotor. The even-numbered device ID addresses (2, 4, 6…) are configured for the left-handed manipulators, like the one that supports the transducer.

1. Locate the sockets for the micromanipulator connections on the back of the controller.
2. As you look directly at the back of the controller, plug the micromanipulator for the transducer into the right socket of the pair.
3. Plug the micromanipulator for the nanomotor into the left socket of the pair.
4. If an additional micromanipulator is needed, it is connected to the control unit

through an optional hub that plugs into one of the manipulator sockets. Assign one of the open device ID addresses to the new manipulator using the Device Settings menu. Always switch off the control unit before connecting or changing the position of a manipulator.

NOTE: The **SN-PZ-50** system has been configured for two manipulators at the factory. Reconfiguration is only necessary if the micromanipulator firmware has been upgraded.

CAUTION: It is very important not to load the manipulators with the drag of the cables of the transducer and the nanomotor. Cables that drag or catch on parts of the apparatus will interfere with normal functioning of the manipulators. Organize the cables of the sensors to eliminate any possible points that will drag. Drag is one of the most common drift sources during the experiments.

CAUTION: The micromanipulators have permanently attached flat, white cables that connect the x-axis and z-axis to the control electronics built into the bases of the manipulators. These white cables cannot tolerate large stresses. Avoid pulling these cables during installation or use. Ensure that they are free to move during normal operation.

NOTE: The cable clip on each manipulator can also be used to electrically ground the micromanipulator to minimize electronic noise during recordings.

Starting the System for the First Time

1. Before turning on the **SN-PZ-50** manipulator system, check:
   - The mounting of the micromanipulators to the base of the **SI-CTS200**.
   - The mounting of the transducer and the nanomotor to the micromanipulators.
   - The connection of the cables of the micromanipulators to the control unit.
2. After the check, press the POWER button on the control unit to turn on the manipulator system. The screen of the control unit displays information about the current version of the control unit firmware.
3. To view information about the current version of the micromanipulator firmware, go to General Settings menu and open the Show version info window.

CAUTION: Always remove the microtweezers or glass fiber mounts from the sensor and motor before performing either Zero Position Initialization or Speed Calibration. These processes will drive each of the three axes of each micromanipulator to their limits. Removing the cell mounts will prevent a possible collision and damage to the cell mounts. Make sure that each micromanipulator has enough clearance to complete these initialization movements.

Zero Position Initialization

When the **SN-PZ-50** micromanipulator system is turned on for the first time, a prompt appears on the dialog window requesting that the zero position of each micromanipulator be initialized. The initialization can be performed on the currently selected device or all devices. To skip the initialization push the Back button.

Fig. 15—The main display window and control knobs/buttons of the **SN-PZ-50** *control unit*

- This procedure should be performed the first time the system is turned on. Also, it may need to be done when a micromanipulator is accidentally moved by hand and when the system is either ON or OFF.
- The initialization begins with the retraction of the X-axis to the outside, followed by the movement of the Y-axis to the front and the lifting of the Z-axis as high as it will travel. After initialization, each axis returns to its Home memory position.
- The manipulators move to their Home memory position in the same order that was used during initialization. The order in which the axes of the micromanipulator move during transition to the memory positions (Home, Target) can be changed using a function on the Device Settings menu.
- Pressing the Reset button before switching off the control unit saves the current position information for the micromanipulator and control unit to the memory of the system. This reset will prevent the Zero Position Initialization dialog from popping up on the screen unless a micromanipulator has been manually moved while the system is powered off.

Speed Calibration

After the transducer and the nanomotor have been mounted, perform a Speed Calibration. This determines the initial control voltage that is required to move the micromanipulators with the added weight (load) of the transducer and the

nanomotor mounted on the manipulators.

Your micromanipulator system is now ready for use. We highly recommend getting accustomed to the system by operating the controls and programming the preferences that will be used in your experiments before using the system in live experiments.

CONTROL UNIT

The control unit provides an ergonomic interface for the precise positioning of the cell mounting devices through the transducer and nanomotor that are mounted on the micromanipulators. The screen on the control unit displays information like the current position of the selected micromanipulator, speed setting, the device ID of the micromanipulator being controlled and the battery capacity or charging (chg) status. (Fig. 16) Also, the window displays the functions of the four small push buttons that surround it. (Menu, Reset, Home and Target in the main display).

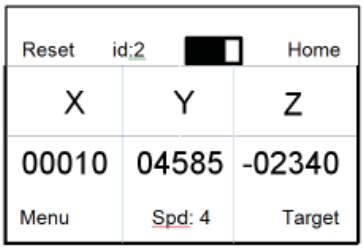


Fig. 16—Main display The control unit user interface is shown below in Fig. 17.

Fig. 17—Control unit from the top.

Reset button has three functions:

- A quick push on this button resets the position readings of the axes that are displayed in the center of the window to zero.
- A push of this button also saves the absolute position information to the micromanipulator that is being controlled.
- A push of the Reset button for longer than one second puts the micromanipulator system into Recording (Sleep) mode, as indicated by the key icon that replaces the label (Reset) on the screen. When this mode is activated, the micromanipulators will not move and the rotary knobs of the X, Y and Z axes are inactivated. This mode prevents the probe or sensor

from being accidentally moved during recordings, and power is conserved, since none is required to maintain the positions of the manipulators. The control unit and micromanipulators are returned to the normal operating mode by pressing the Reset button for longer than one second. The key icon returns to the label (Reset) in normal mode.

Menu button takes you to the Main menu. When the menus are used, the labels in the corners of the window, next to the buttons, identify the functions controlled by the buttons. For example, the labels for the buttons on the right side of the display window transform into arrows that operate the up/down scroll function for navigating through lists of settings.

Speed-/Device 1 button is a round button to the lower left of the display window. It has two functions:

- A quick push on this button reduces the speed of movement and positioning resolution on all three axes. While the **SN-PZ-50** system is in normal operating mode. Each push of the button reduces the speed of the motors on all axes one step at a time. Speeds range from a high of 5 to a low of Pen (5-4-3-2-1-Snail-Pen). An additional push of the button while the system is at Pen speed cycles the speed back to a high of 5. Pen is used to control the speed of penetration of microelectrodes into cells, which is a function not needed with the **Cell Tester**.
- A push of this button for longer than one second selects the micromanipulator identified as device 1 as the device being controlled. Device 1 is the nanomotor on the right side of the **SI-CTS200**. All the device settings, memory positions and speeds that are stored in memory for that device are utilized when that device is selected.

Home button has two functions:

- A quick push of this button, followed by a push of the Ok button to confirm the action, moves the axes to the Home position stored in the memory of the micromanipulator. The Home position could be a position where the tissue mounts are safely changed.
- A push of this button for longer than one second saves the current location in the memory of the manipulator. A message confirming the saving of the position is displayed after the Home position is updated.

Target button has two functions:

- A quick push of this button, followed by a push of the Ok button to confirm the action, will move the axes to the target position stored in the memory of the micromanipulator. The target position could be a position above the cells that rest on the bottom of the cuvette.
- A push of this button for longer than one second saves the current location in the memory of the manipulator. A message confirming the saving of the position is displayed after the target position is updated.

Speed+/Device 2 button is a round button on the lower right of the display window. It functions just like the Speed-/Device 1 button. Device 2 is the transducer on the

left side of the **SI-CTS200**.

Large rotary knobs under the display window are connected to the optical encoders that enable each axis to be controlled individually. The knob-axis configuration can be customized from the General Settings menu. When the system is being operated, the display window shows which axis is assigned to each knob. In Fig. 15, the knobs control the Y, Z and X axes, from left to right.

NOTE: The control unit also has a power saving feature that puts the system into Record (sleep) mode after a period of inactivity that can be defined on the General Settings menu. Awaken the system by pressing the Reset button.

Main Menu

To open the Main menu from the main display window:

1. Push the Menu button. The first four functions of the Main menu will be displayed on the first page of the menu (Fig. 18, left).

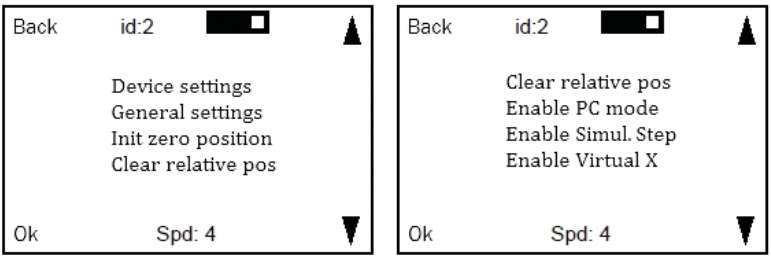


Fig. 18—The two pages of the Main menu

2. Push the Up or Down button to highlight the function needed or to move to the second page of the Main menu.
3. Select the highlighted function from the Main menu by pushing the Ok button.

The following functions are accessible from the Main menu:

Device Settings–Select, detect, address, calibrate and configure the micromanipulators connected to the control unit. (See page 16.)

General Settings–Customize the user interface of the control unit user interface and configure some of the characteristics common to all the micromanipulators. (See page 19.

Init Zero Position–Re-establish the absolute position information of the micromanipulators if one or more of them have been moved manually. This function drives each axis of the selected manipulator to its extremes.

CAUTION: Cell mounts should be removed from the sensor and the nanomotor before the Init Zero Position function is used.

1. Use the Up or Down button to highlight this function on the menu.

2. Push the Ok button to select this function
3. Use the Up or Down button to select the device(s) to be initialized.
4. Push the Ok button to initialize the device(s). Push the Back button to return to Main menu without initializing the devices.

Clear Relative Pos–Clear the relative position information of the micromanipulators from the system memory.

1. Use the Up or Down button to highlight this function on the Main menu.
2. Push the Ok button to clear the relative position information from the system memory.
3. Push the Back button to return to the main window, which now displays the absolute position information.
4. Push the Reset button to save the absolute position information to memory.

Enable PC mode–Control the micromanipulators directly from a computer using an application like a LabView virtual instrument (VI). This function is also used to update the firmware of the manipulators and the control unit from a computer. In both situations, the control unit is connected to the computer with the **SN-PZ-50** USB upgrade cable.

1. Use the Up or Down button to select the function on the menu.
2. Push the Ok button when the window reads Enable PC mode to link the control unit to the computer application. Press the Ok button when the window reads Disable PC mode to break the link between the computer and the control unit.
3. Press the Back button to return to the main window after enabling or disabling PC mode.

Enable Simul. Step–Operate the micromanipulators in Multi-Move mode so that all manipulators connected to the control unit will move "simultaneously" when the Up or Down button is pressed.

NOTE: The Simultaneous Step function is not used on the **SI-CTS200,** because the distances between the cells and the cell mounts are not consistent. These distances vary according to the initial height of the cell mounts above the cuvette bottom, the size of the cells and the thickness of any coating (**MyoTak**) on the cell mounts.

If the label for this function reads Disable Simul.step, the Multimove mode is operational. To turn OFF the Multimove mode:

1. Use the Up or Down button to select the Disable Simul.step function on the menu.
2. Push the Ok button to disable the Simultaneous Step (Multimove) mode so that each micromanipulator can be controlled separately.
3. Push the Back button to return to the Main menu after disabling the simultaneous step mode.

Enable Virtual X only appears in control unit firmware that is older than V3.243. This function operates the X-axis as an orthogonal axis to the Y and Z axes when

the probe on the X-axis is tilted. When the Virtual X-axis is used, the angle of the tilt must also be programmed into the Virtual X Axis function on the Device Settings menu.

If the label for this function reads Disable Virtual X, the Virtual X mode is operational. To turn OFF the Virtual X mode:

1. Use the Up or Down button to select the Virtual X-axis function on the menu.
2. Push the Ok button when the window reads Disable Virtual X.
3. Push the Back button to return to the Main menu after disabling the Virtual X mode.

NOTE: The Virtual X function is not used with the micromanipulators on the **SI-CTS200** since the transducer and nanomotor have already been mounted on the manipulators at a steep angle.

Device Settings

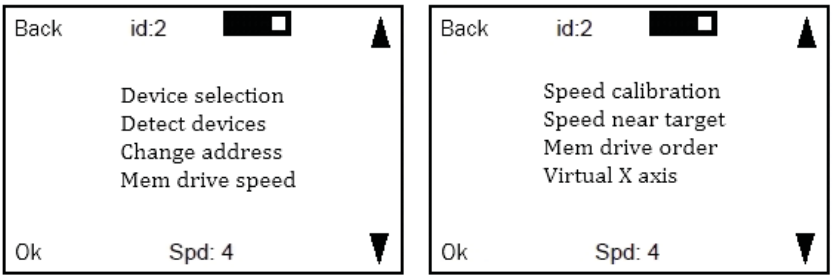


Fig. 19—The two pages of the Device Settings menu that show the functions available

Device selection–Select the micromanipulator to be operated by the knobs and buttons of the control unit.

1. Push the Up or Down button to highlight the Device selection function.
2. Push the Ok button to open its window.
3. Push the Up or Down button to highlight the micromanipulator (Device 1 or 2 in Fig. 15) to be operated.
4. Push the Ok button to select the desired manipulator.
5. Push the Back button to return to the Device Settings menu. Push the Back button again to return to the Main menu, and another time to return to the main screen.

NOTE: Devices can be selected quickly by pushing either the Device 1 or the Device 2 button for longer than one second. Push the Device 1 button to select Device 1. Push the Device 2 button to select Device 2.

Detect devices–Scan the system for the identities of all the devices connected to the control unit.

1. Push the Up or Down button to highlight the Detect Devices function.
2. Push the Ok button to open its window and start the scan. The message

"Scanning Devices" displays.
3. The Device Settings menu appears automatically after the scan is completed. Push the Back button once to return to the Main menu and twice to return to the main screen.

NOTE: This function runs automatically during the initialization of the control unit. It should always be run when a new micromanipulator is added to the system.

Change address.–Add or change the addresses (device IDs) of micromanipulators that are added to the **SN-PZ-50** system.
1. Push the Up or Down button to highlight the Change address function.
2. Push the Ok button to open its window.
3. Push the Up or Down button to select an open device ID for the added micromanipulator.
4. Push the Ok button to finalize the choice of the device ID, or the Back button to return to the Device Settings menu without adding a device ID.
5. Push the Back button again to return to the Device Settings menu, the Main menu and the main screen.

NOTE: Since two manipulators are already connected to the system, the available Device IDs start at 3. Use the odd-numbered device IDs (3, 5, 7…) for the right-handed manipulators, and the even-numbered device IDs (4, 6, 8…) for left-handed manipulators. At the factory, the two micromanipulators shipped with the system are pre-assigned to the first two addresses (Device 1 and Device 2).

Mem drive speed–Set the speed at which the axes move to the Home and Target memory positions.
1. Push the Up or Down button to highlight this function.
2. Push the Ok button to open its window.
3. Push the Up or Down button to select the speed (Slow, Mid, Fast) at which the axes move to the memory positions.
4. Push the Ok button to finalize the selection and return to the Device Settings menu, or push the Back button to return to the previous window without making changes.

Speed calibration–Adjust the control parameters of the motors on each axis for the added weight of the sensors, motors or other probes attached to the manipulators.
1. Push the Up or Down button to highlight this function.
2. Push the Ok button. A dialog window asks if you want to start calibration.
3. Push the Ok button to start the calibration and then return to the Device Settings menu, or push the Back button to return to the Device Settings menu without performing the calibration.

Speed near target–Set the speed of the axes as they approach or leave the Home and Target memory positions.
1. Push the Up or Down button to highlight this function.
2. Push the Ok button to open the window where the targeting speed is set.
3. Push the Up or Down button to select the targeting speed (Extreme,

Extended, Normal, OFF) to use near the memory positions.

4. Push the Ok button to save the speed and then return to the Device Settings menu, or push the Back button to return to the Device Settings menu without making any changes.

NOTE: This function is beneficial when moving near the cells to prevent vibrations that may damage the cells.

The positioning accuracy is the same in all settings.

Mem. Drive Order–Select which axis moves last as the transducer or nanomotor are moved into position to attach cells.

1. Push the Up or Down button to highlight this function.
2. Push the Ok button to open the window where the drive order is selected.
3. Push the Up or Down button to select Vertical (Z Last) order. With this setting order, the Z-axis moves after the other 2 axes when going to Target and before the other 2 axes when going to Home.
4. Push the Ok button to save the selection and then return to the Device Settings menu, or push the Back button to return to the Device Settings menu without making any changes.

NOTE: The memory drive order should be set to Vertical (Z-last) mode when the **SN-PZ-50** system is used on a **SI-CTS200** so that the cell mounts drop straight down into the area where cells are located. If Normal (X last) mode was used, the cell mounts would run into the stimulating electrodes as they moved toward the center of the cuvette.

Virtual X axis–Set the rotational angle of the X-axis when the probe mounted on the X-axis is tilted and the Virtual X-axis mode is activated.

NOTE: The Virtual X function is not used with the micromanipulators on the **SI-CTS200,** since the transducer and nanomotor have already been mounted on the manipulators at a steep angle. The rotational angle is set to OFF, since the sensor and nanomotor move straight down the Z-axis when cells are mounted.

Check the setting for the rotational angle of the X-axis:

1. Push the Up or Down button to highlight this function.
2. Push the Ok button to open the window where the angle is set.
3. Push the Up or Down button to set the rotational angle of the X-axis to Off.
4. Push the Ok button to save the selection and return to the Device Settings menu, or push the Back button to exit the window without making any changes.

General Settings

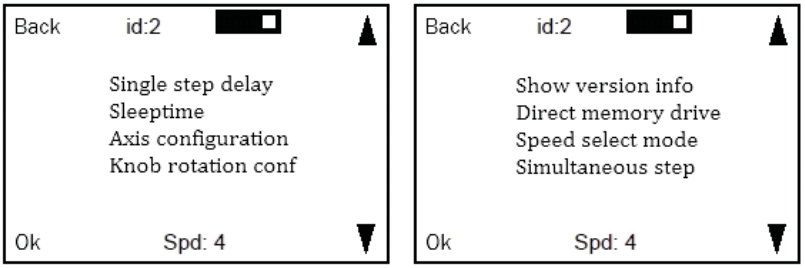


Fig. 20—The two pages of the General Settings menu that show the functions available

Single step delay–Program the length of the delay period needed in Penetration mode to prevent the electrode from being pushed farther into the cell accidentally. Using a delay ensures that single penetration thrusts are made in a reproducible manner.

NOTE: The Single step delay function is not used with a **SI-CTS200** because the Penetration (Pen) mode is not needed. Any value set for this function is acceptable as long as Pen mode is never used.

Sleeptime–Set the duration of inactivity that triggers the **SN-PZ-50** system to go into Sleep (Record) mode.

1. Push the Up or Down button to highlight this function.
2. Push the Ok button to open the window where the time is set.
3. Push the Up or Down button to select the duration of the inactivity period (OFF, 1, 3, 5, 10, 15, 30 min.).
4. Push the Ok button to save the selection and return to the General Settings menu, or push the Back button to exit the window without making any changes.

Axis configuration–Assign the three axes to the three knobs on the control unit in the order that suits you. The main display shows the current configuration of the knobs and axes.

1. Push the Up or Down button to select this function.
2. Push the Ok button to open the window to display the six possible configurations of axes.
3. Push the Up or Down button to select the configuration that is best for the user.
4. Push the Ok button to save the selection and return to the General Settings menu, or push the Back button to exit the window without making any changes.

Knob rotation conf–Change the directions that the axes move when the knobs are turned clockwise or counterclockwise.

1. Push the Up or Down button to highlight this function.

2. Push the Ok button to open the window where the rotation direction is set.
3. Push the Up or Down button to select which of the three axes to configure.
4. Push the Ok button to change the rotation of the selected axis from normal to reverse, or back.
5. Repeat Steps 3 and 4 for any other axis to be changed.
6. Push the Ok button to save the selection and return to the General Settings menu, or push the Back button to exit the window without making any changes.

Show version info–Display the current firmware version for the control unit and micromanipulators.

1. Push the Up or Down button to highlight this function.
2. Push the Ok button to open its window.
3. Push either the Ok or Back button to return to the General Settings menu.

Direct memory drive–Select the speed at which the axes move to Home and Target memory positions.

1. Push the Up or Down button to highlight this function.
2. Push the Ok button to open the window where the memory drive speed is selected.
3. Push the Up or Down button to select the memory drive speed [Normal (Confirm), Direct (Slow, Mid, Fast)].
4. Push the Ok button to save the selection and return to the General Settings menu, or push the Back button to exit the window without making any changes.

Speed select mode–Select the range of speeds that the axes can move when controlled through the Device 1 or Device 2 button:

- Normal mode with seven speeds (Pen, Sn, and 1 through 5).
- Simple mode-Slow with four speeds (Snail and 1 through 3).
- Simple mode-Fast with two speeds (4 and 5).

To select the appropriate speed range:

1. Push the Up or Down button to highlight this function.
2. Push the Ok button to open the window where speeds ranges are listed.
3. Push the Ok button to toggle between Normal and Simple modes.
    - If Normal mode is highlighted, push the Back button to select that range and exit this window.
    - If Simple mode is highlighted, push the Up or Down button to toggle between Slow and Fast ranges.
4. Push the Back button to select the highlighted range, exit this window and return to the General Settings menu.

Simultaneous step–Program the number of one-micron steps that manipulators linked in multi-move mode can make in response to one multi-move command.

NOTE: The Simultaneous Step function is not used with the micromanipulators on the **SI-CTS200,** because the distances between the cells and the cell mounts will vary according to the initial height of the cell mounts above the cuvette bottom, the

size of the cells, and the thickness of any coating (**MyoTak**) on the cell mounts.

To prevent the micromanipulators from working in multi-move (simultaneous step) mode:

1. Push the Up or Down button to highlight this function.
2. Push the Ok button to open the window for this function.
3. Push the Up or Down button to select OFF in the list of multi-move distances (steps). Distances available include OFF, 2, 5, 10, 20, 50, and 100.
4. Push the Ok button to save the selection and return to the General Settings menu, or push the Back button to exit the window without making any changes.

OPERATING INSTRUCTIONS

Positioning Cell Mounts

Positioning of the cell mounts onto the ends of cells is accomplished by turning the large rotary knobs on the control unit.

- You can assign each axis (X, Y and Z) to a rotary knob of your choice by using the Axis configuration function on the General Settings menu. See page 19.
- The X-axis moves the cell mount to the left and right on the horizontal plane (lateral movement), while the Y-axis moves the mount forward and backward on the horizontal plane (axial movement). Finally, the Z-axis moves the cell mount up-down (vertical movement).
- Select the preferred direction of rotation for each knob by using the Knob rotation conf. function on the General Settings menu. See page 19.

NOTE: We recommend that you get accustomed to the positioning and speed control settings with a practice session before performing your first experiments.

CAUTION: If any of the axes stop moving while being driven, check to see if a physical obstacle or a dragging cable prevents the movement of the micromanipulator. If there is no obvious reason for the stoppage, review the Troubleshooting Guide and contact WPI. Do not force the movement of the axes. It may lead to the damage of the micromanipulator.

Adjusting Speed

Adjusting the speed at which the tissue mount moves along the X, Y and Z axes is controlled by the Speed + and Speed - buttons on the lower left and right of the display window (Fig. 15). While the **SN-PZ-50** system is in normal operating mode:

- Each quick push on the Speed - button reduces the speed of movement on all three axes of the micromanipulator a step at a time. Speeds range from a high of 5 to a low of Pen (5-4-3-2-1-Snail-Pen). An additional push of the button while the system is at Pen speed cycles the speed back to a high of 5.
- Each quick push on the Speed + button (6 in Fig. 15) increases the speed of

movement on all three axes a step at a time. Speeds range from a low of Pen to a high of 5 (Pen-Snail-1-2-3-4-5). An additional push of the button while the system is at 5 cycles the speed back to a low of Pen.

Speeds 4 and 5 are designed to rapidly position the tissue mount in proximity of the target. Then, slower speeds are used for precision positioning, because the control logic for the slower speeds is different from the one for the faster speeds (4, 5). Also, turning the rotary knob (encoder) of an axis faster than the selected rotation speed assures that the stepping of the positioning motor on that axis is continuous In addition to providing faster speed, this also eliminates sound and vibrations.

NOTE: Pen speed is NOT used when operating a **Cell Tester**. Pen speed is used to control the speed of penetration of microelectrodes into cells, a function not needed on the **Cell Tester**. To prevent Pen mode from being activated accidentally, a dialog window that confirms its activation opens when Pen is selected.

CAUTION: A push of Device 1 button for longer than one second selects the micromanipulator known as Device 1, which holds the nanomotor on the right side of the **SI-CTS200**, to be controlled by the buttons and knobs. All the device settings, memory positions and speeds that are stored in memory for that device are utilized when that device is selected. Likewise, a long push of the Device 2 button will select the manipulator known as Device 2, which holds the transducer on the left side of the Cell Tester.

Memory Positions

Sending the selected micromanipulator and its tissue mount to either of the memory positions, Home or Target, is controlled by the Home and Target buttons on the right side of the display window.

- A quick push on the Home button retrieves the Home position for the selected manipulator (Device 1 or 2) from the system's memory, and displays the X, Y and Z coordinates of the Home position and speed (Slow, Mid, Fast) that is used to reach that position. Clicking the OK button confirms the selection and initiates the automatic positioning of the tissue mount.
- A quick push on the Target button works in the same way as the Home button to automatically position the manipulator at the target site.

Each micromanipulator has two memory positions that can be saved to memory, Home and Target. To save the current position of the selected micromanipulator as the Target position, push the Target button for longer than one second. Likewise, to save the current position of the selected micromanipulator as the Home position, push the Home button for longer than one second.

Memory Drive Order

The orientation of the transducer and nanomotor on the **SI-CTS200** permits the cell

mounts to be dropped into position over and onto cells by the sole movement of the vertical Z-axis.

- It is important that the memory drive order of the axes be set so that the Z-axis moves last when the cell mounts approach the Target position, and the Z-axis moves first when the cell mounts move to the Home position.
- To set the appropriate memory drive order, go to the Mem Drive Order function on the Device Settings menu. See page 18. Select the Vertical (Z Last) as the drive order.

Resetting Display

The current position of the selected micromanipulator is identified by the values of the X, Y and Z coordinates that are displayed on the window of the controller. The values for those coordinates can be set to zeroes and used as a reference point with a quick push of the Reset button.

To erase the relative position information for the micromanipulators from the memory of the system, see page 15.

Power-Off Recording Mode

When the cell has been attached to the cell mounts, the micromanipulators should be powered off to prevent any damage to the attached cell. Activate the Power-Off Recording mode by pressing Reset button for longer than one second. When activated, this mode locks the rotary knobs of all three axes to prevent accidental movement of the cell mount. The micromanipulators are also powered off to reduce any noise emission to zero. The control unit is placed in stand-by mode to reduce the battery consumption.

Return to the normal operating mode by pressing the Reset button to wake up controller. To unlock the keys of the controller, press the Reset button a second time for longer than one second. These additional steps prevent the accidental waking and movement of the micromanipulators during recordings.

CAUTION: Each micromanipulator has a hardware switch that is used to power off the micromanipulator during servicing. Do NOT touch the switch on the micromanipulator during recordings. Touching the micromanipulator gives rise to movement artifacts that affects the quality of the recording.

Initialize Absolute Position Information

The **SN-PZ-50** micromanipulators have integrated linear position sensors on each of their axes. These sensors provide information about the absolute position of each axis of a manipulator to the controller. When the system is turned on, the position information stored in each micromanipulator is compared to the position

information stored in the memory of the control unit. If these values differ, a dialog window appears in the window of the controller requesting that the Init Zero Position function be run on each of the micromanipulators that has position information that disagrees with the information in the memory of the control unit. This request appears if any of the axes is moved accidentally by hand whether the manipulator is powered-on or powered-off.

To initialize the zero position information, page 14.

NOTE: Press the Back button on the dialog window to continue normal operation without initializing the zero positions. If the micromanipulator has been manually moved, the absolute readings will differ from the real values, but this does not affect its normal use.

CAUTION: The Init zero position drives each of the axes to their extreme. Therefore, this function should only be performed in the absence of the cell mounts to prevent collisions. Always ensure that the micromanipulator has enough clearance to perform this function before starting it.

Charging the Battery

The control unit is delivered with the battery charged.

- The battery indicator, which is located on the upper line of the screen, displays the remaining amount of battery life.
- Recharge the battery, when necessary. The battery can be charged at any time, and it is not necessary to let it fully discharge before charging.
- The charger can be left plugged-in without risk of over-charging.
- It is possible to continue using the micromanipulator while charging the battery, but this is not recommended while making sensitive electrophysiological measurements, because the charger may cause 50/60 Hz noise in the vicinity of the recording apparatus.

To charge the battery of the control unit:

1. Plug the power cord of the charger into a grounded power outlet.
2. Connect the charger plug to the corresponding connector on the right backside of the control unit.
3. Check the display on the controller to make sure the "chg" symbol is displayed on the upper line of the display.

CAUTION: The charger should only be connected to a grounded mains outlet.

Virtual X Axis

This is a function that is very useful when an angled probe of a patch clamp or an intracellular electrometer is mounted on the micromanipulator. Since the cell mounts of the **SI-CTS200** can be moved into position over the ends of cells by sole movement of the vertical Z-axis, the virtual X-axis function is not needed when using micromanipulators on a **SI-CTS200** system.

To deactivate the Virtual X-axis function:

1. Set the X Rotation angle of the X-axis to OFF. Go to the Virtual X axis function on the Device Settings menu. See page 18.
2. Disable the Virtual X function, if your version of firmware has this function. Go to the Enable/Disable Virtual X function on the Main menu. See page 15.

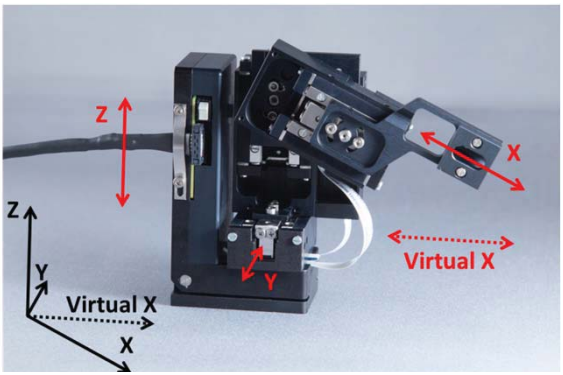


Fig. 21—This illustration shows the idea of the Virtual X axis..

Inverse Virtual Axis

Like the Virtual X-axis, the inverted virtual axis function is not required when the micromanipulators are mounted on the **SI-CTS200**.

Simultaneous Step (Multimove)

This function is useful when multiple manipulators need to be moved up and down the Z-axis over a preselected distance at the same time. When activated, the Multimove function operates at the Snail speed when the Up or Down button on the right side of the screen are pushed. The linked manipulators alternate moving in 1µm steps until the total programmed distance is reached. Since a manipulator cannot make a step until the other manipulator has completed its step, the manipulators cannot be more than 1µm out of synchrony during the total range of movements.

NOTE: Since the diameters of cells, the thickness of the coating on the cell mount,

and the depth of the cell mounts are variable, using the Simultaneous Step function on the **SI-CTS200** is not recommended.

To disable the Simultaneous Step (Multimove) function, see page 15.

If the Simultaneous Step function is enabled, you also need to program the distance that the Z-axis of each linked micromanipulator will move with the single push of either the up or down button. To set the multimove distance on the Simultaneous Step function, see page 20.

MAINTENANCE

The micromanipulator has been designed to be a reliable instrument. In case of a problem, please review the troubleshooting guide. If the issue has not been resolved, contact WPI. User operations that are not specifically mentioned in this section are prohibited and may void the warranty.

CAUTION: This instrument contains no user serviceable parts or components. Contact WPI or your local representative for arranging service. Disassembling the product or attempting self-repair is prohibited and will void the warranty.

CAUTION: To clean the micromanipulation system components, gently wipe them with a clean, dry cloth. The cloth may be slightly dampened with water. Do not submerge the product in water or any other cleaners or solvents.

TROUBLESHOOTING

Problem	Possible Cause	Fix
More than one micromanipulator connected. None, or only some, work normally	Possible software freeze	Restart the system
	Device ID conflict	Connect only one manipulator, and test if it works normally. Repeat the test with another manipulator. If manipulators work normally by themselves, them may have an ID conflict. Check the device IDs. See page 17.
One or more micromanipulator axis does not move, or moves very slowly	Possible software freeze	Restart the system
	Excess loading of the manipulator	Verify the weight of the load (attached sensor and its bracket). Reduce weight to specified range or contact WPI for modification to handle larger loading.
	Cable dragging	Organize the cables to prevent dragging.

Problem	Possible Cause	Fix
Erratic movements	Possible software freeze	Restart the system
	Loosely connected mechanical parts	Check all mounting and angle adjustment screws. Check for firm attachment of sensor and bracket to manipulator. Securely tighten all the bolts and ensure firm mechanical connections. Change to proper electrode holder if one used does not clamp the micropipette firmly.
	Cable dragging	Check for properly organized cables with enough slack to prevent directional pull during positioning. Organize cables if required.
Drift	Mechanism of piezo-drives is inherently drift-free, if loaded to specifications. The likely cause is loosely connected mechanical parts or unstable sensor bracket	Check all mounting and angle adjustment screws. Check for firm attachment of sensor and bracket to manipulator. Securely tighten all the bolts and ensure firm mechanical connections. Change to proper electrode holder if one used does not clamp the micropipette firmly.
	Cable dragging	Check for properly organized cables with enough slack to prevent directional pull during positioning. Organize cables if required.

Problem	Possible Cause	Fix
One or more of the micromanipulator axis stops after normal operation	Possible software freeze	Restart the system
	Cable dragging	Check an obstacle or cable catch/drag that prevents movement.
	Dust or particles (saline crystals) in either piezo drive or linear bearings.	To find resistance in either of these locations, turn OFF the control unit and gently try to move the manipulator axis by hand. Should take less than 6N holding force. Do not move axis with large force! If the point of resistance on the axis of movement is defined, repeatable and narrow and accompanied by a clicking sound, there is particle in the bearings. Contact WPI. If the friction with manual movement varies over the range in non-specific way or movement has a grinding feeling, the problem is located in the piezo-drive. Turn off the controller. Move the affected axis back-and-forth over the range by hand 5 times. Switch on the control unit. Try normal operation. Assist the positioning first by hand, if needed. Check if normal operation is recovered by using the rotary knob to move the affected axis from end-to-end.
Change in behavior over time	Changes in position may be observed over longer time period when large loads are carried by the positioners.	A piezo drive is designed for a greater number of cycles than the number in a typical lifespan. Long term use with exposure to dust, particles and other possible interferences could affect its performance over time. Run the tests describe earlier that look for dust or particles. Then, run the tests described for the drift problem.
Manipulators are not detected. Connected manipulators should be detected automatically.	Manipulator not properly connected.	Check device ID on the main window of the control unit. If device ID is 0 (zero), check the connections of the manipulators to the control unit. Restart the control unit.
	Device not detected	Run the device detection manually. See page 16.

NOTE: If you have a problem/issue with that falls outside the definitions of this troubleshooting section, contact the WPI Technical Support team at 941.371.1003 or technicalsupport@wpiinc.com.

SPECIFICATIONS

The system is intended for use at room temperature in a laboratory environment that is free from mechanical vibrations, electrical noise and voltage fluctuations. The specifications for the manipulators and controller are listed below:

SN-PZ-50 Micromanipulator

Positioning range ..... 20x20x20 mm^3 (x-y-z)
Min. step size 30nm
Closed-loop control ..... 3µm Repeatability
Max. speed ..... ~5 mm/s
Max. Load 70g*
Electrode drive angle ..... 0–50° | 40–90°**
Table mounting ..... magnet | bolt
Electrode retrieval ..... back-flip | back-slide | side-rotate
Dimensions (WxHxL): 39x82x75mm
Weight 260g
Electrical input ..... 12 VDC, max. 1.5 A

*Custom high-load modifications available

**Two approach angle range options available

Control Unit

- Rotary optical encoders and backlit display
- Six speed settings and penetration mode
- 4th virtual axis for orthogonal positioning in angled approach
- Two programmable memory positions for each micromanipulator
- Single control unit can operate up to 14 micromanipulators*
- USB computer interface**

Charger input ..... 90-264 VAC, 50-60 Hz; max. 0.5 A (grounded 3-prong mains outlet required)

Batteries ..... Li-ion (rechargeable)

Dimensions 190x210x40mm

Weight 510g

*1-to-4 connector hubs are provided for multiple manipulator systems

**Software development kits available.

APPENDIX A: UPDATING FIRMWARE

Control Unit Updates

Contact Sensapex if you observe your system malfunctioning. The micromanipulator is controlled by modern embedded electronics, which enables changing the operation and tuning the functionalities of the system with firmware updates.

Visit product support section at: www.sensapex.com to see if there are new firmware updates available for your product.

CAUTION: When downloading firmware files, please note that some Internet browsers automatically change the file extensions. To properly download and save these Sensapex firmware.hex files to your computer, right-click on the download link for the file and use the Save Link As function to save the file on your computer in the proper format.

To update the Control Unit firmware:

1. Download the Firmware upgrade software for PC (Firmware Upgrade Tool) and the Control unit firmware V3.XXX from the Update section of the Sensapex Support page: http://www.sensapex.com/support/downloads-updates/files.html
2. Install the Firmware upgrade software for PC by locating the downloaded file and double clicking on the .exe file. Follow the installation wizard instructions.

   Do not open the Firmware Upgrade Tool at this time.
3. Connect the USB upgrade cable supplied with the **SNP-PZ-50** system to a USB port on the PC computer that was loaded with the installed upgrade tool.
4. Allow Windows to install a suitable driver for the Firmware Upgrade Tool. If the driver does not install automatically, download a driver for your operating system from: http://www.ftdichip.com/Drivers/VCP.htm, and install the USB cable manually using that driver. When installed properly, the USB cable should be listed as an USB-RS485 cable that is available as a serial port (COM port).
5. Verify that the **SNP-PZ-50** control unit is powered OFF. Disconnect all the micromanipulators from the control unit.
6. Connect the other end of the USB upgrade cable to the first port on the left side of the **SNP-PZ-50** control unit.
7. Start the Firmware Upgrade Tool.
8. Open the Program pull-down menu of the upgrade tool and select Settings. The Settings window appears (Fig. 22).
9. Use the COM Port drop-down list in this window to configure the COM Port to match the COM address of the USB upgrade cable.

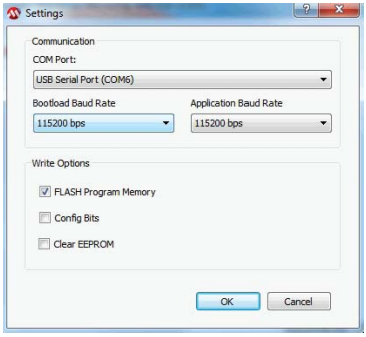


Fig. 22—The Settings window

10. Leave the other settings on the Settings window as they are. Click OK and return to the main window of the upgrade program.
11. Click on the Pause button on the toolbar of the main window of the upgrade application.

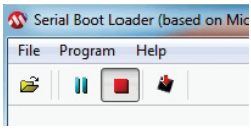


Fig. 23—The Upgrade toolbar showing: the Open folder, Pause, Stop (red square), and the Write (red arrow) buttons

12. Power ON the control unit. The control unit display will remain dark during update process. Wait for 10 seconds.
13. On the upgrade application, click on the Stop (red square) button on the toolbar. If the control unit is successfully linked to the computer and the upgrade application, the information on the versions of bootloader and hardware will be displayed across the bottom of the main window of the upgrade tool.
14. Click on the Open folder icon on the left side of the application toolbar. Locate the control unit firmware update file (CU*.hex file type) on the computer. Select this file on the dialog window. Click Open.
15. Click on the button with the Write (red arrow) that is located on the right side of the upgrade toolbar. Clicking this button updates the control unit firmware. Verify that the control unit firmware is updated by finding the term Write Complete displayed in the lower left corner of the window.

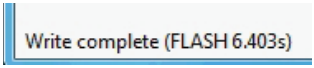


Fig. 24—The Write complete message indicates the firmware has been upgraded successfully.

16. Power OFF the control unit. Remove the upgrade cable from the control unit. Reconnect the micromanipulators to the control unit.

17. Power ON the control unit. Since the new firmware of the control unit has been successfully installed, the new firmware will be used on this and all successive power-ups.

Updating the Micromanipulator Firmware

NOTE: If two or more micromanipulators are used on the same control unit, the firmware on each micromanipulator has to be updated separately.

1. Verify that the control unit is powered off, and disconnect all the micromanipulators from the control unit.
2. Connect the USB upgrade cable to a USB port on the PC computer that was previously loaded with the firmware upgrade tool.
3. Connect the other end of the USB upgrade cable to the control unit and power ON the control unit
4. On the display window of the control unit, push the Menu button to open the Main menu of the controller. Use the Up or Down button to scroll through the Main menu and highlight Enable PC mode. Push the Ok button on the controller to enable PC mode. The words PC Mode appears on the upper edge of the controller screen when enabled.
5. On the computer, start the Firmware Upgrade Tool and configure its settings, if required, by using the same instructions used in the previous section.
6. On the firmware upgrade application, click on the Pause button that is located on the toolbar of the main application window.
7. Connect the cable of the micromanipulator to the open connector on the left side of the control unit. Wait for 10 seconds.
8. On the firmware upgrade application, click on the Stop (red square) button on the toolbar. If the micromanipulator is successfully linked to the computer and the firmware upgrade application, the information on the versions of bootloader and hardware is displayed across the bottom of the main window of the upgrade application.
9. Click on the Open folder icon on the left side of the application toolbar. Locate the micromanipulator firmware update file (MCU*.hex file type) on the computer. Select this file on the dialog window. Click Open.
10. Click on the button with the Write (red arrow) that is located on the right side of the upgrade toolbar. Clicking this button updates the micromanipulator firmware. Verify that the micromanipulator firmware is updated by finding the term Write Complete displayed in the lower, left corner of the window.
11. Restart the control unit. Push on the Menu button on the control unit and select Device Settings from its menu. Verify that the Device Settings (selection, ID, address and memory position drive speed) are set to your preferences. Also, verify that the device IDs of multiple manipulators used on the same controller do not conflict with each other. The update process for this manipulator is now successfully completed.
12. To upgrade the firmware on a second micromanipulator, power OFF the control unit. Note which connector on the left side of the control unit was used for upgrade cable and which one was used for the first micromanipulator.

Disconnect the first micromanipulator from the control unit.

NOTE: During its firmware update, the second micromanipulator must be plugged into the opposite connector on the left side of the controller. Since there are only two connectors on this side of the controller, the upgrade cable will be plugged into the connector that was originally used with the first micromanipulator. And, the second micromanipulator will be plugged into the connector that was used for the upgrade cable when the first micromanipulator was upgraded.

13. Repeat Steps 2 through 11 to upgrade the firmware of the second micromanipulator. Remember to plug the upgrade cable into the other connector so that the second micromanipulator will not be plugged into the same connector that was used for the first micromanipulator.

Device Detection after Firmware Upgrade

After updating the firmware for the control unit and/or the micromanipulators, the micromanipulators may not be automatically recognized by the control unit. The main window on the control unit will show a device ID (ID: 0). If this occurs:

1. Push the Menu button. Use the Up or Down button to select the Device Settings. Click the Ok button.
2. On the Device Settings menu, use the Up or Down button to select Detect devices. Click the Ok button. The controller scans for devices automatically, and then returns to the menu.
3. Complete the device detection by selecting a manipulator. Click the Back button to return to the Main menu. Use the Up or Down button to select Device Settings. Click the Ok button. Use the Up or Down button to select the Device to be confirmed. Click the Ok button to select the device. Automatic detection should work normally after this procedure.

DECLARATION OF CONFORMITY

Manufacturer's Name: Sensapex Oy
Manufacturer's Address: Höyrymyllyntie 38B, 90520 Oulu, Finland declares this product:
Product Name: SMX-series micromanipulation system conforms to the following standards:
Low voltage directive 2006/95/EC: EN 61010-1:2010
EMC directive 2004/108/EC: EN 61326:2006; EN 55011:2009/CISPR 11:2009 (Class A, Group 1)
Best of our knowledge RoHS compliant (2006/95/EC) WEEE directive 2002/96/EC
Batteries and Accumulators Directive 2006/66/EC
Supplementary Information: "The product complies with the requirements of the Low Voltage Directive 2006/95/EC and the EMC Directive 2004/108/EC"
Date: 12.11.2011

Mikko Vähäsöyrinki, CEO Sensapex Oy

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WARRANTY

WPI (World Precision Instruments, Inc.) warrants to the original purchaser that this equipment, including its components and parts, shall be free from defects in material and workmanship for a period of 30 days* from the date of receipt. WPI's obligation under this warranty shall be limited to repair or replacement, at WPI's option, of the equipment or defective components or parts upon receipt thereof f.o.b. WPI, Sarasota, Florida U.S.A. Return of a repaired instrument shall be f.o.b. Sarasota.

The above warranty is contingent upon normal usage and does not cover products which have been modified without WPI's approval or which have been subjected to unusual physical or electrical stress or on which the original identification marks have been removed or altered. The above warranty will not apply if adjustment, repair or parts replacement is required because of accident, neglect, misuse, failure of electric power, air conditioning, humidity control, or causes other than normal and ordinary usage.

To the extent that any of its equipment is furnished by a manufacturer other than WPI, the foregoing warranty shall be applicable only to the extent of the warranty furnished by such other manufacturer. This warranty will not apply to appearance terms, such as knobs, handles, dials or the like.

WPI makes no warranty of any kind, express or implied or statutory, including without limitation any warranties of merchantability and/or fitness for a particular purpose. WPI shall not be liable for any damages, whether direct, indirect, special or consequential arising from a failure of this product to operate in the manner desired by the user. WPI shall not be liable for any damage to data or property that may be caused directly or indirectly by use of this product.

Claims and Returns

Inspect all shipments upon receipt. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed loss or damage should be reported at once to the carrier and an inspection requested. All claims for shortage or damage must be made within ten (10) days after receipt of shipment. Claims for lost shipments must be made within thirty (30) days of receipt of invoice or other notification of shipment. Please save damaged or pilfered cartons until claim is settled. In some instances, photographic documentation may be required. Some items are time-sensitive; WPI assumes no extended warranty or any liability for use beyond the date specified on the container

Do not return any goods to us without obtaining prior approval and instructions from our Returns Department. Goods returned (unauthorized) by collect freight may be refused. Goods accepted for restocking will be exchanged or credited to your WPI account. Goods returned which were ordered by customers in error are subject to a 25% restocking charge. Equipment which was built as a special order cannot be returned.

Repairs

Contact our Customer Service Department for assistance in the repair of apparatus. Do not return goods until instructions have been received. Returned items must be securely packed to prevent further damage in transit. The Customer is responsible for paying shipping expenses, including adequate insurance on all items returned for repairs. Identification of the item(s) by model number, name, as well as complete description of the difficulties experienced should be written on the repair purchase order and on a tag attached to the item.

** Electrodes, batteries and other consumable parts are warranted for 30 days only from the date on which the customer receives these items.*

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