

MCS Hand Control Module

MCS-NH-TAB

User Manual



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1 Manufacturer Declarations

1.1 Declaration of Conformity

Declaration of Conformity

according to ISO/IEC 17050-1:2004

Manufacturer: SmarAct GmbH
Manufacturer's Address: Schütte-Lanz-Straße 9
26135 Oldenburg, Germany



The manufacturer hereby declares that the product

Product name: MCS
Model Numbers: MCS-xxx
Product Options: all

complies – if installed in a compatible chassis from SmarAct – with the following European directives:

2014/35/EU Low Voltage Directive
2014/30/EU EMC Directive
2011/65/EU RoHS Directive

The applied standards certifying the conformity are listed below:

Electromagnetic Emission: EN61000-6-3:2011, EN55011:2011

Electromagnetic Immunity: EN61000-6-1:2007

Safety (Low Voltage Directive): EN61010-1:2001

July 14, 2017
Oldenburg, Germany

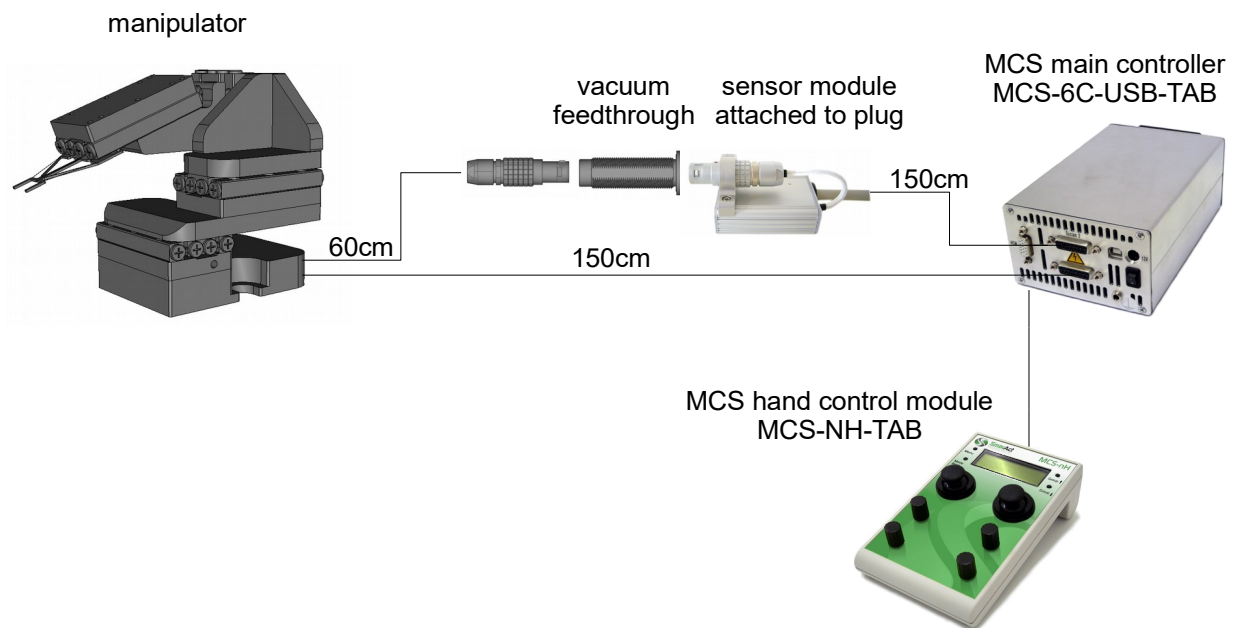

Axel Kortschack
Managing Director

2 Introduction

This document is a user manual for the SmarAct MCS Hand Control Module MCS-NH-TAB, which is connected as external module to the MCS main controller.

The MCS Hand Control Module offers easy and ready-to-go control by joysticks and control knobs - without the need of complex installation procedures.

Below please find a typical configuration with a six-channel controller, a three-channel sensor module as well as a hand control module (MCS-NH-TAB).



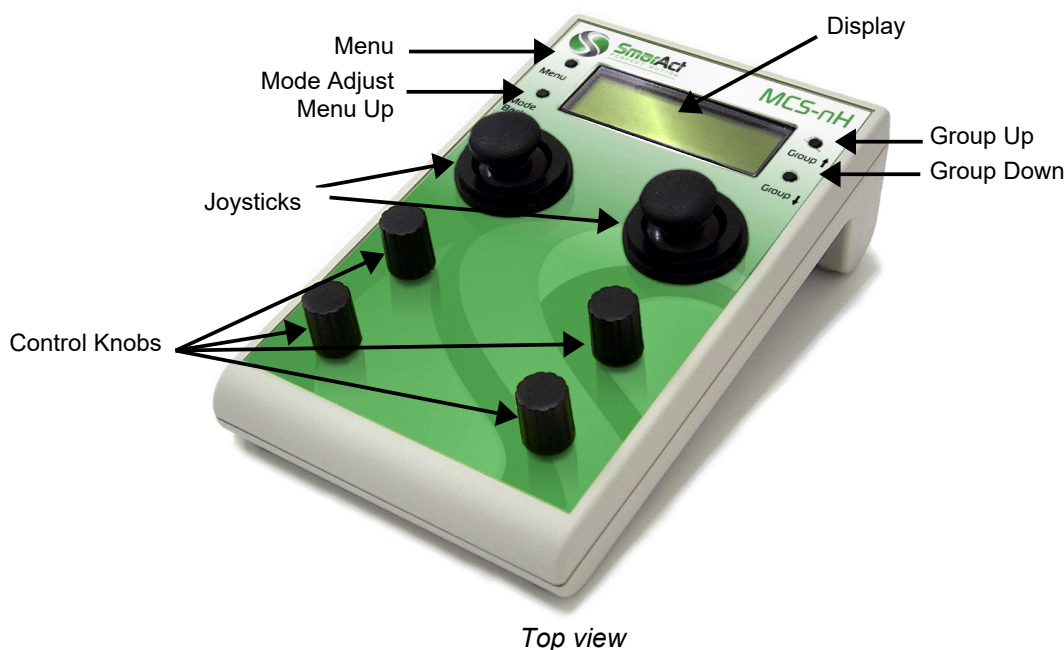
3 Hand Control Module

The Hand Control Module gives you direct control of your positioning system without having to setup a complex control software system. The device may be configured in many ways to suit your needs. However, SmarAct will preconfigure the device for you, so in most cases there will be no need to change the configuration.

After power up, the device is ready to be used and you may start using your positioning system immediately. This section describes how to control your positioning system with the Hand Control Module and how to reconfigure it if you wish to do so.

3.1 General

The device offers two joysticks and four control knobs to control the positioners, as well as a display and four buttons to configure the device.



Hand Control Module MCS-3H-TAB

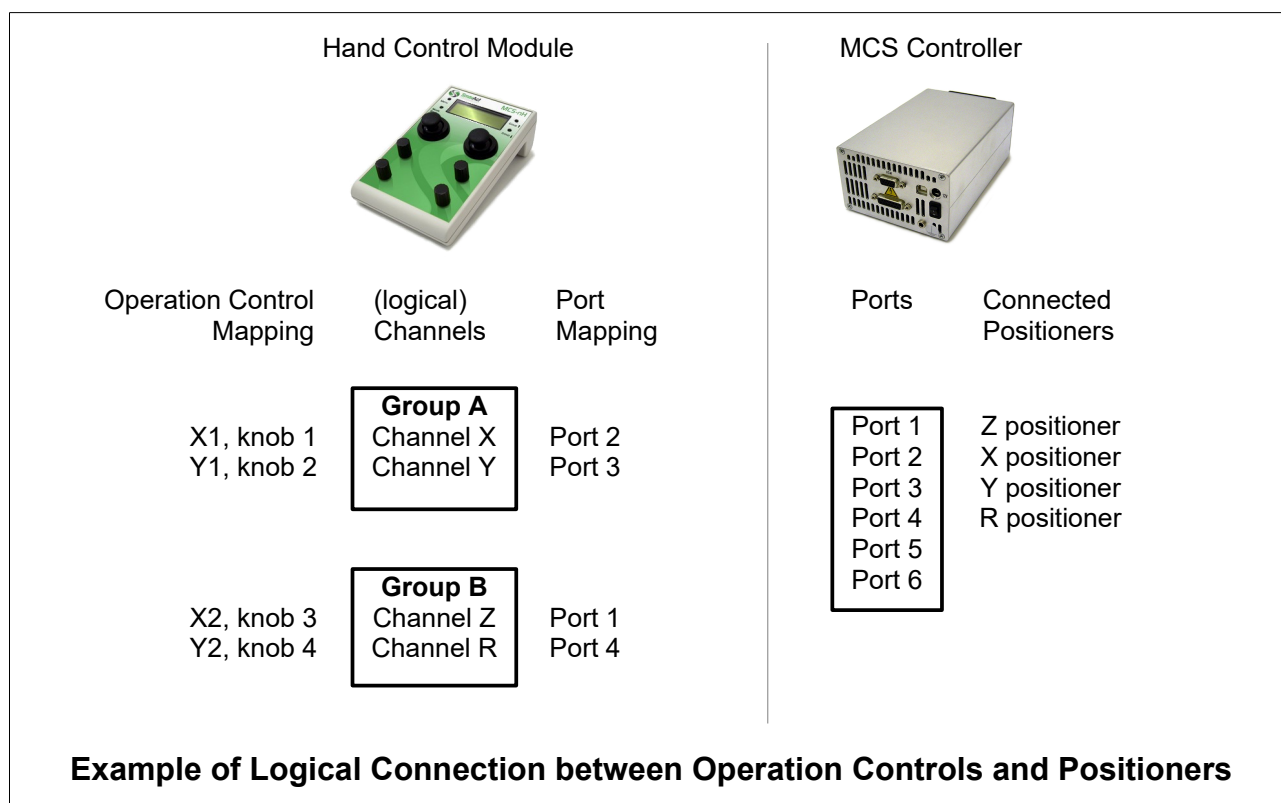
The operation of the device is divided into two modes: the *normal operation mode* and the *menu mode*. In the normal operation mode the device controls are used to control your positioning system. When controlling systems with many positioners (four or more) you may want to divide them into separate groups. The joysticks and knobs may be used to control the positioners of one group. You can use the “Group Up” and “Group Down” buttons next to the display to cycle through the different groups. The “Mode” button lets you select different control modes for each positioner. See section “Normal Operation Mode” for more information on how to control your system.

The “Menu” button enters and exits the menu mode. In this mode the device controls are used to navigate through the menus and sub menus. See section “Menu Mode” for more information.

3.2 Terminology

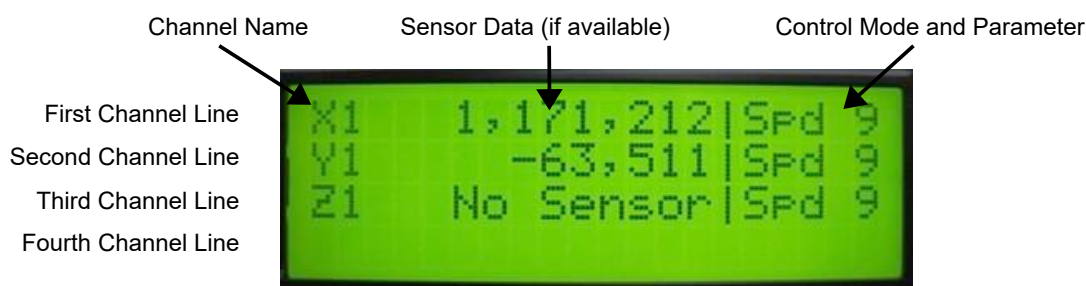
There are some terms that help to understand some basic concepts, especially if you want to adjust the configuration of the device to fit your own needs. Some of these terms are described here.

- **Port** - A port represents a physical signal output pin of the MCS. Each positioner or end effector is connected to a port of the control electronics. Each port has a specific type (positioner or end effector). Positioners may only be connected to positioner ports and end effectors may only be connected to end effector ports. The number of available ports and their types are static properties of the MCS and depend on the hardware you purchased. In a typical case of a complete system the connections from positioners and end effectors to the ports of the MCS are fix and cannot be changed.
- **Channel** - A channel is a logical representation of a positioner or an end effector. During the configuration of the Hand Control Module you may define several channels to control your system. Each channel gets mapped to a port and thus to a positioner or end effector. You may then control your system by setting control parameters for each channel and giving movement commands.
- **Channel Type** - Channels actually do not have a type themselves, since this is a port property. The term “channel type” refers to the type of the port that the channel is currently mapped to.
- **Group** - A group represents a manipulator that is assembled out of several positioners and/or end effectors. A group acts as a “container” for up to four channels. While in normal operation the display shows all the information you need to control the channels of one group, the *current group*. If more than one group is defined you may change the current group by using the “Group Up”/“Group Down” buttons next to the display.
- **Symbols and Names** - Each group may be given a separate *group symbol*, being a single character which is used in the display to refer to that group. The same applies to channels, which are given a *channel symbol*. A *channel name* consists of two characters and is the combination of the channel symbol and the group symbol that the channel is in. In normal operation the channel names are displayed at the beginning of each line.
- **Control Mode** - Each channel may be independently configured with a control mode. The control mode affects the way the positioners or end effectors will behave when turning knobs or moving joysticks to control the system. Each control mode has several parameters that may easily be changed to adjust the behavior of the channels. See section “Control Modes” for more information.



3.3 Normal Operation Mode

On power-up, the device initializes itself and then switches to normal operation. In this mode the display shows information for all channels of the current group. The display is organized in lines (*channel lines*) where each line displays information for one channel. The number of channel lines shown in the display depends on the number of channels that are defined within the current group.



Sample Display Setup in Normal Operation

3.3.1 Channel Lines

The first two characters of each channel line show the channel name consisting of the channel symbol and the group symbol. The contents of the rest of the line depend on the type of the channel, the current control mode of the channel and whether there is sensor data available or not. The different control modes are described in more detail below. Note that the channel name may be changed via the menu (see section "Configuration Menu").

For positioners with integrated sensors, linear position data is displayed in nanometers and rotary position data is displayed in micro degrees.

3.3.2 Control Modes

In normal operation the joysticks and the knobs are used to control positioners and end effectors. Typically, each knob is used to control one positioner or end effector. Which knob corresponds to which depends on the device configuration. The joysticks may also be freely mapped to certain channels.

Turning a knob or moving a joystick will perform a movement. The type of the movement depends on the control mode that is currently configured for the channel. Each channel may be configured with its own control mode independently. The direction of the movement depends on the direction you turned the knob or moved the joystick and also on the invert configuration of the knob or joystick (see section “Configuring Channels”).

To change the control mode of a channel press and hold the “Mode” button next to the display (bottom left). The text “Mode adjust” will appear in the display as long as this button is pressed. In this state, instead of moving the positioners, the knobs are used to change the control modes of the corresponding channels. By turning the knobs you may cycle through the available control modes in both directions.

Each control mode has its own parameters. Generally, the parameters of a control mode for a channel may be changed by pressing the corresponding knob. This brings up an arrow indicating the parameter change state. See the following sections for a detailed description of the control modes and their parameter settings.

3.3.3 Control Modes for Positioners

There are four different modes to control positioners:

- Simple Control Mode
- Advanced Control Mode
- Scan Control Mode
- Closed-Loop Control Mode

Note: The Closed-Loop Control Mode is not available to channels that have no sensor.

Hint: When entering the parameter change state the corresponding channel is implicitly stopped. This may be useful to abort a movement.

Simple Control Mode

In this mode a positioner is moved according to its current *speed level*. The speed level is a generic number ranging from 1 (slowest) to 17 (fastest) and the positioner will perform stepping movements. When turning a knob the positioner will perform bursts of steps. Moving a joystick will lead to a continuous movement until released.

Display

The current speed level of a channel is displayed on the right side of the channel line. If there is sensor data available it will be displayed in the left side of the channel line, otherwise “No Sensor” will be displayed.

Example channel line display without sensor: “A1 No Sensor | Spd 9”

Example channel display line with sensor: “A1 -1,675,756 | Spd 9”

Changing the Speed Level

To change the speed level press the knob corresponding to the channel. An arrow will appear next to the speed level display indicating the parameter change state. In this state the knob is used to adjust the speed level. Turning the knob right will increase the speed level, turning it left will decrease it. Pressing the knob will hide the arrow and exit the parameter change state.

Advanced Control Mode

The Advanced Control Mode is also used for stepping movements. However, in this mode you have more control over the parameters that the steps are performed with. You may adjust amplitude and frequency separately as well as the number of steps that are performed per burst.

The *Frequency* parameter is given in Hz and ranges from 5Hz to 18,500Hz. The *Amplitude* parameter is given as a 12-bit value and ranges from 100 to 4,095. A 0 would correspond to 0 Volts, 4,095 corresponds to 100 Volts. The *Steps* parameter ranges from 1 to 9,000.

Turning a knob will perform a burst of steps with the given parameters.

Moving a joystick will lead to a continuous movement until released. The range of frequencies (and therefore the sensitivity of the joystick) is controlled by the *Steps* parameter. A higher value will result in a coarser movement. The step width remains related to the *Amplitude* parameter. Note that the *Frequency* parameter has no influence when you control the positioner with the joystick.

Display

If there is sensor data available it will be displayed on the left side of the channel line and the *Steps* parameter on the right side (indicated by an 'S'). In this case the *Amplitude* ('A') and *Frequency* ('F') parameters are hidden. If there is no sensor data available all three parameters will be displayed in the channel line.

Example channel line display without sensor: “A1F10000 | A4095 | S1000”

Example channel display line with sensor: “A1 13,286,430 | S1000”

Changing Parameters

To change the parameters press the knob corresponding to the channel. Sensor data (if available) is hidden and all parameters are displayed along with an arrow symbol indicating the parameter currently being edited. Turning the knob will increase resp. decrease the current parameter.

To change the current parameter press and hold the knob. The arrow will change to a left/right arrow symbol. Turning the knob in this state (while pressed) will change the current parameter.

Pressing and releasing the knob without having changed the current parameter will exit the parameter change state.

Scan Control Mode

This mode is exclusively used for scanning movements. No steps will be performed. In this mode you have control over the deflection of the piezo element of the positioner. The current deflection is given as a 12-bit value ranging from 0 to 4,095. Turning a knob or moving a joystick will perform a scanning movement of a certain increment. The increment parameter may be adjusted.

When reaching a boundary (0 or 4,095) the positioner will stop. In this state a scan movement instruction in the direction of the boundary will have no effect. If you wish to move the positioner further in this direction you must switch to one of the other control modes.

Display

The current deflection of the piezo element of the positioner is displayed on the right side of the channel line (given as a 12-bit value). If there is sensor data available it will be displayed in the left side of the channel line, otherwise the increment parameter will be displayed.

Example channel line display without sensor: "A1 ΔV 100 | V2047"

Example channel display line with sensor: "A1 -62,095 | V2047"

Changing the Increment Parameter

To change the increment parameter press the knob corresponding to the channel. Sensor data (if available) is hidden and the increment parameter is displayed along with an arrow symbol indicating the parameter change state. In this state the knob is used to adjust the increment parameter. Turning the knob right will increase the increment, turning it left will decrease it. Pressing the knob will hide the arrow and exit the parameter change state.

Closed-Loop Control Mode

This mode is only available to positioners that are equipped with an integrated sensor. If so you may instruct the positioner to travel a certain (relative) distance. The joysticks can not be used to control positioners in this mode. Turning a knob will move the positioner by the configured increment.

The increment parameter depends on the type of the positioner that is configured for a channel (see section "Configuring Channels"). Linear increments range from 1nm to 5mm. Rotary increments range from 1μ° to 90°.

Display

The current increment is displayed on the right side of the channel line. The sensor data is displayed in the left side of the channel line.

Example channel display line (linear): "A1 -4,462,339 | 100μm"

Example channel display line (rotary): "A1 36,195,735 | 2m°"

Changing the Increment Parameter

To change the increment parameter press the knob corresponding to the channel. An arrow will appear next to the increment display indicating the parameter change state. In this state the knob is used to adjust the increment. Turning the knob right will increase the increment, turning it left will decrease it. Pressing the knob will hide the arrow and exit the parameter change state.

Hold Time

The Closed-Loop Mode has a global parameter that affects all channels equally. The *hold time* represents the time (in seconds) that a target position is actively held after reaching it. To adjust this parameter, enter the main menu (top left button next to the display), select “Sensor Options” and scroll to the “CL Hold Time” entry. A value of 0s will simply stop the positioner once the target is reached. Other values will cause the positioner to hold the position, potentially compensating for drift effects and the like. If set to infinite, the positioner will only stop holding the position on an explicit stop (pressing the knob) or by performing other movements in different control modes.

Note that this option also affects the “Find Reference” function (see section “Reference Marks”).

3.4 Menu Mode

The menu mode is used to configure the Hand Control Module and to execute special commands, e.g. finding reference marks of positioners with sensors. To enter the menu mode press the “Menu” button next to the display (top left). To exit the menu mode press this button again or select the exit menu entry of the main menu.



Menu Display Setup

The navigation through the menu and sub menus follows a simple scheme. The first line of the display shows the name of the current menu. The rest of the lines display the menu entries. Turning any knob will cycle through the entries in a scrolling manner. The solid arrow on the left side indicates the current menu entry (always the middle line). Pressing any knob will select the current menu entry.

A small arrow on the right side of a menu entry indicates that a sub menu will be entered if the entry is selected. To exit a sub menu select the “Exit” menu entry.

To speed up menu navigation you may use the buttons on the left side of the display. The “Menu Up” button (bottom left) will exit the current menu and navigate one hierarchy level upwards. Doing so in the main menu will exit the menu mode and has the same effect as pressing the “Menu” button (top left). The “Menu” button always exits the menu mode immediately.

The joysticks have no function while in menu mode.

The “Alt.” buttons on the right side of the display have context dependent functions. See section “Advanced Features” for more information.

3.4.1 Sensor Options Menu

The Sensor Options menu lets you execute special commands and select options that relate to position sensors that are integrated into your positioners. Note that if your positioning system is not equipped with sensors this menu entry will not appear.

In this menu the following entries are available:

- Zero All: Selecting this entry will cause all positioners to set their current position as their zero position.
- Zero Channel: Instead of zeroing all channels, this entry will enter a sub menu where you can select one or more specific channels to zero.
- Find Ref. All: This will cause all positioners to move to their reference marks. You may specify a special sequence that defines in which order the positioners move to their marks. See section “Reference Marks” for more information.
- Find Ref. Ch: This entry will enter a sub menu where you can select one or more specific channels to move to their reference marks.
- Configure Refs: To configure the sequence in which positioners move to their reference marks when issuing the “Find Ref. All” command you would normally use the Channel Settings menu for each channel. The “Configure Refs” sub menu allows you to configure all channels within one menu. See the section below for more information.
- Calibrate All: This will cause all channels to calibrate their sensors. See section “Sensor Calibration” for more information.
- Calibrate Ch: This entry will enter a sub menu where you can select one or more specific channels to calibrate.
- CL Hold Time: This entry is used to set the Closed-Loop Hold Time parameter. See section “Closed-Loop Control Mode” for more information.
- Mode: Specifies the sensor mode. The available modes are “Disabled”, “Enabled” and “Powersave”. See section “Sensor Modes” for more information.

Configure Reference Marks Menu

When issuing the “Find Ref. All” command from the Sensor Options menu all positioners will move to their reference marks in a special sequence (see section “Reference Marks”). The Configure Reference Marks sub menu lets you configure this sequence for all channels and also their initial search direction (safe direction).

For each positioner channel that supports this feature there will be a menu entry with the name of the channel, its current reference order index and its safe direction. To alter the settings for a channel, navigate to the according menu entry. Press and hold a knob. The arrow will change to a left/right arrow symbol. Turning the knob in this state (while pressed) will move the menu cursor to the reference order index or the safe direction. Releasing the knob on a parameter will allow you to edit the parameter by turning the knob. To exit the edit mode move the menu cursor to the left again or press the “Menu Up” button next to the display (bottom left). This will return to normal menu navigation.

3.4.2 Configuration Menu

Even though the devices are shipped preconfigured, you may want to do some adjustments to the configuration or set it up for a different manipulator system. This section describes how to configure the Hand Control Module.

There are several memory slots that you may use to save and load different configurations (Main menu, “Load Config” / “Save Config”). The first slot is the default slot and will automatically be loaded when the device is powered up.

Note that changes made to the configuration of the device take immediate effect, but will not be saved to a memory slot automatically. If you power down the device before saving the new configuration to a slot the changes will be lost.

To start configuring the device enter the main menu by pressing the “Menu” button and select the “Configuration” menu entry.

Setting up Groups and Channels

Configuration Menu

The Configuration menu will let you manage up to nine different channel groups. Each group has a configurable symbol that will be displayed when referring to that group and each group can hold up to four channels.



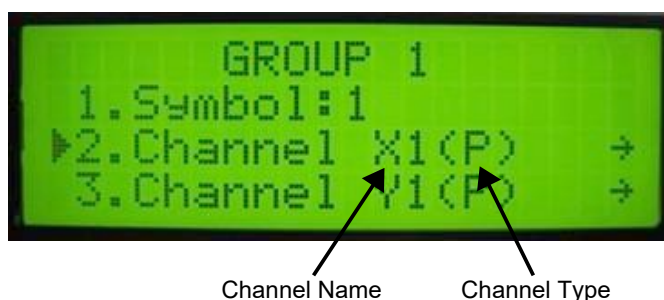
The menu will display a list of currently defined groups using their group symbols. The number in brackets behind each group shows the current size of the group, i.e. the number of channels that are in the group.

To add a new group simply select the “Add Group” menu entry. A new menu entry for the group will be added to the menu. Newly created groups are initially empty. If no groups are currently defined, then only the “Exit” and “Add Group” menu entries are available.

To configure a group simply select its menu entry. This will bring you to the Group menu. There you will also be able to remove the group from the configuration.

Group Menu

The Group menu will let you manage up to four channels for the selected group. Each channel has a configurable symbol. A channel is referred to by its channel name consisting of its channel symbol and the group symbol of the group that it's in. If you change the group symbol all channel names in the group will change accordingly.



The menu will display a list of currently defined channels within the selected group using their channel names. Within the menu mode channels are displayed with an additional symbol in brackets behind the channel name. This symbol indicates the channel type, thus the type of the port that the channel is currently mapped to. A 'P' marks a positioner channel, an 'E' marks an end effector channel.

To change the group symbol select the “Symbol” menu entry. This will bring up a blinking cursor. In this mode you may select a different symbol by turning a knob. Once satisfied, press a knob again to make the changes take effect. To abort the symbol editing press the “Menu Up” button next to the display (bottom left).

To add a new channel to the group select the “Add Channel” menu entry. A new menu entry for the channel will be added to the menu. If no channels are currently defined in the group, then only the “Exit”, “Symbol”, “Add Channel” and “Remove Group” menu entries are available.

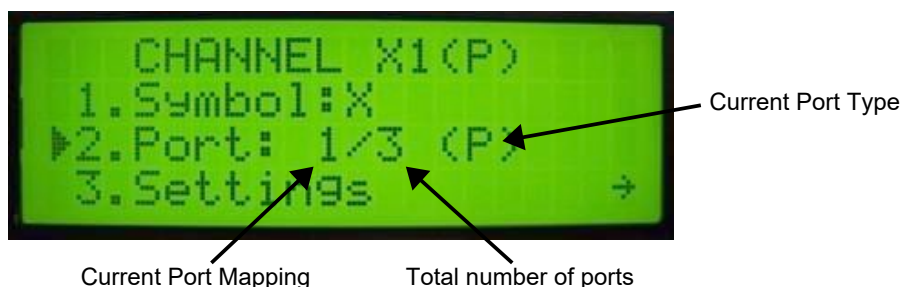
Note: For devices with less than four knobs, group sizes of four are not recommended.

To configure a channel simply select its menu entry. This will bring you to the Channel menu. There you will also be able to remove the channel from the group.

Configuring Channels

Channel Menu

The channel menu lets you configure the properties of the selected channel. The channel symbol is edited in the same way as the group symbol (see above).



The most important setting is the port mapping, i.e. which port the channel is mapped to. This setting defines which positioner or end effector will be controlled if commands are issued to the channel. Selecting the “Port” menu entry will cycle through the available ports of the system. The symbol in brackets indicates the type of the currently selected port. As noted above, a 'P' marks a positioner channel, an 'E' marks an end effector channel. You can test the port mapping immediately by pressing one of the Alt buttons. See section “Advanced Menu Features” below for more information.

To specify further settings of the selected channel select the settings menu entry. The contents of the Channel Settings menu depends on the type of the port that the channel is mapped to.

Channel Settings Menu for Positioners



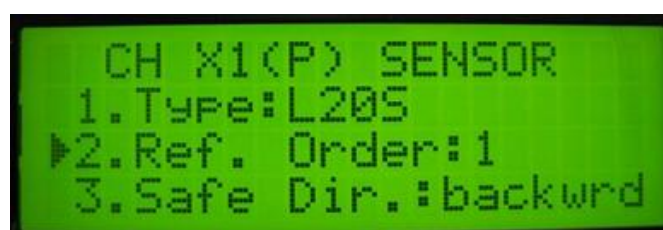
The Channel Settings menu lets you define which knob and joystick should be used to control the channel. Selecting the “Knob” menu entry will cycle through the knobs. The “Joystick” menu entry has the options “X1” (left joystick, horizontal axis), “Y1” (left joystick, vertical axis), “X2” (right joystick, horizontal axis), “Y2” (right joystick, vertical axis) and “none”. In the latter case the channel will not be controllable with a joystick.

Sometimes it may also be convenient to invert the movement direction of movement commands. Adjust the settings to your needs.

Note: It is possible to map several channels to the same knob or joystick axis. Doing so will move positioners simultaneously. However, this is not recommended and should be used with care.

If the positioner that the channel is currently mapped to has an integrated sensor there will be an additional sub menu (“Sensor Settings”) with some additional options.

Sensor Settings Menu for Positioners



Before using positioners that are equipped with sensors, the device must be told which type of sensor is connected to each channel. The setting affects the position calculation and closed-loop control. The “Type” menu entry lets you cycle through the available sensor types. Currently the following types are available:

Type	Positioner Series	Comment
S	SLCxxxxs, SLxxxxs	linear positioners with nano sensor
SR	SR36xxs, SR3511s, SR5714s, SR7021s	rotary positioner with nano sensor
MR	SR1910m	rotary positioner with micro sensor
SP	SLCxxxrs, SLxxxrs	linear positioners with nano sensor, large actuator
SC	SLCxxxsc, SLxxxsc	linear positioners with nano sensor, distance-coded reference marks

M25	SR1410s	rotary positioner with micro sensor
SR20	SR2013s, SR1612s, SR2712s	rotary positioner with nano sensor
M	SLCxxxxm, SLxxxxm	linear positioners with micro sensor
GC	SR1910m	rotary positioner with micro sensor, no reference mark, end stops
GD	SGO60.5m	goniometer with micro sensor (60.5mm radius)
GE	SGO77.5m	goniometer with micro sensor (77.5mm radius)
RA	SFWxxxxam	rotary positioner with absolute sensory
GF	SR1209m	rotary positioner with micro sensor
RB	SR1910m	rotary positioner with micro sensor, no reference mark, no end stops (unlimited rotation)
G605S	SGO60.5s	goniometer with nano sensor (60.5mm radius)
G775S	SGO77.5s	goniometer with nano sensor (77.5mm radius)
SC500	SLL-x	linear positioners with nano sensor, distance-coded reference marks
G955S	SGO95.5s	goniometer with nano sensor (95.5mm radius)
SR77	SR77xs	rotary positioner with nano sensor

The “Ref. Order” menu entry defines the reference order index of the channel and the “Safe Dir.” menu entry defines the safe direction. These settings are relevant if you wish to let channels find their reference marks. See section “Reference Marks” for more information.

3.4.3 Advanced Menu Features

When configuring the device in the menu mode the “Alt” (Alternate) buttons next to the display have some additional context dependent functions that you may find useful. These functions are described in the following.

Swapping Groups or Channels

When cycling through several groups with the “Group Up” and “Group Down” buttons while in the normal operation mode, their order is defined by the order in the configuration menu. If you wish to change the order of the groups without having to remove them and set them up again, you may use an “Alt” button in a “Drag 'n Drop” like fashion to accomplish this:

Say you have three groups A,B and C and want to change their order to A, C and B. Enter the Configuration menu and scroll to the “Group B” menu entry. Press and hold an “Alt” button. You now have “grabbed” group B. A symbol will appear in the top right corner of the display:

- An “x” indicates that the group may not be dropped onto the current menu entry.
- A “!” indicates that a Drag 'n Drop operation will be executed if the group is dropped onto the current menu entry.

While holding down the “Alt” button you may navigate through the menu normally with the usual controls. Navigate to the “Group C” menu entry. The Drag 'n Drop symbol will change to a “!”. Release the “Alt” button to “drop” group B and therefore swap the positions of group B and group C. To abort the operation release the “Alt” button while the Drag 'n Drop symbol shows an “x”.

The same technique may be used to swap the order of channels within a group. Select a group by entering its group menu, grab a channel with an “Alt” button and drop it onto another. This will swap the positions of the channels within the group. This may be useful, since the order of the channels in a group defines the order of their channel lines in the display while in normal operation mode.

You may even swap two channels that are in different groups (grab a channel in one group and drop it onto a channel in another group) or move a channel to a different group (grab a channel in a group and drop it onto another group) provided the target group is able to hold another channel.

Swapping Configuration Slots

Similar to the procedure described above you may swap the contents of configuration slots in the “Load Config” or “Save Config” menu. This might be useful if you have several configurations that you use and temporarily want to make one the default configuration.

To swap two configuration slots, enter either the “Load Config” menu or the “Save Config” menu. Navigate to the first slot you want to swap. Press and hold an “Alt” button. Navigate to the slot you wish to swap and release the button.

Test Settings

When configuring channels in the Channel menu and its sub menus you are able to test the settings you have made without having to leave the menu mode. The following settings support the test feature:

- **Port Mapping (Channel Menu)** - Navigate to the “Port” menu entry in the Channel menu and select the port you wish to map the channel to. Press and hold an “Alt” button. The text “test” will appear instead of the current port mapping. Turning a knob in this state will not navigate through the menu, but instead will execute a small movement on the target port. This makes it easy to identify the desired port.
- **Knob Invert (Channel Settings Menu)** - Similar as to above, holding down an “Alt” key while being on the “Knob Invert” menu entry will let you test the movement inversion of a channel when using a knob. Note that this function ignores the current knob mapping, thus you may turn any knob to test the setting.
- **Joy Invert (Channel Settings Menu)** - Holding down an “Alt” key while being on the “Joy Invert” menu entry will let you test the movement inversion of a channel when using a joystick. Contrary to knob inversion test, you must use the joystick axis which the channel is mapped to in order to test the inversion setting.
- **Safe Direction (Channel Sensor Settings Menu)** - Holding down an “Alt” key while being on the “Safe Dir.” menu entry will let you test the initial movement direction of a channel when moving to the reference mark (see section “Reference Marks”). Note that the executed movement direction does not depend on which direction you turn the knob. It will only depend on the safe direction setting.
- **Safe Direction (Configure Reference Marks Menu)** - Same as above.

Caution: When using the test options provided by the “Alt” buttons, the positioners will perform macroscopic movements. Please ensure that no other equipment can be damaged by these test movements.

3.4.4 User Mode vs. Admin Mode

In some situations it might be desirable to restrict the ability to configure the device. For this the device offers an admin mode and a user mode.

- In admin mode (default) the complete functionality as described in the previous sections is available.
- In user mode only the Sensor Options menu is available when entering the menu with the menu button and you cannot change the sensor mode or configure the reference sequence.

To switch between the admin and user modes press and hold the two right buttons next to the display (Group up / Group down) while entering the menu with the menu button (top left). You are then asked to enter a code. Use the knobs to adjust the digits and enter the code “591”. This code is fixed and cannot be changed. It is merely to avoid an accidental mode change. Press any knob to complete the mode change. The new mode will be displayed as a short message before the menu is entered.

3.5 Additional Information

3.5.1 Sensor Modes

If your positioners are equipped with integrated sensors, you have the option to choose between three different sensor operation modes: “Disabled”, “Enabled” and “Powersave”.

If the sensors are permanently supplied with power (“Enabled” mode) they generate heat which may cause the system to drift in case of weak thermal coupling (e.g. inside an SEM). For this, the sensors may be powered down (“Disabled” mode) if sensor data is (temporarily) not needed. Note though that moving a positioner in this mode will invalidate the position information.

The “Powersave” mode handles the power supply of the sensors automatically. Whenever a positioner is actively moving the sensors are enabled to be able to keep track of the current position of the positioner. When it is stopped the sensors are disabled, only checking the current position once in a while, minimizing heat generation.

3.5.2 Reference Marks

Positioners that are equipped with an integrated sensor and a reference mark may be instructed to move to a known physical position (the reference mark). For this, the positioner moves in the initial search direction. If the reference mark is found, the positioner will stop. If a mechanical end stop is detected before the mark is found, the search direction will be reversed. Once the mark is reached, the positioner will hold its position if configured so with the Closed-Loop Hold Time parameter (see “Sensor Options” menu). If set to zero seconds, the positioner will simply stop and wait for further instructions. Otherwise it will hold the reference mark for the configured time.

To execute a reference command enter the main menu and select “Sensor Options” → “Find Ref. Ch”. This will bring up a list of all available channels with this feature. Select a channel to let the positioner start looking for the reference mark.

Note: The sensor of the positioner must be calibrated in order to be able to find the reference mark (see section below).

The “Find Ref. All” menu entry will let all positioners move to their reference mark at once. A flexible configuration option lets you define in which order the channels will move. Each channel may be configured with a *reference order index* (see section “Sensor Settings Menu”). The system will start moving all positioners to their reference marks that have their indexes set to 1. When these have finished the system will continue with index 2 and so on. Consequently, assigning each channel a different index will move the positioners one after the other. Assigning the same index to all channels will make them move simultaneously. Between these two extremes you have the freedom to choose any combination, e.g. to first move all Z-axes of a multi-manipulator system, then the rest.

You may also set the reference order index to “-” in which case the channel will be omitted when selecting the “Find Ref. All” menu entry.

The *safe direction* option may also be configured for each channel separately and specifies the initial movement direction to search for the reference mark.

Some sensor types (e.g. “M”, linear positioners with micro sensor) do not have a physical reference mark. For these positioners the mechanical end stops are used for referencing. Which end stop is used is defined by the configured safe direction.

3.5.3 Sensor Calibration

For positioners with integrated sensors the calibration may be used to increase the accuracy of the position calculation and should be done once for each channel if the mechanical setup changes (different positioners connected to different ports). The calibration data is automatically saved to non-volatile memory. Therefore, if the mechanical setup is unchanged it is not necessary to issue the calibration routine on each power up. Note though that newly connected positioners have to be calibrated in order to ensure proper operation.

Important: The calibration routine takes a few seconds to complete and the positioner will perform a movement in the range of up to several mm, depending on the positioner type. It must be ensured, that the calibration routine is not issued while the positioner is near a mechanical end stop. Otherwise the calibration might fail and lead to unexpected behavior when using the closed-loop control mode. As a safety precaution, also make sure that the positioner has enough freedom to move without damaging other equipment.

To calibrate a sensor, enter the main menu (top left button next to the display) and select “Sensor Options” → “Calibrate Ch”. This will bring up a list of all available channels with this feature. Select a channel to let the positioner start the calibration routine.

Sensor types that are referenced via mechanical end stops (s.a.) are also moved to the end stop as part of the calibration routine. Which end stop is used is defined by the configured safe direction.

3.6 FAQ

Q: When I turn the knob in the Closed-Loop Mode nothing happens. Why?

A: If the Closed-Loop Hold Time is deactivated (0 seconds) then the movement increments are always executed relative to the current position of the positioner. With this setting, executing very small increments (e.g. 2nm) might have no effect due to sensor noise, since the target is “immediately” reached and the positioner stopped.

To avoid this behavior, increase the Hold Time via the menu settings. This will cause multiple small increments to accumulate. Thus, the increments are not executed relative to the current position of the actuator, but relative to the last target position.

Q: Why can't I select the Closed-Loop Mode for a channel?

A: The Closed-Loop Mode is only available to channels that have a sensor attached to it. If a sensor is present check if all wires are connected properly and restart the system.

Q: I can hear the positioner doing steps, but apparently it is not moving. How can this be?

A: The positioners must be driven with a certain minimum amplitude in order to function properly. This minimum value may vary from positioner to positioner. Try increasing the amplitude value.

Q: When I move a joystick to control a positioner nothing happens. What's wrong?

A: A channel has to be mapped to a joystick axis for this to work. Check the settings of the channel in the configuration menu.

Another reason might be that the positioner is currently configured for closed-loop control. In this mode it is not possible to control the positioner with a joystick.

3.7 Operating Conditions

The MCS controller must be used in normal environmental conditions:

- Indoor usage only.
- Temperature range: 5°C to 40°C.