User Manual

Stepper Motor Controller
SMC2242/SMC4242

1 Technical Assistance

If you need product assistance or if you have suggestions, contact LK-Instruments. You will find the contact information on the LK-Instruments homepage at

```
http://www.lk-instruments.com
```

Representatives of LK-Instruments are available during standard German business hours. Before you contact LK-Instruments, please note the actions you took before you experienced the problem. Then describe those actions and the problem to the technical support engineer.

1.1 Found a mistake?

We encourage comments about this publication. Please report any mistakes to LK-Instruments:

```
support@lk-instruments.com
```

Contents

Thank you for purchasing the SMCx242 Stepper Motor Controller. This user manual will explain you how to operate the Stepper Motor Controller. Please take some time to read it carefully before operating the device. Keep the instructions in a safe place for future reference.

2 Before you start

2.1 Package content

Please check that the package contains all the following items:

- SMCx242 Stepper Motor Controller

- Power supply cable

- USB cable

- User Manual

2.2 Installing the device

The Stepper Motor Controller is designed for the inside use. Therefore it should not be used outside and kept away from water and moisture. Do not operate the unit near any heat sources or in direct sun light. When installing the device ensure to put it on a flat and leveled surface. Also ensure that there is adequate space around the device for ventilation.

After moving the unit to a different location, condensation inside the unit may occur. In this case please wait for some hours before you connect the Stepper Motor Controller to the power supply.

Connect the device only to power sources that meet the specifications written on its rear panel.

3 General Information

The SMCx242 Stepper Motor Controller is a universal controller for bipolar stepper motors. It can be used to drive two (SMC2242) or four (SMC4242) stepper motors. There are three different firmware version available SMCx242-R for rotary axis, SMCx242-L for linear motion and SMCx242-U which features both options.
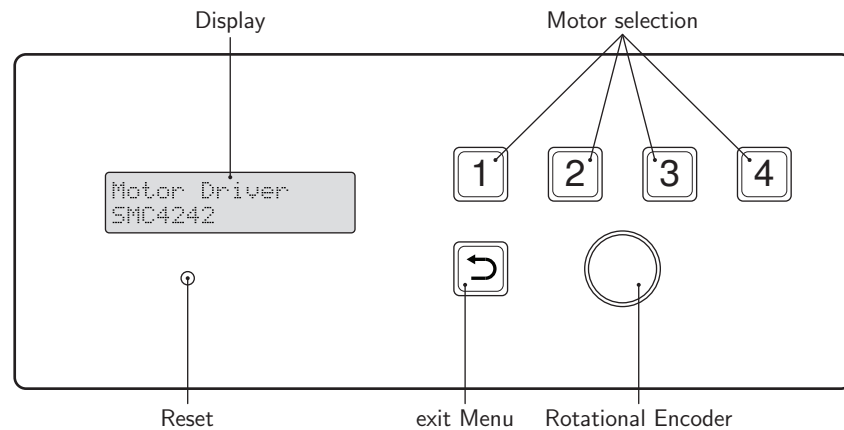
Figure 3.1: Front view of the SMCx242 Stepper Motor Controller.

4 Manual Operation

The SMCx242 Stepper Motor Controller features two operation modes. It can be either operated using the manual user interface or remote controlled by a computer. In this section the manual operation of the device is explained.

4.1 Menu structure

After turning on the Stepper Motor Controller it comes up with its start screen. Turning the rotary encoder serves to scroll through the menus (see figure 4.1). Pressing the rotary encoder enters the selected menu. Pressing the menu-escape-button leaves the menu again.

4.1.1 Display structure

In almost every menu four values are displayed. Depending on the previously selected menu the values correspond to different quantities. Where
the upper left value accompanies to Motor 0,
the upper right value accompanies to Motor 1,
the lower left value accompanies to Motor 2 and
the lower right value accompanies to Motor 3.

4.1.2 Motor selection

To select a motor there are four buttons. Motor selection can solely be done in an entered menu. To select a motor, press the respective motor-selection button. A selected motor is signed with an arrow on the display. Pressing the selection-button again deselects the motor. Once a motor is selected its appropriate value can be changed by turning the rotary encoder. By leaving a menu without motor deselection the selected motor(s) stay selected in an other menu.

4.1.3 Start screen

When entering the menu behind the start screen, the firmware version will be displayed.

```
v1.3
```
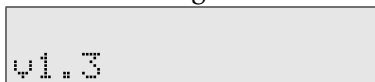
4.1.4 Menu: Change motor position

In this menu the current motor positions are displayed and can be changed by the operator. The default display unit is degree. The position of a selected motor can be changed by turning the rotary encoder. Default steps for different units are:

- 1° if unit is degree

- $0.125 \cdot \pi$ if unit is radian

- 1 step if unit is steps

```
→0.0π     →0.0
→0st      →0.0
```

When pressing the rotary encoder in this menu one enters the fast moving mode. Pressing the rotary encoder again leaves the fast mode. The fast moving mode can be noticed by another marking arrow. Default steps in fast mode are:

- 10° if unit is degree

- $0.125 \cdot \pi$ if unit is radian

- 100 steps if unit is steps

```
>0.0     >0.0
>0.0     >0.0
```

4.1.5 Menu: Set step multiplier

In this menu one can adjust a step multiplier. The step multiplier is applied if the step unit is degree or radian. The standard value is 1.0. If the step multiplier differs from 1.0 the corresponding motor will rotate more or less steps with each rotation of the rotary encoder. For example: if the step multiplier for motor 0 is 1.0 and the step multiplier for motor 2 is 4.0, motor 2 will move four times more steps than motor 0 when changing the motors positions. Negative values are allowed as well. This will result in counter direction movements.

```
→1.0x     →-0.5x
→2.0x      1.0x
```

4.1.6 Menu: Change step unit

In this menu one can choose the unit of the displayed position. There are three possible choices for each motor:

- degree

- radian

- step

```
→radian →degree
→step    degree
```

4.1.7 Menu: Define optical zero position

In this menu one can define the optical zero position. This is necessary due to a mostly unknown placement of the optical element mounted to the motor. Here one can once adjust the desired optical zero position manually. The optical zero position is always defined in steps. In this menu there is also a fast mode available (please refer to 4.1.4 for details about the fast mode). After adjustment it is recommended to save this configuration (see 4.1.12). When performing a zero calibration, as explained in 4.1.14, the zero position will be the defined optical zero position.

```
→0st        0st
 0st        0st
```

4.1.8 Menu: Run internal program

This menu allows the user to step through the internal program list. This function is available only if a program has previously been defined (see 5.2).

```
Program running
Step 0
```

4.1.9 Menu: Set constant angular speed

Here the motors can be set into an infinite moving state in clockwise (CW) or counter clockwise (CCW) direction. To get the motors moving with different velocities one needs to change the wait times between two steps (see 4.1.10).

```
→CW        →CCW
 STOP       STOP
```

4.1.10 Menu: Change step wait time

Here the wait time between two steps can be changed. This results in faster or slower motor movements. The default value is 3 milliseconds. We do not recommend to use shorter wait times, even if this works.

```
→3 ms      →3 ms
→3 ms       3 ms
```

4.1.11 Menu: Change motor substeps

In this menu one can change the motor substeps. Possible values are 1, 2, 4, 8, 16 or 32.

```
→1         →2
 4         →8
```

4.1.12 Menu: Save current configurations

To save the current Stepper Motor Controller configurations enter this menu and turn the rotary encoder in any direction. The menu will be automatically leaved when saving is finished.

Note: The configurations for all motors will be saved.

```
Save all current
configurations
```

4.1.13 Menu: Load last configuration

To load the last saved Stepper Motor Controller configurations enter this menu and turn the rotary encoder in any direction. The menu will be leaved automatically when loading has finished.

Note: The last saved configuration is loaded automatically when powering on the Stepper Motor Controller.

Note: There is just one memory space for a configuration.

```
Load all saved
configurations
```

4.1.14 Menu: Run zero calibration

Here one can calibrate the motor zero position for each motor. To perform a zero calibration select the motors to be calibrated and turn the rotary encoder. Note, that during zero calibration no actions can be done on the device, even serial commands will not be accepted. The zero calibration will automatically deselect a motor when its calibration is finished. The zero calibration menu will be automatically leaved when calibration is finished.

```
→Mot 0   →Mot 1
 Mot 2    Mot 3
```

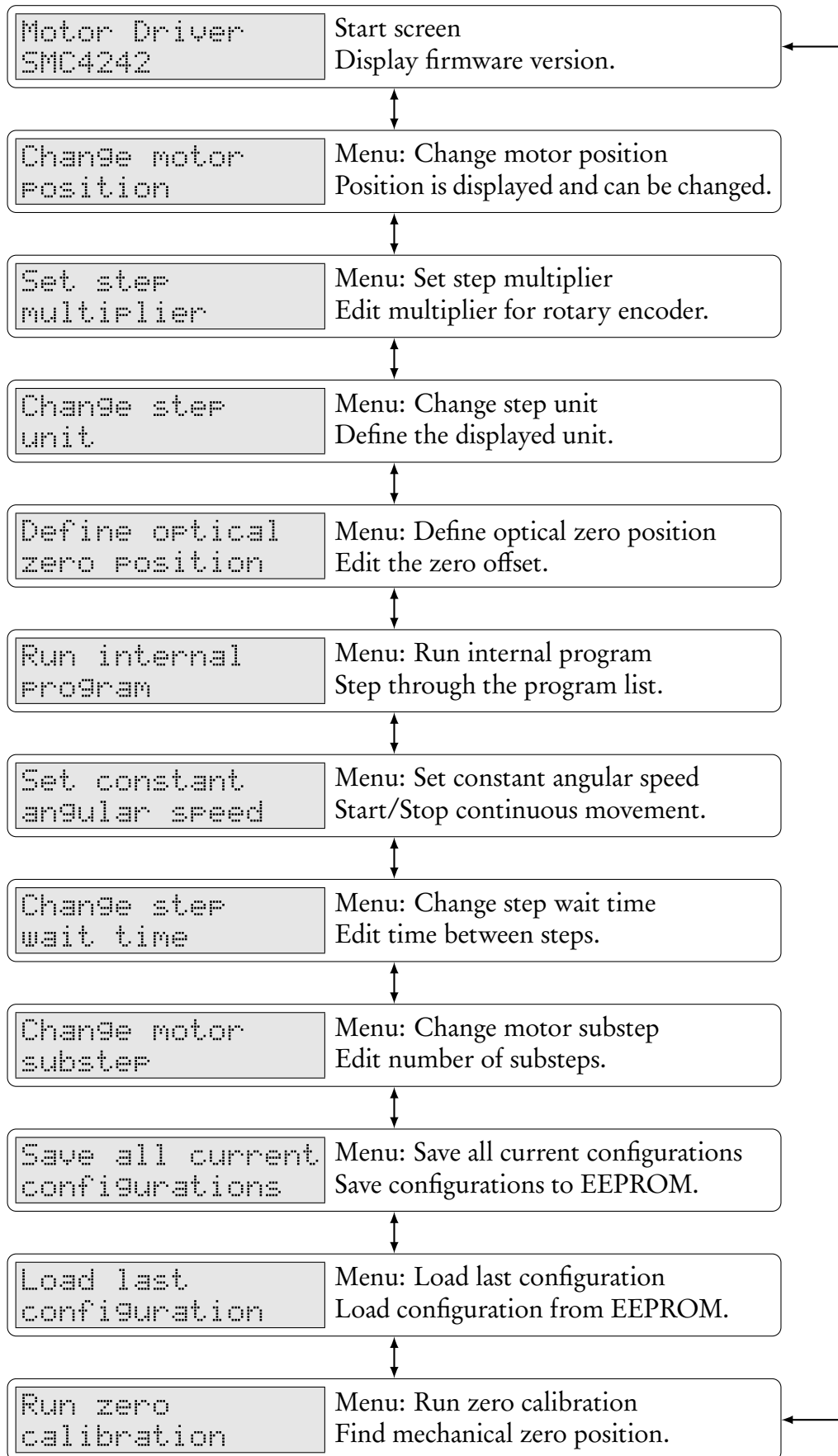|	
Motor Driver SMC4242	Start screen Display firmware version.
Change motor position	Menu: Change motor position Position is displayed and can be changed.
Set step multiplier	Menu: Set step multiplier Edit multiplier for rotary encoder.
Change step unit	Menu: Change step unit Define the displayed unit.
Define optical zero position	Menu: Define optical zero position Edit the zero offset.
Run internal program	Menu: Run internal program Step through the program list.
Set constant angular speed	Menu: Set constant angular speed Start/Stop continuous movement.
Change step wait time	Menu: Change step wait time Edit time between steps.
Change motor substep	Menu: Change motor substep Edit number of substeps.
Save all current configurations	Menu: Save all current configurations Save configurations to EEPROM.
Load last configuration	Menu: Load last configuration Load configuration from EEPROM.
Run zero calibration	Menu: Run zero calibration Find mechanical zero position.

Figure 4.1: Overview of the available menus. By rotating the rotary encoder one can navigate through the list of menus as indicated by the arrows.

5 Computer Control

5.1 Communication Settings

In order to remote control the Stepper Motor Controller from a computer, it needs to be connected to the computer via the USB cable. The Stepper Motor Controller will show up as a new Virtual COM Port (VCP). In some cases it might be necessary to install some drivers. They can be found here:
`http://www.ftdichip.com/Drivers/VCP.htm`
Once the Virtual COM Port has been installed successfully, the Stepper Motor Controller can be controlled by sending commands via a serial terminal. A list of all available commands can be found in section 5.2. The serial terminal needs to be configured as follows:

- 57600 Baud

- 8 bit character size

- no parity bit

- 1 stop bit

- no flow control

5.2 Instruction set

The Stepper Motor Controller has the following commands which can be used. Note, that the command parser is case sensitive. The command parameters, denoted by <xxx>, must be separated by either SPACE or "," or ";" or TAB. The command is completed by sending a Carriage Return + Line Feed (CRLF) or Line Feed (LF).

Command:	`*RST`
Function:	Resets the Stepper Motor Controller to the initial state.
Example:	`*RST`

Command:	`*IDN?`
Function:	Returns the identification name of the Stepper Motor Controller.
Example:	`*IDN?`

Command:	`*IDN <driver_idn>`
Function:	Sets the identification of the Stepper Motor Controller.
Note:	The maximum number of characters is 20.
Example:	`*IDN NewName`
	Sets the string "NewName" as IDN.

Command: `GETMOTSTATE <mot>`
Function: Returns whether motor `<mot>` is turned on or off.
Example: `GETMOTSTATE 3`
            Returns 1 if motor 3 is turned on or 0 if motor 3 is turned off.

Command: `MOVEABS <mot> <pos> <unit>`
Function: Moves motor `<mot>` to the absolute position `<pos>` `<unit>`.
            The units can be steps, degree or radians.
Note: The units must be written in lower case letters.
Example: `MOVEABS 0 0 deg`
            `MOVEABS 0 0 pi`
            `MOVEABS 0 0 steps`
            The examples do the same in different units.

Command: `MOVEREL <mot> <pos> <unit>`
Function: Moves motor `<mot>` relative to the current position.
            The units can be steps, degree or radians.
Note: The units must be written in lower case letters.
Example: `MOVEREL 2 22.5 deg`
            `MOVEREL 2 0.125 pi`
            Both examples do the same in different units.

Command: `ZERORUN <mot>`
Function: Finds the mechanical zero position of the motor.
Note: During motor zero run no communication or usage
            of the Stepper Motor Controller is allowed.
Example: `ZERORUN 1`
            Finds the mechanical zero position of motor 1.

Command: `ENABLE <mot> <on/off>`
Function: Turns motor `<mot>` on (1) or off (0).
Note: Both for enabeling and disabeling of a motor the same command is used.
Example: `ENABLE 2 1`
            Turns motor 2 on.
            `ENABLE 2 0`
            Turns motor 2 off.

Command: `GETPOS <mot> <unit>`
Function: Returns the actual motor position in the given unit.
Example: `GETPOS 1 deg`
            Returns the current position of motor 1 in degree.

Command: SAVECONF
Function: Saves all current configurations for all motors.
Note: The driver configuration is stored in an EEPROM.
            Maximum write cycles are 100000.
Example: SAVECONF

Command: LOADCONF
Function: Loads all saved configurations for all motors.
Example: LOADCONF

Command: GETOPTZEROPOS <mot>
Function: Returns the optical zero position of motor <mot>.
Example: GETOPTZEROPOS 3
            Returns the optical zero position of motor 3.

Command: SETOPTZEROPOS <mot>
Function: Set the optical zero position for motor <mot>.
Note: For the optical zero position the unit is always steps.
Example: SETOPTZEROPOS 3 574
            Sets the optical zero position of motor 3 to 574 steps.

Command: GETWAITTIME <mot>
Function: Returns the wait time between two steps of a motor.
Example: GETWAITTIME 0
            Returns the wait time between two steps of motor 0.

Command: SETWAITTIME <mot> <time>
Function: Sets the wait time between two steps to <time> milliseconds
            for motor <mot>.
Note: The wait time must be an integer. The unit for the wait time
            is always milliseconds.
Example: SETWAITTIME 1 5
            Sets the wait time of motor 1 to 5 milliseconds.

Command: STOPALL
Function: Stops all motor movements immediately.
Example: STOPALL

Command: FACTORYRESET
Function: Resets the Stepper Motor Controller to factory state.
Example: FACTORYRESET

Command: `ISMOVING <mot>`
Function: Returns the motor moving state.
           1: motor `<mot>` is moving.
           0: motor `<mot>` doesn't move.
Example: `ISMOVING 0`

Command: `SETCONSTSPEED <mot> <dir> <time>`
Function: Enables motor `<mot>` to move infinite in direction `<dir>`. Possible
           values for `<dir>` are clock wise `CW` or counter clock wise `CCW`.
           `<time>` specifies the time for one full rotation.
Example: `SETCONSTSPEED 1 CW 10.0`
           Moves motor 1 infinite in clockwise direction.
           One full rotation takes 10 seconds.

Command: `SETFORBZONE <mot> <start> <stop>`
Function: Defines a forbidden zone for motor `<mot>`. The motor will not move
           into this zone. `<start>` must be always smaller than `<stop>`. The unit
           for `<start>` and `<stop>` is always steps.
Example: `SETFORBZONE 0 148 1333`
           Defines a forbidden zone for motor 0 between step 148 and step 1333.

Command: `ENABFORBZONE <mot> <val>`
Function: Enables `<val=1>` or disables `<val=0>` the defined forbidden zone
           for motor `<mot>`
Example: `ENABFORBZONE 0 1`
           Enables the forbidden zone for motor 0.
           `ENABFORBZONE 3 0`
           Disables the forbidden zone for motor 3.

Command: `SETPROGSTEP <step> <posMot0> <posMot1> <posMot2> <posMot3> <mode>`
Function: Defines an internal program step for all four motors. `<step>` is the program
           sequence number. The position of all motors `<posMot0...4>` must be given
           in steps. The mode defines if the movement is to an absolute position `<mode=ABS>`
           or if the movement is relative to the current motor position `<mode=REL>`.
Example: `SETPROGSTEP 0 112 294 0 12 ABS`
           Defines the internal program step 0 so that motor 0 moves to step 112,
           motor 1 moves to step 294, motor 2 moves to step 0 and motor 3 moves to step 12.
           `SETPROGSTEP 1 10 10 -10 -10 REL`
           Defines the internal program step 1 so that motor 0 and motor 1 move
           10 steps forward relative to the actual position and motor 2 and 3 move
           10 steps backwards from the actual position.

6 Specifications

Table 6.1: Specifications of supported motors.

	SMC2242	SMC4242
Number of Motors:	2	4
Motor Type:	Bipolar Stepper Motor	
Motor Drive Voltage:	24 V	
Motor Current:	up to 2.5 A peak or 1.75 A RMS	

Table 6.2: Features of different versions.

	SMCx242-R	SMCx242-L	SMCx242-U
Units:	°, π, steps	m, cm, mm, steps	°, π, m, cm, mm, steps, user-defined
Substeps:	1, 2, 4, 8, 16, 32		
Steps per Revolution:	200, 400		
Gear Ratio:	???		
Reference/Limit Switches:	1	3	

Table 6.3: Technical Specifications.

Power requirements:	?
Power consumption:	W
Dimensions:	245 mm (W) x 85 mm (H) x 260 mm (D)
Weight (without package):	kg

7 Pinout

The connectors for for the stepper motors are 9-Pin D-Type, female connectors. Please refer to figure 7.1 for their pinout.
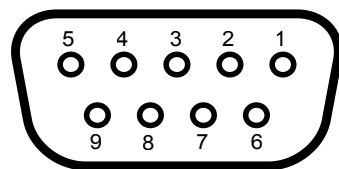
Pin	Description
1	Bridge B output 1
2	Bridge B output 2
3	Bridge A output 2
4	Bridge A output 1
5	Ground
6	+5 V
7	Reference/Limit Switch 1
8	Reference/Limit Switch 2
9	Reference/Limit Switch 3

Figure 7.1: Pinout of the Motor Connector.