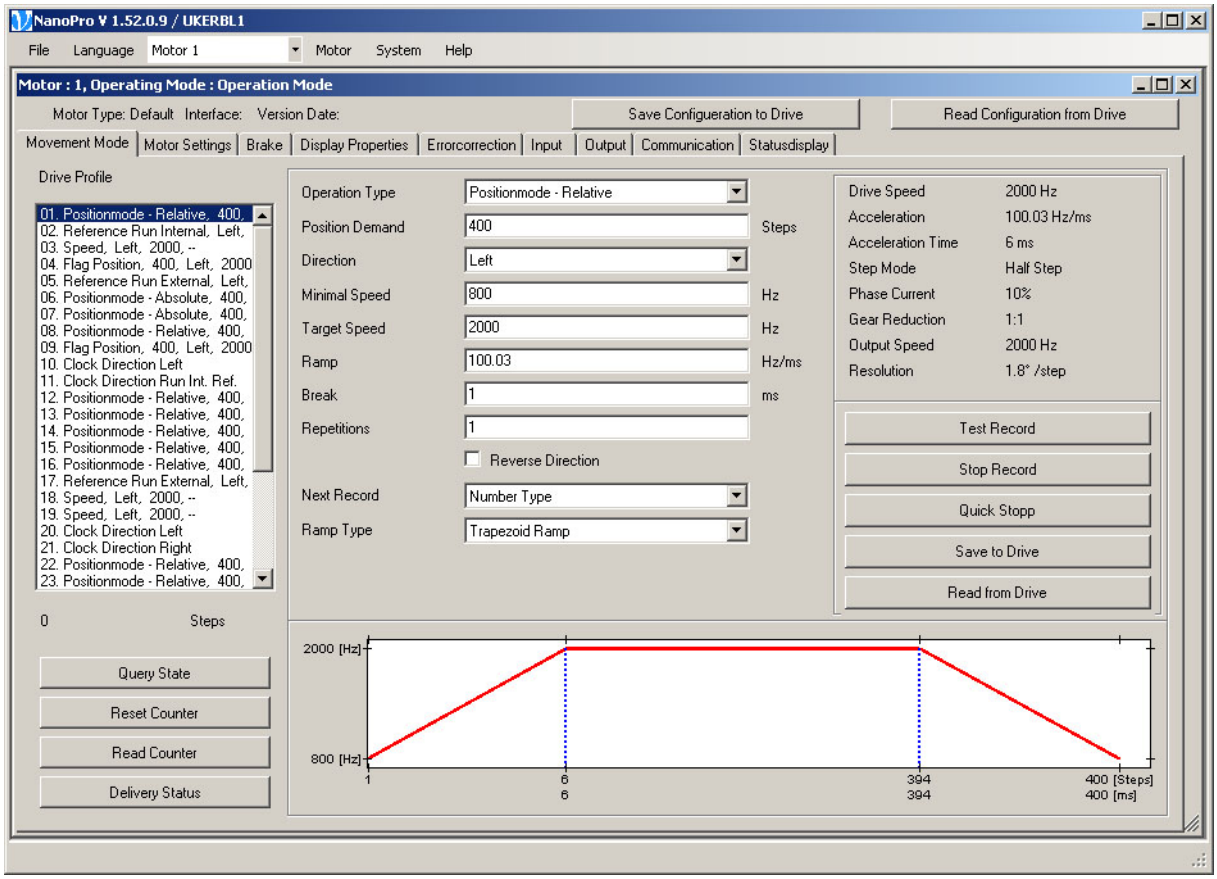
User Manual



NANOPRO

Control software for stepper motor controls and Plug & Drive motors

NANOTEC ELECTRONIC GmbH & Co. KG
Gewerbestraße 11
D-85652 Landsham near Munich, Germany

Tel. +49 (0)89-900 686-0
Fax +49 (0)89-900 686-50
info@nanotec.de

Editorial/About this manual

Nanotec® Electronic GmbH & Co. KG
Gewerbestraße 11
D-85652 Landsham / Pliening, Germany

Tel.: +49 (0)89-900 686-0
Fax: +49 (0)89-900 686-50

Internet: www.nanotec.de

Target group

This user manual is aimed at designers and developers who need to configure one of the Nanotec® SMCI33, SMCI47-S, SMCP33 stepper motor drivers or a Plug & Drive motor of the PDx-N series with the aid of the NANOPRO control software without much experience of stepper motor technology.

About this manual

This manual contains a description of the NANOPRO driver software only.

For the connection and the commissioning of stepper motor controls or Plug & Drive motors, see the respective technical manuals!

NanotecNanotec® reserves the right to make technical alterations and further develop hardware and software in the interests of its customers to improve the function of this product without prior notice.

For criticisms, proposals and suggestions for improvement, please contact the above address or send an email to: info@nanotec.com

Version/Change overview

Version	Date	Changes
1.0	2009-06-03	New issue C+P
2.0	2009-10-01	Revision of the new software release for version 1.52.09

Contents

1 Installation

System requirements

- MS-Windows 2000 / XP / Vista
- Free COM port on your Windows PC

Procedure

To install the NANOPRO driver software on your PC, you must first download the software from the Nanotec website.

Proceed as follows:

Step	Action
1	Open the Nanotec website in your browser: http://www.nanotec.com
2	Go to the "Downloads" area and select the following software: “Windows Software NanoPro for Plug & Drive & SMCI (NEW) >>”
3	Download the file "NanoProNG V xxx.zip” onto your PC.
4	Unpack the zip file on your PC in the required directory.
5	Open the folder "NanoProNG V xxx” and start the setup program by double-clicking on the file "NanoProNG.msi”.
6	Follow the installation instructions of the setup program.

2 Overview of the operating interface

2.1 General information

Introduction

The SMCI33, SMCI47-S, SMCP33 stepper motors drivers and Plug & Drive motors of the PDx-N series can be configured and programmed with the NANOPRO driver software using any standard Windows PC.

Transparent interfaces and simple test functions enable rapid entry into operation and programming and facilitate commissioning.

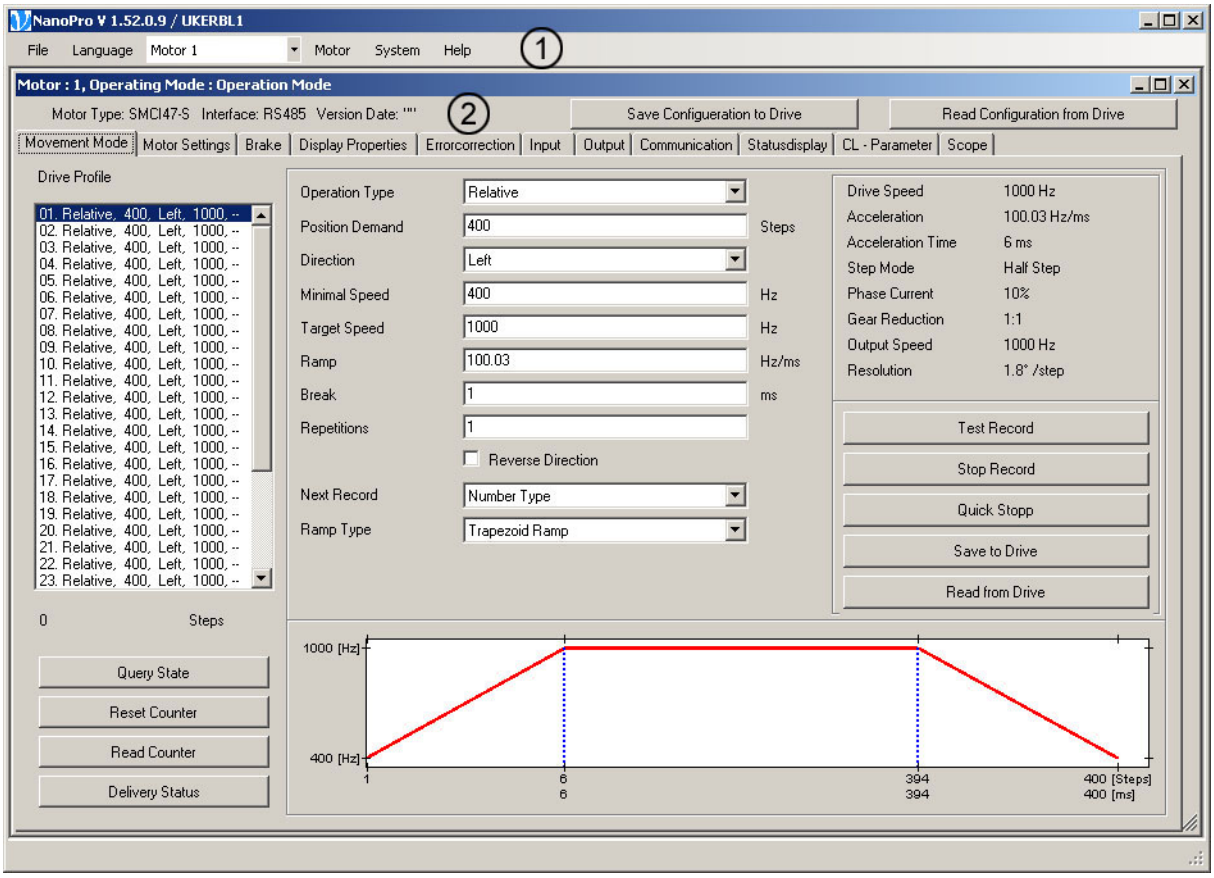
Due to the simple operating interface, not all functions are described in this manual. Many functions are self-explanatory. Only specific operating procedures are looked at in detail.

Familiarize yourself with the operating interface of the NANOPRO control software before starting to commission and program the stepper motor drivers or Plug & Drive motors.

2.2 Layout of operating interface

Menu bar and menu window

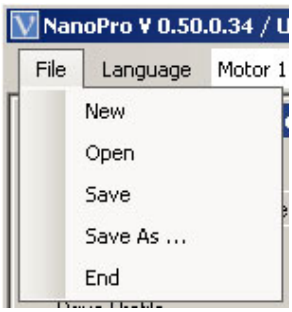
The operating interface is basically set up with a menu bar (1) and a separate menu window (2) for each motor.



2.2.1 The menu bar

<File> menu

Standard functions for file editing.



<Language> menu

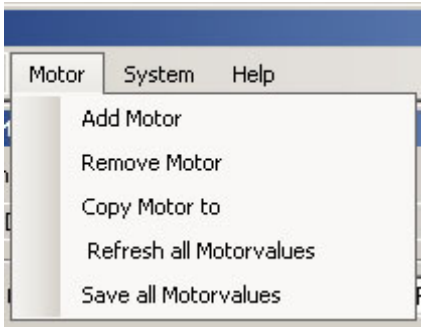
The operating interface language can be changed here (Deutsch/English).

"Motor" selection menu

Selection of the required motor. In networks, up to 32 motors can be operated on a linked basis and actuated by the NANOPRO driver software.

<Motor> menu

The <Motor> menu has the following menu items:

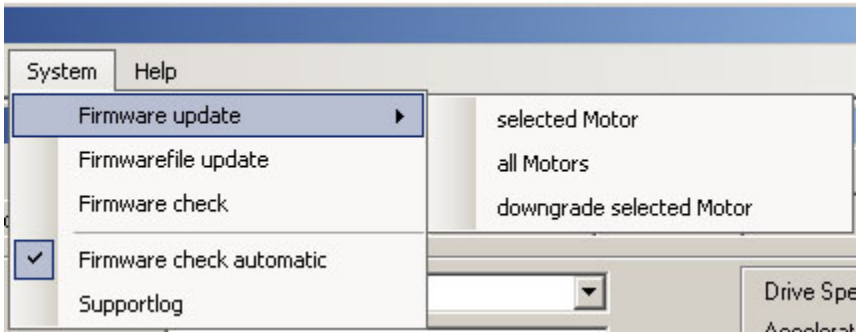


- <Add Motor>
  New motors can be added via the <Add Motor> menu item. An input window for the motor address opens. The address must lie between 1 and 255.
- <Remove Motor>
  Motors that are no longer required can be removed from the driver in the <Remove Motor> menu item.
  This opens a window with the query "Do you really want to delete the motor?" which you can quit with the button <Yes>.

- <Copy Motor to>
  You can copy and adopt the current settings for a new motor with this menu item. An input window for the motor address opens. The address must lie between 1 and 255.
- <Refresh all Motorvalues>
  All motor settings are transferred to the NANOPRO control software.
- <Save all Motorvalues>
  All motor settings are saved in the NANOPRO control software.

<System> menu

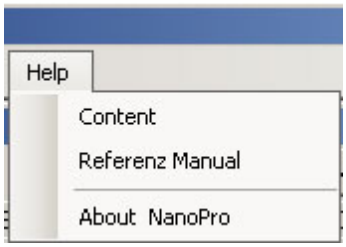
The <System> menu has the following menu items:



- <Firmware update>
  Firmware update for the selected motor or all motors; Downgrade for the selected motor.
- <Firmwarefile update>
  Update of the firmware file.
- <Firmware check>
  Manual check of whether an update for the firmware is available.
- <Firmware check automatic>
  When the checkbox is activated, an automatic check is made of whether a firmware update is available.
- <Supportlog>
  When the checkbox is activated, a log file is automatically created for support purposes.

<Help> menu

The <Help> menu has the following menu items:



- <Content>
  Calls up the online help for NANOPRO.
- <User manual>
  Opens the user manual for NANOPRO as a PDF file.
- <About NanoPro>
  Displays the version information for the latest installation of NANOPRO.

2.2.2 Menu window

Tabs

The menu window contains the following tabs:

Tab	See section
Movement Mode	4 “<Mode> tab”
Motor Settings	5 “<Motor settings> tab”
Brake	6 “<Brake> tab”
Display Properties	7 “<Display Properties> tab”
Errorcorrection	8 “<Errorcorrection> tab”
Input	9 “<Input> tab”
Output	10 “<Output> tab”
Communication	11 “<Communication> tab”
Statusdisplay	12 “<Statusdisplay> tab”
CL - Parameter	13 “<CL - Parameter> (Closed-Loop) tab”
Scope	14 ”<Scope> tab”

Transfer settings to/from driver

The current configuration settings can be saved in the connected driver or read from the connected driver using the following buttons.

- <Save Configuration to Drive>
  The current settings are transferred from the NANOPRO to the connected driver.
- <Read Configuration from Drive>
  The current settings are transferred from the connected driver to NANOPRO.

3 Driver configuration

General information

This section describes the general procedure for configuring the driver. The parameters to be configured on the respective tabs are described in detail in sections 4 to 14.

Procedure

To configure the drivers, proceed as follows:

Step	Action	Note
1	Commissioning the driver.	See technical manual of the respective driver.
2	Click on the <Read Configuration from Driver> button. The connected driver type is detected and displayed in the <Motor settings> tab. The parameters applicable for the respective driver type are displayed.	See section 5 “<Motor settings> tab”
3	If this is not a Plug & Drive motor: Select the motor type and motor designation (see motor type plate) in the <Motor settings> tab. Motor type and designation are detected automatically for Plug & Drive motors.	See section 5 “<Motor settings> tab””
4	Enter the required parameters in the tabs and, if necessary, click on the <Save data> button to transfer the settings of the respective tab to the driver.	See section 4.2 “Entering profile parameters”, for example.
5	If necessary, click on the <Save Configuration to Drive> button to transfer all settings from NANOPRO to the driver.	

4 <Mode> tab

4.1 Overview

Introduction

Depending on the drive profile, the motor can be operated using a total of 14 different operation modes, see also section 4.2 “Entering profile parameters”. Due to the great capacity and functions available, it offers designers and developers a rapid and simple method of resolving numerous drive requirements with less programming effort.

Select the required operating mode for each drive profile and configure the driver according to your requirements.

Overview of operating modes and their areas of application

Operation Type	Application
Relative	Use this mode when you wish to travel to a specific position. The motor travels according to a specified drive profile from a Position A to a Position B. Please refer to section 4.3 “Relative/Absolute Positioning, Internal and External Reference Run”.
Absolute	
Internal reference run	During the internal reference run, the motor travels to an internal reference point at the set minimum speed. Please refer to section 4.3 “Relative/Absolute Positioning, Internal and External Reference Run”.
External reference run	During an external reference run, the motor travels to a switch connected to the reference input. Please refer to section 4.3 “Relative/Absolute Positioning, Internal and External Reference Run”.
Speed mode	Use this mode when you wish to travel with a specific speed (e.g. a conveyor belt or pump speed). In the speed mode, the motor accelerates with a specified ramp from the starting speed (start frequency "V Start") to the specified maximum speed (maximum frequency "V Normal"). Several inputs enable the speed to be changed on-the-fly to different speeds. Please refer to section 4.4 “Speed mode”.
Flag Position mode	The flag positioning mode offers a combination of the speed and positioning modes. The motor is initially operated in speed mode; when a trigger point is reached, it changes to the positioning mode and the specified setpoint position (relative to the trigger position) is approached. This operating mode is used for labeling, for example: the motor first travels with the set ramp to the synchronous speed of the conveyed goods. When the labels are detected, the preset distance (position) is traveled to apply the labels. Please refer to section 4.5 “Flag Position mode”.
Clock direction mode, left	Use this mode when you wish to operate the motor with a superordinate driver (e.g. CNC controller).
Clock direction mode, right	

Operation Type	**Application**
Clock direction mode, Int. Ref.	In the clock direction mode, the motor is operated via two inputs with a clock and a direction signal from a superordinate positioning control (indexer). Depending on the mode selected (Int. Ref. / Ext. Ref.) the internal and external reference runs are supported. Please refer to section 4.6 “Clock Direction mode Run Int. Ref. / Ext. Ref.”.
Clock direction mode, Ext. Ref.	
Analog and Joystick mode	The motor is controlled in this operating mode simply with a potentiometer or a joystick (–10 V to +10 V). Use this mode if you want to use the motor in a simple application: • Setting a specific speed, e.g. via an external potentiometer, • Travelling synchronously with a superordinate controller with analogue output (–10 V to +10 V). Please refer to section 4.7 “Analogue and Joystick mode”.
Analogue Position mode	Use this mode when you wish to travel to a specific position. The voltage level on the analog input is proportional to the required position, thus enabling servo behavior. Please refer to section 4.8 “Analogue Position mode”.
Torque mode	Use this mode when you require a specific output torque independent of the speed as is the case in typical winding and unwinding applications. The maximum torque is specified via the analog input. Please refer to section. 4.9 “Torque mode”

4.2 Entering profile parameters

Introduction

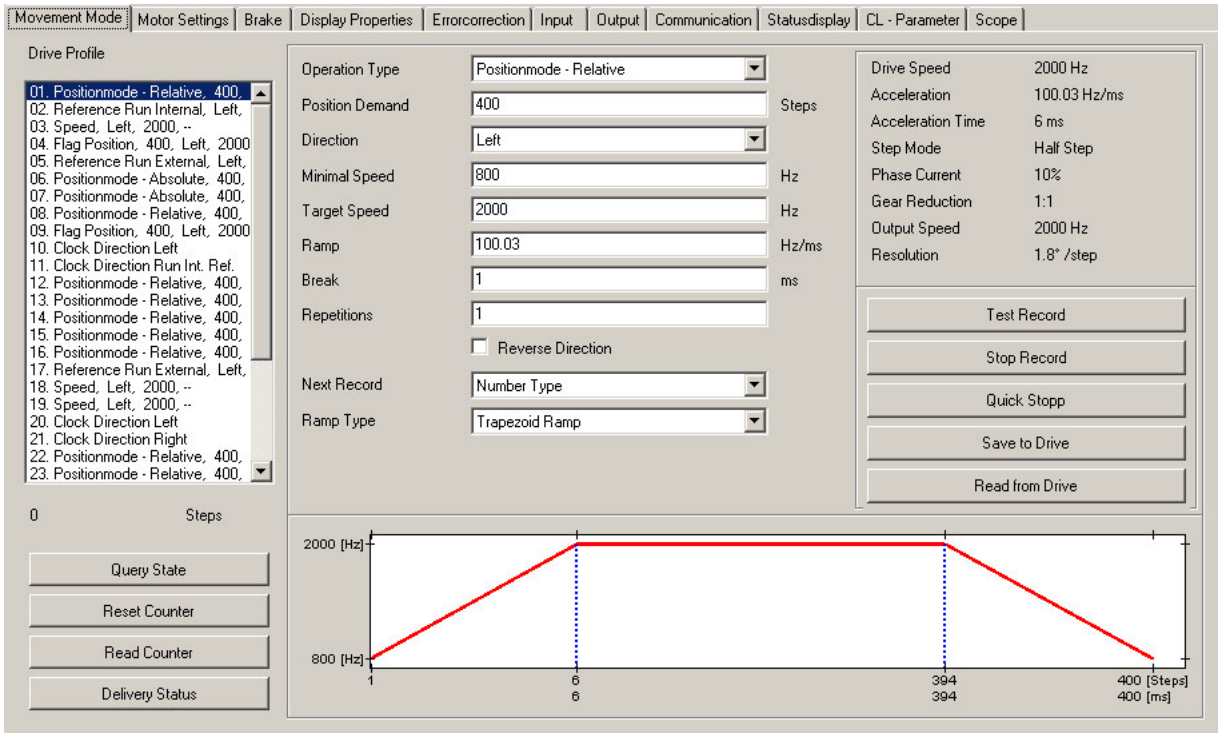
Up to 32 drive profiles can be defined and programmed. The last 16 records (records 17 to 32) cannot be called up via the inputs, only via the programming interface.

You can assign important profile parameters to a travel profile using the NANOPRO software.

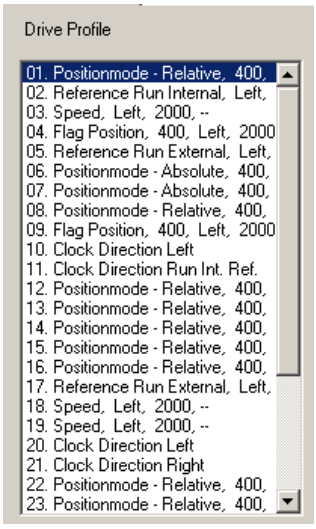
The parameters listed below do not all have to be specified for all drive profiles. When the operating mode is activated or changed, the relevant fields are displayed on the <Mode> tab.

<Movement Mode> tab

The profile parameters for a specific drive profile are set on the <Movement Mode> tab.



Drive Profile selection list

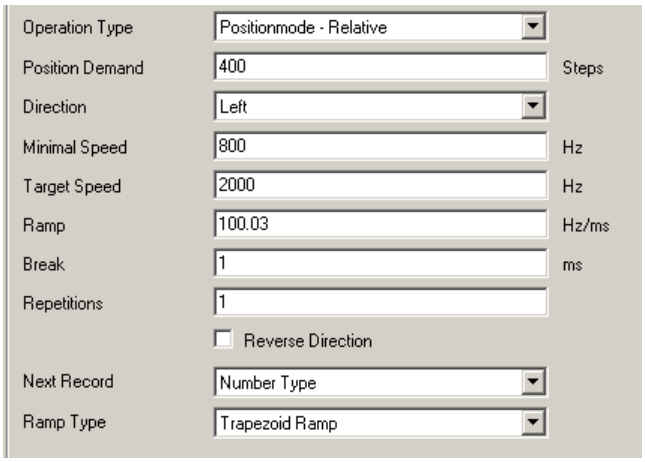


- This window displays the maximum possible 32 travel profiles.
- After selecting the required travel profile, the corresponding profile parameters are displayed in the parameter area.

"Operation Type" selection menu

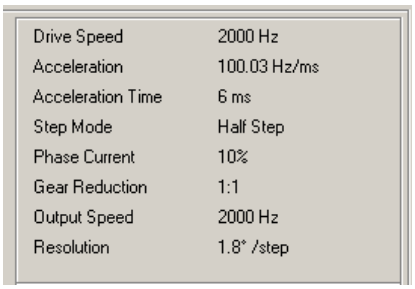
- The required operating type can be selected here.

Profile parameters



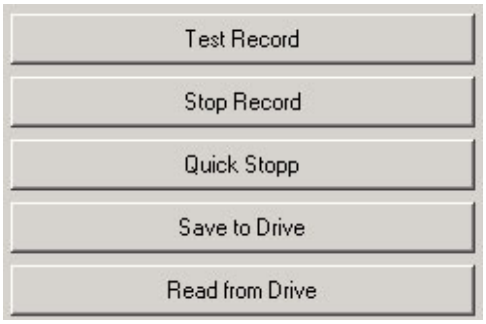
- Displays parameters dependent on the selected operating type and drive profile.
- Settings of required parameters for the various profiles (max. 32).

Motor Settings



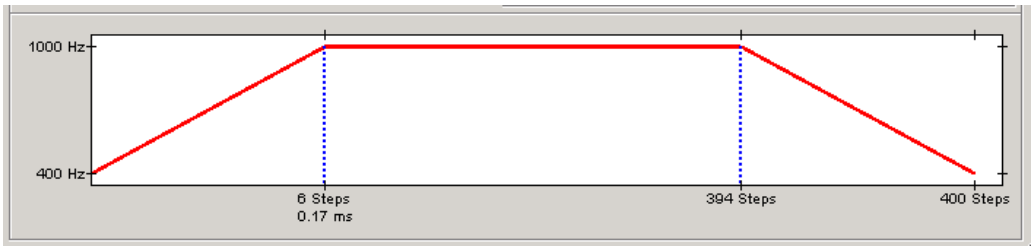
- Display of the parameters of the connected motor.
- Settings of parameters, see section 5 "<Motor settings> tab".

Buttons for communication with the motor



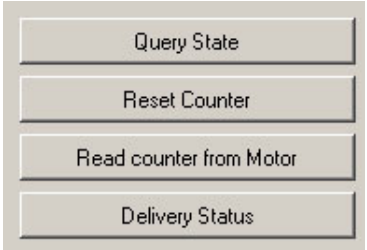
- <Test Record>
  Pressing the button <Test record> transfers the current record to the motor and starts it. The parameters are not saved by the motor.
- <Stop Record>
  The currently operating record is stopped.
- <Quick Stopp>
  The currently operating record is stopped – independent of the drive profile – with the Quick Stopp ramp. For settings, see section 5 “<Motor settings> tab”.
- <Save to Drive>
  Pressing the <Save to Drive> button saves the set drive profile permanently in the motor.
  Transfer can take a few seconds and is visually displayed with a progress bar.
  The drive profiles can then be selected and started via the motor inputs.
- <Read from Drive>
  All data saved in the motor are loaded onto your PC.

Profile graph display



- The displayed profile graph can be used to rapidly see the ramp times (acceleration time) and the overall actuating time for the applicable travel profile.
- The graphic is recalculated after every relevant input.

Buttons for communication with the optional encoder



- <Query State>
  Pressing the <Query State> button queries the actual state of the motor and displays the state on the screen.
- <Reset Counter>
  Pressing the <Reset Counter> button resets the current counter value to zero.

- <Read counter from Motor>
  Pressing the <Read counter from Motor> button queries the actual counter value and displays it on screen.
- <Delivery Status>
  Pressing the <Delivery Status> button resets all parameter settings in the motor to the default status.

Procedure

The following describes an example of how to enter profile parameters for a drive profile in the “Relative” operation type. Other parameters must be defined in other operating modes.

Proceed as follows:

Step	Action	Note
1	Select the required drive profile in the <Movement Mode> tab, e.g. “01. Relative, 400,-”.	The parameter values of the selected travel profile are displayed. The drive profile is defined by the position mode ("Operation Type" selection menu) and the distance in the "Position Demand" field.
2	In the "Operation mode" selection menu, select the "Relative" mode.	The relevant parameter fields are displayed
3	Enter the required distances for the selected travel profile in the "Position Demand" field.	The control variable can be input in steps, degrees or mm. The units can be changed in the <Display settings> tab. Please refer to section 7 “<Display Properties> tab”.
4	Select the required rotation direction of the drive profile in the "Direction" selection menu.	You can choose between "Left" and "Right".
5	Enter the required starting speed of the motor in the "Minimal Speed" field.	The minimal speed is the start-up speed (start-stop frequency) of the motor. To avoid step losses, this should be higher than the intrinsic resonance of the motor. However, too high a minimum speed can also lead to step losses. The speed can be input in Hertz, rpm or mm/s. The units can be changed on the <Display settings> tab. Please refer to section 7 “<Display Properties> tab”.
6	Enter the required normal speed of the motor in the "Target Speed" field.	The normal speed is the travel speed of the motor. To avoid step losses, it should lie outside resonance ranges. Too high a maximum speed can cause step losses and motor stalling.

Step	Action	Note
7	In the "Ramp" field, enter the ramp gradient. You will see the set travel profile in the graphic (profile graphic) in the lower section of the main menu, providing you with an aid to setting the correct values.	Values are entered in Hz/ms. The steeper the ramp, the faster the acceleration. Eventual resonance ranges must be traversed as fast as possible. However, it is possible, if the acceleration is too high, that the motor skips and loses steps. In this case, the ramp must be reduced incrementally. The maximum value is 3000 Hz/ms (which is displayed as 2988.3 Hz/ms due to the underlying conversion table). The minimum value is 0.1 Hz/ms.
8	In the "Break" field, enter the length of the break (motor idle time) after the end of the movement.	The unit is ms. To set a break of e.g. one second, the value 1000 must be entered.
9	In the "Repetitions" field, enter how often the selected travel profile should be implemented automatically in sequence without another start command.	The entry "0" corresponds to constant operation. Minimum number of operations = 1. Maximum number of operations = 254
10	Activate the "Reverse Direction" option field if you want an automatic change of direction.	When the change of direction is activated, the rotation direction of the motor is automatically changed when the same record (operation > 1) is called up several times in sequence or when the same travel profile is called up again at a later time. The direction is changed each time the same travel profile is called up again.
11	If necessary, select a travel profile in the "Next Record" selection menu that will be called up when the record is finished.	In order to use this function, the travel profile must first be saved with the <Save to Drive> button.
12	In the "Ramp Type" selection menu, select the required ramp type.	The following ramp types can be selected: • Trapezoid Ramp • Sinus Ramp • Jerk Free Ramp (see section 4.3.3)
13	If you want to test the entered travel profile: Click on the <Test Record> button.	The motor then travels according to the selected operating mode and travel profile.
14	Repeat steps 1 to 13 if you want to enter further drive profiles.	
15	If you want to permanently store the entered settings: Click on the <Save to Drive> button.	The data will be saved in the motor.

4.3 Relative/Absolute Positioning, Internal and External Reference Run

4.3.1 Description

Function

Relative and Absolute Positioning

In the "Relative" and "Absolute" operation types, the motor moves from a position A to a position B according to a specified drive profile.

They are preferentially used when travel to a specific position is required.

The positions can be defined as absolute or relative values depending on the mode selected. With relative positioning the drive profile is started from the actual position. With absolute positioning the drive profile starts from a specified setpoint position, irrespective of the actual position.

Internal and external reference run

In the "Internal reference run" operation type the motor travels to an internal reference point at the set minimum speed. This reference point is on the motor shaft and is therefore reached with each full motor revolution.

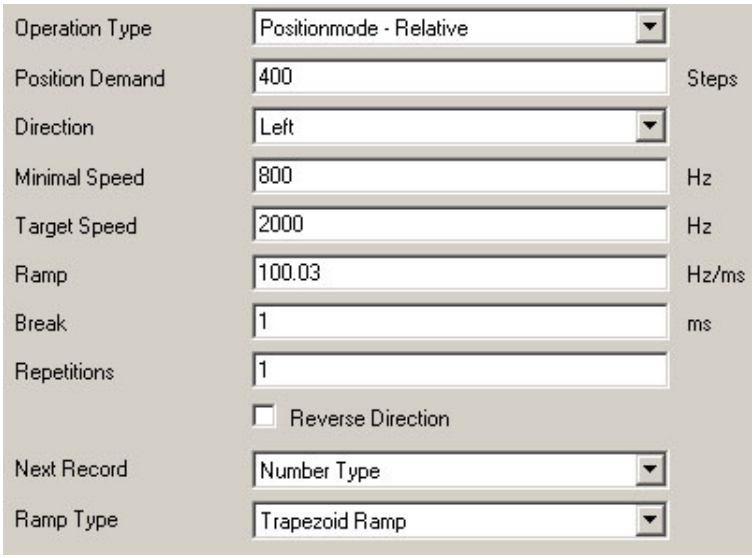
In the "External reference run" operation type the motor travels to a switch connected to the reference input.

After the start of the external reference run, the motor accelerates with the set ramp from the minimum to the maximum speed. When the reference switch is reached, movement is stopped for a break of 100 ms and then, according to the setting "Positioning behavior at the limit switch", travel is recommenced away from the switch at the minimum speed (start/stop speed).

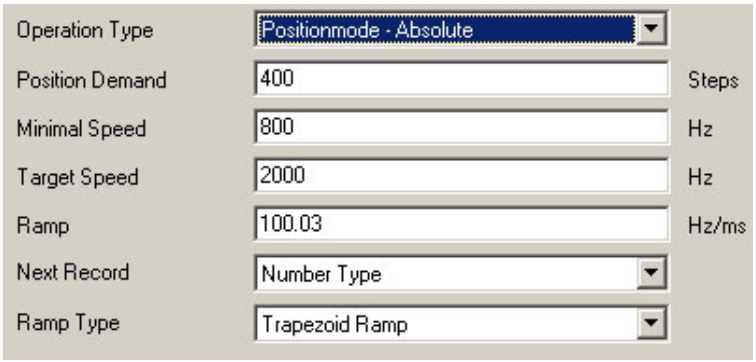
The reference switch can be an opener or a closer. This must be set with the software during programming.

See also section 7 “<Display Properties> tab” and separate manual for the respective stepper motor driver or for the Plug & Drive motor.

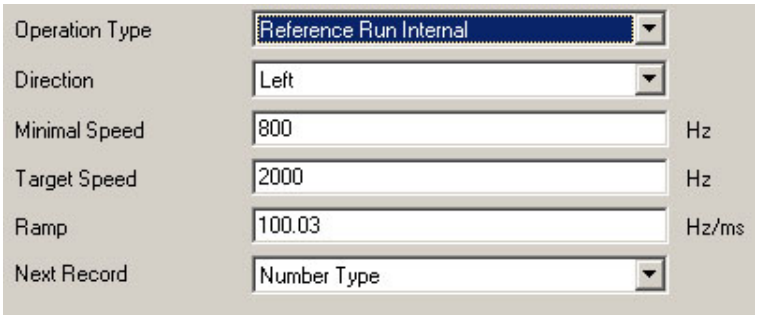
Parameter fields for the "Relative" operation type



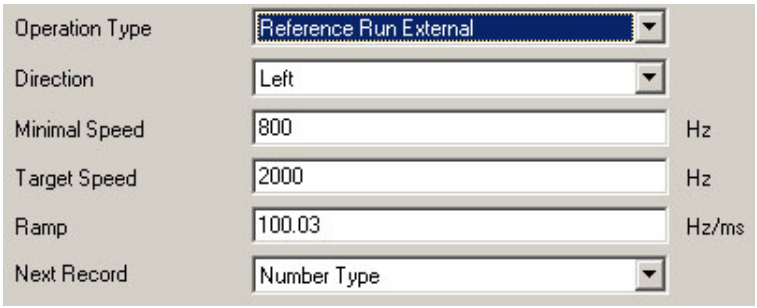
Parameter fields with the “Absolute” operation type



Parameter fields with the "Reference Run Internal” operation type



Parameter fields with the "Reference Run External” operation type



4.3.2 Input and output assignments

Input 1: Start input / Error reset

A signal at input 1 starts the selected travel profile. A negative edge at input 1 can be used to reset an error (speed monitoring).

Inputs 2 to 5: Selection of travel profile

The profile numbers are called up using a binary code with the inputs 2 to 5. When input 1 is activated, the value is read in and the corresponding profile is loaded and started.

Profile number	Input 2	Input 3	Input 4	Input 5
1	0	0	0	0
2	1	0	0	0
3	0	1	0	0
4	1	1	0	0
5	0	0	1	0
6	1	0	1	0
7	0	1	1	0
8	1	1	1	0
9	0	0	0	1
10	1	0	0	1
11	0	1	0	1
12	1	1	0	1
13	0	0	1	1
14	1	0	1	1
15	0	1	1	1
16	1	1	1	1

Input 6: External limit switch

See also section 7 “<Display Properties>” and separate manual for the respective stepper motor driver or for the Plug & Drive motor.

Outputs

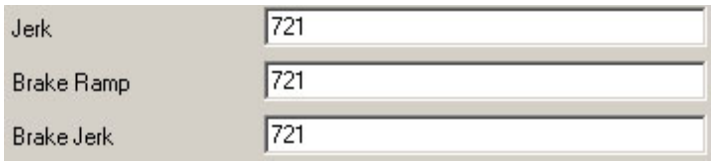
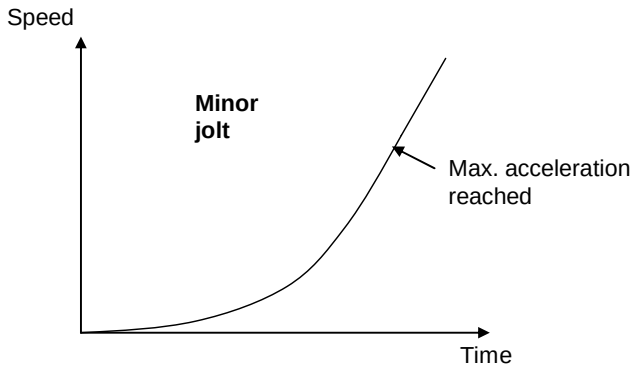
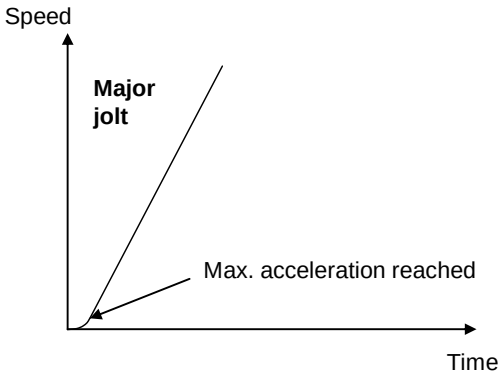
Output 1	Output 2	State
0	1	Motor processing last command.
1	0	"Ready" Motor idle, waiting for new command.
0	0	Error (speed monitoring) or limit switch (normal operation).
1	1	Reference point (zero position) reached.

4.3.3 Profile parameters

Parameter descriptions

The following parameters can be set:

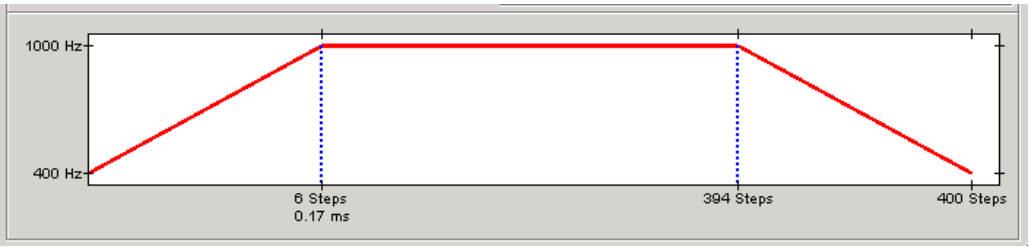
Parameters	Function
Position Demand	• Absolute or relative position for the selected travel profile (distance). • The control variable can be input in steps, degrees or mm. • The units can be changed in the <Display settings> tab.
Direction (not with absolute positioning)	Direction of rotation of travel profile: • Left • Right
Minimal Speed	"Start speed" (V Start): • Start-up speed (start/stop frequency) of the motor in Hz. • To avoid step losses, this should be higher than the intrinsic resonance of the motor. • Too high a minimum speed can also lead to step losses.
Target Speed	"Normal speed" (V Normal): • Normal travel speed of the motor in Hz. • To avoid step losses, it should lie outside resonance ranges. • Too high a maximum speed can cause step losses and motor stalling.
Ramp	Ramp gradient: • Values are entered in Hz/ms. • The steeper the ramp, the faster the acceleration, however, if the acceleration is too high, the motor can skip and lose steps. • Any possible resonance ranges must be traversed as fast as possible. • The maximum value is 3000 Hz/ms. The set value is output as the next possible speed due to the coding in the motor (at 3000 Hz/ms e.g. as 2988.3 Hz/ms). • The minimum value is 0.1 Hz/ms.
Break (only with relative positioning)	• The break indicates the idle time of the motor when several runs must be implemented in sequence. • The unit is ms. • The minimum duration of the adjustable break is 1 ms.
Repetitions (only with relative positioning)	The "Repetitions" parameter indicates how often the selected travel profile should be implemented automatically in sequence without another start command.
Reverse direction (only with relative positioning)	• An automatic change of direction can be activated in the "Reverse Direction" option field. • In active change of direction, the rotation direction of the motor is automatically changed when the same record is called up several times in sequence. • The direction is changed after each call up.

Parameters	Function
Next Record	A travel profile can be defined in this selection menu to be called up when the current record is ended.
Ramp Type	The following ramp types can be selected: • Trapezoid Ramp • Sinus Ramp • Jerk Free Ramp The following additional parameter fields appear if the "Jerk Free Ramp" has been selected:  Possible values: 1 to 65,536 The "Brake Ramp" and "Brake Jerk" parameters indicate the maximum change of acceleration over time. The greater the jerk, the faster the acceleration can change. A very small jerk leads to a sinusoidal acceleration ramp while a large jerk leads to a trapezoidal ramp, see following figure:  

Profile graph display

The displayed profile graph shows the ramp times (acceleration time) and the overall actuating time for the applicable travel profile.

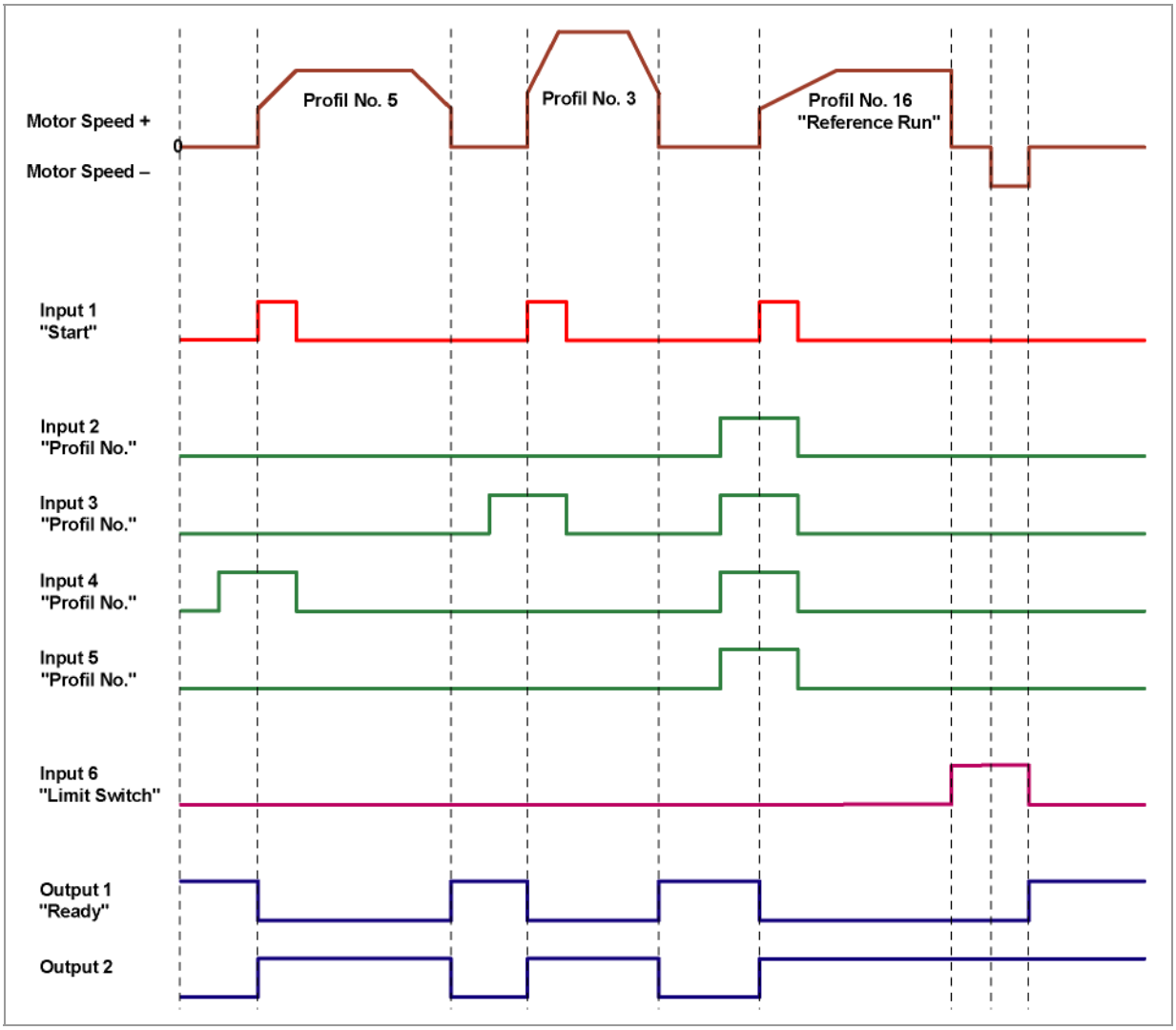
The graphic is recalculated after every relevant input. This allows you to continually check and, where necessary, correct the settings made.



4.3.4 Signal curves

Example of a signal curve

In this example, profile number 5, then profile number 3, followed by profile number 16 (programmed as reference run) are started.



4.4 Speed mode

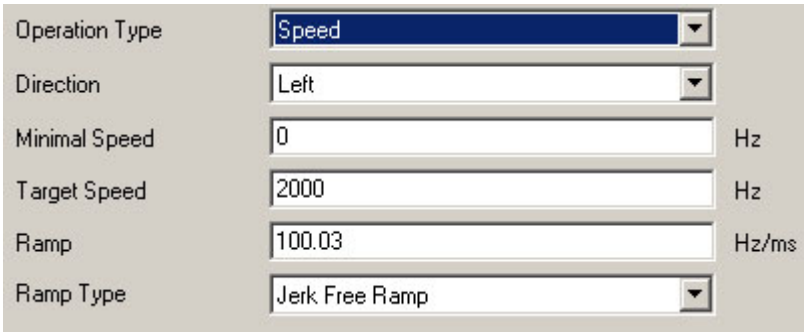
4.4.1 Description

Function

In the speed mode, the motor accelerates with a specified ramp from the starting speed (minimal speed/start frequency) to the specified maximum speed (target speed/maximum frequency).

The speed mode is generally used when a specific travel speed is required (e.g. for a conveyor belt or a pump).

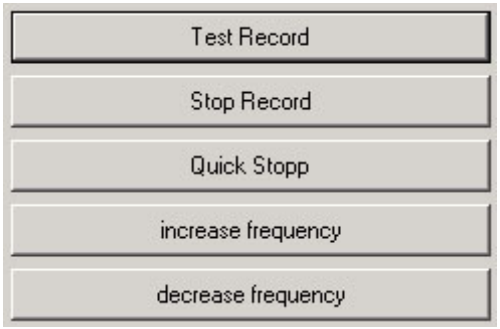
Parameter fields for “Speed” operation type



Speed changes

Speed changes can be implemented at any time via the inputs or the interface.

If you start the motor for test purposes via the driver software NANOPRO (click on <Test Record> button), the following buttons change:



- The <Save to Drive> button changes to the <increase frequency> button:
  Clicking on the button increases the frequency (speed) of the motor by 100 Hz.
  The actual frequency value is displayed in the top right of the window ("Motor speed”).
- The button <Read from Drive> button changes to the button <decrease frequency>:
  Clicking on the button decreases the frequency (speed) of the motor by 100 Hz.
  The actual frequency value is displayed in the top right of the window ("Motor speed”).

4.4.2 Input and output assignments

Input 1: Enable

Input 1 starts and stops the motor. A negative edge at input 1 can be used to reset an error (speed monitoring).

Inputs 2 to 5: Speed

The speed is set with the inputs 2 to 5. The state of the inputs is continuously read and the corresponding speed parameter output. When the speed changes, the motor accelerates or brakes with the set ramp to the new setpoint speed. When the speed changes, the motor accelerates or brakes with the set ramp to the new setpoint speed.

Profile number	Input 2	Input 3	Input 4	Input 5
1	0	0	0	0
2	1	0	0	0
3	0	1	0	0
4	1	1	0	0
5	0	0	1	0
6	1	0	1	0
7	0	1	1	0
8	1	1	1	0
9	0	0	0	1
10	1	0	0	1
11	0	1	0	1
12	1	1	0	1
13	0	0	1	1
14	1	0	1	1
15	0	1	1	1
16	1	1	1	1

Input 6: Direction

Input 6 determines the direction of rotation of the motor.

Outputs

Output 1	Output 2	State
0	1	Speed output running.
1	0	"Ready": motor idle, waiting for new command.
0	0	Error (speed monitoring).
1	1	Zero position reached.

4.4.3 Profile parameters

Parameter descriptions

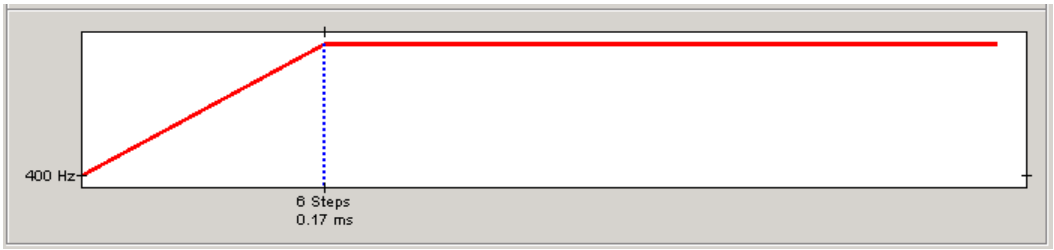
The following parameters can be set in the speed mode:

Parameters	Function
Direction	Direction of rotation of travel profile: • Left • Right The rotation direction of the motor is only relevant when the motor is operated via the programming interface, otherwise the rotation direction is selected via an input.
Minimal Speed	"Starting speed" • The minimum speed in Hz is the start-up speed (start-stop frequency) of the motor. • To avoid step losses, this should be higher than the intrinsic resonance of the motor. • Too high a minimum speed can also lead to step losses.
Target Speed	"Normal speed": • The maximum speed in Hz is the setpoint speed of the motor. • To avoid rough operation, it should lie outside resonance ranges. • Too high a maximum speed can cause step losses and motor stalling.
Ramp	Input of ramp gradient in Hz/ms.
Ramp Type	The following ramp types can be selected: • Trapezoid Ramp • Sinus Ramp • Jerk Free Ramp (see section 4.3.3)

Profile graph display

The displayed profile graph shows the ramp times (acceleration time) and the setpoint speed for the applicable travel profile.

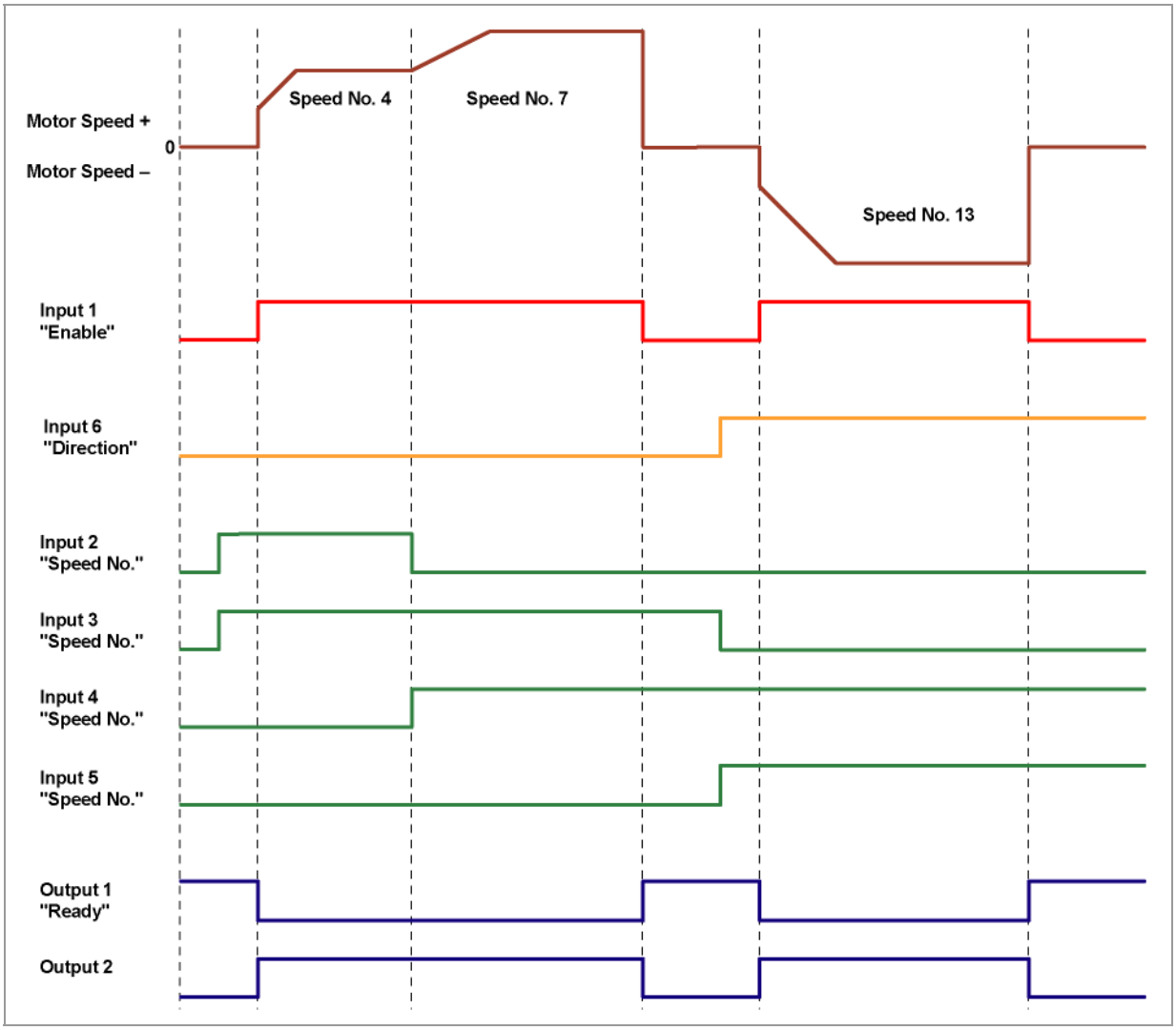
The graphic is recalculated after every relevant input. This allows you to continually check and, where necessary, correct the settings made.



4.4.4 Signal curves in speed mode

Example of a signal curve

In this example, speed 4, speed 7 and then, after a change of direction, speed 13 are started.

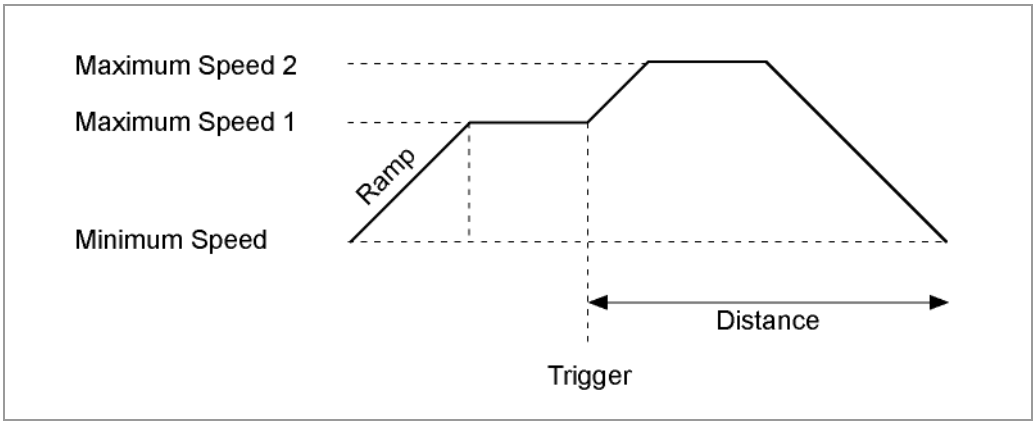


4.5 Flag Position mode

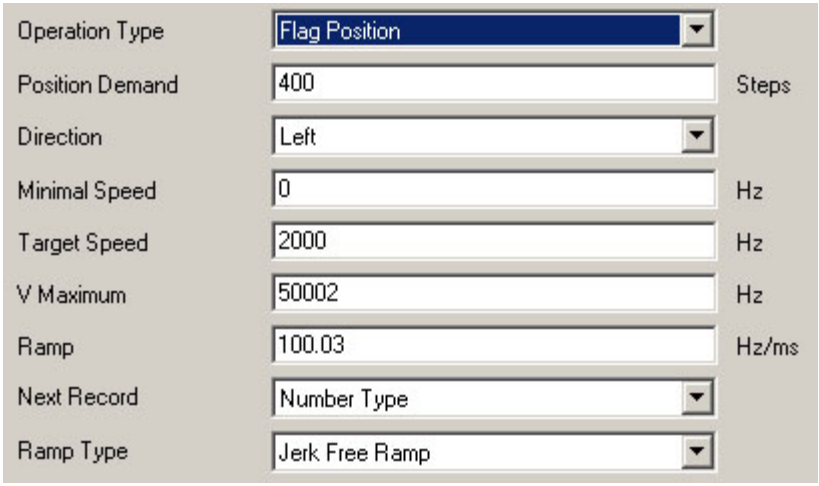
4.5.1 Description

Function

The flag position mode offers a combination of the speed and positioning modes. The motor is first operated in speed mode to travel an undefined distance with a specific speed, for example. When a trigger (trigger point) is reached, e.g. a limit switch, operation is switched to the relative positioning mode to travel to a defined setpoint position (relative to the trigger position).



Parameter fields in the “Flag Position” operation type



Manually setting the trigger signal

The trigger signal can be set manually at input 5 via the NANOPRO driver software.

If you start the motor for test purposes (click on the <Test Record>) button, the button changes as follows:

- The <Test Record> button changes to the <Trigger on> button:
  By clicking on this button the trigger signal is set and the motor changes from the speed mode to the relative position mode.

4.5.2 Input and output assignments

Input 1: Start

A signal at input 1 starts the speed mode.

A negative edge at input 1 can be used to reset an error (speed monitoring).

Inputs 2 to 4: Profile number

The profile number of the profile to be travelled is set with the inputs 2 to 4. When input 1 is activated, the number is read in and the corresponding profile is loaded and started.

Profile number	Input 2	Input 3	Input 4
1	0	0	0
2	1	0	0
3	0	1	0
4	1	1	0
5	0	0	1
6	1	0	1
7	0	1	1
8	1	1	1

Input 5: Trigger

A signal at input 5 starts the positioning mode.

Input 6: External limit switch

See also section 9 “<Input> tab” and separate manual for the respective stepper motor driver or for the Plug & Drive motor.

Outputs

Output 1	Output 2	State
0	1	Motor processing last command.
1	0	"Ready" Motor idle, waiting for new command.
0	0	Error (speed monitoring) or limit switch (normal operation).
1	1	Reference point reached.

4.5.3 Profile parameters

Parameter descriptions

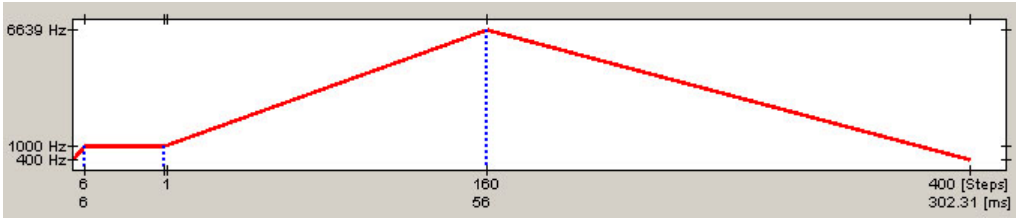
The following parameters can be set in the flag position mode:

Parameters	Function
Position Demand	• Distance for the selected travel profile. • The number of motor steps to be output can be selected up to 16,777,215 steps.
Direction	Direction of rotation of travel profile: • Left • Right
Minimal Speed	"Starting speed" • The minimum speed in Hz is the start-up speed (start-stop frequency) of the motor. • To avoid step losses, this should be higher than the intrinsic resonance of the motor. • Too high a minimum speed can also lead to step losses.
Target Speed	"Normal speed": • The maximum “Speed 1” in Hz is the setpoint speed of the motor. • To avoid step losses, this should be higher than the intrinsic resonance of the motor. • Too high a maximum speed can cause step losses and motor stalling.
V Maximum	• Maximum "Speed 2" in Hz. • Like maximum "Speed 1". • Default set to 2000 Hz.
Ramp	Input of ramp gradient in Hz/ms.
Next Record	A travel profile can be defined in this selection menu to be called up when the current record is ended.
Ramp Type	The following ramp types can be selected: • Trapezoid Ramp • Sinus Ramp • Jerk Free Ramp (see section 4.3.3)

Profile graph display

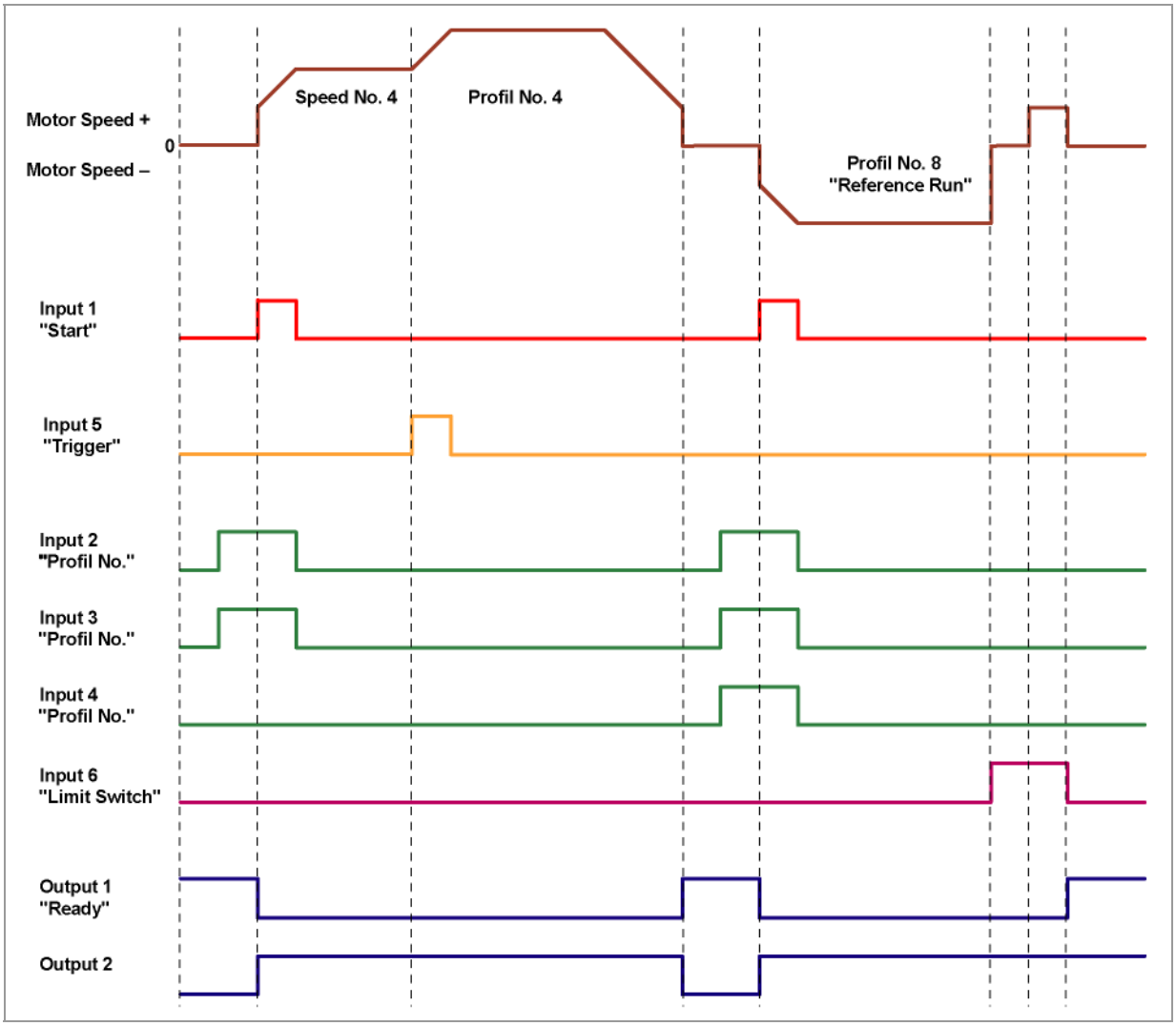
The displayed profile graph shows the ramp times (acceleration time) and the overall actuating time for the applicable travel profile.

The graphic is recalculated after every relevant input. This allows you to continually check and, where necessary, correct the settings made.



4.5.4 Signal curves in Flag Position mode

In this example, profile 4 is started and then a reference run (programmed as profile 8) is started.



4.6 Clock Direction mode Run Int. Ref. / Ext. Ref. / Left / Right

4.6.1 Description

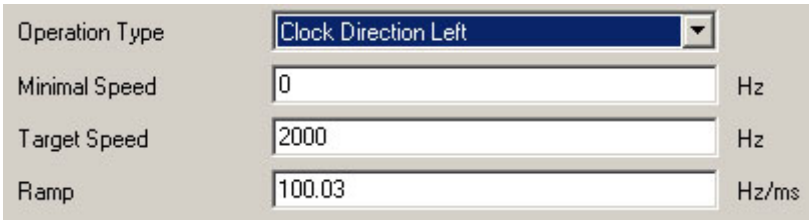
Function

In the Clock Direction mode, the motor is operated via two inputs with a clock and a direction signal from a superordinate positioning control (indexer).

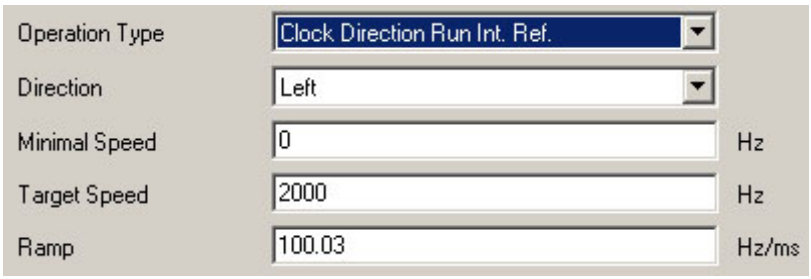
With the Clock Direction Left/Right modes, the motor can be moved manually into the selected rotation direction. With every clock signal, the motor moves one step in the direction set by the direction signal. The motor can be started by clicking on the <Test Record> button.

In the Clock Direction Run Int. Ref. / Ext. Ref. modes the internal or external reference run is supported (see section 9 “<Input>” and separate manual for the respective stepper motor driver or for the Plug & Drive motor).

Parameter fields in the "Clock Direction Left/Right” operation type



Parameter fields in the "Clock Direction Run Int. Ref. / Ext. Ref.” operation type



4.6.2 Functions of the inputs and outputs

Input 1: Enable

The activation of input 1 starts the mode selected by inputs 2 and 3.

A negative edge at input 1 can be used to reset an error (speed monitoring).

Inputs 2 and 3: Mode

The mode is set with inputs 2 and 3. The settings are accepted when Input 1 is activated. The direction of the reference runs is also specified by the saved parameters. In the Clock Direction Left/Right modes, the motor travels 10 steps with a frequency of ca. 2 Hz, then it accelerates to the programmed maximum frequency.

Mode selection

Number	Operation Type	Input 2	Input 3
1	Clock Direction Left	0	0
2	Clock Direction Right	1	0
3	Clock Direction Run Int. Ref.	0	1
4	Clock Direction Run Ext. Ref.	1	1

Input 4: External limit switch

See also section 9 “<Input> tab” and separate manual for the respective stepper motor driver or for the Plug & Drive motor.

Input 5: Direction

The direction input determines the direction of rotation of the motor. A signal change at this input must be completed at least 150 µs before a clock signal.

Input 6: Clock (external)

With every positive edge at the clock input, the motor carries out a step in the direction set by the direction input. The external clock is also active in the reference runs.

Outputs

Output 1	Output 2	State
0	1	Motor processing last command.
1	0	Current reduction active.
0	0	Error (speed monitoring).
1	1	Reference point reached.

4.6.3 Profile parameters

Parameter descriptions

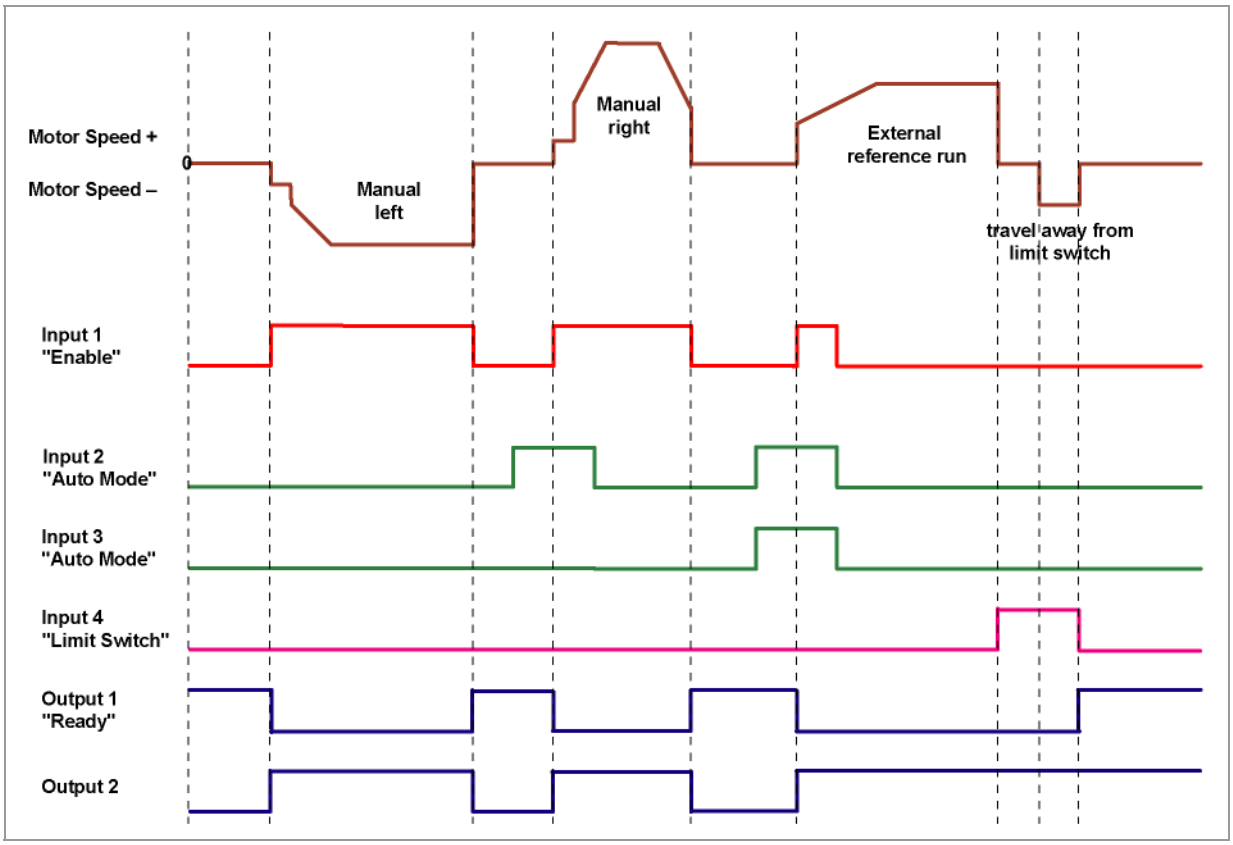
The following parameters can be set in the clock direction mode:

Parameters	Function
Direction	Direction of rotation of travel profile: • Left • Right
Minimal Speed	"Starting speed" • The minimum speed in Hz is the start-up speed (start-stop frequency) of the motor. • To avoid step losses, this should be higher than the intrinsic resonance of the motor. • Too high a minimum speed can also lead to step losses.
Target Speed	"Normal speed": • The maximum speed in Hz is the setpoint speed of the motor. • To avoid step losses, this should be higher than the intrinsic resonance of the motor. • Too high a maximum speed can cause step losses and motor stalling.

Parameters	Function
Ramp	Input of ramp gradient in Hz/ms.

4.6.4 Signal curves in clock direction mode

In this example, the left and right modes are started after one another and then the external reference run is carried out.



4.7 Analogue and Joystick mode

4.7.1 Description

Function

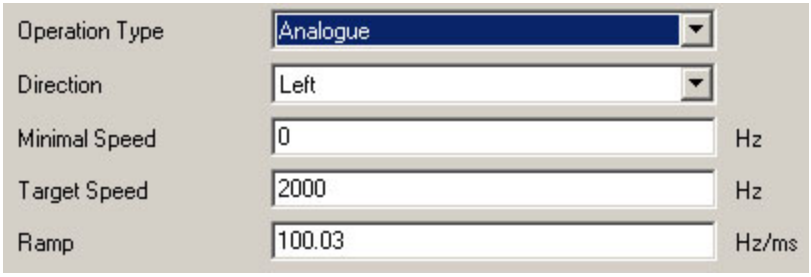
In the analogue or joystick mode, a stepper motor is operated in a simple application:

- with a specific speed, e.g. via an external potentiometer,
- or synchronously with a superordinate controller with analogue output (–10 V to +10 V).

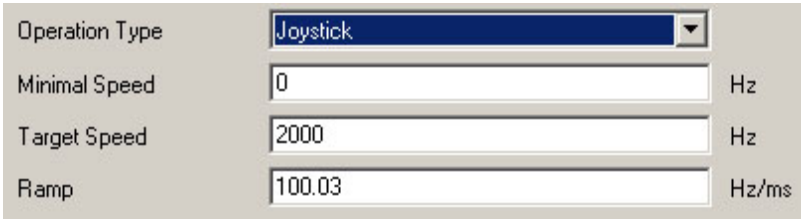
The motor is simply actuated either by a potentiometer or an external power supply and a joystick (maximum –10 V to +10 V).

Note: The analogue and joystick modes differ only in a few points. Both modes are therefore described here in one section.

Parameter fields in the “Analogue” operation type



Parameter fields in the “Joystick” operation type



4.7.2 Function of the inputs and outputs

Input 1: Start

When input 1 is activated, the value is read in and the corresponding profile is loaded and started.

Inputs 2 to 5: Selection of travel profile

The profile number of the profile to be travelled is set with the inputs 2 to 5.

Profile number	Input 2	Input 3	Input 4	Input 5
1	0	0	0	0
2	1	0	0	0
3	0	1	0	0
4	1	1	0	0
5	0	0	1	0
6	1	0	1	0
7	0	1	1	0
8	1	1	1	0
9	0	0	0	1
10	1	0	0	1
11	0	1	0	1
12	1	1	0	1
13	0	0	1	1
14	1	0	1	1
15	0	1	1	1
16	1	1	1	1

Input 6: Direction

In Analogue mode, the direction cannot be defined via the record as the digital inputs/outputs have a higher priority. The direction must however be defined via input 6.

In Joystick mode, the direction of the motor is dependent on a defined voltage range. The direction is changed in the middle of the voltage range (e.g at +5 V in a voltage range of 0 V to +10 V).

Please refer to section 9 “<Input> tab”.

Analogue In

The analog input "Analogue In" can be actuated with max. –10 V to +10 V.

The motor operates at a speed proportional to the applied voltage. The voltage is resolved with an accuracy of 10 bits. The smaller the selected voltage range is, the worse the resolution of the speed will be.

Refer to the example in section 9 “<Input> tab”.

4.7.3 Profile parameters

Parameter descriptions

The following parameters can be set in the Analogue or Joystick mode:

Parameters	Function
Direction (only in Analogue mode)	Direction of rotation of travel profile: • Left • Right **Note:** In Joystick mode, the voltage sign determines the direction of rotation (– means "rotate left", + means "rotate right").
Minimal Speed	"Starting speed" • The minimum speed in Hz is the start-up speed (start-stop frequency) of the motor. • To avoid step losses, this should be higher than the intrinsic resonance of the motor. • Too high a minimum speed can also lead to step losses.
Target Speed	"Normal speed": • The maximum speed in Hz is the setpoint speed of the motor. • To avoid step losses, this should be higher than the intrinsic resonance of the motor. • Too high a maximum speed can cause step losses and motor stalling.
Ramp	Input of ramp gradient in Hz/ms. In the Analogue and Joystick modes, the ramp determines the maximum acceleration. If the voltage changes too fast, e.g. by turning the potentiometer too rapidly, this ramp is used to accelerate to the maximum speed.

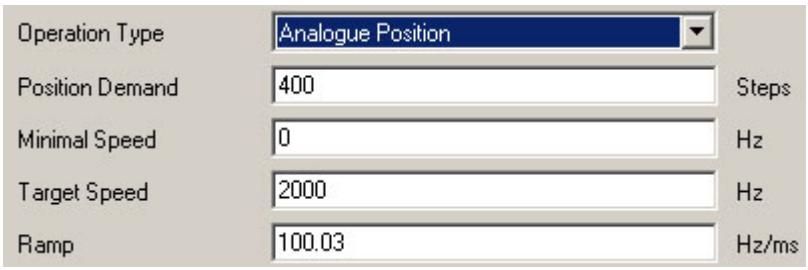
4.8 Analogue Position mode

4.8.1 Description

Function

A specific position can be approached in this mode. The voltage at the analogue input directly controls the position.

Parameter fields



4.8.2 Function of the inputs and outputs

Input 1: Start

When input 1 is activated, the value is read in and the corresponding profile is loaded and started.

Inputs 2 to 5: Selection of travel profile

The profile number of the profile to be travelled is set with the inputs 2 to 5.

Profile number	Input 2	Input 3	Input 4	Input 5
1	0	0	0	0
2	1	0	0	0
3	0	1	0	0
4	1	1	0	0
5	0	0	1	0
6	1	0	1	0
7	0	1	1	0
8	1	1	1	0
9	0	0	0	1
10	1	0	0	1
11	0	1	0	1
12	1	1	0	1
13	0	0	1	1
14	1	0	1	1
15	0	1	1	1
16	1	1	1	1

Analogue In

The analogue input "Analogue In" can be actuated with max. –10 V to +10 V. The voltage at the analogue input directly controls the position.

4.8.3 Profile parameters

Parameter descriptions

The following parameters can be set in the Analogue Position mode:

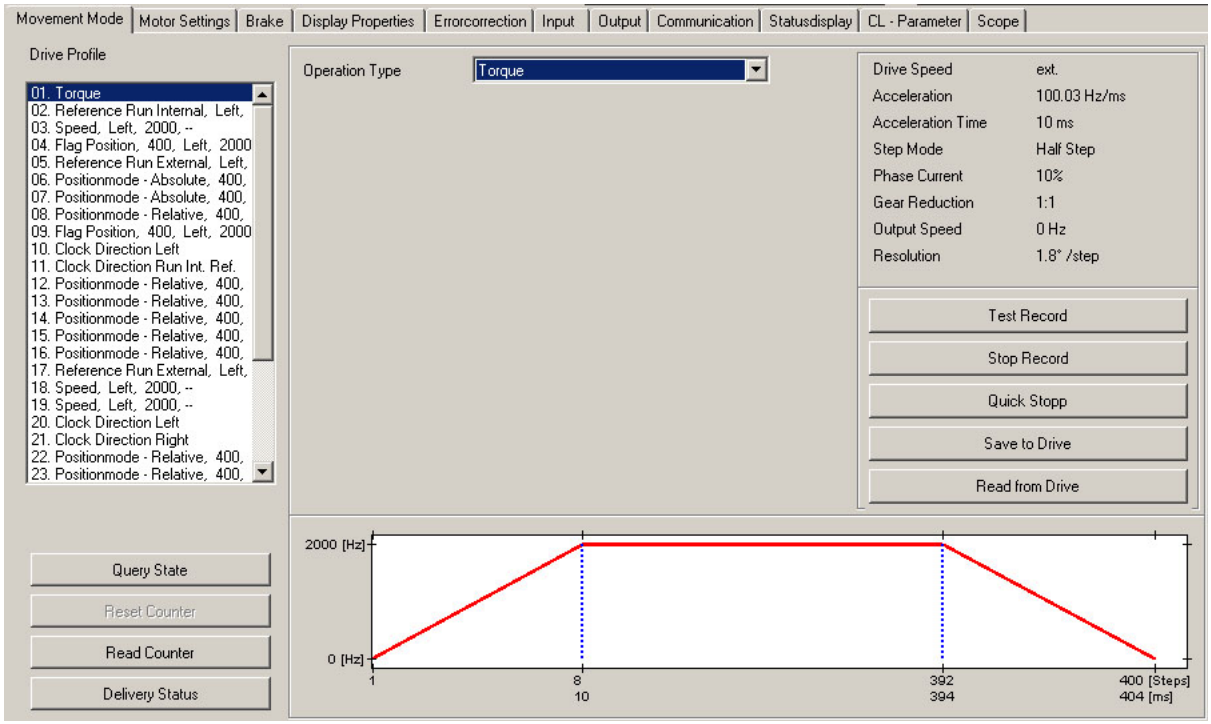
Parameters	**Function**
Position Demand	• Distance for the selected travel profile. • The number of motor steps to be output can be selected up to 16,777,215 steps.
Minimal Speed	"Starting speed" • The minimum speed in Hz is the start-up speed (start-stop frequency) of the motor. • To avoid step losses, this should be higher than the intrinsic resonance of the motor. • Too high a minimum speed can also lead to step losses.
Target Speed	"Normal speed": • The maximum speed in Hz is the setpoint speed of the motor. • To avoid step losses, this should be higher than the intrinsic resonance of the motor. • Too high a maximum speed can cause step losses and motor stalling.
Ramp	Input of ramp gradient in Hz/ms. In the Analogue Position mode, the ramp determines the maximum acceleration. If the voltage changes too fast, e.g. by turning the potentiometer too rapidly, this ramp is used to accelerate to the maximum speed.

4.8.4 Motor Settings

See section 9 “<Input> tab”.

4.9 Torque mode

Display



Function

The torque mode is used to rotate the motor at a constant torque. The torque is specified by the set current ("Phase current" parameter in the <Motor Settings> tab).

The speed is not fixed in this mode: The higher the load on the motor, the lower the speed. The speed that is set depends on the type of motor used and the current setting.

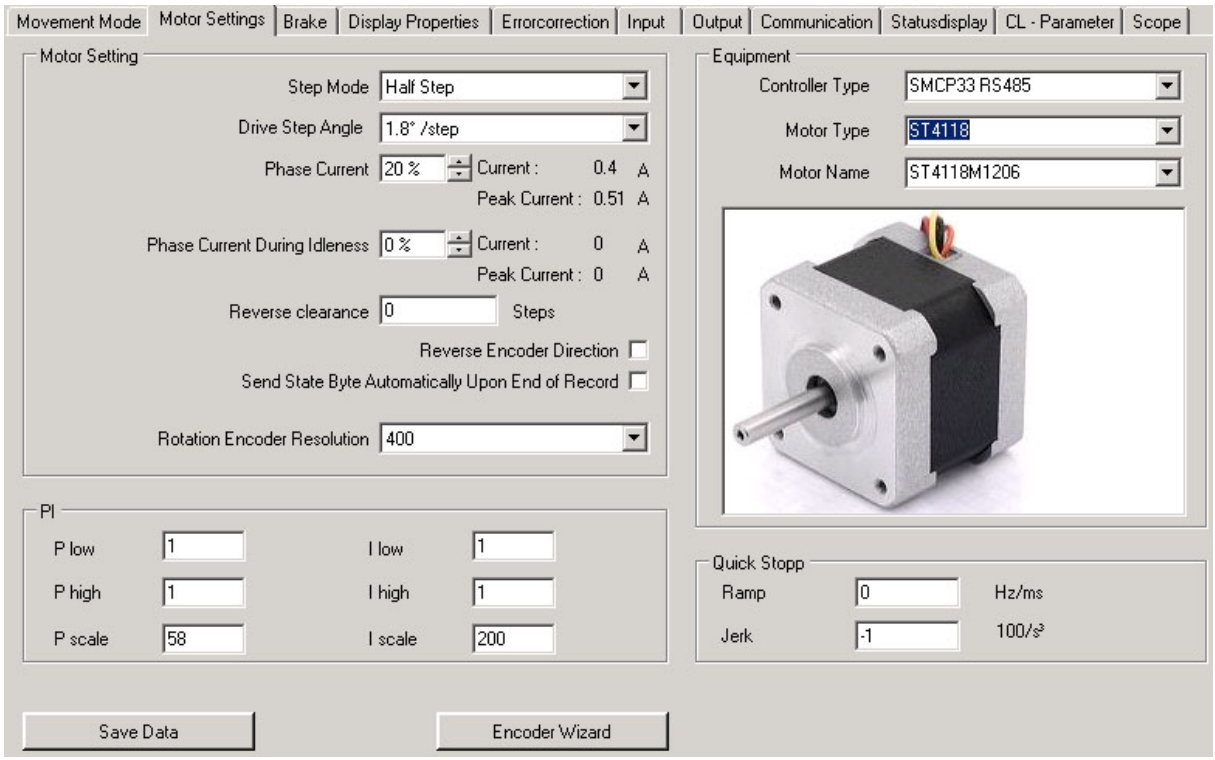
Ramps are not used in the Torque mode. The rate that the motor accelerates depends only on the current setting.

Note:
The Torque mode can only be used when Closed Loop mode is activated.

5 <Motor settings> tab

Display

The general motor parameters are set on the <Motor Settings> tab.



Parameter descriptions

The following parameters can be set for the motor:

Parameters	**Function**	**Note**
Equipment		
Controller Type	Selection of driver type.	The user interface is modified to correspond to the selected controller type.
Motor Type	Selection of motor type.	
Motor Name	Selection of motor designation	

Parameters	Function	Note
Motor Setting		
Step Mode	The following step modes can be selected: • Full Step • Half Step • Quarter Step • Fifth Step • Eighth Step • Tenth Step • 16th Step • 32th Step • 64th Step • Adaptive microstep	The smaller the selected step size is, the larger the resolution: E.g. with a 1.8° stepper motor, a half step is 0.9° and a tenth step is 0.18°. Adaptive microstep means that the step angle automatically increases with increasing speed. Example: at 30 rpm, the motor runs in 64th step mode and at 3000 rpm at full step as a higher speed is possible here and in general accuracy plays a subordinate role.
Drive Step Angle (full step width)	Setting of the step angle of the connected motor	In general, the motor is a 1.8° stepper motor (default). Another step angle can be selected if necessary in the selection menu.
Phase Current	The phase current can be set in steps of 1 %. The corresponding absolute value is automatically calculated and displayed in the "Current" and "Peak Current" display fields.	The surge current is less in full step mode than in the other step modes. To achieve the same output as in full step mode, the motor needs higher surge currents in smaller step modes.
Phase Current During Idleness	Input of phase current at standstill in percent. The corresponding absolute value is automatically calculated and displayed in the "Current" and "Peak Current" display fields. It is recommended to select the highest possible current reduction for standstill.	This current reduction serves to minimise the heat generated by the dissipation loss of the motor windings and the output stage of the driver. However, if the full holding torque is required during standstill, then the current reduction should not be activated or the phase current not reduced.
Reverse clearance	Input of steps to compensate for the reverse clearance of the mechanics, e.g. in linear axles or gears.	The steps entered here are added to every change of direction.

Parameters	Function	Note
Reverse Encoder Direction	Option field for activating the encoder rotation direction change.	In some cases, an incorrect rotation direction is defined. This can be seen when the error message "Position error" is always displayed when testing records. Please also refer to section 16 “Troubleshooting”. This function can be used to change the A/B track in the software.
Automatic sending of the status bytes at the end of a run	If this option field is activated, status bytes are automatically sent at the end of a run.	The use of this option is sensible when just one motor is actuated and the end of the run must be evaluated. **Note:** This option must not be used when a network is set up as this could lead to conflicts and therefore to transmission errors.
Rotation Encoder Resolution	Resolution of the rotation encoder (pulses/revolution)	The following resolutions can be selected: 500, 192, 200, 400, 512, 1000, 1024, 2000, 2048
Quick Stopp		
Ramp	Ramp gradient for the Quick Stopp function in Hz/ms.	
Jerk	Limitation of the maximum acceleration change in 100/ms³ (see also section 4.3.3).	Possible values: 1 – 65,536
PI (only for SMCP33 and PD4-N)		
P low	P and I components of the current regulator.	
P high		
P scale		
I low		
I high		
I scale		

Adjusting the encoder

Note:
Before adjusting the encoder, the motor type or the motor step angle must be correctly set, see section 5 “<Motor settings> tab”.

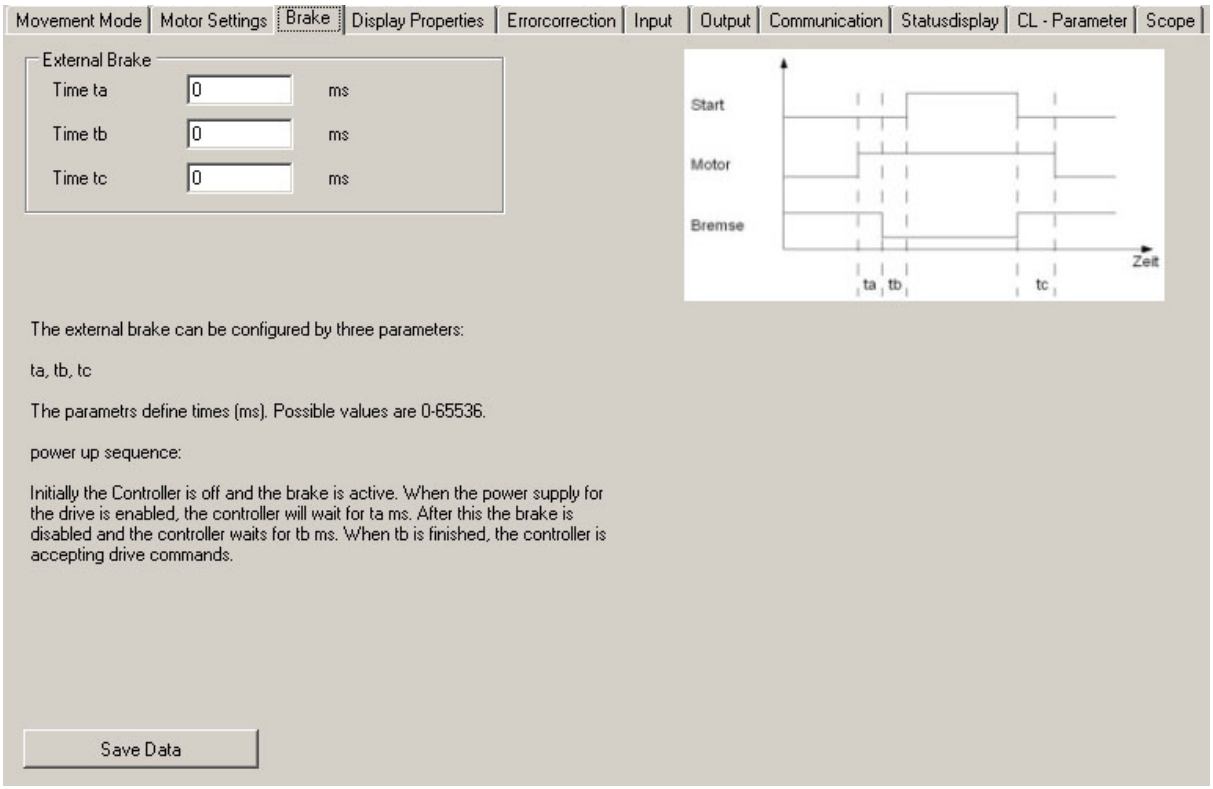
Resolution and direction of rotation of the encoder can be adjusted using the <Encoder Wizard>.

The motor makes one revolution if the button is pressed. The resolution of the rotation encoder is automatically matched and displayed in the <Motor Settings> tab. Depending on the connection, the rotation is also matched if necessary and displayed in the <Motor Settings> tab ("Reverse Encoder Direction" checkbox is activated).

6 <Brake> tab

Display

Settings for the brake are adopted using the <Brake> tab.

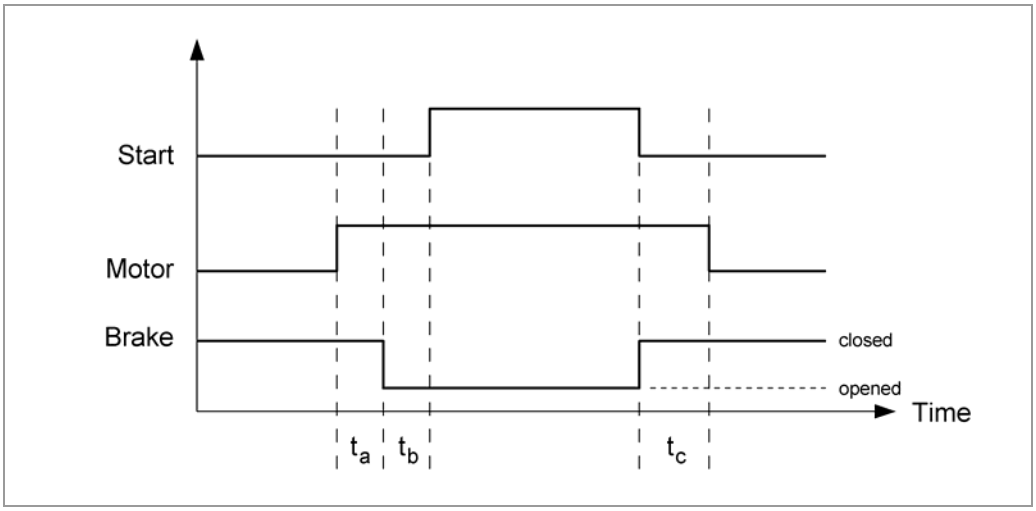


Parameters for External Brake

The following parameters can be set:

- Time ta:
  Waiting time between switching on the motor current and switching off (triggering) the brake in milliseconds.
- Time tb:
  Waiting time between switching off (triggering) the brake and activation of readiness in milliseconds. Travel commands will only be executed after this waiting time.
- Time tc:
  Waiting time between switching on the brake and switching off the motor current in milliseconds.

The parameters indicate times between 0 and 65,536 milliseconds.
Default values of the driver after a reset: 0 ms.



Braking response

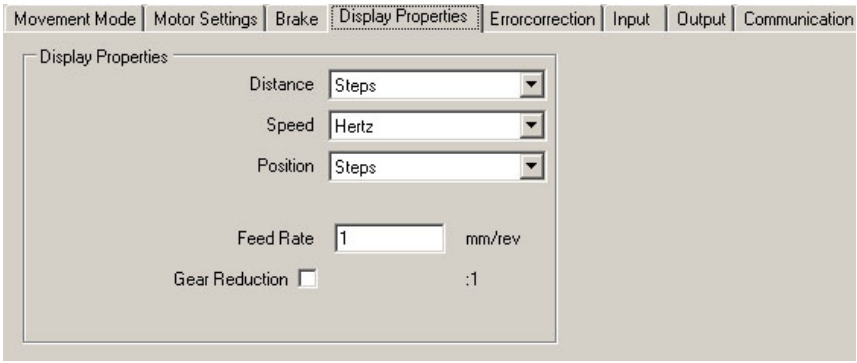
When the driver is switched on, the brake is initially active and the motor is not supplied with power.

Note:
During current reduction, the brake is not actively connected.

7 <Display Properties> tab

Display

Display properties are made using the <Display Properties> tab.



Display Properties

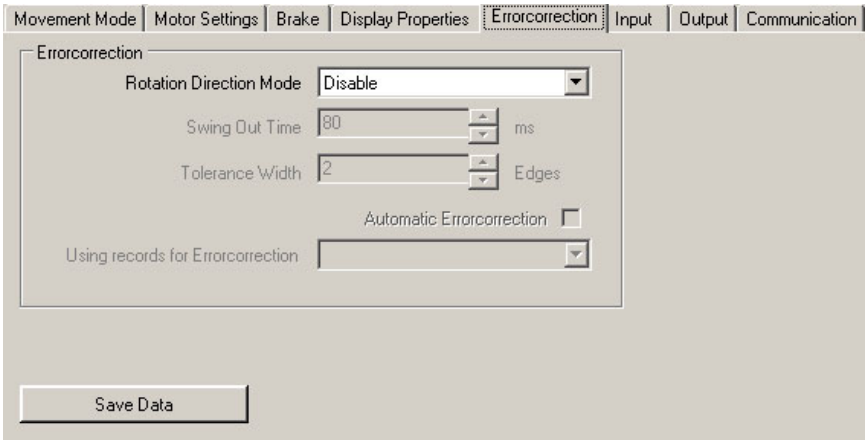
The following parameters can be set:

Parameters	Function	Note
Distance	The distance can be displayed in: • Steps • Degrees • mm	The units of measure set here are inserted in the parameter fields of the various operating modes.
Speed	The speed can be displayed in: • Hz • Rpm • mm/s	The units of measure set here are inserted in the parameter fields of the various operating modes.
Position	The counter reading can be displayed in: • Steps • Degrees • mm	The units of measure set here are inserted in the parameter fields of the various operating modes.
Feed Rate	Definition of feed rate in mm/rev.	If one of the above parameters is set to "mm", then the corresponding feed must be entered in the "Feed Rate" field.
Gear Reduction	Option field for activating the "Gear Reduction" field. Input of gear reduction if field activated.	When the option field is set, the "Gear Reduction" field is activated and the reduction value can be entered. 

8 <Errorcorrection> tab

Display

The settings for speed monitoring and error correction are made on the "Errorcorrection" tab.



Motor function test

The motor has an integrated encoder signal evaluation for checking motor functions and to signal step losses. If the motor loses more than 1 half step (0.9° with a 1.8° stepper motor), output 2 signals an error.

It is possible to compensate for this error at the end of or during the run.

Parameter descriptions

The following parameters can be set for the motor:

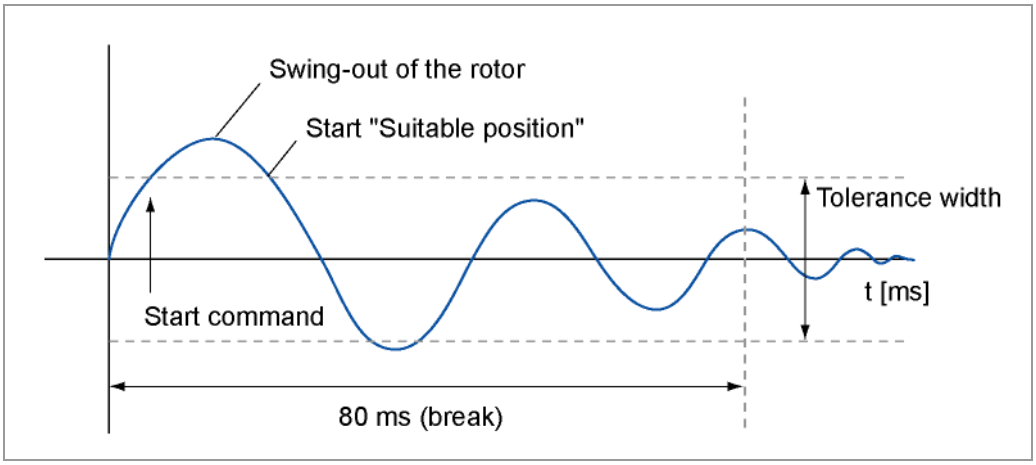
Parameters	Function	Note
Rotation Direction Mode	The following modes are available: • Disable • At end of run • During run	“Disable” means that the rotation encoder monitoring is switched off. All fields in this section are therefore deactivated. The “Disable” mode must be selected when an encoder is not used. The Rotation Direction Mode checks the position of the rotor at the end of the run (after the swing out time) or during the run. As described above, the position of the rotor can also be checked and corrected, if necessary, at the end of the run if the "Automatic Errorcorrection" option field is activated.
Swing Out Time	Definition of a swing out time in 1 ms steps, the time that the encoder waits before it measures the position of the rotor. The recommended standard value is 80 ms.	After a record is completed, the rotor swings out around the set target position before it comes to a standstill. This swing out is taken into account with the definition of a swing out time in order to avoid possible measurement errors. The swing out time decreases the smaller the moment of inertia of the rotor, and other external moments of inertia, is and the larger the damping, system rigidity and friction is.
Tolerance Width	Input of a tolerance within the encoder edges. The recommended standard value is 2 edges.	The tolerance is the maximum deviation in (micro)steps. How large a step is depends on the currently set step mode. If the encoder resolution is insufficient (step mode > 1/10 in 1.8° motors, or. >1/5 in 0.9° motors), additional errors will result from the conversion of encoder increments into microsteps.
Automatic Error Correction	Option field for activating automatic error correction	At the end of a record, the motor calculates the lost steps and compensates for them with a defined correction run. The parameters must be selected so that the motor safely implements the correction without losing any steps. When the setting is during the run, the correction will be implemented during the run itself.
Using records for Errorcorrection	Selection menu for definition of travel profile used for "Automatic Errorcorrection" (activated option field, see above).	The ramp and the speed in the selected travel profile are used for the correction run.

Starting within the swing out time

The specification of a swing out time before measurement of the rotor position by the encoder limits the possibility of rapid reversing movements.

In the relative positioning mode a break between two reversing rotations must also be set (minimum = 1 ms). If the set break is shorter than the swing out time, the motor waits until the rotor is in a suitable position and then carries out the next record. This "suitable position" is determined when the tolerance width is set and avoids step losses.

The length of the break and swing out time (in ms) after the completion of a record is determined by the number of encoder edges. It is possible to realise rapid reversing movements with the specification of a tolerance width (in edges).



Encoder edges

The encoder has a 5 to 10 times higher resolution than the motor. The encoders used operate with 500 pulses/revolution.

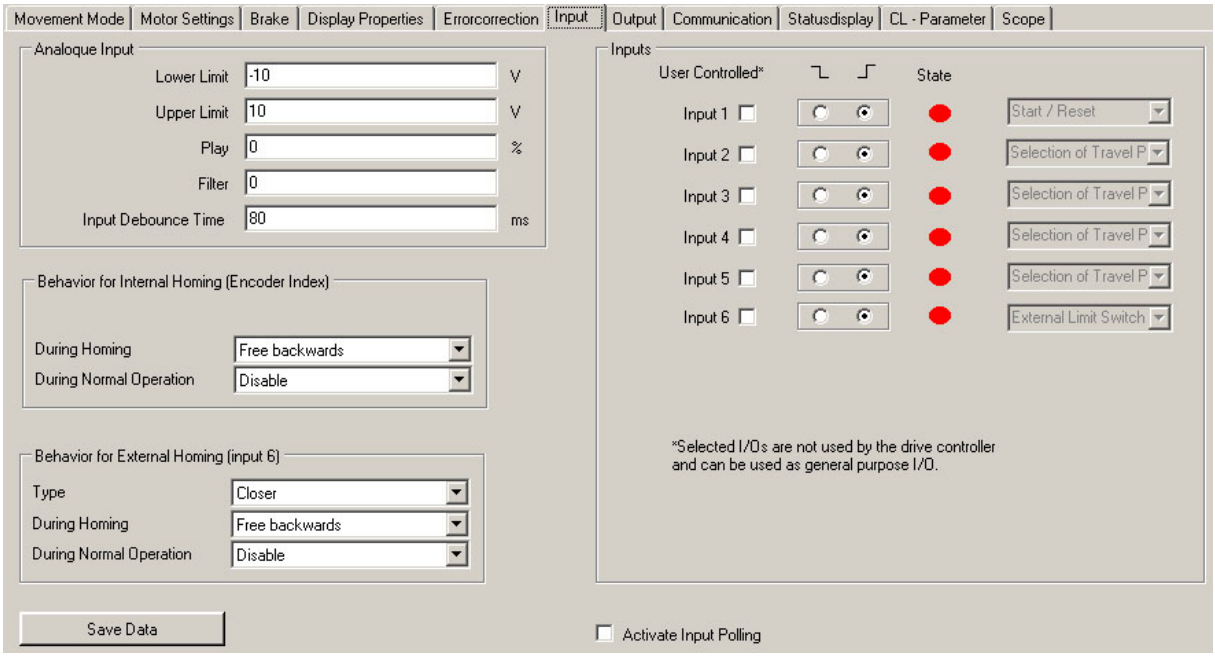
This squaring results in a resolution of 2,000 edges.

The 1.8° stepper motors operate with 200 steps/revolution, therefore a full step equals 10 encoder edges (half step = 5 edges).

The recommended tolerance width is 2 edges.

9 <Input> tab

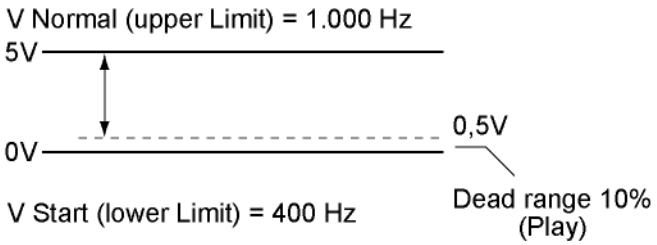
Display



Parameter for Analogue mode

The <Input> tab has five parameters that define the analogue mode:

Parameters	Function
Lower Limit and Upper Limit	These values determine the upper and lower limits of the input voltage. The voltage is resolved with an accuracy of 10 bits. The smaller the selected range is, the worse the resolution of the speed will be (and vice versa): • Start speed: lower limit • Setpoint speed: upper limit • Maximum range: –10 V ... +10 V. **Calculation example** Selected voltage range = 0 V to +5 V Start speed = 400 Hz = 0 V Setpoint speed = 1000 Hz = +5 V Speed adjustable: 10 bit = 1024 = 5 V / 1024 = 0.0048 V corresponds to 2.344 Hz (400 Hz - 1000 Hz = 600 Hz / **256** = 2.344 Hz). The divisor "256" in the above equation is derived from the percentage of the voltage range used: The voltage range of 5 V out of a possible range of 20 V equals 25 %. Based on the 10 bit resolution, this is equal to 25 % of 1024 = 256.

Parameters	Function
Play	The "Play" setting provides an option to hide the interference or ripple voltage in the lower limit range. With a lower limit of 0 V and an upper limit of 5 V, a play of 10% would limit the control range to 0.5 – 5.0 V.  **Calculation example for play:** Selected voltage range = 0.5 V to +5 V Start speed = 400 Hz = 0.5 V Setpoint speed = 1000 Hz = +5 V Speed adjustable: 10 bit = 1024 = 4.5 V / 1024 = 0.0044 V corresponds to 2.604 Hz (400 Hz - 1000 Hz = 600 Hz / **230.4** = 2.604 Hz). Divisor from the percentage of the voltage range used: The voltage range of 4.5 V out of a possible range of 20 V equals 22.5 %. Based on the 10 bit resolution, this is equal to 22.5 % of 256 = 230.4.
Filter	The analogue input samples the input voltage with a frequency of 1 kHz. The input voltage can be smoothed with the help of the analogue input. A filter value between 0 and 16 results in a simple average value formation over the given number (a value of 0 or 1 indicated that averaging has not occurred). As filtering only takes 16 milliseconds with a sample frequency of 1 kHz over maximum 16 supporting points, it is possible to use a recursive filter where the determined value depends on the actually measured value and on the previous "filter value". This method can be used to average a greater number of supporting points, even if insufficient memory is available. However, this is not a real average value, but a signal rounding of the input voltage (first order low pass or PT1 element). The recursive filter is used from a value of 17. The time constant is doubled each time the value is increased. The longest time constant is reached with the value 31. The time constant can be read off from the following table. The time constant T indicates after how much time the filter output approaches 50% of the filter input. After a further time T has passed, the filter output then reaches 75% of the input. With an input jump from 0 to 1, the filter output follows the following rule: Output = $1 - (0.5)^{t/T}$ where t is the time along the x axis and T the time constant of the filter.

<table>
<tr><th>Parameters</th><th>Function</th></tr>
<tr><td></td><td>5*T after changing the input voltage, the value at the filter output has thus reached 97% of the input value.
10*T after changing the input voltage, the value at the filter output will have reached 99.9% of the input value. The deviation corresponds to one stage of the AD converter when the input changes cover the entire range, e.g. a jump from -10 V to +10 V.
<table>
<tr><th>Value</th><th>Time constant T</th><th>Time for 99.9%</th></tr>
<tr><td>17</td><td>1 ms</td><td>10 ms</td></tr>
<tr><td>18</td><td>2 ms</td><td>20 ms</td></tr>
<tr><td>19</td><td>4 ms</td><td>40 ms</td></tr>
<tr><td>20</td><td>8 ms</td><td>80 ms</td></tr>
<tr><td>21</td><td>16 ms</td><td>160 ms</td></tr>
<tr><td>22</td><td>32 ms</td><td>320 ms</td></tr>
<tr><td>23</td><td>64 ms</td><td>640 ms</td></tr>
<tr><td>24</td><td>128 ms</td><td>1.2 s</td></tr>
<tr><td>25</td><td>256 ms</td><td>2.6 s</td></tr>
<tr><td>26</td><td>512 ms</td><td>5.1 s</td></tr>
<tr><td>27</td><td>1 s</td><td>10 s</td></tr>
<tr><td>28</td><td>2 s</td><td>20 s</td></tr>
<tr><td>29</td><td>4 s</td><td>40 s</td></tr>
<tr><td>30</td><td>8 s</td><td>80 s</td></tr>
<tr><td>31</td><td>16 s</td><td>160 s</td></tr>
</table></td></tr>
<tr><td>Debounce time of the inputs</td><td>Sets the time in ms that needs to elapse after a signal change at an input until the signal has stabilized.</td></tr>
</table>

Behavior for Internal / External Homing

There are different way to define the behavior on external and internal limit switches (see technical manual for the respective Plug & Drive motor or for the stepper motor drive). The behaviour of the limit switch during reference runs and in normal operation can be defined in the settings menu.

The following parameters can be set:

Parameters	Function
Type	Selection of the reference switch as an opener or closer depending on the version.
During Homing	Data on whether the limit switch (external and internal) should be approached during the reference run free forwards (without direction change) or backwards (in the opposite direction).
During Normal Operation	Data on how the motor should behave when recognizing the limit switch (external and internal) during normal operation (no reference run).

Procedure

Proceed as follows to set the limit switch behaviour:

Step	Action	Note
1	Select the <Input> tab.	
2	Set the parameters according to your requirements.	
3	Click on the <Save Data> button.	The settings are saved.

User-controlled inputs

The following settings can be made:

- Masking inputs:
  When the checkbox is activated, the corresponding input is “masked”, i.e. it is not directly interpreted by the motor and is available to the user as a "general purpose" input.
  The masked inputs are no longer available for record selection and are interpreted as .
  The masking of an input means that its state (high/low) can be evaluated via the interface. Further information can be found in the relevant section "Command Reference" of the programming manual.
- Switching behaviour:
  A selection can be made for each input as to whether it switches with rising or falling edge:
  -  = falling edge
  -  = rising edge

State

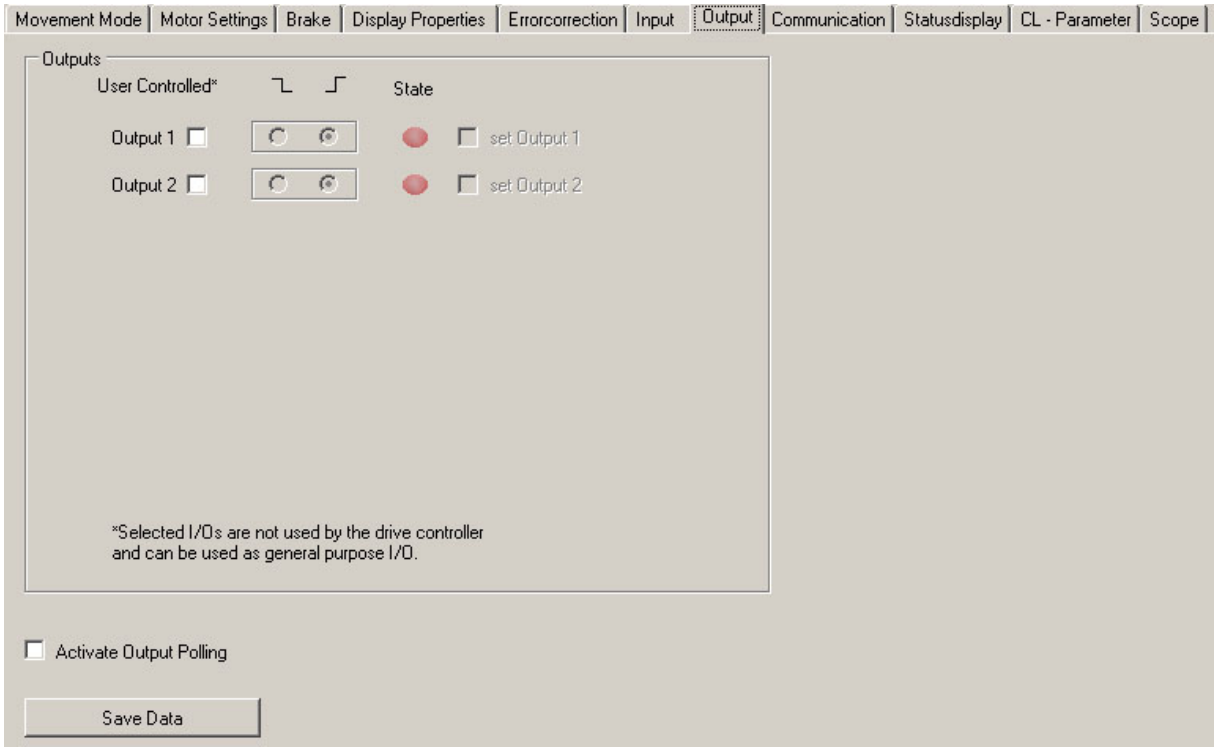
In addition, the state of the inputs present when the tab was opened is displayed (green = high, red = low).

Activate Input Polling

The status display of the inputs is activated if the checkbox is activated.

10 <Output> tab

Display



User-controlled outputs

The following settings can be made:

- Output:
  When the checkbox is activated, the corresponding output is “masked”, i.e. it is not directly interpreted by the motor and is available to the user as a "general purpose” output.
- Set Output:
  When the checkbox is activated, the corresponding output of the firmware is set provided it is masked for open use.
- Switching behaviour:
  A selection can be made for each output whether it switches with rising or falling edge:
  -  = falling edge
  -  = rising edge

State

In addition, the state of the outputs present when the tab was opened is displayed (green = high, red = low).

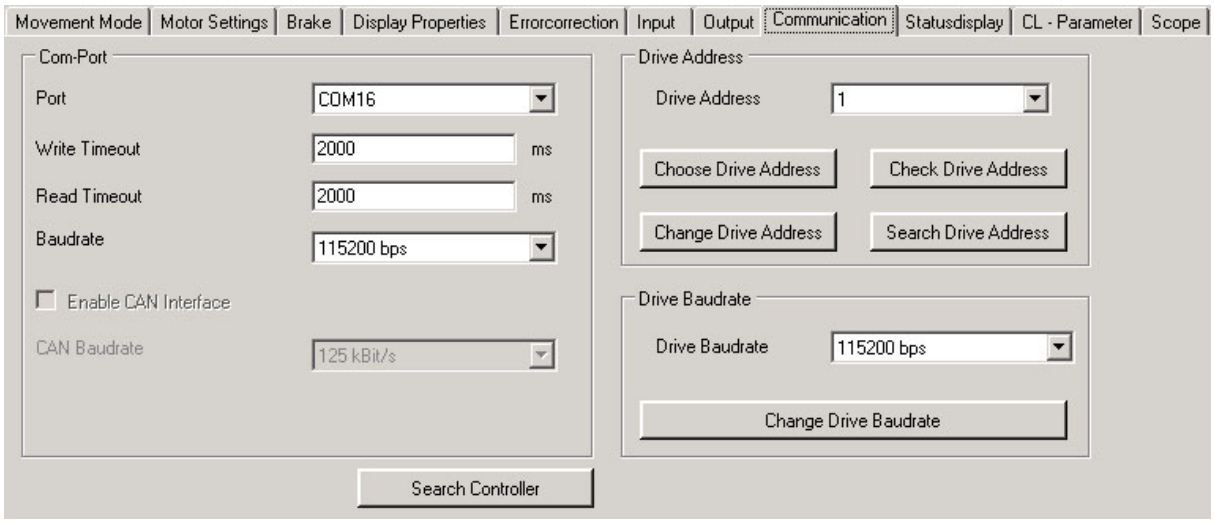
Activate Output Polling

The status display of the outputs is activated if the checkbox is activated.

11 <Communication> tab

Display

The settings for interface parameters and the motor address made on the "Communication" tab:



Interface parameters

The following interface parameters can be set:

Parameters	Function
Port	In the "Port" field, select the COM port to which the motor is connected. The number of the COM port to which the motor is connected can be found in the device manager of your Windows PC.
Write/Read Timeout	Maximum timeout in milliseconds when transferring data to/from the driver.
Baudrate	Data transfer rate in bits per second.
Enable CAN Interface	The CAN interface is active when the checkbox is activated.
CAN Baudrate	Data transfer rate of the CAN interface in bits per second

Setting the drive address

To ensure a fault-free connection with the motor, the motor address (module address) must be set correctly. All motors are delivered with the default address “1”. To operate more motors in an RS485 network, each motor must be assigned a unique address.

The following functions are available in this menu:

- <Check Drive Address>
  Press the button to check whether a motor is connected to the currently configured motor address.
- <Search Drive Address>
  Prerequisite: Only one motor is connected.
  The address of the connected motor is adopted.
- <Change Drive Address>
  Prerequisite: Only one motor is connected.
  The "Motor address" configured in the selection menu is assigned to the motor.

- <Choose Drive Address>
  The address configured in the selection menu "Motor address" is transferred to the selection menu "Motor" (menu bar).

Change Drive Baudrate

Select the required baudrate from the selection menu "Motor baudrate" and then click on the button <Change Motor Baudrate> to transfer the new setting.

Search Controller

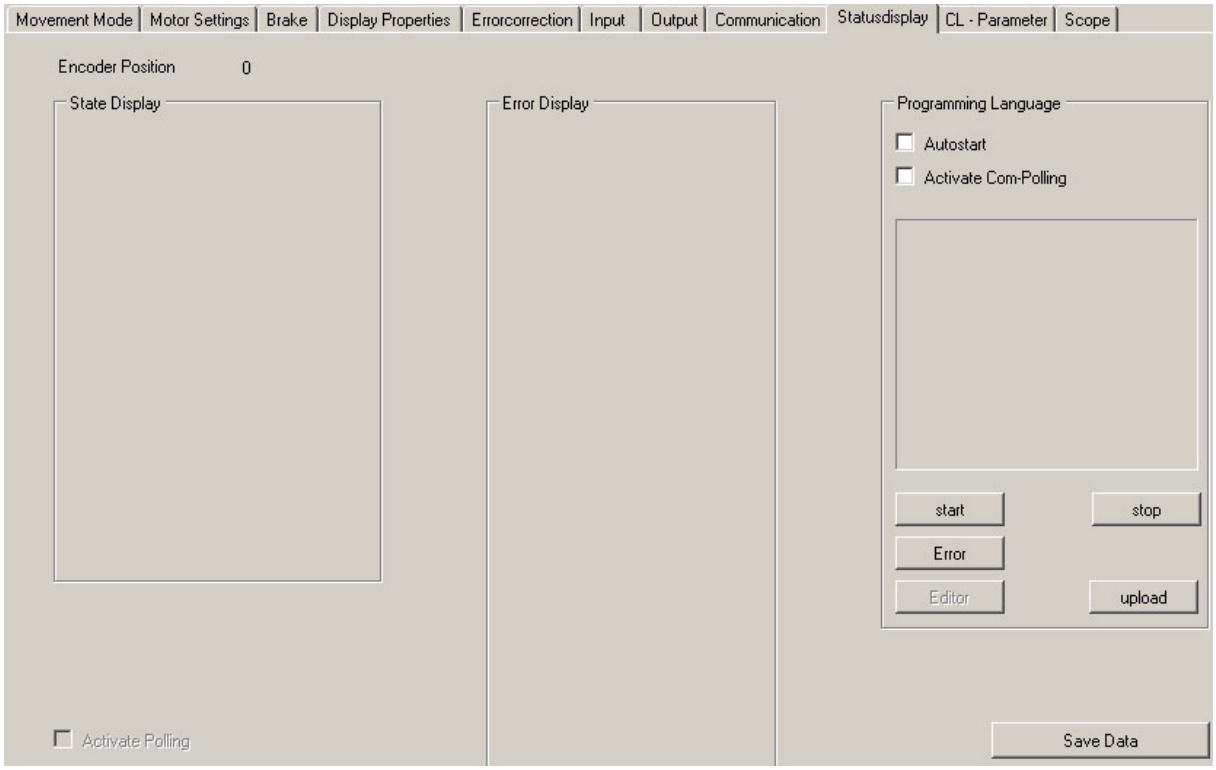
Pressing the <Search Controller> button checks whether a controller is connected to the COM interface.

12 <Statusdisplay> tab

Introduction

The "Statusdisplay" tab can display general status messages, stored error entries and programming settings can also be made.

<Statusdisplay> tab



Displays

The <Statusdisplay> tab contains the following displays:

Display	Function
Encoder Position	Actual encoder position (if an encoder is connected)
State Display	Actual mode, state and last error entry
Error Display	Error memory for the last 32 errors

Activate the state display

Proceed as follows to activate the motor status:

Step	Action	Note
1	Select the "Statusdisplay" tab.	
2	Activate the "Activate Polling" checkbox.	

Programming settings

The following settings can be made in the area "Programming Language”:

Setting	Function
Autostart	When the checkbox is activated, the loaded program is automatically executed if the motor is powered.
Activate Com-Polling	When the checkbox is activated, the status of the COM interface is displayed in the field underneath.
start / stop	Starts/Stops the loaded program.
Error	Displays the last entry of the error memory.
Error Reset	Resets error.
Editor	Opens the NanoJEasy Editor.
upload	Loads the program file.

13 <CL - Parameter> (Closed-Loop) tab

13.1.1 Configuring the Closed Loop current control

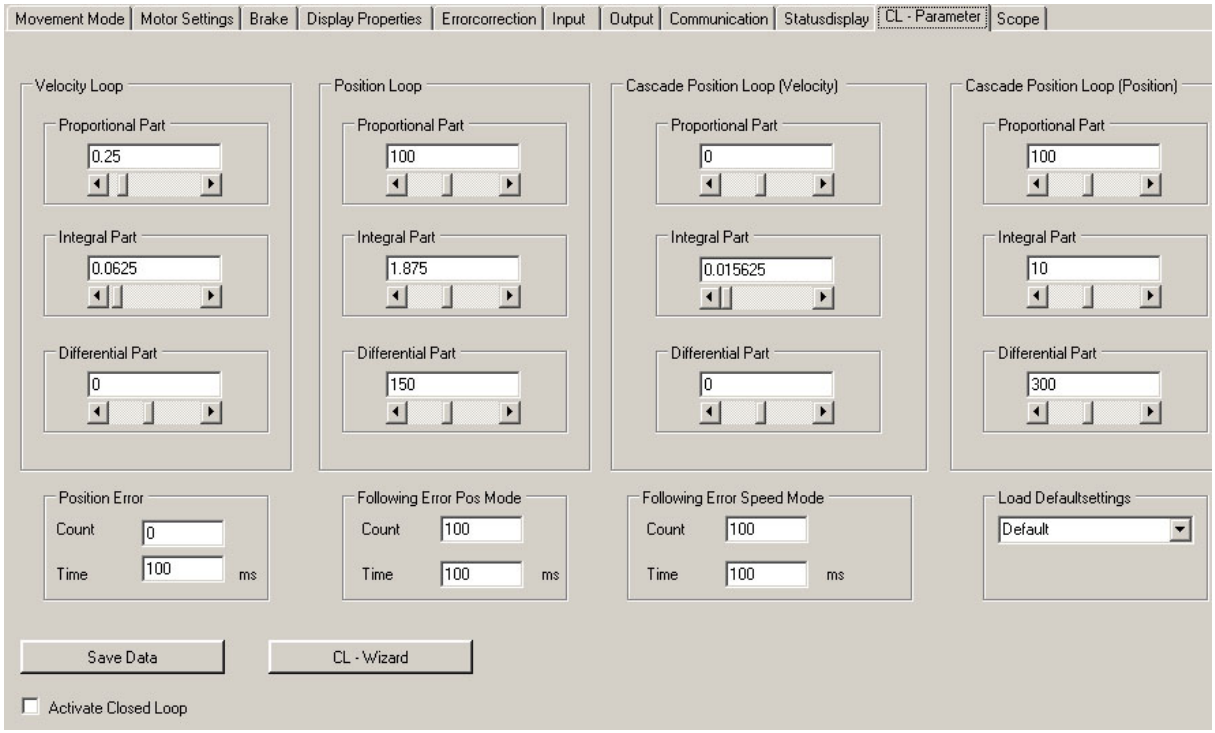
Function

In the Closed Loop mode, the motor does not behave like a normal stepper motor, but like a servomotor. It is controlled via a PID controller dependent on an encoder.

The driver includes two controllers and each controller has its own parameter set.

<CL-Parameter> tab

Settings for the Closed Loop current control are made on the "CL Parameter" tab.



Procedure

Proceed as follows to configure the Closed Loop current control:

Step	Action	Note
1	Select the "CL-Parameter" tab.	
2	Run the Closed Loop wizard in the “CL - Wizard” button.	See section “CL - Wizard”.
3	Activate the "Activate Closed Loop” checkbox.	The motor will carry out an internal reference run.
4	Enter the required parameters.	The parameters are explained in the following sections.
5	Click on the <Save Data> button.	The settings are saved.

13.1.2 Velocity Loop

Description

The speed controller controls the angle speed of the shaft. The position in this mode is not controlled and can therefore deviate greatly from the setpoint.

The speed controller is used in the following operation modes:

- Speed mode
- Analogue mode
- Joystick mode
- Rotor position measurement

Internal calculation principles and parameters

The controlled variables in the speed controller are always based on the actual speed in revolutions per minute (rpm). The set parameters are used to convert the system deviation (deviation of actual speed from setpoint speed) into the control variable (current value).

The control variable of the speed controller is determined with the following equation:

$$u_n = KP * e_n + I_{n-1} + KI * e_n + KD * (e_{n-1} - e_n)$$

The next integral value is derived from:

$$I_n = I_{n-1} + KI * e_n$$

u_n	control variable
KP	Proportional component derived from the numerator/ $2^{denominator}$
KI	Proportional component derived from the numerator/ $2^{denominator}$
KD	Proportional component derived from the numerator/ $2^{denominator}$
e_n	Deviation of actual value from setpoint value
e_{n-1}	Deviation of previous actual value from previous setpoint value
I_{n-1}	Last integral value

Speed error monitoring

The speed controller monitors the set speed. If the actual speed deviates for a specific time from the setpoint speed, the controller is deactivated and the motor stops.

The speed monitoring can be adjusted as required with the parameters in the section "Following Error Speed Mode":

- "Count" position — The maximum amount-based deviation of the actual from the setpoint is output in steps (value range: 0 - 2000000000).
- "Time" — Time is output in milliseconds.

13.1.3 Position Loop

Description

The position controller controls the position. It is used in the following modes:

- Relative/Absolute Position Mode
- Flag Position mode
- Edge mode
- Analogue Position mode
- Closed Loop reference run

Internal calculation principles and parameters

With the position controller, the controlled variables always refer to the actual position deviation in steps. The set parameters are used to convert the system deviation (deviation of actual position from setpoint position) into the control variable (current value)

The control variable of the position controller is determined with the following equation:

$$u_n = KP * e_n + I_{n-1} + KI * e_n + KD * (e_{n-1} - e_n)$$

The next integral value is derived from:

$$I_n = I_{n-1} + KI * e_n$$

u_n	Control variable
KP	Proportional component derived from the numerator/ $2^{denominator}$
KI	Proportional component derived from the numerator/ $2^{denominator}$
KD	Proportional component derived from the numerator/ $2^{denominator}$
e_n	Deviation of actual value from setpoint value
e_{n-1}	Deviation of previous actual value from previous setpoint value
I_{n-1}	Last integral value

Reaching the end position

If the position controller is active, the motor will only signal that it is ready after the end of a run when the measured position remains within a tolerance window for a specific time.

The tolerance width and the minimum time can be set with the parameters in the section "Position Error":

- "Count" The maximum amount-based permissible deviation from the end position is output in steps.
- "Time" The minimum time in milliseconds that the motor must stay at the corresponding position before it signals that it is "ready".

Position error monitoring

The position controller monitors the set position at all times (even following errors are recorded during travel). If the actual position deviates by a specific value from the setpoint position, the controller is deactivated and the motor stops.

The position monitoring can be adjusted as required with the parameters in the section "Following Error Pos Mode":

- "Count": The maximum amount-based deviation of the actual from the setpoint position is output in steps. (value range: 0 - 2000000000).
- "Time": Time is output in milliseconds.

Help for setting the control parameters of the position controller

To adjust the parameters, it is necessary to apply the load that the controller later needs to control to the motor. It does not make sense to set the controller for an unloaded motor as the behaviour will change completely when the load is applied to the motor.

The following table shows possible problems and countermeasures:

Problem	Countermeasures
Motor oscillates up or too long afterwards.	• Reduce I-component • Increase D-component • Increase P-component
Motor "cracks" during the run.	• Reduce D-component • Possibly reduce P-component
Motor takes too long to reach the end position.	• Increase I-component • Increase P-component
Motor compensates for static loads too slowly	• Increase I-component
Motor signals position error.	• Increase permissible following error ("Following Error Pos Mode"). • Operate controller more firmly (increase P-component, increase I-component). • Decrease maximum speed. • Increase phase current. **CAUTION!** Note maximum motor current. A new rotor position initialisation may be necessary.
Motor not accelerating as fast as the set ramp (possibly combined with a position error during the acceleration phase).	• Increase phase current. **CAUTION!** Note maximum motor current. • Set a slower ramp. • Use a stronger motor (with appropriately set phase current).

Cascade controller

The cascade controller consists of two closed loops: an internal closed loop that controls the speed, and an external closed loop that controls the position. The external closed loop does not directly control the motor current, but the setpoint value (setpoint speed) of the internal closed loop.

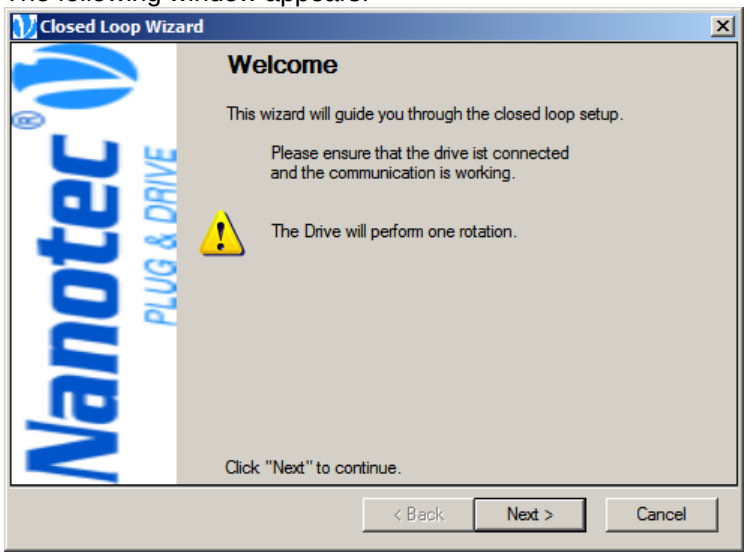
The cascade controller is deactivated in the actual firmware as manual setting without further help is not feasibly possible. Only the actual set values are transmitted so that the set value can be saved in future firmware versions.
Setting is then implemented (semi-)automatically by the firmware.

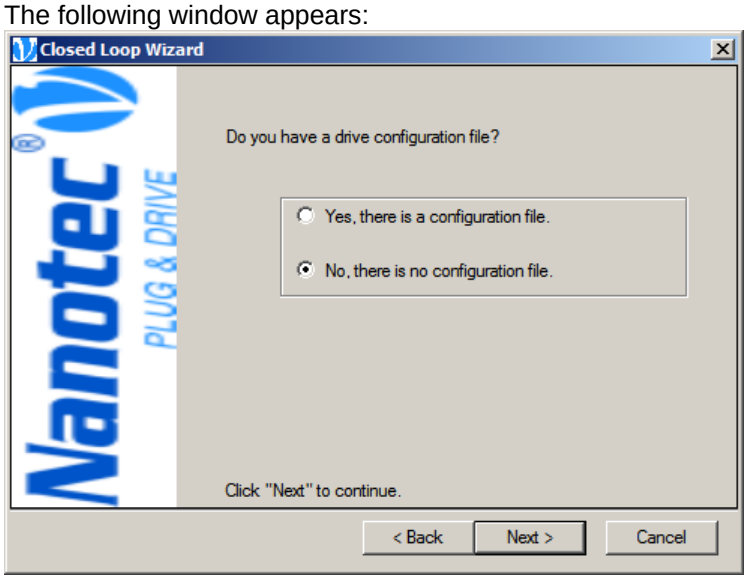
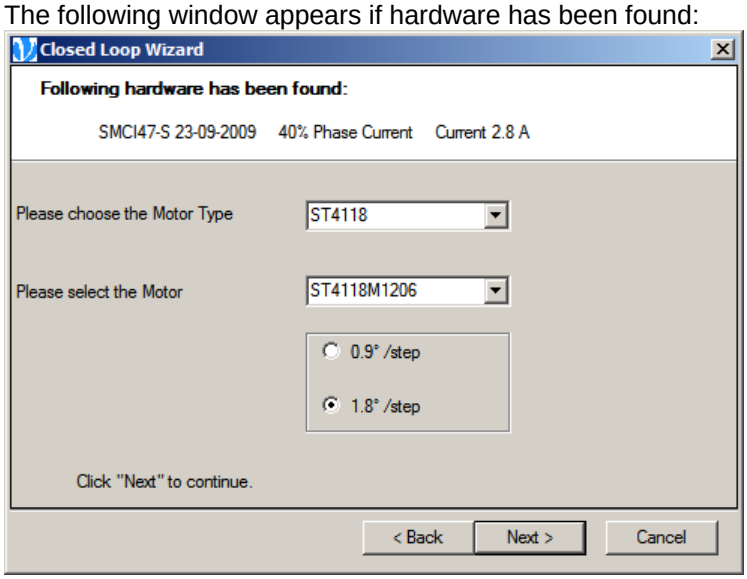
CL - Wizard

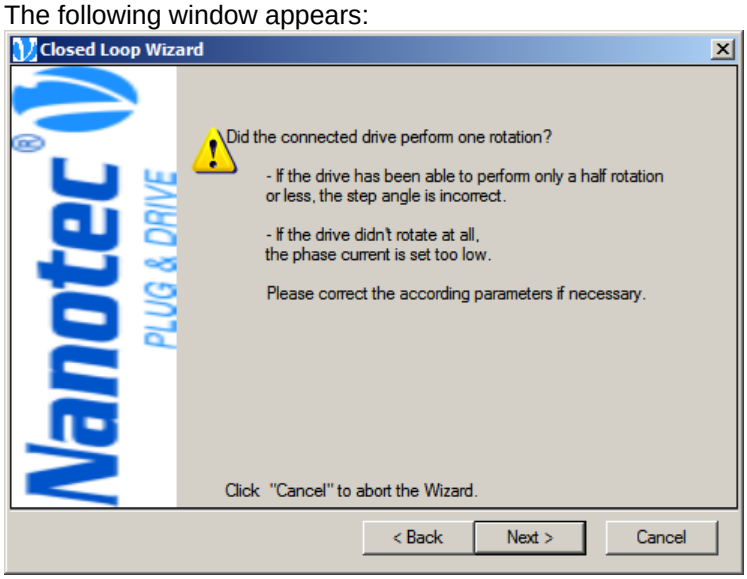
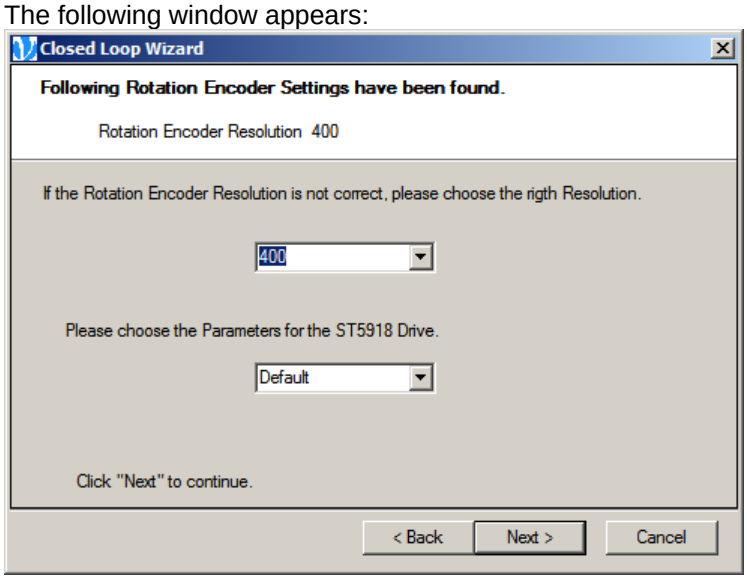
Start the Closed Loop wizard with which the function of the rotation encoder can be checked with the <CL - Wizard> button.

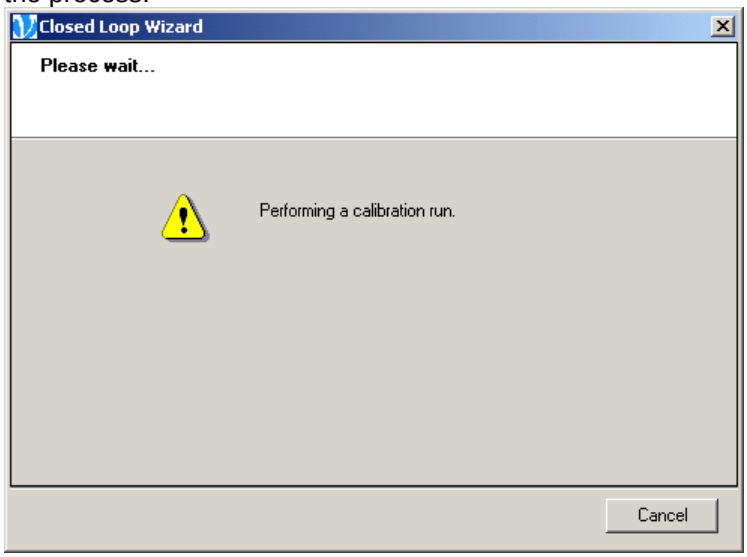
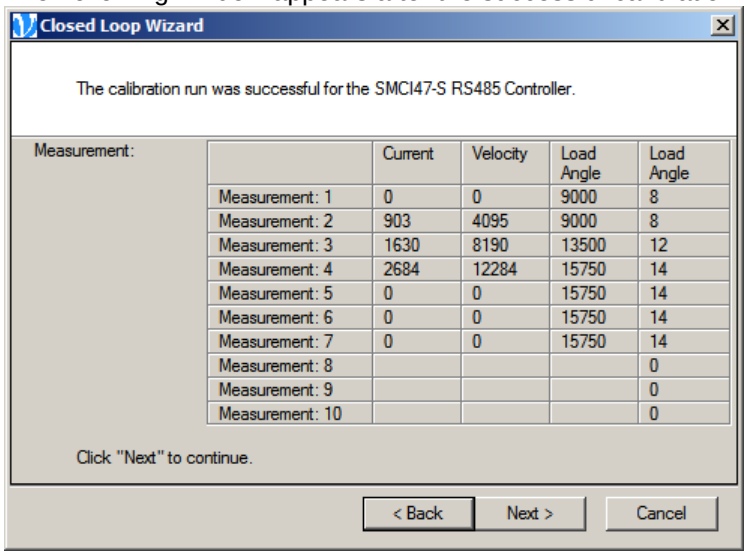
CAUTION!
Motor makes several revolutions.
- Ensure that a motor is connected.
- Check the interface parameters in the <Communication> tab!

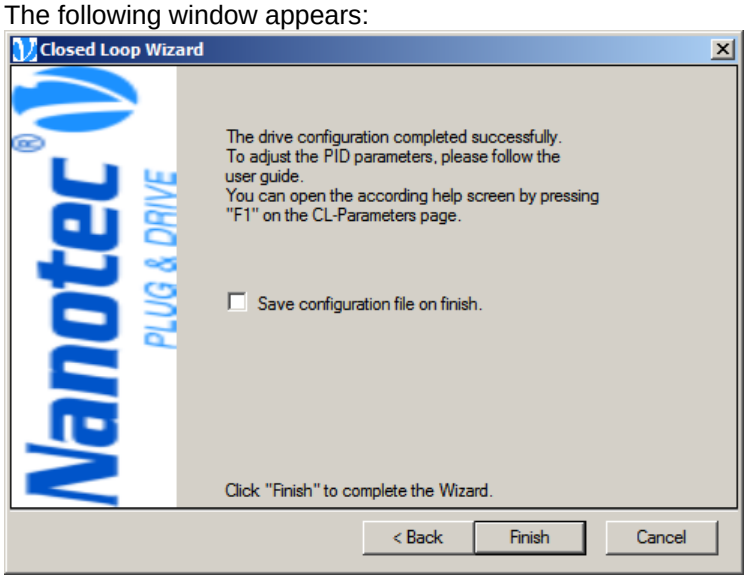
Proceed as follows:

Step	Action
1	Click on the <CL - Wizard> button.
2	The following window appears:  Click on the <Next> button.

Step	Action
3	The following window appears:  • If a configuration file already exists: Select the upper option field and then click on the <Next> button. The "Open" window appears in which you can select the configuration file. • If a configuration file does not exist: Click on the <Next> button. A search is made for connected hardware. The following window appears if hardware has been found:  Check whether the hardware has been detected correctly and change the motor type and step angle if necessary. Click on the <Next> button.

Step	Action
4	The following window appears:  Check whether the connected motor has made a full revolution. Change the settings for the step angle (<Back> button) or motor current if necessary. Click on the <Next> button.
5	The following window appears:  Check whether the encoder resolution has been detected correctly and change the value in the upper selection menu if necessary. Then select a drive profile in the lower selection menu. Click on the <Next> button.

Step	Action
6	A calibration run is being performed. The following window appears during the process:  The following window appears after the successful calibration run:  Measurement: Current Velocity Load Angle Load Angle Measurement: 1 0 0 9000 8 Measurement: 2 903 4095 9000 8 Measurement: 3 1630 8190 13500 12 Measurement: 4 2684 12284 15750 14 Measurement: 5 0 0 15750 14 Measurement: 6 0 0 15750 14 Measurement: 7 0 0 15750 14 Measurement: 8 0 Measurement: 9 0 Measurement: 10 0 Check the measurements of the calibration run and click on the <Next> button.

Step	Action
7	The following window appears:  Activate the checkbox if the configuration file should be saved.
8	Click on the <Finish> button to complete the Closed Loop Wizard.

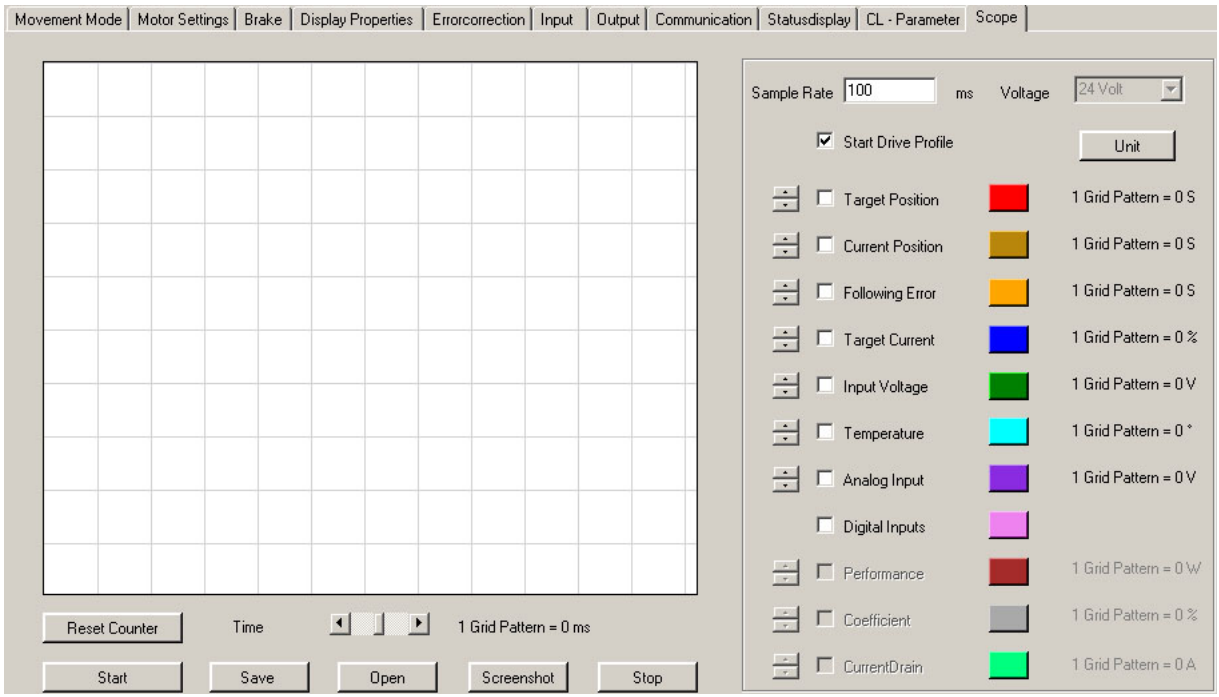
14 <Scope> tab

Function

In scope mode, important motor parameters can be displayed and recorded during a run. This is primarily used to check the set parameters or the commissioning of a drive.

Display

The scope mode settings are made in the <Scope> tab.



Selectable parameters

“Target position" and "Current position" parameters

The Target position is the target value calculated by the ramp generator of the motor.

The **current position** is the position determined with the help of the motor encoder. In normal cases, the target and current positions should match. The current position is always 0 in a motor without encoder. If the target and current position deviate from one another, this may be due to various reasons:

- Step loss during the run:
  When the motor does not reach its target position during open loop operation, step losses have occurred. Possible countermeasures:
  - Select a flatter ramp
  - Select a lower speed
  - Increase motor current so that the motor has more strength

- Incorrect setting of the encoder:
  When the curves for setpoint and actual position are mirrored during a run, the rotation direction of the encoder is inverted (e.g. run of 400 steps, then setpoint position 400 and actual position -400).
  Countermeasure: Reverse the rotation direction of the encoder in the "Motor Settings" tab.

  CAUTION!
  To have these settings accepted for closed loop operation, the motor must be disconnected from the power supply.

  When the curves are identical in direction, but differ in gradient, then the resolution of the encoder is incorrect.
  Countermeasure: Adjust the encoder resolution in the "Motor Settings" tab.

Other parameters

Parameters	**Description**
Following Error	The following error indicates the difference between the target and actual position. If the following error exceeds the set value, the motor will output a position error. For the Open Loop mode the limit value can be set in the <Errorcorrection> tab. For the Closed Loop mode there are separate values for the Speed and the Position mode. They can be set in the "CL - Parameter".
Target Current	The value "Target Current" indicates the current calculated by the motor in the Closed Loop mode.
Input Voltage	Indicates the voltage applied to the motor.
Temperature	Indicates the temperature measured by the motor.
Analog Input	Indicates the voltage at the analogue input.
Digital Inputs	Sets the level of all digital inputs of the motor.

Parameters for the Closed Loop mode

Performance	Indicates the power output by the motor.
Efficiency	Indicates the efficiency of the motor.
CurrentDrain	Indicates the current consumption of the motor.

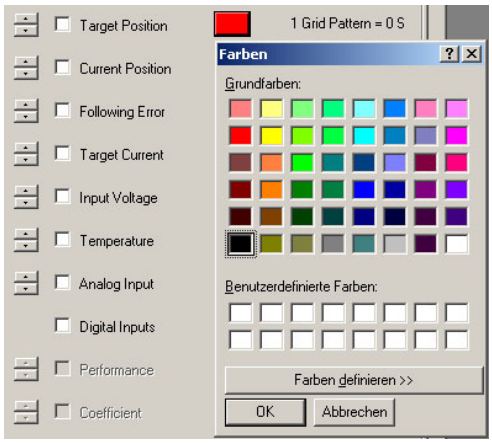
Display of parameters

Activate/Deactivate

Activating the checkbox displays the progression of the respective parameter in the Scope mode.

Color

The color with which the parameter is displayed can be changed by clicking on the colored box.



Scaling

The scaling of the parameter is specified under the <Unit>button and can be changed with the arrow keys (to the left of the checkboxes.

Clicking on the button <Unit> changes its labeling to <Value>. The current parameter values are then displayed instead of parameter scaling when the Scope mode is running.

The horizontal axis can be changed in the ms grid using the <Time> slider.

Adjustment parameters

The following settings can be made for the Scope mode:

Setting	Function
Sample Rate	Setting of the sample rate in milliseconds.
Voltage	Voltage with which the motor is driven.
Start Drive Profile	When the checkbox is activated, the drive profile starts at the same as the Scope mode.

Controlling the Scope mode

Reset Counter	Sets the drive profile to the zero position.
Start / Stop	Starts/Stops the Scope mode.
Save	Saves recorded parameters.
Open	Opens recorded and saved parameters.
Screenshot	Creates a screenshot of the current display.

15 Operating several motors

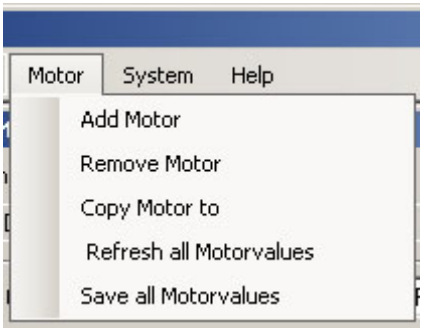
Introduction

Up to 32 motors can be controlled in a network.

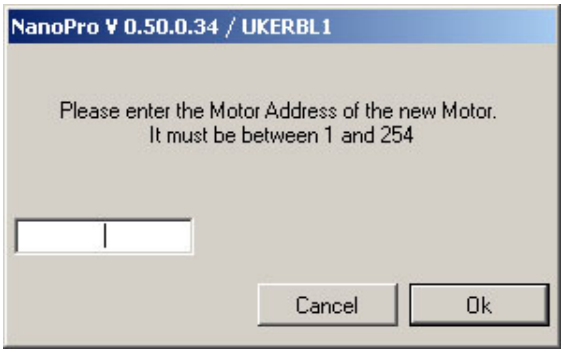
New motors can be added in the "Motor" menu by clicking on the <Add Motor> button.

All the motors are displayed in the selection menu.

Unnecessary motors can be removed from the driver by clicking on the <Remove Motor> button.



“Motor address” menu



Procedure

Proceed as follows to add new motors:

Step	Action	Note
1	Select the "Add Motor" menu item in the "Motor" menu.	The "Motor address" menu opens.
2	Enter a motor address for the motor (number).	Number 1 to 254.
3	Click on the <OK> button.	The settings are saved.

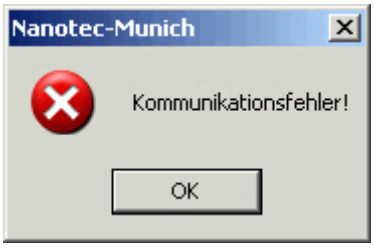
16 Troubleshooting

16.1 General information

Error messages

The motor monitors specific functions and outputs an error message if there is a malfunction.

Error messages are displayed in a pop-up window, e.g.:



Descriptions of possible error messages can be found in section 16.2 “Error messages”.

Troubleshooting procedure

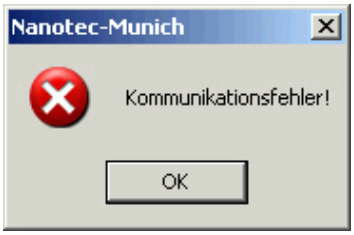
Proceed with care during troubleshooting and error rectification to avoid damaging the motor.

Danger of electrical surges
An operating voltage > 50 V and incorrect connections can destroy the end stage.
Never disconnect the link when operating voltage is applied!
Never disconnect lines when live!

16.2 Error messages

Communication error

This message appears when data transfer to the motor is not possible:



The following causes may be responsible:

- The wrong COM port is set (see section 11 “<Communication>”).
- The communication cable is not connected or interrupted.
- A non-existent motor number is set.
- The voltage supply to the motor is interrupted.

Transmission error

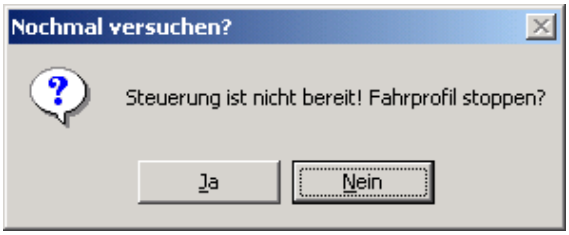
This message appears when the data transfer to the motor is disturbed (transmitter or receiver are disturbed):

The following causes may be responsible:

- Incorrect laying of the communication cable (motor and supply lines must be laid separately).
- The cable is not shielded.
- RS-485 wires are not twisted in pairs.
- The resistances for the resting level are not present in the communication line.
- The bus termination resistances are not present.

Driver is not ready

If inadmissible data is sent to the motor during the output of a travel profile, the following message appears:



Pressing the <Yes> button stops the travel profile and the motor switches back to the "Ready” status. The data can then be resent to the motor.

Pressing the <No> button allows the travel profile to continue.

Driver is not active

If the motor is reset (switching the operating voltage off/on) during the output of a speed profile, the frequency can no longer be changed in the speed mode. The following message is displayed:

The speed mode can be restarted after pressing the <OK> button.

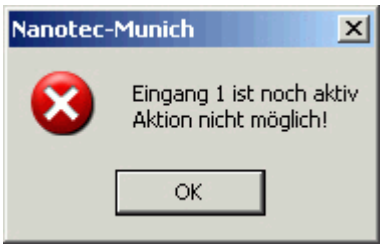
Position error

If a button is clicked while the motor is in error mode (position error or limit switch in normal operation), the following message is displayed.

The error can be reset by pressing the <Yes> button.

Input 1 active

If a button is clicked when a travel profile is already completed but input 1 is still active, the following error message will be displayed:



After the input is deactivated, the required button can be clicked.

Index

J

L

M

N

O

P

Q

R

S

T

U

V