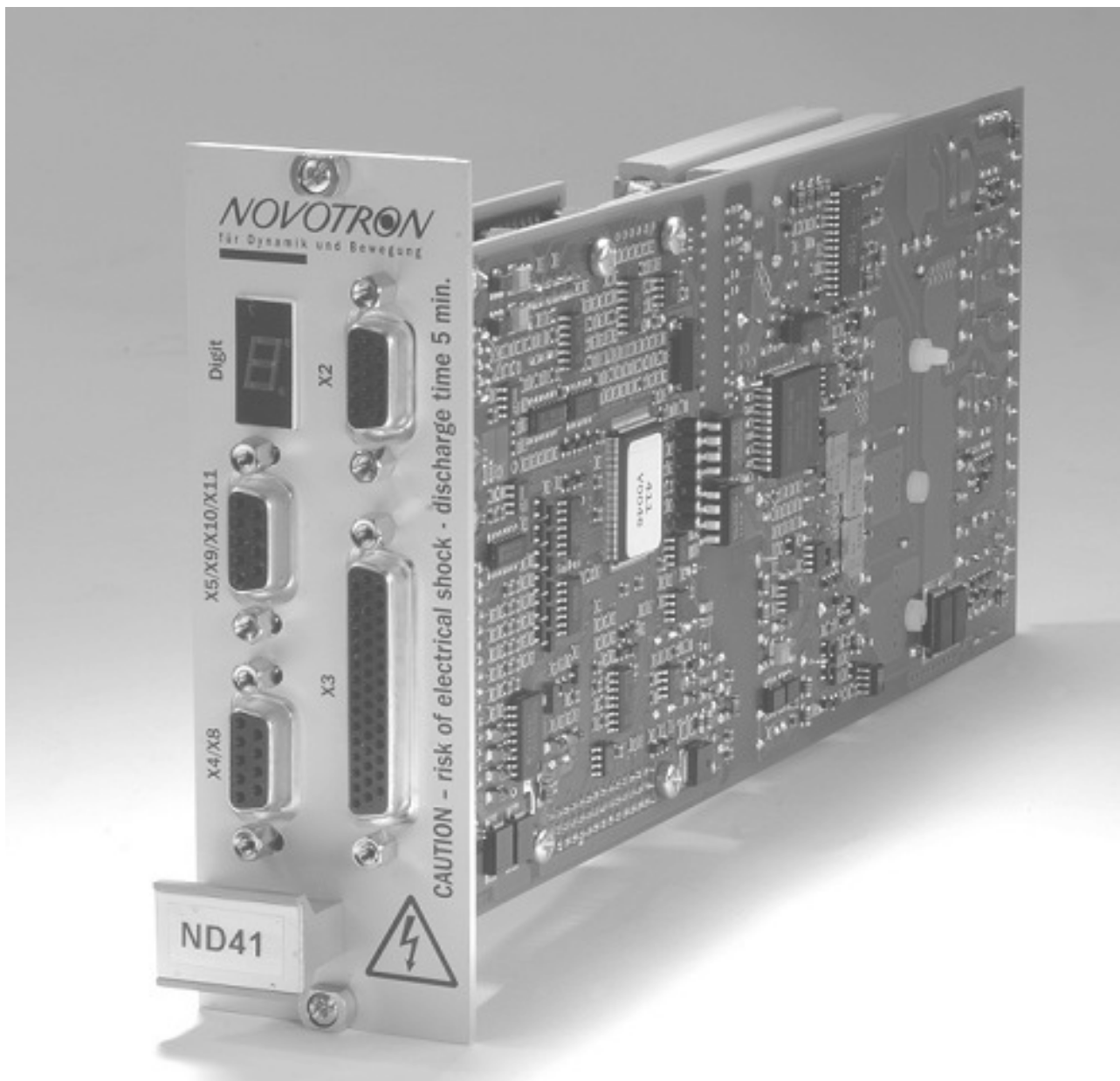


**Manual For Servo Amplifier
NOVODRIVE ND40**

Setup software



Version: 01.02

Stand: 17/12/2009

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1 Contents

2 General Information.....	3
2.1 Customer Service.....	3
2.2 List of Abbreviations.....	3
2.3 Symbols.....	3
2.4 Trademarks.....	3
2.5 User Manual Structure.....	3
3 Safety Information.....	4
3.1 Intended Usage.....	4
3.2 General Safety Instructions.....	4
3.3 Connection.....	5
3.4 Operation.....	6
4 Installation and Use of Setup Software.....	7
4.1 Installation of components.....	7
4.2 First start of ND40Cfg.....	7
4.3 Loading and saving of parameter sets.....	9
5 Directory Structure of Setup Software.....	10
5.1 General.....	11
5.2 EEPROM.....	24
5.3 Oscilloscope.....	25
5.4 Limit values.....	27
5.5 Motor.....	32
5.6 Controller.....	40
5.7 IO.....	44
5.8 Technology – Job Control.....	49
5.9 Manual Operation.....	52
5.10 Bus system.....	53
5.11 Register.....	59
6 Motor Parameter Settings.....	62
6.1 Connection of motor.....	62
6.2 Capture of motor and application parameters.....	63
6.3 Step 1 – Specify feedback system used.....	64
6.4 Step 2 – Determine scaling.....	65
6.5 Step 3 – Specify limit values for ramps and speed.....	66
6.6 Step 4 – Specify limit values for current.....	67
6.7 Step 5 – Execute Autojustage.....	68
6.8 Step 6 – Determine parameters for current control.....	69
6.9 Step 7 – Enter application specific parameters.....	76
6.10 Step 8 – Set speed controller.....	79
6.11 Step 9 – Set position controller.....	83

2 General Information

2.1 Customer Service

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2.2 List of Abbreviations

Abbreviation	Meaning	Abbreviation	Meaning
VAC	AC voltage	VDC	DC voltage
RO	Read Only	RW	Readable and Writeable
WO	Write Only	BCD	binary coded decimal

2.3 Symbols



Warning or important information.

Noncompliance may lead to trouble in operation or to property damage.



Hazard that may lead to

- damage of life or health of user or other persons, or
- major property damage.

2.4 Trademarks

EnDat is a registered trademark of DR. JOHANNES HEIDENHAIN GmbH.

Windows is a registered trademark of Microsoft Corporation.

COMBICON, MICRO COMBICON and POWER COMBICON are product names of Phoenix Contact.

2.5 User Manual Structure

- Volume 1 Basic Device
- Volume 2 Software Reference
- Volume 3 Extension Modules
- Volume 4 initiation (setup)

3 Safety Information



NOVODRIVE works with hazardous voltage!

Line voltage is present at power inputs, motor connectors, brake choppers, DC link circuits, and the motor temperature sensor input. Connectors carrying hazardous voltage are X1, X6, and X7.

3.1 Intended Usage

Devices of the ND40 series are state-of-the-art servo converters for driving brushless servo motors and linear motors featuring an appropriate position sensor.

NOVODRIVE servo converters are components to be installed in electric machines. A NOVODRIVE servo converter may only be put into operation as such an integrated component.



Safe and troublefree operation

Safe and troublefree operation is possible only by correct interplay of NOVODRIVE, motor, and position sensor in combination with correct wiring and appropriate parameterization.

Using NOVODRIVE servo converters for any other purpose may lead to property damage or damage to users and other persons.

NOVODRIVE servo converters may be installed and put into operation only if in technically perfect condition, if used in compliance with the intended usage described above, and if users are aware of risks and hazards that may occur when working with the devices.

Machinery Directive

According to the 2006/42/EG Machinery Directive, machinery manufacturers have to make an appropriate risk assessment for the specific machinery, and they have to take appropriate action in order to prevent damage to persons or property when working with the machinery.

Machinery manufacturers and/or operators are responsible for sticking to applicable guidelines for safe operation and prevention of accidents.

Ambient Conditions

NOVODRIVE servo converters may not be used in explosion-prone areas or in medical areas or other areas classified hazardous.

3.2 General Safety Instructions

Before you install and put into operation a NOVODRIVE servo converter, read this User Manual fully and carefully. Inappropriate handling of NOVODRIVE servo converters may lead to damage to persons or property. Make sure you take notice of the technical specifications and connecting conditions (check type plate and this User Manual).

Transportation and Storage

To transport and store NOVODRIVE servo converters, use the original packaging only.

Repairs and Modifications

Do not dismantle and/or modify NOVODRIVE servo converters.

If a NOVODRIVE servo converter needs repair or modification, this may be done by skilled personnel of NOVOTRON GmbH only.

Working at the motor or axis

Do not work on running gear until NOVODRIVE has been disconnected from the power supply system and NOVODRIVE's capacitors' are fully discharged.

Provide for sufficient protection, as a defect in NOVODRIVE's power part or in the feedback system may speed up the drive enormously within fractions of a second, leading to uncontrolled movements and very high acceleration of the motor.

3.3 Connection

Only skilled personnel may install, put into operation, and maintain NOVODRIVE servo converters.

Skilled personnel are persons familiar with the requirements to assemble, install, put into operation, and work with the product. Such persons need to take notice of and comply with the following norms and guidelines:

- IEC 364 / CENELEC HD 384 or DIN VDE 0100,
- IEC-Report 664 or DIN VDE 0110,
- national directives for accident prevention.

Grounding

Make sure NOVODRIVE's compact case or 19" rack, as the case may be, is grounded before the line voltage is switched on (see 4.2 Technical Specifications and 5.2 Power Part Connections).

Wiring

Always check the wiring before you power up NOVODRIVE. Check

- if all connections are correct and all terminal clamps are tight,
- if grounding / shielding is correct,
- if connectors are locked against getting loose.

Do not pull any (i.e. also low-voltage) energized plug connectors, as this may destroy the electronics.

Make sure no voltage carrying parts can be accidentally touched. Cables carrying line voltage must have double or reinforced insulation between wire and surface. Use appropriate sleeves for wire ends.

Fuse Protection

Make sure NOVODRIVE is equipped with an appropriate and correctly connected fuse protection.

Emergency Shutdown / Emergency Stop

Provide for an emergency shutdown / emergency stop by which the motor can be brought to a standstill at any time (see section 6 Emergency Shutdown / Emergency Stop).

3.4 Operation

Discharge Time

NOVODRIVE contains capacitors which keep on carrying hazardous operating voltage for some time after line voltage has been switched off.

Therefore, after disconnecting NOVODRIVE from line voltage wait at least five minutes before you touch any voltage carrying parts (e.g. pins) or loosen connections. As a safety measure, repeatedly measure the DC link voltage and wait until it is below 40 V.

Electric Shock Protection

A moving motor can produce hazardous voltage also if line voltage is switched off.

Therefore, the discharge time of the capacitors does not start until the motor has stopped.

Power On/Off

Do not switch on and off line voltage of NOVODRIVE frequently in short time, as this may lead to an overload of NOVODRIVE's inrush current limitation, which could destroy the inrush current limiter. Therefore, always wait at least one minute before switching NOVODRIVE on again after you switched it off.

Sequence for Switching On/Off

If you want to switch on NOVODRIVE, first switch on the power supply unit providing the 24 VDC supply voltage for the low-voltage part, and then switch on line voltage for the power part. If you want to switch off NOVODRIVE, proceed vice versa.

4 Installation and Use of Setup Software

System requirements

Pentium 2,4 GHz
512 MB RAM
50 MB hard disk
Windows 2000 or XP
.NET V1.00
Serial interface (RS 232) or USB serial adapter

4.1 Installation of components

File download from www.novotron-online.com

- Installation of DotNetFrameWork (Version 1.0)
- Installation of setup software ND40Cfg

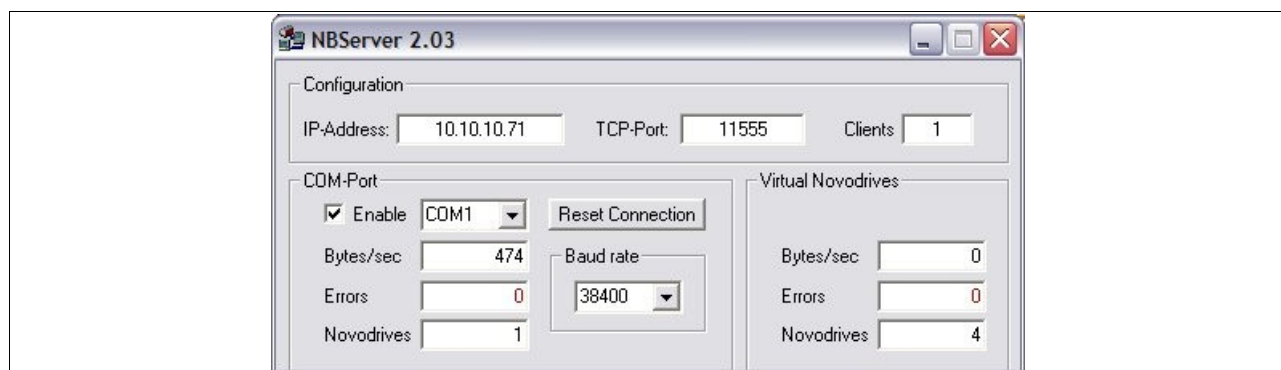
File download requires registration on www.novotron-online.com

4.2 First start of ND40Cfg

4.2.1 Start setup software

Upon double-clicking on ND40Cfg.exe two windows will open up.

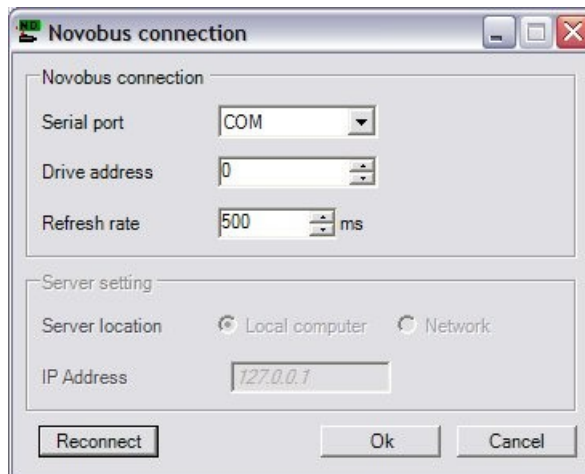
- NBServer



- ND40 Configuration (→ see next page)

4.2.2 Select interface

- In the 'NBServer' window, select the COM port (COM1...COM127) by which NOVODRIVE has been connected with the PC.
- In the menu of the 'ND40 Configuration' window, select 'Edit/Novobus connection'. Then select 'COM' for 'Serial port' and '500 ms' for 'Refresh rate'.



Information on 'Connection quality':

Color	Red	Yellow	Green
Connection information	No connection	Connection disturbed	Connection ok

No connection?

- 7-segment display is off. Is NOVODRIVE switched on?
→ Check 24-V voltage supply
- Has the right COM port been connected?
→ Verify the COM number of the serial interface in the Windows Control Panel

Parameterization of the serial interface (e.g. on bit number, parity, baud rate etc.) is done automatically over NBServer, not over the Windows Control Panel.

- Is NOVODRIVE equipped with a terminating plug (not for single-end NOVOBUS)?
→ Apply terminating plug; check correct wiring

Connection is disturbed?

- Raise 'Refresh rate' of NOVOBUS interface.
- If a high number of errors is indicated in the 'NBServer' window, check earthing/grounding of NOVODRIVE.

4.3 Loading and saving of parameter sets

Loading and saving of parameter sets can be done during online operation only.

**Saving of parameter sets**

Each parameter set must be saved! Without the original parameter set it might be very difficult to put a machine into operation after a servo converter has been exchanged. You may save parameter sets over the PC using the setup software. The saving must be done separately for each machine component and after each change in a set. Use file names which allow for unambiguous assignment to machine axes.

Load

Select the parameter set you want to load from „**File/Load Parameter**“.

After each selection you may decide whether you want to load the 'Parameter' and/or the 'Command sentence' and whether the data are to be saved in the EEPROM.

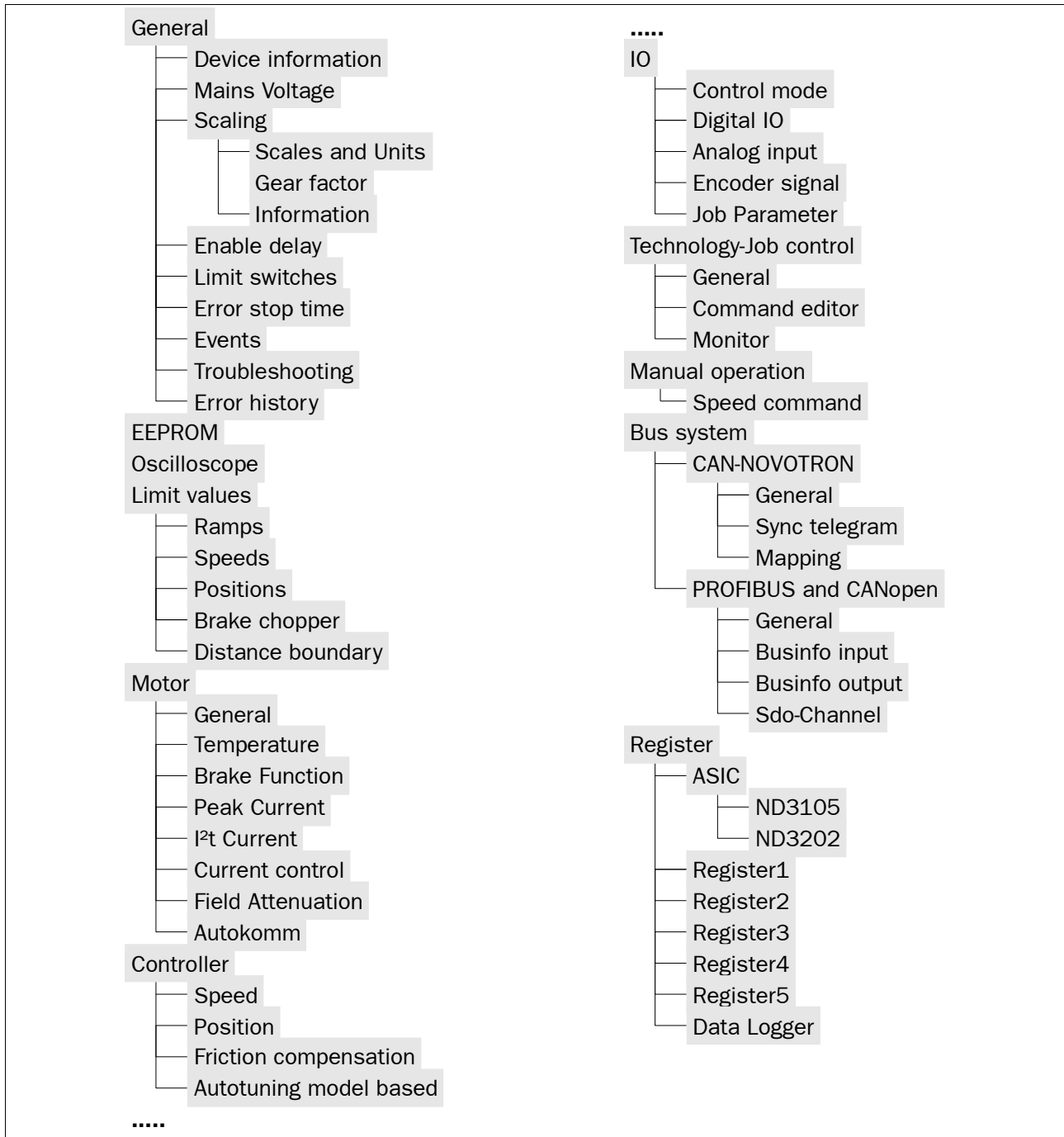
Save

Under „**File/Save Parameter**“ you may name the parameter set you want to save and select a place for its storage.

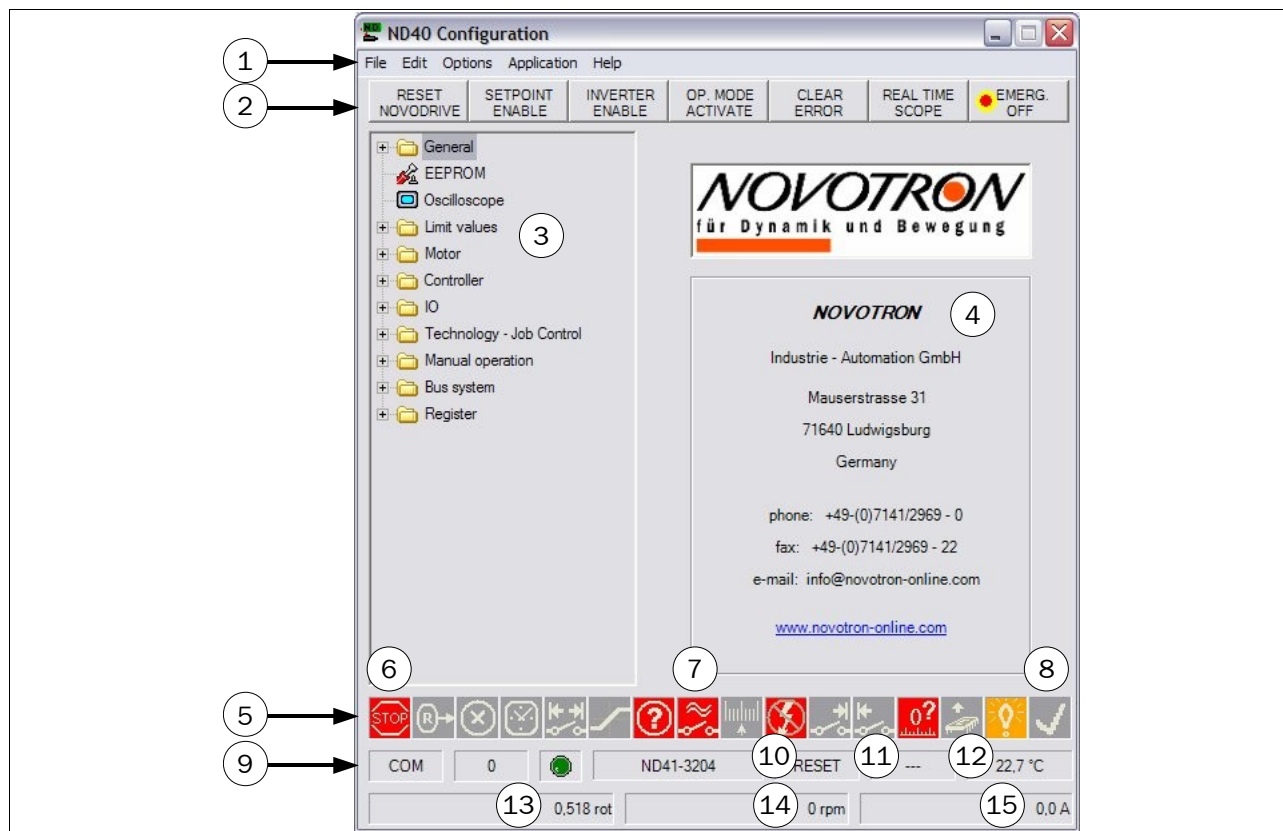
After that you may write a comment for the parameter set and you may decide whether you want to save the 'Parameter' and/or the 'Command sentence'.

5 Directory Structure of Setup Software

Depending on individual user settings (made under „**Application→Standard/Advanced**“) and the version of the NOVODRIVE used probably not all pages / windows presented in the following sections may be provided or accessible.



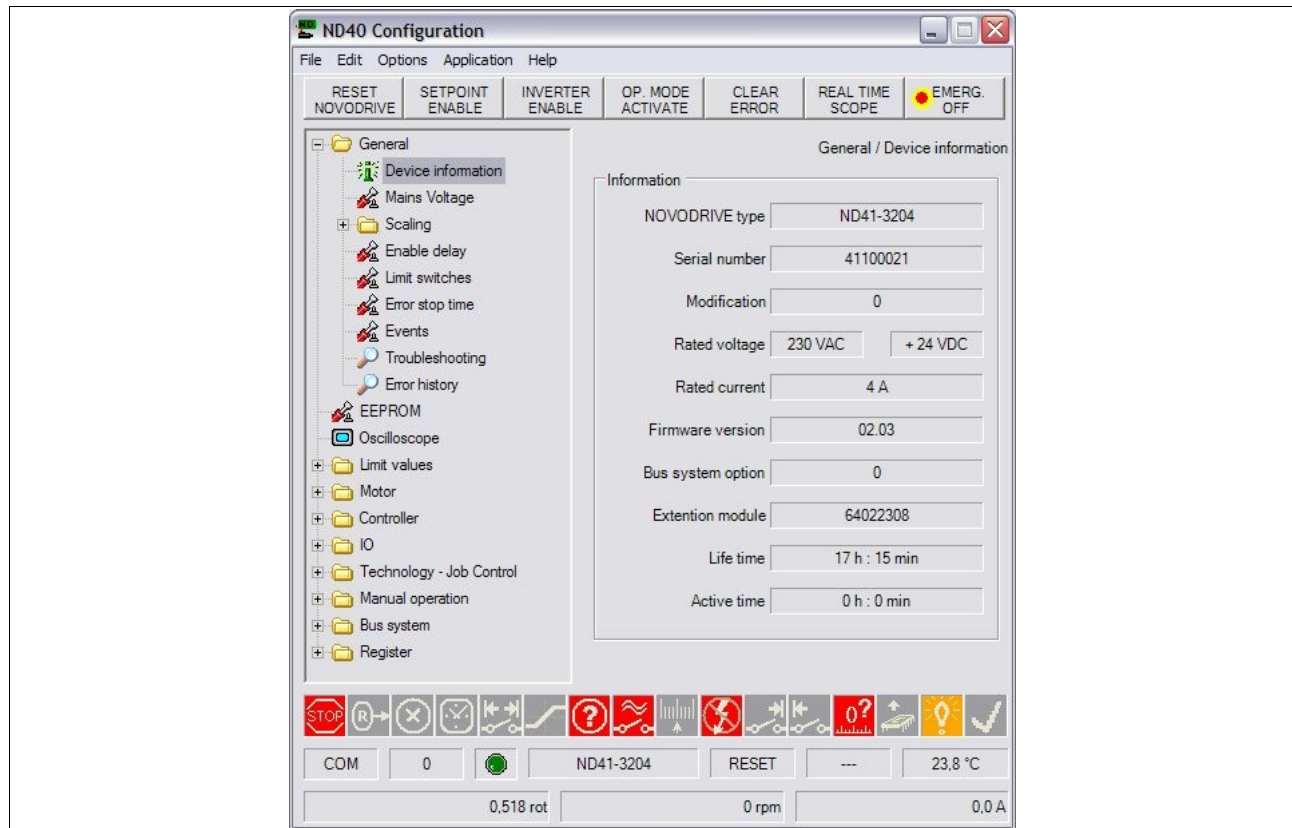
5.1 General



For changes in parameter settings to be permanent, parameter settings must be saved in the EEPROM.

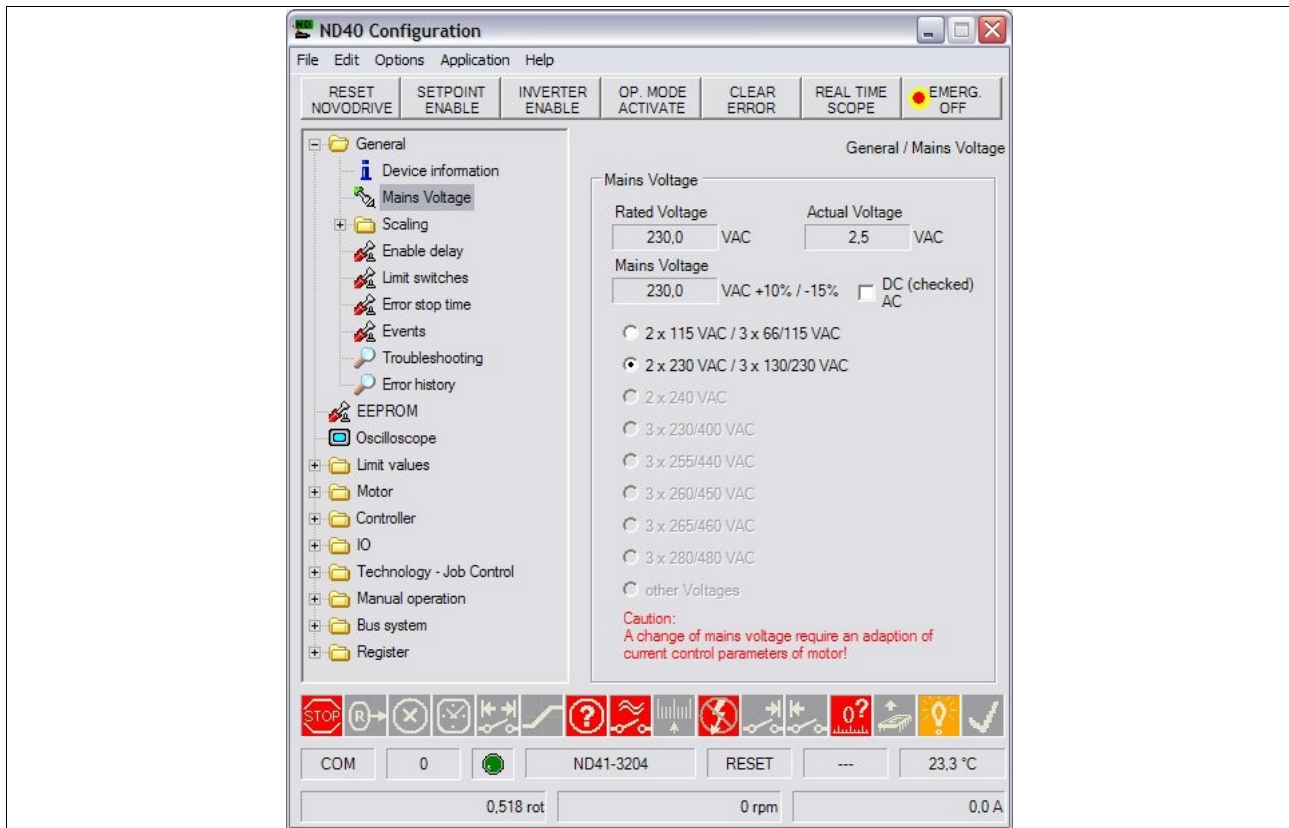
Number	Description
1	<p>Under 'File' you may</p> <ul style="list-style-type: none"> - load parameter sets, - save parameter sets, - save NOVODRIVE as a virtual (NOVO)drive, - load the XRAM, - store the XRAM, - exit the program. <p>Under „Edit“ you may</p> <ul style="list-style-type: none"> - specify the connection parameters of NOVODRIVE and the refresh time to the PC ('Connection'), - refresh the basic data of NOVODRIVE ('Refresh data base'). <p>Under „Options“ you may</p> <ul style="list-style-type: none"> - select the user language (English / German (upon Version 1.10)). <p>Under „Application“ you may</p> <ul style="list-style-type: none"> - specify the editing mode for setup (requires password for authentication). - The password for 'Advanced' Mode: ND40EXPERT. <p>Under „Help“ you may</p> <ul style="list-style-type: none"> - request information on the device version.
2	Button bar, comprising: Reset NOVODRIVE / Inverter enable / Setpoint enable / Activate operation mode / Clear error report / Emergency off
3	Directory for selecting individual pages of the setup software
4	Window of menu item selected
5	Information bar on Register 'Status16': Bit 15... Bit 0 (see User Manual 'Basic Device' – Register 'Status16')
6	1 = Setpoint disabled
7	1 = Inverter disabled
8	1 = Last job successfully completed
9	First section of information bar, comprising information on: interface [COM or VIRTUELL] / address of NOVODRIVE / connection quality / NOVODRIVE connected
10	Red = Reset required
11	Error ID number
12	Heat sink temperature of NOVODRIVE in degree centigrade
13	Actual position of motor [scaled]
14	Actual speed of motor [scaled]
15	Actual current [scaled]

5.1.1 Device Information



Page lists basic data and specifications of the NOVODRIVE used.

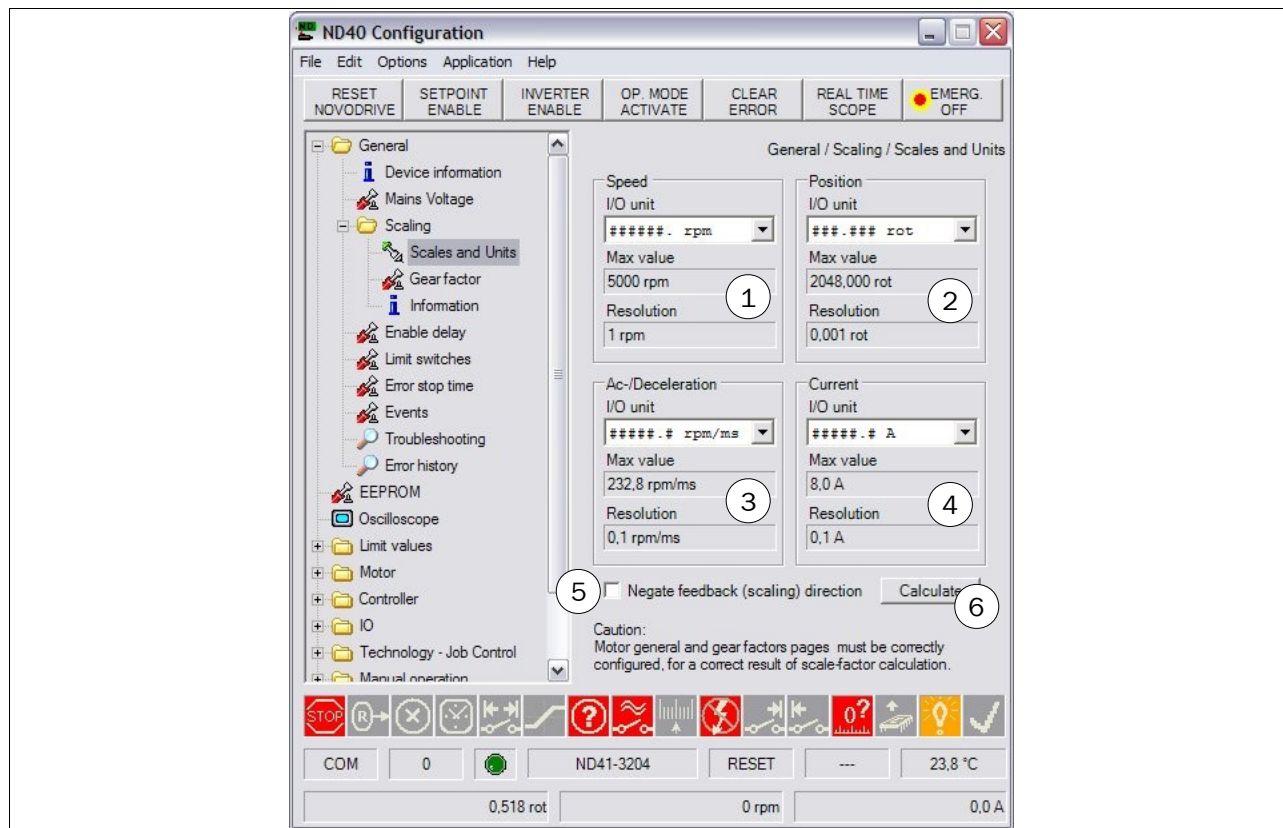
5.1.2 Mains voltage



Page allows selection of line voltage to be used. Line voltages not applicable are grayed out.

Upon changing the line voltage the current control parameters must be adapted to the respective DC link voltage!

5.1.3 Scaling / Scales and Units

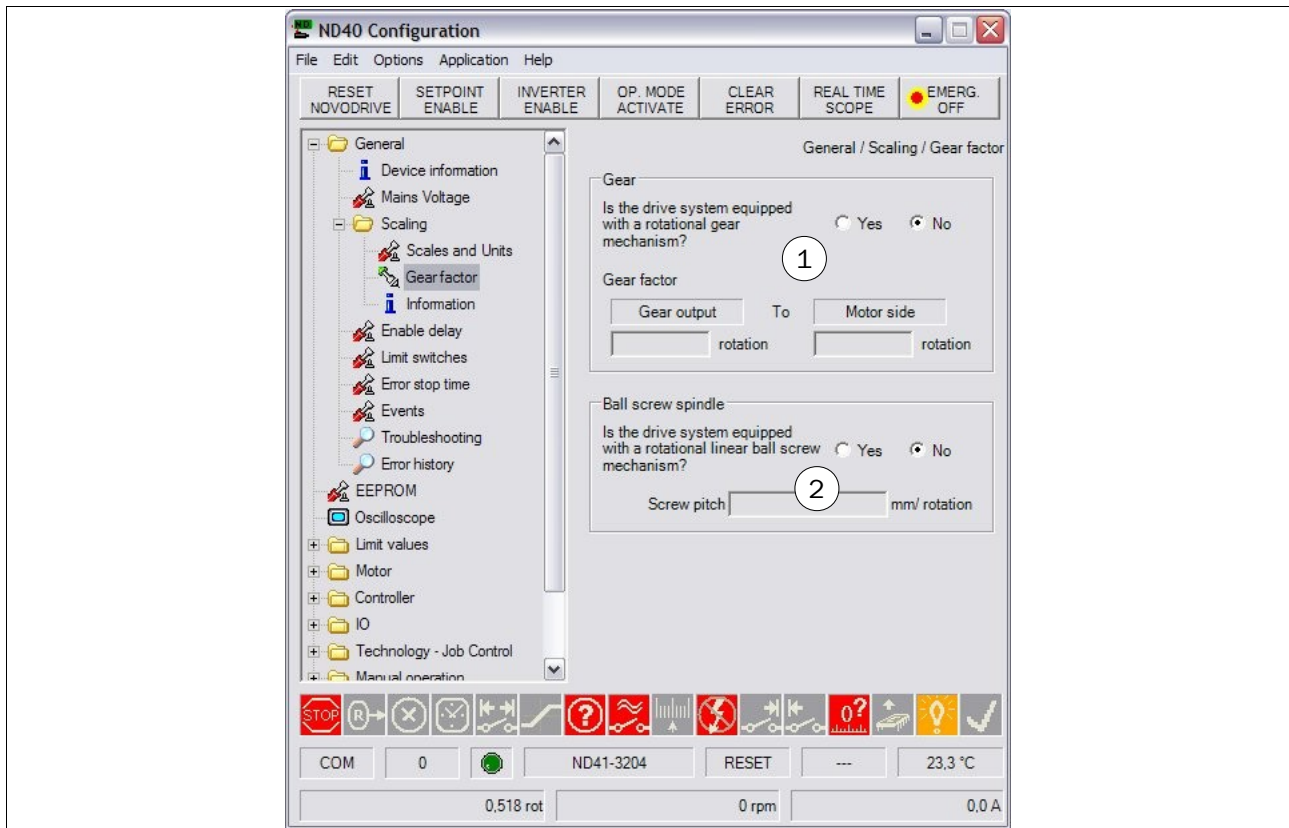


Scaling of values (SI and decimal places) of set-up software and extension modules.

For more information on scaling see User Manual 'Basic Device', Section 'SI Scaling'.

Number	Description
1	Scaling of speed
2	Scaling of position
3	Scaling of acceleration/deceleration ramps
4	Scaling of current
5	Reversing of scaling direction (positive / negative)
6	(Re-)Calculation of scaling factors

5.1.4 Scaling / Gear factor



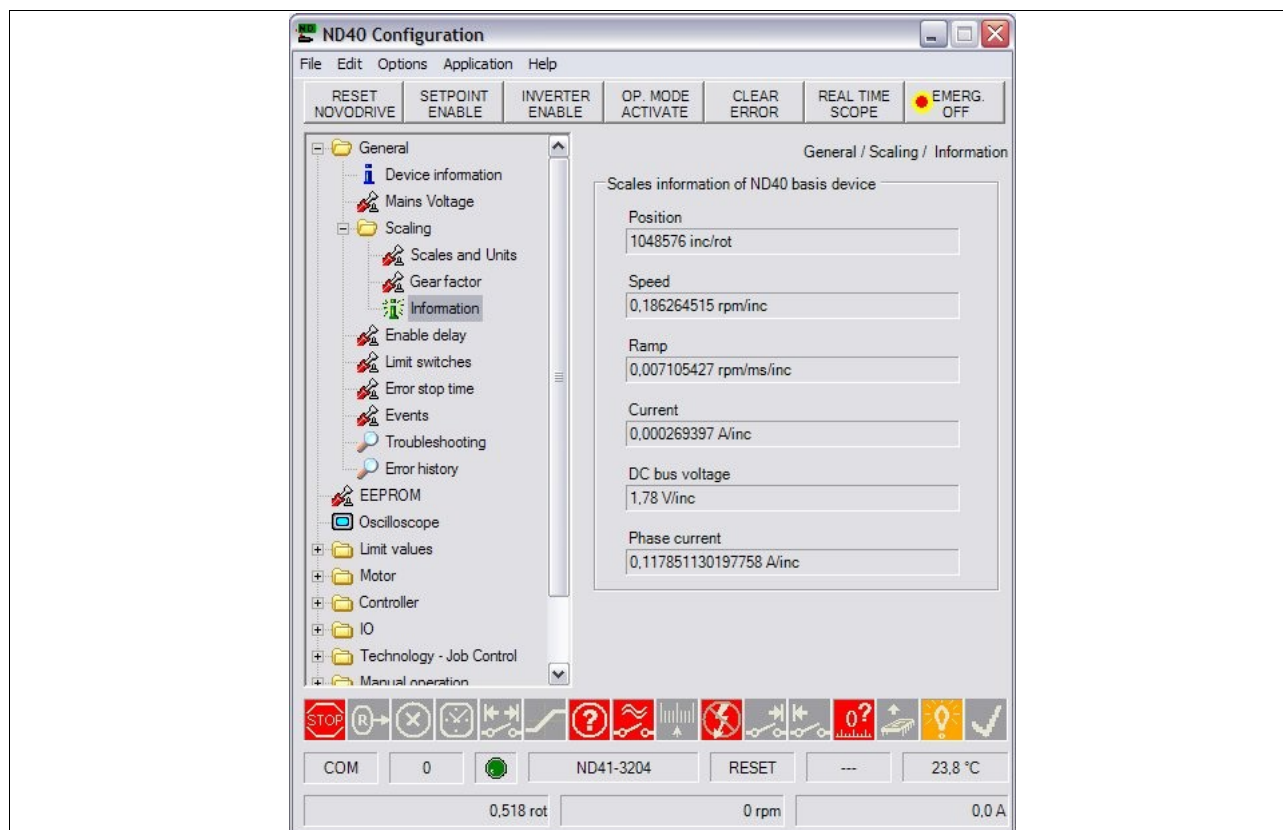
Number	Description
1	Gear specification
2	Spindle specification

If the drive system is equipped with a rotational gear mechanism, the gear transmission ratio must be indicated. Both values need to be whole numbers and > '0'. Values may range between 1...65535.

If values for gear and/or spindle are entered on this page, scaling factors need to be recalculated or the scaling needs to be adapted, respectively.

To do so, go to page '**Scaling/Scales and Units**'.

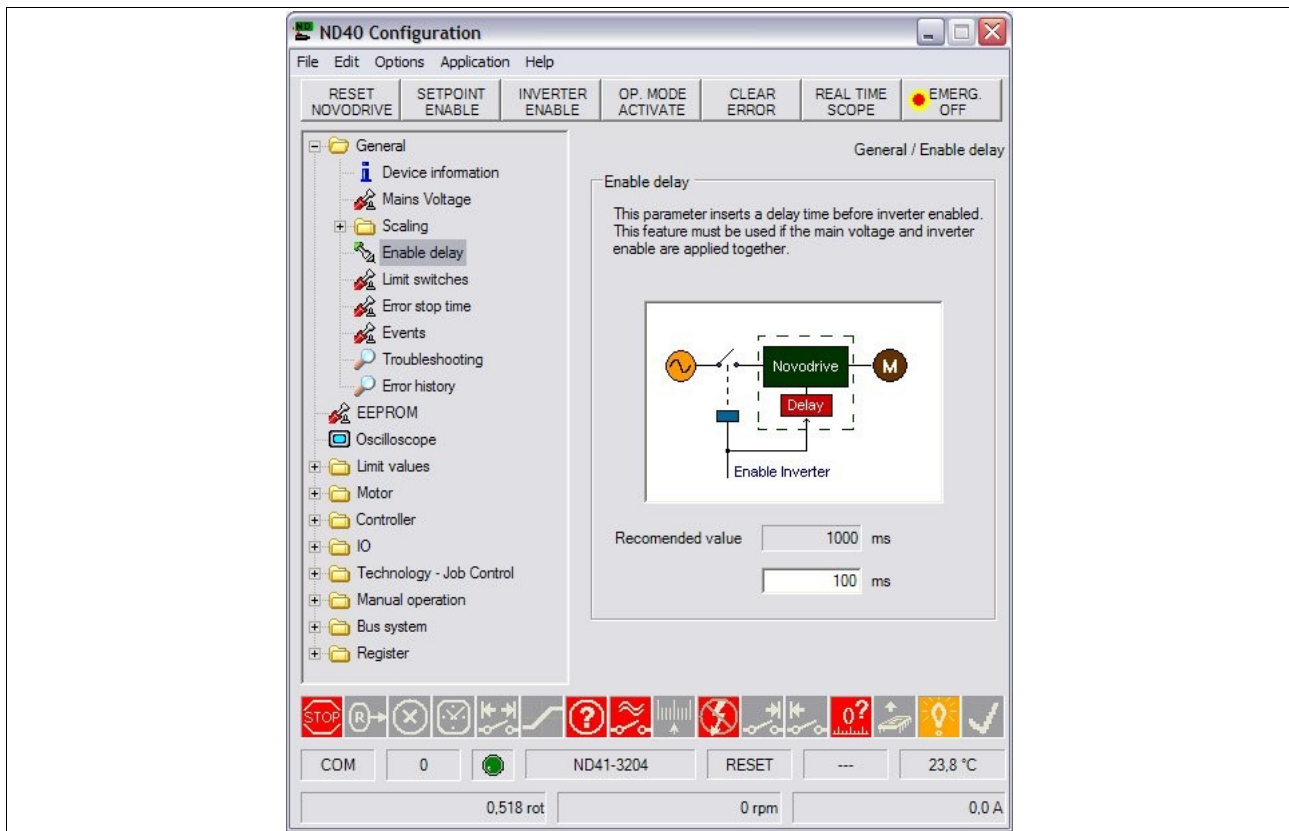
5.1.5 Scaling / Information



Page shows scaling factors of NOVODRIVE's internal, basic values. These values are relevant for control over NOVOBUS or CAN-NOVOTRON and for direct access to registers, respectively.

5.1.6 Enable delay

Only available in the 'Advanced Mode'.

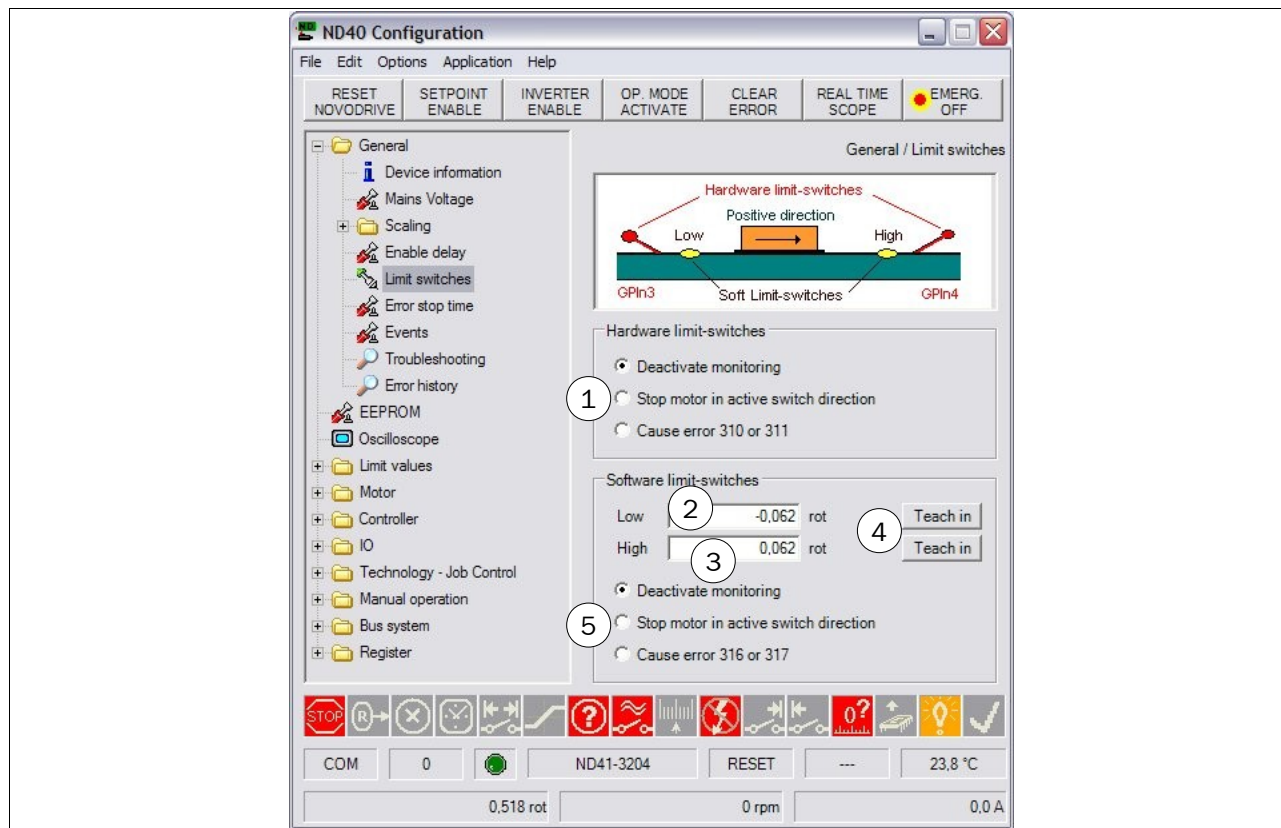


If line voltage and inverter enable are applied together, inverter enable must be delayed internally. This ensures that the DC link is fully loaded before the motor gets powered.

If this function is not used accordingly, Error 976 (undervoltage) may be generated or the charging circuit may be damaged.

Each device type comes with a certain default setting, which should not be changed!

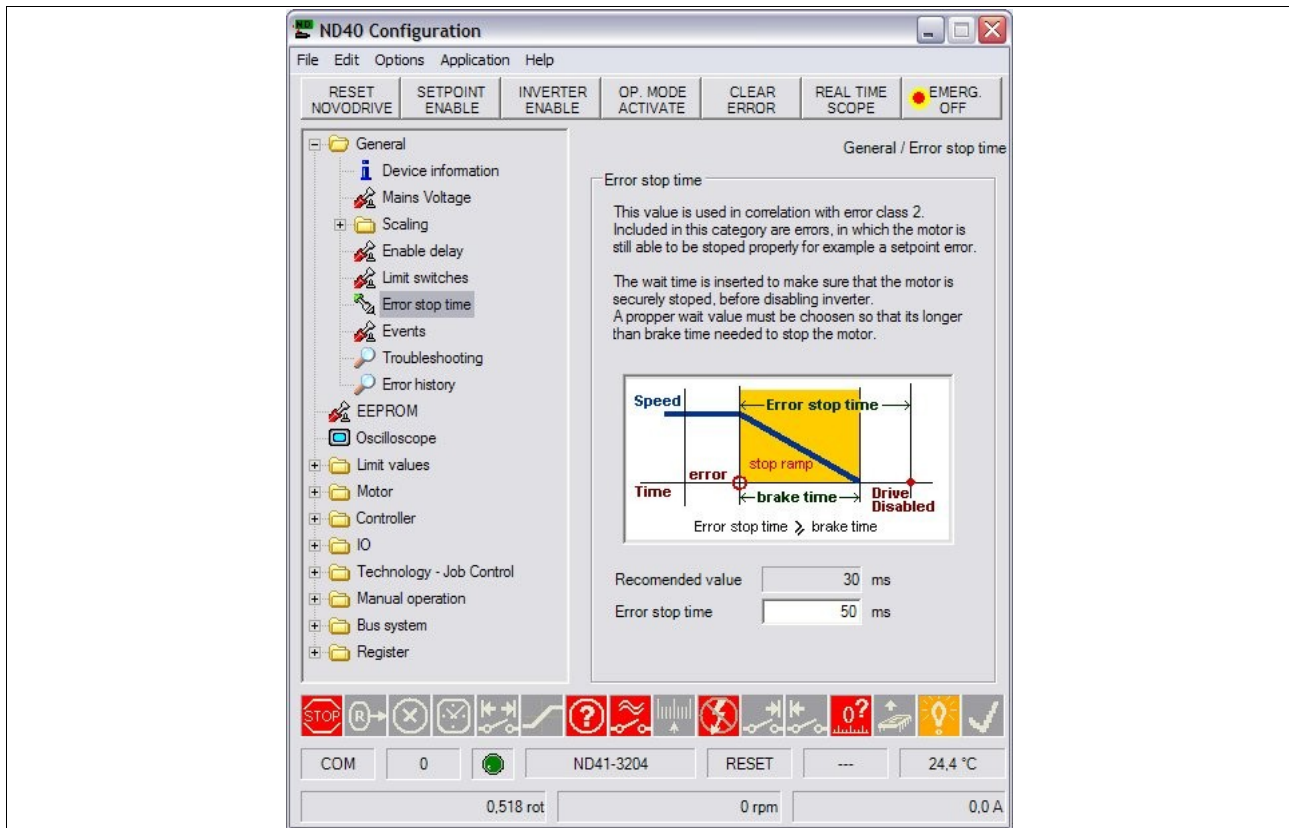
5.1.7 Limit switches



Number	Description
1	<ul style="list-style-type: none"> - Deactivation of hardware limit switches (GPIIn3 and GPIIn4) - Activation of hardware limit switches (GPIIn3 and GPIIn4); a limit switch can be left again when the motor is moved in the opposite direction - Activation of hardware limit switches (GPIIn3 and GPIIn4); if the negative limit switch responds, Error 310 is generated, and when the positive limit switch responds, Error 311 is generated
2	User value for software limit switch in negative direction
3	User value for software limit switch in positive direction
4	Position of software limit switches can be set by positioning the motor accordingly; by pressing the 'Teach in' buttons, the current position of the motor is adopted as position value for the negative and the positive limit switch, respectively
5	<ul style="list-style-type: none"> - Deactivation of software limit switches - Activation of software limit switches; a limit switch can be left again when the motor is moved in the opposite direction - Activation of software limit switches (GPIIn3 and GPIIn4); if the negative limit switch responds, Error 316 is generated, and when the positive limit switch responds, Error 317 is generated

Before software limit switches can be used, do homing or set actual position.

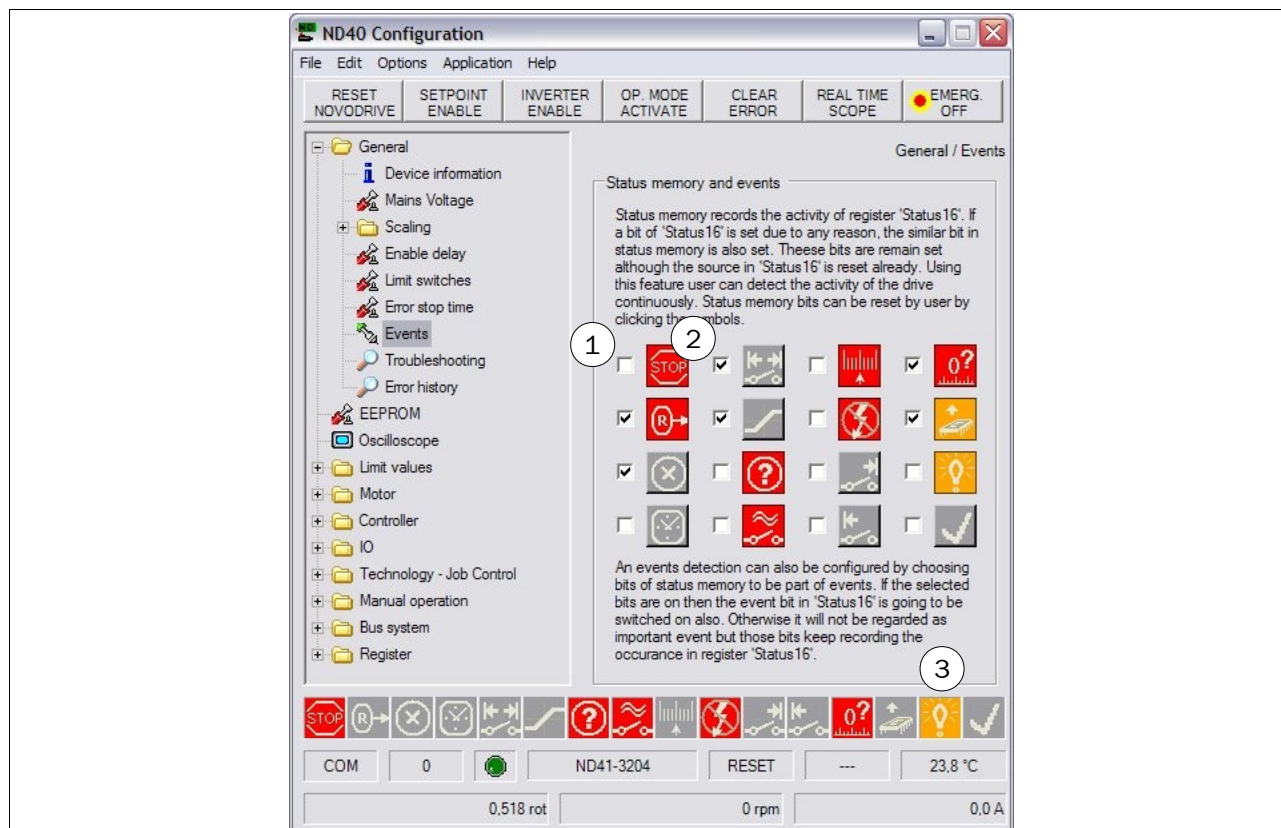
5.1.8 Error stop time



If Class 2 errors occur, the motor gets decelerated automatically and the inverter gets disabled after a defined period of time. This period of time needs to be determined under consideration of the maximum speed and the mass moved. We recommend to enter the value indicated in the grayed-out field.

5.1.9 Events

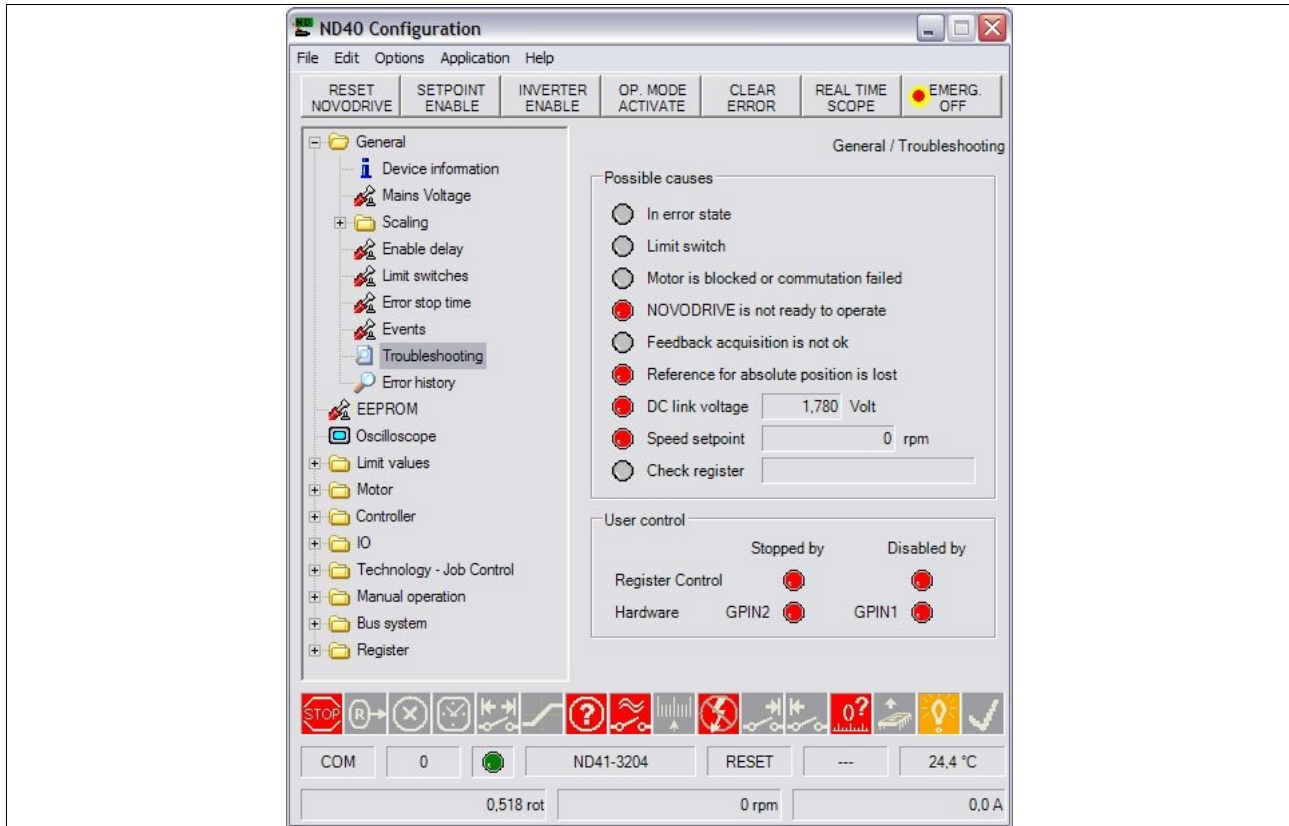
Only available in the 'Advanced Mode'.



Number	Description
1	Boxes for selecting the bits to be monitored (in Register 'Status16')
2	Status memory of selected Bits of „Status16“; by pressing the button the status memory is reset
3	At least one of the bits selected was temporarily set to '1'

The function can be used for monitoring purposes, for example to check whether a speed or current limitation has occurred recently.

5.1.10 Troubleshooting



Page informs about errors and problems that have occurred.

For example, 'Check register' indicates the register containing an invalid value.

5.1.11 Error history

The screenshot shows the 'ND40 Configuration' software window. The 'Error history' tab is selected in the left sidebar. The main area displays a table of error logs. The table has four columns: 'No.', 'hour', 'Error', and 'Description'. The table lists 14 errors, including E401 (Resistance limit value of motor) and E626 (Extension module gets no response). Below the table, there is a 'Further information' section showing details for error number 1, including error info 0 (0xE4010000) and error info 1 (0x000000BF). The software interface also shows various configuration options on the left and a status bar at the bottom.

No.	hour	Error	Description
1	17	E401	Resistance limit value of motor
2	17	E626	Extension module gets no resp
3	17	E626	Extension module gets no resp
4	17	E401	Resistance limit value of motor
5	17	E626	Extension module gets no resp
6	17	E626	Extension module gets no resp
7	15	E401	Resistance limit value of motor
8	14	E401	Resistance limit value of motor
9	14	E626	Extension module gets no resp
10	14	E626	Extension module gets no resp
11	14	E401	Resistance limit value of motor
12	14	E626	Extension module gets no resp
13	13	E626	Extension module gets no resp
14	13	E626	Extension module gets no resp

Further information

Number: 1

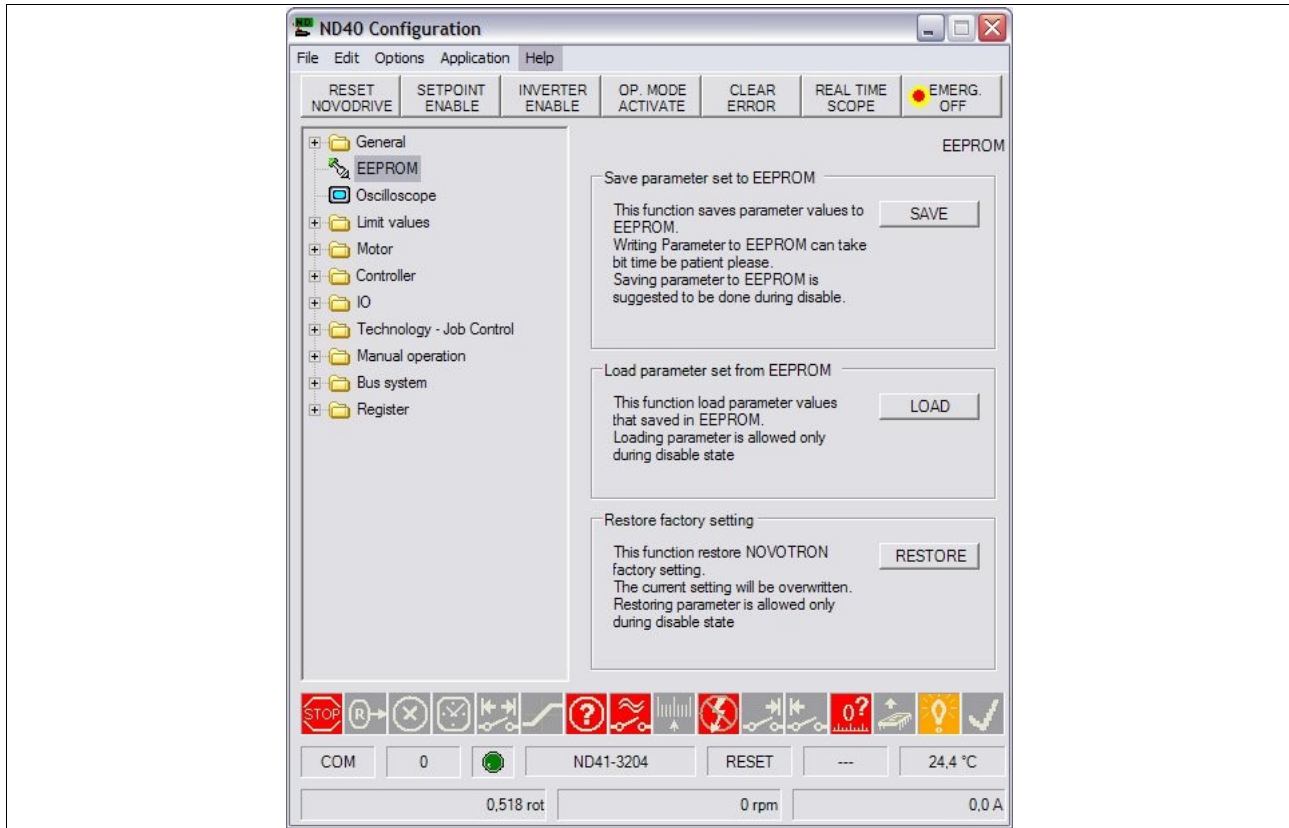
Error info 0: 0xE4010000

Error info 1: 0x000000BF

COM: 0, ND41-3204, RESET, 24.4 °C, 0.518 rot, 0 rpm, 0.0 A

Page lists the last 32 errors including the operating hour in which the error occurred and an error description.

5.2 EEPROM



Page allows to save parameter values to the EEPROM and load parameter values from the EEPROM as well as to reset parameters to default settings.

5.3 Oscilloscope

The image displays the ND40 Configuration and Oscilloscope software interface. The main window, titled "ND40 Configuration", features a menu bar (File, Edit, Options, Application, Help) and a toolbar with buttons for RESET, SETPOINT, INVERTER, OP. MODE, CLEAR, REAL TIME, and EMERG. OFF. A left sidebar lists configuration categories: General, EEPROM, Oscilloscope, Limit values, Motor, Controller, IO, Technology - Job Control, Manual operation, Bus system, and Register. The central area is divided into four channels for configuration:

- Channel 1:** SpeedSetpoint1, Enable, Zoom 0-3.
- Channel 2:** SpeedSetpoint1, Enable, Zoom 0-3.
- Channel 3:** SpeedActual, Enable, Zoom 0-3, 16Bit.
- Channel 4:** SpeedActual, Enable, Zoom 0-3.

At the bottom of the main window, a status bar shows "COM 0", "ND41-3204", "RESET", and "25.4 °C".

An "Oscilloscope" window is open, showing a graph with the following settings:

- Settings:** Name: Current, Setting-No.: 1, save, load.
- Trigger channel:** SpeedSetpoint1, Zoom 0-3.
- Scales:** Increment / Div: 32, Time base / Div: 20 ms.
- Trigger Mode:** Auto triggered, Normally triggered, Bitwise triggered.
- Trigger level:** 0, Trigger delay: -3 div.
- Trigger edge:** Rising edge.
- Trigger bit:** 7 6 5 4 3 2 1 0.
- Buttons:** Copy to clipboard, Stop trigger.

The Oscilloscope window also displays a graph with the following settings:

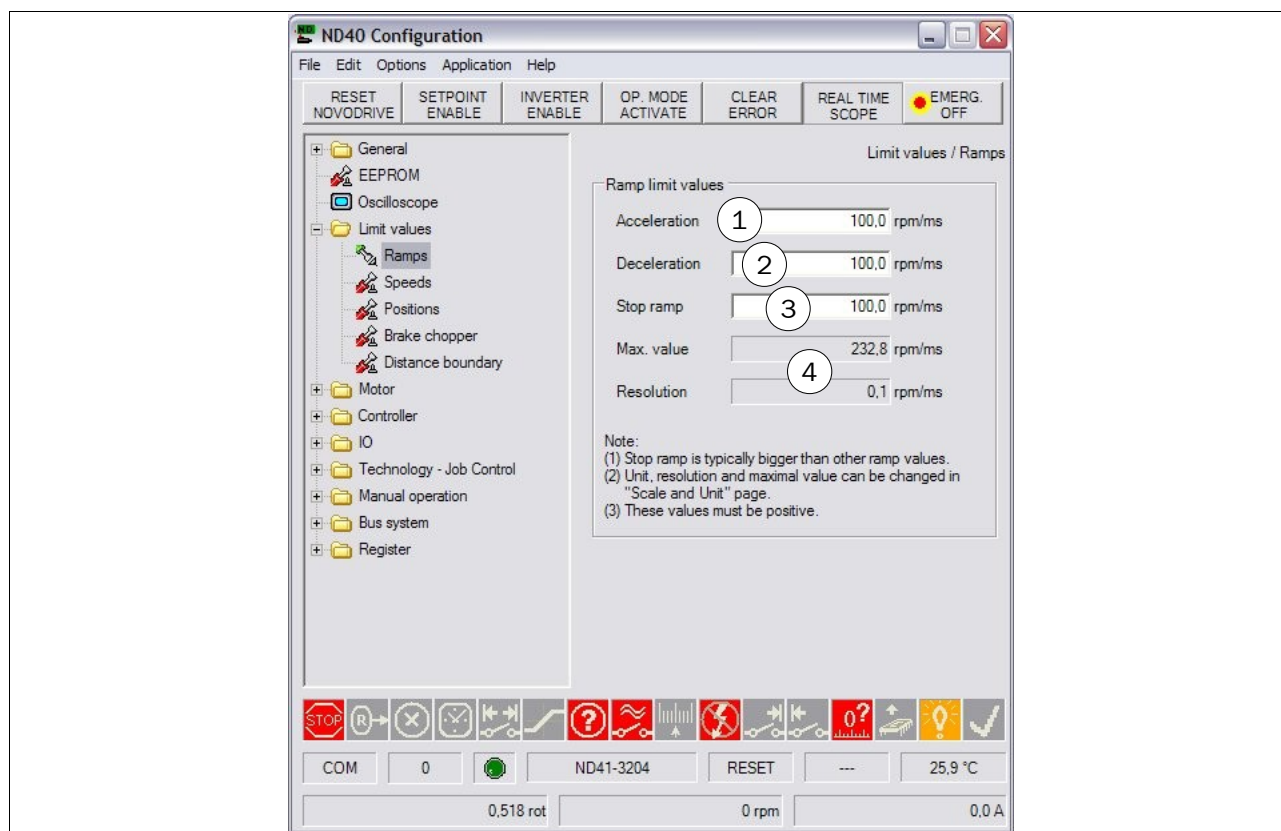
- PhaseCurrSetpointA1:** [32 inc / Div]
- PhaseCurrActualA1:** [32 inc / Div]
- PhaseVoltageA1:** [32 inc / Div]
- SpeedActual:** [4 rpm / Div]
- Time Base:** 10 ms
- Buttons:** 0.0, T, AUTO TRIGGER.

Numbered callouts (1-13) highlight specific features and controls within the interface.

Number	Description
1	Open up / Close oscilloscope window
2	Selection of channels to be analyzed; you may use four channels with 8-Bit resolution each; alternatively, you may use two channels with 16-Bit resolution each; the first two channels allow to use a logic analyzer (representation of bit fields)
3	Activation / deactivation of channel; over 'Zoom' you may select the byte of 16-bit or 32-bit values
4	Tabs for switching between sub-pages ('Signal', 'Trigger', or 'Settings')
5	Save and load settings (max. number of settings to be saved: 10)
6	Selection of trigger channel
7	Specification of resolution and time base
8	Specification of trigger level and trigger delay
9	Selection of trigger mode
10	Specification of trigger edge
11	Copy oscilloscope data to clipboard (data can be transferred to external file)
12	Stop triggering
13	Oscillogram

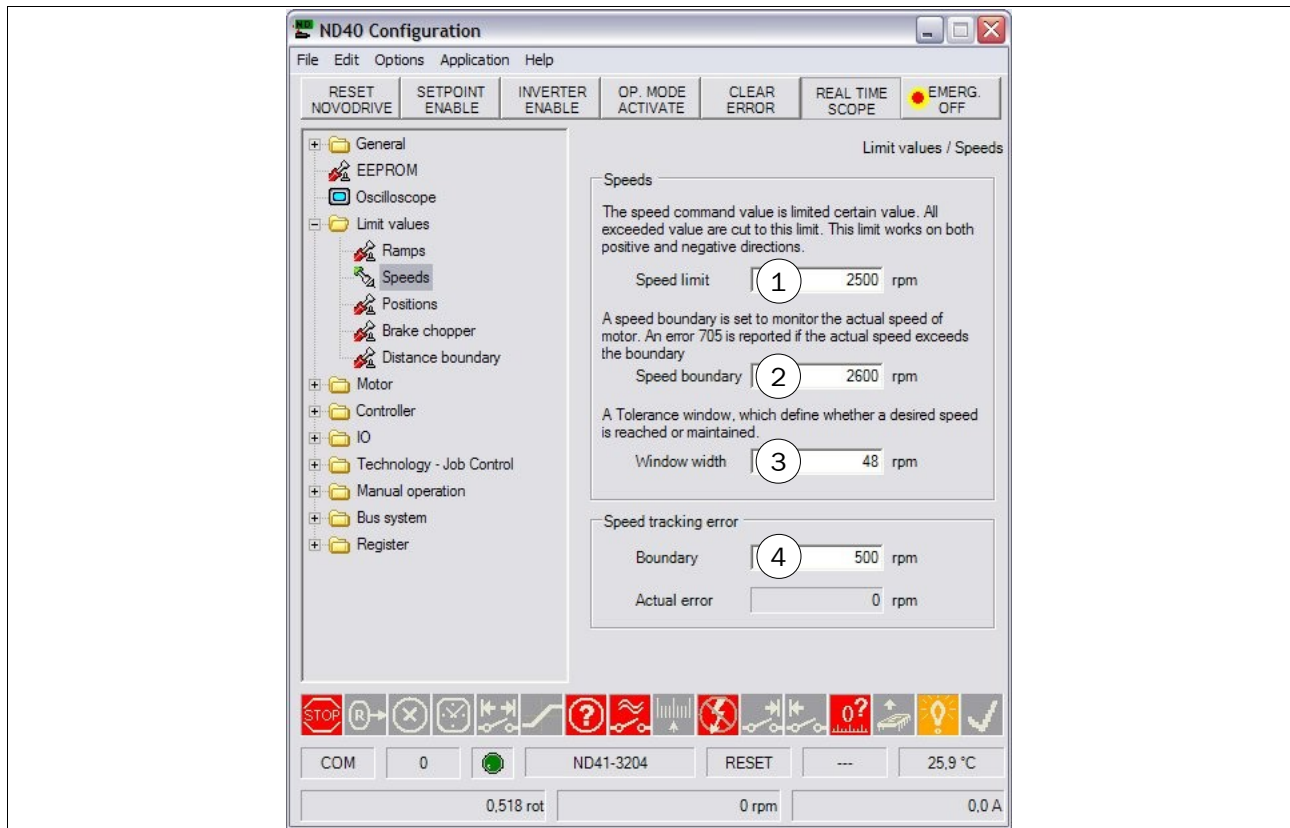
5.4 Limit values

5.4.1 Ramps



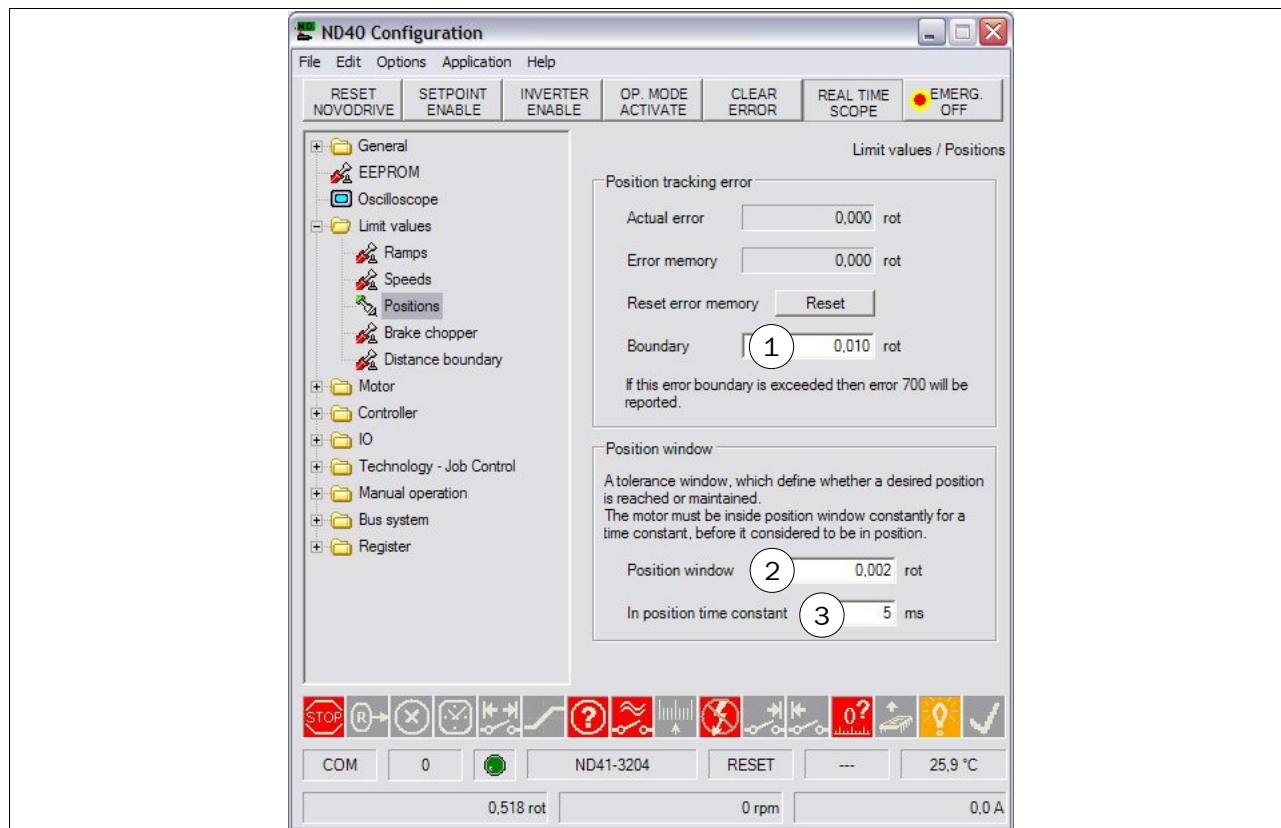
Number	Description
1	Acceleration ramp (scaled value)
2	Deceleration ramp (scaled value)
3	Stop ramp (scaled value), activated upon setpoint disable and/or occurrence of error class 2 (emergency stop)
4	Information on maximum values permitted and resolution

5.4.2 Speeds



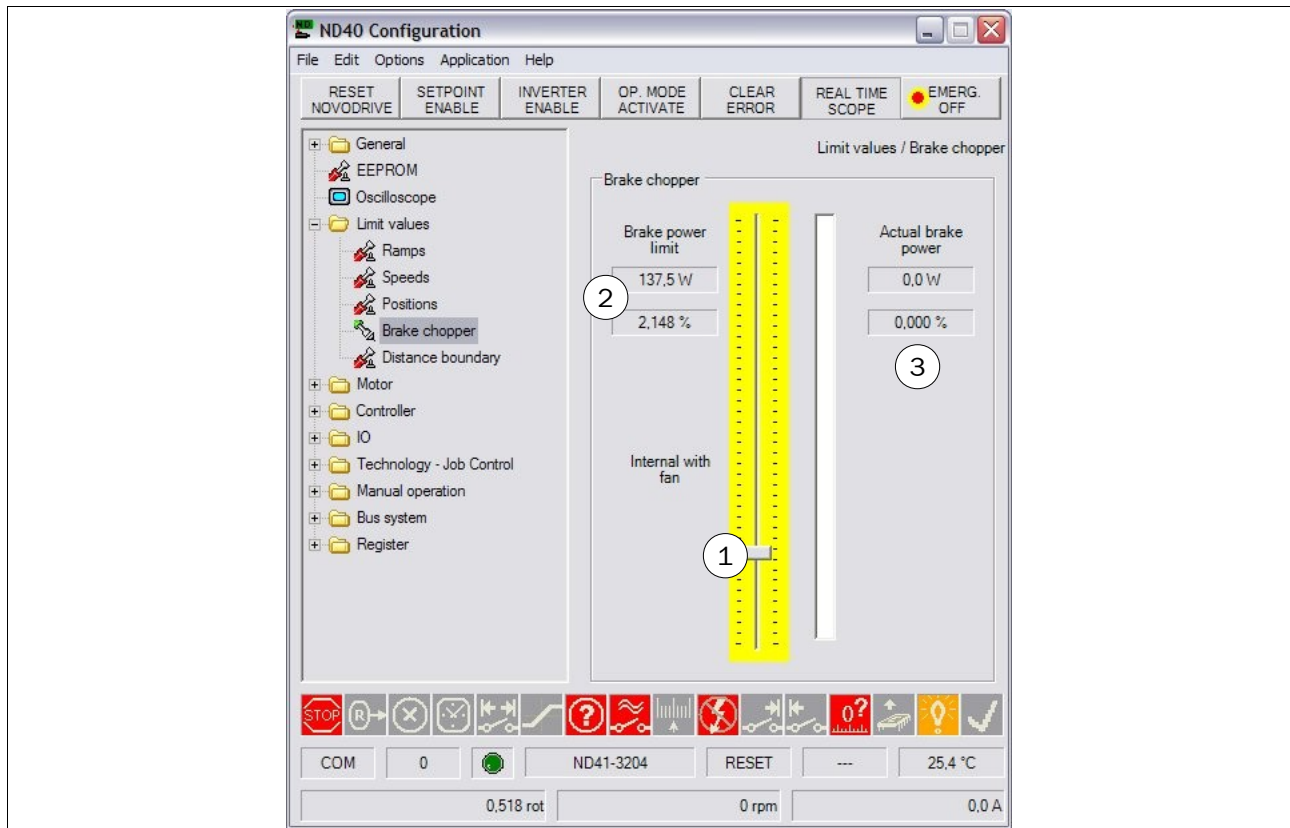
Number	Description
1	Limitation of speed setpoint
2	Monitoring of actual speed; if this value is exceeded, Error 705 is generated
3	Tolerance range for 'in speed' message used by various operating modes
4	Max. permissible deviation between actual speed and speed setpoint; if this value is exceeded, Error 701 is generated

5.4.3 Positions



Number	Description
1	Max. permissible deviation between actual position and position setpoint of the position controller; if this value is exceeded, Error 700 is generated
2	Tolerance range for 'in position' message used by various operating modes
3	Time constant for 'in position' message (see User Manual 'Software Reference', Annex C); typically 10...20 ms

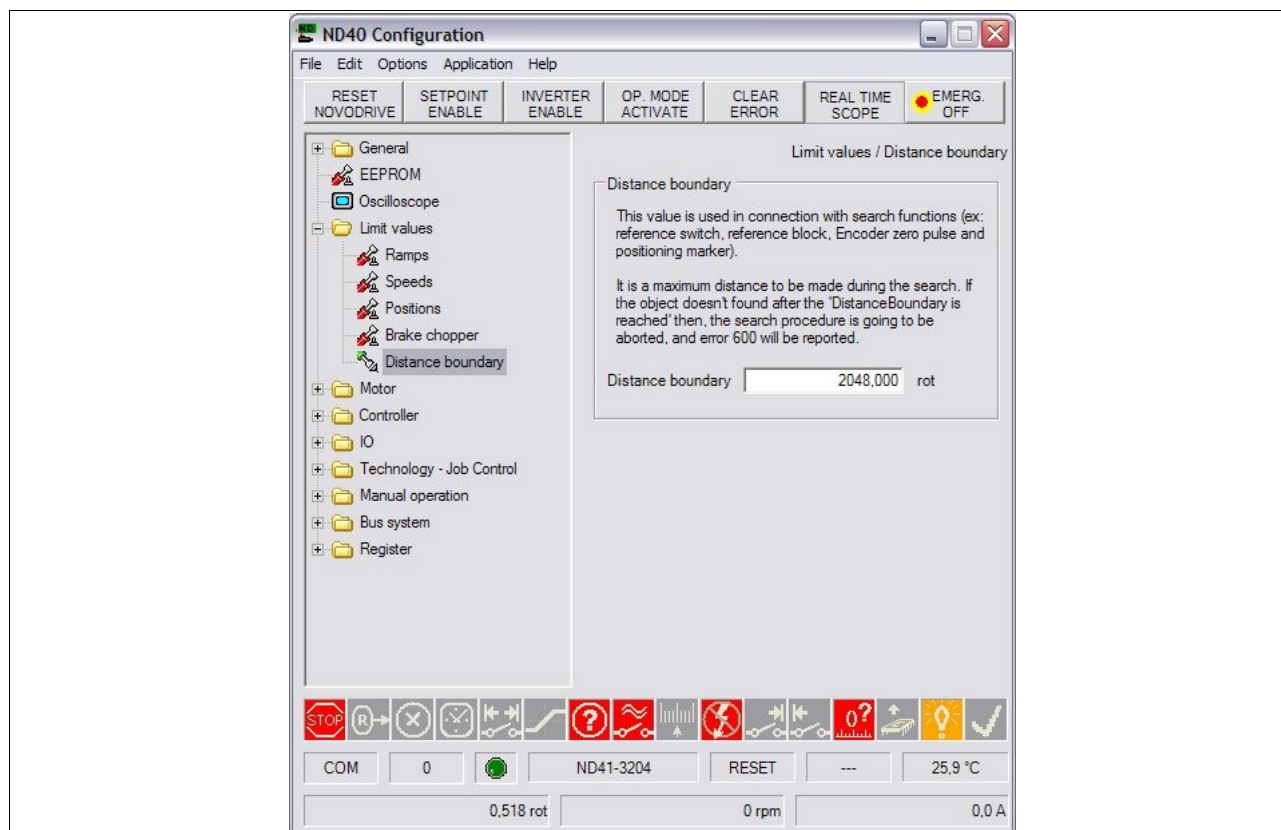
5.4.4 Brake chopper



Number	Description
1	Setting of maximum braking power. If no external brake chopper is used, maximum braking power should be 2,2 % of peak power. If a 19" version without sufficient ventilation is used, maximum braking power should be 1,1 % of peak power only. If an external brake chopper is connected, the value for maximum braking power should be as specified in the braking chopper's specifications.
2	Maximum braking power as an absolute value and in percent of peak power (dependent on NOVODRIVE type)
3	Actual power dissipation

Brake choppers are used to dissipate the energy generated during deceleration of the motor.

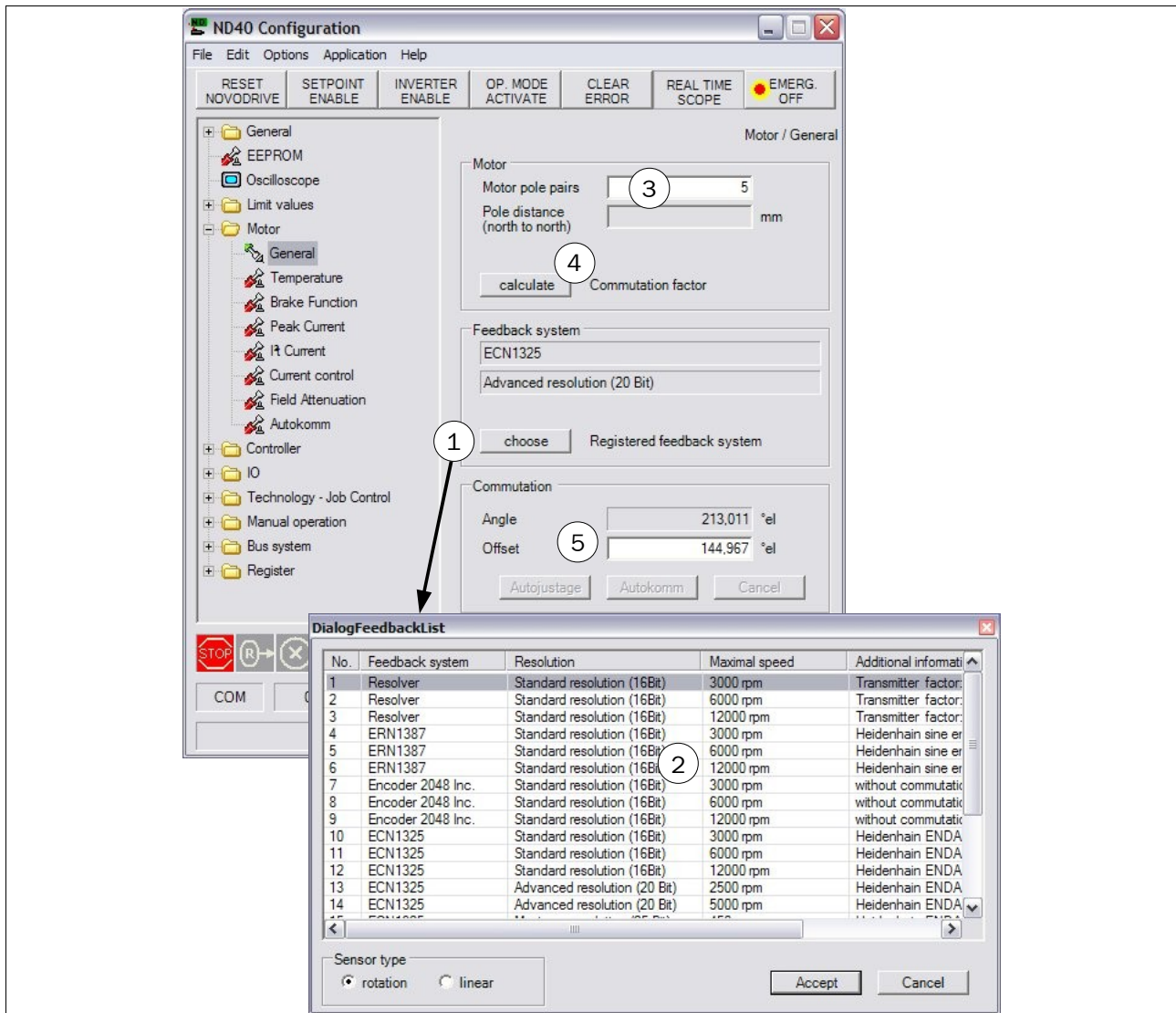
5.4.5 Distance boundary



To be used when working with the following operating modes: 'Homing with switch method', 'Homing with encoder zero marker' and 'Homing with block method'. Determines the maximum distance to be covered during a search. If the switch or zero-point has not been found within the distance specified by this value, the search process is terminated and Error 600 is generated.

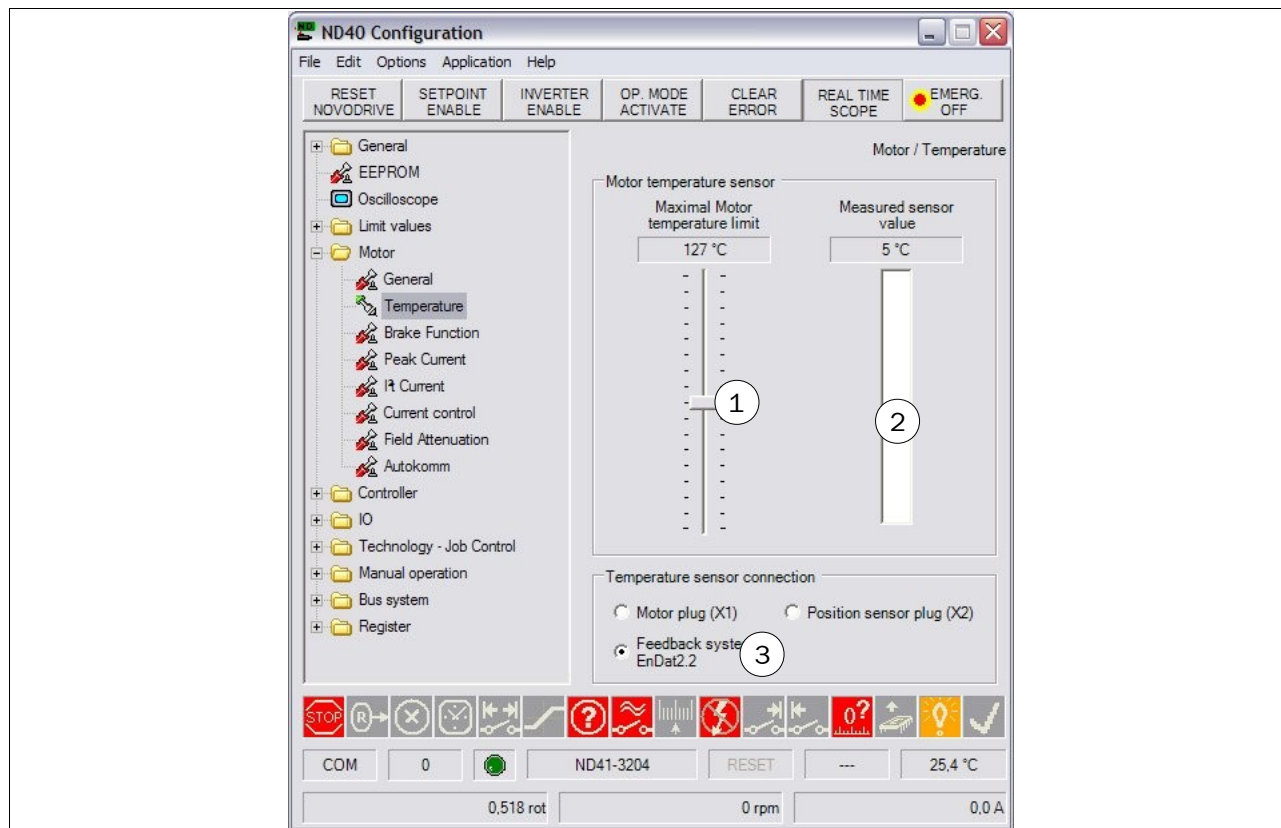
5.5 Motor

5.5.1 General



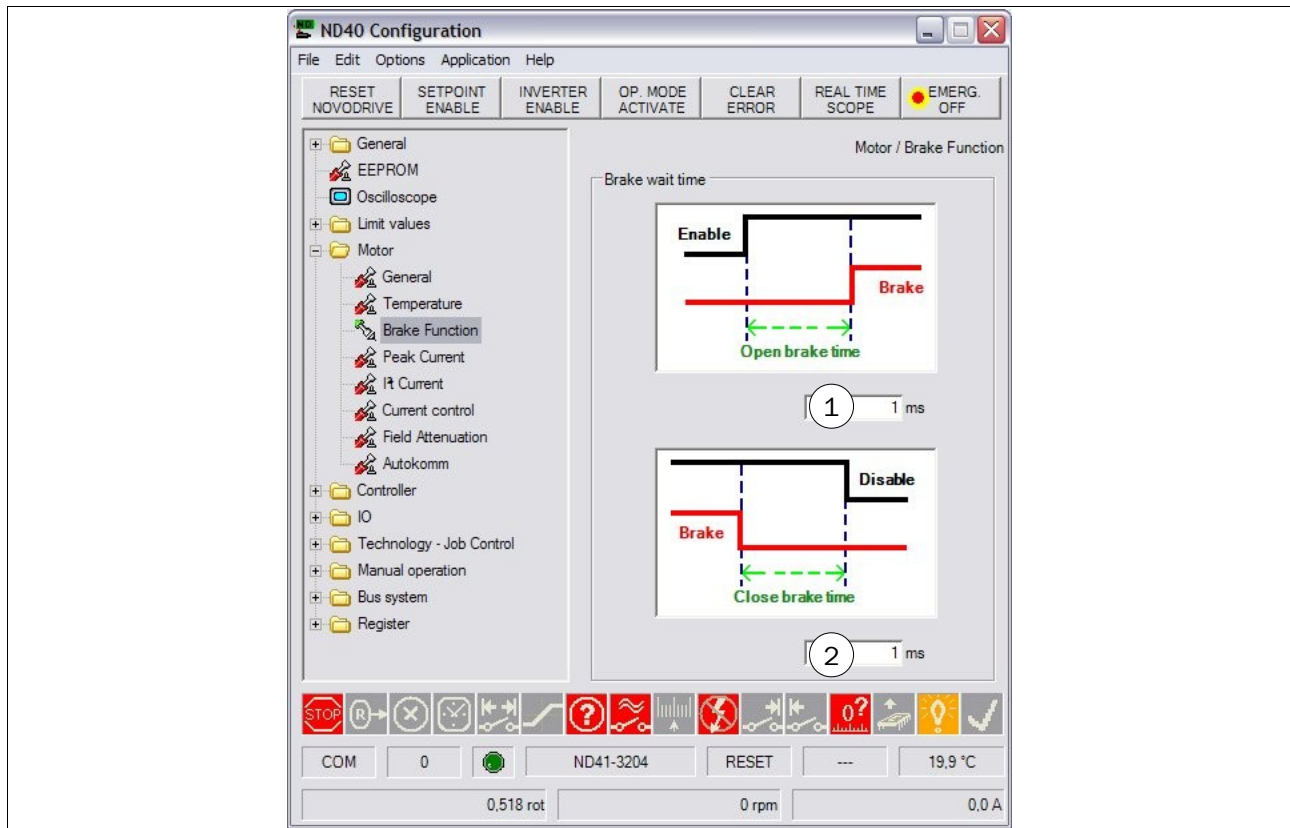
Number	Description
1	Pressing the „Choose“ button opens up a window for selection of the feedback system
2	Selection of feedback system (rotary or linear) under consideration of resolution and maximum speed
3	Specification of number of pole pairs (for rotary motors) and pole distance (for linear motors), respectively; check motor specifications before entering values here
4	Calculation of internal commutation factors
5	Start/Stop of auto adjustment of the motor's commutation angle offset; to be used when motor is not connected; the Autokomm algorithm should be used in special cases only

5.5.2 Temperature



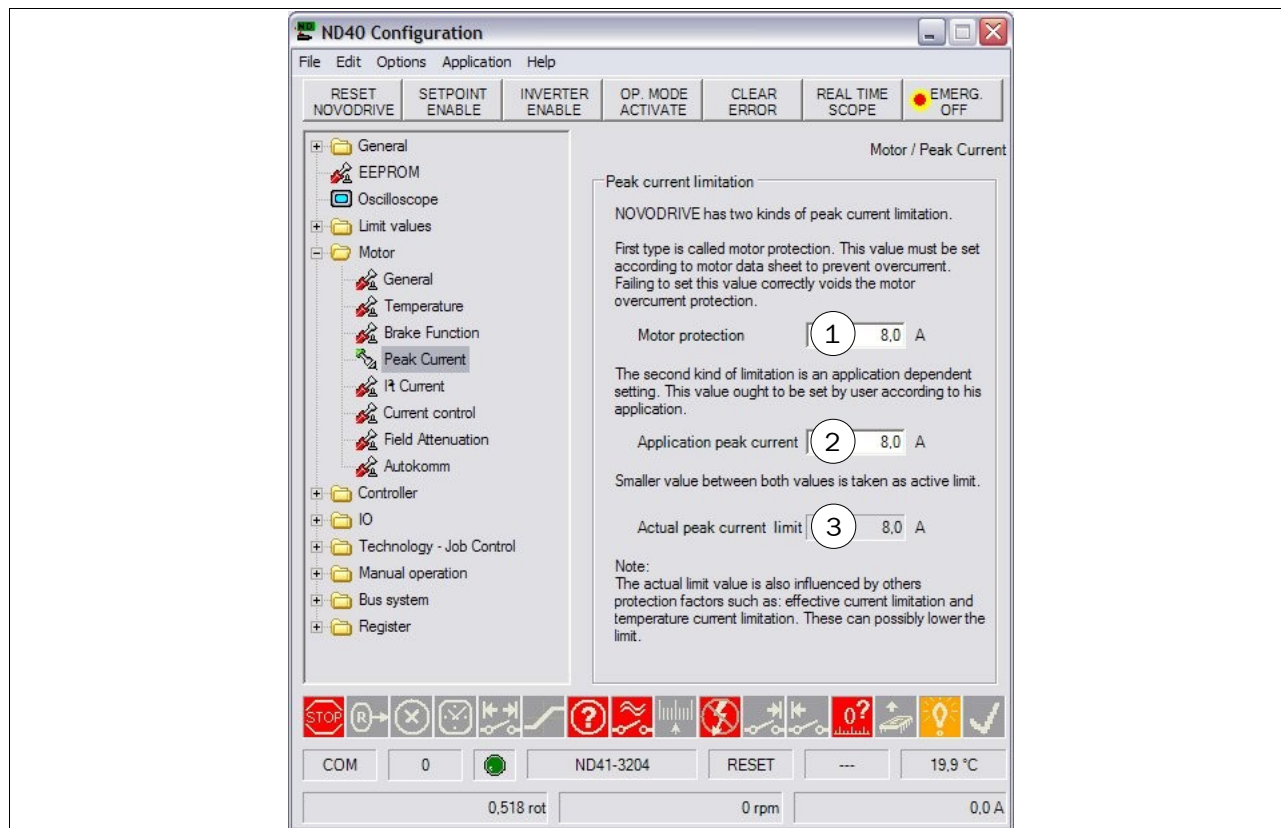
Number	Description
1	Specification of resistance value of motor temperature sensor; if this value is exceeded, Error 401 is generated; check motor specifications before entering any value here; if a thermo switch is used, set on 7,5 kOhm
2	Actual resistance value of motor temperature sensor
3	Selection of temperature sensor connection

5.5.3 Brake Function



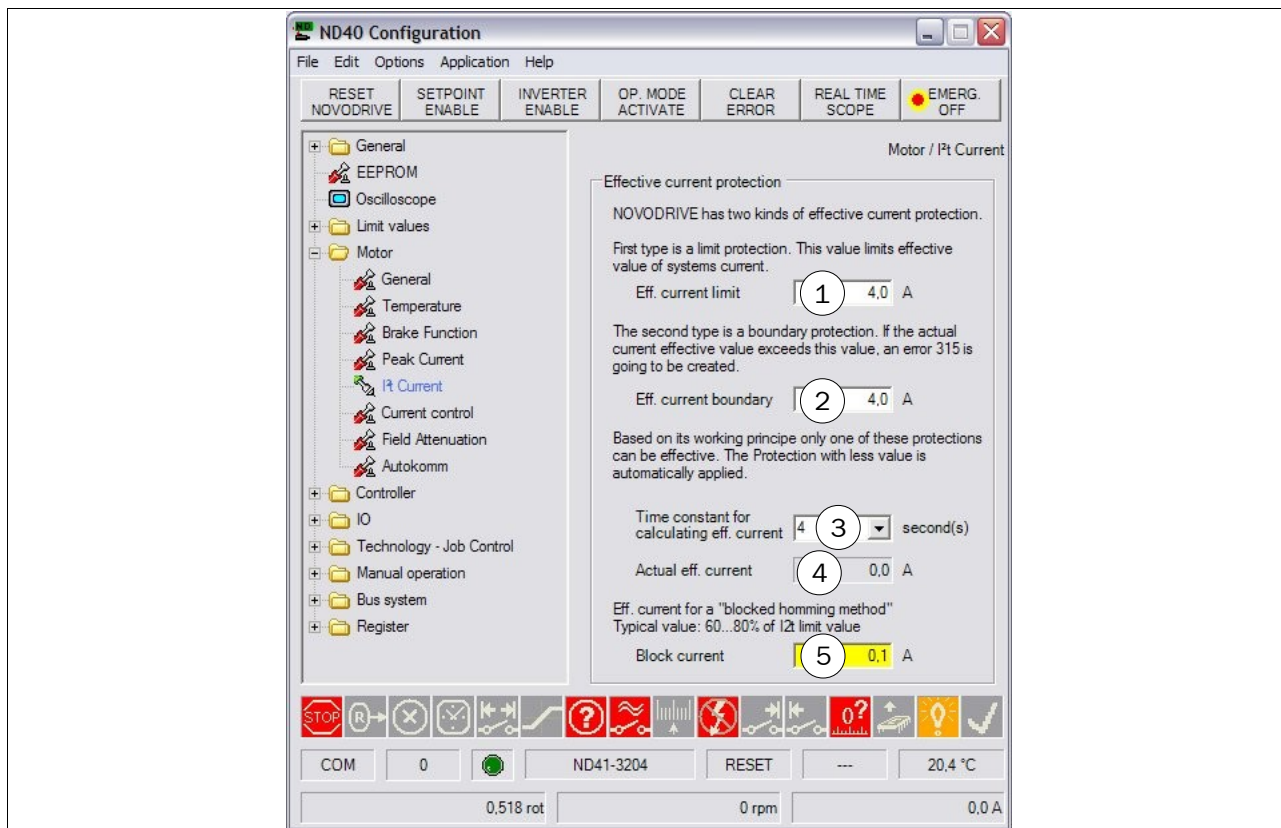
Number	Description
1	Specification of wait time between inverter enable and release of holding brake
2	Specification of wait time between activation of holding brake and inverter disable

5.5.4 Peak Current



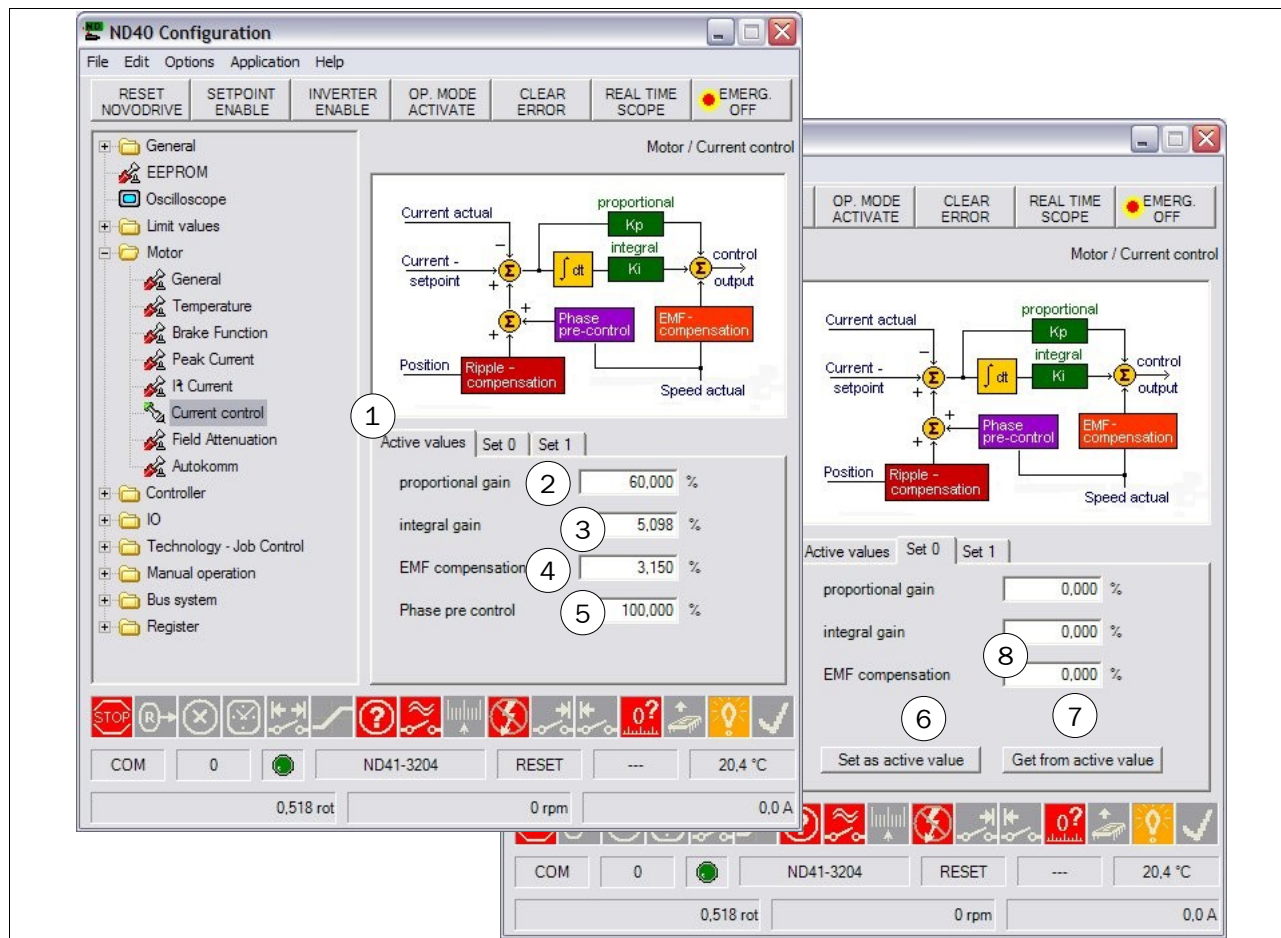
Number	Description
1	Specification of max. permissible peak current of motor
2	Specification of max. permissible peak current of application
3	Max. peak current currently possible

5.5.5 I_{2t} Current



Number	Description
1	Specification of limit value for r.m.s. current; if this value is exceeded, current is limited
2	Specification of limit value for r.m.s. current; if this value is exceeded, Error 315 is generated; if no error message is wanted, set (2) a little higher than (1)
3	Specification of time constant for calculating r.m.s. current; set 25 s for large motors, 12 s for medium-sized motors, and 4 s for small motors
4	Actual r.m.s. current value
5	Specification of current limit value for operating mode #15 ('Homing with block method')

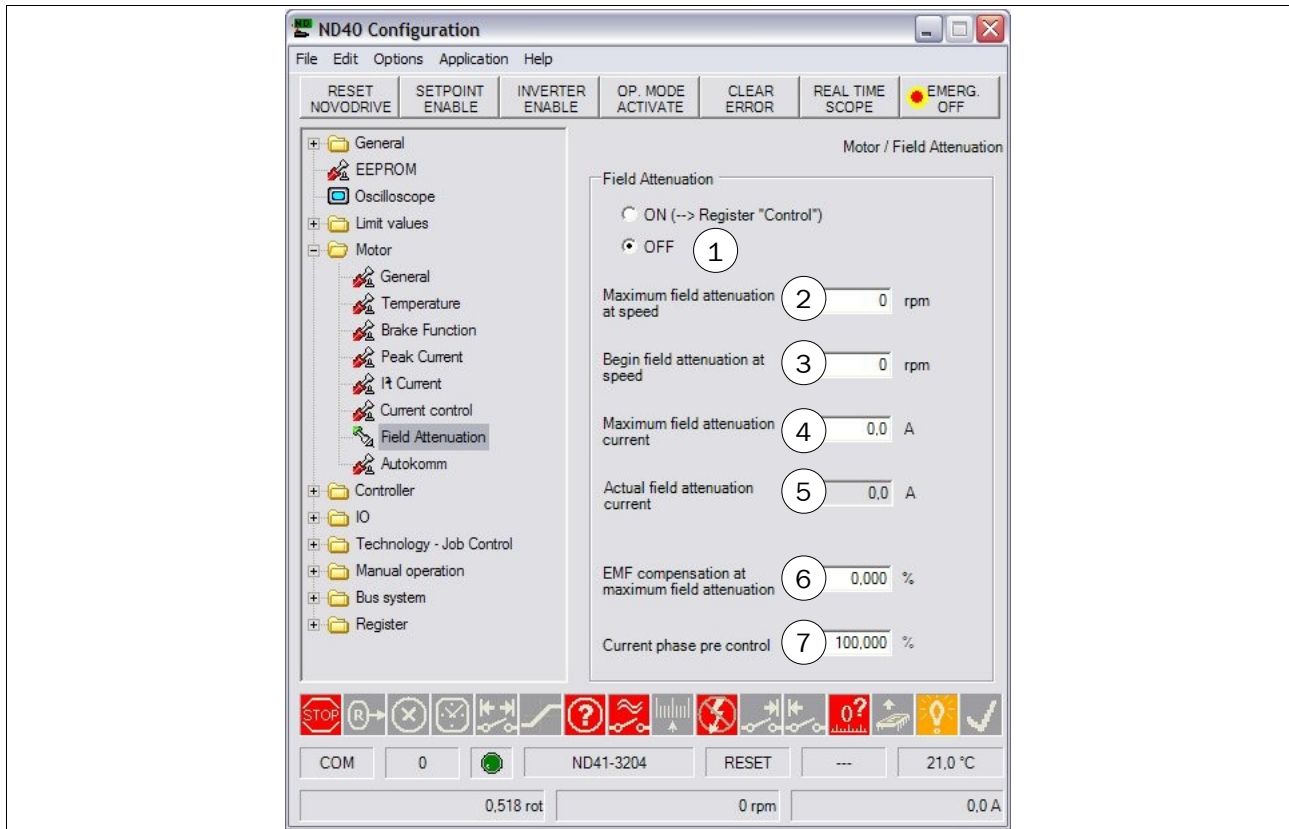
5.5.6 Current control



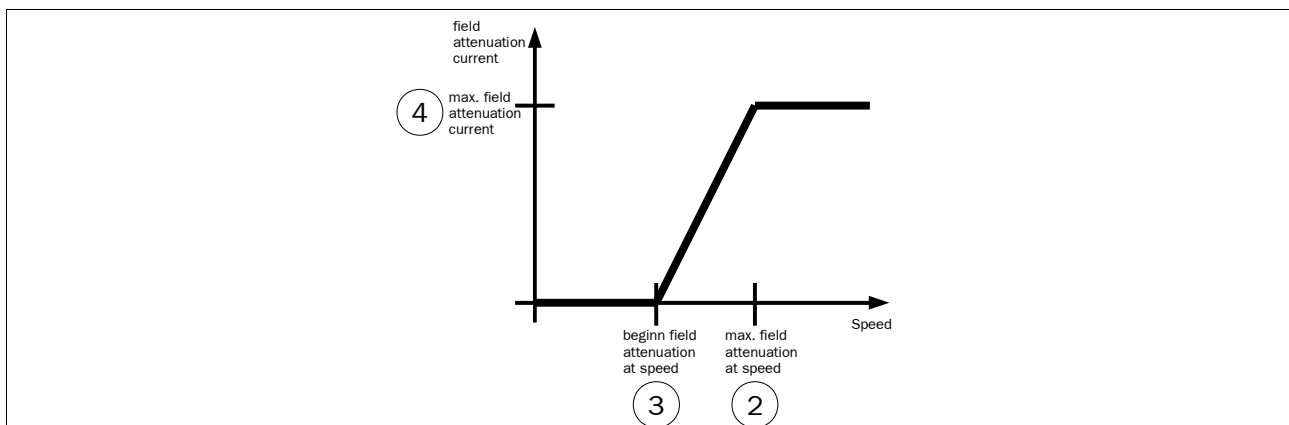
Number	Description
1	Tabs for switching between various parameter sets for current control; besides the active parameter set, two other sets can be specified the values of which can be adopted from the active set and copied into the active set, respectively
2	Specification of proportional gain
3	Specification of integral gain (max. 10% of proportional gain; the higher the value, the bigger the effect)
4	Specification of EMF compensation
5	Specification of phase pre-control; if a resolver is used as feedback system, enter '400' here; in all other cases, enter '100'
6	By pressing the button the values specified under this tab are set as new parameter set
7	By pressing the button the values specified by the active parameter set are adopted for this set
8	Saved values for proportional gain, integral gain and emf compensation

5.5.7 Field Attenuation

Only available in the 'Advanced Mode'.

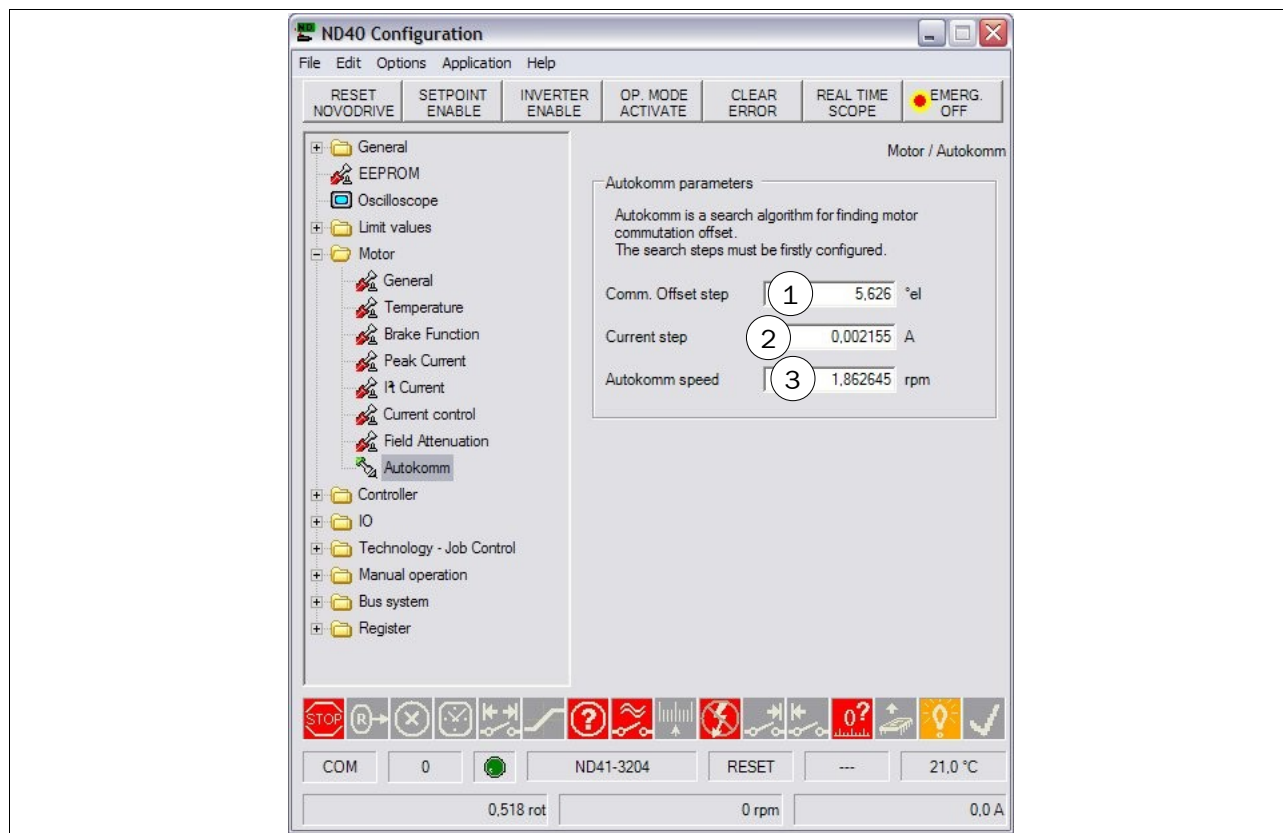


Number	Description
1	Activation / Deactivation of field attenuation; activation is done over the 'Control' register; note that activation of field attenuation is not saved permanently in the parameter set
2	Specification of speed as of which maximum field attenuation is in effect
3	Specification of speed as of which field attenuation starts
4	Specification of maximum field attenuation current
5	Actual field attenuation current
6	Specification of EMF compensation at maximum field attenuation (usually '0')
7	Specification of phase pre-control of current (see 'Current control')



5.5.8 Autokomm

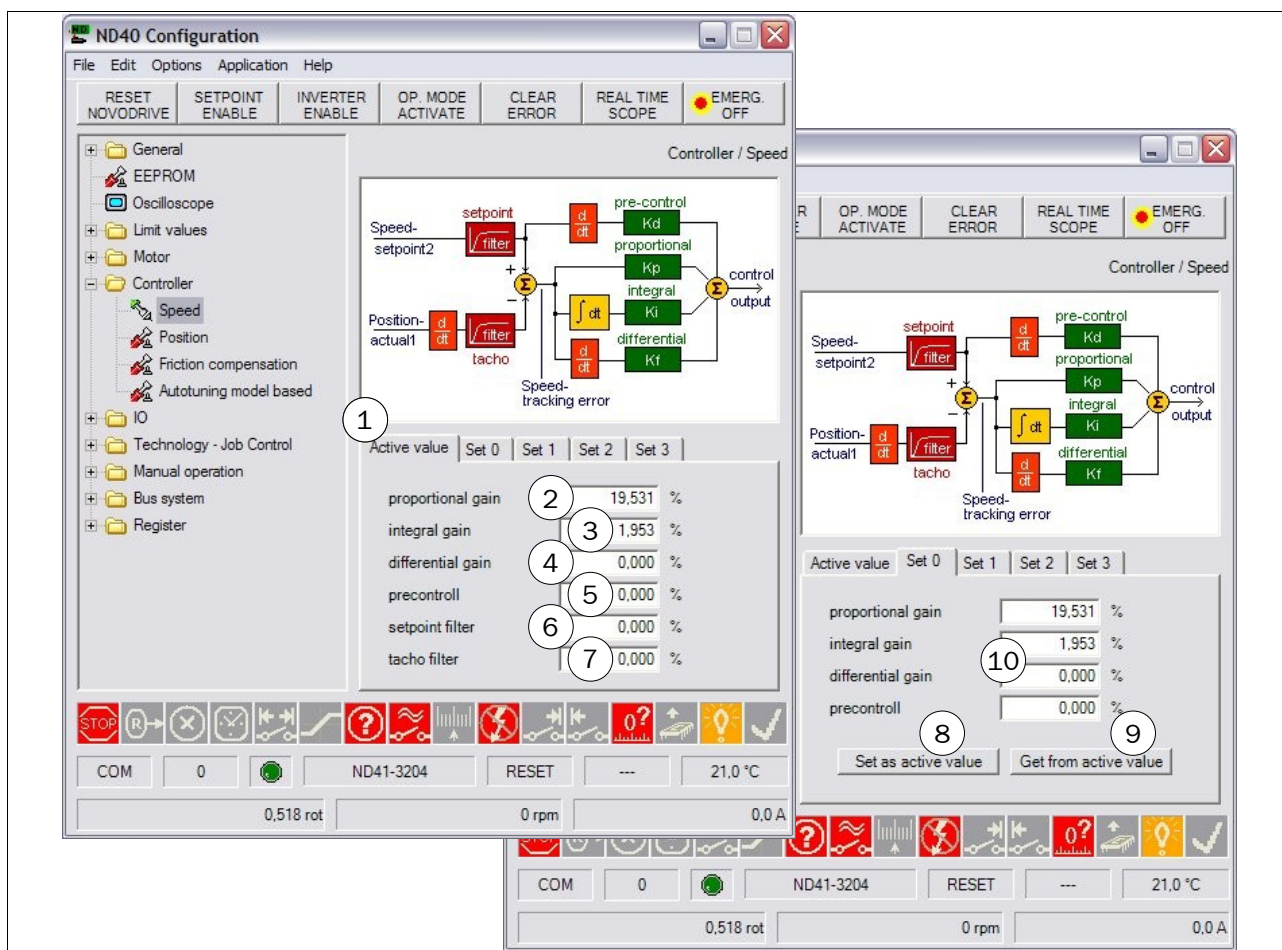
Only available in the 'Advanced Mode'.



Search algorithm for determining the commutation angle offset.

5.6 Controller

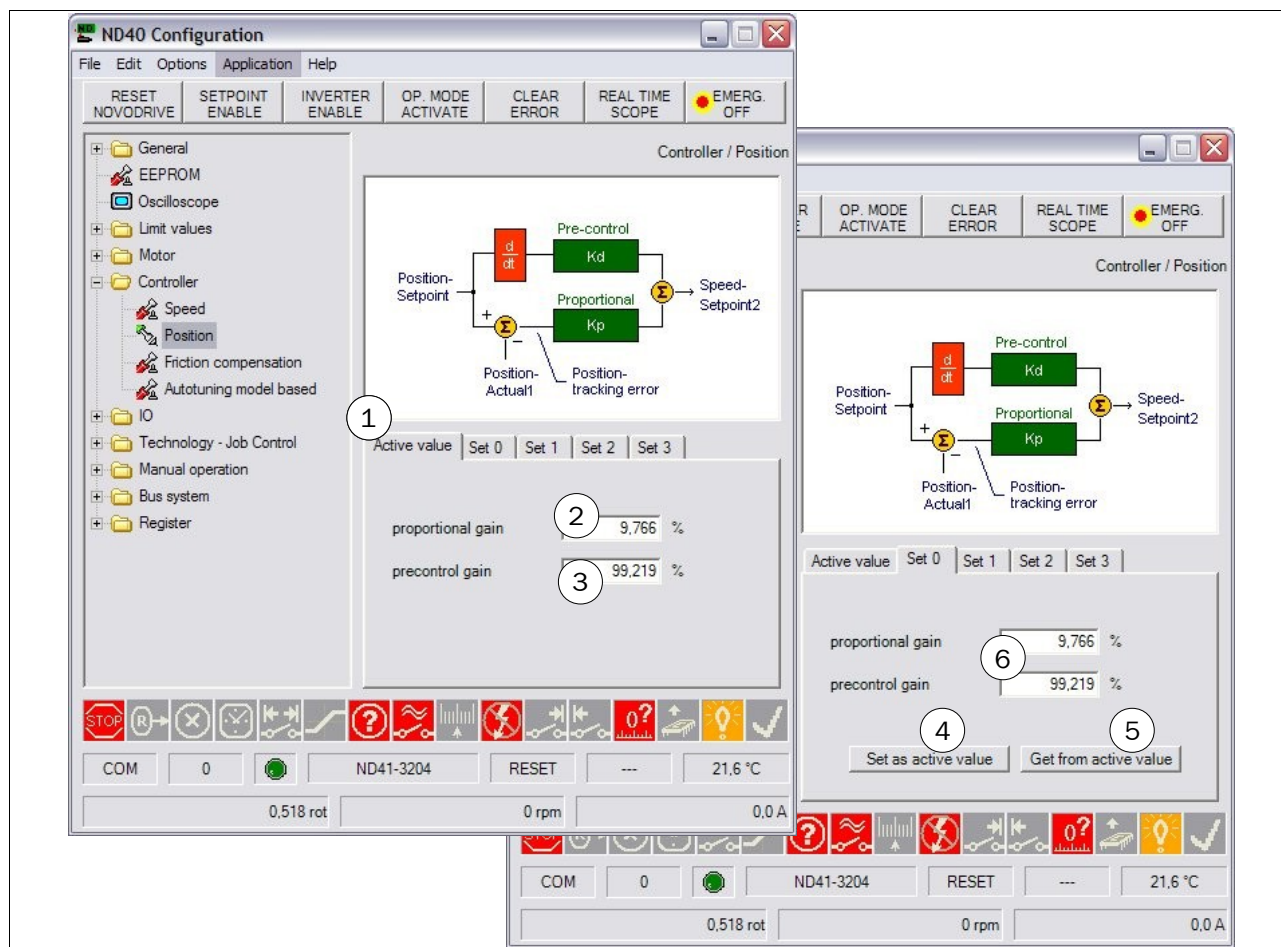
5.6.1 Speed



Settings for speed control

Number	Description
1	Tabs for switching between various parameter sets for speed control; besides the active parameter set, four other sets can be specified the values of which can be adopted from the active set and copied into the active set, respectively
2	Specification of proportional gain
3	Specification of integral gain
4	Specification of differential gain
5	Specification of torque pre-contol when speed is to be changed; leave '0' or set low if control is done over analog input or if a position control is used
6	Specification of filter for smoothing speed setpoint if control is done by step/direction or by encoder signal
7	Specification of tacho filter for smoothing actual speed
8	By pressing the button the values specified under this tab are set as new parameter set
9	By pressing the button the values specified by the active parameter set are adopted for this set
10	Saved values for proportional gain, integral gain, differential gain and pre-control

5.6.2 Position

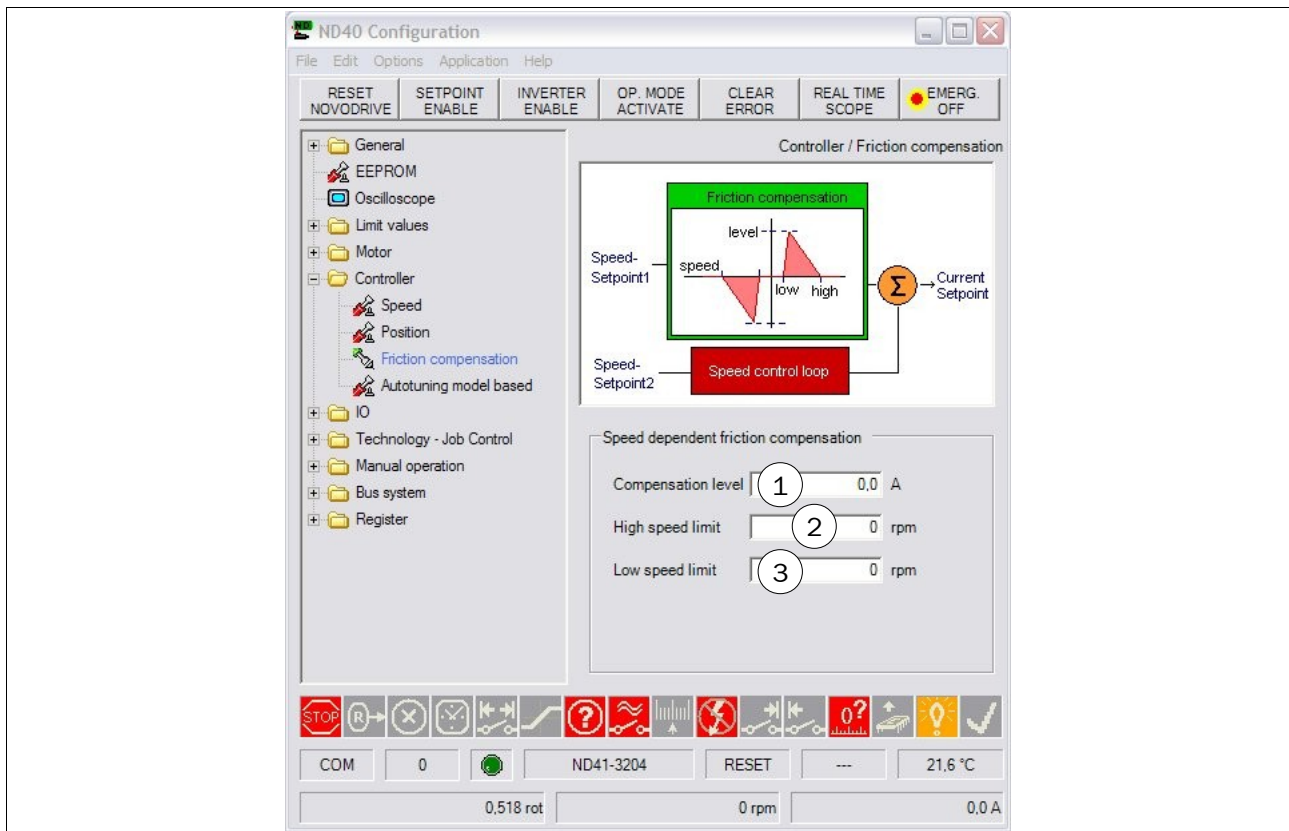


Settings for position control

Number	Description
1	Tabs for switching between various parameter sets for position control; besides the active parameter set, four other sets can be specified the values of which can be adopted from the active set and copied into the active set, respectively
2	Specification of proportional gain
3	Specification of speed pre-control; usually '100'
4	By pressing the button the values specified under this tab are set as new parameter set
5	By pressing the button the values specified by the active parameter set are adopted for this set
6	Saved values for proportional gain and pre-control

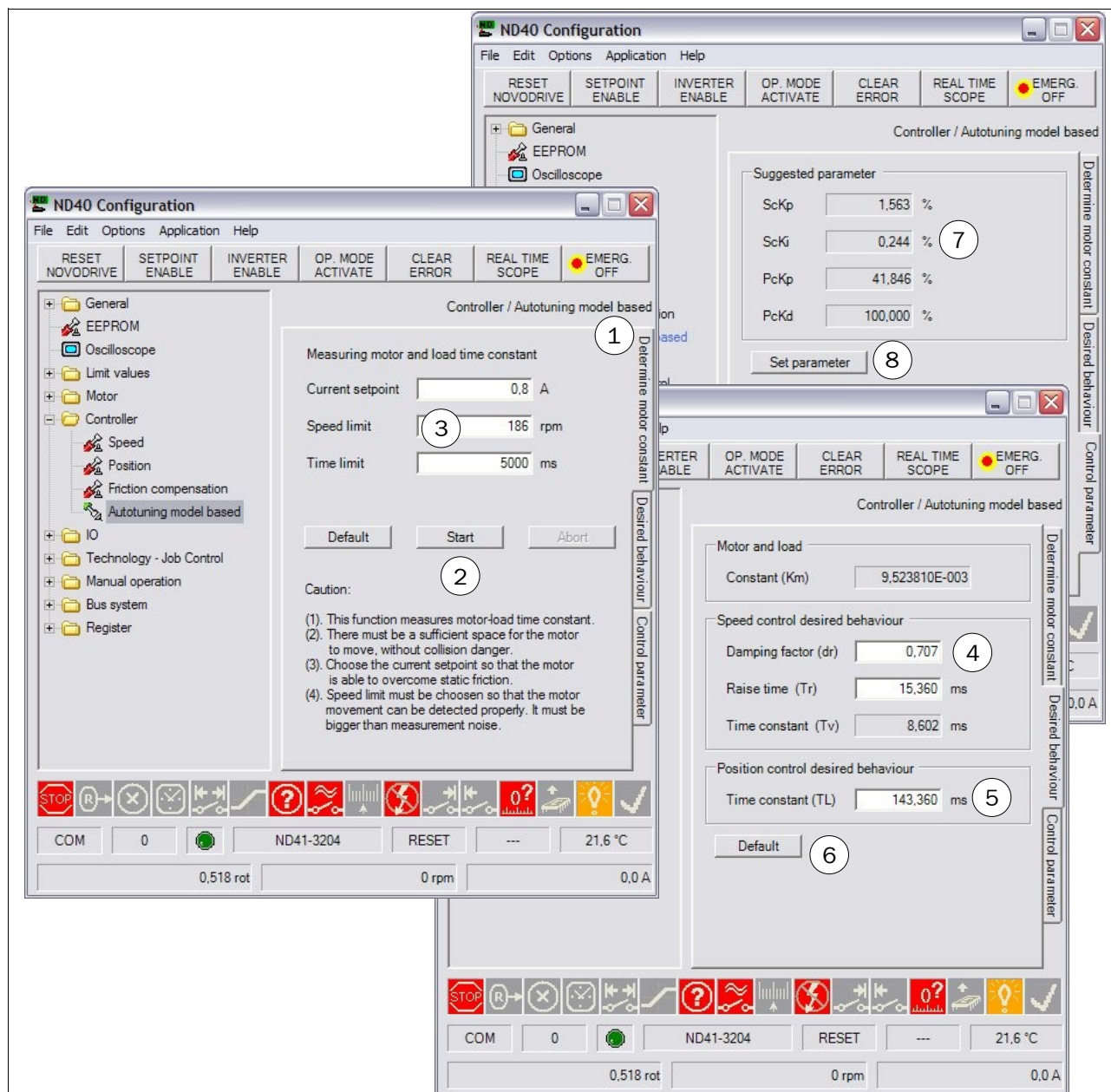
5.6.3 Friction compensation

Only available in the 'Advanced Mode'.



Number	Description
1	Specification of maximum current for friction compensation
2	Specification of upper speed limit, at which friction compensation stops
3	Specification of lower speed limit (close to '0'), at which friction compensation starts

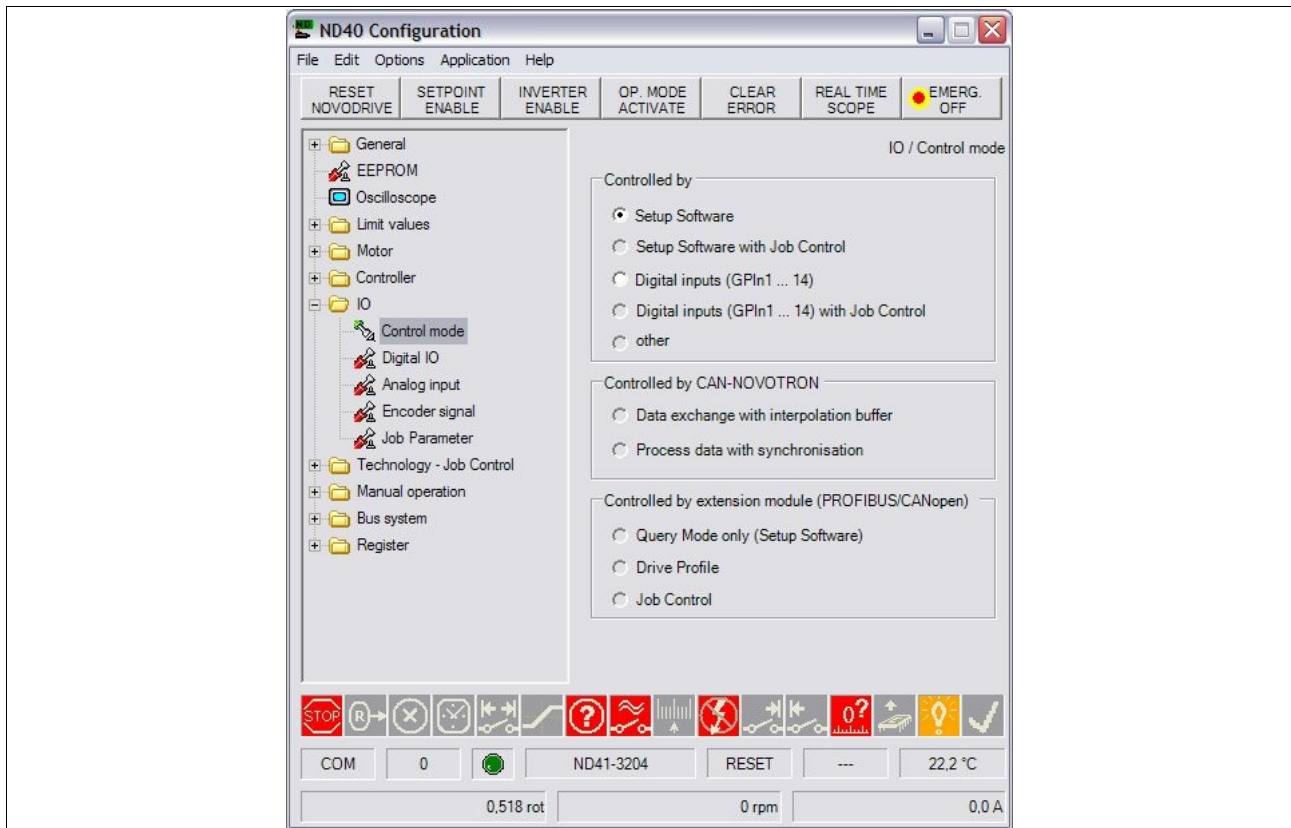
5.6.4 Autotuning model based



Number	Description
1	Tabs for switching between sub-pages
2	Start / Stop auto-tuning
3	Measuring of motor and load time constant
4	Specification of speed control's desired behavior
5	Specification of position control's desired behavior
6	Reset to default values
7	Recommended parameters for speed and position control
8	Accept recommended parameters for speed and position control

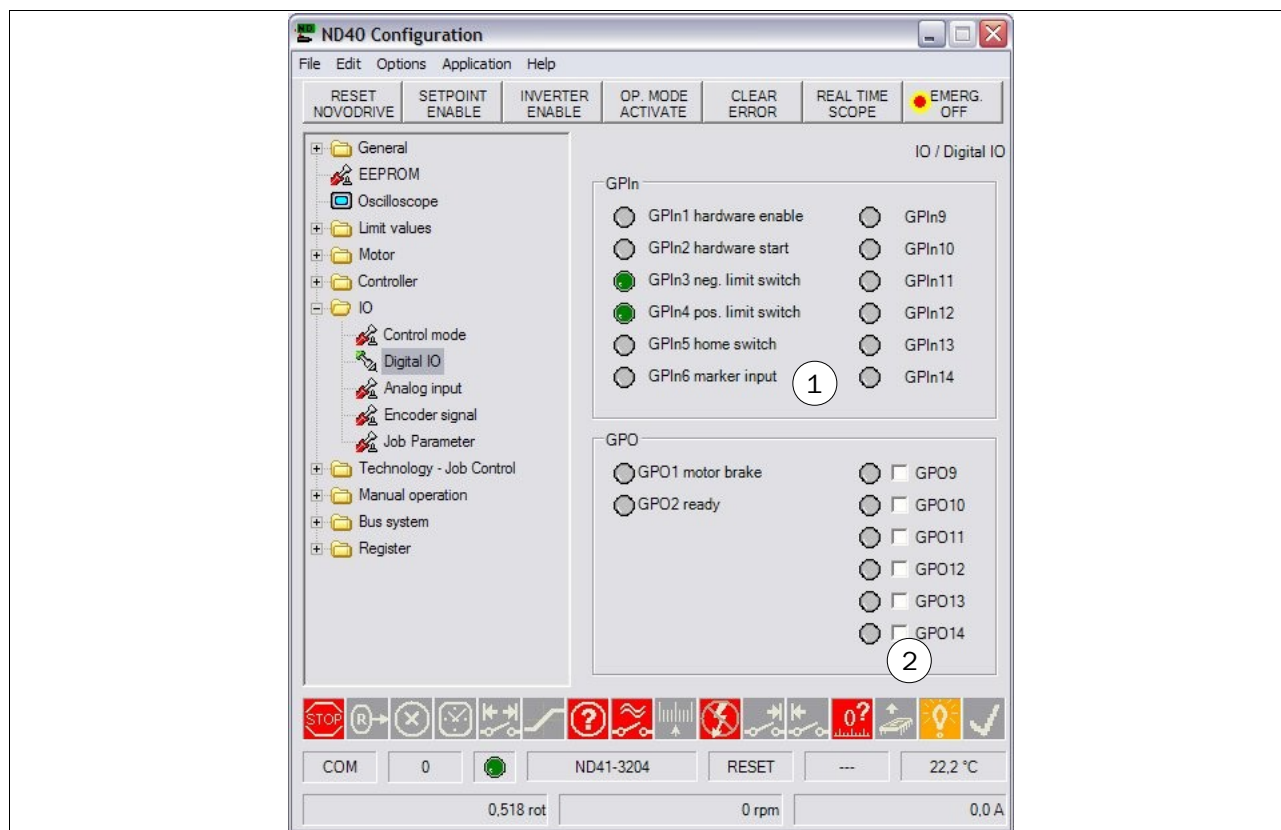
5.7 IO

5.7.1 Control mode



For setting and verifying the control mode.

5.7.2 Digital IO

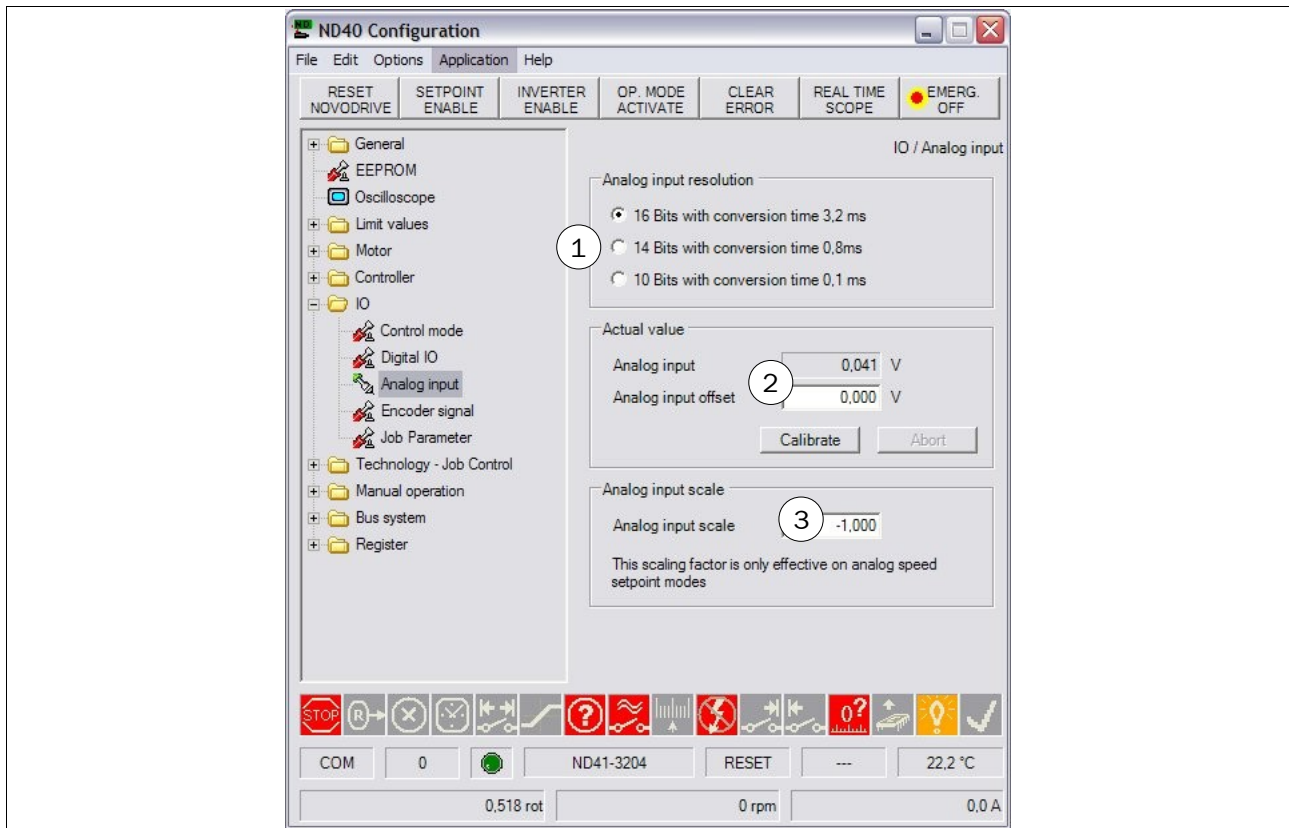


Number	Description
1	Digital inputs of NOVODRIVE
2	Digital outputs of NOVODRIVE; to control the digital outputs over the setup software you must tick the box next to the right of the lamp

Green lamp = Input / Output on 24 V.

Not all inputs / outputs may be available, depending on the type of NOVODRIVE used.

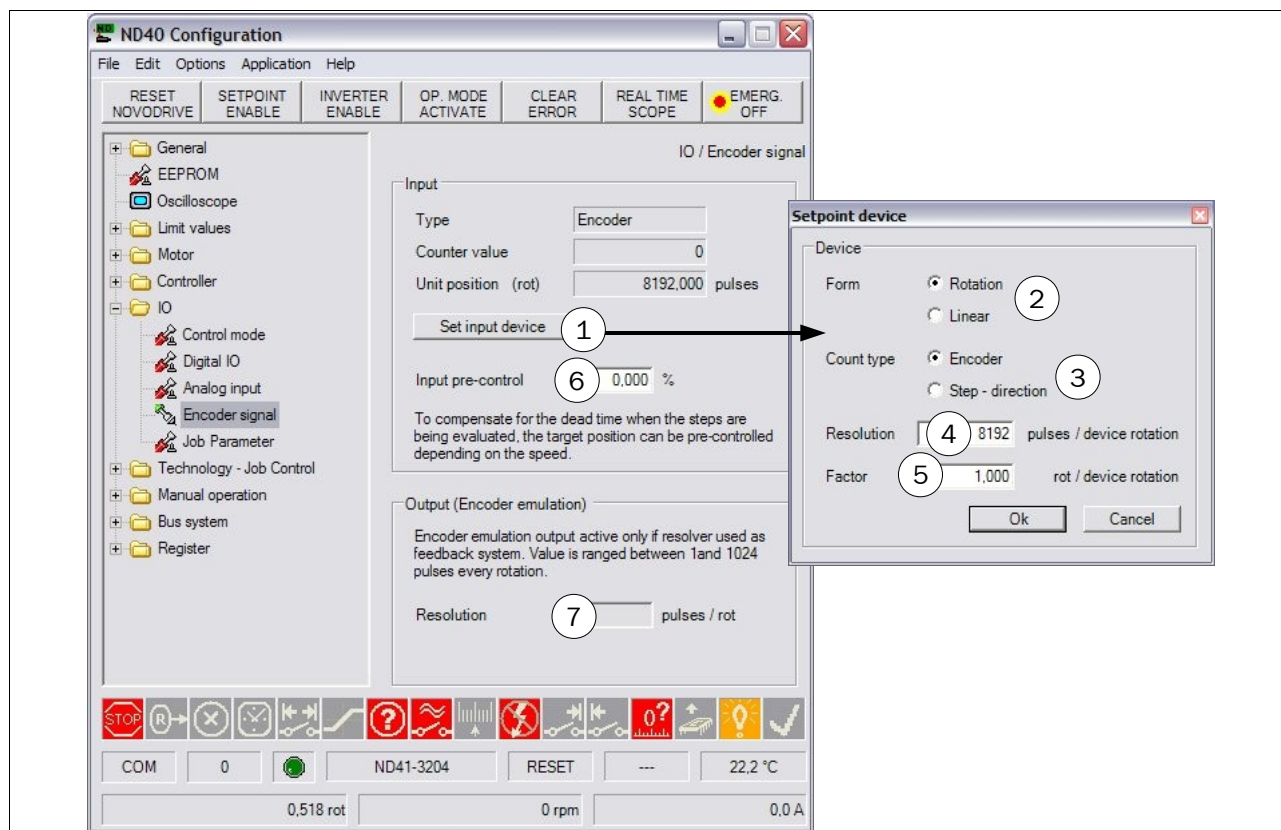
5.7.3 Analog Input



Number	Description
1	Selection of resolution of analog input
2	Information on actual value of analog input voltage; you may set an offset value or adjust it to actual value
3	Scaling of analog input value against speed; the standard value is '-1,00'

For description of the analog input's functionality see User Manual 'Basic Device', Section 'Analog Input'.

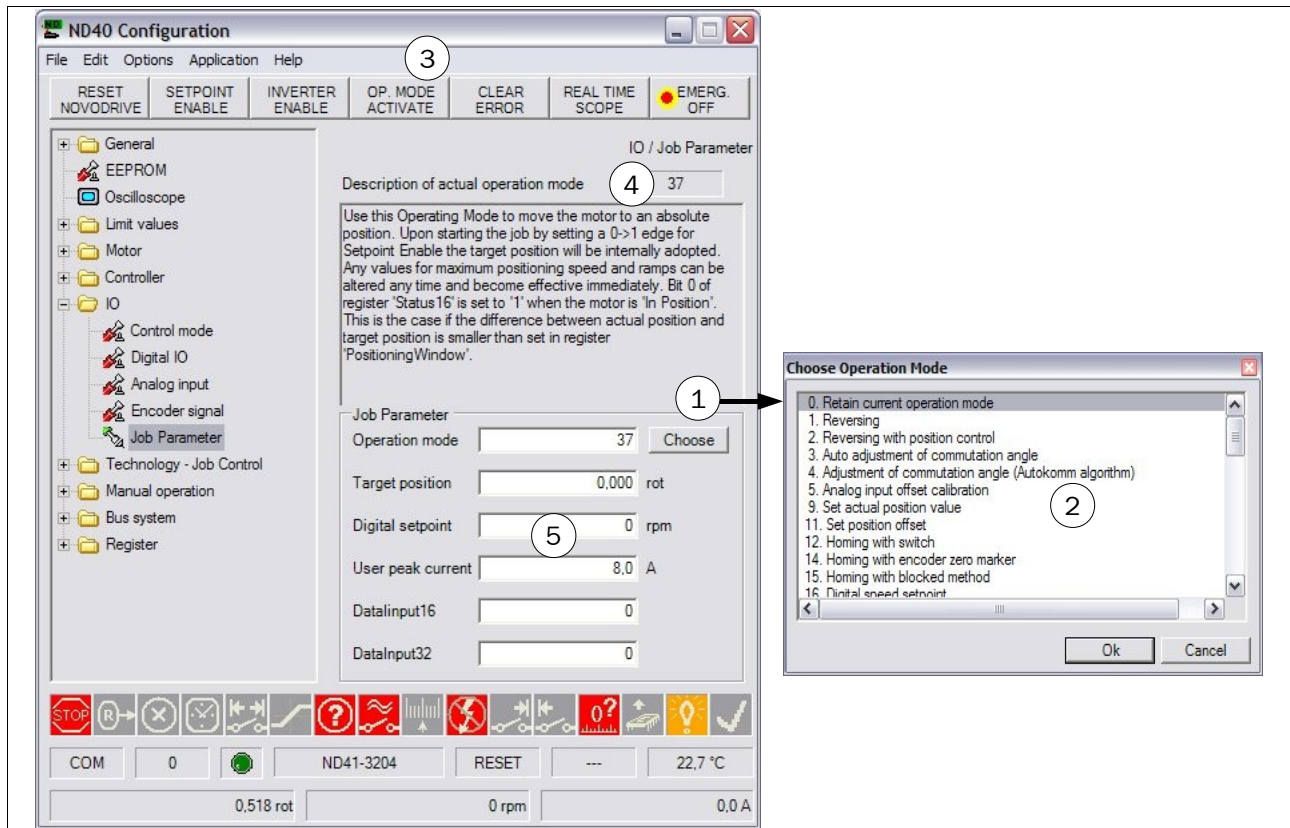
5.7.4 Encoder signal



Number	Description
1	By pressing the button a window for setting the encoder signals opens up
2	Selection between 'rotary' and 'linear'
3	Selection between 'encoder' and 'step/direction'
4	Specification of resolution (pulses per rotation)
5	Scaling (revolutions per rotation)
6	Specification of pre-control of encoder input
7	Specification of resolution for encoder emulation (pulses per rotation); value range: 1.....1024

For description of the encoder input's (counter input's) functionality see User Manual 'Basic Device', Section 'Encoder / Counter Input'.

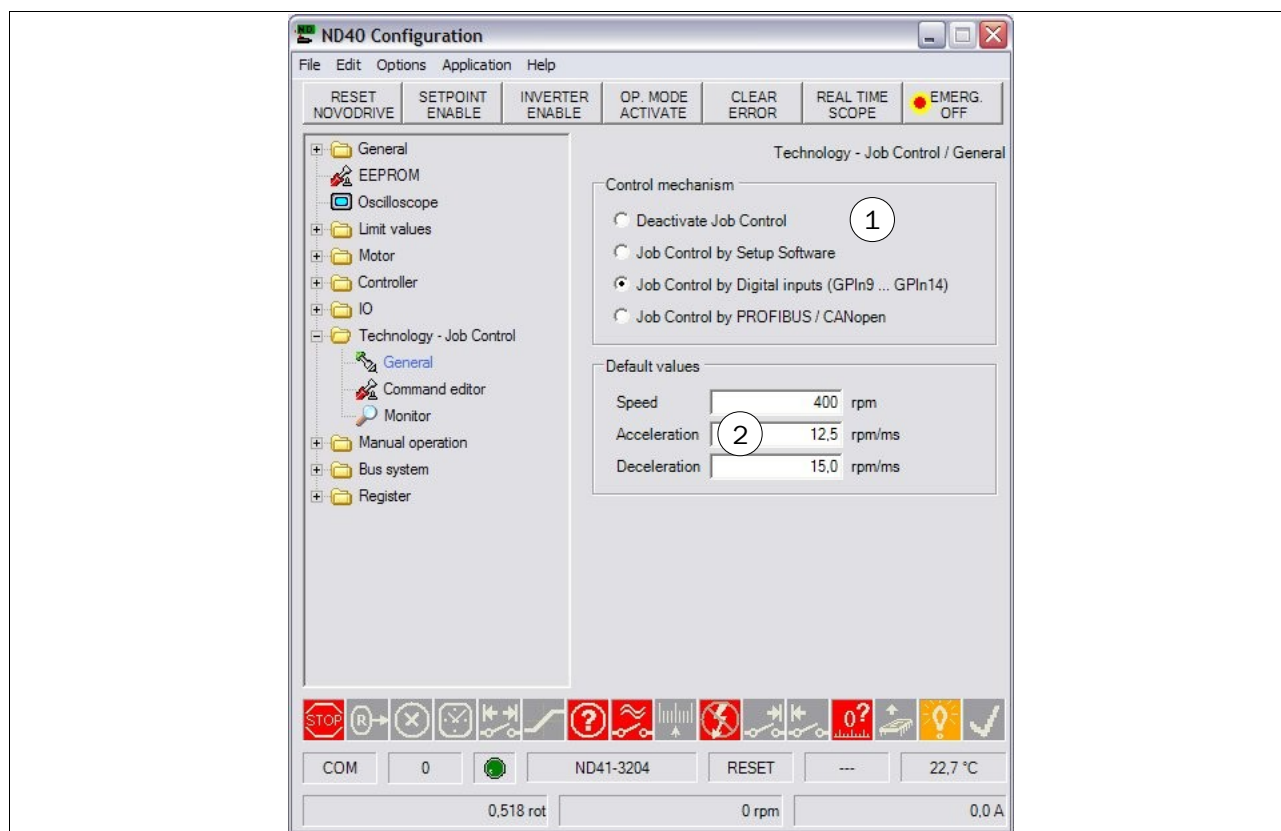
5.7.5 Job Parameter



Number	Description
1	By pressing the button a window for selection of an operating mode opens up
2	Selection of operating mode; to be confirmed with 'Ok'
3	Activation of operating mode
4	ID number of operating mode activated
5	Specification of parameters

5.8 Technology – Job Control

5.8.1 General

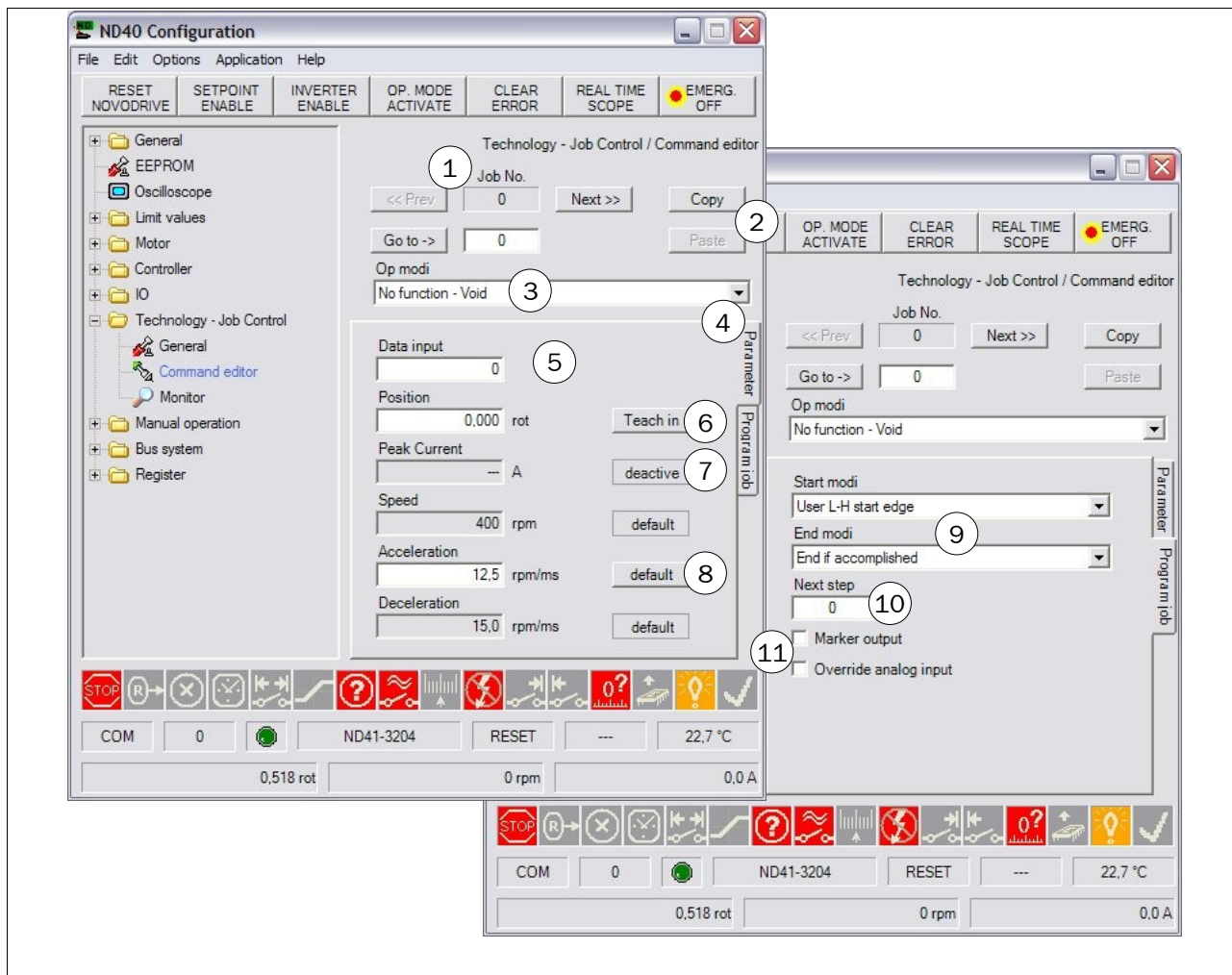


Number	Description
1	Selection of control mode for 'Job Control'
2	Specification of 'Job Control' default values / start values for speed, acceleration and deceleration

Default values can be used for programming 'Job Control' sets.

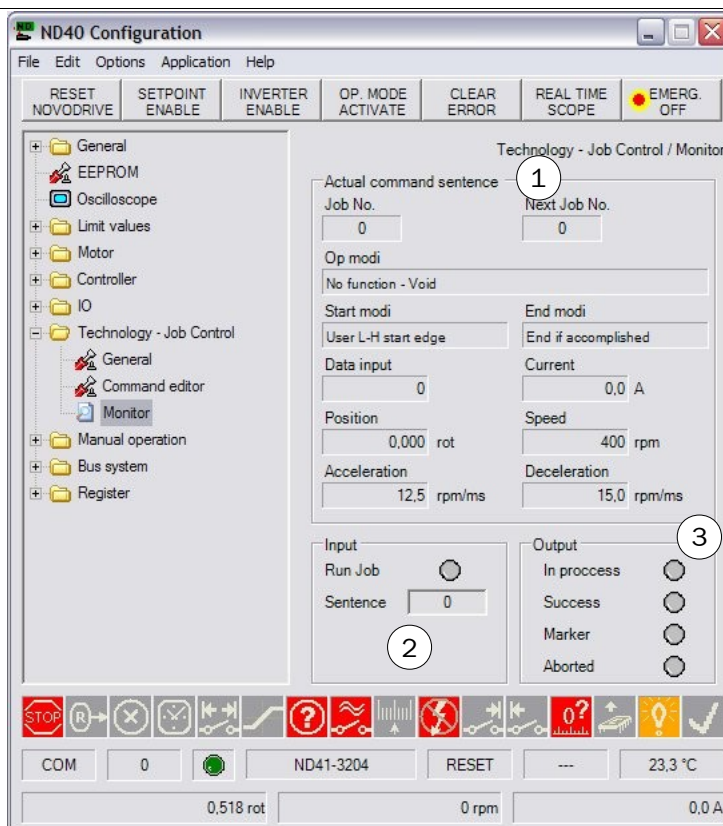
For changes in parameter settings to be permanent, parameter settings must be saved in the EEPROM.

5.8.2 Command editor



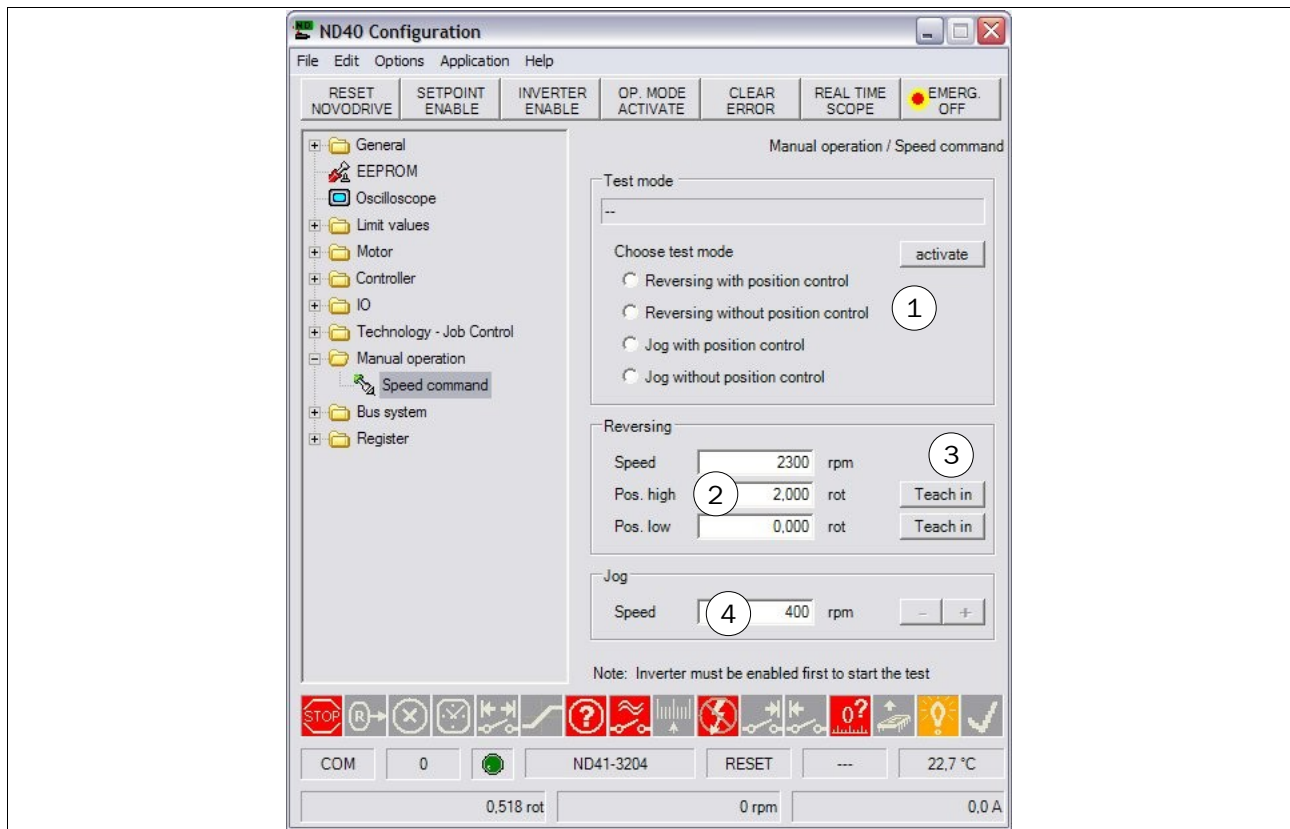
Number	Description
1	Selection of job ID number
2	Copy / Paste jobs
3	Selection of operating mode
4	Tabs for switching between sub-pages ('Parameters' / 'Program job').
5	Specification of operating parameters
6	By pressing this button the motor's actual position value is adopted for the job
7	Activation / Deactivation of current limitation
8	Default values for speed and ramps, respectively (if these values are used, they are grayed out)
9	Specification of start condition and end condition of job
10	Specification of follow-up job (!= '0') or end of job sequence (= '0')
11	Additional options: set marker and override of speed by analog input

5.8.3 Monitor



Number	Description
1	Information on job in progress and its parameters
2	Manual operation of 'Job Control' (only when selected over setup software)
3	Outputs of 'JobControl'

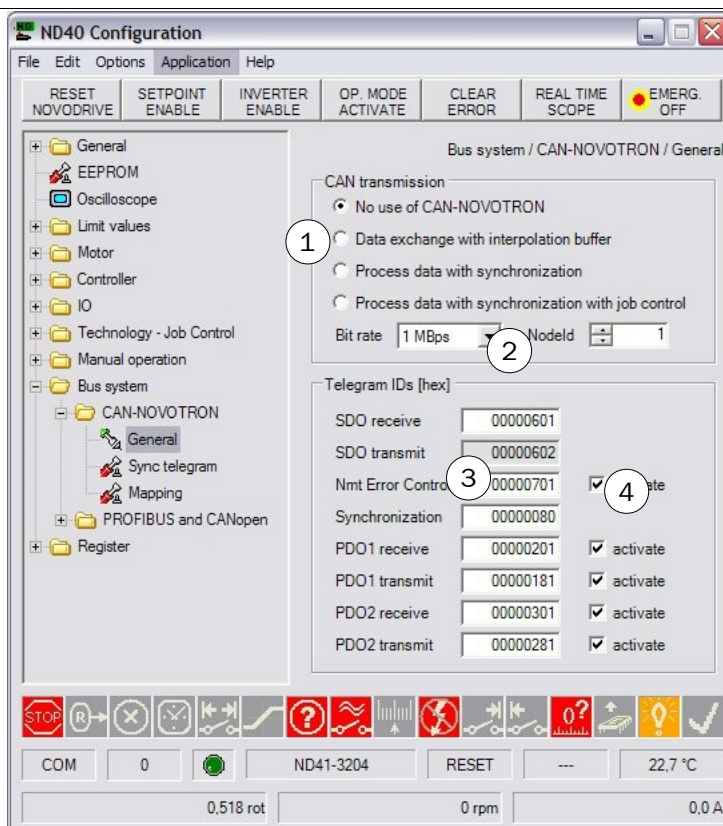
5.9 Manual Operation



Number	Description
1	Selection and activation of operating mode
2	Specification of parameters for reversing
3	By pressing the keys the actual position of the motor is adopted for reversing
4	Specification of parameter for speed setpoint setting

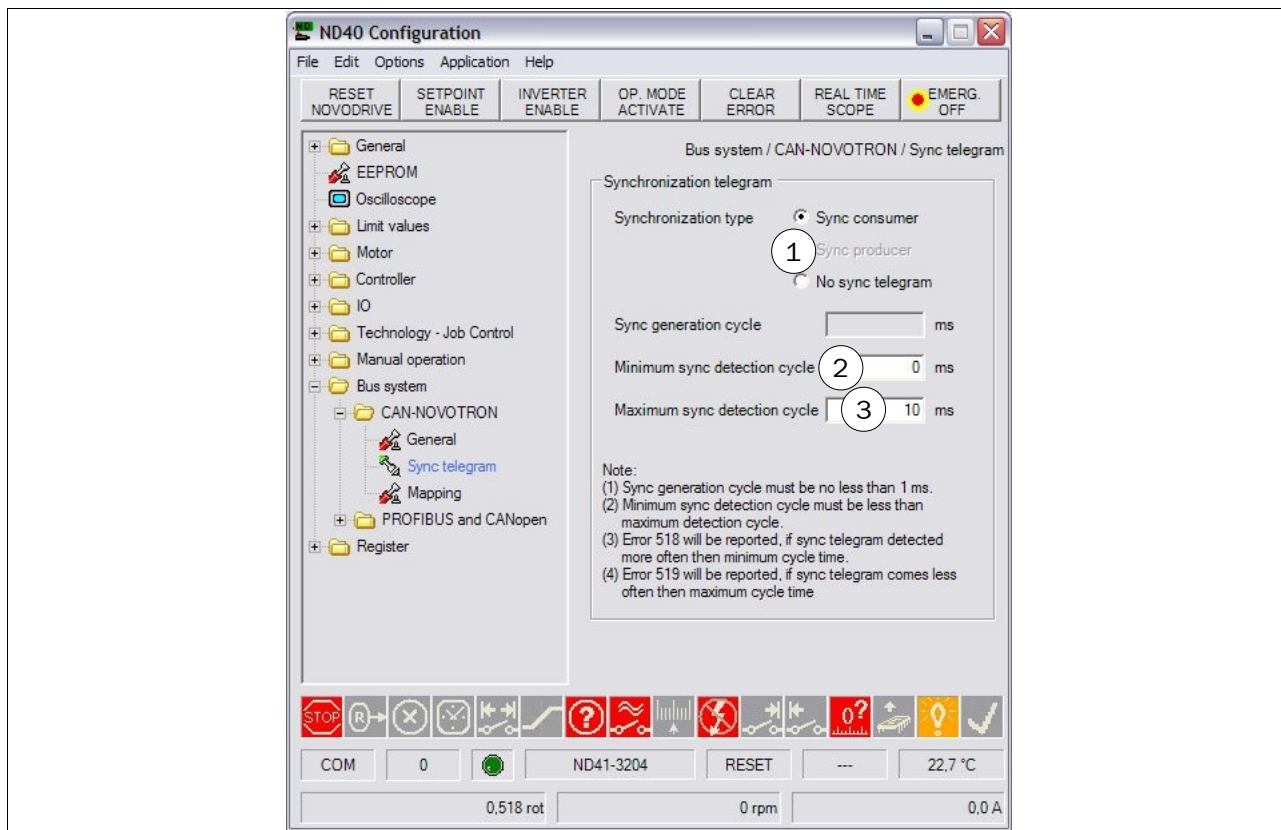
5.10 Bus system

5.10.1 CAN-NOVOTRON / General



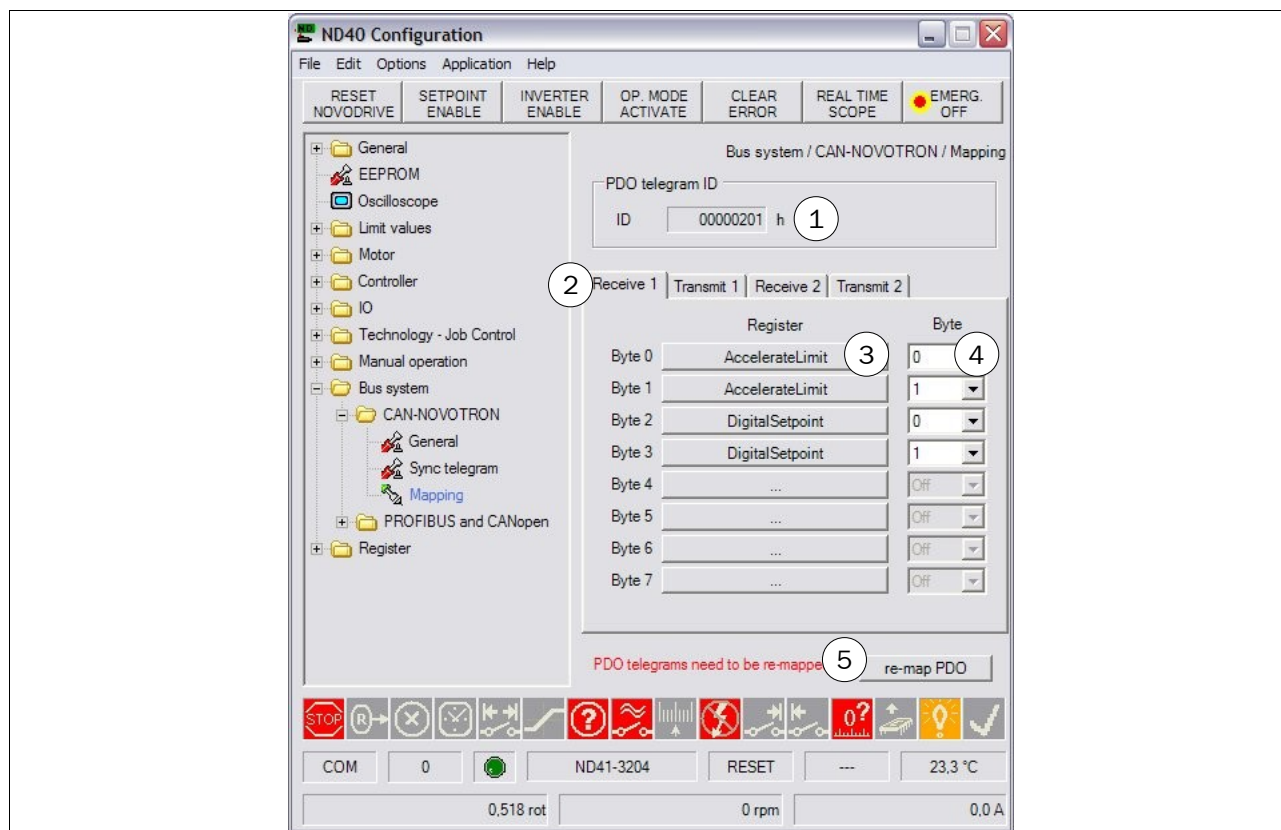
Number	Description
1	Selection of process data protocol
2	Selection of bit rate and Node ID of CAN-NOVOTRON
3	Specification of addresses for various channels
4	Activation / Deactivation of channels

5.10.2 CAN-NOVOTRON / Sync telegram



Number	Description
1	Selection of synchronization type
2	Specification of minimum time between two sync telegrams; if value is undershoot, Error 518 is generated
3	Specification of maximum time between two sync telegrams; if value is exceeded, Error 519 is generated; value serves for making sure there is a connection to the control unit; if no sync telegrams occur, the motor gets stopped

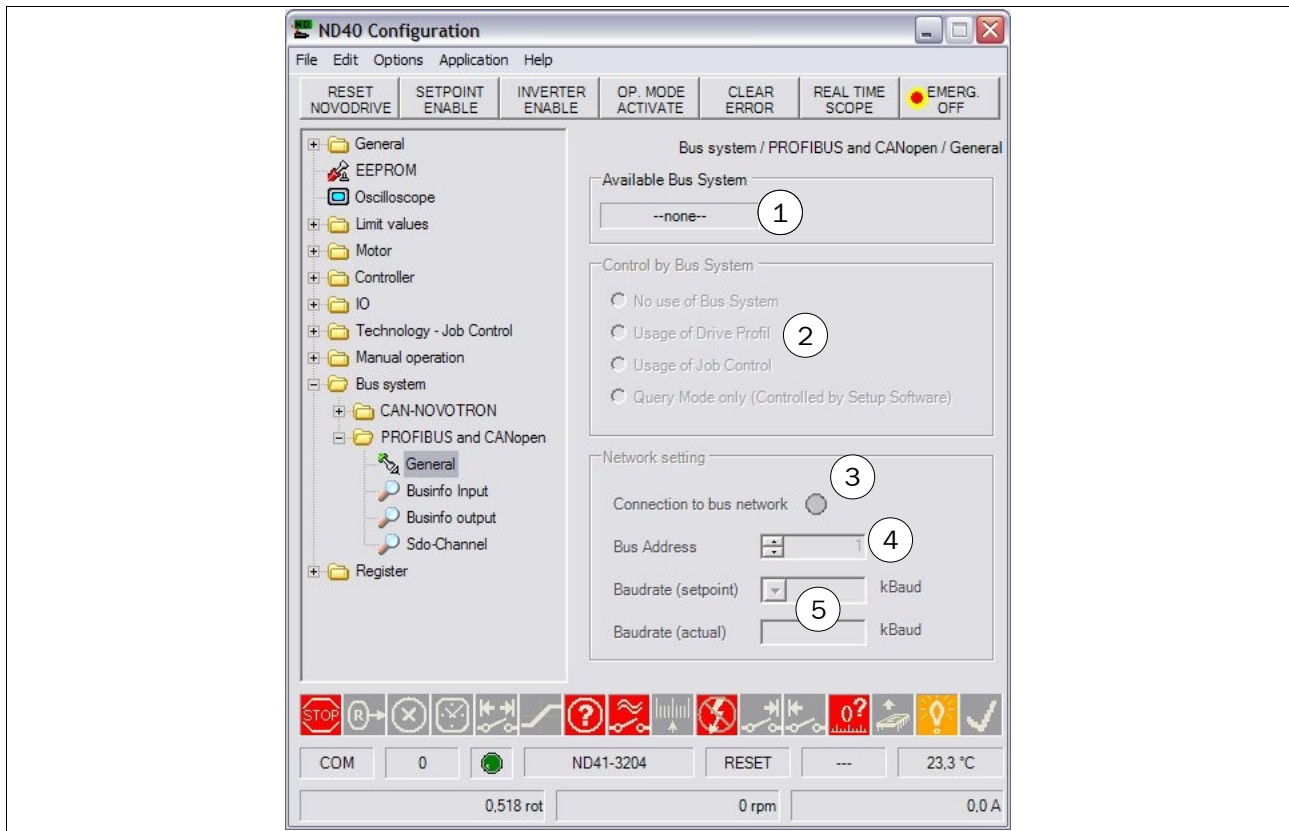
5.10.3 CAN-NOVOTRON / Mapping



Number	Description
1	Address of PDO channel selected below
2	Tabs for switching between sub-pages (PDO channels)
3	Selection of data to be mapped in the PDO
4	Byte selection (for 16-bit or 32-bit registers)
5	Accept mapping parameters

For changes in parameter settings to be permanent, parameter settings must be saved in the EEPROM.

5.10.4 PROFIBUS and CANopen / General

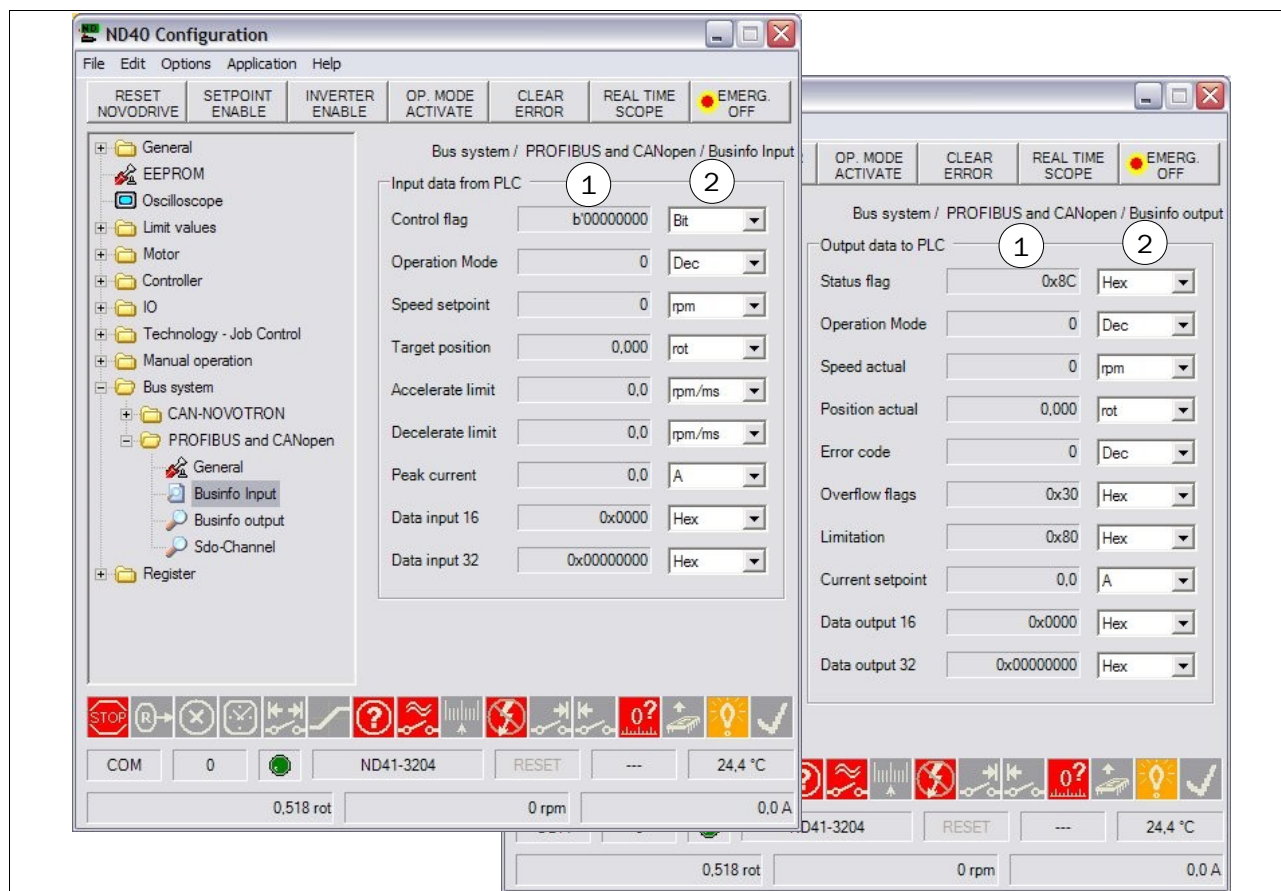


For setting and verifying the bus system's parameters.

Number	Description
1	Bus system available
2	Selection of control mode
3	Information on bus connection (for PROFIBUS only); green = connection ok, red = no connection
4	Specification of bus address
5	Setpoint setting of baud rate (for CANopen only) and information on actual baud rate

For changes in parameter settings to be permanent, parameter settings must be saved in the EEPROM. If the bus address is changed, NOVODRIVE must be reset.

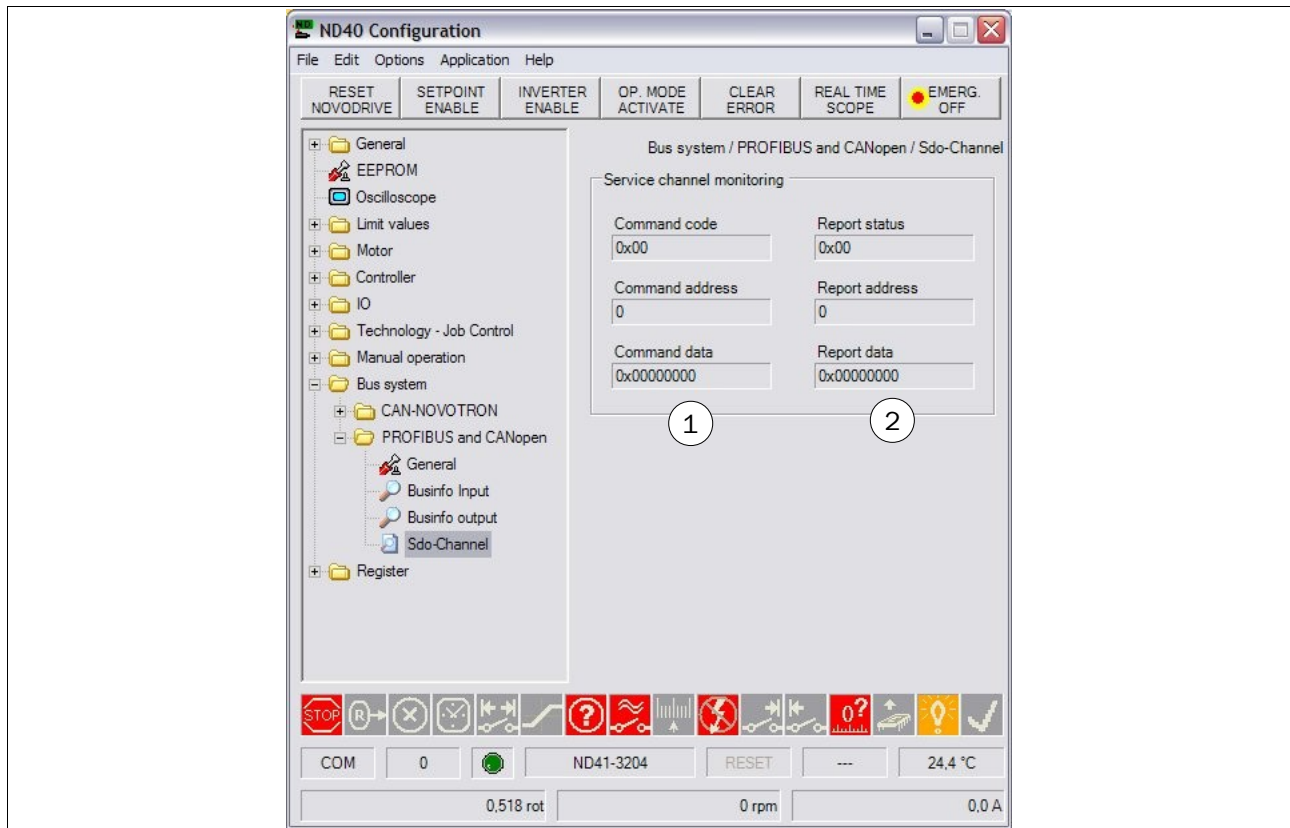
5.10.5 PROFIBUS and CANopen / „Businfo input“ and „Businfo output“



Information on the bus module's process data transfer. Values can be hexadecimal or SI scaled.

Number	Description
1	Value of register
2	Format of register
3	Value of register
4	Format of register

5.10.6 PROFIBUS and CANopen / Sdo-Channel



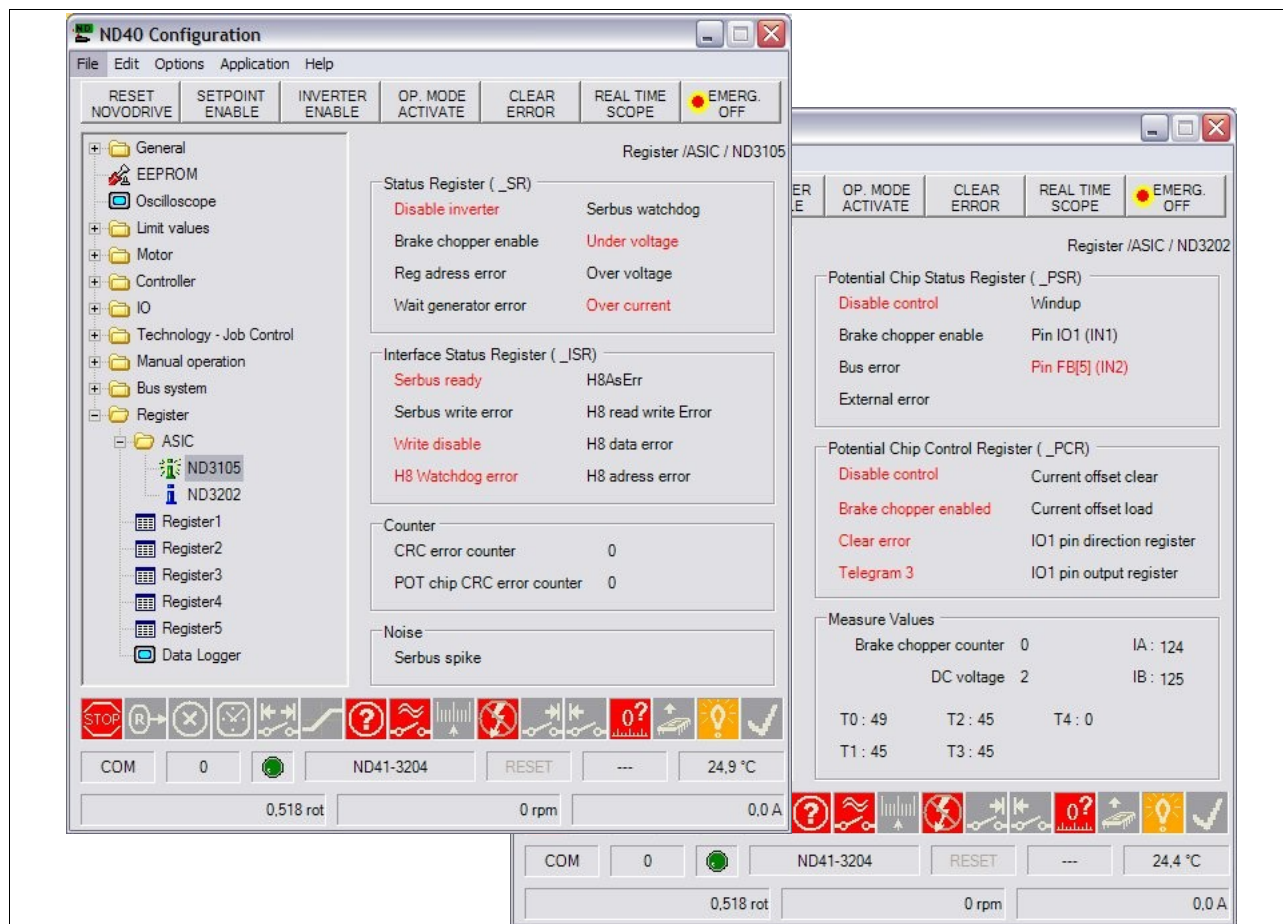
Information on the bus module's service data transfer.

Number	Description
1	Address, data and command code
2	Response from address and data

5.11 Register

5.11.1 'ASIC / 3105' and 'ASIC / 3202'

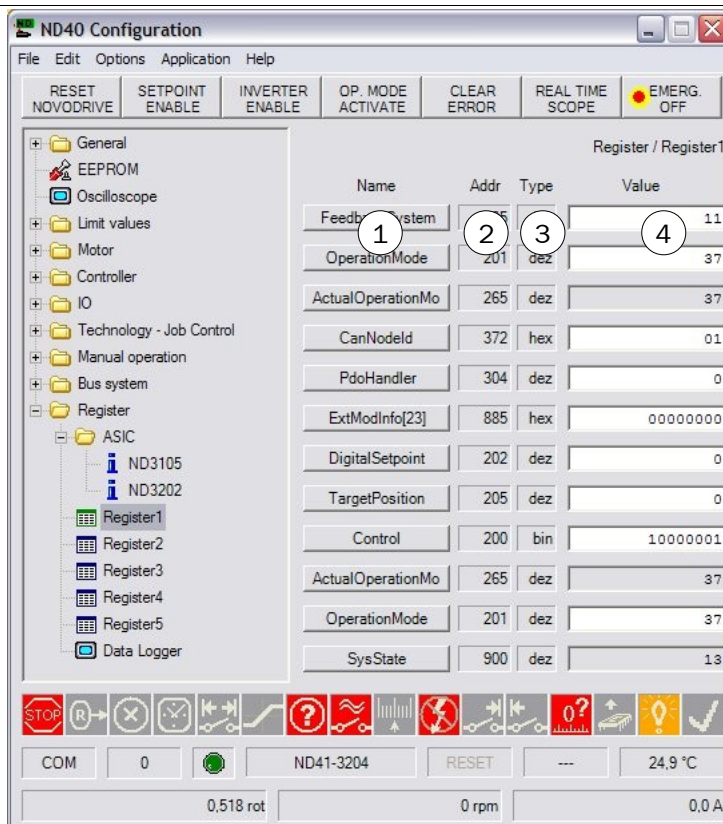
Only available in the 'Advanced Mode'.



Pages offer information on errors that have occurred.

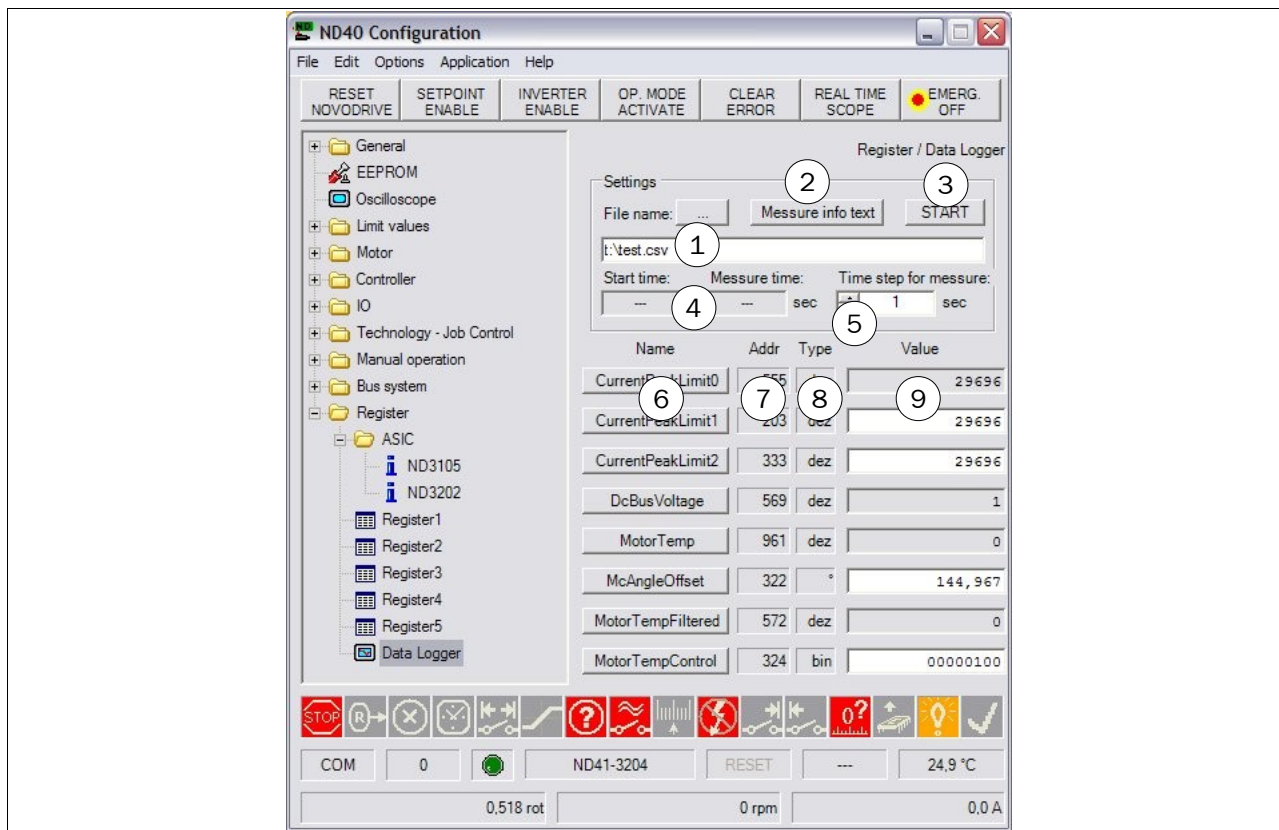
5.11.2 'Register1' ... 'Register5'

Only available in the 'Advanced Mode'.



Number	Description
1	Upon pressing each one of the twelve buttons a window opens up for selection of a register from the registers' list
2	Address of selected register
3	Format the value of the register is given in
4	Value of selected register

5.11.3 'Data Logger'



Page can be used to periodically save measured data. Besides the set of eight registers which can be freely selected, the page allows to record actual values of position, speed, current, and heat-sink temperature (these four registers are SI scaled).

Number	Description
1	Entry field for writing in the file name and the path and folder in which the file is to be saved; click on '...' for selection of an existing file
2	Upon pressing the button a text field opens up into which a comment or remark on the measuring can be written
3	Start / Stop measuring process
4	Information on start time and duration of the measuring process
5	Specification of length of measuring steps (1 sec ... 3600 sec)
6	Upon pressing each one of the eight buttons a window opens up for selection of a register from the registers' list
7	Address of selected register
8	Format the value of the register is given in
9	Value of selected register

This page must not be left during the measuring process, as this could lead to recording of invalid data.

6 Motor Parameter Settings

The following sections refer only to motor parameter settings. Depending on the application, other settings need to be made in addition. However, these settings are not part of the initial startup described in this document.

If you already have a parameter set for your motor, you can skip Steps 1 to 6 and directly load this parameter set.

6.1 Connection of motor

The motor must be connected as specified in User Manual 'Basic Device'.

For initial startup of the motor, the motor shaft must be flanged off and freely movable.

Startup after electric installation comprises

- basic settings for motor and feedback system,
- setting of current control,
- setting of speed control,
- setting of position control.

6.2 Capture of motor and application parameters

The following tables are supposed to help in capturing both the necessary characteristics for the setting of the controllers and the application's requirements on the motor, in order to ensure quick and smooth configuration of NOVODRIVE.

Motor specific values

Data for	Remarks	Value(s)
Feedback system (resolver, ERN1387, Encoder, EnDat2.2 etc.)	Specify the feedback system used plus, if need be, the resolution it should have	
Maximum speed	Specify maximum speed of motor and application (needed for resolution of speed)	
Number of pole pairs (rotary motor) or pole distance (linear motor), respectively		
Temperature sensor	Specify type and resistance value for maximum temperature	
Peak current	Make sure peak current does not exceed NOVODRIVE's maximum peak current capacity	
Rated current	Make sure rated current does not exceed NOVODRIVE's maximum rated current capacity	
I ² t time constant	Make sure the motor winding is not damaged	

Application specific values

Data for	Remarks	Value(s)
- speed - position - ramps - current	Specify scaling factors of setup software; see User Manual 'Basic Device', Section 'SI Scaling'	
- acceleration ramp - deceleration ramp	Value determined by application (dependent on load) or to be specified by user; value must not be higher than the value of the stop ramp, which is determined by the motor load	
Peak current		
Speed monitoring		
Position monitoring		
DistanceBoundary		

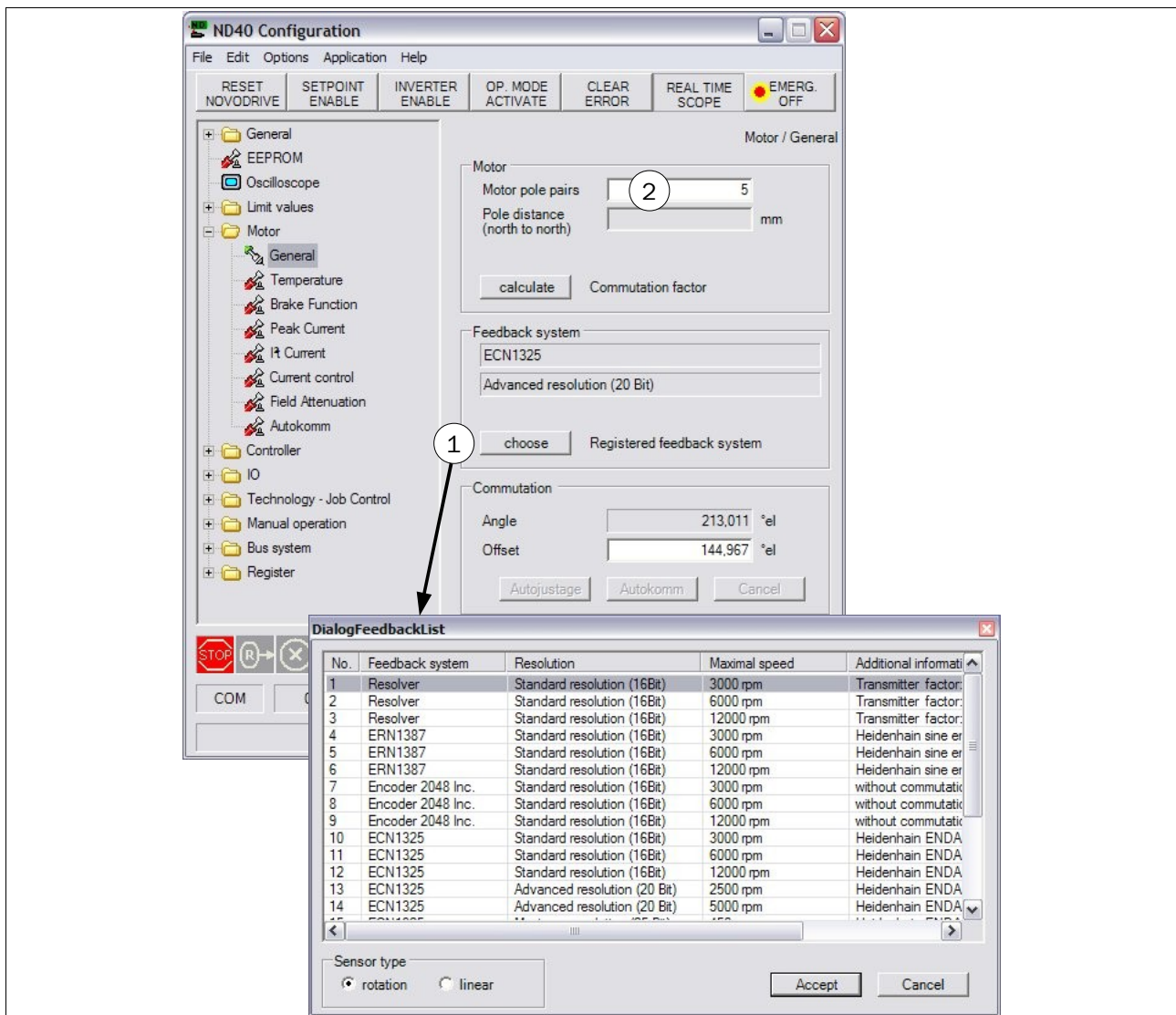
6.3 Step 1 – Specify feedback system used

Information required:

- feedback system used and maximum speed which used in the application (1),
- number of pole pairs or pole distance, respectively (2).

Proceed as follows:

- go to the '**Motor/General**' page; press '**Choose**' button and select feedback system from the list (1); take into account the application's maximum speed
- go to the '**EEPROM**' page; press 'SAVE'; then press 'Reset NOVODRIVE' in the button bar
- go back to the '**Motor/General**' page; enter the number of pole pairs (rotary motor) or the pole distance (linear motor) (2)



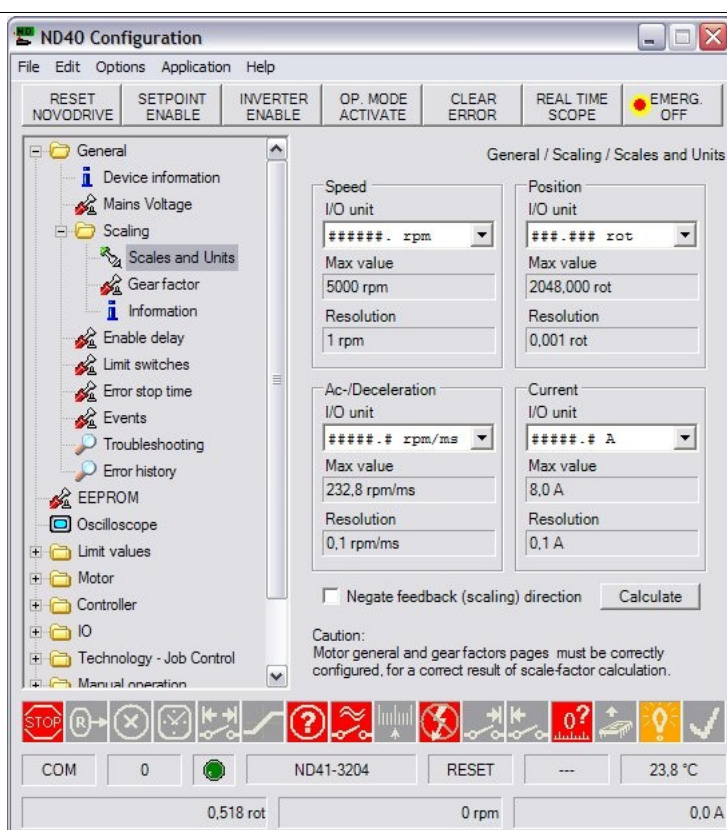
6.4 Step 2 – Determine scaling

Information required:

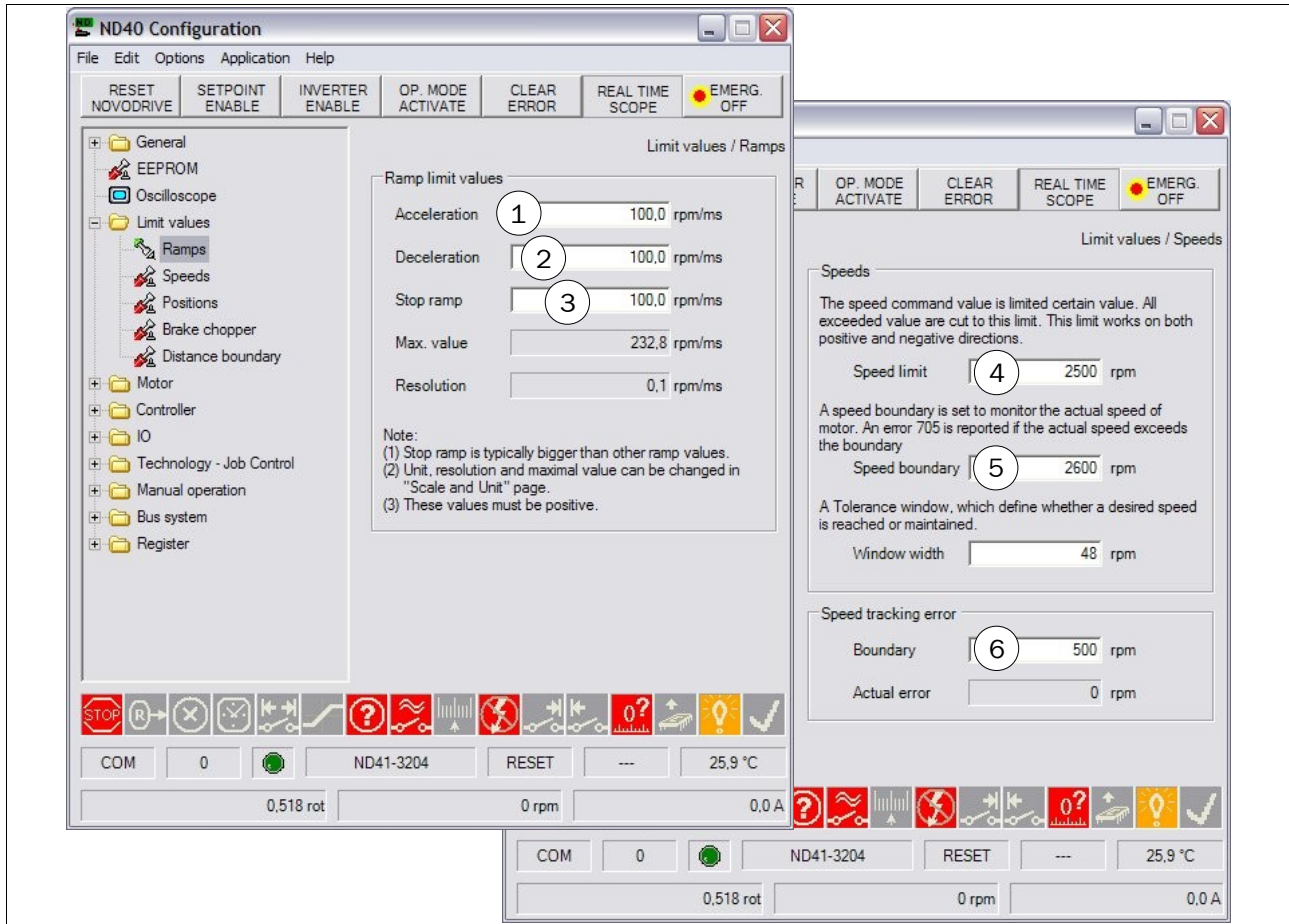
- scales and units of values used by the setup software and the extension modules

Proceed as follows:

- go to the '**General/Scaling/Scales and Units**' page; select the scales and units desired
- if need be, a gear or spindle can be taken into account; to do so, go to the '**General/Scaling/Gear factor**' page
- internal scaling factors need to be recalculated upon any changes made; to do so, press '**Calculate**'



6.5 Step 3 – Specify limit values for ramps and speed



Most operating modes use ramp generators for acceleration and deceleration.

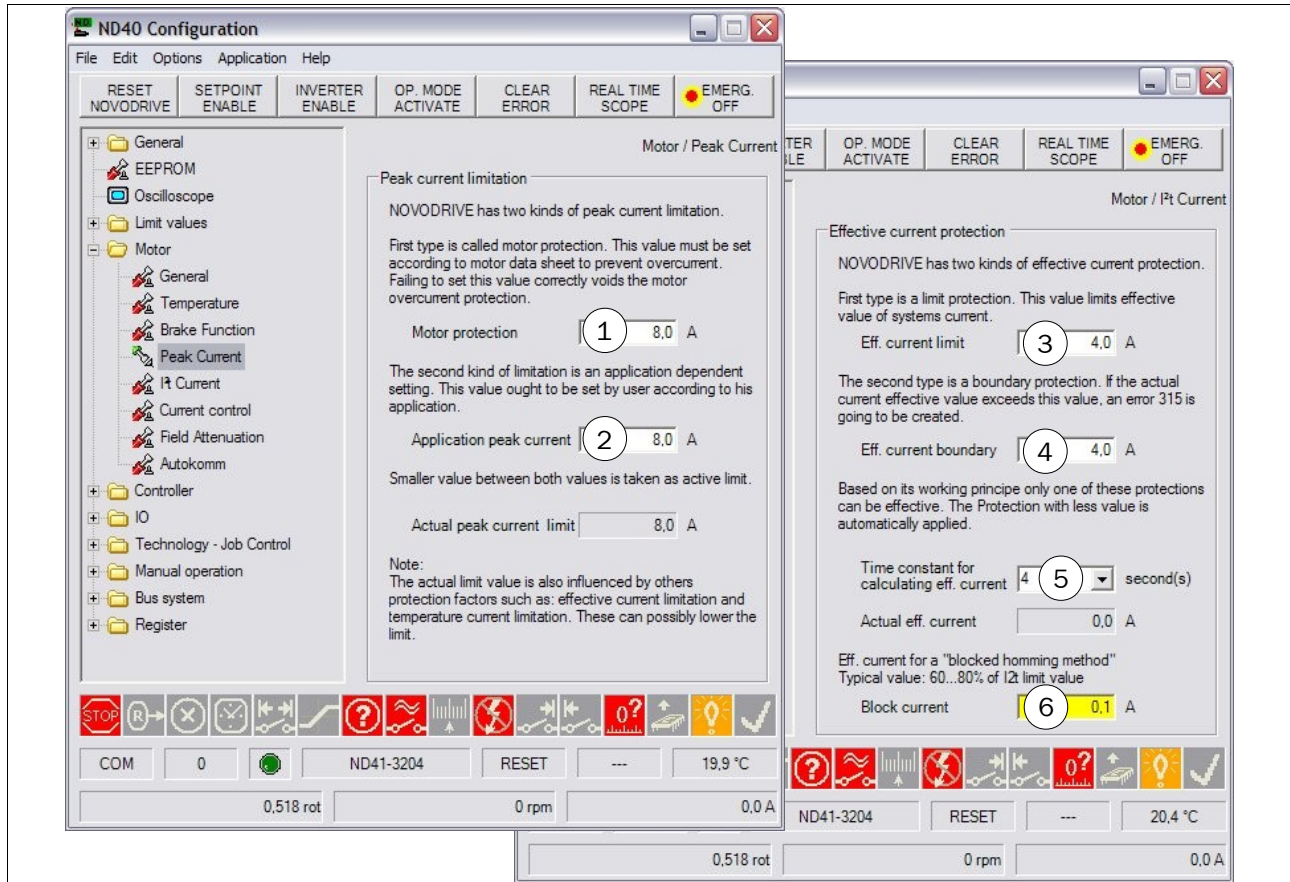
Proceed as follows:

- go to the '**Limit values/Ramps**' page; enter values for the acceleration ramp in (1) and for the deceleration ramp in (2) (usually the same values is used for both ramps)
- physical limitations are given by the motor's peak torque and the mass moved; if the motor can't follow the ramp generator, a tracking error is generated

go to the '**Limit values/Speeds**' page; enter the speed limit value in (4) (determined by the motor's maximum speed), the speed boundary in (5) (10 % higher than the motor's maximum speed), and the maximum speed tolerance limit (6) (speed tracking error boundary)

For determination of the parameters for current control the motor is run without any load. Therefore choose rather high values for ramps and speed when setting the current controller.

6.6 Step 4 – Specify limit values for current



Proceed as follows:

- go to the '**Motor/Peak Current**' page; specify peak current of motor in (1) and (2)
- go to the '**Motor/I²t Current**' page; enter the smaller value from the motor's rated current and NOVODRIVE's rated current in (3) and (4) (usually the value in (4) should be a little higher than the value in (3) in order to avoid generation of an error); enter the value for the thermal time constant (I²t time constant) of the motor in (5)

To ensure long service life of NOVODRIVE, the value for r.m.s. current (eff. current limit) should never be set higher than the value for NOVODRIVE's rated current.

- go to the '**EEPROM**' page; press 'SAVE'; then press 'Reset NOVODRIVE' in the button bar

6.7 Step 5 – Execute Autojustage

Preconditions required

- Motor must be flanged off and freely movable.
- Line voltage must be supplied.
- Hardware inputs (GPIIn1 and GPIIn2) for inverter enable and setpoint enable must be active.
Control of the motor is done by the setup software.

Proceed as follows

- go to the '**Motor/General**' page; press 'Autojustage'

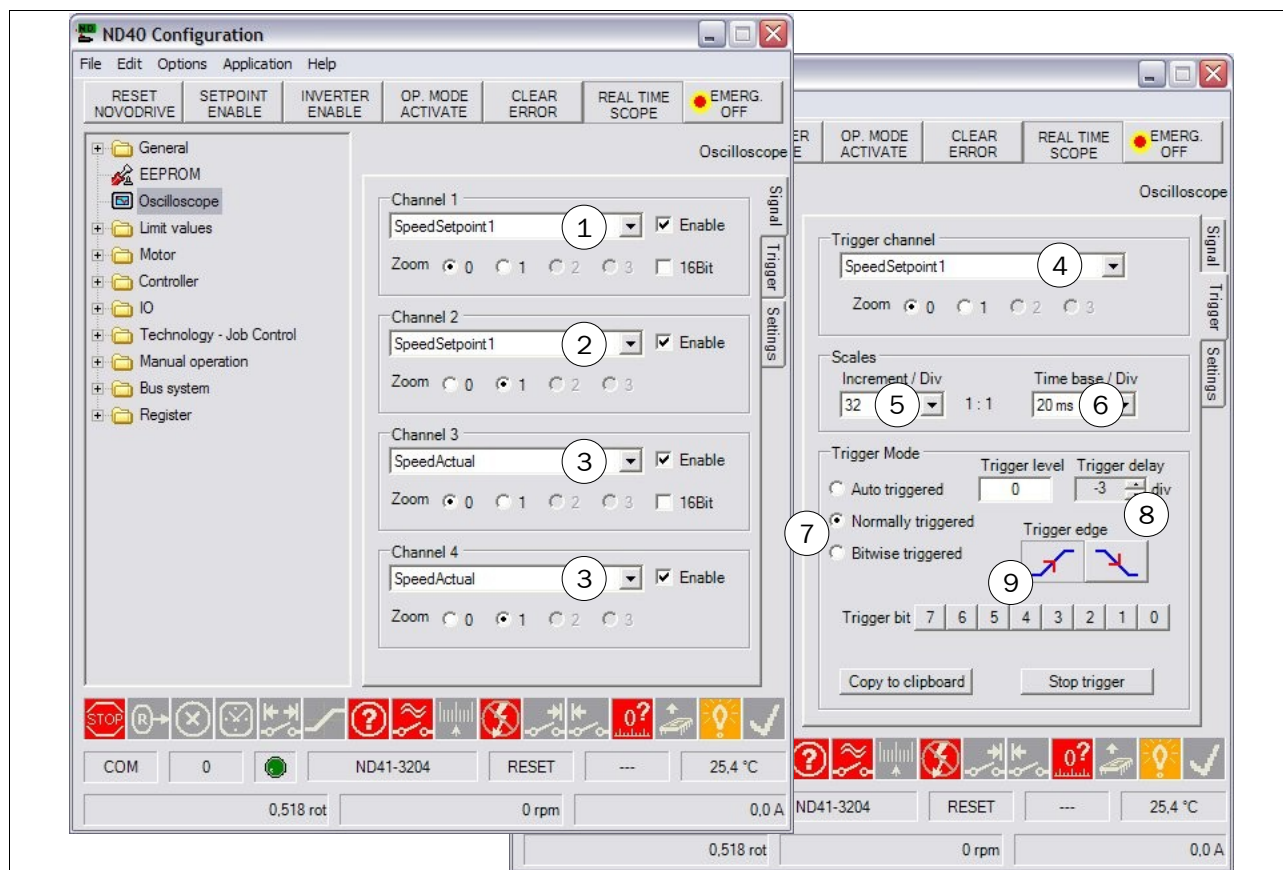
Caution! The motor may now move jerkily!

- wait until Autojustage is complete (indicated by green check mark)
- go to the '**EEPROM**' page; press 'SAVE'

6.8 Step 6 – Determine parameters for current control

6.8.1 Settings

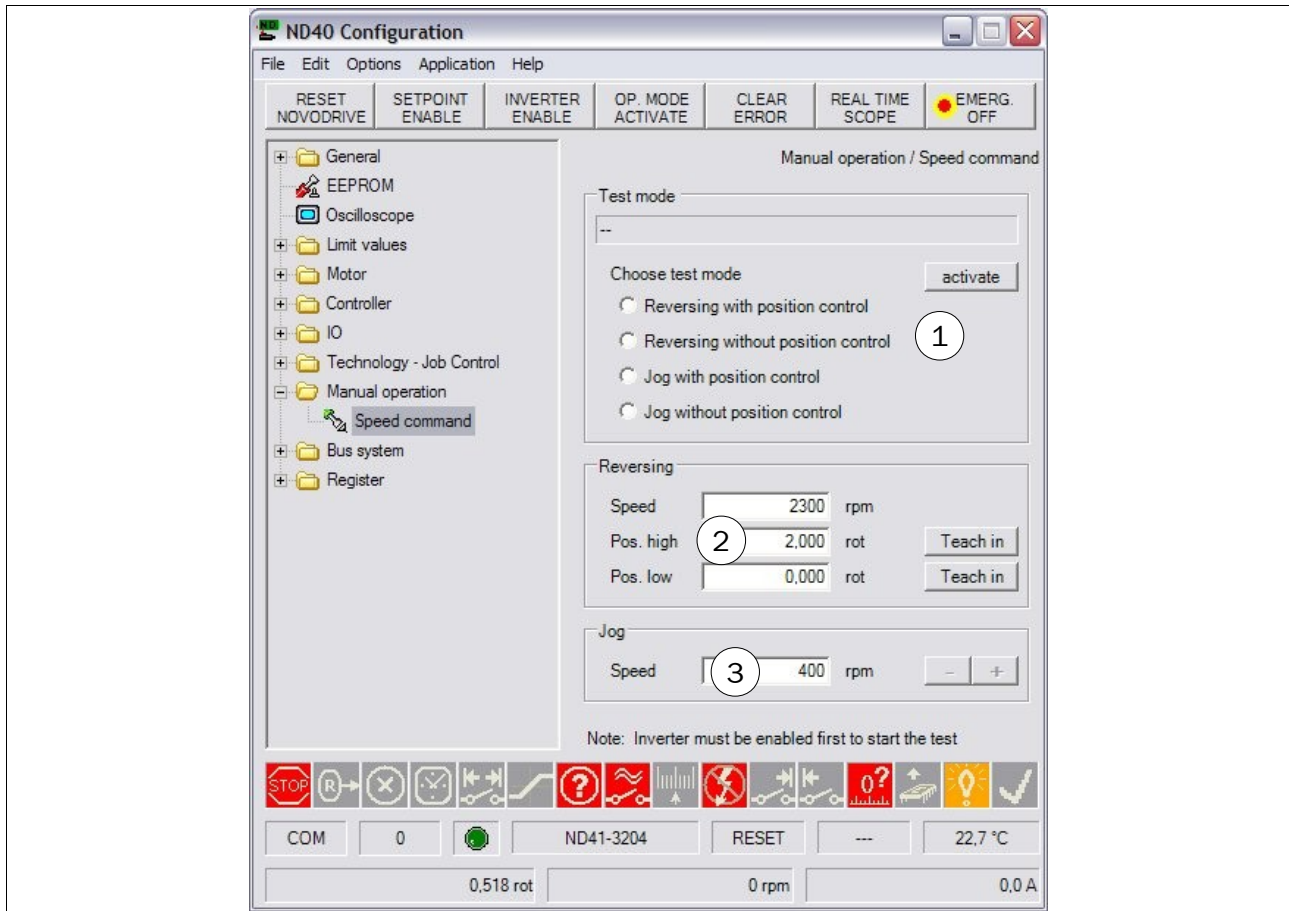
- go to the '**Oscilloscope**' page



Enter data for oscilloscope:

Under 'Signal' tab		Under 'Trigger' tab	
Channel 1	(1) PhaseCurrSetpointA1; Enable	Trigger channel	(4) SpeedSetpoint1
Channel 2	(2) PhaseCurrActualA1; Enable	Scales	(5) 16 ... 64 (depends on motor)
Channel 3	(3) Disable	Timebase	(6) 4 ... 100 ms; (one or two sinus periods should be seen)
Channel 4		Trigger Mode	(7) Normally Triggered
		Trigger delay	(8) 0
		Trigger edge	(9) rising edge

- go to the '**Manual operation/Speed command**' page



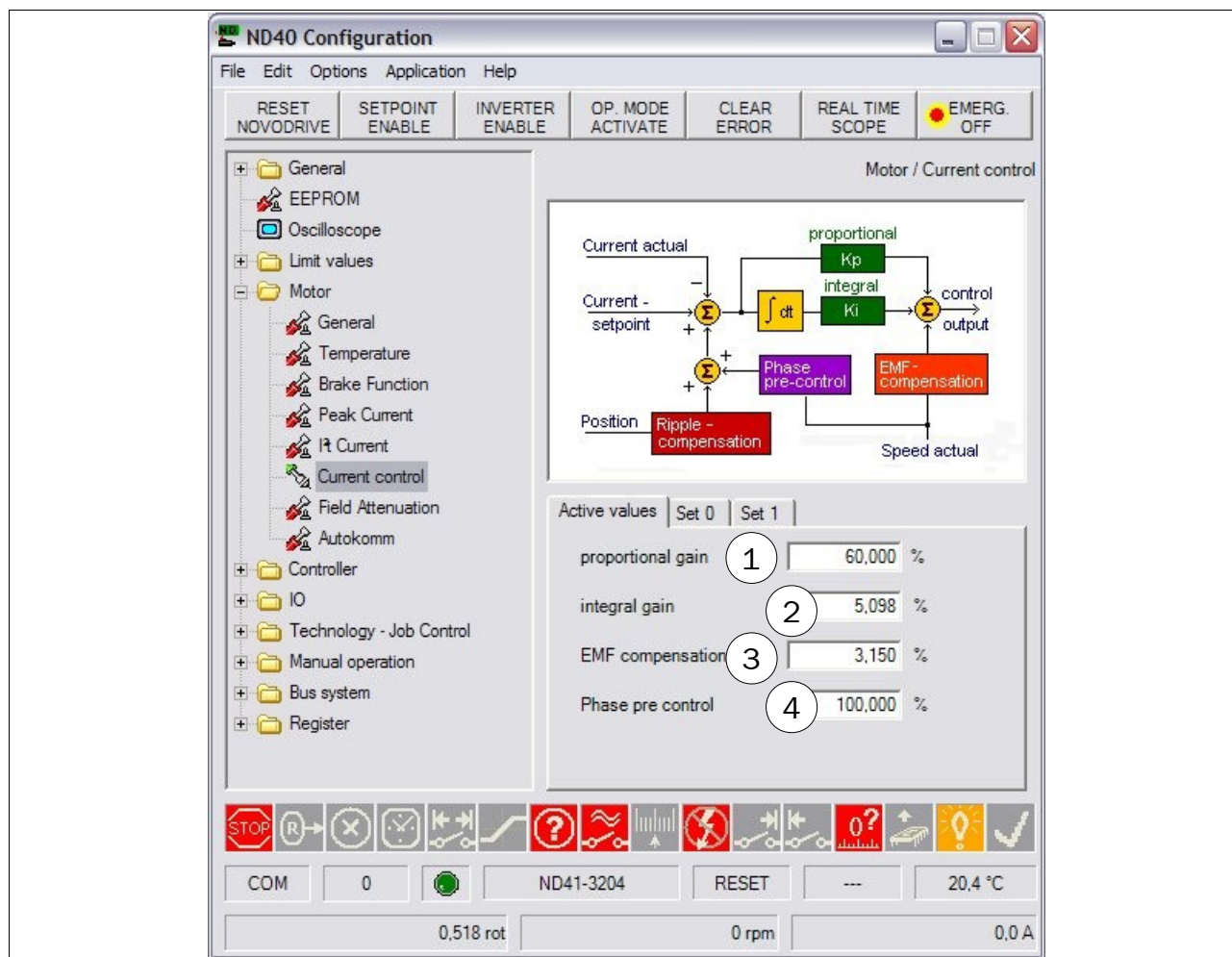
When the motor runs without any load, only very little current flows, making it impossible to assess the current controller's behavior. Because of that the motor is reversed, as the changing of the motor's direction involves a large amount of current.

The values for the ramps and for speed should be large enough to achieve at least half of peak current. Reversing points should be just as far away from each other that it takes 5 to 10 s for the motor to move from one point to the other.

Example (dependent on motor):

Test mode	(1) Select 'Reversing without position control' and press 'activate'
Reversing Speed	(2) 3000 rpm (set motor's maximum speed here)
Pos. high	(2) 10,0 rotations
Pos. low	(2) 0,0 rotations
Jog speed	(3) 3000 rpm

- go to the '**Motor/Current control**' page



Parameters	Default / Start values
Proportional gain	(1) Choose value according to motor inductance: motor inductance < 1 mH = 1 % motor inductance 1...10 mH = 10 % motor inductance > 20 mH = 100 %
Integral gain	(2) 0%
EMF compensation	(3) 0%
Phase pre-control	(4) 400 % when resolver is used as feedback system; for other feedback systems: 100 %

6.8.2 Proceed as follows

- activate 'Inverter enable' and 'Setpoint enable' in the button bar
- view oscillogram

(1) Set P-gain

P-gain should be set just high enough that no oscillation (high frequencies) occur (also during reversing) and that the amplitudes of actual current and current setpoint are matched (phases must not be identical).

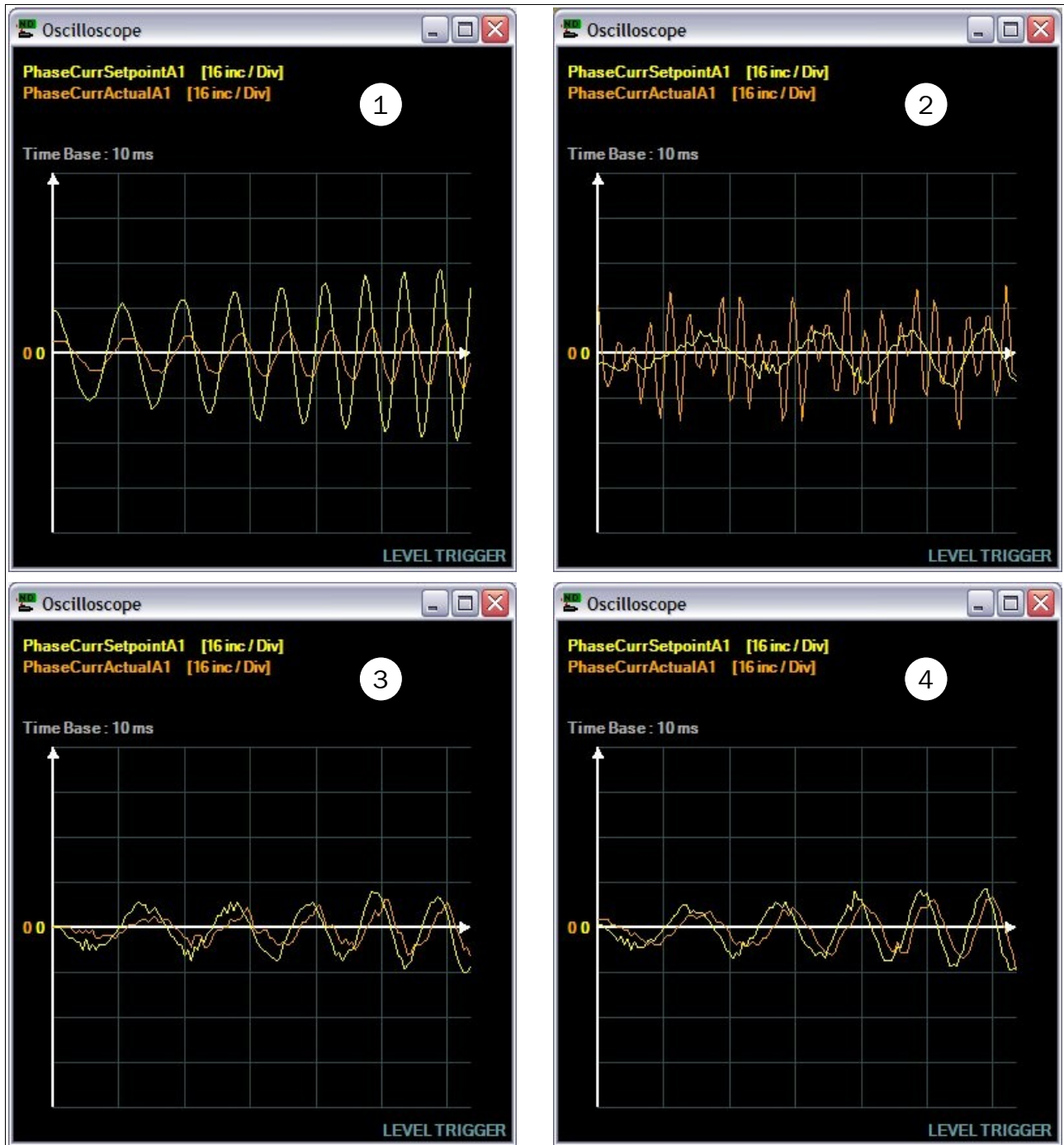
Setting the P-gain can be done online.

The oscillograms on the next page are supposed to help you in setting the P-gain. The value range is 0 % ... 100 %.

- Oscillogram (1): The current setpoint is much higher than the actual current. → Raise P-gain.
- Oscillogram (2): The actual current is much higher than the current setpoint. The control is oscillating. → Reduce P-gain.
- Oscillogram (3): Actual current largely complies with current setpoint. → Leave P-gain as set.

If P-gain is 100 % and the controller does not oscillate, leave P-gain as set and work with 100 %.

If oscillations are too strong, Error 308 is generated. In this case the values of the parameters for current control ('proportional gain', 'integral gain' and 'EMF compensation') have to be clearly reduced and the setting process has to start from the beginning.

Oscillograms for setting current control

(2) Set I-gain

The recommended value for the I-gain is 10 % of the P-gain (see Oscillogram (4)).

Even if P-gain and I-gain are set optimally, there can still be a significant phase shift between the current setpoint and the actual value of current.

- go to the '**Manual operation/Speed command**' page; select 'Jog without position control' and press 'Activate'
- go to the „**Oscilloscope**“ page; under the 'Trigger' tab, select 'Auto Trigger'
- go to the „**Motor/current control**“ page

(3) Set EMF compensation

EMF compensation must be set at high speed, as at low speed EMF is no relevant interfering factor. EMF compensation aims at reducing the phase shift between actual current and current setpoint and minimizing both values.

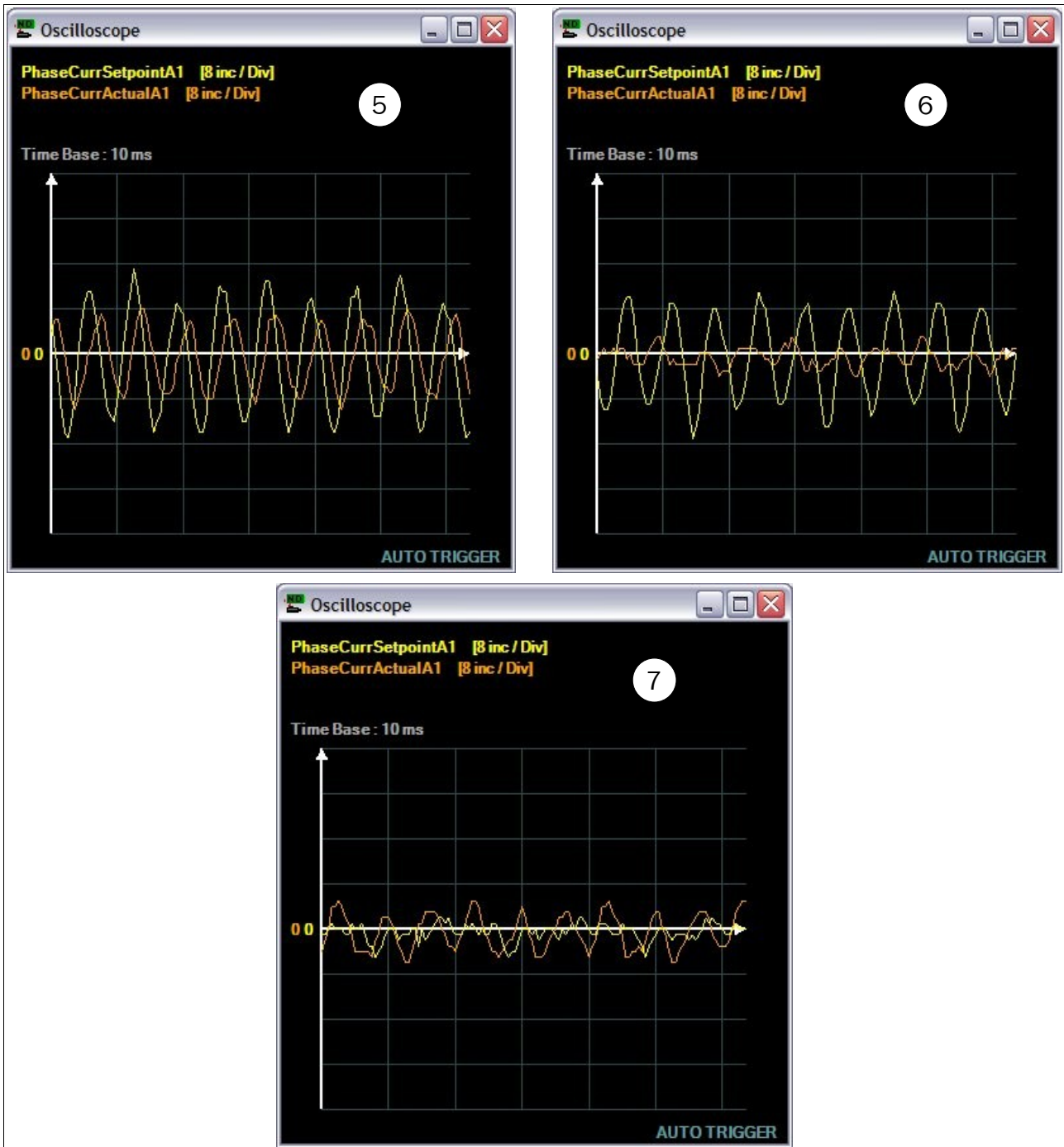
Make sure EMF compensation is set rather a little too low than too high, as otherwise there will be the danger of actual current being significantly higher than the current setpoint, leading to uncontrolled behavior of the motor.

To find the optimal setting, slowly raise EMF compensation in 1%-steps, starting from 0 %.

When you start raising EMF compensation, actual current and current setpoint first are being reduced. Upon exceeding the optimal value, actual current and current setpoint start to rise again.

The oscillograms on the next page are supposed to help you in setting the EMF compensation:

- Oscillogram (5): EMF compensation is set too low.
- Oscillogram (6): EMF compensation is set too high.
- Oscillogram (7): EMF compensation is set correctly. Actual value and current setpoint are both at their lowest value. Now reduce EMF compensation by 1 % or 2 % and enter this value on the „**Motor/current control**“ page.

Oscillograms for setting EMF compensation

- deactivate „Inverter enable“ and „Setpoint enable“ in the button bar

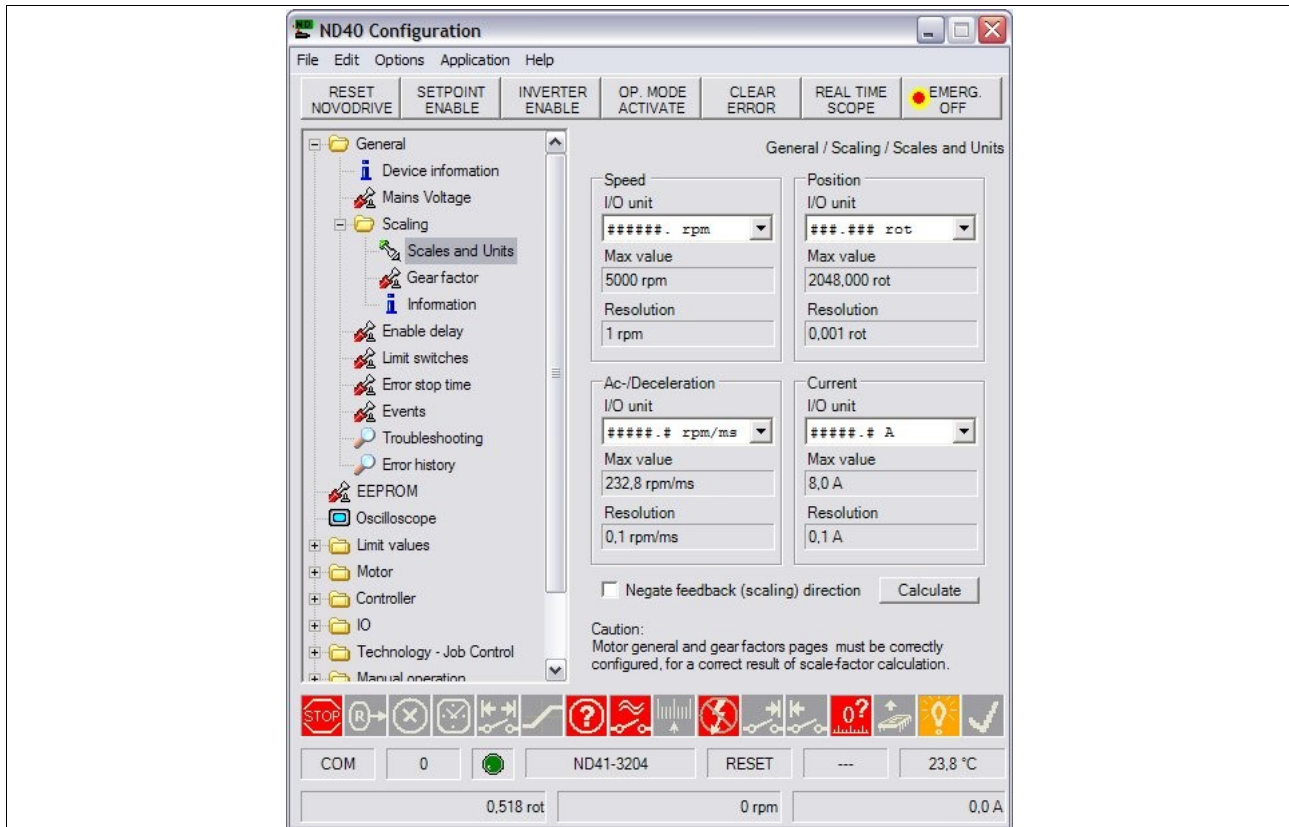
(4) Save values

- go to the „EEPROM“ page; press 'SAVE'

6.9 Step 7 – Enter application specific parameters

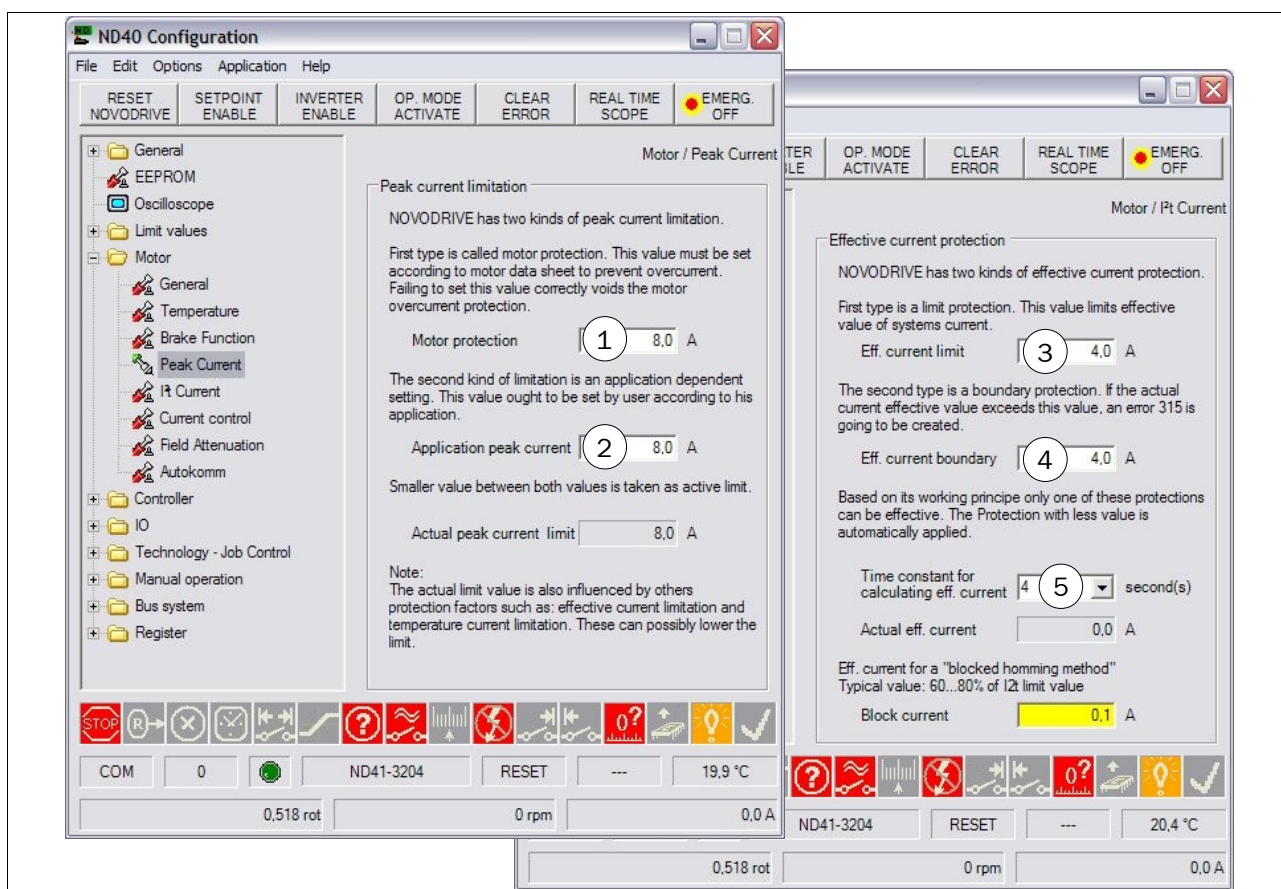
6.9.1 Settings (if not specified already in Step 1 to 6)

- go to the '**General/Scaling/Scales and Units**' page; select scaling factors and activate them by pressing '**Calculate**'



- go to the '**Motor/Peak current**' and the '**Motor/I²t current**' page, respectively; specify values for current the application is supposed to work with

Motor/Peak current	Motor protection	(1)	Do not change
	Application peak current	(2)	Enter the value of the application's maximum peak current
Motor/I²t current	Eff. current limit	(3)	Do not change
	Eff. current boundary	(4)	Do not change
	Time constant	(5)	Do not change



- go to the „Limit values/Speeds“ page; enter the limit values for speed

Limit values/Speeds	Speed limit	(1)	Enter value for maximum speed of the application
	Speed boundary	(2)	Enter maximum value for actual speed of the application; if this value is exceeded, an error is generated; typically this value should be set a little higher than the value for 'Speed limit', as actual speed may overshoot depending on the setting of the controller; in order to prevent Error 705 it might be necessary to change the value during the process of specifying the parameters for the speed control
	Speed tracking error	(3)	Enter maximum value for deviation between speed setpoint and actual speed; low values can be achieved only if the speed controller is set rigid; in order to prevent Error 701 it might be necessary to change the value during the process of specifying the parameters for the speed control

ND40 Configuration

File Edit Options Application Help

RESET NOVODRIVE SETPOINT ENABLE INVERTER ENABLE OP. MODE ACTIVATE CLEAR ERROR REAL TIME SCOPE EMERG. OFF

Limit values / Speeds

Speeds

The speed command value is limited certain value. All exceeded value are cut to this limit. This limit works on both positive and negative directions.

Speed limit **(1)** 2500 rpm

A speed boundary is set to monitor the actual speed of motor. An error 705 is reported if the actual speed exceeds the boundary

Speed boundary **(2)** 2600 rpm

A Tolerance window, which define whether a desired speed is reached or maintained.

Window width 48 rpm

Speed tracking error

Boundary **(3)** 500 rpm

Actual error 0 rpm

COM 0 ND41-3204 RESET 25,9 °C

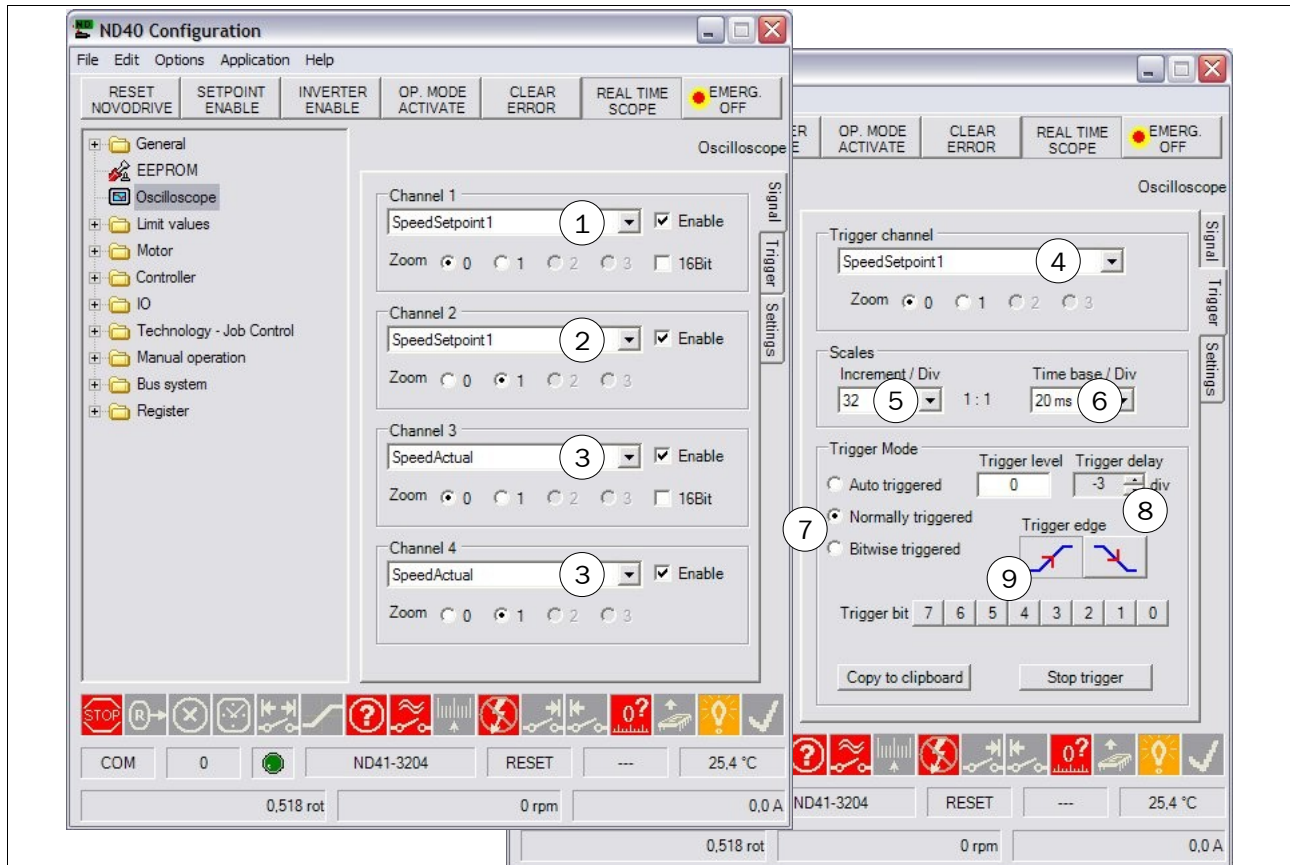
0,518 rot 0 rpm 0,0 A

6.10 Step 8 – Set speed controller

Setting the speed controller is dependent on the load that is to be moved, so make sure the motor is connected before you start with the setting process.

(1) Pre-setting

- go to the „**Manual operation/Speed command**“ page; select 'Reversing without position control' and press 'Activate'
- go to the „**Oszilloscope**“ page

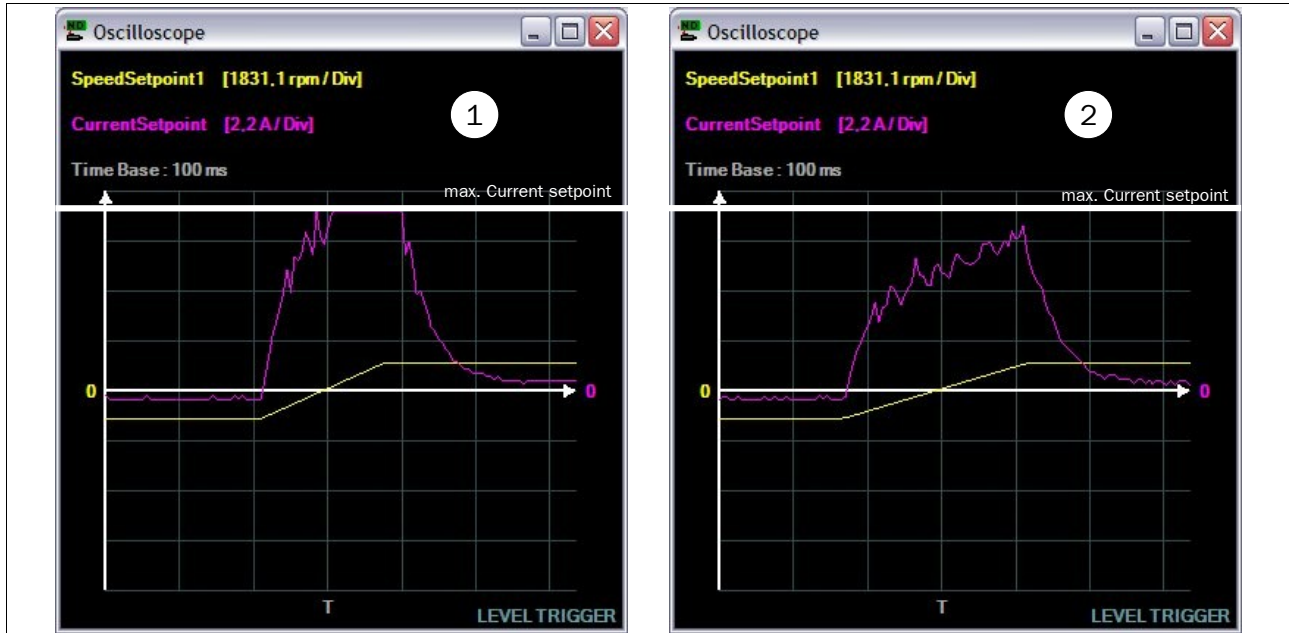


Under 'Signal' tab		Under 'Trigger' tab	
Channel 1	(1) SpeedSetpoint1; Enable, 16 Bit	Trigger channel	(4) SpeedSetpoint1
Channel 2	—	Scales	(5) (depends on speed and current setpoint, respectively)
Channel 3	(2) CurrentSetpoint; Enable, 16 Bit	Timebase	(6) 10 ... 200 ms (depends on load connected)
Channel 4	—	Trigger Mode	(7) Normally Triggered
		Trigger delay	(8) -3
		Trigger edge	(9) rising edge

The timebase should be set in such a way that one entire ramp can be seen on the oscillogram.

(2) Determination of maximum ramp value (stop ramp)

- Activate „Inverter enable“ and „Setpoint enable“ in the button bar
- go to the „**Limit values/Ramps**“ page to determine the values for the acceleration ramp and the deceleration ramp (values should always be identical)



To determine the maximum ramp value for the application, it is necessary to observe the current setpoint given in the oscillogram. The maximum current setpoint is determined by the motor, by NOVODRIVE or by the application ('max. Current setpoint' in the oscillograms above). In both oscillograms shown above the maximum current setpoint to be set for acceleration is 8 A.

- Oscillogram (1): The ramp value is set too high. Current control is not possible anymore, as the current setpoint is permanently at its limit. → Reduce ramp value.
- Oscillogram (2): The maximum current setpoint is not achieved permanently. Current control is still possible. → The ramp value set can be used.

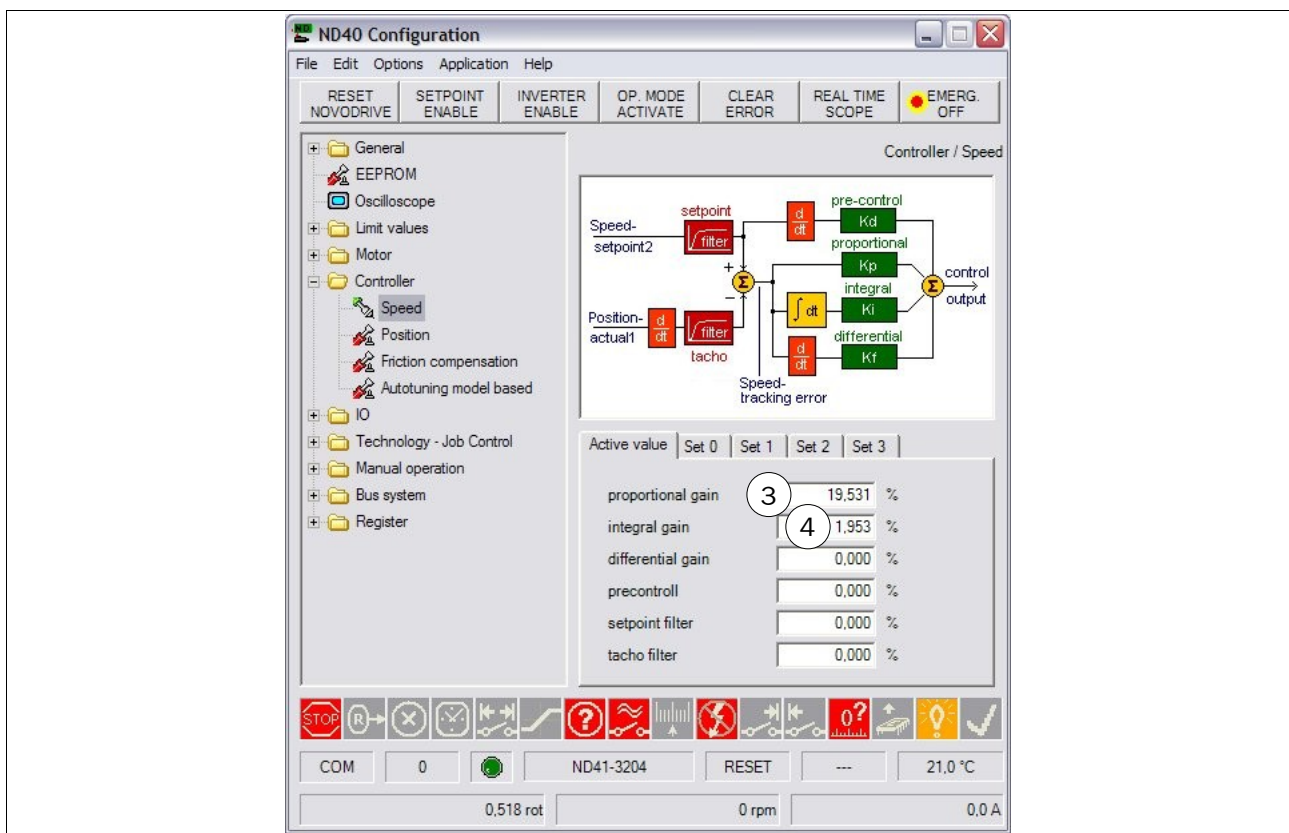
The value determined this way is the maximum value for the acceleration ramp, the deceleration ramp and the stop ramp. Use this value for emergency stop of the application.

(3) Determination of parameters for speed control

- go to the „Oszilloscope“ page

„Signal“:		Trigger:	
Channel 1	(1) SpeedSetpoint1; Enable , 16Bit	Trigger channel	(4) SpeedSetpoint1
Channel 2	—	Scales	(5) (abhängig von der Geschwindigkeit)
Channel 3	(2) SpeedActual; Enable , 16Bit	Timebase	(6) 10 ... 200 ms (abhängig von Last)
Channel 4	—	Trigger Mode	(7) Normally Triggered
		Trigger delay	(8) -3
		Trigger edge	(9) steigende Flanke

- go to the „Controller/Speed“ page to determine the parameters for speed control



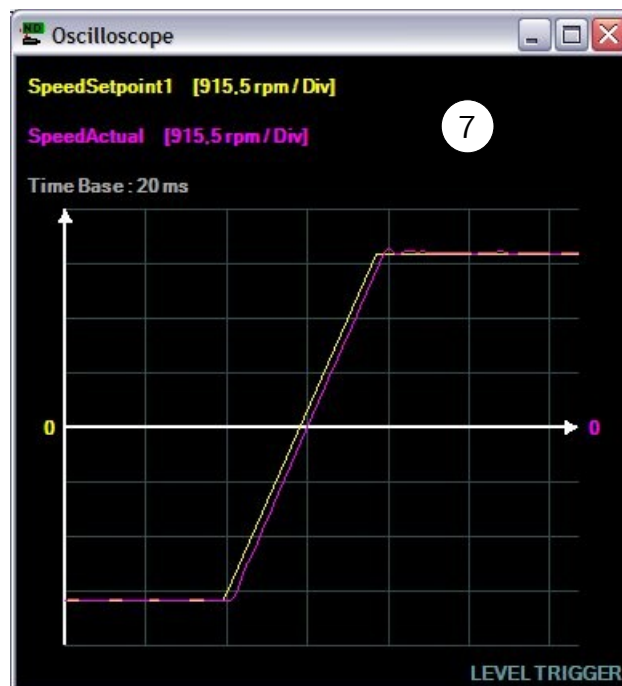
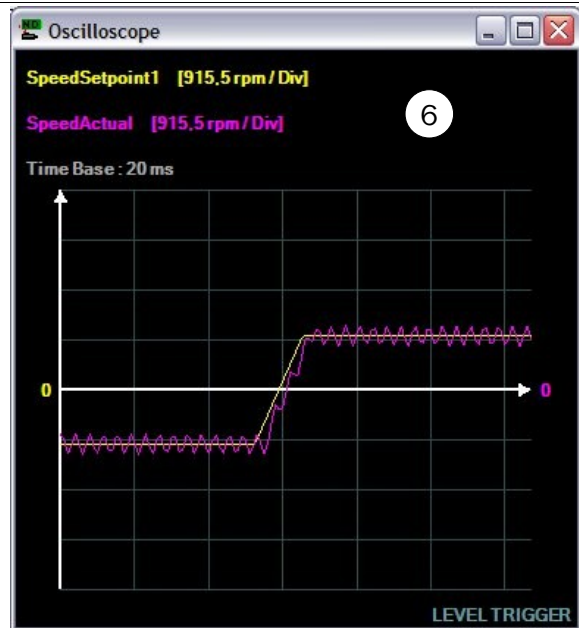
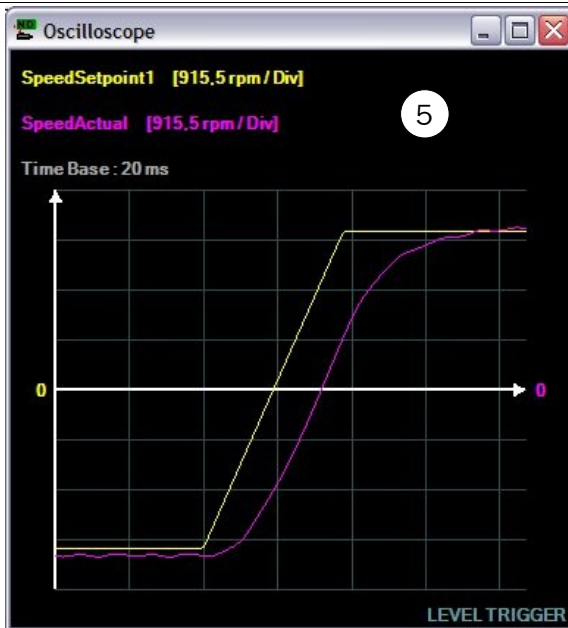
First raise the proportional gain of the speed controller until it starts to oscillate (i.e. until the motor starts to howl; see Oscillogram (6)). Then slowly reduce the value until the oscillating has disappeared.

Proceed in the same way for the integral gain.

Requirements on speed control may vary depending on the specific application. You may want to have a 'rigid' controller, i.e. the motor cannot be moved during standstill. Or you may want to have a 'soft' controller, i.e. the controller may not exceed the setpoint value and must approach the setpoint value asymptotically.

The following oscillograms are supposed to help you in setting the P-gain and the I-gain:

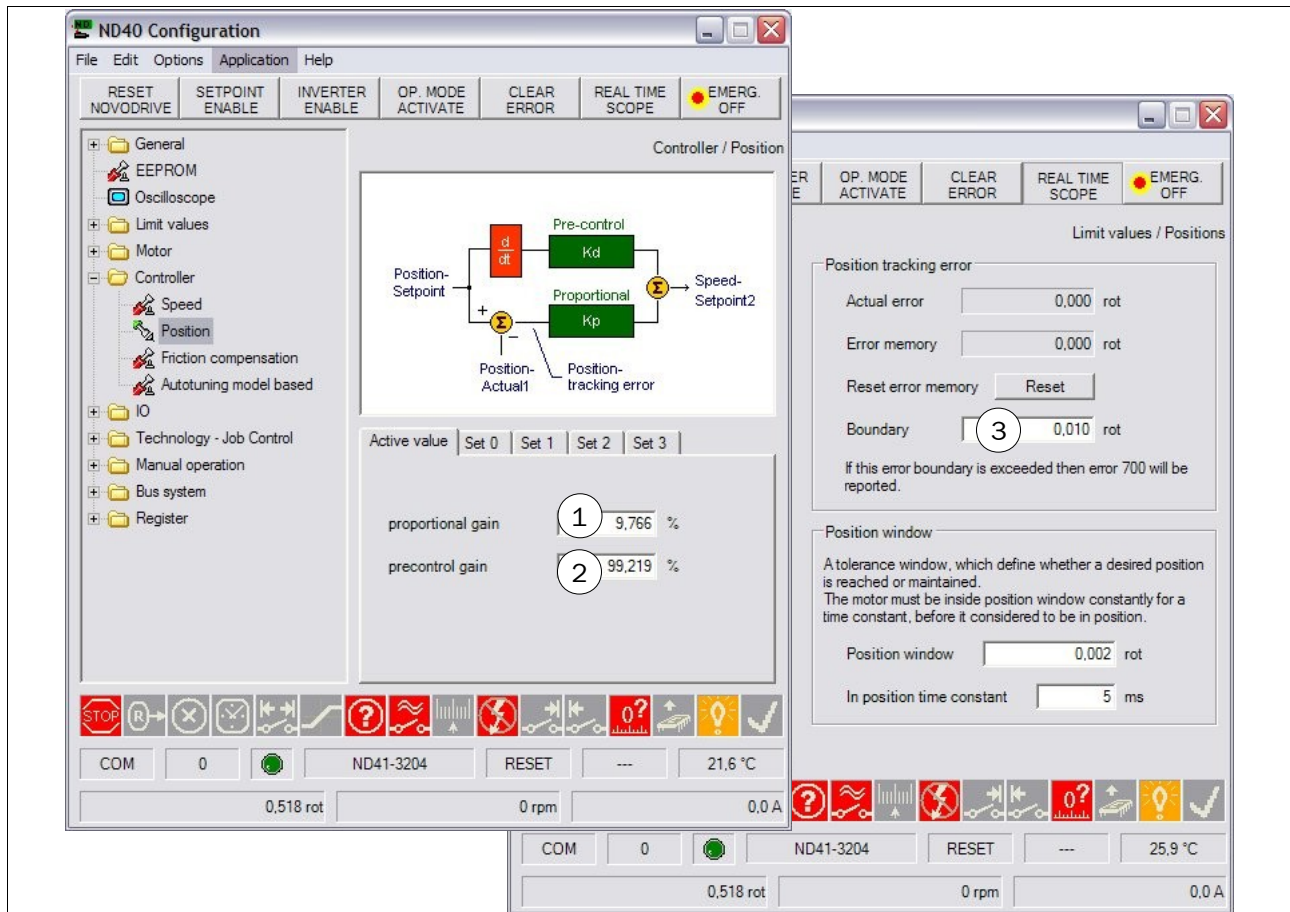
- Oscillogram (5): The P-gain is set too low. The speed controller is 'lagging behind' and is not able to compensate the deviation quickly enough. → Raise P-gain.
- Oscillogram (6): The P-gain is set too high. The speed controller is oscillating. → Reduce P-gain.
- Oscillogram (7): P-gain and I-gain are set correctly. Actual speed follows the speed setpoint with minimal overshooting. There is practically no post-pulse oscillation of actual speed.



6.11 Step 9 – Set position controller

Setting the position controller is dependent on the load that is to be moved, so make sure the motor is connected before you start with the setting process.

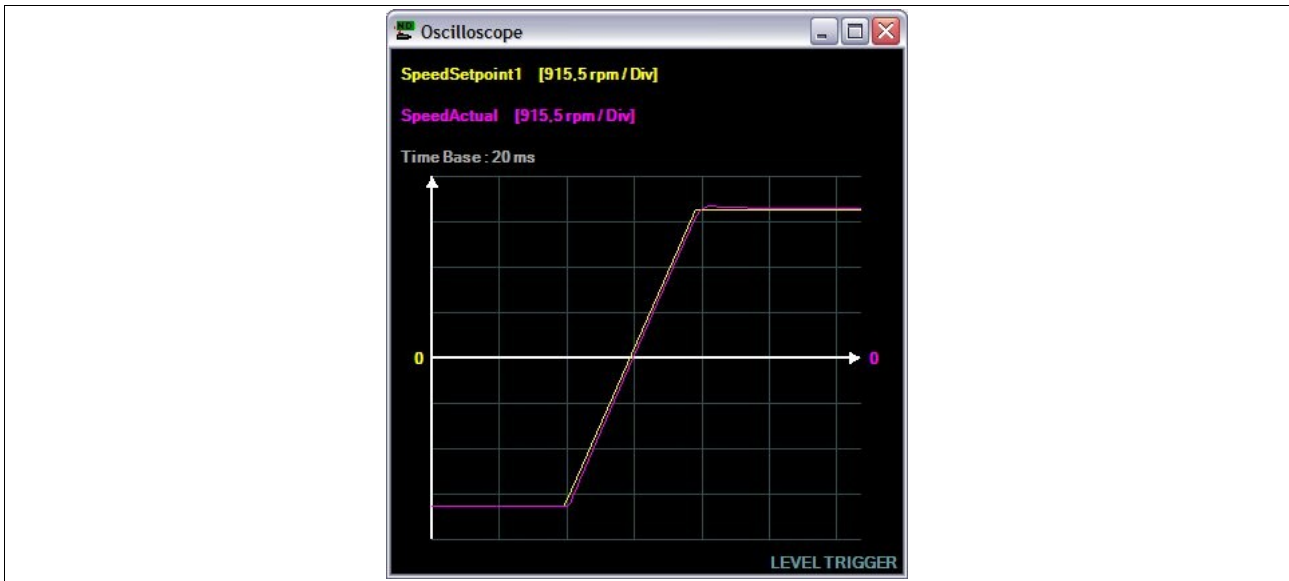
- go to the '**Manual operation/Speed command**' page; select „Reversing with position control“ and press 'Activate'
- go to the '**Controller/Position**' page to determine the parameters for position control



Usually the value for speed pre-control by the position controller is 100 %.

The P-gain (1) of the speed controller can be used to further optimize speed control. The result of that can be seen in the oscillogram on the next page. Active position control is supposed to reduce the deviation between the speed setpoint and the actual speed value.

The speed controller's I-gain has a similar effect as the position controller's P-gain. It may be necessary to reduce the speed controller's I-gain during the setting of the position controller.



- go to the '**EEPROM**' page; press 'SAVE'