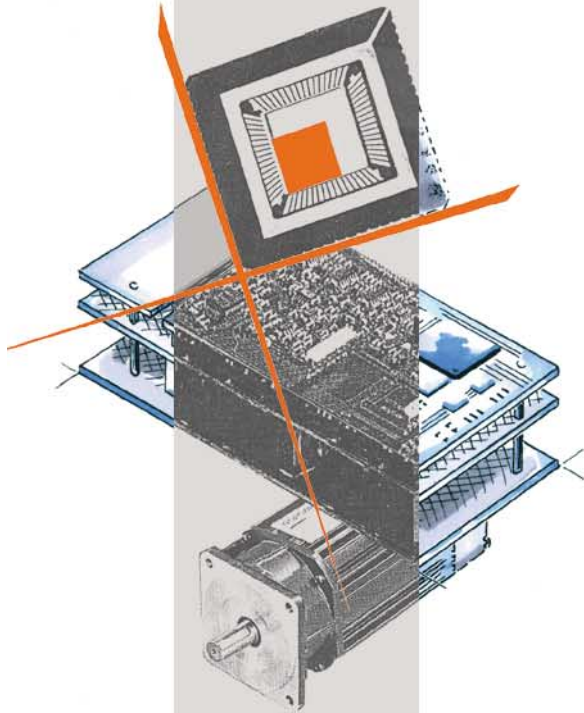


Manual Start-up ND31 and ND32

Version 4/2004



NOVOTRON
für Dynamik und Bewegung

Please read the following information about the symbols used in the manual:



Danger! Voltages may cause serious or fatal injury!

Noncompliance with instructions can endanger the life and sanity of persons!

Caution ! 

Caution! Make sure to handle the device correctly!

Noncompliance with instructions can lead to the destruction or can cause malfunction of the device or the entire equipment!



Link or recommendation

Link to other sections of the text or recommendation for practical usage

1 2

Menu *Limit values*

Command *Channel1*

[], [enter]

Sequencing of an instruction

Designation of a menu or submenu

Designation of a command or function

Designation of a key or key combination

1	General Information	6 - 1
1.1	About this manual	6 - 1
1.2	After-sales service	6 - 1
1.3	Designations	6 - 2
2	Safety Instructions	6 - 3
2.1	Intended Usage	6 - 4
2.2	Organizational Measures	6 - 4
3	ND30Cfg Start-up and Application Software	6 - 5
3.1	Installation	6 - 5
3.1.1	System requirements	6 - 5
3.1.2	Basic concept	6 - 5
3.2	Menu structure	6 - 6
3.3	Selecting a NOVODRIVE	6 - 6
3.4	Loading and saving parameter sets	6 - 7
3.5	Main window	6 - 8
3.6	Parameterization	6 - 9
3.6.1	Notes regarding various parameter configuration pages	6 - 10
3.7	Oscilloscope function	6 - 13
3.8	Oscilloscope window	6 - 14
3.9	Error history	6 - 14
3.10	Error search	6 - 15
3.11	Operational test	6 - 15
3.11.1	Speed Command	6 - 15
3.12	Software	6 - 16
3.13	NBServer	6 - 17
3.14	Extended mode	6 - 19
3.14.1	Monitor / Register	6 - 19
3.14.2	Monitor / XRAM	6 - 19
3.14.3	Software / Program Pointers	6 - 19
3.14.4	Software / Loading Custom Programs	6 - 19
3.15	Troubleshooting	6 - 20
4	Operating NOVODRIVE in Connection with a Motor	6 - 21
4.1	Preliminary remarks	6 - 21
4.2	Electrical supply of NOVODRIVE	6 - 21
4.3	The 7-segment display of NOVODRIVE	6 - 24
4.4	Basic settings of NOVODRIVE	6 - 25

4.5	Function test without main voltage	6 - 32
4.6	Enabling of NOVODRIVE	6 - 32
4.7	Current controller configuration	6 - 33
4.8	Speed controller configuration	6 - 39
4.9	Position controller configuration	6 - 43
4.10	Recommendations for configuring the controllers	6 - 45
4.11	Possible mistakes during the start-up procedure	6 - 46
5	Diagnosis	6 - 49
5.1	Start-up trouble	6 - 49
5.1.1	The motor does not react at all	6 - 49
5.1.2	The motor takes a certain ('preferred') position after enabling	6 - 50
5.1.3	The motor produces high-frequent noise	6 - 50
5.1.4	The motor vibrates or howls after enabling	6 - 51
5.1.5	Error 307 (short-circuit)	6 - 51
5.1.6	Error 308 (overcurrent)	6 - 51
5.1.7	The motor does not achieve the desired speed	6 - 51
5.1.8	The speed overshoots	6 - 52
5.1.9	The position overshoots (during braking)	6 - 52
5.1.10	Error 700 (tracking error)	6 - 52
5.1.11	The motor drifts away	6 - 53
5.1.12	The motor does not react on the analog setpoint	6 - 53
5.1.13	The motor does not react on the step/direction setpoint	6 - 53
5.1.14	NOVODRIVE does not react on analog or digital setpoints	6 - 53
5.1.15	The start-up software signals „Connection interrupted“	6 - 53
5.2	Problems with parameters	6 - 53
5.3	Error Messages	6 - 54
6	Application Examples	6 - 57
6.1	Position setting over encoder input	6 - 57
6.2	Position setting over step/direction input (step motor emulation)	6 - 59
6.3	Speed setting over Analog Input 1	6 - 61
6.4	Analog Outputs 1 and 2	6 - 63
6.5	Encoder emulation	6 - 65
7	Servicing and Maintenance of Machines equipped with NOVODRIVE	6 - 66
8	Appendix	6 - 67

1 General Information

1.1 About this manual

The entire documentation of NOVODRIVE comprises 7 parts:

- 1 Manual Basic Device ND31 and ND32**
Standard
- 2 Manual Bus Functions ND31 and ND32**
Optional
- 3 Manual Basic Functions ND31 and ND32**
Optional
- 4 Manual Additional Functions ND31 and ND32**
Optional
- 5 Reserved**
- 6 Manual Start-up ND31 and ND32**
Standard *)
- 7 Instructions for installation/exchange of ND31 and ND32**
Standard (leaflet)

The symbols used in the manuals are listed and explained on the inside front cover.

*) This manual

1.2 After-sales service

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Fax: +49 - (0)71 41 - 29 69 - 22

1.3 Designations

ND	31 - 32	07	X	S - 0 0 0	0 0 0 - 00	
						00 - Customization
						0 - Standard
						1 - Table interpolation
						0 - 8 k memory
						1 - 128 k memory
						0 - Resolver
						1 - ERN 1387 SinCos/EXE
						2 - ECN/EQN on demand
						3 - Hall sensor (open collector) + encoder
						6 - Resolver + SinCos
						7 - Hall sensor (TTL) + encoder
						0 - NOVOBUS RS232
						1 - CAN Bus NOVO
						2 - InterbusS on demand
						3 - Profibus on demand
						4 - Sercos on demand
						5 - NOVOBUS LWL
						6 - CAN Bus Pro
						7 - CAN Open on demand
						8 - NOVOBUS RS 422
						0 - Standard
						1 - CAN coding
						2 - PLC + CAN coding
						3 - PLC 8051
						4 - galv. isolation CAN Bus
						5 - Reserved
						6 - galv. isolation CAN Bus with GND
						0 - no positioning control
						1 - NOVOMERIK positioning control
						T - trapezoidal EMF
						S - sinusoidal EMF
						V - 19" module
						X - prepared for compact case
						02 - 2 A Rated current
						04 - 4 A Rated current
						05 - 5 A Rated current
						07 - 7 A Rated current
						10 - 10 A Rated current
						12 - 12 A Rated current
						20 - 20 A Rated current
						32 - 320 V DC link voltage
						56 - 560 V DC link voltage
						31 - Version
						32 - Version
						ND - NOVODRIVE

2 Safety Instructions



NOVODRIVE contains voltages that can be fatal !

- Wiring** Before switching on NOVODRIVE, carefully check the wiring. Make sure all plugs are properly connected and the device is properly grounded.
- Protection** Make sure no voltage-carrying parts may be accidentally touched and NOVODRIVE safety components are in place and properly connected.
- Emergency power-off** Provide an emergency power-off by which the motor can be stopped at any time.
- Discharge time and contact voltage** After being switched off the electrolytic capacitors require at least five minutes to discharge. That means: After being switched off the device still contains dangerous voltage for up to five minutes. During this time, do not touch the device or disconnect any plug.
- In case the motor is still turning after the supply voltage has been switched off, hazardous contact voltage may be present in the device until its standstill. Discharge of the capacitors then begins after the standstill.
- Inrush current limitation** Frequent switching of the supply voltage should be avoided, since thereby the inrush current limiter of NOVODRIVE may be overcharged, which may lead to the destruction of the inrush current limiting resistor. Wait one minute between switching on and switching off again.
- Switching on/off sequence** When switching on, first apply the 24 VDC supply voltage for the NOVODRIVE control section before connecting with the power supply. When switching off, proceed vice versa.

2.1 Intended Usage

General aspects NOVODRIVE is a servo converter for controlling brushless servo motors. It has been designed according to the state of the art. Usage other than here described may cause serious injury of the user or of bystanders. Moreover, the converter, the drive or other objects may be damaged.

Use the converter only if it is in a technically faultless condition. Use it in compliance with the intended usage and in knowledge of the dangers and safety instructions described in this manual and in other relevant documentation materials.

Suitable drives Use only brushless servo motors, the specifications of which suit the converter and which comply with regulations.

Regulations Install the converter only in compliance with regulations, rules and guidelines applicable in the respective country.

Ambient conditions Do not use the converter in explosion-prone areas or in connection with medical equipment or in other fields classified as dangerous.

Exception:

The converter is mounted in an enclosure that is permitted for such purposes and that has been inspected under consideration of the respective regulations.

2.2 Organizational Measures

Compliance with safety instructions As the producer and/or operator of a facility in which this converter is used, you are responsible for adhering to applicable regulations concerning safety and accident prevention.

Qualified personnel Make sure installation, operation and maintenance of the device is conducted by qualified personnel only. When operating the device, the safety instructions in the Start-up manual must be followed.

Manuals The producer/developer of a facility in which the converter is installed must have read the manuals and follow safety instructions.

Transportation and storage For transportation and storage of the converters, use the original packing.

Written confirmation of personnel Request a written confirmation from every person working with the device indicating they have read and understood the manuals and the safety instructions.

3 ND30Cfg Start-up and Application Software

3.1 Installation

3.1.1 System requirements

- Pentium processor 1,0 GHz
- 128 MB RAM
- Hard disk capacity: 1,5 MByte (+ 40 MByte .NET)
- Windows 2000, Windows XP (Win98 basically also possible, has not been tested yet).
- Microsoft .NET
- You may install .NET over Microsoft's web pages (see Windows update) or by means of dotnetfx.exe (21 MByte).

Important notes



Since PC software may crash and Windows has no real-time capability, it cannot be guaranteed that a stop command is executed in case of malfunction! Make sure therefore that an appropriate hardware mechanism is always in place by which the drive can be deactivated at any time (e.g. by means of the digital inputs GPIN3 and GPIN5).

This software has been developed exclusively for being used with Novotron's ND31 and ND32 servo converters. For use other than described in the following, Novotron will not incur any liability.

For reasons of technical improvement, Novotron has the right to make changes and modifications of their products any time and without prior notice.

MS-DOS, .NET and Windows etc. are registered trademarks of Microsoft Corporation.

3.1.2 Basic concept

The ND30Cfg software shows you the current state of NOVODRIVE and offers you many options for direct manipulation. Parameters and functions are thematically grouped in directories.

The software is connected with the serial interface over the NBServer program. This program is automatically started in the background and provides the data exchange between the software and the NOVODRIVE. ND30Cfg can be started several times, so that several devices can be connected to the same serial interface. Restrictions are imposed only by the limited data rate of the serial interface and the computing power.

For processing and analyzing parameter set files, you may also work offline.

3.2 Menu structure

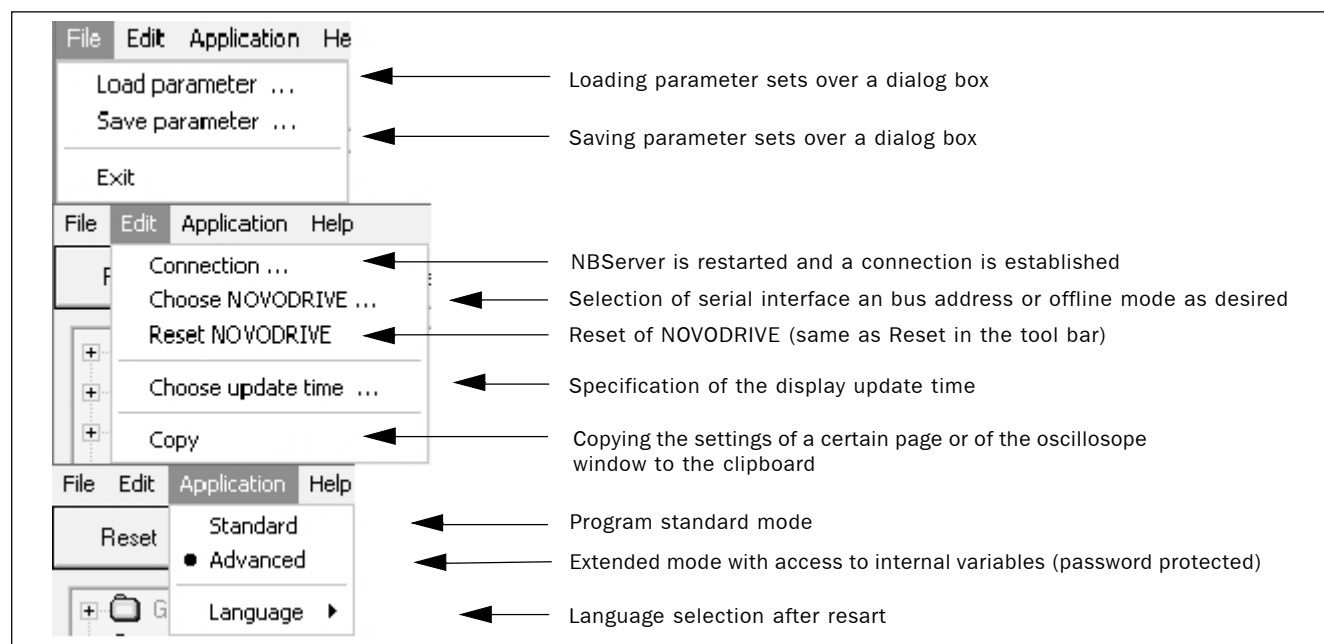


Figure 3.2-1

3.3 Selecting a NOVODRIVE

For the NOVODRIVE interface, you may select COM1, COM2, COM3 or COM4.

Offline option is available for analyzing and editing a parameter set file. For this purpose four virtual NOVODRIVES are provided.

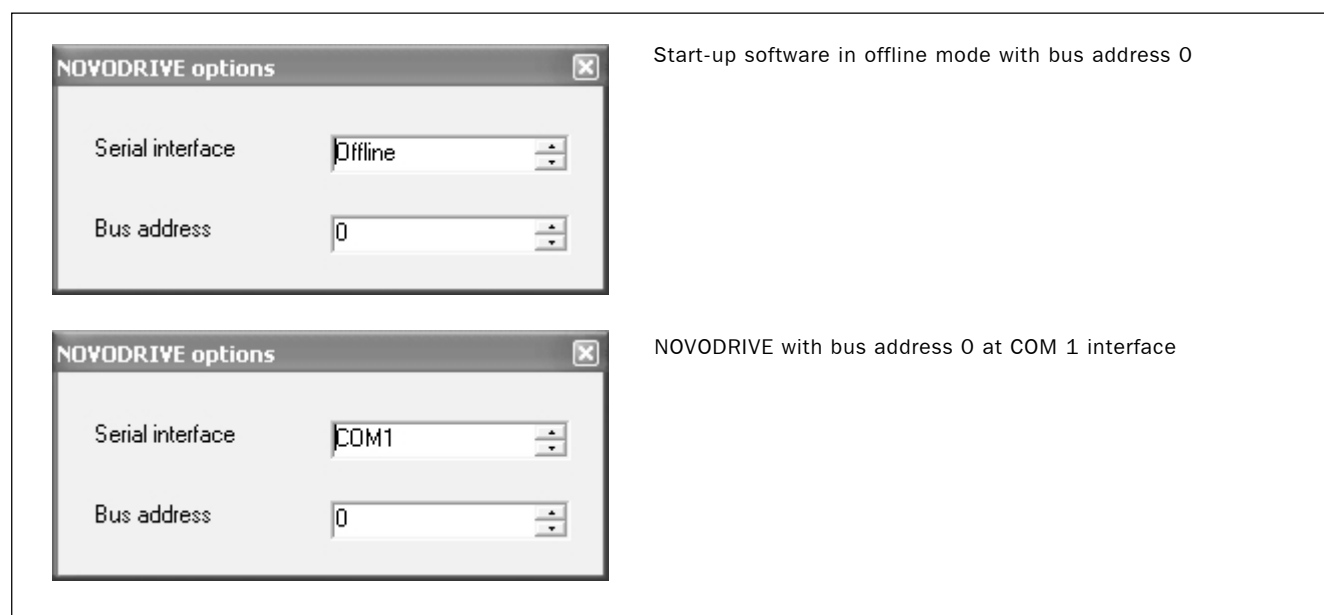


Figure 3.3-1

3.4 Loading and saving parameter sets

Loading and saving of parameter sets is done over a dialog box. You have also the possibility to save comments and annotations of existing parameter files and to modify them later.

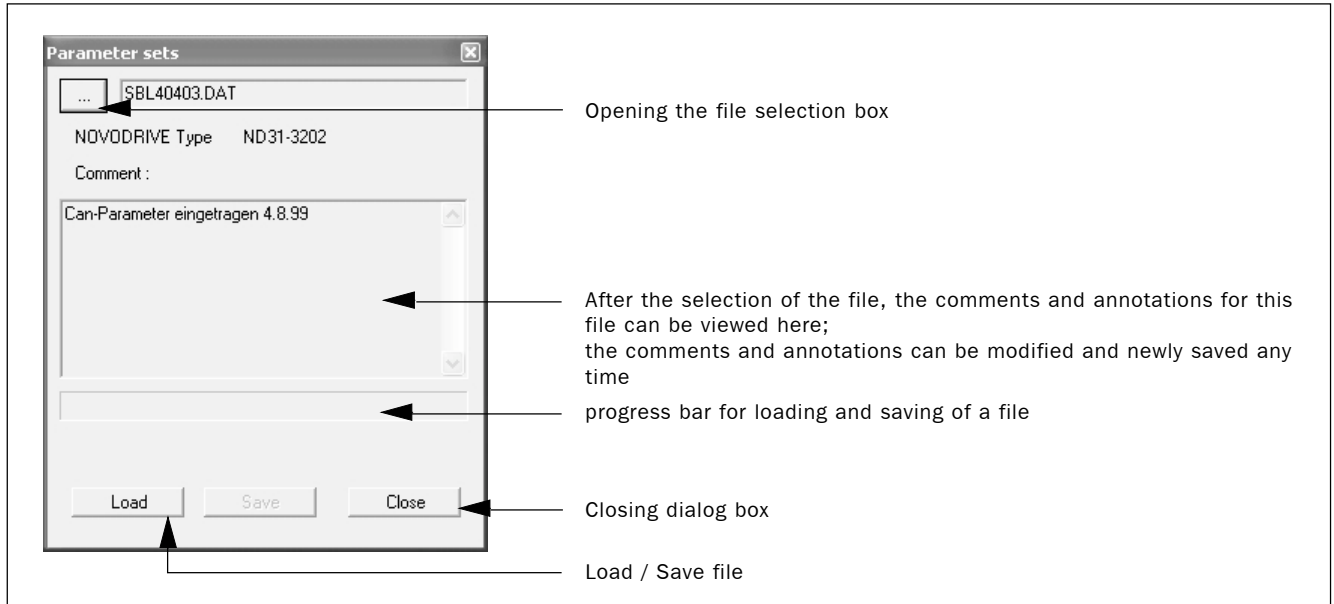


Figure 3.4-1

You can determine the file name over a file selection dialog, which opens upon pressing the [...] button.

Data can be saved with ***.DAT** as file name extension or with the new file name extension ***.ND3**. The file format is not affected by this, yet Windows displays a respective icon when the file name extension has been redefined.

Starting with version 2.04, the parameter set can also be saved in plain text in html format. To do so, select ***.html** as file name extension in the file selection dialog.

3.5 Main window



The **go** and **stop** **commands** of the DOS software ND31.COM and ND31SYS.COM, respectively, can be done in the Windows software by pressing [Start] and [Enable].



The emergency power-off button is no substitute for an external emergency power-off circuit, since it has no functionality if the program has crashed! It has also no influence on NOVODRIVE's mains voltage supply!

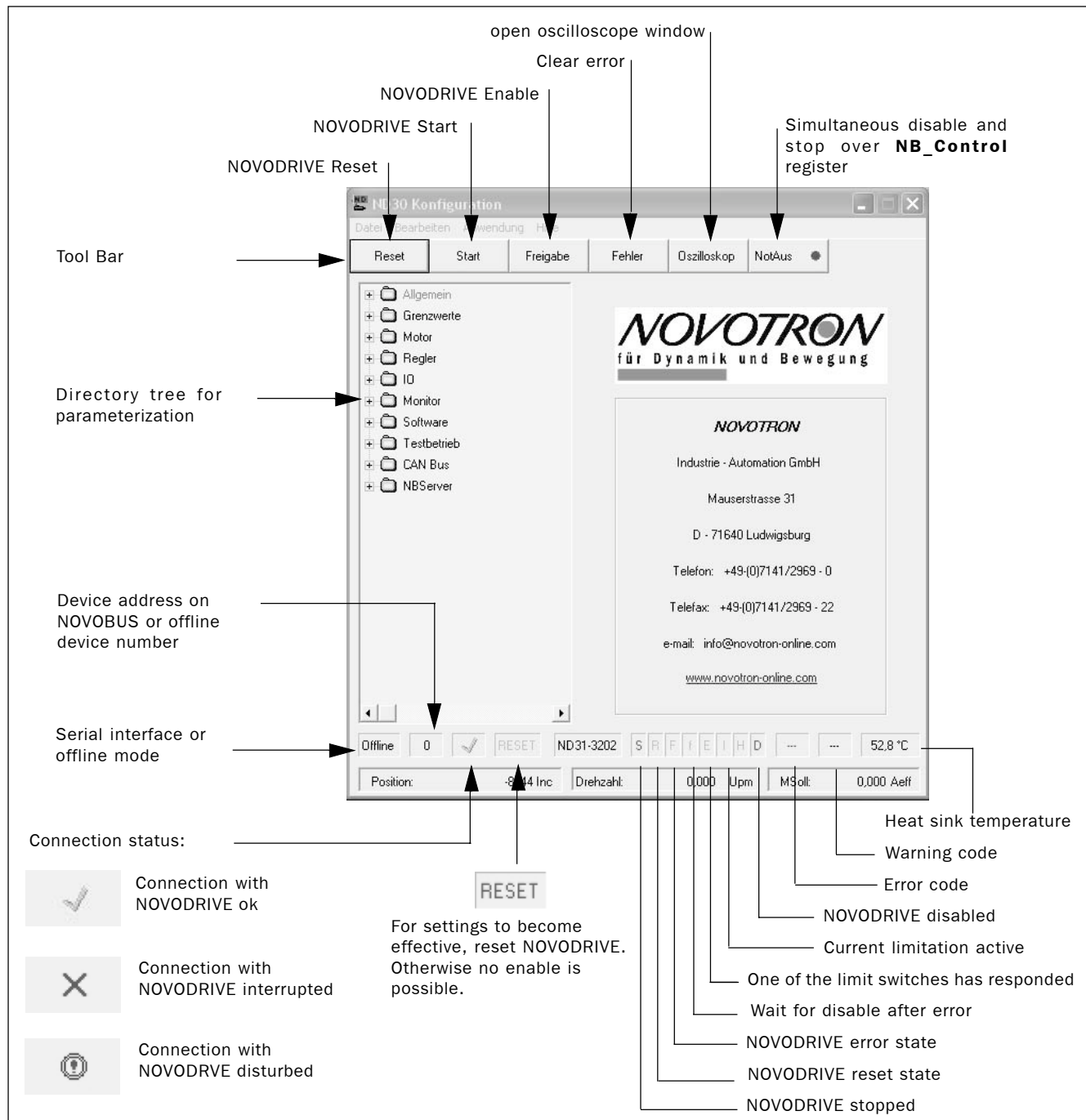


Figure 3.5-1

The status line at the bottom contains information about NOVODRIVE's current position, speed and torque.

On the **Motor / Gear Factor** page, you can select whether information regarding the position is to be given in increments, degrees or millimeters. You can also determine the conversion factor.

3.6 Parameterization

Input of values

Most parameters are set over track bars. You can make a rough adjustment of the parameters by means of the mouse or by means of the pup/pdn keys [Page ↑] and [Page ↓]. With the arrow keys [↑] and [↓], adjustment to the nearest increment is possible.

Some parameters require that values be entered into a text field. For a new entry to be validated, press the return key.

The selection of process-data read and write telegrams for the CAN bus process data is done by drag&drop. Just drag the register you want to select and drop it on the desired CAN telegram.

Acceptance of modifications

Modifications are transmitted to NOVODRIVE within the update time specified.

All modifications are immediately transmitted to the battery backed-up memory and are saved there.

However, some modifications require a reset of NOVODRIVE to be accepted. If this is the case, the reset symbol in the status line flashes up and the drive cannot be enabled anymore.

This procedure allows, for example, to do all basic settings first and then to activate them with one single reset.

Documentation

With **Edit / Copy**, the parameters shown on each page can be copied into the clipboard and integrated into text files for reasons of documentation.

Starting with version 2.04, instead of this the parameter set can be saved in a html file in a human readable format.

Invalid setting

If you choose settings that go beyond certain limits or are expected to cause problems, the respective track bar gets yellow or red. This can be, though not necessarily is, an indication that the setting you have chosen is invalid.

Example For the current controller, the I-Gain is set higher than the P-Gain.

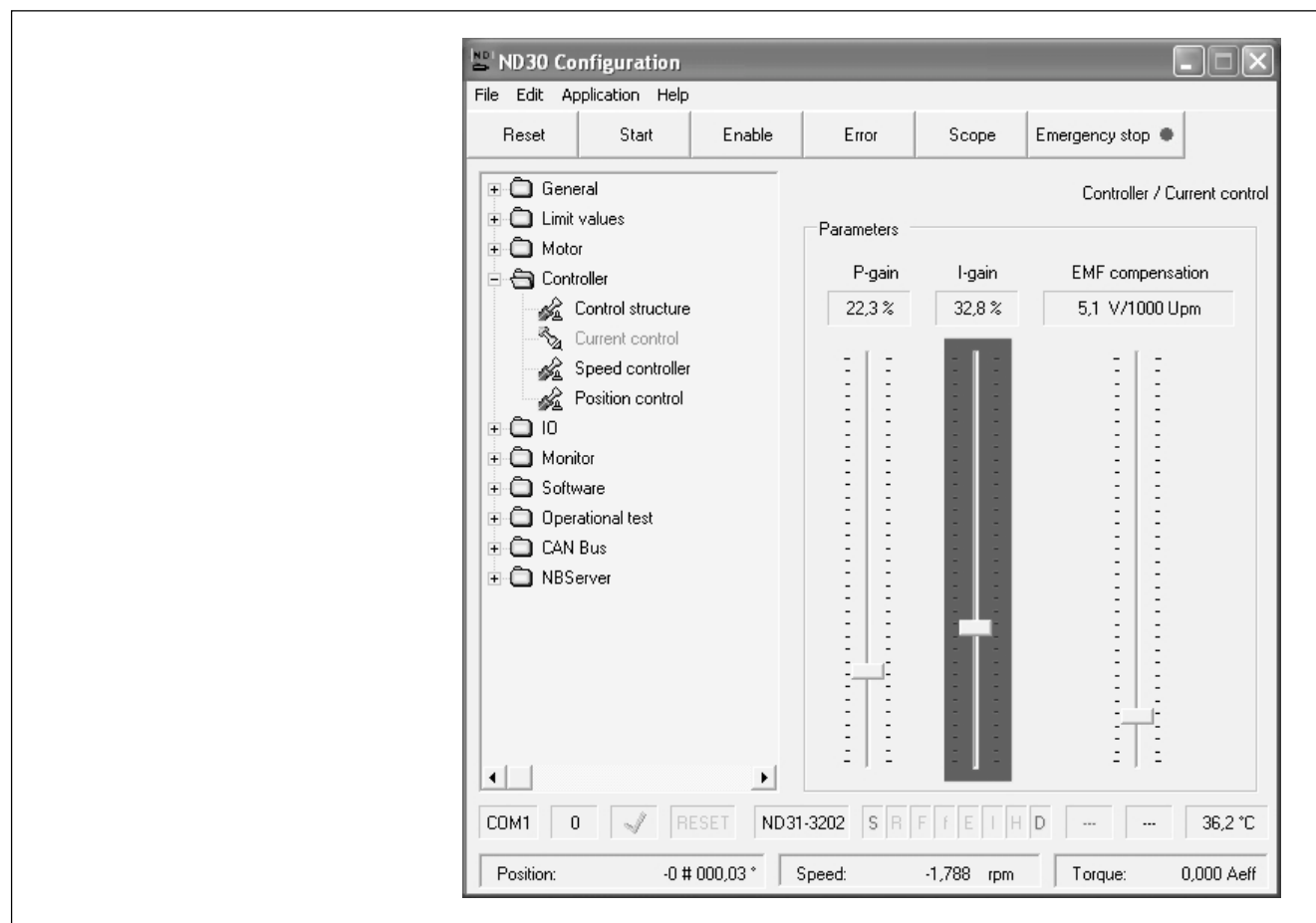


Figure 3.6-1

3.6.1 Notes regarding various parameter configuration pages

Most parameter configuration pages of the start-up software are self-explaining. Anyway, you should take notice of the following information.

Caution



Do not modify any parameters, except control parameters, the setpoint scaling and the oscilloscope configuration, while the drive is enabled! The motor may race off uncontrolledly!
Critical parameters are mainly the parameters listed under General and Motor.

Basic Settings

Do the basic settings before you put the motor into operation! The setting of the speed range, for example, affects the control parameters.

Start state The enable signal switches the voltage at the motor on and off. The start signal, however, only affects the speed setpoint. If the start signal is missing, the speed setpoint is fixed to '0'. Both for NOVODRIVE's enabling and start, several signals must be active at the same time. The enable signal is made up of the state of GPIN3 and Bit 0 of each of the registers **NB_Control**, **CAN_Control** and **SPS_Control**. The start signal is made up of the state of GPIN5 and Bit 7 of each of the registers **NB_Control**, **CAN_Control** and **SPS_Control**. By means of the parameter **Freigabe0**, the state after power-on can be specified. Normally, NOVODRIVE is disabled only by register **NB_Control**. This register is manipulated by pressing the [Start] and [Enable] buttons in the tool bar of the start-up software. If NOVODRIVE is operated without NOVOBUS or CAN bus, do not disable NOVODRIVE by the registers **NB_Control** and **CAN_Control**.

Motor / Basic Settings You can find information regarding the number of poles of the motor in the motor's documentation. If a feedback system has been chosen that involves Hall sensors, the number of poles of the motor is irrelevant. It is set to '2' permanently. Motor manufacturers adjust resolvers differently. You can use the track bar for the commutation offset (**PhiP0**) to adjust the resolver electronically. The commutation offset can be specified by means of the auto adjustment function.



Take notice of the safety instructions on this page or read Chapter 3.6.9 in the „Basic Functions ND31 and ND32“ manual!

Motor / Feedback System If several options appear grey and are inaccessible, this might have the following reasons:

- The operating mode selected involves only one feedback system. If this is the case, separate measuring of speed and position is not possible.
- You selected encoder or step/direction for setpoint setting. Since in this case the encoder input is already assigned, the only feedback system to be selected is **resolver**.

Unlike with resolvers, using digital encoders or sine encoders requires additional steps.



- Please read Chapter 3.9 in the „Basic Functions“ manual. Select the respective page in the **Motor** directory and do the remaining settings.

It is possible to change the spinning direction of the feedback system. If two different measuring systems are used for speed and position, the spinning direction can be specified separately for both systems.

A change of the spinning direction also affects the limit switches.

- Speed range** There are two speed ranges you may select: 0 - 6000 rpm and 0 - 18000 rpm.
A change in the specification of the speed range is accepted without the need of a reset.
If the speed range is modified, the scaling factors and the speed resolution change. Therefore, readjust
- all control parameters,
 - the EMF configuration and
 - the setpoint.



Check the setpoint after a change of the speed range, since the speed can be four times higher than desired!

- Limit switches** The limit switches can be activated or deactivated. Furthermore, the response to a limit switch signal can be specified. You have the following options:
- no response,
 - stop with controlled braking,
 - error with uncontrolled braking.

If controlled braking is programmed, it is only possible to move into the opposite direction as long as the limit switch signal is active.
Limit switches are break contacts which are connected to 24 V.

- Braking circuit** The right bar indicates the braking power occurring in the NOVODRIVE. The power values indicated refer to operation at rated voltage. The left bar is a track bar which can be adjusted by the user. It indicates the power maximally permissible by the connected braking resistor. So if you use the integrated braking resistor, set as a maximum value the value indicated in line 3 of the table in Chapter 4.2.3 in the „Basic Device“ manual. If you use an external braking resistor, the permissible rated power of the resistor must be entered.



When connecting an external braking resistor, please take notice of the information given in Chapter 4.2.3 in the manual „Basic Device“ !

If the braking power exceeds the value set, Error 971 is generated.

- CAN NOVOTRON Identifier** The CAN Identifiers must be right-justified hex values. This format is more common than the format used in the DOS software ND31.COM.

- CAN NOVOTRON process-data read and write telegrams** The process-data read and write telegrams for the CAN bus protocol NOVOTRON can be programmed by drag&drop. Just drag the register you want to select on the left and drop it on the desired telegram on the right.

3.7 Oscilloscope function

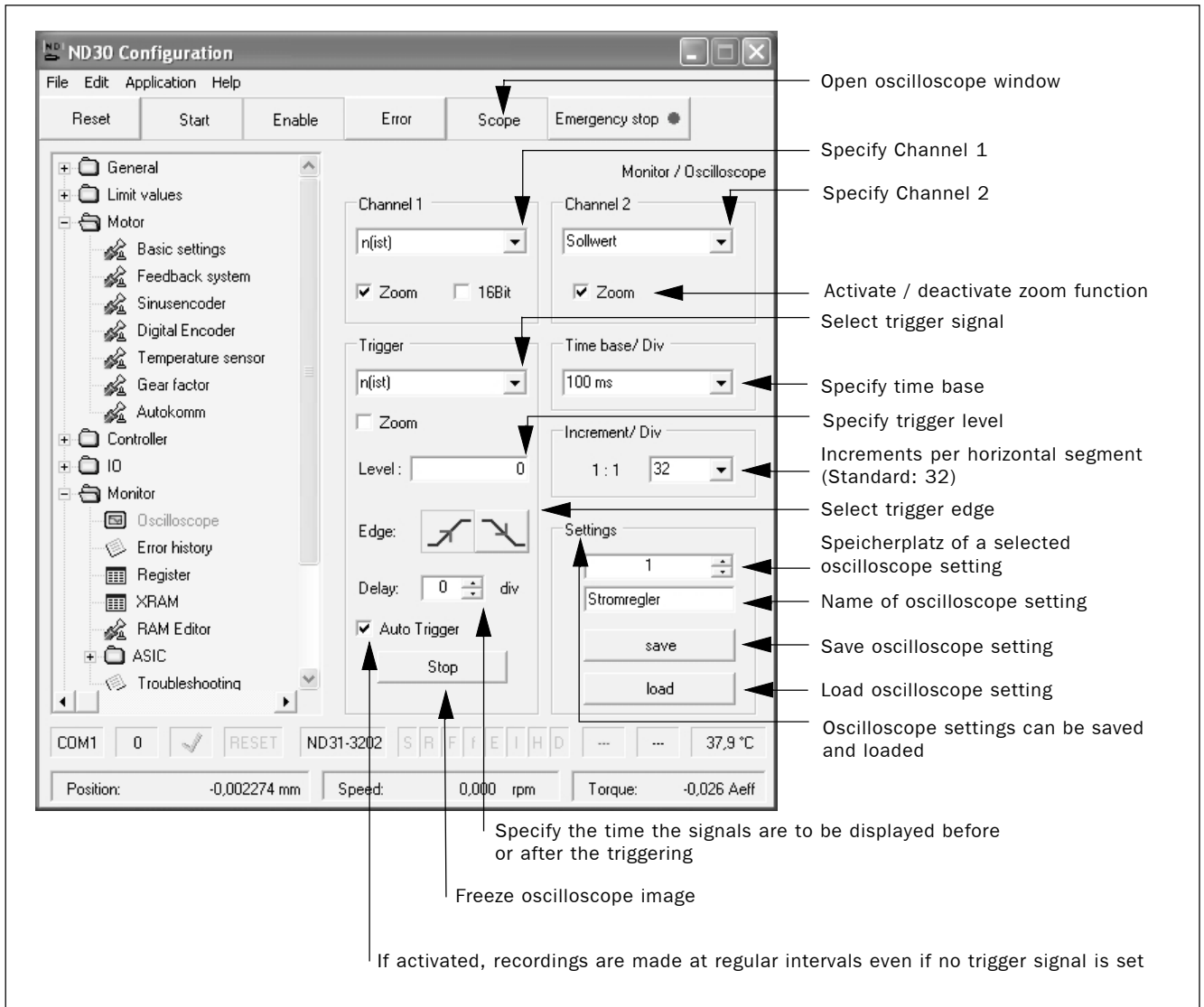


Figure 3.7-1

As an extension to the oscilloscope function provided by the ND31.COM software, the settings may now be saved and reused.

The 13 most important variables, such as setpoints and actual values for speed, can be selected directly for one channel. If ... is selected, a dialog box opens up which provides access to any of NOVODRIVE's registers.

Besides, when 16-bit data are recorded, these data can be displayed with 256-fold magnification using the zoom function. This feature is useful to examine the noise behavior of signals e.g. the analog input or the speed.

3.8 Oscilloscope window

The oscilloscope window can be moved freely and independently from the main window, and you can freely determine its size. The oscilloscope window is opened either on the page **Monitor / Oscilloscope** or by pressing the [Scope] button.

Information displayed in the oscilloscope window can be copied to the clipboard as a bitmap or as raw data (ASCII text) for reasons of documentation. To do so, go to the **Monitor / Oscilloscope** page and select **Edit / Copy** in the main menu.

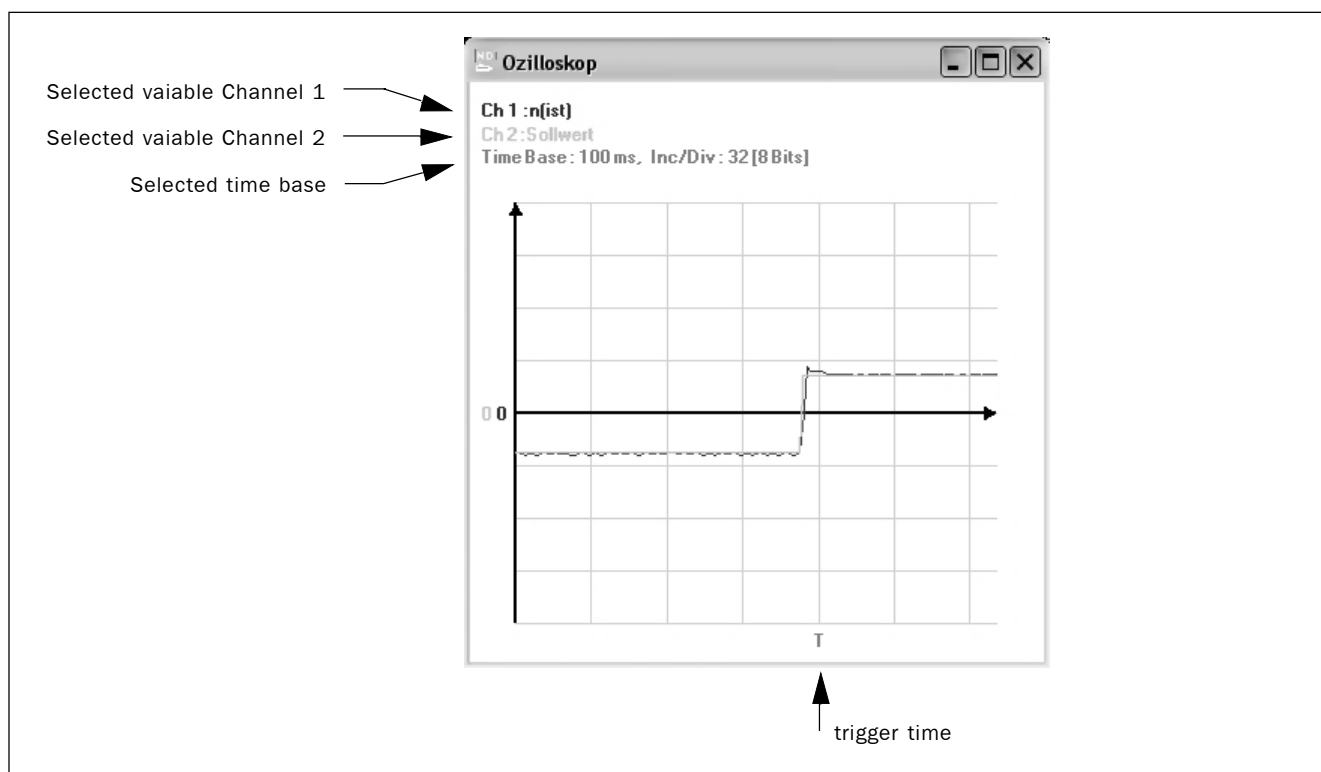


Figure 3.8-1

3.9 Error history

An error buffer provides an error history with a capacity of 63 entries. The error buffer is read out automatically when a page is selected. However, the buffer can also be read out manually.

Starting with version 2.04, the error history can be exported as a html file.

3.10 Error search

Page **Monitor / Troubleshooting** gives you an overview of what might be the reasons if the motor cannot be moved at all. A detailed description of the page **Monitor / Troubleshooting** is given in Chapter 5.1.1 in this manual.



If a problem occurs in connection with **enable and start**, read Chapter 3.4 in the manual „Basic Functions“. You will find a detailed description on this subject there.

3.11 Operational test

3.11.1 Speed Command

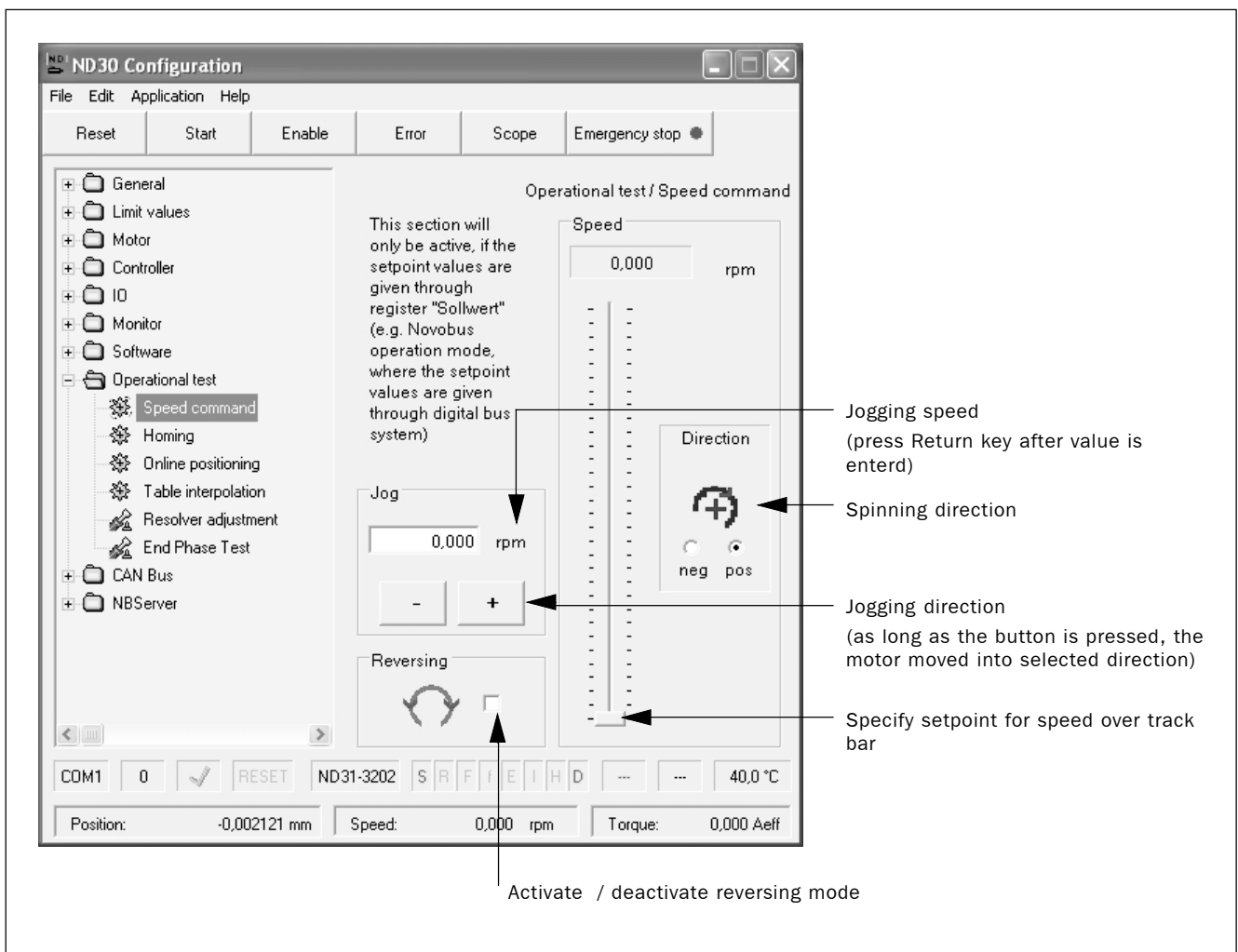


Figure 3.11-1

You may run a test mode for which you can determine the speed, decide between clockwise/counterclockwise direction and choose reversing.

You may also determine a speed for jogging.

3.12 Software

In the **Software** directory you can find several pages for installing and configuring software extensions for NOVODRIVE.

Note

Always install only one software extension! If you install a new program, the previously installed program will be overwritten!
Before installing a software extension, read the corresponding documentation.

Ablaufsteuerung

The software extension SPSPPOS is loaded on the page **Software / Ablaufsteuerung / Installation** by pressing [Install]. By checking/unchecking [Activate], the program is activated/deactivated. To use the Ablaufsteuerung, a program consisting of the functional sets must be created. To create the program, use the pages **Software / Ablaufsteuerung / Command Editor** and **Software / Ablaufsteuerung / GPIN Table**.

The pages are largely self-explaining. You can find information about the functionality of the Ablaufsteuerung in the „Additional Functions“ manual.

The program for the Ablaufsteuerung can be transferred from NOVODRIVE to an external file or from an external file to NOVODRIVE. Use the buttons [Load] and [Save] to do so.

Note

The file format of the ND31ABL DOS program with the file name extension SAT is not compatible with the new file format NA3.

3.13 NBServer

NBServer/Info

This page provides information about the connection of the start-up software with the NBServer software extension. NBServer runs in the background and provides for the data exchange between the software and the NOVODRIVE converters.

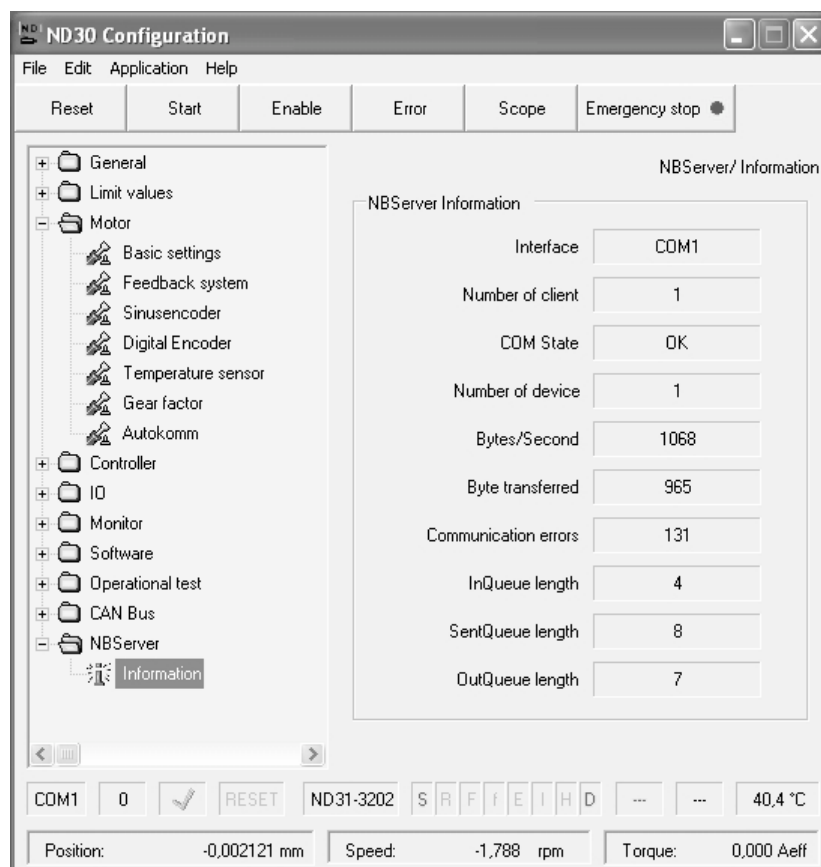


Figure 3.13-1

The NBServer program

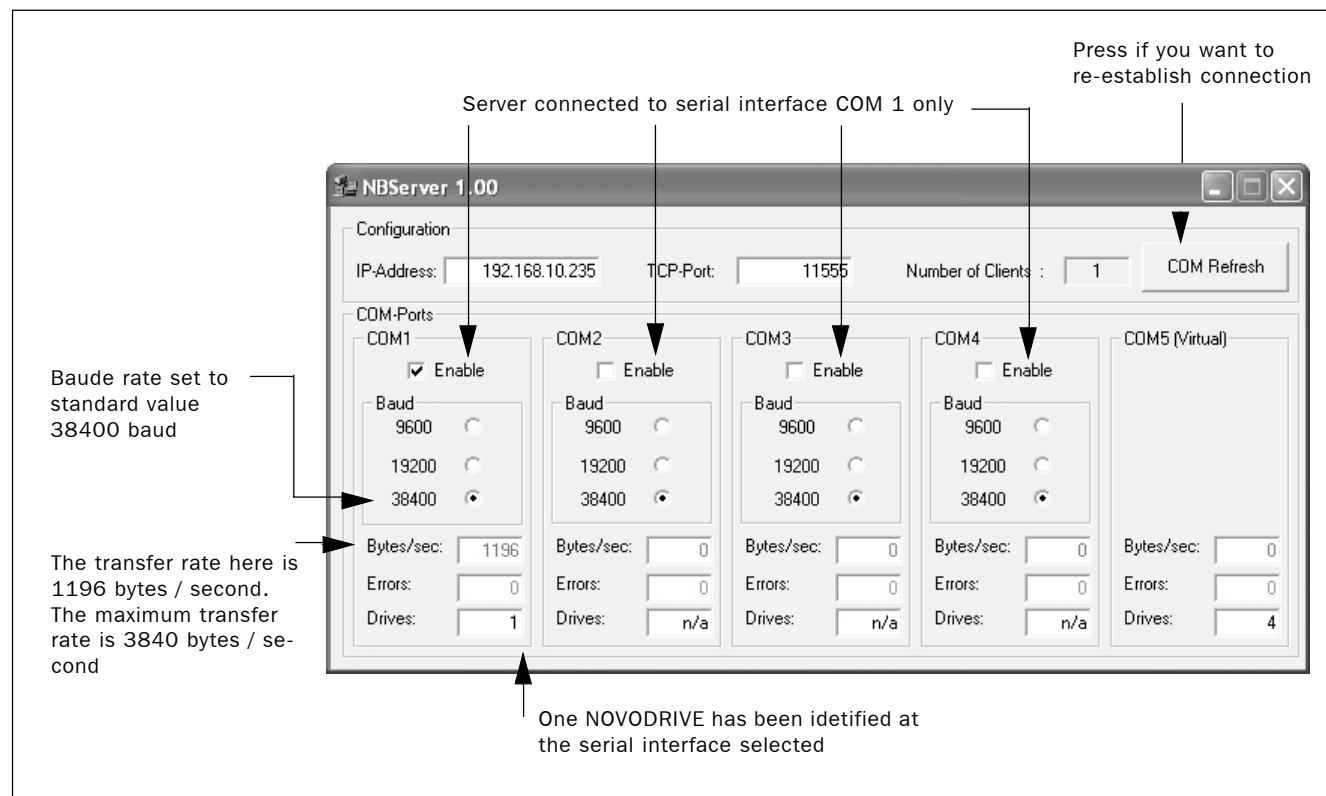


Figure 3.13-2

The program allows to connect and configure the serial interface. After the installation it may be necessary to correct the settings. For searching errors if problems with the serial interface have occurred, the program provides data regarding the number of bytes transmitted and errors occurred.

Attention

If you are not absolutely sure as to what the consequences of your manipulation are, do not set a value other than 38400 baud!

If you want to change the baud rate, always proceed as follows: At first, change the respective setting in the NOVODRIVE on the **General / Basic Settings** page and complete the procedure with a reset. Then change the baud rate in the NBServer program.

Normally, the window can be found in the task bar. If the window is closed, NBServer is switched off and the connection with NOVODRIVE is interrupted.

To start NBServer again, go to the menu and select **Connection ...**

3.14 Extended mode

The extended mode is for experienced users only. It is password-protected. It allows manipulation of internal registers, which may lead to malfunction or defect.



Direct access to registers or addresses can be risky! Therefore, make manipulations only if you are absolutely sure about the consequences! Only by doing so you can prevent the drive from reacting in an undesired way. Install and use software extensions only after reading the corresponding documentation!

The extended mode offers the following additional pages:

3.14.1 Monitor / Register

You may choose up to twelve registers in the drive. Depending on the intended usage of the register, you can display and edit the register as a decimal value, an angle value, a binary value (for flag fields) or a hex value.

Text entries need to be confirmed by pressing the return key. Only then is the value transmitted to NOVODRIVE.

To select a register, press one of the buttons in the left column. A dialog box opens up.

The settings remain in place also when the program is terminated.

3.14.2 Monitor / XRAM

You may display and edit up to twelve word registers in the external memory. The registers are selected by word address of the external memory.

In any other aspect, this page is identical with the page **Monitor / Register**.

3.14.3 Software / Program Pointers

You can activate additional functions such as the positioning control, the table interpolation or customer-specific software by **drop-down boxes**.



A description of the functions is given in the „Additional Functions“ manual.

3.14.4 Software / Loading Custom Programs

This page allows to load customer-specific software into NOVODRIVE's memory. To do so, enter the file name and the block number.



More information on this is given in the description of the software extension.

3.15 Troubleshooting

Connection interrupted



- Make sure you have selected the right NOVODRIVE. If a wrong serial interface or a wrong bus address is set, **Connection interrupted** is displayed.
- Check all cable connections.
- Open the NBServer window. Make sure the connected interface is activated and the correct baud rate is set.
- Select **Edit / Connection**. By pressing the OK button, the server is restarted. Check the settings of NBServer.

Connection disturbed



- Increase the update time under **Edit / Choose update time**
- Check all cable connections.
- Check earthing of PC and NOVODRIVE.

The system is working at full capacity

Due to the non-standard assignment of the D-Sub connector of NOVOBUS, it may be possible that the entire computing capacity is used up by the Windows driver of the serial interface. This is caused by the data transmission of the CAN bus on Pin 8 and Pin 9. The problem can be handled by interposing an adapter into the serial cable. Make sure the adapter connects only Pins 2, 3 and 5 of NOVOBUS with the serial interface of the PC.

Varying error indication

Check earthing of NOVODRIVE and the mass connection with the PC.

- Working with an unearthed NOVODRIVE can be fatal!



Make sure to earth the 24 V supply voltage, NOVODRIVE's PE connector and the compact case or the 19" rack, as the case may be!

- Without the shield of the RS232 cables being earthed, no regular data transfer is possible.

The parameter set cannot be saved or loaded

In order to always have the monitor display the latest data, the simultaneous transfer of the parameter sets is done at low priority. It may be possible that the transfer of the parameter sets is canceled due to timeout.

Close the oscilloscope window and select a directory, so that only the logo page is displayed. If you do so, the maximum bandwidth for the transfer of the parameter sets is made available.



In some cases it may be helpful to raise the update time (see **Connection disturbed**).

4 Operating NOVODRIVE in Connection with a Motor

In the following you will be given information about operating NOVODRIVE in connection with a rotating motor using a resolver, an encoder plus Hall sensors or a sine encoder (e.g. ERN1387). For operating linear motors, please refer also to the respective sections in the manual „Basic Functions“.

Note The following instructions give you a step-by-step description of how to start up and operate a new motor.

If you already have a parameter set for this combination of NOVODRIVE and motor, you may skip some of the following passages.

4.1 Preliminary remarks



For the initial operating phase and for experimenting, the motor should not be built in yet.

- **Several functions and tests require that the motor can turn without load connected.**
- **If NOVODRIVE has been configured incorrectly, the motor may show unexpected behavior!**

4.2 Electrical supply of NOVODRIVE

- Connect the supply voltage to connector X3. The 24 V $\pm 10\%$ supply must be stabilized and earthed. The connector has two contacts for 24 V and two contacts for 0 V. Use them both in parallel.

Since direct wiring of the SCSI plug is somewhat difficult, it is recommended to use the control cable STK25-68-25-1,0-00 or STK09-68-1,0-00. Both control cables transfer a selected group of signals to a 25-pin or 9-pin D-Sub connector. Information on the assignment of cables is given in Chapter 8.

- Minimum connection requires to connect the two inputs enable (GPIN5) and start (GPIN3) at connector X3 over two switches S1 and S2.

The enable signal switches the voltage at the motor on and off. The start signal, however, only affects the speed setpoint. Until the configuration is finished, S1 and S2 should remain open in order to prevent the motor from undesired moving.

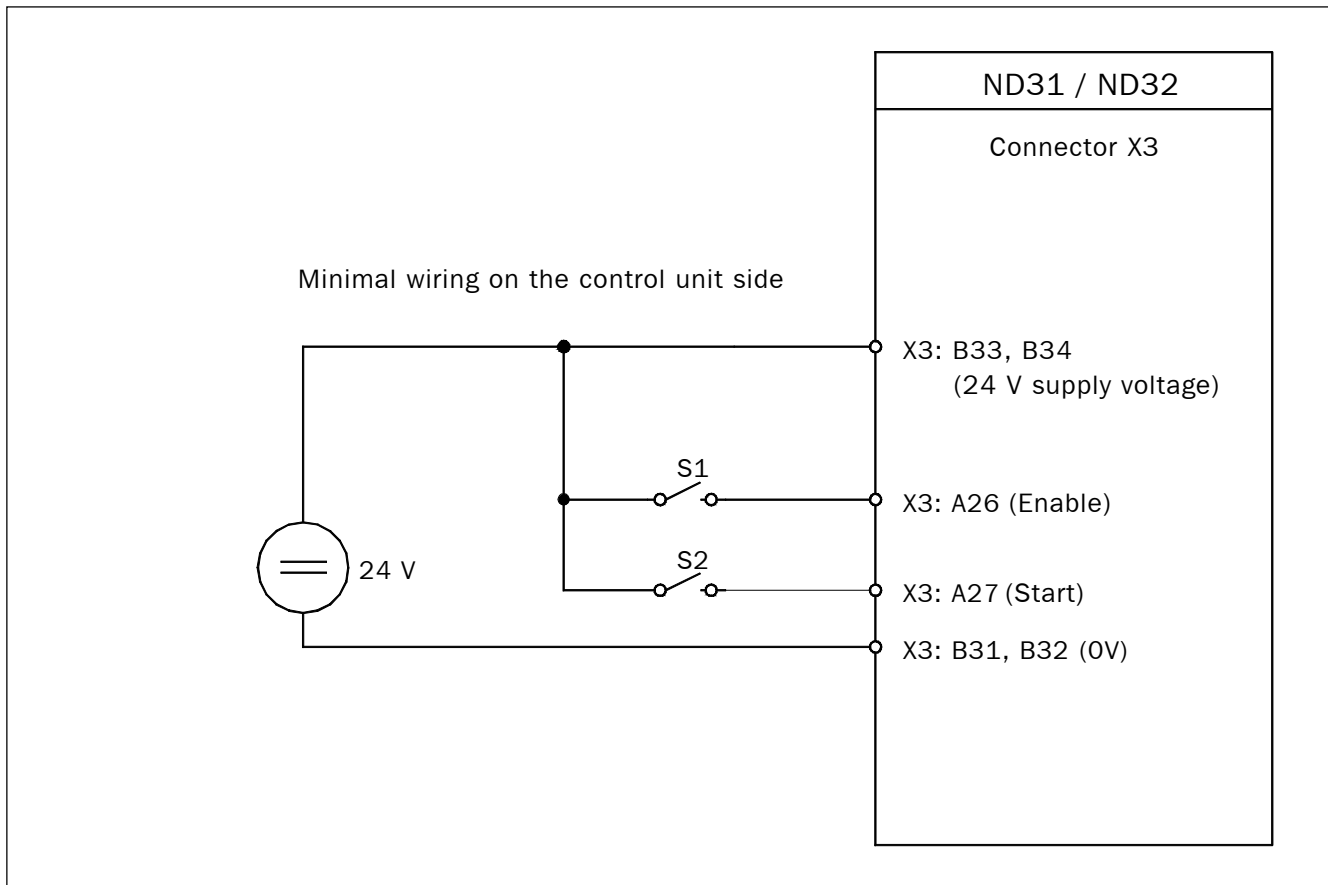


Figure 4.2-1

- Connect NOVODRIVE with the PC. Use a common serial cable (no null modem cable) to connect the PC's serial interface with connector X5 of NOVODRIVE. Connector X4 of NOVODRIVE must be equipped with a terminating plug.

The terminating plug must have a bridge between Pin 2 and Pin 3 in order to connect the transmit line and the receive line. Without the terminating plug, no connection can be established (see Figure 4.2-2)!

Caution !



A difference in the potentials of PC and NOVODRIVE may result in the destruction of the serial interface! Therefore make sure the control voltage of NOVODRIVE and the PC is earthed!

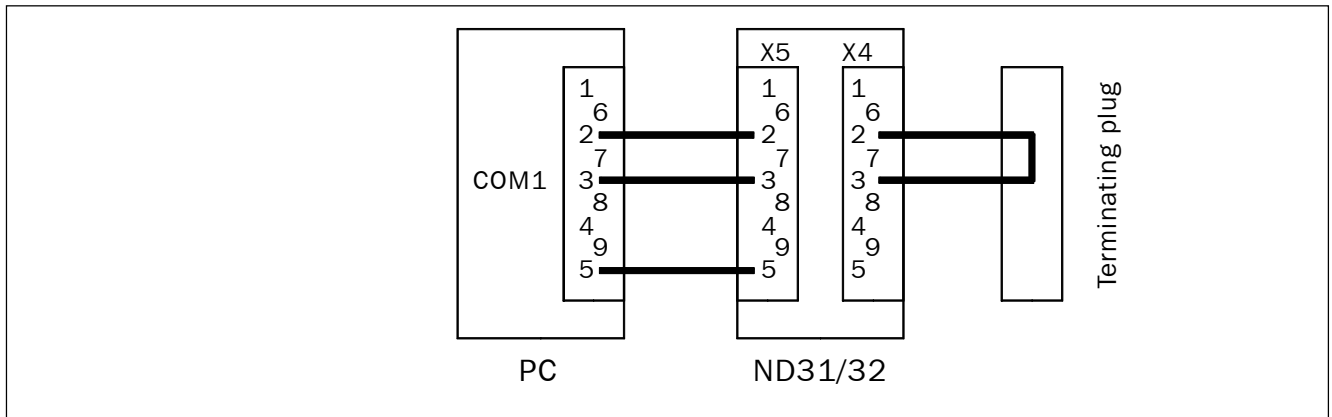


Figure 4.2-2

- Earth NOVODRIVE. See manual „Basic Device“, Chapter 6.2.
- Connect the motor and the position feedback system. See „Basic Device“ manual, Chapter 5.1 and 5.2.

Caution !

Do not plug or unplug connector X2, as long as the control voltage is active! The connected encoder might be damaged!

- The power connection must be single-phase or three-phase over a motor protection switch. The maximum supply voltage for ND31 devices is 240 V. If a single-phase connection is not sufficient, interpose a transformer for generating 3 x 230 V. ND32 devices must be connected three-phase to 400 V.

Caution !

Apply mains voltage only after all other arrangements and settings are done!

- Before the mains voltage is supplied, check the wiring! Make sure voltage-carrying parts cannot be touched accidentally!



Make a final check as to whether all safety instructions according to the „Basic Device“ manual, Chapters 2.3 - 2.5 have been followed!

- Now apply the control voltage.

4.3 The 7-segment display of NOVODRIVE

If everything has been done correctly so far, the 7-segment display runs from '0' - '9' after the 24 V supply voltage has been added. If this self-test has been successful, a small 'u' is displayed.

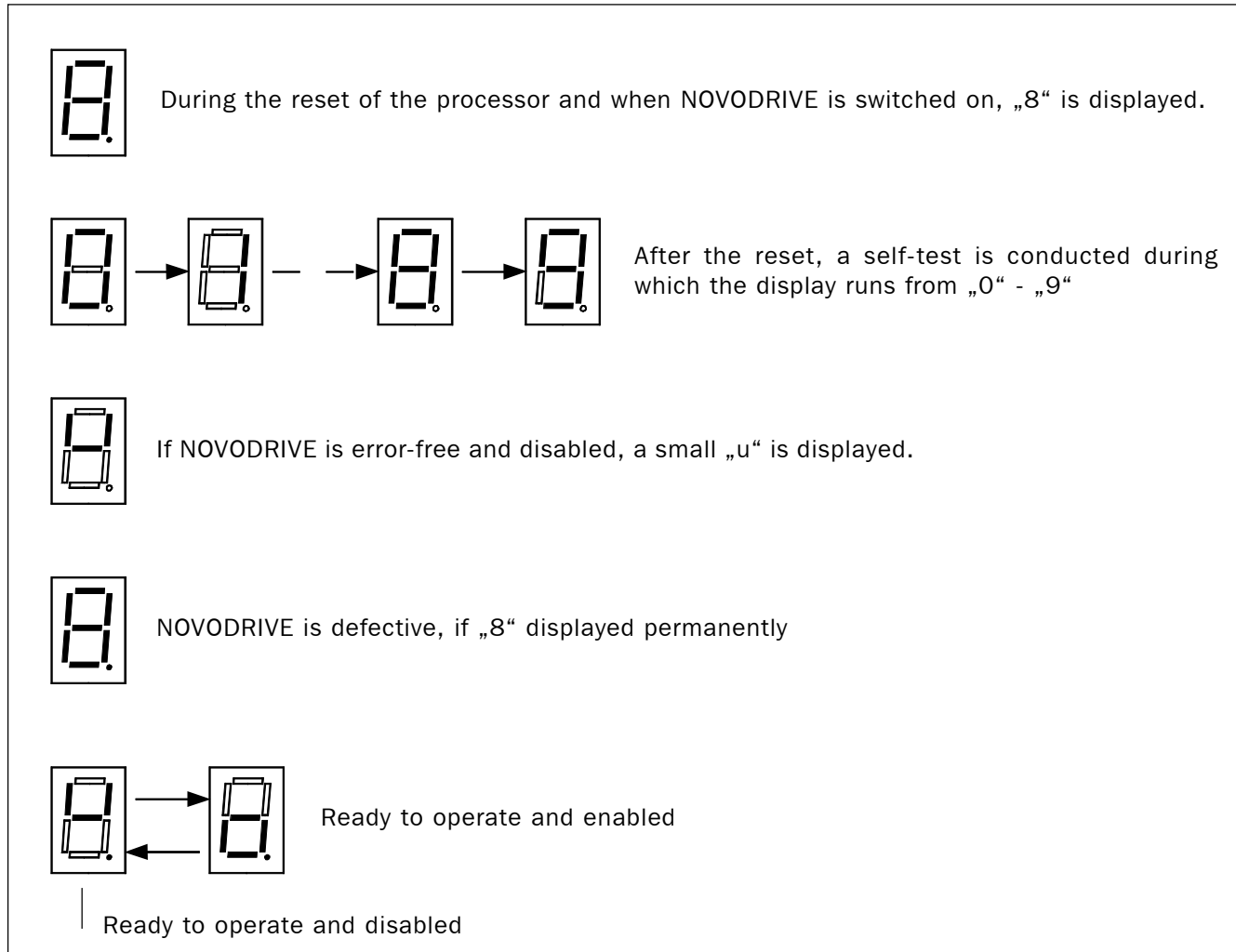


Figure 4.3.1

Power on During the reset of the processor, '8' is displayed.

Self-test After the reset, a self-test is conducted during which the display runs from '0' - '9'.

Disable If NOVODRIVE is error-free and disabled, a small 'u' is displayed. The motor has no torque yet.

Enable If NOVODRIVE is enabled, a small 'o' is displayed. The inverter now works and the motor is energized.

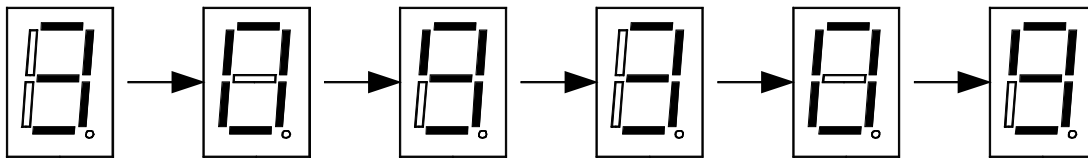
Ready to operate The dot at the bottom indicates whether NOVODRIVE is ready to operate. NOVODRIVE is ready to operate, if no error has occurred and if mains voltage has been applied.



If there is no dot visible, that does not mean that NOVODRIVE is unenergized and free of dangerous voltage! See also Chapter „Safety Instructions“ at the beginning of each manual!

Disabling NOVODRIVE does not mean that the motor is necessarily unenergized and free of voltage

Error state If an error has occurred, the three-digit error code is displayed.



If an error is identified, a three-digit error number is displayed (e.g. 3 - 0 - 9 resolver cable defective or wrongly wired)

Figure 4.3-2

The error number is also shown by the start-up software. You may also access the error buffer, which provides information about the latest 63 errors.

4.4 Basic settings of NOVODRIVE

Before you apply mains voltage for the first time, check all basic settings and make corrections and adjustments, needed!

Caution !



If the wiring has been made incorrectly or if settings of NOVODRIVE are severely wrong, NOVODRIVE and the motor can be destroyed!

- **General / Operation Modes:**
For the parameterization, select Speed Control **under** Controller Mode **and** Digital **under** Setpoint values are given through. By this, you can control NOVODRIVE over the start-up software during the configuration process.
- **General / Basic settings:**
Select the speed range 0...6000 rpm, unless you want to work with higher speeds. This setting also affects the scaling of the setpoint, so be careful after a modification!
- Set the NOVOBUS baud rate to the standard value 38400.

- For the configuration and optimization of the controls, check **Disabled with NBcontrol** under **State after reset**. Uncheck all other boxes.
- For a start-up of NOVODRIVE, it is recommended to activate the motor cable monitoring and the r.m.s. current monitoring under **General / Flags**.
- Deactivate **Controller Synchronization**. This function has been conceived for special applications only.
- If you do the first start-up of NOVODRIVE, set the peak current limitation under **Limit Values / Current** to a low value. Only if all other settings are correct, you may set the peak current limitation to the maximally permissible value.

Caution !



To avoid motor damage during the experimental phase, the peak current should be set to 20 - 30 % of the motor's rated current.

Set the value for the r.m.s. current to the value for the motor's rated current. Normally, the time constant for the calculation of the r.m.s current can remain on the standard value of 25,5 seconds. In case of smaller motors, it is recommended to reduce the time constant.

- The limitation of the setpoint for speed can be done under **Limit Values / Speed**. Set the speed value indicated as maximally permissible in the documentation of the motor or the application, respectively. Starting with version 3.06, the actual speed is also monitored and an error is generated if the value is exceeded. As a limit value, choose either 100 % or 150 % of the speed setpoint limitation. Basically, it is recommended to choose 150 %, as overshooting is very likely to occur during the process of adjustment. Check [Activate speed monitoring].
- By configuring the ramps under **Limit Values / Ramp Generator**, it is possible to define a maximum value for acceleration. Set **Memory places of ramp values** to **Rampe+** and set the maximum value according to the application's requirements. If you do not know the value, set to the highest value.

Example:

- Rated speed = 3000 rpm
- If ramp value 150 rpm/msec = 20 msec ramp length
- If ramp value 300 rpm/msec = 10 msec ramp length
- Limit values of the ramps:
- If ramp value 447 rpm/msec = 0 msec ramp length

- Set the maximally permissible tracking error on the **Limit Values / Tracking Error** page to the highest value. Only when all controllers have been optimized should the optimal value for the tracking error be set, as otherwise NOVODRIVE permanently signals an error. If you do not use the internal position controller, the setting is irrelevant.
- If you use the integrated braking resistor, set as a maximum value under **Limit Values / Brake Chopper** the value indicated in line 3 of the table in Chapter 4.2.3 of the „Basic Device“ manual. If an external braking resistor is connected, enter the permissible rated power of the resistor.
- Specify the number of poles of the motor under **Motor / Basic Settings**. If you do not know the number of poles, you must try out all settings possible. As motors with six poles are most common, try out the number of poles in the following order: 6, 4, 8, 2, 10, 12. Repeat the entire procedure for every number of poles, from auto adjustment to the adjustment of the speed controller.
- If you know the commutation offset, you may set the respective value by means of the track bar. If not, the value can be determined automatically later by means of the auto adjustment function. To do so, however, the motor must not be built in yet.
- If the motor is equipped with Hall sensors for the commutation, the pole number must always be '2'. Determine the commutation offset later by experimenting. Try out the values 0, 60, 120, 180, 240 and 300°.
- Under **Motor / Feedback System**, check
Resolver,
Encoder=position+speed, Hallsensoren=comm. or
Sinusencoder with commutation trace.

If you use a resolver as feedback system, proceed with page **Motor / Temperature Sensor**.

- If the motor is equipped with a digital encoder, enter the number of pulses per revolution under **Motor / Digital Encoder**. Uncheck [Reset of counter at zero pulse].
- If the motor is equipped with a sine encoder, enter the number of pulses under **Motor / Sinusencoder**. Check **Normal Motor**.

- **Motor / Temperature Sensor:**

The temperature sensor in the motor can be connected over the cable of the position measuring system X2 or over connector X1 (ND31) or X7 (ND32), respectively. The difference lies in the potential of the two connections. Connector X2 is at earth potential and may be used only for sensors whose insulation against the motor winding complies with regulations for reinforced insulation. Connectors X1 and X7 are at mains potential and require only basic insulation against the motor winding.

Caution !



Accidental earthing of the temperature sensor input at X1 or X7 leads to the destruction of the input!

The sensor must have a positive temperature characteristic, i.e. when the predefined resistance is exceeded, NOVODRIVE generates an error message.

If the motor is equipped with a PTC resistor, ask the manufacturer for the resistance value of the maximally permissible temperature or characteristic.

If the motor is equipped with a switch (break contact), choose a medium value of 5 kOhm.

You will find information about the temperature sensor in the data sheet of your motor.

- For being displayed by the start-up software and for the programming of the Ablaufsteuerung, a conversion factor can be specified under **Motor / Gear Factor**. This conversion factor does not affect NOVODRIVE's behavior.

- **Controller / Current Control:**

If you are not aware of other recommended values, take the following starting values for the optimization: In case of a motor inductance higher than 2 mH: P- Gain = 40 %, I- Gain = 3 %. In case of lower motor inductances: P- Gain = 10 %, I- Gain = 1 %. You will find information about the motor inductance in the data sheet of your motor.

- The value for the EMF of your motor is given in the data sheet of the motor. However, it is recommended to determine the value later by experimenting and to set the value '0' at the beginning.

Starting values for current controller

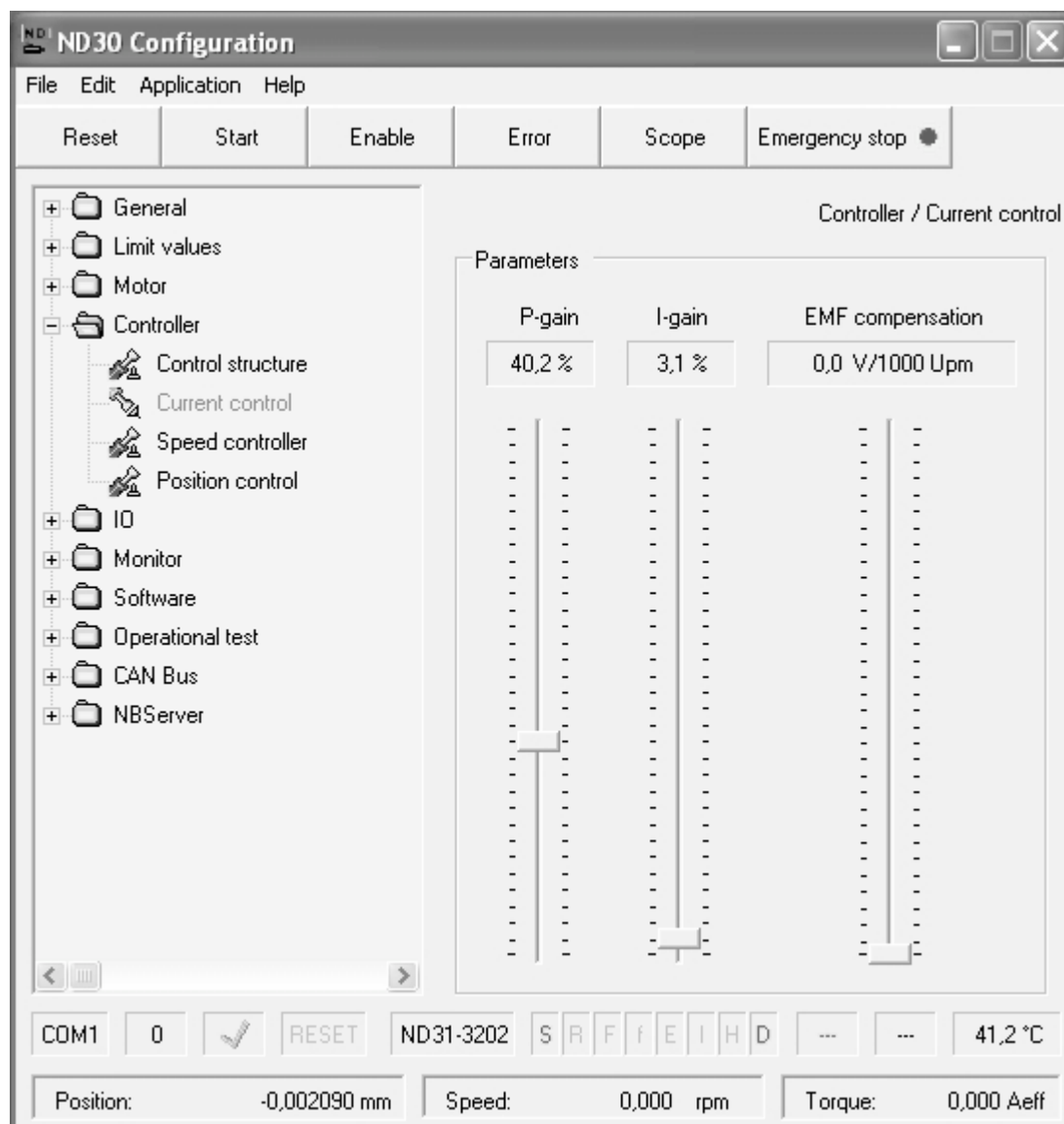


Figure 4.4-1

- **Controller / Speed Controller:**

Take the following starting values for the optimization: filter for setpoint = 0 %, filter for actual value = 0 %, pre-control = 0 %, P- Gain = 14 % and I-V = 5 %, unless you have other values for the motor.

Starting values for speed controller

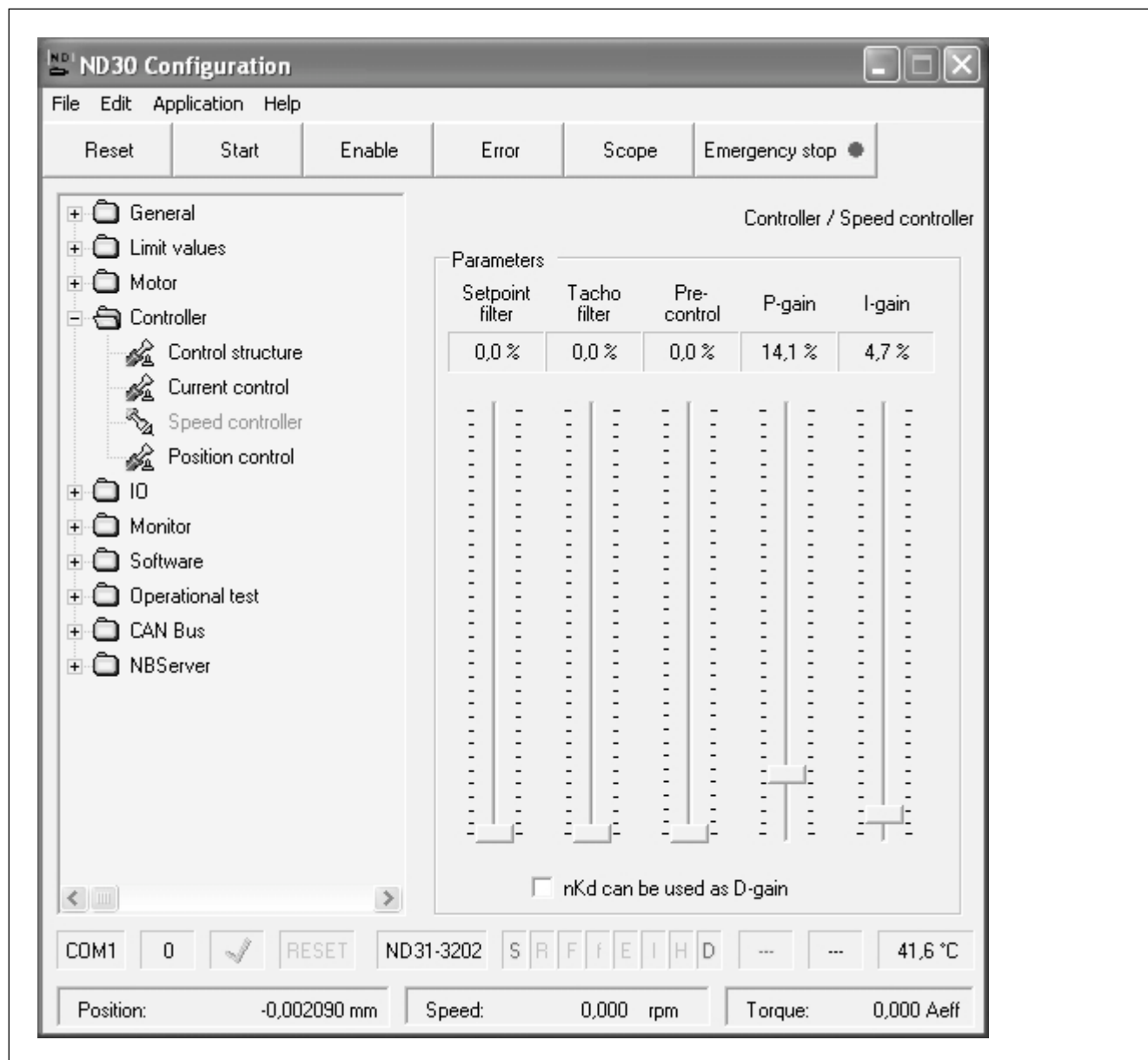


Figure 4.4-2

- **Controller / Position Control:**

Take the following starting values for the optimization: pre-control = 100 % and P- Gain = 10 %. If you do not use the integrated position controller, these settings are irrelevant.

Starting values for position controller

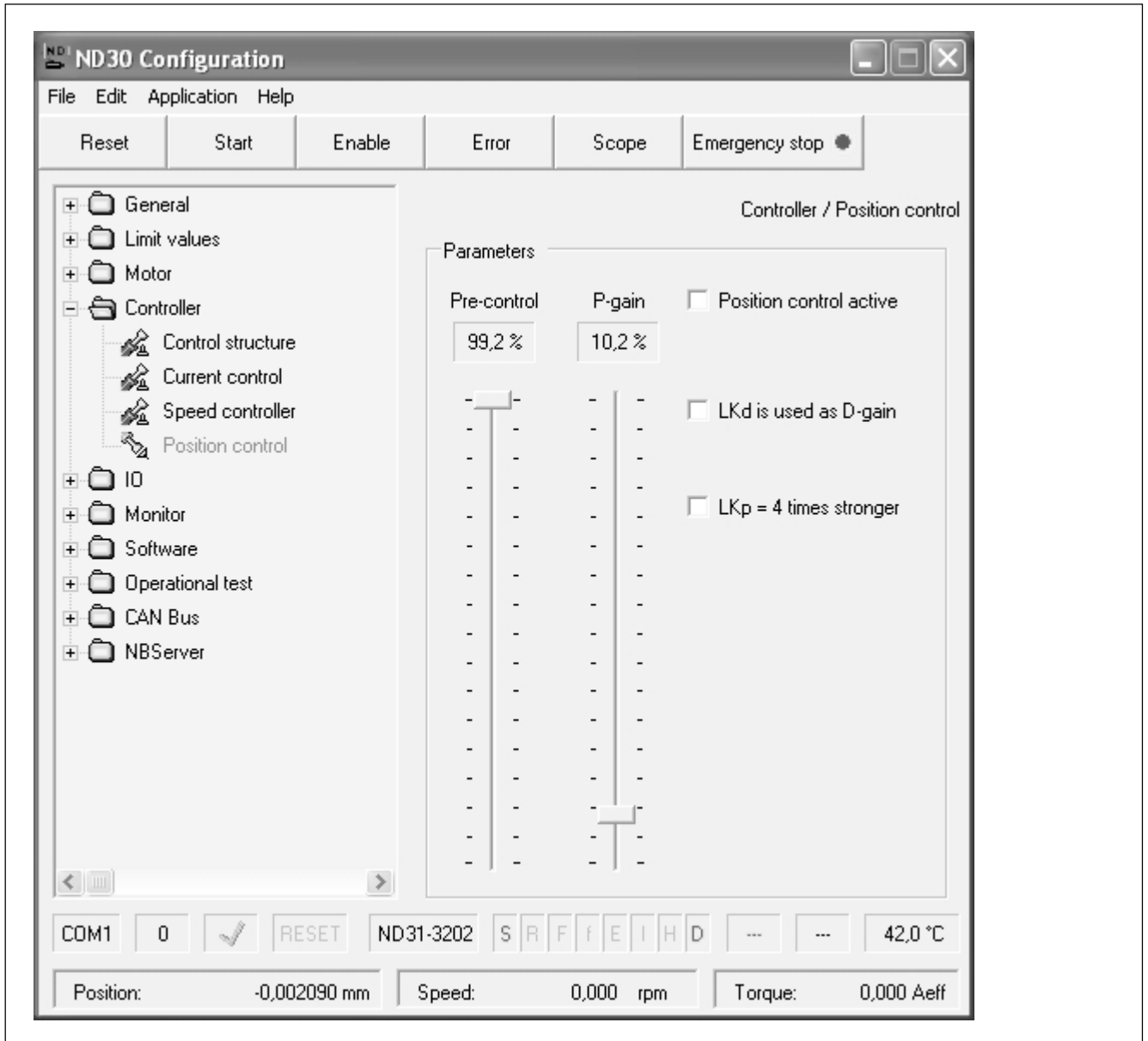


Figure 4.4-3

- The settings in the **IO** directory are irrelevant for the motor. If later you choose analog setpoint setting for speed when using the drive, you may enter the values for offset and scaling of the analog input here.
- Press [RESET] in the tool bar, in order to have the settings accepted.

4.5 Function test without main voltage

You may execute the following operational tests without mains voltage after you have applied the signal voltage:

- Check the position measuring system by turning the motor very slowly by hand. Make sure the value for the position, which is indicated in the status bar at the bottom on the left of the main window, varies accordingly. Turn the motor by at least one revolution.
- If limit switches are connected, check their functionality on the page **IO / Digital IO**. If the limit switches are activated, the lights next to **Limit Switch P** and **Limit Switch N** must change (0 V = black, 24 V = green).

The basic setting is now completed. You may now apply mains voltage.

4.6 Enabling of NOVODRIVE

The aim of the following parameterization is to ensure a regulated operating of the drive (i.e. motor can be stopped and run at low speed). This can be achieved,

- when the motor stands still while the setpoint is '0' or a stop signal is active,
- when the motor moves slowly while a low setpoint is set,
- when the motor achieves maximum speed while high setpoints are set,
- when the motor's reactive current is practically zero in all operating states,
- when the motor responds to setpoint changes with minimum delay and overshooting.



If the motor keeps moving although the starting input has been removed or if the motor oscillates between two fixed positions, an invalid setting has been made.

A description of typical errors including measures for troubleshooting is given in the chapter 'Diagnosis'.

- If you have not determined the commutation offset yet, now it is the right time to do so. Make sure that Enable and Start in the tool bar are not active and that the switches S1 and S2 (see Fig. 4.2-1) are closed. Then connect to mains supply. Go to page **Motor / Basic Settings**.



Make sure the motor is able to turn freely. Then press the auto adjustment button. The motor 'jumps' to a certain ('preferred') position.

Wait until the progress bar indicates completion of the process. If an error has occurred, follow the troubleshooting instructions, clear the error and repeat the procedure. Further information on this is given in the „Basic Functions“ manual, Chapter 3.6.9.

- For NOVODRIVE's first enabling, close S1 and press [Enable]. The inverter now works and the motor should now be in the regulated (i.e. the motor can be stopped and run at low speed) operating mode. The motor must stand still and generate a holding torque. It should not be vibrating, howling, jumping in a preferred position or racing off at high speed. No error message may occur.
- If the motor now runs uncontrolled at high speed, the commutation offset or the number of poles is set wrongly.
- For setpoint setting, close S2 and press [Start].
- Go to page **Operational Test / Speed Command** and enter a speed value of 10 - 20 rpm. The motor must now move slowly in one direction and by two revolutions at least. If you change the spinning direction, the motor must respond to this change immediately.



If you have come this far, the wiring and the basic setting have been done correctly. Now proceed with the fine setting.

4.7 Current controller configuration

Note This section of the manual is only relevant for starting up and operating an unknown motor.

The parameterization of the current controller comprises the setting of the PI controller and the EMF compensation. These are two basic configurations that must be done only once for each combination of NOVODRIVE and a certain motor type.



The configuration of the current controller should be done with the motor not yet built in or outside the application, for this allows you not to worry about mechanical stops, limit switches etc.

All settings of the current controller are made on the page **Controller / Current Control**.

In order to check the settings, use NOVODRIVE's integrated oscilloscope function. To do so, go to page **Monitor / Oscilloscope** and provide for the following configuration:

Channel 1	Ia(ist)
Channel 2	Ia(soll)
Trigger	Sollwert
Level	0
Edge	any
Delay	- 3 div
Time Base / Div	10 ms
Auto Trigger	Active

Both switches should now be closed and [Enable] and [Start] should be active. Go to page **Operational Test / Speed Command** and enter a small value for speed. You should now see the curves of the current's actual value and the setpoint in the oscilloscope window.

If the motor turns with no or just a small load connected, only small currents occur. In order to be able to assess the current controller configuration, put the drive into the reversing mode. To do so, set a medium speed setpoint and raise the speed ramps until the peak current is active for at least 30 ms.

Switch on the reversing mode and uncheck **Auto Trigger** on the page **Monitor / Oscilloscope**.

Raise the speed until you can see a graphical representation as shown in Figure 4.7-2.

Configuration procedure Go to page *Controller / Current Control* in order to optimize the **current controller**.

Take the following starting values for the optimization: in case of a motor inductance higher than 2 mH: P-Gain = 40 %, I-Gain = 3 %; in case of smaller motor inductances: P-Gain = 10 %, I-Gain = 1 %. Set the EMF compensation to '0'.

After that you can increase the P-Gain slowly until the current controller starts to oscillate. You can hear this as a singing noise, and you can see oscillations on the oscillogram. Then reduce the P-Gain again until the oscillations are gone. Then do the same procedure with the I-Gain.

During the configuration process, the following error messages may occur: 307 (short-circuit), 308 (overcurrent), 315 (r.m.s. current monitoring) and 978 (motor cable). Error 307 indicates that the current controller oscillates very strongly, whereas Error 308 indicates that the current controller is set a little too high. Error 978 is generated if the motor inductance is set very high (switch off the monitoring then) or the current controller is set too low. Error 315 is generated if the r.m.s. motor current is too high (reduce the speed and/or the ramp values then).

You can delete the error messages after you have disabled NOVODRIVE. Before you enable NOVODRIVE again, the latest setting (the one that generated the error) should be made undone.

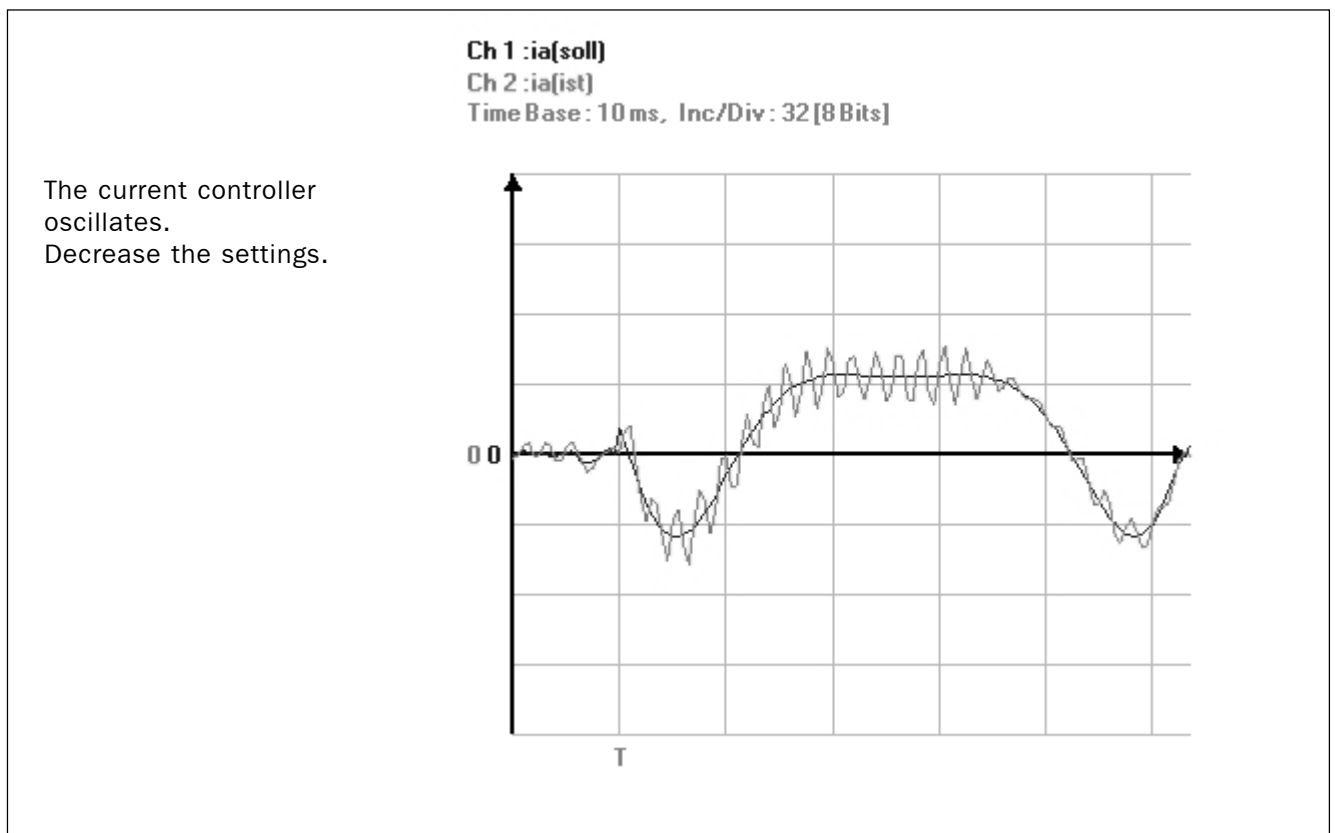


Figure 4.7-1

The aim of the optimization is to achieve best possible congruence of the current's setpoint curve and the current's actual value curve, while avoiding that the current controller oscillates.

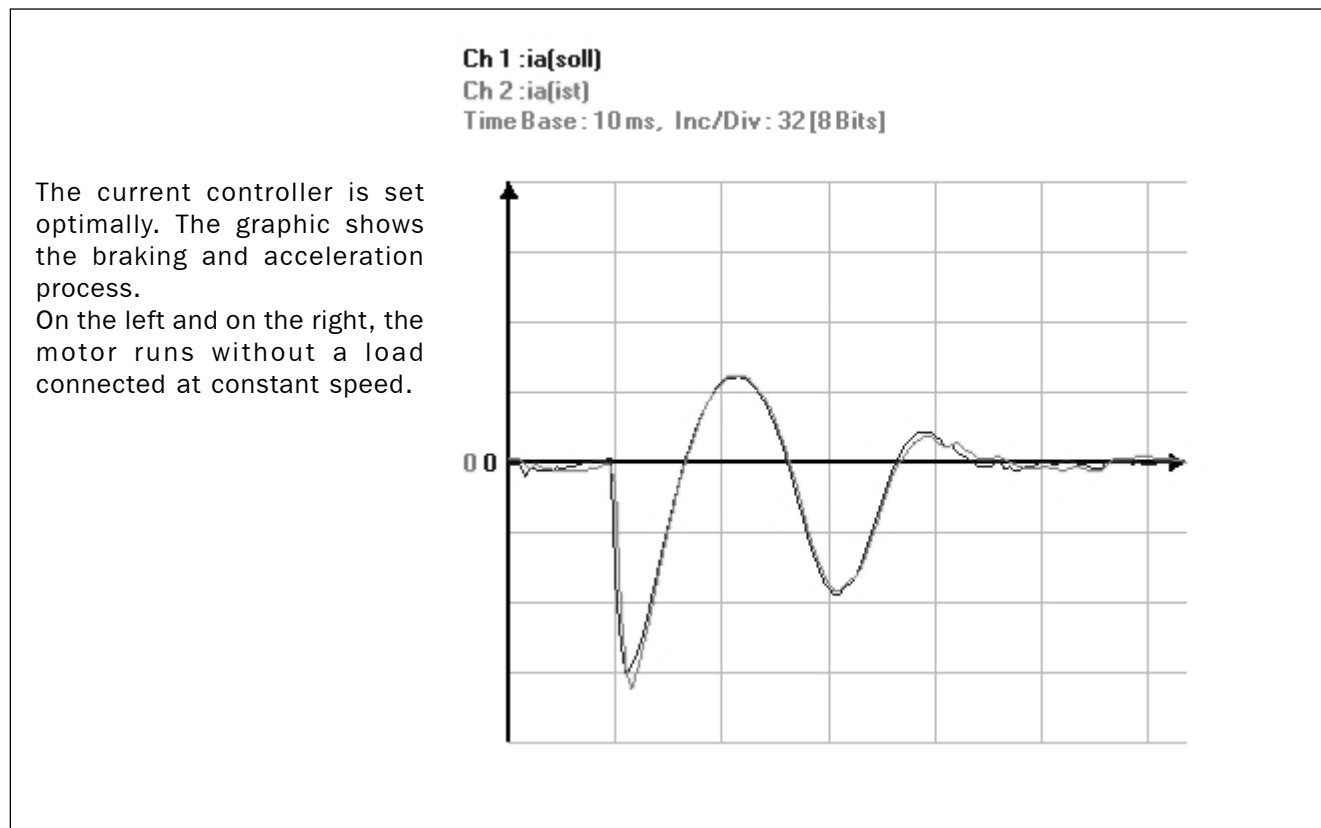


Figure 4.7-2

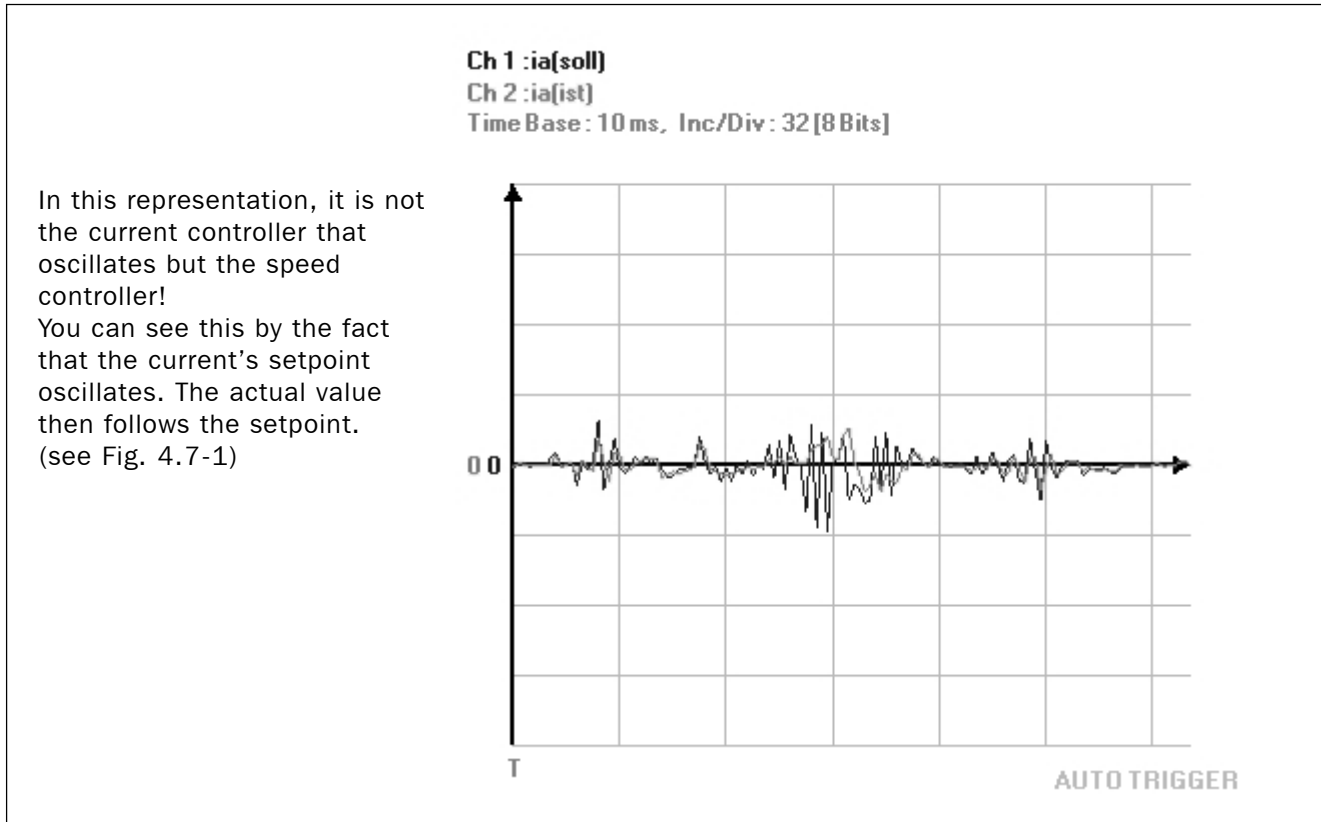


Figure 4.7-3

If you have found a proper configuration, you may now increase the peak current limitation to the value permissible for the motor and the controller.

Despite an optimal setting of P-Gain and I-Gain, a significant phase shift of the current's actual value and the setpoint may remain. This phase shift can be corrected by means of the EMF compensation. You can determine the optimal EMF compensation by constantly letting the motor spin in one direction at approx. 2/3 of its maximum speed while increasing the EMF compensation slowly until the current graphs are congruent. After that you must reduce the EMF compensation again by several percent.

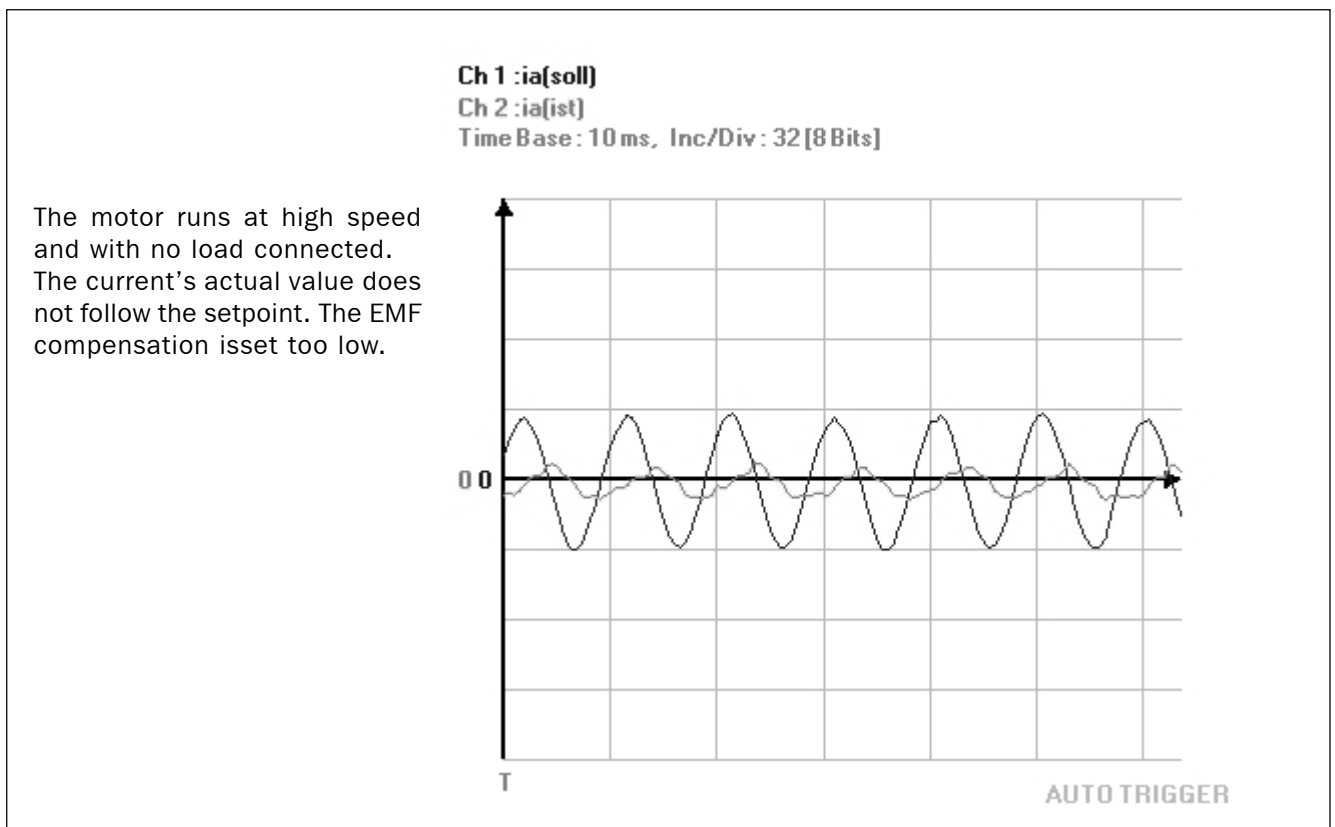


Figure 4.7-4

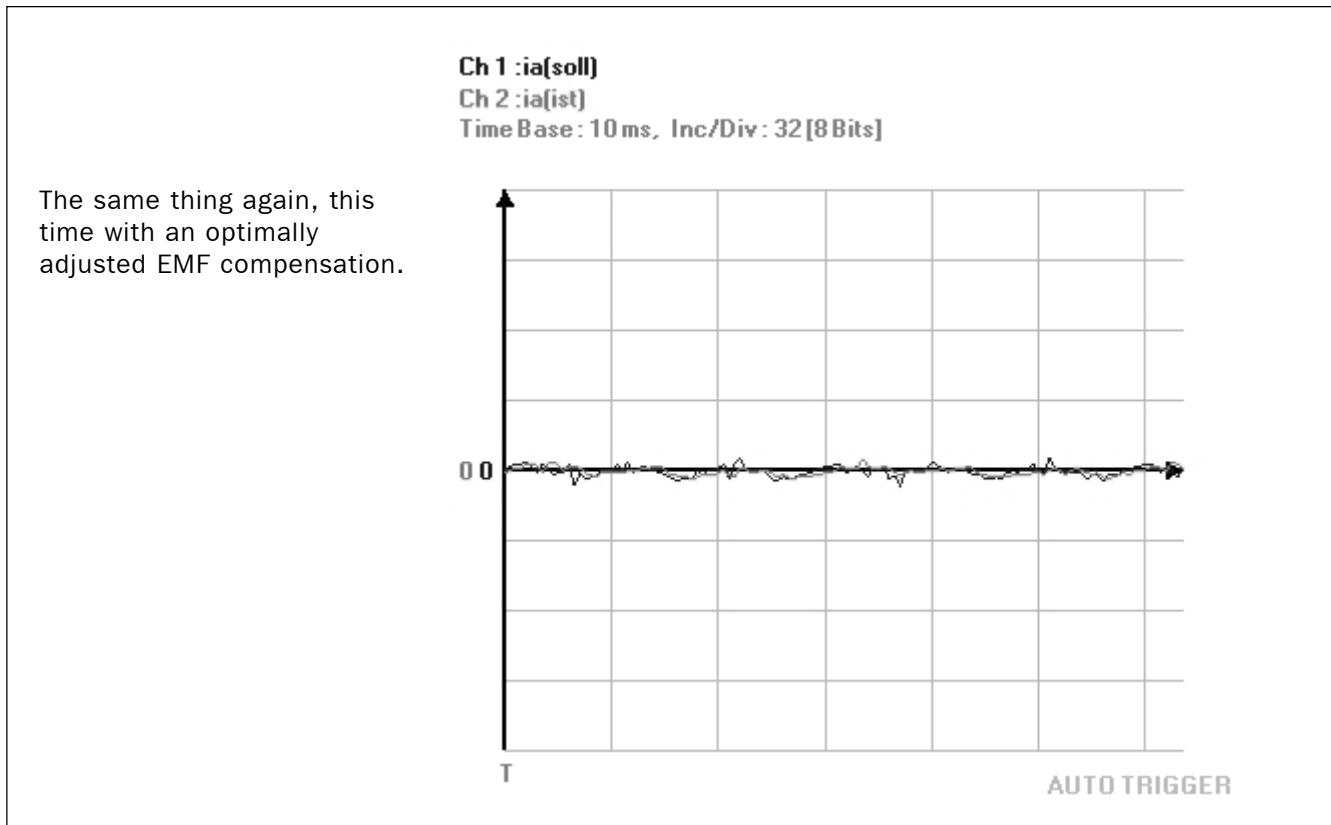


Figure 4.7-5

Attention



If you operate a motor that has a DC link voltage higher than the voltage maximally permissible for the motor, two things can happen:

- **The insulation can fail!**
- **The motor can race off at a speed considerably higher than desired! This is the case if, for example, the EMF compensation lies above the optimal value.**

As there is a mutual dependence of several settings, it is recommended to repeat the auto adjustment now and to check the current controller configuration again afterwards.

If the current graphs are sufficiently congruent, you may now proceed with the speed controller configuration.

4.8 Speed controller configuration

The settings of the speed controller and the position controller depend on the behavior of the load, among other things. Therefore make all remaining settings with the motor built in.

The settings on the pages **Limit Values / Speed** and **Limit Values / Ramp Generator** must comply with the recommended data for the motor and the application.

All settings of the speed controller are made on the page **Controller / Speed Controller**.

Go to page **Monitor / Oscilloscope** and provide for the following configuration:

Channel 1	n(soll)
Channel 2	n(ist)
Trigger	Sollwert
Level	0
Edge	any
Delay	- 3 div
Time Base / Div	20 - 200 ms, depending on mass relations

The scaling of the time base should be adjusted to the time needed for acceleration of the motor as specified by the ramp.

The position controller should be switched off. On page **Operational Test / Speed Command**, set a setpoint for speed that lies in the middle or upper sector of the speed range used later, and switch on the reversing mode. By doing so, the spinning direction is reversed approximately every second.

If there is not enough room for the reversing procedure, either reduce the speed until it works (however, the speed might now be too low to assess NOVODRIVE's behavior) or let your control unit move NOVODRIVE now.

In the latter case, switch the operating mode as desired and make a reset.

Configuration procedure

The speed controller is a PI controller with torque pre-control. Take the following starting values: filter for the setpoint = 0 %, filter for the actual value = 0 %, pre-control = 0 %, P-Gain = 14 % and I-Gain = 5 %.

Higher values make the drive 'harder' and 'stiffer', but also noisy. Lower values make the drive 'softer' and more silent.

First, increase the P-Gain until the speed controller starts to oscillate. The motor now howls, and you can see oscillations on the oscillogram. Then reduce the P-Gain again until the oscillations are gone.

Then do the same procedure with the I-Gain. Try not to let the actual speed overshoot.

The pre-control improves the motor's behavior by giving additional torque at a speed setpoint change. However, the pre-control increases the noise if you have chosen analog setpoint setting. You can view the impact of the pre-control primarily in the first half of the ramp. Later on, the effect of the pre-control is taken over by the I-Gain.

The filter for the actual value is a low-pass filter by which you can reduce the noise. However, it also reduces the system's bandwidth.

The setpoint filter is a low-pass filter for the speed setpoint. It has been conceived for setting values for position in the step/direction mode, and it is normally set to 0 %.

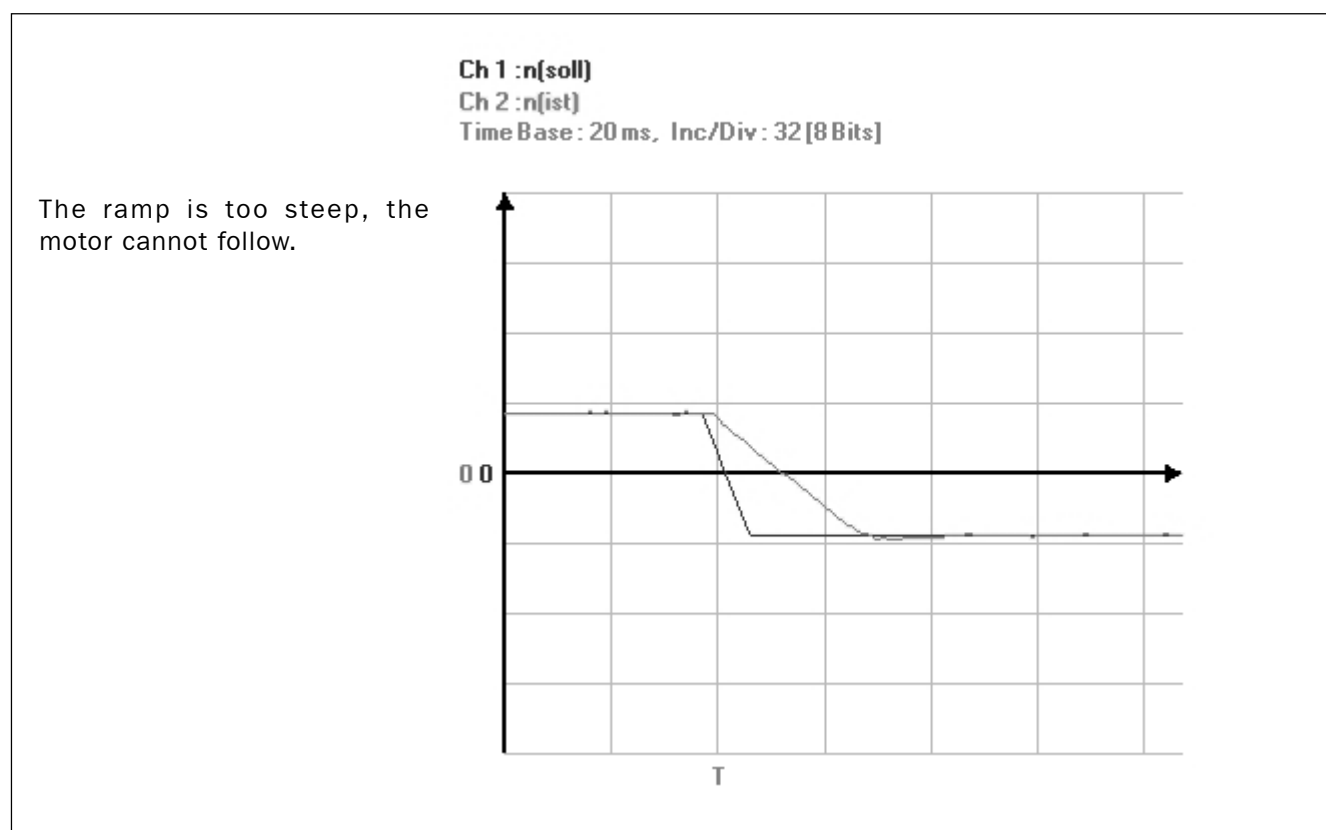


Figure 4.8-1

(Continuation of Figure 4.8-1):
You can tell this from the fact
that the torque setpoint
remains at the lower limit for
some time. During this time, no
more regulation takes place.

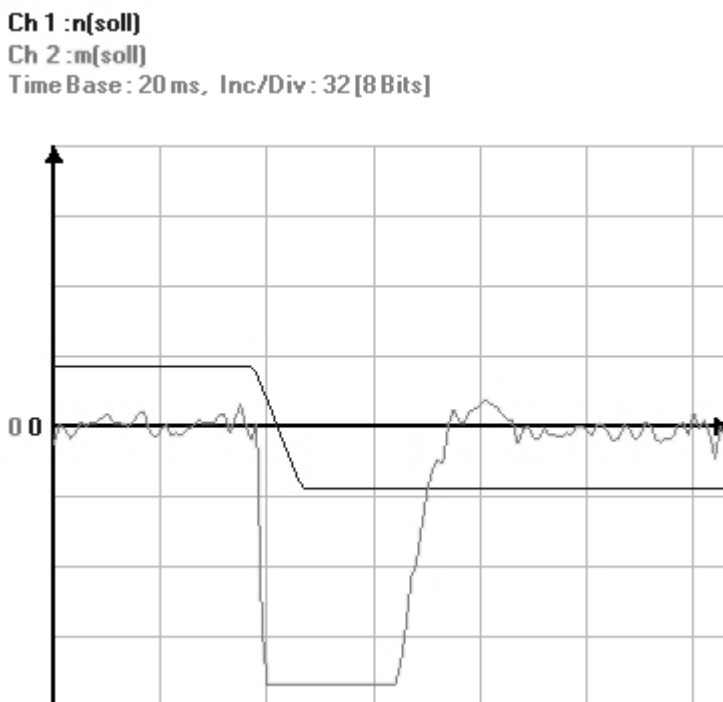


Figure 4.8-2

The p-Gain is set too high. The
Motor makes noises.

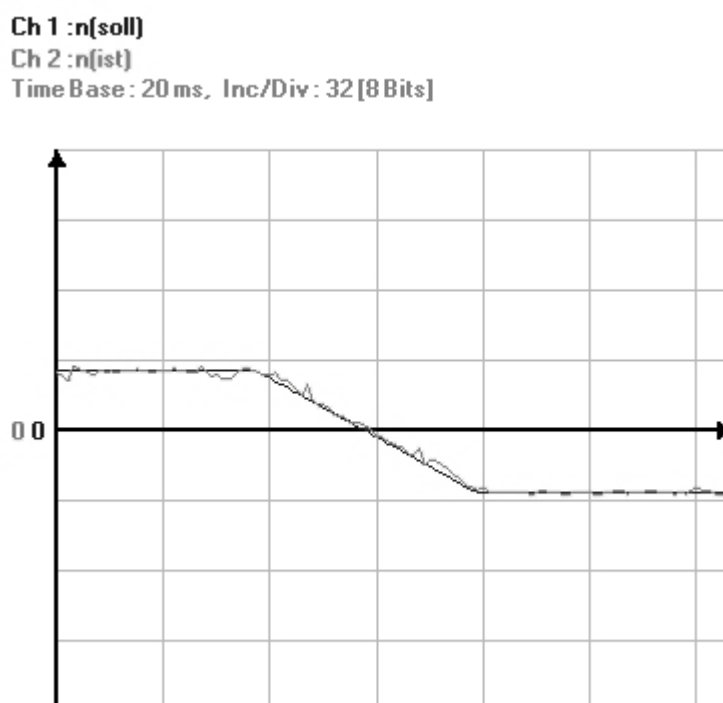


Figure 4.8-3

The I-Gain is too high.

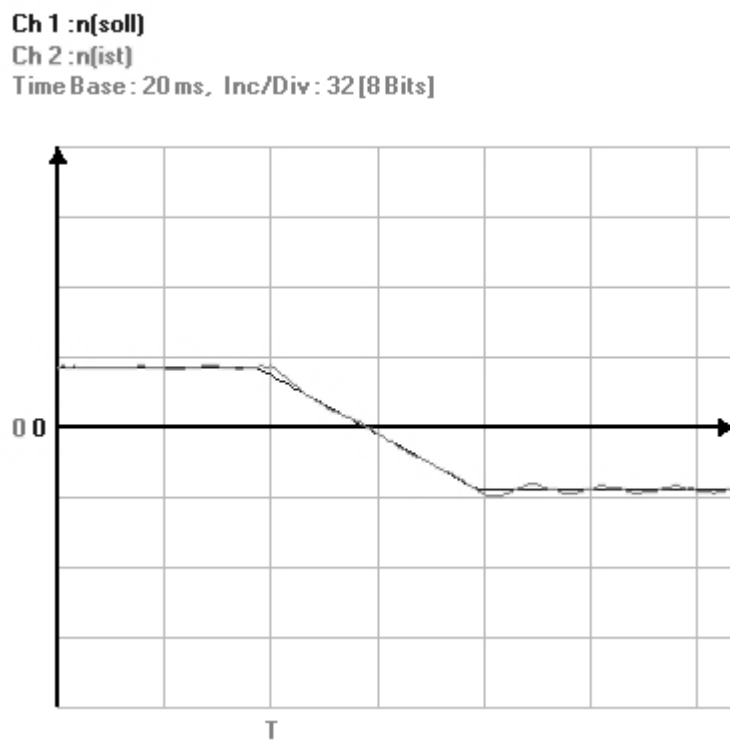


Figure 4.8-4

The speed controller is set optimally.



Figure 4.8-5

4.9 Position controller configuration

Note Configuring the position controller is necessary only if you use the integrated position control. If you plan to work with analog speed setpoint setting, for example, you may skip this chapter.

Switch on the position controller, for example by going to page **General / Operation Modes** and selecting **Speed control with position controller** under **Controller Mode** and **Digital** under **Setpoint values** are given through. Alternatively, you may switch on/off the position controller on page **Controller / Position Control**. However, that setting is not saved when the device is switched off.



Switch on the position controller only when NOVODRIVE is not enabled! Also when the position controller is switched off, a tracking error can occur, causing the motor to race off at maximum speed when the position controller is switched on!

We recommend to choose the same oscilloscope settings for the position controller parameterization as used for the speed controller parameterization. However, instead of the signals **n(ist)** and **n(soll)**, you should now choose **Lage(ist)** and **Lage(soll)**, by which a more precise assessment of the controller's behavior is made possible. Also the operation mode should not be switched.

Configuration procedure NOVODRIVE's position controller is a P-controller with speed pre-control. Take the following starting values: P-Gain = 20 % and pre-control = 99 %.

On the page **Limit Values / Tracking Error** you can clear the buffer for the tracking error. You then get the maximum tracking error.

The optimal value for the speed pre-control lies between 90 % ... 99 %. Only if resonances are produced by the pre-control and the speed controller, it is reasonable to set a lower value.

If the P-Gain is set much too low, the distance between **Lage(ist)** and **Lage(soll)** grows with every movement of the motor. In this case, the curves of **Lage(ist)** and **Lage(soll)** show no correlation. If you increase the P-Gain, the curves of **Lage(ist)** and **Lage(soll)** suddenly become parallel after a certain value is exceeded.

Keep on increasing the P-Gain until the two curves are congruent. Further optimization can then be made only by means of the buffer for the maximum tracking error, which, unlike the graphical representation, indicates the tracking error in a fraction of a degree.

If the P-Gain is set too high, the tracking error grows. Moreover, noises occur that are caused by the position controller's oscillation.

If modifications of the P-Gain show no effect, this may be due to the speed controller being set too low.

It may be necessary to reduce the I-Gain of the speed controller after switching on the position controller. Adjust the parameters until you achieve the desired transient behavior.

Upon completion of the configuration process you may activate the tracking error monitoring and determine the maximally permissible tracking error. If the limit value is exceeded, Error 700 is generated.

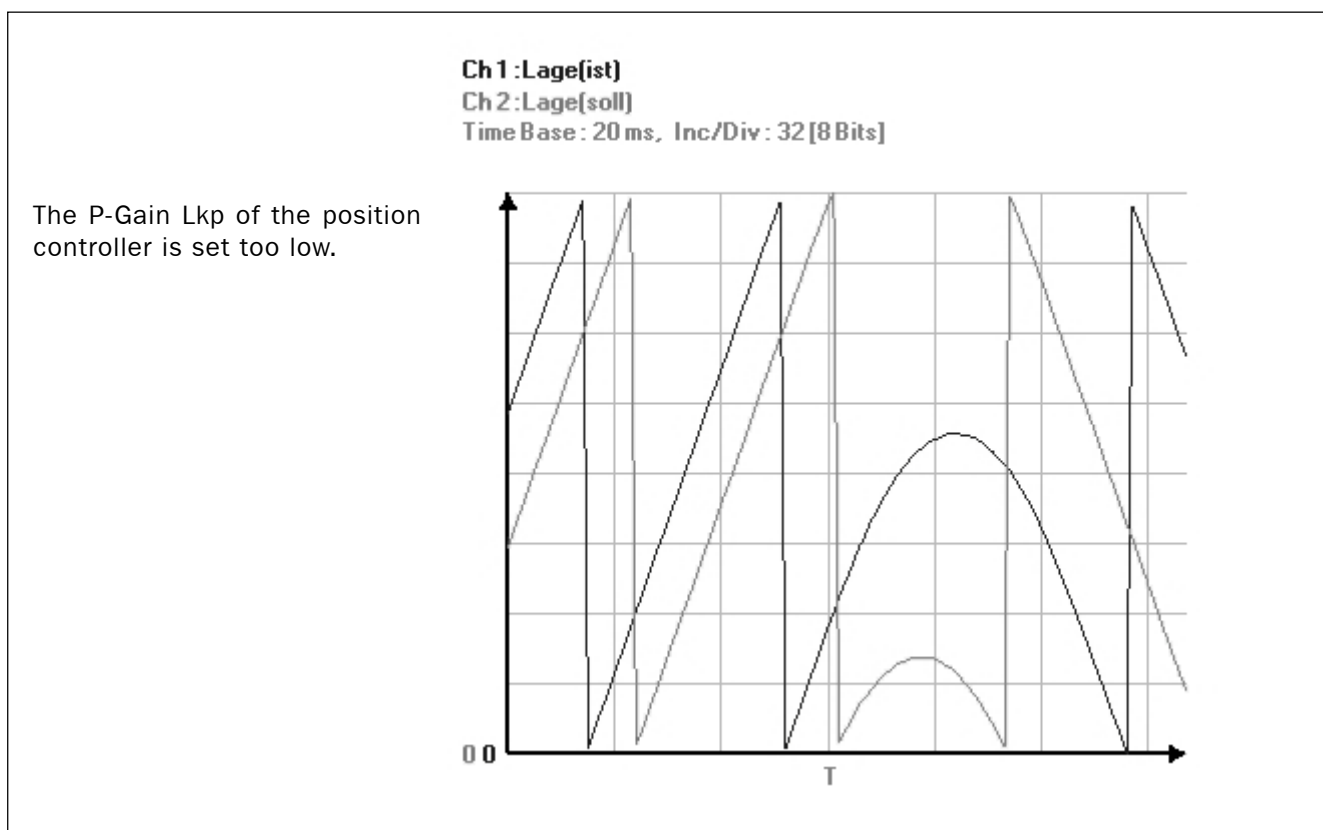


Figure 4.9-1

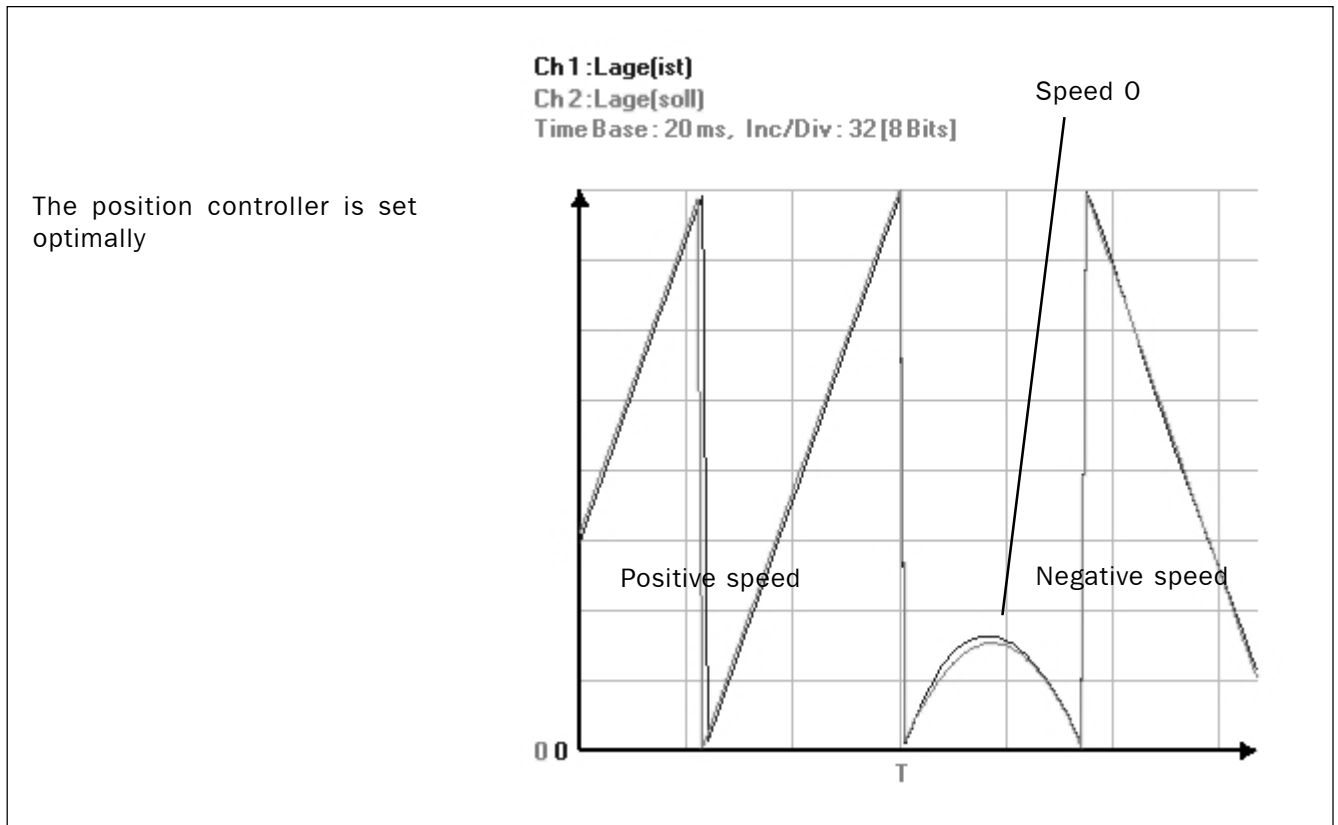


Figure 4.9-2

4.10 Recommendations for configuring the controllers

- High-frequency singing and other noises are normally due to oscillations of the current controller. Reduce P-Gain, I-Gain and EMF compensation on page **Controller / Current Control**, until the noise is gone.
- Current controller oscillations mainly occur during braking, when the DC link voltage is very high.
- Low-frequency noises or vibrations are caused by the speed controller, the position controller or by disturbances of the feedback system (resolver or encoder).
- Minor vibrations can be attenuated by setting the current controller lower. However, the vibrations are not caused by the current controller but by the speed controller and the position controller. In this case, the current controller works as a low-pass filter that attenuates the signals.
- The setting of the actual-value filter for speed (**nFilter**) can have a huge effect. If the filter is switched off with 0 %, the P-Gain of the speed controller is recomputed every 100 μs , i.e. the speed controller's bandwidth rises.
A value higher than 0 % causes a low-pass filtering of the system, and the speed controller's P-Gain is recomputed only every 512 μs .

- Do not set the setpoint filter and the actual-value filter too high (controller gets red). If a certain value is exceeded, rounding errors in the algorithm can occur that may cause the motor to creep although a stop command has been set.
- Some procedures can be executed correctly only after other settings have been optimized. It is therefore reasonable to perform the entire controller configuration procedure several times. Take the auto adjustment function, for example: If the current controller has been set very inadequately, the results of the auto adjustment cannot be optimal. On the other hand, the current controller itself can be set optimally only after the commutation offset has been set optimally.

4.11 Possible mistakes during the start-up procedure

After the motor is enabled, it can respond to a setpoint in various ways:

- The motor takes a certain ('preferred') position. If you change the setpoint or the spinning direction, the motor moves to another position.
→ Two wires in the feedback system connection or the motor cable connection have been assigned the other way round or a wrong pole number has been set.
- The motor races off at high speed and cannot be controlled by the setpoint. It also does not react on a stop command.
→ The commutation offset **PhiPO** is incorrect or several wires in the feedback system connection or the motor cable connection have been wrongly assigned in-phase.
- The motor does not move or has almost no torque.
→ All controllers are set too low.
- The motor moves. After a stop command, it decelerates until it stands still.
→ Correct wiring and configuration.

Wrong wiring

If the feedback system and the motor winding do not have the same spinning direction, this may be due to wrong wiring. If you have a motor wiring list at hand, check whether the wires in the cable are interrupted or whether two wires have been assigned the other way round.

If the problem still occurs, exchange two motor cables at Connector X1 (e.g. A2 and A3) and repeat the entire procedure.

Wrong configuration Check the following settings:

- the number of poles of the motor,
- the feedback system (Error 705 or 309 is generated),
- the impulse number, if an encoder is used.

Commutation offset If the motor spins uncontrolledly after it has been enabled and if you cannot control the motor by means of the setpoint, the commutation offset (**PhiPO**) is set wrongly. You can adjust this parameter on the page **Motor / Basic Settings**.

Note **A fast moving motor at the beginning of the operation process is no sign of correct functionality. Critical aspects during the start-up procedure are controlled standstill and slow movements that can be influenced by the speed setpoint!**

If these initial requirements are fulfilled, you may proceed with higher speed values.

5 Diagnosis

5.1 Start-up trouble

5.1.1 The motor does not react at all

If this is the case, help is provided on the **Monitor / Troubleshooting** page. If errors have occurred, the respective light changes from black (OK) to red (error).

- **In error state:**
NOVODRIVE has generated an error. The error code is indicated in the status bar. Eliminate the error cause and clear the error message.
- **Waiting for disable:**
The error has been eliminated and the error message cleared, but NOVODRIVE is still in the enable state. Remove the enable signal, then provide it again.
- **Limit switch:**
The limit switch has responded. If the limit switch monitoring is active, either stop or an error code is generated. There might be also a mistake in the wiring at Connector X3.
- **DC link voltage:**
The DC link voltage is too low. Usually, Error 976 is generated. Check the mains voltage wiring („Basic Device“ manual, Chapter 5).
- **Desired value:**
The setpoint is missing. Check the settings under **General / Operation Modes**. If relevant, check if your control unit provides a setpoint (e.g. analog voltage as setpoint source).
- **Motor is probably blocked mechanically:**
Check if the motor is blocked by an active brake or something similar.
- **Enable and start:**
If there is a red light under **stopped by**, the start signal is missing. If there is a red light under **disabled by**, the enable signal is missing. In the case of register **NBcontrol**, these are the start and enable signals over NOVOBUS. Maybe the **Freigabe0** register is set wrongly. If there is a red light under **Hardware**, check the wiring of the digital inputs GPIN 3 and GPIN 5 at Connector X3 (see Figure 4.2-1).

Troubleshooting page

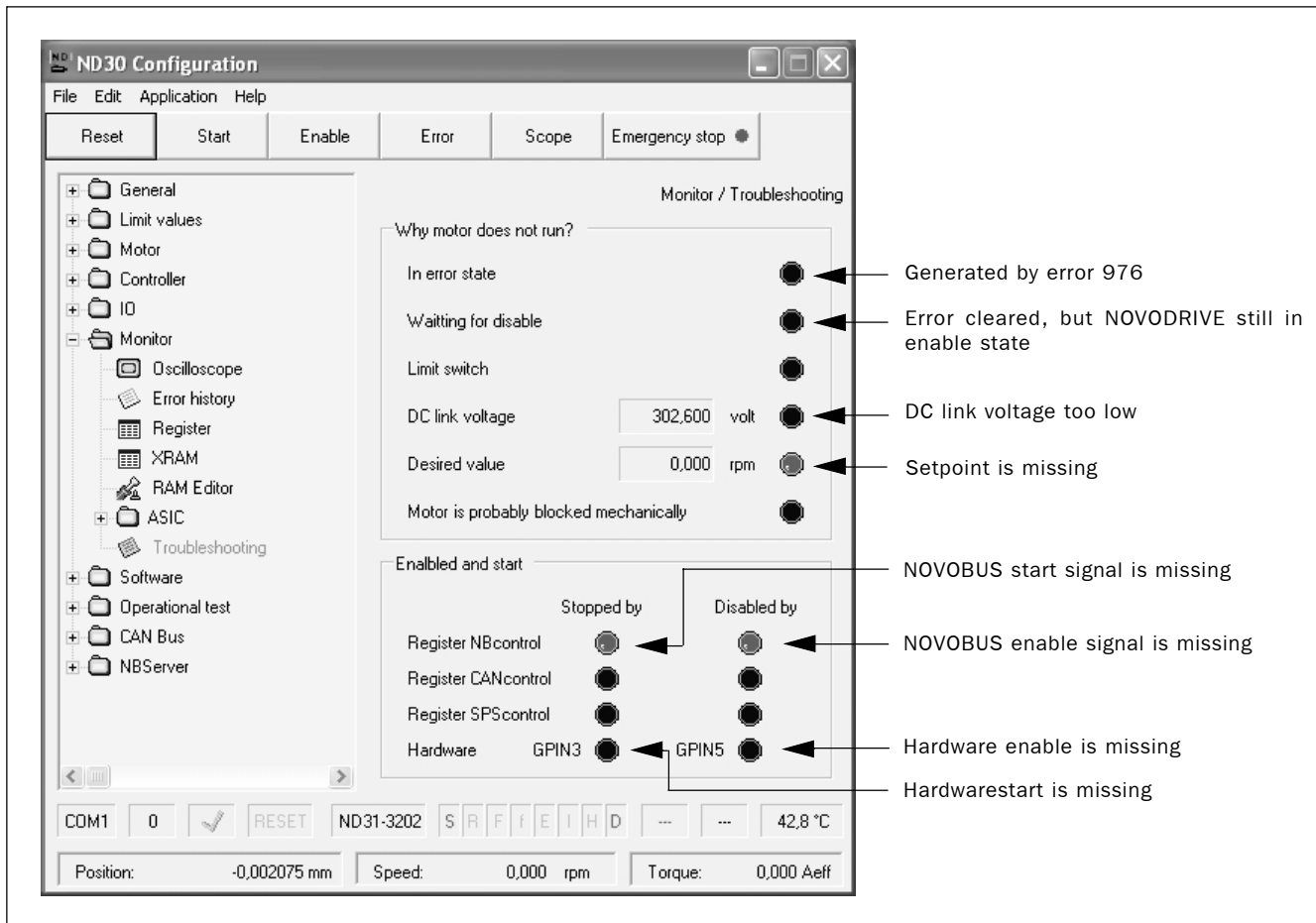


Figure 5.1-1

5.1.12 The motor takes a certain ('preferred') position after enabling

The feedback system and the motor winding do not have the same spinning direction. Check

- the order of connection of the motor phases,
- the connection of the feedback system (resolver, encoder),
- the parameterization of the number of poles of the motor.

5.1.3 The motor produces high-frequent noise

The current controller oscillates and is unstable. Reduce I-Gain, P-Gain and EMF compensation until the noise is gone.

5.1.14 The motor vibrates or howls after enabling

The speed controller or the position controller oscillates. Reduce the settings of both controllers one after another until the vibrations are gone.

5.1.15 Error 307 (short-circuit)

Unless a mistake in the wiring has been made, short-circuit has been produced or the motor winding has been damaged, this error may be caused also by an oscillating current controller. See Error 308.

5.1.16 Error 308 (overcurrent)

The current controller overshoots. Reduce the current controller's I-Gain, P-Gain and EMF compensation.

5.1.17 The motor does not achieve the desired speed

Check whether there is a difference between the speed's actual value and the setpoint by means of the oscilloscope function. If there is no difference, the setpoint setting is incorrect. If there is a difference, this might be the reason:

- The motor specific settings of NOVODRIVE are not optimal. Check all settings in the **Motor** directory. Make an auto adjustment of the commutation offset.
- The speed setpoint limitation is set too low.
- If the integrated position control is used, the P-Gain of the position controller may be set too low.
- The electrical design of the drive is inadequate (see „Basic Device“ manual, Chapter 7). Check the dimensioning by viewing registers **_UASOLL** and **_UBSOLL** by means of the oscilloscope function. The signals must be sine-wave, even at highest speed. If the signals are square-wave, the DC link voltage is not high enough to achieve the speed and torque desired.

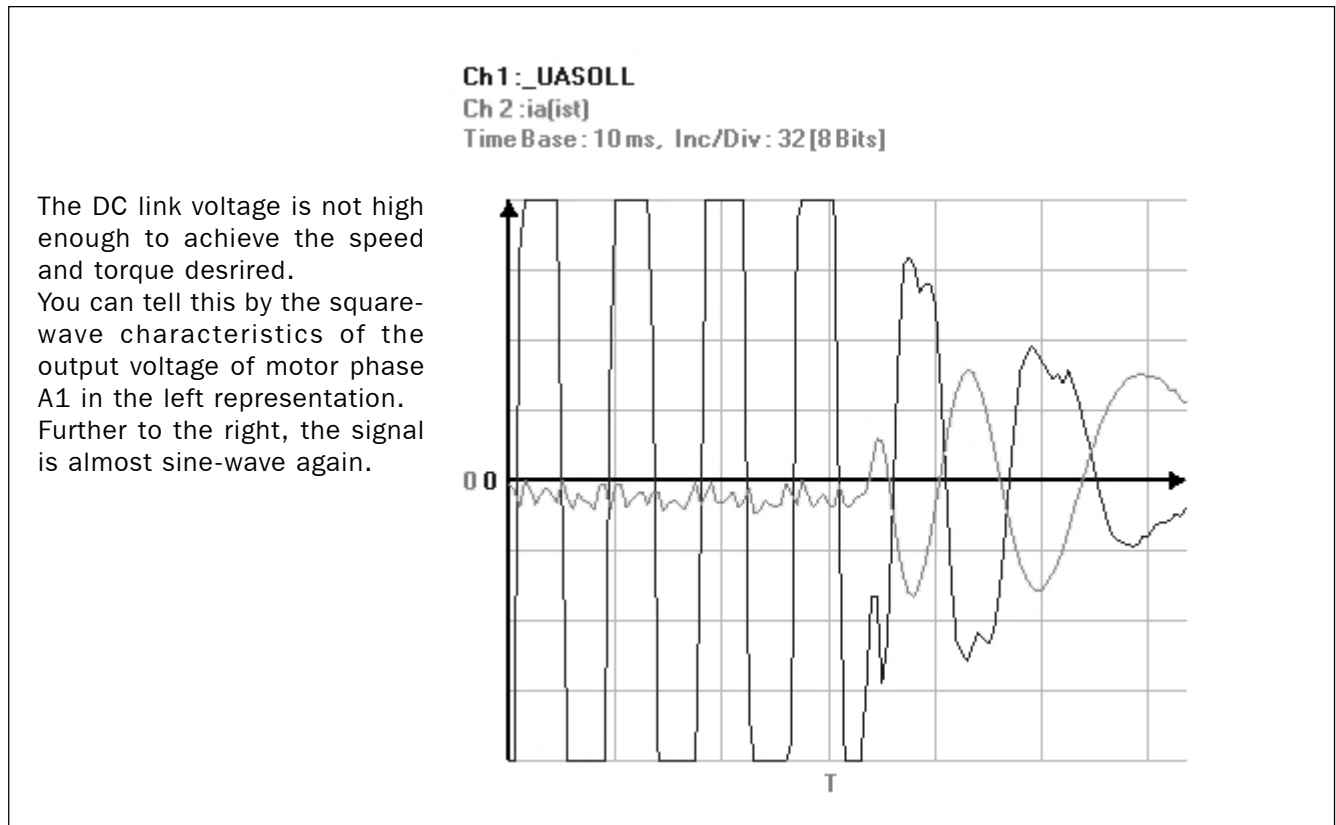


Figure 5.1-2

5.1.8 The speed overshoots

The I-Gain of the speed controller is set too high or the P-Gain of the speed controller is set too low.

6.1.9 The position overshoots (during braking)

- If the integrated position control is used, the P-Gain of the position controller may be set too low.
- The I-Gain of the speed controller is set too high.
- The motor is underdimensioned and the I²T monitoring responds and limits the maximum current, respectively. By this the motor cannot decelerate with the desired ramp anymore. The position controller must correct the drive's behavior and therefore overshoots.

5.1.10 Error 700 (tracking error)

- If this error occurs permanently, the speed controller or the position controller is set wrongly and the maximally permissible tracking error is set too low, respectively.
- If the error occurs sporadically and particularly after long cycles have been passed, this may be due to the responding of the I²T monitoring. The I²T monitoring limits the maximum current and the motor cannot accelerate and decelerate with the desired ramp anymore. A tracking error occurs.

5.1.11 The motor drifts away

- If you chose analog setpoint setting, the analog signal may be disturbed or the offset may not be aligned correctly.
- The settings for the setpoint filter or the actual-value filter are too high (see speed controller).

5.1.12 The motor does not react on the analog setpoint

The analog input has not been defined as setpoint source. Check the configuration and make a reset.

5.1.13 The motor does not react on the step/direction setpoint

Step/direction has not been defined as setpoint source. Check the configuration and make a reset.

5.1.14 NOVODRIVE does not react on analog or digital setpoints

Connector X3 is plugged incorrectly.

5.1.15 The start-up software signals „Connection interrupted“

- For being able to operate the NOVOBUS interface, insert the terminating plug at Connector X4 with a bridge between Pin 2 and Pin 3.
- You may have selected the wrong serial interface or the correct interface is deactivated.

5.2 Problems with parameters

If something went wrong during the parameterization and you cannot find the mistake, save the parameters in a html file. Under „C:\Programme\Novotron\ND30Cfg\Parameter“ you can find the standard parameter set „**Standard Resolver**“. By means of this file, you can reset NOVODRIVE to its initial state again. Load the parameter set and transfer the configuration from the html file.

5.3 Error Messages

Error codes are stored in registers as 3-digit BCD numbers.

Error number	Error	Description
001 to 100	Internal errors	Send device for repair
101	external memory	The part containing the system parameters in the battery backed-cleared up external memory has been cleared; send in device for repair
102 to 103	Internal errors	Error during initialization of variables; probably defective memory; send in device for repair
104 to 107	not assigned	
108	Betriebsart	Impermissible mode of operation
109	Internal error	Send device for repair
110	TempMotHw	Error during measuring of motor temperature
111	TempKKHw	Error during measuring of transistor temperature
112	StromA	Error during measuring of current A
113	StromB	Error during measuring of current B
114 to 139	not assigned	
140	Internal error	Send device for repair
141	Internal error	Send device for repair
142 to 210	not assigned	
211 to 223	Internal errors	Send device for repair
224 to 303	not assigned	
304	Overvoltage	DC link voltage too high; braking resistor not connected; mains voltage too high
305	Undervoltage	See 976
306	not assigned	
307	Inverter	Short-circuit of motor lead or defective inverter
308	Overcurrent	Overcurrent; current controller oscillates
309	Resolver	Defective resolver cable or resolver cable wired wrong
310	EndSchaltP	Positive limit switch has responded
311	EndSchaltN	Negative limit switch has responded
312 to 313	not assigned	
314	EndSchalter	Both limit switches have responded at the same time
315	i2t	R.m.s. current limitation has responded
316 to 399	not assigned	
400	OverTempTr	Temperature monitoring of inverter transistors has responded
401	OverTempMot	Motor temperature sensor has responded
402 to 499	not assigned	
501 to 503	NOVOBUS error	Error during communication over NOVOBUS
504	NOVOBUS	Invalid synchronous byte; frequently indicates invalid length of previous synchronous byte telegram
505	NOVOBUS Commandbyte	Invalid command byte in telegram
506	NOVOBUS Parameteradresse	Invalid address
507	NOVOBUS Checksumme	Invalid check sum
508 to 510	other NOVOBUS errors	Reserved
511 to 514	not assigned	
515	CAN error	Invalid command byte

Error number	Error	Description
516	CAN error	Invalid parameter address
517	CAN error	Invalid check sum
518	CAN error	Timeout through missing clock pulse telegram
519 to 523	CAN error	Error during communication over CAN bus
524 to 530	CAN Open error	Error codes of software extension CAN Open; see relevant documentation
531 to 576	CAN	Transmission error on CAN bus
577 to 600	not assigned	
601	PSOverflow	Error in positioning control
602	PSRampe	Ramp pointers do not point at the same registers
603	PSRampe	Ramp pointers do not point at Rampe+
604	PSRampe	Invalid ramp value
605 to 615	PSOverflow	Error in positioning control; distance too long, ramp too flat, speed too low
616	Ps?512us	Pointer ?512 μ s points at wrong start address
617	PS?sollwert	Pointer ?sollwert points at wrong address
618	PSimax	Internal error
619		Internal error
620	DisPS	No positioning control in place
621 to 650	not assigned	
651 to 660	ENDAT	Error of software extension ENDAT; see relevant documentation
661 to 699	not assigned	
700	Schleppfehler	Monitoring of tracking error has responded
701 to 704	not assigned	
705	nmax	Speed is higher than nmax (with monitoring active) or 1,5 x nmax (with monitoring inactive); or: Failure of position measuring system (see also 309)
706	SINCOS	Error of signals of a sine encoder
707 to 799	not assigned	
800	ParamPole	Invalid number of motor poles
801	Encoder error	Edges on channels A and B closer than 100 ns
802	Pointer error	A program pointer in the parameter set points at an invalid address
803	Error 512us cycle	Overflow 512 μ s cycle, computing load too high
804 to 878	Internal errors	Send in device for repair
879	Ablaufsteuerung	Autokomm function not successfully completed; reset drive to continue
880	Ablaufsteuerung AK_nichtbereit	Autokomm function cannot be started because of an error
881	Ablaufsteuerung noAutokomm	Command execution before execution of Autokomm function
882	Ablaufsteuerung Pos_Sperre	Start of a positioning procedure with disabled controller
883	Ablaufsteuerung FR_Feedback	Step/direction setting possible only with resolver as feedback system
884	CAN Profile Wegüberschreitung	Switch or marker not found within predefined path during home or zero-point search
885	CAN Profile Falsche Funktions- nummer	Invalid number of function indicated
886	not assigned	
887	H8 Version	H8 Version too old for software extension
888 to 899	not assigned	

Error number	Error	Description
900 bis 919	Internal errors	Send device for repair
920	Overcurrent	See 308
921	Overvoltage	See 304
922	Undervoltage	See 976
923 to 930	Internal errors	Send device for repair
931 to 933	Internal errors	Hardware error in connection with encoder outputs; send device for repair
934 to 936	Internal errors	Hardware error in connection with encoder inputs; send device for repair
937	Internal errors	Send device for repair
938 to 939	not assigned	
940 to 946	Internal errors	Send device for repair
947	PER Cos	Resolver error cosine; frequently indicates wrong wiring at X2
948	PER Sin	Resolver error sine; frequently indicates wrong wiring at X2
949	ExtRAM	Error in external memory; send in device for repair
950 to 956	Internal errors	Send device for repair; defect frequently caused by grounding of motor temperature sensor at connector X1 and X6, respectively
957	CAN rdwr	Error in CAN communication
958	CAN Master0	Error in CAN communication; clock pulse telegram without previous process-data write telegram
959	CAN MasterLost	Error in CAN communication; overflow of process-data write telegrams
960 to 969	Internal errors	Send device for repair
970	BallastImax	Peak-current monitoring of braking circuit; braking resistor either not connected or defective
971	BallastIeff	R.m.s. current monitoring of braking circuit; braking circuit overloaded
972	BallastTrTemp	Transistor monitoring of braking circuit; braking circuit overloaded
973	Resolver1	Unstable position measuring; defective resolver wiring or defective device
974	Resolver2	Resolver-cable monitoring; see Error 309
975	Restart	Enable after reset
976	Undervoltage	DC link voltage too low; control mains supply
977	LageSoll	Setpoint change too large in position setting mode
978	Motor cable	Motor-cable monitoring; motor is broken or bad setting of current controller
979	Overvoltage	see 304
980 to 991	Internal errors	Error of register in Potential-ASIC; send in device for repair
992	CAN BusOff	Bus-off status of CAN bus; defective CAN driver or wrong wiring (L and H exchanged)
993 to 996	Internal errors	Send device for repair
997	Up/Download	Error during quick upload/download over NOVOBUS
998 to 000	not assigned	

6 Application Examples

6.1 Position setting over encoder input

Hardware

- As the encoder input is a differential input, all inputs must be connected (A, /A, B, /B, N, /N).
- Apply the signals according to Figure 6.1-1. The signal amplitudes comply with RS422 standard and may not exceed 5 V.
- Make sure the cables for the encoder signals are shielded. Earth the shield on the control unit side and connect it with the enclosure of the SCSI connector on the NOVODRIVE side. In some cases it may be necessary to shield the 24 V supply voltage as well.

Configuration procedure

We recommend to do the controller configuration in the digital operating mode first and to switch to encoder operating mode afterwards. After you have done so, the settings need to be adjusted in order to filter the step-wise characteristic of the setpoints.

Proceed as follows:

- To have NOVODRIVE controlled by the digital inputs only, uncheck all boxes under **State after reset (Register Freigabe0)** on page **General / Basic Settings**.
- Check **Position Control** under **Controller Mode** on page **General / Operation Modes**.
- Check **Encoder Input** under **Setpoint values are given through**.
- Set the values for the acceleration ramp and the braking ramp to '0'. By doing so, the ramp generator is deactivated.
- Specify the pulse number per revolution on the page **IO / Digital Encoder**. Uncheck **Reset of counter at zero pulse**. The range is limited to 17 - 61680 pulses.
- Make a reset.
- Set the setpoint filter on page **Controller / Speed Controller** to a value > '0'. The setpoint filter attenuates the pulses.
- If the pulse number per revolution is set low, the position setting is very coarse, and noises occur. If this is the case, set the pre-control in the position controller and in the speed controller to a low value or to '0'.

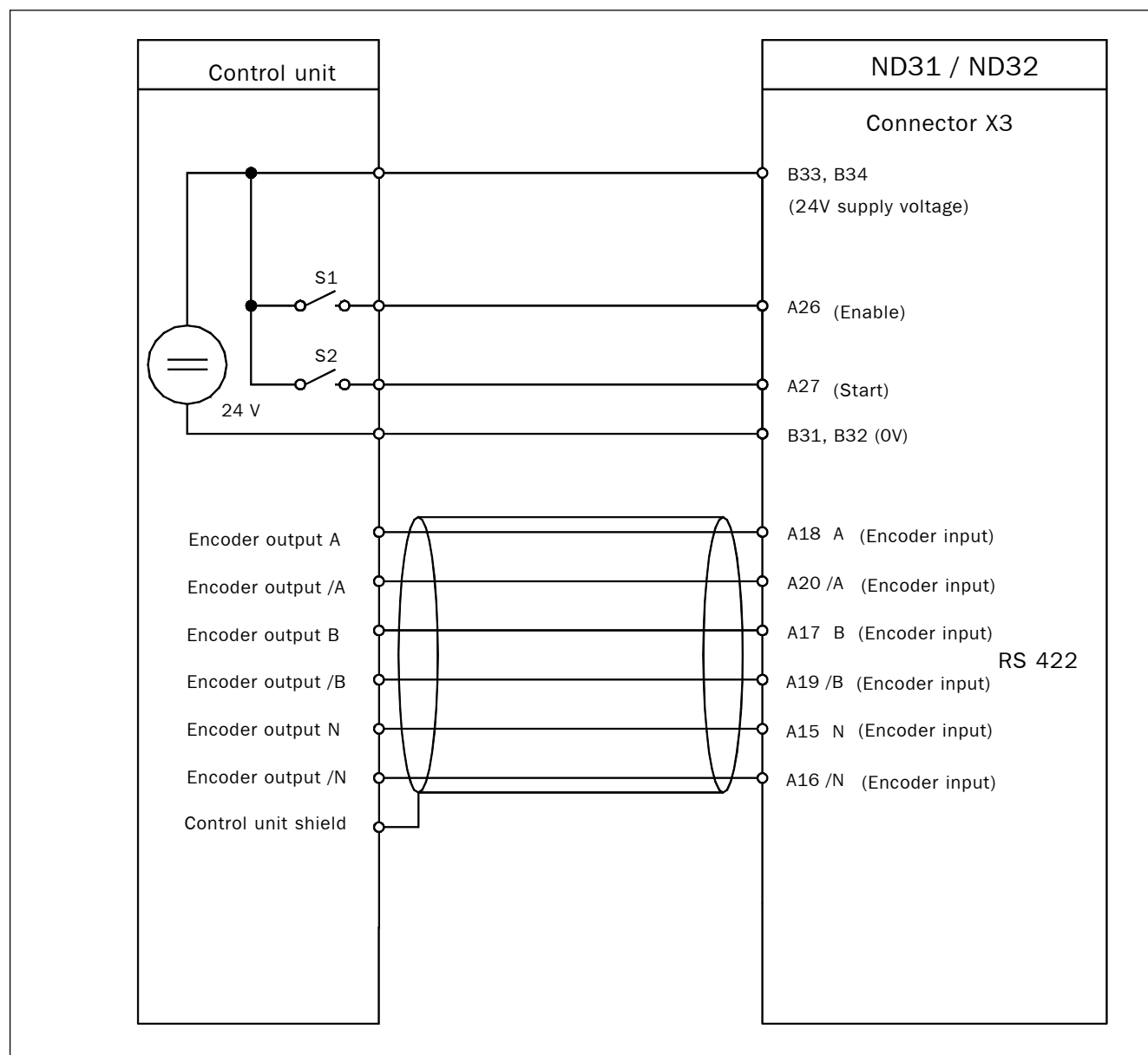


Figure 6.1-1

6.2 Position setting over step/direction input (step motor emulation)

Hardware

- As the step/direction input is a differential input, put the two inverting inputs (A19, A20) to half the signal level of 2,5 V over a voltage divider. To do so, you may connect 100-Ohm resistors with 1/3 W to the +5 V output and GND (see Figure 6.2-1).
- Apply the signals according to Figure 6.2-1. The signal amplitudes may not exceed 5 V.
- The signals must be filtered. If, for example, the step/direction setting is made by means of a mechanical contact, insert an RC element.
- Make sure the cables for the step/direction signals are shielded. Earth the shield on the control unit side and connect it with the enclosure of the SCSI connector on the NOVODRIVE side. In some cases it may be necessary to shield the 24 V supply voltage as well.

Configuration procedure

We recommend to do the controller configuration in the digital operating mode first and to switch to Step / Direction operating mode afterwards. After you have done so, the settings need to be adjusted in order to filter the step-wise characteristic of the setpoints.

Proceed as follows:

- To have NOVODRIVE controlled by the digital inputs only, uncheck all boxes under **State after reset (Register Freigabe0)** on page **General / Basic Settings**.
- Check **Position Control** under **Controller Mode** on page **General / Operation Modes**.
- Check **Step Direction** under **Setpoint values are given through**.
- Set the values for the acceleration ramp and the braking ramp to '0'. By doing so, the ramp generator is deactivated.
- Specify the pulse number per revolution on the page **IO / Digital Encoder**. Uncheck **Reset of counter at zero pulse**.
- Make a reset.
- Set the setpoint filter on page **Controller / Speed Controller** to a value > '0'. In the step/direction mode, the speed setpoint has a step-wise characteristic. The setpoint filter attenuates the pulses.
- If the pulse number per revolution is set low, the position setting is very coarse, and noises occur. If this is the case, set the pre-control in the position controller and in the speed controller to a low value or to '0'.

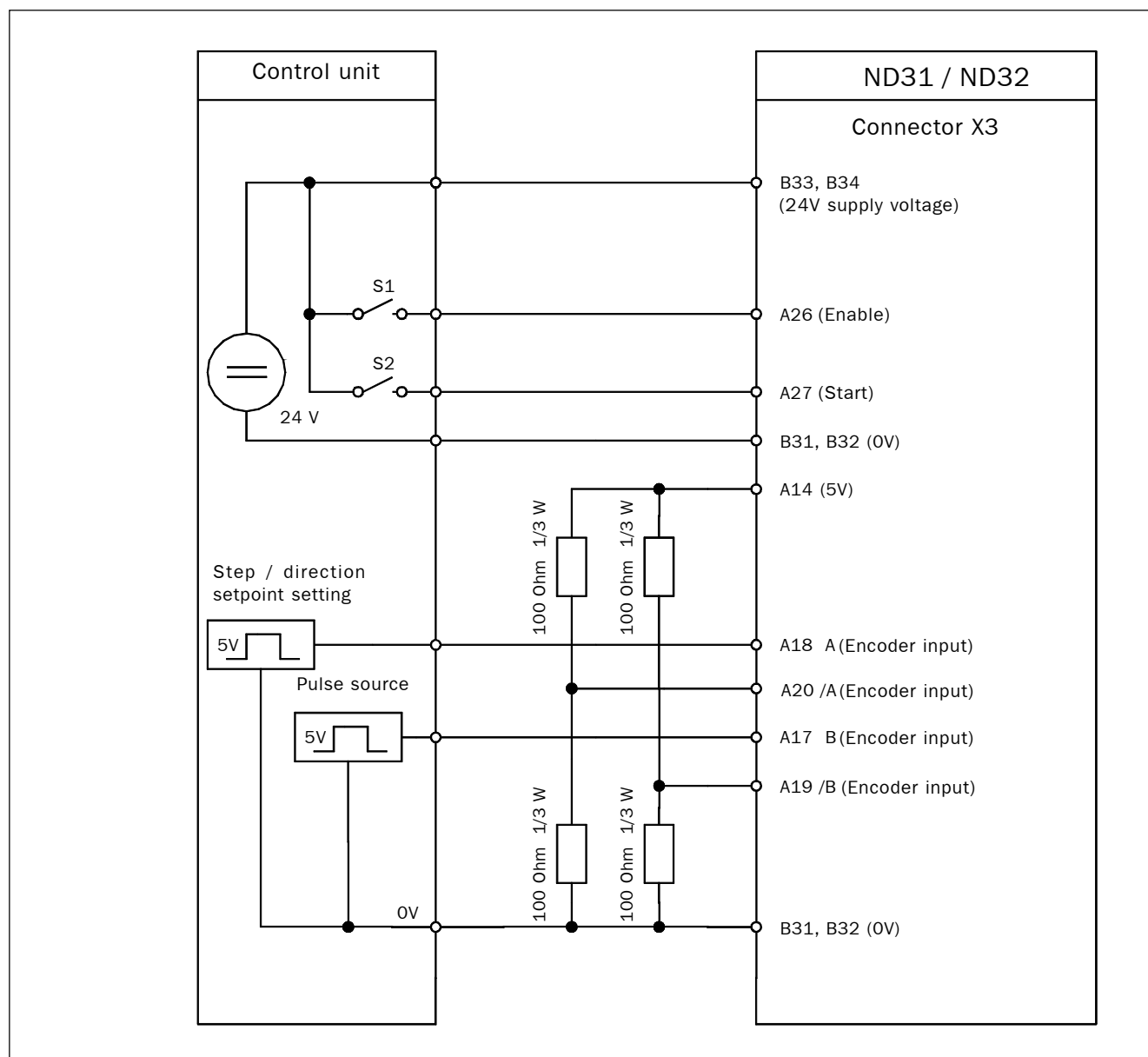


Figure 6.2-1

6.3 Speed setting over Analog Input 1

Hardware Connect the setpoint source to Analog Input 1 according to Figure 6.3-1.

- Analog Input 1 is a differential input. Take the negative input as analog mass and connect it (as close as possible to the analog source) to the reference voltage of the analog source.
- Make sure the cables for the analog signals are shielded. Earth the shield on the control unit side and connect it with the enclosure of the SCSI connector on the NOVODRIVE side.
- Make sure the voltage at the analog input does not exceed +10 V and does not fall below -10 V. Provide an external limitation of the setpoint, if need be.

Configuration procedure We recommend to do the controller configuration in the digital operating mode first and to switch to analog operating mode afterwards.

Proceed as follows:

- To have NOVODRIVE controlled by the digital inputs only, uncheck all boxes under **State after reset (Register Freigabe0)** on page **General / Basic Settings**.
- Check **Speed Control** under **Controller Mode** on page **General / Operation Modes**.
- Check **Analog Input 1** under **Setpoint values are given through**.
- Set the values for the acceleration ramp and the braking ramp as deemed appropriate.
- Make a reset.
- Make an offset alignment on page **IO / Analog Input 1** while the device is on operating temperature. The voltage applied during the offset alignment must comply with zero speed.
- The analog setpoint can be scaled. If the scaling is 100 %, 10 V comply 6000 rpm. If the scaling is 50 %, 10 V comply 3000 rpm.
- For the controller optimization, set the pre-control in the speed controller (**nKd**) to '0' or to a very low value. The pre-control enhances the noise on the analog input and leads to motor noises or vibrations.

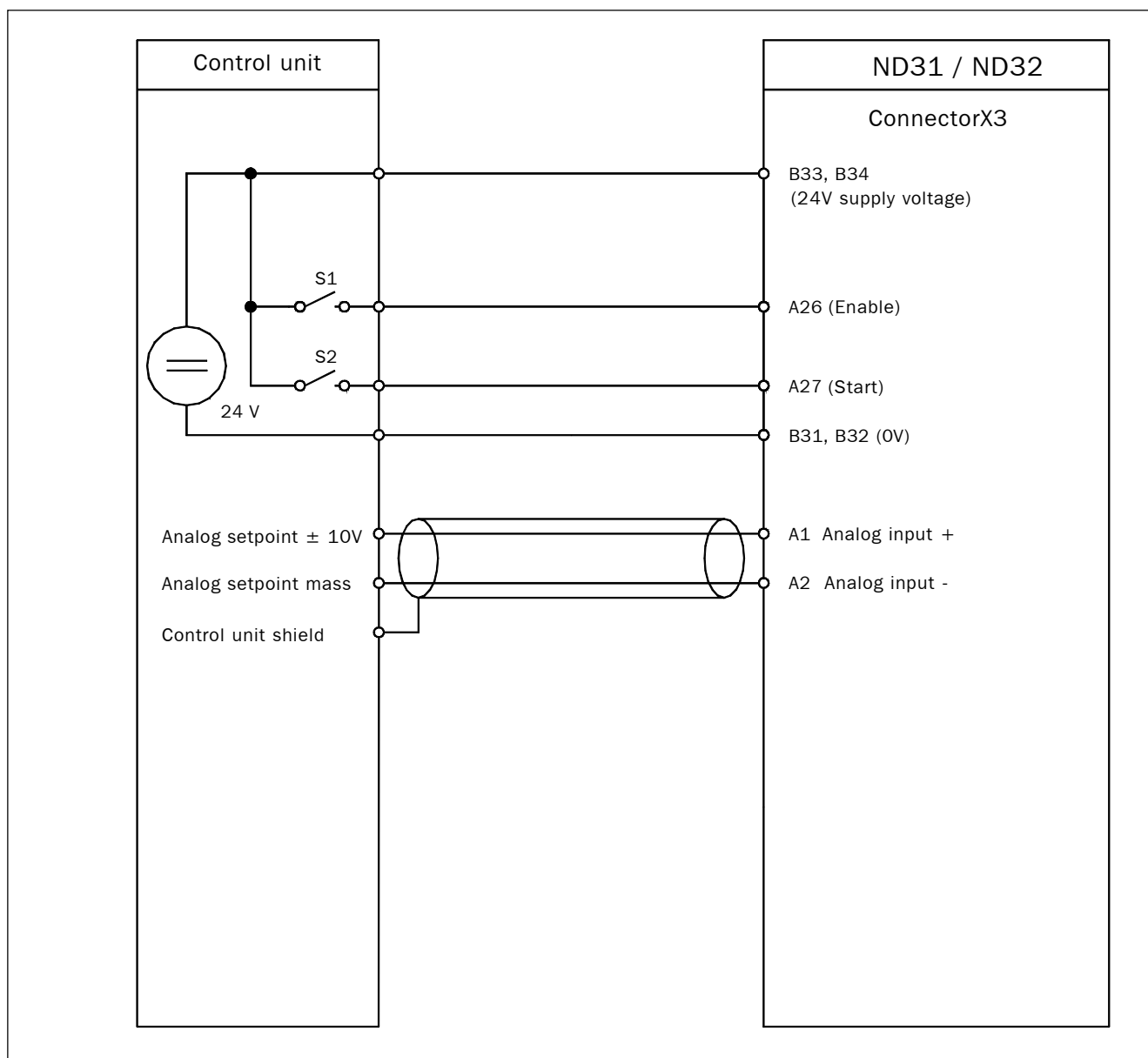


Figure 6.3-1

6.4 Analog Outputs 1 and 2

Hardware Over Analog Outputs 1 and 2, a 8-bit register can be outputted (see Figure 6.4-1). The analog value is generated and filtered over a PWM signal.

For connecting with a differential input, you should not use the common reference mass. You get an interference-free signal if you use Pin B1 on Connector X3 instead.

- Notes**
- Analog Output 1 can be used only if the digital output GPO8 is not used.
 - Analog Output 2 can be used only if the digital output GPO1 is not used.

- Configuration procedure**
- Switch on the analog output you want to use.
 - Make a reset.
 - Select the desired registers. Possible output values are, for example:
 - actual value of speed **n(ist)**,
 - actual value of current in Phase A **ia(ist)**,
 - torque setpoint **m(soll)**.
 - Specify the values for offset and scaling.

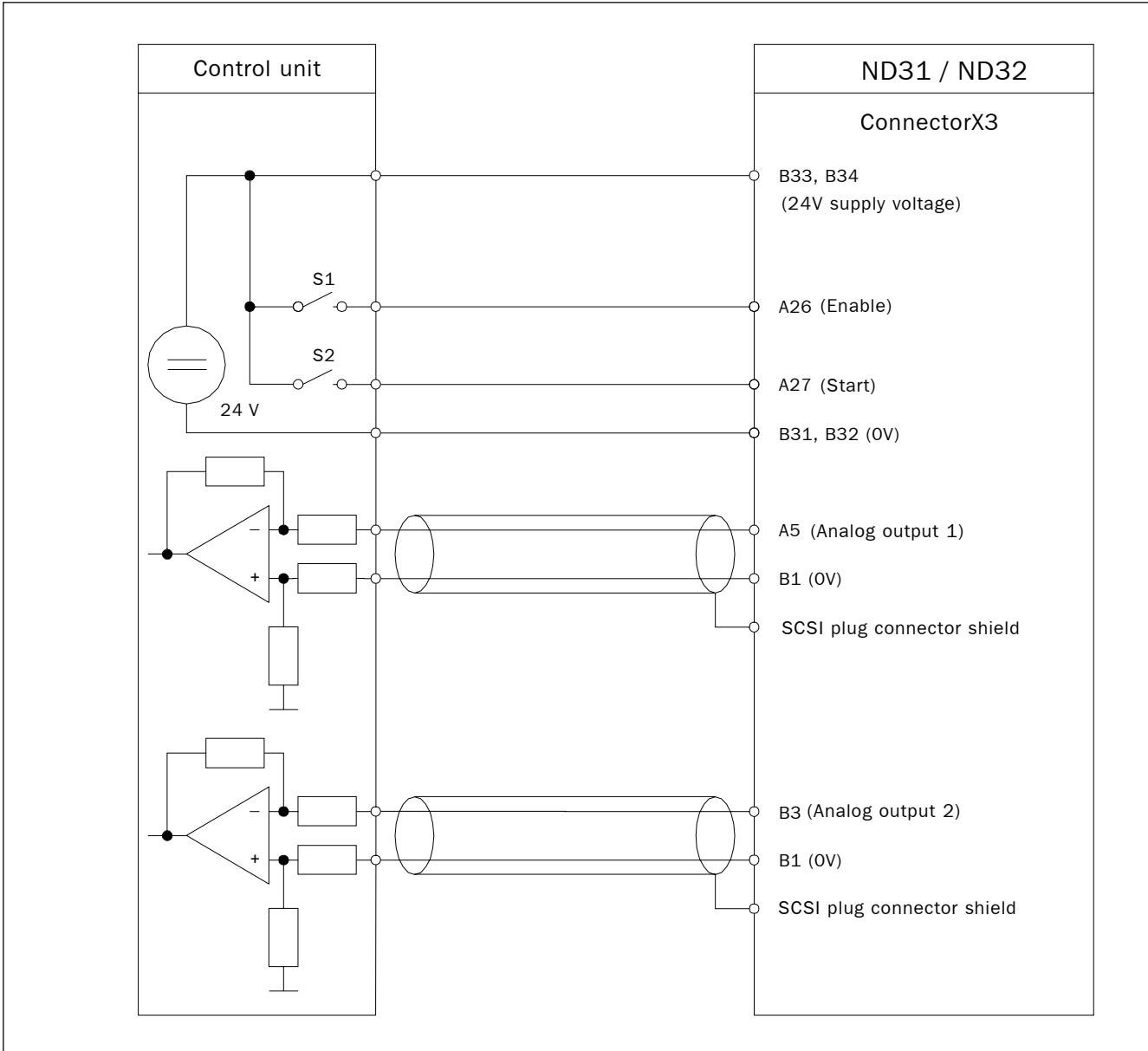


Figure 6.4-1

6.5 Encoder emulation

Hardware Encoder emulation allows position output over incremental signals (see Figure 6.5-1). The signals are differential signals according to RS422. The reference ground is the same as the reference ground of the 24 V supply voltage.

The pulse number can be set between 1 ... 1024 pulses per revolution.

Configuration procedure Just set the pulse number per revolution. Then make a reset.

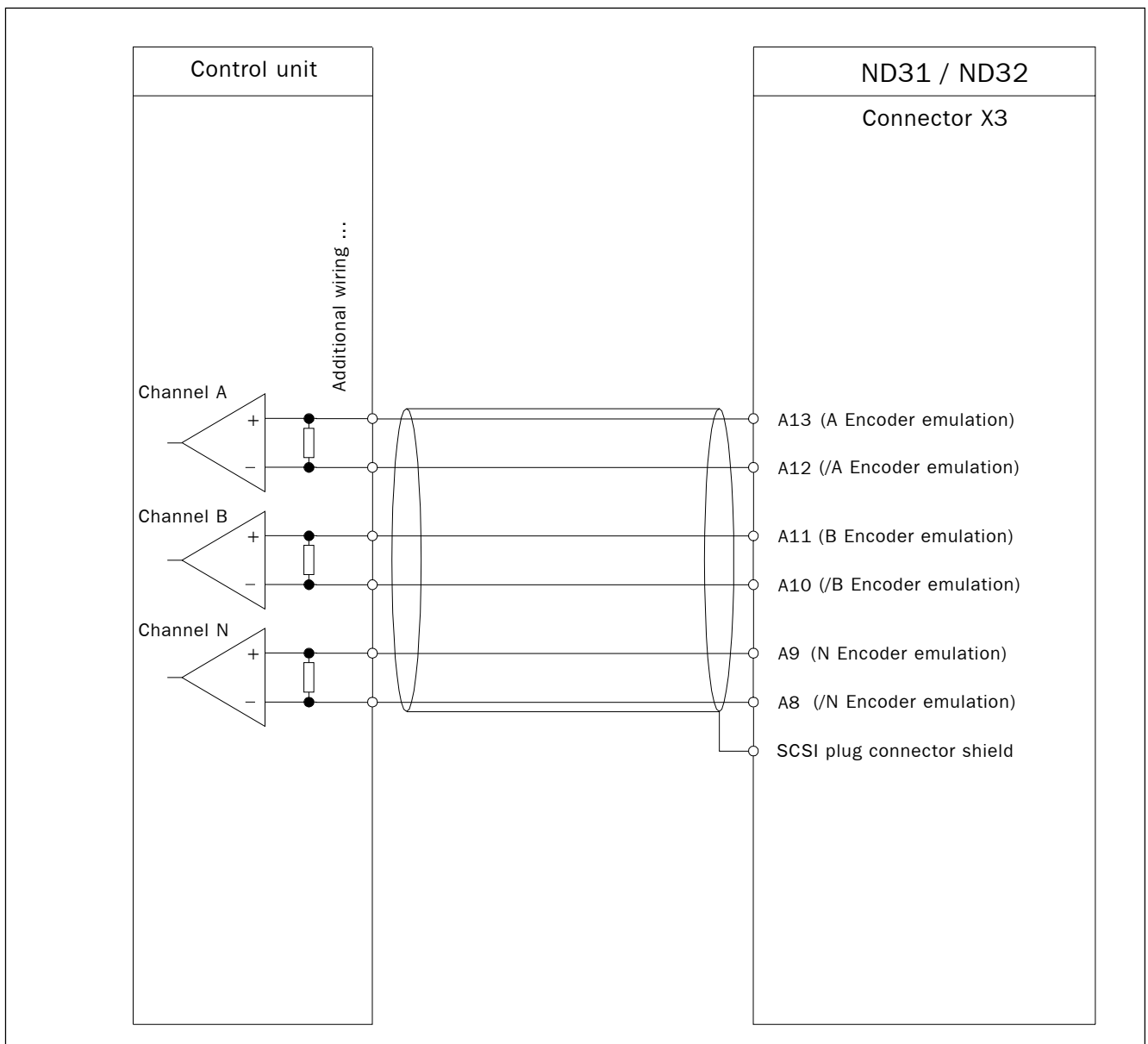


Figure 6.5-1

7 Servicing and Maintenance of Machines equipped with NOVODRIVE

If problems occur with a machine that is equipped with NOVODRIVE, try the following:

- Make sure the plug connectors are tightly screwed and not defective.
- Make sure the ventilation openings of the compact case or 19" rack are free from dust and foreign substances. Check the air flow at the ventilation openings. Fan failure not only leads to a reduction in the performance but also to quicker aging of NOVODRIVE due to excessive temperature.
- If the 7-segment display indicates an error, this may be due to a defect of NOVODRIVE or a defect of the control unit or the components.
- If NOVODRIVE must be replaced, make sure the replacing device has the same type designation. Do not apply mains voltage before the replacing device has been parameterized correctly!
To do so, load the respective parameter set by means of the start-up software ND30Cfg (see Chapter 3.4). If the file is missing, get in touch with the manufacturer of the machine.
The parameter set not only comprises motor relevant information, but also control unit relevant information. Due to this it is not possible to offer a generally applicable parameter set.
- If the mechanical structure of the machine is changed in a way that the mass or the moment of inertia is changed, it is necessary to adjust the settings of the speed controller and the position controller. Ask the manufacturer of the machine whether and which parameters need to be loaded to NOVODRIVE over NOVOBUS or CAN bus from the control unit. If NOVODRIVE's Connector X4 (Bus-Out) and Connector X5 (Bus-In) are not connected, this is not the case.
The reason for this is: If the control unit changes the parameters of the speed controller in relation to the operating situation, for example, it makes no sense to adjust the parameters in NOVODRIVE, as they will be overwritten after the next modification. The modification must then be done in the control unit's software. In this case, get in touch with the manufacturer of the machine.
For adjusting the parameters of the speed controller and the position controller, read Chapters 4.8 and 4.9.

8 Appendix

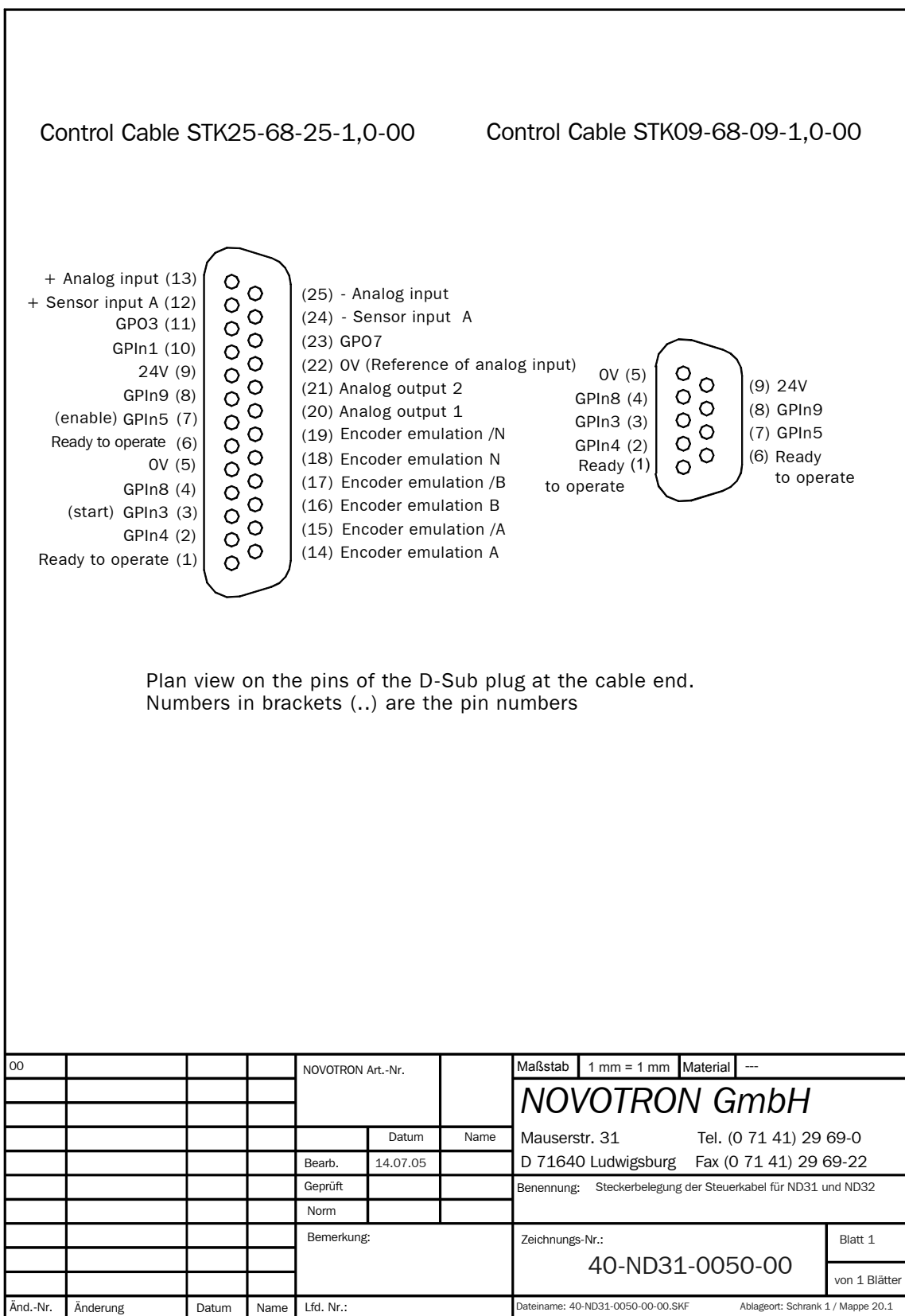
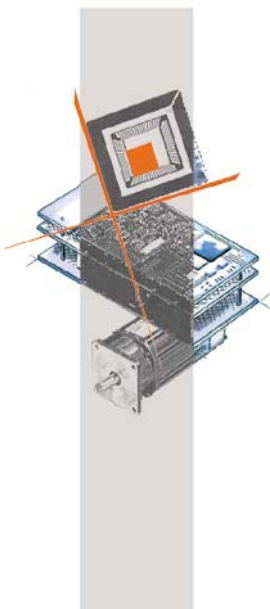


Figure 8-1



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