NOVOTRON

Novodrive ND21

Setup and Parameter Setting of ND21

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Contents

1 Setup Instructions

1.1 Safety remarks

The ND21 contains operating voltages that can be fatal!

Therefore, check the wiring of the ND21 before switching it on. Ensure all plugs are properly inserted and grounding has been properly performed.

Ensure that no voltage carrying parts can be accidentally touched and all safety components of the ND21 are present and properly connected.

Provide an “Emergency Power Off” switch so the motor can be switched off at anytime.

After power-off the electrolytic capacitor takes approximately one minute to unload! This means: One minute after power off, fatal voltages are still present in the device. During this period nothing is to be touched.

In case the motor continues turn after the power supply has been switched off, fatal voltage can be prolonged until a total stop occurs. Only then does the unloading of the electrolytic capacitor begin.

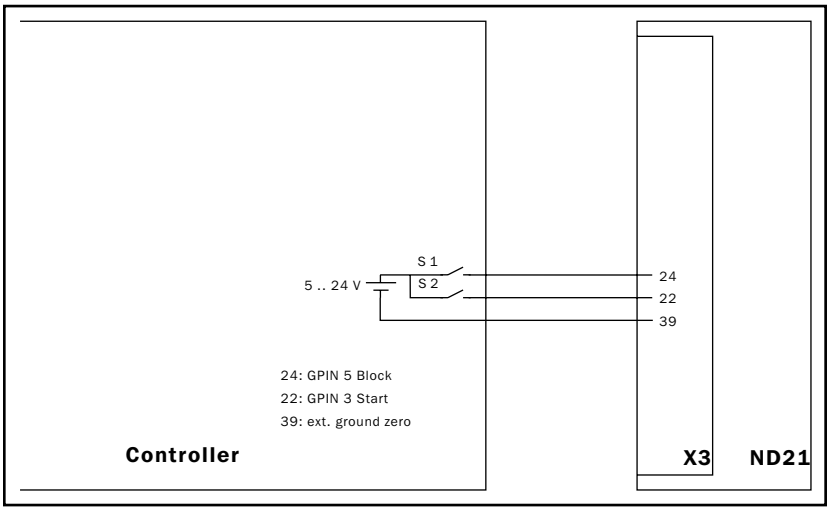
Caution!

Avoid excessive, repeated and rapid on and off switching of the power supply, overloading can lead to the destruction of the end switch limit resistance.

1.2 Hardware requirements

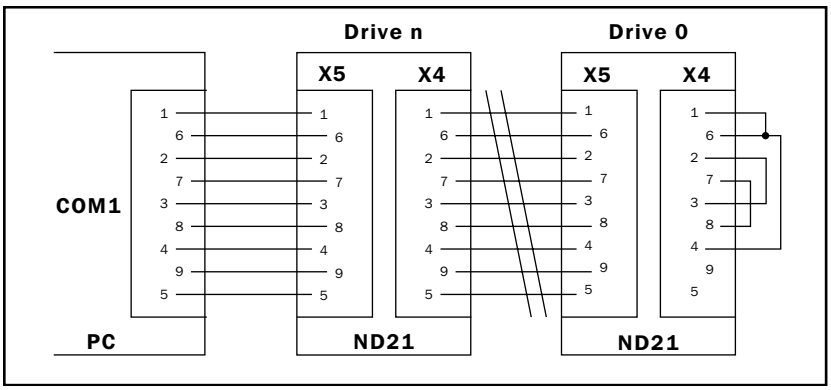
- Motor and resolver are connected as described in the user manual for ND21 chapter 5.

At least the input release (GPIN5) and start (GPIN5) should be wired on the 44 pin plug.



For now the switches S1 and S2 should remain open.

- Connecting PCs to the ND21



NOVOBUS with RS232 and connection check

A connection plug must be connected to the internal bridge on the NOVOBUS cable of the last ND21.

- ND21 grounding is as described in chapter 6.3 (Grounding and Shielding) of the ND21 user manual.
- Power connection to the ND21 via a 10A motor safety switch.

Before applying power to the ND21, check the wiring. Ensure that no voltage carrying parts can be accidentally touched and all safety components of the ND21 are present and properly connected.

Reassure all safety measures described in **chapter 1 (Hardware), section 3 have been** fulfilled.

- Switch on the power supply

If no error is present, you can observe the testing of the counter on the ND21 while counting down the digits 0 - 9. Thereafter a small “u” will blink. This counting function can be switched off.

1.3. Setup software

Insert the Novotron setup disc in the PC drive and start the software.

Example: disc in drive A:	[A] [:] [enter] [n] [d] [2] [1] [enter]
If ND21 is connected to COM2:	[n] [d] [2] [1] [ ] [c] [o] [m] [2] [enter]

The main menu of the Novotron software is displayed.

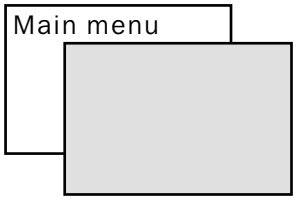
All menus with the exception of the main menu can be exited with:

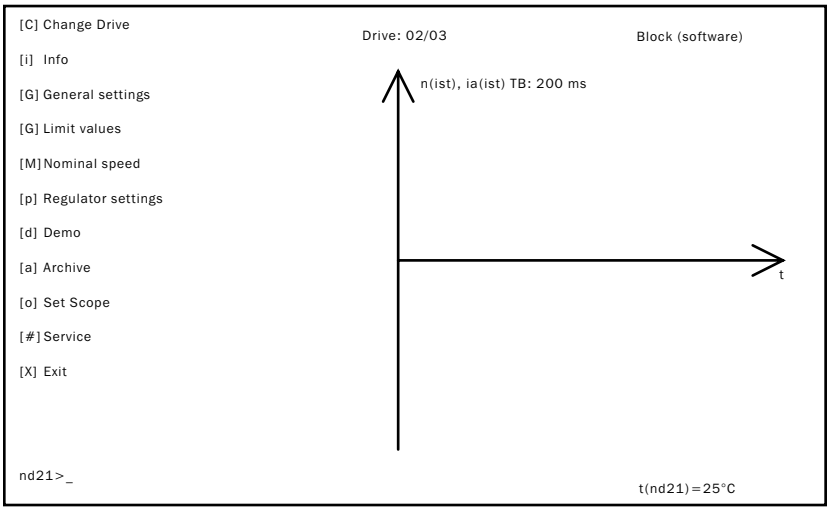
space or with	[ ] [r]

☞ **Note:**
Before starting the motor, ensure you are familiar with the software menus and commands.

1.4 Setup menus

1.4.1 Main menu





The input window is located on the left side of the display. An oscillogram is illustrated on the right side of the display. The status of the drive is shown in the upper right of the display. In this case it is blocked by the ND21 software. If no error is present, a temperature is displayed at the lower right. Should there be an error, it will be displayed instead of the temperature.

☞ **Note:**
Error messages can be acknowledged with the [Del] key.

If several ND21 devices are connected to the NOVOBUS cable, the number of devices and the device selected will be indicated centred at the top of the display.

A submenu or function can be selected using the letters or numbers in the boxed parenthesis. Hereby observe whether capital or small letters are required.

Caution!

With the escape key [esc] the end stage in each menu can be blocked This can be used for switching of the motor when uncontrolled movement due to improper settings occurs. The escape command works immediately. In certain submenus a stop command [s] is provided for stopping the motor. With this command an attempt is first made to regulate motor braking. If this is not possible, the end stage will also be switched off after approx. 5 seconds.

1.4.2 Change Drive

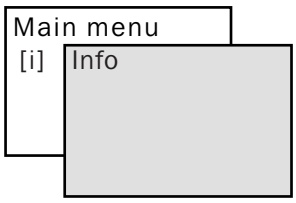
When several ND21s are connected to the NOVOBUS cable, a drive can be selected with the change drive command. All drives on the bus are numbered. The last drive on the cable (the one with the closing plug) has the number 0, and the following the number 1 etc..

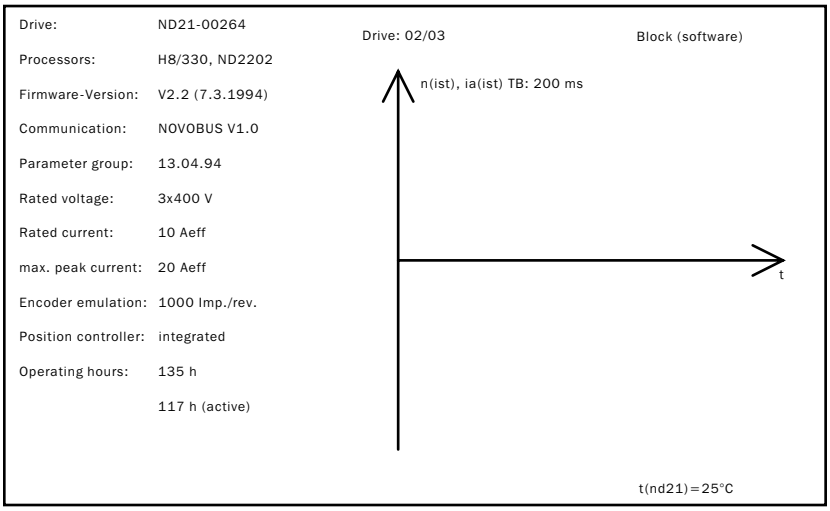
To select the command press capital C [C], insert the number of the desired ND21 and press enter [enter].

All commands and settings hereafter are for the drive selected here.

1.4.3 Info

In the main menu select [i]





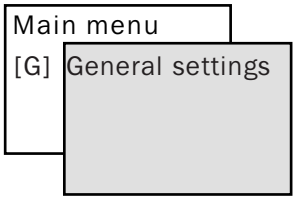
Here you can read:

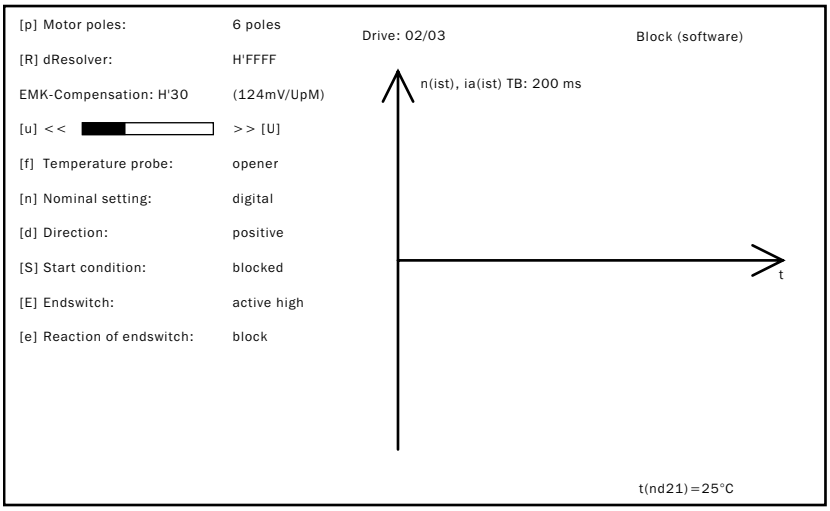
- which serial number of the drive has
- which processor and software version on the ND21
- when the parameter were last modified
- rated connection currents set value
- setting of the encoder emulation
- operating hours, current and total

Exit the menu with space [space]

1.4.4 General settings

In the main menu select [G]





Before the motor can be put into operation, presetting must be made. The settings in the general settings menu are stored immediately in the EEPROM of the ND21. These settings are not lost when the power is switched off.

Exit the general settings menu with [space].

Motor poles

Setting the number of motor poles [p]
i.e. 6 poles [6]

Changes to the motor pole number do not become active until after a reset.

A reset can be performed with [j]
Do not perform reset until all other settings have been saved.

Resolver settings

Setting the resolver adjustments with [R]

Motor manufacturers sometime adjust the resolver differently. Here an electronic adjustment of the resolver can be performed.

The program makes a recommendation for the settings for motors that have already been operated by the ND21. Insert the respective values here if your motor is manufactured by one of the fabrications recommended.

i.e. for a 6 pole SEM-motor [F][1][8][0][enter]

Should you use a different motor, ask your ND21 supplier if the motor is compatible to the ND21. Should it be necessary, your supplier can perform the pre-settings for you.

EMF Compensation

Here you can adjust the voltage stabilizer of your motor.

[u]<<[ ]>>[U]

With small u [u]
you can reduce the value,
with capital U [U]
you can increase the value.

For example for a motor NHD115G6-130 the value 130 mV / rpm would be correct. The data of the motor voltage gradient serves as peak value from phase to phase.

☞ **Note:**
If the voltage gradient of the motor is unknown, this adjustment can be performed by means of experimentation. When performing this the motor should be removed.

The motor is set in reverse. The current in phase A is viewed using the oscilloscope function.

When the motor is improperly adjusted you can detect a high part on alternating current during idling. If this is the case the set current values and actual current values do not match. By increasing or decreasing the EMF compensation the idle alternating current part can be vastly reduced. This also closely matches the set current value to the actual value.

Motor temperature probe

Adjust the motor temperature probe with [f]

Depending on the type of temperature probe in the motor, you can select:

Opener	[ö]
NTC	[n]
PTC	[p]
none	[-]

☞ **Note**:
After the temperature has been changed, it may take a little time until the new value is set. An error message will occur if the improper probe is selected.

☞ **Note**:
In case NTC or PTC are selected, the switching threshold can be adjusted in the service menu. See chapter software reference.

Set point source

Select the set point value from the analogue input	[n]
+/- 10V or +/- 24V mA of the NOVOBUS or from the positioning controller	[a]
of the frequency or direction input	[d]
	[f]

Direction of rotation

Make a positive set point adjustment to the direction of rotation [d]

☞ **Note**:
When changing the direction of rotation the speed as well as the rotor position measurement are reversed.

Caution!

Change only when the motor is blocked.

Start status

Changing the start status [S]

After switching on the power supply the ND21 can be either blocked or enabled. When this is set to blocked, a Go command is required after power is switched on, to activate the end stage.

Polarity of the endswitch

Changing the active level of the endswitch [E]

According to VDE end switches are openers switched at 24V. For this active low is to be set. If no end switches are available, high active can be programmed.

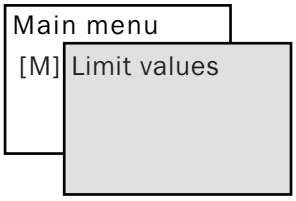
Reaction of the endswitch

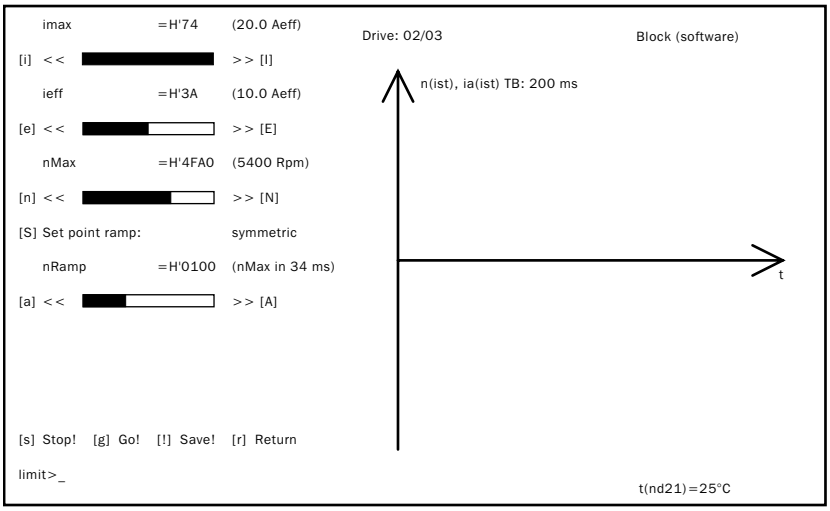
Changing the reaction of the endswitch [e]

Here you can select whether stopping is to occur using the pre-programmed ramp, or if the end stage is to be blocked, whenever the endswitch is activated.

1.4.5 Limit values

In the main menu select [M]





In this menu limits can be set for:

maximum acceleration current:	Imax
rated motor current:	ieff
maximum speed:	nMax
acceleration and braking ramp:	nRamp

To change the values press the letters in the boxed parenthesis.

[e]<< >>[E]

For example:

With small e	[e]
you can reduce the value,	
with capital E	[E]
you can increase the value.	

The current and speed values should be set according to the motor used. The set point ramp should be set according to the application.

With	[S]
you can select between	
symmetric	[s]
asymmetric	[a]
and none	[-]

With a symmetric ramp the acceleration and braking are performed at the same speed. With asymmetric ramp the acceleration and braking can be given different settings. The ramp should only be switched inactive when the set point or nominal settings are switched via frequency and direction.

☞ **Note**:
When operating with the built in position controller the setting must be symmetric. The position controller is not constructed for operation with asymmetric ramping.

Additional command in this menu:

Stop! for stopping the motor,	[s]
Go! to enable the regulator,	[g]
Save! to save setting to the ND21.	[!]

The settings in the limit menu are first stored in the RAM memory of the ND21. To ensure that these settings are not lost by a i.e. loss of power, save them to the ND21 EEPROM using the Save! command.

The Save! command works with all settings in all menus except the general settings menu.

Exit the limit menu with return [r]

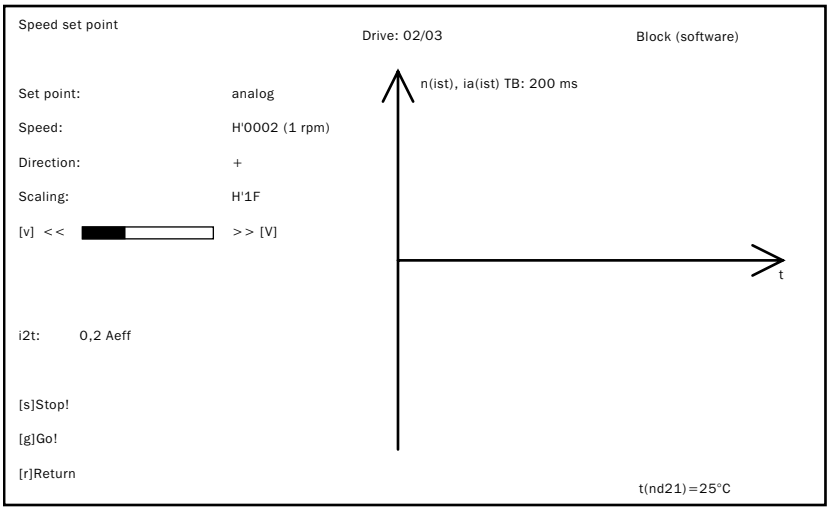
1.4.6 Speed setting

Select in the main menu with [D]

The speed setting menu is used to scale the speed value. That's why the speed setting menu is different depending on which set point source is selected in the general setting menu.

Generally the set point source, the size of the set value in rpm, the direction of rotation and the average effective motor current are displayed. Depending on the set speed, the commands: Stop!, Go! and Return are also available with the same functions as described in the limit menu.

Analogue set point



[v]<<[ ]>>[V]

If an analogue set point is selected, the scaling of the value can be modified using [v] and [V].

The following applies when scaling:

desired speed in revolutions per minute at 10 V - setting / 60

The calculated result is a hexadecimal number to be converted and used as setting for scaling.

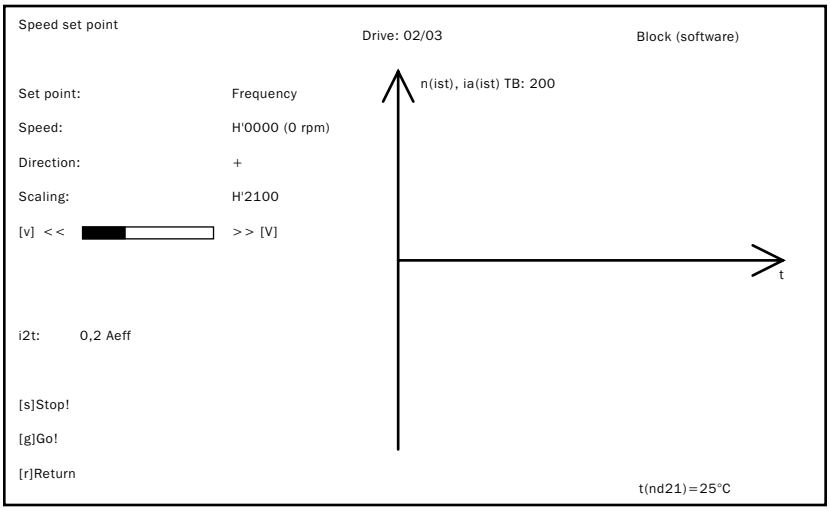
Example:
At a 10 V set point setting, the motor is to rotate at 3000 rpm.

VCOlin = 3000 / 60 = 50 decimal.

Conversion to hexadecimal:
50 / 16 = 3 remainder = 2.

This equals a scaling value of 32 hexadecimal.

Frequency set point



[v]<< >>[V]

If a frequency or directional set point is selected, the scaling of the value can be modified with [v] and [V]

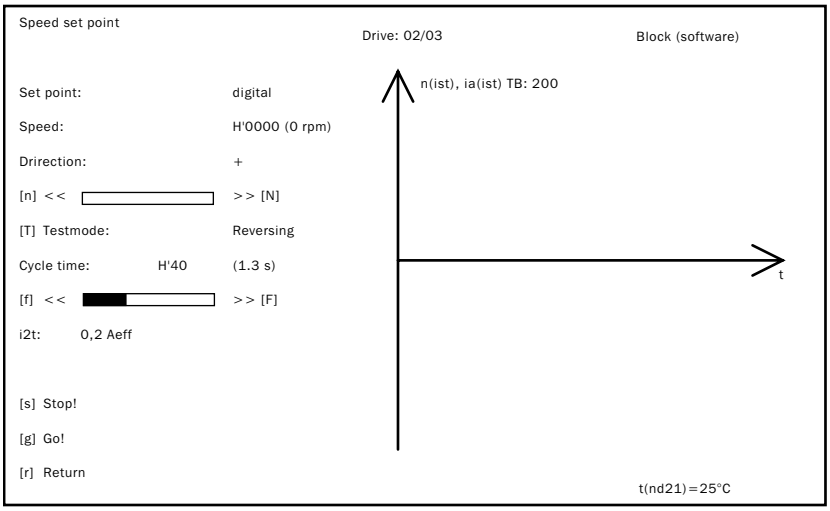
The following applies when scaling:

Scaling = 33554432 / impulses per revolution

The display of the scaling is hexadecimal. For this reason the calculated value is to be converted to a hexadecimal value.

☞ **Note:**
The low value bits of the scale can be inserted via the service menu [#] with the function Write RAM in the byte VCOlinL.

Digital set point



[n]<<[ ]>>[N]

In this setting a speed can be set with [n] and [N]
The direction of rotation can be modified with [d]

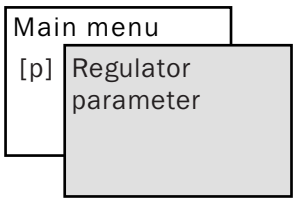
In addition it is possible to activate and deactivate a test mode use [T]
Use Test mode cycle through the changing of the motor rotation direction.

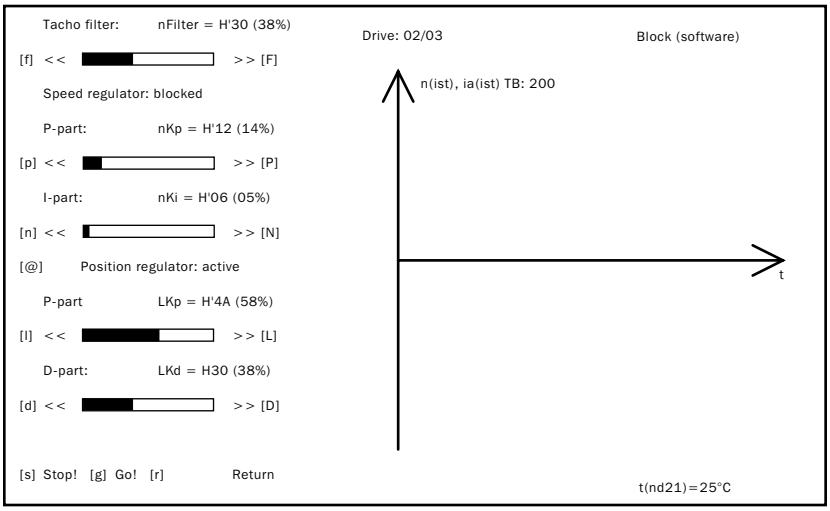
[f]<<[ ]>>[F]

The cycle time can be modified with [f] and [F]
This operating mode is very useful in making regulator adjustments.

1.4.7 Regulator parameter

In the main menu select [p]





As indicated in the regulator parameter, the ND21 has a PI (speed regulator) and a PD (position regulator). The position regulator can be switched off with [@]

☞ **Note**:
To achieve better regulator behaviour, the speed setting can modified with activated position regulator.

The regulator settings can be modified with the letters in boxed parenthesis.

P and I-part of the speed regulator is corresponds to the AC gain potentiometer of an analogue regulator.

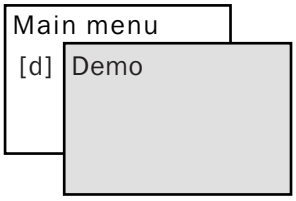
For filtering the actual speed value a tachometer filter is provided. A higher value here depicts a strong filtering and a lower value a weaker filtering.

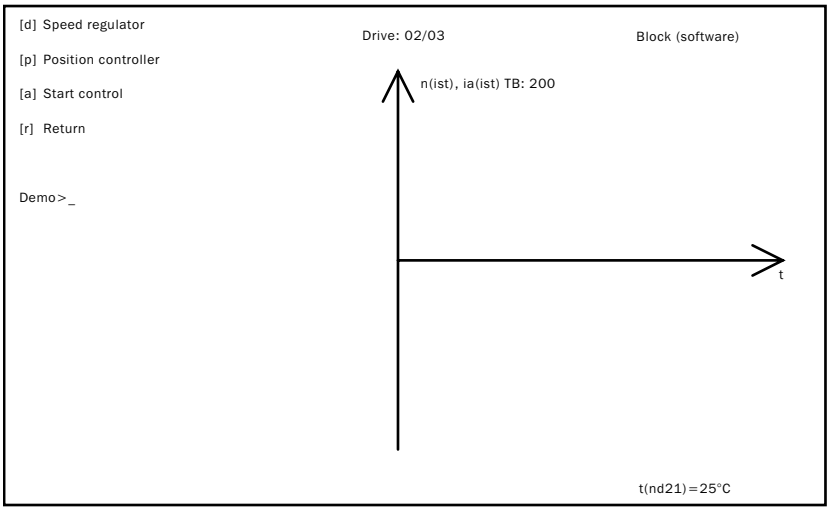
The commands Stop!, Go! and Save! are also available here. These commands have the same function as in the Limit Menu.

☞ **Note**:
The current regulator (PI) can be adjusted in the ASIC menu, a submenu of the service menu.

1.4.8 Demo menu

In the main menu select [d]

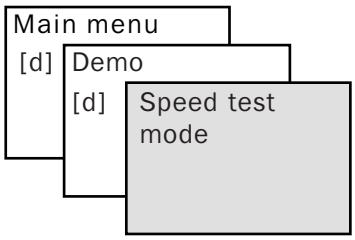


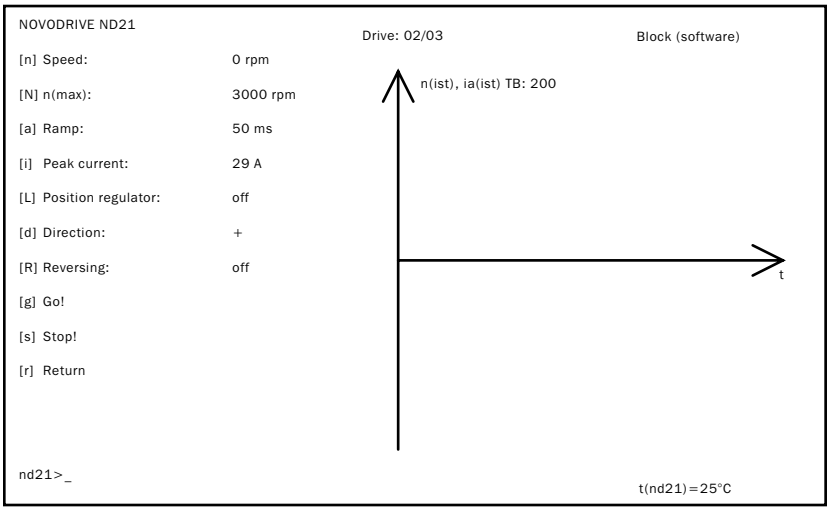


The demo menu has three submenus with which a simple test and setup procedure can be performed.

Speed test mode

In the demo menu select [d]

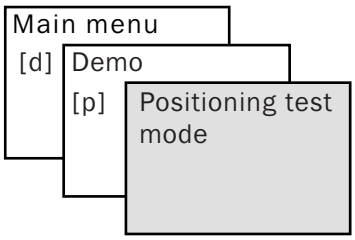


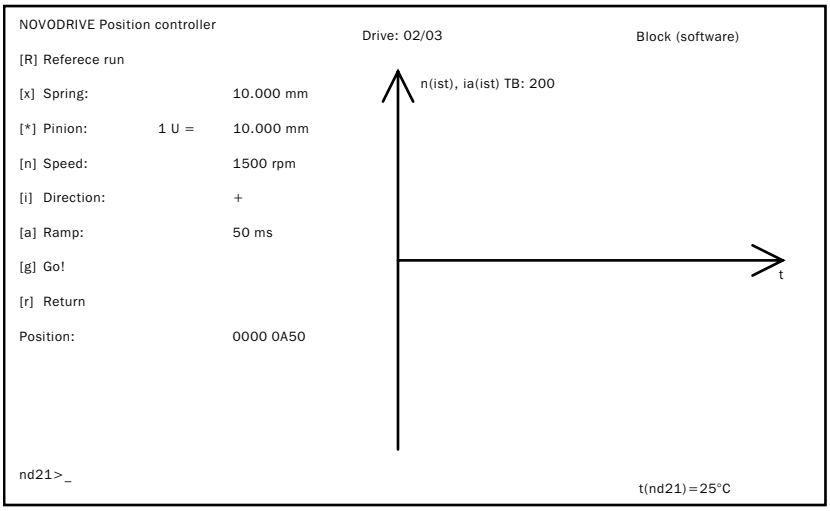


Here can a speed and acceleration ramp for the motor be set, and the motor can be ran with or without position regulator as well as be reversed.

Positioning test mode

In the demo menu select [p]





In this menu positioning testing of the built-in position controller can be tested. Here the following can be performed.

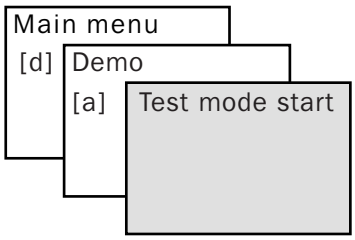
start referencing run	[R]
define a direction	[x]
define a path of rotation	[*]
define the positioning speed	[n]
define the direction of movement	[i]
define an acceleration ramp	[a]
start positioning with	[g]
cancel positioning with	[s]

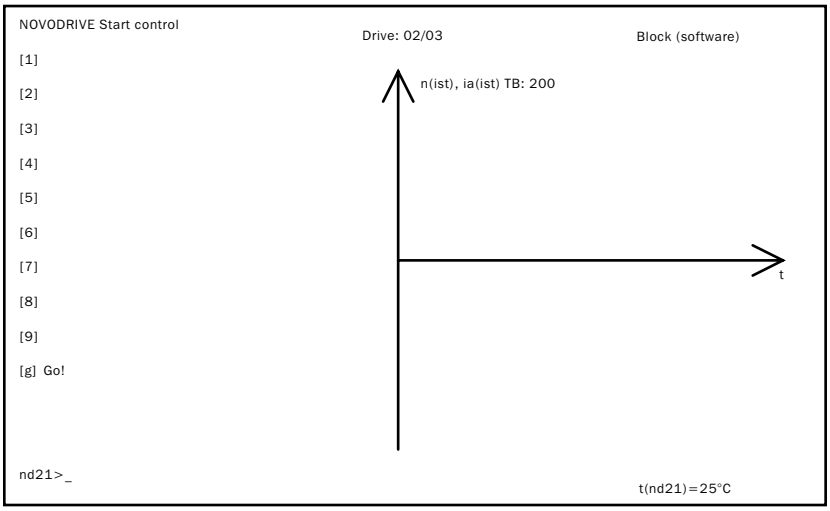
☞ **Note**:
Before you start test positioning, you should have already moved the motor in the speed test mode and preset the regulator parameter.

To start a referencing run, naturally the reference switch on the ND21 be connected (see chapter position controller).

Test mode start

In the demo menu select [a]





In case several test positioning are to be repeatedly performed, these can be programmed in this menu. Up to 9 different paths can be programmed. Positioning is performed respective the settings in the demo menu position-controller.

Paths are entered as follows:

- Insert the path numbers [1]...[9]
- Insert the direction [+] or [-]
- Insert the path in mm i.e. [3] [4]
- Enter key [enter]

To start the automatic process [g]

Insert how often the process is to be repeated.

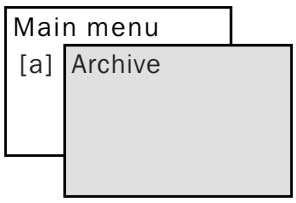
If you just press space instead of inserting a value the process will be repeated until stop [s] is pressed.

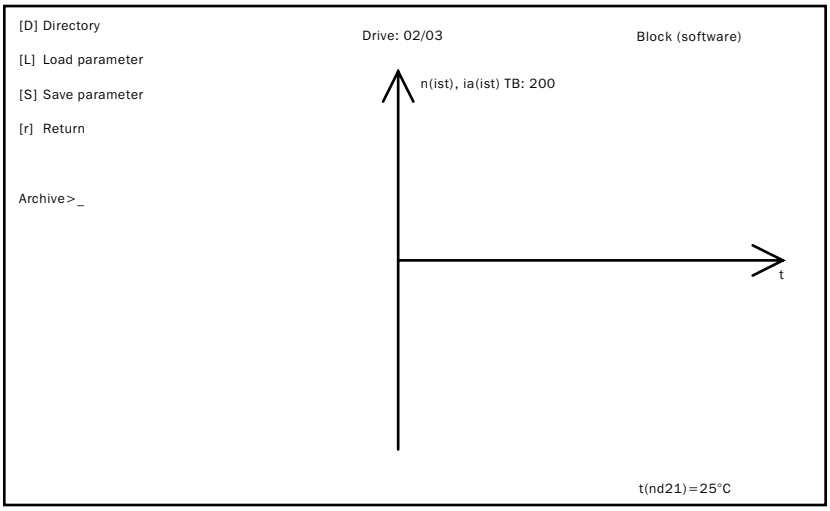
The automatic process ends automatically, when the programmed number of repeats are completed or when stop [s] is pressed.

☞ **Note:**
The test menu start has nothing to do with the integrated start controller in the ND21. No inputs for the integrated controller can be made here. For programming the ND21 start controller see chapter 4 “Position controller”.

1.4.9 Archive

In the main menu select [a]





The setup software offers the option to store and reload all parameter groups to and from floppy or fixed disk.

Herewith different stages of the parameter input can be saved or data for specific motors in certain machines can be archived. When setting up machines produced in series the parameter group can simply be loaded.

Saving the parameter to disc:

In the archive menu select the function “Save Param”	[S]
Insert the desired file name i.e. Novo	[n] [o] [v] [o] [enter]
Are you sure? (y/n)	[y]
Saving “novo.PRM”	

The program no request a comment text. This gives you the opportunity to make a detailed description of the saved parameter.

For example:
which machine?, which motor?, which axis?, unique feature, etc. [parameter for machine XY, Axis Z, motor type A, lift axis with position control optimization with extra load, etc.] [enter] [enter]

The entire half of the monitor is available for comments.

If you don't want to add comments, simply press [enter]

Files are saved to the directory from which the ND21 software was started.

Overview of parameter groups

Using the function directory [D] of the archive menu, you can have an overview of the parameter groups saved.

If there are too many parameter groups to fit the monitor page, answer yes [y] to the question more to see additional groups.

Exit the function with [space]

Loading parameter groups

Loading parameter groups from disc must take place with the motor blocked. If new parameter largely differ from the old, uncontrollable motor reactions may occur.

Block the motor using the Escape-key [esc]
To load a parameter group, select the "load parameter" function in the archive menu with [L]
Insert the filename i.e. Novo [n] [o] [v] [o] [enter]
Comment text is displayed.

If it is the desired parameter group answer the question:
Are you sure? with yes [y]

The software indicates "loading"

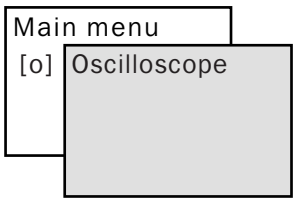
If you note that its the wrong parameter group, answer the question:
Are you sure? with: [n]

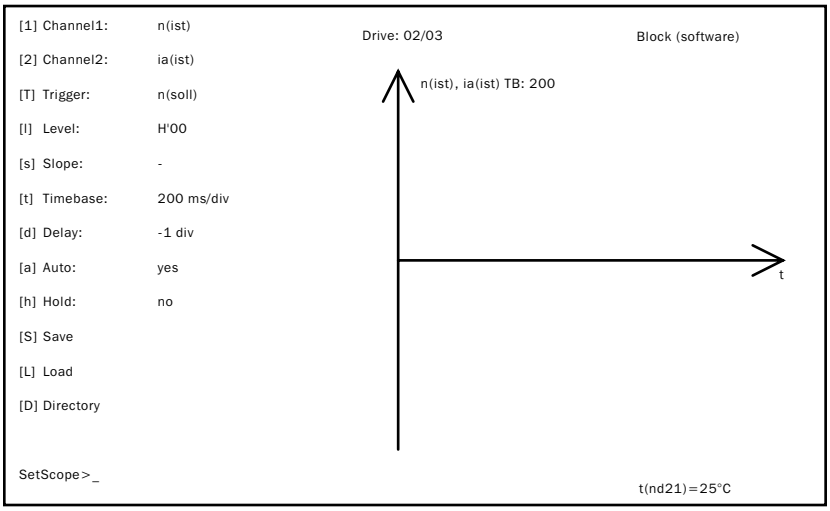
The loaded parameter group will be automatically saved in the EEPROM of the ND21.

Exit the archive menu with [r]

1.4.10 Oscilloscope

In the main menu select [o]





During setup the storage oscilloscope function eliminates the need for a separate storage oscilloscope. With this function the ND21 registers internal data in real time. This data can be transmitted over a serial interface to a printer. The ND21 storage oscilloscope function is operated in the same manner as a conventional two channel storage oscilloscope.

☞ **Note:**
Changes to settings for the oscilloscope function a immediately displayed. Changes are transmitted to the ND21. The last recording with the old settings will be completed and transmitted to the PC. Then the first recording with the new settings begins. As soon as the recording is completed, it is transmitted to the new settings to the PC.

Channel selection

Two channels can be simultaneously displayed.

To select a signal for the display, press the key for channel 1 or 2 [1] or [2]
A list of possible signals will be displayed.

The selection is made by pressing the key for the desired signal, i.e. for

n(nominal) speed set point	[n]
n(ramp) speed set point according to ramp generator	[R]
n(actual) actual speed	[N]
m(nominal) inertia set point	[m]
ia(nominal) current set point phase A	[a]
ia(actual) actual current phase A	[A]
ib(nominal) current set point phase B	[b]
ib(actual) actual current phase B	[B]
position(actual) actual rotor position	[L]
position(nominal) rotor position set point	[l]

☞ **Note**:
Select capital letters for actual values and small letters for nominal values.

Once a signal is selected for one channel, the same procedure can naturally be performed for the other channel.

Selecting the trigger source

Trigger setting

The selection of the signal which is to trigger the storage oscilloscope function, is performed the same way as selecting the signal for the display.

To do this
Select the trigger function [T]

Adjust the trigger threshold by calling up the level function [l]

This is followed by the inputs for the trigger threshold.

Inputs for trigger source

Here a 2 digit hexadecimal number must be inserted.

This means 00h to 75F positive numbers (decimal 0 - 127) and FFh to 80H negative numbers (decimal -1 to -128). The size of the display monitor extends bottom to top from -128 to -127.

i.e. for 50% of the lower diagram half [C] [0] [enter]

Selecting the trigger slope

The trigger slope is modified via the slope function [s]

Autotrigger

The auto trigger function is switched on and off with the auto function [a]

When the auto trigger function is switched on, regular recordings occur even when no trigger signal is present.

Time settings

Selct the function "time base"

Select the function "**time** base" [t]
with up, down [u], [d]
or with the arrow keys select the desired time base.

The displayed time represents a unit on the horizontal time axis.

Exit the function with [r] or [space]

Trigger delay

Here you can define the number of units before or after triggering the actual display or signal is to take place.

Select the function "delay" [d]
insert the desired value (between -5 and +9)
i.e. insert -1 [-] [1]

Saving and loading diagrams

Saving diagrams

To freeze the diagram select the “hold function”	[h]
Select the “save function”	[S]
and insert a name i.e. novo	[n] [o] [v] [o] [enter]
Answer yes to the question: Are you sure? if you want to save this diagram	[y]
otherwise no	[n]
You now have the opportunity to add a comment text for example, on which machine, on which motor, with which parameter group, under which conditions etc. the measurement was used. End the input procedure by pressing the enter key twice	[enter] [enter]
In case you wanted to add comment, a single pressing of the return key is sufficient.	[enter]
After saving, do not forget to remove the freezing of the diagrams.	[h]

Loading diagrams

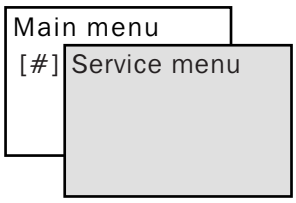
A previously saved diagram can again be displayed with the “load function”.	[L]
Insert the filename i.e. novo	[n] [o] [v] [o] [enter]

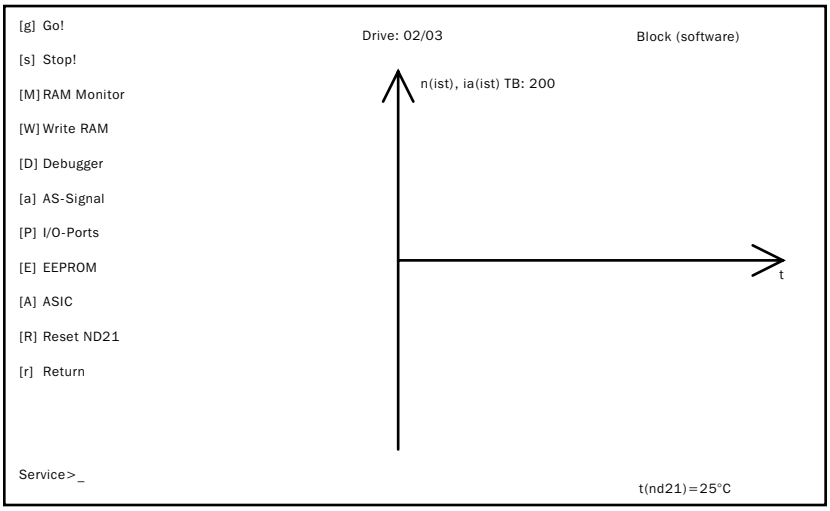
Displaying diagrams

With the function “directory” you can display diagrams which have previously been saved.	[D]
Exit the function with	[space]
Exit the storage oscilloscope menus with	[space]

1.4.11 Service menu

In the main menu select [#]





Caution!

Via the service menu it is possible to access an almost hardware level of the ND21. This is coupled with risk. Change only storage cells, which you know exactly what the functions are and reactions the changes will cause. Then you can prevent un-wanted reactions of the motor.

The commands
Go! [g]
Stop! [s]
are explained in the menu “limit values”, and have the identical functions here.

RAM monitor

With the function “RAM monitor” you can see directly inside the RAM memory of the ND21. [M]

Data are shown with their hexadecimal address, their hexadecimal value and ID.

[u]<<[ ]>>[U]

With up, down or the arrow keys, you can page through the RAM memory of the ND21. Here you will find parameter, actual and set point (nominal) values. [u], [d]

Exit the function RAM monitor with return [r]

Write RAM

With the function write RAM an entry can be made directly into the RAM memory of the ND21. For the address either a hexadecimal address of the desired memory cell or its ID can be entered. Hereby capitalization is to be taken into consideration. [W]

Complete the entry with [enter]

In the display you will then see the hexadecimal address of the memory cell, its present content and the input field for inserting a new value. Here the data input is always in hexadecimal form.

Complete the entry with [enter]

If no changes are to be made simply press the space key.

Debugger

The debugger functions is for checking errors during the development of the ND21 is not accessible by users.

AS signal

Select the AS signal function with [a]

The AS signal function allows via a digital signal, monitoring of the communication from the ND21 with a PLC controller.

For a description of the display see the **ND21 User Manual, chapter 13.**

Exit the AS signal function with [space]

I / O ports

The condition of the input and output lines of the H8 micro controller can be monitored via the I / O port function [P]

Only a few of these signal are of importance to the user:

Port 2 bit 4 “1” 0 V at input GPIN 1 (X3 pin 21)

Port 2 bit 5 “1” 0 V at input GPIN 2 (X3 pin 6)

Port 2 bit 6 “1” 0 V at input GPIN 3 (X3 pin 22)

Port 2 bit 7 “1” 0 V at input GPIN 4 (X3 pin 7)

Port 7 bit 3 “1” 0 V at input GPIN 5 (X3 pin 24)

Port 7 bit 7 “1” 0 V at input GPIN 6 (X3 pin 8)

Port 6 bit 0 “1” 0 V at input GPIN 7 (X3 pin 10)

Port 6 bit 2 “1” 0 V at input GPIN 8 (X3 pin 25)

Port 4 bit 7 “1” 24 V at output GP01 (X3 pin 31)

Port 4 bit 5 “1” 0 V at output GP01 (X3 pin 23)

Exit the function with [space]

EEPROM menu

In service menu select	[E]
In this menu using the function Read Byte a memory cell can be read from the EEPROM memory. A two digit hexadecimal address must inserted.	[R]
With up, down or using the arrow key you can page through the EEPROM contents.	[u] [d]
End the Read Byte command with return	[r]
After inserting the 2 digit hexadecimal address, the present content of the memory cell will be displayed and you can insert a new byte. The previous content will be overwritten when the question “Are your sure [y/n] ?” is answered with	[y]
With “Prog Param” all RAM parameter will be saved in the EEPROM when the question ”Are you sure [y / n] ?” is answered with	[y]
Exit the EEPROM menu with return	[r]

ASIC menu

In the service menu select The PI current regulator is set in the ASIC menu.	[A]
Set the P-part with then insert the setting as hexadecimal number.	[p]
Maximum setting: ASIC 2202 all other ASIC versions	H´ FF H´ 3FF
End input with	[enter]
Set the I-part with then insert the setting a hexadecimal number.	[i]
Maximum setting: ASIC 2202 all other ASIC versions	H´ FF H´ 3FF
End input with	[enter]

The times t1 and t2 should not be changed. These are reserved for internal time settings.

Presetting: t1 = 0, t2 = 10.

Other entry have an informal characterization:

ASIC: ASIC version

(DSP): Cycle frequency of the signal processor in ASIC

f(mod): Cycle frequency of the end stage

f(IRQ0): Registering frequency of the current regulator

t(tot): Dead time between on and of switch of opposite transistors of a bridge branch

t(on): minimum time on for a power transistor

Exit the ASIC menu with return [r]

Reset ND21

With the function Reset ND21 [R] a software reset of the ND21 can be activated. Naturally this can only function when proper communication exist. When older PCs are used with 8088 or 8086 processors, it may take some time until the communication to the NOVOBUS is again synchronized.

Caution!

When a reset occurs, all data in RAM memory is lost. If this is to be avoided, save all data via EEPROM menu with “Prog Param” before resetting.

Exit the service menu with return [r]

1.5 Motor setup

This chapter addresses the procedure for a first time setup of a motor with ND21.

It explicitly addresses the customer, who is using the ND21 for the first time.

After you have become familiar with the setup software, you can now advance to operating the motor. If you are not yet familiar with the ND21, you should begin your first attempts with a motor that is not yet

built into a machine. To avoid difficulties during setup, it is recommended to purchase at least the first ND21 with cable and motor from the same supplier.

Check the settings in the main menu. Especially the number of motor poles, dResolver,

EMF compensation, temperature probe and end switch must be configured.

In the limit menu set a low current maximum value (i.e. 3 A), a low maximum speed (i.e. 1000 rpm) and a slow ramp (i.e. 250 ms).

Is there an error message?

If yes, read up on it in **chapter 6.2. Problems During Setup**.

Turn off the position regulator via the regulator parameter menu. Also set the P-part of the speed regulator to a low value (i.e. 14%). Set the I-part

of the speed regulator to a low value (i.e. 5%). Set the tachometer filter to approximately 30%.

Set the speed set point (nominal) to 0 with

[n] [0] [enter]

with go, you can now start the motor

[g]

On the upper right of the monitor block (hardware) is now displayed. Closing S1. Now the end phase is working and the regulated motor is idle. Stop(ESC) appears on the upper right edge of the moni-

tor. The motor must idle to gain torque. It should not vibrate, wail, spring to a preference position or rev-up. ND21 should not send error messages.

Should an error condition exist, block the motor with ESCAPE or the S1 switch and refer to the problem in **chapter 6.2 Problem during setup**.	Close the S2 switch. “Run (Esc) now appears on the upper right of the monitor. The motor must still be idling.
With the speed function a low speed setting can now be made i.e. 10 rpm.	[n] [1] [0] [enter]
The motor must now rotate a the desired speed. Should there be an incorrect adjustment, so that the motor	doesn’t rotate properly or vibrates, this can be solved by correcting parameters (see Parameter setting).
Now switch to reverse operation via the “reverse function” Observe the behaviour during the changing of direction.	[R]
When exiting the speed menu the oscilloscope menu can be selected	[r] [o]

Here the settings for the oscilloscope function can be made.

Select the actual speed value for channel 1	[1] [N]
the set point speed for channel 2 after the ramp	[2] [R]
to trigger the speed set point for the time base 100 ms	[T] [n] [t] [arrow keys]
if not yet activated, activate auto trigger	[a]
You can exit the oscilloscope menu with return	[r]
Select the speed regulator menu again	[d]

Now enter higher speeds, increase the peak current, select a steeper acceleration ramp, try different oscilloscope settings.

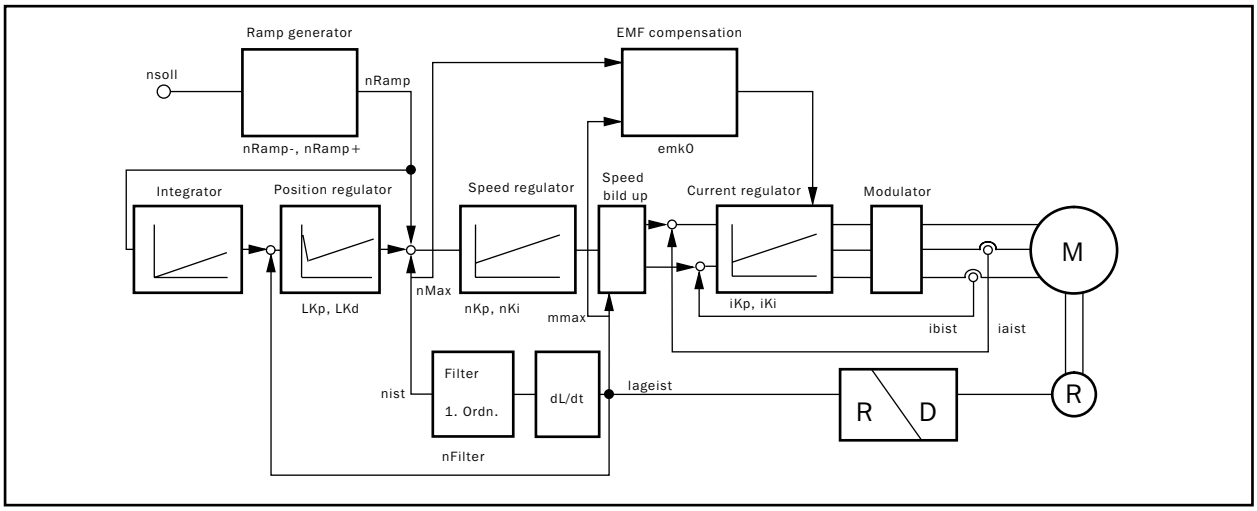
Get a feeling for how to handle the motor, try i.e. closing the position regulator etc..

Once you master oscilloscope menu and the speed regulator menu you can advance to optimizing the drive.

If problems occur, read **chapter 6.2. Problems during Setup**.

1.6 Entering parameter

Regulator structure



General The reverse test mode is very useful in regulator optimization. As a rule, you should always first optimize the current regulator, then the speed regulator, thereafter and only thereafter, the position regulator. I may be necessary, during position regulator optimization, to reset the speed regulator.

In general you could say, the behaviour of ND21 digital regulator is the same as that of a conventional analogue regulator. Therefore the regulator adjustment can be performed in the same manner you accustomed to with analogue regulators.

What used to be potentiometers on analogue regulators are now bars and hexadecimal numbers on the PC. Turn up poti means here increase bar length, or insert a large number. Where here caution is to be taken to ensure number values are continuous and large jumps in numbers are avoided.

The regulator can be blocked at any time by pressing the escape key. ND21 is built, so that it can normally not be destroyed by improper adjustment. When you in addition to this, keep a finger near the escape key, nothing should happen to the motor.

Keep in mind, that all settings which haven't been stored with the save command will be lost when the ND21 is switched off.

1.6.1 Adjusting the current regulation

This includes the adjustment of the PI current regulator, the EMF compensation and the current limits. These are the basic conformations to the used motor. You must therefore only perform them once for the used motor type and can then transfer them to motors of the same type.

Setting the current limit

Setting the current limit

In the limit values menu set the peak and rated current values for your motor type.

Setting the EMF compensation

At high speeds, opposing EMF of the motors enters the circuit as disturbance. Since these disturbances are known and can be calculated, they can be compensated in advance.

The setting is made in the general settings menu.

The entry for the motor voltage gradient is made as peak value from phase to phase.

Setting the PI current regulator

Experimental setting of the current regulator.

For this setting the motor should be in the reversing mode (**see chapter 1.4.8.3 Test mode**). Select the speed and ramp so that they cause noticeable motor currents during the reversing of the motor.

The following settings should be made in the oscilloscope menu:

Channel 1: iasoll	[1] [a]
Channel 2: iaist	[2] [A]
Trigger: nsoll	[T] [n]

Level: 0h	[l] [0] [enter]
Timebase: 5 ms	[t] 6*[u] [r]
Delay: 1	[d] [-] [1]
Auto: yes	[a]
Shortly after these settings have been made, the curves for the nominal and actual current values should appear.	without oscillating the current regulator.
Thereafter open the service menu. The parameter for the current regulator in the sub menu ASIC are to be optimized.	A value of 60h is recommended as a starting value for iKp and 2h for iKi. Hereafter the iKp can be increased until the current regulator begins to oscillate, this can normally be heard as a whistling sound. The oscillation is visible on the oscillogram. The iKp is then to be reduced until no oscillation is detectable.
The goal here is to match the nominal and actual current curves as good as possible	
This can lead to over current or end phase error messages. Should an end phase error	message occur, the device must be switched off and on again.
The over current error message can be erased with the or delete key. However, the last change that caused the error, should be changed back before the drive is re-activated.	[Del]
Note the iKp and iKi values are hexadecimal numbers. This means the 99h doesn't follow 100h, however, 9Ah, 9Bh, 9Ch, 9Dh, 9Eh, 9Fh, A0h etc.. The iKi can be optimized after the iKp has been set.	It is important that the actual current value never exceeds the set point (nominal) value. Therefore iKi can be increased as long as this doesn't occur and the current regulator doesn't oscillate.

1.6.2 Speed regulator settings

Here you can set the speed regulator parameter nKp, nKi and nFilter as well as the speed limit nMax and ramps.

Setting speed limit and ramp

Settings are made in the limits menu according to the motor and machine data.

A value of 38% has proven to be a good starting value. The rule is: higher numeric values - longer filter time constants, lower limit frequency - stronger phase shifting of the tachometer signal.

Tacho-filter presetting

This involves a first class digital filter.

Setting the speed regulator parameter

This involves a PI-speed regulator. A value of 18h has been proven to be a good starting value. The setting is to be made in the same manner used for analogue drive units. Large values cause the motor to run hard an firm, but also louder. Lower values make the motor run softer and smoother.

To better judge the setting procedure, the oscilloscope function must be setup for this. It is recommended to select “nRamp”, and “nist” for channel 1 and channel 2, in the oscilloscope menu. Triggering will be with “nsoll”, the time base is to be set for exactly the same length as the ramp.

Via the speed regulator menu, you should let the motor reverse at an average speed, in order to achieve a reasonable oscillogram in test mode.

Adjust the P-part of the speed regulator in the “regulator parameter” menu.

Increase the P-part until the speed regulator oscillates. This is noticeable by the squealing sound of the motor and on the oscillogram. Thereafter again reduce the P-part until the motor no long oscillates.

Hereafter adjust the I-part.

Continue to increase the nKi as long as nist does not overoscillate and the regulator doesn’t oscillate.

Nkp and nKi are herewith well adjusted.

It is possible to determine the speed regulator parameter using a regulator circuit calculation. This is provided by the regulator transmission function.

1.6.3 Setting the position regulator parameter

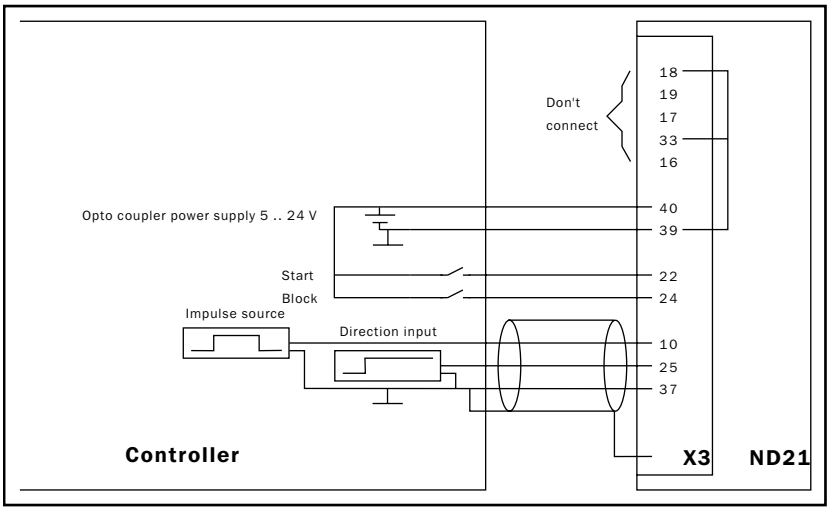
The ND21 position regulator involves a PD regulator, respective this aspect must the parameter LKp and LKd be set. The following pre-settings are recommended:
LKp = 20h
LKd = 30h

It is recommended to select the same oscilloscope settings as used for the speed regulator. In the speed regulator menu, the same settings should be used as in setting the speed regulator parameter. The position regulator is also to be activated.

The position regulator parameter can be changed via the “regulator parameter menu”. It could become necessary during operation with position regulator, to reduce the I-part of the speed regulator (nKi). Change the parameter until the desired transition behaviour is achieved.

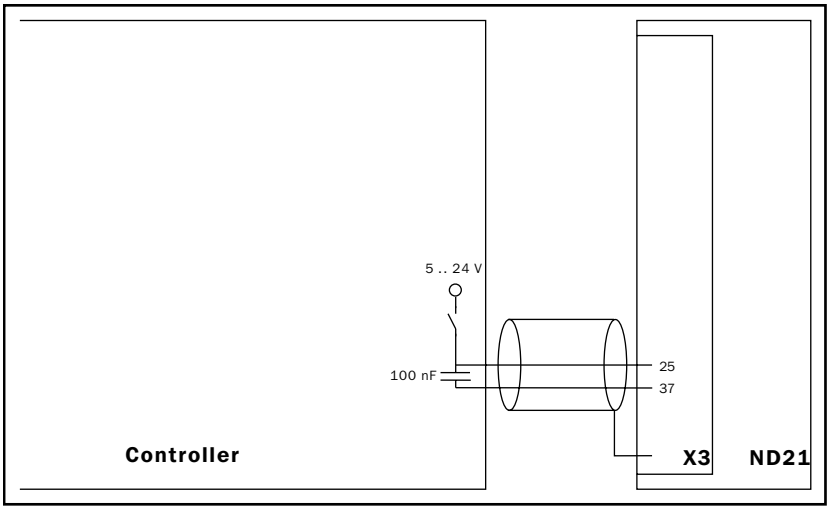
2 Speed input via the frequency input

2.1 Hardware requirements



For frequency operation the follow conditions are required:

- supply the opto-coupler with a voltage between 5 and 24 V.
- Connect the frequency and directional as shown. The signal amplitude should be between 5 and 24 V and the signals should be buffered. If for example, the directional input is given via a mechanical contact, this is to buffered by pre-switching with a suitable capacitor.



Direction input with buffer

The frequency and directional cable must be shielded. The shield is to be grounded on the controller side and on the ND21 side connected to the housing with a D-sub plug connector. In some cases it is necessary to shield the 5 .. 24 V power supply.

2.2 Software settings

It is recommended to make the regulator settings in digital mode and first thereafter switch over to the frequency mode.

Here the position regulator is to be activated and Lkd set to 0h.

In the general setting menu:

Nominal value setting: frequency, if necessary reset device.

☞ **Note**:
If GPIN8 is used as directional input, it is then no longer available as mode switch.

In the limit value menu:

Ramp nominal value: inactive

In regulator parameter menu:

Position regulator: active

D-part: 0

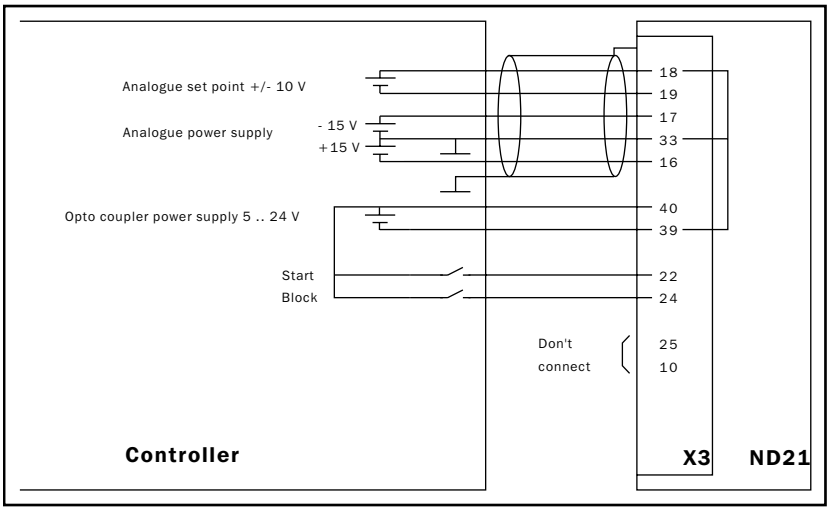
Set the frequency nominal value.
(**see chapter 1.4.6.2 frequency set point**)

Attention!

Please do not forget to save setting i.e. the EEPROM menu with “Prog Param”.

3 Speed input via analogue input

3.1 Hardware requirements



Following conditions are required for analogue operation:

- External supply for the galvanic separated analogue part of the ND21 of — +15V +/- 10% and -15V +/- 10%.
- Supply the opto coupler with a voltage between 5 and 24V. The opto coupler — power supply can also be over +15V.
- The input of the analogue set point (X3 pin no. 19) is connected to the zero — potential of the analogue and the opto coupler power supply (no different input).
- The analogue cable must be shielded. The shield is to be grounded on the controller side and on the — ND21 side connected to the housing with a D-sub plug connector.
- Do not wire pin 25 and pin 10 on X3.
- The voltage on analogue input is not to exceed 11V and go under -11V. — If necessary the nominal value is to be limited externally.

3.2 Software settings

It is recommended to make the regulator settings in the digital mode and first thereafter switch over to analogue operation.

In menu general settings Set point input: analogue, if necessary reset device

In limit value menu Ramp set point: upon request

Set analogue scaling

☞ See chapter 1.4.6. Analogue set point.

Note to scaling, when a speed measurement is available.

Vcolin =

$$\frac{\text{VCOlin (old) x requested speed}}{\text{measured speed}}$$

Example:
Requested speed at 10V nominal input 3000 rpm, measured speed 3357 rpm

A pre-setting of VCOlin at 32 hexadecimal = 50 decimal.

VCOlin = 50.3000 / 3357 = 44,68

rounded: 45

Converting a hexadecimal number:

45 / 16 = 2 rest 13 (= H´D)

VCOlin is to be set to 2Dh.

Attention!

Do not forget to save the setting i.e. in EEPROM menu with “Prog Param”.

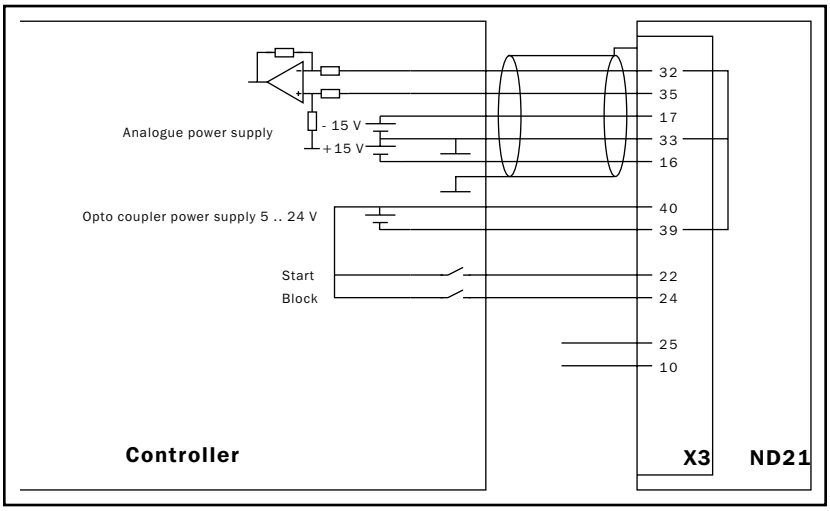
3.3 Method of function

The analogue nominal voltage is converted with a PWM-signal. The signal is transmitted over a very fast opto coupler to the timer input of the micro controller. The micro controller determines the pulse width using a 5 MHz tact (quartz precision). The offset balance and the gain balance is performed automatically.

☞ **Note:**
The analogue input can not be used simultaneous with the frequency and PWM input, since these 3 functions are carried out by the same timer in the micro controller.

4 Analogue output

4.1 Hardware requirements



☞ **Note**:
The analogue output can only be selected when the digital output GP01 is not used.

Function:

A 20 kHz PWM signal at GP01 will be sent as a filtered analogue value.

+15V supply and -15V supply for the analogue part.

5..24V supply for the opto coupler

The -15V can also be used for this current.

4.2 Programming

Activating the analogue output

The analogue output is activated by setting 0 on Bit6 in parameter HwVersion2.

Select service menu	[#]
with the function Write RAM	[W]
call up the parameter HwVersion2	[H] [w] [V] [e] [r] [s] [i] [o] [n] [2] [enter]
Set bit 6 to 0: i.e. 3Fh at end phase low active	[4] [0] [enter]
or BFh at end switch high active	[C] [0] [enter]
2 x space to leave Write RAM	2 x [space]
In the EEPROM menu	[E]
select program parameter	[P[
Are you sure?	[y]
OK	[space]
Return	[r]
Reset ND21	[R]

Offset adjust

Before adjusting the offset you should allow 1h for the ND21 to warm up.

Select service menu	[#]
with Write RAM	[W]
select the parameter window	[W] [i] [n] [d] [o] [w] [Enter]
write down the content of the parameter and set XXh to 0	[0] [enter]
press space to select additional parameter	[space]
type the parameter AnOut	[A] [n] [O] [u] [t] [enter]
insert 7B	[7] [B] [enter]
press space to select additional parameter	[space]
type the parameter AnOutOffset	[A] [n] [O] [u] [t] [O] [f] [f] [s] [e] [t] [enter]
With a voltmeter measure the voltage on the analogue output. Set this voltage 0 by changing the parameter AnOutOffset.	[ ] [enter]

press space to select	
additional parameter	[space]
select window	[W] [i] [n] [d] [o] [w] [enter]
go back to the noted value	[X] [X] [enter]
2 x space to leave Write RAM	2 x [space]
In the EEPROM menu	[E]
select program parameter	[P]
Are you sure?	[y]
OK	[space]
Return	[r]

Signal selection

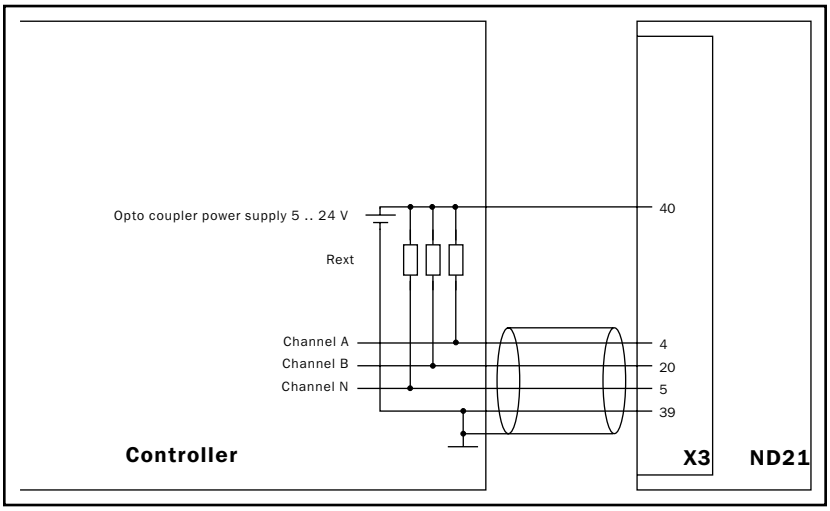
Signal selection is performed according to the following principal: All internal signal of the ND21 are stored in memory cells of the micro controller. Through its operation program the memory cells are updated to the newest actual status every 432 μs by the micro controller. When one of the internal signals of the ND21 are switched to the analogue output, the means a memory cell of the micro controller was selected for this.

Signal	**Abbreviation**	**Memory cell**
moment set point	msoll	02h
current set point phase A	iasoll	04h
current set point phase B	ibsoll	05h
current actual value phase A	iaist	06h
current actual value phase B	ibist	07h
speed set point	nsoll	08h
speed set point after ramp	nsollrampe	0Ah
actual speed	nist	0Ch
position set point	lagesoll	14h
actual position set point	lageist	18h
cooler temperature	tempKK	26h
motor temperature	tempMot	27h

With Write RAM	[W]
call the ANOut parameter	[A] [n] [O] [u] [t] [enter]
insert the desired memory cell i.e. for nist 0Ch	[0] [C] [enter]
2 x space to leave Write RAM	2 x [space]
In you want to save the setting to the EEPROM:	
open the EEPROM menu	[E]
Program Parameter	[P]
Are you sure?	[y]
OK	[space]
Return	[r]

5 Encoder emulation (ROD426)

5.1 Hardware



Opto coupler outputs, internal pull-up-resistors 18 kOhm to external 5..24V supply, output voltage through Z-diodes limited to 15V.

To take full advantage of the opto coupler, an external pull-up-resistor should be connected to the 5..24V.
Size of the external resistor:
Rest = Uext * 18K / (57V - Uext)

☞ **Note:**
An external power supply is required for the operation of the encoder emulation:

Output level:
0..5V (limited by a Z-diode)

The encoder signal is not short circuit proof!

5.2 Settings

The impulse number is for the impulse output in random programmable. The impulse number is set in the EEPROM menu with the Write Byte function.

Storage positions:	H´ 44 and H´45
maximum impulse number:	1024 per revolution
maximum setting in H' 44 and H' 45	H' 0400

Example:

Impulsenumber	**Hex value**	**H' 44**	**H' 45**
1000	03E8	03	E8
500	01F4	01	F4
200	00C8	00	C8
758	02F6	02	F6

The desired impulse is saved in the storage cells H' 44 and H´ 45 of the EEPROM as hexadecimal values.

To activate the setting it is necessary afterwards to reset or switch the ND21 off and on.

The zero point is pre-programmed.

6 Diagnose

6.1 ND21 Error messages

Code	Error message	possible cause	user action
8	8" in display	5V supply defect; 5V monitoring defect:	send in device for repair
101-103	EEPROM defect		send in device for repair
110	Motor temperature probe defect	break in the short circuit of the probe line (at PC or NTC); improper programming	check sensor wiring; check motor temperature programming
111	Temperature sensor; Cooler defect	temperature measuring switch defect	send in device for repair
112-116	Voltage measuring error	device defect	send in device for repair
120 121	Analogue output error	Analogue input can't be calibrated	check power supply; if necessary send in device for repair
130	Resolver converter	resolver / digital transducer defect	end in device for repair
131	Reference oscillator error; resolver monitoring error	short circuit or break in the resolver line; reference oscillator defect; resolver monitoring defect	check resolver wiring, if necessary send in device for repair
132	RAM controller defect	Impulse RAM cannot be programmed; disturbance in connection between micro controller and resolver converter	send in device for repair
133	Resolver adjustment error	loose or improperly adjusted resolver	check resolver
140	Watchdog defect	watchdog hardware defect	send in device for repair
141	internal watchdog of the micro controller	software error; electromagnetic impulse	
150	ASIC error	malfunction of the ASICs Novochip	send in device for repair
300	PAL error	malfunction of PAL monitoring	send in device for repair

Code	Error message	possible cause	user action
302	5 V error	5 V power supply defect; 5Vmonitoring defect	send in device for repair
303	+/- 15V error	+/- 15V power supply defect	send in device for repair
304	Inter circuit over voltage	**overload of the ballast switching through**: a) too high network voltage b) too much braking energy during dynamic operation; c) too much energy in generator mode d) ballast stage defect e) monitoring defect **When operating with extreme ballast resistance:** a) connection to external ballast resistor broken	check the named causes; if necessary send device in for repair
305	Inner circuit over voltage	too low power supply; a circuit stage is missing; protective block defect; transducer defect:	check the named causes; if necessary send device in for repair
306	Watchdog error	program crash: a) software error b) hardware error c) electromagnetic impulse	send device in for repair
307	End stage error	short circuit in the end stage; short circuit in the wiring; short circuit in the motor	check the motor and wiring; send device in for repair
308	Over current	improper setting of the current regulator; device malfunction	check the current regulator setting; if necessary send device in for repair
309 134 135	Resolver	short circuit or break in the resolver line; resolver defect; reference oscillator defect; resolver converter defect	check resolver wiring; if necessary send device in for repair

Code	Error message	possible cause	user action
310	End switch P	end switch triggered and interrupted	check end switch and wiring
311	End switch N	end switch triggered and interrupted	check end switch and wiring
314	End switch error	end switch triggered and interrupted	check end switch wiring; check end switch programming
400	Cooler over-temperature	device over loaded; ventilator defect	check ventilator and cabinet temperature
401	Motor over-temperature	motor overloaded: improper programming of the maximum temperature	check motor load; check motor venting;
508	Bus timeout	over 10 ms no telegram from host computer	check host station; if necessary switch off timeout monitoring
600	Position controller	non-realistic input values (positioning time > 26s)	check input values for position controller
601	Position controller	position controller not enabled	purchase a device with position controller
700	Slipping error (blocked)	positions or speed regulator set improperly or motor is blocked	check regulator settings; check motor; possible send in measurement diagram
701	Current regulator	break in motor line	check motor lines
800	Impulse input	disturbance in the directional input	remove disturbances of the directional input, buffer
0XX	PortXX error	incorrect wiring, or improper signal on portxx of the micro controller	send device in for repair
2XX	micro controller error	error in the micro controller software	call Novotron
5XX	Bus error (NOVOBUS)	error in the bus wiring; defective bus client; disturbance in coupling	check the bus wiring

Advanced diagnosis:

In addition to the listed error messages, it is also possible to record measurement diagrams, with the built-in storage oscilloscope function.

6.2 Setup problems

Problem	Possible cause
Motor is uncontrollably high	Motor wiring; Resolver wiring; Resolver adjustment; Resolver setting Motor; polarity improperly set
Motor goes into predominant position	Motor wiring; Resolver wiring; Motor polarity improperly set
Motor vibrating, squealing	Current regulator set too high; speed value, Position regulator set to high
Error message from ND21	**(see chapter 6.1.)**
Over current error message	Current regulator set too high; I-part of the current too high
No impulse output	Pull-up resistor
Motor doesn't reach the requested speed	Motor gradient is too high; if you are working with position regulator: Lkp is too low
Speed over run	nKi too high, nKp too low
Position over run	LKp to low; LKd improperly set; nKi to high
Motor drifting from analogue set point	Disturbance of the set point or the +/- 15V Power supply; offset on the analogue set point
Motor not reacting to analogue set point	+/- 15V supply for analogue part missing **(see chapter 3.1.)**; 5 – 24V supply missing **(see chapter 3.1.)**; ND21 not set for analogue output (**see chapter 3.2**)
Motor not reacting to frequency set point	5 – 24 supply missing **(see chapter 2.1);** ND21 not set for frequency input **(see chapter 2.2)**
ND21 not reacting to analogue or digital signal	X3 not properly plugged
Setup software reporting "No Connection"	NOVOBUS connection not plugged in; NOVOBUS connecting plug has either non-existing or improper bridged wired; NOVOBUS cable not plugged in, interrupted, or improperly wired.
Setup software transmits "ND is not ready"	ND21 not switched on; NOVOBUS cable improperly wired

7 Calculations

Question:

Can a motor with ND21 which has a demanding torque, reach a certain speed using this torque?

Example:

An application requires a torque of 30 Nm for acceleration . With this torque a speed of 2200 rpm is to be achieved.

The test is to establish if this is possible using a ND21-5610 and a motor NHD 142E6-180S.

The NHD 142E6-180S motor has a continuous idling torque of 16 Nm and for rapid acceleration be 5-fold overloaded. The necessary acceleration is therefore possible. To find out, if with the requested torque, acceleration to the maximum speed can be achieve, use the following calculations:

Inductive voltage drop in the motor:

UL = n p L i 0,0453

With: NHD142E6-180S

n: Speed [revolutions per minute] 2200

p: No. of motor poles 6

i: Acceleration current,

effective 14,3 A

$$i = \frac{M}{3 \text{ torque constants}}$$

$$= \frac{30Nm}{(3 * 0{,}7 \frac{Nm}{A})}$$

L: Motor inductivity
phase – phase [H] 0,222 H

Results:

UL = 188,3 V

Resisting voltage drop on motor:

UR = R i 0,866

With:

R: Internal resistance
phase – phase [W] 1,9

Therefore

UR = 23,5 V

Opposing EMF of the motor

$$U_E = 0{,}5\sqrt{\frac{2\,Vgn}{1000}}$$

with

Vg: Voltage gradient
phase – phase [V/1000] 180

Therefore UE = 280V

Voltage requirement for the motor:

$$U = \sqrt{(u_E + U_R)^2 + U_L{}^2)}$$

$$= 357{,}2V$$

Required inner circuit voltage:

$$U_{ZK} = \sqrt{2U} = 505V$$

With three phase 400 V circuit connection, the ND21 has an intermediate voltage of 565V. So there is sufficient voltage available to achieve the requested speed using the requested torque.