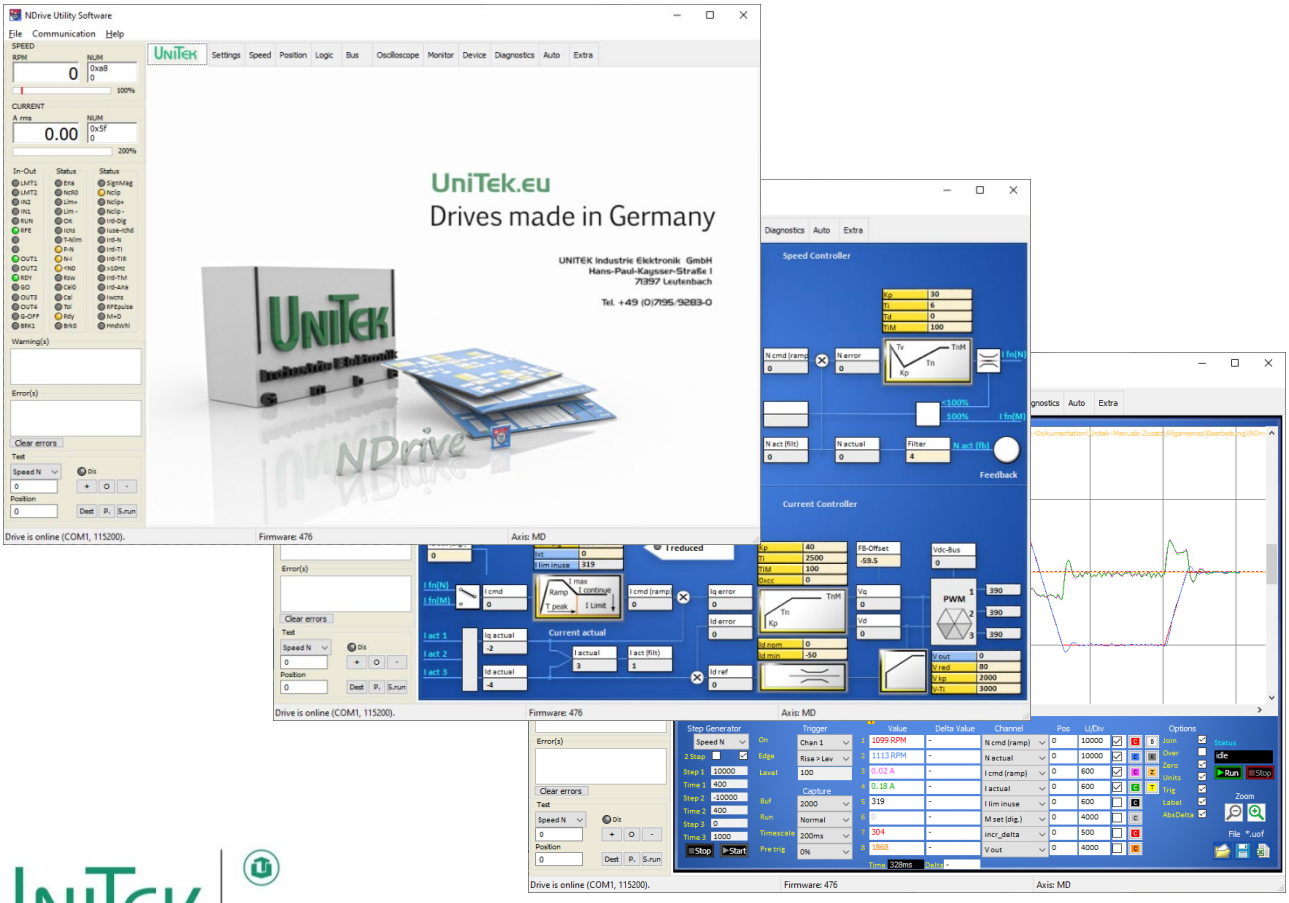
M A N U A L

PC Software Manual

for Servo Amplifiers (DS, DPC)
and Battery Drives
(BAMOBIL-D, BAMOCAR)

NDrive.3



UNITEK Industrie Elektronik GmbH
Hans-Paul-Kaysser-Straße 1
71397 Leutenbach-Nellmersbach

Tel: 07195 / 92 83 - 0
contact@unitek.eu
www.unitek.eu

Edition / Version

2020 / V1

Contents

1 Basic information

1.1 History

Version	Modifications	Date
2016 / V1.1	Fax no. / page 68 (Iq – complete)	02.08.2016
2017 / V1	Error list / Parameter	14.11.2017
2020 / V1	Complete revision	27.01.2020

Note:
Only use NDrive3xx program for units from firmware FW-350 on (from device serial no. 70000)

1.2 Further manuals for digital UniTek units

1.	MANUAL	DPC 4xx-AC DSxx, BAMO-D3, BAMOBIL-Dx	Hardware description
2.	MANUAL	DSxx, BAMO-D3, BAMOBL-Dx	Commissioning
3.	MANUAL	CAN	BUS system

Use all manuals for the planning, the installation, and the commissioning!

CD version included inside the delivery (UNITEK-DOKU-SOFT).
Online: www.unitek.eu

MANUAL includes warning and safety notes, descriptions to standards and regulations, and mechanical and electrical installation notes.

The MANUAL must be available at any time for all persons dealing with the unit.

Short symbols/terms

Servo	Digital UNITEK motor controller
Unit	Digital UNITEK motor controller

1.3 General

The software NDrive3 is used to set-up and to optimise the UNITEK digital servo amplifiers (DS, DPC) and motor drives (BAMOBIL-D, BAMOCAR-D).
Basic computer skills and fundamental knowledge of the Windows software are required.
The NDrive3 software and the respective manual are available on CD or via the UniTek homepage.

1.4 Safety advice

The parameters and settings of the controller (servo drive) and the motor are preset with the NDrive software.
Operating parameters can be preset and changed during operation. The computer and the PC programs are not malfunction-proof.
The user must ensure that in case of malfunctions neither personnel nor machines are endangered and that the drive is stopped.
Saved data can be changed by third parties. Any imported data record must be checked prior to re-use.
Any adjustments or optimising work on the running drive must only be carried out by trained competent personnel with knowledge of drive and control engineering and computer handling.
Further to this, the safety advice for the amplifier and the drive used must be observed.
Any operation not conform to the safety guidelines is not permissible.

1.5 Operating system

NDrive will operate with WINDOWS 2000, WINDOWS NT4, WINDOWS XP, Windows Vista, Windows 8 or Windows 10.

Min. required PC equipment

Processor	80486 or superior
Graphics	WINDOWS compatible
Hard drive, available capacity	3 MB
Floppy disc drive	3.5“
CD drive	CD ROM
RAM, min.	8 MB
Interface	COM1..COM8 (RS232, USB adapter)

WINDOWS is a registered trademark of Microsoft Corp.

Linux
It is possible to use NDrive via a LINUX operating system by means of a Windows emulator (e.g. Wine).

1.6 Software – installation

The user software NDrive can be copied.
An installation of the NDrive program is not required. It can be directly executed.
Since NDrive is not a comercial software application, the acceptance of untrusted software must be selected inside windows at first use when asked to.

Internet:

- Choose www.unitek.eu or www.unitek-industrie-elektronik.de
- Download button → Click NDrive2-Software.zip
- Download and save the file (NDrive2-Software.zip)
- Decompress the file
- Start the program NDrive vXxx.exe
- At first start it is recommended to select the language (Help → Change language…) once and to restart NDrive in case language files are not pre-selected properly.

1.7 Communication RS232 (COMx)

Software communication between the PC and the servo amplifier is effected via RS232, (115200 baud rate).
Use an USB-RS232 adapter with PCs with an USB interface.
Plug and unplug the connecting cable only when the interface is disconnected.
The interface is galvanically connected to device ground (GND).

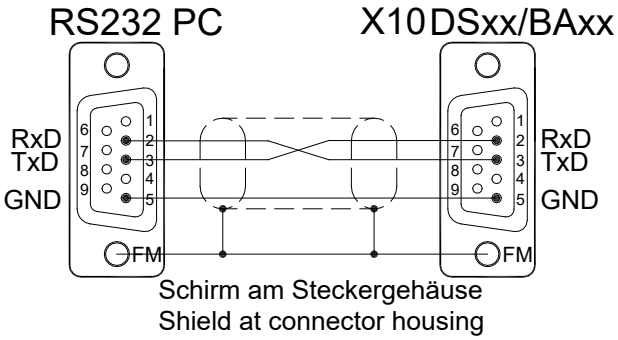


Fig. 1-1

2 Start screen

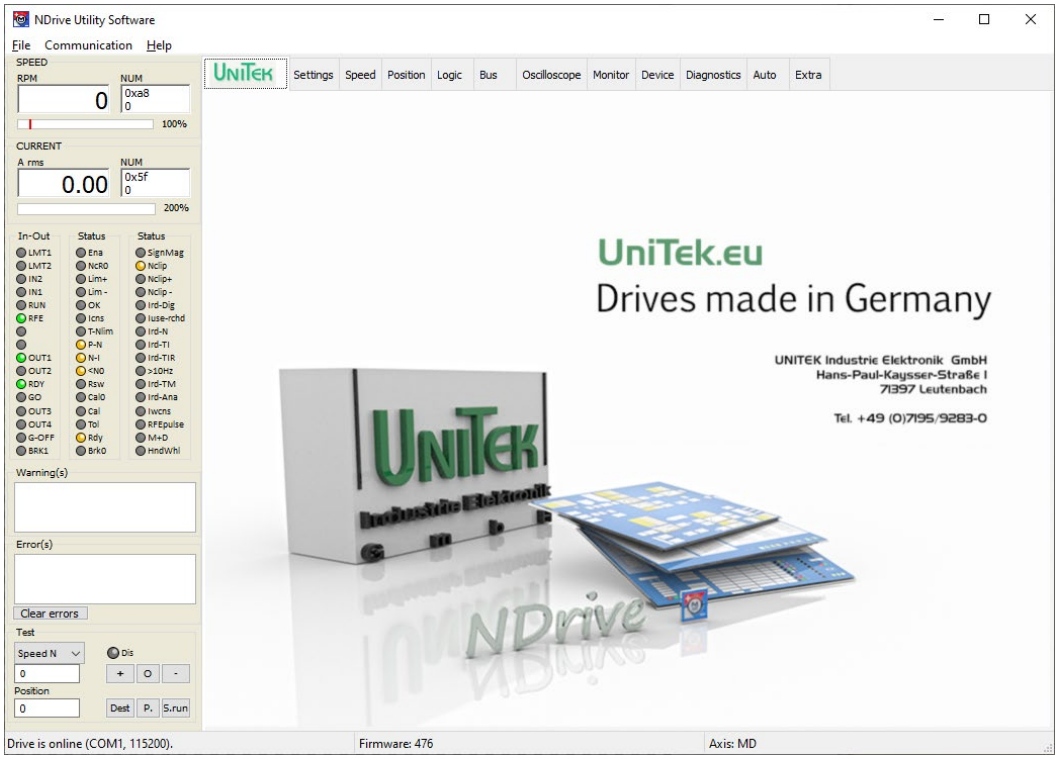


Fig. 2-1 – 00001

2.1 Description

The program presents a screen consisting of two elements. A constant outer frame (grey) and an interleaved page area (blue). The pages are accessed by a horizontal tab bar running across the top of the frame.

Top	Title bar, menu bar, page tabs
Left	Display of speed, current, inputs and outputs, states, errors, and test functions
Bottom	Connection state, Firmware number, Axis description
UNITEK.EU	Link to the Unitek website

- The screen surface switches between pages.
- The tab structure allows for easy access of relevant data and fast switching between the pages.
- The grey frame surface is constantly displayed.
- The selected pages are opened across the complete blue area.
- It is always possible to switch between the pages without a time delay.
- Multi-page parameters are automatically transferred.
- Settings referring to only one page remain unaffected.

2.2 Title bar NDrive – version + parameter set name

Drop-down menu for window commands

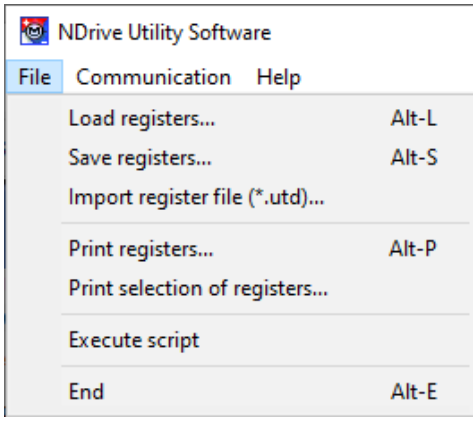


Fig. 2-2 - 00013

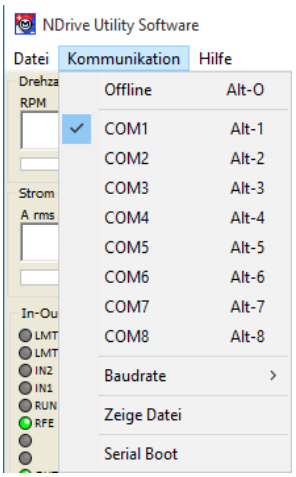


Fig. 2-3 - 00015

Communication
COM port
Baud rate 115200

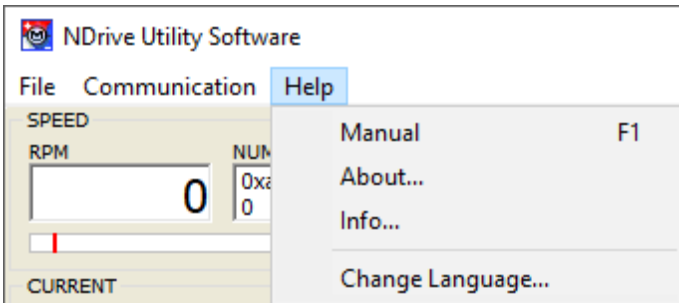


Fig. 2-4 - 00016

Help
Manual (NDrive_DE.pdf or NDrive_EN.pdf)
Select language via ‘Change Language‘

File-Functions:		
Load registers…	NDrive file*.urf	Loading a parameter file from the pc to the unit
Save registers…	NDrive file*.urf	Saving a parameter from the unit to the pc file
Import register file (*.utd.)…	DRIVE file*.utd	Loading a parameter file from the pc to the unit
Print register…	Print file	Printing of all parameters (registers)
Print selection of registers…	Print file	Printing of selected parameters (registers)
Execute script	(for service only)	Loading protected parameters to the unit
End		Closing NDrive program

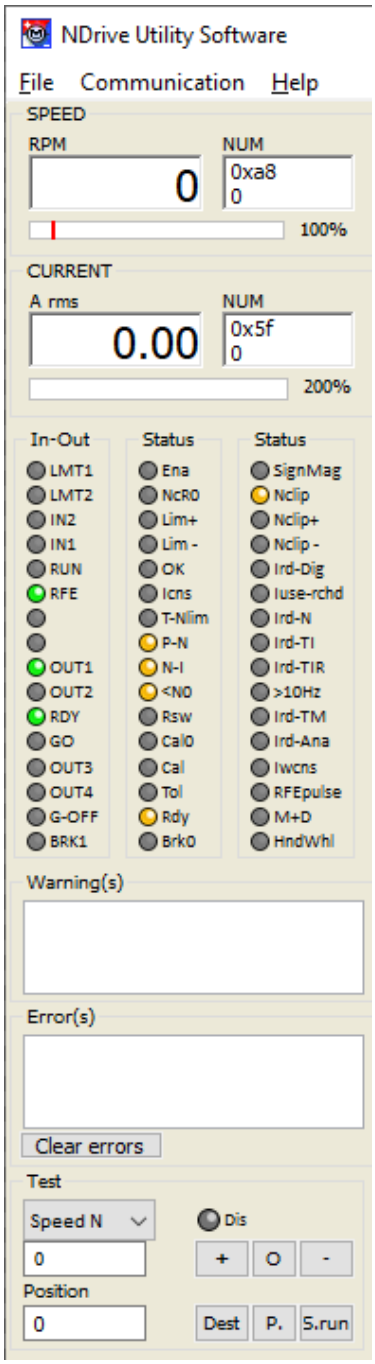


Fig. 2-5 – 00017

Speed	Speed display in rpm and 16 Bit numeric number (num). Bar graph 0..100 % speed
Current	Current display in Arms and 16 Bit numeric number (num). Bar graph 0..200 % nominal rated current
Inputs / Outputs	Display of the active inputs and outputs
States	Display of the states
Warning	Warning messages
Faults	Error display
Test - Speed - Torque - Position	Command field at digital control (speed/torque/position) Numerical entry for a test speed value Numerical entry for a test torque value Dest: = numerical entry of the position P. = Preset entry as actual position value and command value Calib. = Start of a reference run

Footer

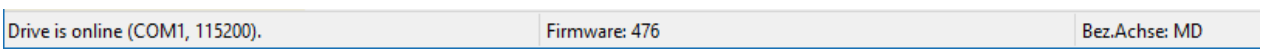


Fig. 2-6 - 00018

Communication Firmware no. Axis designation

2.3 Operation

The PC user interface has a standard WINDOWS format.
Only use whole numbers and write decimals with a point.
Write positive values without a sign, negative values with a (-) sign.

Online operation

Plug the connecting cable RS232. Switch on the PC and the control unit.
Select the baud rate of 115200.
Select the communication interface with <communication - COM1 to COM8>.

When the connection is successful the message <Drive is online> appears in the bottom frame line.
The active drive parameter data will be imported from the drive to the PC and can be manipulated via the input fields as required.

All drive parameters shown may be changed during operation via the NDrive surface and downloaded from the PC directly to the RAM of the drive by clicking the return key (enter).

2.4 Entry and selection

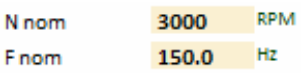


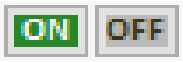
Fig. 2-7 - 00021

Click the **entry field** (left mouse button).
Enter a numerical value and click the return key (enter) to confirm the value. The changed value is saved in servo RAM.

Up-Down value change
Click the input field (left mouse button).
The value can be changed via the mouse wheel.
The values are immediately updated in the servo RAM.

Fig. 2-8 - 00022

Drop-down menu
Click the arrow button of the list box. The drop-down menu shows the available options. Scroll up or down by means of the arrow button and select an option by clicking it. Selecting an option will update the variable and closes the drop-down menu.



Option buttons
Click the selected button. The green button displays the selected function.

A tick in the selection field shows the selected option.

3 Help

Direct help

Hover the mouse cursor over the parameter entry field or setup field and an explanation field opens (tooltip).

Fig. 3-1 - 00024

Help menu

Click ***Help***
Click ***Manual***
The pdf version of the NDrive manual opens.

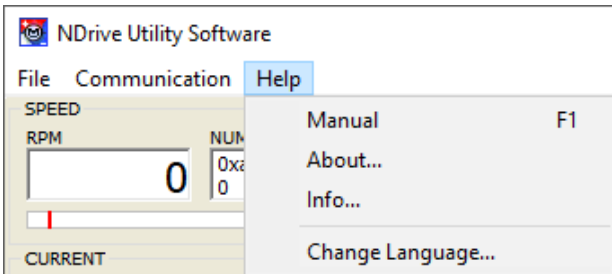


Fig. 3-2 - 00016

Change language

Click ***Help***
Click ***Change Language…*** and a list box opens
Select the language
Close NDrive and restart it in order for the changes to take effect

4 Saving and Loading of servo parameters

4.1 Saving and Loading in the servo (Eprom)

When there is an active communication the parameters displayed on the screen are those currently active inside the RAM of the servo drive. By pressing the return key, the changed value is directly updated to the servo RAM.

4.1.1 Saving in the servo (Eprom)

Eprom writing (permanent saving of parameter data)

Fig 4-1 – 00025

Click **„Eprom - STORE 0 or 1“** on the setting page.

The data are written into the selected level 0 or 1 of the Eprom.
The Eprom level 0 contains the current parameter record.
Each time the 24 V auxiliary voltage is switched on, all parameters of the Eprom level 0 are loaded into the RAM of the servo drive.

Attention:
If the +24 V auxiliary voltage is switched off, the RAM data will be lost.

4.1.2 Loading from the Eprom

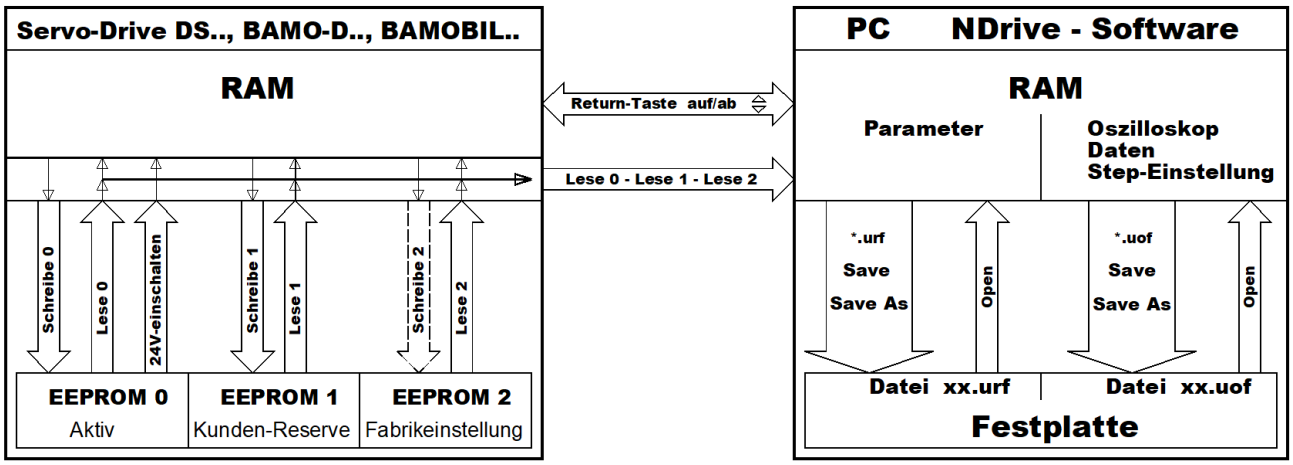
Eprom reading (loading parameters from the Eprom levels)

Fig. 4-2 - 00026

Click **„Eprom - RECALL 0, 1 or 2“** on the setting page.

The parameter data are transferred from the selected level 0, 1, or 2 of the Eprom to the servo RAM and to the RAM of the PC (if connected).
Each time the 24 V auxiliary voltage is switched on, all parameters of the Eprom level 0 are loaded into the RAM of the servo drive.

Note:
The data of the Eprom level 2 are code protected and contain the default factory parameter set.



4.2 Saving parameter data on the pc and loading parameter data from the pc

4.2.1 Saving of parameter data (.urf) on the pc

There are two possibilites to save a .urf (unitek register file) parameter file on the pc data medium (hard disk, etc.) with the contents from the servo RAM.

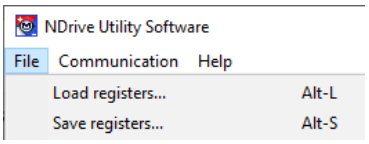


Fig. 4-3 - 00027

Via the menu bar:

Select **File** → **Save registers...** in the menu bar,
and the Save Register File window will open.
Enter or select file name and save.

Fig. 4-4 - 00028

Via the floppy disk symbol (save key):

Click the **floppy disk symbol (save)** on the Settings page,
and the Save Register File window will open.
Enter or select file name and save.

4.2.2 Loading of parameter data (.urf) from the pc

There are two possibilites to load a .urf (unitek register file) parameter file from a pc data medium (hard disk, etc.) to the servo RAM.

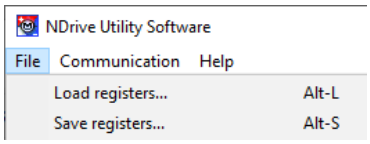


Fig. 4-5 - 00027

Via the menu bar:

Select **File** → **Load Registers...** in the menu bar,
and the Load Register File window will open.
Select and open the parameter (.urf) file.

Fig. 4-6 - 00028

Via the file symbol (load key):

Click the **file symbol (load)** on the Settings page,
and the Load Register File window will open.
Select and open the parameter (.urf) file.

After being loaded the parameter data are in the servo RAM.
At the same time all parameter fields in NDrive are overwritten with the loaded data.

4.2.3 Offline analysis and changes of parameter (.urf) files on the pc

Loading, changing, and saving of parameter (.urf) files while being in offline mode is possible by selecting **Communication** → **View File...** in the menu bar. After selecting the .urf file in the Load Register File window all parameters are loaded into NDrive.

The loaded parameters can now be seen and changed.

Select **File** → **Load Registers...** in the menu bar and save the changes in the same or in a new parameter (.urf) file.

5 Communication with NDrive

5.1 Establish the communication with NDrive

Make sure that the COM channel for the serial connection is known before starting the communication.

Click the menu ***communication*** to drop down the options.
Select the used ***COMx*** interface (COM1..COM8). The checked COM interface will be used to establish a connection to the servo.

The connection state is displayed in the bottom screen frame.
The connection was successful when the message **Drive is online (COMx, …)** is displayed in the bottom state bar.

Drive is online (COM1, 115200).

All parameter fields inside NDrive are updated with the data from the servo RAM.

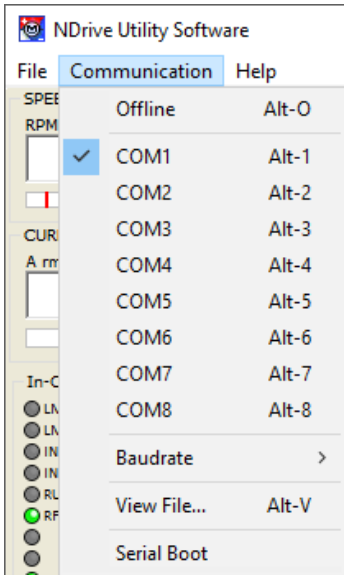


Fig. 5-1 - 00015

Stop communication
Open the drop down menu ***communication*** and click on ***Offline*** .
The connection is cut off and the message **Drive is offline** is displayed in the bottom state bar.

5.2 Faulty communication with NDrive

1. Random scrowling of messages in the warning or error display:
   ➔ COM connection faulty or wrong COM port selected.

2. State symbols flash or an additional window with an error message apears:
   ➔ Download the newest NDrive from the UniTek homepage (Link).
   ➔ Contact the UniTek customer sevice if necessary.

3. All names are displayed incorrectly:
   ➔ Select the language via **Help → Change Language...** and restart NDrive for the changes to take effect.

5.3 Firmware update

Due to update reasons, please use the manual **„Firmware update-2020-C2Prog_DE.pdf“** inside the folder “…\NDrive2-Software\manuals”.

Manual:

On the UniTek CD

UNITEK-CD-DOKU-SOFT

File “SOFTWARE\NDrive2-Software\manuals

or download from the UniTek homepage

www.unitek.eu or www.unitek-online.de

Link	Download	
Download	NDrive2-Software.zip	Press „NDrive2-Software.zip“ and save (e.g. downloads)
Unpack	NDrive2-Software.zip	Press RM + (extract all… / unpack here)
File	“…\NDrive2-Software\manuals”	

6 Communication table

6.1 Measured values and parameters

Measured values			
Symbol:	**Function:**	**Range:**	**ID address:**
N cmd	Speed command value before ramp	±32767	0x31
N cmd Ramp	Speed command value after ramp	±32767	0x32
N actual	Speed actual value	±32767	0x30
N actual-filter	Filtered speed actual value for display	±32767	0xa8
N error	Speed command/actual value error	±32767	0x33
I cmd	Current command value	see table	0x26
I cmd Ramp	Current command value after ramp	see table	0x22
I actual	Actual current(I)	see table	0x20
I actual-Filter	Filtered current actual value for display	see table	0x5F
Pos dest	Position target	±2147483647	0x6E
Pos cmd	Position command value	±2147483647	0x91
Pos actual	Actual position	±2147483647	0x6D
Pos error	Position command/actual value error	±32767	0x70
Zero capture			0x74
I_Limit1	Digital input END1	0/1	0xE4
I_Limit2	Digital input END2	0/1	0xE5
I_Din1	Digital input 1	0/1	0xE6
I_Din2	Digital input 2	0/1	0xE7
I_Run (Frg)	Digital input control unit enable	0/1	0xE8
O_Dout1	Digital output 1	0/1	0xE0
O_Dout2	Digital output 2	0/1	0xE1
O_Dout3	Digital output 3	0/1	0xE1
O_Dout4	Digital output 4	0/1	0xE1
O_Rdy (BTB)	Drive ready message	0/1	0xE2
I_Fault	Intern. error message from the power section	0/1	0xE9
I_Regen (Ballast)	Ballast circuitry state	0/1	0xEA
I_o´/u´ voltage	Over-voltage condition	0/1	0xEB
I_LossOfSignal	Resolver signal missing or faulty	0/1	0xEC
O_Go	Internal enable	0/1	0xE3
O_Brake	Active brake	0/1	0xF2
O_Icns	Limited to continuous current	0/1	0xF3
O_Less_NO	Speed inferior to 0.1%	0/1	0xF5
O_Toler	Within position tolerance range	0/1	0xF4
Rotor	Rotor position signals (RST)	1..6 (0 or 7 = error)	0x5C
Var1	Comparison reference value 1	±32767	0xD1
Var2	Comparison reference value 2	±32767	0xD2
Var3	Comparison reference value 3	±32767	0xD3
Var4	Comparison reference value 4	±32767	0xD4
MPOS_mech	Mechanical rotor position		0x42
MPOS_elec	Electrical motor position		0x43
Ain1	Analog input Ain1	±32767	0xD5
Ain2	Analog input Ain2	±32767	0xD6
I3_adc	Current actual value sensor 3	2048 (±2000)	0xA9
I2_adc	Current actual value sensor 2	2048 (±2000)	0xAA
I1_actual	Current actual value Ph1	s.Tabelle	0x54
I2_actual	Current actual value Ph2	s.Tabelle	0x55
I3_actual	Current actual value Ph3	s.Tabelle	0x56
Iq_actual	Current actual value	0..600	0x27
Id_actual	Current actual value	0..600	0x28
Iq_error	Current actual value - command/actual val. error	0..600	0x38
Id_error	Current actual value - command/actual val. error	0..600	0x39
Id nom	Nominal Id magnetizing current in % of the rated motor current (Inom eff)	0..100 %	0xB2
Id min	Minimal Id magnetizing current in % of the rated motor current (Inom eff)	-100..0 %	0xB5
I lim inuse	Present current limit	0..600	0x48
DC-BUS	Bus voltage	0..32767	0xEB
Vd	Present Vd voltage part	±4096	0x2A
Vq	Present Vq voltage part	±4096	0x29
V out	Output voltage	±4096	0x8A

Measured values			
Symbol:	**Function:**	**Range:**	**ID address:**
V red	Field weakening control – voltage reference value in % of V out	0..100 %	0x8B
pwm1 (5/6)	Pulse width modulation phase 1	750 (±750)	0xAC
pwm2 (3/4)	Pulse width modulation phase 2	750 (±750)	0xAD
pwm3 (1/2)	Pulse width modulation phase 3	750 (±750)	0xAE
T_Motor	Motor temperature	0..32767	0x49
T_IGBT	Output stage temperature	0..32767	0x4A
T_air	Air temperature (unit interior)	0..32767	0x4B
Ballast Count	Ballast power monitoring		0xA1
Temp-Debug	For service only	±32767	0x9A
Logic (Hz)	I/O processing frequency	0..32767	0xAB
Time_1us	Time pulse 1us	1/0	0x98
***PTR1**	*only for service*	±32767	0xB8
***PTR2**	*only for service*	±32767	0xBA
Unknown	*Return value In case of unknown ID-Address*	-1330	

7 Basic status information

7.1 Status information – speed and current

Speed in rpm (revolutions per minute) and as numerical value of the measured value from the ID address 0xA8

Current in Aeff (motor current in ampere effective) and as numerical value of the measured value from the ID address 0x5F

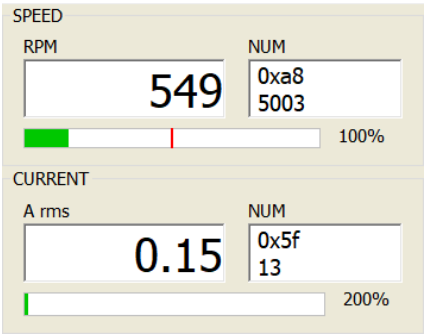


Fig. 7-1 - 00035

7.2 Status information – inputs and outputs

The LEDs are bright when the positive input voltage is >10 V and the output voltage is positive.

Symbol:	**Function:**	**ID address:** 0xD8
LMT1	Digital input Limit 1 active	Bit 0
LMT2	Digital input Limit 2 active	Bit 1
IN2	Digital input Din 2 active	Bit 2
IN1	Digital input Din 1 active	Bit 3
FRG (RUN)	Hardware enable active	Bit 4
RFE	Rotating field enable active	Bit 5
		Bit 6
		Bit 7
OUT1	Digital output Dout 1 on	Bit 8
OUT2	Digital output Dout 2 on	Bit 9
BTB (Rdy)	Hardware relay, output BTB (Rdy) on	Bit 10
GO	Internal enable GO active	Bit 11
OUT3	Digital output Dout 3 on	Bit 12
OUT4	Digital output Dout 4 on	Bit 13
G-OFF		Bit 14
BRK1	Excited brake	Bit 15

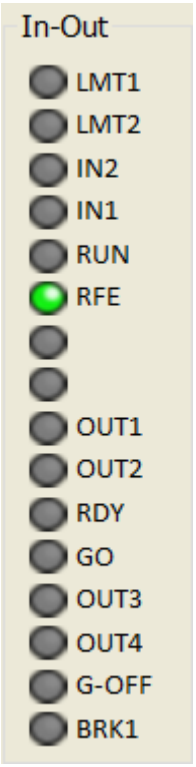


Fig: 7-2 - 00034

7.3 Status information – Status display

The operating states are displayed in the 'Status' field.

Symbol:	Function:	ID address: 0x40
Ena	Drive enable (combination hardware RUN and software)	Bit 0
NcR0	Speed limit to zero (Speed command still active)	Bit 1
Lim+	Limited switch Plus tripped	Bit 2
Lim-	Limited switch Minus tripped	Bit 3
OK	Drive okay (no uncontrolled reset)	Bit 4
Icns	Current is limited to the continuous current level	Bit 5
T-Nlim	Speed limited torque mode active	Bit 6
P-N	Position control active	Bit 7
N-I	Speed control active	Bit 8
<N0	Actual speed less than 0.1 % (standstill)	Bit 9
Rsw	Reference switch tripped	Bit 10
Cal0	Calibration move active	Bit 11
Cal	Calibration move completed (position calibrated)	Bit 12
Tol	Position within tolerance window	Bit 13
Rdy	Drive ready (BTB/RDY contact is closed)	Bit 14
Brk0	Unexcited brake with motor active	Bit 15
SignMag	Speed internally inverted	Bit 16
Nclip	Speed limiting enabled (N-Lim < 90 %)	Bit 17
Nclip+	Speed limiting (positive) via input switch enabled	Bit 18
Nclip-	Speed limiting (negative) via input switch enabled	Bit 19
Ird-Dig	Current limiting via input switch enabled	Bit 20
Iuse-rchd	Actual current limit reached	Bit 21
Ird-N	Current derating to continuous current via speed limit enabled	Bit 22
Ird-TI	Current derating to continuous current due to igbt temperature enabled	Bit 23
Ird-TIR	Current derating to continuous current due to igbt temperature active	Bit 24
>10 Hz	Current derating to continuous current at rotation frequency less than 10 Hz active	Bit 25
Ird-TM	Current derating to continuous current due to motor temperature active	Bit 26
Ird-Ana	Current derating due to analog input (if ≤90 %) possible	Bit 27
Iwcns	Current peak value warning	Bit 28
RFEpulse	Pulsed RFE - input monitoring active	Bit 29
M+d	vacant	Bit 30
HndWhl	Hand-wheel function selected	Bit 31

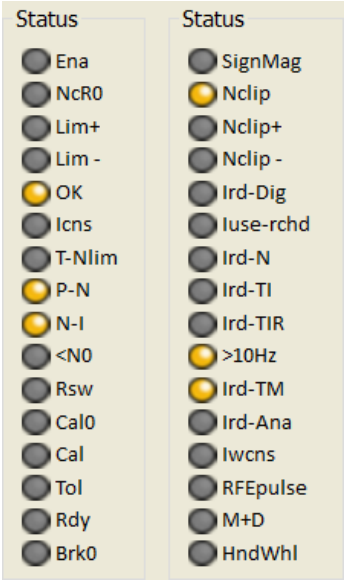


Fig. 7-3 - 00033

7.4 Status information – Error(s)

Display on the servo:	Error message in NDrive:	Function:	ID address: 0x8F$_L$
	NOREPLY-No RS	RS232 interface not plugged in or disrupted	
0	BADPARAS	Defective parameter detected	Bit 0
1	POWER FAULT	Hardware fault	Bit 1
2	RFE	Faulty safety circuit (only active for RUN)	Bit 2
3	BUS TIMEOUT	CAN TimeOut time exceeded	Bit 3
4	FEEDBACK	Bad or faulty encoder signal	Bit 4
5	POWERVOLTAGE	No power supply voltage	Bit 5
6	MOTORTEMP	Motor temperature too high	Bit 6
7	DEVICETEMP	Device temperature too high	Bit 7
8	OVERVOLTAGE	Overvoltage > 1.8 x UN is reached	Bit 8
9	I_PEAK	Over-current or strongly oscillating current detected	Bit 9
A	RACEAWAY (*)	Racing (without command value, incorrect direction)	Bit 10
B	USER	User – error selection	Bit 11
C			Bit 12
D			Bit 13
E	HW_ERR	Current measuring fault	Bit 14
F	BALLAST*	Ballast circuit overload	Bit 15
Flashing decimal point		Active processor	
Dark decimal point		No auxiliary voltage or unit-internal hardware fault	

If an error is detected the error information is send to NDrive via the ID address 0x8F$_L$ and displayed in the field „Error(s)“.

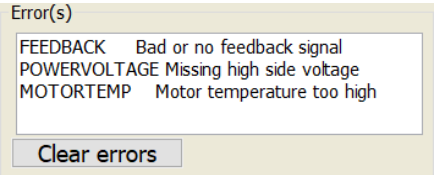


Fig. 7-4 - 00031

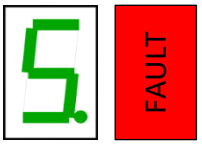
Note:

- * Error F is a unit-dependant error (without function for BAMOBIL and BAMOCAR servo drives)
- When applying the auxiliary voltage with the enable input set (FRG/RUN X1:7 aktiv) the red LED signals an error. There is no fault signal displayed in the 7-segment display.
- Error 1 (POWERFAULT) is a summarised error message received by the hardware watchdog. In addition, it is necessary to check the state of the signal „I_FAULT“.

In case of an error:

- the red LED ‘fault’ lights up and the error no. is displayed
- the BTB (ready) contact is opened
- the software ‚BTB message‘ switches from 1 to 0
- the state message ‚RDY‘ extinguishes
- after switching the enable input to off, the error message will remain

Illuminated display at the servo



The error message is deleted (no enable):

- when switching on ‚Cancel errors‘ via a digital input
- by means of a ‚Cancel Errors‘ command via CAN or serial
- in case of a positive edge from the enable input (FRG/RUN)

7.5 Status information – Warning(s)

Display on the servo:	Warning message in NDrive:	Function:	ID address: $0x8F_H$
0	WARNING_0	Inconsistent device identification	Bit 16
1	ILLEGAL STATUS	Faulty RUN signal, EMI	Bit 17
2	WARNING_2	Inactive RFE signal (without RUN input active)	Bit 18
3			Bit 19
4			Bit 20
5	POWERVOLTAGE	Power supply voltage missing or too low	Bit 21
6	MOTORTEMP	Motor temperature > (I-red-TM or 93 % of M-Temp)	Bit 22
7	DEVICETEMP	Device temperature > 87 % of the limit	Bit 23
8	Vout_Sat	Limit of the existing voltage output reached	Bit 24
9	I_PEAK	Overcurrent 200 %	Bit 25
A	RACEWAY	Resolution range of the speed measuring exceeded	Bit 26
B			Bit 27
C			Bit 28
D			Bit 29
E			Bit 30
F	BALLAST*	Ballast circuit overload > 87 %	Bit 31

If a warning is detected, the warning information is send to NDrive via the ID address $0x8F_H$ and displayed in the field „Warning(s)“.

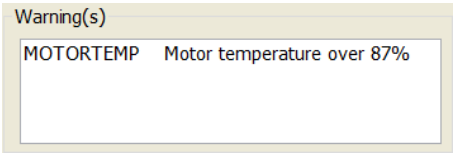


Fig. 7-5 - 00032

Note:

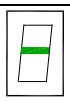
- * Warning F is a unit-dependant error (without function for BAMOBIL and BAMOCAR servo drives).

In case of a warning the red LED flashes and the seven-segment display shows alternately the warning status and the warning number.

Example: Warning 5

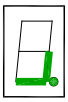
	**Fault**	**Illuminated display:** • FAULT LED red - **flashing** • The display changes between status and warning no. 5	POWERVOLTAGE (missing power voltage)

7.6 Status information – operating status display on the servo

Display: (7-segment LEDs)	Point/ segment:	Status:	Status in NDrive:
	flashing dark	Processor active Auxiliary voltage missing or inherent hardware failure	
	flashing bright dark	Starting state after reset (aux. voltage 24V off-on). The first enable stops the flashing display. Drive enabled Drive disabled (not enabled)	OK = 0 OK = 1, ENA = 1 OK = 1, ENA = 0
	bright	Speed zero (standstill signal)	NO = 1
	bright	Drive revolves clockwise, N currently positive	NO = 0
	bright	Drive revolves anti-clockwise, N currently negative	NO = 0
	flashing bright dark	Motor current reduced to continuous current Icns Motor current at max. current limit I_{max} Normal operation; Motor current within the current limits	Iwcns = 1 Iwcns = 0 Iwcns = 0
	bright for 0.1s	Left segment: A new command (value) was received from the BUS or RS232 Right segment: Digital input changed.	

Example: **Motor revolving clockwise**

Point flashes = Processor active
Bottom segment = Drive enabled
Right segment = Motor revolves clockwise

 (7-segment LEDs)

Ballast circuit
switching: The direction segment (at the right or left bottom) is switched off when the ballast circuit is switched on.

8 Enable

8.1 Enable – Hardware input FRG/RUN

Switching on

Voltage across the enable input (X1:7, X1:G FRG/RUN) is between 10..30 V=.
The power stage of the drive is immediately enabled when the drive enable is switched on. The software control of the power stage is activated 2 ms later. Commands such as command values, reference travel, etc. can be sent 5 ms after the drive enable (RUN).
The enable state is indicated in the state field with 'Ena'.

Switching off

Voltage across the enable input (X1:7, X1:G FRG/RUN) < 4 V=.
When the enable function is switched off, the drive is electronically disabled.

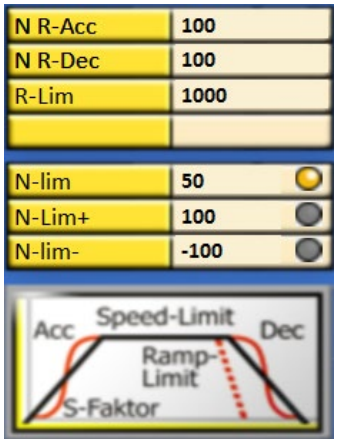


Fig. 8-1 - 00037

Switching off with emergency stop (Coast stop ‚Off')

The drive decelerates to standstill before it is disabled.
When the enable function is switched off, the internal speed command Value of **N cmd Ramp** is reduced to zero by according to the setting of **R-Lim**.
The power section is disabled by means of the internal command **GO** 50 ms after the axis has come to a standstill or after the ramp time (R-Lim) + 50ms has elapsed. The power stage is disabled after 1.5 s at the latest.

Switching off without emergency stop (Coast stop ‚On')

The power section is immediately disabled when the enable function is switched off. The drive decelerates free of torque.

Fig. 8-2 - 00036

If the free coasting is set to off, set **R-Lim** in such a way that the drive is braked to a standstill.
50 ms after the switch-off ramp time (R-Lim) has elapsed, the power section is disabled. The drive is free of torque.

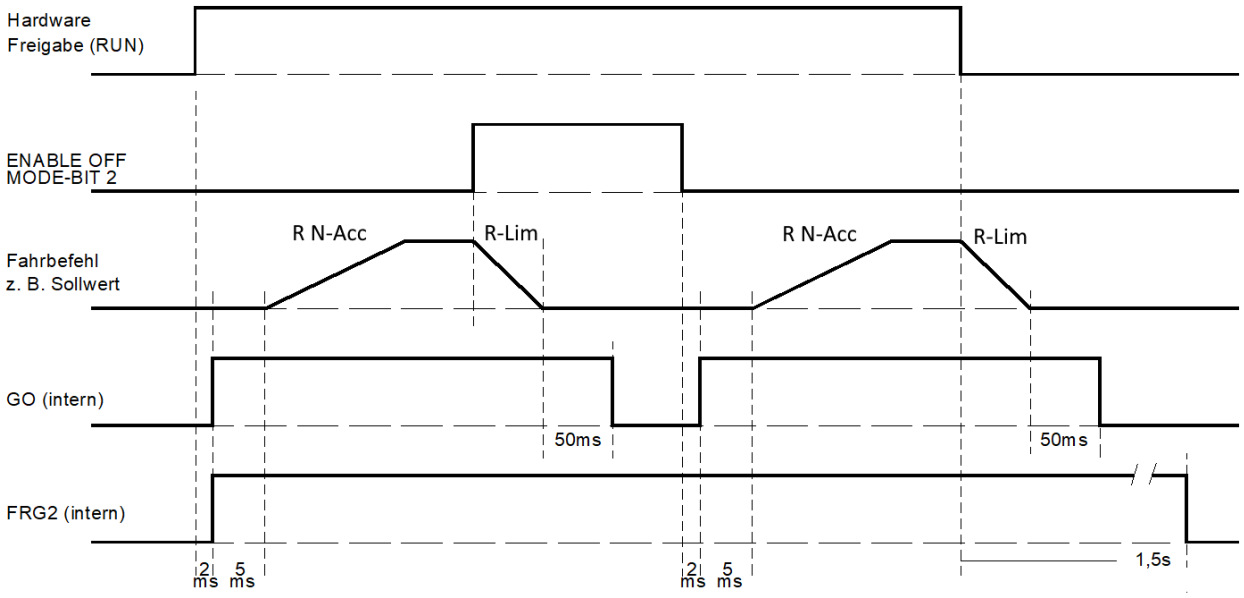


Fig. 8-3

8.2 Enable – Enable and Disable function via interfaces (CAN BUS, RS232)

This is a special method to achieve an enable in case the enable inputs are already set, i.e., the hardware enable function (FRG/RUN) and the safety input RFE are already switched on.

Disable

By means of the command **ENABLE OFF** (MODE-BIT $0x51_{Bit\ 2}$ = 1) the internal speed command value **N cmd (ramp)** is controlled to zero according to the ramp **R-Lim** adjusted in the parameter field 'Speed'.

Enable

By means of the command **NOT ENABLE OFF** (MODE-BIT $0x51_{Bit\ 2}$ = 0) the servo drive is enabled without delay.

Software enable of NDrive

The hardware enable (FRG/RUN) input must be switched on!

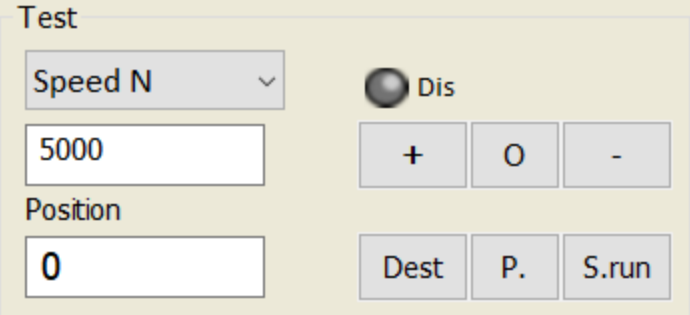


Fig. 8-4 - 00038

Switching field "Dis"
grey = Software enable = ON
red = Software enable = OFF

Enable for hard-wired RFE and FRG/RUN input

1. First disable the servo by means of the command **ENABLE OFF** (MODE-BIT $0x51_{Bit\ 2}$ = 1).
2. Then disable the servo by means of the command **NOT ENABLE OFF** (MODE-BIT $0x51_{Bit\ 2}$ = 0).
   The servo drive is immediately enabled without any delay.
   → An enable is only possible in this order.
   → At the same time all saved errors are deleted.

8.3 Safety input RFE (Rotating field enable)

Warning:
If either one of the two inputs enable (FRG/RUN) or rotating field (RFE) is switched off, the drive is disabled and free of torque.
The drive could move if there is no additional mechanical brake or block provided.

The motor conductors are **not** free of voltage. Only the rotating field is disabled. Prior to any work or maintenance on the motor or servo drive, the Servo drive must be completely disconnected from the mains power supply.

8.3.1 Operation with an external RFE input

- Two-channel disable of the enable via a safety switching device.
- Enable input FRG/RUN + rotating field enable input RFE
- Contacts of the safety device closed
- Enable FRG/RUN 0.5 s after RFE

Safety switch-off
- Contacts of the safety device open
- There is no FRG/RUN signal in the 1st disable channel to disable the PWM pulses in the processor
- There is no RFE signal in the 2nd disable channel to disable the PWM pulses at the output of the processor

Restart
- Release the safety switching device
- Contacts of the safety device closed

The motor can only move after a enable input (FRG/RUN) is set after the rotating field input (RFE).

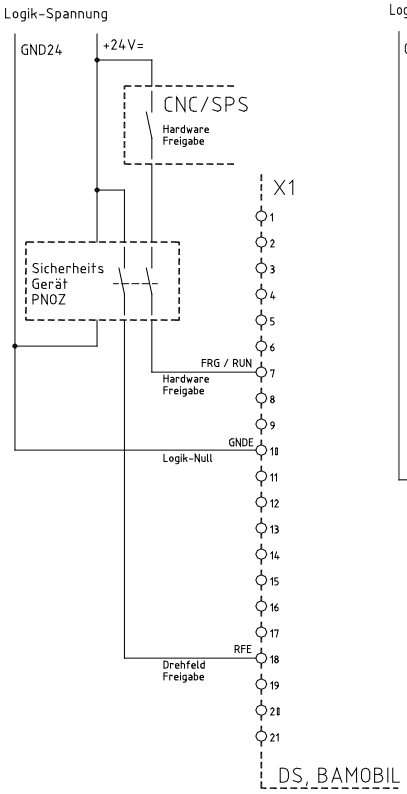


Fig. 8-6

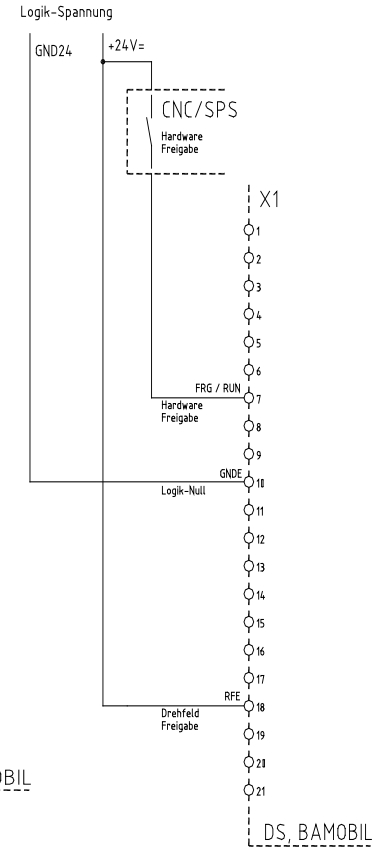


Fig. 8-5

8.3.2 Operation without an external RFE input

The input RFE must be bridged with the logic voltage. i.e., the 24 V output is used as input for RFE.

If the logic voltage corresponds to the auxiliary voltage, the RFE input is bridged with +24 V.

Enable FRG/RUN at least 0.5 s after the RFE signal.

Note:
In case of round or Tyco connectors (BAMOCAR, BAMOBIL) use the plug no. of the device MANUAL.

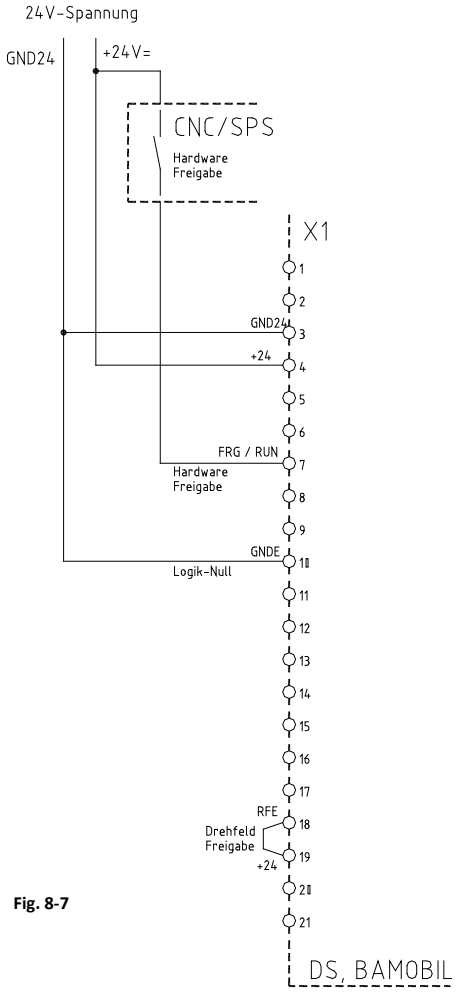


Fig. 8-7

9 Settings

Main parameters and data inputs on the page **Settings**

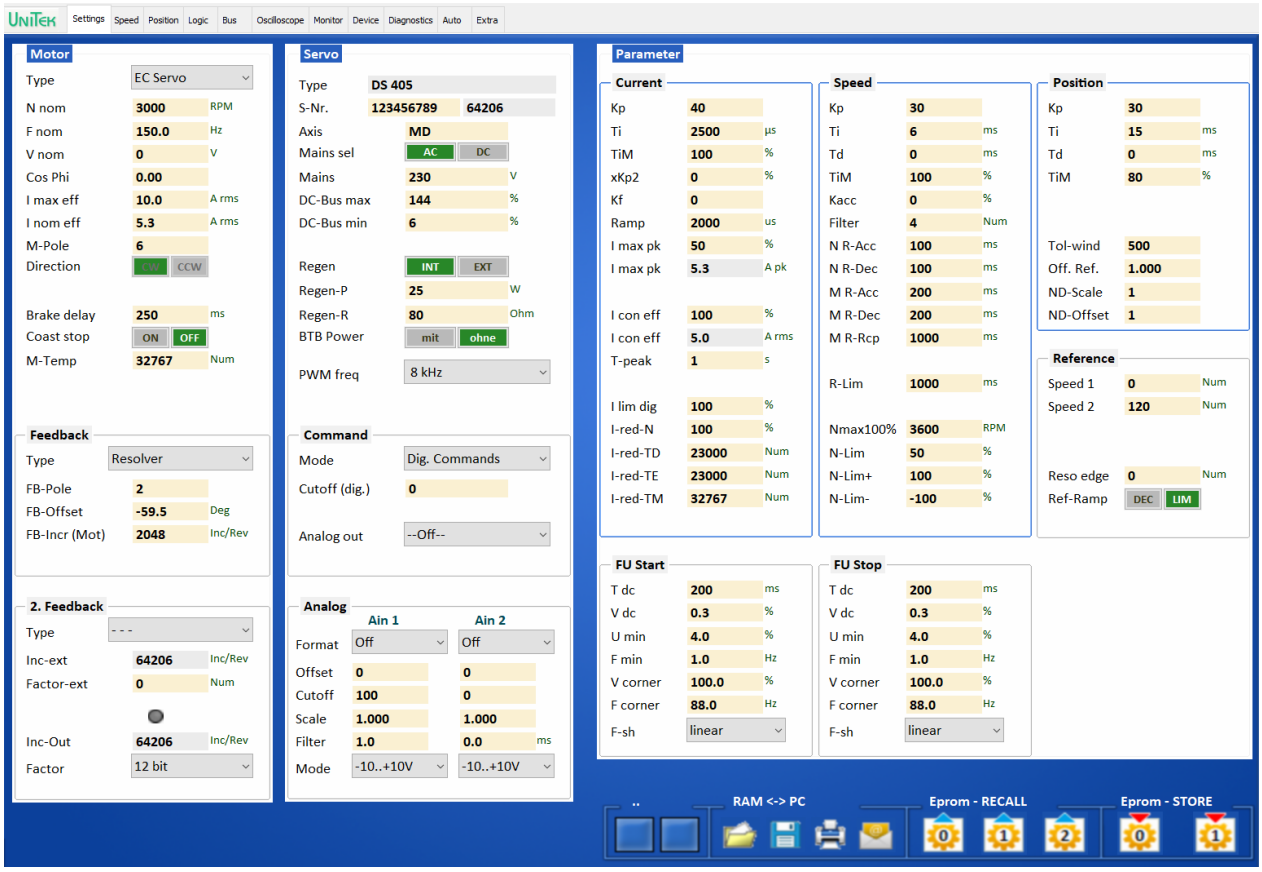


Fig. 9-1 - 00039

Input fields for motor data, device data (servo), and parameter data.
Buttons for the memory functions.

The settings for the motor and the servo drive can only be made via the Settings window.
The parameter data can also be entered on different NDrive windows.
The changed parameter data are immediately updated on all pages.
See detailed information for the input fields.

Note:

Prior to the first commissioning and any change of the motor type the data displayed in the Settings windows must be checked with the name plate or the data sheet of the motor.

Please observe the motor specific connection guidelines!

Any changes of the set value during online operation must only be carried out by competent and qualified personnel!

9.1 Settings – Motor

Parameters of the rated motor data according to the motor nameplate and the motor data sheet

Symbol:	Function:	Range:	Unit:	ID address:
Type	Motor type selection (EC servo, FU, FU servo, DC)			$0x5A_{Bit\ 13..12}$
N nom	Motor speed (for FU autotuning)	60..65000	rpm	0x59
F nom	Frequency rated motor speed (for FU mode)	20..1200	Hz	0x05
U nom	Voltage at rated motor speed (for FU mode)	0..1000	V	0x06
Cos Phi	Motor power factor (for FU mode)	0..327,00	%	0x0E
I max eff	Motor - max. current	0..1000,0	Arms	0x4D
I nom eff	Motor - continuous current	0..1000,0	Arms	0x4E
M-Pole	Motor - pole number (2 x pole pairs)	2..96	Num	0x4F
Brake delay	- Attraction delay time of the electro-mechanical motor brake - Deceleration when no brake is connected	0..1000	ms	0xF1
Coast stop	Free coasting (ON) or emergency stop braking (OFF) (enable (FRG/RUN) is switched off)	On / Off		$0x5A_{Bit\ 3}$
M-Temp	Switch-off point due to motor over-temperature (Error code 6) (At 93 % the warning message 6 is set with current derating Ird-TM activation)	0..32767	Num	0xA3

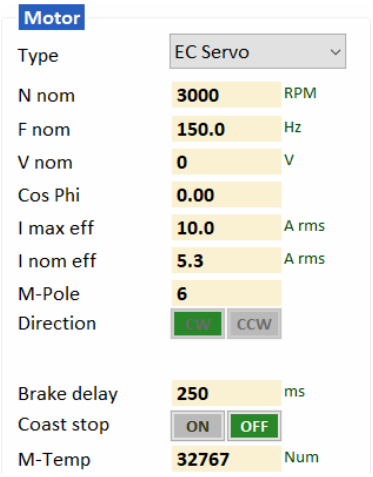


Fig. 9-2 - 00042

Overview of the motor type selection

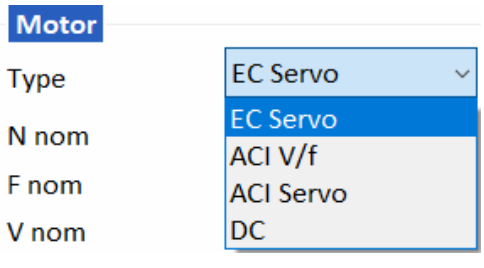


Fig. 9-3 - 0040

Motor type:	
EC Servo	Synchronous servo motor with encoder system (sensor)
ACI V/f	Asynchronous motor frequency converter without sensor (U/F characteristic curve without slip compensation)
ACI servo	Asynchronous motor AC servo vector control with speed encoder system (e.g. position encoder A, B channel)
DC	DC motor without or with DC tacho encoder

9.2 Settings – Feedback (encoder)

Parameters of the setting fields for the rated feedback encoder data according to the encoder data sheet

Short symbol	Function	Range	Unit	ID address
Type	Feedback selection (Rot_Enc_TTL, resolver,…)			$0xA4_{Bit\ 4..2}$
FB-Pole	Encoder no. of poles	2..12	Num	0xA7
FB-Offset	Phase angle correction	±360	Deg	0x44
FB-Incr (Mot)	Encoder resolution	1024..8192	Inc/Rev	0xA6
Voltage	DC tacho voltage		mV/rpm	
Inc ext	Resolution - 2nd Feedback		Inc/Rev	$0xCF_L$
Factor	Multiplicator SIN/COS Inc.	4..16	Num	0x7E

Overview of the suitable feedback encoders for the corresponding motor types

Motor type:	Suitable feedback type:
EC servo	Rot_Enc_TTL, Enc_TTL (restricted) Resolver Abs_Enc_SC, Enc_SC, Abs_SC Rot
ACI V/f	SLS, Enc_TTL
ACI servo	Enc_TTL Resolver Abs_Enc_SC, Enc_SC, Abs_SC
DC	Enc_TTL Resolver Abs_Enc_SC, Enc_SC, Abs_SC DC_Tacho DC_Arm, BL_Arm, DC_Arm_Vir

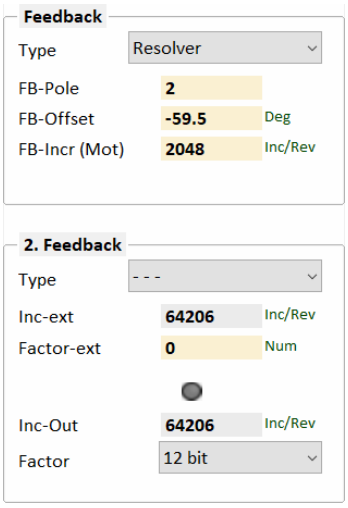


Fig. 9-4 - 00043

Note:

- UniTek Servo drives can only operate certain types of feedback encorder according to their hardware congiguration.
- The feedback encoder must be adapted to the hardware configuration of the motor.
- The selected feedback encoder type must correspond to the configuration of the servo for the respective encoder type, i.e., a digital servo is configured only for a certain type of encoder.

Resolver encoder:

Resolver	Resolver encoder with 10 kHz and 2 Vpp
FB-Pole	No. of encoder poles 2 to 12
FB-Offset	Correction value for the mechanical encoder setting Rotor angle ±360 degree Automatic detection of the offset angle = see page AUTO

Incremental encoder:

Rot_Enc_TTL	Incremental encoder 5 V TTL with rotor commutation tracks
FB-Offset	Correction value for the mechanical encoder setting Automatic detection of the offset angle = see page AUTO
FB-Inkr (Mot)	No. of pulses per revolution

Note: The no. of poles of the rotor position encoder must correspond to the no. of motor poles!

ENC-TTL	Incremental encoder 5 V TTL without rotor commutation tracks
FB-Inkr (Mot)	No. of pulses per revolution Only for asynchronous motors or special drives

SINUS/COSINUS encoder:

Abs_Enc_SC	1 Vss-Sin/Cos encoder with Sin/Cos commutation tracks
FB-Offset	Correction value for the mechanical encoder setting
FB-Inkr (Mot)	No. of pulses per revolution

ENC_SC	1 Vss-Sin/Cos encoder without commutation tracks
FB-Inkr (Mot)	No. of pulses per revolution

ABS_SC	Sine-Cosine signal per motor pole pair (analog Hall sensors)
M-Pole, FB-Pole	No. of motor poles must be equal to the no. of encoder poles (M-Pole = FB-Pole)

Rotor position encoder 5 V, 15 V:

ROT_TACHO	Rotor position encoder with bl-tacho (DC tacho)
FB-Offset	Correction value for the mechanical encoder setting

ROT	Rotor position encoder without bl-tacho, only rotor signals (3 digital Hall sensors)
FB-Offset	Correction value for the mechanical encoder setting

BL-ARM	EC/AC_motor without tacho

Note: The no. of poles of the rotor position encoder must correspond to the no. of motor poles!

Feedback for DC motors:

DC_TACHO	DC motor with tacho
FB-Offset	120 = connection M1-M3 (0=M2-M3, -120=M1-M2)
DC-ARM	DC motor with armature voltage sensor (without tacho)
FB-Offset	120 = M1-M3 (0=M2-M3, -120=M1-M2)
DC_ARM_VIR	Sensorless DC motor without tacho, without armature voltage measuring
FB-Offset	120 = connection M1-M3 (0=M2-M3, -120=M1-M2)

Sensorless drives:

SLS	Sensorless AC motor without feedback encoder in FU-operation (ACI V/f) no setting
SLS_SMO	not yet available
SLS_Usens	not yet available

In case of changing the feedback parameters it is necessary to reset the parameter.
→ Write the parameter set into the EEPROM (Eprom - STORE 0)
→ and re-read the set of parameters (Eprom - RECALL 0)

Fig. 9-5 - 00020

9.3 Settings – 2. Feedback

Parameters for the setting of the X8 connection as 2. Feedback encoder input

Symbol:	Function:	Range:	Unit:	ID address:
Type	Selection of 2. Feedback encoder input			$0xA4_{Bit\ 7..5}$
Inc-ext	Resolution of 2nd incremental encoder		Inc/Rev	$0xCF_{L}$
Factor-ext	Encoder factor 2nd encoder	4..16	Num	0x7E
Inc-Out	Incremental output resolution		Inc/Rev	$0xCF_{H}$
Factor	Multiplying factor of the basic no. of pulses with SinCos (SC) encoder			$0xA4_{Bit\ 14..12}$

Type: Selection for the 2. Feedback encoder input (2. Feedback)

---	input switched off
Enc - Position	connected as input
Enc - Info	connected as output
Enc - Hand.	handwheel input
SSI	SSI encoder input

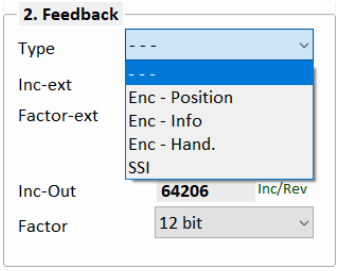


Fig. 9-6 - 00044

Example: Setting X8 as input for incremental encoder signals

Type = Enc - Position:
Incremental encoder TTL 5 V A,B,N + push-pull
Bridge between X8:1 and X8:6 (X8 switched as input)

Factor-ext (scale):
Calculate the transmission
1 motor revolution = 65536 num (internal counter)

Factor-ext for the adaption of the 2. Feedback encoder (0x7E)
Encoder_2_Scale = 65536 / encoder pulse of the 2nd encoder per motor revolution * 4

Input with Factor-ext. (0x7E) = Encoder_2_Scale * 16384

Output:
1 motor revolution corresponds to 0.1 encoder revolution
No. of encoder pulses 1000 rpm
Pulses per motor revolution 0,1 * 1000 * 4 = 400

Input with encoder_2_Scale
= 65536 / 400 = 163,840

Input factor-ext. (0x7E)
= 163,840 * 16384 = 2684354

Example: Setting X8 as input for incremental encoder signals

Typ = Enc - Info:
Setting the value of the no. of output pulses per revolution for resolver encoder signals at the X8 ouput connection.

The encoder signals from the motor (feedback) are output across the sub-D connector X8 as TTL encoder signals (example CN control).
Signals: channel A, channel /A, channel B, channel /B, Kanal N, channel /N

The encoder output is floating.
The voltage is supplied through the encoder cable of the CNC/PLC control.
Voltage supply +5 V ±0.2 V
The output signal corresponds to RS485.

Option: Internal supply from the servo
(LBR1 + LBR2)

Resolution:
For the –RS and –SC versions the resolution can be programmed.
For –IN the output corresponds to the no. of encoder pulses.
Factor - Mulitplication factor for the basic no. of pulses for SinCos (SC)

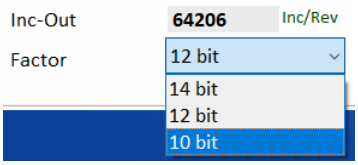


Fig. 9-7 - 00045

Pulses per revolution	**Resolution**	**ID address** $0xA4_{Bit\ 14..12}$
256	10 Bit	3 dec
1024	12 Bit	2 dec
4096	14 Bit	1 dec

9.4 Settings – External brake

Setting and controlling of an external brake:

Many motors have an installed brake which must first be activated to be released before letting the motor revolve. The converter can control this external brake accordingly.

The max. braking power of the motor is applied when the power has been switched off.
According to the electrical brake control the **Brake delay** corresponds to the respective type.

A brake up to 24 V, 1 A can directly be switched by the digital output. For braking processes with higher current or voltage values a relay must be used.

The brake output is activated on the page **Logic** in the parameter field **OUTPUT**. Click the command **O Break** in the drop-down menu at **Dout 1, Dout 2** or **Dout3** to transfer it to the display field.

Configure the operand **=** (equal) or **!=** (not equal) in the drop-down menu by selecting it.
The switching function of the output can be selected by entering **0** or **1** into the parameter field (standard: 0)

The switch-off delay time of the motor brake is configured on the Page Settings at the field Motor in the parameter field **Brake delay** (0-500ms, data from the data sheet of the brake).

When the brake is active, the state is displayed as **BRK1** in the In-Out field.

Caution:
Connect a recovery diode or a varistor directly to the brake connection across the motor.

Example for the setting of a brake output on the page *logic*:

Digital outputs:	Selection:
Dout1	The brake is disconnected from the power supply when the enable is switched off. Set the switch-off delay via the brake delay
Dout2	--Off--
Dout3	--Off--
Dout4	--Off--

Fig 9-8 - 00046

Description of the brake function (control of the external brake):

When the drive enable (FRG/RUN) or the CAN command **ENABLE OFF = 1** is deactivated, the internal speed command value **N cmd Ramp** will be ramped down to zero at a rate defined by **R-Lim**. After a fixed delay time of 50 ms, the **Brake** parameter will switch from 1 to 0. The braking power rises. After the programmed time **Brake delay** has passed, the internal parameter **GO** is switched to 0 and the servo is disabled (standstill with no torque applying).

Description of the brake release function (release of the external brake):

If the brake is active and the enable (FRG/RUN) or the CAN **ENABLE OFF=0** is activated the command value is maintained at 0 and the status **GO** switches immediately to 1.
After 50 % of the delay time (**brake-delay)** has passed, the brake is switched off, and after the complete delay time has passed, the command value will increase at a rate defined by **N R-Acc.**

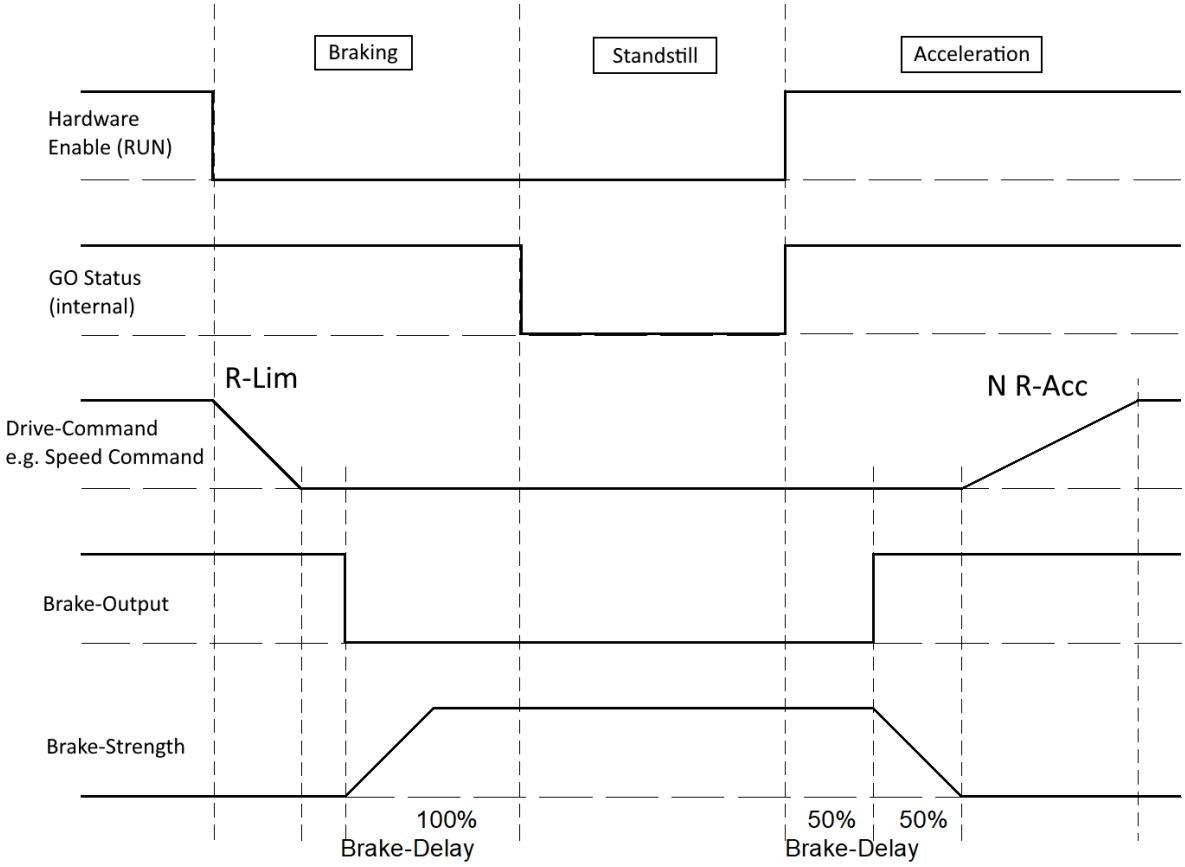


Fig. 9-9 - 00137

Note:

- The sum of the times R-Lim plus brake delay must be inferior to 1s.
- When the enable is switched-off at 1.1 s the hardware of the output stage is disabled.
- The electric braking is interrupted and the drive decelerates freely. When the R-Lim plus brake delay is too long and has elapsed, the mechanical brake is triggered and stops the drive.

9.5 Settings – Rgen circuit

- Servo drive units with a **DIG** (ZW monitor digital) bus circuit setting the regen circuit is directly controlled by the hardware.
- Servo drive units with a **ANA** (ZW monitor analog) bus circuit setting the regen circuit is controlled from the TMS control board.
- With an internal regen resistance the setting parameters of the unit detection is automatically adjusted.
- With an external regen resistance the values for the resistance (Regen-R) and the resistance power (Regen-P) are entered as parameters.

Regen	INT = internal regen resistor EXT = external regen resistor
Regen-P	Enter the resistor power in W
Regen-R	Enter the resistor power in Ohm

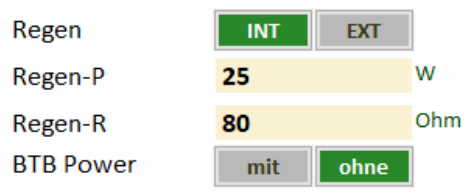


fig. 9-10 - 00047

With an internal ballast resistance the regen power is calculated from the data of the device type.

With an external ballast resistance the regen power is calculated from the entered values of **Regen-P** and **Regen-R**.

The ballast power is displayed as **Regen Power** ($0x45_L$) on the monitor side.

The dc bus voltage (Vdc bus (filt)), the regen switching pulse (I Regen), and the regen power (Regen Power) can be measured in the NDrive oscilloscope.

There will be a warning at 87 % of the regen power (regen circuit >87 % overloaded ($0x8F_{Bit\ 15}$)) and at 100 % the device will be switched off and an error message is displayed (regen circuit overloaded $0x8F_{Bit\ 15}$)).

The function of the ballast circuit is displayed on the servo.
The command value directional bar of the 7-segment display (below left or right) is switched off as long as the ballast circuit is active.

9.6 Settings – Motor temperature monitoring

Parameters for the motor temperature monitoring

Symbol:		Range:	Unit:	ID address:
I-red-TM	Triggering point current reduction on the basis of the motor temperature Warning 6 (MOTORTEMP)	0..32767	Num	0xA2
M-Temp	Switch-off point on the basis of the motor temperature Error 6 (MOTORTEMP) If motor temperature > 93% of M-Temp warning 6 (MOTORTEMP) and current reduction	0..32767	Num	0xA3
T-motor	Present motor temperature	0..32000	Num	0x49

Note:
Due to many different temperature sensors the motor temperature (T-motor) value is displayed as numerical ADC value. The corresponding curves and thus, the physical temperature must be determined by means of the appropriate tables.

The monitoring is deactivated by means of the setting the limit 32767.

Current reduction (derating) on the basis of the motor temperature:
If the motor temperature (T-Motor) exceeds the set value of **I-red-TM**,

- the max. current limit is linearly reduced to continuous current from the triggering point **I-red-TM** to the switching-off point of **M-Temp**
- the message Ird-TM ($0x40_{Bit\ 26}$) is displayed in the Status field
- the warning 6 (I-MOTORTEMP) is displayed

Fig. 9-11 - 00049

Switching-off via error messages on the basis of the motor temperature:
If the motor temperature (T-motor) exceeds the set value of **M-Temp**,

- there will be a switch-off due to an error by the inverter
- the error 6 (MOTORTEMP) is displayed

If the motor temperature (T-motor) exceeds 87 % of the set value of **M-Temp**,

- the max current limit is reduced to continuous current
- the message Ird-TM ($0x40_{Bit\ 26}$) is displayed in the Status field
- the warning 6 (I-MOTORTEMP) is displayed

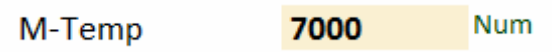


Fig. 9-12 - 00048

Example: Setting with linear sensor type KTY84

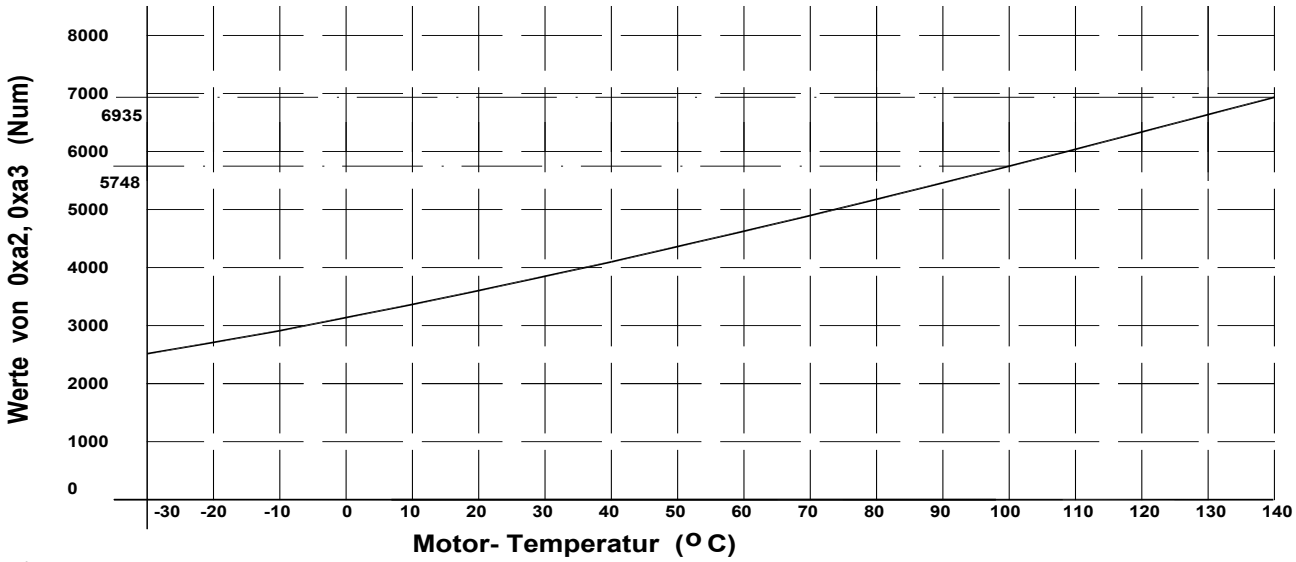


Fig. 9-13

Warning and current reduction from 100 °C	→	Setting l-red-TM (0xA2) = 5748 Num
Error message and switch-off at 140 °C	→	Setting M-Temp (0xA3) = 6935 Num

Example: Setting with linear sensor type PT100

Inaccurate temperature measuring due to a flat characteristic curve and internal measuring tolerances.
An exact temperature measuring is only possible using a ballast measuring amplifier.

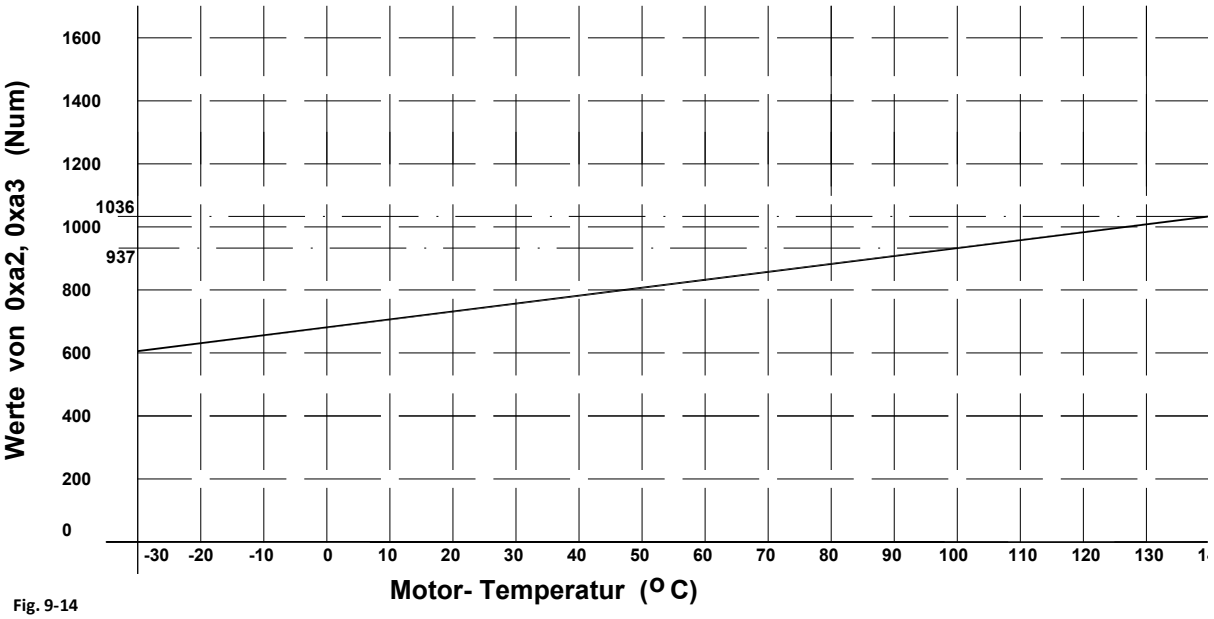


Fig. 9-14

Warning and current reduction from 100 °C → Setting I-red-TM (0xA2) = 937 Num
Error message and switch-off at 140 °C → Setting M-Temp (0xA3) = 1036 Num

Example: Setting with non-linear sensor type thermistor (PTC)

Only error switch-off on the basis of the motor temperature M-TEMP (0xA3)

Note:
A current reduction (derating) on the basis of the motor temperature is not possible with this type of sensor.

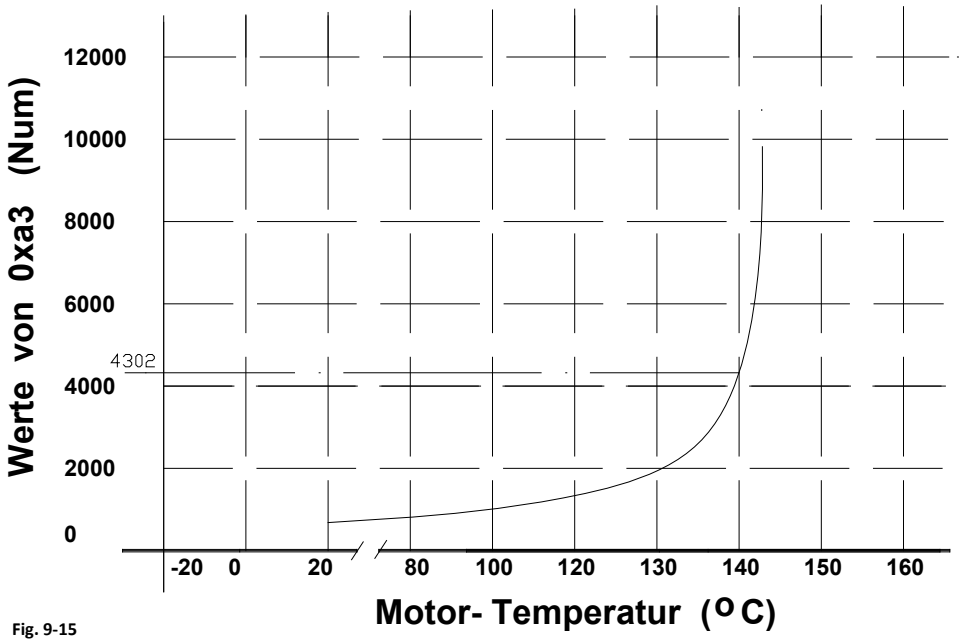


Fig. 9-15

Error message and switch-off at 140 °C → Setting M-Temp (0xA3) = 4302 Num

Note:
The set value is increased for several series sensors in the motor.

9.7 Settings – Power connection/ dc bus circuit monitoring

Parameters for the selection of the power connection and the setting of the DC bus monitoring with analog bus circuit measuring

Symbol:	Function:	Range:	Unit:	ID address:
Mains sel	Selection of the power voltage	AC / DC		$0x5A_{Bit\ 19}$
Mains	Rating of the voltage supply	0..1000	V	0x64
DC-Bus max	Max. voltage limit of the DC Bus (software)	0..200	%	$0xA5_H$
DC-Bus min	Min. voltage limit of the DC Bus (software)	0..200	%	$0xA5_L$

Selection of the mains power supply (Mains sel):
The selection of the power voltage supply between AC or DC voltage is device-specific and must only be carried out if precise knowledge on the basis of the inverter type exists.

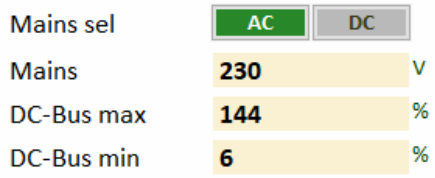


Fig. 9-16 - 00050

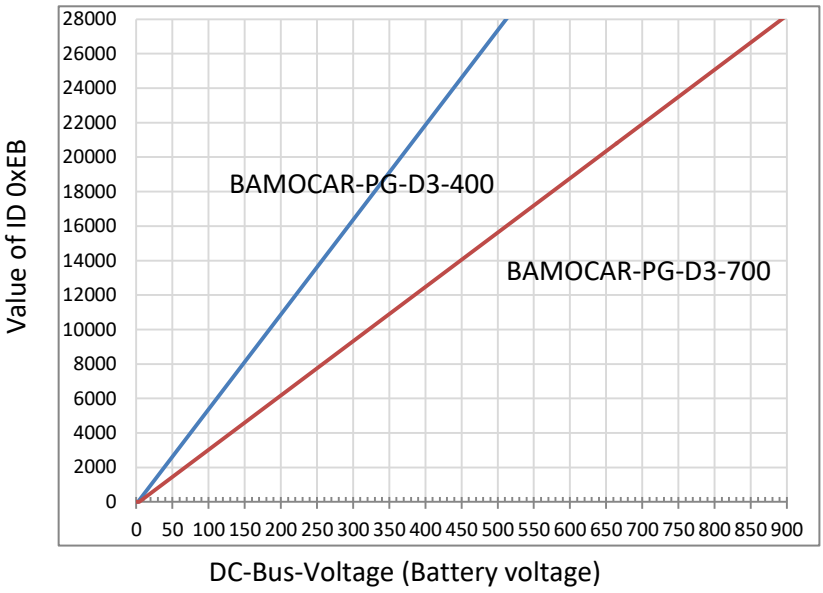
Mains power supply (Mains):
This setting value only refers to the voltage value if AC voltage is used as power supply voltage.

DC-BUS max:
- Setting limit for the max. software voltage limit with inverters having a analog dc bus circuit measuring.
- Entry of **100 % = 32767 Num**
  ➔ Calculate 32767 Num / 2 = **16383 Num** and compare the value with that of the device voltage.
- Setting value for the ballast circuit and the overvoltage monitoring.
- Warning occurs in case of 1.5 fold rated voltage.
- If this threshold is exceeded there will be an error switch-off, the controller is disabled, and the error 8 (OVERVOLTAGE) is displayed.
- The hardware overvoltage monitoring works independently of the software setting.

DC-Bus min:
- Setting limit for the max. software voltage limit with inverters having a analog dc bus circuit measuring.
- Entry of **100 % = 32767 Num**
  ➔ Calculate 32767 Num / 2 = **16383 Num** and compare the value with that of the device voltage table.
- If the value falls below this threshold value there will be an error switch-off, the controller is disabled, and the error 5 (POWERVOLTAGE) is displayed.
- The hardware undervoltage monitoring depends on the inverter and works independently of the software setting.

Note / Important:
- For the determination of the setting values of the limits (min., max) please refer to the hardware device maual description.
- The setting values of the limits **do not refer to the voltage value in „Mains“** but to the inverter-specific rated supply voltage.

Example: Bamocar 400-400 and Bamocar 700-400



Standardization of the dc bus voltage:

Bamocar 400-400: 1V ≙ 55.12044 (Example: 400 V ≙ 22048 Num (0xEB))
Bamocar 700-400: 1V ≙ 31.58483 (Example: 700 V ≙ 22109 Num (0xEB))

Setting of the DC-Bus Max (0x5A$_H$) and DC-Bus Min (0xA5$_L$) limits:
(The setting values of the limits do not refer to the voltage value in „Mains“ but to the inverter-specific rated supply voltage)

Entry of **100 % = 32767 Num**

➔ Calculate 32767 Num / 2 = **16363 Num** and compare the value with that of the device voltage

Bamocar 400-400: 1 % = 163 Num ≈ 2.985 V
Bamocar 700-400: 1 % = 163 Num ≈ 5.208 V

Settings for BAMOCAR-PG-D3- 400/400		
DC Bus max (0xA5$_H$)	for threshold voltage	Num 0xEB
148 %	440 V	24252
134 %	400 V	22048
DC Bus min (0xA5$_L$)	for undervoltage	
107 %	320 V	17638
90 %	270 V	14882

Settings for BAMOCAR-PG-D3- 700/400		
DC Bus max (0xA5$_H$)	for threshold voltage	Num 0xEB
144 %	750 V	23688
134 %	700 V	22109
DC Bus min (0xA5$_L$)	for undervoltage	
115 %	600 V	18950
96 %	500 V	15792

9.8 Settings – Output power stage (igbt) temperature monitoring

Parameters for the setting of the current reduction on the basis of the igbt temperature

Short symbol	Function	Range	Unit	ID address
I-red-TD	Start of the current limit reduction	0..32767	Num	0x58
I-red-TE	End of the current limit reduction	0..32767	Num	0x4C
T-igbt	Measured temperature value of the output stage	0..32767	Num	0x4A

Condition:

- The software monitoring can only be programmed for units with an analog detection of the igbt temperature.
- For the setting values please refer to the hardware device manual.

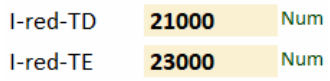
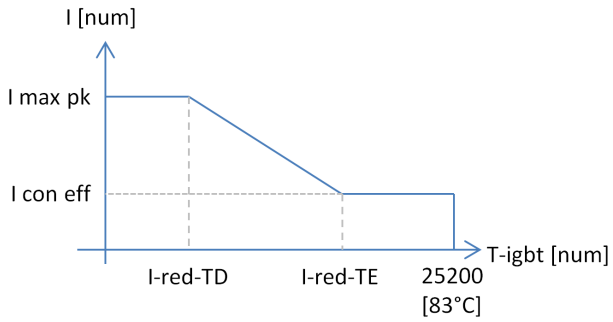
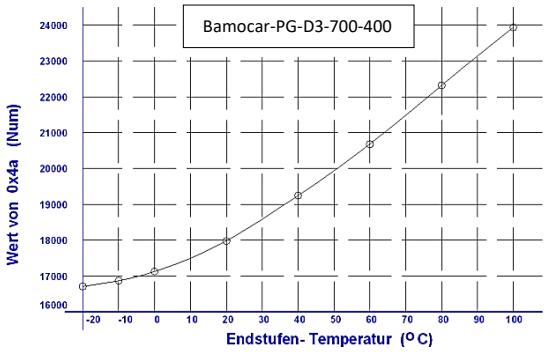


Fig. 9-17 - 00051





I-red-TD:

- Setting value for the start of the current reduction depending on the igbt temperature.
- In case of an increasing igbt temperature the current limit is linearly reduced until the igbt temperature reaches set endpoint of I-red-TE at which point the current limit is set to the continuous current limit.

I-red-TE:

- Setting value for the endpoint of the igbt temperature at which the current limit is limited to the continuous current setting.
- If 85 % of the max. igbt temperature is reached the warning 7 (DEVICETEMP) is set.
- The max. igbt temperature is 25200 Num (approx. 83 °C).
- If the output stage temperature (T-igbt) exceeds the value of 25200 there is an error switch-off from the inverter and the error 7 (DEVICETEMP) is displayed.

The hardware power stage (igbt) temperature monitoring works independently from the software setting.

- For the activation of the derating function via the output stage temperature
  - I-red-TD < I-red-TE and
  - I-red-TD > 0 is valid.

➔ The activation of the function is displayed as Ird-TI ($0x40_{Bit\ 23}$) inside the Status field.
➔ If this current derating function is triggered it is displayed as Ird-TIR ($0x40_{Bit\ 24}$) inside the Status field.

Note:
If there is a derating function activated on the basis of the output stage temperature, the current limitation on the basis of the function of **T-peak** (0xF0) is deactivated.

9.9 Settings – Servo

Parameters on the page Settings in the main section Servo

Symbol:	Function:	Range:	Unit:	ID address:
Type	Unit type (protected)	Nameplate		0x63
S-Nr.	Serial unit no. (protected)	Nameplate		0x62
Axis	Axis designation (freely writable)	4 characters	ASCII	0xF8
Mains sel	Selection of the power voltage	AC / DC		$0x5A_{Bit\ 19}$
Mains	Magnitude of the mains supply voltage	0..1000	V	0x64
DC-Bus max	Max. voltage limit of the DC Bus (software)	0..200	%	$0xA5_{H}$
DC-Bus min	Min. voltage limit of the DC Bus (software)	0..200	%	$0xA5_{L}$
Regen	Selection of regen resistor	INT / EXT		$0x5A_{Bit\ 1}$
Regen-P	Power value of the external regen resistor	Type plate	W	$0x65_{L}$
Regen-R	Resistance value of the external regen resistor	5..100	Ohm	$0x65_{H}$
BTB Power	BTB message with or without bus circuit undervoltage monitoring	with/without		$0x5A_{Bit\ 6}$
PWM freq	PWM pulse frequency	Selection field		$0x5A_{Bit\ 22..20}$
Mode (Command)	Type of the command value presetting for the speed and torque commands	Selection field		$0x36_{Bit\ 13..12}$
Cut-off (dig.)	Zero zone with digital command value presetting	0..32767	Num	0x1E
Analog out	Output analog voltage in relation to the assigned variable	Selection field		0xDC
Format	Selection of the function of the respective analog inputs	Selection field		$0x36_{Bit\ 1..0}$ $0x36_{Bit\ 3..2}$
Offset	Offset compensation of the respective analog inputs	±32767	Num	$0x2F_{L}$ $0xD7_{L}$
Cutoff	Zero zone of the respective analog command value presettings	0..32767	Num	0x50 0x53
Scale	Scale factor of the respective analog inputs	±7.999	Num	$0x2F_{H}$ $0xD7_{H}$
Filter	Filter of the respective analog inputs	0..127.5	Num	0x60
Mode (Analog)	Input level selection of the respective analog inputs	Selection field		$0x36_{Bit\ 5..4}$ $0x36_{Bit\ 9..8}$

Additional overview of the rated servo data

Symbol:	Function:
Type	The controller type is displayed (changes can only be made in the factory)
S-Nr.	Serial no. is displayed (factory-set)
Axis	Axis specification with 4 ASCII letters ((entered by the user)
Mains sel	Power supply voltage AC~/DC= is displayed (factory-set)
Mains	AC and three-phase current voltage AC (30~ to 480 V~) Battery voltage or dc mains (12 V= to 560 V=)
DC-Bus max.	Switching point bus circuit overvoltage Error OVERVOLTAGE (overvoltage >1.8U_N) 0x8F_{Bit8}
DC-Bus min.	Switching point bus circuit under-voltage Error POWERVOLTAGE (missing power voltage) 0x8F_{Bit5}
ZW-Monitor	Selection bus circuit monitoring digital-analog (factory-set)
Regen	Selection list ballast resistance (internal – external)
Regen-P	Enter the power value for an external ballast resistor. Input in Watt. In case of a ballast resistor overload a warning message is displayed. Warning BALLAST (ballast circuit <87 %) 0x8$F_{Bit\ 31}$
Regen-R	Enter the resistance value for an external ballast resistor. Input in Ohm. Check the min. value.
BTB-Power	BTB-Message with or without bus circuit undervoltage. Selection **without** (BTB without undervoltage monitoring). When the enable and the power supply voltage are switched off the RUN/BTB message remains active. Selection **with** (BTB with undervoltage monitoring). When the enable and the power supply voltage are switched off the RUN/BTB is deactivated.

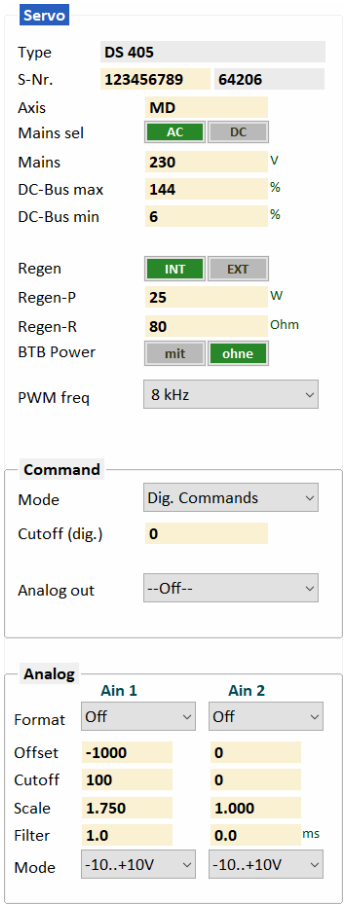


Fig. 9-18 - 00052

9.10 Settings – Servo / PWM pulse frequency

The selection of the switching frequency of the output stage is effected via the parameter **PWM freq** (0x5A$_{Bit\ 22\text{-}20}$)

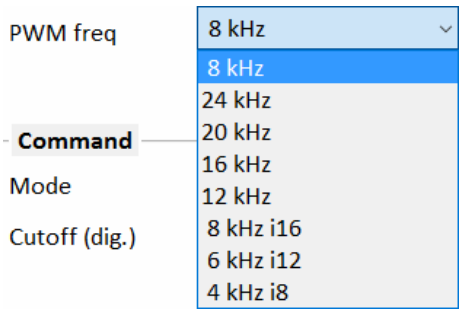


Fig. 9-19 - 00053

Selection (general):
Pulse frequency with constant calculation speed
Values: 8, 12, 16, 20 kHz

Current limit reduction depending on the pulse frequency:

2..8 kHz	100 %
12 kHz	85 %
16 kHz	70 %
from 20 kHz	20 %

Selection (special):
Pulse frequency (kHz) with a higher calculation speed (Ix).
Values: 2 kHz-I4, 4 kHz-I8, 8 kHz-I16

Modification of the pulse frequency:

- Enable must be deactivated
- Set frequency
- Save the parameter set in the EEPROM on level 0
- Read the parameter set from the EEPROM level 0
- The changed frequency is transferred and the current limits are reduced

Recommendation for the pulse frequency depending on the max. motor speed and no. of motor poles:
For a good FOC control it is recommended to have at least 16 measuring points for each electric angle. The max. speed for a motor with 20 poles (10 pairs of poles) is:

(16 kHz)	16000 Hz / 16 = 1000 Hz	(→ max. electrical rotating frequency)
	n_max = (60 * 1000 Hz) / 10 = 6000 rpm	(→ recommended max. rotation speed)
(12 kHz)	12000 Hz / 16 = 750 Hz (= fnom_max)	
	n_max = (60 * 750 Hz) / 10 = 4500 rpm	
(8 kHz)	8000 Hz / 16 = 500 Hz (= fnom_max)	
	n_max = (60 * 500 Hz) / 10 = 3000 rpm	

9.11 Settings – Servo / Analog output

The setting for the definition of the analog output voltage is condifgured via the drop-down selection at **Analog out** (0xDC).

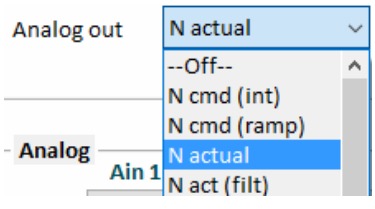


Fig. 9-20 - 00054

Output of the analog output voltage:

- The output voltage ±10V corresponds to ±100 % of the selected signal.
- Digital binary signals supply as output 0 or +10 V.

9.12 Settings – Servo / Command value of the command mode

Overview of the command mode configuration using the parameter **Mode** inside the command field.

Symbol:	**Function:**	**ID address:** $0x36_{Bit13..12}$
Dig. Commands	Speed command value via a digital communication input (CAN-BUS, RS232)	0 dec
Analog Speed	Speed command value via an analog voltage input (AIN1 and AIN2)	2 dec
Analog Torque	Torque command value via an analog voltage input (AIN1 and AIN2)	3 dec
Digi+Ana Speed	Speed command value via a digital communication input and analog voltage input. The sum of both inputs results in the command value	1 dec

Dig. Commands:
Presetting of the digital position, speed or current (torque) command value.
Command value via one of the digital communication interfaces (CAN; RS232).
On the fly switchover between the different operating states (position, speed, current) directly after having received the newest command value.

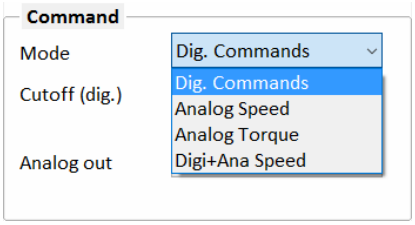


Fig. 9-21 - 00055

Analog speed:
Analog speed command value
Input across the terminal strip X1 → inputs Ain1 and Ain2
Max. input voltage ±11 V corresponds to ±32767 Num
This value corresponds to 100 % of the set 16-Bit resolution of the max. physical speed in **Nmax100%** (0xC8)

Analog torque:
Analog current command value (Iq)
Input across the terminal strip X1 → inputs Ain1 and Ain2
Max. input voltage ±11 V corresponds to ±32767 Num
This value corresponds to 100 % of the device peak current **I max pk** (0xC4)

Digi+Ana speed:
Speed command value via the digital communication interface (CAN; RS232) as well as via the value of the analog speed command. The final command value is the sum of both commands with an internal limiting of ±32767.
This value corresponds to 100 % of the set 16 Bit resolution of the max. physical speed defined inside **Nmax100%** (0xC8).

Tips:
Reversal of the direction of rotation at a unipolar command value with direction signal:
Assign a digital input with **N cmd Reverse** inside the Logic page. Activation either via a real logic level across the set input or by modifying the activation conditions (AL / AH) via the digital communication interfaces (CAN; RS232).

Overwriting the speed command value to 0 rpm:
Same procedure as for the reversal of the rotation direction, but assign instead a digital input with **Speed Ramp 0**.

9.13 Settings – Servo / Analog inputs

Parameters for the setting of the analog inputs Ain1 and Ain2

Symbol:	Function:	Range:	Unit:	ID address: Ain1 - Ain2 -
Format	Selection of the function of the rspective analog inputs	Selection field		$0x36_{Bit\ 1..0}$ $0x36_{Bit\ 3..2}$
Offset	Offset compensation of the respective analog inputs	±32767	Num	$0x2F_L$ $0xD7_L$
Cutoff	Zero zone of the respective analog command value presettings	0..32767	Num	0x50 0x53
Scale	Scale factor of the respective analog inputs	±7,999	Num	$0x2F_H$ $0xD7_H$
Filter	Filter of the respective analog inputs	0..127,5	Num	0x60
Mode (analog)	Input level selection of respective analog inputs	Selection field		$0x36_{Bit\ 5..4}$ $0x36_{Bit\ 9..8}$

Format:
The function definition of the analog inputs **Ain1** and **Ain2** is done via the drop-down selection at **Format**.

Format: Ain1		ID address:
Off	Deactivated	$0x36_{Bit\ 1..0} = 0$
Cmd	Speed command value	$0x36_{Bit\ 1..0} = 1$
-Cmd	Inverted speed command value	$0x36_{Bit\ 1..0} = 2$
sq(Cmd)	Square speed command value	$0x36_{Bit\ 1..0} = 3$
N limit	Speed limiting 0..100 % via Ain1 (for digital command value presetting (position, speed)). This corresponds to 100 % of the max. physical speed in **Nmax100%** (0xC8).	$0x36_{Bit\ 15}$

Format: Ain2		ID address:
Off	Deactivated	$0x36_{Bit\ 3..2} = 0$
Cmd	Speed command value Ain2 is added to Ain1	$0x36_{Bit\ 3..2} = 1$
-Cmd	Speed command value Ain2 is subtracted from Ain1	$0x36_{Bit\ 3..2} = 2$
*Cmd	Speed command value Ain2 is multiplied by Ain1	$0x36_{Bit\ 3..2} = 3$
I limit	Current limiting 0..100% via Ain2 (for all command value presettings digital, analog). This corresponds to 100 % of the device peak current **I max pk** (0xC4)	$0x36_{Bit\ 14}$

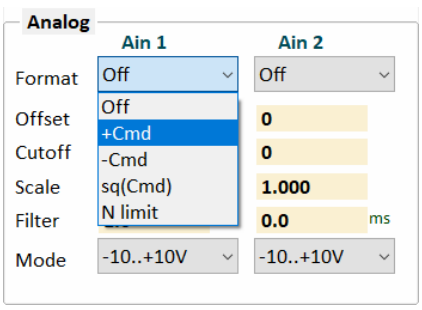


Fig. 9-23 - 00057

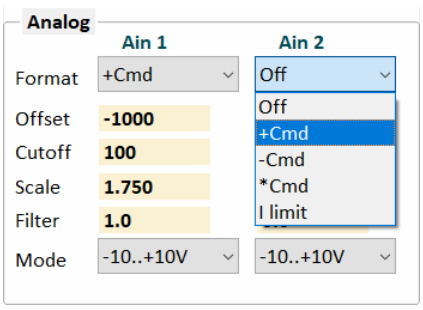


Fig. 9-22 - 00058

Offset:
Compensation of the command value zero error when the input is analog.
With an applying voltage of 0 V alter the offset value positively or negatively such that the preset command value is about zero inside **Ain scaled**.

Cutoff:
Adjustable zero zone for which the unprocessed measured values of Ain1 and Ain2 are set to zero.
A preset command value of 0 is displayed. This helps to cutoff the usual small residual voltage at around 0 V across the inputs of Ain1 and Ain2.

Special cases:

Zero zone at analog speed command value:
The command value is switched to zero within this zone. The drive is at a standstill, no drift (no position parameter entered).
For an external torque which is larger than the servo current limit the drive can be turned from the neutral position

Zero zone at analog speed command value with position hold value
Within the zero zone the drive maintains its zero position by means of an internal position-current-control.
For an external torque which is larger than the servo current limit the drive can be turned from the neutral position. When the torque is smaller the drive returns to its zero position..

Note: The parameters must be entered in the parameter field **Position**.
When an analog command value is provided from a PLC/CNC position control, the value should be very low or zero.

Scale:
Scaling factor of the respective analog input signals. It allows to adapt the complete range of the input voltages (±11 V) to the complete range of the final command value presetting (±32767). In the course of this also the gradient of the command value presetting can be varied. (Input voltages superior to 11 V are cut).

Mode:
Input range for the analog command values of

-10..+10V	Bipolar command value
0..+10V	Unipolar command value
4..20mA	Current command value (external resistance 500 Ohm)
+1..+9V	Command value with potentiometer monitoring

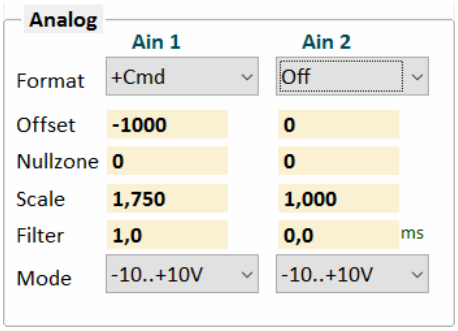


Fig. 9-24 - 00059

After the scaling the preset command value of Ain1 and Ain2 is displayed as scaled variable $Ain_{1,2}$ on the page **Speed** as **$Ain_{1,2}$ scaled**.

$$\mathbf{Ain_{1,2}\ scaled\ =\ (Ain_{1,2}\ ein\ +\ Offset_{1,2})\ x\ Scale_{1,2}}$$

9.14 Settings – Speed / Linear ramp function and speed limiting

Parameters for the setting of the different ramp times (speed, torque and emergency-stop).

Symbol:	Function:	Range:	Unit:	ID address:
N R-Acc	Speed - acceleration ramp	0..30000	ms	$0x35_L$
N R-Dec	Speed - braking ramp	0..30000	ms	$0xED_L$
M R-Acc	Torque - acceleration ramp [1]	0..4000	ms	$0x35_H$
M R-Dec	Torque - deceleration ramp [1]	0..4000	ms	$0xED_H$
M R-Rcp	Torque – recuperation ramp [1,2]	0..4000	ms	$0xC7_H$
R-Lim	Emergency stop, output switch ramp	0..1000	ms	$0xC7_L$
Nmax100%	Physical reference value for the internal resolution of the speed to 16 Bit (±32767)	100..50000	rpm	0xC8
N-Lim	Speed limiting for positive and negative rotation direction [3]	0..100	%	0x34
N-Lim+	Speed limiting for positive rotation direction (if logic input N clip(neg&pos) is activated)	0..100	%	0x3F
N-Lim-	Speed limiting for negative rotation direction (if logic input N clip(neg&pos) is activated)	0..-100	%	0x3E

[1] From FW476 only active if it is a current (torque) presetting
[2] From FW476 only active if ID ($0xCD_{Bit\ 4}$ = 1) is set for digital current (torque) presetting
[3] For the current (torque) presetting and N-Lim < 100 % the torque speed control (Tempomat) is activated

- For the speed ramps (N R-Acc, N R-Dec, R-Lim) the reference for the time is the value for 100 % of the command value of the parameter Nmax100% (0xC8).
- For the torque ramps (M R-Acc, M R-Dec, M R-Rcp) the reference for the time is the value for 100 % of the command value of the peak device current of the parameter I max pk (0xC4).
- All ramps are formed linearly and generate a constant acceleration at the speed presetting.

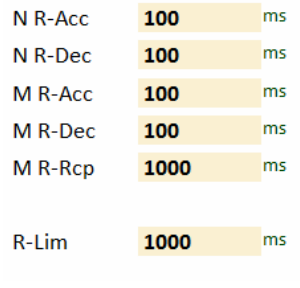


Fig. 9-25 - 00060

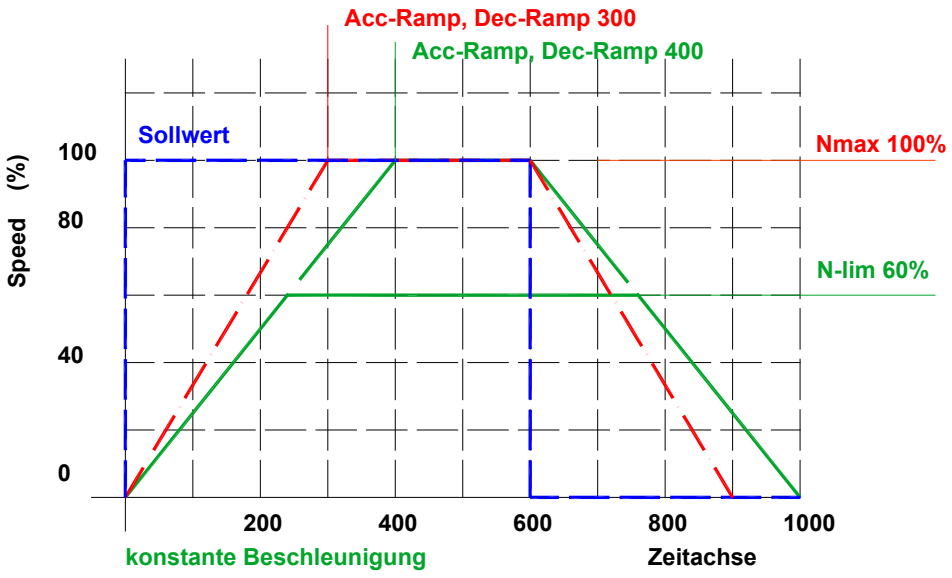


Fig. 9-26

S-ramp function / not yet active

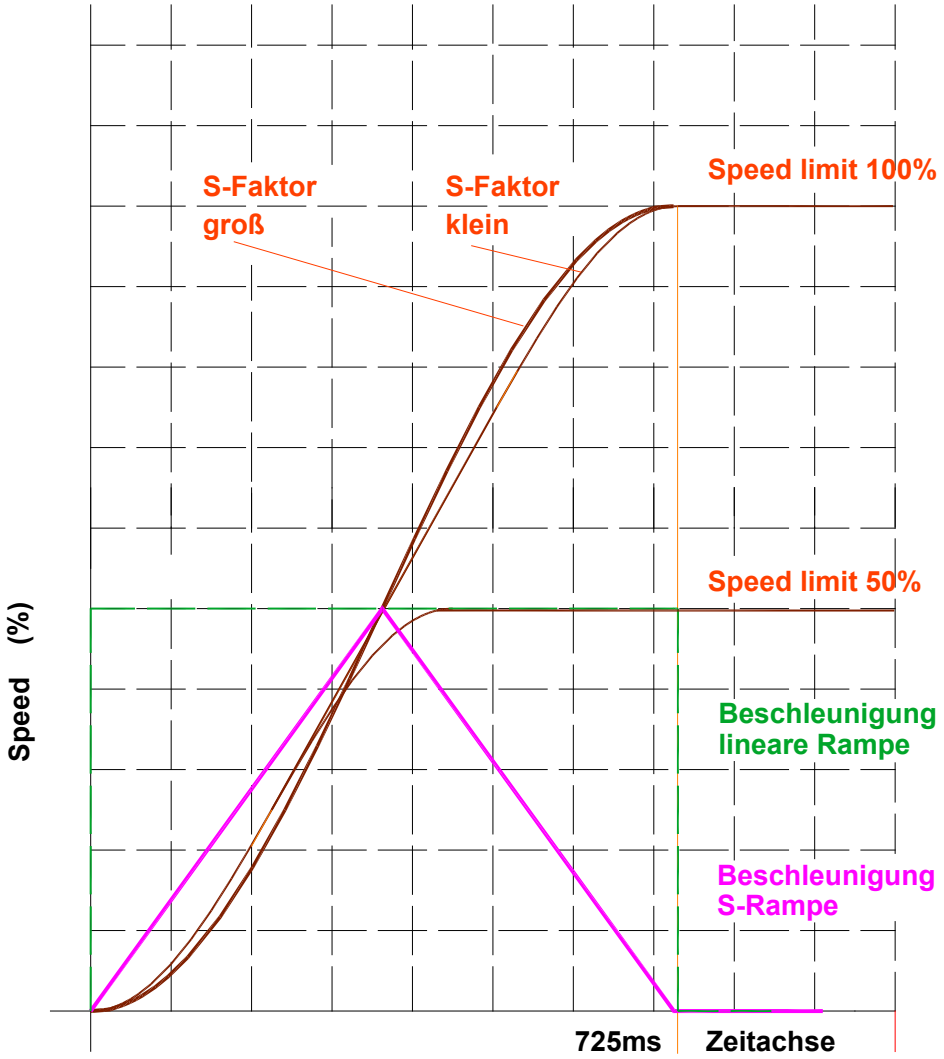


Fig. 9-27

S-ramp function
The linear time function is converted into a s-shaped (sine²) function.
The constant acceleration and deceleration alters to steady changing.
Jerks (acceleration/deceleration) and current peaks are considerably reduced.

9.15 Settings – BTB / RDY

BTB/RDY message (relay contact)
The BTB relay contact (solid state relay) is closed when the device is ready (residual resistance 30Ohm). The BTB contact is opened when an error occurs (resistance >1 MΩ).

Ready for operation BTB
Displayed in the Status field as **Rdy** ($0x40_{Bit\ 14}$).

Not ready for operation BTB (error)
Indicated by the red LED FAULT at the 7-segment LEDs.

BTB and the power supply voltage
When the power supply voltage is switched-off the message status can be selected via **BTB power** in the parameter field **Servo** of the setting window (under-voltage monitoring).

Selection BTB Power - „ without“
BTB without under-voltage monitoring
When the enable and the power supply voltage are switched off, **the message RUN/BTB remains active.**

Fig. 9-28 - 00061

Selection BTB Power - „with“
BTB with under-voltage monitoring
When the enable and the power supply voltage are switched off, **the message RUN/BTB is deactivated**.

Error message and BTB/RDY:
When a system-endangering error X (see list of errors) occurs,

- the **BTB** signal is switched off.
  The drive will immediately be disabled internally and the output **O_GO** (0xE3) will be set to **low**.
- **On the servo:**
  The red LED FAULT at the 7-segment LEDs is activated
  The error no. is indicated in the 7-segment display.
- **Inside NDrive:**
  The error states are displayed in the field **Error(s)**.

The error messages are reset,

- when the drive enable (FRG/RUN) is switched on
- when the command of the parameter **Cancel Error** is sent via a communication interface
- when a digital input which is programmed on the page **Logik** in **Cancel Error(s)** is triggered

10 Communication

10.1 Communication – CAN Bus

Parameters on the page **Bus** for the communication interface CAN Bus.

Short symbol	Function	Range	Unit	ID address
NBT	CAN transfer rate (see list)	0..0xFFFE	hex	$0x73_{Bit\ 11..0}$
Rx ID	CAN ID – receiving address	0..0x7EE	hex	0x68
Tx ID	CAN ID – sending address	0..0x7EE	hex	0x69
T-Out	CAN timeout time	0..60000	ms	0xD0
Axis	Axis designation (freely writable)	4 characters	ASCII	0xF8

Transfer rate NBT:	Setting value in NBT (0x73):	Max. cable length
1000 kBaud	0x4002	20 m
625 kBaud	0x4014	70 m
500 kBaud	0x4025 (default)	70 m
250 kBaud	0x405C	100 m
125 kBaud	0x4325	100 m
100 kBaud	0x4425	100 m

The addresses for the receive/send ID and the baud rate are set in the **CAN-Bus** parameter field.

After changes have been made and saved in the CAN programming the device must be restarted
→ Switching the auxiliary voltage off and on!

Default settings:
Receiving address Rx ID = 0x201
Sending address Tx ID = 0x181
Transfer rate NBT = 4025 (→ 500 kBaud)

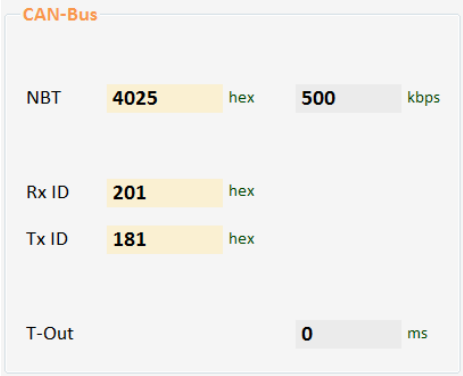


Fig. 10-1 - 00062

Note:
For detailed descriptions/explanations of the CAN communication please download the CAN Manual on the UniTek Homepage.

10.2 Communication – RS232

10.2.1 RS232 Changing the baud rate

The setting of the RS232 baud rate is effected via the ID address $0x5A_{Bit\ 15}$

$0x5A_{Bit\ 15}$	0	corresponds to	115200	(Default)
$0x5A_{Bit\ 15}$	1	corresponds to	9600	

The baud rate saved in the device is displayed after the firmware version no. when the auxiliary voltage 24 V= is switched on.

bd0	corresponds to	115200
bd1	corresponds to	9600

First, the firmware version no. is displayed (e.g. 4 - 7 – 6)
then the baud rate (e.g. b - d - 0)

10.2.2 Structure of the serial RS232 protocols

Presentation of the structure / protocol of a message via the serial RS232 interface

RS 232 16 Bit										
Sending from the pc to the drive								Drive response to the pc		
Char1	Char2	Char3	Char4	Char5	Char6	Char7		Byte 1	Byte 2	
RegID	RegID	Data	Data	Data	Data	Sync		Data	Data	
Bits 07..04	Bit s 03..00	Bits 15..12	Bits 11..08	Bits 07..04	Bits 03..00	"X"		Bits 07..04	Bits 07..04	
ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII		binary	binary	

RS 232 32 Bit														
Sending from the pc to the drive											Drive response to the pc			
Char1	Char2	Char3	Char4	Char5	Char6	Char7	Char8	Char9	Char10	Char11	Byte1	Byte2	Byte 3	Byte4
RegID	RegID	Data	Data	Data	Data	Data	Data	Data	Data	Sync.	Data	Data	Data	Data
Bits 07..04	Bits 03..00	Bits 31..28	Bits 27..24	Bits 23..20	Bits 19..16	Bits 15..12	Bits 12..08	Bits 07..04	Bits 03..00	„X“	Bits 07..04	Bits 07..04	Bits 07..04	Bits 07..04
ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	binary	binary	binary	binary

Example: Requesting the actual speed (0x30)

Sending from the pc to the drive								Drive response to the pc		
Char1	Char2	Char3	Char4	Char5	Char6	Char7		Byte 1	Byte 2	
RegID	RegID	Data	Data	Data	Data	Sync		Data	Data	
Bits 07..04	Bits 03..00	Bits 15..12	Bits 11..08	Bits 07..04	Bits 03..00	"X"		Bits 07..04	Bits 07..04	
3	**D**	**0**	**0**	**3**	**0**	**X**		**lo**	**hi**	
RegID read read (0x3D)		Speed Actual Actual speed valuet (0x30)				ASCII		Value of 0x30		

11 Current control

11.1 Current control – Parameters

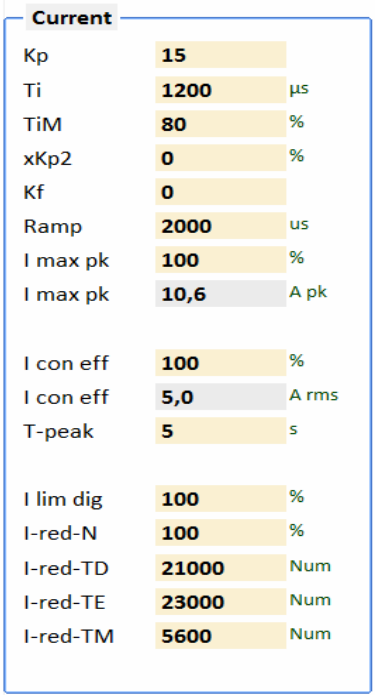


Fig. 11-1 - 00063

Parameters for the settings of the current controller, as well as of the generally permitted current limits of the servo device, and the limits for the activation of derating functions

Note:
Many of these parameters are also described on the pages **Speed** and **Oscilloscope**

Symbol:	Function:	Range:	Unit:	ID address:
Kp	Proportional amplification	0..200	Num	0x1C
Ti	Integration time (integral time constant)	375..10000	ms	0x1D
TiM	Max. value of the integral memory Ti	0..300	%	0x2B
xKP2	Proportional amplification in case the actual current is superior to the current limit	0, 100..500	%	0xC9
Kf	Current feed-foreward control	0..167	Num	0xCB
Ramp	Ramp setting of current command value	125[1]..32000	µs	0x25
I max pk	Device peak current [A]	0..100	%	0xC4
I con eff	Device continuous current [Arms]	0..100	%	0xC5
T-peak[2]	Permitted overcurrent time above the continuous current limit (reduction 5 times longer)	1..40	s	0xF0
I limit (dig)[3]	Current reduction when the logic input I limit (dig.) is activated	0..100	%	0x46
I-red-N	Current reduction by means of the actual speed	0..100	%	0x3C
I-red-TD	Start of the current reduction by means of the output stage temperature	0..32767	Num	0x58
I-red-TE	End of the current reduction by means of the output stage temperature	0..32767	Num	0x4C
I-red-TM	Start of the current reduction by means of the motor temperature	0..32767	Num	0xA2

[1] Depending on the PWM pulse frequency
[2] Only active if the current reduction on the basis of the igbt temperature is not activated ($0x40_{Bit\ 23}$ (Ird-TI) = 0)
[3] The reference is the max. device peak current (I max pk (0xC4) = 100 %)

11.1.1 Additional information of the current controller parameters

The current controller is a classic PI-controller → Kp * (1 + 1/(Ti * s))

Kp Input for the proportional amplification in the current controller
Note: Input value of 33 (Num) ≙ 1.0 (physical correcting variable of the current)

Kp too low:	compensation error, bad dynamics, low-frequency vibrations
Kp too high:	strong motor noise, high-frequency vibrations
Recommended[1]:	10..40 Num

Ti Integration time in the current controller
Note: Ti depending on the proportional amplification Kp

Ti too high:	low-frequency vibrations
Ti too low:	high-frequency vibrations, strong tendency to vibrate
Recommended[1]:	700..2500 ms

TiM Max. value from the integral memory Ti

TiM too low:	preset speed value is not reached with a high load
Recommended[1]:	80..100 %

xKp2 New amplification factor (i.e. new Kp) for the attenuation of the current actual value overshoots above the current limit I lim inuse (0x48)
Note: activate only if demanded by the system

xKp2 too high:	danger of current oscillations
Recommended[1]:	0 (deactivated) or 100..120 %

Kf Feed-foreward control for the compensation of the operating delay in the controller
Note: activate only if demanded by the system

Kf too high:	danger of current oscillations
Recommended[1]:	0 (deactivated) or 10..50 %

Ramp Current increase limiting or ramp increase of the current command value

Ramp too high:	danger of long-wave speed oscillation (motor becomes unstable)
Recommended[1]:	600..2500 µs

[1] Guide values on the basis of years of experience,
however, there may be differences depending on the system

The current control parameters can be determined by means of the motor data such as winding inductance and winding resistance.

Notes:

- The current control parameters must only be modified by trained personal /specialists.
- Improperly set amplification parameters may damage the device or the drive.
- Check all the settings and their effects by using the NDrive oscilloscope.

11.2 Current control – Structure

The structure screen for the current control with entry fields and display windows of the control parameters is shown for numeric values on the page **speed** in ***Current Commands*** and ***Current Controller***

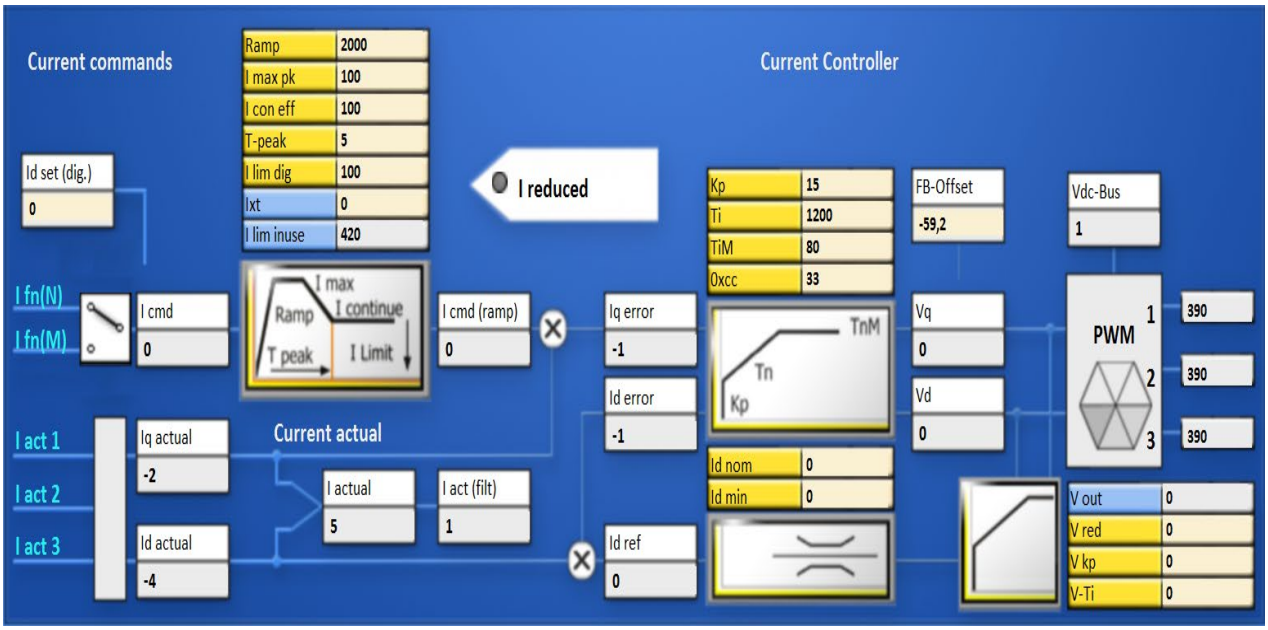


Fig. 11-2 - 00065

Current command values:	Function:	ID address:
I fn(N)	Speed controller output (current command value from the speed controller)	
I fn(M)	Torque command value after ramp (Dig. command value presetting of the Iq-Strom (M set(dig.))	
Id set (dig.)	Dig. command value presetting of the Id-Strom (standardized as M set(dig.))	0x21
I cmd	Current command value (internal)	0x26
I cmd (ramp)	Current command value after ramp and limiting (internal)	0x22
Current controller values:		
Iq actual	Present active current (Iq)	0x27
Id actual	Present reactive current (Id)	0x28
I actual	Present sum current (I)	0x20
I act (filt)	Present sum current after display filter	0x5F
Iq error	Control error Iq-current	0x38
Id error	Control error Id-current	0x39
Id ref	Reference of the Id-current	0x23
Voltage values:		
Vq	Present Vq voltage component	0x29
Vd	Present Vd voltage compenent	0x2A
Vdc-Bus	Measuring value of the dc bus voltage	0xEB
V out	Present output voltage	0x8A
V red	Field weakening control - voltage reference value in % of V out	0x8B
V kp	Field weakening control – proport. amplific. in the voltage controller	0x8C
V-Ti	Field weakening control – integral time (integral time constant)	0x8D

Setting field Ramp on the page **Speed**

Symbol:	Function:	ID address:
Ramp	Current command value ramp setting [µs]	0x25
I max pk	Device peak current [A]	0xC4
I con eff	Device continuous current [Arms]	0xC5
T-peak	Permitted overcurrent time above continuous current limit [s]	0xF0
I lim dig	Current reduction in % if logic input I limit (dig.) is activated	0x46
Ixt	Load	$0x45_H$
I lim inuse	Present current limit [Num]	0x48

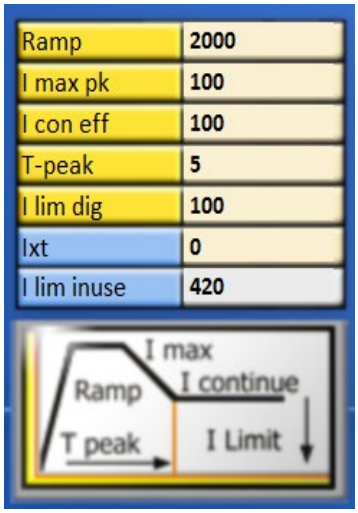


Fig. 11-3 - 00066

The current command value (I cmd) is processed in the setting field (Ramp). The current increase (Ramp), the peak current (I max pk), the continuous current (I con eff), and the peak current time (T-peak) are set.
The summarized current reductions through speed, current, and temperature are displayed at I lim inuse.
At reduced current the LED 'I reduced' lights up. The result of the current command value processing is shown in the display field of the current command value after ramp (I cmd (ramp)).

Setting field - Current Controller on the page **Speed**

Symbol:	Function:	ID address:
Kp	Proportional amplification [Num]	0x1C
Ti	Integration time (integral time constant) [µs]	0x1D
TiM	Max. value from the integral memory Ti [%]	0x2B
free	*Free*	*0xCC*

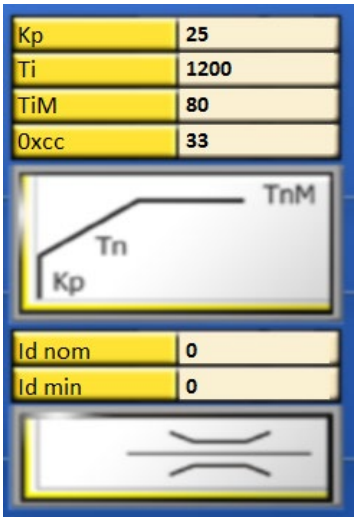


Fig. 11-4 - 00067

Setting field - Field control on the page **Speed**

Symbol:	Function:	ID address:
Id nom	Nominaler Magentisierungsstrom in % vom Motor-Nennstrom [%]	0xB2
Id min	Minimaler Magentisierungsstrom in % vom Motor-Nennstrom [%]	0xB5
V red	Field weakening control – voltage reference value in % of V out [%]	0x8B
V kp	Amplification field weakening [Num]	0x8C
V-Ti	Integration time field weakening [Num]	0x8D

The current actual values (I-Ist1, I-Ist2, I-Ist3) are evaluated as Iq-actual and Id-actual. The displayed current actual value (I act filt) is obtained from the current actual value (I actual) by means of a filter.
The Iq and Id errors are processed in the current controller by means of the amplification parameters (Kp, Ti, TiM). The reference value for the Id control is generated via the vector control feedback.

PWM display field on the page **Speed**

Symbol:	Function:	ID address:
Vdc-Bus	Measured value of the dc bus voltage	0xEB
V out	Present output voltage	0x8A
PWM1	PWM output level Phase 1	0xAC
PWM2	PWM output level Phase 2	0xAD
PWM3	PWM output level Phase 3	0xAE

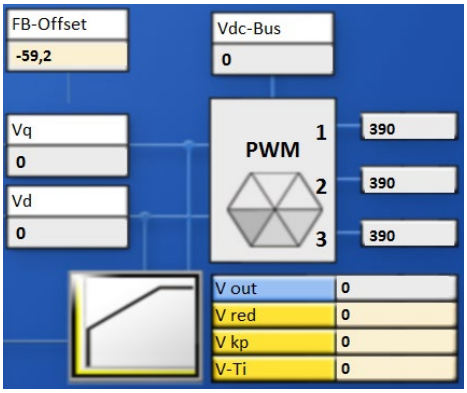


Fig. 11-5 - 00068

The PWM pulses for the output power stage circuit are generated from the current controller output signals Vq and Vd.

11.2.1 Conversion of the current units

The numeric values for the rated current must be observed for the digital communication via RS232 or CAN-BUS.
The numeric values are displayed in the track window.

$$i = RegID[0xNN] * \frac{1}{5} * \frac{RegID[0xC6]}{RegID[0xD9]}\ A_{rms}$$

Note:

- 0xD9 and 0xC6 are fixed and defined and device-dependent values.
- The units of physical values (if existing) are displayed inside the Ndrive oscilloscope in A.

11.2.2 Setting of the current controller parameters (Kp ,Ti, TiM)

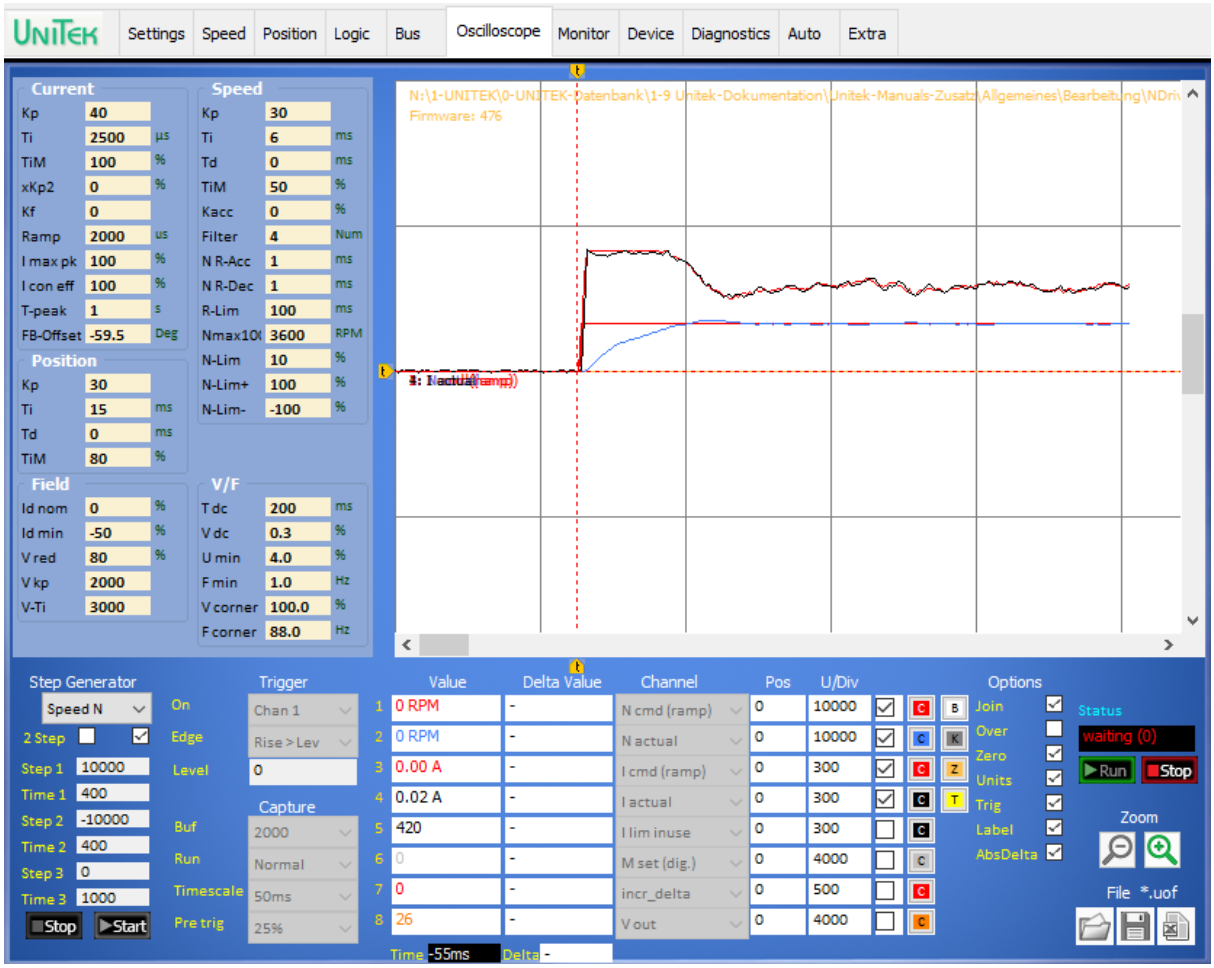


Fig. 11-6 - 00139

The setting of the current controller considerably depends on the characteristics of the complete system and above all on the features of the used and mostly unknown motor.

Generally, the converters are no plug-and-play systems. A close examination of the behavoiur during the current control is necessary and important for a save and smooth operation.

Conditions:

- Handling of theNDrive oscilloscope (signals „I cmd (ramp)“ and „I actual“ as measuring channel).
- The motor should either be free-running or applying across a constant load.
- A steady RS232 communication in order to preset a digital command value and to keep records by means of the NDrive oscilloscope.
- The current controller parameters must only be modified by skilled personal.

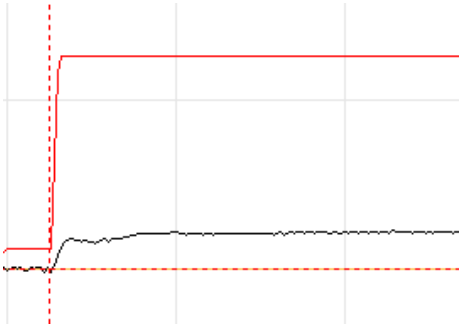
Note:
The following setting of the current controller focuses on the general first step from the command value to the actual value. With high speed values near the voltage limits it is possibly necessary to make corrections.

Setting of the Kp value:

- Removing the integral component (TiM = 0 %)
- Fast speed ramp (N R-Acc = 10..100 ms)
- Set the trigger on the NDrive oscilloscope to channel 1 (N cmd (ramp)), Rise > Lev 100
- Start the oscilloscope recording, send a speed command value (example: 10000), stop the motor, analyze the oscilloscope record

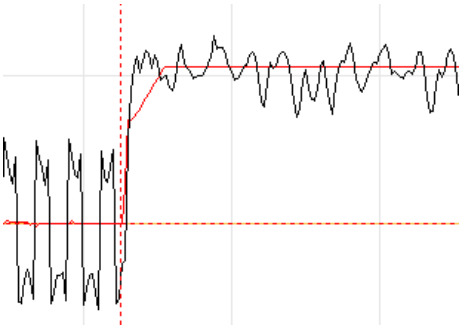
Kp value too small

1. The difference between the current command value (Icmd (ramp)) and actual current value (Iactual) is to large
2. The max. torque is not reached at high speeds



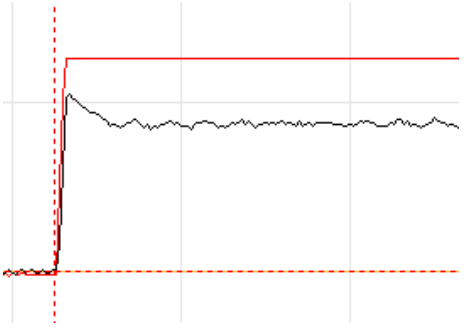
Kp value too high

1. The actual current value overshoots the current command value
2. Rough operation and high-frequency motor noise



Correct Kp value

1. Actual current value does not oscillate
2. The difference between the current command value and actual current value is low
   (optimal: correction error <5 %)

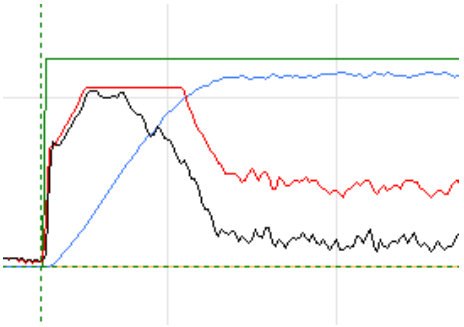


Setting of the Ti and TiM value:

- Maintain the determined Kp value
- Add the integral component (TiM ≠ 0 %, Ti ≠ 0 µs)
- Fast speed ramps (N R-Acc = 10..100 ms)
- Set the trigger on the NDrive oscilloscope to channel (N cmd (ramp)), Rise > Lev 100
- Start the oscilloscope recording, send a speed command value (example: 10000), stop the motor, analyze the oscilloscope record

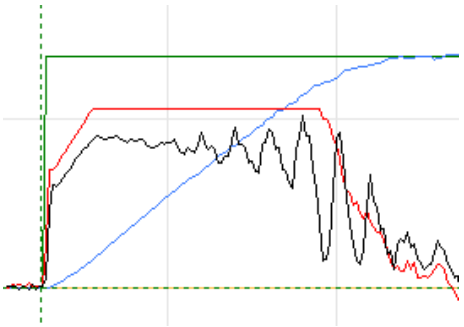
TiM too low

1. Despite a sufficiently high command value current (red) the command value speed (green) is not reached with a high load.
2. The correcting variable for the output voltage is missing
3. Recommendation: 80..100 %



Ti too high

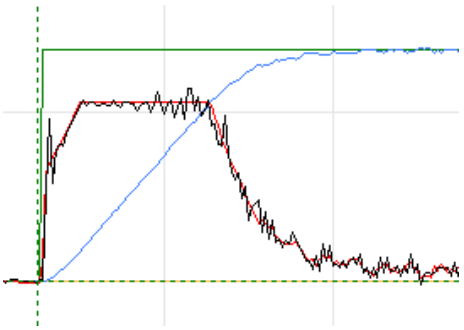
1. The control error is nearly not or too slowly compensated
2. Long-wave oscillations are possible



Ti too low

1. High and fast overshoot at the first command value step
2. Short-wave oscillations are possible

Note:
As Ti depends on Kp a subsequent adaption of Kp influences the behaviour of the integral component

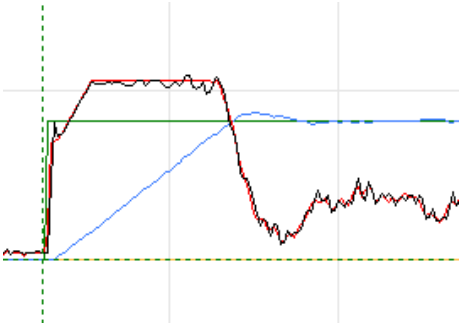


Correctly set Kp and Ti value

1. Fast control of the fast command value step without any high overshoots as well as fast correction in case of command value changes
2. No long-wave or short-wave oscillations

Note:

- In case of fast load changes or near the voltage limit the system may become unstable
- The motor type and the EMV influences considerably affect the control characteristics



12 Current reduction (derating)

12.1 Current reduction – Parameters and description

The permitted current limits of the peak and continuous current during operation are determined on the basis of the set value of the motor and the servo. However, it must be borne in mind that the respectively lower value of the peak current values and continuous current values determine the limits during operation.

	Symbol:	Function:	Range:	Unit:	ID address:
Motor	I max eff	Max. motor current	0..1000.0	Arms	0x4D
	I nom eff	Continuous motor current	0..1000.0	Arms	0x4E
Servo	I max pk	Device peak current [A]	0..100	%	0xC4
	I con eff	Device continuous current [Arms]	0..100	%	0xC5

12.1.1 Current reduction – parameters

Parameters of the different adjustable derating options

For the current reduction (derating) from a permitted peak current to a permitted continuous current there are two options, i.e., the static (fix value) or dynamic (function) current reduction.

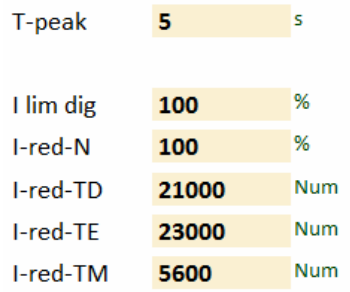


Fig. 12-1 - 00064

Derating:	Symbol:	Function:	Range:	Unit:	ID address:
Time[3]	T-peak	Over-current time function	1..40	s	0xF0
Digital input[1]	I lim dig	Current reduction in % if a logic input I limit (dig.) is activated	0..100	%	0x46
Actual speed value[1]	I-red-N	Overcurrent – speed function	0..32767	Num	0x3C
Output stage temperature (start)[2]	I-red-TD	Start of the reduction to continuous current by means of the igbt temperature	0..32767	Num	0x58
Output stage temperature (end)[2]	I-red-TE	End of the reduction to continuous current by means of the igbt temperature	0..32767	Num	0x4C
Motor temperature[2]	I-red-TM	Reduction by means of the motor temperature	0..32767	Num	0xA2
Motor temperature[2]	M-Temp	Reduction at 93 % of M-Temp	0..32767	Num	0xA3
n < 10 Hz[2]		Reduction to continuous current if the motor speed is inferior to 10 Hz			
Analog input[1]		Ain 2 is set to I limit. Ain 2 determines the permitted peak current	0..32767	Num	$0xD6_H$

[1] Static reduction
[2] Dynamic reduction
[3] Static reduction with dynamic calculation

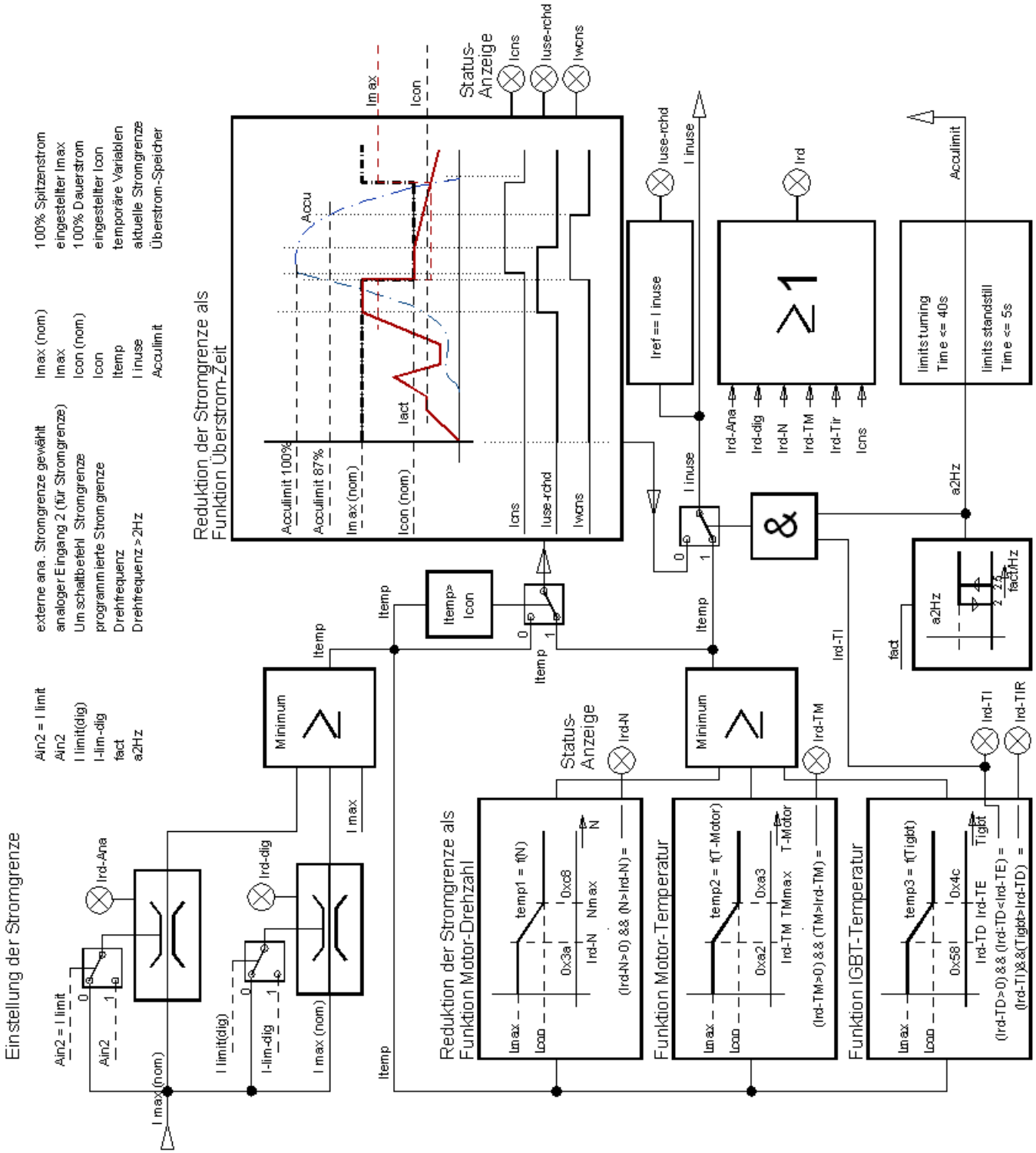


Fig. 12-2

Note: Designations may slightly vary.

12.1.2 Current reduction – description

In general there will be a message in the status field $0x40_{Bit\ 21}$ (**Iuse-rchd**) if the current command value reaches the presently permitted current limit.

T-peak:
If the current is superior to the permitted continuous current a temporal calculation is started in dependance of the surpassing's delta. Thus, the determination is dynamic. If the dynamic temporal calculation corresponds to the set value of **T-peak** (0xF0) the current limit is reduced to continuous current.
If the temporal calculation is at 87.5 % of T-peak this is set in the status field $0x40_{Bit\ 28}$ (Iwcns).
If the current is inferior to the permitted continuous current the time memory is removed again. The rest time is 2 times T-peak.

Note: This current reduction on the basis of the time is only activated if the current reduction on the basis of the output stage temperature is deactivated (I-red-TD = 0 or I-red-TD ≥ T-red-TE).
- The activation of the function of T-peak is displayed in the Status field $0x40_{Bit\ 23}$ (Ird-TI) = 0.

I lim dig:
On the **Logic** page a digital input can be programmed at **I limit (dig)**.
If this input is activated or if a CAN command is received for this input, the current limit is reduced to the parameter value **I lim-dig** (0x46).
- Derating active: Status field $0x40_{Bit\ 20}$ (Ird-Dig)

I-red-N:
The current limit is linearly reduced from the speed value set in the parameter **I-red-N** (0x3C).
At rated speed the current limit corresponds to the continuous current..
- Derating active: Status field $0x40_{Bit\ 22}$ (Ird-N)

I-red-TD and I-red-TE:
If the output stage temperature value of **I-red-TD** (0x58) is exceeded the current limit is linearly reduced.
The message is displayed in the Status field $0x40_{Bit\ 24}$ (Ird-TiR) and the warning 7 (DEVICETEMP) is signalled.
If the value of **I-red-TE** (0x4C) is reached the current limit is reduced to the permitted continuous current.
- Activation conditions: (I-red-TD < I-red-TE) and (I-red-TD > 0)
- Function active: Status field $0x40_{Bit\ 23}$ (Ird-Ti)
- Derating active: Status field $0x40_{Bit\ 24}$ (Ird-TiR)

If the output stage temperature is superior to 25200 Num (83°C) there will be an emergency stop and the error 7 (DEVICETEMP) is signalled.

I-red-TM:
If the motor temperature exceeds the value of **I-red-TM** (0xA2) the current limit is linearly reduced. The message is displayed in the Status field $0x40Bit_{26}$ (Ird-TM) and the warning 6 (MOTORTEMP) is signalled.

If the temperature continues to increase the current limit is further linearly reduced until the value of **M-Temp** (0xA3) is reached. Then there will be an emergency stop and the error 6 (MOTORTEMP) is signalled.

Attention:
The warning messages displayed in the field 'Status' must be observed!
If the current limits are reduced, this might cause failures of the machine or the installation.

12.1.3 Current reduction – status messages

Signals in the Status field (0x40) for the current reduction functions.

Signal:	Derating function:	Description of the signal:	ID address: 0x40
Icns		Current limit is reduced to continuous current	Bit 5
Ird-dig	Digital input	Current limit is reduced due to I lim dig	Bit 20
Iuse-rchd		Current command value has reached the permitted current limit	Bit 21
Ird-N	Actual speed value	Current limit is reduced due to I-red-N	Bit 22
Ird-Ti	Output stage temperature	The current reduction function due to the output stage temperature is active (→ T-peak deactivated)	Bit 23
Ird-TiR	Output stage temperature	The current reduction due to the output stage temperature is active	Bit 24
>10Hz	Actual speed value	Current reduction at a rotating field frequency inferior to 10 Hz → Blocking protection[1]	Bit 25
Ird-TM	Motor temperature	Current limit is reduced due to I-red-TM or M-Temp (93%)	Bit 26
Ird-Ana	Analog input	The current limit is reduced due to Ain2 (I limit) inferior to the current limit	Bit 27
Iwcns	Time	The dynamic time limit is charged to 87.5% of T-peak	Bit 28

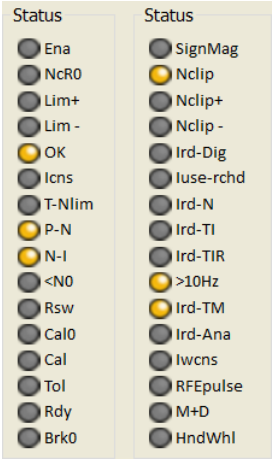


Fig. 12-3 - 00033

Measuring values (monitor)		ID address
T-motor	Present motor temperature	0x49
T-igbt	Present output temperature	0x4A
T-air	Present air temperature in the servo	0x4B
I lim inuse	Present current limit	0x48

[1] Blocking protection:
If the rotating field frequency is inferior to 10 Hz the current limit must be reduced to the permitted servo continuous current. This is important in order to protect the servo drive from high currents.
On one's own risk this blocking protection can be deactivated below a rotation field frequency of 10 Hz by means of an automatic switch-over to a PWM pulse frequency of 4 kHz:

- ID address $0x5A_{Bit\ 31}$ = 0 blocking protection activated (current limit is reduced)
- ID address $0x5A_{Bit\ 31}$ = 1 blocking protection deactivated (pulse frequency switched over to 4kHz)

13 Speed control

13.1 Speed control – Parameters

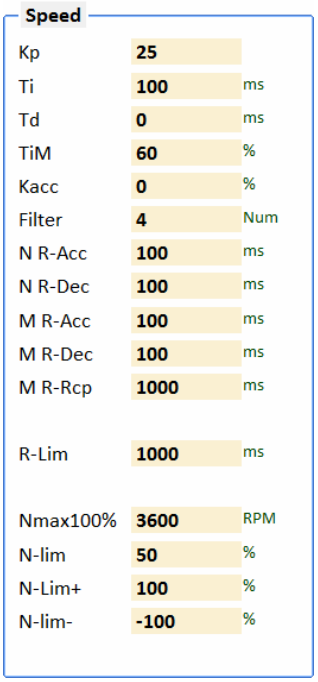


Fig. 13-1 - 00069

Parameters for the speed controller settings as well as the general permitted speed limits

Note:
Many of these parameters are also mentioned on the pages **Speed** and **Oscilloscope**

Symbol:	Function:	Range:	Unit:	ID address:
Kp	Proportional amplification	0..200	Num	0x2C
Ti	Integration time (integral time constant)	0..10000	ms	0x2D
Td	Differential time	0..100	ms	0x2E
TiM	Max. value from the integral memory Ti	0..100	%	0x3B
Kacc	Proportional amplification - delta acceleration	0..100	%	0x5B
Filter	Filter actual speed value	0..10	Num	0x5E
N R-Acc	Speed – acceleration ramp	0..30000	ms	$0x35_L$
N R-Dec	Speed – braking ramp	0..30000	ms	$0xED_L$
M R-Acc	Torque – acceleration ramp	0..4000	ms	$0x35_H$
M R-Dec	Torque – reduction ramp	0..4000	ms	$0xED_H$
M R-Rcp	Torque – recuperation ramp ($0xCD_{Bit\ 4}$)	0..4000	ms	$0xC7_H$
R-Lim	Emergency stop, End switch ramp	0..1000	ms	$0xC7_L$
Nmax100%	Physical reference value for the internal resolution of the speed to 16 Bit (±32767)	100..50000	rpm	0xC8
N-Lim	Speed limiting for positive and negative rotation direction	0..100	%	0x34
N-Lim+	Limiting for the positive rotation direction (if the logic input N clip(neg&pos) is activated)	0..100	%	0x3F
N-Lim-	Limiting for the negative rotation direction (if the logic input N clip(neg&pos) is activated)	0..100	%	0x3E

13.1.1 Additional information of the speed controller parameters

Kp Input for the proportional amplification in the current controller
Note: Input value of 33 (Num) ≙ 1.0 (physical correcting variable of the current)

Kp too low:	compensation error, bad dynamics, low-frequency vibrations
Kp too high:	strong motor noise, high-frequency vibrations
Recommended[1]:	5..50 Num

Ti Integration time in the current controller
Note: Ti depending on the proportional amplification Kp

Ti too high:	low-frequency vibrations, large speed overshoots, very weak
Ti too low:	high-frequency vibrations, strong tendency to vibrate
Recommended[1]:	6..400 ms

TiM Max. value from the integral memory Ti

TiM too low:	preset speed value is not reached with a high load
Recommended[1]:	20..60 %

Td Differential time constant in the speed controller
Note: activate only if demanded by the system

Td too high:	high-frequency vibrations, strong tendency to vibrate
Recommended[1]:	0 (deactivated) or 6..20 ms

Kacc Dynamic acceleration value directly to the current controller
Note: activate only if demanded by the system

Kacc too high:	danger of current oscillations
Recommended:	0 (deactivated) or 10..50 %

Filter Filter for the actual speed value (0 ≙ without filter, 10 is the max. filter effect).

Filter value too low:	motor noise, high-frequency vibrations, strong tendency to vibrate
Filter value too high:	low-frequency vibrations

[1] Guide values on the basis of years of experience,
however, there may be differences depending on the system

13.1.2 Additional information of the speed ramps during speed controller operation

The speed command value of N cmd(int) (0x5D) is adapted according to the ramp settings and is the final speed command value of N cmd (ramp) (0x32) for the speed controller.

N R-Acc Acceleration ramp for the speed and position command values
Parameter value always corresponds to the time from 0 rpm to the reference of Nmax100%

N R-Dec Braking ramp for the speed and position command values
Parameter value always corresponds to the time from 0 rpm to the reference of Nmax100%
set to < 10ms for position control)

M R-Acc
M R-Dec
M R-Rcp These settings of the current ramps are not active during speed control
They are only active at torque control
During speed control only the current ramp calculation on the basis of the parameter **Ramp** (0x25) is active

R-Lim Minimum braking ramp at limit switch and emergency stop
For speed control only active if the free coasting is deactivated
(can be selected for the reference run)

13.1.3 Additional information of the speed limiting during speed controller operation

N max100% Physical reference value for the internal resolution of the speed to 16 Bit (±32767)
Always set this value to max. motor speed
If the speed is to be limited to a lower value please use the parameter N-Lim (0x34)

N-Lim Speed limiting in % for the positive and negative rotation direction in dependance of the reference value of N max100% (0xC8)
For a current presetting (torque control) and N-Lim < 100 % the torque speed control (Tempomat) is activated

N-Lim+ Speed limiting in % for positive rotation direction in dependance of the reference value of N max100% (0xC8)
→ only active if a logic input is set and activated in N clip(neg&pos)
Special function: current limit for automatic recuperation for torque control

N-Lim- Speed limiting in % for negative rotation direction in dependance of the reference value of N max100% (0xC8)
→ only active if a logic input is set and activated in N clip(neg&pos)
Special function: current limit for automatic recuperation for torque control

13.2 Speed control – Structure

The structure screen for the current control with entry fields and display windows of the control parameters is shown for numeric values on the page **Speed** in ***Analog, Speed*** and ***Speed Controller***

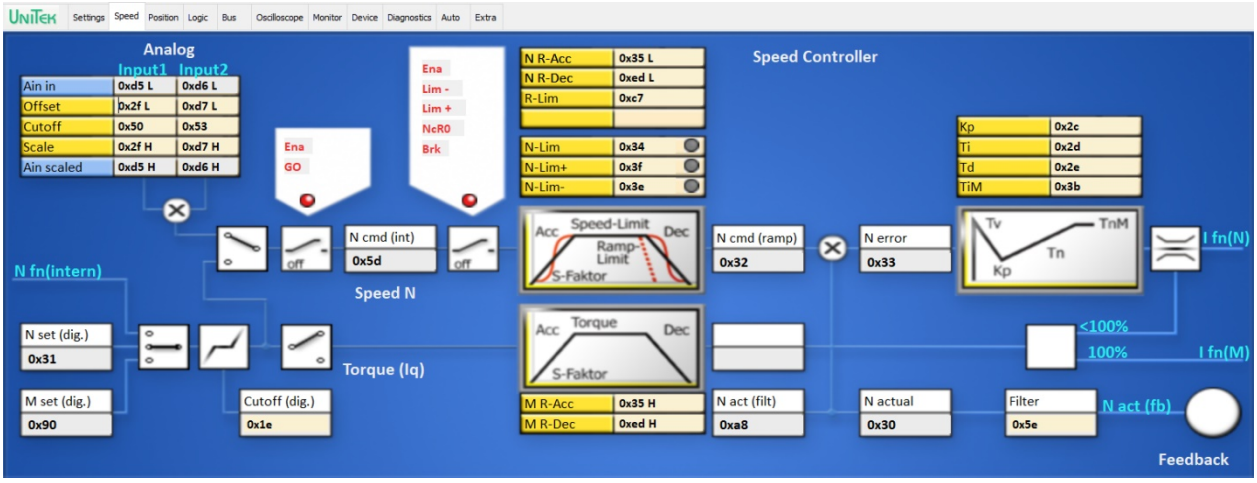


Fig. 13-2 - 00070

Speed command values:		**Function:**	**ID address:**
Ain ein	IN1 / IN2	Analog inputs 1 and 2	$0xD5_L$ / $0xD6_L$
Offset	IN1 / IN2	Offset compensation of the respective analog inputs	$0x2F_L$ / $0xD7_L$
Cutoff	IN1 / IN2	Zero zone for analog command value presetting	0x50 / 0x53
Scale	IN1 / IN2	Scale factor of the respective analog inputs	$0x2F_H$ / $0xD7_H$
Ain scaled	IN1 / IN2	Analog command value presetting of the inputs Ain1 and Ain2	$0xD5_H$ / $0xD6_H$
M set (dig.)		Digital command value presetting of Iq-current	0x90
N set (dig.)		Digital command value presetting of the speed	0x31
Cutoff (dig.)		Zero zone for digital command value presetting	0x1E
Filter		Filter for actual speed value	0x5E
Speed controller values:			
N cmd (int)		Speed command value used (internal)	0x5D
N cmd (ramp)		Speed command value after ramp	0x32
N actual		Actual speed value signal for the control	0x30
N act (filt)		Actual speed value signal for the display	0xA8
N error		Control error actual speed value	0x33

Setting field Analog on the page **Speed**

Symbol:	Function:	Input1: (Ain1)	Input2: (Ain2)
Ain ein	Analog inputs 1 and 2	$0xD5_L$	$0xD6_L$
Offset	Offset compensation of the respective analog inputs	$0x2F_L$	$0x2F_L$
Zero zone	Zero zone for analog command value presetting	0x50	0x53
Scale	Scale factor of the respective analog inputs	$0x2F_H$	$0xD7_H$
Ain scaled	Analog command value presetting of the inputs Ain1 and Ain2 (Ain scaled = (Ain ON + Offset) x scale)	$0xD5_H$	$0xD6_H$

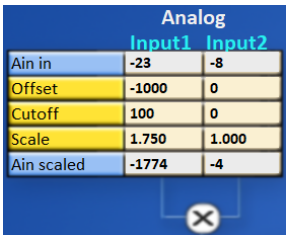


Fig. 13-3 - 00071

The measured analog input values of Input1 and Input2 are displayed in **Ain in$_{1,2}$**.
These signals are processed by means of the parameters offset $_{1,2}$, zero zone$_{1,2}$, and scale$_{1,2}$. The result is displayed in **Ain scaled$_{1,2}$**.
It is possible to select either the analog or the digital command value by means of the selection switch. If both switches are closed the digital and the analog command value are added. The sum at N cmd (int) is internally limited to ±32767.
The digital command values can be entered as digital speed (N set (dig.)), digital torque (M set (dig.)) or they are provided by the position controller directly via N fn (internal).

Command:	Green function:
Ena	Enable hardware
GO	Internal enable (output stage)
Lim-	Limit switch neg.
Lim+	Limit switch pos.
NcRO	Command value zero
Brk	Brake

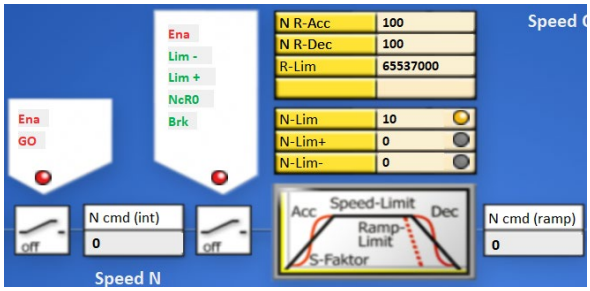


Fig. 13-4 - 00072

Setting field speed ramp on the page **Speed**

Symbol:	Function:	Range:	Unit:	ID address:
N R-Acc	Speed acceleration ramp	0..30000	ms	$0x35_L$
N R-Dec	Speed braking ramp	0..30000	ms	$0xED_L$
R-Lim	Emergency stop, limit switch ramp	0..1000	ms	$0xC7_L$

Setting field command value limits on the page **speed**

Symbol:	Function:	Range:	Unit:	ID address:
N-Lim	Speed limiting for the positive and negative rotation direction	0..100	%	0x34
N-Lim+	Speed limiting for positive rotation direction (if the logic input N clip(neg&pos) is activated)	0..100	%	0x3F
N-Lim-	Speed limiting for negative rotation direction (if the logic input N clip(neg&pos) is activated)	0..100	%	0x3E

Control panel 1:
The speed command value will only be processed, if the servo drive is Enabled (Ena) and the internal status (GO) is shown in a okay state (green). It will then be displayed in the field ‘speed command value‘ (N cmd (int)).

Control panel 2:
When the enable (Ena), the limit switches (Lim-, Lim+), not speed = 0, and not brake are switched (green), the speed command value (N cmd(int)) in the setting field (ramp) is processed.

Ramp field:
The acceleration ramp (N R-Acc), the deceleration ramp (N R-Dec), the limit switches emergency stop ramp (R-Lim), and the speed limits (N-Lim, N-Lim+, N-Lim-) are set. The result is shown in the display field ‘speed command value after ramp’ (N cmd (ramp)).
This processed signal (N cmd (ramp)) is used as input for the speed controller.

Speed controller parameters

Symbol:	Function:	Range:	Unit:	ID address:
Kp	Proportional amplification	0..200	Num	0x2C
Ti	Integration time (integral time constant	0..10000	ms	0x2D
Td	Differential time (differential component)	0..100	ms	0x2E
TiM	Max. value from the integral memory Ti	0..100	%	0x3B

The filtered actual speed value (N act (filt)) is displayed after the filter in the field actual speed value (N actual).

At the mixing point the actual speed value is subtracted from the speed command value.
The result is shown in the display field of the calculated speed error (N error).

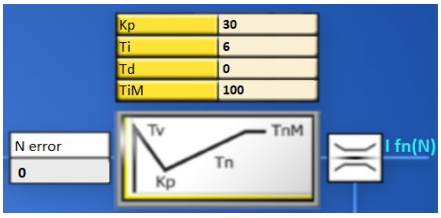


Fig. 13-5 - 00073

The speed correction error is processed in the speed controller (PID amplifier). The proportional amplification (Kp), the integral component (Ti), the differential component (Td), and the memory limit for the speed controller are set.

The output of the speed controller is the unprocessed current command value (I fn(N)).

13.2.1 Setting of the speed controller parameters (Kp ,Ti, TiM)

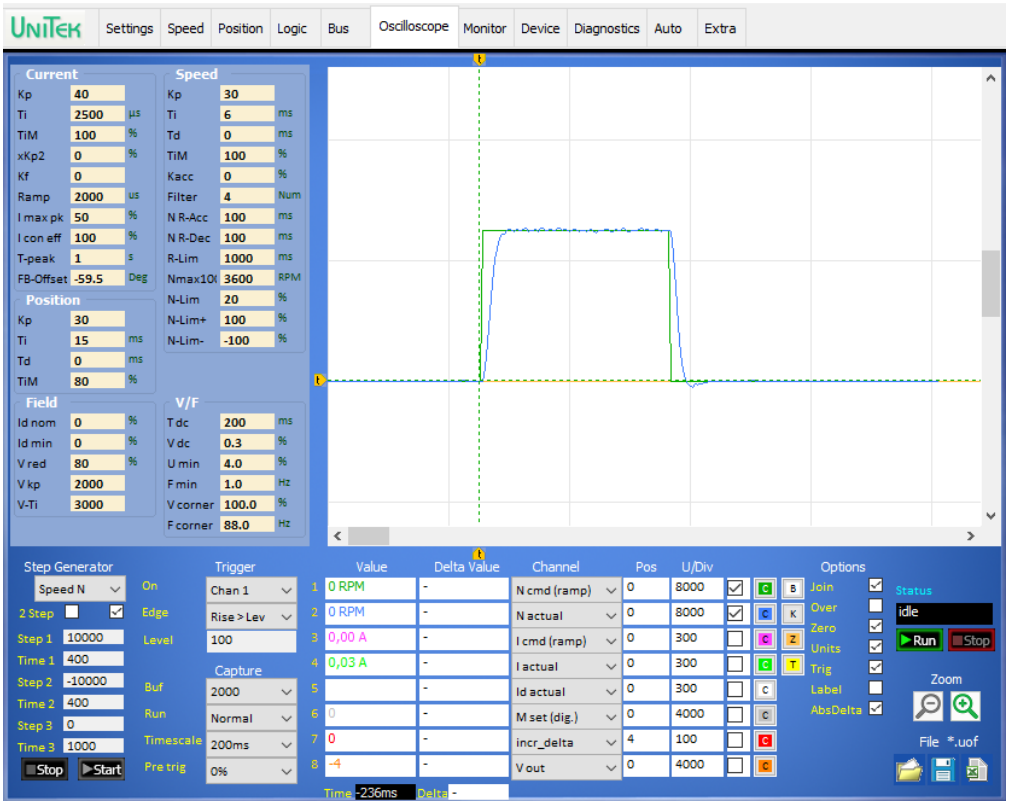


Fig. 13-6 - 00138

The setting of the speed controller is mainly determined by:

- the characteristics of the complete system (load, the frictional torque, and inertia of the drive).
- the power of the converter and motor used (the motor and the converter must be properly rated for the complete system).
- the requested control characteristics of the speed (smooth, aggressive, transient response).

Conditions:

- Handling of theNDrive oscilloscope (signals „N cmd (ramp)“ and „N actual“ as measuring channel).
- The motor should either be free-running or applying across a constant load.
- A steady RS232 communication in order to preset a digital command value and to keep records by means of the NDrive oscilloscope.
- The current controller parameters must only be modified by skilled personal.

Note:

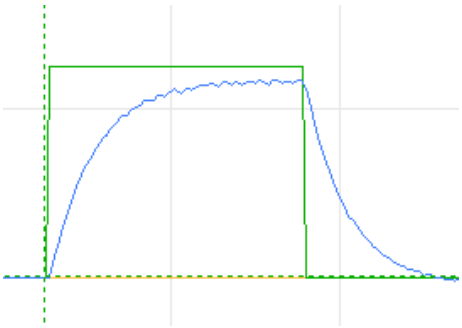
The following setting of the speed controller focuses on the general static complete system. For dynamic systems it is possibly necessary to make corrections.

Setting of the Kp value:

- Removing the integral component (TiM = 0 %)
- Set the requested speed ramp (N R-Acc = 10..10000 ms)
- Set the trigger on the NDrive oscilloscope to channel 1 (N cmd (ramp)), Rise > Lev 100
- Start the oscilloscope recording set a speed command value (example: 1000) (test or step generator), deactivate the converter (FRG = off), analyze the oscilloscope record

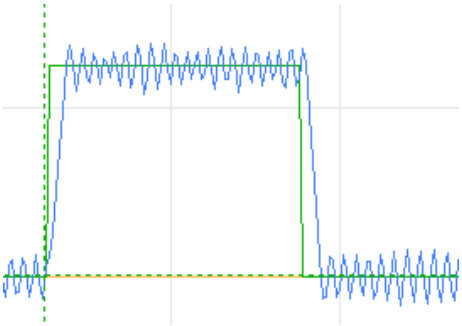
Kp value too low

1. The difference between the speed command value (Ncmd (ramp)) and actual speed value (N actual) is to large
2. The speed command value is not reached and the acceleration is too slow
3. The drive responds smoothly on command value modifications and can easily be moved at standstill



Kp value too high

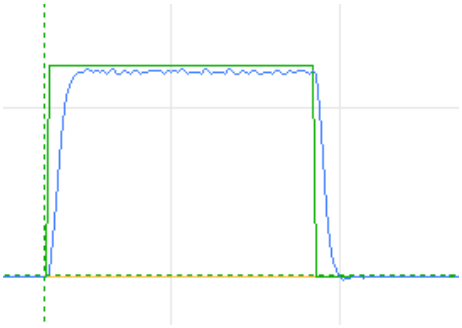
1. The actual speed value considerably overshoots the speed command value
2. Rough operation, strong tendency to vibrate (also at standstill), and motor noise



Correct Kp value

1. Actual speed value does not oscillate
2. The difference between the speed command value and th actual speed value is low (optimal: correction error < 5 %)

   The remaining residual error is corrected via the integral setting.

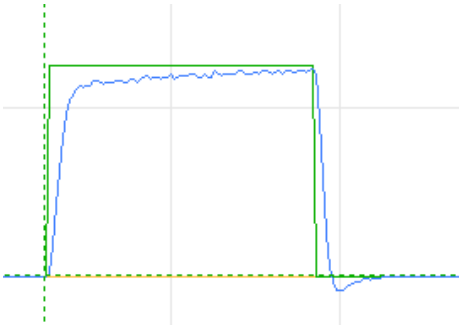


Setting of the Ti and TiM values:

- Maintain the determined KP value
- Adding the integral component (TiM = 0 %)
- Set the requested speed ramp (N R-Acc = 10..10000 ms)
- Set the trigger on the NDrive oscilloscope to channel 1 (N cmd (ramp)), Rise > Lev 100
- Start the oscilloscope recording set a speed command value (example: 1000) (test or step generator), deactivate the converter (FRG = off), analyze the oscilloscope record

Ti too high

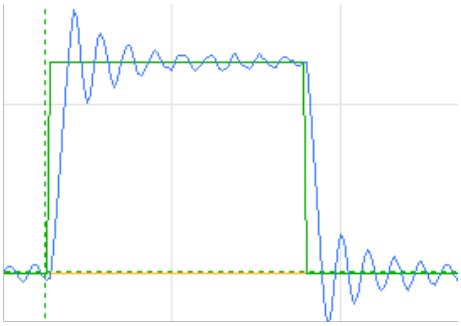
1. The control error is nearly not or too slowly compensated
2. Long-wave oscillations are possible



Ti too low

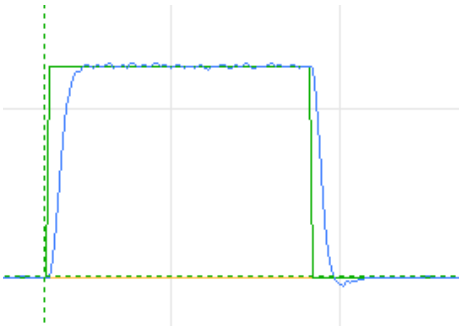
1. High and fast overshoot at the first command value step
2. Short-wave oscillations are possible

Note:
As Ti depends on Kp a subsequent adaption of Kp influences the behaviour of the integral component



Correct Kp and Ti values

1. Fast control of the fast command value step without any high overshoots as well as fast correction in case of command value changes
2. No long-wave or short-wave oscillations



Note:

- In case of fast load changes or near the voltage limit the system may become unstable
- Reduce the control error (overshooting) to minimum by means of the parameter ***TiM*** . Select the TiM value as small as possible.

14 Torque control

14.1 Torque control – Parameters

Parameters for the setting of the general current specifications, of the different ramp times for the speed and torque ramps and the various limit settings

Symbol:	Function:	Range:	Unit:	ID address:
M set (dig.)	Digital command value presetting of the Iq-current **→ Dig. torque command** (standardisation: 32767 ≙ I max pk (at 100 %))	±32767	Num	0x90
I set (dig.)	Digital command value presetting of the Id-current (standardisation: 32767 ≙ I max pk (at 100 %))	±32767	Num	0x21
N R-Acc	Speed – acceleration ramp	0..30000	ms	$0x35_L$
N R-Dec	Speed – braking ramp	0..30000	ms	$0xED_L$
M R-Acc	Torque – acceleration ramp [1]	0..4000	ms	$0x35_H$
M R-Dec	Torque – reduction ramp [1]	0..4000	ms	$0xED_H$
M R-Rcp	Torque – recuperation ramp [1,2]	0..4000	ms	$0xC7_H$
Nmax100%	Physical reference value for the internal resolution of the speed to 16 Bit (±32767)	100..50000	rpm	0xC8
N-Lim	Positive and negative speed limiting N-Lim = 100 % → pure torque operation [4] N-Lim < 100 % → torque cruze control active	0..100	%	0x34
N-Lim+	Current limit for the recuperating braking current (see function ‚automatic recuperation')	0..100	%	0x3F
N-Lim-	Current limit for the recuperating braking current (see function ‚automatic recuperation')	0..-100	%	0x3E
M out	Iq current → actual torque value (standardisation: 32767 ≙ I max pk (at 100 %))	±32767	Num	0xA0

[1] From FW476
[2] From FW476 only active if 0xCD Bit 4 = 1 is set
[3] For current (torque) command and N-Lim < 100 % the torque cruze control is activated
[4] The speed is limited only on the basis of the load and the dc bus voltage

14.2 Torque control – General information

- Actually, the torque control is a current command value presetting. The motor torque is formed on the basis of the motor constant of kt = Nm / 1 Arms which is generally unknown.
- The current command value can be formed either via the analog torque mode or via a digital command value presetting by M set (dig.) (0x90). Both methods specify the active current Iq.
- The reference for the current command value range always refers to 100 % of the possible device current ((±10 V or ±32767) ≙ I max pk (100 %))
- The current command value is directly transferred to the current controller via the torque ramps (M R-Acc, M R-Dec, M R-Rcp).

Note:
For a digital command value the last received data determines the control mode of either speed control mode via 'N set (dig.)' or a torque control mode via 'M set(dig.)'. Thus, it is possible to switch directly between the two different operation modes (example: Hill Hold).

Detailed information of the different setting possibilities for the torque control as well as of the different special functions such as automatic recuperating braking can be find in the additional manuals (NDrive folder \ manuals) „**Bamocar_FAQ.pdf**" and „**Information on special Car applications.pdf**".

14.3 Torque control – Torque cruze control

The torque cruze control is an operating mode at which a current command value is preset, however, the higher-ranking speed controller operation is still active and the current command value will be reduced in order to not exceed the configured speed limit. Thus, the torque cruze control mode is similar to a speed limiter in a vehicle.

N-Lim = 100 % (Torque cruze control deactivated):
- Pure torque (current) operation without intervention of the speed controller.
  → No limiting active.
  → No limiting on the basis of the speed ramps active.
- The speed is limited only on the basis of the applying load and the dc bus voltage.
  → Danger that the actual speed is superior to the 16 Bit resolution of N max100% (0xC8).
- Setting of the speed controller parameters not necessary.

N-Lim < 100 % (Torque cruze control activated):
- Torque (current) operation with intervention of the speed controller on the basis of the max. permitted speed.
- The setting of the speed ramps (N R-Acc, N R-Dec) is always active and provides for a torque operation with a specified acceleration.
  → Detailed considerations concerning the great number of different ramp possibilities is necessary.
- Setting of the speed controller parameters necessary.

Recommendation:
- During torque control always activate the torque cruze control logic (N-Lim = 99 %).
  Reason: loss of control during a sudden load change and speeding-up of the motor is avoided.
- Set the speed controller smoothly (Kp = 5, Ti = 400) so that the current control is smooth.
- Fast speed ramps (N R-Acc = N R-Dec = 10 ms) so that interventions are reduced to a minimum.

15 Position control

15.1 Position control parameters

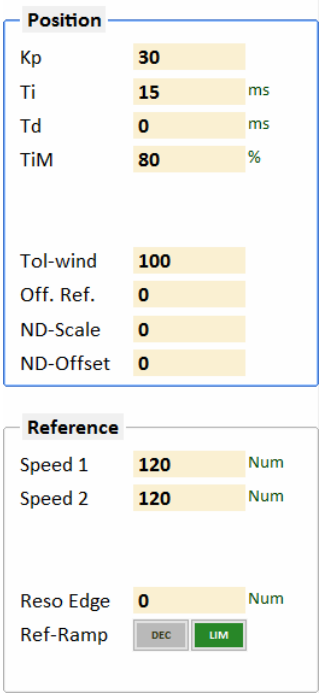


Fig. 15-1 - 00076

Parameters for the setting of the position controller

Note:
Many of these parameters and further ones are described on the pages **Position** and **oscilloscope**

Position control parameters:

Symbol:	Function:	Range:	Unit:	ID address:
Kp	Proportional amplification determines the slope of the deceleration ramp	0..200	Num	0x6A
Ti	Integration time (depending on Kp)	0..10000	ms	0x6B
Td	Differential time (differential component)	0..1000	ms	0x6C
TiM	Max. value from the integral memory Ti	0..100	%	0x71
The amplified position error forms the speed command value The position control is deactivated when Kp = 0 The dynamic control amplification Ti is only effective in the target range				

Reference run parameters:

Symbol:	Function:	Range:	Unit:	ID address:
Speed 1	Speed to the limit switch Depending on the speed the limit switch is passed	0..32000	Num	$0x76_L$
Speed 2	Reverse speed back to the zero pulse (cycle speed)	0..2000	Num	$0x77_L$
Reso Edge	Expected switching edge	0..65536	Num	0x75
Ref Ramp	Selection of the ramp for the reference run between N R-Acc and R-Lim	DEC / LIM		$0x5A_{Bit\ 5}$
The zero point of the incremental measuring system is determined by the reference run				

Positions Parameter:

Symbol:	Function:	Range:	Unit:	ID address:
Tol-wind.	Position tolerance window	0..2000	Num	0x79
Off.Ref.	Mechanic zero point offset		Num	0x72
ND-Scale	NDrive position display factor	32 Bit - 1	Num	0x7C
ND-Offset	NDrive position display offset	32 Bit - 1	Num	0x7D
Pos dest	Target position presetting	±32 Bit - 1	Num	0x6E
Pos cmd	Used target position (internal)	±32 Bit - 1	Num	0x91
Pos actual	Actual position value signal for the control	±32 Bit - 1	Num	0x6D
Pos error	Control error actual position value	±32 Bit - 1	Num	0x70
32 Bit - 1 → 2^{32} - 1 = 4.294.967.295 ±32 Bit - 1 → ±2^{32-1} - 1 = ±2.147.483.647				

Note:

- One motor rotation corresponds to the numeric value of 65536
- The position command values or the parameter values sent from the control via RS232 or CAN are immediately carried out

15.2 Position control – Structure

The structure screen of the position control with entry and display windows for the controller parameters is shown on the page **Position** for numeric values in ***Position Controller***

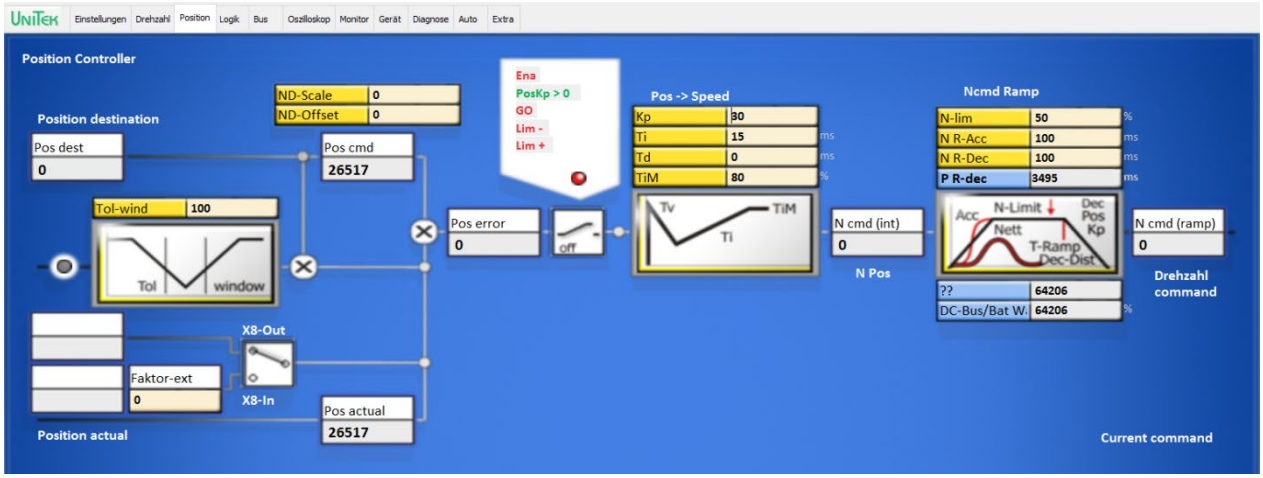


Fig. 15-2 - 00077

The position actual value (Pos actual) is subtracted from the position target value (Pos dest) at the mixing point. If the result is inferior to the set tolerance value (Tol-wind) it is signalled by the status signal in the tolerance window. At enable the position target value (pos dest) proceeds as position command value (pos cmd). The actual position value (Pos actual) is subtracted from the position command value (pos cmd) at the mixing point.

The result is shown in the display field 'speed error' (N error). When the messages (Ena, GO), the limit switches (Lim-, Lim+), and the position controller amplification are not set to zero (PosKp > 0) (green), the position error (Pos error) is processed in the position controller (Pos -> Speed).

For both controllers the proportional amplification (Kp), the integral components (Ti), the differential components (Td), and the memory limiting for the integral component (TiM) are set.

The output value of the position controller is the speed command value as internal function (N fn (internal)).

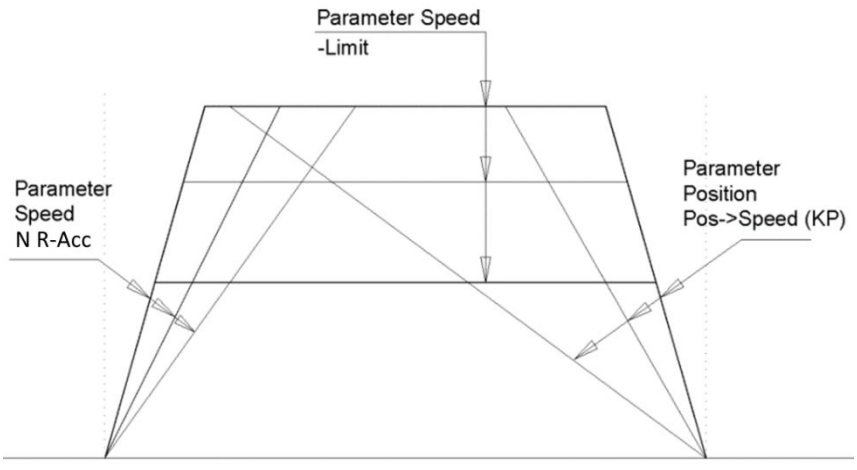


Fig. 15-3

15.2.1 Position controller settings

The amplified position error forms the speed command value

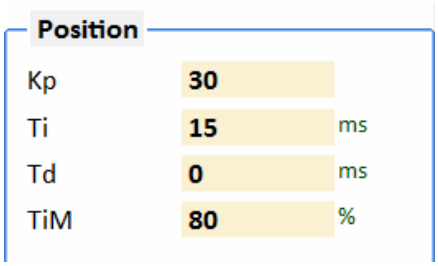
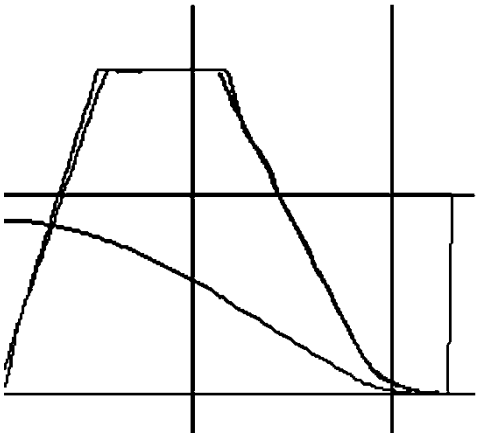


Fig. 15-4 - 00080

Proportional control amplification	
Kp	Proportional amplification position control circuit. Determines the slope of the deceleration ramp
Attention: The position control is switched off if no Kp value is entered	
Dynamic control amplification (only effective in target range)	
Ti	Integral component
Td	Differential component
TiM	Threshold integral component
P R-dec	Position target ramp time: Delay time of max. speed in ms

Diagram travel

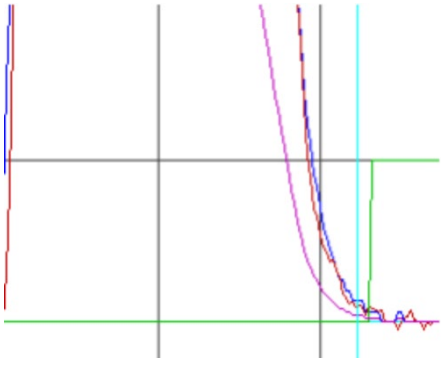


Setting travel

N R-Acc	Determines the acceleration ramp to the speed limit during a constant run
N-Lim	Determines the speed during a constant run
Kp	Determines the target ramp depending on the positions control error
P R-dec	Displays the deceleration time of 100 % speed to the position (speed zero)

- A low Kp amplification results in a long target ramp
- A high Kp amplification creates a short (steep) target ramp
- If the Kp amplification is too high the drive passes over the target position and vibrates in that position
  The optimal target ramp is as long as possible and as short as necessary

Diagram positioningg



Additional positioning

Tol-wind	Position tolerance window (numeric value) At **Pos-actual < Tol-wind** the output **O Toler** is set to 1 and displayed in the status **Tol**

Note:

- One motor rotation corresponds to the numeric value of 65555
- The position command values or the parameter values received via the RS232 or CAN are immediately carried out

15.2.2 Position controller – Additional information settings

Acceleration:

N R-Acc Acceleration time tb to max. speed in ms
Acceleration a=V/tb

Constant run:

N-Lim Speed limiting below the max. speed
Max. speed is 100 % (32767 Num)

Delay:

N R-Dec Set <10 ms for position control

Kp The slope of the delay results from the proportional amplification

Delay time:

T-Ramp **(tv)** from max. speed (32767 Num) to zero, indicated in ms on the page **Position**

Example for delay:
v = max. speed in m/s, tv = delay time (T Ramp) in s
v = 3 m/s, tv = 0.261 s

Delay a in m/s²:

$$a = \frac{v}{tv} \quad \rightarrow \quad a = \frac{3}{0{,}261}\ \frac{m}{s^2} = 11{,}5\ \frac{m}{s^2}$$

Amplification Kp from available speed and delay:

$$Kp = \sqrt{\frac{a*2603}{v}} \quad \rightarrow \quad Kp = \sqrt{\frac{11{,}5*2603}{3}}\ \% = \ 99{,}9\ \%$$

Ramp target distance:

$$s = \frac{v^2}{s*a} \quad \rightarrow \quad s = \frac{3^2}{2*11{,}5}\ m = 0{,}391\ m$$

15.2.3 Position control – Conversion of the units for the position

Pos-act.value range:	Resolver:	Incremental encoder:
Pulse/rpm Max. value ±2147483647 (31Bit-1)	65536 per rpm	65536 per rpm
Resolution (lowest value)	16 (65536/4096 (12Bit))	65536/Ink x 4
Example: Spindle drive with slope:: 5 mm/rpm	 Travel path: 1000 mm = 200 rpm → 200 rpm = 13107200 Resolution: 65536/4096 = 16	Incremental encoder: 2048 Imp/Upm Travel path: 1000 mm = 200 rpm → 200 rpm = 1638400 Resolution: 65536/8192 = 8

15.2.4 Position control – Position scaling

Scale the display factor for the position values for the NDrive presentation
The display of the values for Pos dest, Pos cmd, and Pos actual is set by means of the parameter ND-scale (0x7c, Pos-display factor) in the window 'position'.
At zero the display corresponds to the numerical value (1 motor revolution = 65536 num).

Adaption of the display to the feed value
Calculate the conversion factor necessary for converting the feed distance to motor revolutions.
For the display this factor must be multiplied by the constant 65536.000 (≙ 1.000 mm/rev).

Example 1: distance in mm
Displayed value in mm for *Pos dest*, *Pos cmd,* and *Pos actual*
Spindle slope = 5 mm
Gear i = 20

Conversion factor for one revolution 1/5 *20 = 4
Position display factor 65536.000* 4 = 262144.000
NDrive scale = 262144.000

Example 2: angle in degree
Displayed value in degree for *Pos dest*, *Pos cmd,* and *Pos actual*
Transmission: 1 degree = 10 motor revolutions

Conversion factor for one revolution = 10
Position display factor 65536.000* 10 = 655360.000
NDrive scale = 655360.000

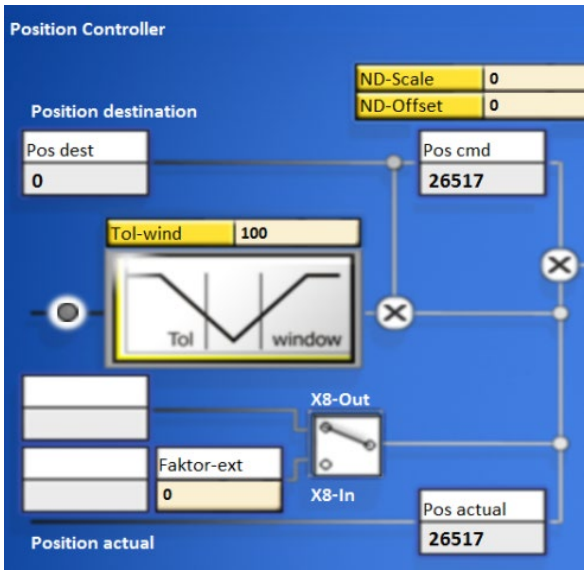


Fig. 15-5 - 00082

15.3 Position control – Reference run

15.3.1 Positioncontrol – Reference run structure screen

The structure screen with entry and display windows of the controller parameters for the reference run for position control is shown on the page **Position** for numeric values in ***Calibration run***

The reference run determines the zero point of the incremental measuring system

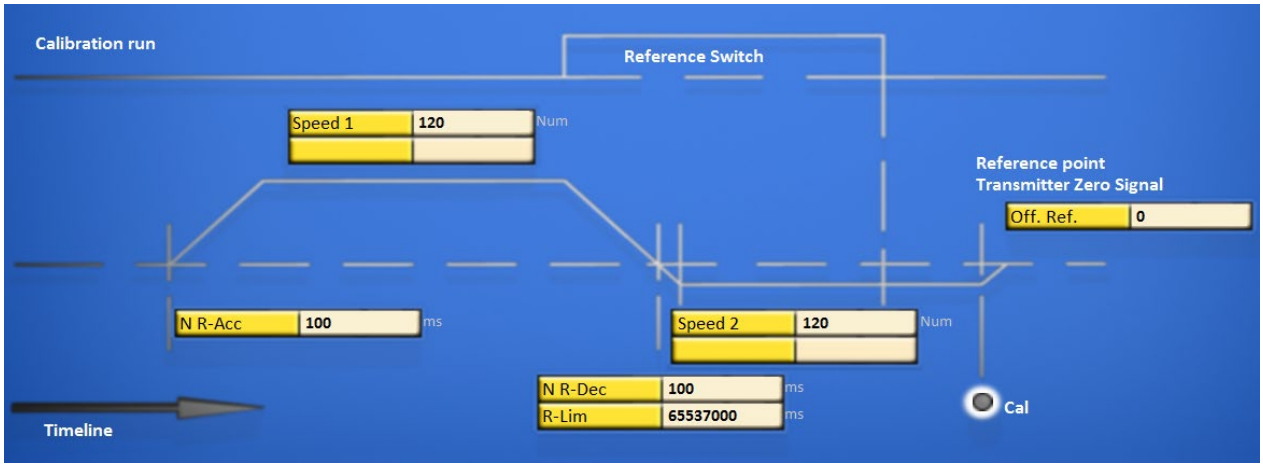


Fig. 15-6 - 00078

Symbol:	Function:	Range:	Unit:	ID address:
Speed 1	Speed to the limit switch Depending on the speed the limit switch is passed	0..32000	Num	$0x76_L$
Speed 2	Reverse speed back to the zero pulse (cycle speed)	0..2000	Num	$0x77_L$
Reso Edge	Expected swiching edge	0..65536	Num	0x75
N R-Dec	Speed braking ramp	0..30000	ms	$0xED_L$
R-Lim	Emergency stop, limit switch ramp	0..1000	ms	$0xC7_L$

The reference switches are selected in the parameter field ‘digital inputs‘. After the machine and the enable (RUN) are switched on the reference run ***(Start Ref Drive)*** is started via a digital input (Din1, Din2) or the interface (CAN-BUS, RS232 via the ID address 0x78 ≠ 0).

Note:
Driving commands such as Start Ref drive, N cmd (int), etc. are recognized only after 5 ms after the enable.
Close or send the enable first, then send the driving commands.

Reference run

The drive runs to the limit switch with ‘Speed 1’, passes the limit switch at loop speed ‘Speed 2’ and returns. With a reference switch the drive runs in a positive direction loop, and for a negative direction in a double loop. The device position zero point is set after the limit switch rising edge at the incremental encoder zero signal.
For the resolver the absolute value of the position (within half a motor revolution) is saved at the limit switch rising edge (Zero Capture).

The mechanical zero point can be shifted in positive or negative direction by means of the parameter ‘Off. ref.’.

Overview of the reference switches to specify a digital input:

Input selection:	Function:
Ref. & Limit Plus	Limit switch - positive rotation direction is the reference switch
Ref. & Limit Minus	Limit switch - negative rotation direction is the reference switch
Ref. Plus	The switch rising edge in positive rotation direction is the reference switch independently from the limit switches

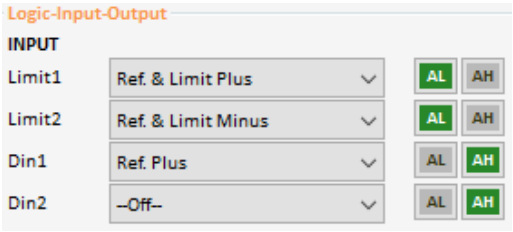
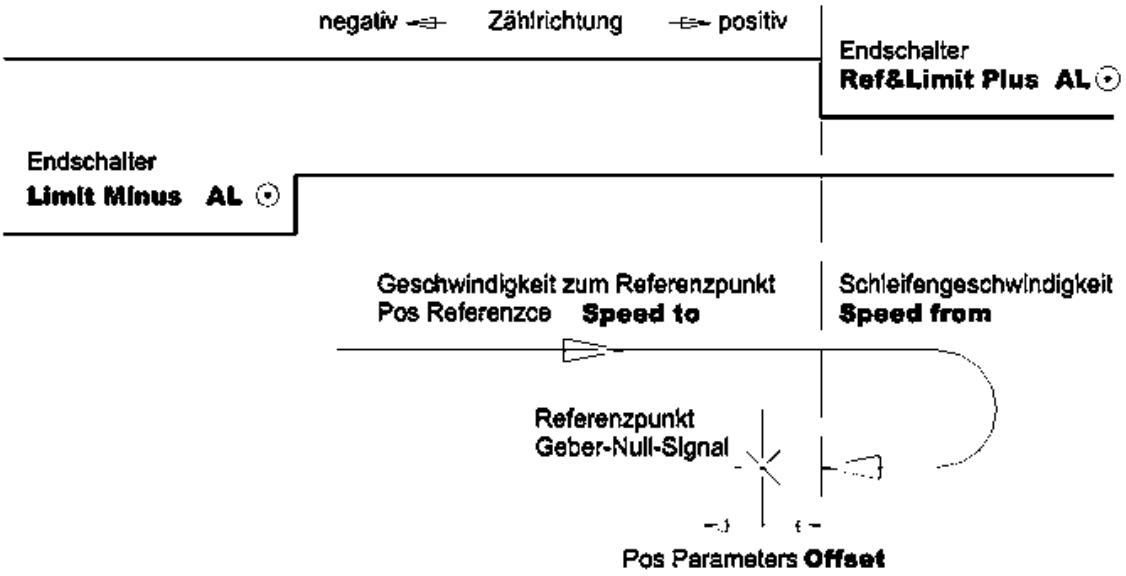
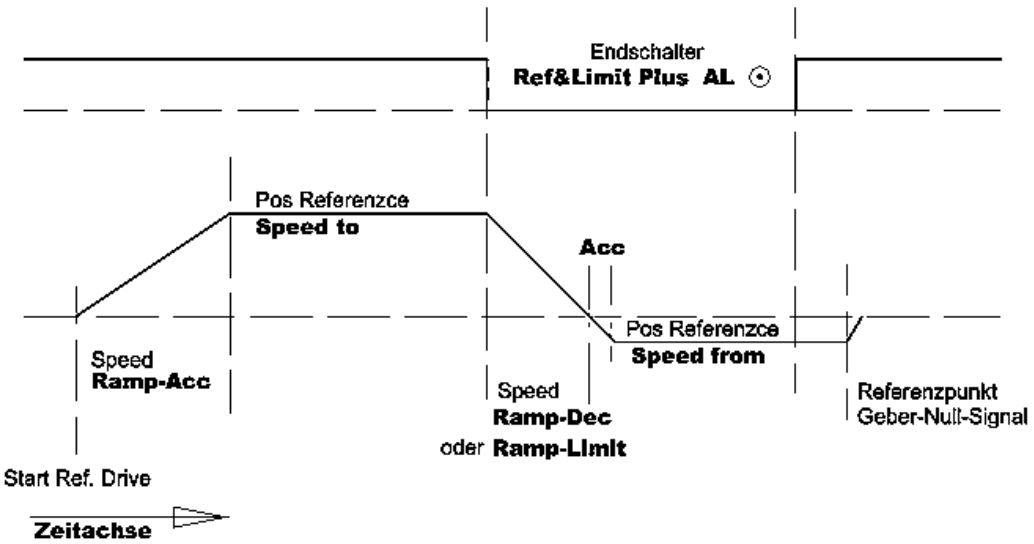


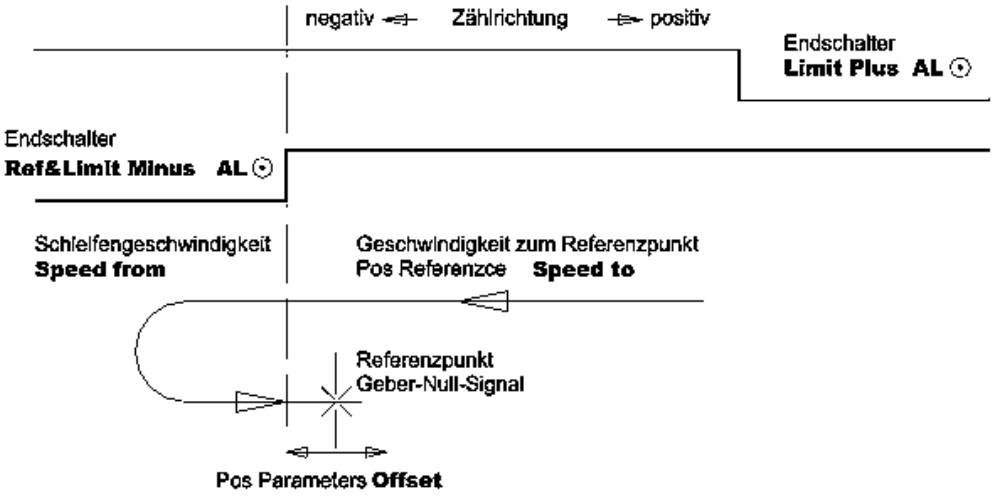
Fig. 15-7 - 00079

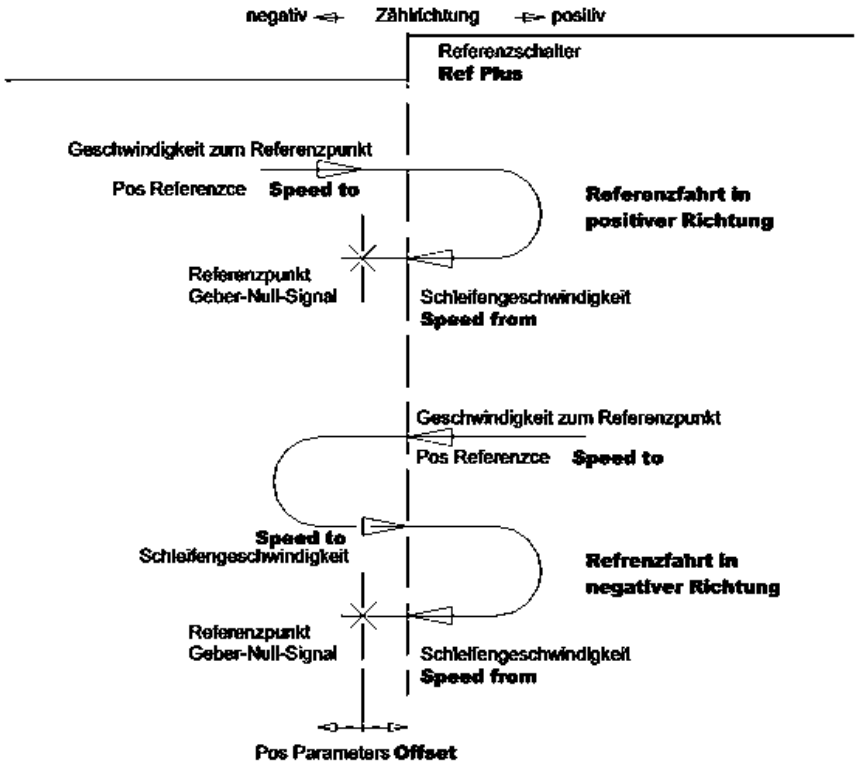
Via the selection window (parameter field servo) the delay is switched from R-Lim to N R-Dec when changing from Speed 1 to Speed 2.

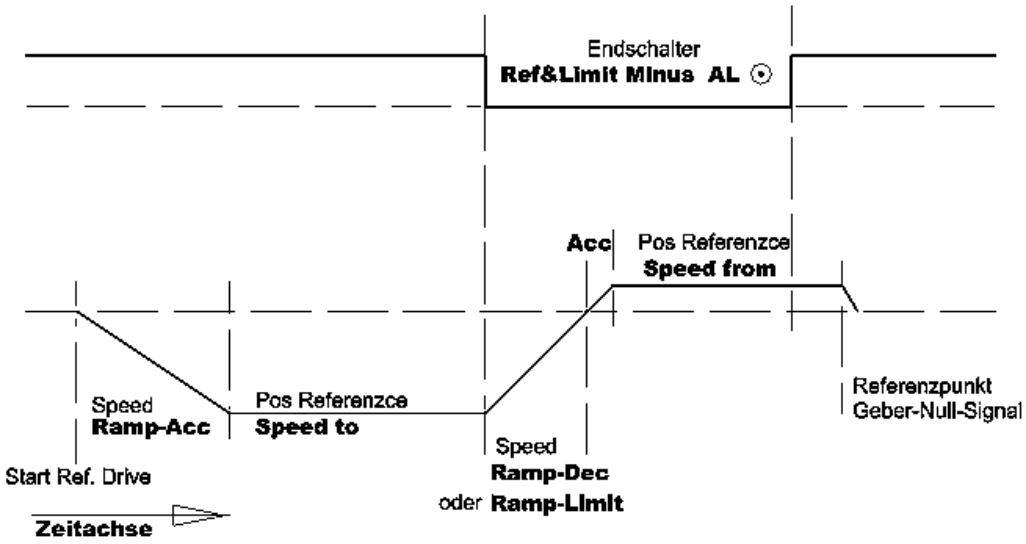
15.3.2 Position controller – Reference run logic diagrams



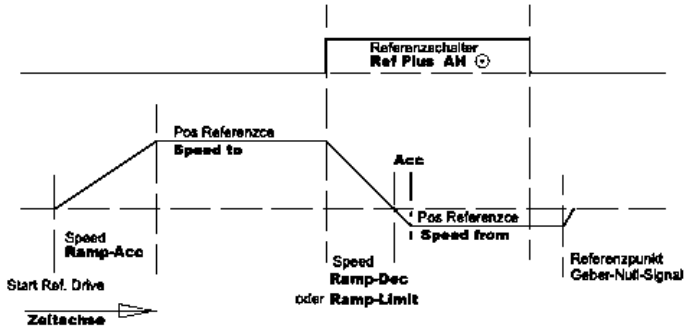



negativ
Zählrichtung
positiv
Endschalter
Limit Plus AL
Endschalter
Ref&Limit Minus AL
Schleifengeschwindigkeit
Speed from
Geschwindigkeit zum Referenzpunkt
Pos Referenzce Speed to
Referenzpunkt
Geber-Null-Signal
Pos Parameters Offset

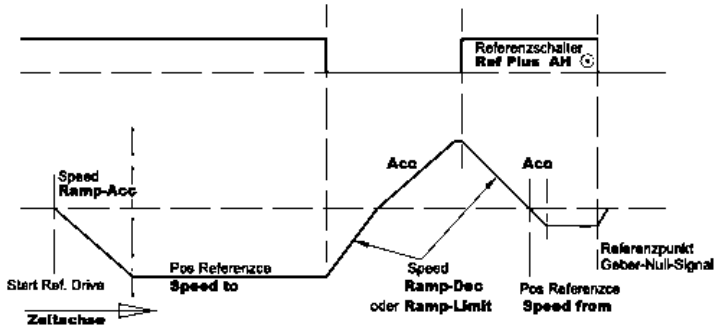

negativ
Zählrichtung
positiv
Referenzschalter
Ref Plus
Geschwindigkeit zum Referenzpunkt
Pos Referenzce Speed to
Referenzfahrt in
positiver Richtung
Referenzpunkt
Geber-Null-Signal
Schleifengeschwindigkeit
Speed from
Geschwindigkeit zum Referenzpunkt
Pos Referenzce Speed to
Speed to
Schleifengeschwindigkeit
Refrenzfahrt in
negativer Richtung
Referenzpunkt
Geber-Null-Signal
Schleifengeschwindigkeit
Speed from
Pos Parameters Offset



Zeitdiagramm Referenzfahrt auf Referenzschalter in positiver Richtung



Zeitdiagramm Referenzfahrt auf Referenzschalter in negativer Richtung



16 Field weakening control

16.1 Field weakening control – Synchronous motor in general

The field weakening mode at synchronous motors with surface magnets is only possible within a small range (max factor 1.2) and thus, economically not viable.

For synchronous motors with integrated magnets (salient-pole machines) it is possible to achieve speed ranges up to the factor 4. At optimal rating the motor and the servo can in this case be dimensioned smaller.

Caution:
If the field weakening (power supply switch-off, error switch-off, etc.) fails at maximum speeds, the motor can generate high induced voltages.
For devices connected to the power supply the threshold voltage is 400 V or 800 V.

For battery-driven devices the counter EMC voltage must always be inferior to the battery voltage.
If the devices or batteries have no external protective circuit they may be destroyed in case of motor overvoltages.

16.2 Field weakening control – Parameter setting

Parameters for the field weakening control

Symbol:	Function:	Range:	Unit:	ID address:
Id nom	Nominal Id-magnetizing current in % of the rated motor current (I nom eff) Recommended: 0 % at PMSM	0..100	%	0xB2
Id min	Min. magnetizing current in % of the rated motor current (I nom eff) Recommended: -50..-30 %	-100..0	%	0xB5
V red	Voltage reference value in % of V out (V red ≠ 0, 100 % → activation field weakening control) Recommended: 60..80 %	0..100	%	0x8B
V kp	Proportional amplification of the field weakening control Recommended: 500..4000	0..65535	Num	0x8C
V-Ti	Integral time of the field weakening control Recommended: 300..5000 Attention: tendency to vibrate	0..65535	Num	0x8D

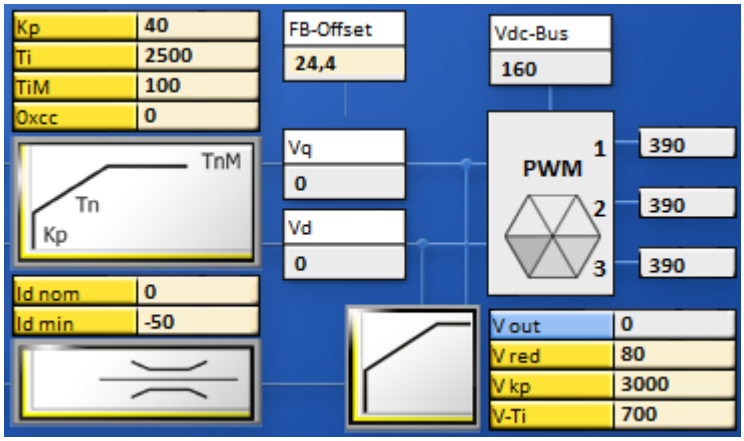


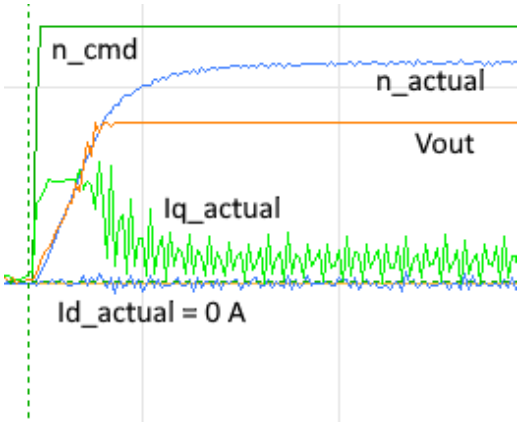
Fig. 16-1 - 00075

Without field weakening:

The speed (n_actual) does not reached the preset speed value (n_cmd) at max. possible output voltage (V out).

As usual with PMSM, the Id-current (Id_actual) is constantly controlled to 0 A.

First the Iq-current (Iq_actual) provides a respective torque for the acceleration and then drops to the max. possible value.



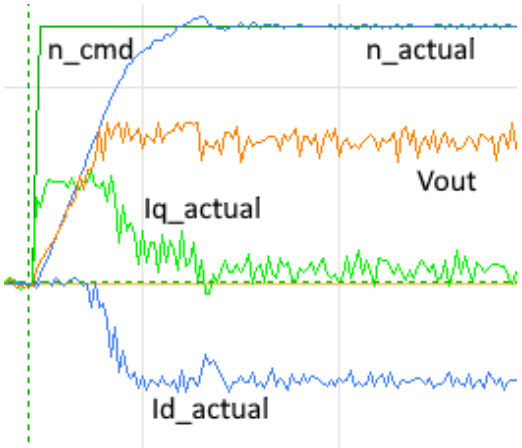
With field weakening :

The speed (n_actual) reaches the preset speed value (n_cmd) at max. possible output voltage (V out)).

The Id-current (Id_actual) is compensated during the field weakening to the value Id_ref which is preset by the field weakening controller.

For motors with surface magnets a high Id current flows for only a small increase in speed.

Here again the Iq-current (Iq_actual) provides a respective torque for the acceleration and then drops to the necessary resp. still available value.



Attention:
The field weakening control is no patent solution for a poorly rated system.

Although the speed can be increased the torque is reduced to a very low value due to the physical characteristics of a PMS motor. That is, the motor is less powerful during field weakening operation despite a high current consumption.

The additional provided reactive current (Id_actual) leads to strong heating of the motor and, despite a very low active current (Iq ≙ torque), the current consumption is very high due to the additional current component.
Meaning that for a system with a HV battery (e.g. vehicle) the battery capacity will be reduced much faster (and thus, the range).

17 Frequency converter operation (ACI v/f)

17.1 Frequency converter – Parameter setting of the FU characteristic curve

Parameters of the frequency converter characteristic curve of **FU Start**

Symbol:	Function:	Range:	Unit:	ID address:
FU start				
T dc	Pre-magnetizing time Delay between the switching-on and the starting of the frequency	10..2000	ms	$0x07_L$
U dc	Pre-magnetization dc voltage value	0..20	%	$0x08_L$
U min	Minimal voltage (boost) at motor standstill → U/F Kennlinie wird angehoben Recommended: U min = U dc	0..100	%	$0x0A_L$
F min	Minimal frequency at motor standstill	0..100,0	Hz	$0x0B_L$
V corner	Maximal output voltage at base freuquency	0..100,0	%	$0x0C_L$
F corner	Base frequency for max. output voltage	1..1000,0	Hz	$0x0D_L$
F-sh	Characteristic curve shape (linear, semi-square, square)			

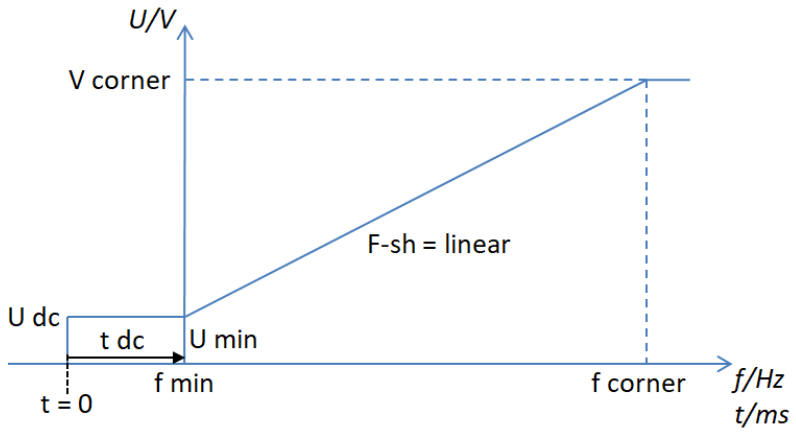


Fig. 17-1 - 00133

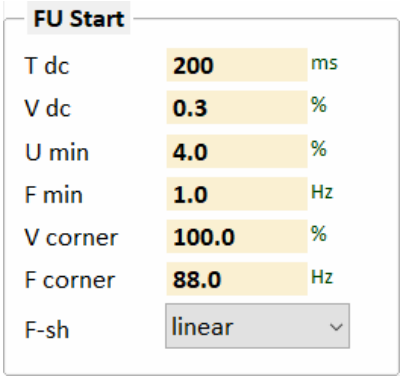


Fig. 17-2 - 00085

Note:
Currently in NDrive only the parameter field FU start of the characteristic curve for the frequency converter is in use. The characteristic curve for FU stop is the same as for FU start.

17.2 Frequency converter – Motor parameter setting

A frequency control without a feedback encoder can be configured via the setting field for the frequency converter in the field 'motor'.

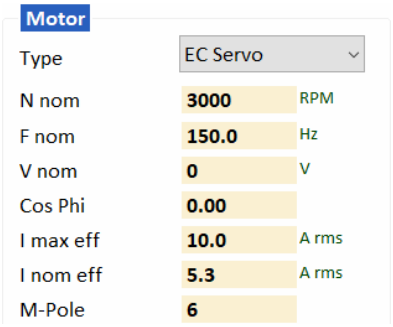


Fig. 17-3 - 00083

For standard motors with mains operation the data for 50/60 Hz operation and star-delta circuit are often written on the type plate. These data are internationally standardized.
For motors with converter mode the rated operating point is at a fixed frequency usually above the 50/60 Hz power supply frequency.
Further data are not always completely indicated by the manufacturers.

Partly the rated speed at the rated operating point (rated frequency, rated load) is not indicated or the data for cosphi is not indicated. Partly the values are unclearly specified, e.g. voltage refered to phase to phase (terminal voltage) or the phase voltage (terminal to star point) or dc bus voltage. Please check the manufacturer data and dimensions carefully (V, VAC, VDC, A, Arms, etc.).

Rated data:	Symbol:	Motor example 50Hz:	Motor example 60Hz:	Unit:
Mains frequency	F nom	50	60	Hz
Rated voltage	U nom	220-240, 360-420	255-275, 440-486	V
Rated current	I nom eff	2.33-2.25, 1.35-1.30	2.26-2.18, 1.30-1.26	A rms
Rated speed	N nom	2820	3385	rpm
Cosphi	Cos Phi	0.85	0.85	

It is possible to determine further values for the motor model by means of the drive internal function 'calc from motplate' and using the above mentioned rated data (→ page **Auto).**

The updating of the display in NDrive is effected by the offline-online process (that is, switching off and on again the RS232 communication).

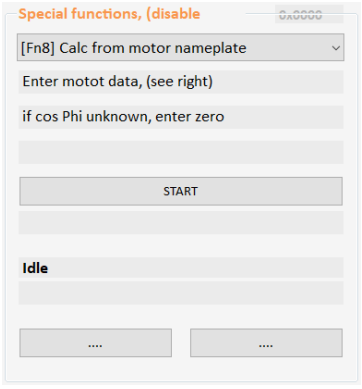


Fig. 17-4 - 00084

Activation of the frequency converter operation:

1. Select „**ACI V/f**" as motor type on the page ‚settings'.
2. Select „**SLS**" as feedback type.

Note:
At frequency converter operation there is no slip compensation during the control of an AS motor without encoder response.

18 Logic

18.1 Logic – General overview

Entry field for the digital inpits (INPUT) and the digital outputs (OUTPUT) in NDrive on the page **Logic**

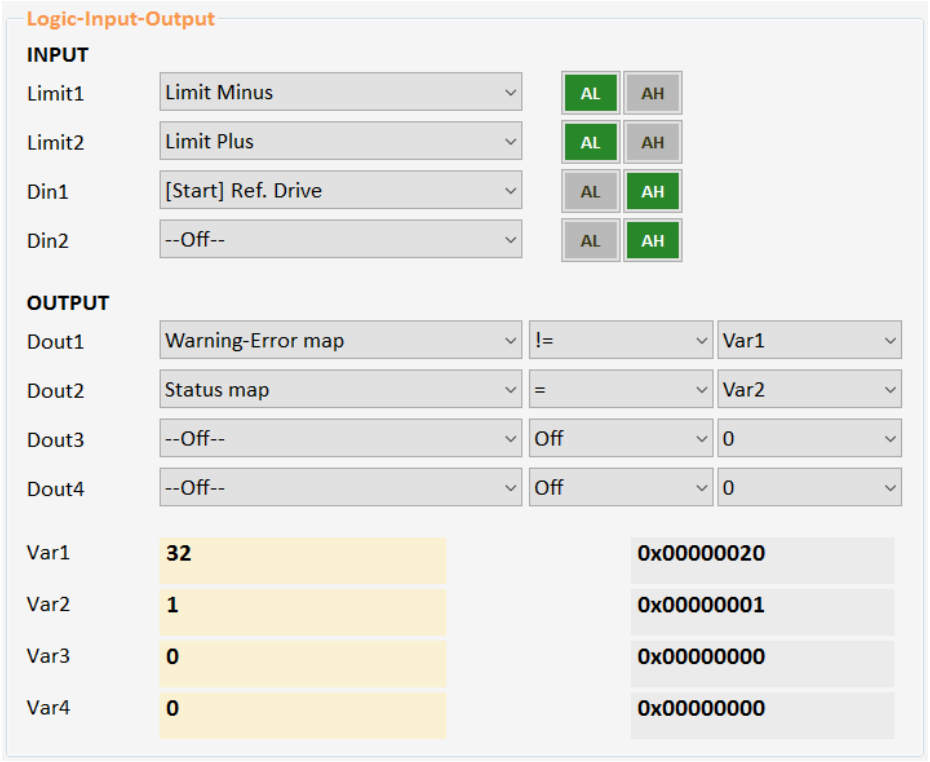


Fig. 18-1 00087

INPUT:	
Limit1	Programmable digital input, preferably as output stage switch and reference switch
Limit2	Programmable digital input, preferably as output stage switch and reference switch
Din1	Programmable digital input
Din2	Programmable digital input

OUTPUT:	
Dout1	Programmable digital output (operant and comparison variable)
Dout2	Programmable digital output (operant and comparison variable)
Dout3	Programmable digital output (operant and comparison variable)
Dout4	Programmable digital output (operant and comparison variable) (Dout4 is not available for all units)
Var1 bis Var4	Comparison variable

18.2 Logic – Digital inputs

18.2.1 Logic – Digital inputs in general

In general it is possible to read the applied logic level of each digital input.

In addition it is possible to assign a great variety of special functions to each individual digital input.

The selection of the special functions is carried out via the respective pull-down menu.

These special functions are triggered by the logic level of the digital input in dependence on the configuration conditions (AL / AH).

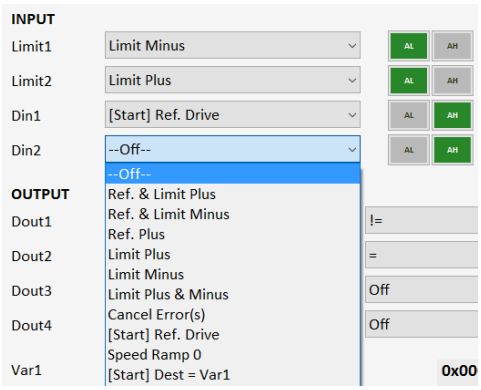


Fig. 18-2 - 00088

The setting of the activation conditions for the special functions is effected via the switches AL = active low and AH = active high.

The functions are written to the RAM and carried out by means of the return key.
By saving the data on the Eprom level 0 the settings are permanently saved and they are applied after a restart.

The output stage switches Limit1, Limit2 are displayed in the status field with Lim+ and Lim-.
They can also be configured for other functions.

Example:

INPUT:	Selection:	Function:	Acv. Logic:
Limit1	Ref. & Limit Plus	Output stage switch positive directionis the reference switch	AL
Limit2	Limit Minus	Output stage switch negative	AL
Din1	[Start]Ref. Drive	Start reference run	AH

Note:
All digital inputs have an internal pull-down resistance and thus, it is not necessary to connect them to a ground if not used.

18.2.2 Logic – Digital inputs configuration overview

Overview of the configuration possibilities resp. of the special functions of a digital input (INPUT)

INPUT:	Function:
Ref. & Limit Plus	Limit switch positive direction is also the reference switch
Ref. & Limit Minus	Limit switch negative direction is also the reference switch
Ref. Plus	Reference switch positive direction
Limit Plus	Limit switch positive direction
Limit Minus	Limit switch negative direction
Limit Plus &.Minus	Limit switch positive and negative direction
Cancel Error(s)	Delete error memory
[Start]Ref. Drive	Start reference run
Speed Ramp 0	Speed command value internally switched to 0 (during speed 0 active)
[Start] Dest > Var1	Position variable1 is started
[Start] Dest > Var2	Position variable2 is started
N cmd Reverse	Command value polarity is switched over
[Preset] Pos = Var3	Actual position value is set to variable3
[Capture] Var3 = Pos	Sets the variable 3 as position (target) and travels to the position
[Capture] Var4 = Pos	Sets the variable 4 as position (target) and travels to the position
[Switch] Spd = !Ain1/Ain2	Switching-over command ‘command value Ain1 or Ain2‘
[Switch] Spd = !Var1 /Var2	Switching-over command ‘command value Var1 or Var2‘
I limit (dig.)	Current limiting to the parameter setting of I limit dig
N clip (neg. & pos.)	Speed limiting to the parameter setting of N-lim+ and N-lim-
[Switch] Cmd = !Dig/Ana	Switch-over command digital + analog command value setting (command mode digi + ana speed)
Speed Ramp 0 + Pos	Positioning to a position within a motor rotation (pos = Reso Edge)
Handrad	Incremental command value from the hand-wheel encoder (2nd counter input)
Brake Car [1]	Regenerative braking function #1 Current setting at N-Lim+ and N-Lim-
recu_disab	Regenerative braking function is switched off
rising bank1, falling bank2	PARA_UPDATE
[Start] Dest = Var1,2,3,4	Position command value resulting from the variable sum of var1 to var2 is started
[Start] cw = Var1,2,3,4	Cw_kombi
Brake Car #2 [1]	Regenerative braking function #2 Consideration of the delta deviation of the analog input for the braking power

[1] see „Information on special car applications.pdf”

18.3 Logic– Digital outputs

18.3.1 Logic – Digital outputs in general

In general it is possible to configure the logic level of each digital output in many ways

A known measured variable is used as reference for the configuration (1st column)). It can be compared in many ways with the user-defined variables by means of operands (2nd column) in order to output the correspondingly requested logic level.

The selection of the measuring value as reference, the operands, and the comparison variables is carried out via the respective pull-down menu.

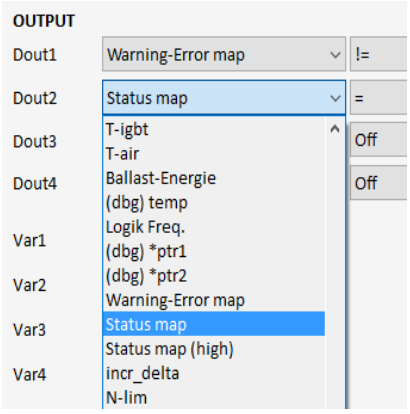


Fig. 18-3 - 00089

The value of the comparison variables is carried out via the entry in the respective entry field for Var1, Var2, Var3, and Var4.

The logic result is output across the digital output as low (< 1 V) or high (> 10 V).

The functions are written to the RAM and carried out by means of the return key.
By saving the data on the Eprom level 0 the settings are permanently saved and they are applied after a restart.

Note:
Switched inductances (Relays, brakes, etc.) must always be provided with a connected overvoltage protection by means of recovery diodes or varistors. The output driver is switched off in case of overvoltage.

18.3.2 Logic – Digital outputs configuration

Configuration posibilities of a digital output

OUTPUT:	Function:	ID address:
I cmd	Current (I) command value (Speed controller output)	0x26
I actual	Current(I) actual value	0x20
N cmd (ramp)	Speed command value	0x32
N actual	Speed actual value	0x30
Pos cmd	Position command value	0x6E
Pos actual	Position actual value	0x6D
N error	Speed error	0x33
Pos error	Position error	0x70
T Motor	Motor temperature	0x49
…	…	…
All parameters of the list ‘measured value selection' can be assigned to the respective outputs		

Operand:	Function:
Off	always off
On	always on
1Hz	pulsed with f = 1 Hz
=	equal
!=	not equal
>	superior to
<	inferior to
abs >	absolut value superior to
abs <	absolut value inferior to
tol >	tolerance input TOL-wind
Tol <	tolerance input TOL-wind
>=	superior or equal to
<=	inferior or equal to
hyst >=	hysteresis at >=
Hyst <=	hysteresis at <=
window	tolerance window +/-25 %

Variable:	Function:	ID address:
0	Logic signal 0	
1	Logic signal 1	
Var1	Numerical value of the entered variable fields	0xD1
Var2		0xD2
Var3		0xD3
Var4		0xD4
Ain1	Numerical value of the voltages across the analog inputs	
Ain2		

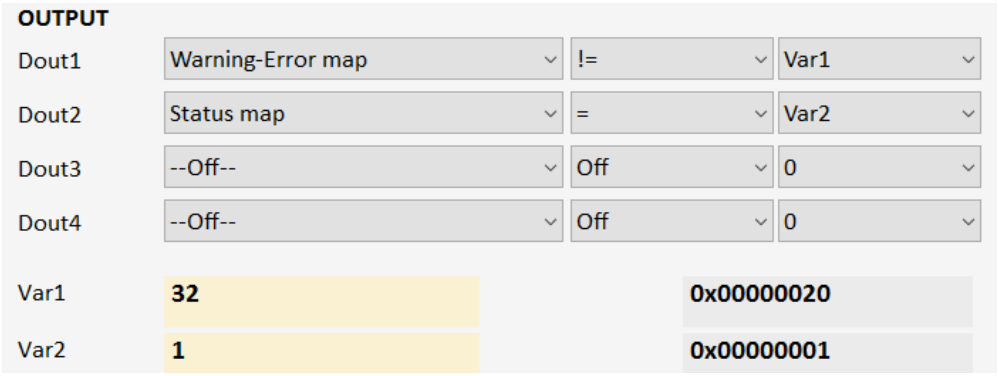


Fig. 18-4 - 00090

Example 1: Configuration of the error „missing power supply voltage“ to a digital output

The aim is:
The output Dout1 should output a high (> 10 V) logic level when the power supply voltage is switched on or if no error 5 (POWERVOLTAGE, power supply voltage missing) is applying.

- Assign the signal (**Warn-Err map**) to the ouput **Dout1** via the pull-down menu.
- Set the operand to (**!=**)
- (**Var1**) is selected as comparison variable
- Enter the decimal value **32** in the entry field for **Var1** for the query of error 5 of the error information (**$0x8F_{Bit\ 5}$**). It is also possible to send a query to a combination of several bits.

Example 2: Configuration of the Status information „Ena“ to a digital output

The aim is:
The output Dout2 should output a high (> 10 V) logic level when the converter is active.
If a voltage via the motor lines is actively output by the PWMs the status information Ena ($0x40_{Bit\ 0}$) is set.

- Assign the signal (**Status map**) to the ouput **Dout2** via the pull-down menu.
- Set the operand to (**=**) (inverted to (!=))
- (**Var2**) is selected as comparison variable
- Enter the decimal value **1** in the entry field for **Var2** for the query the status information Ena ($0x40_{Bit\ 0}$). It is also possible to send a query to a combination of several bits.

19 Diagnostics

19.1 Diagnostics – General overview

The page **Diagnostics** in NDrive is an information window for the display and the manual reading of signals and the setting of parameters

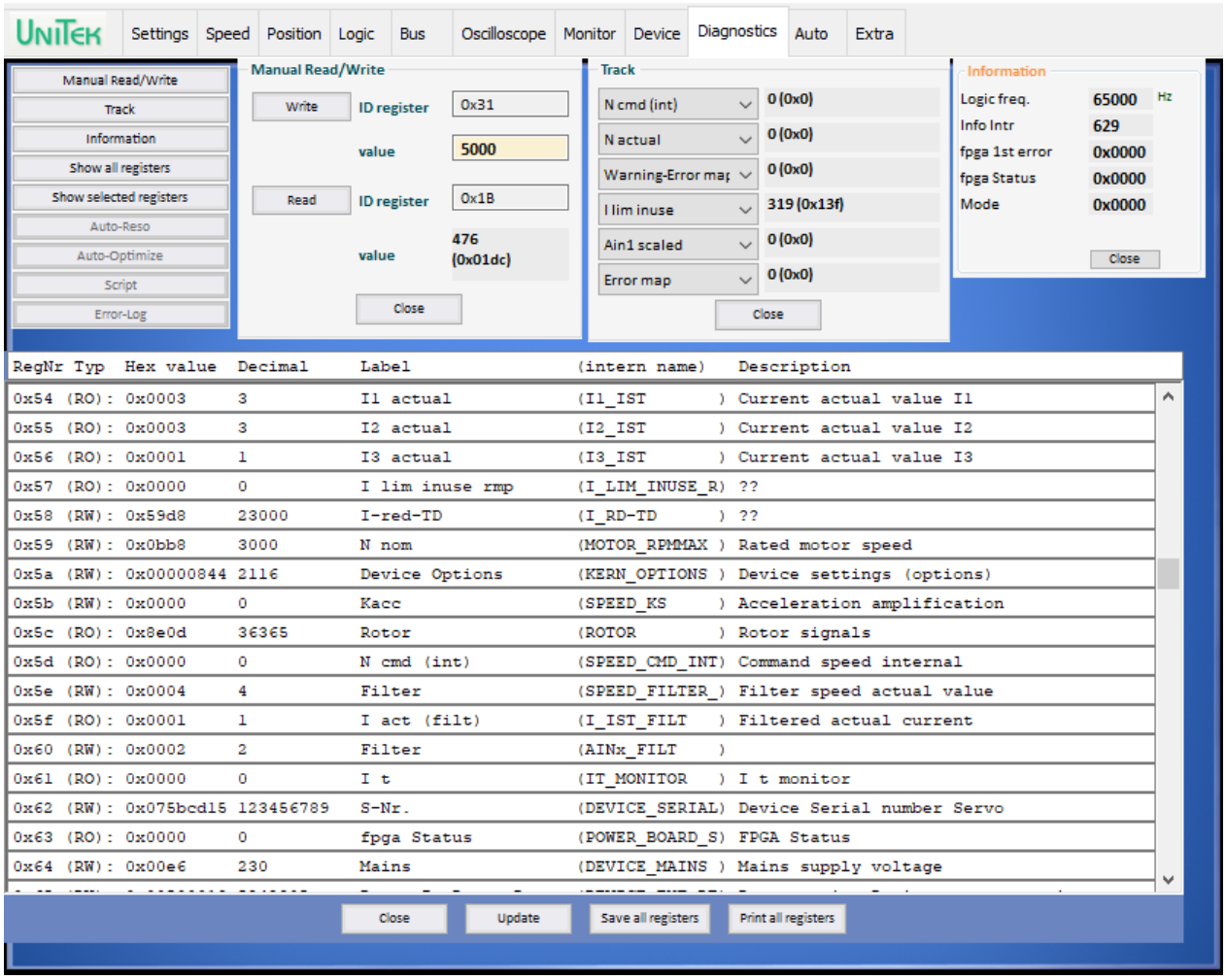


Fig. 19-1 - 00096

Overview of the windows on the page **Diagnostics**

Manual Read / Write	Direct reading or writing of the parameter values to specified ID addresses
Track	Display of the numeric values of the selected parameters
Information	Information about transfer errors
Show all registers	List of all registers
Show selected registers	List of selected registers
Auto-Reso	not yet installed
Auto-optimize	not yet installed
Error history	not yet installed
Script	not yet installed

19.2 Diagnostics – Manual Read/Write

Direct reading and writing of parameter values (Note: only for service!)

Writing of parameters:

- Enter the ID address into the input field **ID register.**
- Enter the value for the selected ID address in the input field value (numeric or as hex value).
- Click the **Enter** key or on the **Write** button.
  The new values are immediately updated.

Reading of parameters:

- Enter the ID address into the input field **ID register**
- Click the **Enter** key or on the **Read** button.
  The contents of the ID register is displayed in the field 'value' (numeric or as hex value).

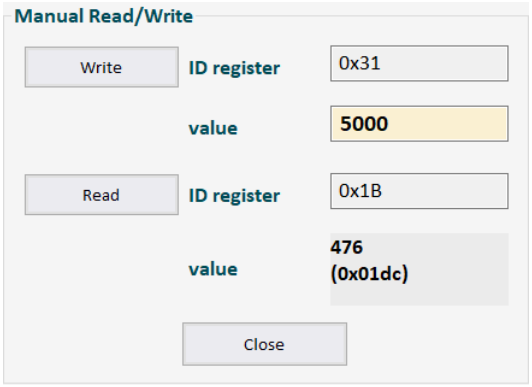


Fig. 19-2 - 00091

19.3 Diagnostics – Track

Display of the automatic periodical reading of up to 8 different selected measuring or parameter values.
(Note: only for service!)

The respective variable is selected via the pull-down menu.

All values are displayed numerically and as hex-values (0x..).

Note:
All measured values can also be displayed inside the oscilloscope.

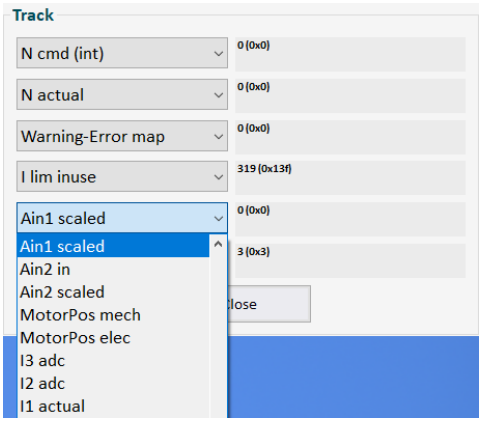


Fig 19-3 - 00092

19.4 Diagnostics – Information

Display field for current states of special signals

Symbol:	Function:
Logik Freq.	Speed of the foreground program
Info Intr	Actual speed value error
fpga 1. error	First recorded error code of the Ecode signal
fpga status	Current error code of the Ecode signal
Mode	Mode bit setting (0x51)

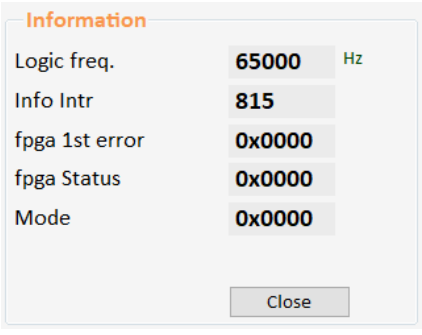
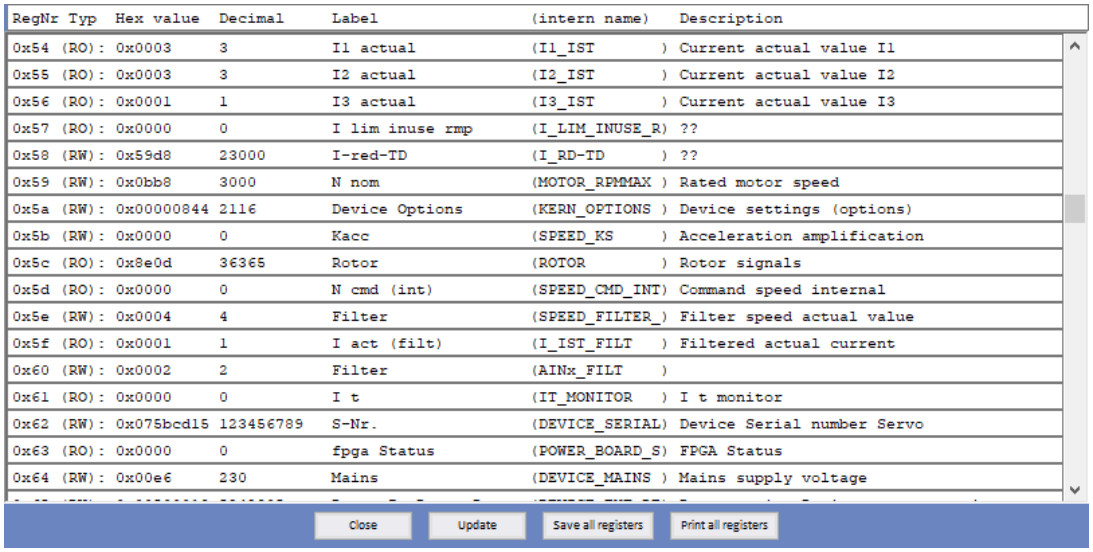


Fig 19-4 - 00093

19.5 Diagnostics – Register display

List display of all or only selected no. of variables
(no periodical update, only one-time update)



RegNr	Typ	Hex value	Decimal	Label	(intern name)	Description
0x54	(RO):	0x0003	3	I1 actual	(I1_IST)	Current actual value I1
0x55	(RO):	0x0003	3	I2 actual	(I2_IST)	Current actual value I2
0x56	(RO):	0x0001	1	I3 actual	(I3_IST)	Current actual value I3
0x57	(RO):	0x0000	0	I lim inuse rmp	(I_LIM_INUSE_R)	??
0x58	(RW):	0x59d8	23000	I-red-TD	(I_RD-TD)	??
0x59	(RW):	0x0bb8	3000	N nom	(MOTOR_RPMMAX)	Rated motor speed
0x5a	(RW):	0x00000844	2116	Device Options	(KERN_OPTIONS)	Device settings (options)
0x5b	(RW):	0x0000	0	Kacc	(SPEED_KS)	Acceleration amplification
0x5c	(RO):	0x8e0d	36365	Rotor	(ROTOR)	Rotor signals
0x5d	(RO):	0x0000	0	N cmd (int)	(SPEED_CMD_INT)	Command speed internal
0x5e	(RW):	0x0004	4	Filter	(SPEED_FILTER_)	Filter speed actual value
0x5f	(RO):	0x0001	1	I act (filt)	(I_IST_FILT)	Filtered actual current
0x60	(RW):	0x0002	2	Filter	(AINx_FILT)	
0x61	(RO):	0x0000	0	I t	(IT_MONITOR)	I t monitor
0x62	(RW):	0x075bcd15	123456789	S-Nr.	(DEVICE_SERIAL)	Device Serial number Servo
0x63	(RO):	0x0000	0	fpga Status	(POWER_BOARD_S)	FPGA Status
0x64	(RW):	0x00e6	230	Mains	(DEVICE_MAINS)	Mains supply voltage

Fig. 19-5 - 00094

Options for register display field:

Selection:	Function:
Show all registers	All 255 registers are shown in a table. The register contents cannot be modified.
Show selected registers	Only the registers which are important for the user are display in a table. The registers can be selected via the textfile “reglist.txt”. → ‘…\NDrive2-Software\settings\reglist.txt‘ The register contents cannot be modified.

Selection of the options in the footer:

Selection:	Function:
Close	Display field is closed.
Update	The parameter values are read again from the servo.
Save all/selected registers	All / the selected registers are written into a file.
Print all/selected registers	All / the selected registers are printed.

20 Monitor

20.1 Monitor – General overview

Overview of the displayed signals on the page **Monitor**

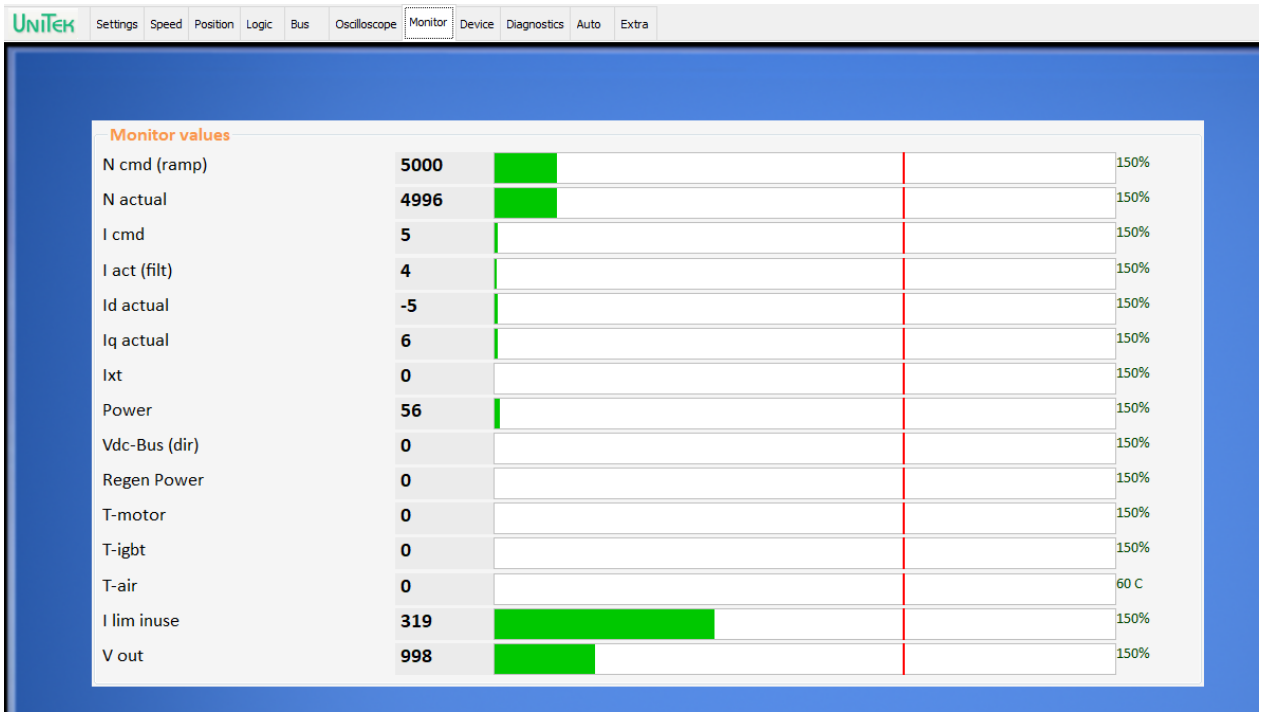


Fig. 20-1 - 00095

Symbol:	Function:	Range:	Unit:	ID address:
N cmd (ramp)	Speed command value after ramp and limit	0..32767	Num	0x32
N actual	Actual speed value	0..32767	Num	0x30
I cmd	Current command value (internal)	0..600	Num	0x26
I act (filt)	Present sum current after display filter	0..600	Num	0x5F
Id actual	Present reactive current (Id)	0..600	Num	0x28
Iq actual	Present active current (Iq)	0..600	Num	0x27
Ixt	Capacity Ixt	0..4000	Num	$0x45_L$
Power	Motor power (DO NOT USE!)	0..4000	Num	0xF6
Vdc-Bus (dir)	Bus circuit voltage	0..32767	Num	0xEB
Regen Power	Ballast power	0..4000	Num	$0x45_H$
T-motor	Present motor temperature	0..32767	Num	0x49
T-igbt	Present output stage temperature	0..32767	Num	0x4A
T-air	Present air temperature in the servo	0..32767	Num	0x4B
I lim inuse	Present current limit	0..600	Num	0x48
V out	Present output voltage	0..4000	Num	0x8A

21 Auto (special functions)

21.1 Auto – General overview

Overview of the page **Auto** in NDrive with the parameters for the motor-specific parameters and the menu for the activation of special functions

Fig. 21-1 - 00101

21.1.1 Auto – Special functions overview

Special function:	**Description:**	**ID address:** 0x85
Idle	Idle state	0 dec
[Fn1] Tuning - Still	not used	1 dec
[Fn2] Tuning - Rotating	not used	2 dec
[Fn3] Phasing - Still	not used	3 dec
[Fn4] Phasing - Rotating	Automatic reading of the rotor offset angle Offset) for synchronous motors (FB-Offset)	4 dec
[Fn5] DC-Injection	Fixed current feed angle of the phases U, V, W with rated motor current	5 dec
[Fn6] Analog offset	Automatic setting of the analog inputs	6 dec
[Fn7] Tacho offset	Automatic setting of the segment offset at bl-Tacho	7 dec
[Fn8] Calc. from motor nameplate	Calculation of the motor data acc. to the nameplate	8 dec
[Fn9] VdcBus zero compensation	1st step measured value correction dc bus voltage → Adjustment for measuring point at 0 V	9 dec
[Fn10] VdcBus voltage compensation	2nd step measured value correction dc bus voltage → Adjustment for measuring point at reference voltage	10 dec

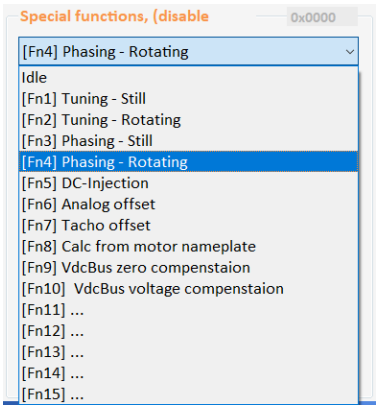


Fig. 21-2 - 00102

21.1.2 Auto – Motor-Parameter

Overview of the **Motor-Parameter** field on the page **Auto**

Symbol:	Function:	Range:	Unit:	ID address:
L sigma-q	q-component of the stator leakage inductance (for ACIM Lsd = Lsq)	0..32.767	mH	0xB1
L sigma-d	d- component of the stator leakage	0..32.767	mH	0xBB
R stator	Stator resistance [1]		mOhm	0xBC
TC stator	Stator time constant (Ls/Rs) [2]		ms	0xB6
L magnet.	Main inductance		mH	0xB3
R rotor	Rotor resistance [1]		mOhm	0xB4
TC rotor	Rotor time constant (Lm/Rr) [2]		ms	0xBD
FB-Offset	Encoder offset angle		Deg	0x44

[1] Entry without comma
[2] Internal calculation

Overview of the **Motor-Nameplate** field on the page **Auto**

Symbol:	Function:	Range:	Unit:	ID address:
Type	Motor type selection (EC servo, FU , FU servo, DC)			$0x5A_{Bit\ 13..12}$
N nom	Motor speed (for FU autotuning)	60..65000	rpm	0x59
F nom	Frequency rated motor speed (for FU mode)	20..1200	Hz	0x05
V nom	Voltage at rated motor speed (for FU mode)	0..1000	V	0x06
Cos Phi	Motor power factor (for FU mode)	0..327,00	%	0x0E
I max eff	Max. motor current	0..1000.0	Arms	0x4D
I nom eff	Continuous motor current	0..1000.0	Arms	0x4E
M-Pole	No. of motor poles (2 x pole pairs)	2..96	Num	0x4F
Id nom	Nominal Id-magnetising current in % of the rated motor current (I nom eff)	0..100	%	0xB2
Id min	Min. magnetising current in % of the rated motor current (I nom eff)	-100..0	%	0xB5

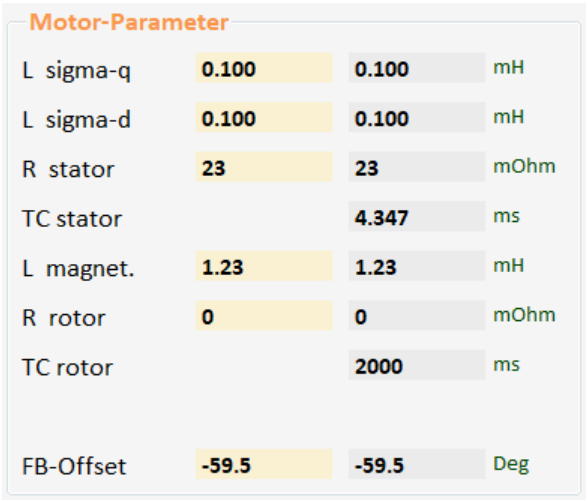


Fig. 21-4 - 00103

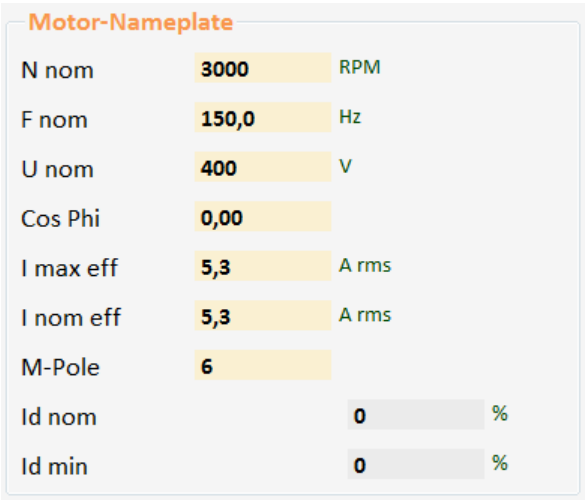


Fig. 21-3 - 00104

21.2 Special function – [Fn1] Tuning - Still

Function not yet activated!

Activation:

1. Selection [Fn1] Tuning - Still
2. Message to the ID address 0x85 = 1

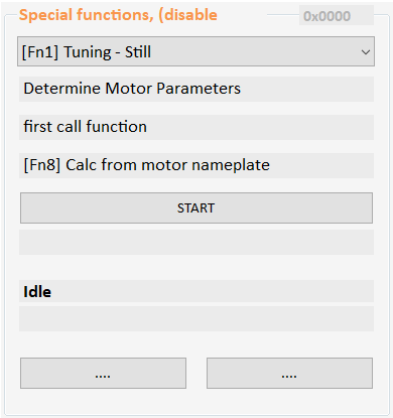


Fig. 21-5 - 00106

21.3 Special functions – [Fn2] Tuning - Rotating

Function not yet activated!

Activation:

1. Selection [Fn2] Tuning - Rotating
2. Message to the ID address 0x85 = 2

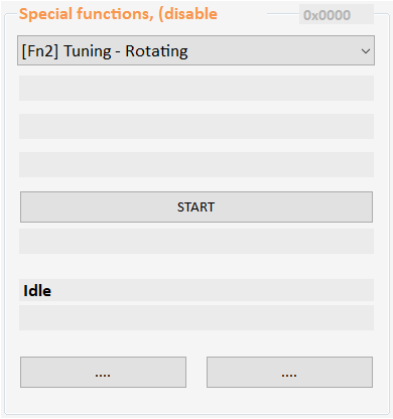


Fig. 21-6 - 00107

21.4 Special functions – [Fn3] Phasing - Still

Function not yet activated!

Activation:

1. Selection [Fn3] Phasing - Still
2. Message to the ID address 0x85 = 3

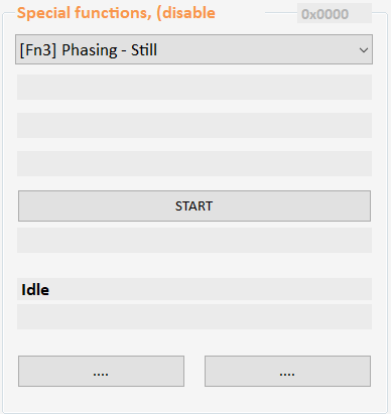


Fig. 21-7 - 00108

21.5 Special functions – [Fn4] Phasing - Rotating

Aims:

- Checking the correct connections of the motor lines (U, V, W).
- Checking the entered no. of motor poles (M-Pole).
- Determination of the encoder phase angle (FB-offset).

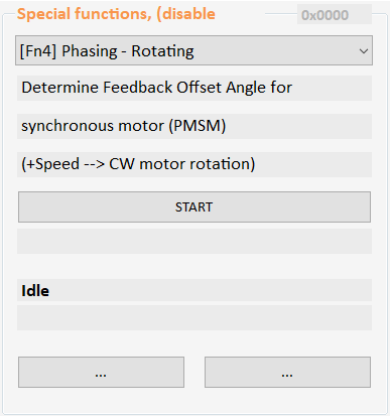


Fig. 21-8 - 00109

Preparation hardware:

- The motor must be free-running or connected to a small load.
- The motor must not represent a hazard in case of an uncontrolled acceleration.
- Supply the device with a power voltage (mains/HV)
  (For devices with HV DC voltage it is recommended to apply a low DC voltage (12..48 V).

Preparation parameter:

- The no. of motor poles **M-Pole** (0x4F) and no. of encoder poles **FB-Pole** (0xA7) must be correctly set.
- Set the reduction of the permitted current **I max pk** to **10 %.**
- Set the rotating speed for the phasing process to 3 % of the rated speed via **Speed 2**
  (Example: 120)

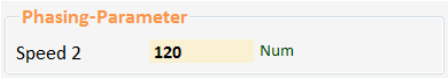


Fig. 21-9 - 00110

Description of the start and the process:

1. Selection [Fn3] Phasing - Rotating
2. Activation of the function → press START button
   (or message to the ID address 0x85 = 4)
3. After having pressed START there are 10 s in order to activate the enable input (FRG/RUN)
   (in NDrive: Waiting for Enable = 1).
4. The current ramp provides the set current and the motor moves with a jerk between two of its electric poles.
5. Then the motor rotates in clockwise direction by exactly 360° from pole to pole depending on the specified no. of motor poles (may jump with a jerk from pole to pole).
6. After a short time the current ramp is reduced again.
   Then the enable input (FRG/RUN) must be deactivated (in NDrive: Waiting for Enable = 0).

Conclusions:

- The correct order of the **connections U, V, W** is confirmed by the slow **clockwise rotation**.
- The correct specification of the **no. of motor poles** (0x4F) is confirmed by the **rotation of 360°**.
- The determined phase angle is displayed in the right of the two fields (grey) (here: -59.8 deg). After the successful phasing process the new value must be entered in the left field (yellow) and saved permanently on the page ‘settings’ on the Eprom level 0.

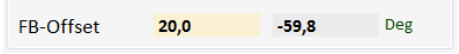


Fig. 21-10 - 00111

Note:

- The FB-offset must only be determined once and not after each restart.
- The accuracy of this method is physically limited to ±2 %. However, this is sufficient for a general operation.

Errors:

- The motor does not rotate
  - U,V,W connection is not correct → *modification unknown*
  - Current limit possibly too low or applyied load too high
  - The value of Speed 2 is too low or too high

- The motor rotates anti-clockwise
  - U,V,W connections are not correct → exchange the connections U and W

- The motor rotates less or more than 360°
  - Incorrect specification of the no. of motor poles M-Pole (0x4F) → correction necessary

Process:

Function:	**Message in NDrive:**	**7-segment display:**
Select function [Fn4] Phasing - rotating and click START		
Switch on the enable within 10sec	Waiting for RUN = 1 (enable)	40
Enable closed	Current ramp	41
Current built up (rotation starts)	Rated value reached	42
Pole angle and detection of the no. of motor poles carried out	Output of the rotation field	43
Correct end	End End, waiting for RUN = 0 (switch off FRG)	49

Termination in case of errors:

Function:	**Message in NDrive:**	**7-segment display:**
Enable is switched off during the measuring process	Error	47
Time out, measuring time exceeded		48

21.6 Special functions – [Fn5] DC-Injection

When a current feed angle is preset (angle) the rotor (motor shaft) is moved into this angle and held (no rotating field)

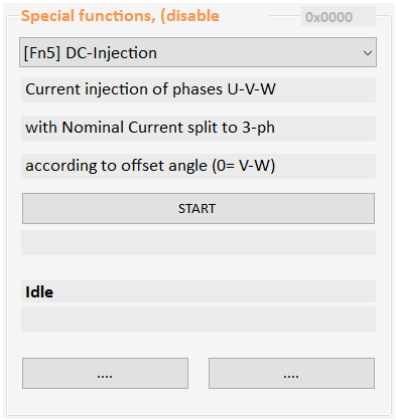


Fig. 21-11 - 00112

Description of the start and the process:

1. Selection [Fn5] DC-Injection
2. Reduce the current limit for the rated current I nom eff to 30%
3. Preset the requested electric angle via FB-Offset (0x44)
4. Apply the power supply voltage across the device (Mains/HV)
5. Activate the function → press START button
   (or message to the ID address 0x85 = 5)
6. Activate the enable input (FRG/RUN)

Conclusions:

- The motor shaft rotates to the preset angle by means of the max. possible current and stops at the angle.
- As long as the enable input is closed, a new angle can be preset for FB-Offset (0x44) on the left (yellow field).
- When switching off the enable input (FRG/RUN), the function is stopped.

Attention:
For further motor operation the correct value for FB-Offset must be entered and saved (level 0).

If the FB-Offset value is incorrect, the drive may rotate or move uncontrolled!

21.7 Special functions – [Fn6] Analog offset

Function not yet activated!

Activation:

1. Selection [Fn6] Analog offset
2. Message to the ID address 0x85 = 6

For the time being the leakage of the analog inputs must be adapted via the settings of the analog parameters (offset, zero zone, and scale).

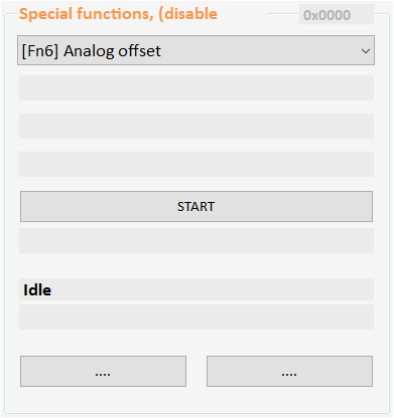


Fig. 21-12 - 00113

21.8 Special functions – [Fn7] Tacho offset

Adjustment of segment offset errors for brushless tacho systems

Fig. 21-13 - 00114

Description of the start and the process:

1. Selection [Fn7] Tacho offset
2. Activate the function → press START button
   (or message to the ID address 0x85 = 7)
3. Switch on enable input (FRG/RUN)
4. After the tacho offset was successful the internally determined value must be permanently saved on the page ‘settings’ on the Eprom level 0

Process:

Function:	Message in NDrive:	7-segment display:
Click function ‘start tacho offset‘		70
Switch on enable		79

Termination in case of errors:

Function:	Message in NDrive:	7-segment display:
Enable switched on during the measuring process		76
Movement on the rotor detected		77
No tacho connected		78

21.9 Special functions – [Fn8] Calc from motor nameplate

Calculation of the motor data for asynchronous motors

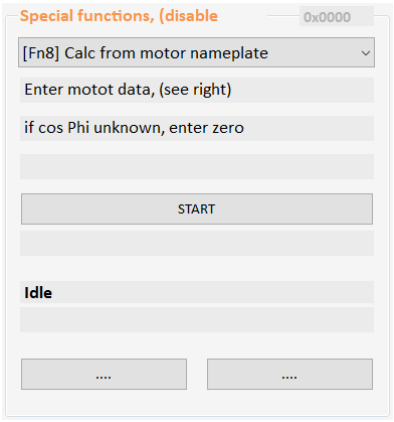


Fig. 21-14 - 00115

Description of the start and the process:

1. Enter the motor data in the window **Motor-Parameter** into the left (yellow) fields
2. Selection of [Fn8] Calc from motor nameplate
3. Activate the function → press START button
   (or message to the ID address 0x85 = 8)

After the calculation is finished the calculated values are displayed in the right column (grey).

For a permanent saving the data must be permanently saved on the page 'settings' on the Eprom level 0.

Motor-Parameter field on the page **Auto**

Symbol:	Function:	Range:	Unit:	ID address:
L sigma-q	q-component of the stator leakage inductance (for ACIM Lsd = Lsq)	0..32.767	mH	0xB1
L sigma-d	d-component of the stator leakage	0..32.767	mH	0xBB
R stator	Stator resistance 1		mOhm	0xBC
TC Stator	Stator time constant (Ls/Rs) 2		ms	0xB6
L magnet.	Main inductance		mH	0xB3
R rotor	Rotor resistance 1		mOhm	0xB4
TC Rotor	Rotor time constant (Lm/Rr) 2		ms	0xBD
FB-Offset	Encoder offset angle		Deg	0x44

[1] Entry without comma
[2] Internal calculation

General information

Various literatures display motor models which are identical in principle. Abbreviations used in the diagrams may vary. Differences can only be found concerning physically measurable quantities (T-model) or further abstraction for simplified calculation models (inverse gamma model).

Some manufacturers provide additional data such as no. of poles, idle current for a specified idle voltage (= magnetization current), ohmic resistance of the stator winding, stator impedance for a specified frequency, as well as values referring to rotor quantities.

These manufacturer data are usually correct and helpful. The real, physical quantities can be measured through direct measuring for stator values and through indirect measuring for rotor values, i.e. by measuring the retroactive effect on the stator.
The graphic presentation of the motor models does partly not refer to the real, physical quantity but to converted quantities.

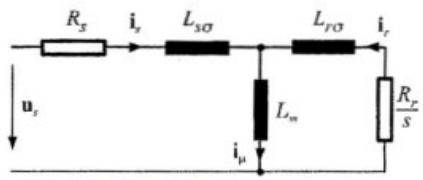


Bild 1: T-Modell, stationary,[2]

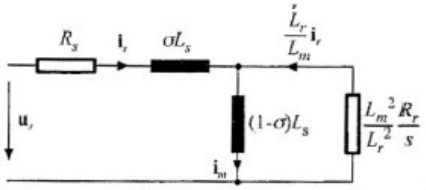


Bild 2: inverses Gamma Modell, stationary,[2]

Rs	Stator resistor
ir	Current in rotor
Lm	Main inductance
Lrσ	Rotor leakage induct.
im	Magnetization current
Rr	Rotor resistance
Lsσ	Stator leakage induct.
iμ	Current through Lm
σ	Complete leakage fact

Basic procedure
During an operating mode FU (page setting ‘type‘) for new or unknown motors it is possible to check the following assignment first: positive speed command value = clockwise rotating field U, V, W = clockwise rotation = positive actual speed value. Set the values on the page ‘settings’ FU left field after U/f-characteristic. Operation in the rated point without load approx. results in the magnetization current.

Optimization procedure
Connect a load machine with aprox. 20 to 50 % rated torque.
Presetting of a corresponding torque in NDrive via the test panel (below left).
Thus, a stationary speed is set.

The Lm or Rr value can be changed when the machine rotates (T-rotor = Lm/Rr).
The result is immediately effective in the control. The target is to optimize the T-rotor to a higher speed at the same load. During operation this results in a lower current consumption at the same load torque.
The value of the T-rotor (in ms) is not updated by NDrive until the offline-online process.

At a second stage Idnom (NDrive page ‘speed‘) can be varied, field weakening not active (Vred = 0). This can be noticed during standstill (current = magnetization current). When the machine rotates this value is also immediately effective. The target is a higher speed at the same load. During operation this results in a higher final speed when reaching the voltage limit (max. modulation).
Compare the values achieved from the tests with existing manufacturer values. Save them and reset the servo (off-on) . Check the values and functions again.

21.10 Special functions – [Fn9] [Fn10] VdcBus compensation

Calibration of the analog VdcBus bus voltage measuring (device-dependent) from firmware 466

The calibration takes two step, i.e., the zero point is determind ([Fn9] VdcBus zero comensation) and the respective reference point is determinded ([Fn10] VdcBus voltage compensation)
In general, all devices are already calibrated in the factory.
If a component is exchanged a new calibration must be carried out.

Step 1: [Fn9] VdcBus zero compensation

Description of the start and the process:

1. For the automatic adjustment the command mode must be set to 'Dig. Commands'
2. Selection of [Fn9] VdcBus zero compensation
3. Do not apply any voltage across the connections VdcBus U+ and U-
   (For Bamobil device U+ and U- must be short-circuited)
4. Activate the function → press START button
   (or message to the ID address 0x85 = 9)
5. After approx. 4 s the successful VdcBus zero adjustment is displayed as 'end' message

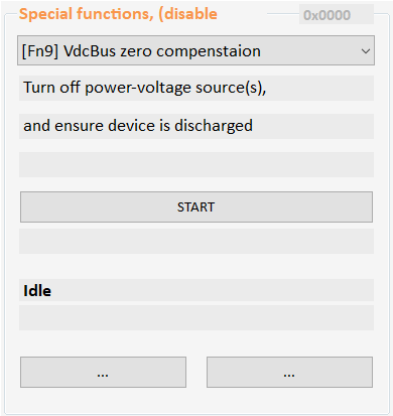


Fig. 21-15 - 00116

Step 2: [Fn10] VdcBus voltage compensation

Description of the start and the process:

1. For the automatic adjustment the command mode must be set to 'Dig. Commands'
2. Selection of [Fn10] VdcBus voltage compensation
3. A constant dc voltage of at least 2/3 of the rated device voltage must be applied across the connections VdcBus U+ and U-
4. Measure the bus circuit voltage by means of a voltmeter
5. The measured voltage value must be entered as reference in the parameter field **Calibr.** (0x1A)
6. Activate the function → press START button
   (or message to the ID address 0x85 = 10)
7. After approx. 4s the successful VdcBus reference point adjustment is displayed as 'end' message

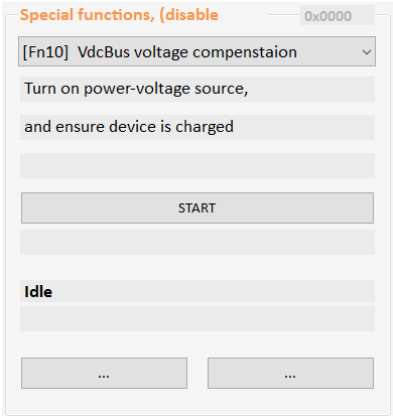


Fig. 21-16 - 00117

Finally, the internally calculated calibration points must be permanently saved on the page 'Settings' on the Eprom levels 0 and 1.

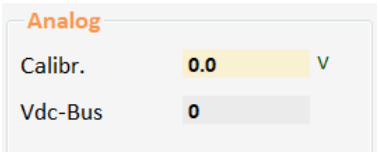


Fig. 21-17 - 00105

Note:
If the calibration points vary too much, the standard default values will be used instead.

22 Oscilloscope

22.1 Oscilloscope – Overview

Overview of the page **oscilloscope** in NDrive showing a compact parameter overview for converter-specific parameters, for the step generator, and the menu for the oscilloscope configuration settings

Fig.g 22-1 - 00118

22.2 Oscilloscope – Settings and display

22.2.1 Oscilloscope – Signal selection

Overview of the selection possibilities of up to 8 channels (signals) and description of the individual fields

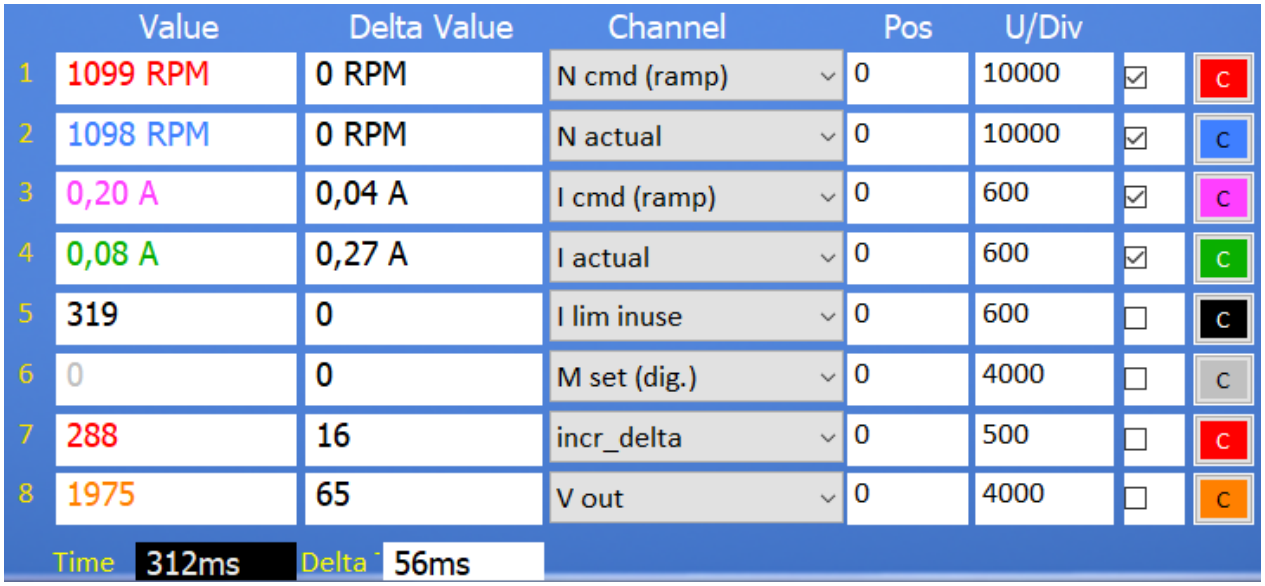


Fig. 22-2 - 00121

Field:	Function:
Value	Values at the first cursor line (numeric or physical (if existing))
Time	Time from the trigger line to the first cursor line
Delta Value	Differential values from the first to the second cursor
Delta (Time)	Differential time from the first to the second cursor
Channel	Selection of the signal to be measured and thus, assignment of the channel no. The channel is switched off at „Off“
Pos	Shifting of the zero line for this channel in positive or negative direction. The entry of 100 corresponds to a vertical shifting of the signal by one grid. The ratio is depends on the measured value.
U/Div	Numeric units for the setting of the vertical grid line I.e., when U/Div = 10000 with N cmd (ramp) the numeric value of 10000 corresponds to a horizontal line The reference always complies with the numeric value and not with the physical one
Switch cabinet	The display of the channel is switched on and off The switched off channel remains in the background and is also saved
Channel colours	The colour of the measuring signal on the oscilloscope screen can be changed via the colour selection window by clicking the colour key C
The trigger line is the line for which triggering was defined The first cursor line is the line which is set by clicking the left mouse button The second cursor line is the line at which the mouse pointer is	

22.2.2 Oscilloscope – Trigger and capture settings

Overview of the trigger and capture settings

Trigger	Function
On	Selection of the signal for the trigger function
Edge	Selection of the trigger function with reference to the selection in the field **On**
Level	Setting of the trigger level (numeric) depending on the trigger function and the selected signal

Capture	Function
Buf	Resolution or no. of measuring points divided over all channels used
Run	Selection trigger switching function
Timescale	Time unit per horizontal grid line
Pre trig	Horizontal shifting of the trigger line Possible display of the measured value in front of the trigger line

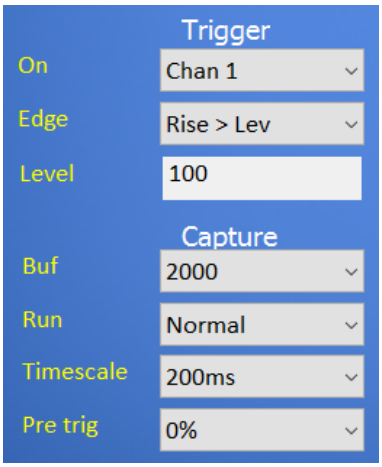


Fig. 22-3 - 00120

The no. of measuring points in the NDrive software oscilloscope is the same as for a real oscilloscope, that is, depending on the settings of the time base (Timescale). Thus, the distances between the measuring points are also depending on these settings. **Meaning that it is no data logger**.
This means that it is not possible to show a more detailed view of the measuring points within a shorter time range by subsequent zooming with a long time scale. It is necessary to be sure in advance on which time base the measuring is to be carried out.

22.2.3 Oscilloscope – Description of the Trigger and Capture settings

On:
The signal for the trigger function is selected via the pull-down menu.
This can either be a certain channel (1..8) or a signal which is listed in the pull-down menu even if it is not specified in one of the channels.

Edge:

Symbol:	Trigger description: (always with regard to the value in **Level**)
Rise > Lev	The signal moves from a low to a higher value of a set Level → **positive edge**
Rise < Lev	The signal moves from a high to a lower value of a set Level → **negative edge**
Rise or Fall	The signal moves either through a **positive or negative edge** of the set Level value
=Lev	The signal is **equal to** the set Level value
!= Lev	The signal is **unequal to gleich** the set Level value
> Lev	The signal is **higher than** the set Level value
< Lev	The signal is **lower than** the set Level value

Level:
The numeric value is the reference for the selection of the trigger function in **Edge**.

Note:
Modifictions are only updated if the activation function of a measuring process (run/stop) is set to ‘stop’.

Buf:
The no. of measuring points of 250, 500, 1000 or 2000 for all 8 channels. At the same time this defines the measuring detail.
For a **Buf** setting of 2000 and only 2 activated channels, each channel is provided with 1000 measuring points.
Recommendation: 2000

Run:

Symbol:	Function:
Auto	Continuous measuring without any trigger function to be detected
Single	If a trigger function is detected a measuring is carried out After this, the activation function (run/stop) is automatically set to stop
Normal	Each time a trigger function is detected ther will be a measuring process

Timescale:
The time unit per horizontal division defines the time unit of the display on the oscilloscope screen and also it defines the sample rate at which a channel measuring point is measured. In general, valid is that a channel has 50 measuring points between each division of a horizontal line.
I.e., for a time scale setting of 500 ms the delta of a measuring point is 10 ms
(measuring point Delta = Time scale / 50 = 500 ms / 50 = 10 ms).

Pre Trig:
The Tre trig shifts the trigger function according to the respective setting depending on the time scale setting. Thus, it is possible to look at events prior to the triggering.

Note:
- It is possible to activate a “force trigger” with a single recording by means of the trigger function (Edge: != Lev) on the signal I_actual and the capture setting (run: single).

- If the Pre trig is superior to 0 % there might be overlappings in the display of the oscilloscope screen. This might occur if a new trigger is detected during the transfer time, especially when the setting Run = Auto. Then, it is recommended to use a Pre trig of 0%.

22.2.4 Oscilloscope – Activation of the measuring process

Measuring activation function for the oscilloscope

Run / Stop:	Symbol:	Function:
Run		The oscilloscope recording is focused via the key **Run** The recording is started by means of the next trigger signal
Stop		The recording is stopped and deleted by means of the key **Stop** The current display is held

22.2.5 Oscilloscope – Status display

Status display for the oscilloscope

Status:	Colour:	Function:
waiting (0)	red	Measuring is activated (Run), waiting for a new trigger event
waiting (xx)	green	Measuring triggered, data are buffered in the servo
reading	blue	Measuring terminated, data are sent from the servo to the pc
drawing		Presentation of the data on the oscilloscope screen
idle	white	Measuring is deactivated (Stop)

22.2.6 Oscilloscope – Zoom options

Zoom options for a measuring process on the oscilloscope screen

Zoom:	Symbol:	Function:
Zoom (+)		The measuring results on the oscilloscope are enlarged
Zoom (-)		The measuring results on the oscilloscope are minimized

Note:
Only the display is enlarged. The no. of measuring points depends on the time scale setting and remains the same regardless of the zoom setting.

22.2.7 Oscilloscope – Savind and loading of measured data

Saving and loading options for an oscilloscope measuring process

File *.uof	Symbol:	Function:
Loading .uof Datei		Loading of a measured UniTek oscilloscope file (.uof)
Saving .uof Datei		Saving the measured data as UniTek oscilloscope file (.uof)
Saving .csv Datei		Saving the measured data as excel file (.csv)

Note:

- Measured data in .uof format can be loaded, modified, and saved again by means of the NDrive oscilloscope (even during offline mode).

- Measured data in .csv format cannot subsequently be loaded and looked at on the NDrive oscilloscope (i.e., not usable for analyses at a later time).

22.2.8 Oscillocope – Adaption of the oscilloscope window

Overview of the possible settings for the oscilloscope window as well as special presentation modes for a measuring process

Options:	Function:
Join	Connect measuring points (interpolated)
Over	Display remains and will be overwritten
Zero	Zero line visible
Units	Display num or real values (if existing)
Trig	Trigger line visible
Label	Channel designation visible
AbsDelta	

Symbol:	Setting of:
B	Background colour
K	Grid line colour
Z	Cursor line colour
T	Trigger line colour

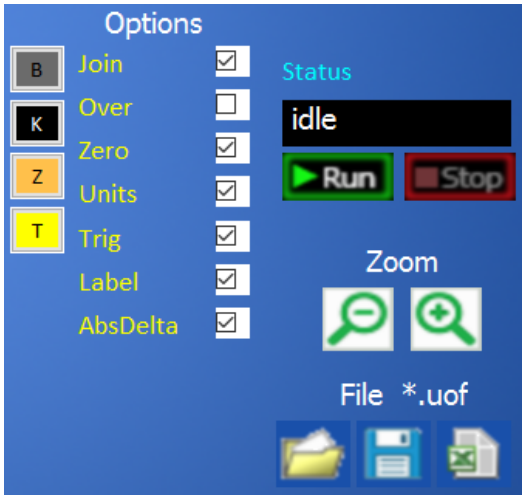


Fig. 22-4 - 00119

22.2.9 Oscilloscope – Measured value display

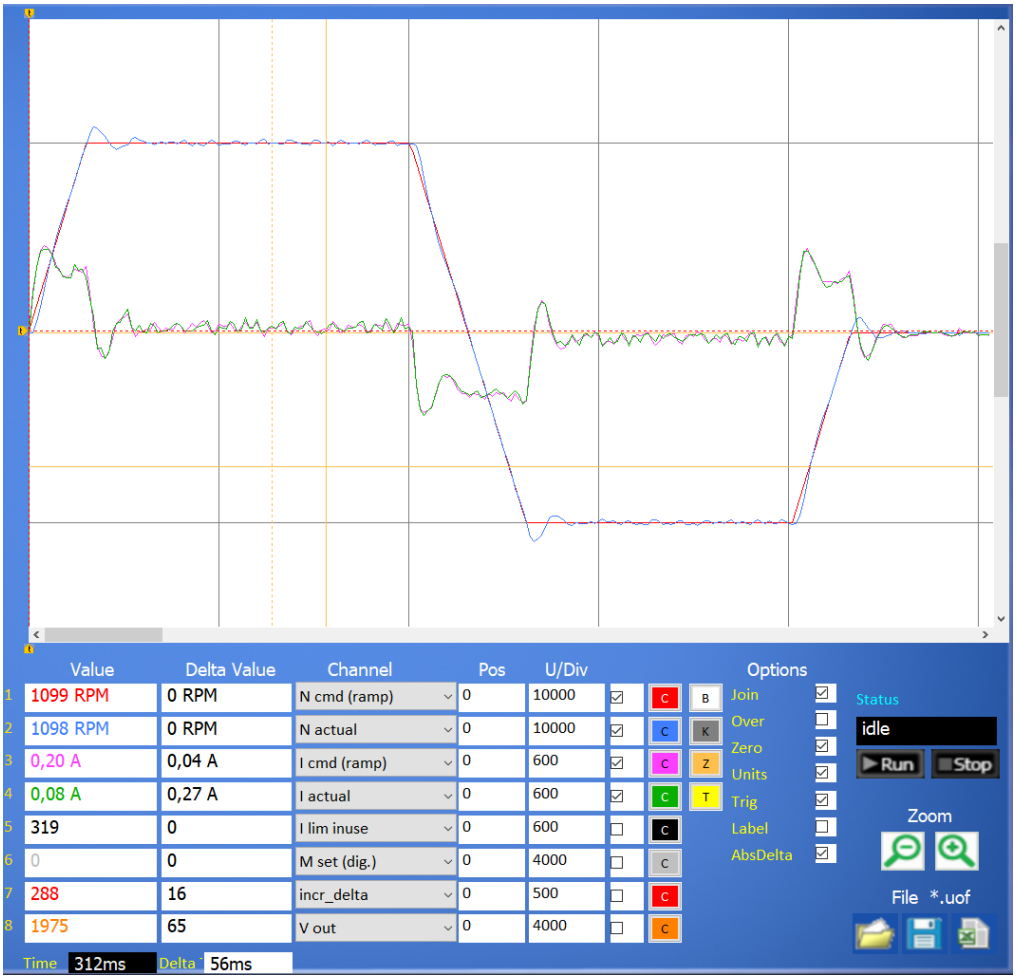


Fig. 22-5 - 00123

The recording of measured data is displayed in the chosen colours.

The first vertical **trigger line** is tagged with an arrow at the upper and lower edge of the screen.
The second vertical line is the first **cursor line.**
The active second cursor is shown as horizontal and vertical crossline.

The measured values of the first verical **cursor line** are displayed at **Value** and saved.
The measured values of the **second cursor** (crossline) are displayed in the field **Delta Value.** They are the differential values to the values at the first cursor.

The elapsed time from the trigger line to the first cursor line is displayed in **Time.**
The elapsed time from the first cursor line to the second cursor line is displayed in **Delta Time.**

If the box **Units** is ticked the displayed values are transformed from numeric to real values if the convertion for the measured signal is available.

22.2.10 Oscillocope – Parameters on the page Oscilloscope

On the page Oscilloscope there is a compact selection of important parameters for a direct modification during an oscilloscope measuring process.

The modifications are updated in the current set of parameters of the RAM.

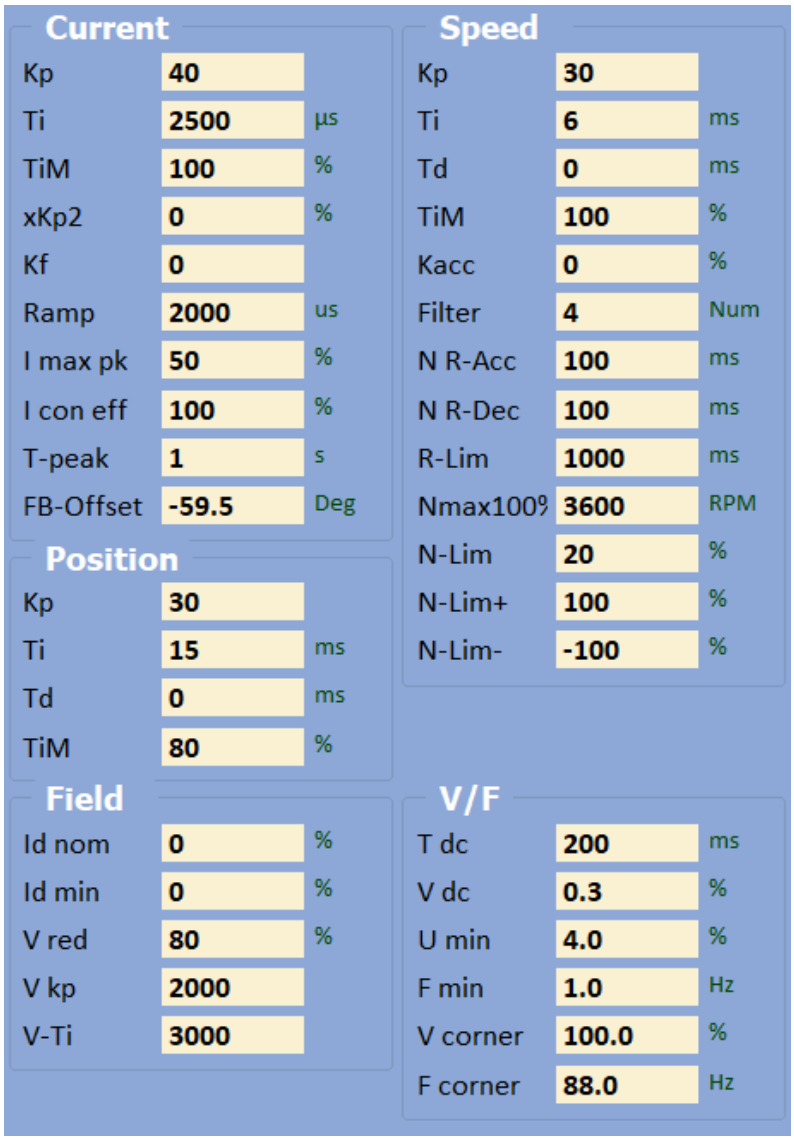


Fig. 22-6 - 00125

23 Test operation

23.1 Test operation – Test

Note :
This field is only for the test function.

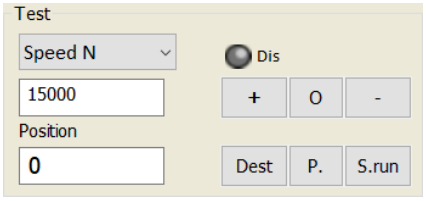


Fig. 23-1 - 00126

Via the Test field it is possible to directly send a digital command value for speed, (Iq) torque or position control. Thus, it is very suitable for general test operations.

In order to use the functions of the Test field, the operating mode **Command Mode** must be set to **Dig. Commands**.

Test operation command value presetting of the speed or (Iq) torque

- The speed or (Iq) torque command value is defined via the respective selection in the pull-down menu.
- The numeric command value is entered in the left field (range: ±32767).
- The entered command value is immediately send to the drive by clicking the (+) or (-) key.
  The command value ‚zero' is send when clicking the 'stop' key (O).

Test operation command value presetting of the position and the reference cycle

- Enter the numeric position command value in the left field (range: ±2147483647).
- When pressing the key (Dest.) the drive immediately travels at the speed selected at N max to the set position command value.
- When pressing the key (…) the servo drive performs a reference cycle.
- When pressing the key (P.) the entered numeric position is updated as actual position and command value position.

Dis Software enable (only when the hardware enable is active).
When pressing the button **Dis** the internal enable function is then disabled (red) and again enabled (grey).

23.2 Testbetrieb – Step Generator

Step Generator for the output of up to 3 cyclically repeating command values

Presetting:	Function:	Range:
(Id) Magnetization	Id current command (Id set (dig.))	±32767
(Iq) Torque	Iq current command (active current) (M_set (dig.))	±32767
Speed	Speed command (n_cmd)	±32767
Position	Position target command (Pos dest)	±2147483647
2 step	Selection 2 or 3 steps	

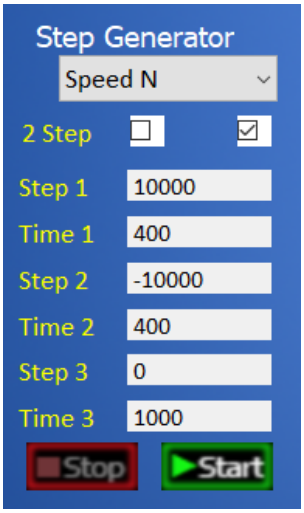


Fig. 23-2 - 00122

Presetting:	Function:	Range:
Step1	Value 1 (current, speed, or position)	*see presetting*
Time1	Time for value 1	0..32767
Step2	Value 2 (current, speed, or position)	*see presetting*
Time2	Time for value 2	0..32767
Step 3	Value 3 (current, speed, or position)	*see presetting*
Time 3	Time for value 3	0..32767
Start Stop	Starts or stops the generator function	

Note:
The time inputs (time) may vary acc. to the pc for values >2000.

Command value step functions are preset by means of the step generator. The ramps are determined via the parameter settings for the current and speed controller.

When the enable input (RUN/Frg) is active, the drive is started by clicking the **Start** button and it is stopped by clicking the **Stop** button. The functions can be selected as current, torque, speed, or position command values. The value for 'stop' at current, torque, and speed should be 0 for standstill.

Particular attention:
If the travel distance is limited it has to be ensured that the travel distance of the test settings is within the machine limits.
At the test setting (Id) magnetization and (Iq) torque the drive may rotate at max. speed.
Over-speed may be achieved at field weakening operation.

24 Parameters

24.1 Parameters – Overview

Motor parameters

Symbol:	Function:	Range:	Unit:	ID address:
Type	Motor type selection (EC servo, FU, FU servo, DC)			$0x5A_{Bit\ 13..12}$
N nom	Motor speed (for FU autotuning)	60..65000	rpm	0x59
F nom	Frequency rated motor speed (for FU mode)	20..1200	Hz	0x05
U nom	Voltage at rated motor speed (for FU mode)	0..1000	V	0x06
Cos Phi	Motor power factor (for FU mode)	0..327,00	%	0x0E
I max eff	Max. motor current	0..1000,0	Arms	0x4D
I nom eff	Continuous motor current	0..1000,0	Arms	0x4E
M-pole	No. of motor poles (2 x pole pairs)	2..96	Num	0x4F
Brake delay	- Attraction delay time of the electro-mechanical motor brake - Deceleration when no brake is connected	0..1000	ms	0xF1
Free coasting	Free coasting (ON) or emergency stop braking (OFF) when the enable (FRG/RUN) is switched off	On / Off		$0x5A_{Bit\ 3}$
M-temp	Switching-off point for the motor over-temperature (Error code 6) (At 93% there will be a warning message 6 with current derating Ird-TM activation)	0..32767	Num	0xA3

[1] Parameters – Motor type

Symbol: Type	Function:	ID address: $0x5A_{Bit\ 13..12}$
EC servo	Synchronous servo motor with encoder system (sensor)	0 dec
ACI V/f	Asynchronous motor frequency converter without sensor (U/F characteristic curve without slip compensation)	1 dec
ACI servo	Asynchronous motor AC servo vector control with speed encoder system (e.g. position encoder A, B channel)	2 dec
DC	DC motor without or with DC tacho encoder	3 dec

Parameters – Feedback encoder

Symbol:	Function:	Range:	Unit:	ID address:
Type [2]	Feedback selection (Rot_Enc_TTL, resolver,…)			$0xA4_{Bit\ 4..0}$
FB-Pole	Encoder no. of poles	2..12	Num	0xA7
FB-Offset	Phase angle correction	±360	Grad	0x44
FB-Ink. (Mot)	Encoder resolution	1024..8192	Inc/Rev	0xA6
Voltage	DC tacho voltage		mV/rpm	
Inc ext	Resolution - 2nd Feedback		Inc/Rev	$0xCF_L$
Factor	Multiplicator SIN/COS Inc.	4..16	Num	0x7E

[2] Parameters – Feedback encoder type

Symbol: Type	Function:	ID address: $0xA4_{Bit\ 4..0}$
Rot_Enc_TTL	Incremental encoder TTL 5 V with rotor position tracks	0 dec
Resolver	Resolver	1 dec
Abs_Enc_SC	Incremental encoder Sin/Cos 1Vss with commutation track	2 dec
Rot_Tacho	Rotor position encoder with brushlesss tacho	3 dec
Rot	Rotor position encoder (without tacho)	4 dec
DC_Tacho	DC tacho generator	5 dec
DC_Arm	Armature voltage (internal)	6 dec
BL_Arm	EC AC motor without tacho	7 dec
Enc_TTL	Incremental encoder TTL 5 V (without rotor position)	8 dec
Enc_SC	Incremental encoder Sin/Cos 1Vss without commutation track	9 dec
Abs_SC	Incremental encoder Sin/Cos 1Vss per motor pole pairs	10 dec
DC_Arm_Vir	Sensorless (DC motor without tacho, without armature voltage measuring	11 dec
SLS	Sensorless (only for ACI V/f operation)	12 dec
SLS_SMO	not activated	13 dec
SLS_Usens	not activated	14 dec
Ana_In1_calc	not activated	15 dec
Ana_In2_calc	not activated	16 dec
Panasonic	not activated	17 dec
DC_Bus	not activated	18 dec

Parameters – 2. Feedback encoder

Symbol:	Function:	Range:	Unit:	ID address:
Type [3]	Selection of 2. Feedback encoder input			$0xA4_{Bit\ 7..5}$
Inc-ext	Resolution of 2nd incremental encoder		Inc/Rev	$0xCF_{L}$
Faktor-ext	Encoder factor 2nd encoder	4..16	Num	0x7E
Inc-Out	Incremental output resolution		Inc/Rev	$0xCF_{H}$
Factor	Multiplying factor of the basic no. of pulses with SinCos (SC)			$0xA4_{Bit\ 14..12}$

[3] Parameter – 2. Feedback encoder Type

Symbol: Type	Function:	ID address: $0xA4_{Bit\ 7..5}$
Off		0 dec
INC-IN	X8 as position input	1 dec
INC-OUT	X8 only display	2 dec
HAND	X8 as handwheel input	3 dec

Parameters – Servo

Symbol:	Function:	Range:	Unit:	ID address:
Type	Unit type (protected)	Nameplate		0x63
S-Nr.	Serial unit no. (protected)	Nameplate		0x62
Axis	Axis designation (freely writable)	4 characters	ASCII	0xF8
Mains sel	Selection of the power voltage	AC / DC		$0x5A_{Bit\ 19}$
Mains	Magnitude of the mains supply voltage	0..1000	V	0x64
DC-Bus max	Max. voltage limit of the DC Bus (software)	0..200	%	$0xA5_{H}$
DC-Bus min	Min. voltage limit of the DC Bus (software)	0..200	%	$0xA5_{L}$
Regen	Selection of regen resistor	INT / EXT		$0x5A_{Bit\ 1}$
Regen-P	Power value of the external regen resistor	Type plate	W	$0x65_{L}$
Regen-R	Resistance value of the external regen resistor	5..100	Ohm	$0x65_{H}$
BTB Power	BTB message with or without bus circuit undervoltage monitoring	with/without		$0x5A_{Bit\ 6}$
PWM freq	PWM pulse frequency	Selection field		$0x5A_{Bit\ 22..20}$
Mode (Command)	Type of the command value presetting for the speed and torque commands	Selection field		$0x36_{Bit\ 13..12}$
Cut-off (dig.)	Zero zone with digital command value presetting	0..32767	Num	0x1E

[4] Parameters – Servo PWM freq

Symbol: PWM freq	Function:	ID address: $0xA4_{Bit\ 22..20}$
8kHz		0 dec
24kHz		1 dec
20kHz		2 dec
16kHz		3 dec
12kHz		4 dec
8kHz I16	internal 16 kHz	5 dec
4kHz I8	internal 8 kHz	6 dec
2kHz I4	internal 4 kHz	7 dec

[5] Parameters – Servo command mode

Symbol: Mode	Function:	ID address: $0x36_{Bit\ 13..12}$
Digital Speed	Digital speed command value from RS232 or CAN-BUS	0 dec
Analog Speed	Analog speed command value	1 dec
Analog Torque	Analog torque command value	2 dec
Digi + Ana Speed	Digital plus analog command value	3 dec

Parameters – Overview Analog (Ain1 + Ain2)

Symbol:	Function:	Range:	Unit:	ID address: Ain1 - Ain2 -
Format [6]	Selection of the function of the respective analog inputs	Selection field		$0x36_{Bit\ 1..0}$ $0x36_{Bit\ 3..2}$
Offset	Offset compensation of the respective analog inputs	±32767	Num	$0x2F_L$ $0xD7_L$
Zero zone	Zero zone of the respective analog command value presettings	0..32767	Num	0x50 0x53
Scale	Scale factor of the respective analog inputs	±7.999	Num	$0x2F_H$ $0xD7_H$
Filter	Filter of the respective analog inputs	0..127.5	Num	0x60
Mode [7] (analog)	Input level selection of the respective analog inputs	Selection field		$0x36_{Bit\ 5..4}$ $0x36_{Bit\ 9..8}$

[6] Parameters – Analog command format (Ain1 + Ain2)

Format: Ain1		ID-Adresse:
Off	Deactivated	$0x36_{Bit\ 1..0}$ = 0
Cmd	Speed command value	$0x36_{Bit\ 1..0}$ = 1
-Cmd	Inverted speed command value	$0x36_{Bit\ 1..0}$ = 2
sq(Cmd)	Square speed command value	$0x36_{Bit\ 1..0}$ = 3
N limit	Speed limiting 0..100 % via Ain1 (for digital command value presetting (position, speed)). This corresponds to 100 % of the max. physical speed in **Nmax100%** (0xC8).	$0x36_{Bit\ 15}$

Format: Ain2		ID-Adresse:
Off	Deactivated	$0x36_{Bit\ 3..2}$ = 0
Cmd	Speed command value Ain2 is added to Ain1	$0x36_{Bit\ 3..2}$ = 1
-Cmd	Speed command value Ain2 is subtracted from Ain1	$0x36_{Bit\ 3..2}$ = 2
*Cmd	Speed command value Ain2 is multiplied by Ain1	$0x36_{Bit\ 3..2}$ = 3
I limit	Current limiting 0..100% via Ain2 (for all command value presettings digital, analog). This corresponds to 100 % of the device peak current **I max pk** (0xC4)	$0x36_{Bit\ 14}$

[7] Parameters – Analog mode (Ain1 + Ain2)

Symbol: Typ	Function:	ID address: $0x36_{Bit\ 5..4}$
-10..+10V	Command value plus-minus max. 10 V	0 dec
0..+10V	Command value plus max. 10 V	1 dec
4..20mA	Command value 4 to 20 mA to 500 Ohm	2 dec
+1..+9V	Command value 1 to max. 9 V	3 dec

Parameters – Current controller

Symbol:	Function:	Range:	Unit:	ID address:
Kp	Proportional amplification	0..200	Num	0x1C
Ti	Integration time (integral time constant)	375..10000	ms	0x1D
TiM	Max. value of the integral memory Ti	0..300	%	0x2B
xKP2	Proportional amplification in case the actual current is superior to the current limit	0, 100..500	%	0xC9
Kf	Current feed-foreward control	0..167	Num	0xCB
Ramp	Ramp setting of current command value	125[1]..32000	µs	0x25

Parameters – Current limits

Symbol:	Function:	Range:	Unit:	ID address:
I max pk	Device peak current [A]	0..100	%	0xC4
I con eff	Device continuous current [Arms]	0..100	%	0xC5
T-peak[2]	Permitted overcurrent time above the continuous current limit (reduction 5 times longer)	1..40	s	0xF0
I limit (dig)[3]	Current reduction when the logic input I limit (dig.) is activated	0..100	%	0x46
I-red-N	Current reduction by means of the actual speed	0..100	%	0x3C
I-red-TD	Start of the current reduction by means of the output stage temperature	0..32767	Num	0x58
I-red-TE	End of the current reduction by means of the output stage temperature	0..32767	Num	0x4C
I-red-TM	Start of the current reduction by means of the motor temperature	0..32767	Num	0xA2
I lim inuse	Present current limit	0..32767	Num	0x48

[2] Only active if the current reduction on the basis of the output stage temperature is not activated ($0x40_{Bit\ 23}$ (Ird-TI) = 0)
[3] The reference is the max. device peak current (I max pk (0xC4) = 100 %)

Parameters – Voltage output stage

Symbol:	Function:	Range:	Unit:	ID address:
Vq	Present Vq voltage component	±4096	Num	0x29
Vd	Present Vd voltage component	±4096	Num	0x2A
V out	Present output voltage	±4096	Num	0x8A
V red	Field weakening control - voltage reference value in % of V out (V red ≠ 0, 100 % → activation field weakening) Recommendation: 60..80 %	0..100	%	0x8B
V kp	Field weakening control – proport. amplific. in the voltage controller	0..65535	Num	0x8C
V-Ti	Field weakening control – integral time (integral time constant)	0..65535	Num	0x8D
Vdc-Bus	Measuring value of the dc bus voltage	0..32767	Num	0xEB

Parameters – Speed command value presetting and actual speed value

Symbol:	Function:	Range:	Unit:	ID address:
Ain 1 scaled	Analog command value presetting – input Ain1	±32767	Num	$0xD5_H$
Ain 2 scaled	Analog command value presetting – input Ain2	±32767	Num	$0xD6_H$
N set (dig.)	Digital speed command value presetting	±32767	Num	0x31
M set (dig.)	Digital command value presetting of Iq-current	±32767	Num	0x90
N cmd (int)	Speed command value used (internal)	±32767	Num	0x5D
N cmd (ramp)	Speed command value after ramp	±32767	Num	0x32
N actual	Actual speed value signal for the control	±32767	Num	0x30
N act (filt)	Actual speed value signal for the display	±32767	Num	0xA8
N error	Control error actual speed value	±32767	Num	0x33

Parameters – Limiting, ramps for the speed and torque presetting

Symbol:	Function:	Range:	Unit:	ID address:
N R-Acc	Speed – acceleration ramp	0..30000	ms	$0x35_L$
N R-Dec	Speed – braking ramp	0..30000	ms	$0xED_L$
M R-Acc	Torque – acceleration ramp	0..4000	ms	$0x35_H$
M R-Dec	Torque – reduction ramp	0..4000	ms	$0xED_H$
M R-Rcp	Torque – recuperation ramp ($0xCD_{Bit\ 4}$)	0..4000	ms	$0xC7_H$
R-Lim	Emergency stop, ramp limit switch	0..1000	ms	$0xC7_L$
Nmax100%	Physical reference value for the internal resolution of the speed to 16 Bit (±32767)	100..50000	rpm	0xC8
N-Lim	Speed limiting for positive and negative rotation direction	0..100	%	0x34
N-Lim+	Limiting for the positive rotation direction (if the logic input N clip(neg&pos) is activated)	0..100	%	0x3F
N-Lim-	Limiting for the negative rotation direction (if the logic input N clip(neg&pos) is activated)	0..100	%	0x3E
Filter	Actual speed value filter	0..10	Num	0x5E

Parameters – Speed controller

Symbol:	Function:	Range:	Unit:	ID address:
Kp	Proportional amplification	0..200	Num	0x2C
Ti	Integration time (integral time constant)	0..10000	ms	0x2D
Td	Differential time	0..100	ms	0x2E
TiM	Max. value from the integral memory Ti	0..100	%	0x3B

Parameters – Position controller reference run

Symbol:	Function:	Range:	Unit:	ID address:
Speed 1	Speed to the limit switch Depending on the speed the limit switch is passed	0..32000	Num	$0x76_L$
Speed 2	Reverse speed back to the zero pulse (cycle speed)	0..2000	Num	$0x77_L$
Reso Edge	Expected switching edge	0..65536	Num	0x75
Ref Ramp	Selection of the ramp for the reference run between N R-Acc and R-Lim	DEC / LIM		$0x5A_{Bit\ 5}$
The zero point of the incremental measuring system is determined by the reference run				

Parameters – Position controller (Pos->Speed)

Symbol:	Function:	Range:	Unit:	ID address:
Kp	Proportional amplification determines the slope of the deceleration ramp	0..200	Num	0x6A
Ti	Integration time (depending on Kp)	0..10000	ms	0x6B
Td	Differential time (differential component)	0..1000	ms	0x6C
TiM	Max. value from the integral memory Ti	0..100	%	0x71
The amplified position error forms the speed command value The position control is deactivated when Kp = 0 The dynamic control amplification Ti is only effective in the target range				

Parameters – Position parameters

Symbol:	Function:	Range:	Unit:	ID address:
Tol-wind.	Position tolerance window	0..2000	Num	0x79
Off.Ref.	Mechanic zero point offset		Num	0x72
ND-Scale	NDrive position display factor	32 Bit - 1	Num	0x7C
ND-Offset	NDrive position display offset	32 Bit - 1	Num	0x7D
Pos dest	Target position presetting	±32 Bit - 1	Num	0x6E
Pos cmd	Used target position (internal)	±32 Bit - 1	Num	0x91
Pos actual	Actual position value signal for the control	±32 Bit - 1	Num	0x6D
Pos error	Control error actual position value	±32 Bit - 1	Num	0x70
Inc-Out	Incremental output		Inc/Rev	$0xCF_H$
Inc-ext	Incremental 2nd feedback		Inc/Rev	$0xCF_L$
Factor-ext	Factor 2nd feedback		Num	0x7E
32 Bit - 1 → 2^{32} - 1 = 4.294.967.295 ±32 Bit - 1 → ±2^{32-1} - 1 = ±2.147.483.647				

Parameters – Frequency converter parameter setting for the FU characteristic curve

Symbol:	Function:	Range:	Unit:	ID address:
FU start				
T dc	Pre-magnetizing time Delay between the switching-on and the starting of the frequency	10..2000	ms	$0x07_L$
U dc	Pre-magnetization dc voltage value	0..20	%	$0x08_L$
U min	Minimal voltage (boost) at motor standstill. → U/F Kennlinie wird angehoben Recommended: U min = U dc	0..100	%	$0x0A_L$
F min	Minimal frequency at motor standstill	0..100,0	Hz	$0x0B_L$
V corner	Maximal output voltage at base freuquency	0..100,0	%	$0x0C_L$
F corner	Base frequency for max. output voltage	1..1000,0	Hz	$0x0D_L$
F-sh [8]	Characteristic curve shape (linear, semi-square, square)	0..3	Num	$0x0F_{Bit\ 2..1}$

[8] Parameters – F-sh (FU start)

Symbol:	Function:	ID address: $0xA4_{Bit\ 2..1}$
Linear	(at the moment only Linear option avaiblable)	0 dec
quad/2		1 dec
quad		2 dec
opt		3 dec

Parameter – Logic Bit

Symbol:	Function:	ID address: 0xD8
LMT1	Digital input limit 1 active	Bit 0
LMT2	Digital input limit 2 active	Bit 1
IN2	Digital input Din 2 active	Bit 2
IN1	Digital input Din 1 active	Bit 3
FRG (RUN)	Hardware enable active	Bit 4
RFE	Rotating field enable active	Bit 5
		Bit 6
		Bit 7
OUT1	Digital output Dout 1 on	Bit 8
OUT2	Digital output Dout 2 on	Bit 9
BTB (Rdy)	Hardware relay, output BTB (Rdy) on	Bit 10
GO	Internal enable GO active	Bit 11
OUT3	Digital output Dout 3 on	Bit 12
OUT4	Digital output Dout 4 on	Bit 13
G-OFF		Bit 14
BRK1	Excited brake	Bit 15

Parameters – Logic output comparison variable

Symbol:	Function:	Range:	Unit:	ID address:
0	Logic signal zero	1/0	Logic	
1	Logic signal one	1/0	Logic	
Var1	Numeric value of the entered variable fields	±32767	Num	0xD1
Var2				0xD2
Var3				0xD3
Var4				0xD4
Ain1	Analog value input Ain1	±32767	Num	
Ain2	Analog value input Ain2	±32767	Num	

Parameters – CAN Bus interface

Symbol:	Function:	Range:	Unit:	ID address:
NBT	CAN transfer rate (see list)	0..0xFFFE	hex	$0x73_{Bit\ 11..0}$
Rx ID	CAN ID – receiving address	0..0x7EE	hex	0x68
Tx ID	CAN ID – sending address	0..0x7EE	hex	0x69
T-Out	CAN Timeout time	0..60000	ms	0xD0
Achse	Axis designation (freely writable)	4 Zeichen	ASCII	0xF8

Parameters – CAN Bus NBT possibilities

Baud rate NBT:	Setting value in NBT (0x73):	Line length max.
1000 kBaud	0x4002	20 m
625 kBaud	0x4014	70 m
500 kBaud	0x4025 (Default)	70 m
250 kBaud	0x405C	100 m
125 kBaud	0x4325	100 m
100 kBaud	0x4425	100 m

Parameters – Error mask

Display on the servo:	Error message in NDrive:	Description:	ID address: 0x8F$_L$
	NOREPLY-No RS	RS232 interface not plugged in or disrupted	
0	BADPARAS	Defective parameter	Bit 0
1	POWER FAULT	Hardware fault	Bit 1
2	RFE	Faulty safety circuit (only active for RUN)	Bit 2
3	BUS TIMEOUT	CAN TimeOut time exceeded	Bit 3
4	FEEDBACK	Bad or faulty encoder signal	Bit 4
5	POWERVOLTAGE	No power supply voltage	Bit 5
6	MOTORTEMP	Motor temperature too high	Bit 6
7	DEVICETEMP	Device temperature too high	Bit 7
8	OVERVOLTAGE	Overvoltage >1.8 x UN is reached	Bit 8
9	I_PEAK	Over-current or strongly oscillating current detected	Bit 9
A	RACEAWAY (*)	Racing (without command value, incorrect direction)	Bit 10
B	USER	User – error selection	Bit 11
C			Bit 12
D			Bit 13
E	HW_ERR	Current measuring fault	Bit 14
F	BALLAST*	Ballast circuit overload	Bit 15
* Error F is a unit-dependant error (without function for BAMOBIL and BAMOCAR)			

Parameters – Warning mask

Display on the servo:	Warning message in NDrive:	Description:	ID address: 0x8F$_H$
0	WARNING_0	Inconsistent device identification	Bit 16
1	ILLEGAL STATUS	Faulty RUN signal, EMI	Bit 17
2	WARNING_2	Inactive RFE signal (without RUN input active)	Bit 18
3			Bit 19
4			Bit 20
5	POWERVOLTAGE	Power voltage missing or too low	Bit 21
6	MOTORTEMP	Motor temperature > (I-red-TM or 93% of M-temp)	Bit 22
7	DEVICETEMP	Device temperature > 87 % of the limit	Bit 23
8	Vout_Sat	Limit of the existing voltage output reached	Bit 24
9	I_PEAK	Overcurrent 200 %	Bit 25
A	RACEWAY	Resolution range of the speed measuring exceeded	Bit 26
B			Bit 27
C			Bit 28
D			Bit 29
E			Bit 30
F	BALLAST*	Ballast circuit overload > 87 %	Bit 31
* Warning F is a unit-dependant error (without function for BAMOBIL and BAMOCAR)			

Parameters – Status display

Symbol:	Function:	ID address: 0x40
Ena	Drive enable (combination hardware RUN and software)	Bit 0
NcR0	Speed limit to zero (Speed command still active)	Bit 1
Lim+	Limited switch Plus tripped	Bit 2
Lim-	Limited switch Minus tripped	Bit 3
OK	Drive okay (no uncontrolled reset)	Bit 4
Icns	Current is limited to the continuous current level	Bit 5
T-Nlim	Speed limited torque mode active	Bit 6
P-N	Position control active	Bit 7
N-I	Speed control active	Bit 8
<N0	Actual speed less than 0.1 % (standstill)	Bit 9
Rsw	Reference switch tripped	Bit 10
Cal0	Calibration move active	Bit 11
Cal	Calibration move completed (position calibrated)	Bit 12
Tol	Position within tolerance window	Bit 13
Rdy	Drive ready (BTB/RDY contact is closed)	Bit 14
Brk0	Unexcited brake with motor active	Bit 15
SignMag	Speed internally inverted	Bit 16
Nclip	Speed limiting enabled (N-Lim < 90 %)	Bit 17
Nclip+	Speed limiting (positive) via input switch enabled	Bit 18
Nclip-	Speed limiting (negative) via input switch enabled	Bit 19
Ird-Dig	Current limiting via input switch enabled	Bit 20
Iuse-rchd	Actual current limit reached	Bit 21
Ird-N	Current derating to continuous current via speed limit enabled	Bit 22
Ird-TI	Current derating to continuous current due to igbt temperature enabled	Bit 23
Ird-TIR	Current derating to continuous current due to igbt temperature active	Bit 24
>10 Hz	Current derating to continuous current at rotation frequency less than 10 Hz active	Bit 25
Ird-TM	Current limiting due to motor temperature reached	Bit 26
Ird-Ana	Current derating due to analog input (if ≤90 %) possible	Bit 27
Iwcns	Current peak value warning	Bit 28
RFEpulse	Pulsed RFE - input monitoring active	Bit 29
M+d	vacant	Bit 30
HndWhl	Hand-wheel function selected	Bit 31

Parameters – Switch settings for special functions (mode bits)

Symbol:	Function:	ID address: $0x51_{Bit\ 9..0}$
Reserve		Bit 0
SPEED = 0	Drive stop, speed command value = 0	Bit 1
ENABLE OFF	Drive disabled, enable internally switch off	Bit 2
CANCEL CAL-CYCLE	Reference run stopped	Bit 3
d(status)->CAN		Bit 4
I-clip on	Current limit in % of the type current active	Bit 5
N-clip on	Speed limiting (positive and negative)	Bit 6
Mix ana on	Speed command value digital plus analog	Bit 7
Allow sync		Bit 8
HndWhl	2nd feedback as handwheel	Bit 9

Parameters – Parameters on the page ‚Monitor‘

Symbol:	Function:	Range:	Unit:	ID address:
N cmd (ramp)	Speed command value after ramp and limit	0..32767	Num	0x32
N actual	Actual speed value	0..32767	Num	0x30
I cmd	Current command value (internal)	0..600	Num	0x26
I act (filt)	Present sum current after display filter	0..600	Num	0x5F
Id actual	Present reactive current (Id)	0..600	Num	0x28
Iq actual	Present active current (Iq)	0..600	Num	0x27
Ixt	Capacity Ixt	0..4000	Num	$0x45_L$
Power	Motor power (DO NOT USE!)	0..4000	Num	0xF6
Vdc-Bus (dir)	Bus circuit voltage	0..32767	Num	0xEB
Regen Power	Ballast power	0..4000	Num	$0x45_H$
T-motor	Present motor temperature	0..32767	Num	0x49
T-igbt	Present output stage temperature	0..32767	Num	0x4A
T-air	Present air temperature in the servo	0..32767	Num	0x4B
I lim inuse	Present current limit	0..600	Num	0x48
V out	Present output voltage	0..4000	Num	0x8A

Parameters – Core options (Do not modify!)

Symbol:	Function:	ID address: 0x5A
Vdc comp	Analoge Zwischenkreismesswert beeinflusst Uout	Bit 0
Rregen-ext	External ballast resistance	Bit 1
TJ spec	Activation encoder monitoring	Bit 2
Coast	Free coasting (do not use an emergency stop ramp)	Bit 3
lact inv	Inverted actual current value polarity (factory setting active for DS450, BAMO-D3)	Bit 4
Ref soft	Reversal ramp for reference run from Limit to „Dec“ set	Bit 5
Rdy - Run	BTB signal even for undervoltage error message	Bit 6
Vdc ana	Analog bus circuit mesuring	Bit 7
Rdy del	Current measuring of I1 activated	Bit 8
Hall inv	Inverted order of the Hall signals	Bit 9
H.2 inv	Hall signal 2 inverted	Bit 10
OL comp	Over Loop current limit or slip compensation enable	Bit 11
MotorType: .0	Motor selection	Bit 13..12
.1		
ana Oup	Measuring range of the Vdc Bus voltage across the processor pin (1 = 0..5V) or (0 = 2.5..5V)	Bit 14
low baud	Interface RS232 uses 9600 Baud	Bit 15
s-ramp	Selection S-ramp active	Bit 16
4-ramp	Selection 4 ramps active	Bit 17
mot brk	Selection with brake active	Bit 18
ad dc	AC or DC power supply	Bit 19
PWM freq: .0	Setting PWM pulse frequency	Bit 22..20
.1		
.2		
ntc	IGBT NTC Temperature Sensor	Bit 23
star-del	Motor phase delta	Bit 24
dc 1Q	DC 1-quadrant, direct voltage supply PWM	Bit 25
dc field	DC field control	Bit 26
dead x2	Deadband *2	Bit 27
block	Block current at feedback RED	Bit 28
dc 1Qmv	DC 1-quadrant, min. switching losses	Bit 29
dc 1Q3p	DC 1-quadrant, no high-side , -UB switch parallel	Bit 30
Frd<10Hz	Switching to 4 kHz with n < 10 Hz (no derating)	Bit 31