M A N U A L

PC User Software

for servo amplifiers (DS, DPC)
and battery motor controller
(BAMOBIL-D, BAMOCAR)

NDrive.3

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Edition / Version

2024 / V1

Table of contents

1 Basis – Information

1.1 History

Version	Change	Date
2016 / V1.1	Fax number changed / page 68 (Iq - adjusted)	02.08.2016
2017 / V1	Error list / parameters	14.11.2017
2020 / V1	Complete revision	27.01.2020
2021 / V1	Adaptation to new Revised NDrive	01.03.2021
2023 / V1	Adaption Error- and Warningslists Correction of spellings and visuals	28.03.2023
2024 / V1	Field Weakening addition for Firmwares ≥ FW482 Small corrections (e.g. Homepage Link, etc.)	16.09.2024

Attention:
Only use **NDrive** for units with firmware FW-350 or higher (device serial number 70000 or higher).

Information:
Due to the great complexity and the constant further development of the NDrive program, sections and especially the images in this NDrive manual may not always correspond to the current version of NDrive.
We are constantly working to keep manuals up to date.

1.2 User manuals for UniTek digital devices

Accesible manuals can be found on our homepage at the section Downloads
Online: https://www.unitek-industrie-elektronik.de/downloads/

This includes:

- NDrive manual
- Hardware device manuals (Analog, Digital, Servo and Thyristor UNITEK motor controller)
- Accessories (Transformer, Choke, UGM, …)
- Whitepaper (CAN-Bus, FAQ, Firmware update, Initialisation guides, Special functions, …)

These manuals contain warnings and safety instructions, explanations of standards, mechanical and electrical installation instructions.

All manuals must be made accessible to all persons working with the unit.

Please also check the NDrive folder .../NDrive/manuals for more interesting manuals.

Abbreviations / Terms

Servo	Digital UNITEK motor controller
Device	Digital UNITEK motor controller

1.3 General

The PC user software NDrive is used for setting and optimising the digital three-phase motor controller (DS, DPC) and analog battery motor controllers (BAMO-D, BAMOBIL-D, BAMOCAR-D) from UniTek.
Basic knowledge of operating a PC and the WINDOWS operating system is required.

The NDrive software and manual are available at our hompage.

1.4 Safety instructions

With the NDrive software, the parameters and
Settings of servo and motor preselected.
The operating parameters can be preset and adjusted during the operation can be changed.
PC and the PC programmes are not functionally reliable.
The user must ensure that, in the event of a malfunction, no Danger to man and machine can occur and the drive is shut down.

Stored data records can be changed by third parties. After a data record has been read in, it must be checked before it is reused.
Only trained specialists with knowledge of drive technology, control technology and PC operation may make settings and optimisations on the running drive.
The safety instructions of the amplifier or motor controller used must also be observed.
Operation deviating from safety conditions is not permitted.

1.5 Operating system

NDrive is executable with Windows - 2000, - NT4, - XP, - Vista, - 7, - 8, - 10, - 11.

Minimum PC equipment	
Processor	80486 or higher
Graphic	WINDOWS compatible
Hard disk space	40 MB
Minimum working memory	8 MB
Interface	COM1 to COM8 (RS232, USB adapter)

Windows is a registered trademark of Microsoft Corp.

Linux
The use of NDrive via one of the LINUX operating systems is possible with the help of a Windows emulator (e.g., Wine).

1.6 Software – Installation

The user software NDrive can be downloaded from the UniTek homepage.

No installation is necessary to run NDrive.
Only the (.exe) application file must be executed.

Hint:
Since NDrive is not a commercial software application, the selection of untrusted software must be accepted once in Windows.

Internet:

- Go to the UniTek homepage https://www.unitek-industrie-elektronik.de/.
- Click on the **Download** → **NDrive2-Software.zip** button.
- Download the file (NDrive2-Software.zip) and save it.
- Unzip the file (NDrive2-Software.zip).
- Start the NDrive programme by executing the (.exe) application file.
- It is advisable to set the language at the very first start (Help → Change language...) and to restart NDrive so that the language files are loaded correctly.

2 NDrive Design

2.1 NDrive Design – Overview

The screen display of NDrive is divided into a fixed screen area and a freely selectable screen area.

The fixed screen area (blue, green and black highlighting) always remains and shows basic important information.

This is divided into the following areas:

Fixed screen area:	**Description:**
Headboard (blue)	• Title bar • Menu bar
Left field (green)	• SPEED Speed display in revolutions per minute (rpm) and 16 Bit numeric (Num) Bar display 0... 100 % speed • CURRENT Current display in Arms and 16 Bit Numeric (Num) Bar graph display 0... 200 % nominal current • In-Out Status display of the digital input and output pins: - Green: Input is present or detected and output is set. - Grey: Input not applied and output not set • Status General status information (operating states, derating, limitations, etc.) • Warnings and errors Information fields of the attached warning and error messages • Test Control panel for manual digital control commands of speed (N), torque (Iq) or position Speed (N) or torque (Iq): Numerical input (0..32767) [+] → Positive command from the set value of Speed (N) or Torque (Iq) [O] → Command value of zero for Speed (N) or Torque (Iq) selection [-] → Negative command from the set value of Speed (N) or Torque (Iq) Position: Numerical input (±32 Bit - 1) Dest → Command to drive to the numerical entry of Position P. → Preset entry as actual position value and command value Calib → Start of a calibration run
Footer (black)	• Left: Communication state of the servo connection to NDrive (serial or CAN) • Middle: Firmware number • Right: Axis designation (self-definable)

The freely selectable screen area (red area) is divided into various tabs and is generally used for setting the various parameters as well as various displays of the internal system structures.

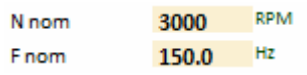
This is divided into the following tabs:

Tab screen area:	**Description:**
Start	UniTek NDrive home page with a link to the homepage and contact information.
Settings	Main parameter settings page. Compact display with all important parameters for configuring the servo controller. This is divided into the main areas of Motor, Servo and Parameter as well as various sub-areas.
Speed	Structural diagram of the speed and current control logic in the servo. Divided into the input speed or torque control commands (analog and digital), speed ramping and control, current ramping and control, as well as the output value of the PWMs and voltage output.
Position	Structural diagram of the position control logic in the servo. Divided into the input position control commands and controller structure, speed ramp settings and the structure image of the calibration run.
Logic	Setting page of the digital inputs and outputs. Subdivided into the configuration of the special functionalities of the inputs and the state setting for automatically setting the respective outputs.
Bus	Setting page of the CAN bus communication.
Oscilloscope	Page with the NDrive software oscilloscope. Useful tool for configuring and analysing the operating characteristics of the servo and tuning the control system.
Monitor	Overview page with important measured variables.
Device	Overview page with important servo information. (Mainly used for service support analysis)
Diagnosis	Diagnostic page for displaying individually selected measured variables, as well as manual readout of signals and setting of parameters via the ID addresses.
Auto	Settings page for motor-specific parameters and the menu for activating special functions.
Extra	Overview page with important servo information. (Mainly used for service support analysis)

Note:
Parameters that appear in different tabs are automatically adopted in the other tabs when changes are made.

2.2 NDrive Design – Controls

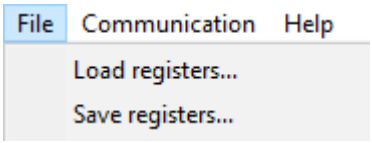
2.2.1 Controls – Input and selection



Input field
Click on the selected parameter input field (left mouse button),
Enter the numerical value and confirm with the return key.
The changed input field is written to the servo RAM.

Use only whole numbers or numbers with dots after them.
Positive values without sign, negative values with (-) sign.

The numerical values of each input field can also be changed with the mouse scroll wheel. Here too, the numerical value is immediately written to the servo RAM.

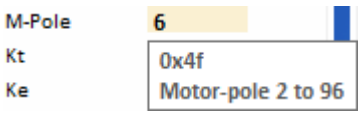


Dropdown menu
Click on the selected option in the menu bar,
and the menu items of the selected drop-down list appear.
Then the desired function of the individual menu items can be selected.

Pull-down menu
Click the arrow key on the selection field. The selection field enlarges. Scroll up or down. Click on the desired selection. The desired selection is accepted and the field is reduced to one display.

Selection keys
Click on the desired option in the keypad. The green keypad shows the selected function.

The tick in the function field shows the selected function



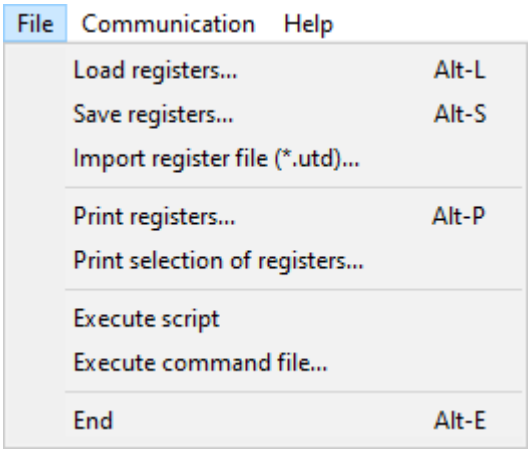
Tooltip
Move the cursor to the parameter field or setting field with the mouse and a pop-up explanation field (tooltip) opens.

This usually contains the corresponding ID address and a short description.

3 Details Menu Bar / Help

3.1 Details Menu Bar / Help – File

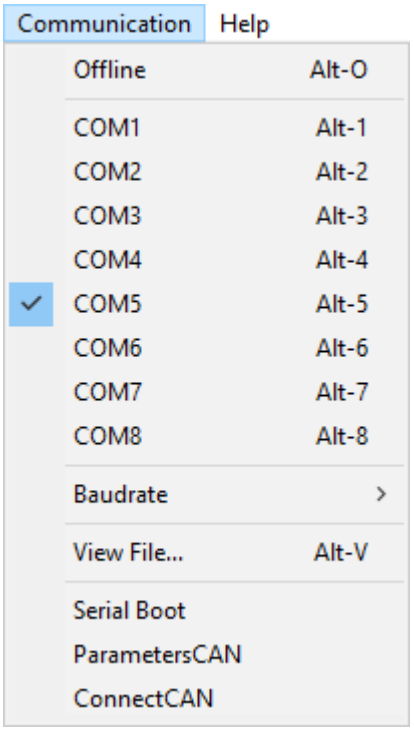
Contents of the menu bar when selecting **File** with the associated hotkeys.



Menu items from File:	Hotkey:	Description:
Load registers...	Alt + L	Load UniTek Register File (.urf) → Load parameter file from PC into servo Ram
Save registers...	Alt + S	Save UniTek Register File (.urf) → Distinction if NDrive is online or offline Online: Save parameter file from servo Ram to PC Offline: Save parameter file from NDrive to PC
Import register file (*.utd)...		Import UniTek Drive File (.utd) → Load drive file from PC into the servo **Note:** *Function currently deactivated!*
Print registers...	Alt + P	Printing contents of all registers (parameters and variables)
Print selection of registers…		Print the contents of the selected tabs → The definition of which registers are selected is made in the file ".... \settings\reglist.txt".
Execute script		Performing a UniTek Script File (.usf) **Note:** For production only!
Execute command file...		Executing a Command File (.cmd) **Note:** *Function currently deactivated!*
End	Alt + X	Close NDrive → Disconnect the servo and close the window

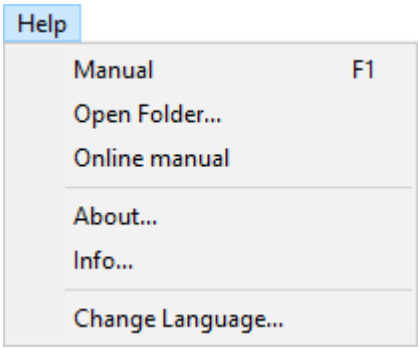
3.2 Details Menu Bar / Help – Communication

Content of the menu bar when selecting **Communication** with the associated hotkeys.



Menu items from Communication:	**Hotkey:**	**Description:**
Offline	Alt + O	Go offline → Terminate communication (serial or CAN) with the servo.
COM1..8	Alt + 1..8	Connect NDrive via the serial COM port (1.. 8) → After selecting the COM port NDrive tries to connect to the servo.
Baudrate		Setting the serial baud rate → The servo default baud rate is 115200
View File…	Alt + V	Show contents of a UniTek Register File (.urf) (offline) → Load parameter file from PC into NDrive. → NDrive disconnects an existing connection to the servo.
Serial Boot		Executing the Serial Boot Function **Note:** *Function currently deactivated!*
ParametersCAN		Open parameter setting for CAN bus configuration → The CommunicationCAN window opens.
ConnectCAN		Connecting the NDrive via the CAN bus → The condition is the correct CAN bus configuration in the CommunicationCAN window.

3.3 Details menu bar / Help – Help



Contents of the menu bar when selecting **Help** with the associated hotkeys.

Menu items from Help:	**Hotkey:**	**Description:**
Manual	F1	NDrive Manual Open (Local) → Open the NDrive manual in the directory "..\manuals".
Open Folder...		Opens the local NDrive directory "..\manuals". **Note:** Contains many other useful servo manuals such as a initialization manual for PMS motors with resolver → "BAMOCAR_Initialization_process.pdf".
Online manual		NDrive Manual Open (Online) → Link to the Online NDrive Manual on the UniTek Homepage.
About...		View NDrive Software Version Information → Opens the About NDrive Utility Software window which displays version information about the NDrive in use.
Info...		View NDrive Software Debug Information → Opens the Menu Info window which displays useful debug information from NDrive. → Useful for analysing connection problems between NDrive and servo.
Change Language...		Set NDrive language → Opens the Language window to set the NDrive language. **Note:** NDrive must be restarted after changing the language.

4 Communication with NDrive

4.1 Communication with NDrive – Hardware

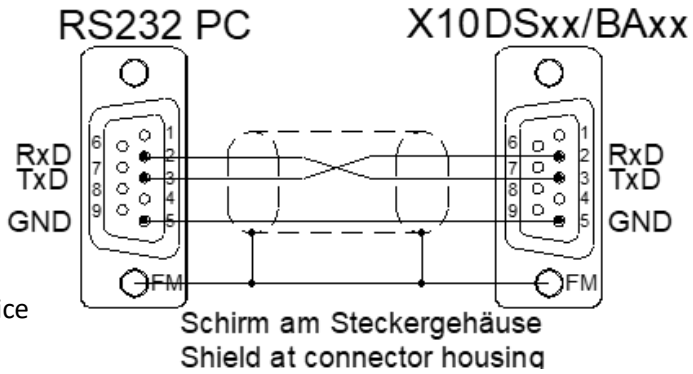
For successful communication with NDrive via either Serial RS232 or CAN, appropriate hardware must be used for the respective communication method.

Serial RS232 (COMx)

NDrive communicates from the PC with the servo via RS232 (default baud rate 115200).

If the PC has a USB interface, use a USB to serial RS232 adapter.

Only connect the connecting cable when the Plug and pull interface.
The interface is galvanically connected to the device ground (GND).



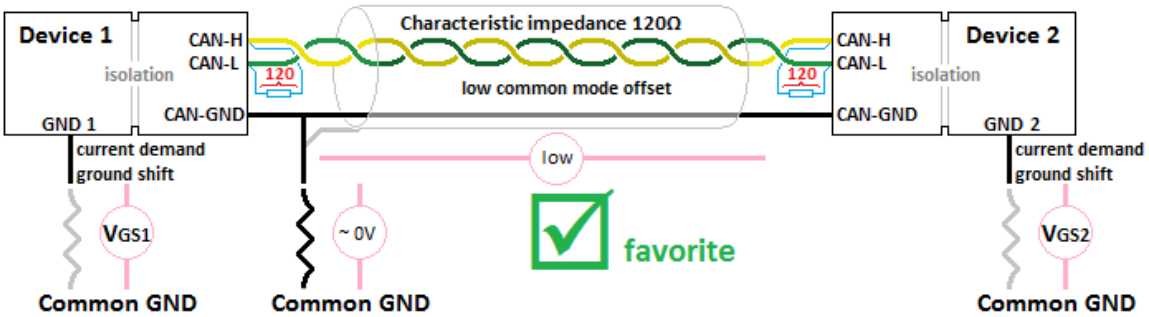
CAN bus

NDrive uses for the communication from the PC to the servo the CAN bus library from PEAK-System Technik GmbH.

Use a PCAN-USB adapter for the PC with USB interface.

An external power supply for the CAN bus is not necessary. The servo has an internal power supply.

The connecting cable from the PCAN-USB adapter to the servo must have the appropriate terminating resistors for a stable connection.



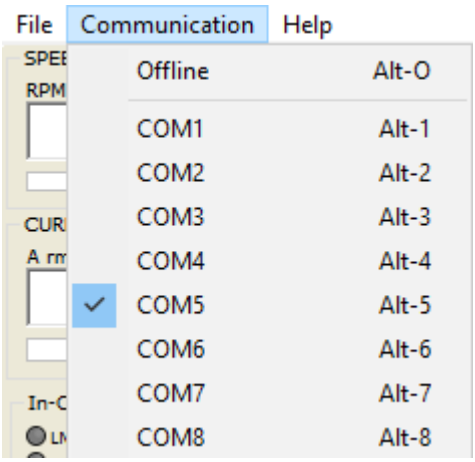
Note:
For general CAN communication with the servo independent of NDrive, other CAN bus providers (e.g. Vector CAN) can also be used.

4.2 Communication with NDrive – Establish connection

No additional drivers need to be installed for NDrive to communicate with the servo.
However, the corresponding drivers of the connected adapters (serial or CAN) must be installed.

4.2.1 Establish connection – Serial RS232

Before starting communication, make sure that the COM channel for the serial connection is known.



In the menu bar, open the option **Communication** and select the **COMx** interface (COM1 to COM8) and click on it. The hooked interface is selected and the connection to the servo is established.

The connection status is displayed in the footer.
The connection was successful if **Drive is online (COMx, ...)** can be seen in the status bar.

Drive is online (COM5, 115200).

All parameter fields update their fields with the values from the servo RAM memory.

End communication:
Open the option **Communication** in the menu bar and click on ***Offline***.
The disconnected connection is displayed in the footer.
The footer flashes: "**Drive is offline.**".

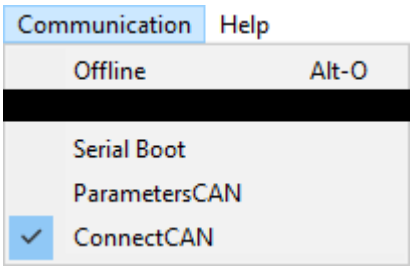
4.2.2 Faulty communication – Serial RS232

1. Scroll through data in the warning or error display
   ➔ COM connection not OK or wrong COM port selected.

2. Status symbols flash or an additional window appears with an error message
   ➔ Download the new NDrive from the UniTek homepage (link).
   ➔ Contact UniTek Customer Service.

3. All names are displayed incorrectly.
   ➔ Select the language via **Help → Change Language...** and restart NDrive.

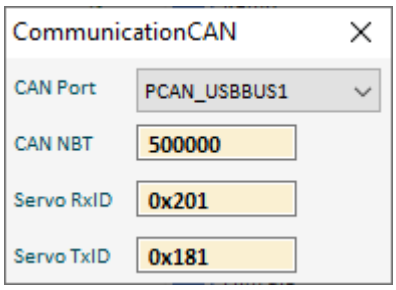
4.2.3 Establish connection – CAN Bus



Ensure before starting communication,
that the CAN port channel of the PCAN-USB adapter is known.

At the beginning, the CAN configuration must be carried out once.

In the menu bar, open the option **Communication** and
select **ParametersCAN** and the **CommunicationCAN** window
opens. This is where the CAN communication is configured.

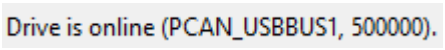


For a first connection, the default settings are

Can Port:	PCAN_USB1	(Depending on user CAN port channel!)
CAN Baud:	500000	(500 kBaud)
Servo RxID:	0x201	
Servo TxID:	0x181	

To establish a connection, open the following in the menu bar
the **Communication** option and click on the **ConnectCAN** selection.

The connection status is displayed in the footer.
The connection was successful if **Drive is online (PCAN_USBBUS1, 500000)**
can be seen in the status bar.



All parameter fields update their fields with the values from the servo RAM memory.

End communication:
Open the option **Communication in** the menu bar and click on ***Offline.***
The disconnected connection is displayed in the footer.
The footer flashes: "**Drive is offline.**".

4.2.4 Faulty communication – CAN bus

1. No connection is established.
   - ➔ Check hardware and wiring.
   - ➔ Check whether the correct drivers are installed for the PCAN-USB adapter and that it was really recognised (→ see Windows Device Manager).
   - ➔ Check the settings in the CommunicationCAN window.

   A good way to check the general CAN communication with the servo is to send a single CAN message via a general CAN program (e.g. PCAN-View) and check if the servo responds.

   Example:

Send	ID: 201h DLC: 3 Msg.: 3D 1B 00	→ Request for firmware number
Receive	ID: 181h DLC: 4 Msg.: 1B DE 01	→ FW number 478

2. All names are displayed incorrectly.
   - ➔ Select the language via **Help → Change Language...** and restart NDrive.

4.3 Firmware update

In the folder of the PC user software NDrive: ...\NDrive2-Software\manuals",
use the manual " **Firmware update-2020-C2Prog_EN.pdf** ".

PC user software NDrive:

UniTek Homepage: https://www.unitek-industrie-elektronik.de/

Link	Download	
Download	NDrive	Press "Software" and save (e.g. downloads)
Extract	NDrive_xxx.zip	Press RM + (Extract all... / Unzip here)
Start	Execute the NDrive .exe file	

5 Saving and Loading of servo parameters

5.1 Saving and Loading in the servo (Eprom)

When communication is active, the parameter set currently displayed in the PC is present in the unit RAM with the same content.
By pressing the return key, the changed parameter is directly updated to the servo RAM.

5.1.1 Saving in the servo (Eprom)

Eprom Write (save parameters permanently):
Click on the **"Eprom - STORE 0 or 1"** button on the Settings page.

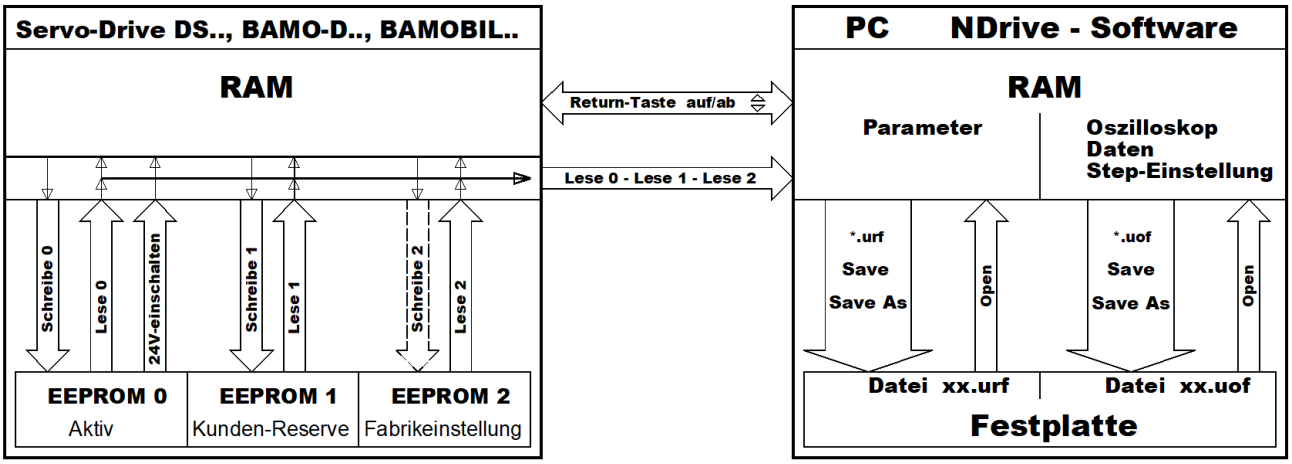
The parameter data is written to the selected level 0 or 1 from the Eprom.
Eprom level 0 contains the current parameter set.
Each time the 24 V auxiliary voltage is switched on, all parameters from Eprom level 0 are loaded into the RAM memory of the servo.

Attention:
When the 24 V auxiliary voltage is switched off, the RAM data is lost.

5.1.2 Loading from the Eprom

Eprom read (parameter load):
On the Setting page, click on the **"Eprom - RECALL 0, 1 or 2"** button.

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



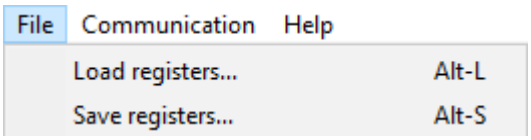
5.2 Save parameter data to and load from PC

5.2.1 Saving parameter data (.urf) on the PC

Saving the .urf (unitek register file) parameter file to the PC data carrier (hard disk, etc.) with the contents from the device RAM from the servo can be done in 2 different ways.

Via the menu bar:

Click on **File** in the menu bar.
Click on the option **Save register...**.
The Save Register File window opens.
Define the file name and save.



With the diskette symbol (save button):

On the Settings page, click on the **diskette symbol** (**Save)**.
The Save Register File window opens.
Define the file name and save.

5.2.2 Loading parameter data (.urf) from the PC

Loading the "unitek register file" (.urf) parameter file from a PC data carrier (hard disk, etc.) into the device RAM of the servo can be done in 2 different ways.

Via the menu bar:

Click on **File in** the menu bar.
Click on the option **Load Register...**.
The Load Register File window opens.
Select the Parameter (.urf) file and open.

With the folder icon (load button):

On the Settings page, click on the **folder icon** (**Load)**.
The Load Register File window opens.
Select the Parameter (.urf) file and open.

After loading, the parameters are now in the device RAM memory of the servo.
At the same time, all parameter fields in NDrive are overwritten with the loaded values.

5.2.3 Offline operation of parameter data (.urf) on the PC

Load, modify and save Parameter (.urf) files in offline mode:
In the menu bar click on **Communication** and then **View File...**.
After selecting the Parameter (.urf) file in the Load Register File window, all parameters are loaded into NDrive.

The loaded parameters can now be viewed and changed.

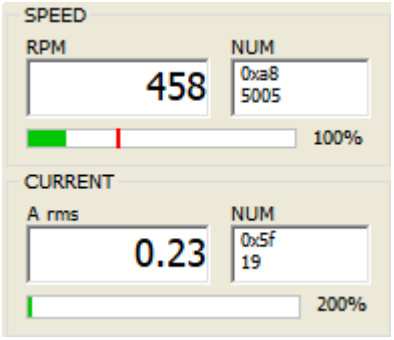
Click on **File** and **Save registers...** in the menu bar and save to the same or as a new parameter (.urf) file.

6 Basic status information

6.1 Status information – Speed and current

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

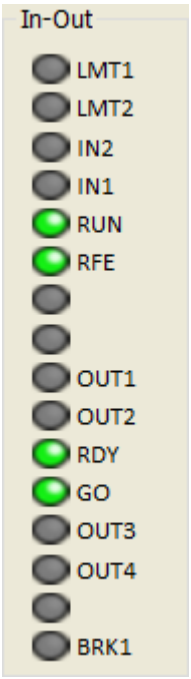
Current in Arms (effective motor current in amps) and as a numerical value from the measured value from the ID address 0x5F.



6.2 Status information – Inputs and outputs

If the input voltage is positive >10 V and the output voltage is set, the LED indicators will light up.

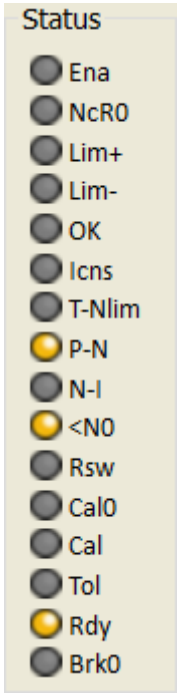
Symbol:	**Function:**	**ID address:** 0xD8
LMT1	Digital input limit 1	Bit 0
LMT2	Digital input limit 2	Bit 1
IN2	Digital input Din 2	Bit 2
IN1	Digital input Din 1	Bit 3
RUN (FRG)	Digital input of the software rotary field enable RUN	Bit 4
RFE	Digital input of the hardware rotary field enable RFE	Bit 5
	rsvd	Bit 6
	rsvd	Bit 7
OUT1	Digital output Dout 1	Bit 8
OUT2	Digital output Dout 2	Bit 9
RDY (BTB)	Hardware relay output BTB-Rdy	Bit 10
GO	State of internal enable GO	Bit 11
OUT3	Digital output Dout 3	Bit 12
OUT4	Digital output Dout 4	Bit 13
	rsvd	Bit 14
BRK1	State of excited Brake	Bit 15

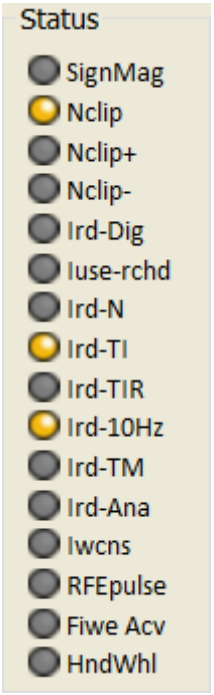


6.3 Status information – Status display

The operating states are shown in the status display / status field.

Symbol:	Function:	ID address: 0x40
Ena	Drive enabled (Combination hardware RFE and software RUN)	Bit 0
NcR0	Speed limited to zero (last setpoint still active)	Bit 1
Lim+	Limit switch plus active	Bit 2
Lim-	Limit switch minus active	Bit 3
OK	Drive in order (no uncontrolled reset)	Bit 4
Icns	Current limit reduced to continuous current	Bit 5
T-Nlim	Speed-limited while in torque control	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 run in progress	Bit 11
Cal	Calibration run completed (position calibrated)	Bit 12
Tol	Position within tolerance window	Bit 13
Rdy	Ready for operation (BTB/RDY contact closed)	Bit 14
Brk0	Brake not excited with motor active	Bit 15
SignMag	Setpoint inverted	Bit 16
Nclip	Speed limitation activated (N-Lim < 90 %)	Bit 17
Nclip+	Speed limitation positive via switch	Bit 18
Nclip-	Speed limitation negative via switch	Bit 19
Ird-Dig	Current limitation via switch	Bit 20
Iuse-rchd	Current reduction limit reached	Bit 21
Ird-N	Current reduction via speed	Bit 22
Ird-TI	Current reduction via output stage temperature enabled	Bit 23
Ird-TIR	Current reduction to continuous current via output stage temperature is active	Bit 24
Ird-10Hz	Current reduction at a rotation frequency smaller than 10 Hz	Bit 25
Ird-TM	Current reduction via motor temperature	Bit 26
Ird-Ana	Current reduction via analogue input (if ≤ 90 %)	Bit 27
Iwcns	Current peak warning	Bit 28
RFEpulse	Pulsed RFE input monitoring active	Bit 29
Fiwe Acv	Fieldweakening active	Bit 30
HndWhl	Handwheel input selected	Bit 31

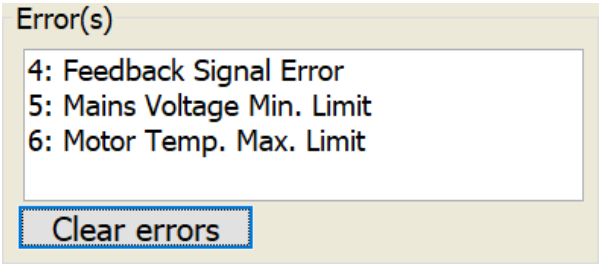




6.4 Status information – Error(s)

Error in NDrive:		ID-Address: 0x8F$_L$	Servo Display:
NOREPLY- No RS232 COM reply	RS232 interface not plugged in or disturbed		
0: Eprom Read Error	Reading from Eprom defective	Bit 0	0
1: HW Fault detected	Critical hardware error detected	Bit 1	1
2: RFE input not present	Safety circuit not present (With RUN input active)	Bit 2	2
3: CAN TimeOut Error	CAN TimeOut Time exceeded	Bit 3	3
4: Feedback Signal Error	Bad or missing feedback signal	Bit 4	4
5: Mains Voltage Min. Limit	Power voltage missing (digital) or below DC-Bus min limit (analogue)	Bit 5	5
6: Motor-Temp. Max. Limit	Motor temperature too high	Bit 6	6
7: IGBT-Temp. Max. Limit	Output stage temperature too high	Bit 7	7
8: Mains Voltage Max. Limit	Power voltage > 1.8 x UN (digital) or above DC-Bus max limit (analogue)	Bit 8	8
9: Critical AC Current	Overcurrent or strong oscillating current detected	Bit 9	9
A: Race Away detected	Spinning (without setpoint, wrong direction)	Bit 10	A
B: ECode TimeOut Error	Bad or missing ECode protocol	Bit 11	B
C: Watchdog Reset	CPU Reset because of Watchdog detected	Bit 12	C
D: I Offset problem	AC Current Offset detection fault	Bit 13	D
E: Internal HW voltage problem	Error beacuse of internal Voltage problem	Bit 14	E
F: Bleed resistor overload	*Only certain motor controllers*	Bit 15	F

In the **Error** state, the information of the errors is transmitted to NDrive via the ID address 0x8F and displayed in the "Error(s)" field.



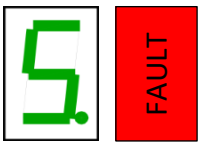
Attention:

- When the auxiliary voltage is applied with the enable closed (RUN X1:7 active), the red LED shows an error. There is no error indication in the 7-segment display.
- Error 1 (POWEWRFAULT) is a sum error message of the hardware monitoring. Additional checking of the status of the signal I Fault (ID: 0xE9) is necessary.

In case of an error:

- the red FAULT diode lights up and the error number is displayed
- the BTB contact is opened
- the software BTB message switches from 1 to 0
- the status message Rdy goes dark
- and when the enable is switched off, the error message remains.

Light indicator on servo



The error message is deleted (enable must not be set):

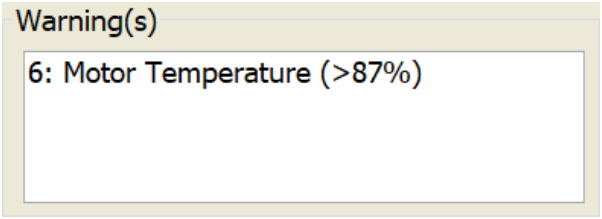
- when Cancel errors is activated by a digital input
- when a Cancel Errors command via CAN or Serial is send
- with a positive edge from the enable input RUN (FRG)

6.5 Status information – Warning(s)

Warnung in NDrive:		ID-Address: $0x8F_H$	Servo Anzeige:
0: Parameter conflict detected	Parameters are from different device type	Bit 16	0
1: Special CPU Fault	RUN input with jitter or EMI problems	Bit 17	1
2: RFE input not present	Safety circuit not present (without RUN input active)	Bit 18	2
3: Auxiliary Voltage Min. Limit[1]	Auxiliary Voltage is too low	Bit 19	3
4: Feedback Signal problem[2]	Bad or missing feedback signal (Feedback supervision deactivated)	Bit 20	4
5: Warn. 5		Bit 21	5
6: Motor-Temperature (>87%)	T-motor > (I-red-TM oder 93 % von M-Temp)	Bit 22	6
7: IGBT Temperature (>87%)	T-igbt > 87 % vom Limit	Bit 23	7
8: Vout Saturation Max. Limit	Limit of existing voltage output reached	Bit 24	8
9: Warn. 9		Bit 25	9
A: SpeedActual resolution Limit	Resolution range of the speed measurement exceeded	Bit 26	A
B: Check ECode ID: 0x94	Error with an ECode information at ID Register 0x94 detected	Bit 27	B
C: Tripzone Glitch detected	Tripzone triggered unintentional	Bit 28	C
D: ADC Sequencer problem	Problem of the ADC Sequencer channels	Bit 29	D
E: ADC Measurement problem	Problem of internal ADC voltages	Bit 30	E
F: Bleeder resistor load (>87%)[1]	Ballast circuit > 87 % overloaded	Bit 31	F

[1] Only certain motor controllers
[2] Feedback supersion is deactivated. Warning indicates that a Problem is present

In the **Warning** state, the information of the warnings is transmitted to NDrive via the ID address 0x8F and displayed in the "Warning(s)" field.

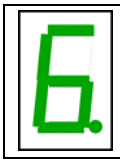


Attention:

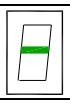
In case of a warning:

- The red error LED flashes and the green 7-segment display alternately shows the status and the warning number.

Example: Warning 6

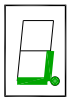
	**Fault**	**Light indicator:** • FAULT LED red - **flashing** • The display alternates between status and warning number 6	6: Motor-Temperature (>87%)

6.6 Status information – Operating status display on the servo

Display: (7 segment LEDs)	Dot/ dash:	Condition:	Status in NDrive:
	flashes dark	Processor active Auxiliary voltage missing or device internal hardware error	
	flashes lights up dark	Start status after reset (auxiliary voltage 24 V off-on) The first release ends the flashing state Drive enabled Drive locked (not enabled)	OK = 0 OK = 1, ENA = 1 OK = 1, ENA = 0
	lights up	Speed equal to zero (standstill message)	NO = 1
	lights up	Drive turns right, N current is positive	NO = 0
	lights up	Drive turns left, N current is negative	NO = 0
	flashes lights up dark	Motor current reduced to continuous current lwcns Motor current at maximum current limit lmax Normal operation. Motor current within current limits	lwcns = 1 lwcns = 0 lwcns = 0
	lights up for 0,1 s	Left bar: A new command (value) has been received from the BUS or RS232 Right bar: Digital input changed	

Example: Motor clockwise

Dot flashes = Processor active
Bottom line = Drive enabled
Right line = Motor turns right


(7 segment LEDs)

Ballast circuit
switches: Direction bar (bottom right or left) is switched off while the ballast circuit is switched on.

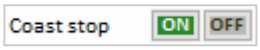
7 Enable

7.1 Enable – Hardware Input RUN (FRG) (Enable)

Switching on
Voltage at the enable input (X1:7, X1:G RUN (FRG)) is between 10..30 V=.
When the enable input is switched on, the power stage is enabled without delay.
The software control of the power stage is delayed by 2 ms.
Send operation commands such as setpoints, homing, etc. 5 ms after enable.
The Enable state is displayed in the status field at **Ena**.

Switching off
Voltage at the enable input (X1:7, X1:G RUN (FRG)) is less than 4 V=.
When the enable is switched off, the drive is electronically disabled.

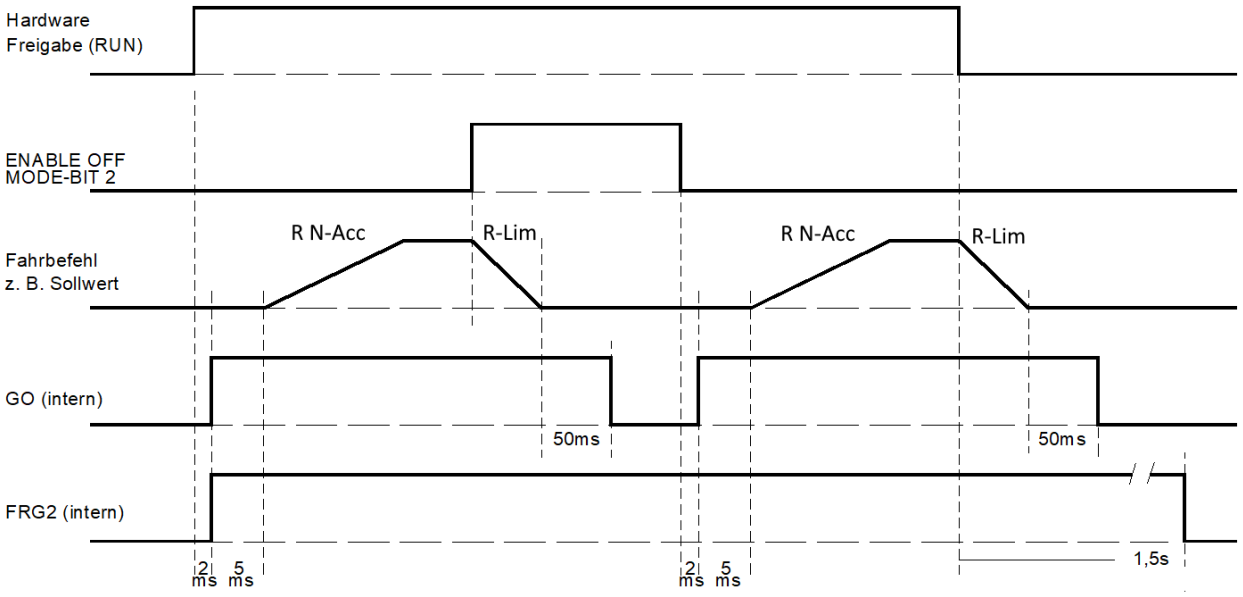
Switching off with emergency stop function (Coast stop Off)



The drive decelerates to standstill before it is disabled.
When the enable function is switched off, the internal speed setpoint value of **N cmd Ramp** is reduced to zero 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 of R-Lim + 50 ms has elapsed. The power stage is disabled after 1.5 s at the latest.

Switching off without emergency stop function (Coast stop ON)
When the enable is switched off, the power stage is immediately blocked.
The drive coasts to a stop without torque.

Set **R-Lim** (if Coast stop is OFF) so that the drive is decelerated to a standstill.
50 ms after the switch-off ramp time R-Lim has elapsed, the power unit is disabled.
After this the drive is free of torque.



7.2 Enable – Lock and enable via interfaces (CAN bus, RS232)

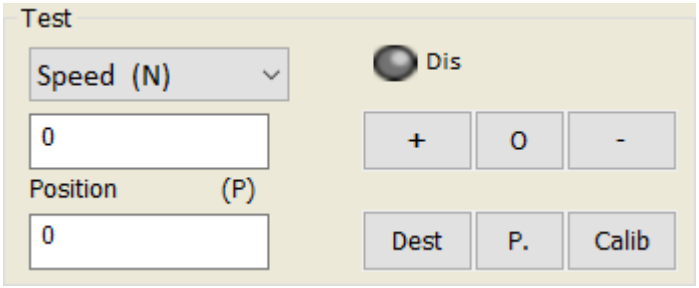
This is a special procedure to obtain a release if the release inputs are already present. I.e. the hardware input RUN (FRG) and the safety input RFE are already switched on.

Lock
With the command **ENABLE OFF** (MODE-BIT $0x51_{Bit\ 2} = 1$) the internal speed setpoint is **N cmd (ramp)** controlled to zero with the ramp **R-Lim** set in the Speed parameter field.

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

Software enable from NDrive
The hardware input RUN (FRG) and the safety input RFE are already switched on.

"Dis" button
grey = software release = ON
red = software release = OFF



Sequence for enabling with hardwired RFE and RUN input:

1. First lock the servo with the command **ENABLE OFF** (MODE-BIT $0x51_{Bit\ 2} = 1$).
2. Then unlock the servo with the command **NOT ENABLE OFF** (MODE-BIT $0x51_{Bit\ 2} = 0$).
   The servo is enabled without delay.
   → Only in this order can an enabled be achieved.
   → At the same time, all stored errors are deleted.

7.3 Safety input RFE (rotating field enable)

Attention:
With the enable input RUN (FRG) switched off - or the rotary field enable (RFE), 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.

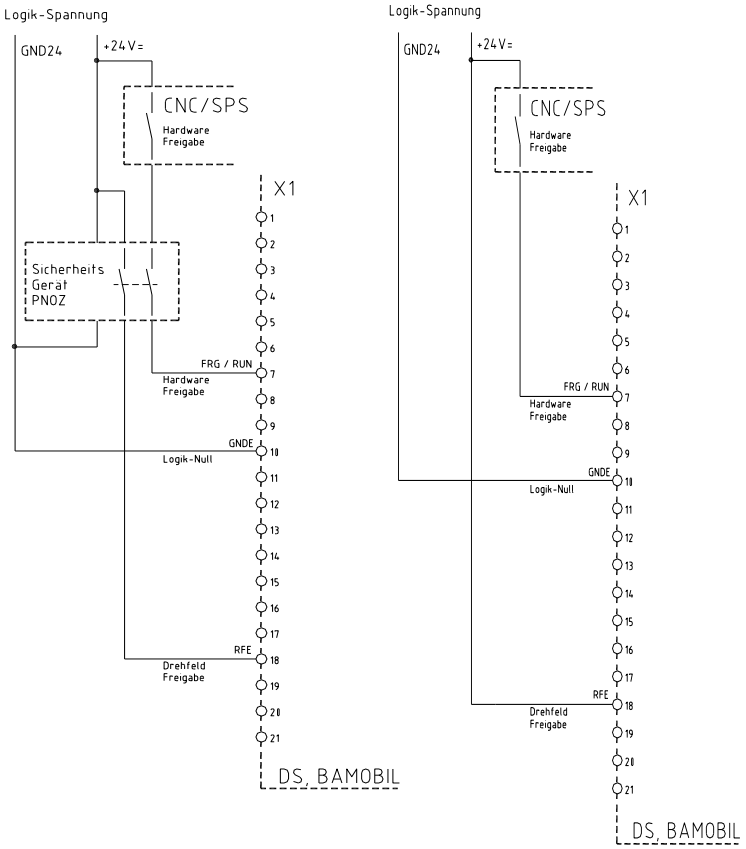
7.3.1 Operation with external RFE input

- Two-channel enabling lock via a safety switching device
- Switch on enable input RUN (FRG) plus rotary field enable input RFE
- Safety device Contacts closed
- Enable RUN (FRG) 0.5 s after RFE

Safety shutdown
- Safety device contacts opened
- No RUN (FRG) signal blocks the PWM pulses in the processor in the first blocking channel
- No RFE signal blocks the PWM pulses in a second blocking channel after the processor

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

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



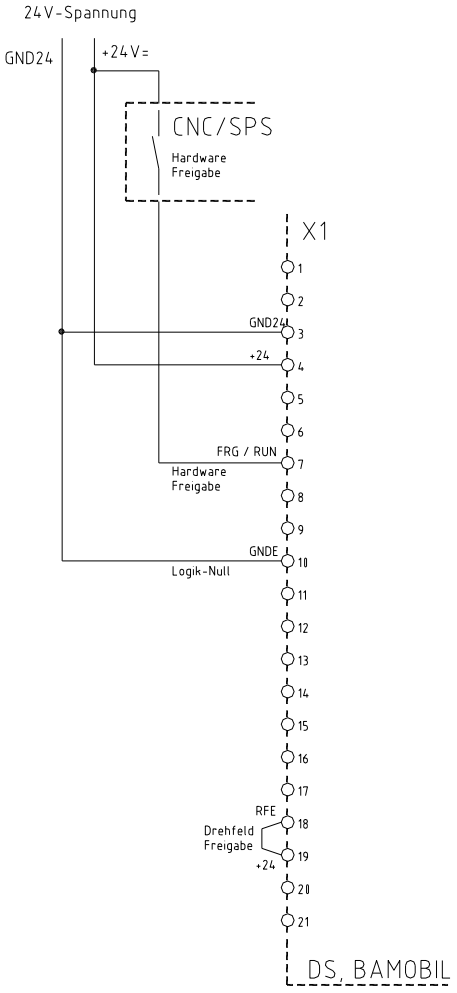
7.3.2 Operation without external RFE input

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

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

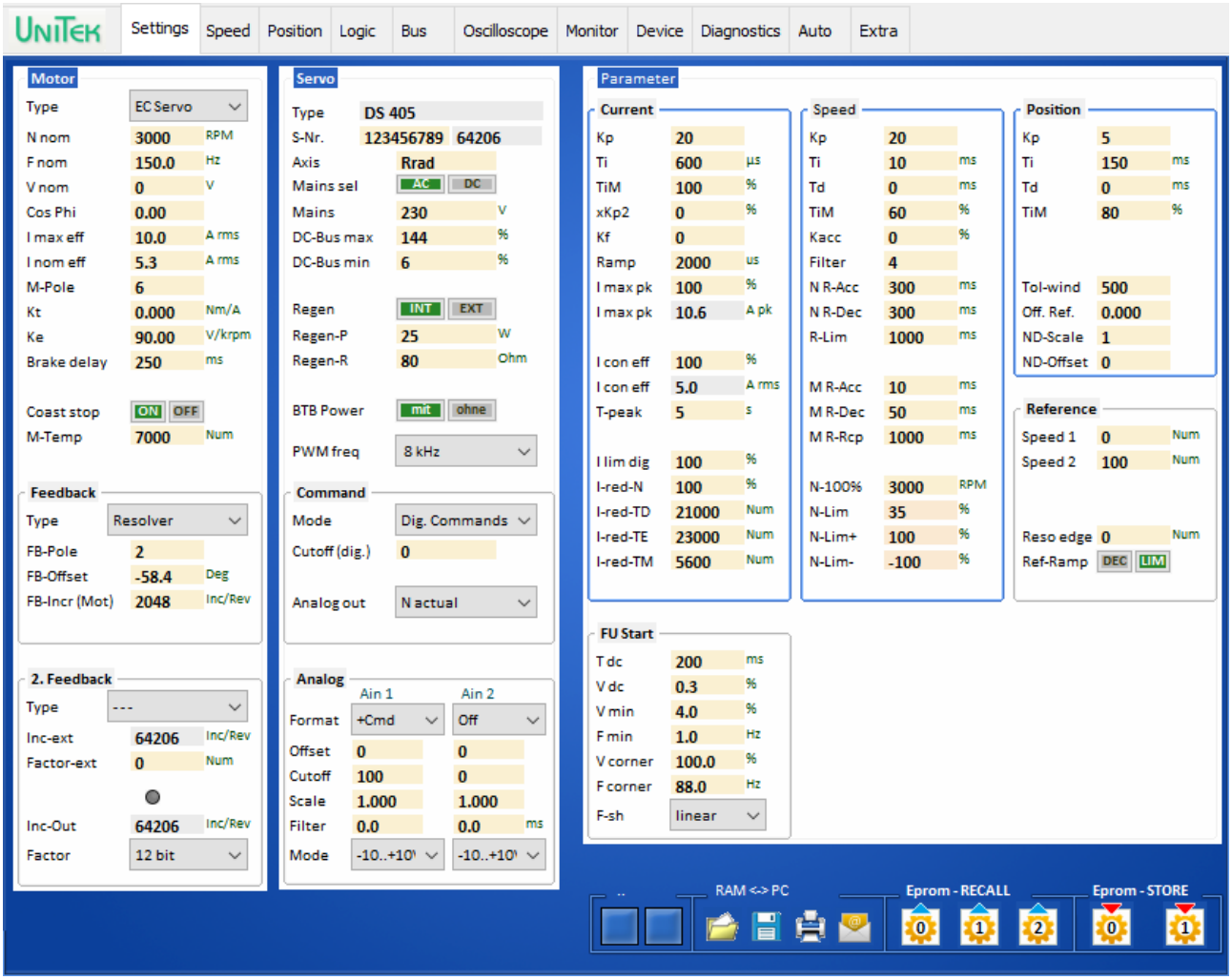
Enable RUN (FRG) 0.5 s after RFE signal.

Attention:
For round plugs or Tyco plugs (BAMOCAR, BAMOBIL) use the plug configuration from the unit MANUAL.



8 Settings

Main parameter overview and input on the **Settings** page.



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

The settings for the motor and servo are only entered on the Settings page.
The parameter inputs can be entered on different pages.
The changed parameter data is immediately adopted on all pages.
See detailed description of the input fields.

Attention:

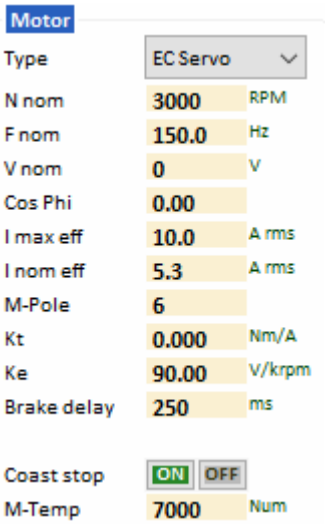
Before the first commissioning and in case of changes of the motor type the data in the setting fields with the type plate or data sheet of the motor.

Observe engine-specific connection instructions!

In online mode, the setting values may only be changed by trained specialist personnel!

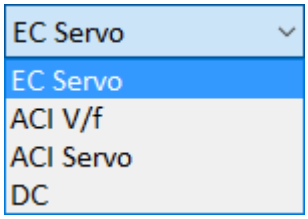
8.1 Settings – Motor

Parameter overview for nominal motor data based on information from the motor nameplate and motor data sheet.



Symbol:	Function:	Range:	Unit:	ID address:
Type	Selection of motor type (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	Motor maximum 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
Kt	Motor Kt constant	0..50,000	Nm/A	$0x87_L$
Ke	Motor Ke constant (Back EMF)	0..500,00	V/krpm	$0x87_H$
Brake delay	- Attraction delay time of the electro-mechanical motor brake - Deceleration delay when no brake is connected	0..1000	ms	0xF1
Coast stop	Free run (ON) or emergency stop braking (OFF) (when switching off the enable RUN)	On / Off		$0x5A_{Bit\ 3}$
M-Temp	Motor overtemperature switch-off point (error code 6) (At 93 % there is a warning message 6 with current derating Ird-TM activation).	0..32767	Num	0xA3

Overview of the motor type selection



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

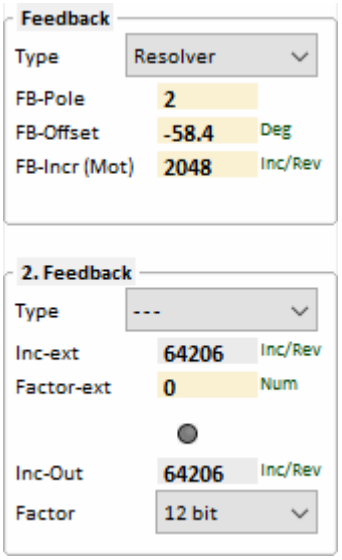
8.2 Settings – Feedback (encoder)

Parameter overview for the setting field of the feedback encoder nominal data on the basis of the encoder data sheet.

Shortz.:	Function:	Range:	Unit:	ID address:
Type	Feedback selection (Red_Enc_TTL, Resolver, ...)			0xA4$_{Bit\ 4...\ 0}$
FB-Pole	Encoder pole number	2..12	Num	0xA7
FB-Offset	Phase angle correction	±360	Degree	0x44
FB-Inc (Mot)	Resolution encoder	1024..8192	Inc/Rev	0xA6
Voltage	DC tachometer voltage		mV/rpm	
Inc-Out	Resolution 2. encoder		Imp/Umd	0xCF$_L$
Factor	Multiplier SIN/COS Inc.	4..16	Num	0x7E

Overview of suitable feedback encoders for the respective motor types.

Engine type:	Suitable feedback type:
EC Servo	Rot_Enc_TTL, Enc_TTL (conditional) 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



Attention:

- Depending on their hardware configuration, servo drives are only designed for certain encoders.
- The encoder must be coordinated with the hardware configuration of the motor.
- The selection of the encoder type must match the configuration of the servo for the respective encoder type. I.e. a digital servo is only configured for a certain type of encoder.

Resolver encoder:

Resolver	Resolver encoder with 10 kHz and 2 Vpp
FB-Pole	Encoder pole number 2 to 12
FB-Offset	Correction value for the mechanical encoder setting Pole wheel angle ±360 degrees Automatic recognition of the offset angle = see page AUTO

Incremental encoder:

Red_Enc_TTL	Incremental encoder 5 V TTL with rotor position tracks
FB-Offset	Correction value for the mechanical encoder setting Automatic recognition of the offset angle = see page AUTO
FB-Inkr (Mot)	Impulse count per revolution

Attention: The encoder rotor position pole number must match the motor pole number!

ENC-TTL	Incremental encoder 5 V TTL without rotor position tracks
FB-Inkr (Mot)	Number of pulses per revolutionOnly 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)	Pulse number per revolution

ENC_SC	1 Vss sin/cos encoder without commutation track
FB-Inkr (Mot)	Pulse number per revolution

ABS_SC	Sine-cosine signal per motor pole pair (analogue Hall sensors)
M-Pole, FB-Pole	Number of motor poles and number of encoder poles equal (M poles = FB poles)

Rotor position encoder 5 V, 15 V:

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

ROT	Rotor position sensor 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

Attention: The encoder rotor position pole number must match the motor pole number!

Feedback for DC motors:

DC_TACHO	DC motor with tachometer
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 tachometer, without armature voltage measurement
FB Offset	120 = Connection M1-M3 (0=M2-M3, -120=M1-M2)

Sensorless drives:

SLS	Sensorless only for 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 Eprom (Eprom - STORE 0)
→ and re-read the set of parameters (Eprom - RECALL 0)

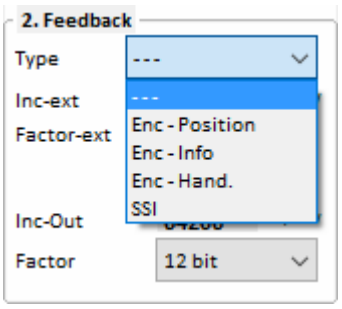
8.3 Settings – 2nd feedback

Parameter overview for setting the X8 connection as the second counter input

Shortz.:	Function:	Range:	Unit:	ID address:
Type	Selection of 2nd Feedback encoder input			$0xA4_{Bit\ 7...5}$
Inc-ext	Resolution increments 2nd encoder		Inc/Rev	$0xCF_{L}$
Factor-ext	Encoder factor 2nd encoder	4..16	Num	0x7E
Inc-Out	Increments output resolution		Inc/Rev	$0xCF_{H}$
Factor	Multiplication factor of the basic pulse number for SinCos (SC)			$0xA4_{Bit\ 14..12}$

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

- - -	Input switched off
Enc - Position	Position input
Enc - Info	Info display only input
Enc - Hand.	Handwheel input
SSI	SSI encoder input



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 (scaling):
Calculate the transmission
1 motor revolution = 65536 Num (internal counter)

Factor-ext for the adjustment of the 2nd encoder (0x7E)
Encoder_2_Scale = 65536 / encoder pulses from 2nd encoder per motor revolution * 4

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

Output:
1 motor revolution corresponds to 0.1 encoder revolutions
Encoder pulse number 1000 rpm
Pulses per motor revolution 0.1 * 1000 * 4 = 400

Input at Encoder_2_Scale
= 65536 / 400 = 163,840

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

Example: Setting X8 as output for incremental encoder signals

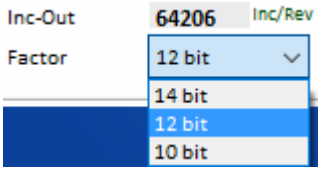
Type = Enc - Info:
Setting value of the output pulse number for resolver encoder signals at the X8 connection.

The encoder signals (feedback) supplied by the motor are used as TTL encoder signals for the output at the Sub-D connector X8 (example CNC control).
Signals: Channel A, Channel /A, Channel B, Channel /B, Channel N, Channel /N

The encoder output is electrically isolated.
Power is supplied via the encoder cable from the CNC/PLC control.
Power supply 5 V (±0.2 V)
The output signal corresponds to RS485

Option: Internal supply from servo
(LBR1 + LBR2)

Resolution:
The resolution is programmable for the variants -RS and -SC.
With -IN, the output corresponds to the encoder pulse count.
Factor - Multiplication factor of the basic pulse number at SinCos (SC).



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

8.4 Settings – External brake

Adjustment and control of an external brake:

Many motors have a built-in brake that must first be released by a control before the motor can be rotated. The inverter can control this external brake accordingly.

The brake built into the motor has the maximum braking force in the de-energised state.
According to the electrical control, the brake has a type-related on-delay and off-delay defined via the **Brake delay** parameter.

The digital output can switch a brake up to 24 V and 1 A directly.
For brakes with higher currents or higher voltages, a relay must be connected in between.

The brake output is activated on the **Logic** page in the parameter field **- Output**.
In the pull-down menu for **Dout 1**, **Dout 2** or **Dout 3,** configure the **O-Break** command by clicking on it in the display field.
In the pull-down menu, select the operand [**=**] **(**equal) or [**!=**] (not equal) by clicking on it.
Select the switching function of the output by selecting **0** or **1** in the variable field (normal 0).

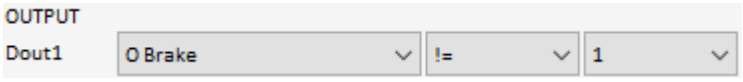
On the Settings page in the **Motor** parameter field, enter the drop-out delay of the motor brake (from the brake data sheet) in the **Brake delay** parameter (0..500 ms).

Brake active is displayed in the status field with "**BRK1**".

Attention:
Connect a free-wheeling diode or a varistor directly to the brake connection on the motor.

Example of setting a brake output on the Logic page:

Digital outputs	Selection
Dout1	Brake de-energised when enable is switched off. Set the release delay with Brake delay.
Dout2	--Off--
Dout3	--Off--
Dout4	--Off--

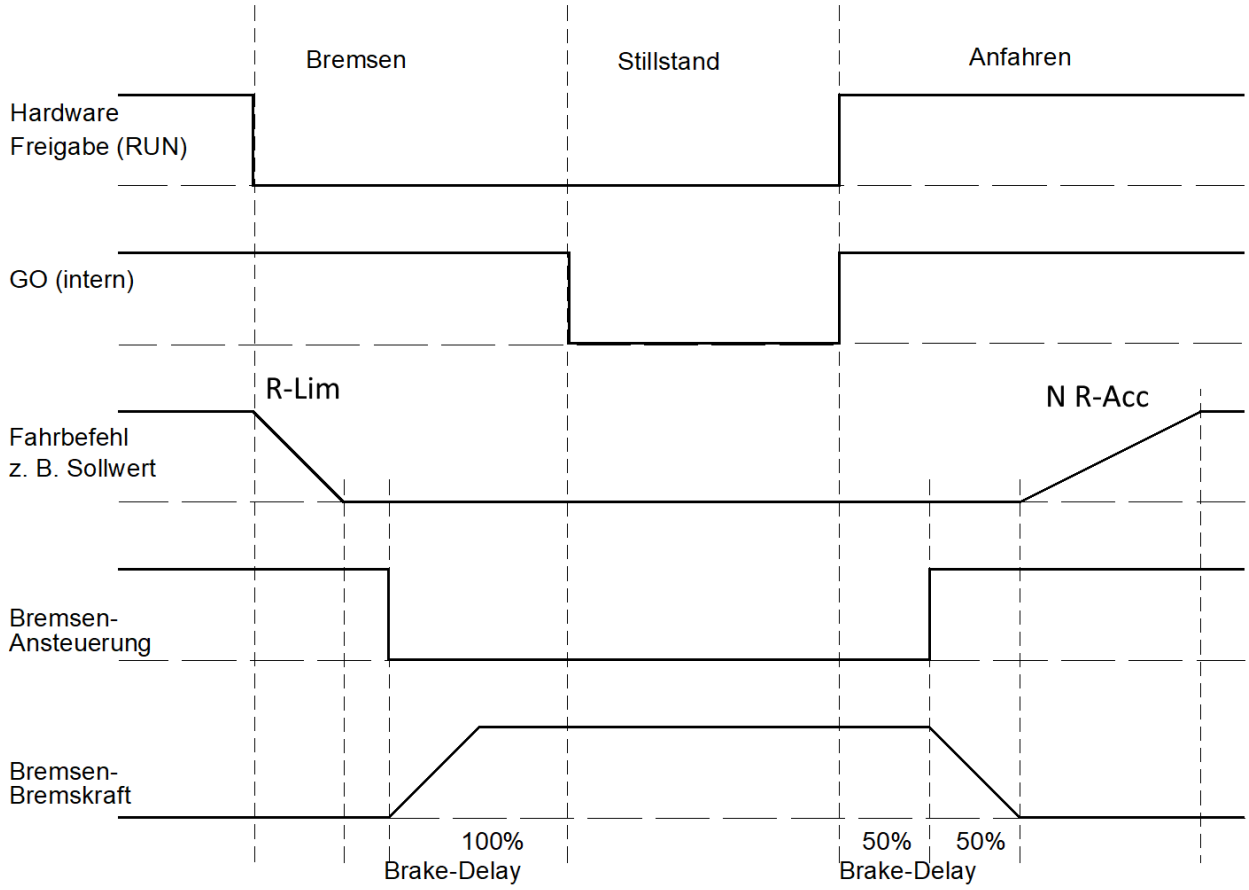


Description of the brake function (control of the external brake):

When deactivating the enable RUN (FRG) or the CAN command **ENABLE OFF = 1**, the internal speed setpoint **N cmd Ramp** is controlled to zero with the programmed ramp **R-Lim**. After a fixed delay time of 50 ms, the parameter **Brake** is switched from 1 to 0. The braking force increases. After the programmed time **Brake delay**, the internal parameter ***GO*** is switched to 0 and the servo is locked (torque-free standstill).

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

When enabling RUN (FRG) or the CAN command **ENABLE OFF = 0** is activated, the setpoint is kept at 0 and the status **GO** is immediately switched to 1 when the brake is active.
After 50 % of the **Brake delay** time, the brake is switched off and after another 50 % the setpoint is increased with the ramp **N R-Acc**.



Attention:

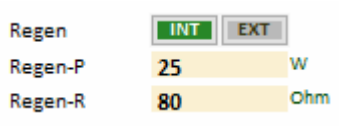
- The sum of the times of **R-Lim** plus **Brake delay** must be less than 1 s.
- At 1.1 s after switching off the enable, the output stage is disabled by hardware.
- The electrical braking is cancelled and the drive coasts to a stop. After the too long time of **R-Lim** plus **Brake delay** has elapsed, the mechanical brake engages and stops the drive.

8.5 Settings – Ballast circuit

- For servo units with a digital DC link setting ($0x5A_{Bit\ 7} = 0$), the ballast circuit operates directly controlled by the hardware.
- For servo units with an analogue DC link setting ($0x5A_{Bit\ 7} = 1$), the ballast circuit is controlled by the TMS control card.
  Control for the ballast circuit depends on the configuration of the DC link monitoring.
  → Activation of the ballast circuit at 93 % depending on DC-BUS max.
  → Deactivation of the ballast circuit control at 87 % depending on DC BUS max.

- With internal ballast resistor, the setting parameters are automatically set from the unit detection.
- For external ballast resistors, the values for the resistance (Ballast-R) and the resistance power (Ballast-P) are entered as parameters.

Regen	INT = Internal ballast resistor EXT = external ballast resistor
Regen-P	Enter the resistor power in W
Regen-R	Enter the resistor value in Ohm



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

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

The regen power is displayed on the Monitor page as **Regen. energy** ($0x45_L$).

In the oscilloscope, the DC BUS voltage (Vdc-Bus), the ballast switching pulse (I Regen and the regen power (Regen. energy) can be displayed.

At 87 % of the regen power, a warning is given (ballast circuit >87 % overloaded ($0x8F_{Bit\ 31}$)) and at 100 % the unit is switched off with an error message (ballast circuit overloaded ($0x8F_{Bit\ 15}$)).

The function of the ballast circuit is displayed on the servo.
With the 7-segment display, the setpoint direction bar (bottom left or right) is switched off as long as the ballast circuit is active.

8.6 Settings – Monitoring motor temperature

Parameter overview of the motor temperature monitoring.

Symbol:	Function:	Range:	Unit:	ID address:
I-red-TM	Triggering point current reduction based on the motor temperature → Warning 6	0..32767	Num	0xA2
M-Temp	Switch-off point based on motor temperature Error 6 At motor temperature > 93 % of M-Temp → Warning 6 and current reduction	0..32767	Num	0xA3
T-motor	Current motor temperature	0..32000	Num	0x49

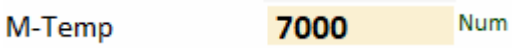
Note:
Due to the large number of different temperature sensors, the motor temperature (T-motor) is output as a purely numerical ADC value. The corresponding curves and thus the actual physical temperature must be determined via corresponding tables.

Deactivation of the monitoring takes place with the setting limit of 32767.

Current reduction (derating) based on the motor temperature:
If the motor temperature (T-motor) rises above the set value of **I-red-TM**,
- the maximum current limit is increased linearly from the application point of **I-red-TM** to the switch-off point of **M-Temp** reduced to continuous current
- the message Ird-TM ($0x40_{Bit\ 26}$) is set in the status field
- warning 6 is set.

Fault switch-off based on the motor temperature:
If the motor temperature (T-motor) rises above the set value of **M-Temp**,
- The inverter switches off the fault
- error 6 is output.

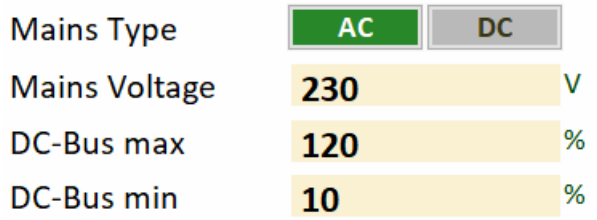
If the motor temperature (T-motor) rises above 87 % of the set value of **M-Temp**,
- the maximum current limit is reduced to continuous current
- the message Ird-TM ($0x40_{Bit\ 26}$) is set in the status field
- warning 6 is set.



8.7 Settings – Power connection / DC bus monitoring

Note / Important:
The manual configuration of the DC link monitoring only works with servo units that have an analogue DC bus measurement.
This applies to all battery DC servo units (Bamobil, Bamocar) and special AC servo units (DPC).

Parameter overview for the selection of the power connection and the setting of the monitoring of the DC bus with analogue DC link measurement.



Symbol:	Function:	Range:	Unit:	ID address:
Mains Type	Power voltage selection	AC / DC		$0x5A_{Bit\ 19}$
Mains Voltage	Size of the mains voltage	0..1000	V	0x64
DC-BUS max	Maximum voltage limit for the DC bus (software)	0..200	%	$0xA5_H$
DC-BUS min	Minimum voltage limit for the DC bus (software)	0..200	%	$0xA5_L$

Mains Type:
The selection of the power voltage between alternating voltage (AC) or direct voltage (DC) is hardware dependent and should only be carried out with precise knowledge of the servo type.

8.7.1 DC bus monitoring with firmware ≥ 478

Mains Voltage:
The reference value used for the min/max DC bus monitoring depends on the actual internal DC bus voltage. Depending on the selection at **Mains Type**.

With a **Mains Type** of:

- [**DC**] → For **Mains Voltage**, specify the nominal DC voltage connected.
  (e.g.: Mains Voltage = 400 V → DC bus = 400 V)
- [**AC**] → For **Mains Voltage**, specify the connected nominal AC phase-to-phase voltage.
  The voltage value in the DC bus DC link is then greater by the factor root 2.
  (e.g.: Mains Voltage = 400 V → DC bus = 565 V)

DC-Bus max:

- Setting limit for the max. software voltage limit in percentage relation to the input at **Mains Voltage** and depending on the selection of **Mains Type**.
- If this limit is exceeded, an error shutdown occurs, the controller is blocked and error 8 is set.
- The hardware overvoltage monitoring depends on the servo type and works independently of the software setting.
- Setting value for the control of the ballast circuit (servo type dependent).

DC-Bus min:

- Setting limit for the min. software voltage limit in percentage relation to the input at **Mains Voltage** and depending on the selection of **Mains Type**.
- If this limit is undershot, an error shutdown occurs, the controller is blocked and error 5 is set.
- The hardware undervoltage monitoring depends on the servo type and works independently of the software setting.

Example 1: Mains Type = DC and Mains Voltage = 400 V
DC-Bus max = 110 % = 440 V
DC-Bus min = 10 % = 40 V

Example 2: Mains Type = AC and Mains Voltage = 400 V
DC-Bus max = 110 % = 622 V
DC-Bus min = 10 % = 62 V

Note / Important:
Resolution problems of the internal min. and max. calculations of the limits in the event of excessive deviations when input at Mains Voltage in relation to the actual nominal servo voltage.

I.e., for a servo with a nominal voltage of 700 V and an input of Mains Voltage = 10 V, no reliable calculation of the limits is guaranteed.

8.7.2 DC bus monitoring with firmware < 478

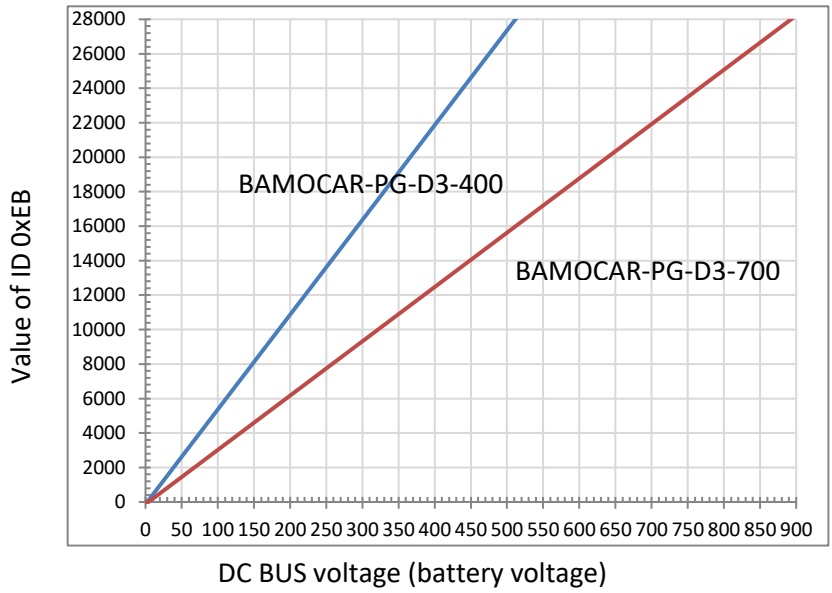
Mains Voltage:
This setting value only refers to the voltage value for alternating voltage (AC) as power voltage. If DC is selected as the Mains Type, the entry at Mains Voltage has no effect.

DC-Bus max:
- Setting limit for the upper software voltage limit for inverters with analogue DC bus measurement.
- Entry of **100 % = 32767 Num**
  ➔ Calculate 32767 Num / 2 = **16383 Num** and compare the value with that of the device voltage table.
- Setting value for the control of the ballast circuit (servo type dependent).
- Warning occurs at 1.5 times the nominal voltage.
- If this limit is exceeded, an error shutdown occurs, the controller is blocked and error 8 is set.
- The hardware overvoltage monitoring depends on the servo type and works independently of the software setting.

DC-Bus min:
- Setting limit for the minimum software voltage limit for inverters with analogue DC link measurement.
- Entry of **100 % = 32767 Num**
  ➔ Calculate 32767 Num / 2 = **16383 Num** and compare the value with that of the device voltage table.
- If this limit is undershot, an error shutdown occurs, the controller is blocked and error 5 is set.
- The hardware undervoltage monitoring depends on the servo type and works independently of the software setting.

Note / Important:
- Refer to the hardware device description to determine the setting values of the limits (min, max).
- The setting values of the limits do **not refer to the voltage value in "Mains Voltage"** but to the servo-specific nominal supply voltage.

Example: Bamocar 400-400 and Bamocar 700-400



Standardisation 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 the DC-Bus max ($0xA5_H$) and DC-Bus min ($0xA5_L$) limits:
(The setting values of the limits do not refer to the voltage value in "Mains Voltage" but to the inverter-specific rated supply voltage).

Entry of **100 % = 32767 Num**

➔ Calculate 32767 Num / 2 = **16363 Num**. Compare this value with the voltage curve.

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 limit 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 limit 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

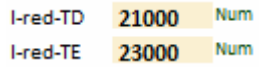
8.8 Settings – Monitoring power stage temperature

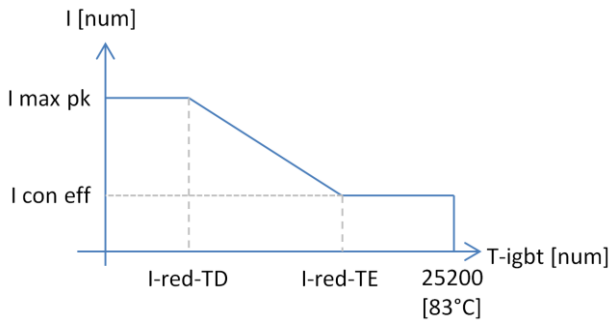
Parameter overview for setting the current reduction based on the output stage temperature

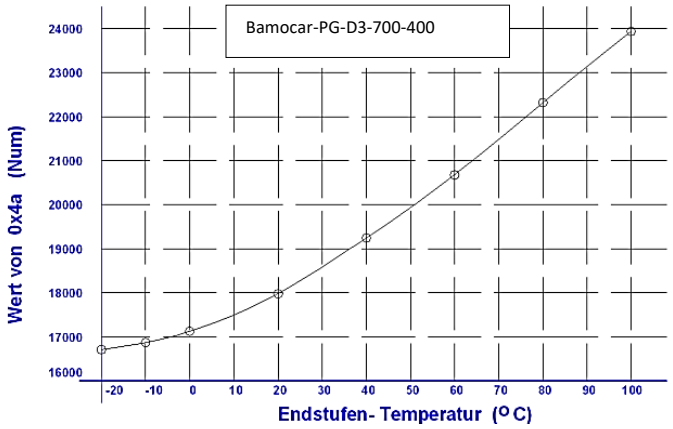
Symbol:	Function:	Range:	Unit:	ID address:
I-red-TD	Current limit reduction starting point	0..32767	Num	0x58
I-red-TE	Current limit reduction end point	0..32767	Num	0x4C
T-igbt	Measured temperature value of the output stage	0..32767	Num	0x4A

Condition:

- Only for units with analogue recording of the power stage temperature the software monitoring can be programmed.
- Refer to the hardware device description for setting values.







I-red-TD:

- Setting value for the start point of the reduction of the current limit depending on the power stage temperature.
- The current limit is lowered linearly to the set end point of I-red-TE to the set continuous current limit as the power stage temperature rises.

I-red-TE:

- Setting value for the end point of the power stage temperature at which the current limit is limited to the set continuous current.
- At 85 % of the maximum power stage temperature, warning 7 (DEVICETEMP) is set.
- The maximum power stage temperature is 25200 Num (approx. 83 °C).
- If the power stage temperature (T-igbt) rises above the value of 25200, an error shutdown occurs from the inverter and error 7 (DEVICETEMP) is set.

The hardware power stage temperature monitoring works independently of the software setting.

- The following applies for the activation functionality of the derating via the power stage temperature
  - I-red-TD < I-red-TE
  - I-red-TD > 0

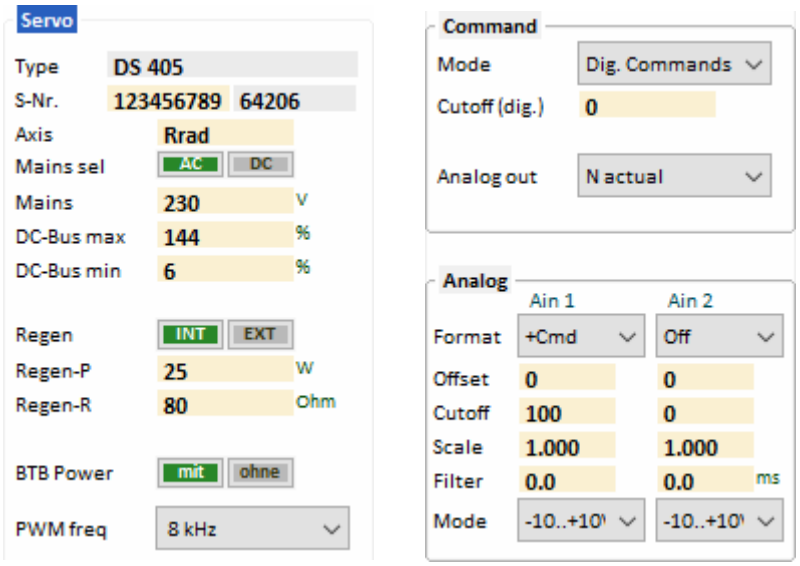
➔ The activation of the functionality is displayed as Ird-TI ($0x40_{Bit\ 23}$) in the status field.

➔ If this current derating functionality is triggered, it is displayed as Ird-TIR ($0x40_{Bit\ 24}$) in the status field.

Note:
If this derating functionality is activated based on the power stage temperature, the current limitation is deactivated based on the function of **T-peak** (0xF0).

8.9 Settings – Servo

Parameter overview on the Settings page in the main **Servo** area.

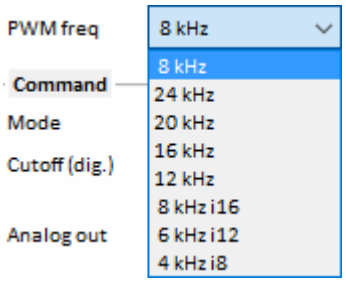


Symbol:	Function:	Range:	Unit:	ID address:
Type	Unit type (protected)	0..255	Num	$0x67_{Bit7..0}$
S-Nr.	Serial unit no. (protected)	32 Bit - 1	Num	0x62
Axis	Axis designation (freely writable)	4 characters	ASCII	0xF8
Mains Type	Selection of the power voltage	AC / DC		$0x5A_{Bit\ 19}$
Mains Voltage	Magnitude 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	25..10000	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	mit / ohne 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 servo nominal data

Symbol:	Function:
Type	Controller type is displayed (changes only possible at the factory)
S-Nr.	Serial number is displayed (changes only possible at the factory)
Axis	Axis designation with 4 ASCII characters (This is entered by the user)
Mains Type	Power connection AC~/DC= is displayed. (Default setting is entered at the factory)
Mains Voltage	AC and three-phase voltage AC (30~ to 480 V~) Battery voltage or DC mains (12 V= to 560 V=)
DC-Bus max	Switching point DC link overvoltage Error OVERVOLTAGE (overvoltage >1.8xUN) $0x8F_{Bit\ 8}$
DC-Bus min	Switching point DC link undervoltage Error POWERVOLTAGE (power voltage missing) $0x8F_{Bit\ 5}$
Regen	Selection list ballast resistor (internal - external)
Regen-P	Enter power value for external ballast resistor Enter in watts. If the ballast resistor is overloaded, a warning message is displayed. Warning BALLAST (ballast circuit <87 %) $0x8F_{Bit\ 31}$
Regen-R	Enter resistance value for external ballast resistor Enter in Ohm. It is also important to observe the minimum value.
BTB Power	BTB message with or without DC link undervoltage: Selection **ohne (without)** (BTB without undervoltage monitoring) with the enable switched off and the power voltage switched off, the RUN/BTB message remains active. Selection **mit (with)** (BTB with undervoltage monitoring). When the enable is switched off and the power voltage is switched off, RUN/BTB is deactivated.

8.10 **Settings – Servo / PWM clock frequency**



Selection of the switching frequency of the output stage is made via the Parameter **PWM freq** (0x5A$_{Bit\ 22..20}$)

Selection (General):
Clock frequency equal to calculation speed
Values: 8, 12, 16 kHz

Current limit reduction depending on clock frequency:

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

Selection (Special):
Clock frequency (kHz) with higher computing speed (Ix).
Values: 2 kHz-I4, 4 kHz-I8, 8 kHz-I16

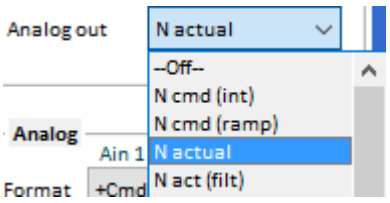
Process Changing the clock frequency:

- Enable RUN (FRG) must be deactivated
- Set frequency
- Save parameter set in Eprom level 0
- Read parameter set from Eprom level 0
- The changed frequency is adopted and the current limits are reduced

Recommendation of the clock frequency depending on the maximum motor speed and number of poles:
For good FOC control, it is recommended to have at least 16 measuring points for each electrical angle. For a motor with 20 poles (10 pole pairs), this results in a maximum speed:

(16 kHz)	16000 Hz / 16 = 1000 Hz	(→ maximum rotating field frequency)
	n_max = (60 * 1000 Hz) / 10 = 6000 rpm	(→ maximum recommended 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	

8.11 **Settings – Servo / Analogue output**



Setting for the definition of the output of the analogue output voltage is done by selecting **Analog out** (0xDC) variable.

Output of the analogue output voltage:

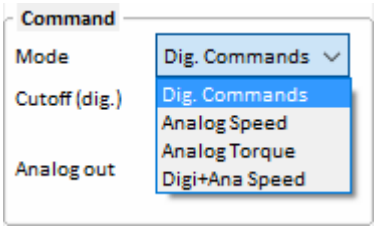
- The output voltage ±10 V corresponds to ±100 % from the selected signal.
- Digital binary signals provide 0 or +10 V as output

8.12 **Settings – Servo / Setpoint Command Mode**

Overview of the setpoint command mode in the selection Parameter **Mode** at Command.

Symbol:	**Function:**	**ID address:** $0x36_{Bit13..12}$
Dig. Commands	General setpoint command via digital communication input (CAN-BUS, RS232)	0 dec
Analogue Speed	Speed setpoint command via analogue voltage input (AIN1 and AIN2)	2 dec
Analogue Torque	Torque (Iq) setpoint command via analogue voltage input (AIN1 and AIN2)	3 dec
Digi+Ana Speed	Speed setpoint via digital communication input and analogue voltage input. The sum of both inputs gives the setpoint	1 dec

Dig. Commands:
Digital position, speed or current (torque) setpoint input
Setpoint specification via one of the digital communication interfaces (CAN; RS232).
Switching between the different operating modes (position, speed, current) directly after receiving the latest Setpoint command.



Analogue Speed:
Analogue speed setpoint
Input at terminal strip X1 → Inputs Ain1 and Ain2
Maximum input voltage ±11 V corresponds to ±32767 Num
This value corresponds to 100 % of the set 16-Bit resolution of the maximum physical speed defined at **N-100%** (0xC8).

Analogue Torque:
Analogue current setpoint (Iq)
Input at terminal strip X1 → inputs Ain1 and Ain2
Maximum input voltage ±11 V corresponds to ±32767 Num
This value corresponds to 100 % of the servo peak current **I max pk** (0xC4).

Digi+Ana Speed:
Speed setpoint both via the digital communication interface (CAN; RS232) and via the Analogue Speed preset. The final setpoint specification is the sum of both specifications with an internal limitation of ±32767.
This value corresponds to 100 % of the set 16-Bit resolution of the maximum physical speed defined at **N-100%** (0xC8).

Tips:
Reversal of direction of rotation for unipolar setpoint with direction signal:
On the Logic page, assign a digital input with **N cmd Reverse**. Activation either via a real logic level at the set input or via changing the activation condition (AL / AH) via the digital communication interfaces (CAN; RS232).

Overwrite setpoint Speed to 0 rpm:
Same as the direction of rotation reversal but assign a digital input with **Speed Ramp 0**.

8.13 **Settings – Servo / Analogue inputs**

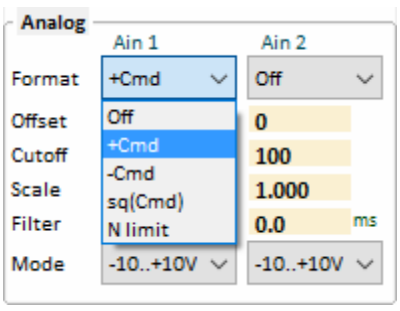
Parameter overview for setting the analogue inputs Ain1 and Ain2

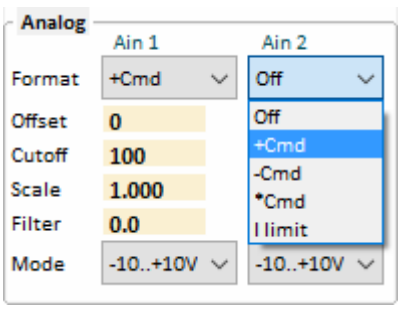
Symbol:	**Function:**	**Range:**	**Unit:**	**ID address:** Ain1 - Ain2 -
Format	Selection of the function of the respective analogue inputs	Selection field		$0x36_{Bit\ 1..0}$ $0x36_{Bit\ 3..2}$
Offset	Offset compensation of the respective analogue inputs	±32767	Num	$0x2F_L$ $0xD7_L$
Cutoff	Zero zone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

Format:
The analogue inputs **Ain1** and **Ain2** are assigned to a function in the **Format** field.

Format: Ain1		**ID address:**
Off	Disabled	$0x36_{Bit\ 1..0} = 0$
+Cmd	Setpoint command normal	$0x36_{Bit\ 1..0} = 1$
-Cmd	Setpoint command inverted	$0x36_{Bit\ 1..0} = 2$
sq(Cmd)	Square reference setpoint command	$0x36_{Bit\ 1..0} = 3$
N limit	Speed limitation 0... 100 % via Ain1 (with digital setpoint input (position, speed)). This corresponds to 100 % of the max. physical speed defined in **N-100%** (0xC8).	$0x36_{Bit\ 15}$

Format: Ain2		**ID address:**
Off	Disabled	$0x36_{Bit\ 3..2} = 0$
+Cmd	Setpoint command normal (Ain2 is added to Ain1)	$0x36_{Bit\ 3..2} = 1$
-Cmd	Setpoint command invertet (Ain2 is subtracted from Ain1)	$0x36_{Bit\ 3..2} = 2$
*Cmd	Setpoint command normal (Ain2 is multiplied by Ain1)	$0x36_{Bit\ 3..2} = 3$
I limit	Current limitation 0..100 % via Ain2 (for all digital, analogue setpoints). This corresponds to 100 % of the unit peak current **I max pk** (0xC4).	$0x36_{Bit\ 14}$





Offset:
Compensation of setpoint zero error with analogue input.
With 0 V voltage applied, change the offset value positively or negatively until the setpoint value input at **Ain scaled** displays the value zero.

Cutoff:
Adjustable zero zone where the unprocessed measured value of Ain1 and Ain2 is set to 0.
Sets a setpoint value equal to 0, since there is usually always a small residual voltage of around 0 V at the inputs of Ain1 and Ain2.

Special cases:

Zero zone with analogue speed setpoint:
The setpoint is internally switched to 0 within this zone. The drive stands still, no drift (no position parameter entered).
If the external torque is greater than the servo current limit, the drive can be rotated from the zero position.

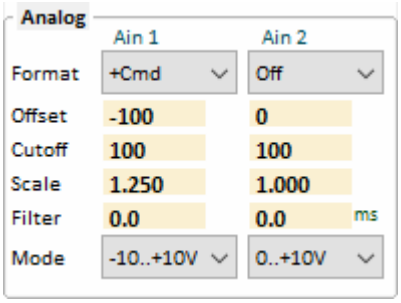
Zero zone for analogue speed setpoint with position hold value:
Within the zero zone, the drive is held at its zero position by means of internal position control. If the external torque is greater than the servo current limit (I max pk), the drive can be rotated out of the zero position. If the torque is smaller, the drive returns to its zero position.

Attention: The parameters must be entered in the Position parameter field.
With an analogue setpoint from a PLC/CNC position control, the value for the Zero zone be very small or 0.

Scale:
Scaling factor of the respective analogue input signals. This allows the entire width of the input voltages (±11 V) to be adjusted over the entire range of the final setpoint (±32767). This also allows the gradient of the setpoint to be varied. (Input voltages greater than 11 V are capped).

Mode:
Input range of the analogue setpoints with

-10..+10V	bipolar setpoint
0…+10V	unipolar setpoint
4..20mA	current setpoint (external resistor 500 Ohm)
+1..+9V	Setpoint with potentiometer monitoring



The setpoint specification of Ain1 and Ain2 after scaling is output in the variables $Ain_{1,2}$ scaled as setpoint. This is displayed on the page Speed at **$Ain_{1,2}$ scaled**.

$Ain_{1,2}$ scaled = ($Ain_{1,2}$ in + $Offset_{1,2}$) x $Scale_{1,2}$

8.14 **Settings – Speed / Linear ramp function and speed limitation**

Parameter overview for setting the different ramp times for the speed, torque and emergency stop ramps.

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

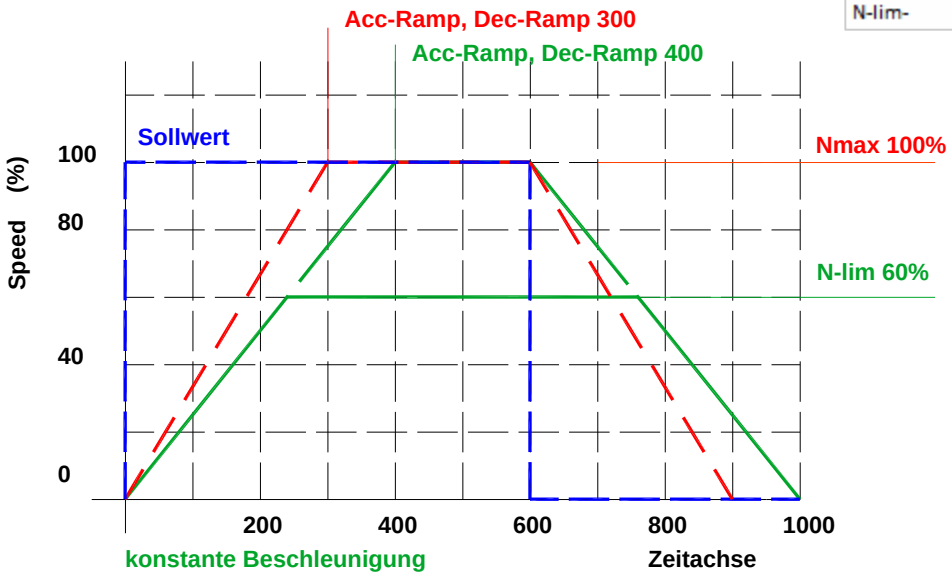
[1] From FW476 only active if it is a current (torque) specification.
[2] From FW476 only active if the ID ($0xCD_{Bit\ 4}$ = 1) is set for digital current (torque) preset.
[3] Torque cruise control is activated at current (torque) setting and N-Lim < 100%.

- For speed ramps (N R-Acc, N R-Dec, R-Lim), the following applies as a reference for the time specification of the value for 100 % setpoint defined in parameter N-100% (0xC8).

- For torque ramps (M R-Acc, M R-Dec, M R-Rcp), the following applies as a reference forthe time specification the value for 100 % setpoint of the unit peak current in the parameter I max pk (0xC4).

- All ramps are formed linearly and, with a speed input, generate a constant acceleration.

N R-Acc	300	ms
N R-Dec	300	ms
R-Lim	1000	ms
M R-Acc	10	ms
M R-Dec	50	ms
M R-Rcp	1000	ms
N-100%	3000	RPM
N-lim	35	%
N-Lim+	100	%
N-lim-	-100	%



S-ramp function

Note:
Not yet active!

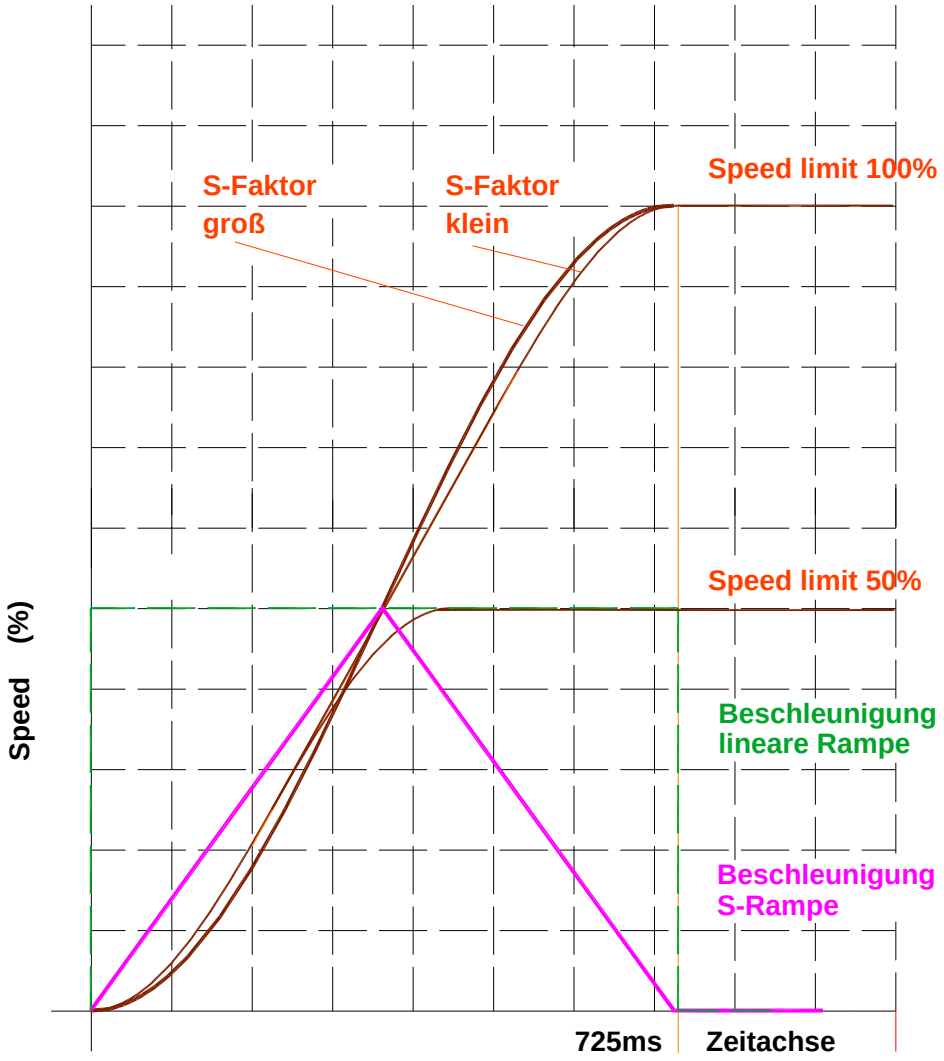


Figure 8-81

S-ramps function
The linear time function is converted into an S-shaped (sinus²) function.
The constant acceleration and deceleration changes into a steady change.
Jerks and current peaks are greatly reduced.

8.15 **Settings – BTB / RDY**

BTB/RDY message (relay contact)
The BTB contact (solid-state relay) is closed when the unit is ready for operation (residual resistance 30 Ohm); in the event of an error, the BTB contact is open (resistance > 1 MΩ).

BTB ready for operation
Is displayed in the status field with **Rdy** ($0x40_{Bit\ 14}$).

Not ready for operation /BTB (error)
Indicated on the front with the red FAULT LED.

BTB and power voltage
The signalling state when the power voltage is switched off can be selected on the **Settings** page in the **Servo** parameter field with **BTB-Power** (Undervoltage monitoring).

Selection BTB Power - "without (ohne)"
BTB without undervoltage monitoring.
With the enable switched off and the
power voltage, **the RUN/BTB message remains.**

Selection BTB Power - "with (mit)"
BTB with undervoltage monitoring.
With enable switched off and power voltage switched off **RUN/BTB drops out**.

Error message and BTB/RDY:
In the event of a system-dangerous error X (see error list), the

- **BTB** message switched off.
  The servo is locked internally without delay
  and the output **O_GO** (0xE3) is set to low.
- **On the servo:**
  The FAULT LED lights up red.
  The 7-segment display shows the error number.
- **In NDrive:**
  The error states are displayed in the **Error** field.

The error messages are reset when:

- Switching on the controller enable RUN (FRG).
- Sending the command Parameter **Cancel Error** via a communication interface.
- Trigger a digital input that is programmed with **Cancel Error(s)** on the **Logic** page.

9 Communication (external) with servo

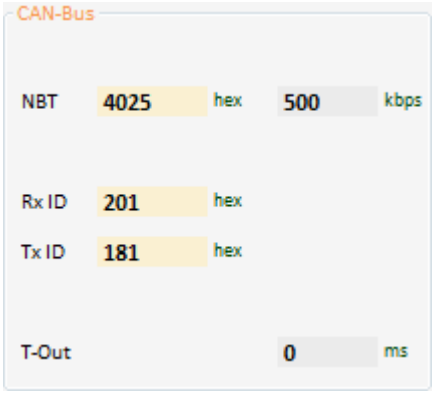
9.1 Communication (external) with servo – CAN bus

Parameter overview of the NDrive page **Bus** for the CAN bus communication interface.

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

Transmission rate NBT:	Setting value in NBT (0x73):	Cable 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

The station addresses for receiving and transmitting and the Transmission rate are set in the parameter field **CAN bus** entered.



After changes in the CAN programming and storage, the unit must be restarted
→ Switch auxiliary voltage off and on!

Default settings:
Receive address Rx ID = 0x201
Transmit address Tx ID = 0x181
Transmission rate NBT = 4025 (→ 500 kBaud)

Note:
For a detailed explanation of CAN communication please download the CAN manual from the UniTek homepage.

9.2 Communication (external) with servo – RS232

9.2.1 Change RS232 baud rate

The RS232 baud rate is set 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 stored in the unit is set when the auxiliary voltage 24 V= is switched on, after the firmware version number, is displayed.

bd0	corresponds to	115200
bd1	corresponds to	9600

First the firmware version is displayed (e.g. 4 - 7 - 8)
Then the baud rate (e.g. b - d - 0)

9.2.2 Structure of the RS232 serial protocol

Representation of the structure / protocol of a message via the serial RS232 interface.

RS 232 16 Bit										
Send from PC to Drive								Answer Drive to 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	
ASCII	ASCII	ASCII	ASCII	ASCII	ASCII	ASCII		binary	binary	

RS 232 32 Bit														
Send from PC to Drive											Answer Drive to 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

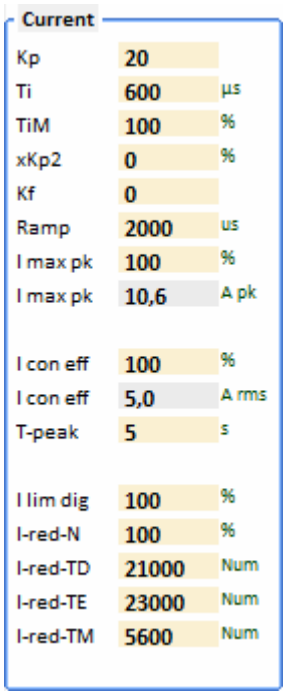
Example: Request from Speed Actual (0x30)

Send from PC to Drive								Answer Drive to 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 Speed actual value (0x30)				ASCII		Value of 0x30		

10 Current control

10.1 Current control – Parameter overview

Parameter overview of the settings for the current controller, as well as the general permitted current limits from the servo unit and the limits for activating derating functions.



Note:
Many of these parameters can also be found on the pages **Speed** and **oscilloscope**.

Symbol:	Function:	Range:	Unit:	ID address:
Kp	Proportional gain	0..200	Num	0x1C
Ti	Reset time (integral time constant)	375..10000	ms	0x1D
TiM	Maximum value from integral memory Ti	0..300	%	0x2B
xKP2	Proportional gain in the case Is current greater than current limit	0, 100..500	%	0xC9
Kf	Current feed forward	0..167	Num	0xCB
Ramp	Ramp setting set current	1251..32000	µs	0x25
I max pk	Devices Peak current [A]	0..100	%	0xC4
I con eff	Devices Continuous current [Arms]	0..100	%	0xC5
T-peak2	Permitted overcurrent time above continuous current limit (degradation 5 times longer)	1.. 40	s	0xF0
I limit (dig)[3]	Current reduction when logic input I limit (dig.) is activated	0.. 100	%	0x46
I-red-N	Current reduction via the actual speed	0.. 100	%	0x3C
I-red-TD	Start of current reduction via the output stage temperature	0.. 32767	Num	0x58
I-red-TE	End of current reduction via the output stage temperature	0.. 32767	Num	0x4C
I-red-TM	Start current reduction via the Motor temperature	0.. 32767	Num	0xA2

[1] Dependent PWM clock frequency
[2] Only active if current reduction based on the output stage temperature is not activated ($0x40_{Bit\ 23}$ (Ird-TI) = 0)
[3] Reference is maximum unit peak current (I max pk (0xC4) = 100 %)

10.1.1 Additional information on the parameters of the current controller

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

Kp Input for the proportional gain in the current controller
Note: Input value of 33 (Num) ≙ 1.0 (Physical manipulated variable of voltage)

Kp too small:	Misalignment, poor dynamics, low-frequency oscillations
Kp too large:	Strong engine noise, high-frequency vibrations
Recommended[1]:	10..40 Num

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

Ti too large:	Low frequency vibrations
Ti too small:	High-frequency vibrations, strong tendency to oscillate
Recommended[1]:	700..2500 ms

TiM Maximum value from integral memory Ti

TiM too small:	Speed target at higher load is not reached
Recommended[1]:	80..100 %

xKp2 New gain factor (i.e. new Kp) for damping the current-actual overshoot above current limit I lim inuse (0x48)
Note: Activate only if the system requires it

xKp2 too large:	Danger of current oscillations
Recommended[1]:	0 (Disabled) or 100..120 %

Kf precontrol to compensate for the response delay in the current controller
Note: Activate only if the system requires it

Kf too large:	Danger of current oscillations
Recommended[1]:	0 (Disabled) or 10..50 %.

Ramp Current rise limitation or ramp rise from the set current

Ramp too large:	Danger of long-wave speed oscillations (motor becomes unstable)
Recommended[1]:	600..2500 µs

[1] Guideline values based on many years of experience
Differences depending on the system are nevertheless possible

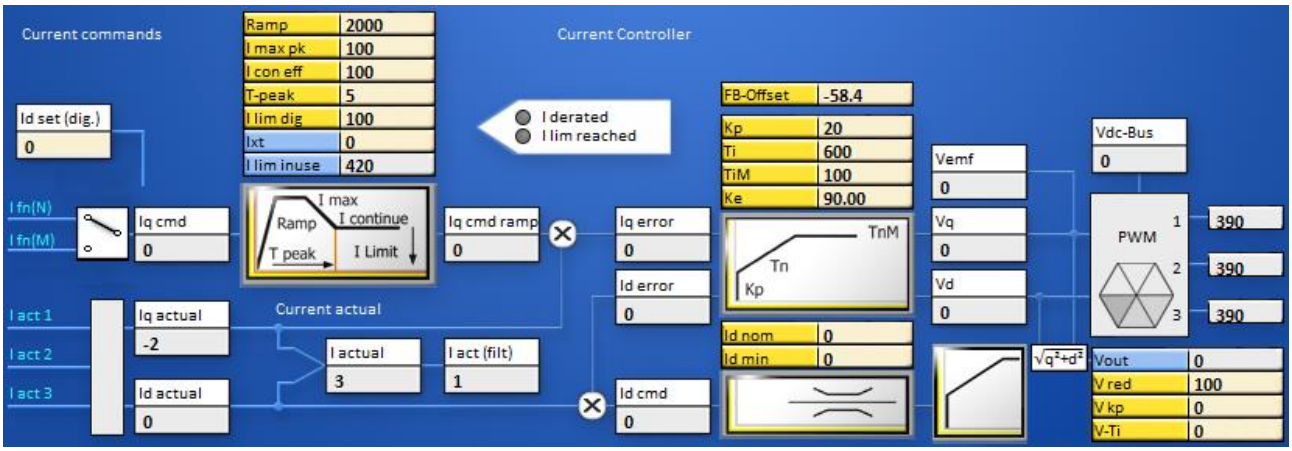
The current control parameters can be determined by the motor data such as winding inductance and winding resistance.

Attention:

- The current controller parameters may only be changed by trained specialist personnel.
- Poorly set gain parameters can damage the unit or the drive.
  damage.
- Check the effect of all settings with the NDrive oscilloscope.

10.2 **Current control – Structural diagram**

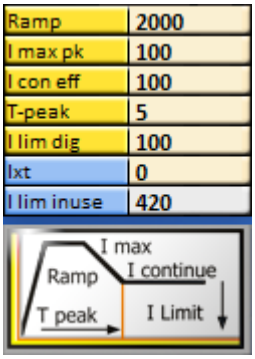
The structural diagram of the current control with input and display window of the controller parameters is shown on the page **Speed** for numerical values under **Current Commands** and **Current Controller**.



Current setpoints:	**Function:**	**ID address:**
I fn(N)	Speed controller output (current setpoint from speed controller)	
I fn(M)	Torque setpoint after ramp (Dig. setpoint preset from Iq current (M set(dig.))	
Id set (dig.)	Dig. setpoint input from Id current (normalised like M set(dig.))	0x21
Iq cmd	Active current (Iq) Setpoint (internal)	0x26
Iq cmd ramp	Active current (Iq) Setpoint (internal) after ramp and limitation	0x22
Id cmd	Reactive current (Id) Setpoint (internal)	0x23
Current controller values:		
Iq actual	Current active current (Iq)	0x27
Id actual	Current reactive current (Id)	0x28
I actual	Actual current value	0x20
I act (filt)	Actual current value after display filter	0x5F
Iq error	Control error active current (Iq)	0x38
Id error	Control error Reactive current (Id)	0x39
Voltage values:		
Vemf	Current Vemf voltage share (feed forward Back EMF)	$0x29_H$
Vq	Current Vq voltage share	$0x29_L$
Vd	Current Vd voltage share	$0x2A_L$
Vout	Current output voltage	$0x8A_L$
Vdc bus	Measured value of the DC link voltage	0xEB
PWM 1	PWM output level phase 1	0xAC
PWM 2	PWM output level phase 2	0xAD
PWM 3	PWM output level phase 3	0xAE
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

Ramp setting field on the Speed page.

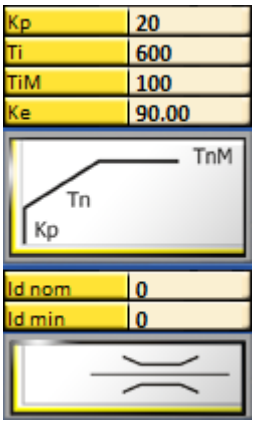
Symbol:	Function:	ID address:
Ramp	Ramp setting set current [µs]	0x25
I max pk	Devices Peak current [A]	0xC4
I con eff	Devices Continuous current [Arms]	0xC5
T-peak	Permitted overcurrent time above continuous current limit [s].	0xF0
I lim dig	Current reduction in % if logic input I limit (dig.) is activated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



The current setpoint (I cmd) is edited in the setting field (Ramp).
The current rise (Ramp), the peak current (I max pk), the continuous current (I con eff) and the permitted overcurrent time (T-peak) are set.
The summarised current reductions due to speed, current and temperature are displayed at I lim inuse.
When the current is reduced, the I reduced LED lights up.
The result of the current setpoint processing is shown in the Current setpoint after ramp (I cmd ramp) display field.

Current controller setting field on the **Speed** page.

Symbol:	Function:	ID address:
Kp	Proportional Gain [Num]	0x1C
Ti	Integral time constant [µs]	0x1D
TiM	Maximum value of the integral memory Ti [%]	0x2B
Ke	Motor Ke Constant (Back EMF)	$0x87_H$



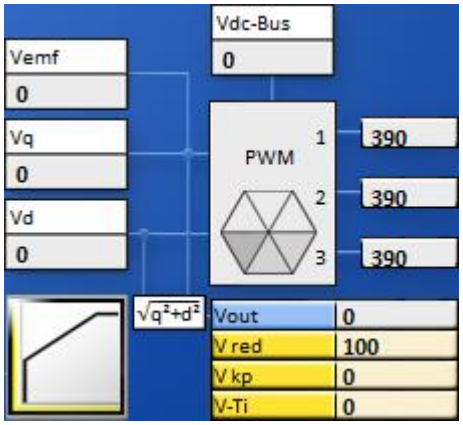
Field control setting field on the **Speed** page.

Symbol:	Function:	ID address:
Id nom	Nominal magnetising current in % of nominal motor current [%].	0xB2
Id min	Minimum magentising current in % of rated motor current [%].	0xB5
V-red	Field weakness control - Voltage Reference Value in % of Vout [%]	0x8B
V-kp	Gain of the field weakening control [Num]	0x8C
V-Ti	Integral time of the field weakening control [Num]	0x8D

The actual current values (I-actual1, I-actual2, I-actual3) are evaluated as Iq-actual and Id-actual. The displayed actual current value I act (filt) is obtained from the actual current value (I actual) with a filter.
In the current controller, the Iq and Id errors are processed with the amplification parameters (Kp, Ti, TiM).
The reference value for the Id control is formed via the vector control feedback.

PWM display field on the Speed page

Symbol:	Function:	ID address:
Vemf	Current Vemf voltage share (feed forward Back EMF)	$0x29_H$
Vq	Current Vq voltage share	$0x29_L$
Vd	Current Vd voltage share	$0x2A_L$
Vout	Current output voltage	$0x8A_L$
Vdc bus	Measured value of the DC link voltage	0xEB
PWM1	Pulse width modulation phase 1	0xAC
PWM2	Pulse width modulation phase 2	0xAD
PWM3	Pulse width modulation phase 3	0xAE



The PWM pulses for the output stage circuit are formed from the current controller output signals Vemf, Vq and Vd.

10.2.1 Conversion of the units of measurement for electricity

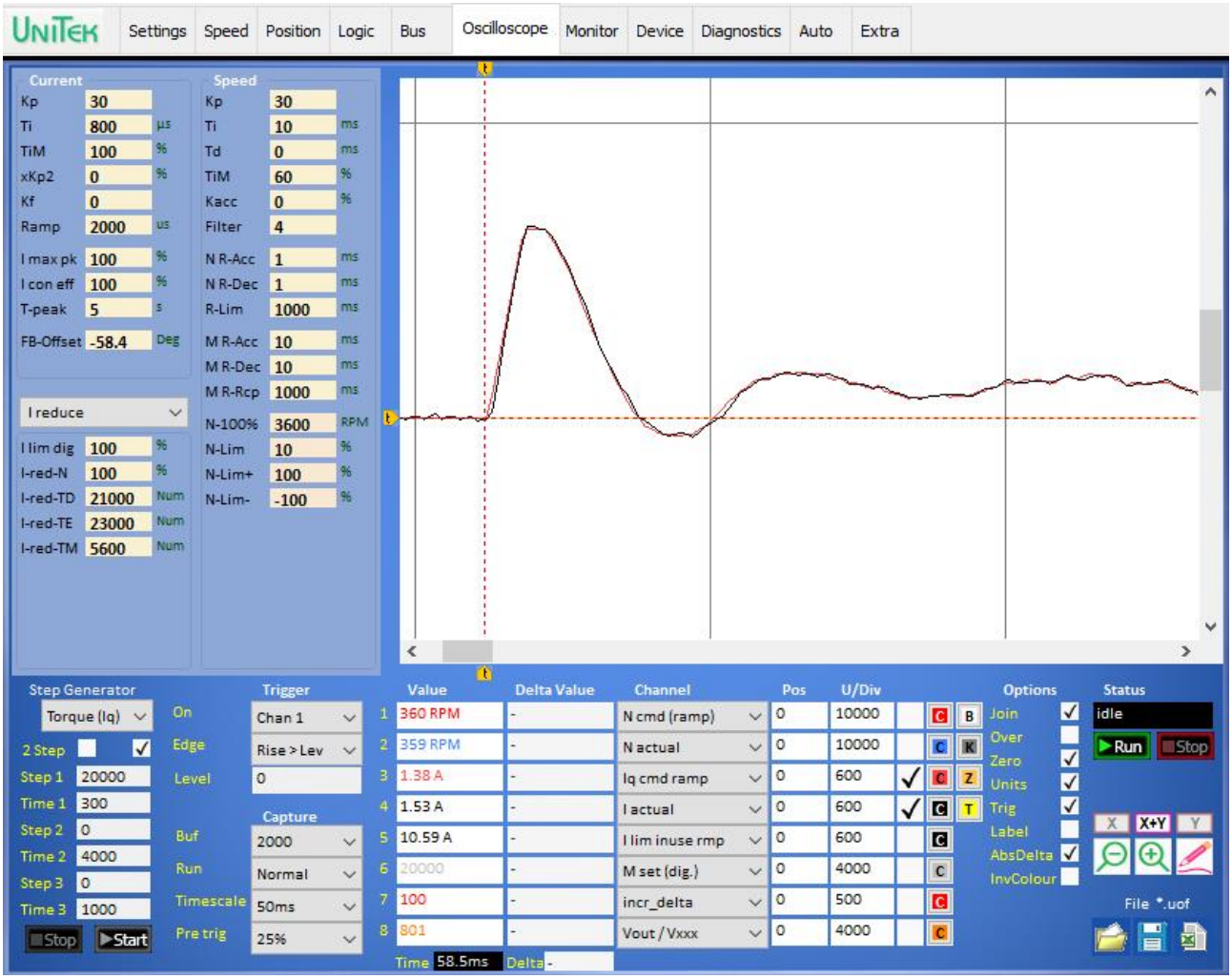
The numerical values for the nominal current must be observed for digital communication via RS232 or CAN Bus.
The track field displays the numerical values.

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

Note:

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

10.2.2 Setting current controller parameters (Kp ,Ti, TiM)



The setting of the current controller is strongly dependent on the characteristics of the overall system and especially on the characteristics of the used and mostly unknown motor.

Inverters are generally not plug and play systems. A special closer look at the behaviour during current control is crucial for safe and quiet operation.

Prerequisite:

- Handling the NDrive oscilloscope (signals "I cmd ramp" and "I actual" as measuring channel).
- The motor should either be freewheeling or at a constant load.
- Stable RS232 communication for setting a digital setpoint and recording with the NDrive oscilloscope.
- The current controller parameters may only be changed by qualified personnel.

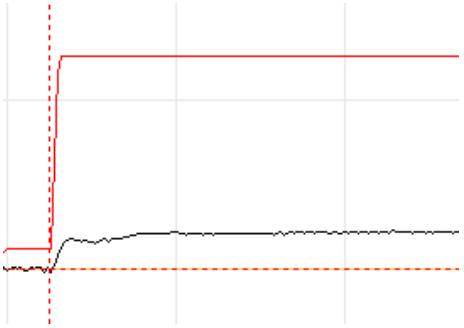
Note:
The following setting from the current controller focuses on the general first jump from setpoint to actual value. At high speeds and near the voltage limit, corrections may have to be made.

Setting Kp value:

- Remove from integral part (TiM = 0 %)
- Fast speed ramps (N R-Acc = 10..100 ms)
- Set trigger in NDrive oscilloscope to channel 1 (N cmd (ramp)), Rise > Lev 100
- Start oscilloscope recording, send speed setpoint (e.g. 10000), stop motor, analyse oscilloscope recording.

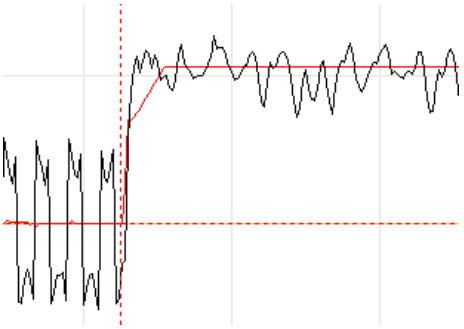
Kp value too small

1. Difference between current setpoint (I cmd (ramp)) and Current actual value (Iactual) too high
2. Maximum torque is not reached at high speeds



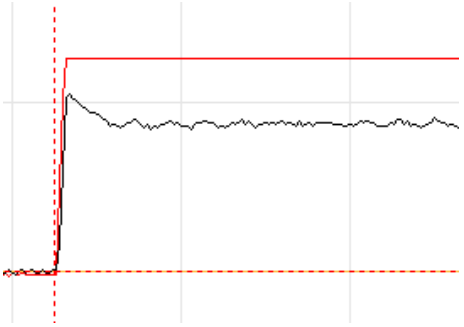
Kp value too large

1. Current actual value oscillates above the current setpoint value
2. Rough running and high-frequency engine noise



Kp value good

1. Current actual value does not oscillate
2. Difference between current setpoint and current actual value is small
   (Optimal: control error < 5 %)

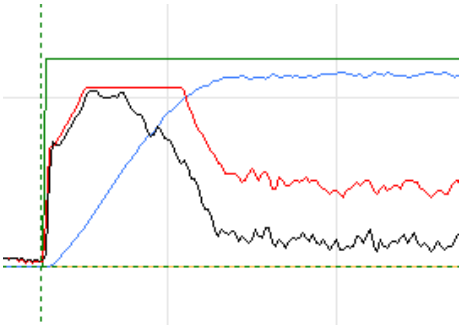


Setting Ti and TiM value:

- Maintain determined KP value
- Adding the integral part (TiM ≠ 0 %, Ti ≠ 0 µs)
- Fast speed ramps (N R-Acc = 10..100 ms)
- Set trigger in NDrive oscilloscope to channel 1 (N cmd (ramp)), Rise > Lev 100
- Start oscilloscope recording, send speed setpoint (e.g. 10000), stop motor, analyse oscilloscope recording.

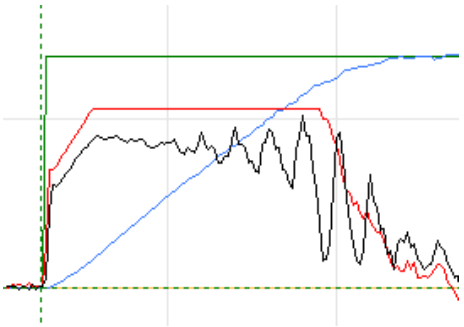
TiM too small

1. The setpoint speed (green) is not reached at higher load despite sufficiently high setpoint current (red)
2. The control variable of the output voltage is missing
3. Recommendation: 80..100 %



Ti too big

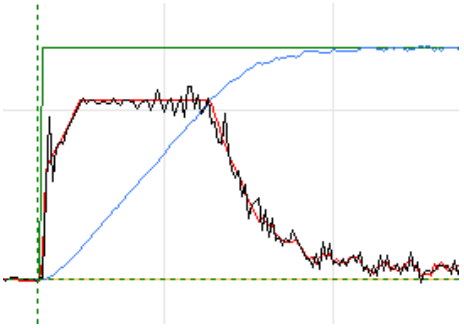
1. Control error is hardly compensated or compensated too slowly
2. Long-wave swing possible



Ti too small

1. Large and fast overshoot at the first target jump
2. Short-wave oscillation possible

Note:
Since Ti depends on Kp, a subsequent adjustment of Kp affects the behaviour of the integral component.

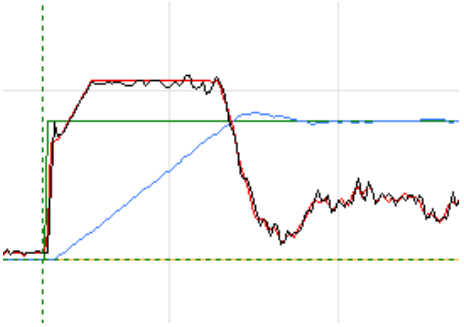


Kp and Ti well adjusted

1. Fast control from the fast setpoint jump without large overshoot as well as fast correction in case of setpoint change
2. No short or long wave oscillation

Note:

- The system can become unstable during rapid load changes or in the range of the voltage limit
- Motor type and EMC influences have a strong effect on the control behaviour



11 Current reduction (Derating)

11.1 Power reduction – Overview and explanation

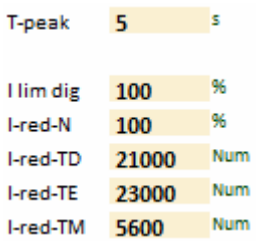
The current limits of peak and continuous current permitted during operation are determined by the set values of the motor and servo. The rule is that the lower value of the respective peak and continuous currents determines the limits during operation.

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

11.1.1 Power reduction – Overview

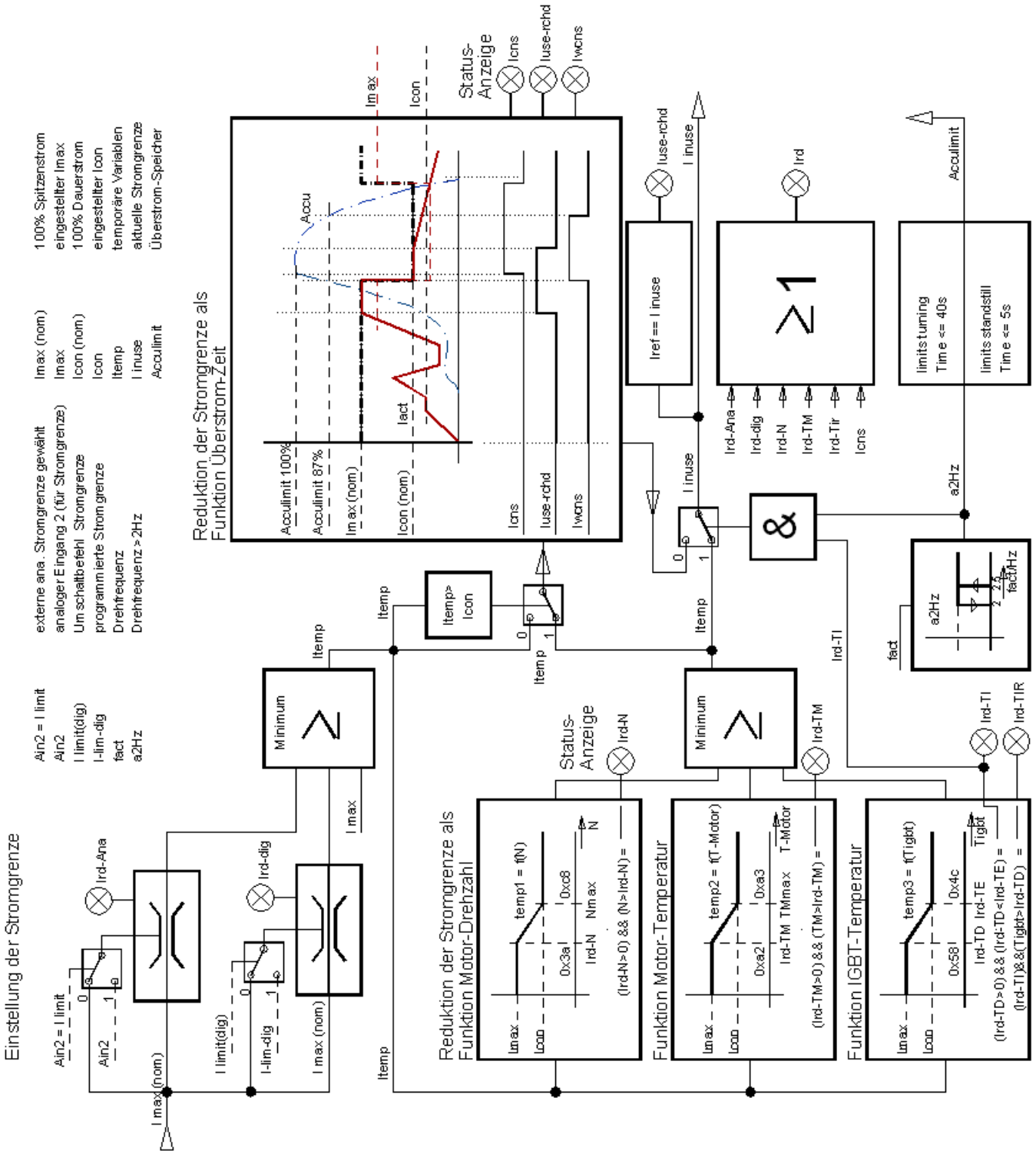
Parameter overview of the various adjustable derating options.

When reducing the current (derating) from the permitted peak current to the permitted continuous current, it is possible to choose between static (fixed value) or dynamic (function) current reduction electricity reduction can be distinguished.



Derating:	Symbol:	Function:	Range:	Unit:	ID address:
Time[3]	T-peak	Overcurrent time function	1..40	s	0xF0
Digital input[1]	I lim dig	Current reduction in % when Logic input I limit (dig.) is activated	0..100	%	0x46
Speed Actual value[1]	I-red-N	Overcurrent speed function	0..32767	Num	0x3C
Power stage temperature (start)[2]	I-red-TD	Start of current reduction via the output stage temperature	0..32767	Num	0x58
Power stage temperature (end)[2]	I-red-TE	End of current reduction via the output stage temperature	0..32767	Num	0x4C
Engine temperature[2]	I-red-TM	Reduction due to motor temperature	0..32767	Num	0xA2
Engine temperature[2]	M-Temp	Reduction from 93 % of M-Temp	0..32767	Num	0xA3
n < 10 Hz[2]		Reduction to continuous current if motor speed is less than 10 Hz			
Analogue input[1]		Ain 2 is set to I limit. Ain 2 determines allowed peak current	0..32767	Num	$0xD6_H$

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



Note: Names may vary slightly.

11.1.2 Current reduction – Explanation

In general, if the target current reaches the currently permitted current limit, this is indicated with the message in the status field $0x40_{Bit\ 21}$ (**Iuse-rchd**).

T-peak:
If the current used is greater than the permitted continuous current, a calculation starts which carries out a time-based calculation depending on the delta of the excess. The calculation is therefore dynamic. If the dynamic time calculation corresponds to the set value of **T-peak** (0xF0), the current limit is reduced to continuous current. If the time calculation is at 87.5 % of T-peak, $0x40_{Bit\ 28}$ (Iwcns) is set in the status field. If the current is less than the permitted continuous current, the time memory is depleted again. The reset time is equal to 2 times T-peak.

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

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

I-red-N:
From the speed entered in parameter **I-red-N** (0x3C), the current limit is reduced linearly.
At nominal speed, the current limit corresponds to the continuous current.
- Derating Active: Status field $0x40_{Bit\ 22}$ (Ird-N)

I-red-TD & I-red-TE:
If the output stage temperature exceeds the value of **I-red-TD** (0x58), the current limit is reduced linearly, the message in status field $0x40_{Bit\ 24}$ is displayed and warning 7 (DEVICETEMP) is set.
If the value of **I-red-TE** (0x4C) is reached, the current limit is reduced to the permitted continuous current.
- Activation condition: (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 power stage temperature exceeds 25200 Num (83°C), an emergency shutdown occurs and error 7 (DEVICETEMP) is set.

I-red-TM:
If the motor temperature exceeds the value of **I-red-TM (**0xA2), the current limit is reduced linearly, the message in status field $0x40_{Bit\ 26}$ (Ird-TM) and warning 6 (MOTORTEMP) is set.

If the temperature continues to rise, the current limit is reduced linearly until the value of **M-Temp** (0xA3) is reached. Then an emergency shutdown occurs and error 6 (MOTORTEMP) is set.

Attention:
The warning messages in the status must be taken into account. Reduced current limits can indicate functional faults in the machine or system.

11.1.3 Current reduction – Status display

Overview of the signals in the status field (0x40) for the current reduction functions.

Signal:	Derating function:	Description of the signals:	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 setpoint is at the permitted current limit	Bit 21
Ird-N	Speed Actual value	Current limit is reduced because of I-red-N	Bit 22
Ird-Ti	Power stage temperature	Function of current reduction due to power stage temperature is activated (→ T-peak deactivated)	Bit 23
Ird-TiR	Power stage temperature	Current reduction due to power stage temperature is active	Bit 24
Ird-10Hz	Speed Actual value	Current reduction with a rotating field frequency lower than 10 Hz → Blocking protection [1]	Bit 25
Ird-TM	Motor temperature	Current limit is reduced because of I-red-TM or M-Temp (93 %)	Bit 26
Ird-Ana	Analogue input	Current limit is reduced due to Ain2 (I limit) smaller than the actual current limit	Bit 27
Iwcns	Time	The dynamic time limit is loaded to 87.5 % of T-peak	Bit 28

Measured values (monitor)		ID address:
T-motor	Current engine temperature	0x49
T-igbt	Current power stage temperature	0x4A
T-air	Current air temperature in the servo	0x4B
I lim inuse	Current limit (internal)	0x48

[1] Blocking protection:
With a rotating field frequency of less than 10 Hz, the current limit must be reduced to the permitted continuous servo current. This is important to protect the servo.
At your own risk, this blocking protection can be deactivated by automatically switching to a PWM clock frequency of 4 kHz below a rotating field frequency of 10 Hz:

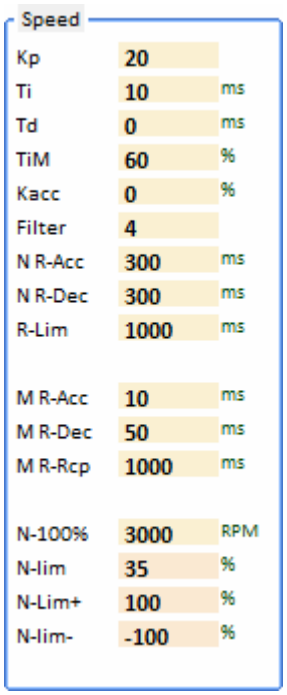
- ID address $0x5A_{Bit\ 31}$ = 0 Blocking protection activated (current limit is reduced)
- ID address $0x5A_{Bit\ 31}$ = 1 Blocking protection deactivated (clock frequency switched to 4 kHz)

12 Speed control

12.1 Speed control – Parameter overview

Parameter overview of the settings for the speed controller and the general permitted speed limits.

Note:
Many of these parameters can also be found on the pages **Speed** and **Oscilloscope**.



Symbol:	Function:	Range:	Unit:	ID address:
Kp	Proportional gain	0..200	Num	0x2C
Ti	Integration time (integral time constant)	0..10000	ms	0x2D
Td	Derivative time	0..100	ms	0x2E
TiM	Maximum value from integral memory Ti	0..100	%	0x3B
Kacc	Proportional Gain - Delta Acceleration	0..100	%	0x5B
Filter	Filter speed actual value	0..10	Num	0x5E
N R-Acc	Speed - Acceleration ramp	0..30000	ms	$0x35_L$
N R-Dec	Speed - Brake ramp	0..30000	ms	$0xED_L$
R-Lim	Emergency stop, limit switch ramp	0..1000	ms	$0xC7_L$
M R-Acc	Torque - Acceleration ramp	0..4000	ms	$0x35_H$
M R-Dec	Torque - Deceleration ramp	0..4000	ms	$0xED_H$
M R-Rcp	Torque - Recuperation Ramp ($0xCD_{Bit\ 4}$)	0..4000	ms	$0xC7_H$
N-100%	Physical reference value for the internal resolution of the speed to 16 Bits (±32767)	100..50000	rpm	0xC8
N-Lim	Speed limitation for positive and negative direction of rotation	0..100	%	0x34
N-Lim+	Limitation for positive direction of rotatio (if logic input N clip(neg&pos) is activated)	0..100	%	0x3F
N-Lim-	Limitation for negative direction of rotation (if logic input N clip(neg&pos) is activated)	0..100	%	0x3E

12.1.1 Additional information of the parameters from the speed controller

Kp Input for the proportional gain in the speed controller
Note: Input value of 33 (Num) ≙ 1.0 (Physical manipulated variable from current)

Kp too small:	correction error, poor dynamics, low-frequency oscillations
Kp too large:	Strong engine noise, high-frequency vibrations
Recommended[1]:	5..50 Num

Ti Integration time in the speed controller
Note: Ti depending on the proportional gain Kp

Ti too large:	Low-frequency vibrations, large speed overshoots, very weak
Ti too small:	High-frequency vibrations, strong tendency to oscillate
Recommended[1]:	6..400 ms

TiM Maximum value from integral memory Ti

TiM too small:	Speed target at higher load is not reached
Recommended[1]:	20..60 %

Td Differential time constant in the rotary speed controller
Note: Activate only if the system requires it.

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

Kacc Dynamic acceleration value directly to the current controller
Note: Activate only if the system requires it.

Kacc too large:	Danger of current oscillations
Recommended[1]:	0 (Disabled) or 10..50 %

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

Filter too small:	motor noise, high-frequency vibrations, strong tendency to vibrate
Filter too large:	low-frequency oscillations

[1] Guideline values based on many years of experience.
Differences depending on the system are nevertheless possible.

12.1.2 Additional information of the speed setpoint ramps in speed controller mode

The speed setpoint in N cmd (int) (0x5D) is adjusted according to the ramp settings and sets the final speed setpoint in N cmd (ramp) (0x32) to the speed controller.

N R-Acc Acceleration ramp for speed and position setpoint
Parameter value always corresponds to the time from 0 rpm to the reference of N-100%.

N R-Dec Brake ramp for speed and position setpoint
Parameter value always corresponds to the time from 0 rpm to the reference of N-100%.
(set to < 10 ms for position control)

R-Lim Minimum braking ramp for limit switch and emergency stop
With speed control only active if free run-out is deactivated
(can be selected for calibration run)

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 during gate control.
For speed control, only the current ramp calculation using the parameter **Ramp** (0x25) active.

12.1.3 Additional information of the speed setpoint limitation in speed controller mode

N-100% Physical reference value for the internal resolution of the speed to 16 Bits (±32767).
Always set this value to Maximum engine speed.
If the speed is to be limited to a smaller value,
please use the parameter N-Lim (0x34).

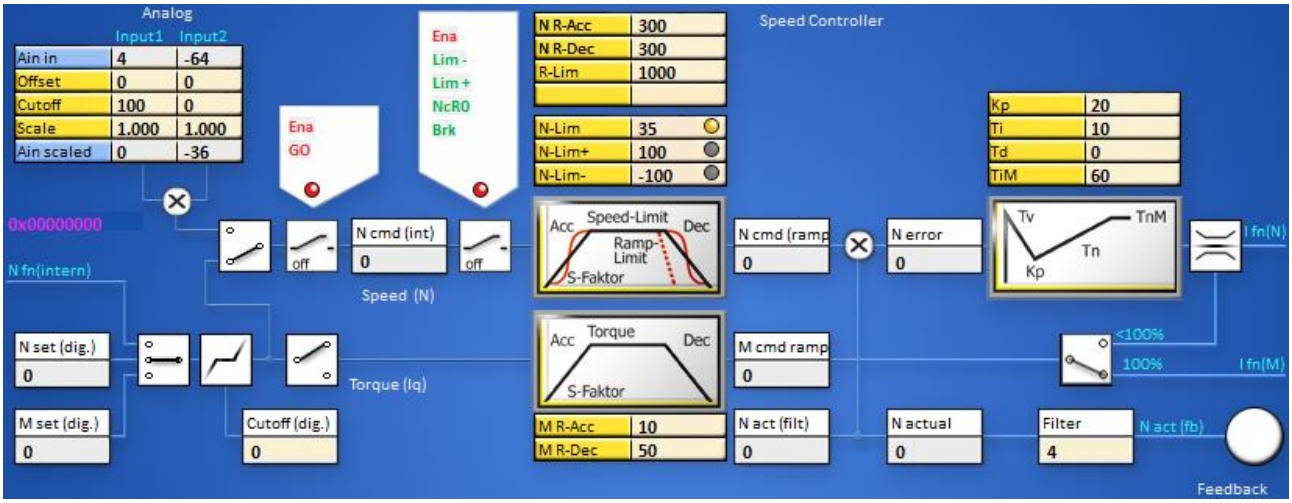
N-Lim Speed limitation in % for positive and negative direction of rotation depending on the reference value in N-100% (0xC8) .
With a current setting (torque control) and N-Lim < 100 %, the torque cruise control (speed limitation) is activated.

N-Lim+ Speed limitation in % for positive direction of rotation depending on reference value in N-100% (0xC8)
→ Active only if a logic input is set to N clip(neg&pos) and activated.
Special function: Current limit for automatic recuperation with torque control

N-Lim- Speed limitation in % for negative direction of rotation depending on reference value in N-100% (0xC8)
→ Active only if a logic input is set to N clip(neg&pos) and activated.
Special function: Current limit for automatic recuperation with torque control

12.2 **Speed control – Structural diagram**

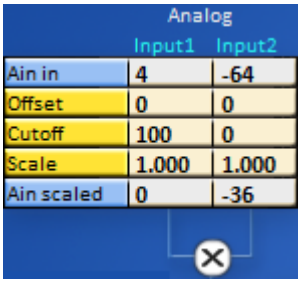
The structural diagram of the speed control with input and display window of the controller parameters is shown on the page **Speed** for numerical values under **Analog, Speed** and **Speed Controller**.



Speed and active current (Iq) setpoints:		**Function:**	**ID address:**
Ain a	IN1 / IN2	Analogue input 1 and 2	$0xD5_L$ / $0xD6_L$
Offset	IN1 / IN2	Offset compensation of the respective analogue inputs	$0x2F_L$ / $0xD7_L$
Zero zone	IN1 / IN2	Zero zone with analogue setpoint setting	0x50 / 0x53
Scale	IN1 / IN2	Scaling factor of the respective analogue inputs	$0x2F_H$ / $0xD7_H$
Ain scaled	IN1 / IN2	Analogue setpoint setting of inputs Ain1 and Ain2	$0xD5_H$ / $0xD6_H$
N set (dig.)		Digital setpoint setting of the speed	0x31
M set (dig.)		Digital setpoint setting from active current (Iq)	0x90
Cutoff (dig.)		Zero zone with digital setpoint setting	0x1E
Speed controller values:			
N cmd (int)		Speed setpoint used (internal)	0x5D
N cmd (ramp)		Speed setpoint after ramp	0x32
N actual		Speed actual value signal for the control	0x30
N act (filt)		Actual speed signal for the display	0xA8
N error		Control error speed actual value	0x33
M cmd ramp		Active current (Iq) setpoint after ramp (scaled)	$0x3A_L$

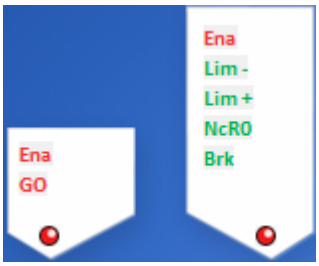
Analogue setting field on the **Speed** page.

Symbol:	Function:	Input1 (Ain1)	Input2 (Ain2)
Ain in	Analogue input 1 and 2	$0xD5_L$	$0xD6_L$
Offset	Offset compensation of the respective analogue inputs	$0x2F_L$	$0x2F_L$
Cutoff	Zero zone with analogue setpoint setting	0x50	0x53
Scale	Scaling factor of the respective analogue inputs	$0x2F_H$	$0xD7_H$
Ain scaled	Analogue setpoint setting of inputs Ain1 and Ain2 (Ain scaled = (Ain in + Offset) x Scale)	$0xD5_H$	$0xD6_H$



With **Ain in$_{1,2}$** the measured analogue input values of Input1 and Input2 are displayed.
These signals are processed with the parameters Offset$_{1,2}$, Cutoff$_{1,2}$ and Scale$_{1,2}$. The result is displayed in **Ain scaled$_{1,2}$**.
The selector switches are used to choose between analogue and digital setpoint. If both switches are closed, the digital and analogue setpoints are added together. The sum value for N cmd (int) is internally limited to ±32767.
The digital setpoints can be specified as digital Speed (N set (dig.)), digital Torque (M set (dig.)) or by the position controller directly via N fn(intern).

Signals:	Function green:
Ena	Approval hardware / software
GO	Internal release (output stage)
Lim-	Limit switch minus
Lim+	Limit switch plus
NcRO	Setpoint zero
Brk	Brake

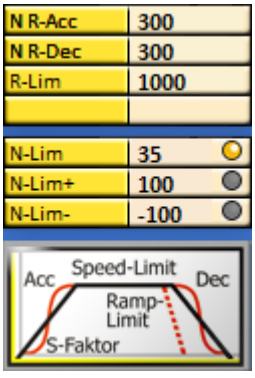


Ramp setting field on the **RPM** page.

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

Setpoint limits setting field on the **Speed** page.

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



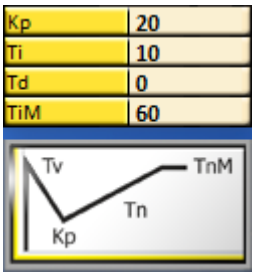
Control panel 1:
The speed setpoint is only switched on (green) with enable (Ena) and internal enable (GO) and displayed in the speed setpoint display field (N cmd (int)).

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

Ramp field:
The acceleration ramp (N R-Acc), the deceleration ramp (N R-Dec), the limit switch emergency stop ramp (R-Lim) and the speed limitation (N-Lim, N-Lim+, N-Lim-) are set. The result is shown in the speed setpoint after ramp (N cmd (ramp)) display field.
This processed signal (N cmd (ramp)) is finally the input for the speed controller.

Speed controller parameters

Symbol:	Function:	Range:	Unit:	ID address:
Kp	Proportional gain	0..200	Num	0x2C
Ti	Integration time (integral time constant)	0..10000	ms	0x2D
Td	Derivative time (differentiation part)	0..100	ms	0x2E
TiM	Maximum value from integral memory Ti	0..100	%	0x3B

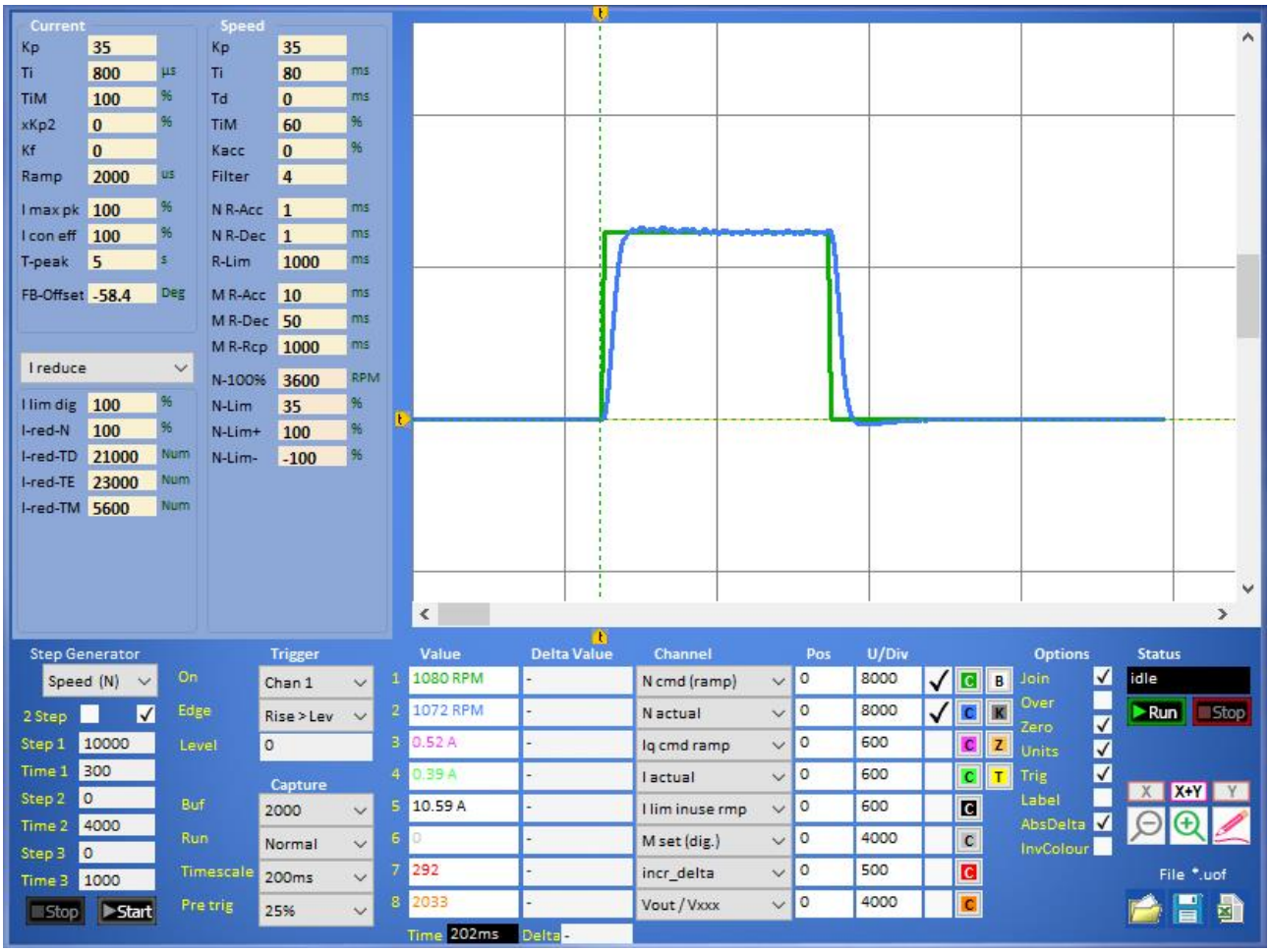


The filtered actual speed value (N act (filt)) is displayed after the filter in the field actual speed value (N actual) is displayed.
The actual speed value is subtracted from the speed setpoint at the mixing point. The result is shown in the speed error (N error) display field.

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

The output from the speed controller is the unprocessed current setpoint (I fn(N)).

12.2.1 Speed controller parameter setting (Kp ,Ti, TiM)



The setting of the speed controller is mainly dependent on:

- the properties of the overall system (load, friction and inertia torques of the drive)
- depends on the power of the inverter and motor used (motor and inverter must be correctly rated for the overall system)
- the required control behaviour of the speed (smooth, aggressive, transient behaviour)

Prerequisite:

- Handling the NDrive oscilloscope (signals "N cmd (ramp)" and "N actual" as measuring channel).
- The motor should either be freewheeling or at a constant load.
- Have a stable RS232 communication to set a digital setpoint and record with the NDrive oscilloscope.

Note:

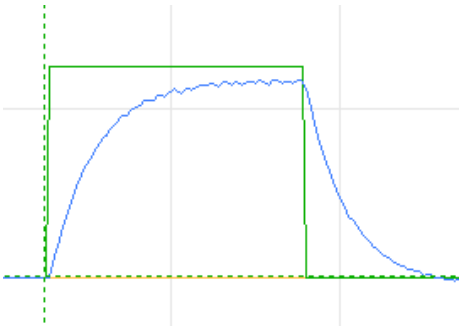
The following setting of the speed controller concentrates on generally static overall systems.
For dynamic systems, adjustments may have to be made subsequently.

Setting Kp value:

- Remove from integral part (TiM = 0 %).
- Set desired speed ramp (N R-Acc = 10..10000 ms).
- Set trigger in NDrive oscilloscope to channel 1 (N cmd (ramp)), Rise > Lev 100.
- Start oscilloscope recording, specify speed setpoint (e.g. 1000) (test or step generator), deactivate inverter (RUN (FRG) = Off), analyse oscilloscope recording.

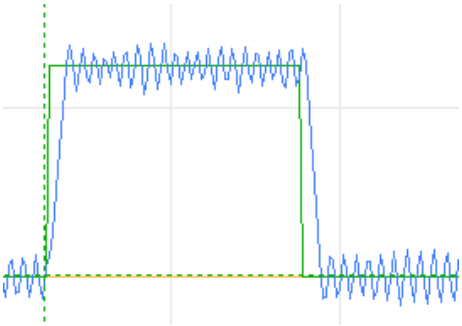
Kp value too small

1. Difference between speed setpoint (N cmd (ramp)) and Actual speed value (N actual) too high.
2. The speed setpoint is not reached and the acceleration is too low.
3. The drive reacts softly to setpoint changes and can be turned without much force when at standstill.



Kp value too large

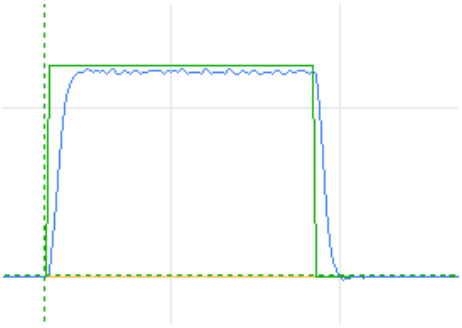
1. Actual speed value oscillates strongly above the speed setpoint value.
2. Rough running, high tendency to vibrate (even when stationary) and engine noise.



Kp value good

1. Speed actual value does not oscillate.
2. Difference between speed setpoint and actual speed is small (optimum: control error < 5 %).

   The remaining speed error is compensated with the integral setting.

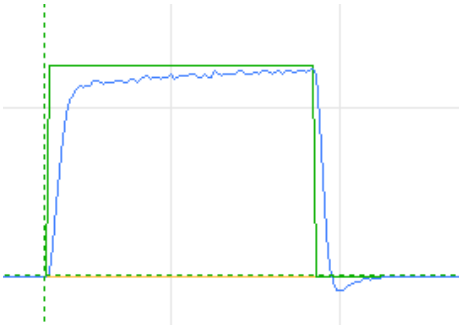


Setting Ti and TiM value:

- Maintain determined KP value.
- Adding the integral part (TiM ≠ 0 %, Ti ≠ 0 µs).
- Set desired speed ramp (N R-Acc = 10..10000 ms).
- Set trigger in NDrive oscilloscope to channel 1 (N cmd (ramp)), Rise > Lev 100.
- Start oscilloscope recording, specify speed setpoint (e.g. 1000) (test or step generator), deactivate inverter (RUN (FRG) = Off), analyse oscilloscope recording.

Ti too big

1. Rule error is hardly compensated or compensated too slowly.
2. Long-wave swing possible.

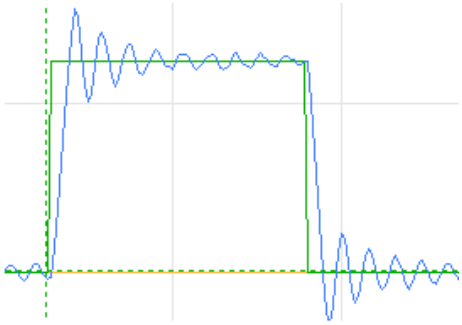


Ti too small

1. Large and fast overshoot at the first target jump.
2. Short-wave oscillation possible.

Note:

3. Since Ti depends on Kp, a subsequent adjustment of Kp affects the behaviour of the integral component.

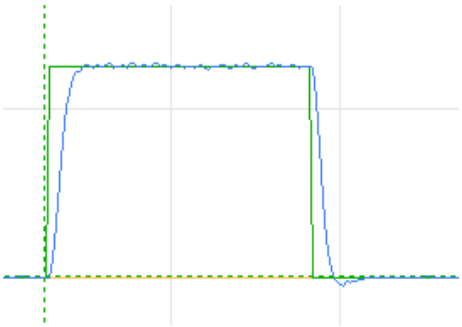


Kp and Ti well adjusted

1. Fast control from the fast setpoint jump without large overshoot as well as fast correction in case of setpoint change.
2. No short or long wave oscillation.

Note:

- The system can become unstable in the event of rapid load changes or in the range of the voltage limit.
- Set the **TiM** parameter to minimum to reduce the overshoot. Select TiM value as small as possible.



13 Torque control

13.1 Torque control – Parameter overview

Parameter overview for setting the general current specifications, the various ramp times for the speed and torque ramps and the various limitations.

Symbol:	Function:	Range:	Unit:	ID address:
M set (dig.)	Digital setpoint for the active current (Iq) **→ Dig. torque setpoint** (Normalisation: 32767 ≙ I max pk (at 100 %))	±32767	Num	0x90
Id set (dig.)	Digital setpoint for the reactive current (Id) (Normalisation: 32767 ≙ I max pk (at 100 %))	±32767	Num	0x21
N R-Acc	Speed - Acceleration ramp	0..30000	ms	$0x35_L$
N R-Dec	Speed - Brake ramp	0..30000	ms	$0xED_L$
M R-Acc	Torque - Acceleration ramp [1]	0..4000	ms	$0x35_H$
M R-Dec	Torque - Decelaration ramp [1]	0..4000	ms	$0xED_H$
M R-Rcp	Torque - recuperation ramp [1,2]	0..4000	ms	$0xC7_H$
N-100%	Physical reference value for the internal resolution of the speed to 16 Bits (±32767)	100..50000	rpm	0xC8
N-Lim	Positive and negative speed limitation N-Lim = 100 % → Pure torque operation [4] N-Lim < 100 % → Torque cruise control active	0..100	%	0x34
N-Lim+	Current limit for recuperating braking current (see automatic recuperation function)	0..100	%	0x3F
N-Lim-	Current limit for recuperating braking current (see automatic recuperation function)	0..-100	%	0x3E
M out	Iq current → torque actual value (Normalisation: 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] Torque cruise control is activated with current (torque) setting and N-Lim < 100%.
[4] Speed is limited only based on the load and the DC link voltage

13.2 Torque control – General

- A torque control is actually a current setpoint specification. The motor torque is formed from the motor constant of kt = Nm / 1 Arms, which is generally unknown.
- The current setpoint can either be analogue via the analogue torque mode or as a digital setpoint via M set (dig.) (0x90). Both specify the active current (Iq).
- The reference for the current setpoint range always refers to 100 % of the possible servo current ((±10 V or ±32767) ≙ I max pk (100 %)).
- The current setpoint specification is switched directly to the current controller via the torque ramps (M R-Acc, M R-Dec, M R-Rcp)

Note:
In the case of digital setpoint input, the last input received decides whether it is a speed control (N set (dig.)) or a torque control (M set(dig.)). It is therefore possible to switch directly between the different operating modes (e.g.: Hill Hold).

A detailed description of the various torque control settings as well as the various special functions such as automatic recuperative braking, can be found in the additional manuals (NDrive folder \ manuals) "**Bamocar_FAQ.pdf**" and "**Information on special Car applications.pdf**".

13.3 Torque control – Torque cruise control

Torque cruise control is an operating mode in which a current setpoint is set as a default, but the higher-level speed controller is still actively working and reduces the current setpoint in order not to exceed the speed limit. Torque cruise control is thus comparable to a limiter in a vehicle.

N-Lim = 100 % (torque cruise control deactivated):
- Pure torque (current) operation without intervention of the speed controller.
  → No limit active
  → No limiting based on the speed ramps active
- Speed is limited only based on the applied load and the DC link voltage.
  → Risk that the actual speed is greater than the 16-Bit resolution of N-100% (0xC8).
- No need to set the parameters of the speed controller.

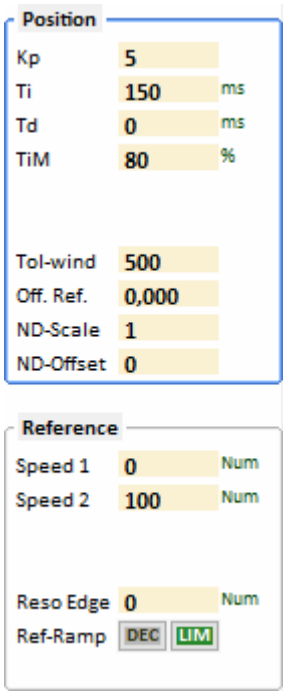
N-Lim < 100 % (torque cruise control activated):
- Torque (current) operation with intervention of the speed controller based on the maximum permitted speed.
- The speed ramp setting (N R-Acc, N R-Dec) is always active and ensures torque operation with defined acceleration.
  → Precise consideration of the large number of different ramp options required.
- Setting the parameters of the speed controller necessary

Recommendation:
- Activation of torque cruise control (N-Lim = 99 %) always with torque control.
  Reason: Prevents loss of control in the event of sudden load changes and prevents the motor from running away.
- Set the speed controller soft (Kp = 5, Ti = 400), then the current control remains smoother.
- Fast speed ramps (N R-Acc = N R-Dec = 10 ms) so that intervention remains minimal.

14 Position control

14.1 Position control – Parameter overview

Parameter overview of the settings for the position controller.



Note:
Many of these parameters and others
can also be found on the **Position** and **Oscilloscope** pages.

Position controller Parameter:

Symbol:	Function:	Range:	Unit:	ID address:
Kp	Proportional gain Determines the steepness of the deceleration ramp	0..200	Num	0x6A
Ti	Integration time (depending on Kp)	0..10000	ms	0x6B
Td	Derivative time (differential share)	0..1000	ms	0x6C
TiM	Maximum value from integral memory Ti	0..100	%	0x71
The amplified position error forms the speed setpoint Position control is deactivated when Kp = 0 The dynamic control gains Ti are only effective in the target range				

Calibration run Parameter:

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

Position parameters:

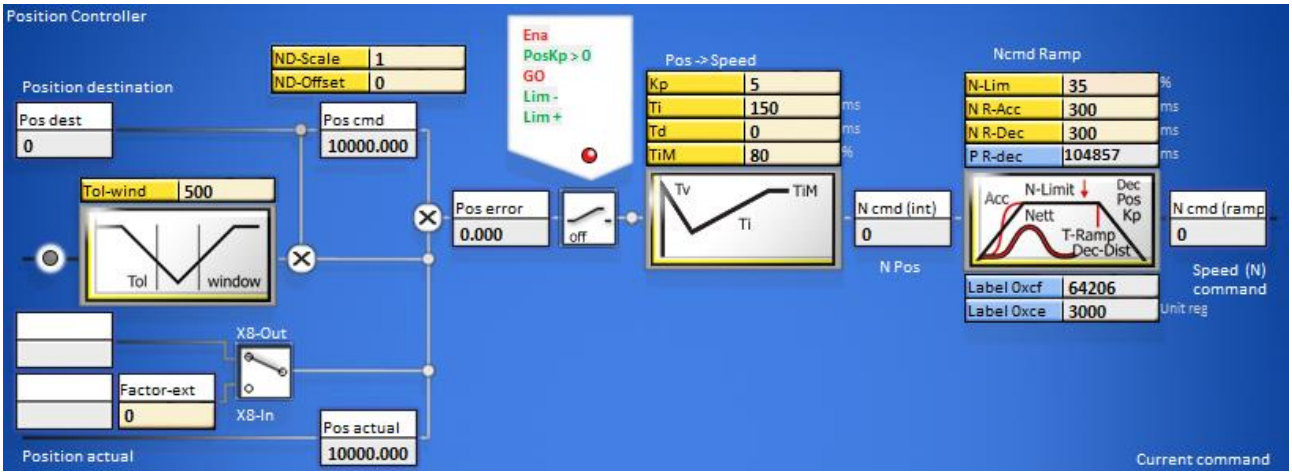
Symbol:	Function:	Range:	Unit:	ID address:
Tol-wind	Position tolerance window	0..2000	Num	0x79
Off. Ref.	Mechanical zero offset		Num	0x72
ND-Scale	NDrive position display factor	32 Bit - 1	Num	0x7C
ND-Offset	NDrive Position display offset	32 Bit - 1	Num	0x7D
Pos dest	Preset target position	±32 Bit - 1	Num	0x6E
Pos cmd	Target position used (internal)	±32 Bit - 1	Num	0x91
Pos current	Actual position value	±32 Bit - 1	Num	0x6D
Pos error	Position control error 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 revolution corresponds to the numerical value of 65536.
- The position setpoints or parameter values sent by the controller via RS232 or CAN are executed immediately.

14.2 **Position control – Structural diagram**

The structural diagram of the position control with input and display window of the controller parameters is shown on the **Position** page for numerical values under Position **Controller**.

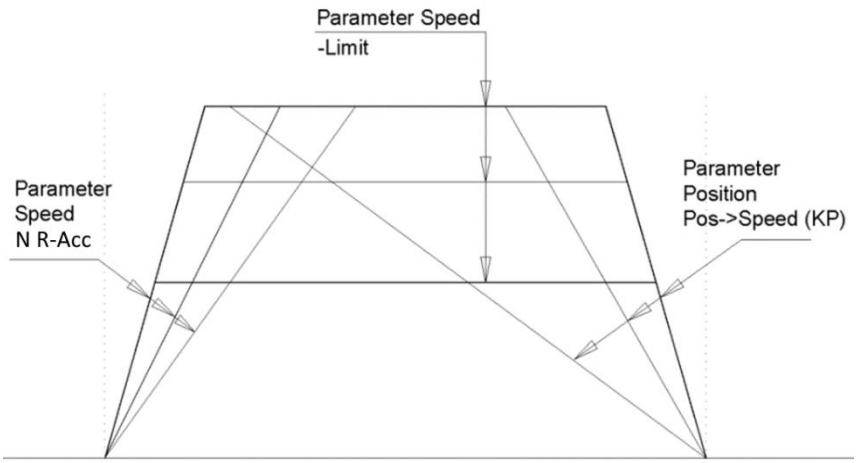


The actual position value (Pos actual) is subtracted from the target position value (Pos dest) at the mixing point. If the result is smaller than the set tolerance value (Tol-wind), the status signal reports this at the tolerance window. When released, the position target value (Pos dest) is switched on as the position setpoint (Pos cmd). The actual position value (Pos current) is subtracted from the position setpoint (Pos cmd) at the mixing point.

The result is shown in the speed error (N error) display field. If the messages of the releases (Ena, GO), the limit switches (Lim-, Lim+), and the position controller amplification are not zero
(PosKp > 0) are switched (green), the position error (Pos error) is indicated in the position controller.
(Pos → Speed).

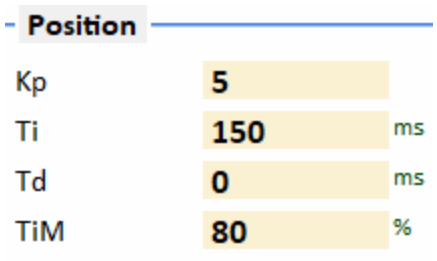
The proportional amplification (Kp), the integral component (Ti), the differentiating component (Td) and the memory limitation for the integral component (TiM) are set for both amplifiers.

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



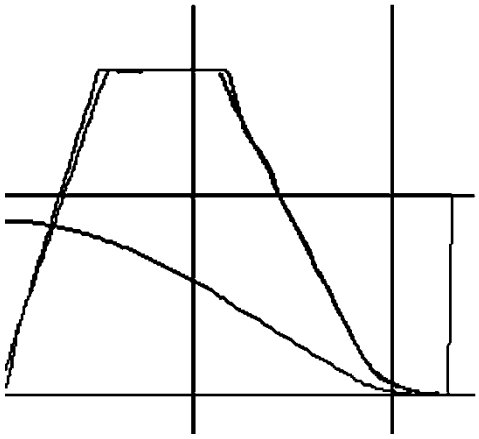
14.2.1 Position controller – Settings

The amplified position error forms the speed setpoint



Proportional control gain	
Kp	Proportional gain position control loop. Determines the steepness of the deceleration ramp.
Attention: The position control is switched off when no Kp value is entered.	
Dynamic control gain (only effective in the target area)	
Ti	Integral time
Td	Differential time
TiM	Limit integral part
P R-dec	Position target ramp time: Delay time from maximum speed in ms.

Depiction of travel

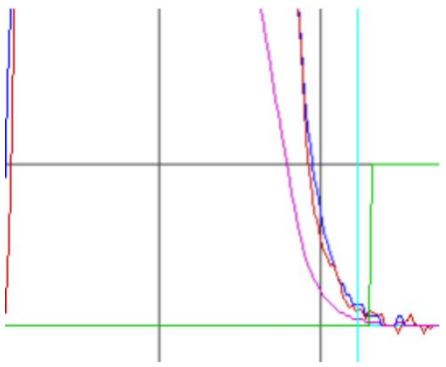


Setting - travel

N R-Acc	Determines the acceleration ramp up to the speed limit for constant travel.
N-Lim	Determines the speed at constant speed.
Kp	Determines the target ramp depending on the position control error.
P R-dec	Displays the delay time from 100 % speed to the position (zero speed).

- Small Kp gain leads to a long target ramp.
- High Kp gain creates a short (steep) target ramp.
- If the Kp gain is too high, the drive overruns the target position and oscillates in position.
  The optimal target ramp is as long as possible and as short as necessary.

Representation positioning



Addition - Positioning

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

Note:

- One motor revolution corresponds to the numerical value of 65555.
- The position setpoints or parameters received via RS232 or CAN are executed immediately.

14.2.2 Position controller – Additional information Settings

Acceleration:

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

Constant drive:

N-Lim Speed limit below the maximum speed
Maximum speed is 100 % (32767 Num)

Delay:

N R-Dec Set <10 ms for position control

Kp The slope of the deceleration results from the proportional amplification

Delay time:

T-Ramp **(tv)** from maximum speed (32767 Num) to zero is displayed in ms on the Position page

Example of delay:
v = maximum speed in m/s, tv = deceleration time (T Ramp) in s
v = 3 m/s, tv = 0.261 s

Deceleration a in m/s²:

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

Gain Kp from given speed and deceleration:

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

Ramp target distance:

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

14.2.3 Position control – Conversion of the units of measurement for position

Range Pos-actual value:	Resolver:	Incremental encoder:
Pulses/rpm Maximum value ±2147483647 (31 Bit - 1)	65536 per rpm	65536 per rpm
Resolution (smallest value)	16 (65536/4096 (12 Bit))	65536/Inc 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/rpm Travel path: 1000 mm = 200 rpm → 200Upm = 1638400 Resolution: 65536/8192 = 8

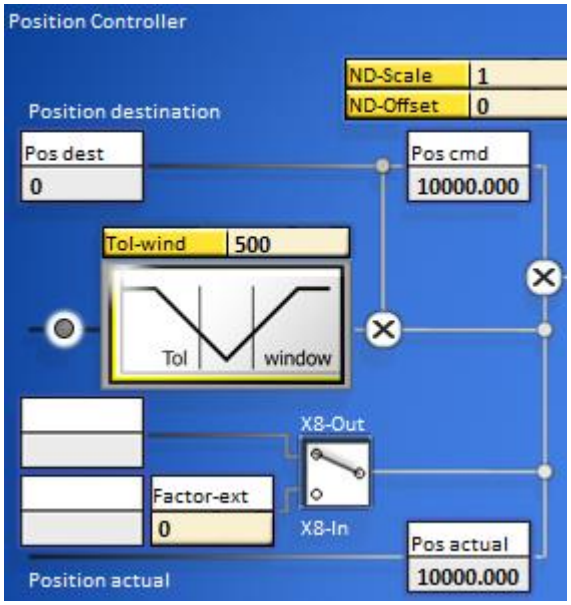
14.2.4 Position control – Scaling position

Display factor scale position values for NDrive display
The parameter ND-Scale (0x7C, Pos display factor) sets the display of the values for Pos dest, Pos cmd and Pos current on the Position page. With value zero, the display corresponds to the numerical value (1 motor revolution is equal to 65536 Num).

Adjust the display to the feed value
Calculate the conversion factor from the feed path to one motor revolution.
For the display, this value must be multiplied by the constant 65536.000 (≙ 1.000 mm / rev).

Example 1: distance in mm
Display value in mm at Pos dest, Pos cmd and Pos aktuell
Spindle slope = 5 mm
Gear ratio i = 20

Conversion factor for one revolution 1/5 * 20 = 4
Pos display factor 65536.000 * 4 = 262144.000
ND-Scale is equal to 262144.000



Example 2: angle in degrees
Display value in degrees for Pos dest, Pos cmd and Pos actual
Gear ratio 1 degree equals 10 motor revolutions

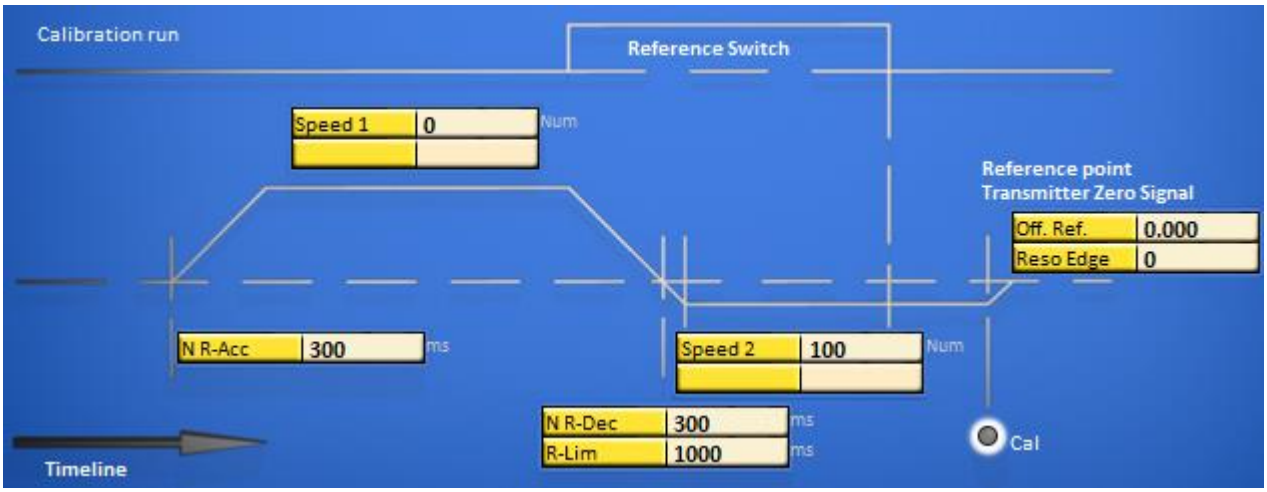
Conversion factor for one revolution = 10
Pos display factor 65536.000 * 10 = 655360.000
ND-Scale is equal to 655360.000

14.3 **Position control – Calibration run**

14.3.1 Position control – Calibration run structural image

The structural image of the Calibration run for position control with input and display window of the controller parameters is shown on the **Position** for numerical values page under **Calibration run**.

The calibration run is used to determine the zero point of the incremental measurement system.



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

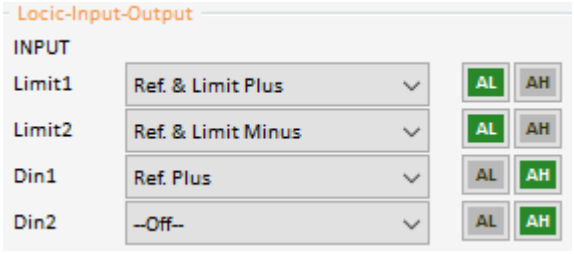
The reference switches are selected in the Digital Inputs parameter field. After switching on the machine and enabling RUN (FRG), the calibration run (**Start Ref Drive**) is triggered by a digital input (Din1, Din2) or by the interface (CAN-BUS, RS232 via ID address 0x78 ≠ 0).

Attention:
Move commands such as Start Ref Drive, N cmd (int) and others are only recognised 5 ms after release. First close or send the release and then send the move commands.

Calibration run
The drive travels to the limit switch at speed Speed 1, passes over it at loop speed Speed 2 and returns. With a reference switch, the drive travels in positive direction with a loop, in negative direction with a double loop. The unit position zero point is set after the limit switch edge at the incremental encoder zero signal.
With the resolver, the absolute value of the position (within half a motor revolution) is stored at the limit switch edge (Zero-Capture).
The mechanical zero point can be shifted in plus or minus direction with the parameter Off. Ref. in plus or minus direction.

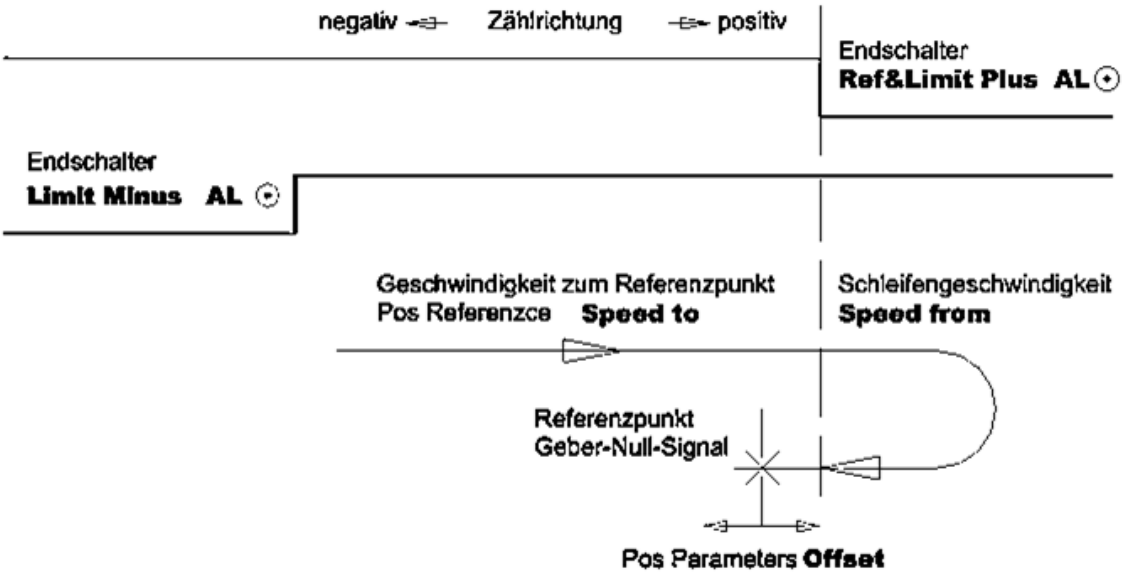
Overview of the reference switches for defining a digital input.

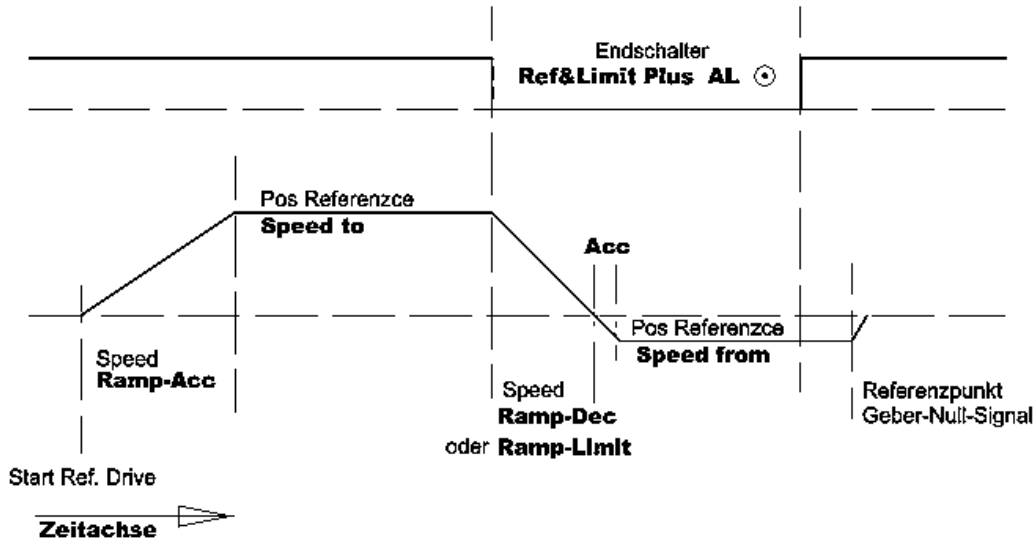
Input selection:	**Function:**
Ref. & Limit Plus	Limit switch positive Direction of rotation is reference switch
Ref. & Limit Minus	Limit switch negative direction of rotation is reference switch
Ref. Plus	Switch flank in positive direction of rotation, independent of limit switches, is reference switch

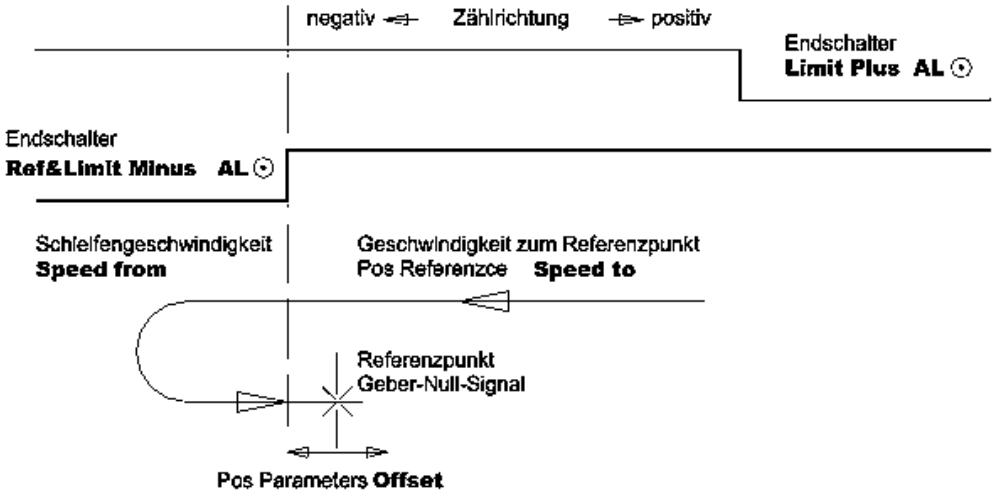


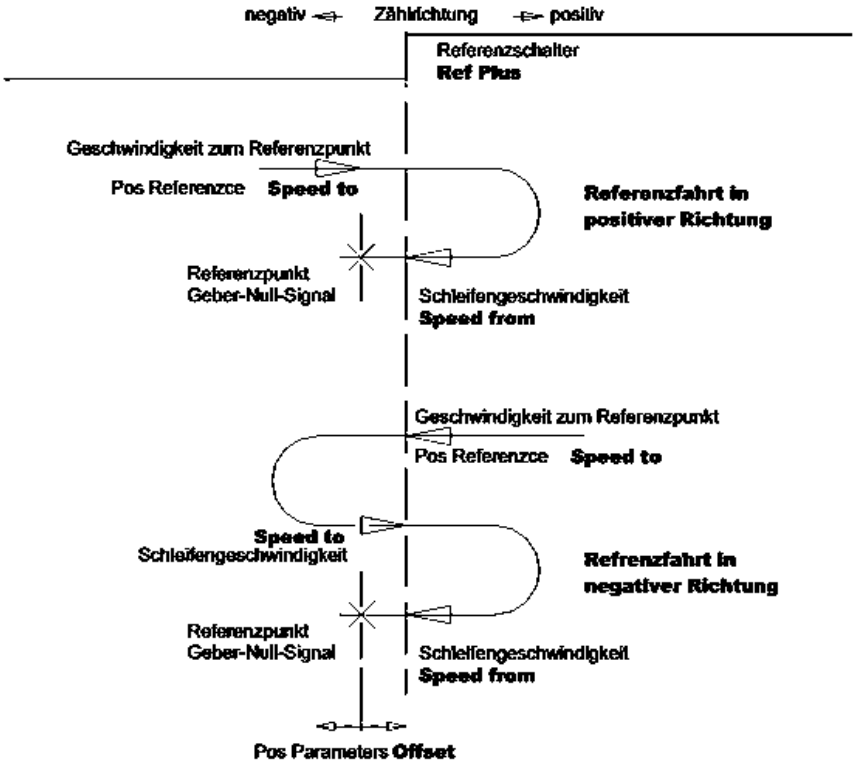
The selection window (parameter field Servo) is used to switch the delay when changing from Speed 1 to Speed 2 from R-Lim to N R-Dec.

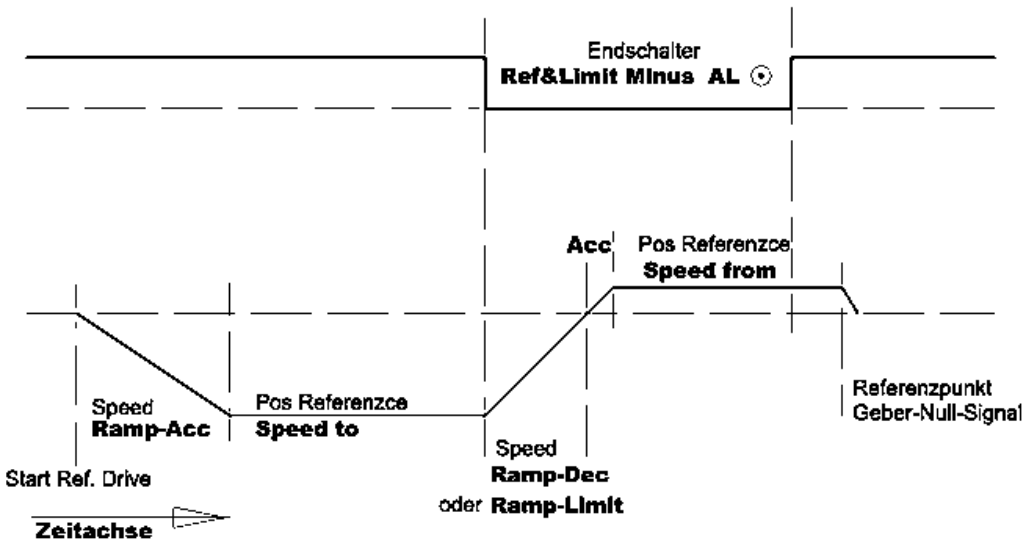
14.3.2 Position controller – Homing Logic diagrams



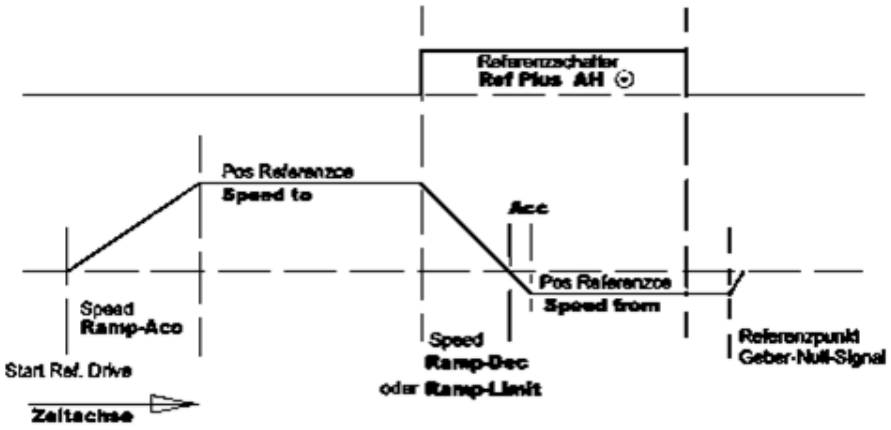



negativ
Zählrichtung
positiv
Endschalter
Limit Plus AL
Endschalter
Ref&Limit Minus AL
Schleifengeschwindigkeit
Speed from
Geschwindigkeit zum Referenzpunkt
Pos Referenzce Speed to
Referenzpunkt
Geber-Null-Signal
Pos Parameters Offset

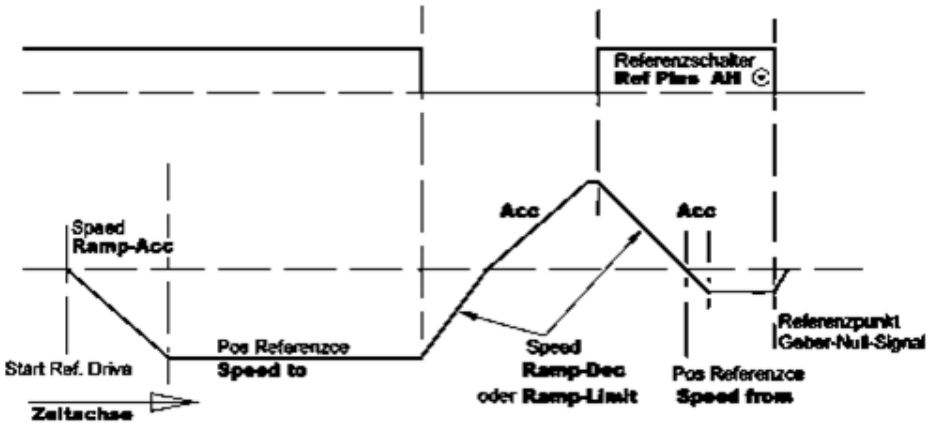

negativ
Zählrichtung
positiv
Referenzschalter
Ref Plus
Geschwindigkeit zum Referenzpunkt
Pos Referenzce Speed to
Referenzfahrt in
positiver Richtung
Referenzpunkt
Geber-Null-Signal
Schleifengeschwindigkeit
Speed from
Geschwindigkeit zum Referenzpunkt
Pos Referenzce Speed to
Speed to
Schleifengeschwindigkeit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



15 Field weakening control

15.1 Field weakening control – Synchronous motor in general

Field weakening operation in synchronous motors with surface magnets is only possible in a small range. In general, only a max. increase factor of 1,2 is possible and therefore not economically viable.

In synchronous motors with embedded magnets (shank pole machines), speed increase of up to a factor of 4 can be achieved. In this case, the motor and the servo can be dimensioned smaller if the design is optimal.

Attention:
In case the inverter control has got a failure during field weakening operation at high rpm speeds (e.g. mains disconnection, feedback fault, etc.), high induced regenerative voltages can be generated by the motor, creating a risk of damaging the applied power source.

For servo units powered using the AC mains, the limit voltage is 400 V or 800 V.
For battery-operated units, the Back EMF voltage must always be lower than the connected battery voltage.

Without external protective circuits, the servo units or batteries can be destroyed in the event of motor overvoltage.

Additional:
Field weakening is not a recommended approach of solving a poorly designed system.

Although the rpm speed of the motor can be increased, the torque drops to a very low value due to the physical properties of a PMS motor. This means that the motor has significantly less power in field weakening mode despite high power consumption.

Additionally, the reactive current (Id actual) ensures on the one hand that the motor heats up very strongly and on the other hand, although the active current (Iq actual ≙ torque) is very low, the consumption from the supply is very high due to the additional current component.

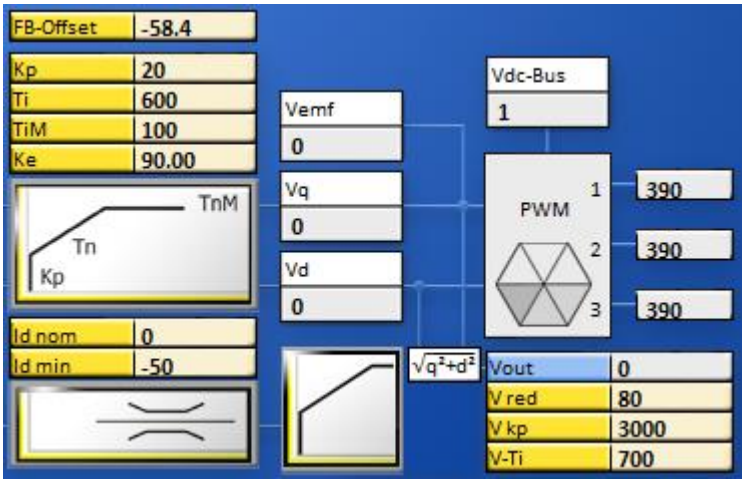
This means that in a system with a HV battery (e.g. vehicle), this is at the expense of the battery capacity and thus the driving range.

15.2 **Field weakening control (Firmware < FW 482)**

Parameter settings

Parameter overview for the field weakening control on the **Speed** page.

Note:
Many of these parameters can also be found on the **Oscilloscope** page.



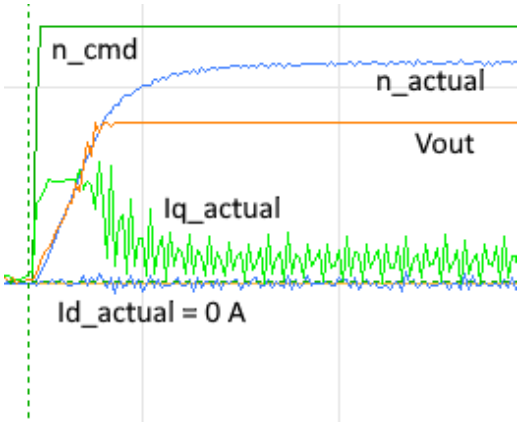
Symbol:	Function:	Range:	Unit:	ID address:
Id nom	Nominal Id magnetising current in % of the nominal motor current (I nom eff) > Recommendation: 0 % for PMSM	0..100	%	0xB2
Id min	Minimum magnetising current in % of the nominal motor current (I nom eff) > Recommendation: -50..-30 %	-100..0	%	0xB5
V-red	Voltage reference value in % of Vout (V-red ≠ 0, 100 % → activation field weakening control) > Recommendation: 60..80 %	0..100	%	0x8B
V-kp	Proportional amplification of the field weakening control > Recommendation: 500..4000	0..65535	Num	0x8C
V-Ti	Integral time of the field weakening control > Recommendation: 300..5000 > Attention: Vibration tendency	0..65535	Num	0x8D

Without field weakening:

The speed (n_actual) does not reach the speed specification (n_cmd) at maximum possible output voltage (Vout).

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

The Iq-current (Iq_actual) first provides a corresponding torque for the acceleration and then drops to the maximum possible value.



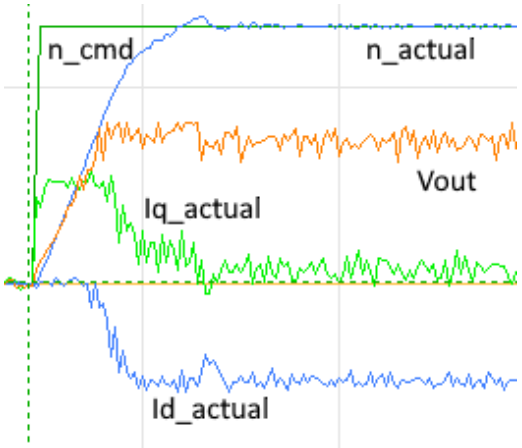
With field weakening:

The speed (n_actual) reaches the speed specification (n_cmd) below the maximum possible output voltage (Vout).

The Id current (Id_actual) is regulated for the field weakening to the value of Id_ref specified by the field weakening controller.

In the case of motors with surface magnets, a high Id current for a small increase in speed.

Here, too, the Iq-current (Iq_actual) first provides a corresponding torque for the acceleration and then drops to the required or still available value.



15.3 **Field weakening control (Firmware ≥ FW 482)**

The general logic for field weakening control has changed with the firmware release of FW 482.
This also includes the general voltage limit supervision and voltage correction in case the motor speed reaches the maximum possible AC voltage duty cycle output. This new logic has improved the stability of the general control immensely while also operating in critical operation areas.

➔ It is therefore recommended to update the inverter to the newest firmware release version.

General principle:
Depending on the DC voltage, the motor BackEMF constant, the additional voltage drop inside the motor due to current load and the general inverter losses, an electric motor can only reach a certain rpm speed.

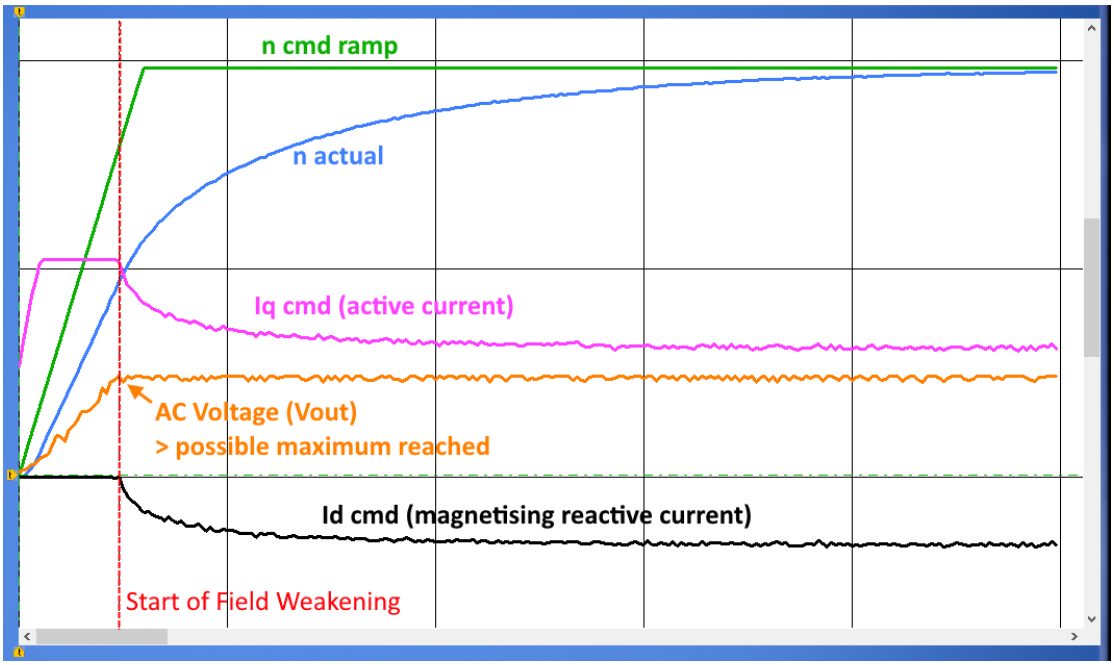
This will always be represented with the duty cycle percentage of the used AC voltage variable (Vout). If Vout reaches its maximum of 3981 Num, the integral correction of the field weakening controller will start its operation by increasing the correction value.

- The negative magnetising reactive current (Id) will be commanded.
  This is the field weakening current which will influence the BackEMF properties of the motor.
  The limit for this current is defined with the parameter (Id min)
  - Id command limit = Id min [%] of I nom eff

- At the same time, depending on if the general maximum total allowed current limit is already reached, the torque driving active current (Iq) will also be reduced.

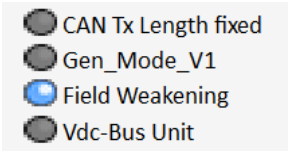
- This will result in
  - the operation of the AC voltage will stay within stable operation areas.
  - the rpm speed of the motor will be increased.

- The time for the integral correction is adjusted with the parameter ‘V-Ti’.
  In case you are experiencing strong oscillations during field weakening control, we recommend adjusting this parameter by setting a *slower* integration time (10, 50, 100, 200 ms).



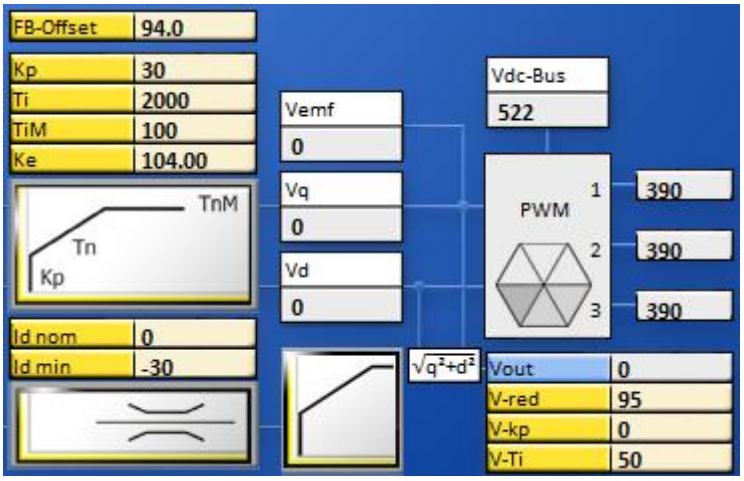
Parameter settings

Step1:
General activation of field weakening control 0xDC$_{Bit\ 10}$ = 1
(see NDrive **Device** page)



Step 2:
Parameter overview for the field weakening control on the **Speed** page.

Note:
Many of these parameters can also be found on the **Oscilloscope** page.

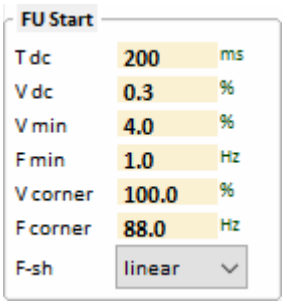


Symbol:	Function:	Range:	Unit:	ID address:
Id nom	Nominal Id magnetising reactive current in % of the nominal motor current (I nom eff) > Recommendation: 0 % for PMSM	0..100	%	0xB2
Id min	Minimum magnetising reactive current (Id) in % of the nominal motor current (I nom eff) > Recommendation: -50..-10 %	-100..0	%	0xB5
V-red	Control correction factor for allowed field weakening current (Id) and the reduction of active current (Iq) > Recommendation: 95 %	0..100	%	0x8B
V-kp	*No function*	0..65535	Ziffern	0x8C
V-Ti	Integral time of the field weakening control > Recommendation: 50 (..200) > Attention: Vibration tendency	0..65535	Ziffern	0x8D

16 Frequency converter operation (ACI V/f)

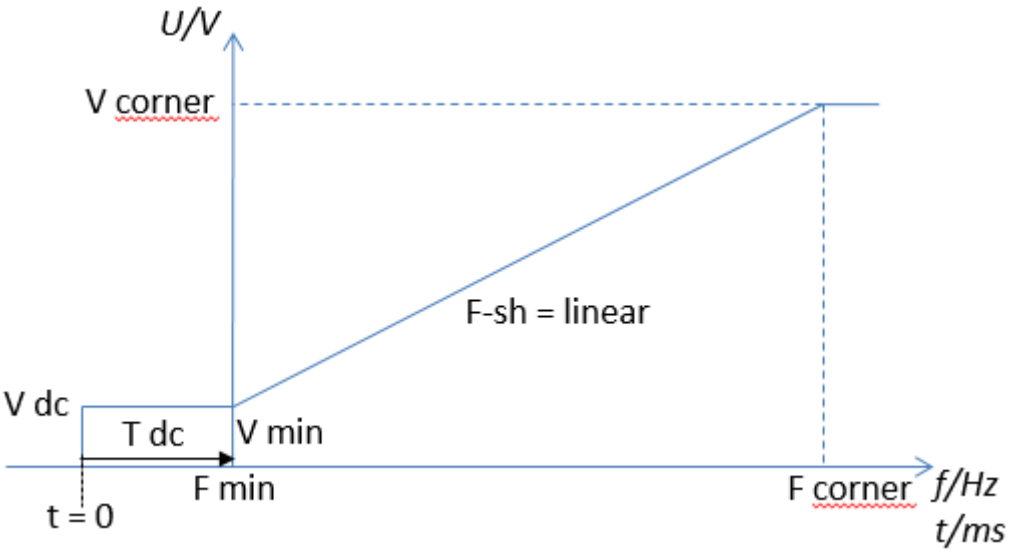
16.1 Frequency converter – Parameter setting of the FU characteristic curve

Parameter overview of the frequency inverter characteristic curve of **FU Start**.



Note:
Many of these parameters can also be found on the **Oscilloscope** page.

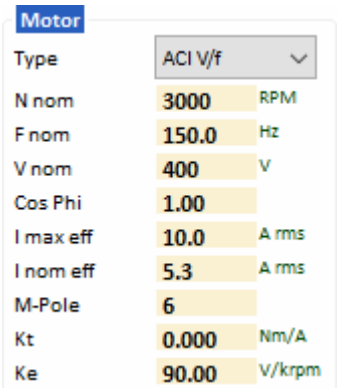
Symbol:	Function:	Range:	Unit:	ID address:
T dc	Premagnetisation time Delay between switching on and starting the frequency	10..2000	ms	$0x07_L$
V dc	Premagnetisation DC voltage value	0..20	%	$0x08_L$
V min	Minimum voltage (boost) when the motor is at a standstill → U/F characteristic curve is raised Recommended: V min = V dc	0..100	%	$0x0A_L$
F min	Minimum frequency when the motor is at a standstill	0..100,0	Hz	$0x0B_L$
V corner	Maximum output voltage at the cut-off frequency	0..100,0	%	$0x0C_L$
F corner	Cut-off frequency for maximum output voltage	1..1000,0	Hz	$0x0D_L$
F-sh	Shape of the characteristic curve (linear, half-square, square)			



Note:
In Ndrive, only the parameter field FU Start of the characteristic curve setting for frequency inverter operation is currently in use. The characteristic curve for FU Stop is the same as that of FU Start.

16.2 **Frequency converter – Setting motor parameters**

Frequency control without a feedback encoder can be configured via the setting field for the frequency inverter in the Motor field.

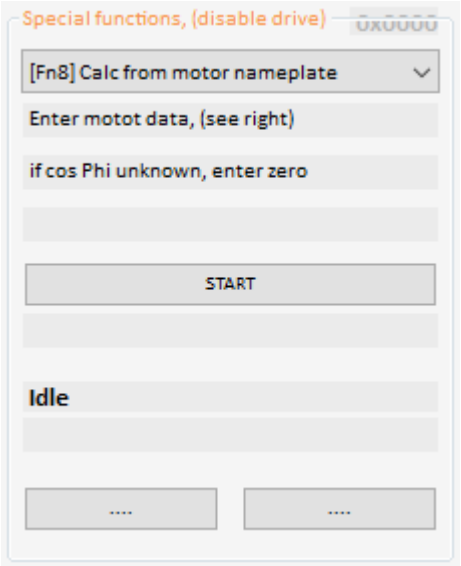


For standard motors for AC mains operation, the nameplate indicates often specifications for 50/60 Hz operation and star-delta connection can be found. These specifications are internationally standardised.
For motors for inverter operation, the nominal operating point is at a fixed frequency, usually above 50/60 Hz Mains frequency.
Not all manufacturers specify the further values completely.

The nominal speed at the nominal operating point (nominal frequency, nominal load) is sometimes missing or the specification of Cosphi is missing. In some cases, the values are also given in a misleading way, e.g. voltage related to phase to phase (terminal voltage), or phase voltage (terminal to star point), or DC bus voltage Please check the manufacturer's specifications and dimensions carefully (V, VAC, VDC, A, Arms, etc.).

Nominal data:	**Symbol:**	**Example motor 50Hz:**	**Example motor 60Hz:**	**Unit:**
Mains frequency	F nom	50	60	Hz
Rated voltage	V 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	Arms
Rated speed	N nom	2820	3385	rpm
Cosphi	Cos Phi	0.85	0.85	

From the above nominal data, the drive's internal function "[Fn8] Calc from motor nameplate" to determine further values for the motor model (→ page **Auto**).



Updating the display in NDrive only takes place with process offline-online (i.e. RS232 communication disconnect and reconnect).

Activation of frequency inverter operation:

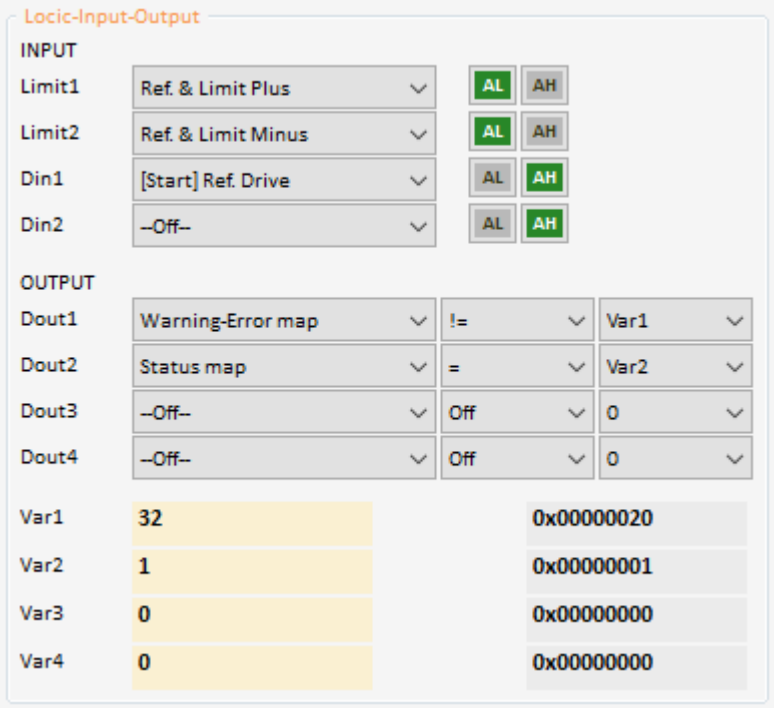
1. On the Settings page, select "**ACI V/f**" as the motor type.
2. Select "**SLS**" as the feedback type.

Note:
In frequency converter operation when controlling an AS motor without an encoder feedback, there is no slip compensation.

17 Logic

17.1 Logic – General overview

Setting field for the digital inputs (INPUT) and the digital outputs (OUTPUT) in NDrive on the **Logic** page.



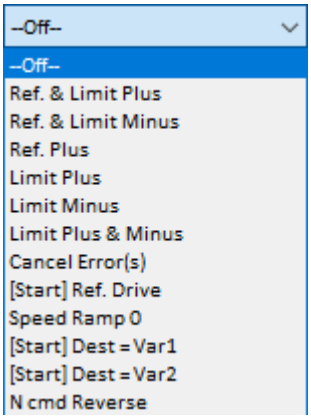
INPUT:	
Limit1	Programmable digital input, preferred as limit switch and reference switch
Limit2	Programmable digital input, preferred as limit switch and reference switch
Din1	Programmable digital input
Din2	Programmable digital input

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 on all devices)
Var1 to Var4	Comparison variable

17.2 **Logic – Digital inputs**

17.2.1 Logic – Digital inputs General

In general, the logic level can be read out for each digital input.



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

The special functions are selected via the respective pull-down menu.

These special functions are triggered by the logic level of the digital input depending on the configuration of the activation condition (AL / AH).

The setting of the activation condition of the special functions takes place via the switches AL = Active Low and AH = Active High.

With the return key, the functions are written into the RAM memory and executed
By saving in Eprom level 0, these settings are also permanently saved and are applied after a restart.

The limit switch inputs Limit1, Limit2 are displayed in the status field with Lim+ and Lim-.
However, these can also be configured for other functions.

Example:

INPUT:	Selection:	Function:	Acv. Logic:
Limit1	Ref. & Limit Plus	Limit switch positive direction is also a reference switch	AL
Limit2	Limit minus	Limit switch minus	AL
Din1	[Start]Ref. Drive	Start calibration run	AH

Note:
All digital inputs have an internal pull-down resistor and therefore do not need to be wired low if not used.

17.2.2 Logic – Digital Inputs overview configuration

Overview of the configuration options or the special functions of a digital input (INPUT)

INPUT:	Function:
Ref. & Limit Plus	Limit switch positive direction is also a reference switch
Ref. & Limit Minus	Limit switch minus direction is also reference switch
Ref. Plus	Reference switch plus direction
Limit Plus	Limit switch positive direction
Limit minus	Limit switch minus direction
Limit Plus &. Minus	Limit switch plus direction and minus direction
Cancel Error(s)	Clear error memory
[Start]Ref. Drive	Start calibration run
Speed Ramp 0	Speed setpoint internally switched to 0 (during Speed 0 active)
[Start] Dest > Var1	Position Variable 1 is started
[Start] Dest > Var2	Position Variable 2 is started
N cmd Reverse	Setpoint polarity is switched (speed direction inverted)
Preset] Pos = Var3	Position actual value is set to variable 3
[Capture] Var3 = Pos	Sets variable 3 as position (destination) and moves to position
[Capture] Var4 = Pos	Sets variable 4 as position (destination) and moves to position
[Switch] Spd = !Ain1/Ain2	Toggle command setpoint Ain1 or setpoint Ain2
[Switch] Spd = !Var1/Var2	Changeover command setpoint Var1 or setpoint Var2
I limit (dig.)	Current limitation to the setting of parameter I limit dig
N clip (neg. & pos.)	Speed limitation to the setting of the parameter N-Lim+ and N-Lim-
[Switch] Cmd = !Dig/Ana	Switch command setpoint digital + analogue setting (Command Mode Digi + Ana Speed)
Speed Ramp 0 + Pos	Positioning to position within one motor revolution (pos = Reso Edge)
Handwheel	Incremental setpoint from handwheel encoder (2nd counter input)
Brake Car [1]	Regenerative braking function #1 (Current setting for 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 setpoint from sum of variables Var1 to Var2 is started
[Start] cw = Var1,2,3,4	Cw_combi
Brake Car #2 [1]	Regenerative braking function #2 Consideration of the delta deviation from the analogue input for the braking force

[1] See "Information on special Car applications.pdf".

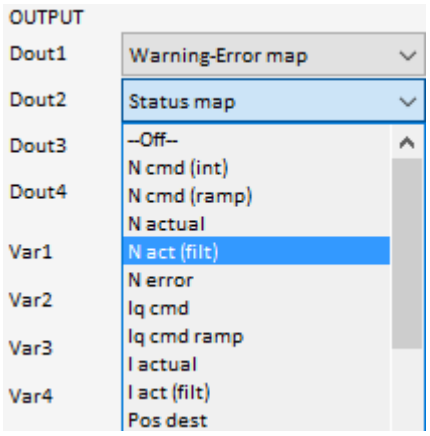
17.3 **Logic – Digital outputs**

17.3.1 Logic – Digital outputs in general

In general, the output logic level of each digital output can be configured using a wide range of possibilities.

For the configuration, a known measure variable (first column) is used as a reference. This can then be used via a variety of possibilities of comparison operands (second column) with self-defined variables to output the corresponding desired logic level.

The selection of the measure variable used as a reference, the operants and the selection of the comparison variables is done via the respective pull-down menu.



The value of the comparison variable is entered in the respective input field of Var1, Var2, Var3 and Var4.

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

With the return key, the functions are written into the RAM memory and executed.
By saving to Eprom level 0, these settings are also permanently saved and are applied after a restart.

Attention:
For switched inductances (relays, brakes, etc.), connect overvoltage protection by means of free-wheeling diodes or varistors. The output driver switches off in case of overvoltage.

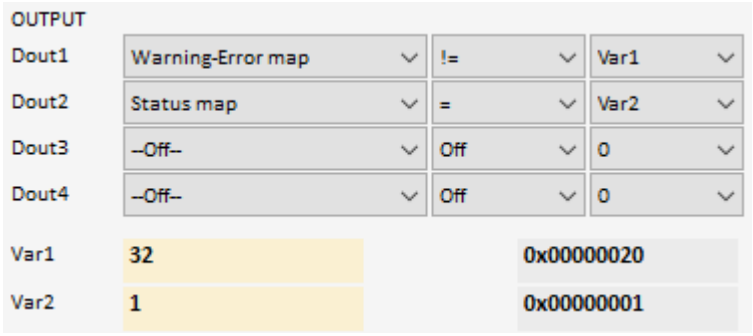
17.3.2 Logic – Digital outputs overview configuration

Overview of the configuration options of a digital output.

OUTPUT:	Function:	ID address:
I cmd	Current setpoint (result speed controller)	0x26
I actual	Actual current value	0x20
N cmd (ramp)	Speed setpoint	0x32
N actual	Actual speed value	0x30
Pos cmd	Target position used (internal)	0x6E
Pos actual	Actual position value	0x6D
N error	Speed control error	0x33
Pos error	Control error Position actual value	0x70
T-motor	Motor temperature	0x49
…	…	…
All parameters listed in the measured value selection can be assigned to the outputs		

Operant:	Function:
Off	Always off
On	Always On
1Hz	Pulses with f = 1 Hz
=	same
!=	unequal
>	greater than
<	smaller than
abs >	Absolute value greater than
abs <	Absolute value less than
tol >	Tolerance input TOL-wind
Tol <	Tolerance input TOL-wind
>=	greater than or equal to
<=	Less than or equal to
hyst >=	Hysteresis at >=
Hyst <=	Hysteresis at <=
window	Tolerance window ±25 %

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



Example 1: Configuring an inverted the "Power voltage missing" error on a digital output

Target:
Output Dout1 should output a high (> 10 V) logic level when the power voltage is switched on or when no error 5 (POWERVOLTAGE, power voltage missing) is present.

- Select the signal (**Warning-Error map**) for the **Dout1** output via the pull-down menu.
- Set operant to (**!=**).
- (**Var1**) is selected as the comparison variable.
- In the input field for **Var1, enter** the decimal value **32** for the query on error 5 of the error information. (**0x8F**$_{\text{Bit 5}}$). A query on a combination on several Bits is also possible.

Example 2: Configuring the status information "Ena" on a digital output

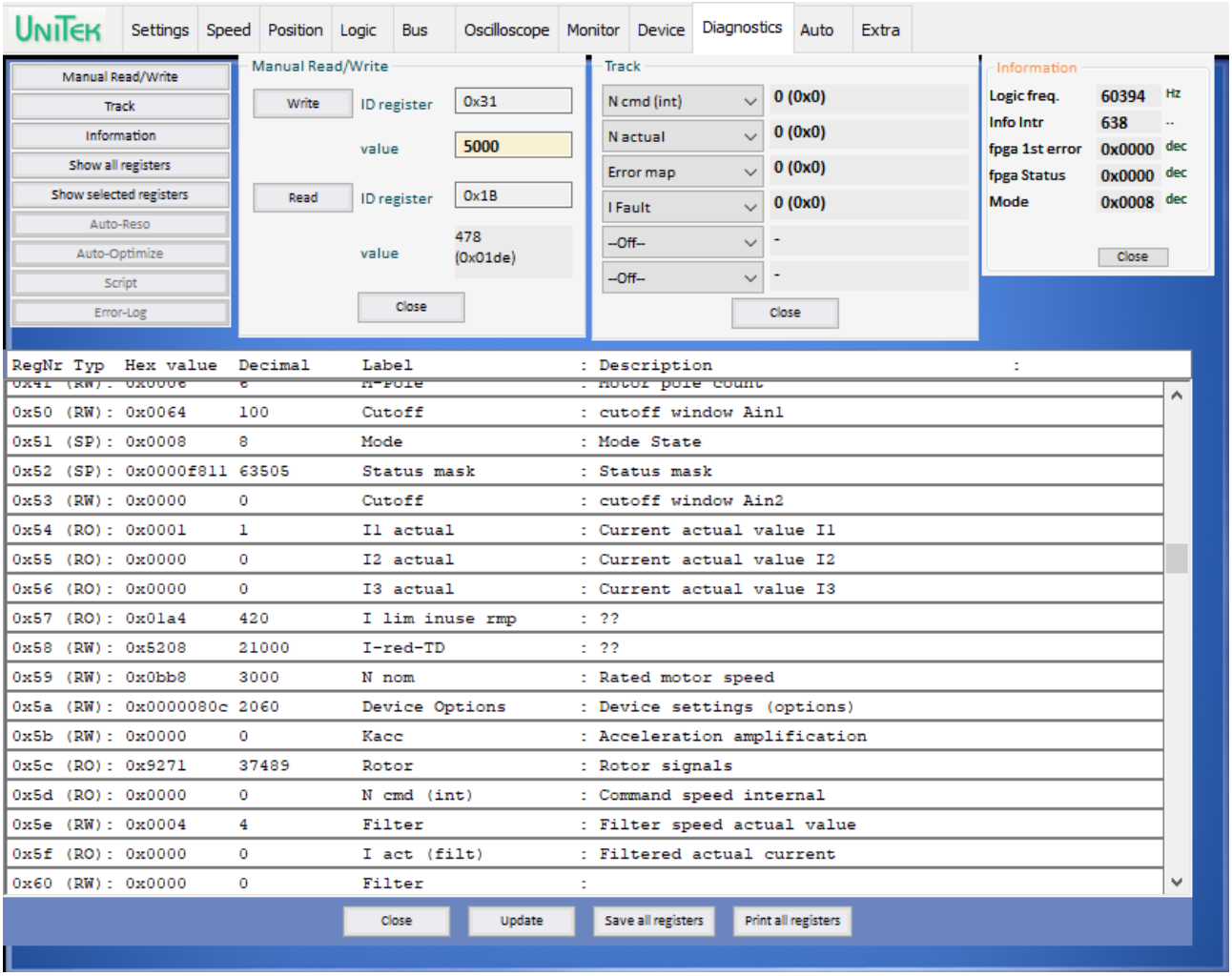
Target:
Output Dout2 should output a high (> 10 V) logic level when the inverter is activated or if the PWMs actively output a voltage on the motor lines, the status information **Ena** (0x40$_{\text{Bit 0}}$) is set.

- Select the signal (**Status Map**) for the **Dout2** output via the pull-down menu.
- Operant set to (**=**) (Inverted to (!=)).
- (**Var2**) is selected as the comparison variable.
- Enter the decimal value **1** for the query on the status information Ena (0x40$_{\text{Bit 0}}$) in the input field for **Var2**. A check for a combination of several Bits is also possible.

18 Diagnostics

18.1 Diagnostics – General overview

The **Diagnostics** page in NDrive is an information window for displaying as well as manually reading signals and setting parameters.

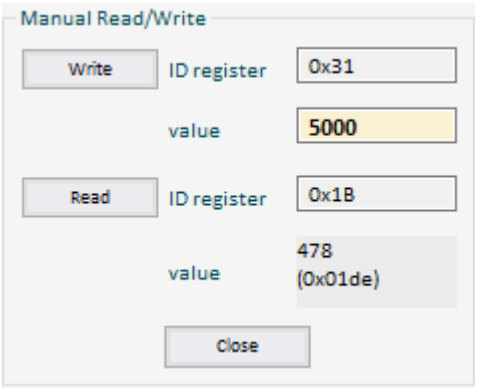


Overview of the individual windows on the Diagnostics page.

Manual Read / Write	Direct readout and input of parameter values on defined ID addresses
Track	Display of selected measured signals (numerical)
Information	Display field for current states of special signals
Show all registers	All registers are listed as a table
Show selected registers	Selected registers are listed as a table
Auto-reso	Not yet installed
Auto-Optimize	Not yet installed
Script	Not yet installed
Error log	Not yet installed

18.2 **Diagnostics – Manual Read/Write**

Direct readout and entry of parameter values (Attention: only for service!).



Parameter Write:

- Enter the ID address in the **ID register** input field.
- In the **value** input field, enter the value for the selected ID address (numeric or as hex value).
- **Enter** or click on the **Write** button.
  The new value is adopted immediately.

Parameter Read:

- Enter the ID address in the **ID register** input field.
- Press **Enter** or click on the **Read** button.
  The content of the ID address is displayed in the **value** field (numeric and as hex value).

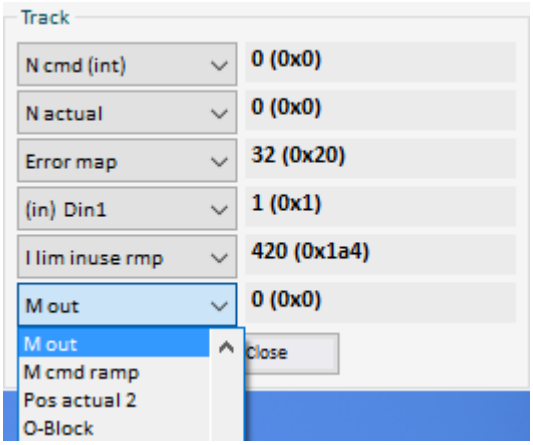
18.3 **Diagnostics - Track**

Displays with automatic cyclical readout of a selection of up to 8 different measuring and Parameter values (Attention: only for service!).

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

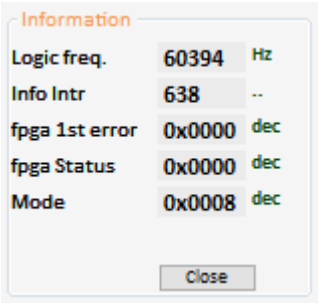
The current values are displayed numerically as well as in hex values (0x..).

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



18.4 **Diagnostics – Information**

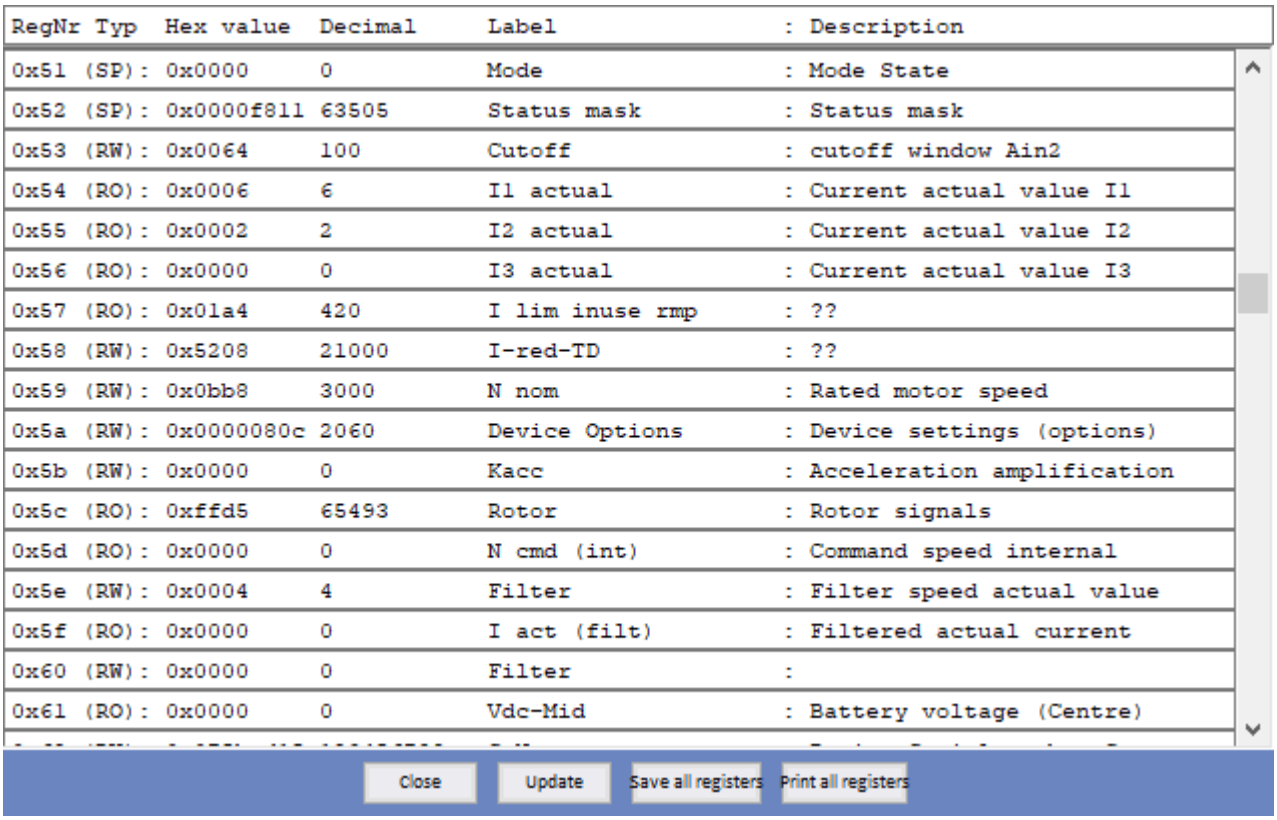
Display field for current states of special signals.



Shortz.:	**Function:**
Logic Freq.	Speed of the foreground programme
Info Intr	Speed actual value fault
fpga 1st error	First error code recorded from the Ecode signal
fpga status	Current error code from the Ecode signal
Fashion	Mode Bit setting (0x51)

18.5 **Diagnostics – Show register**

Displaying a list view of all or only a certain number of variables.
(No cyclical updating but only once)



Options for the display field for registers:

Selection:	**Function:**
Show all registers	All 255 registers are displayed in a table. The register contents cannot be changed.
Show selected registers	Only the registers that are important for the user are shown in a table. The selection is made with the configuration of the text file "reglist.txt". → '...\NDrive2-Software\settings\reglist.txt' The register contents cannot be changed.

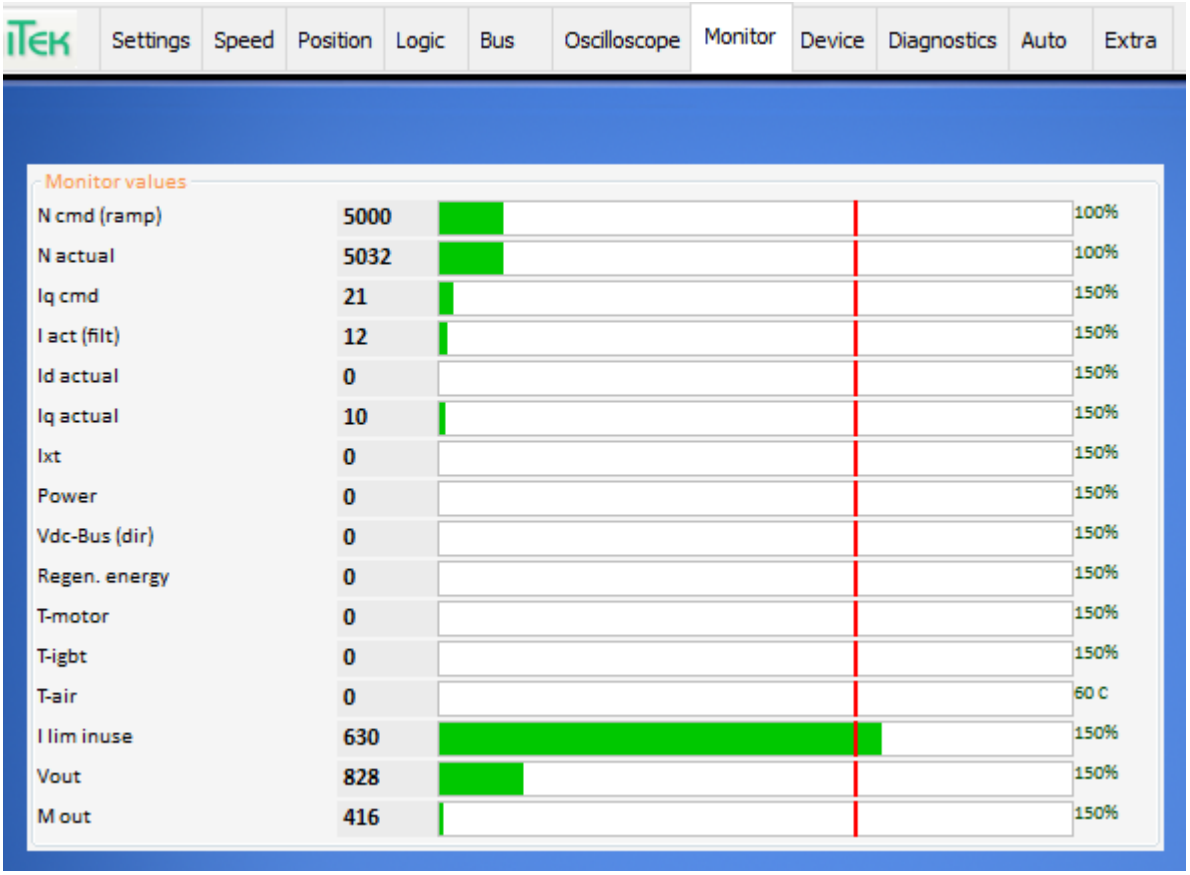
Selection of options in the footer:

Selection:	**Function:**
Close	Display field is closed.
Update	The parameter values are read anew from the device (servo).
Save all / selected Registers	All / The displayed registers are written to a file.
Print all / selected registers	All / The displayed registers are printed.

19 Monitor

19.1 Monitor – General overview

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



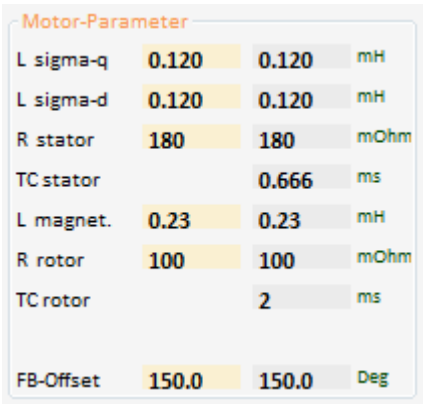
Symbol:	Function:	Range:	Unit:	ID address:
N cmd (ramp)	Speed setpoint after ramp and limit	0..32767	Num	0x32
N actual	Speed actual value	0..32767	Num	0x30
Iq cmd	Active current (Iq) Setpoint (internal)	±2000	Num	0x26
I act (filt)	Actual current value after display filter	±2000	Num	0x5F
Id actual	Current reactive current (Id)	±2000	Num	0x28
Iq actual	Current active current (Iq)	±2000	Num	0x27
Ixt	Capacity utilisation Ixt	0..4000	Num	$0x45_L$
Power	Motor power (do not use!)	0..4000	Num	0xF6
Vdc-Bus (dir)	DC link voltage	0..32767	Num	0xEB
Regen. energy	Ballast power	0..4000	Num	$0x45_H$
T-motor	Current engine temperature	0..32767	Num	0x49
T-igbt	Current power stage temperature	0..32767	Num	0x4A
T-air	Current air temperature in the servo	0..32767	Num	0x4B
I lim inuse	Current limit	0..2000	Num	0x48
Vout	Current output voltage	0..4000	Num	0x8A
M out	Actual active current (Iq) standardised	±32767	Num	0xA0

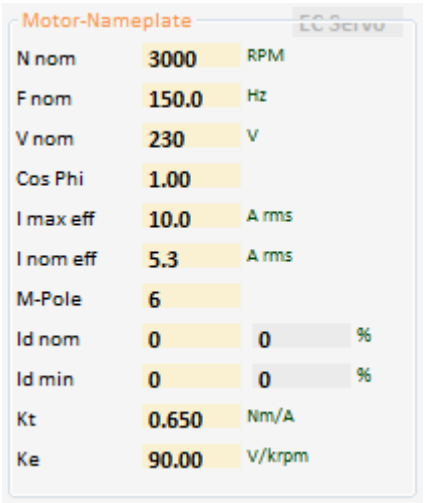
20 Auto (special functions)

The **Auto** page in NDrive contains an overview of engine-specific parameters and the menu for activating special functions.

20.1 Auto – Motor parameters

Overview of the **Motor-Parameter** and the **Motor-Nameplate** parameters on the **Auto** page.





Symbol:	Function:	Range:	Unit:	ID address:
L sigma-q	q component of the stator leakage inductance (for ACIM, Lsd = Lsq)	0.. 65,535	mH	0xB1
L sigma-d	d component of the stator leakage inductance	0.. 65,535	mH	0xBB
R stator	Stator resistor [1]	0..65535	mOhm	0xBC
TC stator	Stator time constant (Ls/Rs) [2]	0..32767	ms	0xB6
L magnet.	Main inductance	0..655,35	mH	0xB3
R rotor	Rotor Resistor [1]	0..65535	mOhm	0xB4
TC rotor	Rotor time constant (Lm/Rr) [2]	0..2000	ms	0xBD
FB-Offset	Encoder offset angle	±360	Deg	0x44

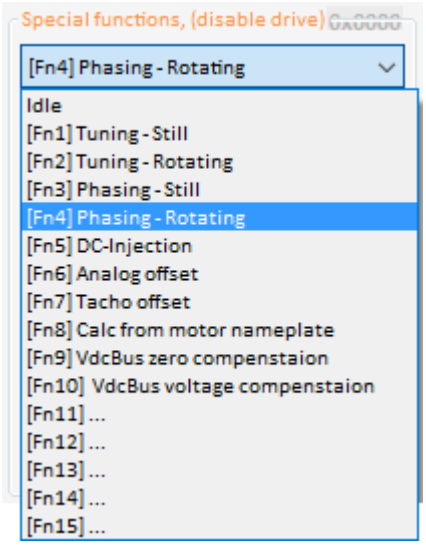
[1] Enter without a comma
[2] Calculation takes place internally

Symbol:	Function:	Range:	Unit:	ID address:
N nom	Engine 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	Motor maximum 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
Id nom	Nominal Id magnetising current in % of nominal motor current (I nom eff)	0..100	%	0xB2
Id min	Minimum magnetising current in % of rated motor current (I nom eff)	-100..0	%	0xB5
Kt	Motor Kt constant	0..50,000	Nm/A	$0x87_L$
Ke	Motor Ke Constant (Back EMF)	0..500,00	V/krpm	$0x87_H$

20.2 **Auto – Special functions**

20.2.1 Special functions – Overview

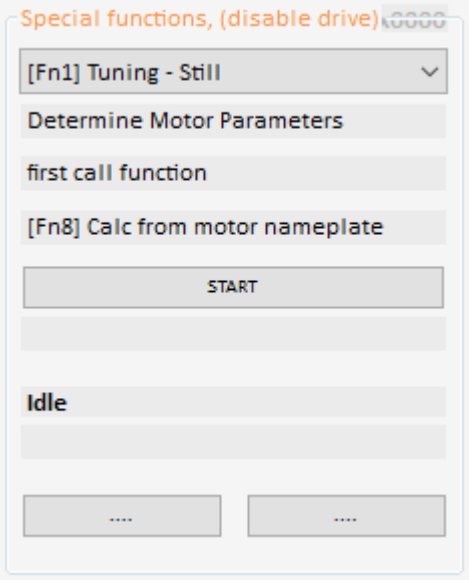
Overview of the individual special functions in the window **Special functions** on the **Auto** page.



Special function:	**Meaning:**	**ID address:** 0x85
Idle	Hibernation	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 detection of rotor offset angle for synchronous motors (FB offset)	4 dec
[Fn5] DC Current	Fixed current angle of phases U, V, W with rated motor current	5 dec
[Fn6] Analogue offset	Automatic adjustment of the analogue inputs	6 dec
[Fn7] Speedometer offset	Automatic adjustment of the segment offset for bl-tacho	7 dec
[Fn8] Calculation from motor nameplate	Calculating the motor data according to nameplate data	8 dec
[Fn9] Adjustment VdcBus Zero	1.Step measured value correction DC link voltage → Adjustment for measuring point at 0 V	9 dec
[Fn10] Adjustment VdcBus Voltage	2. Step measured value correction DC link voltage → Adjustment for measuring point at reference voltage	10 dec

20.2.2 Special functions – [Fn1] Tuning - Still

Function not yet released!

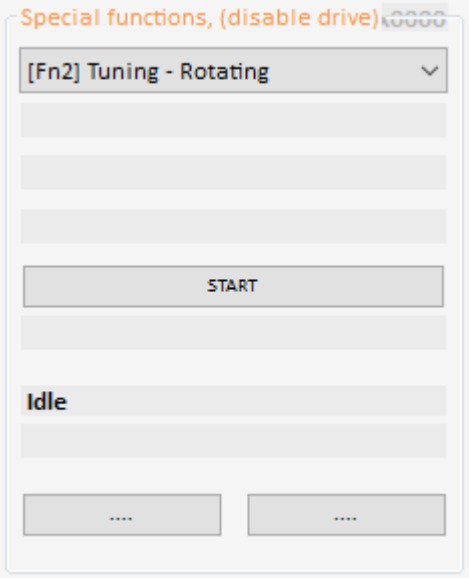


Activation:

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

20.2.3 Special functions – [Fn2] Tuning - Rotating

Function not yet released!

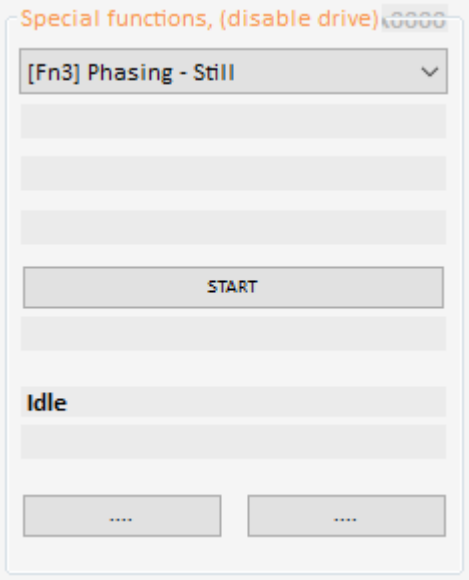


Activation:

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

20.2.4 Special functions – [Fn3] Phasing - Still

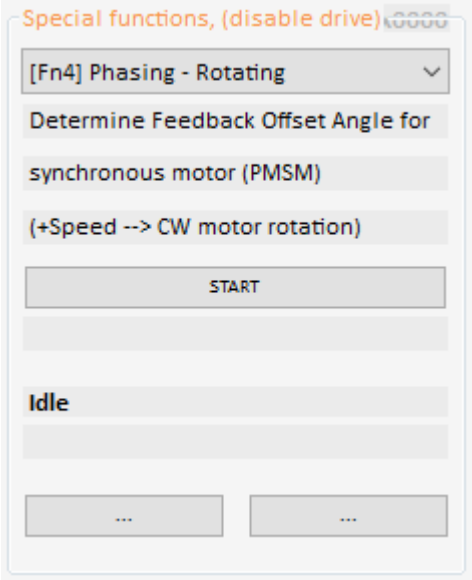
Function not yet released!



Activation:

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

20.2.5 Special functions – [Fn4] Phasing - Rotating



Goals:

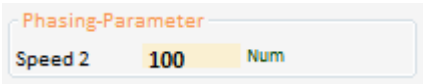
- Check correct connection of motor cables (U, V, W).
- Check input of the number of motor poles (M-Pole).
- Determination of the encoder phase angle (FB-Offset).

Hardware preparation:

- The motor must be freewheeling or connected on a light load.
- The motor must not present a hazard in the event of uncontrolled acceleration.
- Supply unit with power voltage (mains / HV)
  (For units with HV DC voltage, it is recommended to apply a low DC voltage (12..48 V)).

Preparation parameters:

- Motor pole number **M-Pole** (0x4F) and encoder pole number **FB-Pole** (0xA7) must be set correctly.
- Set the reduction of the permitted current **I max pk** to **10%**.
- Set the rotational speed for the phasing process via **Speed 2** to 3 % of the nominal speed (e.g.: 100).

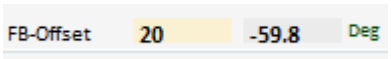


Start and procedure description:

1. Selection [Fn3] Phasing - Rotating
2. Activating the function → Press START (or message on the ID address 0x85 = 4)
3. After pressing START, 10 s remain to activate the enable RUN (FRG) input
   (In NDrive: Wait for RUN = 1).
4. The current ramp sets the set current, and the motor moves with a jerk between 2 of its electrical poles.
5. The motor then rotates clockwise for exactly 360° from pole to pole depending on the motor pole number (may jump jerkily from pole to pole).
6. After a short time, the current ramp degrades again.
   Finally, disable the enable RUN (FRG) input (In NDrive: Wait for RUN = 0).

Findings:

- The slow **clockwise rotation** confirms the correct arrangement of the U,V,W connections.
- The **360° rotation** confirms the correct specification of the motor pole number M-Pole (0x4F).
- The phase angle determined is displayed in the right-hand field (grey) (here: -59.8 Deg). After a successful phasing process, the new value must be entered in the left field (yellow) and saved permanently on the page Setting Eprom level 0.



Note:

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

Error situation:

- The motor does not turn
  - U,V,W connection is not correct → *change unknown*
  - Current limit possibly too small or the connected load is too large
  - The value of Speed 2 is too small or too large

- The motor rotates anticlockwise (counterclockwise)
  - U,V,W connection is not correct → Replace connection U and W

- The motor rotates more or less than 360°.
  - Incorrect specification of the number of motor poles M-Pole (0x4F) → correction

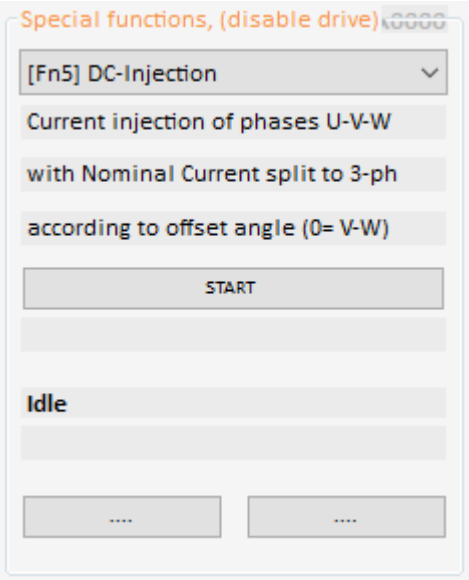
Overview of the process:

Function:	**Message at NDrive:**	**7-segment display:**
Select function [Fn4] Phasing - rotating and click START		
Switch on enable within 10 seconds	Waiting for RUN = 1 (enable RUN input)	40
Release closed	Current ramp	41
Current built up (rotary movement begins)	Nominal value reached	42
Pole angle and motor pole number detection performed	Output rotating field	43
End correct	End End, wait for RUN = 0 (disable RUN input)	49

Abort on error:

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

20.2.6 Special functions – [Fn5] DC-Injection



By specifying an angle of current flow (angle), the rotor (motor shaft) is moved to this angle and held (no rotating field).

Start and procedure description:

1. Selection of [Fn5] DC-Injection
2. Reduce current limit nominal current I nom eff to 30%.
3. Set the desired electrical angle under FB Offset (0x44).
4. Supply unit with power voltage (mains / HV)
5. Activate function → Press START
   (or message on the ID address 0x85 = 5)
7. Enable the RUN input

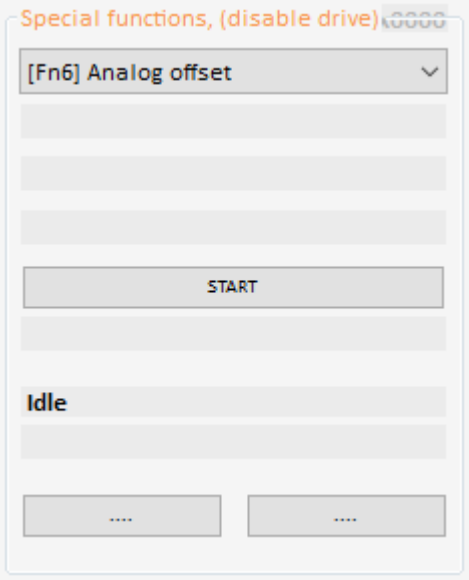
Result:

- The motor shaft rotates and sets itself to the specified angle with the maximum possible current.
- As long as the enable is set, a new angle for FB-Offset (0x44) can be specified in the left field (yellow).
- Switching off the RUN input disables the function.

Attention:
Before further motor operation, the correct value for FB offset must be re-entered and saved (Eprom level 0).

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

20.2.7 Special Functions – [Fn6] Analog offset



Function not yet released!

Activation:

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

Now, the scattering of the analogue inputs can be adjusted using the settings of the analogue parameters (Offset, Cutoff and Scale).

20.2.8 Special functions – [Fn7] Tacho offset

Adjustment of segment offset error in brushless tacho systems.

Start and procedure description:

1. Selection of [Fn7] Tacho offset
2. Activate function → Press START
   (or message on the ID address 0x85 = 7)
3. Enable the RUN (FRG) input
4. After a successful tacho offset, one must set the Internal value determined on the Setting page. Save permanently in Eprom level 0.

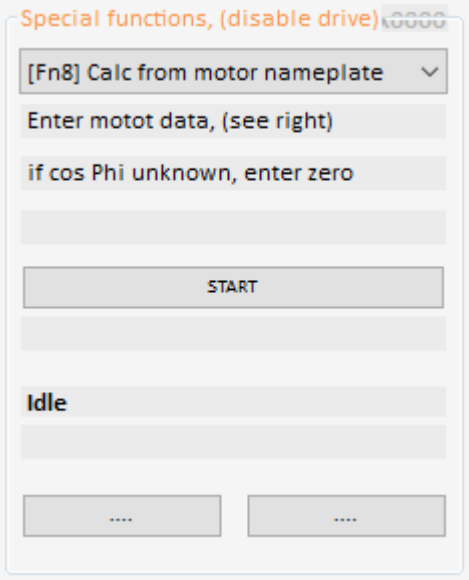
Overview of the process:

Function	Message at NDrive:	7-segment display:
Click on the Start Tacho offset function Enable the RUN (FRG) input		70
End correct		79

Abort on error:

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

20.2.9 Special functions – [Fn8] Calc from motor nameplate



Calculation of motor data for asynchronous motors.

Start and procedure description:

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

After the calculation has been completed, the calculated values are displayed in the right-hand column (grey).

For permanent storage, the data must be permanently save on the Setting page in Eprom Level 0.

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

Symbol:	Function:	Range:	Unit:	ID address:
L sigma-q	q component of the stator leakage inductance (for ACIM, Lsd = Lsq)	0..65,535	mH	0xB1
L sigma-d	d component of the stator leakage inductance	0..65,535	mH	0xBB
R stator	Stator resistor [1]	0..65535	mOhm	0xBC
TC Stator	Stator time constant (Ls/Rs) [2]	0..32767	ms	0xB6
L magnet.	Main inductance	0..655,35	mH	0xB3
R rotor	Rotor Resistor [1]	0..65535	mOhm	0xB4
TC Rotor	Rotor time constant (Lm/Rr) [2]	0..2000	ms	0xBD
FB-Offset	Encoder offset angle	±360	Deg	0x44

[1] Enter without a comma
[2] Calculation takes place internally

General

There are various descriptions of the motor model in the literature, all of which are identical in principle. Some of the abbreviations used may be different. Differences exist only in the proximity to physically measurable quantities (T-model), or further abstraction for simplified calculation models (inverse gamma model).

Some manufacturers provide additional values such as number of poles, open-circuit current at a defined open-circuit voltage (= magnetising current), ohmic resistance of the stator windings, stator impedance at a defined frequency, as well as values on the rotor-related variables.

This information from the manufacturer is usually helpful and correct. The real, physical values can be measured. For values related to the stator, by direct measurement. For values related to the rotor, indirectly, by measuring the reaction on the stator.
The representation in the motor models partly no longer refers to the real physical values, but to converted values.

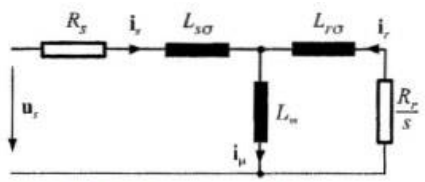


Bild 1: T-Modell, stationary,[2]

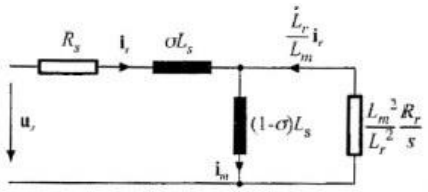


Bild 2: inverses Gamma Modell, stationary,[2]

Rs	Stator resistance
ir	Current in rotor
Lm	Main inductance
Lrσ	Rotor leakage inductance
im	Magnetising current

Rr	Rotor resistance
Lsσ	Stator leakage inductance
iμ	Current through Lm
σ	total scattering factor

Basic procedure
For new or unknown motors, the following assignment can first be checked in the operating mode FU, page Settings "Type": positive speed setpoint = clockwise field U, V, W = clockwise rotation = positive speed actual value. Set values on page "Settings", FU left field according to V/f-characteristic. Operation at nominal point without load results in approx. magnetising current.

Optimisation process
Couple a loading machine with approx. 20 to 50 % of the nominal torque.
Set a constant torque in the NDrive via the test control panel (bottom left).
The result is a stationary speed.

When the machine is rotating, the value of Lm or Rr can be changed (T-rotor = Lm/Rr).
The effect is immediate in the control. The aim is to optimise the T-rotor for a higher resulting speed at the same load. The result in operation is a lower current consumption with the same load torque.
The value of T-Rotor in ms is only updated by NDrive during the offline-online process.

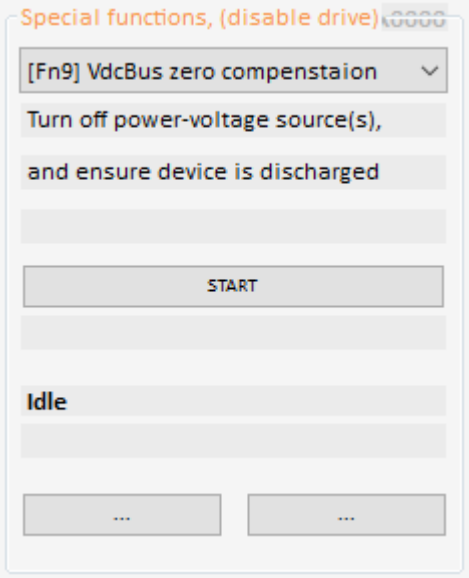
In a second stage, Id nom (NDrive side speed) can be varied, no field weakening active (V-red = 0). Easy to observe at standstill (current = magnetising current). When the machine is rotating, the value again becomes effective immediately. The goal is again a higher resulting speed at the same load. The result in operation is a higher final speed when the voltage limit is reached (maximum modulation).
Compare the values determined on a test basis with any values provided by the manufacturer. Save and reset the servo (Off-On). Check values and function again.

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

Calibration of the analogue VdcBus DC link measurement (device-dependent) as of firmware 466.

Calibration is carried out in 2 steps, one of which determines the zero point ([Fn9] VdcBus zero compensation) and the other the corresponding reference point ([Fn10] VdcBus voltage compensation).
In principle, all units are already calibrated at the factory.
When replacing a component, the adjustment must be carried out again.

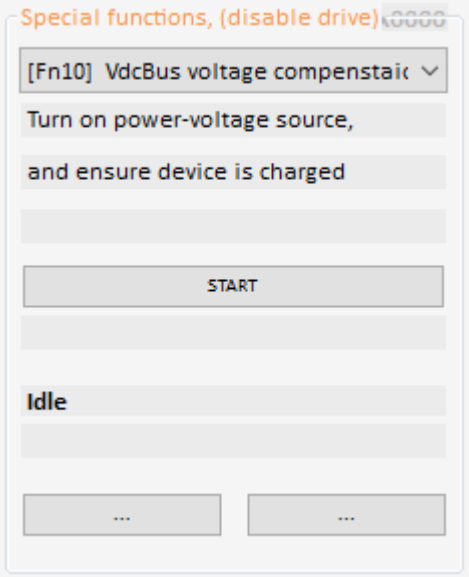
Step 1: [Fn9] VdcBus zero compensation



Start and process description:

1. For the automatic adjustment, the Command Mode must be set to Dig. Commands.
2. Selection of [Fn9] VdcBus zero compensation
3. At the VdcBus U+ and U- connections apply no voltage (for Bamobil devices please short-circuit U+ and U-)
4. Activate function → Press START
   (or message on the ID address 0x85 = 9)
5. After approx. 4 s the message "End" informs the successful VdcBus zero compensation.

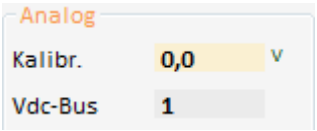
Step 2: [Fn10] VdcBus voltage compensation



Start and process description:

1. For the automatic adjustment, the Command Mode must be set to Dig. Commands.
2. Selection of [Fn10] VdcBus voltage compensation
3. At the VdcBus U+ and U- connections apply a constant DC voltage with min. 2/3 of the units nominal voltage.
4. Measure the DC link voltage with a voltmeter.
5. In the parameter field **Calibr.** (0x1A) enter the measured voltage value as the reference voltage.
6. Activate function → Press START
   (or message on the ID address 0x85 = 10)
7. After approx. 4 s the message "End" informs the successful VdcBus reference point adjustment.

The internal calculated calibration points must finally be saved permanently on the Setting page in Eprom level 0 and 1.



Note:
If the calibration points deviate too much from the standard, default values are taken.

21 Oscilloscope

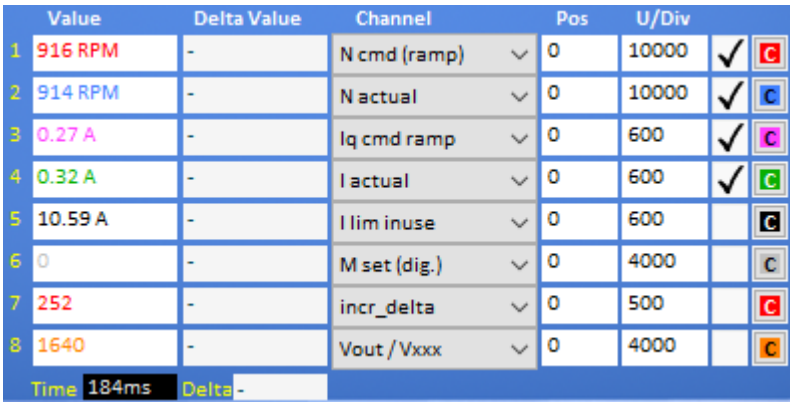
21.1 Oscilloscope – General overview

Overview of the **Oscilloscope** page in NDrive with compact parameter overview for inverter specific parameters, Step Generator and the menu for the oscilloscope settings.

21.2 **Oscilloscope – Settings and display**

21.2.1 Oscilloscope – Signal selection

Overview of the selection of up to 8 channels (signals) and description of the individual fields on the **Oscilloscope** page.



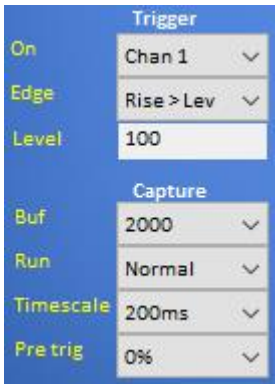
Field:	Function:
Value	Values at the first cursor line (numeric or physical (if available)).
Time	Time from the trigger line to the first cursor line.
Delta Value	Difference values from the first to the second cursor.
Delta (Time)	Difference time from the first to the second cursor.
Channel	Selection of the signal to be measured and thus assignment of the channel number. With -Off- the channel is switched off.
Pos	Shifting the zero line for this channel in positive or negative direction. The input of 100 corresponds to a vertical shift of the signal by one grid. The ratio depends on the measured value.
U/Div	Numerical units for setting the vertical grid line. I.e. with U/Div = 10000 at N cmd (ramp) the numerical value of 10000 equals a horizontal line. The reference is always based on the numerical and not the physical value.
Control box	The display of the channel is switched on and off. The channel that is switched off remains in the background and is also saved.
Channel colours	By clicking the colour key C, the colour of the measuring signal in the oscilloscope window can be changed via the colour selection window.
The trigger line is the line on which the trigger was defined. The first cursor line is the line that is set by pressing the left mouse button. The second cursor line is the line at which the mouse pointer is located.	

21.2.2 Oscilloscope – Overview Trigger and Capture Setting

Overview of trigger and capture settings.

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

Capture:	Function:
Buf	Resolution or number of measuring points divided among all channels used
Run	Trigger switching function selection
Timescale	Time unit per horizontal grid line
Pre trig	Horizontal shift of the trigger line Measured value display possible before the trigger line



The number of measuring points in the NDrive software oscilloscope depends on the settings of the time base (timescale), just like in a real oscilloscope. Thus, the distances between the measuring points are also dependent on these settings. **It is therefore not a data logger**.
I.e. zooming in afterwards on a long timescale setting cannot show a more detailed view of the measurement points in a smaller time range. You have to be clear on which time base you are measuring.

21.2.3 Oscilloscope – Description of trigger and capture settings

On:
The selection of the signal for the trigger function is selected via the pull-down menu.
Either a specific channel (1..8) or a signal listed in the pull-down menu can be taken, even if it is not defined in one of the channels.

Edge:

Symbol:	Trigger Description: (Always in relation to the value in **Level**)
Rise > Lev	The signal crosses from a smaller to a larger of the set level value → **Positive edge**.
Rise < Lev	The signal crosses from a larger to a smaller of the set level value → **Negative edge**.
Rise or Fall	The signal crosses a **positive or negative edge of** the set level value.
=Lev	The signal is **equal to the** set level value.
!= Lev	The signal is **not equal to** the set level value.
> Lev	The signal is **greater than** the set level value.
< Lev	The signal is **less than** the set level value.

Level:
This numerical value is the reference for selecting the trigger function in **Edge**.

Note:
Changes are only accepted if the activation function of a measurement (Run/Stop) is set to Stop.

Buf:
The number of measuring points of 250, 500, 1000 or 2000 for all 8 channels simultaneously defines the detail of the measurement.
With a **Buf** setting of 2000 and only 2 channels activated, each channel receives 1000 measuring points
Recommendation: 2000

Run:

Symbol:	Function:
Auto	Continuous measurement without the need to detect a trigger function.
Single	If a trigger function is detected, a measurement is carried out. Afterwards, the activation function (Run / Stop) is automatically set to Stop.
Normal	A measurement is carried out for each trigger function detected.

Timescale:
The time unit (timescale) per horizontal subdivision defines not only the time unit of the display in the oscilloscope window but also the delta intervals at which a measuring point of a channel is measured. In general, a channel has 50 measuring points between each grid of a horizontal subdivision.
This means that with a timescale setting of 500 ms, the delta of a measuring point is equal to 10 ms.
(Measuring point Delta = Timescale / 50 = 500 ms / 50 = 10 ms).

Pre Trig:
The Tre trig shifts the trigger function by the corresponding setting depending on the Timscale setting. It allows events to be viewed before the actual trigger.

Note:
- With the trigger function (Edge: != Lev) on the signal I_actual and Capture (Run: Single) setting, it is easy to trigger a "force trigger" with a single recording.

- If the pre trig is greater than 0 %, the display in the oscilloscope window may overlap. This happens when a new trigger is detected during the transmission time.
  This happens especially when Run = Auto is set. It is then advisable to use a pre trig
  of 0 % to be used.

21.2.4 Oscilloscope – Measurement Activate

Overview of the activation function of a measurement for the oscilloscope.

Run / Stop:	Symbol:	Function:
Run		The **Run** keypad is used to arm the oscilloscope recording Recording is started at the next trigger signal
Stop		The **Stop** button stops and discards the recording The current display is frozen

21.2.5 Oscilloscope – Status display

Overview of the status display for the oscilloscope.

Status:	Colour:	Function:
waiting (0)	Red	Measurement is activated (Run) and waiting for a new trigger event
waiting (xx)	Green	Measurement was triggered and data is temporarily stored in the servo
reading	Blue	Measurement is finished and data is sent from the servo to the PC
drawing		Displaying the data in the oscilloscope window
idle	White	Measurement is deactivated (Stop)

21.2.6 Oscilloscope – Zoom Options

Overview of the zoom options of a measurement in the oscilloscope window.

Zoom:	Symbol:	Function:
Zoom **[+]**		Measurement in the oscilloscope window is enlarged depending on the selected zoom axes direction.
Zoom **[-]**		Measurement in the oscilloscope window is scaled down depending on the selected zoom axes direction.

Zoom axes direction:	Symbol:	Function:
[X] and **[Y]** - Axis		Measurement is performed on the **X and Y axes with** this selection. enlarged (→ zoom **[+]**) or reduced (→ zoom **[-]**)
[X] - Axis		Measurement is displayed on the **X-axis** with this selection. enlarged (→ zoom **[+]**) or reduced (→ zoom **[-]**)
[Y] - Axis		Measurement is displayed on the **Y-axis** with this selection. enlarged (→ zoom **[+]**) or reduced (→ zoom **[-]**)

Note:
Only the display is enlarged. The number of measuring points depends on the timescale setting and always remains the same regardless of the zoom setting.

21.2.7 Oscilloscope – Line thickness (pencil) 

The **pencil** symbol allows you to choose between 3 different thicknesses of the measuring lines.
This changes the line thickness of all 8 measuring channels.

21.2.8 Oscilloscope – Saving and loading of measurements

Overview of the save and load options of an oscilloscope measurement.

File *.uof	Symbol:	Function:
Load .uof file		Load measurement from a UniTek oscilloscope file (.uof)
Save .uof file		Save measurement as UniTek oscilloscope file (.uof)
Save .csv file		Save measurement as Excel file (.csv)

Note:

- Measurements in .uof format can be loaded in the NDrive oscilloscope (also in offline mode), changed and saved again.

- Measurements in .csv format cannot be subsequently loaded and viewed in the NDrive oscilloscope (i.e. unusable for later analyses).

21.2.9 Oscillocope – Oscilloscope Window Customise

Overview of the options for setting the oscilloscope window and special display of a measurement.

Option:	Function:
Join	Connect measuring points (interpolated)
Over	Display remains and is overwritten
Zero	Zero line visible
Units	Display Num or real values (if available)
Trig	Trigger line visible
Label	Channel name visible
AbsDelta	*Function not yet activated*
InvColour	Invert all colours

Symbol:	Settings:
B	Background colour
K	Raster line colour
Z	Cursor line colour
T	Trigger line colour

21.2.10 Oscilloscope – Measured value display

Measured values Display:

- The records of the measured values are displayed in the selected colours.
- Measured values can be displayed or hidden via the tick symbol.
- The tick symbol in the **Units** box switches the displayed values from numerical values to physical values if the conversion is available for the signal.

Trigger line:

- The **first trigger line (vertical)** is marked by an arrow symbol at the top and bottom of the screen. This is defined by the trigger setting via the **Pre Trig** selection.
- The **second trigger line (horizontal)** is marked by an arrow symbol on the left edge of the picture. This is defined by the trigger setting via the **Level** value**.**

Cursor line:

- The **first cursor line (solid cross line)** is always located where the **mouse pointer** is.
  Depending on this position, the value for each measurement variable is displayed at **Value.**
- The **second cursor line (dashed vertical line)** is defined by the user (left mouse button) depending on the current position of the first cursor line.
  In the **Delta Value** field, the **difference value** between the first and the second cursor line is displayed for each measured value.

Time:

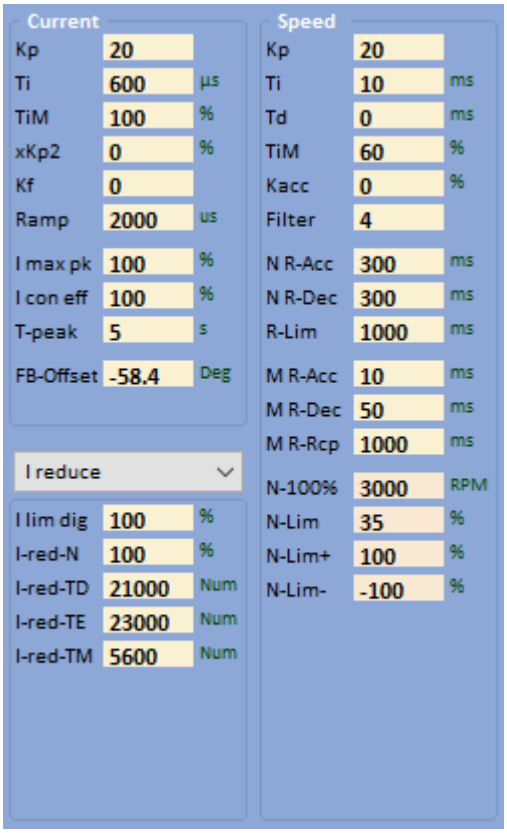
- The **Time** window shows the time from the first trigger line (vertical) to the first cursor line (solid cross line).
- The **Delta (Time)** window shows the time from the second cursor line (dashed vertical line) to the first cursor line (solid cross line).

21.2.11 Oscilloscope - Parameters on the Oscilloscope page

The Oscilloscope page contains a compact selection of important parameters for direct modification while making measurements with the oscilloscope.

In the area depending on the selection of the pull-down menu (here: I reduce), various blocks of parameters can be displayed.

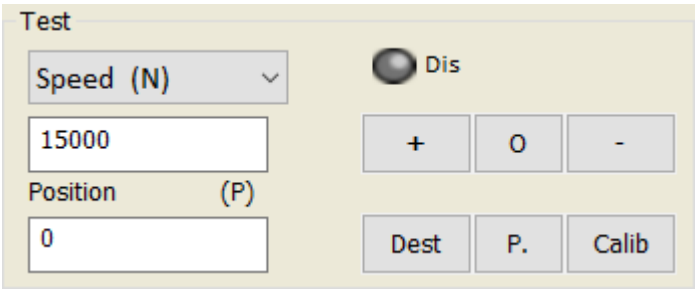
The changes are applied to the current parameter set in the RAM memory and automatically to the other tabs.



22 Test mode

22.1 Test mode – Test

Attention :
This field is only intended for test operation.



The test field allows direct digital setpoint commands to be sent for either Speed (N), Torque (Iq) or Position. This makes it very suitable for general test operation.

To be able to use the functions of the test field, the operating **mode Command Mode** must be set to **Dig. commands must** be set.

Test mode setpoint Setting of Speed (N) or Torque (Iq)

- The setting of a Speed (N) or Torque (Iq) setpoint is defined via the corresponding selection in the pull-down menu.
- The numerical setpoint is entered in the left field (range: 0..32767).
- When clicking the (+) or (-) button, the entered setpoint is executed immediately.
  When the stop button (O) is clicked, the setpoint is set to zero.

Test mode of setpoint preset position and reference cycle

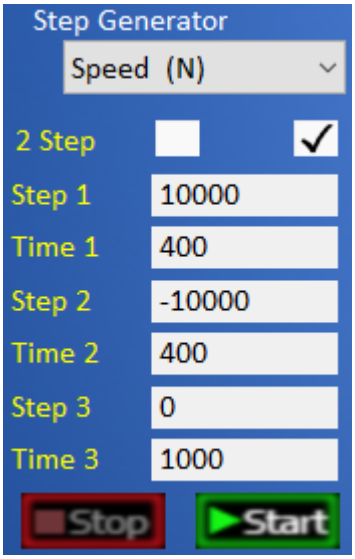
- Enter the numerical position setpoint in the left field (range: ±2147483647).
- When the button (Dest.) is clicked, the drive immediately moves to the entered position setpoint at the speed selected at N max.
- When the button (Calib) is clicked, the drive runs a reference cycle.
- With the key (P.) the entered numerical position is taken over as actual position and as target position.

Dis Software release (only with active hardware release)
The **Dis** button can be used to lock (red) and unlock (grey) the release.

22.2 **Test mode – Step generator**

Step generator for output of up to 3 cyclic repeating setpoints.

Default:	**Function:**	**Range:**
Flux (Id)	Reactive current (Id) Default → Id set (dig.)	±32767
Torque (Iq)	Active current (Iq) Default → M_set (dig.)	±32767
Speed (N)	Speed (N) as default → n_cmd	±32767
Position (P)	Position target as default → Pos dest	±2147483647
2 Step	Selection 2 or 3 steps	



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

Note:
The time entries (Time) can vary for values >2000 depending on the PC.

Setpoint step functions are specified with the step generator. The ramps are determined in the parameter settings for current and speed controllers.

When the controller enable (RUN) is active, the drive is started by clicking the **Start** button and stopped with **Stop.** The functions can be selected as flux (Id), torque (Iq) and speed (N) or position values. The value for Stop is 0 for flux (Id), torque (Iq) and speed (N).

Pay special attention:
With limited travel, ensure that the travel is within the machine limits for the test settings.
With the test setting flux (Id) and torque (Iq), the drive can rotate at maximum speed.
With field weakening, overspeed can be achieved.

23 Measured values and parameters

23.1 Measured values (RO) – Overview

Symbol:	Function:	Range:	Unit:	ID address:
Firmware no.	Software firmware number (protected)	0..9999	Num	0x1B
Type	Unit designation (protected)	0..255	Num	$0x67_{Bit7..0}$
S-Nr.	Serial number device (protected)	32 Bit - 1	Num	0x62
Status	Current status information	32 Bit - 1	Bitmask	0x40
Warning-Error	Current error and warning information	32 Bit - 1	Bitmask	0x8F
Error	Current error information	0.. 32767	Bitmask	$0x8F_L$
Warning	Current warning information	0.. 32767	Bitmask	$0x8F_H$
Ain1 in	Analogue input 1	±32767	Num	0xD5
Ain2 in	Analogue input 2	±32767	Num	0xD6
Ain1 scaled	Analogue input 1 scaled	±32767	Num	0xFB
Ain2 scaled	Analogue input 2 scaled	±32767	Num	0xFC
N cmd (int)	Speed setpoint used (internal)	±32767	Num	0x5D
N cmd (ramp)	Speed setpoint after ramp	±32767	Num	0x32
N actual	Actual speed	±32767	Num	0x30
N act (filt)	Actual speed value filtered for display	±32767	Num	0xA8
N error	Control error speed actual value	±32767	Num	0x33
M cmd ramp	Active current (Iq) Setpoint (scaled) after ramp	±32767	Num	$0x3A_L$
M out	Actual active current (Iq) (scaled)	±32767	Num	0xA0
Iq cmd	Active current (Iq) Setpoint (internal)	±2000	Num	0x26
Iq cmd ramp	Active current (Iq) Setpoint (internal) after ramp and limitation	±2000	Num	0x22
Id cmd	Reactive current (Id) Setpoint (internal)	±2000	Num	0x23
I lim inuse	Current limit (internal)	±2000	Num	0x48
I lim inuse ramp	Current limit (internal) after ramp	±2000	Num	0x57
I2_adc	ADC Voltage of the actual current sensor 2	2048 (±2000)	Num	0xAA
I3_adc	ADC Voltage of the actual current sensor 3	2048 (±2000)	Num	0xA9
I1 actual	Actual current phase 1	±2000	Num	0x54
I2 actual	Actual current phase 2	±2000	Num	0x55
I3 actual	Actual current phase 3	±2000	Num	0x56
I actual	Actual current value	±2000	Num	0x20
I act (filt)	Actual current value after display filter	±2000	Num	0x5F
Iq actual	Current active current (Iq)	±2000	Num	0x27
Id actual	Current reactive current (Id)	±2000	Num	0x28
Iq error	Control error active current (Iq)	±2000	Num	0x38
Id error	Control error reactive current (Id)	±2000	Num	0x39
32 Bit - 1 → 2^{32} - 1 = 4.294.967.295 ±32 Bit - 1 → $±2^{32-1}$ - 1 = ±2.147.483.647				

Symbol:	Function:	Range:	Unit:	ID address:
Vemf	Current Vemf voltage share	±4096	Num	$0x29_H$
Vq	Current Vq voltage share	±4096	Num	$0x29_L$
Vd	Current Vd voltage share	±4096	Num	$0x2A_L$
Vout	Current output voltage	±4096	Num	$0x8A_L$
Vdc-Bat	Measured value of the DC link voltage	0..32767	Num	0x66
Vdc-Bus	Measured value of the DC link voltage filtered	0..32767	Num	0xEB
Pos dest	Preset target position	±32 Bit - 1	Num	0x6E
Pos cmd	Target position used (internal)	±32 Bit - 1	Num	0x91
Pos actual	Actual position value	±32 Bit - 1	Num	0x6D
Pos error	Control error Position actual value	±32 Bit - 1	Num	0x70
Zero-Capture	Absolute value zero crossing for resolver	0..65535	Num	0x74
InOut Block	Digital input and output Bit mask	0..32767	Bitmask	0xD8
in limit1	Digital input LMT1	0/1	Bit	0xE4
in limit2	Digital input LMT2	0/1	Bit	0xE5
in Din1	Digital input IN1	0/1	Bit	0xE6
in Din2	Digital input IN2	0/1	Bit	0xE7
in Run (Frg)	Digital input controller enable RUN	0/1	Bit	0xE8
I Fault	Int. error message from the power unit	0/1	Bit	0xE9
I Regen	Ballast circuit state	0/1	Bit	0xEA
I Voltage Err	Overvoltage message (only for servo units with digital Vdc bus measurement)	0/1	Bit	0xEB
I LossOfSignal	Hardware resolver signal error message	0/1	Bit	0xEC
out Dout1	Digital output OUT1	0/1	Bit	0xE0
out Dout2	Digital output OUT2	0/1	Bit	0xE1
out Dout3	Digital output OUT3	0/1	Bit	0xDE
out Dout4	Digital output OUT4	0/1	Bit	0xDF
out Rdy (BTB)	Ready-to-operate message RDY	0/1	Bit	0xE2
O Go	Internal release GO	0/1	Bit	0xE3
O Brake	Brake active BRK1	0/1	Bit	0xF2
O Icns	Reduction to continuous current Icns	0/1	Bit	0xF3
O Less NO	Speed less than 0.1 %	0/1	Bit	0xF5
O Toler	Within the position tolerance	0/1	Bit	0xF4
incr_delta	Difference rotor position after sampling time	0..32767	Num	0x41
MotorPos mech	Rotor position mechanical	0..32767	Num	0x42
MotorPos elec	Rotor position electric	0..32767	Num	0x43
Rotor	Rotor position signals (RST) (0 or 7 = error)	1..6	Num	0x5C
pwm1 (1/2)	Pulse width modulation phase 1	750 (±750)	Num	0xAC
pwm2 (3/4)	Pulse width modulation phase 2	750 (±750)	Num	0xAD
pwm3 (5/6)	Pulse width modulation phase 3	750 (±750)	Num	0xAE
32 Bit - 1 → 2^{32} - 1 = 4.294.967.295 ±32 Bit - 1 → $±2^{32-1}$ - 1 = ±2.147.483.647				

Symbol:	Function:	Range:	Unit:	ID address:
T-motor	Motor temperature	0..32767	Num	0x49
T-igbt	Power stage temperature	0..32767	Num	0x4A
T-air	Air temperature (unit interior)	0..32767	Num	0x4B
Ixt & Regen. Energy	Monitor from Ixt & Regen Circuite		Num	0x45
Ixt	Ixt monitoring	0..32767	Num	$0x45_L$
Ballast energy	Ballast energy monitoring	0..32767	Num	$0x45_H$
Ballast Count	Ballast performance monitoring	0..32767	Num	0xA1
fpga status	ECODE from the FPGA device	0..32767	Bitmask	0x63
fpga 1st error	ECODE from the FPGA device from the first detected error	0..32767	Bitmask	0x94
Logic (Hz)	Main processing frequency	0..65000	Hz	0xAB
Ctrl	Control Status	32 Bit - 1	Num	0x11
Temp debug	For service only	±32767	Num	0x9A
*PTR1	For service only	±32767	Num	0xB8
*PTR2	For service only	±32767	Num	0xBA
32 Bit - 1 → 2^{32} - 1 = 4.294.967.295 ±32 Bit - 1 → $±2^{32-1}$ - 1 = ±2.147.483.647				

23.2 **Parameters (RW / SP) – Overview**

Parameters – Motor

Symbol:	Function:	Range:	Unit:	ID address:
Type [1]	Selection of motor type (EC servo, FU, FU servo, DC)			$0x5A_{Bit\ 13..12}$
N nom	Engine speed (for FU autotuning)	60..65000	rpm	0x59
F nom	Frequency Rated motor speed (for FI mode)	20..1200	Hz	0x05
U nom	Voltage at rated motor speed (for FI mode)	0..1000	V	0x06
Cos Phi	Motor power factor (for FI mode)	0..327,00	%	0x0E
I max eff	Motor maximum 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
Kt	Motor Kt constant	0..50,000	Nm/A	$0x87_L$
Ke	Motor Ke Constant (Back EMF)	0..500,00	V/krpm	$0x87_H$
Brake delay	- Attraction delay time of the electro-mechanical motor brake - Deceleration delay when no brake is connected	0..1000	ms	0xF1
Coast stop	Free run (ON) or emergency stop braking (OFF) (when switching off the enable RUN)	On / Off		$0x5A_{Bit\ 3}$
M-Temp	Motor overtemperature switch-off point (error code 6) (At 93 % there is a warning message 6 with current derating Ird-TM activation).	0..32767	Num	0xA3

[1] Parameter – 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 without slip compensation)	1 dec
ACI Servo	Asynchronous motor AC servo-vector control with speed encoder system (e.g., bearing encoder A, B channel)	2 dec
DC	DC motor without or with DC tacho encoder	3 dec

Parameter – Feedback encoder

Symbol:	Function:	Range:	Unit:	ID address:
Type [2]	Feedback selection (Red_Enc_TTL, Resolver, ...)			$0xA4_{Bit\ 4...\ 0}$
FB-Pole	Encoder pole number	2..12	Num	0xA7
FB-Offset	Phase angle correction	±360	Degree	0x44
FB-Incr (Mot)	Resolution encoder	1024..8192	Inc/Rev	0xA6
Voltage	DC tachometer voltage		mV/rpm	
Inc-Out	Resolution- 2.donor		Inc/Rev	$0xCF_L$
Factor	Multiplier 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 1Vpp with commutation track	2 dec
Rot_Tacho	Rotor position sensor with brushless tachometer	3 dec
Rot	Rotor position sensor (without tacho)	4 dec
DC_Tacho	DC tachogenerator	5 dec
DC_Arm	Armature voltage (internal)	6 dec
BL_Arm	EC-AC motor without tachometer	7 dec
Enc_TTL	Incremental encoder TTL 5 V (without rotor position)	8 dec
Enc_SC	Incremental encoder Sin/Cos 1Vpp without commutation track	9 dec
Abs_SC	Incremental encoder Sin/Cos 1Vpp per motor pole pair	10 dec
DC_Arm_Vir	Sensorless (DC motor without tacho, without armature voltage measurement	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

Parameter – 2. Feedback encoder

Symbol:	Function:	Range:	Unit:	ID address:
Type [3]	Selection 2nd counting input			$0xA4_{Bit\ 7..5}$
Inc-ext	Resolution increments 2nd encoder		Inc/Rev	$0xCF_{L}$
Factor-ext	Encoder factor 2nd encoder	4..16	Num	0x7E
Inc-Out	Increments output resolution		Inc/Rev	$0xCF_{H}$
Factor	Multiplication factor of the basic pulse number for SinCos (SC)			$0xA4_{Bit\ 14..12}$

[3] Parameters – 2. Feedback encoder: Type

Symbol: Type	Function:	ID address: $0xA4_{Bit\ 7...5}$
- - -	Input switched off	0 dec
Enc - Position	Position input	1 dec
Enc - Info	Info display only input	2 dec
Enc - Hand.	Handwheel input	3 dec
SSI	SSI encoder input	

Parameter – Servo

Symbol:	Function:	Range:	Unit:	ID address:
Type	Unit type (protected)	0..255	Num	$0x67_{Bit\ 7..0}$
S-Nr.	Serial unit no. (protected)	32 Bit - 1	Num	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	25..10000	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	mit / ohne with / without		$0x5A_{Bit\ 6}$
PWM freq [4]	PWM pulse frequency	Selection field		$0x5A_{Bit\ 22..20}$
Mode [5] (Command)	Type of the command value presetting for the speed and torque commands	Selection field		$0x36_{Bit\ 13..12}$
Cutoff (dig.)	Zero zone with digital command value presetting	0..32767	Num	0x1E

[4] Parameters – Servo: PWM freq

Symbol: PWM freq	Function:	ID address: $0x4A_{Bit\ 22..20}$
8kHz		0 dec
24kHz	*Not active!*	1 dec
20kHz	*Not active!*	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 setpoint from RS232 or CAN-BUS	0 dec
Analog Speed	Speed setpoint analogue	1 dec
Analog Torque	Torque - setpoint analogue	2 dec
Digi + Ana Speed	Digital plus analogue setpoint	3 dec

Parameter – Overview Analogue (Ain1 + Ain2)

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

[6] Parameters – Analog Command Format (Ain1 + Ain2)

Format: Ain1		ID address:
Off	Disabled	$0x36_{Bit\ 1..0}$ = 0
+Cmd	Setpoint command normal	$0x36_{Bit\ 1..0}$ = 1
-Cmd	Setpoint command inverted	$0x36_{Bit\ 1..0}$ = 2
sq(Cmd)	Square reference setpoint command	$0x36_{Bit\ 1..0}$ = 3
N limit	Speed limitation 0... 100 % via Ain1 (with digital setpoint input (position, speed)). This corresponds to 100 % of the max. physical speed defined in **N-100%** (0xC8).	$0x36_{Bit\ 15}$

Format: Ain2		ID address:
Off	Disabled	$0x36_{Bit\ 3..2}$ = 0
+Cmd	Setpoint command normal (Ain2 is added to Ain1)	$0x36_{Bit\ 3..2}$ = 1
-Cmd	Setpoint command invertet (Ain2 is subtracted from Ain1)	$0x36_{Bit\ 3..2}$ = 2
*Cmd	Setpoint command normal (Ain2 is multiplied by Ain1)	$0x36_{Bit\ 3..2}$ = 3
I limit	Current limitation 0..100 % via Ain2 (for all digital, analogue setpoints). This corresponds to 100 % of the unit peak current **I max pk** (0xC4).	$0x36_{Bit\ 14}$

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

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

Parameter – Current controller

Symbol:	Function:	Range:	Unit:	ID address:
Kp	Proportional gain	0..200	Num	0x1C
Ti	Reset time (integral time constant)	375..10000	ms	0x1D
TiM	Maximum value from integral memory Ti	0..300	%	0x2B
xKP2	Proportional amplification in case of actual current greater than current limit	0, 100..500	%	0xC9
Kf	Current feed forward	0..167	Num	0xCB
Ramp	Ramp adjustment set current	125..32000	µs	0x25

Parameter – Current limits

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

[2] Only active if current reduction based on the output stage temperature is not activated ($0x40_{Bit\ 23}$ (Ird-TI) = 0)
[3] Reference is maximum unit peak current (I max pk (0xC4) = 100 %)

Parameters – Output stage voltages

Symbol:	Function:	Range:	Unit:	ID address:
Vemf	Current Vemf voltage share (feed forward Back EMF)	±4096	Num	$0x29_H$
Vq	Current Vq voltage share	±4096	Num	0x29
Vd	Current Vd voltage share	±4096	Num	0x2A
Vout	Current output voltage	±4096	Num	0x8A
V-red	Voltage reference value in % of Vout (V-red ≠ 0, 100 % → activation field weakening control) Recommendation: 60..80 %	0..100	%	0x8B
V-kp	Proportional amplification of the field weakening control	0..65535	Num	0x8C
V-Ti	Integral time of the field weakening control	0..65535	Num	0x8D
Vdc bus	DC link voltage	0..32767	Num	0xEB

Parameter – Speed -setpoint, -actual value

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

Parameters – Limitation, ramps for speed and torque setting

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

Parameter – Speed controller

Symbol:	Function:	Range:	Unit:	ID address:
Kp	Proportional gain	0..200	Num	0x2C
Ti	Reset time (integral time constant)	0..10000	ms	0x2D
Td	Derivative time (differentiation part)	0..100	ms	0x2E
TiM	Maximum value from integral memory Ti	0..100	%	0x3B

Parameter – Position controller reference run

Symbol:	Function:	Range:	Unit:	ID address:
Speed 1	Speed to limit switch The limit switch is overrun depending on the speed	0..32000	Num	$0x76_L$
Speed 2	Reverse speed back to zero pulse (loop speed)	0..2000	Num	$0x77_L$
Reso Edge	Expected switching edge	0..65536	Num	0x75
Ref soft	Selection of the ramp during homing between N R-Acc and R-Lim	DEC / LIM		$0x5A_{Bit\ 5}$
The calibration run is used to determine the zero point of the incremental measuring system				

Parameter – Position controller (Pos → Speed)

Symbol:	Function:	Range:	Unit:	ID address:
Kp	Proportional gain Determines the steepness of the deceleration ramp	0..200	Num	0x6A
Ti	Integration reset time (depending on Kp)	0..10000	ms	0x6B
Td	Derivative time (differential share)	0..1000	ms	0x6C
TiM	Maximum value from integral memory Ti	0..100	%	0x71
The amplified position error forms the speed setpoint Position control is deactivated when Kp = 0 The dynamic control gains Ti are only effective in the target range				

Parameter – Position Parameter

Symbol:	Function:	Range:	Unit:	ID address:
Tol-wind	Position tolerance window	0..2000	Num	0x79
Off.Ref.	Mechanical zero 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	Preset target position	±32 Bit - 1	Num	0x6E
Pos cmd	Target position used (internal)	±32 Bit - 1	Num	0x91
Pos actual	Actual position value	±32 Bit - 1	Num	0x6D
Pos error	Control error Position actual value	±32 Bit - 1	Num	0x70
Inc-ext	Resolution increments 2nd encoder		Inc/Rev	$0xCF_L$
Factor-ext	Encoder factor 2nd encoder	4..16	Num	0x7E
Inc-Out	Increments output resolution		Inc/Rev	$0xCF_H$
32 Bit - 1 → 2^{32} - 1 = 4.294.967.295 ±32 Bit - 1 → $±2^{32-1}$ - 1 = ±2.147.483.647				

Parameters – Frequency inverter setting Parameters of the frequency inverter characteristic curve

Symbol:	Function:	Range:	Unit:	ID address:
FU Start				
T dc	Premagnetisation time Delay between switching on and starting the frequency	10..2000	ms	$0x07_L$
V dc	Premagnetisation DC voltage value	0..20	%	$0x08_L$
V min	Minimum voltage (boost) when the motor is at a standstill → U/F characteristic curve is raised Recommended: V min = V dc	0..100	%	$0x0A_L$
F min	Minimum frequency when the motor is at a standstill	0..100,0	Hz	$0x0B_L$
V corner	Maximum output voltage at the cut-off frequency	0..100,0	%	$0x0C_L$
F corner	Cut-off frequency for maximum output voltage	1..1000,0	Hz	$0x0D_L$
F-sh [8]	Shape of the characteristic curve (linear, half-square, square)	0..3	Num	$0x0F_{Bit\ 2..1}$

[8] Parameters – F-sh (FU Start)

Symbol:	Function:	ID address: $0x0F_{Bit\ 2..\ 1}$
linear	(currently only linear usable)	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	Bit 0
LMT2	Digital input limit 2	Bit 1
IN2	Digital input Din 2	Bit 2
IN1	Digital input Din 1	Bit 3
RUN (FRG)	Digital input of the software rotary field enable RUN	Bit 4
RFE	Digital input of the hardware rotary field enable RFE	Bit 5
	rsvd	Bit 6
	rsvd	Bit 7
OUT1	Digital output Dout 1	Bit 8
OUT2	Digital output Dout 2	Bit 9
RDY (BTB)	Hardware relay output BTB-Rdy	Bit 10
GO	State of internal enable GO	Bit 11
OUT3	Digital output Dout 3	Bit 12
OUT4	Digital output Dout 4	Bit 13
	rsvd	Bit 14
BRK1	State of excited Brake	Bit 15

Parameter – 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	Numerical value of the entered variable fields	±32767	Num	0xD1
Var2				0xD2
Var3				0xD3
Var4				0xD4
Ain1	Analogue value input Ain1	±32767	Num	
Ain2	Analogue value input Ain2	±32767	Num	

Parameter – CAN bus interface

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

Parameter – CAN Bus NBT possibilities

Transmission rate NBT:	Setting value in NBT (0x73):	Cable 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

Parameter – Error Mask

Error in NDrive:		**ID address:** 0x8F$_L$	**Servo Display:**
NOREPLY- No RS232 COM reply	RS232 interface not plugged in or disturbed		
0: Eprom Read Error	Reading from Eprom defective	Bit 0	0
1: HW Fault detected	Critical hardware error detected	Bit 1	1
2: RFE input not present	Safety circuit not present (With RUN input active)	Bit 2	2
3: CAN TimeOut Error	CAN TimeOut Time exceeded	Bit 3	3
4: Feedback Signal Error	Bad or missing feedback signal	Bit 4	4
5: Mains Voltage Min. Limit	Power voltage missing (digital) or below DC-Bus min limit (analogue)	Bit 5	5
6: Motor-Temp. Max. Limit	Motor temperature too high	Bit 6	6
7: IGBT-Temp. Max. Limit	Output stage temperature too high	Bit 7	7
8: Mains Voltage Max. Limit	Power voltage > 1.8 x UN (digital) or above DC-Bus max limit (analogue)	Bit 8	8
9: Critical AC Current	Overcurrent or strong oscillating current detected	Bit 9	9
A: Race Away detected	Spinning (without setpoint, wrong direction)	Bit 10	A
B: ECode TimeOut Error	Bad or missing ECode protocol	Bit 11	B
C: Watchdog Reset	CPU Reset because of Watchdog detected	Bit 12	C
D: I Offset problem	AC Current Offset detection fault	Bit 13	D
E: Internal HW voltage problem	Error beacuse of internal Voltage problem	Bit 14	E
F: Bleed resistor overload	*Only certain motor controllers*	Bit 15	F

Parameter – Warning Mask

Warnung in NDrive:		**ID address:** $0x8F_H$	**Servo Anzeige:**
0: Parameter conflict detected	Parameters are from different device type	Bit 16	0
1: Special CPU Fault	RUN input with jitter or EMI problems	Bit 17	1
2: RFE input not present	Safety circuit not present (without RUN input active)	Bit 18	2
3: Auxiliary Voltage Min. Limit[1]	Auxiliary Voltage is too low	Bit 19	3
4: Feedback Signal problem[2]	Bad or missing feedback signal (Feedback supervision deactivated)	Bit 20	4
5: Warn. 5		Bit 21	5
6: Motor-Temperature (>87%)	T-motor > (I-red-TM oder 93 % von M-Temp)	Bit 22	6
7: IGBT Temperature (>87%)	T-igbt > 87 % vom Limit	Bit 23	7
8: Vout Saturation Max. Limit	Limit of existing voltage output reached	Bit 24	8
9: Warn. 9		Bit 25	9
A: SpeedActual resolution Limit	Resolution range of the speed measurement exceeded	Bit 26	A
B: Check ECode ID: 0x94	Error with an ECode information at ID Register 0x94 detected	Bit 27	B
C: Tripzone Glitch detected	Tripzone triggered unintentional	Bit 28	C
D: ADC Sequencer problem	Problem of the ADC Sequencer channels	Bit 29	D
E: ADC Measurement problem	Problem of internal ADC voltages	Bit 30	E
F: Bleeder resistor load (>87%)[1]	Ballast circuit > 87 % overloaded	Bit 31	F

[1] Only certain motor controllers
[2] Feedback supersion is deactivated. Warning indicates that a Problem is present

Parameter – Status display

Symbol:	Function:	ID address: 0x40
Ena	Drive enabled (Combination hardware RFE and software RUN)	Bit 0
NcR0	Speed limited to zero (last setpoint still active)	Bit 1
Lim+	Limit switch plus active	Bit 2
Lim-	Limit switch minus active	Bit 3
OK	Drive in order (no uncontrolled reset)	Bit 4
Icns	Current limit reduced to continuous current	Bit 5
T-Nlim	Speed-limited while in torque control	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 run in progress	Bit 11
Cal	Calibration run completed (position calibrated)	Bit 12
Tol	Position within tolerance window	Bit 13
Rdy	Ready for operation (BTB/RDY contact closed)	Bit 14
Brk0	Brake not excited with motor active	Bit 15
SignMag	Setpoint inverted	Bit 16
Nclip	Speed limitation activated (N-Lim < 90 %)	Bit 17
Nclip+	Speed limitation positive via switch	Bit 18
Nclip-	Speed limitation negative via switch	Bit 19
Ird-Dig	Current limitation via switch	Bit 20
Iuse-rchd	Current reduction limit reached	Bit 21
Ird-N	Current reduction via speed	Bit 22
Ird-TI	Current reduction via output stage temperature enabled	Bit 23
Ird-TIR	Current reduction to continuous current via output stage temperature is active	Bit 24
Ird-10Hz	Current reduction at a rotation frequency smaller than 10 Hz	Bit 25
Ird-TM	Current reduction via motor temperature	Bit 26
Ird-Ana	Current reduction via analogue input (if ≤ 90 %)	Bit 27
Iwcns	Current peak warning	Bit 28
RFEpulse	Pulsed RFE input monitoring active	Bit 29
Fiwe Acv	Fieldweakening active	Bit 30
HndWhl	Handwheel input selected	Bit 31

Parameter – Settings Switch for various special functions and settings adjustments - Part 1

Symbol:	Function:	ID address: 0xCD
DC Current Sensor (Internal)	Enable the internal DC current sensor (Only specific inverters)	Bit 0
DC Current Limiting	Enable auto. DC Bus current limiting (Motor / Generator) → Requires DC Current Sensor	Bit 1
DC Power Limiting	Enable auto. DC Bus power limitation (Motor / Generator) → Requires DC Current Sensor	Bit 2
Enable with Torque Command	Always start inverter using torque command → Enable with free running torque	Bit 3
Torque recuperation ramp	Activate the 'M R-Rcp' ramps settings option, to control recuperation Acc torque ramps	Bit 4
Reset SpeedRamp at n=0rpm*	Reset Speed Ramps if the actual Speed has a sign change	Bit 5
Torque TimeOut after 100ms	Automatically sets Torque command to 0 if no new external torque command input within 100 ms is registered	Bit 6
Auto. N-Lim Saturation	Auto. Saturation of the max allowed rpm speed depending on the measured Vdc-Bus and a fix constant factor value	Bit 7
DC Current External Usage	Usage of the received external DC Current value for the auto. DC Bus current/power limitation (Motor / Generator)	Bit 8
rsvd_12..8	…	Bit 12..9
Auto. Brake Multipl. Factor	A Multiplication factor can be defined to the automatic recuperation logic for additional braking force	Bit 13..12
Dig E Brake At0NmCmd	Activates the automatic recuperative braking logic, if the received torque command equals 0 (Mset(dig.) = 0)	Bit 14
Dig. E-Brake Activation	Activates automatic recuperative braking logic	Bit 15
Enable Traction Control (TC)*	Enable internal Traction Control Logic (TC)	Bit 16
TC- DeltaTime configuration*	TC delta time configuration. Time steps on when actual speed difference should be checked	Bit 18..17
TC- Min. Speed configuration*	TC minimum speed configuration. Defines at what motor speed the TC should start operation	Bit 20..19
TC- n Command Reset Option*	Reset Option for n command in case TC was triggered	Bit 21
rsvd_31..22	…	Bit 31..22
* In development … usage possible Note: Some functions require certain inverter types		

Parameter – Settings Switch for various special functions and settings adjustments - Part 2

Symbol:	Function:	ID address: 0xDC
DAC Output Channel	Configuration of the DAC output selection	Bit 7..0
CAN Extended	CAN messages will always send a data length of 8 Bytes	Bit 8
Generator Mode V1	Generator logic by controlling the Vdc-Bus level for DC-loading → This is a very customer specific logic and will not be explained	Bit 9
rsvd_10	…	Bit 10
Vdc-Bus Unit	Change the unit on how the Vdc-Bus voltage value (ID: 0xEB) is transmitted [0 = Num ; 1 = dV]	Bit 11
ENA only at cmd = 0	Safety logic, where the inverter only enables if speed and torque command is 0	Bit 12
Generator Mode V2	Generator logic where the max. allowed current will automatically be limited according to the Vdc-Bus voltage value → Full Battery = No recuperation current allowed	Bit 13
MTPA Logic*	Maximum Torque Per Ampere (MTPA) calculation for motors with different L sigma (d,q) properties	Bit 14
CanOpen Acv	Defines the used CAN protocol [0 = CAN ; 1 = CANopen] *Application User Protected*	Bit 15
Bamobil 3.2 I`Offset**	Current offset correction for Bamobil 3.2 inverter type (Only specific inverters) *Application User Protected*	Bit 16
ECode Re-Define**	Re-Definition of the ECode message (Only specific inverters) *Application User Protected*	Bit 19..17
HAL Estimator	Interpolation of the HAL feedback signal to achieve linearization of the electrical angle	Bit 20
SW-Lock Init	Initialisation with activ SW-Lock (Software disable) → (ID: 0x51 Bit 2) is set during Initialisation	Bit 21
Auto. CAN Msg	8 Pre-Defined Variables are configured to be send on the CAN Bus at inverter initialisation	Bit 22
SC Compensator	Special compensation logic to improve the Sine and Cosine signals of a SC feedback encoder	Bit 23
PID I – DIC*	Dynamic Integral Clamping for current PID controller *Application User Protected*	Bit 24
rsvd_25	…	Bit 25
Auto. 16kHz PWM switch*	Auto. Switch to 16kHz PWM frequency if motor speed is above a defined rotation speed *Application User Protected*	Bit 26
PWM Bootstrap**	Disable the Bootstrap logic during PWM Initialisation (Only specific inverters)*Application User Protected*	Bit 27
10Hz Derating	Disable the 10Hz derating logic *Application User Protected*	Bit 28

Check I peak configuration	Configuration for the Critical Currents Shut-Off Limits *Application User Protected*	Bit 31..29
* In development… ** Special Inverter type settings → Do not change! Note: Some functions require certain inverter types		

Parameter – Settings Switch for variaous special functions and settings adjustments - Part 3

Symbol:	**Function:**	**ID address:** $0x51_{Bit\ 9...0}$
Reserve		Bit 0
SPEED = 0	Drive stop speed setpoint = 0	Bit 1
ENABLE OFF	Drive disabled Enable internally switched off	Bit 2
CANCEL CAL-CYCLE	Calibration run stopped	Bit 3
d(status) → CAN		Bit 4
I-clip on	Current limit in % of type current active	Bit 5
N-clip on	Speed limitation (positive and negative)	Bit 6
Mix ana on	Speed setpoint digital plus analogue	Bit 7
Allow sync		Bit 8
HndWhl	2. Feedback as handwheel	Bit 9

Parameters – Parameters on the Monitor page

Symbol:	Function:	Range:	Unit:	ID address:
N cmd (ramp)	Speed setpoint after ramp and limit	0..32767	Num	0x32
N actual	Speed actual value	0..32767	Num	0x30
Iq cmd	Active current (Iq) Setpoint (internal)	±2000	Num	0x26
I act (filt)	Actual current value after display filter	±2000	Num	0x5F
Id actual	Current reactive current (Id)	±2000	Num	0x28
Iq actual	Current active current (Iq)	±2000	Num	0x27
Ixt	Capacity utilisation Ixt	0..4000	Num	$0x45_L$
Power	Motor power (do not use!)	0..4000	Num	0xF6
Vdc-Bus (dir)	DC link voltage	0..32767	Num	0xEB
Regen. energy	Ballast power	0..4000	Num	$0x45_H$
T-motor	Current engine temperature	0..32767	Num	0x49
T-igbt	Current power stage temperature	0..32767	Num	0x4A
T-air	Current air temperature in the servo	0..32767	Num	0x4B
I lim inuse	Current limit	0..2000	Num	0x48
Vout	Current output voltage	0..4000	Num	0x8A
M out	Actual active current (Iq) standardised	±32767	Num	0xA0

Parameters – Device Options (Do not modify!)

Symbol:	Function:	ID address: 0x5A
Vdc comp	Analogue DC link measured value influences Uout	Bit 0
Rregen-ext	External ballast resistor	Bit 1
TJ spec	Encoder monitoring activation	Bit 2
Coast	Free run-out (do not use an emergency stop ramp)	Bit 3
Iact inv	Actual current polarity inverted (factory setting active for DS450, BAMO-D3)	Bit 4
Ref soft	Reversal ramp set to "Dec" during calibration run from limit.	Bit 5
Rdy - Run	BTB signal also with undervoltage error message	Bit 6
Vdc ana	Analogue DC link measurement	Bit 7
Iact 1 ena	Current measurement I1 activated	Bit 8
Hall inv	Sequence Hall signals inverted	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 at the processor pin (1 = 0.. 5V) or (0 = 2.5.. 5V)	Bit 14
low baud	Interface RS232 uses 9600 baud	Bit 15
s-ramp	S-ramp selection 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	PWM clock frequency setting	Bit 22..20
.1		
.2		
ntc	IGBT NTC Temperature Sensor	Bit 23
star-del	Motor phases triangle	Bit 24
dc 1Q	DC 1quadrant, direct voltage setting PWM	Bit 25
dc field	DC field controller	Bit 26
dead x2	Deadband *2	Bit 27
block	Block current for ROT Feedback	Bit 28
dc 1Qmv	DC 1quadrant, minimal switching losses	Bit 29
dc 1Q3p	DC 1quadrant, no high-side , -UB switch parallel	Bit 30
Frd<10Hz	Switching to 4 kHz at n < 10 Hz (no derating)	Bit 31