EN

F1

CDA3000

Application Manual

Inverter drive system
to 90 kW

Adaptation of the drive system to the application

LUST

LUST

Overview of documentation

Before purchase

CDA3000 Catalogue

Selecting and ordering a drive system

With shipment (depending on supply package)

CDA3000 Operation Manual

D

Quick and easy initial commissioning

Operating Instructions KEYPAD KP200

E

Operation via KEYPAD KP200

Application Manual

F1

Adaptation of the drive system to the application

CAN$_{Lust}$ Communication Module Manual

G1

Project planning, installation and commissioning of the CDA3000 on the field bus

CAN$_{open}$ Communication Module Manual

G2

Project planning, installation and commissioning of the CDA3000 on the field bus

PROFIBUS-DP Communication Module Manual

G3

Project planning, installation and commissioning of the CDA3000 on the field bus

F1

Application Manual CDA3000

ID no.: 0840.22 B.1-00

Date: Mai 2001

Applicable as from software version V2.10

We reserve the right to make technical changes.

LUST

Dear User,

This manual is aimed primarily at you as a **programmer** of drive and automation solutions. It describes how you can adapt your new CDA3000 drive system optimally to your specific application. We assume that your drive is already running – if not, you should first consult the Operation Manual.

Don't be put off by the size of the manual: Only sections 1 to 3 contain essential information with which you need to familiarize yourself. The remaining sections and the appendix are provided **as reference resources**: They demonstrate the full scope of functions and flexibility of the CDA3000's software package in solving a wide variety of drive tasks. In those sections you can concentrate on the functions relevant to your own application, such as power failure bridging or DC braking.

Good luck, and have a nice day!

How to use this manual

DE
EN

Pictograms

➢ **Attention!** Misoperation may result in damage to the drive or malfunctions.

➢ **Danger from electrical tension!** Improper behaviour may endanger human life.

➢ **Danger from rotating parts!** The drive may start running automatically.

➢ **Note:** Useful information.

➢ **Reference:** More information in other sections of the Application Manual or in additional documentation.

Revision history

Changes from version:	**0840.02B.2-00**	**March 2000**
to version:	**0840.02B.3-00**	**October 2000**

The following pages are new to this revision:

Section	Page(s)	Comments/Subject
6.1.5		Entirely new

The following pages have been amended/corrected:

Section	Page(s)	Comments/Subject
Cover	inside	Software version changed from V1.4 to V2.10
2.1	2-4	ISD00 changed to ISD01
2.4	2-9 2-10	Switching level Low/High: <5V/>15V DC changed to <5V/ >18V DC
	2-11	Notes added
2.5	2-14	Device state added
4	9 to 59	Change relay contact representation in all displays
4.3	4-8 4-9 to 4-55	Representation changed Representation changed in all control terminal assign-ments
4.3.6	4-24	Parameters 640 and 645 added
	4-25	FOR: to V1.40 added
4.4.5	4-37	Parameter 151-ASTER changed to 151-ASTPR ROT_4: FFTB0 changed from ISD02 to ISD03
	4-38	Parameters 289, 320, 640 and 645 changed
	4-39	FOR: to V1.40 added
4.5.2	4-44	Note added
4.5.4	4-47	Parameter 151-ASTER changed to 151-ASTPR OPTN2 under BUS_1: Was duplicated, one occurrence deleted ISD00 and ISD01 Bus 2 and 3 changed
4.6.5	4-61	Parameter 151-ASTER changed to 151-ASTPR Parameters 320, 640 and 645 changed DC holding added
	4-62	FOR: to V1.40 added Field bus operation changed to Master/Slave operation

Section	Page(s)	Comments/Subject
5.1	5-5	Table: BUS/KP/DM added Notes added
	5-6	Text misprint amended
	5-16	Input changed to output Terminal operation changed to UDS switchover
5.2	5-17	Reference added
5.2.1	5-21	Note added
	5-22	Table heading changed
5.2.3	5-31	Note added Explanatory note moved
	5-33	Limit switch evaluation - drawing changed
5.2.5	5-38	253-FFMX2: 10 Hz changed to 10 kHz
	5-39	Text wording amended
5.3.1	5-54	Online ID omitted
5.3.4	5-65	Parameter 354 added
5.3.5	5-72	References and notes added
5.3.6	5-76	Notes added
5.3.7	5-77	References to rating plates added
5.3.9	5-83	In table, Hex value and bit changed Table re-sorted
5.3.10	5-85	512-_R-OFF: LOCK changed to HALT
	5-86	543-R-OL5 added Settings expanded
	5-87	Explanatory notes expanded
5.4.2	5-93	Parameters 576 to 579 added
5.5.1	5-96	Diagram changed
5.5.3	5-105	Online ID added From V2.10 added Explanatory note added
5.5.9	5-121	SATPRx changed to STPRx
5.5.10	5-122	i_a changed to i_q
	5-123	i_a changed to i_q
5.5.11	5-124	Notes added
5.5.12	5-130	Explanatory note added
	5-132	Notes added
5.5.15	5-137	Values in BUS column expanded

Section	Page(s)	Comments/Subject
6.1	6-7	Table changed
6.1.1	6-8	Figure 6.4 representation changed
6.1.4	6-20	Parameter X760: FS 80 changed to FS 120 Parameter X763: FS 80 changed to FS 120
	6-21	Parameters 766 to 769 added
	6-22	Note on current injection expanded
6.2	6-23	Notes added
	6-28	Summary added
	6-41	Notes added Bullet point added
	6-42	FOR: to V1.40 added Explanatory notes expanded
6.3.1	6-45	Formula expanded Line encoder 4096 added
	6-46	Formula expanded Line encoder 4096 added
	6-47	Speed frequency 0 ...160 changed to 0 ... 1600
Appendix	A-2	Parameter 153 omitted
	A-5	Number 90 factory setting 1.30 changed to G
	A-6	Number 92 factory setting 1.30 changed to G
		Number 106 factory setting 00 changed to G
		Number 127 factory setting G added
		Number 394 factory setting G added
		Number 397 0 changed to G
	A-8	Numbers 641, 642, 643, 646, 647, 648 changed to G
	A-9	Numbers 760, 761, 763, 764 factory setting changed to G

Table of contents

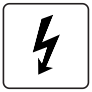
1 Safety

1.1 Measures for your safety

The CDA3000 inverter drives are quick and safe to handle. For your own safety and for the safe functioning of your device, please be sure to observe the following points:

Read the Operation Manual first!

- Follow the safety instructions!

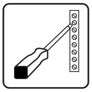


Electric drives are dangerous:

- Electrical voltages > 230 V/460 V: Dangerously high voltages may still be present 10 minutes after the power is cut, so always make sure the system is no longer live!
- Rotating parts
- Hot surfaces

Your qualification:

- In order to prevent personal injury and damage to property, only personnel with electrical engineering qualifications may work on the device.
- The qualified personnel must familiarize themselves with the Operation Manual (refer to IEC364, DIN VDE0100).
- Knowledge of national accident prevention regulations (e.g. VBG 4 in Germany, regulations laid down by the employers' liability insurance associations) is essential.



During installation observe the following instructions:

- Always comply with the connection conditions and technical specifications.
- Comply with the standards for electrical installations, such as regarding wire cross-section, grounding lead and ground connections.
- Do not touch electronic components and contacts (electrostatic discharge may destroy components).

1.2 Intended use

Inverter drives are components that are intended for installation in electrical systems or machines. The inverter may not be commissioned (i.e. it may not be put to its intended use) until it has been established that the machine as a unit complies with the provisions of the EC Machinery Directive (89/392/EEC). EN 60204 (Safety of machines) must be observed.

CE	The CDA3000 conforms to the Low Voltage Directive (73/23/EEC).
EMC	The following generic standards are complied with in application of the installation instructions: • EN 50081-1 and EN 50081-2 (line-borne and radiated interference emission) • IEC 1000-4-2 to 5 / EN61000-4-2 to 5 (Interference immunity of the inverter module)

If the frequency inverter is used for special applications (e.g. in areas subject to explosion hazard), the required standards and regulations (e.g. EN 50014, “General provisions” and EN 50018 “Flameproof enclosure”) must always be observed.

Repairs may only be carried out by authorized repair workshops. Unauthorized opening and incorrect intervention could lead to physical injury or material damage. The warranty provided by LUST would thereby be rendered void.

1.3 Responsibility

Electronic devices are fundamentally not fail-safe. The company setting up and/or operating the machine or plant is itself responsible for ensuring that the drive is rendered safe if the device fails.

EN 60204-1/DIN VDE 0113 “Safety of machines”, in the section on “Electrical equipment of machines”, stipulates safety requirements for electrical controls. They are intended to protect personnel and machinery, and to maintain the function capability of the machine or plant concerned, and must be observed.

The function of an emergency off system does not necessarily have to cut the power supply to the drive. To protect against danger, it may be more beneficial to maintain individual drives in operation or to initiate specific safety sequences. Execution of the emergency off measure is assessed by means of a risk analysis of the machine or plant, including the electrical equipment to EN 1050, and is determined with selection of the circuit category in accordance with prEN 954 “Safety of machines – Safety-related parts of controls”.

2 Inverter module CDA3000

This section sets out basic aspects of the device hardware which are essential to understanding and using the Application Manual. For more information on the device hardware refer to the CDA3000 Operation Manual.

2.1 Device and terminal view

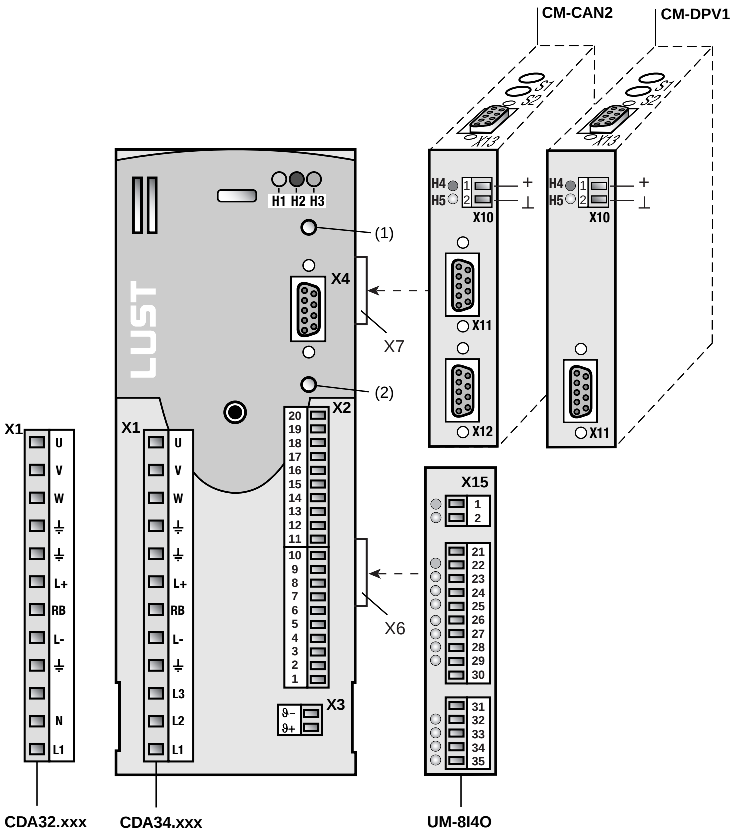


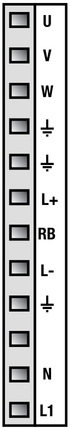
Figure 2.1 Layout, CDA3000

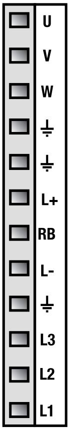
No.	Designation	Function
H1, H2, H3	LEDs	Device status display
X1	Power terminal	Mains, motor, braking resistor (L+/RB), DC supply
X2	Control terminal	4 digital inputs 3 digital outputs (of which 1 relay) 2 analog inputs 1 analog output
X3	PTC terminal	PTC, Klixon evaluation or linear temperature transmitter

Table 2.1 Key to Figure 2.1

No.	Designation	Function
X4	RS232 terminal	For DRIVEMANAGER or KEYPAD KP200
X6	Option slot 1	e.g. for user module UM8I40
X7	Option slot 2	e.g. for communication module
X10	Voltage supply for communication module	+ 24 V, ground
X11	CAN-In / PROFIBUS-DP	Bus connection input
X12	CAN-Out	CAN bus connection output
X13	Address coding plug	Only for CAN_{open}, Profibus DP
X15	User module UM-8I40	Voltage supply, 8 digital inputs, 4 digital outputs
(1)	Reset button	See section 2.7
(2)	Boot button	See section 2.7
S1, S2	Address coding switch	Only for CAN_{open}, Profibus DP

Table 2.1 Key to Figure 2.1





NT	Designation	NT	Designation
U	Motor cable U	U	Motor cable U
V	Motor cable V	V	Motor cable V
W	Motor cable W	W	Motor cable W
⏚	Grounding lead PE	⏚	Grounding lead PE
⏚	Grounding lead PE	⏚	Grounding lead PE
L+	DC-link voltage +	L+	DC-link voltage +
RB	Braking resistor	RB	Braking resistor
L-	DC-link voltage -	L-	DC-link voltage -
⏚	Grounding lead PE	⏚	Grounding lead PE
	NC	L3	Mains phase L3
N	Neutral conductor	L2	Mains phase L2
L1	Mains phase	L1	Mains phase L1

Table 2.2 Power terminal designation, CDA3000

X2	Designation	Function
20	OSD02/14	Changeover relay make contact
19	OSD02/11	Changeover relay root
18	OSD02/12	Changeover relay break contact
17	DGND	Digital ground
16	OSD01	Digital output
15	OSD00	Digital output
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Digital input
11	ISD02	Digital input
10	ISD01	Digital input
9	ISD00	Digital input
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V DC
6	U_V	Auxiliary voltage 24 V DC
5	OSA00	Analog output
4	AGND	Analog ground
3	ISA01	Analog input
2	ISA00	Analog input
1	U_R	Reference voltage 10V

Table 2.3 Control terminal designation, CDA3000

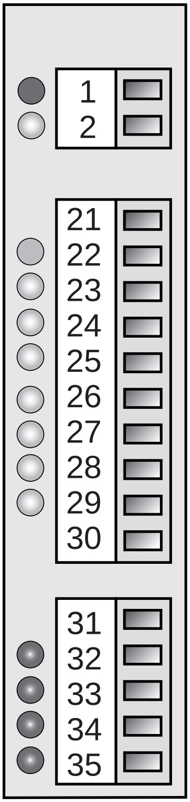
X15	Designation	Function
		
1	U_V	24 V DC supply, feed
2	DGND	Digital ground
21	U_V	Auxiliary voltage 24 V DC
22	IED00	Digital input
23	IED01	Digital input
24	IED02	Digital input
25	IED03	Digital input
26	IED04	Digital input
27	IED05	Digital input
28	IED06	Digital input
29	IED07	Digital input
30	DGND	Digital ground
31	DGND	Digital ground
32	OED00	Digital output
33	OED01	Digital output
34	OED02	Digital output
35	OED03	Digital output

Table 2.4 Control terminal designation, UM-8140

2.2 Module mounting

Inverter modules **up to size BG5** are side mounted. To remove them, press the red release lever on the front and withdraw the module to the side.

As from size BG6 the modules are built-in. This additionally requires **mounting package MP-xxxx** for each module (see Order Catalogue).

The modules are interconnected with the aid of the mounting package from X6 ⟶ X6 and X7 ⟶ X7.

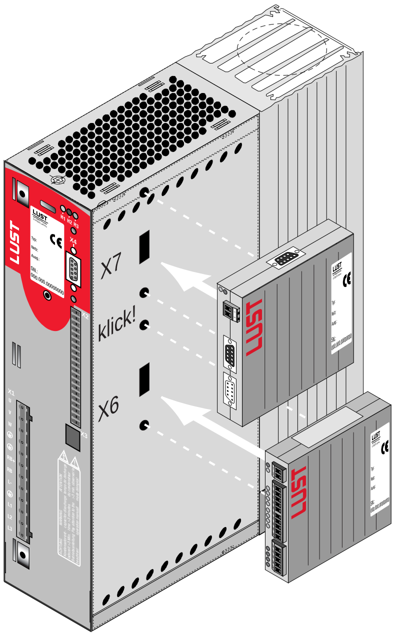
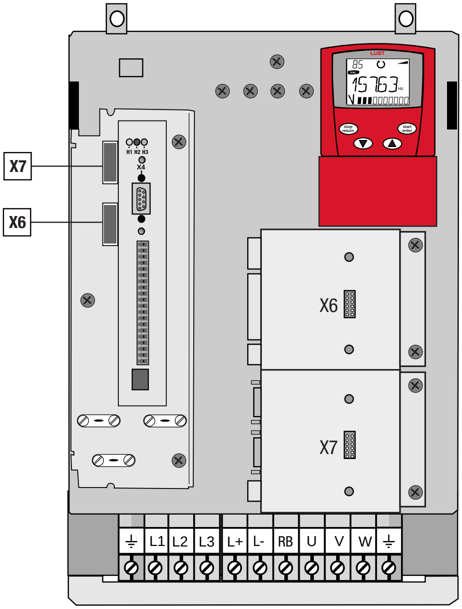
Inverter module BG1 ... BG5	Inverter module BG6 ... BG8
	
X6 = option slot 1 for user modules (UM-xxxx) X7 = option slot 2 for communication modules (CM-xxxx)	The CDA3000 inverter modules have two option slots to accommodate user and communication modules.

Figure 2.2 Mounting of user/communication modules

Attention: Do not plug modules in during operation.

2.3 Ambient conditions

Characteristic		Inverter module	User and communication module
Temperature range	in operation	-10 ... 45 ° C (BG1 ... BG5) 0 ... 40 ° C (BG6 ... BG8) with power reduction to 55 ° C	-10 ... 55 °C
	in storage	-25 ... +55 °C	
	in transit	-25 ... +70 °C	
Relative air humidity		15 ... 85 %, condensation not permitted	
Mechanical strength to IEC 68-2-6	in stationary use	Vibration: 0.075 mm in frequency range 10 ... 58 Hz Shock: 9.8 m/s² in frequency range >58 ... 500 Hz	
	in transit	Vibration: 3.5 mm in frequency range 5 ... 9 Hz Shock: 9.8 m/s² in frequency range >9 ... 500 Hz	
Protection	Device	IP20 (NEMA 1)	
	Cooling method	Cold plate IP20 Push-through heat sink IP54 (3 ...15 kW) Push-through heat sink IP20 (22 ... 37 kW)	Convection IP20
Touch protection		VBG 4	
Power reduction		See section 5.5.12 “ Modula-tion”	None
Mounting height		Up to 1000 m above MSL, above 1000 m above MSL with power reduction of 1% per 100 m, max. 2000 m above MSL	

Table 2.5 Ambient conditions for the modules

2.4 Specification of control terminals

Inverter module CDA3000

Des.	Terminal	Specification	Floating
Analog inputs			
ISA00	X2-2	• U_{IN} = +10 V DC, ±10 V DC I_{IN} = (0) 4-20 mA DC, software-switchable to: • 24V digital input, PLC-compatible (reception of signals to IEC1131 possible) • Switching level Low/High: <4.8 V / >8 V DC • Resolution 10-bit • R_{in}=110kΩ • Terminal scan cycle = 1ms • Floating against digital ground	U: ±1% o.m.v. I: ±1% o.m.v.
ISA01	X2-3	• U_{IN} = +10 V DC, software-switchable to: • 24V digital input, PLC-compatible (reception of signals to IEC1131 possible) • Switching level Low/High: <4.8 V / >8 V DC • Resolution 10-bit • R_{IN}=110 kΩ • Terminal scan cycle = 1ms • Floating against digital ground	U: ±1% o.m.v.
Analog output			
OSA0 0	X2-5	• PWM with carrier frequency 19.8 kHz • Resolution 10-bit • f_{Limit} = 1.1 kHz • R_{OUT}=100 Ω • U_{out}=+10 V DC • I_{max}=5 mA • Short-circuit proof • Internal signal delay time≈ 1ms • Tolerance ±2.5%	✔

Table 2.6 Specification of control terminals

Des.	Ter-minal	Specification	Floating
Digital inputs			
ISD00	X2-9	• Limit frequency 5 kHz • PLC-compatible (IEC1131) • Switching level Low/High: <5 V / >18 V DC • I_{max} at 24 V = 10 mA • R_{IN} = 3 kW • Internal signal delay time ≈ 100µs • Terminal scan cycle = 1ms	✔
ISD01	X2-10	• Limit frequency 150 kHz • PLC-compatible (IEC1131) • Switching level Low/High: <5 V / >18 V DC • I_{max} at 24 V = 10 mA • R_{IN} = 3 kW • Internal signal delay time ≈ 2µs • Terminal scan cycle = 1ms • Data input with reference coupling (Master/-Slave)	✔
ISD02	X2-11	• Limit frequency 500 kHz • PLC-compatible (IEC1131) • Switching level Low/High: <5 V / >18 V DC • I_{max} at 24 V = 10 mA • R_{IN} = 3 kW • Internal signal delay time ≈ 2µs • Terminal scan cycle = 1ms • A-input with square encoder evaluation for 24V HTL encoder against GND_EXT • Permissible pulse count 32...16384 pulses per rev. (2^n with n = 5...14)	✔
ISD03	X2-12	• Limit frequency 500 kHz • PLC-compatible (IEC1131) • Switching level Low/High: <5 V / >18 V DC • I_{max} at 24 V = 10 mA • R_{IN} = 3 kW • Internal signal delay time ≈ 2µs • Terminal scan cycle = 1ms • B-input with square encoder evaluation for 24V HTL encoder against GND_EXT • Permissible pulse count 32...16384 pulses per rev. (2^n with n = 5...14)	✔

Table 2.6 Specification of control terminals

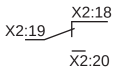
Des.	Ter-minal	Specification	Floating
ENPO	X2-8	• Power stage enable = High level • Switching level Low/High: <5 V / >18 V DC • I_{max} at 24 V = 10 mA • R_{IN} = 3 kW • Internal signal delay time ≈ 20µs • Terminal scan cycle = 1ms • PLC-compatible (IEC1131)	✔
Digital outputs			
OSD0 0	X2-15	• Short-circuit proof • PLC-compatible (IEC1131) • I_{max} = 50 mA • Internal signal delay time ≈ 250µs • Terminal scan cycle = 1ms • Protection against inductive load • High-side driver	✔
OSD0 1	X2-16	• Short-circuit proof with 24V supply from inverter module • PLC-compatible (IEC1131) • I_{max} 50mA • Internal signal delay time ≈ 2µs • Terminal scan cycle = 1ms • No internal freewheeling diode; provide external protection • High-side driver • Data output with reference coupling	✔ 1)
Relay output			
OSD0 2	X2-18 X2-19 X2-20	• Relay 48 V / 1 A AC, changeover contact • Usage category AC1 • Operating delay approx. 10 ms 	✔
Motor temperature monitor			
PTC1/ 2	X3-1 X3-2	• Measured voltage max. 12 V DC • Measuring range 100 Ω - 15 kΩ • Suitable for PTC to DIN 44082 • Suitable for temperature sensor KTY84, yellow • Suitable for thermostatic circuit-breaker (Klixon) • Sampling time 5 ms	✔

Table 2.6 Specification of control terminals

Des.	Ter-minal	Specification	Floating
1) Applicable to limited degree			
Voltage supply			
+10.5V	X2-1	• Auxiliary voltage U_R =10.5 V DC • Short-circuit proof • I_{max} = 10 mA	–
+24V	X2-6 X2-7 X2-13	• Auxiliary voltage U_V = 24 V DC • Short-circuit proof • I_{max} = 200 mA (overall, also includes the driver currents for outputs OSDox) • No polarity reversal protection	✔
Analog ground			
AGND	X2-4	• Isolated from DGND	
Digital ground			
DGND	X2-14 X2-17	• Isolated from AGND	

Table 2.6 Specification of control terminals

Note: The sampling time of the inputs and outputs is 1 ms. The digital voltages relate to the digital ground and the analog voltages to the analog ground.
In the range >5 V to <18 V DC the response of the digital inputs is undefined.

Pin assignment of serial interface X4

Pin no.	Function
1	+15 V DC for KeyPad KP200
2	TxD, send data
3	RxD, receive data
4	NC, free contact
5	GND for +15 V DC of KeyPad KP200
6	+24 V DC, control pcb power supply
7	NC, free contact
8	NC, free contact
9	GND for +24 V DC, control pcb power supply

Table 2.7 Specification of interface contacts

User module UM-8I4O

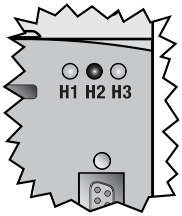
Des.	Terminal	Specification	Floating
Digital input			
+24V DC	X15-21	Supply voltage for IEDxx	
IED00 to IED07	X15-22 to X15-29	• Limit frequency 5 kHz • PLC-compatible (IEC1131) • Switching level Low/High: >5 V / >15 V DC • I_{max} at 24 V = 6 mA • R_{IN} = 4 kΩ • Internal signal delay time ≈ 2µs • Terminal scan cycle = 1ms	✔
DGND	X15-30	• Digital ground for IEDxx	

Table 2.8 Specification of control terminals, UM-8I4O

Des.	Terminal	Specification	Floating
OED00 to OED03	X15-32 to X15-35	• Short-circuit proof, I_{kmax} = 1.2 A/OEDxx • PLC-compatible (IEC1131) • Current at “1”: I_{min} = 5 mA I_{max} = 500 mA • I_{max} in parallel operation = 125 mA • Internal signal delay time ≈ 250µs • Terminal scan cycle = 1ms • Protection against inductive load • Thermal overload protection • High-side driver	✔
DGND	X15-31	• Digital ground for OEDxx	
Supply voltage, module feed			
+24V DC	X15-1	• U_V = 24 V DC ±20% • I = 0.6 A • No polarity reversal protection	
DGND	X15-2	• Digital ground	

Table 2.8 Specification of control terminals, UM-8I4O

2.5 LEDs



At the top right of the inverter module there are three status LEDs colored red (H1), yellow (H2) and green (H3).

Device status	Red LED (H1)	Yellow LED (H2)	Green LED (H3)
24 V DC supply voltage for control unit applied (24 V DC internal or external), or controller in "parameter setting" mode			●
Ready (ENPO set)	❍	●	●
In service/auto-tuning active	❍	✳	●
Warning (in "ready" condition)	●	●	●
Warning (in "service"/"auto-tuning active")	●	✳	●
Error	✳ (flash code)	❍	●
❍ LED off ● LED on ✳ LED flashing			

Table 2.9 Meanings of LEDs

Note: The parameter-setting mode by control unit is not indicated separately.

Flash code of red LED H1	KeyPad DISPLAY	Error cause
1x	E-CPU	CPU errors and other rare errors
2x	E-OFF	Undervoltage shut-off
3x	E-OC	Current overload shut-off
4x	E-OV	Voltage overload shut-off
5x	E-OLM	Motor overloaded
6x	E-OLI	Device overloaded
7x	E-OTM	Motor temperature too high
8x	E-OTI	Cooling temperature too high

Table 2.10 Error messages

Error messages can be viewed in more detail using the KEYPAD KP200 control unit or the DRIVEMANAGER.

2.6 Isolation concept

The analog and digital grounds are isolated from each other in order to avoid transient currents and interference over the connected lines. The analog ground is connected directly to the inverter module processor. It serves as the reference potential for analog reference input. The digital inputs and outputs are isolated from it. Disturbance variables are thereby kept away from the processor and the analog signal processing function. To enhance operating safety we recommend that the analog and digital grounds should not be interconnected.

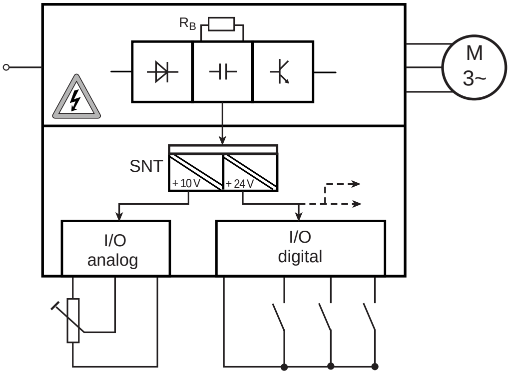


Figure 2.3 Voltage supply to I/Os

When selecting the cable, note that the cables for the analog inputs and outputs must always be shielded. The cable or wire core shield on shielded pairs should cover as large an area as possible in respect of EMC considerations. In this way high-frequency interference voltages are safely discharged (skin effect).

Special case: use of an analog input as a digital input

Use of the internal 24 V DC as the supply voltage when using an analog input with the “digital input” function requires connection of analog and digital ground. For the reasons mentioned above, this can lead to interference, and demands extra care in selecting and connecting the control cables.

A bridge is only required when the internal 24 V is used.

X2	Function
1	Reference voltage 10V, 10mA
2	ISA00, as dig. input
3	ISA01, as dig. input
4	Analog ground
5	OSA00
6	Auxiliary voltage 24 V, max. 200 mA
7	
13	Auxiliary voltage 24 V
14	Digital ground
15	
16	
17	Digital ground

Figure 2.4 Removal of isolation when using the analog inputs with the digital function

If more digital inputs and outputs are required than are present on the inverter module, we recommend using user module UM-8I4O. It ensures safe operation of the CDA3000 inverter module with no disturbance of the analog signals. Safe operation based on burst immunity to EN 61000-4-4 is not affected by connection of the analog and digital ground. The only effect may be on evaluation of the analog input resulting from interference voltage where long cables are attached to the digital outputs and inputs.

Example: risk of disturbance

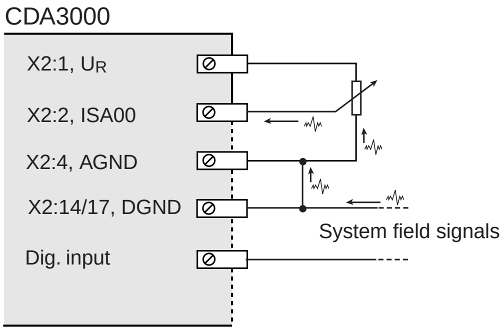


Figure 2.5 Disturbance of the analog input

Note: The analog inputs may only be used either both in analog or both in digital mode. It is not permissible to mix the analog inputs with one in analog mode and one in digital mode.

2.7 Reset

Parameter reset

In PARA menu of KEYPAD: Press the two cursor keys to reset the **parameter currently being edited** to the factory defaults (152-ASTER = DRV_1).

In DRIVEMANAGER: In the edit window of the parameter editor choose the “Default” button.

Factory setting of a data set

By setting parameter 4-PROG = 1 in subject area _86SY- System, the active data set in the RAM is reset to its factory defaults.

Attention: The factory setting causes application data set 1 (traction and lifting drive, DRV_1) to be loaded. Pay attention to the terminal assignment and the functionality of the inverter module in this operation mode.

Lastly, the factory setting in the RAM should be stored by way of parameter 164-UMWR in subject area “_15 FC-Initial commissioning” in a user data set. Caution: Storing the factory setting by way of 150-SAVE = START in subject area “_15 FC-Initial commissioning” will result in user data set 1 being overwritten, because it is preset by default in the factory setting.

Factory setting of all user data sets (complete device in delivery condition)

- DRIVEMANAGER: By setting parameter 4-PROG = 850 in subject area _86SY-System, the device is reset completely to its factory setting. This includes all user data sets. During this process communication with the DRIVEMANAGER is cut. Reconnect.
- KEYPAD: You can achieve the same effect by simultaneously pressing the two cursor keys on the KEYPAD KP200 while the inverter module is powering up. The KEYPAD displays “RESET”.

The reset takes approx. 30 seconds to restore the factory defaults of all user data sets. Then the device is ready to start again. User data set 1 is in the active data set (RAM).

Attention: The factory setting causes application data set 1 (traction and lifting drive, DRV_1) to be loaded. Pay attention to the terminal assignment and the functionality of the inverter module in this operation mode.

Device reset via Reset button

Note: The Reset button is not designed for continuous operation, and should only be used as a backup, instead of a parameter reset. Do not press the button beyond its contact point, otherwise it may be permanently damaged.

Device reset

The inverter module can be reset by way of the **Reset** button. This initiates a system initialization and causes the processor to be reset.

Parameters altered only in the RAM - that is, not saved by parameter 150-SAVE from subject area "_15 FC-Initial commissioning", are reset to their original, last saved, values.

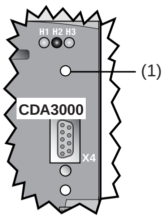


Figure 2.6 Reset button (1)

2.8 Loading device software

Loading new device software

With the DRIVEMANAGER a new device software release (firmware) can be loaded into the Flash-EPROM of the CDA3000. This means the software can be updated without opening up the inverter module.

1. To perform the update, connect the DRIVEMANAGER to the inverter module.
2. From the Tools menu choose “Load device software (firmware) ...”. The DRIVEMANAGER then guides you through the further work steps. LEDs H2 and H3 are lit steadily during transfer of the firmware. If the transfer has been successful, LED H2 goes out when no ENPO signal is applied.

Device software damaged (Bootstrap)

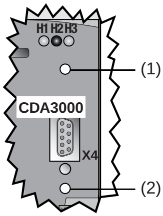
The Bootstrap button is not designed for frequent use, and so should not be pressed unnecessarily.

Note: Do not press the button beyond its contact point, otherwise it may be permanently damaged.

If there is no software in the inverter module, or if the connection was cut while a software release was being transferred, the following procedure is required:

1. The required firmware (Hex file “3_xxx_xx.hex”) must be present.
2. Start the firmware transfer. From the DRIVEMANAGER under Tools - “Load device software (firmware) ...”.
3. Select device type “CDA3000 (frequency inverter)”.
4. Follow the prompt to set the device to Bootstrap mode.

Bootstrap mode on the CDA3000: With the Boot key (2) pressed down, tap the Reset button (1) briefly once. LED H2 goes out, if it was previously lit.



5. The DRIVEMANAGER prepares the device for the firmware transfer and erases the program memory (Flash-EPROM). Then LED H2 lights up in addition to LED H3 and the firmware is transferred.
6. The device responds with “Software transferred successfully”.
7. A new connection is set up. Message: “Waiting for readiness” from 0...100 %. When the transfer is completed successfully, LED H2 goes out provided no ENPO signal is applied.
8. A message reminds you that you need to exit Bootstrap mode (relates only to series MC7000).
   The CDA3000 automatically cancels Bootstrap mode.

3 User interface and data structure

The user interface and data structure of the CDA3000 is highly flexible, as a result of various user control variants and wide-ranging parameter-setting facilities. In this way an ordered data structure provides assistance in data handling and in setting the parameters of the CDA3000 inverter module.

A special subject area containing the key parameters for safe operation of the drive provides assistance for quick and easy initial commissioning.

The parameters of the inverter module can be set using the simple KEYPAD KP200 control unit or the user-friendly DRIVEMANAGER PC user software.

3.1 Data structure

For parameter setting, individual parameters, parameter groups in subject areas or complete, predefined parameter data sets can be selected. These preset parameter data sets are termed application data sets (ADS). If the application data sets are modified by adaptations for the customer, the results are user data sets (UDS). Parameters can only be set in the active data set.

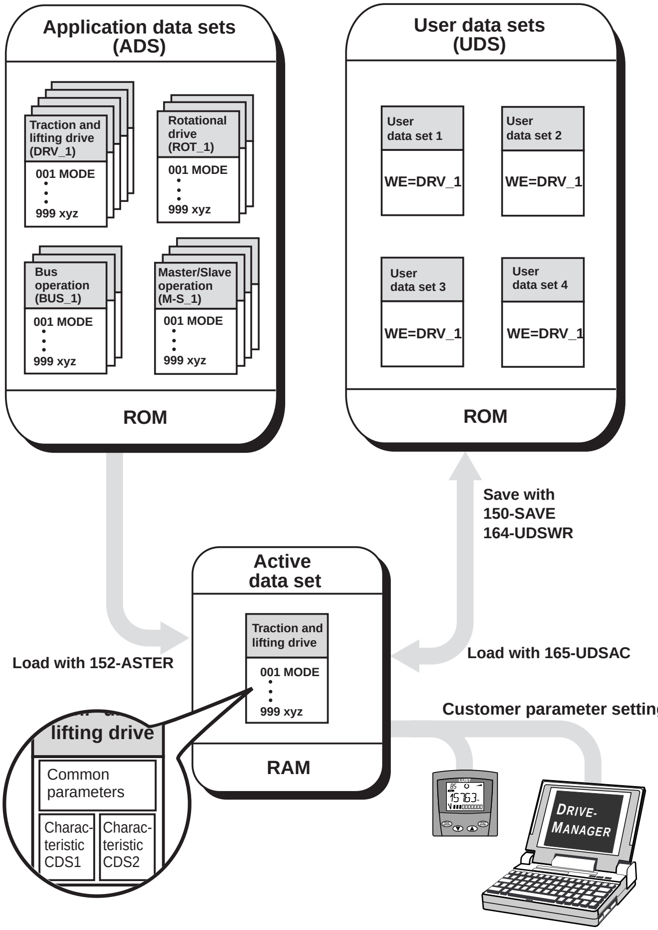


Figure 3.1 Data structure of the CDA3000

Explanatory notes:

- Parameters from subject area "_15 FC-Initial commissioning".
- FS = Factory setting

Note: Any change to the parameters is made only in the volatile RAM, and must be saved by parameter 150 -SAVE, in subject area “_15 FC-Initial commissioning”, to the ROM. The same effect is achieved by simultaneously pressing the two cursor keys on the KEYPAD KP200 control unit for approx. 2 seconds while at the menu level. At the menu level the display shows “MENU”.

Parameters

The parameters are changeable variables which are all assigned a predefined factory setting (FS). They have a fixed value range with a minimum and maximum value. The current parameter value is always displayed.

Subject areas

For ease of handling the parameters are bundled into parameter groups. The parameter groups are termed subject areas, and contain the software functions of the CDA3000 inverter module.

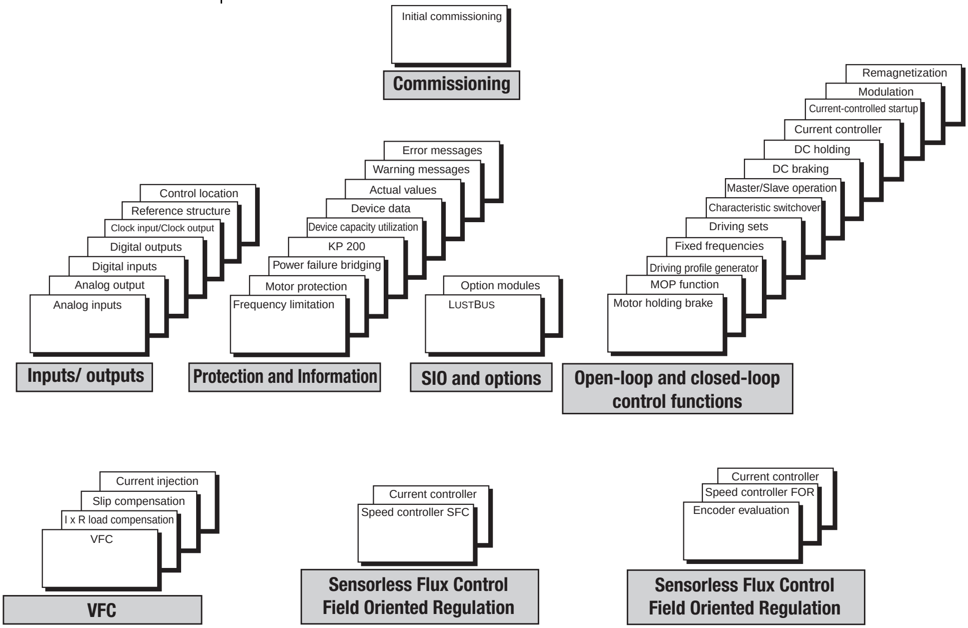


Figure 3.2 Subject areas for function-oriented operation of the inverter module.

3.1.1 Application data sets

Application data sets (ADS) are preset, complete parameter data sets which are provided to handle a wide variety of application-typical movement tasks.

Loading an application data set into the RAM automatically configures the inverter module (see Figure 3.1). All subject areas, including the signal processing inputs and outputs, are preset to the chosen solution.

Using an application data set makes commissioning of the inverter module much quicker and easier. By changing individual parameters, the application data sets can be adapted to the needs of the specific task. These modified application data sets are stored in the device as user data sets. In this way you can arrive more rapidly at your desired movement solution.

A total of 15 application data sets cover the typical areas of application of the CDA3000 inverter module.

Application data sets and typical applications:

➢ **“Traction and lifting drive”:**	Conveyor belt, rack, trolley, spindle and lifting gear drives
➢ **“Rotational drive”:**	Spindle, extruder and Winding drives or centrifuges
➢ **“Bus operation”:**	Integration of the inverter system in a network via CAN_{Lust}, CAN_{open} or Profibus-DP
➢ **“ Master/-Slave operation”:**	Reference coupling of several inverter modules

Note: The **factory setting (FS)** is application data set 1 of the “traction and lifting drive” category. It is automatically loaded and activated the first time the unit is started. After every subsequent start the selected user data set is loaded.

3.1.2 User data sets

When the application data set has been adapted to the respective application, the resultant new data set must be saved as a custom setting in the user data set. It is not possible to store the data in a factory predefined application data set (see Figure 3.1).

Four user data sets (UDS) can be managed in the inverter module, with one user data set containing two subordinate characteristic data sets (CDS).

The user data sets managed by the inverter can be selected and activated via the KEYPAD or DRIVEMANAGER, by bus access or via terminals. Online switching (drive started) between the user data sets is not possible.

For a user data set switchover the “ENPO” signal can remain set but the power stage of the inverter module must be inactive, i.e. no start signal must be applied. The switchover takes approximately 2 to 3 seconds. The "completed" signal for the switchover can be delivered to a digital output.

Example of switchover via terminals:

Terminal 1	Terminal 2	User data set
0	0	⇨ User data set 1 (001 MODE ⋮ 999 xyz)
1	0	⇨ User data set 2 (001 MODE ⋮ 999 xyz)
0	1	⇨ User data set 3 (001 MODE ⋮ 999 xyz)
1	1	⇨ User data set 4 (001 MODE ⋮ 999 xyz)

Table 3.1 Example of selection of user data sets via terminals

3.1.3 Characteristic data sets

Each user data set and the application data sets may contain a second characteristic data set. The switch can be made to this second characteristic data set

- by terminals
- when a frequency limit is reached
- when the direction is reversed or
- by bus access.

Online switching between characteristic data sets CDS1 and CDS2 **is possible**.

The following subject areas contain parameters for the second characteristic data set:

➢ **Reference structure:**	Min., max. and fixed frequency
➢ **Driving profile generator:**	Ramps
➢ **Current-controlled startup:**	All parameters
➢ **Voltage Frequency Control:**	All parameters
➢ **IxR load compensation:**	All parameters
➢ **Slip compensation:**	All parameters
➢ **Current injection:**	All parameters
➢ **Magnetizing:**	All parameters
➢ **Speed controller SFC:**	All parameters
➢ **Speed controller FOR**	All parameters
➢ **Analog inputs**	Scaling

3.2 User levels in the parameter structure

By means of the parameters the inverter module can be fully adapted to the application task. In addition there are parameters for the internal variables of the inverter module which, for the sake of general operating safety, are protected against user access.

The user levels are set by way of parameter 01-MODE in subject area "_36 KP-KEYPAD". The number of editable and displayable parameters changes depending on the user level. The higher the user level the greater the number of accessible parameters. In contrast, users are presented with a more concise range of those parameters which are really required, allowing them to find their specific solution more rapidly. Consequently, choosing as low a user level as possible makes operation significantly easier.

Note: The user levels protect against unauthorized access. Consequently, to protect the inverter module parameter setting, parameter 01-MODE, in subject area "_36 KP-KEYPAD", should always be reset to the lowest user level after adaptation.

Whether a parameter can be only viewed, or viewed and edited, on the current user level is indicated by symbols.

In DRIVEMANAGER	In KEYPAD	Description
	-S-	Parameter display only (shown)
	-E-	Parameter editable (edit)
	-E- (flashing)	Parameter being edited (edit)

Table 3.2 Indication of whether a parameter is editable

Error ATT1

If a user attempts to edit a display-only parameter in the KEYPAD, access is denied and a warning message ATT1 is displayed. The warning message can be reset by pressing the **Start/Enter key**.

More user error and fault messages are detailed in the appendix.

Changing user level

If a higher user level is selected by way of parameter 01-MODE, a prompt for the associated password is automatically delivered. The password can be changed by way of a password parameter in subject area "_36 KP-KEYPAD" (setting "000" = password disabled).

Target group	Password parameter	Comments	User level 01-MODE	Password in FS 1)
Layman	No parameter	No access permission, for status monitoring only • No parameter setting • Display of basic parameters	1	-
Beginner	362-PSW2	With basic knowledge for minimal operation • Expanded basic parameters editable • Expanded parameter display	2	000
Advanced	363-PSW3	For commissioning and field bus connection • Parameter setting for standard applications • Expanded parameter display	3	000
Expert	364-PSW4	With control engineering skills • All control parameters editable • Expanded parameter display	4	000
Other	365-PSW5	For system integrators	5	-
Specialist personnel	367-PSWCT	For operation and commissioning by KEYPAD KP 200	CTRL menu	000
1) FS = Factory setting				

Table 3.3 Setting user levels via subject area "_36 KP-KEYPAD"

Changing the password for a user level

A password can only be changed for the authorized levels - passwords to a higher user level cannot be viewed or changed. The password is changed by selecting the parameter, editing it and then saving it by pressing the Enter key on the KEYPAD KP 200. It can also be changed by way of the DRIVEMANAGER.

Note: Please make a note of any change of password and keep your passwords safe from third parties.

3.3 Operation with KEYPAD KP200

Mounting and connection of the KEYPAD

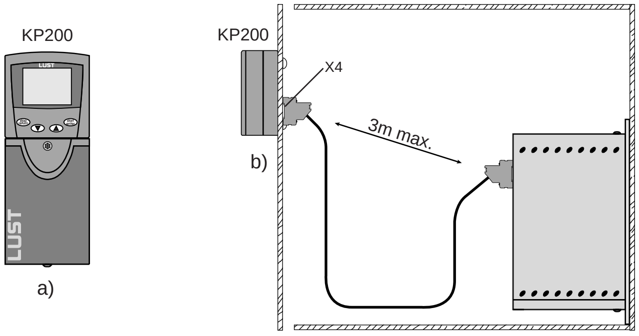
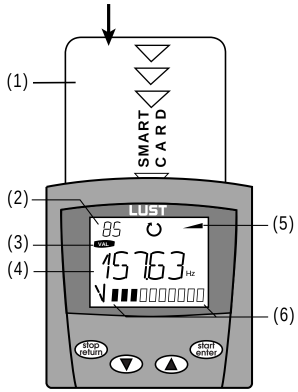


Figure 3.3 Mounting the KEYPAD: a) on the CDA3000 inverter module (connector X4) or b) on the switch cabinet door

Controls and displays



(1) Chipcard (SMARTCARD) to back-up and transfer settings

(2) 3-digit display, e.g. for parameter number

(3) Current menu

(4) 5-digit display for parameter name and value

(5) Acceleration or braking ramp active

(6) Bar graph display, 10-digit

Call up menu branches or parameters; save changes; Start in “Control drive” mode

Quit menu branches; cancel changes; stop in “Control drive” mode

Select menu, subject area or parameter; increase setting

Select menu, subject area or parameter; reduce setting

Figure 3.4 Controls and displays on the KEYPAD KP200

Menu structure

The KEYPAD KP200 has a menu structure which provides for user-friendly operation and is identical to the menu structure of the KP100 for the SMARTDRIVE VF1000 inverters and the MASTERCONTROL servocontrollers.

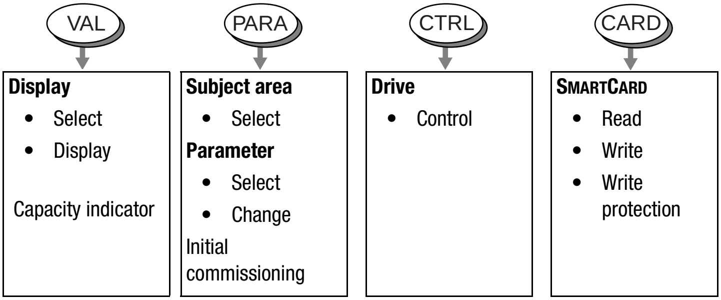


Figure 3.5 Functions of the menus

On the menu level (“MENU” display) you can use the cursor keys to switch between menus. Press the **Start/Enter key** to open a menu and the **Stop/Return key** to quit the menu.

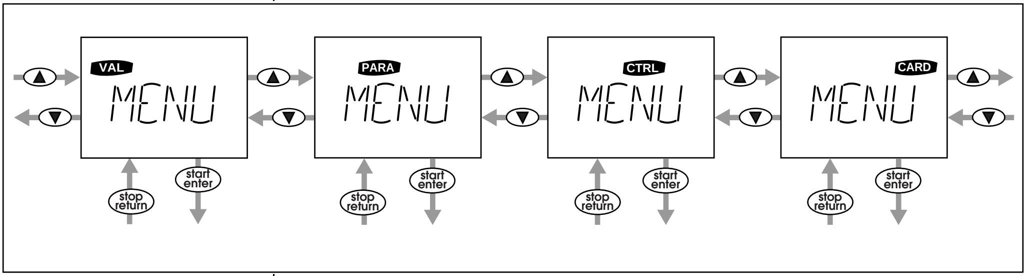
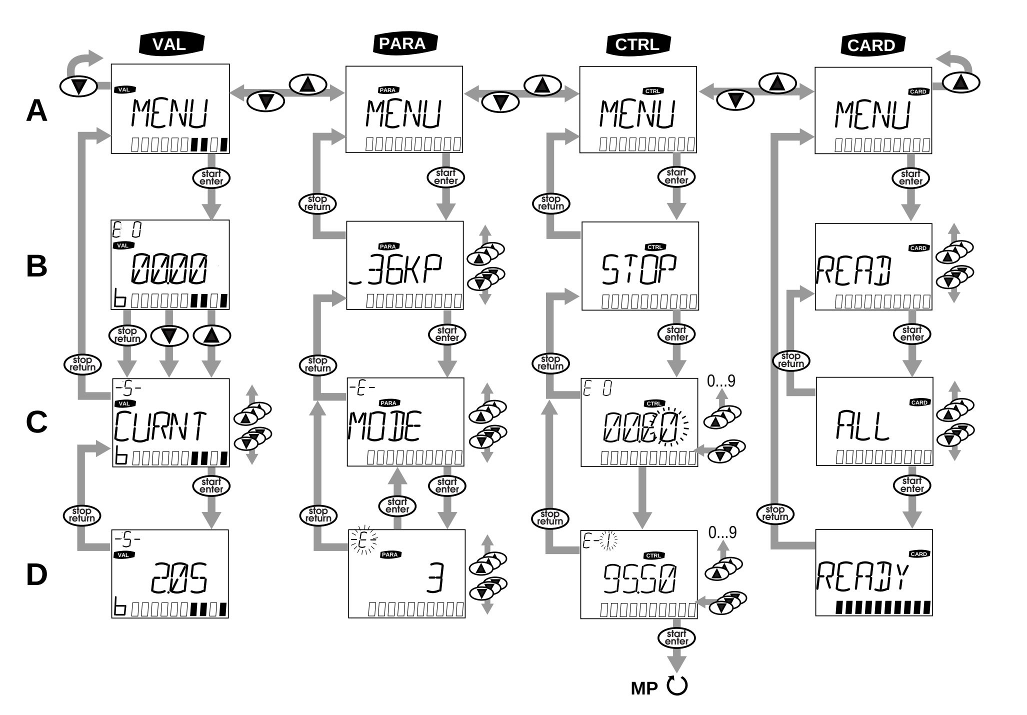


Figure 3.6 Navigation at menu level



A	Select VAL menu (display actual values)	Select PARA menu (parameter setting)	Select CTRL menu (control drive via KEYPAD)	Select CARD menu (load/save with SMARTCARD)
B	Display continuous actual value, use cursor key to switch to ...	Select subject area	Drive stopped (where appropriate password prompt with display PASSW, factory setting = no password)	READ = load from SMARTCARD WRITE = save to SC LOCK = + write protection UNLOCK = - write protection
C	Next actual value	Select parameter	Enter reference	Select parameter area, start with Start/Enter key
D	Display actual value	Display parameter value and change as necessary	Start drive with **Start/Enter**, use cursor key to change reference value (MP = MOP function)	Function terminated without error

Table 3.4 Menu structure of the KEYPAD KP200 at a glance

For more information on operation with the KEYPAD refer to the KEYPAD KP200 operating instructions.

Exponential value display

The five-digit parameter value display is in exponential format. The reference input in the CTRL menu is likewise entered and displayed in exponential format.

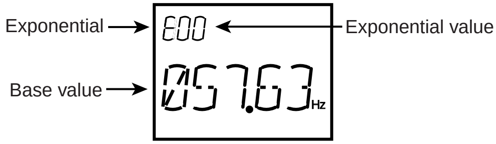


Figure 3.7 Exponential representation on the KP200 display

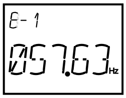
The exponential format is easy to work with if you view the exponential value as a “decimal point shift factor”.

Exponential value	Direction of decimal point shift in base value
positive	to right ⊃ value increases
negative	to left ⊃ value decreases

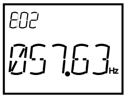
Table 3.5 Exponential value as “decimal point shift factor”

The decimal point is shifted in the base value by the number of places according to the exponential value.

Example:



decimal point shifted by one place to the left
⊃ 57.63^{-1} Hz = 5.763 Hz



decimal point shifted by two places to the right
⊃ 57.63^{2} Hz = 5763 Hz

3.4 Operation with DRIVEMANAGER

The quick route to a drive solution

Connection and startup

- Connect the interface cable and switch on the power supply to the drive unit.
- When the program starts the DRIVEMANAGER automatically connects to the attached drive unit (at least V2.3).
- If the connection setup does not occur automatically, check the settings in the **Tools > Options** menu and start the connection setup with the  .

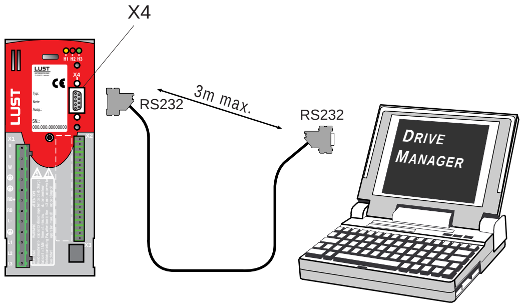


Figure 3.8 Connection via RS232 interface cable (9-pin, plug-and-socket)

The key functions

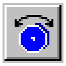
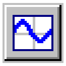
Icon	Function	Menu
	Edit parameters	Active device > Change settings
	Print parameter data set	Active device > Print settings
	Control drive	Active device > Control > Basic operation modes
	Digital scope	Active device > Monitor > Quickly changing digital scope values

Table 3.6 Functions of the DRIVEMANAGER

For more information refer to the DRIVEMANAGER Help.

1 2 3 4 5 6 A
DE EN

3.5 Commissioning

Procedure for commissioning with the aid of the Application Manual

1. Initial commissioning based on Operation Manual:

The precondition is initial commissioning with the aid of the Operation Manual.
The user manual only covers adaptation of the software functions.

If the settings from the initial commissioning based on the Operation Manual are not adequate for your application:

2. Selection of the optimum application data set

The application data sets record the typical applications of the CDA3000 inverter module.

see table with overview of application data sets (see section 4.2, “Selection of application data set”).

The application data set which best covers the specific application is selected.

3. Custom adaptation of the application data set to the application

The application data sets serve as the starting point for application-oriented adaptation. Other function adaptations are made to the parameters in the function-oriented subject areas (see Figure 3.2 in section 3.1 “Data structure”). Save your settings by means of parameter 150 - SAVE = START in subject area “_15 FC-Initial commissioning”.

4. Checking the set application solution

To preserve the safety of personnel and machinery, the application solution should only be checked at low speed. Make sure the direction of rotation is correct. In case of emergency the inverter power stage can be disabled, and the drive stopped, by removing the ENPO signal.

5. Concluding commissioning

When you have successfully completed commissioning, save your settings (using the SMARTCARD or DRIVEMANAGER) and store the data set in the device.

4 Application data sets

The inverter module contains **preset solutions** for the most frequent applications (so-called “application data sets”). The object of these pre-sets is to find the optimum device setup for the application with minimal parameter setting.

Based on the application-specific basic settings for the “traction and lifting drive” and “rotational drive” categories, all software functions relevant

here are already optimized to those applications.
With additional basic settings the inverter module can be very easily be preset for field bus operation or for network operation with several inverter modules (Master/-Slave operation).

Within these four presets, the inverter module offers users the possibility of selecting various control terminal settings. In this way the inputs and outputs of the inverter module are adapted to the signals required in the process.

With the total of 15 available presets the inverter module can be adapted with a small number of parameters to virtually any application, thereby greatly reducing commissioning times.

4.1 Activating an application data set

By means of assistance parameter 152-ASTER, in subject area “_15 FC-Initial commissioning”, a preset application data set is activated in the inverter module. This means that the presets for the application in question are loaded.

Parameter 151-ASTPR, in subject area “_15 FC-Initial commissioning”, always retains the original device preset as its display value when an application data set is edited.

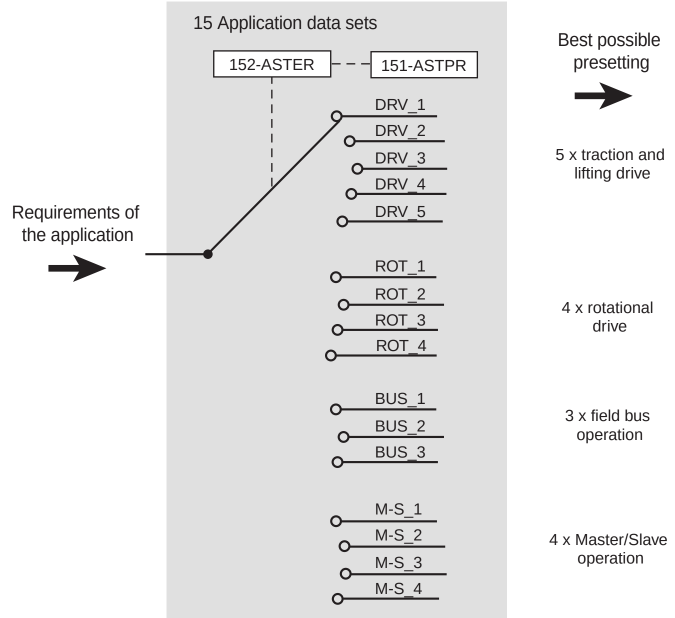


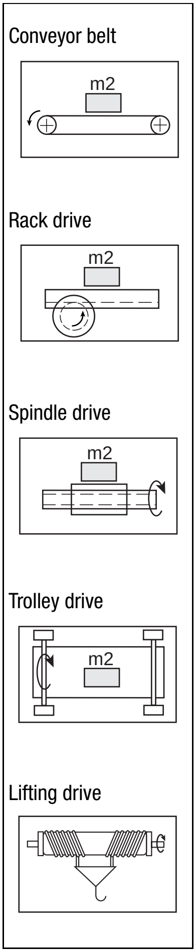
Figure 4.1 Activating a preset with assistance parameter 152-ASTER in subject area “_15 FC-Initial commissioning”

4.2 Selection of application data set

Application data set: traction and lifting drive (activated by 152-ASTER = DRV_x)

Traction and lifting drive

DRIVE



Data set	Functions
DRV_1	• Quick jog/slow jog driving profile • Process messages
DRV_2	• Quick jog/slow jog driving profile • Characteristic data set switchover • User data set switchover • Process messages
DRV_3	• Quick jog/slow jog driving profile • User data set switchover • Limit switch evaluation • Process messages
DRV_4	• Time-optimized driving profile (fixed frequency) • User data set switchover • Encoder evaluation • Process messages
DRV_5	• Time-optimized driving profile • Table sets for fixed frequencies • User data set switchover • Encoder evaluation • Limit switch evaluation • Process and warning messages

Table 4.1 Application: Traction and lifting drive

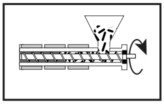
Note: Application data set DRV_5 requires user module UM-8I40 at option slot 1 (terminal X6).

Application data set: rotational drive (activated by 152-ASTER = ROT_x)

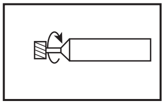
Rotational drive

ROTATION

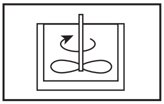
Extruders



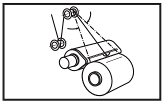
Spindle drive



Stirrer



Winding drive



ROT_1	• Analog speed input • Speed adjustment via button (MOP function) • Process messages
ROT_2	• Analog speed input (0-10 V) • Analog speed correction (0-10 V) • Encoder evaluation • Process message
ROT_3	• Analog speed input • Analog speed correction • Table sets for fixed frequencies • User data set switchover • Encoder evaluation • Process and warning messages
ROT_4	• Analog speed input • Fixed frequencies • Process messages

Table 4.2 Application: Rotational drive

Note: Application data set ROT_3 requires user module UM-8I40 at option slot 1 (terminal X6).

Application data set: field bus operation (activated by 152-ASTER = BUS_x)

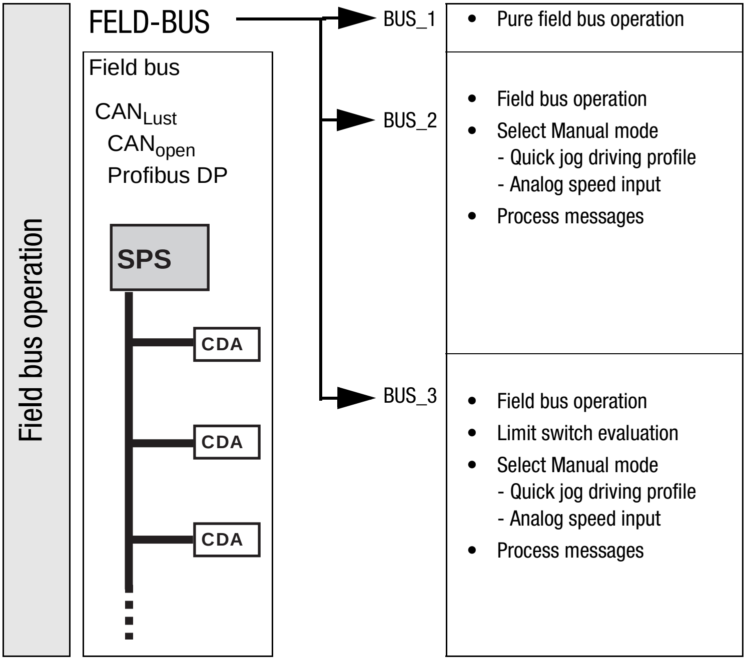


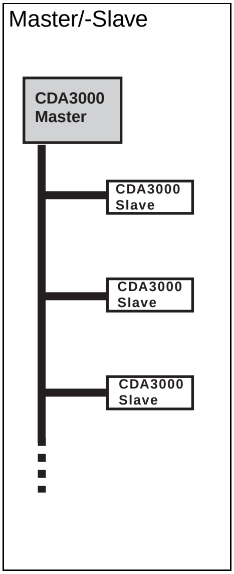
Table 4.3 Application: Field bus operation

Note: The “field bus operation” application requires the appropriate communication module at option slot 2 (terminal X7).

Application data set: Master/-Slave operation (activated by 152-ASTER = M-S_x)

Master/-Slave operation

MASTER/-SLAVE



Setting	Functions
M-S_1	• Master • Digital guide value input • Adaptation of guide value via button (MOP function) • Analog speed input • Process messages
M-S_2	• Master • Digital guide value input • Analog speed input • Encoder evaluation • Process messages
M-S_3	• Slave • Digital guide value recording • Adaptation of guide value via button (MOP function) • Process messages
M-S_4	• Slave • Digital guide value recording • Encoder evaluation • Process messages

Table 4.4 Application: Master/-Slave operation

4.3 Traction and lifting drive

Loading one of the application data sets DRV_1 to DRV_5 into the RAM by setting parameter 152-ASTER, in subject area "_15 FC-Initial commissioning", causes the inverter module automatically to adopt the preset software functions as well as the presets for all the inputs and outputs for the traction and lifting drive application.

Active functions in the preset

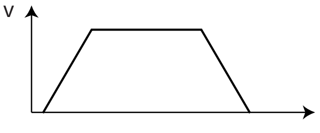
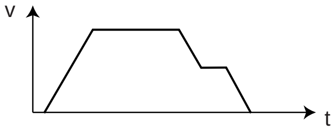
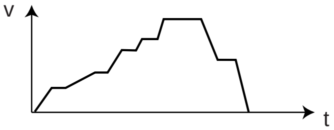
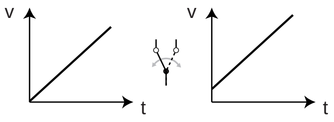
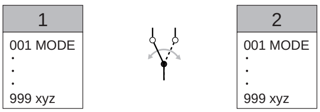
Function		152-ASTER =				
		DRV_1	DRV_2	DRV_3	DRV_4	DRV_5
	Quick jog driving profile	✔	✔	✔	✔	✔
	Quick jog/slow jog driving profile	✔	✔	✔		✔
	Table sets with fixed frequencies and ramps					✔
	Characteristic data switchover for load adjustment		✔			
	User data set switchover		✔	✔	✔	✔

Table 4.5 Traction and lifting drive presets

Function	152-ASTER =				
	DRV_1	DRV_2	DRV_3	DRV_4	DRV_5
Limit switch evaluation			✔		✔
Motor brake actuation	✔	✔	✔	✔	✔
Encoder evaluation (necessary for control mode FOR)				✔	✔
Messages: • Ready to start • Speed reached	✔	✔	✔	✔	✔
Warnings: • Inverter module overloaded • 80% of IN rea-ched • Motor overloaded • Inverter ambient temperature too high					✔

Table 4.5 Traction and lifting drive presets

Aster	Summary description	Page reference
DRV_1	"Quick jog/slow jog driving profile"	Page 4-9
DRV_2	"Quick jog/slow jog driving profile with switchover"	Page 4-11
DRV_3	"Quick jog/slow jog driving profile with limit switch evalua-tion"	Page 4-14
DRV_4	"Clock drive with fixed frequency and encoder evaluation"	Page 4-17
DRV_5	"Clock drive with fixed frequencies, encoder and limit switch evaluation"	Page 4-20

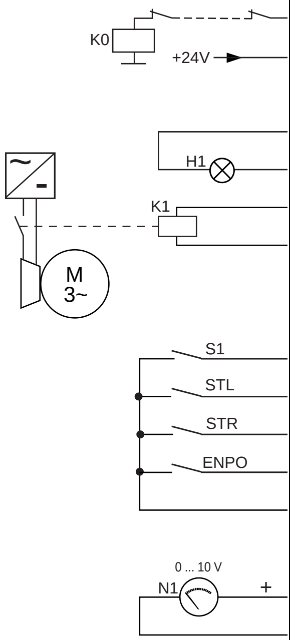
Table 4.6 Page reference to summary description of DRV_x

4.3.1 DRV_1

Quick jog/slow jog driving profile

Preset 1 for traction and lifting drives

Function	Application
• Clock drive with time-optimized quick jog driving profile or • Quick jog/slow jog driving profile	• Conveyor belt • Trolley drive • Rack drive • Spindle drive etc.

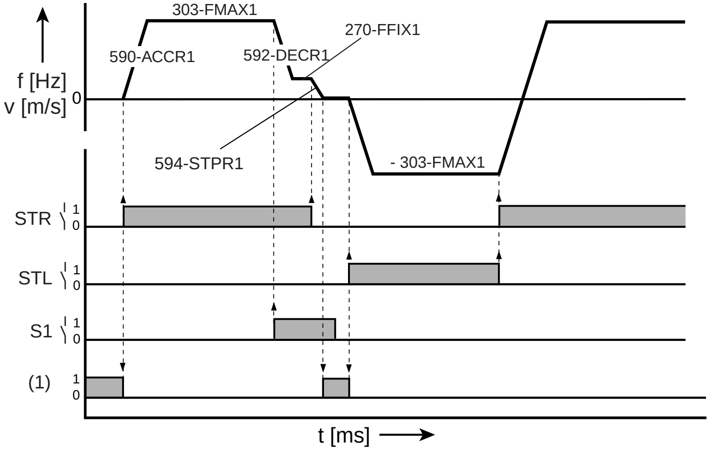


X2	Des.	Function
20	OSD02/14	14 — Relay contact for “Ready” message
19	OSD02/11	11 — Relay contact for “Ready” message
18	OSD02/12	12 — Relay contact for “Ready” message
17	DGND	Digital ground
16	OSD01	“Reference reached” message
15	OSD00	Output for motor holding brake
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Not assigned
11	ISD02	Selection of slow jog
10	ISD01	Start/Stop quick jog anti-clockwise
9	ISD00	Start/Stop quick jog clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Not assigned
2	ISA00	Not assigned
1	U_R	Reference voltage 10V, 10mA

Figure 4.2 Control terminal assignment with ASTER = DRV_1

The parameter presets for application data sets DRV_x are located as parameter comparison references in section 4.3.6 “Comparison of parameters, traction and lifting drive”.

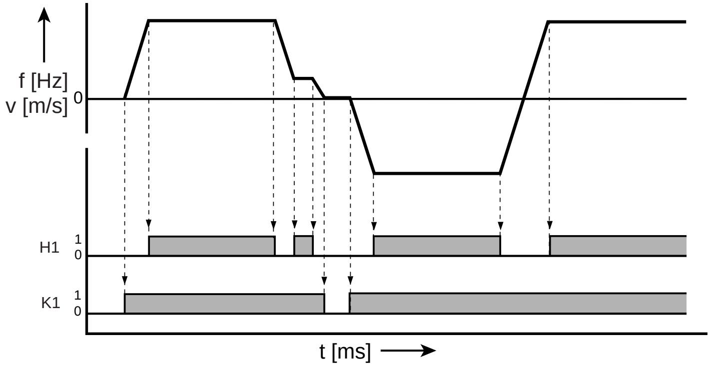
Input signals



(1) DC braking torque, subject area _68HO

Figure 4.3 Example of a quick jog/slow jog driving profile for two directions of rotation (ASTER = DRV_1)

Output signals



H1 Speed reached
K1 Motor holding brake

Figure 4.4 Output signals dependent on driving profile (ASTER = DRV_1 to DRV_5)

4.3.2 DRV_2

Quick jog/slow jog driving profile with switchover

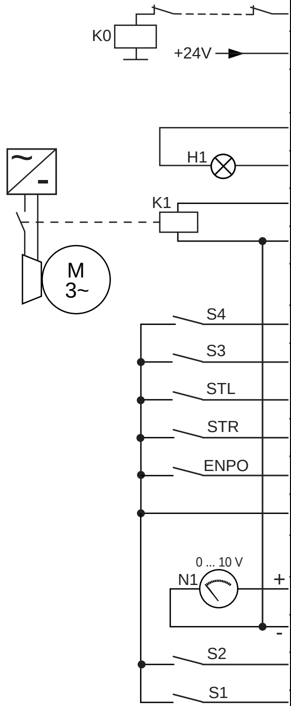
Preset 2 for traction and lifting drives

Function

- Clock drive with time-optimized quick jog driving profile or
- Quick jog/slow jog driving profile
- Application switchover
- Switchover of setting when load changed

Application

- Conveyor belt
- Trolley drive
- Rack drive
- Spindle drive
- Lifting drive etc.



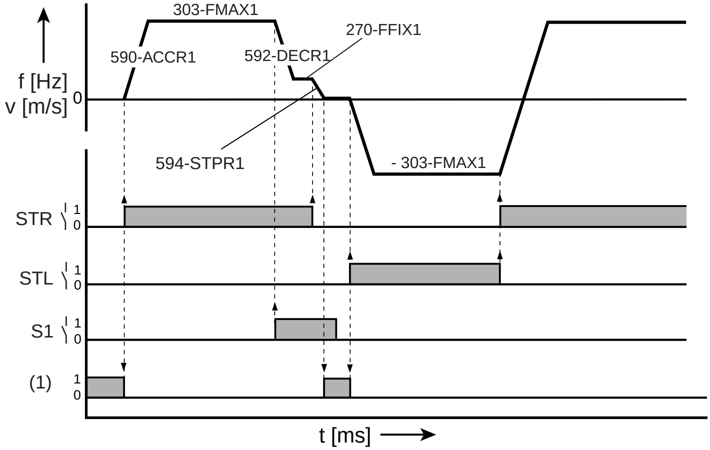
X2	Des.	Function
20	OSD02/14	14 — Relay contact for “Ready” message
19	OSD02/11	11
18	OSD02/12	12
17	DGND	Digital ground
16	OSD01	“Reference reached” message
15	OSD00	Output for motor holding brake
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Characteristic data set switchover
11	ISD02	Selection of slow jog
10	ISD01	Start/Stop quick jog anti-clockwise
9	ISD00	Start/Stop quick jog clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	User data set switchover
2	ISA00	User data set switchover
1	U_R	Reference voltage 10V, 10mA

Figure 4.5 Control terminal assignment with ASTER = DRV_2

Note: After parameter setting of the user data sets the parameter value 166-UDSSL must be changed from PARAM (KeyPad, DriveManager) to TERM (terminal operation) and saved accordingly (see section 5.1 “_15 FC-Initial commissioning”).

The parameter presets for application data sets DRV_x are located as parameter comparison references in section 4.3.6 “Comparison of parameters, traction and lifting drive”.

Input signals



(1) DC braking torque, subject area _68HO

Figure 4.6 Example of use of the control terminal default with ASTER = DRV_2

The output signals are presented in section 4.3.1 “DRV_1” in Figure 4.4.

User data set switchover (switchable offline)

S1	S2	Active UDS	Example
0	0	UDS 1 for application 1	x-axis, traction drive
1	0	UDS 2 for application 2	y-axis, traction drive
0	1	UDS 3 for application 3	z-axis, lifting drive
1	1	UDS 4 for application 4	Sorting belt

Table 4.7 User data set switchover

Characteristic data set switchover (switchable online)

S4	Active characteristic data set	Example
0	Characteristic data set 1	Lifting drive with load
1	Characteristic data set 2	Lifting drive without load

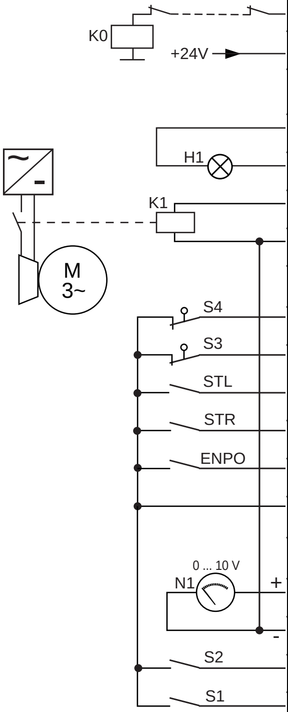
Table 4.8 Characteristic data set switchover

4.3.3 DRV_3

Quick jog/slow jog driving profile with limit switch evaluation

Preset 3 for traction and lifting drives

Function	Application
• Clock drive with time-optimized quick jog driving profile or • Quick jog/slow jog driving profile • Application switchover • Evaluation of safety limit switches	• Rack drive • Spindle drive • Trolley drive • Lifting drive • etc.



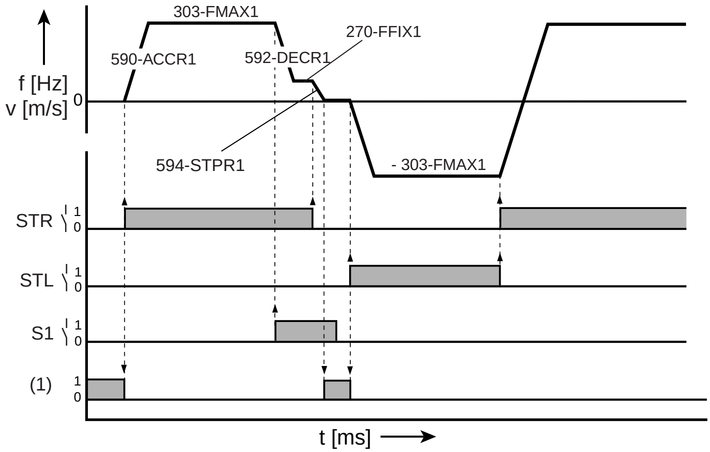
X2	Des.	Function
20	OSD02/14	Relay contact for "Ready" message (14)
19	OSD02/11	(11)
18	OSD02/12	(12)
17	DGND	Digital ground
16	OSD01	"Reference reached" message
15	OSD00	Output for motor holding brake
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Limit switch left
11	ISD02	Limit switch right
10	ISD01	Start/Stop quick jog anti-clockwise
9	ISD00	Start/Stop quick jog clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Selection of slow jog
2	ISA00	User data set switchover
1	U_R	Reference voltage 10V, 10mA

Figure 4.7 Control terminal assignment with ASTER = DRV_3

Note: After parameter setting of the user data sets the parameter value 166-UDSSL must be changed from PARAM (KEYPAD, DRIVEMANAGER) to TERM (terminal operation) and saved accordingly (see section 5.1 “_15 FC-Initial commissioning”).

The parameter presets for application data sets DRV_x are located as parameter comparison references in section 4.3.6 “Comparison of parameters, traction and lifting drive”.

Input signals



(1) DC braking torque, subject area _68HO

Figure 4.8 Example of use of the control terminal default with ASTER=DRV_3

The output signals are presented in section 4.3.1 “DRV_1” in Figure 4.4.

User data set switchover (switchable offline)

S1	Active UDS	Example
0	UDS 1 for application 1	x-axis, traction drive
1	UDS 2 for application 2	z-axis, lifting drive

Table 4.9 User data set switchover

Limit switch evaluation

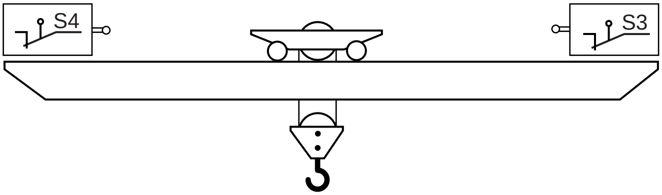


Figure 4.9 Example of a limit switch evaluation

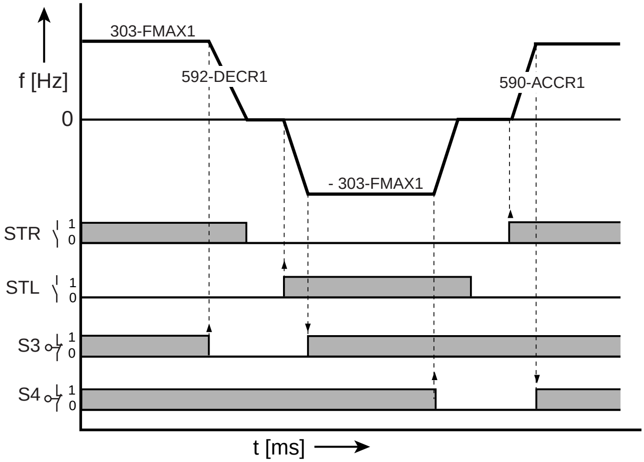


Figure 4.10 Limit switch evaluation of S4 and S3

Example: Limit switch right resets Start-Clockwise. Resetting of Start-Clockwise is not evaluated. The Start-Anti-Clockwise command can be used to move out of the limit switch zone.

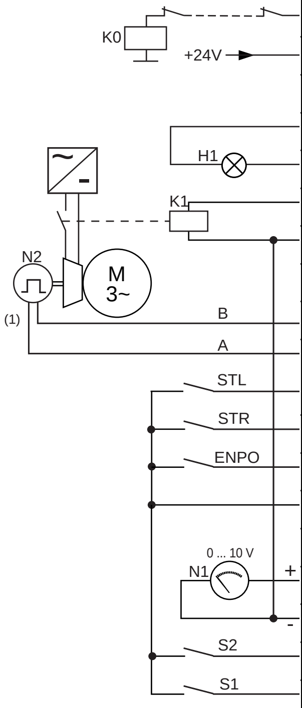
Note: Overriding the limit switches is not permitted! For this reason, a mechanical override guard must be provided. The limit switches are evaluated on the basis of evaluation of static signals and not based on signal edges, so an override is not evaluated.

4.3.4 DRV_4

Clock drive with fixed frequency and encoder evaluation

Preset 4 for traction and lifting drives

Function	Application
• Clock drive with time-optimized driving profile • Switchover for application • Encoder evaluation	• Conveyor belt • Rack drive • Spindle drive • Trolley drive • Lifting drive • etc.



X2	Des.	Function	
20	OSD02/14	14	Relay contact for “Ready” message
19	OSD02/11	11	
18	OSD02/12	12	
17	DGND	Digital ground	
16	OSD01	“Reference reached” message	
15	OSD00	Output for motor holding brake	
14	DGND	Digital ground	
13	U_V	Auxiliary voltage 24 V	
12	ISD03	Encoder track B	
11	ISD02	Encoder track A	
10	ISD01	Start/Stop anti-clockwise	
9	ISD00	Start/Stop clockwise	
8	ENPO	Power stage hardware enable	
7	U_V	Auxiliary voltage 24 V	
6	U_V	Auxiliary voltage 24 V	
5	OSA00	Actual frequency 0 ... FMAX	
4	AGND	Analog ground	
3	ISA01	User data set switchover	
2	ISA00	User data set switchover	
1	U_R	Reference voltage 10V, 10mA	

(1) The encoder is evaluated only in control mode FOR.
For notes on the encoder see Figure 4.12 or section 6.3.1 “_79 EN-Encoder evaluation”

Figure 4.11 Control terminal assignment with ASTER = 4

Note: After parameter setting of the user data sets the parameter value 166-UDSSL must be changed from PARAM (KEYPAD, DRIVEMANAGER) to TERM (terminal operation) and saved accordingly (see section 5.1 “_15 FC-Initial commissioning”).

The parameter presets for application data sets DRV_x are located as parameter comparison references in section 4.3.6 “Comparison of parameters, traction and lifting drive”.

Attention: When control mode FOR is changed to VFC in parameter 300-CFCON, it is essential that the response to reference 0 Hz in parameter 597-RF0 should be set to OFF, otherwise current will be continuously applied to the motor in uncontrolled mode while at standstill. This may result in the motor overheating.

Encoder

A HTL encoder (see Figure 4.12) can be connected to terminals X2:11 and X2:12.

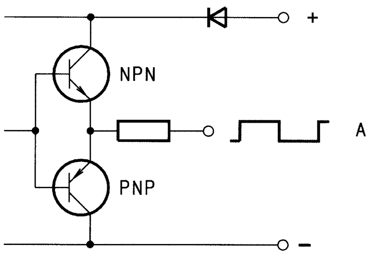


Figure 4.12 Block diagram, HTL output circuit

Input signals

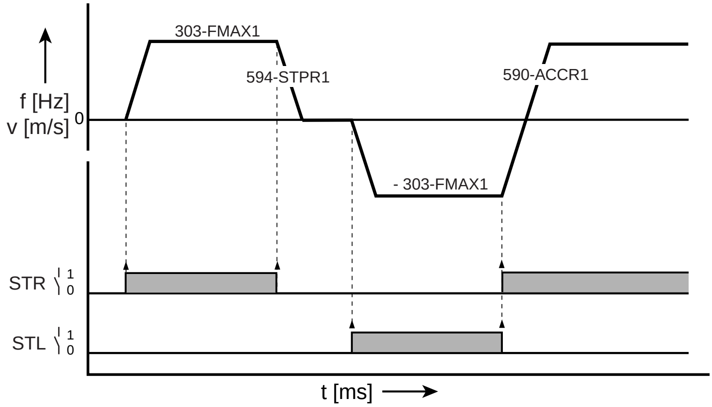


Figure 4.13 Example of a quick jog driving profile for two directions of rotation (ASTER=DRV_4)

The output signals are presented in section 4.3.1 “DRV_1” in Figure 4.4.

User data set switchover (switchable offline)

S1	S2	Active UDS	Example
0	0	UDS 1 for application 1	x-axis, traction drive
1	0	UDS 2 for application 2	y-axis, traction drive
0	1	UDS 3 for application 3	z-axis, lifting drive
1	1	UDS 4 for application 4	Sorting belt

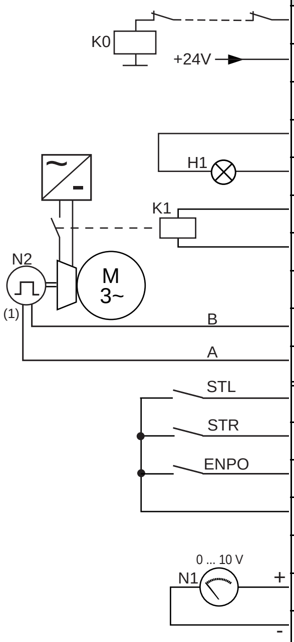
Table 4.10 User data set switchover

4.3.5 DRV_5

Clock drive with fixed frequencies, encoder and limit switch evaluation

Preset 5 for traction and lifting drives

Function	Application
• Clock drive with time-optimized driving profile • Selection of fixed frequencies • Encoder evaluation • Limit switch evaluation • Switchover of applications	• Conveyor belt • Rack drive • Trolley drive • Spindle drive • Lifting drive

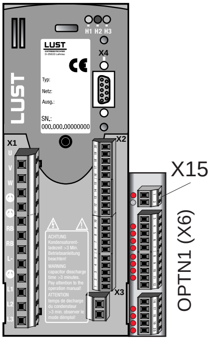


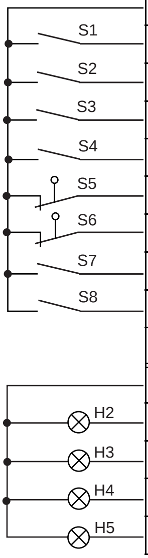
X2	Des.	Function
20	OSD02/14	14 — Relay contact for “Ready” message
19	OSD02/11	11 — Relay contact for “Ready” message
18	OSD02/12	12 — Relay contact for “Ready” message
17	DGND	Digital ground
16	OSD01	“Reference reached” message
15	OSD00	Output for motor holding brake
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Encoder track B
11	ISD02	Encoder track A
10	ISD01	Start/Stop anti-clockwise
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Not assigned
2	ISA00	Not assigned
1	U_R	Reference voltage 10V, 10mA

(1) The encoder is evaluated only in control mode FOR. For notes on the encoder see Figure 4.12 in section 4.3.4 “DRV_4” or section 6.3.1 “_79 EN-Encoder evaluation”

Figure 4.14 Control terminal assignment with ASTER = DRV_5

Control terminals of user module UM-8I4O





X1	Des.	Function
1	U_V	24 V supply +20%, 0.6 A
2	DGND	Digital ground
21	U_V	Auxiliary voltage 24 V
22	IED00	Switch to driving sets
23	IED01	Select driving sets for fixed frequencies (section 5.5.5 _60TB Driving sets)
24	IED02	
25	IED03	
26	IED04	Limit switch right
27	IED05	Limit switch left
28	IED06	User data set switchover
29	IED07	
30	DGND	Digital ground
31	DGND	Digital ground
32	OED00	Warning “Inverter module overloaded”
33	OED01	Warning “Motor overloaded”
34	OED02	Warning “80% of I_N exceeded”
35	OED03	Warning “Ambient temperature too high”

Figure 4.15 Assignment of control terminal expansion with ASTER = DRV_5

Note: If limit switch evaluation is not required, the 24 V auxiliary voltage (UV) should be jumpered from terminal X15:21 directly to terminals X15:26 and X15:27 of the limit switch inputs. As an alternative, both digital inputs can also be deactivated with function selectors 218-FIE04 and 219-FIE05 respectively, or be assigned a different function (see section 5.2.3).

Note: After parameter setting of the user data sets the parameter value 166-UDSSL must be changed from PARAM (KEYPAD, DRIVEMANAGER) to TERM (terminal operation) and saved accordingly (see section 5.1 “_15 FC-Initial commissioning”).

The parameter presets for application data sets DRV_x are located as parameter comparison references in section 4.3.6 “Comparison of parameters, traction and lifting drive”.

Input signals

v/t diagram

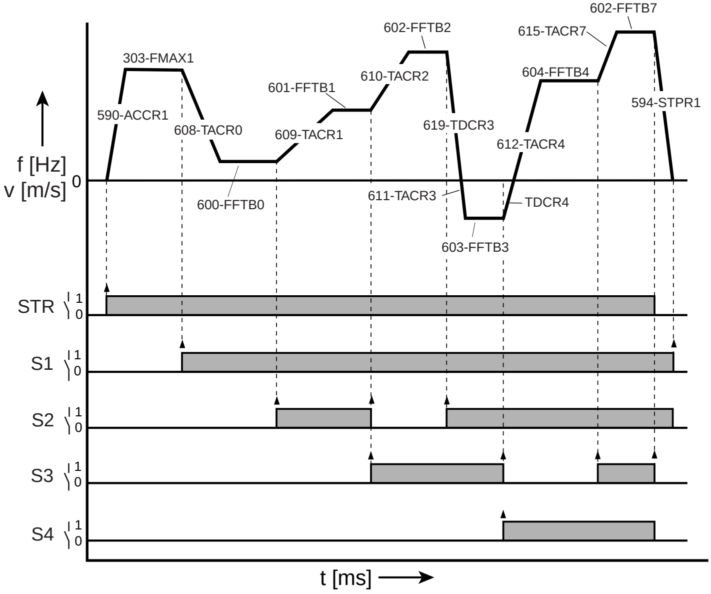


Figure 4.16 Example of use of table sets with fixed frequencies and ramps (ASTER=DRV_5)

The output signals are presented in section 4.3.1 “DRV_1” in Figure 4.4.

User data set switchover (switchable offline)

S7	S8	Active UDS	Example
0	0	UDS 1 for application 1	x-axis, traction drive
1	0	UDS 2 for application 2	y-axis, traction drive
0	1	UDS 3 for application 3	z-axis, lifting drive
1	1	UDS 4 for application 4	Sorting belt

Table 4.11 User data set switchover

4.3.6 Comparison of parameters, traction and lifting drive

Comparison of application data sets for **traction and lifting drives** with the factory setting (152-ASTER = DRV_1):

I/O	Parameter	Function	152-ASTER =				
			DRV_1 (FS)	DRV_2	DRV_3	DRV_4	DRV_5
Initial commissioning							
	151-ASTPR	Original device preset	DRV_1	DRV_2	DRV_3	DRV_4	DRV_5
	152-ASTER	Preset within the active application data set	DRV_1	DRV_2	DRV_3	DRV_4	DRV_5
	166-UDSSL	Control location for switchover of the active user data set	PARAM	1)	1)	1)	1)
	300-CFCON	Current open-loop/closed-loop control mode of the device	VFC			FOR	FOR
Driving profile generator							
	597-RF0	Response at reference value 0 Hz	OFF			0 Hz	0 Hz
CDA3000 inverter module inputs and outputs							
ISA00	180-FISA0	Function selector analog standard input ISA00	OFF	UM0	UM0	UM0	
ISA01	181-FISA1	Function selector analog standard input ISA01	OFF	UM1	SADD1	UM1	
ISD00	210-FIS00	Function selector digital standard input ISD00	STR				
ISD01	211-FIS01	Function selector digital standard input ISD01	STL				
ISD02	212-FIS02	Function selector digital standard input ISD02	SADD1		/LCW	ENC	ENC
ISD03	213-FIS03	Function selector digital standard input ISD03	OFF	CUSEL	/LCCW	ENC	ENC
OSA00	200-FOSA0	Function selector for analog output OSA00	AACTF				
OSD00	240-FOS00	Function selector digital standard output OSD00	BRK_1				
OSD01	241-FOS01	Function selector digital standard output OSD01	REF				
OSD02	242-FOS02	Function selector digital standard output OSD02	S_RDY				

1) After setting the parameters of the user data sets, change parameter value 166-UDSSL from PARAM (KEYPAD KP200, DRIVEMANAGER) to TERM (terminal operation).

Table 4.12 Automatic changes by means of the assistance parameter

I/O	Parameter	Function	152-ASTER =				
			DRV_1 (FS)	DRV_2	DRV_3	DRV_4	DRV_5
User module UM-8I40 inputs and outputs							
IED00	214-FIE00	Function selector digital input IED00	OFF				SADD1
IED01	215-FIE01	Function selector digital input IED01	OFF				FFTB0
IED02	216-FIE02	Function selector digital input IED02	OFF				FFTB1
IED03	217-FIE03	Function selector digital input IED03	OFF				FFTB2
IED04	218-FIE04	Function selector digital input IED04	OFF				/LCW
IED05	219-FIE05	Function selector digital input IED05	OFF				/LCCW
IED06	220-FIE06	Function selector digital input IED06	OFF				UM0
IED07	221-FIE07	Function selector digital input IED07	OFF				UM1
OED00	243-FOE00	Function selector digital output OED01	OFF				WIIT
OED01	244-FOE01	Function selector digital output OED01	OFF				WIT
OED02	245-FOE02	Function selector digital output OED02	OFF				WIS
OED03	246-FOE03	Function selector digital output OED03	OFF				WOTD
Reference structure							
	280-RSSL1	Reference selector 1	FMAX				
	289-SADD1	Offset for reference selector 1	10			0	9
Current-controlled acceleration							
	640-CLSL1	CDS1: Current-controlled startup function selector	CCNFS			OFF	OFF
	645-CLSL2	CDS2: Current-controlled startup function selector	CWFS			OFF	OFF
Characteristic switchover							
	651-CDSSL	Characteristic data set switchover	OFF	TERM			
1) After setting the parameters of the user data sets, change parameter value 166-UDSSL from PARAM (KEYPAD KP200, DRIVEMANAGER) to TERM (terminal operation).							

Table 4.12 Automatic changes by means of the assistance parameter

An empty line means that the setting is the same as for DRV_1 (factory setting).

Active functions with traction and lifting drive

Function	Effect	VFC	SFC	FOR
IxR load compensation	In case of load surges a higher torque is available, and the motor heats up less.	✔		
Current injection	Increase in starting torque	✔		
Current-controlled start-up with ramp stop	Protection against current overload shut-off in acceleration of large moments of inertia	✔	✔	✔ to V. 1.40
DC holding	Rotation of the motor shaft without load is counteracted.	✔		
Magnetizing	Increase in startup and standstill torque		✔	✔

Table 4.13 Active functions

More details of the software functions and setting options are presented in section 5 “Software functions” and section 6 “Control modes”.

4.4 Rotational drive

Loading one of the application data sets ROT_1 to ROT_3 into the RAM by setting parameter 152-ASTER causes the inverter module automatically to adopt the preset of the software functions as well as all inputs and outputs for the “rotational drive” application.

Active functions in the preset

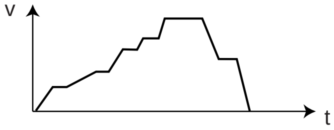
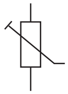
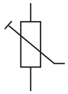
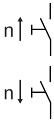
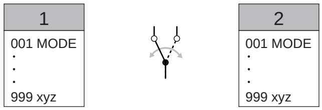
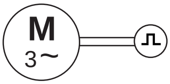
Function		152-Aster = ROT_1	152-Aster = ROT_2	152-Aster = ROT_3
	Table sets with fixed frequencies and ramps			✔
	Speed input -10 to +10 V	✔	✔	✔
	Speed correction 0 to 10 V		✔	✔
	Speed change via button (MOP function)	✔		
	User data set switchover			✔
	Encoder evaluation (necessary for control mode FOR)		✔	✔

Table 4.14 Presets: Rotational drives

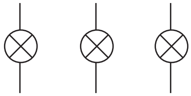
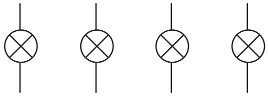
Function	152-Aster =		
	ROT_1	ROT_2	ROT_3
 Messages: • Reference rea-ched • Standstill • Ready to start	✔	✔	✔
 Warnings: • Inverter module overloaded • 80% of IN rea-ched • Motor overloaded • Inverter ambient temperature too high			✔

Table 4.14 Presets: Rotational drives

Aster	Summary description	Page reference
ROT_1	“Analog speed input”	Page 4-28
ROT_2	“Analog speed input with correction value and encoder evaluation”	Page 4-30
ROT_3	“Analog speed input with switchover to driving sets”	Page 4-32

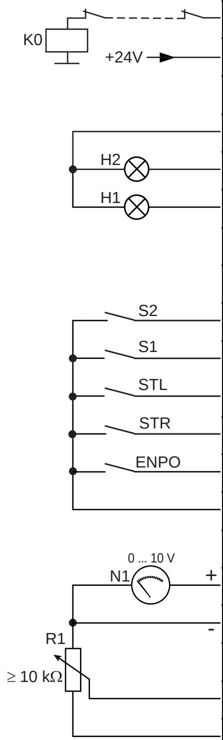
Table 4.15 Page reference to summary description of ROT_x

4.4.1 ROT_1

Analog speed input

Preset 1 for rotational drive

Function	Application
• Analog speed input for two directions of rotation • Adjustment of speed via button (MOP function)	• Spindle • Winding drive • Vacuum pumps • Extruder • Stirrer • etc.



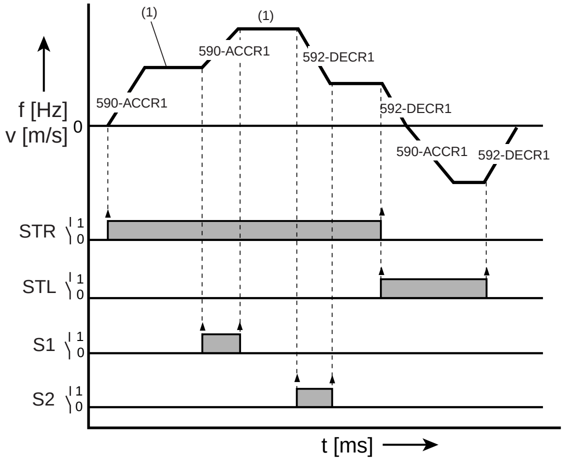
X2	Des.	Function
20	OSD02/14	Relay contact for “Ready” message
19	OSD02/11	
18	OSD02/12	
17	DGND	Digital ground
16	OSD01	“Standstill” message
15	OSD00	“Reference reached” message
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Reduce speed
11	ISD02	Increase speed
10	ISD01	Start/Stop anti-clockwise
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Not assigned
2	ISA00	Reference -10 V ... + 10 V
1	U_R	Reference voltage 10V, 10mA

Figure 4.17 Control terminal assignment with ASTER = ROT_1

The parameter presets for application data sets ROT_x are located as parameter comparison references in section 4.4.5 “Comparison of parameters, rotational drives”.

Input signals

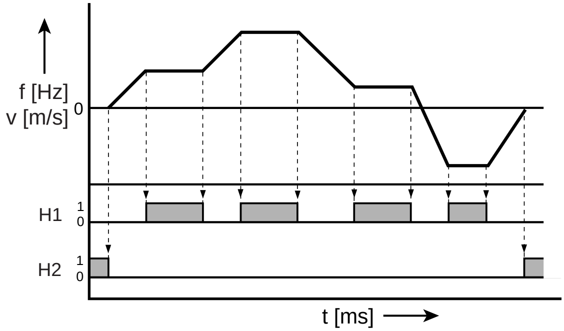
v/t diagram



(1) Reference value of ISA00

Figure 4.18 Example of a driving profile for two directions of rotation (ASTER=ROT_1)

Output signals



H2 Speed reached
H1 Standstill

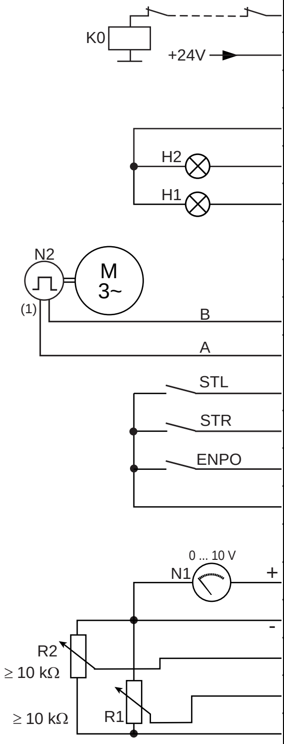
Figure 4.19 Output signals dependent on driving profile (ASTER=ROT_1, ROT_2 and ROT_3)

4.4.2 ROT_2

Analog speed input with correction value and encoder evaluation

Preset 2 for rotational drives

Function	Application
• Analog speed input for two directions of rotation • Adjustment of speed via correction value • Encoder evaluation	• Spindle • Winding drive • Extruder • etc.



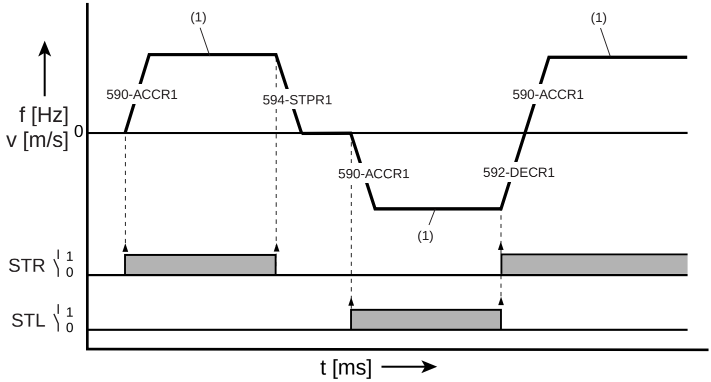
X2	Des.	Function
20	OSD02/14	Relay contact for “Ready” message (14, 11, 12)
19	OSD02/11	
18	OSD02/12	
17	DGND	Digital ground
16	OSD01	“Standstill” message
15	OSD00	“Reference reached” message
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Encoder track B
11	ISD02	Encoder track A
10	ISD01	Start/Stop anti-clockwise
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Correction value 0 V ... + 10 V
2	ISA00	Reference -10 V ... + 10 V
1	U_R	Reference voltage 10V, 10mA

(1) The encoder is evaluated only in control mode FOR. For notes on the encoder see section 6.3.1 “_79 EN-Encoder evaluation”.

Figure 4.20 Control terminal device with ASTER=ROT_2

The parameter presets for application data sets ROT_x are located as parameter comparison references in section 4.4.5 “ Comparison of parameters, rotational drives”.

Input signals



(1) Reference value of ISA00

Figure 4.21 Example of a driving profile for two directions of rotation (ASTER=ROT_2)

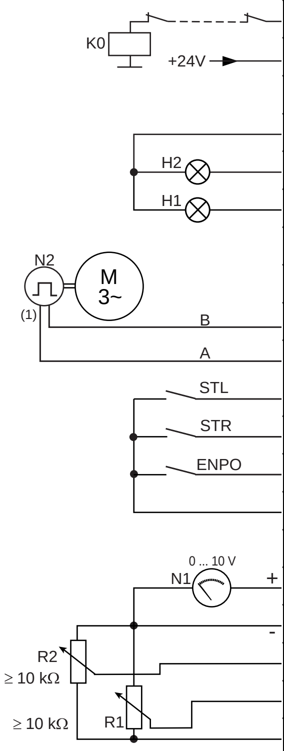
The output signals are presented in section 4.4.1 “ROT_1” in Figure 4.19.

4.4.3 ROT_3

Analog speed input with switchover to driving sets

Preset 3 for rotational drives

Function	Application
• Analog speed input for two directions of rotation • Adjustment of speed via correction value • Selection of fixed frequencies • Switchover of applications • Encoder evaluation	• Spindle • Winding drive • etc.



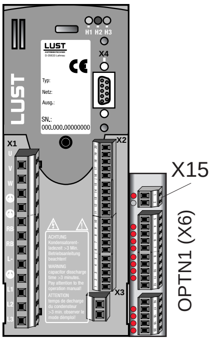
X2	Des.	Function
20	OSD02/14	14 / 11 / 12 — Relay contact for “Ready” message
19	OSD02/11	
18	OSD02/12	
17	DGND	Digital ground
16	OSD01	“Standstill” message
15	OSD00	“Reference reached” message
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Encoder track B
11	ISD02	Encoder track A
10	ISD01	Start/Stop anti-clockwise
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Correction value 0 V ... + 10 V
2	ISA00	Reference -10 V ... + 10 V
1	U_R	Reference voltage 10V, 10mA

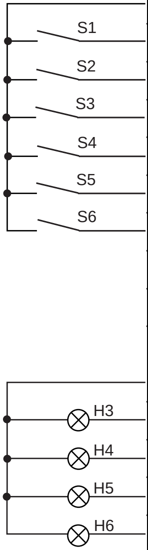
(1) The encoder is evaluated only in control mode FOR. For notes on the encoder see Figure 4.12 or section 6.3.1 “_79 EN-Encoder evaluation”

Figure 4.22 Control terminal assignment with ASTER = ROT_3

The parameter presets for application data sets ROT_x are located as parameter comparison references in section 4.4.5 “Comparison of parameters, rotational drives”.

Control terminals of user module UM-8I4O





X1	Des.	Function
1	U_V	24 V supply +20%, 0.6 A
2	DGND	Digital ground
21	U_V	Auxiliary voltage 24 V
22	IED00	Switch to driving sets
23	IED01	Select fixed frequencies (section 5.5.5 _60TB Driving sets)
24	IED02	
25	IED03	
26	IED04	User data set switchover
27	IED05	
28	IED06	Not assigned
29	IED07	
30	DGND	Digital ground
31	DGND	Digital ground
32	OED00	Warning “Inverter module overloaded”
33	OED01	Warning “Motor overloaded”
34	OED02	Warning “80% of I_N exceeded”
35	OED03	Warning “Ambient temperature too high”

Figure 4.23 Assignment of control terminal expansion with ASTER = ROT_3

Input signals

v/t diagram

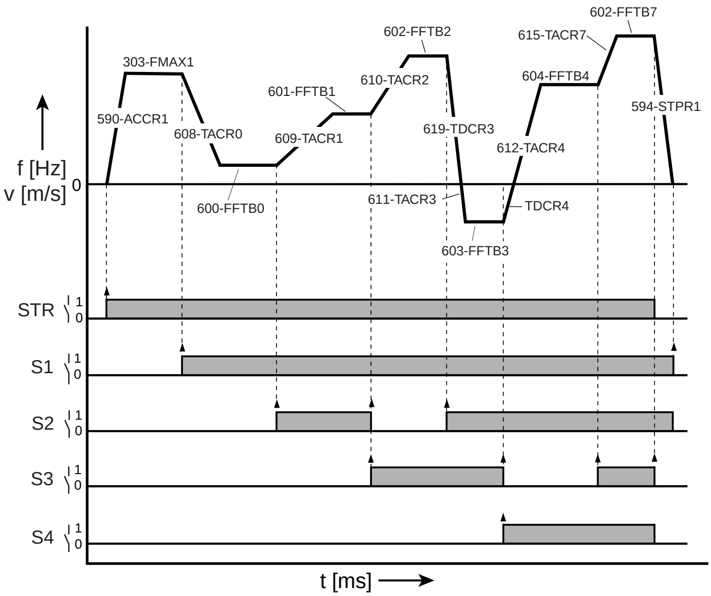


Figure 4.24 Example of use of table sets with ramps (ASTER = ROT_3)

The output signals are presented in section 4.4.1 “ROT_1” in Figure 4.19.

User data set switchover (switchable offline)

S5	S6	Active UDS	Example
0	0	UDS 1 for application 1	Spindle 1
1	0	UDS 2 for application 2	Spindle 2
0	1	UDS 3 for application 3	Spindle 3
1	1	UDS 4 for application 4	Sorting belt

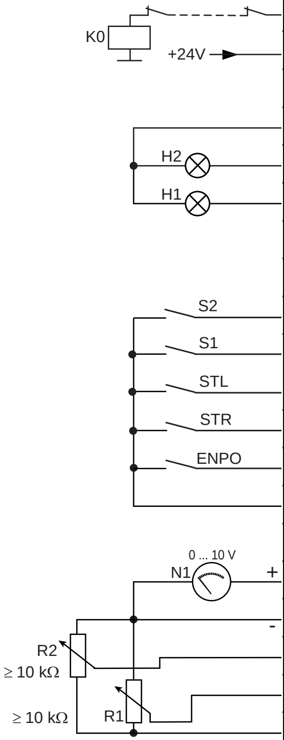
Table 4.16 User data set switchover

4.4.4 ROT_4

Analog speed input with switchover to driving sets

Preset 4 for rotational drives

Function	Application
• Analog speed input for two directions of rotation • Adjustment of speed via correction value • Selection of fixed frequencies	• Spindle • Winding drive • etc.



X2	Des.	Function
20	OSD02/14	14 / 11 / 12 — Relay contact for “Ready” message
19	OSD02/11	
18	OSD02/12	
17	DGND	Digital ground
16	OSD01	“Standstill” message
15	OSD00	“Reference reached” message
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Fixed frequency 2
11	ISD02	Fixed frequency 1
10	ISD01	Start/Stop anti-clockwise
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Correction value 0 V ... + 10 V
2	ISA00	Reference -10 V ... + 10 V
1	U_R	Reference voltage 10V, 10mA

Figure 4.25 Control terminal assignment with ASTER = ROT_4

Input signals

v/t diagram

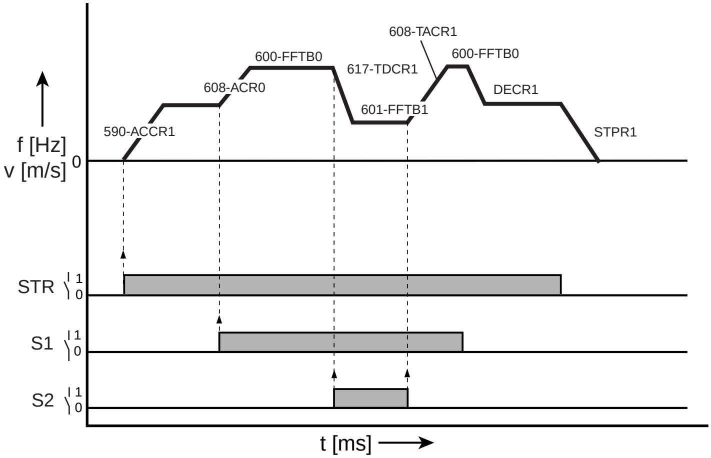


Figure 4.26 Example of use of (ASTER = ROT_4)

The output signals are presented in section 4.4.1 “ROT_1” in Figure 4.19.

User data set switchover (switchable offline)

S1	S2	Active reference source
0	0	Analog inputs ISA00 and ISA01
1	0	Table set 0 (608-TACR0, 600_FFTB0, 616-TDCR0)
1	1	Table set 1 (609-TACR1, 601-FFTB1, 617-TDCR1)

Table 4.17 Fixed frequency selection

4.4.5 Comparison of parameters, rotational drives

Comparison of the application data sets for **rotational drives** with the factory setting (152-ASTER = DRV_1):

I/O	Parameter	Function	152-ASTER =				
			DRV_1 (FS)	ROT_1	ROT_2	ROT_3	ROT_4
Initial commissioning							
	151-ASTPR	Original device preset	DRV_1	ROT_1	ROT_2	ROT_3	ROT_4
	152-ASTER	Preset within the active application data set	DRV_1	ROT_1	ROT_2	ROT_3	ROT_4
	166-UDSSL	Control location for switchover of the active user data set	PARAM			1)	
	300-CFCON	Current open-loop/closed-loop control mode of the device	VFC			FOR	
Driving profile generator							
	597-RF0	Response at reference value 0 Hz	OFF			0 Hz	
CDA3000 inverter module inputs and outputs							
ISA00	180-FISA0	Function selector analog standard input ISA00	OFF	PM10 V	PM10 V	PM10 V	PM10 V
ISA01	181-FISA1	Function selector analog standard input ISA01	OFF		0-10V	0-10 V	0-10 V
ISD00	210-FIS00	Function selector digital standard input ISD00	STR				
ISD01	211-FIS01	Function selector digital standard input ISD01	STL				
ISD02	212-FIS02	Function selector digital standard input ISD02	SADD1	MP-UP	ENC	ENC	
ISD03	213-FIS03	Function selector digital standard input ISD03	OFF	MP-DN	ENC	ENC	FFTB0
OSA00	200-FOSA0	Function selector for analog output OSA00	AACTF				
OSD00	240-FOS00	Function selector digital standard output OSD00	BRK_1	REF	REF	REF	REF
OSD01	241-FOS01	Function selector digital standard output OSD01	REF	ROT_0	ROT_0	ROT_0	ROT_0
OSD02	242-FOS02	Function selector digital standard output OSD02	S_RDY				
User module UM-8I40 inputs and outputs							
IED00	214-FIE00	Function selector digital input IED00	OFF			SADD1	
IED01	215-FIE01	Function selector digital input IED01	OFF			FFTB0	
IED02	216-FIE02	Function selector digital input IED02	OFF			FFTB1	
IED03	217-FIE03	Function selector digital input IED03	OFF			FFTB2	
IED04	218-FIE04	Function selector digital input IED04	OFF			UM0	
IED05	219-FIE05	Function selector digital input IED05	OFF			UM1	
OED01	243-FOE00	Function selector digital output OED01	OFF			WIIT	

1) After setting the parameters of the user data sets, change parameter value 166-UDSSL from PARAM (KEYPAD KP200, DRIVEMANAGER) to TERM (terminal operation).

Table 4.18 Automatic changes by means of the assistance parameter

I/O	Parameter	Function	152-ASTER =				
			DRV_1 (FS)	ROT_1	ROT_2	ROT_3	ROT_4
OED01	244-FOE01	Function selector digital output OED01	OFF			WIT	
OED02	245-FOE02	Function selector digital output OED02	OFF			WIS	
OED03	246-FOE03	Function selector digital output OED03	OFF			WOTD	
Reference structure							
	280-RSSL1	Reference selector 1	FMAX	FA0	FA0	FA0	FA0
	281-RSSL2	Reference selector 2	FCON		FA1	FA1	FA1
	289-SADD1	Offset for reference selector 1	10	0	0	7	7
MOP function							
	320-MPSEL	Configuration for motor operated potentiometer	OFF	F1			
Current-controlled startup							
	640-CLSL1	DS1: Function selector	CCWFS	CCWFR	OFF	OFF	CCWFR
	645-CLSL2	DS2: Function selector	CCWFS	CCWFR	OFF	OFF	CCWFR
DC holding							
	681-HODCT	Holding time	0.5	0	0	0	0

1) After setting the parameters of the user data sets, change parameter value 166-UDSSL from PARAM (KeyPad KP200, DriveManager) to TERM (terminal operation).

Table 4.18 Automatic changes by means of the assistance parameter

An empty line means that the setting is the same as for DRV_1 (factory setting).

Active functions with rotational drives

Function	Effect	VFC	SFC	FOR
IxR load compensation	In case of load surges a higher torque is available, and the motor heats up less	✔		
Current injection	Increase in starting torque	✔		
Current-controlled star-tup with ramp reversal	Protection against current overload shut-off in acceleration of large load torques Protection against drive stalling Acceleration and deceleration proces-ses with maximum dynamics along the current limit	✔	✔	✔ to V. 1.40
Magnetizing	Increase in startup and standstill tor-que		✔	✔

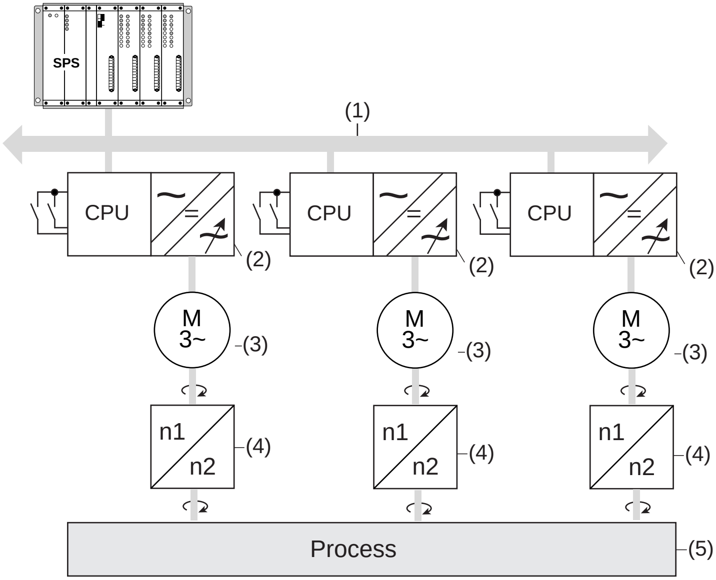
Table 4.19 Active functions

More details of the software functions and setting options are presented in section 5 “Software functions” and section 6 “Control modes”.

4.5 Field bus operation

By setting parameter 152-ASTER one of the application data sets BUS_1 to BUS_3 is loaded into the RAM (see Figure 4.1 in section 4.1 “Activating an application data set”). As a result the software functions and the inputs and outputs for the “field bus operation” application are preset.

The precondition for field bus operation is that an appropriate communication module is mounted on the CDA3000.



(1) Field bus
(2) Inverter module
(3) IEC standard motor
(4) Gearing
(5) Application

Figure 4.27 Drive solution: “Field bus operation”

Active functions in the preset

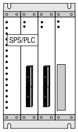
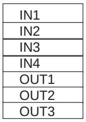
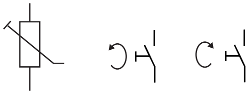
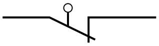
Function	ASTER	BUS_1	BUS_2	BUS_3
	Reference and control via PLC	✔	✔	✔
	Digital inputs and outputs readable and writable over the bus	✔		
	Manual mode independent of bus		✔	✔
	Limit switch evaluation			✔

Table 4.20 Presets: Field bus operation

Aster	Summary description	Page reference
BUS_1	“Control via field bus (complete)”	Page 4-42
BUS_2	“Additional emergency operation”	Page 4-43
BUS_3	“Additional emergency operation with limit switch evaluation”	Page 4-45

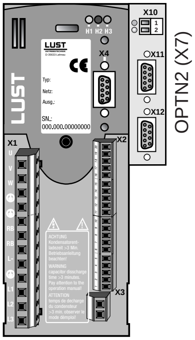
Table 4.21 Page reference to summary description of BUS_x

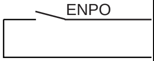
4.5.1 BUS_1

Control via field bus (complete)

Preset 1 for field bus operation

Function	Application
• Control of the inverter module over the field bus • All digital inputs and outputs can be set and read over the bus.	• Traction and lifting drive • Rotational drive





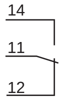
X2	Des.	Function	
20	OSD02/14		Relay contact for “Ready” message
19	OSD02/11		
18	OSD02/12		
17	DGND	Digital ground	
16	OSD01	Digital output 2:	
15	OSD00	Digital output 1:	
14	DGND	Digital ground	
13	U_V	Auxiliary voltage 24 V	
12	ISD03	Digital input 4	
11	ISD02	Digital input 3	
10	ISD01	Digital input 2	
9	ISD00	Digital input 1	
8	ENPO	Power stage hardware enable	
7	U_V	Auxiliary voltage 24 V	
6	U_V		
5	OSA00	Analog output	
4	AGND	Analog ground 0 ... 10 V corresponding to 0 ... FMAX	
3	ISA01	Analog output 2	
2	ISA00	Analog output 1	
1	U_R	Reference voltage 10V, 10mA	

Figure 4.28 Control terminal configuration with ASTER = BUS_1

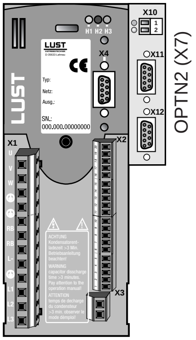
The parameter presets for application data sets BUS_x are located as parameter comparison references in section 4.5.4 “Comparison of parameters, field bus operation”.

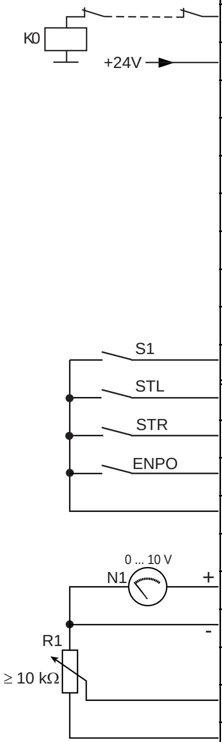
4.5.2 BUS_2

Additional emergency operation

Preset 2 for field bus operation

Function	Application
• Control of the inverter module over the field bus • Control of the device in emergency also independently of field bus • Manual/automatic switchover • Setting and reading of digital inputs and outputs over the bus	• Traction and lifting drive • Rotational drive



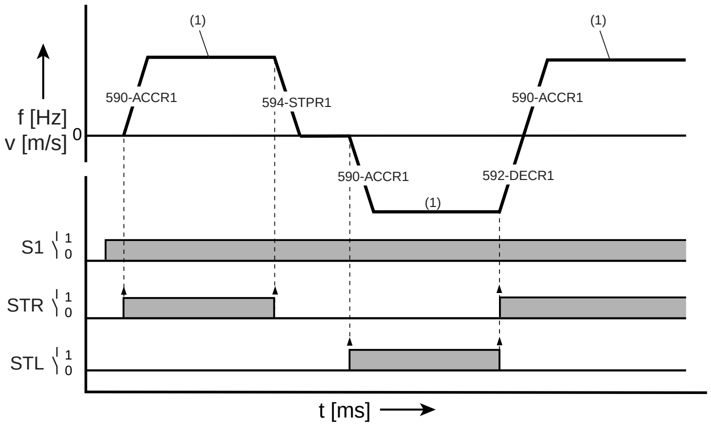


X2	Des.	Function
20	OSD02/14	14 / 11 / 12 — Relay contact for "Ready" message
19	OSD02/11	
18	OSD02/12	
17	DGND	Digital ground
16	OSD01	Digital output 2:
15	OSD00	Digital output 1:
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Digital input 4
11	ISD02	Selection of manual mode
10	ISD01	Start/Stop anti-clockwise for manual mode
9	ISD00	Start/Stop clockwise for manual mode
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Not assigned
2	ISA00	Reference for manual mode 0...10 V
1	U_R	Reference voltage 10V, 10mA

Figure 4.29 Control terminal configuration with ASTER=BUS_2

The parameter presets for application data sets BUS_x are located as parameter comparison references in section 4.5.4 “Comparison of parameters, field bus operation”.

Input signals



(1) Analog reference value of ISA00

Figure 4.30 Example of use of manual mode independently of bus operation, ASTER = BUS_2

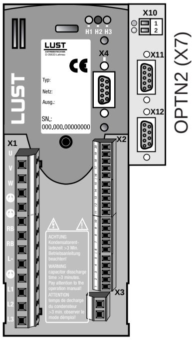
Note: While the “MAN” function is active, the “settings must not be saved in the device”, as the reference structure is changed in the background and the “MAN” function would be activated after the next power-on.

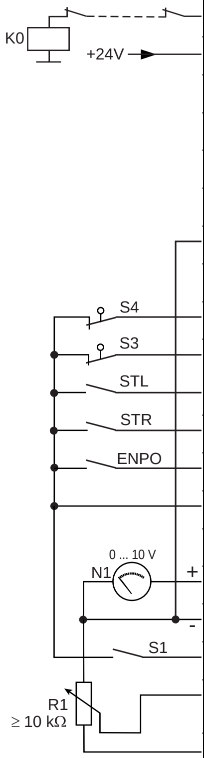
4.5.3 BUS_3

Additional emergency operation with limit switch evaluation

Preset 3 for field bus operation

Function	Application
• Control of the inverter module over the field bus • Control of the device in emergency also independently of bus • Manual/automatic switchover • Evaluation of safety limit switches	• Traction and lifting drive

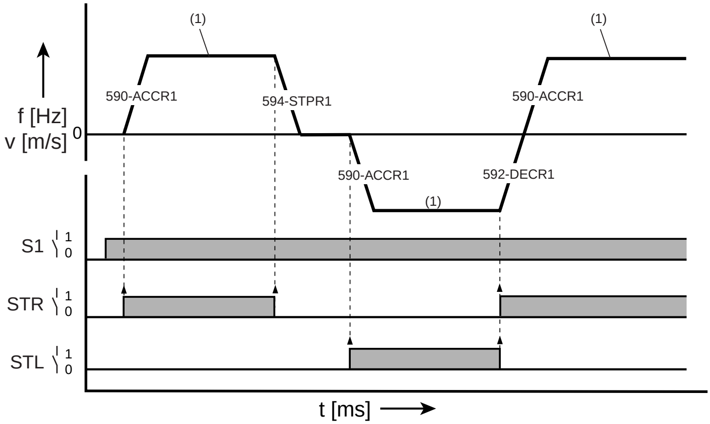




X2	Des.	Function
20	OSD02/14	14 — Relay contact for “Ready” message
19	OSD02/11	11
18	OSD02/12	12
17	DGND	Digital ground
16	OSD01	Digital output 2:
15	OSD00	Digital output 1:
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Limit switch left
11	ISD02	Limit switch right
10	ISD01	Start/Stop anti-clockwise
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Selection of manual mode
2	ISA00	Reference for manual mode 0...10 V
1	U_R	Reference voltage 10V, 10mA

Figure 4.31 Control terminal configuration with ASTER = BUS_3

The parameter presets for application data sets BUS_x are located as parameter comparison references in section 4.5.4 “Comparison of parameters, field bus operation”.



(1) Analog reference value of ISA00

Figure 4.32 Example of use of emergency operation independently of bus operation ASTER = BUS_3

The mode of functioning of the limit switch evaluation is shown in Figure 4.9 and Figure 4.10 in section 4.3.3 “DRV_3”.

4.5.4 Comparison of parameters, field bus operation

Comparison of the application data sets for **field bus operation** with the factory setting (152-ASTER = DRV_1):

I/O	Parameter	Function	152-ASTER = DRV_1 (FS)	BUS_1	BUS_2	BUS_3
Initial commissioning						
	151-ASTPR	Original device preset	DRV_1	BUS_1	BUS_2	BUS_3
	152-ASTER	Preset within the active application data set	DRV_1	BUS_1	BUS_2	BUS_3
	166-UDSSL	Control location for switchover of the active user data set	PARAM	1)	1)	1)
CDA3000 inverter module inputs and outputs						
ISA00	180-FISA0	Function selector analog standard input ISA00	OFF	OPTN2	PM10V	PM10V
ISA01	181-FISA1	Function selector analog standard input ISA01	OFF	OPTN2		MAN
ISD00	210-FIS00	Function selector digital standard input ISD00	STR	OPTN2		
ISD01	211-FIS01	Function selector digital standard input ISD01	STL	OPTN2		
ISD02	212-FIS02	Function selector digital standard input ISD02	SADD1	OPTN2	MAN	/LCW
ISD03	213-FIS03	Function selector digital standard input ISD03	OFF	OPTN2	OPTN2	/LCCW
OSA00	200-FOSA0	Function selector for analog output OSA00	AACTF	OFF		
OSD00	240-FOS00	Function selector digital standard output OSD00	BRK_1	OPTN2	OPTN2	OPTN2
OSD01	241-FOS01	Function selector digital standard output OSD01	REF	OPTN2	OPTN2	OPTN2
OSD02	242-FOS02	Function selector digital standard output OSD02	S_RDY	OPTN2		
Reference structure						
	280-RSSL1	Reference selector 1	FMAX	FOPT2	FOPT2	FOPT2
	281-RSSL2	Reference selector 2	FCON			
	289-SADD1	Offset for reference selector 1	10	0	0	0
Control location						
	260-CLSEL	Control location selector	TERM	OPTN2	OPTN2	OPTN2

1) After setting the parameters of the user data sets, change parameter value 166-UDSSL from PARAM (KeyPad KP200, DriveManager) to TERM (terminal operation).

Table 4.22 Automatic changes by means of the assistance parameter

An empty line means that the setting is the same as for DRV_1 (factory setting).

Active functions in field bus operation

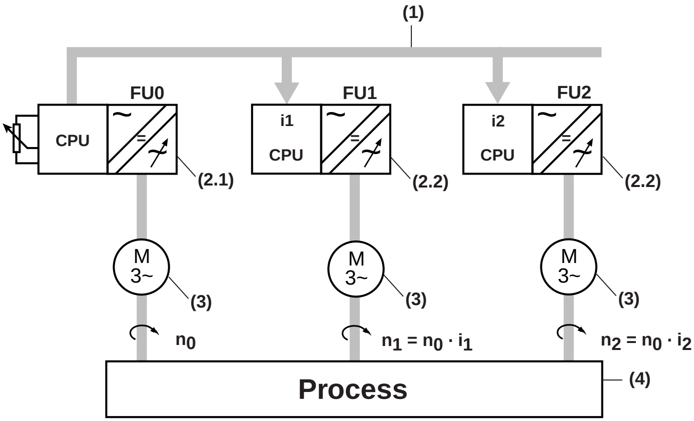
Function	Effect	VFC	SFC	FOR
IxR load compensation	In case of load surges a higher torque is available, and the motor heats up less	✔		
Current injection	Increase in starting torque	✔		
Current-controlled startup with ramp stop	Protection against current overload shut-off in acceleration from high load torques	✔	✔	✔
DC holding	Rotation of the motor shaft without load is counteracted	✔		
Magnetizing	Increase in coasting and standstill torque		✔	✔

Table 4.23 Active functions

More details of the software functions and setting options are presented in section 5 “Software functions” and section 6 “Control modes”.

4.6 Master/-Slave operation

Application data sets M-S_1 to M-S_4 contain settings for Master/-Slave operation between inverter modules. In this way the speeds of a maximum of six drives are permanently coupled together.



(1) Reference coupling
(2) Inverter module
(2.1) Master
(2.2) Slave
(3) IEC standard motor
(4) Application

Figure 4.33 Drive solution: “Master/-Slave operation”

In Master/-Slave operation the reference values of the inverter modules are permanently coupled together. This reference coupling can be effected with up to six units, with one unit being the master. The reference value of the master is also the guide value for the devices connected to the master (slaves). The master transmits the reference value to the slaves by way of a data telegram. In each slave the guide value received from the master can be scaled, meaning that any desired transmission ratios can be set. In this way it is possible to replace mechanical speed couplings.

Note: Coupling of the electrical axles in control modes VFC and SFC causes the motors to run at a fixed ratio. Only in the FOR control mode do the motors run speed-synchronous.

Characteristics of the control methods in comparison

Characteristics	VFC Voltage Frequency Control	SFC Sensorless Flux Control	FOR Field-Oriented Regulation
Speed manipulating range $M=M_{Nom}$	1 : 20	1 : 50	> 1 : 10000
Static speed accuracy referred to the rated speed	typically 1 to 5%	typically 0.5%	quartz-accurate
Frequency resolution	0.01 Hz	0.0625 Hz	2^{-16}

Table 4.24 Comparison of motor control methods

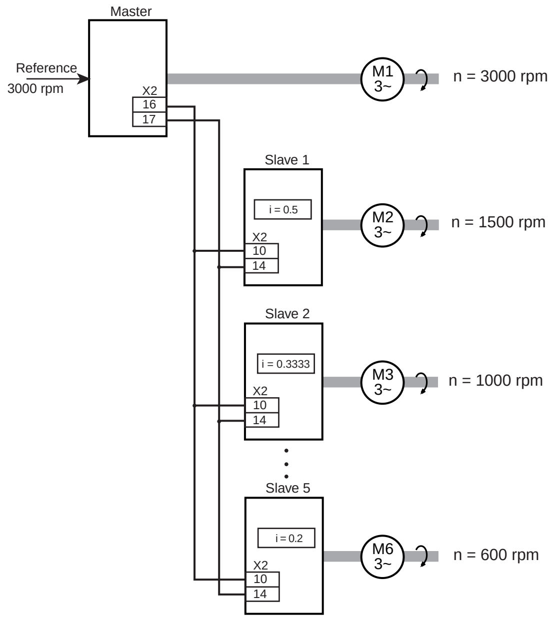


Figure 4.34 Master/-Slave coupling via two control cables

Note: In primary frequency coupling a dead time of max. 2 ms is created between the axles.

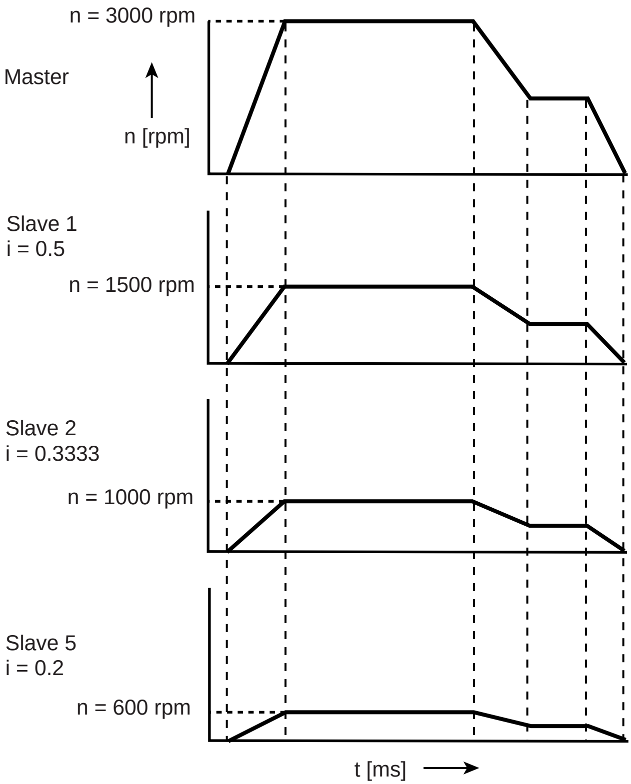


Figure 4.35 Speed curve in Master/-Slave operation

Active functions in the preset

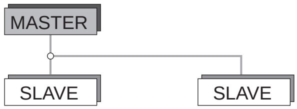
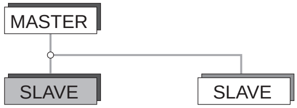
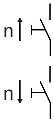
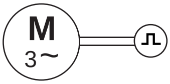
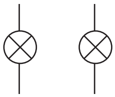
Function		152-ASTER =			
		M-S1[1]	M-S2[2]	M-S3[3]	M-S4[4]
	Inverter module is master	✔	✔		
	Inverter module is slave			✔	✔
	Speed change via button (MOP function)	✔		✔	
	Encoder evaluation		✔		✔
	Messages: • Standstill • Ready to start	✔	✔	✔	✔

Table 4.25 Presets: Master/-Slave operation

Aster	Summary description	Page reference
M-S_1	"Master drive with analog guide value input"	Page 4-53
M-S_2	"Master drive with encoder evaluation"	Page 4-55
M-S_3	"Slave drive"	Page 4-57
M-S_4	"Slave drive with encoder evaluation"	Page 4-59

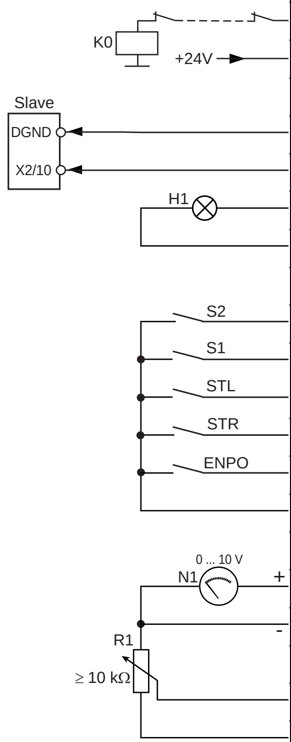
Table 4.26 Page reference to summary description of M-S_x

4.6.1 M-S_1

Master drive with analog guide value input

Preset 1 for Master/-Slave operation

Function	Application
• Speed synchronism of several drives with programmable transmission ratio • Inverter module is master • Digital guide value input • Adjustment of guide value via button (MOP function)	• Replacement of mechanical gears and line shafts (not angle-synchronous) • Winding drive • Drafting equipment • Trolley drive



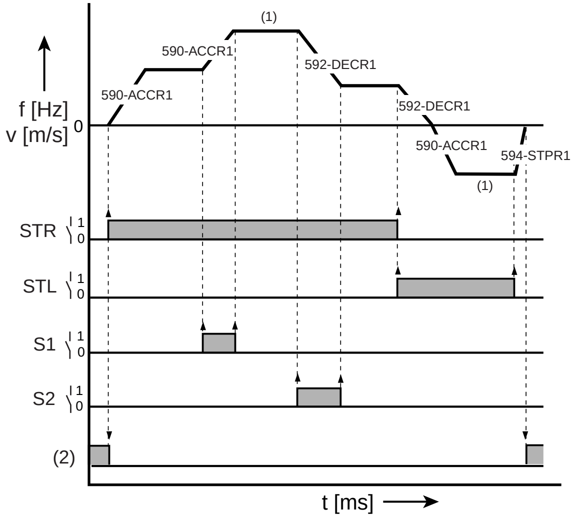
X2	Des.	Function
20	OSD02/14	14 / 11 / 12 — Relay contact for "Ready" message
19	OSD02/11	
18	OSD02/12	
17	DGND	Digital ground
16	OSD01	Slave interface
15	OSD00	"Standstill" message
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Reduce speed
11	ISD02	Increase speed
10	ISD01	Start/Stop anti-clockwise
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Not assigned
2	ISA00	Reference -10 V ... + 10 V
1	U_R	Reference voltage 10V, 10mA

Figure 4.36 Control terminal assignment with ASTER = M-S_1

The parameter presets for application data sets M-S_x are located as parameter comparison references in section 4.6.5 "Comparison of parameters, Master/-Slave operation".

Input signals

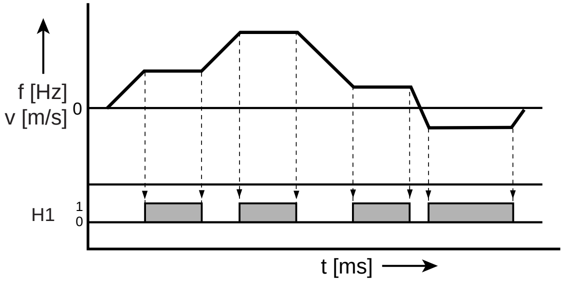
v/t diagram



(1) Analog reference value of ISA00
(2) DC braking torque

Figure 4.37 Example of a driving profile for two directions of rotation (ASTER=ROT_2)

Output signals



H1 Standstill

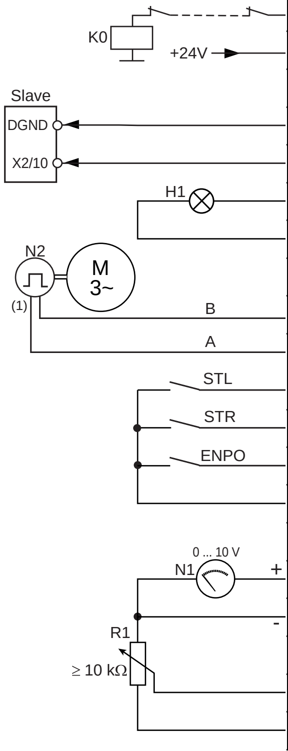
Figure 4.38 Output signals dependent on driving profile (ASTER=M-S_1 and M-S_2)

4.6.2 M-S_2

Master drive with encoder evaluation

Preset 2 for Master/-Slave operation

Function	Application
• Speed synchronism of several drives with programmable transmission ratio	• Replacement of mechanical gears and line shafts (not angle-synchronous)
• Inverter module is master	• Winding drive
• Digital guide value input	• Drafting equipment
• Encoder evaluation	• Trolley drive



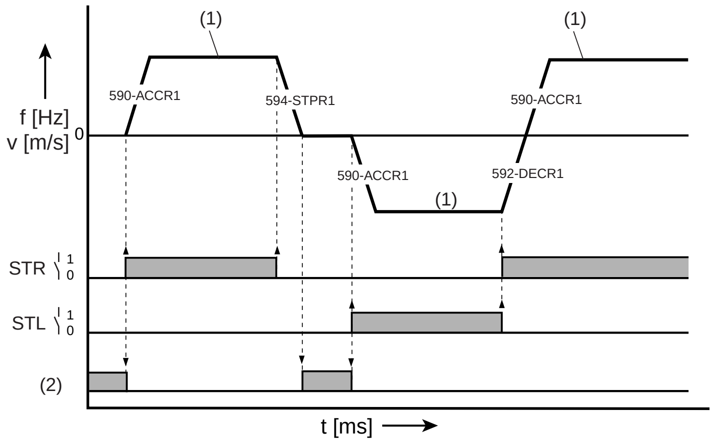
X2	Des.	Function
20	OSD02/14	14 – Relay contact for “Ready” message
19	OSD02/11	11
18	OSD02/12	12
17	DGND	Digital ground
16	OSD01	Slave interface
15	OSD00	“Standstill” message
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Encoder track B
11	ISD02	Encoder track A
10	ISD01	Start/Stop anti-clockwise
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Not assigned
2	ISA00	Reference -10 V ... + 10 V
1	U_R	Reference voltage 10V, 10mA

(1) The encoder is evaluated only in control mode FOR.
For notes on the encoder see section 6.3.1 “_79 EN-Encoder evaluation”.

Figure 4.39 Control terminal assignment with ASTER = M-S_2

The parameter presets for application data sets M-S_x are located as parameter comparison references in section 4.6.5 “Comparison of parameters, Master/-Slave operation”.

Input signals



(1) Analog reference value of ISA00
(2) DC braking torque

Figure 4.40 Example of a driving profile for two directions of rotation (ASTER=M-S_2)

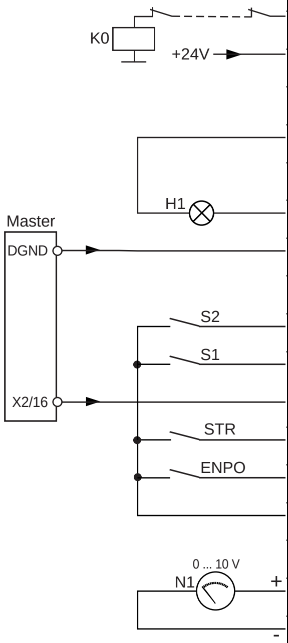
The characteristic of the output signals is shown in section 4.6.1 “M-S_1” in Figure 4.38.

4.6.3 M-S_3

Slave drive

Preset 3 for Master/-Slave operation

Function	Application
• Speed synchronism of several drives with programmable transmission ratio • Inverter module is slave • Adjustment of guide value via button (MOP function)	• Replacement of mechanical gears and line shafts (not angle-synchronous) • Winding drive • Drafting equipment • Trolley drive

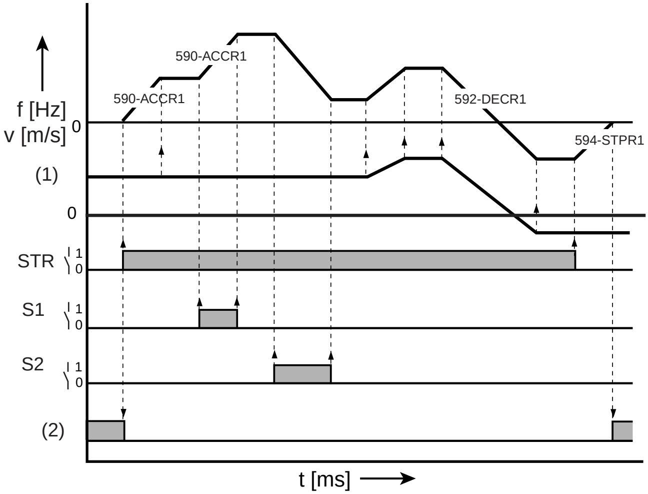


X2	Des.	Function	
20	OSD02/14	14	Relay contact for “Ready” message
19	OSD02/11	11	
18	OSD02/12	12	
17	DGND	Digital ground	
16	OSD01	Disabled in M/S operation	
15	OSD00	“Standstill” message	
14	DGND	Digital ground	
13	U_V	Auxiliary voltage 24 V	
12	ISD03	Reduce speed	
11	ISD02	Increase speed	
10	ISD01	Master interface	
9	ISD00	Start/Stop clockwise	
8	ENPO	Power stage hardware enable	
7	U_V	Auxiliary voltage 24 V	
6	U_V	Auxiliary voltage 24 V	
5	OSA00	Actual frequency 0 ... FMAX	
4	AGND	Analog ground	
3	ISA01	Not assigned	
2	ISA00	Not assigned	
1	U_R	Reference voltage 10V, 10mA	

Figure 4.41 Control terminal assignment with ASTER = M-S_3; with S1 and S2 an offset can be added to or subtracted from the guide value

The parameter presets for application data sets M-S_x are located as parameter comparison references in section 4.6.5 “Comparison of parameters, Master/-Slave operation”.

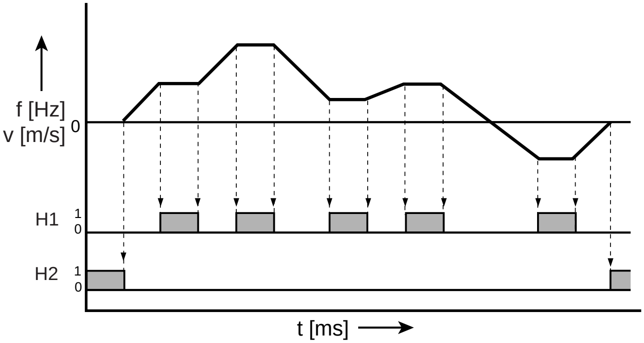
Input signals



(1) Guide value from master
(2) DC braking torque

Figure 4.42 Example of a driving profile with Master/-Slave coupling (ASTER = M-S_3)

Output signals



H1 Reference reached
H2 Standstill

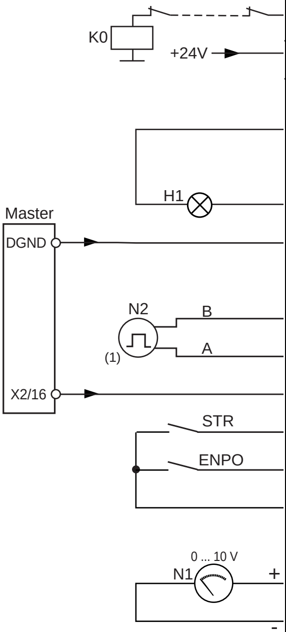
Figure 4.43 Output signals dependent on driving profile (ASTER = M-S_3 and M-S_4)

4.6.4 M-S_4

Slave drive with encoder evaluation

Preset 4 for Master/-Slave operation

Function	Application
• Speed synchronism of several drives with programmable transmission ratio • Inverter module is slave • Encoder evaluation	• Replacement of mechanical gears and line shafts (not angle-synchronous) • Winding drive • Drafting equipment • Trolley drive



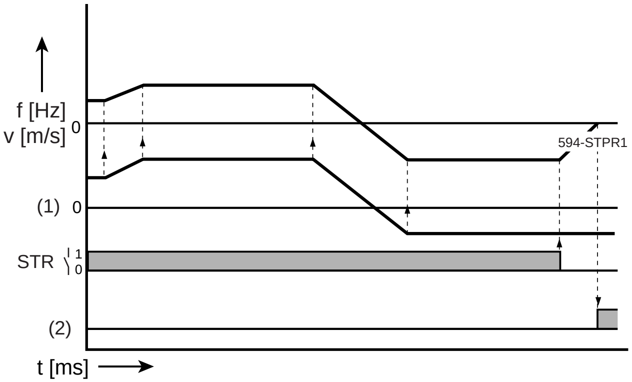
X2	Des.	Function
20	OSD02/14	14 / 11 / 12 — Relay contact for “Ready” message
19	OSD02/11	
18	OSD02/12	
17	DGND	Digital ground
16	OSD01	Disabled in M/S operation
15	OSD00	“Standstill” message
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Encoder track B
11	ISD02	Encoder track A
10	ISD01	Master interface
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Not assigned
2	ISA00	Not assigned
1	U_R	Reference voltage 10V, 10mA

(1) The encoder is evaluated only in control mode FOR.
For notes on the encoder see section 6.3.1 “_79 EN-Encoder evaluation”.

Figure 4.44 Control terminal assignment with ASTER = M-S_4

The parameter presets for application data sets M-S_x are located as parameter comparison references in section 4.6.5 “Comparison of parameters, Master/-Slave operation”.

Input signals



(1) Guide value from master
(2) DC braking torque

Figure 4.45 Example of a driving profile with Master/-Slave coupling (ASTER = M-S_4)

The characteristic of the output signals is shown in section 4.6.3 “M-S_3” in Figure 4.43.

4.6.5 Comparison of parameters, Master/-Slave operation

Comparison of the application data sets for **Master/-Slave operation** with the factory setting (152-ASTER = DRV_1):

I/O	Parameter	Function	152-ASTER = DRV_1 (FS)	M-S_1	M-S_2	M-S_3	M-S_4
Initial commissioning							
	151-ASTPR	Original device preset	DRV_1	M-S_1	M-S_2	M-S_3	M-S_4
	152-ASTER	Preset within the active application data set	DRV_1	M-S_1	M-S_2	M-S_3	M-S_4
	166-UDSSL	Control location for switchover of the active user data set	PARAM	1)	1)	1)	1)
	300-CFCON	Current open-loop/closed-loop control mode of the	VFC		FOR		FOR
CDA3000 inverter module inputs and outputs							
ISA00	180-FISA0	Function selector analog standard input ISA00	OFF	PM10V	PM10V		
ISD01	211-FIS00	Function selector digital standard input ISD01	STL			FSMI	FSMI
ISD02	212-FIS02	Function selector digital standard input ISD02	SADD1	MP-UP	ENC	MP-UP	ENC
ISD03	213-FIS03	Function selector digital standard input ISD03	OFF	MP-DN	ENC	MP-DN	ENC
OSA0	200-FOSA0	Function selector for analog output OSA00	AACTF				
OSD0	240-FOS00	Function selector digital standard output OSD00	BRK_1	ROT_0	ROT_0	ROT_0	ROT_0
OSD0	241-FOS01	Function selector digital standard output OSD01	REF	FMSO	FMSO	OFF	OFF
OSD0	242-FOS02	Function selector digital standard output OSD02	S_RDY				
Reference structure							
	280-RSSL1	Reference selector 1	FMAX	FA0	FA0	FDIG	FDIG
	281-RSSL2	Reference selector 2	FCON				
	289-SADD1	Offset for reference selector 1	10	0	0		0
MOP function							
	320-MPSEL	Configuration for motor operated potentiometer	OFF	F1		F1	
Driving profile generator							
	597-RF0	Response at reference value 0 Hz	OFF		0 Hz		0 Hz
Current-controlled startup							
	640-CLSL1	DS1: Function selector	CCWFS	CCWFR	OFF	CCWFR	OFF
	645-CLSL2	DS2: Function selector	CCWFS	CCWFR	OFF	CCWFR	OFF
DC holding							
	681-HODCT	Holding time	0.5	0	0		

1) After setting the parameters of the user data sets, change parameter value 166-UDSSL from PARAM (KEYPAD KP200, DRIVEMANAGER) to TERM (terminal operation).

Table 4.27 Automatic changes by means of the assistance parameter

An empty line means that the setting is the same as for DRV_1 (factory setting).

Active functions in Master/-Slave operation

Function	Effect	VFC	SFC	FOR
IxR load compensation	In case of load surges a higher torque is available, and the motor heats up less	✔		
Current injection	Increase in starting torque	✔		
Current-controlled startup with ramp stop	Protection against current overload shut-off in acceleration from high load torques	✔	✔	✔ to V. 1.40
DC holding	Rotation of the motor shaft without load is counteracted	✔		
Magnetizing	Increase in coasting and standstill torque		✔	✔

Table 4.28 Active functions

More details of the software functions and setting options are presented in section 5 “Software functions” and section 6 “Control modes”.

5 Software functions

Control method parameters: ➔6 “Control modes”.
Overview of all parameters: ➔Appendix A “Overview of parameters”.

Explanatory notes on the following tables

“Online” column

Many parameters can be altered online that is to say the changed value takes effect immediately. This means a change in parameter value need only be confirmed by pressing the Enter key.

Therefore these parameters do not require controller initialization by briefly removing the enable signal ENPO or the start signal.

“Factory setting” column (“FS”)

The factory settings are identified by the abbreviation **FS**. The following lists and tables contain all parameters up to user level 01-MODE = 4 in their factory setting (152-ASTER = DRV_1).

“KP/DM” and “BUS” columns

The abbreviations “KP/DM” represent the settings made in the DRIVEMANAGER and the KEYPAD KP200. “BUS” represents the setting as a digit for bus operation.

Types of parameters

The software of the inverter module differentiates between different types of parameters which are marked by symbols in the parameter editor of the DRIVEMANAGER:

- Parameters dependent on the existing hardware.
  - These are automatically detected by the inverter module and their parameters set accordingly.
- Parameters dependent on the specific application.
  - These must be entered accordingly by the user.
  - In the parameter editor of the DRIVEMANAGER editable parameters are identified by this symbol.

5.1 _15 FC-Initial commissioning

Function	Application
• Input of the characteristic motor data • Selection and activation of the application data set with the preset solutions • Controller auto-tuning	• Quick and easy commissioning of the inverter module • Automatic setup of all controllers • Identification of the connected motor

The general procedure for initial commissioning is described in the operating instructions and in section 3.5.

Initial commissioning parameters

Parameter	Function	Value range	FS	Unit	Online
150-SAVE	Back-up device setup	STOP/START			✔
151-ASTPR	Original device preset	DRV_1 ... M-S_4	DRV_1		
152-ASTER	Preset (ADS)	OFF ... M-S_4 see 4.1	DRV_1		
154-MOPNM	Motor rated power	*	*	kW	
155-MOVNM	Motor rated voltage	*	*	V	
156-MOFN	Motor rated frequency	0.1 ... 1000	50	Hz	
157-MOSNM	Rated speed	0 ... 100000	*	rpm	
158-MOCNM	Motor rated current	*	*	A	
159-MOCOS	Motor cosφ	0 ... 1	1		
160-MOJNM	Mass moment of inertia of the motor	0 ... 100	see Table 5.4		
161-SCJ1	CDS1: Mass moment of inertia of the system	0 ... 1000	0		
162-SCJ2	CDS2: Mass moment of inertia of the system	0 ... 1000	0		
163-ENSC	Enable auto-tuning	STOP/START	STOP		
164-UDSWR	Back-up device setup in a user data set	1 ... 4	1		✔
165-UDSAC	Activate user data set	1 ... 4	1		
166-UDSSL	Control location for switchover of the active user data set	see Table 5.14	PARAM		✔
167-SCPRO	Auto-tuning progress indicator	0 ... 100	0	%	
300-CFCON	Current open-loop/closed-loop control mode of the device	see Table 5.9	VFC		

Table 5.1 Parameters of subject area "_15 FC-Initial commissioning"

Explanatory notes

- Parameter values resulting from the size of the current inverter module are assigned an asterisk (*) in the “Value range” and “Factory setting” columns.

Backing-up the device setup (150-SAVE)

With the setting 150-SAVE = START the device setup is stored in the active user data set.

During the save operation the parameter value START is displayed; it does not switch to STOP until the operation has been completed successfully.

The same effect is achieved by simultaneously pressing the two cursor keys on the KEYPAD KP200 control unit for approx. 2 seconds while at the menu level. At the menu level the display shows “MENU”.

Setting of application data set (152-ASTER)

Selection of the application data set defines the framework parameters of the predefined application solutions. This special adaptation to different preset solutions is made with parameter 152-ASTER.

When a parameter of an application data set is changed, the assistance parameter 152-ASTER is automatically set to OFF. Parameter 151-ASTPR for the active application data set retains its setting.

BUS	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
KP/ DM	OFF	DRV_ 1	DRV_ 2	DRV_ 3	DRV_ 4	DRV_ 5	ROT_1	ROT_2	ROT_3	BUS_1	BUS_2	BUS_3	M-S_1	M-S_2	M-S_3	M-S_4	ROT_4

For explanatory notes on assistance parameter 152-ASTER refer to section 4 “Application data sets”.

Note: Select a suitable application data set before setting the inverter parameters for your application. Selecting the application data set later will overwrite your parameter setting with the fixed presets of the application data set concerned. The only exceptions are the auto-tuning parameters.

Input of motor data

The motor data are read from the motor rating plate, depending on on circuit type and frequency inverter, and entered in the parameters.

Motor connection of an IEC standard motor (230/400 V, Δ/Y)

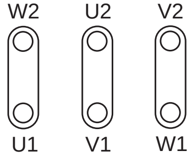
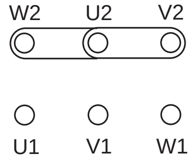
Frequency inverter	Rated voltage/ circuit type	Motor terminal block
CDA 32.xxx	3 x 230 V/Δ	
CDA 34.xxx	3 x 400 V/Y	

Table 5.2 Connection of a 3 x 230 / 400 V standard motor as per IEC 34

Note: When using special three-phase AC motors not conforming to IEC34, obtain information on the type of termination from the motor manufacturers.

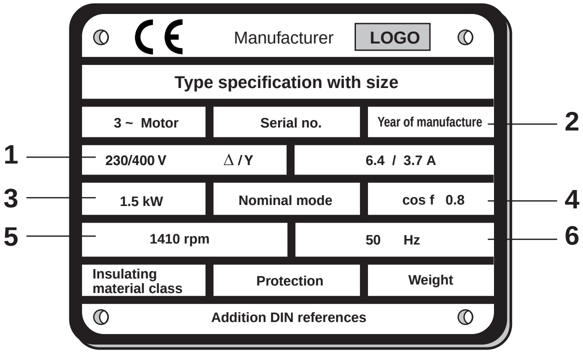


Bild 5.1 Motor rating plate

No.	Function	Parameter	Setting
1	Rated voltage of motor in circuit type Δ → 230 V Y → 400 V	155 -MOVNM	Δ: 230 V Y: 400 V
2	Rated current of motor in circuit type Δ → 6.4A Y → 3.7A	158 -MOCNM	Δ: 6.4A Y: 3.7A
3	Rated power of motor	154 -MOPNM	1.5 kW
4	Power factor cos f of motor	159-MOCOS	0.8
5	Rated speed of motor	157 -MOSNM	1410 rpm
6	Rated frequency of motor	156-MOFN	50 Hz

Table 5.3 Motor rating plate data

Setting of motor mass moment of inertia (160-MOJNM)

The mass moment of inertia of the motor must be entered under parameter 160-MOJNM in order to ensure optimum running in control mode SFC/ FOR.

If no mass moment of inertia is entered (160-MOJNM=0), a mass moment of inertia matching an IEC standard motor is defined based on the motor data.

The basis is provided by the table presented below for a six-pole asynchronous motor.

The mass moment of inertia of the motor is dependent on the number of pole pairs and the related rotor design. Consequently, the table values are adjusted according to the number of pole pairs.

Mass moments of inertia of standard three-phase a.c. motors with squirrel-cage rotor to DIN VDE 0530, 1000 rpm, 6-pole, 50 Hz and internally cooled, stored in the CDA3000:

Power P [kW]	Mass moment of inertia J_M [kgm]
0.09	0.00031
0.12	0.00042
0.18	0.00042
0.25	0.0012
0.37	0.0022
0.55	0.0028
0.75	0.0037
1.1	0.0050
1.5	0.010
2.2	0.018
3.0	0.031
4.0	0.038
5.5	0.045
7.5	0.093
11	0.127
13	0.168
15	0.192
20	0.281
22	0.324
30	0.736
37	1.01
45	1.48
55	1.78
75	2.36
90	3.08

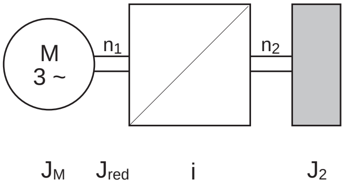
Table 5.4 Base values for the mass moment of inertia referred to a six-pole IEC standard motor

Setting of mass moment of inertia of system (160-SCJ1, 162-SCJ2)

The mass moment of inertia of the system must be entered under parameters 160-SCJ1 (CDS1) and 162-SCJ2 (CDS2) in order to ensure optimum running in control mode SFC/FOR.

If no mass moment of inertia is entered for the system, a 1:1 adjustment of the mass moment of inertia is assumed and the mass moment of inertia of the system is set equal to that of the motor.

Reduction of the mass moment of inertia of the system



$$J_{red} = \frac{J_2}{i^2} = \frac{J_2}{\left(\frac{n_1}{n_2}\right)^2}$$

J_M = Mass moment of inertia of the motor (MOJNM)
J_{red} = Reduced mass moment of inertia of system (SCJx)
i Transmission ratio

Figure 5.2 Reduction of mass moment of inertia

Note: Above a ratio of 1:5 (J_M : J_{red}) the mass moment of inertia of the application must be specified, otherwise the control response will not be stable.

Note: Specification of the mass moments of inertia is of significance for control modes SFC and FOR. The speed controller is set on the basis of the mass moments of inertia during auto-tuning (see section 6.2 “Sensorless Flux Control” and 6.3 “ Field Oriented Regulation”).

1
2
3
4
5
6
A
DE
EN

Activation of auto-tuning (163-ENSC)

Before activating auto-tuning it is essential to enter the motor rating plate data. Likewise, the reduced mass moment of inertia of the system and the mass moment of inertia of the motor must also be entered, if known.

Necessity for auto-tuning

Open-loop or closed-loop control mode	Auto-tuning necessary?
VFC	Motor power output < inverter power output **and** application of one of the following functions: • Current injection • Magnetizing • DC braking • DC holding • Slip compensation • IxR load compensation
SFC	Auto-tuning should always be performed in the initial commissioning phase.
FOR	

Table 5.5 Conditions for auto-tuning

Successful auto-tuning requires that the motor power output is less than the inverter output.

The START value of parameter 163-ENSC activates auto-tuning of the inverter module. Auto-tuning identifies the motor and its characteristic values are automatically entered in the “Motor data” subject area. Additionally, all controller parameters are set up for the motor.

During auto-tuning the parameter value START is displayed; it does not switch to STOP until auto-tuning has been completed successfully. A percentage progress indicator (0-100%) is additionally displayed by way of parameter 167 -SCPRO.

Attention: In the final auto-tuning phase the values obtained are **not** automatically stored in the active user data set.

The parameter data set is stored by way of 150-SAVE=START in the current user data set or directly by parameter 164-UDSWR in a different user data set.

Parameters written to during auto-tuning of the device are retained when a new application data set is selected. Switching user data set does overwrite the auto-tuning parameters, however. The auto-tuning should therefore be performed before parameter setting of the user data sets (UDS).

Auto-tuning parameters		Used in control mode		
		VFC	SFC	FOR
_15FC Initial commissioning, section 5.1				
160-MOJNM	Mass moment of inertia of motor		✔	✔
161-SCJ1	CDS1: Mass moment of inertia of system		✔	✔
162-SCJ2	CDS2: Mass moment of inertia of system		✔	✔
_64 CA Current-controlled startup				
641-CLCL1	CDS1: Current limit, current-controlled startup	✔	✔	
642-CLFL2	CDS1: Lowering frequency, current-controlled startup	✔	✔	
643-CLFR1	CDS1: Initial frequency, current-controlled startup	✔	✔	
646-CLCL2	CDS2: Current limit, current-controlled startup	✔	✔	
647-CLFL2	CDS2: Lowering frequency, current-controlled startup	✔	✔	
648-CLFR2	CDS2: Initial frequency, current-controlled startup	✔	✔	
_70VF Voltage frequency control, section 6.1.1				
700-VB1	CDS1: Boost voltage	✔		
701-VN1	CDS1: Motor rated voltage	✔		
702-FN1	CDS1: Motor rated frequency	✔		
715-VB2	CDS2: Boost voltage	✔		
716-VN2	CDS2: Motor rated voltage	✔		
717-FN2	CDS2: Motor rated frequency	✔		
_74IR IxR load compensation, section 6.1.2				
741-KIXR1	CDS1: IxR compensation factor	✔		
743-KIXR2	CDS2: IxR compensation factor	✔		
_75SL Slip compensation, section 6.1.3				
751-KSC1	CDS1: Slip compensation factor	✔		
753-KSC2	CDS2: Slip compensation factor	✔		

Table 5.6 Parameters changed during auto-tuning

Auto-tuning parameters		Used in control mode		
		VFC	SFC	FOR
_76CI Current injection, section 6.1.4 (as from firmware V1.4)				
760-CICN1	CDS1: Current injection reference value 1	✔		
763-CICN2	CDS2: Current injection reference	✔		
_77MP Magnetizing, section 5.5.14				
770-MPCN1	CDS1: Magnetizing current	✔	✔	✔
772-MPCN2	CDS2: Magnetizing current	✔	✔	✔
774-MPT	Magnetization time for SFC and FOR		✔	✔
_78SS Speed controller SFC, section 6.2.1				
780-SSGF1	CDS1: Scaling of speed controller gain		✔	
781-SSG1	CDS1: Controller gain of encoder		✔	
782-SSTL1	CDS1: Speed controller lag time		✔	
783-SSTF1	CDS1: Filter time constant of speed estimate		✔	
784-SSGF2	CDS2: Scaling of speed controller gain		✔	
785-SSG2	CDS2: Controller gain of encoder		✔	
786-SSTL2	CDS2: Speed controller lag time		✔	
787-SSTF2	CDS2: Filter time constant of speed estimate		✔	
_80CC Current control, section 6.3.3				
800-CCG	Current controller gain	✔	✔	✔
801_CCTLG	Current controller lag time	✔	✔	✔
802-CCTF	Filter time constant for current measurement	✔	✔	
803-VCSFC	Correction factor of fault voltage characteristic SFC		✔	✔
804-CLIM1	CDS1: Maximum reference current for current control	✔	✔	✔
805-CLIM2	CDS2: Maximum reference current for current control	✔	✔	✔
_81CC Speed controller FOR, section 6.3.2				
810-SCGF1	CDS1: Scaling of speed controller gain			✔
811-SCG1	CDS1: Speed controller gain			✔
812-SCTL1	CDS1: Speed controller lag time			✔
813-SCTF1	CDS1: Jitter filter time constant			✔
814-SCGF1	CDS2: Scaling of speed controller gain			✔
815-SCG1	CDS2: Speed controller gain			✔

Table 5.6 Parameters changed during auto-tuning

Auto-tuning parameters		Used in control mode		
		VFC	SFC	FOR
816-SCTL1	CDS2: Speed controller lag time			✔
817-SCTF1	CDS2: Jitter filter time constant			✔
818-SCGF0	Speed controller gain at frequency zero			✔
_84 MD Motor data, section 5.5.13				
840 -MOFNM	Nominal pole flux		✔	✔
841-MOL_S	Leakage inductance		✔	✔
842-MOR_S	Stator resistance		✔	✔
843-MOR_R	Rotor resistance		✔	✔
844-MONPP	Number of pole pairs of motor		✔	✔

Table 5.6 Parameters changed during auto-tuning

Storing a user data set (UDS) (164-UDSWR)

Customer/user settings are stored in one of the four possible user data sets.

The user data set is selected by way of parameter 164-UDSWR and then the parameter settings in the RAM are stored as a complete user data set.

Note: Parameter 150-SAVE only ever saves the active data set to the current user data set.

Switching between UDS (165-UDSAC, 166-UDSSL)

A user data set can be activated by way of parameter 165-UDSAC. The active user data set is displayed as the parameter value.

The control location for activation of a user data set is defined with parameter 166-UDSSL.

Settings with 166-UDSSL for switchover of the active user data set

BUS	KP/DM	Function
0	PARAM	Switchover by direct editing of the parameter
1	TERM	Switchover by input with function selector setting UM0 (significance 2^0) or UM1 (significance 2^1)
2	SIO	Switchover by SIO control word (RS 232 port)
3	OPTN1	Switchover by control word of option module to slot 1
4	OPTN2	Switchover by control word of option module to slot 2

Table 5.7 Settings for switchover of the active user data set with 166-UDSSL

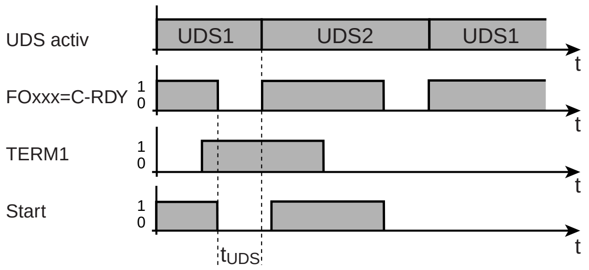
User data sets cannot be switched “online”. The hardware enable via the “ENPO” signal may still be applied, but the inverter module power stage must be inactive. This means no start signal must be present in the switchover phase.

Example of switchover by terminal operation (166-UDSSL = TERM)

Terminal 1	Terminal 2	User data set
0	0	⇨ User data set 1: 001 MODE … 999 xyz
1	0	⇨ User data set 2: 001 MODE … 999 xyz
0	1	⇨ User data set 3: 001 MODE … 999 xyz
1	1	⇨ User data set 4: 001 MODE … 999 xyz

Table 5.8 Example of selection of user data sets via terminals

A UDS switchover takes several seconds, depending on the number of internal parameters to be changed. The UDS switchover can be monitored by setting the parameters of a digital output (section 5.2.4 “_24OD-Digital outputs”) by way of its function selector. For this, the relevant function selector must be set to “C-RDY”.



FOxxx Function selector of a digital output
TERM1UDS switchover via a digital input
Start Start enable via STR/STL
t_{UDS} Internal device time for parameter switch to a new UDS

Figure 5.3 UDS switchover

For more information on the data structure see section 3.1.

Current open-loop/closed-loop control modes (300-CFCON)

BUS	KP/DM	Function	Reference
0	VFC	Controlled operation based on an adjustable V/F characteristic	Section 6.1
1	SFC	Sensorless Flux Control with overlaid current control	Section 6.2
2	FOR	Encoder-controlled speed control (Field-Oriented Regulation)	Section 6.3

Table 5.9 Settings via 300-CFCON

Note: Control modes SFC and FOR only work with an asynchronous motor. Control mode VFC additionally supports synchronous and reluctance motors.

5.2 Inputs and outputs

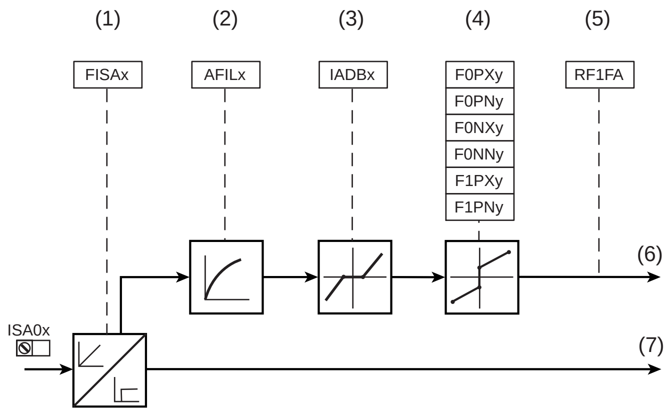
Each input and output of the inverter module has a parameter which assigns it a function. These parameters are termed “function selectors” and are located in the relevant subject areas of the inputs and outputs.

The reference structure and the control location additionally have an influence on the function of the inputs and outputs. Presets are already entered in the application data sets.

For information on the input and output hardware refer to section 2.4 “Specification of control terminals” and to the operation manual.

5.2.1 _18IA-Analog inputs

Function	Effect
• Definition of the internal processing of the analog input signals	• Conditioning and filtering of the analog reference input or use as a digital input



(1) Analog reference input or use as a digital input
(2) Input filter for fault isolation from 0 to 64 ms
(3) Backlash function for fault isolation around zero
(4) Scaling of the analog input
(5) Scaling factor [%], see section 5.2.6 “_28 RS-Reference structure”
(6) Analog value
(7) Digital value
x Number of the input
y Number of the characteristic data set (CDS)

Figure 5.4 Function block for adaptation of the analog inputs

Configuration options, ISA0x

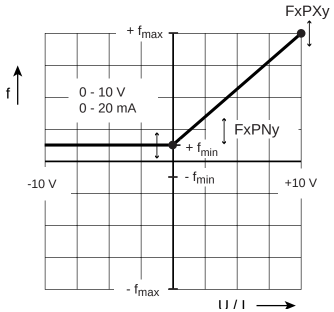


Figure 5.5 Scaling in unipolar operation

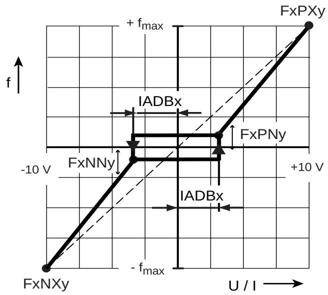


Figure 5.6 Backlash function in bipolar operation

Parameters for analog inputs ISA0x

Parameter	Function	Value range	FS	Unit	Online
180-FISA0	Function selector analog standard input ISA00	see Table 5.11	OFF		
181-FISA1	Function selector analog standard input ISA01	see Table 5.11	OFF		
182-F0PX1	CDS1: Maximum value ISA00 at +10V	-1600 ... 1600	50	Hz	
183-F0PN1	CDS1: Minimum value ISA00 at +0V	-1600 ... 1600	0	Hz	
184-F0NX1	CDS1: Maximum value ISA00 at -10V	-1600 ... 1600	0	Hz	
185-F0NN1	CDS1: Minimum value ISA00 at -0V	-1600 ... 1600	0	Hz	
186-F1PX1	CDS1: Maximum value ISA01 at +10V	-1600 ... 1600	50	Hz	
187-F1PN1	CDS1: Minimum value ISA01 at +0V	-1600 ... 1600	0	Hz	
188-AFIL0	Filter time constant for analog channel ISA00	(2^x), x = 0 ... 6	3		✔
189-AFIL1	Filter time constant for analog channel ISA01	(2^x), x = 0 ... 6	3		✔
190-F0PX2	CDS2: Maximum value ISA00 at +10V	-1600 ... 1600	50	Hz	
191-F0PN2	CDS2: Minimum value ISA00 at +0V	-1600 ... 1600	0	Hz	
194-F0NX2	CDS2: Maximum value ISA00 at -10V	-1600 ... 1600	0	Hz	
195-F0NN2	CDS2: Minimum value ISA00 at -0V	-1600 ... 1600	0	Hz	
196-F1PX2	CDS2: Maximum value ISA01 at +10V	-1600 ... 1600	50	Hz	
197-F1PN2	CDS2: Minimum value ISA01 at +0V	-1600 ... 1600	0	Hz	
192-IADB0	ISA00 play range	0 ... 90	0.00	% 1)	
193-IADB1	ISA01 play range	0 ... 90	0.00	% 1)	

1) Referred to 10 V

Table 5.10 Parameters from subject area “_18IA-Analog inputs”

Settings for 180-FISA0 and 181-FISA1 analog inputs

BUS	KP/DM	Function	Effect
0	OFF	No function	Input off
1	STR	Start clockwise	Start enable for motor clockwise running
2	STL	Start anti-clockwise	Start enable for motor anti-clockwise running
3	INV	Reverse direction	Reference is inverted, causing a reversal of direction
4	/STOP	/Emergency stop	Stop ramp is executed dependent on active characteristic data set (CDS). Attention: Signal inverted (/) (section 5.5.3 "_59 DP-Driving profile generator")
5	SADD1	Offset for reference selector 280 -RSSL1	Reference selector 280-RSSL1 is offset by the value in 289-SADD1 to a different reference source (section 5.2.6 "_28 RS-Reference structure").
6	SADD2	Offset for reference selector 281 -RSSL2	Reference selector 281-RSSL2 is offset by the value in 290-SADD2 to a different reference source (section 5.2.6 "_28 RS-Reference structure").
7	E-EXT	External error	Error messages from external devices produce a fault signal with response as defined in parameter 524-R-EXT (section 5.3.10 "_51ER-Error messages").
8	RSERR	Reset error message	Error messages are reset if the error is no longer present.
9	MP-UP	MOP, increase reference value	The reference value of the digital MOP function is increased (section 5.5.2 "_32 MP-MOP function").
10	MP-DN	MOP, reduce reference value	The reference value of the digital MOP function is reduced (section 5.5.2 "_32 MP-MOP function").
11	CUSEL	Select characteristic data set (CDS)	Switch characteristic data set (CDS) 0 = CDS1, 1 = CDS2 (section 5.5.6 "_65 CS-Characteristic data switchover (CDS)").
12	FFTB0	Driving set selection (significance 2^0)	Binary driving set selection (bit 0), frequency with acceleration and deceleration ramp (section 5.5.5 "_60 TB-Driving sets").
13	FFTB1	Driving set selection (significance 2^1)	Binary driving set selection (bit 1), fixed frequency with acceleration and deceleration ramp (section 5.5.5 "_60 TB-Driving sets").

Table 5.11 Settings for analog inputs

BUS	KP/DM	Function	Effect
14	FFTB2	Driving set selection (significance 2^2)	Binary driving set selection (bit 2), fixed frequency with acceleration and deceleration ramp (section 5.5.5 "_60 TB-Driving sets").
15	UM0	User data set (UDS) switchover, (significance 2^0)	Binary data set selection (bit 0) (section 5.1 "_15 FC-Initial commissioning").
16	UM1	User data set (UDS) switchover, (significance 2^1)	Binary data set selection (bit 1) (section 5.1 "_15 FC-Initial commissioning").
17	/LCW	Limit switch clockwise	Limit switch evaluation without limit override guard, response to error message in case of reversed limit switches as defined in parameter 534-R-LSW (section 5.3.10 "_51ER-Error messages").
18	/LCCW	Limit switch clockwise	Limit switch evaluation without limit override guard, response to error message in case of reversed limit switches as defined in parameter 534-R-LSW (section 5.3.10 "_51ER-Error messages").
19	SIO	Input appears in status word of serial interface (terminal X4)	Status of input readable via status word parameter 550-SSTAT of LUST-BUS (section 5.4.1 "_55 LB-LUSTBUS").
20	OPTN1	Reserved for option module at slot 1	Input is available to option module at slot 1, usable only in conjunction with communication modules
21	OPTN2	Reserved for option module at slot 2	Input is available to option module at slot 2, usable only in conjunction with communication modules
22	USER0	Reserved for modified software	Input can be used by special software
23	USER1	Reserved for modified software	Input can be used by special software
24	USER2	Reserved for modified software	Input can be used by special software
25	USER3	Reserved for modified software	Input can be used by special software
26	MAN	Manual mode activation in field bus operation	An inverter module configured for bus operation can be switched to manual mode (e.g. setup or emergency operation mode)

Table 5.11 Settings for analog inputs

BUS	KP/DM	Function	Effect
29	0-10V	Analog reference input 0-10 V	Reference input 0-10 V. Pay attention to scaling and adapt reference structure by means of reference selector (section 5.2.6 “_28 RS-Reference structure”).
30	SCALE	Limitation of motor current	The current value CLIM1/2 for SFC and FOR is limited and thus also the maximum torque (section 5.5.10 “_80 CC-Current controller”).
31	PM10V	Voltage input -10 V ... +10 V	Reference input 0-10 V. Pay attention to scaling and adapt reference structure by means of reference selector (section 5.2.6 “_28 RS-Reference structure”).
32	0-20	Current input 0 ... 20 mA	
33	4-20	Current input 4 ... 20 mA	If the current falls below 4 mA, the wire-break monitor is tripped. Response to error message is defined by way of parameter 529 -R-WBK (section 5.3.10 “_51ER-Error messages”).

Table 5.11 Settings for analog inputs

Explanatory notes

- The settings STR to MAN of the function selectors evaluate the input as a digital input (24V digital input, PLC-compatible to IEC1131-2).
- Wire-break monitoring: When 4-20 is set, the system state monitor triggers an error as soon as the current at the input (ISA00 only) falls below 4 mA (for error message see appendix).
- For characteristic switchover via CUSEL, the control location for the switchover must be set in parameter 651-CDSSL to TERM (terminal operation).
- The “MAN” function permits a device configured for bus operation to be operated by the operator locally, e.g. from the switch cabinet. This function can be used for system setup or emergency operation mode.
  By the “MAN” function the parameters are automatically assigned new parameter values, as set out in Table 5.12.

Note: While the “MAN” function is active, the “settings must not be saved in the device”, as the reference structure is changed in the background and the “MAN” function would be activated after the next power-on.

Action	Function	Parameter
Control location	Terminals	260-CLSEL = TERM
Input ISD00	Start clockwise	210-FIS00 = STR
Input ISD01	Start anti-clockwise	211-FIS01 = STL
Reference channel 1	Analog input 0	276-RSSL1 = FA0
Reference channel 2	Off	277-RSSL2 = FCON

Table 5.12 Changes based on activation of the input with the MAN function

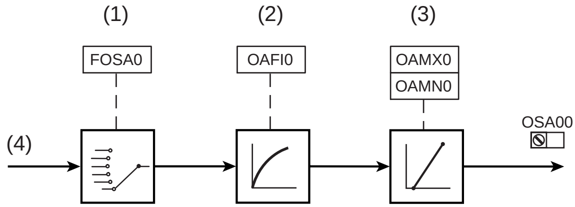
- When the analog inputs are operated digitally, the static signal at the terminal is evaluated (see section 2.4 “Specification of control terminals”). It should be noted in this that the filter time constant (parameter 188-AFIL0 and 169-AFIL1) will cause a delay in the response time. If this is not wanted, for example when the inputs are assigned the limit switch evaluation function, parameters 188-AFIL0 and 189-AFIL1 must be set to 0.

When the analog input is used as a digital input, the notes regarding the isolation concept must be observed (see section 2.6 “Isolation concept”).

The response of the CDA3000 inverter module to the reference value 0Hz can be set in the driving profile generator subject area by parameter 597-RF0.

5.2.2 _200 A-Analog output

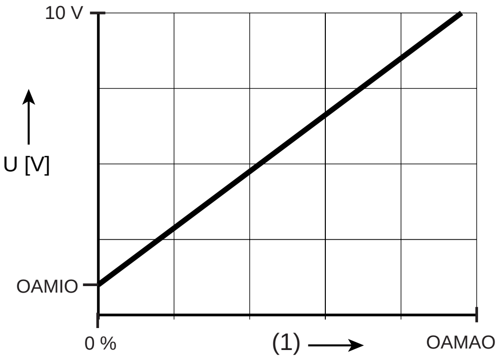
Function	Effect
• Definition of which scaled actual value is delivered at the analog output (0 ... 10V)	• Conditioning and filtering of the analog actual value • The analog output provides diagnosis by way of a volt-meter if no DRIVEMANAGER with digital scope is available.



(1) Selection of the analog actual value
(2) Output filter for fault isolation from 0 to 64 ms
(3) Scaling of the analog output
(4) Actual value

Figure 5.7 Function block for adaptation of the analog output

Configuration options, OSA00



(1) Output variable, e.g. frequency

Figure 5.8 Scaling of the analog output

Parameters for analog output

Parameter	Function	Value range	FS	Unit	Online
200-FOSA0	Function selector analog standard output OSA00	see Table 5.14	ACTF		
201-OAMN0	Minimum value for analog output OSA00	-200 ... 200	0	%	
202-OAMX0	Maximum value for analog output OSA00	-200 ... 200	100	%	
203-OAFI0	Filter time constant for analog channel OSA00	(2^x), x = 0 ... 6	4		
204-TSCL	Torque scaling value	*, see Table 5.15	*	Nm	

Table 5.13 Parameters from subject area _20OA Analog output

Explanatory notes

- For the two vertices (0 V, 10 V) the actual value can be adapted in the range from - 200 % to + 200 % relative to a referenced value.

Settings for 200-FOSA0

BUS	KP/DM	Function	Effect/Notes	Referenced value 10 V
0	OFF	No function	Output off	
1	ACTF	Current actual frequency	Clockwise only (positive values only) Control mode FOR: true actual frequency Control mode SFC: estimated actual frequency Open-loop control mode VFC: display of reference frequency	FMAX1/2
2	ACTN	Current actual speed	Only only (positive values only) Control mode FOR: true actual frequency Control mode SFC: estimated actual frequency Open-loop control mode VFC: no display	nN
3	APCUR	Current apparent current		2*IN
4	ACCUR	Current active current		2*IN
5	ISA0	Voltage or current at analog input ISA00		10 V / 20 mA
6	ISA1	Voltage at analog input ISA01		10 V
7	MTEMP	Current motor tempera-ture	Motor temperature only with linear evaluation (PTC)	200 °C

Table 5.14 Settings for 200-FOSA0 analog output

BUS	KP/DM	Function	Effect/Notes	Referenced value 10 V
8	KTEMP	Current heat sink temperature	≤ 15 kW: Temperatures > 100 °C in the power stage module correspond to temperatures > 85 °C on the heat sink and result in shut-off ≥ 15 kW: Temperatures >86 °C result in shut-off, because temperature sensor directly on heat sink	200 °C
9	DTEMP	Current interior temperature	Interior temperatures > 85 °C result in shut-off	200 °C
10	DCV	DC-link voltage	Referenced values dependent on device version CDA32.xxx 500 V CDA34.xxx 1000 V	500 V / 1000 V
11	VMOT	Motor voltage	Referenced values dependent on device version CDA32.xxx 500 V CDA34.xxx 1000 V	500 V / 1000 V
12	PS	Apparent power		2*PN
13	PW	Active power		2*PN
14	ACTT	Current actual torque	Control mode FOR: true actual frequency Control mode SFC: estimated actual frequency Open-loop control mode VFC: no display	Dependent on device, see table
15	AACTF	Amount of current actual frequency	Clockwise (pos. value) and anti-clockwise (neg. value) are represented as amounts. Control mode FOR: true actual frequency Control mode SFC: estimated actual frequency Open-loop control mode VFC: display of reference frequency	FMAX1/2
16	AACTN	Amount of current actual speed	Clockwise (pos. value) and anti-clockwise (neg. value) are represented as amounts. Control mode FOR: true actual speed Control mode SFC: estimated actual speed Open-loop control mode VFC: no display	nN

Table 5.14 Settings for 200-FOSA0 analog output

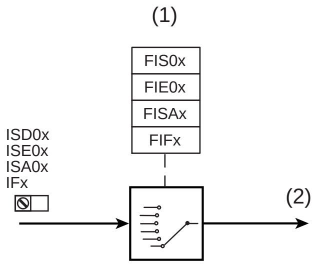
Device-dependent torques for scaling (204-TSCL)

Device type	Power [kW]	Torque for scaling	
		Value range for 204-TSCL	BV [Nm]
CDA32.003	0.375	0.05 ... 200 % of BV	5
CDA32.004	0.75		10.2
CDA32.006	1.1		15
CDA32.008	1.5		20
CDA34.003	0.75		10.2
CDA34.005	1.5		20
CDA34.006	2.2		30
CDA34.008	3		40
CDA34.010	4		54
CDA34.014	5.5		72
CDA34.017	7.5		98
CDA34.024	11		144
CDA34.032	15		196
CDA34.045	22		288
CDA34.060	30		392
CDA34.072	37		480
CDA34.090	45		584
CDA34.110	55		712
CDA34.143	75		968
CDA34.170	90		1162
BV: Device-dependent base value			

Table 5.15 Torque scaling values for various device power classes

5.2.3 _21ID-Digital inputs

Function	Effect
• The function selectors determine the function of the digital inputs.	• Free function assignment of all digital inputs



(1) Selection of function of digital input
(2) Digital value

Figure 5.9 Function block for adaptation of the digital inputs

Parameters for digital inputs

Parameter	Function	Value range	FS	Unit	Online
210-FIS00	Function selector digital standard input ISD00	see Table 5.17	STR		✔ 1)
211-FIS01	Function selector digital standard input ISD01	-"-	STL		✔
212-FIS02	Function selector digital standard input ISD02	-"-	SADD-1		✔
213-FIS03	Function selector digital standard input ISD03	-"-	OFF		✔
214-FIE00	Function selector digital input of user module IED00	-"-	OFF		✔
215-FIE01	Function selector digital input of user module IED01	-"-	OFF		✔
216-FIE02	Function selector digital input of user module IED02	-"-	OFF		✔
217-FIE03	Function selector digital input of user module IED03	-"-	OFF		✔
218-FIE04	Function selector digital input of user module IED04	-"-	OFF		✔
219-FIE05	Function selector digital input of user module IED05	-"-	OFF		✔
220-FIE06	Function selector digital input of user module IED06	-"-	OFF		✔

Table 5.16 Parameters from subject area _21ID Digital inputs

Parameter	Function	Value range	FS	Unit	Online
221-FIE07	Function selector digital input of user module IED07	-"-	OFF		✔
222-FIF0	Function selector virtual digital fixed input 0	-"-	OFF		✔
223-FIF1	Function selector virtual digital fixed input 1	-"-	OFF		✔
1) Switch between FMSI and simple input functions does not work online					

Table 5.16 Parameters from subject area _21ID Digital inputs

Explanatory notes

- The analog inputs ISA00 and ISA01 can also be assigned digital functions (see section 5.2.1).
- Selectors FIF0 and FIF1 provide two virtual inputs with the fixed value 1 (High level). They can be used in place of a permanently active switch.

Settings for FIS00 ... 214-FIE00 ... 223-FIF1

BUS	KP/ DM	Function	Effect	FIS00	FIS01	FIS02	FIS03	FIE0x	FIFx
0	OFF	No function	Input off	✔	✔	✔	✔	✔	✔
1	STR	Start clockwise	Start enable for motor clockwise running	✔	✔			✔	✔
2	STL	Start anti-clockwise	Start enable for motor anti-clockwise running	✔	✔			✔	✔
3	INV	Reverse direction	Reference is inverted, causing a reversal of direction	✔	✔	✔	✔	✔	✔
4	/STOP	/Emergency stop via stop ramp	Stop ramp is executed dependent on active characteristic data set (CDS). **Attention:** Signal inverted (/) (section 5.5.3 "_59 DP-Driving profile generator")	✔	✔	✔	✔	✔	✔
5	SADD1	Offset for reference selector 280-RSSL1	Reference selector 280-RSSL1 is offset by the value in 289-SADD1 to a different reference source. (section 5.2.6 "_28 RS-Reference structure")	✔	✔	✔	✔	✔	✔

Table 5.17 Settings of the function selectors

BUS	KP/ DM	Function	Effect	FIS00	FIS01	FIS02	FIS03	FIE0x	FIFx
6	SADD2	Offset for reference selector 281-RSSL2	Reference selector 281-RSSL2 is offset by the value in 290-SADD2 to a different reference source. (section 5.2.6 "_28 RS-Reference structure")	✔	✔	✔	✔	✔	✔
7	E-EXT	External error in another device	Error messages from external devices produce a fault signal with response as defined in parameter 524-R-EXT. (section 5.3.10 "_51ER-Error messages")	✔	✔	✔	✔	✔	
8	RSERR	Reset error message	Error messages are reset if the error is no longer present.	✔	✔	✔	✔	✔	
9	MP-UP	MOP, increase reference value	Reference value of digital MOP function is increased. (section 5.5.2 "_32 MP-MOP function")	✔	✔	✔	✔	✔	
10	MP-DN	MOP, reduce reference value	Reference value of digital MOP function is reduced. (section 5.5.2 "_32 MP-MOP function")	✔	✔	✔	✔	✔	
11	CUSEL	Select characteristic data set (CDS)	Switch characteristic data set (CDS) 0 = CDS1, 1 = CDS2 (section 5.5.6 "_65 CS-Characteristic data switchover (CDS)")	✔	✔	✔	✔	✔	
12	FFTB0	Driving set selection (significance 2^0)	Binary driving set selection (bit 0), fixed frequency with acceleration and deceleration ramp. (section 5.5.5 "_60 TB-Driving sets")	✔	✔	✔	✔	✔	
13	FFTB1	Driving set selection (significance 2^1)	Binary driving set selection (bit 1), fixed frequency with acceleration and deceleration ramp. (section 5.5.5 "_60 TB-Driving sets")	✔	✔	✔	✔	✔	
14	FFTB2	Driving set selection (significance 2^2)	Binary driving set selection (bit 2), fixed frequency with acceleration and deceleration ramp. (section 5.5.5 "_60 TB-Driving sets")	✔	✔	✔	✔	✔	
15	UM0	User data set (UDS) switchover, (significance 2^0)	Binary data set selection (bit 0) (section 5.1 "_15 FC-Initial commissioning")	✔	✔	✔	✔	✔	

Table 5.17 Settings of the function selectors

BUS	KP/ DM	Function	Effect	FIS00	FIS01	FIS02	FIS03	FIE0x	FIFx
16	UM1	User data set (UDS) switchover, (significance 2[1])	Binary data set selection (bit 1) (section 5.1 "_15 FC-Initial commissioning")	✔	✔	✔	✔	✔	
17	/LCW	Limit switch clockwise	Limit switch evaluation without limit override guard. Response to error message in case of reversed limit switches as defined in parameter 534-R-LSW. (section 5.3.10 "_51ER-Error messages")	✔	✔	✔	✔	✔	
18	/ LCCW	Limit switch anti-clockwise	Limit switch evaluation without limit override guard. Response to error message in case of reversed limit switches as defined in parameter 534-R-LSW. (section 5.3.10 "_51ER-Error messages")	✔	✔	✔	✔	✔	
19	SIO	Input appears in status word of serial interface (terminal X4)	Status of input readable via status word parameter 550-SSTAT of LUSTTBUS (section 5.4.1 "_55 LB-LUSTBUS")	✔	✔	✔	✔	✔	
20	OPTN1	Reserved for option module at slot 1	Input available to option module at slot 1. Usable only in conjunction with communication modules.	✔	✔	✔	✔	✔	
21	OPTN2	Reserved for option module at slot 2	Input available to option module at slot 2. Usable only in conjunction with communication modules.	✔	✔	✔	✔	✔	
22	USER0	Reserved for modified software	Input can be used by special software	✔	✔	✔	✔	✔	
23	USER1	Reserved for modified software	Input can be used by special software	✔	✔	✔	✔	✔	
24	USER2	Reserved for modified software	Input can be used by special software	✔	✔	✔	✔	✔	
25	USER3	Reserved for modified software	Input can be used by special software	✔	✔	✔	✔	✔	
26	MAN	Manual mode activation in field bus operation	An inverter module configured for bus operation can be switched to manual mode (e.g. setup or emergency operation mode)			✔	✔	✔	

Table 5.17 Settings of the function selectors

BUS	KP/ DM	Function	Effect	FIS00	FIS01	FIS02	FIS03	FIE0x	FIFx
27	ENC	Encoder input	Connection of A or B signal of a HTL encoder (section 6.3.1 “_79 EN-Encoder evaluation”)			✔	✔		
28	FMSI	Reference coupling input	Slave input for reference input in Master/-Slave coupling. (section 5.5.7 “_66 MS-Master/-Slave operation”)		✔				
34	INCLK	Clock input	Input for reference input via a clock frequency of 0-10 kHz (section 5.2.5 “_25 CK-Clock input/ Clock output”)		✔				

Table 5.17 Settings of the function selectors

Explanatory notes

- In closed-loop control mode “FOR” an encoder with HTL signal is connected at inputs ISD02 and ISD03. Input ISD02 is assigned track A and ISD03 track B.
- If input ISD01 is assigned the function FMSI (fast reference coupling), the digital output OSD01 cannot be used.
- For characteristic switchover via CUSEL, the control location for the switchover must be set in parameter 651-CDSSL to TERM (terminal operation).
- The “MAN” function permits a device configured for bus operation to be operated by the operator locally, e.g. from the switch cabinet. This function can be used for system setup or emergency operation mode.
  By the “MAN” function the parameters are automatically assigned new parameter values, as set out in Table 5.18.

Note: While the “MAN” function is active, the “settings must not be saved in the device”, as the reference structure is changed in the background and the “MAN” function would be activated after the next power-on.

Action	Function	Parameter
Control location	Terminals	260-CLSEL = TERM
Input ISD00	Start clockwise	210-FIS00 = STR
Input ISD01	Start anti-clockwise	211-FIS01 = STL
Reference channel 1	Analog input 0	276-RSSL1 = FA0
Reference channel 2	Off	277-RSSL2 = FCON

Table 5.18 Changes based on activation of the input with the MAN function

Explanatory notes

- The digital inputs only evaluate static signals (see section 2.4 “Specification of control terminals”).

Terminals

The start command for a direction of rotation can be set by way of the terminals of the inverter module. The start commands determine the direction.

If the reference value has a negative preceding sign the fact is indicated during starting by an inverted response - that is to say, in response to Start Clockwise the motor shaft rotates anti-clockwise.

STL	STR	Explanation
0	0	STOP, Motor is uncontrolled if stop ramp and DC braking are off. Otherwise the motor decelerates with the programmed stop ramp or the preset braking current down to 0 Hz and is then brought to a standstill with the preset holding current for a variable holding time.
1	0	START anti-clockwise, Acceleration with ACCRx or DECRx
0	1	START clockwise, Acceleration with ACCRx or DECRx
1	1	BRAKING with DECRx or TDCRx. As soon as the motor reaches 0 Hz it is brought to a standstill with the preset holding current if the DC holding function is activated. Otherwise the motor is uncontrolled at standstill. The braking process can be interrupted by applying only one start contact; the motor then accelerates again.
0 ↓ 1	1 ↓ 0	Reverse direction of rotation, overlap time (STL and STR = 1) min. 8 ms

Table 5.19 Truth table for control via terminals

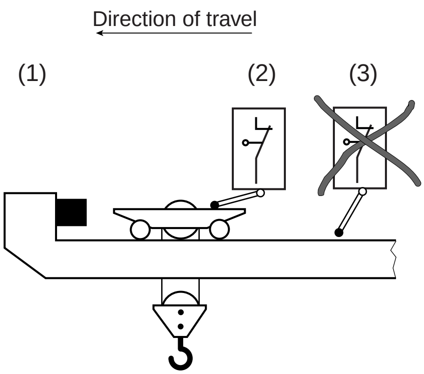
Limit switch evaluation

Limit switch evaluation is based on the evaluation of static signals. No signal edges are evaluated.

The limit switches are monitored dependent on direction of rotation, so reversed limit switches are signalled as errors. The drive runs down uncontrolled.

Mechanical passing of the limit switches is not permitted and is not monitored in terms of plausibility.

Example: If the right side limit switch is approached in clockwise running, this signal stops the drive. But if this signal is overridden and the limit switch is no longer damped, the drive starts up again in the direction of rotation if the clockwise start enable is still applied.



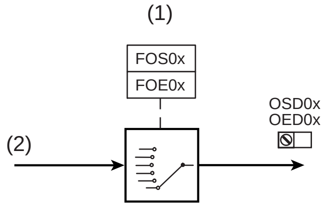
(1) Mechanical end stop
(2) Limit switches not overridable
(3) Limit switches overridable

Figure 5.10 Limit switch evaluation

Note: The evaluation of pulse switches or upstream limit switches is not supported. Bridges in limit switches, leads and switch cabinets are not monitored or detected.
In accordance with EN 954-1 “Safety of machines”, category B is attained without additional control elements.

5.2.4 _24OD-Digital outputs

Function	Effect
• The function selectors determine the function of the digital outputs.	• Free function assignment of all digital outputs



(1) Selection of function of digital output
(2) Digital value

Figure 5.11 Function block for adaptation of the digital outputs

Parameters for digital outputs

Parameter	Function	Value range	FS	Unit	Online
240-FOS00	Function selector digital standard output OSD00	see Table 5.21	OFF		✔
241-FOS01	Function selector digital standard output OSD01	-”-	OFF		✔ 1)
242-FOS02	Function selector digital standard output OSD02 (changeover relay)	-”-	OFF		✔
243-FOE00	Function selector digital output of user module OED00	-”-	OFF		✔
244-FOE01	Function selector digital output of user module OED01	-”-	OFF		✔
245-FOE02	Function selector digital output of user module OED02	-”-	OFF		✔
246-FOE03	Function selector digital output of user module OED03	-”-	OFF		✔

1) Switch between FMSO/FCLK and simple output functions does not work online.

Table 5.20 Parameters from subject area “_24OD-Digital outputs”

Settings for 240-FOS00, ... 246-FOE03

BUS	KP/ DM	Function	Effect	FOS00	FOS01	FOS02	FOE0x
0	OFF	No function	Output off	✔	✔	✔	✔
1	ERR	Collective error message	Device in error state. The error must be eliminated and acknowledged before operation can be restarted. (Section 5.3.10 "_51ER-Error messages")	✔	✔	✔	✔
2	WARN	Collective warning message	Parameterizable warning limit exceeded, device still ready. (Section 5.3.9 "_50 WA-Warning messages")	✔	✔	✔	✔
3	/ERR	Collective error message negated	Device in error state. The error must be eliminated and acknowledged for operation to be restarted. (Section 5.3.10 "_51ER-Error messages")	✔	✔	✔	✔
4	/WARN	Collective warning message negated	Parameterizable warning limit exceeded, device still ready. Wire-break-proof output. (Section 5.3.9 "_50 WA-Warning messages")	✔	✔	✔	✔
5	ACTIV	Control in function	Power stage active and closed-loop/open-loop control control in function	✔	✔	✔	✔
6	ROT_ R	Clockwise rotation	Motor running clockwise	✔	✔	✔	✔
7	ROT_L	Anti-clockwise rotation	Motor running anti-clockwise	✔	✔	✔	✔
8	ROT_0	Motor at standstill	Motor in standstill window (f=0 Hz). Control mode FOR: Safe standstill message. Control mode SFC: Dependent on estimated speed Open-loop control mode VFC: Dependent on reference value.	✔	✔	✔	✔
9	LIMIT	Reference limitation active	The internally processed reference value exceeds the reference limit and is restricted to the limit value. (Section 5.3.1 "_30 OL-Frequency limitation")	✔	✔	✔	✔
10	REF	Reference reached	The preset reference has been reached.	✔	✔	✔	✔
11	SIO	Access by control word of LustBus	Output can be set via the serial interface by the LUSTBUS CONTROL WORD. (Section 5.4.1 "_55 LB-LUSTBUS")	✔	✔	✔	✔
12	OPTN1	Reserved for option module, slot 1	Output available to option module at slot 1. Usable only in conjunction with communication modules.	✔	✔	✔	✔
13	OPTN2	Reserved for option module, slot 2	Output available to option module at slot 1. Usable only in conjunction with communication modules.	✔	✔	✔	✔

Table 5.21 Settings for function selector FOxxx of the digital outputs

BUS	KP/ DM	Function	Effect	FOS00	FOS01	FOS02	FOE0x
14	BRK1	Holding brake function 1 (without motor current monitoring)	Output is set if actual speed in control modes FOR/ SFC has exceeded value in parameter FBCxx. In open-loop control mode VFC the reference infringement is evaluated. (Section 5.5.1 “_31 MB-Motor holding brake”)	✔	✔	✔	✔
15	BRK2	Holding brake function 2 (with motor current monitoring)	Output is set if actual speed in control modes FOR/ SFC has exceeded value in parameter FBCxx. In open-loop control mode VFC the reference infringement is evaluated. (Section 5.5.1 “_31 MB-Motor holding brake”) In addition, current must have flowed in all motor phases. (Section 5.5.1 “_31 MB-Motor holding brake”)	✔	✔	✔	✔
16	WUV	Warning: undervoltage in DC link	Warning message when DC-link voltage has fallen below value in parameter 503-WLUV. Device ready. (Section 5.3.9 “_50 WA-Warning messages”)	✔	✔	✔	✔
17	WOV	Warning: voltage overload in DC link	Warning message when DC-link voltage has exceeded value in parameter 503-WLUV. Device still ready. (Section 5.3.9 “_50 WA-Warning messages”)	✔	✔	✔	✔
18	WIIT	Warning: I^2t integrator started (device)	Warning message when integrator of current I over time t has tripped to protect the device. (Section 5.3.3 “Device protection”)	✔	✔	✔	✔
19	WOTM	Warning: motor temperature	Warning message when motor temperature has exceeded value in parameter 502-WLTM. (Section 5.3.9 “_50 WA-Warning messages”)	✔	✔	✔	✔
20	WOTI	Warning: heat sink temperature of device	Warning message when the heat sink temperature of the device has exceeded the value in parameter 500-WLTI. (Section 5.3.9 “_50 WA-Warning messages”)	✔	✔	✔	✔
21	WOTD	Warning: interior temperature of device	Warning message when the interior temperature of the device has exceeded the value in parameter 501-WLTD. (Section 5.3.9 “_50 WA-Warning messages”)	✔	✔	✔	✔
22	WIS	Warning message: apparent current limit	Warning message when apparent current has exceeded value in parameter 506-WLIS. (Section 5.3.9 “_50 WA-Warning messages”)	✔	✔	✔	✔
23	WFOUT	Warning message: output frequency limit	Warning message when output frequency has exceeded value in parameter 505-WLF. (Section 5.3.9 “_50 WA-Warning messages”)	✔	✔	✔	✔

Table 5.21 Settings for function selector FOxxx of the digital outputs

BUS	KP/ DM	Function	Effect	FOS00	FOS01	FOS02	FOE0x
24	WFDIG	Warning: master reference value incorrect	Warning message when the reference value of the master passed to the slave is incorrect. (Section 5.3.9 "_50 WA-Warning messages")	✔	✔	✔	✔
25	WIT	Warning: ixt integrator started (motor)	Warning message when integrator for current I over time t has tripped to protect the motor. (Section 5.3.2 "_33 MO-Motor protection")	✔	✔	✔	✔
26	S_ RDY	Device initialized	Output is set if the device is initialized after power-on.	✔	✔	✔	✔
27	C_ RDY	Device ready	Output is set if by setting the signal ENPO the device is "ready to start", parameters for a UDS switchover have been completely reset and there are no error messages.	✔	✔	✔	✔
28	DCV	DC-link buffering active	DC link is buffered by means of power failure bridging. (Section 5.3.4 "_34 PF-Power failure bridging")	✔	✔	✔	✔
29	USER0	Reserved for modified software	Output can be used by modified software	✔	✔	✔	✔
30	USER1	Reserved for modified software	Output can be used by modified software	✔	✔	✔	✔
31	USER2	Reserved for modified software	Output can be used by modified software	✔	✔	✔	✔
32	USER3	Reserved for modified software	Output can be used by modified software	✔	✔	✔	✔
33	FMSO	Reference coupling output, Master/-Slave operation	Output of master for reference input to slave in Master/-Slave coupling (Section 5.5.7 "_66 MS-Master/-Slave operation")		✔		
34	OCLK	Clock output for reference input	Output for reference input via a clock frequency of 0-10 kHz (Section 5.2.5 "_25 CK-Clock input/ Clock output")		✔		

Table 5.21 Settings for function selector FOxxx of the digital outputs

Explanatory notes

- The warning messages are not displayed in the DRIVEMANAGER. They can be evaluated in bit-coded form in parameter 120-WRN.
- Parameters can be set for warning limits in subject area _50WA-Warning messages (section 5.3.9).

5.2.5 _25 CK-Clock input/ Clock output

Function	Effect
• Definition of the internal processing of the clock input • Scaling of the output frequency of the clock output	• The reference value can be set by way of a clock frequency • The actual value is mapped onto a clock signal at OSD01

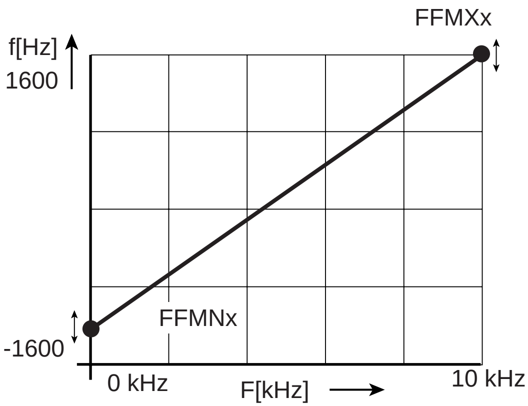


Figure 5.12 Scaling of clock input ISD01

Parameters for clock input/clock output

Parameter	Function	Value range	FS	Unit	Online
250-OCLK	Multiplier for clock output OSD01	1x, 2x, 4x ... 128x	1x		
251-FFMX1	CDS1: Maximum value of clock input ISD01 at 10 kHz	-1600 ... 1600	50	Hz	
252-FFMN1	CDS1: Minimum value of clock input ISD01 at 0 kHz	-1600 ... 1600	0	Hz	
253-FFMX2	CDS2: Maximum value of clock input ISD01 at 10 kHz	-1600 ... 1600	50	Hz	
254-FFMN2	CDS2: Minimum value of clock input ISD01 at 0 kHz	-1600 ... 1600	0	Hz	
255-INCLF	Filter time constant for the clock input	0.002-20	0.01	s	

Table 5.22 Parameters of subject area “_25 CK-Clock input/ Clock output”

Explanatory notes

- By way of the digital input ISD01 the reference of the device can be specified with a clock signal of 0-10 kHz. The function selector 211-FIS01 must be set to INCLK.
- A clock signal proportional to the output frequency of the device can be delivered at OSD01. The transmission ratio is adjustable in increments of 2^n from 1x to 128x, and is limited to the switching frequency of the power stage (parameter 690-PMFS). The function selector 241-FOS01 must be set to OCLK.

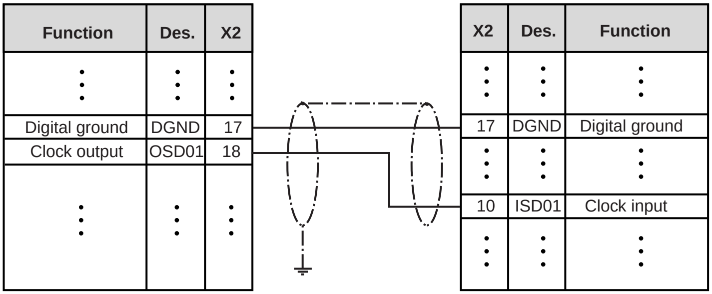


Figure 5.13 Wiring for reference coupling via clock signal 0-10 kHz

Note: The clock cables must be shielded. The shield must be grounded over a wide area on one side.

5.2.6 _28 RS-Reference structure

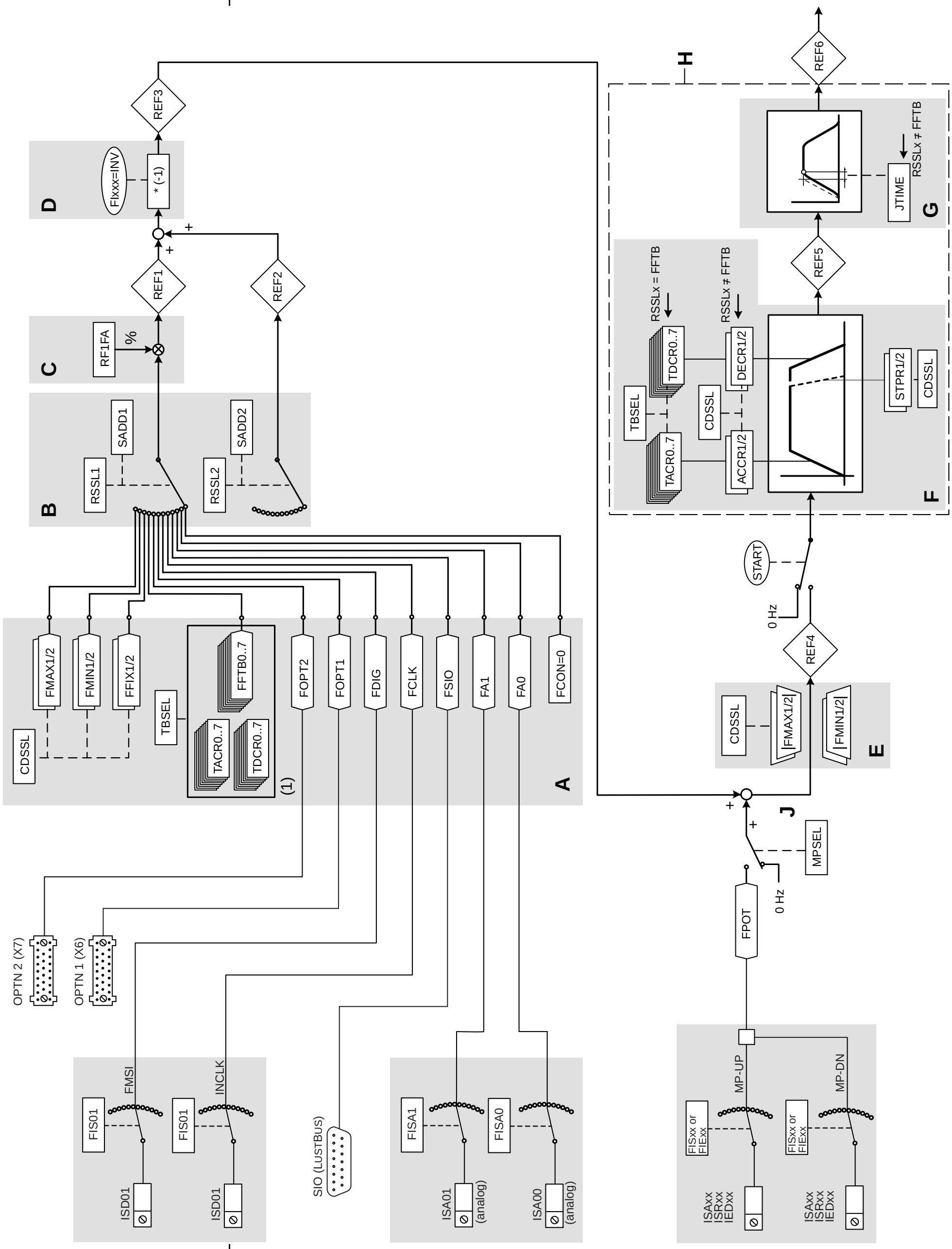
Function	Effect
• By way of the reference structure the two reference channels are added together. Each channel can draw a reference source from a predefined selection.	• The reference structure is adjusted to the application by the assistance parameters such that no adaptation is required for most applications. • For special requirements, the internal processing of the reference value can be adapted by way of the flexible reference structure.

Note: This section is intended only for users who are unable to find their drive solution, or any suggested solution, in the preset application data sets.

Explanatory notes to Figure 5.14

1. **Reference channels:** Reference selectors (B) RSSL1 and RSSL2 switch a reference source (A) onto the reference channel. The selectors can additionally be switched by digital inputs.
   After reference channel 1 has been influenced by parameter RF1FA (0 ... 100%) reference channel 2 is added to it. The sum of the two channels can then also be inverted.
   At various points within the reference structure the current reference value can be observed by means of parameters REF1 to REF6.
2. **Driving profile generator:** The driving profile generator consists of a ramp generator and a smoothing generator (F and G). The ramp generator can switch in operation between different ramp steepnesses from the two characteristic data sets (651-CDSSL).
   Simultaneously setting inputs STR and STL presets the reference 0 Hz for the ramp generator (see also sections 5.2.7 “_26 CL-Control location” and 5.5.3 “_59 DP-Driving profile generator”).
3. **Driving sets:** The driving sets are activated by setting one of the reference selectors to FFTB. The ramps TACR0...7 or TDCR0 ... 7 as appropriate are used (see also section 5.5.5 “_60 TB-Driving sets”).

Reference input block diagram



A Reference sources
B Reference selectors (RSSLx) with offset function (SADDx)
C Reference adjustment, percentage
D Possibility of inversion
E Reference limitation (amount only)
F Ramp generator
G Activate/deactivate smoothing (inactive in table FFTB)
H Driving profile generator
J MOP function
(1) Table with 8 driving sets, incl. acceleration and braking ramps

Figure 5.14 Parameters from subject area _28RS Reference structure

Explanatory notes to Figure 5.14

4. **Smoothing time:** The filter smoothes the beginning and end of the ramp to limit bucking. The acceleration and braking times are extended by the smoothing time (0 to 2000 ms).
   When the driving sets are used the smoothing time is deactivated.

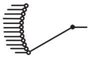
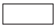
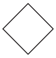
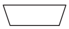
Symbol	Meaning
	Reference source (input), e.g. with second characteristic data set
	Reference selector (switch)
	Mathematical influence
	Interim reference values (for display only)
	Limitation of reference value (upper limit)

Table 5.23 Symbols used in Figure 5.14

Parameters of the reference structure

Parameter	Function	Value range	FS	Unit	Online
280-RSSL1	Reference selector 1	see Table 5.25	FMAX		✔
281-RSSL2	Reference selector 2	see Table 5.25	FCON		✔
282-FA0	Analog reference input ISA00	*	0	Hz	
283-FA1	Analog reference input ISA01	*	0	Hz	
284-FSIO	Reference serial interface	*	0	Hz	✔
285-FPOT	Reference of MOP	*	0	Hz	
286-FDIG	Digital reference input (reference coupling)	*	0	Hz	
287-FOPT1	Reference value of option slot 1	*	0	Hz	
288-FOPT2	Reference value of option slot 2	*	0	Hz	
289-SADD1	Offset value for reference selector 1	0 ... 11	10		✔
290-SADD2	Offset value for reference selector 2	0 ... 11	0		✔
291-REF1	Reference value of reference channel 1	*		Hz	
292-REF2	Reference value of reference channel 2	*		Hz	
293-REF3	Reference before reference limitation	*		Hz	
294-REF4	Reference before ramp generator	*		Hz	
295-REF5	Reference before ramp smoothing	*		Hz	
296-REF6	Reference for transfer to control	*		Hz	
297-RF1FA	Factor for reference channel 1	0 ... 100	100	%	

Table 5.24 Parameters from subject area _28RS Reference structure

Explanatory notes

- Parameter values which are produced from calculations and so are not editable have an asterisk (*) in the “Value range” column.
- The offset value for the reference selector is entered as a purely decimal number.

Setting for 280-RSSL1 and 281-RSSL2

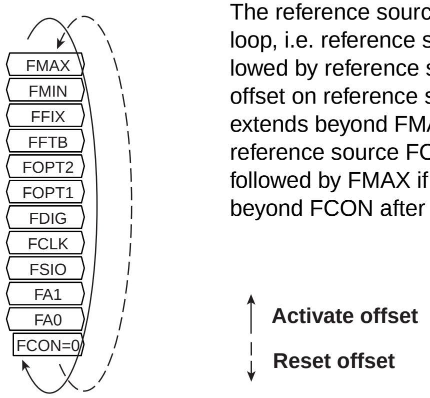
BUS	KP/DM	Function
0	FCON	Shuts off unused reference channel
1	FA0	Analog reference value of input ISA00 (± 10 V, 0 ... 20mA etc.)
2	FA1	Analog reference value of input ISA01 (0 ... + 10 V)
3	FSIO	Reference via serial interface
4	FCLK	Reference via clock signal 0 ... 10 kHz at ISD01
5	FDIG	Reference for Master/-Slave operation
6	FOPT1	Reference of option module at slot 1 (user module)
7	FOPT2	Reference of option module at slot 2 (communication module)
8	FFTB	Table with eight fixed frequencies and associated acceleration and braking ramps; selection of table position via inputs with the FFTBx function or directly in parameter TBSEL
9	FFIXx	Fixed frequency, switchable with characteristic data set switchover (FFIX1 and FFIX2)
10	FMINx	Minimum output frequency, switchable with characteristic data set switchover (FMIN1 and FMIN2)
11	FMAXx	Maximum output frequency, switchable with characteristic data set switchover (FMAX1 and FMAX2)

Table 5.25 Settings for reference selectors

Working with reference selectors RSSLx and offset SADDx

Reference channels 1 and 2 are supplied by the reference sources depending on the setting of reference selectors 276-RSSL1 and 277-RSSL2. By adding together the two reference sources, an offset from reference channel 2 can be added to reference channel 1 for example.

An offset SADDx can be applied to the selectors RSSLx. In this way the reference selector can be switched between various sources in operation. The offset can be changed by way of the digital inputs. For this, the function selectors of the inputs must be configured accordingly to the parameter value SADDx. The offset consists of a 4-bit data word (here: 0...11) positioned in the relevant parameter 28x-SADDx. The inputs set the offset for the reference selector with the rising edge and cancel the offset with the falling edge.



The reference sources are selected in a loop, i.e. reference source FMAX is followed by reference source FCON if the offset on reference selector RSLLx extends beyond FMAX. In the same way, reference source FCON is automatically followed by FMAX if the offset extends beyond FCON after removal.

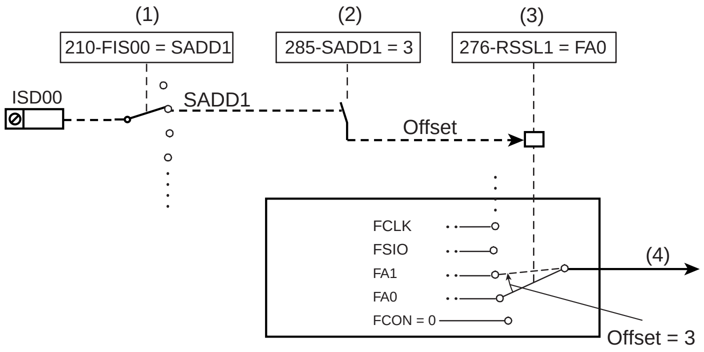
Figure 5.15 Selection of reference sources

Note: Selector RSSLx can only be switched by a digital input, assigned the offset SADDx. Several digital inputs with the offset SADDx do not cause repeated feedforward of selector RSSLx.

Example of reference source switching:

210-FIS00 = SADD1	The digital input ISD00 switches the offset value of parameter 285-SADD1 on/off
285-SADD1 = 3	The offset value of parameter SADD1 has a stepwidth of 3 increments

If the digital input ISD00 is set, the reference selector RSSL1 is increased by the value “3 increments” from parameter 285-SADD1 (see Figure 5.16). If there is a falling edge at input ISD00, the offset is cancelled again, causing the original reference source to be set.



(1) Activate offset via digital input
(2) Offset value for base reference source
(3) Base reference source
(4) Reference from selected reference source on reference channel

Figure 5.16 Example: Input ISD00 delivers offset for reference selector RSSL1. Operation of input ISD00 switches the reference source.

Procedure for setting reference input

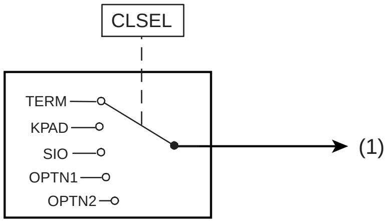
The precondition is the factory setting (FS) in which only the first characteristic data set is active (650-CDSAC= 0). It is advisable always to follow the procedure below to set the reference input for your application:

Step	Function	Explanation	Subject area	Parameter
1	Select reference source	Set the reference selector to the desired reference source (see table: “Explanation of reference sources”).	“_28 RS-Reference structure”	280 -RSSL1
2	Define reference limit	Define the reference limits for minimum and maximum output frequency.	“_30 OL-Frequency limitation”	301 -FMIN1 303 -FMAX1
3	Set ramp generator	Enter the acceleration and braking ramps and any applicable stop ramp.	“_59 DP-Driving profile generator”	590 -ACCR1 592 -DECR1 594 -STPR1
4	Activate bucking limitation	Define the smoothing of your driving profile as necessary in order to obtain smooth transitions between the individual ramps.	“_59 DP-Driving profile generator”	596-JTIME
5	Reference adjustment	Set the parameters for a reference adjustment as necessary. This may be a percentage factor by which reference channel 1 is multiplied, or an inversion of the common reference value from both reference channels by way of a function selector.	“_28 RS-Reference structure”	297 -RF1FA FIxxx= INV

Table 5.26 Procedure for setting reference input

5.2.7 _26 CL-Control location

Function	Effect
• The control location determines the source from which the control commands are given. • Auto-Start after power-up	• Possible control locations are: -Terminals - KEYPAD KP200 control unit - Serial interface - Option slot 1 or 2 • Drive starts directly in Auto-Start function if contact ENPO is set.



(1) Chosen control location

Figure 5.17 Function block: Control location selector

Parameters for control location

Parameter	Function	Value range	FS	Unit	Online
7-AUTO	Auto-Start	OFF/ON	OFF		✔
260 -CLSEL	Control location selector	see Table 5.28	TERM		✔

Table 5.27 Parameters from subject area _26CL Control location

Settings of the control location selector 260-CLSEL

BUS	KP/DM	Function
0	TERM	Terminals
1	KPAD	KEYPAD KP200
2	SIO	Serial interface RS232 (Serial Input Output)
3	OPTN1	Option module at slot 1 (user modules)
4	OPTN2	Option module at slot 2 (communication modules)

Table 5.28 Settings for 260-CLSEL Control location selector

1 2 3 4 5 6 A DE EN

Terminals

The start command for a direction of rotation can be set by way of the terminals of the inverter module. The start commands determine the direction.

Attention: If the reference value (BUS, SIO, +/- 10 V, etc.) has a negative preceding sign, the fact is indicated on startup by an inverted response, i.e. the motor shaft rotates anti-clockwise in response to a clockwise start.

STL	STR	Explanation
0	0	STOP, Motor is uncontrolled if stop ramp and DC braking are off. Otherwise the motor decelerates with the programmed stop ramp or the preset braking current down to 0 Hz and is then brought to a standstill with the preset holding current for a variable holding time.
1	0	START anti-clockwise, Acceleration with ACCRx or DECRx
0	1	START clockwise, Acceleration with ACCRx or DECRx
1	1	BRAKING with DECRx or TDCRx. As soon as the motor reaches 0 Hz it is brought to a standstill with the preset holding current if the DC holding function is activated. Otherwise the motor is uncontrolled at standstill. The braking process can be interrupted by applying only one start contact; the motor then accelerates again.
0 ↓ 1	1 ↓ 0	Reverse direction of rotation, overlap time (STL and STR = 1) min. 8 ms

Table 5.29 Truth table for control via terminals

KEYPAD KP200

In the CONTROL menu the KEYPAD takes over complete control over the inverter. It attunes the control location selector and the reference channel 1 to itself. The second reference channel is shut off.

By way of the KEYPAD control of the inverter can be seized and a reference value with preceding sign can be set to determine the direction of rotation.

Parameters for setting and adapting the KEYPAD are located in subject area _36KP.

For more information on the KEYPAD refer to the separate documentation, “User Manual DRIVEMANAGER and KEYPAD”.

Serial interface

To control the inverter module via the serial interface (terminal X4) the LustBus protocol is used. By way of the LustBus protocol the DriveManager accesses the module. Control of the inverter can be seized by way of the serial interface.

The control location is set to SIO as soon as the DriveManager function "Control device" is selected.

At the end of the control window the old setting is restored before the control function is taken over by the DriveManager.

Note: If communication between the inverter module and the DriveManager is interrupted, the setting can no longer be reset by the DriveManager.

Parameters for setup and data exchange of the serial interface are located in subject area "_55 LB-LustBus" (section 5.4.1).
For more information on control via the serial interface refer to the separate documentation: "Data transfer protocol, LustBus".

Option slots 1 and 2

Activation of the inverter module by way of communication modules can be handled via the DRIVECOM state machine or the LUST-specific protocol.

The control location is set to OPTx.

The option slots are described in section 2.2 "Module mounting". Pay attention to the special notes set out there.
Parameters for setting and data exchange of the communication modules are described in section 5.4.2 "_57 OP-Option modules".

1 2 3 4 5 6 A

Overview of option modules

Order designation	Option modules	Summary description	Control location
CM-CAN1	CAN_{Lust}	Conforming to CiA Draft Standard 301	OPTx
CM-CAN2	CAN_{open}	Conforming to CiA Draft Standard 402	OPTx
CM-DPV1	PROFIBUS-DP	Conforming to EN 50170 / DIN 19245	OPTx
UM-8I40	I/O module	Terminal expansion module with 8 inputs and 4 outputs	TERM

Table 5.30 Overview of option modules

5.3 Protection and information

Protection of the motor and of the CDA3000 inverter module is preset depending on the power class of the module. By means of parameter setting the protection can be adapted for special applications and the protection zone made more sensitive. These safety devices are indicated by warning and error messages. As an aid to setup, indications of the current actual values and of the device capacity utilization can be obtained in the form of a peak value memory.

A special case is power failure bridging, which can be parameterized in response to infringement of a minimum voltage at the mains voltage input.

5.3.1 _30 OL-Frequency limitation

Function	Effect
• Limitation of the output frequency for a characteristic data set	• Setting of maximum and minimum limit frequencies

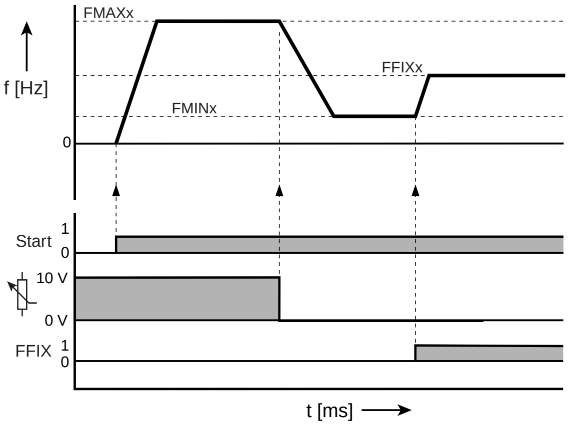


Figure 5.18 Limitation of output frequency

Parameters of frequency limitation

Parameter	Function	Value range	FS	Unit	Online
301-FMIN1	CDS1: Minimum reference frequency	0 ... 1600	0	Hz	
302-FMIN2	CDS2: Minimum reference frequency	0 ... 1600	0	Hz	
303 -FMAX1	CDS1: Maximum reference frequency	0 ... 1600	50	Hz	
305 -FMAX2	CDS2: Maximum reference frequency	0 ... 1600	50	Hz	
306 -FMXA1	CDS1: Absolute maximum frequency	0 ... 1600	1600	Hz	
307 -FMXA2	CDS2: Absolute maximum frequency	0 ... 1600	1600	Hz	

Table 5.31 Parameters from subject area _30OL Frequency limitation

Explanatory notes

- CDS = Characteristic data set
- With FMINx 0 Hz, after starting the output frequency is accelerated from 0 Hz with the ramp ACCRx to FMINx.
- The absolute maximum frequency FMXAx limits the output frequency of control functions, such as slip compensation in V/F operation.
- Online parameter setting of the absolute maximum frequency is possible, but results in a direct frequency jump if the reference is lower than the maximum frequency.
  Consequently, the absolute maximum frequency must not be changed online.
- Changing parameter FMINx or FMAXx activates a controller initialization.

5.3.2 _33 MO-Motor protection

Function	Effect
• Monitoring of motor temperature by temperature sensors (PTC) or by temperature-sensitive switches and Ixt monitoring. • Both functions are deactivated in the factory setting.	The inverter module shuts off the motor with an error message: • E-OTM, if the motor temperature exceeds a programmable limit value. • E-OLM if the up-integrated current/time value exceeds the required motor-dependent limit value for a specific release time. This function replaces a motor circuit-breaker. • The inverter module can deliver a warning message when the Ixt motor protection integrator starts.

Note: The resistance of the PTC has a value of > 3 kW (cf. DIN 41081 and DIN 44082) at the nominal response temperature.

PTC evaluation

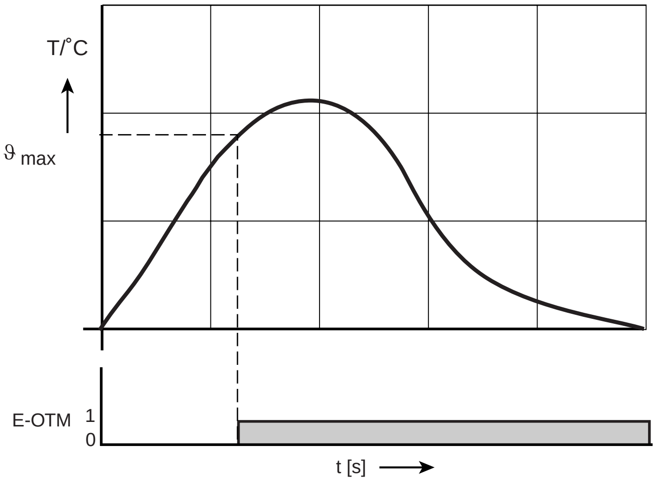


Figure 5.19 PTC evaluation operation diagram

Explanatory notes

The inverter module shuts off the motor with the error message E-OTM if the temperature exceeds a limit value.

The following temperature sensors can be used:

- Linear PTC (KTY 84, yellow)
- Threshold PTC (to DIN 44082)
- Thermostatic circuit-breaker (Klixon)

Note: With KTY 84-Evaluation the current motor temperature is displayed in parameter 407-MTEMP in ˚C (actual value/VAL menu).

Ixt monitoring

Ixt monitoring protects the motor against overheating over its entire speed range. This is especially important for internally cooled motors, since in lengthy service at low speed the cooling provided by the fan and the housing is insufficient. When set correctly, this function replaces a motor circuit-breaker. The characteristic can be adapted to the operating conditions by way of interpolation points.

Motor protection characteristic in factory setting

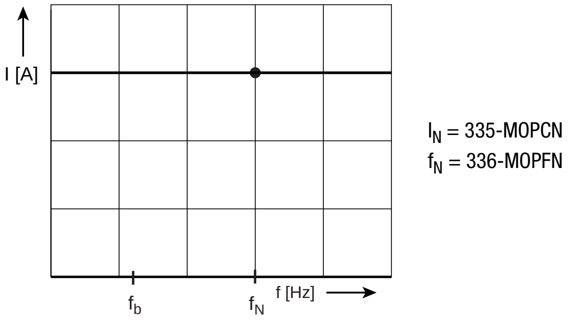


Figure 5.20 Factory setting of the motor protection characteristic

In the factory setting, the shutdown time under differing loads can be read from the diagram below. The characteristic shifts according to the output frequency along the x-axis (I/I_N) of the diagram.

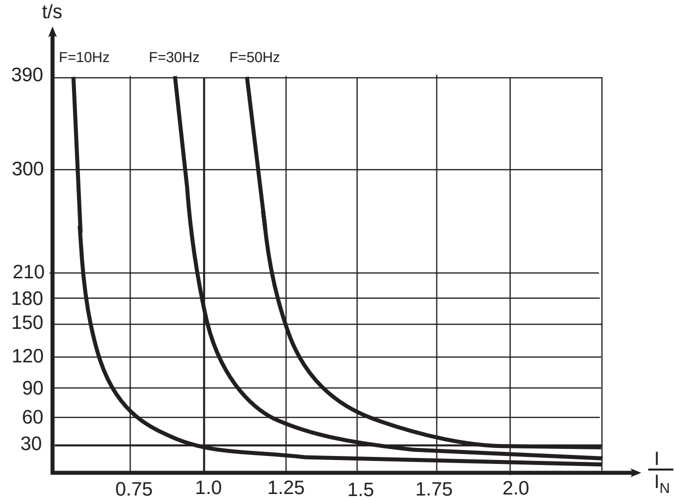


Figure 5.21 Determination of the shutdown time in the factory setting

Characteristic adaptation

The motor protection characteristic can be adapted to the motor manufacturers' specifications by means of the interpolation points A and B and the nominal point N.

Factory setting

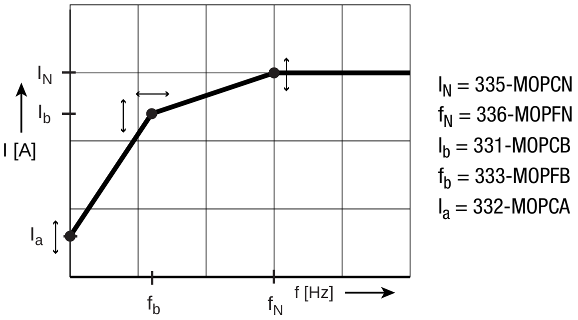


Figure 5.22 Below the rated frequency f_N (or rated current I_N) the motor can be protected by freely programmable current limits (for explanations of the short names see Table 5.33).

Note: The shutdown times in the case of characteristic adaptation cannot be read from a pre-drawn diagram, but must be calculated separately for individual operation points.

If the current and actual frequency of an operation point are known, the Ixt monitoring can be calculated.

For segments 1 , 2 and 3 different calculation formulae are produced. The appropriate formula is determined on the basis of the actual frequency.

1. Calculation of the maximum Ixt factor (limit)

ixt_{max} = (1.5 - 1.1) x MOCNM x 60 s

- 60 s: Max. overload time
- MOCNM: Motor rated current
- 1.1: Current factor for start of Ixt monitoring
- 1.5: Current factor for max. motor current

ixt_{max} = 24 x MOCNM

2. Calculation of max. overload time at operation point

Condition	Segment	Calculation
$\lvert f_{ist}\rvert < MOPFB$	1	$i_{lim1} = \frac{MOPCB - MOPCA}{MOPFB} \cdot \lvert f_{ist}\rvert + MOPCA$ $i_{start1} = 1,1 \cdot i_{lim1}$ $t_{off} = \frac{ixt_{max}}{i_{ist} - i_{start1}}$
$MOPFB \le \lvert f_{ist}\rvert < MOFN$	2	$i_{lim2} = \frac{MOCNM - MOPCB}{MOFN - MOPFB} \cdot (\lvert f_{ist}\rvert - MOFN) + MOCNM$ $i_{start2} = 1,1 \cdot i_{lim2}$ $i_{start2} = \frac{ixt_{max}}{i_{ist} - i_{start2}}$
$MOFN < \lvert f_{ist}\rvert$	3	$i_{lim3} = MOCNM$ $i_{start3} = 1,1 \cdot i_{lim3}$ $t_{off} = \frac{ixt_{max}}{i_{ist} - i_{start3}}$

Table 5.32 Overload calculation with adapted motor protection characteristic

f_{ist}	Actual frequency of operation point
i_{ist}	Actual current of operation point
MOPCA	Motor current in [A] of interpolation point A
MOPCB	Motor current in [A] of interpolation point B
MOPFB	Motor frequency in [Hz] of interpolation point B
MOCNM	Motor rated current in [A] of nominal point N
MOFN	Motor rated frequency in [Hz] of nominal point N
i_{lim}	Limit current at operation point
i_{start}	Startup current for Ixt monitoring at operation point
i_{off}	Integration time to shut-off

Negative value → Integrator not active

Positive value → Integrator active

Explanatory notes

- Ixt monitoring protects the motor against overheating over its entire speed range. This is useful for internally cooled motors, because in lengthy service at low speeds the cooling by the fan may not be adequate.
- The inverter module shuts off the motor with error message E-OLM if the up-integrated current time value exceeds the motor-dependent limit value for a specific release time. This function replaces a motor circuit-breaker.
- For thermal reasons, up-integration is 10 times faster than down-integration.
- Startup of the Ixt integrator can be delivered with the setting of function selector FOSxx=WIT to a digital output (see section 5.2.4 "_24OD-Digital outputs").
- Ixt integration of the individual user data sets (UDSs) always remains active. This means that when a UDS is active the Ixt integrators of the inactive UDS's are down-integrated. In the case of a UDS switchover, such as to operate a multi-axle system, the Ixt integrator of the motor protector is down-integrated in the standstill time of the inactive axles, in the same way as in cooling of the motor.

Parameters for motor protection

Parameter	Function	Value range	FS	Unit	Online
330-MOPTC	Type of PTC evaluation	see Table 5.34	OFF		✔
331-MOPCB	2nd current interpolation point (I_b) of the motor protection characteristic (referred to the max. characteristic current)	0 ... 100	100	%	
332-MOPCA	1st current interpolation point (I_a) of the motor protection characteristic (referred to the max. characteristic current)	0 ... 100	100	%	
333-MOPFB	2nd frequency interpolation point f_b) of the motor protection characteristic	0.1 ... 1600	50	Hz	
334-MOTMX	Maximum motor temperature	10 ... 250	150	°C	✔
335-MOPCN	Motor rated current (I_N) for motor protection	Dependent on inverter module, see Table 5.35	I_N	A	
336-MOPFN	Motor rated frequency (f_N) for motor protection	0.1 ... 1000	50	Hz	

Table 5.33 Parameters from subject area _33MO Motor protection

1 2 3 4 5 6 A

Explanatory notes

- To protect the motor, the characteristic and operation of the IEC standard motor should generally conform to the following limit values:

  f = 0 Hz ≈ 30% I_N

  f = 25 Hz ≈ 80% I_N

  f_N = 50 Hz ≈ 100% I_N

  Consult the motor manufacturers for precise data.

The following temperature sensors can be set by way of parameter 330-MOPTC:

BUS	KP/DM	Function
0	OFF	Monitoring off
1	KTY	Linear PTC (KTY84, yellow)
2	PTC	Threshold PTC (to DIN 44082)
3	TSS	Klixon (temperature switch as break contact)

Table 5.34 Settings for 330-MOPTC Temperature sensor

Settings for 335-MOPCN

Inverter module	Recommended 4-pole IEC standard motor [kW]	Motor rated current for motor protection, MOPCN [A]
CDA32003	0.375	2.0
CDA32004	0.75	3.4
CDA32006	1.1	5.1
CDA32008	1.5	6.5
CDA34003	0.75	2.0
CDA34005	1.5	3.8
CDA34006	2.2	5.6
CDA34008	3.0	7.5
CDA34010	4.0	9.1
CDA34014	5.5	11.6

Table 5.35 Motor rated current dependent on inverter module and IEC standard motor

Inverter module	Recommended 4-pole IEC standard motor [kW]	Motor rated current for motor protection, MOPCN [A]
CDA34017	7.5	16.3
CDA34024	11	23.1
CDA34032	15	31.1
CDA34045	22	44.1
CDA34060	30	57.1
CDA34072	37	70.1
CDA34090	45	85.1
CDA34110	55	98.1
CDA34143	75	140.1
CDA34170	90	168.1

Table 5.35 Motor rated current dependent on inverter module and IEC standard motor

Note: The linear PTC evaluation is adapted to a KTY84 with yellow tolerance marking, i.e. 100 ˚C is in the tolerance band 970 ... 1030 Ω.

5.3.3 Device protection

Function	Effect
• Protection of the CDA3000 inverter module against destruction by overload	The inverter module shuts off the motor with an error message: • E-OTI, if the device temperature exceeds a fixed limit value. • E-OLI if the up-integrated current/time value exceeds the preset limit value dependent on the inverter module for a specific release time. • E-OC in case of short-circuit or ground fault detection • The inverter module can deliver a warning message when the I^2xt device protection integrator starts.

The software and hardware of the CDA3000 inverter module autonomously monitors and protects the frequency inverter.

The power stage protects itself against overheating dependent on

- the heat sink temperature
- the current DC-link voltage
- the power stage transistor module used and
- the modulation switching frequency

Note: The current heat sink temperature of the inverter module in the range of the power transistors (KTEMP) and the device interior temperature (DTEMP) are displayed in ˚C (actual value/VAL menu).

Under high load the I^2xt integrator is activated. The I^2xt monitor protects the device against permanent overload. The shutdown limit is calculated from the rated current of the device, which can be outputted for 60 seconds.

Device	Ixt device shutdown limit
CDA32.003 (0.375 kW) to CDA34.032 (15 kW)	1.8 x device rated current
CDA34.045 (22 kW) to CDA34.170 (90 kW)	1.5 x device rated current

Table 5.36 Ixt shutdown limits according to device size

When the I^2 xt integrator starts up a warning message can be delivered at a digital output. For this, the function selector of the digital output must be set to the value WIT.

Short-circuit or ground fault

The hardware of the inverter module detects a short-circuit at the motor output and shuts down the motor.

A ground fault is detected by measurement of all three phase currents even when the power stage is deactivated. This means that increased leakage currents can also be registered.

Short-circuits or ground faults are detected automatically by the hardware.

5.3.4 _34 PF-Power failure bridging

Function	Effect
• After a power failure the inverter module is powered by the rotational energy of the motor.	• A short-time interruption of the mains voltage merely causes a reduction in motor speed, which is restored to the original level when the power is restored.

Note: The power failure bridging function should **only** be operated with control modes SFC and FOR. When the power failure bridging function is active the current-controlled startup function is deactivated.

Parameters for power failure bridging

Parameter	Function	Value range	FS	Unit
340-PFSEL	Power failure bridging selector	see Table 5.38	0	
341-PFVON	DC-link switching threshold as from which power failure bridging is active	32.xxx ⇨ 212 ... 408 34.xxx ⇨ 425 ... 782	260 452	V V
342-PFVRF	DC-link control reference	32.xxx ⇨ 212 ... 408 34.xxx ⇨ 425 ... 782	236 438	V V
343-PFTIM	Time span until check as from mains power restoration	1 ... 10000	50	ms
351-PFC	Power failure bridging active current reference	0 ... 180	100	%
354-PFR	Power failure bridging deceleration ramp	1 ... 999	999	Hz/s

Table 5.37 Parameters from subject area _34PF Power failure bridging

Power failure bridging selector 340-PFSEL

BUS	KP/DM	Function
0	OFF	Power failure bridging off
1	NOFCT	No function
2	RETRN	Longest possible DC-link bridging with restart
3	NORET	Longest possible DC-link bridging without restart
4	NOLIM	Fastest possible DC-link controlled speed reduction

Table 5.38 Settings for 340-PFSEL

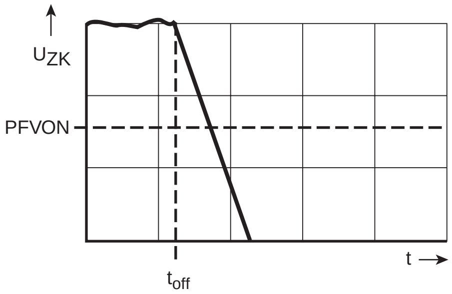
Note: The power failure bridging selector presets the parameters of the subject area to values for max. DC-link buffering or fastest possible speed reduction. We therefore recommend not changing the parameter setting.

Explanatory notes

- When "fastest possible DC-link controlled speed reduction" is set with 340-PFSEL=NOLIM and "longest possible DC-link buffering without restart is set with 340-PFSEL=RETRN, no check is made for restoration of mains power.
- If the DC-link control reference (342-PFVRF) is above the DC-link switching threshold above which power failure bridging is activated (341 -PFVON), the power failure bridging function jumps between "on" and "off". When "... with restart" is set, this results in a switch between deceleration and acceleration ramp.

Power failure detection

The power failure is detected based on the measured DC-link voltage (U_{ZK}) when a parameterizable lower limit voltage threshold (PFVON) is infringed.



PFVON DC-link switching threshold as from which power failure bridging is activated

t_{off} Time of power failure

Figure 5.23 Power failure voltage threshold

(1) Longest possible DC-link buffering by DC-link controlled speed reduction

(regenerative braking)

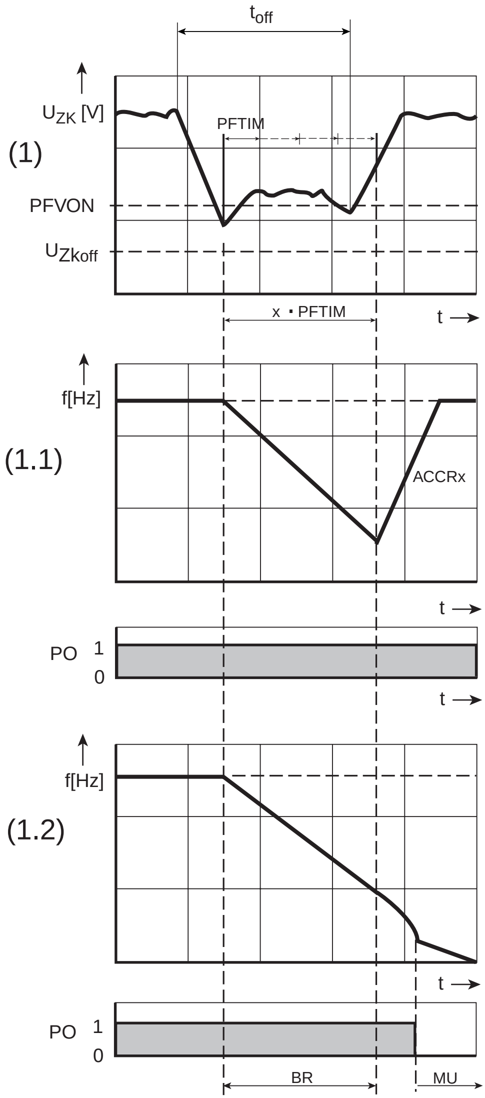
After a detected power failure, the DC-link voltage is regulated to the parameter value 341-PFVON. The motor is automatically run in regenerative mode and braked as required by DC-link buffering. If the rotational energy of the motor is no longer adequate for DC-link buffering, when the fixed undervoltage shutdown threshold U_{Zkoff} is reached the power stage is disabled and the motor coasts uncontrolled.

(1.1) Setting with restart (PFSEL = RETRN)

If the mains power is restored before the undervoltage shutdown threshold U_{Zkoff} is reached, the inverter automatically returns to speed-controlled operation. Regardless of the current speed of the motor, the motor is accelerated back up via the preset ramps ACCRx and governed to the frequency reference active prior to the power failure.

(1.2) Setting without restart (PFSEL = NORET)

When the mains power is restored the inverter remains in power failure bridging mode. The motor coasts uncontrolled, if it has not already come to a standstill. The motor can be accelerated again with a new controller enable and start signal.



PO Status of power stage (active/inactive)
MU Motor uncontrolled
BR Regenerative braking
T_{off} Power failure time
U_{ZK} DC-link voltage

Figure 5.24 Controlled speed reduction

Effect of setting of active current reference 351-PFC

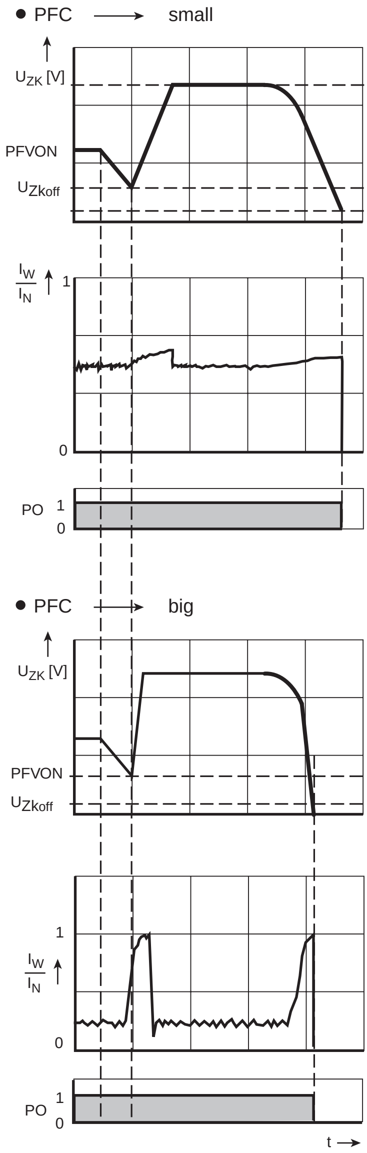
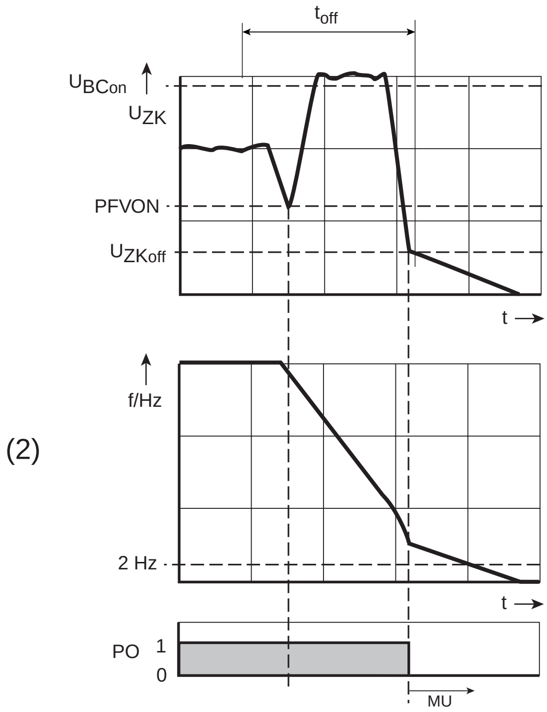


Figure 5.25 Effect of active current reference PFC

(2) Fastest possible DC-link controlled speed reduction without limitation of ramp steepness (PFSEL = NOLIM)

(emergency stop in case of power failure)

A detected power failure is followed by a fastest possible speed reduction regulated to the voltage reference. The voltage reference is above the braking chopper threshold, so the energy of the motor can be discharged by way of the braking chopper if a braking resistor is connected. When the fixed undervoltage shutdown threshold U_{ZKOff} is reached, the motor coasts uncontrolled. When the power is restored the frequency is not automatically increased to the preset frequency reference.

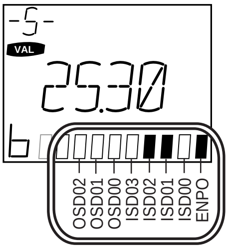


U_{BCon}	Braking chopper switching threshold
PO	Status of power stage (active/inactive)
MU	Motor uncontrolled
BR	Regenerative braking
t_{off}	Power failure time
U_{ZK}	DC-link voltage

Figure 5.26 Maximum speed reduction

5.3.5 _36 KP-KEYPAD

Function	Effect
• Password settings for the user levels • Definition of the permanent displays	• Protection of the inverter module against unauthorized access • Selection of key actual values for permanent display



inactive (Low level)

active (High level)

Figure 5.27 Display for continuous actual value display and bar graph

The continuous actual value display and bar graph can be used separately to display actual values. The bar graph is used for status display of system values or to view trends of individual actual values.

Parameters of the KEYPAD

Parameter	Function	Value range	FS	Unit	Online
360-DISP	Continuous actual value display of the KP200	see Table 5.40	406		✔
361-BARG	Bar graph display of the KP200		419		✔
362-PSW2	Password for user level 2 of the KP200	0 ... 65535	0		✔
363-PSW3	Password for user level 3 of the KP200	0 ... 65535	0		✔
364-PSW4	Password for user level 4 of the KP200	0 ... 65535	0		✔
367-PSWCT	Password for the CTRL menu of the KP200	0 ... 65535	0		✔
368-PNUM	Activate/deactivate parameter number display of the KP200	ON / OFF	OFF		✔
369-CTLFA	Multiplier of incremental value in CTRL menu of KP200	1 ... 65535	10000		✔
1-MODE	User level of KP200	1 ... 6	1		✔

Table 5.39 Parameters from subject area _36KP KEYPAD

Explanatory notes

- The user levels are presented in detail in section 3.2. By way of parameter MODE the user level is selected and, where appropriate, a prompt is delivered for the password, unless deactivated by the entry 0.
- Parameter CTLFA is used to set the scrolling speed of the Up ↑ and Down ↓ cursor keys for setting reference values in the CTRL menu.

Error messages resulting from user error in operation of the KEYPAD or SMARTCARD are detailed in appendix B.

Note: KEYPAD user error: Reset with **start/enter**
User error SMARTCARD: Reset with **stop/return**.

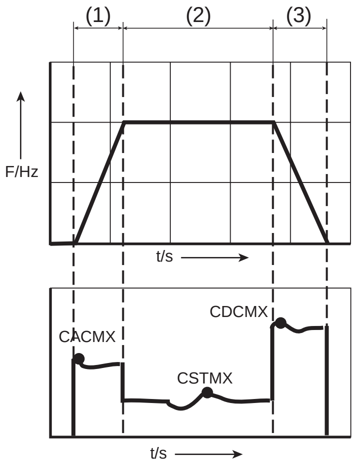
Settings for 360-DISP and 361-BARG

No.	Parameter	Function	DISP	BARG
14	14-ACTT	Actual torque (SFC and FOR)	✔	✔
401	401-ACTN	Actual speed (FOR)	✔	✔
404	404-VMOT	Output voltage	✔	
405	405-DCV	DC-link voltage	✔	✔
400	400-ACTF	Current actual frequency	✔	
406	406-REFF	Current reference frequency	✔	
409	409-ACCUR	Effective value of active current	✔	✔
408	408-APCUR	Effective value of apparent current	✔	✔
428	428-PS	Apparent power	✔	
429	429-PW	Active power	✔	
86	86-TSYS	System time after power-up	✔	
87	87-TOP	Inverter operating hours	✔	
413	413-ACTOP	Power stage operating hours	✔	
410	410-IOSTA	States of digital inputs and outputs	✔	✔
416	416-ISA0	Filtered input voltage ISA00	✔	
417	417-ISA1	Filtered input voltage ISA01	✔	
418	418-ISA0I	Filtered input current ISA00	✔	
407	407-MTEMP	Motor temperature with KTY84 - Evaluation	✔	
425	425-DTEMP	Interior temperature	✔	✔
427	427-KTEMP	Heat sink temperature	✔	✔

Table 5.40 Settings for continuous actual value display and bar graph

5.3.6 _38TX-Device capacity utilization

Function	Effect
• Display of all information of importance for drive configuration as – Peak value memory – Mean device capacity utilization	• Optimization of drive configuration • Rapid fault rectification



(1) Acceleration
(2) Stationary operation
(3) Braking

Figure 5.28 Peak current value storage for checking of drive dimensioning

The peak current value memory continuously stores the absolute peak values in the acceleration, stationary operation and braking phases. Also, the mean device capacity utilization is calculated by means of a filter time constant. When the values have been read they can be reset.

Parameters for device capacity utilization

Parameter	Function	Value range	FS	Unit	Online
380-CACMX	Max. current in acceleration phase referred to device rated current	2 x I_N device	*	%	
381-CDCMX	Max. current in braking phase referred to device rated current	0 ... 300% I_N device	*	%	
382-CSTMX	Max. current in stationary operation referred to device rated current	0 ... 300% I_N device	*	%	
383-CFCMX	Effective value of maximum current	0 ... 300% I_N device	*	A	
384-CSCLR	Reset peak value storage	ACTIV / CLEAR	ACTIV		✔
388-CMID	Mean device capacity utilization	0 ... 250 % I_N device	100	%	
389-CMIDF	Filter time constant for mean device capacity utilization	1 ... 1000	20	s	

Table 5.41 Parameters from subject area _38TX Device capacity utilization

Explanatory notes

- Parameter values which are produced from current calculations and so are not editable have an asterisk (*) in the “Value range” column.
- Peak value storage in the entire subject area _38TX is reset by setting the value 384-CSCLR = CLEAR.
- For display of the mean device capacity utilization via 388-CMID, the filter time constant 389-CMIDF must be set to a value greater than five times the cycle duration of the drive.

Example: Mean device capacity utilization

The mean device capacity utilization will be formed by way of a filter element in the form of a PT1 element. For this, the filter constant should be set to five times the cycle duration of the drive.

Block diagram:

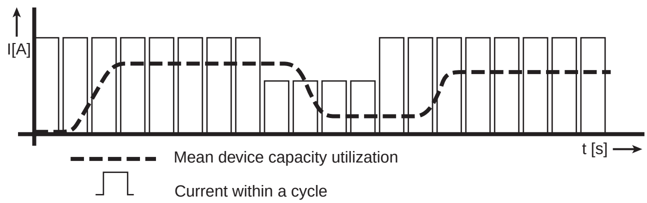


Figure 5.29 Mean device capacity utilization

Calculation of effective inverter capacity utilization

Note: The following condition must be met for safe operation:

$I_{eff} < I_{N-inverter}$

The following condition must additionally be met:

$[(I_{Last})^2 - (I_{N\text{-}Umrichter})^2] \cdot t_{Überlast}$

with

0.37 kW to 15 kW: [1.8 - 1] · 30 s ≤ 67.2 As

22 kW to 90 kW: [1.5 - 1] · 60 s ≤ 75 As

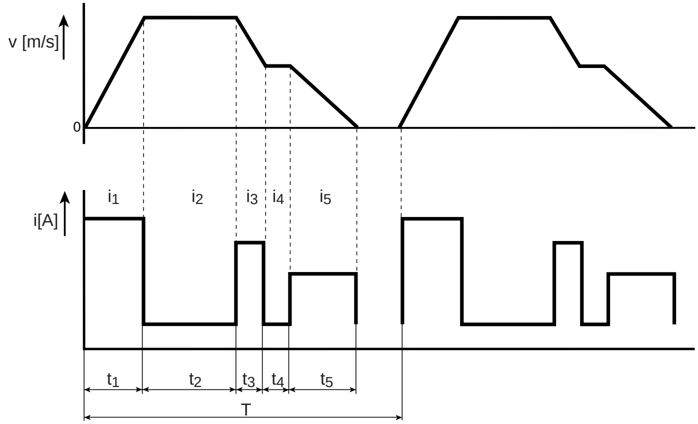


Figure 5.30 Effective inverter capacity utilization

$$I_{eff} = \sqrt{\frac{i_1^2 \cdot t_1 + i_2^2 \cdot t_2 + i_3^2 \cdot t_3 + i_4^2 \cdot t_4 + i_5^2 \cdot t_5}{T}}$$

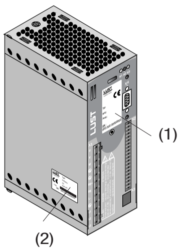
T	Cycle duration
i_x	Current in cycle segment x in [A]
t_x	Time for cycle segment x in [s]
I_{eff}	Effective inverter current

5.3.7 _39DD-Device data

Function	Effect
• Delivery of all data of the inverter module	• Unique identification of the inverter module and the device software

The device data contain information on the inverter hardware and software which should be kept to hand and quoted when calling on telephone support from LUST.

The device data can in part also be read from the rating plates.



1. Rating plate with performance data of hardware, type designation and serial number
2. Rating plate with software version details, type designation and serial number

Note: A more recent firmware than indicated on the software rating plate (2) should additionally be indicated by a notice on the device itself.

Parameters for device data

Parameter	Function	Value range	FS	Unit	Online
89-NAMDS	Data set name	0-28 characters	-		✔
90-SREV	Base standard version of modified software	*			
92-REV	Software revision	*			
93-KOMP	Compatibility class of SMARTCARD	*			
106-CRIDX	Revision index as suffix to revision number	*			
127-S_NR	Serial number of device	*			
130-NAME	Symbolic device name	0-32 characters	-		✔

Table 5.42 Parameters from subject area _39DD Device data

Parameter	Function	Value range	FS	Unit	Online
390-TYPE	Inverter type	*			
394-A_NR	Article number of device	*			
397-CFPNM	Device rated current	*		A	

Table 5.42 Parameters from subject area _39DD Device data

Explanatory notes

- Parameter values which are produced from current calculations and so are not editable have an asterisk (*) in the “Value range” column.
- The symbolic device name is used in device network lists for ease of identification of the inverter module. The parameter can only be edited with the DRIVEMANAGER. When a name is issued it is displayed ahead of the device designation.
- For ease of identification the complete data set (all four UDS) can be assigned a name, such as for archiving of machine data sets.

5.3.8 _VAL-Actual values

Function	Effect
• Display of all actual values of importance for diagnosis and monitoring	• Monitoring of process variables • Quick diagnosis of errors

Display

Actual values can be displayed in the DRIVEMANAGER (DM), the KEYPAD KP200 (KP) or by way of the analog output OSA00:

Parameter	Function	DM	KP	OSA00	Unit
14-ACCT	Actual torque (in SFC or FOR)	✔	✔	✔	Nm
86-TSYS	System time after power-up in [min.]	✔	✔		min.
87-TOP	Operating hours meter	✔	✔		h
400-ACTF	Current actual frequency	✔	✔	✔	Hz
401-ACTN	Current actual speed (with SFC and FOR)	✔	✔	✔	rpm
404-VMOT	Output voltage of inverter	✔	✔	✔	V
405-DCV	DC-link voltage	✔	✔	✔	V
406-REFF	Current reference frequency	✔	✔		
407-MTEMP	Motor temperature in KTY84 evaluation	✔	✔		°C
408-APCUR	Effective value of apparent current	✔	✔	✔	A
409-ACCUR	Effective value of active current	✔	✔	✔	A
413-ACTOP	Operating hours of power stage	✔	✔		h
416-ISA0	Filtered input voltage ISA00	✔	✔	✔	V
417-ISA1	Filtered input voltage ISA01	✔	✔	✔	V
418-ISA0I	Filtered input current ISA00	✔	✔	✔	A
419-IOSTA	States of digital and analog I/Os	✔	✔		
422-CNTL	Control word of system (see field bus description)	✔			
423-ERPAR	Number of a faulty parameter in self-test	✔			
425-DTEMP	Interior temperature of the inverter module	✔	✔	✔	°C
427-KTEMP	Heat sink temperature of the inverter module	✔	✔	✔	°C
428-PS	Apparent power	✔	✔	✔	VA
429-PW	Active power	✔	✔	✔	W

Table 5.43 Parameters from subject area _VAL Actual value parameters

Explanatory notes

- The actual values can be displayed in the KeyPad KP200 either in the bar graph or as numerical values in the continuous actual value display.
  For more details refer to section 5.3.5 “KEYPAD”.
- The filtered input voltages and currents of parameters 416...418 are influenced by way of the parameters of subject area “_18IA-Analog inputs” (section 5.2.1).

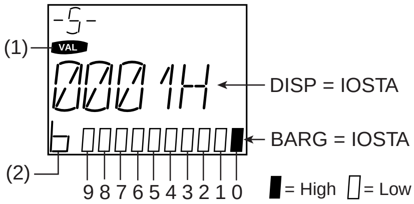
Control word of system (422-CNTL)

The control word of the system provides information on the current control status, such as Braking, Start Clockwise or Start Anti-clockwise. Details of the current status word of the inverter module should be kept to hand for quoting when calling on Telephone support from LUST.

The control word contains the control bits for activation of the inverter. In control via terminal the control bits are set according to the status of the inputs. The parameter is read-only and is used by LUST for support purposes.

Status word of system (419-IOSTA)

The status word can be displayed in hexadecimal form in the KEYPAD and DRIVEMANAGER or in binary form in the bar graph (KP200):



Hexadecimal: Parameter 360-DISP = IOSTA (subject area _36KP)

Binary: Parameter 361 - BARG = IOSTA (subject area _36KP)

(1) Actual values in the VAL menu
(2) Binary representation in the bar graph

Figure 5.31 Representation of states via KEYPAD KP200

Status word 419-IOSTA

Bit	I/O	Function	DISP	BARG 9 8 7 6 5 4 3 2 1 0
0	ENPO	Digital hardware enable input	0001H	□□□□□□□□□■
1	ISD00	Digital input	0002H	□□□□□□□□■□
2	ISD01	Digital input	0004H	□□□□□□□■□□
3	ISD02	Digital input	0008H	□□□□□□■□□□
4	ISD03	Digital input	0010H	□□□□□■□□□□
5	OSD00	Digital output	0020H	□□□□■□□□□□
6	OSD01	Digital output	0040H	□□□■□□□□□□
7	OSD02	Digital output (relay)	0080H	□□■□□□□□□□
8	ISA00	Analog input in digital function	0100H	□■□□□□□□□□
9	ISA01	Analog input in digital function	0200H	■□□□□□□□□□

Table 5.44 Status word IOSTA in subject area VAL

Status word 419-IOSTA for factory setting DRV_1 with ENPO = 0 (off)

Input/ output	Function [input/output]	DISP	BARG 9 8 7 6 5 4 3 2 1 0
ISD00/OSD02	Start clockwise/ready to start	0082H	□□■□□□□□■□
ISD01/OSD02	Start anti-clockwise/ready to start	0084H	□□■□□□□■□□
ISD02/OSD02	Slow jog/ready to start	0088H	□□■□□□■□□□
ISD03/OSD02	Not assigned/ready to start	0090H	□□■□□■□□□□

Table 5.45 Status word IOSTA in subject area VAL

Digital output OSD02 operates the relay when the inverter is “ready to start”. This is indicated by bit 7 in the bar graph and hex value 0080H on the display.

5.3.9 _50 WA-Warning messages

Function	Effect
• When programmable limit values are exceeded for various actual values of the inverter module or of the motor a warning is delivered.	• An impending fault in the drive system is signalled in good time to the system control.

Warning messages are automatically reset as soon as the cause of the warning no longer exists. The warning message is sent via the digital outputs, and at the same time the actual value to be monitored for the warning is also defined.

Warning messages

Parameter	Function	Value range	FS	Unit	Online
120-WRN	Status word, warnings	0000 .... FFFF		Hex	✔
500-WLTI	Device temperature warning threshold	5 ... 100	100	°C	✔
501-WLTD	Interior temperature warning threshold	5 ... 80	80	°C	✔
502-WLTM	Motor temperature warning threshold	5 ... 250	180	°C	✔
503-WLUV	Undervoltage warning threshold	0 ... 800	0	V	✔
504-WLOV	Voltage overload warning threshold	0 ... 800	800	V	✔
505-WLF	Frequency warning threshold	0 ... 1600	0	Hz	✔
506-WLIS	Apparent current warning threshold	0 ... 999.95	999.95	A	✔

Table 5.46 Parameters from subject area _50WA Warning messages

Explanatory notes

- Any warning can be delivered at any digital output.
- The motor temperature warning (WLTM) indicates a motor overload.
- The device temperature warning (WLTI) takes the temperature value from the sensor on the heat sink on the power stage transistors or, in the case of small inverter modules, directly from the power stage module.

- Inadequate or excessive DC-link voltage triggers the undervoltage (WLUV) or voltage overload (WLOV) warning as appropriate.
- The frequency warning relates to the current output frequency of the inverter module.
- The status word 120-WRN is formed from the current warning messages.

Note: The warning messages are not displayed in the DRIVEMANAGER. They can be evaluated in hexadecimal coding in parameter 120-WRN.

A listing of the error and warning messages displayed in the DRIVEMANAGER is given in the Appendix.

Warning messages are assigned a hysteresis:

Physical variable	Hysteresis
Voltages	(+/- 5 V)
Temperature	(+/- 2.5 °C)
Frequency	(+/- 0.5 Hz)

Table 5.47 Hysteresis of warning messages

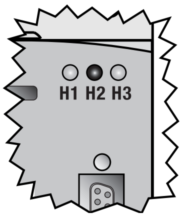
Status word 120-WRN

Warning	Function	Hex value	Bit
WOTI	Warning message when heat sink temperature has exceeded value in parameter 500-WLTI	0001H	0
WOTD	Warning message when interior temperature has exceeded value in parameter 501-WLTD	0002H	1
WOTM	Warning message when motor temperature has exceeded value in parameter 502-WLTM	0004H	2
WOV	Warning message when DC-link voltage has exceeded value in parameter 504-WLOV	0008H	3
WUV	Warning message when DC-link voltage has fallen below value in parameter 503-WLUV	0010H	4
WFOUT	Warning message when output frequency has exceeded value in parameter 505-WLF	0020H	5
WIS	Warning message when apparent current has exceeded value in parameter 506-WLIS	0040H	6
WIIT	Warning message when I^2*t integrator of device is active	0080H	7
WFDIG	Warning message from slave when reference value from master is faulty in Master/-Slave operation	0100H	8
WIT	Warning message when Ixt integrator of motor is active	0200H	9

Table 5.48 Hexadecimal representation of warning messages

5.3.10_51ER-Error messages

Function	Effect
• Display of faults in the drive system	• Quick location of the cause of the error and definition of the response of the drive to an error



Error messages can be detected and evaluated by way of the status LEDs of the inverter module. If the red LED H1 is flashing an error has occurred.

The response to an error can be parameterized according to the cause of the error.

Flash code of red LED (H1)	KEYPAD display	Error cause
1x	E-CPU	CPU errors and other rare errors
2x	E-OFF	Undervoltage shut-off
3x	E-OC	Current overload shut-off
4x	E-OV	Voltage overload shut-off
5x	E-OLM	Motor overloaded
6x	E_OLI	Device overloaded
7x	E-OTM	Motor temperature too high
8x	E-OTI	Heat sink/device temperature too high

Table 5.49 Error messages

Note: For more error numbers and possible causes refer to the appendix.

Acknowledgment and resetting of errors

Errors can be acknowledged and reset in various ways:

- Rising edge at digital input ENPO
- Rising edge at a programmable digital input with setting of the function selector to ERES
- Write value 1 to parameter 74-ERES via control unit or bus system

Parameters for error messages

Parameter	Function	Value range	FS	Unit	Online
74-ERES	Reset device errors	STOP/START	STOP		✔
140-R-RNM	Response to error in setting an operation mode	RESET	RESET		
510-R-SIO	Response to SIO watchdog	STOP ... RESET	STOP		✔
511-R-CPU	Response to CPU error	RESET	RESET		✔
512-R-OFF	Response to undervoltage	STOP ... RESET	STOP		✔
513-R-OC	Response to current overload	STOP ... RESET	LOCK		✔
514-R-OV	Response to voltage overload	STOP ... RESET	LOCK		✔
515-R-OLI	Response to Ixt cut-off of inverter	STOP ... RESET	LOCK		✔
516-R-OTM	Response to motor overheating	0 ... RESET	LOCK		✔
517-R-OTI	Response to inverter module overheating	STOP ... RESET	LOCK		✔
518-R-SC	Response to error during initial commis-sioning	LOCK ... RESET	LOCK		✔
519-R-OLM	Response to motor I^2xt cut-off	STOP ... RESET	LOCK		✔
520-R-PLS	Response to software runtime error	RESET	RESET		✔
521-R-PAR	Response to faulty parameter list	RESET	RESET		✔
522-R-FLT	Response to floating point error	RESET	RESET		✔
523-R-PWR	Response to unknown power pack	RESET	RESET		✔
524-R-EXT	Response to external error message	STOP ... RESET	STOP		✔
525-R-USR	Response to modified software error message	STOP ... RESET	STOP		✔
526-R-OP1	Response to error in option module slot 1	STOP ... RESET	STOP		✔
527-R-OP2	Response to error in option module slot 2	STOP ... RESET	STOP		✔
529-R-WBK	Response to wire break ISA00 at 4 ... 20mA	STOP ... RESET	STOP		✔
530-R-EEP	Response to memory error in FLASHEP-ROM	RESET	RESET		

Table 5.50 Parameters from subject area _51ER Error messages

Parameter	Function	Value range	FS	Unit	Online
531-EFSCL	Ground fault detection response threshold scaling	0 ... 200	0	%	✔
532-R-PF	Response after DC-link buffering	STOP ... RESET	STOP		✔
533-R-FDG	Response to reference coupling transmission error	STOP ... RESET	STOP		✔
534-R-LSW	Response to reversed limit switches	1 ... 3	LOCK		✔
543-R-OL5 from SW 2.0	Response to Ixt shut-off below 5 Hz	Stop ... Reset	LOCK		✔
94-TERR	System time on occurrence of last error	0 ... 65535	0	h	
95-ERR1	Last error	0 ... 65535	0	h	
96-ERR2	Second-last error	0 ... 65535	0	h	
97-ERR3	Third-last error	0 ... 65535	0	h	
98-ERR4	Fourth-last error	0 ... 65535	0	h	

Table 5.50 Parameters from subject area _51ER Error messages

Settings for 140-RNM to 534-R-LSW

BUS	KP/ DM	Function
0	WRN	No response
1	STOP	Disable power stage
2	LOCK	Disable power stage and secure against restarting (prevent autostart)
3	RESET	Disable power stage and reset device after confirmation of error. The device is rebooted and runs through an initialization and self-test phase.

Table 5.51 Response to error

Explanatory notes

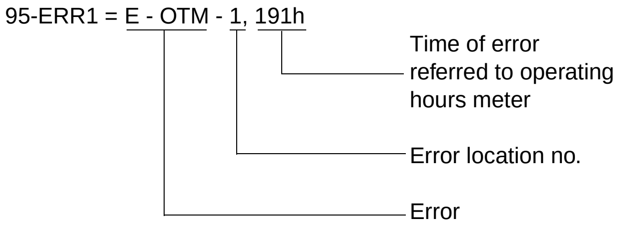
- The gray highlighted parameters cannot be set, they are for display purposes only.
- Setting 0% deactivates the ground fault detector 531-EFSCL. Settings below 10% may lead to shutdowns due to the limited measurement accuracy of the current.
- The response to a ground fault detection error or an insulation error is defined by parameter 513-R-OC “Response to current overload”.
- After a reset the device runs through an initialization and self-test phase. During this time it cuts bus connections and detects no signal changes at the inputs. Additionally, the outputs return to their hardware home positions. Conclusion of an initialization and self-test phase can be indicated by way of a digital output with “Device ready” (see section 5.2.4 “_24OD-Digital outputs”, Setting C_RDY).

Representation of error history

Parameters 95-ERR1 to 98-ERR4 store the error with its location and number and the time of error referred to the operating hours meter.

After each error the error memory scrolls on and error parameter 95-ERR1 displays the last error.

Example of viewing on DRIVEMANAGER:



Note: A list of the error and warning messages displayed on the DRIVEMANAGER is given in appendix B.

Fault current monitoring by differential current monitoring

The implemented differential current monitoring is based on typical RCM differential current protection devices.

Based on the scaleable response threshold of the ground fault detector by way of parameter 531-EFSCL, fault currents can be detected and the device power stage can be disabled. Error message E-OC-110 is delivered.

The basic principle of electrical engineering requires that all conductors (except grounding leads) are routed through a converter. In an error-free system the sum total of all currents is then equal to zero, so no differential current is evaluated by the software via the current sensors of the inverter.

As a result, symmetrical insulation errors occurring in all motor cables against PE or ground cannot be detected by the differential current monitor.

5.4 Bus operation and option modules

This Manual details only the software parameters of the CDA3000 inverter module. For more details on the field bus systems refer to the relevant documents relating to the option modules.

5.4.1 _55 LB-LUSTBUS

Function	Effect
• Creation of the device addresses and baud rate for the service and diagnostic interface	• Adaptation of the serial interface (RS232) to as PC with the DRIVEMANAGER software or the KEYPAD KP200

Parameters for LUSTBUS

Parameter	Function	Value range	FS	Unit	Online
81-SBAUD	LUSTBUS transfer rate	9600 1200 2400 4800 19200 2880 57600	57600	Bit/s	✔
82-SADDR	LUSTBUS device address	0 ... 30	1		
83-SDMMY	LUSTBUS dummy parameter	0 ... 255	0		
84-SWDGT	LUSTBUS watchdog time setting	0.00 ... 20.00	0.00	s	✔
85-SERR	LUSTBUS error status word	00H ... FFH	00 Hex		✔
550-SSTAT	Status word of serial interface	0 ... 65535	0		✔
551-SCNTL	Control word of serial interface	0000H ... FFFFH	0000Hex		✔

Table 5.52 Parameters from subject area _55LB LUSTBUS

Explanatory notes

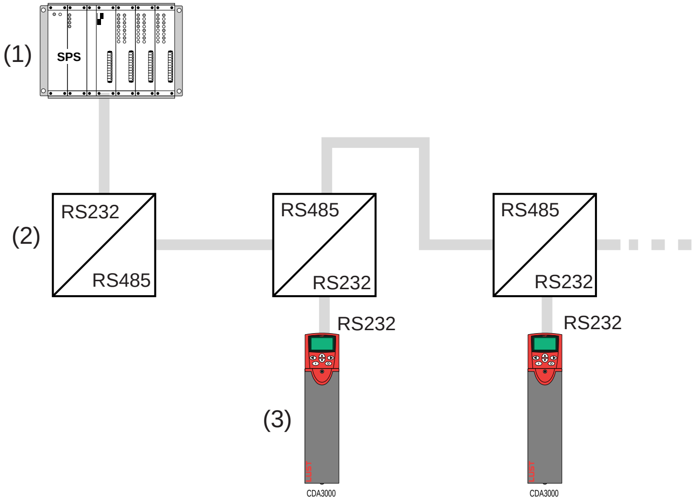
- If only one inverter module is operated on the DRIVEMANAGER no device address need be set. For more than one device, different address parameters must be set.
- The LUSTBUS watchdog time setting is deactivated to 0.0 s at the factory.

Note: Where there are several devices on a bus system, to provide a clearer differentiation between them it is advisable to enter a symbolic name in each device by way of parameter 130-Name (see section 5.3.7 “Device data”).

LustBus interconnection OF INVERTER MODULES

By way of the serial service interface (RS232) a bus system can be set up based on the proprietary LUSTBUS PROTOCOL. The basic layout is shown in the graphic below. For protocol information relating to the interconnection of inverter modules refer to the detailed documentation: “Data transfer protocol, LUSTBUS”.

Interconnection on LUSTBUS via bus interface



(1) Higher-order controller (master)
(2) T-coupler bus interface TK100
(3) CDA3000 inverter module

Figure 5.32 Interconnection on LUSTBUS via bus interface TK100

LUSTBUS interconnection

By way of the bus interface T-coupler TK100 an electrically isolated bus system is set up based on the serial interface to RS485 standard. Bus users can be connected up via interfaces of type RS485 or RS232.

Since the CDA3000 inverter modules can only communicate via the serial RS232 service interface, the interface variant “RS485 to RS232” should be selected.

A RS232 interface is only suitable for connection of **one** terminal device.

Note: To attain greater interference immunity of the bus system, all the interface cables must be shielded. The shield should be connected centrally on one end to a grounding lead (PE). The bus system should be terminated at the first and last T-couplers on the bus by way of jumpers.

5.4.2 _57 OP-Option modules

Function	Effect
• Setting of device addresses and baud rate for the communication modules • Configuration of process data for the communication modules • Diagnostic data for field bus operation	• Adaptation of the option modules to the application

An up-to-date overview of the option modules is given in the CDA3000 Catalogue.

Overview of option modules

Order designation	Option modules	Summary description
CM-CAN1	CAN_{Lust}	Conforming to CiA Draft Standard 102
CM-CAN2	CAN_{open}	Conforming to CiA Draft Standard 301/402
CM-DPV1	PROFIBUS-DP	Conforming to EN 50170 / DIN 19245
UM-8I40	I/O module	Terminal expansion module with 8 inputs and 4 outputs

Table 5.53 Overview of option modules

Parameters for option modules

Parameter	Function	Value range	FS	Unit	Online
489 -CLBDR	CAN_{Lust} controller baud rate	25 ... 500	500		
492 -CACNF	CAN_{Lust} control/reference transfer mode	0 ... 4	4		✔
570 -CAMOD	Function selection option module CAN_{Lust}	Slave/Master	Slave		
571 -CLADR	CAN bus Device address	0 ... 29	0		
572-CASTA	Status word CAN_{Lust}-Bus	0000H ... FFFFH	0000 Hex		
573 -CACTR	CAN bus control word	0000H ... FFFFH	0000 Hex		✔
574 -CAWDG	CAN bus watchdog time	0 ... 255	0	ms	✔
575 -CASCY	Sampling time for status message	1 ... 32000	80	ms	✔

Table 5.54 Parameters from subject area _570P Option modules

Parameter	Function	Value range	FS	Unit	Online
576-OP1RV	SW version of communication module at option slot	*	0.00		
577-OP2RV		*	0.00		
578-OPTN2	Assignment of option module	*	NONE		
579-OPTN1	Assignment of option module	*	NONE		
580 -COADR	CAN_{open} device address	1 ... 127	1		
581 -COBDR	CAN_{open} controller baud rate	25 ... 1000	500		
582 -CPADR	Profibus DP device address	0 ... 127	0		
583-IOEXT	Status word of user module	0000H ... FFFFH	0000 Hex		
* module-dependent					

Table 5.54 Parameters from subject area _570P Option modules

Explanatory notes

- All option modules communicate with the CDA3000 inverter module based on the standard of the CANLust protocol.
- The watchdog monitoring is deactivate to 0 ms at the factory.

Baud rates of CAN controllers

CAN system	Parameter	Values [bit/s]
CAN_{Lust}	489-CLBDR	25, 50, 75, 125, 250, 500
CAN_{open}	581-COBDR	25, 125, 500, 1000

Table 5.55 Transmission speed of CAN controllers

Status word of user module 583-IOEXT

I/O	Function	Hex value	Bit=1
-	Module detected and logged onto bus	8000H	15
IED00	Digital input	8001H	15/0
IED01	Digital input	8002H	15/1
IED02	Digital input	8004H	15/2
IED03	Digital input	8008H	15/3

Table 5.56 Status word IOEXT of user module

I/O	Function	Hex value	Bit=1
IED04	Digital input	8010H	15/4
IED05	Digital input	8020H	15/5
IED06	Digital input	8040H	15/6
IED07	Digital input	8080H	15/7
OED00	Digital output	8100H	15/8
OED01	Digital output	8200H	15/9
OED02	Digital output	8400H	15/10
OED03	Digital output	8800H	15/11

Table 5.56 Status word IOEXT of user module

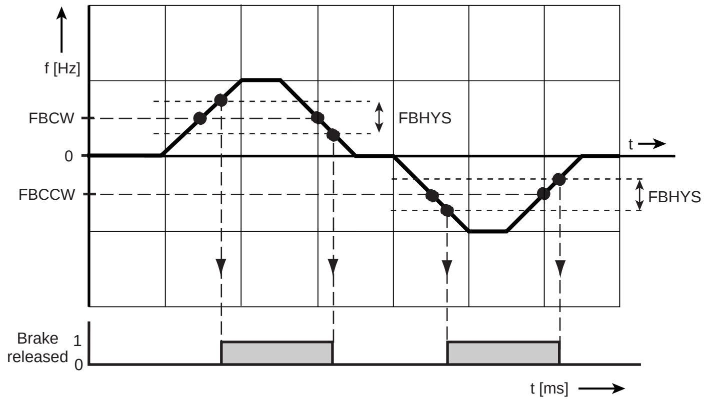
5.5 Open-loop and closed-loop control

The following software functions are used in both the open-loop and the closed-loop control modes.

5.5.1 _31 MB-Motor holding brake

Function	Effect
• An electromechanical holding brake can be actuated depending on a limit value	• The holding brake engages when a minimum frequency limit is infringed. This may also be configured dependent on monitoring of the motor currents.

The diagram below represents the function of the motor holding brake within the programmable frequency range. The brake can be released by a digital output set by the function selector.



(1) Brake released

Figure 5.33 Frequency ranges of the holding brake. An output releases the motor brake within the frequency range -FBRL ... +FBRR

Parameters for motor holding brake

Parameter	Function	Value range	FS	Unit	Online
310-FBCW	Frequency limit for motor brake in clockwise running	0 ... 1600	3	Hz	✔
311-FBCCW	Frequency limit for motor brake in anti-clockwise running	-1600 ... 0	-3	Hz	✔
312-FBHYS	Hysteresis for operation point of motor holding brake	0 ... 1600	1	Hz	✔

Table 5.57 Parameters from subject area _31MB Motor holding brake

Settings of digital outputs for motor holding brake

Setting	Function	FOSD0	FOSD1	FOSD2	FOSEx
BRK1	Output is set when the actual speed has exceeded the value in parameter FBCxx (clockwise: FBCW, anti-clockwise: FBCCW).	✔	✔	✔	✔
BRK2	Output is set if the actual speed has exceeded the value in parameter FBCxx and current is flowing in all motor phases (clockwise: FBCW, anti-clockwise: FBCCW).	✔	✔	✔	✔

Table 5.58 Settings for FOxxx of digital outputs for motor holding brake

Explanatory notes

- The frequency limit for engagement of the holding brake can be set independently for clockwise and anti-clockwise running.
- The optional monitoring of the motor current (BRK2) provides the security when the holding brake is opened that the motor is correctly connected and has already developed torque.

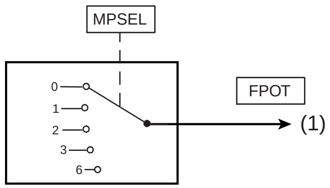
For this, a minimum phase current is monitored sequentially in all three phases. If the minimum current is registered **once** in all phases, the holding brake is actuated and the drive thus enabled. There is no continuous monitoring of the motor current.

Inverter module	Inverter output power [kW]	Detected I_{min} [A]
CDA32003	0.375	0.23
CDA32004	0.75	0.38
CDA32006	1.1	0.51
CDA32008	1.5	0.66
CDA34003	0.75	0.21
CDA34005	1.5	0.37
CDA34006	2.2	0.53
CDA34008	3.0	0.72
CDA34010	4.0	0.94
CDA34014	5.5	1.29
CDA34017	7.5	1.58
CDA34024	11	2.16
CDA34032	15	2.83
CDA34045	22	3.00
CDA34060	30	4.00
CDA34072	37	4.96
CDA34090	45	6.11
CDA34110	55	7.07
CDA34143	75	9.44
CDA34170	90	12.01

Table 5.59 Current threshold for detection of current application to motor

5.5.2 _32 MP-MOP function

Function	Effect
• With two inputs the reference can be increased or reduced in linear form	• Simple adaptation of the motor speed to the process



(1) Active MOP function in reference source FPOT

Figure 5.34 Function block: MOP function selector

Parameters for MOP function

Parameter	Function	Value range	FS	Unit	Online
320-MPSEL	Configuration for motor operated potentiometer	0 ... 6	0		✔

Table 5.60 Parameters from subject area _32MP MOP function

Settings for MOP function

BUS	KP/DM	Function
0	OFF	No function
1	F1	Increase and reduce speed within limits FMINx ... FMAXxFMAXx with inputs MP_UP and MP_DN.

Table 5.61 Settings for 320-MPSEL MOP function

BUS	KP/DM	Function
2	F2	Increase and reduce speed within limits FMINx ... FMAXx with inputs MP_UP and MP_DN. If both inputs are set simultaneously, the offset speed is reset to 0 Hz.
3	F3	Increase and reduce speed within limits FMINx ... FMAXx with inputs MP_UP and MP_DN. In case of failure of the mains voltage the offset speed is stored.
4	F4	Increase and reduce speed within limits FMINx ... FMAXx with inputs MP_UP and MP_DN. If both inputs are set simultaneously, the offset speed is reset to 0 Hz. In case of failure of the mains voltage the offset speed is stored.
5	F5	Increase and reduce speed within limits FMINx ... FMAXx with inputs MP_UP and MP_DN. The offset speed is reset to 0 Hz when the start command is cancelled.
6	F6	Increase and reduce speed within limits FMINx ... FMAXx with inputs MP_UP and MP_DN. If both inputs are set simultaneously, the offset speed is reset to 0 Hz. The offset speed is reset to 0 Hz when the start command is cancelled.

Table 5.61 Settings for 320-MPSEL MOP function

Definitions

Base value	Analog speed reference set at input ISAxx
Offset	Portion of the increase or decrease in the base value, influenced by the inputs with the functions MP_UP and MP_DN
ISDxx = MP_UP	Offset input for reference increase
ISDxx = MP_DN	Offset input for reference decrease

Setting of inputs for MOP functions

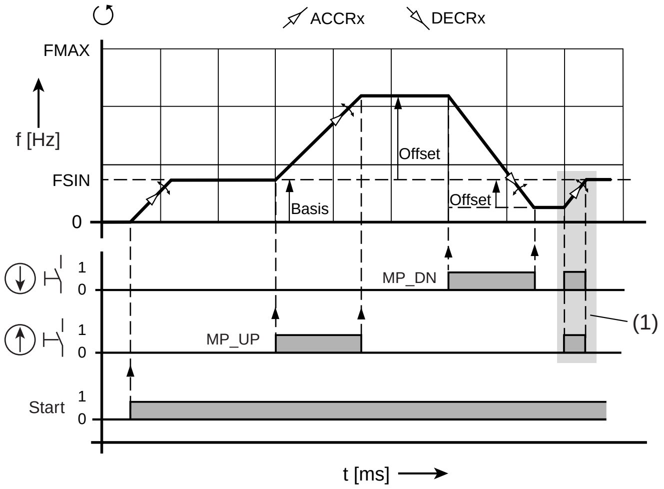
Note: In terminal operation the function selector of one digital or one analog input (in digital function) is configured with

MP-UP = increase reference
MP-DN = reduce reference

(see section 5.2 “Inputs and outputs”).

Example: Setting F1 of MOP function

A digital potentiometer is operated by way of two digital inputs. One input reduces the reference value, the other increases it. At the analog input ISA0x a base value can be set as the analog speed reference FSIN, so the digital inputs act as an offset. The MOP function assigns the reference source FPOT a reference value.



(1) Reset reference to base value

Figure 5.35 Basic function with reset to base value (corresponds to setting F1 in Table 5.61)

5.5.3 _59 DP-Driving profile generator

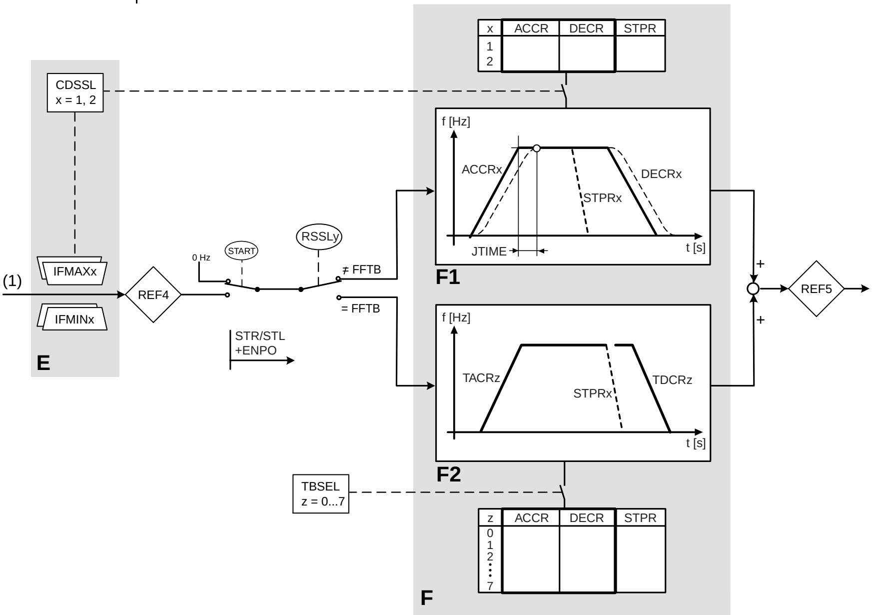
Function	Effect
• Setting of the acceleration and deceleration ramps	• Adaptation of the motor dynamics to the application
• Setting of a smoothing of the the start and end point of the linear ramp	• Reduced drive bucking

Driving profile generator

The reference limiter is inserted upstream of the driving profile generator. By way of the reference selector the reference sources are selected, and thus indirectly in the driving profile generator the general ramp generator or table-supported ramp generator. The driving profile generator generates the appropriate acceleration and deceleration ramps to attain the specified frequency reference. The braking ramp STPRx is effective throughout the entire driving profile generator if it is activated with STPRx ≠ 0.

- Normal, non-table-supported driving sets (RSSLx ≠ FFTB):
  Ramp generator with characteristic data sets, selection of characteristic data set by way of characteristic data selector 650-CDSSL
- Table-supported driving sets (RSSLx = FFTB):
  Driving sets from a stored table, selection of data sets by way of table selector 624-TBSEL

Driving profile generator block diagram



E Reference limiter (subject area "_30 OL-Frequency limitation")
F Driving profile generator
F1 Ramp generator, normal (see Table 5.63)
Smoothing adjustable only after interim reference REF5, visible as from REF6
F2 Table-supported ramp generator (subject area "_60 TB-Driving sets")
(1) Frequency reference

Figure 5.36 Parameters in subject area _59DP (cf. reference structure Figure 5.14)

Ramp generator

The ramp generator can smooth linear ramps at the end points in order to limit bucking.

Movement mode	Setting
Dynamic, bucking	JTIME = 0, linear ramps without smoothing
Low impact on mechanism	JTIME $\neq 0$, sin usoidal ramps based on smoothing by x [ms].

Table 5.62 Ramp generator

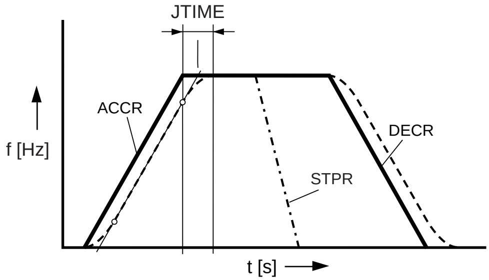


Figure 5.37 Driving profile of the normal ramp generator

Sinusoidal ramps

As a result of the bucking limitation the acceleration and deceleration times are increased by the smoothing time JTIME. An emergency stop via the stop ramp STPRx is executed in linear mode - that is to say without bucking limitation - to keep the braking duration as short as possible.

Note: The mechanism is left heavily vibrated. Material fatigue due to load changes is reduced. A mechanism with play is subject to less deflection.

Parameters for the ramp generator

Parameter	Function	Value range	FS	Unit	Online
590-ACCR1	CDS1: Acceleration ramp	0 ... 999	20	Hz/s	✔*
591-ACCR2	CDS2: Acceleration ramp	0 ... 999	20	Hz/s	✔*
592-DECR1	CDS1: Deceleration ramp	0 ... 999	20	Hz/s	✔*
593-DECR2	CDS2: Deceleration ramp	0 ... 999	20	Hz/s	✔*
594-STPR1	CDS1: Stop ramp	0 ... 999	20	Hz/s	✔*
595-STPR2	CDS2: Stop ramp	0 ... 999	20	Hz/s	✔*
596-JTIME	Smoothing time of sinusoidal ramp	0 ... 10000	0	ms	
597-RF0	Response at reference value 0 Hz	OFF / 0 Hz	OFF	-	✔
* from firmware V. 2.10					

Table 5.63 Parameters from subject area _59DP Driving profile generator

Explanatory notes

- If one of the two ramps (acceleration ramp ACCRx, deceleration ramp DECRx) of a characteristic data set is set to 0 (zero), both ramps are inactive.
- The DC braking function has priority over the stop ramp STPRx.
- Standard control signals with the assignment of the ramps are set out in Table 5.29 (section 5.2.7).
- The ramp values can only be changed online as from firmware V. 2.10.

Note: Dynamic acceleration and deceleration results in high startup and braking currents. This also applies to the emergency stop by way of the stop ramp. In deceleration the motor drops into regenerative operation and increases the DC-link voltage (DCV).

Error messages in acceleration processes

Acceleration	Error	Remedy
positive	• E-OC (current overload)	• Flatter ramp
	• E-OLI (inverter module I^2xt cut-off)	• Higher-powered inverter module
negative	• E-OV (voltage overload)	• Flatter ramps
	• E-OLI (inverter module I^2xt cut-off)	• External braking resistor
	• E-OTI (inverter module overheating)	• Higher-powered inverter module

Table 5.64 Rectification of errors in acceleration processes

5.5.4 _27 FF-Fixed frequencies

Function	Effect
• Setting of a fixed frequency per characteristic data set	• Operation of a drive in quick jog/slow jog driving profile • Simple reference input

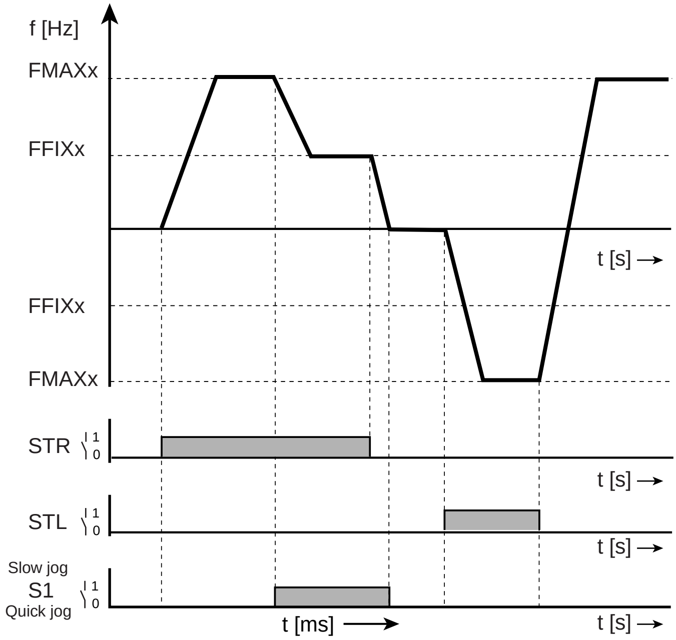


Figure 5.38 Fixed frequency for quick jog/slow jog application

Parameters of the fixed frequencies

Parameter	Function	Value range	FS	Unit	Online
270-FFIX1	CDS1: Fixed frequency	-1600 ... 1600	20	Hz	✔
271-FFIX2	CDS2: Fixed frequency	-1600 ... 1600	20	Hz	✔

Table 5.65 Parameters from subject area _27FF Fixed frequencies

Explanatory notes

- The fixed frequency can be selected by way of the digital inputs. For this, the reference source must be set to 280-RSSL1 = FFIX by modification of the reference structure (see section 5.2.6 “_28 RS-Reference structure”).

5.5.5 _60 TB-Driving sets

Function	Effect
• Setting of up to 8 fixed frequencies with the associated acceleration and deceleration ramp	• Adaptation of the motor dynamics to the application

A driving set contains a fixed frequency, which when the set is selected serves as the frequency reference, and an acceleration and deceleration ramp. Up to 8 driving sets can be stored in a table.

Initiation of an emergency stop by means of a braking ramp with parameter STPRx≠0 disables the table-supported ramps and activates the braking ramp.

Note: For explanatory notes on the driving profile generator refer to section 5.5.3 "_59 DP-Driving profile generator".

Example of application of the driving sets

Preconditions:

- Function selector of digital input ISD00: FIS00 = FFTB0
- Function selector of digital input ISD01: FIS01 = FFTB1

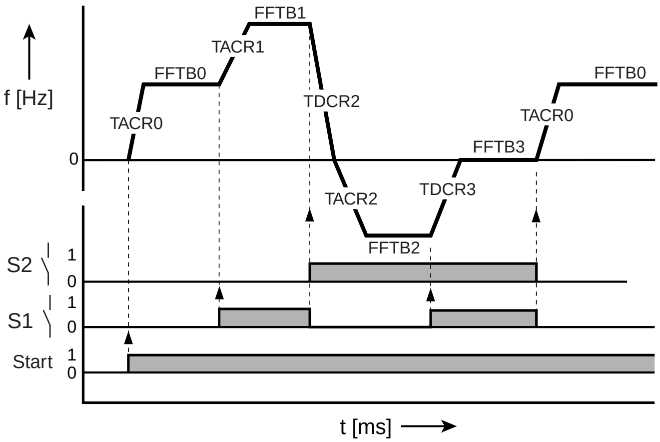


Figure 5.39 Example of driving sets with fixed frequencies

Selection of driving sets

Driving set	FIxxx= FFTB2	FIxxx= FFTB1	FIxxx= FFTB0	Fixed frequency	Acceleration ramp	Deceleration ramp
0	0	0	0	FFTB0	TACR0	TDCR0
1	0	0	1	FFTB1	TACR1	TDCR1
2	0	1	0	FFTB2	TACR2	TDCR2
3	0	1	1	FFTB3	TACR3	TDCR3
4	1	0	0	FFTB4	TACR4	TDCR4
5	1	0	1	FFTB5	TACR5	TDCR5
6	1	1	0	FFTB6	TACR6	TDCR6
7	1	1	1	FFTB7	TACR7	TDCR7

Table 5.66 Selection of driving sets

The **driving sets** (rows in the table) are selected by way of:

- the inputs which are parameterized to switch to FFTBx, or
- the control word in field bus systems

Parameters of the driving sets

Parameter	Function	Value range	FS	Unit	Online
600-FFTB0	Table frequency 1	-1600 ... 1600	5	Hz	✔
601-FFTB1	Table frequency 2	-1600 ... 1600	10	Hz	✔
602-FFTB2	Table frequency 3	-1600 ... 1600	15	Hz	✔
603-FFTB3	Table frequency 4	-1600 ... 1600	20	Hz	✔
604-FFTB4	Table frequency 5	-1600 ... 1600	25	Hz	✔
605-FFTB5	Table frequency 6	-1600 ... 1600	30	Hz	✔
606-FFTB6	Table frequency 7	-1600 ... 1600	40	Hz	✔
607-FFTB7	Table frequency 8	-1600 ... 1600	50	Hz	✔
608-TACR0	Table acceleration ramp 1	0.01 ... 999	20	Hz/s	
609-TACR1	Table acceleration ramp 2	0.01 ... 999	20	Hz/s	
610-TACR2	Table acceleration ramp 3	0.01 ... 999	20	Hz/s	
611-TACR3	Table acceleration ramp 4	0.01 ... 999	20	Hz/s	
612-TACR4	Table acceleration ramp 5	0.01 ... 999	20	Hz/s	
613-TACR5	Table acceleration ramp 6	0.01 ... 999	20	Hz/s	
614-TACR6	Table acceleration ramp 7	0.01 ... 999	20	Hz/s	

Table 5.67 Parameters from subject area _60TB Driving sets

Parameter	Function	Value range	FS	Unit	Online
615-TACR7	Table acceleration ramp 8	0.01 ... 999	20	Hz/s	
616-TDCR0	Table deceleration ramp 1	0.01 ... 999	20	Hz/s	
617-TDCR1	Table deceleration ramp 2	0.01 ... 999	20	Hz/s	
618-TDCR2	Table deceleration ramp 3	0.01 ... 999	20	Hz/s	
619-TDCR3	Table deceleration ramp 4	0.01 ... 999	20	Hz/s	
620-TDCR4	Table deceleration ramp 5	0.01 ... 999	20	Hz/s	
621-TDCR5	Table deceleration ramp 6	0.01 ... 999	20	Hz/s	
622-TDCR6	Table deceleration ramp 7	0.01 ... 999	20	Hz/s	
623-TDCR7	Table deceleration ramp 8	0.01 ... 999	20	Hz/s	
624-TBSEL	Table driving set selector	*			

Table 5.67 Parameters from subject area _60TB Driving sets

Explanatory notes

- Deactivation of parameter by the value 0 (zero)
- Parameter values which are produced from current calculations and so are not editable have an asterisk (*) in the "Value range" column.

5.5.6 _65 CS-Characteristic data switchover (CDS)

Function	Effect
• Online switching is possible between two characteristic data sets.	• Adaptation of the motor dynamics to the application • Operation of two different motors on one inverter module

Parameters for characteristic data set switchover

Parameter	Function	Value range	FS	Unit	Online
650-CDSAC	Characteristic data set (CDS) active	see Table 5.67	0		
651-CDSSL	Control location for switchover of characteristic data set (CDS)	see Table 5.71	OFF		✔
652-FLIM	Limit frequency for switchover to CDS	-1000 ... 1000	20	Hz	✔

Table 5.68 Parameters from subject area _65CS Characteristic data switchover

Explanatory notes

- Any application data set may contain a second characteristic data set.
- An overview of the functional areas containing parameters for the second characteristic data set is presented by Table 5.69.

Functional areas with characteristic data sets

Subject area	Parameter
Analog inputs	Scaling parameter
Clock input/clock output	Scaling parameter
Fixed frequencies	All parameters
Frequency limitation	All parameters
Reference structure	Min., max. and fixed frequency
Driving profile generator	Ramps
Current-controlled acceleration	All parameters
Voltage Frequency Control	All parameters
IxR load compensation	All parameters
Slip compensation	All parameters

Table 5.69 Subject areas with parameters in the second characteristic data set (CDS)

Subject area	Parameter
Current injection	All parameters
Magnetizing	All parameters
Speed controller SFC	All parameters
Current control	Reference current for control
Speed controller FOR	All parameters

Table 5.69 Subject areas with parameters in the second characteristic data set (CDS)

Active characteristic data set display

BUS	KP/DM	Function
0	CDS1	Characteristic data set 1 (CDS1) active
1	CDS2	Characteristic data set 2 (CDS2) active

Table 5.70 Display for 650-CDSAC

Possibilities of characteristic data set switchover with 651-CDSSL

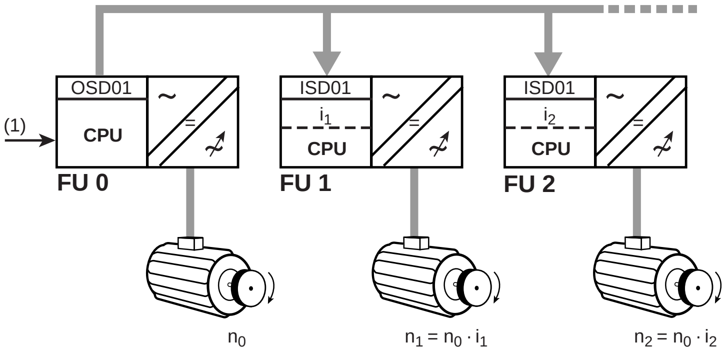
BUS	KP/DM	Function
0	OFF	No switchover • CDS 1 active
1	FILIM	Switchover on exceeding of frequency of value in parameter FILIM • CDS 2, if frequency > FLIM, otherwise CDS 1
2	TERM	Switchover via digital input • CDS 2, if IxDxx = 1, otherwise CDS 1
3	ROT	Switchover on reversal of direction • CDS 2, if anti-clockwise, otherwise CDS 1
4	SIO	Switchover via SIO • CDS 2, if control bit set, otherwise CDS 1
5	OPTN1	Switchover via field bus at option slot 1 • CDS 2, if control bit set, otherwise CDS 1
6	OPTN2	Switchover via field bus at option slot 2 • CDS 2 if control bit set, otherwise CDS 1

Table 5.71 Settings for 651-CDSSL

5.5.7 _66 MS-Master/ -Slave operation

Function	Effect
• Speed synchronism of several different drives by setting of the coupling factor in Master/-Slave operation	• Determine transmission ratio for reference coupling

One inverter module is parameterized as the master. The master passes the signal for fast reference coupling to up to five inverter modules parameterized as slaves.



(1) Reference
i_x Coupling factor of slave axle, parameter 837-MSFCT

Figure 5.40 Fast reference coupling via Master/-Slave operation

Function	Parameter setting of the function selector	Terminal
Master	Digital output OSD01: FOS01 = FMSO	Signal: X2-16 Dig. ground: X2-17
Slave	Digital input ISD01: FIS01 = FMSI	Signal: X2-10 Dig. ground: X2-14

Table 5.72 Setting instructions

Parameters for Master/-Slave operation

Parameter	Function	Value range	FS	Unit	Online
837-MSFCT	Coupling factor for Master/-Slave operation	0.0 ... 1000, 000000	1		✔
838-MSECT	Error trigger time in case of failure of reference master	0 ... 65535	0	ms	✔

Table 5.73 Parameters from subject area _66MS Master/-Slave operation

Explanatory notes

- A maximum of 6 devices can be interlinked.
- In the event of failure of the reference input from the master, or if the reference signal checksum is faulty, the slave inverter responds after the set time in parameter 838-MSECT by stopping the slave inverter.
- When the time period from 838-MSECT starts a warning message can be delivered. For this, the relevant function selector of the digital output must be set to the warning message WFDIG.
- Fast reference coupling is limited to output OSD01 and input ISD01.
- The coupling factor MSFCT is represented in INT 32Q16 number format.
  That means that the decimal places are represented at a pitch of 65536.

Attention: Digital output OSD01 has no function in the slave inverter module, and cannot be used as the master for other slaves.

Example of coupling factor MSFCT

Input of coupling factor in parameter 837-MSFCT

given: i = 2.032 → 837-MSFCT=2.032

tot: Execute value of coupling factor with internal processing of processor

1. 2.032 x 65536 = 133169.152
2. Eliminate decimal places: 133169
3. 133169 : 65536 = 2.0319

Structure of reference processing in the slave

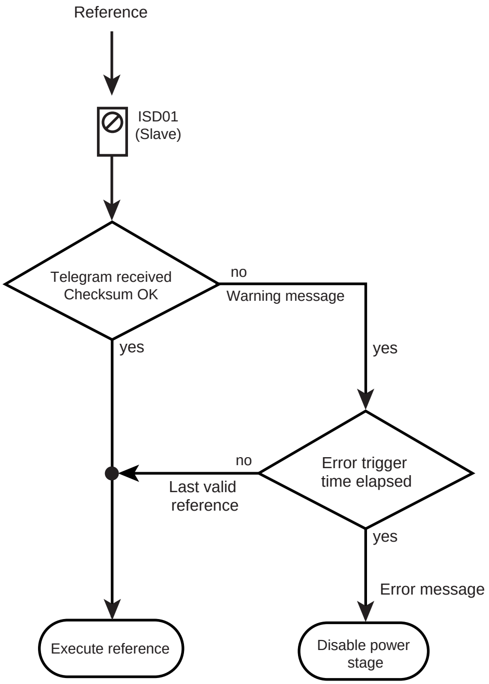


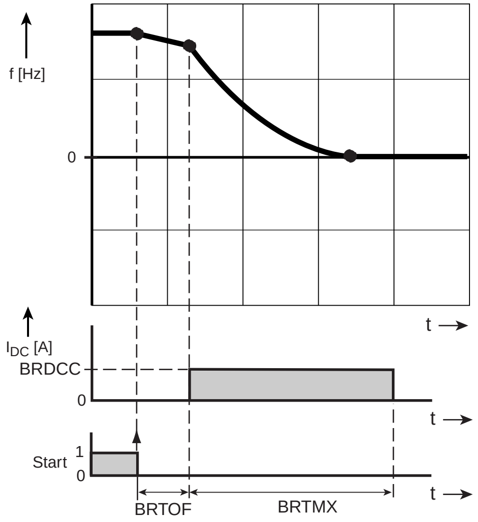
Figure 5.41 Structure of reference processing in the slave

If no telegram with a correct checksum is received within the error trigger time the power stage is disabled when the time has elapsed.

During the error trigger time the last valid reference is executed.

5.5.8 _67 BR-DC braking

Function	Effect
• Feed of a direct current into the motor, causing it to brake.	• No braking resistor is required to stop motors.



IDC =Output direct current of CDA3000

Figure 5.42 DC braking with demagnetization time BRTOF and braking time BRTMX

For demagnetization purposes no current is applied to the motor in the time BRTOF, so the field in the motor can be safely removed. Then for the time BRDCT the direct current BRDCC is injected into the motor and the motor is braked without energy feedback into the inverter module. The motor converts the braking energy directly into heat.

Note: If too short a demagnetization time is chosen, the residual magnetization of the motor may result in error shutdowns in the inverter module.

Application with differing motor types:

- Asynchronous motor: ✔ — Braking time longer than braking with stop ramp, but no braking resistor necessary for inverter module.
- Synchronous motor, reluctance motor: ⊘ — No braking effect, because at high speeds the sum total of the braking torques per revolution is virtually zero (due to the rotor design). The resulting regenerative operation may lead to error messages.

Parameters for DC braking

Parameter	Function	Value range	FS	Unit	Online
670-BRDC	Mode of actuation of DC braking	OFF ... STOP	OFF		✔
671-BRDCC	Braking current for DC braking referred to device rated current	0 ... 180	80	%	
672-BRTMX	Maximum braking time	0 ... 60	15	s	✔
673-BRTOF	Demagnetization time before DC braking	0.10 ... 10.00	2	s	✔
674-BRTMN	Minimum braking time	0 ... 65535	0	ms	✔

Table 5.74 Parameters from subject area _67BR DC braking

Explanatory notes

- Depending on parameter setting, the motor may either run down uncontrolled, or be decelerated with a stop ramp or with direct current.
- After DC braking, the DC holding function can be appended to counteract any rotation caused by the load on the motor.
- The braking power is reduced to approx. one third of the braking power in operation with a braking resistor (braking chopper operation).
- The minimum braking time (674-BRTMN) cannot be aborted by a start signal.
- In the time between the minimum braking time (674-BRTMN) and the maximum braking time (672-BRTMX) the DC braking can be aborted by a start signal.
- The maximum braking time period (672-BRTMX) includes the minimum braking time (674-BRTMN).

Attention: By activating the DC brake, in response to STR/ STL=0 DC braking is executed instead of the stop ramp (STPRx).

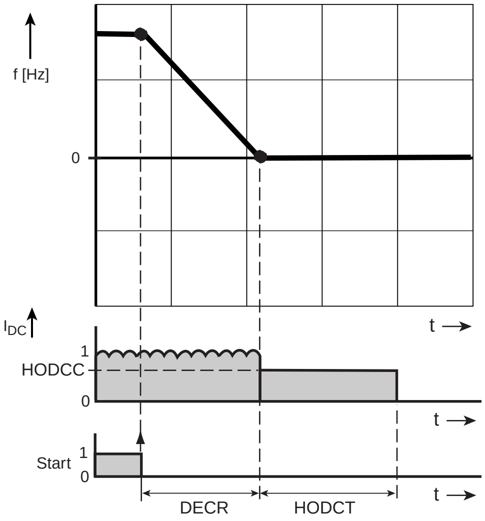
Settings of the DC braking activation mode with 670-BRDC

BUS	KP/DM	Function
0	OFF	No DC braking
1	NSTRT	DC braking active after cancellation of starting
2	STOP	Selection of DC braking via digital input or SOI control bit (field bus system) Digital input: FIxxx = /STOP

Table 5.75 Settings for 670-BRDC DC braking

5.5.9 _68 HO-DC holding

Function	Effect
• On completion of DC braking an adjustable direct current is injected into the motor.	• Rotation of the motor shaft under no load is counter-acted. No standstill torque is applied against a load on the motor shaft.



I_E Output current of CDA3000
DECR Controlled braking (DECRx, STPRx, BRDC)

Figure 5.43 DC holding for the time HODCT

Parameters for DC holding

Parameter	Function	Value range	FS	Unit	Online
680-HODCC	Holding current referred to device rated current	0 ... 180	60	%	
681-HODCT	Holding time in DC holding	0.00 ... 60.00	0.5	s	✔

Table 5.76 Parameters from subject area _68HO DC holding

Explanatory notes

- Deactivation of DC holding by HODCT = 0 s.

Activation of DC holding with 68-HODCT $\neq$ 0 s

Preceding function	Activation condition, DC holding
DC braking 670-BRDC = OFF	At end of maximum braking time 672-BRTMX
Stop ramp STPRx	On reaching of reference zero
Braking ramp DECRx	

Table 5.77 Activation conditions for DC holding

1
2
3
4
5
6
A
DE
EN

5.5.10 _80 CC-Current controller

Function	Effect
• Setting of the PI controller for current control	Parameter setting of the PI current controllers for the functions • DC braking • DC holding • Remagnetization (VFC) • Current injection (VFC) • Torque-forming current i_q in SFC • Flux and torque-forming current in FOR

Note: Activation of auto-tuning of the motor and controller parameters by way of parameter 161-ENSC = START in subject area "_15 FC-Initial commissioning" (section 5.1) automatically optimizes the current controller setting.

Parameters of the current controller

Parameter	Function	Value range	FS	Unit	Online
800-CCG	Current controller gain	0 ... 500	dependent on inverter		
801-CCTLG	Current controller lag time	0.001 ... 100	dependent on inverter	s	
802-CCTF	Filter time constant for current measurement in SFC	0.0005 ... 20	dependent on inverter	s	
803-VCSFC	Correction of fault voltage characteristic (SFC, FOR)	0 ... 199	dependent on inverter	%	✔
804-CLIM1	CDS1: Maximum reference current for current control	0 ... 180	100	%	
805-CLIM2	CDS2: Maximum reference current for current control	0 ... 180	100	%	

Table 5.78 Parameters from subject area _80CC Current controller

Explanatory notes

- The filter time constant for current measurement is used only by the Sensorless Flux Control (SFC) mode.
- The following functions are operated with the parameters determined by auto-tuning:
  - DC braking
  - DC holding
  - Remagnetization (VFC)
  - Current injection (VFC)
  - Torque-forming current i_q in SFC
  - Flux and torque-forming current in FOR
- The factory setting of the current controller relates to an IEC standard motor with the respective device power rating. The motor is specified in subject area "_15 FC-Initial commissioning" (section).
- With the analog input ISA01 by way of FISA1=SCALE the current can be influenced for torque formation within CLIMx. A torque limitation can thus be effected by way of the analog input.

Notes on optimization

Open-loop/ closed-loop control mode	Need for optimization
VFC	Motor power output = inverter output and IEC standard motor • No optimization required, because 1:1 rating in factory setting Motor output power < inverter output or no IEC standard motor • Optimization and adaptation by activation of auto-tuning (see section 5.1 "_15 FC-Initial commissioning")
SFC	Optimized after successful initial commissioning with auto-tuning (see section 5.1 "_15 FC-Initial commissioning"). Further information: Setting aids as required in section 6.2.3 "Tips and optimization aids for control engineers".
FOR	Optimized after successful initial commissioning with auto-tuning (see section 5.1 "_15 FC-Initial commissioning").

Table 5.79 Notes on optimization

5.5.11 _64CA-Current-controlled startup

Function	Effect
• The drive accelerates with the preset acceleration ramp. When a programmable current limit is reached the acceleration is slowed or stopped, depending on selected function, until sufficient current reserves are available again. • The same applies to deceleration of the drive.	• Protection against current overload shut-off in acceleration of large moments of inertia • Protection against drive stalling • Acceleration and deceleration processes with maximum dynamics along the current limit

Parameters of current-controlled startup/rundown

Parameter	Function	Value range	FS	Unit	Online
639-CLTF	Filter time constant for current-controlled startup/rundown	0.002 ... 20	0.01	s	
640-CLSL1	CDS1: Function selector	0 ... 2	2		✔
641-CLCL1	CDS1: Current limit value	0 ... 200	100	%	
642-CLFL1	CDS1: Lowering frequency	0 ... 100	4	Hz	
643-CLFR1	CDS1: Initial frequency	0 ... 1600	0	Hz	
644-CLRR1	CDS1: Lowering ramp	0 ... 1600	100	Hz	
645-CLSL2	CDS2: Function selector	0 ... 2	2		✔
646-CLCL2	CDS2: Current limit value	0 ... 200	100	%	
647-CLFL2	CDS2: Lowering frequency	0 ... 100	4	Hz	
648-CLFR2	CDS2: Initial frequency	0 ... 1600	0	Hz	
649-CLRR2	CDS2: Lowering ramp	0 ... 1600	100	Hz	

Table 5.80 Parameters of subject area _64CA Current-controlled startup

Note: When setting the parameter values manually in VFC mode, please pay attention to the information set out in section 6.1.5 “Tips and optimization aids for control engineers” (step 3), otherwise the “current-controlled startup” function may negatively affect the “current injection” function.

Settings of the function selector CLCLx for current-controlled startup/rundown

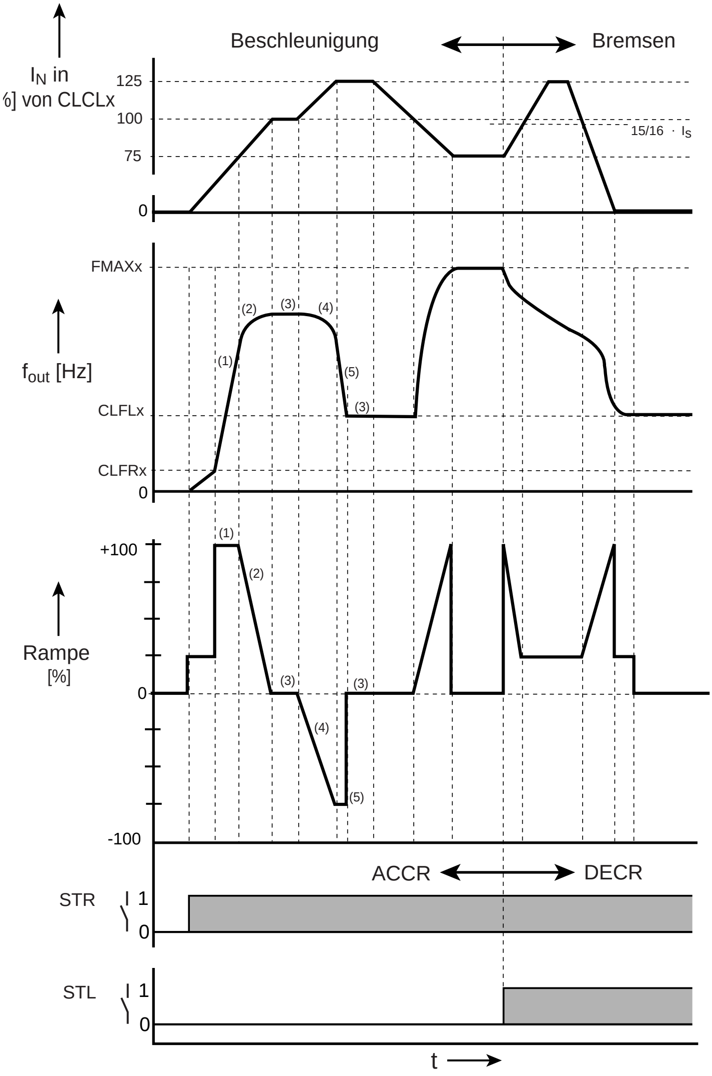
BUS	KP/DM	Function
0	OFF	Current-controlled startup inactive
1	CCWFR	During acceleration with the acceleration ramp ACCRx (1), when 75% of the current limit CLCLx (2) is reached the acceleration is reduced in linear mode from 100% ACCRx at the current limit 75% CLCLx to 0% ACCRx at 100%CLCLx. This means that at 100% CLCLx the drive is no longer being accelerated (3). If the current limit 100% CLCLx is exceeded (4), the reference frequency is reduced. The reduction is effected with the steepness specified in CLRRx. The steepness rises in linear mode up to 100% CLRRx at the current limit 125% CLCLx. This process is limited when the lowering frequency CLFLx is reached (5). When the apparent current falls below the current limit 100% CLCLx the drive is again accelerated with the acceleration ramp ACCRx. The conditions previously detailed apply once again. The same also applies to braking, where the frequency can be increased up to the maximum.
2	CCWFS	Function as in the case of CLSLx = 1, but the output frequency is stopped at 125% CLCLx. That is to say, there is no acceleration or frequency reduction.
	( )	For a representation of the operation phases see Figure 5.44 and Figure 5.45.

Table 5.81 Settings for function selector CLSLx

Explanatory notes

- The function implements a current limitation by altering the startup/ rundown ramps.
- In the frequency range 0 Hz to the initial frequency CLFRx the current acceleration ramp ACCRx is reduced to 25%.
- The control remains active after startup. In this way, under increasing load - and thus increasing current - the speed is reduced under ramp control, in order to protect the motor against stalling. The same also applies to braking, where the frequency can be increased up to the maximum.
- The current limit CLCLx relates to the device rated current. The rated current of the respective inverter module is designated as CLCLx = 100%.

Example: Acceleration and braking in motorized operation with CLSLx = CCWFR



I_N	Device rated current as apparent current I_S
CLFLx	Lowering frequency
CLFRx	Initial frequency

(1) to (5) see Figure 5.45 and Table 5.81

Figure 5.44 Acceleration and braking in motorized operation CLSLx = CCWFR

Notes for control engineers:

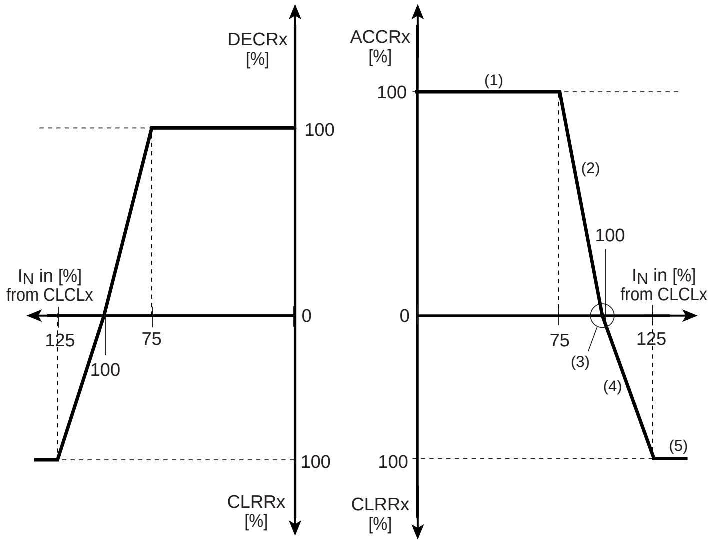
f_{out} < CLFRx (initial frequency)

If the actual speed of the motor is below the initial frequency CLFRx, the preset ramp steepness ACCRx/DECRx is limited to a quarter.

$f_{out} \geq$ CLFRx (initial frequency)

Operating state / Load	Function
• Braking, regenerative • Acceleration, motorized • Stationary, motorized	see Figure 5.45
• Braking, motorized • Acceleration, regenerative	see Figure 5.46

Table 5.82 Modes of action of current-controlled startup/rundown



(x) Representation of operation phases (1) to (5) in Table 5.81 and Figure 5.44

Figure 5.45 Dependency of the ramp steepness on the device rated current dimensioned to the current limit value

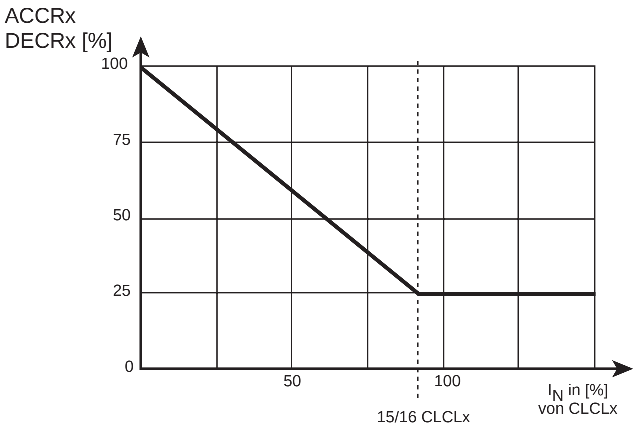


Figure 5.46 Dependency of the ramp steepness on the device rated current and load case dimensioned to the current limit CLCLx

Attention: In lifting applications, regenerative load from the lowering action during braking may cause the drive to be accelerated as a result of the apparent current I_S.

5.5.12 _69 PM-Modulation

Function	Effect
• Setting of switching frequency of inverter power stage	The higher the switching frequency, • the lower the noise, • the smoother the motor runs at high speed and • the lower the output power of the inverter module.

As the switching frequency (modulation frequency) increases the power loss of the inverter module also increases. The reason for this lies in the common losses in the switching of power semiconductors in the power stage. This necessitates a reduction in the power of the inverter module in order to prevent the device from overheating. The power rating is also influenced by the motor cable length, the ambient temperature and the mounting height.

Minimum switching frequency of power stage for very smooth running of the motor

Switching frequency of power stage	Output frequency of inverter
4 kHz	to 400 Hz
8 kHz	to 800 Hz
16 kHz	to 1600 Hz

Table 5.83 Minimum switching frequency for adequately smooth running of the motor

Rule of thumb: The modulation frequency should be 8 to 10 times the maximum output frequency of the inverter.

Parameters of the modulation frequency

Parameter	Function	Value range	FS	Unit	Online
690-PMFS	Switching frequency of power stage	4, 8, 16	dependent on device	kHz	

Table 5.84 Parameters from subject area _69PM Modulation

Explanatory notes

- Factory setting of devices < 22 kW:8 kHz
  Factory setting of devices > 22 kW:4 kHz
- Safety functions for the device are automatically adapted to the modulation frequency.
- Devices with outputs of 22 kW and above cannot be operated at 16 kHz.

Permissible rated current of single-phase inverter module 0.37 kW to 2.2 kW

	1 x 230 V mains voltage					
	45 °C ambient temperature 4 kHz clock frequency 10 m motor cable	40 °C ambient temperature 8 kHz clock frequency 10 m motor cable	40 °C ambient temperature 16 kHz clock frequency 10 m motor cable	45 °C ambient temperature 4 kHz clock frequency 25 m motor cable	40 °C ambient temperature 8 kHz clock frequency 25 m motor cable	40 °C ambient temperature 16 kHz clock frequency 25 m motor cable
Inverter modules	Rated current [A]	Rated current [A]	Rated current [A]	Rated current[4)] [A]	Rated current[4)] [A]	Rated current[4)] [A]
CDA32.003,Cx.x[1)]	2.40	2.40	2.40	2.25	2.15	2.00
CDA32.004,Cx.x[2)]	4.00	4.00	3.00	3.85	3.70	2.60
CDA32.006,Cx.x	5.60	5.40	4.00	5.45	5.25	3.85
CDA32.008,Cx.x[3)]	7.10	7.10	5.20	6.95	6.85	4.80

1) Mounted side-by-side without additional cooling area, e.g. backplane
2) Mounted side-by-side, with backplane (650 mm x 100 mm = 0.065 m) as additional cooling area
3) Inverter module with heat sink “HS32.200” and 20 mm gap when mounted side-by-side
4) The rated current with a 25 meter motor cable is less than with a 10 meter motor cable by the amount of the current losses occurring on the motor cable (see Table 5.87)

Table 5.85 Output current for inverter modules with 230 V power supply

Permissible rated current of three-phase inverter modules 0.75 kW to 90 kW

Inverter modules	3 x 400 V mains voltage 45 °C ambient temperature 4 kHz clock frequency 10 m motor cable Rated current [A]	40 °C ambient temperature 8 kHz clock frequency 10 m motor cable Rated current [A]	40 °C ambient temperature 16 kHz clock frequency 10 m motor cable Rated current [A]	45 °C ambient temperature 4 kHz clock frequency 25 m motor cable Rated current [A]	40 °C ambient temperature 8 kHz clock frequency 25 m motor cable Rated current [A]	40 °C ambient temperature 16 kHz clock frequency 25 m motor cable Rated current [A]
CDA34.003,Cx.x	2.2	2.2	1.8	2.0	1.7	0.5
CDA34.005,Cx.x	4.1	4.2	2.2	3.9	3.6	1.4
CDA34.006,Wx.x	5.7	5.7	3.2	5.5	5.2	2.6
CDA34.008,Wx.x	7.8	7.8	Not available at time of going to press	7.6	7.3	Not available at time of going to press
CDA34.010,Wx.x	10	10		9.8	9.5	
CDA34.014,Wx.x	14	14		14	14	
CDA34.017,Wx.x	17	17		17	17	
CDA34.024,Wx.x	24	24		24	24	
CDA34.032,Wx.x	32	32		32	32	
CDA34.045,Wx.x	45	45	*	45	45	*
CDA34.060,Wx.x	60	60	*	60	60	*
CDA34.072,Wx.x	72	72	*	72	72	*
CDA34.090,Wx.x	90	90	*	90	90	*
CDA34.110,Wx.x	110	110	*	110	110	*
CDA34.143,Wx.x	143	143	*	143	143	*
CDA34.170,Wx.x	170	170	*	170	170	*

* Not permitted

Table 5.86 Output current for inverter modules with 400 V power supply

Current losses on motor cables

Clock Frequency	Mains voltage 1 x 230 V		Mains voltage 1 x 400 V		Mains voltage 1 x 460 V	
	Motor choke		Motor choke		Motor choke	
	without [mA per m]	with [mA per m]	without [mA per m]	with [mA per m]	without [mA per m]	with [mA per m]
4	10	Not available at time of going to press	15	Not available at time of going to press	20	Not available at time of going to press
8	15		30		40	
16	25		60		70	

Table 5.87 Current losses on motor cable dependent on clock frequency

Allow for current losses with cable lengths >10 m or 25 m.
Table 5.87 applies to motor cable lengths up to 150 meters.

5.5.13 _84 MD-Motor data

Function	Effect
• Filing of acquired motor data for further calculation	• The motor data can be transferred to other inverter modules • In systems with identical motors no motor identification is required as the parameters can be transferred

Motor data acquired during auto-tuning

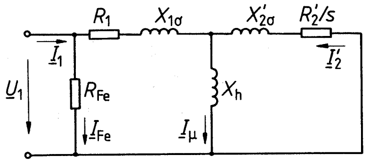
Parameter	Function	Value range	FS	Unit	Online
839-MONAM	Name of motor	0 ... 28 characters			
840-MOFNM	Nominal pole flux	0 ... 100	*	Vs	
841-MOL_S	Leakage inductance	0 ... 10	*	H	
842-MOR_S	Stator resistance	0 ... 128	*	W	
843-MOR_R	Rotor resistance	0 ... 500	*	W	
844-MONPP	Number of pole pairs of motor	0 ... 32	*		
850-MOL_M	Magnetizing inductance of motor	0 ... 10	*	H	

Table 5.88 Parameters of subject area _84MD Motor data

Explanatory notes

- The fields marked with an asterisk (*) are dependent on the rated power of the inverter module.
- In the factory setting the typical data of an IEC asynchronous standard motor of the device rated power are entered in the parameters.
- During auto-tuning of the inverter module (163 -ENSC=START) the motor data are acquired in the course of initial commissioning. The precondition for this is correct input of the motor rating plate data.
- All motor data can be transferred by way of the SMARTCARD or the DRIVEMANAGER. The parameters of the current and speed control loops should additionally be transferred so that the motor can be run correctly on the inverter module.

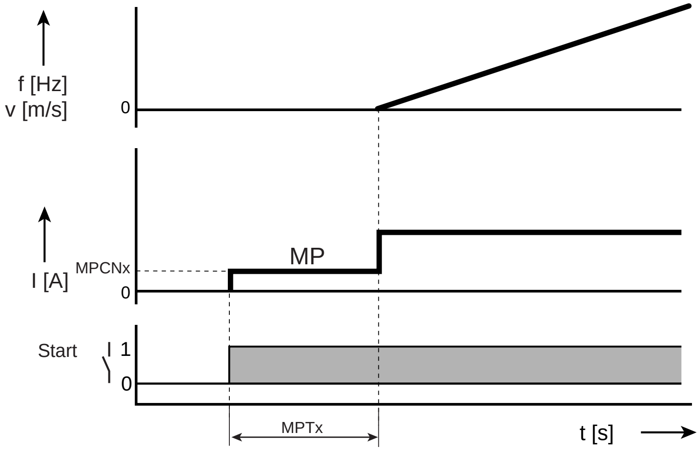
Simplified equivalent circuit diagram of the asynchronous machine



s	Slip
X_h	Magnetizing inductance
R_1	Stator phase resistance
R_2	Rotor resistance
$X_{1\sigma}$	Stator leakage inductance
$X_{2\sigma}$	Rotor leakage inductance
R_{FE}	Core loss resistance
I_M	Magnetizing current

5.5.14 _77 MP-Remagnetization

Function	Effect
• Injection of a defined direct current via a PI current control loop into the motor	• Increase starting and standstill torque • Deactivation of VFC mode during magnetization and flux build-up phase



MPCNx Magnetizing current
MPTx Remagnetization time

Figure 5.47 Magnetization phase (MP)

Parameters of remagnetization

Parameter	Function	Value range	FS	Unit	Online
770-MPCN1	CDS1: Magnetizing current	0 ... 180	33	%	
771-MPT1	CDS1: Magnetization time VFC	0.00 ... 2.00	0.00	s	
772-MPCN2	CDS2: Magnetizing current	0 ... 180	33	%	
773-MPT2	CDS2: Magnetization time VFC	0.00 ... 2.00	0.00	s	
774-MPT	Magnetization time for SFC and FOR (calculated during auto-tuning)	0.00 ... 16.00	0.50	s	

Table 5.89 Parameters from subject area _77MP Remagnetization

Explanatory notes

- When the time MPTx elapses the inverter module switches to the “Open-loop control/Closed-loop control active” state. That means that during the magnetization phase voltage frequency control is deactivated for a short time.
- The transition can be made directly from the magnetization phase to current injection.
- The magnetization time for control modes SFC and FOR is calculated during auto-tuning (163-ENSC) and should only be altered by highly experienced control engineers.

5.5.15 _86SY-System

Function	Effect
• Performance of a device test • Triggering of a controller reinitialization	• The device is optionally reset completely or in part to its factory setting (FS) • Controller data and limit values are recalculated

Parameters of the system

Parameter	Function	Value range	FS	Unit	Online
4-PROG	Reset device to factory setting	0 ... 65535	2		✔
15-PLRDY	Activate control initialization	ON/OFF	OFF		✔

Table 5.90 Parameters from subject area _86SY-System

Explanatory notes

- In the factory setting the application data set DRV_1 is activated (see parameter list in appendix).
- A control initialization is always carried out under the following conditions:
  - Setting of ENPO signal and startup (STR or STL)

  In KP200 operation:
  - Quitting of the subject area level in the PARA menu branch, into the menu branch selection level (menu level). The display shows “MENU”.
- Activation of a control initialization by means of parameter 15-PLRDY is only necessary when the DRIVEMANAGER device status indicator shows “Parameter setting” and the device is to adopt the newly set values of parameters for control of the device in advance. After the control initialization the device status is set to switch-on inhibited/ready.
- Not every parameter setting leads to the “Parameter setting” device state.

Reset device to factory setting 4-PROG

BUS	KP/DM	Function
1	1	Reset the active data set in the RAM to its factory setting. The factory setting must then be saved to a user data set, because the RAM is a volatile storage medium.
815	815	Reset the active data set in the RAM and all user data sets **up to user level 4** to factory setting. In the final step, the factory setting is saved to all user data sets.
850	850	Reset the active data set in the RAM and all user data sets **up to user level 6** to factory setting. In the final step, the factory setting is saved to all user data sets.

Table 5.91 Factory setting reset functions

6 Control modes

During commissioning of the inverter module three different control methods can be selected. The necessary identification of the motor is carried out automatically by the CDA3000 inverter module, causing all control circuits to be preset.

Overview of motor control methods

Voltage Frequency Control (VFC):

- Asynchronous motors
- Reluctance motors
- Synchronous motors
- Special motors

- Motor running is controlled by characteristic
- Voltage of motor is altered proportional to output frequency of inverter

Sensorless Flux Control (SFC):

- Asynchronous motors

- Calculation of the rotor speed and the rotor angle from the electrical variables
- High torque output based on field orientation (calculation of the currents to be set)
- High dynamics and smooth running
- Operation **without** encoder

Field-Oriented Regulation (FOR):

- Asynchronous motors

- Calculation of the rotor speed and rotor angle from the encoder information
- Very high torque output based on field orientation (calculation of the currents to be set)
- Maximum dynamics and smoothness
- Operation **with** encoder

Properties of the motor control methods in comparison

Characteristics	VFC Voltage/Frequency Control	SFC Sensorless Flux Control	FOR Field-Oriented Regulation
Torque rise time	20-30 ms	< 2 ms	< 2ms
Dynamic disturbance correction	NO	YES	YES
Standstill torque	NO	NO	YES
Acceleration torque[1)]	1.2 · MNom	1.8· MNom	2 · MNom
Current usage of inverter	60%	90%	100%
Anti-stall protection	limited	YES	YES

Tabelle 6.1 Motor control method

Characteristics	VFC Voltage/Frequency Control	SFC Sensorless Flux Control	FOR Field-Oriented Regulation
Speed manipulating range $M = M_{Nom}$	1:20	1:50	>1:10000
Static speed accuracy	typically 1 to 5%[2)]	typically 0.5%[2)]	quartz accurate[2)]
Frequency resolution	0.01 Hz	0.0625 Hz	2^{-16} Hz
Motor principle	asynchronous synchronous reluctance	asynchronous	asynchronous
1) $I_{Inverter} = 2 \cdot I_{Motor}$ 2) referred to nominal speed			

Tabelle 6.1 Motor control method

General points on operation of three-phase AC motors with frequency inverters

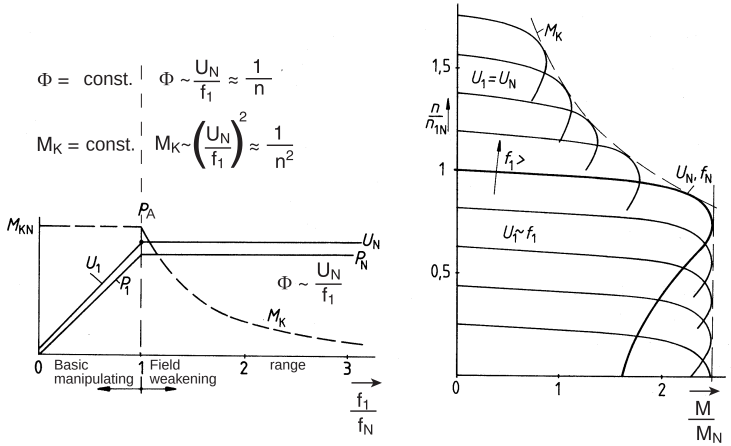


Figure 6.1 Characteristic of speed curves

Three-phase AC machines are executed in synchronous and asynchronous design. Their stator windings are arranged and their electrical properties designed such that in operation in a three-phase AC system a rotating field is created in the motor which drives the rotor.

The synchronous speed (n_S) of a motor is determined by the number of pole pairs (P) and the feed frequency (f_1) of the stator.

$$n_s = \frac{f_1 \cdot 60}{p}$$

Based on the induction from the stator rotating field, asynchronous motors develop a torque which drives the rotor and which attempts to reduce the speed relative to the stator rotating field and thus to counteract the cause of induction. Without the induction of a voltage in the rotor, however, no current (i_2) capable of forming a torque will flow. Consequently, a relative difference is established between the stator speed (n_1) and the rotor speed (n), which is defined as the slip (s).

$$s = \frac{\Delta n}{n_1} = \frac{n_1 - n}{n_1}$$

The asynchronous operating speed (n_b) is thus composed of the synchronous speed (n_S) and the slip (s).

$$n_b = \frac{f_1 \cdot 60}{p} \cdot (1 - s)$$

Low-loss speed control is only possible by means of a change of frequency. In order to retain a constant motor torque in the event of a speed adjustment, the magnetic flux Φ_1 in the stator winding must remain constant. The voltage U_1 must therefore be adjusted proportional to the stator frequency f_1.

$$M \sim \Phi_1 \cdot i_2 \text{ and } \Phi_1 \sim \frac{U_1}{f_1}$$

A frequency/speed adjustment by means of the frequency inverter thus results in a parallel shift of the characteristic in the basic setting range along the speed axis (see Figure 6.1 diagram on right).

If the stator frequency is increased further when the rated frequency f_N and rated voltage U_N are reached, even though the maximum output voltage of the frequency inverter has been reached (U=Const.), the result is a field weakening.

As the speed rises, this results in a drop in torque with

$$M \sim \frac{1}{n^2}$$

General points on the interaction between control methods and motors

If control methods such as SFC and FOR are used for speed control, the correct motor data are decisive factors in terms of the quality of the methods.

During auto-tuning of the inverter module, all controllers are optimally set up based on the rating plate data and the automatically calculated electrical motor parameters.

If the motor data from the rating plate do not exactly match the actual electrical data of the motor, the control quality decreases. If the nominal speed nn is imprecisely specified, for example, the number of pole pairs may be incorrectly calculated or an unfavourable motor flux may be set. All further controller settings will then also be incorrect.

As already outlined, this will negatively affect the dimensioning and optimization of the controllers.

1
2
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A
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6.1 Voltage Frequency Control (VFC)

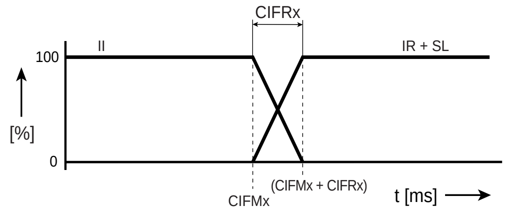
The multiplicity of functions of Voltage Frequency Control does not permit unrestricted simultaneous usage. However, in many cases it is possible to sequence functions such as DC braking followed by DC holding.

Combination of voltage frequency control functions

1st active function → / Activate 2nd function ↓	Remagnetization	Current injection	IxR load compensation	Slip compensation	Current-controlled startup	DC braking	DC holding
Remagnetization							
Current injection			❍	❍			
IxR load compensation		❍		✓	✓		
Slip compensation		❍	✓		✓		
Current-controlled startup			✓	✓			
DC braking							
DC holding							

(empty box)	Simultaneous combination not possible
✓	Simultaneous combination possible without restriction
❍	Simultaneous combination possible only with restrictions:

In a fixed frequency range both functions may overlap and thus restrict simultaneous working.



II: Current injection; IR: IxR load compensation; SL: Slip compensation
CIFMx: Limit frequency of current injection

Figure 6.2 Combination of voltage frequency control functions

Note: In the factory setting the inverter module is preset to a 1:1 ratio between the inverter output and the power output of the asynchronous standard motor.

Settings when motor power output < inverter output

- Auto-tuning with application of one of the following functions

Function	Active in FS
Magnetizing	
IxR load compensation	✔
Slip compensation	
DC braking	
DC holding	
Current injection	✔
Current-controlled startup	✔

Table 6.2 Generally applied functions in open-loop control mode VFC

Note: The factory setting of the inverter module is Voltage Frequency Control with 50 Hz characteristic over two interpolation points. IxR load compensation and current injection are additionally activated.
Please refer to the information given in the relevant sections regarding the IxR load compensation and current injection software functions.

6.1.1 _70VF-Voltage Frequency Control

Function	Effect
• Adaptation of the inverter module to the motor and to the load characteristic of the application	• Generation of the optimum torque for the application

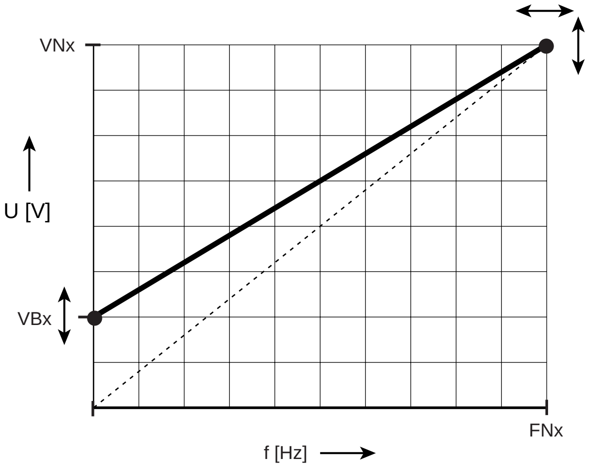


Figure 6.3 Voltage frequency control with two interpolation points

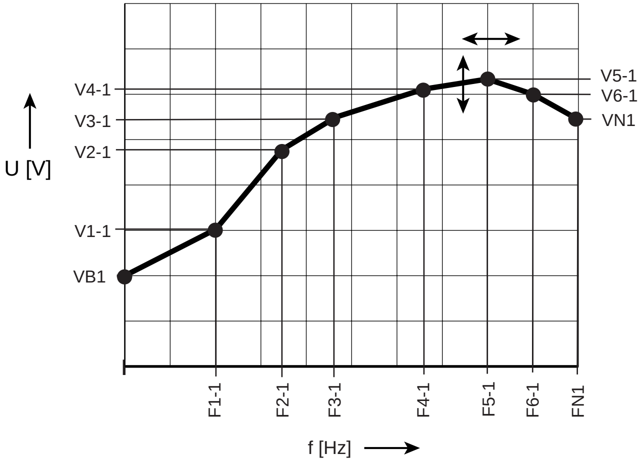


Figure 6.4 Voltage frequency control with six interpolation points

Parameters of voltage frequency control

Parameter	Function	Value range	FS	Unit	Online
700-VB1	CDS1: Boost voltage	0 ... 100	0	V	
701-VN1	CDS1: Motor rated voltage	0 ... *	*	V	
702-FN1	CDS1: Motor rated frequency	0 ... 1600	50	Hz	
703-V1-1	CDS1: Voltage buffer value 1	0 ... *	0	V	
704-V2-1	CDS1: Voltage buffer value 2	0 ... *	0	V	
705-V3-1	CDS1: Voltage buffer value 3	0 ... *	0	V	
706-V4-1	CDS1: Voltage buffer value 4	0 ... *	0	V	
707-V5-1	CDS1: Voltage buffer value 5	0 ... *	0	V	
708-V6-1	CDS1: Voltage buffer value 6	0 ... *	0	V	
709-F1-1	CDS1: Frequency buffer value 1	0 ... 1600	0	Hz	
710-F2-1	CDS1: Frequency buffer value 2	0 ... 1600	0	Hz	
711-F3-1	CDS1: Frequency buffer value 3	0 ... 1600	0	Hz	
712-F4-1	CDS1: Frequency buffer value 4	0 ... 1600	0	Hz	
713-F5-1	CDS1: Frequency buffer value 5	0 ... 1600	0	Hz	
714-F6-1	CDS1: Frequency buffer value 6	0 ... 1600	0	Hz	
715-VB2	CDS2: Boost voltage	0 ... 100	0	V	
716-VN2	CDS2: Motor rated voltage	0 ... *	*	V	
717-FN2	CDS2: Motor rated frequency	0 ... 1600	50	Hz	
718-V1-2	CDS2: Voltage buffer value 1	0 ... *	0	V	
719-V2-2	CDS2: Voltage buffer value 2	0 ... *	0	V	
720-V3-2	CDS2: Voltage buffer value 3	0 ... *	0	V	
721-V4-2	CDS2: Voltage buffer value 4	0 ... *	0	V	
722-V5-2	CDS2: Voltage buffer value 5	0 ... *	0	V	
723-V6-2	CDS2: Voltage buffer value 6	0 ... *	0	V	
724-F1-2	CDS2: Frequency buffer value 1	0 ... 1600	0	Hz	
725-F2-2	CDS2: Frequency buffer value 2	0 ... 1600	0	Hz	
726-F3-2	CDS2: Frequency buffer value 3	0 ... 1600	0	Hz	
727-F4-2	CDS2: Frequency buffer value 4	0 ... 1600	0	Hz	
728-F5-2	CDS2: Frequency buffer value 5	0 ... 1600	0	Hz	
729-F6-2	CDS2: Frequency buffer value 6	0 ... 1600	0	Hz	
730-ASCA1	CDS1: Assistance parameter for Voltage Frequency Control	see Table 6.4	OFF		
731-ASCA2	CDS2: Assistance parameter for Voltage Frequency Control	see Table 6.4	OFF		

Table 6.3 Parameters from subject area _70VF Voltage frequency control

Explanatory notes

- The values marked with an asterisk (*) are dependent on device version 230 V or 400 V.
- CDS1 = Characteristic data set 1, CDS2 = Characteristic data set 2
- The voltages between two interpolation points are interpolated in linear mode.
- Interpolation points with the setting 0 Hz are inactive.
- The sequence of interpolation points is automatically sorted in ascending order of frequency. As a result, a new interpolation point can also be entered without having to shift other interpolation point settings.
- During controller initialization the limit values of the settings are checked. If the limit values are infringed an error message is delivered (see Appendix).

Settings of assistance parameters 730-ASCA1 and 731 -ASCA2

The parameters ASCU contain preset characteristic shapes based on the setting options of the six interpolation points of the V/F characteristic.

BUS	KP/DM	Function	Usage
0	OFF	Fully programmable characteristic with up to six interpolation points	Optimum setting options for V/F control of special motors
1	L50Hz	Linear 50 Hz characteristic with two interpolation points	Standard motor (European market)
2	L60Hz	Linear 60 Hz characteristic with two interpolation points	Standard motor (American market)
3	L87Hz	Linear 87 Hz characteristic with two interpolation points	Expanded manipulating range for Δ
4	Q50Hz	Quadratic 50 Hz characteristic with six interpolation points	Standard motor (European market) for pump and fan applications
5	Q60Hz	Quadratic 60 Hz characteristic with six interpolation points	Standard motor (American market) for pump and fan applications

Table 6.4 Setting of predefined V/F characteristics

87 Hz characteristic for expanded manipulating range

The operating range with constant torque of a 400 V / 50 Hz motor in star configuration can be expanded to 87 Hz in delta configuration.

Note: It should be checked whether the motor is adequate to the load (400 V / Δ at 87 Hz), since the motor can be run above its rated power. Only the motor manufacturer can give precise information.

Example: Expanded manipulating range based on 87 Hz characteristic

1. Motor data taken from rating plate

- Motor type: Asynchronous motor
- Rated power: 4 kW
- Rated speed: 1420 rpm
- Rated voltage: 230 V / **400 V**
- Configuration: Δ / Y

2. Change motor circuitry on terminal board

- Change motor from star configuration (400 V / Y) to delta configuration (230 V / Δ).

3. Adapt power output of inverter module

- As a result of the changed configuration of the motor (400 V / Δ) the power of the inverter module must be adjusted.

  Condition: $P_{Inverter} \geq P_{Motor} \cdot \sqrt{3}$ $P_{Inverter} = (4kW \cdot 1,73)$

➢ **Selected inverter module: CDA34.017 (rated power 7.5 kW)**

4. Adapt specification of motor data in “Initial commissioning” subject area.

a) 154-MOPNM = P_{n50Hz} x $\sqrt{3}$
b) 155-MOVNM = 400 V
c) 156-MOFN = 87 Hz
d) 157-MOSNM = n_{n50Hz} x $\sqrt{3}$
e) 158-MOCNM = $I_{\Delta Motor}$

5. Drive diagram of 87 Hz characteristic

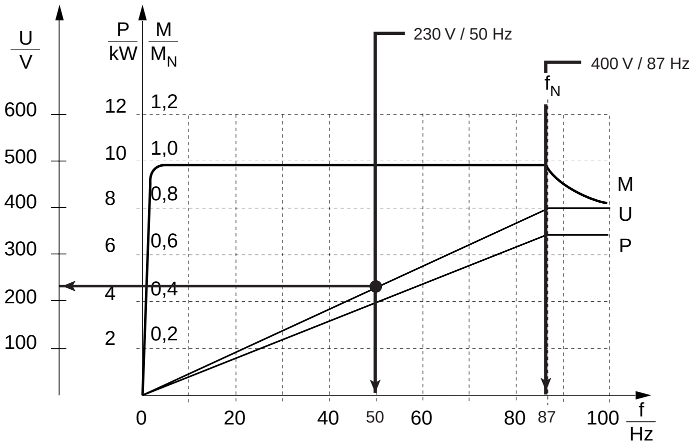


Figure 6.5 Constant torque range to 87 Hz

6.1.2 _74 IR-IxR load compensation

Function	Effect
• Automatic adaptation of the V/F characteristic to the load situation • Compensation for voltage drop on motor stator resistor	• In case of load surges a higher torque is available • The motor heats up less under load

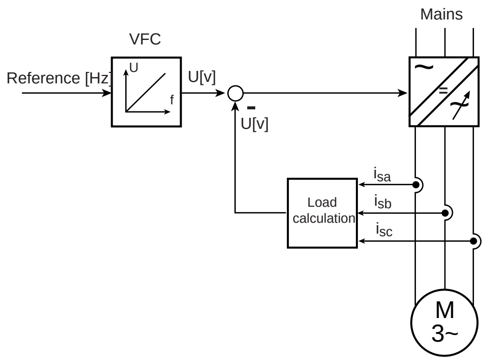
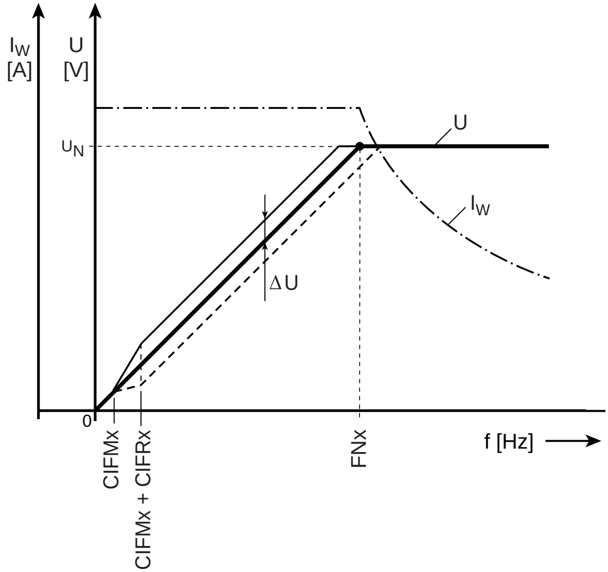


Figure 6.6 IxR load compensation block diagram

IxR load compensation is implemented by shifting the V/F characteristic by a voltage amount ΔY dependent on the active current. The V/F characteristic is determined by the parameters from subject area _70VF Voltage Frequency Control.



I_W	Active current
U	Output voltage
U_N	Rated voltage
CIFMx	Initial frequency
ΔY	Voltage adjustment by IxR load compensation

Figure 6.7 V/F characteristics of IxR load compensation

Parameters of IxR load compensation

Parameter	Function	Value range	FS	Unit	Online
740-IXR1	CDS1: IxR load compensation on/off	OFF, ON	ON		✔
741-KIXR1	CDS1: IxR compensation factor	0 ... 100	*	Ω	
742-IXR2	CDS2: IxR load compensation on/off	OFF, ON	ON		✔
743-KIXR2	CDS2: IxR compensation factor	0 ... 100	*	Ω	
744-IXRTF	Filter time constant for IxR compensation	0.0005 ... 20	0.01	s	

Table 6.5 Parameters from subject area _74IR IxR load compensation

Explanatory notes

- The precondition for IxR load compensation is correct setting of parameters 159-MOCOS (cosφ) and 158-MOCNM (motor rated current INM).
- If the output frequency exceeds the motor rated frequency (parameter FNx), the IxR load compensation is deactivated. IxR load compensation takes effect as from frequency CIFMx and is 100% active as from frequency CIFMx + CIFRx.
- The stator resistance required for the function is automatically calculated during initial commissioning and stored in parameter KIXRx (IxR compensation factor).
- Parameter values marked by an asterisk (*) in the “Factory setting” (FS) column are dependent on the device power output. The values correspond to an asynchronous IEC standard motor with the rated device power output.

6.1.3 _75 SL-Slip compensation

Function	Effect
• Increase output frequency proportional to the load on the motor	• Compensate for the slip caused by the load on the motor, thus producing a constant speed

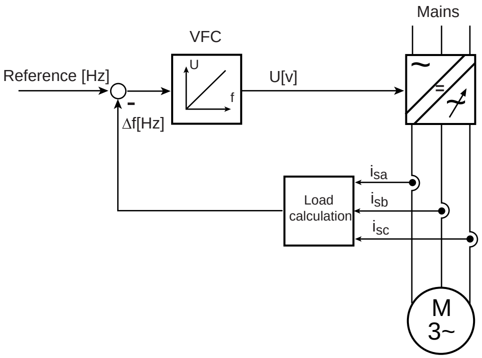


Figure 6.8 Slip compensation block diagram

Parameters of slip compensation

Parameter	Function	Value range	FS	Unit	Online
750-SC1	CDS1: Slip compensation on/off	OFF, ON	OFF		✔
751-KSC1	CDS1: Slip compensation factor	0 ... 30	*	%	
752-SC2	CDS2: Slip compensation on/off	OFF, ON	OFF		✔
753-KSC2	CDS2: Slip compensation factor	0 ... 30	*	%	
754-KSCTF	Filter time constant for slip compensation	0.0005 ... 20	0.01	s	

Table 6.6 Parameters from subject area _75SL Slip compensation

Explanatory notes

- Parameter values marked by an asterisk (*) in the “Factory setting” (FS) column are dependent on the device power output. The values correspond to an asynchronous IEC standard motor with the rated device power output.
- The precondition for slip compensation is correct setting of parameters MOCOS (cosφ) and MOCNM (motor rated current I_{NM}).
- A frequency correction proportional to the active current is added to the reference frequency. Slip compensation takes effect as from frequency CIFMx and is 100% active as from frequency CIFMx + CIFRx.
- The compensation factor KSCx required for the function is automatically calculated during initial commissioning and stored in parameter KSCx.
- The frequency correction Δϕ may be positive or negative, depending on whether motorized or regenerative operation is selected.

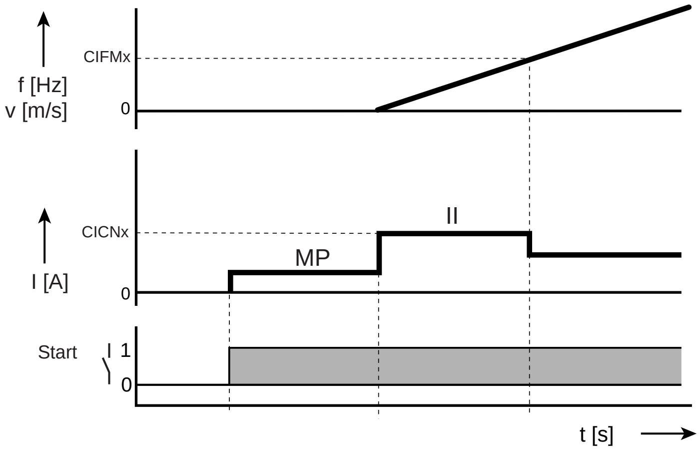
Note for control engineers: The compensation factor KSC can be calculated by the following equation:

$$KSCx = \frac{n_{sync} - n_{nom}}{n_{sync}} \cdot 100 \ \%$$

Note: If the slip compensation and the IxR load compensation influence each other, increasing the filter time of the slip compensation may bring a remedy.

6.1.4 _76 CI-Current injection

Function	Effect
• Current injection via current control as from a parameterizable limit value as a percentage of device rated current	• Increase the starting torque up to the set limit frequency



CIFMx Limit frequency of current injection
CICNx Reference for current injection
MP Remagnetization
II Current injection

Figure 6.9 Current injection (II)

Parameters of current injection

Parameter	Function	Value range	FS	Unit	Online
760-CICN1	CDS1: Current injection reference	0 ... 180	120	%	
761-CIFM1	CDS1: Current injection limit frequency	0 ... 100	4	Hz	
762-CIFR1	CDS1: Current injection transition range	0.5 ... 10	2	Hz	
763-CICN2	CDS2: Current injection reference	0 ... 180	120	%	
764-CIFM2	CDS2: Current injection limit frequency	0 ... 100	4	Hz	
765-CIFR2	CDS2: Current injection transition range	0.5 ... 10	2	Hz	
766-CITM1	CDS1: Current injection timer for switchover to CICT1	0 ... 60	6	s	

Table 6.7 Parameters from subject area _76CI Current injection

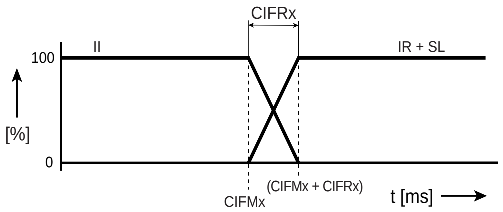
Parameter	Function	Value range	FS	Unit	Online
767-CICT1	CDS1: Current injection reference at end of CITM1	0 ... 180	30	%	
768-CITM2	CDS2: Current injection timer for switchover to CICT2	0 ... 60	6	s	
769-CICT2	CDS2: Current injection reference at end of CITM2	0 ... 180	30	%	

Table 6.7 Parameters from subject area _76CI Current injection

Explanatory notes

- In the frequency range CIFRx the current injection is regulated back to the normal operating current as from the limit frequency CIFMx.
- In conjunction with IxR load compensation and slip compensation, current injection can only operate simultaneously to a limit degree in the startup phase.

In a fixed frequency range both functions may overlap and thus restrict simultaneous working.



II: Current injection; IR: IxR load compensation; SL: Slip compensation

CIFMx: Limit frequency of current injection

Note: When setting the parameter values manually in VFC mode, please pay attention to the information set out in section 6.1.5 “Tips and optimization aids for control engineers” (step 3), otherwise the “current-controlled startup” function may negatively affect the “current injection” function.

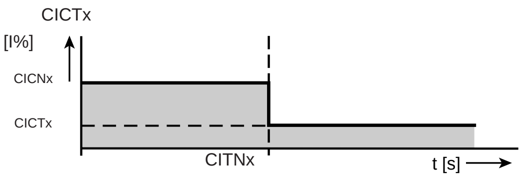
Note: The current injection reference is a percentage of the device rated current (I_{GN}) of the inverter module.

Up to firmware V1.35 at motor power outputs < inverter output the reference should be adjusted manually to 80% of the motor rated current (I_{MN}).

$$CICNx = \frac{I_{MN}}{I_{GN}} \cdot 80\,\%$$

From firmware V1.4 the adjustment is made during auto-tuning (see section 5.1 "_15 FC-Initial commissioning") to 100% of the motor rated current.

From firmware V2.10 the adjustment is made during auto-tuning to 120% of the motor rated current up to 1.5 times the motor rated slip. This limit frequency CIFMx is likewise automatically calculated during auto-tuning. Also, after the time CITMx the injected current is reduced to CICTx.



Attention: In motors with internal cooling:
When application data sets DRV_4, DRV_5, ROT_2, ROT_3, M-S_2 or M-S_4 are switched from closed-loop control mode 300-CFCON=FOR to open-loop control mode VFC, parameter 597-RF0=0Hz from subject area _59DP Driving profile generator must be set to OFF. Otherwise at standstill a current in the amount of CICNx will be injected which may over time destroy the motor by overheating, because internally cooled motors have no fan cooling when at a standstill.

6.1.5 Tips and optimization aids for control engineers

The following section presents a tips and optimization aids to deal with typical application errors.

Step	Checks	Help
1	Check that your wiring is connected properly and the phase sequence is correct.	see section 2.1 "Device and terminal view".
2	**In IEC standard motors:** Enter correct (plausible) motor data and start auto-tuning.	see section 5.1 "_15 FC-Initial commissioning".
	In special, reluctance or synchronous motors:	Continue with step 3.
3	Check the current injection.	Optimization of current injection in this section.
4	Check the IxR load compensation.	Optimization of IxR load compensation in this section.
5	Check the boost voltage.	Optimization of boost voltage in this section.
6	Check the interaction between current injection, IxR load compensation and boost voltage.	Optimization of the interaction in this section.
7	Check the voltage frequency control.	Optimization of voltage frequency control in this section.

Table 6.8 Procedure for optimization of voltage frequency control

Note: Please take note of the general information regarding the properties of the motor control methods in the introduction to section 6 "Control modes"

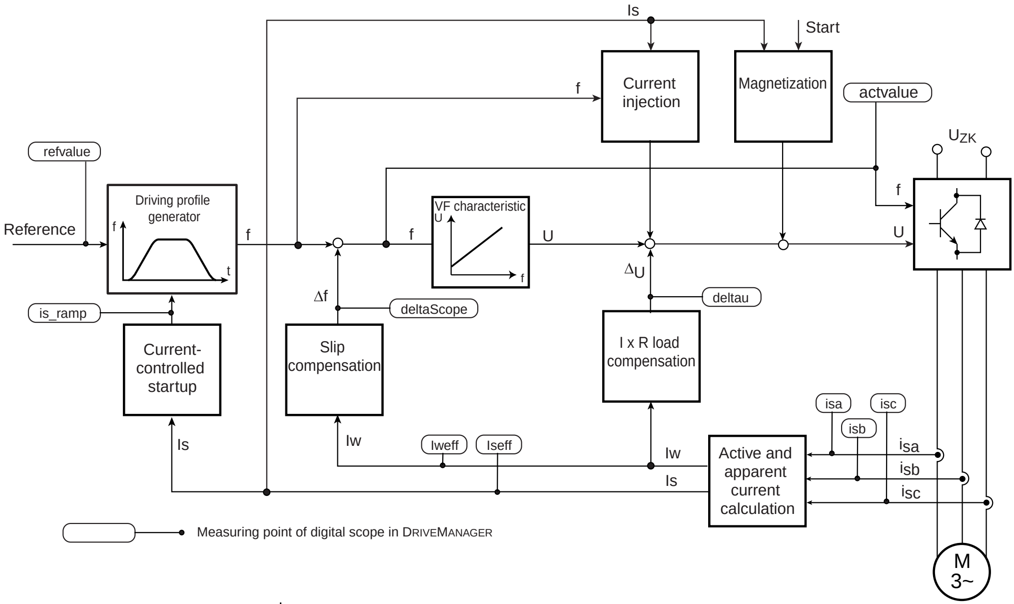


Figure 6.10 Block diagram of control circuit (VFC)

Recording variables of the scope function in the DRIVEMANAGER

Recording variable	Abbreviation	User level menu
Control reference	**refvalue**	**1**
Control actual value	**actvalue**	**1**
Frequency change by slip compensation	**deltaScope**	**3**
Voltage change by IxR	**deltau**	**3**
Phase current in phase U	**isa**	**1**
Phase current in phase V	**isb**	**1**
Phase current in phase W	**isc**	**1**
Apparent current after filter for current-controlled startup	**is_ramp**	**3**
Effective value of apparent current	**Iseff**	**1**
Effective value of active current	**Iweff**	**1**

Table 6.9 Recording variables of the DRIVEMANAGER SCOPE

Current injection

The current injection should be set to 1.5 times the slip frequency (FMx) and the reference value (CICNx) to 120% of the motor rated current.

Typical slip frequencies of asynchronous motors

Power	Typical slip frequency
up to 15 kW	3-7 Hz
up to 90 kW	up to 1 Hz

Table 6.10 Typical slip frequencies dependent on power group

Calculation of motor slip frequency

$$f_{Slip} = \frac{(n_{synchronous} - n_{asynchronous}) \cdot P}{60}$$

At motor rated frequency 50 Hz:

$$f_{Slip} = 50Hz - \frac{n_{asynchronous} \cdot P}{60}$$

with

$n_{synchron}$:	Synchronous speed of motor
$n_{asynchron}$:	Asynchronous speed of motor
P:	Number of pole pairs of asynchronous motor

Above the limit frequency (CIFMx) the current injection (reference CICNx) is regulated in linear mode over a transfer range (CIFRx) and then activated functions are inserted.

Note: The limit current of the current-controlled startup should be adjusted if the initial and lowering frequencies fall into the current injection range. For this, the initial (CLFRx) and lowering (CLFLx) frequencies should be set to at least the limit frequency of the current injection (CIFMx) +2 Hz. During the injection phase the boost voltage is not applied, because the set voltage is determined by the current injection.

IxR load compensation

4.

The stator resistance dependent on the effective active current influences the control. The stator resistance as a compensation factor KIXRx can be determined by measuring a winding phase with an ohmmeter.

Note: Pay attention to the circuit type of your motor. In star configurations, the measured value between two motor cables should be divided by two.

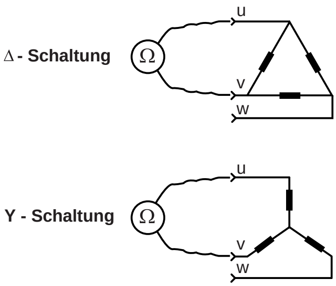


Figure 6.11 Measurement of the stator resistance

Boost voltage

5.

By increasing the boost voltage the drive can be provided with more current for acceleration purposes in the lower frequency range. The rule here is: as much boost voltage as necessary, but as little as possible.

An unnecessarily high boost voltage will lead to overheating of the motor. During current injection the voltage to be set is determined by the control, in order to inject a constant current. Consequently, the current injection adopts the torque increase factor in the starting torque.

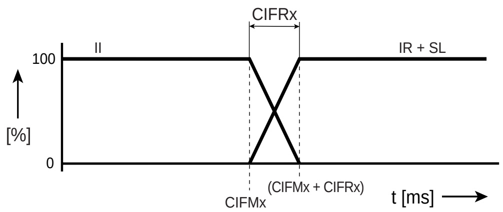
Calculation of boost voltage:

$$VNx = R_{Stator} \cdot I_{N-Motor}$$

6.

Interaction between current injection, IxR load compensation and boost voltage

As shown in Figure 6.12, the transition from current injection to IxR load compensation and boost / V/f characteristic is set by way of the current injection limit frequency (CIFMx).



II: Current injection; IR: IxR load compensation; SL: Slip compensation

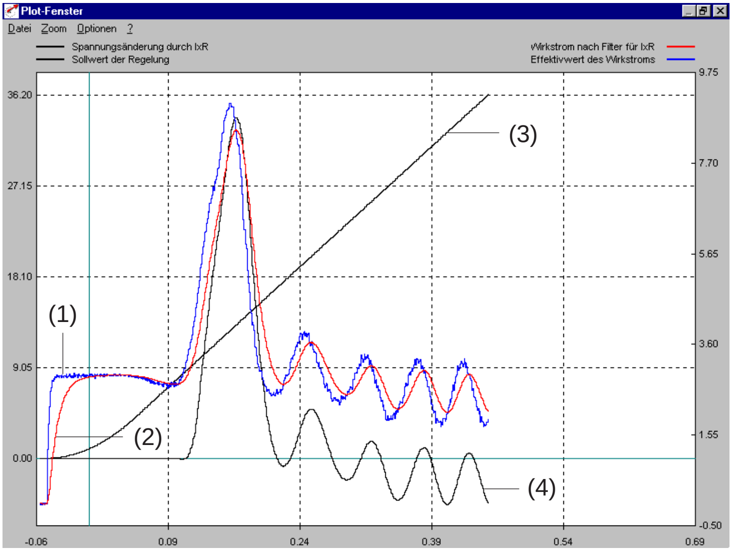
CIFMx: Limit frequency of current injection

Figure 6.12 Combination of voltage frequency control functions

Since the stator resistance influences the control dependent on the effective active current, if the transition from current injection to IxR load compensation is poor the IxR load compensation may cause oscillations in the voltage change. In critical configurations in the overload range of the frequency inverter this may lead to inverter shut-off, so it is advisable to perform the commissioning with no IxR load compensation.

The following example illustrates the relative current conditions when parameters are not optimized and when they are optimized.

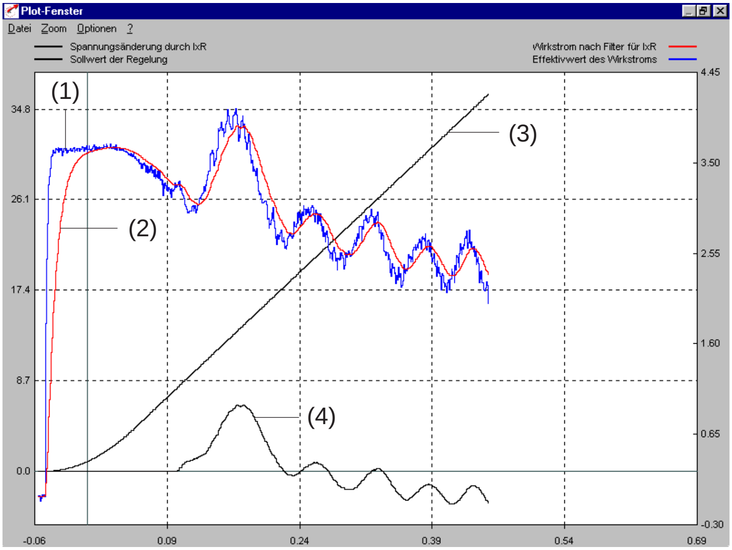
Non-optimized setup:



(1) Effective value of active current
(2) Active current after filter for IxR
(3) Control reference
(4) Voltage change by IxR

Figure 6.13 Scope recording with motorized load torque of 8 Nm on a 1.5 kW asynchronous motor with holding brake and 100% current injection

Optimized setup



(1) Effective value of active current
(2) Active current after filter for IxR
(3) Control reference
(4) Voltage change by IxR

Figure 6.14 Scope recording with motorized load torque of 8 Nm on a 1.5 kW asynchronous motor with holding brake and 120% current injection

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Fazit: The active current in the optimum setup is lower by a factor of 2.

Voltage Frequency Control

The response of the drive can be influenced by the setting of the voltage frequency control parameters by means of interpolation points. If resonance points or oscillation occurs in the drive, it can be "quietened" by reducing the voltage in the calculated frequency range. The reduced voltage causes less current to be delivered to the drive. Conversely, purposely increasing the voltage can deliver more current to the drive in order to compensate for increased load torques, such as those caused by the mechanism.

6.2 Sensorless Flux Control (SFC)

Please take note of the general information regarding the properties of the motor control methods in the introduction to section 6 “Control modes”.

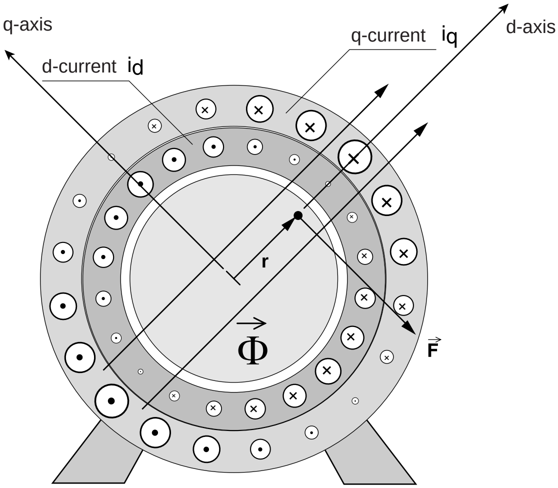
Note: Sensorless Flux Control is only suitable for asynchronous motors in standalone operation (not for multi-motor operation!).

Principle of Sensorless Flux Control

Sensorless Flux Control is based on activation of the motor with voltages which are oriented to the stator flux. For the stator flux orientation a machine model of the asynchronous motor is evaluated of which the parameters can be determined by self-commissioning.

By transforming the currents and voltages into a system of coordinates oriented to the stator flux, the flux and torque formation can be analyzed in isolation from each other.

The stator flux angle ε_{FS} is estimated based on the measured current curves and the injected voltages. Consequently, the d- and q-currents and voltages are likewise estimates. The d-components of the current and voltage point in the direction of the stator flux and thus contribute to formation of the field (flux-forming). The 90° offset q-components of the current and voltage run transverse to the stator flux and form the torque. This correlation is illustrated in Figure 6.15.



$\vec{\Phi}$ Magnetic flux as vector

$\vec{F}$ Force as vector ($F_N \sim iq \cdot \Phi$)

Figure 6.15 Principle of function of the asynchronous motor

Software functions

In Sensorless Flux Control mode (SFC) not all functions of the inverter module are required. The following functions can be selected, but they do not activate.

Inactive functions in SFC

- Current injection
- IxR load compensation
- Slip compensation

Active functions in SFC

Function	Section cross-reference	Simultaneously with SFC
Current-controlled acceleration	Section 6.1.6	✔
DC braking	Section 5.5.8	
DC holding	Section 5.5.9	
Magnetizing	Section 5.5.14	✔

Table 6.11 Activatable functions in conjunction with SFC

Explanatory notes

- In the event of strong load surges resulting in rapid speed changes, the stator flux orientation of the SFC may be lost, and current overload shut-offs (error E-OC) may occur. This is counteracted by the "current-controlled startup" function (see section 5.5.11) setting a steep lowering ramp.
- The DC braking and DC holding functions can only be sequenced. If both functions are activated the DC holding function is not activated until the braking time has elapsed. No check that the rotor has come to a standstill is made before activation of the holding time.
- Remagnetization can be deactivated by way of parameter 774-MPT=0s in subject area "_77 MP-Remagnetization". During autotuning the remagnetization time is determined automatically.

Information for auto-tuning

For auto-tuning of the controller and motor parameters the rating plate data of the motor must be entered in the parameters of the "Initial commissioning" subject area (see section 5.1). Precise motor data should be obtained as necessary from the manufacturer.

The operating points of the motor are set based on these data, so precise information from the motor manufacturer is important.

Note: Auto-tuning determines the controller and motor parameters automatically and enters them in the relevant parameters.

In special application cases a further optimization of the parameters based on experimentation with the application may improve the result. Manual optimization is particularly advisable for applications in the limit zone of the electric power rating of the inverter module as well as in case of major load surges, or for special motors (e.g. high-frequency spindles). This optimization based on tests is intended to produce the desired success in terms of the drive solution.

Note: During identification the switching frequency of the power stage should be reduced in subject area “_69 PM-Modulation” by means of parameter 690-PMFS to 4kHz. This reduction improves the accuracy of motor identification, because the influence of the fault voltages of the inverter power stage is reduced. This measure can improve control response at inverter outputs above 22 kW (as from CDA34.045) especially.

6.2.1 _78SS Speed controller SFC

Function	Effect
• Setting of speed control loop	• Smooth running and good dynamics of the drive

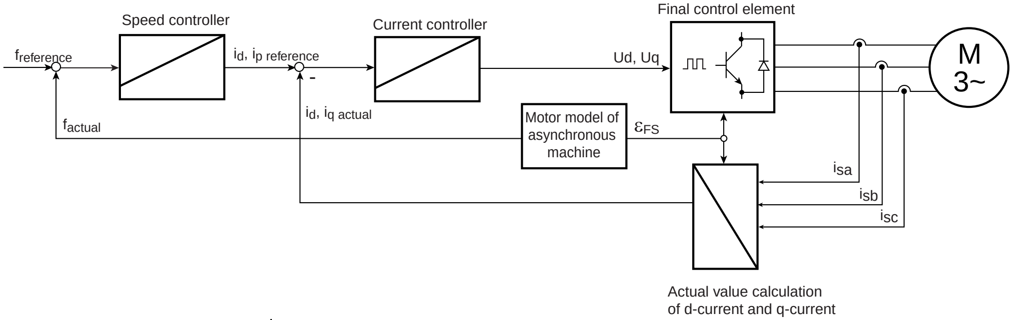


Figure 6.16 Sensorless Flux Control SFC

Parameters of speed controller SFC

Parameter	Function	Value range	FS	Unit	Online
780-SSGF1	CDS1: Scaling of speed controller gain	0.00...999.95	100	%	✔
781-SSG1	CDS1: Speed controller gain	0...16383	1		
782-SSTL1	CDS1: Speed controller lag time	0.001...2	0.02	s	
783-SSTF1	CDS1: Filter time constant of speed estimate	0.0005...20	0.02	s	
784-SSGF2	CDS2 Scaling of speed controller gain	0.00...999.95	100	%	✔
785-SSG2	CDS2: Speed controller gain	0...16383	1		
786-SSTL2	CDS2: Speed controller lag time	0.001...2	0.02	s	
787-SSTF2	CDS2: Filter time constant of speed estimate	0.0005...20	0.02	s	

Table 6.12 Parameters of speed controller SFC

Explanatory notes

- All controllers are set by the initial commissioning. With the speed controller SFC and the current controller (see section 5.10) it is possible to make fine adjustments of the controller properties to the application where necessary.
- The dimensioning of the speed control loop is based on the values specified by auto-tuning for the motor and system moments of inertia. If the value 0 is entered the inverter module enters estimated moments of inertia for the motor and the system (see section 5.1).
- The speed controller gain is adapted by way of the scaling parameter SSGFx according to the requirements of the application.

Controller setting	Effect
SSGFx low	• Long rise times, slow control response • Disturbance compensation slow, the controller appears undynamic
SSGFx high	• Short rise times, fast control response • Disturbance compensation fast, the controller appears dynamic • Speed is noisy • High noise

Table 6.13 Response of the speed controller

6.2.2 _80 CC-Current controller

Function	Effect
• Setting of current controller functions	• Parameter setting of the PI current controller

The parameters of the current control subject area are detailed in section 5.5.10. Please note the information given there.

Parameters of current control

Parameter	Function	Value range	FS	Unit	Online
800-CCG	Current controller gain	0...500	48		
801-CCTLG	Current controller lag time	0.001...100	0.0036	s	
802-CCTF	Filter time constant for current measurement in SFC	0.0005...20	0.01	s	
803-VCSFC	Correction factor of fault voltage characteristic SFC	0...199	*	%	✔
804-CLIM1	CDS1: Maximum reference current for current control	0...180	100	%	
805-CLIM2	CDS2: Maximum reference current for current control	0...180	100	%	

Table 6.14 Parameters of subject area _80CC Current control

Explanatory notes

- The filter time constant for current measurement is used only by the Sensorless Flux Control (SFC) control mode.
- The parameters of the current controller are set automatically during auto-tuning in the initial commissioning phase. It is not necessary to change the calculated values of the PI controller for the gain (800-CCG) and the lag time (801-CCTLG).
- The q-current is regulated to its reference value by the PI current controller.
- The D-current generally deviates from its reference value. An optimization can be achieved with the aid of the VCSFC parameter, enabling online adaptation of the fault voltage characteristic for the application (see section 6.2.3 “Tips and optimization aids for control engineers”, subsection headed “Optimization of the D-current”).
- Parameter values marked by an asterisk (*) in the “Factory setting” (FS) column are dependent on the device power output. The values correspond to an asynchronous IEC standard motor with the rated device power output.

1
2
3
4
5
6
A

6.2.3 Tips and optimization aids for control engineers

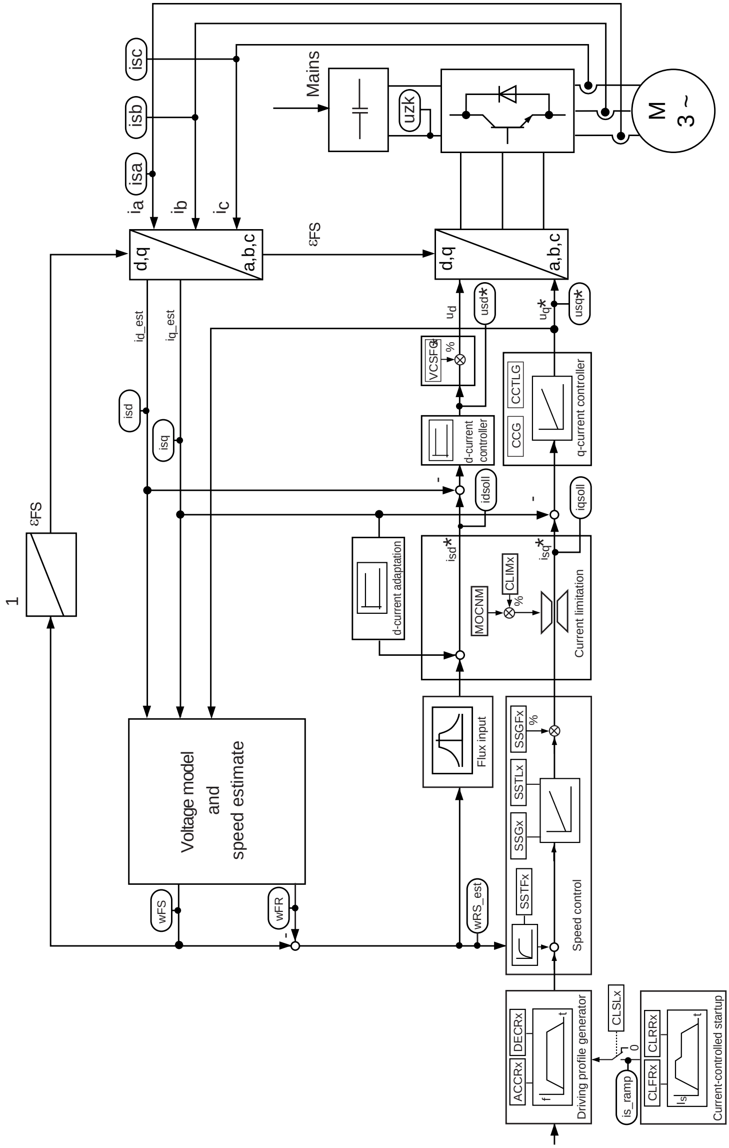
The following presents a systematic procedure for setting of the control.

Note: In the event of strong load surges resulting in rapid speed changes, the stator flux orientation of the SFC may be lost, and current overload shut-offs (error E-OC) may occur. This error is counteracted by the “current-controlled startup” function (see section 5.5.11) setting a steep lowering ramp.

Step	Checks	Help
1	Check that your wiring is connected properly and the phase sequence is correct.	see section 2.1 “Device and terminal view”.
2	Enter correct (plausible) motor data and start auto-tuning.	see section 5.1 “_15 FC-Initial commissioning”.
3	Check the fault voltage compensation.	Optimization of the D-current in this section
4	Check the limit values for the apparent current.	Setting of the current limitation in this section
5	Check the speed controller.	Optimization of the speed controller in this section

Table 6.15 Procedure for optimization of SFC

Structure diagram of SFC



Measuring points of the scope in the DRIVEMANAGER

Parameter

ε_{FS} Stator flux angle

* Reference

est Estimated value (by calculation)

Figure 6.17 Structure diagram of Sensorless Flux Control

1
2
3
4
5
6
A
DE
EN

Recording variables of the scope function in the DRIVEMANAGER

Recording variable	Abbreviation	User level menu
d-axle reference current	idsoll	4
q-axle reference current	iqsoll	4
d-axle current	isd	4
q-axle current	isq	4
Phase current phase U	isa	1
Phase current phase V	isb	1
Phase current phase W	isc	1
Apparent current after filter for current-controlled startup	is_ramp	3
DC-link voltage	uzk	1
Slip frequency	wFR	4
Output frequency (SFC)	wFS	3
Rotor frequency	wRS_est	1

Table 6.16 Recording variables in the SFC structure diagram

Optimization of the D-current

3.

Adaptation of fault voltage characteristic

At low asynchronous motor resistances (e.g. in motors with higher power outputs) it may be necessary to optimize the current controller by fault voltage compensation by way of parameter 803-VCSFC in subject area “_80 CC-Current controller”.

Note: A compromise needs to be found between formation of a high torque at low speeds (VCSFC high) and stability of the control (VCSFC low).

Optimization instructions:

1. Run motor with reference 0 Hz (parameter 597-RF0 = 0 Hz) in subject area “_59 DP-Driving profile generator”
2. Open scope and set the currents “d-axle current” (i_{sd}) and “d-axle reference current” (i_{sd_soll}). (Note: User level 4 required!)
3. Compare the currents and set them to the following ratio by way of parameter 803-VCSFC:

   “d-axle current” (i_{sd}) =0.9 * “d-axle reference current” (i_{sd_soll})

Example: ASM with $P = 1.5$ kW,
$U_N = 400V$,
$I_{NU} = 3.7A$ in U-configuration
$n_N = 1410$ rpm

After auto-tuning the inverter module set parameter 803-VCSFC at 68 %. The following diagrams illustrate the effect of parameter 803-VSSFC.

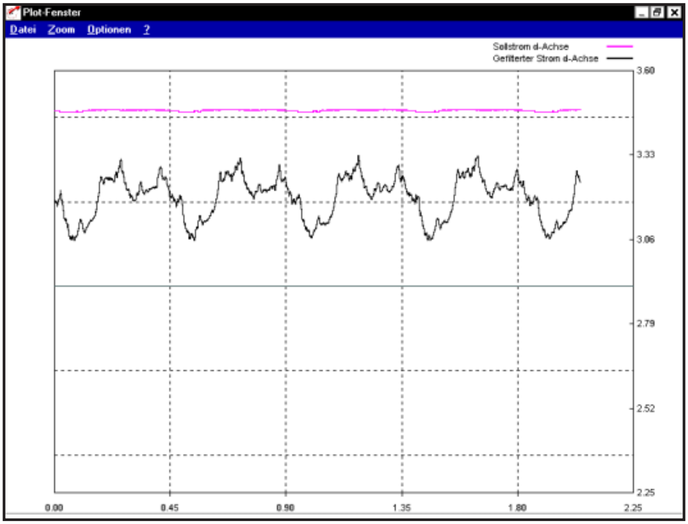


Figure 6.18 803-VCSFC = 199 %

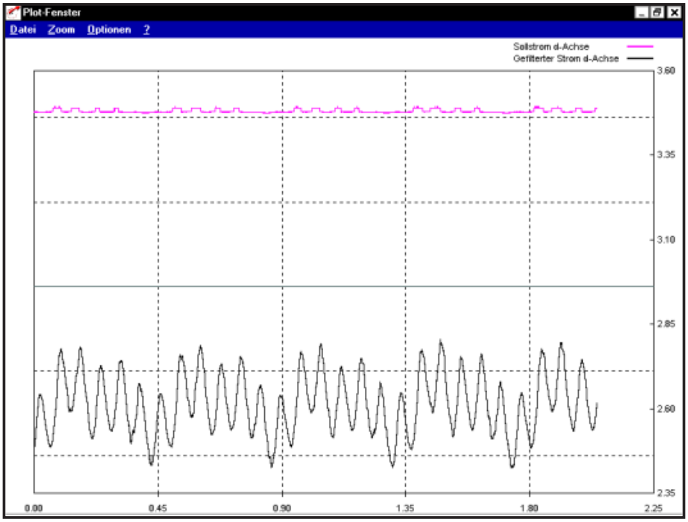


Figure 6.19   803-VCSFC = 0 %

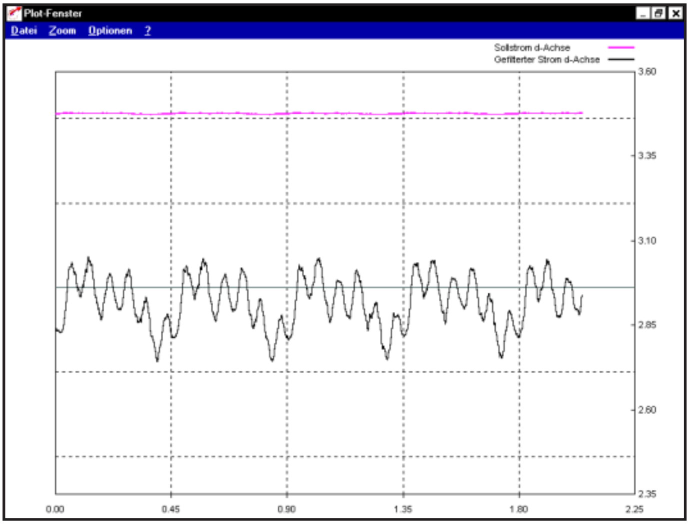


Figure 6.20   803-VCSFC = 68 % after calculation by auto-tuning

Note: If 803-VCSFC is too high the motor may rotate with maximum slip. This is indicated by the fact that the estimated speed (400-ACTF) is unequal to the specified reference speed and the current of the q-axle (isq) enters the device limit. It is also shown on the motor, when the reference value is 0 Hz, by the motor shaft rotating slowly.

Optimization of current control

With regard to the following optimization and adaptation tips it should be remembered that the overall current is composed of the d- and q-current based on the following relationship:

$$|i| = \sqrt{i_d^2 + i_q^2}$$

As a result the effective value of the apparent current is produced as:

$$I_S = |i| / \sqrt{2}$$

At a maximum device rated current (397-CFPNM) equivalent to the apparent current I_S the d- and q-current variables are thereby automatically limited.

When the motor is run at nominal torque, the nominal value of the D-current is usually less than the nominal value of the q-current. In standard applications which do not demand the nominal torque of the motor the q-current is usually smaller than the d-current.

Optimization of the maximum q-current

Optimization of the maximum reference current for current control

When subject to high load surges or heavy load it may be necessary to adjust the maximum reference current. The limitation affects the reference of the q-current (torque-forming) and reaches its upper limit in the device rated current 397-CFPNM in subject area “_39DD-Device data”.

Note: A compromise must be found between formation of a maximum torque and the risk of current overload shut-off (error E-OC).

Setting CLIMx	Effect
Increase	• Higher torque • Greater tendency to current overload shut-off
Reduce	• Lower torque • Low tendency to current overload shut-off

Table 6.17 Setting of max. reference current for current control

5.

Optimization of the speed controller with the gain SSGFx

With precisely set moments of inertia, Sensorless Flux Control tends toward 20-30 % overshoot when a stepped change of the frequency reference is set. This can be checked with the aid of the DRIVEMANAGER.

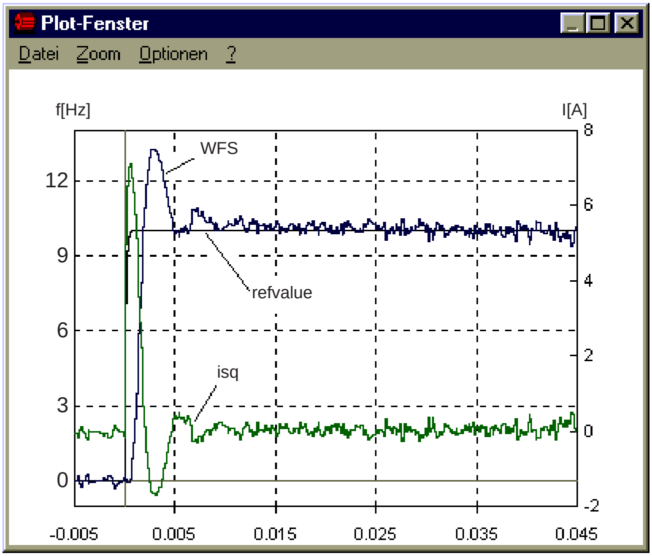
Note: **Record step response**
The DRIVEMANAGER scope must be used to record the step response. The reference step should only be specified at a low frequency (approx. 10 Hz).

Setting of the scope

tab	Recording variable	Scope recording variable
0	Reference step	Control reference
1	Step response (actual value)	Output frequency (FOR and SFC)
2	Current i_q (torque)	q-axle current

Table 6.18 Recording variables of the DRIVEMANAGER SCOPE

Attention: The following diagrams illustrate the ideal condition of a system. In actual applications such characteristics are not attainable because of backlash, elasticity or fluctuations in moments.

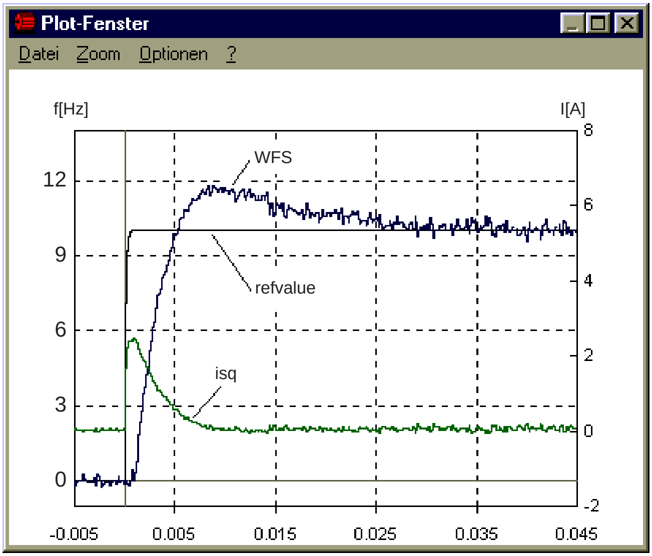


Gain SSGFx too high
⟶ Reduce value for SSFGx

Figure 6.21 Step response of frequency with high overshoot

Abbreviation	Recording variable	User level menu
refvalue	Control reference	1
wFS	Output frequency (FOR and SFC)	3
ISQ	q-axle current	4

Table 6.19 Recording variables of the plotting window

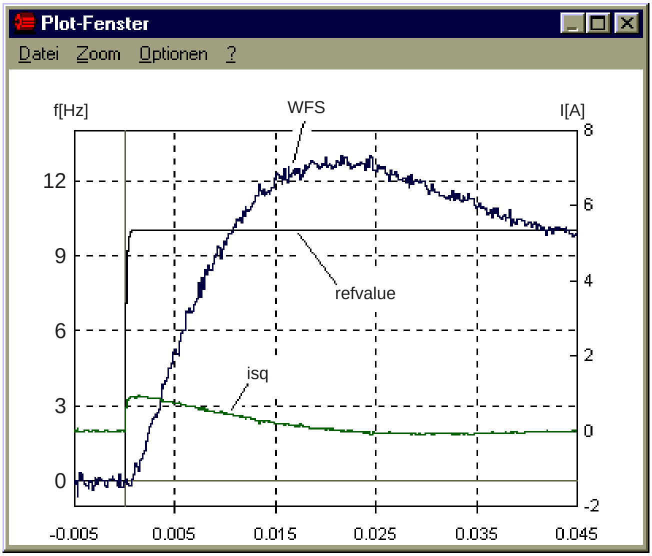


Gain SSGFx optimum (lowest overshoot)
→ Do not change value for SSFGx

Figure 6.22 Step response of frequency is optimal

Abbreviation	Recording variable	User level menu
refvalue	Control reference	1
wFS	Output frequency (FOR and SFC)	3
ISQ	q-axle current	4

Table 6.20 Recording variables of the plotting window



Gain SSGFx too low

→ Increase value for SSFGx

Figure 6.23 Step response of frequency with long settling time

Abbreviation	Recording variable	User level menu
refvalue	Control reference	1
wFS	Output frequency (FOR and SFC)	3
ISQ	q-axle current	4

Table 6.21 Recording variables of the plotting window

Tips and optimization aids

Problem	Cause	Remedy
• Implausibly high d-current reference in motors with high power output	The influence of the fault voltages at high inverter outputs (typically > 22 kW) and motors with low stator resistance results in the magnetizing inductance being identified too low.	Reduce switching frequency 690-PMFS to 4 kHz during auto-tuning.
• Incorrect number of pole pairs detected	Enter synchronous speed as nominal speed or motor with large number of pole pairs (p>4) and high slip frequency.	Correct rated speed of ASM: • Check rating plate data • Consult motor manufacturer or • Estimate a logical value and then restart a new auto-tuning process Enter correct number of pole pairs.
• Torque too low because operating point wrong	Imprecise data on motor rating plate.	• Check plausibility of rating plate data.
• Rated speed not attainable because operating point wrong	Imprecise data on motor rating plate.	• Check plausibility of rating plate data.

Table 6.22 Optimization aids

6.3 Field-Oriented Regulation (FOR)

Please take note of the general information regarding the properties of the motor control methods in the introduction to section 6 “Control modes”.

Note: Field-oriented regulation is only suitable for asynchronous motors in standalone operation (not for multi-motor operation!).

Software functions

In field-oriented speed control (FOR) not all functions of the inverter module are required. The following functions can be selected, but they do not activate.

Inactive functions in FOR

- Current injection
- IxR load compensation
- Slip compensation
- From firmware V. 2.10: Current-controlled startup

Active functions in FOR

Function	Section cross-reference	Simultaneously with FOR
Current-controlled acceleration	Section 6.1.6	✔ to V. 1.40
DC braking	Section 5.5.8	
DC holding	Section 5.5.9	
Magnetizing	Section 5.5.14	✔

Figure 6.24 Activatable functions in conjunction with FOR

Explanatory notes

- Since setting of FOR mode represents a fully regulated system with speed feedback, the "current-controlled startup" function is not required.
  Consequently, as from firmware V. 2.10, to aid commissioning of field-oriented regulation (FOR) the "current-controlled startup" software function is disabled in the presets of the following application data sets:
  - DRV_4, DRV_5
  - ROT_2, ROT_3
  - M-S_2, M-S_4
- The DC braking and DC holding functions can only be sequenced. If both functions are activated the DC holding function is not activated until the braking time has elapsed. No check that the rotor has come to a standstill is made before activation of the holding time.
- Remagnetization can be deactivated by way of parameter 774-MPT=0s in subject area "_77 MP-Remagnetization". During auto-tuning the remagnetization time is determined automatically.

Information for auto-tuning

For auto-tuning of the controller and motor parameters the rating plate data of the motor must be entered in the parameter of the "Initial commissioning" subject area (see section 5.1). Precise motor data should be obtained as necessary from the manufacturer.

The operating points of the motor are set based on these data, so precise information from the motor manufacturer is important.

Note: Auto-tuning determines the controller and motor parameters automatically and enters them in the relevant parameters.

In special application cases a further optimization of the parameters based on experimentation with the application may improve the result. Manual optimization is particularly advisable for applications in the limit zone of the electric power rating of the inverter module as well as in case of major load surges, or for special motors. This optimization based on tests should bring the desired success in terms of the drive solution.

Note: During identification the switching frequency of the power stage should be reduced in subject area "_69 PM-Modulation" by means of parameter 690-PMFS to 4kHz. This reduction improves the accuracy of motor identification, because the influence of the fault voltages of the inverter power stage is reduced. This measure can improve control response at inverter outputs above 22 kW (as from CDA34.045).

6.3.1 _79 EN-Encoder evaluation

Function	Effect
• Input of encoder data	• Adaptation of the inverter module to the encoder of the motor

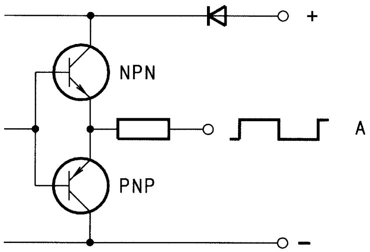


Figure 6.25 Block diagram of HTL output configuration

Note: To maintain the switching times and edge steepness of the encoder, the cable length dependent on the sampling rate and the supply voltage must not be exceeded. Therefore please refer to the manufacturer's data sheet.

Parameters of the encoder evaluation subject area

Parameter	Function	Value range	FS	Unit	Online
790-ECLNC	Lines per revolution of encoder	32...16384	1024		

Table 6.23 Parameters from subject area _79 EN-Encoder evaluation

Explanatory notes

- On the inverter module the A and B track of a HTL encoder can be evaluated. Differential transducers cannot be evaluated.
- Permissible pulse counts are in the range 2^n with n=5 to 14.
- For speed control the encoder signal in the inverter module is quadrupled, so a good level of speed control is possible with small pulse counts.

Only inputs ISD02 and ISD03 can be used for encoder evaluation; see section 5.2.3 “_21ID-Digital inputs”.

Minimum reference speed

The minimum reference speed indicates the minimum speed as from which at least one pulse of the encoder per scan cycle of the inverter module can be evaluated.

Formula for calculation of minimum reference speed depending on lines per revolution of encoder:

$$n_{min} = \frac{200}{4 \cdot SZ} \cdot 60 \cdot \frac{1}{min} = \frac{9 \cdot 10^6}{SZ} \cdot \frac{1}{min}$$

SZ	Lines per revolution
n_{min}	Minimum reference speed in [rpm]

Minimum reference speeds

Encoder lines per revolution pulses per rev	Minimum reference speed rpm	Minimum frequency [Hz]	
		2-pole ASM	4-pole ASM
32	94	1.6	3.3
64	48	0.8	1.6
128	24	0.4	0.8
256	12	0.2	0.4
512	6	0.1	0.2
1024	3	0.05	0.1
2048	1.5	0.03	0.05
4096	0.8	0.02	0.04
8192	0.4	0.01	0.03
16384	0.2	0.01	0.01

Table 6.24 Minimum speeds when using encoders with differing lines per revolution

Maximum reference speed

The maximum reference speed indicates up to what speed the pulses of the encoder can be evaluated by the input of the inverter module.

For specifications of the limit frequency for inputs ISD02 and ISD03 for encoder evaluation refer to section 2.4 “Specification of control terminals”.

Formula for calculation of maximum reference speed depending on lines per revolution of encoder:

$$n_{max} = \frac{f_{max}[kHz]}{SZ} \cdot 10^3 \cdot 60 \frac{1}{min} = \frac{3000}{SZ} \cdot \frac{1}{min}$$

SZ	Lines per revolution
n_{max}	Maximum reference speed in [rpm]
f_{max}	Limit frequency of inverter input in [kHz]

Typical maximum reference speeds

Encoder lines per revolution pulses per rev	Maximum reference speed [rpm]	Maximum frequency	
		2-pole ASM	4-pole ASM
32	281250	4687 1)	9375 1)
64	140625	2343 1)	4687 1)
128	70312	1171 1)	2343 1)
256	35156	585 1)	1171 1)
512	17578	292	585 1)
1024	8789	146	292
2048	4394	73	146
4096	2198	37	74
8192	1098	18	36
16384	549	9	18
1) Maximum rotating field frequency dependent on inverter type			

Table 6.25 Maximum reference speed when using encoders with differing lines per revolution

The maximum frequency which can be delivered by the inverter is limited by the design size.

Inverter type	Rotating field frequency [Hz]	Switching frequency [kHz]
CDA32.003 (0.375 kW) to CDA34.032 (15 kW)	0 ... 1600	4/8/16
CDA34.045 (22 kW) to CDA34.170 (90 kW)	0 ... 400	4/8

Table 6.26 Maximum rotating field frequency of inverter types

6.3.2 _81SC-Speed controller FOR

Function	Effect
• Setting of speed control loop	• Very smooth running and high drive dynamic

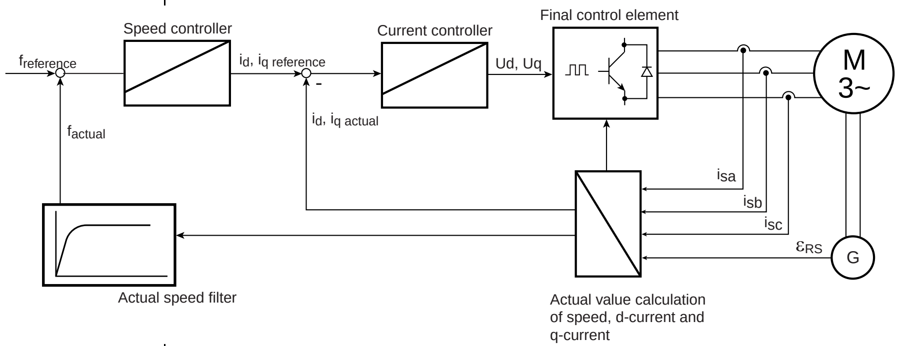


Figure 6.26 Structure diagram of speed control

Parameters of the speed controller FOR subject area

Parameter	Function	Value range	FS	Unit	Online
810-SCGF1	CDS1: Scaling of speed controller gain	0.00...999.95	100	%	✔
811-SCG1	CDS1: Speed controller gain	0...16383	1		
812-SCTL1	CDS1: Speed controller lag time	0.001...2	0.02	s	
813-SCTF1	CDS1: Jitter filter time constant	0...0.032	0.001	s	
814-SCGF2	CDS2: Scaling of speed controller gain	0.00...999.95	100	%	✔
815-SCG2	CDS2: Speed controller gain	0...16383	1		
816-SCTL2	CDS2: Speed controller lag time	0.001...2	0.02	s	
817-SCTF2	CDS2: Jitter filter time constant	0...0.032	0.001	s	
818-SCGF0	Speed controller gain at frequency zero	0.00...99.95	10	%	

Table 6.27 Parameters from subject area _81SC-Speed controller FOR

Explanatory notes

- All controllers are set by the initial commissioning. With the FOR speed controller the controllers can be fine-tuned as necessary to the special needs of the application.
- The quality of the dimensioning of the speed control loop is based on exact values for the moments of inertia of the motor and the system. If the value 0 is entered the inverter module enters estimated moments of inertia for the motor and the system (see section 5.1).
- The speed controller gain should be adapted by way of scaling parameter SCGFx according to the application requirements.

Controller setting	Effect
SCGFx small	• Long rise times, slow control response • Disturbance compensation slow, the controller appears undynamic
SCGFx large	• Short rise times, fast control response • Disturbance compensation fast, the controller appears dynamic • Speed is noisy • High noise

Table 6.28 Response of the encoder

6.3.3 _80 CC-Current control

Function	Effect
• Setting of current controller functions	• Optimum parameter setting of the PI current controller

Note: The parameters of the current control subject area are detailed in section 5.5.10. Please note the information given there.

Parameters of current control

Parameter	Function	Value range	FS	Unit	Online
800-CCG	Current controller gain	0...500	48		
801-CCTLG	Current controller lag time	0.001...100	0.0036	s	
802-CCTF	Filter time constant for current measurement in SFC	0.0005...20	0.01	s	
803-VCSFC	Correction factor of fault voltage characteristic	0...199	70	%	✔
804-CLIM1	CDS1: Maximum reference current for current control	0...180	100	%	
805-CLIM2	CDS2: Maximum reference current for current control	0...180	100	%	

Table 6.29 Parameters of subject area _80CC Current control

Explanatory notes

- No adaptation of the fault voltage compensation is required.
- The parameters of the current controller are set automatically during auto-tuning in initial commissioning. It is not necessary to change the calculated values of the PI controller for the gain (800-CCG) or the lag time (801-CCTLG).

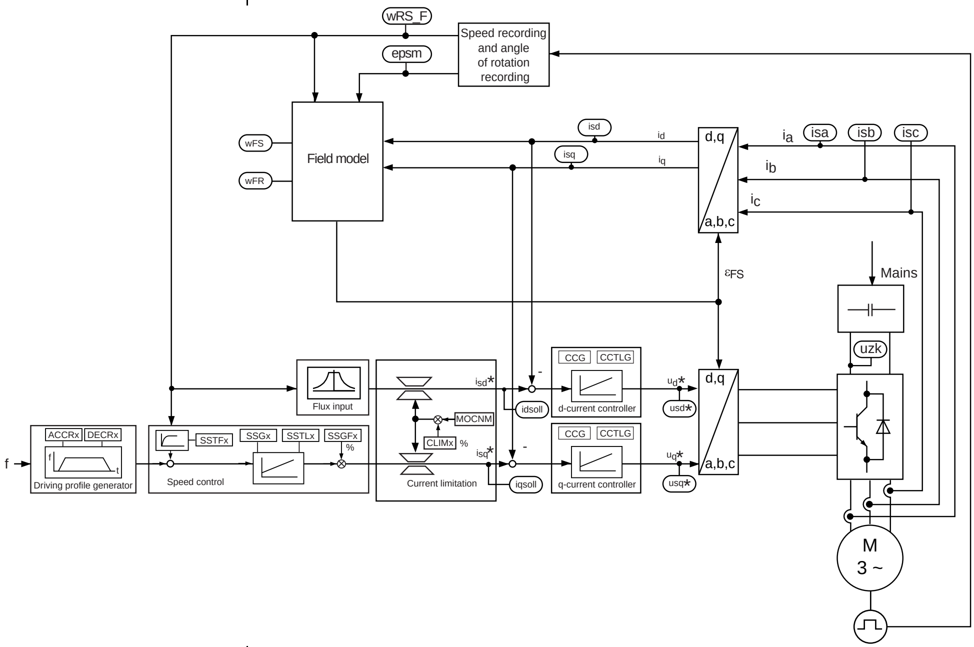
6.3.4 Tips and optimization aids for control engineers

The following section presents a tips and optimization aids to deal with typical application errors.

Step	Checks	Help
1	Check that your wiring is connected properly and the phase sequence is correct.	see section 2.1 “Device and terminal view”.
2	Enter correct (plausible) motor data and start auto-tuning.	see section 5.1 “_15 FC-Initial commissioning”.
3	Check the current control.	Optimization of current control in this section
4	Check the speed controller.	Optimization of the speed controller in this section

Table 6.30 Procedure for optimization of FOR

Structure diagram of FOR



Measuring points of the scope in the DRIVEMANAGER

Parameter

ε_{FS} Stator flux angle

* Reference

Figure 6.27 Structure diagram of field-oriented speed control (FOR)

Recording variables of the scope function in the DriveManager

Recording variable	Abbreviation	User level menu
d-axle reference current	idsoll	4
q-axle reference current	iqsoll	4
d-axle current	isd	4
q-axle current	isq	4
Phase current phase U	isa	1
Phase current phase V	isb	1
Phase current phase W	isc	1
Apparent current after filter for current-controlled startup	is_ramp	3
DC-link voltage	uzk	1
Slip frequency	wFR	4
Output frequency (FOR)	wFS	3
Rotor frequency (FOR)	wRS_F	1

Table 6.31 Recording variables in the structure diagram of control with FOR (Figure 6.27)

Optimization of current control

3.

With regard to the following optimization and adaptation tips it should be remembered that the overall current is composed of the d- and q-current based on the following relationship:

$$|i| = \sqrt{i_d^2 + i_q^2}$$

As a result the effective value of the apparent current is produced as:

$$I_S = |i| / \sqrt{2}$$

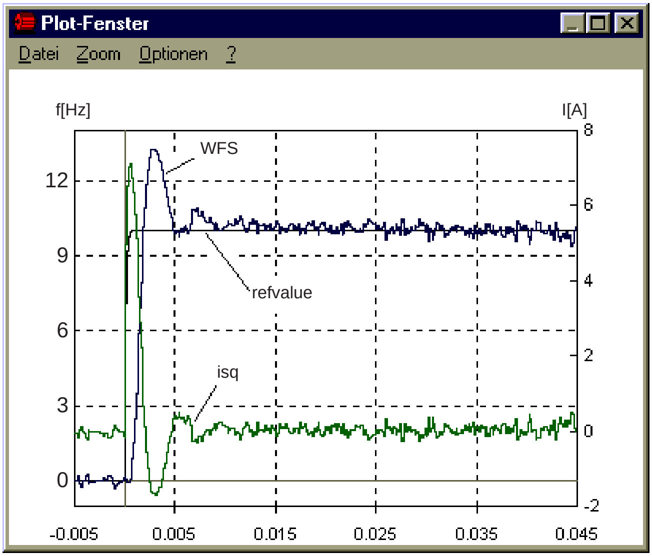
At a maximum device rated current (397-CFPNM) equivalent to the apparent current IS the d- and q-current variables are thereby automatically limited.

When the motor is run at nominal torque, the nominal value of the D-current is usually less than the nominal value of the q-current. In standard applications which do not demand the nominal torque of the motor the q-current is usually smaller than the d-current.

4.

Optimization of the speed controller with the gain SSGFx

For Field-Oriented Regulation the encoder is set in exactly the same way as for Sensorless Flux Control.



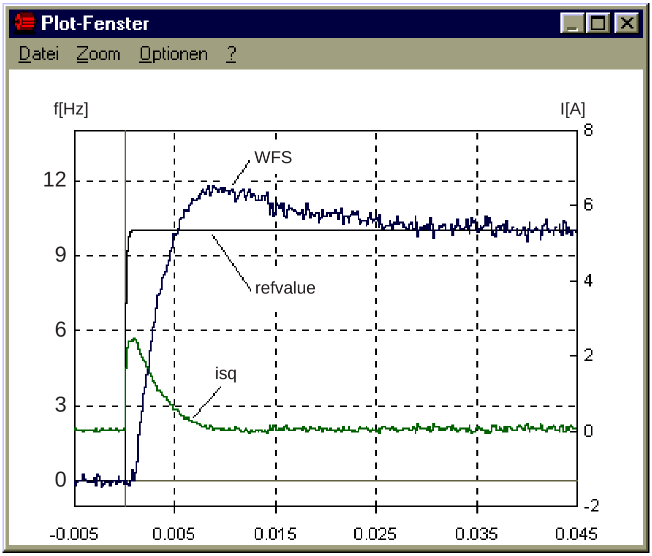
Gain SSGFx too high

Reduce value for SCGFx

Figure 6.28 Step response of frequency with high overshoot

Abbreviation	Recording variable	User level menu
revalue	Control reference	1
wFS	Output frequency (FOT and SFC)	3
ISQ	q-axle current	4

Table 6.32 Recording variables of the plotting window



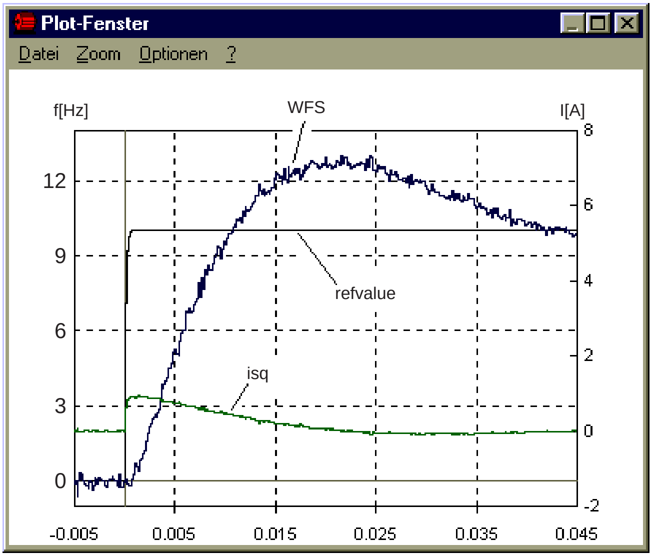
Gain SCGFx too optimal

Do not change value for SCGFx

Figure 6.29 Step response of frequency is optimal

Abbreviation	Recording variable	User level menu
revalue	Control reference	1
wFS	Output frequency (FOT and SFC)	3
ISQ	q-axle current	4

Table 6.33 Recording variables of the plotting window



Gain SCGFx too small

Increase value for SCGFx

Figure 6.30 Step response of frequency with long settling time

Abbreviation	Recording variable	User level menu
revalue	Control reference	1
wFS	Output frequency (FOT and SFC)	3
ISQ	q-axle current	4

Table 6.34 Recording variables of the plotting window

Appendix A Overview of parameters

The following parameter overview contains all the parameters up to user level 01-MODE = 4 in the factory setting (152-ASTER = DRV_1), in software version V1.30-0.

Abbreviations:

R	Read level (LE), indicates the user level (01-MODE) as from which the parameter is **displayed**
W	Write level (SE), indicates the user level (01-MODE) as from which the parameter can be **edited**
RAM C V	RAM control variable
RAM A V	RAM actual value
FIXPT	Fixed point
FLASH	Flash-EPROM, retained after power-off
G	dependent on device

Note: The DRIVEMANAGER has a user-friendly print function which you can use at any time to print off your latest parameter list.

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
_15 FC-Initial commissioning, from page 5-4									
150	SAVE		Back-up device setup	STOP		2	2	USIGN8	RAM C V
151	ASTPR		Original device preset	OFF		3	5	USIGN8	FLASH
152	ASTER		Presets within the application data set (ADS)	DRV_1		1	2	USIGN8	FLASH
154	MOPNM	kW	Motor rated power	G		1	2	FLOAT32	FLASH
155	MOVNM	V	Motor rated voltage	G		1	2	FLOAT32	FLASH
156	MOFN	Hz	Motor rated frequency	50		1	2	FLOAT32	FLASH
157	MOSNM	rpm	Rated speed	G		1	2	FLOAT32	FLASH
158	MOCNM	A	Motor rated current	G		1	2	FLOAT32	FLASH
159	MOCOS		Motor nominal cos-phi	G		1	2	FLOAT32	FLASH
160	MOJNM	kgmm	Mass moment of inertia of motor	G		3	3	FLOAT32	FLASH
161	SCJ1	kgmm	CDS 1: Mass moment of inertia of system	0		3	3	FLOAT32	FLASH
162	SCJ2	kgmm	CDS 2: Mass moment of inertia of system	0		3	3	FLOAT32	FLASH
163	ENSC		Enable auto-tuning	STOP		2	2	USIGN8	RAM C V
164	UDSWR		Back-up device setup in a USER data set	1		3	3	USIGN8	RAM C V
165	UDSAC		Activate USER data set	1		3	3	USIGN8	FLASH
166	UDSSL		Control location for switchover of the active USER data set	PARAM		3	3	USIGN8	FLASH
167	SCPRO		Auto-tuning progress indicator	0		2	6	STRING	RAM C V
300	CFCON		Current open-loop control / closed-loop control mode of the device	VFC		2	2	USIGN8	FLASH
_18IA-Analog inputs, from page 5-17									
180	FISA0		Function selector analog standard input ISA00	OFF		1	2	USIGN8	FLASH
181	FISA1		Function selector analog standard input ISA01	OFF		1	2	USIGN8	FLASH
182	F0PX1	Hz	Maximum value ISA0 at +10V, CDS 1	50		3	3	INT16	FLASH
183	F0PN1	Hz	Minimum value ISA0 at +0V, CDS 1	0		3	3	INT16	FLASH
184	F0NX1	Hz	Maximum value ISA0 at -10V, CDS 1	0		3	3	INT16	FLASH
185	F0NN1	Hz	Minimum value ISA0 at -0V, CDS 1	0		3	3	INT16	FLASH
186	F1PX1	Hz	Maximum value ISA1 at +10V, CDS 1	50		3	3	INT16	FLASH
187	F1PN1	Hz	Minimum value ISA1 at +0V, CDS 1	0		3	3	INT16	FLASH
188	AFIL0		Filter for analog channel ISA0	0		4	4	USIGN8	FLASH
189	AFIL1		Filter for analog channel ISA1	0		4	4	USIGN8	FLASH
190	F0PX2	Hz	Maximum value ISA0 at +10V, CDS 2	50		3	3	INT16	FLASH
191	F0PN2	Hz	Minimum value ISA0 at +0V, CDS 2	0		3	3	INT16	FLASH
192	IADB0		ISA0 play range	0.00		4	4	FIXPT1 6	FLASH
193	IADB1		Play range ISA1	0.00		4	4	FIXPT1 6	FLASH
194	F0NX2	Hz	Maximum value ISA0 at -10V, CDS 2	0		3	3	INT16	FLASH
195	F0NN2	Hz	Minimum value ISA0 at -0V, CDS 2	0		3	3	INT16	FLASH
196	F1PX2	Hz	Maximum value ISA1 at +10V, CDS 2	50		3	3	INT16	FLASH
197	F1PN2	Hz	Minimum value ISA1 at +0V, CDS 2	0		3	3	INT16	FLASH

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
200 A-Analog output, from page 5-23									
200	FOSA0		Function selector analog output OSA00	ACTF		1	2	USIGN8	FLASH
201	OAMN0		Minimum value for analog output OSA00	0		3	3	INT16	FLASH
202	OAMX0		Maximum value for analog output OSA00	100		3	3	INT16	FLASH
203	OAFI0		Filter constant for OSA00	0		3	3	USIGN8	FLASH
204	TSCL	Nm	Torque (scaling value)	G		3	3	FLOAT3 2	FLASH
21ID-Digital inputs, from page 5-27									
210	FIS00		Function selector digital standard input ISD00	STR		1	2	USIGN8	FLASH
211	FIS01		Function selector digital standard input ISD01	STL		1	2	USIGN8	FLASH
212	FIS02		Function selector digital standard input ISD02	SADD1		1	2	USIGN8	FLASH
213	FIS03		Function selector digital standard input ISD03	OFF		1	2	USIGN8	FLASH
214	FIE00		Function selector digital input IED00 (terminal expansion)	OFF		3	3	USIGN8	FLASH
215	FIE01		Function selector digital input IED01 (terminal expansion)	OFF		3	3	USIGN8	FLASH
216	FIE02		Function selector digital input IED02 (terminal expansion)	OFF		3	3	USIGN8	FLASH
217	FIE03		Function selector digital input IED03 (terminal expansion)	OFF		3	3	USIGN8	FLASH
218	FIE04		Function selector digital input IED04 (terminal expansion)	OFF		3	3	USIGN8	FLASH
219	FIE05		Function selector digital input IED05 (terminal expansion)	OFF		3	3	USIGN8	FLASH
220	FIE06		Function selector digital input IED06 (terminal expansion)	OFF		3	3	USIGN8	FLASH
221	FIE07		Function selector digital input IED07 (terminal expansion)	OFF		3	3	USIGN8	FLASH
222	FIF0		Function selector virtual fixed input 0	OFF		4	4	USIGN8	FLASH
223	FIF1		Function selector virtual fixed input 1	OFF		4	4	USIGN8	FLASH
240D-Digital outputs, from page 5-34									
240	FOS00		Function selector digital standard output OSD00	BRK1		1	2	USIGN8	FLASH
241	FOS01		Function selector digital standard output OSD01	REF		1	2	USIGN8	FLASH
242	FOS02		Function selector digital standard output OSD02 (relay)	S_RDY		1	2	USIGN8	FLASH
243	FOE00		Function selector digital output OSE00 (terminal expansion)	OFF		3	3	USIGN8	FLASH
244	FOE01		Function selector digital output OSE01 (terminal expansion)	OFF		3	3	USIGN8	FLASH
245	FOE02		Function selector digital output OSE02 (terminal expansion)	OFF		3	3	USIGN8	FLASH

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
246	FOE03		Function selector digital output OSE03 (terminal expansion)	OFF		3	3	USIGN8	FLASH
_25 CK-Clock input/ Clock output, from page 5-38									
250	OCLK		Multiplier for clock output OSD01	1X		3	3	USIGN8	FLASH
251	FFMX1	Hz	Maximum value clock input 10 kHz, CDS 1	50		3	3	INT16	FLASH
252	FFMN1	Hz	Minimum value clock input 10 kHz, CDS 1	0		3	3	INT16	FLASH
253	FFMX2	Hz	Maximum value clock input 10 kHz, CDS 2	50		3	3	INT16	FLASH
254	FFMN2	Hz	Minimum value clock input 10 kHz, CDS 2	0		3	3	INT16	FLASH
255	INCLF	s	Filter time constant for clock input 10 kHz	0.01		4	4	FLOAT3 2	FLASH
_26 CL-Control location, from page 5-49									
7	AUTO		Auto-Start	OFF		4	4	USIGN8	FLASH
260	CLSEL		Control location selector	TERM		4	4	USIGN8	FLASH
_27 FF-Fixed frequencies, from page 5-107									
270	FFIX1	Hz	Fixed frequency CDS 1	20		2	2	INT32Q16	FLASH
271	FFIX2	Hz	Fixed frequency CDS 2	20		2	2	INT32Q16	FLASH
_28 RS-Reference structure, from page 5-40									
280	RSSL1		Reference selector 1	FMAX		4	4	USIGN8	FLASH
281	RSSL2		Reference selector 2	FCON		4	4	USIGN8	FLASH
282	FA0	Hz	Analog reference input ISA00	0		4	15	INT32Q16	RAM A C
283	FA1	Hz	Analog reference input ISA01	0		4	15	INT32Q16	RAM A C
284	FSIO	Hz	Reference serial interface	0		4	6	INT32Q16	RAM C V
285	FPOT	Hz	Reference of MOP	0		4	15	INT32Q16	RAM A C
286	FDIG	Hz	Digital reference input	0		4	15	INT32Q16	RAM A C
287	FOPT1	Hz	Reference value of option slot 1	0		4	15	INT32Q16	RAM A C
288	FOPT2	Hz	Reference value of option slot 2	0		4	15	INT32Q16	RAM A C
289	SADD1		Offset for reference selector 1	10		4	4	USIGN8	FLASH
290	SADD2		Offset for reference selector 2	0		4	4	USIGN8	FLASH
291	REF1	Hz	Reference of reference selector 1	0		4	15	INT32Q16	RAM A C
292	REF2	Hz	Reference of reference selector 2	0		4	15	INT32Q16	RAM A C
293	REF3	Hz	Reference before limiter	0		4	15	INT32Q16	RAM A C
294	REF4	Hz	Reference before ramp generator	0		4	15	INT32Q16	RAM A C
295	REF5	Hz	Reference after ramp generator	0		4	15	INT32Q16	RAM A C
296	REF6	Hz	Reference for transfer to control	0		4	15	INT32Q16	RAM A C
297	RF1FA		Factor for reference channel 1	100		4	4	USIGN16	FLASH
_30 OL-Frequency limitation, from page 5-53									
301	FMIN1	Hz	Minimum frequency CDS 1	0		2	2	INT32Q16	FLASH
302	FMIN2	Hz	Minimum frequency CDS 2	0		2	2	INT32Q16	FLASH
303	FMAX1	Hz	Maximum frequency CDS 1	50		2	2	INT32Q16	FLASH
305	FMAX2	Hz	Maximum frequency CDS 2	50		2	2	INT32Q16	FLASH
306	FMXA1	Hz	Absolute limit output frequency CDS 1	1600		4	4	INT32Q16	FLASH
307	FMXA2	Hz	Absolute limit output frequency CDS 2	1600		4	4	INT32Q16	FLASH
_31 MB-Motor holding brake, from page 5-96									
310	FBCW	Hz	Frequency limit for motor brake (clockwise)	3		3	3	INT32Q16	FLASH
311	FBCCW	Hz	Frequency limit for motor brake (anti-clockwise)	-3		3	3	INT32Q16	FLASH

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
312	FBHYS	Hz	Switch-on hysteresis of motor brake	1		4	4	USIGN16	FLASH
32 MP-MOP function, from page 5-99									
320	MPSEL		Configuration for motor operated potentiometer	0		3	3	USIGN8	FLASH
33 MO-Motor protection, from page 5-55									
330	MOPTC		Type of PTC evaluation	OFF		2	3	USIGN8	FLASH
331	MOPCB		2nd interpolation point, motor protection characteristic (referred to MOCNM)	100		4	4	USIGN8	FLASH
332	MOPCA		1st interpolation point, motor protection characteristic (referred to MOCNM)	100		4	4	USIGN8	FLASH
333	MOPFB	Hz	2nd interpolation point, motor protection characteristic	50		4	4	FLOAT32	FLASH
334	MOTMX		Maximum motor temperature	150		4	4	USIGN16	FLASH
335	MOPCN	A	Motor rated current for motor protection	G		1	2	FLOAT32	FLASH
336	MOPFN	Hz	Motor rated frequency for motor protection	50		4	4	FLOAT32	FLASH
34 PF-Power failure bridging, from page 5-65									
340	PFSEL		Power failure bridging selector	0		4	6	USIGN8	FLASH
351	PFC		Power failure bridging active current reference	100		4	4	USIGN16	FLASH
354	PFR	Hz/s	Deceleration ramp power failure bridging	999		4	6	INT32Q16	FLASH
36 KP-KeyPad, from page 5-71									
1	MODE		User level of KP200	2		1	1	USIGN8	RAM C V
360	DISP		Parameter for continuous actual value display of KP200	406		2	2	USIGN16	FLASH
361	BARG		Parameter for bar graph display of KP200	419		2	2	USIGN16	FLASH
362	PSW2		Password for user level 2 of KP200	0		2	2	USIGN16	FLASH
363	PSW3		Password for user level 3 of KP200	0		3	3	USIGN16	FLASH
364	PSW4		Password for user level 4 of KP200	546		4	4	USIGN16	FLASH
367	PSWCT		Password for Control menu of KP200	0		3	3	USIGN16	FLASH
368	PNUM		Parameter number display of KP200 on/off	OFF		4	4	USIGN8	FLASH
369	CTLFA		Multiplier of incremental value in CTRL menu of KP200	10000		4	4	USIGN16	FLASH
38TX-Device capacity utilization, from page 5-74									
304	CFCMX	A	Effective value of maximum current	8		4	7	FLOAT32	RAM A C
380	CACMX		Max. current in acceleration phase in of device rated current	0		4	7	USIGN8	FLASH
381	CDCMX		Max. current in braking phase in of device rated current	0		4	7	USIGN8	FLASH
382	CSTMX		Max. current in stationary operation in of device rated current	0		4	7	USIGN8	FLASH
384	CSCLR		Reset peak value storage	ACTIV		4	4	USIGN8	RAM C V
388	CMID		Mean device capacity utilization	0		4	15	USIGN8	RAM A C
389	CMIDF	s	Filter time constant for mean device capacity utilization	20		4	4	FLOAT32	FLASH
39DD-Device data, from page 5-77									
89	NAMDS		Designation of parameter setting (data set)			1	2	STRING	FLASH

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
90	SREV		Base standard version of modified software	G		4	7	FIXPT16	RAM C V
92	REV		Software version	G		1	7	FIXPT16	FLASH
106	CRIDX		Revision index as suffix to version number	G		4	7	USIGN8	RAM C V
127	S_NR		Serial number of device	G		3	7	STRING	FLASH
130	NAME		Symbolic device name			1	6	STRING	FLASH
390	TYPE		Device type	30000		1	15	USIGN16	RAM A C
394	A_NR		Article number of device	G		3	7	STRING	FLASH
397	CFPNM	A	Device rated current	G		4	7	FLOAT32	RAM A C
_50 WA-Warning messages, from page 5-82									
120	WRN		Warnings	0000H		3	15	USIGN16	RAM A C
500	WLTI		Device temperature warning threshold	100		3	3	USIGN16	FLASH
501	WLTD		Interior temperature warning threshold	80		3	3	USIGN16	FLASH
502	WLTM		Motor temperature warning threshold	180		3	3	USIGN16	FLASH
503	WLUV	V	Undervoltage warning threshold	0		3	3	INT16	FLASH
504	WLOV	V	Voltage overload warning threshold	800		3	3	INT16	FLASH
505	WLF	Hz	Frequency warning threshold	0		3	3	INT16	FLASH
506	WLIS	A	Apparent current warning threshold	999.95		3	3	FIXPT16	FLASH
_51ER-Error messages, from page 5-85									
74	ERES		Reset device errors	STOP		4	4	USIGN8	RAM C V
94	TERR	min	System time on occurrence of last error	0		1	7	USIGN16	RAM A C
95	ERR1		Last error	- 0.0h		1	7	ERR_ STR	FLASH
96	ERR2		Last-but-one error	- 0.0h		2	7	ERR_ STR	FLASH
97	ERR3		Last-but-two error	- 0.0h		2	7	ERR_ STR	FLASH
98	ERR4		Last-but-three error	- 0.0h		2	7	ERR_ STR	FLASH
140	R-RNM		Response to error in setting of a mode	3		4	4	USIGN8	FLASH
510	R-SIO		Response to SIO watchdog	1		4	4	USIGN8	FLASH
511	R-CPU		Response to CPU error	3		4	4	USIGN8	FLASH
512	R-OFF		Response to undervoltage	1		4	4	USIGN8	FLASH
513	R-OC		Response to current overload	2		4	4	USIGN8	FLASH
514	R-OV		Response to voltage overload	2		4	4	USIGN8	FLASH
515	R-OLI		Response to controller I*I*t shut-off	2		4	4	USIGN8	FLASH
516	R-OTM		Response to motor overheating	2		4	4	USIGN8	FLASH
517	R-OTI		Response to controller overheating	2		4	4	USIGN8	FLASH
518	R-SC		Response to error during initial commissioning	2		4	4	USIGN8	FLASH
519	R-OLM		Response to motor I*t shut-off	2		4	4	USIGN8	FLASH
520	R-PLS		Response to software runtime error	3		4	4	USIGN8	FLASH
521	R-PAR		Response to faulty parameter list	3		4	4	USIGN8	FLASH
522	R-FLT		Response to floating point error	3		4	4	USIGN8	FLASH
523	R-PWR		Response to unknown power pack	3		4	4	USIGN8	FLASH
524	R-EXT		Response to external error message	1		4	4	USIGN8	FLASH
525	R-USR		Response to modified software error message	1		4	4	USIGN8	FLASH
526	R-OP1		Response to error in option module slot 1	1		4	4	USIGN8	FLASH
527	R-OP2		Response to error in option module slot 2	1		4	4	USIGN8	FLASH
528	R-WRN		Response to warnings	0		4	4	USIGN8	FLASH

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
529	R-WBK		Response to wire break ISA0 (4..20mA)	1		4	4	USIGN8	FLASH
530	R-EEP		Response to memory error (EEPROM)	3		4	4	USIGN8	FLASH
531	EFSCL		Ground fault detection response threshold scaling	0		4	4	USIGN8	FLASH
532	R-PF		Response after DC-link buffering	1		4	4	USIGN8	FLASH
533	R-FDG		Response to reference coupling transmission error	1		4	4	USIGN8	FLASH
534	R-LSW		Response to reversed limit switches	2		4	4	USIGN8	FLASH
55 LB-LustBus, from page 5-90									
81	SBAUD	1/s	LustBus transfer rate	57600		4	4	USIGN8	FLASH
82	SADDR		LustBus device address	1		4	4	USIGN8	FLASH
83	SDMMY		LustBus dummy parameter	0		4	4	USIGN8	RAM C V
84	SWDGT	s	LustBus watchdog time setting	0.00		4	4	FIXPT16	FLASH
85	SERR		LustBus error status word	00H		4	4	USIGN8	RAM A C
550	SSTAT		Status word of serial interface	0000H		4	4	USIGN16	RAM A C
551	SCNTL		Control word of serial interface	0000H		4	4	USIGN16	RAM C V
57 OP-Option modules, from page 5-93									
489	CLBDR		CANlust baud rate	500		3	3	USIGN8	FLASH
492	CACNF		CANlust control/reference transfer mode	2		3	3	USIGN8	FLASH
570	CAMOD		Function selection option module CANlust	SLAVE		4	4	USIGN8	FLASH
571	CLADR		CANlust device address	0		3	3	USIGN8	FLASH
572	CASTA		CAN bus status word	0000H		3	15	USIGN16	RAM A C
573	CACTR		CAN bus control word	0000H		3	15	USIGN16	RAM A C
574	CAWDG	ms	CAN bus watchdog time (0 = OFF)	0		3	3	USIGN8	FLASH
575	CASCY	ms	Sampling time for status message (ms)	80		3	3	USIGN16	FLASH
576	OP1RV		Software version option module slot 1	0.00		3	7	FIXPT16	RAM A C
577	OP2RV		Software version option module slot 2	0.00		3	7	FIXPT16	RAM A C
580	COADR		CANopen device address	1		3	3	USIGN8	FLASH
581	COBDR		CANopen baud rate	500		3	3	USIGN8	FLASH
582	PBADR		Profibus DP device address	0		3	3	USIGN8	FLASH
59 DP-Driving profile generator, from page 5-102									
590	ACCR1	Hz/s	Acceleration ramp CDS 1	20		2	2	INT32Q16	FLASH
591	ACCR2	Hz/s	Acceleration ramp CDS 2	20		2	2	INT32Q16	FLASH
592	DECR1	Hz/s	Deceleration ramp CDS 1	20		2	2	INT32Q16	FLASH
593	DECR2	Hz/s	Deceleration ramp CDS 2	20		2	2	INT32Q16	FLASH
594	STPR1	Hz/s	Stop ramp CDS 1	20		2	2	INT32Q16	FLASH
595	STPR2	Hz/s	Stop ramp CDS 2	20		2	2	INT32Q16	FLASH
596	JTIME	ms	Smoothing time of S-shaped ramp in ms	0		3	3	USIGN16	FLASH
597	RF0		Response with reference 0Hz	OFF		4	4	USIGN8	FLASH
60 TB-Driving sets, from page 5-109									
600	FFTB0	Hz	Table frequency 1	5		3	3	INT32Q16	FLASH
601	FFTB1	Hz	Table frequency 2	10		3	3	INT32Q16	FLASH
602	FFTB2	Hz	Table frequency 3	15		3	3	INT32Q16	FLASH
603	FFTB3	Hz	Table frequency 4	20		3	3	INT32Q16	FLASH
604	FFTB4	Hz	Table frequency 5	25		3	3	INT32Q16	FLASH

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
605	FFTB5	Hz	Table frequency 6	30		3	3	INT32Q16	FLASH
606	FFTB6	Hz	Table frequency 7	40		3	3	INT32Q16	FLASH
607	FFTB7	Hz	Table frequency 8	50		3	3	INT32Q16	FLASH
608	TACR0	Hz/s	Table acceleration ramp 1	20		3	3	INT32Q16	FLASH
609	TACR1	Hz/s	Table acceleration ramp 2	20		3	3	INT32Q16	FLASH
610	TACR2	Hz/s	Table acceleration ramp 3	20		3	3	INT32Q16	FLASH
611	TACR3	Hz/s	Table acceleration ramp 4	20		3	3	INT32Q16	FLASH
612	TACR4	Hz/s	Table acceleration ramp 5	20		3	3	INT32Q16	FLASH
613	TACR5	Hz/s	Table acceleration ramp 6	20		3	3	INT32Q16	FLASH
614	TACR6	Hz/s	Table acceleration ramp 7	20		3	3	INT32Q16	FLASH
615	TACR7	Hz/s	Table acceleration ramp 8	20		3	3	INT32Q16	FLASH
616	TDCR0	Hz/s	Table deceleration ramp 1	20		3	3	INT32Q16	FLASH
617	TDCR1	Hz/s	Table deceleration ramp 2	20		3	3	INT32Q16	FLASH
618	TDCR2	Hz/s	Table deceleration ramp 3	20		3	3	INT32Q16	FLASH
619	TDCR3	Hz/s	Table deceleration ramp 4	20		3	3	INT32Q16	FLASH
620	TDCR4	Hz/s	Table deceleration ramp 5	20		3	3	INT32Q16	FLASH
621	TDCR5	Hz/s	Table deceleration ramp 6	20		3	3	INT32Q16	FLASH
622	TDCR6	Hz/s	Table deceleration ramp 7	20		3	3	INT32Q16	FLASH
623	TDCR7	Hz/s	Table deceleration ramp 8	20		3	3	INT32Q16	FLASH
624	TBSEL		Table driving set selection	0		3	15	USIGN8	RAM A C
64CA-Current-controlled startup, from page 5-124									
639	CLTF	s	Filter time constant for current-controlled startup/rundown	0.01		3	3	FLOAT32	FLASH
640	CLSL1		CDS 1: Current-controlled startup function selector	2		3	3	USIGN8	FLASH
641	CLCL1		CDS 1: Current limit, current-controlled startup	G		3	3	USIGN16	FLASH
642	CLFL1	Hz	CDS 1: Lowering frequency, current-controlled startup	G		3	3	FLOAT32	FLASH
643	CLFR1	Hz	CDS 1: Initial frequency, current-controlled startup	G		3	3	FLOAT32	FLASH
644	CLRR1	Hz/s	CDS 1: Lowering ramp, current-controlled startup	100		3	3	INT32Q16	FLASH
645	CLSL2		CDS 2: Current-controlled startup function selector	2		3	3	USIGN8	FLASH
646	CLCL2		CDS 2: Current limit, current-controlled startup	G		3	3	USIGN16	FLASH
647	CLFL2	Hz	CDS 2: Lowering frequency, current-controlled startup	G		3	3	FLOAT32	FLASH
648	CLFR2	Hz	CDS 2: Initial frequency, current-controlled startup	G		3	3	FLOAT32	FLASH
649	CLRR2	Hz/s	CDS 2: Lowering ramp, current-controlled startup	100		3	3	INT32Q16	FLASH

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
65 CS-Characteristic data switchover (CDS), from page 5-112									
650	CDSAC		Activate characteristic data set (CDS)	0		2	15	USIGN8	RAM C V
651	CDSSL		Control location for switchover of characteristic data set (CDS)	OFF		2	3	USIGN8	FLASH
652	FLIM	Hz	Limit frequency for switchover CDS 2	20		2	3	INT32Q16	FLASH
66 MS-Master/-Slave operation, from page 5-114									
837	MSFCT		Master/-Slave coupling factor (FDIG)	1		4	4	INT32Q16	FLASH
838	MSECT	ms	Error trigger time in case of failure of reference master	0		4	4	USIGN16	FLASH
67 BR-DC braking, from page 5-117									
670	BRDC		Mode of actuation of DC braking	OFF		3	3	USIGN8	FLASH
671	BRDCC		Braking current for DC braking	80		3	3	USIGN16	FLASH
672	BRTMX	s	Maximum DC braking time	15		3	3	USIGN16	FLASH
673	BRTOF	s	Demagnetization time before DC braking	2.00		4	4	FIXPT16	FLASH
674	BRTMN	ms	Minimum DC braking time	0		3	3	USIGN16	FLASH
68 HO-DC holding, from page 5-120									
680	HODCC		DC holding current	60		3	3	USIGN16	FLASH
681	HODCT	s	DC holding time	3.00		3	3	FIXPT16	FLASH
69 PM-Modulation, from page 5-129									
690	PMFS		Switching frequency of power stage	G		4	4	USIGN8	FLASH
70VF-Voltage Frequency Control, from page 6-8									
700	VB1	V	CDS 1: Boost voltage	G		3	3	FLOAT32	FLASH
701	VN1	V	CDS 1: Motor rated voltage	G		3	3	FLOAT32	FLASH
702	FN1	Hz	CDS 1: Motor rated frequency	50		3	3	FLOAT32	FLASH
703	V1-1	V	CDS 1: Voltage buffer value 1	0		4	4	FLOAT32	FLASH
704	V2-1	V	CDS 1: Voltage buffer value 2	0		4	4	FLOAT32	FLASH
705	V3-1	V	CDS 1: Voltage buffer value 3	0		4	4	FLOAT32	FLASH
706	V4-1	V	CDS 1: Voltage buffer value 4	0		4	4	FLOAT32	FLASH
707	V5-1	V	CDS 1: Voltage buffer value 5	0		4	4	FLOAT32	FLASH
708	V6-1	V	CDS 1: Voltage buffer value 6	0		4	4	FLOAT32	FLASH
709	F1-1	Hz	CDS 1: Frequency buffer value 1	0		4	4	FLOAT32	FLASH
710	F2-1	Hz	CDS 1: Frequency buffer value 2	0		4	4	FLOAT32	FLASH
711	F3-1	Hz	CDS 1: Frequency buffer value 3	0		4	4	FLOAT32	FLASH
712	F4-1	Hz	CDS 1: Frequency buffer value 4	0		4	4	FLOAT32	FLASH
713	F5-1	Hz	CDS 1: Frequency buffer value 5	0		4	4	FLOAT32	FLASH
714	F6-1	Hz	CDS 1: Frequency buffer value 6	0		4	4	FLOAT32	FLASH
715	VB2	V	CDS 2: Boost voltage	G		3	3	FLOAT32	FLASH
716	VN2	V	CDS 2: Motor rated voltage	G		3	3	FLOAT32	FLASH
717	FN2	Hz	CDS 2: Motor rated frequency	50		3	3	FLOAT32	FLASH
718	V1-2	V	CDS 2: Voltage buffer value 1	0		4	4	FLOAT32	FLASH
719	V2-2	V	CDS 2: Voltage buffer value 2	0		4	4	FLOAT32	FLASH
720	V3-2	V	CDS 2: Voltage buffer value 3	0		4	4	FLOAT32	FLASH
721	V4-2	V	CDS 2: Voltage buffer value 4	0		4	4	FLOAT32	FLASH
722	V5-2	V	CDS 2: Voltage buffer value 5	0		4	4	FLOAT32	FLASH
723	V6-2	V	CDS 2: Voltage buffer value 6	0		4	4	FLOAT32	FLASH

1 2 3 4 5 6 A

DE EN

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
724	F1-2	Hz	CDS 2: Frequency buffer value 1	0		4	4	FLOAT32	FLASH
725	F2-2	Hz	CDS 2: Frequency buffer value 2	0		4	4	FLOAT32	FLASH
726	F3-2	Hz	CDS 2: Frequency buffer value 3	0		4	4	FLOAT32	FLASH
727	F4-2	Hz	CDS 2: Frequency buffer value 4	0		4	4	FLOAT32	FLASH
728	F5-2	Hz	CDS 2: Frequency buffer value 5	0		4	4	FLOAT32	FLASH
729	F6-2	Hz	CDS 2: Frequency buffer value 6	0		4	4	FLOAT32	FLASH
730	ASCA1		Assistance parameter for Voltage Frequency Control in CDS 1	OFF		1	2	USIGN8	FLASH
731	ASCA2		Assistance parameter for Voltage Frequency Control in CDS 2	OFF		1	2	USIGN8	FLASH
_74 IR-IxR load compensation, from page 6-13									
740	IXR1		CDS 1: I*R load compensation on/off	ON		3	3	USIGN8	FLASH
741	KIXR1	Ohm	CDS 1: I*R compensation factor	G		3	3	FLOAT32	FLASH
742	IXR2		CDS 2: I*R load compensation on/off	ON		3	3	USIGN8	FLASH
743	KIXR2	Ohm	CDS 2: I*R compensation factor	G		3	3	FLOAT32	FLASH
744	IXRTF	s	Filter time constant for IxR compensation	0.01		3	3	FLOAT32	FLASH
_75 SL-Slip compensation, from page 6-16									
750	SC1		CDS 1: Slip compensation on/off	OFF		3	3	USIGN8	FLASH
751	KSC1		CDS 1: Slip compensation factor	G		3	3	FLOAT32	FLASH
752	SC2		CDS 2: Slip compensation on/off	OFF		3	3	USIGN8	FLASH
753	KSC2		CDS 2: Slip compensation factor	G		3	3	FLOAT32	FLASH
754	KSCTF	s	Filter time constant for slip compensation	0.01		3	3	FLOAT32	FLASH
_76 CI-Current injection, from page 6-18									
760	CICN1		CDS 1: Current injection reference	G		3	3	USIGN16	FLASH
761	CIFM1	Hz	CDS 1: Current injection limit frequency	G		3	3	FLOAT32	FLASH
762	CIFR1	Hz	CDS 1: Current injection transition range	2		4	4	FLOAT32	FLASH
763	CICN2		CDS 2: Current injection reference	G		3	3	USIGN16	FLASH
764	CIFM2	Hz	CDS 2: Current injection limit frequency	G		3	3	FLOAT32	FLASH
765	CIFR2	Hz	CDS 2: Current injection transition range	2		4	4	FLOAT32	FLASH
_77 MP-Remagnetization, from page 5-134									
770	MPCN1		CDS 1: Magnetizing current	33		3	3	USIGN16	FLASH
771	MPT1	s	CDS 1: Magnetization time	0.00		3	3	FIXPT16	FLASH
772	MPCN2		CDS 2: Magnetizing current	33		3	3	USIGN16	FLASH
773	MPT2	s	CDS 2: Magnetization time	0.00		3	3	FIXPT16	FLASH
774	MPT	s	Magnetization time for SFC and FOR	0.50		3	3	FIXPT16	FLASH
_78SS Speed controller SFC, from page 6-33									
780	SSGF1		CDS 1: Scaling of speed controller gain	100.00		3	3	FIXPT16	FLASH
781	SSG1		CDS 1: Speed controller gain	1		3	4	FLOAT32	FLASH
782	SSTL1	s	CDS 1: Speed controller lag time	G		4	4	FLOAT32	FLASH
783	SSTF1	s	CDS 1: Filter time constant of speed estimate	G		4	4	FLOAT32	FLASH
784	SSGF2		CDS 2: Scaling of speed controller gain	100.00		3	3	FIXPT16	FLASH
785	SSG2		CDS 2: Speed controller gain	1		3	4	FLOAT32	FLASH
786	SSTL2	s	CDS 2: Speed controller lag time	G		4	4	FLOAT32	FLASH
787	SSTF2	s	CDS 2: Filter time constant of speed estimate	0.02		4	4	FLOAT32	FLASH

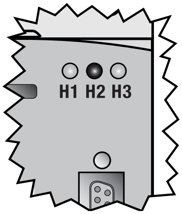
No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
_79 EN-Encoder evaluation, from page 6-50									
790	ECLNC		Lines per revolution of encoder	1024		2	3	USIGN16	FLASH
_80 CC-Current control, from page 6-56									
800	CCG		Current controller gain	G		4	4	FLOAT32	FLASH
801	CCTLG	s	Current controller lag time	G		4	4	FLOAT32	FLASH
802	CCTF	s	Filter time constant for current measurement	0.01		4	4	FLOAT32	FLASH
803	VCSFC		Correction factor of fault voltage characteristic	70		4	4	USIGN8	FLASH
804	CLIM1		CDS 1: Maximum reference current for current control	100		3	3	USIGN16	FLASH
805	CLIM2		CDS 2: Maximum reference current for current control	100		3	3	USIGN16	FLASH
_81SC-Speed controller FOR, from page 6-54									
810	SCGF1		CDS 1: Scaling of speed controller gain	100.00		3	3	FIXPT16	FLASH
811	SCG1		CDS 1: Speed controller gain	1		3	4	FLOAT32	FLASH
812	SCTL1	s	CDS 1: Speed controller lag time	0.02		4	4	FLOAT32	FLASH
813	SCTF1	s	CDS 1: Jitter filter time constant	0.001		4	4	FLOAT32	FLASH
814	SCGF2		CDS 2: Scaling of speed controller gain	100.00		3	3	FIXPT16	FLASH
815	SCG2		CDS 2: Speed controller gain	1		3	4	FLOAT32	FLASH
816	SCTL2	s	CDS 2: Speed controller lag time	0.02		4	4	FLOAT32	FLASH
817	SCTF2	s	CDS 2: Jitter filter time constant	0.001		4	4	FLOAT32	FLASH
818	SCGF0		Speed controller gain at frequency zero	10.00		3	3	FIXPT16	FLASH
_84 MD-Motor data, from page 5-132									
839	MONAM		Symbolic motor name (max. 64 characters)			3	3	STRING	FLASH
840	MOFNM	Vs	Nominal pole flux	G		4	5	FLOAT32	FLASH
841	MOL_S	H	Leakage inductance	G		4	5	FLOAT32	FLASH
842	MOR_S	Ohm	Stator resistance	G		4	5	FLOAT32	FLASH
843	MOR_R	Ohm	Rotor resistance	G		4	5	FLOAT32	FLASH
844	MONPP		Number of pole pairs of motor	2		4	5	USIGN8	FLASH
850	MOL_M	H	Magnetizing inductance from mag. characteristic	G		4	15	FLOAT32	RAM A C
_86SY System									
4	PROG		Reset device to factory setting	2		4	4	USIGN16	FLASH
15	PLRDY		Activate control initialization	OFF		4	4	USIGN8	RAM C V
Menu control KP200									
8	GROUP		Subject area of KP200	_15FC		1	1	USIGN8	RAM C V
VAL menu actual value parameter									
14	ACTT	Nm	Actual torque	0		1	7	INT32Q16	RAM A C
86	TSYS	min	System time after power-up in [min].	0		3	15	USIGN16	RAM A C
87	TOP	h	Operating hours meter	0		3	7	USIGN16	FLASH
400	ACTF	Hz	Current actual frequency	0		1	15	INT32Q16	RAM A C
401	ACTN	rpm	Actual speed	0		1	15	INT32Q16	RAM A C
404	VMOT	V	Output voltage of inverter	0.00		1	15	FIXPT16	RAM A C
405	DCV	V	DC-link voltage	0.00		1	15	FIXPT16	RAM A C
406	REFF	Hz	Current reference frequency	0		1	15	INT32Q16	RAM A C

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
407	MTEMP		Motor temperature in KTY84 evaluation	0.00		1	15	FIXPT16	RAM A C
408	APCUR	A	Effective value of apparent current	0.00		1	15	FIXPT16	RAM A C
409	ACCUR	A	Effective value of active current	0.00		1	15	FIXPT16	RAM A C
413	ACTOP	h	Operating hours of power stage	0		1	7	USIGN16	FLASH
415	AINP		Unfiltered analog values of the reference inputs	0		4	15	INT16	RAM A C
416	ISA0	V	Filtered input voltage ISA0	0		4	15	INT32Q16	RAM A C
417	ISA1	V	Filtered input voltage ISA1	0		4	15	INT32Q16	RAM A C
418	ISA0I		Filtered input current ISA0	0		4	15	INT32Q16	RAM A C
419	IOSTA		States of digital and analog I/Os	0000H		2	15	USIGN16	RAM A C
422	CNTL		Control word of system	0000H		4	15	USIGN16	RAM A C
423	ERPAR		Number of a possibly faulty parameter in the startup phase	0		4	15	USIGN16	RAM A C
425	DTEMP		Interior temperature	0.00		1	15	FIXPT16	RAM A C
427	KTEMP		Heat sink temperature	0.00		1	15	FIXPT16	RAM A C
428	PS	W	Apparent power	0		1	15	FLOAT32	RAM A C
429	PW	W	Active power	0		1	15	FLOAT32	RAM A C

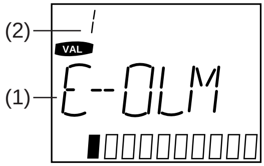
Appendix B Error messages

Errors in operation are signalled as follows:

- CDA3000: Red LED (H1) flashes (flash code see section 2.5 “LEDs”)



- DRIVEMANAGER: Possible causes of the error and measures to remedy are displayed in a window.
- KEYPAD KP200: The display is backlit in red and indicates the error (1) and an error location number (2). The error location number precisely specifies the cause of the error (see Table A.1).



Acknowledgment and resetting of errors

Errors can be acknowledged and reset in various ways:

- Rising edge at digital input ENPO
- Rising edge at a programmable digital input with setting of the function selector to ERES
- Write value 1 to parameter 74-ERES via control unit or bus system

Response to error

In case of error the inverter module responds with one of the following responses (see Table A.2).

Bus	DM/KP	Function
0	WRN	No response
1	STOP	Disable power stage
2	LOCK	Disable power stage and secure against restarting (prevent autostart)
3	RESET	Disable power stage and reset device after confirmation of error

Table A.1 Response to error

Error messages

Bus	DM/KP	Error location no.	Error cause	Possible remedy	Response no. in FS
0	--	--	No error		
1	E-CPU	1	Error resulting from defective control unit or incorrect software version	Switch device off and back on. (1)	RESET
		8	Error in self-test: Parameter initialization failed because of incorrect parameter description	Switch device off and back on. (1)	
		17	RAM area inadequate for scope functionality	(1)	
		30	Program memory data faulty	(1)	
2	OFF	1	DC-link voltage too low (also indicated on normal power-off)	Repair mains failure or connect higher mains voltage.	STOP
3	E-OC	1	Overcurrent due to: 1. incorrectly set parameters; 2. short-circuit, ground-fault or insulation error; 3. internal device fault	1. Check parameters of control circuits; 2. Check installation; 3. (1)	LOCK
4	E-OV	1	Overvoltage due to: 1. overload of the braking chopper (braking too long or too heavy); 2. mains voltage surge	1. Set DECR ramp parameter slower (_REF), use ext. braking resistor or chopper; 2. Adjust mains voltage	LOCK

(1) If this error is repeated please contact your local Service Partner.

Table A.2 Error messages of the CDA3000

Bus	DM/KP	Error location no.	Error cause	Possible remedy	Response no. in FS
5	E-OLM	1	Ixt shut-off to protect motor (permissible current/time area exceeded once/more than once)	1. Reduce load; 2. Use higher-powered Motor	LOCK
6	E-OLI	1	I^2xt shut-off to protect power stage (permissible current/time area exceeded once/more than once)	Reduce load.	LOCK
7	E-OTM	18	Motor overheating (PTC in motor tripped) due to: 1. PTC not connected; 2. Motor overload	1. Allow motor to cool down; 2. Connect PTC or jumper terminals with 100 Ohms; 3. Use a higher-powered motor	LOCK
8	E-OTI	31	Power stage overheating due to: 1. ambient temperature too high; 2. load too high (power stage or braking chopper)	1. Improve ventilation; 2. Use higher-powered device	LOCK
		32	Overheating in device interior due to: 1. ambient temperature too high; 2. load too high (power stage or braking chopper)	1. Improve ventilation; 2. Use higher-powered device	

(1) If this error is repeated please contact your local Service Partner.

Table A.2 Error messages of the CDA3000

Bus	DM/KP	Error location no.	Error cause	Possible remedy	Response no. in FS
9	E-PLS	1	Plausibility check detected invalid parameter or impermissible program sequence	(1)	RESET
		6	Unknown switching frequency in initialization of power stage protection	(1)	
		8	Parameter list could not be initialized in device startup phase. KP200 indicates number of incorrect parameter when appropriate at top left of display.	Reset device by: 1. Set parameter PROG=1. 2. Switch off device, press and hold down Up and Down key on KP200 and switch device back on. KP200 indicates “RESET”	
		9	Plausibility check detected invalid parameter object (incorrect data type or data length)	(1)	
		10	No readable parameter exists at the current user level or parameter access error via KP200	(1)	
		13	Both slots assigned the same module	Remove one module.	
		20	Error in auto-tuning	1. Check motor rating plate data matches corresponding motor parameters and restart auto-tuning. 2. (1)	
		101	Unknown switching frequency in initialization of PWM	(1)	

(1) If this error is repeated please contact your local Service Partner.

Table A.2 Error messages of the CDA3000

Bus	DM/KP	Error location no.	Error cause	Possible remedy	Response no. in FS
10	E-PAR	0	Invalid parameter setting	Correct parameter setting or reset device to factory setting.	RESET
		2	Parameter FMINx greater than parameter FMAXx or error in initialization of current-controlled startup	Set FMINx < FMAXx	
		7	The value of a parameter after the device startup phase is outside its value range.	Parameter 423-ERPAR contains the number of the incorrect parameter whose setting needs to be checked.	
		8	Error in first initialization of parameter list. A parameter could not be set to the factory setting.	Parameter 423-ERPAR contains the number of the incorrect parameter whose setting needs to be checked.	
		13	The combination of function selector settings for one of the analog inputs and the reference selector are mutually contradictory.	Check and change setting.	
		16	The setting of parameter FOSA0 (function selector, output OSA0) is outside its value range.	Check and change setting.	
		100	Error in controller initialization	Check setting of controller and motor parameters. Restart auto-tuning as necessary.	
		101	Error in initialization of PWM	(1)	
		102	Error in initialization of encoder evaluation	(1)	
		104	Error in initialization of Voltage Frequency Control	(1)	
		105	Error in initialization of actual value recording	(1)	
		106	Two interpolation points of V/F characteristic have same frequency.	Change setting.	
		107	Pitch between two interpolation points for V/F characteristic is too large.	Change setting.	
		108	Error in initialization of SFC resulting from unfavourable parameter settings of motor and controller.	Check controller and motor settings and restart auto-tuning as necessary.	
11	E-FLT	0	Global error in floating point calculation	(1)	RESET

(1) If this error is repeated please contact your local Service Partner.

Table A.2 Error messages of the CDA3000

Bus	DM/KP	Error location no.	Error cause	Possible remedy	Response no. in FS
12	E-PWR	6	Power pack not correctly detected	Send in device .	RESET
13	E-EXT	1	Error in an external device	Rectify error in external device.	STOP
15	E-OP1	150	Error in module at option slot 1	1. Check module and identifier; 2. (1)	STOP
		151	Error at option slot 2: BUS-OFF state detected	Check contacting of module. If the error reoccurs after switching on/off, the device or the module is faulty.	
		152	Error at option slot 2: Transmit protocol could not be sent.	Check contacting of module. If the error reoccurs after switching on/off, the device or the module is faulty.	
		153	Error at option slot 2: Module not responding	Check contacting of module. If the error reoccurs after switching on/off, the device or the module is faulty.	
		154	Error at option slot 2: Module has signalled error.	Check contacting of module. If the error reoccurs after switching on/off, the device or the module is faulty.	
16	E-OP2	200	Error in module at option slot 2	1. Check module and identifier; 2. (1)	STOP
		201	Error on option 2: BUS-OFF state detected	Check contacting of module. If the error reoccurs after switching on/off, the device or the module is faulty.	
		202	Error on option 2: Transmit protocol could not be sent.	Check contacting of module. If the error reoccurs after switching on/off, the device or the module is faulty.	
		203	Error on option 2: Module not responding	Check contacting of module. If the error reoccurs after switching on/off, the device or the module is faulty.	
		204	Error on option 2: Module has signalled error.	Check contacting of module. If the error reoccurs after switching on/off, the device or the module is faulty.	
18	E-SIO	11	Watchdog monitoring communication over LustBus tripped	1. Check connection; 2. Check bus master or increase parameter SWDGT.	STOP
19	E-EEP	3	Error accessing parameter memory	1. Switch device off and back on; 2.(1)	RESET
20	E-WBK	1	Possible wire break at input ISA01. Current less than 4mA in parameter setting to 4-20mA	Check wiring of input ISA01.	STOP
(1) If this error is repeated please contact your local Service Partner.					

Table A.2 Error messages of the CDA3000

Bus	DM/KP	Error location no.	Error cause	Possible remedy	Response no. in FS
21	E-SC	20	Error in auto-tuning	1. Check motor wiring and repeat process; 2. (1)	LOCK
		21	Error in auto-tuning. Motor connected or partially disconnected	1. Check motor wiring and repeat process; 2. (1)	
		22	Auto-tuning is suitable only for asynchronous machines. \n	Set parameter 153-CFMOT to ASM if a relevant motor is being used and repeat auto-tuning.	
		23	Auto-tuning is unable to identify the connected motor correctly. \n	1. Get motor parameters from manufacturer and enter manually; 2. If possible use another motor.	
22	E-PF	1	Error in power failure bridging: The DC-link voltage was not restored within the preset time (parameter 343-PFTIM).	Check mains power supply.	STOP
23	E-RM	0	Error in activation of an application data set	1. The error location number identifies the incorrect parameter; 2. (1)	RESET
24	E-FDG	1	Transmission error in reference coupling	Check connection.	STOP
25	E-LSW	1	Limit switches reversed	Correct wiring.	LOCK

(1) If this error is repeated please contact your local Service Partner.

Table A.2 Error messages of the CDA3000

Error messages

If a fault occurs in operation it is indicated by a flash code from LED H1 (red) on the inverter module. The code indicates the type of error. If a KP200 is connected the KP200 indicates the error type as an abbreviation.

Flash code of red LED H1	KeyPad DISPLAY	Response no.	Explanation	Cause/Remedy
1x	E-CPU	3	Error in CPU (processor)	Switch power off and back on again. If error reoccurs notify LUST Service.
2x	E-OFF	1	Undervoltage shut-off	Check power supply. Also occurs briefly in response to normal power-off.
3x	E-OC	2	Current overload shut-off	Short-circuit, ground fault: Check cabling of connections, check motor coil, check neutral conductor and grounding (see also section 3, Installation). Device setup not correct: Check parameters of control loops. Check ramp setting.
4x	E-OV	2	Voltage overload shut-off	Voltage overload from mains: Check mains voltage. Restart device. Voltage overload resulting from feedback from motor (regenerative operation): Slow down braking ramps. If not possible, use a braking resistor.
5x	E-OLM	2	Motor protection shut-off	Motor overloaded (after I x t monitoring): Slow down process cycle rate if possible. Check motor dimensioning.
6x	E-OLI	2	Device protection shut-off	Device overloaded: Check dimensioning. Possibly use a larger device.
7x	E-OTM	2	Motor temperature too high	Motor PTC correctly connected?: Parameter MOPTC (type of motor PTC evaluation) correctly set? Motor overloaded? Allow motor to cool down. Check dimensioning.
8x	E-OTI	2	Inverter overheating	Ambient temperature too high: Improve ventilation in switch cabinet. Load too high during driving/braking: Check dimensioning, poss. use braking resistor.

Table A.3 Error messages

Service Hotline

If you need further assistance, our specialists at the LUST Service Center will be glad to help.

You can reach us:

Mon.-Thur.:	8 a.m. - 5 p.m.	Tel. 06441/966-136, Fax -211
Fri.:	8 a.m. - 4 p.m.	Tel. 06441/966-136, Fax -211
e-mail:	service@lust-tec.de	

User errors in KEYPAD OPERATION

Error	Cause	Remedy
ATT1	Parameter cannot be changed at current user level or is not editable.	Select user level 1-MODE higher.
ATT2	Motor must not be controlled via the CTRL menu.	Cancel start signal from a different control location.
ATT3	Motor must not be controlled via the CTRL menu because of error state.	Reset error.
ATT4	New parameter value impermissible	Change value.
ATT5	New parameter value too high	Reduce value.
ATT6	New parameter value too low	Increase value.
ATT7	Card must not be read in current state.	Reset start signal.
ERROR	Invalid password	Enter correct password.

Table A.4 KEYPAD user error: Reset with **Start/Enter**

User errors in SmartCard operation

Error	Meaning	Remedy
ERR91	SmartCard write-protected	Use different SmartCard
ERR92	Error in plausibility check	
ERR93	SmartCard not readable, wrong inverter type	
ERR94	SmartCard not readable, parameter not compatible	
ERR96	Connection to SmartCard broken	
ERR97	SmartCard data invalid (checksum)	
ERR98	Insufficient memory on SmartCard	
ERR99	Selected area not present on SmartCard, no parameters transferred to SmartCard	

Table A.5 SmartCard error: Reset with **Stop/Return**

Appendix C Glossary

87 Hz characteristic	Expanded manipulating range of the motor for constant torque delivery. A motor with 400 V / 50 Hz in star configuration can be expanded to 87 Hz in delta configuration at this voltage.
Abscissa	(Latin: abscissus = torn off, separated) Horizontal axis in coordinates system
Actual value	Return value of the external signal acquisition in loop-controlled systems. In open-loop control systems the value calculated on the basis of preset conditions.
Address coding plug	Address coding of a device in a bus system by means of a plug connector. An address in a bus system must be unique within a fixed address range.
ADS	**A**pplication **d**ata **s**et; data sets with preset solutions for typical standardized applications, which also serve as the basis for customizations. A customized application data set can only be saved to one user data set.
Analog/digital ground	The analog and digital grounds are isolated from each other in order to avoid transient currents. The analog ground is connected directly to the inverter module processor. It serves as the reference potential for analog reference input. The digital inputs and outputs are isolated from it.
Application data set (ADS)	Factory predefined parameter data set to solve typical applications.

Asynchronous motor	Also termed IEC standard motor, squirrel-cage rotor or cage motor. Three-phase a.c. motor which does not run synchronous with the stator speed. The rotor is composed of several rods which are shorted at the ends by rings. The energy transfer from the stator to the rotor is inductive (without brushes or slip rings). Very robust and low-cost.
Attenuation choke	Choke between the output of the inverter module and the motor, to reduce noise. Noise occurs in the motor due to high-frequency components of the current and voltage of an inverter.
Axial	(Latin noun: axis) In the direction of the axis
Basic range	Speed range below the rated speed of a three-phase a.c. motor in which the stator voltage and the frequency are changed proportionally.
Baud	Jean **Baud**ot; measurement unit in bps (bits per second) for the speed of data transmission.
Bootstrap	Mode in which a new software release can be transferred to a device. If there is a software program in the device, the device can be switched to Bootstrap mode without pressing the Bootstrap button.
Braking chopper	If the DC-link voltage of the inverter becomes too high, switches a resistor parallel to the DC-link to convert the energy fed back by the machine into heat.
Burst immunity	Resistance to short-time electromagnetic interference signals with steep rising edges
CANLust	(CAN = Controller Area Network); Networking concept based on the CAN bus system according to the CiA (CAN in Automation) standards, but with Lust-specific communication identifiers, oriented to the CAL (CAN Application Layer) protocol
CANopen	(CAN = Controller Area Network); CANopen bus system according to the CiA (CAN in Automation) standards, based on the networking concept of the CAN serial bus system
CDS	Characteristic data set; subsidiary data set within a user data set of the typical parameters for adaptation of the motor characteristic and of the controller and open-loop control properties.

Characteristic data set (CDS) A user/application data set contains two characteristic data sets for expanded adaptation to the movement task. A characteristic data set comprises a selection of parameters, but not all the parameters available in the inverter module.

Closed-loop control The controlled variable is recorded, compared against the reference input variable and adapted accordingly to the reference input variable by means of a mathematical relation. Characteristic is a control loop with feedback of the output variables to the input variables.

Control deviation Difference between controlled variable and reference input variable. If the deviation is equal to zero, the output variable of the controller remains at its quiescent value.

Control deviation The negative control deviation xw is termed control deviation x_d.

Control difference $x_d = -x_w = w - x$

Control deviation The negative control deviation is termed control deviation x_d.

$x_d = x_w = x - w.$

DC braking Feed of a direct current into the motor, causing it to brake. The resultant braking energy is converted directly into heat in the motor. The braking power is lower than when a braking resistor is used on the inverter.

Delta voltage Effective nominal value of the outer conductor voltage of a three-phase AC system

DM DRIVEMANAGER user-friendly control unit for PCs based on Win 9x or Win NT

Driving profile generator The driving profile generator contains the general ramp generator and the table-supported ramp generator. The ramp generators form a driving profile which is run through to attain the frequency reference.

Driving set A driving data set contains a frequency reference and an assigned acceleration or deceleration ramp which, when the driving set is selected from a table, is set to attain the frequency reference in the table-supported ramp generator.

Driving set	Characterized by a fixed frequency and associated acceleration and deceleration ramps. A driving set is not the same as a positioning set, which also includes a value for a position.
Dynamic speed accuracy	Speed deviation during the startup or braking process of a speed change. The greatest deviation very often occurs in the transient response in settling to the desired speed.
EMC	**E**lectro**m**agnetic **C**ompatibility; limit values laid down in directive aimed at reducing the interference emitted by devices and preserving the operating safety of devices subject to interference.
ENPO	**EN**able **PO**wer; non-software-dependent hardware enable for the inverter power stage.
Exponent	(Latin: exponere = expose) Power of a mathematical expression positioned to the top right of it (base). The exponent indicates how often the base is to be multiplied by itself.
Fast reference coupling	In Master/-Slave operation the slave drive is controlled by the master speed-synchronously by way of a digital reference transfer. The transmission ratio can be determined by way of a coupling factor.
Field range, Field weakening range	Speed range above the rated speed of a three-phase a.c. motor in which the stator voltage remains constant and only the frequency is changed.
FIXPT16	16-bit raw value divided by 20, to get decimal places resolution in 0.05 increments
FLOAT32	32-bit number format with floating point. No fixed number of places (bits) is reserved for the post-decimal places.
FOR	Field Oriented Regulation, control method in which the rotor speed and current angle of the rotor are ascertained with an encoder. The voltage pointers are placed dependent on the calculated information to form the torque from the current. Very high dynamics and smooth running, also safeguarded against stalling.
Freewheeling diode	Diode to protect electronic components under inductive loads. Inductors (such as relay coils) produce high induced voltages at the moment of shutdown which attempt to maintain the current flow in the circuit and result in the destruction of components.

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Function selector	Selector switch for function options
Fundamental	Inverters modulate a quasi-sinusoidal pulse width modulated voltage. The flowing current assumes a sinusoidal characteristic based on the inductance of the motor. According to Fourier, the characteristic results from the addition of several sinusoidal oscillations of differing frequency and amplitude. The fundamental is the sinusoidal oscillation with the frequency of the total signal.
Ground fault	A conductive connection of an outer conductor or insulated center conductor to ground or grounded components resulting from a fault or from arcing.
Harmonic	Inverters modulate a quasi-sinusoidal pulse width modulated voltage. The flowing current assumes a sinusoidal characteristic based on the inductance of the motor. According to Fourier, the characteristic results from the addition of several sinusoidal oscillations of differing frequency and amplitude. Harmonics are oscillations with a frequency of a whole-number multiple of the fundamental.
High-side driver	Semiconductor component which actively outputs a voltage. No voltage is connected to ground, as in open-collector circuits. These drivers are generally monitored for overheating and short-circuit.
HTL encoder	Encoder with HTL square signals as output signals. Typical voltage range 10 to 30 V DC. For detection of speed and direction, at least two 90° phase shifted output signals are required. Their output voltages make HTL encoders suitable for direct connection to PLC-compatible inputs as per IEC1131.
Initial commissioning	Quick and easy parameter setting of the inverter module by means of the key basic parameters, based on the factory setting of the CDA3000 inverter module.
INT16	Whole number in 16-bit data format
INT32Q16	32-bit number format in which the last 16 bits represent the decimal places; no floating point.
IxR load compensation	By shifting of the load characteristic by a voltage amount Δ dependent on the active current

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EN

Lag time	Short name T_N. Characteristic quantity of a PI controller required in a step response to attain a change of a manipulated variable by means of the I-effect. This I-effect is equal to that created by the P-component.
Leakage current	Current occurring in operation as a result of parasitic capacitances or Y-capacitors fitted in devices between live conductors and the ground potential/ grounding lead. For safety reasons the leakage current must not exceed device and country specific limit values.
Line choke	Minimizes network feedback from power converters such as commutation notches and harmonics.
Manipulated variable	Output variable of the controlling system and thus the input variable for the controlled system.
Motor identification	Automated definition of the electrical parameters of a three-phase a.c. motor.
Open-loop control	The input variables influence the output variables based on a predefined mathematical relationship. The characteristic feature is a path of action with no feedback of the output variables to the input variables.
Outer conductor	Conductor connected to an external point, e.g. L1, L2, L3
Outer conductor voltage	Voltage between two outer conductors, e.g. U_{12}, U_{23}, U_{31} in a three-phase AC system (see also: Delta voltage)
Parameter	Variable with a fixed value range and a predefined factory setting.
PTC	**P**ositive **T**emperature **C**oefficient; (thermistor) Temperature-sensitive resistor of which the resistance increases as it heats up.
PWM	**P**ulse **W**idth **M**odulation, for simulation of a signal.
Ramp generator	The preset frequency reference is attained by acceleration or deceleration of the drive. The necessary ramps are set in the ramp generator.
Reference	Analog or digital input value with which the system is to be operated. Value of the reference input variable in a given moment under analysis.

Reference input variable	Variable not influenced by the control which is fed into the control circuit from the outside. The output variable of the control follows the reference input variable in mathematical dependency. The current value of the reference input variable is termed the reference.
Reluctance motor	Asynchronous motor which, due to its design, runs asynchronous in the startup phase and which, based on its strong pole formation, declines into synchronism in stationary operation.
Remagnetization	Increase in startup and standstill torque by means of magnetic flux build-up prior to starting of the drive
RS232	**R**ecommended **S**tandard 232; standardized serial interface for **one** terminal with max. 15 m line length.
RS485	**R**ecommended **S**tandard 485; standardized serial interface for max. 240 terminals and 1000 m line length.
Sampling time	Time for all instructions of the inverter software to be processed.
SFC	Sensorless Flux Control, control method in which the rotor speed and the current angle of the rotor are determined without encoder by way of the electrical variables. The voltage pointers are placed dependent on the calculated information to form the torque from the current. Good dynamics and smooth running, also high torque formation.
Slip	Determines the rotor frequency f_L of the asynchronous motor. As the load increases the slip s becomes greater and the speed decreases. Slip defined in rpm or as % of field speed n_F
Slip compensation	Compensates for load-dependent speed changes of a drive. As load increases the compensation provides an increase in output voltage and frequency, and reduces output voltage and frequency as the load is relieved.

Smoothing A driving profile with linear ramps is smoothed by sinusoidal speed ramps. This produces an s-shaped speed profile which results in bucking limitation with increased acceleration and deceleration time. The difference in time between the linear ramp and the sinusoidal ramp is termed the smoothing time JTIME.

Smoothness Measure for the smooth running of a motor.

Speed control range, speed manipulating range Ratio of maximum speed (usually rated speed) and minimum speed at which the drive is run stationary. Braking and acceleration processes are not taken into account.

Speed manipulating range Range in which the motor can always deliver nominal torque M_N.

Standstill torque Momentum built up by the motor from feed via the inverter module in order to counteract a load-dependent rotation of the rotor from its current position.

Static speed accuracy Speed deviation in the steady (static) state after completion of startup. In operation with speed control a high-frequency ripple is superimposed on the actual speed.

Subject area Parameters assembled into parameter groups based on function orientation.

Synchronous motor Motor with permanent magnet excited rotor which requires no slip to the field speed n_F of the stator in order to build up an electromagnetic force. The field speed of the stator and the rotor speed rotate synchronously.

Table-supported ramp generator The frequency reference drawn from a table; is attained with the assigned acceleration or deceleration ramp of the driving set. The necessary ramps are set in the table-supported ramp generator.

Torque rise time	Time which expires after a reference step from 0Nm to M_N until the actual value of the torque in the motor has reached 95% of the nominal value.
Usage categories	Indication of the suitability of contactors, auxiliary and motor switches for special operating conditions in direct current (DC) or alternating current (AC) systems. Relays of the inverter module: AC-1 = non-inductive or low-inductance loads
User data set (UDS)	Custom parameter data set to solve an application task which cannot be solved by the application data set. Data set adapted by a user.
User level menu	Access level to subject areas and parameter to simplify operability. The higher the user levels, the more subject areas and parameters are visible to the user. User levels may be password protected.
VFC	Voltage Frequency Control; the voltage of the motor is changed based on a characteristic proportional to the output frequency of the inverter module.

Appendix D Index

F

G

H

I

K

P

Q

R

S

T

U

V

W

LUST
ANTRIEBSTECHNIK

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ID no.: 0840.22B.1-00 • Date: 05/01
We reserve the right to make technical changes.