COMBIVERT

G6

Programming Manual

Power unit

Firmware version 2.1.x.x

for control types:

G6L-G	v/f	(characteristic-controlled)
G6L-M	ASCL	(Asynchronous Sensorless Closed Loop)
G6P-S	SCL	(Sensorless Closed Loop)

Mat.No.	Rev.
00G6NEA-0020	1B

KEB

1. Table of Contents 3

2. Preface 12

2.1 General 12
2.2 Safety Instructions 12
2.3 Validity and liability 12
2.4 Copyright 12
2.5 Specified application 13
2.6 Product description 13
2.7 Type code 14

3. Hardware 16

3.1 Overview of the control unit interfaces 16

4. Operation 17

4.1 Fundamentals 17
4.2 Password structure 17
4.2.1 Passwords and password levels 17

5. Selection of Operating Mode 18

5.1 Reference speed / reference frequency 19

6. Start-Up 20

6.1 Preparatory measures 20
6.1.1 After unpacking the goods 20
6.1.2 Installation and connection 20
6.1.3 Checklist prior to start-up 20
6.2 Initial Start-up 20
6.2.1 Start-up of an asynchronous motor 21
6.2.1.1 v/f characteristic operation 22
6.2.1.2 Start-up G6L-M (ASCL/ vector controlled with motor model) 24
6.2.2 Start-up of a synchronous motor 28
6.2.2.1 Start-up G6P-S (SCL) 28

7. Functions 30

7.1 Operating and appliance data 30
7.1.1 Overview of the ru-Parameters 30
7.1.2 Overview of the In-Parameters 31
7.1.3 Overview of the Sy-Parameters 32
7.1.4 Explanation to parameter description 32
7.1.5 Description of the ru-Parameters 33
7.1.6 Description of the In-Parameters 43
7.1.7 Description of the Sy-Parameters 47

8. Analog Inputs and Outputs 50

8.1 Summary description analog inputs 50

8.2 Interface selection 51

8.2.1 AN1 / AN2 (An00 / An10) 51

8.3 Noise filter (An01 / An11) 52

8.4 Save mode (An02 / An12) 52

8.4.1 Input selection (An03 / An13) 53

8.5 Zero clamp (An04 / An14) 54

8.6 Gain of the input characteristic (An05...An07 / An15...An17) 55

8.7 Lower limit and upper limit (An08, An09, An18, An19) 56

8.8 Selection REF input / AUX-function (An30) 57

8.9 Brief description analog outputs 58

8.10 Output signals 59

8.11 Analog output / display (ru33...ru34 / ru35...ru36) 59

8.12 ANOUT 1... 4 / function (An31 / An36 / An41 / An47) 60

8.13 Gain of the output characteristic (An33...An35 / An38...An40 / An43...An45 / An49... An51) 61

8.14 ANOUT 1...4 Digital setting (An32 / An37 / An42 / An48) 62

9. Digital Inputs and Outputs 63

9.1 Summary description digital inputs 63

9.2 Control release with Safe Torque Off (STO) 63

9.3 Input signal PNP 64

9.4 Digital input setting per software (di01, di02) 64

9.5 Input terminal state (ru21), internal input state (ru22) 65

9.6 Digital noise filter (di03) 65

9.7 Input logic (di04) 65

9.8 Turn on- and turn off delay time of the digital inputs 66

9.9 Input trigger (di05) 66

9.10 Strobe dependent inputs (di06, di07, di08) 67

9.11 Error reset input selection (di09) and error reset negative slope (di10) 69

9.12 Assignment of the inputs 69

9.13 Software-ST and locking of the control release 72

9.14 Deactivation of the digital control release 72

9.15 Short description - digital outputs 73

9.16 Output signals / Hardware 74

9.17 Output filter (do43, do44) 74

9.18 Switching conditions (do00...do07) 75

9.19 Inverting of switching conditions for flags 0...7 (do08...do15) 79

9.20 Selection of the switching conditions for flags 0...7 (do16...do23) 79
9.21 AND / OR connection of the switching conditions (do24)... 80
9.22 Inverting of flags (do25...do32) 81
9.23 Selection of flags (do33...do40) 81
9.24 AND / OR connection of the flags (do41) 82
9.25 Output terminal state (ru25) and digital output state (ru80).. 83
9.26 Hardware output allocation (do51) 83
9.27 Programming example digital outputs 84

10. Setpoint-, Rotation- and Ramp Setting 85

10.1 Short description of the setpoints 85
10.2 Reference source oP00... 86
10.3 Rotation source oP01 87
10.4 Deceleration of the rotation correction 91
10.5 Step values (oP18...oP23)... 92
10.6 Setpoint limits.. 94
10.7 Setpoint calculation 96
10.7.1 Setpoint adjustment in percent 96
10.7.2 Absolute setpoint setting 96
10.7.3 Assignment of the setpoint sources 96
10.7.4 Fade out target for setpoint 96
10.8 High-resolution setpoint setting 97
10.9 Ramp generator 98
10.9.1 acc dec mode 98
10.9.2 Ramp with constant ascent 99
10.9.2.1 Linear ramps 100
10.9.2.2 S-curve times 101
10.9.3 Ramp with constant time 103
10.9.4 Ogive run 104
10.9.4.1 Time factor acceleration/deceleration (oP62).. 104
10.9.5 Modulation switch-off range... 105

11. Motor Data and Controller Setting of the Asynchronous Motor...........106

11.1 Open-loop operation (v/f characteristic) 107
11.1.1 Rated frequency (uF00), boost (uF01) and delta boost (uF04 / uF05)............ 107
11.1.2 Max. voltage mode (uF10) 108
11.1.3 Add. frequency / voltage (uF02 / uF03).. 108
11.1.4 Voltage stabilisation (uF09).. 108
11.1.5 Deactivation of the voltage stabilisation via digital input 111
11.1.6 Switching frequency (uF11)...111
11.1.7 Energy saving function (uF06...uF08) 111
11.1.8 SMM (sensorless motor management) 113
11.1.8.1 Motor name plate 113

11.1.8.2 Determination of the stator resistance (dr06) 114
11.1.8.3 Load mot.dependent parameter (Fr10), controller activation 115
11.1.8.4 Adjustment of the slip compensation (cS00, cS01, cS04, cS06, cS09) 115
11.1.8.5 Improved slip compensation (cS00 bit 6 = 64, cS03) 116
11.1.8.6 Adjustment of the autoboost (uF16, uF17) 117
11.1.9 Winding temperature evaluation 117
11.1.9.1 Winding temperature detection via AUX 118
11.1.9.2 Winding temperature detection via estimation of the motor temperature 119
11.1.10 Select 50Hz / 60Hz mode (Ud06) 120

11.2 Vector controlled operation (ASCL) 121

11.2.1 Initial settings 121
11.2.1.1 Motor rating plate data 122
11.2.1.2 motor adaption 122
11.2.1.3 Speed feedback and selection of the speed direction 124
11.2.1.4 Electrical parameters (equivalent circuit data) of the motor 124
11.2.2 Identification of the motor model / general 124
11.2.2.1 Automatic mode 125
11.2.2.2 Single identification 126
11.2.2.3 Motor identification error state dr66 128
11.2.2.4 Additional trimming 129
11.2.2.5 Generally adjustments for operation with motor model 130
11.2.2.6 Magnetisation current adaption / with motor model 132
11.2.2.7 Special functions 132
11.2.2.8 ASCL / low speed operation 135
11.2.2.9 Switch to consecutive motor 137
11.2.2.10 function mode 138
11.2.2.11 Speed estimate controller (dS14, dS15) and speed smoothing (dS17) 139
11.2.3 Special function: Rotor adaption 139
11.2.4 Block diagram 141

12. Adjustments of the Synchronous Motor 143

12.1 Initial settings 143

12.1.1 Motor name plate 143
12.1.2 speed control configuration 144
12.1.3 act. source 144
12.1.4 Motor adaption 145

12.2 Speed-controlled operation without encoder feedback (SCL) 146

12.2.1 Initial settings for sensorless operation 146
12.2.2 Identification of the motor data 146
12.2.3 Auto identification 148
12.2.4 Single identification 148
12.2.4.1 Deadtime compensation (uF18) 150
12.2.4.2 Motor identification error state dr66 150
12.2.5 Standstill and starting phase 151
12.2.6 Low speed 153
12.2.7 Motor model 154
12.2.8 Function mode 156

12.2.9 Operation with sine-wave filter 156
12.2.10 Rotor position detection for synchronous motors without rotation........ 157
12.2.11 Rotor position detection for synchronous motors at low speeds (HF supply) . 158
12.3 Block diagram........ 159

13. Speed Control 163

13.1 Speed controller parameters........ 163
13.1.1 Initial setting 163
13.1.2 Automatic adjustment of the speed controller (only at operating with motor model) 163
13.1.3 Operating state-dependent control parameters........ 164
13.2 Determination of the mass moment of inertia 165
13.3 PT1 output filter........ 166
13.4 Acceleration dependent pre-control........ 166
13.4.1 Precontrol reciprocal of amplification / filtering........ 167
13.4.2 Setpoint smoothening........ 168
13.5 Square influence of the controller parameters........ 169

14. Torque Display and Limiting........ 172

14.1 Maximum voltage controller, voltage limit........ 172
14.2 Physical torque limits ASM 173
14.2.1 Torque limits in base speed range........ 173
14.2.2 Torque limits in base speed range........ 173
14.3 Physical torque limits SM........ 175
14.3.1 Torque limits in base speed range (dr27, dr15)........ 175
14.3.2 Torque limits in base speed range........ 175
14.3.2.1 Determination of the magnetizing current limit (dS13) 176
14.3.2.2 Definition of the limiting characteristic 177
14.3.2.3 Shifting of the limiting characteristic 179
14.3.2.4 Influence of the current limit 180
14.4 Adjustment of application-dependent torque limits 180
14.5 Display of actual torque values and limits........ 182
14.6 Display of the torque-related motor load ru90 183
14.6.1 Mode 1: „reference torque“ LE27 = 0 183
14.6.2 Mode 2: „reference torque“ LE27 unequal 0 184

15. Torque Control 186

15.1 Torque reference source........ 186
15.2 Rate of change torque reference 186
15.3 Speed limiting........ 187
15.4 Control mode 187
15.4.1 Mode 1: Torque-controlled operation with emergency changeover to speed control 187
15.4.2 Mode 2: Torque-controlled mode with superimposed speed control 188

16. Current Control, Limiting and Switching Frequencies 189
16.1 Current control 189
16.2 Current limit 190
16.3 Switching frequencies and derating 191
16.3.1 Current ripple 192
17. Gear Factor 193
17.1 Definition 193
17.2 Gear factor / analog setting 194
17.3 Gear factor / set-programming 195
18. Protective Functions 196
18.1 Error and warning messages 196
18.1.1 Underpotential 196
18.1.2 Overvoltage 197
18.1.3 Overcurrent 197
18.1.4 Overload 197
18.1.5 Inverter over temperature 197
18.1.6 External fault 198
18.1.7 Bus error 198
18.1.8 Motor protection with temperature sensor 199
18.1.9 Software motor protection (I^2t-function) 200
18.1.10 Set selection error 201
18.1.11 Speed limit exceeded 201
18.1.12 Speed controller limit reached 201
18.1.13 General power circuit error 201
18.1.14 Phase failure 202
18.1.15 Maximum acceleration exceeded 202
18.2 Response to malfunction messages 203
18.2.1 Selection of the response 203
18.2.2 Parameterization of the quick stop at malfunction 204
18.3 Automatic restart 204
18.3.1 Undervoltage error (ERROR underpotential) 205
18.3.2 Overvoltage error (ERROR overpotential) 205
18.3.3 Overcurrent error (ERROR overcurrent) 205
18.3.4 Error messages and pre-warnings 205
18.4 Base block 206
18.5 quick stop 206
18.5.1 Quick stop in the V/F characteristic operation 206
18.5.2 Quick stop at closed-loop systems 209
18.5.3 Time monitoring abnormal stopping 210
18.5.4 S-curve for quick stop ramp 210
18.5.5 Quick stop via control word 210
18.6 Speed search 210

18.6.1 Extension of the speed search ... 211
18.6.2 Speed search in ASCL mode ... 212
18.7 Ramp stop ... 212
18.7.1 Current-dependent ramp stop ... 213
18.7.2 DC link voltage-dependent ramp stop ... 213
18.7.3 Ramp stop dependent on a digital input ... 213
18.8 Current limit constant run (stall function) ... 213
18.9 Electronic motor protection for G6L (asynchronous motors) ... 216
18.10 Motor protection function for G6P (synchronous motors) ... 218
18.11 Power-off function ... 220
18.12 GTR7-control ... 226
18.12.1 Activation via digital input ... 226
18.12.2 Adjustment of the activation threshold ... 227
18.12.3 Activation conditions ... 227
18.12.4 Electrical work via braking transistor ... 228
18.13 Motor stall detection ... 228
18.14 Testing the safety function STO ... 229
18.14.1 On-off-on test with simultaneous rotation setting ... 229
18.14.2 On-off-on test with delayed rotation setting ... 229
18.15 special functions ... 230
18.15.1 Flow control ... 232
18.15.2 Fan control ... 234

19. Parameter Sets ... 235

19.1 Parameterisation with COMBIVIS 6 by sub indices (according DS301) ... 235
19.2 Not set-programmable parameters ... 235
19.3 Security parameters ... 235
19.4 System parameters ... 236
19.5 Indirect and direct set-addressing ... 236
19.6 Pointer parameter ... 236
19.7 Copying of parameter sets / load factory setting (Fr01, Fr09) ... 236
19.8 Parameter set selection ... 237
19.8.1 Input-coded set selection ... 238
19.8.2 Binary-coded set selection ... 240
19.8.3 Set change mode modulation on (Fr12) ... 241
19.9 Locking of parameter sets ... 241
19.10 Set activation / deactivation delay (Fr05, Fr06) ... 242

20. Special Functions ... 243

20.1 DC braking ... 243
20.1.1 DC braking in v/f mode ... 245
20.1.2 DC braking in speed-controlled operation without feedback (ASCL) ... 245
20.2 Energy saving function ... 246

20.3 Motorpoti function ... 248

20.4 Timer / counter programming ... 250

20.5 Brake control ... 253

20.5.1 Mode brake control ... 253

20.5.2 Monitoring of the brake control ... 254

20.5.3 Sequence of the brake control ... 254

20.5.4 Brake control in vector controlled operation (for ASCL and SCL) ... 256

20.5.5 Brake control in v/f-characteristic controlled operation ... 258

20.6 Sweep generator ... 259

20.7 Diameter correction ... 261

20.8 Analog setting of parameter values ... 262

20.9 Technology control ... 263

20.9.1 The PID controller ... 263

20.9.2 PID set value ... 266

20.9.3 PID actual value ... 267

20.9.4 Application examples ... 268

20.10 Positioning function in open-loop (v/f) mode ... 271

21. Define CP-Parameters ... 272

21.1 Overview ... 272

21.2 Assignment of CP-Parameters ... 273

21.3 Create CP-Parameter menu ... 274

21.4 Display norm ... 275

21.5 Variable norm for CP-Parameters ... 277

22. Error Diagnosis ... 280

22.1 Troubleshooting ... 280

22.1.1 General ... 280

22.1.2 Error messages and their cause ... 280

23. Fieldbus ... 286

23.1 Available hardware ... 286

23.2 Bus parameters ... 286

23.2.1 Inverter address (Sy06) ... 286

23.2.2 Baud rate int. bus (Sy11) ... 286

23.2.3 Watchdog time (Pn06) ... 286

23.2.4 Response to error watchdog (Pn05) ... 286

23.2.5 Watchdog time internal bus (Sy09) ... 287

23.2.6 Auto store (Ud05), auto store state (Ud04) ... 287

23.2.7 Status and control word ... 288

23.2.8 Speed setting via bus ... 291

23.3 Description of the DSP402 parameters ... 292

23.3.1 Description of the state machine ... 292
23.3.2 Device Control mode ... 294
23.3.3 Velocity mode ... 297

24. Parameter Overview ... 300

24.1 Parameter ... 300
24.1.1 Parameter groups ... 300
24.1.2 Parameter listing ... 301

25. Annex ... 314

25.1 UL Marking ... 314
25.2 Index ... 315

2. Preface

2.1 General

First we would like to welcome you as a customer of the company Karl E. Brinkmann GmbH and congratulation to the purchase of this product. You have decided for a product on highest technical level.
The described hard- and software are developments of the Karl E. Brinkmann GmbH. The enclosed documents correspond to conditions valid at printing. Misprint, mistakes and technical changes reserved.
The instruction manual must be made available to the user. Prior to performing any work on the unit the user must familiarize himself with the unit. This especially applies to the knowledge and observance of the following safety and warning indications. The used pictograms have following significance:

	Danger Warning Caution	Is used when the life or health of the user is in danger or considerable damage to property can occur.

	Attention observe at beachten	Is used when a measure is necessary for safe and disturbance-free operation.

	Information Aid Tip	Is used, if a measure simplifies the handling or operation of the unit.

2.2 Safety Instructions

	Observe safety and operating instructions	Precondition for all further steps is the knowledge and observance of the safety, EMC and operating instructions (Part 1 „Before beginning" 0000NEB-0000“). This is provided accompanied by the device or by the download site of www.keb.de.

Non-observance of the safety and operating instructions leads to the loss of any liability claims. The warnings and safety instructions in this manual work only supplementary. This list is not exhaustive.
The respective control circuit instruction manual is available at www.keb.de for more information.

2.3 Validity and liability

The information contained in the technical documentation, as well as any user-specific advice in spoken and written and through tests, are made to best of our knowledge and information about the application. However, they are considered for information only without responsibility. This also applies to any violation of industrial property rights of a third-party.
Selection of our units in view of their suitability for the intended use must be done generally by the user.
Tests can only be done by the machine manufacturer in combination with the application. They must be repeated, even if only parts of hardware, software or the unit adjustment are modified.

The suspension of liability is also valid especially for operation interruption damages, loss of profit, data loss or other damages. This is also valid, if we referred first to the possibility of such damages.
If individual regulations should be futile, not effective or impracticable, then the effectivity of all other regulations or agreements is not affected by this.

2.4 Copyright

The customer may use the instruction manual as well as further documents or parts from it for internal purposes. Copyrights are with KEB and remain valid in its entirety. All rights reserved.
KEB®, COMBIVERT®, COMBICONTROL® and COMBIVIS® are registered trademarks of Karl E. Brinkmann GmbH.

Other wordmarks or/and logos are trademarks (™) or registered trademarks (®) of their respective owners and are listed in the footnote on the first occurrence.
When creating our documents we pay attention with the utmost care to the rights of third parties. Should we have not marked a trademark or breach a copyright, please inform us in order to have the possibility of remedy.

2.5 Specified application

The COMBIVERT G6 serves exclusively for the control and regulation of three-phase motors. The operation of other electric consumers is prohibited and can lead to the destruction of the unit. Inverter are components designed for inclusion in electrical installations or machinery.
The used semiconductors and components of KEB are developed and dimensioned for the use in industrial products. If the KEB COMBIVERT F5 is used in machines, which work under exceptional conditions or if essential functions, life-supporting measures or an extraordinary safety step must be fulfilled, the necessary reliability and security must be ensured by the machine builder. The operation of our products outside the indicated limit values of the technical data leads to the loss of any liability claims.

2.6 Product description

The product family COMBIVERT G6 has been developed for the universal use at open-loop three-phase drives. The COMBIVERT G6 can be operated open-loop or encoderless speed or torque-controlled. The units are equipped with an integrated EMC filter according to class C1 and C2. Caused by low leakage currents of the filter to ground, the COMBIVERT G6 is well qualified for the use with FI protective switches I <30mA.

	An instruction manual with general safety instructions and EMC-compatible wiring is available at www.keb.de.

2.7 Type code

xx G6 X X X-X X X X

Cooling (not valid for customer-/special version)	
0	Air-cooling (housing C, E); air-cooling/flat rear (housing A, B)
1	Flat rear

Control/keyboard/display (not valid for customer-/special version)		
A	G6L-G	Open-loop without keyboard/display
B	G6L-G	Open-loop with keyboard/display
2	G6P-S	SCL* without keyboard/display
3	G6P-S	SCL with keyboard/display
4	G6L-M	ASCL** without keyboard/display
5	G6L-M	ASCL with keyboard/display

Switching frequency; short time current limit; overcurrent cut-off (not valid at customer/special version)			
1	4 kHz	125 %	150 %
2	8 kHz	125 %	150 %
5	4 kHz	150 %	180 %
6	8 kHz	150 %	180 %
9	4 kHz	180 %	216 %
A	8 kHz	180 %	216 %

Voltage, connection type (not valid for customer-/special version)							
0	1-phase	230 V	AC/DC	3	3-phase	400 V	AC/DC
1	3-phase	230 V	AC/DC	5		400 V	DC
2	1/3-phase	230 V	AC/DC	6	1-phase	230 V	AC
A-Z	Customer-/special version (firmware, hardware and download)						

Housing type A, B, C, E

Variants					
0	without filter, no braking transistor, without safety function STO	A	like 0 with STO	H	like A with f=0Hz
1	without filter, with braking transistor, without safety function STO	B	like 1 with STO	I	like B with f=0Hz
2	internal filter; without braking transistor, without safety function STO	C	like 2 with STO	K	like C with f=0Hz
3	internal filter, with braking transistor, without safety function STO	D	like 3 with STO	L	like D with f=0Hz

Control type	
C	Analog/digital (standard)
D	CAN® [1]
E	IO-Link® [2]

continued on the next page

xx	G6	X	X	X-X	X	X	X

F	EtherCAT® [3]
H	reserved
I	VARAN

G6 unit type
Inverter size

*

[1] CANopen® is registered trademark of CAN in AUTOMATION - International Users and Manufacturers Group e.V.

[2] IO-LINK® is registered trademark of PROFIBUS user organisation e.V.

[3] EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany

* SCL = Sensorless Closed Loop

** ASCL = Asynchronous Sensorless Closed Loop

3. Hardware

3.1 Overview of the control unit interfaces

No.	Name	Description
1	X4A	Diagnosis interface
2	X2B	Safety function STO STO (optional)
3	X2A	Control terminal block
4	LED1	Inverter state LED
5	-	Display/keyboard (optional)
6	X4B	RJ45 terminals (optional)
7	X4C	

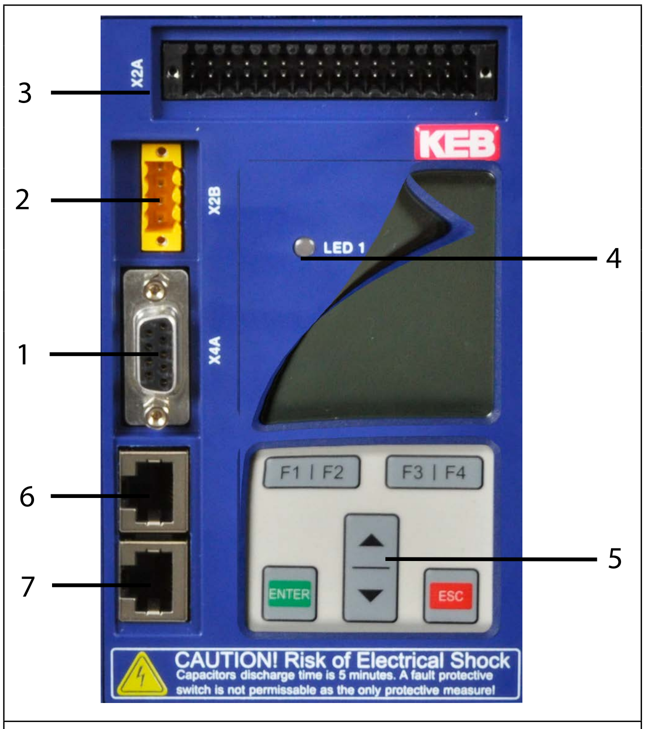


Figure 3.1 Sample image

The following controls are available for the KEB COMBIVERT G6:

Control type	
•	Standard
•	CANopen
•	IO-Link
•	EtherCAT
•	VARAN

In this chapter there are not any more information on the single controls. The respective control circuit instruction manual is available at www.keb.de for more information.

4. Operation

The following chapter describes the fundamentals of the software structure.

The operation of the LC display is described in the respective programming manual of the control.

4.1 Fundamentals

The G6 frequency inverter includes the following operating modes:

Display mode of the control board	
Customer mode	**Application mode**
- is a list of parameters (CP-Parameter), freely definable, which are necessary or important for the end user - supplied with a parameter list defined by KEB - is generated by the application parameters	- all parameters, parameter groups (exception:CP-parameter) and parameter sets can be selected and, if necessary, changed - usually it is activated only for the adaption to the application

4.2 Password structure

The KEB COMBIVERT G6 is provided with extensive password protection. The different passwords are used to

- change the display modes

4.2.1 Passwords and password levels

By selecting one of the following passwords you can switch to the respective password level:

Password level	password	Description
CP - read only	100	Only the customer parameter group is visible, except for CP00 all parameters are in read-only state
CP - on	200	Only the customer parameter group is visible. All parameters can be changed.
Application	440	All application, operator and CP-Parameters are visible and can be changed.

The passwords are only valid for the display. These passwords are irrelevant in COMBIVIS, since the inverter is not in CP mode.

The password input is dependent on the current operating mode. The password in parameter CP00 must be changed if the inverter is in the CP mode. The password in parameter Ud01 must be changed if the inverter is in the application mode.

5. Selection of Operating Mode

This instruction manual is valid for the following software conditions:

Software type	Control type Control type (adjustment in Ud02)	Description
		Standard software for the operation:
G6L-G V2.1.5.x	0: G6L-G / 400Hz 1: G6L-G / 800Hz	- of asynchronous motors with v/f characteristic control
		ASCL software for the operation:
G6L -M V2.1.5.x	0: G6L-G / 400Hz 1: G6L-G / 800Hz	- of asynchronous motors with v/f characteristic control
	4: G6L-M / 4000rpm 5: G6L-M / 8000rpm 6: G6L-M / 16000rpm 7: G6L-M / 32000rpm	- of asynchronous motors with vector control
		SCL software for the operation:
G6P-S V2.1.3.x	0: G6P-G / 400Hz	- of asynchronous motors with v/f characteristic control
	8: G6P-S / 4000rpm 9: G6P-S / 8000rpm 10: G6P-S / 16000rpm 11: G6P-S / 32000rpm	- of synchronous motors with vector control

Some parameters (e.g. set speed, speed limits, etc.) are not correct displayed if a download list is downloaded to an inverter with different control type, or if the COMBIVIS Config-File is used for another control type. COMBIVIS recognizes the use of inappropriate lists and select the correct config file automatically. Unintended settings and wrong displays can occur if the warning messages are ignored.

Products made for export are limited to an output frequency of 599Hz. Ramps and setpoint limits are calculated to the adjusted value in parameter Ud02 (e.g. 800Hz).

The standardisation of some parameters is depending on the speed range of the control type. The following parameters are affected.

Software type	Control type (adjustment in Ud02)	Speed- / frequency range	Resolution	Parameter
G6L-G	0: G6L-G 1: G6L-G	400 Hz 800 Hz	0.0125 Hz 0.025 Hz	ru01, ru02, ru07, ru10 oP03, oP06, oP07, oP10, oP11, oP14, oP15, oP21, oP22, oP23, oP40, oP41, oP65, oP66, oP67, oP68 Pn32, Pn37, Pn41, Pn48
G6L-M / G6P-S	4: G6L-M / 8: G6P-S 5: G6L-M / 9: G6P-S 6: G6L-M / 10: G6P-S 7: G6L-M / 11: G6P-S	4000 rpm 8000 rpm 16000 rpm 32000 rpm	0.125 rpm 0.25 rpm 0.5 rpm 1 rpm	ru01, ru02, ru07, ru10, ru79 oP03, oP06, oP07, oP10, oP11, oP14, oP15, oP21, oP22, oP23, oP40, oP41, oP65, oP66, oP67, oP68 Pn32, Pn37, Pn41, Pn48 dS21
	4: G6L-M / 8: G6P-S 5: G6L-M / 9: G6P-S 6: G6L-M / 10: G6P-S 7: G6L-M / 11: G6P-S	4000 rpm 8000 rpm 16000 rpm 32000 rpm	0.0125 Hz 0.025 Hz 0.05 Hz 0.1 Hz	ru03 uF00, uF02

5.1 Reference speed / reference frequency

Some parameters (e.g. ramp adjustments) have reference values, which are depending on the selected speed range (4000, 8000, 16000, 32000 rpm).

Speed range / frequency range	Reference value	Parameter
400 Hz	100 Hz	amongst others Pn21, Pn60 oP28 .. oP31, oP46 ... oP48 dr49 dS22
800 Hz	200 Hz	
4000 rpm	1000 rpm	
8000 rpm	2000 rpm	
16000 rpm	4000 rpm	
32000 rpm	8000 rpm	

The description of single parameter adjustments provides (unless otherwise mentioned) a speed range of 4000 rpm (Ud02 = 4 or 8).

6. Start-Up

But because of the complex application possibilities we must restrict ourselves to explaining the start-up of standard applications.

6.1 Preparatory measures

6.1.1 After unpacking the goods

After unpacking the goods and checking them for complete delivery following measures are to be carried out:

Visual control for transport damage:
Should any external damages to the KEB COMBIVERT be visible get in tough with your forwarding agent and return the unit with a corresponding report to KEB.

Check the voltage class:
Absolute check before assembly whether the supply voltage of the KEB COMBIVERT matches the application.

6.1.2 Installation and connection

A manual with installation and connecting-up instructions is available at www.keb.de.

6.1.3 Checklist prior to start-up

Before switching on the inverter go through the following checklist:

- Is the inverter firmly screwed in the control cabinet?
- Is there enough space to ensure sufficient air circulation?
- Are mains and motor cables as well as the control cables installed separately from each other?
- Are the inverters connected to the correct supply voltage?
- Are all mass and earthing cables attached and well contacted?
- Ensure that mains and motor cables are not interchanged as that will lead to the destruction of the inverter!
- Is the motor connected in phase?
- Check tacho, initiator and encoder for firm attachment and correct connection!
- Check, whether all power and control cables are firmly in place!
- Remove any tools from the control cabinet!
- Attach all covers and protective caps to ensure that all live parts are secured against direct contact.
- When using measuring instruments or computers an isolating transformer should be used, if not, make sure that the equipotential bonding between the supply lines is guaranteed!
- Open the control release of the inverter to avoid the unintended starting of the machine.

6.2 Initial Start-up

After all preparatory measures have been carried out and checked, the KEB COMBIVERT G6 can be switched on.

The control release ST (X2A.6) must be deactivated when switching on the first time, since the frequency inverter is not custom-specific parameterized.

The following descriptions suppose that the inverter is on the password level "application mode" (Ud01 = application mode). The selection of the password level is described in the manual chapter 4. The start-up should be executed with COMBIVIS in order to have a short start-up time.

Attention: The start-up instruction manual can only give a short overview of the parameter adjustments which are mandatory necessary to start-up the motor.
Thus it represents a check list and not a complete parameter description.
The appropriate chapters of the application manual must be read carefully for exact information about the parameters, additionally points to consider and application-specific adjustments!

The wiring of the motor must be checked before start-up:

In-phase connection (inverter terminals U, V, W must be connected at the motor terminal board with the appropriate contacts):
If the wiring is correct the following direction of rotation occurs at setting "forward rotation":

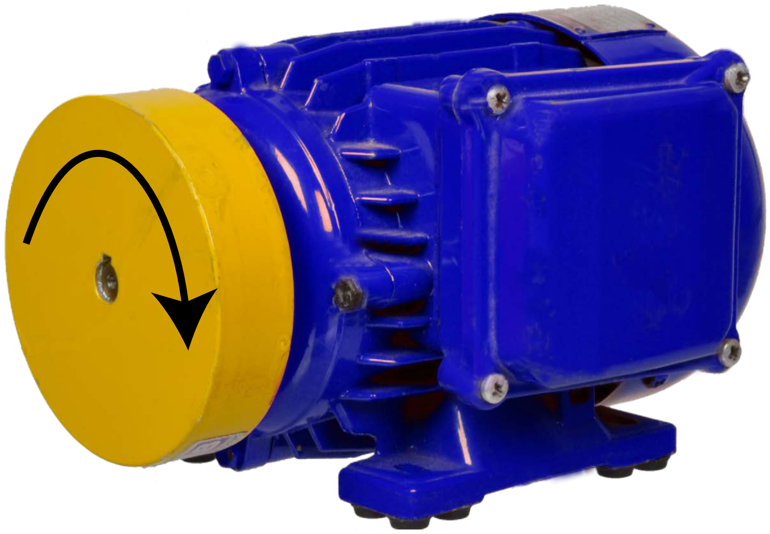


Figure 6.1 Sample illustration of an asynchronous motor

6.2.1 Start-up of an asynchronous motor

The following chapters describe the start-up of an asynchronous motor in the two available modes:

- v/f characteristic open-loop operation (G6L-G or G6P-G)
- speed-controlled operation without encoder feedback (ASCL / G6L-M)

6.2.1.1 v/f characteristic operation

1. Open control release
deactivate terminal X2A.6 - inverter state ru00 = „0: no control release“

2. Selection of the speed range
The required speed range / frequency range (e.g.: 0: 400Hz) is selected. - Ud02 control type = 0...1 All data for the adjustment of the controller type (e.g. resolution of the speed, etc.) see chapter 5.1

⚠	Changing the control type releases loading of the default parameters! The speed range should be selected at least 10% higher than the highest setpoint speed in the application.

3. Loading the default parameters
Loading the default parameters (KEB factory setting) by - Fr01 copy parameter set = - 4

⚠	Pre-adjustments (e.g. function of the digital inputs) disappear.

4. Selection of the controller configuration
adjust V/f characteristic operation - cS00 controller configuration = 0: off (default v/f – characteristic operation) Motor data are not necessary for standard v/f - characteristic operation. The following parameters must be examined if SMM (sensorless motor management for speed stabilization during load) should not be used: Frequency when the highest voltage is output: - uF00 rated frequency (typically rated motor frequency) Voltage in [%], which is output at 0Hz: - uF01 boost Parameter uF09 must be adjusted if the motor input voltage does not agree with the mains voltage. - uF09 voltage stabilisation

ℹ	Points 5-8 are for the SMM mode. If standard v/f characteristic operation is used, you can proceed with step 9.

5. Input of the motor data
Values dr00 to dr05 must be taken from the motor name plate. The value for dr06 can be identified automatically (see point 6). - dr00 DASM rated current - dr01 DASM rated speed - dr02 DASM rated voltage - dr04 DASM cos phi - dr05 DASM rated frequency - dr06 DASM stator resistance

6. Measurement of the stator resistance
The stator resistance dr06 can be determined automatically by the KEB COMBIVERT. Inverter must be in status „70: standstill (modulation off)“. This can be achieved e.g. by setting oP02 to value 0. Then start the measurement with the input of => dr06 = 250000: on. Open control release (X2A.6) after measurement

7. Calculation of motor-dependent data
Activation of SMM, as well as the adaption of the v/f characteristic is made by the input of: - Fr10 load mot. dependent parameter = 3

8. Adjust speed controller
The speed controller must be adjusted via cS06 and cS09 to the application.

9. Enter application specific data
e.g. limits (speed limits, torque limits etc.) acceleration / deceleration ramps, function of the digital inputs/ outputs, type of speed setpoint setting etc.

i	Proper data for the adaption of the inverter to the respective application can be find in the corresponding chapters.

10. Test run
Test run, in order to check whether the drive runs stable in all speed ranges and under all load conditions and if a sufficient safety distance to the current- and load limits is available etc.

6.2.1.2 Start-up G6L-M (ASCL/ vector controlled with motor model)

⚠	The motor temperature sensor must be connected.

1. Open control release
deactivate terminal X2A.6 - inverter state ru00 = „0: no control release“

2. Selection of the speed range
The required speed range is selected in control type Ud02 (e.g.: 0..+/- 4000 rpm). - The required speed range is selected in control type Ud02 control type = 4…7 The speed range should be selected at least 10% higher than the highest setpoint speed in the application.

⚠	Changing the control type releases loading of the default parameters! All data for the adjustment of the control type (e.g. resolution of the speed, etc.) see chapter 5.1.

3. Loading the default parameters
If the control type Ud02 was not changed, loading of the default parameters (KEB factory setting) can be released by setting - Fr01 copy parameter set = 4

⚠	Pre-adjustments (e.g. function of the digital inputs) disappear

4. Selection of the controller configuration
adjust speed-controlled operation - cS00 controller configuration = 4 (control mode = speed control)

5. Select source of the speed feedback
Motor speed feedback not available. - cS01 actual source = 2: calculated actual value

6. Input of the motor data
Values dr00 to dr05 must be taken from the motor name plate. The values for dr06 to dr08 (if available) can be taken from the motor data sheet or automatically identified (see point 10). The DASM head-inductance (dr10) should always be identified, because it is dependent on the selected magnetizing current. - dr00 DASM rated current - dr01 DASM rated speed - dr02 DASM rated voltage - dr03 DASM rated power - dr04 DASM cos phi - dr05 DASM rated frequency - dr06 DASM stator resistance - dr07 DASM leakage inductance - dr08 DASM rotor resistance - dr10 DASM head inductance

⚠	The interconnection of the motor must be considered at acceptance of the values of the motor data sheet. The data sheet contains mostly phase values. The phase-phase values must be entered in parameters dr06...dr10.

ℹ	If no equivalent circuit data are known the default values can remain in dr06 to dr10 up to the identification

7. Parameterize flux-/rotor adaptation mode
The operation with motor model is activated in parameter dS04 flux/rotor adaptation mode. - dS04 = 249 Further necessary adjustments for the operation with motor model are additionally made by this parameter: • Maximum voltage controller active, maximum voltage 100% (no overmodulation) • Flux controller and magnetization build-up active before start-up

⚠	Further adjustments must be done in connection with the maximum voltage controller: Parameterisation of the controller, activating of the active current limitation in the field weakening range (see chapter 14).

ℹ	Further information about the flux controller and flux build-up see chapter 11 Adjustments of the asynchronous motor.

8. Calculation of motor-dependent data
Even if the motor data dr06 to dr10 are unknown, the motor-dependent data (e.g. dr18 field weak. speed) must be calculated once at this point. - Fr10 motor adaption = 1: uF09

9. Identification of the equivalent circuit data

The equivalent circuit data dr06...dr10 can be determined automatically by the KEB COMBIVERT. The following must be considered:

- The motor must be in no-load operation for identification of the main inductance. By default, the motor rotates with dr17: "Speed for maximum torque". The speed limits (oP-Parameter see chapter 10.5) must be programmed accordingly if this is not permissible.
- The direction of rotation is forward, the acceleration time is preset by dr49: „Lh.ident. acc/dec time“

- The speeed controller must be parameterized for acceleration (dynamics not necessary => select small value for cS09: KI speed)

- The brake control mode must be activated
(corresponding to KEB factory setting)

- After successful measurement ru00 = 127 (drive data calculated/Cddr) is displayed.
The identification is started with

- dr48 = 8:complete auto identification! with rotation!

Close control release (X2A.6) for starting the identification and open it after the measurement.

Depending on the used motor the identification takes some minutes. Noises in the motor can occur caused by high frequency test signals. The sequence of the identification can be tracked in parameter dr62 dr.„state motor ident.".
Since the drive is not optimally parameterized, a flat acceleration ramp (dr49) should be selected for the identification to avoid overload of the motor.
Note: If the measurement is interrupted with an error, ru00 = 60 (Error! drive data / E.Cdd) is displayed. Read chapter 14.2 for further data of the identification.

10. Adjustment of specific data

- dS02 current decoupling = 1: on
- uF15 hardware current lim. mode = 0: off
- uF18 deadtime compensation mode = 3: automatically

11. Enter application specific data

Application specifc data are e.g.

- limit values (speec limits, torque limits etc.)

  - oP parameter (chapter 10 Setpoint limits)
  - cS parameter (chapter 14 Torque display and limitation)

•acceleration- / deceleration ramps

  - oP parameter (chapter 10 Ramp generator)

- Function of the digital in-/ outputs

  - di parameter (chapter 9 digital in- and outputs)

- type of speed setpoint setting

  - oP parameter (chapter 10) etc.

Proper data for the adaption of the inverter to the respective application can be find in the corresponding chapters

12. Adjust speed controller

The speed controller parameters can be calculated by the inverter for applications with constant inertia and rigidly coupled load (see chapter 17).

The speed controller must be manually adapted if this adjustment is not workable for the application or if the result is nonsatisfying. The maximum voltage controller must be parameterized if the field weakening range is used.

Current and flux controller are automatically adjusted during identification.

13. Test run

Check whether the drive operates stable in all speed ranges and under all load conditions. In some cases operation with ASCL at low speed is critical. If the behaviour of the drive (e.g. when reversing or stopping) is not optimal, additional measures must be executed (described in chapter 11 "operation at low speed").

If error messages occur during the start-up phase, read chapter 22 „Fault diagnosis“.

6.2.2 Start-up of a synchronous motor

The following chapter describes the initial start-up of a speed-controlled synchronous motor without encoder feedback (G6P-S).

6.2.2.1 Start-up G6P-S (SCL)

1. Open control release

deactivate terminal X2A.6
- ru00 inverter state = nop/ „no control release“

2. Selection of the speed range

The usable speed range is set with Ud02: - Ud02 control type = 8…11

See chapter 5.1 for all data of the adjustment

3. Loading the default parameters

- Fr01 copy parameter set = - 4

4. speed control configuration

- cS00 control mode = 4: speed control

5. Select source of the speed feedback

- cS01 actual source = 2 : calculated actual value

6. Input of the motor rating plate data

- dr23 DSM rated current
- dr24 DSM rated speed
- dr25 DSM rated frequency
- dr26 DSM EMF voltage constant [Vpk x 1000rpm] *
- dr27 DSM rated torque
- dr28 DSM current for zero speed
- dr30 DSM stator resistance *
- dr31 DSM inductance *

* dr30 and dr31 must be entered as phase-phase value (R_{UV}, L_{UV}). Equivalent circuit data must be entered according to the data sheet OR the data must be identified automatically like step 8. Parameter dr26 must be programmed as peak value of the phase-phase voltage U_{UV}. Equivalent circuit data must be entered according to the data sheet OR the data must be identified automatically like step 8.

7. Calculation of motor-dependent data

- Fr10 motor adaption = 1: uF09

8. Identification of the equivalent circuit data

ATTENTION: Requires motor revolution in no-load operation
- dr48 motor identification = 8: complete auto-identification, close control release (X2A.6)
- After successful identification ru00 = 127 : cddr/ „drive data calculated“ is displayed.

Open control release again (X2A.6). Further data see chapter 12.

i	Depending on the used motor the identification takes some minutes. Noises in the motor can occur caused by high frequency test signals.

9. Adjustment of specific data

- dS02 current decoupling = 1: on
- uF15 hardware current lim. mode = 0: off
- uF18 deadtime compensation mode = 3: automatically overload characteristic of the motor:
- dr33 DSM max. torque (otherwise 5 x dr27 rated torque)

10. Optimize speed controller

See chapter 13 for all data of the adjustment

The start-up is successful completed if no error messages have arisen.
A detailed parameter description and their effects are described in chapter 12.

!	Special adjustments are required for the operation of special or high-frequency motors. Please contact KEB for this case.

7. Functions

7.1 Operating and appliance data

The parameter groups „ru“, „In“ and „SY“ are described in this chapter. They serve for the operational monitoring, error analysis and evaluation as well as for the unit identification.

7.1.1 Overview of the ru-Parameters

The ru- (run) parameter group represents the multimeter of the inverter. Here speeds, currents, voltages etc. are displayed, with those a statement about the operating condition of the inverter can be made. Especially during start-up or trouble shooting on a unit, this can turn out to be a great aid. Following parameters are available:

ru00	inverter state	ru41	modulation on counter
ru01	set value display	ru42	modulation grade
ru02	ramp output display	ru43	timer 1 display
ru03	actual frequency display	ru44	timer 2 display
ru05	encoder 2 frequency	ru45	act. switching frequency
ru06	actual value calculated	ru46	motor temperature
ru07	actual value display	ru47	act. torque limit mot.
ru10	encoder 2 speed	ru48	act. torque limit gen.
ru11	set torque display	ru49	actual reference torque
ru12	actual torque display	ru52	ext. PID out display
ru13	actual utilization	ru53	AUX display
ru14	peak utilization	ru68	rated DC voltage
ru15	apparent current	ru73	set torque in percent
ru16	peak apparent current	ru74	act. torque in percent
ru17	active current	ru78	act. val.display in perc.
ru18	actual DC voltage	ru79	abs. speed value (EMK)
ru19	peak DC voltage	ru80	digital output state
ru20	output voltage	ru81	active power
ru21	input terminal state	ru82	ramp value disp. high-res.
ru22	internal input state	ru83	act. value display high-res.
ru23	output condition state	ru87	magnetising current
ru24	State of output flags	ru89	act. src. speed
ru25	output terminal state	ru90	max. torque in percent
ru26	active parameter set	ru91	energy over gtr7
ru27	AN1 pre amplifier disp.	ru92	input power
ru28	AN1 post amplifier display	ru93	power loss
ru29	AN2 pre amplifier disp.	ru96	active sub index
ru30	AN2 post ampl. disp.	ru97	internel temperature
ru33	ANOUT1 pre ampl. disp.		
ru34	ANOUT1 post ampl. disp.		
ru35	ANOUT2 pre ampl. disp.		
ru36	ANOUT2 post ampl. disp.		
ru37	motorpoti actual value		
ru38	Power module temperature		
ru39	Overload integrator (E.OL)		

7.1.2 Overview of the In-Parameters

The In- (Information) parameter group contains data and information on the identification of the hardware and software as well as on the type and number of the errors that occurred. Following parameters are available:

In00	inverter type
In01	rated inverter current
In02	max. output frequency
In03	max. carrier frequency
In04	rated switching frequency
In06	software version
In07	software date
In09	serial no.
In10	serial no. (date)
In11	serial no. (count)
In12	serial no. (AB-no. high)
In13	serial no. (AB-no. low)
In14	customer no. high
In15	customer no. low
In16	QS no.
In17	temp.- mode
In18	hardware current inverter
In19	rated inverter act. power
In22	user parameter 1
In23	user parameter 2
In24	last error
In25	Error Assistance
In26	E.OC error counter
In27	E.OL error counter
In28	E.OP error counter
In29	E.OH error counter
In30	E.OHI error counter
In39	deadtime selector
In40	Dead time value
In41	serial no. 2 (date)
In42	serial no. 2 (count)
In43	QS no. 2

7.1.3 Overview of the Sy-Parameters

The Sy- (system) parameter group contains system specific parameters. Following parameters are available:

Sy02	inverter identifier
Sy03	power unit code
Sy06	inverter address
Sy09	watchdog time int. bus
Sy11	baud rate int. bus
Sy32	scope timer
Sy41	control word (high)
Sy42	status word (high)
Sy43	control word (long)
Sy44	status word (long)
Sy50	control word (low)
Sy51	status word (low)
Sy52	set speed value
Sy53	actual speed value
Sy56	start display address

7.1.4 Explanation to parameter description

The ru-, In-, Sy parameters are described in detail in this chapter.

Legend:

Addr.	=	Address				
PG	=	set-programmable	→	+	=	set-programmable
				-	=	not set-programmable
E	=	ENTER-Parameter	→	+	=	yes
				-	=	no
R	=	Rights	→	ro	=	read only
				rw	=	read / write
1)	=	Resolution and value range depending on the control type (Ud02)				
Min. value	=	Minimum value				
Max. value	=	Maximum value				
Res.	=	Resolution				
Default	=	Default value				
[?]	=	Unit				

7.1.5 Description of the ru-Parameters

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru00	inverter state	2200h	ro	-	-	0	255	1	-	0

The inverter status shows the current operating condition of the inverter. In the case of an error the current error message is displayed, even if the display has already been reset with ENTER (Error-LED on the operator is still blinking). For more information about status messages as well as its cause and removal refer to chapter 18.1 „Errors and warning messages“.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru01	Set value display 1)	2201h	ro	-	-	-4000	4000	0.125	rpm	0

Display of the actual set speed. For control reasons the set speed is displayed even if control release or direction of rotation are not switched. If no direction of rotation is set, the set speed for clockwise rotation (forward) is displayed.

A counter-clockwise rotating field (reverse) is represented by a negative sign. Precondition is the phase-correct connection of the motor.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru02	Display ramp output 1)	2202h	ro	-	-	-4000	4000	0.125	rpm	0

The displayed speed corresponds to the synchronous speed output at the ramp output. The output is displayed like ru01.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru03	actual frequency display 1)	2203h	ro	-	-	-400	400	0.0125	Hz	0

The displayed actual frequency corresponds to the rotary field frequency output at the inverter output. The output is displayed like ru01.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru05	encoder 2 frequency	2205h	ro	-	-	-400	400	0.0125	Hz	0

The displayed value corresponds to the measured frequency of encoder 2. Channel 2 is an initiator input and can not be used as speed feedback or for the motor model. The initiator input channel 2 is only available for inverters with CAN control board.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru06	actual value calculated	2206h	ro	-	-	-400	400	0.0125	Hz	0

Display of the calculated rotor speed in act. speed resolution

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru07	actual value display 1)	2207h	ro	-	-	-4000	4000	0.125	rpm	0

The actual speed is calculated or encoder channel 2 is displayed depending on the adjusted actual source (cS01).

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru10	encoder 2 speed[1)]	2210h	ro	-	-	-4000	4000	0.125	rpm	0
The displayed value corresponds to the measured actual speed of encoder 2. Channel 2 is an initiator input and can not be used as speed feedback or for the motor model. The initiator input channel 2 is only available for inverters with CAN control board.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru11	set torque display	220Bh	ro	-	-	-32000	32000	0.01	Nm	0
The indicated value corresponds to the current set torque.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru12	actual torque display	220Ch	ro	-	-	-32000	32000	0.01	Nm	0
The indicated value corresponds to the actual torque.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru13	actual utilization	220Dh	ro	-	-	0	255	1	%	0
Display of the current utilization referred to the rated current of the inverter. Only positive values are indicated, thus it is not possible to differentiate between a motoric or generatoric operation.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru14	peak utilization	220Eh	rw	-	-	0	255	1	%	0
ru14 permits the detection of short-time peak loads within an operating cycle. To this end the highest occurred value of ru13 is stored in ru14. The peak value memory can be deleted by pressing the keys UP, DOWN or ENTER and via bus by writing any chosen value to the address of ru14. Switching off the inverter also clears the memory.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru15	apparent current	220Fh	ro	-	-	0	6553.5	0.1	A	0
Display of the actual apparent current.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru16	peak apparent current	2210h	rw	-	-	0	6553.5	0.1	A	0
ru16 permits the detection of short-time peak currents within an operating cycle. To this end the highest occurred value of ru15 is stored in ru16. The peak value memory can be deleted by pressing the keys UP, DOWN or ENTER and via bus by writing any chosen value to the address of ru16. The switch off of the inverter also clears the memory.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru17	active current	2211h	ro	-	-	-3276.7	3276.7	0.1	A	0
Display of the torque-forming active current. Negative current corresponds to generatoric operation, positive current corresponds to motoric operation. The more precise the motor data are entered, the more precise is the indication of the active current. The maximum values depend on the size of the inverter.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru18	actual DC voltage	2212h	rw	-	-	0	1500	1	V	0

Display of current DC-link voltage. Typical values:

Normal operation	Overvoltage (E.OP):	Undervoltage (E.UP):
230V class approx. 300...330VDC	approx. 400 VDC	approx. 216 V
400V class approx. 530...620VDC	approx. 840 VDC	approx. 240 V

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru19	peak DC voltage	2213h	ro	-	-	0	1500	1	V	0

ru19 permits the detection of short-time voltage rise within an operating cycle. To this end the highest occurred value of ru18 is stored in ru19. The peak value memory can be deleted by pressing the keys UP, DOWN or ENTER and via bus by writing any chosen value to the address of ru19. The switch off of the inverter also clears the memory.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru20	output voltage	2214h	ro	-	-	0	1167	1	V	0

Display of the current output voltage.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru21	input terminal state	2215h	ro	-	-	0	4095	1	-	0

Display of the digital inputs controlled currently. The logic levels are indicated at the input terminals or at the internal inputs regardless of the following logic operations (see chapt. 9 „Digital in- and outputs“). According to following table a specific decimal value is given out for each digital input. If several inputs are controlled, the sum of the decimal values is indicated.

Bit -No.	Dec.	Input	Terminal
0	1	ST (Prog. input „control release/reset“)	X2A.6
1	2	RST (Prog. input „reset“)	X2A.5
2	4	F (Prog. input „forward“)	X2A.8
3	8	R (Prog. input „reverse“)	X2A.7
4	16	I1 (Prog. input 1)	X2A.10
5	32	I2 (Prog. input 2)	X2A.9
6	64	I3 (Prog. input 3)	X2A.12
7	128	I4 (Prog. input 4)	X2A.11
8	256	IA (internal input A)	no
9	512	IB (internal input B)	no
10	1024	IC (internal input C)	no
11	2048	ID (internal input D)	no

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru22	internal input state	2216h	ro	-	-	0	4095	1	-	0

Display of the digital external and internal inputs set currently. The input is only regarded as set if it is available as effective signal to the further processing (i.e. accepted by strobe, edge-triggering or logic operation). A specific decimal value is output for each digital input according to table like ru21. If several inputs are controlled, the sum of the decimal values is indicated (also see Chapt. 9 „Digital in- and outputs“).

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru23	output condition state	2217h	ro	-	-	0	255	1	-	0

Switching conditions that serve as base for setting the outputs can be selected with parameters do00...do07. This parameter indicates which of the selected switching conditions are met before they are linked or inverted by the programmable logic (also see chapter 9 "Digital inputs and outputs"). According to following table a specific decimal value is given out for the switching conditions. If several of the selected switching conditions are met, the sum of the decimal values is indicated.

Bit -No.	Decimal value	Output
0	1	Condition 0 (do00)
1	2	Condition 1 (do01)
2	4	Condition 2 (do02)
3	8	Condition 3 (do03)
4	16	Condition 4 (do04)
5	32	Condition 5 (do05)
6	64	Condition 6 (do06)
7	128	Condition 7 (do07)

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru24	state of output flags	2218h	ro	-	-	0	255	1	-	0

Display of the output flags after logic step 1. The selected switching conditions are linked in logic step 1 (do08...23) and indicated (see also Chapter 9 „Digital Inputs and Outputs“). According to following table a specific decimal value is given out for any output flags. If several output flags are set, the sum of the decimal values is indicated.

Bit -No.	Decimal value	Output
0	1	Flag 0 (do08...do23)
1	2	Flag 1 (do08...do23)
2	4	Flag 2 (do08...do23)
3	8	Flag 3 (do08...do23)
4	16	Flag 4 (do08...do23)
5	32	Flag 5 (do08...do23)
6	64	Flag 6 (do08...do23)
7	128	Flag 7 (do08...do23)

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru25	output terminal state	2219h	ro	-	-	0	255	1	-	0

Display of the external and internal digital outputs set currently. According to following table a specific decimal value is given out for each digital output. If several outputs are set, the sum of the decimal values is indicated.

Bit -No.	Decimal value	Output	Terminal
0	1	O1 (digital output 1)	X2A.14
1	2	O2 (digital output 2)	X2A.13
2	4	R1 (Relay R1-A, R1-B, R1-C)	X2A 30, 28, 26
3	8	R2 (Relay R2-A, R2-B, R2-C)	X2A 29, 27, 25
4	16	OA (internal output A)	no
5	32	OB (internal output B)	no
6	64	OC (internal output C)	no
7	128	OD (internal output D)	no

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru26	active parameter set	221Ah	ro	-	-	0	7	1	-	0

The KEB COMBIVERT can have access to 8 parameter sets (0-7). Through programming the inverter can change parameter sets autonomously and can thus start different modes of operation. This parameter shows the parameter set, with which the inverter is operating currently. Another parameter set can be edited independently via bus (see also chapter 19 "Parameter sets").

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru27	AN1 pre amplifier disp.	221Bh	ro	-	-	-100	100	0.1	%	0

This parameter indicates the value in percent of the analog signal AN1 on the differential voltage input (terminal X2A.17 / X2A.18) before signal amplification. The indicated value of 0...±100 % corresponds depending on An00: 0...±10 V; 0...±20 mA or 4...20 mA (see also chapter 8 „Analog in- and outputs“)

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru28	AN1 post amplifier display	221Ch	ro	-	-	-400	400	0.1	%	0

This parameter shows the value of the analog signal AN1 in percent after passing the characteristic amplifier. The display range is limited to ±400 % (see also chapt. 8 „Analog in- and outputs“).

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru29	AN2 pre amplifier disp.	221Dh	ro	-	-	-100	100	0.1	%	0

This parameter shows the value in percent of the analog signal AN2 on the differential voltage input (terminal X2A.19 / X2A.20) before the signal amplification. The indicated value of 0...±100 % corresponds depending on An10: 0...±10 V; 0...±20 mA or 4...20 mA (see also chapter 8 „Analog in- and outputs“)

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru30	AN2 post ampl. disp.	221Eh	ro	-	-	-400	400	0.1	%	0
This parameter shows the value of the analog signal AN2 in percent after passing the characteristic amplifier. The display range is limited to ±400 % (see also chapt. 8 „Analog in- and outputs“).										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru33	ANOUT1 pre ampl. disp.	2221h	ro	-	-	-400	400	0.1	%	0
This parameter shows the value of the analog signal ANOUT1 in percent before passing the characteristic amplifier (also see chapter 8 „Analog in- and outputs“)										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru34	ANOUT1 post ampl. disp.	2222h	ro	-	-	-115	115	0.1	%	0
This parameter shows the value of the signal given out on analog output ANOUT1 (terminal X2A.22) in percent. A value of 0...±115% corresponds to an output signal of 0...±11.5V (also see chapt. 8 „Analog in- and outputs“)										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru35	ANOUT2 pre ampl. disp.	2223h	ro	-	-	-400	400	0.1	%	0
This parameter indicates the value of the analog signal ANOUT2 in percent before passing the characteristic amplifier (also see chapter 8 „„Analog in- and outputs“)										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru36	ANOUT2 post ampl. disp.	2224h	ro	-	-	-115	115	0.1	%	0
This parameter indicates the value of the signal given out on analog output ANOUT2 (terminal X2A.24) in percent. A value of 0...±115% corresponds to an output signal of 0...±11.5V (also see chapt. 8 „Analog in- and outputs“)										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru37	motorpoti actual value	2225h	ro	-	-	-100	100	0.01	%	0
The motorpoti-function in the KEB COMBIVERT imitates a mechanical, motor operated potentiometer. The control occurs via 2 prog. inputs („Poti up“ and „Poti down“). The display is limited by oP53/54. The adjustment of the motorpoti is done with parameters oP50...oP59 (also see chapt. 20.3 „Motorpoti function“). By way of the bus the motorpoti can be set to any chosen value between -100...100%. In addition to the inputs the motorpoti can be operated with the keys „UP“ and „DOWN“. Then the rate of change is not constant.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru38	power module temperature	2226h	ro	-	-	-30	127	1	°C	0
ru38 displays the actual temperature at the power module.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru39	OL counter display	2227h	ro	-	-	0	100	1	%	0
In order to prevent "error: overload" due too high load (timely load reduction) the internal count of the OL counter can be made visible with this display. On reaching 100 % the inverter switches off with error "error! overload". The error can be reset only after a cooling time (blinking display „no ERROR overload“).										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru40	power on counter	2228h	ro	-	-	0	65535	1	h	0
The operating hours meter shows the time the inverter was switched on. The indicated value comprises all operating phases. On reaching the maximum value (approx. 7.5 years) the display remains on the maximum value.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru41	modulation on counter	2229h	ro	-	-	0	65535	1	h	0
The modulation hours meter shows the time the inverter was active (power modules controlled). On reaching the maximum value (approx. 7.5 years) the display remains on the maximum value.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru42	modulation grade	222Ah	ro	-	-	0	110	1	%	0
The modulation factor shows the output voltage in percent. 100% correspond to the input voltage (no-load). At a value of > 100 % the inverter works with overmodulation.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru43	timer 1 display	222Bh	rw	-	-	0	655.35	0.01	-	0
The count of the free-programmable timer 1 is indicated. The display is done either in seconds, in hours or in slopes/100 (see LE21). The counter can be adjusted to any chosen value by keyboard or bus. The programming of the counter is done with parameters LE17...LE21 (see also chapter 20.4 „Timer / counter programming“)										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru44	timer 2 display	222Ch	rw	-	-	0	655.35	0.01	-	0
The count of the free-programmable timer 2 is indicated. The display is done either in seconds, in hours or in slopes/100 (see LE26). The counter can be adjusted to any chosen value by keyboard or bus. The programming of the counter is done with parameters LE22...LE26 (see also chapter 20.4 „Timer / counter programming“)										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru45	act. switching frequency	222Dh	ro	-	-	0	4	1	-	0
Indicates the actual switching frequency of the inverter. The displayed values correspond to the following switching frequencies:										

	0 = 2 kHz	1 = 4 kHz	2 = 8 kHz	3 = 12 kHz	4 = 16 kHz	

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru46	motor temperature	222Eh	ro	-	-	0	255	1	°C	0

Indicates the current motor temperature. Precondition for this function is aspecial power circuit. The temperature detection is connected to terminals T1/T2.

Analog values in °C are only issued with a special power unit (not available for all housing types). If the special power unit is not available, only the values from the following table can be issued.

0:	T1/T2 closed
252:	power unit not ready
253, 254:	Cable breakage; short circuit; detection error
255:	T1/T2 open

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru47	act. torque limit mot.	222Fh	ro	-	-	-32000	32000	0.01	Nm	0

This parameter indicates the actual adjusted set torque limit for motor operation.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru48	act. torque limit gen.	2230h	ro	-	-	-32000	32000	0.01	Nm	0

This parameter displays the currently adjusted set torque limit for generatoric operation.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru49	actual ref. torque	2231h	ro	-	-	-32000	32000	0.01	Nm	0

This parameter displays the preadjusted setpoint torque at the input of the torque controller.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru52	ext. PID out display	2234h	ro	-	-	-400	400	0.1	%	0

A universal PI-controller is integrated into the inverter. It can be used externally as well as internally. So that the controller is as independent as possible, the displayed manipulated variable, referring to a +/- signal, is output in percent.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru53	AUX display	2235h	ro	-	-	-400	400	0.1	%	0

The AUX input is adjusted with An30. This parameter shows the value of the analog signal AUX in percent. The display range is limited to ±400 % (see also chapt. 8 „Analog in- and outputs“).

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru68	rated DC voltage	2244h	ro	-	-	0	1500	1	V	0

This parameter displays the rated DC link voltage automatically determined by the inverter. The value is measured at switch-on.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru73	set torque in percent	2249h	ro	-	-	-400	400	0.1	%	0

This parameter displays the adjusted set torque (ru11) in percent at the input referring to the absolute torque reference (cS19).

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru74	actual torque in percent	224Ah	ro	-	-	-400	400	0.1	%	0
This parameter displays the actual torque display (ru12) in percent at the input referring to the absolute torque reference (cS19).										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru78	act. val.display in perc.	224Eh	ro	-	-	-400	400	0.1	%	0
This parameter displays the actual value (ru.07) in percent referring to the max. reference forward (oP.10).										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru79	abs. speed value (EMC)	224Fh	ro	-	-	-4000	4000	0.125	rpm	0
In order to protect the inverter against overvoltage in the field weakening range, an EMC dependent speed should not be exceeded. This calculated value has priority to all other limits and it is displayed in ru79.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru80	digital output state	2250h	ro	-	-	0	255	1	-	0
The digital output signals can be assigned to the hardware outputs with do51 (see also chapter 9 „Digital in- and outputs“). This parameter displays the state of the output signals before the assignment in accordance with the following table. If several outputs are set, the sum of the decimal values is indicated.										

Bit -No.	Dec. value	Output	Terminal
0	1	O1 (transistor output 1)	X2A.14
1	2	O2 (transistor output 2)	X2A.13
2	4	R1 (Relay R1-A, R1-B, R1-C)	X2A.30, 28, 26
3	8	R2 (Relay R2-A, R2-B, R2-C)	X2A.29, 27, 25
4	16	OA (internal output A)	no
5	32	OB (internal output B)	no
6	64	OC (internal output C)	no
7	128	OD (internal output D)	no

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru81	active power	2251h	ro	-	-	-1000	1000	0.01	kW	0
The current active power of the inverter is displayed with parameter ru81. Negative values are displayed during generatoric operation.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru82	ramp value disp. high-res.	2252h	ro	-	-	-2147483647	2147483647	1	-	0
Parameter ru82 displays the value of the ramp output (ru02) in high-resolution (see chapter „Setpoint setting“).										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru83	act. value display high-res.	2253h	ro	-	-	-2147483647	2147483647	1	-	0
Parameter ru.83 displays the actual value (ru.07) in high-resolution (see chapter „Setpoint setting“).										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru87	magnetising current	2257h	ro	-	-	-3276.7	3276.7	0.1	A	0
The magnetizing current is displayed in ru87.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru88	act. src. frequency	2258h	ro	-	-	-400	400	0.0125	Hz	0
Parameter ru88 displays the frequency, which is set in cS01 as the actual value for frequency control.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru89	act. src. speed	2259h	ro	-	-	-32000	32000	1	rpm	0.000
Parameter ru89 displays the speed which is set in cS01 as actual value for speed control.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru90	max. torque in percent	225Ah	ro	-	-	0	400	0.01	%	0
Parameter ru90 displays the actual torque in percent related to the max. torque. The max torque can be related to different parameters (LE27: reference torque, LE28: ref torque mode, act. torque limit ru47 / ru48).										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru91	energy over gtr7	225Bh	rw	np	-	0	99999	1	KWh	0
The energy which is converted over the GTR7 resistor is displayed in parameter ru91. On reaching the maximum value of 99999 kWh the counter is limited to this value.Parameter ru91 is writeable. It is set to its default value by new-initialization										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru92	input power	225Ch	ro	-	-	-1000	1000	0.01	kW	0
The input power is displayed with parameter ru92.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru93	power loss	225Dh	ro	-	-	-1000	1000	0.01	kW	0
The power losses are displayed with parameter ru93.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru96	active sub index	2260h	ro	-	-	1	8	1	-	1
Displays the active subindex.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
ru97	internel temperature	2261h	ro	-	-	-30	127	1	°C	0
Displays the internal inverter temperature.										

7.1.6 Description of the In-Parameters

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
In00	inverter type	2E00h	ro	-	-	0	65535	1	-	0

Bit	Description	Meaning			
0			binary coded, e.g. 00101 for size 05		
1					
2					
3					
4					
5	Voltage class	0	230 V	1	400 V
6	Power phases	0	single phase	1	3-phase
7	free	0			
8	Housing size	000 h	A housing		
9		100 h	B-housing		
10		200 h	C housing		
12		400 h	E housing		
13	Control type	0000 h	SH2 control	C000 h	P control
14		8000 h	K control		
15		E000 h	L control		

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
In01	rated inverter current	2E01h	ro	-	-	LTK	LTK	0.1	A	0

Display of the inverter rated current in A. The value is determined from the power circuit identification (P-ID) and cannot be changed.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
In02	max. output frequency	2E02h	ro	-	-	0	32768	1	Hz	0

Display of the maximum output frequency.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
In03	max. switching frequency	2E03h	ro	-	-	0	4	1	-	0

Display of the maximum possible switching frequency in kHz for this inverter. The displayed values correspond to the following switching frequencies:

0 = 2 kHz	1 = 4 kHz	2 = 8 kHz	3 = 12 kHz	4 = 16 kHz

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
In04	rated switching frequency	2E04h	ro	-	-	0	LTK	1	-	LTK

Display of the rated switching frequency in kHz. The displayed values correspond to the following switching frequencies:

0 = 2 kHz	1 = 4 kHz	2 = 8 kHz	3 = 12 kHz	4 = 16 kHz

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
In06	software version	2E06h	ro	-	-	SW	SW	1	-	-

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
Display of the software version number. 1. and 2. digit: Software version (e.g. 1.1) 3. digit: Special version (0 = standard)										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
In07	software date	2E07h	ro	-	-	SW	SW	0.1	-	-
Display of the software date. The value for the software date consists of year, month and day. Example: Display = 2012.0127 Date = 27.01.2012										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
In09		2E09h	ro	-	-	0	2147483647	1	-	-
Display of the serial number										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
In10	serial no. (date)	2E0Ah	ro	-	-	0	65535	1	-	0
In11	serial no. (count)	2E0Bh	ro	-	-	0	65535	1	-	0
In12	serial no. (AB-no. high)	2E0Ch	ro	-	-	0	65535	1	-	0
In13	serial no. (AB-no. low)	2E0Dh	ro	-	-	0	65535	1	-	0
In14	customer no. high	2E0Eh	ro	-	-	0	65535	1	-	0
In15	customer no. low	2E0Fh	ro	-	-	0	65535	1	-	0
In16	QS no.	2E10h	ro	-	-	0	65535	1	-	0
The serial number and the customer number identify the inverter. The QS-number contains production internal information.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
In17	Temperature mode	2E11h	ro	-	-	0	LTK	1	-	LTK
Parameter In17 displays the temperature mode of the inverter.										

In17	Function of T1, T2	Pn72	Resistance	Display ru46	Error/ warning [1)]
0xh	PTC (according to DIN EN 60947-8)	-	< 750 Ω	T1-T2 closed	-
			0.75…1.65 kΩ (reset resistance)	not defined	-
			1.65…4 kΩ (tripping resistance)	not defined	X
			> 4 kΩ	T1-T2 open	X

Parameter	Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default

7xh	KTY 84 3)	0	< 215 Ω	Detection error 253	X
			498 Ω	1°C	- ²)
			1 kΩ	100°C	x ²)
			1.722 kΩ	200°C	x ²)
			> 1811 Ω	Detection error 254	X
	PTC (according to DIN EN 60947-8) (Standard)	1	< 750 Ω	T1-T2 closed	-
			0.75...1.65 kΩ (reset resistance)	-	-
			1.65...4 kΩ (tripping resistance)	-	X
			> 4 kΩ	T1-T2 open	X
1)	The column is valid at factory setting and Ud02 ≥ 4 (G6L, G6P). At Ud02 < 4 the function must be programmed accordingly with parameters Pn12, Pn13 and Pn62 (not available for all housing types).				
2)	The shutdown is dependent on the adjusted temperature in Pn62.				
3)	A temperature evaluation with KTY sensor is only possible in E housing.				

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
In18	hardware current inverter	2E12h	ro	-	-	LTK	LTK	0.1	A	-
The short-time current limit can be read in parameter In18.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
In19	rated inverter act. power	2E13h	ro	-	-	LTK	LTK	0,01	kW	-
Parameter In19 displays the rated inverter act. power of the motor recommended by KEB. The rated active power of the recommended motor is different (depending on the frequency inverter size)										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
In22	User parameter 1	2E16h	rw	-	-	0	65535	1	-	0
In23	user parameter 1	2E17h	rw	-	-	0	65535	1	-	0
This parameters are not assigned to any function and are available to the user for input.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
In24	last error	2E18h	ro	-	-	0	255	1	-	-
In24 stores the 8 errors that occurred last, the display is set-programmable. Errors „undervoltage“, „loading“ and „phase loss“ are not stored. The error messages are described in chapter 22.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
In25	error diagnosis	2E19h	ro	-	-	0	65535	1	-	0

Shows the last 8 errors that occurred (in the sets 0...7). Only the errors of parameters In26...In30 are listed. The oldest error is in set 7. Between errors of the same type a difference time is determined and stored too.

Bit 0...11	Value	Description
	0...4094	Difference time in minutes
	4095	Difference time > 4094 minutes

Bit 12...15	Value	Error		Value	Error		Value	Error
	0	E R R O R disabled		3	E.OP		6...15	free
	1	E.OC		4	E.OH			
	2	E.OL		5	E.OHI			

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
In26	E.OC error counter	2E1Ah	ro	-	-	0	65535	1	-	0
In27	E.OL error counter	2E1Bh	ro	-	-	0	65535	1	-	0
In28	E.OP error counter	2E1Ch	ro	-	-	0	65535	1	-	0
In29	E.OH error counter	2E1Dh	ro	-	-	0	65535	1	-	0
In30	E.OHI error counter	2E1Eh	ro	-	-	0	65535	1	-	0

The error counters (for E.OC, E.OL, E.OP, E.OH, E.OHI) specify the total number of errors of each error type.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
In39	deadtime selector	2E27h	rw	-	+	0	329	1	-	0

The measured values of the characteristic "deadtime selector" can be read out in parameter In39. In39 is the selector parameter for the value in parameter In40.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
In40	deadtime	2E28h	rw	-	-	0	255	1	-	0

The measured values of the characteristic "deadtime" can be read out in parameter In40.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
In41	serial no. 2 (date)	2E29h	ro	-	-	-2147483648	2147483647	1	-	0
In42	serial no. 2 (count)	2E2Ah	ro	-	-	-2147483648	2147483647	1	-	0
In43	QS no. 2	2E2Bh	ro	-	-	0	65535	1	-	0

The serial number 2 identifies the power unit. The QS-number 2 contains production-internal information.

7.1.7 Description of the Sy-Parameters

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
Sy02	Inverter identifier	2002h	ro	-	-	0000	9999	1	hex	-
An unique number is assigned to each inverter type and firmware version which identifies the inverter. This value is used for example by COMBIVIS to load the correct configuration files. Sy02 can be written with the indicated value (e.g. for the identification of download lists).										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
Sy03	power unit code	2003h	ro	-	-	LTK	LTK	1	-	LTK
This parameter is used to display the power unit code. On the basis of the power unit code the control recognizes the used power unit.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
Sy06	inverter address	2006h	rw	-	+	0	239	1	-	1
The address if the inverter shall be responded via „COMBIVIS“ or another control can be adjusted in Sy06. Values between 0 and 239 are possible, the default value is 1. If several inverters are operated on the bus simultaneously, it is absolutely necessary to assign different addresses to them. Since otherwise it leads to communication failures, because several inverters may answer at the same time. This parameter is only effective for the diagnostic interface. More information can be found in the description of the DIN 66019II protocol (C0F501I-K001). Sy06 is not reset on loading the default parameters.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
Sy09	watchdog time int. bus	2009h	rw	-	+	0	10	0.05	s	0
The watchdog function monitors the communication of the internal bus (control board - power unit). After expiration of an adjustable time (0.05...10 s) without incoming telegrams, the response adjusted in Pn05 is triggered. Value „0: off“ deactivates the function.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
Sy11	baud rate int. bus	200Bh	ro	-	+	20	23	1	-	LTK
The transmission rate between power unit / control board is determined with the internal baudrate. Following values are possible:										
Value	Baud rate									
20	Synchronous 1Mbps / 1ms BCC									
21	Synchronous 1Mbps / 2ms BCC									
22	Synchronous 1Mbps / 1ms CRC									
23	Synchronous 1Mbps / 2ms CRC									

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
Sy32	scope timer	2020h	ro	-	-	0	65535	1	-	LTK
The scope timer generates a time period of 1 ms. This can be used by external programs, e.g. scope, to represent time patterns. The timer counts from 0...65535 and starts again with 0 after an overflow.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
Sy41	control word (high)	2029h	rw	-	+	0	65535	1	-	0

The control word is used for state control of the inverter via bus. The control word long (Sy43) consists of the two 16-bit parameters control word high (Sy41) and control word low (Sy50). The status word is bit-coded. The description of the individual bits is found in chapter 24.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
Sy42	status word (high)	202Ah	ro	-	-	0	65535	1	-	0

With the status word the current condition of the inverter can be readout via bus. The status word long (Sy44) consists of the two 16-bit parameters status word high (Sy42) and status word low (Sy51). The status word is bit-coded. The description of the individual bits is found in chapter 24.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
Sy43	control word (long)	202Bh	rw	-	+	-2147483648	2147483647	1	-	0

The control word is used for state control of the inverter via bus. The control word long (Sy43) consists of the two 16-bit parameters control word high (Sy41) and control word low (Sy50). The status word is bit-coded. The description of the individual bits is found in chapter 24.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
Sy44	status word (long)	202Ch	ro	-	-	-2147483648	2147483647	1	-	0

With the status word the current condition of the inverter can be readout via bus. The status word long (Sy44) consists of the two 16-bit parameters status word high (Sy42) and status word low (Sy51). The status word is bit-coded. The description of the individual bits is found in chapter 24.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
Sy50	control word (low)	2032h	rw	-	+	0	65535	1	-	0

The control word is used for state control of the inverter via bus. The control word long (Sy43) consists of the two 16-bit parameters control word high (Sy41) and control word low (Sy50). The status word is bit-coded. The description of the individual bits is found in chapter 24.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
Sy51	status word (low)	2033h	ro	-	-	0	65535	1	-	0

With the status word the current condition of the inverter can be readout via bus. The status word long (Sy44) consists of the two 16-bit parameters status word high (Sy42) and status word low (Sy51). The status word is bit-coded. The description of the individual bits is found in chapter 24.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
Sy52	set speed value	2034h	rw	-	-	-32000	32000	1	rpm	0

Setting of the set speed value in the range of ±32000 rpm. The reference source oP00 must be set to „5“ for setpoint setting via Sy52. The rotation source is determined via oP01 like the other absolute reference sources.

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
Sy53	actual speed value	2035h	ro	-	-	-32000	32000	1	rpm	0
The actual speed in rpm can be read out with this parameter. The direction of rotation is signalled by the sign. The rated motor speed must be correctly entered in modes G6L-G and G6P-S (v/f operation) to calculate the frequency.										

Parameter		Addr.	R	PG	E	Min. value	Max. value	Res.	[?]	Default
Sy56	start display address	2038h	rw	-	+	0	32767	1	-	LTK
Sy56 adjusts the parameter address which shall be represented in the display when switching on. Operator parameters (control board parameter) can also be set as starting display. Only valid addresses are accepted. If there is adjusted an invalid address (neither assigned in the inverter nor on the control board) the control board searches for the next existing address of the parameter group. If this parameters is available in the CP-Mode, the setting becomes effective there. Otherwise CP00 is indicated as start parameter.										

8. Analog Inputs and Outputs

8.1 Summary description analog inputs

By selecting an input interface (An00/An10) input AN1 or AN2 can be adjusted to the applied input signal. Subsequently the analog inputs are smoothed in an electronic filter (An01 / An11) by averaging. A save mode can be set with An02/An12 and activated with a programmable input (An03/An13). To avoid voltage fluctuations and ripple voltages around the zero point the analog signal can be faded out around the zero point up to ±10 % (An04/An14). In the characteristic amplifier the input signals can be influenced in X and Y direction as well as in the rise (An05...An07/ An15...An17/An25...An27). At the output of the characteristic amplifier the signal can be limited to a minimum and maximum value (An08, An09/An18, An19). At the output of the block it can be defined with An30 which analog signal serves as reference value and which one serves as AUX-value. The ru-Parameters are used for the display of the analog signal pre and post amplifier. The internal values are limited to ±400%.

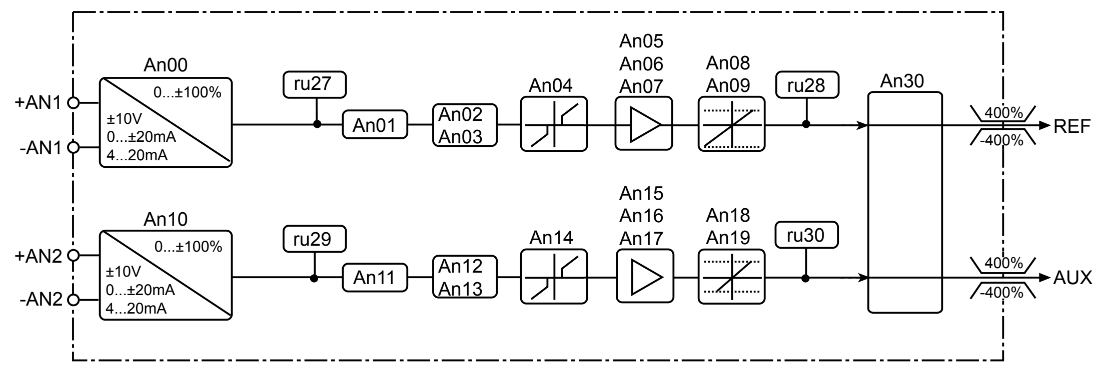


Figure 8.1 Principle of the analog inputs

An00	AN1 interface selection
An01	AN1 noise filter
An02	AN1 save mode
An03	AN1 save trig. input selection
An04	AN1 zero clamp
An05	AN1 gain
An06	AN1 offset X
An07	AN1 offSet Y
An08	AN1 lower limit
An09	AN1 upper limit
An10	AN2 interface selection
An11	AN2 noise filter
An12	AN2 save mode
An13	AN2 save trig. input selection
An14	AN2 zero clamp
An15	AN2 gain
An16	AN2 offset X
An17	AN2 offset Y
An18	AN2 lower limit
An19	AN2 upper limit
An30	sel.REF inp./AUX-function
ru27	AN1 pre amplifier disp.
ru28	AN1 post amplifier display
ru29	AN2 pre amplifier disp.
ru30	AN2 post ampl. disp.

8.2 Interface selection

8.2.1 AN1 / AN2 (An00 / An10)

Depending on the adjusted interface (An00 / An10) the analog inputs AN1 and AN2 can process the following input signals:

An00 / An10: Interface selection	
Value	Meaning
0	0...±10 V (default)
1	0...±20 mA
2	4...20 mA

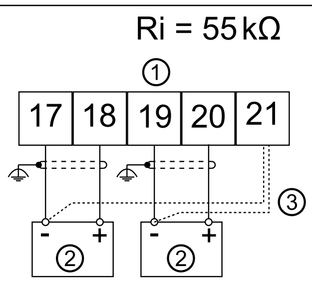


Figure 8.2 Connection as differential voltage inputs 0...±10V DC

1) Terminal strip X2A
2) PLC
3) Connect equipotential bonding conductor only, if a potential difference of > 30 V exists between the controls (PLC -frequency inverter control board). The internal resistance of the frequency inverter is reduced here to 30 kOhm.

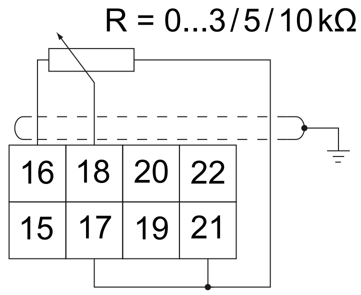


Figure 8.3 Control with poti and internal reference voltage

> Ri amounts 30 kΩ at the terminals at value 0 (0...10V DC) in parameters An00 / An10. Terminal CRF (Pin 16) at X2A may be loaded with max. 4mA.

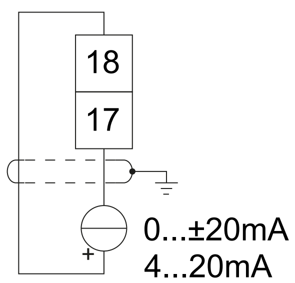


Figure 8.4 Control with current signal (An00 / An10 = 1 or 2)

8.3 Noise filter (An01 / An11)

The noise filters shall suppress disturbances and ripples of the input signals. If the noise filter is switched off the analog inputs are queried every 2 ms and the recorded value is transferred then. The noise filter adjustments preset the number of sampled values for the averaging.

An01 / An11: Noise filter	
Value	Function
0	off (no averaging)
1	2 times
2	4 times
3	8 times
4	16 times
5	32-fold
6	64-fold

8.4 Save mode (An02 / An12)

Coming from the input filter the save mode can be switched on with An02 / An12. If now the programmable digital input (value 1) is set the analog signal is processed directly and written parallel into the non-volatile memory. As soon as the digital input is disconnected (value 0), the inverter continuos to run with value stored in the memory. Moreover, with An02 / An12 it can be determined whether the memory contents are saved or deleted upon switch off.

An04 / An14: Save mode		
Bit	Value	Meaning
0	0	Always release (default)
	1	Release via digital input
1	0	No reset at power-on-reset (default)
	2	Reset at power-on-reset

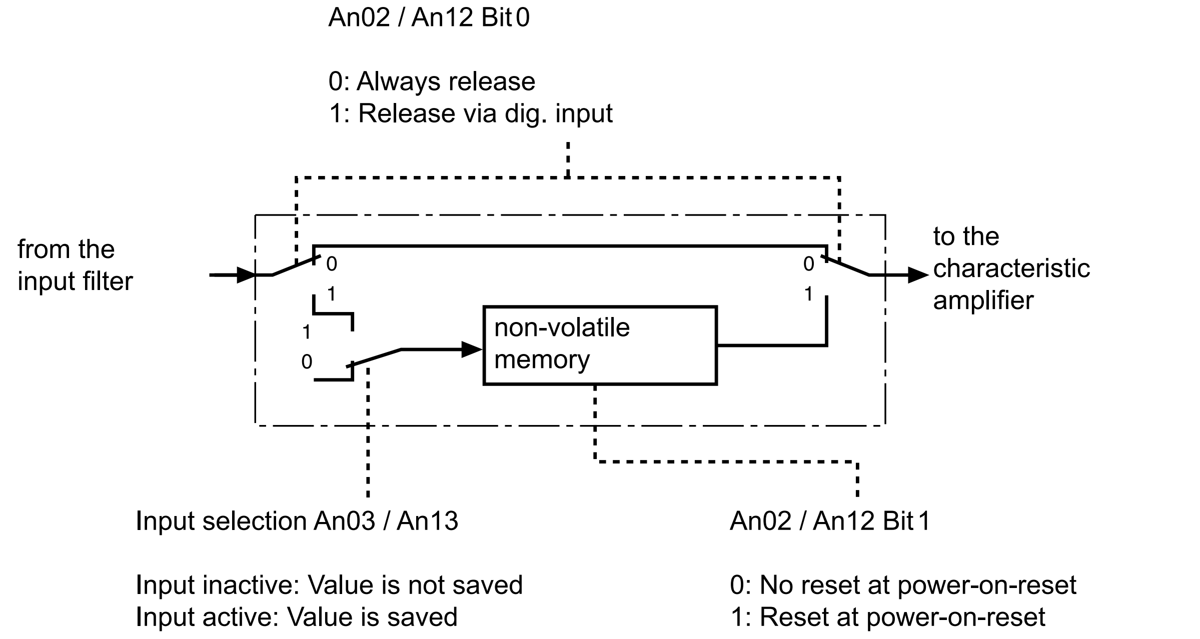


Figure 8.5 Save mode

8.4.1 Input selection (An03 / An13)

The digital inputs for storing are selected with An03 / An13 in accordance with the table „Input selection“ (see also chapter „Assignment of the inputs“). In order to store an analog value, the save mode must be switched on (An02 / An12 = 1) and the selected input must be activated

An03 / An13: Input selection			
Bit	Decimal value	Input	Terminal
0	1	ST (prog. input „control release/reset“)	X2A.6
1	2	RST (prog. input „reset“)	X2A.5
2	4	F (prog. input „forward“)	X2A.8
3	8	R (prog. input „reverse“)	X2A.7
4	16	I1 (prog. input 1)	X2A.10
5	32	I2 (prog. input 2)	X2A.9
6	64	I3 (prog. input 3)	X2A.12
7	128	I4 (prog. input 4)	X2A.11
8	256	IA (internal input A)	no
9	512	IB (internal input B)	no
10	1024	IC (internal input C)	no
11	2048	ID (internal input D)	no

8.5 Zero clamp (An04 / An14)

Through capacitive as well as inductive coupling on the input lines or voltage fluctuations of the signal source, the motor connected to the inverter can still drift (tremble) during standstill in spite of the analog input filter. It is the task of the zero clamp to suppress this.
With parameters An04 / An14 the respective analog signals can be faded out within a range of 0...±10%. The adjusted value is valid for positive and negative input signals. If a negative percent value is adjusted the hysteresis acts in addition to the zero point around the current setpoint. Setpoint changes are accepted only if they are larger than the adjusted hysteresis.

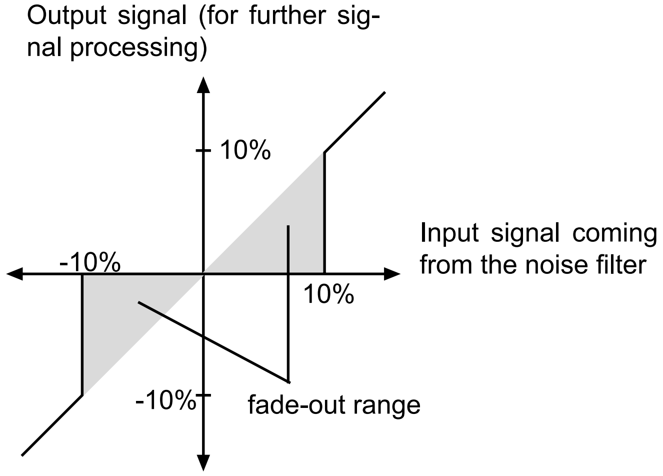


Figure 8.6 Zero clamp

An04 / An14: Zero clamp	
Value range	Meaning
-10.0%...10.0%	Value range of the hysteresis for An04 and An14.

8.6 Gain of the input characteristic (An05...An07 / An15...An17)

With these parameters the input signals can be adapted in X and Y direction as well as in the rise to the requirements. In the case of factory setting no zero point offset is adjusted, the rise (gain) is 1, i.e. the input value corresponds to the output value of this stage (see Fig. 8.7). The output value is calculated according to following formula:

Out = Amplification • (In - Offset X) + Offset Y

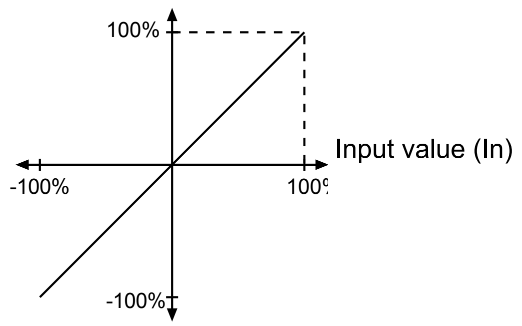


Figure 8.7 Factory setting: no offset, gain 1

Input	AN1	AN2	Value range	Resolution	Default value
Gain	An05	An15	-20.00...20.00	0.01	1.00
Offset X	An06	An16	-100.0%...100.0%	0.1%	0.0%
Offset Y	An07	An17	-100.0%...100.0%	0.1%	0.0%

By means of some examples, we want to show the possibilities of these functions.

According picture 8.8
Example 1. adjustment of the X-offset for input AN1 to 50 (%)
Example 2. adjustment of the gain to 2

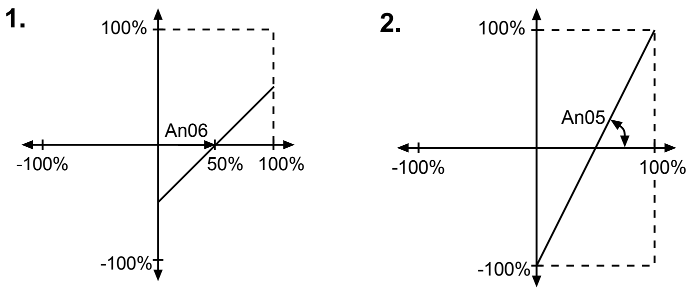


Figure 8.8 X-Offset (An06) = 50%; Gain (An05) = 2.00

With these settings the entire speed range can be driven with 0...10 V via input AN1. (rotation direction = ±analog)

0% In	corresponds to	-100% Out
50% In	corresponds to	0% Out
100% In	corresponds to	100% Out

According picture 8.9
Example 3. adjustment of the X-offset for input AN1 to 75 (%)
Example 4. adjustment of the Y-Offset for input AN1 to 100 (%)
Example 5. adjustment of the gain to -1

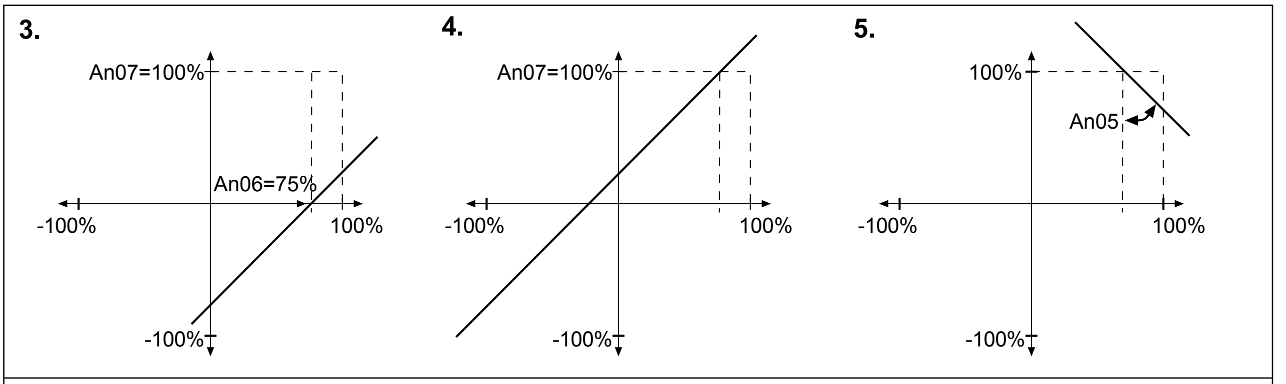


Figure 8.9 X-Offset (An06) =75%; Y-Offset (An07) = 100%; Gain (An05) = -1.00

8.7 Lower limit and upper limit (An08, An09, An18, An19)

These parameters serve for limiting of the analog signals after the amplifier stage. All parameters are adjustable in the range of -400...400 %. Since no mutual locking exists, it is to be ensured, that the lower limit is adjusted smaller than the upper limit.

An08	AN1 lower limit
An09	AN1 upper limit
An18	AN2 lower limit
An19	AN2 upper limit

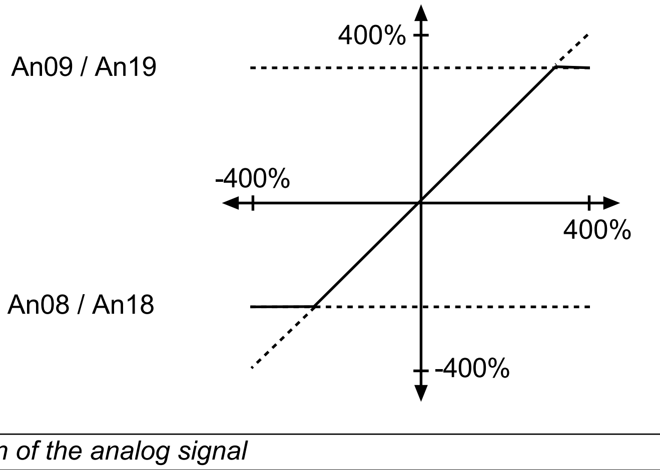


Figure 8.10 Limitation of the analog signal

8.8 Selection REF input / AUX-function (An30)

Assignment of the analog inputs:

An30: sel.REF inp./ AUX-function				
Bit	Function	Value	Description	Explanation
0...2	Selec-tion REF Input	0	AN2 input (ru30)	The REF input is selected with value 0 (analog input 1) or 1(analog input 2).
		1	AN2 input (ru30)	
3...5	AUX mode	0	Aux = source 1	Selection of the calculation of the AUX input value (addition, multiplication or absolute-value generation)
		8	Aux = source 1 + source 2	
		16	Aux = source 1 x (source 2 + 100%)	
		24	Aux = source 1 x source 2	
		32	Aux = amount source 1	
6...10	AUX Source 1	0	AN2 input (ru30)	Source 1 = AN1 post amplifier
		64	AN2 input (ru30)	Source 1 = AN2 post amplifier
		128	digital % (oP05)	Source 1 = value of op05
		192	motorpoti (ru37)	Source 1 = motorpoti value
		256	ext. PID output (ru52)	Source 1 = PID controller base value
		320	reserved	
		384	reserved	
		448	Encoder 2 value (ru05 / 10)	Source 1 = ru10 / reference value x 100%
		512	Actual value (ru07)	Frequency-/ speed range value > 100%
		576	ANOUT 1 (ru34)	100% > 100%
		640	ANOUT 2 (ru36)	100% > 100%
11...15	AUX Source 2	0	AN2 input (ru30)	Source 2 = AN1 post amplifier
		2048	AN2 input (ru30)	Source 2 = AN2 post amplifier
		4096	digital % (oP05)	Source 2 = value of oP05
		6144	motorpoti (ru37)	Source 2 = motorpoti value
		8192	ext. PID output (ru52)	Source 2 = PID controller base value
		10240	reserved	
		12288	reserved	
		14336	Encoder 2 value (ru05 / 10)	Source 2 = ru10 / reference value x 100%
		16384	Actual value (ru07)	Frequency-/ speed range value > 100%
		18432	ANOUT 1 (ru34)	100% > 100%
		20480	ANOUT 2 (ru36)	100% > 100%

The reference value for the calculation of the AUX signal from the encoder values of channel 1 or 2 is depending on Ud02:

- Reference value = 100Hz in the 400Hz mode (Ud02 = 0)
- Reference value = 200Hz in the 800Hz mode (Ud02 = 1)
- Reference value = 1000 rpm in the 4000 mode (Ud02 = 4 or 8)
- Reference value = 2000 rpm in the 8000 mode (Ud02 = 5 or 9)
- etc. (see chapter 5 Selection of the operating mode)

8.9 Brief description analog outputs

The KEB COMBIVERT has four programmable analog outputs (ANOUT 1, 2 and ANOUT 3, 4). Outputs ANOUT 3 and ANOUT 4 are realized by software. Parameters An31 / An36 allow the selection of one size which is given out at the outputs X2A.22 / 24. ANOUT 3 and ANOUT 4 (An41 and 47) can be output as switching condition 42 or 43 with the digital outputs as PWM signal. The analog signal can be adapted to the requirements with the characteristic amplifier (An33...An35 / An38...An40 / An43...An45 / An49...An51). The ru-parameters show the current size before and after the amplification. The period time for the PWM signal can be adjusted with An46 / An52.

An31 / An36 / An41 / An47

Function		Value
Actual value absolute	ru07	0
Setpoint absolute	ru01	1
Actual value	± ru07	2
Setpoint	± ru01	3
Output voltage	ru20	4
Actual DC voltage	ru18	5
Apparent current	ru15	6
Active current	ru17	7
Digital setting by An32/An37/ An42/An48	Anxx	8
Ext. PID out display	± ru52	9
Display external PID output absolut	ru52	10
Active current absolute	ru17	11
Power module temperature	ru38	12
Motor temperature	ru46	13
Actual torque	± ru12	14
Actual torque absolute	ru12	15
Ref. torque	± ru11	16
Set torque absolute	ru11	17
System deviation/speed controller	-	18
Ramp output display	± ru02	19
Display ramp output absolute	ru02	20
reserved		21
AN1 pre amplifier disp.	ru27	22
AN1 post amplifier display	ru28	23
AN2 pre amplifier disp.	ru29	24
AN2 post ampl. disp.	ru30	25
Active power	ru81	26
reserved		27
reserved		28
Max. torque in percent	ru90	29

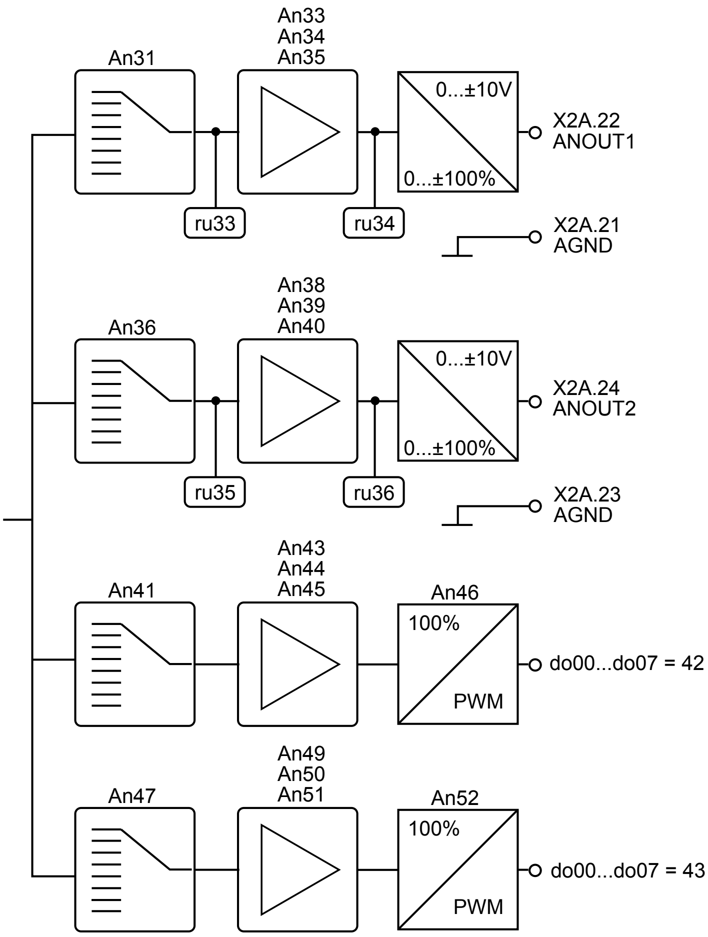


Figure 8.11 Principle of the analog outputs

The reference values for mode 0-3 and 18-20 changes depending on Ud02.

8.10 Output signals

ANOUT 1 / ANOUT 2, bipolar

A voltage of 0...±11.5VDC represents the selected size in the range of 0...±115% with a resolution of 11 bit at the output. In order to be able to balance load-dependent voltage drops, the limitation at the output of the characteristic amplifiers is ±115%.

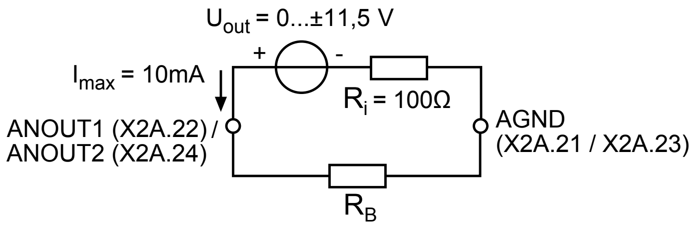


Figure 8.12 Analog output

ANOUT 3 / ANOUT 4, PWM outputs

Process variables, that change only slowly, as for example the power module temperature, can be output over two virtual analog outputs (ANOUT3 und ANOUT 4). This is realised through generation of a PWM-signal (pulse-width-modulation) on a digital output. The period T can be adjusted with parameter An46 or An52 „ANOUT period“ of 1...240s.

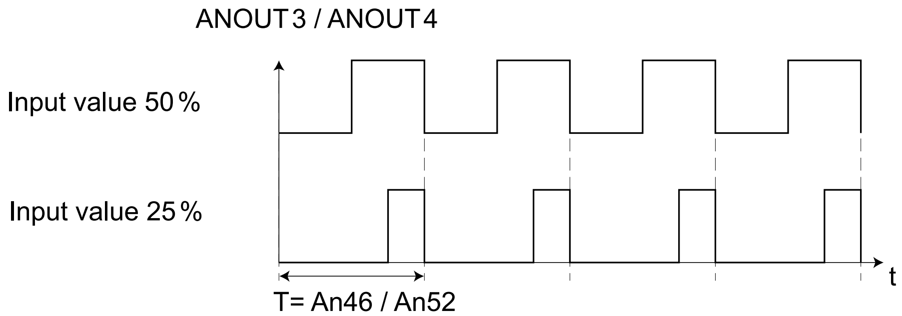


Figure 8.13 PWM output signal

8.11 Analog output / display (ru33...ru34 / ru35...ru36)

Following parameters are used for the display of the analog outputs, before and after the characteristic amplification:

ru33 ANOUT1 / pre amplifier display	0...±400%
ru34 ANOUT1 / post amplifier display	0...±100%
ru35 ANOUT2 / pre amplifier display	0...±400%
ru36 ANOUT2 / post amplifier display	0...±100%

No display is provided at analog outputs ANOUT3 and ANOUT4.

8.12 ANOUT 1... 4 / function (An31 / An36 / An41 / An47)

These parameters define the function which controls the respective output. Following adjustments are possible:

An31/ An36/ An41/ An47				
Value	Function	Output of		100 % corresponds to
0	Absolute actual value (ru07)	Amount of the speed actual value		3000 rpm [2]
1	Absolute set value (ru01)	Amount of speed set value before ramp generator		
2	Actual value (ru07)	Speed actual value		
3	Set value (ru01)	Speed set value		
4	Output voltage (ru20)	Output voltage		0...1500 V
5	Actual DC voltage (ru18)	Actual DC voltage		0...1167 V
6	Apparent current (ru15)	Apparent current		0...2 x rated inverter current (In01)
7	Active current (ru17)	Active current		
8	Digital setting by (An32/ An37/ An42/ An48)	Value setting by An32/ An37/ An42/ An48		0...100 %
9	External PID output (ru52)	Output value of the PID controller		0...400 %
10	Absolute ext. PIDoutput (ru52)	Amount of the PID controller output value		
11	Absolute active current (ru17)	Amount of the active current		0...2 x inverter rated current (In01)
12	Power module temperature (ru38)	Power module temperature		0...100 °C
13	Motor temperature r(u46)	Motor temperature		
14	Actual torque (G6L-M / G6P-S)	Actual torque	only in closed-loop operation	0...3 x rated torque DASM: dr14 DSM: dr27
15	Absolute actual torque (G6L-M / G6P-S)	Amount actual torque		
16	Set torque (G6L-M / G6P-S)	Ref. torque		
17	Absolute set torque (G6L-M / G6P-S)	Amount set torque		
18	System deviation of the speed controller	System deviation of the speed controller		0...3000 rpm
19	Speed reference variable (ru02)	Speed set value after ramp generator		
20	Absolute speed reference variable (ru02)	Angle difference		
21	reserved			
22	Analog input 1 pre amplifier (ru27)	Value of An01 at terminal		0...100 %
23	Analog input 1 post amplifier (ru28)	Value of An01 post analog value processing		
24	Analog input 2 pre amplifier (ru29)	Value of An02 at terminal		
25	Analog input 2 post amplifier (ru30)	Value of An02 post analog value processing		
26	Active power (ru81)	Active power		0...2 x max. rated motor power of the frequency inverter [2]
27	reserved			
28	reserved			
29	Max. torque in % (ru90)	Act. torque, referring to the max. permissible torque of the drive chain		0...100 %

[1] Depending on the rated inverter current (In01), [2] depending on Ud02, [3] depending on the motor
[4] The value can be found in the technical data of the power circuit manual .

8.13 Gain of the output characteristic (An33...An35 / An38...An40 / An43...An45 / An49...An51)

The characteristic amplifier are following after selecting the signal to be given out (see Fig. 8.11). With these parameters the input signals can be adapted in X and Y direction as well as in the rise to the requirements. No zero offset is adjusted at factory setting, the gain is 1, i.e. 100% of the output variable correspond to 10V at the analog output.

Function	ANOUT1	ANOUT2	ANOUT3	ANOUT4	Value range	Resolution	Default
Gain	An33	An38	An43	An49	±20.00	0.01	1.00
X offset	An34	An39	An44	An50	±100.0%	0.1%	0.0%
Y offset	An35	An40	An45	An51	±100.0%	0.1%	0.0%

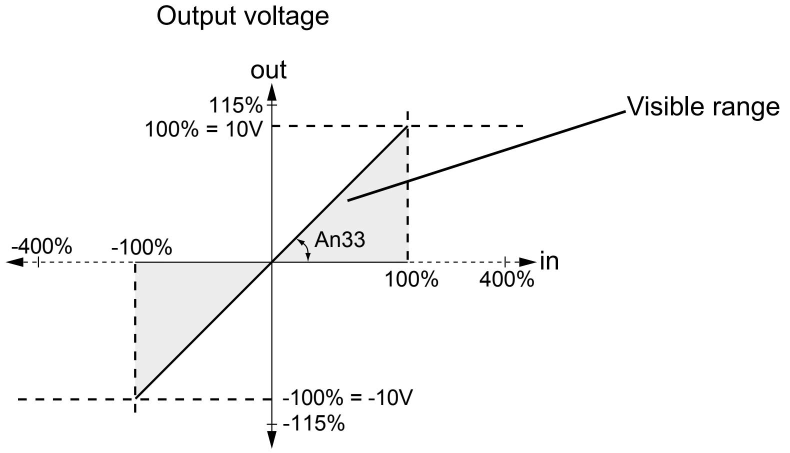


Figure 8.14 Factory setting: no offset, gain 1

Inverting the analog output

An example for using the characteristic amplifier is shown in Fig. 8.15

1. Adjust X offset (An34) to 100 (%)
2. Adjust the gain (An33) to -1

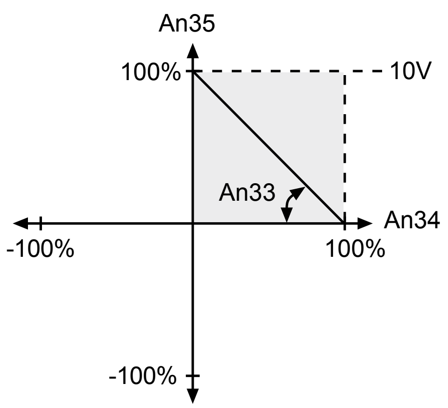


Figure 8.15 Inverting the analog output

These settings result in an inverting of the analog signal.

0%	corresponds to	10V	at the output
100%	corresponds to	0 V	at the output

Analog output as switch
An example for using the analog output as 0/10V switch is shown in picture 8.16

1. Adjust the gain (An33) to 20.00
2. Adjust X offset (An34) to the desired switching level

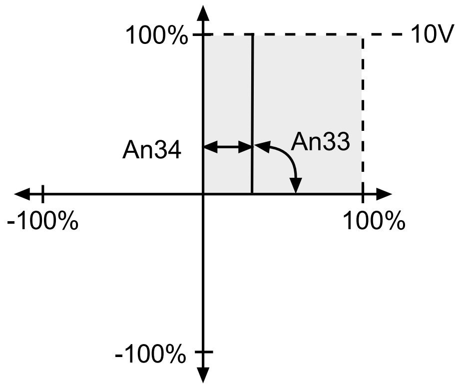


Figure 8.16 Analog output as switch

Because of the high amplification the analog output switches in a relative small switching window.

Calculation of the gain (An33 / An38 / An43 / An49)
Since the analog output always works firmly onto the values defined in 8.12, one can adjust the characteristic with the aid of the gain that the complete range 0...±10V is used.

$$\frac{\text{defined value}}{\text{desired value}} = \text{gain (An33 / An38 / An43 / An49)}$$

Example output frequency:

$$\frac{100\text{Hz}}{68\text{Hz}} = 1.47$$

8.14 ANOUT 1...4 Digital setting (An32 / An37 / An42 / An48)

Analog values can be preset in percent for the respective input with parameters An32 / An37 / An42 / An48. For that purpose value 8: „digital setting“ must be adjusted as process variable. The setting is done within the range ±100 %.

9. Digital Inputs and Outputs

9.1 Summary description digital inputs

KEB COMBIVERT has 8 external digital inputs and 4 internal inputs (IA…ID). All inputs can be assigned to one or several functions.

The external inputs are generally controlled with PNP wiring in the standard version. Parameter ru21 displays the actual controlled inputs. Each input can be set either with di01 via the terminal block or by software with di02. A digital filter di03 reduces the noise sensitivity of the inputs. The inputs can be inverted with di04 and with di 05 one can switch to edge-triggering. A strobe mode can be activated with parameters di06…di08. The input state ru22 displays the inputs that are actually set for processing. The function(s) carried out by a programmed input is defined by means of the input selection of the corresponding function or di11…22.

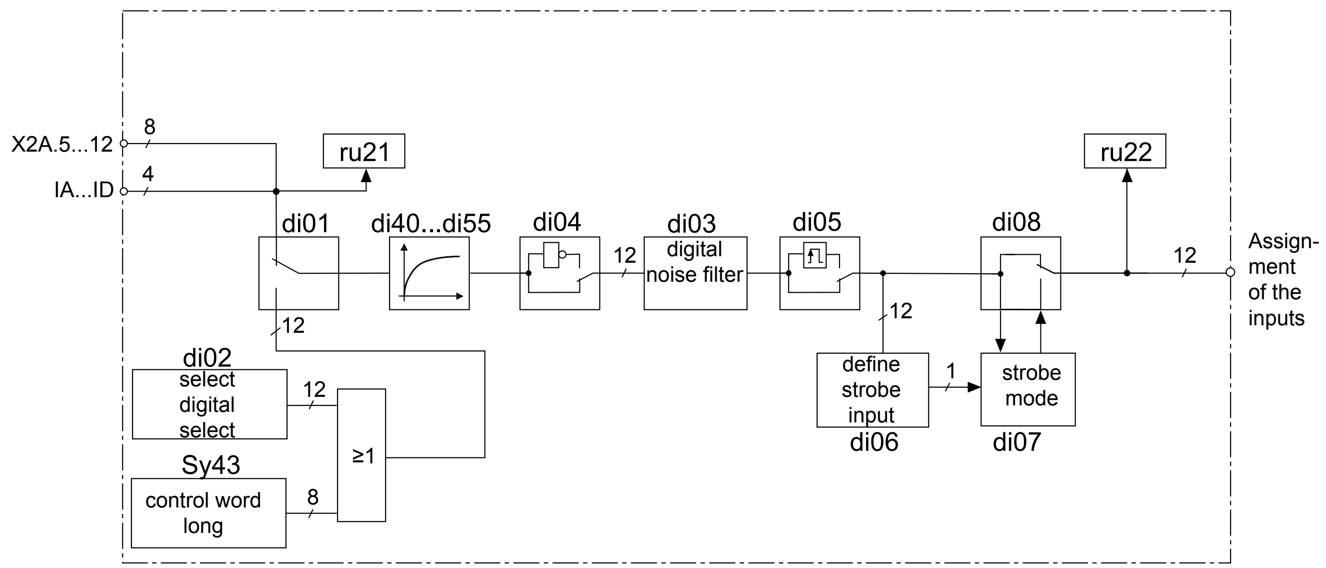


Figure 9.1 Principle of the digital inputs

9.2 Control release with Safe Torque Off (STO)

For safety reasons the control release (ST) or the STO terminals must generally be switched by hardware. Edge-triggering, inversion and strobe signal can be adjusted but have no influence.

For units with safety function (STO) the STO terminal (X2B) acquires the function of the ST terminal (X2A.6)

The G6 Safety manual (Safety function STO) is available at www.keb.de for more information.

9.3 Input signal PNP

Control voltage for digital inputs = 15...30V DC ±0% smoothed

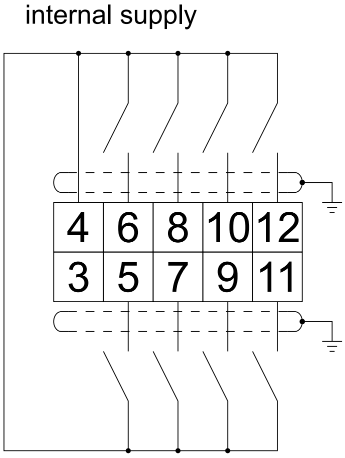


Figure 9.2 Digital inputs in PNP control

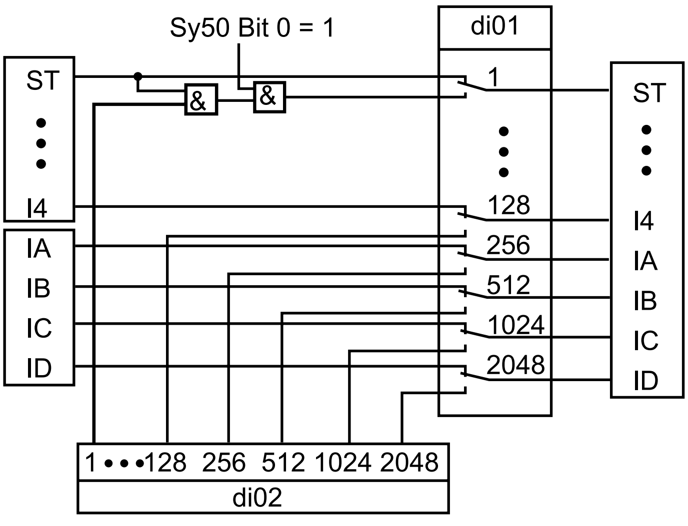
9.4 Digital input setting per software (di01, di02)

Digital inputs without external wiring can be set with parameters di01 „select signal source“ and di02 „digital input setting“.

The control release must generally be switched by means of hardware even if one switches by software (see Fig. 9.3 AND-operation with di02 and Sy50)!

Terminal strip

internal inputs



internal input state

Figure 9.3 Digital inputs controlled by software (di01 / di02)

As seen in Fig. 9.3, it can be selected with di01 if the inputs are switched by the terminal strip (default) or via parameter di02. Both parameters are bit-coded, i.e. the appropriate value for the input is to be entered according to the following table. In the case of several inputs the sum is to be formed.
Exception: The control release must be supplied with 24V. The 24V supply can be done e.g. with the 24V output (X2A.4).

Table: Terminal status

di07: select signal source			
Bit	Decimal value	Input	Terminal
0	1	ST (prog. input „control release/reset“)	X2A.6
1	2	RST (prog. input „reset“)	X2A.5
2	4	F (prog. input „forward“)	X2A.8
3	8	R (prog. input „reverse“)	X2A.7
4	16	I1 (prog. input 1)	X2A.10
5	32	I2 (prog. input 2)	X2A.9
6	64	I3 (prog. input 3)	X2A.12
7	128	I4 (prog. input 4)	X2A.11
8	256	IA (internal input A)	no
9	512	IB (internal input B)	no
10	1024	IC (internal input C)	no
11	2048	ID (internal input D)	no

Example: ST, F and IB are controlled, indicated value = 1+4+512 = 517

9.5 Input terminal state (ru21), internal input state (ru22)

The input terminal state (ru21) displays the logical level at the input terminals. It is unimportant, whether the inputs are internally active or not. If a terminal is controlled, the appropriate decimal value according to table "terminal state" is output. If several terminals are active, then the sum of the decimal values is output.
The internal input state (ru22) displays the logical state of the digital inputs internally set for further processing. If an input is set, the appropriate decimal value according to the table „Terminal state“ is output. If several inputs are set, then the sum of the decimal values is output.

9.6 Digital noise filter (di03)

The digital noise filter reduces the susceptibility to interferences on the digital inputs. Only hardware inputs can be filtered. Each input has a separate filter counter that counts up at active input and down at inactive input. The output of the filter is set on reaching the filter time and reset when zero is reached.

An04 / An14: Save mode
Value range
0...127 ms

9.7 Input logic (di04)

If a signal is 1- or 0-active (inverted)can be adjusted with parameter di04. The parameter is bit-coded, i.e. the value corresponding to the input must be entered. If several inputs shall be inverted, then the sum is to be formed. (Exception: An inversion of the control release remains without function).

9.8 Turn on- and turn off delay time of the digital inputs

Turn on- and turn off delay time for the digital inputs can be realized with parameters di40...di55.

di40	I1 activation delay	di41	I1 deactivation delay
di42	I2 turn on delay time	di43	I2 deactivation delay
di44	I3 turn on delay time	di45	I3 deactivation delay
di46	I4 turn on delay time	di47	I4 deactivation delay
di48	IA turn on delay time	di49	IA deactivation delay
di50	IB turn on delay time	di51	IB deactivation delay
di52	IC turn on delay time	di53	IC deactivation delay
di54	ID turn on delay time	di55	ID deactivation delay

di40...di55: activation / deactivation delay	
Value range	Description
0:	Protecting function off
0.01...32.00 s	Adjustable delay time

Function:
The function can be switched off with the value = 0 in parameters di40...di55. The turn on delay starts with the positive edge of the input, the turn off delay with the negative edge.

9.9 Input trigger (di05)

As a standard the inverter is controlled with static signals, i.e. an input is set for as long as a signal is applied. However, practice has shown that a signal may be available for a limited time only, but the input shall still remain set. In that case the input or several inputs can be adjusted to edge-triggered flip-flop. Then a rising edge with a pulse duration that is longer than the response time of the digital filter is sufficient for switch-on. Switch-off is effected with the next rising edge.

Control release (ST) can be set to edge-triggered flip-flop, but this remains without affect on the function, since it is a pure static signal.

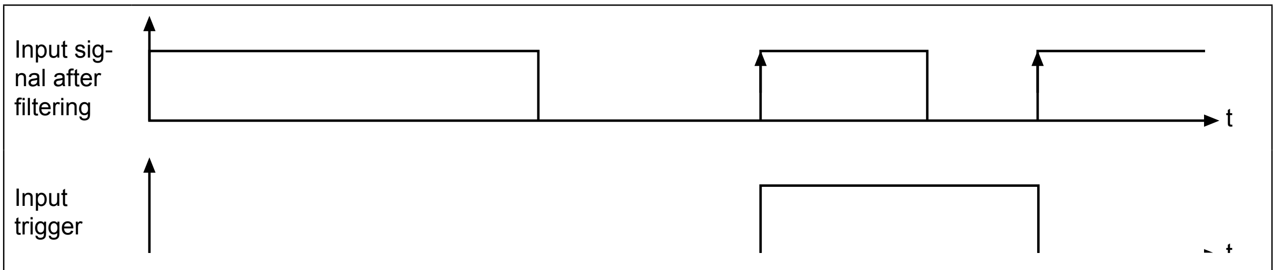


Figure 9.4 Example of a signal flow diagram for input I1 (di05 = 16)

9.10 Strobe dependent inputs (di06, di07, di08)

A strobe signal is used mainly for triggering the input signals. For example, two inputs shall be used for the parameter set selection. But the signals for the control do not arrive exactly even, so for a short time it would be switched into an unintended set. With active strobe (scanning signal) the current input signals of the strobe-dependent inputs are accepted and kept until the next scanning.

Which inputs are switched by strobe?
With di08 any input can be selected as strobe-dependent input. With the control release di.08 has no function since this is a static input.

From where comes the strobe signal?
The strobe input can be adjusted with parameter di06. If several inputs are adjusted as strobe they are linked in OR-operation.

Edge-active or static strobe?
As a standard the strobe is edge-active, i.e. the input conditions on the strobe input are accepted with rising edge and maintained until the next rising edge. For some applications it is sensible to use the strobe in a manner of a gate function. In that case the strobe signal is static, i.e. the input signals are accepted for as long as the strobe signal is set (or for as long as the gate is open).

Strobe mode (di07)

di07: strobe mode		
Value	Function	Description
0	Strobe on positive edge (default)	Input states are transferred with the rising edge at the strobe input and held until the next rising edge.
1	Strobe static / frooze	Input states are updated as long as the strobe signal is set. If the signal becomes inactive, the state is held.
2	Strobe static / reset to 0	Input states are updated as long as the strobe signal is set. If the signal becomes inactive, the state is reset.

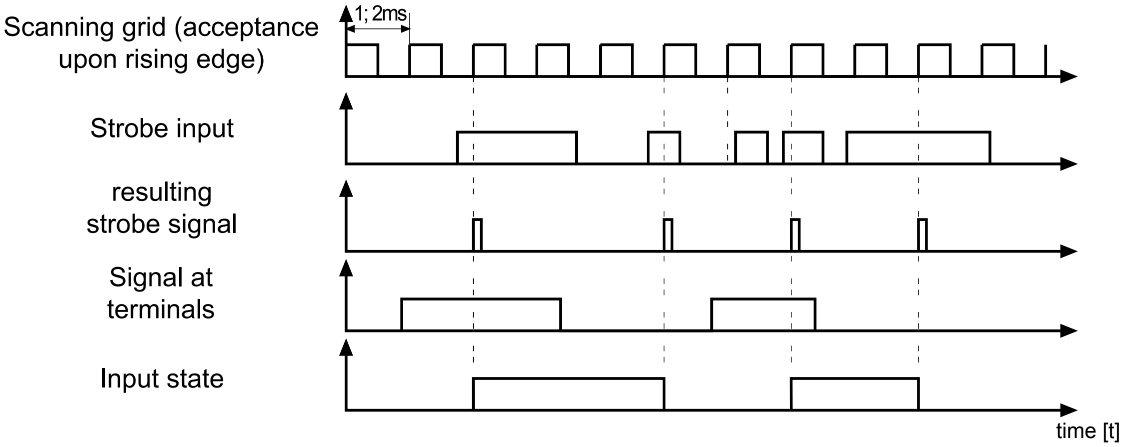


Figure 9.5 Edge active strobe (di07 = 0)

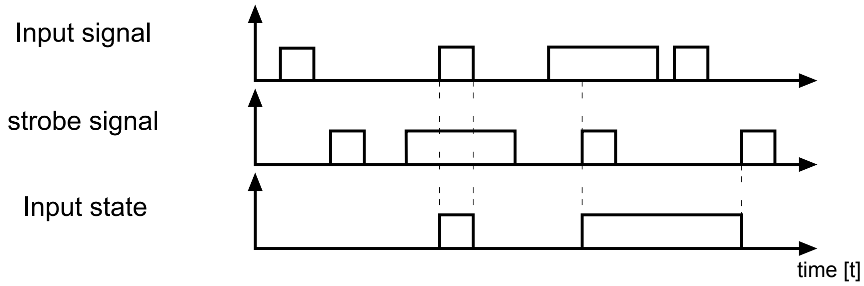


Figure 9.6 Static strobe mode 1 (di07 = 1)

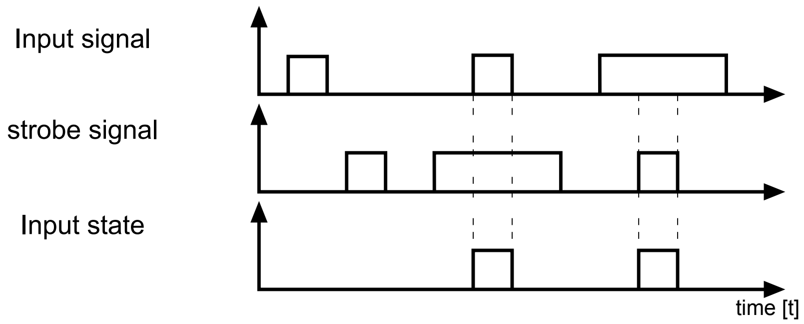


Figure 9.7 Static strobe mode 2 (di07 = 2)

9.11 Error reset input selection (di09) and error reset negative slope (di10)

Parameter di09 defines the reset input according to the table „Terminal state“. If the reset input shall react to a negative edge, one or several of the reset inputs defined with di09 can be switched to negative edge evaluation with di10.

9.12 Assignment of the inputs

There are two different procedures for the assignment of inputs.

a.) One or several inputs can be assigned to each function. This means an input can be selected at the single functions (fixed value selection, increase motorpoti etc.) which activates this function.

b.) One or several functions can be assigned to each digital input. This means, one or more functions can be assigned to each digital input in parameters di11...di22 „Function“ and di24...di35 „+ Function“. Several functions can be assigned to the respective inputs in parameters di11...di22 , only one can be selected in parameters di24...di35.

Both variants are locked against each other; if an input is assigned to a function,also parameters di11...di22 and di24...di35 are adjusted accordingly.

Due to the two variants the operation combines two advantages:

- with the functional programming of the inputs, the function's parametrization also permits selecting which inputs will activate the function,
- the input-related display gives an overview of the complete function of an input and finally it can be checked if there are undesired function overlappings.

The following table shows a list of parameters with which the various functions can be assigned digital inputs:

An03	save AN1	oP20	step value input sel. 2
An13	save AN2	oP56	mot.poti inc. input sel.
cn11	PID reset 2 input sel.	oP57	mot.poti dec. input sel.
cn12	I reset inp. sel.	oP58	mot.poti reset input sel.
cn13	fade in reset inp. sel.	op60	dir. forward input sel.
di09	reset input selection	oP61	dir. reverse input sel.
di36	software ST input selection	Pn04	ext. fault input select
di37	ST lock input sel.	Pn23	LAD stop input selection
di39	disable dig. ST inp.sel.	Pn29	DC brake input selection
dr.61	Rs corr auto temp inp.sel	Pn42	brake check input sel.
Fr07	paraset input sel.	Pn49	power off start inp.sel.
Fr11	reset set input sel.	Pn64	set GTR7 input selection
LE17	timer 1 start input sel.	Pn78	UPS operation input sel.
LE19	timer 1 reset input sel.	Pn93	flow switch input select
LE22	timer 2 start input sel.	Ud07	memory store input sel.
LE24	timer 2 reset input sel.	uF08	energy saving input sel.
oP19	step value input sel. 1	uF21	dt. comp. off input sel.

The following table gives an overview of all functions which can be assigned to a digital input with parameters di11...di22 (several functions are possible).

di24...di35: input function			
Bit	Value	Explanation	Fct. Para [1)]
0	1: step value 1	Select fixed values	oP19
1	2: step value 2		oP20
2	4: increase motorpoti	Motorpoti	oP56
3	8: dec motorpoti		oP57
4	16: reset motorpoti		oP58
5	32: forward	rotation setting	op60
6	64: reverse		oP61
7	128: reset error	release reset	di09
8	256: Ramp stop	stop ramp	Pn23
9	512: dc brake (vvc only)	Activate DC braking	Pn29
10	1024: energy saving (vvc only)	Flux reduction	uF08
11	2048: parameter set selection	Parameter set selection	Fr07
12	4096: Reset to set 0		Fr11
13	8192: external fault	Release error state in the inverter	Pn04
14	16384: save AN1	activate save mode for the analog inputs	An03
15	32768: save AN2		An13
16	65536: reserved		
17	131072: run timer 1	Start / Stop Timer	LE17
18	262144: reset timer 1		LE19
19	524288: run timer 2		LE22
20	1048576: reset timer 2		LE24
21	2097152: reset PID controller	PID controller	cn11
22	4194304: reset ext.pid(I)		cn12
23	8388608: reset ext. pid (fade-in)		cn13
24	16777216: reserved		
25	33554432: reserved		
26	67108864: reserved		
27	134217728: reserved		
28	268435456: control GTR7	GTR7 (braking transistor) permanently on	Pn64
29	536870912: reserved		
30	1073741824: reserved		
31	2147483648: I+ prog. function (di24...35)	additional function („+“ function) is selected	

[1)] the column "Fct Para" displays the function-related parameter corresponding to the value in di11...di22.

The following table gives an overview of the functions, which can be assigned additionally to a digital input with parameters di24...di35 (only one auxilliary function per input is possible / bit 31 „I+ function“ must be activated for the appropriate input):

di24...di35: Input „+“ function		
Value	Explanation	Fct. Para[1)]
0...4: reserved		
5: Software ST (not at di05)	Any digital input gets the function „control release“ (software emulation / function can not be set to input ST)	di36
6: ST lock (not at di35)	Setting the input effects a locking of the software control release	di37
7: reserved		
8: Brake monitoring	Between the end of the brake closing time (Pn40) and the beginning of the break release time (Pn36) the brake must always be closed. If the input becomes (or is) active in this phase, error: „Error! brake control“ is triggered.	Pn42
9: Dead time compensation off	As long as the input is active, the dead time compensation is switched off	uF21
10: UPS operation 400V class	Activation of the input causes reduction of the level for triggering and reset of the underpotential error. Reduction of the UP tripping level to 200V Reduction of the UP reset level to 280V	Pn78
11: no digital ST (di35 no function)	Control release is only preset via terminal strip (di01 / di02 and control word Sy43 / Sy50 without function)	di39
12: Start Rs correction auto temperature	Start of the temperature-dependent stator resistance adaptation (only at V/f characteristic open-loop operation and SMM)	dr61
13...18: reserved		
19: Start power off	Only hardware inputs are supported with this function, since these are scanned in the same grid, where the power off control is active. A setting via the control word or di01 / di 02 is not possible.	Pn49
20: Safe memory	A digital input which can release fast storage of all parameters in the EEPROM is selected with this parameter. See chapter „24 auto store (Ud05), auto store state (Ud04)“.	
21: Flow switch	The flow control with valve control and flow monitor is adjusted with this function.	
22: Voltage stabilization off	This function deactivates the voltage stabilisation uF09. The motor voltage will be gradually increased or decreased when the function is activated. The time for increasing and decreasing can be adjusted with uF06.	uF27

[1)] the column "Fct Para" displays the function-related parameter corresponding to the value in di11...di22.

9.13 Software-ST and locking of the control release

di36 software ST, di37 ST lock, di38 turn off ST delay time

The function is switched off, if no input is selected in di36. ST can not be selected as software ST or input for locking.
With the locking function the control release can be controlled in case of voltage failure (even if the controlled PLC is failure) as long as the (e.g.) power off function needs for stopping the drive.
Condition is that the ST terminal (X2A.6) is connected with the 24V output (X2A.4).
The turn off of an input (selection in di36) is decelerated by the delay time adjusted in di38. Within this time the locking input (selection in di37) must become active in order to secure the function.
A software input e.g. (IA-ID) can be assigned as locking input with the function power off (do.00...do.07 = 17, switching condition for OA-OD).

i	The safety function must be observed for units which are operated with Safe Torque Off (STO)!

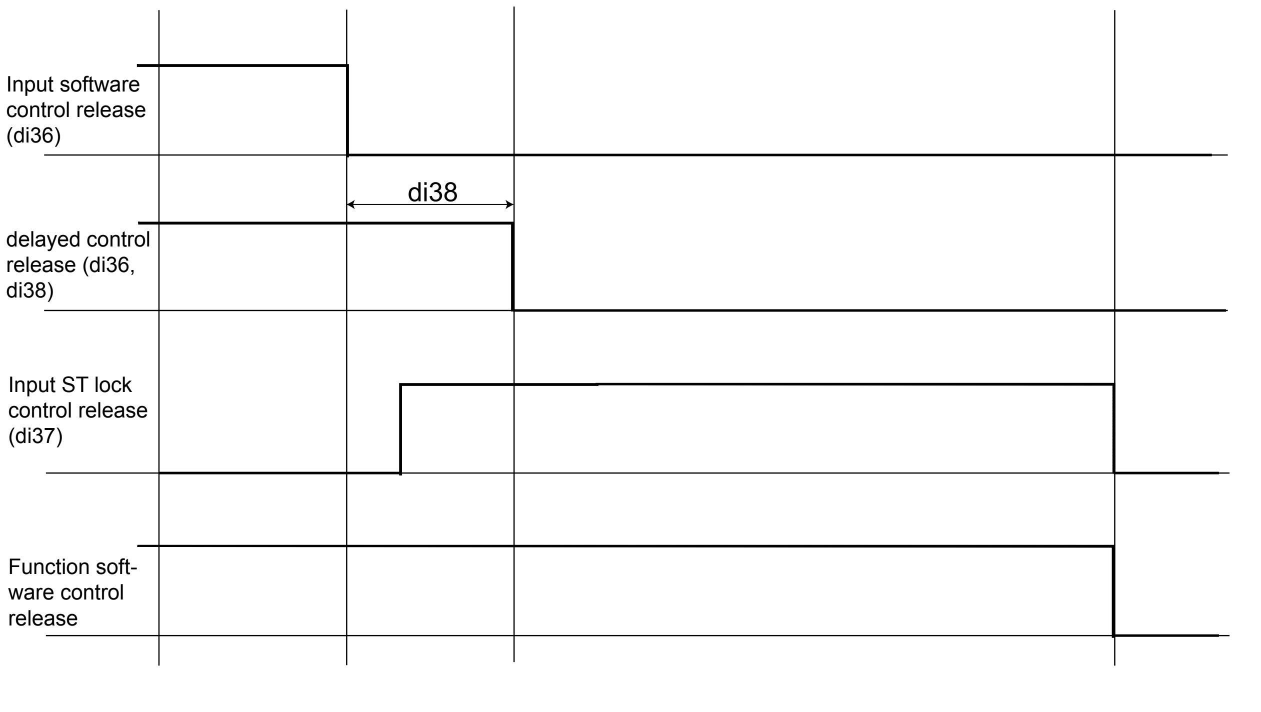


Figure 9.8 Software-ST, locking of the control release

9.14 Deactivation of the digital control release

The control release can be set digital (e.g. via bus system) with the digital input selection (di01 / di02) or the control word (Sy43/Sy50). Additionally terminal ST must always be activated.
An input which can deactivate the digital setting of the control release can be selected with parameter di39 „disable dig. ST input selection“. Thus only terminal ST is effective.

Thus it is possible to realize hand operation on failure of the bus system.

9.15 Short description - digital outputs

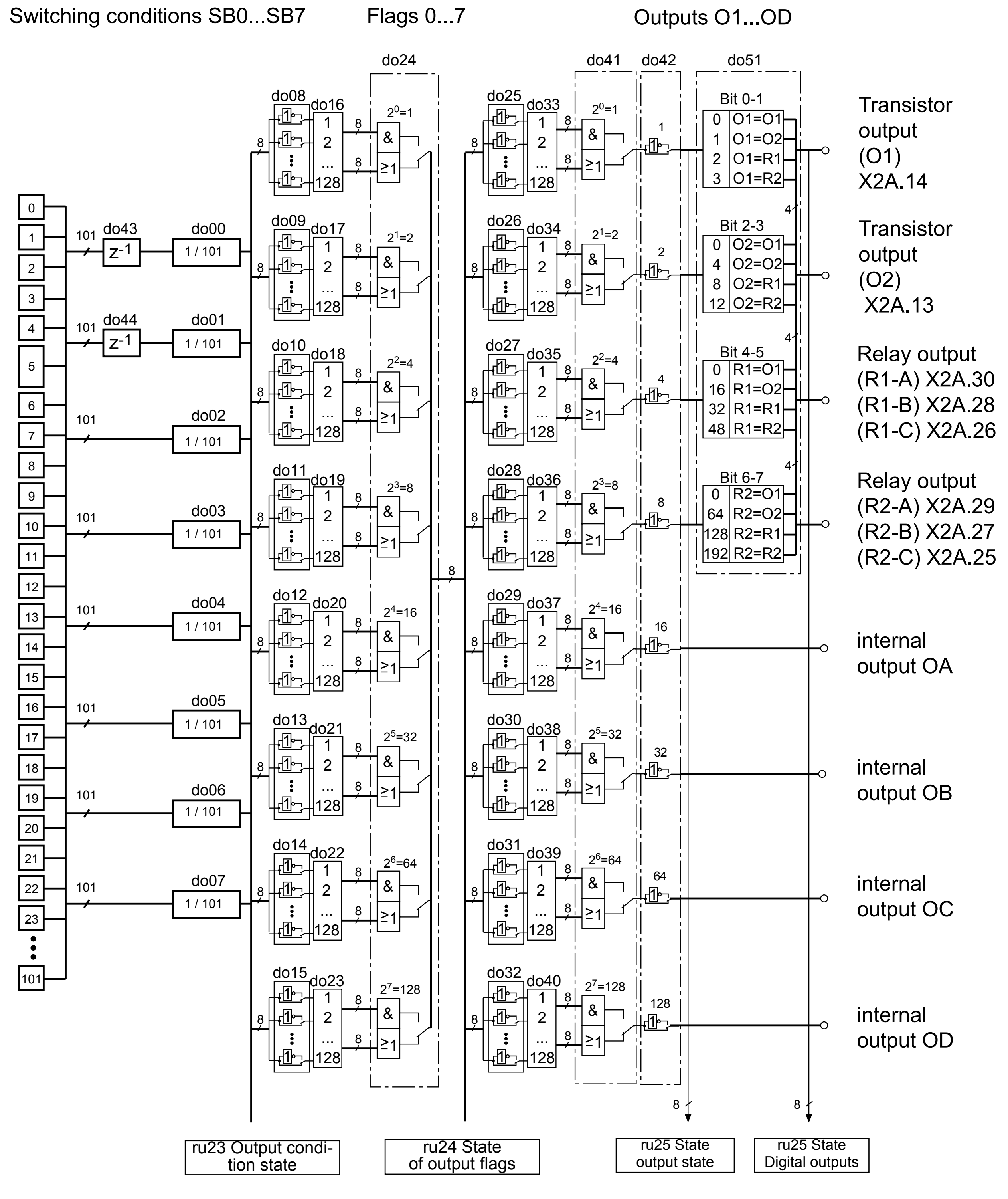


Figure 9.9 Principle of the digital outputs

Description of the digital outputs
Up to 8 different conditions can be selected for switching the digital outputs. These are entered in do00...do07. Switching condition 0 and 1 can be filtered by do43 and do44. Parameter ru23 displays if one or several of these conditions are met. For each flag it can be selected now which of the 8 conditions shall apply to it (do.16...do.23). Each condition can still be inverted before selection (do08...do15). As a standard all conditions (if several are selected) are OR operated. This can be changed to AND operation with do24, i.e. all conditions selected for this flag must be fulfilled before it is set. Parameter ru24 displays the flags which are set in this stage. Parameters do33...do40 form a second logic step whereby a selection of the flags from logic step 1 can be made. Each single flag can be inverted with do25...do32. The type of the connection (AND/ OR, like do24) can be adjusted with parameter do41. Parameter do42 is used for inverting one or several outputs. The output signals are assigned to the terminals with do51. ru.80 serves for the display of the digital output state, thereafter ru25. The internal outputs OA...OD are directly connected with the internal inputs IA...ID.
All switching conditions and flags are set-programmable. The appropriate comparison level (parameters LE00...LE07) must be adjusted to many switching conditions (parameters do00...do07). Switching conditions (do00...do07) can be connected simultaneously with different flags.

9.16 Output signals / Hardware

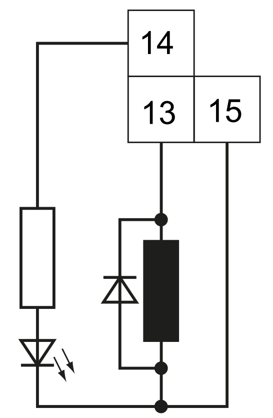


Figure 9.10 Transistor outputs

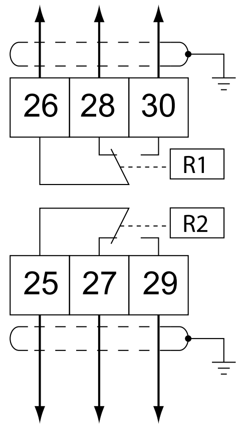


Figure 9.11 Relay outputs

The total current of X2A.13 or X2A.14 is limited to 50mA. In case of inductive load at the relay outputs or at the transistor output a protective wiring is to be provided (free-wheeling diode)!

9.17 Output filter (do43, do44)

A filter can be set for switching condition 0 with do43. With do44 for switching condition 1. The change of a switching condition must be applied for the filter time, then it becomes active at the output of the filter. If the change is cancelled during the filter time the filter time is reset and restarted with the next change. The filter time can be adjusted in a range of 0 (off)...1000 ms.

9.18 Switching conditions (do00...do07)

From the following switching conditions one can select up to 8 for further processing. The values are entered in parameters do00...do07.

do00...do07: switching conditions		
Value	Function	Description
0	always switched-off	Switching condition never fulfilled
1	always active	Switching condition always fulfilled
2	Run signal	Drive is running and there is no malfunction (also set if modulation generally released, but temporary blocked by for example "motor de-excitation").
3	ready (no error)	Drive is ready for operation (inverter state without error).
4	error message	There is an error message (inverter state equal to error).
5	error mess./no ar.	Is not set for errors for which an automatic restart is programmed.
6	err.mess./abn.stopping	Warning or error message is also issued when the inverter fulfils an abnormal stopping condition (ru00).
7	OL warning	ru39 is an overload counter, counting in steps of 1%. On reaching 100 % the inverter switches off. Upon exceeding of level Pn09 (default 80 %) the overload warning is given. The performance in case of a warning can be adjusted with Pn08 (response to OL-warning).
8	OH warning	Overheating-prewarning (OH)! Depending on the power circuit the inverter switches off between 60...95°C heat sink temperature. The prewarning is output, when the level OH-warning (Pn11) is reached (default 70 °C). The performance in case of a warning can be adjusted with Pn10 (response to OL-warning).
9	dOH warning	PTC-prewarning (dOH), on tripping of the motor-PTC connected to the terminals T1/T2. The inverter switches off with E.dOH after expiration of an adjustable delay time Pn13 (0...120s). The behaviour in case of a warning can be adjusted with Pn12 (response to dOH-warning).
10	OH2 warning	Motor protection pre-warning (OH2), if the defined motor protection release time according VDE has expired. The behaviour in case of a warning can be adjusted with Pn14 (warning OH2 stop. mode).
11	OHI warning	Interior temperature-prewarning (OHI) is output if the interior temperature of the inverter exceeds the level OHI-warning. The behavior can be adjusted with Pn16 (response to OHI-warning).
12	error AN1 4...20mA	Cable breakage at 4...20mA setpoint setting at An01 or An02. Trips, if the setpoint current drops below 2mA.
13	error AN3 4...20mA	
14	stall (I > Pn20)	Pn20 „Stall level “ exceeded (only for v/f characteristic-controlled operation).
15	LAD stop	Ramp is stopped (LA-/LD-Stop active). Pn24 „LAD load level“ or Pn25 „LD voltage“ exceeded at acceleration/deceleration.
16	DC-braking	DC voltage-braking active
continued on the next page		

do00...do07: switching conditions		
Value	Function	Description
17	power off	The state of the inverter is „Power-off function active“.
18	brake control	The output is used for brake control. The output becomes active if the brake is to be ventilated.
19	speed ctrl. diff. > level	ru02 „ramp output display“ – ru07 „actual value display“ > switching level
20	act. value = set value	Is set, if parameter ru07 „actual value display“ is in a window of +/- LE16 „Freq/speed hysteresis“ around ru01 „set value display“. Not set in state "no control release" or "standstill". The state of the condition is undefined if the ramp generator is deactivated by another function (e.g. speed search, DC braking, etc.).
21	acceleration	Ramp generator is in phase forward acceleration, reverse acceleration or acceleration stop.
22	deceleration	Ramp generator is in phase forward deceleration, reverse deceleration or deceleration stop.
23	act. rot. = set rot.	The directions of rotation at the input and at the output of the ramp generator are equal. The sign of ru02 „ramp output display“ is identical with the sign of ru01 „set value display“.
24	act. utilization > level	utilization (ru13) > switching level
25	abs.val.act.curr. > level	abs. value active current (ru17) > switching level
26	DC voltage > level	actual DC voltage ru18 > switching level
27	actual value > level	Actual value display (ru07) > switching level
28	set value > level	Set value display (ru01) > switching level (only valid if the ramp generator is active)
29	reserved	
30	act. torque > level	Actual torque > switching level
31	abs. value AN1 > level	Absolut value AN1 / AN2 at theoutput of the characteristic amplifier > switching level
32	abs. value AN2 > level	
33	reserved	
34	AN1 > level	AN1 / AN2 at the output of the characteristic amplifier > switching level (with sign evaluation)
35	AN1 > level	
36	reserved	
37	timer 1 > level	ru43 „Timer 1 display“ or ru44 „Timer 2 display“ > switching level
38	timer 2 > level	
39	reserved	
40	hardw.curr.limit active	Protective function „hardware current limit“ is active
41	modulation on	is set, if the modulation is active
42	ANOUT3 PWM	Output of the analog signal ANOUT3 or ANOUT4 as PWM signal. The period can be adjusted with parameter An46 or An52.
43	ANOUT4 PWM	
44	inv.status (ru00) = level	Number of the inverter state (e.g. 18 at error! Watchdog) = switching level
45	pow. mod. temp. > level	Heat sink temperature > switching level
46	motortemp. > level	Motor temperature > switching level
continued on the next page		

<table>
<tr><th colspan="3">do00...do07: switching conditions</th></tr>
<tr><th>Value</th><th>Function</th><th>Description</th></tr>
<tr><td>47</td><td>ramp output val. (ru02) > level</td><td>Value ramp output display (ru02) > switching level</td></tr>
<tr><td>48</td><td>apparent current (ru15) > level</td><td>Apparent current (ru15) > switching level</td></tr>
<tr><td>49</td><td>rot. forward</td><td rowspan="2">actual direction of rotation forward or reverse (only set if the ramp generator is active).</td></tr>
<tr><td>50</td><td>rot. reverse</td></tr>
<tr><td>51</td><td>OL2 warning</td><td>Upon exceeding of level Pn09 (default 80 %) the overload warning is given. The performance in case of a warning can be adjusted with Pn08 (response to OL-warning).</td></tr>
<tr><td>52</td><td>I-control limit active</td><td>I-control limit active</td></tr>
<tr><td>53</td><td>n-control limit active</td><td>n-control limit active</td></tr>
<tr><td>54...58</td><td>reserved</td><td></td></tr>
<tr><td>59</td><td>dig.in (ru22) AND level</td><td rowspan="4"><table><tr><th>Function</th><th>Switching condition met if:</th></tr><tr><td>AND</td><td>all selected inputs are active</td></tr><tr><td>or</td><td>at least one selected input is active</td></tr><tr><td>NAND</td><td>at least one selected input is inactive</td></tr><tr><td>NOR</td><td>all selected inputs are not active</td></tr></table>The selection of inputs to be linked occurs via the comparison level parameters LE00...LE07.<table><tr><td>Input</td><td>ST</td><td>RST</td><td>F</td><td>R</td><td>I1</td><td>I2</td><td>I3</td><td>I4</td><td>IA</td><td>IB</td><td>IC</td><td>ID</td></tr><tr><td>Value</td><td>1</td><td>2</td><td>4</td><td>8</td><td>16</td><td>32</td><td>64</td><td>128</td><td>256</td><td>512</td><td>1024</td><td>2048</td></tr></table>The sum of the inputs to be queried is entered in the switching levels.
Example: If R and I1 shall be linked for condition 0 F, value 4 + 8 + 16 = 28 must be entered in LE00.</td></tr>
<tr><td>60</td><td>dig.in (ru22) OR level</td></tr>
<tr><td>61</td><td>dig.in (ru22) NAND level</td></tr>
<tr><td>62</td><td>Inputs in NOR-operation (ru22)</td></tr>
<tr><td>63</td><td>abs.val. ANOUT2 > level</td><td rowspan="2">Amount of ANOUT1 (amount of ru34 „ANOUT1 post ampl. display) or ANOUT2 (amount of ru36 „ANOUT2 post ampl. display) higher than the switching level</td></tr>
<tr><td>64</td><td>abs.val. ANOUT2 > level</td></tr>
<tr><td>65</td><td>ANOUT2 > level</td><td rowspan="2">ANOUT1 (ru34 „ANOUT1 post ampl. display) or ANOUT2 (ru36 „ANOUT2 post ampl. display) higher than the switching level</td></tr>
<tr><td>66</td><td>ANOUT2 > level</td></tr>
<tr><td>67...68</td><td>reserved</td><td></td></tr>
<tr><td>69</td><td>ext.PID ctrl.diff > level</td><td>Amount of the system deviation of the external PID controller> switching level</td></tr>
<tr><td>70</td><td>driver VCC active</td><td>The driver voltage for the control of power modules is active for inverters with safety relay.</td></tr>
<tr><td>71...72</td><td>reserved</td><td></td></tr>
<tr><td>73</td><td>abs.val. act.power > level</td><td>Amount ru81 „active power“ > switching level</td></tr>
<tr><td>74</td><td>active power > level</td><td>ru81 „active power“ > switching level</td></tr>
<tr><td>75...79</td><td>reserved</td><td></td></tr>
<tr><td>80</td><td>active current > level</td><td>ru17 „active power“ higher than the switching level (sign of ru17 is considered).</td></tr>
<tr><td colspan="3">continued on the next page</td></tr>
</table>

do00...do07: switching conditions		
Value	Function	Description
81	reserved	
82	act.value ch.2 > level	Amount ru10 „encoder 2 speed“ > switching level.
83	reserved	
84	act.val. < min. ref. op.06/07	Amount ru07 „actual value display“ is smaller than oP06 „min. reference forward“ or oP07 „min.reference reverse“.
85	EF warning	Der Eingang, der „Warnung! externer Eingang“ oder „Fehler! externer Eingang“ auslöst, ist aktiv (Status des Umrichters hat keinen Einfluss).
86	BUS warning	The watchdog (watchdog internal bus Sy09 or watchdog time Pn06) has triggered (status of the drive has no effect).
87	ACC warning	The acceleration has exceeded the value of parameter Pn79 „acceleration limit (1/s)^2“. Pn80 „acceleration scan time“ determines the period over which the acceleration is averaged. For calculation the speed difference must be converted from rpm to 1/s. *
88	warning pow.unit + drive	Pre-warning level for an overload protection function, which monitors the motor or the inverter, is exceeded. The warning messages 7(OL), 8(OH), 9(dOH), 11(OHI), 10(OH2), 51(OL2) are combined in this switching condition (OR-connected). Additionally this switching condition has the following function: If „auto retry E.UP“ is activated in Pn00 and if a time limit for the restart function is adjusted in Pn76 „max. time E.UP warning“, the switching condition is active during the warning time (i.e. the time when an automatic restart would be carried out).
89	act.value < level*ref.val.	ru07 „actual value display“ is smaller than switching level / 100 x ru02 „ramp output display“. This switching condition is not active when the modulation is switched off and special functions e.g. speed search.
90	motortemp.corr. >level	The switching condition is met when the motor temperature for the Rs correction (dr51) is higher than the switching level.
91	reserved	
92	quick stop	Switching condition is set at active quick stop function.
93...95	reserved	
96	blockade active	The setpoint must be above the level of Pn86. If the actual value is below the level, a counter is incremented as long as the time "blockade waiting time" (Pn87) has elapsed.
97...98	reserved	
99	flow control warning	The switching condition is set if there is an error in the flow control or if there is no flow or constant flow for the adjusted deceleration time (Pn94).
100	combination of sev. cond	Combination condition; Error or OL-pre-warning or OH-pre-warning or ((Status POFF or PLS) and Fout=0Hz).
101	halt after DC-brake > lev.	Switching condition „101“ is set at „halt after DC brake > level“. I.e. the switching condition is met when the DC braking is completed and the mean value of the apparent current during DC braking is higher than the adjusted level referring to the rated current.

$$\text{* acceleration} = \frac{\text{Speed change during scan time (in rpm)}}{\text{60 x scan time (in seconds)}}$$

Switching level 0...7, LE00...LE07
These parameters define the levels of the switching conditions.
Level 0 (LE00) applies for switching condition 0; LE01 for switching condition 1 ... and so forth.

Hysteresis 0...7, LE08...LE15
The hysteresis based on the adjusted values determine parameters LE08...LE15.
Hysteresis 0 (LE08) applies for switching level 0; LE09 for switching level 1... etc.

Frequency- / speed hysteresis LE16
LE16 defines the hysteresis for the status constant run

9.19 Inverting of switching conditions for flags 0...7 (do08...do15)

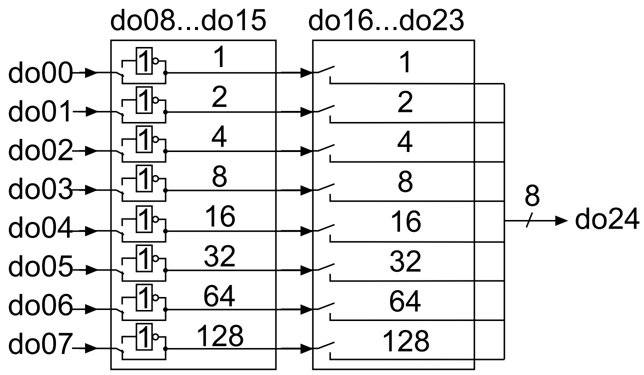


Figure 9.12 Inverting and selecting the switching conditions

With parameters do08...do15 each of the 8 switching conditions (do00...do07) can be inverted separately for each flag. With this function it is possible to set any chosen switching condition as non-condition. The parameter is bit-coded. According to Fig. 9.12 the weighting for the switching condition must be entered in do08... do15. If several conditions shall be inverted, the sum is to be formed.

Example:
Output X2A.13 shall be set when the inverter is not accelerating! In this case we assign switching condition 21 (inverter accelerates) e.g. to do.01 (enter value 21). Inverting of condition do01 with do09, enter value „2“.

9.20 Selection of the switching conditions for flags 0...7 (do16...do23)

Parameter do16...do23 serve for the selection of the 8 preassigned switching conditions. The selection is done for each flag separately, where one can choose between no one and up to all 8 switching conditions. The value of the selected switching conditions must be entered in do16...do23 in accordance with Fig. 9.13. If several conditions shall be inverted, the sum is to be formed.

9.21 AND / OR connection of the switching conditions (do24)

After the switching conditons are selected for each output, now it can be determined how these are connected. As default all conditions are OR connected, i.e. if one of the selected conditions is fulfilled, the flag is set. Another possibility is the AND connection which can be adjusted with do24 do. AND connection means that all selected conditions must be fulfilled before the flag is set. Parameter do24 is bit-coded. Figure 9.12 displays the assignment of the flags.

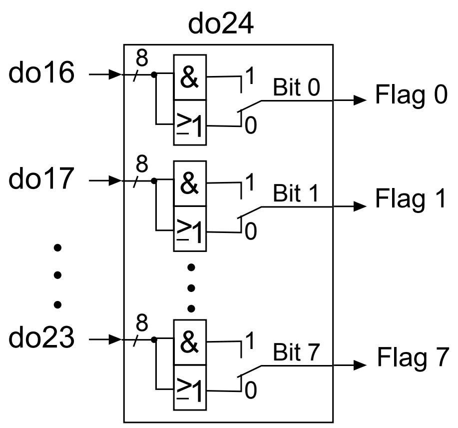


Figure 9.13 Linking the switching conditions in logic step 1

9.22 Inverting of flags (do25...do32)

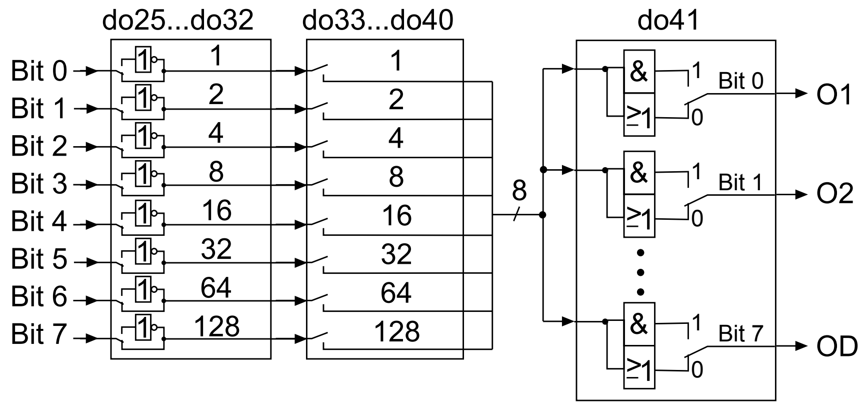


Figure 9.14 Inverting and selection of flags

With parameters do25....do32 each of the 8 flags (bit 0...7) from logic step 1 can be inverted separately.

With this function it is possible to set any chosen flag as inverted flag. The parameter is bit-coded. According to Fig. 9.14 the weighting of the flag to be inverted must be entered in do25...do32. If several flags shall be inverted, the sum is to be formed.

9.23 Selection of flags (do33...do40)

A selection of flags of the first logic step can be made in the second logic step. The selection is done for each output separately, where one can choose between none and up to all 8 flags. The value of the selected flags must be entered in do33...do40 in accordance with Fig. 9.14. The sum is to be formed if several flags shall be selected.

9.24 AND / OR connection of the flags (do41)

After the flags are selected for each output, now it can be determined how these are linked. As default all flags are OR connected, i.e. if one of the selected flags is set, the output switches. Another possibility is the AND connection which can be adjusted with do24 do.. AND connection means, all selected flags must be set before the output switches.

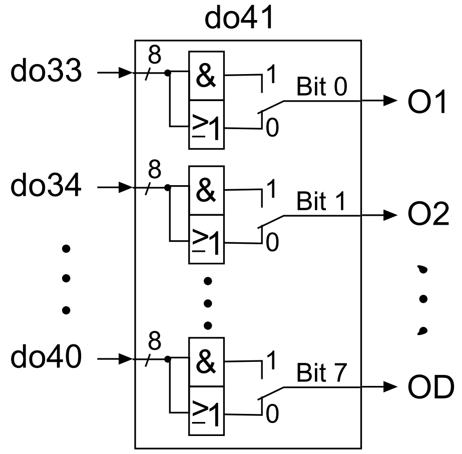


Figure 9.15 Linking the outputs

As shown in Fig.9.16 the outputs can be inverted again after linking with parameter do42. Parameter do42 is bit-coded, i.e. the value corresponding to the output must be entered (according to the following picture). If several outputs shall be inverted, the sum is to be formed.

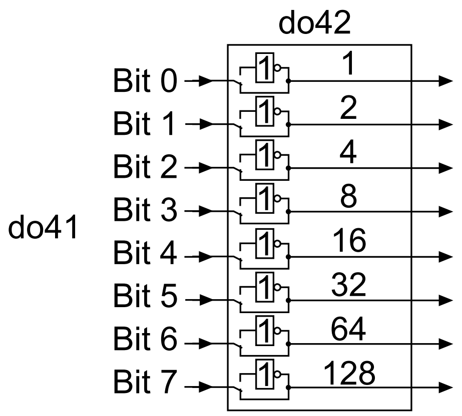


Figure 9.16 Inversion of Outputs

9.25 Output terminal state (ru25) and digital output state (ru80)

Parameter ru25 displays the logic condition of the digital outputs after the allocation by parameter do51 . Parameter ru80 displays the logical condition before the allocation . If an output is set, the appropriate decimal value is output (see table)

ru25: output terminal state			
Bit	Value	Name	Function
0	1	O1	Transistor output
1	2	O2	Transistor output
2	4	R1	Relay output
3	8	R2	Relay output
4	16	OA	Internal output
5	32	OB	Internal output
6	64	OC	Internal output
7	128	OD	Internal output

9.26 Hardware output allocation (do51)

The output signals are allocated to output terminals O1, O2, R1 and R2 with do51. The assignment is done according to following table:

<table>
<tr><th colspan="5">do51: hardware output allocation</th></tr>
<tr><th>Bit</th><th>Value</th><th>Signal</th><th>Output</th><th>Default</th></tr>
<tr><td rowspan="4">0...1</td><td>0</td><td>O1</td><td rowspan="4">O1 (terminal 13)</td><td>X</td></tr>
<tr><td>1</td><td>O2</td><td></td></tr>
<tr><td>2</td><td>R1</td><td></td></tr>
<tr><td>3</td><td>R2</td><td></td></tr>
<tr><td rowspan="4">2...3</td><td>0</td><td>O1</td><td rowspan="4">O2 (terminal 4)</td><td></td></tr>
<tr><td>4</td><td>O2</td><td>X</td></tr>
<tr><td>8</td><td>R1</td><td></td></tr>
<tr><td>12</td><td>R2</td><td></td></tr>
<tr><td rowspan="4">4...5</td><td>0</td><td>O1</td><td rowspan="4">R1 (terminal 26, 28, 30)</td><td></td></tr>
<tr><td>16</td><td>O2</td><td></td></tr>
<tr><td>32</td><td>R1</td><td>X</td></tr>
<tr><td>48</td><td>R2</td><td></td></tr>
<tr><td rowspan="4">6...7</td><td>0</td><td>O1</td><td rowspan="4">R2 (terminal 25, 27, 29)</td><td></td></tr>
<tr><td>64</td><td>O2</td><td></td></tr>
<tr><td>128</td><td>R1</td><td></td></tr>
<tr><td>192</td><td>R2</td><td>X</td></tr>
</table>

9.27 Programming example digital outputs

For better understanding the correlations are deepened in the following example.
Following conditions are required:

- Condition 1: Output X2A.13 switches, if the inverter accelerates
- Condition 2: Relais X2A.25...27 switches, if the inverter load is > 100 %
- Condition 3: Relay X2A.28...30 switches, if the actual value is > 100 %
- Output X2A.14 switches, if the conditions 2 and 3 are realized, but the inverter does **not** accelerate.

Solution proposal:

Adjust switching conditions, levels and hysteresis
First adjust the switching conditions and levels.
set do00 to „21“ (inverter accelerates),
set do01 to „24“ (utilization > level); set LE01 to „100“ (utilization level for do01 100 %); set LE09 to „5“ (5 % hysteresis for comparison level 1; not required but reasonable for optimal switching performance),
set do02 to „27“ (actual value > level); set LE02 to „4“ (frequency level for do02); set LE10 to „0.5“ (0.5 Hz hysteresis for comparison level 2; not required but reasonable for optimal switching performance).

Select switching conditions
set do16 to „1“ (switching condition from do00 is evaluated),
set do17 to „2“ (switching condition from do01 is evaluated),
set do18 to „4“ (switching condition from do02 is evaluated),
set do08, do09 and do10 to „0“ (no inversion).

The setting of do24 is independent for this example, since only one condition each is set at do16...do18.

Adjust flags
Output O1 (terminal X2A.14)
set do33 to „7“ (flag 1, 2 and 3 are evaluated)
set do25 to „1“ (flag 1 is inverted, i.e. the condition is fulfilled if the inverter does not accelerate).
set do41 to „1“ (the flags selected with do33 are AND connected)

Output O2 (terminal X2A.13)
set do34 to „1“ (flag 1 is evaluated).
set do26 to „0“ (no inversion)
The adjustment of do41 is independent for this example, as only one flag is adjusted at do36.

Relay output R1 (terminal X2A.25...27)
set do35 to „2“ (flag 2 is evaluated).
set do27 to „0“ (no inversion)
The adjustment of do41 is independent for this example, as only one flag is adjusted at do36.

Relay output R2 (terminal X2A.28...30)
set do36 to „4“ (flag 3 is evaluated).
set do28 to „0“ (no inversion)
The adjustment of do41 is independent for this example, as only one flag is adjusted at do36.

10. Setpoint-, Rotation- and Ramp Setting

The examples described in this chapter refer to speed or frequencies.

10.1 Short description of the setpoints

The setpoints of the KEB COMBIVERT G6 can be preadjusted analog as well as digital. The AUX-function adds or multiplies an analog setpoint with other setpoint settings.
The setpoint and rotation selection links the different setpoint sources with the possible rotation sources. The obtained signal is used for further setpoint calculation.
Only after scanning the absolute setpoint limits, all data are available which are necessary for the ramp calculation.

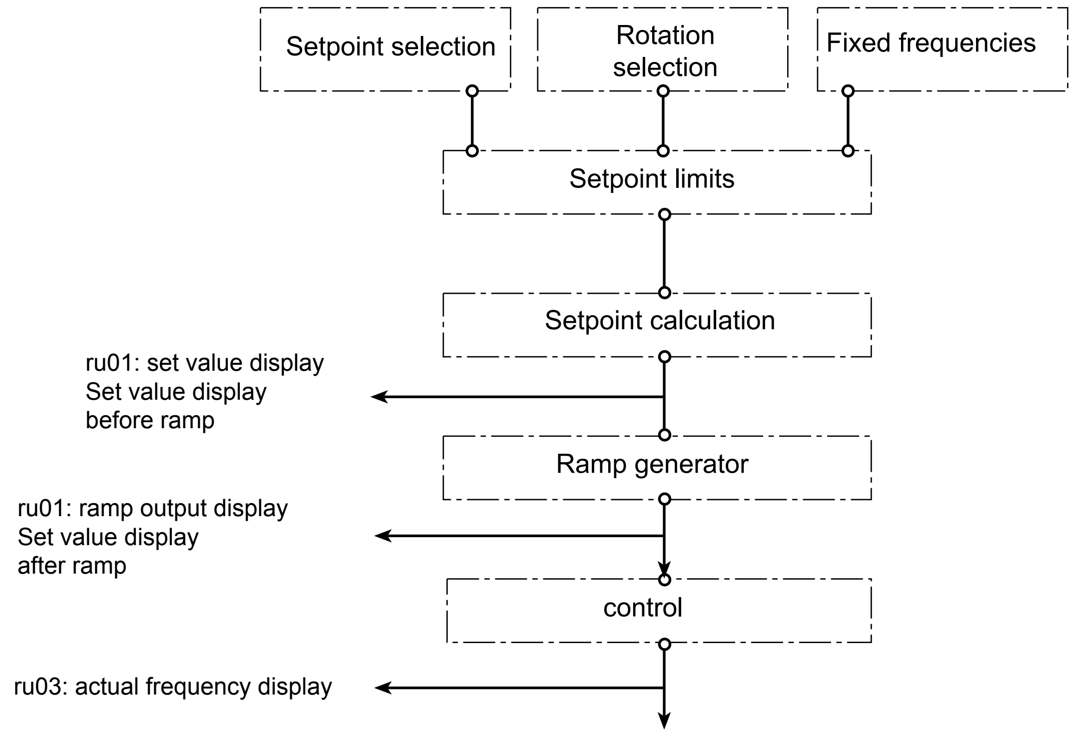


Figure 10.1 Principle of the setpoint and ramp presetting

10.2 Reference source oP00

oP00: reference source		
Value	Function	Notice
0: Analog input REF	Setting of the speed setpoint via REF or AUX input. 0% corresponds to the „min. reference“ (oP06 at forward / oP07 at reverse rotation) +100% corresponds to the „max. reference“ (oP10 at forward / oP11 at reverse). If the rotation direction is determined by the sign of the setpoint, then positive values and 0 represent forward rotation, negative values represent reverse rotation.	The selection of a hardware analog input as REF is done via parameter An30 „sel. REF inp./ AUX funct.“ factory setting: AN1 is the REF input. The selection of how the AUX input value is calculated is also done via An30. Factory setting: AN2 is the AUX input.
1: analog AUX		
2: digital absolute (oP03)	The value of oP03 „reference setting“ is used as speed setpoint.	The value range and the resolution depend on the setting of the speed mode in parameter Ud02 „control type“.
3: digital in % (oP76)	The percentage value in oP05 "reference setting" is used for the speed setpoint.	Calculation of the speed setpoints from the percentage values occurs similarly as for the REF or AUX input.
4: motorpoti (ru37)	The percentage value oP52 „motorpoti value" is used as speed setpoint (for more on motorpoti function see chapter 20).	
5: set speed value (Sy52)	The value of Sy52 „set speed value“ is used as speed setpoint.	In v/f characteristic operation (G6L-G, and G6P-G) Parameter dr01:DASM rated speed must be correct adjusted in order that the frequency is correct calculated.
6: ext. PID output (ru52)	The percentage output value of the PID controller (ru52 „ext. PID output display“) is used as speed setpoint.	Calculation of the speed setpoints from the percentage values occurs similarly as for the REF or AUX input.
7: reserved		
8: speed acquisition 2	Channel 2 is an initiator input and can not be used as speed feedback or for the motor model. Channel 2 is not available for all devices.	
9: reserved		
10: high resolution in % (oP63)	Setting of the speed setpoint by oP63 "ref. value high-res.".This mode must be used if the default speed resolution is not sufficient.	Configuration of the high resolution and calculation of the speed setpoint from parameters oP63 / oP64 see description.
11: digital absolute (oP03)	The value of oP75 „ref. setting all sets“ is used as speed setpoint.	Calculation of the speed setpoints from the percentage values occurs similarly as for the REF or AUX input. Attention: writing in all sets!
12: digital in % (oP76)	The percentage value in oP76 „reference setting % all sets“ is used as speed setpoint.	

further on next side

Other functions like quick stop or fixed frequency have priority over "standard operation" and can therefore lead to different speed setpoints than selected in oP00.

10.3 Rotation source oP01

The rotation selection determines the manner in which the rotation direction is preset. The following possibilities are available:

oP01: rotation source	
Value	Function
0	digital (oP02); 0-limited
1	digital (oP02); absolute
2	terminals FOR / REV; 0-limited
3	terminals FOR / REV; absolute
4	terminal Start / Stop; 0-limited
5	terminal Start / Stop; absolute
6	reference, LS
7	reference, no LS
8	ctrl.word (Sy50), 0-lim.
9	ctrl.word (Sy50), abs.
10	ref. ctrl.word (Sy50), R/S

Rotation setting 0-limited or absolute
Concerning the adjustment of direction of rotation it is differentiated between two evaluations:

Rotation setting 0-limited:
negative setpoints are set to zero, i.e. only positive setpoints are driven in accordance with the selected rotation direction

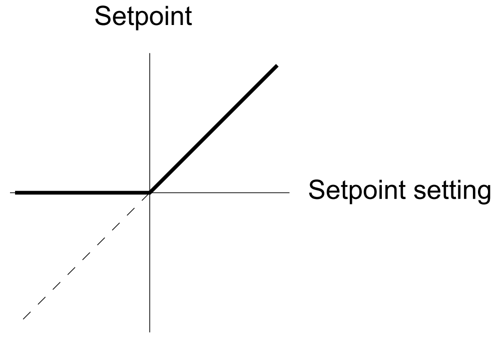


Figure 10.2 0-limited

Rotation setting absolute:
no sign of the set value is evaluated and it is always driven with the amount in accordance with the selected rotation direction.

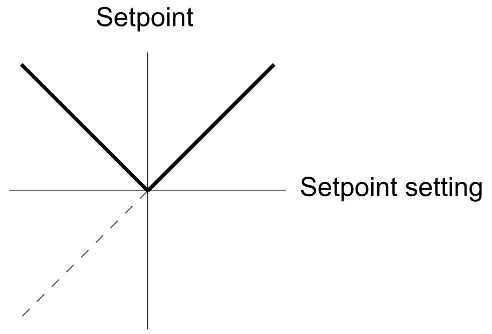


Figure 10.3 absolute

Rotation setting oP02; (oP01 = 0 or 1)

oP02: rotation setting	
Value	Setpoint rotation
0	standstill (low speed)
1	forward
2	reverse

Rotation adjustment via terminal strip
The rotation selection via terminal strip allows the adjustment of the direction of rotation via switch or from a primary control.

Direction forward input selection (run / stop) oP60, reverse (forward / reverse) oP61
Parameter oP.60 defines one input for rotation direction forward (or run/stop) and parameter oP.61 defines one input for rotation direction reverse (or forward/reverse). (see chapter 9)

oP01 = „2“ or „3“
The inputs defined with oP60 and oP61 operate as follows at rotation setting forward/reverse (oP01 = „2“ or „3“):

forward	reverse	Input
F	R	Function
0	0	LS
0	1	reverse
1	0	forward
1	1	forward

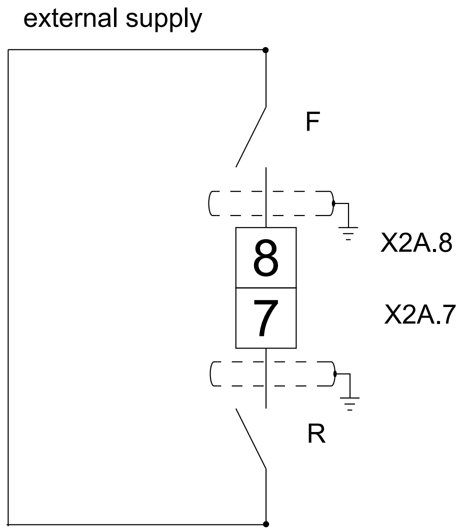


Figure 10.4 oP01 = value 4 or value 5

oP01 = „4“ or „5“
The inputs defined with oP60 and oP61 operate as follows at rotation setting run / stop and forward/ reverse (oP01 = „4“ or „5“):

forward	reverse	Input
F	R	Function
0	0	LS
0	1	LS
1	0	forward
1	1	reverse

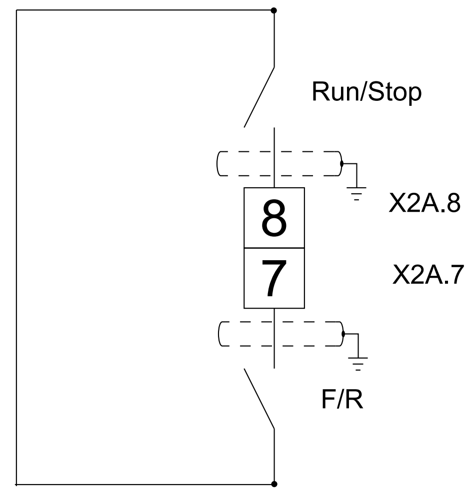


Figure 10.5 oP01 = value 4 or value 5

Rotation direction is dependent on the sign of the set value
The direction of rotation can be defined with the preadjusted set value signal. In the case of analog signals through adjustment of positive or negative voltages. In the case of digital signals through adjustment of positive values (without sign) or negative values (negative sign in the display).

The following adjustments are possible for the evaluation with LS

Evaluation with LS (switch off the modulation) (oP01 = 6, 10 or 11)
In this case „F“ or „R“ must be set via a digital input, digital via oP02 or "start" via control word Sy50 in order for the inverter to modulate. It is unimportant which rotation setting is used, because the direction of rotation is dependent on the setpoint.

oP01 = 10: The rotation direction release is done exclusively via the control word run/stop

No direction of rotation is set	->	LS (switched off)
direction of rotation is set and oP01 = 6 or 10	->	forward direction with positive setpoint
	->	reverse direction with negative setpoint

Evaluation without LS (oP01 = 7)
In this case the inverter modulates always. No direction of rotation must be set.

oP01 = 7:	positive setpoints (also 0)	->	forward direction of rotation
	negative setpoints	->	reverse direction of rotation

Direction of rotation dependent on the inverter control word Sy50 (oP01 = 8 or 9)
The control word is used for the state control of the inverter via fieldbus. In order for the inverter to react to the control word, the respective control process must be enabled (oP01 = 8 or 9). When setting the direction of rotation via the control word, the setpoint can be evaluated 0-limited (oP01 = 8) or absolute (oP01 = 9).

Sy50: control word low		
Bit	Function	Description
2	run / stop	0 = set direction of rotation stop; 1 = set direction of rotation run (set rotation source oP01 = 6, 8, 9 or 10)
3	For / Rev	0 = set direction of rotation forward; 1 = set direction of rotation reverse (set rotation source oP01 = 6, 8, 9 or 10)

If run / stop is to be adjusted via the control word, oP02 must be set to "0". Terminals F/R may not be wired (OR-connection of terminal oP02 and Sy50).

10.4 Deceleration of the rotation correction

oP16 rotation delay time	
Value range	Function
0.0...10.00	Adjustable deceleration time

The function can be switched off with the value oP16 = 0.
If the function is activated, the new direction of rotation is disabled for the adjusted time, the inverter decelerates and changes if necessary to LS.
If the same direction of rotation is deactivated and then activated, the time will not expire.
oP16 is set to 2.00 s in the following example:

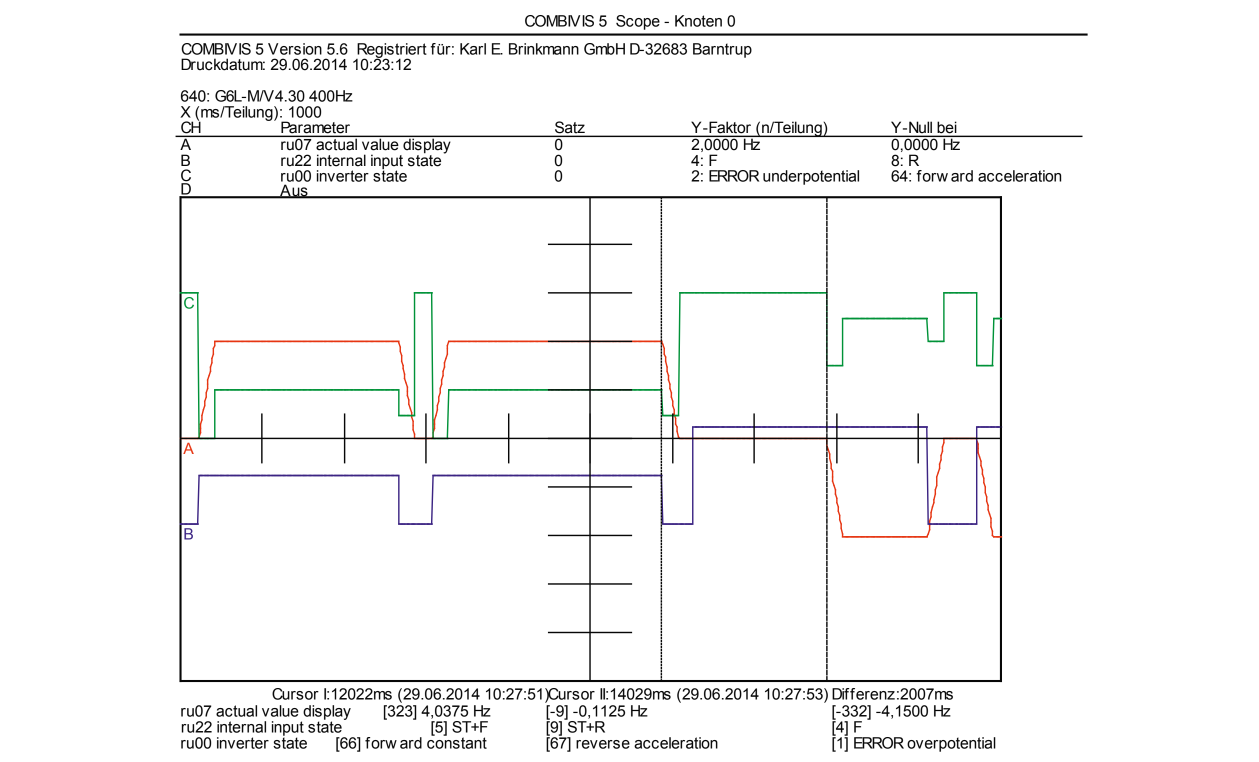


Figure 10.6 Deceleration of rotation reversal

10.5 Step values (oP18...oP23)

The KEB COMBIVERT supports up to 3 fixed frequencies for each parameter set, which can be selected binary-coded via two digital inputs. The inputs required for the selection are defined with oP19 and oP20 (see also chapter "Assignment of the inputs"). The rotation source for the step values is defined with oP18. The adjustment is independent of oP01 and is valid exclusively for the fixed frequencies. The setting of a fixed frequency has priority over the "normal" setpoint setting.

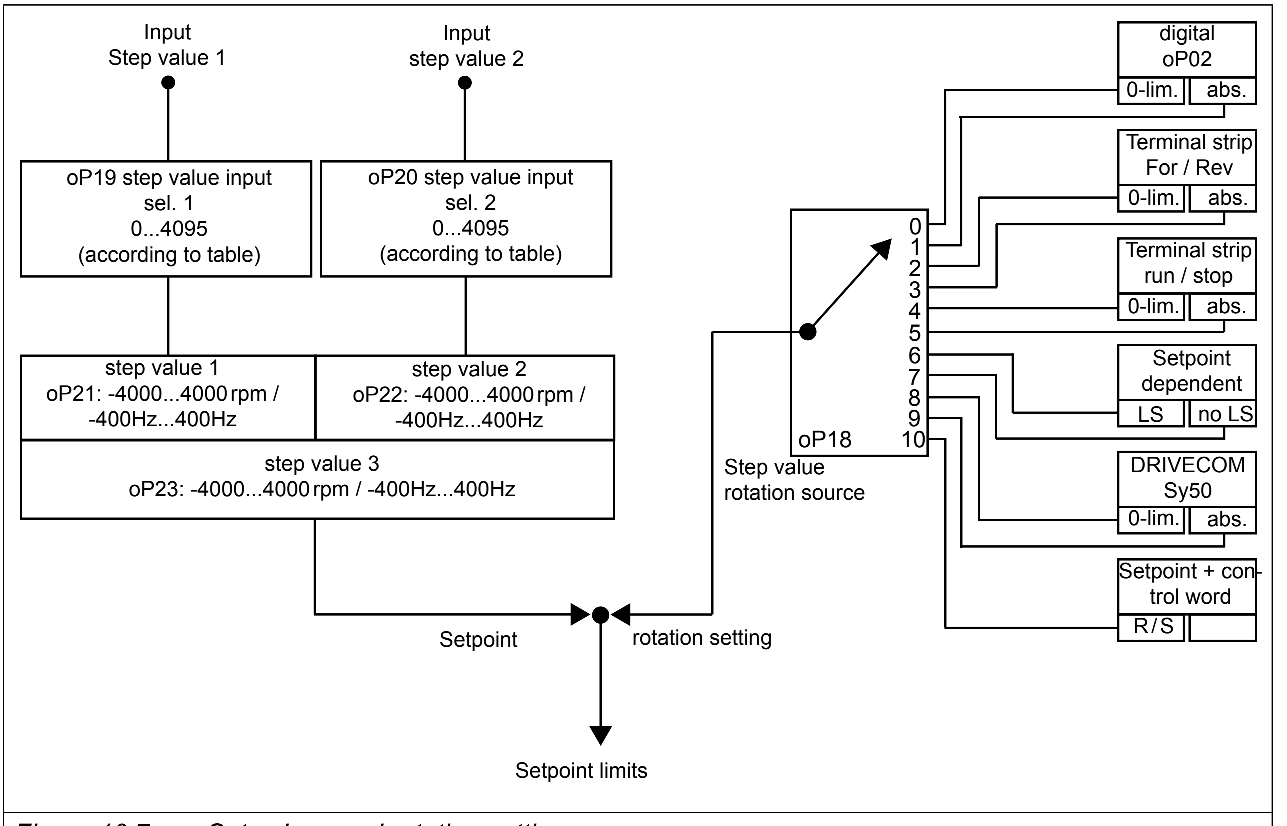


Figure 10.7 Set values and rotation setting

Selection of fixed values

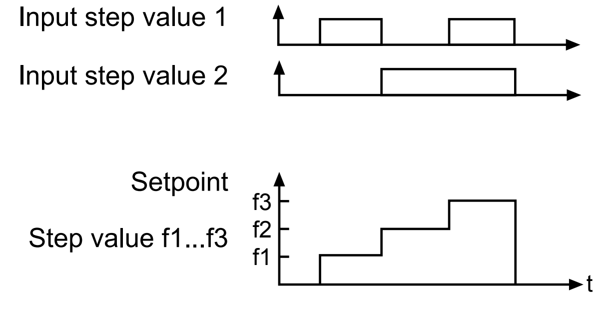


Figure 10.8 Selection of fixed values

Step value rotation source (oP18)
The rotation source is determined with oP18 at active fixed value. The function and the value range correspond to oP01.

oP18: step value rot. source	
Value	Function
0	dig. oP02, 0-lim.
1	dig. oP02, abs.
2	FOR/REV, 0-lim.
3	FOR/REV, abs.
4	terminal Start / Stop; 0-limited
5	terminal Start / Stop; absolute
6	reference, LS
7	reference, no LS
8	ctrl.word (Sy50), 0-lim.
9	ctrl.word (Sy50), abs.
10	ref. ctrl.word (Sy50), R/S

Step value input selection 1 and 2 (oP19, oP20)
See chapter 9 "Digital inputs".

Step value 1...3 (oP21, oP22, oP23)
The 3 step values oP21...23 are set-programmable and can be adjusted in a range of -4000...4000 rpm / -400...400 Hz. The value range depends on the setting in parameter Ud02: control type.

10.6 Setpoint limits

Following limit values can be preset:

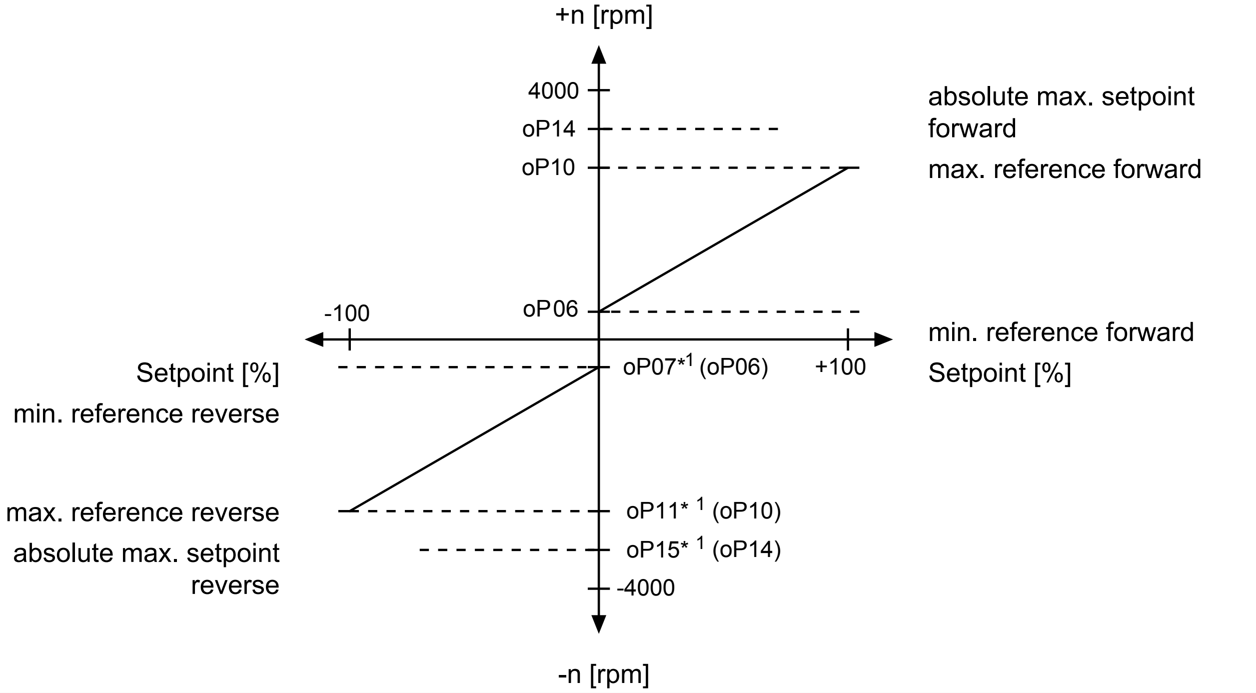


Figure 10.9 Setpoint limits

*1 If value "=For" is adjusted in these parameters (limit values rotation direction reverse), then the adjusted values for rotation direction forward (oP06, oP10 and oP14) are valid.

Min. / max. references (oP06, oP07, oP10, oP11)

In case of analog and setpoint setting in percent, the min. and max. references form the characteristic for the setpoint calculation (0% = min. reference; 100% = max. reference). In case of digital setpoint setting or fixed value the setpoint is limited by these parameters.Separate limits can be adjusted for both rotation directions. If the value "For" is adjusted for rotation direction "reverse", then the values for "forward" are valid.

Setting range:	oP06: 0...4000 rpm	Default: 0 rpm
	oP10: 0...4000 rpm	Default: 2100 rpm
	oP07: =For, 0...4000 rpm	Default: =forward
	oP11: =For, 0...4000 rpm	Default: =forward

The value range depends on the setting in parameter Ud02: control type.

Absolute max. reference (oP14, oP15)

The setpoint is limited by the abs. max. references (after min./max. references) and then output to the ramp generator. Since the analog setpoint is always calculated in relation to the max. reference (oP10, oP11) it is possible (despite different absolute max. references) to adjust the characteristic of the analog setpoint with the same ascent for both rotation directions (see Fig. 10.9). The absolute maximum speed of oP14 is valid for both directions of rotation if value -1 „For“ is adjusted in oP15.

Max. output value forward (oP40) / max. output value reverse (oP41)
All other limitations (oP10 / oP11 „max. reference“ and oP14 / oP15 „abs. max. reference“) limit only the speed setpoint.

The state „58: ERROR overspeed“ is triggered, if ru07 „actual value display“ exceeds either the value of oP40/ oP41 „max. output value“ or the value of ru79 „abs. speed value EMF“ (only for synchronous motors). The user defines limits with oP40 / oP41 that may not be exceeded by the application under any circumstances.
ru79 displays the abs. speed for a synchronous motor which, if exceeded, leads to an EMF of the motor high enough to damage the DC link circuit of the inverter.
Too small distance between maximum set value and speed limit can be the reasons for overspeed, thus overshoots can trigger an error. Other causes can be (e.g., caused by EMC) malfunctions in the speed measurement or a noisy, insufficiently smoothed speed estimate in the encoderless control (SCL or ASCL).

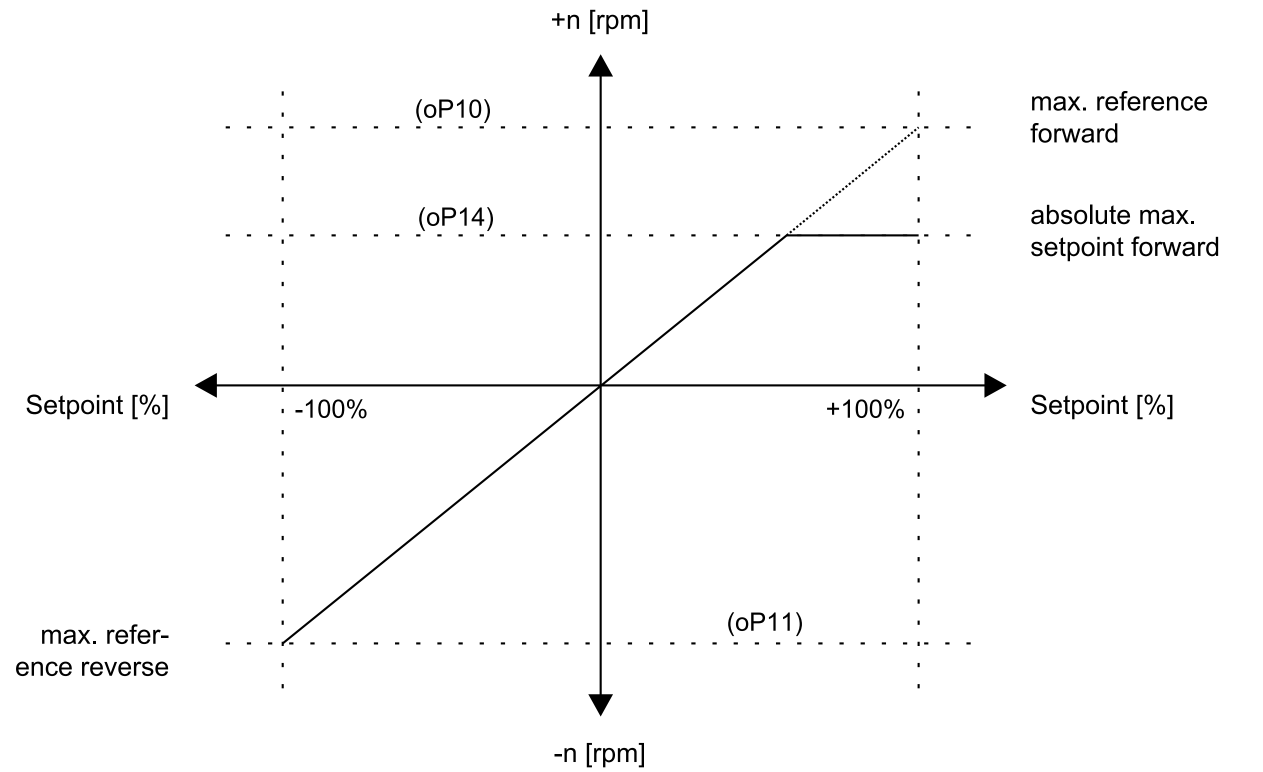


Figure 10.10 Setpoint limits

10.7 Setpoint calculation

The unit differentiates between two setpoint adjustments:

10.7.1 Setpoint adjustment in percent

With the adjusted setpoint limits the speed range 0%...100% is defined. In this case the adjustment of 0% corresponds to the minimal speed and 100% to the maximal speed.

The speed is calculated according to following formula:

$$\text{positive setpoint} = oP06 + (\text{setpoint setting [\%]} \times \frac{oP11 - oP07}{100\%})$$

$$\text{negative setpoint} = oP07 + (\text{setpoint setting [\%]} \times \frac{oP11 - oP07}{100\%})$$

10.7.2 Absolute setpoint setting

The setpoint is directly preset as speed or frequency and limited by the corresponding min. and max. setpoints as well as by the absolute max. setpoints.

10.7.3 Assignment of the setpoint sources

Setpoint adjustment in percent	Absolute setpoint setting
Terminal strip (analog setpoint)	Keyboard/bus absolute (oP03: digital setpoint setting)
Keyboard/ bus in % (oP05: reference setting in %)	Speed setpoint (Sy52: set speed value)
Motorpoti (oP52: motorpoti value)	Speed measurement
Technology controller (ru52: ext. PID output display)	

10.7.4 Fade out target for setpoint

Setpoint ranges are faded out with this function, in order to avoid resonances in the selected speed range. The target is pass through with the ramp. The setpoint value is always adjusted to the upper or lower limit of the target.

Parameter:

oP65: min.	prohibited reference 1
oP66: max.	prohibited reference 1
oP67: min.	prohibited reference 2
oP68: max.	prohibited reference 2

These parameters are not set-programmable. The adjusted values are accepted still as setpoint value, thus the function is not active in case that lower and upper limit have the same value. If a higher value is selected for the lower limit than for the upper limit, the function is also not active.

10.8 High-resolution setpoint setting

The high-resolution setpoint setting was introduced for applications that require higher resolution. To this end the setpoint is specified as 32-bit value. Since only a 16-bit value can be output, to the lower 16 bits of the ramp output value are added integer.
At overflow the output value is increased for one cycle (1 ms) (by 0.125 rpm in 4000 rpm mode).
This setpoint fluctuations are smoothed by the mechanics, which results in higher resolution in the middle.

There are two parameters in order to achieve the highest possible resolution for the application:

oP64 rel. value high-res.
Parameter oP64 adjusts the rel. value of the calculation and is dependent on Ud02.

oP63 ref. value high-res.
The factor for ref. value calculation is adjusted here:

$$\text{ref. value} = \frac{\text{oP63 x oP64}}{2^{30}}$$

That means: If value 230 is preset for oP63, the ref. value is equal to oP64 "rel. value high-res.“. The double rel. value can be adjusted as max. ref value.
The achievable high-resolution is calculated as follows:

$$\text{high-resolution} = \frac{\text{oP64}}{2^{30}}$$

If oP64 is set to 2000 rpm, to the half max. value (4000 rpm mode), there is a high-resolution of:

$$\text{high-resolution} = \frac{\text{oP64}}{2^{30}} = 1.86 \times 10^{-6}$$

This should be sufficient for all applications.
The setting value for oP63 is calculated as follows:

$$\text{oP63} = \frac{\text{required ref. value}}{\text{oP64}} \text{ x} 2^{30}$$

Example 1:

rel. value (oP64): 2000 rpm

required ref. value: 0.140624 rpm

$$oP63 = \frac{0.140624\,rpm}{2000\,rpm} \quad x2^{30} \quad = 75497$$

Example 2:

rel. value (oP64): 2000 rpm

required ref. value: 32.37843 rpm

$$oP63 = \frac{32.37843\,rpm}{2000\,rpm} \quad x2^{30} \quad = 17383037$$

10.9 Ramp generator

The ramp generator assigns an adjustable time to a speed change. The acceleration time (for pos. speed changes) and deceleration time (for neg. speed changes) can be preset separately for each direction of rotation.

10.9.1 acc dec mode

The different ramp functions can be adjusted separately for every speed change (acceleration forward, deceleration, forward ...etc). The selection is made with oP27 and is adjustable separately in each set.

Mode „constant ramp“ concerns to the standard ramp generator with defined acceleration, deceleration and jerk values (see chapter 10.7.2).

Mode „constant time“ is needed only in exceptional cases, if acceleration/deceleration shall be executed always independent of the setpoint in the same time (see chapter 10.7.3).

Mode „ogive run“ is a special form of the mode „constant ascent “, which is particulary suitable for lift and traversing drives (see chapter 10.7.4).

The more exact explanation of each operation mode is done in the respective sub-chapters.

oP27: acc dec mode			
Bit	Ramp	Value	Explanation
0, 1	forward acceleration	0: FACC constant ramp	Standard operation mode
		1: FACC constant time/act. reference	constant time
		2: FACC constant time/last cnst. ref.	Do not adjust!
		3: FACC ogive	Ogive run
2, 3	deceleration forward	0: FDEC constant ramp	Standard operation mode
		4: FDEC constant time/act. ref.	Do not adjust!
		8: FDEC c.t./last cnst. ref.	constant time
		12: FDEC ogive	Ogive run

continued on the next page

oP27: acc dec mode			
Bit	Ramp	Value	Explanation
4, 5	reverse acceleration	0: RACC const. ramp	Standard operation mode
		16: RACC const.time/act. ref.	constant time
		32: RACC c.t./last cnst. ref.	Do not adjust!
		48: RACC ogive	Ogive run
6, 7	reverse deceleration	0: RDEC const. ramp	Standard operation mode
		64: RDEC const.time/act. ref.	Do not adjust!
		128: RDEC c.t./last cnst. ref.	constant time
		192: VL ogive	Ogive run
8	All	0: Reference value constant	as indicated in Bit 0…7
		256: var. ramp reference (FOR: oP10, REV: oP11)	only constant ascent ogive run: variable (oP10 or oP11)

oP27 Bit 8
If the function is activated, oP10 is valid as reference value for the modes "constant ramp" and "ogive run" for forward direction and oP11 for reverse direction. The specified reference value is valid furthermore in the mode for constant time.

Limitations:
The scaling factor of the ramp time is very comprehensive. Therefore all involved parameters are accepted neither for analog setting nor as process data.
Since this has not been valid for oP10 and oP11, the following limitations exist for compatibility reasons:

- Analog setting of oP10
- oP10 or oP11 as process write date

The calculation of the ramp times is not executed with these settings, even if it is adjusted in oP27. The previous adjustment remains. The calculation is executed only after power on, at set copying and direct writing of the parameters.

10.9.2 Ramp with constant ascent

This mode is the KEB factory setting. The acceleration / deceleration values are defined with parameters oP28 to oP31.
The jerk (i.e. the permissible acceleration / deceleration change) is defined with parameters oP32...oP35 and oP70... oP73.

10.9.2.1 Linear ramps

The linear ramps are parameterized with parameters oP28 „acceleration time forward“, oP29 „acceleration time reverse“, oP30 „deceleration time forward“ and oP31 „deceleration time reverse":

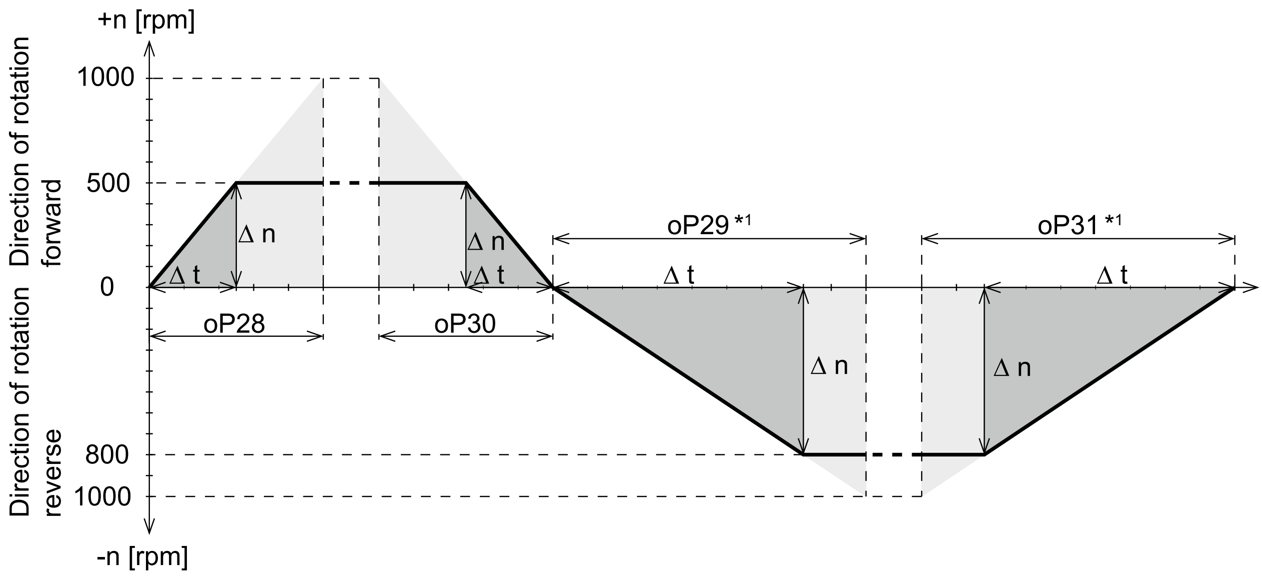


Figure 10.11 Acceleration and deceleration times

oP28	Acceleration time forward
oP29 *1	Acceleration time reverse
oP30 *2	Deceleration time forward
oP31 *1	Deceleration time reverse
Δ n	Speed change
Δ t	Acceleration time for Δn

*1 If value "=For" is adjusted in these parameters (acceleration and deceleration times for rotation direction reverse), then the values of rotation direction forward (oP28 and oP30) are valid.

*2 If the value „=Acc“ is adjusted, then the value of acceleration forward (oP28) is valid.

$$\frac{\text{ramp time to be adjusted (oP28...oP31)}}{\text{reference speed (depending on Ud02)}} = \frac{\text{required ramp time } (\Delta t)}{\text{speed change } (\Delta n)}$$

Reference speed = 1000 rpm in 4000 rpm mode (see chapter 5.1)
2000 rpm in 8000 rpm mode (see chapter 5.1)

Example:

A drive shall accelerate from 100 rpm to 1000 rpm in 5s
desired ramp time Δ t = 5 s
speed change Δ n = 900 rpm
4000 rpm mode reference speed = 1000 rpm
ramp time to be adjusted

$$\text{oP28} = \frac{5\text{ s} * 1000\text{ rpm}}{900\text{ rpm}} = 5.56\text{ s}$$

10.9.2.2 S-curve times

For certain applications it is of advantage when the drive starts and stops jerk-free. This function is achieved through a straightening of the acceleration and deceleration ramps.

Parameters oP32 „s-curve time acc. for.“ to oP35 „s-curve time dec. rev.“ and oP70 „s-curve up time acc. forward“ to oP73 „s-curve up time deceleration reverse“ define the time for acceleration / deceleration from 0 to the max. value or from the max. value to 0.

The max. value for acceleration / deceleration is defined by the linear ramp times oP28 .. oP31.

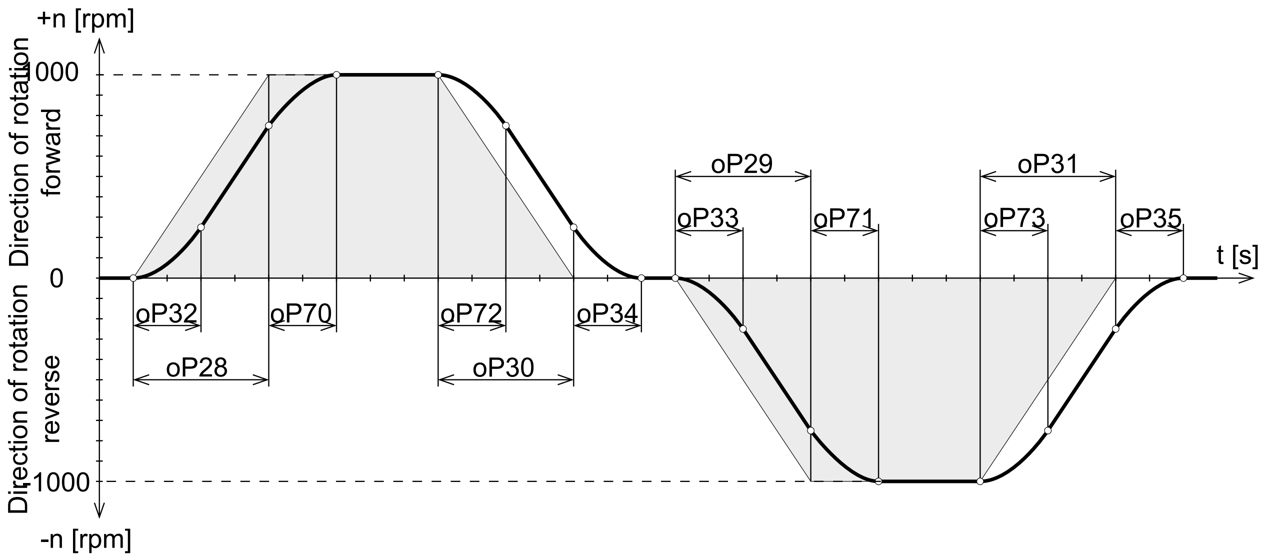


Figure 10.12 S-curve time

Definition of the s-curves (straightening time):

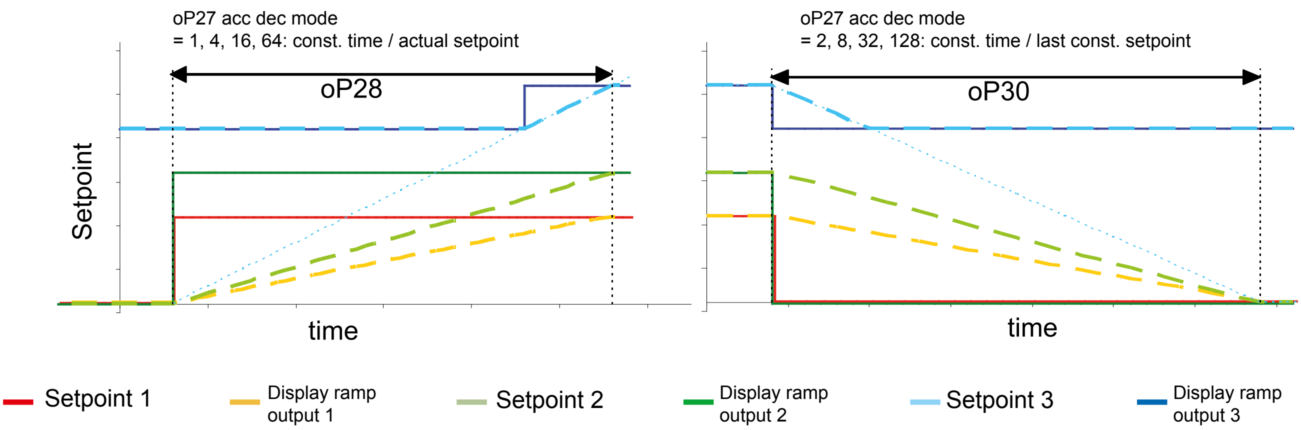
Parameter	Value range	Factory setting	Notice
oP32: S-curve time acceleration forward	0: off	X	
	0.01 s...5 s		
oP32: S-curve time acceleration reverse	-1: see forward	X	= oP32
	0: off		
	0.01 s...5 s		
oP34: S-curve time deceleration forward	-1: see acceleration	X	= oP32
	0: off		
	0.01 s...5 s		
oP35: S-curve time deceleration reverse	-1: see forward	X	= oP32
	0: off		
	0.01 s...5 s		
oP70: s-curve up time acc. for.	-1: lower s-curve	X	= oP32
	0: off		
	0.01 s...5 s		
			further on next side

Parameter	Value range	Factory setting	Notice
oP71: s-curve up time acc. rev.	-2: forward parameter		= oP32
	-1: lower s-curve	X	= oP32
	0: off		
	0.01 s...5 s		
oP72: s-curve up time dec. for.	-2: acceleration parameter		= oP32
	-1: lower s-curve	X	= oP32
	0: off		
	0.01 s...5 s		
oP73: s-curve up time dec. rev.	-2: acceleration parameter		= oP32
	-1: lower s-curve	X	= oP32
	0: off		
	0.01 s...5 s		

10.9.3 Ramp with constant time

At the ramp with constant time, oP28...oP31 adjusts the time the inverter accelerates from speed 0 to the actual setpoint (ramp mode = 1) and/or decelerates from the last setpoint to speed 0 (ramp mode = 2). Then the acceleration / deceleration time at start/stop operation is independent on the setpoint. s-curves are not possible in this operating mode.
Example for the use of ramps with constant time:
Two conveyor belts run with different speeds. Both of them receive the stop-command at the same time. The belts reduce the speed in proportion to the adjusted time and come to a standstill simultaneously.

Acceleration **Deceleration**



Acceleration at ramp mode =
constant time / actual setpoint
(value 2, 8, 32, 128) is:

$$\frac{\Delta n}{\Delta t} = \frac{\text{actual setpoint}}{\text{acceleration time (oP28/oP29)}}$$

Deceleration at ramp mode =
constant time / last setpoint
(value 2, 8, 32, 128) is:

$$\frac{\Delta n}{\Delta t} = \frac{\text{last setpoint}}{\text{deceleration time (oP30/oP31)}}$$

Ramp mode „constant time / actual setpoint“ should always be selected for acceleration and "constant time / last setpoint" for deceleration.

The other adjustments are programmable and can be used if it shall be operated between different setpoint speeds (except 0).
When starting from 0 and/or deceleration to 0, they have the following effects:

If the mode „constant time/ actual setpoint“ is selected for deceleration, deceleration is calculated to:

$$\frac{\Delta n}{\Delta t} = \frac{\text{actual setpoint}}{\text{acceleration time (oP30/oP31)}} = \frac{\text{0 rpm}}{\text{deceleration time}} = 0$$

This means that the drive don´t decelerate, it keeps running with the last setpoint before stop command.
Minimum acceleration / deceleration is limited programatically to:

$\Delta n / \Delta t$ = reference speed / 4800 s (reference speed dep. on Ud02 / see chapter 5)

This means the drive would not continue to run constantly, but it decelerates very slowly.

10.9.4 Ogive run

In the mode "constant ascent", a change in setpoint while the inverter is still in the acceleration / deceleration phase will lead to the fastest possible response. If the new setpoint requires e.g., a change from acceleration to deceleration, the acceleration ramp is interrupted and the deceleration ramp is started immediately. This can lead to an undefined jerk.

If ogive run is selected, the programmed s-curve times are always used, the acceleration / deceleration change continuously and no undefined jerk occurs.

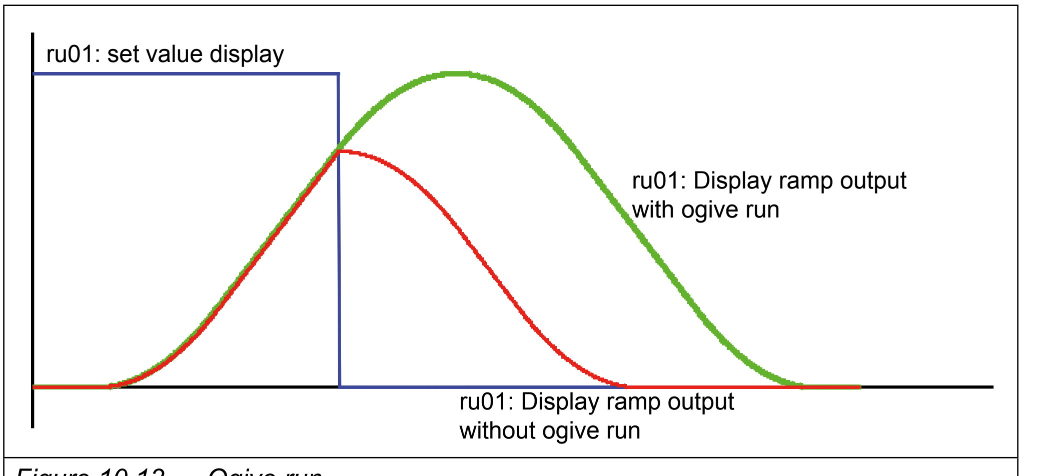


Figure 10.13 Ogive run

10.9.4.1 Time factor acceleration/deceleration (oP62)

The time factor accelerates or decelerates the standard ramp times (oP28... oP31) by the adjusted value. The S-curve times do not change at values 0...4. The S-curve times are considered at value 5.

oP62: acceleration deceleration time factor	
Value	Description
0: off	The linear ramp times are extended or reduces by the adjusted factor.
1: 2 times	
2: 4 times	
3: 8 times	
4: 16 times	
5: 1/10 times, and s-curve	

10.9.5 Modulation switch-off range

If a frequency > 0Hz is adjusted in oP36 / oP37, all output frequencies < oP36 / oP37 are suppressed and the modulation is switched off. The acceleration and deceleration ramps start resp. end at this frequency. Switching off/on of the modulation when exceeding or falling below of oP36 / oP37 occurs without hysteresis. With analog setpoint setting it must be ensured that the setpoint is not in the range of oP36 / oP37. Parameters oP36 / oP37 are only available in v/f characteristic operation.

oP36: min. output value forward	
Value	Description
0.0000...400.0000 Hz	The setpoint jumps from 0, without ramps to the adjusted value in oP37. The adjusted values of oP07 and oP11 are considered as limits

oP37: min. output value reverse	
Value	Description
-1 = forward	The value is the same as in oP36
0.0000...400.0000Hz	The setpoint jumps from 0, without ramps to the adjusted value in oP37. The adjusted values of oP07 and oP11 are considered as limits

11. Motor Data and Controller Setting of the Asynchronous Motor

The asynchronous motor has two principally different modes of operation:

- V/f characteristic operation
V/f characteristic operation, with SMM (Sensorless Motor Management) for speed stabilisation and different current limiting protective functions

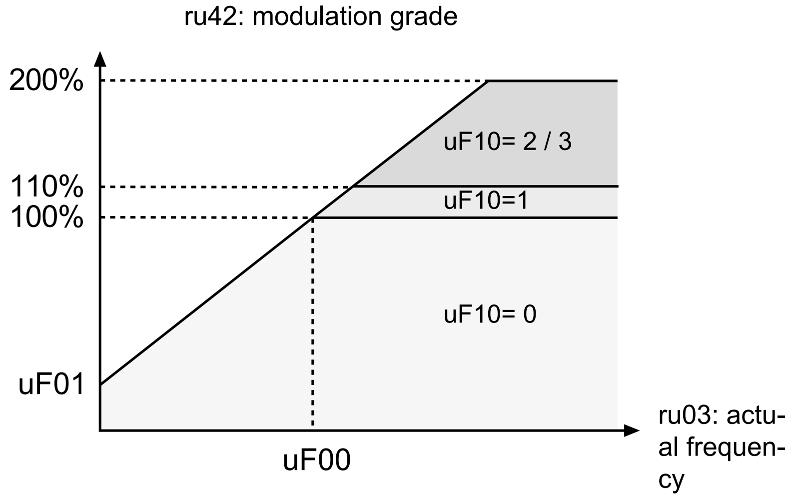
- Vector controlled operation with motor model without encoder feedback (ASCL)
During speed-controlled operation of an asynchronous motor without encoder feedback (Asynchronous Sensorless Closed Loop => ASCL), the speed is estimated with a mathematical model of the asynchronous machine.

11.1 Open-loop operation (v/f characteristic)

11.1.1 Rated frequency (uF00), boost (uF01) and delta boost (uF04 / uF05)

The voltage /frequency characteristic (v/f) is adjusted by the rated frequency (uF00) and the boost (uF01). The rated frequency adjusts the frequency at which 100 % modulation depth (~input voltage) are achieved. The boost adjusts the output voltage to 0 Hz. Depending on uF10 the modulation limit can be increased up to 110% on this level (see Fig.11.1).

uF00 = 0.00...400 Hz; Default = 50 Hz
uF01 = 0.0...25.5 %; Default = LTK*



* LTK = power circuit-dependent

Figure 11.1 Rated frequency and boost

The delta-boost is a time-limited boost used to overcome large breakaway torques. The delta-boost acts adding to the boost; but the sum is limited to 25.5 %.

uF04 = 0.0...25.5 %; Default = 0 %
uF05 = 0.00...10.00 s; Default = 0 s

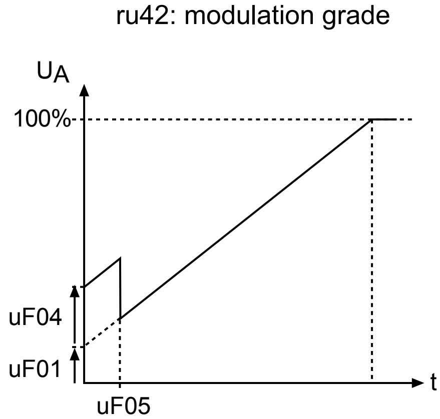


Figure 11.2 Delta boost

11.1.2 Max. voltage mode (uF10)

By changing the maximal voltage mode more torque can be released free above the rated frequency through overmodulation (110% voltage). Raising the v/f-characteristic has an influence at activated energy saving function or at voltage stabilisation.

uF18: max. voltage mode		
Value	Modulation	Description
0	100 % v/f / 100% voltage	without overmodulation; all limitations 100% of modulation factor
1	110 % v/f / 110% voltage	with overmodulation; all limitations 110% of modulation factor
2	200 % V/f / 100% voltage	limitation of the voltage generating functions 200 %; limitation before modulator 100% of modulation factor
3	200 % V/f / 110% voltage	limitation of the voltage generating functions 200 %; 110 % output voltage

11.1.3 Add. frequency / voltage (uF02 / uF03)

An additional point can be specified with uF02 and uF03 to adapt the v/f characteristic to special conditions. uF02 defines the frequency and uF03 the voltage. The adjustment is ignored at uF02 = 0 Hz. The parabolic characteristic is activated with uF02 = „-1: parabolic characteristic". Then parameter uF03 has no function.

uF02 = -1: Parabolic characteristic
0.0...400 Hz; Default = 0.0 Hz

uF03 = 0.0...100.0 %; Default = 0.0 %

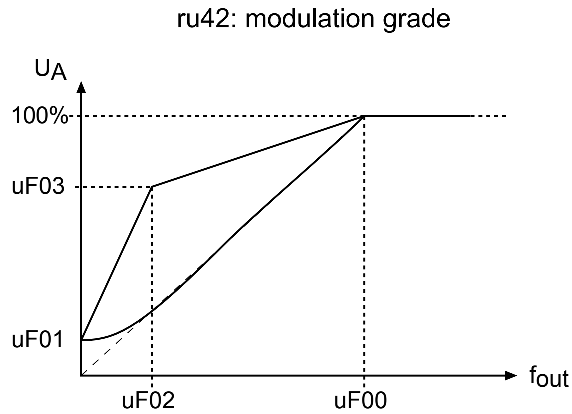


Figure 11.3 Additional point

11.1.4 Voltage stabilisation (uF09)

The DC link voltage and thereby the directly dependent output voltage can be changed by fluctuations of the mains voltage or the load. The fluctuations of the output voltage are compensated when the voltage stabilisation is activated. i.e., 100% output voltage correspond to the value set in uF09, but maximally 110% · (UDC link / √ 2) depending on the adjustment of uF10. This function further allows operation of motors with low rated voltage at the inverter.

Example: uF09 = 230V

Value range uF09: 1..1119 V
Deactivation of the function by:
Value 650: off OR value 1120: off

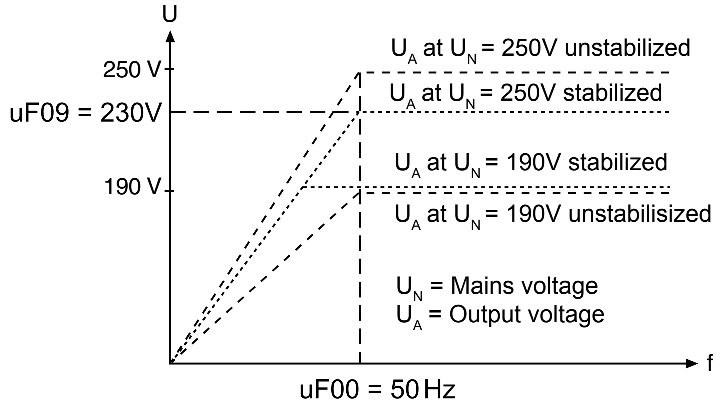


Figure 11.4 voltage stabilisation

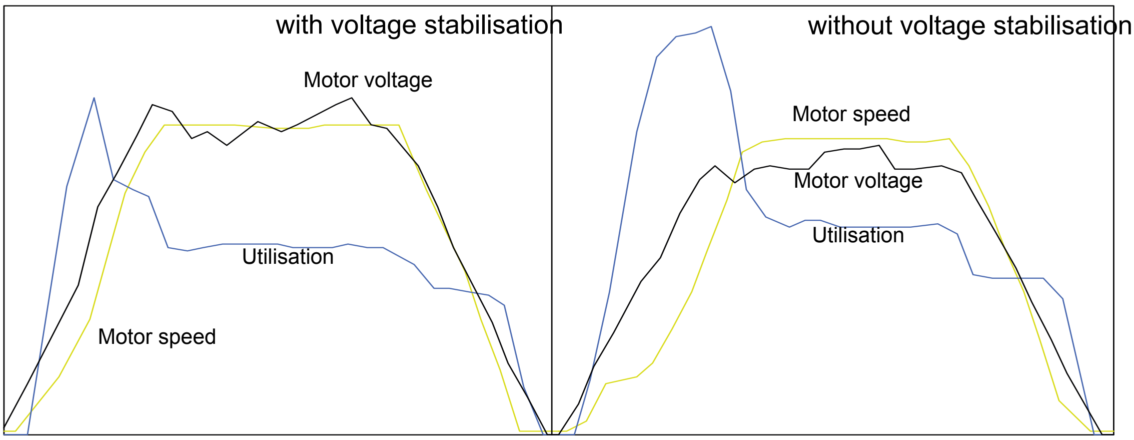


Figure 11.5 Example: Acceleration with load

Voltage stabilisation PT1 time

The time constant of a PT1 element is determined with uF19. The PT1 element serves to smooth the DC link voltage (UDC). The output value of the PT1 element is used as actual value for the DC link compensation.

uF19: voltage stabilisation PT1-timeconst.	
Value	Meaning
0	function switched off
1	2 ms smoothing time
2	4 ms smoothing time
3	8 ms smoothing time
4	16 ms smoothing time
5	32 ms smoothing time
6	64 ms smoothing time
7	128 ms smoothing time
8	256 ms smoothing time
9	512 ms smoothing time
10	1024 ms smoothing time

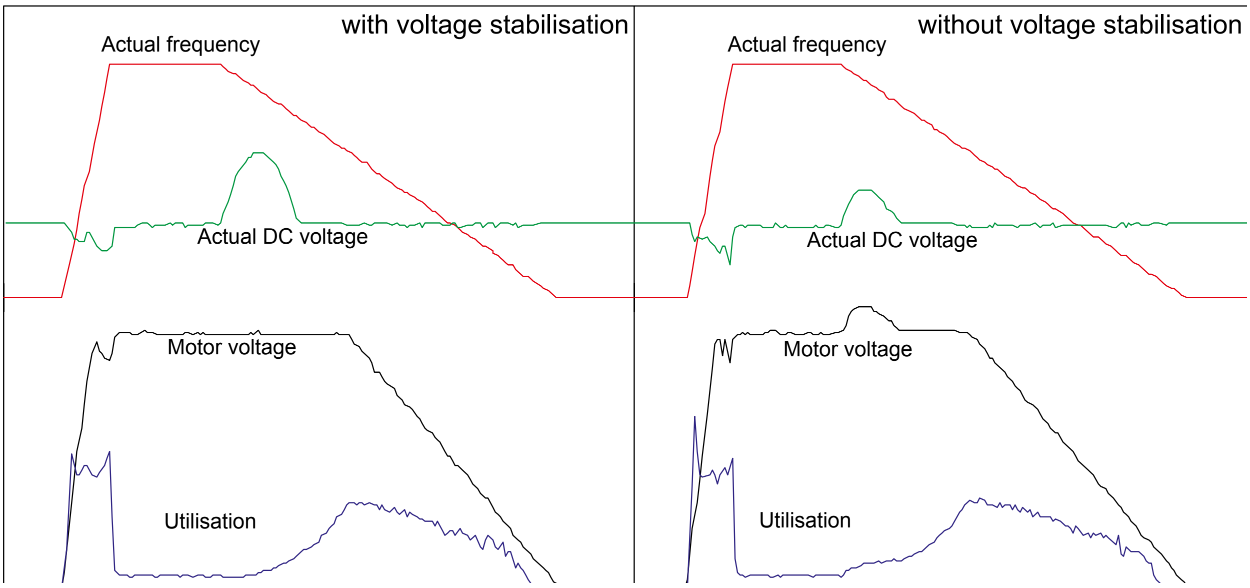


Figure 11.6 Example: Deceleration of a high-inertia drive from 80Hz

11.1.5 Deactivation of the voltage stabilisation via digital input

The voltage stabilisation uF09 can be deactivated via a digital input with parameter uF27 or di22...di35 with value 22.
The motor voltage will be gradually increased or decreased when the function is activated. The time for increasing and decreasing can be adjusted with uF06.

uF27: uF09 off input select		
Bit	Value	Description
0	1	ST (prog. input „control release/reset“)
1	2	RST (prog. input „reset“)
2	4	F (prog. input „forward“)
3	8	R (prog. input „reverse“)
4	16	I1 (prog. input 1)
5	32	I2 (prog. input 2)
6	64	I3 (prog. input 3)
7	128	I4 (prog. input 4)
8	256	IA (internal input A)
9	512	IB (internal input B)
10	1024	IC (internal input C)
11	2048	ID (internal input D)

11.1.6 Switching frequency (uF11)

Information to the switching frequencies can be found in chapter 16.3 "Switching frequencies and derating".

11.1.7 Energy saving function (uF06...uF08)

The energy saving function allows the lowering or raising of the current output voltage. Corresponding to the activation condition defined in uF06, the voltage in accordance with the v/f characteristic is scaled to the energy saving factor (uF07).
With activated torque compensation (see chapter 11.1.7), the energy saving function is used for control optimization. The V/f characteristic will then not be affected.
The maximum output voltage cannot be higher than the input voltage, even for a factor > 100 %. The function is used e.g.in cyclic executed load/no-load applications. The speed is maintained during the no-load phase, but energy is saved as a result of the voltage reduction.

uF07: energy saving factor	
Value	Meaning
0.0...130.0%	Output voltage in %, on which is modulated at activated energy saving function.

uF08 energy saving input selection
0...4095 (Default 0)
For the assignment of the inputs to the parameter values, refer to chapter 9.1 „Digital inputs“.

uF06: energy saving mode			
Bit	Description	Value	Function
0...3	Activation	0	generally off
		1	generally active
		2	at actual value = set value
		3	activated by dig. input
		4	at rotation forward
		5	at rotation reverse
		6	at forward constant
		7	at reverse constant
		8...15	generally off
4...7	Voltage ramp	0	standard time *
		16	time / 2
		32	time / 4
		48	time / 8
		64	time / 16
* default setting 1.6s			

11.1.8 SMM (sensorless motor management)

The SMM-function (sensorless motor management) includes the torque and slip compensation. These two functions can be activated separately. For an optimal control characteristic, the combination of both functions is required.
Setting the correct motor data is required, since they are used in calculations needed by the inverter to achieve the best possible results in the control of boost and slip.

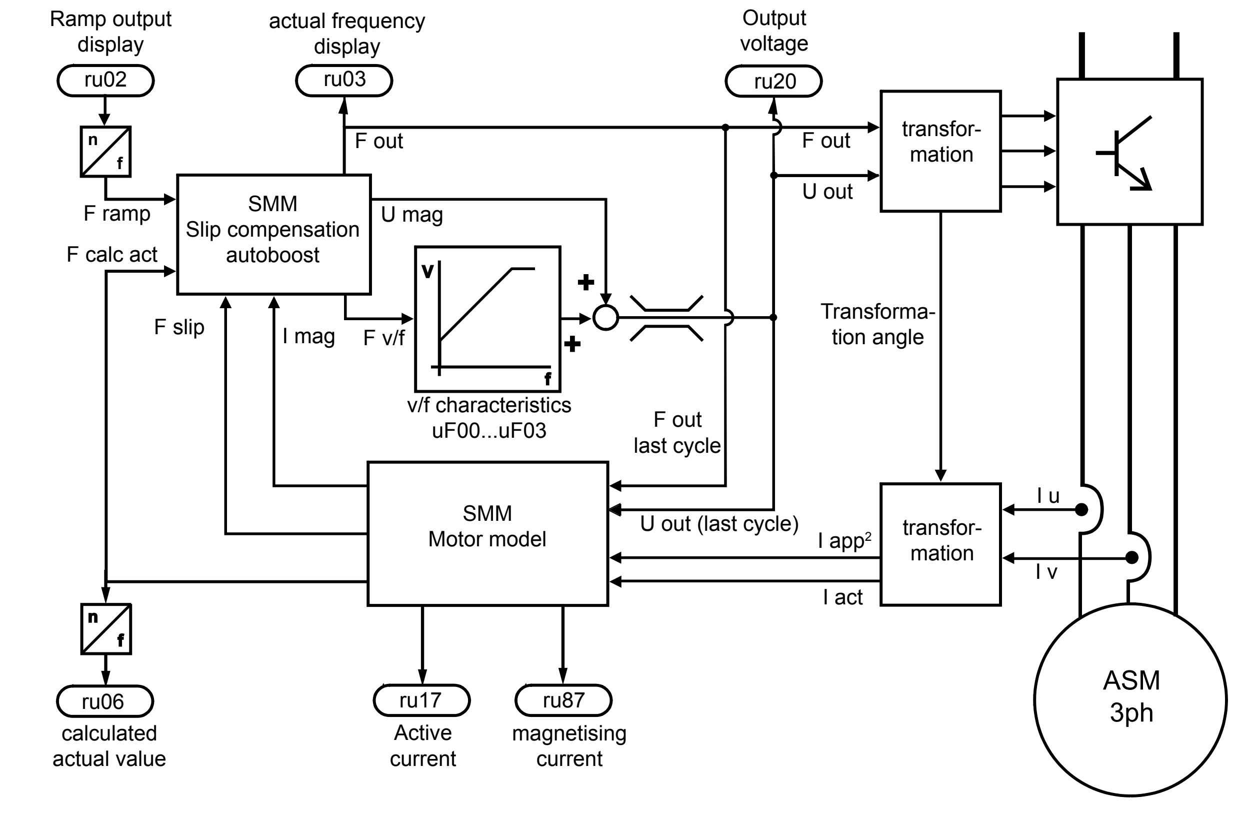


Figure 11.7 Control SMM

Torque compensation
Torque compensation adapts the voltage at variable load torques in such a way that the magnetizing current is kept constant. This ensures a larger maximum torque at low output frequencies compared to the uncompensated operation (block diagram see chapter 11.2.4.)

11.1.8.1 Motor name plate

Following parameters can be taken directly from the name plate and entered:

- dr00 DASM rated current
- dr01 DASM rated speed
- dr02 DASM rated voltage
- dr03 DASM rated power
- dr04 DASM rated cos(phi)
- dr05 DASM rated frequency

Parameters dr00 and dr.02 must be adjusted according to the used connection (star/delta).

The following parameters can be taken from the corresponding data sheet or can be determined by measurements:

- dr06 DASM stator resistance (can be measured)
- dr09 DASM breakdown factor (can not be measured, must be taken from the motor data sheet)

11.1.8.2 Determination of the stator resistance (dr06)

The stator resistance can either be measured with an ohmmeter or determined automatically.
In this way the ohmic line resistance is registered simultaneously (important in the case of long incoming lines).
For the measurement with an ohmmeter, the connection between motor and inverter has to be broken. The measurement is carried out on a warm motor, between 2 phases of the motor feed cable, independent of the motor wiring (Δ / Y). For a more accurate result, all 3 values (U/V, U/W and V/W) should be measured and the values then be averaged.
The automatic determination can be carried out for each parameter set separately. Thus a parameter set can be programmed for example as "Warm-up set" for particularly critical applications.

Adhere to the following procedure:

- Enter motor data of the type plate into the parameter set which is to program
- possibly call and activate parameter set
- Execute the measurement dependent on the operational case in cold status respectively let the motor warm up to operating temperature.
- Preset no direction of rotation (inverter must be in status „LS“)
- Activate control release
- Maximum value "250000" of parameter dr06 starts the resistance measurement

"Calculate drive data" is displayed in the status display (ru00) during determination. Upon successful determination the motor stator resistance is entered in dr06. If an error occurs during determination then error message „ERROR calc. drive data“ is output.

11.1.8.3 Load mot.dependent parameter (Fr10), controller activation

After input of the rating plate data of a new motor or after automatic measurement of the stator resistance, an automatic optimisation of the torque and slip compensation can be carried out with Fr10 (see chapter 11.1.7). The optimisation is started by writing value "3" on Fr.10. Thereby the inverter must be in status „no operation" (no control release). Provided that only one motor is used, the measurement can occur with direct set programming for all parameter sets at once.

Fr10: load mot.dependent parameter		
Value	Function	Explanation
0	done	loading completed
1	uF09	only for closed loop operation (G6L/P)
2	act. dc voltage	only for closed loop operation (G6L/P)
3	start motor adaption	Adjustment for torque and slip compensation

Following parameters are changed by the activation of Fr10:

- uF00 rated frequency = DASM rated frequency (dr05)
- uF01 boost = calculated value
- uF02 additional frequency = -0.0125 Hz (parabolic characteristic)
- uF03 additional voltage = 0.0%
- uF09 voltage stabilisation = DASM rated voltage (dr02)
- uF16 autoboost configuration = 1 (sign-sensitive)
- uF17 autoboost gain = 1.2 (default value)
- cS00 speed control configuration = 34 (speed control SMM + breakdown factor (dr09))
- cS01 actual source = 2 (calculated)
- cS04 speed control limit = 4 • rated slip of the motor
- cS06 KP speed = 50
- cS09 KI speed = 500

The adaption covers approx. 90 % of the applications. For an application-specific adjustment a manual fine adjustment can be carried out in individual cases.

11.1.8.4 Adjustment of the slip compensation (cS00, cS01, cS04, cS06, cS09)

The integrated speed controller is used at cS00 = 2 for slip compensation. The rotor speed calculated from the motor model is selected as actual controller value with cS01 = 2. The slip compensation can be configured with bits 3-6 in cS00.

cS00: speed control configuration			
Bit	Meaning	Value	Explanation
0...2	control mode	0	no rot. change by ctrl.
		1	process ctrl. (only v/f operation)
		2	speed ctrl. (only v/f operation)
3		0	no rot. change by ctrl.
		8	rot. change by ctrl.
4		0	no controller intervention at controller setpoint = 0 Hz
		16	controller intervention also at controller setpoint = 0 Hz
5		0	no slip limitation
		32	slip limitation (rated slip x dr09)
6		0	default slip compensation
		64	impr. slip compensation

cS01: act. source			
Bit	Meaning	Value	Function
0...1	act. source	0	reserved
		1	channel 2 (initiator input)
		2	calculated actual value
		3	reserved
2	System inversion	0	off
		4	on

cS04: speed control limit	
Value range	Function
0...4000 rpm	The speed limit determines the maximum controller intervention.

The value range depends on the setting in parameter Ud02: control type.

cS06 KP speed, cS09 KI speed
0…32767, default 300(KP), 100(KI)
Proportional and/or integral factor of the speed controller.

These parameters must be adjusted before activation of the slip compensation. The default values are optimised for closed-loop operation.
This adaption is carried out with the motor adaption (see chapter 11.1.7.3), and only a fine adjustment is necessary.

11.1.8.5 Improved slip compensation (cS00 bit 6 = 64, cS03)

The slip is proportional calculated from the effective current at standard slip compensation. This calculation becomes imprecise above the nominal setpoint and in regenerative operation. With the improved slip compensation, the slip calculation during motor operation above the nominal setpoint is approximated to the real M/n-characteristic with a parabolic function. Major inaccuracies will occur then only above double rated torque.

During generatoric operation, the linear dependency is preserved. The steepness of the characteristic can be adjusted with cS03.

11.1.8.6 Adjustment of the autoboost (uF16, uF17)

The autoboost is activated and configured by uF16 and uF17. Magnetising current, setpoint and actual value are calculated in the motor model.

Through overcompensation increased motor currents and associated inadmissible heating can occur particularly at low frequencies.

uF16: autoboost configuration		
Value	Function	Explanation
0	off	Torque compensation off
1	sign-dependent	Torque compensation acts motoric and generatoric
2	0-limited	Torque compensation works only in the motoric operation; resulting in a smoother run in the generatoric operation.
3	absolute	Torque compensation in motoric operation; overcompensation in the generatoric operation; resulting in a higher maximum torque and increased current in the generatoric operation compared to 1 and 2; because of the higher motor-own losses a braking resistor is only necessary at higher energy recovery compared to 0, 1 and 2.

uF17: autoboost gain	
Value range	Function
0.00...2.50	The magnetizing current setpoint can be adapted to the application with the energy saving function (uF06...uF08, see chapter 11.1.6). If a drive operates in the partial load range for a long period, decreasing the energy saving factor can reduce motor warming and energy consumption.

11.1.9 Winding temperature evaluation

The temperature in the motor affects the rotor resistance and the stator resistance very different. The resistances of rotor and stator have different effects on the speed. The rotor resistance have effects on the total speed, the stator resistance effects especially the lower speed range.
Several factors must be observed at the resistance change:

- Stator cooling (eventually water cooling)
- Heat dissipation of the rotor
- thermal time constants
- Slip frequency
- Motor voltage
- Switching frequency (2, 4, 8 kHz) of the inverter
- etc.

Parameter dr68 can be activated in order to reach an accurate temperature. The source and the rotor resistance mode can be adjusted in parameter dr68 „resistance adaption mode“.

dr68: resistance adapt. mode			
Bit	Value	Description	Function
0...2	0	Selection of the source	off
	1		autom. selection
	2		calculated
	3		measured by motor sensor
	4		measured via Aux
	5		reserved
	6		reserved
	7		reserved
3...4	0	Rotor resistance mode	off
	8		Temperature = Rs
	16		reserved
	24		reserved

Then the corrected motor temperature is displayed in parameter dr51 „motortemp for Rs corr“.

The actual temperature is not considered at the motor identification.

The temperature coefficient for motor temperature measurement must be set in parameter dr52.

dr52: temperature coefficient	
Value	Function
0: off	switched off
0.1...25.0	Adjustable value range for the temperature coefficient

The temperature coefficient for copper is $4.3*10^{-3}$ / K

11.1.9.1 Winding temperature detection via AUX

The following must be observed for the evaluation of the winding temperature via the Aux input.

Parameter dr53 is parameterized via the AUX input if value 0 is set. A value must be preset if the motor temperature is estimated. In this case it is recommended to set a value of 100°C and to carry out a fine adjustment after run in of the motor.

dr53: corr. delta temperature	
Value	Function
0: off	switched off
1...250°C	Adjustable value range for the delta temperature

11.1.9.2 Winding temperature detection via estimation of the motor temperature

Additionally to the analog and AUX winding temperature detection, the following must be observed.

Parameters dr54 and dr55 must be entered for winding temperature detection via estimation of the motor temperature.
The warming time and the cooling time for the stator resistance correction (Rs correction) is entered in parameters dr54 and dr55.

dr54: Rs corr warming time	
Value	Function
240...16000	Adjustable value range of values for the warming time

dr55: Rs corr cooling time	
Value	Function
240...16000	Adjustable value range of values for the warming time

Simplified calculation for parameters dr.54 and dr.55.

$$\text{dr54} = \frac{\text{warming time [s]} + \text{dr53}}{\text{warming [°C]}}$$

$$\text{dr55} = \frac{\text{warming time [s]} + \text{dr53}}{\text{cooling [°C]}}$$

Cooling, cooling time, warming and warming time must be determined itself for this case. That means, the motor must be changed from cold into warm condition and the respective values for the calculation of parameters dr54 and dr55 must be stored.

The maximum temperature for the estimated motor temperature is determined in parameter dr56.

dr56: Rs corr max. temp.	
Value	Function
30...90°C	Adjustable maximum value for the estimated motor temperature

11.1.10 Select 50Hz / 60Hz mode (Ud06)

The COMBIVERT G6 can be changed with parameter Ud06 between 50 Hz and 60 Hz mains and motor operation.

Parameter Ud06 is only available in open-loop mode G6x-G.

Ud24: Select 50 Hz / 60 Hz mode	
Value	Function
0	Current values and limits, motor data, voltages, frequencies and speeds refer to a 50 Hz mains.
1	Current values and limits, motor data, voltages, frequencies and speeds refer to a 60 Hz mains.

The setting in parameter Ud06 can only be changed if the control release is open. Otherwise the error message „ERROR! operation not possible!“ is output.

The following parameters change with the change of 50 Hz / 60 Hz:

dr00: DASM rated current
dr01: DASM rated Speed
dr02: DASM rated voltage
dr05: DASM rated frequency
dr06: DASM stator resistance
dr12: motorprot. rated current
In01: rated inverter current
uF00: rated frequency
uF01: boost

When changing the mode, all parameters are reset to the default value!

11.2 Vector controlled operation (ASCL)

Since the speed can be calculated only with the aid of a mathematical model, this operating mode may only be used with the following limitations:

- Vector control around frequency = 0 is not possible.
- During operation in the low speed range, the motor model may become unstable. Therefore this range must be left always quickly.
- No safety functions may be derived from the calculated speed.

This operating mode is only available in the G6L software.
For the motor model, there are some additional parameter for adapting the encoderless vector control to the application.
Operation without speed feedback is activated by cS01 = 2 "calculated actual value".
Value 4 „speed control“ or 5 respectively 6 „torque control“ must be adjusted in parameter cS00 „speed control configuration“.

The vector controlled operation with motor model is possible only if the electrical characteristic data of a motor are known. The motor model calculation must be activated in parameter dS04 for this operating mode.

dS04: flux / rotor adaption mode			
Bit	Meaning	Value	Explanation
0	Motor model (ASM)	0: off	Activation of the motor model calculation
		1: on	

The torque display (ru12) is invalid after change-over to frequency controlled operation!

The start-up can be executed alternatively with an "Online Wizard" in COMBIVIS 6 .

11.2.1 Initial settings

Vector controlled operation is activated by inputting the values 4, 5 or 6 into the category "control mode" of parameter cS.00 "speed control config.".

cS00: speed control configuration			
Bit	Meaning	Value	Explanation
0...2	control mode	0: off	
		1...2	reserved for V/f-open loop operation
		3: off	
		4: Speed control (G6L/P)	Speed control and current controlled operation without speed feedback
		5: Speed control (G6L/P)	torque-controlled operation / see chapter 15
		6: Torque/number (G6L/P)	
		7: off	

The speed controlled operation (cS00 = 5 or 6) is a special form described in chapter 15.

The following adjustments are necessary in speed-controlled operation, in all modes with motor model:

11.2.1.1 Motor rating plate data

Input of the motor rating plate data is at the beginning of each start-up:

- dr00 DASM rated current
- dr01 DASM rated speed
- dr02 DASM rated voltage
- dr03 DASM rated power
- dr04 DASM cos(phi)
- dr05 DASM rated frequency

11.2.1.2 motor adaption

After input of this data, the operator must switch to closed-loop operation (cS00 = 4) and enter Fr10 = 1 or 2 (explanation see below) once.

Fr10: motor adaption	
Value	Function
1: uF09 (G6L/P)	Precharging dependent on the voltage class of the inverter and/or the value of uF09
2: act. DC link voltage (G6L/P)	precharging dependent on the current DC link voltage of the inverter

In order to reset the field-oriented control parameters, the inverter must be in state „no Operation", i.e. input „control release" (ST) may not be set. The following parameters are preset by the reset of field-oriented control parameters (depending on the motor and inverter data):

Definition of the limiting characteristic:
- dr16 DASM max. torque corner speed
- dr17 DASM speed for max torque
- dr18 DASM field weakening speed

Definition of magnetisation:
- dr19 flux adaption factor
- dr20 field weakening curve

Current controller
- dS00 KP current
- dS01 KI current

Torque limits:
- cS19 „absolute torque reference"
- cS20...cS23 torque limit (for. mot., rev. mot., for. gen., rev. gen.)
- Pn61 Quick stop torque limit

Flux controller:
- dS11 KP flux
- dS12 KI flux
- dS13 magn. current limit

Inertia:
- cS25 inertia (kg x cm²)

Speed controller (preloaded only if automatic speed controller setting is activated by cS26 ≠ 0):
- cS06 KP speed
- cS09 KI speed

at ASCL (G6L):
- dS14 KP speed calculation ASCL
- dS15 KI speed calculation ASCL
- dS19 limit uf-control dec ASCL

Some of these parameters (e.g., the limiting characteristic) depend upon the available voltage. The voltage stabilisation should be generally "off" in speed-controlled operation. The software-integrated current controllers control the voltages and a simultaneous intervention of the voltage stabilization increases the system´s vibrational tendencies.

uF09: voltage stabilisation	
Value	Function
1120	off

With Fr10 = 1, precharging occurs dependent on the voltage class of the inverter (400V or 230V)
The actual DC link voltage of the inverter, which is proportional to the mains input voltage, is considered for the calculations at Fr10 = 2.
If parameter uF09 „voltage stabilisation" is not set to the default value „1120: off", then the adjusted value in uF09 is taken as reference voltage for the calculations in Fr10 = 1 or 2.
If the drive is to be operated at a different voltage then during initial start-up, proceed as follows :

Enter the rated voltage to be used later in parameter uF09, activate Fr10 = 1 and reset parameter uF09 to „off" .

After completion of a possible "fine tuning", i.e., the manual adjustment of controller parameters, torque limits, etc., parameter Fr10 may not be activated anymore. Otherwise, the manually adjusted parameters will be overwritten by the calculated values!

11.2.1.3 Speed feedback and selection of the speed direction

The actual value source for the speed must be selected in parameter cS01.
At the G6L in vector operation (ASCL operation) the value in cS01 must be set to 2 "calculated".

cS01: act. source			
Bit	Function	Value	Explanation
0...1	act. source	0: reserved	
		1: channel 2	Channel 2 is an initiator input and can not be used as speed feedback or for the motor model. The initiator input channel 2 is only available for inverters with CAN control board.
		2: calculated actual value	Control to calculated speed (from motor model)
		3: reserved	
2	System inversion	0: off	Activates the system inversion
		4: on	

With activation of the system inversion it is reached that the motor with selected rotation direction "forward" (e.g. by setpoint- or rotation setting) has the physically direction "reverse" respectively at setting "reverse" the physical rotation "forward". Precondition is a phase-correct wiring of the motor.

11.2.1.4 Electrical parameters (equivalent circuit data) of the motor

The parameters DASM stator resistance (dr06), DASM leakage inductance (dr07) and DASM rotor resistance (dr08) can be taken from a motor data sheet or they can be automatically determined by the KEB COMBIVERT using the motor identification. The resistances are very low (only a few mΩ) for motors with high power. This can lead to errors in the automatic identification. For these motors, it may be sensible to use the value from the motor data sheet for dr08.
Due to saturation, parameter dr10 "TPIM main inductivity" is depending on the selected magnetising current. This is defined by the rated motor current (dr00), cos(phi) (dr04) and factor flux adaption (dr19). Since the value of the main inductance given in the motor data sheet possibly applies for a different current, this parameter (dr10) must always be identified to ascertain the correct value for the actual magnetising current.

11.2.2 Identification of the motor model / general

The required equivalent circuit data for the motor model can be determined by the KEB COMBIVERT itself.

There are two possibilities to start the identification:

- Writing of parameter dr48 in inverter state "stop (mod. off)", measurement is starting automatically.
- Writing of parameter dr48 in inverter state „no Operation“ with subsequently control release

Parameter dr48 cannot be written in other operating conditions.
The measured values can be invalid in case of strong overdimensioning of the inverter. The rated current of the motor should be at least 1/3 of the maximum short time current limit of the inverter. The short time current limit is determined by the overload characteristics and can be taken from the power circuit manual or parameter In18 (hardw. curr. inverter).

The direction of rotation during identification of the main inductance is always "forward"!

Value „82: calculate drive data“ is output in inverter state ru00 during the measurement. After successful measurement parameter ru00 displays „127: calc. drive data ready“. If the measurement is interrupted with an erruor, ru00 = „60: ERROR calc. drive data“ is displayed.

No correct operation can be ensured in case of interruption.
The actual state of the identification is displayed in parameter dr62 "state motor ident.". The control release must be switched off in order to leave the identification mode.
Parameter dr48 must be written again in order to start a new measurement.

If the internal brake handling is used in the application (Pn34 „brake control mode“), then it must be deactivated for the motor identifikation. For safety reasons the output signal "brake release" is not set during measurement, since the motor cannot generate a defined torque in this time. Stator resistance, rotor resistance and leakage inductance can be measured also at engaged brake.
For the identification of the main inductance, the drive must be decoupled from the load and the output switching condition which is assigned to the break control must be set to value "1" (= always active), setting the brake permanently open.

11.2.2.1 Automatic mode

The automatic mode should be used generally for the identification of the parameters. The automatic mode is the most simple method of parameter identification. Measurement of the dead time compensation characteristics, as well as the stator- and rotor resistance and the leakage inductance is done in standstill. A small rotation of the motor caused by the test signals is possible.

dr48: motor identification			
Bit	Description	Value	Function
0...4	Measurement	0: off	The motor identification is switched off
		7: auto ident. without move	automatic measurement of the dead time characteristic and of all equivalent circuit data - with the exception of the main inductance. This measurement is carried out with the motor stopped, but a rotation of the motor due to the test signals is possible.
		8: auto ident with move	**! Attention: requires motor revolution in no-load operation!** automatic measurement of the dead time characteristic and of all equivalent circuit data - including main inductance. The motor accelerates to "speed for Mmax" (dr17)

It is necessary for the identification of the main inductance, that the motor accelerates to the speed for maximum torque (dr17) and then it operates in no-load operation.

There is a special ramp dr49 „motor identification ramp time“ for identification. This ramp applies during calibration of the main inductance for the acceleration to dr17 and the deceleration at the end of the identification. The speed controller must be sensibly parametrised (choose small Ki). The drive may not vibrate during the identification.

The following chapter, "single identification", contains more detailed information with respect to the separate steps of the identification and can be skipped if automatic mode is chosen. In the chapter after the next, "additional trimmings", two further identifications are described which are not part of the automatic mode and that are unnecessary in many cases.

The explanations of the parameters required to be set continues in chapter 11.2.2.5 "generally required settings for operation with motor model".

11.2.2.2 Single identification

Single identifications should not be used for the first measurement of the motor parameters, since invalid measuring results can occur in case of a wrong identification sequence or omitting of individual points.
Single identification can always be used if a complete automatic measurement was executed and only individual parameters shall be identified. This can be (e.g.) a resistance measurement at operating temperature or a new measurement of main inductance after changing parameter dr19 "factor flux adaption".

dr48: motor identification		
Description	Value	Function
Measurement	0: off	The motor identification is switched off
	1: calc. head-ind. Lh / EMF*	Precharging of the current controller parameters and main inductance from rating plate data
	2: inductance Ls/L (ASM) *	Measurement of the leakage inductance
	3: stator-resistance Rs *	Measurement of the stator resistance
	4: ASM rotor-resistance Rr *	Measurement of the rotor resistance
	5: init model/curr.reg. *	Based on the equivalent circuit data, the model parameters and the setting of the controller are determined in the dS-parameters (current-, flux-, and speed calculation controller)
	6: Main inductance (ASM) *	**! Attention: requires motor revolution in no-load operation!** Measurement of the main inductance at "speed for Mmax" (dr17)
	7: AutoIdent. without main inductance (ASM) *	automatic measurement of the dead time characteristic and of all equivalent circuit data - with the exception of the main inductance. This measurement is carried out with the motor stopped, but a rotation of the motor due to the test signals is possible.
	8: auto ident with move	**! Attention: requires motor revolution in no-load operation!** automatic measurement of the dead time characteristic and of all equivalent circuit data - including main inductance. The motor accelerates to "speed for Mmax" (dr17)
	9: reserved	
	10: Dead time detection 4kHz *	Measurement of dead time compensation characteristics for different switching frequencies
	11: Dead time detection 8kHz *	
	12: reserved	
	13: reserved	
continued on the next page		

dr48: motor identification		
Description	Value	Function
Frequency	0: 1000Hz	The measuring frequency is changed independently during measurement. Therefore, leave the value at 0: 1000Hz ! Only changeable for test and diagnostics purposes.
	32: 500Hz	
	64: 250Hz	
	96: 125Hz	
	128: 62.5Hz	
	160: 32.25Hz	
	192: 15.625Hz	
	224: 7.8125Hz	

* Automatically identified at dr48 = 8

Pre-adjustment of the main inductance (dr48 = 1)
A starting value for the main inductance is calculated from the rating plate data with dr48 = 1 (calculation of the main inductance (ASM) / EMF(SM)).

Leakage inductance measurement (dr48 = 2)
The measurement of the leakage inductance (dr07) occurs with a test signal during standstill. The frequency of the measuring signal is adjustable via bit 5...7 in parameter dr48.
Since the inverter determines automatically the ideal measuring frequency, value 0 should always be selected for bits 5...7.

Leakage inductance measurement (dr48 = 3)
The measurement of the stator resistance is done with DC current.

Leakage inductance measurement (dr48 = 4)
The measurement of the leakage inductance (dr08) occurs with a test signal during standstill. The frequency of the measuring signal is adjustable via bit 5...7 in parameter dr48.
Since the inverter determines automatically the ideal measuring frequency value 0 should always be selected for bit 5...7.
Since the measurement frequency occasionally has to be reduced to 7.8125 Hz for better measurement accuracy, the motor may rotate.

Model-/ controller parameterisation (dr48 = 5)
The internal model parameters and also the current, flux and speed calculation controller parameters are calculated from the equivalent circuit data with dr48 = 5. If a mode other than automatic is used for the identification, this action should be executed after the measurement of the leakage inductance, rotor and stator resistance, but before the identification of the main inductance, in order that the controllers are correctly parametrised for the speed ramp-up.

Main inductance (ASM) (dr48 = 6)
It is necessary for the identification of the main inductance that the motor accelerates to the speed for maximum torque (dr17). The speed controller must be parameterised reasonable (select small Ki), the drive may not vibrate during the identification.
The motor must be able to rotate in no-load operation. After the main inductance has been identified, the drive stops automatically.
There is a special ramp „motor identification ramp time“ (dr49) for identification. This ramp applies for acceleration at the beginning and deceleration at the end of the identification.

Deadtime ident. (dr48 = 10, 11)
The dead time detection only works as single identification if the stator resistance is correct preset.
The measured dead-time values can be read out via In39 and In40.
The calibrated dead time compensation characteristics are in force if uF18 = 3 is set.

11.2.2.3 Motor identification error state dr66

In error case parameter „motor identification error code" (dr66) displays the reason for this error:

dr66: motor identification errorstate		
Value	Description	Explanation
0	ERROR disabled	
1	Stator resistance Rs not within permissible range	0.001…250 Ohm
2	Rotor resistance Rr not within permissible range	0.001…250 Ohm
3	Leakage / winding inductance not within permissible range	0.01…655.35 mH
4	Main inductance not within permissible range	0.1…3276.7 mH
5	DASM mag. current (dr13) not within permissible range	0.25…0.75 rated motor current
6	internal switching frequency error	Occurs if the inverter exceeds the rating limit during the motor identification.
7	Rotor resistance measurement phase shifting not within permissible range	The phase angle between current and voltage is >65 ° at smallest measuring frequency and <10 °at the largest.
8	Stator resistance measuring or dead time has reached 100% modulation	The modulation factor has reached 100%.
9	Frequency at Ls/L measurement not within permissible range	

11.2.2.4 Additional trimming

dr48: motor identification			
Bit	Description	Value	Function
0...4	Measurement	0: off	Detection of the no-load torque at different switching frequencies. During operation this torque is subtracted from torque display ru12.
		14: reserved	
		15: torque ident 4 kHz	
		16: torque ident 8 kHz	
		17: reserved	
		18: torque ident 16 kHz	
		19: current offset ident	Detection of the current offset in phase U and V
		20: Usd Step	Only for synchronous motor
		21: head-ind. Lh flux adapt.	As value 6, unless the magnetizing current is not static but it is calculated adaptively.
		22: autoidentification w.m. f. adpt.	As value 8, unless the magnetizing current is not static but it is calculated adaptively.

Head inductance (ASM) / autoidentification w.m. f. adpt.! (dr48 = 21, 22)
Values 21 and 22 should only be used from a motor size of about 11 kW. Values 21 and 22 are used for the optimisation of the magnetization current for the entered rated motor data.

11.2.2.4.1 Torque detection (dr48 = 15,16)

For applications with particularly high demands on the accuracy of the torque display, this can be calibrated. As standard the torque display does not display a value of 0 in encoderless operation during no-load operation. The reason for this is switching frequency-dependent losses in the inverter and friction losses due to the application.
If the torque display has to be corrected for this offset, the torque offset of the whole drive can be calibrated with dr48 = 15, 16 for the various switching frequencies.
Thereby the drive accelerates step by step with the adjusted ramp in dr49 to maximum 1.3-fold of the synchronous speed. The speed limits set in the oP-parameters remain operative during this phase.
The calibrated no-load torque is stored as correction characteristic. The display of the actual torque in ru12 is corrected during operation with this characteristic.
The torque offset characteristic can be read out with parameters dr58 / dr59.
This should be executed only if the application really requires increased torque accuracy.

11.2.2.4.2 Current offset ident. (dr48 = 19)

As standard the current offset from the inverter is permanently ascertained and balanced, as long as the modulation is switched off. Therefore, the current offset detection via dr48 is usually not required. In some cases, one achieves more accurate current offset values if one carries out the trimming with current in the motor.
If dr48 = 19 is selected, the inverter provides a test signal to the motor and so carries out the trimming once.
A disadvantage of this current offset detection is that it is carried out only once and therefore temperature and ageing effects are not taken into account.
To preserve the identified offset, automatic measurement is deactivated with dr48 = 19.

Since the automatic measurement can only be reactivated by the KEB service personnel, the current offset detection should preferably be carried out only in consultation with KEB.

11.2.2.5 Generally adjustments for operation with motor model

The drive is only ready for operation after switching the modulation if the flux is build up. If one starts earlier, the drive can display undefined behaviours (erroneous torque display, too high currents, bad control behaviour).

dS04: flux / rotor adaption mode			
Bit	Meaning	Value	Explanation
7	Wait for magnetisation (ASM)	0: off 128: on	The setpoint setting (ru01) is applied only after the flux build-up, i.e., only then ramps and speed controller become active.

Bit 7 in dS04 („Wait for magnetisation (ASM)“))") must therefore always be set (value 128). Thus the setpoint setting is only released if the adjusted value in parameter dS26: wait for min. flux is reached.

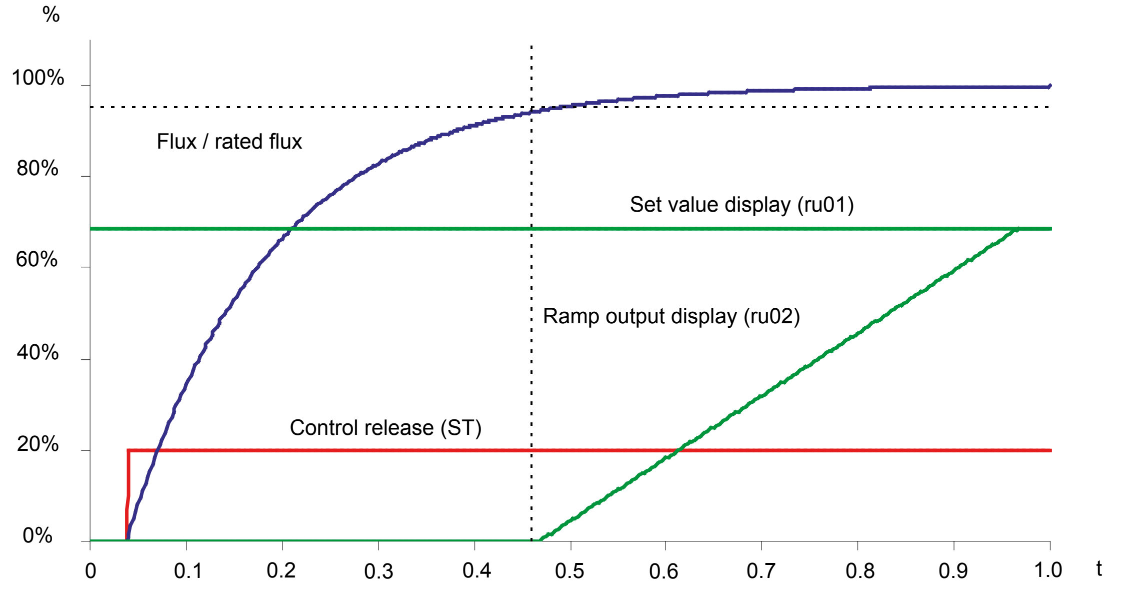


Figure 11.8 Operation with motor model

Also the flux controller must be activated for the operation with motor model.
The parameterization of the controller (KP flux / dS11, KI flux / dS12, magn. current limit / dS13) is done automatically by Fr10 and after motoridentification (dr48).

dS04: flux / rotor adaption mode			
Bit	Meaning	Value	Explanation
5, 6	Flux control (ASM)	0: off	Flux controller always off (these adjustment is not allowed for the operation with motor model)
		32: reserved	
		64: on, n^3/ dr17^3	Flux controller active, speed-dependent limit of the controller (at speed 0 = 0 / at speed dr17 = dS13)
		96: on, start and n^3/ dr17^3	as value 64, exception: start of the drive: here, (despite speed 0) for magnetisation the limit of the flux controller is set to the value dS13.

Value 64 or 96 should be selected during operation without speed feedback. Parameter dS13 „magn. current limit“ is set with Fr10 to half rated motor current. If the flux build-up time is to be shortened or if particularly high demands are made on the dynamics in the field weakening range, this value can be changed to DASM rated current (dr00).
The inverter can only provide the standstill current at speed 0. If the current is higher „ERROR overload 2" is triggered after a short time. Thereby this can lead to problems during magnetizing for some motor/inverter combinations. In these cases, the setting dS04 Bit 5, 6 = 64 "flux controller not active during boot" must be chosen.

11.2.2.5.1 Magnetization with variable motor flux

A percentage value can be adjusted with parameter ds26 "wait for min. flux" from which the setpoint setting is enabled. In order that this function becomes active, bit 7 resp. value 128 must be set in parameter dS04 "flux/rotor adaptation mode".
If in parameter dS04 „flux/rotor adaption mode“ Bit 7 resp. value 128 is set, the magnetisation is parallel running to the premagnetizing time in parameter Pn35. The time adjusted in parameter Pn35 must elapse, independent of the flux to start the setpoint setting. If parameter Pn35 is set to 0s the waiting time is dependent on the rotor time constant of the motor.

dS26: wait for minimum flux	
Value	Function
40%...100%	Value for the minimum rated motor flux when the setpoint setting is released.

11.2.2.5.2 Dead time compensation

The drive has also measured the dead time compensation characteristic during automatic identification. This calibrated characteristic should be activated for the control with motor model by the setting "dead time compensation mode" (uF18) = 3: „automatic".

uF18: deadtime compensation mode	
Value	Explanation
0: off	Deactivates the dead time compensation
1: reserved	
2: e-function	Only required for special applications

3: automatically	Activation of the identified characteristic. Shall always be used at control of asynchronous motors with motor model

Further available kinds of the dead time compensation are only required for special applications (applications with high frequencies, some special motors) or in other operating modes (e.g. V/f characteristics controlled). The dead time compensation can be switched off via a digital input. The digital input is selected with parameter uF21. This disconnection is only required for special applications with high frequency.

11.2.2.6 Magnetisation current adaption / with motor model

The automatic calculation of the magnetising current occasionally returns values which are too high for large motors. This way, the dynamic operation in the field weakening range may worsen.
Whether the automatically calculated magnetising current is too high, can be tested by accelerating the drive to the field weakening speed (dr18) with no load. At this speed, the voltage limit (modulation factor 100%) should not be reached yet. Othwise the „flux adaption factor“ (dr19) should be reduced until the modulation factor is about 90 - 95%.
Subsequently, a new identification of the head-inductance must be carried out (dr48 = 6) and the controller must be adapted to the new head-inductance with dr48 = 5.
The new "factor flux adaption" must then be checked with a new ramp-up.

If the factor is reduced too much, the available voltage will not be fully exploited anymore (modulation factor ru42 even for high speed and a load always smaller than 95%) and the motor current increases!

11.2.2.7 Special functions

11.2.2.7.1 High-frequency spindle

A special start-up must be executed for motors with output frequencies > 200 Hz.

Rating plate data „rated speed“
The ratedspeed is often not indicated on the type plate of the spindles. When driving with motor model this rated speed ist only important for calculation of the pole-pair number and the model tripping level in parameter ds19 (default value => 2*slip speed).

If no value is indicated here, then 98.5% of the synchronous speed can be accepted.

nn = fn * 60 * 0.985 / ppn

ppn = pole-pair number
fn = ratedfrequency
nn =ratedspeed

Selection of the ratedswitching frequency of the inverter
The output frequency should not exceed 1/10 of the switching frequency.
Thus the following applies:

switching frequency	max. output frequency	output speed (for pole-pair number = 2)
4 kHz	400Hz	12000 rpm
8 kHz	800Hz	24000 rpm

Voltage output for HF applications (dS18 Bit 6, value 64)

An additional voltage vector can be output for 8 kHz. The current controller is calculated only every 12 µs. The transformation angle can be changed every 62.5 µs because the current controller uses "estimated model flows" as controller feedback. This is useful e.g. at HF spindles, where the current measurement is falsified by high current ripple of the motor current or due to saturation effects high-frequency harmonics are contained in the current which can activate the controller.

Switching off the hardware current limit (HCL)
If the motor model is activated, the HCL should generally be deactivated via (uF15: 0 = off) because the motor model control and the hardware current control can disturb each other.

11.2.2.7.2 Identification of the equivalent circuit data:

- Main inductance:

  There can be problems at the measurement of the main inductance in lower speed range and when reaching the target speed.

  Lower speed range:

  The measurement of the main inductance is started with a value for the inductance which is calculated from the motor data. The lower speed range must be passed through speedy because the mode of calculation can only be estimated and additionally the motor data of the manufacturers are problematically. The auxilliary ramp in dS21 and dS22 is reasonable for this.

Resolution mode	dS21	max. dS22
4000 rpm	1/12 rated speed	1 s
8000 rpm	1/12 rated speed	2 s
16000 rpm	1/12 rated speed	4 s
32000 rpm	1/12 rated speed	8 s

- Leakage inductance:

  Measurement of the leakage inductance can lead to wrong values, if the inductance of the motor has a pronounced current dependence. The current has a „bell-shaped“ curve at setting of sine-wave voltage. This can often be observed at spindle motors. It can be seen in COMBIVIS to what extend the motor to put into operation is affected. This is possible during the rotor resistance measurement with parameter ru87. Depending on the deviation of the current from the sine form the inductance is reduced to 85..70% of the identified value.

- Check current controller adjustments:

  A correction of the current controller adjustment is eventually necessary if the identified leakage inductance (dS07) is < 1.4mH:

  dS00 = dS00_def * 1.0…1.5

  dS01 = dS01_def * 1.5…2

Control to model currents (dS18 = 8):
Control to model currents (dS18 bit 3 = value 8) has the advantage that disturbances of the measured currents enter filtered to the motor model and thus the calculated model current and the current control are smoother. The disadvantage is in the danger that the drive could change to OC when there is a difference between measured and calculated current. Thus pay special attention to the identification of the equivalent circuit data.

Observer motor model (dS18 = 16):
The observer (dS18 bit 4 = value 16) adjusts the model currents dependent on the measured currents by the adjusted factor in parameter dS23 „observer factor".

Square-law load torque characteristic:
If the drive shall be accelerated at torque limit, it is mandatory necessary that the max. breakdown torque is not exceeded. Parameter (dS03 Bit 1 = value 2) must be activated and the breakdown torque at DASM field weakenening speed (dr18) must be entered in parameter dr16 (DASM max. torque corner speed). The DASM field weakening speed (dr18) should be set to the DASM rated current (dr01). If the breakdown torque should not be arise from the data sheet, the breakdown torque must be calculated from the equivalent circuit data.

Rough formula : Mk = 2.0 * Mn

Mk = DASM max. torque corner speed (dr16)
Mn = DASM rated torque (dr14)

Switching off the dead time compensation at high output frequencies:
The dead time compensation is mandatory required up to 200 Hz, above 200 Hz it should be switched off. For this a digital software output e.g. for (do04 = „27: actual value > level“) level (LE04 = 12000 rpm (ppz=1)) with hysterese LE12 = 500 rpm and input function uF21 „dead time compensation off“ = 256 must be assigned to the corresponding software input. With uF25 you can define a time where the dead time is soft switched off.

Load rejection of the current controller at dynamic procedures:
In order to unload the current controller at high output frequencies there are two possibilities:

a) Activate Pt1 element after the speed controller
After the PI speed controller, a PT1 element can be activated via parameter cS29. A PT1 time of 2...8ms is recommended. Parameter cS29 is considered in the calculation for the controller parameters of the speed controller via the mass moment of inertia.

b) Ramp time and s-curve at deceleration

Resolution mode	Min. oP30...oP31 / Min. oP34...oP35
4000 rpm	0.05 s
8000 rpm	0.1 s
16000 rpm	0.15 s
32000 rpm	0.25 s

Maximum current limiting and design of the inverter:
A max. current can be preset in dr37 in order to protect the inverter against overcurrent errors. Additionally parameter dS03 Bit 0 =1: max. current mode on must be set.

The distance to OC level is depending on:

- Current ripple dependent on the switching frequency (ft) and leakage inductance (Ls). A calculation of this part is possible, but very extensive.
  Rough formula : I Ripple = 46.4 / ft / Ls * kHz * mH *A (Ls in mH / ft in kHz)
- overshoot of the current controller, approx. 10% of the selected maximum current.
- the „300Hz“ reload voltage ripple (at 50Hz mains frequency) in the DC link. This serves for a superimposed current oscillation in the output frequency (output freq. - 300Hz). This part is depending on many factors (size of DC capacitors (C), line supply impedance, leakage inductance of the motor (LS), active power (Pw).
  Rough formula : I Rippel_dc = Pw^2 / C / Ls * 105 * µF * mH / kW^2 (Pw in kW / Ls in mH / C in µF

Additional distance to the OC level up to 15% can be reached by using an input choke.

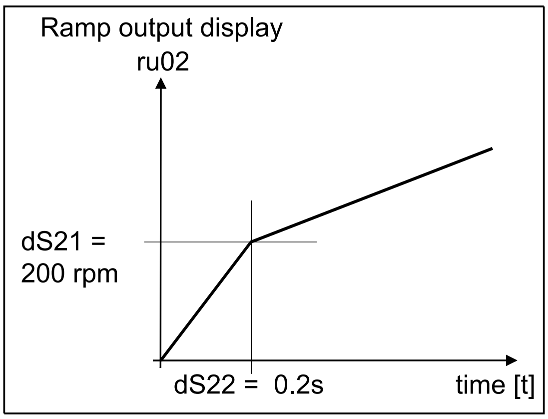
11.2.2.8 ASCL / low speed operation

The operation at small speed is a critical range which should be passed very quickly.
The size of this range cannot be indicated universally valid. It is strongly dependent on the used motors.
The usable speed range for standard-asynchronous motors is approx.:

Power	mot. operation	gen. operation
2.2 kW	1 : 50	1 : 20
85 kW	1 : 100	1 : 50

Start-/ stop ramp for low speed (dS21 / dS22)
In order to leave the critical range of small speed at starting and stopping there is an additional ramp for this range.
The ramp is defined by parameter dS21 „startup speed“ and dS22 „startup time“.

Parameter dS21 indicates the speed range for which the start ramp applies. dS.22 indicates the acceleration-/ deceleration time.



Example:

Ud02 = 4 (4000 rpm - mode)
dS21 = 200 rpm
dS22 = 0.2s

Figure 11.9 ASCL at low speed

ASCL model deactivation during deceleration (dS19, dS20)
If the drive is to be stopped, the critical range of low frequencies must be passed again.
The additional problem of the drive not stopping completely, but instead running permanently at a low frequency with a very high current occurs here, leading to a miscalculation of the speed.

Under the following conditions, therefore, the mode is switched from vector controlled to current regulated, frequency controlled operation:

- drive decelerates
- - the estimated output frequency is smaller than dS19 („limit uf-contr. dec ASCL“)

The drive then shows the following behaviour:

- the output frequency is ramped down according to the adjusted deceleration ramp
- the current is kept constant starting from the switching time

Parameter dS19 is loaded with a default value by the identification or Fr10 „load mot.dependent para.“. Should problems still occur during deceleration, the value for dS19 can be increased.

If the drive is stopped by switching off the rotation direction release, the modulation is switched off after reaching output frequency 0.

If the drive is stopped by setting the setpoint to 0, the current is reduced to the magnetising current after reaching the output frequency = 0.
At this point, the real speed of the motor is not yet 0 in some cases. Therefore, the time for which the higher constant current is set can be increased with parameter dS20 „delay time uf-contrl.".

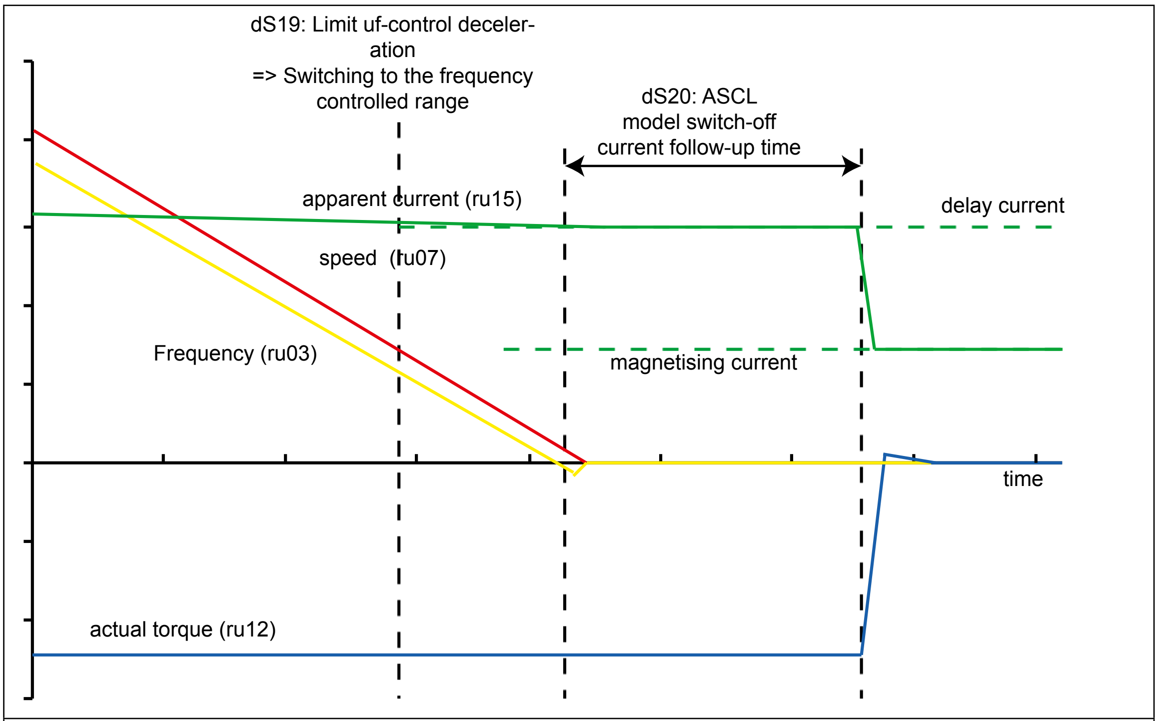


Figure 11.10 ASCL model deactivation during deceleration

The torque display (ru12) is invalid after change-over to frequency controlled operation!

ASCL / reversing
If one wants to run the drive through zero speed without stopping to change (reverse) the direction of rotation, switching to the frequency controlled mode can be disruptive.
Therefore, this switching can be deactivated by setting bit 2 in parameter "function mode" (dS.18).

dS18: function mode			
Bit	Meaning	Value	Explanation
2	model switch-off	0: activated 4: deactivated	Deactivate switching to the frequency driven, current-controlled operation

To utilise the open-loop mode for stopping, but, on the other hand, avoid negative effects during reversal, the inverter must be programmed by way that stopping of the motor always follows in the same set.
Then, one can let the switch to the open-loop mode be activated for this set (stop-set) (dS18 = 0) and avoid interfering effects during reversal for other sets with dS.= dS18 4.
The, it is only necessary to ascertain that the range of low frequencies is traversed quickly.
This can be achieved by suitable adjustment of parameter "startup time" (dS22) and parameter "startup speed" (dS21), which apply to acceleration as well as deceleration.

ASCL / constant run with low speeds
Speed setpoints lying within the critical range must be avoided.
To avoid continuous operation in low frequency range, the minimum setpoint (oP06 / oP07) should be set to speeds outside the critical range.
Alternatively, too small setpoints may also be masked by parameter oP65...oP68 (prohibited setpoints).

11.2.2.9 Switch to consecutive motor

If the motor still rotates when switching the modulation (e.g. "coast down" after malfunction) the calculation of the actual speed can become unstable due to the motor model.
If there is the risk that the motor has not reached speed 0 for the start, there are two alternative starting methods:
Speed search condition (Pn26) or DC braking mode (Pn28 / Pn33)

During speed search, the drive attempts to determine the current speed via its mathematical model. The operation corresponding to the setpoint settings is re-established starting at this speed. This type of switch-in can be used for many standard motors.
For some motors or applications, e.g. for spindles, application of the speed search will be unsuccessful. In these cases, speed is calculated incorrectly, the drive can vibrate, or the inverter can malfunction.
In these cases, the motor must be stopped by DC braking before the drive can be restarted. During DC braking, a DC voltage is connected to the motor´s clamps. The small braking torque while the motor is still running at high speed is a disadvantage.

For more (appropriate parameters, settings, etc.) see chapter 18.6 speed search and 20.1 DC braking, respectively.

11.2.2.10 function mode

Some auxilliary functions can be activated via parameter dS18. Value 4 is an exception: Model deactivation (see "ASCL model deactivation during deceleration" / subsection "reversal").

dS18: function mode			
Bit	Meaning	Value	Explanation
0	reserved		
1	stator resistance / adaption	0: off 2: on	activates setpoint tracing of the stator resistance, which may change during operation due to temperature effects
2	model switch-off	0: activated 4: deactivat-ed	Switching in the frequency controlled, current regulated oper-ation during stopping
3	Current control	0: measured 8: calculated	Selection of the actual value source of the current controller: 0: measured current 8: current calculated from the model
4	observer hs model	0: off 16: on	Activation of an observer for high frequency applications
5	reserved		
6	Voltage output for HF applications	0: off 64: on	Activation of a faster voltage output. Only important for high frequency applications
7	deviation control	0: off 128: on	Activation of the deviation controller
8	reserved		
9 10	Estimated value limit	0: off 512: 1024: 1536:	Estimation limit off Estimation limit depending on the speed setpoint Estimation limit via oP14/oP15 to zero reserved
11	isdq mean value filter	0: off 2048: on	Activation of a software filter in the current measuring system

stator resistance / adaption

The stator resistance can stabilise the model at low output frequencies, particularly in regenerative operation . At low motor rating, the effect of the stator resistance in this range is quite large. Due to the motor warming, changes of up to 40% compared to the resistance calibrated in the cold state are possible. The stator resist-ance adaption can compensate for this change. Under certain operating conditions, (e.g. high dynamic) the adaption diminishes the operational performance of the drive. Therefore, this function should only be activat-ed when problems with breaking and stopping may occur for motors with small power (< 5 kW).

Current control by measured / calculated currents

For the current control, either the measured currents or those calculated from the model can be used as ac-tual values. As a standard, the measured currents are used for control since only this assures direct control over the real currents.

Using the calculated currents is advantageous only in high frequency applications: The delay (detection of the actual current until the output of the voltages as response to the current measurement) is noticeable in these applications. For control based on calculated current, this time is minimised.

Observer / motor model, observer effect / motor model

The observer causes an equalisation between the measured currents and the currents calculated from the motor model. This is useful for some high frequency applications. The reciprocal of amplification of the ob-server is defined with parameter „observer factor“ (dS23).

Voltage output for HF applications
At high output frequencies, the voltage vector must be calculated and output in a shorter time pattern. This is possible only at 8 kHz and 16 kHz. Important for high frequency applications

Deviation control
The deviation controller becomes only active if the current control (bit 03 = value 8) is active. The deviation controller adjusts the estimated currents to the measured currents. The deviation controller should always be activated if the current control is active in order to reach a better control characteristic. The influence of the controller can be adjusted with parameter dS27 „deviation control time". The lower the time is adjusted in dS27, the nearer it is controlled to the measured currents.

Estimated value limit
Depending on the speed setpoint (Bit 9: 512)
Depending on the setpoint, the limit for the negative direction is limited to 0 rpm. Reversal is possible, because the old direction of rotation is only blocked when the actual value has reached 0 rpm.

via oP14 / oP15 to zero (Bit 10: 1024)
The estimated controller output is blocked if a value of 0 rpm is entered in oP14 (abs. max. reference forward) or oP15 (abs. max. reference reverse). The estimated controller output is also blocked at „speed search“.

isdq mean value filter
The isdq mean value filter is a software filter for the current measurement system. For motors with low inductance (<1 mH), it is reasonable to activate this filter.

11.2.2.11 Speed estimate controller (dS14, dS15) and speed smoothing (dS17)

The KP (dS14) and KI (dS15) of the speed calculation controller are automatically calculated during the identification of the motor parameters and may not be changed.
Only parameter dS17 „speed PT1 time ASCL" can be adapted to the respective application. A higher PT1 time (up to 32ms for large motors) in non-dynamic applications leads to a steadier calculated speed, without degradation of the control characteristics of the drive. A lower speed frequently permits a more dynamic setting of the speed control parameters. If parameter dS17 "speed PT1 time ASCL" is changed, a previously conducted adaption of the speed controller must be checked.
If the automatic calculation of the speed controller parameters (parameter cS26 optimisation) is used, it must be reactivated.

11.2.3 Special function: Rotor adaption

In speed control with speed feedback, the motor model can be used to adapt the rotor time constant. The rotor time constant is dependent on the rotor resistance, among others. Due to the temperature change of the motor rotor, the rotor resistance can change significantly compared to the identified value. This also changes the rotor time constant. This change leads to a less accurate torque display and an inferior performance of the drive.
The rotor adaption compensates for the temperature deviations of the resistance. It is activated with bit 1 in parameter dS04 „flux/rotor adaption mode“.

dS04: flux/rotor adaption mode			
Bit	Meaning	Value	Explanation
0	Motor model (ASM)	0: off 1: on	Activation of the motor model
1	Rotor adaption (ASM)	0: off 2: on	Activation of the rotor adaption
2	Rotor adaption/ store (ASM)	0: no 4: yes	Storage of the last rotor adaption value obtained during operation
3...4	Maximum voltage controller	0: off, max. 110% 8: on, max. 110% 16: off, max 100% 24: on, max. 100%	see chapter: Torque display and limiting, section: Maximum voltage controller, voltage limit
5...6	Flux controller (ASM)	0: off 32: on 64: on, n^3/dr17^3 96: on, start and n^3/dr17^3	see section: Generally adjustments for operation with motor model
7	Wait for magnetisation	0: off 128: on	see section: Generally adjustments for operation with motor model
8	Energy saving function (ASM)	0: off 256: on	-
9	Mode always active (ASM)	0: off 512: on	-

Bit 2 = value 4 determines whether the drive stores the rotor adaption value on modulation switch-off. If memory ist activated (memory: yes), the inverter starts with the last value obtained during operation after re-activation of the modulation. If memory ist deactivated (memory: no) the inverter starts with the value 100%. After "net on" the inverter always starts with the value 100%.

The state of the rotor adaption can be read in parameter ru59 „factor rotor adaption“: 100% means that the drive is working with the identified values. Values unequal 100% mean that the actual rotor resistance is = ru59 * dr08 (TPIM rotor resistance).

11.2.4 Block diagram

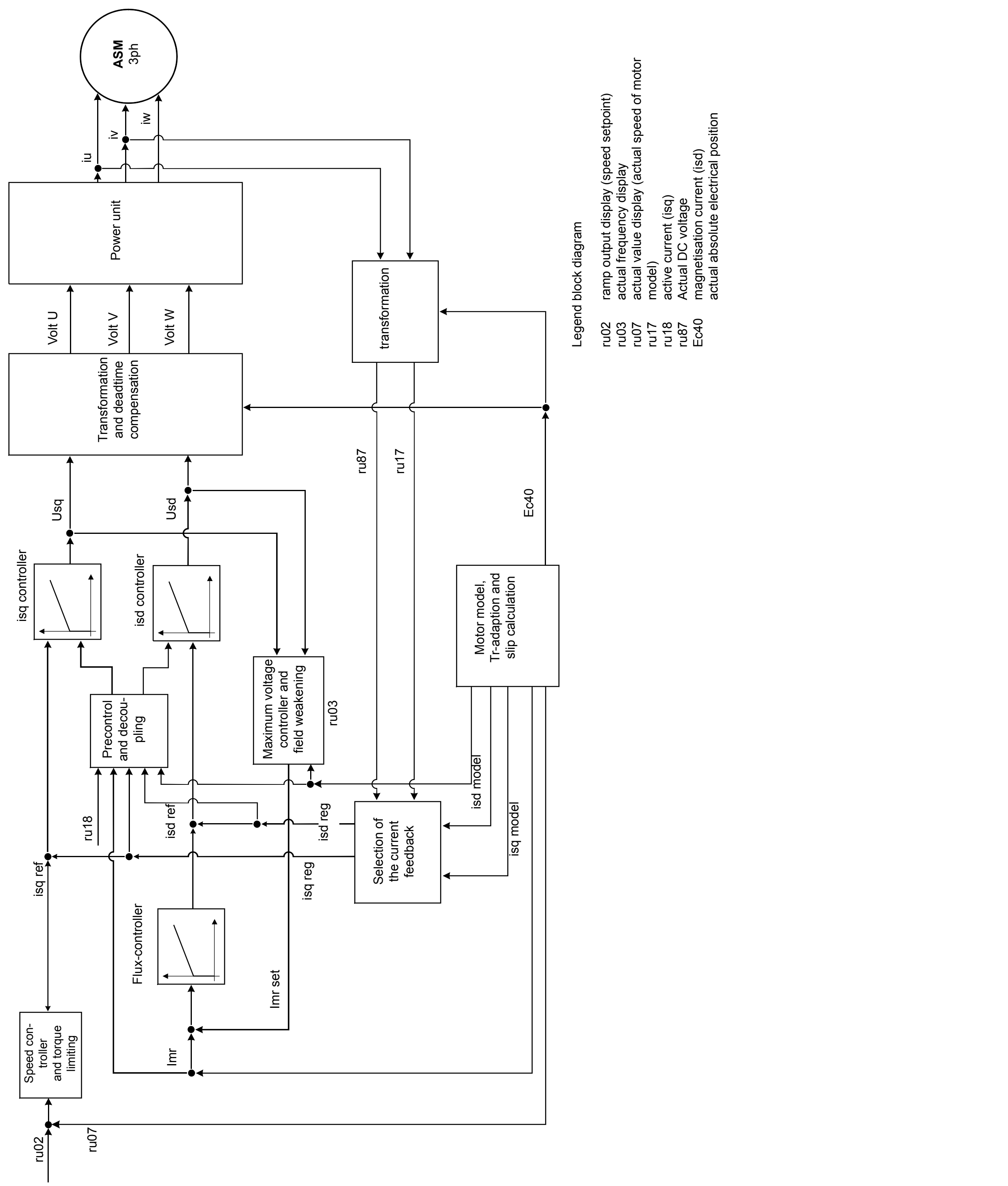


Figure 11.11 Block diagram ASCL

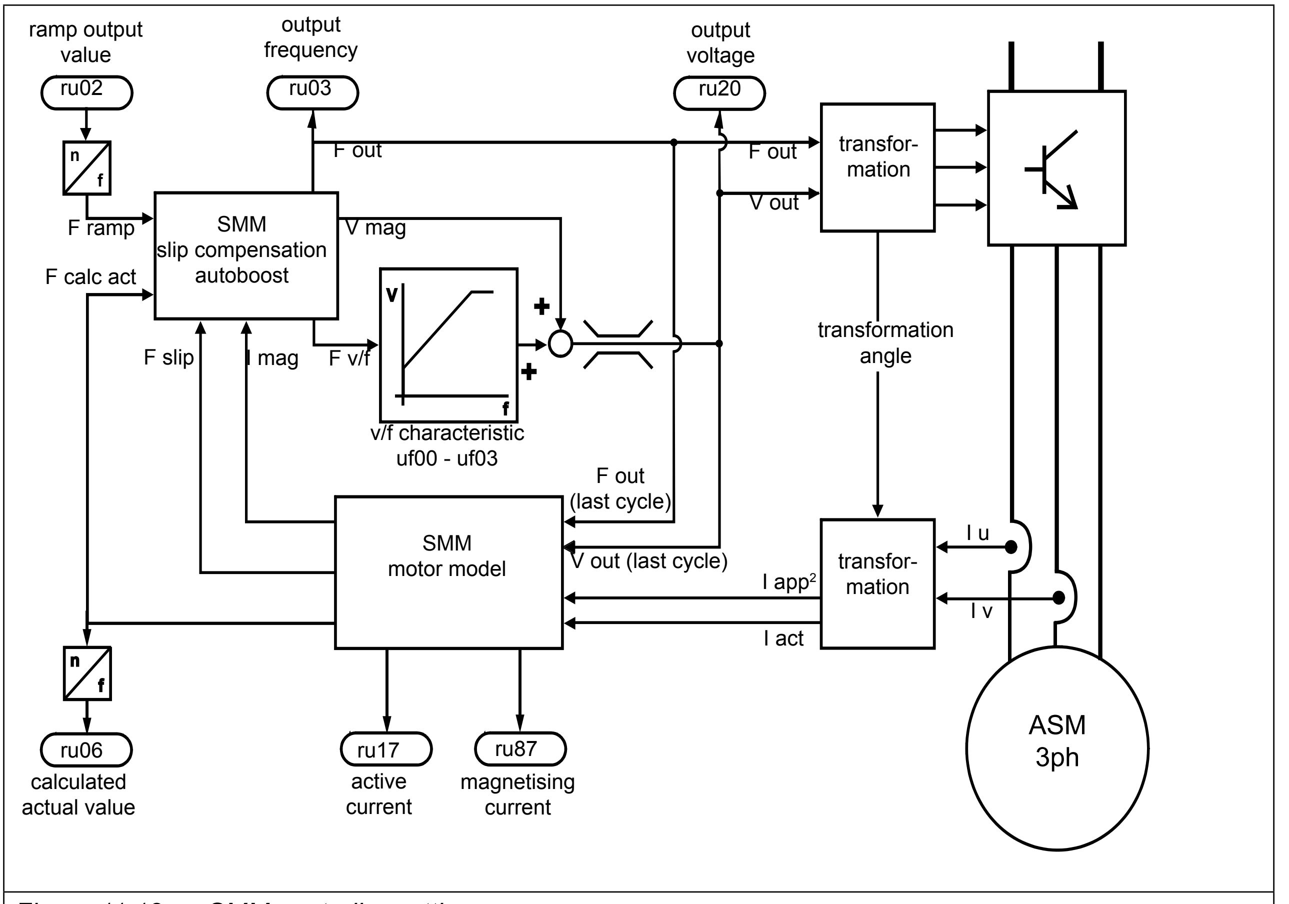


Figure 11.12 SMM controller setting

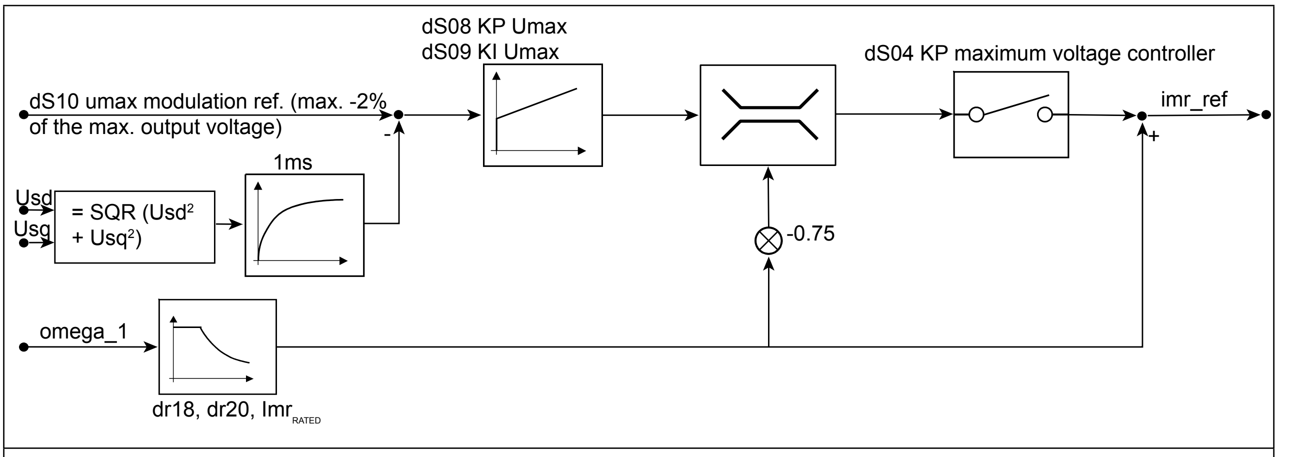


Figure 11.13 Field weakening

12. Adjustments of the Synchronous Motor

Speed-controlled operation without encoder feedback
Speed-controlled operation of synchronous motors without encoder feedback SCL (sensorless closed loop) is only possible if the electrical characteristic data of the motor are known. The rotor position is emulated by means of a mathematical model of the synchronous motor. Speed control is based on a speed calculated from the rotor position rather than on the encoder feedback.
A frequency inverter with the appropriate hardware and G6P software is required for operating mode SCL.

12.1 Initial settings

The following settings are always necessary in speed-controlled operation:

12.1.1 Motor name plate

Input of the motor rating plate data is at the beginning of each start-up:

- dr23 DSM rated current
- dr24 DSM rated speed
- dr25 DSM rated frequency
- dr27 DSM rated torque
- dr28 DSM curr. f. zero speed

The following equivalent circuit data can be taken from the motor data sheet.
Identification of the data offers a high accuracy and acquires the additional line resistance. The identification can be executed as described in chapter 12.2.2 (SCL).

- dr26 DSM EMF [Vpk*1000RPM]
- dr30 DSM stator resistance
- dr31 DSM inductance
- dr64 DSM winding inductance Luv maximum value

Beside the minimal value in dr31 also the max. value in dr64 can be preset for SCL. These parameters are also preset by the identification of the winding inductance. Servo motor manufacturers indicate the lower value of the inductance Luv. This value must be entered in dr31.

DSM EMF voltage constant (dr26, dr63)
EMF is the induced voltage in no-load operation and must be entered as peak value (phase-phase) referring to 1000 rpm.

$$dr26 = EMFeff \times \sqrt{2}$$

i	Parameter dr26 is only considered if parameter dr63 has value 0.

No decimal places can be entered for the EMF in parameter dr26.

The maximum permissible speed which is displayed in ru79 (abs. speed [EMF]) is also calculated from the EMF. The maximum DC link voltage, UZKmax, can be found in the power circuit manual.

$$ru79 = \frac{\text{Max. } UDC_{link} \text{ x } 1000 \text{ rpm}}{dr26}$$

DSM current for zero speed (dr28)
The current for zero speed affects the electronic motor protection function (see chapter 18).

12.1.2 speed control configuration

Parameter cS00 must be set to value 4 „speed control“ for closed-loop operation.

cS00: speed control configuration			
Bit	Description	Value	Function
0...2	control mode	4: speed control	(description see chapter 13)
		5: torque control	(description see chapter 15)
		6: torque/ speed	

12.1.3 act. source

The actual source for the speed control must be selected in parameter cS01.
Parameter cS01 must be set to value 2 (calculated actual value) for the operation with SCL

cS01: act. source			
Bit	Description	Value	Function
0...1	act. source	0: reserved	
		1: channel 2	Control to encoder interface 2
		2: calculated actual value	Control to estimated speed
		3: reserved	
2	System inversion	0: off	Activates the system inversion
		4: on	

With activation of the system inversion it is reached that the motor with selected rotation direction "forward" (e.g. by setpoint- or rotation setting) has the physically direction "reverse" respectively at setting "reverse" the physical rotation "forward". Precondition is a correct wiring of motor.

12.1.4 Motor adaption

Fr10 = 2 (for some applications Fr10 = 1 (explanation see below) must be entered once after input of the motor data.
The parameter can only be written in state „no operation“!

Fr10: motor adaption	
Value	Function
0: done	Calculation is completed
1: uF09 (G6L/P)	Calculation depending on uF09 or voltage class
2: act. DC link voltage (G6L/P)	Calculation depending on act. DC link voltage

The calculation at Fr10 = 1 is depending on the voltage entered in parameter uF09 „voltage stabilisation“. If this parameter displays "off" (standard adjustment), then the voltage class of the frequency inverter (400V or 230V) is used.
The actual DC link voltage of the inverter, which is proportional to the mains input voltage, is considered for the calculations at Fr10 = 2. However this only applies if uF09 is set to „off". Thus the following parameter are pre-charged dependent on the motor and inverter data:

Current controller

- dS00 KP current
- dS01 KI current

Torque limits:

- cS19 abs. torque ref
- cS06...cS12 torque limit rev. gen.
- Pn61 quick stop torque limit
- dr33 DSM max. torque

Motor type (only at SCL):

- nn01 stabilisation current
- nn02 min. speed for current
- nn03 max. speed for current
- nn10 standstill current
- nn11 stabilisation time

12.2 Speed-controlled operation without encoder feedback (SCL)

With this software the speed of the motor can be calculated by the measured currents and the motor data (by means of a model). This calculated speed can be used as feedback for the speed controller. The necessary motor data for the model can be identified by the KEB COMBIVERT itselfs. Static operation with small frequencies must be avoided, because the model can become unstable. The usable frequency range is approx. 1:100. At setpoint speed 0, the speed control is deactivated and the motor is aligned using a predefined DC current.

12.2.1 Initial settings for sensorless operation

The following adjustments are default values and must not be adjusted:

- The speed control configuration cS00 must be set to value „4: speed control“.
- The actual source cS01 must be set to value „2: calculated actual value“.
- The brake handling Pn34 must be activated (default value = 2: brake control without display)
- The motor model nn00 must be set to value „191“.

12.2.2 Identification of the motor data

The required equivalent circuit data for the motor model can be determined by the KEB COMBIVERT itself. First, the motor data must be entered according chapter 12.1 and the motor adaption must be executed.

There are two possibilities to start the identification:

- Writing of parameter dr48 in inverter state „stop (LS)", measurement is starting automatically.
- Writing of parameter dr48 in inverter state „no control release (no operation)“ with subsequently control release

Parameter dr48 cannot be written in other operating conditions.

The measured values can be invalid in case of strong overdimensioning of the inverter. The rated current of the motor should be at least 1/3 of the maximum short time current limit. The short time current limit is determined by the overload characteristics and can be taken from the power circuit manual or parameter In18 (hardw. curr. inverter).

i	The direction of rotation during identification of the EMF (except for system inversion) is always "forward"!

Value 82 „calculate drive data“ is output in inverter state ru00 during the measurement. After successful measurement parameter ru00 displays 127 „calc. drive data ready“.
If the measurement is interrupted with an error, ru00 displays 60 „ERROR calc. drive data". No correct operation can be ensured in case of interruption.
The actual state of the identification is displayed in parameter dr62 "state motor ident.". The control release must be switched off in order to leave the identification mode. Parameter dr48 must be written again in order to start a new measurement.

For safety reasons the output signal "brake release" is not set during measurement, since the motor cannot generate a defined torque in this time.

Since the identification in auto mode is very reliable and for the user the most pleasant method it is recommended to use it generally (according to chapter 12.2).

dr48: motor identification			
Bit	Description	Value	Function
0...4	Measurement	0: off	
		1: calc head-ind. Lh / EMF*	Calculation of the EMF from motor data
		2: inductance Ls/L*	Measurement of the winding inductance respectively
		3: stator resistance Rs*	Stator resistance
		5: init model/curr.reg.*	Calculation of the current controller from equivalent circuit data
		6: EMF move*	**Attention: requires motor rotation!** EMF measurement
		7: auto ident without move	Start of the automatic measurement without EMF
		8: auto ident with move	**Attention: requires motor rotation!** Start of the automatic measurement with EMF
		9: reserved	Measurement of dead time compensation characteristics for different switching frequencies
		10: deadtime ident 4 kHz *	
		11: deadtime ident 8 kHz *	
		12: reserved	
		13: reserved	
		14: reserved	Detection of the no-load torque at different switching frequencies. During operation this torque is subtracted from torque display ru12.
		15: torque ident 4 kHz	
		16: torque ident 8 kHz	
		17: reserved	
		18: reserved	
		19: current offset ident	Detection of the current offset in phase U and V
		20: Usd Step	Energizes the motor with 4 pulses
		21: head-ind. Lh flux adpt.	As value 6, unless the magnetizing current is not static but it is calculated adaptively
		22: autoident w.m. f. adpt.	As value 8, unless the magnetizing current is not static but it is calculated adaptively.
5...7	Frequency	0: 1000Hz	The measuring frequency is changed independently during measurement. Therefore, leave the value at 0: keep 1000Hz!
		32: 500Hz	
		64: 250Hz	
		96: 125Hz	
		128: 62.5Hz	
		160: 31.25Hz	
		192: 15.625Hz	
		224: 7.8125Hz	

* at dr48 = 8 auto identification

12.2.3 Auto identification

The auto identification can be carried out with move (dr48 = 8) or without move (dr48 = 7) (see table dr48). The measurement of the dead time compensation characteristics as well as stator resistance and leakage inductance occurs during standstill.
For the identification of the EMF it is necessary to accelerate the motor onto 60% of its rated speed. An additional ramp of dr49 „motor identification ramp time“ is effective for this case. The calculation of the ramp can be taken from chapter 10.

For large synchronous motors, it leads to significant mechanical vibration and thus to noise development during measurement of the leakage inductance with motor rated current. Here it is reasonable to reduce the measuring current to 10..30% of the rated current.
The measured inductance is depending on the current level (saturation effects)!

The same function as for inductance is used for the current offset detection. Thus the parameter also has influence here on the current level.

dr67: current for Ls/Ioff iden	
Value range	Function
10...250%	Determination of the current limit for the identification of leakage inductance and current offset

The speed controller should be parameterized with small Kp-, Ki values before the motor can be accelerated. The speed controller can be preset optimally if the motor mass-moment of inertia is known (see chapter 13.1.2).

Depending on the used motor the identification takes some minutes!

⚠	Auto identification cannot be executed if a sine-wave filter is connected!

12.2.4 Single identification

As far as possible single identifications should not be used for the first measurement of the motor adaption, since invalid test reading can occur at false sequence of the identifications.
Single identification can always be used if a complete automatic measurement was executed and only individual parameters shall be identified. For example this can be a resistance measurement at operating temperature.

Default setting of the current controller parameters and EMF (dr48 = 1)
The EMF can be approximately calculated from the entered motor data like rated current and rated torque. dr48 = 1 „calculation of the EMF“ must be written for it.

$$EMC = \frac{M_n \times 90}{I_n}$$

The current controller values are also roughly preset.

Winding inductance (dr48 = 2)
Measurement of dr31 „winding inductance" occurs with a high-frequency AC current in standstill. The measurement is started with dr48 = 2. Measurement current is DSM rated current dr23. The frequency of the measuring signal is adjustable via bit 5...7 in parameter dr48. If the measurement current cannot be reached with

1kHz, then the identification reduces the measuring frequency automatically. Therefore the frequency value should not be changed. The inductance value is automatically written in dr31 after identification.

Stator resistance (dr48 = 3)
The measurement of the resistance occurs with DC current in the phase U to V.
The measurement is started with dr48 = 3. The resistance value is entered in dr30 at successful identification.

Controller parameter (dr48 = 5)
The current controller parameters are calculated from the pre-identified equivalent circuit data with the adjustment of dr48 = 5. Is not identifed in the automatic mode if this calculation should occur before the identification of the EMF.

EMF move (dr48 = 6)
The drive accelerates upto 60% of its rated speed for the identification of the EMF. The ramp of dr49 (ident. acc/dec time) is used for the acceleration. The general speed limits of the oP parameters are valid! (see chapter 10 setpoint setting). This measurement is only possible if the EMF adaptation is activated in parameter nn00 (motor model adjustment) (default setting!)
If the identification is successful executed the value is written in dr26 (DSM EMF peak value) and additionally in dr63 (DSM EMF HR).
Parameter dr63 has a higher resolution and is suitable for applications with high frequencies.

Deadtime ident. (dr48 = 10, 11)
The deadtime identification works only as single identification if the stator resistance is correct entered/identified. The measured deadtime values can be read out via In39 „deadtime selector“ and In40 „deadtime.
The measured deadtime compensation characteristics are effective during operation, if uF18 "deadtime comp. mode" is adjusted to value 3: "auto. ident". The characteristics are not cleared by Fr01 „load default set“.

Torque ident. (dr48 = 15, 16)
This should be executed only if the application really requires increased torque accuracy. The displayed residual torque in ru12 (actual torque) is subtracted during operation, so that the real shaft torque is displayed. This residual torque is partly caused by switching frequency-dependent losses in the inverter and also by means of friction losses.
The torque offset of the complete drive for the different switching frequencies is measured by dr48 = 15, 16. Thereby the drive accelerates in 16 steps with the adjusted ramp in dr49 to maximum 1.3-fold synchronous speed. The general speed limits from the oP parameters are effective.
The measured residual torque is stored and interpolated as correction characteristic.
The torque offset characteristic can be read out with parameters dr58 „torque offset selector“ and dr59 „torque offset“.
The characteristics are cleared by Fr01 „load default“ with value -4 and also with Fr10 „load mot.dependent para.“.

Current offset ident. (dr48 = 19)
The current offset is caused by tolerances of the components in the test circuit and as standard automatically synchronized in non-energized state (inverter state "noP"). Caused by current-dependent tolerances in the current detection it is necessary for some applications that the synchronization is done in energized state. For this adjust 19 in parameter dr48, so the inverter outputs a high-frequency AC current. The rated current of the motor is injected with a starting frequency of 1kHz. The frequency is automatically reduced if this is not possible.
Furthermore the automatic measurement is deactivated when the modulation is switched off, so the identified offset remains permanently.

Voltage pulse (dr48 = 20)
A preset voltage step by dr31 energizes the motor with 4 pulses with this function. A step response can be recorded with the COMBIVIS scope. The appropriate resonances can be identified from this step response.

EMF (SM) / autoidentification w.m. f. adpt.! (dr48 = 21, 22)
Values 21 and 22 should only be used from a motor size of about 11 kW. Values 21 and 22 are used for the optimisation of the magnetization current for the entered rated motor data.

It is recommended to change current offset values only in compliance with KEB.

12.2.4.1 Deadtime compensation (uF18)

The drive has also measured the dead time compensation characteristic during automatic identification. This calibrated characteristic should be activated for the control with motor model by the setting "dead time compensation mode" (uF18) = 3 „automatic". Alternatively also value 2 can be selected.

uF18: dead time comp. mode	
Value	Function
0: off	Deactivates the dead time compensation
1: reserved	
2: e-function	Only required for special applications
3: automatically	Activation of the identified characteristic. Shall always be used at control of synchronous motors with motor model

The dead time compensation can be switched off via a digital input. The digital input is selected with parameter uF21. This disconnection is only required for special applications with high frequency.

12.2.4.2 Motor identification error state dr66

See chapter 11.2.2.2 Motor identification error state dr66.

12.2.5 Standstill and starting phase

It must be secured that the rotor is in a defined position after switching on of the control release ST. Therefore a DC current is injected at standstill. Then the rotor rotates into its origin position.
The standstill current is ½ of the rated current and can be adapted in parameter nn10 in default setting after operation of Fr10.
The times (Pn35 and Pn36) of the brake handling are active for standstill operation. In order that the rotor does not vibrate after setting the control release, the current reaches the setpoint value in a half of the time adjusted in Pn35 "premagenetizing time" (see figure 12.1).
The half current-dependent load torque is acceptable as mechanical load (e.g. ¼ of the rated torque at ½ of rated current at standstill).

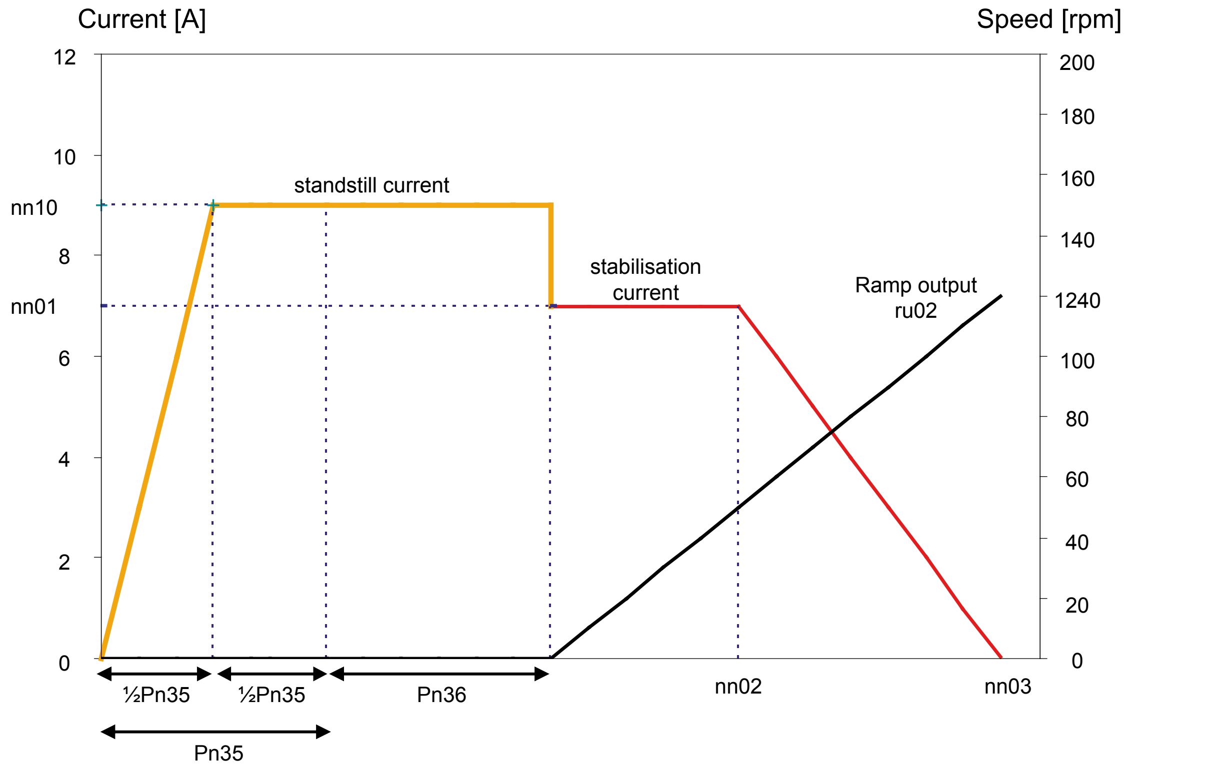


Figure 12.1 Standstill and starting phase

Speed search
The rotor rotates at some applications when the modulation is switched on. The current speed can be determined with Pn26 „speed search condition“ (for details, see Chapter 18.6).

Additional start ramp
In order to leave the critical range of small speed at starting and stopping there is an additional ramp for this range.

The ramp is defined by parameter nn08 "startup speed" which indicates the speed range and parameter nn09 „startup time" which indicates the appropriate acceleration-/ deceleration time (see figure 12.2).

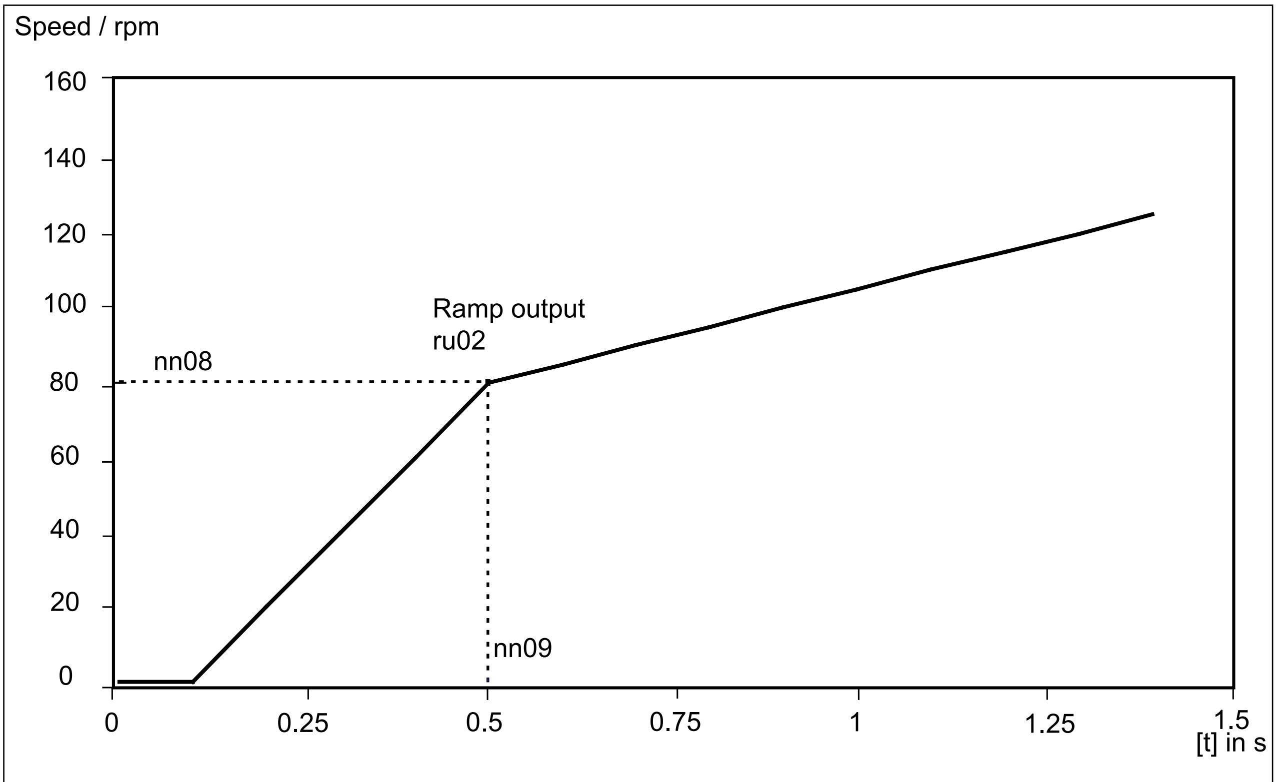


Figure 12.2 Auxiliary ramp

Example:

Ud02 = 8: G6P / 4000 rpm
nn08 = 80 rpm
nn09 = 6.25 s

Open loop operation/ start ramp

The open loop operation is activated with bit 9 in parameter nn00 "motor model select" and is only active during the start ramp. Condition: start ramp is parameterized.
The current of nn01 „stabilisation current" must be regarded as maximum active current. The current ramp of nn02 and nn03 must be parametrized by such way (see chapter 12.2.5) that the lowering of current (nn03) is upside the deactivation of the open-loop operation (nn03 > nn08).

12.2.6 Low speed

The critical speed range (typically below 1% of the rated speed) is stabilized by reactive current. This current adjustable in nn01 "stabilisation current" is linear reduced depending on the actual speed in ru07 from speed nn02 "min speed for current" to nn03 "max. speed for current".

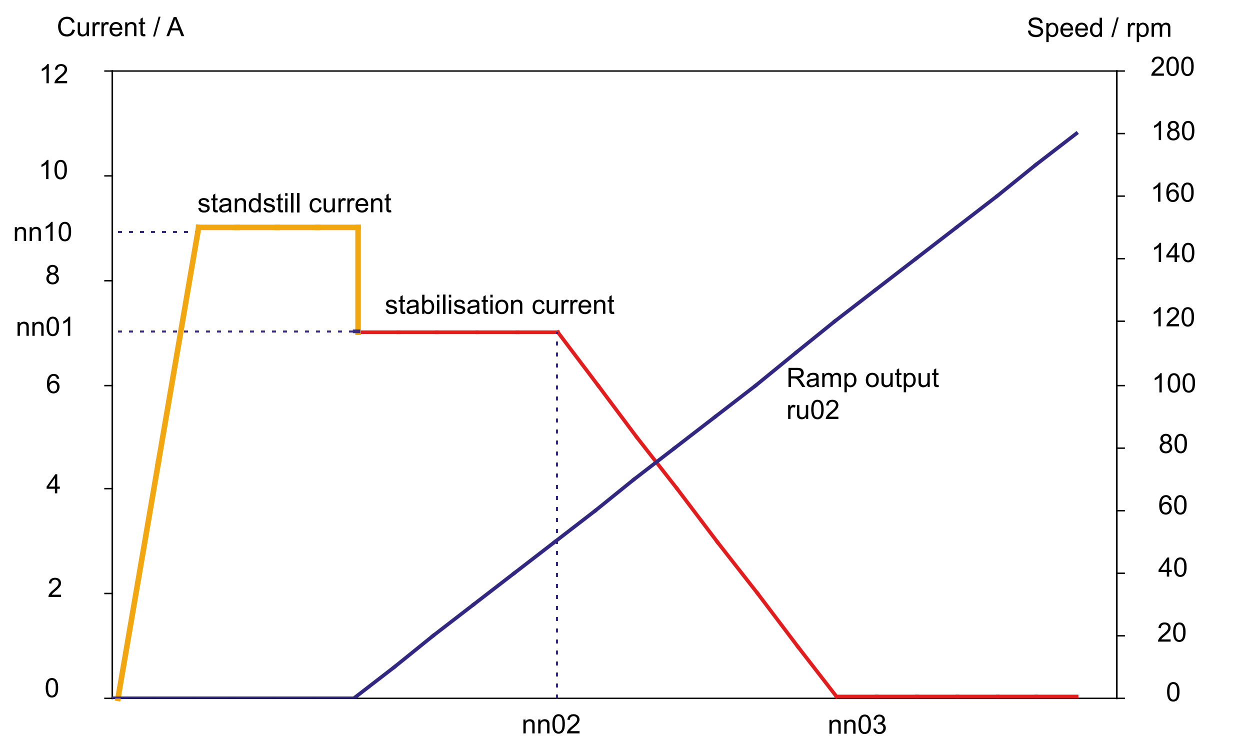


Figure 12.3 Low speed

It is necessary to adapt the current or the ramp if there are vibrations during steady state.

12.2.7 Motor model

The motor model calculates an estimated speed from the motor data and the actual values of voltage and current. Then this speed is admitted to the speed controller. The calculated model currents can be used also for current control.

nn00: motor model select			
Bit	Description	Value	Function
0	Standstill current and stabilisation current	0: off	Activation of nn01 and nn10
		1: On *	
1	model stabilisation	0: off	Stabilizes the motor model
		2: On *	
2	stator resistance / adaption	0: off	Adapts the stator resistance at low speed
		4: On *	
3	speed source	0: reserved	
		8: Model *	Speed control with spreed estimation
4	high speed model	0: off	Activates the high-speed model for upper speed
		16: On *	
5	observer hs model	0: off	Becomes noticeable at high speeds
		32: On *	
6	current control with	0: measured currents*	Current control to model currents
		64: current control	
7	EMF adaption	0: off	Adapts the EMC at upper speed
		128: On *	
8	reserved	0: reserved	
		256: reserved	
9	open loop start	0: Off *	Switching off the model during start ramp
		512: an	
10	band-stop filter	0: Off *	Activates the harmonic absorber for the operation with sine-wave filter
		1024: On *	
11	deviation control	0: Off *	Deviation of model currents to measured currents
		2048: an	
12	Voltage output for HF applications	0: Off *	Activates double voltage output
		4096: an	
13	reserved	0: reserved	
		8192: reserved	
14	HF injection	0: reserved	Can determine the rotor position continuously at low speed.
		16348: reserved	

* Default values

Stabilisation and standstill current (nn01, nn10)

The currents nn01 „stabilisation current“ and nn10 „standstill current“ can be switched off with bit 0 of nn00. The starting phase with activated currents runs more steady so that this adjustment should not be changed! If the rated motor current is higher than the rated inverter current the values are limited (after loading Fr10) to ½ of the HSR current In18.

Stator resistance / adaption

The stator resistance changing by temperature influences can affect the behavior at low speed as well as the start. The RS adaptation adjusts the stator resistance and stabilizes the motor model therefore.
The I-part of the adaptation can be adjusted with nn06 „rs adaption factor“. The rs adaption becomes active at ru17 „active current“ > nn01.

EMF adaption

The EMF changing by load and temperature influences is adjusted at higher speed.
The adaption becomes active at actual speed ru07 > ¼ of the rated speed dr24 and improves the accuracy of the actual torque display ru12.

Observer

The observer amplifies the influence of the measured currents in the model. The most effects become noticeable in the upper speed range.
The value must be increased if current oscillations occur at e.g. applications with high frequency.
The observer factor can be adjusted with nn07 "observer factor".

Speed estimation

The speed estimate controller is calculated by writing on Fr10 and cannot be changed. The speed estimate controller estimates a speed from the currents of the motor model. Parameter nn04 „time speed calculation" determines the scan time of the speed estimate controller. This time should not be changed.

Parameter nn05 „filter speed calculation“ determines the smoothing time at the output of the controller. Oscillations are reduced when the value is increased, but the drive becomes more non-dynamic.
At special applications the drive has to rotate only into oneway direction. The respective direction of rotation can be locked with oP40 / oP41 "max. output val. for/rev" by writing the parameter value to "0" and thus the speed calc. is limited. To limit the speed estimate controller see also chapter 11.2.2.11.

The general speed control settings can be adjusted according to chapter 13 "Speed control".
Diagram of the controller structure for operation without encoder feedback, see chapter 12.3.

12.2.8 Function mode

dS18: function mode			
Bit	Meaning	Value	Explanation
9 10	Estimated value limit	0: off 512: 1024: 1536:	Estimation limit off Estimation limit depending on the speed setpoint Estimation limit via oP14/oP15 to zero reserved
11	isdq mean value filter	0: off 2048: on	Activation of a software filter in the current measuring system

Estimated value limit
depending on the speed setpoint (Bit 9: 512)
Depending on the setpoint, the limit for the negative direction is limited to 0 rpm. Reversal is possible, because the old direction of rotation is only blocked when the actual value has reached 0 rpm.

via oP14 / oP15 to zero (Bit 10: 1024)
The estimated controller output is blocked if a value of 0 rpm is entered in oP14 or oP15. The estimated controller output is also blocked at „speed search“.

isdq mean value filter
The isdq mean value filter is a software filter for the current measurement system. For motors with low inductance (<1 mH), it is reasonable to activate this filter.

12.2.9 Operation with sine-wave filter

For the operation with sine-wave filter it is necessary to filter the resonance frequency with a band-stop filter. The resonance frequency of the sine-wave filter and the corresponding filter parameters can be determined with the tool sine-wave filter exe (www.keb.de). The equivalent circuit data of the motor and sine-wave filter must be entered in order to generate a parameter list. Then this parameter list must be loaded to the inverter. The filter parameters are stored in the fh parameter group.
The resonance frequency is filtered of the estimated currents with software filter, in order that there is no reaction. The band-stop filter must be activated in nn00 "motor model select" bit 10 (band-stop filter). Also it must be controlled to the estimated currents nn00 bit 6 (current control). The deviation controller should be switched on with bit 11 of nn00 in order to avoid possible effects on wrong estimation. The deviation controller adjusts the estimated currents to the measured currents with the scan time of nn12 „deviation control time". This time can be increased in case of current oscillations.
The inverter current is mostly higher than the motor current because there is a current through the capacitor of the sine-wave filter. A single-phase capacitor value must be entered in nn13 "C-filter [UF]" in order to clear this error.
The EMF adaptation must be deactivated with bit 7 of nn00.

The increased current ripple and the capacitor current must be considered at the dimensioning of the inverter! The minimum inverter switching frequency must be greater or equal than the minimum switching frequency of the sine-wave filter.

12.2.10 Rotor position detection for synchronous motors without rotation

Since not all motors in the rotor position detection can rotate freely, there are 2 possibilities to determine the rotor position at standstill. These can be selected in parameter dS31. The rotor position detection can be activated with parameter ds30 "rotor position detection" by selecting when the rotor position detection becomes active.

dS30: rotor position detection		
Bit	Value	Function
0	0: off, no position	no position detection
	1: after „NOP“	Detection after state: „NOP“
1	2: at Power On	Detection after Power On of the inverter
2	4: after „Low Speed“	Detection after state: „Low Speed“
3	8: after Reset	Detection after reset

There are 2 different possibilities to determine the rotor position. This can be adjusted in parameter dS31 respectively the more favorable mode is preset by the motor identification. Which of the two functions is set depends on the ratio of Ld to Lq.

- The difference between Ld and Lq (minimum and maximum value) should be greater than 20%.
- The value of Ld to Lq should be approx. 0%

If the difference between Ld and Lq is greater than 20%, value 0 is entered in dS31 . If Ld=Lq, value 1 is entered in dS31.

dS31: rotor position mode
Value
0: Ld different Lq
1: Ld equal Lq

Parameter dS32 is used for optimisation of the first operating mode in parameter dS31 = 0. An 1 kHz-signal is impressed and the controller is adjusted with a Ki in this mode.

dS32: KI HF detection
Value range
0...32767

Parameter dS33 is used for optimisation of the second operating mode in parameter dS31 = 1. Five different current peaks are given to the motor winding in this mode. The rotor position can be determined from this result. The value in this parameter must be increased if the rotor position is suboptimal.

dS33: step current
Value range
0...15000

The current is internal limited to the rated inverter current In01. This function is only given, if the inductance in parameter dr31 is correctly measured or adjusted.

12.2.11 Rotor position detection for synchronous motors at low speeds (HF supply)

The HF supply can be activated in parameter nn.00 "motor model adaptation" with bit 14.

nn00: motor model select			
Bit	Meaning	Value	Explanation
14	HF-supply	0: off	Can continuously determine the rotor position at low speeds.
		16348: an	

The rotor position can be determined continuously with a test signal at operation in standstill and at low speeds.

A switching frequency of 8 kHz must be set for the rotor position detection.

The internal FoH filter is used for HF supply. The default values of parameters fh01... fh09 are preset to 1 kHz with quality 5. Regularly the speed controller must be adjusted slightly softer if HF supply is used.

Since the HF supply only provide benefits in the lower speed range, it will be deactivated above the adjusted value in nn03. When falling below the adjusted value in nn02, the Hf supply is activated again. Advantageous is the HF supply only in the lower speed range, if there are problems with the motor model.

nn14 amplitude HF injection
The signal amplitude of the HF supply can be modified here. A higher value means more information, but also greater losses and more noise development.
The default value is selected by way that 1/8 of the rated motor current is used. However, maximum 25% of the maximum output voltage.

nn15 optimization HF injection
The PI controller for speed identification at HF supply can be modified here. This PI controller is parameterized by parameters dr31, dr64, nn14 and nn15.

nn17 open loop speed
The speed limit for „open loop speed“ is separately adjustable from the auxiliary ramp (nn08) via nn17. In order that all remains downward compatible, nn08 is still active for "open loop speed" if nn17 is set to 0.

12.3 Block diagram

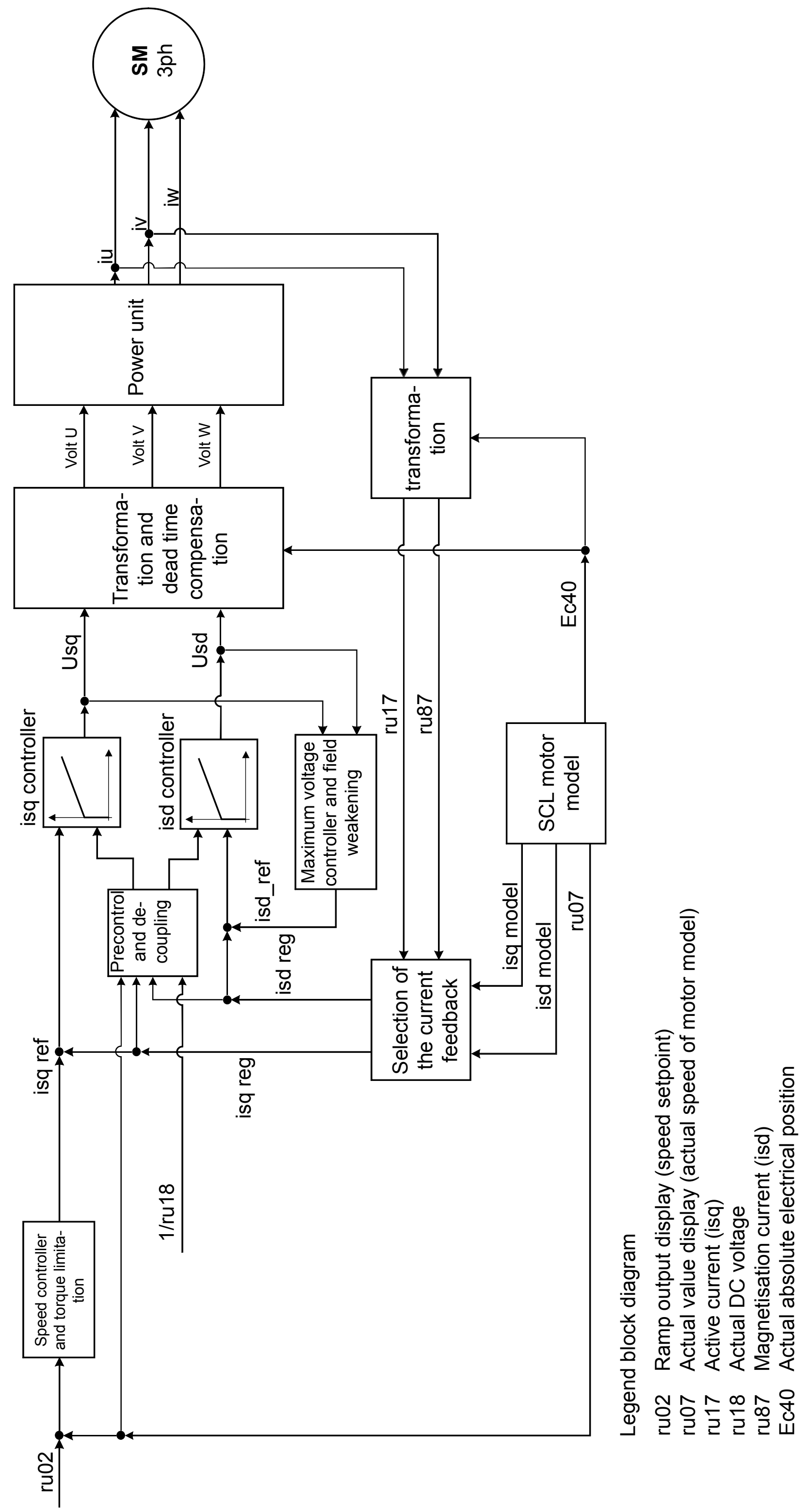


Figure 12.4 Block diagram SCL

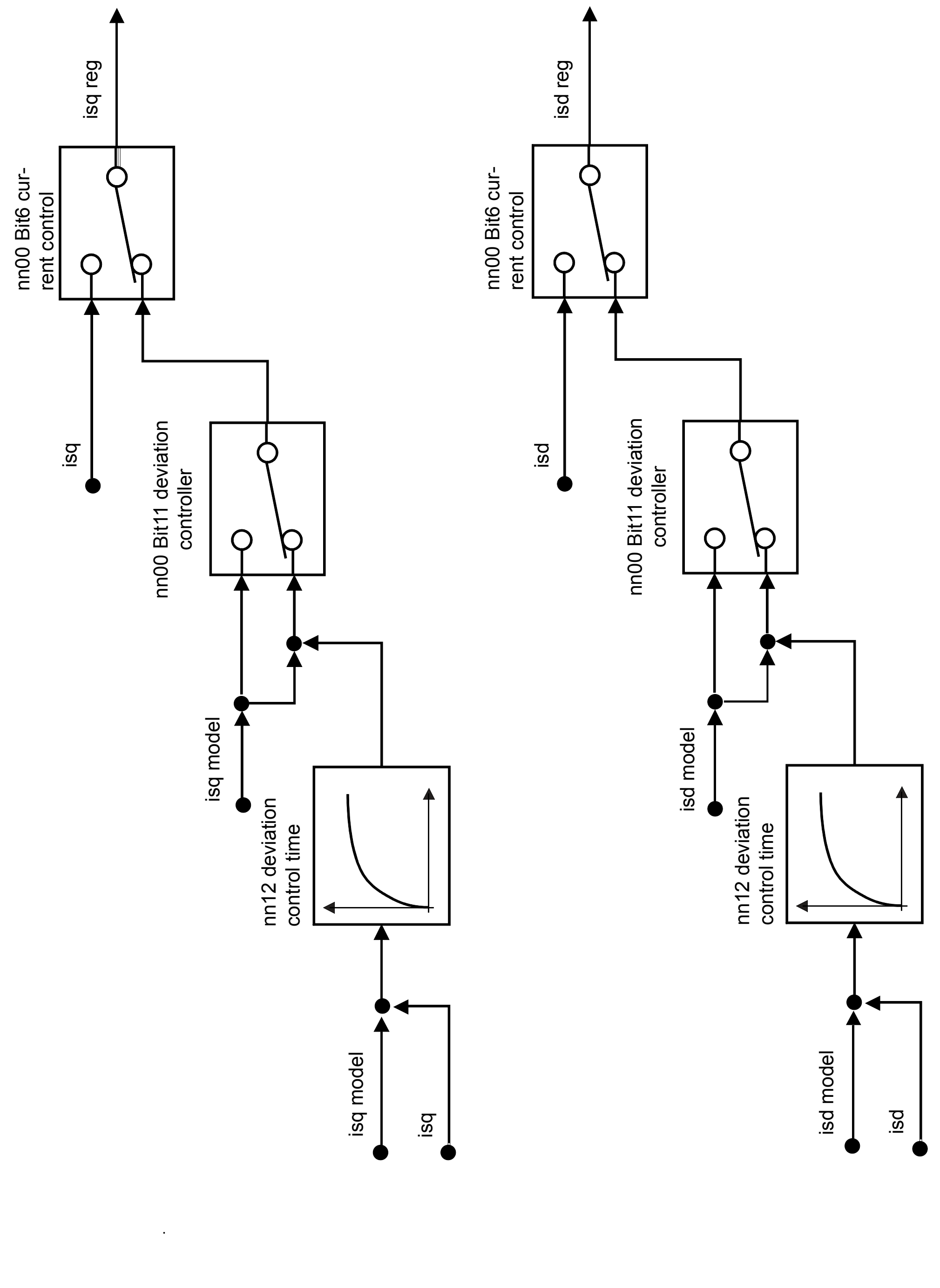


Figure 12.5 SCL current feedback

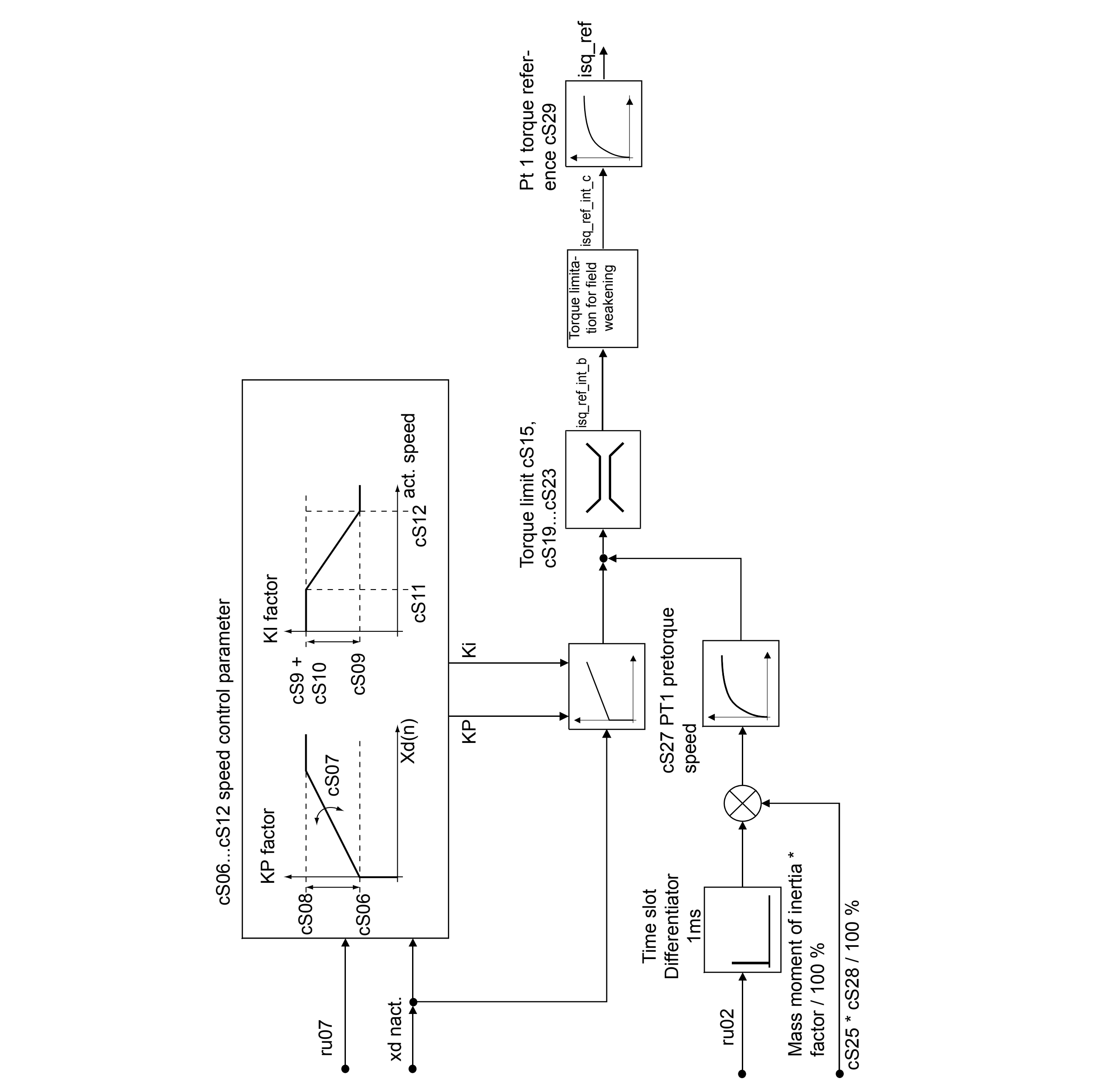


Figure 12.6 Speed controller and torque limitation

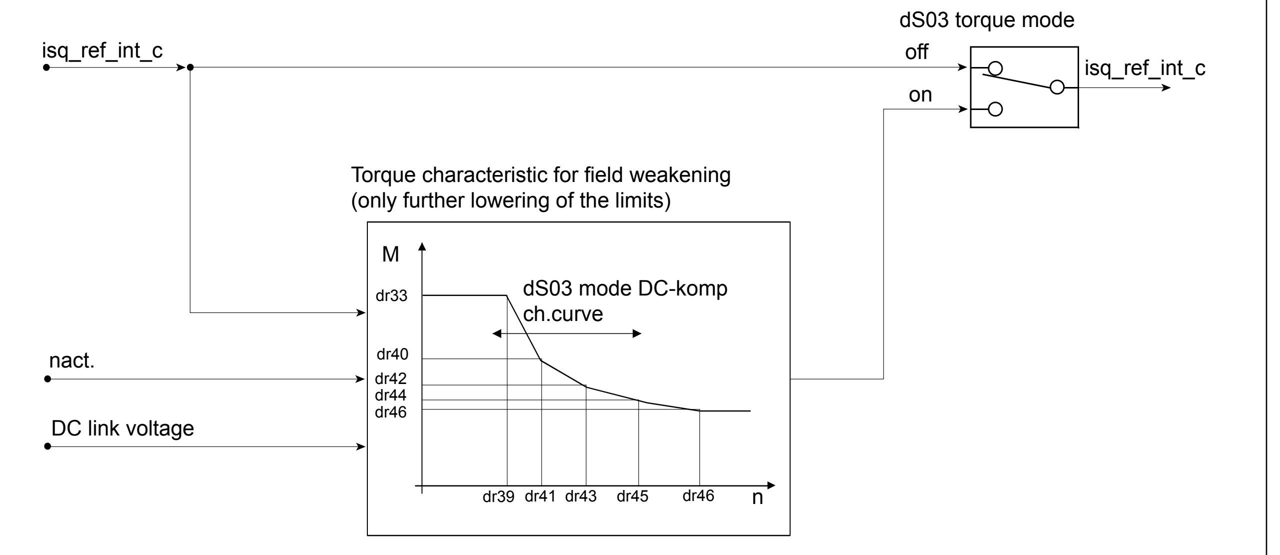


Figure 12.7 Torque limitation field weakening

13. Speed Control

The speed controller is a PI controller. A PT1 low pass filter is series-connected. The integral factor Ki can be changed speed-dependent. The proportional factor Kp can be increased proportionally to the control deviation. In order to improve the control performance of the drive (low overshoot, higher dynamics), the speed controller can be pre-controlled with known mass-moment of inertia.

13.1 Speed controller parameters

13.1.1 Initial setting

The speed controller is a PI controller.
The proportional factor „KP speed“ is adjusted in cS06, the integral factor „KI speed“ in cS09.

13.1.2 Automatic adjustment of the speed controller (only at operating with motor model)

The KP cS06 and KI cS09 of the speed controller can be preset by the inverter. For this the mass moment of inertia of the complete system (motor + rigidly coupled load) must be entered in cS25 „inertia“.

Parameter Fr10 „load motor dep. parameter“ = 1 or 2 must be entered once after input of the motor data. Dependent on the adjusted rated power dr03 the mass-moment of inertia was pre-charged for a standard asynchronous motor in cS25. The value of cS25 has the right dimension for 50Hz standard motors, because at some applications the ratio of the load inertia is in a range of 0.5...2 x motor inertia.

Better results can be realized if the total moment of inertia is exactly preset. If the value is unknown it can be determined as described in chapter 13.2.
Parameter cS26 „optimisation" determines the control characteristic which should be achieved by the calculated parameters.

The precharging of the speed controller parameters can be deactivated with setting of value "19 = off" in cS26.
The speed control parameters are overwritten when the value for cS26 is changed.

Parameters for a dynamic, hard speed controller adjustment are calculated with cS26 = 20. Interference factors, such as torsion or tolerance of the load coupling can intensify vibrations, so that a higher value must be entered in cS26.

Parameters for a soft and slow speed controller adjustment are calculated with cS26 = 150. Which value between 2 and 15 is most suitable for the application is depending on the oscillation-grade of the total system.

An oscillation of the estimated speed is a possible disturbance at encoderless operation of asynchronous motors (ASCL). Increase of the value in parameter "ASCL speed PT1 time" (ds17) often enables a dynamic speed controller adjustment, that means a smaller value for cS26.

13.1.3 Operating state-dependent control parameters

The following parameters serve for the "fine tuning" of the speed controller and may not be changed in many applications.

variable proportional factor KP

The proportional gain is adjusted in „KP speed“ (cS06). A system-deviation-dependent proportional gain can be adjusted additionally to the standard KP value with cS07 and cS08. With it the dynamic performance can be improved and overshootings can be dampened.

KP factor

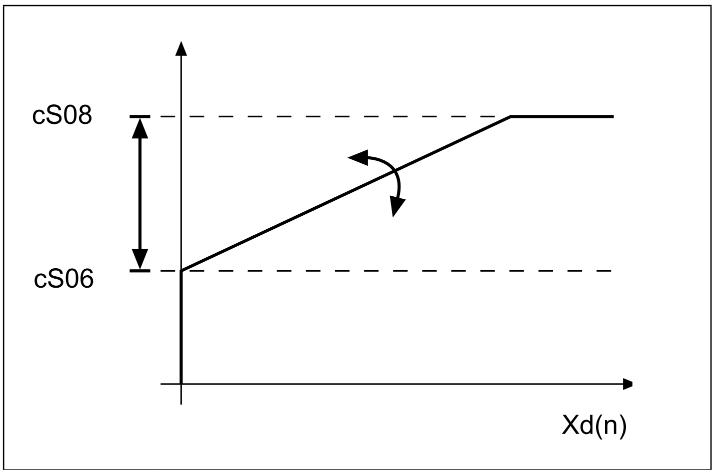


Figure 13.1 variable proportional factor KP

variable integral factor KI

Parameters cS09...cS12 determine the integral factor of the speed controller. The KI factor can be varied speed-dependent in order to reach improved speed rigidity at small speeds and at standstill.
- cS09 forms the base value
- the maximum value for the integral factor is cS09 + cS10.
- the two corner speeds cS11 and cS12 determine the speed range in which the KI value is changed.

KI factor

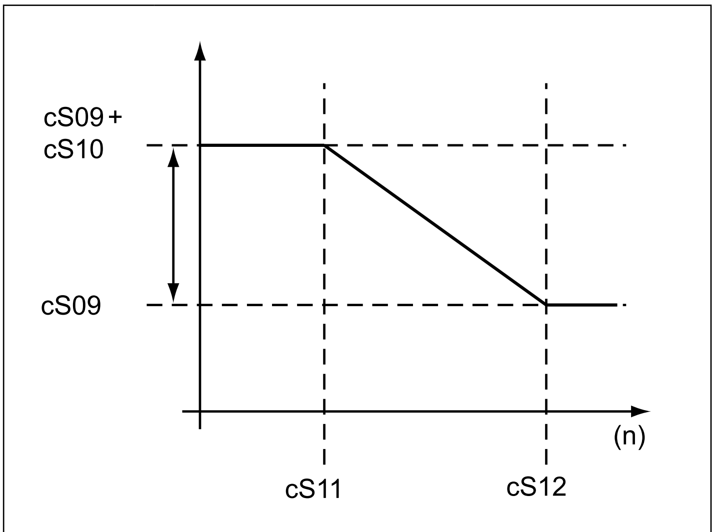


Figure 13.2 variable integral factor KI

A special function A special function can be activated in parameter max. speed for max. KI (cS11) by setting „-1: brake release which works only in connection with the brake control.
An enormous speed rigidity is required for load transfer with hoist drives or lifts, in order that the brake release and the load transfer are not significant by the inverter.
This controller adjustment is not to be used for normal operation, since the speed controller oscillates too much at this adjustment.
The solution is to enter a high value in parameter "KI offset“ (cS10) in order make the controller rigidy. If cS11 indicates the value „-1: brake release", this "KI offset" is set immediately to 0 at the end of the brake release time, not reduced during operating in a speed range.

13.2 Determination of the mass moment of inertia

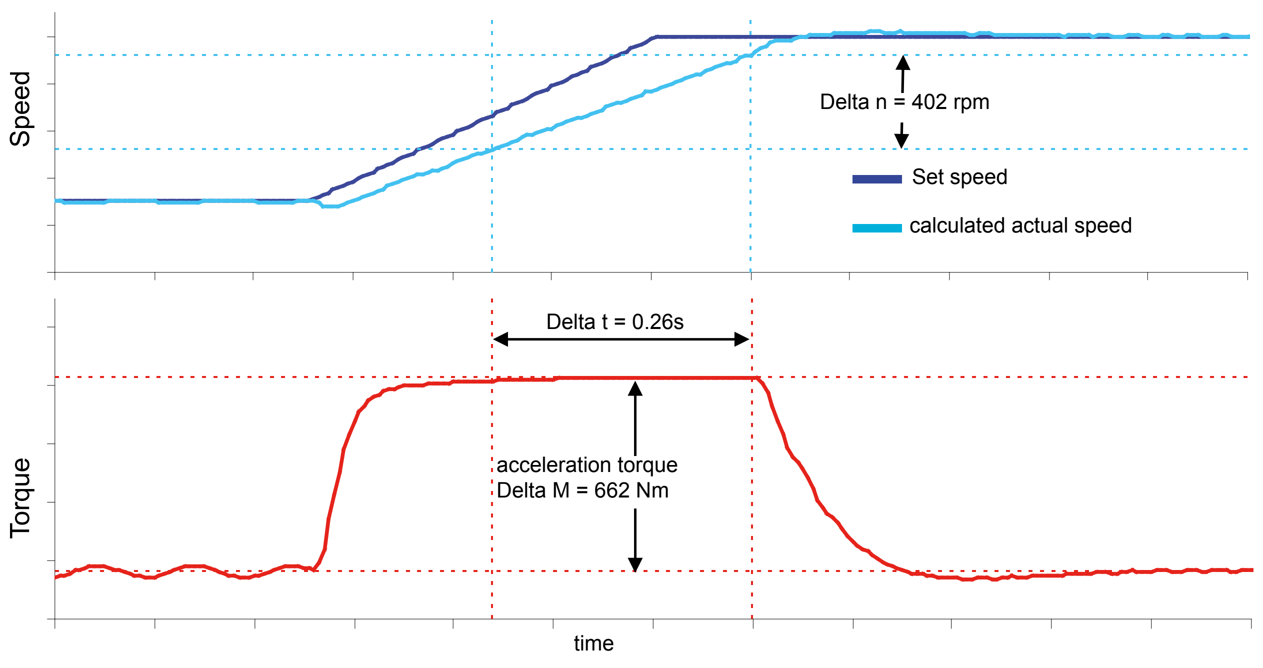


Figure 13.3 Process to determination of the mass moment of inertia

The knowledge of the mass moment of inertia of the system (= motor + rigidly coupled load) is required for the automatic calculation of the speed controller parameters as well as for the pre-control of the acceleration torque.
If this mass moment of inertia is unknown, it can be determined by an acceleration test.
For this the system must be accelerated with defined, constant torque. It must be guaranteed that no significant and acceleration-independent load torque occurs by the application.

The following formula is valid:

$$J = 95493 \text{ x } \Delta M \text{ x } \frac{\Delta t}{\Delta n}$$

Example: Ramp-up was recorded with COMBIVIS:

$$J = 95493 \text{ x } 662 \text{ Nm } \frac{0.26 \text{ s}}{402 \text{ rpm}} = 40886 \text{ kg*cm}^2$$

In order to eliminate the effect of friction from the calculation, you can determine the mass moment of inertia a second time in similar manner, however by deceleration test. The average value of both inertia, determined at ramp-up or deceleration must be entered in parameter cS25 „inertia (kg cm^2)“.

13.3 PT1 output filter

A PT1 low pass filter is series-connected to the speed controller.

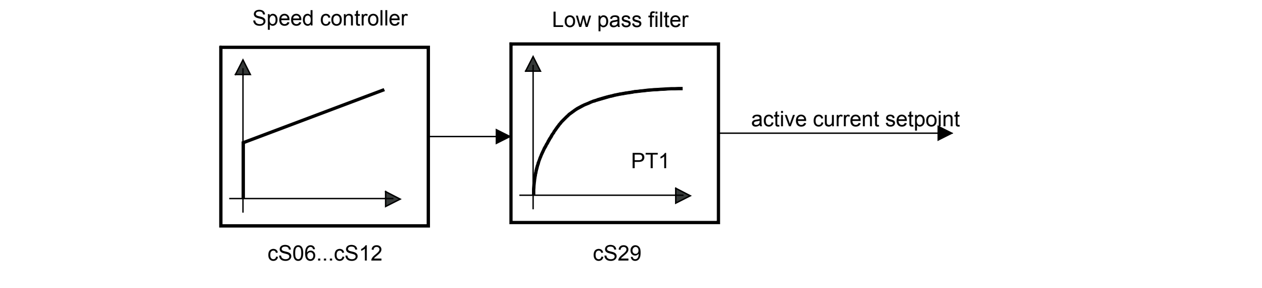


Figure 13.4 Output filter

High frequency oscillations (caused by spring elements in the mechanics of the drive train) can be filtered by this way from the active current setpoint signal.
The filter time must be adjusted in parameter cS29 „act. curr. ref. PT1-time“. A longer filter time causes a stronger smoothing of the active current signal, but also less dynamic control characteristic and increased oscillation inclination.
An adaptation of the speed controller is required on changing the Pt1-time. This filter is used e.g. for spindles in order to avoid jumps in the current setpoint at fast load changes.

13.4 Acceleration dependent pre-control

If the mass moment of inertia of a drive is known it can be calculated which torque is required to accelerate the drive. This function is activated, if a value unequal 0 is entered in parameter cS28 „pretorq. speed fact.%/". This parameter must be set to 100% for a complete pre-control.

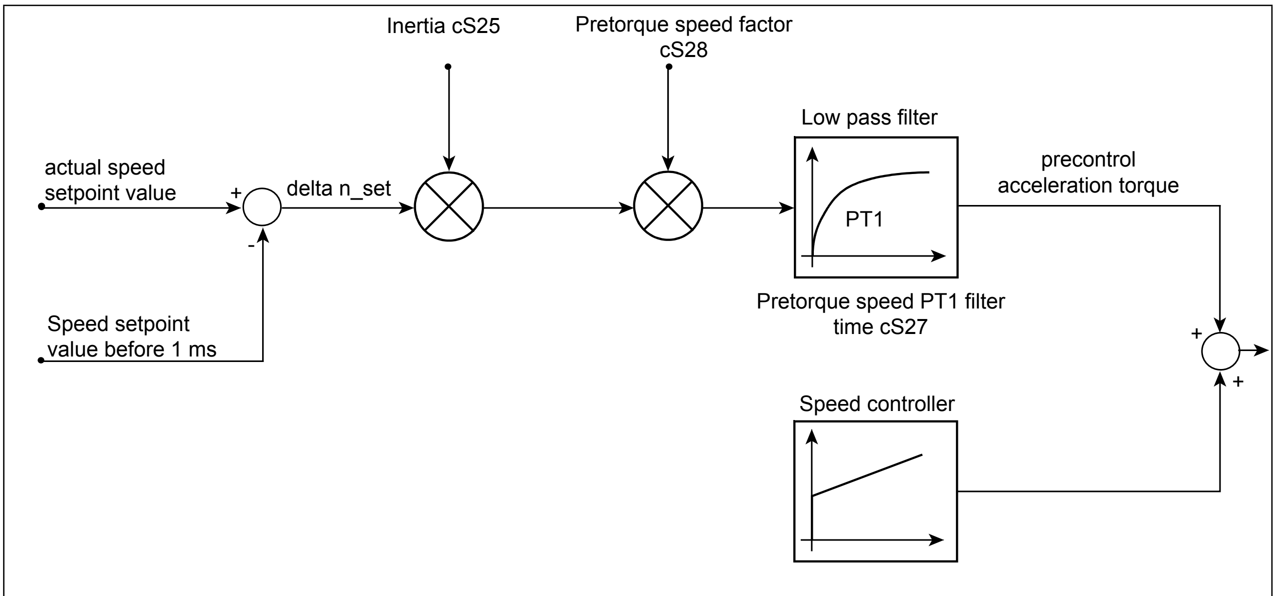


Figure 13.5 Acceleration dependent pre-control

13.4.1 Precontrol reciprocal of amplification / filtering

For some applications it is not necessary to pre-control the complete acceleration torque (cS28 = 100%) see the following reasons:

- a different torque is required with the same acceleration at motoring or generating (e.g. due to friction)
- the speed setpoint setting (e.g. by external control) is made in steps, so torque jumps can occur
- the (analog) speed setpoint setting is superimposed by a noise, which must be damped for the pre-control

The influence of the pre-control can be damped with parameter cS28 „pretorq. speed fact. %" for these applications.
Torque peaks, which are caused by a speed setpoint setting in steps, can be reduced by means of a low pass filter. Here also valid: the higher the time in parameter cS27 „pretorq. speed PT1 time“ the better the smoothing, but also the undynamic of precontrol.

13.4.2 Setpoint smoothening

For applications, when new setpoints are preset by an external control within fixed time base there is one additional function for the acceleration torque pre-control: the setpoint smoothening.

without setpoint smoothening
(Parameter oP74 „reference splitting“ = 0: off)
A high precontrol value is calculated at every new setpoint step without setpoint smoothening. The precontrol function cannot be used.

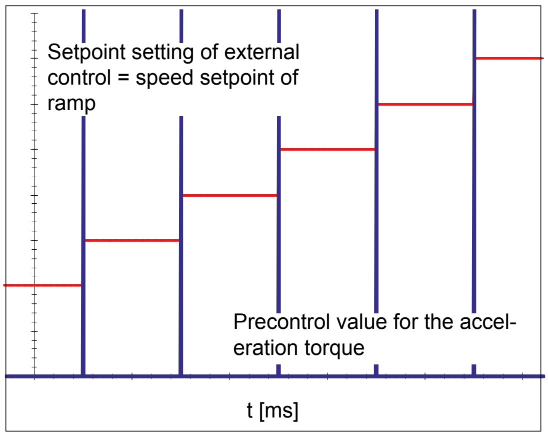


Figure 13.6 oP74 = value 0

with optimal reference splitting
(Parameter oP74 „reference splitting“ = cycle time of the external setpoint setting in ms)
The speed setpoint is smoothed, the precontrol value remains constant.

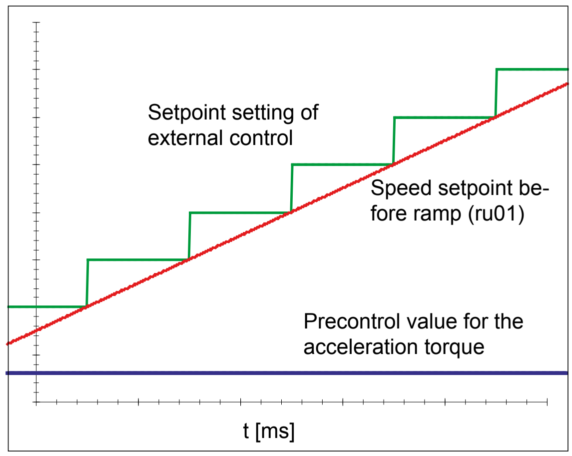


Figure 13.7 oP74 = cycle time

with reference splitting and variable clock time of the external control
The longest clock time (in ms) must be entered in parameter oP74 „reference splitting" for optimal precontrol at non-constant cycle time of the external control.
This causes a short delay of the reference value, but also a smoother precontrol value.

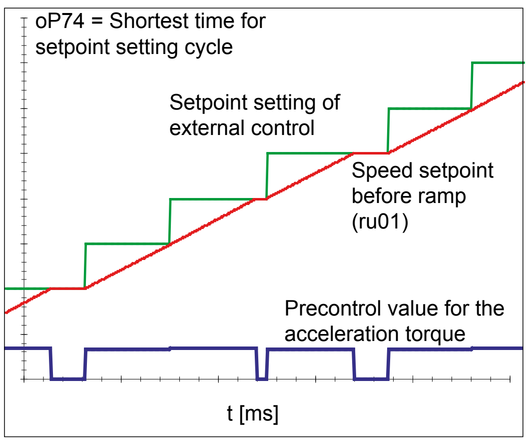


Figure 13.8 short cycle time entered in oP74

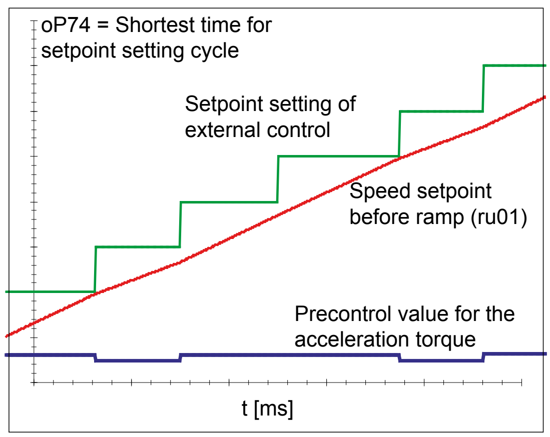


Figure 13.9 longest cycle time entered in oP74

13.5 Square influence of the controller parameters

The speed controller parameters (KP, KI) can be influenced depending on the actual speed with this function.

LowGain = 100%
KP speed gain / peak % = cS07
KP speed limit / gain % = cS08
Speed for square function = cS14
Max. speed for square function = cS13
K1 = -(LowGain – PKGain) / Speed^2
K2 = -(HiGain – PKGain) / (Speed^2 – 2*Speed*MaxSpeed+MaxSpeed^2)
n = 0…MaxSpeed
Gain(n) = if [n<Speed, LowGain + K1*n^2;hiGain + K2 * (n – MaxSpeed)^2]
Gain is internally limited to 0…800%
KP = cS06 * Gain / 100%
KI = cS09 * Gain / 100%

cS05: speed KP / KI mode	
Function	Value
speed KP / KI mode	0: variable KP/KI
	1 = square KP function
	2 = quadratische KI funktion
	3 = square KP + KI function

If the square mode is adjusted, the variable KI and KP have no function. Mode cS11= -1 brake release remains possible.

Possible curves:

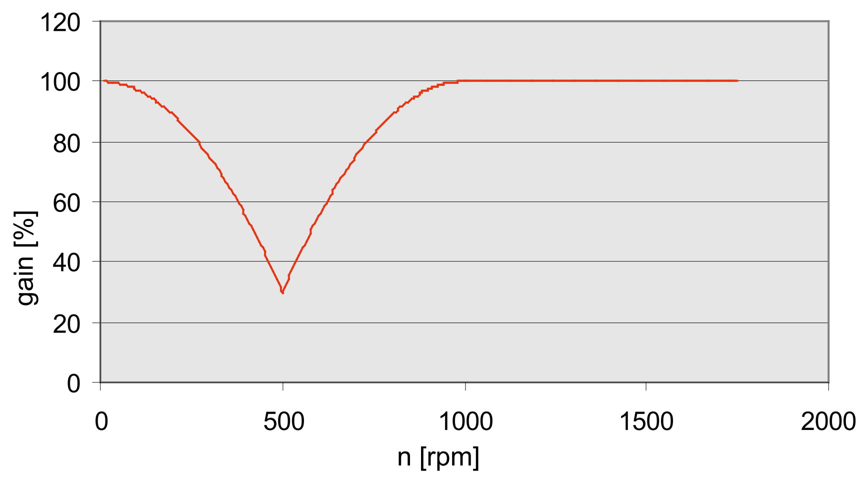


Figure 13.10 cS07=30; cS08=100; cS12=500; cS13=1000, „resonance point“

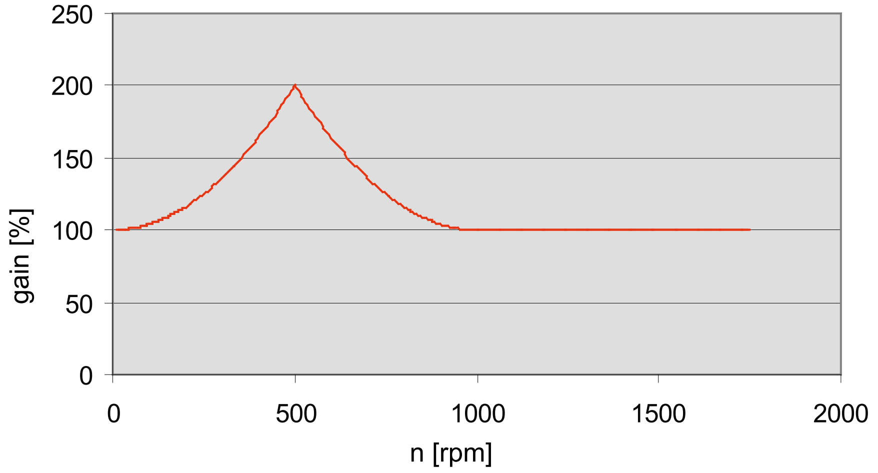


Figure 13.11 cS07=200; cS08=100; cS12=500; cS13=1000

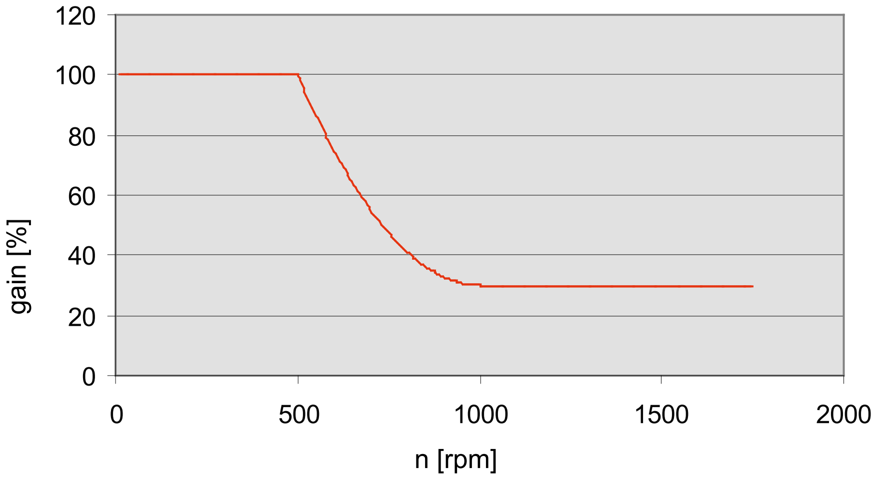


Figure 13.12 cS07=100; cS08=30; cS12=500; cS13=1000

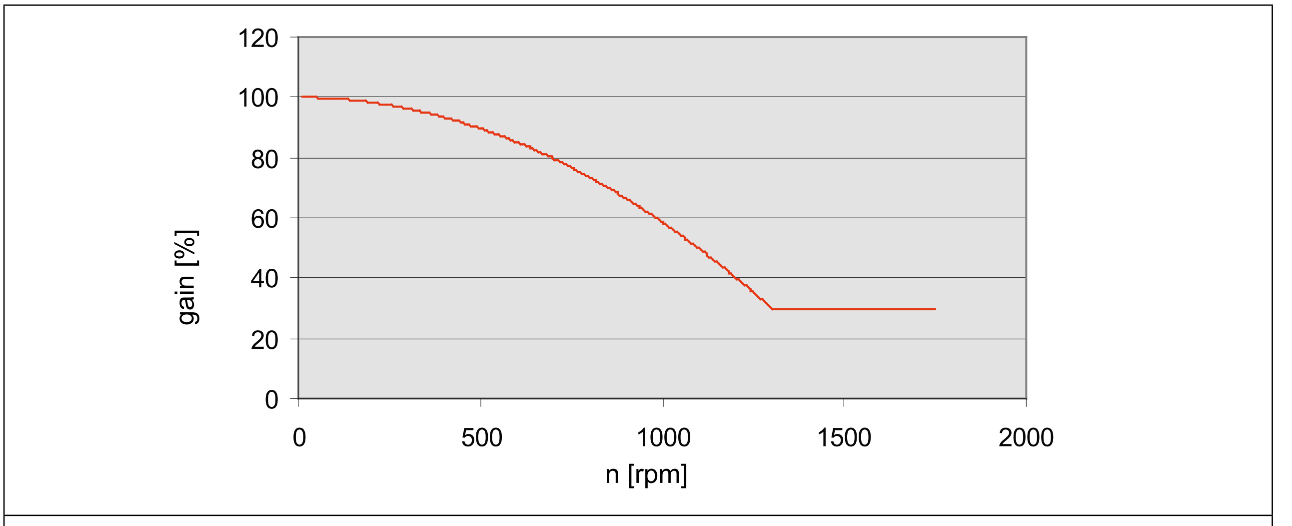


Figure 13.13 cS07=30; cS08=30; cS12=1300; cS13=1800

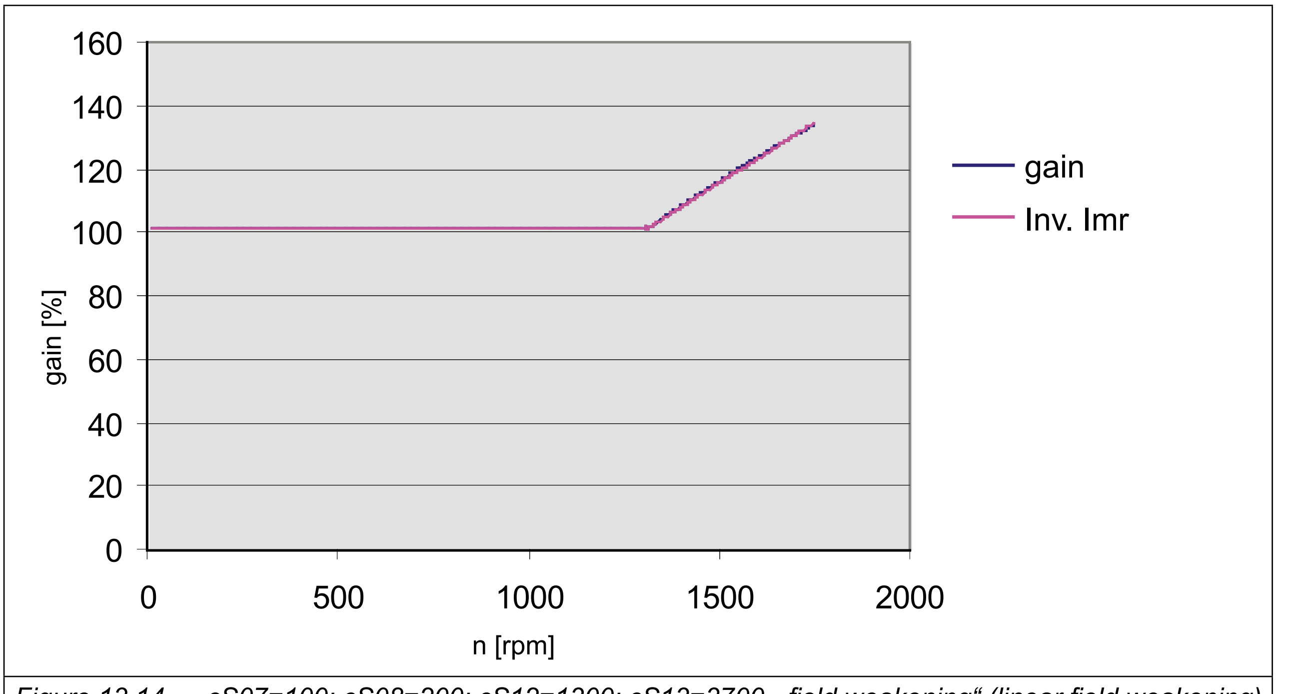


Figure 13.14 cS07=100; cS08=200; cS12=1300; cS13=3700, „field weakening“ (linear field weakening)

14. Torque Display and Limiting

Several factors can limit the max. available torque of a drive. In the base speed range, the max. torque is limited by the current the inverter is able to supply and in the field weakening range, additionally the voltage that limits the breakdown torque of the motor. Torque limit e.g. to protect the mechanics is also required for some applications.

14.1 Maximum voltage controller, voltage limit

The inverter always requires a voltage control reserve on order to regulate the current. The maximum voltage controller limits the output voltage if it is too high (higher dS10 „Umax modulation limit“). The maximum voltage controller is activated by the input of the values 8 or 24 in „maximum voltage controller“ of parameter dS04 "flux/rotor adaption mode". The controller is switched off at value 0 or 16.

dS04: flux/rotor adaption mode			
Bit	Meaning	Value	Explanation
3, 4	Maximum voltage controller	0: off, max. 110%	controller off, max. modulation factor=110%
		8: on, max. 110%	controller on, max. modulation factor = dS10 + 2%
		16: off, max. 100%	controller off, max. modulation factor=100%
		24: on, max. 100%	controller on, max. modulation factor=100%

The voltage range for which a modulation factor > 100% is needed is designated as overmodulation range.
The voltages in this area are no longer sinusoidal, which causes distortions in the phase currents, turbulent speed estimation in encoderless operation and a worse torque accuracy.
A better output voltage is contrary to these disadvantages.
Overmodulation is not allowed for the selection "max. 100%" (value 16 and 24). This adjustment should be selected if the drive shall be operated in a mode with motor model.
The available voltage increases due to exploitation of the non-sinusoidal overmodulation range for the selection „max. 110%“ (value 0 or 8).
Value 0 should not be used because there are important negative effects.
The negative effects are minimized at value 8 by limiting the overmodulation range to „Umax modulation limit“ dS10 + 2%. i.e. the maximum modulation factor is 105%, if dS10 = 103% is selected. This limitation is only valid for the overmodulation range.
Values 0 and 8 should only be used after careful testing.

The controller is adjusted via parameters dS08 „KP Umax“, dS09 „KI Umax“, dS10 „Umax modulation ref.".
dS08 has only a minor effect and can remain on value 0.
dS09 determines the dynamics of the controller. If this parameter is adjusted too small, the drive can arrive voltage limitation. If the parameter is adjusted too high, the drive starts to vibrate. If the modulation factor becomes much noisier due to an increase of dS09, it indicates that the controller setting is too high.
A temporary reaching of the voltage limitation is normally not a problem.
The modulation factor to be controlled is determined with parameter dS10. The closer this is to 100%, the better the inverter voltage is utilised, but also the lower are the control reserves useable for the dynamic.
The default value of 97% is usually a good agreement.
For the asynchronous machine, the voltage limitation occurs by flux reduction.
The motor flow can be reduced by the controller to ¼ of the value which is required according to the magnetisation characteristic.
For the synchronous machine, the voltage limitation is done by setting a negative magnetising current. The maximum value of this current is determined with parameter dS13 „magn. current limit“. (see chapter 14.3 "physical torque limits of the synchronous motor" about the influence and adjustment of dS13).

14.2 Physical torque limits ASM

14.2.1 Torque limits in base speed range

The DASM rated torque of the motor (calculated from rated power and rated speed) is displayed in parameter dr14.
The max. torque (limited by the maximum current of the inverter) is displayed in dr15.
At activated hardware current limit (uF15 = 1 or 2) the maximum current is equal to the hardware current level (In18) less safety reserve of 5% of the inverter rated current.
At deactivated hardware current limit (uF15 = 0) the maximum current is equal to the overcurrent error limit less safety reserve of 10%.

Additionally the motor current can be limited by software with parameter dr37 „max. current“. This limitation also affects the maximum torque, but is not displayed in dr15 .
Also the active current is limited by torque limitation in the base speed range. But nevertheless the current limit of the inverter can be exceeded by the additional magnetizing current. Therefore, also the software current limit should be activated.

14.2.2 Torque limits in base speed range

If the motor is overloaded, i.e. if a torque is required, beyond its limit torque, the maximum voltage controller reduces the flux too much and thereby also reduces the maximum achievable torque.
Therefore the maximum permissible torque must be reduced in the field weakening range.
The torque limiting characteristic is defined with parameters dr15...dr18.

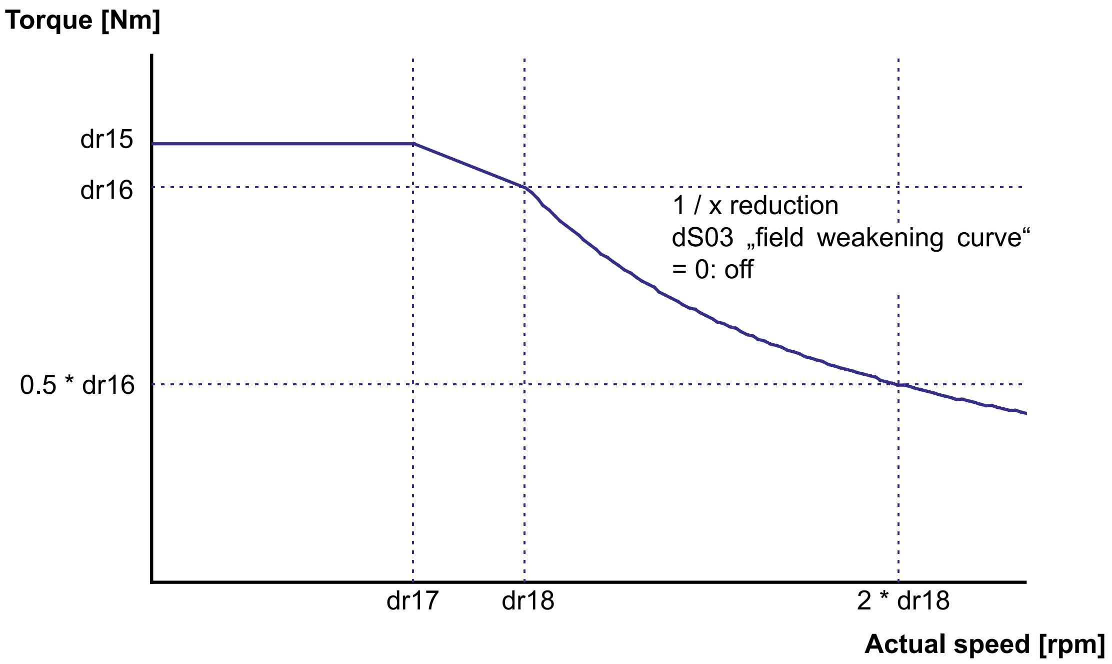


Figure 14.1 Field weakening range 1/x reduction

The "max. torque FI" (dr15) is depending on the maximum inverter current and can not be changed.
At default setting the maximum torque in the field weakening is reduced to a 1/x function - because of flux reduction.
The physical breakdown torque characteristic of the motor is a quare characteristic, i.e. also the maximum active power in the field weakening range must become smaller.
The square limiting characteristic must be activated if the motor shall be driven to its limits. This is done with value 2 in "field weakening characteristic" of parameter dS03 „current/torque mode“.

dS03: current/torque mode			
Bit	Meaning	Value	Explanation
1	field weak. curve	0: off 2: on	Activation of the active current limitation in the field-weakening range

The limiting characteristic is adapted to the motor with parameter dr16 „DASM max torque corn. sp“.
dr16 = breakdown torque of the motor (at speed dr18) - safety reserve

Example:
a motor shall have the following rated data:

rated speed: 1470 rpm	rated frequency = 50Hz
rated torque: 36Nm	M_{rated} / $M_{breakdown}$ = 2.5
selected value for DASM field weakening speed (dr18):	1500 rpm
Data sheet value for breakdown torque of the motor at rated frequency:	2.5 * 36Nm = 90Nm
Safety reserve	25% = 22.5 Nm

dr16 „DASM max torque corn. sp“ = 90Nm – 22.5Nm = 67.5Nm

The value for dr16 can be higher than the value in dr15 since the breakdown torque of the motor can be higher than the maximum torque of the inverter.
The safety reserve is necessary because the limiting characteristic must be sufficiently far from the physical breakdown torque of the motor.

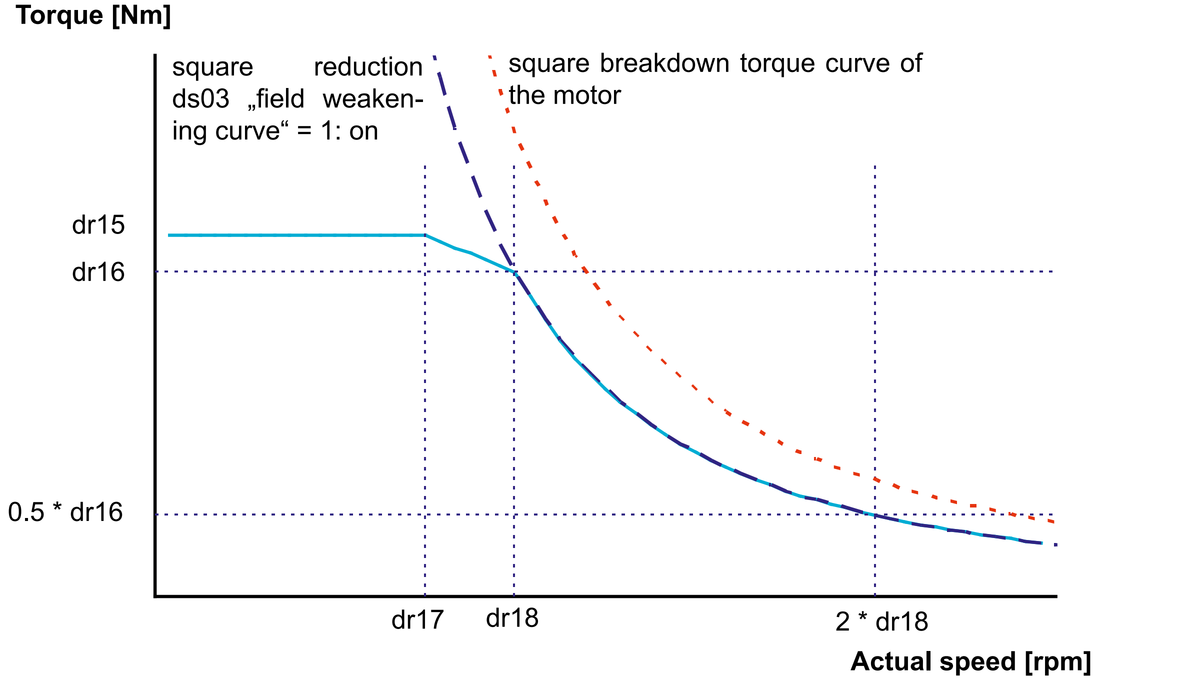


Figure 14.2 Field weakening range square reduction

14.3 Physical torque limits SM

14.3.1 Torque limits in base speed range (dr27, dr15)

The rated torque of the synchronous motor must be entered in parameter dr27 according to the name plate.
The max. torque (limited by the maximum current of the inverter) is displayed in dr15.
At activated hardware current limit (uF15 = 1 or 2) the maximum current is equal to the hardware current level (In18) less safety reserve of 5% of the inverter rated current.
At deactivated hardware current limit (uF15 = 0) the maximum current is equal to the overcurrent error limit less safety reserve of 10%.

14.3.2 Torque limits in base speed range

Normally a synchronous motor is operated with a magnetization current of 0.
If the usable speed range shall be increased, drive into the "field weakening range". In this range, the maximum voltage controller provides a magnetising current that counteracts the pulse wheel voltage. If the inverter changes to error, the magnetizing current is = 0. Then the motor refeeds the pulse wheel voltage into the inverter. This voltage may reach maximally the overvoltage threshold, otherwise the inverter is damaged. Therefore the permissible speed is limited. If the drive exceeds the value of parameter ru79 „abs. speed (EMF)" the inverter changes into "Error! overspeed“.

$$\text{pulse wheel voltage} = \frac{\text{EMF voltage constant (dr26) x actual speed}}{\text{1000 rpm}}$$

	There are several disadvantages contrary to the advantage of higher maximum speed: - the drive is more prone to vibrations in the base speed range - not all motors are suitable for field weakening operation - a higher current is required for the same torque due to the magnetizing current demand

14.3.2.1 Determination of the magnetizing current limit (dS13)

There is a specific 'ideal' magnetization current limit for each motor. The available field-weakening range is very small if the limit is too small.
The following picture shows the connexion between the maximum reachable torque and the magnetizing current limit dS13.

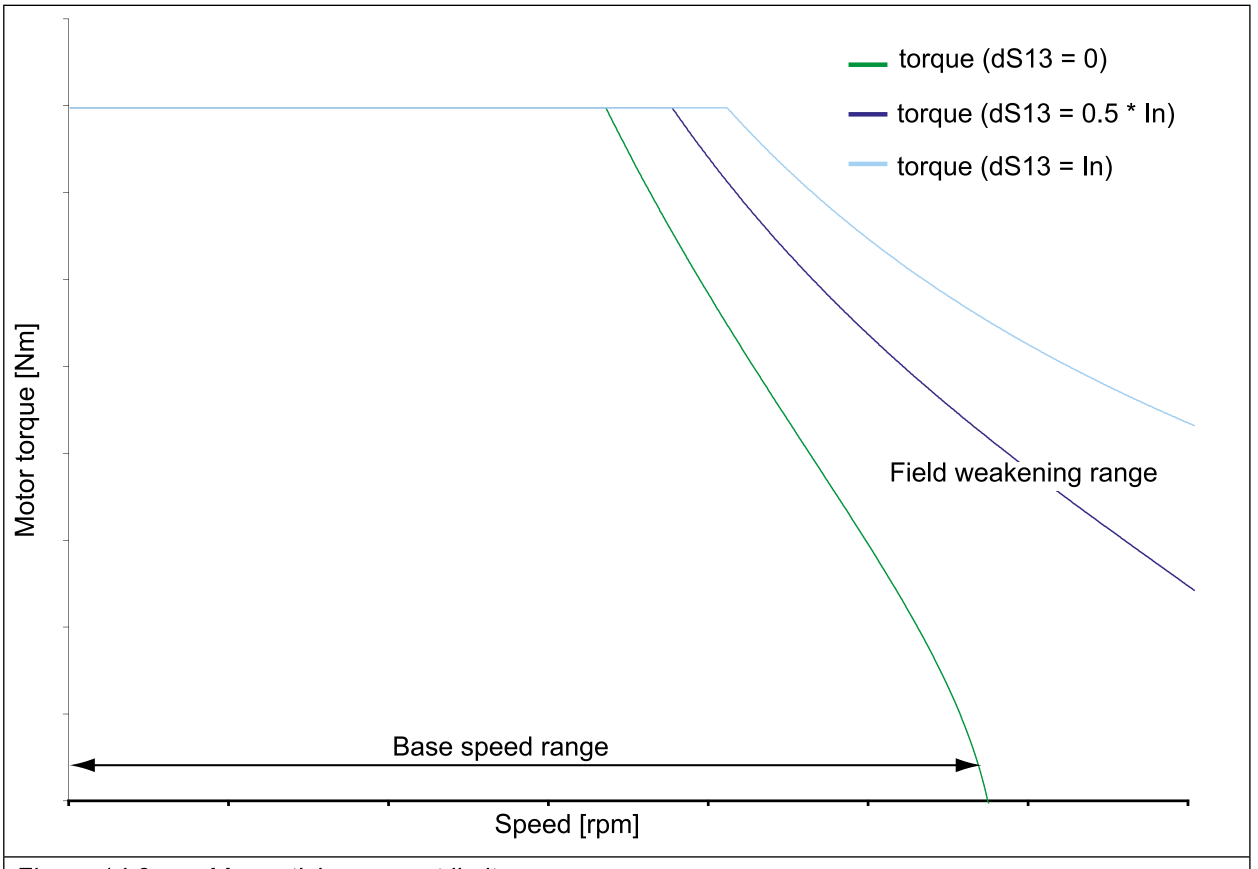


Figure 14.3 Magnetizing current limit

If the magnetizing current limit is selected too high, the available torque becomes smaller again. Furthermore too high value for dS13 can cause the maximum voltage controller to "hang". That means: for setting the magnetizing current, more voltage is used than is gained from the field weakening. The voltage remains too high.

A typical value for dS13 is the rated motor current. In the field weakening range, the current needed to set a defined torque increases.

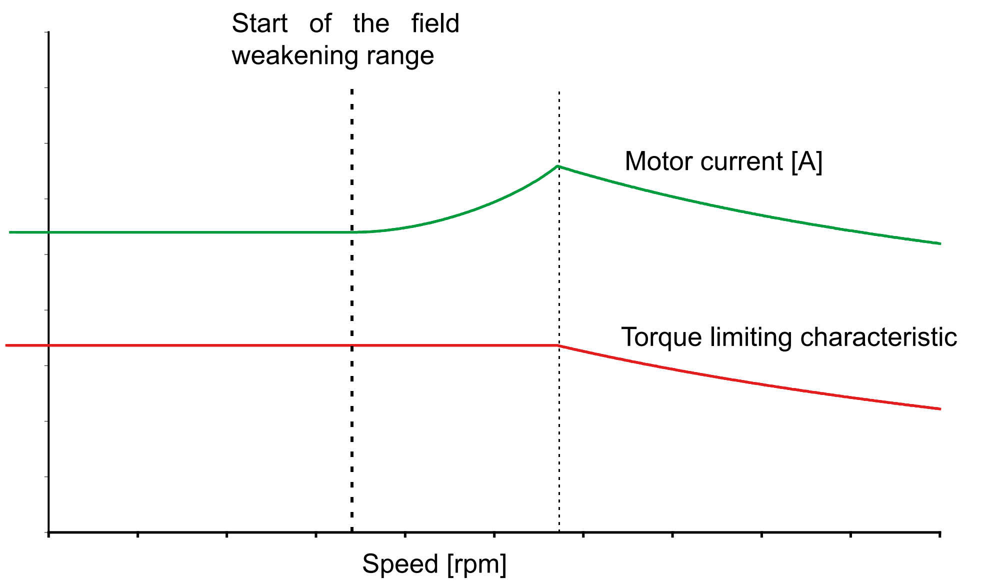


Figure 14.4 Limit current in the field weakening range

⚠	To ensure that the speed controller can control the drive, an active current must always be available that should not fall below 0.5 x dS13! Pay attention to appropriate adjustment of the torque limit and max. current!

14.3.2.2 Definition of the limiting characteristic

Starting at a certain speed, the drive cannot provide the same torque in field weakening operation that it provides in the base speed range.

If the drive is to accelerate at a constant torque limit (e.g. double the rated torque), the motor is (despite field weakening) physically unable to provide this torque.

The set torque can not be adjusted anymore and the drive „hangs“ in the voltage limit (modulation factor ru42 = 100%). Therefore, a limiting characteristic that mirrors the physical limits of the drive must be given. This limit is depending on parameter dS13.

If no limiting characteristic is given, the user must insure that the motor is not asked to deliver an inadmissibly high torque by choosing suitable acceleration /deceleration ramps and by appropriate selection of the load. Parameters dr33 and dr39...dr47 serve for setting the limiting characteristic.

⚠	Value 0 should not be used for the torque values of the limiting characteristic. Also, the torque at the highest speed (i.e., the last point on the characteristic) should minimally be set to the following value:

$$M_{min} = 0.37 \times \frac{\text{Magnetising current limit (dS13)}}{\text{DSM rated current (dr32)}} \times \text{DSM rated torque (dr27)}$$

This value may not be fallen below for the following reason:

A potential error in the position sensing leads to the magnetising current creating a torque in the field weakening range. An error of 20° electrical causes an unwanted torque from the magnetising current of maximally:

$$M_{dS13} = \sin(20°) \times \frac{\text{Magnetising current limit (dS13)}}{\text{DSM rated current (dr32)}} \times \text{DSM rated torque (dr27)}$$

If this torque error cannot be compensated for due to the limiting characteristic, the drive becomes uncontrollable.
All other torque values must be selected higher accordingly.
Parameters dr33, dr40, dr42, dr44, dr46 contain the maximum torque for the speeds in dr39, dr41, dr43, dr45, dr47. Linear interpolation between these points.

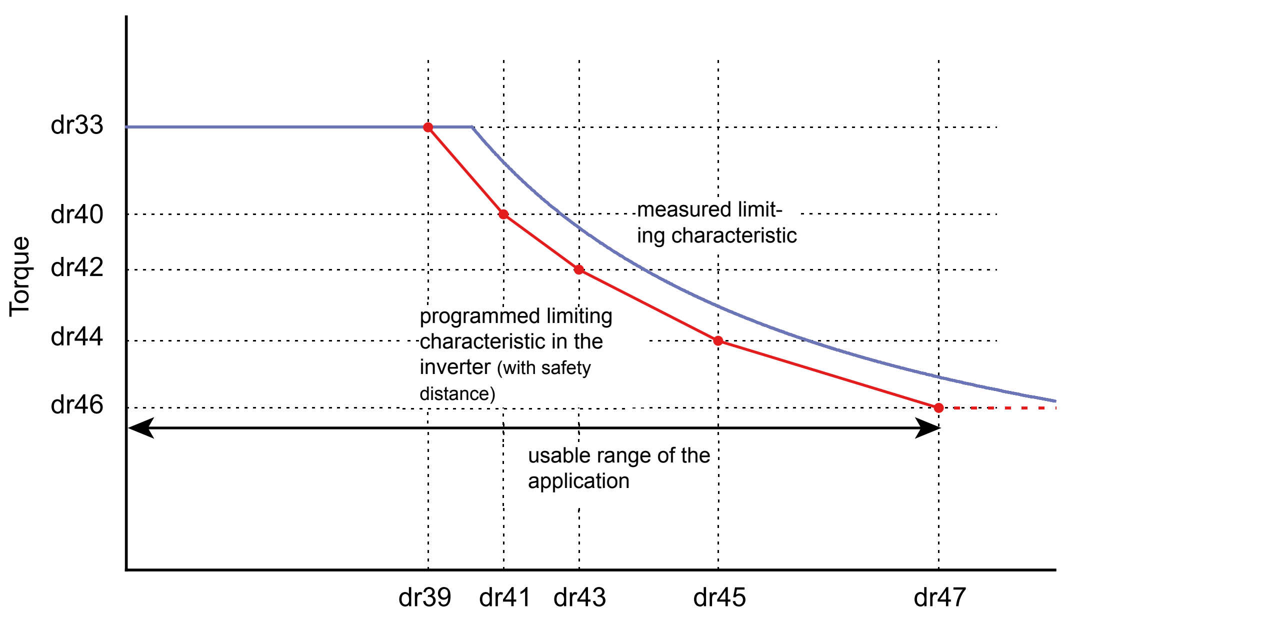


Figure 14.5 Limiting characteristic

The limiting characteristic is activated via dS03 bit 1.

dS03: current/torque mode			
Bit	Meaning	Value	Explanation
1	field weak. curve	0: off 2: on	Activation of the limiting characteristic (defined by dr33, dr40...dr47)

14.3.2.3 Shifting of the limiting characteristic

The physical torque limiting characteristic of the motor is depending on the maximum output voltage of the inverter. This is determined by the DC link voltage, which is depending on the mains input voltage and the inverter load.
Therefore different modes can be selected in dS03 for the programmed limiting characteristic.

dS03: current/torque mode			
Bit	Meaning	Value	Explanation
2, 3	DC link depending shifting of the characteristic (SM)	0: off	Shifting generally not active
		4: on	Shifting generally active
		8: >Un(FI) = off, abnormal stopping = off	Shifting not active if DC link voltage higher than rated voltage (also at emergency stop)
		12: >Un(FI) = off, abnormal stopping = on	Shifting at abnormal stopping generally active, otherwise inactive if DC link voltage higher than rated voltage

The value 0 ("off") can be used if the limiting characteristic for the mains input voltage is programmed, the machine is operated with it and this voltage is relatively constant.
The advantage (e.g., during ramp-up at the torque limit) is that the continuous, load-dependent fluctuations of the intermediate circuit cannot cause any torque fluctuations.

If, however, the mains input voltage is variable (e.g., affected by other users) or if the mains voltage at the location of the machine is unknown, set dS03 = 4, 8 or 12.
Then the programmed limiting characteristic is always valid for the inverter rated voltage (400V or 230V) and is proportional adjusted to the voltage.

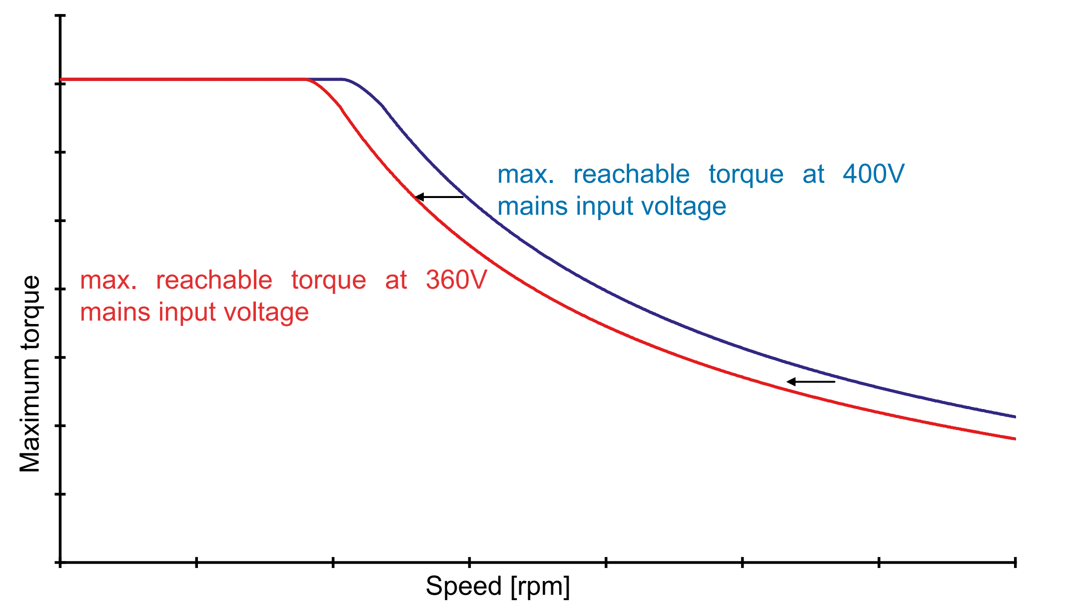


Figure 14.6 Shifting of the limiting characteristic

The limiting characteristic must always be programmed higher than the speed range where the motor shall be operated. Otherwise, the drive operates in an undefined range at lower DC link voltage values due to the shift of the characteristic to lower speeds.

The limiting characteristic is shifted in both directions at value 4 ("on"); to lower speeds at lower voltage and to higher speeds at higher voltages. At this value, the motor achieves maximum torque. It is unfavorable especially at regenerative operation that the DC link voltage can increase very quickly and in a wide range. These dynamic changes can cause high disturbance in the field weakening range.

Therefore preferable setting is 8 („>Un(FI) = off, abnormal stopping = off"). Only the necessary physical shifting of the characteristic due to low DC link voltage is executed here. That means the characteristic is only shifted if the DC link voltage is lower than the rated DC link voltage (= √ 2 * inverter rated voltage).
There is no shifting if the DC link voltage is higher than the rated voltage.

Value 12 („>Un(FI)= off, abnormal stopping= on") can be selected if the maximum achievable torque shall be available for emergency stop. In this mode the characteristic at higher DC link voltage is shifted to higher speeds only during emergency stop operation. Generally value "8" should be used if possible.

14.3.2.4 Influence of the current limit

The total power of the motor in the field weakening range consists of active current and magnetizing current. The maximum torque limits only the active current.

For some motors there is a maximum current specified in the data sheet. This is valid for both components together. Therefore the total motor current can be limited by this parameter.

The magnetization current has priority if both components together exceed the current limit.

> To ensure that the speed controller can control the drive, active current flow must always be able. Therefore the magnetization current limit (dS13) must always significantly lower than the maximum current (dr37). dS13 should be maximally 0.75 x dr37.

The max. current limit dr37 is activated by bit 0 of parameter dS03.

dS03: current/torque mode			
Bit	Meaning	Value	Explanation
0	max. current-/ torque mode	0: off	software-based current limit off
		1: on	software-based current limit on

14.4 Adjustment of application-dependent torque limits

General adjustment of the torque limits

For some applications it is not required to provide the maximum possible torque, but rather the application requires other process-related limitations (e.g. to protect mechanical components). These can be adjusted via parameters cS19...cS23. The torque limiting characteristic which is defined by maximum current and available voltage remains always active as superior limit.

Parameter „abs. torque ref" (cs19) can be used if only one limit is required for all operating ranges (forward, reverse, motor and regenerative operation). All other limits (cS20...cS23) must be set to value „-1:off".
If different torque limits are required, enter these limits in parameters cS20...cS23 (=torque limit for the different operating ranges).
The torque limits can be adjusted during operation for special applications by multiplying with a factor of 0...100%.
Parameter „torque reference source" (cS15) determines how this factor is built for the adjusted torque limits (cS19...cS23).

Example: cS20 torque limit for. mot. = 20Nm
cS21 torque limit rev. mot. = 20Nm
cS22 torque limit for. gen. = 15Nm
cS22 torque limit rev. gen. = 10Nm
cS15 source torque reference = 3: digital % (cS18)
cS18 torque ref. setting % = 50%

resulting torque limits
Forward rotation: motorized = 10Nm / regenerative = 7.5Nm
Reverse rotation: motorized = 10Nm / regenerative = 5Nm

Overview of parameter cS15

cS01: torque reference source	
Value	Explanation
0: analog REF	Parameter „sel. Ref input / Aux-function“ (An30) defines, how the Ref or Aux value is calculated (see chapter 8). As standard AN1 is the Ref value and AN2 the Aux value. They are limited to 100% as multiplier for cS19.
1: analog Aux	
2: digital abs(cS19...23)	the value in cS19 generates directly the torque reference
3: digital % (cS18)	cS18 is factor for cS19
4: motorpoti (ru37)	the output value of the motorpoti function (see chapter 20.3) is the factor for the torque limits (cS19...cS23)
5: ext. PID out (ru52)	the output value of the PID controller (see chapter 20.9) is the factor for cS19 The output value can be read out in ru52
6: direct AN2 (+/- 10V)	Analog input value AN2 is the factor for cS19. The analog input is scannned and processed in faster steps with this adjustment. To realize this faster processing, the following parameters do not have any function: „AN2 noise filter“ (An11), „AN2 offset Y“ (An17), „AN2 zero clamp“ (An14), „AN2 save mode“ (An12). The value of AN2 is limited as multiplier to 100%.

This limits can be lowered by the limiting characteristic.

Adjustment of the torque limits for the respective quadrants (forward / reverse, motor / regenerative operation)
The parameter values of cS19…cS23 can be changed independently in 1, 2 ms step with parameter An54 and e.g. an analog input. The step width is depending on the control board. This provides the possibility e.g. to change the motor limit analog and to keep the regenerative limit constant. Parameter cS19 is the absolute torque reference for motor and regenerative operation. Torque limits for certain quadrants (forward / reverse, motor / regenerative operation) can be adjusted independently with parameters cS20...cS23
The speed range to the standstill must be considered critically. In this speed range, there may be speed jumps or speed jerks and the inverter can drive into torque limit.

14.5 Display of actual torque values and limits

Parameter ru11 and ru12 display the actual set or actual torque of the drive.

The torque in [%] referring to parameter„absolute torque reference“ (cS19) is displayed in ru73 and ru74.

The effective limits for the actual direction of rotation can be read in parameters ru47 "act. torque limit mot." and ru48 "act. torque limit gen.". Parameters ru47 and ru48 are depending on the programmed torque limits, the limiting characteristic and current limits (e.g. hardware current limit or dr37 "max. current“).

14.6 Display of the torque-related motor load ru90

The load of the total drive can be displayed with ru90.
The calculation of ru90 is depending on the mode.

14.6.1 Mode 1: „reference torque“ LE27 = 0

Then the calculation of ru90 is done according to the formula:

$$ru90 = \frac{\text{actual torque (ru12)}}{\text{act. torque limit (ru47}_{\text{mot.}}\text{ respectively ru48}_{\text{gen.}}\text{)}}$$

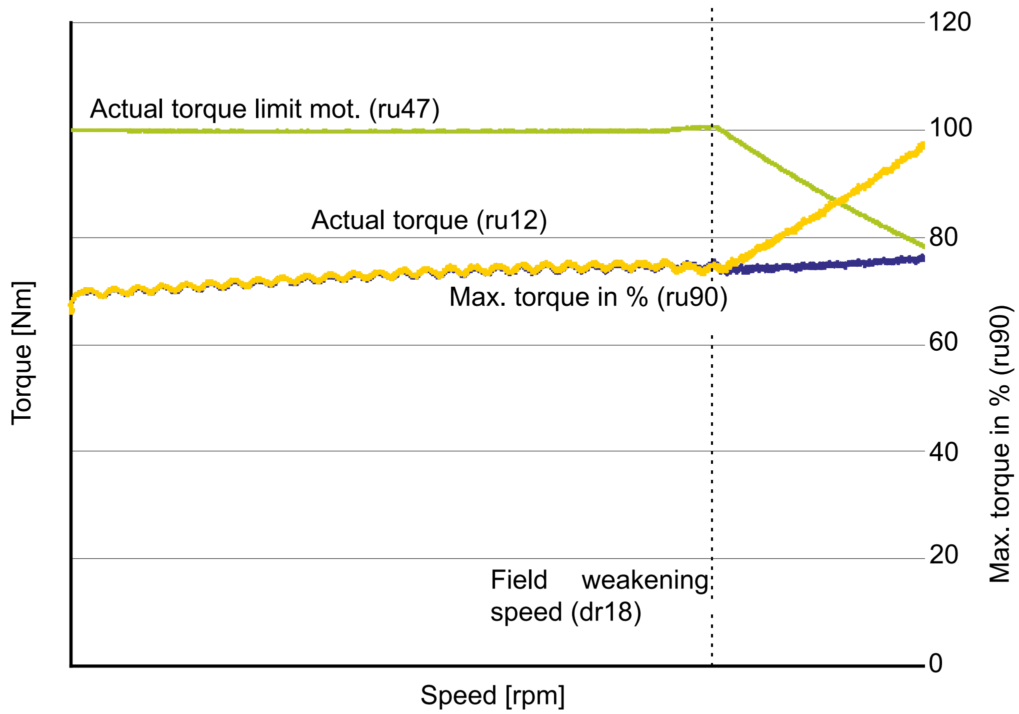


Figure 14.7 LE27 = 0

14.6.2 Mode 2: „reference torque“ LE27 unequal 0

If the „reference torque“ LE27 is unequal 0 there are several modes available for the calculation of ru90. The mode is selected with LE28 „ref. torque mode“.

If parameter LE27 ≠ 0 is adjusted, the overload protection of the motor is also activated.

LE28: ref. torque mode		
Meaning	Value	Explanation
Motor limit, reference mode	0: off	„reference torque mode“ is not active. The reference torque is equal to the actual torque limit (ru47,ru48 or LE27)
	1: on	„reference torque mode“ is active. As value 0, additionally continuous operation (S1) of the motor (according rated data) is considered for the reference torque
	2: on calculated reduced DC link voltage	As value 1, with consideration to the shifting of the S1-characteristic by the DC link voltage

Valid for all values in parameter LE28:
The programmed speed-torque characteristic is accepted as 100% utilization of the inverter. This characteristic is made up of the torque limits in the cS parameters (e.g. cS19) and the limiting characteristic in the dr parameters (e.g. dr15...dr18).
The adjusted value in parameter „reference torque“ (LE27) corresponds to 100% utilization in the application. This could be e.g. the torque which is permanent permissible for the mounted worm gears or the mounted gear box.

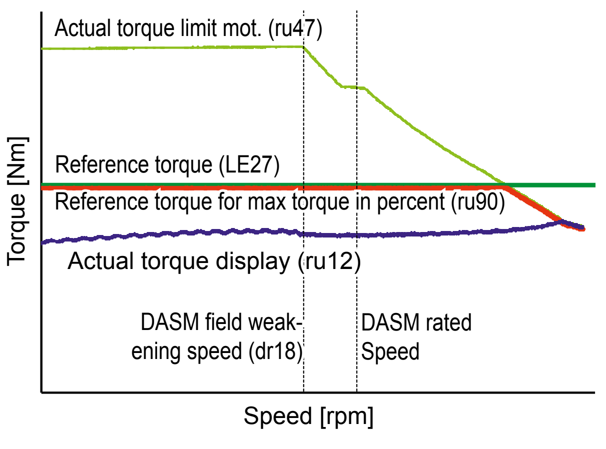


Figure 14.8 Parameter LE28 value 0

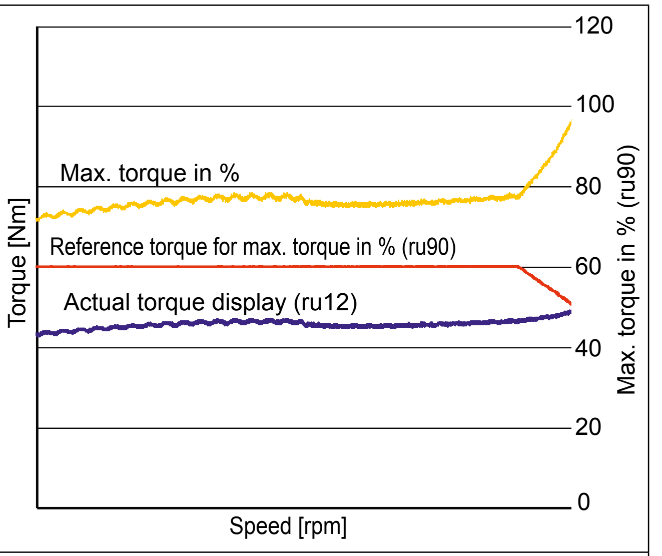


Figure 14.9 Display ru90 value 0

At parameter LE28 value 0 the smaller of the two max. values is the reference torque for ru90.

The thermal load of the motor is additionally considered in parameter LE28 value 1 and 2.
The thermal max. torque is taken as 100% utilization of the motor, i.e. in base speed range the rated torque and in the range "higher rated speed", the rated torque attenuated following a 1/x-function.
The smallest of the 3 values indicates the torque with which the whole drive can be loaded permanently at the corresponding speed. This torque is the reference torque for the calculation of parameter "max torque in percent" (ru90).

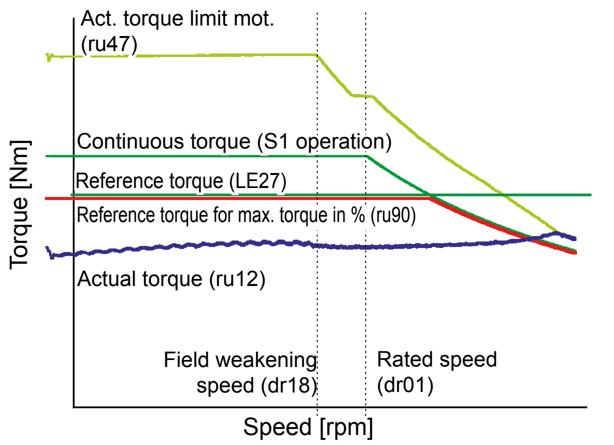


Figure 14.10 LE27 ≠ 0 reference torque

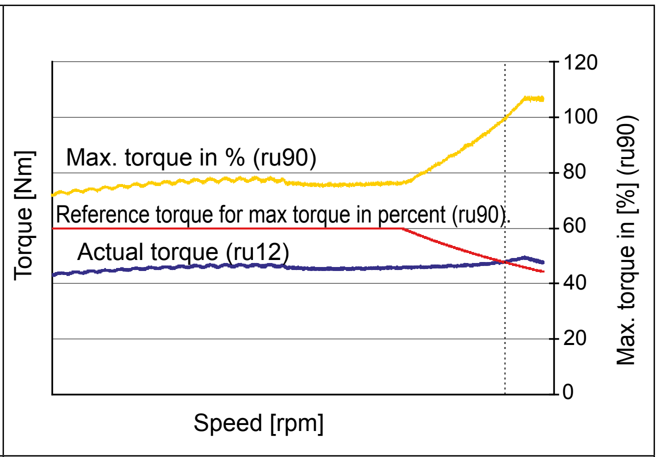


Figure 14.11 Display ru90 (LE27 ≠ 0)

The influence of the DC link voltage is additionally considered in parameter LE28 value 2. The S1 characteristic is shifting if the average value of the actual DC link voltage is smaller than DC link min.

The DC link voltage min is calculated as follows:
Asynchronous motor: DC link voltage min = dr02 (rated voltage) * (√2 / max. modulation factor)
Synchronous motor: DC link voltage min = (dr26 (EMF) / 1000 * (dr24 (rated speed) / max. modulation factor)

ℹ	The max. modulation factor is depending on the adjustment in parameter dS04 (100% /110%).

The new application point for the field weakening operation is:
At DASM

$$\text{DASM rated speed (dr01) x } \frac{\text{smoothed DC link voltage}}{\text{DC link voltage min}}$$

At DSM

$$\text{DSM rated speed (dr24) x } \frac{\text{smoothed DC link voltage}}{\text{DC link voltage min}}$$

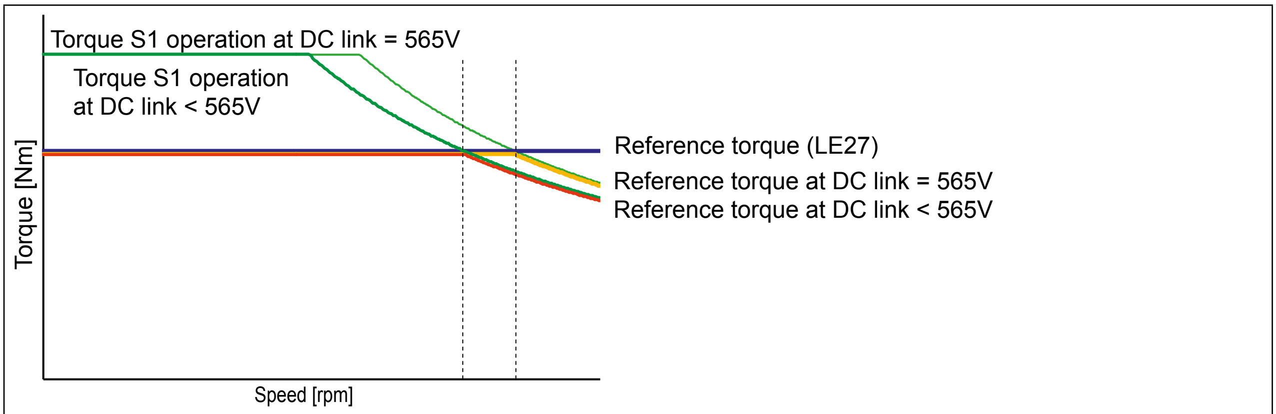


Figure 14.12 LE28 value 2

15. Torque Control

The user presets the motor torque in torque-controlled operation. If the set torque is not reached, the drive accelerates to the speed setpoint.

15.1 Torque reference source

The set torque is calculated from the value in parameter cS19 multiplied with a factor (0 .. 100%) which can be preset by different sources (analog inputs, motorpoti etc.). The selection of the torque reference source is made by parameter cS15.

cS01: torque reference source	
Value	Explanation
0: analog REF	Parameter „sel. Ref input / Aux-function“ (An30) defines, how the Ref or Aux value is calculated (see chapter 8). As standard AN1 is the Ref value and AN2 the Aux value. They are limited to 100% as multiplier for cS19.
1: analog Aux	
2: digital absolut (cS19...cS23)	the value in cS19 generates directly the torque reference
3: digital % (cS18)	cS18 is factor for cS19
4: motorpoti (ru37)	the output value of the motorpoti function (see chapter 20.3) is the factor for the torque limits (cS19...cS23)
5: external PID output (ru57)	the output value of the PID controller (see chapter 20.9) is the factor for cS19 The output value can be read out in ru52
6: AN2 direct (+/- 10V)	Analog input value AN2 is the factor for cS19. The analog input is scannned and processed in faster steps with this adjustment. To realize this faster processing, the following parameters do not have any function: „AN2 noise filter“ (An11), „AN2 offset Y“ (An17), „AN2 zero clamp“ (An14), „AN2 save mode“ (An12). The value of AN2 is limited as multiplier to 100%.

The superior torque limiting, such as „max. torque FU“ (dr15) remain effective.

15.2 Rate of change torque reference

The rate of change of the torque reference can be limited with cS16.

cS16: torque acc. time	
Value	Explanation
0: off	Torque reference is transferred directly without ramp
1...60000 ms	The maximum rate of change for the torque reference amounts to rated motor torque per adjusted ramp time (cS16).

15.3 Speed limiting

The setpoint speed after the ramp generator (ru02) serves for speed limiting. The setpoint speed is formed (with exception of the rotation direction) in the same manner as in speed-controlled operation or open-loop operation. The direction of rotation results from the sign of the torque reference. Without limiting the speed, the drive would accelerate to indefinitely high speeds if the counter torque disappears.
Since the limiting is based on the speed at the ramp generator output, the acceleration/ deceleration ramps should be set to 0 s for this operating mode.

15.4 Control mode

There are two different modes for torque-controlled operation. They can be selected by cS00 = 5 or cS00 = 6.

15.4.1 Mode 1: Torque-controlled operation with emergency changeover to speed control

This mode is activated with cS00 = 5.

The speed controller is not active until the drive does not exceed the maximum speed for torque-controlled operation (= set speed ru02).
This has the advantage that the parameterization of the speed controller has no influence to the set torque.
The change to speed-controlled operation occurs only when the speed limit is reached. Caused by the change-over the control characteristic is not optimal here. Overshoots can occur.

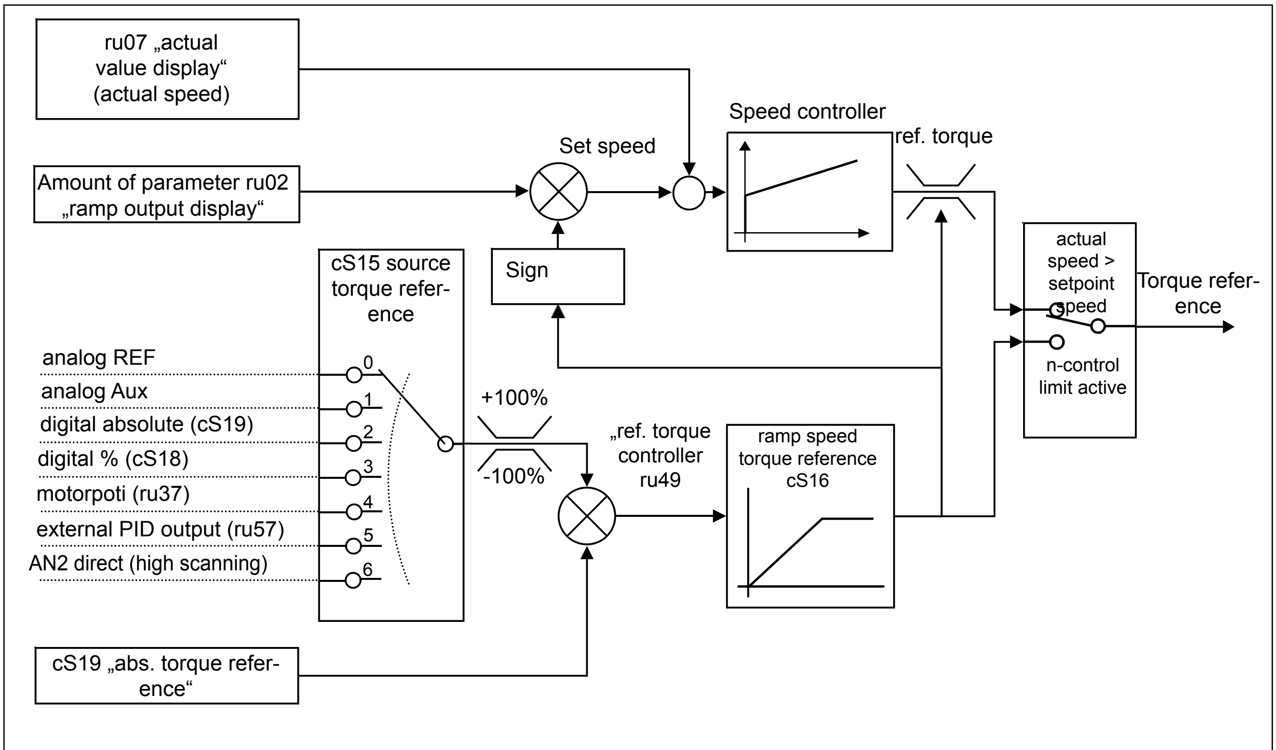


Figure 15.1 Mode 1

15.4.2 Mode 2: Torque-controlled mode with superimposed speed control

This mode is activated with cS00 = 6.

The speed controller is permanent active, but the limitation of the controller is always set equal to the torque reference.
As long as the drive does not exceed the maximum speed for torque-controlled operation (setpoint speed = ru02), the speed controller is in limitation, i.e. its output signal is equal to the torque reference.
This mode has the advantage that the speed controller is always activated and therefore the behavior on reaching the maximum speed is improved.
The disadvantage is that with an unfavorable parametrisation of the speed controller (e.g. very small amplification chosen), the torque reference can be further delayed by the controller. That means, even if the ramp time cS16 is 0:off, the speed controller must first run to the new limit value after torque reference increase.

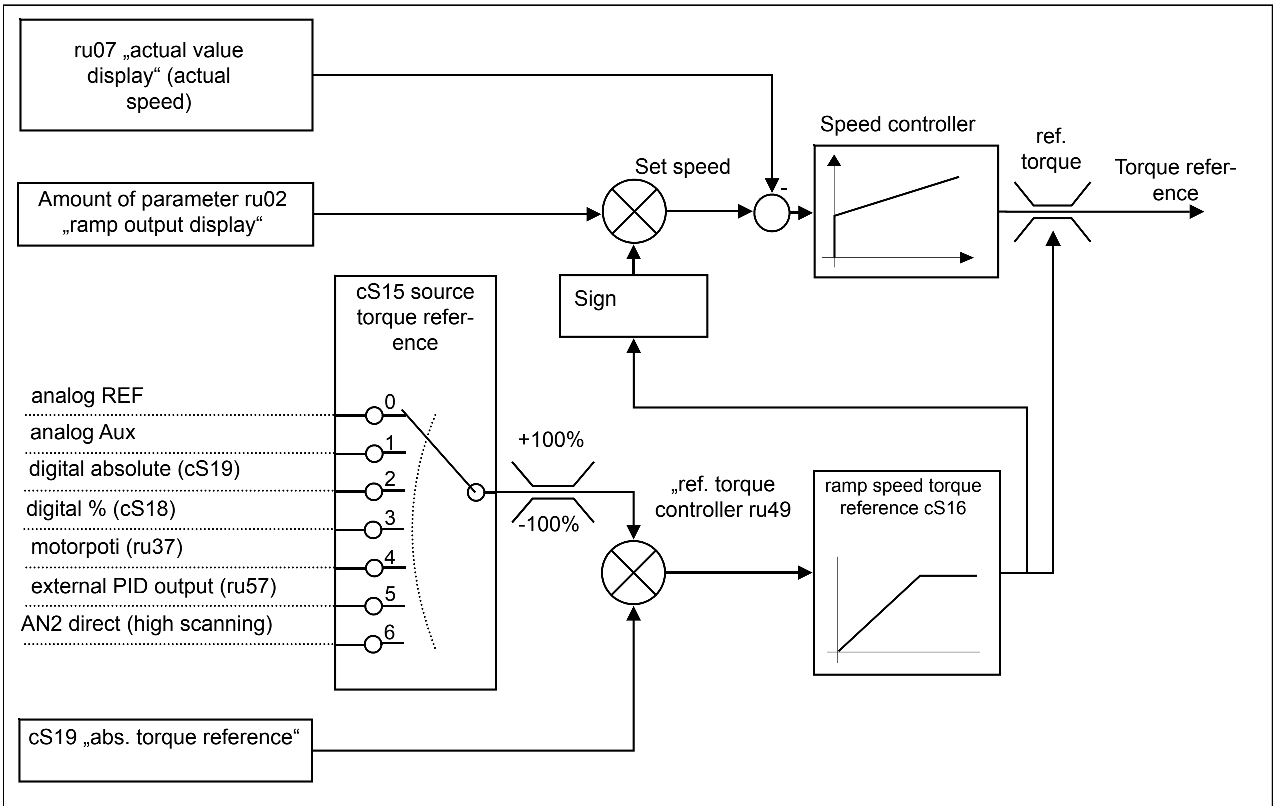


Figure 15.2 Mode 2

16. Current Control, Limiting and Switching Frequencies

16.1 Current control

The current controller (dS00 „KP current“, dS01 „KI current“) are automatically precharged by actuation of Fr.10 by means of the equivalent circuit data.
The controller parameters are calculated from the equivalent circuit data.
The current decoupling must be activated in dS02 for optimal control characteristic. For the asynchronous machine it is differentiated between "1: on" and "2: on, without main inductance“.
Mode 2 (without main inductance) must be used, if there are high DC link voltage fluctuations (e.g. at low mains or spindle motors). The complete decoupling can lead to boosted current oscillation.
Otherwise mode „1: on“ for synchronous and asynchronous motor must be selected.

dS02: current decoupling	
Value	Function
0: off	Current decoupling off
1: on	Current decoupling on
2: on, without main inductance (ASM)	partial current decoupling (mode only for asynchronous motors with unsmooth DC link voltage)
3: only Usq (SM)	The decoupling of the S-mode can be activated separately.
4: only Usd (SM)	

Exception: The controller parameters are only calculated according to the rating plate data at speed-controlled operation of an asynchronous motor without motor model. These adjustments are default values for standard motors and they are not suitable for special motors (e.g. high-and medium-frequency motors). A manual adaption must be made here.

A current decoupling is also not possible in cases where the equivalent circuit data are unknown. Therefore parameter dS02 must be to value 0.

dS03: current/torque mode			
Bit	Meaning	Value	Function
4	Current controller/ priority assignment (ASM)	0: off	Current controller / priority of
		16: on	Activation of the active current controller-priority in the regenerative range

The priority of the active current controller can be assigned in regenerative operation with bit 4 of parameter dS03. In special applications this is advantageous for the quality of current control

A change of bit 4 in parameter dS03 is normally not necessary and should be done only by authorized KEB service personnel.

16.2 Current limit

The hardware current limit becomes active if the phase current exceeds the value of In18 „hardware current“. Through short-time power shutdown the current limit can eliminate short current peaks at low speeds, e.g. when starting the motor. However if the current level is exceeded at high speed under load, disconnection of the voltage leads to a reduction of the breakdown torque of the motor and thus to a "fall back" of the motor. Additionally the motor model is falsified. Therefore this function should be switched off for controlled drives.

The hardware current limitation limits the current at the maximum and triggers no error. This can lead to torque sags at the motor shaft. This function is very critical especially during operation "lifting and lowering". The drive may sag due to missing torque without brake engage.

uF15: hardw. curr. lim. mode	
Value	Function
0: off	recommended adjustment for encoderless closed-loop operation
1: Single-phase mode	Limits the current reliable, but deep sag in the current
2: Zero vector mode	Lower current sag, but overcurrent errors can occur in rare cases.

The software current limiting (dr37) should be used instead of the hardware protective function. The maximum permissible current must be entered in parameter dr37.
If the application does not require another value it is reasonable to enter the hardware current inverter (In18) here. The function is activated by setting "current/torque mode = 1: on" in parameter (dS03) „current/torque mode.

dS03: current/torque mode			
Bit	Meaning	Value	Function
0	Maximum current mode	0: off	Maximum current mode off
		1: on	Activation of the software current limiting

16.3 Switching frequencies and derating

Switching frequency (uF11, In03, In04, ru45)

The required switching frequency can be selected in parameter uF11.The higher the switching frequency, the smaller the noise level and the smaller the current ripple and the associated losses in the motor. Simultaneously the losses in the inverter and also the isolation straining of the motor increase caused by switching edges.

uF11: switching frequency
Value
1: 4 kHz
2: 8 kHz

	Generally the switching frequency should be at least 10 times higher than the maximum occurring output frequency of the inverter.

The maximum switching frequency can be read in parameter In03. The inverter can be operated permanently (independent on temperature and utilization) only with its rated switching frequency (In04).
If a switching frequency is selected in parameter uF11 that is higher than the rated value, an automatic "derating", i.e. reduction of the switching frequency is carried out depending on the temperature, output frequency and utilization of the motor. This carrier frequency change-over is generally not good for the control characteristic of the drive. Therefore, the switching frequency uF11 should be as similar as possible to the rated switching frequency. However, the effects of derating are negligible in many applications.

16.3.1 Current ripple

The current ripple is a harmonic current which superimposes the sine-wave output current. It is generated by the clocked output voltage of the frequency inverter. This ripple increases the maximum value of the current and thus may lead to triggering of the overcurrent error or the hardware current limit, although the displayed apparent current (ru15) or utilization value (ru13) is significant below this limit.

1 Base frequency of the phase current

2 actual current = base frequency with superimposed ripple

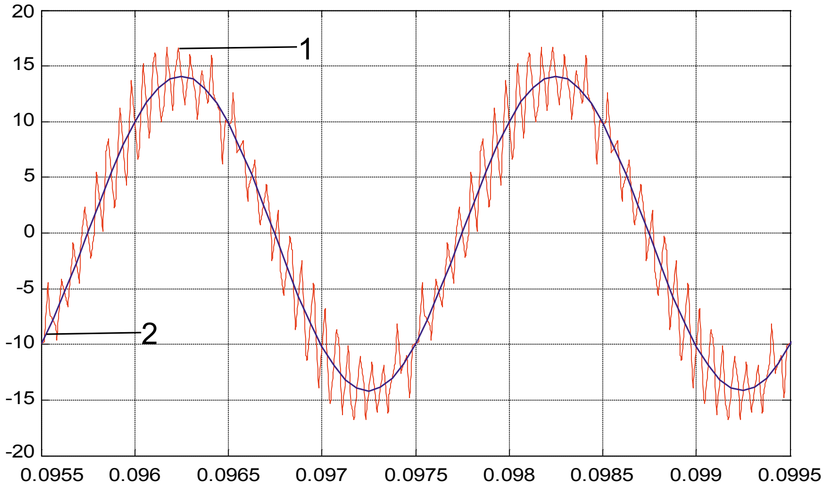


Figure 16.1 Switching frequencies

The size of the current ripple is depending on the switching frequency and the motor inductance. The current ripple is usually insignificant for standard motors with a power < 50kW and a rated switching frequency of the unit of min. 4 kHz.

The smaller the leakage inductance (ASM) and/or the winding inductance (SM) the higher the ripple. This is particularly the case for motors with high power or spindle motors. Therefore the carrier frequency must be selected as high as possible for these motors.

17. Gear Factor

17.1 Definition

The gear factor (ratio drive speed tooutput speed) is defined by two parameters: gear factor numerator and gear factor denominator

$$\text{Gear factor} = \frac{\text{Counter}}{\text{Numerator}}$$

A gear factor can be preset for encoder channel 2.Ec14 / Ec15 define the gear factor.

Overview of the parameters for gear factor setting:

Parameter	Description	Value range	Default value
Ec14	Gear 2 numerator	0…30000	1000
Ec15	Gear 2 determinator	1...30000	1000

Setting a gear factor is necessary in the following applications:

- Motor encoder connection via a gear
- If the speed sensor for the motor speed cannot be connected directly to the motor shaft, the gear ratio between motor and speed sensor must be set.

> Channel 2 is an initiator input and can not be used as speed feedback or for the motor model.
> The initiator input channel 2 is only available for inverters with CAN control board.

17.2 Gear factor / analog setting

The gear factor numerator (Ec14) can be changed via the analog parameter setting (see chapter 20.8).

Example:
The target is to be able to adjust the gear factor for encoder channel 2 between 0.9 and 1.1.
Gear factor denominator is chosen as 1000.
The gear factor numerator must also be settable to between 900 and 1100.

The analog setting shall be done via the Aux-input
=> An53 analog parameter setting source = 0: Aux input (ru53)

The target of the setting is Ec.14 gear factor channel 2 numerator (bus address 300Eh)
=> An54 analog parameter setting dest. = 300Eh

For an analog value of 0%, one should have gear factor numerator = 1000
=> An55 analog para. setting offset = 1000

For an analog value of 100%, the gear factor numerator should be 1100
=> An56 analog para. setting max value = 1100

i	With this setting, a gear factor of 0.9 to 1.1 can be set with an Aux value of -100%...100%.

17.3 Gear factor / set-programming

The gear factor is generally not set-programmable.
There is a workaround in case the application needs a set-dependent gear factor.
One uses the option of analogously setting the gear factor for this purpose. A motorpoti value, which can be specified set-dependently, is selected as source for the analog parameter setting (not an analog input).

Example:
in set 0 the gear factor should have the value 0.5, in set 1 value 1 and in set 2 value 1.5. Gear factor denominator is chosen as 1000. Therefore the gear factor numerator must be: in set 0 = 500, in set 1 = 1000, and in set 2 = 1500.

The analog setting should be done via the motorpoti
=> An53 analog parameter setting source = 1: motorpoti (ru37)

The target of the setting is Ec.14 gear factor channel 2 numerator (bus address 300Eh)
=> An54 analog parameter setting dest. = 300Eh

The value range is symmetrical around 1000 (+/- 500)
=> An55 analog para. setting offset = 1000

The maximum value for the gear factor numerator should be 1500
=> An56 analog para. setting max value = 1500

Set 0...2:	oP53 motorpoti min. value	=	-100%
Set 0...2:	oP54 motorpoti max. value	=	100%
Set 0:	oP52 motorpoti value	=	-100%
Set 1:	oP52 motorpoti value	=	0
Set 2:	oP52 motorpoti value	=	100%

18. Protective Functions

The protective functions protect the inverter against switch off caused by overcurrent, overvoltage as well as thermal overheating. Furthermore, you can restart the drive after an error automatically (Keep-On-Running).

18.1 Error and warning messages

For diagnostic purposes, the inverter displays various malfunction and error messages. Errors are all those events that trigger an immediate switch-off of the modulation, malfunctions allow a defined response (shutdown of the drive by abnormal stopping).
For some events (ext. error, bus monitor response, the drive hitting a limit switch, etc.) one can decide in the programming whether this is an error or a malfunction.
A pre-warning can be generated for some errors (e.g. overload error). This pre-warning is treated like a malfunction, i.e., the appropriate response to the pre-warning is programmable.

Example 1 (error):
The inverter recognizes overcurrent and changes to error (display in parameter ru00) „4: ERROR overcurrent“. Since this error cannot be predicted, there is no possibililty of a pre-warning. The modulation is switched off immediately and the drive spins down.

Example 2 (operating condition programmed as error):
The reaction of the bus monitor ("watchdog") shall trigger an error. Programming Pn05: "Watchdog response" = 0 (error / no auto restart). Display in parameter ru00 „18: ERROR bus“. If a digital output is programmed on a fault signalling relay, the relay switches.

Example 3 (pre-warning):
When the heat sink temperature exceeds a limit (dependent on the inverter type), the modulation is switched off, the inverter raises an error. A temperature which generates a pre-warning can be adjusted with Pn11 „OH warning level“.
Desired response: when exceeding the temperature of Pn11, the inverter executes an abnormal stop and switches off the modulation. An automatic restart shall be done if the heat sink temperature decreases. Programming Pn10 „warning OH stop. mode“ = 4 (stop/modulation off/ auto restart). Display in parameter ru00: "A.STOP! overheat pow.mod.“. If the temperature decreases due to the abnormal stopping, the inverter executes an automatic restart. If, however, the heat sink temperature continues to rise and exceeds the error limit, the inverter raises an "ERROR 8: overheat pow.mod.

18.1.1 Underpotential

Error „2: ERROR underpotential“ is triggered if the DC link voltage drops due to voltage dips or generally weak power grid. For this error, the automatic restart can be activated.

Pn36: no PU / E.UP delay time	
Value	Explanation
0: off	Delay time off
.,01 ... 32.00	Suppression of „2: Error! underpotential“ and „13: ERROR power unit not ready" with inactive control release

The following function is activated with parameter Pn84 (value ≠ 0):
with inactive control release „2: ERROR underpotential“ is not an ERROR (status word), ru00 displays nevertheless 2: ERROR underpotential“. With inactive control release „13: ERROR power unit not ready“ is not an ERROR (status word), ru00 displays nevertheless error status „13 power unit not ready“. Other errors (e.g. "31: ERROR external fault"," 9: ERROR drive overheat") are also triggered.
If the control release is activated „2: ERROR underpotential" or „13: ERROR power unit not ready“ is triggered after the adjusted time is up, if the condition is still met (DC link too low or LT_OK signal not active).

If „2: ERROR underpotential“ or „13: power unit not ready“ is once activated as ERROR, the status remains until reset.
Reset is only possible at activated control release if the DC link is high enough and/or the signal LT_OK is active.
If the control release is deactivated, status ERROR is deactivated with a reset.

18.1.2 Overvoltage

Error status „1: ERROR overvpotential“ is triggered among others, if the DC link voltage increases beyond the overvoltage level due to energy recovery in regenerative operation.

18.1.3 Overcurrent

The error status „4: ERROR overcurrent“ is triggered, if the „OC-tripping current“ (see technical data in the instruction manual power unit G6) is exceeded.
If this error occurs permanently, either the connected motor (short circuit or ground fault) or the inverter itself is defective.
The "maximum short time current limit" is below the overcurrent limit. If it is exceeded, the hardware current limit can be triggered with uF15. The response of this function is not regarded as error or malfunction and the appropriate switching conditions are not set. If the function is active, status „80: hardware current limit“ is displayed. This function should be deactivated for current controlled drives, since it may have negative effects for the motor model calculation and the behaviour of the drive.

18.1.4 Overload

The inverter overload protection is a function that triggers an error for which a pre-warning can be generated. There are two overload protection functions: one for the range of standstill and low frequencies (overload 2) and one for the remaining frequency range (overload/ OL). A value between 0...100 % which sets the "warning! overload" or "warning overload 2" can be adjusted with Pn09 „OL warning level“. The response to the overload warning is defined with Pn08 "warning OL stop. mode".

Overload in the standstill (OL2)
The motor current is guided via a PT1 link with a time constant of 280 ms. If this delayed current exceeds the OL2 limit, "19: ERROR overload 2“ is triggered. If the delayed current decreases to 0 again, the inverter enters the status "20: no ERROR overload 2". The error can now be reset.

Overload (OL)
If the 100% load factor of the inverter is exceeded by 5 %, the internal overload counter starts to count forward. If the load factor falls below 100 %, the counter counts backward. The actual counter reading can be read in parameter ru39 „OL counter display“. Upon reaching 100 % in parameter ru39, the inverter switches off with the error message „16: ERROR overload“ and the counter counts backward. If it has reached 0 %, the status changes to „17: no ERROR overload“ and the error can be reset.

18.1.5 Inverter over temperature

Heat sink overtemperature
The heat sink temperature acquisition protects the power module from thermal overload. The temperature at which the inverter switches off with error message "8: ERROR overheat pow.mod.“ is dependent on the power unit (see technical data in the power unit instruction manual).
After a cooling period the status changes from „8: ERROR overheat pow.mod.“ to „36: ERROR drive overheat“ and is therefore resettable.
A level when the adjusted response is triggered between 0° C and 90° C can be adjusted with Pn11 „OH warning level“. The response to the warning message is set with Pn10 "warning OH stop. mode".

Internal overtemperature
The temperature monitoring protects the inverter against malfunction due to high temperatures.
The interior fan is activated in E housing size 19 in case of exceeding a device-specific temperature.
A level when the adjusted response is triggered between 0° C and 90° C can be adjusted with Pn17 „E.OHI delay time“. The response is set with Pn16. Error E.OHI is triggered at 100°C independent of the setting in Pn16.

18.1.6 External fault

One or more digital inputs can be programmed with Pn04 „ext. fault input select“ which can trigger the error "31: ERROR external fault".
The response of the inverter to the digital input is defined with Pn03 „E.EF stopping mode“. The function of Pn04 can be changed and the triggering of an error via digital input can be deactivated with Pn65 Bit 1 „2: Pn04 = E.UP".

18.1.7 Bus error

The inverter contains two watchdogs that monitor the communication between an external bus, control circuit and power unit.
The response to a watchdog - error is determined with parameter Pn05 „E.buS stopping mode“. Dependent on the selected adjustment, either "18: ERROR bus" (E.buS) or „93: ABN.STOP bus“ is issued or a warning message via a digital output is generated.

Watchdog time (Pn06)
This watchdog monitors the communication at the control card interface. With activated watchdog, the response set in Pn05 is triggered after expiration of an adjustable time (0.01...40 s) without incoming telegram. The function is deactivated by setting the value "0: off".

Watchdog internal bus (Sy09)
The internal watchdog monitors the communication of the internal HSP5 interface (control card and power unit). After expiration of an adjustable time (0.01...10 s) without incoming telegrams, the response adjusted in Pn05 is triggered. Value „0: off“ in Sy09 deactivates the function.

18.1.8 Motor protection with temperature sensor

Parameter In17 displays the temperature evaluation installed in the inverter. A switchable KTY / PTC detection is installed at In17 = 7x hex. This can be set with Pn72 to the corresponding sensor (0 = KTY; 1 = PTC). If no switchable detection is installed, Pn72 has no function.

Pn72: set prog. spec. functions	
Value	Function
0	Motor sensor = KTY
1	Motor sensor = PTC

KTY

A temperature in the range of 0... 200° C is defined in Pn62 „dOH warning level“ and a warning is displayed if this value is exceeded. The actual temperature is displayed in ru46 "motor temperature".

Pn62: dOH warning level	
Value range	Function
0...200°C	Adjustable temperature range for the motor temperature level

i	A temperature evaluation with KTY sensor is only possible in E housing.

If the temperature evaluation displays an overtemperature, then the delay time adjusted in Pn13 „E.dOH delay time“ starts. The switching condition "96: ABN.STOP drive overheat“ of the digital outputs is set and the adjusted response in Pn12 „warning dOH stop. mode“ is triggered. If a value of 1...5 is selected in Pn12 the inverter changes into error „96: ABN.STOP drive overheat“
Error „9: ERROR drive overheat“ is triggered after expiration of the delay time in Pn13.

If the overtemperature condition is past, message „91: no A. drive overheat" or "no ERROR drive overheat“ is issued. Only then the error can be reset or the automatic restart can be carried out.

PTC
A temperature sensor integrated into the motor winding is connected to the terminals T1/T2 of the inverter. If a resistance of 1650...4000 Ohm is exceeded, motor overtemperature is detected. If the resistance drops below 750...1650 Ohm, the state motor overtemperature is reset.

Thermal contact (NC contact)
A thermal contact integrated into the motor winding is connected to the terminals T1/T2 of the inverter. The opened state is recognised as motor overtemperature.
The motor temperature ru46 only displays T1-T2 closed or T1-T2 open.

18.1.9 Software motor protection (I^2t-function)

Additionally to the monitoring of the motor with a temperature sensor, a motor protection can be realised also by monitoring the motor current.
The monitoring function is implemented differently for asynchronous and synchronous motors.

Emulation of an electronic motor protection relay
The functional description (times, current level, etc.) are found in chapter 18.9 "electronic motor protection". The response to the triggering of the electronic motor protection relay can be defined with Pn14 „warning OH2 stop. mode". Dependent on the programming, the inverter changes to "30: ERROR motor protection“ or „97: ABN.STOP motor protect.
After the cooling period, the error or the malfunction, respectively, can be reset.

Motor current monitoring for servo drives
The functional description (times, current level, etc.) are found in chapter 18.9 "electronic motor protection". When the protection function triggers, the error "30: ERROR motor protection“ is triggered. The error is resettable after approximately 100 ms.
A level of 0...100 % (100% = triggering time of the error) can be adjusted with Pn15 „OH2 warning level" which generates a pre-warning.
The response to the pre-warning is set with Pn14 "warning OH2 stop. mode". With this, an abnormal stopping can be executed before the drive raises an error. During the abnormal stopping, the inverter is in status „ABN. STOP motor protection“. Switching condition "10: no ERROR detected" is met at the digital outputs.

18.1.10 Set selection error

Sets can be locked with Fr03 „parameter set lock“. If a disabled set is selected, the inverter remains in the old set, i.e., no set change occurs.
The response to the selection of a locked set is defined with Pn18 „E.Set stopping mode“. Error "39: ERROR set“ is triggered in factory setting. Error „E.Set stopping mode“ is generated at Pn18 = 1...5. The drive continues running in the old set without message at Pn18 = „6: protecting function off".

18.1.11 Speed limit exceeded

The state „58: ERROR! overspeed“ is triggered, if ru07 „actual value display“ exceeds either the value of oP40/ oP41 „max. output value“ or the value of ru79 „abs. speed value EMF“ (only for synchronous motors). The user defines limits with oP40 / oP41 that may not be exceeded by the application under any circumstances.
ru79 displays the abs. speed for a synchronous motor which, if exceeded, leads to an EMF of the motor high enough to damage the DC link circuit of the inverter.
Too small distance between maximum set value and speed limit can be the reasons for overspeed, thus overshoots can trigger an error. Other causes can be (e.g. caused by EMC) malfunctions in the speed measurement or a noisy, insufficiently smoothed speed estimate in the encoderless control (SCL or ASCL).

18.1.12 Speed controller limit reached

Parameter Pn75 „E.SCL stopping mode" determines how the output should respond if the speed controller reaches the limit, i.e., if the set torque reaches the maximum possible value. In factory setting, this operating condition can be applied to a digital output (switching condition "53: speed control in limitation"). With Pn75, however, it is also possible to execute an abnormal stopping on reaching the torque limit (state „ABN.STOP speed ctrl. lim“) or to trigger an error (status „25: ERROR speed ctrl. lim" / E.SCL)

18.1.13 General power circuit error

Monitors for the internal hardware (e.g. fans) are integrated on some inverter types. If one of these monitoring circuits reports an error, "12: ERROR power unit“ is triggered.

18.1.14 Phase failure

State „3: ERROR phase failure“ is identified indirectly via the ripples in the DC link voltage.
If one power phase is missing, the waviness in the DC link is considerably increased under load. In no-load operation or at small load, the error of the power phase is, however, not recognised. For this error, an automatic restart cannot be programmed.

Phase loss detection at the output

If one of the output phases is interrupted during operation, this is detected by the inverter and the error message "ERROR output phase fail." is issued.

Pn74 out phase check mode

Pn74: out phase check mode	
Value	Explanation
0: off	The out phase check mode is off
1: on	The out phase check mode is on

The function is active if all following conditions are met:
Parameter Pn74 must be set to 1(on). Bit 0...2 = 0...2 must be set in parameter cS00 for inverter type G6L.
The output frequency at ru03 must be higher than 4Hz. The utilization of ru13 must be higher than 7%.

Due to strong fluctuating load after disconnecting a phase, a tripping time between 250 and 600ms is set.

ℹ	This function is only available for G6L.

18.1.15 Maximum acceleration exceeded

The maximum permissible acceleration is defined with Pn79 „acceleration limit 1/s2“. Pn80 „acceleration scan time“ determines the period during which the acceleration value is averaged. The change of the actual speed (ru07) during this period, divided by the scan time (Pn80) is the actual acceleration. For the calculation of acceleration, the speed difference must be converted from rpm to 1/s.

$$\text{Acceleration} = \frac{\text{Speed change during the scan time (in rpm)}}{\text{60 x acceleration scan time (in seconds)}}$$

If the acceleration limit (Pn79) is exceeded, the response defined by Pn81 „warning acc.stop. mode“ is triggered. Depending on the programming, the drive changes into status „24: ERROR max. acceleration“ (E.Acc) or „106: ABN.STOP max. acceleration“ (A.Acc).

18.2 Response to malfunction messages

18.2.1 Selection of the response

Abnormal stopping (i.e., automatic shutdown of the drive) is possible for all errors that do not enforce immediate shutdown of the modulation or for which pre-warnings can be generated. If abnormal stopping is not sensible in the application, the possibility to set a digital output is available for many malfunctions.

The response is programmable for the following malfunctions:

- Ext. error	Pn03	E.EF stopping mode
- Watchdog	Pn05	E.buS stopping mode
- Hardware limit switch	Pn07	proh. rot. stopping mode
- Set selection error	Pn18	E.Set stopping mode
- Speed controller limit	Pn75	E.SCL stopping mode
- Acceleration monitoring	Pn81	warning acc.stop mode

Other errors switch off the modulation, but a pre-warnings can be generated prior to their triggering. In the time between the pre-warning signal and the triggering of the error, the drive can be hut down via abnormal stopping. The response is programmable:

- Overload	Pn08	warning OL stop. mode
- Heat sink overtemperature	Pn10	OL warning level
- Internal overtemperature	Pn16	warning OHI stop. mode

The motor protection functions can be deactivated. If they are to be used, a pre-warning can be generated here as well prior to the triggering of an error, providing time to shut down the drive.

- motor protection	Pn14	warning OH2 stop. mode
- motor overtemperature	Pn12	warning dOH stop. mode

The descriptions of the errors and the corresponding pre-warning signals are contained in chapter 22 "Error assistance".

The following responses can be used for all malfunctions and errors, respectively:

Pn03, Pn05, Pn07, Pn08, Pn10, Pn12, Pn14, Pn16, Pn18, Pn75, Pn81: Response	
Value	Explanation
0: ERROR, no auto restart	the malfunction turns into the error (display: ERROR xxx), immediate shutdown of the modulation, restart only after RESET
1: Quickstop, modulation off, no auto retry	Deceleration at the abnormal stopping-ramp or the torque- and current limit, respectively, shutdown of the modulation after reaching speed 0, restart only after RESET
2: Quickstop, modulation on, no auto retry	Deceleration at the abnormal stopping-ramp or the torque- and current limit, respectively, holding torque after reaching speed 0, restart only after RESET
3: Modulation off, auto retry	Immediate shutdown of the modulation, automatic restart as soon as the malfunction is resolved
4: Quickstop, modulation off, auto retry	Deceleration at the abnormal stopping-ramp or the torque- and current limit, respectively, shutdown of the modulation after reaching speed 0, automatic restart, as soon as the malfunction has been resolved
	continued on the next page

Pn03, Pn05, Pn07, Pn08, Pn10, Pn12, Pn14, Pn16, Pn18, Pn75, Pn81: Response	
Value	Explanation
5: Quickstop, modulation on, auto retry	Deceleration at the abnormal stopping-ramp or the torque- and current limit, respectively, holding torque after reaching speed 0, automatic restart, as soon as the malfunction has been resolved

Pn03, Pn05, Pn08, Pn10, Pn14, Pn16, Pn75, Pn81: Response	
Value	Explanation
6: Warning by digital output	No response of the drive, the malfunction (or pre-warning) can be output via digital output

The response to the error message of parameter Pn07 and set selection error can be completely switched off.

Pn07, Pn18: Response	
Value	Explanation
6: protecting function off	The malfunction is ignored, no reaction of the drive, no message possible via digital output

Pn16: Response	
Value	Explanation
7: Error deactivated	No message via digital output. Error E.OHI is triggered at 100°C independent of the setting in Pn16.

For the malfunction "motor overtemperature", several additional choices exist:

Pn12: warning dOH stop. mode	
Value	Explanation
6: Warning by digital output	The motor temperature is monitored, but the drive does not execute an automatic abnormal stop during the pre-warning time, the pre-warning message can only be issued via a digital output. After expiration of the pre-warning period, the inverter goes to error „9: ERROR drive overheat“.
7: ERROR disabled	Motor temperature is not monitored, errror „9: ERROR drive overheat“ is never triggered. No message via digital output possible.
8: ERROR disabled at modulation off	The motor temperature is not monitored during the modulation is switched off. If the modulation is switched on, monitoring occurs, too. The pre-warning signal and error „9: ERROR drive overheat“ is generated after the pre-warning period.
9: ERROR triggered at modulation off	Warning via dig. output when dOH signal is present (= value 6). Error is triggered after the pre-warning time has elapsed or when the modulation is switched off.

18.2.2 Parameterization of the quick stop at malfunction

For parameterization of the quick stop see chapter 18.5

18.3 Automatic restart

With the automatic restart, the inverter error automatically resets or automatically terminates the abnormal stopping caused by a malfunction or pre-warning.
The function can be activated separately for the different errors and malfunctions with the Pn parameters.

The automatic restart only makes sense if the error can be expected based on the application. Normally, the cause of the error must first be investigated and eliminated before the drive restarts by executing the reset.

Therefore, it must be selected after which errors an automatic restart should be executed.

⚠	Because of the independent starting of the machine safety measures must be provided for operating personnel and machine!

18.3.1 Undervoltage error (ERROR underpotential)

The automatic restart for the undervoltage error is activated in the factory setting in Pn00 „auto retry UP“.

A typical application for the automatic restart E.UP (Pn00) is operation on a bad power grid where sporadic brownouts are to be expected. With this function, the application continues running as soon as the mains voltage is sufficiently high again.

A time within the automatic restart is permissible can be defined for the underpotential error.

Pn76: max. E.UP warning time	
Value	Explanation
0: off	If the automatic restart function is activated, it will be carried out always after undervoltage error (independent of the time the error has been present). The error bit in the status word Sy44 or Sy51 is set, as long as the inverter is in "ERROR underpotential (E.UP)".
0.01...32.00 s	After expiration of this time, no automatic restart is executed. During expiration of this time, the error bit is not set in the status word Sy44 or Sy51. The status message in ru00 and the switching condition „4: ERROR“ however display the underpotential error.

18.3.2 Overvoltage error (ERROR overpotential)

The error overvoltage occurs mostly at high speed. By activation of Pn01 "auto retry OP", it can be avoided that the drive "spins down" for a long time after this error. This function makes sense only in combination with the speed search (see chapter 18.6).
The base block time (bbL) is at least 1 second, even if the value in uF12 „base block time“ is smaller. Furthermore, the base block time before the restart is always observed, even if uF13 "base block voltage level" is undershot.

18.3.3 Overcurrent error (ERROR overcurrent)

The automatic restart after occurence of an overcurrent error is activated with Pn02 "auto retry OC". It can be used if impact overloads of the FI, e.g. due to blocking of the motor, can be expected in v/f-characteristic operation.
The base block time is treated as in overvoltage errors.
After 10 restart attempts, the inverter state must be unequal to the base-block time or the overcurrent error for at least one second, otherwise the restart is aborted.

18.3.4 Error messages and pre-warnings

An error response with automatic restart is selected in parameters Pn03, Pn05, Pn07, Pn08, Pn10, Pn12, Pn14, Pn18, Pn75 and Pn81 with the values 3...5.
The base block time (bbL) is observed only if the drive is above uF13 "base block voltage level".

18.4 Base block

After shutdown of the modulation (e.g., when opening the control release or if an error occurs), one must wait for the time shown in uF12 „base block time“ before the modulation can be switched on again. Statue „76: base block“ is indicated in ru00 and on the display during this phase.
If ru42 „modulation grade“ is below uF13 „base block voltage level" when switching off the modulation, there is no base block time. Even at low frequencies, the base-block time is not observed.
Exception: After overvoltage- or overcurrent-error, a minimum base-block time of 1s is inserted.
Parameters uF12 and uF13 are dependent on the power circuit and serve only to inform the user which minimum switch-off times are to be expected in the application.
The status message "76: base block" can be suppressed in parameter Pn65 / Bit 8 „256: BBL is not displayed“, in order that the event caused by the modulation switch-off is immediately visible.

The base block time can be extended with parameter uF26.

uF26: baseblock extension time	
Value range	Explanation
0...2.00 s	adjustable value range

If a value ≠ 0 is entered in parameter uF26, the baseblock time is arise from uF12 + uF26. If value 0 is entered in uF26 the baseblock time coresponds to uF12.

18.5 quick stop

The abnormal stopping function serves to shut down the drive (mostly in case of a malfunction) as quickly as possible. Therefore, there is a separate ramp time (Pn60: „quick stop dec time“) and in closed-loop operation separate torque limits (Pn61: „quick stop torque limit“, Pn67: „q.stop max. torq.corn.sp“), which can be adjusted highter than the torque limits for normal operation, to provide the required fast deceleration.

Quick stop can be activated by malfunction and via the control word (Sy50 Bit 8). The functionality is the same in both cases, but "79: quick stop“ is displayed as state.

For all modes, one can choose whether the quick stop bit is reset in the status word (Sy51 or Sy44 bit 8) on reaching standstill, or whether it remains active until leaving the function.

Pn58: quick stop mode			
Bit	Meaning	Value	Explanation
3	Status bit at standstill	0: Status bit on	Status bit "79: quick stop" remains active until leaving the function
		8: Status bit off	Status bit "79: quick stop“ is reset when the drive has reached standstill

ℹ	The quick stop function is different for speed-controlled systems (cS00 = 4, 5, 6) and for systems with v/f-characteristic control.

18.5.1 Quick stop in the V/F characteristic operation

In v/f-characteristic operation, one can choose in Pn58 "quick stop mode" between ramp generator and differential controller“. For the differential controller, the time constant is set in Pn60. The setpoint value of the differential controller is preset in Pn59: „quick stop level“, Pn58 selects the actual value from either apparent current or active current.

For quick stop with v/f-characteristic control, the drive is decelerated with the adjusted ramp time or at the current limit. Whether braking occurs at the ramp or at the current limit is defined in parameter Pn58.

Pn58: quick stop mode			
Bit	Meaning	Value	Explanation
0	Quick stop mode (vvc)	0: Ramp generator	The deceleration time is Pn60
		1: Differential controller	The deceleration time is dependent on the difference current limit (Pn59) - actual current. The time constant of the controller is adjusted with Pn21, the setpoint with Pn20.
1	Quick stop act. value (vvc)	0: Apparent current	Current limit for deceleration refers to the apparent current
		2: Active current	Current limit for deceleration refers to the active current
2	Quick stop via control word (Sy50)	0: Sy50 Modulation off	Shutoff of the modulation after reaching of speed 0 due to abnormal stopping
		4: Sy50 Modulation on	Fast stop with holding torque on reaching speed 0
3	Status bit at standstill	0: Status bit on	The status bit "quick stop" remains active until leaving the function
		8: Status bit off	The status bit "quick stop" is reset when the drive has reached standstill
4	Deceleration stop mode	0: Deceleration stop voltage-dependent	The deceleration stop is shutdown at the limit of parameter Pn25.
		16: Deceleration stop voltage and current-dependent	The deceleration stop is shutdown at the limits of Pn24 and Pn25.

Depending on the setting of Pn58, the ramp time of the quick stop function or the time constant of the controller is adjusted in Pn60.
Bit 1 and bit 2 must be set in parameter Pn22 for bit 4 „deceleration stop mode“.

Pn60: quick stop dec time	
Value	Explanation
0..300 s	Deceleration ramp for quick stop function

At abnormal stopping with differential controller, this ramp is modified that the drive decelerates preferably at a current limit.

This current limit is set in Pn59 „quick stop level“.

Pn59: quick stop level	
Value	Explanation
0...200 %	Current limit for differential control = 0...200 % rated inverter current (In01)

It can be selected with Pn58 bit 1 whether the inverter shall decelerate at the active current limit or at the apparent current limit.

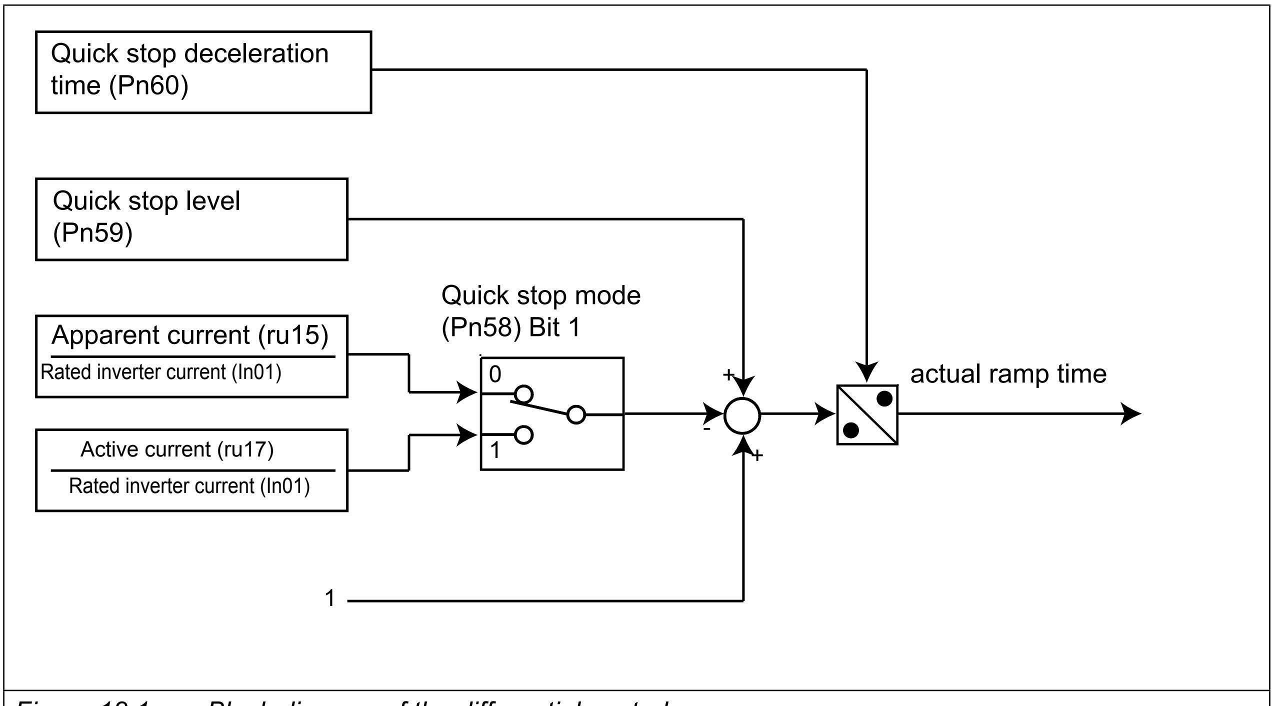


Figure 18.1 Block diagram of the differential control:

18.5.2 Quick stop at closed-loop systems

At quick stop with closed-loop systems the drive is decelerated with the adjusted ramp time or at the torque limit.

Pn60: quick stop dec time	
Value	Explanation
0...300 s	Deceleration ramp for quick stop function

For the abnormal stopping, the "normal" torque limitations of the application often do not apply since the automatic shutdown is always a malfunction response. To permit a quicker deceleration with a greater torque here, there is a unique torque limit for abnormal stopping.

Pn61: quick stop torque limit	
Value	Explanation
0...32000.00 Nm	Quick stop torque limit

The torque limitation superimposed by the limiting characteristic and the available current remain in effect. For asynchronous motors, the maximum cutoff torque for abnormal stopping can also be increased to make more torque available for braking, even in the field weakening range.

Pn67: q.stop max. torq.corn.sp	
Value	Explanation
0...32000.00 Nm	the limiting characteristic at quick stop is defined by Pn67 (instead dr16)

18.5.3 Time monitoring abnormal stopping

For safety, a maximum time for the abnormal stopping-function can be programmed.

Pn68: Max. abn. stopping time	
Value	Explanation
0.01...100.00 s	Time after which the inverter switches from malfunction ("abnormal stop" A.XX) to the error state (E.XX)

If the inverter is still in error state (A.XX) after this time (no RESET or automatic restart was carried out), the inverter switches off the modulation and changes into the corresponding error state (A.XX => E.XX).

18.5.4 S-curve for quick stop ramp

Pn83: quick stop s-curve time	
Value	Explanation
0...5.00 s	Quick stop s-curve time is valid for the quick stop ramp (Pn60), set-programmable

18.5.5 Quick stop via control word

Quick stop can also be triggered via the control word (Sy43 or Sy50). Then, the status displays "79: quick stop“. The behaviour for quick stop can be defined via control word in parameter Pn58 „quick stop mode.

The quick stop mode determines the behaviour for quick stop via control word.

Pn58: quick stop mode			
Bit	Meaning	Value	Explanation
2	Quick stop via control word (Sy50)	0: Sy50 Modulation off	Shutoff of the modulation after reaching of speed 0 due to abnormal stopping
		4: Sy50 Modulation on	Quick stop with holding torque on reaching speed 0
3	Status bit at standstill	0: Status bit on	The status bit "quick stop" remains active until leav-ing the function
		8: Status bit off	The status bit "quick stop" is reset when the drive has reached standstill

18.6 Speed search

The speed search permits a relatively smooth engagement of the frequency inverter onto a running motor. Without activation of the speed search, the motor is always slowed down first. The motor must be stopped with DC braking in closed-loop operation without encoder.
On activation of the speed search, however, the current speed is determined and the drive is accelerated or decelerated from this starting point to the setpoint speed, according to the adjusted ramps.
Parameter Pn26 "Speed search condition" determines when the speed search shall be executed.

Pn26: speed search condition		
Bit	Value	Explanation
0	0: AutoReset	Speed search after auto reset
	1: Speed search after noP	Speed search after status "no control release"
1	2: Speed search after power-on-reset	Speed search after power on
2	4: Speed search after reset	Speed search after execution of a reset
3	8: Speed search after auto reset	Speed search after automatic restart
4	16: Speed search after LS	Speed search after status "standstill (modulation off)"

⚠	The speed search is not possible with a sine-wave filter. The sine-wave filter distorts the measurement results of the speed search.

18.6.1 Extension of the speed search

The "speed search mode" Pn27 determines the frequency and voltage jumps as well as the max. maximum load factor with which the function works. Higher values let the function work faster, lower values make the function „softer“.

Pn27: speed search mode			
Bit	Meaning	Value	Explanation
0...2	Frequency reduction	0: 50 Hz/s	If the load limit is exceeded, the output frequency is decreased according to the adjusted reduction rate
		1: 70 Hz/s	
		2: 100 Hz/s	
		3: 150 Hz/s	
		4: 200 Hz/s	
		5: 280 Hz/s	
		6: 400 Hz/s	
		7: 560 Hz/s	
3...4	Voltage rise	0: 0.025 %/ms	If the load limit is exceeded, the output voltage is increased with the selected speed
		8: 0.12 %/ms	
		16: 0.24 %/ms	
		24: 0.48 %/ms	
5	Load limit	0: 80 %	The load limit for the frequency reduction and voltage rise is defined here
		32: 130 %	
6...7	Setpoint for speed search	0: Setpoint	Start value is the actual speed setpoint
		64: measured actual value	If the calculated actual value is selected as actual value source in cS01, the actual speed setpoint is used as start value.
		128: last output value	Start value is the last output frequency value
		192: measured actual value	If the calculated actual value is selected as actual value source in cS01, the last output frequency value is used as start value.

18.6.2 Speed search in ASCL mode

In closed-loop operation without encoder, the current actual speed must be estimated from the motor model. For special motors (e.g., high frequency spindles) or applications (e.g., operation in very high field weakening range), this estimate for the engagement onto a running motor may not work. The speed is then calculated incorrectly and the drive vibrates or the inverter raises a malfunction.
In these cases, the motor must be stopped by DC braking (see chapter 20.1) before the drive can be restarted. Generally, however, the speed search is the most jerk-free and quickest path to switch to a running motor.

Pn90: SSf. lowest limit (ASCL)	
Value	Explanation
-20.0...20.0 %	The value refers to the rated speed of the motor

If the determined speed after speed search is below the limit in Pn90, speed = 0 rpm is preset.
Advantage: The drive is not in state "delay", thus the motor model remains always active from the start.

18.7 Ramp stop

The ramp stop function fulfils two main tasks. The function reduces the risk of:

- overcurrent errors (Error! overcurrent) during the acceleration or deceleration phase (only for v/f characteristic operation)
- overvoltage errors (Error! overvoltage) during the deceleration phase (in all operating modes)

by stopping the ramp on exceeding of Pn24 „LAD load level“ or Pn25 „LD voltage“.
Moreover, the ramp stop function can be activated by a digital input.

Pn22 selects which of the ramps (acceleration, deceleration or both ramps) can be stopped.

Pn22: LAD stop function		
Bit	Value	Explanation
0	1: LA stop	The acceleration ramp is stopped on exceeding of Pn24 "LAD load level" or if the input programmed in Pn23 „LAD stop input selection" is set.
1	2: Deceleration stop U-dep.	The deceleration ramp is stopped on exceeding of Pn25 "LD voltage" or if the input programmed in Pn23 „LAD stop input selection" is set.
2	4: deceleration stop I-dep.	The deceleration ramp is stopped on exceeding of Pn24 "LAD load level“ or if the input programmed in Pn23 „LAD stop input selection" is set.

18.7.1 Current-dependent ramp stop

In v/f characteristic operation, overcurrent errors can occur due to short ramps.
Therefore, a current limit can be programmed with Pn24 "LAD load level" that is frozen on exceeding the ramp generator output value (ru02).
In closed-loop operation the current is limited by software via the control-internal current and torque limits. Therefore the functions acceleration stop (LA-Stop) and deceleration stop dependent on the current (LD-Stop (I)) are useless.

Pn24: LAD load level	
Value	Explanation
0 .. 200%	Current level at which the ramp is stopped

If the acceleration stop is active in speed-controlled operation in order to use the interruption of the ramp via a digital input, so the load level in Pn24 must be set to 200% to avoid negative effects.

18.7.2 DC link voltage-dependent ramp stop

The LD-Stop (U) function can be used to prevent overvoltage errors during deceleration.
During deceleration energy is refeed into the frequency inverter, which causes a rise of the DC link voltage.
If too much energy is recovered, the inverter can switch to overvoltage (OP) error.
If the LD-Stop (U) function is activated with Pn22, the DEC ramp is stopped if the actual DC voltage (ru18) exceeds the adjusted LD voltage (Pn25).

Pn25: LD voltage	
Value	Explanation
200V...1200V	DC-link voltage level at which the ramp is stopped.

Overvoltage errors cannot be safely avoided with this protection function, because after setting the ramps and the speed controller, further deceleration can occur despite stopping the ramp. If the drive decelerates, e.g., at the torque limit, and can therefore not follow the ramp, it does not help to stop this ramp. An undershoot of the speed controller due to a sudden termination of the ramp can also lead to further energy recovery in the DC link.
Generally, the deceleration process is slowed down by this protection function. The use of a braking resistor is necessary for a dynamic deceleration.

18.7.3 Ramp stop dependent on a digital input

A digital input for triggering the ramp stop can be selected with Pn23 "LAD stop input selection". This input is only active if the stop for the corresponding ramp is permitted in Pn22.

18.8 Current limit constant run (stall function)

The Stall-function protects the frequency inverter against overload.
If the current (depending on the setting in Pn19 active or apparent current) reaches the current limit (Pn20), an attempt is made to lower the load by increasing / decreasing the output frequency.

Whether the output frequency must be increased or decreased depends on the torque characteristic of the application. For a fan, e.g., the load factor increases with the speed, and the output frequency must be reduced during overload. For a drilling machine, the load factor decreases with the speed, and the drive must therefore be accelerated during overload. When falling below the maximal constant current the inverter accelerates / decelerates again with the normal ramp times. The stall function is active until the original setpoint speed is reached. This protection function only operates at G6L in open-loop operation (cS00 = off).

The basic mode of operation is determined with Pn19:

Pn19: stall mode			
Bit	Meaning	Value	Explanation
0, 1	Control limits	0: min. reference oP06 / oP07 or max. reference oP10 / oP11	Final value to which it is possible to decelerate/accelerate.
		1: min. reference oP36 / oP37 or max. reference oP10 / oP11	
		2: min. reference oP06 / oP07 or max. reference oP40 / oP41	
		3: min. reference oP36 / oP37 or max. reference oP40 / oP41	
2	Control characteristic in regenerative operation	0: no change	With this bit, it is set whether the control direction (frequency increase and decrease, respectively) inverts in regenerative operation.
		4: Inversion	
3	Ramp control	0: Ramp generator	The frequency is increased/decreased by way of the ramp generator. The ramp time is preset here by Pn21.
		8: Differential controller	The increase / decrease of the frequency is done via controller. The rate of change is dependent on the difference current limit (Pn20) - actual current. The time constant of the controller is adjusted with Pn21, the setpoint with Pn20.
4	Release of the function	0: only at constant run	Stall function only active at constant run (see inverter state)
		16: always (also during the ramp)	Stall function always active
5	Variable	0: Apparent current	Stall function intervenes if the apparent current (ru15) exceeds the stall level Pn20.
		32: Active current	Stall function intervenes if the absolute value of the active current (ru17) exceeds the stall level Pn20.
6	Control direction	0: deceleration	Fits the function to the torque / speed characteristic of the application. Examples: For a fan, one must decelerate if the current level is exceeded. For drilling machines, one must accelerate.
		64: acceleration	
7	Level decrease above rated frequency	0: no	Determines whether the current limit that activates the stall function should be decreased above the rated point. The decrease is then done according to the following formula:
		128: yes	Stall level = Pn20 $\left(\frac{\text{rated frequency (uF00)}}{\text{actual frequency (ru03)}}\right)^2$
8	Constant current limit release	256: Constant current limit release	Constant current limit always released

Stall level (Pn20)
The stall level is adjusted in parameter Pn20. When exceeding this limit, the inverter increases or decreases automatically the output frequency (depending on the adjustment in Pn19) in order to reduce the load.

Pn20: stall level	
Value	Explanation
0...199%	Current limit in % (reference value: 100% = rated inverter current (In01))
200: off	Stall function deactivated

Stall acc/dec time (Pn21)
The rate of change of the output frequency is dependent on Pn21. Depending on the setting of Pn19, the ramp time of the stall function or the time constant of the controller is adjusted in Pn21.

Pn21: stall acc/dec time	
Value	Explanation
0...300s	Ramp time and time constant of the controller, respectively

Function of the current limit

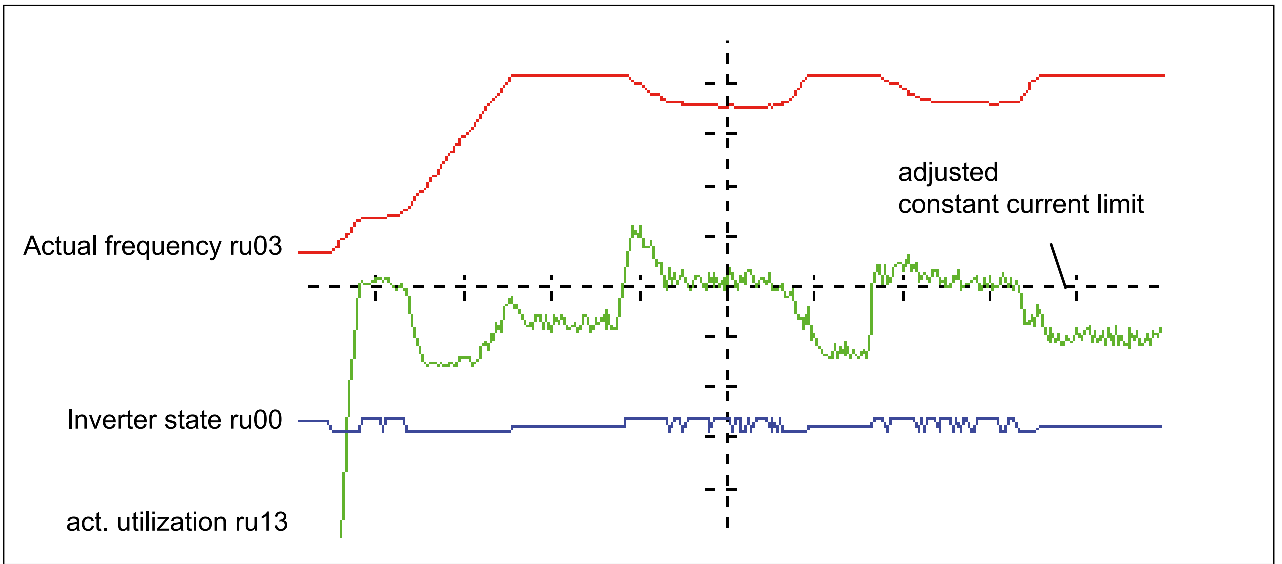


Figure 18.2 Function of the stall level at constant run (default setting)

The deceleration stop is active if a quick stop ramp time is entered in Pn60.

18.9 Electronic motor protection for G6L (asynchronous motors)

Functional description for G6L

The motor protection function protects then connected motor against thermal destruction caused by high currents. The function corresponds largely to mechanical motor protection components, additionally the influence of the motor speed on the cooling of the motor is taken into consideration. The load of the motor is calculated from the measured apparent current (ru15) and the adjusted motorprot. rated current (dr12).
The following tripping times (VDE 0660, Part 104) apply for motors with separately driven fan or at rated frequency of a self-ventilated motor:

1,2	• I_n	⇒ 2 hours
1.5	• I_n	⇒ 2 minutes
2	• I_n	⇒ 1 minute
8	• I_n	⇒ 5 seconds

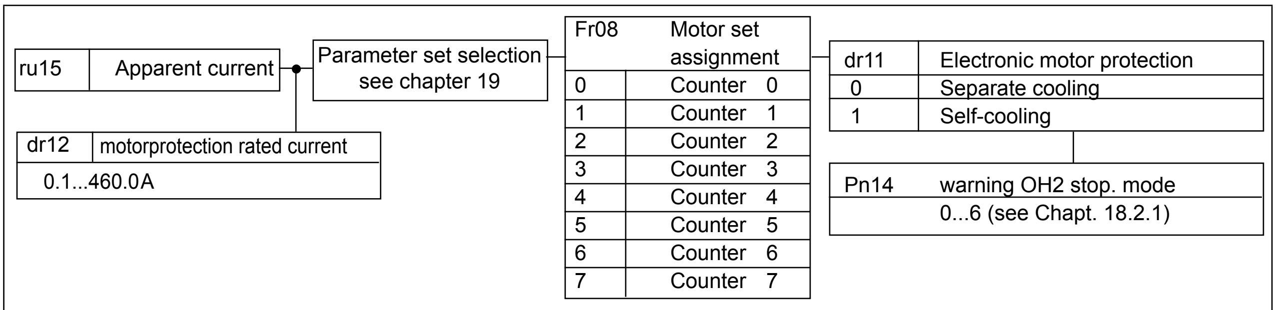


Figure 18.3 Motor protection mode

The cooling mode of the motor is set with parameter dr11.

dr11: motorprotection mode		
Bit	Value	Meaning
0	0	Separate cooling
	1	Self-cooling (default)

Parameter dr12 (motorprot. rated current) specifies the rated current for each set (= 100% utilisation) for the motor protection function. The motor protection-load is calculated as follows:

$$\text{Motor protection load} = \frac{\text{apparent current (ru15)}}{\text{motorprot. rated current (dr12)}}$$

Parameter Pn14 specifies the performance of the drive on activation of the motor protective function.

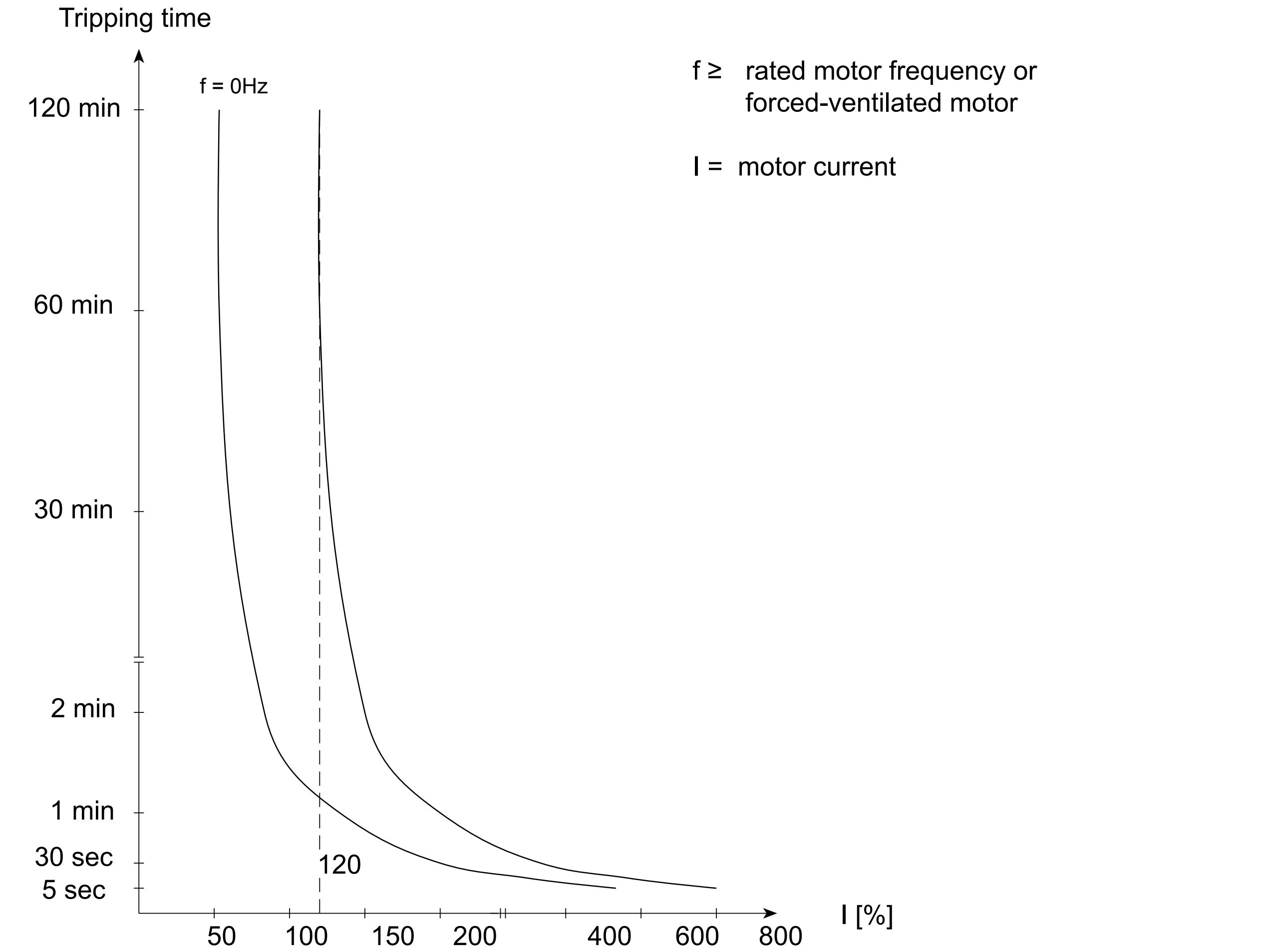


Figure 18.4 tripping times

For self-ventilated motors the tripping times decrease with the frequency of the motor (see picture). The motor protective function acts integrating, i.e. times with overload on the motor are added, times with underload are substracted. After triggering the motor protection function, the new tripping time is reduced to 1/4 of the specified value, if the motor has not been operated for an appropriate time with underload.

Motor protection function for G6L

In some applications, several motors are operated alternately at one inverter. The change-over between the motors is done synchronously with the set changeover.
Then the motor protection function must be able to distinguish which of the motors is currently being supplied.

For this there is parameter Fr08 „motor set classification“. Each motor is assigned a number from 0 to maximally 7 and this value is entered in parameter Fr08 in all sets where the respective motor is supplied.

Example:
Three motors are operated alternately on the inverter.

	assigned number	engaged if the active set (ru26) = :
Motor 1	0	0, 1, 2, 3
Motor 2	1	4, 5
Motor 3	2	6, 7

Then the following programming must be done:

Motor 1		Motor 2		Motor 3	
Set 0	Fr08 = 0	Set 4	Fr08 = 1	Set 6	Fr08 = 2
Set 1	Fr08 = 0	Set 5	Fr08 = 1	Set 7	Fr08 = 2
Set 2	Fr08 = 0				
Set 3	Fr08 = 0				

The motor protection function is calculated separately for all motors, i.e., for each individual motor, a separate overload counter is running.
If one of the counters reaches the limit of 100 %, the behaviour programmed in Pn14 "warning OH2 stop. mode" is triggered.

18.10 Motor protection function for G6P (synchronous motors)

The motor protection function is activated if the ratio of apparent current (ru15) to continuous current (Is/Id) exceeds the value of dr50 "mot.prot. min Is/Id". The release time for this point is set in dr34 „mot.prot. time min Is/Id". The release time for maximum current is set in dr35 „mot.prot. time Imax“. If a higher value is programmed in dr35 than in dr34 the time dr34 is valid in the whole range.

The maximum current is preset by dr33 „DSM max. torque“ or dr15 „max. torque FU“. The smaller of the two values determines the maximum current.

The continuous current is speed-dependent. At speed 0 it is equal to dr28 „DSM curr. f. zero speed“ and reaches at dr24 „DSM rated speed“ the value dr23 „DSM rated current“.

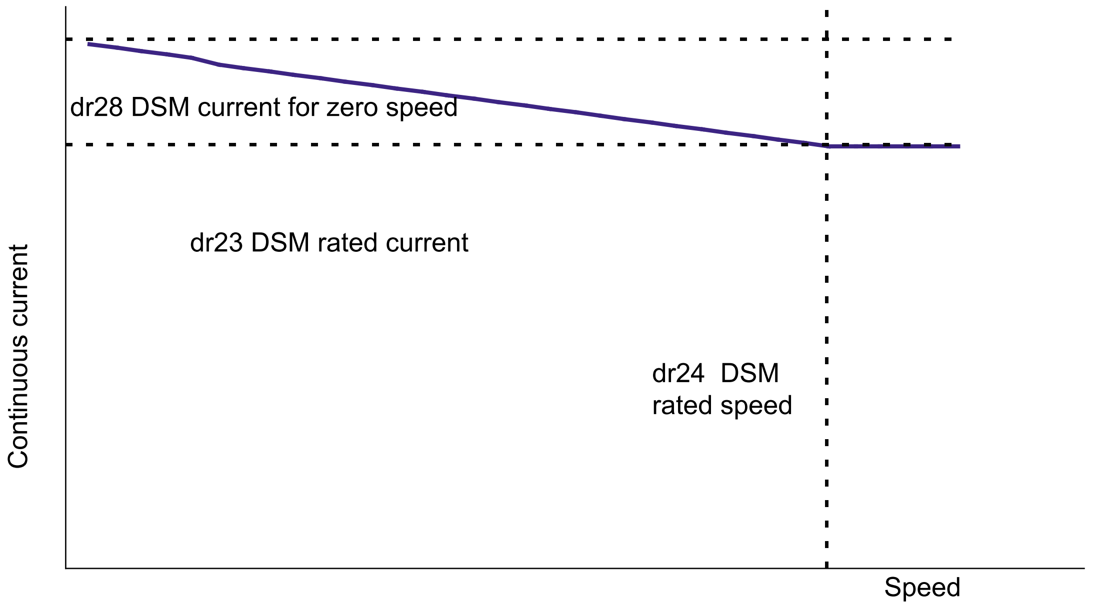


Figure 18.5 Continuous current

The tripping time is the time required by the internal counter to count from 0 to 100%. Error „motor protection" is triggered on reaching 100%.

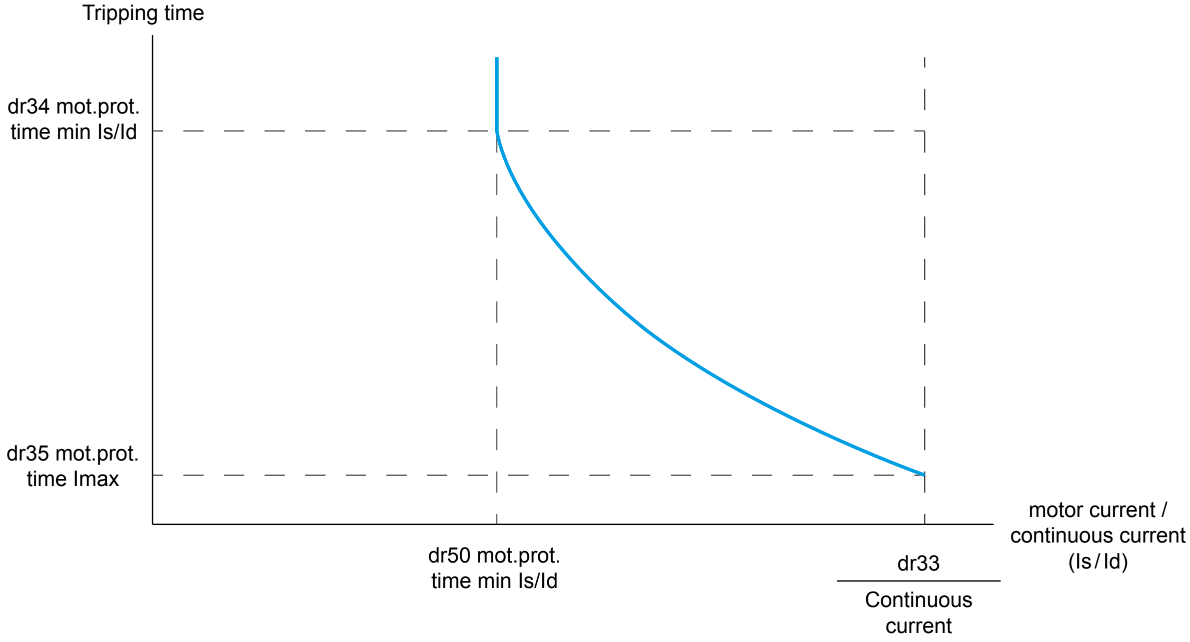


Figure 18.6 Release time motor protection function

A warning level can be adjusted in Pn15 „OH2 warning level". If the counter reaches this level, the adjusted response in Pn14 „warning OH2 stop. mode" is carried out.
The counter is reduced if the ratio apparent current to continuous current is lower than the value in dr50. The recovery time dr36 "mot.prot. recovery time" is the time which the counter requires to count from 100% to 0% (after triggering of the error, i.e., without current flow). The error triggered by the motor protection function can already be reset before the recovery time expires.

18.11 Power-off function

The power-off function has to provide a controlled deceleration of the drive until standstill in case of under-voltage (e.g. due to power failure). The kinetic energy of the rotating drive is used to support the inverter DC-link voltage. As a result the inverter remains in operation and can decelerate the drive in a controlled manner. Especially in the case of parallel running drives (e.g.textile machines) the uncontrolled running down of the motors and the consequences resulting from it (thread breakage) can be avoided.

For the various operating modes, the amount of available functions differs.
For the vector controlled modes, some parameters have no function.

Here is an overview:

Parameter	V/F-characteristic operation	vector controlled DASM	vector controlled DSM
Pn44 power off mode	yes	yes	yes
Bit 0, 1, 3, 4, 5	yes	yes	yes
Bit 2, 8	yes	no function	no function
Bit 6, 7, 9	yes	only values 0 and 192	only values 0 or 192
Pn45 power off start DC volt.	yes	yes	yes
Pn46 power off auto st. level	yes	yes	yes
Pn47 power off brake torque	yes	yes	yes
Pn48 power off restart level	yes	yes	yes
Pn49 power off start inp. sel.	yes	yes	yes
Pn50 power off ref. DC volt.	yes	no function	hidden
Pn51 power off KP DC volt.	yes	yes	yes
Pn52 power off restart delay	yes	yes	yes
Pn53 power off KP	yes	no function	hidden
Pn54 power off KI	yes	no function	hidden
Pn55 power off KD	yes	no function	hidden
Pn56 power off jump factor	yes	no function	hidden
Pn57 power off KI DC volt.	yes	yes	yes

Power off mode (Pn44)
The parameter power off mode (Pn44) activates the function and determines the basic behaviour:

Pn44: power off mode			
Bit	Meaning	Value	Explanation
0	Power off / activation	0: off	Power-off function deactivated
		1: on	Power-off function activated
1	Start voltage	0: automatically	Auto determination of the start voltage
		2: Start DC voltage (Pn45)	Setting the start voltage with Pn45
2	Initial jump (only v/f -characteristic)	0: from the slip	Determination of the initial jump from the calculated slip
		4: from the load	Determination of the initial jump from the load factor
continued on the next page			

Pn44: power off mode			
Bit	Meaning	Value	Explanation
3, 4	Behaviour on reaching standstill	0: Mod. on, no restart	Status "78: Power off function active" (POFF), modulation on, reset required
		8: Mod. on, restart	Status "78: Power off function active" (POFF), modulation on, restart on power recovery after Pn52 "power off restart delay"
		16: PLS, no restart	Status "84: no direction of rotation after power off" (PLS), modulation off, reset required
		24: reserved	reserved
5	Start mode	0: act. start voltage	Start according to the setting of bit 1
		32: dig. input of Pn49	Start via digital input
6, 7	Setpoint selection (not for vector controlled DSM)	0: actual start voltage	Bridging of mains gaps. Restart on power recovery, as long as the initial speed is not lower than Pn48 "power off restart level".
		64: DC voltage Pn50 immediately (only v/f characteristic)	Emergency stop without braking module. Restart possible only on reaching standstill.
		128: DC voltage Pn50, if f< Pn48 (only v/f characteristic)	Bridging of mains gaps. Restart on power recovery above Pn48 "power off restart level". Setpoint increase from initial voltage to voltage setpoint below Pn48.
		192: Brake torque (Pn47)	Emergency stop with braking module Restart possible only on reaching standstill.
8	Voltage stabilization at power off (only v/f-char.)	0: = uF09	Voltage stabilization during power off = uF09
		256: Voltage stabilization off	Voltage stabilization during power off deactivated
9	Error, if no restart after system recovery	0: no error, if no restart	The status changes to error as soon as the restart value (Pn48) is decreased at active power off function or the maximum time for restart (Pn96) is elapsed. This concerns Sy51 Bit 1, Sy44 Bit 1 and the switching conditions do00... do07 = 3...5. The inverter status (ru00) does not change, but the error LED flashes.
		512: Error, if no restart	

Tripping of power off
The power off function starts when the DC link voltage drops below a certain value (start voltage). The start voltage can be set automatically or manually depending on Pn44 Bit 1.

Start DC voltage (Pn45)
At manual setting the starting voltage can be preset with Pn45 in the range of 200...1200 volt. The adjusted starting voltage must be at least 50V over the UP-threshold for safe operation (UP: 200V class = 216V DC; 400V class = 240V DC; 600V class = 360V DC)

Auto start voltage (Pn46)
The auto start voltage in the range of 50...90% (Default: 80 %) of the rated DC voltage (ru68) is adjusted with Pn46.
The rated DC link voltage is measured at „power on“ and displayed in ru68.

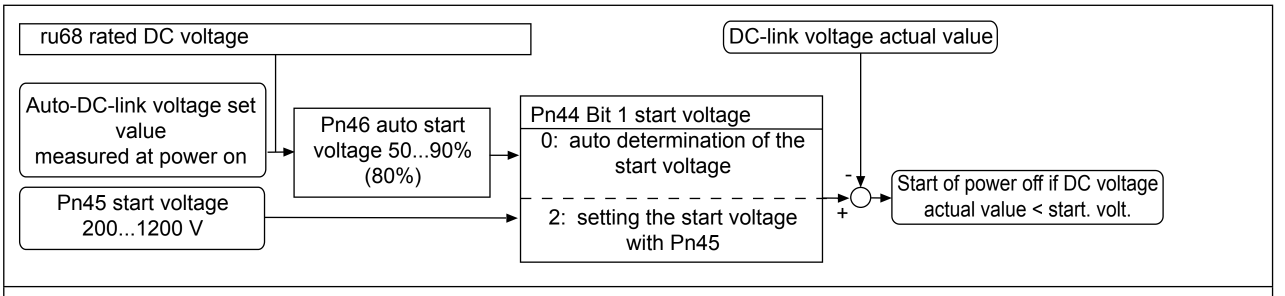


Figure 18.7 Starting the power off function

Initial jump for regenerative operation (only v/f characteristic operation)
After triggering power off first of all the drive must be brought into regenerative operation that energy can be regenerated into the DC link. This is achieved by making a frequency jump, so that the speed of the drive is larger than the output rotating field speed of the inverter.

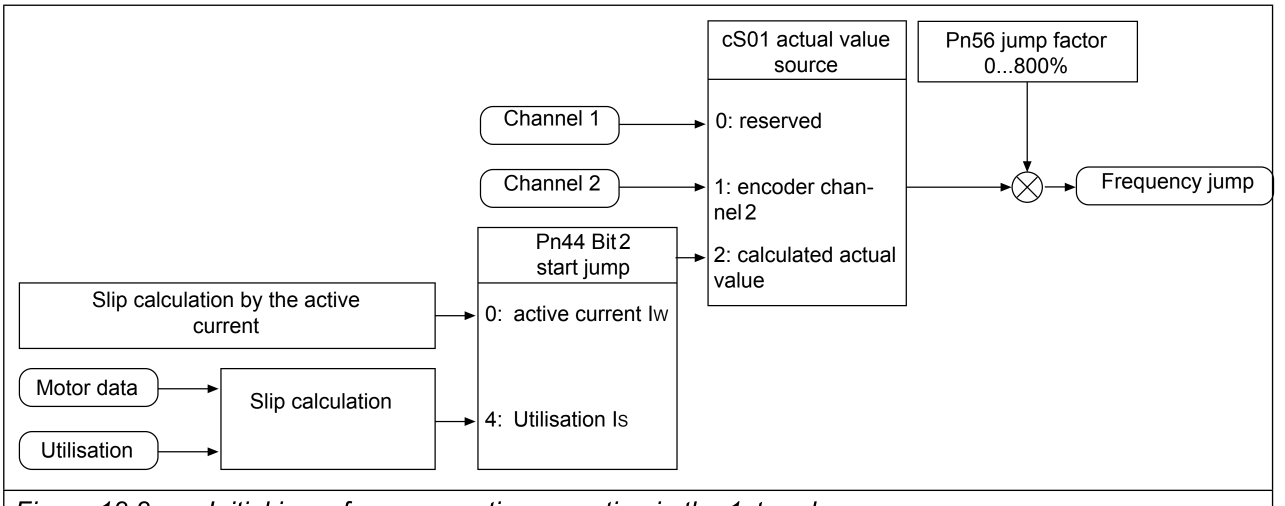


Figure 18.8 Initial jump for regenerative operation in the 1st cycle

Initial jump calculation (Pn44 Bit 2)
Parameter Pn44 Bit 2 determines, whether the starting jump is calculated from the active current or from the utilisation. This setting has no effect on slip regulation. Default value is the calculation of the active current and it may come to wrong values at high harmonic content of the output current. The initial jump must be determined from the load in this case. To get proper values enter motor data into dr-parameters first.

Power off jump factor (Pn56)
By means of the jump factor the automatically determined starting jump can be adapted to the respective application.
The inverter changes to „2 Error! undervoltage“ in case of too small jump factor!
If the jump factor is too high, the inverter runs into hardware current limitation (status "80: hardware current limit"). The control cannot work correctly, thus causing a wrong calculation of the active current!

Power off controller (not for vector controlled operation with DSM)
There are two controllers: the DC-link voltage controller and the active current controller.
The active current controller is series-connected in v/f characteristic operation to the DC link voltage controller.
The output of the DC link voltage controller is used as torque limit in vector controlled operation.
The DC link voltage controller is deactivated if the braking torque is selected as setpoint (Pn44 Bit 6, 7 = 3).

Setpoint = start voltage (Pn44 Bit 6...7 = 0)
The initial voltage value selected with Pn44 Bit 1 is the setpoint of the DC link voltage controller (see also: triggering power off).
This setting is used to bridge voltage drops. At power recovery, the drive restarts if the output speed is not yet fallen below the "power off restart level" (Pn48).

Setpoint = braking torque (Pn47; Pn44 Bit 6...7 = 3) (only v/f characteristic operation)
The braking torque can be preset within the range of 0.0...100.0 %.
The braking torque is used as setpoint source, if the drive must be stopped as fast as possible in case of power failure. The DC link voltage controller is switched off in this case. Since the DC link voltage increases very strongly in this mode, a braking module is required.
Since the hardware current limit should not be reached with active current control, the setpoint is internally limited (can lead to oscillations). In that case the setpoint can be reduced, which leads to prolongation of the delay. If the voltage stabilization is switched on (Pn44 Bit 8 = "1") and uF09 = rated voltage is adjusted, the voltage is not very high and the deceleration is more evenly.

Setpoint = DC link voltage (Pn50; Pn44 Bit 6...7 = 1 or 2) (only v/f characteristic operation)
The setpoint DC-link voltage can be preset in the range of 200...1200 V. The internal value is limited down in order to ensure safe operation. The value of the DC-link voltage in normal operation plus approx. 50V adjusts itself as minimum value. If a braking resistor is connected, the adjusted value may not lie above the threshold of the braking transistor , else the controller cannot work (threshold 200V class: 380V; 400V-class: 780V; 600V class: 1140V).

If Pn44 Bit 6...7 = 1, the voltage setpoint is used as setpoint immediately after triggering power off. A restart is only possible in this mode after reaching standstill.

In mode Pn44 Bit 6...7 = 2, initial voltage is adjusted to first after triggering. The setpoint is increased with a ramp to the voltage setpoint (Pn50) (if below the restart level (Pn48)). This ensures that the drive upon reaching the standstill in critical applications has enough energy for braking.

Power off KP DC volt. (Pn51), power off KI DC volt. (Pn57)
To be able to adapt the drive individually to the application, the proportional factor of the DC link voltage controller can be adjusted with Pn51 and the integral factor with Pn57, in the range of 0...32767. In most cases the default setting will achieve sufficient results. If, however, overshoots or fall backs of the motor occur, the values must be lowered.

Power off KP (Pn53), power off KI (Pn54), power off KD (Pn55) (only v/f characteristic operation)
Pn53, Pn54 and Pn55 are the controller parameters of the active current controller.
A D-part usually has a positive effect in the control. Pn55 should have about 10-times the value of Pn53.

Behaviour at power recovery and below the restart value (Pn48)
The following parameters effect the behaviour of the inverter if the mains voltage returns during the power off function.

Power off restart level (Pn48)
Depending on the application, it can be reasonable to execute the restart on power recovery only above a defined output value. This restart value is adjusted in Pn48.
Dependent on the setpoint value source (Pn44 Bit 6...7) the following conditions occur:

1. Control to start voltage (Pn44 Bit 6...7 = 0):
A restart is carried out on power recovery if the output value is higher than the restart value. The output value is kept constant during the restart delay (Pn52). Afterwards it is accelerated to the current setpoint value. Below the restart value it is delayed at power recovery with the quick stop function (DEC ramp). If the power does not recover, the controller parameters of the active current controller are decreased linearly with the base value in v/f characteristic operation.

2. Control to the ref. DC volt. Pn50 when base value smaller than restart value (Pn44 Bit 6...7 = 2):
As long as the base value is greater than the restart value, the inverter behaves as in item 1. Below the restart value the voltage setpoint is increased to Pn50. The controller parameters of the active current controller are decreased linearly with the output value at active current control (v/f mode). At power recovery a restart is only possible after reaching standstill.

3. Control to the ref. DC volt. Pn50 or brake control Pn47 (Pn44 Bit 6...7 = 1 or 3):
The controller parameters of the active current controller (v/f mode) are lowered below the restart value, linearly with the output value.
At power recovery a restart is only possible after reaching the standstill.

Power-off max. time for restart at power recovery (Pn96)
This parameter has principally the same function as Pn48 (power off return value).
The drive does not restart at system recovery if the time adjusted in Pn96 is up but it is decelerated with quick stop to standstill .
If both parameters are adjusted (Pn48 and Pn96) the condition that is reached earlier is valid.
Example: Pn48 = 25 Hz; Pn96 = 10 s.
a) 25 Hz fall below after 8 s - no restart after 8 s
b) 25 Hz fall below after 12 s - no restart after 10 s

Pay attention:
The maximum time contains Pn52 (restart delay).
Example: Pn52 = 1 s; Pn96 = 10 s.
a)System recovery after 8.5 s - restart after 9.5 s
b) System recovery after 9.5 s - no restart because Pn96 is exceeded.

Behaviour on reaching standstill (Pn44 Bit 3...4)
Pn44 Bit 3...4 determines how the drive behaves on reaching standstill.

Pn44 Bit 3...4 = 0:
The inverter modulates independent of a rotation setting with the adjusted boost and is in status "78: Power off function active“.
Pn44 Bit 3...4 = 1:
The inverter modulates independent of a rotation setting with the adjusted boost and is in status „Power off function active“ (POFF). After expiration of the restart delay Pn52 (if adjusted) the inverter restarts automatically when the mains voltage is returned.

Pn44 Bit 3...4 = 2:
The inverter switches off the modulation and is in status "84: no direction of rotation after power off". A reset is necessary for the restart.

Power off restart delay (Pn52)
If a restart is allowed the restart delay time is kept constant after power recovery of the output value. It is adjustable within the range of 0...100s (Default 0s). After expiration of this time it is accelerated again onto the current setpoint.

Power off start input selection (Pn49)
Only hardware inputs can be adjusted with this parameter, since these inputs are scanned in the same cycle where the power off control is active. Setting via control word or di01/di02 is not possible.

Examples of the power off operating modes
To better illustrate the context, the operating modes are explained in more detail in the following section.

Bridging of mains gaps (this function is not suitable for G6P (vector operation with SM))
Setpoint source: Start voltage (Pn44 Bit 6..7 = 0)
ref. DC voltage Pn50, if output value < Pn48 (Pn44 Bit 6...7 = 2)

In this mode the motor shall be operated almost in no-load operation and only the energy the inverter requires for operation should be regenerated. The start voltage is simultaneously the setpoint of the DC-link voltage controller. In v/f characteristic operation, the set value is the setpoint of the active current controller and in vector controlled operation, the torque limit of the speed controller.
In case of "weak" supply systems it is recommended to choose the automatic starting voltage, as in this case the starting voltage value is adapted to slow voltage fluctuations.
In the first cycle, a speed jump is issued in v/f-characteristic operation, and in vector controlled operation, the limit of the speed controller is set to the measured slip so that the drive is put in no-load operation.
To safely decelerate the drive in v/f-characteristic operation, the controller parameters of the active current controller are lowered to below of the restart value, linearly with the base value.

Restart at power recovery
Only in this mode the system recovery can be constantly detected. An immediate restart upon power recovery is possible.
The restart delay (Pn52) runs down after detecting the power recovery and the drive accelerates to the actual setpoint.

An immediate restart is not carried out below the restart value (Pn48). The drive decelerates with the quick stop function (Pn60..61) and behaves according to the adjustment in Pn44 bit 3...4 or after expiration of Pn96.

To have more energy available for braking the inertia mass on reaching standstill in v/f characteristic operation, the voltage setpoint can be increased to the ref. DC voltage (Pn50) (Pn44 Bit 6...7 = 2) (if below the restart level (Pn48)).
In this case the control remains active with the increased setpoint value. A restart is possible then only after reaching the standstill. Then the behaviour of Pn44 Bit 3...4 is defined.
The lowering of the controller parameters is also executed in this mode.

Emergency stop with braking module (this function is not suitable for G6P (vector operation with SM))
Setpoint source: braking torque (Pn44 Bit 6...7 = 3)

In this mode the drive is to be stopped as fast as possible. Since the recovered energy can be very high, a braking resistor is necessary.
The DC-link voltage controller is not active. In v/f characteristic operation, the setpoint of the active current controller is the braking torque (Pn47). In vector controlled operation, the drive decelerates with the quick stop function (Pn60, 61, 67; see chapter 18.5) and behaves according to the adjustment in Pn44 Bit 3...4.
In v/f-characteristic operation the drive at low speed supplies no energy. In this case, the control must be very soft, to prevent fall back.
It is possible to adjust the restart value (Pn48). The controller parameters of the active current controller are lowered to below this value, linearly with the base value.

Emergency stop without braking module (only v/f characteristic operation)
Setpoint source: ref. DC voltage Pn50 (Pn44 Bit 6...7 = 1)

In some cases one can do without a braking module at the emergency stop function, if the losses in the motor are very high at high DC-link voltage.
The voltage stabilization should be switched off in this case. This can be done with Pn44 Bit 8 = 1 during power off.
The DC-link voltage control is active. Deceleration is always to standstill. Then the behaviour results from the setting of Pn44 Bit 3...4.
The drive supplies no energy anymore at low speed. In this case, the control must be very soft, to prevent fall back.
It is possible to adjust the restart value (Pn48). The controller parameters of the active current controller are lowered to below this value, linearly with the base value.

Power off in vector controlled operation with SM (G6P)
Only the emergency-stop function with braking module can be activated in this operating mode. After triggering of power off, the drive decelerates with the quick stop function (Pn60, Pn61; see chapter 18.5) and behaves according to the adjustment in Pn44 Bit 3...4.

18.12 GTR7-control

The braking transistor (GTR7) serves to control a braking resistor.
In the factory setting, the GTR7 is operated dependent on the DC link voltage to discharge recovered energy. Here, the GTR7 is active only if the converter (the modulation), too, is enabled.
The switching performance of the GTR7 can be modified with parameters Pn64 „set GTR7 input selection“, Pn65 „special functions“ and Pn69 „GTR7 voltage.

18.12.1 Activation via digital input

An input for activation of the GTR7 can be defined with Pn64. Thereby, the activation of the braking transistors of all inverters in a DC interconnection of several drives can be synchronised and the occuring braking energy is distributed to all inverters.
The GTR7 controls the braking resistor, in this case, independent of the inverter state and the DC link voltage, as soon as the input is active.
Exception: On opening the control release (noP), the GTR7 is always switched off for safety reasons. I.e., as soon as a digital input is selected for activation of the braking transistor, the adjustments in Pn65 concerning the GTR7 and parameter Pn69 are without function.

18.12.2 Adjustment of the activation threshold

The DC link voltage threshold where the braking transistor becomes active can be adjusted with Pn69 „GTR7 voltage“. This value is internally limited down in the inverter: the braking transistor becomes active no earlier than "ru68 „rated DC voltage“ * 1.0625. The rated DC voltage is the measured DC link voltage at "power on".

18.12.3 Activation conditions

In the factory settings, the braking transistor is only active when the modulation is also enabled.
The reason for this is that for "standard" asynchronous motors the regeneration of energy into the inverter also ends with switching off the modulation.
When using synchronous machines in the field weakening range, or using sine filters at the inverter output, recovery may continue despite the modulation being switched off.
Then Pn65 should be changed.

Pn65: special functions		
Bit	Value	Explanation
0	1: GTR7 release at LS	GTR7 function also available in status „70: standstill (modulation off)" (LS)
3	8: GTR7 release at error	GTR7 function also available if the inverter is in error state. Exception: On opening of the hardware control release (terminal X2A.6) and for an unpowered power circuit (status:13 power unit not ready), the GTR7 is always switched off.
5	32: GTR7 rel.at software NOP	Terminal ST causes an immediate hardware deactivation of the braking transistor. The software control release must be used if the braking transistor function shall be available in status „0: no control release“ (can be activated via di36). Then the braking transistor can be activated with bit 5 for status "0: no operation". Exception: On opening the hardware control release (terminal X2A.6), the braking transistor is always switched off.

In which cases the braking transistor remains active even if modulation is switched off depends of the specific application.

18.12.4 Electrical work via braking transistor

The energy which is converted over braking transistor is displayed in parameter ru91. The correct input of the braking resistor in parameter Pn82 is required therefore. On reaching the maximum value of 99999 kWh the counter is limited to this value.

Parameter ru91 is writeable. It is set to its default value by new-initialization and writing on power on counter (ru40).

Pn82: GTR7 resistance		
Bit	Value	Explanation
0	0.000...5000.000 Ohm	The resistance value of the connected braking resistor

ru91: energy over gtr7		
Bit	Value	Explanation
0	0...99999 kWh	The energy which is converted over the braking resistor is displayed in parameter ru91.

18.13 Motor stall detection

The motor stall detection is used to protect parts of the entire drive. The motor stall detection compares the ramp output value (ru02) with the actual value (ru07). The set value and the ramp output value must be above the adjusted value in Pn86 in order that the motor blockage detection works If the actual value (ru07) is below the adjusted value in Pn86 , a counter counts up until the adjusted time in Pn87 is reached. If this time is reached, the modulation is switched off and error „29: ERROR blockade“ is triggered.
The motor blockage detection should be parameterized by way that the detection triggers before the motor model becomes unstable at operation with ASCL/SCL.

Pn85: blockade mode		
Bit	Value	Explanation
0...2	0: off	The motor blockage detection is switched off
	1: stop model	The actual state is kept when a blockade is triggered. This state is kept depending on the adjustment in bit 4. Thus, the applied torque is maintained until the set value is 0.
	2: Ramps with slip	The actual active current, magnetizing current and actual speed turns to zero, respectively the magnetizing current turns to zero or to its rated value depending on the setting in Bit 3 and on the adjusted ramp time (Pn88). After expiration of the ramp time it is proceed depending on the adjusted value in bit 4
	3: Ramps in DC mode	The output frequency is immediately set to zero. The active current and the magnetizing current turns to zero, respectively the magnetizing current turns to zero or to its rated value depending on the setting in Bit 3 and on the adjusted ramp time (Pn88). After expiration of the ramp time it is proceed depending on the adjusted value in bit 4
	4...7: reserved	reserved
3	0: to zero	The magnetizing current is controlled to value zero.
	8: to rated magnetizing current	The magnetizing current is controlled to the rated magnetizing current.
continued on the next page		

Pn85: blockade mode		
Bit	Value	Explanation
4	0: Warning by digital output	A warning is issued via a digital output. The warning is reset if the set value is set to 0 or the sign is changed.
	16: ERROR, no auto reset	The frequency inverter changes into status „29: ERROR! blockade“. Auto reset is not possible.

Pn86: blockade level	
Value	Explanation
0.000...4000.000 rpm	Adjustable limit when the blockade waiting time expires. If the adjusted limit is below the actual value, the adjusted time in Pn87 expires.

Pn87: blockade waiting time	
Value	Explanation
0.00...100.00s	If the adjusted blockage waiting time has elapsed, error "ERROR blockade" is triggered.

Pn88: blockade ramp time	
Value	Explanation
0.00...100.00s	During this time, the current is lowered to 0.

18.14 Testing the safety function STO

Before releasing the modulation, the control board checks the switching off of the IGBTs in the power unit with the on-off-on test.
In order for the test to be carried out, 24V must be applied to both STO inputs and a direction of rotation must be specified.

18.14.1 On-off-on test with simultaneous rotation setting

If both STO inputs are supplied with 24V and a rotation direction is specified within 50ms, the on-off-on test is carried out. Bit "RUN" is set in Sy51 after successful completion of the on-off-on test.

18.14.2 On-off-on test with delayed rotation setting

If the direction of rotation is delayed, a new test cycle will start after approx. 100ms.
If a direction of rotation is specified shortly before the end of a test cycle, it cannot be guaranteed that the test has been carried out successfully. As a result, the STO inputs are deactivated for 8ms (ru00 displays noP during this time). This process cannot be deactivated.

18.15 special functions

In these parameters, many different functions for adapting the inverter behaviour to special applications are pooled.

Pn65: special functions		
Bit	Value	Explanation
0	1: GTR7 release at LS	Braking transistor function also available in status „0: no control release " (LS). *[1]
1	2: Pn04 = E.UP	With the selected input in Pn04 „ext. fault input select" „2: ERROR underpotential" is triggered (not „31: ERROR external fault"). This can achieve that, for coupled drives, all inverters simultaneously go to undervoltage as soon as there is a voltage dip on one of the inverters, and all inverters also execute an automatic restart simultaneously when the mains voltage returns to the valid range on all inverters. The undervoltage error from the DC link voltage measurement remains active.
2	4: PU not ready = no error	The state „13: power unit not ready", which the inverter enters for an unpowered power circuit, is not treated as an error. That means, the switching conditions 4..6 are not met and the bit 1 in status word "Error" is not set.
3	8: GTR7 release at error	Braking transistor function also available if the inverter is in an error state. Exception: On opening of the hardware control release (terminal X2A.6) and for an unpowered power circuit (status „13: power circuit not ready") the braking transistor is always switched off. *[1]
4	16: OL2 temperature-dep.	On activation of this bit, the current limit for the overload protection in the lower speed range (OL2 function) is dependent on the heat sink temperature
5	32: GTR7 rel.at software NOP	The terminal ST causes an immediate hardware switch-off of the braking transistor. If the braking transistor function shall be available in status „0: no control release" (nop), the software control release must be used (can be activated via di36). Then the braking transistor can be activated with bit 5 for status "no control release". Exception: When the hardware control release (terminal X2A.6) is opened, the braking transistor is always switched off. *[1]
6	64: derating limit with OL2	The current limit for the overload protection in the lower speed range is reduced for switching frequencies above the rated switching frequency. On activation of this bit, the inverter reduces the switching frequency to the rated switching frequency to prevent the error "19: overload 2".
7	128: E.UP no error at NOP and LS	The state „2: ERROR! undervoltage" is not treated as an error if the rotation setting or the control release is missing. That means, the switching conditions 4...6 are not met and bit 1 "Error" is not set in status word.
8	256: no display BBL	The state „76: Base Block active/ motor de-excitation" is not displayed anymore. Advantage: the cause of the deactivation of the modulation (e.g. error) is immediately visible in ru00 and can be evaluated by an external control. Disadvantage: An error reset is only possible after expiration of the base-block time, it is not apparent without display when a reset can be executed.
9	512: reserved	reserved
10	1024: A.XX = ERROR	If this bit is active, the ERROR bit in status word Sy51 and the switching condition that responds to an error are set in case of a malfunction (status warning / XX).
11	2048: no dig. ST = no E.Bus	The two watchdog (watchdog internal bus and watchdog time) are deactivated by the programmed input in di39 „disable dig. ST inp. sel." *[2].
12	4096: ERROR Reset at 0	A malfunction or error reset is only permitted if the amount of the actual value (ru07) is lower than the operating hysteresis (LE16). This applies also to the automatic restart.
		continued on the next page

Pn65: special functions		
Bit	Value	Explanation
13	8192: chk.act = ref at mod. off	The comparison ru07 „actual value display“ = ru01 „set value display“ (for status word and condition „constant run“) is continuously carried out, even if the modulation is switched off and during status „74: speed search“. This affects the status word, the timer start and reset conditions and the switching condition 20 (do00 ... do07).
14	16384: reserved	reserved

*1 to bit 0, 3, 5: With the braking transistor, a braking resistor can be connected to the DC link that absorbs regenerated energy when the motor is working as a generator.
By default, the braking transistor is off when the modulation is switched off.
For some applications (e.g., synchronous motor operated in the field weakening range) it is sensible to remain the braking transistor active when the modulation is switched off, so that the braking resistor can be added when the DC link voltage exceeds the value of Pn69 "GTR7 voltage".
The braking transistor function is available for the respective inverter state by setting these bits.

*2 to bit 11: If a drive is controlled via a bus system and the control release is also switched via the control word, the two watchdogs (watchdog internal bus and watchdog time) should be activated so that the drive is stopped on failure of the bus system. However, the drive can then not be repositioned by hand anymore, since – as long as the bus is down - the malfunction- or error message of the watchdog remains in force.
An input can already be selected with parameter di39 „disable dig. ST inp. sel.“ which can deactivate the digital setting of the control release (i.e., setting via di - parameter or control word). Only terminal ST (X2A.6) is effective and the control of the control release can be done again only via the digital input.
If this bit is set, the two watchdogs are also deactivated with the selected input (in di39). If a response with automatic restart is now selected for the watchdog error, the malfunction automatically resets and the drive can be used in manual operation.

18.15.1 Flow control

The flow control with valve control and flow monitor is adjusted with this function.

<table>
<tr><th colspan="4">Pn91: flow control mode</th></tr>
<tr><th>Bit</th><th>Value</th><th>Meaning</th><th>Explanation</th></tr>
<tr><td rowspan="2">0</td><td>0: off</td><td rowspan="2">flow control mode</td><td rowspan="4">Flow control mode off/on</td></tr>
<tr><td>1: on</td></tr>
<tr><td rowspan="2">1</td><td>0: Drive active = run</td><td rowspan="2">Mode drive active</td></tr>
<tr><td>2: Drive active = ready + ST</td></tr>
<tr><td colspan="4">If the function is activated, the mode for status „drive active“ can be selected. If the function is not active (Pn91 Bit 0 = 0) no error and warning is triggered.</td></tr>
<tr><td colspan="4">There are two adjustments for the status „drive active“:</td></tr>
<tr><td colspan="2">Drive active = run</td><td colspan="2">The drive is active if the modulation is released.</td></tr>
<tr><td colspan="2" rowspan="4">Drive active = ready + ST</td><td colspan="2">The drive is active if all following conditions are met:</td></tr>
<tr><td colspan="2">- the power unit is supplied</td></tr>
<tr><td colspan="2">- there is no malfunction</td></tr>
<tr><td colspan="2">- the control release is active</td></tr>
</table>

Pn92: valve crtl. output select		
Bit	Value	Explanation
0	1: O1	Transistor output
1	2: O2	Transistor output
2	4: R1	Relay output
3	8: R2	Relay output
4	16: OA	Internal output
5	32: OB	Internal output
6	64: OC	Internal output
7	128: OD	Internal output

<table>
<tr><th colspan="4">Pn93: flow switch input select</th></tr>
<tr><th>Bit</th><th>Decimal value</th><th>Input</th><th>Terminal</th></tr>
<tr><td rowspan="2">0</td><td>0</td><td>no input</td><td></td></tr>
<tr><td>1 (default)</td><td>ST (prog. input „control release/reset“)</td><td>X2A.6</td></tr>
<tr><td>1</td><td>2</td><td>RST (prog. input „reset“)</td><td>X2A.5</td></tr>
<tr><td>2</td><td>4</td><td>F (prog. input „forward“)</td><td>X2A.8</td></tr>
<tr><td>3</td><td>8</td><td>R (prog. input „reverse“)</td><td>X2A.7</td></tr>
<tr><td>4</td><td>16</td><td>I1 (prog. input 1)</td><td>X2A.10</td></tr>
<tr><td>5</td><td>32</td><td>I2 (prog. input 2)</td><td>X2A.9</td></tr>
<tr><td>6</td><td>64</td><td>I3 (prog. input 3)</td><td>X2A.12</td></tr>
<tr><td>7</td><td>128</td><td>I4 (prog. input 4)</td><td>X2A.11</td></tr>
<tr><td>8</td><td>256</td><td>IA (internal input A)</td><td>no</td></tr>
<tr><td>9</td><td>512</td><td>IB (internal input B)</td><td>no</td></tr>
<tr><td>10</td><td>1024</td><td>IC (internal input C)</td><td>no</td></tr>
<tr><td>11</td><td>2048</td><td>ID (internal input D)</td><td>no</td></tr>
</table>

Pn94: flow ctrl. warning delay		
Bit	Value	Explanation
0	0.00...60.00	The reaction time of 0...60.00 s of valve / flow monitor is adjusted here. The default value for Pn94 is: 0 (off).

Pn95: flow ctrl. min. temp.
Value range
0…90°C

Defines the temperature limit in the range of 0...90°C, condensation risk. All parameters are not set-programmable.

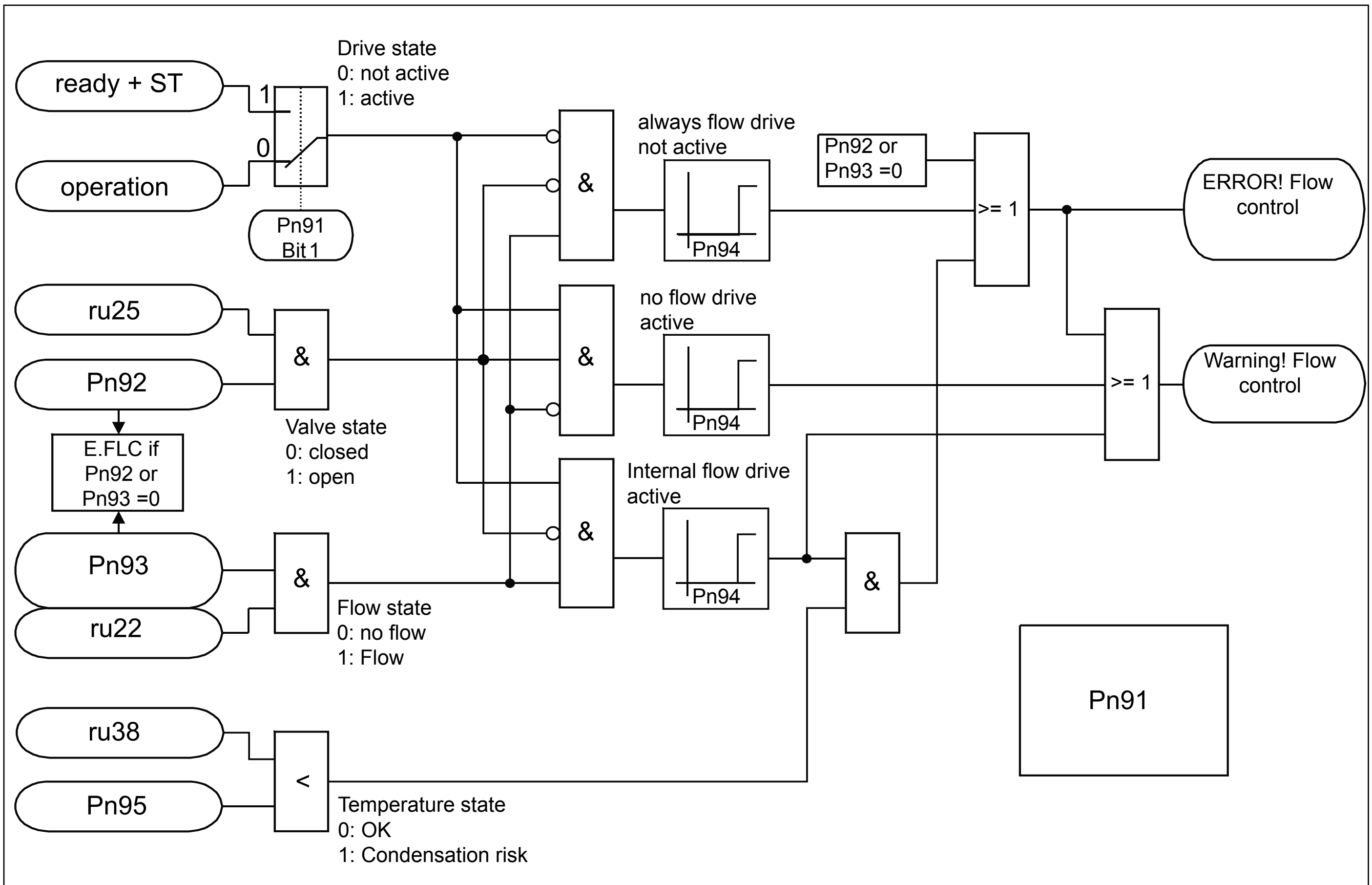


Figure 18.9 Flow control

18.15.2 Fan control

The heat sink fan, internal fan and the fan function test, which is performed at the start can be adjusted with parameter Pn97. A value for the heat sink fan can be selected with the bits 0... 2. A value for the fan function test can be selected with bits 3...4. The value for the internal fan can be selected with bits 5...6.
The adjustable value is a combination of run mode and fan function test. Using the example of the default value it should be made clear how the value to be set is made up. The default value of parameter Pn97 is 20. This value is made up as follows => value 4 + value 16. Test at power on and automatic control during operation.

Pn97: fan control power unit			
Bit	Meaning	Value	Explanation
0...2	Run mode heat sink fan	0: switched off	Setting of the heat sink fan during inverter operation.
		1: reserved	
		2: switched on	
		3: reserved	
		4: auto. control	
		5: off / overtemperature protection	
		6: reserved	
		7: reserved	
3...4	Fan function test	0: off	Setting of the heat sink fan during start-up. Checking the fan function.
		8: reserved	
		16: switched on	
5...6	Internal fan	0: Automatic fan control	Setting of the internal fan at inverter operation. (unit-dependent)
		32: switched off	
		64: switched on	
		96: off / overtemperature protection	

19. Parameter Sets

The KEB COMBIVERT contains 8 parameter sets (0...7), i.e. all set-programmable parameters are available 8 times in the inverter and independent of each other they can be assigned with different values. Since many parameters have equal values in the parameter sets, it would be relatively complex to change every parameter in each set individually. This section describes how one copies complete parameter sets, locks them, selects them and reinitializes the inverter.

19.1 Parameterisation with COMBIVIS 6 by sub indices (according DS301)

The set-programmable parameters can be responded in COMBIVIS 6 by subindex addressing.

Instructions for subindex addressing

- Numbering of the sub-indices from 1...8 (not 0...7)

Example:	Set 0	=	Subindex 1
	Set 1	=	Subindex 2
	...		
	Set 7	=	Subindex 8

- Only direct sub indexing possible
- No indirect addressing via set pointer possible
- No access to "active set" possible

19.2 Not set-programmable parameters

Certain parameters are not set-programmable, since its value must be equal in all sets (e.g. bus address or baud rate). In the inverter these parameters have no parameter set number in the parameter identification. These parameters have no "+" in the unit editor in COMBIVIS 6. Since "+" is not available, no subgroup can be opened. All not set-programmable parameters are displayed in subindex 0.

!	The same value is valid for all non-programmable parameters independent of the selected parameter set!

19.3 Security parameters

The security parameters contain the Baud rate, inverter address, hours/meter, control type, serial-/customer number, trimming values and error diagnosis. These parameters are not overwritten when copying parameter sets or loading default values.

The following parameters are not overwritten when copying parameter sets:

Sy02, Sy03, Sy06, Sy11

ru40, ru41

Ud01, Ud02, Ud06

Fr01

In10...In16, In24...In30

19.4 System parameters

The system parameters contain the motor and encoder data:

dr-Parameter
Pn61 (at G6L-M, G6P-S) / Pn67 (at G6L-M)
cS00...cS22 (at G6L-G cS00/ cS01/ cS03/ cS04/ cS06/ cS09)
dS00...dS01/ dS13 (not at G6L-G)
Ec14/ Ec15/ Ec64 (at G6P-S Ec40)
Fr10

19.5 Indirect and direct set-addressing

At indirect set-addressing the parameter values are displayed and edited based on the set pointer (Fr09). The direct set-addressing enables the display or writing of a parameter value independent of the set indicator directly into one or several parameter sets.

19.6 Pointer parameter

After power-on reset all pointer parameters hold value 0. Excludes the set pointer Fr09 and the CP parameter selection Ud15.

19.7 Copying of parameter sets / load factory setting (Fr01, Fr09)

Two parameters are responsible at indirect set-addressing to copy parameter sets. Fr09 defines the target set. Fr01 defines the source parameter set and starts the copy process. The source set (Fr01) is copied in the selected parameter sets at direct set-programming.
The following copying actions can be practised:

Target set Fr09	Source set Fr01	Action
0...7	0...7	All programmable parameters of the source set are copied into the target set.
0	-1: KEBdef/cust. par/sel.sets	Default values are copied into all parameters of set 0 (with exception of system and security parameters).
1...7	-1: KEBdef/cust. par/sel.sets	Default values are copied into all programmable parameters of the target set (with the exception of system and security parameters).
All	-2: KEBdef/cust. par/all sets	Default values are copied into all parameters of all sets (with the exception of system and security parameters).
0	-3: KEBdef/ cust+sys/sel. sets	Default values are copied into all parameters of set 0 (with the exception of security parameters).
1...7	-3: KEBdef/ cust+sys/sel. sets	Default values are copied into all programmable parameters of the target set (with the exception of security parameters).
All	-4: KEBdef/ cust+sys/all sets	Default values are copied into all parameters of all sets (with the exception of security parameters).

All definitions defined by the user are reset by loading the factory setting! This can comprise the terminal assignment, set changeover or operating states. Before loading the default set it is to be ensured that no unintended operating states occur.

19.8 Parameter set selection

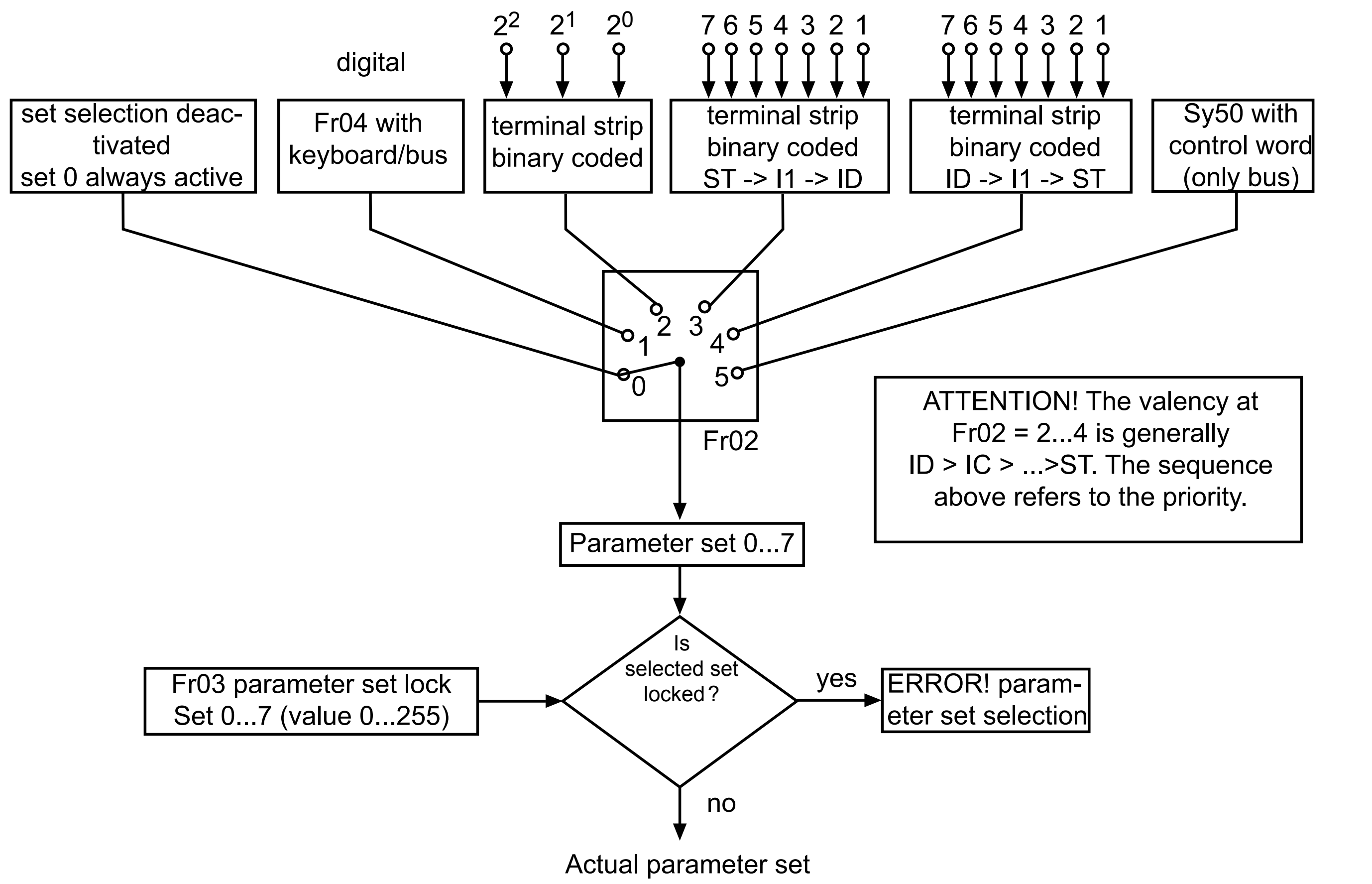


Figure 19.1 Principle of the parameter set selection

Fr02 Parameter set source
As shown in Fig. 19.1, it is defined with Fr02 whether the parameter set selection is enabled or disabled via keyboard/bus (Fr04), terminal block or via control word (Sy50).

Fr02: parameter set source	
Value	Function
0	Set selection deactivated; set 0 always active
1	Set selection via keyboard/bus with Fr04
2	Set selection binary-coded via terminal strip
3	Set selection input-coded via terminal strip priority: ST>RST>R>F>I1>I2>I3>I4>IA>IB>IC>ID
4	Set selection input-coded via terminal strip priority: ID>IC>IB>IA>I4>I3>I2>I1>R>F>RST>ST
5	Set selection via control word Sy50

Fr04 Parameter set setting
The setting for the parameter set can be selected with parameter Fr04. The desired parameter set (0...7) is preadjusted directly as value and activated with "Enter".

Fr02: Parameter set setting	
Value range	Description
0...7	Selection of the parameter set

Fr07 Parameter set input selection
The setting via terminal strip can be made binary-coded or input-coded. The inputs are defined with parameter Fr07. With binary-coded set selection maximally 3 inputs should be programmed for set selection to avoid set selection errors.

Fr02: paraset input sel.			
Bit	Value	Description	Terminal
0	1 [1)]	ST (prog. input „control release/reset“)	X2A.6
1	2	RST (prog. input „reset“)	X2A.5
2	4	F (prog. input „forward“)	X2A.8
3	8	R (prog. input „reverse“)	X2A.7
4	16	I1 (prog. input 1)	X2A.10
5	32	I2 (prog. input 2)	X2A.9
6	64	I3 (prog. input 3)	X2A.12
7	128	I4 (prog. input 4)	X2A.11
8	256	IA (internal input A)	no
9	512	IB (internal input B)	no
10	1024	IC (internal input C)	no
11	2048	ID (internal input D)	no

[1)] The input ST is occupied by hardware with the function „control release“. Further functions can be adjusted only „additionally“.

19.8.1 Input-coded set selection

With input-coded set selection

- maximally 7 of the internal or external inputs may be programmed to set selection (0...7 sets) to avoid set selection errors.
- the lowest of the selected inputs has priority at Fr02 = „3“
  (ST>RST>R>F>I1>I2>I3>I4>IA>IB>IC>ID)
- the lowest of the selected inputs has priority at Fr02 = „4“
  (ID>IC>IB>IA>I4>I3>I2>I1>R>F>RST>ST)

Example:
With input-coded set selection (Fr02 = 3) I1, I2 and F are defined for set selection. In this case F = set 1; I1 2 = and I2 3 = would be acticated as the valence is (I2>I1>F). If I1 and I2 are triggered simultaneously the inverter switches into set2, since the priority is F>I1>I2 at Fr02=3.

Example 1: Set 0...7 shall be selected with 3 inputs (F, I1 and I4)

1.) Set parameter Fr07 to value „148“
2.) Set Fr02 to value „2“ (set selection binary-coded via terminal)

I4	I1	F	Input
2^2	2^1	2^0	Set
0	0	0	0
0	0	1	1
0	2	0	2
0	2	1	3
4	0	0	4
4	0	1	5
4	2	0	6
4	2	1	7

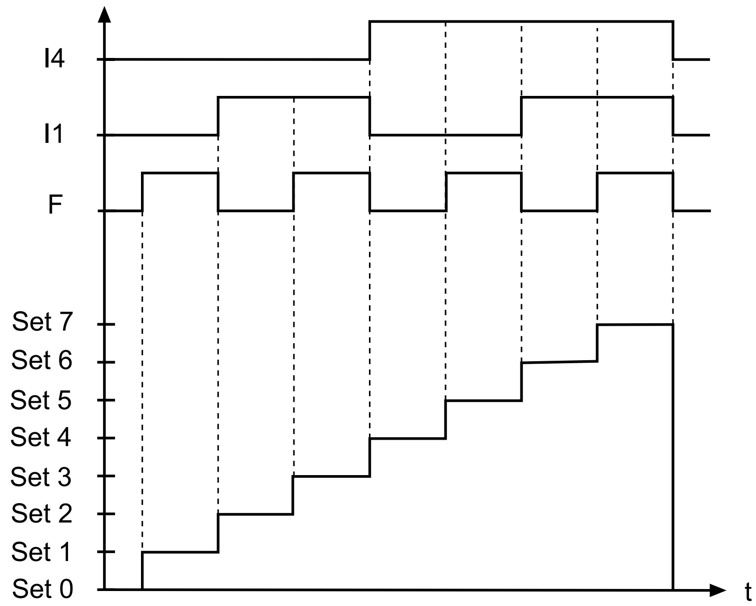


Figure 19.2 Example 1: Input-coded set selection

Example 2: With 5 inputs (I1, I2, I4, IB and ID) set 0...5 shall be selected

1.) Set parameter Fr07 to value „2736“
2.) Set Fr02 to value „3“ (set selection input-coded via terminal)

ID	IB	I4	I2	I1	Set	Set
				Fr02 =	3	4
0	0	0	0	0	0	0
0	0	0	0	1	1	1
0	0	0	2	0	2	2
0	0	3	0	0	3	3
0	4	0	0	0	4	4
5	0	0	0	0	5	5
5	0	3	0	0	3	5
5	0	3	0	1	1	5

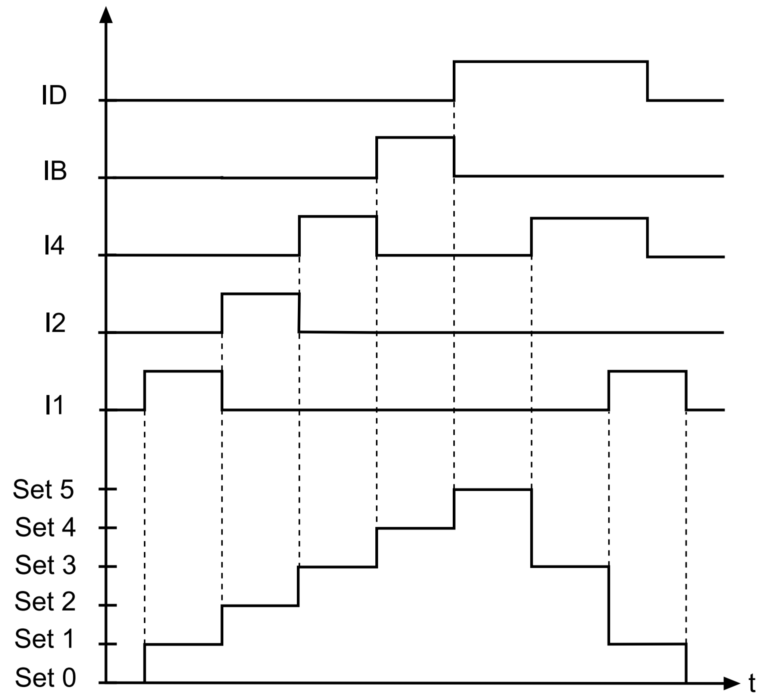


Figure 19.3 Example 2: Input-coded set selection

Reset set input selection (Fr11)
Parameter Fr11 defines an input for switching into parameter set 0, independent of the actual parameter set. This function is only active at Fr02 = 2...4.

- the inverter remains in set 0 at static input assignment, as long as the input is set.
- set 0 is activated with the first edge at edge-triggered inputs. the parameter set which is activated by the other inputs is selected again with the second edge.

19.8.2 Binary-coded set selection

With binary-coded set selection:

- maximally three of the internal or external inputs may be programmed to set selection (2^3=8 sets) to avoid set selection errors.
- the valence of the inputs programmed for set selection rises (ID>IC>IB>IA>I4>I3>I2>I1>R>F>RST>ST)

19.8.3 Set change mode modulation on (Fr12)

Parameter Fr12 adjusts the behaviour at set change. A motor set change without parameter set change is only possible when the modulation is deactivated.
The lock of the set change causes with activated modulation that a programmed set change triggers the error 'set selection error'. The set change is carried out when the modulation is deactivated.

Fr12: Set change mode		
Bit	Value	Description
0: Deactivate parameter set change	0	released
	1	locked
1: Deactivate motor set change	0	released
	2	locked

19.9 Locking of parameter sets

Fr03 Parameter set lock
Parameter sets, that shall/may not be selected can be locked with Fr03. If one of the locked sets is selected, the adjusted response in Pn18 is executed (default: error/ no AutoRestart).

Example:
Sets 2 and 5 should be blocked. As seen in the table of Fr03, value 4 and value 32 must be entered. The outcome of this is a total value of 36, which must be entered.

Fr02: Parameter set source	
Value	Locked set
1	0
2	1
4	2
8	3
16	4
32	5
64	6
128	7

19.10 Set activation / deactivation delay (Fr05, Fr06)

These parameters adjust the time,

- which delays the activation of a new set (Fr05)
- which delays the deactivation of the old set (Fr06)

The OFF time of the old set and ON time of the new set are added at set changeover.

Example

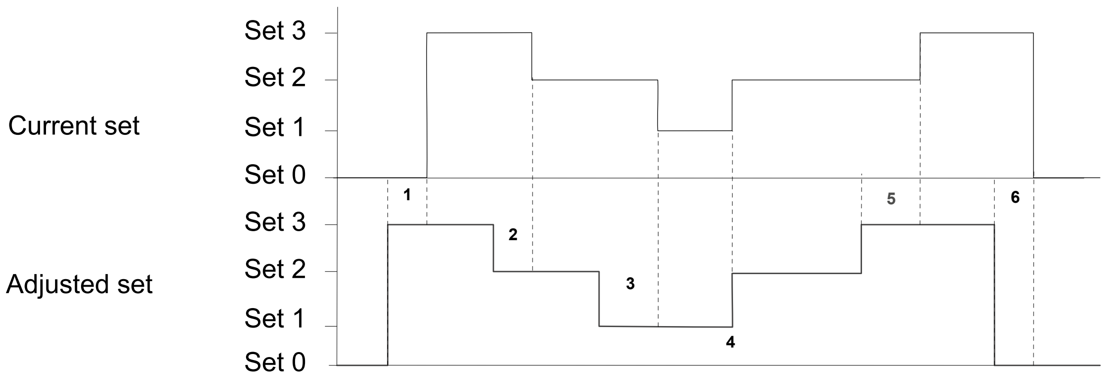


Figure 19.4 On and off delay

	on	off
Set	Fr05	Fr06
0	0s	0s
1	2s	0s
2	0s	1 s
3	2s	2s

1:	ON delay for set 3 of 2s
2:	OFF delay for set 3 of 2s
3:	OFF delay for set 2 of 1s and
	ON delay for set 1 of 2 s
4:	immediate changeover as no delay is adjusted
5:	OFF delay for set 2 of 1s and
	ON delay for set 3 of 2s
6:	OFF delay for set 3 of 2s

20. Special Functions

The following section should facilitate the adjustment and programming of special functions.

20.1 DC braking

The DC braking is available:

- in software type G6L-G, for v/f characteristic - control of asynchronous motors (cS00 / control mode < 4)
- in software type G6L-M (for ASCL) in speed-controlled operation of asynchronous motors without encoder feedback (cS01/ actual value source = „2: calculated actual value“)

During the DC braking the motor is not decelerated over the ramp. The braking is done with a DC voltage and a DC current, respectively, that is applied to the motor winding.
The modulation is switched off by activation of the DC braking and the base-block time must be awaited until the DC voltage is switched to the motor (base-block time, duration dependent on the power circuit).
Whereby the DC braking is triggered can be adjusted with Pn28. Depending on the adjusted mode the speed / frequency which triggers the DC braking can be preset with Pn32. Pn30 „DC braking time“ determines the braking time (time when DC voltage is applied to the motor). Pn29 is bit-coded and defines the inputs which trigger DC braking.

Pn28: **DC braking mode**			
Bit	Meaning	Value	Explanation
0...3	DC braking mode	0: no DC braking	DC braking is never triggered
		1: LS + actual value = 0	DC braking, if the setpoint reaches 0 rpm after the ramp generator (ru02 „display ramp output") and the rotation setting is missing. The braking time is determined by Pn30 (independent of the actual speed). If the rotation setting is applied again, the DC braking is aborted.
		2: no rotation	DC braking after deactivation of the rotation setting. The braking time is dependent on Pn30 and the actual frequency. [1,2] The DC braking does not stop when the direction of rotation is connected again.
		3: rotation change	DC braking as soon as the rotation setting changes (different rotation or no setting). The braking time is dependent on Pn30 and actual frequency (ru03)[1,2]. At restarting of the rotation setting the DC braking is not interrupted.
		4: LS + actual value <Pn32	DC braking if the actual frequency ru03 [2], falls below the Pn32 „DC braking start level“ and the rotation setting is missing. The braking time is depending on Pn30 and Pn32 [3]. on The DC braking does not stop when the direction of rotation is connected again.
		5: DEC +actual value < Pn32	DC braking if the actual frequency ru03 [2], falls below the Pn32 „DC braking start level“ and the rotation setting is missing. The braking time is depending on Pn30 and Pn32 [3]. on The DC braking does not stop when the direction of rotation is connected again.
		6: ref. value < Pn32	The set value before the ramp generator (ru.01 "set value display) is smaller than Pn32 „DC braking start level". The braking time is dependent on Pn30 and the actual frequency (ru03). [1,2]. To leave the status „77: no rotation setting after DC braking“, ru01 must be higher than Pn32 + LE16 „freq/speed hysteresis“. An increase of the setpoint does not abort the DC braking.
		7: input active, time dep.	DC braking as soon as an input programmed to DC braking (Pn29) is active. The braking time is dependent on Pn30 and then actual frequency (ru03)1, 2.Restart only after the input is deactivated.
		8: input active	DC braking as long as an input programmed to DC braking is active.
		9: start of modulation	DC braking after modulation release (direction of rotation + control release) for the time Pn30.
		10: conditions	DC braking according to the conditions programmed in bit 4..8. The braking time is equal to Pn30 „DC braking time"
4		16: DCB after NOP	DC braking after status „0: no control release" [4]
5		32: DCB at power on	DC braking after power-on-reset (power on) [4]
6		64: DCB at Reset	DC braking after reset
7		128: DCB at Auto-Retry	DC braking after automatic restart [4]
8		256: DCB after LS	DC braking after status „70: standstill“ [4]

[1] The braking time is dependent on the actual frequency (ru03), not from the actual speed (ru07). The reference value for the calculation of the braking time, however, is a speed (dependent on ud02 "control type", for "4: G6L/ 4000rpm“ is the reference value 1000 rpm). To calculate the braking time the actual frequency (ru03) must be converted to speed according to the following formula:

$$\frac{\text{ru03} * 60}{\text{pole-pair number of the motor}}$$

[2] actual braking time = Pn30 * ru03 * 60 / pole-pair number of the motor / reference value (the reference value is dependent on ud02 "control type". The ref. value in 4000 rpm mode is 1000 rpm and 2000 rpm in 8000 rpm mode etc.)

[3] actual braking time = Pn30 * Pn32 / ref. value (the reference value is dependent on ud02 "control type". The reverence value in 4000 rpm mode is 1000 rpm and 2000 rpm in 8000 rpm mode etc.)

[4] These adjustments are only effective if value "10: conditions" is selected in Bit 0...3 "DC braking mode". DC braking has priority if the same condition is also adjusted for speed search.

20.1.1 DC braking in v/f mode

In v/f-characteristic control, a DC voltage is applied to the motor. The max. braking voltage is set with Pn31 „DC braking max voltage“.
The current is limited only by the inverter. If the inverter is oversized compared to the motor, the maximum braking voltage (Pn31) must be decreased to avoid overheating of the motor.
The max. braking voltage can lead to overcurrent errors at high power. Pn31 must also be decreased in this case.

20.1.2 DC braking in speed-controlled operation without feedback (ASCL)

In ASCL-mode, a DC current is impressed on the motor.
The braking current is set with Pn33 „DC braking max. current ASCL“. The current can be preset in a range of 0...400.0% referring to the DASM rated current (dr00).
The current is limited by the permissible standstill current (see technical data of the corresponding inverter) or with dr37 "max. current", if the maximum current mode is activated in dS03. The lower limit is given by the magnetising current.

After ending of the DC braking function, the rated flux of the machine must flow before the motor is started. To that end, "wait for flux = 128: on" (Bit 7 = 1) must be programmed in parameter dS04. The torque display is not valid in the DC braking (display always 0 Nm).

20.2 Energy saving function

The energy saving function allows the lowering or raising of the current output voltage. Corresponding to the activation condition defined in uF06, the voltage in accordance with the v/f characteristic is scaled to the energy saving factor (uF07).
However, the maximal output voltage cannot be higher than the input voltage even if the value is > 100 %. The function is used e.g.in cyclic executed load/no-load applications. The speed is maintained during the no-load phase, but energy is saved as a result of the voltage reduction.

uF06: Energy saving mode			
Bit	Description	Value	Function
0...3	Activation	0	generally off
		1	generally active
		2	at actual value = set value
		3	activated by dig. input
		4	at rotation forward
		5	at rotation reverse
		6	at forward constant
		7	at reverse constant
		8...15	generally off
4...7	Voltage ramp	0	standard time *
		16	Default time / 2
		32	Default time / 4
		48	Default time / 8
		64	Default time / 16

* default setting 1.6s

uF07: Energy saving factor	
Value	Meaning
0,0...130,0%	Output voltage in %, on which is modulated at activated energy saving function.

uF08: Energy saving input selection		
Bit	Value	Input
0	1	ST (Prog. input „control release/reset“)
1	2	RST (Prog. input „reset“)
2	4	F (Prog. input „forward“)
3	8	R (Prog. input „reverse“)
4	16	I1 (Prog. input 1)
5	32	I2 (Prog. input 2)
6	64	I3 (Prog. input 3)
7	128	I4 (Prog. input 4)
8	256	IA (internal input A)
9	512	IB (internal input B)
10	1024	IC (internal input C)
11	2048	ID (internal input D)

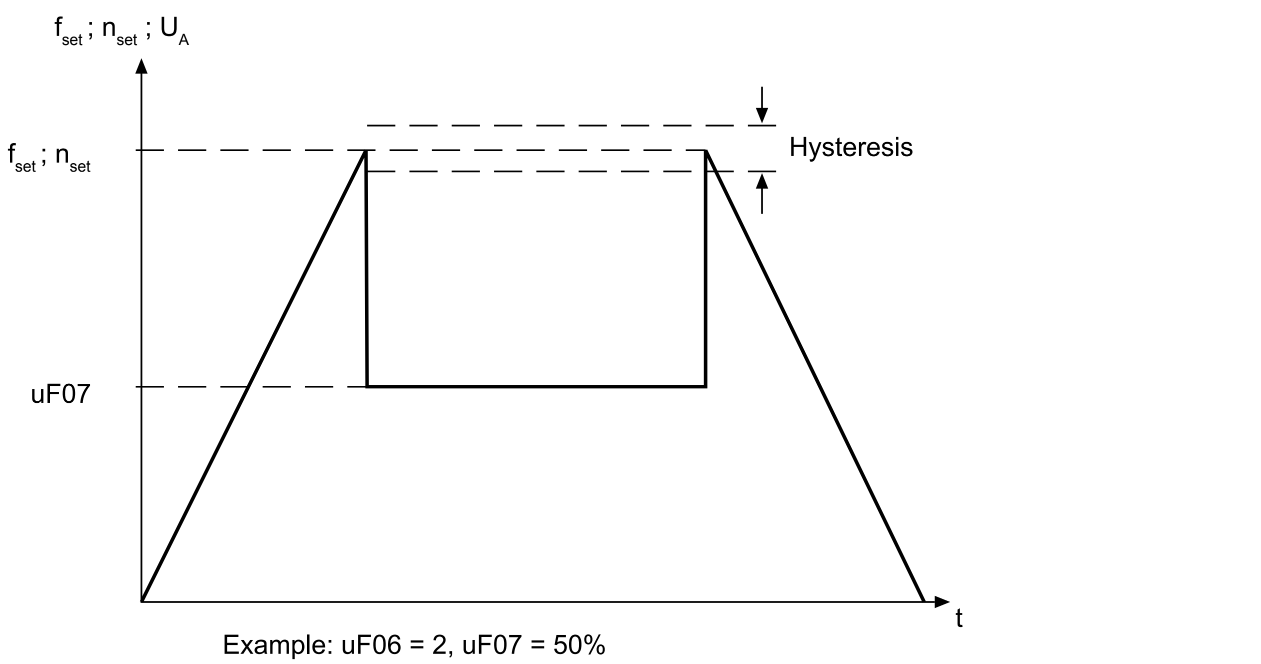


Figure 20.1 Energy saving function

20.3 Motorpoti function

This function simulates a mechanic motor potentiometer. Over two inputs the motor potentiometer value can be increased or decreased.

oP50: Motorpoti / function		
Bit	Value	Meaning
0	0	Value is changed in the current set
	1	Value is changed only in set 0
1	0	no motorpoti reset after power on
	2	Reset at Power On to oP55

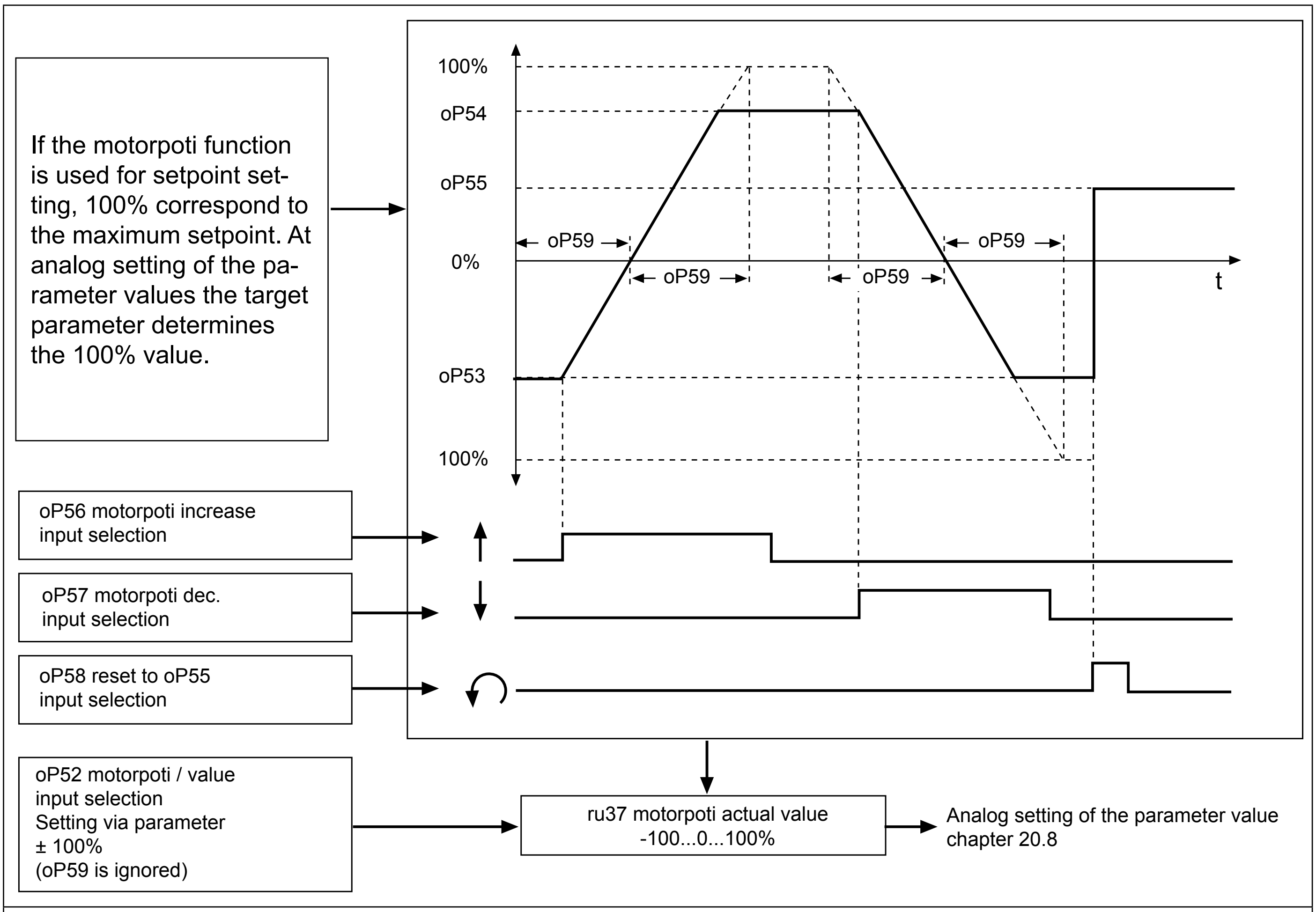


Figure 20.2 Motorpoti function

Define inputs (oP56...oP58)
First two inputs must be defined which increases or decreases the motorpoti value. To that end, one input is assigned to parameters oP56 and oP57 according to the input table. If both inputs are triggered simultaneously, the potentiometer value is decreased.

Increase motorpoti value	Decrease motorpoti value
⇓	⇓
oP56	oP57

Another input (oP58) can be used to reset the motorpoti to the adjusted reset value oP55.

Input table for oP56...oP58

Bit	Value	Input	Terminal
0	1	ST (Prog. input „control release/reset“)	X2A.6
1	2	RST (Prog. input „reset“)	X2A.5
2	4	F (Prog. input „forward“)	X2A.8
3	8	R (Prog. input „reverse“)	X2A.7
4	16	I1 (Prog. input 1)	X2A.10
5	32	I2 (Prog. input 2)	X2A.9
6	64	I3 (Prog. input 3)	X2A.12
7	128	I4 (Prog. input 4)	X2A.11
8	256	IA (internal input A)	no
9	512	IB (internal input B)	no
10	1024	IC (internal input C)	no
11	2048	ID (internal input D)	no

Motorpoti function (oP50)
The fundamental function of the motorpoti is defined with oP50 . The parameter is bit-coded.

oP50: motorpoti function			
Bit	Meaning	Value	Explanation
0	Target set of the motorpoti value	0: act. set (ru26)	Motorpoti value is changed in the active parameter set (display in ru26). Functions using the motorpoti value work with the value of the actual set.
		1: Set 0	Motorpoti value is changed in set 0 Functions using the motorpoti value work with the value of set 0.
1	Reset at switch on	0: no reset	Motorpoti value remains stored on power off
		2: Reset to oP55	Motorpoti value is written in all sets at power on to the value of oP55 "motorpoti reset value"
2	Motorpoti source set	0: Set 0	The adjustment of the motorpoti value occurs with the value of oP59 „motorpoti inc/dec time" from set 0.
		4: act. set (ru26)	The adjustment of the motorpoti value occurs with the value of oP59 „motorpoti inc/dec time“ from the active set

Motorpoti inc/dec time (oP59)
This parameter defines the time for the motorpoti in order to run from 0...100%. The time is adjustable between 0...50000 s.

Control range (oP53, oP54)
The control range is limited by parameters oP53 „motorpoti min. value“ and oP54 "motorpoti max. value" (see picture 20.2).

Motorpoti actual value (ru37)
This parameter shows the actual value of the motorpoti in percent.

Motorpoti value (oP52)
A value in % can be adjusted directly via display or bus with this parameter. The ramp time remains unconsidered at this setting.
The parameter value is limited by oP53 / oP54. If a digital input is set for increasing or decreasing the motorpoti value, the value of oP52 changes.

Motorpoti dec. time (oP69)
The motorpoti dec. time is adjusted with this parameter. The default value is: -1 = Inc. time (oP59). The parameter has a value range of -1...5000.00s.

20.4 Timer / counter programming

Two timers are incorporated in the COMBIVERT. As long as one of the adjustable starting conditions (LE18/LE23) or a programmable input (LE17/LE22) is set, the timer counts until reaching the final value range. If one of the reset conditions (LE.20/25) is fulfilled or one programmable input (LE.19/24) is set, the timer jumps back to zero. The clock source and counting direction is defined with LE21 / LE26. It can be counted in seconds, hours or by a special programmed input. The actual counter reading is displayed in ru43 / ru44. With reaching an adjustable switching level (LE00...LE07) switching condition 37 / 38 is set in do00...do07. This can be used to set an output.

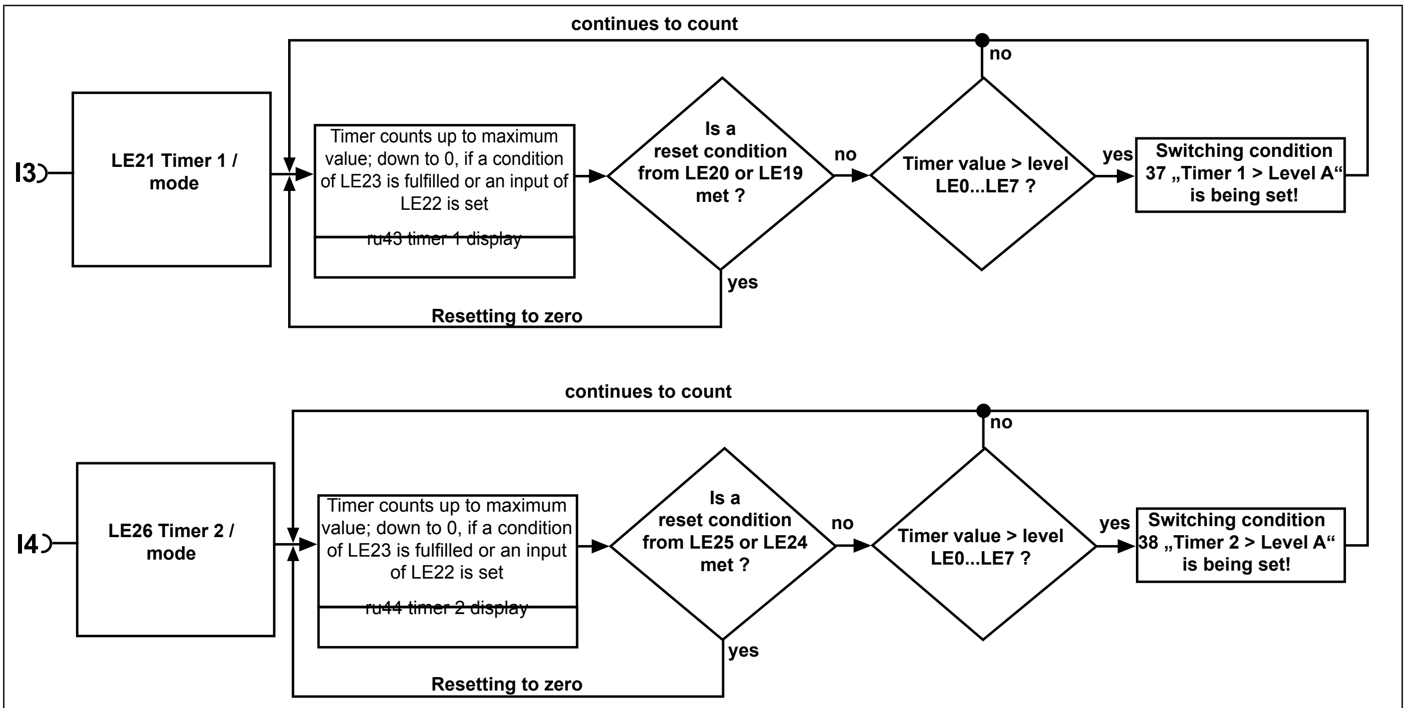


Figure 20.3 Timer programming

Timer / mode (LE21 / LE26)

LE21 and LE26 determine the clock source and the counting direction of timer 1 and 2. Clock source can be the time counter in 0.01s or 0.01h grid, pulses from a digital input. The timer runs generally as long as a starting condition is active. After a reset the timer starts again at zero. Following clock sources can be selected:

LE20 / LE25: Timer 1 / 2 mode			
Bit	Meaning	Value	Explanation
0...2	Selection clock pulse source	0: 0,01s (internally clock)	The timer value increases / decreases every 10 ms by 0.01
		1: 0,01h (internally clock)	The timer value increases / decreases every 36s by 0.01
		2: every edge T1-I3 / T2-I4	Each edge on I3 (for timer 1) or I4 (for timer 2) increases / decreases the timer value by 0.01
		3: positive edge T1-I3 / T2-I4	A rising edge on I3 (for timer 1) or I4 (for timer 2) increases / decreases the timer value by 0.01
		4... 7: reserved	
3, 4	Counting direction	0: upward	The counting direction of the timer is always upwards
		8: dep. on actual direction FOR = upwards REV=downward	The counting direction of the timer is dependent on the current direction of rotation
		16: dep. on actual direction FOR = downward REV = upward	
		24: reserved	
5	Overflow behaviour	0: Stop at limit	The timer stops on reaching the maximum value of 655.35 or the minimum value of 0
		32: Overflow	The timer always runs through. After reaching of the maximum value (655.35) the timer starts again at 0. After reaching of the minimum value (0) the timer starts again at 655.35.

Timer / start condition (LE18 / LE23)
The timer start conditions can be selected from the following table. The individual conditions are OR-operated with the timer start input selection (LE17 / LE22).

LE20 / LE25: Timer / Starting condition		
Bit	Value	Timer / Starting condition
0	1	Modulation on
1	2	Modulation off
2	4	Constant run
3	8	Modulation off/ no power on res.

The values must be added in case of several starting conditions.

Timer start input selection (LE17 / LE22)
Additionally the timer can be activated by one or several inputs. The sum of the valences must be entered if the timer shall be started by different inputs. The individual inputs are OR-operated. The start input selection is OR-operated with the timer start condition (LE18 / LE22).

LE20 / LE25: Timer start input selection			
Bit	Value	Input	Terminal
0	1	ST (Prog. input „control release/reset“)	X2A.6
1	2	RST (Prog. input „reset“)	X2A.5
2	4	F (Prog. input „forward“)	X2A.8
3	8	R (Prog. input „reverse“)	X2A.7
4	16	I1 (Prog. input 1)	X2A.10
5	32	I2 (Prog. input 2)	X2A.9
6	64	I3 (Prog. input 3)	X2A.12
7	128	I4 (Prog. input 4)	X2A.11
8	256	IA (internal input A)	no
9	512	IB (internal input B)	no
10	1024	IC (internal input C)	no
11	2048	ID (internal input D)	no

Timer reset input selection (LE19 / LE24)
The inputs which reset the timer can be specified according to the following table. The individual inputs are OR-operated, i.e. if one of the specified inputs is triggered, the timer jumps back to zero. If a starting and reset condition are active simultaneously, reset has priority. (see table „Timer start input selection (LE17 / LE22)“)

Timer reset condition (LE20 / LE25)
The conditions to reset the timer additionally to the inputs can be defined according to the following table. The individual conditions are OR-operated.

LE20 / LE25: Timer reset condition		
Bit	Value	Condition
0	1	Modulation on
1	2	Modulation off
2	4	Constant run
3	8	Change of parameter set
4	16	Power-on-reset

Timer display (ru43 / ru44)
Parameter ru43 / ru44 displays the actual counter reading depending on the selected clock source (LE21 / LE26). The counter can be set to a value by writing on ru43/ ru44. If the clock source is changed at run time, the counter reading remains, but is interpreted according to the new clock source.

Comparison level 0...7 (LE00...LE07)
LE00...LE07 define the level for the switching conditions 37 / 38 („Timer > level“). If the timer exceeds the adjusted value, switching condition (do00...do07) is set. A level in the range of -30000.00 to 30000.00 can be adjusted. Reasonable for the timer are only values from 0...655.35.

20.5 Brake control

For applications in the areas lifting and lowering, or other applications requiring the use of a brake, the control of the brake can be taken over by the KEB frequency inverter.
The control of the brake is done via relay or transistor output. A signal is output for the control of the brake. Brake control is activated with parameter Pn34 „brake control mode“. At the selected output (do00...do07) for the brake, select value 18 „brake control“ . The output becomes active, if the brake shall be released.

20.5.1 Mode brake control

Pn34 can also define the status display during the brake handling and a monitoring function can be activated. The brake control is set-programmable.

Pn34: brake ctrl. mode	
Value	Explanation
0: off	Brake control deactivated.
1: with display	Brake control activated. Status messages "85: close brake“ or „86: open brake“
2: without display	Brake control activated. No brake-specific status messages.
3: with phase check / with display	Brake control activated. Status messages "85: close brake“ or „86: open brake“. Check whether all 3 inverter output phases can be powered. If one phase is missing, error „56: error! brake control“ is triggered.
4: with phase check / without display	Brake control activated. No brake-specific status messages. Check whether all 3 inverter output phases can be powered. If one phase is missing, error „56: error! brake control“ is triggered.
5: quick stop / with display	Brake control activated. If the drive restarts during brake closing time (Pn40) the brake release time starts immediately (Pn36).
6: quick stop / without display	Brake control activated. If the drive restarts during brake closing time (Pn40) the brake release time starts immediately (Pn36). No brake-specific status messages.
7: phase check / quick stop / with display	Brake control activated. If the drive restarts during brake closing time (Pn40) the brake release time starts immediately (Pn36). Check whether all 3 inverter output phases can be powered. If one phase is missing, error „56: error! brake control“ is triggered.
8: phase check / quick stop / without display	Brake control activated. If the drive restarts during brake closing time (Pn40) the brake release time starts immediately (Pn36). No brake-specific status messages. Check whether all 3 inverter output phases can be powered. If one phase is missing, error „56: error! brake control“ is triggered.

20.5.2 Monitoring of the brake control

Pn43 „Min. load brake control“

Further brake control can be activated with Pn43 "min. load brake control". A min. load level can be adjusted in this parameter for the monitoring of the load transfer by the inverter.
If the brake is to be opened on start at the end of the premagnetizing time (Pn35), the load factor may not be smaller than the adjusted level. Otherwise error „56: error! brake control“ is triggered. Reaching the hardware current limit during this phase also triggers error „56: error! brake control“. The current is monitored only at this time (directly before the opening of the brake).
The monitoring is deactivated when Pn43 is set to 0.

Pn42 „brake check input selection“

The brake must always be closed between the end of the brake closing time (Pn40) and the beginning of the brake release time (Pn36). If the input becomes (or is) active in this phase, status „56: error! brake control“ is triggered.
The brake must always be ventilated from the end of the brake release time (Pn36) to the end of the brake delay time (Pn39). If the input becomes (or is) inactive in this phase, status „56: Error! brake control“ is also triggered.
A protection monitoring (e.g.) could be executed with this input.

20.5.3 Sequence of the brake control

The sequence of the brake control is defined by five times, two for the opening and three for the closing of the brake.

open brake

The opening of the brake is started when the control release is closed and the command to start the drive is received.
Means in speed-controlled operation the activation of the rotation direction, the set speed has no effect. That means: the brake is opened as well on setting the speed setpoint value = 0.

- Pn35: premagnetizing time

  The premagnetizing time serves for the build-up of a holding torque to minimise the „stall out“ of the drive at brake release. The adjustment of this time and the brake control start ref. (Pn37) is dependent on mode (v/f-characteristic controlled or vector-controlled) and is described in the items 20.5.4 and 20.5.5.
- Pn36: brake release time

  The signal to open the brake is issued with begin of the brake release time.
  During brake release time when the brake is mechanically released, the speed set value (ru01) is not yet stored, but the brake control start ref. (Pn37) is still maintained. Pn37 must contain value 0 rpm for vector-controlled systems both at synchronous and asynchronous motors.

close brake
Closing the brake is triggered by switching off the direction of rotation (speed control) or switching off the modulation (open control release or error).
If the modulation is switched off, the break control output is immediately deactivated so that the brake closes.

In all other cases, the sequence is as follows:

- Pn39: brake delay time

  After switching off the rotation setting, the drive runs to the stop ref. Pn41 (this parameter must contain value 0 rpm for vector-controlled drives) and waits there for the duration of the brake delay time.

- Pn40: brake closing time

  Afterwards, the brake control output is deactivated and the brake takes the load during the brake closing time. The inverter remains during this time on the stop speed Pn41.

- Pn38: brake fadeout time

  The fadeout time expires after expiration of the brake closing time (Pn40). During this time, the current is lowered to 0. After expiration of the fadeout time, the modulation remains switched on for another 100 ms. Thereby, the noise that can occur in the motor during a jolt-like shutdown of the current can be prevented.
  After the current has been drained, the inverter changes into status „70: standstill (modulation off)“.

The following figure shows the sequence of the brake control without fadeout time. In vector controlled system, the start- and the stop-value (Pn37 / Pn41) must be set to 0 rpm.

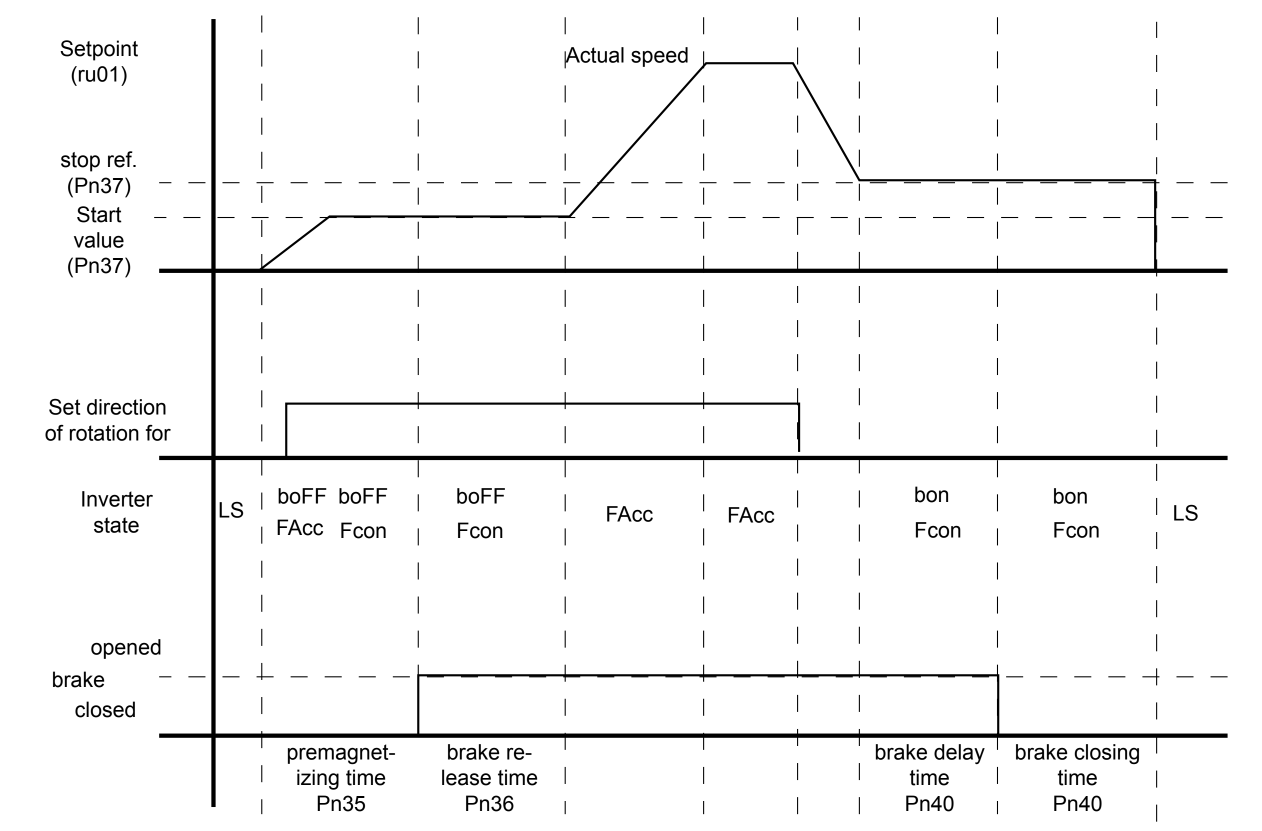


Figure 20.4 Brake control

20.5.4 Brake control in vector controlled operation (for ASCL and SCL)

Premagnetization and delay time

In vector controlled operation, the drive also builds up torque at setpoint speed 0. Therefore, no start or stop speed is required (Pn37 = Pn41 = 0 rpm). Thus also the premagnetizing time Pn35 can be set to zero. The time the drive requires for flux build-up is always await, until the output for brake release is set.

Optimisation of load transfer

In vector controlled operation, there are two other special functions which optimise the load transfer by the drive:

- speed-dependent Ki for the speed controller

  An enormous speed rigidity is required for load transfer with hoist drives or lifts, in order that the brake release and the load transfer are not significant by the inverter. This rigidity can be achieved for the speed controller with a very high "KI-increase" (cS10).
  This increase is normally reversed again via an adjustable speed range. This slow build-up cannot be used for extremely high KI-increases, since the speed controller vibrates too much.
  With input of value "-1: brake release“ in parameter „max. speed for max. KI“ (cS11) it can be reached that the "KI-increase" is set immediately to 0 at the end of the brake release time.
- Brake precontrol

  Without precontrol, the drive must first move, that means a system deviation must be built up so that the controller provides a counter torque.
  With the precontrol, the speed controller is preloaded with a torque at the beginning of the brake opening time. To avoid "stall out", this torque should be equal (in ideal case) to the load that shall be taken by the brake.
  The precontrol value is set with a ramp within 1/5 of the brake ventilation time. The function is activated, by selecting in Pn70 „brake pretorque source" how the precontrol value is preset.

Pn70: Brake pretorque source	
Value	Function
0: off	Precontrol function off
1: analog REF	Setting of the precontrol torque in % of the rated torque via the analog channel REF or AUX. The analog signal can come from, e.g., a load weighing setup in a lift cabin.
2: analog Aux	
3: digital % (Pn71)	Setting the precontrol torque in % of the rated torque via parameter Pn71 „pretorque ref. setting %“

Example: A lift is equipped with a counterweight so that for a half-loaded cabin, no holding torque must be expended.

For an empty cabin, the load weighing setup provides a signal of 0%.

In order to keep the cabin the motor requires + rated torque.

For a fully loaded cabin, the load weighing setup provides a signal of 100%.

In order to keep the cabin the motor requires - rated torque.

The signal of the load weighing setup is connected to AN2, which serves as AUX input.

That means: a signal of 0% on AN2 shall produce a precontrol value of 100%

a signal of +100% on AN2 shall produce a precontrol value of -100%.

„AN2 Offset X“ (An16) is equal 0%, „AN2 lower limit“ (An18) = -100% and „AN2 upper limit“ (An19) = 100%

The formula for amplification and offset setting is then for AN2:

Output signal = "AN2 gain" (An15) * input signal + "AN2 offset Y" (An17)

This gives, for "AN2 offset Y" = 100% and for "AN2 amplification" = -2

20.5.5 Brake control in v/f-characteristic controlled operation

Start ref. (Pn37), stop ref. (Pn41)

In v/f-characteristic controlled operation, start and stop values must be set to hold the load in standstill. Reach standstill after deceleration, in order that the brake can engage again.
The adjustable start/stop value stands in direct connection with the necessary holding torque. A preset value can be obtained according to the following formula:

$$\text{Start or stop value} = \frac{(\text{synchronous speed} - \text{rated speed}) \times \text{required holding torque}}{\text{rated torque}}$$

Based on these value, an adaption to the particular application must be made since other values, e.g., the boost, also have an effect on the behaviour during load transfer.

Example: a 4-pole motor has a rated frequency of 50 Hz and a rated speed of 1460 rpm. The synchronous speed of the motor is 1500 rpm. The slip speed at rated torque and rated voltage is 1500 – 1460 = 40 rpm. If a ref. value (Pn37) of 40 rpm is preset the drive should be able to generate rated torque at brake release.

Premagnetizing time (Pn35)

So that a torque can be built up, the flux in the motor must have been built up. The motor is energized with starting the premagnetizing time. This time must be long enough for the motor to build up its flux. Depending on the motor, this time can be between approximately 100 ms (small power) and fractions of a second (motors with large power).

Brake delay time (Pn39)

In v/f-characteristic controlled operation, the speed follows the predefined deceleration ramp not quite exactly. After completion of the deceleration ramp a delay time must be await to mask out dynamic effects.

20.6 Sweep generator

The sweep generator enables a sawtooth process of the set value (changeable in period and amplitude). It is activated with parameter oP44 Bit 0...3 = „1“.

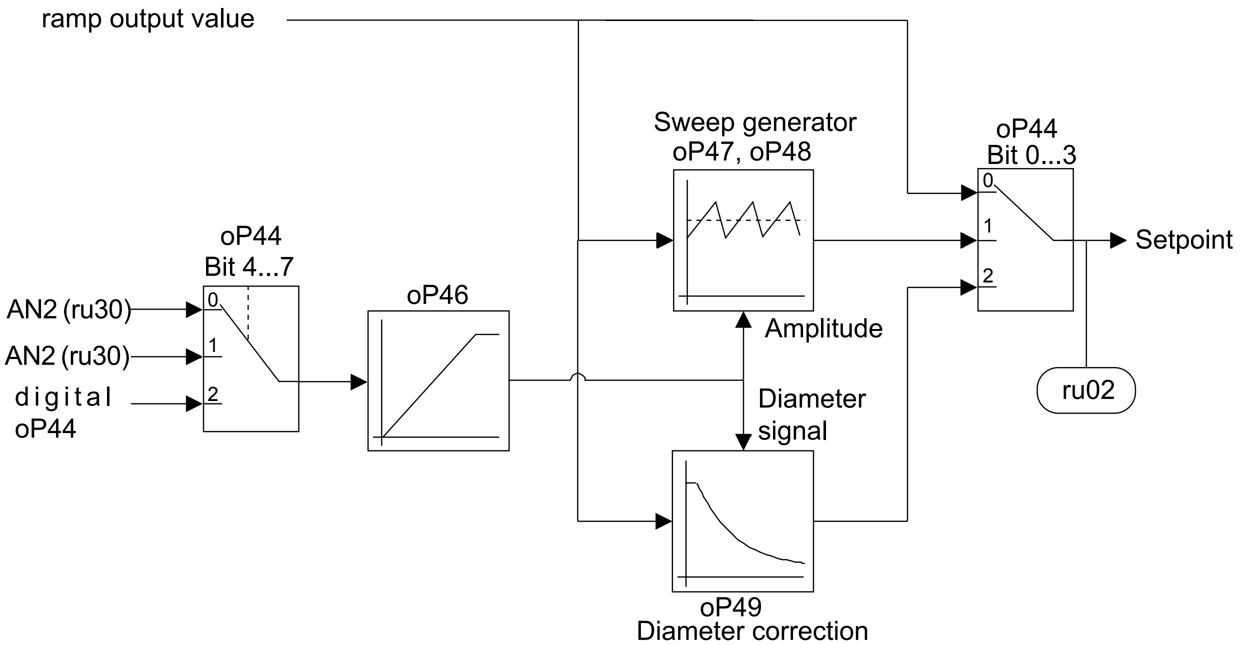


Figure 20.5 Auxiliary function: Sweep generator

Activation of the sweep generator and determination of the sweep amplitude height

The sweep function must be activated in parameter oP44. Parameter oP44 determines the source which presets the height of the amplitude of the sweep function.
Beside the analog setting via AN1, AN2 or AUX the sweep amplitude can also be preset via oP45 „ext. function digital source“ in a range of 0...100%.

oP44: Ext. function mode / source		
Bit	Value	Meaning
0...3	0: off	Select function
	1: Sweep-gen. function	
	2: Diameter correction	
	3...15: off	
4...7	0: AN2 input (ru30)	Adjust input source
	16: AN2 input (ru30)	
	32: reserved	
	48: Digital source (oP45)	
	64: Input AUX (ru53)	

Change of the sweep amplitude
The maximum rate of change of the sweep amplitude is limited with parameter oP46 „ext. function acceleration/ deceleration time“.
Parameter oP46 defines a time between 0.00...20.00 s, inside the sweep amplitude can increase or decrease. The specified value refers to a sweep amplitude change of 100 %.

Period of the sweep period
The acceleration time of the sweep signal is parameterized with oP47 „sweep-gen. acceleration time“ and the deceleration time with oP48 „sweep-gen. deceleration time“. Both times are adjustable within the range of 0… 20.00 s. These two parameters form the sweep period of the sweep function.

Operating principle of the wobble function
The following picture shows the setpoint process, which is generated by the wobble function:

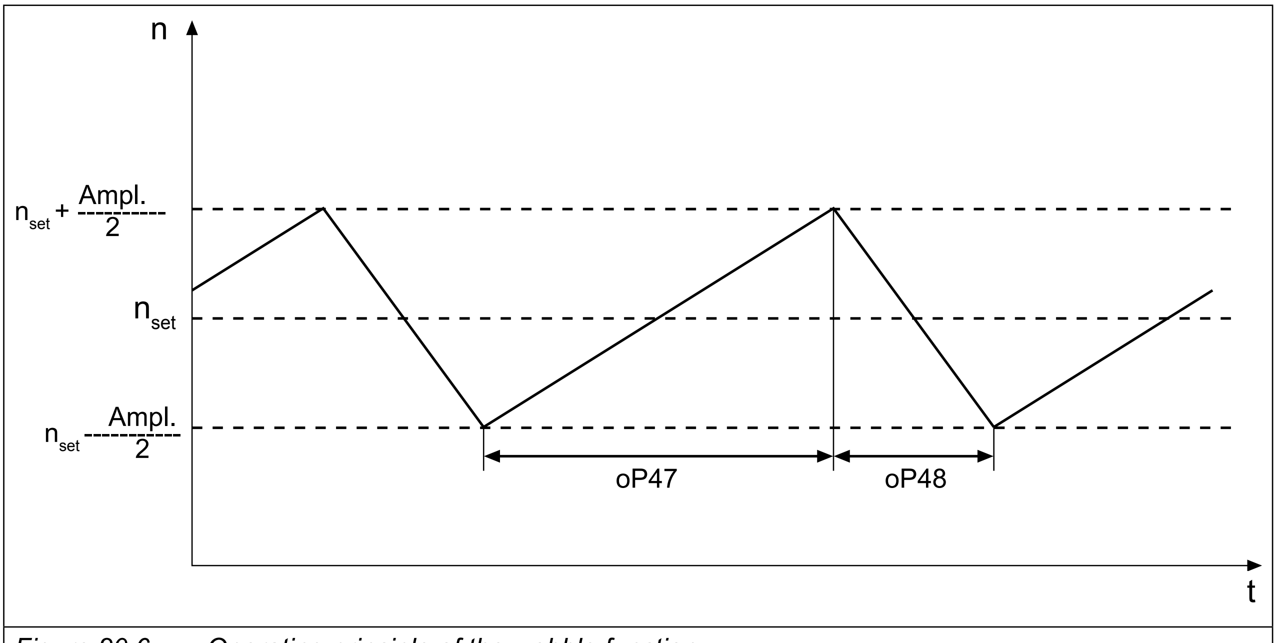


Figure 20.6 Operating principle of the wobble function

20.7 Diameter correction

Through the use of the diameter correction the tool path feedrate of a winding product can be kept constant at changing diameter of the reel bale.

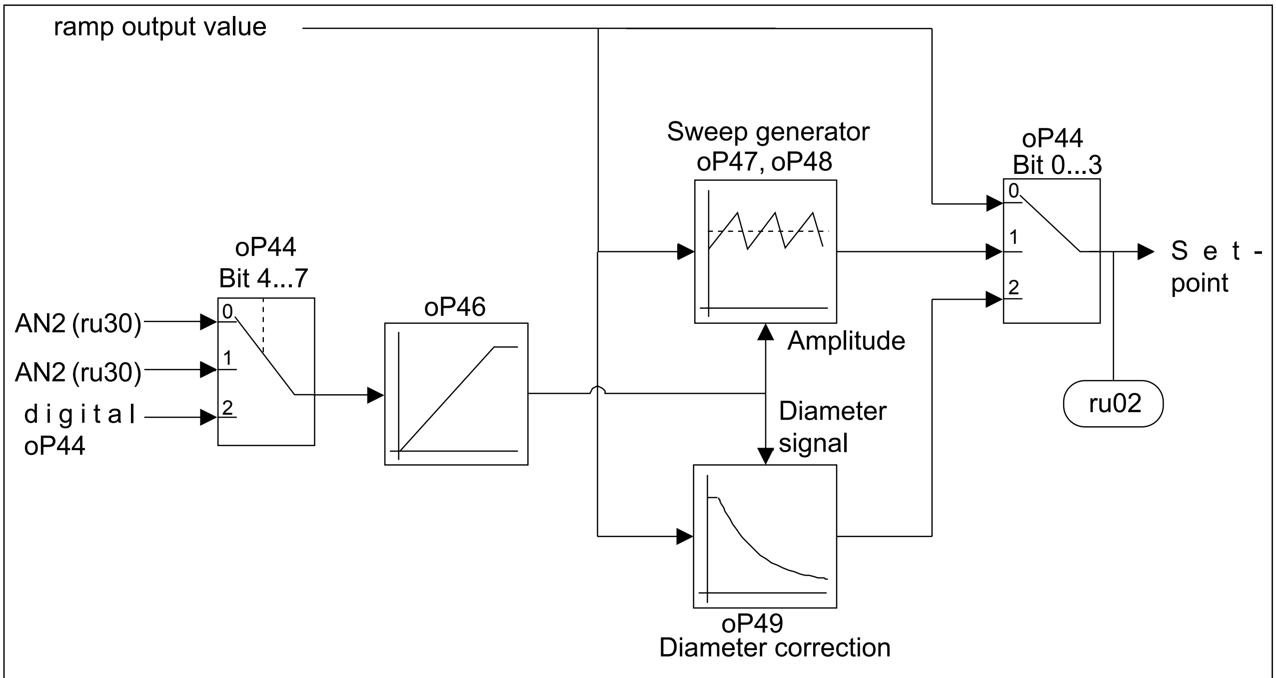


Figure 20.7 Auxiliary function: Diameter correction

Activation of the diameter correction and determination of the diameter signal

The diameter correction must be activated in parameter oP44. oP44 determines also the source for the diameter signal which is used for correction. Beside the analog setting via AN1, AN2 or AUX, the diameter signal can also be preset via oP45 „ext. function digital source“ in a range of 0...100%.

oP44: Ext. function mode / source		
Bit	Value	Meaning
0...3	0: off	Select function
	1: Sweep-gen. function	
	2: Diameter correction	
	3...15: off	
4...7	0: AN2 input (ru30)	Adjust input source
	16: AN2 input (ru30)	
	32: reserved	
	48: Digital source (oP45)	
	64: Input AUX (ru53)	

Specification of the diameter correction
The diameter signal is evaluated within the range of 0% to 100% . Values < 0% are set to 0%, values > 100% are limited to 100%.
The diameter signal of 0% corresponds to the minimum diameter of the reel bale (dmin). The output speed of the ramp generator (ru02) is not changed in this case. A diameter signal of 100% corresponds to the maximum diameter of the reel bale (dmax).

The ratio of minimum to maximum diameter (dmin/dmax) must be known in order to be able to calculate the required speed change.
The ratio of min. to max. diameter (dmin/dmax) is preset via oP49 and can be adjusted within the range of 0.010...0.990 with a resolution of 0.001.

The corrected output speed of the ramp generator is determined as follows:

$$\text{fn\_Setting:} \quad = \quad \frac{\text{fn\_Ramp}}{1+\text{DS} \cdot (1/\text{oP49}-1)}$$

fn_Ramp:	Output frequency/speed of ramp generator
fn_presetting:	Corrected output frequency/speed
DS:	Diameter signal 0…100 % (0…1)
oP49:	(d_{min}/d_{max})

Rate of change of the diameter signal
The rate of change of the diameter signal can be limited by a ramp generator. Parameter oP46 „ext. funct. acc/dec time“ defines a time within the range of 0.00...20.00 s, which is required for a change of the diameter signal of 0...100%.

20.8 Analog setting of parameter values

With this function it is possible to preset parameter values analog. The AUX-function or the motor-poti function can be adjusted as source.

An. parameter setting source (An53)
This parameter determines whether the analog parameter setting occurs via the motorpoti or the Aux function.

An53: Analog parameter setting source	
Value	Explanation
0	AUX input
1	Motorpoti function

Parameter An54 „an. para setting dest.“ determines the bus address which parameter presets the analog value.

An54: Analog para setting dest.	
Value	Explanation
-1	off
0...32767	adjustable value range

The following parameters can be adjusted in parameter An54 „an. para setting“ .

uF01 / uF07
cn04 / cn05 / cn06
An32 / An37 / An42 / An48
LE00 / LE01 / LE02 / LE03 / LE04 / LE05 / LE06 / LE07
cS06 / cS09 / cS19 / cS20 / cS21 / cS22 / cS23
Ec14

In case an invalid parameter address is selected, message "data invalid" is output and the adjustment is ignored.

Analog parameter setting offset (An55)
Defines the parameter value, that adjusts itself at 0 % analog parameter setting. The parameter value must be entered with the internal scaling factor of the target parameter.

$$\text{Value to be set} = \frac{\text{desired value of target parameter}}{\text{resolution of target parameter}}$$

Analog parameter setting max. value (An56)
Defines the parameter value, that adjusts itself at 100 % analog parameter setting. The parameter value must be entered with the internal scaling of the target parameter (see An55).

Analog parameter setting set pointer (An57)
An57 determines the parameter set in which the selected parameter is edited. If a set-programmable parameter is adjusted as target parameter, the adjusted set in An57 is edited.

An57: Analog parameter setting set pointer	
Value	Explanation
-1	active set is edited
0...7	adjusted set is edited

If a non-set-programmable parameter is adjusted as target parameter, it is always edited in set 0 (independent on An57).

20.9 Technology control

The KEB COMBIVERT is equipped with an universal programmable technology controller, which is able to build up pressure-, temperature- or dancer position control.

20.9.1 The PID controller

The technology controller consists of a set /actual value comparator, which transmits the system deviation to the PID controller. The P- I- and D-component is adjusted with cn04, cn05 and cn06. Parameters cn07 and cn08 limit the max. manipulated variable of the controller.
The PID fading time (cn09) determines the controller ratio from 0.00...300.00s. Parameter cn14 adjusts the frequency ratio in Hz/% (only G6L-G). The PID controller, the I-component separately and/or the controller fading can be reset with parameters cn11, cn12 and cn13. A PID reset condition can be adjusted with cn10 .

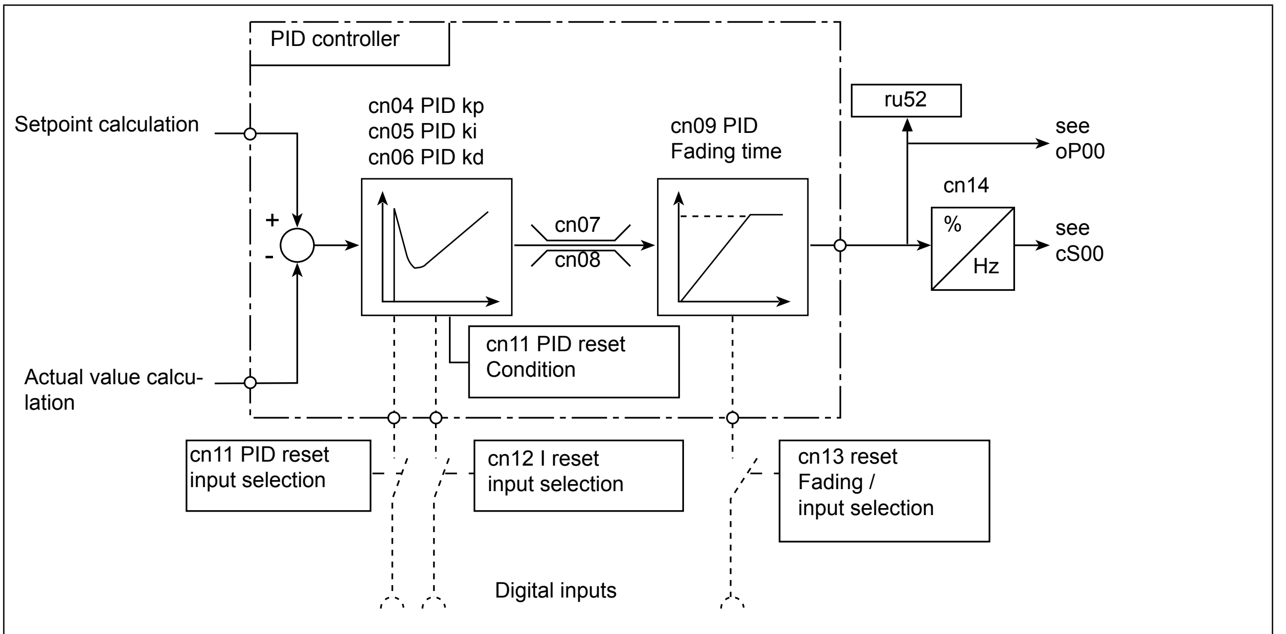


Figure 20.8 PID controller

PID controller KP (cn04)
Determines the proportional gain factor in the range of 0.00...250.00.

PID controller KI (cn05)
Determines the integral gain factor in the range of 0.000...30.000.

PID controller KD (cn06)
Determines the differential gain factor in the range of 0.000...250.00.

PID pos. limit (cn07), PID neg. limit (cn08)
The maximum positive manipulated variable in the range of -400.0...400.0 % is specified with cn07, the maximum negative manipulated variable in the range of -400.0...400.0 % with cn08.

PID fading time (cn09)
The controller intervention can be linear increased at the start or linear reduced at a reset of fading with this parameter. The time refers to 100% controller output value. If an input is programmed to „fade in reset inp. sel. (cn13)“, fade in is counted down at active input and counted up at inactive input.

If „- 1“ is adjusted, the fade in is calculated in accordance with the following formula:

Fade in factor = $f_{setting}$ (ru02) / max. reference (oP10 / oP11)

The function is only active if the technology controller is used as process controller (cS00 Bit 0...2 = 1). The fading time is 0 if it is used as setpoint controller.

PID reset condition (cn10)
The reset condition of the PID controller can be preset via cn10. Simple speed controls for both directions of rotation can be realized thereby.

cn10: PID reset condition			
Bit	Value	Function	Explanation
0	0	no reset	PID controller is not reset
	1	reset always	PID controller = 0 (constantly reset)
1	2	reset at modulation off	PID controller is reset at modulation off

Adjust value „2“ for speed control, in order that the I-component of the controller is reset at status „no direction of rotation preset“ or „no control release“. Value „1“ serves primary for the start-up, in order to reset the controller manually.

Reset the controller via digital inputs (cn11 / cn12 / cn13)
The total controller, the I-component as well as the controller fading can be reset via the digital inputs. The fading time of parameter cn09 is valid when resetting the fading. For that the decimal value of the corresponding inputs must be entered in the following parameters (see table below):

Reset the controller via digital inputs (cn11 / cn12 / cn13) Reset PID input selection / reset I inp. sel. / fade in reset inp. sel.			
Bit	Decimal value	Input	Terminal
0	1	ST (Prog. input „control release/reset“)	X2A.6
1	2	RST (Prog. input „reset“)	X2A.5
2	4	F (Prog. input „forward“)	X2A.8
3	8	R (Prog. input „reverse“)	X2A.7
4	16	I1 (Prog. input 1)	X2A.10
5	32	I2 (Prog. input 2)	X2A.9
6	64	I3 (Prog. input 3)	X2A.12
7	128	I4 (Prog. input 4)	X2A.11
8	256	IA (internal input A)	no
9	512	IB (internal input B)	no
10	1024	IC (internal input C)	no
11	2048	ID (internal input D)	no

PID output frequency at 100% (cn14)
This block converts the proportional controller output value to frequency. The adjustment of cn14 determines PID output frequency at 100%. A frequency of -400.0...400.0 Hz can be adjusted (dependent on ud02). The output value forms the output frequency (ru03) at cS00 Bit 0… 1 = 1 added with the ramp output frequency (ru02).

20.9.2 PID set value

This block describes the PID controller set value. The PID set value consists of the absolute reference (cn01) and an additional reference source adjustable with cn00. The two values are added and form the PID controller reference.

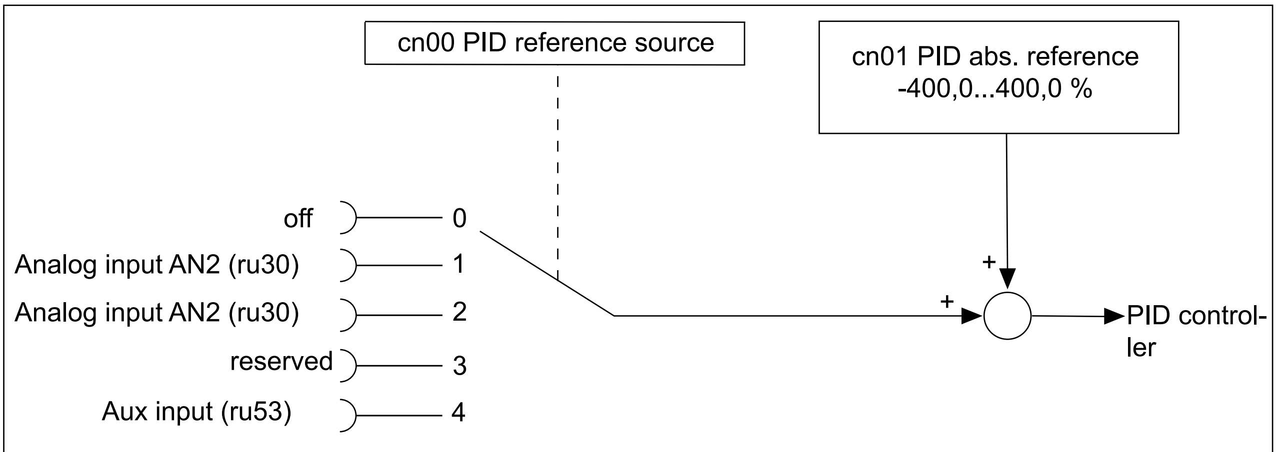


Figure 20.9 PID set value

PID reference source (cn00)
Parameter cn00 determines, which input supplies an additional reference. The following possibilities are available:

cn00: PID reference source	
Value	Explanation
0	off (default)
1	AN2 input (ru30)
2	AN2 input (ru30)
3	reserved
4	Input AUX (ru53)

If one of the analog channels is adjusted, the signals can be adapted with the analog amplifiers individually to the requirements (see chapter 8).

PID controller abs. reference (cn01)
The abs. reference of the PID controller in the range of -400.0…400.0% is preset with cn01. The parameter is set-programmable.

20.9.3 PID actual value

This block describes the PID controller actual value. The actual value is selected with the PID actual value source (cn02).

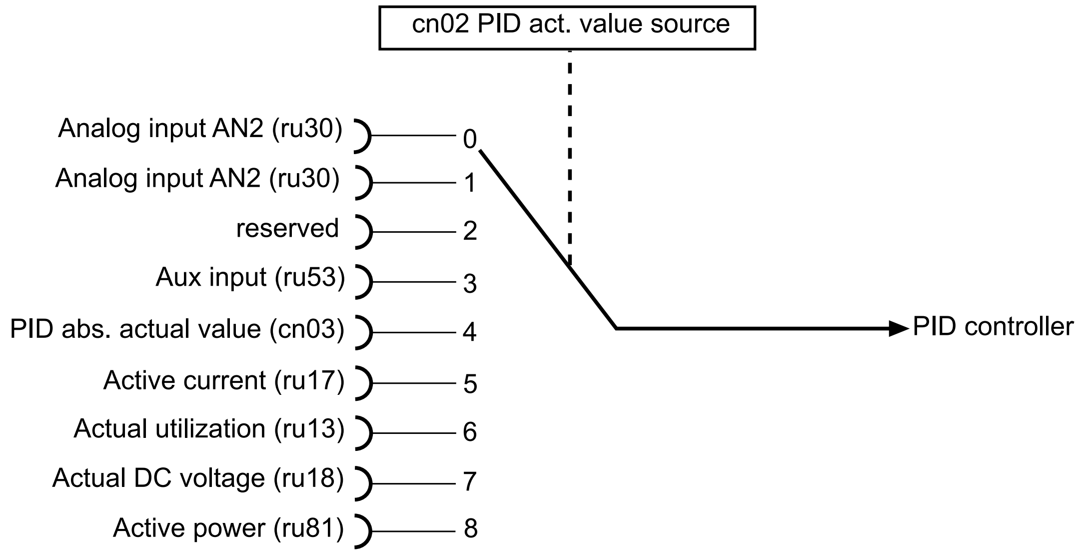


Figure 20.10 PID actual value

PID actual value source (cn02)
The PID actual value source (cn02) defines wherefrom the PID controller receives the actual value signal. Following signals are available:

cn02: PID act. value src.		
Value	Signal	Explanation
0	Input AN1 (ru28)	Signal of the analog input 1 (see chapter 8)
1	Input AN1 (ru28)	Signal of the analog input 2 (see chapter 8)
2	reserved	
3	Input AUX (ru53)	Signal of the Aux input (see chapter 8)
4	digital (cn03)	PID absolute actual value is preset with cn03 within the range of -400.0...400.0 %
5	Active current (ru17)	The displayed active current -200...200 % in parameter ru17 is used as actual value signal (100 % = I_{rated})
6	Actual utilization (ru13)	The displayed utilization 0...255 % in parameter ru13 is used as actual value signal (100 % = 100 %)
7	Actual DC voltage (ru18)	The displayed actual DC voltage 0...1000 V (1000 V = 100 %) in parameter ru18 is used as actual value signal.
8	Active power (ru81)	Reference value: 2 * Default dr03 → 100%

20.9.4 Application examples

Some application examples of the PID controller are given in the following part.

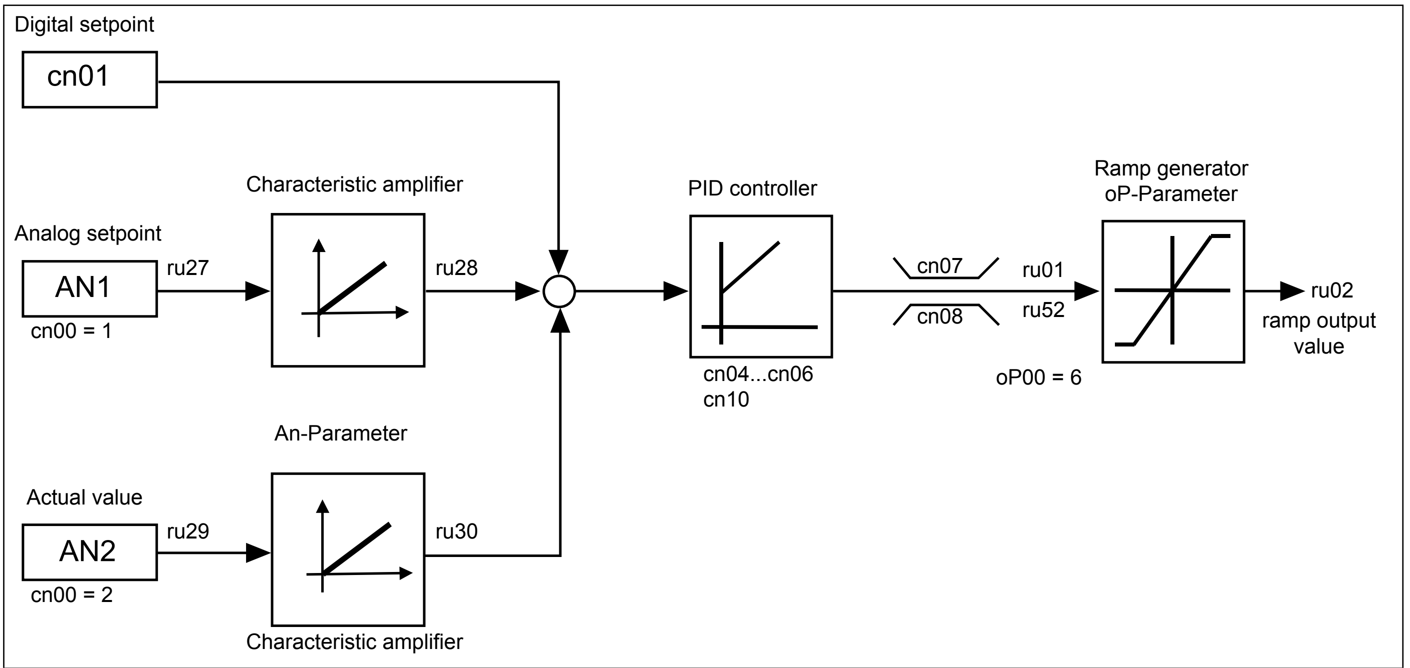


Figure 20.11 PID controller without precontrol (e.g. for pressure-, temperature-, liquid level control)

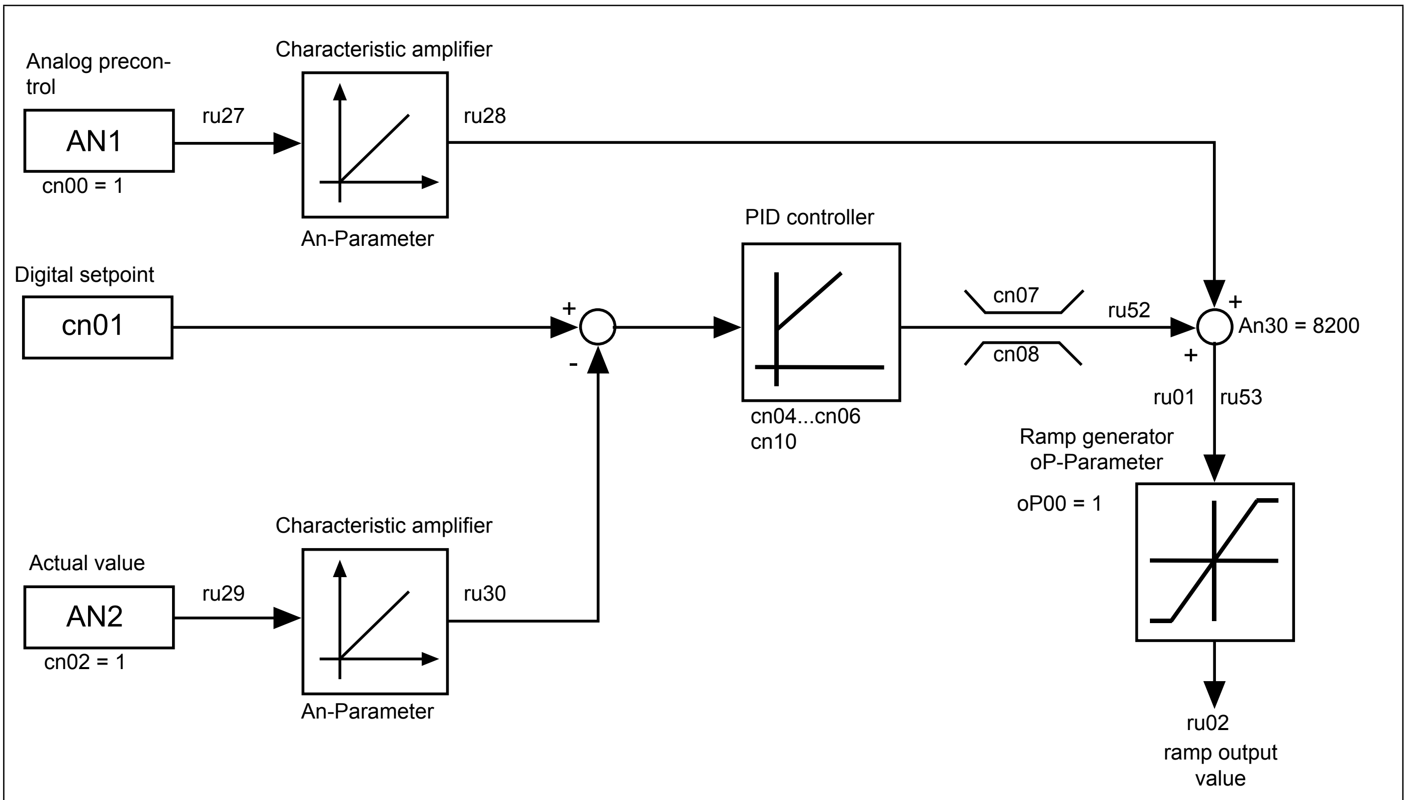


Figure 20.12 PID controller with precontrol (variant 1)

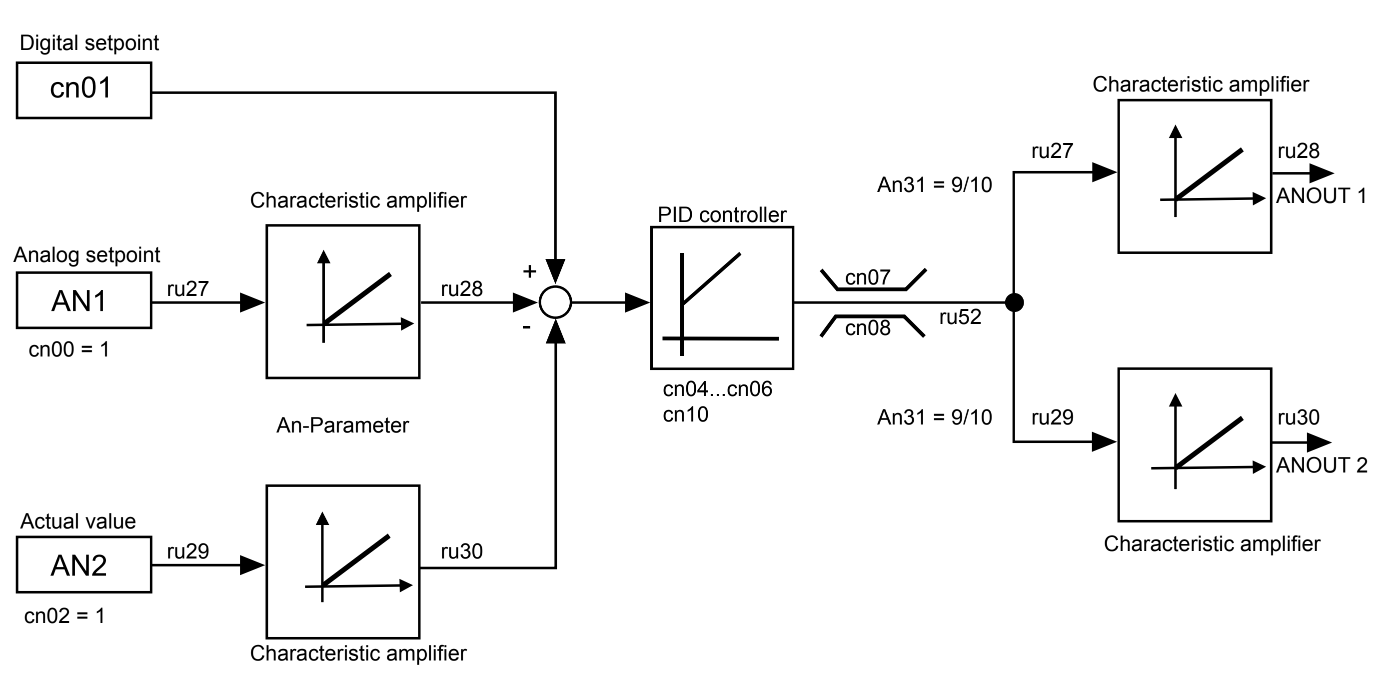


Figure 20.13 PID controller to the output

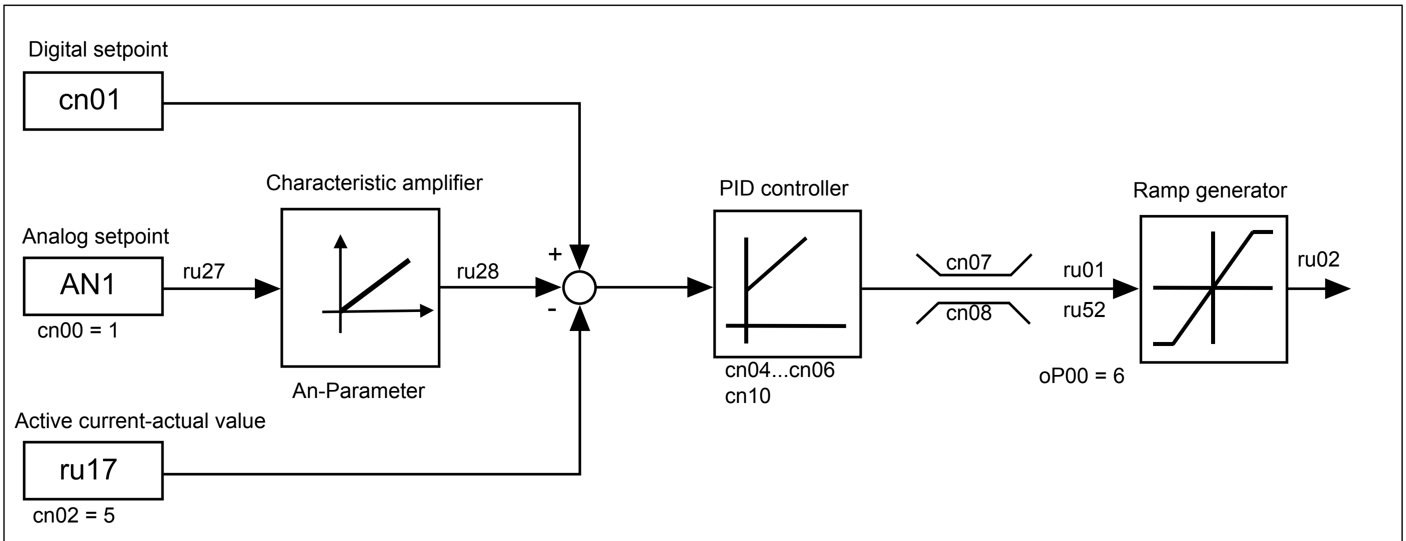


Figure 20.14 PID controller as active current- (torque-) control without precontrol

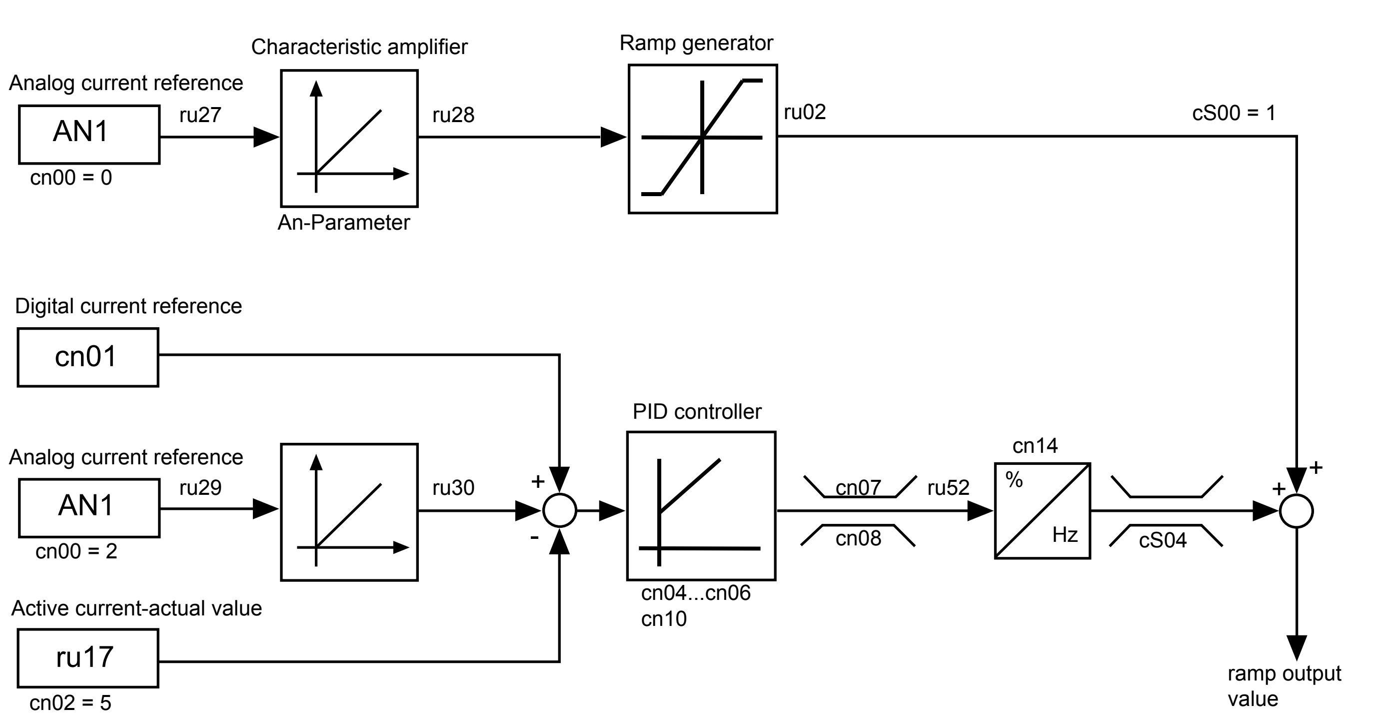


Figure 20.15 PID controller as active current- (torque-) control with precontrol

20.10 Positioning function in open-loop (v/f) mode

The positioning function allows approaching of a position with a signal of different frequencies. The positioning process is triggered by disabling the direction of rotation via an external signal (e.g by set changeover). The positioning will be carried out correctly only if the maximum frequency of the positioning set is not exceeded at triggering and no s-curves are used.
Status 'Positioning' is displayed in parameter ru00 during the positioning process.

In order to approach always the same distance in case of different frequencies after the positioning start, the drive runs with constant frequency until the position is reached with the adjusted deceleration. The frequency-dependent constant runtime is calculated as follows:

$$\text{Frequency-dependent constant runtime} = \frac{\frac{t\_dec}{2}}{\text{reference frequency}} * \left(\frac{t\_max^2}{f\_actual} - f\_actual \right)$$

Pn63: positioning delay	
Value range	Explanation
-2: Posi interruptible	The positioning can be interrupted.
-1: Posi off	Positioning function not active (default)
0.00...327.67 s	Positioning is active. Adjustable range for positioning delay.

A shifting of the holding position can be set via parameter Pn.63, which entail an additional constant runtime. Thus the shifting of the initiator can be replaced. The additional constant runtime is also frequency-dependent and is calculated as follows:

$$\text{additional constant runtime} = \frac{Pn63 * (oP10 \text{ or } oP11)}{ru03}$$

i	The determined deceleration ramp in oP10 or oP11 remains the same.

The positioning can be corrected with parameter Pn73.

Pn73: positioning correction	
Value range	Explanation
0...32767	adjustable value range

$$t\_const\_Pn73 = Pn73 * \frac{f\_max - f\_actual}{f\_max}$$

The entire positioning time is dependent on the maximum frequency oP10 / oP11, the deceleration time in oP30, the mode in Ud02, the positioning delay Pn63 and the adjusted value in Pn73.

21. Define CP-Parameters

Once the development stage of a machine is completed, usually only a few parameters are required for the adjustment or the control of the inverter. To make the handling easier and the user documentation more understandable as well as to increase the safety of operation against unauthorized access, there is the possibility to create an own user surface and the CP-Parameters. There are 49 parameters (CP00...CP48) available for it, 48 of them (CP01...CP48) can be assigned free. Parameter CP00 is preset.

21.1 Overview

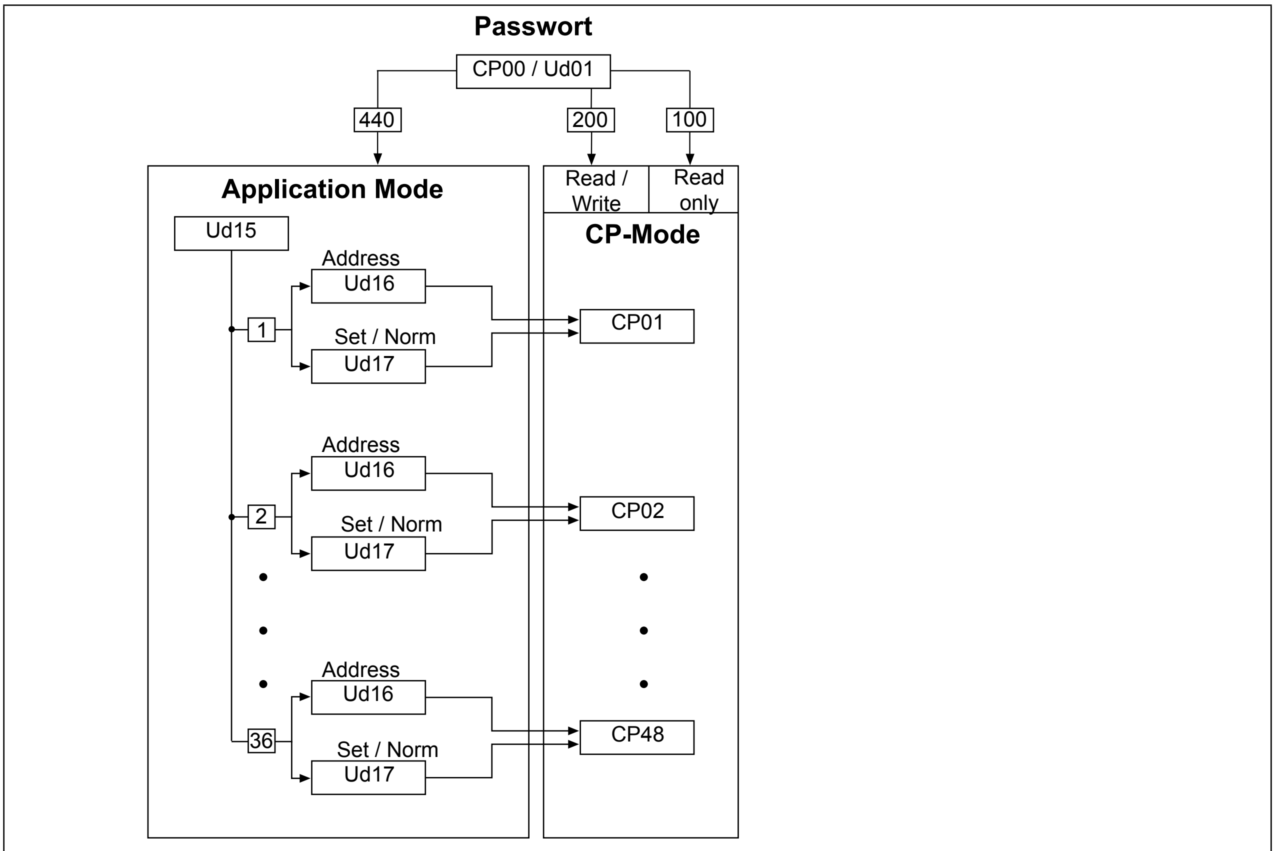


Figure 21.1 Definition structure

Ud15 determines the CP-Parameter which shall be processed. The CP-Parameter is defined by its address, the respective set and the display norm with Ud16 and Ud17.

Parameter CP00 is not programmable, it always contains the password input. If the inverter is in application mode,Ud01 is used for password input.
Parameter, die nicht als CP-Parameter zulässig sind (z.B. Ud15...Ud17 sowie Fr01), werden mit „Daten ungültig“ quittiert. When entering an invalid parameter address the parameter is set to „oFF“ (-1). The appropriate CP-parameter is not displayed at this setting.

21.2 Assignment of CP-Parameters

Pointer CP definition (Ud15)
The CP-Parameter to be programmed is adjusted with Ud1 in the range of 1...48. CP00 is not adjustable.

CPaddress (Ud16)
Ud16 determines the parameter address (see chapter 24) of the parameter to be displayed:

Ud16: CP-Adresse		
Value	Function	Explanation
-1	off	This parameter is not used
0...32767	Parameter address	Value range for the adjustable parameters

Not available or allowed parameter addresses are rejected with „data invalid“.

CP set / scaling (Ud17)
Ud17 determines the set, the addressing and the scaling factor of the parameter to be displayed. The parameter is bit-coded. The individual bits are decoded as follows:

Determination for direct set addressing

Bit 0...7 determine the set selection for direct set programming, i.e. all selected sets contain the same value, which is defined by the CP-Parameter. If direct set programming (Bit 8, 9) is selected, at least one set must be selected, otherwise error message „data invalid“ is displayed in the CP menu.

Ud17: CP set / scaling			
Bit	Value	Function	Explanation
0	0	-	Data invalid, if Bit 8 + 9 = 0
0	1	Set 0	Writing in set 0
1	2	Set 1	Writing in set 1
2	4	Set 2	Writing in set 2
...			
7	128	Set 7	Writing in set 7

Determination of set addressing mode
Bit 8 and 9 determine the set addressing:

Ud17: CP set / scaling			
Bit	Value	Function	Explanation
8	0	direct (Bit 0...7)	direct set-addressing; the sets determined by Bit 0...7 are valid
	256	active set (ru26)	current set; the current set is displayed / edited
9	512	indirect (Fr09)	indirect set addressing, the parameter set determined with the set pointer Fr09 is displayed / edited
	768	reserved	

Display norm
Bit 10...12 determine how the defined parameter value is displayed. Es können mit den Parametern Ud18... Ud21 bis zu sieben verschiedene Benutzernormierungen (weiter unten in diesem Kapitel) festgelegt werden.

Ud17: CP set / scaling			
Bit	Val-ue	Function	Explanation
10	0	Standard	Use standard scaling of the parameter
	1024	Display scaling from set 1	Display scaling of parameters Ud18...21 from set 1
...			
12	7168	Display scaling from set 7	Display scaling of parameters Ud18...21 from set 7

21.3 Create CP-Parameter menu

As an example a user menu with the following features shall be programmed:

1. Display of the actual frequency (ru03) in the respective set
2. Setting of a fixed frequency / fixed value (oP21) in set 2
3. Setting of a fixed frequency / fixed value (oP21) in set 3
4. Beschleunigungs- und Verzögerungszeit (oP28 / oP30) für Satz 2 und 3
5. Energy saving factor (uF07) shall be displayed in set 0 with display scaling from set 4
6. Adjust all other parameters (like CP07) to „off“ thus there is no display.

	Ud15 = 1	CP01
1.	Ud16 = 2203h	Parameter address for ru03
	Ud17 = 256	Display in the active set
	Ud15 = 2	CP02
2.	Ud16 = 2315h	Parameter address for oP21
	Ud17 = 4	Setting in set 2
	Ud15 = 3	CP03
3.	Ud16 = 2315h	Parameter address for oP21
	Ud17 = 8	Setting in set 3
	Ud15 = 4	CP04
	Ud16 = 231Ch	Parameter address for oP28
	Ud17 =12	Setting in set 2 and 3
4.		
	Ud15 = 5	CP05
	Ud16 = 231Eh	Parameter address for oP30
	Ud17 =12	Setting in set 2 and 3
	Ud15 = 6	CP06
5.	Ud16 = 2507h	Parameter address for uF07
	Ud17 = 4097	Setting in set 0 and display scaling from set 4
	Ud15 = 7	CP07
6.	Ud16 = -1: off	CP07 is faded-out
	Ud17 = xxx	Ud17 is without function

21.4 Display norm

The KEB COMBIVERT gives the user the possibility to define his own norms (e.g. km/h or bottles/min) in the CP mode. Die Parameter Ud18...Ud20 dienen zur Umrechnung, Ud21 zur Bestimmung der Berechnungsmethode, der Nachkommastellen sowie der in KEB COMBIVIS angezeigten Einheit.

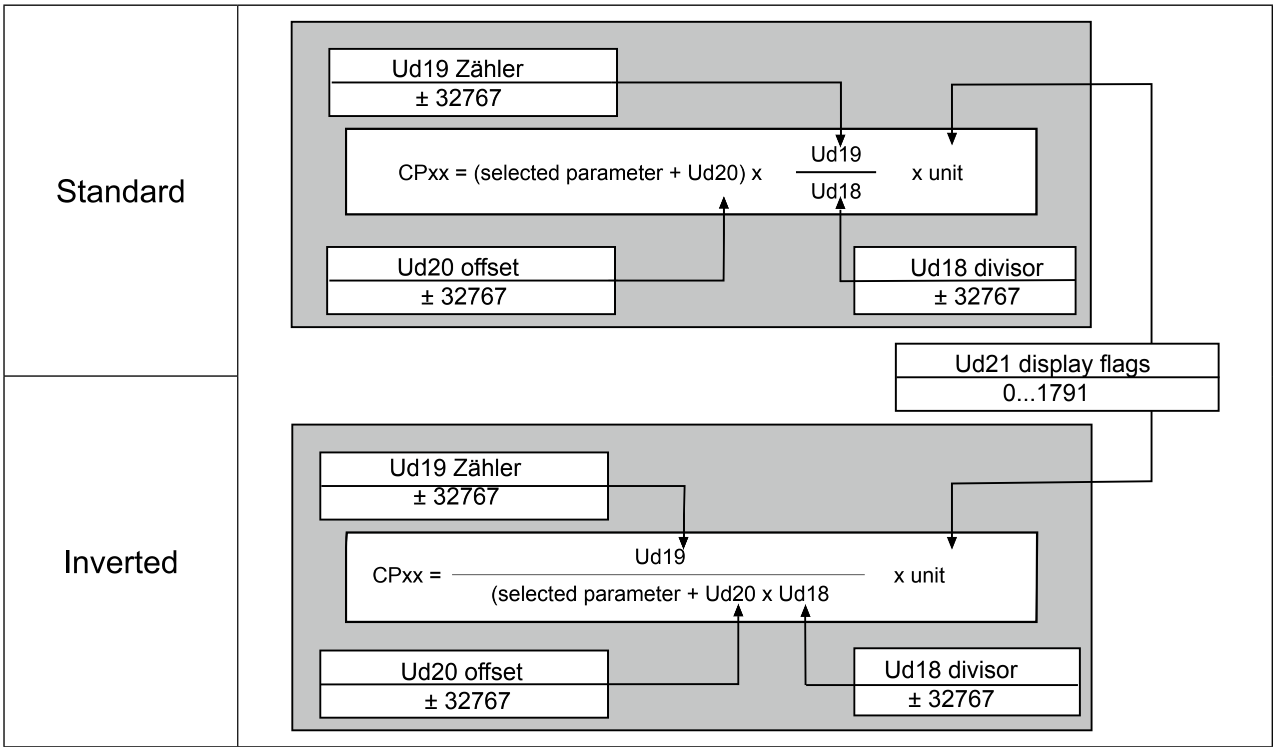


Figure 21.2 Definition of own standardization

Either the non-normalized value or the normalized value/resolution is used for the „selected parameter"!

Ud18 divisor display norm
Adjusts the divisor in the range of ±32767 (default 1). The parameter is set-programmable.

Ud19 multiplier display norm
Adjusts the multiplier in the range of ±32767 (default 1). The parameter is set-programmable.

Ud20 offset display norm
Adjusts the offset in the range of ±32767 (default 0). The parameter is set-programmable.

Ud21 control display norm
The calculation mode, the decimal places as well as the units indicated in KEB COMBIVIS are adjusted with ud21. The parameter is bit-coded and set-programmable. It is adjustable in the range of 0...1791.

Ud21: ctrl. display norm		
Bit	Value	Explanation
0...5	Unit	see table 1
6...7	Calculation mode	see table 2
8...11	Decimal places	see table 3
12...15	free	

Table 1 Unit (Bit 0...5)

Value	Unit	Value	Unit	Value	Unit	Value	Unit
0	no	16	km/h	32	K	48	lbin
1	mm	17	rpm	33	m Ohm	49	in/s
2	cm	18	Hz	34	Ohm	50	ft/s
3	M	19	kHz	35	k Ohm	51	ft/min
4	km	20	mV	36	Inc	52	ft/s^2
5	g	21	V	37	%	53	ft/s^3
6	kg	22	kV	38	KWh	54	MPH
7	us	23	mW	39	mH	55	hp
8	ms	24	W	40	reserved	56	psi
9	s	25	kW	41	reserved	57	°F
10	h	26	VA	42	In	58	reserved
11	Nm	27	kVA	43	ft	59	reserved
12	kNm	28	mA	44	yd	60	reserved
13	m/s	29	A	45	oz	61	reserved
14	m/s^2	30	kA	46	lb	62	reserved
15	m/s^3	31	°C	47	lbft	63	reserved

Table 2 Calculation mode (Bit 6...7)

Value	Function
0	$(\text{selected parameter} + Ud20) \times \frac{Ud19}{Ud18} = CPxx$
64	$\frac{Ud19}{(\text{selected parameter} + Ud20) \times Ud18} = CPxx$
128	reserved
192	reserved

The „non-normalized value“ is used for the „selected parameter“!
Non-normalized value = normalized value / resolution

Table 3 Representation (Bit 8...11)

Value	Representation
0	0 decimal places
256	1 decimal place
512	2 decimal places
768	3 decimal places
1024	4 decimal places
1280	variable decimal places
1536	hexadecimal display

Example

The actual frequency shall be displayed in rpm in CP01. Display norm from set 4.

Ud15 = 1	CP01
Ud16 = 2203h	Actual frequency ru03
Ud17 = 4352	Display in the actual set, display norm from set 4
Set 4, Ud18 = 80	Conversion from 1/80 Hz into rpm without pole-pair number
Set 4, Ud19 = 60	
Set 4, Ud20 = 0	no offset
Set 4, Ud21 = 17	Unit rpm, calculation mode direct, no decimal places

21.5 Variable norm for CP-Parameters

Target of these parameters is to provide a set of parameter addresses to the control, thus user-definable inverter parameters can be addressed with self-specified norms.

Required parameters

The following configuration parameters must be available for one programmable parameter.

- (Ud23) pp address
- (Ud24) pp properties

The following settings can be done in the properties:

Ud24: PP Eigenschaft		
Bit	Value	Explanation
0...7	1...128 (set 0...7)	Target/-source set with direct addressing
8...11	0: direct (Bit 0...7)	Ziel/-Quellsatz aus bit 0...7
	256: act. set (ru26)	Target/-source set = actual set
	512: indirect (Fr09)	Target/-source set = Fr09
	768 via bus telegram	Accept target/source setting from PP-Para telegram
	1024...3840: reserved	
12...13	0: Standard calculation	Calculation mode
	4096...12288: reserved	
14	16384:	Mult write variable yes / no
15	32768:	Shifter write variable yes / no
16	65536:	Mult read variable yes / no
17	131072:	Shifter read variable yes / no
18	262144:	Offset variable yes / no
19	0: r/w	Write protection is not active, reading and writing possible
	524288: ro	Write protection is active, only reading

The configuration parameters are inserted in the Ud.group and indirect addressed like the configuration parameters of the CP parameters over a selector.

The following parameters result from it:

Ud22:	PP parameter selection	Value range: 0...47
Ud23:	PP Adresse	Value range: -1(off)..32676, only available and permitted addresses are accepted
Ud24:	PP Eigenschaft	Value range: 1...1048575
Ud25	PP Multiplikator/Schreiben	Value range: +/- 32767
Ud26	PP Shifter/Schreiben	Wertebereich 0...48
Ud27	PP Multiplikator/ Lesen	Value range: +/- 32767
Ud28	PP Shifter/Lesen	Wertebereich 0...48
Ud29	PP Offset	Wertebereich +/- 2^31-1
Ud30	PP Obergrenze	Wertebereich +/- 2^31-1
Ud31	PP Untergrenze	Wertebereich +/- 2^31-1

Example

Reading of the prog. parameters
The values of the source parameter in the selected sets are compared. If all values are equal then this value is displayed, otherwise „data invalid“ is displayed. If no source parameter is defined „data invalid“ is displayed.

Writing of the prog. parameters
The write value is written into all selected sets of the target parameter. The following characteristics of the target parameter are checked:
- Exceeding the limits: „invalid data“
- generally write protection: „write protected parameters“
- write protection when modulation is on: „operation not possible“
- write protection in the active set: „invalid set“
- Password: ‘password invalid‘ is only displayed at parameters with supervisor password
- „data invalid“ is always displayed if no target parameter is defined.

Invalid target/source parameters
Some parameters cannot be adjusted as target/source parameter in Ud23. These parameters are acknowledged with the status "invalid data" and the input is ignored.

Prog. parameters as process data
The prog. parameters can be used as process data. Restrictions occur only if a prog. parameter is assigned with a process date invalid parameter. In this case the process date is switched off and the adjusted address in the corresponding Sy parameter is negated, in order to mark this process date as switched off. This also applies to the case when the prog. parameter is switched off (Ud23 = -1).
A prog. parameter is additionally inadmissible as process writing date when the target parameter is read-only (generally at activated modulation in active set).
The set definition of the process date is always valid as set source for the process data (e.g. Sy17 for process read date 1). The adjustment in Ud24 is without meaning.

Prog. parameters as scope data
The prog. parameters can be used as scope data. Ist der gewählte prog. Parameter abgeschaltet (Ud23 = -1), wird das Scopedatum abgeschaltet und die im entsprechenden Sy-Parameter eingestellte Adresse wird negiert, um dieses Scopedatum als abgeschaltet zu kennzeichnen.
Da die prog. Parameter den Typ LONG haben, können sie

- bei COMBIVIS 5 nicht auf Scope Kanal 3 und 4
- bei COMBIVIS 6 auf Scope Kanal 1 bis 4

gelegt werden, ohne dass COMBIVIS den schnellen Scope-Modus verlässt.
The set definition of the scope data is always valid as set source for scope data (e.g. Sy34 for scope data 1). The adjustment in Ud24 is without meaning.

22. Error Diagnosis

The following chapter shall help you to avoid errors as well as help you to determine and remove the cause of errors on your own. The error messages of all KEB COMBIVERT G6 are represented, although depending upon device and design some are missing.

22.1 Troubleshooting

22.1.1 General

If error messages or malfunctions occur repeatedly during operation, the first thing to do is to pinpoint the exact error. To do that go through the following checklist:

Is the error reproducable?
For that reset the error and try to repeat it under the same conditions. If the error can be reproduced, the next step is to find out during which operating phase the error occurs.

Does the error occur during a certain operating phase (e.g. always during acceleration)?
If so, consult the error messages and remove the causes listed there.

Does the error occur or disappear after a certain time?
That may be an indication for thermal causes. Check, whether the inverter is used in accordance to the ambient conditions and that no moisture condensation takes place.

22.1.2 Error messages and their cause

The status display is divided at COMBIVERT G6 in status, error and warning messages.
Status messages display the actual operating condition of the unit. They have no special identification and are used for information only.
Error messages always consist of the word "Error" and the cause. Error messages cause the immediate deactivation of the modulation. Der Wiederanlauf ist erst nach Reset oder AutoReset möglich. In case of temperature or overload errors it must be waited until the status message appears that the error has been removed. A reset can be carried out only then.
Warning messages always consist of the word "warning" and the cause. How the inverter will behave on warning messages can be defined via parameters in the application mode.
The following table lists the status messages, error messages and finally the warning messages each in alphabetic sequence.

Display	Value	Meaning
Status messages		
calculate drive data	82	Measurement of the motor stator resistance
reverse acceleration	67	Acceleration with the adjusted ramp times in anti-clockwise direction of rotation.
forward acceleration	64	Acceleration with the adjusted ramps in clockwise direction of rotation.
LA Stop	72	This message is displayed if during acceleration the load is limited to the adjusted load level
blockade detected	129	The setpoint must be above the level Pn86. The counter starts if the actual value is below the level. A blockade is recognized if the counter reaches the adjusted time in Pn86. The output function do00…07 = 96 (blockade active) is set. On exceeding the limit, the value of the counter decreases.
continued on the next page		

Display	Value	Meaning
blockade resettable	130	The warning message blockade is no longer available. The message can be reset. The output function do00…07 = 97 "blockade resettable" is set.
close brake	85	Brake control (see chapter "Brake control")
open brake	86	Brake control (see chapter "Brake control")
DC brake	75	Motor is decelerated by DC voltage at the output.
speed search	74	Speed search function active, i.e. the inverter attempts to synchronize onto a running out motor.
no A.STOP overheat int.	92	The temperature in the interior of the inverter is again below the warning threshold.
no A. overheat pow.mod.	88	The heat sink temperature is again below the adjusted warning level.
no A. drive overheat	91	The motor temperature is again below the adjusted warning level. The switch off time is stopped.
no ABN.STOP overload	98	Warning: no more overload, OL counter has reached 0 %, warning „overload" can be reset.
no ABN.STOP overload 2	101	The cooling time after “Warning! Overload during standstill" has elapsed. The warning message can be reset.
hardware current limit	80	The message is output if the output current reaches the hardware current limit.
no ERROR overheat int.	7	No longer overheating in the interior, interior temperature has fallen by at least 3°C, error resettable
No direction of rotation preset, modulation off.	70	No direction of rotation preset, modulation off.
low speed / power off	84	No modulation after power off.
no operation	0	Control release is not set. Terminal ST (for units without safety module) Terminals STO (for units with safety module) Software control release (only in addition with ST or STO)
reverse constant	69	Acceleration / deceleration phase is completed and it is driven with constant speed / frequency in clockwise direction of rotation.
forward constant	66	Acceleration / deceleration phase is completed and it is driven with constant speed / frequency in clockwise direction of rotation.
no E. overheat pow.mod.	36	Temperature of the heat sink is again in the permissible operating range. The error can be reset now.
power unit not ready	13	Power circuit not ready or not identified by the control.
no rotation setting after DC braking	77	Modulation is switched off after DC braking (see chapter brake control).
calc. drive data ready	127	Calculation drive data ready
base block	76	Power modules for motor de-excitation locked
no ERROR drive overheat	11	Motor temperature switch or PTC at the terminals T1/T2 is again in the normal operating range. The error can be reset now.
power off	78	Depending on the programming of the function (see chapter „Power-off function) the inverter restarts automatically upon system recovery or after reset.
quick stop	79	The message is output if the quick stop function becomes active as response to a warning signal.
stall	71	This message is displayed if during constant operation the load is limited to the adjusted current limit.
continued on the next page		

Display	Value	Meaning
no ERROR overload	17	No more overload, OL-counter has reached 0%; after "Error! overload" a cooling phase has to be awaited. This message appears upon completion of the cooling phase. The error can be reset now. The inverter must remain switched on during the cooling phase.
no ERROR overload 2	20	The cooling time has elapsed. The error can be reset.
check STO	131	The safety function is checked (100ms).
reverse deceleration	68	It is stopped with the adjusted ramp times in anti-clockwise direction of rotation.
deceleration forward	65	Forward deceleration with the adjusted ramp times.
Ld stop	73	This message is displayed if during deceleration the load is limited to the adjusted load level or the DC-link current to the adjusted voltage level.
continued on the next page		

Display	Value	Meaning
Error messages		
ERROR calc. drive data	60	Error: During the automatic motor stator resistance measurement.
ERROR output phase fail.	5	Phase loss detection at the output
ERROR blockade	26	A blockade was recognized. Pn85 Bit 4 is at error, no auto-reset.
ERROR brake	56	Error can occur with activated brake control (see chapter brake control) if: • the load during the start is below the min. load level (Pn43) or the missing of a motor phase was detected. • the load is too high and the hardware current limit is reached.
ERROR speed ctrl. lim	25	Speed controller limit reached
ERROR flow control	27	The flow control is activated in Pn91. No input and output for valve control is selected in Pn92 and Pn93.
ERROR input error detect	53	Hardware error at start/stop measurement.
ERROR external fault	31	Is triggered, if a digital input is being programmed as external error input and trips.
ERROR overspeed	58	The speed is outside the defined limits. (can also occur on exceeding of the absolute speed referring to EMF = EMF wrong (servo drives).
ERROR overheat internal	6	Overheating in the interior. Error can only be reset at "no ERROR overheat int." if the interior temperature has dropped by at least 3 °C
ERROR load shunt fault	15	Load-shunt relay has not picked up, occurs for a short time during the switch-on phase, but must automatically be reset immediately. If the error message remains the following causes may be applicable: • load-shunt defective • input voltage wrong or too low • high losses in the supply cable • braking resistor wrongly connected or damaged • braking module defective
ERROR power unit	12	Error: General power circuit fault
ERROR motor protection	30	Electronic motor protective relay has tripped.
ERROR max. acceleration	24	Maximum acceleration exceeded
ERROR drive overheat	9	Error: Overtemperature of motor PTC. Error can only be reset at "no ERROR drive overheat" if PTC is again low-resistance. Causes: • Resistance at terminals T1/T2 >1650 Ohm • Motor overloaded • Line breakage to the temperature sensor
ERROR set selection	39	It has been attempted to select a locked parameter set. Programmed response "Error, restart after reset".
ERROR phase failure	3	One phase of the input voltage is missing (ripple-detection)
ERROR safety	28	Error in a function that is monitored by the optional safety module. See safety instructions mat.no. 00G6N1F-0000. The error „ERROR 28: safety" can not be reset with a digital input. The error can only be reset by switching off and on of the frequency inverter.
ERROR overfrequency	61	Current frequency is above the permissible range.

continued on the next page

Display	Value	Meaning
ERROR overload	16	Overload error can only be reset at "no ERROR overload" if OL-counter reaches 0% again. Occurs, if the overload is longer than the permissible time (see technical data). • mechanical fault or overload in the application • inverter not correctly dimensioned • motor wrongly wired • poor controller adjustment
ERROR overload 2	19	Occurs if the current for zero speed is exceeded (see technical data in the power unit manual). The error can only be reset if the cooling time has elapsed and "no ERROR overload 2" is displayed.
ERROR overpotential	1	Voltage in the DC link circuit too high. Occurs if the DC link voltage exceeds the permissible value. Causes: • bad controller adjustment (overshooting) • input voltage too high • interference voltages at the input • deceleration ramp too short • braking resistor defective or too small
ERROR Overcurrent	4	Occurs, if the specified peak current is exceeded. Causes: • acceleration ramps too short • the load is too big at switched off acceleration stop and switched off constant current limit • short circuit at the output • ground fault • deceleration ramp too short • motor cable too long • EMC • DC brake active at high power (see chapter brake control)
ERROR overheat pow.mod.	8	Overtemperature of power module. The error can only be reset at "no E. overheat pow.mod.". Causes: • insufficient air flow at the heat sink (soiled) • ambient temperature too high • ventilator clogged
ERROR underpotential	2	Error: Undervoltage (DC link circuit). Occurs, if DC link voltage falls below the permissible value. Causes: • input voltage too low or unstable • inverter rating too small • voltage losses through wrong cabling • the supply voltage through generator / transformer breaks down at very short ramps • jump factor (Pn56) too small • if a digital input is programmed as external error input with error message "underpotential" (Pn65).
ERROR bus	18	The adjusted monitoring time (watchdog) of the communication between control board and PC (on an optional fieldbus interface) or between control board and power unit has been exceeded.
Warning messages		
ABN.STOP speed ctrl. lim	107	The speed controller is in limitation. The response to the cause can be programmed with Pn75.
ABN.STOP external fault	90	This warning is triggered via an external input. The response to this warning can be programmed.
continued on the next page		

Display	Value	Meaning
ABN.STOP motor protect.	97	Warning: electronic motor protective relay has tripped. The response to this warning can be programmed.
ABN.STOP drive overheat	96	The motor temperature has exceeded an adjustable warning level (Pn13). The switch off time is started. The response to this warning can be programmed.
ABN.STOP set	102	It has been attempted to select a locked parameter set. The response to this warning can be programmed.
ABN.STOP overload	99	A level between 0 and 100 % of the load counter can be adjusted. The warning is output on exceeding this level. The response to this warning can be programmed.
ABN.STOP overload 2	100	The warning is output when the standstill continuous current is exceeded (see technical data and overload characteristics). The response to this warning can be programmed. The warning message can only be reset after the cooling time has elapsed and "no ABN.STOP overload 2" is displayed.
ABN.STOP overheat int.	87	The temperature in the interior of the inverter is above the permissible level. The switch off time was started. The programmed response to this warning message is executed.
A.STOP overheat pow.mod	89	This warning is output when the defined level is exceeded. Furthermore the response to this warning can be programmed.
ABN.STOP bus	93	Watchdog for the communication between control board and PC (on an optional fieldbus interface) or control board and power unit has responded. The response to this warning can be programmed.

23. Fieldbus

23.1 Available hardware

The following controls are available for the KEB COMBIVERT G6:

	Control type
•	Standard (analog / digital)
•	CANopen
•	IO-Link
•	EtherCAT
•	VARAN

In this chapter there are not any more information on the single controls. The respective installation manual is available at www.keb.de for more information.

23.2 Bus parameters

23.2.1 Inverter address (Sy06)

The address if the inverter shall be responded via „COMBIVIS“ or another control can be adjusted in Sy06. Values between 0 and 239 are possible, the default value is 1. If several inverters are operated on the bus simultaneously, it is absolutely necessary to assign different addresses to them, since otherwise it leads to communication failures, because several inverters may answer at the same time. This parameter is only effective for the diagnostic interface. More information can be found in the description of the DIN 66019II protocol (C0F501I-K001). Sy06 is not reset on loading the default parameters.

23.2.2 Baud rate int. bus (Sy11)

The transmission speed between control board and power unit is determined with the internal baud rate. This parameter can only be read, not written. The following values are possible (unit-dependent):

Sy50: baud rate int. bus	
Value	Description
20: Synchronous 1Mbps / 1ms BCC	Transmission speed between control board and power unit
21: Synchronous 1Mbps / 2ms BCC	
22: Synchronous 1Mbps / 1ms CRC	
23: Synchronous 1Mbps / 2ms CRC	

23.2.3 Watchdog time (Pn06)

For continuous control of the communication (on an optional fieldbus interface) it is possible to trigger an error message of the inverter, without incoming telegrams after expiration of an adjustable time (0.01…40 s). The function can be deactivated by setting the value "off".

23.2.4 Response to error watchdog (Pn05)

This parameter determines the response to a watchdog error. Depending on the selected setting a message error watchdog or warning watchdog is issued.

23.2.5 Watchdog time internal bus (Sy09)

The watchdog function monitors the communication of the internal bus (control board - power unit). After expiration of an adjustble time (0.05...10 s) without incoming telegrams, the response adjusted in Pn05 is triggered. Value „0: off“ deactivates the function.

23.2.6 Auto store (Ud05), auto store state (Ud04)

Ud05 auto store

When supplied by mains voltage, all parameters and operating data are stored when the mains voltage is switched off (inverter state: ERROR underpotential). Manual intervention for data backup by the user is not required.

A complete storage is cyclically performed in 60s cycles with separate voltage supply of the control card (at Ud05 value 1). Wait after the last parameter change at least 60 seconds before the voltage supply is switched off.

Alternatively, manual storing can be released via parameter Ud05. Set Ud05 to value 0. When switching to value 0, it is stored once. „stand by“ is displayed in Ud04 after the storage. When the device is restarted, value 1 is active again in Ud05.

No further parameters are stored in status Ud04 = "stand by"!

Ud05: auto store	
Value	Description
0: act. off/on at power-on	Stores once when switching to value 0. When the device is restarted, value 1 is active again.
1: on (store always)	Stores cyclically every 60s and at inverter state: ERROR underpotential.
2: off (store never)	Stores never

Ud04 auto store state

The status of the storage routine is visible here. The range of the hour meter and error counter is stored in each case approx. every 60s.

Ud04: Ud04 auto store state	
Value	Description
0: Stand by	Parameter storage completed, only operating data are stored.
1: compare	Comparison of the parameters
3: write active	Data are stored
4: secure hour meter	Hour meter is stored

Ud07 memory store input selection

A digital input, which can trigger the storing of all parameters can be selected with Ud07. Parameter Ud05 must be set to value 1, in order that storing occurs via Ud07.

Ud07: memory store input selection			
Bit	Value	Input	Terminal
0	1	ST (prog. input „control release/reset“)	X2A.6
1	2	RST (prog. input „reset“)	X2A.5
2	4	F (prog. input „forward“)	X2A.8
3	8	R (prog. input „reverse“)	X2A.7
4	16	I1 (prog. input 1)	X2A.10
5	32	I2 (prog. input 2)	X2A.9
6	64	I3 (prog. input 3)	X2A.12
7	128	I4 (prog. input 4)	X2A.11
8	256	IA (internal input A)	no
9	512	IB (internal input B)	no
10	1024	IC (internal input C)	no
11	2048	ID (internal input D)	no

23.2.7 Status and control word

The control word is used for state control of the inverter via bus. The actual state of the inverter can be read out with the status word.

The control word low is bit-coded designed as follows.

Sy50: control word low			
Bit	Function	Value	Description
0	Control release	1: ST	This bit is only effective if di01 „„select signal source“ bit 0 is set. Then the AND-operation of this bit with di02 „„digital input setting“ bit 0 is valid.
1	Reset	2: RST	An error reset is carried out when changing from not activated (0) to activated (2).
2	Start / stop	0: Stop	Rotation release or the „start “(„run “) command can be given via the control word, if oP01 „rotation source“ contains the values 6, 8, 9 or 10.
		4: RUN	
3	FOR/REV	0: FOR	If oP01 „rotation source“ contains the values 8 or 9, the direction of rotation is preset via this bit.
		8: REV	
4...6	Parameter set	0: Set 0	Selection of the active parameter set, if value „5: control word (Sy50)“ is programmed in Fr02 „parameter set source".
		16: Set 1	
		32: Set 2	
		48: Set 3	
		64: Set 4	
		80: Set 5	
		96: Set 6	
		112: Set 7	
7	reserved		

continued on the next page

Sy50: control word low			
Bit	Function	Value	Description
8	quick stop on/off	256: quick stop	Triggers quick stop (OR operation with other quick stop sources).
9...15	reserved		

Sy41: control word high			
Bit	Function	Value	Description
16	I1	1: I1	Corresponding input is set via the control word instead via hardware input. These bits are only effective if in di01 „„select signal source“ the bit for the appropriate input is set. Then the OR connection of this bit with the appropriate bits of parameter di02 „digital input setting“ is valid.
17	I2	2: I2	
18	I3	4: I3	
19	I4	8: I4	
20	IA	16: IA	
21	IB	32: IB	
22	IC	64: IC	
23	ID	128: ID	
24	O1	256: O1	Appropriate output is set via the control word or via the switching conditions. Output signals O1, O2, R1 and R2 (visible in parameter ru80) are OR operated with the appropriate bits of the control word. The connection occurs according di42 „inverted outputs“ (inverting level for the output signals) and before they are switched with do51 „hardware output allocation“ to the hardware outputs.
25	O2	512: O2	
26	R1	1024: R1	
27	R2	2048: R2	
28...31	reserved		

Control word long Sy43
The control word long (32 Bit) consists of Sy50 and Sy41.

Status word low Sy51
The actual state of the inverter can be read out with the status word.

Sy51: status word low		
Bit	Value	Description
0	1: ST	1= set control release (AND connection with di01 bit 0)
1	2: Error	Inverter is in error state
2	0: Stop	The modulation is switched off with „stop“ and switched on with „start“.
	4: Start	
3	0: FOR	Display of the actual direction of rotation
	8: REV	
continued on the next page		

Sy51: status word low		
Bit	Value	Description
4...6	0: Set 0	Display of the actual parameter set
	16: Set 1	
	32: Set 2	
	48: Set 3	
	64: Set 4	
	80: Set 5	
	96: Set 6	
	112: Set 7	
7	128: act. value = set value	ru07 „actual value display“ has with a hysteresis of +/- LE16 „frequence/speed hysteresis“ the same value as ru01 „set value display“.
8	256: quick stop	Quick stop is active
9	512: HSP5 bus synchron	Inverter is in bus synchron operation (between control card and power unit)
10...14	reserved	
15	32768: internal limit	The speed setpoint or any controller (e.g. current, flux, speed or external PID controller) is in limitation (also in V/f characteristic open-loop operation)

Status word high Sy42
The status word high is bit-coded designed as follows.

Sy42: status word high		
Bit	Value	Explanation
0...7	1: I1	Display of the internal input terminal status (input terminals and software inputs after the input processing block). Corresponds to the display in ru22 „internal input state“.
	2: I2	
	4: I3	
	8: I4	
	16: IA	
	32: IB	
	64: IC	
	128: ID	
8...15	256: O1	Display of the state of the output terminals and software outputs (digital outputs after the output proccessing block). Corresponds to the display in ru25 „output terminal state“.
	512: O2	
	1024: R1	
	2048: R2	
	4096: OA	
	8192: OB	
	16384: OC	
	32768: OD	

The watchdog (Pn06) must be active at control via bus (via control word).

Status word long Sy44
The control word long (32 Bit) consists of Sy51 and Sy42.

23.2.8 Speed setting via bus

Set speed value Sy52

Setting of the set speed value in the range of ±32000 rpm. The rotation source is determined via oP01 like the other absolute reference sources. The reference source oP00 must be set to „5“ for setpoint setting via Sy52.

Actual speed value Sy53

The actual speed can be read out in rpm with this parameter. The direction of rotation is signalled by the sign.

23.3 Description of the DSP402 parameters

23.3.1 Description of the state machine

The state machine provides information about the actual operating state of the drive and describes the change between the operating states. The state machine is controlled via pr64 control word and internal events (e.g. occurrence of an error). The actual state is displayed via pr65 status word. The following block diagram displays the state machine. The states are also displayed in english in the german documentation with the original english designations, since these became generally accepted also in German-speaking areas.

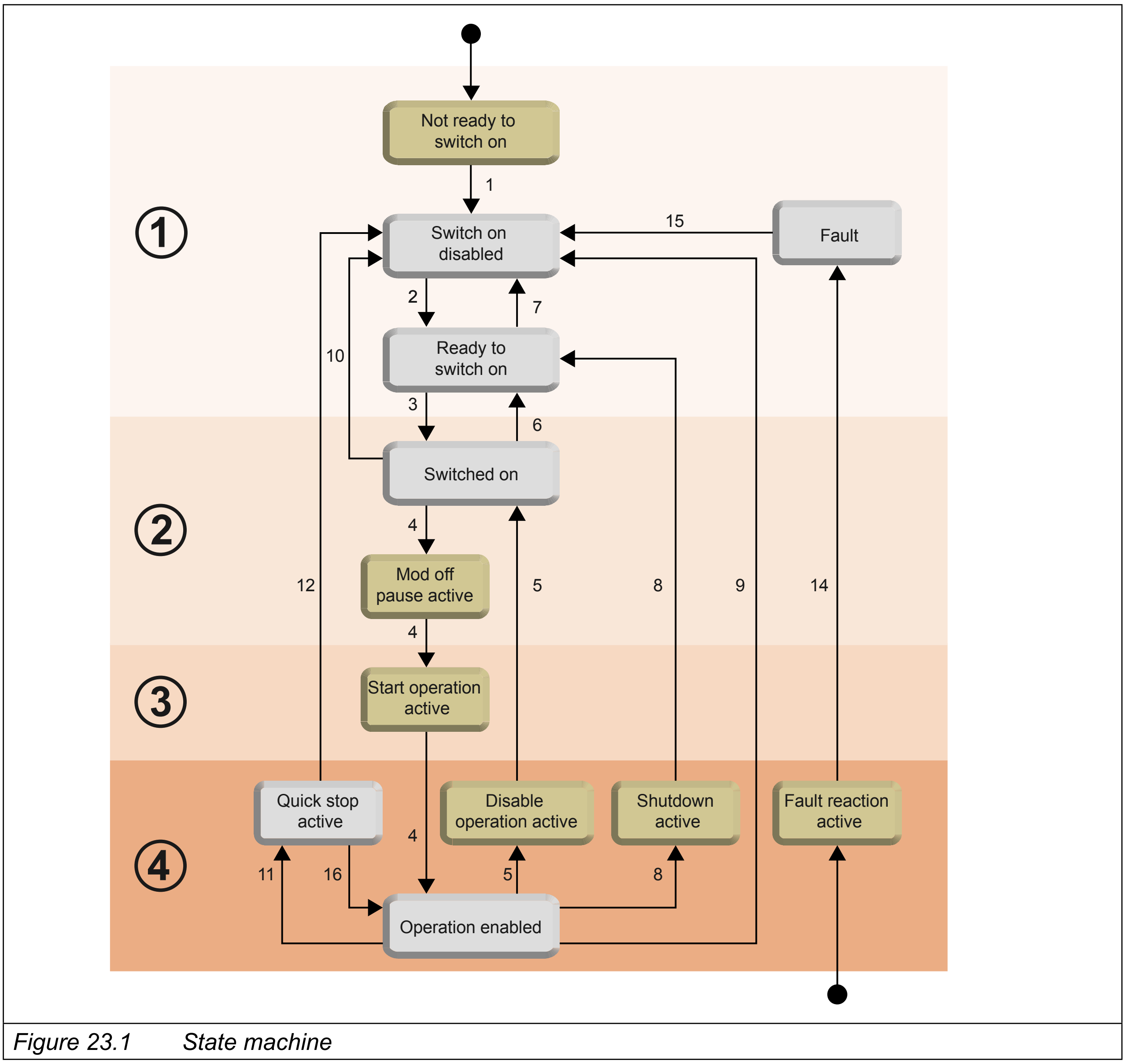


Figure 23.1 State machine

Legend

1 24V control voltage applied; voltage power unit can be applied

2 Voltage power unit applied; no torque at the motor

3 Voltage power unit applied; Torque can be applied (flux build-up, speed search etc.)

4 Torque at the motor

Not ready to switch on:

This state is pass through after switching on the control voltage (initialisation of the control hard and software). After completion of the initialisation the unit changes automatically into state Switch on disabled.

Switch on disabled:

The state Switch on disabled is reached, when:

- the initialisation is completed (1).
- an error reset was successful (15).
- bit Enable voltage is set to 0 in pr64 control word (9,10).
- the control release (release at safety module) is not preset (9,10).
- the charging of the DC link is not completed (Supply Error Chain).
- the bit of state quick stop active is set to 1.

Ready to switch on:

The state Ready to switch on is reached, when:

- Bit Enable voltage is set to 1 in state Switch on disabled (2).
- Bit Switch on is set to 0 in state Switched on (6).
- Bit Switch on is set to 0 in state Operation enabled (8).

Switched on:

The state Switched on is reached, when:

- Bit Switch on is set to 1 in state Ready to switch on (3).
- Bit Enable operation is set to 0 in state Operation enabled (5).

The state Switched on can only be reached with voltage supply at the power unit.

Mod off pause active:

This state is reached, when:

- Bit Enable operation is set to 1 in state Switched on (4).

If the minimum off time of the unit is up, the drive changes into state Start operation active.

Start operation active:

This state is reached, when:

- Bit Enable operation is set to 1 in state Switched on (4) and the minimum turn-off time of the unit is up.

In state Start operation active the operations which are required for the start of the drive control are done by the drive. Which operations are executed is dependent on the used motor type, the control mode and the application-dependent parameterization of the unit.

Possible functions are:

- Structure of the magnetic flux (asynchronous machine), determination of the rotor position (encoderless control method) etc.

After completion of these functions the drive changes into state Operation enabled.

Operation enabled:

The state Operation enabled is reached, when:

- Bit Enable operation is set to 1 in state Switched on (4) and both the minimum turn-off time is up and also the start operations were executed.

Quick stop active:

The state Quick stop active is reached, when:

- the state Operation enabled is active and the bit for quick stop is set (11)

Fault reaction active:

The state Fault reaction active is reached, when:

- an error occurs.

Fault:

The state Fault is reached, when:

- the error response is completed.

23.3.2 Device Control mode

Parameter pr63 displays the actual error state of the drive converter. This parameter is internally displayed in ru00.

pr63: DSP402 Error Code				
Index (Hex address)	read / write permission	Bit	Value	Description
0x603F	Read_only	0...15	0...65535	The error state is output in hex form

List of error messages in pr63

Error state / display	Value in ru00	Error code in pr63
ERROR overpotential	1	3210h
ERROR underpotential	2	3220h
ERROR phase failure	3	1000h
ERROR overcurrent	4	2300h
ERROR output phase fail.	5	1000h
ERROR overheat internal	6	4110h
no ERROR overheat int.	7	4110h
ERROR overheat pow.mod.	8	4210h
ERROR drive overheat	9	4310h
no ERROR drive overheat	11	4310h
ERROR Power unit	12	5400h
ERROR overload	16	3230h
no ERROR overload	17	3230h
ERROR bus	18	1000h
ERROR overload 2	19	3230h
no ERROR overload 2	20	3230h
		continued on the next page

Error state / display	Value in ru00	Error code in pr63
ERROR max. acceleration	24	-
ERROR ABN.STOP speed ctrl. lim	25	-
ERROR blockade	26	7121h
ERROR flow control	27	-
ERROR Safety	28	-
ERROR motor protection	30	1000h
ERROR external fault	31	1000h
no E. overheat pow.mod.	36	4210h
ERROR parameter set selection	39	1000h
ERROR brake	56	1000h
ERROR overspeed	58	1000h
ERROR calc. drive data	60	-
ERROR overfrequency	61	-
check STO	131	1000h

Status and warning messages are displayed in parameter pr63 with the Code „0000h“.

Parameter pr64 is used to change the state control of the inverter. The parameter is bit-coded. This parameter is internally displayed on Sy50.

pr64: DSP402 control word				
Index (Hex address)	read / write permission	Bit	Value	Description
0x6040	Read_Write	0	0: no condition	No condition is set
			1: switch on	Command to the state change (see below)
		1	2: enable voltage	Command to the state change (see below)
		2	4: no quick stop	
		3	8: enable operation	Command to the state change (see below)
		7	128: fault reset	Command to the state change (see below)

Using bits 0...3 and 7 commands for changing the state						
Command	Bits in the control word					Change
	Fault reset	Enable operation	Quick stop	Enable voltage	Switch on	
Shutdown	0	x	1	1	0	2,6,8
Switch on	0	0	1	1	1	3
Disable voltage	0	x	x	0	x	7,9,10,12
Quick stop	0	X	0	1	X	7,10,11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4, 16
Fault reset	↑	x	x	x	x	15

Parameter pr65 displays the actual state of the inverter. The parameter is bit-coded.

pr65: DSP402 Status word				
Index (Hex address)	read / write permission	Bit	Value	Description
0x6041	Read_only	0	0: no condition	No condition is set
			1: ready to switch on	Display of the actual state (see below)
		1	2: switched on	Display of the actual state (see below)
		2	4: operation enabled	Display of the actual state (see below)
		3	8: fault	1 = fault
		4	16: voltage enabled	1 = Operating voltage in the power circuit OK
		5	32: no quick stop	Quick stop is not active
		6	64: switch on disabled	Display of the actual state (see below)
		10	1024: Target reached	Target reached
		11	2048: Internal limit active	Internal limit reached.

The modulation must be switched on within 100ms after setting the control release. Non-observance can lead to temporary deactivation of the control release during "STO test cycle". This can be seen in parameter pr65.

Determination of the actual state of the state machine from the status word

Statusword	State of the state machine
xxxx xxxx x0xx 0000	Not ready to switch on
xxxx xxxx x1xx 0000	Switch on disabled
xxxx xxxx x01x 0001	Ready to switch on
xxxx xxxx x01x 0011	Switched on
xxxx xxxx x01x 0111	Operation enabled
xxxx xxxx x00x 0111	Quick stop active
xxxx xxxx x0xx 1111	Fault reaction active
xxxx xxxx x0xx 1000	Fault

Parameter pr96 serves for setting the DSP402 operation mode.

pr96: DSP402_ModesOfOperation				
Index (Hex address)	read / write permission	Bit	Value	Description
0x6060	Read_Write	...	-1: Profile mode off	The profile mode is switched off
		1	2: Velocity mode	Setting the target speed by the control. Generation of the speed profile in the drive. Speed and torque control in the drive

Parameter pr97 displays the selected mode in pr96.

pr97: DSP402_ModesOfOperDispl.				
Index (Hex address)	read / write permission	Bit	Value	Description
0x6061	Read_only	...	-1: Profile mode off	The profile mode is switched off
		1	2: Velocity mode	Setting the target speed by the control. Generation of the speed profile in the drive. Speed- and torque control in the drive

23.3.3 Velocity mode

In order to avoid malfunction of the inverter, first the dr parameters must be written and then all pr parameters or the switch off / on the device.

Parameter pr66 specifies the set speed. This parameter is internally displayed on Sy52

pr66: VL_TargetVelocity				
Index (Hex address)	read / write permission	Bit	Value	Description
0x6042	Read_Write	...	-32000...32000	Setting of the set speed value in the range of ±32000 rpm

Parameter pr67 displays the ramp output. The display is indicated in speed in v/f operation. This parameter is internally displayed on ru02.

pr67: VL_VelocityDemand				
Index (Hex address)	read / write permission	Bit	Value	Description
0x6043	Read_only	...	-32000...32000 rpm	Display of the ramp output

Parameter pr68 displays the actual speed. This parameter is internally displayed on Sy53.

pr68: VL_ControlEffort				
Index (Hex address)	read / write permission	Bit	Value	Description
0x6044	Read_only	...	-32000...32000 rpm	Display of the actual speed

Parameters pr70...pr74 must be converted in rpm in v/f mode.

The min. and the max. set value can be preset with parameter pr70. The set value is valid for reverse and forward rotation. Subindex 1 of this parameter is internally displayed on oP06 and oP07. Subindex 2 of this parameter is internally displayed on oP10 and oP11.

pr68: vl velocity min max amount					
Index (Hex address)	read / write permission	Bit	Subindex	Value	Description
0x6046	Read_Write	...	1	100...(variable [1])	The min. set value can be set in subindex 1.
			2		The max. set value can be set in subindex 2.

Parameters of oP14 and oP15 apply primarily for pr70 and must be adapted additionally.

The acceleration ramp can be adjusted with parameter pr72. The acceleration ramp is valid for reverse and forward rotation. Both, linear ramps and s-curves can be driven (the oP parameters are considered for the s-curves).

pr72: vl velocity accelaration					
Index (Hex address)	read / write permission	Bit	Subindex	Value	Description
0x6048	Read_Write	...	1	100...(variable [1])	The reference speed can be adjusted in subindex 1. It refers to the adjusted ramp time in subindex 2.
			2	0...300s	The ramp time can be adjusted in subindex 2. It refers to the adjusted speed in subindex 1.

The deceleration ramp can be adjusted with parameter pr73. The deceleration ramp is valid for reverse and forward rotation. Both, linear ramps and s-curves can be driven (the oP parameters are considered for the s-curves).

pr73: vl velocity deceleration					
Index (Hex address)	read / write permission	Bit	Subindex	Value	Description
0x6049	Read_Write	...	1	100...(variable [1])	The reference speed can be adjusted in subindex 1. It refers to the adjusted ramp time in subindex 2.
			2	0...300s	The ramp time can be adjusted in subindex 2. It refers to the adjusted speed in subindex 1.

The quick stop ramp can be adjusted with parameter pr74. The quick stop ramp is valid for reverse and forward rotation.

pr74: vl velocity quick stop					
Index (Hex address)	read / write permission	Bit	Subindex	Value	Description
0x604A	Read_Write	...	1	100...(variable [1])	The reference speed can be adjusted in subindex 1
			2	0...300s	The ramp time can be adjusted in subindex 2.

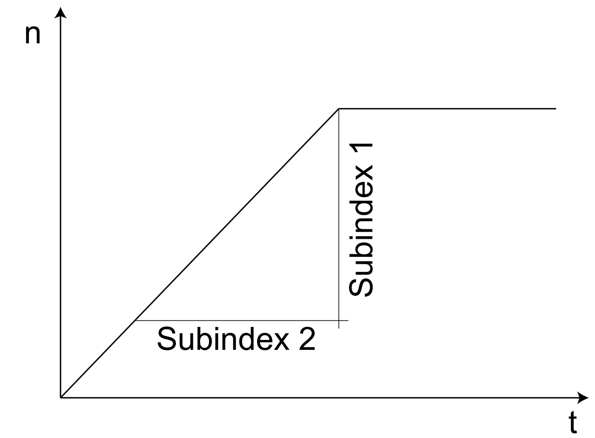


Figure 23.2 Exemplary presentation for pr72, pr73 und pr74

1) The max. speed value of parameters pr70, pr72, pr73 and pr74 is variable. In v/f operation the max. value is dependent on the output frequency in relation to the pole-pair number. In closed-loop operation the max. value is dependent on the adjusted speed mode in Ud02.

For a detailed description of the ramps see Chapter 10.7.2.1 "Linear ramps".

The pole no. can be adjusted with parameter pr77. In order that the correct output frequency can be output, the correct pole no. must be adjusted (not the pole-pair number!). This parameter is internally not displayed on the inverter.

pr77: vl pole number				
Index (Hex address)	read / write permission	Bit	Value	Description
0x604D	Read_Write	...	2...62	Only even numerical values may be indicated.

Parameter pr77 is not active in closed-loop operation. The pole no. is calculated from the motor data in closed-loop operation.

Parameter oP04 can select the parameter to be used as source for the respective setting (e.g. direction of rotation).

<table>
<tr><th colspan="4">oP04: VL mode options</th></tr>
<tr><th>Bit</th><th>Description</th><th>Value</th><th>Function</th></tr>
<tr><td rowspan="2">0</td><td rowspan="2">ref. rotation source</td><td>0: VL mode pr66</td><td rowspan="10">At oP04 = value 0:
The adjusted values of the pr parameters are used.

At oP04 > value 0:
The described set-dependent parameters are used.</td></tr>
<tr><td>1: oP00 / oP01</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">min. max. source</td><td>0: VL mode pr70</td></tr>
<tr><td>2: oP06 / oP10</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">ACC / DEC source</td><td>0: VL mode pr72 / pr73</td></tr>
<tr><td>4: oP28 / oP30</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">quick stop source</td><td>0: VL mode pr74</td></tr>
<tr><td>8: Pn60</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">PPZ source</td><td>0: VL mode pr77</td></tr>
<tr><td>16: dr01 / dr05</td></tr>
</table>

24. Parameter Overview

24.1 Parameter

24.1.1 Parameter groups

All available parameter groups and the corresponding abbreviations of the COMBIVERT G6 are listed in this table.

Parameter groups	
Abbreviations	Parameter group name
AA	Adjustment / Assistant parameter
An	Analog inputs / outputs
cn	Technology control
cS	Control parameters
di	Digital inputs
do	Digital outputs
dr	Motor data
dS	Drive-dependent controller
Ec	Encoder parameters
Fh	Filter parameters
Fr	Parameter sets
In	Unit-Specific data
LE	Switching level / timer
nn	Motor model parameters
oP	Set values / ramps
pd	Fieldbus parameters
Pn	Protection / Special function
PP	Prog. parameters
Pr	DSp402 parameters
ru	Operating data - displays
Sy	System parameters
Ud	Operating surface
uF	V / f-characteristic / modulation

24.1.2 Parameter listing

Legend

Parameter: Parameter group, number and name (ordered by parameter group and number)

Addr.: parameter address in hex

R: Password level: appl => Application: ro => Cp read only

P: p => set-programmable; np => not set-programmable

E: E => Enter-parameter

Lower limit: Min. value (normalized); the non-normalized value results on division by the step range

Upper limit: max. value (normalized); the non-normalized value results on division by the step range

Step: Step size, resolution

Default: Default value (normalized); the non-normalized value results on division by the step range
LTK => the default value is dependent on the power circuit identification

Unit: Unit

Reference: further information to this parameter on stated page (not chapter)

BA: Operating mode: G => v / f; M => ASCL; S => SCL; ALL => All operating modes

Parameter		Addr.	BA	R	P	E	Lower limit	Upper limit	Default	Step	Unit
AA16	speed diff. filter	3210h	ALL	appl	np	---	0	1	0	1	---
AA59	modus iSd_ref	323Bh	S	appl	np	---	0	6	0	1	---
AA60	pT1-Tau isd_ref	323Ch	S	appl	np	---	0	65535	1024	1	---
AA61	appc./act. torque pT1-time	323Dh	ALL	appl	np	---	0	10	3	1	---
AA64	act. value. pT1-time	3240h	ALL	appl	np	---	0	10	0	1	---
AA76	reset error flags	324Ch	ALL	appl	np	---	0	4	0	1	---
AA77	error flags 1	324Dh	ALL	appl	np	---	0	2147483648	0	1	---
AA78	error flags 2	324Eh	ALL	appl	np	---	0	2147483648	0	1	---
An00	AN1 interface selection	2A00h	ALL	appl	np	E	0	2	0	1	---
An01	AN1 noise filter	2A01h	ALL	appl	np	E	0	6	0	1	---
An02	AN1 save mode	2A02h	ALL	appl	np	E	0	3	0	1	---
An03	AN1 save trig. inp. sel.	2A03h	ALL	appl	np	E	0	4095	0	1	---
An04	AN1 zero clamp	2A04h	ALL	appl	np	---	-10.0	10.0	0.2	0.1	%
An05	AN1 gain	2A05h	ALL	appl	p	---	-20	20	1	0.01	---
An06	AN1 offset X	2A06h	ALL	appl	p	---	-100	100	0	0.1	%
An07	AN1 offSet Y	2A07h	ALL	appl	p	---	-100	100	0	0.1	%
An08	AN1 lower limit	2A08h	ALL	appl	p	---	-400	400	-400	0.1	%
An09	AN1 upper limit	2A09h	ALL	appl	p	---	-400	400	400	0.1	%
An10	AN2 interface selection	2A0Ah	ALL	appl	np	E	0	2	0	1	---
An11	AN2 noise filter	2A0Bh	ALL	appl	np	E	0	6	0	1	---
An12	AN2 save mode	2A0Ch	ALL	appl	np	E	0	3	0	1	---
An13	AN2 save trig. input selection	2A0Dh	ALL	appl	np	E	0	4095	0	1	---
An14	AN2 zero clamp	2A0Eh	ALL	appl	np	---	-10.0	10.0	0.2	0.1	%
An15	AN2 gain	2A0Fh	ALL	appl	p	---	-20	20	1	0.01	---
An16	AN2 offset X	2A10h	ALL	appl	p	---	-100	100	0	0.1	%
An17	AN2 offset Y	2A11h	ALL	appl	p	---	-100	100	0	0,1	%
An18	AN2 lower limit	2A12h	G	appl	p	---	-400	400	-400	0.1	%
An18	AN2 lower limit	2A12h	M, S	appl	p	---	-400	400	0	0.1	%
An19	AN2 upper limit	2A13h	ALL	appl	p	---	-400	400	400	0.1	%
An30	sel. REF input / AUX-funct.	2A1Eh	ALL	appl	p	E	0	22527	2112	1	---
An31	ANOUT1 function	2A1Fh	ALL	appl	p	E	0	29	2	1	---
An32	ANOUT1 value	2A20h	ALL	appl	p	---	-100	100	0	0.1	%
An33	ANOUT1 gain	2A21h	ALL	appl	p	---	-20	20	1	0.01	---
An34	ANOUT1 offset X	2A22h	ALL	appl	p	---	-100	100	0	0.1	%
An35	ANOUT1 offset Y	2A23h	ALL	appl	p	---	-100	100	0	0.1	---
An36	ANOUT2 function	2A24h	ALL	appl	p	E	0	29	6	1	---
An37	ANOUT2 value	2A25h	ALL	appl	p	---	-100	100	0	0.1	%
An38	ANOUT2 gain	2A26h	ALL	appl	p	---	-20	20	1	0.01	---
An39	ANOUT2 offset X	2A27h	ALL	appl	p	---	-100	100	0	0.1	%
An40	ANOUT2 offset Y	2A28h	ALL	appl	p	---	-100	100	0	0.1	%
An41	ANOUT3 function	2A29h	ALL	appl	np	E	0	29	12	1	---
An42	ANOUT3 value	2A2Ah	ALL	appl	np	---	-100	100	0	0.1	%
An43	ANOUT3 gain	2A2Bh	ALL	appl	np	---	-20	20	1	0.01	---
An44	ANOUT3 offset X	2A2Ch	ALL	appl	np	---	-100	100	0	0.1	%
An45	ANOUT3 offset Y	2A2Dh	ALL	appl	np	---	-100	100	0	0.1	%
An46	ANOUT3 period	2A2Eh	ALL	appl	np	E	1	240	1	1	s
An47	ANOUT4 function	2A2Fh	ALL	appl	np	E	0	29	12	1	---
An48	ANOUT4 value	2A30h	ALL	appl	np	---	-100	100	0	0.1	%
An49	ANOUT4 gain	2A31h	ALL	appl	np	---	-20	20	1	0.01	---
An50	ANOUT4 offset X	2A32h	ALL	appl	np	---	-100	100	0	0.1	%
An51	ANOUT4 offset Y	2A33h	ALL	appl	np	---	-100	100	0	0.1	%

continued on the next page

Parameter		Addr.	BA	R	P	E	Lower limit	Upper limit	Default	Step	Unit
An52	ANOUT4 period	2A34h	ALL	appl	np	E	1	240	1	1	s
An53	an. para setting source	2A35h	ALL	appl	np	E	0	5	0	1	---
An54	an. para setting dest.	2A36h	ALL	appl	np	E	-1	32767	-1	1	---
An55	an. para. setting offset	2A37h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
An56	an. para setting max. value	2A38h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
An57	an. para set. set pointer	2A39h	ALL	appl	np	E	-1	7	0	1	---
cn00	PID reference source	2700h	ALL	appl	p	---	0	4	0	1	---
cn01	PID abs. reference	2701h	ALL	appl	p	---	-400	400.0	0	0.1	%
cn02	PID act. value src.	2702h	ALL	appl	p	---	0	8	0	1	---
cn03	PID abs. act. value	2703h	ALL	appl	np	---	-400	400.0	0	0.1	-%
cn04	PID kp	2704h	ALL	appl	p	---	0	250.00	0	0.01	---
cn05	PID ki	2705h	ALL	appl	p	---	0	30.000	0	0.001	---
cn06	PID kd	2706h	ALL	appl	p	---	0	250.00	0	0.01	---
cn07	PID pos. limit	2707h	ALL	appl	p	---	-400	400.0	400	0.1	%
cn08	PID neg. limit	2708h	ALL	appl	p	---	-400	400.0	-400	0.1	%
cn09	PID fading time	2709h	ALL	appl	p	---	-1	300.00	0	0.01	s
cn10	PID reset condition	270Ah	ALL	appl	p	---	0	2	0	1	---
cn11	PID reset 2 input sel.	270Bh	ALL	appl	np	E	0	4095	0	1	---
cn12	I reset inp. sel.	270Ch	ALL	appl	np	E	0	4095	0	1	---
cn13	fade in reset inp. sel.	270Dh	ALL	appl	np	E	0	4095	0	1	---
cn14	PID out freq at 100%	270E	G	appl	p		-400	400	0	0.0125	Hz
cS00	speed control configuration	2F00h	G, M	appl	p	E	0	127	0	1	---
cS00	speed control configuration	2F00h	S	appl	p	E	4	6	4	1	---
cS01	act. source	2F01h	G, S	appl	p	E	0	6	2	1	---
cS01	act. source	2F01h	M	appl	p	E	0	6	0	1	---
cS03	slipcom. regen. gain (vvc)	2F03h	G, M	appl	p	---	0.5	2.5	1	0.01	---
cS04	speed ctrl. limit (vvc)	2F04h	G	appl	p	---	0	200	25	0.0125	Hz
cS04	speed ctrl. limit (vvc)	2F04h	M	appl	p		0	4000	750	0.125	rpm
cS05	speed kp/ki modus	2F05h	M, S	appl	p	E	0	3	0	1	---
cS06	KP speed	2F06h	G	appl	p	---	0	32767	300	1	---
cS06	KP speed	2F06h	M, S	appl	p	---	0	32767	50	1	---
cS07	KP speed gain/pk gain%	2F07h	M, S	appl	p	---	0	32767	0	1	---
cS08	KP speed limit /hi gain%	2F08h	M, S	appl	p	---	0	32767	0	1	---
cS09	KI speed	2F09h	G	appl	p	---	0	32767	500	1	---
cS09	KI speed	2F09h	M, S	appl	p	---	0	32767	100	1	---
cS10	KI offset	2F0Ah	M, S	appl	p	---	0	32767	0	1	---
cS11	max. speed for max KI	2F0Bh	M, S	appl	p	---	-1	16000	10	1	rpm
cS12	min speed for cS09	2F0Ch	M, S	appl	p	---	0	16000	500	1	rpm
cS13	max speed for q.f.	2F0Dh	M, S	appl	p	---	0	32000	32000	1	rpm
cS14	speed for q.f.	2F0Eh	M, S	appl	p	---	0	32000	500	1	rpm
cS15	torque reference source	2F0Fh	M, S	appl	p	E	0	6	2	1	---
cS16	torque acc. time	2F10h	M, S	appl	p	---	0	60000	0	1	ms
cS18	torque ref. setting %	2F12h	M, S	appl	p	---	-100	100	100	0.1	%
cS19	abs. torque ref	2F13h	M, S	appl	p	---	-32000	32000	LTK	0.01	Nm
cS20	torque limit for. mot.	2F14h	M, S	appl	p	---	-1	32000	-1	0.01	Nm
cS21	torque limit rev. mot.	2F15h	M, S	appl	p	---	-1	32000	-1	0.01	Nm
cS22	torque limit for. gen.	2F16h	M, S	appl	p	---	-1	32000	-1	0.01	Nm
cS23	torque limit rev. gen.	2F17h	M, S	appl	p	---	-1	32000	-1	0.01	Nm
cS24	stand still pos.	2F18h	M, S	appl	p	---	0	32767	0	1	---
cS25	inertia (kg*cm^2)	2F19h	M, S	appl	p	---	0	10737418,23	0	0.01	---
cS26	optimisation	2F1Ah	M, S	appl	p	E	19	150	19	0.1	---
cS27	pretorque speed PT1-time	2F1Bh	M, S	appl	p	---	0	9	3	1	---
cS28	pretorque speed fact.	2F1Ch	M, S	appl	p	---	0	200	0	0.1	%
cS29	act. curr. ref. PT1-time	2F1Dh	M, S	appl	p	---	0	9	0	1	---
cS30	speed ref. PT1-time	2F1Eh	M, S	appl	np	---	0	16383.75	0	0.25	ms
cS31	spline pret. PT1-time	2F1Fh	M, S	appl	np	---	0	16383.75	0	0.25	ms
cS32	spline speed. ref. PT1	2F10h	M, S	appl	np	---	0	16383.75	0	0.25	ms
di01	select signal source	2B01h	ALL	appl	np	E	0	4095	0	1	---
di02	digital input setting	2B02h	ALL	appl	np	E	0	4095	0	1	---
di03	digital noise filter	2B03h	ALL	appl	np	E	0	127	0	1	ms
di04	input logic	2B04h	ALL	appl	np	E	0	4095	0	1	---
di05	Input trigger	2B05h	ALL	appl	np	E	0	4095	0	1	---
di06	select strobe source	2B06h	ALL	appl	np	E	0	4095	0	1	---
di07	strobe mode	2B07h	ALL	appl	np	E	0	2	0	1	---
di08	input strobe dependence	2B08h	ALL	appl	np	E	0	4095	0	1	---
di09	reset input selection	2B09h	ALL	appl	np	E	0	4095	3	1	---
di10	neg. slope f. reset inputs	2B0Ah	ALL	appl	np	E	0	4095	3	1	---
di11	I1 functions	2B0Bh	ALL	appl	np	E	-2147483648	2147483647	1	1	---
di12	I2 functions	2B0Ch	ALL	appl	np	E	-2147483648	2147483647	2	1	---
di13	I3 functions	2B0Dh	ALL	appl	np	E	-2147483648	2147483647	8192	1	---
di14	I4 functions	2B0Eh	G	appl	np	E	-2147483648	2147483647	512	1	---
di14	I4 functions	2B0Eh	M, S	appl	np	E	-2147483648	2147483647	0	1	---

continued on the next page

Parameter		Addr.	BA	R	P	E	Lower limit	Upper limit	Default	Step	Unit
di15	IA functions	2B0Fh	ALL	appl	np	E	-2147483648	2147483647	0	1	---
di16	IB functions	2B10h	ALL	appl	np	E	-2147483648	2147483647	0	1	---
di17	IC functions	2B11h	ALL	appl	np	E	-2147483648	2147483647	0	1	---
di18	ID functions	2B12h	ALL	appl	np	E	-2147483648	2147483647	0	1	---
di19	FOR functions	2B13h	ALL	appl	np	E	-2147483648	2147483647	32	1	---
di20	REV functions	2B14h	ALL	appl	np	E	-2147483648	2147483647	64	1	---
di21	RST functions	2B15h	ALL	appl	np	E	-2147483648	2147483647	128	1	---
di22	ST functions	2B16h	ALL	appl	np	E	-2147483648	2147483647	128	1	---
di24	I1 prog. function	2B18h	ALL	appl	np	E	0	22	0	1	---
di25	I2 prog. function	2B19h	ALL	appl	np	E	0	22	0	1	---
di26	I3 prog. function	2B1Ah	ALL	appl	np	E	0	22	0	1	---
di27	I4 prog. function	2B1Bh	ALL	appl	np	E	0	22	0	1	---
di28	IA prog function	2B1Ch	ALL	appl	np	E	0	22	0	1	---
di29	IB prog. function	2B1Dh	ALL	appl	np	E	0	22	0	1	---
di30	IC prog. function	2B1Eh	ALL	appl	np	E	0	22	0	1	---
di31	ID prog. function	2B1Fh	ALL	appl	np	E	0	22	0	1	---
di32	FOR prog. function	2B20h	ALL	appl	np	E	0	22	0	1	---
di33	REV prog. function	2B21h	ALL	appl	np	E	0	22	0	1	---
di34	RST prog. function	2B22h	ALL	appl	np	E	0	22	0	1	---
di35	ST prog. function	2B23h	ALL	appl	np	E	0	22	0	1	---
di36	software ST input sel.	2B24h	ALL	appl	np	E	0	4095	0	1	---
di37	ST lock input sel.	2B25h	ALL	appl	np	E	0	4095	0	1	---
di38	turn off ST delay time	2B26h	ALL	appl	np	---	0	10	0	0.1	s
di39	disable dig. ST inp.sel.	2B27h	ALL	appl	np	E	0	4095	0	1	---
di40	I1 activation delay	2B28h	ALL	appl	np	---	0	32.00	0	0.01	s
di41	I1 deactivation delay	2B29h	ALL	appl	np	---	0	32.00	0	0.01	s
di42	I2 turn on delay time	2B2Ah	ALL	appl	np	---	0	32.00	0	0.01	s
di43	I2 deactivation delay	2B2Bh	ALL	appl	np	---	0	32.00	0	0.01	s
di44	I3 turn on delay time	2B2Ch	ALL	appl	np	---	0	32.00	0	0.01	s
di45	I3 deactivation delay	2B2Dh	ALL	appl	np	---	0	32.00	0	0.01	s
di46	I4 turn on delay time	2B2Eh	ALL	appl	np	---	0	32.00	0	0.01	s
di47	I4 deactivation delay	2B2Fh	ALL	appl	np	---	0	32.00	0	0.01	s
di48	IA turn on delay time	2B30h	ALL	appl	np	---	0	32.00	0	0.01	s
di49	IA deactivation delay	2B31h	ALL	appl	np	---	0	32.00	0	0.01	s
di50	IB turn on delay time	2B32h	ALL	appl	np	---	0	32.00	0	0.01	s
di51	IB deactivation delay	2B33h	ALL	appl	np	---	0	32.00	0	0.01	s
di52	IC turn on delay time	2B34h	ALL	appl	np	---	0	32.00	0	0.01	s
di53	IC deactivation delay	2B35h	ALL	appl	np	---	0	32.00	0	0.01	s
di54	ID turn on delay time	2B36h	ALL	appl	np	---	0	32.00	0	0.01	s
di55	ID deactivation delay	2B37h	ALL	appl	np	---	0	32.00	0	0.01	s
do00	condition 0	2C00h	ALL	appl	p	E	0	101	20	1	---
do01	condition 1	2C01h	ALL	appl	p	E	0	101	3	1	---
do02	condition 2	2C02h	ALL	appl	p	E	0	101	4	1	---
do03	condition 3	2C03h	K	appl	p	E	0	101	27	1	---
do03	condition 3	2C03h	L, P	appl	p	E	0	101	2	1	---
do04	condition 4	2C04h	ALL	appl	p	E	0	101	0	1	---
do05	condition 5	2C05h	ALL	appl	p	E	0	101	0	1	---
do06	condition 6	2C06h	ALL	appl	p	E	0	101	0	1	---
do07	condition 7	2C07h	ALL	appl	p	E	0	101	0	1	---
do08	inv. cond. for flag 0	2C08h	ALL	appl	p	E	0	255	0	1	---
do09	inv. cond. for flag 1	2C09h	ALL	appl	p	E	0	255	0	1	---
do10	inv. cond. for flag 2	2C0Ah	ALL	appl	p	E	0	255	0	1	---
do11	inv. cond. for flag 3	2C0Bh	ALL	appl	p	E	0	255	0	1	---
do12	inv. cond. for flag 4	2C0Ch	ALL	appl	p	E	0	255	0	1	---
do13	inv. cond. for flag 5	2C0Dh	ALL	appl	p	E	0	255	0	1	---
do14	inv. cond. for flag 6	2C0Eh	ALL	appl	p	E	0	255	0	1	---
do15	inv. cond. for flag 7	2C0Fh	ALL	appl	p	E	0	255	0	1	---
do16	cond. select. for flag 0	2C10h	ALL	appl	p	E	0	255	1	1	---
do17	cond. select. for flag 1	2C11h	ALL	appl	p	E	0	255	2	1	---
do18	cond. select. for flag 2	2C12h	ALL	appl	p	E	0	255	4	1	---
do19	cond. select. for flag 3	2C13h	ALL	appl	p	E	0	255	8	1	---
do20	cond. select. for flag 4	2C14h	ALL	appl	p	E	0	255	16	1	---
do21	cond. select. for flag 5	2C15h	ALL	appl	p	E	0	255	32	1	---
do22	cond. select. for flag 6	2C16h	ALL	appl	p	E	0	255	64	1	---
do23	cond. select. for flag 7	2C17h	ALL	appl	p	E	0	255	128	1	---
do24	AND conn. for. flags	2C18h	ALL	appl	p	E	0	255	255	1	---
do25	inv. flags for O1	2C19h	ALL	appl	p	E	0	255	0	1	---
do26	inv. flags for O2	2C1Ah	ALL	appl	p	E	0	255	0	1	---
do27	inv. flags for R1	2C1Bh	ALL	appl	p	E	0	255	0	1	---
do28	inv. flags for R2	2C1Ch	ALL	appl	p	E	0	255	0	1	---
do29	inv. flags for OA	2C1Dh	ALL	appl	p	E	0	255	0	1	---
do30	inv. flags for OB	2C1Eh	ALL	appl	p	E	0	255	0	1	---
do31	inv. flags for OC	2C1Fh	ALL	appl	p	E	0	255	0	1	---
do32	inv. flags for OD	2C20h	ALL	appl	p	E	0	255	0	1	---

continued on the next page

Parameter		Addr.	BA	R	P	E	Lower limit	Upper limit	Default	Step	Unit
do33	flag select. for O1	2C21h	ALL	appl	p	E	0	255	1	1	---
do34	flag select. for O2	2C22h	ALL	appl	p	E	0	255	2	1	---
do35	flag select. for R1	2C23h	ALL	appl	p	E	0	255	4	1	---
do36	flag select. for R2	2C24h	ALL	appl	p	E	0	255	8	1	---
do37	flag select. for OA	2C25h	ALL	appl	p	E	0	255	16	1	---
do38	flag select. for OB	2C26h	ALL	appl	p	E	0	255	32	1	---
do39	flag select. for OC	2C27h	ALL	appl	p	E	0	255	64	1	---
do40	flag select. for OD	2C28h	ALL	appl	p	E	0	255	128	1	---
do41	AND conn. for outputs	2C29h	ALL	appl	p	E	0	255	0	1	---
do42	inverted outputs	2C2Ah	ALL	appl	p	E	0	255	0	1	---
do43	cond. 0 filter time	2C2Bh	ALL	appl	p	---	0	1000	0	1	ms
do44	cond. 1 filter time	2C2Ch	ALL	appl	p	---	0	1000	0	1	ms
do51	hardware output allocation	2C33h	ALL	appl	p	E	0	255	228	1	---
dr00	DASM rated current	2600h	G, M	appl	p	---	0	1500	15	0.1	A
dr01	DASM rated Speed	2601h	G, M	appl	p	---	1	64000	1450	1	rpm
dr02	DASM rated voltage	2602h	G, M	appl	p	---	120	830	LTK	1	V
dr03	DASM rated power	2603h	G, M	appl	p	---	0.1	1000	LTK	0.01	kW
dr04	DASM rated coS(phi)	2604h	G, M	appl	p	---	0.5	1	LTK	0.01	---
dr05	DASM rated frequency	2605h	G, M	appl	p	---	0	1600	LTK	0.1	Hz
dr06	DASM stator resistance	2606h	G, M	appl	p	E	0	250	LTK	0.001	Ohm
dr07	DASM leakage inductance	2607h	M	appl	p	---	0.01	655.35	LTK	0.01	mH
dr08	DASM rotor resistance	2608h	M	appl	p	---	0	250	LTK	0.001	Ohm
dr09	breakdown factor	2609h	G, M	appl	p	---	0.5	4	2.5	0.1	---
dr10	DASM head-inductance	260Ah	M	appl	p	---	0.1	3276.7	LTK	0.1	mH
dr11	motorprotection mode	260Bh	G, M	appl	p	---	0	1	1	1	---
dr12	motorprot. rated current	260Ch	G, M	appl	p	---	0	1500	LTK	0.1	A
dr13	DASM mag. current	260Dh	M	appl	p	---	0.0	1500.0	0.0	0.1	A
dr14	DASM rated torque	260Eh	M	ro	p	---	0.01	32000	0.01	0.01	Nm
dr15	max. torque FU	260Fh	M	ro	p	---	0.01	32000	0.01	0.01	Nm
dr15	max torque FU	260Fh	S	ro	np	---	0.01	32000	0.01	0.01	Nm
dr16	DASM max torque corner speed	2610h	M	appl	p	---	0.01	32000	0.01	0.01	Nm
dr17	DASM speed for max torq.	2611h	M	appl	p	---	1	64000	900	1	rpm
dr18	DASM field weak. speed	2612h	M	appl	p	---	0	64000	0	1	rpm
dr19	flux adaption factor	2613h	M	appl	p	---	25	250	100	1	%
dr20	field weak. curve	2614h	M	appl	p	---	0.01	2	1.20	0.01	---
dr21	no load voltage	2615h	M	appl	p	---	0	100	75	0.1	%
dr23	DSM rated current	2617h	S	appl	np	---	0	1600	LTK	0.1	A
dr24	DSM rated Speed	2618h	S	appl	np	---	1	64000	LTK	1	rpm
dr25	DSM rated frequency	2619h	S	appl	np	---	0	1600	LTK	0.1	Hz
dr26	DSM EMF (Vpk/1000rpm)	261Ah	S	appl	np	---	0	32000	LTK	1	---
dr27	DSM rated torque	261Bh	S	appl	np	---	0.1	6553.5	LTK	0.1	Nm
dr28	DSM curr. f. zero speed	261Ch	S	appl	np	---	0	1490	LTK	0.1	A
dr30	DSM stator resistance	261Eh	S	appl	np	---	0	250	LTK	0.001	Ohm
dr31	DSM inductance	261Fh	S	appl	np	---	0.01	500.00	LTK	0.01	mH
dr32	DSM rated power	2620h	S	ro	np	---	0.01	1000	LTK	0.01	kW
dr33	DSM max. torque	2621h	S	appl	np	---	0.1	6553.5	LTK	0.1	Nm
dr34	mot.prot. time min.Is/Id	2622h	S	appl	np	---	0.1	25.5	8	0.1	s
dr35	mot. prot. time Imax	2623h	S	appl	np	---	0.1	10	0.2	0.1	s
dr36	mot.prot. recovery time	2624h	S	appl	np	---	0.1	300	5	0.1	s
dr37	max. current	2625h	M, S	appl	np	---	0	1500	LTK	0.1	A
dr39	DSM corner speed 1	2627h	S	appl	np	---	0	64000	32000	1	rpm
dr40	DSM corn. max. torque 2	2628h	S	appl	np	---	0.1	6553.5	0.1	0.1	Nm
dr41	DSM corner speed 2	2629h	S	appl	np	---	0	64000	32000	1	rpm
dr42	DSM corn. max. torque 3	262Ah	S	appl	np	---	0.1	6553.5	0.1	0.1	Nm
dr43	DSM corner speed 3	262Bh	S	appl	np	---	0	64000	32000	1	rpm
dr44	DSM corn. max. torque 4	262Ch	S	appl	np	---	0.1	6553.5	0.1	0.1	Nm
dr45	DSM corner speed 4	262Dh	S	appl	np	---	0	64000	32000	1	rpm
dr46	DSM corn. max. torque 5	262Eh	S	appl	np	---	0.1	6553.5	0.1	0.1	Nm
dr47	DSM corner speed 5	262Fh	S	appl	np	---	0	64000	32000	1	rpm
dr48	motor identification	2630h	M, S	appl	np	E	0	255	0	1	---
dr49	ident. acc/dec time	2631h	M, S	appl	np	---	0	300	5	0.01	s
dr50	mot.prot. min. Is/Id	2632h	S	appl	np	---	100	500	150	1	%
dr51	motortemp for Rs corr.	2633h	G, M	appl	np	---	0	200	20	1	°C
dr52	temperature coefficient	2634h	G, M	appl	np	---	0	25.0	0	0.1	---
dr53	corr. delta temperature	2635h	G, M	appl	np	---	0	200	0	1	°C
dr54	Rs corr warming time	2636h	G, M	appl	np	---	240	16000	4000	1	s
dr55	Rs corr cooling time	2637h	G, M	appl	np		240	16000	4000	1	s
dr56	Rs corr max. temp.	2638	G, M	appl	np		30	200	90	1	°C
dr58	torque offset selector	263Ah	M, S	appl	np	E	0	79	0	1	---
dr59	torque offset	263Bh	M, S	appl	np	---	-320	320	0.00	0.01	Nm
dr60	Rs corr auto temp. mode	263Ch	M, S	appl	np	---	0	1	0	1	---
dr61	Rs corr auto temp. in.Sel	263Dh	G, M	appl	np	E	0	4095	0	1	---
dr62	state motor ident.	263Eh	M, S	ro	np	---	0	255	0	1	---
dr63	DSM EMF HR (Vpk/1000rpm)	263Fh	S	appl	np	---	0	255.996	0	0.004	---

continued on the next page

Parameter		Addr.	BA	R	P	E	Lower limit	Upper limit	Default	Step	Unit
dr64	DSM winding inductance max	2640h	S	appl	np	---	0.01	500.00	LTK	0.01	mH
dr65	DASM head-ind. 50% flux	2641h	M	appl	p	---	99.994	305.18	99.994	0.006	%
dr66	motor ident. error	2642h	M, S	ro	np	---	0	255	0	1	---
dr67	current for Ls/Ioff identification	2643h	M, S	appl	np	---	10	250	100	1	%
dr68	resistance adapt. mode	2644h	G, M	appl	np	---	0	31	1	1	---
dS00	Kp current	3100h	M	appl	p	---	0	32767	1500	1	---
dS00	Kp current	3100h	S	appl	np	---	0	32767	1500	1	---
dS01	KI current	3101h	M	appl	p	---	0	32767	1500	1	---
dS01	KI current	3101h	S	appl	np	---	0	32767	1500	1	---
dS02	current decoupling	3102h	M	appl	p	E	0	4	0	1	---
dS02	current decoupling	3102h	S	appl	np	E	0	4	0	1	---
dS03	curr./torq. mode	3103h	M	appl	p	E	0	127	0	1	---
dS03	curr./torq. mode	3103	S	appl	np	E	0	127	0	1	---
dS04	flux/rotor adaption mode	3104h	M	appl	p	E	0	1027	0	1	---
dS04	flux/rotor adaption mode	3104h	S	appl	np	E	0	1027	0	1	---
dS05	Kp current (q)	3105h	M	appl	p	---	0	32767	1500	1	---
dS05	Kp current (q)	3105h	S	appl	np	---	0	32767	1500	1	---
dS06	KI current (q)	3106h	M	appl	p	---	0	32767	1500	1	---
dS06	KI current (q)	3106h	S	appl	np	---	0	32767	1500	1	---
dS07	KI rotor adaption	3107h	M	appl	p	---	0	32767	1000	1	---
dS08	Kp umax	3108h	M	appl	p	---	0	32767	0	1	---
dS08	Kp umax	3108h	S	appl	np		0	32767	0	1	---
dS09	KI umax	3109h	M	appl	p	---	0	32767	50	1	---
dS09	KI umax	3109h	S	appl	np	---	0	32767	50	1	---
dS10	umax modulation ref.	310Ah	M	appl	p	---	0	109.99756	96.875	0.0061	%
dS10	umax modulation ref.	310Ah	S	appl	np	---	0	109.99756	96.875	0.0061	%
dS11	Kp flux	310Bh	M	appl	p	---	0	32767	1000	1	---
dS12	KI flux	310Ch	M	appl	p	---	0	32767	300	1	---
dS13	magn. current limit	310Dh	M	appl	p	---	-1500	1500.0	0	0.1	A
dS13	magn. current limit	310Dh	S	appl	np	---	-1500	1500	0	0.1	A
dS14	Kp speed calc ASCL	310Eh	M	appl	p	---	0	32767	1500	1	---
dS15	Kp speed calc ASCL	310Fh	M	appl	p	---	0	32767	1500	1	---
dS17	speed PT1-time ASCL	3111h	M	appl	p	---	0	9	3	1	---
dS18	function mode	3112h	M	appl	p	---	0	4095	0	1	---
dS18	function mode	3112h	S	appl	np	---	0	4095	0	1	---
dS19	limit uf-control dec ASCL	3113h	M	appl	p	---	0	32000	0	1	rpm
dS20	delay time uf-contrl.	3114h	M	appl	p	---	-1	4000	0	1	ms
dS21	startup speed	3115h	M	appl	p	---	0	4000	0	0.125	rpm
dS22	startup time	3116h	M	appl	p	---	0	300	0.01	5	s
dS23	observer factor	3117h	M	appl	p	---	0	99.9938	1.953	0.0061	%
dS24	Ki current multiplier	3118h	M	appl	p	---	0	65535	65535	1	---
dS24	Ki current multiplier	3118h	S	appl	np	---	0	65535	65535	1	---
dS26	wait for minimum flux	311Ah	M	appl	p	---	40.283	99.993	95.001	0.006	%
dS27	deviation control time	311Bh	M	appl	np	---	0	4095.9375	4	0.0625	ms
dS30	rotor position detection	311Eh	S	appl	np	E	0	15	0	1	---
dS31	rotor position mode	311Fh	S	appl	np	E	0	1	0	1	---
dS32	KI HF detection	3120h	S	appl	np	---	0	32767	1500	1	---
dS33	step current	3121h	S	appl	np	---	0	1500	0	0.1	A
Ec14	gear 2 numerator	300Eh	ALL	appl	np	---	0	32000	1000	1	---
Ec15	gear 2 denominator	300Fh	ALL	appl	np	---	1	32000	1000	1	---
Ec40	act. absolute pos. el.	3028h	S	ro	np	---	0	65535	0	1	---
Ec64	speed ch2 no gear	3040h	ALL	ro	np	---	-32000	32000	0	1	rpm
Fh01	factor 1	3501h	S	appl	np	---	-131068	131068	59010	1	---
Fh02	factor 2	3502h	S	appl	np	---	-131068	131068	-9727	1	---
Fh03	factor 3	3503h	S	appl	np	---	-131068	131068	1442	1	---
Fh04	factor 4	3504h	S	appl	np	---	-131068	131068	63071	1	---
Fh05	factor 5	3505h	S	appl	np	---	-131068	131068	60587	1	---
Fh06	factor 6	3506h	S	appl	np	---	-131068	131068	1538	1	---
Fh09	factor 9	3509h	S	appl	np	---	-1310068	131068	794	1	---
Fr01	copy parameter set	2901h	ALL	appl	p	E	-4	7	0	1	---
Fr02	parameter set source	2902h	ALL	appl	np	E	0	5	0	1	---
Fr03	parameter set lock	2903h	ALL	appl	np	E	0	255	0	1	---
Fr04	Parameter set source	2904h	ALL	appl	np	E	0	7	0	1	---
Fr05	set activation delay	2905h	ALL	appl	p	---	0	32	0	0.01	s
Fr06	set deactivation delay	2906h	ALL	appl	p	---	0	32	0	0.01	s
Fr07	paraset input sel.	2907h	ALL	appl	np	E	0	4095	0	1	---
Fr08	motor set classification	2908h	G, M	appl	p	E	0	7	0	1	---
Fr09	indirect set pointer	2909h	ALL	appl	np	---	-1	7	0	1	---
Fr10	motor adaption	290Ah	G, M	appl	p	E	0	3	0	1	---
Fr10	motor adaption	290Ah	S	appl	np	E	0	2	0	1	---
Fr11	reset set input sel.	290Bh	ALL	appl	np	E	0	4095	0	1	---

continued on the next page

Parameter		Addr.	BA	R	P	E	Lower limit	Upper limit	Default	Step	Unit
Fr12	set change mode	290Ch	G, M	appl	np	E	0	3	2	1	---
Fr12	set change mode	290Ch	S	appl	np	E	0	1	0	1	---
In00	inverter type	2E00h	ALL	ro	np	---	0	65535	0	1	---
In01	rated inverter current	2E01h	ALL	ro	np	---	LTK	LTK	LTK	0.1	A
In02	max. output frequency	2E02h	ALL	ro	np	---	0	32768	0	1	Hz
In03	max. switching frequency	2E03h	ALL	ro	np	---	0	4	LTK	1	---
In04	rated switching frequency	2E04h	ALL	ro	np	---	0	LTK	LTK	1	---
In06	software version	2E06h	G	ro	np	---	SW	SW	SW	1	---
In07	software date	2E07h	ALL	ro	np	---	SW	SW	SW	0,1	---
In10	serial no. (date)	2E0Ah	ALL	ro	np	---	0	65535	0	1	---
In11	serial no. (count)	2E0Bh	ALL	ro	np	---	0	65535	0	1	---
In12	serial no. (AB-no. high)	2E0Ch	ALL	ro	np	---	0	65535	0	1	---
In13	serial no. (AB-no. low)	2E0Dh	ALL	ro	np	---	0	65535	0	1	---
In14	customer no. high	2E0Eh	ALL	ro	np	---	0	65535	0	1	---
In15	customer no. low	2E0Fh	ALL	ro	np	---	0	65535	0	1	---
In16	QS no.	2E10h	ALL	ro	np	---	0	65535	0	1	---
In17	temp.- mode	2E11h	ALL	ro	np	---	LTK	LTK	LTK	1	---
In18	hardware current inverter	2E12h	ALL	ro	np	---	LTK	LTK	LTK	0.1	A
In19	rated inverter act. power	2E13h	ALL	ro	np	---	LTK	LTK	LTK	0.01	kW
In22	user parameter 1	2E16h	ALL	appl	np	---	0	65535	0	1	---
In23	user parameter 2	0E17h	ALL	appl	np	---	0	65535	0	1	---
In24	last error	2E18h	ALL	ro	p	E	0	255	0	1	---
In25	error diagnosis	2E19h	ALL	ro	p	---	0	65535	0	1	---
In26	E.OC error counter	2E1Ah	ALL	ro	np	---	0	65535	0	1	---
In27	E.OL error counter	2E1Bh	ALL	ro	np	---	0	65535	0	1	---
In28	E.OP error counter	2E1Ch	ALL	ro	np	---	0	65535	0	1	---
In29	E.OH error counter	2E1Dh	ALL	ro	np	---	0	65535	0	1	---
In30	E.OHI error counter	2E1Eh	ALL	ro	np	---	0	65535	0	1	---
In39	deadtime selector	2E27h	M, S	appl	np	E	0	329	0	1	---
In40	deadtime	2E28h	M, S	appl	np	---	0	255	0	1	---
In41	serial no. 2 (date)	2E29h	ALL	ro	np	---	-2147483648	2147483647	0	1	---
In42	serial no. 2 (count)	2E2Ah	ALL	ro	np	---	-2147483648	2147483647	0	1	---
In43	QS no. 2	2E2Bh	ALL	ro	np	---	-2147483648	2147483647	0	2	---
LE00	comparison level 0	2D00h	G	appl	p	---	-30000	30000	0	0.01	---
LE00	comparison level 0	2D00h	M, S	appl	p	---	-10737418.24	10737418.23	0	0.01	---
LE01	comparison level 1	2D01h	G	appl	p	---	-30000	30000	0	0.01	---
LE01	comparison level 1	2D01h	M, S	appl	p	---	-10737418.24	10737418.23	0	0.01	---
LE02	comparison level 2	2D02h	G	appl	p	---	-30000	30000	100	0.01	---
LE02	comparison level 2	2D02h	M, S	appl	p	---	-10737418.24	10737418.23	100	0.01	---
LE03	comparison level 3	2D03h	G	appl	p	---	-30000	30000	4	0.01	---
LE03	comparison level 3	2D03h	M, S	appl	p	---	-10737418.24	10737418.23	4	0.01	---
LE04	comparison level 4	2D04h	G	appl	p	---	-30000	30000	0	0.01	---
LE04	comparison level 4	2D04h	M, S	appl	p	---	-10737418.24	10737418.23	0	0.01	---
LE05	comparison level 5	2D05h	G	appl	p	---	-30000	30000	0	0.01	---
LE05	comparison level 5	2D05h	M, S	appl	p	---	-10737418.24	10737418.23	0	0.01	---
LE06	comparison level 6	2D06h	G	appl	p	---	-30000	30000	0	0.01	---
LE06	comparison level 6	2D06h	M, S	appl	p	---	-10737418.24	10737418.23	0	0.01	---
LE07	comparison level 7	2D07h	G	appl	p	---	-30000	30000	0	0.01	---
LE07	comparison level 7	2D07h	M, S	appl	p	---	-10737418.24	10737418.23	0	0.01	---
LE08	hysteresis 0	2D08h	ALL	appl	p	---	0	300	0	0.01	---
LE09	hysteresis 1	2D09h	ALL	appl	p	---	0	300	0	0.01	---
LE10	hysteresis 2	2D0Ah	ALL	appl	p	---	0	300	5	0.01	---
LE11	hysteresis 3	2D0Bh	ALL	appl	p	---	0	300	0.5	0.01	---
LE12	hysteresis 4	2D0Ch	ALL	appl	p	---	0	300	0	0.01	---
LE13	hysteresis 5	2D0Dh	ALL	appl	p	---	0	300	0	0.01	---
LE14	hysteresis 6	2D0Eh	ALL	appl	p	---	0	300	0	0.01	---
LE15	hysteresis 7	2D0Fh	ALL	appl	p	---	0	300	0	0.01	---
LE16	freq/speed hysteresis	2D10h	G	appl	np	---	0	20	0.8	0.0125	Hz
LE16	freq/speed hysteresis	2D10h	M, S	appl	np	---	0	200	15	0.125	rpm
LE17	timer 1 start input sel.	2D11h	ALL	appl	np	E	0	4095	0	1	---
LE18	timer 1 start condition	2D12h	ALL	appl	np	E	0	15	0	1	---
LE19	timer 1 reset input sel.	2D13h	ALL	appl	np	E	0	4095	0	1	---
LE20	timer 1 reset condition	2D14h	ALL	appl	np	E	0	31	16	1	---
LE21	timer 1 mode	2D15h	ALL	appl	np	---	0	63	0	1	---
LE22	timer 2 start input sel.	2D16h	ALL	appl	np	E	0	4095	0	1	---
LE23	timer 2 start condition	2D17h	ALL	appl	np	E	0	15	0	1	---
LE24	timer 2 reset input sel.	2D18h	ALL	appl	np	E	0	4095	0	1	---
LE25	timer 2 reset condition	2D19h	ALL	appl	np	E	0	31	16	1	---
LE26	timer 2 mode	2D1Ah	ALL	appl	np	---	0	63	0	1	---
LE27	reference torque	2D1Bh	M, S	appl	np	---	0	32000	0	0.01	Nm
LE28	ref. torque mode	2D1Ch	ALL	appl	np		0	2	1	1	---
nn00	motor model select	3400h	S	appl	np	E	0	32767	191	1	---

continued on the next page

Parameter		Addr.	BA	R	P	E	Lower limit	Upper limit	Default	Step	Unit
nn01	stabilisation current	3401h	S	appl	np	---	0	1500.0	0	0.1	A
nn02	min. speed for current	3402h	S	appl	np	---	0	32000	0	1	rpm
nn03	max. speed for current	3403h	S	appl	np	---	0	32000	0	1	rpm
nn04	time speedcalculation	3404h	S	appl	np	---	0	4095.9375	0.125	0.0625	ms
nn05	filter speedcalculation	3405h	S	appl	np	---	0	4095.9375	1	0.0625	ms
nn06	rs adaption factor	3406h	S	appl	np	---	0	32767	100	1	---
nn07	observer factor	3407h	S	appl	np	---	0	60	2	0.0015	%
nn08	startup speed	3408h	S	appl	np	---	0	4000	0	0.125	rpm
nn09	startup time	3409h	S	appl	np	---	0	300.00	5.00	0.01	s
nn10	standstill current	340Ah	S	appl	np	---	0	1500	0	0.1	A
nn11	stabilisation time	340Bh	S	appl	np	---	0	4095.9375	0.5	0.0625	ms
nn12	deviation control time	340Ch	S	appl	np	---	0	4095.9375	10	0.0625	ms
nn13	C filter [uF]	340Dh	S	appl	np	---	0	655.35	0	0.01	---
nn14	amplitude HF injection	340Eh	S	appl	np	---	0	16383	1500	1	---
nn15	optimisat. HF injection	340Fh	S	appl	np	---	20	150	4.0	0.1	---
nn17	open loop speed	3411h	S	appl	np	---	0	4000	0	0.125	rpm
oP00	reference source	2300h	ALL	appl	p	E	0	12	0	1	---
oP01	rotation source	2301h	G	appl	p	E	0	10	2	1	---
oP01	rotation source	2301h	M, S	appl	p	E	0	10	7	1	---
oP02	rotation setting	2302h	ALL	appl	p	E	0	2	0	1	---
oP03	reference setting	2303h	G	appl	p	---	-400	400	0	0.125	Hz
oP03	reference setting	2303h	M, S	appl	p	---	-4000	4000	0	0.0125	rpm
oP04	VL mode options	2304h	ALL	appl	np	.---	0	31	0	1	---
oP05	reference setting %	2305h	ALL	appl	p	---	-100	100	0	0.1	%
oP06	min. reference forward	2306h	G	appl	p	---	0	400	0	0.0125	Hz
oP06	min. reference forward	2306h	M, S	appl	p	---	0	4000	0	0.125	rpm
oP07	min. reference reverse	2307h	G	appl	p	---	-0-0125	400	-0.0125	0.0125	Hz
oP07	min. reference reverse	2307h	M, S	appl	p	---	0.125	4000	-0.125	0.125	rpm
op10	max. reference forward	230Ah	G	appl	p	---	0	400	70	0.0125	Hz
op10	max. reference forward	230Ah	M, S	appl	p	---	0	4000	2100	0.125	rpm
oP11	max. reference reverse	230Bh	G	appl	p	---	-0.0125	400	-0.0125	0.0125	Hz
oP11	max. reference reverse	230Bh	M, S	appl	p	---	-0.125	4000	-0.125	0.125	rpm
oP14	abS. max. reference for	230Eh	G	appl	p	---	0	400	400	0.0125	Hz
oP14	abs. max. reference for	230Eh	M, S	appl	p	---	0	4000	4000	0.125	rpm
oP15	abs. max. reference rev	230Fh	G	appl	p	---	-0.0125	400	-0.0125	0.0125	Hz
oP15	abs. max. reference rev	230Fh	M, S	appl	p	---	-0.125	4000	-0.125	0.125	rpm
oP16	rotation delay time	2310h	ALL	appl	np	---	0.0	10.00	0.0	0.01	s
oP18	step value rot. source	2312h	G	appl	p	E	0	10	2	1	---
oP18	step value rot. source	2312h	M, S	appl	p	E	0	10	7	1	---
oP19	step value input sel. 1	2313h	ALL	appl	np	E	0	4095	16	1	---
oP20	step value input sel. 2	2314h	ALL	appl	np	E	0	4095	32	1	---
oP21	step value 1	2315h	G	appl	p	---	-400	400	5	0.0125	Hz
oP21	step value 1	2315h	M, S	appl	p	---	-4000	4000	100	0.125	rpm
oP22	step value 2	2316h	G	appl	p	---	-400	400	50	0.0125	Hz
oP22	step value 2	2316h	M, S	appl	p	---	-4000	4000	-100	0.125	rpm
oP23	step value 3	2317h	G	appl	p	---	-400	400	70	0.0125	Hz
oP23	step value 3	2317h	M, S	appl	p	---	-4000	4000	0	0.125	rpm
oP27	acc dec mode	231Bh	ALL	appl	p	E	0	511	0	1	---
oP28	acc. time for.	231Ch	ALL	appl	p	---	0	300	5	0.01	s
oP29	acc. time rev.	231Dh	ALL	appl	p	---	-1	300	-0.01	0.01	s
oP30	dec. time for.	231Eh	ALL	appl	p	---	-1	300	5	0.01	s
oP31	dec. time rev.	231Fh	ALL	appl	p	---	-1	300	-0.01	0.01	s
oP32	s-curve time acc. for.	2320h	ALL	appl	p	---	0	5	0	0.01	s
oP33	s-curve time acc. rev.	2321h	ALL	appl	p	---	-1	5	-0.01	0.01	s
oP34	s-curve time dec. for.	2322h	ALL	appl	p	---	-1	5	-0.01	0.01	s
op35	S-curve time dec. rev.	2323h	ALL	appl	p	---	-1	5	-0.01	0.01	s
oP36	min. output val. for.	2324h	G	appl	p	---	0	400	0	0.0125	Hz
oP37	min. output val. for.	2325h	G	appl	p	---	-0.0125	400	-0.0125	0.0125	Hz
oP40	max. output value forward	2328h	G	appl	p	---	0	400	400	0.0125	Hz
oP40	max. output value forward	2328h	M, S	appl	p	---	0	4000	4000	0.125	rpm
oP41	max. output value reverse	2329h	G	appl	p	---	-1	400	-1	0.0125	Hz
oP41	max. output value reverse	2329h	M, S	appl	p	---	-1	4000	-1	0.125	rpm
oP44	ext. function mode / source	232Ch	ALL	appl	p	E	0	79	0	1	---
oP45	ext. funct. dig. source	232Dh	ALL	appl	p	---	0	100	0	0.01	%
oP46	ext. funct. acc/dec time	232Eh	ALL	appl	p	---	0	20	10	0.01	s
oP47	sweep-gen. acc. time	232Fh	ALL	appl	p	---	0	20	10	0.01	s
op48	sweep-gen. dec. time	2330h	ALL	appl	p	---	0	20	10	0.01	s
oP49	diam. corr. dmin/dmax	2331h	ALL	appl	p	---	0.01	0.99	0.5	0.001	---
oP50	motorpoti function	2332h	ALL	appl	np	E	0	7	0	1	---
oP52	motorpoti value	2334h	ALL	appl	p	---	-100	100	0	0.01	%
oP53	motorpoti min. value	2335h	ALL	appl	np	---	-100	100	0	0.01	%
oP54	motorpoti max. value	2336h	ALL	appl	np	---	-100	100	100	0.01	%
oP55	motorpoti reset value	2337h	ALL	appl	np	---	-100	100	0	0.01	%

continued on the next page

Parameter		Addr.	BA	R	P	E	Lower limit	Upper limit	Default	Step	Unit
oP56	mot.poti inc. input sel.	2338h	ALL	appl	np	E	0	4095	0	1	---
oP57	mot.poti dec. input sel.	2339h	ALL	appl	np	E	0	4095	0	1	---
oP58	mot.poti reset inp. sel.	233Ah	ALL	appl	np	E	0	4095	0	1	---
oP59	motorpoti inc/dec time	233Bh	ALL	appl	p	---	0	50000	66	0.01	s
op60	dir. forward input sel.	233Ch	ALL	appl	np	E	0	4095	4	1	---
oP61	dir. reverse input sel.	233Dh	ALL	appl	np	E	0	4095	8	1	---
oP62	acc/dec time factor	233Eh	ALL	appl	np	E	0	5	0	1	---
oP63	ref. value high-res.	233Fh	ALL	appl	np	---	-2147483647	2147483647	0	1	---
oP64	rel. value high-res.	2340h	G	appl	p	---	20.0000	400.0000	70.0000	0.0125	Hz
oP64	rel. value high-res.	2340h	M, S	appl	p	---	600.0000	4000.0000	2100.000	0.125	rpm
oP65	min. proh. reference 1	2341h	G	appl	np	---	-400	400	0	0.0125	Hz
oP65	min. proh. reference 1	2341h	M, S	appl	np	---	-4000	4000	0	0.125	rpm
oP66	max. proh. reference 1	2342h	G	appl	np	---	-400	400	0	0.0125	Hz
oP66	max. proh. reference 1	2342h	M, S	appl	np	---	-4000	4000	0	0.125	rpm
oP67	min. proh. reference 2	2343h	G	appl	np	---	-400	400	0	0.0125	Hz
oP67	min. proh. reference 2	2343h	M, S	appl	np	---	-4000	4000	0	0.125	rpm
oP68	max. proh. reference 2	2344h	G	appl	np	---	-400	400	0	0.0125	Hz
oP68	max. proh. reference 2	2344h	M, S	appl	np	---	-4000	4000	0	0.125	rpm
oP69	motorpoti dec time	2345h	ALL	appl	p	---	-1	50000	-0.01	0.01	s
oP70	s-c.up time acc. for.	2346h	ALL	appl	p	---	-1	5	-0.01	0.01	s
oP71	s-c.up time acc. rev.	2347h	ALL	appl	p	---	-2	5	-0.01	0.01	s
oP72	s-c.up time dec. for.	2348h	ALL	appl	p	---	-2	5	-0.01	0.01	s
oP73	s-c.up time dec. rev.	2349h	ALL	appl	p	---	-2	5	-0.01	0.01	s
oP74	reference splitting	234Ah	M, S	appl	np	---	0	127	0	1	ms
oP75	ref. setting all sets	234Bh	G	appl	np	---	-400	400	0	0.0125	Hz
oP75	ref. setting all sets	234Bh	M, S	appl	np	---	-4000	4000	0	0.125	rpm
oP76	ref. setting % all sets	234Ch	ALL	appl	np	---	-100	100	0	0.1	%
pd00	pd0 byte order	2100h	ALL	appl	np	E	0	2	2	1	---
pd01	pd0 out index	2101h	ALL	appl	p	E	0	32767	0	1	---
pd02	pd0 out subindex	2102h	ALL	appl	p	E	0	8	1	1	---
pd03	pd0 out offset	2103h	ALL	appl	p	E	0	15	0	1	---
pd04	pd0 out type	2104h	ALL	appl	p	E	0	3	0	1	---
pd05	pd0 out count	2105h	ALL	appl	np	E	0	8	0	1	---
pd06	pd0 in index	2106h	ALL	appl	p	E	0	32767	0	1	---
pd07	pd0 in subindex	2107h	ALL	appl	p	E	0	8	1	1	---
pd08	pd0 in offset	2108h	ALL	appl	p	E	0	15	0	1	---
pd09	pd0 in type	2109h	ALL	appl	p	E	0	3	0	1	---
pd10	pd0 in count	210Ah	ALL	appl	np	E	0	8	0	1	---
pd11	pd1 out index	210Bh	ALL	appl	p	E	0	32767	0	1	---
pd12	pd1 out subindex	210Ch	ALL	appl	p	E	0	8	1	1	---
pd13	pd1 out offset	210Dh	ALL	appl	p	E	0	15	0	1	---
pd14	pd1 out type	210Eh	ALL	appl	p	E	0	3	0	1	---
pd15	pd1 out count	210Fh	ALL	appl	np	E	0	8	0	1	---
pd16	pd1 in index	2110h	ALL	appl	p	E	0	32667	0	1	---
pd17	pd1 in subindex	2111h	ALL	appl	p	E	0	8	1	1	---
pd18	pd1 in offset	2112h	ALL	appl	p	E	0	15	0	1	---
pd19	pd1 in type	2113h	ALL	appl	p	E	0	3	0	1	---
pd20	pd1 in count	2114h	ALL	appl	np	E	0	8	0	1	---
pd21	pd2 out index	2115h	ALL	appl	p	E	0	32767	0	1	---
pd22	pd2 out subindex	2116h	ALL	appl	p	E	0	8	1	1	---
pd23	pd2 out offset	2117h	ALL	appl	p	E	0	15	0	1	---
pd24	pd2 out type	2118h	ALL	appl	p	E	0	3	0	1	---
pd25	pd2 out count	2119h	ALL	appl	np	E	0	8	0	1	---
pd26	pd2 in index	211Ah	ALL	appl	p	E	0	32767	0	1	---
pd27	pd2 in subindex	211Bh	ALL	appl	p	E	0	8	1	1	---
pd28	pd2 ín offset	211Ch	ALL	appl	p	E	0	15	0	1	---
pd29	pd2 in type	211Dh	ALL	appl	p	E	0	3	0	1	---
pd30	pd2 in count	211Eh	ALL	appl	np	E	0	8	0	1	---
Pn00	auto retry UP	2400h	ALL	appl	np	---	0	1	1	1	---
Pn01	auto retry OP	2401h	ALL	appl	np	---	0	1	0	1	---
Pn02	auto retry OC	2402h	ALL	appl	np	---	0	1	0	1	---
Pn03	E.EF stopping mode	2403h	ALL	appl	np	---	0	6	0	1	---
Pn04	ext. fault input select	2404h	ALL	appl	np	E	0	4095	64	1	---
Pn05	E.buS stopping mode	2405h	ALL	appl	np	---	0	6	6	1	---
Pn06	watchdog time	2406h	ALL	appl	np	E	0	40	0	0.01	s
Pn07	proh. rot. stopping mode	2407h	M, S	appl	np	---	0	6	6	1	---
Pn08	warning OL stop. mode	2408h	ALL	appl	np	---	0	6	6	1	---
Pn09	OL warning level	2409h	ALL	appl	np	---	0	100	80	1	%
Pn10	warning OH stop. mode	240Ah	ALL	appl	np	---	0	6	6	1	---
Pn11	OH warning level	240Bh	ALL	appl	np	---	0	90	70	1	°C
Pn12	warning dOH stop. mode	240Ch	G	appl	np	---	0	9	6	1	---
Pn12	warning dOH stop. mode	240Ch	M, S	appl	np	---	0	9	6	1	---
Pn13	E.dOH delay time	240Dh	G	appl	np	---	0	120	10	1	s

continued on the next page

Parameter		Addr.	BA	R	P	E	Lower limit	Upper limit	Default	Step	Unit
Pn13	E.dOH delay time	240Dh	M, S	appl	np	---	0	120	0	1	s
Pn14	warning OH2 stop. mode	240Eh	ALL	appl	np	---	0	6	6	1	---
Pn15	OH2 warning level	240Fh	S	appl	np	---	0	100	100	1	%
Pn16	warning OHI stop. mode	2410h	ALL	appl	np	E	0	7	7	1	---
Pn17	E.OHI delay time	2411h	ALL	appl	np	---	0	90	70	1	°C
Pn18	E.Set stopping mode	2412h	ALL	appl	np	---	0	6	0	1	---
Pn19	stall mode	2413h	G, M	appl	p	E	0	511	0	1	---
Pn20	stall level	2414h	G, M	appl	p	---	0	200	200	1	%
Pn21	stall acc/dec time	2415h	G, M	appl	p	---	0	300	2	0.01	s
Pn22	LAD stop function	2416h	G	appl	p	E	0	7	1	1	---
Pn22	LAD stop function	2416h	M, S	appl	p	E	0	7	0	1	---
Pn23	LAD stop input selection	2417h	ALL	appl	np	E	0	4095	0	1	---
Pn24	LAD load level	2418h	ALL	appl	p	---	0	200	140	1	%
Pn25	LD voltage	2419h	ALL	appl	p	---	200	1200	720	1	V
Pn26	speed search condition	241Ah	G, M	appl	p	E	0	31	8	1	---
Pn26	speed search condition	241Ah	S	appl	p	E	0	31	0	1	---
Pn27	speed search mode	241Bh	G	appl	np	E	0	255	0	1	---
Pn27	speed search mode	241Bh	M	appl	np	E	0	288	88	1	---
Pn28	DC braking mode	241Ch	G, M	appl	p	E	0	506	7	1	---
Pn29	DC brake input selection	241Dh	G	appl	np	E	0	4095	0	1	---
Pn29	DC brake input selection	241Dh	M	appl	np	E	0	4095	128	1	---
Pn30	DC braking time	241Eh	G, M	appl	p	---	0	100	10	0.01	s
Pn31	DC braking max. voltage	241Fh	G, M	appl	p	---	0	25.5	25.5	0.1	%
Pn32	DC braking start level	2420h	G	appl	p	---	0	400	4	0.0125	Hz
Pn32	DC braking start level	2420h	M	appl	p		0	4000	120	0.125	rpm
Pn33	DC braking max.cur. ASCL	2421h	M	appl	p	---	0	400	100	0.1	%
Pn34	brake ctrl. mode	2422h	G, M	appl	p	E	0	8	0	1	---
Pn34	brake ctrl. mode	2422h	S	appl	p	E	0	8	2	1	---
Pn35	premagnetizing time	2423h	G, M	appl	p	---	0	100	0.25	0.01	s
Pn35	premagnetizing time	2423h	S	appl	p	---	0	100	1	0.01	s
Pn36	brake release time	2424h	ALL	appl	p	---	0	100	0.25	0.01	s
Pn37	brake ctrl. start ref.	2425h	G	appl	p	---	-20	20	0	0.0125	Hz
Pn37	brake ctrl. start ref.	2425h	G, M	appl	P	---	-600	600	0	0.125	rpm
Pn38	brake fadeout time	2426h	ALL	appl	p	---	0	0.5	0	0.01	s
Pn39	brake delay time	2427h	ALL	appl	p	---	0	100	0.25	0.01	s
Pn40	brake closing time	2428h	ALL	appl	p	---	0	100	0.25	0.01	s
Pn41	brake ctrl. stop ref.	2429h	G	appl	p	---	-20	20	0	0.0125	Hz
Pn41	brake ctrl. stop ref.	2429h	G, M	appl	p	---	-600	600	0	0.125	rpm
Pn42	brake check input sel.	242Ah	ALL	appl	np	E	0	4095	0	1	---
Pn43	min. load brake ctrl.	242Bh	ALL	appl	p	---	0	100	0	1	%
Pn44	power off mode	242Ch	ALL	appl	np	E	0	1023	0	1	---
Pn45	power off start DC volt.	242Dh	ALL	appl	np	---	200	1200	500	1	V
Pn46	power off auto st. level	242Eh	ALL	appl	np	---	50	90	80	1	%
Pn47	power off brake torque	242Fh	ALL	appl	np	---	0	100	0	0.1	%
Pn48	power off restart level	2430h	G	appl	np	---	0	400	0	0.0125	Hz
Pn48	power off restart level	2430h	G, M	appl	np	---	0	4000	0	0.125	rpm
Pn49	power off start inp.sel.	2431h	ALL	appl	np	E	0	255	0	1	---
Pn50	power off ref. DC volt.	2432h	G, M	appl	np	---	200	1200	500	1	V
Pn51	power off Kp DC volt.	2433h	ALL	appl	np	---	0	32767	128	1	---
Pn52	power off restart delay	2434h	ALL	appl	np	---	0	100	0	0.01	s
Pn53	power off Kp	2435h	G, M	appl	np	---	0	32767	800	1	---
Pn54	power off KI	2436h	G, M	appl	np	---	0	32767	800	1	---
Pn55	power off KD	2437h	G, M	appl	np	---	0	32767	0	1	---
Pn56	power off jump factor	2438h	G, M	appl	np	---	0	800	100	1	%
Pn57	power off KI DC volt.	2439h	ALL	appl	np	---	0	32767	5	1	---
Pn58	quick stop mode	243Ah	ALL	appl	np	E	0	31	0	1	---
Pn59	quick stop level	243Bh	G, M	appl	np	---	0	200	200	1	%
Pn60	quick stop dec time	243Ch	ALL	appl	p	---	0	300	2	0.01	s
Pn61	quick stop torque limit	243Dh	M, S	appl	p	---	0	32000	0	0.01	Nm
Pn62	dOH warning level	243Eh	ALL	appl	np	---	0	200	100	1	°C
Pn63	positioning delay	243Fh	G	appl	p	E	-2	327.67	-1	0.01	---
Pn64	set GTR7 input selection	2440h	ALL	appl	np	E	0	4095	0	1	---
Pn65	Special functions	2441h	ALL	appl	np	E	0	32767	0	1	---
Pn67	q.stop max. torq.corn.sp	2443h	M	appl	p	---	0	32000	0	0.01	Nm
Pn68	max. abn. stopping time	2444h	ALL	appl	np	---	0	100	0	0.01	s
Pn69	GTR7 voltage	2445h	ALL	appl	np	---	300	1500	780	1	V
Pn70	brake pretorq. source	2446h	M, S	appl	p	E	0	3	0	1	---
Pn71	pretorque ref. setting %	2447h	M, S	appl	p	---	-400	400	100	0,1	%
Pn72	set prog. spec. functions	2448h	ALL	appl	p	---	0	1	1	1	---
Pn73	positioning correction	2449h	G	appl	p	---	0	32767	0	1	---
Pn74	out phase check mode	244Ah	G, M	appl	np	---	0	1	0	1	---
Pn75	E.SCL stopping mode	244Bh	M, S	appl	np	---	0	6	6	1	---
Pn76	max. E.UP warning time	244Ch	ALL	appl	np	---	0	32.00	0	0.01	s
Pn78	USV operation inp. sel.	244Eh	ALL	appl	np	E	0	4095	0	1	---
Pn79	acceleration limit 1/S^2	244Fh	ALL	appl	np	---	0.01	10737418.23	0.01	0.01	---

continued on the next page

Parameter		Addr.	BA	R	P	E	Lower limit	Upper limit	Default	Step	Unit
Pn80	acc. scan time	2450h	ALL	appl	np	---	0	60000	0	1	ms
Pn81	warning acc.stop mode	2451h	ALL	appl	np	---	0	6	6	1	---
Pn82	GTR7 resistance	2452h	ALL	appl	np	---	0	5000	0	0.001	Ohm
Pn83	quick stop s-curve time	2453h	ALL	appl	p	---	0	5	0	0.01	s
Pn84	no Pu/E.UP delay time	2454h	ALL	appl	np	---	0	32	0	0,01	s
Pn85	blockade mode	2455h	ALL	appl	np	E	0	27	0	1	---
Pn86	blockade level	2456h	G	appl	np	---	0	400	4	0.0125	Hz
Pn86	blockade level	2456h	M, S	appl	np	---	0	4000	120	0.125	rpm
Pn87	blockade waiting time	2457h	ALL	appl	np	---	0	100	0.25	0.01	s
Pn88	blockade ramp time	2458h	ALL	appl	np	---	0	100	0.25	0.01	s
Pn90	SSf. lowest limit (ASCL)	245Ah	M	appl	np	---	-20	20	2	0.1	%
Pn91	flow ctrl. mode	245Bh	ALL	appl	np	E	0	3	0	1	---
Pn92	valve ctrl. output select	245Ch	ALL	appl	np	E	0	255	0	1	---
Pn93	flow switch input select	245Dh	ALL	appl	np	E	0	4095	0	1	---
Pn94	flow ctrl. warning delay	245Eh	ALL	appl	np	---	0	60	0	0.01	s
Pn95	flow ctrl. min. temp.	245Fh	ALL	appl	np	---	0	90	0	1	°C
Pn96	pow.off max. time f. rest.	2460h	ALL	appl	np	---	0	100	0	0.1	s
Pn97	fan control power unit	2461h	ALL	appl	np	E	0	127	20	1	---
PP00	prog. parameter 00	3300h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP01	prog. parameter 01	3301h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP02	prog. parameter 02	3302h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP03	prog. parameter 03	3303h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP04	prog. parameter 04	3304h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP05	prog. parameter 05	3305h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP06	prog. parameter 06	3306h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP07	prog. parameter 07	3307h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP08	prog. parameter 08	3308h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP09	prog. parameter 09	3309h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP10	prog. parameter 10	330Ah	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP11	prog. parameter 11	330Bh	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP12	prog. parameter 12	330Ch	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP13	prog. parameter 13	330Dh	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP14	prog. parameter 14	330Eh	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP15	prog. parameter 15	330Fh	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP16	prog. parameter 16	3310h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP17	prog. parameter 17	3311h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP18	prog. parameter 18	3312h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP19	prog. parameter 19	3313h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP20	prog. parameter 20	3314h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP21	prog. parameter 21	3315h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP22	prog. parameter 22	3316h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP23	prog. parameter 23	3317h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP24	prog. parameter 24	3318h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP25	prog. parameter 25	3319h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP26	prog. parameter 26	331Ah	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP27	prog. parameter 27	331Bh	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP28	prog. parameter 28	331Ch	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP29	prog. parameter 29	331Dh	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP30	prog. parameter 30	331Eh	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP31	prog. parameter 31	331Fh	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP32	prog. parameter 32	3320h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP33	prog. parameter 33	3321h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP34	prog. parameter 34	3322h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP35	prog. parameter 35	3323h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP36	prog. parameter 36	3324h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP37	prog. parameter 37	3325h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP38	prog. parameter 38	3326h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP39	prog. parameter 39	3327h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP40	prog. parameter 40	3328h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP41	prog. parameter 41	3329h	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP42	prog. parameter 42	332Ah	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP43	prog. parameter 43	332Bh	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP44	prog. parameter 44	332Ch	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP45	prog. parameter 45	332Dh	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP46	prog. parameter 46	332Eh	ALL	appl	np	---	-2147483647	2147483647	0	1	---
PP47	prog. parameter 47	332Fh	ALL	appl	np	---	-2147483647	2147483647	0	1	---
pr63	error code	603Fh	ALL	ro	np	---	0	65535	0	1	---
pr64	controlword	6040h	ALL	appl	np	E	0	65535	0	1	---
pr65	statusword	6041h	ALL	ro	np	---	0	65535	0	1	---
pr66	VL_TargetVelocity	6042h	ALL	appl	np	---	-32000	32000	0	1	rpm
pr67	VL_VelocityDemand	6043h	G	ro	np	---	-400	400	0	0.0125	Hz
pr68	VL_ControlEffort	6044h	ALL	ro	np	---	-32000	32000	0	1	rpm

continued on the next page

Parameter		Addr.	BA	R	P	E	Lower limit	Upper limit	Default	Step	Unit
pr70 subindex1	vl velocity min	6046h	ALL	appl	np	---	100	LTK	0	1	rpm
pr70 subindex2	vl velocity max	6046h	ALL	appl	np	---	100	LTK	0	1	rpm
pr72 subindex1	vl velocity accelaration	6048h	ALL	appl	np	---	100	LTK	0	1	rpm
pr72 subindex2	vl velocity accelaration	6048h	ALL	appl	np	---	100	300	0	1	s
pr73 subindex1	vl velocity deceleration	6049h	ALL	appl	np	---	100	LTK	0	1	rpm
pr73 subindex2	vl velocity deceleration	6049h	ALL	appl	np	---	100	300	0	1	s
pr74 subindex1	vl velocity quick stop	604Ah	ALL	appl	np	---	100	LTK	0	1	rpm
pr74 subindex2	vl velocity quick stop	604Ah	ALL	appl	np	---	100	300	0	1	s
pr77	vl pole number	604Dh	ALL	appl	np	---	2	62	4	1	---
pr96	modes of operation	6060h	ALL	appl	np	---	-1	2	-1	1	---
pr97	modes of operation display	6061h	ALL	appl	np	---	-1	2	-1	1	---
ru00	inverter state	2200h	ALL	ro	np	---	0	255	0	1	---
ru01	set value display	2201h	G	ro	np	---	-400	400	0	0.0125	Hz
ru01	set value display	2201h	M, S	ro	np	---	-4000	4000	0	0.125	rpm
ru02	Ramp output display	2202h	G	ro	np	---	-400	400	0	0.0125	Hz
ru02	Ramp output display	2202h	M, S	ro	np	---	-4000	4000	0	0.125	rpm
ru03	actual frequency display	2203h	ALL	ro	np	---	-400	400	0	0.0125	Hz
ru05	encoder 2 frequency	2205h	ALL	ro	np	---	-400	400	0	0.0125	Hz
ru06	calculated act. value	2206h	G	ro	np	---	-400	400	0	0.0125	Hz
ru07	actual value display	2207h	G	ro	np	---	-400	400	0	0.0125	Hz
ru07	actual value display	2207h	M, S	ro	np	---	-4000	4000	0	0.125	rpm
ru10	encoder 2 speed	220Ah	ALL	ro	np	---	-32000	32000	0	1	rpm
ru11	set torque display	220Bh	M, S	ro	np	---	-32000	32000	0	0.01	Nm
ru12	actual torque display	220Ch	M, S	ro	np	---	-32000	32000	0	0.01	Nm
ru13	actual utilization	220Dh	ALL	ro	np	---	0	255	0	1	%
ru14	peak utilization	220Eh	ALL	appl	np	---	0	255	0	1	%
ru15	Apparent current	220Fh	ALL	ro	np	---	0	6553.5	0	0.1	A
ru16	peak apparent current	2210h	ALL	appl	np	---	0	6553.5	0	0.1	A
ru17	Active current	2211h	ALL	ro	np	---	-3276.7	3276.7	0	0.1	A
ru18	actual DC voltage	2212h	ALL	ro	np	---	0	1500	0	1	V
ru19	peak DC voltage	2213h	ALL	appl	np	---	0	1500	0	1	V
ru20	output voltage	2214h	ALL	ro	np	---	0	1167	0	1	V
ru21	input terminal state	2215h	ALL	ro	np	---	0	4095	0	1	---
ru22	internal input state	2216h	ALL	ro	np	---	0	4095	0	1	---
ru23	output condition state	2217h	ALL	ro	np	---	0	255	0	1	---
ru24	state of output flags	2218h	ALL	ro	np	---	0	255	0	1	---
ru25	output terminal state	2219h	ALL	ro	np	---	0	255	0	1	---
ru26	active parameter set	221Ah	ALL	ro	np	---	0	7	0	1	---
ru27	AN1 pre amplifier disp.	221Bh	ALL	ro	np	---	-100	100	0	0.1	%
ru28	AN1 post amplifier display	221Ch	ALL	ro	np	---	-400	400	0	0.1	%
ru29	AN2 pre amplifier disp.	221Dh	ALL	ro	np	---	-100	100	0	0.1	%
ru30	AN2 post ampl. disp.	221Eh	ALL	ro	np	---	-400	400	0	0.1	%
ru33	ANOUT1 pre ampl. disp.	2221h	ALL	ro	np	---	-400	400	0	0.1	%
ru34	ANOUT1 post ampl. disp.	2222h	ALL	ro	np	---	-115	115	0	0.1	%
ru35	ANOUT2 pre ampl. disp.	2223h	ALL	ro	np	---	-400	400	0	0.1	%
ru36	ANOUT2 post ampl. disp.	2224h	ALL	ro	np	---	-115.0	115.0	0	0.1	%
ru37	motorpoti actual value	2225h	ALL	ro	np	---	-100	100	0	0.01	%
ru38	power module temperature	2226h	ALL	ro	np	---	-30	127	0	1	°C
ru39	OL counter display	2227h	ALL	ro	np	---	0	100	0	1	%
ru40	power on counter	2228h	ALL	ro	np	---	0	65535	0	1	h
ru41	modulation on counter	2229h	ALL	ro	np	---	0	65535	0	1	h
ru42	modulation grade	222Ah	ALL	ro	np	---	0	110	0	1	%
ru43	timer 1 display	222Bh	ALL	appl	np	---	0	655.35	0	0.01	---
ru44	timer 2 display	222Ch	ALL	appl	np	---	0	655.35	0	0.01	---
ru45	act. switching frequency	222Dh	ALL	ro	np	---	0	4	0	1	---
ru46	motor temperature	222Eh	ALL	ro	np	---	0	255	0	1	°C

continued on the next page

Parameter		Addr.	BA	R	P	E	Lower limit	Upper limit	Default	Step	Unit
ru47	act. torque limit mot.	222Fh	M, S	ro	np	---	-32000	32000	0	0.01	Nm
ru48	act. torque limit gen.	2230h	M, S	ro	np	---	-32000	32000	0	0.01	Nm
ru49	ref. torque	2231h	M, S	ro	np	---	-32000	32000	0	0.01	Nm
ru52	ext. PID out display	2234h	ALL	ro	np	---	-400	400	0	0.1	%
ru53	AUX display	2235h	ALL	ro	np	---	-400	400	0	0.1	%
ru68	rated DC voltage	2244h	ALL	ro	np	---	0	1500	0	1	V
ru73	set torque in percent	2249h	M, S	ro	np	---	-400	400	0	0.1	%
ru74	actual torque in percent	224Ah	M, S	ro	np	---	-400	400	0	0.1	%
ru78	act. val.display in perc.	224Eh	ALL	ro	np	---	-400	400	0	0.1	%
ru79	abs.speed value (EMF)	224Fh	S	ro	np	---	-4000	4000	0	0.125	rpm
ru80	digital output state	2250h	ALL	ro	np	---	0	255	0	1	---
ru81	active power	2251h	ALL	ro	np	---	-1000	1000	0	0.01	kW
ru82	ramp value disp. high-res.	2252h	ALL	ro	np	---	-2147483648	2147483648	0	1	---
ru83	act. value display high-res.	2253h	ALL	ro	np	---	-2147483648	2147483648	0	1	---
ru87	magnetising current	2257h	ALL	ro	np	---	-3276.7	3276.7	0	0.1	A
ru88	act. src. frequency	2258h	G	ro	np	---	-400	400	0	0.0125	Hz
ru89	act. src. speed	2259h	ALL	ro	np	---	-4000	4000	0	0.125	rpm
ru90	max. torque in percent	225Ah	ALL	ro	np	---	0	400	0	0.01	%
ru91	energy over gtr7	225Bh	ALL	appl	np	---	0	99999	0	1	kWh
ru92	input power	225Ch	ALL	ro	np	---	-1000	1000	0	0.01	kW
ru93	power loss	225Dh	ALL	ro	np	---	-1000	1000	0	0.01	kW
ru96	active sub index	2260h	ALL	ro	np	---	1	8	1	1	---
ru97	internal temperature	2261h	ALL	ro	np	---	-30	127	0	1	---
Sy02	inverter identifier	2002h	ALL	cp-ro	np	---	identifier	identifier	identifier	1	hex
Sy03	power unit code	2003h	ALL	cp-ro	np	E	LTK	LTK	LTK	1	---
Sy04	cfg. data sel.	2004h	ALL	cp-ro	np	---	0	24	0	1	---
Sy05	cfg. data	2005h	ALL	cp-ro	np	---	-32767	32767	0	1	---
Sy06	inverter address	2006h	ALL	appl	np	E	0	239	1	1	---
Sy09	watchdog time int. bus	2009h	ALL	cp-ro	np	E	0	10	0	0.05	s
Sy10	G6L-G, G6L-M, G6p-S	200Ah	ALL	ro	np	---	0	0	0	1	---
Sy11	baud rate int. bus	200Bh	ALL	cp-ro	np	E	20	23	LTK	1	---
Sy32	scope timer	2020h	ALL	ro	np	---	0	65535	LTK	1	---
Sy33	scope data 1 defin.	2021h	ALL	cp-ro	np	---	-1	32767	-1	1	---
Sy34	scope data 1 set	2022h	ALL	cp-ro	np	---	1	128	1	1	---
Sy35	scope data 2 defin.	2023h	ALL	cp-ro	np	---	-1	32767	-1	1	---
Sy36	scope data 2 set	2024h	ALL	cp-ro	np	---	1	128	1	1	---
Sy37	scope data 3 defin.	2025h	ALL	cp-ro	np	---	-1	32767	-1	1	---
Sy38	scope data 3 set	2026h	ALL	cp-ro	np	---	1	128	1	1	---
Sy39	scope data 4 defin.	2027h	ALL	cp-ro	np	---	-1	32767	-1	1	---
Sy40	scope data 4 set	2028h	ALL	cp-ro	np	---	1	128	1	1	---
Sy41	control word (high)	2029h	ALL	appl	np	E	0	65535	0	1	---
Sy42	status word (high)	202Ah	ALL	ro	np	---	0	65535	0	1	---
Sy43	control word (long)	202Bh	ALL	appl	np	E	-2147483648	2147483647	0	1	---
Sy44	status word (long)	202Ch	ALL	ro	np	---	-2147483648	2147483647	0	1	---
Sy50	control word (low)	2032h	ALL	appl	np	E	0	65535	0	1	---
Sy51	status word (low)	2033h	ALL	ro	np	---	0	65535	0	1	---
Sy52	set speed value	2034h	ALL	appl	np	---	-32000	32000	0	1	rpm
Sy53	actual speed value	2035h	ALL	ro	np	---	-32000	32000	0	1	rpm
Sy56	start display address	2038h	ALL	cp-ro	np	E	0	32767	8711	1	---
Sy56	start display address	2038h	ALL	cp-ro	np	E	0	32767	8707	1	---
Sy57	watchdog time address	2039h	ALL	cp-ro	np	---	-2	-1	-2	1	---
Sy98	power unit control word	2062h	ALL	cp-ro	np	E	-2147483648	2147483647	0	1	---
Sy99	power unit satus word	2063h	ALL	ro	np	---	-2147483648	2147483647	0	1	---
Ud01	password	2801h	ALL	cp-ro	np	E	0	9999	Application	1	---
Ud02	control type	2802h	G	appl	np	E	0	1	0	1	---
Ud02	control type	2802h	M	appl	np	E	0	7	4	1	---
Ud02	control type	2802h	S	appl	np	E	0	11	8	1	---
Ud04	auto store state	2804h	ALL	ro	np	---	0	4	0	1	---
Ud05	auto store	2805h	ALL	appl	np	---	0	2	1	1	---
Ud06	select 50Hz/60Hz mode	2806h	G	appl	np	E	0	1	0	1	---
Ud07	memory store input sel.	2807h	ALL	appl	np	E	0	4095	0	1	---
Ud15	cp selector	280Fh	ALL	appl	np	E	1	48	1	1	---
Ud16	cp address	2810h	ALL	appl	np	E	-1	32767	8707	1	---
Ud17	cp set norm	2811h	ALL	appl	np	E	1	8191	1	1	---
Ud18	divisor display norm	2812h	ALL	appl	p	E	-32767	32767	1	1	---
Ud19	multiplier display norm	2813h	ALL	appl	p	E	-32767	32767	1	1	---
Ud20	offset display norm	2814h	ALL	appl	p	E	-32767	32767	0	1	---
Ud21	ctrl. display norm	2815h	ALL	appl	p	E	0	1791	0	1	---
Ud22	pp selector	2816h	ALL	appl	np	E	0	47	0	1	---
Ud23	pp address	2817h	ALL	appl	np	E	-1	32767	-1	1	
Ud24	pp properties	2818h	ALL	appl	np	E	1	1048575	1	1	---
Ud25	pp write multiplier	2819h	ALL	appl	np	---	-32767	32767	1	1	---
Ud26	pp write shifter	281Ah	ALL	appl	np	---	0	48	0	1	---

continued on the next page

Parameter		Addr.	BA	R	P	E	Lower limit	Upper limit	Default	Step	Unit
Ud27	pp read multiplier	281Bh	ALL	appl	np	---	-32767	32767	1	1	---
Ud28	pp read shifter	281Ch	ALL	appl	np	---	0	48	1	1	---
Ud29	pp offset	281Dh	ALL	appl	np	---	-2147483648	2147483648	0	1	---
Ud30	pp upper limit	281Eh	ALL	appl	np	---	-2147483648	2147483648	2147483648	1	---
Ud31	pp lower limit	281Fh	ALL	appl	np	---	-2147483648	2147483648	-2147483648	1	---
uF00	rated frequency	2500h	G, M	appl	p	---	0	400	50	0.0125	Hz
uF01	boost	2501h	G, M	appl	p	---	0	25.5	LTK	0.1	%
uF02	add. frequency	2502h	G, M	appl	p	---	-0.0125	400	0	0.0125	Hz
uF03	add. voltage	2503h	ALL	appl	p	---	0	100	0	0.1	%
uF04	delta boost	2504h	G, M	appl	p	---	0	25.5	0	0.1	%
uF05	delta boost time	2505h	G, M	appl	p	---	0	10	0	0.01	s
uF06	energy saving mode	2506h	G, M	appl	p	---	0	79	0	1	---
uF07	energy saving factor	2507h	G, M	appl	p	---	0	130	70	0.1	%
uF08	energy saving input sel.	2508h	G, M	appl	np	E	0	4095	0	1	---
uF09	voltage stabilisation	2509h	G, M	appl	np	E	1	1120	1120	1	V
uF09	voltage stabilisation	2509h	S	appl	np	E	1	1120	1120	1	V
uF10	max. voltage mode	250Ah	G, M	appl	p	---	0	3	0	1	---
uF11	switching frequency	250Bh	ALL	appl	p	E	1	4	1	1	---
uF12	base block time	250Ch	ALL	ro	np	---	0.05	10	LTK	0.01	s
uF13	base block voltage level	250Dh	ALL	ro	np	---	1	50	LTK	1	%
uF15	hardw. curr. lim. mode	250Fh	ALL	appl	np	E	0	2	1	1	---
uF16	autoboost configuration	2510h	G, M	appl	p	---	0	3	0	1	---
uF17	autoboost gain	2511h	G, M	appl	p	---	0	2.5	1.2	0.01	---
uF18	deadtime comp. mode	2512h	ALL	appl	np	E	0	3	2	1	---
uF19	voltage stabilisation PT1-timeconst.	2513h	G	appl	np	---	0	10	0	1	---
uF21	dt. comp. off input sel.	2515h	ALL	appl	np	E	0	4095	0	1	---
uF25	dead time soft on/off	2519h	ALL	appl	np	---	0	1024	0	1	ms
uF26	baseblock extension time	251Ah	ALL	appl	np	E	0	2.00	0.01	s	s
uF27	uF09 off input select	251Bh	G, M	appl	np	---	0	4095	0	1	---

25. Annex

25.1 UL Marking

Acceptance according to UL is marked at KEB inverters with the adjacent logo on the type plate.

In this chapter there are not any more information to the UL-marking. The respective control circuit instruction manual is available at www.keb.de for more information.

25.2 Index

A

Abnormal stopping 203

Absolute
  Setpoint setting 41, 42, 87, 88, 168

Acceleration
  time 14, 21, 26, 31, 32, 34, 35, 39, 45, 46, 47, 59, 65, 66, 67, 68, 71, 72, 74, 75, 78, 79, 91, 98, 99, 100, 101, 102, 103, 104, 107, 110, 111, 112, 117, 119, 124, 125, 126, 128, 129, 131, 132, 134, 135, 136, 137, 138, 139, 140, 141, 145, 146, 147, 148, 149, 150, 151, 152, 155, 156, 159, 160, 163, 164, 165, 166, 167, 168, 186, 188, 190, 196, 197, 198, 199, 200, 202, 203, 204, 205, 206, 207, 208, 209, 210, 214, 215, 216, 217, 218, 219, 220, 221, 224, 225, 228, 229, 230, 231, 232, 236, 243, 244, 245, 246, 247, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 263, 264, 265, 266, 281, 282, 283, 284, 285, 286, 287, 288, 294, 295, 299

Active current 58, 60, 113, 159, 207, 208, 214, 268, 270, 271

Actual frequency
  display 14, 17, 27, 30, 32, 33, 34, 37, 38, 39, 40, 41, 42, 45, 47, 49, 50, 58, 59, 60, 69, 74, 76, 77, 78, 85, 86, 89, 95, 96, 104, 113, 114, 121, 129, 130, 135, 136, 140, 141, 146, 147, 155, 159, 182, 184, 187, 188, 196, 197, 201, 203, 205, 206, 230, 237, 245, 246, 250, 251, 253, 254, 273, 275, 276, 277, 278, 281, 291, 295, 298

Actual speed 174, 175, 257, 292
  display 14, 17, 27, 30, 32, 33, 34, 37, 38, 39, 40, 41, 42, 45, 47, 49, 50, 58, 59, 60, 69, 74, 76, 77, 78, 85, 86, 89, 95, 96, 104, 113, 114, 121, 129, 130, 135, 136, 140, 141, 146, 147, 155, 159, 182, 184, 187, 188, 196, 197, 201, 203, 205, 206, 230, 237, 245, 246, 250, 251, 253, 254, 273, 275, 276, 277, 278, 281, 291, 295, 298
  Value 46, 47, 51, 52, 53, 54, 55, 57, 58, 60, 61, 65, 66, 68, 70, 71, 75, 77, 83, 86, 87, 88, 91, 93, 98, 101, 102, 104, 105, 108, 109, 110, 111, 112, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 128, 129, 130, 131, 137, 138, 140, 144, 145, 146, 147, 148, 150, 154, 156, 157, 158, 169, 172, 174, 177, 178, 179, 180, 181, 184, 186, 189, 190, 191, 193, 196, 198, 199, 202, 203, 204, 205, 206, 207, 209, 210, 211, 212, 213, 214, 215, 216, 220, 227, 228, 229, 230, 231, 232, 234, 238, 239, 242, 245, 247, 248, 249, 250, 252, 253, 254, 258, 260, 262, 263, 264, 266, 267, 268, 272, 274, 275, 276, 277, 278, 279, 281, 287, 288, 289, 290, 291, 295, 296, 297, 298, 299, 300

Actual torque 58, 60, 76

Actual utilization 268

Additional function
  acceleration/deceleration 75, 98, 104
  mode 17, 21, 22, 24, 25, 26, 28, 29, 31, 42, 44, 50, 52, 53, 57, 58, 63, 65, 68, 70, 75, 86, 97, 98, 99, 100, 103, 104, 108, 112, 116, 118, 120, 121, 125, 126, 127, 130, 131, 132, 133, 134, 135, 136, 137, 138, 140, 143, 144, 146, 149, 150, 156, 157, 162, 169, 172, 174, 178, 179, 180, 181, 183, 184, 186, 187, 188, 189, 190, 196, 197, 198, 199, 200, 201, 202, 203, 204, 206, 207, 208, 210, 211, 212, 214, 215, 216, 218, 219, 220, 221, 222, 223, 224, 225, 226, 228, 231, 234, 242, 244, 245, 246, 247, 251, 252, 254, 255, 260, 262, 272, 273, 274, 276, 277, 278, 281, 294, 295, 297, 298, 300
  source 24, 28, 33, 48, 54, 57, 64, 65, 86, 87, 90, 92, 93, 115, 116, 118, 124, 138, 144, 146, 154, 180, 181, 186, 187, 188, 194, 195, 211, 222, 223, 224, 225, 226, 237, 238, 242, 244, 250, 251, 252, 253, 258, 260, 261, 262, 263, 267, 268, 269, 278, 279, 280, 287, 289, 290, 292, 300

Analog
  mass 20, 135, 148, 163, 165, 166, 225

Analog input
  display 14, 17, 27, 30, 32, 33, 34, 37, 38, 39, 40, 41, 42, 45, 47, 49, 50, 58, 59, 60, 69, 74, 76, 77, 78, 85, 86, 89, 95, 96, 104, 113, 114, 121, 129, 130, 135, 136, 140, 141, 146, 147, 155, 159, 182, 184, 187, 188, 196, 197, 201, 203, 205, 206, 230, 237, 245, 246, 250, 251, 253, 254, 273, 275, 276, 277, 278, 281, 291, 295, 298

Angle difference 60

ANOUT 57, 58, 59, 60, 62, 270

An-Parameter
  An00 37, 50, 51
  An01 50, 52, 60, 75
  An02 50, 52, 53, 60, 75
  An03 50, 53, 69, 70
  An04 50, 52, 54, 65
  An05 50, 55, 56
  An06 50, 55, 56
  An07 50, 55, 56
  An08 50, 56
  An09 50, 56
  An10 37, 50, 51
  An11 50, 52, 181, 186
  An12 50, 52, 53, 181, 186
  An13 50, 53, 69, 70
  An14 50, 52, 54, 65, 181, 186
  An15 50, 55, 258
  An16 50, 55, 258
  An17 50, 55, 181, 186, 258
  An18 50, 56, 258
  An19 50, 56, 57, 258
  An30 40, 50, 57, 86, 181, 186, 269
  An31 58, 60, 270
  An32 58, 60, 62, 264
  An33 58, 61, 62
  An34 61, 62
  An35 58, 61

An36 58, 60
An37 60, 62, 264
An38 58, 61, 62
An39 61
An40 58, 61
An41 58, 60
An42 60, 62, 264
An43 58, 61, 62
An44 61
An45 58, 61
An46 59, 76
An47 58, 60
An48 60, 62, 264
An49 58, 61, 62
An50 61
An51 58, 61
An52 59, 76
An53 194, 195, 263
An54 182, 194, 195, 263, 264
An55 194, 195, 264
An56 194, 195, 264
An57 264
An-Parameter 269, 270, 271

Apparent current 58, 60, 77, 207, 208, 214

Automatic 125, 163, 204, 234, 288
restart 75, 78, 196, 199, 202, 203, 204, 205, 210, 211, 220, 221, 223, 224, 225, 226, 229, 230, 231, 245, 284

AUX 30, 40, 50, 57, 85, 86, 118, 119, 258, 260, 261, 262, 263, 267, 268
display 14, 17, 27, 30, 32, 33, 34, 37, 38, 39, 40, 41, 42, 45, 47, 49, 50, 58, 59, 60, 69, 74, 76, 77, 78, 85, 86, 89, 95, 96, 104, 113, 114, 121, 129, 130, 135, 136, 140, 141, 146, 147, 155, 159, 182, 184, 187, 188, 196, 197, 201, 203, 205, 206, 230, 237, 245, 246, 250, 251, 253, 254, 273, 275, 276, 277, 278, 281, 291, 295, 298
Function 27, 44, 52, 57, 58, 60, 61, 66, 68, 69, 72, 75, 77, 83, 86, 87, 88, 89, 90, 91, 93, 112, 115, 116, 117, 118, 119, 120, 122, 123, 124, 125, 126, 129, 131, 144, 145, 147, 148, 150, 154, 156, 157, 169, 189, 190, 199, 215, 216, 238, 247, 258, 266, 274, 275, 277, 289, 290, 300

Auxiliary function
mode 17
Source 194, 195

B

Binary-coded set selection 242

Braking
option 195
resistance 23, 25, 28, 44, 45, 51, 71, 108, 114, 115, 117, 118, 119, 120, 124, 125, 126, 127, 128, 133, 138, 139, 140, 143, 147, 148, 149, 154, 155, 200, 228, 281, 284
time 14, 21, 26, 31, 32, 34, 35, 39, 45, 46, 47, 59, 65, 66, 67, 68, 71, 72, 74, 75, 78, 79, 91, 98, 99, 100, 101, 102, 103, 104, 107, 110, 111, 112, 117, 119, 124, 125, 126, 128, 129, 131, 132, 134, 135, 136, 137, 138, 139, 140, 141, 145, 146, 147, 148, 149, 150, 151, 152, 155, 156, 159, 160, 163, 164, 165, 166, 167, 168, 186, 188, 190, 196, 197, 198, 199, 200, 202, 203, 204, 205, 206, 207, 208, 209, 210, 214, 215, 216, 217, 218, 219, 220, 221, 224, 225, 228, 229, 230, 231, 232, 236, 243, 244, 245, 246, 247, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 263, 264, 265, 266, 281, 282, 283, 284, 285, 286, 287, 288, 294, 295, 299
torque 13, 23, 26, 27, 28, 29, 30, 34, 40, 41, 42, 58, 60, 76, 108, 111, 113, 115, 117, 121, 122, 123, 125, 127, 129, 130, 134, 136, 137, 140, 141, 143, 144, 145, 146, 147, 148, 149, 151, 155, 159, 161, 162, 165, 166, 167, 168, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 201, 203, 204, 206, 207, 209, 210, 213, 214, 218, 220, 221, 223, 225, 226, 228, 246, 255, 257, 258, 259, 270, 271, 293, 297
transistor 14, 41, 70, 74, 223, 226, 227, 228, 230, 254

braking transistor 14

C

cn-Parameter
cn00 267, 269, 270, 271
cn01 267, 268, 269, 270, 271
cn02 268, 269, 270, 271
cn03 268
cn04 264, 265, 269, 270, 271
cn05 264, 265
cn06 264, 265, 269, 270, 271
cn07 264, 265, 269, 270, 271
cn08 264, 265, 269, 270, 271
cn09 264, 265, 266
cn10 265, 266, 269, 270, 271
cn11 69, 70, 265, 266
cn12 69, 70, 265, 266
cn13 69, 70, 265, 266
cn14 264, 265, 266, 271

COMBIVIS 17, 18, 21, 47, 121, 133, 149, 165, 236, 276, 280, 287

communication 47, 198, 285, 286, 287, 288

Copying
of parameter sets 237, 242

CP - Parameter 17

CP-Parameter
assignment 41, 69, 81, 84, 111, 189, 216, 238, 241
define 60, 63, 79, 101, 134, 193, 253, 254, 276

cS-Parameter
cS00 22, 24, 28, 115, 116, 121, 122, 144, 146, 187, 188, 202, 206, 215, 237, 244, 265, 266, 267, 271
cS01 24, 28, 33, 42, 115, 116, 121, 124, 144, 146, 181, 186, 211, 222, 237, 244
cS03 116, 117, 237
cS04 115, 116, 237, 271
cS05 169
cS06 23, 115, 116, 123, 145, 161, 163, 164, 166, 169, 237, 264
cS07 161, 164, 169, 170, 171
cS08 161, 164, 169, 170, 171
cS09 23, 26, 115, 116, 123, 161, 163, 164, 169, 237, 264
cS10 161, 164, 258
cS11 161, 164, 169, 258
cS12 145, 161, 164, 166, 169,

170, 171
cS13 169, 170, 171
cS14 169
cS15 161, 180, 181, 182, 186, 187, 188
cS16 186, 187, 188
cS18 181, 186, 187, 188
cS19 40, 41, 122, 145, 161, 180, 181, 182, 184, 186, 187, 188, 264
cS20 122, 180, 181, 182, 264
cS21 181, 264
cS22 181, 237, 264
cS23 122, 161, 180, 181, 182, 186, 264
cS25 123, 161, 163, 165, 166
cS26 123, 139, 163
cS27 161, 166, 167
cS28 161, 166, 167
cS29 135, 161, 166

Current limit
level 12, 17, 21, 62, 65, 71, 74, 75, 76, 77, 78, 79, 84, 107, 132, 134, 135, 148, 173, 175, 190, 191, 196, 197, 198, 199, 200, 203, 205, 206, 207, 208, 209, 212, 213, 214, 215, 219, 220, 221, 223, 224, 225, 229, 245, 251, 253, 255, 269, 281, 282, 283, 284, 286, 290

D

DC
brake 26, 69, 70, 71, 76, 78, 125, 146, 151, 164, 169, 190, 220, 224, 254, 255, 256, 257, 258, 259, 282, 284, 285, 296
link 35, 40, 95, 108, 110, 122, 123, 135, 144, 145, 162, 179, 180, 184, 185, 189, 196, 197, 201, 202, 213, 220, 222, 223, 225, 226, 227, 229, 230, 283, 285, 294

DC-link
voltage 20, 22, 23, 25, 27, 28, 30, 35, 37, 39, 40, 50, 51, 54, 58, 59, 60, 61, 64, 71, 72, 75, 76, 77, 107, 108, 109, 110, 111, 113, 115, 117, 120, 122, 123, 124, 128, 132, 133, 135, 137, 138, 139, 140, 141, 142, 143, 144, 145, 149, 154, 158, 159, 162, 172, 173, 175, 176, 177, 179, 180, 184, 185, 189, 190, 192, 196, 197, 202, 205, 206, 207, 211, 212, 213, 220, 221, 222, 223, 224, 225, 226, 227, 229, 230, 244, 246, 247, 259, 268, 282, 283, 284, 285, 288, 293, 294, 296, 297

Diameter
correction 71, 78, 91, 119, 129, 133, 149, 260, 262, 263, 272
ratio 157, 163, 193, 218, 219, 263, 264
signal 36, 37, 38, 40, 50, 51, 52, 54, 56, 57, 58, 59, 61, 62, 63, 64, 65, 66, 67, 68, 75, 76, 85, 89, 125, 127, 130, 146, 148, 157, 158, 166, 188, 196, 197, 203, 204, 254, 255, 258, 260, 261, 262, 263, 268, 272, 282, 289, 290

digital
mass 20, 135, 148, 163, 165, 166, 225

di-Parameter
di01 63, 64, 71, 72, 225, 289, 290
di02 63, 64, 71, 72, 225, 289, 290
di03 63, 65
di04 63, 65
di05 66, 71
di06 63, 67
di07 65, 67, 68, 69
di08 63, 67
di09 69, 70
di10 69
di11 63, 69, 70, 71, 72
di22 69, 70, 71, 72, 111
di24 69, 70, 71
di35 69, 70, 71, 111
di36 69, 71, 72, 227, 230
di37 69, 71, 72
di38 72
di39 69, 71, 72, 230, 231
di40 66
di41 66
di42 66, 290
di43 66
di44 66
di45 66
di46 66
di47 66
di48 66
di49 66
di50 66
di51 66
di52 66
di53 66
di54 66
di55 66

Direction of rotation
selection 12

dmin/dmax 263

do-Parameter
do00 36, 74, 75, 79, 84, 221, 230, 251, 253, 254, 281, 282
do01 36, 79, 84
do02 36, 84
do03 36
do04 36, 134
do05 36
do06 36
do07 36, 74, 75, 79, 221, 230, 252, 253, 254
do08 36, 74, 79, 84
do09 79
do10 84
do15 74, 79
do16 79, 84
do17 84
do18 84
do23 36, 79
do24 74, 79, 81, 82, 84
do25 74, 81, 84
do26 84
do27 84
do28 63
do32 81
do33 74, 81, 82, 84
do34 84
do35 84
do36 63, 84
do40 81, 82
do41 63, 74, 82, 84
do42 74, 83
do43 74
do44 74
do51 41, 74, 83, 84, 290

dr-Parameter
dr00 23, 25, 113, 114, 120, 122, 124, 131, 246
dr01 23, 25, 86, 113, 120, 122, 134, 185, 300
dr02 23, 25, 113, 115, 120, 122, 185
dr03 25, 113, 122, 163, 268
dr04 23, 25, 113, 122, 124
dr05 23, 25, 113, 115, 120, 122, 300
dr06 23, 25, 26, 114, 120, 124
dr07 25, 124, 127
dr08 25, 108, 124, 127
dr09 114, 115, 116

dr10 25, 26, 124
dr11 216
dr12 120, 216
dr13 128
dr14 60, 134, 173
dr15 173, 174, 175, 184, 186, 218
dr16 122, 134, 174, 175, 209
dr17 26, 122, 125, 126, 127, 131, 174, 175
dr18 25, 122, 132, 134, 142, 173, 174, 175, 183, 184, 185
dr19 122, 124, 127, 132
dr20 122, 142
dr23 28, 143, 148, 219
dr24 28, 143, 155, 185, 219
dr25 28, 143
dr26 28, 143, 144, 149, 176, 185
dr27 28, 29, 60, 143, 175, 177, 178
dr28 28, 143, 144, 219
dr30 28, 143, 149
dr31 28, 143, 148, 149, 158
dr32 177, 178
dr33 29, 145, 162, 177, 178, 218, 219
dr34 218, 219
dr35 218, 219
dr36 219
dr37 135, 173, 180, 183, 190, 246
dr39 162, 177, 178
dr40 162, 178
dr41 162, 178
dr42 162, 178
dr43 162, 178
dr44 162, 178
dr45 162, 178
dr46 162, 178
dr47 177, 178
dr48 26, 29, 124, 125, 126, 127, 128, 129, 130, 131, 132, 146, 147, 148, 149, 150
dr49 19, 26, 125, 128, 129, 148, 149
dr50 218, 219
dr51 78, 118
dr52 118
dr53 118, 119
dr54 119
dr55 119
dr56 119, 120
dr58 130, 149
dr59 130, 149
dr61 71
dr62 26, 125, 146
dr63 143, 149
dr64 143, 158
dr66 128, 129, 151
dr67 148
dr68 117, 118
dr-Parameter 237

dS-Parameter
dS00 122, 133, 145, 189, 237
dS01 122, 133, 145, 189, 237
dS02 26, 29, 189
dS03 134, 135, 162, 174, 178, 179, 180, 189, 190, 246
dS04 25, 121, 130, 131, 140, 142, 172, 185, 246
dS07 133
dS08 142, 172
dS09 142, 172
dS10 142, 172
dS11 123, 131
dS12 123, 131
dS13 123, 131, 172, 176, 177, 178, 180, 237
dS14 123, 139
dS15 123, 139
dS17 139
dS18 133, 134, 137, 138, 156
dS19 123, 136
dS20 136, 137
dS21 19, 133, 135, 136, 137
dS22 19, 133, 135, 136, 137
dS23 134, 139
dS26 131
dS27 139
dS30 157
dS31 157
dS32 157
dS33 157

E

Ec-Parameter
Ec14 193, 194, 195, 237, 264
Ec15 193, 237
Ec40 141, 159, 237
Ec64 237

Electronic motor protection 216

EMC 12, 13

Encoder 57

ENTER-Parameter 32

Error
diagnosis 27, 46, 236

F

Factory setting 55, 61, 86, 101, 102

Fr-Parameter
Fr01 22, 24, 28, 149, 236, 237, 273
Fr02 238, 239, 240, 241, 242, 289
Fr03 201, 238, 242
Fr04 238, 239
Fr05 243
Fr06 243
Fr07 69, 70, 239, 240, 241
Fr08 216, 217, 218
Fr09 237, 274, 278
Fr10 23, 25, 28, 115, 122, 123, 124, 131, 136, 145, 149, 151, 155, 163, 237
Fr11 69, 70, 241
Fr12 242

Fundamentals 17

G

Gear factor 193, 194, 195
analog setting 99, 194, 195, 249, 261, 263
set-programming 195, 237

Gear Factor
analog setting 194, 195
set-programming 195

H

Heat sink overtemperature 197, 203

Hysteresis 79, 248

I

Incremental encoder
input 17, 22, 23, 30, 33, 34, 35, 36, 37, 39, 40, 41, 42, 45, 50, 51, 52, 53, 54, 55, 56, 57, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 71, 72, 76, 77, 86, 88, 89, 92, 93, 107, 111, 112, 115, 116, 118, 122, 123, 124, 132, 134, 135, 145, 150, 163, 172, 179, 181, 182, 186, 193, 194, 195, 198, 212, 213, 221, 225, 226, 227, 228, 229, 230, 231, 232, 238, 239, 241, 245, 247, 248, 249, 250, 251, 252, 253, 255, 258, 260, 262, 263, 265, 266, 267, 268, 273, 279, 284, 285, 289, 290, 291
output 18, 22, 30, 31, 33, 35, 36, 37, 38, 39, 40, 41, 43, 50, 55,

57, 58, 59, 60, 61, 62, 63, 64, 65, 72, 73, 74, 75, 76, 77, 78, 79, 81, 82, 83, 84, 85, 86, 94, 95, 96, 97, 103, 104, 105, 107, 108, 110, 111, 113, 115, 120, 125, 130, 132, 133, 134, 135, 136, 137, 138, 139, 141, 142, 146, 151, 152, 153, 154, 155, 156, 158, 159, 166, 172, 179, 181, 186, 187, 188, 191, 192, 196, 198, 201, 202, 203, 204, 211, 213, 215, 223, 224, 225, 227, 228, 229, 232, 245, 247, 252, 254, 256, 257, 258, 260, 262, 263, 264, 265, 266, 267, 269, 270, 271, 281, 282, 284, 285, 286, 290, 291, 295, 298, 300

In-Parameter
- In00 31, 43
- In01 31, 43, 60, 120, 158, 207, 208, 215
- In03 31, 43, 191
- In04 31, 43, 191
- In06 31, 43
- In07 31, 44
- In10 31, 44, 236
- In11 31, 44
- In12 31, 44
- In13 31, 44
- In14 31, 44
- In15 31, 44
- In16 31, 44, 236
- In17 31, 44, 199
- In18 31, 45, 125, 146, 155, 173, 175, 190
- In19 31, 45
- In22 31, 45
- In23 31, 45
- In24 31, 45, 236
- In25 31, 46
- In26 31, 46
- In27 31, 46
- In28 31, 46
- In29 31, 46
- In30 31, 46, 236
- In39 31, 46, 128, 149
- In40 31, 46, 128, 149
- In41 31, 46
- In42 31, 46
- In43 31, 46

input
- coded set selection 239, 240, 241, 242

Input
- terminal status 291

Inputs
- Analog 14, 37, 38, 40, 50, 59, 60, 62, 86, 99, 181, 186, 249, 263, 264, 267, 268, 269, 270, 271

Input trigger 66

InterBus
- Loop 15, 106
- operator 17, 33, 122

Interface
- operator 17, 33, 122

Internal overtemperature 198, 203

Inverter
- rated current 23, 25, 28, 34, 43, 60, 78, 113, 120, 122, 124, 134, 143, 146, 148, 149, 151, 173, 175, 177, 178, 216, 219, 246
- status 23, 32, 33, 48, 65, 76, 78, 79, 114, 115, 196, 197, 200, 201, 202, 205, 206, 207, 210, 211, 221, 223, 224, 225, 227, 229, 230, 231, 245, 254, 255, 256, 266, 279, 281, 288, 289, 290, 291, 293, 295, 298

J

K

Keep-On-Running 196

L

LE-Parameter
- LE00 74, 77, 79, 251, 253, 264
- LE01 79, 84, 264
- LE02 84, 264
- LE03 264
- LE04 134, 264
- LE05 264
- LE06 264
- LE07 74, 77, 79, 251, 253, 264
- LE08 79
- LE09 79, 84
- LE10 84
- LE12 134
- LE15 79
- LE16 76, 79, 230, 245, 291
- LE17 39, 69, 70, 251, 253
- LE18 251, 252, 253
- LE19 69, 70, 251, 253
- LE20 251, 252, 253
- LE21 39, 251, 252, 253
- LE22 39, 69, 70, 251, 253
- LE23 251, 252
- LE24 69, 70, 251, 253
- LE25 251, 252, 253
- LE26 39, 251, 252, 253
- LE27 42, 183, 184, 185
- LE28 42, 184, 185

M

Master
- position 141, 143, 151, 154, 157, 158, 159, 178, 264, 272, 294

mode 17, 21, 22, 24, 25, 26, 28, 29, 31, 42, 44, 50, 52, 53, 57, 58, 63, 65, 68, 70, 75, 86, 97, 98, 99, 100, 103, 104, 108, 112, 116, 118, 120, 121, 125, 126, 127, 130, 131, 132, 133, 134, 135, 136, 137, 138, 140, 143, 144, 146, 149, 150, 156, 157, 162, 169, 172, 174, 178, 179, 180, 181, 183, 184, 186, 187, 188, 189, 190, 196, 197, 198, 199, 200, 201, 202, 203, 204, 206, 207, 208, 210, 211, 212, 214, 215, 216, 218, 219, 220, 221, 222, 223, 224, 225, 226, 228, 231, 234, 242, 244, 245, 246, 247, 251, 252, 254, 255, 260, 262, 272, 273, 274, 276, 277, 278, 281, 294, 295, 297, 298, 300

Mode 18, 49, 98, 140, 169, 183, 184, 187, 188, 189, 231, 254, 273

Modulation
- hour meter 288

Motor
- temperature 24, 30, 38, 40, 42, 44, 45, 58, 59, 60, 71, 75, 76, 78, 114, 117, 118, 119, 120, 127, 130, 138, 139, 140, 148, 155, 191, 196, 197, 198, 199, 200, 204, 229, 234, 264, 269, 281, 282, 284, 285, 286

Motorpoti
- actual value 24, 28, 30, 33, 38,

41, 42, 60, 76, 78, 84, 95, 110, 112, 113, 116, 117, 121, 124, 134, 138, 139, 141, 142, 144, 146, 156, 187, 188, 201, 206, 211, 222, 228, 229, 230, 244, 245, 247, 249, 251, 264, 268, 269, 270, 271, 272, 281, 291
function 14, 16, 22, 23, 24, 38, 40, 45, 47, 50, 57, 60, 63, 66, 67, 69, 70, 71, 72, 76, 78, 79, 81, 85, 86, 91, 93, 96, 97, 99, 101, 108, 109, 110, 111, 113, 117, 131, 134, 137, 138, 139, 140, 144, 148, 149, 150, 156, 158, 164, 166, 168, 169, 174, 181, 185, 186, 190, 196, 197, 198, 199, 200, 201, 202, 204, 205, 206, 207, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 224, 225, 226, 227, 229, 230, 231, 234, 239, 241, 246, 247, 248, 249, 250, 255, 258, 260, 261, 262, 263, 264, 266, 272, 275, 281, 282, 283, 284, 287, 288
Maximum value 195
Max. value 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49
Minimum value 195
Min. value 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49
Ramp time 135, 215

Motor protection
function 14, 16, 22, 23, 24, 38, 40, 45, 47, 50, 57, 60, 63, 66, 67, 69, 70, 71, 72, 76, 78, 79, 81, 85, 86, 91, 93, 96, 97, 99, 101, 108, 109, 110, 111, 113, 117, 131, 134, 137, 138, 139, 140, 144, 148, 149, 150, 156, 158, 164, 166, 168, 169, 174, 181, 185, 186, 190, 196, 197, 198, 199, 200, 201, 202, 204, 205, 206, 207, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 224, 225, 226, 227, 229, 230, 231, 234, 239, 241, 246, 247, 248, 249, 250, 255, 258, 260, 261, 262, 263, 264, 266, 272, 275, 281, 282, 283, 284, 287, 288

N

nn-Parameter
nn00 146, 149, 152, 154, 156, 157, 158, 160
nn01 145, 151, 152, 153, 154, 155
nn02 145, 151, 152, 153, 158
nn03 145, 151, 152, 153, 158
nn04 155
nn05 155
nn06 155
nn07 155
nn08 143, 152, 153, 159
nn09 152
nn10 145, 151, 153, 154
nn11 145
nn12 156, 160
nn13 157
nn14 158
nn15 158
nn17 143, 158, 159

O

Operating
data 12, 13, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 34, 61, 85, 99, 113, 114, 115, 120, 121, 122, 123, 124, 125, 126, 127, 129, 132, 133, 134, 143, 145, 146, 147, 148, 149, 150, 154, 156, 163, 174, 180, 184, 189, 197, 222, 223, 237, 246, 264, 273, 274, 279, 280, 281, 282, 284, 285, 286, 288, 296, 300
mode 17, 21, 22, 24, 25, 26, 28, 29, 31, 42, 44, 50, 52, 53, 57, 58, 63, 65, 68, 70, 75, 86, 97, 98, 99, 100, 103, 104, 108, 112, 116, 118, 120, 121, 125, 126, 127, 130, 131, 132, 133, 134, 135, 136, 137, 138, 140, 143, 144, 146, 149, 150, 156, 157, 162, 169, 172, 174, 178, 179, 180, 181, 183, 184, 186, 187, 188, 189, 190, 196, 197, 198, 199, 200, 201, 202, 203, 204, 206, 207, 208, 210, 211, 212, 214, 215, 216, 218, 219, 220, 221, 222, 223, 224, 225, 226, 228, 231, 234, 242, 244, 245, 246, 247, 251, 252, 254, 255, 260, 262, 272, 273, 274, 276, 277, 278, 281, 294, 295, 297, 298, 300

oP-Parameter
oP00 48, 86, 87, 265, 269, 270, 292, 300
oP01 48, 87, 88, 89, 90, 91, 92, 93, 289, 292, 300
oP02 23, 87, 88, 89, 90, 92, 93
oP03 19, 86, 96
oP04 287, 300
oP05 57, 86, 96
oP06 19, 78, 86, 94, 96, 137, 214, 299, 300
oP07 19, 78, 86, 94, 96, 105, 137, 214, 299
oP10 19, 86, 94, 95, 99, 214, 244, 266, 272, 299, 300
oP11 19, 86, 94, 95, 96, 99, 105, 214, 244, 266, 272, 299
oP14 19, 94, 95, 138, 139, 156, 298
oP15 19, 94, 95, 138, 139, 156, 298
oP16 91, 92
oP18 92, 93
oP19 69, 70, 92, 93
oP20 69, 70, 92, 93
oP21 19, 92, 93, 275
oP22 19, 92, 93
oP23 19, 92, 93
oP27 98, 99, 103
oP28 19, 100, 101, 103, 105, 275, 300
oP29 100, 101, 103
oP30 100, 101, 103, 134, 244, 275, 300
oP31 19, 100, 101, 103, 105, 134
oP32 100, 101, 102
oP33 101
oP34 101, 134
oP35 100, 101, 134
oP36 85, 86, 105, 214
oP37 85, 86, 105, 214
oP40 19, 95, 155, 201, 214
oP41 19, 95, 155, 201, 214
oP44 260, 262
oP45 260, 261, 262, 263
oP46 19, 260, 261, 262, 263
oP47 260, 261, 262
oP48 19, 260, 261, 262
oP49 260, 262, 263
oP50 38, 249, 250, 251
oP52 86, 96, 195, 249, 251
oP53 38, 195, 249, 251
oP54 195, 249, 251
oP55 249, 250
oP56 69, 70, 249, 250
oP57 69, 70, 249, 250

oP58 69, 70, 249, 250
oP59 38, 249, 250, 251
oP60 69, 70, 88
oP61 69, 70, 88
oP62 104
oP63 86, 97, 98
oP64 86, 97, 98
oP65 19, 96, 137
oP66 19, 96
oP67 19, 96
oP68 19, 96, 137
oP69 251
oP70 100, 101
oP71 101
oP72 101, 102
oP73 100, 101, 102
oP74 168
oP75 86
oP76 86
oP-Parameter 26, 269

output
state 17

Output
terminal 16, 21, 22, 24, 28, 30, 35, 37, 38, 60, 63, 64, 65, 71, 72, 73, 83, 84, 87, 88, 90, 93, 227, 229, 230, 231, 238, 239, 241, 291
voltage 20, 22, 23, 25, 27, 28, 30, 35, 37, 39, 40, 50, 51, 54, 58, 59, 60, 61, 64, 71, 72, 75, 76, 77, 107, 108, 109, 110, 111, 113, 115, 117, 120, 122, 123, 124, 128, 132, 133, 135, 137, 138, 139, 140, 141, 142, 143, 144, 145, 149, 154, 158, 159, 162, 172, 173, 175, 176, 177, 179, 180, 184, 185, 189, 190, 192, 196, 197, 202, 205, 206, 207, 211, 212, 213, 220, 221, 222, 223, 224, 225, 226, 227, 229, 230, 244, 246, 247, 259, 268, 282, 283, 284, 285, 288, 293, 294, 296, 297

outputs
analog 37, 38, 40, 50, 51, 52, 53, 54, 56, 57, 58, 59, 60, 61, 62, 70, 76, 85, 86, 89, 94, 96, 99, 119, 167, 181, 182, 186, 187, 188, 194, 195, 249, 258, 261, 263, 264, 267, 268, 287
digital 14, 22, 23, 24, 27, 30, 35, 36, 37, 41, 50, 52, 53, 57, 58, 59, 63, 64, 65, 66, 69, 71, 72, 73, 74, 83, 84, 85, 86, 87, 89, 92, 94, 96, 111, 132, 134, 150, 181, 186, 187, 188, 196, 198, 199, 200, 201, 203, 204, 212, 213, 221, 226, 227, 229, 231, 238, 251, 252, 258, 260, 261, 262, 263, 266, 268, 284, 285, 287, 289, 290, 291
Terminal status 65

Outputs
Analog 194, 195

over
current 14, 17, 23, 25, 26, 28, 29, 30, 31, 33, 34, 35, 40, 41, 42, 43, 45, 48, 51, 54, 58, 60, 67, 74, 75, 76, 77, 78, 106, 111, 113, 116, 117, 120, 121, 122, 123, 124, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 166, 172, 173, 174, 175, 176, 177, 178, 179, 180, 182, 183, 189, 190, 191, 192, 197, 200, 203, 204, 207, 208, 209, 210, 212, 213, 214, 215, 216, 217, 218, 219, 220, 222, 223, 224, 225, 226, 228, 229, 230, 244, 246, 247, 249, 252, 255, 256, 268, 270, 271, 274, 282, 283, 284, 285, 286, 291
load 22, 23, 26, 27, 29, 39, 47, 59, 74, 75, 84, 108, 109, 111, 113, 115, 117, 125, 126, 127, 129, 132, 134, 136, 143, 147, 149, 151, 155, 163, 164, 165, 166, 177, 179, 183, 184, 190, 197, 202, 211, 212, 213, 215, 216, 217, 220, 223, 225, 237, 247, 255, 256, 258, 259, 281, 282, 283, 284, 285, 286

P

Parameter listing 17

PID
output 18, 22, 30, 31, 33, 35, 36, 37, 38, 39, 40, 41, 43, 50, 55, 57, 58, 59, 60, 61, 62, 63, 64, 65, 72, 73, 74, 75, 76, 77, 78, 79, 81, 82, 83, 84, 85, 86, 94, 95, 96, 97, 103, 104, 105, 107, 108, 110, 111, 113, 115, 120, 125, 130, 132, 133, 134, 135, 136, 137, 138, 139, 141, 142, 146, 151, 152, 153, 154, 155, 156, 158, 159, 166, 172, 179, 181, 186, 187, 188, 191, 192, 196, 198, 201, 202, 203, 204, 211, 213, 215, 223, 224, 225, 227, 228, 229, 232, 245, 247, 252, 254, 256, 257, 258, 260, 262, 263, 264, 265, 266, 267, 269, 270, 271, 281, 282, 284, 285, 286, 290, 291, 295, 298, 300

Pn-Parameter
Pn00 78, 205
Pn01 205
Pn02 205
Pn03 198, 203, 204, 205
Pn04 69, 70, 198, 229
Pn05 47, 196, 198, 203, 204, 205, 287, 288
Pn06 78, 198, 287, 291
Pn07 203, 204, 205
Pn08 75, 77, 197, 203, 204, 205
Pn09 75, 77, 197
Pn10 75, 196, 197, 203, 204, 205
Pn11 75, 196, 197
Pn12 45, 75, 199, 203, 204, 205
Pn13 45, 75, 199, 286
Pn14 75, 200, 203, 204, 205, 216, 217, 218, 219
Pn15 200, 219
Pn18 201, 203, 204, 205, 242
Pn19 213, 214, 215
Pn20 75, 207, 213, 214, 215
Pn21 19, 207, 214, 215, 216
Pn22 207, 212, 213
Pn23 69, 70, 212, 213
Pn24 75, 207, 212, 213
Pn25 75, 207, 212, 213
Pn26 137, 151, 210, 211
Pn27 211
Pn28 137, 244, 245
Pn29 69, 70, 244, 245
Pn30 244, 245, 246
Pn31 246
Pn32 19, 244, 245, 246
Pn33 137, 246
Pn34 125, 146, 254
Pn35 131, 151, 255, 257, 258, 259
Pn36 71, 151, 196, 254, 255, 257
Pn37 19, 255, 257, 259
Pn38 256

Pn39 255, 256, 259
Pn40 71, 254, 255, 256, 257
Pn41 19, 256, 257, 259
Pn42 69, 71, 255
Pn43 255, 284
Pn44 220, 222, 223, 224, 225, 226
Pn45 220, 222
Pn46 220, 222
Pn47 220, 221, 223, 224, 226
Pn48 19, 220, 221, 223, 224, 225, 226
Pn49 69, 71, 220, 221, 225
Pn50 220, 221, 223, 224, 225, 226
Pn51 220, 223
Pn52 220, 221, 224, 225
Pn53 220, 224
Pn54 220, 224
Pn55 220, 224
Pn56 220, 222, 223, 285
Pn57 220, 223, 224
Pn58 206, 207, 208, 210
Pn59 206, 207, 208, 209
Pn60 19, 206, 207, 208, 209, 210, 216, 225, 226, 300
Pn61 122, 145, 206, 209, 226, 237
Pn62 45, 199
Pn63 244, 272
Pn64 69, 70, 226
Pn65 198, 206, 226, 227, 228, 229, 230, 285
Pn67 206, 209, 237
Pn68 210
Pn69 226, 227, 230
Pn70 258
Pn71 258
Pn72 44, 199
Pn73 244, 272
Pn74 202
Pn75 201, 203, 204, 205, 285
Pn76 78, 205
Pn78 69, 71
Pn79 78, 202
Pn80 78, 202
Pn81 202, 203, 204, 205
Pn82 228
Pn83 210
Pn84 196
Pn85 228, 284
Pn86 78, 228, 229, 281
Pn87 78, 228, 229
Pn88 228, 229
Pn90 212
Pn91 231, 233, 284
Pn92 232, 233, 284
Pn93 69, 232, 233, 284
Pn94 78, 232, 233
Pn95 232, 233
Pn96 221, 224, 225
Pn97 196, 234

Posi mode
principle 261, 262

Product description 13

pr-Parameter
pr63 295, 296
pr64 293, 294, 296
pr65 293, 297
pr66 298, 300
pr67 298
pr68 298
pr70 298, 300
pr72 299, 300
pr73 299, 300
pr74 298, 299, 300
pr77 300
pr96 297, 298
pr97 297, 298

Q

Quick stop 122, 206, 207, 208, 209, 210, 291, 295, 296, 297
at closed-loop systems 209

R

Ramp output
display 14, 17, 27, 30, 32, 33, 34, 37, 38, 39, 40, 41, 42, 45, 47, 49, 50, 58, 59, 60, 69, 74, 76, 77, 78, 85, 86, 89, 95, 96, 104, 113, 114, 121, 129, 130, 135, 136, 140, 141, 146, 147, 155, 159, 182, 184, 187, 188, 196, 197, 201, 203, 205, 206, 230, 237, 245, 246, 250, 251, 253, 254, 273, 275, 276, 277, 278, 281, 291, 295, 298

Reset
Error messages 205, 281, 284

ru-Parameter
ru00 22, 24, 26, 28, 29, 30, 33, 75, 76, 114, 125, 146, 196, 205, 206, 215, 221, 230, 272, 295, 296
ru01 19, 30, 33, 58, 60, 76, 85, 104, 130, 168, 230, 245, 255, 257, 269, 270, 291
ru02 19, 30, 33, 41, 58, 60, 76, 77, 78, 113, 130, 135, 141, 142, 151, 152, 153, 159, 161, 187, 188, 213, 228, 245, 260, 262, 263, 265, 267, 269, 270, 271, 298
ru03 19, 30, 33, 85, 107, 113, 136, 141, 142, 202, 214, 215, 245, 246, 267, 272, 275, 278
ru05 30, 33, 57
ru06 30, 33, 113, 142
ru07 19, 30, 33, 57, 58, 60, 76, 78, 95, 136, 141, 153, 155, 159, 161, 187, 188, 201, 202, 228, 230, 246, 291
ru10 19, 30, 34, 57, 78
ru11 30, 34, 40, 58, 182
ru12 30, 34, 41, 58, 121, 129, 130, 136, 147, 149, 155, 182, 183, 184, 185
ru13 30, 34, 76, 192, 202, 215, 268
ru14 30, 34
ru15 30, 34, 58, 60, 77, 136, 192, 208, 214, 216, 218
ru16 30, 34
ru17 30, 34, 58, 60, 76, 77, 113, 141, 142, 155, 159, 208, 214, 268, 270, 271
ru18 30, 35, 58, 60, 76, 141, 159, 213, 268
ru19 30, 35
ru20 30, 35, 58, 60, 113, 142
ru21 30, 35, 36, 63, 65
ru22 30, 36, 63, 65, 77, 233, 291
ru23 30, 36, 73, 74
ru24 30, 36, 73, 74
ru25 30, 37, 73, 74, 83, 233, 291
ru26 30, 37, 218, 250, 274, 278
ru27 30, 37, 50, 58, 60, 269, 270, 271
ru28 30, 37, 50, 58, 60, 268, 269, 270, 271
ru29 30, 37, 50, 58, 60, 269, 270, 271
ru30 30, 38, 50, 57, 58, 60, 260, 262, 267, 268, 269, 270, 271
ru33 30, 38, 59
ru34 30, 38, 57, 59, 77
ru35 30, 38, 59
ru36 30, 38, 57, 59, 60, 77
ru37 30, 38, 57, 86, 181, 186, 187, 188, 195, 249, 251
ru38 30, 38, 58, 60, 233
ru39 30, 39, 75, 197
ru40 39, 228, 236
ru41 30, 39, 236
ru42 30, 39, 107, 108, 132, 177,

206
ru43 30, 39, 76, 251, 253
ru44 30, 39, 76, 251, 253
ru45 30, 39, 191
ru46 30, 40, 44, 58, 199, 200
ru47 30, 40, 42, 182, 183, 184, 185
ru48 30, 40, 42, 182, 184
ru49 30, 40, 187, 188
ru52 30, 40, 57, 58, 60, 86, 96, 181, 186, 265, 269, 270, 271
ru53 30, 40, 194, 260, 262, 267, 268, 269
ru68 30, 40, 222, 227
ru73 30, 40, 182
ru74 30, 41, 182
ru79 19, 30, 41, 95, 144, 175, 201
ru80 30, 41, 83, 290
ru81 30, 41, 58, 60, 77, 268
ru87 30, 42, 113, 133, 141, 142, 159
ru88 42
ru89 30, 42
ru90 30, 42, 58, 60, 183, 184, 185
ru91 30, 42, 228
ru92 30, 42
ru93 30, 42
ru96 30, 42
ru97 30, 42

S

S-curves
time 14, 21, 26, 31, 32, 34, 35, 39, 45, 46, 47, 59, 65, 66, 67, 68, 71, 72, 74, 75, 78, 79, 91, 98, 99, 100, 101, 102, 103, 104, 107, 110, 111, 112, 117, 119, 124, 125, 126, 128, 129, 131, 132, 134, 135, 136, 137, 138, 139, 140, 141, 145, 146, 147, 148, 149, 150, 151, 152, 155, 156, 159, 160, 163, 164, 165, 166, 167, 168, 186, 188, 190, 196, 197, 198, 199, 200, 202, 203, 204, 205, 206, 207, 208, 209, 210, 214, 215, 216, 217, 218, 219, 220, 221, 224, 225, 228, 229, 230, 231, 232, 236, 243, 244, 245, 246, 247, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 263, 264, 265, 266, 281, 282, 283, 284, 285, 286, 287, 288, 294, 295, 299

select
Analog 194, 195

Setpoint
and ramp presetting 85
calculation 57, 78, 85, 86, 94, 96, 97, 99, 116, 117, 119, 121, 123, 126, 127, 132, 133, 135, 137, 139, 141, 145, 148, 149, 155, 165, 183, 184, 185, 197, 202, 222, 223, 246, 265, 276, 278
setting 21, 22, 23, 24, 26, 27, 36, 41, 42, 45, 48, 49, 50, 55, 58, 60, 61, 62, 64, 70, 71, 72, 75, 85, 86, 87, 88, 89, 90, 92, 93, 94, 96, 97, 98, 99, 101, 102, 112, 116, 120, 123, 124, 125, 126, 130, 131, 132, 133, 136, 137, 139, 142, 144, 148, 149, 150, 151, 163, 164, 167, 168, 172, 174, 176, 177, 180, 181, 190, 193, 194, 195, 198, 201, 204, 205, 207, 213, 215, 221, 222, 223, 224, 226, 228, 230, 231, 237, 238, 239, 245, 248, 249, 251, 256, 258, 261, 263, 264, 273, 278, 282, 287, 289, 290, 292, 298

Setpoint value
calculation 57, 78, 85, 86, 94, 96, 97, 99, 116, 117, 119, 121, 123, 126, 127, 132, 133, 135, 137, 139, 141, 145, 148, 149, 155, 165, 183, 184, 185, 197, 202, 222, 223, 246, 265, 276, 278
display 14, 17, 27, 30, 32, 33, 34, 37, 38, 39, 40, 41, 42, 45, 47, 49, 50, 58, 59, 60, 69, 74, 76, 77, 78, 85, 86, 89, 95, 96, 104, 113, 114, 121, 129, 130, 135, 136, 140, 141, 146, 147, 155, 159, 182, 184, 187, 188, 196, 197, 201, 203, 205, 206, 230, 237, 245, 246, 250, 251, 253, 254, 273, 275, 276, 277, 278, 281, 291, 295, 298
fluctuations 50, 54, 97, 108, 179, 189, 225
limits 18, 23, 26, 27, 41, 85, 92, 94, 95, 96, 105, 120, 122, 123, 129, 145, 149, 162, 172, 173, 174, 175, 177, 180, 181, 182, 184, 186, 190, 201, 206, 207, 213, 214, 279, 284

Set speed
Value 46, 47, 51, 52, 53, 54, 55, 57, 58, 60, 61, 65, 66, 68, 70, 71, 75, 77, 83, 86, 87, 88, 91, 93, 98, 101, 102, 104, 105, 108, 109, 110, 111, 112, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 128, 129, 130, 131, 137, 138, 140, 144, 145, 146, 147, 148, 150, 154, 156, 157, 158, 169, 172, 174, 177, 178, 179, 180, 181, 184, 186, 189, 190, 191, 193, 196, 198, 199, 202, 203, 204, 205, 206, 207, 209, 210, 211, 212, 213, 214, 215, 216, 220, 227, 228, 229, 230, 231, 232, 234, 238, 239, 242, 245, 247, 248, 249, 250, 252, 253, 254, 258, 260, 262, 263, 264, 266, 267, 268, 272, 274, 275, 276, 277, 278, 279, 281, 287, 288, 289, 290, 291, 295, 296, 297, 298, 299, 300

Set torque
limit 13, 14, 27, 30, 40, 42, 45, 50, 56, 57, 76, 77, 78, 94, 95, 96, 97, 107, 115, 116, 122, 123, 124, 128, 131, 132, 134, 136, 138, 139, 140, 145, 146, 148, 155, 156, 158, 161, 169, 172, 173, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 187, 188, 190, 192, 196, 197, 201, 202, 203, 204, 206, 207, 209, 211, 212, 213, 214, 215, 216, 218, 223, 225, 229, 230, 234, 246, 252, 255, 258, 264, 265, 281, 282, 284, 285, 291, 297

Slave
position 141, 143, 151, 154, 157, 158, 159, 178, 264, 272, 294

Software
date 31, 44, 46, 99, 279, 280

source
Parameter set 70, 216, 238, 239, 242, 289

Source set 237

Special
functions 13, 55, 63, 69, 70, 71, 78, 87, 98, 106, 108, 113,

121, 132, 138, 157, 196, 197, 199, 203, 213, 220, 226, 227, 229, 230, 231, 239, 244, 259, 294

Speed search 137, 151, 210, 211, 212, 282

ST 21, 35, 53, 63, 64, 65, 66, 69, 71, 72, 73, 77, 111, 122, 130, 151, 227, 230, 231, 232, 233, 238, 239, 241, 248, 250, 253, 266, 282, 289, 290

Stall
- function 14, 16, 22, 23, 24, 38, 40, 45, 47, 50, 57, 60, 63, 66, 67, 69, 70, 71, 72, 76, 78, 79, 81, 85, 86, 91, 93, 96, 97, 99, 101, 108, 109, 110, 111, 113, 117, 131, 134, 137, 138, 139, 140, 144, 148, 149, 150, 156, 158, 164, 166, 168, 169, 174, 181, 185, 186, 190, 196, 197, 198, 199, 200, 201, 202, 204, 205, 206, 207, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 224, 225, 226, 227, 229, 230, 231, 234, 239, 241, 246, 247, 248, 249, 250, 255, 258, 260, 261, 262, 263, 264, 266, 272, 275, 281, 282, 283, 284, 287, 288
- level 12, 17, 21, 62, 65, 71, 74, 75, 76, 77, 78, 79, 84, 107, 132, 134, 135, 148, 173, 175, 190, 191, 196, 197, 198, 199, 200, 203, 205, 206, 207, 208, 209, 212, 213, 214, 215, 219, 220, 221, 223, 224, 225, 229, 245, 251, 253, 255, 269, 281, 282, 283, 284, 286, 290

Start-up 20, 21, 24, 28

Static strobe 68

STO 14

Strobe
- mode 17, 21, 22, 24, 25, 26, 28, 29, 31, 42, 44, 50, 52, 53, 57, 58, 63, 65, 68, 70, 75, 86, 97, 98, 99, 100, 103, 104, 108, 112, 116, 118, 120, 121, 125, 126, 127, 130, 131, 132, 133, 134, 135, 136, 137, 138, 140, 143, 144, 146, 149, 150, 156, 157, 162, 169, 172, 174, 178, 179, 180, 181, 183, 184, 186, 187, 188, 189, 190, 196, 197, 198, 199, 200, 201, 202, 203, 204, 206, 207, 208, 210, 211, 212, 214, 215, 216, 218, 219, 220, 221, 222, 223, 224, 225, 226, 228, 231, 234, 242, 244, 245, 246, 247, 251, 252, 254, 255, 260, 262, 272, 273, 274, 276, 277, 278, 281, 294, 295, 297, 298, 300

Switching
- frequency 14, 17, 18, 19, 21, 22, 23, 25, 26, 28, 29, 30, 31, 33, 39, 42, 43, 45, 49, 51, 60, 62, 84, 85, 86, 87, 92, 96, 105, 107, 108, 110, 111, 113, 115, 117, 120, 121, 122, 126, 127, 128, 129, 132, 133, 135, 136, 137, 138, 139, 141, 142, 143, 145, 146, 147, 148, 149, 150, 155, 156, 158, 166, 174, 189, 191, 192, 197, 202, 210, 211, 212, 213, 214, 215, 216, 217, 223, 228, 229, 230, 244, 245, 246, 254, 259, 263, 264, 266, 267, 272, 275, 278, 282, 284, 295, 300
- hysteresis 54, 55, 76, 79, 84, 85, 230, 245, 291

Switching condition
- linking 82
- Select 24, 28, 70, 84, 120, 260, 262
- Status 78, 206, 207, 210, 221, 254, 272, 281, 289, 290, 291, 292, 296, 297

Switching conditions
- state 17

Synchronous mode
- principle 261, 262

Sy-Parameter
- Sy02 32, 47, 236
- Sy03 32, 47, 236
- Sy06 32, 47, 236, 287
- Sy09 32, 47, 78, 198, 288
- Sy11 32, 47, 236, 287
- Sy32 32, 47
- Sy34 273
- Sy41 32, 48, 290
- Sy42 32, 48, 291, 292
- Sy43 32, 48, 71, 72, 210, 290
- Sy44 32, 48, 205, 206, 221, 292
- Sy50 32, 48, 64, 71, 72, 87, 89, 90, 92, 93, 206, 207, 210, 238, 287, 289, 290, 296
- Sy51 32, 48, 205, 206, 221, 230, 290, 292, 297
- Sy52 32, 48, 86, 96, 292, 298
- Sy53 32, 49, 292, 298
- Sy56 32, 49
- Sy-Parameter 280

T

Target set 237, 250

Technology controller 96

Temperature
- mode 17, 21, 22, 24, 25, 26, 28, 29, 31, 42, 44, 50, 52, 53, 57, 58, 63, 65, 68, 70, 75, 86, 97, 98, 99, 100, 103, 104, 108, 112, 116, 118, 120, 121, 125, 126, 127, 130, 131, 132, 133, 134, 135, 136, 137, 138, 140, 143, 144, 146, 149, 150, 156, 157, 162, 169, 172, 174, 178, 179, 180, 181, 183, 184, 186, 187, 188, 189, 190, 196, 197, 198, 199, 200, 201, 202, 203, 204, 206, 207, 208, 210, 211, 212, 214, 215, 216, 218, 219, 220, 221, 222, 223, 224, 225, 226, 228, 231, 234, 242, 244, 245, 246, 247, 251, 252, 254, 255, 260, 262, 272, 273, 274, 276, 277, 278, 281, 294, 295, 297, 298, 300

Terminal status 65

thermal overheating 196

Timer
- programming 17, 37, 39, 69, 115, 195, 196, 200, 202, 218, 237, 244, 251, 274, 282

tool path feedrate 262

Torque reference 186, 187, 188

Transistor output 73, 83, 232

tripping times 216, 217

Type code 14

U

Ud-Parameter
- Ud01 17, 21, 236, 273
- Ud02 18, 19, 22, 24, 28, 32, 45,

57, 58, 61, 86, 94, 97, 100, 103, 116, 135, 152, 236, 244, 300
Ud04 71, 288
Ud05 71, 288, 289
Ud06 120, 121, 236
Ud07 69, 289
Ud15 237, 273, 274, 275, 278
Ud16 273, 274, 275, 278
Ud17 273, 274, 275, 278
Ud18 275, 276, 277, 278
Ud19 276, 277, 278
Ud20 276, 277, 278
Ud21 275, 276, 278
Ud22 279
Ud23 278, 279, 280
Ud24 120, 274, 278, 279, 280
Ud25 279
Ud26 279
Ud27 279
Ud28 279
Ud29 279
Ud30 279
Ud31 279

uF-Parameter
uF00 19, 22, 107, 109, 113, 115, 120, 214
uF01 22, 107, 115, 120, 264
uF02 19, 108, 115
uF03 108, 113, 115
uF04 107
uF05 107
uF06 71, 111, 112, 117, 247, 248
uF07 111, 247, 248, 264, 275
uF08 69, 70, 111, 117, 248
uF09 22, 25, 28, 71, 108, 109, 111, 115, 122, 123, 124, 145, 221, 223
uF10 107, 108
uF11 111, 191
uF12 205, 206
uF13 205, 206
uF15 26, 29, 134, 173, 175, 190, 197
uF16 115, 117
uF17 115, 117
uF18 26, 29, 108, 129, 131, 132, 149, 150
uF19 110
uF21 69, 71, 132, 134, 150
uF25 134

underload 217

Use 12

Using
intended 12

Utilization
actual 24, 28, 30, 32, 33, 34, 35, 38, 39, 40, 41, 42, 49, 60, 63, 76, 77, 78, 84, 85, 95, 103, 107, 108, 110, 112, 113, 115, 116, 117, 118, 121, 123, 124, 125, 130, 134, 136, 137, 138, 139, 141, 142, 144, 145, 146, 149, 153, 154, 155, 156, 159, 165, 166, 169, 176, 182, 183, 184, 185, 187, 188, 192, 197, 199, 201, 202, 206, 207, 208, 211, 212, 213, 214, 221, 222, 225, 228, 229, 230, 241, 244, 245, 246, 247, 249, 250, 251, 252, 253, 264, 268, 269, 270, 271, 272, 275, 278, 281, 289, 290, 291, 292, 293, 295, 297, 298

V

Voltage
reduction 39, 70, 71, 111, 172, 174, 175, 190, 191, 211, 247

W

winding product 262

Wobble
amplitude 158, 260, 261
generator 27, 60, 76, 77, 85, 94, 98, 187, 206, 207, 213, 214, 230, 245, 260, 262, 263, 269, 270, 271, 285

write protection 17

Write protection 278

X

Y

Z

Karl E. Brinkmann GmbH
Försterweg 36-38 • D-32683 Barntrup
fon: +49 5263 401-0 • fax: +49 5263 401-116
net:www.keb.de • mail: info@keb.de

KEB worldwide…

KEB Automation GmbH
Ritzstraße 8 • 4614 Marchtrenk
fon: +43 7243 53586-0 • fax: +43 7243 53586-21
net: www.keb.at • mail: info@keb.at

KEB Automation KG
Herenveld 2 • 9500 Geraadsbergen
fon: +32 5443 7860 • fax: +32 5443 7898
mail: vb.belgien@keb.de

KEB Power Transmission Technology (Shanghai) Co.,Ltd.
No. 435 Qianpu Road, Chedun Town, Songjiang District,
Shanghai 201611, P.R. China
fon: +86 21 37746688 • fax: +86 21 37746600
net: www.keb.de • mail: info@keb.cn

KEB Automation GmbH
Organizační složka
Suchovrbenske nam. 2724/4 • 370 06 České Budějovice
fon: +420 387 699 111 • fax: +420 387 699 119
mail: info@keb.cz

KEB Antriebstechnik GmbH
Wildbacher Str. 5 • 08289 Schneeberg
fon: +49 3772 67-0 • fax: +49 3772 67-281
mail: info@keb-drive.de

KEB España
C/ Mitjer, Nave 8 - Pol. Ind. LA MASIA
08798 Sant Cugat Sesgarrigues (Barcelona)
fon: +34 93 897 0268 • fax: +34 93 899 2035
mail: vb.espana@keb.de

Société Française KEB
Z.I. de la Croix St. Nicolas • 14, rue Gustave Eiffel
94510 LA QUEUE EN BRIE
fon: +33 1 49620101 • fax: +33 1 45767495
net: www.keb.fr • mail: info@keb.fr

KEB (UK) Ltd.
Morris Close, Park Farm Industrial Estate
Wellingborough, NN8 6 XF
fon: +44 1933 402220 • fax: +44 1933 400724
net: www.keb.co.uk • mail: info@keb.co.uk

KEB Italia S.r.l.
Via Newton, 2 • 20019 Settimo Milanese (Milano)
fon: +39 02 3353531 • fax: +39 02 33500790
net: www.keb.de • mail: kebitalia@keb.it

KEB Japan Ltd.
15–16, 2–Chome, Takanawa Minato-ku
Tokyo 108-0074
fon: +81 33 445-8515 • fax: +81 33 445-8215
mail: info@keb.jp

KEB Korea Seoul
Room 1709, 415 Missy 2000
725 Su Seo Dong, Gang Nam Gu
135-757 Seoul/South Korea
fon: +82 2 6253 6771 • fax: +82 2 6253 6770
mail: vb.korea@keb.de

KEB RUS Ltd.
Lesnaya Str. House 30, Dzerzhinsky (MO)
140091 Moscow region
fon: +7 495 632 0217 • fax: +7 495 632 0217
net: www.keb.ru • mail: info@keb.ru

KEB America, Inc.
5100 Valley Industrial Blvd. South
Shakopee, MN 55379
fon: +1 952 224-1400 • fax: +1 952 224-1499
net: www.kebamerica.com • mail: info@kebamerica.com

More and latest addresses at http://www.keb.de

Mat.No.	00G6NEA-0020
Rev.	1B
Date	03/2019