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APPLICATION MANUAL

F5 BASIC COMPACT GENERAL

KEB COMBIVERT F5-BASIC / COMPACT / GENERAL 3.2

KEB

Charge 40,- Euro

Part.No.: 00.F5.GEA-K320

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1. Introduction
This chapter shall allow a fast access to the wanted information. It consists of contents, index and search criterion.

2. Summary
Here the inverter and its features as well as the operating conditions and application purpose are described.

3. Hardware
Description of hardware, technical data of the inverter as well as connection of power and control terminals.

4. Operation
The basic operation of the KEB COMBIVERT like password input, parameter and set selection.

5. Parameter
A list of all parameters classified according to parameter groups. The parameter description comprises addresses, value ranges and references with regard to the functions for which they are used.

6. Functions
To make the programming easier all inverter functions and the parameters belonging to it are comprised in this chapter.

7. Start-up
Gives support with regard to the initial start-up and shows possibilities and techniques for the optimization of the drive.

8. Special Operation
Describes special operating modes, like e.g. DC-coupling.

9. Error Assistance
Avoidance of errors, evaluation of error messages and elimination of the causes.

10. Project Planning
Serves as aid for the lay out design during the planning stage.

11. Networks
Survey of the possible interconnection of the KEB COMBIVERT in existing networks.

12. Annex
Everything that didn't fit anywhere else or what we didn't think of earlier.

1. Introduction
1.1 General
1.1.1 Table of Contents

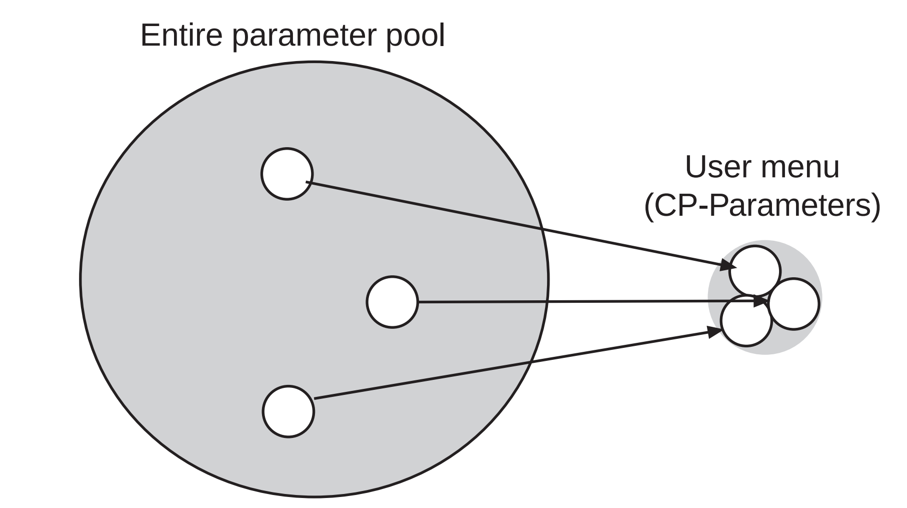
1.1.2 Preface

Who shall read all this?
Everybody who is entrusted with the development and construction of applications. He who knows the extensive programming possibilities of the KEB COMBIVERT, can save external controls and expensive cabling already in the planning stage of a machine simply by using the unit as active control element. This manual is **not** a replacement of the documentation accompanying the unit, it serves only as completion.

1000 and one application...
and if possible with one unit. Who does not know this demand from purchasing departments, production or service. We have taken this request very seriously and developed a series with open programming, which can be adapted to the different applications with PC or operator.

Nobody can handle this...
some sceptics may say. But we have found a solution to this too. Once the development stage of a machine is completed only a few adjustment possibilities are needed on the inverter and in some cases even none at all. So why should all parameters still be visible? Said and done, by defining an own menu only selected parameters are visible. This makes the handling much easier, simplifies the user documentation and improves the safety of operation against unauthorized access (see picture 1.1.2).

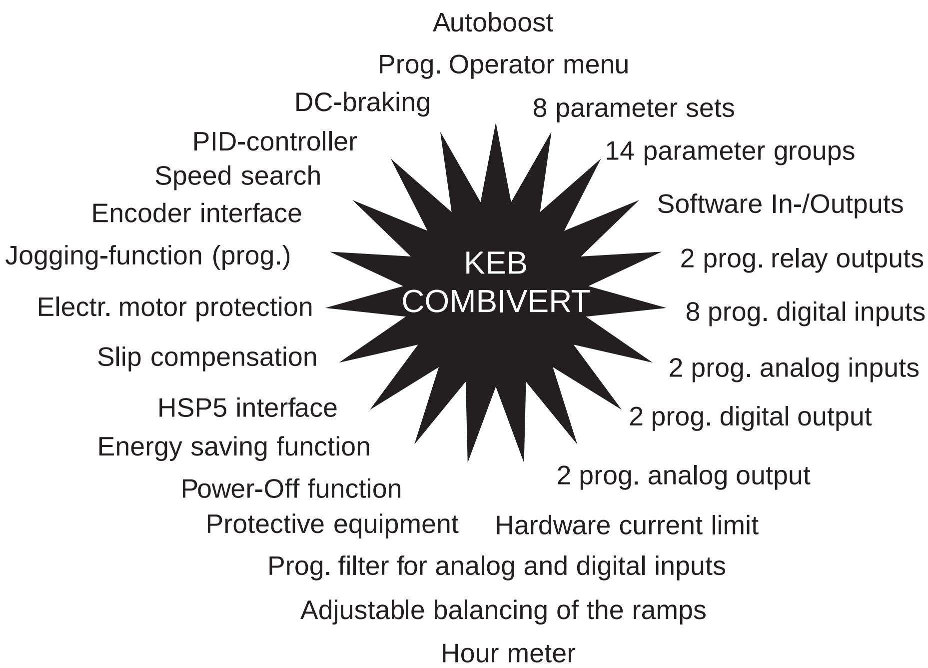
Picture 1.1.2



2. Overview

2.1 Product Description

2.1.1 Features of KEB COMBIVERT



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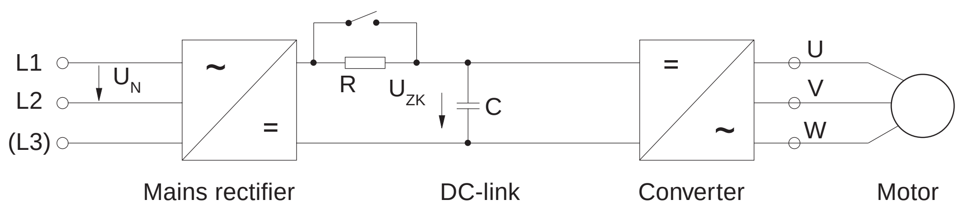
2.1.2 Function Principle

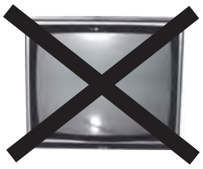
The power circuit of a frequency inverter consists basically of a mains rectifier, the DC-link and an inverter at the output. The mains rectifier consists of an uncontrolled single or three-phase bridge connection, the single-phase design is restricted to small powers. It converts the AC-voltage of the mains into a DC-voltage, which is smoothed by the DC-link capacitor, thus in the ideal case (inverter unloaded) the DC-link is charged with a voltage of $U_{ZK} = \sqrt{2} \cdot U_{N}$.
Since during the charging of the DC-link capacitor very high currents flow for a short time which would lead to the tripping of the input fuses or even to the destruction of the mains rectifier, the charging current must be limited to a permissible level. This is achieved by using an inrush current limiting resistor in series to the capacitor. After the charging of the capacitor is completed the limiting resistor is bridged, for example, by a relay and is therefore only active at the switch-on of the inverter.
As the smoothing of the DC-link voltage requires a large capacity, the capacitor still has a high voltage for some time after the disconnection of the inverter from the mains.
The actual task of the frequency inverter, to produce an output voltage variable in frequency and amplitude for the control of the three-phase AC motor, is taken over by the converter at the output. It makes available a 3-phase output voltage according to the principle of the pulse-width modulation, which generates a sinusoidal current at the three-phase asynchronous motor

Picture 2.1.2 Block diagram of an inverter power circuit



2.1.3 Application as directed

The KEB COMBIVERT is a frequency inverter with DC-voltage link. It works according to the principle of the pulse-width modulation and serves exclusively for the stepless speed control of three-phase AC motors.
The unit has been developed subject to the relevant safety standards and is manufactured with the highest demands on quality. Condition for an unobjectionable operation is the function-conform configuring of the drive and correct transport and storage as well as careful installation and connection.



The operation of other electric consumers is prohibited and can lead to the destruction of the units as well as consequential damages as a result from it.

2.1.4 Type Code

10.F5.G1B–3200

at FI: Cooling
0: Standard
1: Flat rear
2: Water-cooled
3: Convection

at Servos: motor cooling
0: Self-cooling
1: External cooling

Encoder interface type see control part

0: no interface	5: Resolver a. SSI	A: Ink.-Input a. Initiator	F: Hiperface a. Ink.-Outp.
1: Ink.-Input a. Ink.-I/O	6: Hiperface a. SSI	B: Resolver a. Initiator	G: Ink.-Input a. Ink.-Inp.
2: Resolver a. Ink.-I/O	7: Ink.-Input a. Tacho	C: Hiperface a. Initiator	H: Resolver a. Ink.-Inp.
3: Hiperface a. Ink.-I/O	8: Resolver a. Tacho	D: Ink.-Input a. Ink.-Outp.	I: Hiperface a. Ink.-Inp.
4: Ink.-Input a. SSI	9: Hiperface a. Tacho	E: Resolver a. Ink.-Outp.	

at FI: Switching frequency / max. short time current / OC-tripping current

0: 2 kHz/125%/150%	5: 4 kHz/150%/180%	A: 8 kHz/180%/216%	F: 16 kHz/200%/240%
1: 4 kHz/125%/150%	6: 8 kHz/150%/180%	B: 16 kHz/180%/216%	G: 2 kHz/400%/480%
2: 8 kHz/125%/150%	7: 16 kHz/150%/180%	C: 2 kHz/200%/240%	H: 4 kHz/400%/480%
3: 16 kHz/125%/150%	8: 2 kHz/180%/216%	D: 4 kHz/200%/240%	I: 8 kHz/400%/480%
4: 2 kHz/150%/180%	9: 4 kHz/180%/216%	E: 8 kHz/200%/240%	K: 16 kHz/400%/480%

at Servos: motor speed
1: 1500 rpm 2: 2000 rpm 3: 3000 rpm 4: 4000 rpm 6: 6000 rpm

Input identification

0:	1ph 230V AC/DC	5:	400V DC	A:	6ph 400V AC
1:	3ph 230V AC/DC	6:	1ph 230V AC	Z:	230V AC or AC/DC
2:	1/3ph 230V AC/DC	7:	3ph 230V AC	Y:	400V AC or AC/DC
3:	3ph 400V AC/DC	8:	1/3ph 230V AC	W:	230V DC
4:	230V DC	9:	3ph 400V AC	V:	400V DC

Housing type A, B, D, E, G, H, R, U, W

Accessory

0: without	4: integrated PFC 2)
1: GTR 7 1)	5: GTR 7 1), integrated PFC 2)
2: integrated filter	6: integrated filter , integrated PFC 2)
3: GTR 7 1), integrated filter	7: GTR 7 1), integrated filter, integrated PFC 2)

Control type
B: BASIC (controlled frequency inverter with standard function)
G: GENERAL (controlled frequency inverter with enhanced function)
C: COMPACT (controlled frequency inverter with enhanced function)
M: MULTI (regulated, field-oriented frequency inverter for three-phase asynchronous motors)
S: SERVO (regulated frequency inverter for synchronous motors)

Series F5

at FI in the 1. and 2. place: unit size

at Servos: motor identification / motor dimension wide

1) GTR 7: brake transistor
2) PFC: Power Factor Control

2.1.5 Validity of Specifications

The following technical specifications refer to 2-/4-pole standard motors. In case of different pole numbers the frequency inverter must be dimensioned for the rated motor current. With regard to special or medium frequency motors, please contact KEB.
Site altitude max. 2000 m. For altitudes of 1000 m or more above N.N. a power reduction of 1 % per 100m must be taken into account.

2.1.6 Unit Sizes 230V-Class

Inverter Size		**05**			**07**			**09**				**10**				**12**	**13**
Housing size		**A**	**B**		**A**	**B**		**B**		**D**		**B**		**D**		**D**	**E**
Phases		1	1	3	1	1	3	1	3	1	3	1	3	1	3	3	3
Output nominal power	[kVA]	0,9			1,6			2,8				4,0				6,6	9,5
Max. rated motor power	[kW]	0,37			0,75			1,5				2,2				4,0	5,5
Output nominal current	[A]	2,3			4			7				10				16,5	24
Max. short time current 1)	[A]	4,1			7,2			12,6				18				29,7	36
OC-tripping current	[A]	5,0			8,6			15,1				21,6				35,6	43
Nominal input current	[A]	4,6	4,6	3,2	8,0	8,0	5,6	14	9,8	14	9,8	20	14	20	14	23	31
Nominal input current 2)	[A]	–	3,7	–	–	6,4	–	–				–				–	–
Real input rated power 2)	[kW]	–	0,85	–	–	1,5	–	–				–				–	–
Max. permissible mains fuse (inert)	[A]	10	16		10	20	16	20	16	20	16	25	20	25	20	25	35
Rated switching frequency	[kHz]	4	16		8	16		16				8		16		8	8
Max. switching frequency	[kHz]	4	16		8	16		16				16				16	16
Power loss at nominal operating	[W]	30	50		55	65		90		130		105		170		210	290
Power loss at rated operation 2)	[W]	–	85	–	–	130	–	–				–				–	–
Stall current at 4kHz 3)	[A]	2,3			4			7				10				16,5	24
Stall current at 8kHz 3)	[A]	2,3			4			7				10				16,5	24
Stall current at 16kHz 3)	[A]	–	2,3		–	4		7				8,5		10		10	16,8
Max. heat sink temperature TOH	[°C]	90															
Motor line cross section 4)	[mm²]	1,5			1,5	2,5	1,5	2,5	1,5	2,5	1,5	4	2,5	4	2,5	4	6
Min. braking resistor 5)	[Ohm]	100	56		100	56		47				33				27	16
Typ. braking resistor 5)	[Ohm]	180			180			100				68				33	27
Max. braking current	[A]	4,5	7,5		4,5	7,5		9,5				12				15	25
Overload curve (page appendex)		1															
Tightening torque for terminals	[Nm]	0,5															1,2
Mains voltage	[V]	180…260 –0 (230 V Nominal voltage)															
Mains frequency	[Hz]	50 / 60 +/- 2															
Output voltage	[V]	3 x 0…U Mains (3 x 0…255V 2))															
Output frequency	[Hz]	see Control board															
Max.shielded motor line length at 4 kHz 6)	[m]	10	30	10		100		100									
Max.shielded motor line length at 8 kHz 6)	[m]	10	20	10		50		100									
Max.shielded motor line length at 16 kHz 6)	[m]	-	10	-		20		40		100							
Storage temperature	[C]	-25…70 C															
Operating temperature	[C]	-10…45 C															
Model / protective system		IP20															
Relative humidity		max. 95% without condensation															
EMC tested according to		EN 61800-3															
Climatic category		3K3 in accordance with EN 50178															

1) With the regulated systems F5-M as well as F5-S 5% are to be subtracted as control reserve.
2) Fuses of type Ferraz Shawmut 6,6 UD Type 31
3) Max. current before the responding of the OL2-function (only F5-M; F5-S; F5-A)
4) Recommended minimum cross section for rated power and a cable length of upto 100m (copper)
5) This data is only valid for units with internal brake transistor (see "unit identification")
6) Rated voltage 400V; at mains voltage ³ 460V multiply the rated current with factor 0.86.
7) The temperature range is only valid for the control circuit. For the power circuit the temperature range is depending on the control cabinet installation and the cooling system.
8) 31.F5 only watercooled.

Inverter Size		14		15		16	17	18	19	20	21
Housing size		**E**	**G**	**G**	**H**	**H**	**R**	**R**	**R**	**R**	**R**
Phases		3		3		3	3	3	3	3	3
Output nominal power	[kVA]	13		19		26	33	40	46	59	71
Max. rated motor power	[kW]	7,5		11		15	18,5	22	30	37	45
Output nominal current	[A]	33		48		66	84	100	115	145	180
Max. short time current [1]	[A]	49,5		72		99	126	150	172	217	270
OC-tripping current	[A]	59		86		119	151	180	206	261	324
Nominal input current	[A]	43		63		86	92	116	126	165	198
Max. permissible mains fuse (inert)	[A]	50		80		80	100	160	160	200	315
Rated switching frequency	[kHz]	4	16	8	16	16	8	8	8	8	8
Max. switching frequency	[kHz]	16		16	16	16	16	8	8	8	8
Power loss at nominal operating	[W]	350	410	460	430	550	850	1020	1200	1350	1620
Stall current at 4kHz [2]	[A]	33	36	36	53	72,5	92	110	126	159	198
Stall current at 8kHz [2]	[A]	24	33	-	53	72,5	84	100	115	145	180
Stall current at 16kHz [2]	[A]	16,8	26	-	53	66	50	-	-	-	-
Max. heat sink temperature TOH	[C]	90									
Motor line cross section [3]	[mm²]	10		25		25	35	50	50	95	95
Min. braking resistor [4]	[Ohm]	16	8	8	5,6	5,6	4,7	4,7	3,9	2	2
Typ. braking resistor [4]	[Ohm]	20		13		10	7	5,6	4,7	3,9	3,0
Max. braking current	[A]	25	50	50	70	70	85	85	102	160	160
Overload curve (page appendex)		1									
Tightening torque for terminals	[Nm]	1,2	2,5	4			6				
Mains voltage [5]	[V]	180…260 –0 (230 V Nominal voltage)									
Mains frequency	[Hz]	50 / 60 +/- 2									
Output voltage	[V]	3 x 0…U Mains									
Output frequency	[Hz]	see Control board									
Max.shielded motor line length	[m]	100						50			
Storage temperature	[C]	-25…70 C									
Operating temperature	[C]	-10…45 C									
Model / protective system		IP20									
Relative humidity		max. 95% without condensation									
EMC tested according to		EN 61800-3									
Climatic category		3K3 in accordance with EN 50178									

1) With the regulated systems F5-M as well as F5-S 5% are to be subtracted as control reserve.
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4) Recommended minimum cross section for rated power and a cable length of upto 100m (copper)
5) This data is only valid for units with internal brake transistor (see "unit identification")
6) Rated voltage 400V; at mains voltage ³ 460V multiply the rated current with factor 0.86.
7) The temperature range is only valid for the control circuit. For the power circuit the temperature range is depending on the control cabinet installation and the cooling system.
8) 31.F5 only watercooled.

2.1.7 Unit Sizes 400V-Class

Inverter Size	**05**	**07**	**09**		**10**			**12**			**13**			**14**		
Housing size	**B**	**B**	**B**	**D**	**B**	**D**	**D**	**B**	**D**	**E**	**D**	**E**	**G**	**D**	**E**	**G**
Phases	3	3	3		3			3			3			3		
Output nominal power [kVA]	0,9	1,8	2,8		4,0			6,6			8,3			11		
Max. rated motor power [kW]	0,37	0,75	1,5		2,2			4,0			5,5			7,5		
Output nominal current [A]	1,3	2,6	4,1		5,8			9,5			12			16,5		
Max. short time current [1] [A]	2,3	4,7	7,4		10,4			17			21,6		18	29,7		24,8
OC-tripping current [A]	2,8	5,6	8,9		12,5			21			25,9		21,6	35,6		29,7
Nominal input current [A]	1,8	3,6	6		8			13			17			23		
Max. permissible mains fuse (inert) [A]	16	16	16		16			20			25			25		
Rated switching frequency [kHz]	16	16	8		8	4	16	4	8	16	4	16		2	8	16
Max. switching frequency [kHz]	16	16	16		16			4	16		16			16 [6]	16	
Power loss at nominal operating [W]	60	90	80	105	120	140	170	150	185	300	185	250	200	185	320	380
Stall current at 4kHz [2] [A]	1,3	2,6	4,1		5,8			9,5			12			14,5	16,5	
Stall current at 8kHz [2] [A]	1,3	2,6	4,1		5,8	5,2	5,8	-	9,5		9,5	12		7,4	16,5	
Stall current at 16kHz [2] [A]	1,3	2,6	3,5		4,9	3,5	5,8	-	5,8	9,5	5,8	12		5,7	10	12
Max. heat sink temperature TOH [C]	90															
Motor line cross section [3] [mm²]	1,5	1,5	1,5		1,5			2,5			4			4		
Min. braking resistor [4] [Ohm]	390	120	120		82			82		39	56	39	50	56	39	
Typ. braking resistor [4] [Ohm]	620	620	390		270			150			110			85		
Max. braking current [A]	2,2	7,5	7,5		10			10		21	15	21	15	15	21	
Overload curve (page appendex)	1															
Tightening torque for terminals [Nm]	0,5												1,2	0,5		1,2
Mains voltage [5] [V]	305…500 –0 (400 V Nominal voltage)															
Mains frequency [Hz]	50 / 60 +/- 2															
Output voltage [V]	3 x 0…U Mains															
Output frequency [Hz]	see Control board															
Max.shielded motor line length at 4 kHz [m]	10	10	100		100			50	100		100			100		
Max.shielded motor line length at 8 kHz [m]	8	8	30		50	100		-	100		100			-	100	
Max.shielded motor line length at 16 kHz [m]	4	5	10		10	20		-	100		100			-	100	
Storage temperature [C]	-25…70 C															
Operating temperature [C]	-10…45 C															
Model / protective system	IP20															
Relative humidity	max. 95% without condensation															
EMC tested according to	EN 61800-3															
Vibration/Jolt according to	Germanischer Lloyd; EN 50155															
Climatic category	3K3 in accordance with EN 50178															

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3) Max. current before the responding of the OL2-function (only F5-M; F5-S; F5-A)
4) Recommended minimum cross section for rated power and a cable length of upto 100m (copper)
5) This data is only valid for units with internal brake transistor (see "unit identification")
6) Rated voltage 400V; at mains voltage ³ 460V multiply the rated current with factor 0.86.
7) The temperature range is only valid for the control circuit. For the power circuit the temperature range is depending on the control cabinet installation and the cooling system.
8) 31.F5 only watercooled.

Inverter Size		15			16			17		18		19	
Housing size		**E**	**G**	**H**	**E**	**G**	**H**	**G**	**H**	**H**	**R**	**H**	**R**
Phases		3			3			3		3		3	
Output nominal power	[kVA]	17			23			29		35		42	
Max. rated motor power	[kW]	11			15			18,5		22		30	
Output nominal current	[A]	24			33			42		50		60	
Max. short time current 1)	[A]	36			49,5			63		75		90	
OC-tripping current	[A]	43			59			75		90		108	
Nominal input current	[A]	31			43			55		65		66	
Max. permissible mains fuse (inert)	[A]	35			50			50	63	80		80	
Rated switching frequency	[kHz]	4	8	16	2	8	16	4	8	8	16	4	8
Max. switching frequency	[kHz]	16			4	16		16		16		16	
Power loss at nominal operating	[W]	350	290	360	330	310	490	360	470	610	850	540	750
Stall current at 4kHz 2)	[A]	24			27	33		42		50		60	
Stall current at 8kHz 2)	[A]	16	19	24	-	21,5	33	21,4	30	45	50	39	60
Stall current at 16kHz 2)	[A]	10	8,4	15	-	9,5	20	-	13,5	20	40	18	27
Max. heat sink temperature TOH	[C]	90											
Motor line cross section 3)	[mm²]	6			10			10	16	25		25	
Min. braking resistor 4)	[Ohm]	39		22	25		22	25	22	13	9	13	9
Typ. braking resistor 4)	[Ohm]	56			42			30		20		15	
Max. braking current	[A]	21		37	32	30	37	30	37	63	88	63	88
Overload curve (page appendex)		1											
Tightening torque for terminals	[Nm]	1,2		2,5	1,2		2,5	1,2	2,5	2,5	6	2,5	6
Mains voltage 5)	[V]	305…500 –0 (400 V Nominal voltage)											
Mains frequency	[Hz]	50 / 60 +/- 2											
Output voltage	[V]	3 x 0…U Mains											
Output frequency	[Hz]	see Control board											
Max. shielded motor line length	[m]	100											
Storage temperature	[C]	-25…70 C											
Operating temperature	[C]	-10…45 C											
Model / protective system		IP20											
Relative humidity		max. 95% without condensation											
EMC tested according to		EN 61800-3											
Climatic category		3K3 in accordance with EN 50178											

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Inverter Size		**20**	**21**		**22**		**23**		**24**		
Housing size		**R**	**R**		**R**		**R**	**U**	**R**	**U**	
Phases		3	3		3		3		3		
Output nominal power	[kVA]	52	62		80		104		125		
Max. rated motor power	[kW]	37	45		55		75		90		
Output nominal current	[A]	75	90		115		150		180		
Max. short time current 1)	[A]	112	135		172		225		270		
OC-tripping current	[A]	135	162		207		270		324		
Nominal input current	[A]	83	100		127		165		198		
Max. permissible mains fuse (inert)	[A]	100	160		160		200		315		
Rated switching frequency	[kHz]	8	4	8	4	8	2	8	2	4	8
Max. switching frequency	[kHz]	16	16		16		12	8	8		
Power loss at nominal operating	[W]	900	1000	1100	1200	1500	1300	1900	1700	2000	2400
Stall current at 4kHz 2)	[A]	75	90		115	115	127,5	150	144	180	
Stall current at 8kHz 2)	[A]	75	63	90	80	115	90	150	108	180	
Stall current at 16kHz 2)	[A]	34	45	54	46	51	-	-	-	-	
Max. heat sink temperature TOH	[C]	90									
Motor line cross section 3)	[mm²]	35	50		50		95		95		
Min. braking resistor 4)	[Ohm]	9					6	5	4		
Typ. braking resistor 4)	[Ohm]	12	10		8,6		6,7		5		
Max. braking current	[A]	88					133	160	200		
Overload curve (page appendex)		1									
Tightening torque for terminals	[Nm]	6					15				
Mains voltage 5)	[V]	305…500 –0 (400 V Nominal voltage)									
Mains frequency	[Hz]	50 / 60 +/- 2									
Output voltage	[V]	3 x 0…U Mains									
Output frequency	[Hz]	see Control board									
Max. shielded motor line length	[m]	50									
Storage temperature	[C]	-25…70 C									
Operating temperature	[C]	-10…45 C							-10…40 C		
Model / protective system		IP20									
Relative humidity		max. 95% without condensation									
EMC tested according to		EN 61800-3									
Climatic category		3K3 in accordance with EN 50178									

1) With the regulated systems F5-M as well as F5-S 5% are to be subtracted as control reserve.
2) Fuses of type Ferraz Shawmut 6,6 UD Type 31
3) Max. current before the responding of the OL2-function (only F5-M; F5-S; F5-A)
4) Recommended minimum cross section for rated power and a cable length of upto 100m (copper)
5) This data is only valid for units with internal brake transistor (see "unit identification")
6) Rated voltage 400V; at mains voltage ³ 460V multiply the rated current with factor 0.86.
7) The temperature range is only valid for the control circuit. For the power circuit the temperature range is depending on the control cabinet installation and the cooling system.
8) 31.F5 only watercooled.

Inverter Size		25	26	27
Housing size		**U**	**U**	**U**
Phases		3	3	3
Output nominal power	[kVA]	145	173	208
Max. rated motor power	[kW]	110	132	160
Output nominal current	[A]	210	250	300
Max. short time current [1]	[A]	263	313	375
OC-tripping current	[A]	315	375	450
Nominal input current	[A]	231	275	330
Max. permissible mains fuse (inert)	[A]	315	400	450
Rated switching frequency	[kHz]	4	4	2
Max. switching frequency	[kHz]	8	8	8
Power loss at nominal operating	[W]	2300	2800	3100
Stall current at 4kHz [2]	[A]	210	250	240
Stall current at 8kHz [2]				
Stall current at 16kHz [2]		-		
Max. heat sink temperature TOH	[C]	90		
Motor line cross section [3]	$[mm^2]$	95	120	150
Min. braking resistor [4]	[Ohm]	4	4	4
Typ. braking resistor [4]	[Ohm]	4,3	4,3	4,3
Max. braking current	[A]	200	200	200
Overload curve (page appendex)		2		
Tightening torque for terminals	[Nm]	25		
Mains voltage [5]	[V]	305…500 –0 (400 V Nominal voltage)		
Mains frequency	[Hz]	50 / 60 +/- 2		
Output voltage	[V]	3 x 0…U Mains		
Output frequency	[Hz]	see Control board		
Max. shielded motor line length	[m]	50		
Storage temperature	[C]	-25…70 C		
Operating temperature	[C]	-10…40 C		
Model / protective system		IP20		
Relative humidity		max. 95% without condensation		
EMC tested according to		EN 61800-3		
Climatic category		3K3 in accordance with EN 50178		

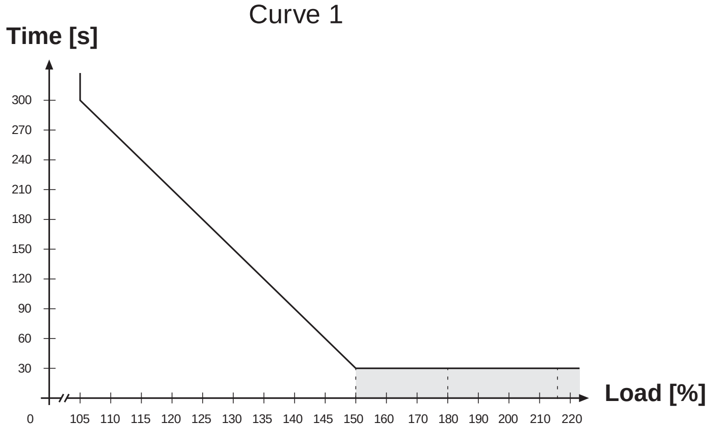
1) With the regulated systems F5-M as well as F5-S 5% are to be subtracted as control reserve.
2) Fuses of type Ferraz Shawmut 6,6 UD Type 31
3) Max. current before the responding of the OL2-function (only F5-M; F5-S; F5-A)
4) Recommended minimum cross section for rated power and a cable length of upto 100m (copper)
5) This data is only valid for units with internal brake transistor (see "unit identification")
6) Rated voltage 400V; at mains voltage ≥ 460V multiply the rated current with factor 0.86.
7) The temperature range is only valid for the control circuit. For the power circuit the temperature range is depending on the control cabinet installation and the cooling system.
8) 31.F5 only watercooled.

Inverter Size		**28**		**29**		**30**	**31**
Housing Size		**W**					
Phases		3	2 x 3	3	2 x 3	2 x 3	2 x 3
Output nominal power	[kVA]	256		319		395	436
Max. rated motor power[8]	[kW]	200		250		315	355
Output nominal current	[A]	370		460		570	630
Max. short time current [1]	[A]	463		575		713	787
OC-tripping current	[A]	555		690		855	945
Nominal input current	[A]	410	2x205	510	2x255	2x315	2x350
Max. permissible mains fuse (inert)	[A]	550	315	700	400	450	550
Rated operating frequency	[kHz]	2		2		2	2
Max. operating frequency	[kHz]	4		2		2	2
Power loss at nominal operating	[W]	3500		4200		5100	5600
Stall current at 4kHz [3]	[A]	370		–		–	
Max. heat sink temperature TOH	[°C]	90		90		90	60
Motor line cross section [4]	[mm²]	2x95		2x150		2x185	2x185
Min. braking resistor [5]	[Ohm]	1,2		1,2		1,2	1,2
Typ. braking resistor [5]	[Ohm]	2,2		1,7		1,3	–
Max. braking current	[A]	660		660		660	660
Overload curve		2					
Tightening torque for terminals	[Nm]	25…30					
Mains voltage [6]	[V]	305…500 ±0					
Mains frequency	[Hz]	50 / 60 +/- 2					
Output voltage	[V]	3 x 0…U mains					
Output frequency	[Hz]	see control card					
Max. shielded motor line length	[m]	50					
Storage temperature	[°C]	-25…70 °C					
Operating temperature	[°C]	-10…45 °C				-10…45 °C [7]	
Model / protective system		IP20					
Relative humidity		max. 95% without condensation					
EMC tested in accordance with …		EN 61800-3					
Climatic category		3K3 according EN 50178					

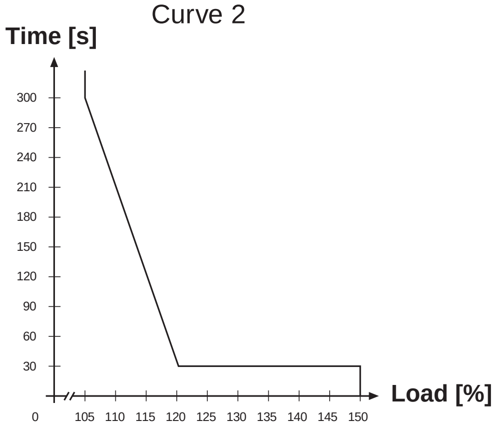
1) With the regulated systems F5-M as well as F5-S 5% are to be subtracted as control reserve.
2) Fuses of type Ferraz Shawmut 6,6 UD Type 31
3) Max. current before the responding of the OL2-function (only F5-M; F5-S; F5-A)
4) Recommended minimum cross section for rated power and a cable length of upto 100m (copper)
5) This data is only valid for units with internal brake transistor (see "unit identification")
6) Rated voltage 400V; at mains voltage ³ 460V multiply the rated current with factor 0.86.
7) The temperature range is only valid for the control circuit. For the power circuit the temperature range is depending on the control cabinet installation and the cooling system.
8) 31.F5 only watercooled.

2.1.8 Overload curve

Curve 1



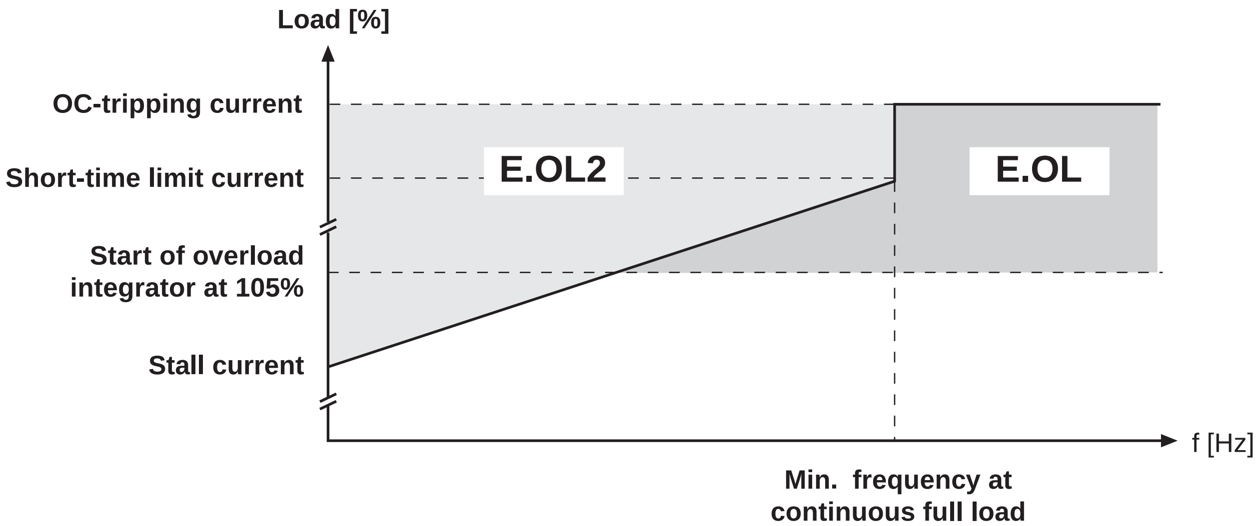
Curve 2



The characteristic declines device-dependently in this range (see technical data)

On exceeding a load of 105 % the counter starts. When falling below the counter counts backwards. If the counter achieves the overload characteristic that corresponds to the inverter the error E.OL is triggered.

2.1.9 Overload protection in the lower speed range
(only valid for F5-M and F5-S, stall current see technical data)



If the permissible current is exceeded a PT1-element (t=280ms) starts, after its sequence of operation the error E.OL2 is triggered.

3. Hardware

3.1 Control Units

In this application manual the control cards F5-BASIC, F5-COMPACT and F5-GENERAL are described. The control card F5-GENERAL is available in two version, one version for housing size B and another version for larger housings. The control cards F5-BASIC and F5-GENERAK in the B-housing have a restriced functional range compared to the large F5-GENERAl control card. These restrictions generally refer to the missing hardware components and the appropriate parameters.

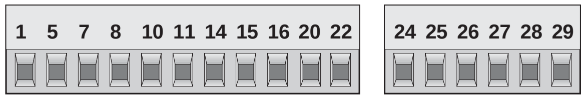
3.1.1 Survey

The following section is to get an overview of the F5 control cards.

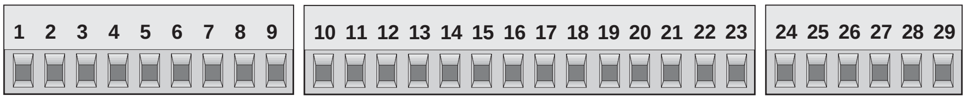
Contol card	**B**ASIC	**C**OMPACT	**G**ENERAL B	**G**ENERAL >=D
Inputs				
Set value input	1	2	2	2 (optional +1)
Digital inputs (programmable)	5	8	8	8
Înternal inputs	4	4	4	4
External supply of the control card	-	X	X	X
Encoder interface	-	-	-	X (optional)
Scan time of the in- and outputs	2 ms	2 ms	1 ms	1 ms
Outputs				
Analog outputs ±10 V	1	2	1	2
Digital outputs	-	2	2	2
Relay outputs	2	2	2	2
Internal outputs	4	4	4	4
Potential-free operator output	X	X	X	X
Functions				
Parameter sets	8	8	8	8
Aux function	X	X	X	X
Brake control	X	X	X	X
DC braking	X	X	X	X
Energy saving function	X	X	X	X
Speed search	X	X	X	X
Autoboost	X	X	X	X
Slip compensation	X	X	X	X
Fixed frequencies	X	X	X	X
Electronic motor protection	X	X	X	X
Power on counter	X	X	X	X
Power off function	X	X	X	X
PID controller	X	X	X	X
Jerk lever starting by s-curves	X	X	X	X
Bus response time	2 ms	2 ms	1 ms	1 ms
Suitable for				
Housing size A	X	-	-	-
Housing size B	X	X	X	-
Housing size D	X	X	-	X
Housing size E	X	X	-	X
Housing size >= G	X	X	-	X

3.1.2 Terminal strip X2A

BASIC



GENERAL/ COMPACT



PIN	Function	Name	Description
1	+ Set Value input 1	AN1+	The input signal (0...±10 V; 0...±20 mA and 4...20 mA) is determined
2	- Set Value input 1	AN1-	with An.0/10. Specification and control see chap. 6.2.2.
3	+ Set Value input 2	AN2+	Resolution: 12 Bit (BASIC and GENERAL B-housing: 11 Bit)
4	- Set Value input 2	AN2-	Scan time: 1 ms (BASIC: 2 ms)
			at directly setpoint input: 250 µs (see chapter 6.4.2)
5	Analog Output 1	ANOUT1	The variable for outputting at analog output 2 is determined with
			An.31 / 36. Specification and control see chap. 6.2.11.
6	Analog Output 2	ANOUT2	Voltage range: 0...±10V, Ri = 100 W, Resolution: ±10 Bit
7	+10 V Output	CRF	Reference voltage output +10 VDC +5% / max. 4 mA for set value potentiometer.
8	Analog Mass	COM	Mass for analog in- and outputs
9	Analog Mass	COM	Mass for analog in- and outputs
10	Progr. Input 1	I1	Specifications, control and programming of the digital
11	Progr. Input 2	I2	inputs see chap. 6.3.1...6.3.11
12	Progr. Input 3	I3	All digital inputs are free programmable.
13	Progr. Input 4	I4	The control release is firmly linked with the input ST, but can be
14	Progr. Input Forward	F	additional occupied with other functions.
15	Progr. Input Reverse	R	Ri = 2,1 kW
16	Progr. Input Control Rel.	ST	Scan time: 1 ms (BASIC: 2 ms)
17	Progr. Input Reset	RST	
18	Transistor Output 1	O1	Specifications, control and programming of the digital
19	Transistor Output 2	O2	transistor outputs see chap. 6.3.12...6.3.22,
			a total of max. 50 mADC for both outputs
20	+24 V Output	U_{out}	approx. 24V DC output (max.100 mA)
21	20...30 V Input	U_{in}	Ext. supply voltage for digital in-/outputs, potential 0V (X2A.22/23)
22	Digital Mass	0V	Potential for digital in-/outputs
23	Digital Mass	0V	Potential for digital in-/outputs
24	Relay 1 /NO contact	RLA	Programmable relay output 1 (Terminal X2A.24...26);
25	Relay 1 /NC contact	RLB	Programmable relay output 2 (Terminal X2A.27...29)
26	Relay 1 /switching contact	RLC	Specifications, control and programming of the relay outputs
27	Relay 2 /NO contact	FLA	see chapter 6.3.11...6.3.17
28	Relay 2 /NC contact	FLB	max. 30 V DC, 1 A
29	Relay 2 /switching contact	FLC	

3.1.3 Connection of the control

In order to prevent a malfunction caused by interference voltage supply on the control inputs, the following directions should be observed:

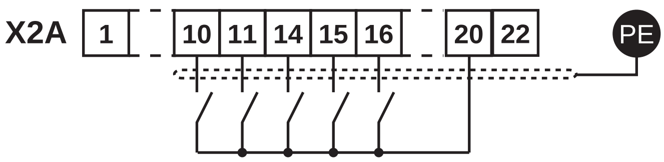
EMC

- Use shielded/drilled cables
- Lay shield **on one side** of the inverter onto earth potential
- Lay control and power cable **separately** (about 10...20 cm apart)
- Lay crossings in a right angle (in case it cannot be prevented)

3.1.4 Digital inputs

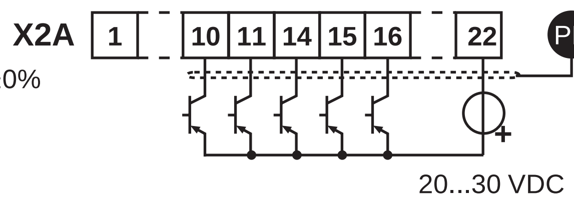
Control card BASIC:

Use of **internal** voltage supply



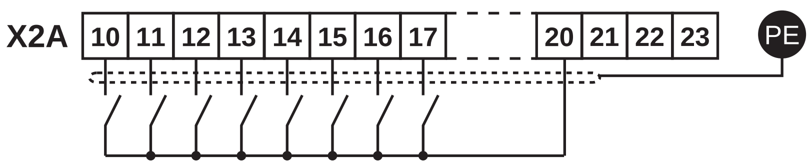
Use of **external** voltage supply

13...30V DC ±0%
smoothed
Ri = 2,1 kW



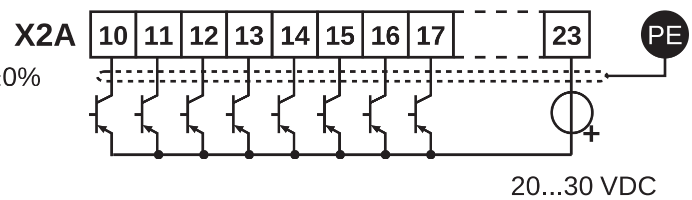
Control card GENERAL:

Use of **internal** voltage supply



Use of **external** voltage supply

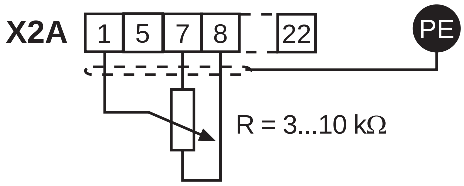
13...30V DC ±0%
smoothed
Ri = 2,1 kW



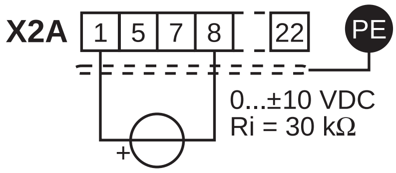
3.1.5 Analog inputs

Control card BASIC:

Internal analog
set-point setting



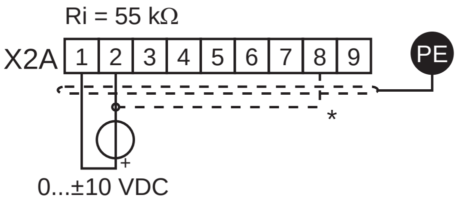
External analog
set-point setting



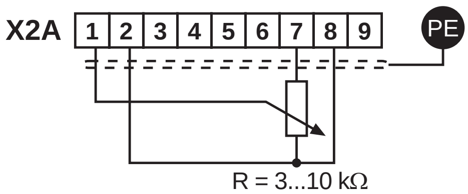
Control card GENERAL:

Connect unused analog inputs to common, to prevent set value fluctuations!

External analog
set-point setting



Internal analog
set-point setting

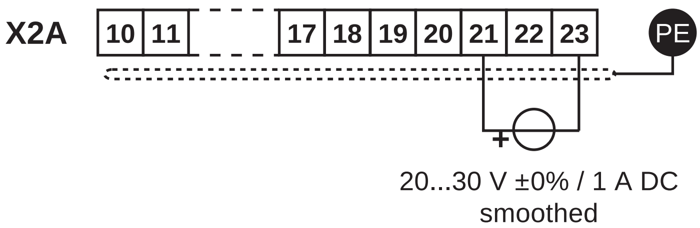


*) Connect potential equalizing line only
if a potential difference of > 30 V exists between the controls.

3.1.6 Voltage Input / External Power Supply

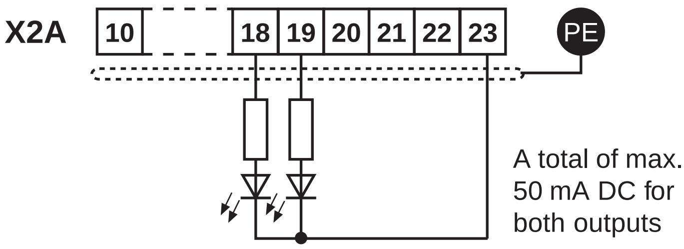
The supply of the control circuit through an external voltage source keeps the control in operational condition even if the power stage is switched off. To prevent undefined conditions at external power supply the basic procedure is to first switch on the power supply and after that the inverter.

Control card GENERAL:



3.1.7 Digital Outputs

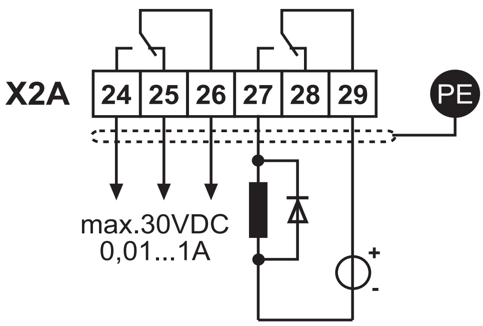
Control card GENERAL:



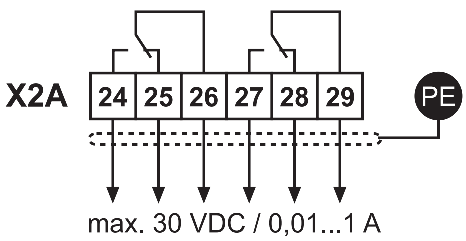
3.1.8 Relay Outputs

In case of inductive load on the relay outputs a protective wiring must be provided (e.g. free-wheeling diode)!

Control card BASIC:

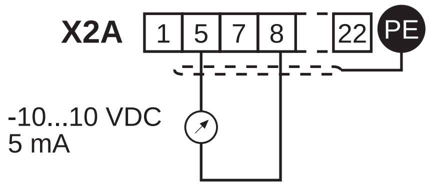


Control card GENERAL:

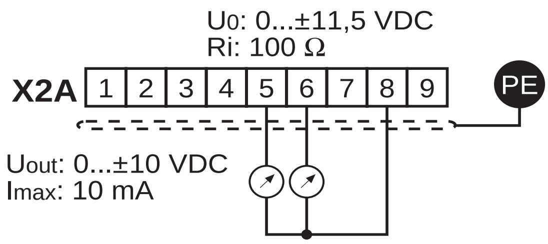


3.1.9 Analog Outputs

Control card BASIC:



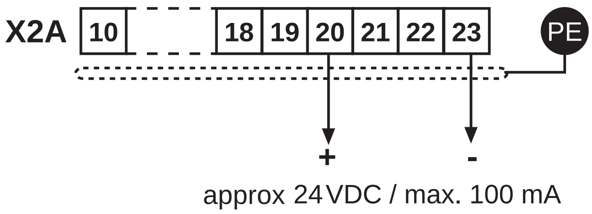
Control card GENERAL:



3.1.10 Voltage Output

The voltage output serves for the setting of the digital inputs as well as for the supply of external control elements. Do no exceed the maximum output current of 100 mA.

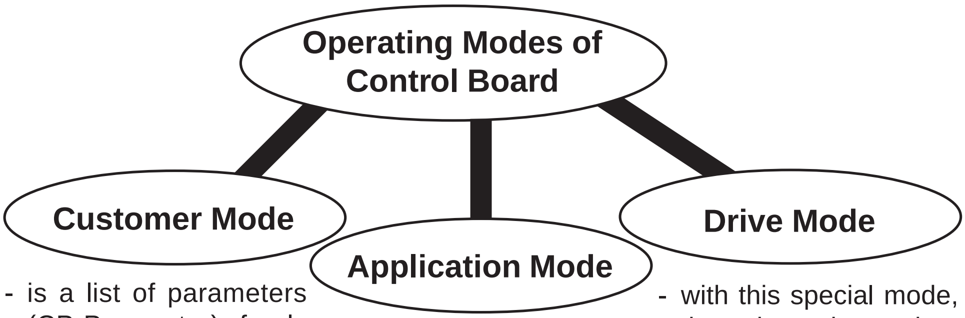
Control card GENERAL:



4. Operation
4.1 Fundamentals

The following chapter describes the fundumentals of the software structure as well as the operation of the unit.

The control boards F5-BASIC anf F5-GENERAL incorporates 3 operating modes:



Customer Mode

- is a list of parameters (CP-Parameter), freely definable, which are necessary or important for the user.
- suppllied with a parameter list defined by KEB

Application Mode

- all 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

Drive Mode

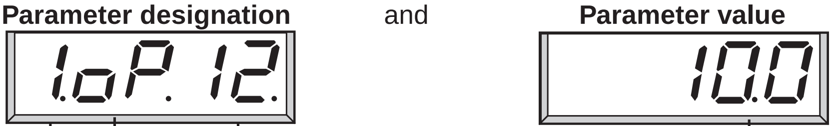
- with this special mode, the unit can be put into operation via operator
- with the exception of the control release no terminal wiring is needed

4.1.1 Parameters, Parameter Groups, Parameter Sets

What are parameters, parameter groups and parameter sets?

Parameters are values changeable by the operator in a program, which have an influence on the program flow. A parameter consists of

Parameter designation and **Parameter value**



The **parameter value** shows the actual setting.

The **parameter number** specifies the parameters within a group.

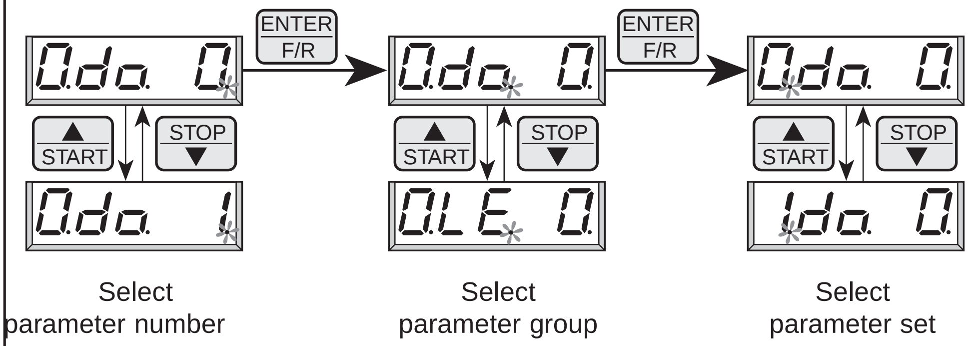
To maintain a cleary-to-survey operation inspite of the great number of parameters, we have combined function-related parameters into **parameter groups** (e.g. all motor-related parameters are combined in the Drive(dr)-group).

8 **parameter sets** (0...7) exist to adjust several values for one parameter. If the active values shall be displayed for a running unit the digit is set to „A“. The digit is not-applicable for non-programmable parameters (see chapter 6.8).

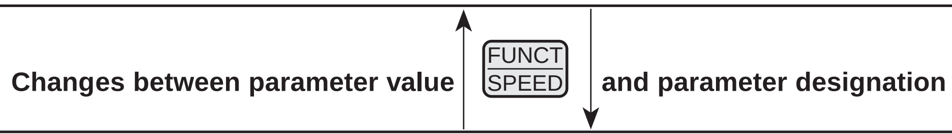
Example: A conveyor belt shall be used with 3 different speeds. A parameter set is programmed for each „speed“ ... acceleration, deceleration etc. can be adjusted individually.

4.1.2 Selection of a Parameter

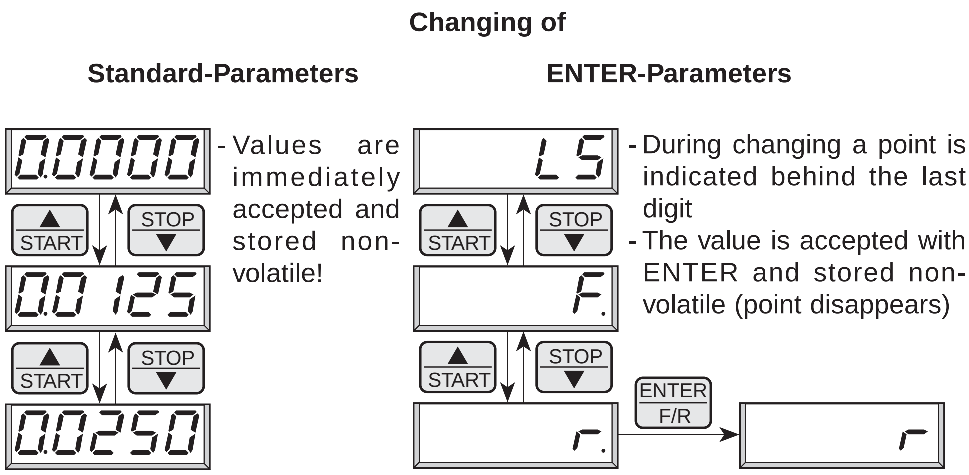
The blinking point indicates the changeable area. By pressing the ENTER-key the blinking point is shifted.



A parameter set number is not displayed for non-programmable parameters (see 4.1.5)!



4.1.3 Adjustment of Parameter Values



Parameter values can be changed only, when the parameter set is not adjusted to „Active parameter set“ (A) ! (see 4.1.6)

4.1.4 ENTER-Parameter

For some parameters it is not sensible that the selected values become active immediately. For that reason they are called ENTER-parameters, they do not become active until the ENTER-key is pressed.

Example: At digital setting of rotation direction the rotation reverse (r) shall be selected from standstill (LS). As shown above, the actuation must be done via rotation forward (F). However, the drive must not start yet, first the rotation direction reverse has to be selected and confirmed with ENTER (point disappears).

4.1.5 Non-programmable Parameters

Certain parameters are not programmable, as their value must be the same in all sets (e.g. bus address or baud rate). For an easy identification of these parameters the parameter set number is missing in the parameter identification. **For all non-programmable parameters the same value is valid independent of the selected parameter set!**

4.1.6 Resetting of Error Messages

If a malfunction occurs during operation, the actual display is overwritten by a blinking error message. The error message can be cancelled by pressing the ENTER-key, so that the original value is again shown in the display.
ATTENTION! The resetting of the error message with ENTER is no error reset, i.e. the error status in the inverter is not reset. Thus it is possible to correct adjustments before the error reset. An error reset is only possible through the reset terminal or control release.

4.1.7 Resetting of Peak Values

To permit conclusions on the operational performance of the drive, parameters are provided that indicate the peak values. Peak value means that the highest measured value is stored for the ON-time of the inverter (slave pointer principle). The peak value is cancelled by s or t and the actual measured value is shown in the display.

4.1.8 Acknowledgement of Status Signals

To monitor the correct execution of an action some parameters send a status signal. For example, after copying a set the display shows „PASS“ to indicate that the action was carried out without error. These status signals must be acknowledged with ENTER.

4.2 Password Structure

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

- change the operating mode
- set a write protection
- activate the Service-Mode
- switch to the Drive-Mode

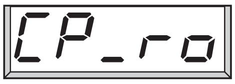
Depending on the actual operating mode the password can be entered in following parameters

when the CP-Mode is active

when the applicatioan mode is active

4.2.1 Password Levels

The parameter value of the above parameters shows the actual password level. Following indications are possible:

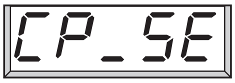


CP - read only

Only the Customer-parameter group is visible, exept for CP.0 all parameters are in the read-only status (see chapter 4.3).

CP - on

Only the Customer-parameter group is visible. All parameters can be changed.



CP - Service

Like CP-on, but the parameter identification is indicated according to the original parameter (see chapter 4.3).

Application

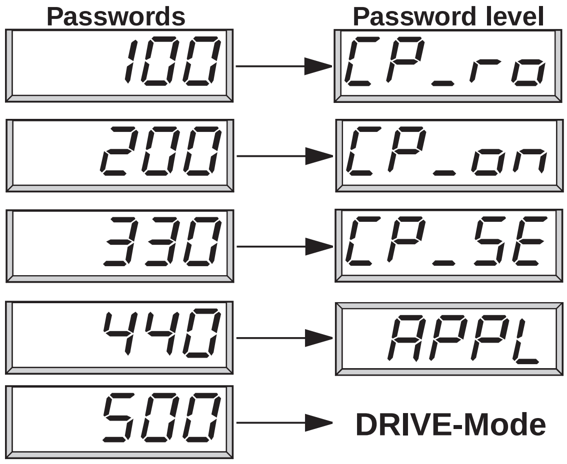
All application parameters are visible and can be changed. The CP-parameters are not visible.

Drive-Mode

The Drive-Mode is a special operating mode, here the unit can be put into operation via the operator (see chapter 4.4).

4.2.2 Passwords

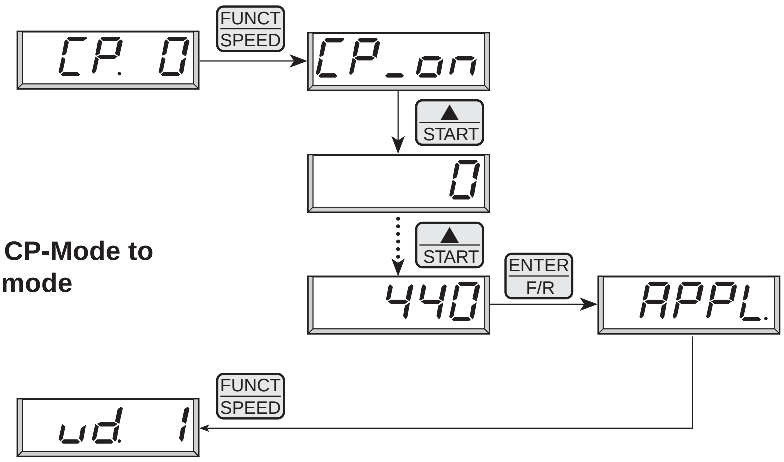
By selecting one of the following passwords you can switch to the respective password level:



To finish the Drive-Mode press ENTER + FUNCT key for approx. 3 sec. (see chapter 4.4).

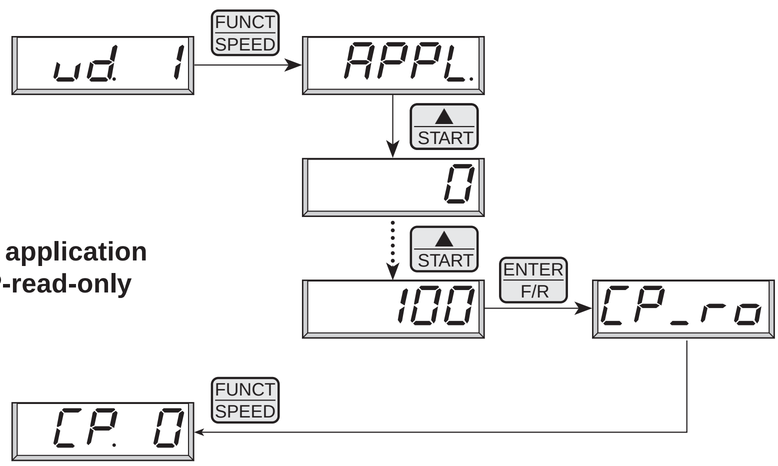
4.2.3 Changing of Password Level

Example 1:
Switching from CP-Mode to the application mode



With the exception of the service password all entered password levels are generally stored non-volatile!

Example 1:
Switching from application mode to the CP-read-only mode



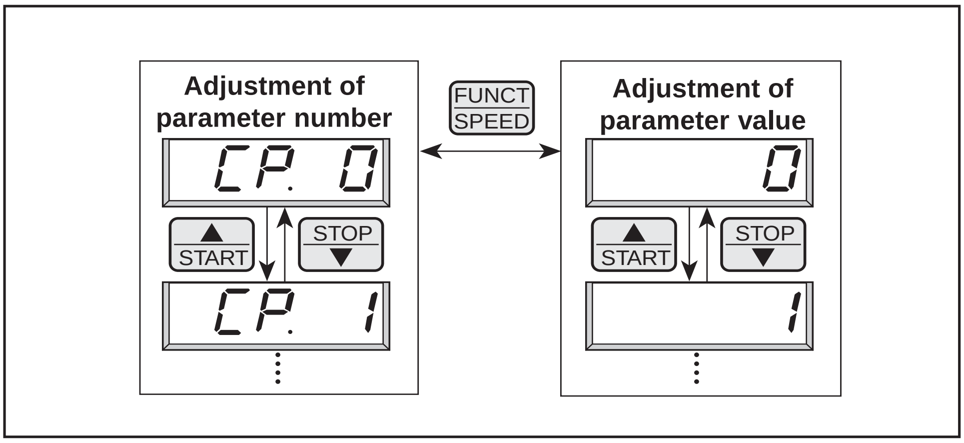
4.3 CP-Parameter

The Customer-Parameters (CP) are a special group of parameter. With the exception of CP.0 (Password input), they can be defined by the user (see Chapter 6.13). The following Parameters are preset at delivery.

Advantages from it:
- operator-friendly for the customer
- critical parameters are protected against maloperation
- low documentation cost for the machine builder

4.3.1 Operation in CP-Mode

Compared to the Application-Mode the operation in the CP-Mode is easier because parameter set selection and parameter group selection are unnecessary.



4.3.2 Factory Setting

The following list shows the CP-parameter group predefined by us. The definition of the CP-parameters is done in the User-Definition-Parameters (ud). How you can define your own parameters is described in Chapter 6.13.

Display	Parameter	Setting range	Resolution	Factory setting	Appl. Parameter
CP. 0	Password input	0…9999	1	–	ud.1 / 0801h
CP. 1	Actual frequency display	–	0,0125 Hz	–	ru.3 / 0203h
CP. 2	Set frequency display	–	0,0125 Hz	–	ru.1 / 0201h
CP. 3	Inverter status display	–	–	–	ru.0 / 0200h
CP. 4	Apparent current	–	0,1 A	–	ru.15 / 020Fh
CP. 5	Apparent current / Peak value	–	0,1 A	–	ru.16 / 0210h
CP. 6	Utilization	–	1 %	–	ru.13 / 020Dh
CP. 7	Intermediate circuit voltage	–	1 V	–	ru.18 / 0212h
CP. 8	Intermediate circuit voltage/ Peak value	–	1 V	–	ru.19 / 0213h
CP. 9	Output voltage	–	1 V	–	ru.20 / 0214h
CP.10	Minimal frequency	0…400 Hz	0,0125 Hz	0 Hz	op.6 / 0306h
CP.11	Maximal frequency	0…400 Hz	0,0125 Hz	70 Hz	op.10 / 030Ah
CP.12	Acceleration time	0,00…300,00 s	0,01 s	5,00 s	op.28 / 031Ch
CP.13 031Eh	Deceleration time (-1 = CP.12)	-0,01; 0,00…300,00s		0,01 s	5,00 sop.30 /
CP.14	S-curve time	0,00 (off)…5,00 s	0,01 s	0,00 s (off)	op.32 / 0320h
CP.15	Boost	0,0…25,5 %	0,1 %	2,0 %	uf.1 / 0501h
CP.16	Rated frequency	0…400 Hz	0,0125 Hz	50 Hz	uf.0 / 0500h
CP.17 1)	Voltage stabilization	1…650 V (off)	1 V	650 (off)	uf.9 / 0509h
CP.18 1)	Carrier frequency	2/4/8/12/16 kHz 2)	1	– 2)	uf.11 / 050Bh
CP.19	Fixed frequency 1	-400...400 Hz	0,0125 Hz	5 Hz	op.21 / 0315h
CP.20	Fixed frequency 2	-400...400 Hz	0,0125 Hz	50 Hz	op.22 / 0316h
CP.21	Fixed frequency 3	-400...400 Hz	0,0125 Hz	70 Hz	op.23 / 0317h
CP.22 1)	DC-braking / Mode	0…9	1	7	pn.28 / 041Ch
CP.23	DC-braking / Time	0,00…100,00 s	0,01 s	10,00 s	pn.30 / 041Eh
CP.24	Max. ramp current	0…200 %	1 %	140 %	pn.24 / 0418h
CP.25	Max. constant current	0…200 % (off)	1 %	200 % (off)	pn.20 / 0414h
CP.26 1)	Speed search condition	0…15	1	8	pn.26 / 041Ah
CP.27	Quick stop time	0,00…300,00 s	0,01 s	2,00 s	pn.60 / 043Ch
CP.28	Reaction of ext. overtemperature	0…7	1	7	pn.12 / 040Ch
CP.29 1)	Analog output 1 / Function	0…20	1	2	an.31 / 0A1Fh
CP.30	Analog output 1 / Amplification	-20,00…20,00	0,01	1,00	an.33 / 0A21h
CP.31 1)	Relay output 1 / function	0…75	1	4	do.2 / 0C02h
CP.32 1)	Relay output 2 / function	0…75	1	27	do.3 / 0C03h
CP.33 0D03h	Relay output 2 / switching level	-30000,00…30000,00		0,01	4,00 le.3 /
CP.34 1)	Source of rotation direction	0…9	1	2	op.1 / 0301h
CP.35 1)	AN1 interface selection	0…2	1	0	an.0 / 0A00h
CP.36	AN1 zero point hysteresis	-10,0…10,0 %	0,1 %	0,2 %	an.4 / 0A04h

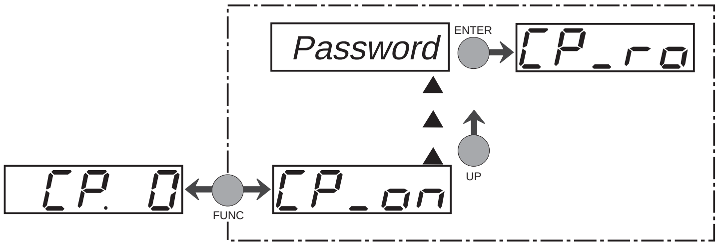
1) Enter-Parameter
2) depending on power circuit

4.3.3 Password Input

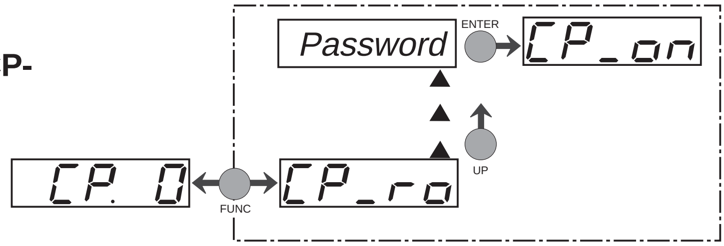
CP. 0

Ex works the frequency inverter is supplied without password protection, this means that all changeable parameters can be adjusted. After parameterizing the unit can be barred against unauthorized access (Passwords: see chapter 4.2). The adjusted mode is stored.

Barring the CP-Parameter



Enabling the CP-Parameter



4.3.4 Operating Display

The parameters below serve for thecontrolling of the frequency inverter during operation.

Actual frequency display

CP. 1

Display of the actual output frequency with a resolution of 0.0125 Hz. The operator displays additionally „noP“ and „LS“ if the control release or the direction of rotation are not switched (see CP.3). The rotation of the inverter is indicated by the sign.

Examples:

18.3	Output frequency 18.3 Hz, rotation forward
- 18.3	Output frequency 18.3 Hz, rotation reverse

Set frequency

CP. 2

Display of actually set frequency. The indication is done in the same manner as at CP.1. For control reasons the set frequency is displayed even if control release or direction of rotation are not switched. If no direction of rotation is set, the set frequency for clockwise rotation (forward) is displayed.

Inverter status display

CP. 3

The status display shows the actual working conditions of the inverter. Possible displays and their meanings are:

noP	"no Operation" control release not bridged, modulation switched off, output voltage = 0 V, drive is not controlled.
LS	"Low Speed" no rotation preset, modulation switched off, output voltage = 0 V, drive is not controlled.

FAcc	"Forward Acceleration" drive accelerates with direction of rotation forward .
FdEc	"Forward Deceleration" drive decelerates with direction of rotation forward.
rAcc	"Reverse Acceleration" drive accelerates with direction of rotation reverse.
rdEc	"Reverse Deceleration" drive decelerates with direction of rotation reverse.
Fcon	"Forward Constant" drive runs with a constant speed and direction of rotation forward.
rcon	"Reverse Constant" drive runs with constant speed and direction of rotation reverse.

Other status messages are described at the parameters, where they occur.

Apparent current

CP. 4

Display of the actual apparent current in ampere.

Apparent current / Peak value

CP. 5

CP.5 makes it possible to recognize the max. apparent current. For that the highest value of CP.4 is stored in CP.5. The peak value memory can be cleared by pressing the UP, DOWN or ENTER key or over bus by writing any value you like to the address of CP.5. The switch off of the inverter also clears the memory.

Utilization

CP. 6

Display of the actual inverter rate of utilization in percent. 100% rate of utilization is equal to the inverter rated current. Only positive values are displayed, meaning there is no differentiation between motor and regenerative operation.

Intermediate circuit voltage

CP. 7

Display of actual DC voltage in volt.
Typical calues:

V-class	Normal operation	Over volt. (E.OP)	Under volt. (E.UP)
230 V	300…330 V DC	approx. 400 V DC	approx. 216 V DC
400 V	530…620 V DC	approx. 800 V DC	approx. 240 V DC

Intermediate circuit voltage/ Peak value

CP. 8

CP.8 makes it possible to recognize short-time voltage rises within an operating cycle. For that the highest value of CP.7 is stored in CP.8. The peak value memory can be cleared by pressing the UP, DOWN or ENTER key or over bus by writing any value you like to the address of CP.8. The switch off of the inverter also clears the memory.

Output voltage

CP. 9

Display of the actual output voltage in volt.

4.3.5 Basic Adjustment of the Drive

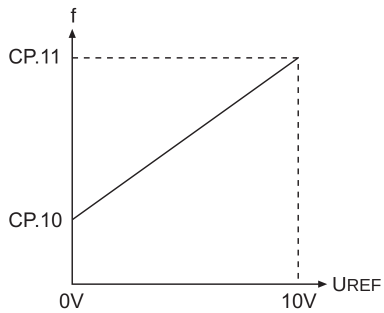
The following parameters determine the fundamental operating data of the drive. They should be checked and/or adapted to the application.

Minimum frequency

CP.10

With this frequency the inverter operates without presetting an analog set value. Internal limiting of the fixed frequencies CP.19…CP.21.

Adjustment range:	0...400 Hz
Resolution:	0,0125 Hz
Factory setting:	0,0 Hz



Maximum frequency

CP.11

With this frequency the inverter operates with maximum analog set value.
Internal limiting of the fixed frequencies CP.19…CP.21.

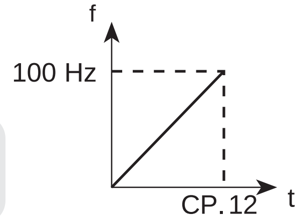
Adjustment range:	0...400 Hz
Resolution:	0,0125 Hz
Factory setting:	70 Hz

Acceleration time

CP.12

The parameter determines the time needed to accelerate from 0 Hz to 100 Hz. The actual acceleration time is proportional to the frequency change.

$$\frac{100\ \text{Hz}}{\text{delta f}} \times \text{actual acceleration time} = \text{CP.12}$$



Adjustment range:	0,00...300,00 s
Resolution:	0,01 s
Factory setting:	5,00 s

Example: actual acceleration time = 5s; the drive should accelerate from 10 Hz to 60 Hz. delta f = 60 Hz - 10 Hz = 50 Hz

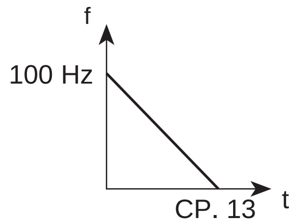
CP.12 = (100 Hz / 50 Hz) x 5 s = 10 s

Deceleration time

CP.13

The parameter determines the time needed to decelerate from 100 Hz to 0 Hz. The actual deceleration time is proportional to the frequency change.

$$\frac{100\ \text{Hz}}{\text{delta f}} \times \text{actual deceleration time} = \text{CP.13}$$



Adjustment range:	-0,01; 0,00...300,00 s
Resolution:	0,01 s
Factory setting:	5,00 s

At deceleration time = -0,01 see CP.12 (Display: "=Acc")!

Example: actual deceleration time = 5s; the drive should decelerate from 60 Hz to 10 Hz. delta f = 60 Hz - 10 Hz = 50 Hz

CP.12 = (100 Hz / 50 Hz) x 5 s = 10 s

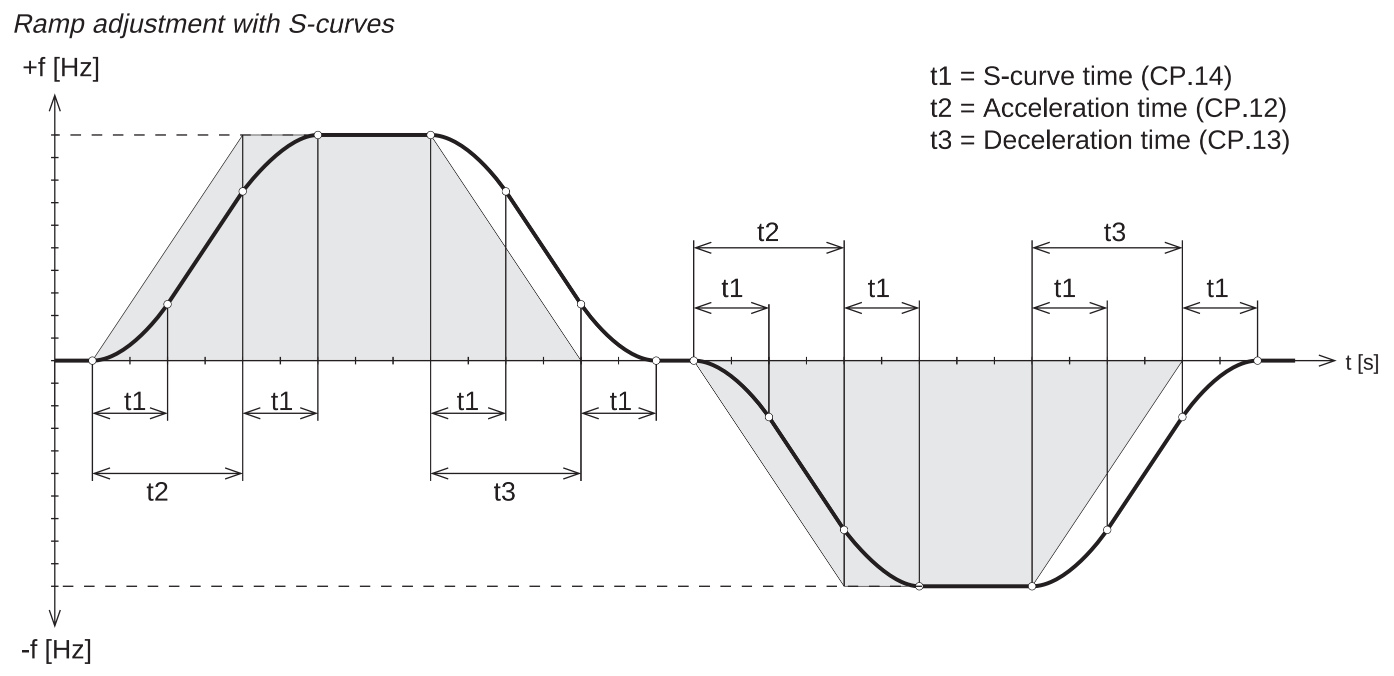
S-curve time

CP.14

For some applications it is of advantage when the drive starts and stops jerk-free. This is achieved through a straightening of the acceleration and deceleration ramps. The straightening time, also called S-curve time, can be adjusted with CP.14.

Adjustment range:	0,00 (off)...5,00 s
Resolution:	0,01 s
Factory setting:	0,00 s (off)

In order to drive defined ramps with activated S-curve time, the acceleration and deceleration times (CP.12 and CP.13) must be adjusted higher than the S-curve time (CP.14).

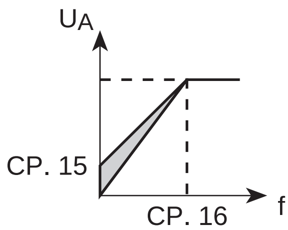


Boost

CP.15

In the lower speed range a large part of the motor voltage decreases on the stator resistance. To keep the breakdown torque nearly constant over the entire speed range, the voltage decrease can be compensated with the boost.

Adjustment range:	0,0...25,5 %
Resolution:	0,1 %
Factory setting:	2,0 %



Adjustment:
- Determine the rate of utilzation in no-load operation with rated frequency
- Preset about 10 Hz and adjust the boost, so that about the same rate of utilization is reached as with the rated frequency.

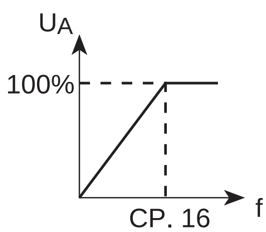
⚠ When the motor, during continuous operation, drives with low speed and too high voltage it can lead to an overheating of the motor.

Rated frequency

CP.16

With the adjusted frequency the inverter reaches a maximal output voltage. The adjustment of the rated motor frequency is typical in this case. **Note: Motors can overheat when the rated frequency is incorrectly adjusted!**

Adjustment range:	0...400 Hz
Resolution:	0,0125 Hz
Factory setting:	50 Hz



4.3.6 Special Adjustments

The following parameters serve for the optimization of the drive and the adaption to certain applications. These adjustments can be ignored at the initial startup.

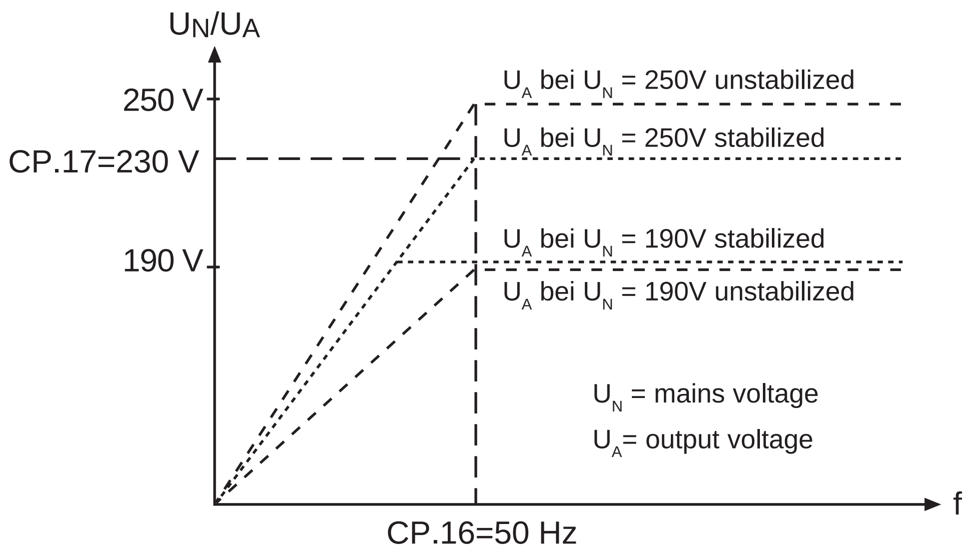
Voltage stabilization

CP.17

With this parameter a regulated output voltage in relation to the rated frequency can be adjusted. For that reason voltage variations at the input as well as in the intermediate circuit only have a small influence on the output voltage (U/f-characteristic). The function allows, among other things, an adaption of the output voltage to special motors.

Adjustment range:	1...650 V (off)
Resolution:	1 V
Factory setting:	650 V (off)
Note:	Enter-Parameter

In the example below the output voltage is stabilized to 230 V (0% boost).



Carrier frequency

CP.18

The switching frequency with which the power modules are clocked can be changed depending on the application. The employed power stage determines the maximum switching frequency as well as the factory setting (see manual: part2). Refer to following list to learn about influences and effects of the switching frequency.

low switching frequency	high switching frequency
• less inverter heating • less discharge current • less switching losses • less radio interferences • improved concentricity with low speed	• less noise development • improved sine-wave simulation • less motor losses

Adjustment range (depending on power circuit):	2 / 4 / 8 / 12 / 16 kHz
Factory setting:	depending on power circuit
Note:	Enter-Parameter

⚠ At switching frequencies above 4 kHz pay absolute attention to the max. motor line length in the technical data of the chapter 2.1.

Step frequency 1...3

Input I1

CP.19

Input I2

CP.20

Input I1 and I2

CP.21

Three fixed frequencies can be adjusted. The fixed frequencies are selected with the inputs I1 and I2.

Adjustment range:	-400...400 Hz
Resolution:	0,0125 Hz
Factory settingCP.19:	5 Hz
Factory settingCP.20:	50 Hz
Factory settingCP.21:	70 Hz

If adjustments are made that are outside the fixed limits of CP.10 and CP.11, then the frequency is internally limited. The negative values are released in application mode.

The rotation source of the fixed frequencies is not changed by CP.34, it always corresponds to CP.34 = 2.

DC-braking / Mode

CP.22

With DC-braking the motor is not decelerated by the ramp. Quick braking is caused by D.C. voltage, which is applied onto the motor winding. This parameter determines how the dc-braking is triggered.

Value	Activation
0	DC-braking deactivated
1	DC-braking at switch off of the direction of rotation and upon reaching 0Hz. The braking time is CP.23 or until the next direction of rotation.
2*	DC-braking as soon as setting for the direction of rotation is absent.
3*	DC-braking as soon as the direction of rotation changes or is absent.
4*	DC-braking on disabling the direction of rotation and if the real frequency falls below 4 Hz.
5*	DC-braking when the real frequency falls below 4 Hz.
6*	DC-braking as soon as the set value falls below 4 Hz.
7*	DC-braking when input I4 is switched. Braking time depends on the real frequency. At control circuit B = value "0"
8	DC-braking as long as input I4 is switched. At control circuit B = value "0"
9	DC-braking after switching on the modulation on.

* Braking time depends on the actual frequency.

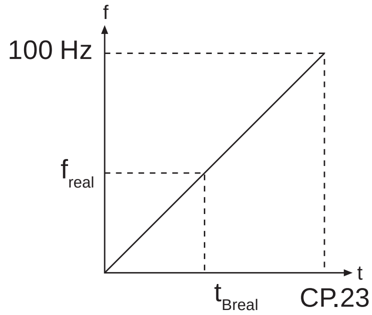
Adjustment range:	0...9
Resolution:	1
Factory setting:	7
Note:	Enter-Parameter

DC-braking / Time

CP.23

If the braking time depends on the actual frequency (CP.22 = 2...7), it is calculated as follows:

$$t_{Breal} = \frac{CP.23 \times f_{real}}{100\ Hz}$$



Otherwise the braking time corresponds to CP.23.

Adjustment range:	0,00...100,00 s
Resolution:	0,01 s
Factory setting:	10,00 s

Max. ramp current

CP.24

This function protects the frequency inverter against switching off through overcurrent during the acceleration ramp. When the ramp reaches the adjusted value,it is stopped so long until the current decreases again. CP.3 displays "LAS" at active function.

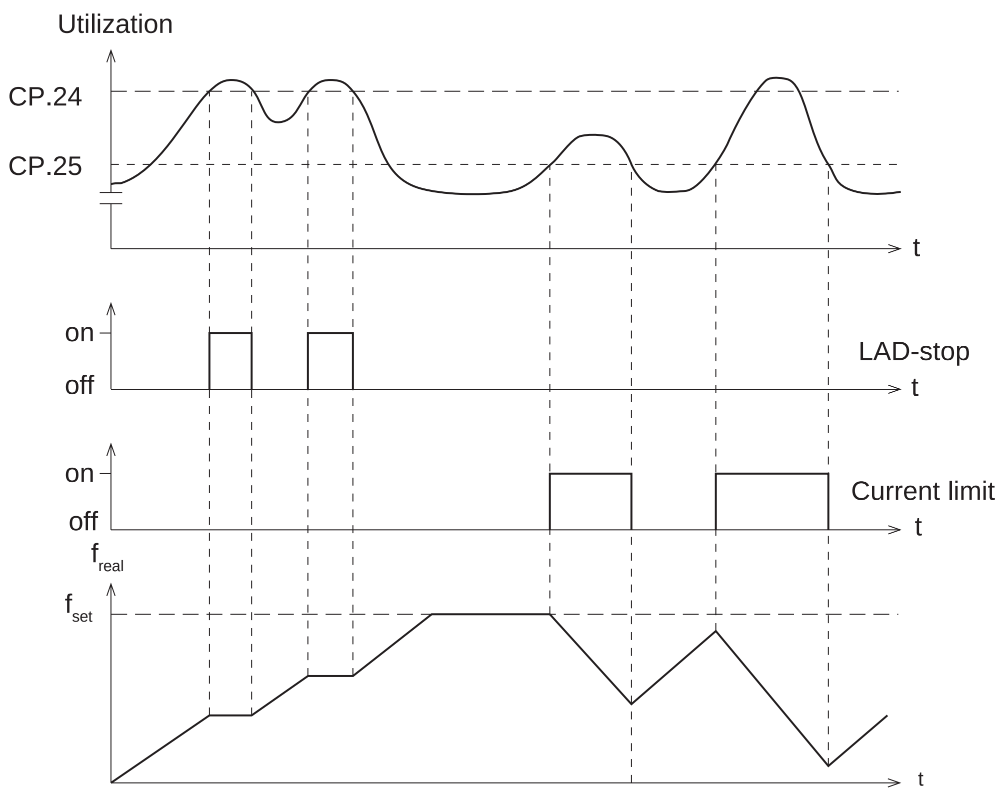
Adjustment range:	0...200 %
Resolution:	1 %
Factory setting:	140 %

Max. constant current

CP.25

This function protects the frequency inverter against switch off through overcurrent during constant output frequency. When exceeding the adjusted value, the output frequency is reduced until the value drops below the adjusted value. CP. 3 displays "SSL" at active function.

Adjustment range:	0...200 % (off)
Resolution:	1 %
Factory Setting:	200 % (off)



Speed search condition

CP.26

When connecting the frequency inverter onto a decelerating motor, an error can be triggered by the differing rotating field frequencies. With activated speed search the inverter searches for the actual motor speed, adapts its output frequency and accelerates with the adjusted ramp to the given set value. During speed search CP.3 displays "SSF". The parameter determines, under what conditions the functions operate. In case of several conditions the sum of the value must be entered.

Example: CP.26 = 12 means after reset **and** after auto-reset UP.

Value	Condtion
0	function off
1	at control release
2	at switch on
4	after reset
8	after Auto-Reset UP

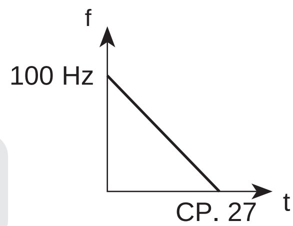
Adjustment range:	0...15
Resolution:	1
Factory setting:	8
Note:	Enter-Parameter

Quick stop time

CP.27

The fast-stop function is activated depending on CP.28. The parameter determines the time needed to decelerate from 100 Hz to 0 Hz. The actual deceleration time is proportional to the frequency change. The response to overtemperature (CP.28) is disabled in the factory setting. If it is activated then the modulation switches off automatically after 10 s if the motor is still too hot.

$$\frac{100\text{ Hz}}{\text{delta f}} \text{ x actual deceleration time = CP.27}$$



Adjustment range:	0,00...300,00 s
Resolution:	0,01 s
Factory setting:	2,00 s

Example: actual deceleration time = 5s; the drive should decelerate from 50 Hz to 0 Hz. delta f = 50 Hz - 0 Hz = 50 Hz

CP.27 = (100 Hz / 50 Hz) x 5 s = 10 s

Reaction of external overtemperature

CP.28

This parameter determines the response of the drive on the external temperature monitoring **(factory setting = off)**. In order to activate this function the power circuit terminals T1/T2 must be connected in accordance with the instruction manual Part 2. After that the response can be adusted according to following table.
If overheat no longer exists, the message E.ndOH (or A.ndOH) is output. Only then the error can be reset or the automatic restart can be carried out.

CP.28	Display	Reaction	Restart
0	**E.dOH**	Immediate disabling of modulation	Remove fault; Actuate reset
1 *	**A.dOH**	Quick stopping / disabling of modulation after reaching speed 0	
2 *	**A.dOH**	Quick stopping/holding toruqe at speed 0	
3	**A.dOH**	Immediate disabling of modulation	Automatic reset, if the fault is no longer present
4 *	**A.dOH**	Quick stopping / disabling of modulation after reaching speed 0	
5 *	**A.dOH**	Quick stopping/holding toruqe at speed 0	
6 *	**no**	No effect on the drive; With CP.31/32 = 9 an external module can be controlled (e.g. fan)	- inapplicable -
7	**no**	No effect on the drive; **!Störung existiert nicht!** External Temperature monitoring is not activated	

*) If the motor is still too hot after 10 seconds, the error E.dOH is triggered and the modulation is switched off!

Adjustment range:	0...7
Resolution:	1
Setting range:	7

Analog ouput 1 / Function

CP.29

CP.32 defines the function of analog output 1.

Value	Function	
0	absolute actual value	100 Hz
1	absolute set value	100 Hz
2	actual value ru.7	±100 Hz
3	set value ru.1	±100 Hz
4	output voltage ru.20	500 V
5	DC voltage ru.18	1000 V
6	apparent current ru.15	$2 \bullet I_{rated}$
7	active current ru.17	$2 \bullet \pm I_{rated}$
8	digital An.32/An.37/An.42	100 %
9	external PID output ru.52	±100 %
10	absolute ext. PID output ru.52	100 %
11	absolute active current ru.17	$2 \bullet I_{rated}$
12	power mod. temperature ru.38	100°C
13	motor temperature	0...100 °C
14-18	application mode only	
19	ramp output frequency	0...±100 Hz
20	absolute ramp output frequency	0...100 Hz

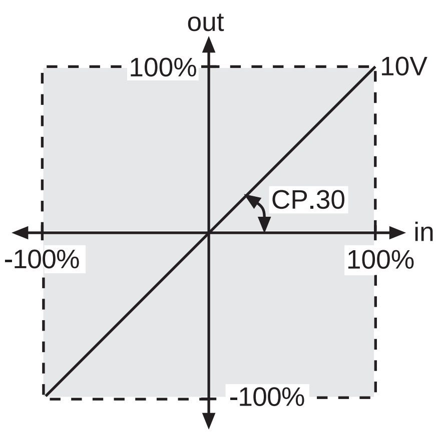
Adjustment range:	0...20
Resolution:	1
Factory setting:	2
Note:	Enter-Parameter

Analog output 1 / Amplification

CP.30

With the amplification the output voltage of the analog output can be tuned the signal to be given out. An amplification of 1 corresponds to ±100 % = ±10 V.

Adjustment range:	-20,00...20,00
Resolution:	0,01
Factory setting:	1,00



Setting aid:
The analog output shall give out +10 V at 70 Hz instead at 100 Hz:

$$CP.30 = \frac{100\ Hz}{70\ Hz} = 1{,}43$$

Relay output 1 / Function

CP.31

Relay output 2 / Function

CP.32

CP.31 and CP.32 determine the function of the two outputs.
CP.31 for relay output 1 (terminal X2A.24...X2A.26)
CP.32 for relay output 2 (terminal X2A.27...X2A.29)

The switching level of CP.32 is CP.33!

Value	Function
0	No function (generelly off)
1	Generelly on
2	Run signal; also by DC-braking
3	Ready signal (no error)
4	Fault relay
5	Fault relay (not at under voltage error)
6	Warning or error message at abnormal stopping
7	Overload alert signal
8	Overtemperature alert signal power modules
9	External Overload alert signal motor
10	Only application-mode
11	Excess-temperature alert signal interior OHI
12	Cable breakage 4...20 mA on analog input 1
13	Only application-mode
14	Max. constant current (stall, CP.25) exceeded
15	Max. ramp current (LA-Stop CP.24) exceeded
16	DC-braking active
17-19	Only application-mode
20	Actual value=set value (CP.3=Fcon, rcon; not at noP, LS error,SSF)
21	Accelerate (CP.3 = FAcc, rAcc, LAS)
22	Decelerate (CP.3 = FdEc, rdEc, LdS)
23	Real direction of rotation = set direction of rotation
24	Utilization (CP.6) > 100% (only CP.31)
25	Active current > switching level (only CP.32)
26	Intermediate circuit voltage (CP.7)>switching level (only CP.32)
27	Real value (CP.1) > switching level (only CP.32)
28	Set value (CP.2) > switching level (only CP.32)
29/30	Only application-mode
31	Absolut set value on AN1 > switching level (only CP.32)
32	Absolut set value on AN2 > switching level (only CP.32)
33	Only application-mode
34	Set value on AN1 > switching level (only CP.32)
35	Set value on AN2 > switching level (only CP.32)
36-39	Only application-mode
40	Hardware current limit activated
41	Modulation on-signal
42-43	Only application-mode
44	Inverter status (CP.3) = switching level
45	Power module temperatur > Level
46	Motor temperatur > Level
47	Ramp output frequency > Level
48	Apparent current (CP.4) > Level
49	Clockwise rotation (not at noP, LS, abnormal stopping, Fehler)
50	Counter clockwise (not at noP, LS, abnormal stopping, Fehler)
51-62	Only application-mode
63	Absolut ANOUT1 > switching level
64	Absolut ANOUT2 > switching level
65	ANOUT1 > switching level
66	ANOUT2 > switching level
67-69	Only application-mode
70	Driver voltage activ (Safety relay)
71-72	Only application-mode
73	Absolut active power
74	Active power
75	Only application-mode

Factory setting CP.31:	4
Factory setting CP.32:	27
Note:	Enter-Parameter

Relay output 2 / Switching level

CP.33

This parameter determines the switching point for the relay output 2 (CP.32). After the switching of the relay, the value can move within a window (hysteresis), without the relay dropping off. Since the operator can display only 5 characters, the last digits are not represented in the case of higher values.

Adjustment range:	-30000,00...30000,00
Resolution:	0,01
Factory setting:	4,00
Hysteresis:	
Frequency:	0,5 Hz
Voltage:	1 V
Analog values:	0,5 %
Current:	0,5 A
Temperature	1 °C

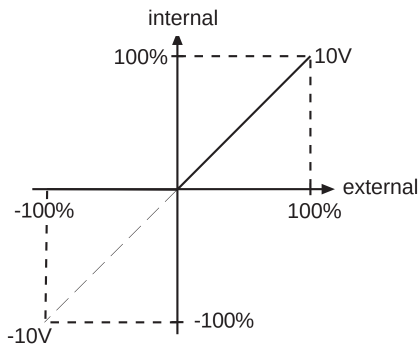
Source of rotation direction

CP.34

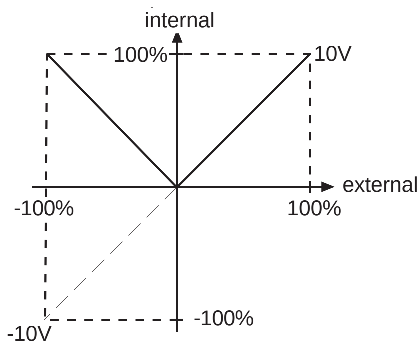
The source rotation setting and the mode of evaluating the rotation setting is defined with this parameter (Enter-Parameter). With CP.34 one does not modify the rotation source of the fixed frequencies (CP.19... 21).

Value	Function
0/1	Only application mode
2	Setting by way of terminal strip forward/reverse; negative set values are set to zero (factory setting)
3	Setting by way of terminal strip forward/reverse; the signs of the setpoint values have no effect on the direction of rotation
4	Setting by way of terminal strip run/stop (X2A.14) and forward/reverse (X2A.15); negative values are set to zero
5	Setting by way of terminal strip run/stop (X2A.14) and forward/reverse; the signs of the setpoint values have no effect on the direction of rotation
6	Set value dependent, positive value - clockwise rotation; negative value-counterclockwise rotation; with set value "0" it is switched into status "Low speed" (LS)
7	Set value dependent, positive value - clockwise rotation; clockwise rotation is indicated
8/9	Only application mode

Set value
0-limited
(Value 2 and 4)



Set value
absolute
(Value 3 and 5)

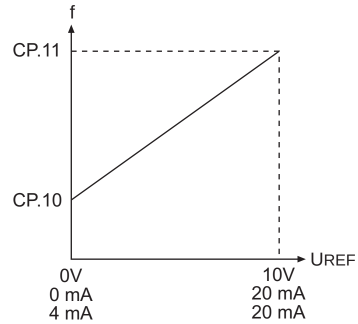


Adjustment range:	0...9
Resolution:	1
Factory setting:	2
Note:	Enter-Parameter

AN1 Interface selection

CP.35

The set value input 1 (AN1) at the F5-GENERAL control can be triggered by various signal levels. In order to correctly evaluate the signal, this parameter must be adapted to the signal source. At F5-BASIC in A- or B-housing the signal source may not be re-adjusted.



Value	Reference signal
0	0...±10 V DC / Ri = 56 kOhm
1	0...±20 mA DC / Ri = 250 Ohm
2	4...20 mA DC / Ri = 250 Ohm

Adjustment range:	0...2
Resolution:	1
Factory setting:	0
Note:	Enter-Parameter

AN1 Zero point hysteresis

CP.36

Through capacitive as well as inductive coupling on the input lines or voltage fluctuations of the signal source, the motor connected to the inverter may start to drift inspite of the analog input filters. It is the function of the zero point hysteresis to suppress this drifting.
With parameter CP.36 the analog signal for the input REF can be faded out in the range of 0...±10%. The adjusted value is valid for both directions of rotation.
If a negative percentage value is adjusted then the hysteresis is not only effective on the zero point but also around the actual set value. Set value changes are accepted only when they are larger than the adjusted hysteresis.

Adjustment range:	-10,0...10,0 %
Resolution:	0,1 %
Factory setting:	0,2 %

4.4 Drive-Mode

The Drive-Mode is a special operating mode of the KEB COMBIVERT. It allows an easy manual start-up. To activate the Drive-Mode enter the password „500" in **'CP.0'** or **'ud.1'**. Following settings are possible:

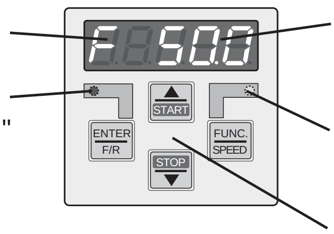
4.4.1 Adjustment Possibilities

– Stop / Start / Run
– Setpoint value
– Direction of rotation

All other settings like setpoint limitation, acceleration time, deceleration time etc. correspond to the preselection in the parameter sets.

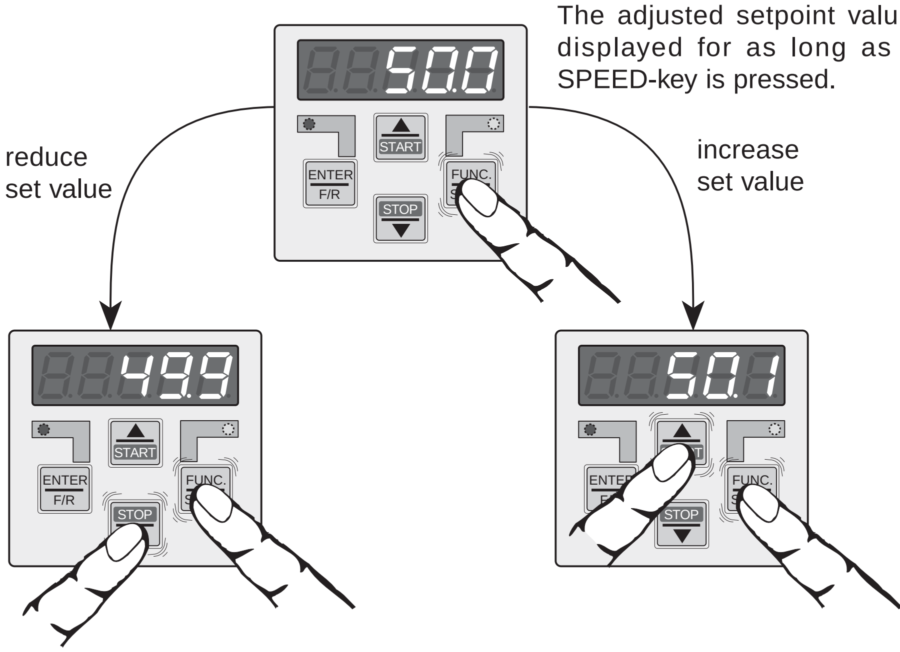
! Hardware condition: The control release must be bridged!

4.4.2 Display and Keyboard



4.4.3 Setpoint Display / Setpoint Input

The adjusted setpoint value is displayed for as long as the SPEED-key is pressed.



Press the SPEED-key and reduce the displayed setpoint value with the DOWN-key.

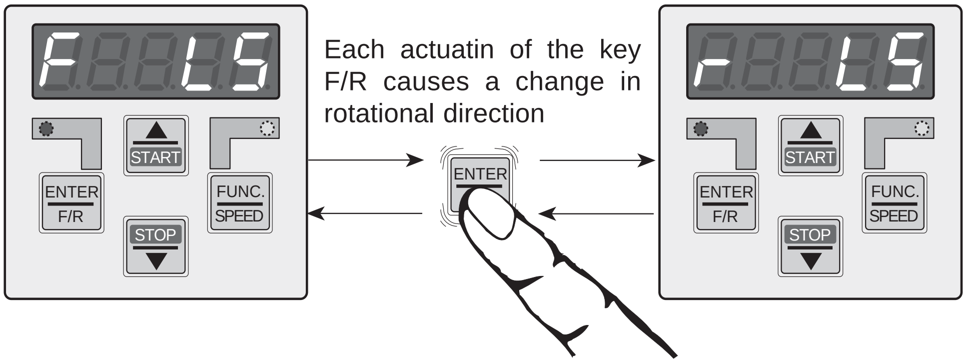
Press the SPEED-key and increase the displayed setpoint value with the UP-key.

The actual set value could be read by bus at Sy.45.

The setpoint entry via keyboard is possible only for parameter ud.9 = 0 (see 4.4.7).

4.4.4 Rotation Setting

Setting possibilities: **F** = forward (clockwise rotation)
r = reverse (counter-clockwise rotation)



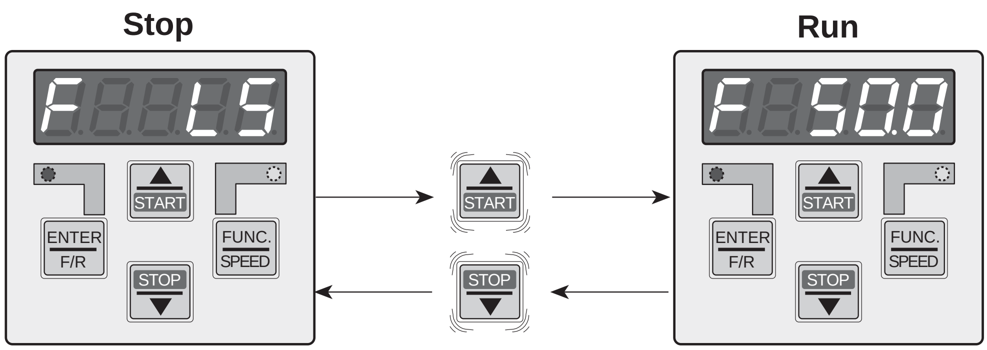
4.4.5 Start / Stop / Run

3 operating states exist in the Drive-Mode:

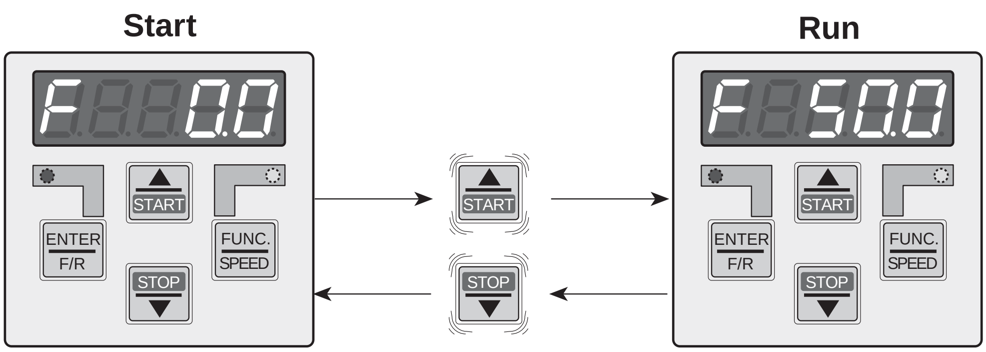
Status „Stop“	Status „Start“	Status „Run“
Power module disconnected, drive is freewheeling (e.g. „F LS“)	Power module is controlled with 0 Hz, drive stands with holding torque (e.g. „F 0.0“)	The drive runs with preselected frequency (e.g. „F 50.0“)

Bit 2 and 3 of the parameter ud.9 determines in what way the keys START and STOP approach the individual operating states:

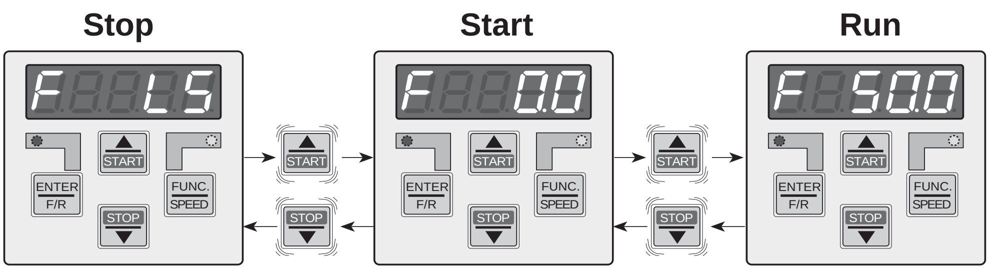
ud. 9 Bit 2, 3 = 0
(default)



ud. 9 Bit 2, 3 = 1

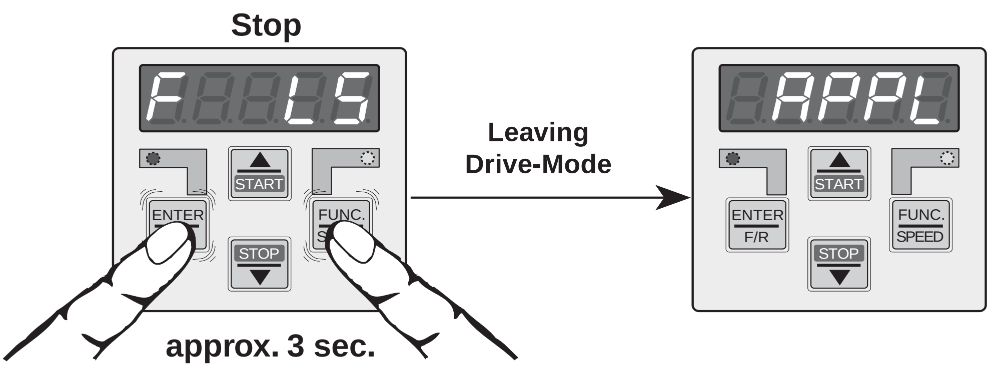


ud. 9 Bit 2, 3 = 2



4.4.6 Leaving the Drive-Mode

To leave the Drive-Mode, the keys „FUNC“ and „ENTER“ must be pressed simultaneously for approx. 3 seconds while being in status „Stop“! The unit jumps back into the mode from where the Drive-Mode was started.



4.4.7 Further Settings

With the Drive-Mode operating mode (ud.9) the setpoint sources and the conditions at starting/stopping can be specified. As setpoint source serves either the keyboard in the Drive-Mode as described under 4.4.3 or the setpoint source selected under parameter oP.0. Refer to 4.4.5 to learn about the different operating conditions at starting / stopping.
The status at starting / stopping (Bit 2 and 3) are only accepted after a restart the drive mode !

Bit 3	Bit 2	Bit 1	Bit 0	Function ud.9
x	x	x	0	Set value setting by keyboard
x	x	x	1	Set value setting by set value source oP.0
x	x	0	x	set value is 0-limited (negativ values = 0)
x	x	1	x	absolut set value settings
0	0	x	x	LS => run
0	1	x	x	0 Hz => run
1	0	x	x	LS => 0 Hz => run
1	1	x	x	reserved

! To avoid undefined conditions, it must be ensured that the minimum frequency (oP.6, oP.7) is set to 0 Hz at the values ud.9 Bit 2, 3 = 1 or 2.

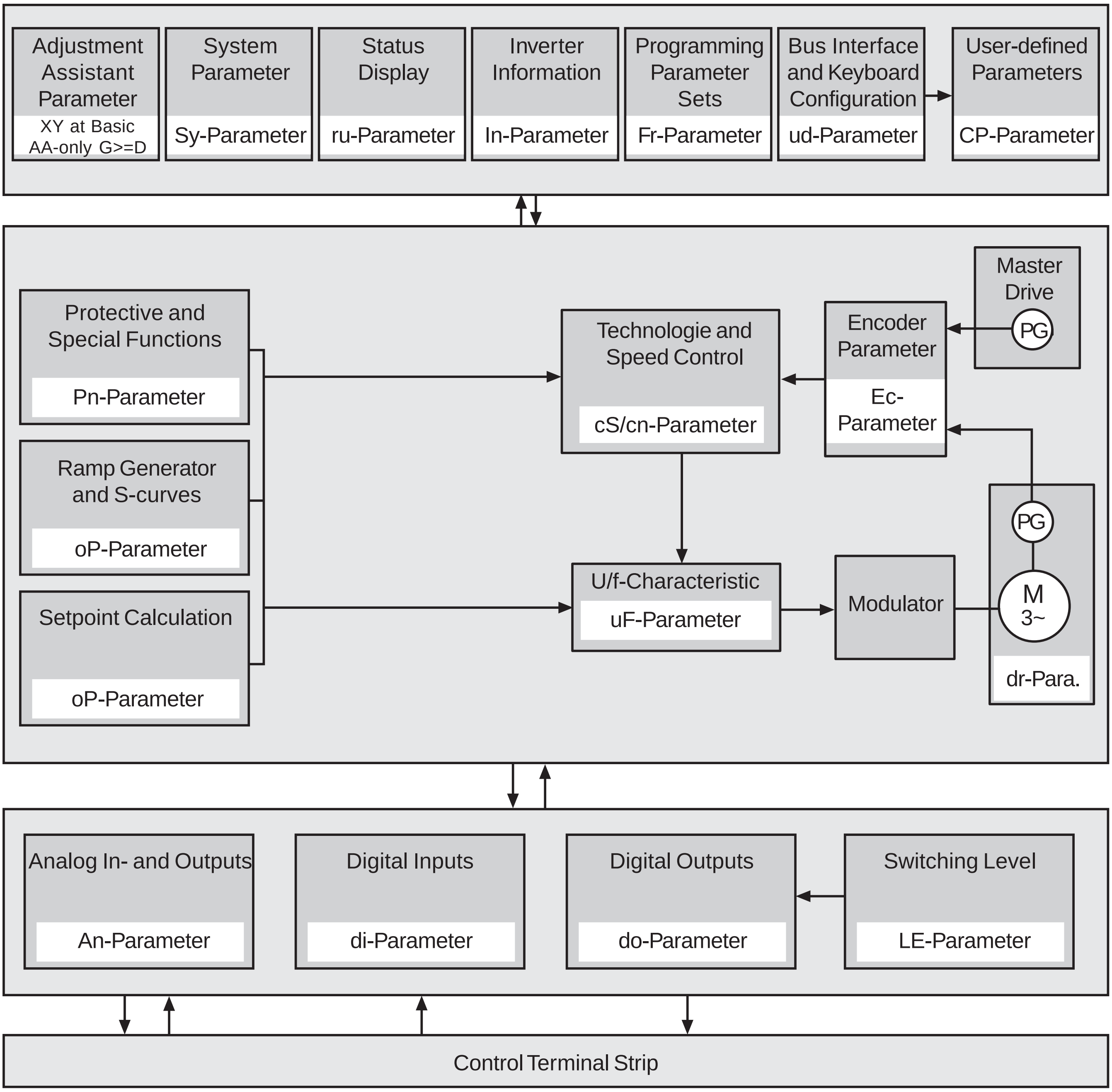
5. Parameter

5.1 Parameter

The frequency inverters KEB COMBIVERT F5-GENERAL and F5-BASIC contains 16 (>= D=housing 17) fixed, one free-to-define parameter group. We have already learned about the free-to-define group (CP). In the fixed parameter groups the parameters are combined function-related.

5.1.1 Parameter Groups

Picture 5.1.1



5.1.2 F5-BASIC Control

This control card is used for all housing sizes. Following parameters are not available with the control F5-BASIC, so they do not need to be considered in the parameter description:

ru 4	encoder 1 frequency
ru 5	encoder 2 frequency
ru 6	calculated act. freq.
ru 7	actual value display
ru 9	encoder 1 speed
ru 10	encoder 2 speed
ru 29	AN2 pre amplifier disp.
ru 30	AN2 post amplifier disp.
ru 31	AN3 pre amplifier disp.
ru 32	AN3 post amplifier disp.
ru 35	ANOUT2 pre ampl. disp.
ru 36	ANOUT2 post ampl. disp.
an 10	AN2 interface selection
an 11	AN2 noise filter
an 12	AN2 save mode
an 13	AN2 save trig. inp. sel.
an 14	AN2 zero clamp
an 15	AN2 gain
an 16	AN2 offset X
an 17	AN2 offset Y
an 18	AN2 lower limit
an 19	AN2 upper limit
an 20	AN3 interface selection
an 21	AN3 noise filter
an 22	AN3 save mode
an 23	AN3 save trig. inp. sel.
an 24	AN3 zero clamp
an 25	AN3 gain
an 26	AN3 offset X
an 27	AN3 offset Y
an 28	AN3 lower limit
an 29	AN3 upper limit
an 36	ANOUT2 function
an 37	ANOUT2 value
an 38	ANOUT2 gain
an 39	ANOUT2 offset X
an 40	ANOUT2 offset Y
di 0	PNP / NPN selection
do 25	inv. flags for O1
do 26	inv. flags for O2
do 33	flag select. for O1
do 34	flag select. forO2
in 8	software version p. unit
in 9	software date p. unit

5.1.3 F5-GENERAL Control B-housing

This control card is used for housing size B. The parameters In.8 and In.9 are only available at this control card.The following parameters are not available, so they do not need to be considered in the parameter description:

ru 4	encoder 1 frequency
ru 5	encoder 2 frequency
ru 6	calculated act. freq.
ru 7	actual value display
ru 9	encoder 1 speed
ru 10	encoder 2 speed
ru 31	AN3 pre amplifier disp.
ru 32	AN3 post amplifier disp.
op 44	ext. funct. mode/src
op 45	ext. funct. dig. source
op 46	ext. funct. acc/dec time
op 47	sweep-gen. acc. time
op 48	sweep-gen. dec. time
op 49	diam. corr. dmin/dmax
op 51	motorpoti destination
an 20	AN3 interface selection
an 21	AN3 noise filter
an 22	AN3 save mode
an 23	AN3 save trig. inp. sel.
an 24	AN3 zero clamp
an 25	AN3 gain
an 26	AN3 offset X
an 27	AN3 offset Y
an 28	AN3 lower limit
an 29	AN3 upper limit
in 5	interface type
in 17	temp.- mode
cs 1	act. source
dr 3	DASM rated power
ec 0	encoder 1 interface
ec 1	encoder 1 (inc/r)
ec 3	time 1 for speed calc.
ec 4	gear 1 numerator
ec 5	gear 1 determinator
ec 6	enc.1 rotation
ec 7	enc.1 trigger
ec 10	encoder 2 interface
ec 11	encoder 2 (inc/r)
ec 13	time 2 for speed calc.
ec 14	gear 2 numerator
ec 15	gear 2 determinator
ec 16	enc.2 rotation
ec 17	enc.2 trigger
ec 20	enc.2 operating mode
ec 21	SSI multiturn res.
ec 22	SSI clock frq. sel.
ec 23	SSI data code
ec 25	nominal tacho speed
ec 27	operation mode output
aa 14	evaluation para 1
aa 15	evaluation para 2
aa 16	evaluation para 3
aa 17	evaluation para 4
aa 18	evaluation para 5
aa 19	evaluation para 6
aa 20	evaluation para 7
aa 21	evaluation para 8
aa 22	evaluation para 9
aa 23	evaluation para 10
aa 24	evaluation para 11
aa 25	evaluation para 12

5.1.4 F5-GENERAL Control >= D-housing

This control card is used for housing size D and upwards. The control comprises the entire parameters (except In.8 / In.9 and ud.5) and functions, that are described in this instruction manual.

5.1.5 Parameter Listing

Legend

Parameter: Parameter group, number and name
Adr.: Parameter address
Control: shows on in which control the appropriate parameter is present
B => F5-Basic; C => F5-COMPACT; g => F5-General ; G => F5-General >= D-housing;
M => F5-Multi, S => F5-Servo; A => F5-Servo at A-housing
Properties: R => read only; P => programmable; E => Enter parameter; V => variable resolution (dep. on ud.2)
min.: Min. value (normalized); the non-normalized value results on division by the step range
max.: Max. value (normalized); the non-normalized value results on division by the step range
Step: Step range
default: Default value (normalized); the non-normalized value results on division by the step range
[?]: Unit of measure
See on page: Additional informations for this parameter on page ... (not chapter)

Parameter	Adr.	Control							Properties				min.	max.	Step	default	[?]	See on page
		B	C	g	G	M	S	A	R	P	E	V						
an 0 AN1 interface selection	0A00	B	C	g	G	M	S	A	-	-	E	-	0	2	1	0	-	6.2.4
an 1 AN1 noise filter	0A01	B	C	g	G	M	S	A	-	-	E	-	0	4	1	0	-	6.2.5
an 2 AN1 save mode	0A02	B	C	g	G	M	S	A	-	-	E	-	0	3	1	0	-	6.2.5
an 3 AN1 save trig. inp. sel.	0A03	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	0	-	6.2.5
an 4 AN1 zero clamp	0A04	B	C	g	G	M	S	A	-	-	-	-	-10,0	10,0	0,1	0,2	%	6.2.6
an 5 AN1 gain	0A05	B	C	g	G	M	S	A	-	P	-	-	-20,00	20,00	0,01	1,00	-	6.2.7
an 6 AN1 offset X	0A06	B	C	g	G	M	S	A	-	P	-	-	-100,0	100,0	0,1	0,0	%	6.2.7
an 7 AN1 offset Y	0A07	B	C	g	G	M	S	A	-	P	-	-	-100,0	100,0	0,1	0,0	%	6.2.7
an 8 AN1 lower limit	0A08	B	C	g	G	M	S	A	-	P	-	-	-400,0	400,0	0,1	-400,0	%	6.2.8
an 9 AN1 upper limit	0A09	B	C	g	G	M	S	A	-	P	-	-	-400,0	400,0	0,1	400,0	%	6.2.8
an10 AN2 interface selection	0A0A	-	C	g	G	M	S	-	-	-	E	-	0	2	1	0	-	6.2.4
an11 AN2 noise filter	0A0B	-	C	g	G	M	S	-	-	-	E	-	0	4	1	0	-	6.2.5
an12 AN2 save mode	0A0C	-	C	g	G	M	S	-	-	-	E	-	0	3	1	0	-	6.2.5
an13 AN2 save trig. inp. sel.	0A0D	-	C	g	G	M	S	-	-	-	E	-	0	4095	1	0	-	6.2.5
an14 AN2 zero clamp	0A0E	-	C	g	G	M	S	-	-	-	-	-	-10,0	10,0	0,1	0,2	%	6.2.6
an15 AN2 zero clamp	0A0F	-	C	g	G	M	S	-	-	P	-	-	-20,00	20,00	0,01	1,00	-	6.2.7
an16 AN2 offset X	0A10	-	C	g	G	M	S	-	-	P	-	-	-100,0	100,0	0,1	0,0	%	6.2.7
an17 AN2 offset Y	0A11	-	C	g	G	M	S	-	-	P	-	-	-100,0	100,0	0,1	0,0	%	6.2.7
an18 AN2 lower limit	0A12	-	C	g	G	-	-	-	-	P	-	-	-400,0	400,0	0,1	-400,0	%	6.2.8
an19 AN2 upper limit	0A13	-	C	g	G	M	S	-	-	P	-	-	-400,0	400,0	0,1	400,0	%	6.2.8
an20 AN3 interface selection	0A14	-	-	-	G	M	S	-	-	-	E	-	0	1	1	0	-	6.2.4
an21 AN3 noise filter	0A15	-	-	-	G	M	S	-	-	-	E	-	0	4	1	0	-	6.2.5
an22 AN3 save mode	0A16	-	-	-	G	M	S	-	-	-	E	-	0	3	1	0	-	6.2.5
an23 AN3 save trig. inp. sel.	0A17	-	-	-	G	M	S	-	-	-	E	-	0	4095	1	0	-	6.2.5
an24 AN3 zero clamp	0A18	-	-	-	G	M	S	-	-	-	-	-	-10,0	10,0	0,1	0,0	%	6.2.6
an25 AN3 gain	0A19	-	-	-	G	M	S	-	-	P	-	-	-20,00	20,00	0,01	1,00	-	6.2.7
an26 AN3 offset X	0A1A	-	-	-	G	M	S	-	-	P	-	-	-100,0	100,0	0,1	0,0	%	6.2.7
an27 AN3 offset Y	0A1B	-	-	-	G	M	S	-	-	P	-	-	-100,0	100,0	0,1	0,0	%	6.2.7
an28 AN3 lower limit	0A1C	-	-	-	G	M	S	-	-	P	-	-	-400,0	400,0	0,1	-400,0	%	6.2.8
an29 AN3 upper limit	0A1D	-	-	-	G	M	S	-	-	P	-	-	-400,0	400,0	0,1	400,0	%	6.2.8
an30 sel.REF inp./AUX-funct.	0A1E	-	C	-	G	M	S	A	-	P	E	-	0	65535	1	2112	-	6.2.9
an30 sel.REF inp./AUX-funct.	0A1E	B	-	g	-	-	-	-	-	P	E	-	0	1	1	1	-	6.2.9
an31 ANOUT1 function	0A1F	B	C	g	G	M	S	A	-	P	E	-	0	20	1	2	-	6.2.11
an32 ANOUT1 value	0A20	B	C	g	G	M	S	A	-	P	-	-	-100,0	100,0	0,1	0,0	%	6.2.13
an33 ANOUT1 gain	0A21	B	C	g	G	M	S	A	-	P	-	-	-20,00	20,00	0,01	1,00	-	6.2.12
an34 ANOUT1 offset X	0A22	B	C	g	G	M	S	A	-	P	-	-	-100,0	100,0	0,1	0,0	%	6.2.12
an35 ANOUT1 offset Y	0A23	B	C	g	G	M	S	A	-	P	-	-	-100,0	100,0	0,1	0,0	%	6.2.12
an36 ANOUT2 function	0A24	-	C	g	G	M	S	-	-	P	E	-	0	20	1	6	-	6.2.11
an37 ANOUT2 value	0A25	-	C	g	G	M	S	-	-	P	-	-	-100,0	100,0	0,1	0,0	%	6.2.13
an38 ANOUT2 gain	0A26	-	C	g	G	M	S	-	-	P	-	-	-20,00	20,00	0,01	1,00	-	6.2.12
an39 ANOUT2 offset X	0A27	-	C	g	G	M	S	-	-	P	-	-	-100,0	100,0	0,1	0,0	%	6.2.12
an40 ANOUT2 offset Y	0A28	-	C	g	G	M	S	-	-	P	-	-	-100,0	100,0	0,1	0,0	%	6.2.12
an41 ANOUT3 function	0A29	B	C	g	G	M	S	-	-	-	E	-	0	20	1	12	-	6.2.11
an42 ANOUT3 value	0A2A	B	C	g	G	M	S	-	-	-	-	-	-100,0	100,0	0,1	0,0	%	6.2.13
an43 ANOUT3 gain	0A2B	B	C	g	G	M	S	-	-	-	-	-	-20,00	20,00	0,01	1,00	-	6.2.12
an44 ANOUT3 offset X	0A2C	B	C	g	G	M	S	-	-	-	-	-	-100,0	100,0	0,1	0,0	%	6.2.12
an45 ANOUT3 offset Y	0A2D	B	C	g	G	M	S	-	-	-	-	-	-100,0	100,0	0,1	0,0	%	6.2.12
an46 ANOUT3 period	0A2E	B	C	g	G	M	S	-	-	-	E	-	0	240	1	0	s	6.2.13
an47 ANOUT4 function	0A2F	-	C	-	G	M	S	-	-	-	E	-	0	20	1	12	-	6.2.11
an48 ANOUT4 value	0A30	-	C	-	G	M	S	-	-	-	-	-	-100,0	100,0	0,1	0,0	%	6.2.13
an49 ANOUT4 gain	0A31	-	C	-	G	M	S	-	-	-	-	-	-20,00	20,00	0,01	1,00	-	6.2.12
an50 ANOUT4 offset X	0A32	-	C	-	G	M	S	-	-	-	-	-	-100,0	100,0	0,1	0,0	%	6.2.12
an51 ANOUT4 offset Y	0A33	-	C	-	G	M	S	-	-	-	-	-	-100,0	100,0	0,1	0,0	%	6.2.12

Parameter	Adr.	Control							Properties				min.	max.	Step	default	[?]	see on Page
an 52 ANOUT4 period	0A34	-	C	-	G	M	S	-	-	-	E	-	0	240	1	0	s	6.2.13
an 53 analog para setting mode	0A35	-	-	-	G	M	S	A	-	-	E	-	0	1	1	0	-	6.9.34
an 54 an. para setting dest.	0A36	-	-	-	G	M	S	A	-	-	E	-	-1	7FFFH	1	-1	hex	6.9.34
an 55 an. para setting offset	0A37	-	-	-	G	M	S	A	-	-	-	-	-2^31	2^31-1	1	0	-	6.9.34
an 56 an. para set. max. value	0A38	-	-	-	G	M	S	A	-	-	-	-	-2^31	2^31-1	1	0	-	6.9.34
cn 0 PID reference source	07 00	B	C	g	G	M	S	A	-	P	-	-	0	4	1	0	-	6.12.5
cn 1 PID abs. reference	07 01	B	C	g	G	M	S	A	-	P	-	-	-400,0	400,0	0,1	0,0	%	6.12.5
cn 2 PID act. value src.	07 02	B	C	g	G	M	S	A	-	P	-	-	0	7	1	0	-	6.12.6
cn 3 PID abs. act. value	07 03	B	C	g	G	M	S	A	-	-	-	-	-400,0	400,0	0,1	0,0	%	6.12.6
cn 4 PID kp	07 04	B	C	g	G	M	S	A	-	P	-	-	0,00	250,00	0,01	0,00	-	6.12.3
cn 5 PID ki	07 05	B	C	g	G	M	S	A	-	P	-	-	0,000	30,000	0,001	0,000	-	6.12.3
cn 6 PID kd	07 06	B	C	g	G	M	S	A	-	P	-	-	0,00	250,00	0,01	0,00	-	6.12.3
cn 7 PID pos. limit	07 07	B	C	g	G	M	S	A	-	P	-	-	-400,0	400,0	0,1	400,0	%	6.12.3
cn 8 PID neg. limit	07 08	B	C	g	G	M	S	A	-	P	-	-	-400,0	400,0	0,1	-400,0	%	6.12.3
cn 9 PID fading time	07 09	B	C	g	G	M	S	A	-	P	-	-	-0,01	300,00	0,01	0,00	s	6.12.3
cn 10 PID reset condition	07 0A	B	C	g	G	M	S	A	-	P	-	-	0	2	1	0	-	6.12.4
cn 11 PID reset inp. sel.	07 0B	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	0	-	6.12.4, 6.3.8
cn 12 I reset inp. sel.	07 0C	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	0	-	6.12.4, 6.3.8
cn 13 fade in reset inp. sel.	07 0D	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	0	-	6.12.4, 6.3.8
cn 14 PID out freq at 100%	07 0E	B	C	g	G	-	-	A	-	P	-	V	-400	400	0,0125	0	Hz	6.12.4
cs 0 speed control config.	0F 00	B	C	g	G	-	-	-	-	P	-	-	0	63	1	0	-	6.11.5
9.20 cs 1 act. source	0F 01	-	-	-	G	-	-	-	-	P	-	-	0	2	1	2	-	6.11.5
cs 4 speed ctrl. freq. limit	0F 04	B	C	g	G	-	-	A	-	P	-	V	0	200	0,0125	25	Hz	6.11.5
cs 6 KP speed	0F 06	B	C	g	G	-	-	A	-	P	-	-	0	32767	1	50	-	6.6.14
cs 9 KI speed	0F 09	B	C	g	G	-	-	A	-	P	-	-	0	32767	1	500	-	6.6.14
di 0 PNP / NPN selection	0B00	-	C	g	G	M	S	A	-	-	E	-	0	SHR	1	0	-	6.3.3
di 1 select signal source	0B01	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	0	-	6.3.4
di 2 digital input setting	0B02	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	0	-	6.3.4
di 3 digital noise filter	0B03	B	C	g	G	M	S	A	-	-	E	-	0	127	1	0	ms	6.3.5
di 4 input logic	0B04	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	0	-	6.3.5
di 5 input trigger	0B05	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	0	-	6.3.5
di 6 select strobe source	0B06	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	0	-	6.3.6
di 7 strobe mode	0B07	B	C	g	G	M	S	A	-	-	E	-	0	2	1	0	-	6.3.7
di 8 input strobe dependence	0B08	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	0	-	6.3.6
di 9 reset input selection	0B09	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	3	-	6.3.8
di 10 reset input slope sel.	0B0A	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	3	-	6.3.8
di 11 I1 functions	0B0B	B	C	g	G	M	S	A	-	-	E	-	0	H'3FFFFFFF	1	1	hex	6.3.9
di 12 I2 functions	0B0C	B	C	g	G	M	S	A	-	-	E	-	0	H'3FFFFFFF	1	2	hex	6.3.9
di 13 I3 functions	0B0D	B	C	g	G	M	S	A	-	-	E	-	0	H'3FFFFFFF	1	8192	hex	6.3.9
di 14 I4 functions	0B0E	B	C	g	G	-	-	-	-	-	E	-	0	H'3FFFFFFF	1	512	hex	6.3.9
di 15 IA functions	0B0F	B	C	g	G	M	S	A	-	-	E	-	0	H'3FFFFFFF	1	0	hex	6.3.9
di 16 IB functions	0B10	B	C	g	G	M	S	A	-	-	E	-	0	H'3FFFFFFF	1	0	hex	6.3.9
di 17 IC functions	0B11	B	C	g	G	M	S	A	-	-	E	-	0	H'3FFFFFFF	1	0	hex	6.3.9
di 18 ID functions	0B12	B	C	g	G	M	S	A	-	-	E	-	0	H'3FFFFFFF	1	0	hex	6.3.9
di 19 F functions	0B13	B	C	g	G	M	S	-	-	-	E	-	0	H'3FFFFFFF	1	32	hex	6.3.9
di 20 R functions	0B14	B	C	g	G	M	S	-	-	-	E	-	0	H'3FFFFFFF	1	64	hex	6.3.9
di 21 RST functions	0B15	B	C	g	G	M	S	-	-	-	E	-	0	H'3FFFFFFF	1	128	hex	6.3.9
di 22 ST functions	0B16	B	C	g	G	M	S	A	-	-	E	-	0	H'3FFFFFFF	1	128	hex	6.3.9
do 0 condition 0	0C00	B	C	g	G	M	S	A	-	P	E	-	0	68	1	20	-	6.3.13
do 1 condition 1	0C01	B	C	g	G	M	S	A	-	P	E	-	0	68	1	3	-	6.3.13
do 2 condition 2	0C02	B	C	g	G	M	S	A	-	P	E	-	0	68	1	4	-	6.3.13
do 3 condition 3	0C03	B	C	g	G	-	-	-	-	P	E	-	0	68	1	27	-	6.3.13
do 4 condition 4	0C04	B	C	g	G	M	S	A	-	P	E	-	0	68	1	0	-	6.3.13
do 5 condition 5	0C05	B	C	g	G	M	S	A	-	P	E	-	0	68	1	0	-	6.3.13
do 6 condition 6	0C06	B	C	g	G	M	S	A	-	P	E	-	0	68	1	0	-	6.3.13
do 7 condition 7	0C07	B	C	g	G	M	S	A	-	P	E	-	0	68	1	0	-	6.3.13
do 8 inv. cond. for flag 0	0C08	B	C	g	G	M	S	A	-	P	E	-	0	255	1	0	-	6.3.16
do 9 inv. cond. for flag 1	0C09	B	C	g	G	M	S	A	-	P	E	-	0	255	1	0	-	6.3.16
do 10 inv. cond. for flag 2	0C0A	B	C	g	G	M	S	A	-	P	E	-	0	255	1	0	-	6.3.16
do 11 inv. cond. for flag 3	0C0B	B	C	g	G	M	S	A	-	P	E	-	0	255	1	0	-	6.3.16
do 12 inv. cond. for flag 4	0C0C	B	C	g	G	M	S	A	-	P	E	-	0	255	1	0	-	6.3.16
do 13 inv. cond. for flag 5	0C0D	B	C	g	G	M	S	A	-	P	E	-	0	255	1	0	-	6.3.16
do 14 inv. cond. for flagr 6	0C0E	B	C	g	G	M	S	A	-	P	E	-	0	255	1	0	-	6.3.16
do 15 inv. cond. for flag 7	0C0F	B	C	g	G	M	S	A	-	P	E	-	0	255	1	0	-	6.3.16
do 16 cond. select. for flag 0	0C10	B	C	g	G	M	S	A	-	P	E	-	0	255	1	1	-	6.3.16
do 17 cond. select. for flag 1	0C11	B	C	g	G	M	S	A	-	P	E	-	0	255	1	2	-	6.3.16
do 18 cond. select. for flag 2	0C12	B	C	g	G	M	S	A	-	P	E	-	0	255	1	4	-	6.3.16
do 19 cond. select. for flag 3	0C13	B	C	g	G	M	S	A	-	P	E	-	0	255	1	8	-	6.3.16
do 20 cond. select. for flag 4	0C14	B	C	g	G	M	S	A	-	P	E	-	0	255	1	16	-	6.3.16
do 21 cond. select. for flag 5	0C15	B	C	g	G	M	S	A	-	P	E	-	0	255	1	32	-	6.3.16
do 22 cond. select. for flag 6	0C16	B	C	g	G	M	S	A	-	P	E	-	0	255	1	64	-	6.3.16
do 23 cond. select. for flag 7	0C17	B	C	g	G	M	S	A	-	P	E	-	0	255	1	128	-	6.3.16
do 24 AND conn. for flags	0C18	B	C	g	G	M	S	A	-	P	E	-	0	255	1	0	-	6.3.16
do 25 inv. flags for O1	0C19	-	C	g	G	M	S	A	-	P	E	-	0	255	1	0	-	6.3.17
do 26 inv. flags for O2	0C1A	-	C	g	G	M	S	A	-	P	E	-	0	255	1	0	-	6.3.17
do 27 inv. flags for R1	0C1B	B	C	g	G	M	S	A	-	P	E	-	0	255	1	0	-	6.3.17
do 28 inv. flags for R2	0C1C	B	C	g	G	M	S	-	-	P	E	-	0	255	1	0	-	6.3.17

Parameter	Adr.	Control	Properties	min.	max.	Step	default	[?]	see on Page
do29 inv. flags for OA	0C1D	B C g G M S A	- P E -	0	255	1	0	-	6.3.17
do30 inv. flags for OB	0C1E	B C g G M S A	- P E -	0	255	1	0	-	6.3.17
do31 inv. flags for OC	0C1F	B C g G M S A	- P E -	0	255	1	0	-	6.3.17
do32 inv. flags for OD	0C20	B C g G M S A	- P E -	0	255	1	0	-	6.3.17
do33 flag select. for O1	0C21	- C g G M S A	- P E -	0	255	1	1	-	6.3.17
do34 flag select. for O2	0C22	- C g G M S A	- P E -	0	255	1	2	-	6.3.17
do35 flag select. for R1	0C23	B C g G M S A	- P E -	0	255	1	4	-	6.3.17
do36 flag select. for R2	0C24	B C g G M S -	- P E -	0	255	1	8	-	6.3.17
do37 flag select. for OA	0C25	B C g G M S A	- P E -	0	255	1	16	-	6.3.17
do38 flag select. for OB	0C26	B C g G M S A	- P E -	0	255	1	32	-	6.3.17
do39 flag select. for OC	0C27	B C g G M S A	- P E -	0	255	1	64	-	6.3.17
do40 flag select. for OD	0C28	B C g G M S A	- P E -	0	255	1	128	-	6.3.17
do41 AND conn. for outputs	0C29	B C g G M S A	- P E -	0	255	1	0	-	6.3.17
do42 inverted outputs	0C2A	B C g G M S A	- P E -	0	255	1	0	-	6.3.18
do43 cond. 0 filter time	0C2B	- C - G M S A	- P - -	0	1000	1	0	ms	6.3.12
do44 cond. 1 filter time	0C2C	- C - G M S A	- P - -	0	1000	1	0	ms	6.3.12
do51 hardw. outp. allocation	0C33	- C - G M S A	- P - -	0	255	1	228	-	
dr 0 DASM rated current	06 00	B C g G M - A	- P - -	0,0	710	0,1	LTK	A	6.6.3
dr 1 DASM rated speed	06 01	B C g G M - A	- P - -	0	64000	1	LTK	rpm	6.6.3
dr 2 DASM rated voltage	06 02	B - g G M - A	- P - -	120	500	1	LTK	V	6.6.3
dr 3 DASM rated power	06 03	- C - G M - A	- P - -	0,35	400,00	0,01	LTK	kW	6.6.3
dr 4 DASM rated cos(phi)	06 04	B C g G M - A	- P - -	0,50	1,00	0,01	LTK	-	6.6.3
dr 5 DASM rated frequency	06 05	B C g G M - A	- P - -	0,0	1600,0	0,1	LTK	Hz	6.6.3
dr 6 DASM stator resistance	06 06	B C g G M - A	- P - -	0,000	50,000	0,001	LTK	Ohm	6.6.4
dr 9 breakdown factor	06 09	B C g G - - A	- P - -	0,5	4,0	0,1	2,5	-	
dr 11 motorprotection mode	06 0B	B C g G M - A	- P - -	0	1	1	1	-	6.7.16
dr 12 motorprot. rated current	06 0C	B C g G M - A	- P - -	0,0	710,0	0,1	LTK	A	6.7.16
ec 0 encoder 1 interface	10 00	- - - G M S A	- - X -	-127	127	1	GBK	-	6.10.10
ec 1 encoder 1 (inc/r)	10 01	- - - G M S A	- - - -	GBK	GBK	1	GBK	inc	6.10.10
ec 3 time 1 for speed calc.	10 03	- - - G M S A	- - - -	0	9	1	3	-	6.10.10
ec 4 gear 1 numerator	10 04	- - - G M S A	- - - -	-10000	10000	1	1000	-	6.10.11
ec 5 gear 1 determinator	10 05	- - - G M S A	- - - -	1	10000	1	1000	-	6.10.11
ec 6 enc.1 rotation	10 06	- - - G M S A	- - - -	0	19	1	0	-	6.10.11
ec 7 enc.1 trigger	10 07	- - - G M S -	- - - -	GBK	GBK	1	GBK	-	6.10.11
ec10 encoder 2 interface	10 0A	- - - G M S A	- - X -	-127	127	1	GBK	-	6.10.6, 6.10.10
ec11 encoder 2 (inc/r)	10 0B	- - - G M S A	- - - -	GBK	GBK	1	GBK	inc	6.10.10
ec13 time 2 for speed calc.	10 0D	- - - G M S A	- - - -	0	9	1	3	-	6.10.10
ec14 gear 2 numerator	10 0E	- - - G M S A	- - - -	-10000	10000	1	1000	-	6.10.11
ec15 gear 2 determinator	10 0F	- - - G M S A	- - - -	1	10000	1	1000	-	6.10.11
ec16 enc.2 rotation	10 10	- - - G M S A	- - - -	0	19	1	0	-	6.10.11
ec17 enc.2 trigger	10 11	- - - G M S -	- - - -	GBK	GBK	1	GBK	-	6.10.11
ec20 enc.2 operating mode	10 14	- - - G M S A	- - - -	0	1	1	0	-	6.10.7
ec21 SSI multiturn res.	10 15	- - - G M S -	- - - -	0	13	1	12	-	6.10.13
ec22 SSI clock frq. sel.	10 16	- - - G M S -	- - - -	0	1	1	0	-	6.10.13
ec23 SSI data code	10 17	- - - G M S -	- - - -	0	1	1	1	-	6.10.13
ec25 nominal tacho speed	10 19	- - - G M S -	- - - -	1	16000	1	1500	rpm	6.10.13
ec27 operation mode output	10 1A	- - - G M S -	- - E -	0	47	1	0	-	6.10.12
ec31 abs. position ch1	10 1F	- - - G M S A	- - - -	-2^31	2^31-1	1	0	inc	6.10.13
ec32 abs. position ch2	10 20	- - - G M S -	- - - -	-2^31	2^31-1	1	0	inc	6.10.13
ec36 enc.1 encoder type	10 24	- - - G M S -	- - - -	0	255	1	0	-	6.10.13
ec37 enc.1 encoder status	10 25	- - - G M S -	- - - -	0	255	1	0	-	6.10.13
ec38 enc.1 encoder r/w	10 26	- - - G M S -	- - E -	0	2	1	0	-	6.10.13
fr 1 copy parameter set	09 01	B C g G M S A	- P E -	-4	7	1	0	-	6.8.4
fr 2 parameter set source	09 02	B C g G M S A	- - E -	0	5	1	0	-	6.8.5
fr 3 parameter set lock	09 03	B C g G M S A	- - E -	0	255	1	0	-	6.8.8
fr 4 parameter set setting	09 04	B C g G M S A	- - E -	0	7	1	0	-	6.8.5
fr 5 set activation delay	09 05	B C g G M S A	- P - -	0,00	2,55	0,01	0,00	s	6.8.8, 6.9.31
fr 6 set deactivation delay	09 06	B C g G M S A	- P - -	0,00	2,55	0,01	0,00	s	6.8.8, 6.9.31
fr 7 paraset input sel.	09 07	B C g G M S A	- - E -	0	4095	1	0	-	6.8.6, 6.3.8
fr 8 motor set classification	09 08	B C g G M - A	- P - -	0	7	1	0	-	6.7.14
fr 9 bus parameter set	09 09	B C g G M S A	- - - -	-1	7	1	0	-	6.8.4
fr 10 load mot.dependent para.	09 0A	- C - G - - -	- P E -	3	3	1	3	-	6.6.6
fr 11 reset set input sel.	09 0B	B C g G M S A	- - E -	0	4095	1	0	-	6.8.7, 6.3.8
in 0 inverter type	0E00	B C g G M S A	R - - -	LTK	LTK	1	LTK	hex	6.1.19
in 1 rated inverter current	0E01	B C g G M S A	R - - -	LTK	LTK	0,1	LTK	A	6.1.19
in 3 max. carrier frequency	0E03	B C g G M S A	R - - -	LTK	LTK	1	LTK	-	6.1.20
in 4 rated carrier frequency	0E04	B C g G M S A	R - - -	LTK	LTK	1	LTK	-	6.1.20
in 6 software version	0E06	B C g G M S A	R - - -	SW	SW	0,01	SW	-	6.1.20
in 7 software date	0E07	B C g G M S A	R - - -	SW	SW	0,1	SW	-	6.1.20
in 8 software version p. unit	0E08	- - g - - - -	R - - -	LTK	LTK	1	LTK	-	
in 9 software date p. unit	0E09	- - g - - - -	R - - -	LTK	LTK	1	LTK	-	
in 10 serial no. (date)	0E0A	B C g G M S A	R - - -	0	65535	1	0	-	6.1.21
in 11 serial no. (count)	0E0B	B C g G M S A	R - - -	0	65535	1	0	-	6.1.21
in 12 serial no. (AB-no. high)	0E0C	B C g G M S A	R - - -	0	65535	1	0	-	6.1.21
in 13 serial no. (AB-no. low)	0E0D	B C g G M S A	R - - -	0	65535	1	0	-	6.1.21
in 14 customer no. high	0E0E	B C g G M S A	R - - -	0	65535	1	0	-	6.1.21
in.15 customer no. low	0E0F	B C g G M S A	R - - -	0	65535	1	0	-	6.1.21

Parameter	Adr.	Control							Properties				min.	max.	Step	default	[?]	see on Page
in 16 QS no.	0E10	B	C	g	G	M	S	A	R	-	-	-	0	65535	1	0	-	6.1.21
in 17 temp.- mode	0E11	-	-	-	G	M	S	A	R	-	-	-	LTK	LTK	1	LTK	-	6.1.21
in 22 user parameter 1	0E16	B	C	g	G	M	S	A	-	-	-	-	0	65535	1	0	-	6.1.21
in 23 user parameter 2	0E17	B	C	g	G	M	S	A	-	-	-	-	0	65535	1	0	-	6.1.21
in 24 last error	0E18	B	C	g	G	M	S	A	R	-	E	-	0	255	-	0	-	6.1.21
in 25 error diagnosis	0E19	B	C	g	G	M	S	A	R	P	-	-	0	65535	1	0	hex	6.1.22
in 26 E.OC error counter	0E1A	B	C	g	G	M	S	A	R	-	-	-	0	65535	1	0	-	6.1.22
in 27 E.OL error counter	0E1B	B	C	g	G	M	S	A	R	-	-	-	0	65535	1	0	-	6.1.22
in 28 E.OP error counter	0E1C	B	C	g	G	M	S	A	R	-	-	-	0	65535	1	0	-	6.1.22
in 29 E.OH error counter	0E1D	B	C	g	G	M	S	A	R	-	-	-	0	65535	1	0	-	6.1.22
in 30 E.OHI error counter	0E1E	B	C	g	G	M	S	A	R	-	-	-	0	65535	1	0	-	6.1.22
le 0 comparison level 0	0D00	B	C	g	G	-	-	-	-	P	-	-	-30000,00	30000,00	0,01	0,00	-	6.3.15, 6.9.13
le 1 comparison level 1	0D01	B	C	g	G	-	-	-	-	P	-	-	-30000,00	30000,00	0,01	0,00	-	6.3.15, 6.9.13
le 2 comparison level 2	0D02	B	C	g	G	-	-	-	-	P	-	-	-30000,00	30000,00	0,01	100,00	-	6.3.15, 6.9.13
le 3 comparison level 3	0D03	B	C	g	G	-	-	-	-	P	-	-	-30000,00	30000,00	0,01	4,00	-	6.3.15, 6.9.13
le 4 comparison level 4	0D04	B	C	g	G	-	-	-	-	P	-	-	-30000,00	30000,00	0,01	0,00	-	6.3.15, 6.9.13
le 5 comparison level 5	0D05	B	C	g	G	-	-	-	-	P	-	-	-30000,00	30000,00	0,01	0,00	-	6.3.15, 6.9.13
le 6 comparison level 6	0D06	B	C	g	G	-	-	-	-	P	-	-	-30000,00	30000,00	0,01	0,00	-	6.3.15, 6.9.13
le 7 comparison level 7	0D07	B	C	g	G	-	-	-	-	P	-	-	-30000,00	30000,00	0,01	0,00	-	6.3.15, 6.9.13
le 8 hysteresis 0	0D08	B	C	g	G	M	S	A	-	P	-	-	0,00	300,00	0,01	0,00	-	6.3.15
le 9 hysteresis 1	0D09	B	C	g	G	M	S	A	-	P	-	-	0,00	300,00	0,01	0,00	-	6.3.15
le 10 hysteresis 2	0D0A	B	C	g	G	M	S	A	-	P	-	-	0,00	300,00	0,01	5,00	-	6.3.15
le 11 hysteresis 3	0D0B	B	C	g	G	M	S	A	-	P	-	-	0,00	300,00	0,01	0,50	-	6.3.15
le 12 hysteresis 4	0D0C	B	C	g	G	M	S	A	-	P	-	-	0,00	300,00	0,01	0,00	-	6.3.15
le 13 hysteresis 5	0D0D	B	C	g	G	M	S	A	-	P	-	-	0,00	300,00	0,01	0,00	-	6.3.15
le 14 hysteresis 6	0D0E	B	C	g	G	M	S	A	-	P	-	-	0,00	300,00	0,01	0,00	-	6.3.15
le 15 hysteresis 7	0D0F	B	C	g	G	M	S	A	-	P	-	-	0,00	300,00	0,01	0,00	-	6.3.15
le 16 freq/speed hysteresis	0D10	B	C	g	G	-	-	-	-	-	-	V	0	20	0,0125	0,8	Hz	6.3.15
le 17 timer 1 start inp. sel.	0D11	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	0	-	6.3.8, 6.9.12
le 18 timer 1 start condition	0D12	B	C	g	G	M	S	A	-	-	E	-	0	7	1	0	-	6.3.8, 6.9.12
le 19 timer 1 reset inp. sel.	0D13	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	0	-	6.3.8, 6.9.12
le 20 timer 1 reset condition	0D14	B	C	g	G	M	S	A	-	-	E	-	0	31	1	16	-	6.9.13
le 21 timer 1 mode	0D15	B	C	g	G	M	S	A	-	-	-	-	0	31	1	0	-	6.9.11
le 22 timer 2 start inp. sel.	0D16	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	0	-	6.3.8, 6.9.12
le 23 timer 2 start condition	0D17	B	C	g	G	M	S	A	-	-	E	-	0	7	1	0	-	6.3.8, 6.9.12
le 24 timer 2 reset inp. sel.	0D18	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	0	-	6.3.8, 6.9.12
le 25 timer 2 reset condition	0D19	B	C	g	G	M	S	A	-	-	E	-	0	31	1	16	-	6.9.13
le 26 timer 2 mode	0D1A	B	C	g	G	M	S	A	-	-	-	-	0	31	1	0	-	6.9.11
op 0 reference source	0300	B	C	g	-	-	-	-	-	P	E	-	0	6	1	0	-	6.4.4, 6.9.9
op 0 reference source	0300	-	-	-	G	M	S	A	-	P	E	-	0	9	1	0	-	6.4.4, 6.9.9
op 1 rotation source	0301	B	C	g	G	-	-	-	-	P	E	-	0	9	1	2	-	6.4.6, 6.9.9
op 2 rotation setting	0302	B	C	g	G	M	S	A	-	P	E	-	0	2	1	0	-	6.4.6
op 3 reference setting	0303	B	C	g	G	-	-	-	-	P	-	V	-400	400	0,0125	0	Hz	6.4.4
op 5 reference setting %	0305	B	C	g	G	M	S	A	-	P	-	-	-100,0	100,0	0,1	0,0	%	6.4.4
op 6 min. reference forward	0306	B	C	g	G	-	-	-	-	P	-	V	0	400	0,0125	0	Hz	6.4.11
op 7 min. reference reverse	0307	B	C	g	G	-	-	-	-	P	-	V	-0,0125	400	0,0125	-0,0125	Hz	6.4.11
op10 max. reference forward	030A	B	C	g	G	-	-	-	-	P	-	V	0	400	0,0125	0	Hz	6.4.11
op11 max. reference reverse	030B	B	C	g	G	-	-	-	-	P	-	V	-0,0125	400	0,0125	-0,0125	Hz	6.4.11
op14 abs. max. reference for	030E	B	C	g	G	-	-	-	-	P	-	V	0	400	0,0125	400	Hz	6.4.11
op15 abs. max. reference rev	030F	B	C	g	G	-	-	-	-	P	-	V	-0,0125	400	0,0125	-0,0125	Hz	6.4.11
op18 step value rot. source	0312	B	C	g	G	-	-	-	-	P	E	-	0	9	1	2	-	6.4.9
op19 step value input sel. 1	0313	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	16	-	6.4.9, 6.3.8
op20 step value input sel. 2	0314	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	32	-	6.4.9, 6.3.8
op21 step value 1	0315	B	C	g	G	-	-	-	-	P	-	V	-400	400	0,0125	5	Hz	6.4.9
op22 step value 2	0316	B	C	g	G	-	-	-	-	P	-	V	-400	400	0,0125	50	Hz	6.4.9
op23 step value 3	0317	B	C	g	G	-	-	-	-	P	-	V	-400	400	0,0125	70	Hz	6.4.9
op27 acc dec mode	031B	B	C	g	G	M	S	A	-	P	E	-	0	255	1	0	-	6.4.16
op28 acc. time forward	031C	B	C	g	G	M	S	A	-	P	-	-	0,00	300,00	0,01	5,00	s	6.4.13
op29 acc. time reverse	031D	B	C	g	G	M	S	A	-	P	-	-	-0,01	300,00	0,01	-0,01	s	6.4.13
op30 dec. time forward	031E	B	C	g	G	M	S	A	-	P	-	-	-0,01	300,00	0,01	5,00	s	6.4.13
op31 dec. time reverse	031F	B	C	g	G	M	S	A	-	P	-	-	-0,01	300,00	0,01	-0,01	s	6.4.13
op32 s-curve time acc. for.	0320	B	C	g	G	M	S	A	-	P	-	-	0,00	5,00	0,01	0,00	s	6.4.14
op33 s-curve time acc. rev.	0321	B	C	g	G	M	S	A	-	P	-	-	-0,01	5,00	0,01	-0,01	s	6.4.14
op34 s-curve time dec. for.	0322	B	C	g	G	M	S	A	-	P	-	-	-0,01	5,00	0,01	-0,01	s	6.4.14
op35 s-curve time dec. rev.	0323	B	C	g	G	M	S	A	-	P	-	-	-0,01	5,00	0,01	-0,01	s	6.4.14
op36 min. output freq. for	0324	B	C	g	G	-	-	A	-	P	-	V	0	400	0,0125	0	Hz	
op37 min. output freq. rev	0325	B	C	g	G	-	-	A	-	P	-	V	-0,0125	400	0,0125	-0,0125	Hz	
op40 max. output val. for.	0328	B	C	g	G	-	-	-	-	P	-	V	0	400	0,0125	400	Hz	6.4.15, 6.7.5
op41 max. output val. rev.	0329	B	C	g	G	-	-	-	-	P	-	V	-0,0125	400	0,0125	-0,0125	Hz	6.4.15, 6.7.5
op44 ext. funct. mode/src	032C	-	C	-	G	M	S	A	-	P	E	-	0	63	1	0	-	6.9.27, 6.9.29
op45 ext. funct. dig. source	032D	-	C	-	G	M	S	A	-	P	-	-	0,00	100,00	0,01	0,00	%	6.9.27, 6.9.29
op46 ext. funct. acc/dec time	032E	-	C	-	G	M	S	A	-	P	-	-	0,00	20,00	0,01	10,00	s	6.9.27, 6.9.30
op47 sweep-gen. acc. time	032F	-	C	-	G	M	S	A	-	P	-	-	0,00	20,00	0,01	10,00	s	6.9.27
op48 sweep-gen. dec. time	0330	-	C	-	G	M	S	A	-	P	-	-	0,00	20,00	0,01	10,00	s	6.9.27
op49 diam. corr. dmin/dmax	0331	-	C	-	G	M	S	A	-	P	-	-	0,010	0,990	0,001	0,500	-	6.9.30
op50 motorpoti function	0332	B	C	g	G	M	S	A	-	-	E	-	0	3	1	0	-	6.9.8
op52 motorpoti value	0334	B	C	g	G	M	S	A	-	P	-	-	-100,00	100,00	0,01	0,00	%	6.9.9

Parameter	Adr.	Control							Properties				min.	max.	Step	default	[?]	see on Page
op53 motorpoti min. value	03 35	B	C	g	G	M	S	A	-	-	-	-	-100,00	100,00	0,01	0,00	%	6.9.8
op54 motorpoti max. value	03 36	B	C	g	G	M	S	A	-	-	-	-	-100,00	100,00	0,01	100,00	%	6.9.8
op55 motorpoti reset value	03 37	B	C	g	G	M	S	A	-	-	-	-	-100,00	100,00	0,01	0,00	%	6.9.7
op56 Eing.wahl MPoti erhöhen	03 38	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	0	-	6.3.8, 6.9.8
op57 mot.poti dec. input sel.	03 39	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	0	-	6.9.8, 6.3.8
op58 mot.poti reset inp. sel.	03 3A	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	0	-	6.9.8, 6.3.8
op59 motorpoti inc/dec time	03 3B	B	C	g	G	M	S	A	-	-	-	-	0,00	50000,00	0,01	66,00	s	6.9.8
op60 dir. forward input sel.	03 3C	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	4	-	6.3.8, 6.4.7
op61 dir. reverse input sel.	03 3D	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	8	-	6.3.8, 6.4.7
op62 acc/dec time factor	03 3E	B	C	g	G	M	S	A	-	-	E	-	0	4	1	0	-	6.4.13
op63 ref. value high-res	033F	-	-	-	-	M	S	A	-	-	-	-	-2^31-1	2^31-1	1	0		6.4.5
op64 rel. value high-res	0340	-	-	-	-	M	S	A	-	-	-	-	0	n * 400	n * 0,0125	1	Hz	6.4.5
op65 min. proh. reference 1	0341	-	-	-	-	M	S	A	-	-	-	-	-4000	4000	0,125	0	rpm	6.4.6
op66 max. proh. reference 1	0342	-	-	-	-	M	S	A	-	-	-	-	-4000	4000	0,125	0	rpm	6.4.6
op67 min. proh. reference 2	0343	-	-	-	-	M	S	A	-	-	-	-	-4000	4000	0,125	0	rpm	6.4.6
op68 max. proh. reference 2	0344	-	-	-	-	M	S	A	-	-	-	-	-4000	4000	0,125	0	rpm	6.4.6
pn 0 auto retry UP	04 00	B	C	g	G	M	S	A	-	-	-	-	0	1	1	1	-	6.7.7
pn 1 auto retry OP	04 01	B	C	g	G	M	S	A	-	-	-	-	0	1	1	0	-	6.7.7
pn 2 auto retry OC	04 02	B	C	g	G	M	S	A	-	-	-	-	0	1	1	0	-	6.7.7
pn 3 E. EF stopping mode	04 03	B	C	g	G	M	S	A	-	-	-	-	0	6	1	0	-	6.7.10
pn 4 ext. fault input select	04 04	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	64	-	6.7.9, 6.3.8
pn 5 E.buS stopping mode	04 05	B	C	g	G	M	S	A	-	-	-	-	0	6	1	6	-	6.7.10, 11.2.3
pn 6 watchdog time	04 06	B	C	g	G	M	S	A	-	-	E	-	0,00:off	10,00	0,01	0,00:off	s	6.7.10, 11.2.3
pn 8 warning OL stop. mode	04 08	B	C	g	G	M	S	A	-	-	-	-	0	6	1	6	-	6.7.11, 6.3.15
pn 9 OL warning level	04 09	B	C	g	G	M	S	A	-	-	-	-	0	100	1	80	%	6.7.10
pn10 warning OH stop. mode	04 0A	B	C	g	G	M	S	A	-	-	-	-	0	6	1	6	-	6.7.11, 6.3.15
pn11 OH warning level	04 0B	B	C	g	G	M	S	A	-	-	-	-	0	90	1	70	°C	6.7.11
pn12 warning dOH stop. mode	04 0C	B	C	g	G	-	-	-	-	-	-	-	0	7	1	7	-	6.7.11, 6.3.15, 6.7.18
pn13 E.dOH delay time	04 0D	B	C	g	G	-	-	-	-	-	-	-	0	120	1	10	s	6.7.11, 6.7.18
pn14 warning OH2 stop. mode	04 0E	B	C	g	G	M	S	A	-	-	-	-	0	6	1	6	-	6.7.12, 6.7.17, 6.3.15
pn16 warning OHI stop. mode	04 10	B	C	g	G	M	S	A	-	-	-	-	0	7	1	7	-	6.7.12, 6.3.16
pn17 E.OHI delay time	04 11	B	C	g	G	M	S	A	-	-	-	-	0	120	1	0	s	6.7.12
pn18 E.Set stopping mode	04 12	B	C	g	G	M	S	A	-	-	-	-	0	6	1	0	-	6.7.12
pn19 stall mode	04 13	-	C	-	G	M	-	-	-	P	E	-	0	255	1	0	-	6.7.5
pn19 stall mode	04 13	B	-	g	-	-	-	A	-	P	E	-	0	127	1	0	-	6.7.5
pn20 stall level	04 14	B	C	g	G	M	-	A	-	P	-	-	0	200	1	200:off	%	6.7.6
pn21 stall acc/dec time	04 15	B	C	g	G	M	-	A	-	P	-	-	0	300,00	0,01	2,00	s	6.7.6
pn22 LAD stop function	04 16	B	C	g	G	M	S	A	-	P	E	-	0	7	1	1 / 0	-	6.7.3
pn23 LAD stop input selection	04 17	B	C	g	G	M	S	A	-	-	E	-	0	4095	1	0	-	6.7.3, 6.3.8
pn24 LAD load level	04 18	B	C	g	G	M	S	A	-	P	-	-	0	200	1	140	%	6.7.3
pn25 LD voltage	04 19	B	C	g	G	M	S	A	-	P	-	-	200	800	1	375 / 720	V	6.7.3
pn26 speed search condition	04 1A	B	C	g	G	M	-	-	-	P	E	-	0	15	1	8	-	6.7.7
pn27 speed search mode	04 1B	B	C	g	G	M	-	-	-	-	E	-	0	127	1	0/88	-	6.7.7
pn28 DC braking mode	04 1C	B	C	g	G	M	-	-	-	P	E	-	0	9	1	7	-	6.9.4
pn29 DC brake input selection	04 1D	B	C	g	G	M	-	-	-	-	E	-	0	4095	1	128	-	6.9.4, 6.3.8
pn30 DC braking time	04 1E	B	C	g	G	M	-	-	-	P	-	-	0,00	100,00	0,01	10,00	s	6.9.3
pn31 DC braking max. voltage	04 1F	B	C	g	G	M	-	-	-	P	-	-	0,0	25,5	0,1	25,5	%	6.9.3
pn32 DC braking start freq.	04 20	B	C	g	G	-	-	-	-	P	-	V	0	400	0,0125	4	Hz	6.9.3
pn34 brake control mode	04 22	B	C	g	G	M	S	A	-	P	E	-	0	4	1	0	-	6.9.16
pn35 premagnetizing time	04 23	B	C	g	G	M	S	A	-	P	-	-	0,00	100,00	0,01	0,25	s	6.9.15
pn36 brake release time	04 24	B	C	g	G	M	S	A	-	P	-	-	0,00	100,00	0,01	0,25	s	6.9.15
pn37 Bremsenstrg. Startwert	04 25	B	C	g	G	-	-	-	-	P	-	V	-20	20	0,0125	0	Hz	6.9.17
pn39 brake delay time	04 27	B	C	g	G	M	S	A	-	P	-	-	0,00	100,00	0,01	0,25	s	6.9.15
pn40 brake closing time	04 28	B	C	g	G	M	S	A	-	P	-	-	0,00	100,00	0,01	0,25	s	6.9.15
pn41 brake ctrl. stop ref.	04 29	B	C	g	G	-	-	-	-	P	-	V	-20	20	0,0125	0	Hz	6.9.17
pn41 brake ctrl. stop ref.	04 29	-	-	-	-	M	S	A	-	P	-	V	-600	600	0,125	0	rpm	6.9.17
pn43 min. load brake ctrl.	04 2B	B	C	g	G	M	S	A	-	P	-	-	0	100	1	0	%	6.9.16
pn44 power off mode	04 2C	B	C	g	G	M	S	A	-	-	E	-	0	511	1	0	-	6.9.19, 6.9.20, 6.9.23
pn45 power off start voltage	04 2D	B	C	g	G	M	S	A	-	-	-	-	200	800	1	290 / 500	V	6.9.20, 6.9.21
pn46 power off auto st. level	04 2E	B	C	g	G	M	S	A	-	-	-	-	50	90	1	80	%	6.9.20, 6.9.21
pn47 power off brake torque	04 2F	B	C	g	G	-	-	-	-	-	-	-	0,0	100,0	0,1	0,0	%	6.9.21
pn48 power off restart level	04 30	B	C	g	G	-	-	-	-	-	-	V	0	400	0,0125	0	Hz	6.9.22
pn50 power off ref. DC volt.	04 32	B	C	g	G	-	-	-	-	-	-	-	200	800	1	290 / 500	V	6.9.21
pn51 power off KP DC volt.	04 33	B	C	g	G	M	-	-	-	-	-	-	0	32767	1	128	-	6.9.22
pn52 power off restart delay	04 34	B	C	g	G	M	S	A	-	-	-	-	0,00	100,00	0,01	0,00	s	6.9.23
pn53 power off KP act.curr.	04 35	B	C	g	G	-	-	-	-	-	-	-	0	32767	1	50	-	6.9.22
pn54 power off KI act.curr.	04 36	B	C	g	G	-	-	-	-	-	-	-	0	32767	1	50	-	6.9.22
pn55 power off KD act.curr.	04 37	B	C	g	G	-	-	-	-	-	-	-	0	32767	1	0	-	6.9.22
pn56 power off jump factor	04 38	B	C	g	G	-	-	-	-	-	-	-	0	800	1	100	%	6.9.20
pn57 power off KI DC volt.	04 39	-	C	-	G	M	-	-	-	-	-	-	0	32767	1	5	-	6.9.22
pn58 quick stop mode	04 3A	B	C	g	G	-	-	A	-	-	E	-	0	3	1	0	-	6.7.13
pn59 quick stop level	04 3B	B	C	g	G	-	-	-	-	-	-	-	0	200	1	200	%	6.7.13
pn60 quick stop acc/dec time	04 3C	B	C	g	G	M	S	A	-	-	-	-	0	300,00	0,01	2,00	s	6.7.13
pn62 dOH warning level	04 3E	-	-	-	G	M	S	A	-	-	-	-	0	200	1	100	°C	6.7.11
pn63 positioning delay	04 3F	B	C	g	G	-	-	A	-	P	-	-	-0,02	327,67	0,01	-0,01	s	6.9.31
pn64 set GTR7 input selection	04 40	-	C	-	G	M	S	A	-	-	E	-	0	4095	1	0	-	6.7.19, 6.3.8
pn65 special functions	04 41	-	C	-	G	M	S	A	-	-	-	-	0	7	1	0	-	6.7.20, 6.7.19, 6.7.9

Parameter	Adr.	Control							Properties				min.	max.	Step	default	[?]	see on Page
pn 69 GTR7 voltage	04 19	-	C	g	G	M	S	A					300	1000	1	380;740	V	
ru 0 inverter state	02 00	B	C	g	G	M	S	A	R	-	-	-	0	255	1	0	-	6.1.6
ru 1 set value display	02 01	B	C	g	G	-	-	-	R	-	-	V	-400	400	0,0125	0	Hz	6.1.6, 6.9.3
ru 2 ramp output display	02 02	B	C	g	G	-	-	-	R	-	-	V	-400	400	0,0125	0	Hz	6.1.6
ru 3 actual frequency display	02 03	B	C	g	G	M	S	A	R	-	-	V	-400	400	0,0125	0	Hz	6.1.6
ru 4 encoder 1 frequency	02 04	-	-	-	G	-	-	A	R	-	-	V	-400	400	0,0125	0	Hz	
ru 5 encoder 2 frequency	02 05	-	-	-	G	-	-	A	R	-	-	V	-400	400	0,0125	0	Hz	
ru 6 calculated act. freq.	02 06	-	-	-	G	-	-	A	R	-	-	V	-400	400	0,0125	0	Hz	
ru 7 actual value display	02 07	-	-	-	G	-	-	-	R	-	-	V	-400	400	0,0125	0	Hz	6.1.7
ru 9 encoder 1 speed	02 09	-	-	-	G	-	-	-	R	-	-	V	-32000	32000	1	0	rpm	6.1.7
ru 10 encoder 2 speed	02 0A	-	-	-	G	-	-	-	R	-	-	V	-32000	32000	1	0	rpm	6.1.7
ru 13 actual utilization	02 0D	B	C	g	G	M	S	A	R	-	-	-	0	65535	1	0	%	6.11.6, 6.1.8
ru 14 peak utilization	02 0E	B	C	g	G	M	S	A	-	-	-	-	0	65535	1	0	%	6.1.8
ru 15 apparent current	02 0F	B	C	g	G	M	S	A	R	-	-	-	0	6553,5	0,1	0	A	6.1.8
ru 16 peak apparent current	02 10	B	C	g	G	M	S	A	-	-	-	-	0	6553,5	0,1	0	A	6.1.8
ru 17 active current	02 11	B	C	g	G	M	S	A	R	-	-	-	-3276,7	3276,7	0,1	0	A	6.12.6, 6.1.9
ru 18 actual DC voltage	02 12	B	C	g	G	M	S	A	R	-	-	-	0	1000	1	0	V	6.12.6, 6.1.9
ru 19 peak DC voltage	02 13	B	C	g	G	M	S	A	-	-	-	-	0	1000	1	0	V	6.1.9
ru 20 output voltage	02 14	B	C	g	G	M	S	A	R	-	-	-	0	778	1	0	V	6.1.9
ru 21 input terminal state	02 15	B	C	g	G	M	S	A	R	-	-	-	0	4095	1	0	-	6.1.10, 6.3.5
ru 22 internal input state	02 16	B	C	g	G	M	S	A	R	-	-	-	0	4095	1	0	-	6.1.10, 6.3.8
ru 23 output condition state	02 17	B	C	g	G	M	S	A	R	-	-	-	0	255	1	0	-	6.1.11
ru 24 state of output flags	02 18	B	C	g	G	M	S	A	R	-	-	-	0	255	1	0	-	6.1.11
ru 25 output terminal state	02 19	B	C	g	G	M	S	A	R	-	-	-	0	255	1	0	-	6.1.12, 6.3.18
ru 26 active parameter set	02 1A	B	C	g	G	M	S	A	R	-	-	-	0	7	1	0	-	6.1.12
ru 27 AN1 pre amplifier disp.	02 1B	B	C	g	G	M	S	A	R	-	-	-	-100,0	100,0	0,1	0	%	6.1.12, 6.2.3, 6.4.4
ru 28 AN1 post amplifier disp.	02 1C	B	C	g	G	M	S	A	R	-	-	-	-400,0	400,0	0,1	0	%	6.1.12, 6.2.3, 6.4.4
ru 29 AN2 pre amplifier disp.	02 1D	-	C	g	G	M	S	-	R	-	-	-	-100,0	100,0	0,1	0	%	6.1.13, 6.2.3, 6.4.4
ru 30 AN2 post amplifier disp.	02 1E	-	C	g	G	M	S	-	R	-	-	-	-400,0	400,0	0,1	0	%	6.1.13, 6.2.3, 6.4.4
ru 31 AN3 pre amplifier disp.	02 1F	-	-	-	G	M	S	-	R	-	-	-	-100,0	100,0	0,1	0	%	6.1.13, 6.2.3, 6.4.4
ru 32 AN3 post amplifier disp.	02 20	-	-	-	G	M	S	-	R	-	-	-	-400,0	400,0	0,1	0	%	6.1.13, 6.2.3, 6.4.4
ru 33 ANOUT1 pre ampl. disp.	02 21	B	C	g	G	M	S	A	R	-	-	-	-400,0	400,0	0,1	0	%	6.1.14, 6.2.12
ru 34 ANOUT1 post ampl. disp.	02 22	B	C	g	G	M	S	A	R	-	-	-	-115,0	115,0	0,1	0	%	6.1.14, 6.2.12
ru 35 ANOUT2 pre ampl. disp.	02 23	-	C	g	G	M	S	-	R	-	-	-	-400,0	400,0	0,1	0	%	6.1.14, 6.2.12
ru 36 ANOUT2 post ampl. disp.	02 24	-	C	g	G	M	S	-	R	-	-	-	-115,0	115,0	0,1	0	%	6.1.14, 6.2.12
ru 37 motorpoti actual value	02 25	B	C	g	G	M	S	A	R	-	-	-	-100,00	100,00	0,01	0	%	6.1.14, 6.9.8
ru 38 power module temperature	02 26	B	C	g	G	M	S	A	R	-	-	-	0	150	1	0	°C	6.1.15
ru 39 OL counter display	02 27	B	C	g	G	M	S	A	R	-	-	-	0	100	1	0	%	6.1.15
ru 40 power on counter	02 28	B	C	g	G	M	S	A	R	-	-	-	0	65535	1	0	h	6.1.15
ru 41 modulation on counter	02 29	B	C	g	G	M	S	A	R	-	-	-	0	65535	1	0	h	6.1.15
ru 42 modulation grade	02 2A	B	C	g	G	M	S	A	R	-	-	-	0	110	1	0	%	6.1.15
ru 43 timer 1 display	02 2B	B	C	g	G	M	S	A	-	-	-	-	0	655,35	0,01	0	-	6.1.15, 6.9.12
ru 44 timer 2 display	02 2C	B	C	g	G	M	S	A	-	-	-	-	0	655,35	0,01	0	-	6.1.16, 6.9.12
ru 45 act. carrier frequency	02 2D	B	C	g	G	M	S	A	R	-	-	-	0	4	1	0	-	6.1.16
ru 46 motor temperature	02 2E	B	C	g	G	M	S	-	R	-	-	-	0	255	1	0	°C	6.1.16
ru 52 ext. PID out disp.	02 34	B	C	g	G	M	S	A	R	-	-	-	-100,0	100,0	0,1	0	%	6.1.17, 6.4.4
ru 53 AUX display	02 35	B	C	g	G	M	S	A	R	-	-	-	-400,0	400,0	0,1	0	%	6.1.17, 6.12.6
ru 68 rated DC voltage	02 44	B	C	-	G	M	S	A	R	-	-	-	0	1000	1	0	V	6.1.17
ru 69 distance ref.-zeropoint	02 45	B	-	-	G	M	S	A	R	-	-	-	-2^31	2^31 – 1	0	1	inc.	6.1.17
ru 71 teach/scan position	02 47	B	-	-	G	M	S	A	R	-	-	-	-2^31	2^31 – 1	0	1	inc.	6.1.17
ru 73 set torque in percent	02 49	B	-	-	G	M	S	A	R	-	-	-	-100,0	100,0	0,1	0	%	6.1.17
ru 74 act torque in percent	02 4A	B	-	-	G	M	S	A	R	-	-	-	-100,0	100,0	0,1	0	%	6.1.17
ru 78 act. val. display in percent	02 4E	B	-	-	G	M	S	A	R	-	-	-	-100,0	100,0	0,1	0	%	6.1.17
ru 79 abs. speed value	02 4F	B	-	-	G	M	S	A	R	-	-	-	n*-4000	n*4000	n*0,125	0	rpm	6.1.17
ru 80 digital output state	02 50	B	C	-	G	M	S	A	R	-	-	-	0	255	1	0	-	6.1.18
ru 81 active power	02 51	B	C	-	G	M	S	A	R	-	-	-	-400	400	0,00	0,00	kW	6.1.18
sy 2 inverter identifier	00 02	B	C	g	G	M	S	A	-	-	-	-	identifier	identifier	1	identifier	hex	6.1.23
sy 3 power unit code	00 03	B	C	g	G	M	S	A	-	-	E	-	1	255	1	LTK	-	6.1.23
sy 6 inverter address	00 06	B	C	g	G	M	S	A	-	-	E	-	0	239	1	1	-	6.1.23, 11.2.3
sy 7 baud rate ext. bus	00 07	B	C	g	G	M	S	A	-	-	E	-	0	6	1	5	-	6.1.23, 11.2.3
sy 9 HSP5 watchdog time	00 09	B	C	g	G	M	S	A	-	-	E	-	0,00:off	10,00	0,01	0,00:off	s	6.1.24, 11.2.3
sy 11 baud rate int. bus	00 0B	B	C	g	G	M	S	A	-	-	E	-	3	11	1	5	-	6.1.24, 11.2.3
sy 32 scope timer	00 20	B	C	g	G	M	S	A	R	-	-	-	0	65535	1	0	-	6.1.24
sy 41 control word (high)	00 29	-	C	-	G	M	S	A	-	-	E	-	0	65535	1	0	hex	6.1.24, 11.2.4
sy 42 status word (high)	00 2A	-	C	-	G	M	S	A	R	-	-	-	0	65535	1	0	hex	6.1.25, 11.2.5
sy 43 control word (long)	00 2B	-	C	-	G	M	S	A	R	-	-	-	-2^31	2^31 - 1	1	0	hex	6.1.25, 11.2.5
sy 50 control word (low)	00 32	B	C	g	G	M	S	A	-	-	E	-	0	65535	1	0	hex	6.1.25, 6.4.8, 11.2.4
sy 51 status word (low)	00 33	B	C	g	G	M	S	A	R	-	-	-	0	65535	1	0	hex	6.1.25, 11.2.4
sy 52 set speed value	00 34	B	C	g	G	M	S	A	-	-	-	-	-16000	16000	1	0	rpm	6.1.26, 11.2.4
sy 53 actual speed value	00 35	B	C	g	G	M	S	A	R	-	-	-	-16000	16000	1	0	rpm	6.1.25, 11.2.4
sy 56 start display address	00 38	B	C	g	G	-	-	A	-	-	E	-	0	7FFFH	1	0203H	hex	6.1.25
ud 1 password	08 01	B	C	g	G	M	S	A	-	-	-	-	0	9999	1	-	-	4.2.3, 4.4.3, 6.13.3
ud 2 maximum frequency mode	08 02	B	C	g	-	-	-	-	-	-	-	-	0	2	1	0	-	6.5.3
ud 2 control type	08 02	-	-	-	G	M	S	A	-	-	E	-	0	10	1	0	-	6.5.3
ud 5 auto store	08 05	B	C	g	-	-	-	-	-	-	-	-	0	1	1	1	-	11.2.3
ud 9 drive-mode-control	08 09	B	C	g	G	M	S	A	-	-	-	-	0	11	1	0	-	4.4.4
ud 15 cp selector	08 0F	B	C	g	G	M	S	A	-	-	E	-	1	36	1	1	-	6.13.4

Parameter	Adr.	Control							Properties				min.	max.	Step	default	[?]	see on Page
ud16 cp address	0810	B	C	g	G	M	S	A	-	-	E	-	-1	32767	1	Tabelle	hex	6.13.4
ud17 cp set norm	0811	B	C	g	G	M	S	A	-	-	E	-	1	32767	1	1	-	6.13.4
ud18 divisor display norm	0812	B	C	g	G	M	S	A	-	P	E	-	-32767	32767	1	1	-	6.13.6
ud19 multiplier display norm	0813	B	C	g	G	M	S	A	-	P	E	-	-32767	32767	1	1	-	6.13.6
ud20 offset display norm	0814	B	C	g	G	M	S	A	-	P	E	-	-32767	32767	1	0	-	6.13.6
ud21 ctrl. display norm	0815	B	C	g	G	M	S	A	-	P	E	-	0	1791	1	0	-	6.13.6
uf 0 rated frequency	0500	B	C	g	G	M	-	A	-	P	-	V	0	400	0,0125	50	Hz	6.5.4
uf 1 boost	0501	B	C	g	G	M	-	A	-	P	-	-	0,0	25,5	0,1	2,0	%	6.5.4
uf 2 add. frequency	0502	B	C	g	G	M	-	A	-	P	-	V	-1	400	0,0125	0:off	Hz	6.5.4
uf 3 add. voltage	0503	B	C	g	G	M	-	A	-	P	-	-	0,0	100,0	0,1	0,0	%	6.5.4
uf 4 delta boost	0504	B	C	g	G	M	-	A	-	P	-	-	0,0	25,5	0,1	0,0	%	6.5.4
uf 5 delta boost time	0505	B	C	g	G	M	-	A	-	P	-	-	0,00	10,00	0,01	0,00	s	6.5.4
uf 6 energy saving mode	0506	B	C	g	G	M	-	A	-	P	-	-	0	7	1	0	-	6.9.5
uf 7 energy saving factor	0507	B	C	g	G	M	-	A	-	P	-	-	0,0	130,0	0,1	70,0	%	6.9.5
uf 8 energy saving input sel.	0508	B	C	g	G	M	-	A	-	-	E	-	0	4095	1	0	-	6.9.5, 6.3.8
uf 9 voltage stabilisation	0509	B	C	g	G	M	-	-	-	P	E	-	1	650:off	1	650:off	V	6.5.5
uf 10 max. voltage mode	050A	-	C	-	G	M	-	A	-	P	-	-	0	3	1	0	-	6.5.6
uf 10 max. voltage mode	050A	B	-	g	-	-	-	-	-	P	-	-	0	2	1	0	-	6.5.6
uf 11 carrier frequency	050B	B	-	g	G	M	S	A	-	P	E	-	0	LTK	1	LTK	-	6.5.6
uf 12 base block time	050C	B	-	g	G	M	S	A	R	-	-	-	LTK	LTK	0,01	LTK	s	6.7.9
uf 13 base block voltage level	050D	B	-	g	G	M	S	A	R	-	-	-	LTK	LTK	1	LTK	%	6.7.9
uf 15 hardw. curr. lim. mode	050F	-	-	-	G	M	S	A	-	-	-	-	0	2	1	1	-	6.7.3
uf 15 hardw. curr. lim. mode	050F	B	-	g	-	-	-	-	-	-	-	-	0	1	1	1	-	6.7.3
uf 16 autoboost configuation	0510	B	-	g	G	-	-	A	-	P	-	-	0	3	1	0	-	6.11.4
uf 17 autoboost gain	0511	B	C	g	G	-	-	A	-	P	-	-	0,00	2,50	0,01	1,20	-	6.11.4
uf 18 deadtime comp. mode	0512	B	C	g	G	M	-	-	-	-	-	-	0	1	1	1	-	6.7.9
uf 19 volt.stab.PT1-timeconst.	0513	-	-	-	G	-	-	A	-	-	-	-	0	10	1	0	-	6.5.5
uf 20 KI Offset-Control	0514	-	-	-	-	-	-	-	-	-	-	-	0	32767	1	50	-	

6. Functional Description

6.1 Operating and Appliance Data

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

6.1.1 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 startup or trouble shooting on a plant, this can turn out to be a great aid. Following parameters are available:

ru.	**0**	**Inverter status**
ru.	**1**	**Set value display**
ru.	**2**	**Ramp output display**
ru.	**3**	**Actual frequency display**
ru.	**4**	**Encoder 1 frequency**
ru.	**5**	**Encoder 2 frequency**
ru.	**6**	**Calculated actual frequency**
ru.	**7**	**Actual value display**
ru.	**9**	**Encoder 1 speed**
ru.	**10**	**Encoder 2 speed**
ru.	**13**	**Actual utilization**
ru.	**14**	**Peak utilization**
ru.	**15**	**Apparent current**
ru.	**16**	**Apparent current/peak value**
ru.	**17**	**Active current**
ru.	**18**	**DC-link voltage**
ru.	**19**	**DC-link voltage/peak value**
ru.	**20**	**Output voltage**
ru.	**21**	**Input terminal state**
ru.	**22**	**Internal input state**
ru.	**23**	**Output condition state**
ru.	**24**	**State of output flags**
ru.	**25**	**Output terminal state**
ru.	**26**	**Active parameter set**
ru.	**27**	**AN1 display before amplification**
ru.	**28**	**AN1 display after amplification**
ru.	**29**	**AN2 display before amplification**
ru.	**30**	**AN2 display after amplification**
ru.	**31**	**AN3 display before amplification**
ru.	**32**	**AN3 display before amplification**
ru.	**33**	**Analog output 1 display before amplification**
ru.	**34**	**Analog output 1 display after amplification**
ru.	**35**	**Analog output 2 display before amplification**
ru.	**36**	**Analog output 2 display after amplificaiton**
ru.	**37**	**Motorpoti - actual value**
ru.	**38**	**Power module temperature**
ru.	**39**	**OL-counter display**
ru.	**40**	**power on counter**
ru.	**41**	**Modulation on counter**
ru.	**42**	**Modulation grade**
ru.	**43**	**Timer 1 display**
ru.	**44**	**Timer 2 display**
ru.	**45**	**Actual carrier frequency**
ru.	**46**	**Motor temperature**
ru.	**52**	**External PID out display**
ru.	**53**	**AUX display**
ru.	**68**	**Rated DC voltage**

6.1.2 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:

In.	**0**	**Inverter type**
In.	**1**	**Rated inverter current**
In.	**3**	**Max. switching frequency**
In.	**4**	**Rated switching frequency**
In.	**5**	**Interface type**
In.	**6**	**Software version**
In.	**7**	**Software date**
In.	**8**	**Software version power circuit**
In.	**9**	**Software date power circuit**
In.	**10**	**Serial number (date)**
In.	**11**	**Serial number (counter)**
In.	**12**	**Serial number (Ackn.-No. High)**
In.	**13**	**Serial number (Ackn.-No. Low)**
In.	**14**	**Customer number (High)**
In.	**15**	**Customer number (Low)**
In.	**16**	**QS-Number**
In.	**17**	**Temperature mode**
In.	**22**	**User parameter 1**
In.	**23**	**User parameter 2**
In.	**24**	**Last error**
In.	**25**	**Error diagnosis**
In.	**26**	**Error counter OC**
In.	**27**	**Error counter OL**
In.	**28**	**Error counter OP**
In.	**29**	**Error counter OH**
In.	**30**	**Error counter OHI**

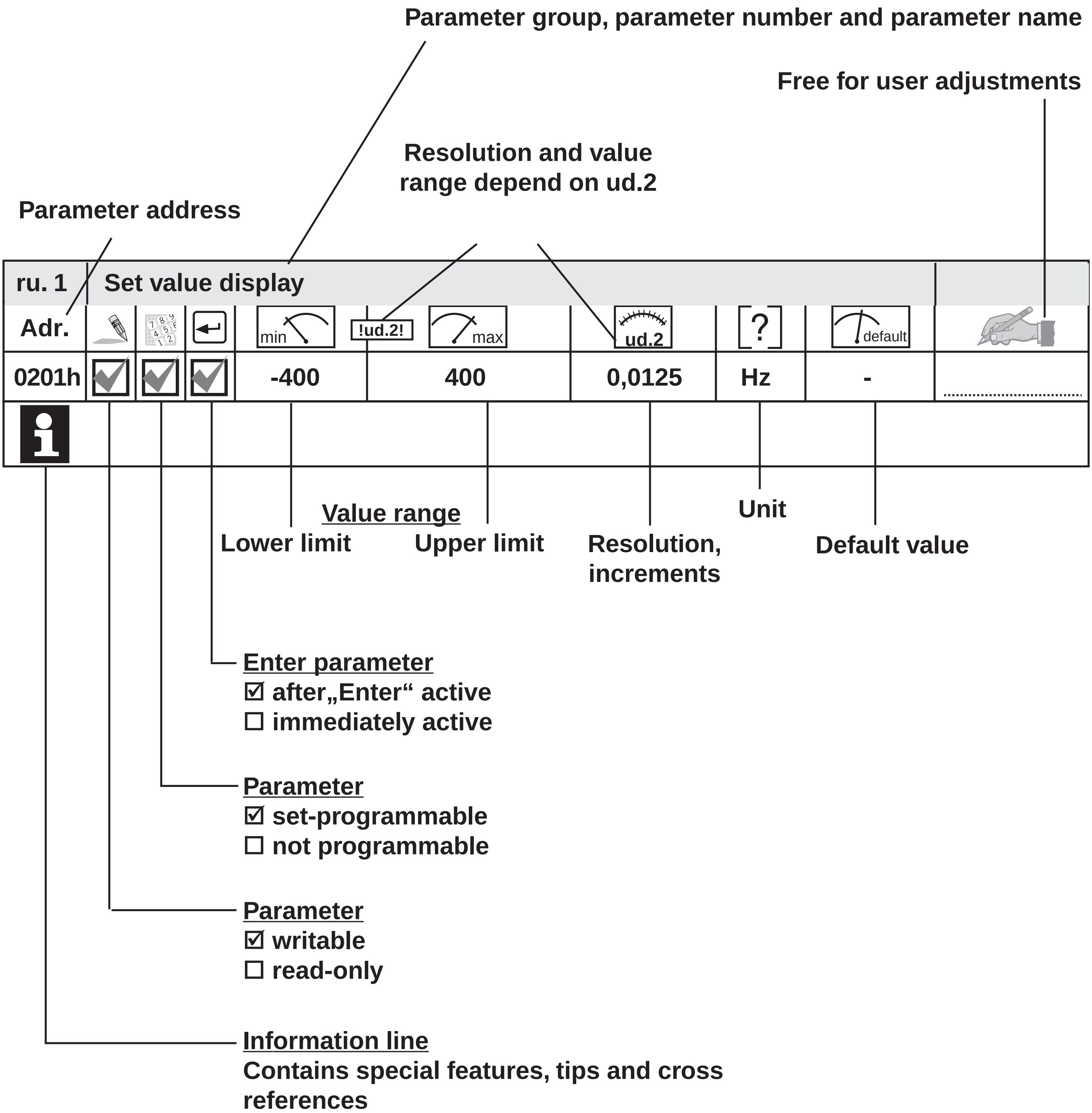
6.1.3 Overview of the Sy-Parameters

As the name already says the Sy- (system) parameter group contains system-specific parameters. Following parameters are available:

Sy.	**2**	**Inverter identifier**
Sy.	**3**	**Power unit code**
Sy.	**6**	**Inverter address**
Sy.	**7**	**Baud rate ext. bus**
Sy.	**9**	**HSP5 Watchdog time**
Sy.	**11**	**Baud rate int. bus**
Sy.	**32**	**Scope timer**
Sy.	**41**	**Control word high**
Sy.	**42**	**Status word high**
Sy.	**43**	**Control word long**
Sy.	**44**	**Status word long**
Sy.	**50**	**Control word low**
Sy.	**51**	**Status word low**
Sy.	**52**	**Set speed value**
Sy.	**53**	**Actual speed value**
Sy.	**56**	**Start display address**

6.1.4 Explanation to Parameter Description

The parameters described in the following receive a symbol line with following details for a better overview:



6.1.5 Description of the ru-Parameters

ru. 0	Inverter status								
Adr.				min	max		?	default	
0200h	☐	☐	☐	0	78	-	-	-	....

The inverter status shows the current operating condition of the inverter (e.g. constant forward run, standstill etc.). 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 9 „Error Diagnosis".

ru. 1	Set value display								
Adr.				min !ud.2!	max	!ud.2!	?	default	
0201h	☐	☐	☐	-400	400	0.0125	Hz	-	....

Display of current setpoint frequency. The operator displays additionally „noP" and „LS" if the control release or the direction of rotation are not switched.

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

- 18.37 counter-clockwise rotation (reverse)

18.375 clockwise rotation (forward)

ru. 2	Ramp output display								
Adr.				min !ud.2!	max	!ud.2!	?	default	
0202h	☐	☐	☐	-400	400	0,0125	Hz	-	....

The indicated actual frequency corresponds to the rotary field frequency given out at the ramp output. The representation is the same as at ru.1.

ru. 3	Actual frequency display								
Adr.				min !ud.2!	max	ud.3	?	default	
0203h	☐	☐	☐	-400	400	0.0125	Hz	-	....

The indicated actual frequency corresponds to the rotary field frequency given out at the inverter output. The representation is the same as at ru.1.

ru. 4 Encoder 1 frequency

Adr.				min	max	!ud.2!	?	default	
0204h	☐	☐	☐	-400	400	0,0125	Hz	-	....

The displayed value corresponds to the actual frequency measured at the encoder input 1. The value „0“ is indicated, even if no encoder interface is available.

ru. 5 Encoder 2 frequency

Adr.				min	max	!ud.2!	?	default	
0205h	☐	☐	☐	-400	400	0,0125	Hz	-	....

The displayed value corresponds to the actual frequency measured at the encoder input 2. The value „0“ is indicated, even if no encoder interface is available.

ru. 6 Calculated actual frequency

Adr.				min	max	!ud.2!	?	default	
0206h	☐	☐	☐	-400	400	0,0125	Hz	-	....

The displayed value corresponds to the actual frequency calculated from the inverter.

ru. 7 Actual value display

Adr.				min	max	!ud.2!	?	default	
0207h	☐	☐	☐	-400	400	0,0125	Hz	-	....

The displayed value corresponds to the rotary field frequency given out at the inverter output (cS.0 Bit 0...2 = 0 or 1). At cS.0 Bit 0...2 = 2 the frequency of the channel selected in cS.1 is displayed (ru.4/5/6).

ru. 9 Encoder 1 speed

Adr.				min	max	!ud.2!	?	default	
0209h	☐	☐	☐	-4000	4000	0,125	rpm	-	....

The displayed speed corresponds to the actual speed measured at the encoder input 1. The value „0“ is indicated, even if no encoder interface is available.

ru.10 Encoder 2 speed

Adr.				min	max	!ud.2!	?	default	
020Ah	☐	☐	☐	-4000	4000	0,125	rpm	-	....

The displayed speed corresponds to the actual speed measured at the encoder input 2. The value „0“ is indicated, even if no encoder interface is available.

ru.13	Actual utilization								
Adr.				min	max		[?]	default	
020Dh	☐	☐	☐	0	255	1	%	-	....

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.

ru.14	Peak utilization								
Adr.				min	max		[?]	default	
020Eh	☑	☐	☐	0	255	1	%	-	....

ru.14 permits the detection of short-time peak loads within an operating cycle. The highest occurred value of ru.13 is stored in ru.14. The peak value memory can be cleared by pressing the keys UP, DOWN or ENTER and by bus through writing any chosen value to the address of ru.14. Switching off the inverter also results in a clearing of the memory.

ru.15	Apparent current								
Adr.				min	max		[?]	default	
020Fh	☐	☐	☐	0	unit-dependent	0.1	A	-	....

Display of the current apparent current. The maximum values depend on the size of the inverter.

ru.16	Apparent current / peak value								
Adr.				min	max		[?]	default	
0210h	☑	☐	☐	0	unit-dependent	0.1	A	-	....

ru.16 permits the detection of short-time peak currents within an operating cycle. The highest occurred value of ru.15 is stored in ru.16. The peak value memory can be cleared by pressing the keys UP, DOWN or ENTER and by bus through writing any chosen value to the address of ru.16. Switching off the inverter also results in a clearing of the memory.

ru.17	Active current								
Adr.				min	max		[?]	default	
0211h	☐	☐	☐	-unit-depend.	+unit-dependent	0.1	A	-	....

Display of the torque-forming active current (stator losses already deducted). 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.

ru.18	DC-link voltage								
Adr.				min	max		[?]	default	
0212h	☐	☐	☐	0	1000	1	V	-	....

Display of current DC-link voltage. Typical values are

Normal operation:	**230V**-class 300-330V	over volt. (E.OP): approx. 400V	under volt. (E.UP): approx. 216V
	400V-class 530-620V	approx. 800V	approx. 240V

ru.19	DC-link voltage / peak value								
Adr.				min	max		[?]	default	
0213h	☑	☐	☐	0	1000	1	V	-	....

ru.19 permits the detection of short-time voltage rises within an operating cycle. The higest occurred value of ru.18 is stored in ru.19. The peak value memory can be cleared by pressing the keys UP, DOWN or ENTER and by bus through writing any chosen value to the address of ru.19. Switching off the inverter also results in a clearing of the memory.

ru.20	Output voltage								
Adr.				min	max		[?]	default	
0214h	☐	☐	☐	0	778	1	V	-	....

Display of the current output voltage.

ru.21 Input terminal state

Adr.				min	max		?	default	
0215h	☐	☐	☐	0	4095	1	-	-	....

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 (also see Chapt. 6.3 „Digital inputs“). 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.	Decimal Value	Input	Terminal
0	1	ST (prog. input „control release/Reset“)	X2A.16
1	2	RST (prog. input „Reset“)	X2A.17
2	4	F (prog. input „forward“)	X2A.14
3	8	R (prog. input „reverse“)	X2A.15
4	16	I1 (prog. input 1)	X2A.10
5	32	I2 (prog. input 2)	X2A.11
6	64	I3 (prog. input 3)	X2A.12
7	128	I4 (prog. input 4)	X2A.13
8	256	IA (internal input A)	none
9	512	IB (internal input B)	none
10	1024	IC (internal input C)	none
11	2048	ID (internal input D)	none

ru.22 Internal input state

Adr.				min	max		?	default	
0216h	☐	☐	☐	0	4095	1	-	-	....

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 through Strobe, edge-triggering or logic operation). 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 (see ru.21) is indicated (also see Chapt. 6.3 „Digital inputs“)

ru.23	Output condition state								
Adr.				min	max		[?]	default	
0217h	☐	☐	☐	0	255	1	-	-	....

With parameters do.0...do.7 switching conditions can be selected, that serve as a base for setting the outputs. This parameter indicates which of the selected switching conditions are met before they are linked or inverted by programmable logic (also see Chapt. 6.3 „Digital 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	switching condition 0 (do.0)
1	2	switching condition 1 (do.1)
2	4	switching condition 2 (do.2)
3	8	switching condition 3 (do.3)
4	16	switching condition 4 (do.4)
5	32	switching condition 5 (do.5)
6	64	switching condition 6 (do.6)
7	128	switching condition 7 (do.7)

ru.24	State of output flags								
Adr.				min	max		[?]	default	
0217h	☐	☐	☐	0	255	1	-	-	....

Display of the links after logic step 1. The selected switching conditions are linked in logic step 1 (do.8...24) and indicated here (see Chapt. 6.3 „Digital outputs"). According to following table a specific decimal value is given out for each linkage. If several links are set, the sum of the decimal values is indicated.

Bit -No.	Decimal value	Output
0	1	flag 0
1	2	flag 1
2	4	flag 2
3	8	flag 3
4	16	flag 4
5	32	flag 5
6	64	flag 6
7	128	flag 7

ru.25	Output terminal state								
Adr.				min	max		[?]	default	
0218h				0	255	1	-	-	....

Display of the external and internal digital output 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 (transistor output 1)	X2A.18
1	2	O2 (transistor output 2)	X2A.19
2	4	R1 (relay RLA,RLB,RLC)	X2A.24...26
3	8	R2 (relay FLA,FLB,FLC)	X2A.27...29
4	16	OA (internal output A)	none
5	32	OB (internal output B)	none
6	64	OC (internal output C)	none
7	128	OD (internal output D)	none

ru.26	Active parameter set								
Adr.				min	max		[?]	default	
021Ah				0	7	1	-	-	....

The frequency inverter F5-GENERALand F5-BASIC can fall back on 8 internal 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. Independent of it another parameter set can be edited by bus (also see chapter 6.8 „Parameter sets“).

ru.27	Analog input 1 / display before amplification								
Adr.				min	max		[?]	default	
021Bh				-100	100	0.1	%	-	....

This parameter indicates the value of the analog signal AN1 on the differential voltage input (terminal X2A.1 / X2A.2) before signal amplification in percent. In dependence on An.0 the indicated value 0...±100 % corresponds to: 0...±10 V; 0...±20 mA or 4...20 mA (also see Chapt. 6.2 „Analog inputs“).

ru.28	Analog input 1 / display after amplification								
Adr.				min	max		[?]	default	
021Ch				-400	400	0.1	%	-	....

This parameter shows the value of the analog signal AN1 in percent after passing the characteristic amplifier. The range of indication is limited to ±400 % (also see Chapt. 6.2 „Analog inputs“).

ru.29	Analog input 2 / display before amplification								
Adr.				min	max		?	default	
021Dh	☐	☐	☐	-100	100	0.1	%	-	....

This parameter shows the value of the analog signal AN2 on the differential voltage input (terminal X2A.3 / X2A.4) before signal amplification in percent. In dependence on An.10 the indicated value of 0...±100 % corresponds to: 0...±10 V; 0...±20 mA or 4...20 mA (also see Chapt. 6.2 „Analog inputs").

ru.30	Analog input 2 / display after amplification								
Adr.				min	max		?	default	
021Eh	☐	☐	☐	-400	400	0.1	%	-	....

This parameter shows the value of the analog signal AN2 in percent after passing the characteristic amplifier. The range of indication is limited to ±400 % (also see Chapt. 6.2 „Analog inputs").

ru.31	Analog input 3 / display before amplification								
Adr.				min	max		?	default	
021Fh	☐	☐	☐	-100	100	0.1	%	-	....

This parameter shows the value of the analog signal on the optionally analog input AN3 before signal amplification in percent. The indicated value of 0...±100 % corresponds to 0...±10 V (also see Chapt. 6.2 „Analog inputs").

ru.32	Analog input 3 / display after amplification								
Adr.				min	max		?	default	
0220h	☐	☐	☐	-400	400	0.1	%	-	....

This parameter shows the value of the analog signal AN3 in percent after passing the characteristic amplifier. The range of indication is limited to ±400 % (also see Chapt. 6.2 „Analog inputs").

ru.33	Analog output 1 / display before amplification									
Adr.				min	max		[?]	default	
0221h	☐	☐	☐	-400	400	0.1	%	-	....

This parameter shows the value of the analog signal ANOUT1 in percent before passing the characteristic amplifier (also see Chapt. 6.2. „Analog outputs“).

ru.34	Analog output 1 / display after amplification								
Adr.				min	max		[?]	default	
0222h	☐	☐	☐	-100	100	0.1	%	-	....

This parameter shows the value of the signal given out on analog output ANOUT1 (terminal X2A.5) in percent. A value of 0...±100 % correponds to an output signal of 0...±10 V (also see Chapt. 6.2 „Analog outputs“).

ru.35	Analog output 2 / display before amplification								
Adr.				min	max		[?]	default	
0223h	☐	☐	☐	-400	400	0.1	%	-	....

This parameter shows the value of the analog signal ANOUT2 in percent before passing the characteristic amplifier (also see Chapt. 6.2 „Analog outputs“).

ru.36	Analog ouptut 2 / display after amplification								
Adr.				min	max		[?]	default	
0224h	☐	☐	☐	0	100	0.1	%	-	....

This parameter shows the value of the signal given out on analog output ANOUT2 (terminal X2A.6) in percent. The value of 0...±100 % corresponds to an output signal of 0...±10 V (also see Chapt. 6.2 „Analog outputs“).

ru.37	Motorpoti - actual value								
Adr.				min	max		[?]	default	
2025h	☑	☑	☐	-100	100	0.01	%	0	....

The motorpoti-function in the KEB COMBIVERT imitates a mechanical, motor operated potentiometer. The control occurs via 2 programmable inputs („poti up“ and „poti down“). The display is limited by oP.53/54. The adjustment of the motorpoti is done with the parameters oP.50...oP.59 (also see Chapt. 6.9.3 „Motorpoti“). 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.

ru.38	Power module temperature								
Adr.				min	max		?	default	
0226h	☐	☐	☐	0	150	1	°C	-	....

ru.38 shows the current power moduls temperature of the inverter.

ru.39	OL - counter display								
Adr.				min	max		?	default	
0227h	☐	☐	☐	0	100	1	%	-	....

In order to preclude „E.OL“ - errors by too high load (load reduction in due time), the internal count of the OL-counter can be made visible with this indication. At 100 % the inverter switches off with error „E.OL“. The error can be reset only after a cooling time (blinking display „E.nOL“).

ru.40	Operating hours meter								
Adr.				min	max		?	default	
0228h	☑	☐	☐	0	65535	1	h	-	....

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 indication remains on the maximum value.

ru.41	Modulation hours meter								
Adr.				min	max		?	default	
0229h	☑	☐	☐	0	65535	1	h	-	....

The modulation hours meter shows the time the inverter was active (power modules controlled). On reaching the maximum value (approx. 7.5 years) the indication remains on the maximum value.

ru.42	Modulation factor								
Adr.				min	max		?	default	
022Ah	☐	☐	☐	0	110	1	%	-	....

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.

ru.43	Timer 1 / display								
Adr.				min	max		?	default	
022Bh	☑	☐	☐	0	655.35	0.01	s / h	-	....

The count of the free-programmable timer 1 is indicated. The display is done either in seconds, in hours or in slopes/ 100 (see LE.21). The counter can a adjusted to any chosen value by keyboard or bus. The programming of the counter is done with the parameters LE.17...LE.21 (also see Chapt. 6.9.4 „Timer“).

ru.44	Timer 2 / display								
Adr.				min	max		[?]	default	
022Ch	☑	☐	☐	0	655.35	0.01	s / h	-	....

The count of the free-programmable timer 2 is indicated. The display is done either in seconds, in hours or in slopes/ 100 (see LE.26). The counter can be adjusted to any chosen value by keyboard or bus. The programming of the counter is done with the parameters LE.22...LE.26 (also see Chapt. 6.9.4 „Timer").

ru.45	Actual switching frequency								
Adr.				min	max		[?]	default	
022Dh	☐	☐	☐	0	4	1	-	-	....

Shows the current switching frequency of the inverter. The displayed value corresponds to following switching frequencies:

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

ru.46	Motor temperature (optionally)								
Adr.				min	max		[?]	default	
022Eh	☐	☐	☐	0	255	1	°C	-	....

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

0: T1/T2 closed
253, 254: broken cable; short circuit; detection error
255: T1/T2 open

ru.52	External PID out display								
Adr.				min	max		[?]	default	
0234h	☐	☐	☐	-100,0	100,0	0,1	%	-	....

A universal PI-controller is integrated into the inverter. It can be used externally as well as internally. The indicated manipulated variable is given out in a range of ±100 %.

ru.53	AUX display								
Adr.				min	max		[?]	default	
0235h	☐	☐	☐	-400,0	400,0	0,1	%	-	....

The AUX input is setting with An.30. This parameter shows the value of the analog signal AUX in percent. The range of indication is limited to ±400 % (also see Chapt. 6.2 „Analog inputs").

ru.68	Rated DC voltage								
Adr.				min	max		[?]	default	
0244h	☐	☐	☐	0	1000	1	V	-	....

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

ru.69	Distance ref.- zeropoint								
Adr.				min	max		[?]	default	
0245h	☑	☐	☐	-2^31	2^31-1	1	inc.	0	....

This parameter displays the distance to the zeropoint after relieve the reference switch.

ru.71	Teach/ scan position								
Adr.				min	max		[?]	default	
0247h	☐	☐	☐	-2^31	2^31-1	1	inc.	0	....

This parameter displays the current teach position. This position remains until a new position is teached.

ru.73	Set torque in percent								
Adr.				min	max		[?]	default	
0249h	☐	☐	☐	-100,0	100,0	0,1	%	0	....

This parameter displays the set torque (ru.11) in percent at the input referring to the absolute torque reference (cs.19).

6

ru.74	Act. torque in percent								
Adr.				min	max		[?]	default	
024Ah	☐	☐	☐	-100,0	100,0	0,1	%	0	....

This parameter displays the actual torque display (ru.12) in percent at the input referring to the absolute torque reference (cs.19).

ru.78	Act. val. display in perc.								
Adr.				min	max		[?]	default	
024Eh	☐	☐	☐	-100,0	100,0	0,1	%	0	....

This parameter displays the actual value display (ru.7) in percent referring to the max. reference forward (oP.10).

ru.79	Abs. speed value (EMK)								
Adr.				min	max		[?]	default	
024Fh	☐	☐	☐	n*-4000	n*4000	n*-125	rpm	0	....

In order to protect the inverter against overvoltage in the field weakening range, an EMK dependent speed should not be exceeded. This calculated value has priority to all other limits. It is is displayed in ru.79.

ru.80 Digital output state

Adr.	min	max	step	unit	default
0250h	0	255	1	-	0

With do.51 the digital output signals can be assigned to the hardware outputs (see chapter 6.3.). This parameter shows the digital output state of the output signals in accordance with the following table. If several outputs are set, the sum of the decimal values is indicated.

Bit -No.	Decimal value	Output	Terminal
0	1	O1 (Transistor output 1)	X2A.18
1	2	O2 (Transistor output 2)	X2A.19
2	4	R1 (Relay RLA,RLB,RLC)	X2A.24...26
3	8	R2 (Relay FLA,FLB,FLC)	X2A.27...29
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

ru.81 Active power

Adr.	min	max	step	unit	default
0251h	-400,00	400,00	0,00	kW	0,00

The active power of the inverter is displayed with parameter ru.81. Negative values are displayed during generatoric operation

6.1.6 Description of the In-Parameters

In. 0	Inverter type								
Adr.	(edit)	(set)	(enter)	min	max	step	[?]	default	(notes)
0E00h	☐	☐	☐	0h	FFFFh	1	hex	-	....

The inverter type is displayed in hexadecimal numbers. The bits have following meaning:

Bit 0-4	Unit size	05, 07, 09 etc.		
Bit 5	Voltage class	0 = 230 V 1 = 400 V		
Bit 6	Phase number	0 = 1-phase 1 = 3-phase		
Bit 7	free			
Bit 8-12	Housing	0 = A 1 = B 2 = C 3 = D 4 = E 5 = F 6 = G 7 = H 8 = I 9 = J	10 = K 11 = L 12 = M 13 = N 14 = O 15 = P 16 = Q 17 = R 18 = S 19 = T	20 = U 21 = V 22 = W 23 = X 24 = Y 25 = Z
Bit 13-15	Control	0 = G 1 = M 2 = B 3 = S 4 = A 5 = C 6 = R		

Example:

hex	0				4				0				A			
binary	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0
decimal	0			4					0		0	10				

=> 10.F5 G-Control / E-housing / 230V / 1ph.

In. 1	Rated inverter current								
Adr.	(edit)	(set)	(enter)	min	max	step	[?]	default	(notes)
0E01h	☑	☐	☐	0	710	0.1	A	-	....

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

6

In. 3	Max. switching frequency								
Adr.				min	max		[?]	default	
0E03h	☐	☐	☐	0	4	1	-	P-ID	....

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

0: 2 kHz / 1: 4 kHz / 2: 8 kHz / 3: 12 kHz / 4: 16 kHz

In. 4	Rated switching frequency								
Adr.				min	max		[?]	default	
0E04h	☐	☐	☐	0	4	1	-	P-ID	....

Display of the rated switching frequency. The displayed value corresponds to the following switching frequencies:

0: 2 kHz / 1: 4 kHz / 2: 8 kHz / 3: 12 kHz / 4: 16 kHz

In. 6	Software version								
Adr.				min	max		[?]	default	
0E06h	☐	☐	☐	0.00	9.99	0.01	-	-	....

Display of the software version number..

1. and 2. digit: Software version (z.B. 2.1)

3. digit: Special version (0 = standard)

In. 7	Software date								
Adr.				min	max		[?]	default	
0E07h	☐	☐	☐	-	-	0.1	-	-	....

Display of the software date. The value contains day, month and year, from the year only the last digit is indicated.

Example: Display = 2102.0

Date = 21.02.2000

In. 8	Software version LT								
Adr.				min	max		?	default	
0E08h	☐	☐	☐	0.00	9.99	0.01	-	-	....

This parameter shows the software version of the power section. Definition like at In.6.

In. 9	Software date LT								
Adr.				min	max		?	default	
0E09h	☐	☐	☐	-	-	0.1	-	-	....

Display of the software date of the power section. Display and value range like at In.7.

In.10	Serial number / date				0E0Ah				
In.11	Serial number / counter				0E0Bh				
In.12	Serial number / Ackn.-No. high				0E0Ch				
In.13	Serial number / Ackn.-No. low				0E0Dh				
In.14	Customer number / high				0E0Eh				
In.15	Customer numer / low				0E0Fh				
In.16	QS-number				0E10h				
Adr.				min	max		?	default	
s.a.	☑	☐	☐	0	65535	1	-	0	....

The serial number and the customer number identify the inverter. The QS-number contains production internal information.

In.17	Temperature mode								
Adr.				min	max		?	default	
0E11h	☐	☐	☐	0	P-ID	1	-	P-ID	....

This parameter is for service personell only.

In.22	User parameter 1								
Adr.				min	max		[?]	default	
0E16h	☑	☐	☐	0	65535	1	-	0	....

This parameter is not assigned to any function and is available to the user for input.

In.23	User parameter 2								
Adr.				min	max		[?]	default	
0E17h	☑	☐	☐	0	65535	1	-	0	....

This parameter is not assigned to any function and is available to the user for input.

In.24	Last error								
Adr.				min	max		[?]	default	
0E18h	☐	☐	☐	0	255	1	-	-	....

In.24 shows the last error that occurred.E. UP is not stored. The error messages are described at chapter 9.

In.25	Error diagnosis								
Adr.				min	max		[?]	default	
0E19h	☐	☑	☐	0	65535	1	-	4095	....

Shows the last 8 errors that occurred (in the sets 0...7). 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 0...4094 difference time minutes
Value 4095 difference time > 4094 minutes

Bit 12...15

Value	Error type	Value	Error type	Value	Error type
0	no error	3	E.OP	6...15	free
1	E.OC	4	E.OH		
2	E.OL	5	E.OHI		

In.26	Error counter OC	0E1Ah							
In.27	Error counter OL	0E1Bh							
In.28	Error counter OP	0E1Ch							
In.29	Error counter OH	0E1Dh							
In.30	Error counter OHI	0E1Eh							
Adr.				min	max		[?]	default	
s.o.	☑	☐	☐	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.

6.1.7 Description of the Sy-Parameters

Sy. 2	Inverter identifier								
Adr.				min	max		[?]	default	
0002h	☑	☐	☐	0000	9999	1	hex	-	....

A unique number is assigned to each type of frequency inverter which identifies the hard- and software. This value is used for example by COMBIVIS to load the correct configuration files. Sy.2 kann mit dem angezeigten Wert beschrieben werden (z.B. zur Identifikation von Downloadlisten).

Sy. 3	Power unit code								
Adr.				min	max		[?]	default	
0003h	☑	☐	☐	-255	255	1	P-ID	-	....

On the basis of the power circuit identification the control recognizes the used power circuit respectively a change of the power circuit and adjusts certain parameters accordingly. To accept a new P-Id enter positive values (see chap. 9 „E.Puch").

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Sy. 6	Inverter address								
Adr.				min	max		[?]	default	
0006h	☑	☐	☑	0	239	1	-	1	....

With Sy.6 the address is adjusted under which the inverter is addressed by „COMBIVIS" or another control. The possible values are between 0 and 239, the default value is 1. If several inverters are operated simulaneously on the bus, it is absolutely necessary to assign different addresses, since otherwise communication problems arise because several inverters may responded at the same time. The development info DIN 66019II protocol (C0.F5.01I-K001) contains further information.

Sy. 7	Baud rate ext. bus								
Adr.				min	max		[?]	default	
0007h	☑	☐	☑	0	6	1	-	5	....

Following values are possible for the baudrate of the serial interface:

Parameter value	Baudrate
0	1200 baud
1	2400 baud
2	4800 baud
3 (default)	9600 baud
4	19200 baud
5	38400 baud
6	55500 baud

If the value for the baudrate is changed over the serial interface, it can only be changed again by way of the keyboard or after adapting the baudrate of the master, since no communication is possible in the case of different baudrates between master and slave.
If problems occur during the data transmission, select a baudrate up to max. 38400 baud.

Sy. 9 HSP5 Watchdaog time

Adr.				min	max		?	default	
0009h	☑	☐	☑	0 (off)	10,00	0,01	s	0 (off)	....

The HSP5 Watchdog-function monitores the communication of the HSP5-interface (control card - operator; or control card - PC). After expiration of an adjustable time (0,01...10 s) without incoming telegrams, the response adjusted in Pn.5 is triggered. The value „off“ deactivates the function.

Sy. 11 Baud rate int. bus

Adr.				min	max		?	default	
000Bh	☑	☐	☑	3	11	1	-	5	....

With the internal baudrate the transmission rate between operator and inverter is determined. Following values are possible:

Value	Baudrate	Value	Baudrate	Value	Baudrate
3	9,6 kBaud	6	55,5 kBaud	9	115,2 kBaud
4	19,2 kBaud	7	57,6 kBaud	10	125 kBaud
5	38,4 kBaud	8	100 kBaud	11	250 kBaud

Sy. 32 Scope Timer

Adr.				min	max		?	default	
0020h	☐	☐	☐	0	65535	1	-	0	....

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.

Sy. 41 Control word high

Adr.				min	max		?	default	
0029h	☑	☐	☑	0	65535	1	-	0	....

The control word is used for the status control of the inverter via bus. The control word long (Sy.43) consists of the two 16 bit parameters control word high (Sy.41) and Control word low (Sy.50). The status word is bit-coded. The description of the individual bits is found in Chapter 11.2.7.

Sy. 42 Status word high

Adr.				min	max		?	default	
002Ah	☐	☐	☐	0	65535	1	-	0	....

With the status word the current condition of the inverter can be readout. The status word long (Sy.44) consists of the two 16 bit parameters status word high (Sy.42) and status word low (Sy.51). The status word is bit-coded. The description of the individual bits is found in Chapter 11.2.7.

Sy. 43	Control word long								
Adr.	[write]	[keypad]	[enter]	[min]	[max]	[resolution]	[?]	[default]	[notes]
002Bh	☑	☐	☑	-2147483648	2147483647	1	-	0	....

The control word is used for the status control of the inverter via bus. The control word long (Sy.43) consists of the two 16 bit parameters control word high (Sy.41) and Control word low (Sy.50). The status word is bit-coded. The description of the individual bits is found in Chapter 11.2.7.

Sy. 44	Status word long								
Adr.	[write]	[keypad]	[enter]	[min]	[max]	[resolution]	[?]	[default]	[notes]
002Ch	☐	☐	☐	-2147483648	2147483647	1	-	0	....

With the status word the current condition of the inverter can be readout. The status word long (Sy.44) consists of the two 16 bit parameters status word high (Sy.42) and status word low (Sy.51). The status word is bit-coded. The description of the individual bits is found in Chapter 11.2.7.

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Sy. 50	Control word								
Adr.	[write]	[keypad]	[enter]	[min]	[max]	[resolution]	[?]	[default]	[notes]
0032h	☑	☐	☑	0	65535	1	-	0	....

The control word is used for the status control of the inverter via bus. The control word long (Sy.43) consists of the two 16 bit parameters control word high (Sy.41) and Control word low (Sy.50). Das Steuerwort ist bitcodiert. The status word is bit-coded. The description of the individual bits is found in Chapter 11.2.7.

Sy. 51	Status word								
Adr.	[write]	[keypad]	[enter]	[min]	[max]	[resolution]	[?]	[default]	[notes]
0033h	☐	☐	☐	0	65535	1	-	0	....

With the status word the current condition of the inverter can be readout. The status word long (Sy.44) consists of the two 16 bit parameters status word high (Sy.42) and status word low (Sy.51). Das Steuerwort ist bitcodiert. The status word is bit-coded. The description of the individual bits is found in Chapter 11.2.7.

Sy. 52	Set speed value								
Adr.	[write]	[keypad]	[enter]	[min]	[max]	[resolution]	[?]	[default]	[notes]
0034h	☑	☐	☐	-16000	16000	1	rpm	0	....

Presetting of the setpoint speed in the range of ±16000 rpm. The source of direction of rotation is determined as with the other absolute setpoint sources over oP.1. The setpoint source oP.0 must be adjusted to „5“ for setpoint setting by Sy.52.

Sy. 53	Actual speed value								
Adr.				min	max		[?]	default	
0035h	☐	☐	☐	-16000	16000	1	rpm	0	....

With this parameter the current actual speed can be readout in rpm. The direction of rotation is signaled by the sign.

Sy. 56	Start display address								
Adr.				min	max		[?]	default	
0038h	☑	☐	☑	0	7FFF	1	hex	0203	....

Sy.56 adjusts the parameter address which shall be represented on switching on the operator. Only valid addresses are accepted.
If this parameters is available in the CP-Mode, the setting becomes effective there. Otherwise CP.0 is indicated as start parameter.

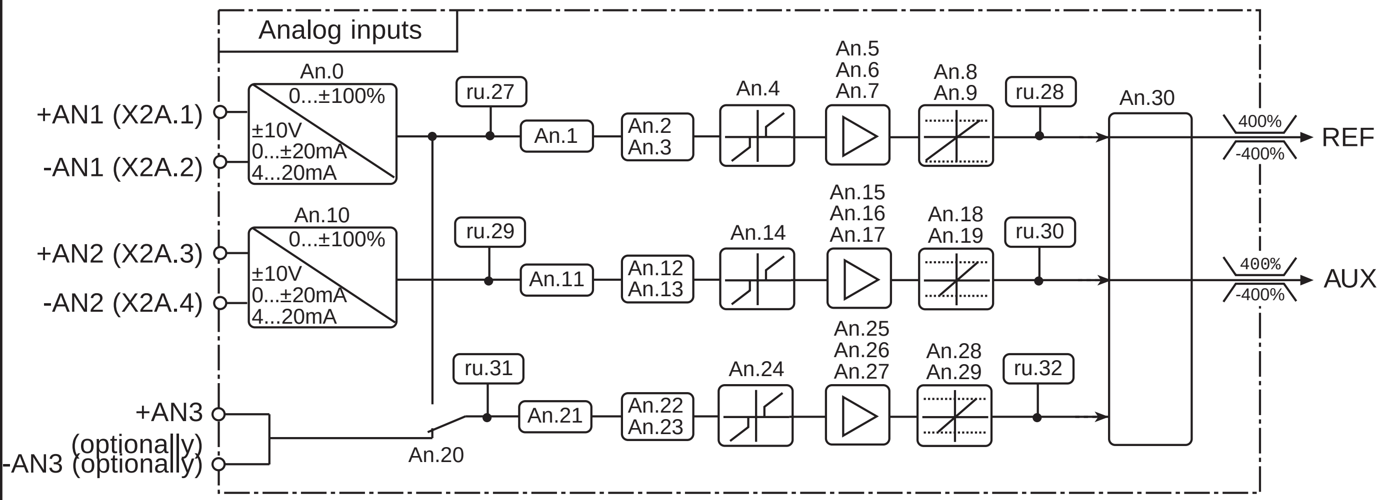
6.2 Analog In- and Outputs

6.2.1 Summary Description Analog Inputs

Observe the different functional range of the hard- and software of the different control cards (see chapter 3).

By selecting an input interface (An.0 / 10) input AN1, e.g. AN2 can be adjusted to the applied input signal. By An.20 the third analog input can be switched additionally to AN1. Subsequently the analog inputs are smoothed in an electronic filter (An.1 / 11 / 21) by averaging. With An.2 / 12 / 22 a save mode can be adjusted and activated with a programmable input (An.3 / 13 / 23). 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 % (An.4 / 14 / 24). In the characteristics amplifier the input signals can be influenced in X and Y direction as well as in the rise (An.5...7 / 15...17 / 25...27). At the output of the characteristic amplifier the signal can be limited to a minimum and a maximum value (An.8, 9 / 18, 19 / 28, 29). At the output of the block it can be defined with An.30 which analog signal serves as reference value and which one serves as auxiliary value. The ru-parameters are used for the indication of the analog signal before and after the amplification. The internal values are limited to ±400%.

Fig. 6.2.1 Principle of the analog inputs



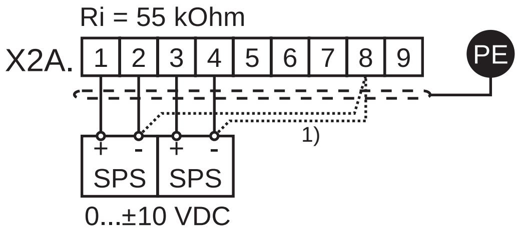
An. 0	**AN1 Interface selection**	**An. 19**	**AN2 Upper limit**
An. 1	**AN1 Interference suppression filter**	**An.20**	**AN3 Interface selection**
An. 2	**AN1 Save mode**	**An.21**	**AN3 Interference suppression filter**
An. 3	**AN1 Input selection**	**An.22**	**AN3 Save mode**
An. 4	**AN1 Zero point hysteresis**	**An.23**	**AN3 Input selection**
An. 5	**AN1 Amplification**	**An.24**	**AN3 Zero point hysteresis**
An. 6	**AN1 Offset X**	**An.25**	**AN3 Amplification**
An. 7	**AN1 Offset Y**	**An.26**	**AN3 Offset X**
An. 8	**AN1 Lower limit**	**An.27**	**AN3 Offset Y**
An. 9	**AN1 Upper limit**	**An.28**	**AN3 Lower limit**
An.10	**AN2 Interface selection**	**An. 29**	**AN3 Upper limit**
An.11	**AN2 Interference suppression filter**	**An.30**	**Selection REF-input / AUX-function**
An.12	**AN2 Save mode**	**ru. 27**	**AN1 Display before amplification**
An.13	**AN2 Input selection**	**ru. 28**	**AN1 Display after amplification**
An.14	**AN2 Zero point hysteresis**	**ru. 29**	**AN2 Display before amplification**
An.15	**AN2 Amplification**	**ru. 30**	**AN2 Display after amplification**
An.16	**AN2 Offset X**	**ru. 31**	**AN3 Display before amplification**
An.17	**AN2 Offset Y**	**ru. 32**	**AN3 Display after amplification**
An.18	**AN2 Lower limit**		

6.2.2 Interface Selection (An.0; An.10)

Depending on the selected interface (An.0/An.10) the analog inputs AN1 and AN2 can process following input signals:

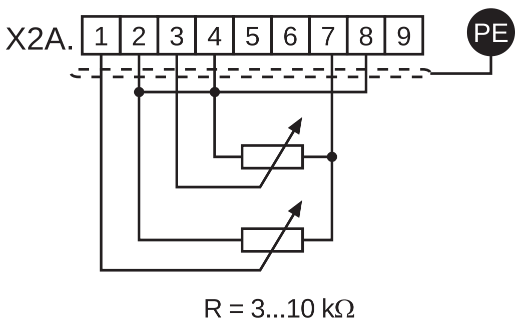
An.0 / An.10	= 0	0...±10 V (default)
	= 1	0...±20 mA
	= 2	4...20 mA

Fig. 6.2.2.a Connection as differential voltage inputs 0...±10V DC



1) Connect equipotential bonding conductor only, if a potential difference of > 30V exists between the controls. The internal resistance is reduced to 30 kOhm.

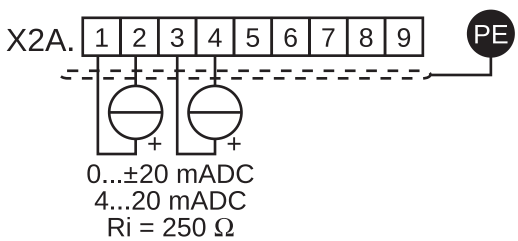
Fig. 6.2.2.b Control with potentiometer and internal reference voltage



0...10V DC
Ri=30kW
(An.0 / An.10 = 0)

The output CRF Kl. X2A.7 may be loaded with maximal 6mA!

Fig. 6.2.2.c Control with current signal



An.0 / An.10 = 1 or 2

Interface Selection (An.20)

With An.20 it is determined from where the 3. analog setpoint signal is received. Following values can be defined:

Value	Function
0	Analog value from the optional analog input (default)
1	Analog value via the terminals of AN1

6.2.3 Interference Suppression Filter (An.1; An.11; An.21)

The interference suppression filters shall suppress disturbances and ripples of the input signals. If the interference suppression filter is switched off the analog inputs are queried every 1 ms (control card BASIC 2 ms) and the recorded value is then transferred. With the interference suppression filters the inputs can now be queried 2-, 4-, 8- or 16-times. From these values an average value is determined which is then transferred.

An.1 / 11 / 21	Function
0	no averaging (default)
1	averaging over 2 values
2	averaging over 4 values
3	averaging over 8 values
4	averaging over 16 values

6.2.4 Save Mode (An.2; An.12; An.22)

Coming from the input filter the save mode can be switched on with An.2 / An.12 / An.22. If now the programmable digital input (value 1) is set the analog signal is processed directly and written parallel into the nonvolatile memory. As soon as the digital input is disconnected (value 0), the inverter continous to run with value stored in the memory. Moreover, with An.2 / An.12 / An.22 it can be determined whether the memory contents are saved or deleted upon switch off. The parameter is bit-coded, the sum of the decimal values must be entered.

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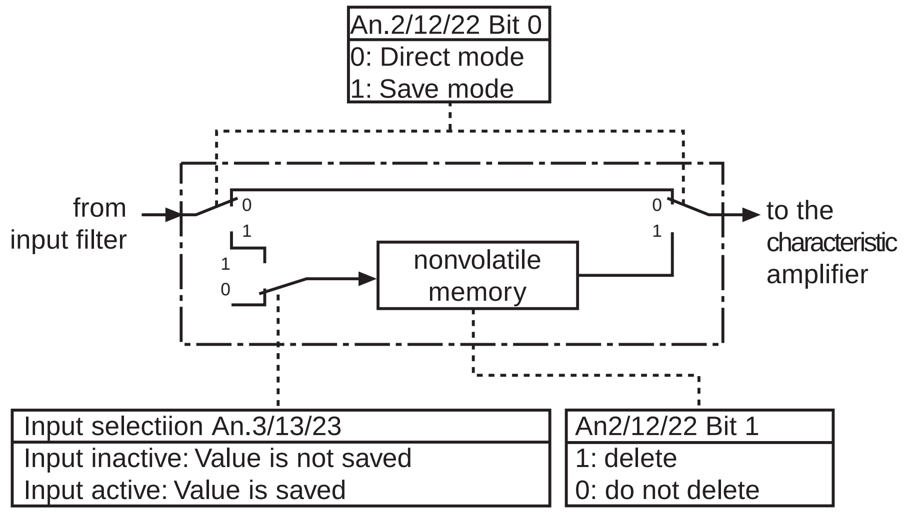
Bit	Dez.	Meaning
0	0	Direct mode (default)
	1	Save mode
1	0	Do not delete memory contents at switch off (default)
	2	Delete memory contents at switch off

Bild 6.2.4 Save mode



6.2.5 Input Selection (An.3; An.13; An.23)

With An.3 / 13 / 23 the digital inputs for storing are selected according to the table on the next page (also see Chapter 6.3.11 „Assignment of inputs“). In order to save an analog value, the save mode (An.2 / 12 / 22 = 1) must be switched on under An2 / 12 / 22 and the selected input must be activated.

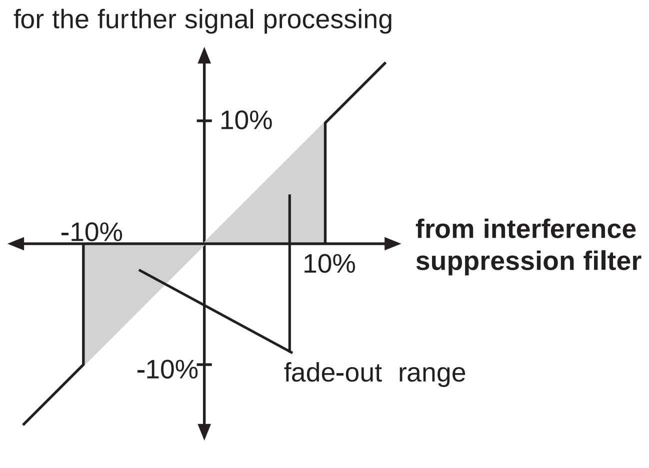
Input selection table

Bit -No.	Decimal value	Input	Terminal
0	1	ST (prog. input „control release/Reset“)	X2A.16
1	2	RST (prog. input „Reset“)	X2A.17
2	4	F (prog. input „forward“)	X2A.14
3	8	R (prog. input „reverse“)	X2A.15
4	16	I1 (prog. input 1)	X2A.10
5	32	I2 (prog. input 2)	X2A.11
6	64	I3 (prog. input 3)	X2A.12
7	128	I4 (prog. input 4)	X2A.13
8	256	IA (internal input A)	none
9	512	IB (internal input B)	none
10	1024	IC (internal input C)	none
11	2048	ID (internal input D)	none

6.2.6 Zero Point Hysteresis (An.4; An.14; An.24)

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 point hysteresis to suppress this.
With the parameters An.4 / 14 / 24 the respective analog signals can be faded out within a range of 0...10% . The adjusted value is applicable for both directions of rotation.
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.

Fig. 6.2.6 Zero point hysteresis



Value range

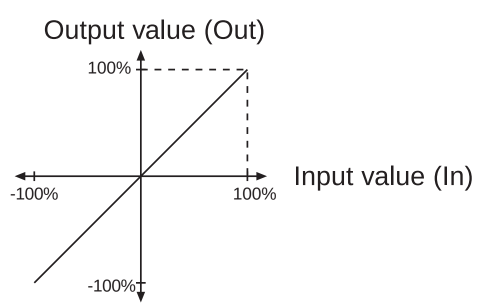
Input	Parameter	Value range	Resolution	Default value
AN1	An.4	0...±10%	0,1%	0,2%
AN2	An.14	0...±10%	0,1%	0,2%
AN3	An.24	0...±10%	0,1%	0,2%

6.2.7 Amplifier of the Input Characterstic (An.5...7; An.15...17; An.25...27)

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 step (see Fig. 6.2.7.a) The output value is calculated according to following formula:

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

Fig. 6.2.7.a Factory setting: no Offset, Gain 1

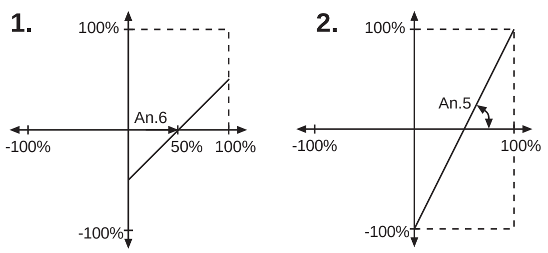


Input	AN1	AN2	AN3	Value range	Resolution	Default value
Amplification	An.5	An.15	An.25	-20,00...20,00	0,01	1,00
Offset X	An.6	An.16	An.26	-100,0%...100,0%	0,1%	0,0%
Offset Y	An.7	An.17	An.27	-100,0%...100,0%	0,1%	0,0%

By means of some examples, we want to show the possibilities of this function. According to Fig. 6.2.7.b

1. adjustment of the X-Offset for input AN1 to 50 (%)
2. adjustment of the amplificaiton to 2

Fig. 6.2.7.b X-Offset (An.6)=50%; amplification (An.5)=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

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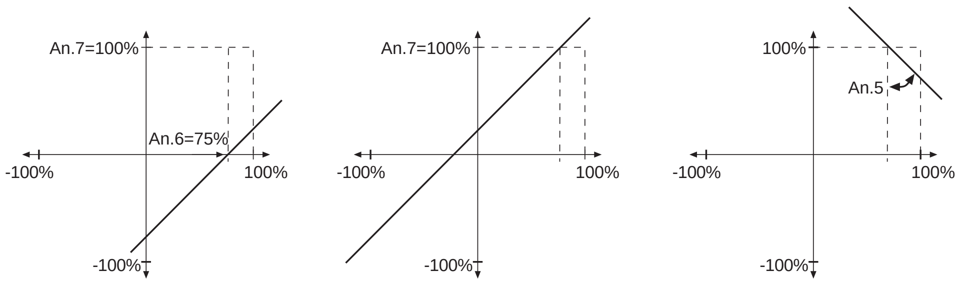
According to Fig. 6.2.7.c
1. adjustment of the X-Offset for input AN1 to 75 (%)
2. adjustment of the Y-Offset for input AN1 to 100 (%)
3. adjustment of the amplificaiton to -1

Fig. 6.2.7.c X-Offset (An.6)=75%; Y-Offset (An.7)= 100%; amplification. (An.5)= -1.00

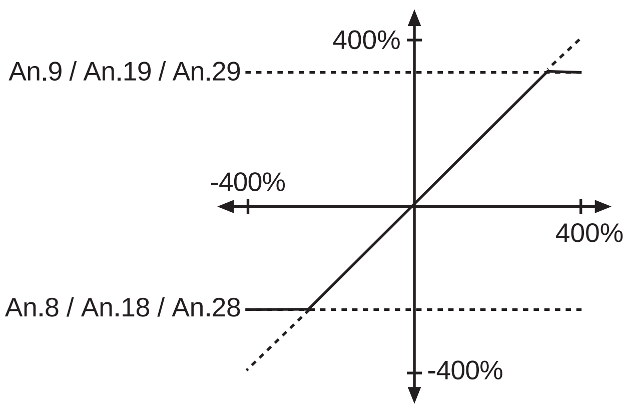


6.2.8 Lower and Upper Limit (An.8; An.9; An.18; An.19; An.28; An.29)

These parameters serve for the 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 (exception F5-M: if lower limit > upper limit then the output value is the lower limit).

An.8 AN1 lower limit
An.9 AN1 upper limit
An.18 AN2 lower limit
An.19 AN2 upper limit
An.28 AN3 lower limit
An.29 AN3 upper limit

Fig. 6.2.8 Limiting of the analog signal



6.2.9 Selection Set Point-/Auxiliary Input (An.30)

Following functions are combined in An.30:

- Bit 0..2 Selection of the analog input (AN1, AN2, AN3) as REF analog
- Bit 3..5 Mode of the AUX-Function
- Bit 6..10 Selection source 1 for the AUX-Function
- Bit 11..15 Selection source 2 for the AUX-Function

For possible expansions not all values are defined in the bit groups. Not defined values have the same function as value 0. The sum of the respective values is to be entered.

Assignment of the analog inputs:

Bit 0..2	Function	
Value	REF analog	
0	AN1 (ru.28) (default)	
1	AN2 (ru.30)	x
2	AN3 (ru.32)	x
Bit 3..5	Function	
Value	Mode of the AUX-Function	
0	Source 1 (default)	
8	Source 1 + Source 2	
16	Source 1 * (100% + Source 2)	
24	Source1 * Source 2	
32	Source1 absolute	
Bit 6..10	Function	
Value	Aux-input source 1	
0	AN1 (ru.28)	
64	AN2 (ru.30) (default)	x
128	Percental setpoint value (op.5)	
192	Motorpoti (ru.37)	
256	Process controller output (ru.52)	
320	AN3 (ru.32)	x
Bit 11..15	Function	
Value	Aux-input source 2	
0	AN1 (ru.28)	
2048	AN2 (ru.30) (default)	x
4096	Percental setpoint value (op.5)	
6144	Motorpoti (ru.37)	
8192	Process controller output (ru.52)	
11240	AN3 (ru.32)	x

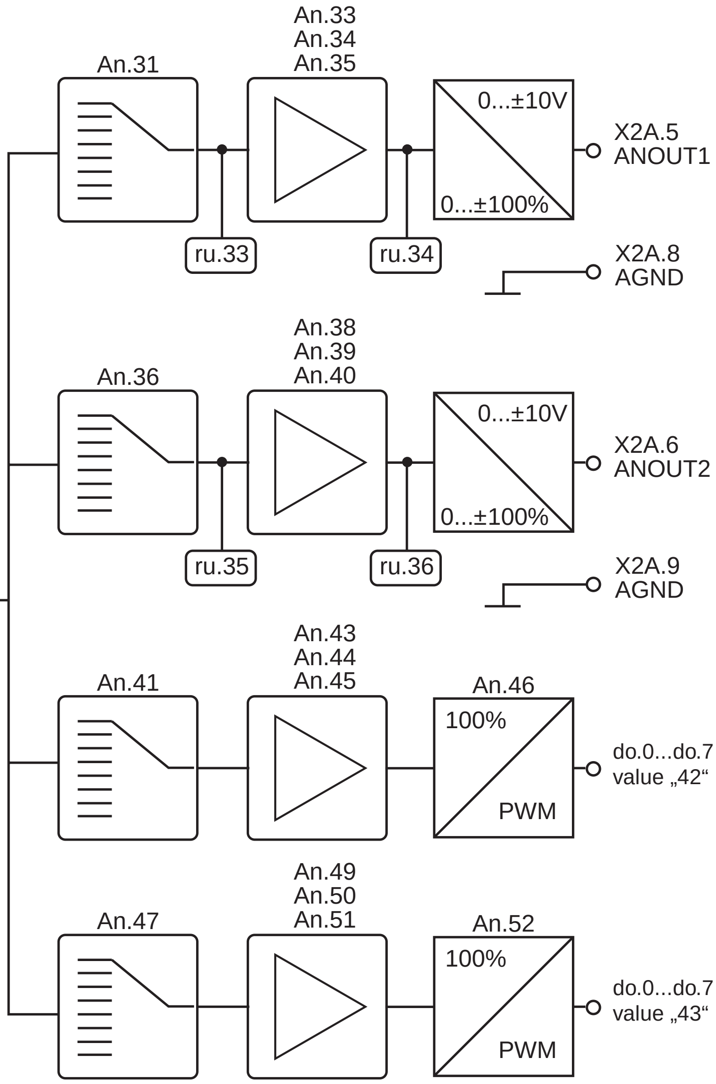
x: not for control card BASIC

6.2.10 Brief Description Analog Outputs

The KEB COMBIVERT has three programmable analog outputs (ANOUT1...4). Parameters An.31 and An.36 allow the selection of one size each which is given out at the outputs X2A.5 / 6. The third and fourth analog output (An.41/47) is not led to the terminal strip, it can be output as switching condition 42, e.g. 43 with the digital outputs as PMW-signal. By means of the characteristic amplifier (An.33...35 / 38...40 / 43...45/ 49...51) the analog signals can be adapted to the requirements. The ru-parameters show the current size before and after the amplification. The period time for the PWM-signal can be adjusted with An.46/52.

Fig. 6.2.10 Principle of analog output

100% correspond to An.31/36/41/47 =		
absolute actual value (100 Hz/1000 min^{-1})	0	ru.7
absolute set value (100 Hz/±1000 min^{-1})	1	ru.1
actual value (±100 Hz/±1000 min^{-1})	2	±ru.7
set value (±100 Hz/±1000 min^{-1})	3	±ru.1
output voltage (500 V)	4	ru.20
DC voltage (1000 V)	5	ru.18
apparent current (2 * I_{rated})	6	ru.15
active current (2 * ±I_{rated})	7	ru.17
digital An.32/37/42/48	8	An.xx
external PID output (±100 %)	9	±ru.52
absolute ext. PID output (100 %)	10	ru.52
absolute active current (2 • I_{rated})	11	ru.17
Power mod. temperature (100 °C)	12	ru.38
Motor temperature (100 °C)	13	ru.46
actual torque (F5-M/S)	14	±ru.12
absolute actual torque (F5-M/S)	15	ru.12
set torque (F5-M/S)	16	±ru.11
absolute set torque (F5-M/S)	17	ru.11
system deviation/speed controller (±100Hz/±1000min^{-1})	18	-
speed reference variable (±100 Hz/±1000 min^{-1})	19	±ru.2
absolute speed reference variable (100 Hz/1000 min^{-1})	20	ru.2

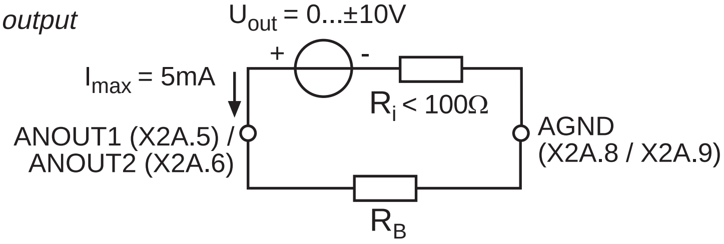


Observe the different functional range of the hard- and software of the different control cards !
The reference values of real and set values depends on ud.2.

6.2.11 Output signals

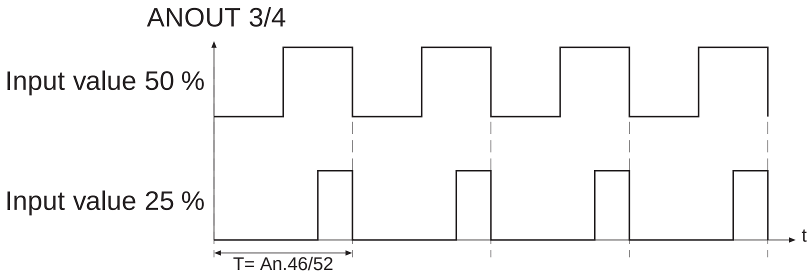
A voltage of 0...±11,5 VDC represents the selected size in the range of 0...±115 % with a resolution of ±10 Bit at the output. 100% correspond to the bracket values specified in Fig. 6.2.10. In order to be able to balance load-dependent voltage drops, the limitation at the output of the characteristic amplifiers is ±115 %.

Fig. 6.2.11 Analog output



Process variables, that change only slowly, as for example the power module temperature, can be output over two virtual analog outputs (ANOUT3 and 4). This is realised through generation of a PWM-signal (pulse-width-modulation) on a digital output. At that the period T is adjustable from 1...240 s.

Bild 6.2.11.a PWM - output signal



6.2.12 Analog Output / Functions (An.31/An.36/ An.41)

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

An.xx	Function	Scaling factor 0...100 %
0	absolute actual value	0...100 Hz/3000 min^{-1} [2)]
1	absolute set value	0...100 Hz/3000 min^{-1} [2)]
2	actual value ru.7	0...±100 Hz/±3000 min^{-1} [2)]
3	set value ru.1	0...±100 Hz/±3000 min^{-1} [2)]
4	output voltage ru.20	0...500 V
5	DC voltage ru.18	0...1000 V
6	apparent current ru.15	0...2 • I_{rated} [1)]
7	active current ru.17	0...2 • $\pm I_{rated}$ [1)]
8	digital An.32/An.37/An.42	0...100 %
9	external PID output ru.52	0...±100 %
10	absolute ext. PID output ru.52	0...100 %
11	absolute active current ru.17	0...2 • I_{rated} [1)]
12	power mod. temperature ru.38	0...100°C
13	Motor temperature ru.46	0...100°C
14	actual torque (F5-M/S)	0...± 3 • rated torque
15	absolute actual torque (F5-M/S)	0...3 • rated torque
16	set torque (F5-M/S)	0...± 3 • rated torque
17	absolute set torque (F5-M/S)	0...3 • rated torque
18	system deviation/speed controller	0...±100 Hz/±3000 min^{-1} [2)]
19	speed reference variable ru.2	0...±100 Hz/±3000 min^{-1} [2)]
20	absolute speed reference variable ru.2	0...100 Hz/1000 min^{-1} [2)]
22	analog input 1 before gain (ru.27)	+/- 100 % 0> +/- 100 %
23	analog input 1 after gain (ru.28)	+/- 100 % 0> +/- 100 %
24	analog input 2 before gain (ru.29)	+/- 100 % 0> +/- 100 %
25	analog input 2 after gain (ru.30)	+/- 100 % 0> +/- 100 %
26	active power (ru.81)	+/- 2* Pnenn => +/- 100 %

[1)] dependent of inverter rated current (In.1) [2)] dependent of ud.2

6.2.13 Analog Output / Display

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

ru.33 ANOUT1 pre ampl. display	0...±400 %
ru.34 ANOUT1 post ampl. display	0...±115 %
ru.35 ANOUT2 pre ampl. display	0...±400 %
ru.36 ANOUT2 post ampl. display	0...±115 %

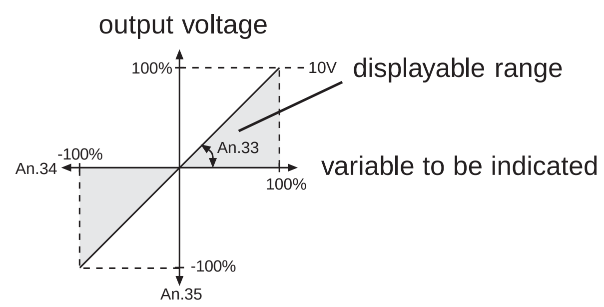
At the outputs ANOUT 3 and 4 there is no display provided.

6.2.14 Gain of Output Characteristic (An.33...35 / An.38...40 / An.43...45)

After selecting the signal to be given out it can be adapted to the requirements by means of characteristic amplifier in X/Y-direction or gain. With factory setting no zero point offset is adjusted, the gain is 1, i.e. 100% of the variable to be given out correspond to 10V at the analog output (see Fig. 6.2.14.a).

Function	ANOUT1	-2	-3	-4	Value range	Resolution	Default
Gain	An.33	An.38	An.43	An.49	±20,00	0,01	1,00
X-Offset	An.34	An.39	An.44	An.50	±100,0%	0,1%	0,0%
Y-Offset	An.35	An.40	An.45	An.51	±100,0%	0,1%	0,0%

Fig. 6.2.14.a Factory setting: no Offset, Gain 1

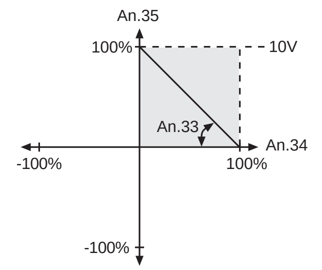


Inverting the analog output

An example for using the characteristic amplifier is shown in Fig. 6.2.14.b:

1. adjustment of the X-Offset (An.34) to 100 (%)
2. adjustment of the amplification (An.33) to -1.00

Fig. 6.2.14.b Inverting the analog output



These settings result in an inverting of the analog signal.

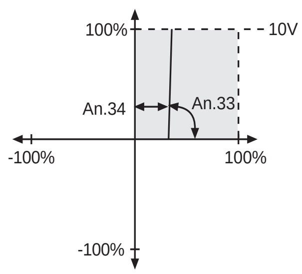
0% correspond to 10V at the output
100% correspond to 0V at the output

Analog output as switch

An example for using the analog output as 0/10V-switch is shown in Fig. 6.2.14.c:

1. adjustment of the amplification (An.33) to 20.00
2. adjustment of the X-Offset (An.34) to the desired switching level

Fig. 6.2.14.c Analog output as switch



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

Computation of the amplification

Since the analog output always works firmly onto the values defined under 6.2.10, one can adjust the characteristic with the aid of the amplification so that the complete range of 0...±10V is utilized.

$$\frac{\text{defined value}}{\text{desired value}} = \text{Amplification (An.33 / 38 / 43 / 49)}$$

Example output frequency

$$\frac{100\text{Hz}}{68\text{Hz}} = 1{,}47$$

6.2.15 Period ANOUT3 (An.46)

The amount of the selected process variable (An.41/47) is converted into a percentage. The output of the characteristic amplifier (An.43...45 / An.49...51) is limited to values from 0...100 %. The multiplication of the base value with the cycle duration (An.46 / 52) results in the ON period of the digital output (selection in do.0..7 value „42/43“). The period can be adjusted in a range from 1...240 s.

6.2.16 ANOUT 1...4 Digital Settings (An.32/37/42/48)

With these parameters analog values can be adjusted in percent for the respective input. For that purpose the value „8 digital setting“ must be adjusted as process variable. The setting is done within the range ±100 %.

6.2.17 Used Parameters

Param.	Adr.	R/W	PROG.	ENTER	min	max	Step	default	
ru.1	0201h	-	-	-	-400 Hz	400 Hz	0,0125 Hz	-	resolution and value range see ud.2
ru.2	0202h	-	-	-	-400 Hz	400 Hz	0,0125 Hz	-	resolution and value range see ud.2
ru.7	0207h	-	-	-	-400 Hz	400 Hz	0,0125 Hz	-	resolution and value range see ud.2
ru.15	020Fh	-	-	-	0 A	6553,5 A	0,1 A	-	-
ru.17	0211h	-	-	-	-3276,7 A	3276,7 A	0,1 A	-	-
ru.18	0212h	-	-	-	0 V	1000 V	1 V	-	-
ru.20	0214h	-	-	-	0 V	778 V	1 V	-	-
ru.27	021Bh	-	-	-	-100,0 %	100,0 %	0,1 %	-	-
ru.28	021Ch	-	-	-	-400,0 %	400,0 %	0,1 %	-	-
ru.29	021Dh	-	-	-	-100,0 %	100,0 %	0,1 %	-	-
ru.30	021Eh	-	-	-	-400,0 %	400,0 %	0,1 %	-	-
ru.31	021Fh	-	-	-	-100,0 %	100,0 %	0,1 %	-	-
ru.32	0220h	-	-	-	-400,0 %	400,0 %	0,1 %	-	-
ru.33	0221h	-	-	-	-400,0 %	400,0 %	0,1 %	-	-
ru.34	0222h	-	-	-	-100,0 %	100,0 %	0,1 %	-	-
ru.35	0223h	-	-	-	-400,0 %	400,0 %	0,1 %	-	-

Param.	Adr.	R/W	PROG.	ENTER	min	max	Step	default	
ru.36	0224h	-	-	-	-100,0 %	100,0 %	0,1 %	-	-
ru.38	0226h	-	-	-	0 °C	150 °C	1 °C	-	-
ru.46	022Fh	-	-	-	0 °C	255 °C	1 °C	-	0; 253...255 see desciption
ru.52	0234h	-	-	-	-100,0 %	100,0 %	0,1 %	-	-
An.0	0A00h	4	-	4	0	2	1	0	-
An.1	0A01h	4	-	4	0	4	1	0	-
An.2	0A02h	4	-	4	0	3	1	0	-
An.3	0A03h	4	-	4	0	4095	1	0	-
An.4	0A04h	4	-	-	-10,0 %	10,0 %	0,1 %	0,2 %	-
An.5	0A05h	4	4	-	-20,00	20,00	0,01	1,00	-
An.6	0A06h	4	4	-	-100,0 %	100,0 %	0,1 %	0,0 %	-
An.7	0A07h	4	4	-	-100,0 %	100,0 %	0,1 %	0,0 %	-
An.8	0A08h	4	4	-	-400,0 %	400,0 %	0,1 %	-400,0 %	-
An.9	0A09h	4	4	-	-400,0 %	400,0 %	0,1 %	400,0 %	-
An.10	0A0Ah	4	-	4	0	2	1	0	-
An.11	0A0Bh	4	-	4	0	4	1	0	-
An.12	0A12h	4	-	4	0	3	1	0	-
An.13	0A13h	4	-	4	0	4095	1	0	-
An.14	0A0Eh	4	-	-	0,0 %	10,0 %	0,1 %	0,2 %	-
An.15	0A0Fh	4	4	-	-20,00	20,00	0,01	1,00	-
An.16	0A10h	4	4	-	-100,0 %	100,0 %	0,1 %	0,0 %	-
An.17	0A11h	4	4	-	-100,0 %	100,0 %	0,1 %	0,0 %	-
An.18	0A12h	4	4	-	-400,0 %	400,0 %	0,1 %	-400,0 %	-
An.19	0A13h	4	4	-	-400,0 %	400,0 %	0,1 %	400,0 %	-
An.20	0A14h	4	-	4	0	1	1	0	-
An.21	0A15h	4	-	4	0	4	1	0	-
An.22	0A16h	4	-	4	0	3	1	0	-
An.23	0A17h	4	-	4	0	4095	1	0	-
An.24	0A18h	4	-	-	-10,0 %	10,0 %	0,1 %	0,2 %	-
An.25	0A19h	4	4	-	-20,00	20,00	0,01	1,00	-
An.26	0A1Ah	4	4	-	-100,0 %	100,0 %	0,1 %	0,0 %	-
An.27	0A1Bh	4	4	-	-100,0 %	100,0 %	0,1 %	0,0 %	-
An.28	0A1Ch	4	4	-	-400,0 %	400,0 %	0,1 %	-400,0 %	-
An.29	0A1Dh	4	4	-	-400,0 %	400,0 %	0,1 %	400,0 %	-
An.30	0A1Eh	4	4	4	0	12287	1	2112	-

Param.	Adr.	R/W	PROG.	ENTER	min	max	Step	default	
An.31	0A1Fh	4	4	4	0	12	1	2	-
An.32	0A20h	4	4	-	-100,0 %	100,0 %	0,1 %	0,0 %	-
An.33	0A21h	4	4	-	-20,00	20,00	0,01	1,00	-
An.34	0A22h	4	4	-	-100,0 %	100,0 %	0,1 %	0,0 %	-
An.35	0A23h	4	4	-	-100,0 %	100,0 %	0,1 %	0,0 %	-
An.36	0A24h	4	4	4	0	12	1	6	-
An.37	0A25h	4	4	-	-100,0 %	100,0 %	0,1 %	0,0 %	-
An.38	0A26h	4	4	-	-20,00	20,00	0,01	1,00	-
An.39	0A27h	4	4	-	-100,0 %	100,0 %	0,1 %	0,0 %	-
An.40	0A28h	4	4	-	-100,0 %	100,0 %	0,1 %	0,0 %	-
An.41	0A29h	4	4	4	0	12	1	12	-
An.42	0A2Ah	4	4	-	-100,0 %	100,0 %	0,1 %	0,0 %	-
An.43	0A2Bh	4	4	-	-20,00	20,00	0,01	1,00	-
An.44	0A2Ch	4	4	-	-100,0 %	100,0 %	0,1 %	0,0 %	-
An.45	0A2Dh	4	4	-	-100,0 %	100,0 %	0,1 %	0,0 %	-
An.46	0A2Eh	4	4	4	1 s	240 s	1 s	1 s	-
An.47	0A2Fh	4	4	4	0	20	1	12	-
An.48	0A30h	4	4	-	-100,0 %	100,0 %	0,1 %	0,0 %	-
An.49	0A31h	4	4	-	-20,00	20,00	0,01	1,00	-
An.50	0A32h	4	4	-	-100,0 %	100,0 %	0,1 %	0,0 %	-
An.51	0A33h	4	4	-	-100,0 %	100,0 %	0,1 %	0,0 %	-
An.52	0A34h	4	4	4	1 s	240 s	1 s	1 s	-

The parameters An.53 to An.57 are descriped at the Special functions in chapter 6.9.

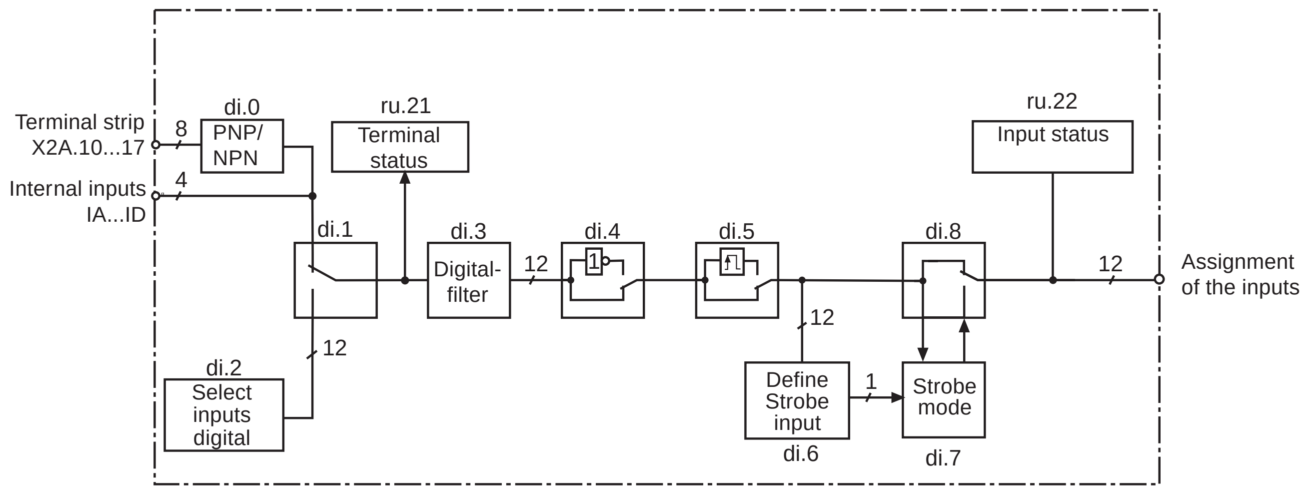
6.3 Digital In- and Outputs

6.3.1 Summary Description Digital Inputs

Observe the different functional range of the hard- and software of the different control cards *(see chapter 3).*

The KEB COMBIVERT has 8 external digital inputs and 4 internal inputs (IA...ID). All inputs can be assigned to one or several functions.
Coming from the terminal strip it can be defined with parameter di.0 (not at F5-B), whether external inputs shall be controlled in PNP or NPN (not at safety relais) wiring. Parameter ru.21 shows the currently controlled input. Each input can optionally (di.1) be set via terminal strip or by means of software with di.2. A digital filter (di.3) reduces the interference susceptibility of the inputs. The inputs can be inverted with di.4 and with di.5 one can switch to edge-triggering. With the parameters di. 6...di. 8 a Strobe-mode can be activated. The input status (ru.22) shows the inputs that are actually set for processing. The function(s), that a programmed input carries out, is defined by means of the input selection of the corresponding function or by di.11...22.
For safety reasons the control release (ST) must generally be switched by means of hardware. Edge-triggering, inversion and strobe signal can be adjusted but have no influence.

Fig. 6.3.1 Principle of digital inputs



6.3.2 Input Signals PNP / NPN (di.0)

Not valid for BASIC!

Fig. 6.3.2.a Digital inputs with PNP control (di.0 = 0)

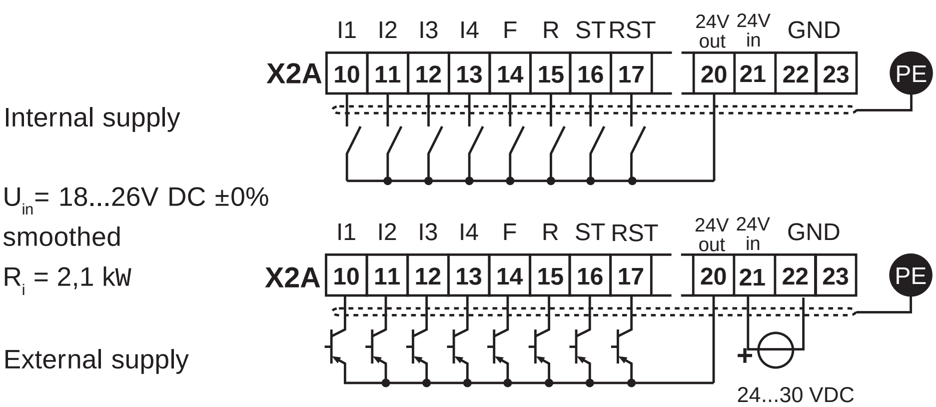
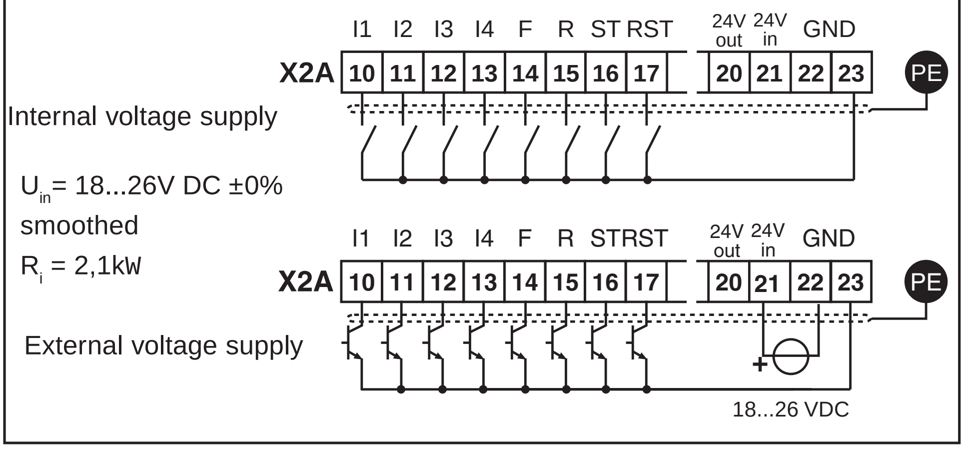


Fig. 6.3.2.b Digital inputs with NPN control (di.0 = 1)

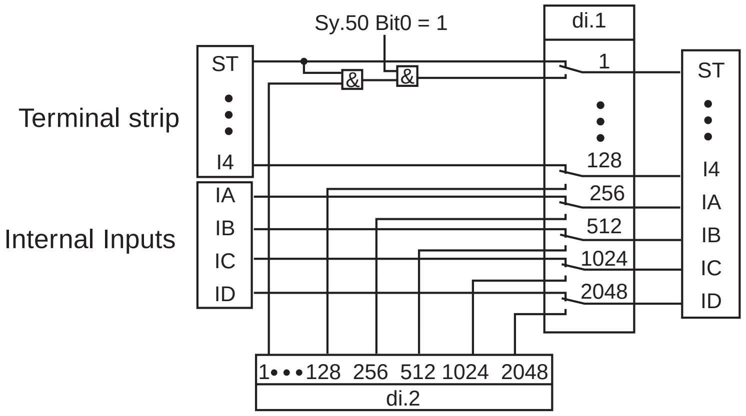


Not valid for BASIC and A-Servo!

6.3.3 Setting of Digital Inputs by Software (di.1, di.2)

With the aid of parameter di.1 and di.2 the digital input can be set without external wiring.

Fig. 6.3.3 Digital inputs controlled by Software (di.1/di.2)



The control release must generally be switched by means of hardware even if one switches by software (see Fig. 6.3.3 AND-operation wtih di.2 and Sy.50)!

As shown in Fig. 6.3.3, it can be selected with di.1, whether the inputs shall be switched from the terminal strip (default) or by way of parameter di.2. Both parameters are bit-coded, i.e. according to following table, the appropriate value for the input is to be entered. In the case of several inputs the sum is to be formed. (Exception: Control release must always be bridged at the terminal strip).

Bit -No.	Decimal value	Input	Terminal
0	1	ST (Prog. input „Control release/Reset“)	X2A.16
1	2	RST (Prog. input „Reset“)	X2A.17
2	4	F (Prog. input „Forward“)	X2A.14
3	8	R (Prog. input „Reverse“)	X2A.15
4	16	I1 (Prog. input 1)	X2A.10
5	32	I2 (Prog. input 2)	X2A.11
6	64	I3 (Prog. input 3)	X2A.12
7	128	I4 (Prog. input 4)	X2A.13
8	256	IA (Internal input A)	none
9	512	IB (Internal input B)	none
10	1024	IC (Internal input C)	none
11	2048	ID (Internal input D)	none

6.3.4 Terminal Status (ru.21)

The terminal status shows the logic level on the input terminals. It is unimportant, whether the inputs are internally active or not. If a terminal is controlled, then the appropriate decimal value according to the table below is output. If several terminals are active, then the sum of the decimal values is output.

Bit -No.	Decimal value	Input	Terminal
0	1	ST (Prog. input „Control release/Reset“)	X2A.16
1	2	RST (Prog. input „Reset“)	X2A.17
2	4	F (Prog. input „Forward“)	X2A.14
3	8	R (Prog. input „Reverse“)	X2A.15
4	16	I1 (Prog. input 1)	X2A.10
5	32	I2 (Prog. input 2)	X2A.11
6	64	I3 (Prog. input 3)	X2A.12
7	128	I4 (Prog. input 4)	X2A.13
8	256	IA (Internal input A)	none
9	512	IB (Internal input B)	none
10	1024	IC (Internal input C)	none
11	2048	ID (Internal input D)	none

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

6.3.5 Digital Filter (di.3)

The digital filter reduces the susceptibility to interferences on the digital inputs. With di.3 a response time is adjusted. For the duration of the adjusted time the conditions of **all** inputs must remain constant, so that a transfer occurs. The transfer takes place at the positive edge of the scanning grid (see Fig. 6.3.7).

Parameter	Setting range	Response time
di.3	0...127	(adjusted value +1) x program run time

Program run time: 1 ms at F5-General; 2 ms at F5-Basic

6.3.6 Inversion of Inputs (di.4)

With parameter di.4 it can be adjusted, whether a signal is 1- or 0-active (inverted). The parameter is bit-coded, i.e. according to the table below, the appropriate value for the input is to 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).

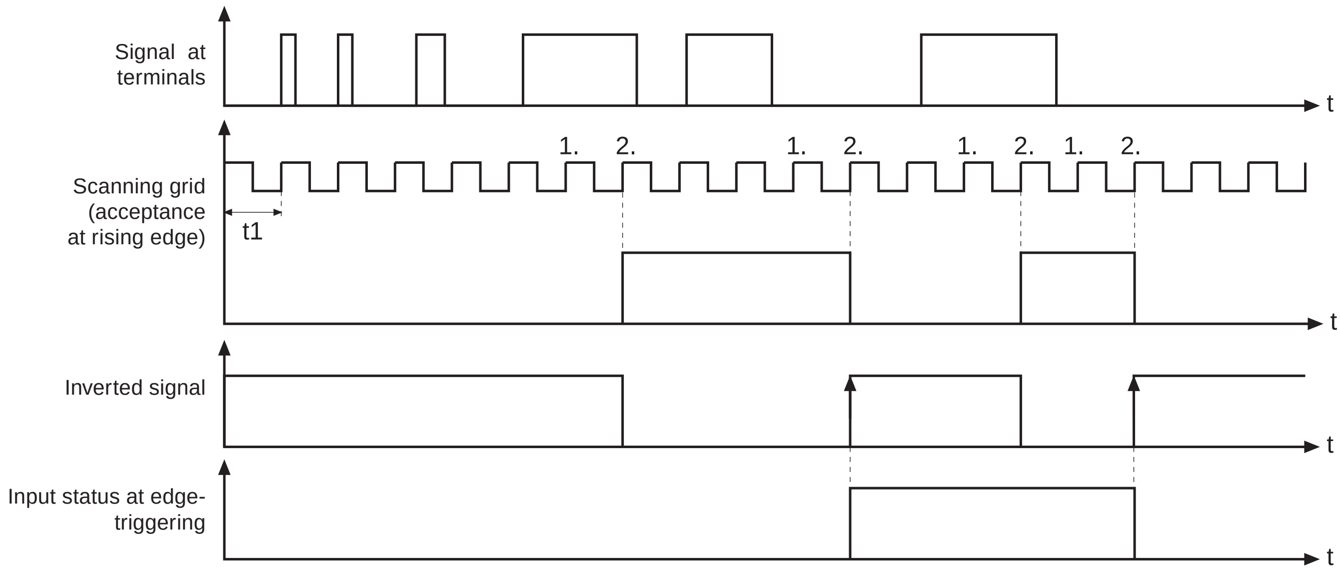
6.3.7 Edge-triggering (di.5)

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-triggering. 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-triggering, but remains without affect on the function, since it is a pure static signal.

Bit -No.	Decimal value	Input	Terminal
0	1	ST (Prog. input „Control release/Reset“)	X2A.16
1	2	RST (Prog. input „Reset“)	X2A.17
2	4	F (Prog. input „Forward“)	X2A.14
3	8	R (Prog. input „Reverse“)	X2A.15
4	16	I1 (Prog. input 1)	X2A.10
5	32	I2 (Prog. input 2)	X2A.11
6	64	I3 (Prog. input 3)	X2A.12
7	128	I4 (Prog. input 4)	X2A.13
8	256	IA (Internal input A)	none
9	512	IB (Internal input B)	none
10	1024	IC (Internal input C)	none
11	2048	ID (Internal input D)	none

Fig. 6.3.7 Example of a signal flow diagram for input I1 (di.3=1; di.4=16; di.5=16)



t1: 1 ms at F5-General; 2 ms at F5-Basic

6.3.8 Strobe-dependent Inputs (di.6, di.7, di.8)

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 di.8 any input can be selected as Strobe-dependent input. With the control release di.8 has no function since this is a static input.

From where comes the Strobe signal?

With parameter di.6 the Strobe input is set. If several inputs are adjusted as Strobe they are linked in **OR-operation**. At the next rising edge of the clock signal, the Strobe signal is triggered.

di.8 Strobe-dependent inputs
di.6 Selection strobe signal

Bit -No.	Decimal value	Function di.6 / di.8 / ru.22 / di.9 / di.10	Terminal
0	1 *	ST (Prog. input „Control release/Reset“)	X2A.16
1	2	RST (Prog. input „Reset“)	X2A.17
2	4	F (Prog. input „Forward“)	X2A.14
3	8	R (Prog. input „reverse“)	X2A.15
4	16	I1 (Prog. input 1)	X2A.10
5	32	I2 (Prog. input 2)	X2A.11
6	64	I3 (Prog. input 3)	X2A.12
7	128	I4 (Prog. input 4)	X2A.13
8	256	IA (Internal input A)	none
9	512	IB (Internal input B)	none
10	1024	IC (Internal input C)	none
11	2048	ID (Internal input D)	none

* No function at di.8, as the control release works static.

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 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).

di.7 Strobe-mode

Parameter	Setting range	Function
di.7	0	edge-active Strobe (default)
	1	static strobe - frooze if strobe is not active
	2	static strobe - only active at active strobe

Fig. 6.3.8.a Edge-active Strobe (di.7=0)

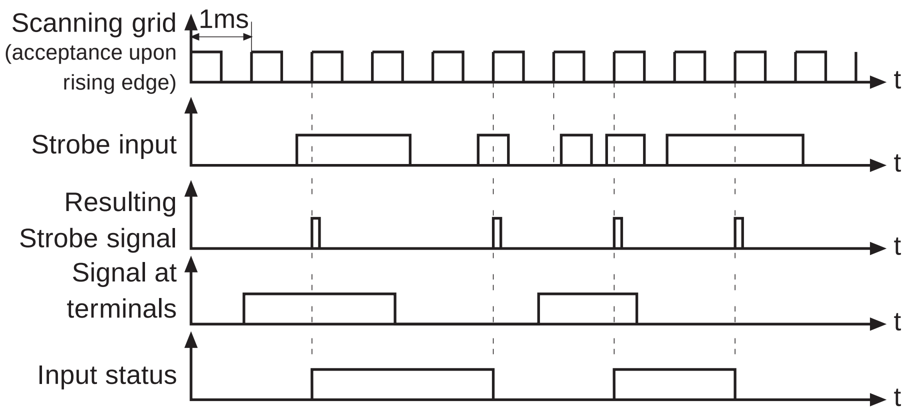


Fig. 6.3.8.b Static Strobe Mode 1 (di.7=1)

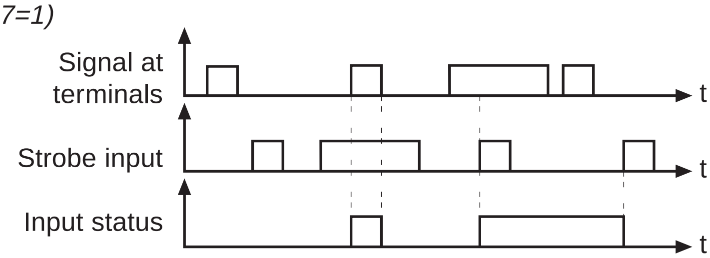
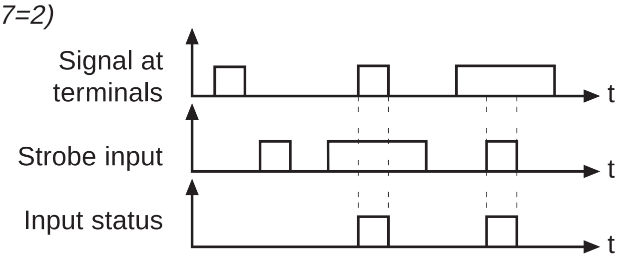


Fig. 6.3.8.c Static Strobe Mode 2 (di.7=2)



6.3.9 Input Status (ru.22)

The internal input status shows the logic condition of the digital inputs which are internally set for processing. It is unimportant, whether the external terminals are active or not. If an input is set, the appropriate decimal value according to the table under 6.3.8 is output. If several inputs are set, then the sum of the decimal values is output.

6.3.10 Reset/Input Selection and Edge Evaluation (di.9 / di.10)

With di.9 the reset input is defined according to the table under 6.3.8. If the reset input shall react to an edge, one or several of the reset inputs defined with di.9 can be switched to edge evaluation with di.10.

6.3.11 Assignment of the Inputs

There are two different procedures for the assignment of inputs. Both variants are locked against each other to give the user maximum flexibility.
List of parameters, that can be assigned with inputs:

An. 3	AN1 save trigger / input selection	oP.57	Motorpoti decrease / input selection
An.13	AN2 save trigger / input selection	oP.58	Motorpoti Reset / input selection
An.23	AN3 save trigger / input selection	oP.60 [1)]	Rotation forward (Run) / input selection
cn.11	PID reset / input selection	oP.61 [1)]	Rotation reverse (Stop) / input selection
cn.12	I reset / input selection	Pn. 4	External fault / input selection
cn.13	Fade in reset / input selection	Pn.23	Ramp stop / input selection
di. 9	Reset / input selection	Pn.29	DC-braking / input selection
Fr. 7	Parameter set / input selection	Pn.64	set GTR7 input selection
Fr.11	Reset set / input selection	PS.2	pos/sync input select
LE.17	Timer 1 Start / input selection	PS.3	shift. slave input selection
LE.19	Timer 1 Reset / input selection	PS.10	shift slave invers input selection
LE.22	Timer 2 Start / input selection	PS.18	reference switch input selection
LE.24	Timer 2 Reset / input selection	PS.19	start reference input selection
oP.19	Fixed value / input selection 1	PS.29	start posi input selection
oP.20	Fixed value / input selection 2	uF. 8	Energy-saving function / input selection
oP.56	Motorpoti increase / input selection		

[1)] By selecting the source of rotation (oP.1) the adjustment can be changed from forward/ reverse to Run/Stop.

Additional functions

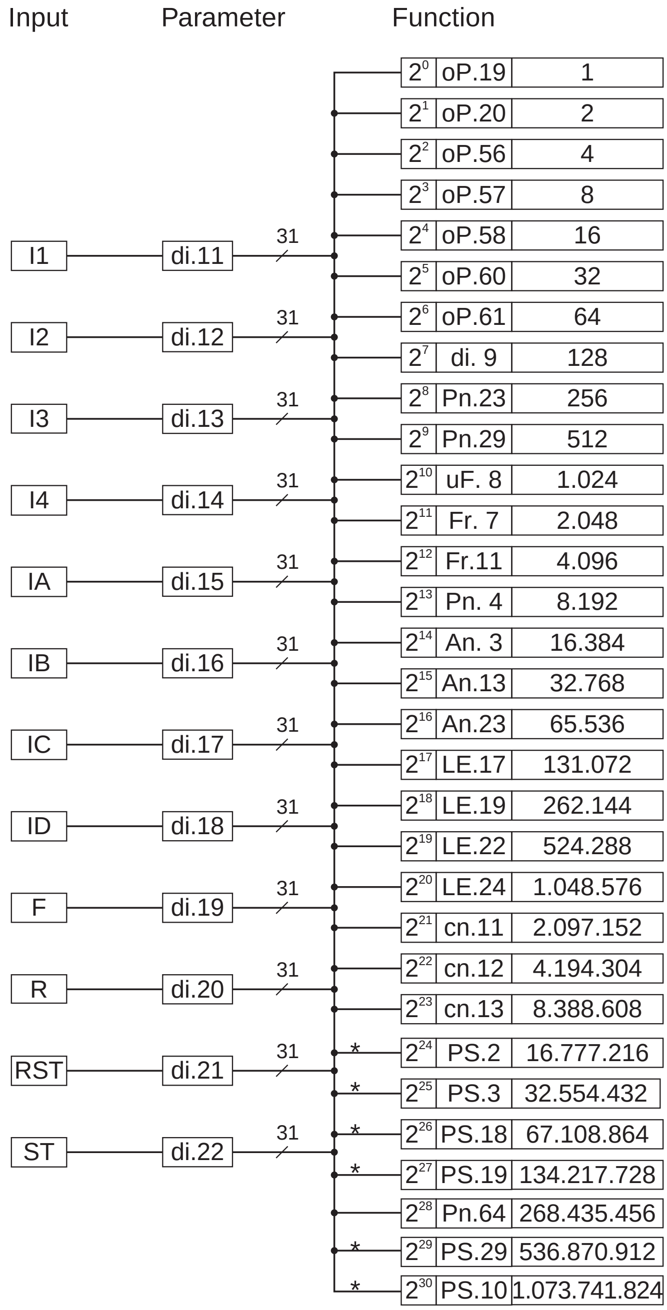
Parameters can be allocated with one additional function each. The parameters are firmly assigned to the prefixed inputs and are activated by setting bit 31.

di.24	I1 prog. function	di.30	IC prog.function
di.25	I2 prog. function	di.31	ID prog.function
di.26	I3 prog.function	di.32	FOR prog.function
di.27	I4 prog.function	di.33	REV prog.function
di.28	IA prog.function	di.34	RST prog.function
di.29	IB prog.function	di.35	ST prog.function

Value	Function	
0	PS.11	Reset Master/Slave Difference / input selection
1	PS.13	Set reference point / input selection
2	PS.36	Teach position / input selection

- **Input-related assignment**
  A parameter is assigned to each input (di.11...22) which adjusts the desired function(s).
  The appropriate function is determined by the input of the decimal value. If several functions should be selected, then the sum of the decimal values must be entered.

Fig. 6.3.11a Input-related assignment

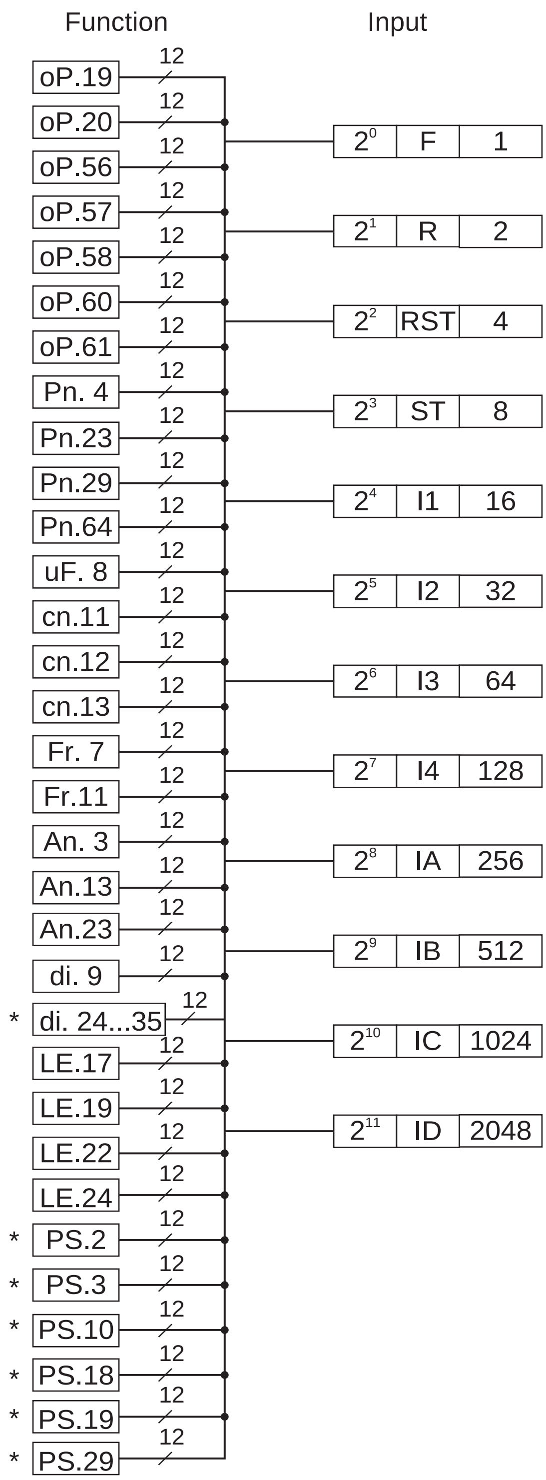


* no function at F5-G/B

The input ST is assigned by hardware means with the function „control release“. Further functions can be adjusted only „additionally“.

- **Function-related assignment**
  A parameter is assigned to each function which adjusts the desired input(s). The appropriate input is determined by the input of the decimal value. If several inputs should be selected, then the sum of the decimal values must be entered.

Fig. 6.3.11b Function-related assignment

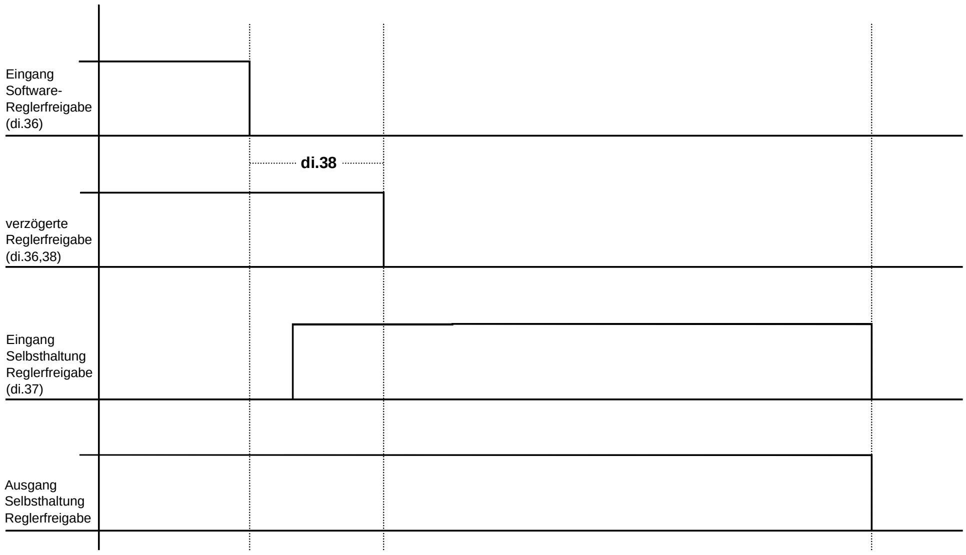


* no function at F5-G/C/B

Software-ST and locking of the control release

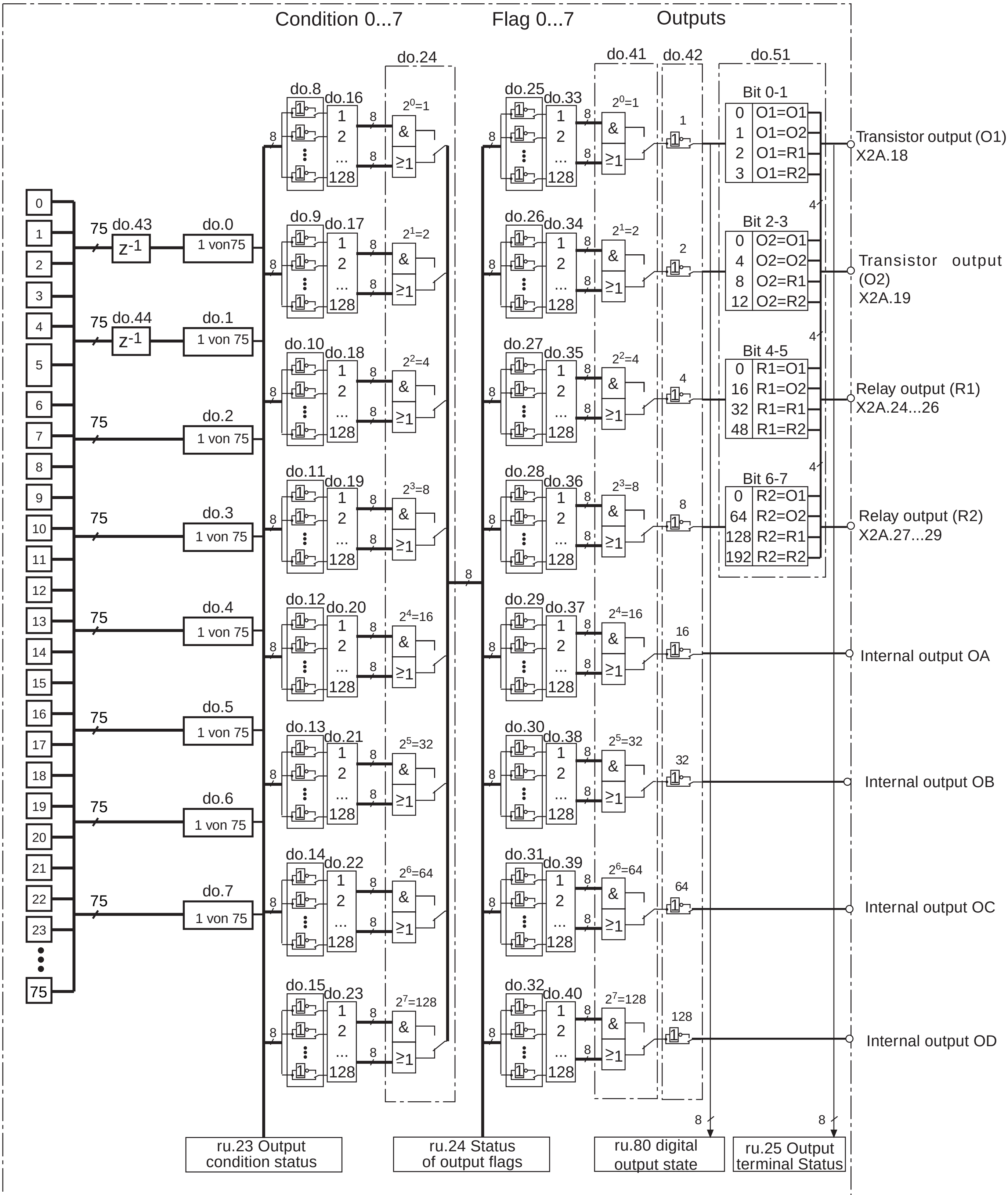
di.36 Software ST
di.37 Locking ST
di.38 Switch-off deceleration ST

The function is switched off, if no input is selected in di.36. 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 e.g. Power off needs for stopping the drive.
Condition: terminal ST must be bridged !
Switching off an input (selection in di.36) is decelerated for the time adjusted in di.38. Within this time the locking input (selection into di.37) must be active in order to secure the function.
A software input e.g. (IA-ID) can be assigned with the function Power off (do.0-7 = 17, switching condition for OA-OD) as locking input.



6.3.12 Summary Description - Digital Outputs

Fig. 6.3.12 Principle of digital outputs



6

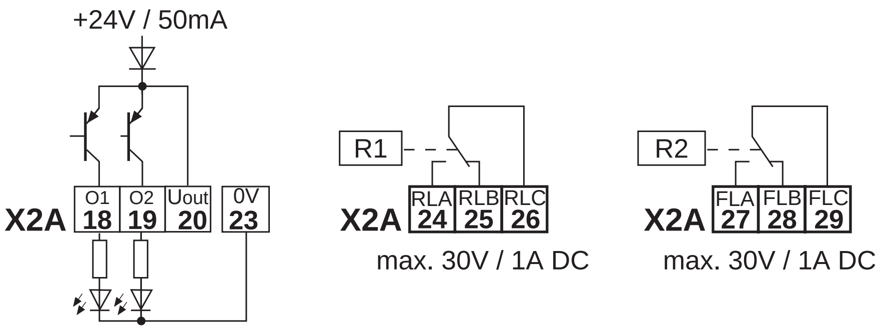
Description

For the switching of the digital outputs one can choose up to 8 conditions from the 69 different conditions. These are entered in do.0...do.7. Switching condition 0 and 1 can be filtered by do.43 and do.44. Parameter ru.23 shows, if one or several of these conditions are met. For each channel it can now be selected which of the 8 conditions shall apply to it (do.16...do.23). Each condition can still be inverted before selection (do.8...do.15). As a standard all conditions (if several are selected) are OR-operated, i.e. if one of the selected conditions is fulfilled, the channel is set. With do.24 this can be changed to AND-operation, i.e. all conditions selected for this channel must be fulfilled before it is set. Parameter ru.24 shows the channels which are set in this stage. do.33...40 form a second logic step with which a selection of the channels from logic step 1 can be made. Every individual condition can be inverted with do..25...32. do.41 adjusts the manner of the linkage (AND/OR). Parameter do.42 is used for inverting one or several outputs.With do.51 the output signals are assigned to the terminals. ru.80 serves for the display of the status prior to allocation, thereafter ru.25. The internal outputs OA...OD are directly connected with the internal inputs IA...ID.

6.3.13 Output Signals

The total current of X2A.18...20 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)!

Fig. 6.3.12 Connection of digital outputs



6.3.14 Output filter (do.43, do.44)

With do.43 a filter can be set for switching condition 0, with do.44 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 of a switching condition is cancelled during the filter time, the filter time is reset and restarted at the next change. The filter time is adjustable within the range of 0 (off)...1000 ms.

6.3.15 Switching Conditions (do.0...do.7)

From the following switching conditions one can select up to 8 for further processing. The values are then entered in the parameters do.0...do.7.

Value	Function
0	Off
1	Always active
2	Run signal; also at DC-braking
3	Ready for operation; if no fault exists (ru.0 <> error)
4	Fault relay trips, when the inverter is switched off with an error
5	Fault relay, as at 2, but not for errors which are reset automatically with activated „Auto-restart-function“
6	Warning or error signal is given, when the inverter fulfills an abnormal-stopping condition (ru.0).
7	Overload-prewarning! ru.39 is an overload counter, counting in steps of 1%. On reaching 100 % the inverter switches off. Upon exceeding the level of Pn.9 (default 80%) the overload warning is given. The performance in case of a warning can be adjusted with Pn.8 (response to OL-warning)
8	Overheating-prewarning (OH)! Depending on the power circuit the inverter switches off between 60...95°C power module temperature. The prewarning is output, when the level OH-warning (Pn.11) is reached (default 70°C). The behaviour in case of an warning can be adjusted with Pn.10 (response to OH-warning).
9	PTC-prewarning (dOH), on tripping of the motor-PTC connected to the terminals T1/T2. After expiration of an adjustable switch-off time Pn.13 (0...120s) the inverter switches off. the behaviour in case of an error can be adjusted with Pn.12 (response to dOH-warning).
10	Motor protection prewarning (OH2), if the motor protection triggering time defined according to VDE has expired. The response to the warning can be adjusted with Pn.14 (response to motor protective function)(see Chapter 6.7 „Motor protective function“).
11	Interior temperature-prewarning (OHI) is output, when the interior temperature of the inverter exceeds the level OHI-warning (Pn.17). The behaviour in case of an error can be adjusted with Pn.16 (response to OHI-warning). Not at Pn.16 = 7
12	Cable breakage at 4...20mA setpoint adjustment at AN1; Trips, if the setpoint current drops below 2mA (An.0 = 2).
13	Cable breakage at 4...20mA setpoint adjustment at AN2; Trips, if the setpoint current drops below 2mA (An.10 = 2).
14	Max. constant current (Stall) exceeded (Pn.17). See chapter 6.7 „Constant current limit“.
15	Ramp stop function active (LA-/LD-Stop), current (Pn.22) or voltage (Pn.23) exceeded during acceleration/ deceleration. See chapter 6.7 „Ramp stop“.
16	DC-braking active; see chapter 6.9 „DC-brake“
17	Power-Off function active (see chapter 6.9 „Power-Off“), in case of an error or SSF the condition is not fulfilled
18	Brake control is set, when the brake shall be released (see chapter 6.9 „Brake control“)
19	Speed control difference > level
20	Actual value = setpoint at constant run; not at ru.0 = noP, LS, Error or SSF.
21	Inverter is in the acceleration phase, at ru.0 = FAcc, rAcc and LAS (acceleration stop)
22	Inverter is in the deceleration phase, at ru.0 = Fdec, rdec and LDS (deceleration stop)
23	Actual direction of rotation = set direction of rotation
24	Utilization (ru.13) > level
25	Active current (ru.17) > level
26	DC-link voltage > level
27	Actual value (ru.7) > level
28	Setpoint value (ru.1) > level
29	Ref. point run completed (only F5-M/S)
30	Actual torque > level (only F5-M/S)
31	AN1 on output of characteristic amplifier > level; without sign evaluation
32	AN2 on output of characteristic amplifier > level; without sign evaluation

33	AN3 on output of characteristic amplifier > level; without sign evaluation
34	AN1 on output of characteristic amplifier > level; with sign evaluation
35	AN2 on output of characteristic amplifier > level; with sign evaluation
36	AN3 on output of characteristic amplifier > level; with sign evaluation
37	Timer 1 > level
38	Timer 2 > level
39	Angle difference > level (only F5-M/S)
40	Hardware current limit active
41	Modulation on-signal
42	Output of analog signal ANOUT3 as PWM-signal. The period is adjusted with An.46.
43	Output of analog signal ANOUT4 as PWM-signal. The period is adjusted with An.52.
44	Inverter state (ru.0) = Level
45	Power module temperatur (ru.38) > Level
46	Motor temperatur (ru.46) > Level
47	Ramp output value (ru.2) > Level
48	Apparent current (ru.15) > Level
49	Clockwise rotation (not at noP, LS, abnormal stopping, error)
50	Counter clockwise (not at noP, LS, abnormal stopping, error)
51	Warning E.OL2
52	Current control at the limit (only F5-M/S)
53	Speed control at the limit
54	Target window reached (Posi module at F5-M/S)
55	Current position > Level (Posi module at F5-M/S)
56	Positioning active (Posi module at F5-M/S)
57	Position inaccessible (Posi module at F5-M/S)
58	Profile processing active (Posi module at F5-M/S)
59	AND-operation of the selected inputs. The condition is active, if all selected inputs are active. The selection is done with the switching levels (LE.0...7) according to following table: Input ST RST F R I1 I2 I3 I4 IA IB IC ID Value 1 2 4 8 16 32 64 128 256 512 1024 2048 The sum of the inputs to be queried is entered in the switching levels. Example: If the inputs I3 **and** I4 are active, the condition do.4 shall be set. Adjust switching condition 4 (do.4) to „59“. Adjust switching level 4 (LE.4) to „192“ („64“ for I3 + „128“ for I4).
60	OR-operation of the selected inputs. The condition is active, if at least one of the selected inputs is active. Adjustment as at value „59“.
61	NAND-operation of the selected inputs. The condition is active, if at least one of the selected inputs is inactive. Adjustment as at value „59“.
62	NOR-operation of the selected inputs. The condition is active, if all of the selected inputs are inactive. Adjustment as at value „59
63	Absolute value ANOUT1 > Level
64	Absolute value ANOUT2 > Level
65	ANOUT1 > Level
66	ANOUT2 > Level
67	Active relative position > Level. The output is set, if the distance covered after the starting position is larger than the adjusted level. That means, the function works relative to the starting position. If the positioning is completed, the output is reset (Posi module at F5-M/S).
68	Active position to the target > Level. The output is set, if the distance to be covered to the target is larger than the adjusted level. If the positioning is completed, the output is reset (Posi module at F5-M/S).
69	Absolute control difference of the external PI controller > Level
70	Driver voltage activ (driver relay)

71	Drive runs synchronously; is set, if after the activation of the synchronous run the drive is synchronized (F5-M/S).
72	Actual position index = Level (Posi modul at F5-M/S)
73	Absolute active power > Level
74	Active power > Level
75	Absolute (actuel position – scan position) > Level (Posi modul at F5-M/S)
76	Actual position = position of index ps.28
78	reservated
79	reservated
80	Actual current > level

Level 0...7
LE.0...LE.7

These parameters defines the level of the switching conditions. Level 0 (LE.0) applies for switching condition 0; LE.1 for switching condition 1 ... and so forth.

Setting range:	-30000,00...30000,00
Step:	0,01
Default:	see parameter table

At pretending in increments one increment is 0,01.

Hysteresis 0...7
LE. 8...LE.15

The hysteresis, in reference to the adjusted values, defines the parameters LE. 8...LE.15. Hysteresis 0 (LE.8) applies for comparison level 0; LE.9 for comparison level 1 ... and so forth.

Default:

Frequency:	0,5 Hz
Voltage:	1 V
Analog values:	0,5 %
Current:	0,5 A
Temperature:	1 °C

Frequency hysteresis LE.16

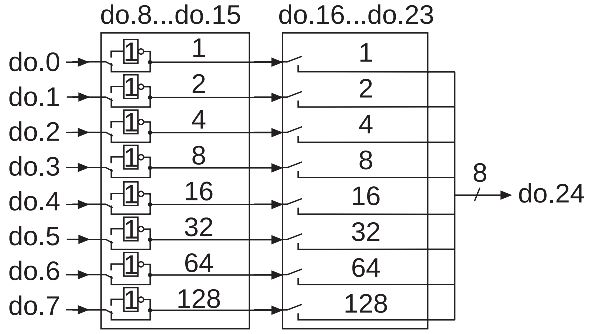
LE.16 defines the hysteresis for the status constant-run and tripping frequencies for the DC-brake.

Response to warning signals
Pn.8, Pn.10, Pn.12, Pn.14, Pn.16

These parameters determine the behaviour of the inverter in case of warning signals. To learn more about the adjustment possibilities as well as the performance of the appropriate drive please refer to Chapter 6.7 „Protective functions“.

6.3.16 Inverting of Switching Conditions for Flags (do.8...do.15)

Fig. 6.3.15 Inversion and selection of switching conditions



With the parameters do.8...do.15 each of the 8 switching conditions (do.0...do.7) can be inverted for each flag separately. Through this function it is possible to set any chosen switching condition as Non-condition. The parameter is bit-coded. According to Fig. 6.3.15 the weighting of the switching conditions to be inverted must be entered in do.8...do.15. If several conditions shall be inverted, the sum is to be formed.

Example: Output X2A.19 shall be set when the inverter is not accelerating. In this case we assign the switching condition 21 (inverter accelerates) for example to do.1 (enter value 21). We invert the switching condition with do.9, so enter value 2.

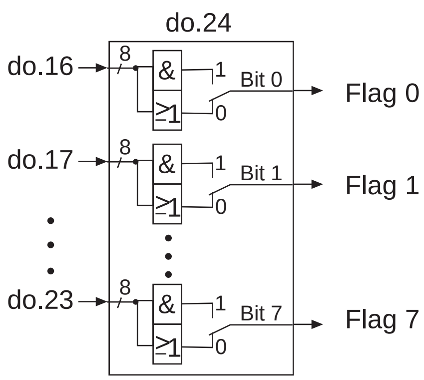
6.3.17 Selection of Switching Conditions for Flags (do.16...do.23)

The parameters do.16...do.23 serve for the selection of the 8 defined switching conditions. The selection is done for each chanel separately, where one can choose between no one and up to all 8 switching conditions. According to Fig. 6.3.15 the weighting of the selected switching conditions is to be entered into do.16...do.23 . If several conditons are selected, the sum is to be formed.

6.3.18 Linking the Switching Conditions for Flags (do.24)

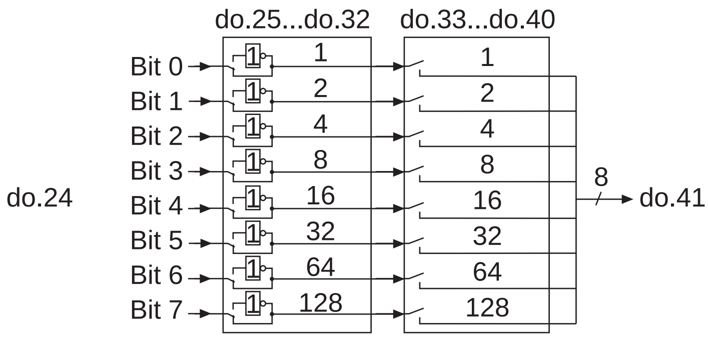
After the switching conditons are selected for each output, it can now be determined, how these are linked. As a default all conditions are OR-operated, i.e. if one of the selected conditions is met, the output switches. Another possibility is the AND-operation which can be adjusted with do.24. AND-operation means that all selected conditions must be fulfilled before the output switches.
Parameter do.24 is bit-coded. The table under 6.3.17 shows the assignment.

Fig. 6.3.17 Linking the switching conditions in logic step 1



6.3.19 Inverting of Flags (do.25...do.32)

Fig. 6.3.18 Inversion and selection of switching conditions from step 1



With the parameters do.25...do.32 each of the 8 flags (bit 0...7) from logic step 1 can be inverted separately. Through this function it is possible to set any chosen flag as Non-flag. The parameter is bit-coded. According to Fig. 6.3.18 the weighting of the switching conditions to be inverted must be entered in do.25...do.32. If several flags shall be inverted, the sum is to be formed.

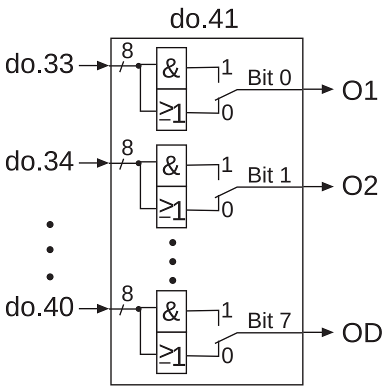
6.3.20 Selection of Flags (do.33...do.40)

In the second logic step a selection of the flags of the first logic step can be made. The selection is done for each output separately, where one can choose between no one and up to all 8 flags. According to Fig. 6.3.18 the weighting of the selected flags is to be entered into do.33...do.40. If several flags shall be selected, the sum is to be formed.

6.3.21 Linking the Flags (do.41)

After the switching conditions are selected for each output, it can now be determined, how these are linked. As a default all conditions are OR-operated, i.e. if one of the selected conditions is met, the output switches. Another possibility is the AND-operation, which is adjusted with do.41. AND-operation means, that all selected condtions must be fulfilled before the output switches.
Parameter do.41 is bit-coded. The table under 6.3.20 shows the assignment.

Fig. 6.3.19 Linking the switching conditions in logic step 2

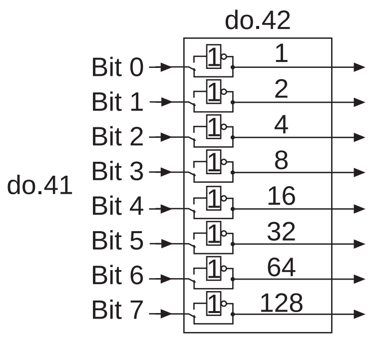


Terminal	Name	Function	Decimal values do.41
X2A.18	O1	Transistor output	1
X2A.19	O2	Transistor output	2
X2A.24...26	R1	Relay output	4
X2A.27...29	R2	Relay output	8
-	OA	Internal output	16
-	OB	Internal output	32
-	OC	Internal output	64
-	OD	Internal output	128

6.3.22 Inversion of Outputs (do.42)

As shown in Fig. 6.3.21, with parameter do.42 the outputs can be once again inverted after the linking. The parameter is bit-coded, i.e. according to following table the value belonging to this output must be entered. If several outputs shall be inverted the sum is to be formed

Fig. 6.3.21 Inverting the outputs



Terminal	Name	Function
X2A.18	O1	Transistor output
X2A.19	O2	Transistor output
X2A.24...26	R1	Relay output
X2A.27...29	R2	Relay output
-	OA	Internal output
-	OB	Internal output
-	OC	Internal output
-	OD	Internal output

6.3.23 Output Terminal Status (ru.25)

Parameter ru.25 indicates the logic condition of the digital outputs after the allocation by do.51. Parameter ru.80 indicates the logic condition before the allocation. It is irrelevant whether the output is set due to conditions or by inverting. If an output is set the appropriate decimal value, according to the table below, is output. If several outputs are set, then the sum of the decimal values is output.

Terminal	Name	Function	Decimal values ru.25
X2A.18	O1	Transistor output	1
X2A.19	O2	Transistor output	2
X2A.24...26	R1	Relay output	4
X2A.27...29	R2	Relay output	8
-	OA	Internal output	16
-	OB	Internal output	32
-	OC	Internal output	64
-	OD	Internal output	128

6.3.24 Hardware output allocation (do.51)

With do.51 the output signals are assigned to the output terminals O1, O2, R1 and R2. The assignment is done according to following table:

Bit	Value	Signal	Output	Default
0 + 1	0	O1	O1 (terminal X2A.18)	x
	1	O2		
	2	R1		
	3	R2		
2+3	0	O1	O2 (terminal X2A.19)	
	4	O2		x
	8	R1		
	16	R2		
4+5	0	O1	R1 (terminal X2A.24...26)	
	16	O2		
	32	R1		x
	48	R2		
6+7	0	O1	R2 (terminal X2A.27...29)	
	16	O2		
	32	R1		
	48	R2		x

6.3.25 Programming Example

For a better understanding, the correlations are explained on the basis of a little more complex example. Following conditions are required:

- Condition 1: Output X2A.19 switches, if the inverter accelerates
- Condition 2: Relais X2A.24...26 switches, if the inverter load is > 100 %
- Condition 3: Relais X2A.27...29 switches, if the actual frequency is > 4 Hz
- Output X2A.18 switches, if the conditions 2 and 3 are realized, but the inverter **does not** accelerate.

Solution proposal:

Set switching conditions, levels and hysteresis

First set the switching conditions and levels.
Set do.0 to „21“ (inverter accelerates)
Set do.1 to „24“ (inverter utilization > level); set LE.1 to „100“ (load level for do.1 100 %); set LE.9 to „5“ (5 % hysteresis for level 1; not required but reasonable for optimal switching performance)
Set do.2 to „27“ (actual frequency > level); set LE.2 to „4“ (frequency level for do.2=4 Hz); set LE.10 to „0.5“ (0.5 Hz hysteresis for level 3; not required but reasonable for optimal switching performance)

Set switching conditions of stage 1

Set do.16 to „1“ (evaluate switching condition of do.0)
Set do.17 to „2“ (evaluate switching condition of do.1)
Set do.18 to „4“ (evaluate switching condition of do.2)
Set do.8, do.9 and do.10 to „0“ (no inverting)
The setting of do.24 is independent for this example, as only one condition each is set at do.16...18.

Set flags

Output O1 (terminal X2A.18)
Set do.33 to „7“ (evaluate flags 1...3)
Set do.25 to „1“ (flag 1 is inverted, it means that the condition is fulfilled if the inverter does not accelerate.
Set do.41 to „1“ (the conditions selected with do.33 become AND-operated)

Output O2 (terminal X2A.19)
Set do.34 to „1“ (evaluate flag 1)
Set do.26 to „0“ (no inverting)
The setting of do.41 is independent for this example, as only one condition is set at do.34.

Relay output R1 (terminal X2A.24...26)
Set do.35 to „2“ (evaluate flag 2)
Set do.27 to „0“ (no inverting)
The setting of do.41 is independent for this example, as only one condition is set at do.35.

Relay output R2 (terminal X2A.27...29)
Set do.36 to „4“ (evaluate flag 3)
Set do.28 to „0“ (no inverting)
The setting of do.41 is independent for this example, as only one condition is set at do.36.

6.3.26 Used Parameters

Param.	Adr.	R/W	PROG.	ENTER	min	max	Step	default	
di.0	0B00h	4	-	4	0	1	1	0	0: PNP 1:NPN (without safety relay)
di.1	0B01h	4	-	4	0	4095	1	0	-
di.2	0B02h	4	-	4	0	4095	1	0	-
di.3	0B03h	4	-	4	0	127	1	0	-
di.4	0B04h	4	-	4	0	4095	1	0	-
di.5	0B05h	4	-	4	0	4095	1	0	-
di.6	0B06h	4	-	4	0	4095	1	0	-
di.7	0B07h	4	-	4	0	2	1	0	-
di.8	0B08h	4	-	4	0	4095	1	0	-
di.9	0B09h	4	-	4	0	4095	1	3	ST+RST
di.10	0B0Ah	4	-	4	0	4095	1	3	ST+RST
di.11	0B0Bh	4	-	4	0	$2^{31} - 1$	1	1	-
di.12	0B0Ch	4	-	4	0	$2^{31} - 1$	1	2	-
di.13	0B0Dh	4	-	4	0	$2^{31} - 1$	1	8192	-
di.14	0B0Eh	4	-	4	0	$2^{31} - 1$	1	512	-
di.15	0B0Fh	4	-	4	0	$2^{31} - 1$	1	0	-
di.16	0B10h	4	-	4	0	$2^{31} - 1$	1	0	-
di.17	0B11h	4	-	4	0	$2^{31} - 1$	1	0	-
di.18	0B12h	4	-	4	0	$2^{31} - 1$	1	0	-
di.19	0B13h	4	-	4	0	$2^{31} - 1$	1	32	-
di.20	0B14h	4	-	4	0	$2^{31} - 1$	1	64	-
di.21	0B15h	4	-	4	0	$2^{31} - 1$	1	128	-
di.22	0B16h	4	-	4	0	$2^{31} - 1$	1	128	-
di.24	0B18h	4	-	4	0	2	1	0	-
di.25	0B19h	4	-	4	0	2	1	0	-
di.26	0B1Ah	4	-	4	0	2	1	0	-
di.27	0B1Bh	4	-	4	0	2	1	0	-
di.28	0B1Ch	4	-	4	0	2	1	0	-
di.29	0B1Dh	4	-	4	0	2	1	0	-
di.30	0B1Eh	4	-	4	0	2	1	0	-
di.31	0B1Fh	4	-	4	0	2	1	0	-
di.32	0B20h	4	-	4	0	2	1	0	-
di.33	0B21h	4	-	4	0	2	1	0	-
di.34	0B22h	4	-	4	0	2	1	0	-

Param.	Adr.	R/W	PROG.	ENTER	min	max	Step	default	
di.35	0B23h	4	-	4	0	2	1	0	-
do.0	0C00h	4	4	4	0	80	1	27	-
do.1	0C01h	4	4	4	0	80	1	3	-
do.2	0C02h	4	4	4	0	80	1	4	-
do.3	0C03h	4	4	4	0	80	1	27	-
do.4	0C04h	4	4	4	0	80	1	0	-
do.5	0C05h	4	4	4	0	80	1	0	-
do.6	0C06h	4	4	4	0	80	1	0	-
do.7	0C07h	4	4	4	0	80	1	0	-
do.8	0C08h	4	4	4	0	255	1	0	-
do.9	0C09h	4	4	4	0	255	1	0	-
do.10	0C0Ah	4	4	4	0	255	1	0	-
do.11	0C0Bh	4	4	4	0	255	1	0	-
do.12	0C0Ch	4	4	4	0	255	1	0	-
do.13	0C0Dh	4	4	4	0	255	1	0	-
do.14	0C0Eh	4	4	4	0	255	1	0	-
do.15	0C0Fh	4	4	4	0	255	1	0	-
do.16	0C10h	4	4	4	0	255	1	1	-
do.17	0C11h	4	4	4	0	255	1	2	-
do.18	0C12h	4	4	4	0	255	1	4	-
do.19	0C13h	4	4	4	0	255	1	8	-
do.20	0C14h	4	4	4	0	255	1	16	-
do.21	0C15h	4	4	4	0	255	1	32	-
do.22	0C16h	4	4	4	0	255	1	64	-
do.23	0C17h	4	4	4	0	255	1	128	-
do.24	0C18h	4	4	4	0	255	1	0	-
do.25	0C19h	4	4	4	0	255	1	0	-
do.26	0C1Ah	4	4	4	0	255	1	0	-
do.27	0C1Bh	4	4	4	0	255	1	0	-
do.28	0C1Ch	4	4	4	0	255	1	0	-
do.29	0C1Dh	4	4	4	0	255	1	0	-
do.30	0C1Eh	4	4	4	0	255	1	0	-
do.31	0C1Fh	4	4	4	0	255	1	0	-
do.32	0C20h	4	4	4	0	255	1	0	-
do.33	0C21h	4	4	4	0	255	1	1	-

Param.	Adr.	R/W	PROG.	ENTER	min	max	Step	default	
do.34	0C22h	4	4	4	0	255	1	2	-
do.35	0C23h	4	4	4	0	255	1	4	-
do.36	0C24h	4	4	4	0	255	1	8	-
do.37	0C25h	4	4	4	0	255	1	16	-
do.38	0C26h	4	4	4	0	255	1	32	-
do.39	0C27h	4	4	4	0	255	1	64	-
do.40	0C28h	4	4	4	0	255	1	128	-
do.41	0C29h	4	4	4	0	255	1	0	-
do.42	0C2Ah	4	4	4	0	255	1	0	-
do.43	0C2Bh	4	4	4	0 ms	1000 ms	1 ms	0 ms	-
do.44	0C2Ch	4	4	4	0 ms	1000 ms	1 ms	0 ms	-
LE. 0	0D00h	4	4	-	-30000,00	30000,00	00,1	0,00	-
LE. 1	0D01h	4	4	-	-30000,00	30000,00	00,1	0,00	-
LE. 2	0D02h	4	4	-	-30000,00	30000,00	00,1	100,00	-
LE. 3	0D03h	4	4	-	-30000,00	30000,00	00,1	4,00	-
LE. 4	0D04h	4	4	-	-30000,00	30000,00	00,1	0,00	-
LE. 5	0D05h	4	4	-	-30000,00	30000,00	00,1	0,00	-
LE. 6	0D06h	4	4	-	-30000,00	30000,00	00,1	0,00	-
LE. 7	0D07h	4	4	-	-30000,00	30000,00	00,1	0,00	-
LE. 8	0D08h	4	4	-	0,00	300,00	0,01	0,00	-
LE. 9	0D09h	4	4	-	0,00	300,00	0,01	0,00	-
LE.10	0D0Ah	4	4	-	0,00	300,00	0,01	5,00	-
LE.11	0D0Bh	4	4	-	0,00	300,00	0,01	0,50	-
LE.12	0D0Ch	4	4	-	0,00	300,00	0,01	0,00	-
LE.13	0D0Dh	4	4	-	0,00	300,00	0,01	0,00	-
LE.14	0D0Eh	4	4	-	0,00	300,00	0,01	0,00	-
LE.15	0D0Fh	4	4	-	0,00	300,00	0,01	0,00	-
LE.16	0D10h	4	-	-	0 Hz	20 Hz	0,0125 Hz	0,8 Hz	dependent on ud.2
LE.17	0D11h	4	-	4	0	4095	1	0	-
LE.19	0D13h	4	-	4	0	4095	1	0	-
LE.22	0D16h	4	-	4	0	4095	1	0	-
LE.24	0D18h	4	-	4	0	4095	1	0	-
ru.21	0215h	-	-	-	0	4095	1	-	-
ru.22	0216h	-	-	-	0	4095	1	-	-
ru.23	0217h	-	-	-	0	255	1	-	-

Param.	Adr.	R/W	PROG.	ENTER	min	max	Step	default	
ru.24	0218h	-	-	-	0	255	1	-	-
ru.25	0219h	-	-	-	0	255	1	-	-
oP.19	0313h	4	-	4	0	4095	1	16	I1
oP.20	0314h	4	-	4	0	4095	1	32	I2
oP.56	0337h	4	-	4	0	4095	1	0	-
oP.57	0338h	4	-	4	0	4095	1	0	-
oP.58	0339h	4	-	4	0	4095	1	0	-
oP.60	033Bh	4	-	4	0	4095	1	4	F
oP.61	033Ch	4	-	4	0	4095	1	8	R
Pn. 4	0404h	4	-	4	0	4095	1	64	I3
Pn.23	0417h	4	-	4	0	4095	1	0	-
Pn.29	041Dh	4	-	4	0	4095	1	128	Default 0 at F5-M/S
Pn.64	0440h	4	-	4	0	4095	1	0	-
uF. 8	0508h	4	-	4	0	4095	1	0	-
Fr. 7	0907h	4	-	4	0	4095	1	0	-
Fr.11	090Bh	4	-	4	0	4095	1	0	-
An. 3	0A03h	4	-	4	0	4095	1	0	-
An.13	0A0Dh	4	-	4	0	4095	1	0	-
An.23	0A17h	4	-	4	0	4095	1	0	-
cn.11	070Bh	4	-	4	0	4095	1	0	-
cn.12	070Ch	4	-	4	0	4095	1	0	-
cn.13	070Dh	4	-	4	0	4095	1	0	-

6.4 Setpoint-, Rotation- and Ramp Adjustment

6.4.1 Summary Description

The setpoint values of the KEB COMBIVERT F5 can be preadjusted analog as well as digital. The AUX-function adds or multiplies an analog setpoint to/with other setpoint settings.
The setpoint and rotation selection links the different setpoint sources with the possible sources of rotation direction. The signal thus obtained is used for further setpoint calculation.
Only after interrogation of the absolute setpoint limits, all the data that is required for the ramp calculation is available.

Fig. 6.4.1 Principle of set value and ramp adjustment

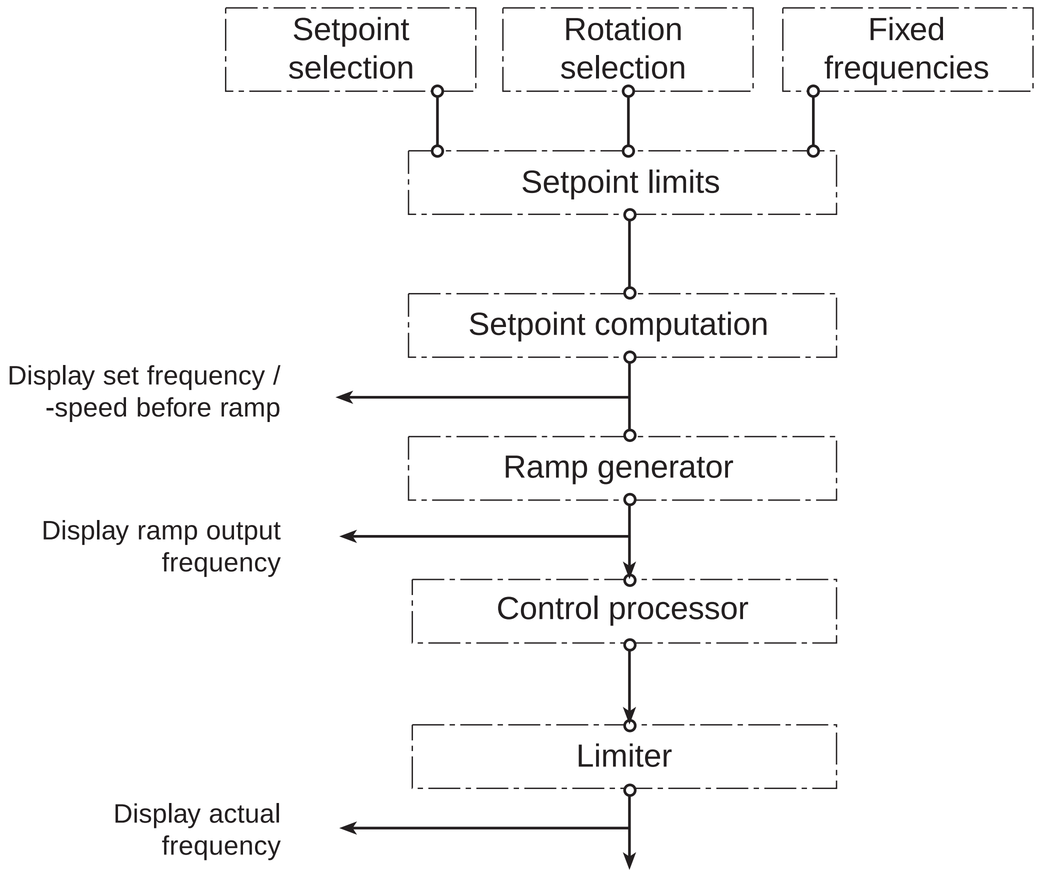
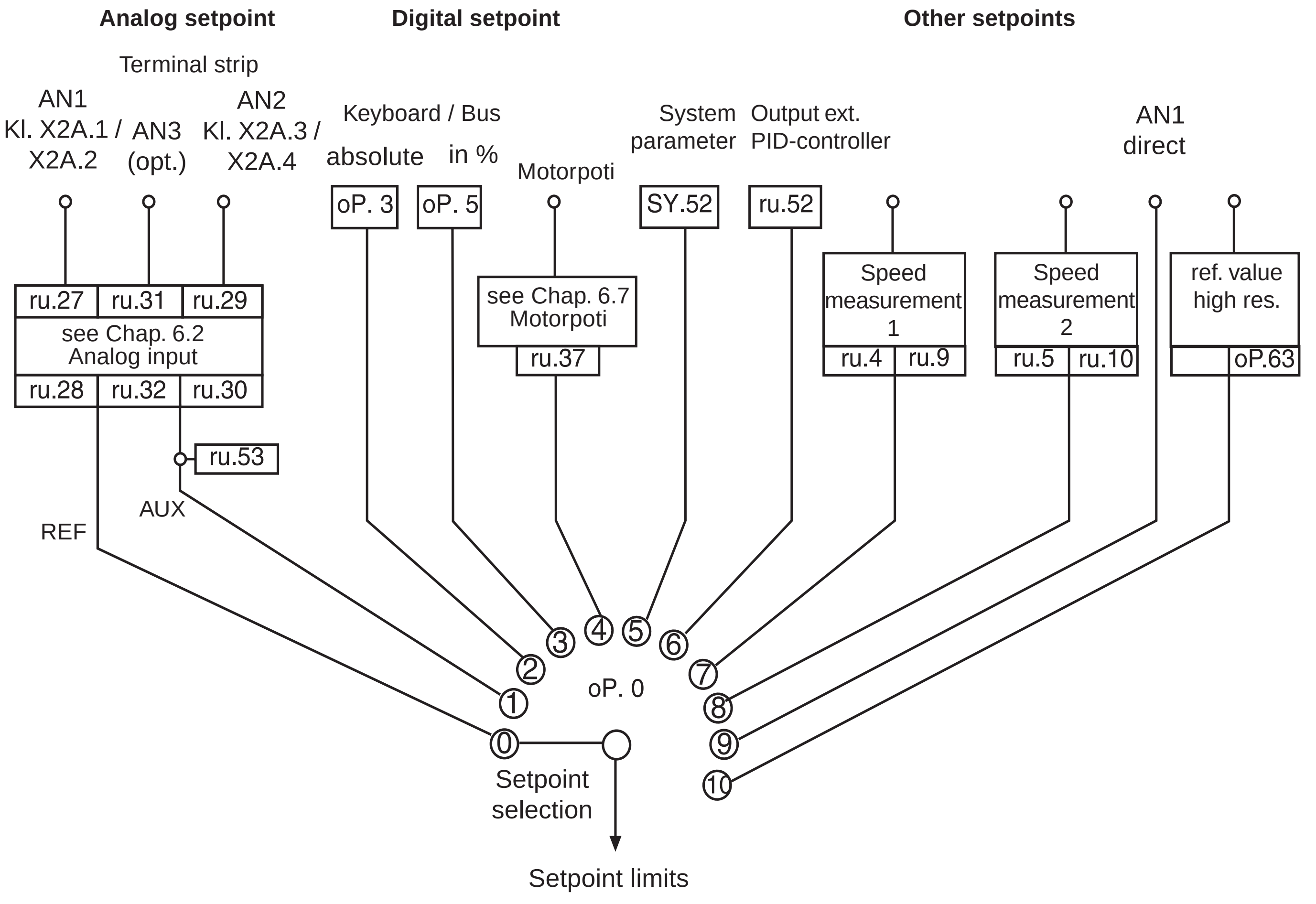


Fig. 6.4.2 Setpoint selection



With oP.0 it is determined how the setpoint is adjusted.

Analog setpoint

The analog setpoints are adjusted via AN1, AN2 or AN3 (option). Chapter 6.2 *„Analog In- and Outputs"* describes the analog signal processing. The indication of the setpoints can occur either before or after the signal processing (ru.27...32, ru.53).

Digital setpoint

With parameter oP.3 *„Absolute digital setpoint adjustment"* a setpoint frequency of -400... 400 Hz can be adjusted.
With parameter oP.5 *„Digital setpoint adjustment in percent"* a setpoint of -100% ... +100% of the maximal frequency (oP.10 / oP.11) can be adjusted.

Motorpoti function

With the motorpoti function a setpoint of -100%...0...100% between the limits adjusted in the parameters oP.6 / oP.7 and oP.10 / oP.11 can be adjusted via digital inputs **(see 6.9.3 „Motorpoti function").**

System parameters

Adjustment of absolute setpoint speed in rpm (SY.52) via the system parameters.

Output external PID-controller

Adjustment of the setpoint value from the output of the technology controller (see 6.12).

Speed measurement (not at B-control)

Adjustment of the setpoint value via one of the two speed measurements (see 6.10).

Direct analog setpoint adjustment (AN1 direct)

(not at B-control)

The cycle time of the software is 1 ms (BASIC: 2). During this time the analog input/output status is updated once. Additionally the inverter requires a processing time of 1...3 ms before the new setpoint value is calculated. If the inverter is used as secondary final control element of a superior control, this time can impair the dynamics of the entire closed-loop control system.
In such cases the analog setpoint value can be processed directly to the control processor (direct setpoint adjustment). Thus a sampling time of 250 ms is possible. To enable this fast response to an analog setpoint value, some restrictions must be accepted:

- The setpoint limitations oP. 6 / oP. 7 / oP. 11 do not have any function; the frequency setpoint is only limited by oP. 14 (for both directions).
- The calculation formula of the analog setpoint value changes. The parameters oP.6 / oP. 7 are without influence on the setpoint calculation.

  n_{set} = (analog value/10V * 100% - An. 6) * An. 5 * oP.10

- The acceleration / deceleration and S-curve time have no effect; it is operated internally without ramps.
- The parameters An.1...4 and An. 7...9 are without any function.
- The maximal filter time for the analog inputs is 2 ms.
- The stop position controller cannot be activated.

High-resolution reference setting (oP.63, oP64)

The reference value is determined as follows from oP.63 and oP.64 at oP.0 = 10 (internal resolution):

Ref. value (high-resolution) = 0P.64 * resolution factor * oP.63/ 2^14

A 32-bit-value results from this modulation. The upper 16 bits are processed directly (modulator or speed controller reference value). The lower 16 bits are integrated. In case of an overflow the value of the upper 16 bits is increased by 1, so a fine value results in the midrange.

Example

oP.0 = 10
oP.64 = 100 Hz
Resolution factor = 80 Hz
oP.63 = 150994

Ref. value (high-resolution) = 100 * 80 * 150994/ 2^14 = 73727/ 2^16 = 1,124985

This corresponds to 0,0140625 Hz.

In case of a resolution of 0.0125 Hz, 0.0250 Hz must be given out in each eight cycle, in order to reach the reference value

Dec. place of the reference value = Remain of the reference value/ 2^16 = 8191

The overflow when integrating the decimal place can be determined as follows, in order to reach the mean value.

Number of cycles up to the overflow = 2^16/ decimal places = 8,00098

The following displayed values results of:

ru.82 (ramp output) = 150992

converted in Hz:

Ramp output (Hz) = ru.82 * oP.64./ 2^30 = 0,0140622 Hz

ru.83 (actual value) = 134217 and in each eight cycle 268434

converted in Hz:

Actual value = ru.83 * oP.64/ 2^30 = 0,0125 Hz
in each eight cycle 0,025 Hz

Fade out target for setpoint value

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

Parameter:

oP.65	min. proh. reference 1
oP.66	max. proh. reference 1
oP.67	min proh. reference 2
oP.68	max. proh. reference 2

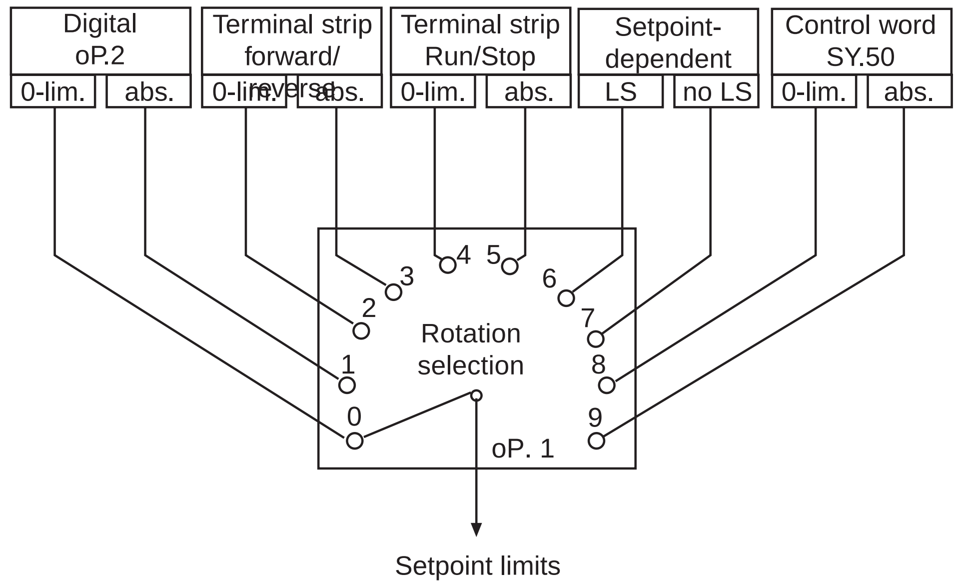
The parameters are not programmable.

The adjusted values are accepted still as setpoint value, so that 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.

6.4.3 Rotation Selection oP.1

The selection of rotation direction determines the manner in which the rotation direction is adjusted. One can choose between following possibilities:

Fig. 6.4.3 Rotation selection with oP.1



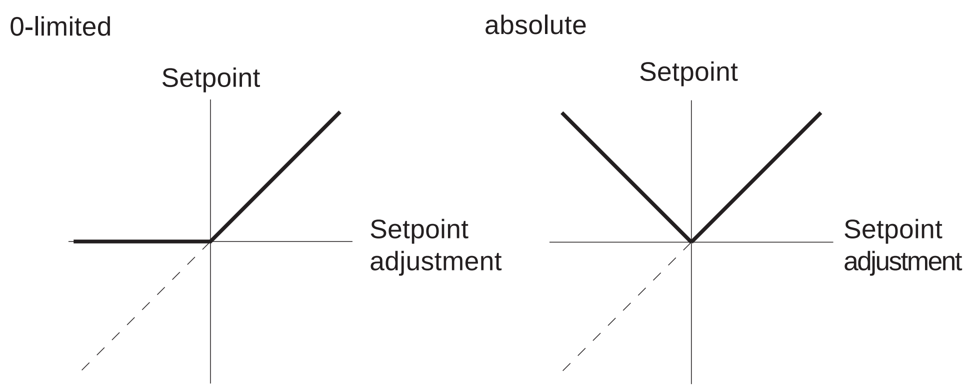
0-limited or absolute

Concerning the adjustment of direction of rotation it is differentiated between two evaluations:

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

absolute - no sign of the setpoint is evaluated and it is always driven with the amount in accordance with the selected rotation direction

6.4.3.a Absolute and 0-limited



Digital rotation adjustment (oP.2)

oP.2	Display	Setpoint rotation
0	LS	Standstill (Low Speed)
1	F	Forward (Forward)
2	r	Reverse (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.

Input selection
Rotation direction F (Run/Stop) oP.60
Rotation direction R (forward/reverse) oP.61

With parameter oP.60 one input is determined for rotation direction forward (or run/stop) and with oP.61 one input for rotation direction reverse (or forward/reverse).

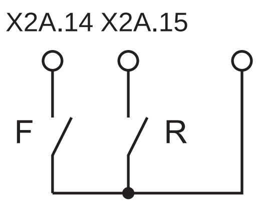
Bit -No.	Decimal value	Input	Terminal
0	1	ST (Prog. input „Control release/Reset“)	X2A.16
1	2	RST (Prog. input „Reset“)	X2A.17
2	4	F (Prog. input „Forward“) 1)	X2A.14
3	8	R (Prog. input „Reverse“) 2)	X2A.15
4	16	I1 (Prog. input 1)	X2A.10
5	32	I2 (Prog. input 2)	X2A.11
6	64	I3 (Prog. input 3)	X2A.12
7	128	I4 (Prog. input 4)	X2A.13
8	256	IA (Internal input A)	none
9	512	IB (Internal input B)	none
10	1024	IC (Internal input C)	none
11	2048	ID (Internal input D)	none

1) default at oP.60 2) default at oP.61

oP.1 = „2“ or „3“

In the case of rotation selection forward/reverse (oP.1= „2“ or „3“) the inputs determined with oP.60 and oP.61 work as follows:

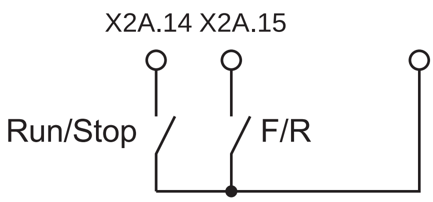
Forward	Revers	Input
F	R	Function
0	0	LS
0	1	Reverse
1	0	Forward
1	1	Forward



oP.1 = „4“ or „5“

In the case of rotation selection run/stop and forward/reverse (oP.1= „4“ or „5“) the inputs determined with oP.60 and oP.61 work as follows:

Revers	Forward	Input
F/R	Run/Stop	Function
0	0	LS
0	1	Forward
1	0	LS
1	1	Reverse



Rotation direction is dependent on the sign of the setpoint

The direction of rotation can be defined with the preadjusted setpoint signal. In the case of analog signals through adjustment of positive or negative voltages. In the case of digital signals through adjustment of positive frequencies (without sign) or negative frequencies (negative sign in the display). Following settings are possible:

Evaluation with LS (switch-off of modulation)

In this case a direction of rotation must be adjusted via a digital input, digitally via oP.2 or via control word SY.50 in order for the inverter to modulate. It is unimportant which direction of rotation is adjusted, as the direction of rotation is dependent on the setpoint.

	no rotation direction set	->	LS (Modulation disabled)
oP.1 = 6	set direction of rot.;pos. value (also 0)	->	rotation direction forward
	set direction of rot.;negative value	->	rotation direction revers

Evaluation without LS

In this case the inverter always modulates. No direction of rotation needs to be adjusted.

oP.1 = 7	positive value (also 0)	->	rotation direction forward
	negative value	->	rotation direction reverse

Rotation direction is dependent on the control word SY.50

The control word is used for the state control of the inverter via bus. In order for the inverter to react to the control word, the respective control process must be enabled (oP.1=8 or 9). When adjusting the direction of rotation via the control word, the setpoint can be evaluated 0-limited (oP.1 = 8) or absolute (oP.1 = 9).

Control word (low) Sy.50

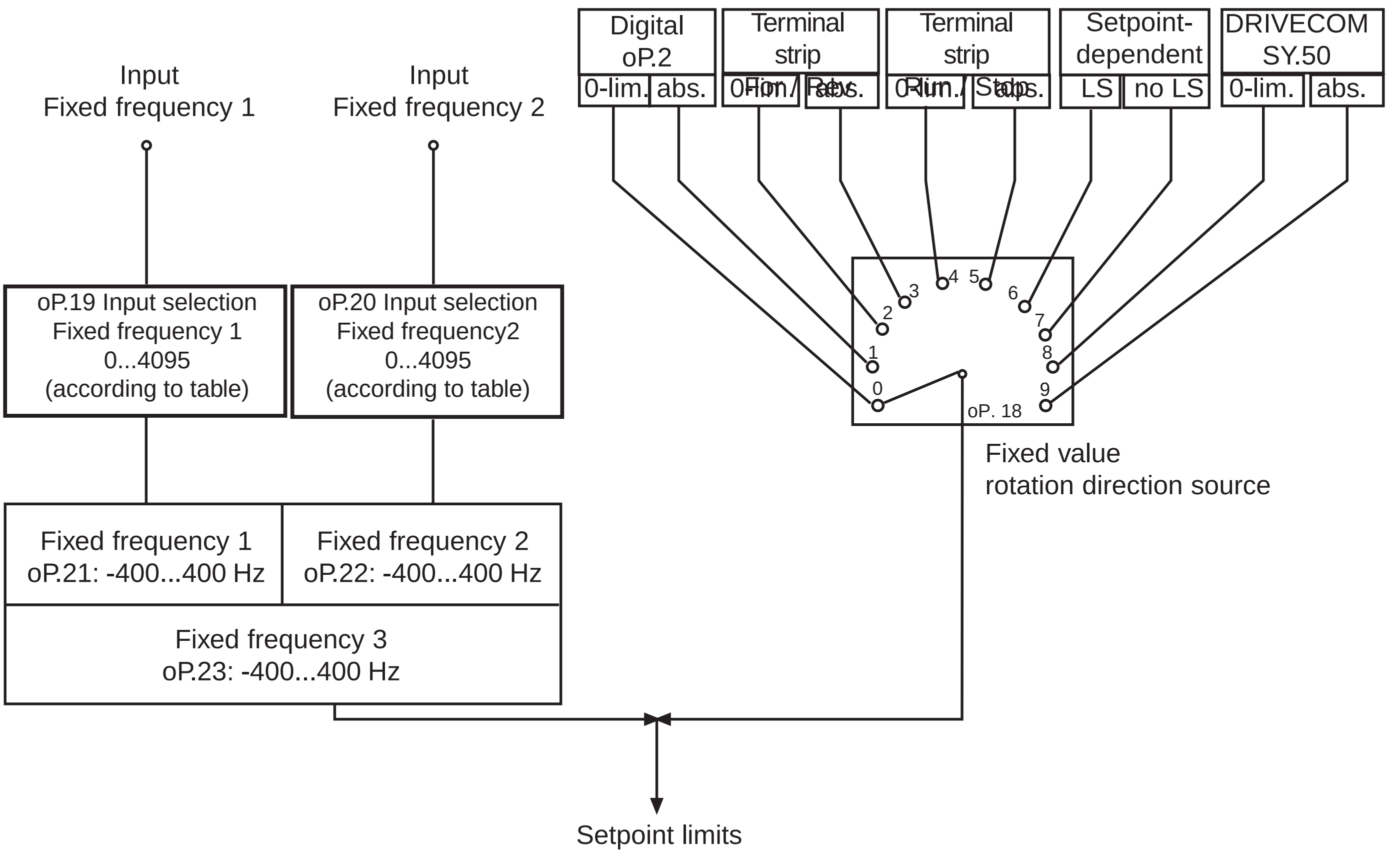
Bit	Function	Description
0	Control release	0 = control release not enabled; 1= control release enabled This bit takes effect only if di.1 Bit 0 is set. Then the AND-operation with di.2 Bit 0 and the terminal ST is effective); control release ST (hardware) must be set additionally.
1	Reset	Triggers reset when changing from 0 => 1
2	**Run / Stop**	0 = setpoint rotation Stop; 1 = setpoint rotation Run (source of setpoint direction op.1 = 8 or 9)
3	**For / Rev**	0 = setpoint rotation forward; 1 = setpoint rotation reverse (source of setpoint rotation op.1 = 8 or 9)
4-6	Current set	Source of set selection fr.2 = 5
7	Free	
8	Fast stop	0 = fast stop not activated; 1 = fast stop activated (OR-operation with further sources for fast stop)
9-15	Free	

If Run/Stop is to be adjusted over the control word, oP.2 must be set to „0“. The terminals F/R may not be wired (OR-operation of terminal, oP.2 and Sy.50).

6.4.4 Fixed Frequencies (oP.18...23)

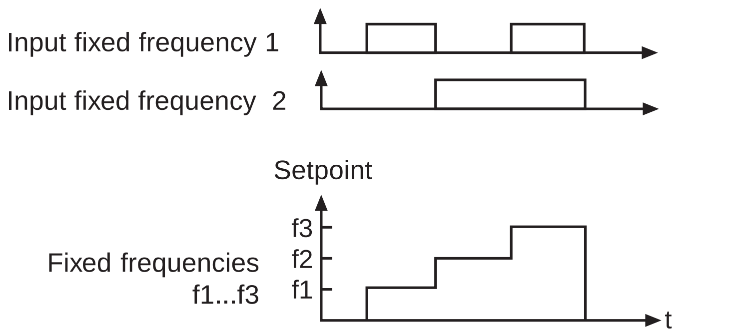
The KEB COMBIVERT supports up to 3 fixed frequencies for each parameter set, which can be selected via two digital inputs. With oP.19 and oP.20 the inputs required for the selection are defined (also see „Digital inputs“ Chapt. 6.3.11). The rotation direction source for fixed frequency mode is defined with oP.18. The adjustment is independent of oP.1 and is valid exclusively for the fixed frequencies. The adjustment of a fixed frequency has priority over the „normal“ setpoint adjustment.

Fig. 6.4.4 Fixed frequencies



Selection of fixed frequencies

Fig. 6.4.4.a Selection of fixed frequencies



Fixed-value rotation direction source (oP.18)

With oP.18 it is defined how the direction of rotation is determined in case of active fixed frequency. The function and the value range correspond to oP.1.

oP.18	Rotation direction source for fixed frequencies
0	digital via oP.2; setpoint 0-limited
1	digital via oP.2; setpoint absolute
2	terminal strip F/R; setpoint 0-limited
3	terminal strip F/R; setpoint absolute
4	terminal strip Run/Stop; setpoint 0-limited
5	terminal strip Run/Stop; setpoint absolute
6	setpoint-dependent with LS-recognition
7	setpoint-dependent without LS-recognition
8	control word SY.50; 0-limited
9	control word SY.50; 0-absolute

Fixed-value input selection 1 and 2 (oP.19; oP.20)

Bit -No.	Decimal value	Input	Terminal
0	1	ST (Prog. input „Control release/Reset“)	X2A.16
1	2	RST (Prog. input „Reset“)	X2A.17
2	4	F (Prog. input „Forward“)	X2A.14
3	8	R (Prog. input „Reverse“)	X2A.15
4	16	I1 (Prog. input 1)	X2A.10
5	32	I2 (Prog. input 2)	X2A.11
6	64	I3 (Prog. input 3)	X2A.12
7	128	I4 (Prog. input 4)	X2A.13
8	256	IA (Internal input A)	none
9	512	IB (Internal input B)	none
10	1024	IC (Internal input C)	none
11	2048	ID (Internal input D)	none

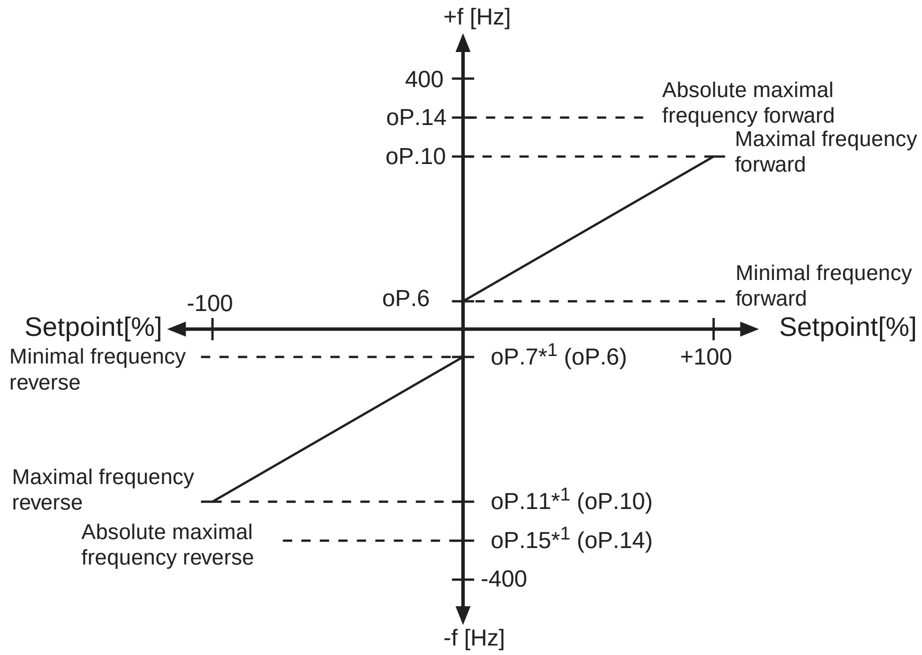
Fixed frequency 1...3 (oP.21, oP.22, oP.23)

The three fixed frequencies oP.21...23 are set-programmable and can be adjusted in the range of -400...400 Hz.

6.4.5 Setpoint Limits

Following limit values can be preadjusted:

Fig. 6.4.5 Setpoint limits



*1 If the value „=For“ is adjusted in these parameters (limit values rotation direction reverse), then the adjusted values for rotation direction forward (oP.6, oP.10 and oP.14) are valid.

Minimal- / Maximal frequency (oP.6, oP.7, oP.10, oP.11)

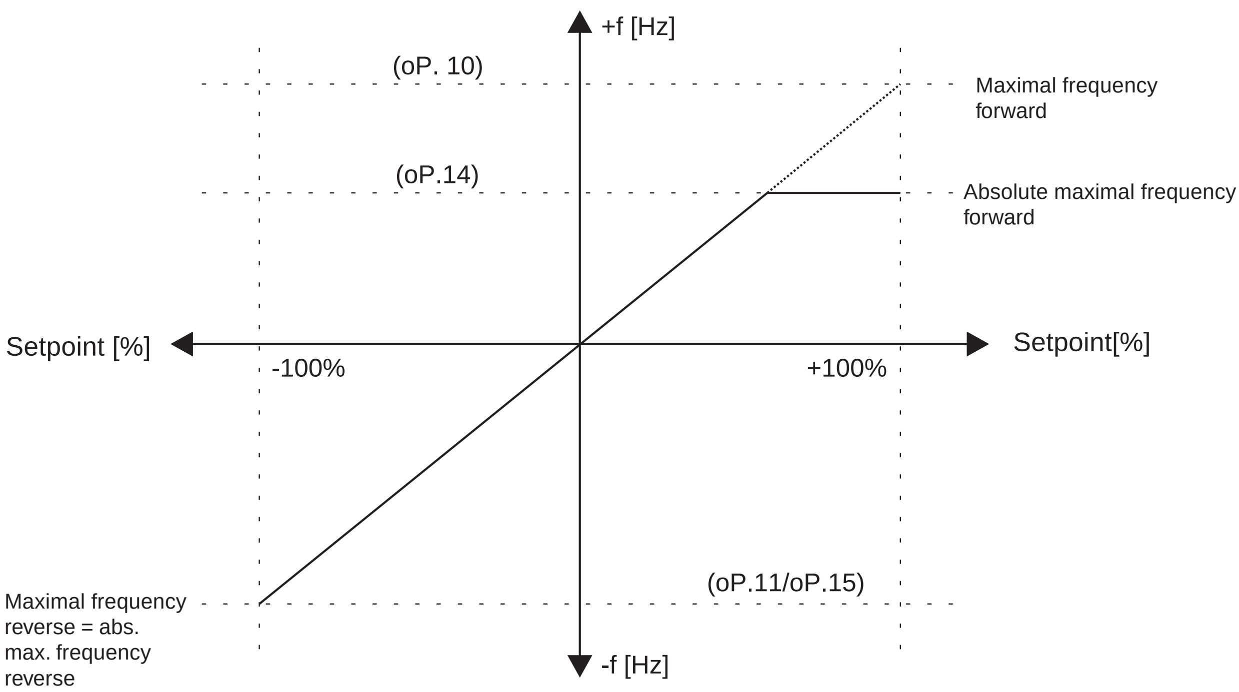
In case of setpoint adjustment in percent the minimal and maximal frequencies form the characteristic for the frequency calculation (0% = minimal frequency; 100% = maximal frequency). In case of absolute setpoint adjustment the minimal and maximal frequencies limit the setpoint. Separate limits can be adjusted for both rotation directions. If the value „For“ is adjusted for rotation direction „Reverse“, then the values for „Forward“ are valid.

Setting range:	oP.6: 0...400 Hz	Default: 0 Hz
	oP.10: 0...400 Hz	Default: 70 Hz
	oP.7: =For, 0...400 Hz	Default: =For
	oP.11: =For, 0...400 Hz	Default: =For

Absolute maximal frequency (oP.14, oP.15)

After the minimal and maximal frequencies the setpoint is limited through the absolute maximal frequency and subsequently transferred to the ramp generator. Since the analog setpoint is always calculated onto the maximal frequencies (oP.10, oP.11), it is possible, to adjust the characteristic of the analog setpoint with the same gain for both rotation directions (see Fig. 6.4.5.a) in spite of different maximal output frequencies. If the value „=For“ is adjusted in oP.15, then the absolute maximal frequency of oP.14 is valid for both rotation directions.

Fig. 6.4.5.a Setpoint limits



6.4.6 Setpoint Computation

The unit differentiates between two setpoint adjustments:

- the setpoint adjustment
  With the adjusted setpoint limits the frequency range 0%...100% is defined. in this case the adjustment 0% corresponds to the minimal frequency and 100% to the maximal frequency. The frequency is calculated according to following formula:

  $$\text{positive setpoint [Hz]} = \text{oP.6} + (\text{setpoint adjustment [\%]} \times \frac{\text{oP.10-oP.6}}{100\%})$$

  $$\text{negative setpoint [Hz]} = \text{oP.7} + (\text{setpoint adjustment [\%]} \times \frac{\text{oP.11-oP.7}}{100\%})$$

  The frequency is limited through the corresponding maximal frequencies.

- the absolute setpoint adjustment, i.e. the setpoint is directly adjusted as frequency and limited through the corresponding minimal and maximal frequencies as well as through the absolute maximal frequency.

The setpoint sources are assigned as follows:

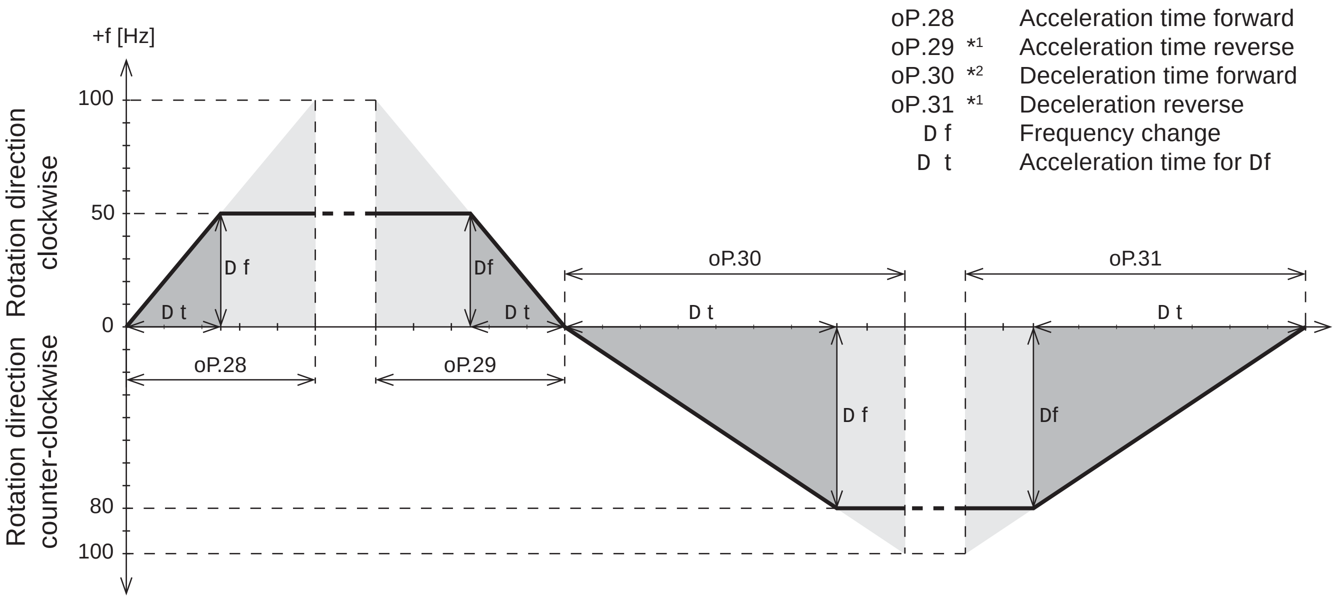
Setpoint adjustment in percent	Absolute setpoint adjustment
Terminal strip (analog setpoint)	Keyboard/Bus absolute
Keyboard/Bus in %	Set speed value SY.52
Motorpoti	Speed detection
PID-controller	

6.4.7 Ramp Generator

The ramp generator assigns an adjustable time to a frequency change, during this time the change stall take place. The acceleration time (for pos. frequency changes) and deceleration time (for neg. frequency changes) can be adjusted separately for both directions of rotation. To enable jerk-free acceleration and deceleration, so-called S-curves can be adjusted in addition to it.
The adjusted ramp times refer to 100Hz (at ud.2=0). The ramp times changes in proportion to the frequency change. The times to be adjusted are calculated as follows:

$$\frac{\text{desired ramp time}}{\text{ramp time to be adjusted (oP.28...oP.31)}} = \frac{\text{frequency change (Df)}}{\text{100 Hz (dep. on ud.2)}}$$

Fig. 6.4.7 Acceleration and deceleration times



*1 If the value „=For“ is adjusted in these parameters (acceleration and deceleration times for rotation direction reverse), then the values for rotation direction forward (oP.28 and oP.30) are valid.
*2 If the value „=Acc“ is adjusted, then the value for acceleration forward (oP.28) is valid.

ACC/DEC time factor (oP.62)

The time factor extends the standard ramp time (oP.28...31) by the adjusted value. The S-curve time do not change.

Value	Ramp time
0	adjusted value x 1
1	adjusted value x 2
2	adjusted value x 4
3	adjusted value x 8
4	adjusted value x 16

Calculation of the acceleration and deceleration times:

$$\text{oP.28...oP.31} = \frac{\text{100Hz x real ramp time}}{\text{Df}}$$

Example

A drive shall accelerate from 10Hz to 70Hz in 5s.

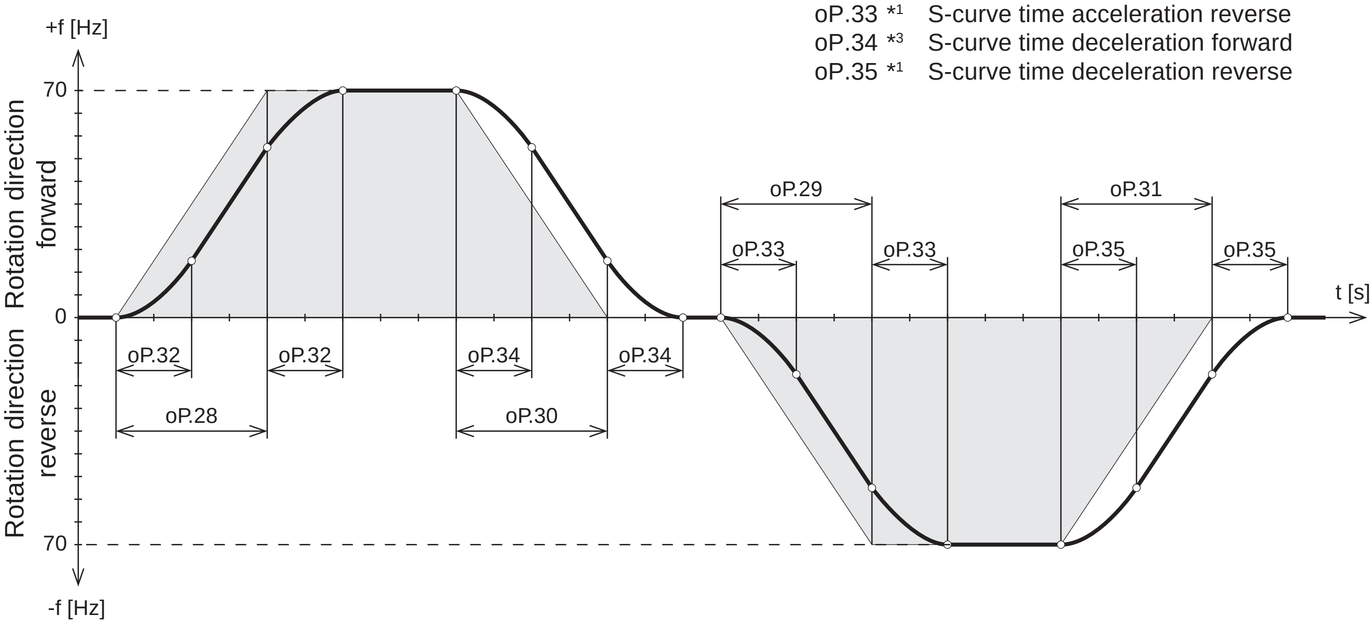
$$\text{oP.28} = \frac{\text{5s x 100Hz}}{\text{(70Hz-10Hz)}} = 8{,}33\text{s}$$

S-curve time

For some applications it is of advantage if the drive starts and stops nearly jerk-free. This function is achieved by straightening the acceleration and deceleration ramps. The straightening time, also called S-curve time, can be preadjusted with the parameters oP.32...oP.35. But S-curves are excecuted only with the adjustment „Ramp with constant rise“.

Fig. 6.4.6.a S-curve time

oP.28 Acceleration time forward
oP.29 *1 Acceleration time reverse
oP.30 Deceleration time forward
oP.31 *1 Deceleration time reverse
oP.32 *2 S-curve time acceleration forward
oP.33 *1 S-curve time acceleration reverse
oP.34 *3 S-curve time deceleration forward
oP.35 *1 S-curve time deceleration reverse



*1 If the value „For“ is adjusted in these parameters (for rotation direction reverse), then the values adjusted in the parameters for rotation direction forward are valid.
*2 If the value „=Acc“ is adjusted, then the value for acceleration forward (oP.28) is valid.
*3 If the value „=Acc“ is adjusted in parameter oP.34, then the value adjusted in parameter oP.32 is valid for all S-curve times.
Value „0“ switches the corresponding S-curve off.

! In order to drive defined ramps with activated S-curve time, the preadjusted acceleration and deceleration times (oP.28...oP.31) must be larger than the S-curve time (oP.32...oP.34) belonging to it.

Example for acceleration with rotation direction forward

At the beginning and the end of the acceleration ramp a parabolic curve is driven for the time adjusted in parameter oP.32. As a result the adjusted ramp time is extended by oP.32.

Total acceleration time = oP.28 + oP.32

6.4.8 Limiter (oP.36...41)

The setpoint after the ramp generator can be changed for example through slip compensation. Before the setpoint triggers the modulator, it is once again limited. So the limiter determines the minimal and maximal output frequency and can be programmed differently in all sets.

Minimal output frequency clockwise rotation (oP.36)
Minimal output frequency counter-clockwise rotation (oP.37)

If the frequency drops below the adjusted minimal output frequency, the modulation is switched off. For oP.37 = „=For“, the value for clockwise-rotation oP.36 is valid.

Setting range oP.36	0...400 Hz	Default: 0 Hz
Setting range oP.37	=For; 0...400 Hz	Default: =For

Maximal output frequency clockwise rotation (oP.40)
Maximal output frequency counter-clockwise rotation (oP.41)

If the frequency rises above the adjusted maximal output frequency, it is limited onto the adjusted value. For oP.41 = „=For“, the value for clockwise-rotation oP.40 is valid.

Setting range oP.40	0...400 Hz	Default: 200 Hz
Setting range oP.41	=For; 0...400 Hz	Default: =For

6.4.9 Ramp with constant time

At the ramp with constant time the acceleration and deceleration times adjusted with oP.28...oP.31 always equal the real ramp times, independent of the set value. In this operating mode S-curves are not possible.

Here a little 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.

Fig. 6.4.9.a Forward acceleration with constant ramp time

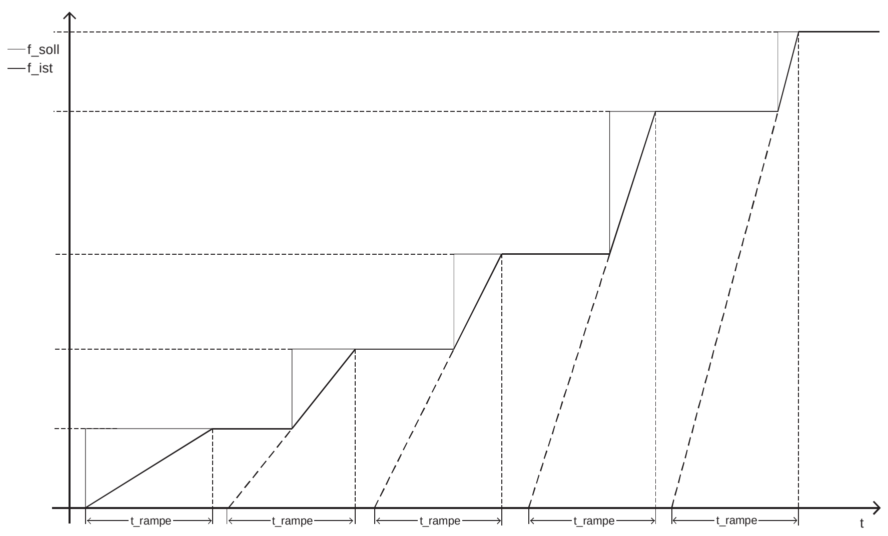
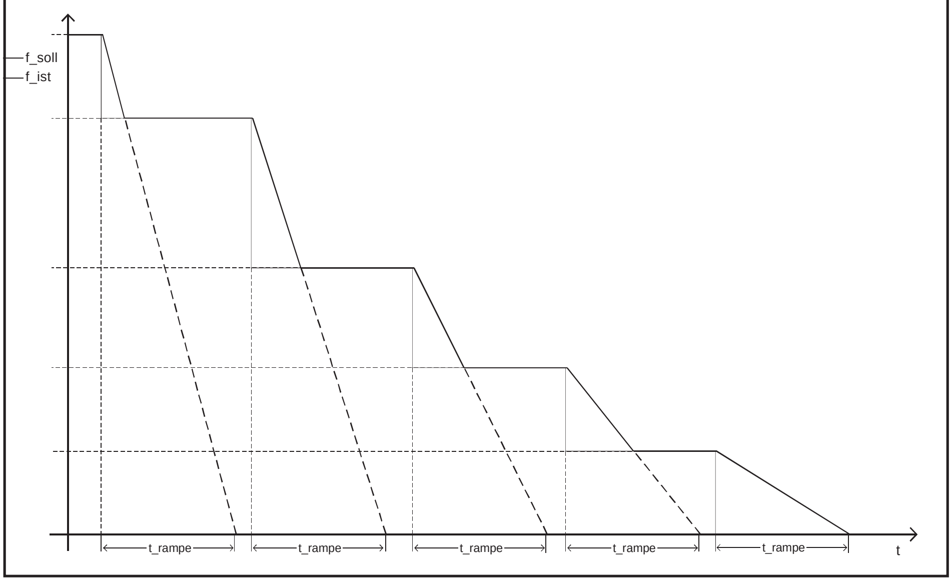


Fig. 6.4.9.b Forward deceleration with constant ramp time



Ramp mode (oP.27)

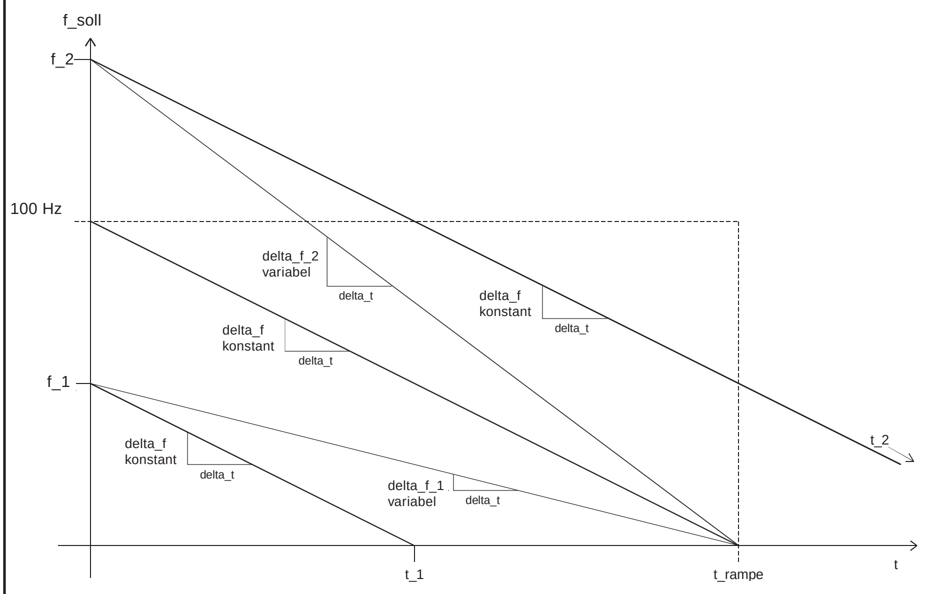
The different ramp functions can be adjusted separately for every frequency change (acceleration forward, deceleration forward and so on). The selection is made with oP.27 and is adjustable separately in each set.The function is activated after pressing „ENTER“.

Ramp	Bit-No	Value	Mode	Reference frequency
Acc. forward	0 + 1	0 1 2 3	const. ascent const. time *const. time reserved	100 Hz (dep. of ud.2) actual set value last set value at constant run
Dec. forward	2 + 3	0 4 8 12	const. ascent *const. time const. time reserved	100 Hz (dep. of ud.2) actual set value last set value at constant run
Acc. reverse	4 + 5	0 16 32 48	const. ascent const. time *const. time reserved	100 Hz (dep. of ud.2) actual set value last set value at constant run
Dec. reverse	6 + 7	0 64 128 192	const. ascent *const. time const. time reserved	100 Hz (dep. of ud.2) actual set value last set value at constant run

* Do not adjust these values - they are only sensible, if acceleration does not take place from standstill or deceleration is not made to standstill.

If the mode constant time is activated for a ramp, then the s-curve function is deactivated for this ramp. The ascent is limited to minimum 100 Hz / 4800 s.

Fig. 6.4.9.c Graph with ramp modes



Calculations

The frequency change per raster scan delta_t (step size delta_f) for the mode constant ascent is calculated from the ramp time t_ramp and the reference frequency (100 Hz dependend on ud.2) as follows:

$$\text{delta\_f} = \frac{100\ \text{Hz}}{\text{t\_rampe} / \text{delta\_t}}$$

For different set values the real ramp time is calculated according to following formula:

$$t = \text{t\_ramp} * \frac{\text{f\_set}}{100\ \text{Hz}}$$

The actual step size for the mode constant time is calculated from the step size delta_f and the actual set value f_set as follows:

$$\text{delta\_f(variabel)} = \text{delta\_f} * \frac{\text{f\_set}}{100\ \text{Hz}}$$

For the simplification of the internal calculation as frequency reference 102.4 Hz (e.g. 204.8 Hz or 409.6 Hz dependend on ud.2) is used :

$$\text{delta\_f(variabel)} = \text{delta\_f} * \frac{\text{f\_set}}{102.4\ \text{Hz}}$$

As a result an error of -2,4 % for the real ramp time occurs. If a certain real ramp time has to be adjusted, the desired value must be divided by 1.024.

Example:

desired ramp time = 10 s
adjusted ramp time = 10 s / 1.024 = 9.77 s

6.4.10 Used Parameters

Param.	Adr.	R/W	PROG.	ENTER	min	max	Step	default	
oP.0	0300h	4	4	4	0	9	1	0	-
oP.1	0301h	4	4	4	0	9	1	7	-
oP.2	0302h	4	4	4	0	2	1	0	-
oP.3	0303h	4	4	-	-4000 rpm	4000 rpm	0,125 rpm	0 rpm	dep. on ud.2
oP.5	0305h	4	4	-	-100 %	100 %	0,1 %	0,0 %	-
oP.6	0306h	4	4	-	0 rpm	4000 rpm	0,125 rpm	0 rpm	dep. on ud.2
oP.7	0307h	4	4	-	-0,125 rpm	4000 rpm	0,125 rpm	-0,125 rpm	-0,125 rpm: =For (dep. on ud.2)
oP.10	030Ah	4	4	-	0 rpm	4000 rpm	0,125 rpm	2100 rpm	dep. on ud.2
oP.11	030Bh	4	4	-	-0,125 rpm	4000 rpm	0,125rpm	-0,125 rpm	-0,125 rpm: =For (dep. on ud.2)
oP.14	030Eh	4	4	-	0 rpm	4000 rpm	0,125 rpm	4000 rpm	dep. on ud.2
oP.15	030Fh	4	4	-	-0,125 rpm	4000 rpm	0,125rpm	-0,125 rpm	-0,125 rpm: =For (dep. on ud.2)
oP.18	0312h	4	4	4	0	9	1	7	-
oP.19	0313h	4	-	4	0	4095	1	16	-
oP.20	0314h	4	-	4	0	4095	1	32	-
oP.21	0315h	4	4	-	-4000 rpm	4000 rpm	0,125 rpm	100 rpm	dep. on ud.2
oP.22	0316h	4	4	-	-4000 rpm	4000 rpm	0,125 rpm	-100 rpm	dep. on ud.2
oP.23	0317h	4	4	-	-4000 rpm	4000 rpm	0,125 rpm	0 rpm	dep. on ud.2
oP.27	031Bh	4	4	4	0	255	1	0	-
oP.28	031Ch	4	4	-	0,00 s	300,00 s	0,01 s	5,00 s	-
oP.29	031Dh	4	4	-	-0,01 s	300,00 s	0,01 s	-0,01 s	-0,01 s: =For
oP.30	031Eh	4	4	-	-0,01 s	300,00 s	0,01 s	5,00 s	-0,01 s: =Acc
oP.31	031Fh	4	4	-	-0,01 s	300,00 s	0,01 s	-0,01 s	-0,01 s: =For
oP.32	0320h	4	4	-	0,00 s	5,00 s	0,01 s	0,00 s	0,00 s: off
oP.33	0321h	4	4	-	-0,01 s	5,00 s	0,01 s	-0,01 s	-0,01 s: =For; 0,00 s: off
oP.34	0322h	4	4	-	-0,01 s	5,00 s	0,01 s	-0,01 s	-0,01 s: =Acc; 0,00 s: off
oP.35	0323h	4	4	-	-0,01 s	5,00 s	0,01 s	-0,01 s	-0,01 s: =For; 0,00 s: off
oP.40	0328h	4	4	-	0 rpm	4000 rpm	0,125 rpm	4000 rpm	dep. on ud.2
oP.41	0329h	4	4	-	-0,125 rpm	4000 rpm	0,125rpm	0,01 rpm	-0,125 s: =For; dep. on ud.2
oP.60	033Ch	4	-	4	0	4095	1	4	-
oP.61	033Dh	4	-	4	0	4095	1	8	-
SY.52	0034h	4	-	-	-16000 rpm	16000 rpm	1 rpm	0 rpm	-
oP.62	033Eh	-	-	4	0	4	1	0	-
oP.63	033Fh	-	-	-	-2^31-1	2^31-1	1	0	-
oP.64	0340h	-	-	-	0	n * 400	n * 0,0125	0	Hz

Param.	Adr.	R/W	PROG.	ENTER	min	max	Step	default	
oP.65	0341h	-	-	-	-4000 min^{-1}	4000 min^{-1}	0,125 min^{-1}	0 min^{-1}	-
oP.66	0342h	-	-	-	-4000 min^{-1}	4000 min^{-1}	0,125 min^{-1}	0 min^{-1}	-
oP.67	0,43h	-	-	-	-4000 min^{-1}	4000 min^{-1}	0,125 min^{-1}	0 min^{-1}	-
oP.68	0344h	-	-	-	-4000 min^{-1}	4000 min^{-1}	0,125 min^{-1}	0 min^{-1}	-
SY.52	0034h	4	-	-	-16000 min^{-1}	16000 min^{-1}	1 min^{-1}	0 min^{-1}	-

6.5 Voltage-/ Frequency Characteristic Adjustment

In the following chapter all parameters for the adjustment of the voltage/frequency characteristic as well as the appropriate adjustments like modulation, voltage rise (Boost) and switching frequency are described. Except for the switching frequency these adjustments apply only to F5-C, F5-B, F5-G and F5-M in controlled operation (CS.0=off).

6.5.1 Control Type (ud.2) and Max Frequency Mode (only F5-B)

This parameter depends in the value range on the used control. The values 0...3 apply to open loop systems (F5-B/ -C and -G), the values 4...7 to closed loop systems (F5-M) and the values 8...11 to servos (F5-S).

This parameter defines the maximal possible output frequency/speed, the resolution and the reference values for the ramp times, the analog outputs and the dc brake.Changes effect all frequency/speed dependent parameters. The parameter can only be written with opened control release. After a change the initialization is passed through, so that no Power-On-Reset is necessary.

! The switching frequency (uF.11) must be adjusted at least 10-times higher than the maximal possible output frequency!

ud. 2	Control type	Maximal frequency	Resolution
0	F5-C/B/G	400 Hz	0,0125 Hz
1	F5-C/B/G	800 Hz	0,025 Hz
2	F5-C/B/G	1600 Hz	0,05 Hz
3	F5-G	50 Hz	1,56 mHz
4	F5-M	4000 rpm	0,125 rpm
5	F5-M	8000 rpm	0,25 rpm
6	F5-M	16000 rpm	0,5 rpm
7	F5-M	500 rpm	0,0156 rpm
8	F5-S	4000 rpm	0,125 rpm
9	F5-S	8000 rpm	0,25 rpm
10	F5-S	16000 rpm	0,5 rpm
11	F5-S	500 rpm	0,0156 rpm

For every frequency mode COMBIVIS uses an own Config-File. In the case of a mode changeover all parameter information are read from the inverter and a new Config-File is generated should it not already exist.

High-Torque-Modus

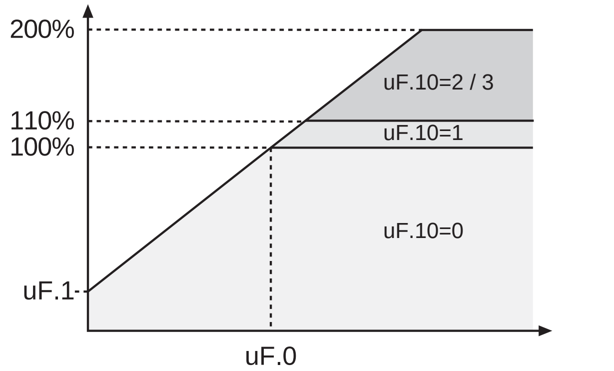
For applications with maximum torque with small output frequency a new mode was introduced.
Special characteristics at High-Torque-Modus:
• default of the set torque; the display is in 0,01 Nm
• default of the rated speed /-frequency in 0,125 rpm / 0,0125 Hz.
• the EMC constant for synchronous motors can be default up to 32 kV / 1000 rpm, that means rated speeds of the motors up to 12,5 rpm.

6.5.2 Rated frequency (uF.0) and Boost (uF.1)

The voltage/frequency characteristic (U/f) is adjusted with the rated frequency (uF.0) and the Boost (uF.1).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 uF.10 the modulation limit can be further increased in this stage up to 200 % (see Fig. 6.5.2).

Fig. 6.5.2 Rated Frequency and Boost

uF.0 = 0,00...400 Hz; Default = 50 Hz
uF.1 = 0,0...25,5 %; Default = PU-Id



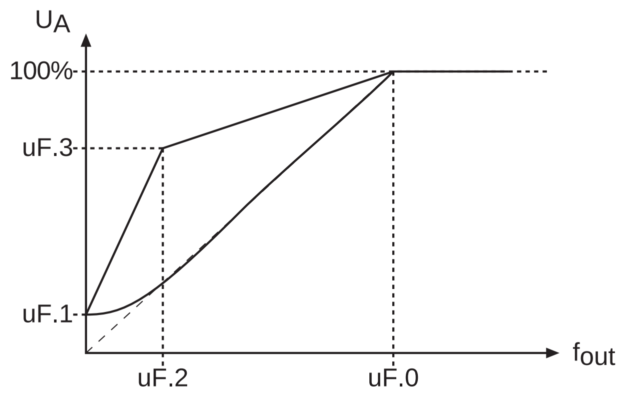
6.5.3 Additional Rated Point (uF.2/uF.3)

To adapt the U/f-characteristic to special conditions an additional point of support can be specified with uF.2 and uF.3. uF.2 defines the frequency and uF.3 the voltage. At uF.2 = 0 Hz the adjustment is ignored.

Fig. 6.5.3 Additional Rated Point

uF.2 =-1: parabolic characteristic
0,0...400 Hz; Default = 0,0 Hz

uF.3 = 0,0...100,0 %; Default = 0,0 %

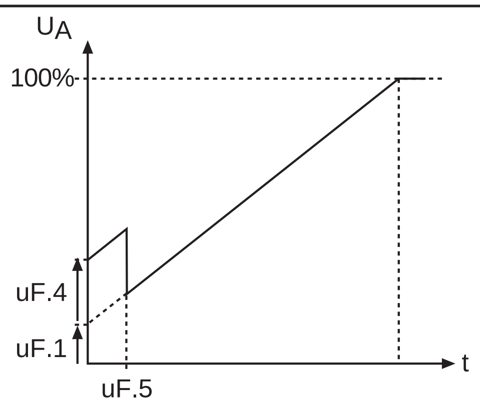


6.5.4 Delta Boost (uF.4/ uF.5)

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 %.

Fig. 6.5.4 Delta Boost

uF.4 = 0,0...25,5 %; Default = 0 %
uF.5 = 0,00...10,00 s; Default = 0 s

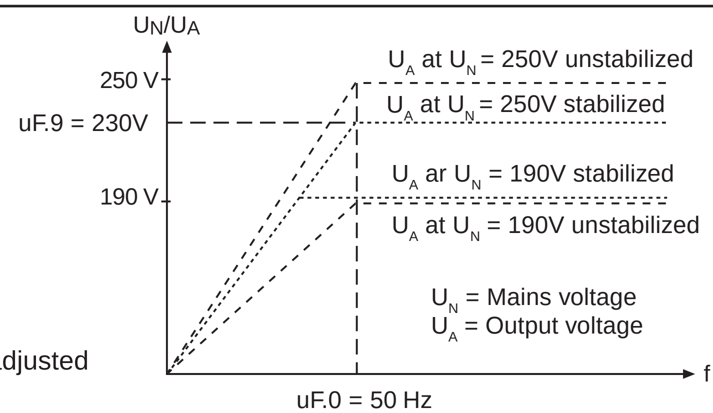


6.5.5 Voltage Stabilization (uF.9)

Due to fluctuations of the mains voltage or the load the DC-link voltage and with it the directly dependent output voltage can change. In the case of enabled voltage stabilization the fluctuations of the output voltage are compensated. That means 100% output voltage correspond to the value adjusted in uF.9, but maximally 110 % · (DC-link voltage / Ö 2). ÖFurthermore, this function makes it possible to adapt motors with a smaller rated current to the inverter. The function can be smoothed with uF.19. In closed loop operation the voltage stabilization works as limitation, which is not desired, especially in generatoric operation.

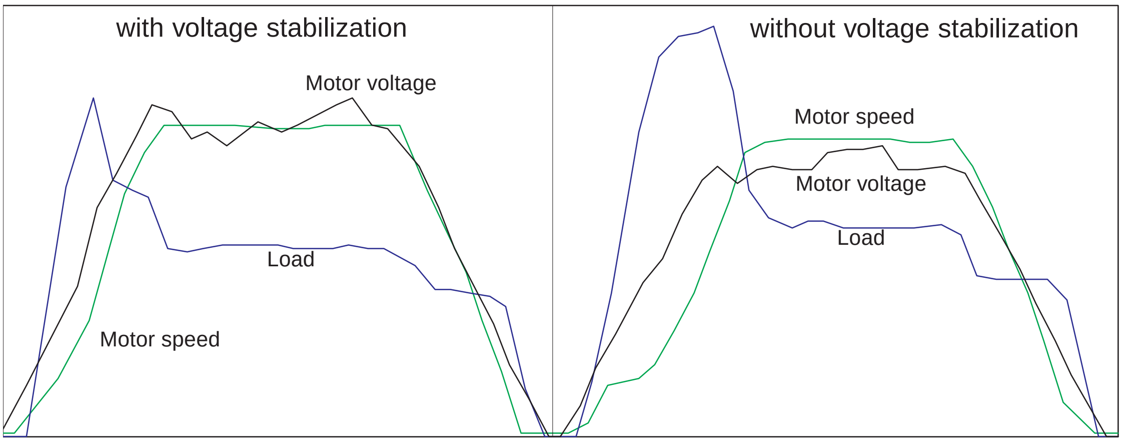
Fig. 6.5.5.a Voltage stabilization

uF.9 = 1...649 V
650 = off (default)



Example: uF.9 = 230V
no Boost is adjusted

Fig. 6.5.5.b Example*: Acceleration with load*



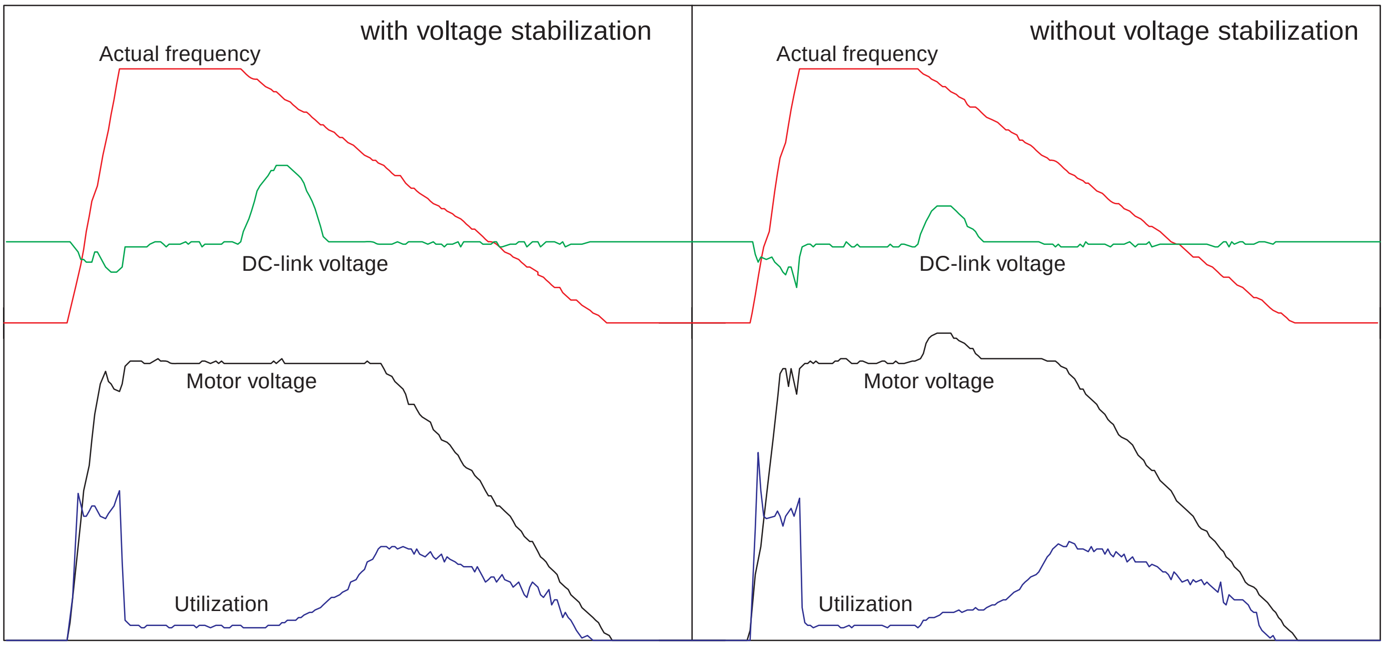
Voltage stabilization PT1-time constant (uF.19)

(only for F5-G upto D-housing)

With uF.19 the time constant of a PT1-element is defined. The PT1-element serves for the smoothing of the DC-link voltage. The initial value of the PT1-element is used as actual value for the voltage stabilization.

uF.19	PT1-time constant
0	function off
1	2 ms
2	4 ms
3	8 ms
4	16 ms
5	32 ms
6	64 ms
7	128 ms
8	256 ms
9	512 ms
10	1024 ms

Fig. 6.5.5.c Example: Deceleration of a high-inertia drive from 80Hz



6.5.6 Maximal voltage mode (uF.10)

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

uF.10	Modulation	Description
0	100 % U/f / 100% voltage	without overmodulation; all limitations 100% of modulation factor
1	110 % U/f / 110% voltage	with overmodulation; all limitations 110% of modulation factor
2	200 % U/f / 100% voltage	limitations between voltage-forming functions 200%; limitation before modulator 100% of modulation factor
3	200 % U/f / 110% voltage	limitations between voltage-forming functions 200%; limitation before modulator 110% of modulation factor

6.5.7 Switching Frequency (uF.11)

The switching frequency with which the power modules are clocked, can be changed depending on the application. The maximal possible switching frequency as well as the factory setting are determined by the employed power circuit. The display occurs in kHz.

uf.11 Switching frequency		
COMBIVIS	Display/Plaintext	Frequency
0	2	2 kHz
1	4	4 kHz
2	8	8 kHz
3	12	12 kHz
4	16	16 kHz

⚠ At switching frequencies above 4 kHz absolutely consider the max. motor line length specified in chapter 2.1.6 and 2.1.7.

The current switching frequency is indicated in the parameter ru.45, the max. switching frequency in In.3 and the rated switching frequency in In.4.

Influences and effects of the switching frequency are listed below:

small switching frequency	high switching frequency
- less inverter heating - less discharge current - less switching losses - less radio interferences - improved concentricity at small speeds	- less noise development - improved sine-wave simulation - lessmotor losses

6.5.8 Used Parameters

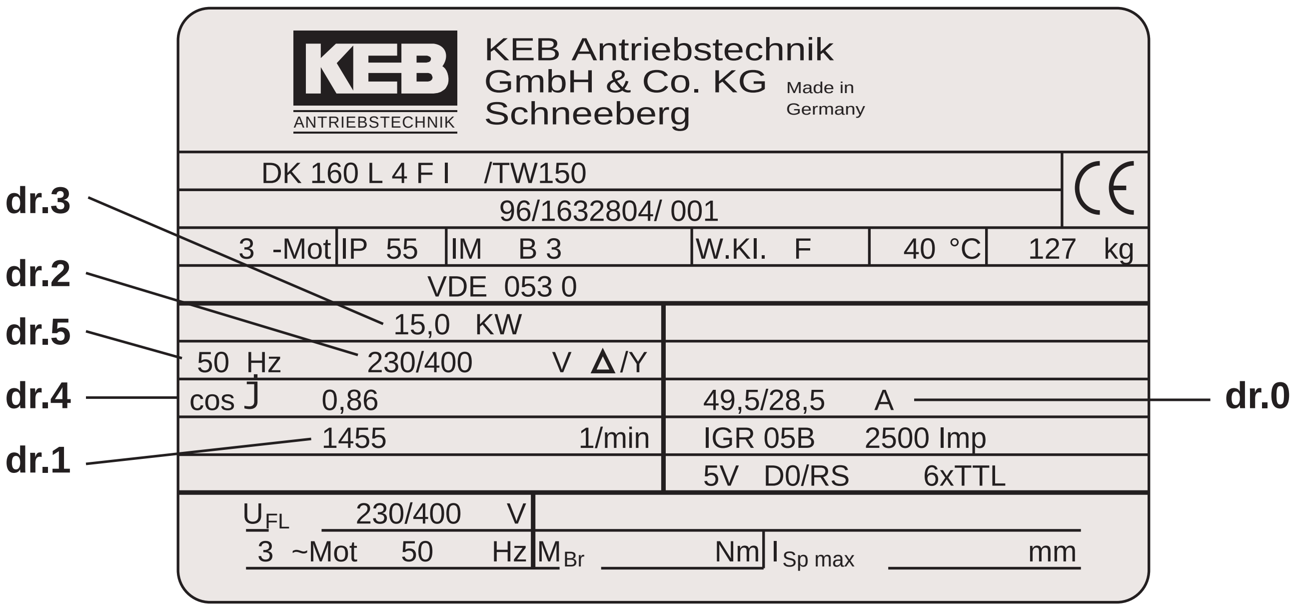
Param.	Addr.	R/W	PROG.	ENTER	min	max	Step	default	
ud. 2	0802h	yes	-	-	0	11	1	0/4/8	default value dep. on the control
uf.0	0500h	yes	yes	-	0 Hz	400 Hz	0,0125 Hz	50,0 Hz	dependent on ud.2
uf.1	0501h	yes	yes	-	0,0 %	25,5 %	0,1 %	2,0 %	-
uF.2	0502h	yes	yes	-	-1 Hz	400 Hz	0,0125 Hz	0,0 Hz	dep. on ud.2; -0,0125=parabolic
uF.3	0503h	yes	yes	-	0,0 %	100,0 %	0,1 %	0,0 %	-
uF.4	0504h	yes	yes	-	0,0 %	25,5 %	0,1 %	0,0 %	-
uF.5	0505h	yes	yes	-	0,00 s	10,00 s	0,01 s	0,00 s	-
uf.9	0509h	yes	yes	-	1 V	649 V; 650: off	1 V	650:off	-
uF.10	050Ah	yes	yes	-	0	3	1	0	-
uf.11	050Bh	yes	yes	-	0	PU-Id	1	PU-Id	PU-Id = Power unit Identification
uF.19	0513h	-	-	-	0	10	1	0	-

6.6 Motor Data Adjustment

The adjustment of the correct motor data is important for many inverter functions, since calculations are derived from it, which the inverter requires to achieve the best possible results in the control of Boost and slip compensation.

6.6.1 Motor Name Plate

Fig. 6.6.1 Example of a motor name plate



6.6.2 Motor Data from the Name Plate (dr.0...dr.5)

Following parameters can be taken directly from the name plate (see above) and entered:

- dr.0	Rated motor current	0.0...710.0 A (Star-/Delta-connection)
- dr.1	Rated motor speed	0...64000 rpm
- dr.2	Rated motor voltage	120...500 V (Star-/Delta-connection)
- dr.3	Rated motor power	0.35...400.00 kW
- dr.4	Rated motor power factor	cos(phi) 0.00...1.00
- dr.5	Rated motor frequency	0...1600.0 Hz

Parameter dr.0 and dr.2 are always to be adjusted according to the used wiring (star/delta). For above stated motor name plate that is 230 V / 49.5 A at delta-connection and 400 V / 28.5 at star-connection

6.6.3 Motor Data from Data Sheets (dr. 9)

Usually the breakdown torque factor (M_K/M_N) is not included in the motor rating plate. This data is found in the corresponding data sheet or the motor catalog. For KEB standard motors (4-pole) the information is listed in the following table:

kW	0,37	0,75	1,1	1,5	2,2	3,0	4,0	5,5	7,5
M_K/M_N	2,2	2,3	2,5	2,6	3,1	2,8	3,2	3,0	2,9

kW	11,0	15,0	18,5	22,0	30,0	37,0	45,0	55,0	75,0
M_K/M_N	3,3	3,0	2,9	2,6	2,4	2,5	2,5	2,3	2,2

kW	90,0	110,0	132,0	160,0	200,0	250,0	315,0	
M_k/M_N	2,2	2,2	2,2	2,0	2,4	2,3	2,5	

If the motor stator resistance is taken from a data sheet, then there is usually $R1_{20}$ - equivalent resistance (phase value) specified. Depending on the used connection the following value must be adjusted in dr.6:

Star connection: dr.6 = 2 • $R1_{20}$ to 2,24 • $R1_{20}$
Delta connection: dr.6 = 0,666 • $R1_{20}$ to 0,75 • $R1_{20}$

If only the warm resistance R_W is specified:

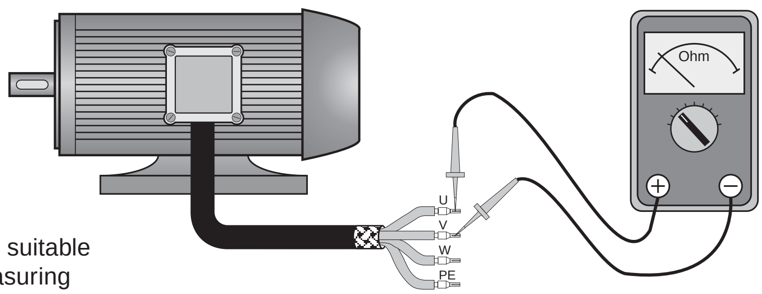
Star connection: dr.6 = 1,4 • $R1_W$ to 1,6 • $R1_W$
Delta connection: dr.6 = 0,46 • $R1_W$ to 0,53 • $R1_W$

6.6.4 Motor Stator Resistance (dr.6)

The motor stator resistance is measured independent of the motor wiring (D / Y) with a warm motor between 2 phases of the motor incoming line. To obtain a more exact result all 3 values (U/V, U/W and V/W) can be measured and the average value be formed.
In this way the ohmic line resistance is registered simultaneously (important in the case of long incoming lines).

If the measured resistance should be larger than the maximal value, the maximal value is to be adjusted.

Fig. 6.6.3 Measuring the motor stator resistance



Use suitable measuring devices

Standard values, if no suitable measuring equipment is available!

230V / 400V-motors in	D-connection	Y-connection
P/kW	R/W (dr.6)	R/W (dr.6)
0.37	14.0	42.0
0.55	12.0	36.0
0.75	9.0	27.0
1.1	5.5	16.5
1.5	3.5	10.5
2.2	2.5	7.5
3.0	1.5	4.5
4.0	1.1	3.3

230V / 400V-motors in Y-connection 400V / 690V-motors in D-connection	
P/kW	R/W (dr.6)
5.5	2.2
7.5	1.5
11.0	0.9
15.0	0.6
18.5	0.45
22.0	0.36
30.0	0.24
45.0	0.15
55.0	0.12
75.0	0.09

Automatic determination of the motor stator resistance

The KEB COMBIVERT supports an automatic determination of the motor stator resistance. For that proceed as follows:

- input motor data of the identification plate into the parameter set which is to programm.
- select and activate the parameter set which is to programm.
- Execute the measurement dependent on the operational case in cold status respectively let the motor warm up to operating temperature.
- Switch control release
- Preset no direction of rotation (inverter must be in status „LS“)
- Write maximal value „50.000“ to parameter dr.6

During the determination the status display (ru.0) indicates „Cdd“. Upon successful determination the motor stator resistance is entered in dr.6. If an error occurs during the determination then the error signal „E.Cdd“ is output. The detection 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.

Load motor dependent parameters (Fr.10)

After input of the name plate data of a new motor or after the automatic measurement of the stator resistance, an automatic optimization of autoboost and slip compensation can be executed with Fr.10.
The optimization is started by writing value „3“ on Fr.10. At that the inverter must be in the status „noP“ (no control release. Provided that only one motor is used, the measurement can occur with direct set programming for all parameters at once.
Following parameters are changed by the activation of Fr.10:

uF.0 Rated frequency = Rated motor frequency (dr.5)
uf.1 Boost = calculated value
uF.2 Additional Frequency = -0,0125 Hz (parabolic characteristic)
uF.3 Additional Voltage = 0
uF.9 Voltage stabilization = Rated motor voltage (dr.2)
uF.16 Autoboost configuration = 1 (with sign)
uF.17 Autoboost gain = 1,2
cS.0 Speed control configuration = 34 (speed controller + slip limitation)
cS.1 Actual Source = 2 (calculated)
cS.4 speed controller frequency limitation= 4 • rated motor slip

The adaption should cover approx. 90 % of the applications. For an application-specific adjustment a manual fine adjustment can now still be carried out for an individual case.

6.6.5 Used Parameters

Param.	Adr.	R/W	PROG.	ENTER	min	max	Step	default	
dr.0	0600h	4	4	-	0,0 A	710,0 A	0,1 A	P-ID*)	max. 25,5 A at B-housing
dr.1	0601h	4	4	-	0 rpm	64000 rpm	1 rpm	P-ID*)	-
dr.2	0602h	4	4	-	120 V	500 V	1 V	P-ID*)	-
dr.3	0603h	4	4	-	0,35 kW	400,00 kW	0,01 kW	P-ID*)	-
dr.4	0604h	4	4	-	0,50	1,00	0,01	P-ID*)	-
dr.5	0605h	4	4	-	0,0 Hz	1600,0 Hz	0,1 Hz	P-ID*)	-
dr.6	0606h	4	4	-	0,000 Ohm	50,000 Ohm	0,001 Ohm	P-ID*)	50 Ohm start automatic determitation
dr.9	0609h	4	4	-	0,5	4,0	0,1	2,5	-
Fr.10	090Ah	4	4	4	3	3	1	3	-

*) dependent on the power circuit identification

6.7 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).

6.7.1 Ramp Stop and Hardware Current Limit

The ramp stop function essentially fulfills two tasks. It prevents

- overcurrent errors (E.OC) during the acceleration phase,
- overvoltage and overcurrent errors (E.OC/E.OP) during the deceleration phase,

by stopping the ramp on exceeding adjustable levels. Moreover, the ramp stop function can be activated by a digital input.
Beyond that a hardware current limit is integrated which intervenes independent of the software and is thus much faster. Although these functions can be activated in controlled operation, this is to be avoided, since the KEB COMBIVERT regulates here at the torque limits.

Fig. 6.7.1.a Survey ramp stop function

Ramp stop → see „Digital outputs“ do.0...do.7 value „15“

Pn.23 Ramp stop Input selection: 0...4095 (Default 0) also see 6.3 „Digital inputs“

Pn.22	Ramp stop/Activation		
	LD-Stop (I)	LD-Stop (U)	LA-Stop
0	off	off	off
1	off	off	on
2	off	on	off
3	off	on	on
4	on	off	off
5	on	off	on
6	on	on	off
7	on	on	on

Pn.25 Deceleration stop / DC-voltage
200…800 V

Pn.24 Max. Ramp current
0…200 %

LA-Stop The function protects the frequency inverter against switch off caused by overcurrent during the acceleration phase. The current level is adjustable with Pn.24 in the range of 0…200 %. The protective function can be deactivated with Pn.22.

LD-Stop During deceleration energy is refeed into the frequency inverter, which causes a rise of the DC-link voltage.
If too much energy is refeed the inverter can trip to error OP or OC. If the LD-Stop function is activated with Pn.22, the DEC-ramp is regulated according to the adjusted DC-link voltage (Pn.25) or the DC-link current (Pn.24), so that errors are avoided to a large extent.
An activation of LD-Stop(I) - functionality leads to the deceleration stop, if the setpoint is reduced or if the protective function maximum constant current (stall-function) should cause a reduction of the frequency. Consequently inverters „get stuck“ at high speeds concerning applications like e.g. pumps / fans and overload errors can occur.
Since the error E.OP occurs far more often during deceleration and the avoidance of such errors is covered by the function LD(U), LD(I) should be activated only if it is absolutely necessary (overcurrent error during deceleration).

Hardware current limit (uF.15)

The hardware current limit is an additional, fast protection to prevent faults caused by overcurrent. Upon exceeding the max. short-time current limit (see Chapt. 2.1.6 and 2.1.7) the hardware current limit becomes active. The following settings are possible with uF.15:

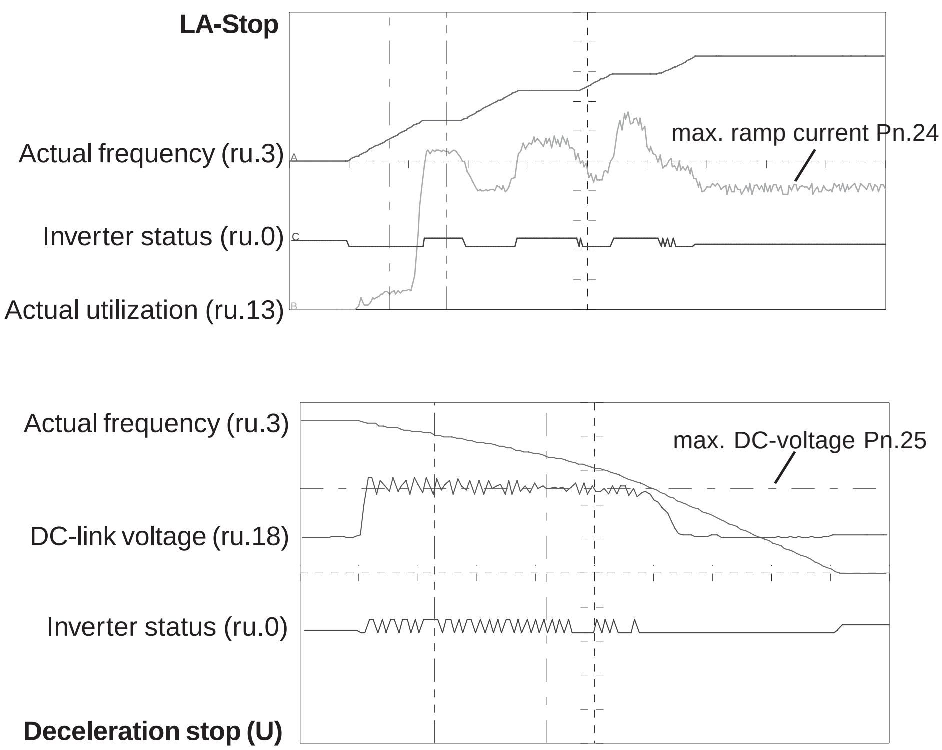
higher torque limit during interruption of the HCL possible!

Not valid for BASIC and COMPACT!

0	off; Hardware current limit disabled
1	Single phase mode; Hardware current limit enabled; works both in motoric and generatoric operation
2	Zero vector mode; Hardware current limit enabled; works only motoric, but at activated function it makes available more torque. Generatoric operation switches to Mode 1.

The hardware current limit limits the current at the limit and triggers no error. This can lead to torque breakdowns at the motor shaft, which is especially important during the operation „lifting and lowering“ since the drive can sag because of missing torque without the brake engaging.

Fig. 6.7.1.b Example for ramp stop function



Used Parameters

Param.	Addr.	R/W	PROG.	ENTER	min	max	Step	default	
Pn.22	0416h	yes	yes	yes	0	7	1	1	bit-coded
Pn.23	0417h	yes	-	yes	0	4095	1	0	-
Pn.24	0418h	yes	yes	-	0 %	200 %	1 %	140 %	% referring to inverter rated current
Pn.25	0419h	yes	yes	-	200 V	800V	1 V	375/720V	depending on voltage class
uF.15	050Fh	yes	-	-	0	2	1	1	-

6.7.2 Current Limit Constant Run (Stall-Function)

The Stall-function protects the frequency inverter against overload. Upon reaching the maximal constant current the utilization is reduced by increasing/decreasing the output frequency. When falling below the maximal constant current the inverter accelerates/decelerates again with the normal ramp time. These adjustments apply only to F5-B, F5-G and F5-M in controlled operation (CS.0=off).
The basic mode of operation is determined with Pn.19:

Pn.19 Stall mode

Binary	Dec.	Description	
Bit 0/1		Final value to which deceleration/acceleration takes place. Both limits are always adjusted as the control direction may be inverted during generatoric operation.	
		decelerates to	accelerates to
xxxxxx00	**0**	oP.6/oP.7	oP.10/oP.11
xxxxxx01	**1**	oP.36/oP.37	oP.10/oP.11
xxxxxx10	**2**	oP.6/oP.7	oP.40/oP.41
xxxxxx11	**3**	oP.36/oP.37	oP.40/oP.41
Bit 2		With this bit one adjusts whether the control direction inverts itself during generatoric operation.	
xxxxx0xx	**0**	Control direction independent on active current	
xxxxx1xx	**4**	Control direction is inverted in the case of negative active current (generatoric operation)	
Bit 3		This bit determines the control mode.	
xxxx0xxx	**0**	The frequency is increased/decreased by way of the ramp generator. The ramp time is preset by Pn.21.	
xxxx1xxx	**8**	The frequency is increased/decreased by a setpoint/actual-value differential controller. The time constant of the controller is preset by Pn.21, the setpoint is preset by Pn.20.	
		Determines when the stall controller should intervene,	
Bit 4			
xxx0xxxx	**0**	Stall-controller only active during constant running factual=fset (status ru.0: fcon or rcon	
xxx1xxxx	**16**	Stall-controller generally on	
		Determines which actual value serves for the control	
Bit 5			
xx0xxxxx	**0**	Apparent current (default)	
xx1xxxxx	**32**	Active current; this setting in combination with Bit3 = „1“ is necessary for generatoric operation (at F5-B = value 0)	
		Determines the torque/speed characteristic of the Stall-function.	
Bit 6			
x0xxxxxx	**0**	Positive characteristic, e.g. for fans, the frequency must be reduced so that the utilization decreases.	
x1xxxxxx	**64**	Negative characteristic, e.g. for drilling machines, the frequency must be increased so that the utilization decreases.	
		Current limitation calculation above the rated point	
		No current limitation calculation	
Bit 7		Current limitation calculation above the rated point. Above the rated point (uf.0) the Stall-level (Pn.20) is lowered according to following formula:	
0xxxxxxx	**0**		
1xxxxxxx	**128**	$$\text{Current limit} = \text{Pn.20} \left(\frac{\text{Rated point (uf.0)}}{\text{Actual frequency (ru.3)}}\right)^2$$	

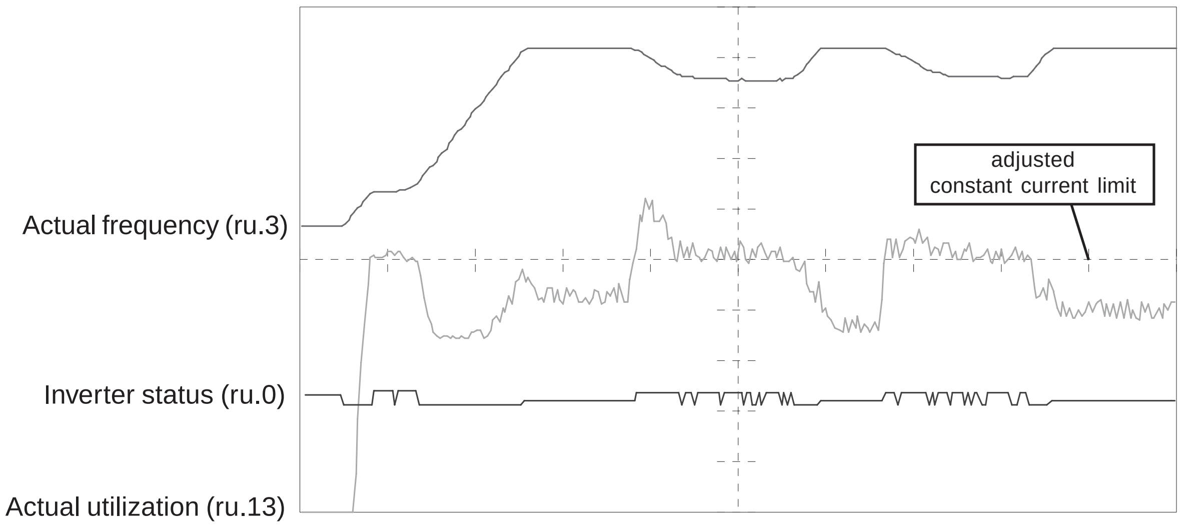
Pn.20 Stall level

The max. constant current represents the setpoint for the control. The adjusted value refers to the inverter rated current (In.1).
Setting range: 0...199 %; 200 = off (default)

Pn.21 Stall Acc/Dec time

Depending on the setting of Pn.19 (bit 3) the ramp time or the time constant of the differential controller is adjusted here. The adjusted ramp times refer to 100 Hz / 1000 rpm (depending on ud.2).
Setting range 0...300,00 s (2,00 s default)

Fig. 6.7.2 Functioning of Stall-function with standard setting



Used Parameters

Param.	Addr.	R/W	PROG.	ENTER	min	max	Step	default	
Pn.19	0413h	yes	yes	yes	0	255	1	0	bit-coded
Pn.20	0414h	yes	yes	-	0 %	199 % (200 = oFF)	1 %	oFF	% referring to inverter rated current
Pn.21	0415h	yes	yes	-	0,00 s	300,00 s	0,01 s	2,00 s	-

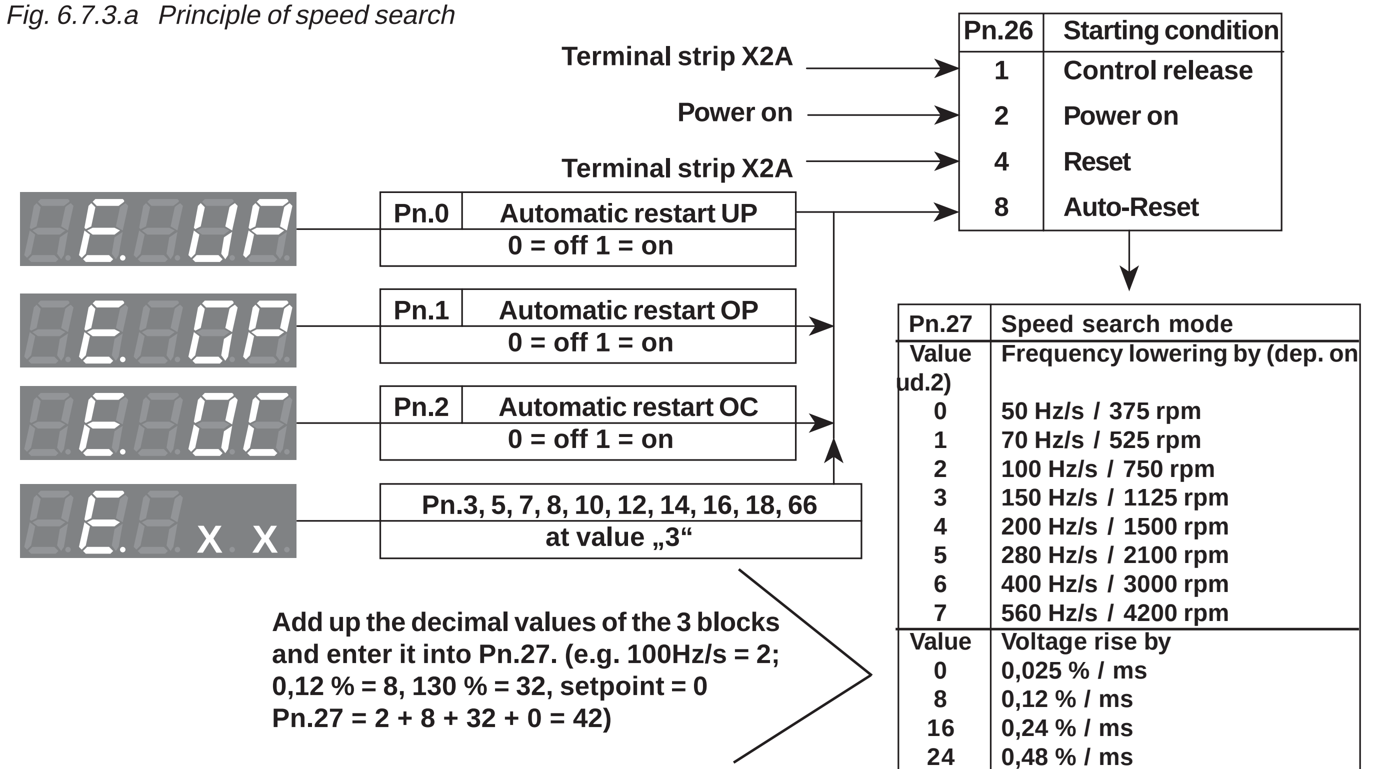
6.7.3 Automatic Restart and Speed Search

With automatic restart the inverter can reset errors automatically. The function can be activated in a separate manner according to error with the Pn-parameters.

! Because of the independent starting of the machine safety measures must be provided for operating personnel and machine.

The function speed search permits the connection of the frequency inverter onto a running out motor. After the function has been activated by the selected starting conditions (Pn.26), it searches for the actual motor speed and adapts the output frequency and voltage accordingly. If the synchronization point is found the inverter accelerates the drive with the adjusted ACC-ramp to the setpoint.In regulated operation the ramp output value is set to the measured actual value.

Fig. 6.7.3.a Principle of speed search



Pn.27	Speed search mode
Value	Frequency lowering by (dep. on ud.2)
0	50 Hz/s / 375 rpm
1	70 Hz/s / 525 rpm
2	100 Hz/s / 750 rpm
3	150 Hz/s / 1125 rpm
4	200 Hz/s / 1500 rpm
5	280 Hz/s / 2100 rpm
6	400 Hz/s / 3000 rpm
7	560 Hz/s / 4200 rpm
Value	Voltage rise by
0	0,025 % / ms
8	0,12 % / ms
16	0,24 % / ms
24	0,48 % / ms
Value	Utilization level up to
0	80%
32	130%
Value	Search
0	Set value
64	Measured actual value

Conditions at the start of speed search			Function
actual setpoint	³	old setpoint	secure
	³	act. motor speed	secure
	<	act. motor speed	critical
actual rotation direction	=	old rotation direct.	secure
	¹	old rotation direct.	critical

Speed search

Speed Search / Mode Pn.27

The speed search mode determines the frequency and voltage jumps as well as the maximum utilization with which the function works. Higher values let the function work faster, lower values make the function „softer“.

Fig. 6.7.3.b Speed search with „soft“ adjusted function

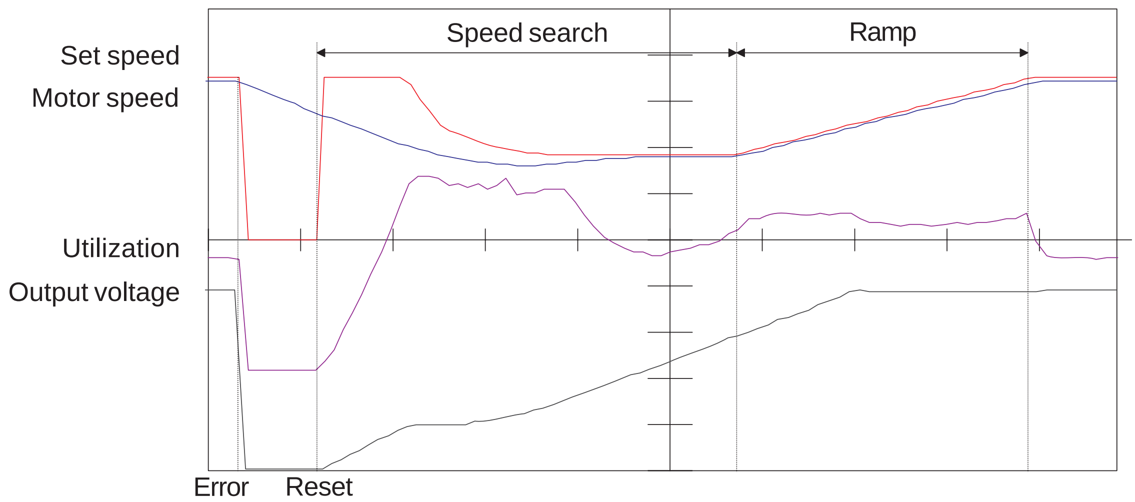
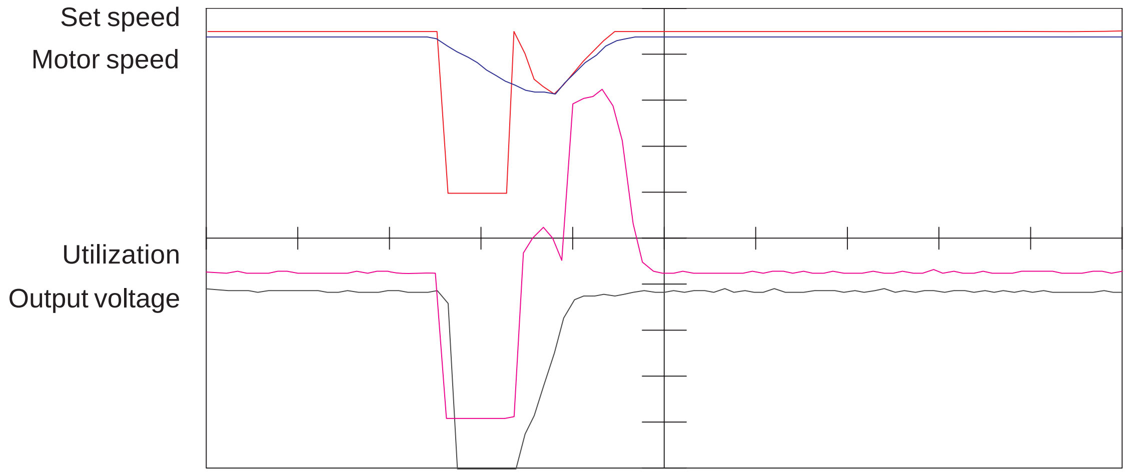


Fig. 6.7.3.c Speed search with „fast“ adjusted function



Used Parameters

Param.	Addr.	R/W	PROG.	ENTER	min	max	Step	default	
Pn.0	0400h	yes	-	-	0	1	1	1	-
Pn.1	0401h	yes	-	-	0	1	1	0	-
Pn.2	0402h	yes	-	-	0	1	1	0	-
Pn.26	041Ah	yes	yes	yes	0	15	1	8	bit-coded
Pn.27	041Bh	yes	-	yes	0	127	1	0	bit-coded

6.7.4 Dead Time Compensation (uF.18)

The dead time compensation optimizes the switch-off times of the power module semiconductors. The parameter is intended for service purposes only and should not be changed.

uF.18	Dead Time Compensation / Mode
0	off
1	on (default)

6.7.5 Base-Block Time (uF.12) and Voltage Level (uF.13)

On switching off the modulation (e.g. on opening the control release or triggering the DC-brake) the motor induces a voltage which acts contrary to its cause. The Base-Block time (uF.12 in s) protects the power modules against destruction by blocking the power modules in this stage. The duration of the Base-Block time depends on the power stage. During the Base-Block time the display indicates „bbl“. Below the indicated Base-Block voltage level uF.13 no Base-Block time occurs. The current modulation grade is indicated in ru.42.

6.7.6 Response to Errors or Warning Signals

The following errors or warning signals must not lead automatically to the disconnection of the inverter. The behaviour can be adjusted by parameters:

Pn.4 Input selection external error => Pn.3 Response to external fault
Pn.6 Watchdog time => Pn.5 Response to error watchdog
=> Pn.7 Response to limit switch
=> Pn.18 Response to set-warning
=> Pn.66 Response to soft limit switch

At the following signals one can react to the interference additionally by setting a switching condition:

Pn.9 Level OL-warning => Pn.8 Response to OL-warning
Pn.11 Level OH-warning => Pn.10 Response to OH-warning
Pn.13 Clearing time E.dOH => Pn.12 Response to dOH-warning
Motor protective circuit-breaker Chap. 6.7.8 => Pn.14 Response to OH2-warning
Pn.17 Level OHI-warning => Pn.16 Response to OHI-warning

Input selection external fault (Pn.4)

In order to trigger an error in the inverter with an external signal, one or several inputs can be selected for it with Pn.4.

i With Pn.65 Bit 1 it can be defined, whether with the inputs selected here E.EF (with response from Pn.3) or E.UP (response from 6.7.3) is triggered.

Bit -No.	Decimal value	Input	Terminal
0	1	ST (prog. input „control release/reset“)	X2A.16
1	2	RST (prog. input „reset“)	X2A.17
2	4	F (prog. input „forward“)	X2A.14
3	8	R (prog. input „reverse“)	X2A.15
4	16	I1 (prog. input 1)	X2A.10
5	32	I2 prog. input 2)	X2A.11
6	64	I3 (prog. input 3)	X2A.12
7	128	I4 (prog. input 4)	X2A.13
8	256	IA (internal input A)	none
9	512	IB (internal input B)	none
10	1024	IC (internal input C)	none
11	2048	ID (internal input D)	none

In case of several inputs the sum of their decimal values must be entered.

Response to E.EF (Pn.3)

With Pn.3 it is defined how the inverter reacts when an external error (E.EF; A.EF) is triggered. Following reactions can be selected:

Pn.3	Response	Description
0 1	Error; restart after Reset Fast stop; modulation off;	Error message E.xx Immediate switch off of modulation. Correct the error for the restart and activate reset. The prewarning changes to an error. The drive remains in the error state until a reset signal is recognized.
2	restart after Reset Fast stop; holding torque;	Status message A.xx Fast stop - switch off of modulation after reaching 0Hz. Correct the error for the restart and activate reset. The drive remains in condition fast stop until a reset signal is recognized.
3	restart after Reset modulation off; automatic restart	Status message A.xx Fast stop - holding torque on reaching 0 Hz. Correct the error for the restart and activate reset. The drive remains in condition fast stop until a reset signal is recognized.
4	Fast stop; modulation off; automatic restart	Status message A.xx Immediate switch off of modulation; the drive returns automatically to normal operation, as soon as the fault no longer exists.
5	Fast stop; holding torque; automatic restart	Status message A.xx Fast stop - switch off of modulation after reaching 0Hz. The drive returns automatically to normal operation, as soon as the fault no longer exists. Status message A.xx
6	Protective function off; no reaction	Fast stop - Holding torque on reaching 0 Hz. The drive returns automatically to normal operation, as soon as the fault no longer exists. no status message
		No effect on the drive. Fault is being ignored.

Watchdog-time (Pn.6)

The Watchdog-time monitores communication on the external bus between operator and e.g. PC. The response upon exceeding the adjusted time is defined with Pn.5. The time is adjustable in the range of 0 (no reaction); 0.01...10.00 s.

Response to E.buS (Pn.5)

The possible reactions correspond to the reactions of Pn.3 (see above). Depending on the selected setting a status message E.buS or A.buS is output or fault is being ignored.

Level OL-warning (Pn.9)

If the 100%-utilization of the inverter is exceeded by 5 %, the internal overload counter starts to count forward. If the utilization falls below 100 %, the counter counts backward. The current counter content can be read in parameter ru.39. Upon reaching 100 % the inverter switches off with error message „E.OL“ and the counter counts backward. When it has reached 0 % the status changes to E.nOL. The error can now be reset.
With Pn.9 a level between 0...100 % can be adjusted, at which the condition OL-warning is fulfilled. The response to the warning signal is defined with Pn.8.

Response to OL-warning (Pn.8)

Depending on the selected setting a status message E.OL or A.OL is output or the fault is being ignored.

Pn.8	Response	Description
0...5	see Pn.3	see Pn.3
6	warning signal only at dig. output	No effect on the drive upon reaching 100 %. Switching condition do.0...7 value „7“ is set.

Limit switch error response (Pn.7) (only F5-M/S)

This parameter adjusts the response if one of inputs programmed as limit switch is triggered. The possible reactions correspond to the reactions of Pn.3 (see left page).Depending on the selected setting and the rotation direction an error/status message E.Prr/A.Prr or E.PrF/A.PrF is output.

Level OH-warning (Pn.11)

The overtemperature detection protects the power module against thermal overload. The temperature, at which the frequency inverter switches off with error message "E.OH" depends on the power circuit (usually 90°C). After a cooling phase the status changes from E.OH to E.nOH and can then be reset.
With Pn.11 a level between 0° C up to 90 °C is adjustable, at which the condition OH-warning is fulfilled. The response to the warning signal is defined with Pn.10.

Response to OH-warning (Pn.10)

Pn.10	Response	Description
0...5	see Pn.3	see Pn.3
6	warning signal only at dig. output	No effect on the drive upon reaching the switching off level. Switching condition do.0...7 Value „8“ is set.

6

Disconnecting time E.dOH (Pn.13)

The motor temperature detection protects the motor against thermal overload. A temperature sensor integrated into the motor winding is connected to the terminals T1/T2 of the inverter. Upon exceeding a resistance of 1650 Ohm (e.g. a motor temperature > Level Pn.62) the disconnecting time adjusted with Pn.13 is started, the switching condition "9" (dOH-warning) is set and the adjusted response to the warning signal is carried out. After the expiration of the disconnecting time (Pn.13) the error E.dOH is triggered.

Response to dOH-warning (Pn.12)

Depending on the selected setting an error / status message E.dOH or A.dOH is output and the selected response is activated. If overheat no longer exists, the message E.ndOH (or A.ndOH) is output. Only then the error can be reset or the automatic restart can be carried out.

Pn.12	Response	Description
0...5	see Pn.3	see Pn.3
6	warning signal only at dig. output	Switching condition Value „9“ is set. No effect on the drive until the disconnecting time (Pn.13). Switch off with error message E.dOH.
7	warning signal disabled **(default)**	Function disabled; terminals are not queried. Switching condition Value „9“ dOH warning is not set.

Level dOH-warning (Pn.62)

A special power circuit is necessary for this function. The motor overtemperature level defines a temperature in the range of 0...200 °C. On exceeding the adjusted temperature the turn-off time (Pn.13) starts, the switching condition „46“ is set and the response according to Pn.12 is executed. After expiration of the turn-off time the inverter switches off with the error message E.dOH. The current temperature is indicated in ru.46.
With a standard power circuit Pn.62 has no function. In the motor temperature display ru.46 only T1-T2 closed or T1-T2 open is displayed.
An electronic motor protective circuit-breaker is integrated in servo F5-S (see Chapt.

Level OH2-warning (Pn.15)

(only for F5-S)

6.7.8). A level of 0...100 % of the tripping time is adjustable with Pn.15. On reaching the adjusted level, the switching condition „OH2-warning“ is set (also see „Digital outputs“). The response to the warning signal is defined with Pn.14.

Response to OH2-warning (Pn.14)

An electronic motor protective circuit-breaker is integrated in KEB COMBIVERT (see Chapt. 6.7.8). When the tripping times, defined according to VDE 0660, are exceeded the switching condition "OH2-warning" is set (also see 6.3 „Digital outputs“).

Pn.14	Response	Description
0...5	see Pn.3	see Pn.3
6	warning signal only at dig. output	No effect on the drive. Fault is being ignored. Switching condition do.0...7 value „10“ is set.

E.OHI delay time (Pn.17)

The interior temperature monitoring protects the inverter against malfunctions caused by too high temperature in the interior of the inverter. Upon exceeding a unit-specific temperature the interior fan is activated. If after approx. 10 minutes the temperature is still too high, the switch off time adjusted with Pn.17 is started, the switching condition „11“ OHI-warning is set and the adjusted response to the warning message is executed. After expiration of the switch-off time (0...120 s) the error E.OHI is triggered (also see 6.3 „Digital Outputs“).

OHI stopping mode (Pn.16)

The response to the warning signal is defined with Pn.16. Depending on the selected setting an error/status message E.OHI or A.OHI is output. After a cooling phase the inverter status changes from E.OHI to E.nOHI or in case of warning from A.OHI to A.nOHI and can then be reset (see also 6.3 "Digital Outputs").

Pn.16	Response	Description
0...5	see Pn.3	see Pn.3 The prewarning changes to an error. The drive remains in the error status until a reset signal is detected.
6	warning signal only at dig. output	No effect on the drive until the disconnecting time (Pn.17). Switching condition Value „11“ is set. Function disabled; interior temperature is not evaluated.
7	warning signal disabled	

E.Set stopping mode (Pn.18)

This parameter determines the response to a set selection error. The possible reactions correspond to the reactions of Pn.3 (see left page). Depending on the selected setting an error/status message E.Set or A.Set is output.

Software limit switch error response (Pn.66)

This parameter determines the response to a software limit switch error. The possible reactions correspond to the reactions of Pn.3 (see left page). Depending on the selected setting and the rotation direction an error/status message E.SLF/A.SLF or E.SLr/A.SLr is output.
The software limit switches are only active if:
• after a reference point approach or setting the reference point active
• the position is stored (PS.14 Bit 0-1 = 3)
• the position is valid (PS.14 Bit 7 = 1) (absolute value encoder)

6.7.7 Quick Stop

The function quick stop is triggered through malfunctions (abnormal stopping) or by the control word (sy.50 Bit 8).It is defined by the following parameters.

The quick stop mode determines the basic operating mode of the function.

Quick Stop / Mode (Pn.58) (F5-G)

Pn.58	Description
Bit 0	Control mode
0	Control via ramp generator (default)
1	Control via differential controller
Bit 1	Actual value for differential controller
0	Apparent current (default)
2	Active current
Bit 2	Behaviour at standstill after activation by control word (sy.50)
0	Modulation off
4	Holding torque
Bit 3	Status word Bit 8 at standstill
0	= 1, until quick stop function is left
8	= 0, if standstill is reached

Quick Stop / Level (Pn.59) (F5-G)

The fast stop level determines the setpoint value for the differential control. The adjustable value of 10...200% refers to a rated inverter current (In.1).

Quick Stop / Ramp time (Pn.60)

Depending on the adjustment of the control mode in Pn.58 the ramp time or the time constant of the differential controller is adjusted here within the range of 0...300.00 s (default 2.00 s). The ramp time refers to 100 Hz / 1000 rpm (depending on ud.2).

Quick Stop Torque limit (Pn.61) (F5-M/S)

Adjustment of the torque limit during fast stop in the range of 0...10000 Nm. Pn.61 is limited to dr.15 (max. torque FI) and dr.33 (three-phase motor) (dr.15 > dr.33 > cS.19).

Quick Stop max. torque at corner speed (Pn.67) (F5-M/S)

Setting of the max. torque at field weakening speed (dr.18) during quick stop in the range 0...10000,00 Nm (also see chap. 6.6.4).

Max. abn. stopping time (Pn.68) (not at F5-B/C)

An active quick stop is interrupted with the adjusted time here. The frequency inverter switches the modulation off and changes into the corresponding error status (A.xx => E.xx). Value 0 switches the function off

Function description F5-G

Regulation by ramp generator:

Quick stop with time delay stop (LD(U)-Stop) onto the minimum output value (op.36 / op.37). At abnormal stopping with holding torque the modulation remains switched on, otherwise it is switched off (also at quick stop by control word sy.50 Bit 8).

Regulation by differential controller

Quick stop with time delay stop (LD(U)-Stop) onto the minimum output value (op.36 / op.37) with variable step size (see below). At abnormal stopping with holding torque the modulation remains switched on, otherwise it is switched off.
The differential controller changes the adjusted step size (from pn.60), if the actual value is larger than the setpoint value:

$$\text{Adjusted step size} = \frac{100\text{Hz}}{\text{Ramp time}}$$

$$\text{Step size} = \text{adjusted step size} * \left(1 + \frac{\text{Setpoint value - Actual value}}{\text{Inverter rated current}}\right)$$

Description for F5-M and F5-S

At quick stop the motor is decelerated with the adjusted ramp time (pn.60) with LD(U)-Stop or at the torque limit (pn.61) to 0 rpm.
At abnormal stopping with holding torque the modulation remains switched on, otherwise it is switched off (also at quick stop by control word sy.50 Bit 8).

Used Parameters

Parameter	Addr.	ro	prog		min	max		default	[?]	Notes
Pn.3 E.EF stopping mode	0403	-	-	0	6	1	0	-	-	
Pn.4 ext. fault input select	0404	-	-	yes	0	4095	1	64	-	64 => I3
Pn.5 E.buS stopping mode	0405	-	-	-	0	6	1	6	-	
Pn.6 watchdog time	0406	-	-	-	0: off	10,00 s	0,01 s	0: off	-	
Pn.7 proh. rot. stopping mode	0407	-	-	-	0	6	1	6	-	not at F5-B/C/G
Pn.8 warning OL stop. mode	0408	-	-	-	0	6	1	6	-	
Pn.9 OL warning level	0409	-	-	-	0 %	100 %	1 %	80 %	-	
Pn.10 warning OH stop. mode	040 A	-	-	-	0	6	1	6	-	
Pn.11 OH warning level	040B	-	-	-	0 °C	90 °C	1 °C	70 °C	-	
Pn.12 warning dOH stop. mode	040C	-	-	-	0	7	1	6	-	not at F5-B/C/G
Pn.13 E.dOH delay time	040D	-	-	-	0	120 s	1 s	10 s	-	not at F5-B/C/G
Pn.14 warning OH2 stop. mode	040E	-	-	-	0	6	1	6	-	
Pn.15 OH2 warning level	040F	-	-	-	0 %	100 %	1 %	100 %	-	only for F5-S
Pn.16 warning OHI stop. mode	0410	-	-	-	0	7	1	7	-	
Pn.17 E.OHI delay time	0411	-	-	-	0 s	120 s	1 s	0 s	-	
Pn.18 E.Set stopping mode	0412	-	-	-	0	6	1	0	-	
Pn.58 quick stop mode	043 A	-	-	yes	0	3	1	0	-	not at F5-M/S
Pn.59 quick stop level	043B	-	-	-	0 %	200 %	1 %	200 %	-	not at F5-M/S
Pn.60 quick stop acc/dec time	043C	-	-	-	0,00 s	300,00 s	0,01 s	2,00 s	-	
Pn.61 quick stop torque limit	043D	-	-	-	0,00 Nm	10000,00 Nm	0,01 Nm	Adaption	-	not at F5-B/C/G
Pn.62 dOH warning level	043E	-	-	-	0 °C	200 °C	1 °C	100 °C	-	not at F5-B/C
Pn.66 soft. limit stopping mode	0442	-	-	-	0	6	1	6	-	not at F5-B/C/G
Pn.67 q. stop max. torq. corn. sp.	0443	-	yes	-	0	10000,00	0,01	Adap.	Nm	not at F5-B/C/G
Pn.68 max. abn. stopping time	0444	-	-	-	0,00	100,00	0,01	0,00	s	not at F5-B/C

6.7.8 Motor Protection Mode

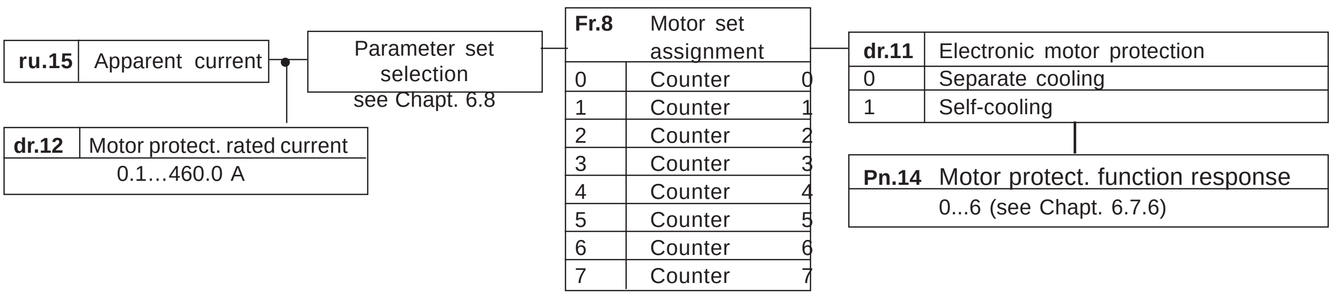
Description for F5-B, F5-G and F5-M

The motor protective function protects the connected motor against thermal desctruction caused by high currents.The function corresponds largely to mechanical motor protective 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 (ru.15) and the adjusted rated motor current (dr.12).

For motors with separately driven fan or at rated frequency of a self-ventilated motor following tripping times (VDE 0660, Part 104) apply:

1,2	• I_n	Þ	2 hours
1,5	• I_n	Þ	2 minutes
2	• I_n	Þ	1 minute
8	• I_n	Þ	5 seconds

Fig. 6.7.8.a Motor protection mode



Motor set assignment fr.8

If several motors are operated on one inverter, each motor can be individually protected by selecting different counters (0...7).

Example: - a different counter is assigned to each motor

1. Motor	2. Motor	3. Motor
ß	ß	ß
Counter 0	Counter 1	Counter 2

- this counter is now adjusted in all parameter sets of the corresponding motor

Counter 0 = Value „0“	Counter 1 = Value „1“	Counter 2 = Value „2“
ß ß ß	ß	ß ß
Set 1 Set 5 Set 0	Set 2	Set 6 Set 3

following values adjust:	ß	ß	ß
	0.fr.8 = 0	2.fr.8 = 1	3.fr.8 = 2
	1.fr.8 = 0		6.fr.8 = 2
	5.fr.8 = 0		

The counter works only in the active set with the measured value. In all inactive sets it is counted down. If one counter exceeds the limit, the response adjusted in Pn.14 is triggered.

Motor protection / Mode (dr.11)

The cooling mode of the motor is adjusted with these programmable parameters.

Value	Function
0	Separate cooling (default)
1	Self-cooling

Motor protection / rated current (dr.12)

This parameter specifies for each set the rated current (= 100% utilization) for the motor protective function. The motor protection-load is calculated as follows:

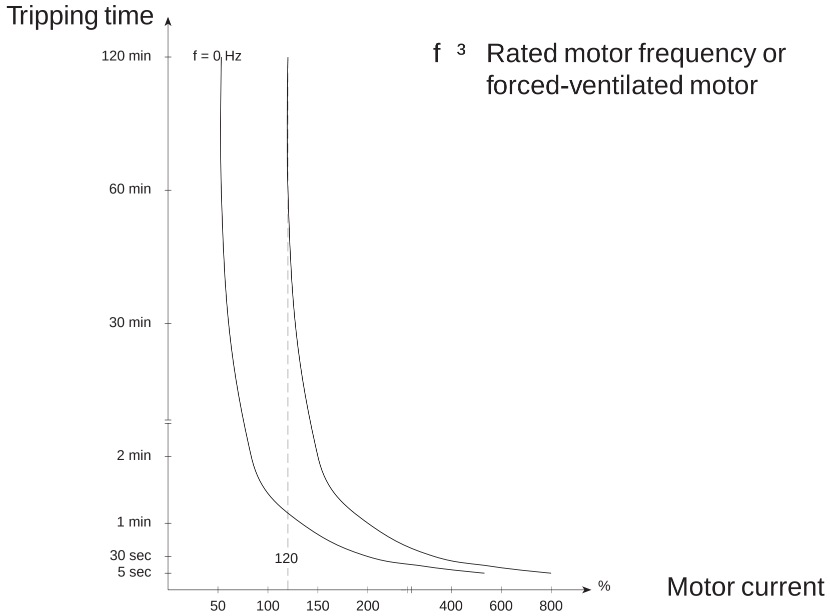
$$\text{Motor protection-load} = \frac{\text{Inverter Apparent current (ru.15)}}{\text{Motor protection rated current (dr.12)}}$$

Motor protective function response (Pn.14)

Pn.14 specifies the performance of the drive on activation of the motor protective function. The function is described in Chapter 6.7.6.

Fig. 6.7.8.b Tripping times for F5-B, F5-G and F5-M

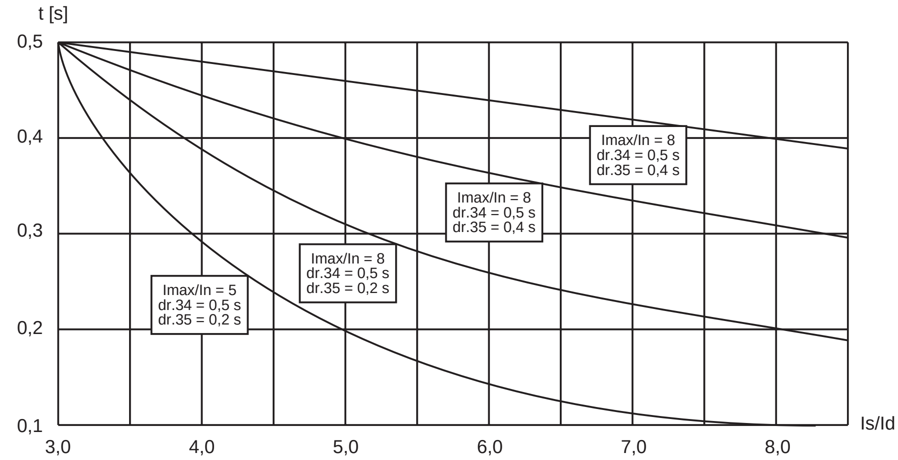
For self-ventilated motors the tripping times decrease with the frequency of the motor (see picture). The motor protective function acts integrating, i.e. times with overload on the motor are added, times with underload are substracted.After triggering the motor protective function, the new tripping time is reduced to 1/4 of the specified value, if the motor has not been operated for an appropriate time with underload.



Functional Description for F5-S

The motor protection function becomes active, if the ratio apparent current to continuous current (Is/Id) reaches 300%. The tripping time for this point is adjusted in dr.34. The tripping time at Is = Imax (max. current) is adjusted in dr.35. If dr.35 > dr.34, dr.34 is valid within the entire range. The tripping time is the time, which the internal counter needs, in order to count from 0 to 100%. A warning level can be adjusted in Pn.15. If the counter reaches this level, the adjusted response in Pn.14 is executed.
The counter is reduced if the relation apparent current to continuous current is < 300%. The recovery time is the time which the counter needs in order to count from 100% to 0 (after an error is triggered). This time is adjusted in dr.36.

Fig. 6.7.8.c Tripping time for F5-S



Calculation of continuous current

$$Id = (In - Id0) * \frac{N}{nN} + Id0$$

Id: continuous current
Id0: continuous standstill current (dr.28)
In: rated motor current (dr.23)
n: actual speed
nn: rated motor speed (dr.24)

Calculation of maximum current

$$Imax = In * \frac{Mmax}{MN}$$

Imax: maximum current
In: rated motor current (dr.23)
Mmax: maximum torque (dr.33, limited to dr.15)
Mn: rated motor torque (dr.27)

Level OH2-warning (Pn.15)

With Pn.15 a level of 0...100 % of the final counter value can be adjusted. On reaching the adjusted level, the switching condition „OH2-warning“ is set (also see „Digital outputs“). The response to the warning signal is defined with Pn.14.

Motor protective function response (Pn.14)

Pn.14 specifies the performance of the drive on activation of the motor protective function. The function is described in Chapter 6.7.6.

Motor protective time at 300 % Id (dr.34)

This parameter displays the tripping time at a ratio of apparent current to continuous current (Is/Id) of 300 % (adjustable with V2.5 and upwards).

Motor protective time at Imax (dr.35)

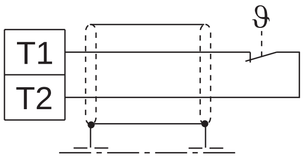
This parameter displays the tripping time at apparent current = maximum current (Is = Imax).

Motor protection recovery (dr.36)

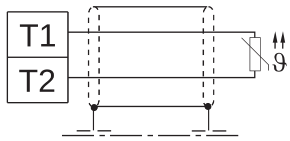
The time, that must expire after triggering an OH2-error, before the error can be reset, is adjusted in dr.36.

External error control procedure

The KEB COMBIVERT provides another possibility to protect the motor by connecting an external temperature monitoring. Following components can be connected to terminals T1/T2:



Thermo contact
(NC contact)



Temperature sensor (PTC)
1650W ...4kW tripping resistance
750W ...1650W reset resistance

dOH stopping mode (Pn.12)
dOH delay time (Pn.13)

With these two parameters the behaviour of the terminals T1/T2 is determined. The function is described in Chapter 6.7.6.

Used Parameters

Parameter	Addr.	ro	prog	↵	min	max	step	default	[?]	Notes
Fr.8 motor set classification	0908	-	yes	-	0	7	1	0	-	not at F5-S
Pn.12 warning dOH stop. mode Response	040C			-	-	-	0	7	1	6 - -
Pn.13 E.dOH delay time	040D	-	-	-	0	120	1	0	s	-
Pn.14 warning OH2 stop. mode	040E	-	-	-	0	6	1	6	-	-
Pn.15 OH2 warning level	040F	-	-	-	0	100	1	100	%	only F5-S
dr.11 motor protection mode	060B	-	yes	-	0	1	1	1	-	not at F5-S
dr.12 motor prot. rated current	060C	-	yes	-	0,0	710,0 A	0,1 A	PU-Id	A	not at F5-S
dr.34 mot.prot. time 300% Id	0622	-	-	-	0,1	10,0	0,1	0,5	s	only F5-S
dr.35 mot.prot. time Imax	0623	-	-	-	0,1	10,0	0,1	0,2	s	only F5-S
dr.36 mot.prot. recovery time	0624	-	-	-	0,1	10,0	0,1	5,0	s	only F5-S
ru.15 apparent current	020F	yes	-	-	0,0	6553,5 A	0,1 A	-	A	-

6.7.9 GTR7-Control (not at F5-B/C)

The GTR7 (brake transistor) serves for the control of the brake resistor. As a standard the GTR7 is switched in dependence on the DC-link voltage, in order to discharge fed-back energy. The switching behaviour of the GTR7 can be altered with the parameters Pn.64 and Pn.65. In the following some applications are specified, at which the factory setting should be modified.

Output filter

Output filters, with the contained capacities and inductivities, form an oscillatory circuit with the motor, thus the drive also operates as generator.

Synchronous motors

Synchronous motors operate as generator even if the modulation is switched off.

Especially at low-load systems voltages can be induced, which can lead to the destruction of the inverter if no attention is paid to it.

Special functions (Pn.65) Bit 0

The energy fed into the intermediate circuit is transferred over the GTR7 to the brake resistor. However, as a standard the GTR7 only operates if the inverter modulates.Generally drives should always be decelerated in a controlled manner. In case of voltage failure this can be guaranteed with the Power-Off function. With parameter Pn.65 the switching behaviour of the GTR7 can be adjusted as follows:

Pn.65	Switching behaviour GTR7 (Bit 0)
0	not in status „LS“ (default)
1...3	also switches level-dependent at „LS“
4	output is not set (do.0...7 = 4/5/6)

Input selection GTR7 (Pn.64)

With Pn.64 an input can be defined for the activation of the GTR7. In this case the GTR7 switches independent of the inverter status and the DC-link voltage as soon as the input is active.
Exception: On opening the control release (noP) the inverter must switch off the GTR7 for safety reasons.

Bit -No.	Decimal value	Input	Terminal
0	1	ST (prog. input „control release/reset“)	X2A.16
1	2	RST (prog. input „reset“)	X2A.17
2	4	F (prog. input „forward“)	X2A.14
3	8	R (prog. input „reverse“)	X2A.15
4	16	I1 (prog. input 1)	X2A.10
5	32	I2 prog. input 2)	X2A.11
6	64	I3 (prog. input 3)	X2A.12
7	128	I4 (prog. input 4)	X2A.13
8	256	IA (internal input A)	none
9	512	IB (internal input B)	none
10	1024	IC (internal input C)	none
11	2048	ID (internal input D)	none

Parallel connection of inverters (DC-interconnection)

In a DC-interconnection of inverters the occurring braking energy can be distributed onto different inverters with brake resistor. With Pn.64 an input at the corresponding inverter can be defined over which the activation of the GTRs is synchronized.

Used Parameters

Parameter		Addr.	ro	prog	↵	min	max	step	default	[?]	Notes
Pn.64	GTR7 input selection	0440	-	-	E	0	4095	1	0	-	not at F5-B/C
Pn.65	Special Functions	0441	-	-	-	0	8	1	0	-	not at F5-B/C

6.7.10 Special Functions
(not at F5-B)

Special functions (Pn.65)

Functions which influence the behaviour of the frequency inverter in certain operating modes are summarized here.

Bit	Value	Meaning
0		Switching behaviour GTR7 (see Chapter 6.7.9 „GTR-control")
	0	not in status „LS" (default)
	1	also switches level-dependent at „LS"
1		This bit determines the error-/warning message, that is triggered at the switching of an external error input (Pn.4).
	0	Pn.4 is selection for external error-/warning message. The response to this message (A.EF/E.EF) is defined with Pn.3.
	1	Pn.4 is selection for error undervoltage (E.UP). Pn.3 has no function in this case.
2		Status, if the power circuit is not ready (no_PU). This setting applies to the output switching conditions do.0...7 = 4...6 and the ERROR-bit in the status word (sy.44/sy.51 Bit 1).
	0	State „no_PU" is an Error
	1	State „no_PU" is no Error
3		Like LS the GTR7 can be activated level dependent also in the case of error. **Exception: When opening the control release and with not supplied power circuit (no_PU) the GTR7 is switched off.**
	0	GTR7 not active in case of error
	1	GTR7 level-dependent in case of error
4		temperature-dependent OL2
	0	not temperature-dependent
	1	temperature-dependent
5		Release GTR7 at software noP, with some applications it is reasonable that the GTR7 is not immediately switched off when control release is opened. The software control release must be activated for this via di.36.
	0	not released
	1	dependent on the voltage level
6		Limiting of the derating characteristics. A limiting can be switched on with the OL2-characteristics in order that the OL2-function releases only when the rated frequency is reached.
	0	no
	1	yes
7		status word Bit 1 = 0 at E.UP
	0	no
	1	yes
8		suppression status display BBL in ru.00
	0	Status BBL is displayed
	1	Status BBL is not displayed

6.8 Parameter Sets

The KEB COMBIVERT contains 8 parameter sets (0...7), i.e. all programmable parameters are available 8 times in the inverter and independent of each other they can be assigned with different values. As a lot of parameters in the parameter sets contain the same value, it would be relatively complicated to change every parameter in each set individually. In this section it is described, how one copies whole parameter sets, locks them, selects them and reinitializes the inverter.

6.8.1 Non-programmable Parameters

Certain parameters are not programmable, as their value must be the same in all sets (e.g. bus address or baud rate). For an easy identification of these parameters the parameter set number is missing in the parameter identification. **For all non-programmable parameters the same value is valid independent of the selected parameter set!**

6.8.1 Non-programmable Parameters

Sy-Parameter	**Pn.0-18/23/27/29/44-60/62-66**
ru-Parameter	**uF.8/12-15/18 (uF.9 at F5-S)**
Ec-Parameter	**ud.1-17 (all at F5-S)**
AA-Parameter	**Fr.2-4/7/9/11 (Fr.10 at F5-S)**
di-Parameter	**An.0-4/10-14/20-24/41-56**
In-Parameter (exception: In.25)	**LE.16-26**
dr-Parameter (not at F5-S)	**cn.3/11-13**
oP.19/20/50/53-62	**dS.0-1 (only F5-S)**
	PS.2-4/10-27/29-31

6

6.8.2 Security Parameters

The security parameters contain the Baud rate, inverter address, hours/meter, control type, serial-/customer number, trimming values and error diagnosis. They are not overwritten while copying parameter sets from the default set.

6.8.2 Security Parameters

Sy.2/3/6/7/11
ru.40/41
ud. 1/2
Fr.1
In.10-16/24-31

6.8.3 System Parameters

The system parameters contain the motor and encoder data.

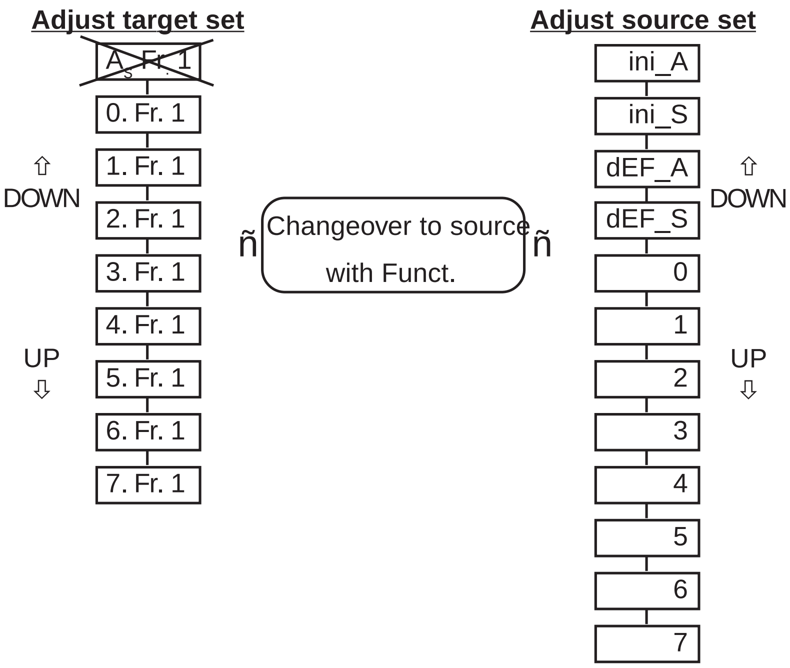
6.8.3 System Parameters

dr-Parameter	**Pn.61/67**
cS.0-19-22	**dS.0-1/13**
Ec.1-7/11-27/36-38	**Fr.10**

6.8.4 Indirect and Direct Set-Addressing

During indirect set addressing the parameter values are indicated and edited to the adjustment of the set indicator (Fr.9). 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. The direct set programming is only possible with bus operation.

6.8.5 Copying of Parameter Sets via Keyboard (Fr.1)



With the keys UP/Down and at flashing point the target set 0...7 is adjusted in addition to the parameter set number. The active (A) parameter set must not be adjusted as target set while copying. If the target set is > 0, only the programmable parameters are overwritten!

The source set is adjusted with the keys UP/Down. The copying process is started with „Enter“. Copying is only possible with opened control release or error, otherwise „I_oPE“ appears in the display (invalid operation).
After copying „PASS“ appears in the display and could be erase by „ENTER“.

6.8.6 Copying of Parameter Sets via Bus (Fr.1, Fr.9)

In case of indirect set addressing at Bus operation two parameters are responsible for the copying of parameter sets. Fr.9 defines the target set. Fr.1 defines the source parameter set and starts the copying process. In the case of direct set programming the source set (Fr. 1) is copied into the selected parameter sets. The following copying actions can be practised:

! By loading the factory setting all definitions defined by the mechanical engineer are reset! 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.

Target set	Source set	Action
0...7	0...7	All programmable parameters (System parameters too) of the source set are copied into the target set.
0	-1: dEF_S	Default values are copied into all parameters of set 0 (with exception of System and Security parameters).
1...7	-1: dEF_S	Default values are copied into all programmable parameters of the target set (with the exception of System and Security parameters).
All	-2: dEF_A	Default values are copied into all parameters of all sets (with the exception of System and Security parameters).
0	-3: ini_S	Default values are copied into all parameters of set 0 (with the exception of Security parameters).
1...7	-3: ini_S	Default values are copied into all programmable parameters of the target set (with the exception of Security parameters).
All	-4: ini_A	Default values are copied into all parameters of all sets (with the exception of Security parameters).

Custom-specific default values

Value	Source Default values	copied parameters	Target sets
-1	KEB	Customer parameters	
	selected		
-2	KEB	Customer parameters	all
-3	KEB	Customer/ system parameters	
	selected		
-4	KEB	Customer/ system parameters	all
-5	custom-specific	Customer parameters	
	selected		
-6	custom-specific	Customer parameters	all
-7	custom-specific selected	Customer/ system parameters	
-8	custom-specific	Customer/ system parameters	all
-9	Current parameter setting store as custom-specific default values	Customer/ system parameters	all

The values -5 to -8 are corresponding to the previous values -1 to -4 referring to the copied parameters and target sets. They differ only in the default value source.
Value -9 enables storing of the current parameter setting as custom-specific default values. The values of all customer and system parameters are stored in all sets thereby.

Parameters only with KEB-Default value

Bit 27 is set in characteristics 2 for parameters, which contains only the KEB default value. These are among others all security parameters and all write protected parameters.
During loading the specific default values (fr.01 = -5..-8) these parameters are loaded with KEB default values if necessary.

Indirect addressed Parameters

The indicator parameter (first parameter of an indirect addressed group) has not a customer default value, because the parameter was set to 0 with Power-On-Reset. The parameters belonging to the group have a default value for each value of the indicator.

Storing the custom-specific default values

A source table is generated. For this one byte is reserved for each parameter in the sequence of the bus addresses. This byte contains the information for each set, whether the default value is determined from the parameter definition (= 0, KEB default value) or if the value is stored in the custom-specific storage area (= 1). This information is determined by comparison to the KEB default value.
For indirect addressed parameters the number of reserved bytes for each group member is equal to the number of valid values of the indicator.
36 byte are reserved for ud.16 and ud.17, ud.15 = 1..36
16 byte are reserved for ps.24..27, ps.23 = 0..15
The custom-specific default values are stored in the sequence of the bus addresses (ascending) set depending (set 7..0).
The custom-specific default values for indirect addressed parameters are stored first to bus address (ascending), then to indicator value (max. .. min.), then set dependent (set 7..0).

Example: Default value ud.09, default values ud.16 for ud.15 = 36..1, default values ud.17 for ud.15 = 36..1, default values ud.18 for set 7..0, etc.

Copy custom-specific default values in the sets

With the bits in the source table the default value for each set is determined either from the parameter definition for each parameter in the sequence of the bus address or read-out from the custom-specific memory area and written into the parameter. Parameters only with KEB default value are loaded with the KEB default value in this case.

Reset of the custom-specific default values

The default values are reset for all parameters to KEB default values in the following cases:

- All parameters are set to default values (initial loading)
- The version identification of the software changes (new version, or new date code)
- The control type is changed (ud.02 Bit 2+3)

The custom-specific default values can be reset manually as follows:

- Loading KEB default values in all sets (fr.01 = -4)
- Storing defaul values (fr.01 = -9)

Changed power unit or encoder identifier, changeover standard/US setting

The power unit identification was changed:

- The power unit identifiction dependent KEB default values are adapted.
- if necessary uf.11 is limited in all sets to the maximal switching frequency (in.03).
- If a custom-specific default value of uf.11 is not within the valuer a n g e (0..in.03), uf.11 is loaded during default value loading in the corresponding set with the KEB-default value.
- If the write value of sy.03 is unequal to the reading power unit identification, all customer and system parameters are loaded with KEB default values (according to fr.01 = -4)

The encoder identifier was changed:

- The encoder identifier dependent KEB default values are adapted.
- EC-Parameters are loaded with KEB default values.
- Changeover standard/US setting (change in.21 bit 0 at in.20 = 32):
- The KEB default values depending on this setting are adapted.
- Customer and system parameters are loaded with KEB default values (corresponding to fr.01 = -4)

Memory management

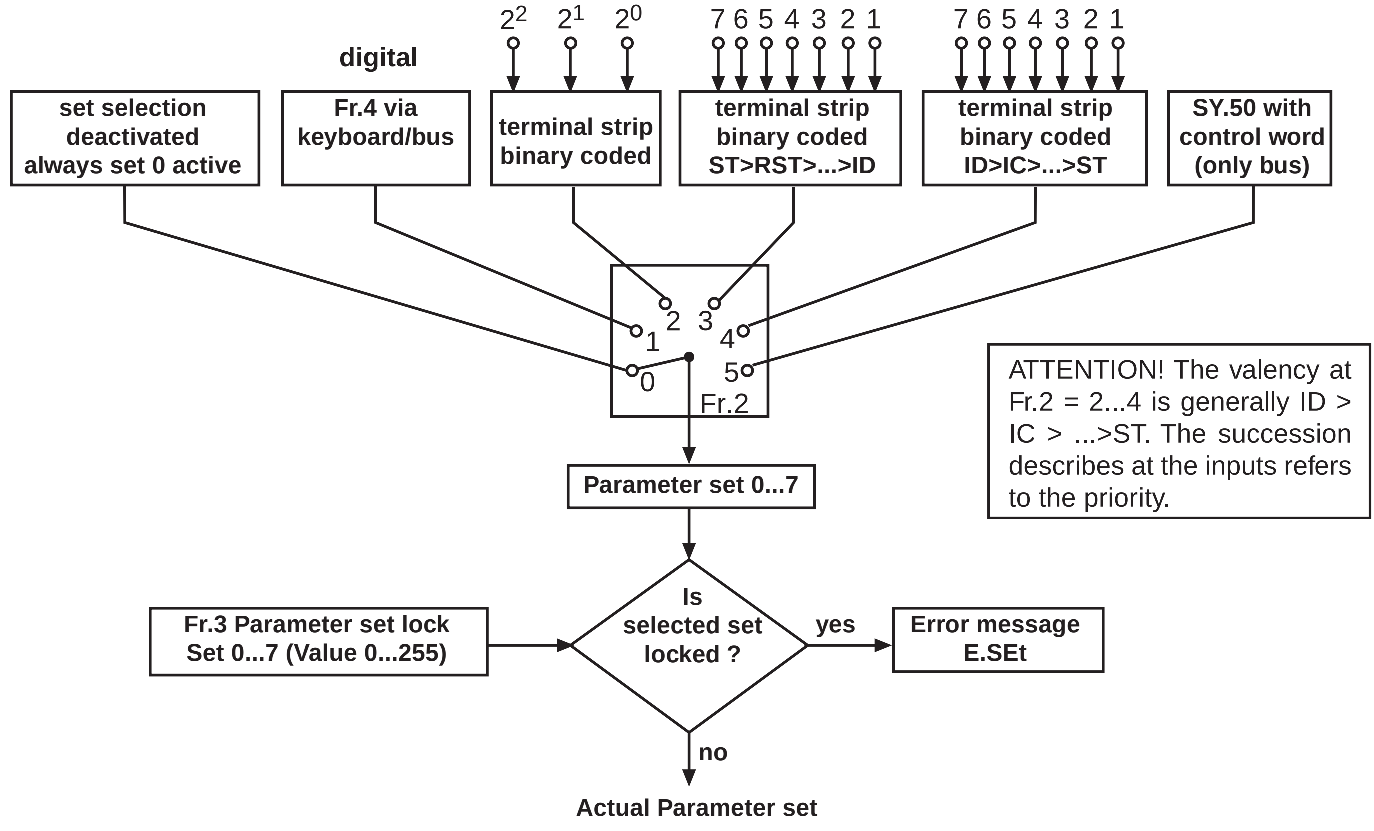
The length of the source table (in byte) and the length of the memory area of the customer default values (in byte) are stored in one word at the end of the external RAM.
The source table for the custom-specific default value range is in front of these two cells. The length is dependent on the number of permitted parameters of the adjusted control type (ud.02 bit 2+3)
The memory area for the custom-specific default values starts next to the source table. The length is dependent on the number of values stored here. Only the values which are different to the KEB default values are stored. The default values are stored in descending order of memory addresses.
The off-line memory includes the period between the temporary variables and the memory area for the custom-specific default values. The size of the off-line memory is depending on the number of custom-specific default values.

Complete use of the available memory

fr.01 = -10 (customer default memory is full) is set if the memory area is completely filled with custom-specific default values, all values could not be stored. That means only one part of the parameter settings (with low bus addresses) contain custom-specific default values, further settings only contain KEB default values. This restriction should not occur since enough memory capacity is available.

6.8.7 Parameter Set Selection

Fig. 6.8.7 Principle of parameter set selection



Fr.2 Source parameter set

As shown in Fig. 6.8.7, with Fr.2 it is defined whether the parameter set selection is enabled or disabled via keyboard/Bus (Fr.4), the terminal strip or via control word (SY.50). The selection is activated with „Enter".

Fr.2	Function
0	Set selection deactivated; set 0 always active
1	Set selection via keyboard/bus with Fr.4
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 SY.50

Fr.4 Adjustment parameter set

This parameter can be written by bus as well as by keyboard. The desired parameter set (0...7) is preadjusted directly as value and activated with „Enter".

Fr.7 Parameter set Input selection

The adjustment via terminal strip can be made binary-coded or input-coded. The inputs are defined with parameter Fr.7. With binary-coded set selection maximally 3 inputs should be programmed to set selection to avoid set selection errors.

Bit -No.	Decimal value	Input	Terminal
0	1 [1)]	ST (prog. input „control release/reset“)	X2A.16
1	2	RST (prog. input „reset“)	X2A.17
2	4	F (prog. input „forward“)	X2A.14
3	8	R (prog. input „reverse“)	X2A.15
4	16	I1 (prog. input 1)	X2A.10
5	32	I2 prog. input 2)	X2A.11
6	64	I3 (prog. input 3)	X2A.12
7	128	I4 (prog. input 4)	X2A.13
8	256	IA (internal input A)	none
9	512	IB (internal input B)	none
10	1024	IC (internal input C)	none
11	2048	ID (internal input D)	none

[1)] The input ST is occupied by hardware means with the function „Control release“. Further functions can be adjusted only „additionally“.

Example

For input-coded set selection (Fr.2=3) I1, I2 and F are defined for set selection. In this case F = set1; I1 = set2 and I2 = set3 would be acticated as the valence is (I2>I1>F).If I1 and I2 are triggered simulateously the inverter switches into set2 since the priority is F>I1>I2 at Fr.2=3.

Binary-coded set selection

With binary-coded set selection

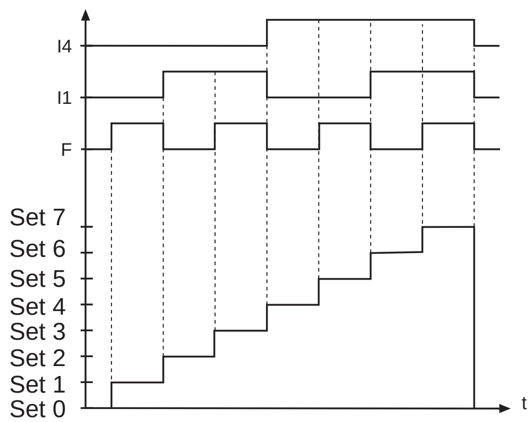
- maximally 3 of the internal or external inputs may be programmed to set selection (2^3=8 sets) to avoid set selection errors.
- the valence of the inputs programmed for set selection rises (ID>IC>IB>IA>I4>I3>I2>I1>R>F>RST>ST)

Example 1: With 3 inputs (F, I1 and I4) set 0...7 shall be selected

1.) Adjust parameter Fr. 7 to value „148“
2.) Adjust Fr.2 to value „2“ (set selection binary-coded via terminal strip)

Fig. 6.8.7.b Binary-coded parameter set selection

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



Input-coded set selection

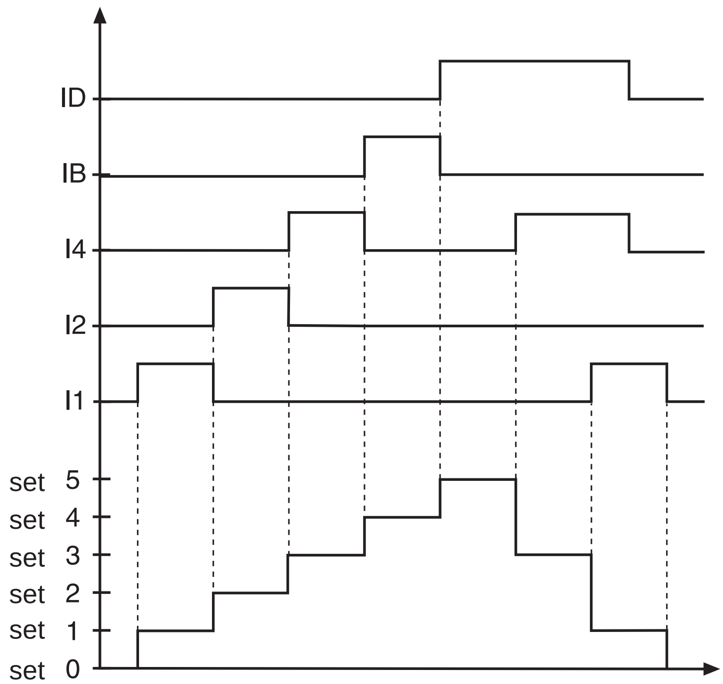
With input-coded set selection
- maximally 7 of the internal or external inputs may be programmed to set selection (0...7 sets) to avoid set selection errors.
- the lowest of the selected inputs has priority at Fr.2 = „3“ (ST>RST>R>F>I1>I2>I3>I4>IA>IB>IC>ID)
- the highest of the selected inputs has priority at Fr.2 = „4“ (ID>IC>IB>IA>I4>I3>I2>I1>R>F>RST>ST)

Example 1: With 5 inputs (I1, I2, I4, IB and ID) set 0...5 shall be selected.

1.) Adjust parameter Fr. 7 to value „2736“
2.) Adjust Fr.2 to value „3“ (set selection input-coded via terminal strip)

Fig. 6.8.7.c Input-coded parameter set selection (Fr.2=3)

ID	IB	I4	I2	I1	set	set
				Fr.2 =	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



Reset set input selection (fr.11)

This parameter defines an input, with which one can switch independently of the current parameter set in to parameter set 0 (see table at Fr.7). This function is only active at Fr.2 = 0...4.
– with static input assignment the inverter remains in set 0 as long as the input is set.
– with edge-triggered inputs set 0 is always activated with the 1st edge. With the 2 nd edge the set activated by the other inputs is selected again.

6.8.8 Locking of Parameter Sets

Parameter sets, that shall not and must not be selected, can be locked with Fr.3. If one of the locked sets is selected, the inverter switches off with set selection error (E.SEt).

Fr.3 Parameter set lock

Value	Locked set	Example
1	0	-
2	1	-
4	2	4
8	3	-
16	4	-
32	5	32
64	6	-
128	7	-
Set 2 and Set 5 locked	Sum	36

6.8.9 Parameter Set ON/OFF Delay (Fr.5, Fr.6)

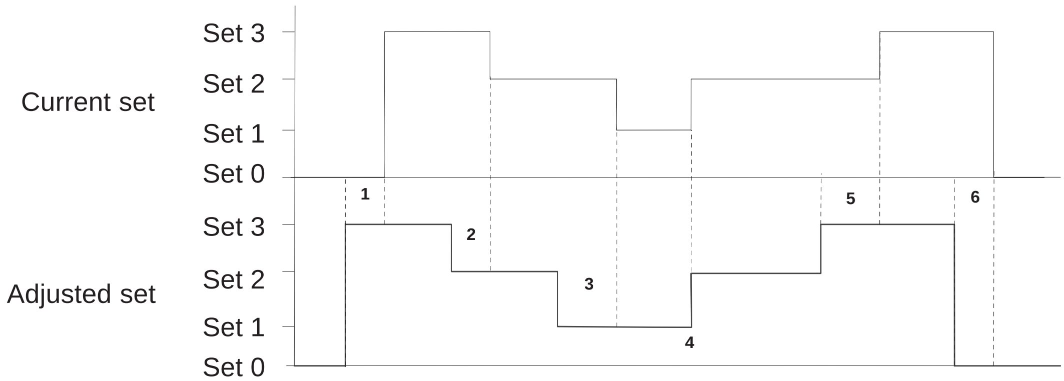
With these parameters the time is adjusted,

- with which the activation of a new set is delayed (Fr.5)
- with which the deactivation of an old set is delayed (Fr.6)

In the case of set changeover the OFF time of the old set and ON time of the new set are added up.

Fig. 6.8.9 ON and OFF-delay

Example		
	on	off
set	Fr.5	Fr.6
0	0 s	0 s
1	2 s	0 s
2	0 s	1 s
3	2 s	2 s



1: ON delay for set 3 of 2s
2: OFF delay for set 3 of 2s
3: OFF delay for set 2 of 1s + ON delay for set 1 of 2 s
4: immediate changeover as no delay is adjusted
5: OFF delay for set 2 of 1s + ON delay for set 3 of 2s
6: OFF delay for set 3 of 2s

6.8.10 Used Parameters

Parameter		Addr.	ro	prog		min	max		default	[?]	Notes
Fr. 1	Copy parameter set	0901	-	yes	yes	-4	7	1	0	-	
Fr.2	Parameter set source	0902	-	-	yes	0	5	1	0	-	
Fr.3	Parameter set lock	0903	-	-	yes	0	255	1	0	-	
Fr.4	Parameter set setting	0904	-	-	yes	0	7	1	0	-	
Fr.5	Set activation delay	0905	-	yes	-	0	32,00	0,01	0	s	
Fr.6	Set deactivation delay	0906	-	yes	-	0	32,00	0,01	0	s	
Fr.7	Paraset input sel.	0907	-	-	yes	0	4095	1	0	-	
Fr.9	Bus parameter set	0909	-	-	-	-1	7	1	0	-	-1:active set (only via bus)
Fr.11	Reset>set 0 input sel.	090B	-	yes	yes	0	4095	1	0	-	

6.9 Special Functions

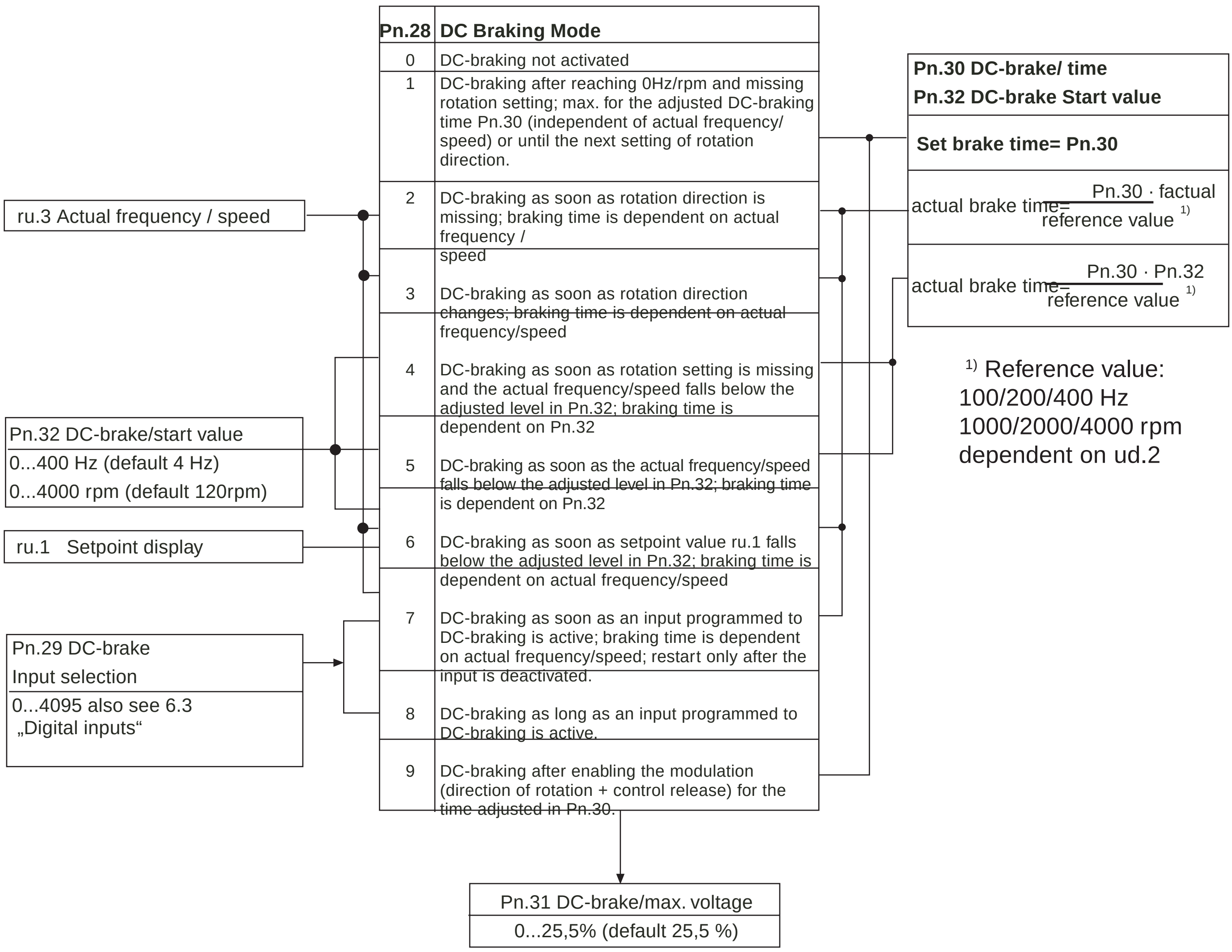
The following section should facilitate the adjustment and programming of special functions.

6.9.1 DC-Braking

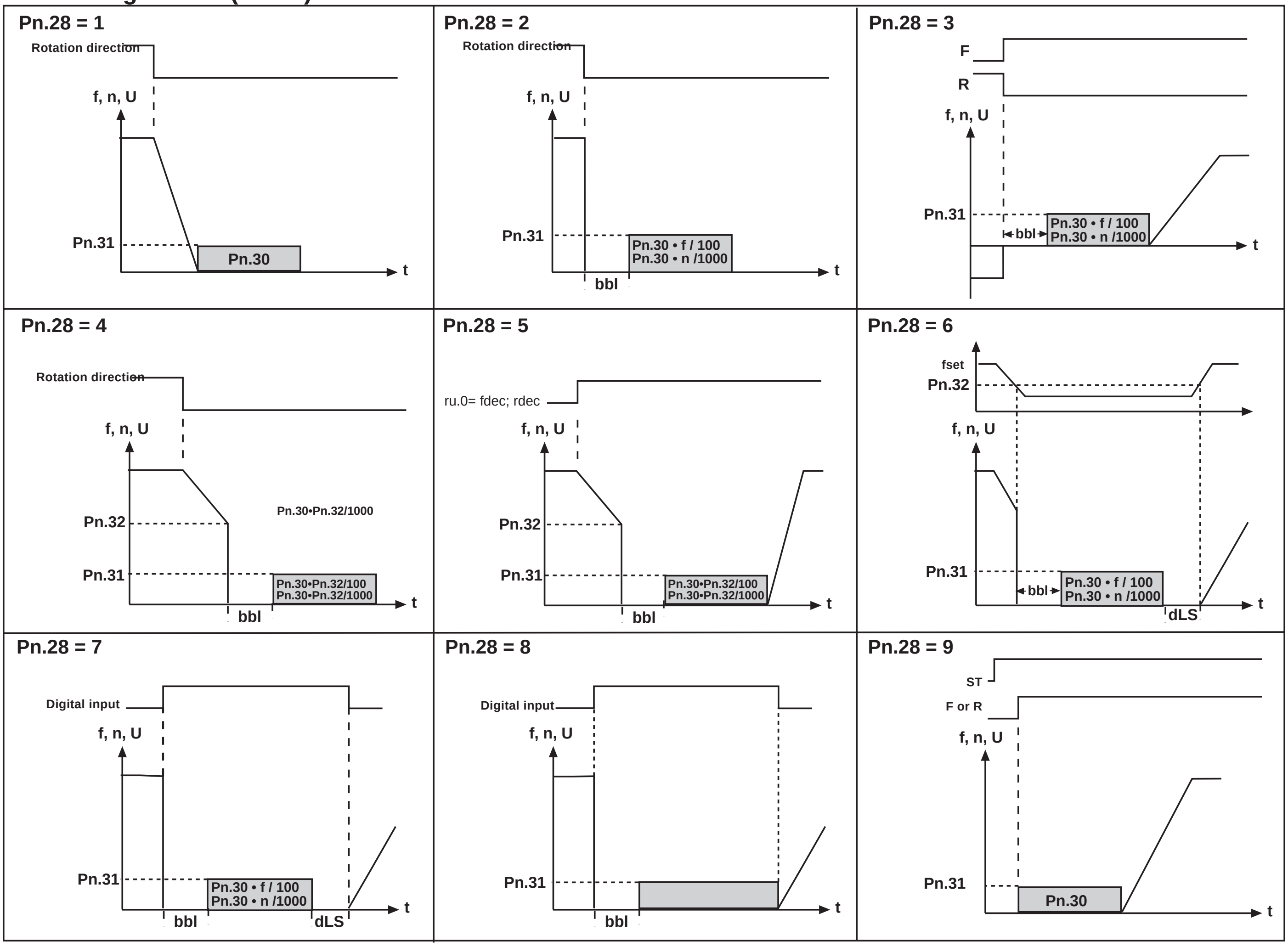
(only F5-B, F5-G and F5-M if cS.0=0)

During the DC-braking the motor is not decelerated over the ramp. The fast deceleration is done with DC-voltage, that is given onto the motor winding.
Between the activation and the triggering of DC-braking a time constant called Base-Block time (bbl) of 150…5000 ms (depending on the power circuit) is necessary.It serves as protection of the power modules during the motor de-excitation time.
With Pn.28 one adjusts through what the DC-brake is triggered. According to the adjusted mode one can preset with Pn.32 the frequency/speed from which the DC-brake is triggered. Pn.30 defines the braking time. The maximum braking voltage is adjusted with Pn.31.The brake controllers are dimensioned 1:1 of inverter to motor, thus the maximum braking voltage must be reduced in the case of deviating dimensioning to prevent the overheating of the motor. At large ratings the maximum braking voltage can lead to overcurrent errors (OC). In that case reduce it with Pn31.
Pn.29 is bit-coded and defines the inputs which trigger DC-braking.

Fig. 6.9.1 Principle of DC-brake



DC Braking / Mode (Pn.28)



DC braking Input selection (Pn.29)

Bit	Decimal value	Input	Terminal
0	1	ST (prog. input „control release/reset“)	X2A.16
1	2	RST (prog. input „reset“)	X2A.17
2	4	F (prog. input „forward“)	X2A.14
3	8	R (prog. input „reverse“)	X2A.15
4	16	I1 (prog. input 1)	X2A.10
5	32	I2 prog. input 2)	X2A.11
6	64	I3 (prog. input 3)	X2A.12
7	128	I4 (prog. input 4)	X2A.13
8	256	IA (internal input A)	none
9	512	IB (internal input B)	none
10	1024	IC (internal input C)	none
11	2048	ID (internal input D)	none

Used Parameters

Parameter		Addr.	ro	prog	↵	min	max	step	default	[?]	Notes
Pn.28	DC braking mode	041C	-	yes	yes	0	9	1	7	-	
Pn.29	DC brake input selection	041D	-	-	yes	0	4095	1	0	-	default at F5-M: 128
Pn.30	DC braking time	041E	-	yes	-	0,00	100,00 s	0,01 s	10,00 s	-	
Pn.31	DC braking max. voltage	041F	-	yes	-	0	25,5 %	0,1 %	25,5 %	-	
Pn.32	DC braking start freq.	0420	-	yes	-	0	400 Hz	0,0125 Hz	4 Hz	-	F5-G/B dep. on ud.2
Pn.32	DC braking start freq.	0420	-	yes	-	0	4000 rpm	0,125 rpm	120 rpm	-	F5-M dep. on ud.2

6.9.2 Energy Saving Function

(only F5-B, F5-G and F5-M if cS.0=0)

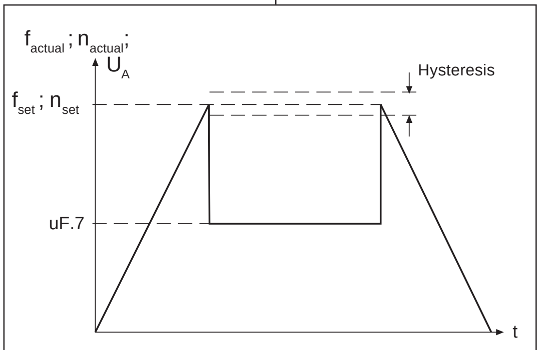
The energy saving function allows the lowering or raising of the current output voltage. In accordance with the activation conditions defined in uF.6, the voltage valid according to the V/Hz-characteristic is changed in percent onto the energy saving level (uF.7).

However, the maximal output voltage cannot be higher than the input voltage even if the value is > 100 %. The function is used for example in cyclic executed load/no-load applications. During the no-load phase the speed is maintained, but energy is saved as a result of the voltage reduction.

uF.7	Energy saving factor
	0,0…130,0 % (default 70 %)

uF.8	Energy saving function Input selection
	0...4095 (Default 0) also see 6.3 „Digital inputs“

uF.6	Energy saving function / Mode
Bit 0...3	Activation
0	Function off
1	Generally on
2	When actual = setpoint frequency/speed
3	Activation through programmable inputs
4	Generally at rotation direction forward
5	Generally at rotation direction reverse
6	Rotation direction forward and actual = set freq./speed
7	Rotation direction reverse and actual = set freq./ speed
8...15	reserved
Bit 4...6	Adjustment of the voltage ramp
	Voltage ramp at B/C-control approx. 1 s
	Voltage ramp at G/M/S-control approx. 1,6 s
0	Voltage ramp
16	Voltage ramp / 2
32	Voltage ramp / 4
48	Voltage ramp / 8
64	Voltage ramp / 16



Example: uF.6 = 2, uF.7 = 50 %

6

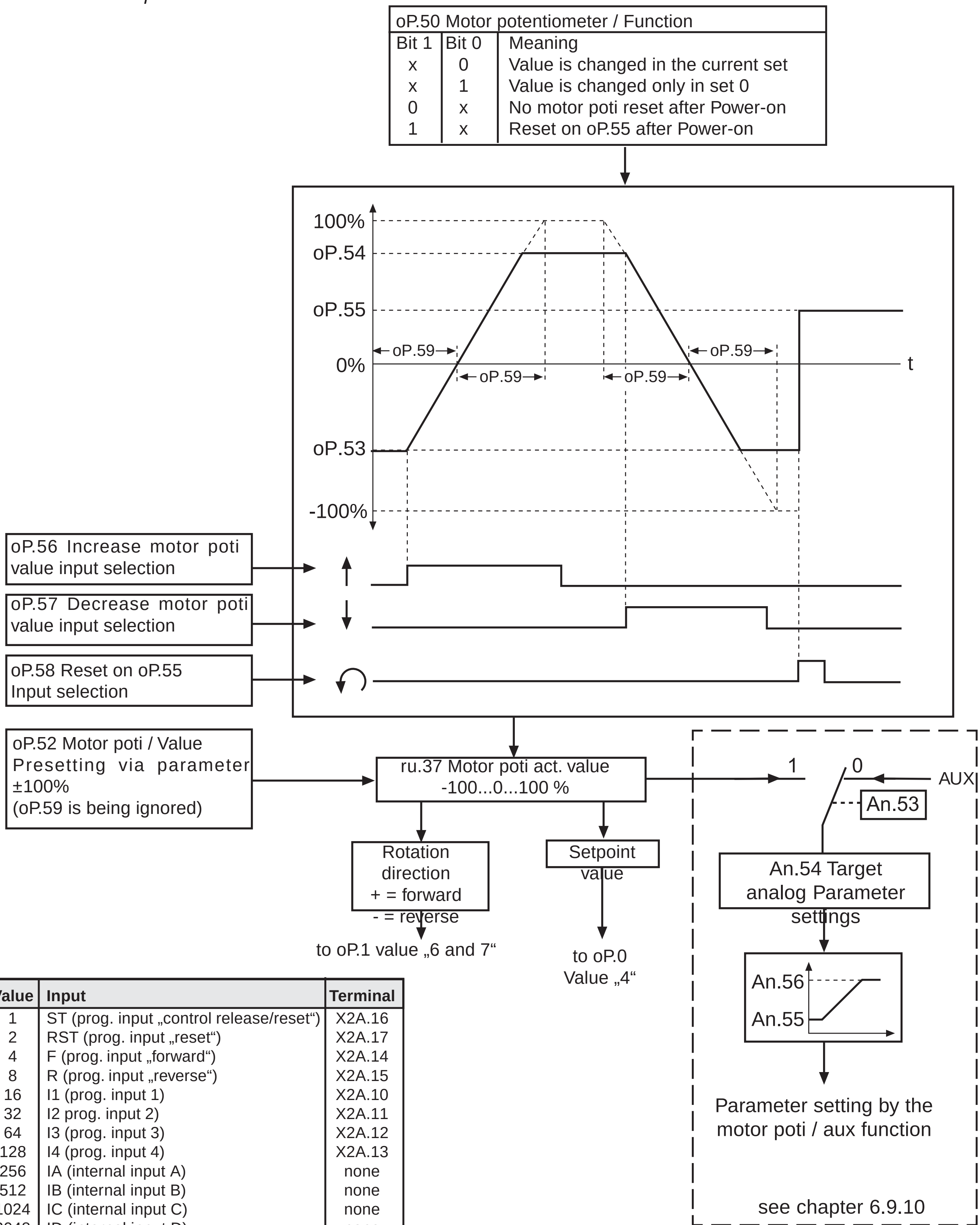
Used Parameters

Parameter	Addr.	ro	prog	↵	min	max	step	default	[?]	Notes
uF.6 Energy saving function / Mode	0506	-	yes	-	0	79	1	0	-	
uF.7 Energy saving factor	0507	-	yes	-	0,0 %	130,0 %	1 %	70 %	-	
uF.8 Energy saving input sel.	0508	-	-	yes	0	4095	1	0	-	

6.9.3 Motorpoti Function

This function simulates a mechanic motor potentiometer. Over two inputs the motor potentiometer value can be increased or decreased.

Fig. 6.9.3 Motorpoti Function



Bit	Value	Input	Terminal
0	1	ST (prog. input „control release/reset“)	X2A.16
1	2	RST (prog. input „reset“)	X2A.17
2	4	F (prog. input „forward“)	X2A.14
3	8	R (prog. input „reverse“)	X2A.15
4	16	I1 (prog. input 1)	X2A.10
5	32	I2 prog. input 2)	X2A.11
6	64	I3 (prog. input 3)	X2A.12
7	128	I4 (prog. input 4)	X2A.13
8	256	IA (internal input A)	none
9	512	IB (internal input B)	none
10	1024	IC (internal input C)	none
11	2048	ID (internal input D)	none

Determine inputs (oP.56...oP.58)

In the first step 2 inputs must be defined with which the motor potentiometer can be increased or decreased. For that purpose one input each according to the input table is assigned to the parameters oP.56 and oP.57. If both inputs are triggered simultaneously, the potentiometer value is decreased.

Increase motorpoti value ß oP.56	Decrease motorpoti value ß oP.57

Another input (oP.58) can be used to reset the motor potentiometer to the adjusted reset value oP.55.

Input table

Bit -No.	Decimal value	Input	Terminal
0	1	ST (prog. input „control release/reset“)	X2A.16
1	2	RST (prog. input „reset“)	X2A.17
2	4	F (prog. input „forward“)	X2A.14
3	8	R (prog. input „reverse“)	X2A.15
4	16	I1 (prog. input 1)	X2A.10
5	32	I2 prog. input 2)	X2A.11
6	64	I3 (prog. input 3)	X2A.12
7	128	I4 (prog. input 4)	X2A.13
8	256	IA (internal input A)	none
9	512	IB (internal input B)	none
10	1024	IC (internal input C)	none
11	2048	ID (internal input D)	none

Motorpoti function (oP.50)

The basic working method of the motor potentiometer is defined with oP.50. The parameter is bit-coded.

Bit		oP.50 Motor potentiometer / Function
1	0	
x	0	Motor poti is changed in the current set (default)
x	1	Motor poti is changed only in set 0
0	x	Motor poti value is maintained after Power-on (default)
1	x	Motor poti value is reset to reset value oP.55

Motor poti inc/dec time (oP.59)

With this parameter a time is defined, which the motor potentiometer needs in order to run from 0...100%. The time is adjustable between 0...50000 s.

The correcting range (oP.53, oP.54)

The correcting range is limited by the parameters oP.53 „Motor poti min. value“ and oP.54 „Motor poti max. value“ (see Fig. 6.9.3).

Display of motor potentiometer value (ru.37)

This parameter shows the current value of the motor potentiometer in percent.

Motor potentiometer value (oP.52)

With this parameter a value in percent can be adjusted within the preset limits directly by operator or bus. The ramp time remains unconsidered at this setting.

Source of Setpoint (oP.0) and Direction of rotation (oP.1)

In order to preset the setpoint by way of the motor potentiometer oP.0 (setpoint source) must be set to value „4". The source of rotation direction (oP.1) must be adjusted in dependence on the setpoint (value „6" or „7").
If the motor potentiometer is used as setpoint source, the setpoint is calculated from this with the respective limits just as with other percental setpoint sources (see Chapter 6.4. „Set Value Adjustment").

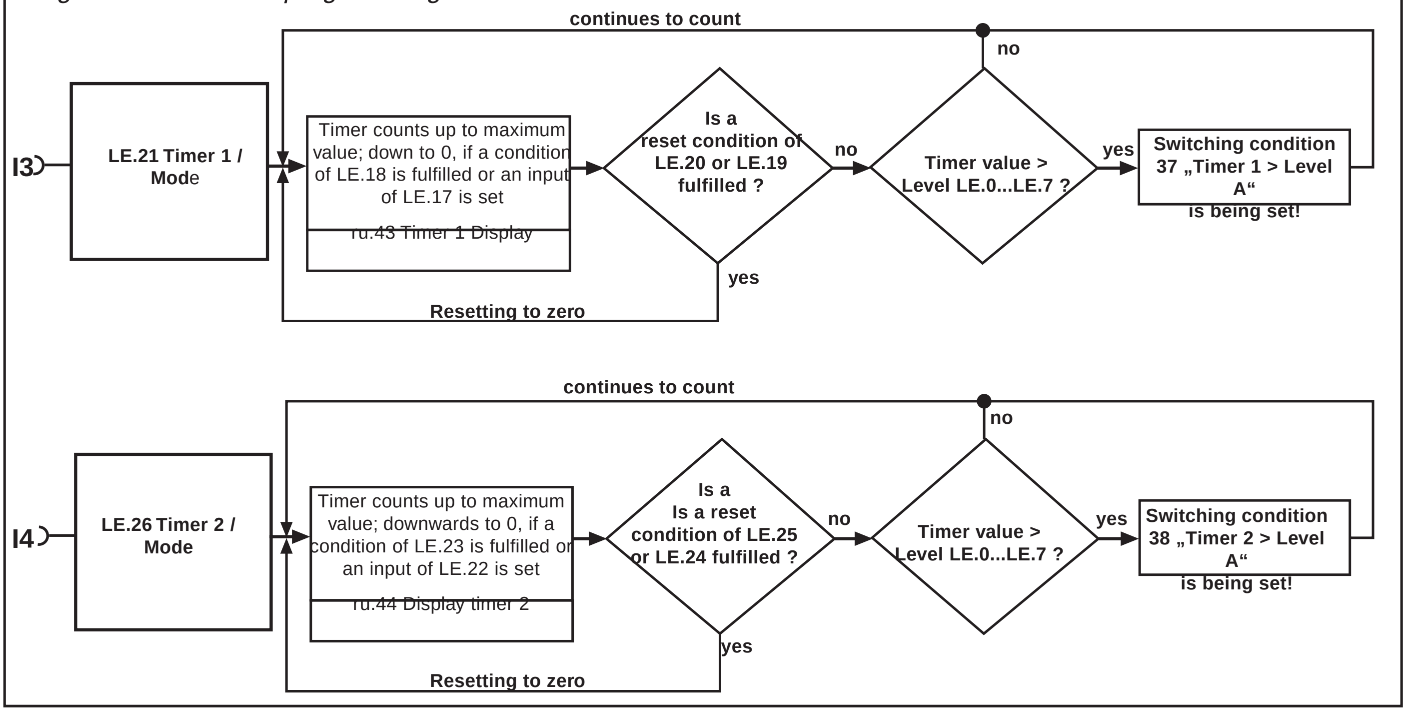
Used Parameters

Param.	Addr.	ro	PROG.	ENTER	min	max	Step	default	
ru.37	0225h	-	-	-	-100,00 %	100,00 %	0,01 %	-	-
oP.0	0300h	-	4	4	0	9	1	0	„4" for motor potentiometer
oP.1	0301h	-	4	4	0	9	1	2	„6 a. 7" rotation direct. over setpoint
oP.50	0332h	-	-	4	0	3	1	0	-
oP.52	0334h	-	4	-	-100,00 %	100,00 %	0,01 %	0,00 %	-
oP.53	0335h	-	-	-	-100,00 %	100,00 %	0,01 %	0,00 %	-
oP.54	0336h	-	-	-	-100,00 %	100,00 %	0,01 %	100,00 %	-
oP.55	0337h	-	-	-	-100,00 %	100,00 %	0,01 %	0,00 %	-
oP.56	0338h	-	-	4	0	4095	1	0	-
oP.57	0339h	-	-	4	0	4095	1	0	-
oP.58	033Ah	-	-	4	0	4095	1	0	-
oP.59	033Bh	-	-	-	0,00 s	50000,00 s	0,01 s	66,00 s	-

6.9.4 Timer and Counter

Two timers are incorporated in the COMBIVERT. As long as one of the adjustable starting conditions (LE.18/23) or a programmable input (LE.17/22) is set, the timer counts until reaching the final range value. 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 the counting direction is adjusted with LE.21/26. It can be counted in seconds, hours or by a special programmed input for that. The current timer content is displayed in ru.43/44. On reaching an adjustable comparison level (LE.0...7), the switching condition 37/38 is set. It can be used to set an output.

Fig. 6.9.4 Timer programming



Timer / Mode (LE.21/26)

LE.21 and LE.26 determine the clock source and the counting direction of timer 1 and 2. Clock source can be the time counter in 0,01 s or h-grid or impulses from an input. The timer runs generally as long as a starting condition is active. After a reset the timer starts again at zero. The timer stops at the maximal value of 655,35. Following clock sources can be selected:

Input I3 => Timer 1

Input I4 => Timer 2

at BASIC:

Input I1 => Timer 1

Input I2 => Timer 2

Bit	Value	Function
0...2		Clock source
	0	Time counter 0,01 s (default)
	1	Time counter 0,01 hour
	2	Edge counter, each edge increases/decreases the counter by 0,01
	3	Edge counter, only positive edges increases/decreases the counter by 0,01
	4...7	reserved
3...4		Counting direction
	0	Upward
	8	The counting direction is dependent on direction of rotation (FOR=upward; REV=downward)
	16	The counting direction is dependent on direction of rotation (REV=upward; FOR=downward)
5		Overflow behaviour
	0	Stop at limit
	32	Reset and further

The values from Bit 0...2 and 3...5 are to be added up.

Timer / Starting condition (LE.18/23)

From the following table the conditions can be selected at which the timer is started. The individual conditions are OR-operated with the Timer start input selection (LE.17/ LE.22).

Bit	Value	Timer / Starting condition
0	1	Modulation on
1	2	Modulation off
2	4	Actual freq. =setpoint freq.

In case of several starting conditions the values are to be added up.

Timer start Input selection (LE.17/22)

Additionally the timer can be activated by one or several inputs. The sum of the valences is to 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 / starting condition (LE.18/LE.22).

Bit -No.	Decimal value	Input	Terminal
0	1	ST (prog. input „control release/reset“)	X2A.16
1	2	RST (prog. input „reset“)	X2A.17
2	4	F (prog. input „forward“)	X2A.14
3	8	R (prog. input „reverse“)	X2A.15
4	16	I1 (prog. input 1)	X2A.10
5	32	I2 prog. input 2)	X2A.11
6	64	I3 (prog. input 3)	X2A.12
7	128	I4 (prog. input 4)	X2A.13
8	256	IA (internal input A)	none
9	512	IB (internal input B)	none
10	1024	IC (internal input C)	none
11	2048	ID (internal input D)	none

Timer Display (ru.43/44)

ru.43 / ru.44 displays the actual counter reading dependent of the adjusted clock source (LE.21/26). By writing on ru.43/44 the counter can be set to a value. If the clock source is changed during the running time the counter content is maintained but is interpreted according to the new clock source.

Timer Reset Input selection (LE.19/24)

According to the following table the inputs with which the timer is reset can be specified. 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.

Bit -No.	Decimal value	Input	Terminal
0	1	ST (prog. input „control release/reset“)	X2A.16
1	2	RST (prog. input „reset“)	X2A.17
2	4	F (prog. input „forward“)	X2A.14
3	8	R (prog. input „reverse“)	X2A.15
4	16	I1 (prog. input 1)	X2A.10
5	32	I2 prog. input 2)	X2A.11
6	64	I3 (prog. input 3)	X2A.12
7	128	I4 (prog. input 4)	X2A.13
8	256	IA (internal input A)	none
9	512	IB (internal input B)	none
10	1024	IC (internal input C)	none
11	2048	ID (internal input D)	none

Timer Reset condition (LE.20/25)

According to the following table the conditions can be defined under which the timer is reset in addition to the inputs. The individual conditions are OR-operated.

Bit -No.	Decimal value	Condition
0	1	Modulation on
1	2	Modulation off
2	4	Actual value = Setpoint value
3	8	Change of parameter set
4	16	Power-On-Reset

Level 0...7 (LE.0...LE.7)

LE.0...LE.7 define the level for the switching conditions 37/38 („Timer > Level"). If the timer exceeds the adjusted value the switching condition is set. A level in the range of -10.737.418,24 to 10.737.418,23 can be adjusted. But only values of 0...655,35 are sensible for the counter.

Used Parameters

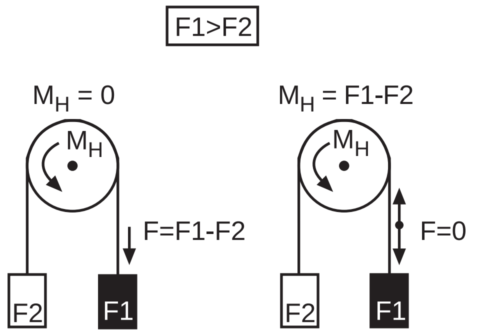
Param.	Addr.	ro	PROG.	ENTER	min	max	Step	default	
ru.43	022Bh	-	-	-	0,00	655,35	0,01	0,00	-
ru.44	022Ch	-	-	-	0,00	655,35	0,01	0,00	-
LE. 0	0D00h	-	4	-	-10737418,24	10737418,23	0,01	0	-
LE. 1	0D01h	-	4	-	-10737418,24	10737418,23	0,01	0	-
LE.2	0D02h	-	4	-	-10737418,24	10737418,23	0,01	0	-
LE.3	0D03h	-	4	-	-10737418,24	10737418,23	0,01	0	-
LE. 4	0D04h	-	4	-	-10737418,24	10737418,23	0,01	0	-
LE. 5	0D05h	-	4	-	-10737418,24	10737418,23	0,01	0	-
LE. 6	0D06h	-	4	-	-10737418,24	10737418,23	0,01	0	-
LE. 7	0D07h	-	4	-	-10737418,24	10737418,23	0,01	0	-
LE.17	0D11h	-	-	4	0	4095	1	0	bit-coded
LE.18	0D12h	-	-	4	0	7	1	0	-
LE.19	0D13h	-	-	4	0	4095	1	0	bit-coded
LE.20	0D14h	-	-	4	0	31	1	16	-
LE.21	0D15h	-	-	-	0	31	1	0	-
LE.22	0D16h	-	-	4	0	4095	1	0	bit-coded
LE.23	0D17h	-	-	4	0	7	1	0	-
LE.24	0D18h	-	-	4	0	4095	1	0	bit-coded
LE.25	0D19h	-	-	4	0	31	1	16	-
LE.26	0D1Ah	-	-	-	0	31	1	0	-

6.9.5 Brake Control

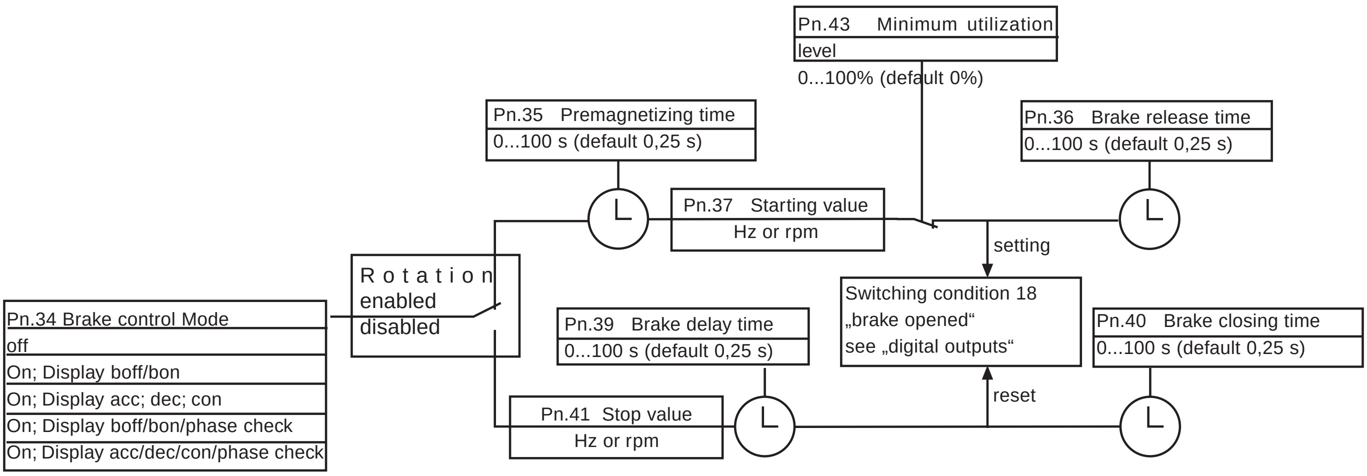
For applications in the field of lifting and lowering the control of the holding brake can be taken over by this function. A digital output can be programmed as control signal. The function is set-programmable.

Mode of functioning

As shown in the opposite graphic a torque in the amount of the power difference F1-F2 must be built up, so that F1 does not slump after releasing the brake. We call that holding torque. In the case of the slip-affected three-phase asynchronous machine a frequency in the direction of the holding torque must be preset.



6.9.5.b Principle of brake control



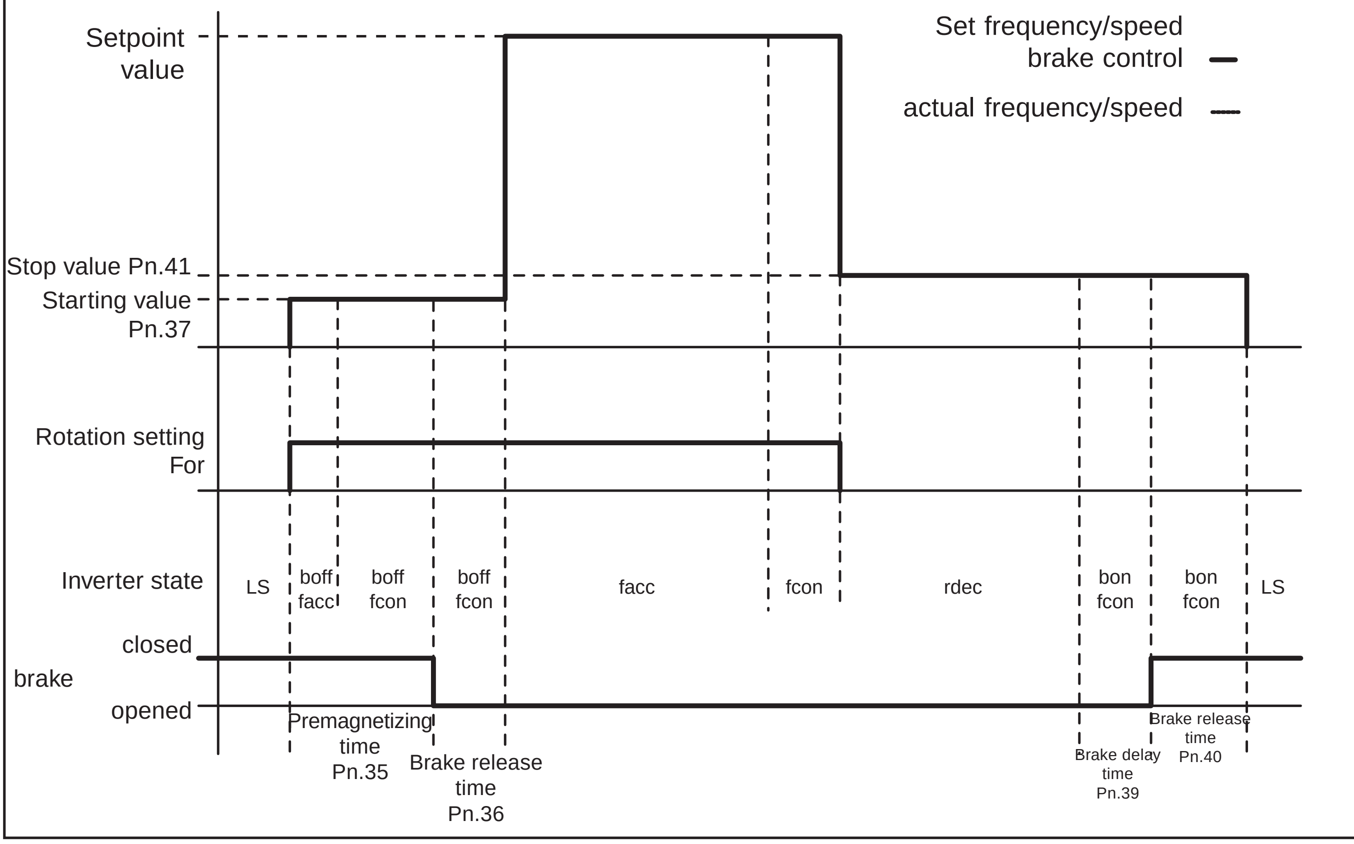
Brake control

During the start, triggered by switching on the direction of rotation, a holding torque is built up first. For it a premagnetizing time (Pn.35) and a starting value (Pn.37) are preset. As a safety function the monitoring of the acceptance of the inverter can now be adjusted. Before releasing the brake the utilization is compared with the minimum utilization level (Pn.43). If the utilization is less than this level or the hardware current limit is reached, the error E. br is triggered and the brake remains engaged. If the utilization acceptance is ensured, the signal for releasing the brake is given after the time has elapsed. For an additional time (Pn.36: brake release time), in which the brake is mechanically released, the holding frequency is maintained. Then it accelerates to the adjusted setpoint.

Brake release

During stopping, triggered by taking away the direction of rotation, the inverter runs first to the holding frequency (Pn.41). After expiration of the brake delay time (Pn.39) the signal for engaging the brake is given. After expiration of the brake closing time (Pn.40), in which the brake takes over the utilization, it is decelerated until standstill and the inverter changes into status LS.

6.9.5.c Example: Setpoint direction forward; positive holding frequency



Mode brake control (Pn.34)

The function is activated and the status display can be changed over with this parameter. Furthermore a motor phase monitoring can be activated, which checks before acceleration to the starting value, if all motor phases are connected. If one phase is missing E.br is triggered. Pn.34 is set-programmable.

Value	Function
0	Function deactivated (default)
1	Brake control active, display boff/bon
2	Brake control active, display acc/dec/con
3	Brake control active, display boff/bon with phase monitoring
4	Brake control active, display acc/dec/con with phase monitoring

The status display during the holding phases depends on the setting of the mode for the brake control (see Fig. 6.9.5.c).

At - Pn.34 =1+3 the status boff (release brake) or bon (engage brake) is displayed.

- Pn.34 =2+4 the normal ramp status is displayed.

In addition to it a digital output (switching condition 18) is to be programmed for the control (see Chapter 6.3).

Minimal utilization level (Pn.43)
Error message E. br

For the monitoring of the utilization acceptance through the inverter a minimal utilization level can be adjusted in this parameter. When the brake shall be released during the start, the utilization may not be less than the adjusted level. Otherwise the error E. br is triggered. Reaching the hardware current limit the error E.br is triggered too.

The monitoring is deactivated when Pn.43 is set to 0.

Start value (Pn.37)
Stop value (Pn.41)

The adjustable start/stop value stands in direct connection with the necessary holding torque. The preadjustment, according to following formula, is valid for rated motor torques:

$$\text{Start-/Stop value} = \frac{\text{(no-load motor speed - rated motor speed) x rated motor frequency}}{\text{no-load motor speed}}$$

$$\text{Example: } \frac{(1500\text{rpm} - 1420\text{rpm}) \times 50\text{Hz}}{1500\text{ rpm}} = 2{,}67\text{ Hz}$$

The direction into which the holding torque shall take effect is determined by the sign. The parameters are set-programmable.

At using the brake control the direction of rotation (oP.1) may not be set to „7“, because then no Low-Speed-Signal (LS) is output.

Used Parameters

Param.	Addr.	ro	PROG.	ENTER	min	max	Step	default	
Pn.34	0422h	-	4	4	0	4	1	0	-
Pn.35	0423h	-	4	-	0,00 s	100,00 s	0,01 s	0,25 s	-
Pn.36	0424h	-	4	-	0,00 s	100,00 s	0,01 s	0,25 s	-
Pn.37	0425h	-	4	-	-20 Hz	20 Hz	0,0125 Hz	0 Hz	F5-G/C/B depending on ud.2
	0425h	-	4	-	-600 rpm	600 rpm	0,125 rpm	0 Hz	F5-M/S depending on ud.2
Pn.39	0427h	-	4	-	0,00 s	100,00 s	0,01 s	0,25 s	-
Pn.40	0428h	-	4	-	0,00 s	100,00 s	0,01 s	0,25 s	-
Pn.41	0429h	-	4	-	-20 Hz	20 Hz	0,0125 Hz	0 Hz	F5-G/C/B depending on ud.2
	0429h	-	4	-	-600 rpm	600 rpm	0,125 rpm	0 Hz	F5-M/S depending on ud.2
Pn.43	042Bh	-	4	-	0	100 %	1 %	0 %	-

6.9.6 Power-Off Function

It is the task of the Power-Off function to ensure a controlled deceleration of the drive until standstill in case of undervoltage (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.
The parameter Power-Off-Mode (Pn.44) switches on the function and determines the basic behaviour:

Power-Off Mode (Pn.44)

8	7	6	5	4	3	2	1	0	Bit Wert	Funktion
									Ein-/Aus-Schalten von Netz-Aus	
x	x	x	x	x	x	x	x	0	**0**	aus
x	x	x	x	x	x	x	x	1	1	ein
									Netz-Aus / Startspannung	
x	x	x	x	x	x	x	0	x	**0**	Automatische Ermittlung der Startspannung
x	x	x	x	x	x	x	1	x	2	Vorgabe der Startspanunng mit Pn.45
									Ermittlung des Anfangssprung	
x	x	x	x	x	x	0	x	x	**0**	aus dem Schlupf
x	x	x	x	x	x	1	x	x	4	aus der Auslastung
									Verhalten des Antriebes bei Ausgangswert <= min. Ausgangswert	
x	x	x	x	0	0	x	x	x	**0**	Status Poff, Modulation an, Reset erforderlich
x	x	x	x	0	1	x	x	x	8	Poff, Mod. An, Wiederanlauf bei Netzrückkehr nach Pn.52
x	x	x	x	0	0	x	x	x	16	Status PLS, Modulation aus, Reset erforderlich
x	x	x	x	1	1	x	x	x	24	reserviert
									reserviert	
x	x	x	0	x	x	x	x	x	**0**	reserviert
x	x	x	1	x	x	x	x	x	32	reserviert
									Auswahl des Sollwertes (bei F5-S immer Bremsmoment)	
x	0	0	x	x	x	x	x	x	**0**	Startspannung
x	0	1	x	x	x	x	x	x	64	Spannungssollwert (Pn.50)
x	1	0	x	x	x	x	x	x	128	Startspannung, wenn Istfrq. > Pn.48 sonst Spannungssollwert
x	1	1	x	x	x	x	x	x	192	bremsmoment (Pn.47)
									Spannungsstabilisierung	
0	x	x	x	x	x	x	x	x	**0**	eingeschaltet
1	x	x	x	x	x	x	x	x	256	ausgeschaltet

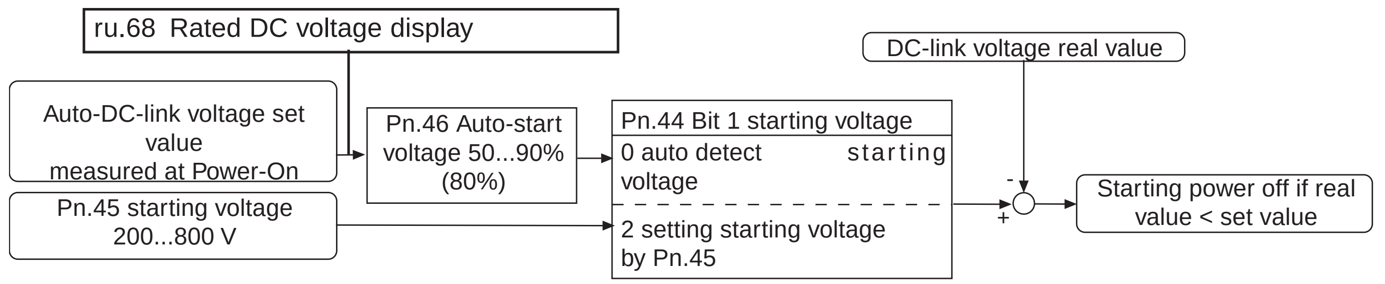
Switch on Power-Off (Pn.44 Bit 0)

The Power-Off function is switched on/off with Bit 0 of Pn.44. Parameter Pn.44 is an Enter-parameter.

Tripping of Power-Off

The Power-Off function starts when the DC-link voltage drops below a certain value, the start voltage. The start voltage can be set automatically or manually depending on Pn.44 Bit 1.

Fig. 6.9.6.a Starting the Power-Off function



Rated DC-voltage (ru.68)

The rated DC-voltage is always measured during switch on of the power circuit or after E.UP and displayed in ru.68.

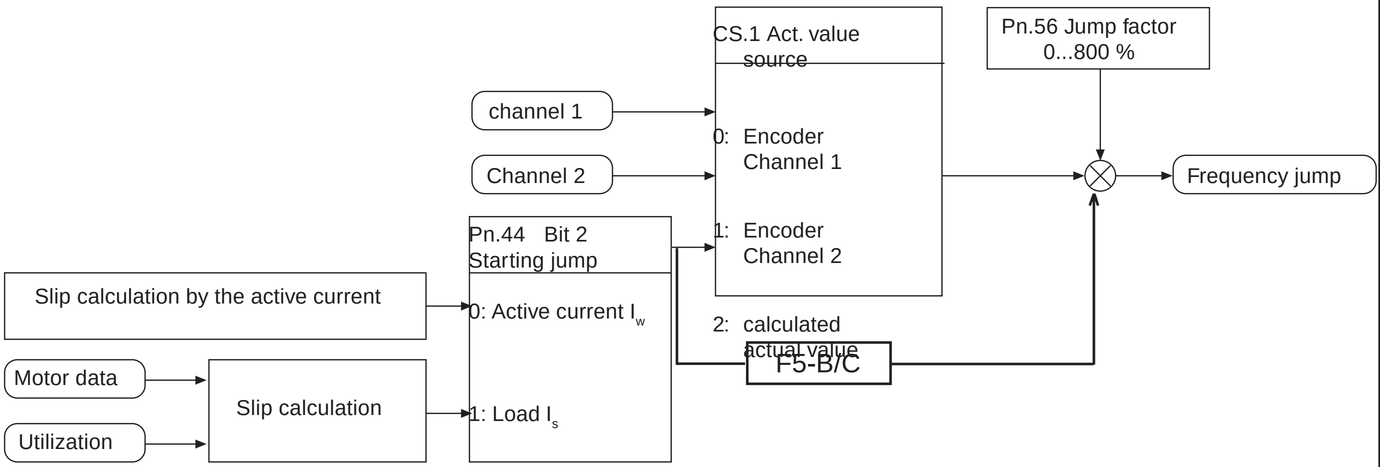
Starting voltage (Pn.45)

With manual adjustment the starting voltage can be preset with Pn.45 in the range of 200...800 volt. For a secure range the adjusted starting voltage must be at least 50V over the UP-threshold (UP: 400V-class=240V; 200V-class=216V DC).

Auto starting voltage (Pn.46)

With automatic starting voltage the DC-link voltage is measured at "Power-On" and displayed in ru.68. The auto-start voltage is determined by Pn.46, which adjusts the starting voltage in percent in the range of 50...90 % (Default 80 %) of the measured value.
If the DC-link voltage drops below the starting voltage, adjusted automatically or manually, the Power-Off function is started.

Fig. 6.9.6.b Frequency jump for generatoric operation at the 1. cycle



Frequency jump for generatoric operation

First of all the drive must be brought into generatoric operation to enable the feed back of energy into the intermediate circuit. 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.

Actual source (cS.1)

(at F5-B/C always active current control)

With the actual value source it is defined whether the Power-Off works as slip control (with speed detection on channel 1 or 2 value „0“ or „1“) or as active current control (without speed detection value „2“). Normally this parameter is adjusted at the setup of the speed control (see Chapter 6.11) and should not be changed here.

Starting jump (Pn.44 Bit 2)

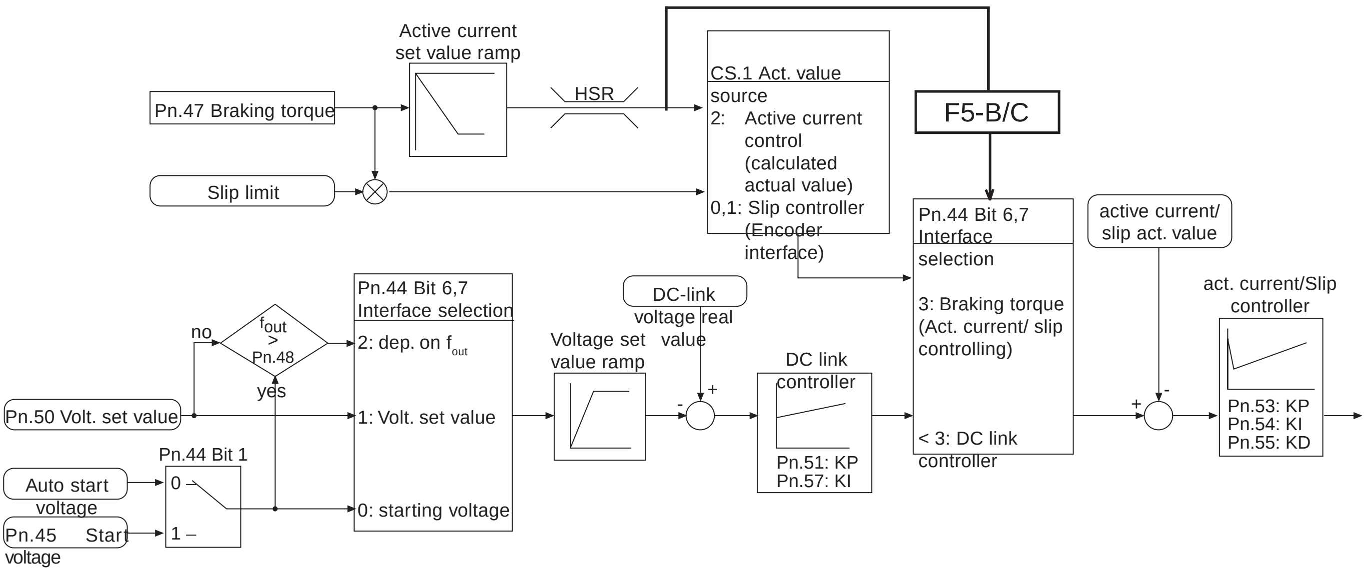
Enter motor data into dr-parameters! **!**

The parameter Pn.44 Bit 2 determines, whether the starting jump is calculated from the active current or from the utilization. This setting has no effect on slip regulation. Default value is the calculation of the active current, but in the case of high harmonic content of the output current it can lead to false values. In that case the starting jump must be determined from the utilization. To get proper values enter motor data into dr-parameters first.

Jump factor (Pn.56)

By means of the jump factor the automatically determined starting jump can be adapted to the respective application.
In case the jump factor is too small, the inverter trips to UP!
In case the jump factor is too high, the inverter runs into the hardware current limitation. The control cannot work correctly, thus causing a wrong calculation of the active current!

Fig. *6.9.6.c Power off controller*



Power off controller

In Fig. 6.9.3.c the different controls (DC-link voltage, active current and slip control) as well as the setpoint and actual value sources are represented. The parameter CS.1 is normally defined by the encoder (see Chapter 6.11) and should not be changed here.

Starting voltage (Pn.45)

The starting voltage is used as setpoint value source, if the adjustment is Pn.44 Bit 1 = „1“ and Bit 6-7 = „0“. The starting voltage can be preset within the range of 200...800 Volt.

Auto starting voltage (Pn.46)

The auto starting voltage is used as setpoint value source, if the adjustment is Pn.44 Bit 1 = „0“ and Bit 6-7 = „0“. With automatic starting voltage the DC-link voltage is measured at "Power-On" and displayed in ru.68. The auto starting voltage is determined by Pn.46, which adjusts the voltage in percent in the range of 50...90 % (Default 80 %) of the measured value.

Braking torque (Pn.47)

The braking torque is used as setpoint value source, if the drive must be stopped as quickly as possible in case of power failure. For this setting to become effective, Pn.44 Bit 6-7 must be set to „3“. In this case the DC-link control is disabled, i.e. it is a pure active current/slip control. The braking torque can be preset within the range of 0,1...100,0 %. Depending on CS.1 the active current control or the slip control works.

Setpoint DC-link voltage (Pn.50)

The voltage setpoint value is used as setpoint value source, if the adjustment is Pn.44 Bit 6-7 = „1“. If Bit 6-7 are adjusted to „2“, the voltage setpoint value takes effect only below the restart value (Pn.48), so that the drive still has enough energy for braking when reaching the minimum output value. On reaching the restart value the starting voltage is increased over a ramp to the voltage setpoint value.
The setpoint DC-link voltage can be preset in the range of 200...800 V. To ensure a safe operation the internal value is limited down. 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 resistor, else the controller cannot work (threshold 200V-class: 380V; 400V-class: 740V).

Power off KP DC volt. (Pn.51)
Power off KI DC volt. (Pn.57)

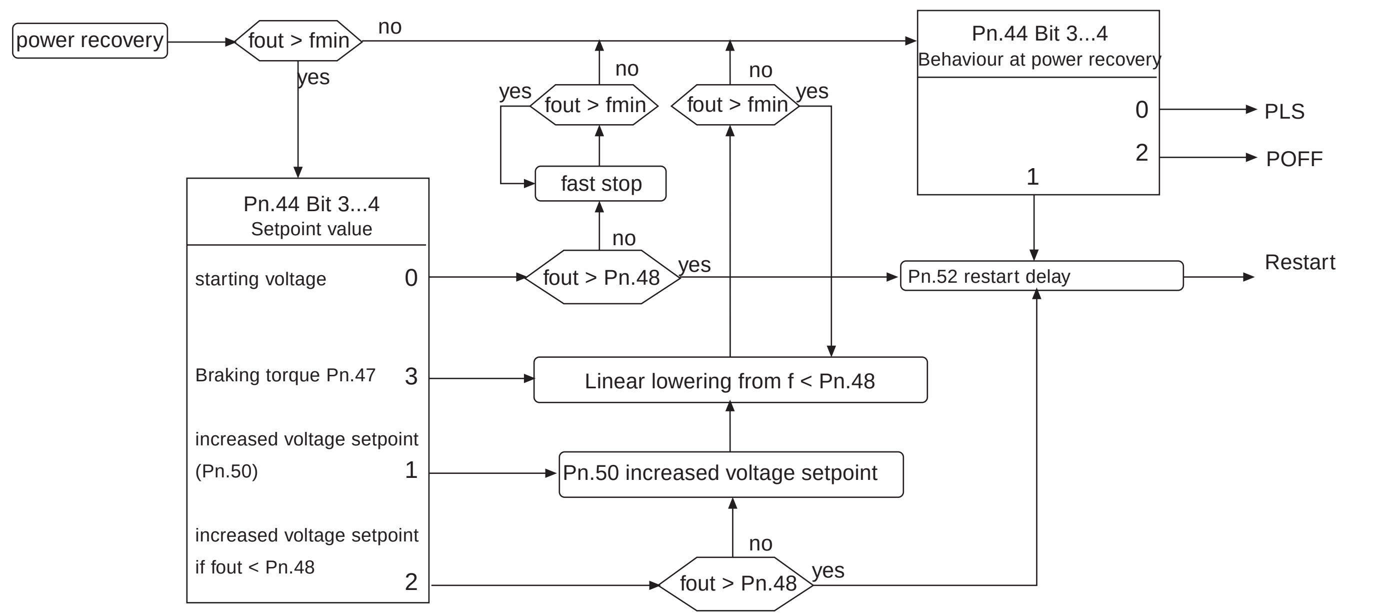
In order to adapt the drive individually to the application, the proportional factor of the DC-link voltage controller can be adjusted with Pn.51 and the integral factor with Pn.57 (not at F5-B/C). In most cases the default setting will achieve sufficient results. But if it comes to overshoots or if the motor looses synchronism the value must be reduced.

Power off KP (Pn.53)
Power off KI (Pn.54)
Power off KD (Pn.55)

Pn.53 to Pn.55 are the control parameters of the active current control and the slip control. The active current control is active at CS.1 = 2 (actual value = calculated value), the slip control is active at CS.1 = 0 or 1 (actual value = measured value of channel 1 or 2).

At the active current control (without speed control) a D-part in the control has a positive effect. Pn.55 should have approx. 10-times the value of Pn.53.
Since the hardware current limit should not be reached with active current control, the setpoint value is limited internally which can lead to oscillations. In that case the setpoint value can be reduced, which leads to prolongation of the delay. If the voltage stabilization is switched on (Pn.44 Bit 8 = „1“) and uf.9 = rated voltage, the voltage is not so high and the deceleration becomes more uniform.
At the slip control (with speed detection) the D-part is unfavorable. Pn.55 should be set on 0.

Fig. *6.9.6.d* *Behaviour at power recovery*



behaviour at power recovery

The following parameters effect the behaviour of the inverter if the system voltage returns during the Power-Off-function.

Restart value (Pn.48)

Depending on the application the restart makes may only be sensible up to a certain value. This restart value is adjusted in Pn.48.
Dependent on the setpoint value source (Pn.44 Bit 6-7) following conditions occur:

1. Regulation of the starting voltage (Pn.44 Bit 6-7 = 0):
   If the output value is larger than the restart value, the restart is carried out

upon power recovery. The output value is kept constant during the restart delay (Pn.52). Afterwards it is accelerated to the current setpoint value. Below the restart value it is delayed in case of power recovery with the fast-stop-function (DEC-ramp at F5-B/C).

2. Regulation onto the voltage setpoint, if the output value is smaller than the restart value (Pn.44 Bit 6+7 = 2):
As long as the output frequency and/or the actual speed is larger than the restart value, the inverter behaves as described under Point 1. Below the restart value the voltage setpoint value of Pn.50 is increased and with active current control (without speed detection) the control parameters of the active current control are reduced linearly with the output value.

3. 3. Regulation onto the voltage setpoint Pn.50 or braking torque Pn.47 (Pn.44 Bit 6+7 = 1 or 3):
The control parameters of the active current control (without speed detection) are reduced below the restart value linearly with the output value.

Restart at minimum output value (Pn.44 Bit 3, 4)

Bit 3 and 4 of Pn.44 determine the behaviour of the drive upon attaining the minimum output value.

- Bit 3 = „0“ and Bit 4 = „0“; the inverter modulates independent of a set direction of rotation with the adjusted boost and is in status „POFF“ (Caution: Motor heating). A reset is necessary for the restart.
- Bit 3 = „1“ and Bit 4 = „0“; the inverter modulates independent of a set direction or rotation with the adjusted boost and is in status „POFF“. After expiration of the restart delay Pn.52 (if adjusted) the inverter restarts automatically.
- Bit 3 = „0“ and Bit 4 = „1“; the inverter switches off the modulation and is in status „PLS“. A reset is necessary for the restart.

Restart delay (Pn.52)

The restart delay is the time during which the output value is kept constant after power recovery, if a restart is allowed. It is adjustable within the range of 0...100 s (Default 0 s). After expiration of the time it is accelerated again onto the current setpoint value.

Examples

To better understand the correlation, the operating modes are explained according to the control types in the following section.

functional sequence F5-G

If the Power-Off-function is switched on (pn.44 Bit 0 = 1), it becomes active if the DC-link voltage drops below the starting voltage value. In the first cycle the frequency jump is given which shall put the drive into no-load running. Afterwards it is regulated onto the DC-link voltage or only onto the active current respectively slip depending on the setpoint value source. The changeover between active current control (without speed detection) and slip control (with speed detection) takes place over cs.1. At cs.1 = 2 (actual value = calculated value) the active current control is active, at cs.1 = 0 or 1 the slip control is active.

ride-through of short-time supply failure

Set value source
Starting voltage (Pn.44 Bit 6-7 = Mode 0) or setpoint DC-link voltage Pn.50, if output value < restart value Pn.48 (Pn.44 Bit 6-7 = Mode 2)

In this mode the motor shall be operated almost in no-load operation and only recover the energy which the inverter requires for the operation. The starting voltage is at the same time the setpoint value for the DC-link voltage control. The value of manipulated variable represents the setpoint value of the slip controller.

Restart at power recovery
In mode 0 the power recovery is constantly detected and in mode 2 up to reaching the restart threshold. An immediate restart upon power recovery is possible.
After detecting the power recovery the restart delay (Pn.52) runs down and the drive accelerates to the current setpoint value.

Behaviour below the restart threshold
• Setpoint value = starting voltage (Pn.44 Bit 6-7 = 0):
    An immediate restart is not executed below the restart threshold (Pn.48). The drive decelerates with the fast-stop function (Pn.58..60) and then behaves according to the adjustment in Pn.44 Bit 3-4.

• Increase voltage setpoint value (Pn.44 Bit 6-7 = 2):
    In order to have more energy to slow down the flywheel masses when the minimum output value is reached, the voltage setpoint value can be raised to the voltage setpoint value Pn.50 (Pn.44 Bit 6-7 = 2) should it fall below the restart threshold (Pn.48).
    In this case the control remains active with the increased setpoint value. At small speeds the drive supplies no more energy. For operation without speed detection the control must be very smooth in this range to prevent stalling. Below the restart value the control parameters of the active current control are lowered linearly with the output frequency.

Emergency stop with braking module

Set value source
Braking torque Pn.47 (Pn.44 Bit 6-7 = 3)

In this mode the drive is to be stopped as fast as possible. As the refeed energy can be very high, a braking resistor is necessary.
The DC-link voltage controller is not active. The setpoint value of the active current e.g. slip controller can be adjusted in Pn.47. It is always decelerated onto the minimum output value. Accordingly the performance results from the adjustment of Pn.44 Bit 3-4.
At small speeds the drive supplies no more energy. For operation without speed detection (active current control) the control must be very smooth in this range to prevent stalling. It is possible to adjust the restart (Pn.48). Below the restart value the control parameters of the active current control are lowered linearly with the output frequency.

Emergency stop without braking module

Set value source
Increased voltage setpoint value Pn.50 (Pn.44 Bit 6-7 = 1)

In some cases one can do without a braking module with 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 Pn.44 Bit 8 = 1 during Power-Off.
The DC-link voltage control is active. It is always decelerated onto the minimum output value. Accordingly the performance results from the adjustment of Pn.44 Bit 3-4.
At small speeds the drive supplies no more energy. For operation without speed detection the control must be very smooth in this range to prevent stalling. It is possible to adjust the restart (Pn.48). Below the restart value the control parameters of the active current control are lowered linearly with the output frequency.

If the Power-Off-function is switched on (pn.44 Bit 0 = 1), it becomes active if the DC-link voltage drops below the starting voltage value. The behaviour depends on the adjustment of the setpoint source (Pn.44 Bit 6-7). The behaviour setpoint source = voltage setpoint value (Pn.44 Bit 6-7 = 1 or 2) is the same as with voltage setpoint value = starting voltage (Pn.44 Bit 6-7 = 0).

Functional sequence F5-M

For F5-M only the parameters Pn.44..46, Pn.48, Pn.51, Pn.52 and Pn.57 are visible. In Pn.44 the Bits 2 and 8 are ineffective.
The Power-Off function is switched off in controlled operation (cs.0 Bit 0..2 = 0..3).

Setpoint value source:
Starting voltage (Pn.44 Bit 6-7 = 0)

Bridging of mains gaps

In this mode the motor shall be operated almost in no-load operation and only recover the energy which the inverter requires for the operation. The starting voltage is at the same time the setpoint value for the DC-link voltage control. The value of manipulated variable represents 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 the limit of the speed control is adjusted to the measured slip, so that the drive is put into no-load operation.

Restart at power recovery
Only in this mode the system recovery can be constantly detected. An immediate restart upon power recovery is possible.
After detecting the power recovery the restart delay (Pn.52) runs down and the drive accelerates to the current setpoint value.
An immediate restart is not executed below the restart value (Pn.48). The drive decelerates with the fast-stop function (Pn.60..61) and then behaves according to the adjustment in Pn.44 Bit 3-4.

Setpoint value source:
Braking torque Pn.47 (Pn.44 Bit 6-7 = 3)

Emergency stop with braking module

In this mode the drive is to be stopped as fast as possible. As the refeed energy can be very high, a braking resistor is necessary.
The DC-link voltage controller is not active. The drive decelerates with the fast-stop function (Pn.60..61) and then behaves according to the adjustment in Pn.44 Bit 3-4.

If the Power-Off-function is switched on (pn.44 Bit 0 = 1), it becomes active if the DC-link voltage drops below the starting voltage value. The drive decelerates with the fast-stop function (Pn.60..61) and then behaves according to the adjustment in Pn.44 Bit 3-4.

Depending on the adjustment of bit 0 and in the quick stop mode (Pn.58) the ramp time (bit 0 = 0) or the time constant of the differential controller (bit 0 = 1, F5-G) is

Quick stop dec time (Pn.60)

adjusted here.

The ramp time refers dependent on ud.2 bit 0+1 to 100/200/400/12.5 and/or 1000/2000/4000/125 rpm in the standard software. In the high speed software the ramp time refers at ud.2 bit 0+1 = 3 to 800 Hz and/or 8000 rpm.

The internally effective value is limited downward:

GTR7 voltage (Pn.69)

min. GTR7-Level = ru.68 (rated DC link voltage) * 1,0625

Input voltage = 400 V: min. GTR7-Level = 601 V
Input voltage = 230 V: min. GTR7-Level = 346 V

Functional sequence F5-S

For F5-S only the parameters Pn.44..46 and Pn.52 are visible. At Pn.44 only the Bits 0, 1 and 3..-4 are active.

Quick stop torque limit (F5-M, F5-S) (Pn.61)

The torque limit for the quick stop function can be adjusted here.

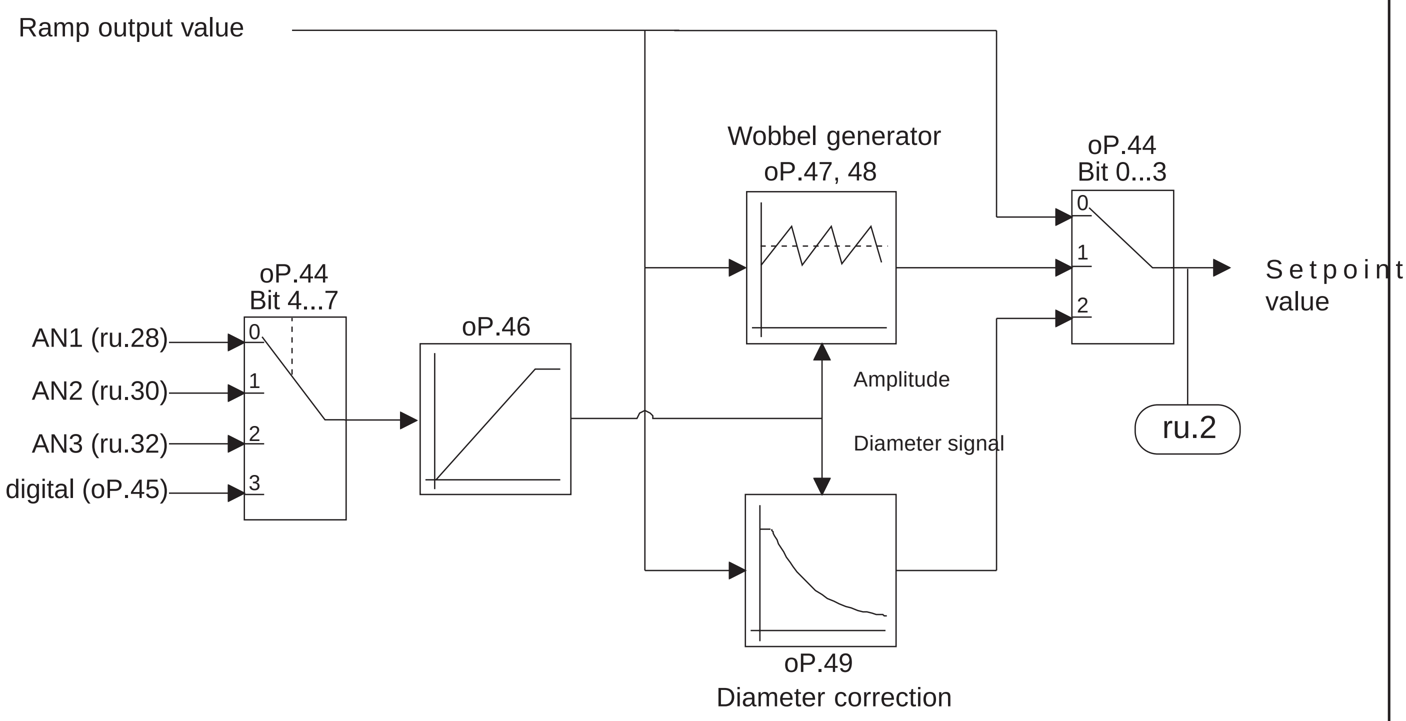
Used Parameters

Param.	Addr.	R/W	PROG.	ENTER	min	max	Step	default	
Pn.44	042Ch	4	-	4	0	511	1	0	-
Pn.45	042Dh	4	-	-	200 V	800V	1 V	290/500 V	dep. of the voltage class
Pn.46	042Eh	4	-	-	50 %	90 %	1 %	80 %	-
Pn.47	042Fh	4	-	-	0,0 %	100,0 %	0,1 %	0 %	only F5-G/B
Pn.48	0430h	4	-	-	0 Hz	400 Hz	0,0125 Hz	0 Hz	only F5-G/B
	0430h	4	-	-	0 rpm	4000 rpm	0,125 rpm	0 rpm	only F5-M ; dep. on ud.2
Pn.50	0432h	4	-	-	200 V	800 V	1 V	290/500 V	dep. of the voltage class
Pn.51	0433h	4	-	-	0	32767	1	128 (512)	only F5-G; F5-M; (F5-B)
Pn.52	0434h	4	-	-	0,00 s	100,00 s	0,01 s	0,00 s	-
Pn.53	0435h	4	-	-	0	32767	1	800 (50)	only F5-G; (F5-B)
Pn.54	0436h	4	-	-	0	32767	1	800 (50)	only F5-G; (F5-B)
Pn.55	0437h	4	-	-	0	32767	1	0	only F5-G/B
Pn.56	0438h	4	-	-	0 %	800 %	1 %	100 %	only F5-G/B
Pn.57	0439h	4	-	-	0	32767	1	5	only F5-G; F5-M
Pn.60	043Ch	-	-	-	0,00 s	300 s	0,01 s	2,00 s	-
Pn.61	043Dh	-	-	-	0 Nm	32000 Nm	0 Adapt.	0,01 Nm	only F5-M ; F5-S
Pn.69	0445h	4	-	4	300V	1000 V	1 V	380V; 740V	-

6.9.7 Wobbel Function
(not at B-housing)

The wobbel generator enables in period and amplitude changeable sawtooth process of the setpoint value. It is activated with the parameter oP.44 Bit 0...3 = „1“.

6.9.7 Additional function: Wobbel generator



Additional function / Mode (oP.44 Bit 0...3)

Two different functions can be activated with oP.44 Bit 0...3. The value is to be added to Bit 4...7.

oP.44 Bit 0...3	Function
0	no function activated
1	**Wobbel generator activated**
2	Diameter correction (see chapter 6.9.8)
3...15	reserved

Additional function / Source (oP.44 Bit 4...7)

The input source for the functions is determined with oP.44 Bit 4...7. The value is to be added to Bit 0...3.

oP.44 Bit 4...7	Function
0	Analog input AN1
16	Analog input AN2
32	Analog input AN3
48	Digital presetting with oP.45

Additional function digital setting (oP.45)

If the value „49“ (sweep function with digital specification) is adjusted in oP.44, the sweep amplitude is preset with oP.45 within the range of 0...100 %.

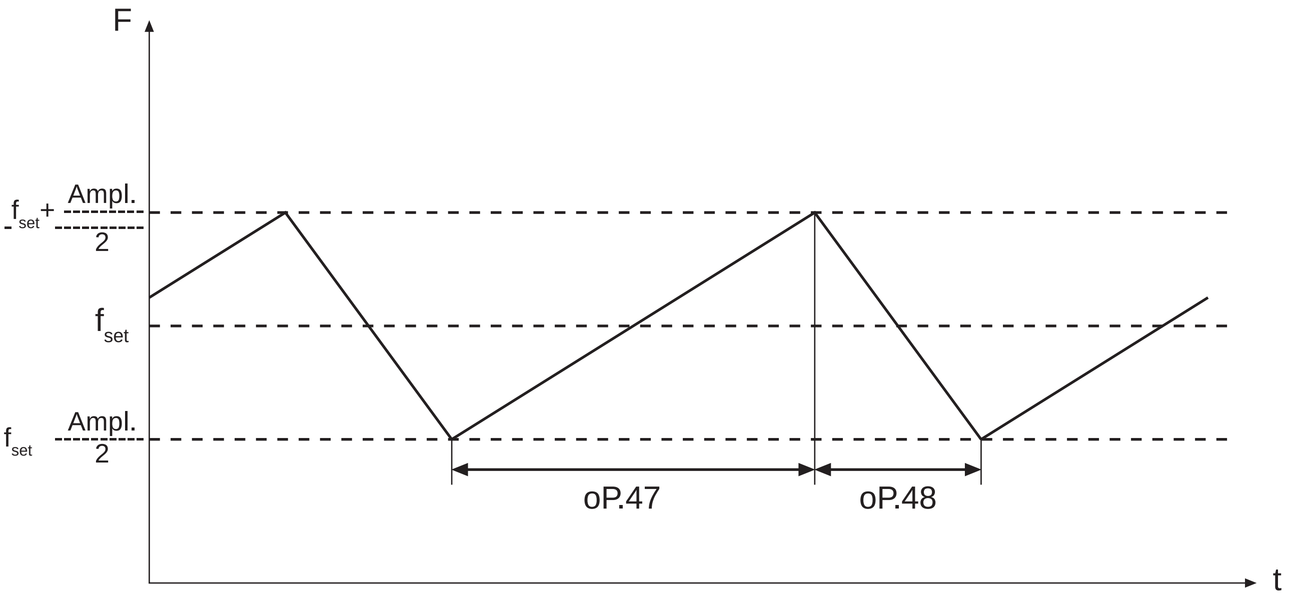
Additional function acceleration/deceleration (oP.46)

With oP.46 a time can be preset between 0...20 s, with which the sweep amplitude rises/falls. The entered value refers to a sweep amplitude of 100 %.

Wobbel generator
Acceleration time (oP.47)
Deceleration time (oP.48)

With oP.47 the acceleration time and with oP.48 the deceleration is adjusted in each case within the range of 0...20,00 s. Together the two parameters result in the period duration of the wobbel period.

6.9.7.b Acceleration and deceleration times of the wobbel generator

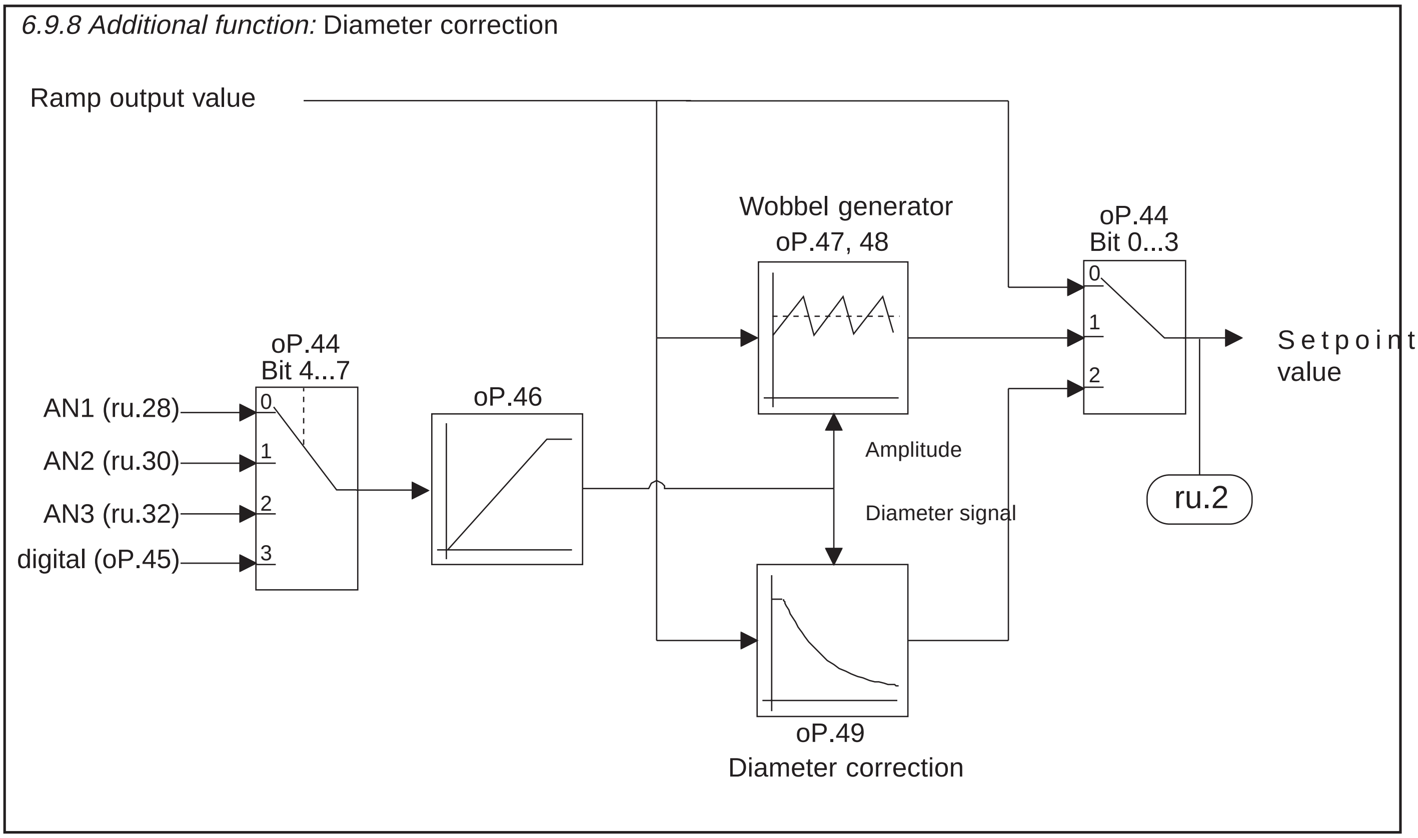


Used Parameters

Param.	Addr.	R/W	PROG.	ENTER	min	max	Step	default	
oP.44	032Ch	4	-	4	0	63	1	0	-
oP.45	032Dh	4	-	-	0,00 %	100,00 %	0,01 %	0,00 %	-
oP.46	032Eh	4	-	-	0,00 s	20,00 s	0,01 s	10,00 s	-
oP.47	032Fh	4	-	-	0,00 s	20,00 s	0,01 s	10,00 s	-
oP.48	0330h	4	-	-	0,00 s	20,00 s	0,01 s	10,00 s	-

6.9.8 Diameter Correction (not at F5-B)

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.



Additional function / Mode (oP.44 Bit 0...3)

Two different functions can be activated with oP.44 Bit 0...3. The value is to be added to Bit 4...7.

oP.44 Bit 0...3	Function
0	no external function activated
1	Wobbel generator (see chapter 6.9.7)
2	**Diameter correction activated**
3...15	reserved

Additional function / Source (oP.44 Bit 4...7)

The input source for the functions is determined with oP.44 Bit 4...7. The value is to be added to Bit 0...3.

oP.44 Bit 4...7	Function
0	Analog input AN1
16	Analog input AN2
32	Analog input AN3
48	Digital presetting with oP.45

Additional function digital presetting (oP.45)

If the value "50“ (sweep function with digital specification) is adjusted in oP.44, the diameter signal can be preset with oP.45 within the range of 0...100 %.

Diameter correction dmin/ dmax (oP.49)

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 (d_{min}). The output frequency/speed of the ramp generator is not changed in this case.
A diameter signal of 100% corresponds to the maximum diameter of the reel bale (d_{max}). In order to be able to calculate the frequency/speed change the program requires the ratio of minimum to maximum diameter (d_{min}/d_{max}).
The ratio of minimum to maximum diameter (d_{min}/d_{max}) is preset by way of oP.49 and can be adjusted within the range of 0,010...0,990 with a resolution of 0,001.

The corrected output frequency of the ramp generator is determined as follows:

$$fn\_presetting = \frac{fn\_Ramp}{1+DS\cdot(1/oP.49-1)}$$

fn_Ramp: Output frequency/speed of ramp generator
fn_presetting: Corrected output frequency/speed
DS: Diameter signal 0 - 100% (0 to 1)
oP.49: (d_{min}/d_{max})

Additional function acceleration/deceleration (oP.46)

The rate of change of the diameter signal can be limited by a ramp generator. By way of oP.46 the time can be preset within the range of 0,0...20 s, which is required for a signal difference of 0...100%.

Used Parameters

Param.	Addr.	R/W	PROG.	ENTER	min	max	Step	default	
oP.44	032Ch	4	-	4	0	63	1	0	-
oP.45	032Dh	4	-	-	0,00 %	100,00 %	0,01 %	0,00 %	-
oP.46	032Eh	4	-	-	0,00 s	20,00 s	0,01 s	10,00 s	-
oP.49	0331h	4	4	-	0,010	0,990	0,001	0,500	-

6.9.9 Positioning Function
(only for F5-G/B)

The positioning function enables the approach of a position with a signal from different frequencies. The positioning procedure is triggered by disabling the direction of rotation through an external signal (e.g. through set changeover). The positioning is executed correctly only if at triggering the positioning the maximum frequency of the positioning set is not exceeded and no s-curves are used. During the positioning procedure the status ‘Positioning’ is displayed (value 83, display ‘POSI’).

Calculation of the frequency-dependent constant running time

In order to always travel the same distance in the case of different frequencies, the drive continues to run with constant frequency after starting the positioning until the position is reached with the adjusted deceleration. The frequency-dependent constant running time is calculated as follows:

$$t\_const = \frac{\frac{t\_dec}{2}}{\text{Reference frequency}} \bullet \left(\frac{f\_max^2}{f\_actual} - f\_actual \right)$$

t_const: frequency-dependent constant running time *[sec.]*
t_dec: adjusted deceleration time *[sec.]*
Reference frequency*: 100Hz / 200Hz / 400Hz (dependent on ud.2)*
f_max: m*aximum frequency [Hz]*
f_actual: actual frequency [Hz] on triggering the positioning

Positioning delay (Pn.63)

With parameter Pn.63 a shifting of the stop position can be adjusted, which entails an additional running time. Thus the shifting of the initiator can be omitted. The additional constant running time is also frequency-dependent and is calculated as follows:

$$t\_delay = \frac{Pn.63 \bullet f\_max}{f\_actual}$$

t_delay: additional constant running time *[sec.]*
Pn.63: Positioning / delay [sec.]
f_max: m*aximum frequency [Hz]*
f_actual: actual frequency [Hz] on triggering the positioning

Pn.63	Function
-0,02	Positioning switched off
-0,01	Positioning function switched off (standard)
0,00...327,67 s	Positioning function switched on; positioning delay by the adjusted value; set change over during the positioning not possible, unless it shall be changed in a set which is adjusted with Pn.63 = -0,02.

Set activation delay (Fr.5)
Set deactivation delay (Fr.6)

With the set switch-on delay (fr.5) and the set switch-off delay (fr.6) a delay time after reaching the position e.g at set changeover can be adjusted.

Used Parameters

Param.	Addr.	ro	PROG.	ENTER	min	max	Step	default	
Pn.63	043Fh	-	4	4	-0,02 s	326,76 s	0,01 s	-0,01 s	-0,01 = posi off; -0,02=abort
Fr.5	0905h	-	4	-	0,00 s	32,00 s	0,01 s	0,00 s	-
Fr.6	0906h	-	4	-	0,00 s	32,00 s	0,01 s	0,00 s	-

Example 1 The drive runs a distance, positions and remains at the stop position for a time. The new cycle starts.

Download list:

set	Parameter		Value	Notes
0	Ud01	Password	440	
0	Fr01	Copy parameter set	-2: def.cust.para all sets	
0-1	oP00	Reference source	0: Analog REF	
0	oP01	Rotation source	2: F/R, 0-lim.	Set 0: running
1	oP01	Rotation source	0: dig., 0-lim.	Set 1: positioning
1	oP02	Rotation setting	0: low speed	
0-1	oP10	Max. reference forward	70,0000 Hz	The max. setpoint value must be the same in all sets.
0-1	oP28	Acc. time forward	0,01 s	
0-1	oP30	Dec. time forward	0,20 s	
0	Pn63	Positioning delay	-1: off	
1	Pn63	Positioning delay	5,00 s	Shifting of the stop position
0	Fr02	Parameter set source	3: term. inp. coded ST-I1-ID	
0	Fr05	Set activation delay	1,00 s	Additional break at the stop position
1	Fr05	Set activation delay	0,00 s	This time must be = 0
0	Fr06	Set deactivation delay	0,00 s	This time must be = 0
1	Fr06	Set deactivation delay	2,55 s	Break at the stop position
0	Fr07	Para. set input selection	16: I1	
0	di11	I1 Function	2048: P. set selection	initiator signal

Example 2 The drive runs with different speed back and forth and always reverses at the same points.

Download list:

set	Parameter		Value	Notes
0	Ud01	Password	440	
0	Fr01	Copy parameter set	-2: def. cust.para all sets	
0-3	oP00	Reference source	0: Analog REF	
0-3	oP01	Rotation source	0: dig.(op.2), 0-lim.	
0	oP02	Rotation setting	1: forward	Set 0: clockwise rotation
1	oP02	Rotation setting	0: low speed	Set 1: clockwise rotation positioning
2	oP02	Rotation setting	2: reverse	Set 2: counterclockwise rotation
3	oP02	Rotation setting	0: low speed	Set 3: counterclockwise positioning
0-3	oP10	Max. reference forward	70,0000 Hz	The max. setpoint value must be the same in all sets.
0-3	oP11	Max. reference reverse	-1: = see oP.10	The max. setpoint value can be different for the direction of rotation.
0-3	oP28	Acc. time forward	0,10 s	
0-3	oP30	Dec. time forward	0,10 s	
0	Pn63	Positioning delay	-1: off	
1	Pn63	Positioning delay	0,8 s	Shifting of the position at clockwise rotation
2	Pn63	Positioning delay	-1: off	
3	Pn63	Positioning delay	3,1 s	Shifting the position at counterclockwise rotation
0	Fr02	Parameter set source	2: terminal binary coded	
0	Fr05	Set activation delay	0,00 s	Additional break between counter-clockwise and clockwise rotation
1	Fr05	Set activation delay	0,00 s	This time must be = 0
2	Fr05	Set activation delay	0,00 s	Additional break between clockwise and counterclockwise rotation
3	Fr05	Set activation delay	0,00 s	This time must be = 0
0	Fr06	Set deactivation delay	0,00 s	This time must be = 0
1	Fr06	Set deactivation delay	1,00 s	Break between clockwise and counterclockwise rotation
2	Fr06	Set deactivation delay	0,00 s	This time must be = 0
3	Fr06	Set deactivation delay	1,00 s	Break between counterclockwise and clockwise rotation
0	Fr07	Paraset input sel.	272: I1+IA	
0	Fr11	Reset set input selection	0: no input	
0	di11	I1 Function	2048: Set sel.	initiator signal
0	di15	IA Function	2048: Set sel.	Changeover between clockwise and counterclockwise rotation
0	do04	Condition SB4	0: off	Initiator active: -> set 1
1	do04	Condition SB4	1: on	Positioning completed: -> set 2
2	do04	Condition SB4	1: on	Initiator active: -> set 3
3	do04	Condition SB4	0: off	Positioning completed: -> set 0

6.9.10 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.

Source analog parameter setting (An.53)

This parameter determines whether the analog parameter setting occurs via the motor-poti or the aux-function.

An.53	Function
0	AUX
1	Motorpoti function

Target analog parameter setting (An.54)

The Bus-address of the parameter, that is to be adjusted in analog mode, is adjusted here (see chapter 5). Following parameters can be adjusted.

uF.1 / 7
cn. 4 / 5 / 6
An.32 / 37 / 42 / 48
LE.0 / 1 / 2 / 3 / 4 / 5 / 6 / 7
cS.6 / 9
Ec.4 / 14
PS.31 / 33

In case an invalid parameter address is selected, the message „IdAtA“ (or „data invalid“ at COMBIVIS) is output and the setting is ignored.

Offset analog parameter setting (An.55)

Defines the parameter value, that adjusts itself at 0 % analog parameter setting. The parameter value must be entered with the internal standardization of the target parameter.

$$\text{Value to be adjusted} = \frac{\text{Desired value of target parameter}}{\text{Resolution of target parameter}}$$

Maximal value analog parameter setting (An.56)

Defines the parameter value, that adjusts itself at 100 % analog parameter setting. The parameter value must be entered with the internal standardization of the target parameter.

Set indicator analog parameter setting (An.57)

An.57 determines the parameter set which edited the selected parameter. If a programmable parameter is adjusted as target parameter, the adjusted set in An.57 is edited.

An.57	Function
-1	active set is edited
0...7	adjusted set is edited

If a non-programmable parameter is adjusted as target parameter, it is always edited in set 0 independent on An.57.

Used Parameters

Parameter		Addr.	ro	prog	↵	min	max		default	[?]	Notes
An.53	Source anal. Para.setting	0A35	-	-	yes	0	1	1	0	-	
An.54	Target anal. Para.setting	0A36	-	-	yes	-1: off	7FFFH	0001h	-1: off	-	
An.55	Offset anal. Para.setting	0A37	-	-	yes	-2^{31}	2^{31-1}	1	0	-	
An.56	Maximal value anal. Para.setting.	0A38		-	-	yes	-2^{31}	2^{31-1}	1	0	-
An.57	Set indicator anal. Para.setting	0A39	-	-	yes	-1	7	1	0	-	

6.10 Encoder Interface

(not for B-housing)

6.10.1 Designs

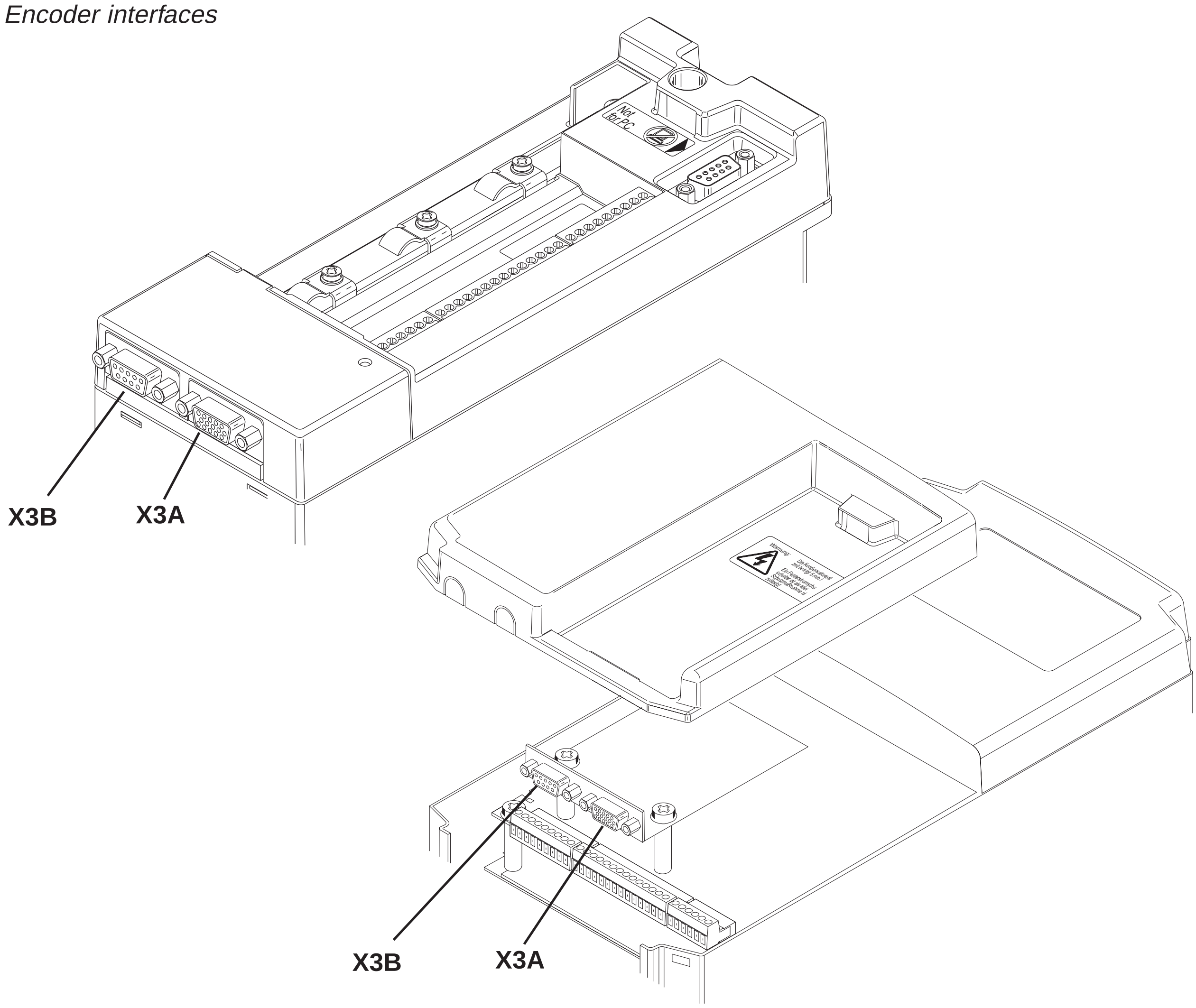
The KEB COMBIVERT F5 supports two from each other separated encoder channels. Each encoder channel can support following interface dependent on the available hardware:

Encoder channel 1 (X3A)
- is a 15-pole incremental encoder input for rectangular signals

Encoder channel 2 (X3B) can support following interfaces
- 9-pole incremental encoder input for rectangular singal
- Incremental encoder output
- Incremental encoder In-/Output

Further Interfaces (describes in separate manuals)
- Synchronous serial interface (SSI)
- Tachometer input
- Initiator input
- Hiperface
- Endat
- SinCos

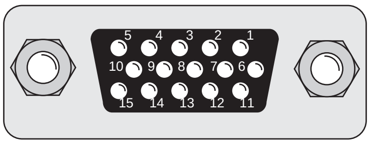
6.10.1 Encoder interfaces



6.10.2 Encoder Interface Channel 1 (X3A)

TTL incremental encoder input (default at F5-M)

Fig. 6.10.2 Encoder interface channel 1 (X3A)



! Only when the inverter is switched off and the voltage supply is disconnected may the plug be pulled out or plugged in!

Pin description

Signal	X3A	Description
U_{var}	11	Supply voltage for encoder
+5,2 V	12	Supply voltage for encoder
0 V	13	Reference potential
A	8	Signal input A
$\overline{A}$	3	Signal input A inverted
B	9	Signal input B
$\overline{B}$	4	Signal input B inverted
N	15	Reference marking input N
$\overline{N}$	14	Reference marking input N inverted
Shield	Housing	Shielding

Inputs

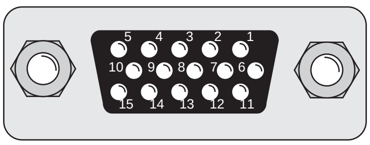
The signal and reference marking inputs can be triggered with rectangular pulses. The signal inputs must generally be connected. The reference marking singals are only needed for the reference point approach in the positioning operation (F5-M/S. Following specifications apply to the encoder interface 1 (X3A):

- max. operating frequency of input f_G = 300 kHz
- internal terminating resistor R_t = 150 W
- 2…5 V high level at rectangular signals

Please contact KEB regarding encoder inputs with HTL-level.

Resolver interface (default at F5-S)

Bild 6.10.2.a Resolver interface channel 1 (X3A)



! Only when the inverter is switched off and the voltage supply is disconnected may the plug be pulled out or plugged in!

Signal	X3A	KEB servo motor	Description
SIN-	3	1	Sinus signal cable inverted
SIN+	8	10	Sinus signal cable
REF-	5	5	Reference signal inverted
REF+	10	7	Reference signal
COS-	4	2	Cosinus signal cable inverted
COS+	9	11	Cosinus signal cable
GND	14	-	Shielding of the signal cables
Shield	housing	housing	Shielding of the hole cable

Bild 6.10.2.b Resolver connector at the KEB servo motor

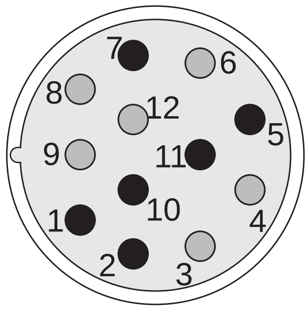
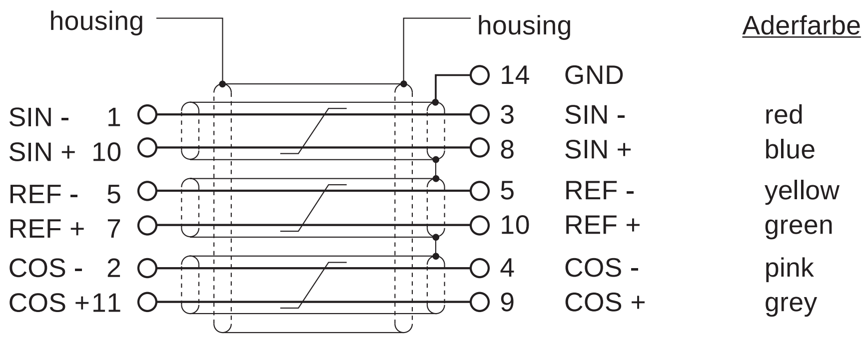
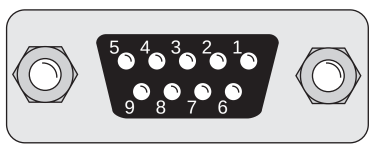


Bild 6.10.2.c Resolver cable



6.10.3 Encoder Inteface Channel 2 (X3B)

Fig. 6.10.3 Encoder interface channel 2 (X3B)



! Only when the inverter is switched off and the voltage supply is disconnected may the plug be pulled out or plugged in!

ec.10 Definition of the interface

Channel 2 can be equipped with different interfaces. To avoid the connection of a wrong encoder, the installed interface is indicated in ec.10.

Incremental encoder input

In synchronous operation the second incremental encoder serves as input of the master drive. A second position encoder can be connected for positioning operation.

Signal	X3B	Description
U_{var}	5	Supply voltage for encoder (see 6.10.2)
+5,2 V	4	Supply voltage for encoder (see 6.10.2)
0 V	9	Reference potential
A	1	Signal input A
$\overline{A}$	6	Signal input A inverted
B	2	Signal input B
$\overline{B}$	7	Signal input B inverted
N	3	Reference marking input N
$\overline{N}$	8	Reference marking input N inverted
Shield	Housing	Shielding

The signal inputs of the second encoder interface support **only rectangular signals**.

Following specifications apply to the endocer interface 2 (X3B):

- max. operating frequency of input f_G = 300 kHz
- internal terminating resistor R_t = 150 W
- 2…5 V high level at rectangular signals

Incremental encoder output

The incremental encoder output gives out the signals recorded at the encoder interface 1:1 in RS422-specification over the second channel (e.g. master drive in synchronous operation).

Signal	X3B	Description
U_{var}	5	Supply voltage for encoder (see 6.10.2)
+5,2 V	4	Supply voltage for encoder (see 6.10.2)
0 V	9	Reference potential
A	1	Signal output A
$\overline{A}$	6	Signal output A inverted
B	2	Signal output B
$\overline{B}$	7	Signal output B inverted
N	3	Reference marking output N
$\overline{N}$	8	Reference marking output N inverted
Shield	Housing	Shielding

Operating mode encoder 2 (ec.20)

With parameter ec.20 it is defined whether the encoder channel 2 shall work as input or output. Precondition for that is a built-in switch-selectable encoder interface (In.5 = 7).

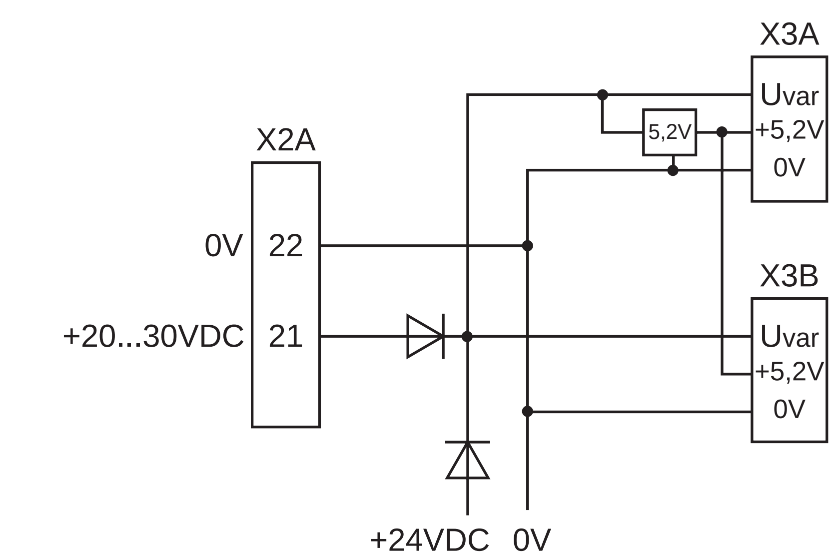
ec.20	Function
0	Incremental encoder input
1	Incremental encoder output

Geberbetriebsart (Ec.20) Ec.20 defines the function of the encoder interfaces.

Ec.20	Function
Bit 0	channel 2 function
0	Incremental encoder input
1	Incremental encoder output
Bit 1	terminating resistor at channel 2
0	input with terminating resistor
2	input without terminating resistor
Bit 2	channel 1 Incremental encoder alert (encoder cable breakage)
0	alert off
4	alert on (the encoder must support alert function)
Bit 3	channel 2 Incremental encoder alert (encoder cable breakage)
0	alert off
8	alert on (the encoder must support alert function)

6.10.4 Power Supply of Encoder

Fig. 6.10.4 Power supply



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U_{var} U_{var} is an unstabilized voltage that is provided by the power stage of the KEB COMBIVERT. Dependent on the size of unit and the load, the voltage amounted to 15... 30 V DC. Uvar is loadable at X3A and X3B with altogether 170 mA. If higher voltages / currents to supply the encoders are needed then the control must be supplied with an external voltage.

+5,2 V The +5 V voltage is a stabilized voltage and loadable at X3A and X3B with altogether 500 mA. Since +5.2 V are generated from Uvar, the current from Uvar is reduced according to following formula:

$$I_{var} = 170\text{ mA} - \frac{5{,}2\text{ V} \times I_{+5V}}{U_{var}}$$

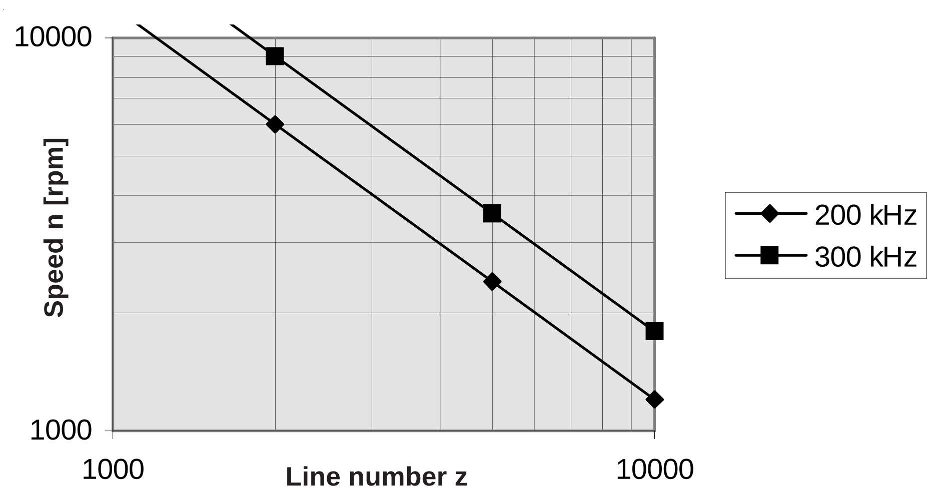
6.10.5 Selection of Encoder

Precondition for a good control behaviour of the drive is not least a question of the selection and the correct connection of the encoder. This also includes the mechanical as well as the electrical connection.

Max. operating frequency (max.sampling frequency)

Depending on the max. operating frequency of the encoder input, the encoder and the maximum speed of the drive the line number of the encoder can be selected.

6.9.4 Speed and line number in dependence on the max. operating frequency of the encoder inputs



The max. signal frequency, which is given out by the encoder, is calculated as follows:

$$f_{max}\,[kHz] = \frac{n_{max}[rpm] \times z}{60000}$$

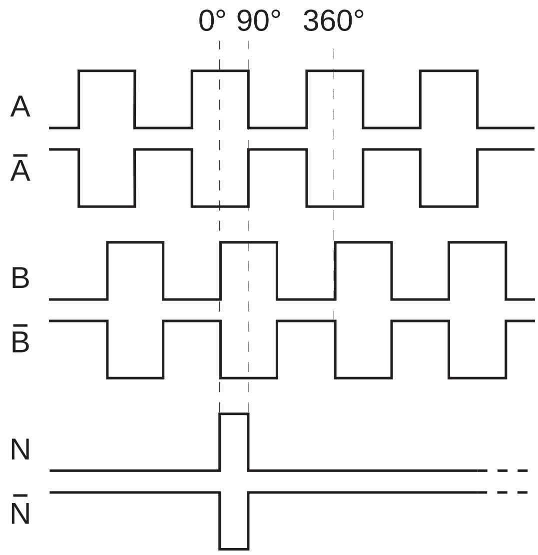
f_{max}: max. signal frequency
n_{max}: max. speed
z: encoder line number

The following condition must be met:

f_{max} < max. operating frequency of encoder < max. operating frequency of interface

6.10.5.a Input signals

TTL-voltage differential levels according to TIA/EIA-RS422-B



The two, by 90° electrically out of phase signals, A and B as well as their inverted signals are generally evaluated. The zero track is needed for the reference point approach in the positioning module (F5-M/S). Zero track (also reference marking channel) gives out 1 signal per revolution.

Cable length

To achieve an unobjectionable function following cable lengths should not be exceeded. Precondition for it is that the supply voltage at the rotary encoder is within the specified tolerances.

The encoder lines should not be longer than 50 m. If longer cables are needed, please contact KEB.

Further information can be taken from the documentation of the respective manufacturer.

6.10.6 Basic Setting

Prior to start-up the inverter must be adapted to the encoder(s) which is/are used.

Encoder interface 1 / 2 (Ec.0, Ec.10)

Ec.0 displays the installed encoder interface 1; Ec.10 displays the installed encoder interface 2. The values correspond to following interfaces:

Value	Encoder interface
0	no Interface
1	Incremental encoder input TTL
2	Incremental encoder output 5 V
3	Incremental encoder input and output direct (not divisible by Ec.27; switchable with Ec.20)
4	Incremental encoder input and output TTL (switchable with Ec.20)
5	Initiator
6	SSI Interface
7	Resolver Interface
8	Tacho
9	Incremental encoder output TTL (from resolver over channel 2)
10	Incremental encoder output TTL
11	Hiperface
12	Incremental encoder input 24 V HTL
13	Incremental encoder input TTL with error detection
14	Sin/cos encoder input
15	Incremental encoder input 24 V HTL with error detection (push-pull)
16	ENDAT
17	Incremental encoder input 24 V HTL with error detection
18	Analog option ±10 V

In case of an invalid encoder indentification the error „E.Hyb“ is indicated and the measured value in is displayed inverted in ec.0/ec.10.
On changing the encoder interface the error „E.HybC“ is indicated. By writing on parameter ec.0 or ec.10 the change is confirmed and the default values for the new interface are loaded.

Adjustment of encoder line number (Ec.1, Ec.11)

With this parameter the encoder line number is adjusted to the connected encoder within a range of 1…16383.
- ec.1 for encoder interface 1
- ec.11 for encoder interface 2

Speed sampling time (Ec.3, Ec.13)

This parameter defines the time over which the speed average is determined. At that the resolution of the speed detection is defined simultaneously.

ec.3 ec.13	Sampling time	Speed resolution with the use of an incremental encoder with 2500 pulses
0	0,5 ms	12 rpm
1	1 ms	6 rpm
2	2 ms	3 rpm
3	4 ms	1,5 rpm (Factory setting)
4	8 ms	0,75 rpm
5	16 ms	0,375 rpm
6	32 ms	0,1875 rpm
7	64 ms	0,09375 rpm
8	128 ms	0,046875 rpm
9	256 ms	0,0234375 rpm

When using other line numbers:

$$\text{Speed resolution} = \frac{\text{Specified speed resolution x 2500}}{\text{Line number}}$$

Encoder track change (Ec.6, Ec.16)

With Ec.6 bit 0...1 a rotation change for encoder input 1 and with Ec.16 a rotation change for encoder input 2 can be executed.
With Bit 4 (value 16) a system inverting can be activated. With the system inverting it is possible to run the motor with positive setting counter-clockwise at the shaft, without changing the hardware.
Following adjustments are possible:

Value	Function
	Direction of rotation
0	no change (default)
1	inverted
2	depends on the sign of the actual frequency (initiator)
3	depends on track B (initiator terminal 4)
4-16	reserved
	Encoder system
0	no change (default)
16	inverted

Multiple evaluation (Ec.7, Ec.17)

Value	Evaluation of the encoder signals
0	Single (for initiator: evaluation of positive edges only) (2^0)
1	2-fold (for initiator: evaluation of positive and negative edge) (2^1)
2	4-fold (for incremental encoder) (2^2) default
3	8-fold (2^3)
4	16-fold (2^4)
5	32-fold (2^5)
6	64-fold (2^6)
...	
13	8192-fold (2^{13})

Gear factor (Ec.4; Ec.5, Ec.14, Ec.15)

Through the gear factors it is possible to evaluate incremental encoders, which are not directly mounted onto the motor shaft. The parameters Ec.4 and Ec.5 adjust the gear factor for encoder channel 1, Ec.14 and Ec.15 for encoder channel 2. The gear factors are defined as follows:

$$\text{Gear factor} = \frac{\text{Motor speed}}{\text{Gear speed}}$$

$$\text{Gear factor 1} = \frac{\text{Ec.4 gear factor numerator 1}}{\text{Ec.5 gear factor denominator 1}} = \frac{-10000...10000}{1...10000}$$

$$\text{Gear factor 2} = \frac{\text{Ec.14 gear factor numerator 2}}{\text{Ec.15 gear factor denominator 2}} = \frac{-10000...10000}{1...10000}$$

As additional function it is possible to trigger one of the two numerators with the function „Analog parameter setting“ (see Chapter 6.9.10).

Example

Pretend parameter ec.14 set dependently in the range from -2000...2000

Formula:

$$\frac{Ec.14}{Ec.15} = \frac{-2000...2000}{1000}$$

Adjustments of the analog parameter defaults

An.53	=	motor poti		=	1
An.54	=	100Eh		=	ec.14
An.55	=	2000		=	100%
oP.53			100%	=	motor poti min. value
oP.52	set	0	100%	=	motor poti value
		1	50%		
		2	50%		
		3	100%		

Simulation mode (Ec.27)

With this parameter an encoder simulation can be adjusted.

Bit	Value	Function
0..1		Acceptance of the values
	0	from channel 1
	1	from channel 2
	2	from current actual value
2..3		Number of increments to be output (at Bit 0..1 = 2)
	0	256
	4	512
	8	1024
	12	2048
4...5		Divisor
	0	1 (direct)
	16	2
	32	4

Ec.27 adjusts the mode of the simulation channel. If channel 2 is adjusted with Ec.20 to incremental encoder output, then the mode in CH2 becomes effective with Ec.27 (Ec.27 source => CH2 useless). Otherwise the adjustments refer to a third pure simulation channel (e.g. channel 2 15-poles).

! When adjusting Ec.27 Bit 0...1 = actual value, then channel 2 may not be occupied, since the internal encoder counter is used for the generation of the zero signal.

Absolute position channel 1/ 2 (Ec.2 / Ec.12) (only F5-S)

This parameter exists only at F5-S. The system position of the attached resolver system is adjusted (factory setting).
With this parameter it is possible to adjust the controller to a not aligned motor. If the system position of the motor is unknown an automatic trimming can carried out.
Before starting with the adjustment, the direction of rotation must be checked. The speed display (ru.9) must be positive in the case of clockwise rotation by hand. If that is not the case, the direction of rotation can be exchanged with Ec.6 as described.

- enter motor data
- the connected motor must be able to rotate freely
- open control release
- enter Ec.2/12 = 2206
- close control release

The motor is excited now with its rated current.
If the direction of rotation of the connected motor is not correct or two motor phases are exchanged, E.EnC is triggered.
For resolver sytems the signal SIN+ and SIN- must be exchanged.
If the system postion displayed in Ec.2/12 no longer changes the alignment is completed.

- open control release

If motors with aligned encoder systems are used, the value determined by the automatic alignment can be entered directly in Ec.2/12.

In order to replace S4-systems by F5-S the following calculation must be carried out:

ec.7 (S4) * Pole pair number
- Furthermore pay attention to the encoder cable -
- The lower 16 Bit of the result must be entered in Ec.2/12 -

6.10.7 Additional Parameters

The following parameters are needed only for specific encoder interfaces and are explained more closely in the appropriate documentation.

SSI Multiturn resolution (Ec.21)

If an SSI-multiturn-absolute value encoder is connected, the number of the bits for the multiturn-resolution can be adjusted here (12 Bit).

SSI Clock frequency select (Ec.22)

The clock frequency of the SSI-encoder is adjusted in Ec.22. Two clock frequencies are available 0 : 312,5 kHz or 1 : 156,25 kHz. The smaller clock frequency should only be adjusted for long cables or in case interferences occur.

SSI Data code (Ec.23)

The unit supports two data formats for the SSI-encoders:
0 : binary coded 1 : Gray code

Nominal tacho speed (Ec.25)

As reference speed the max. tachometer speed is adjusted in Ec.25.

Position channel 1 direct (Ec.29)
Position channel 2 direct (Ec.30)

Position value directly from encoder channel 1 / 2 (with complete revolutions).

Position Channel 1 (Ec.31)
Position Channel 2 (Ec.32)

Ec.31 and Ec.32 show the position values of channel 1 and 2 after the gearbox.

System offset Channel 1 (Ec.33)
System offset Channel 2 (Ec.34)

Formula: actual position (ru.54) = position value - system offset (ec.33/34)

Which channel is taken for the actual value display is dependent on the adjusted mode

PS.0 = OFF /SYNCHRON -> CS.1
PS.0 = POSI ->PS.1

In case of posi at the output (cs.1 < > ps.1) it shall be driven speed controlled between. In order to receive the actual position further on by ps.1, the posi mode can be left only by disconnecting from input ps.2!

Start-up procedure of a multiturn encoder:

If a multiturn encoder is mounted in the unit, it displays any position after Power-On (ec.29/30). By approaching to reference point and/or manual setting of the reference point, the actual position in ru.54 can be defined now. For this the system offset in parameters ec.33/34 is used. If the encoder leaves its value range (final value), then its position value starts with ZERO

1.An overflow of the encoder may not lead to a jump in the actual position (ru.r4)

2.After power off >on the position value (ru.54) must be available.

Conclusion: the overflow of the encoder must be noticed.

For this the position in ec.31/ 32 is internally stored and compared with the position of the encoder of ec.29/30 after power on. A recognized overflow is considered in the system offset ec.33/34, i.e. the system offset is changed by the overflow.
After power off, the encoder may not change more than the half value range (final value/2)!

Encoder 1 Typ (Ec.36)

Ec.36 indicates the type of the first supported encoder interface.

0	no encoder detected
64	undefined type

The following hiperface types are supported:

2	SCS 60/70
7	SCM 60/70
34	SRS 50/60
39	SRM 50/60

Encoder 1 state (Ec.37)

Ec.37 indicates the status of intelligent encoder interfaces (Hiperface, ENDAT, etc.).

„96“ is displayed if another encoder is used. With the F5-M/ S the change leads to the display "E.Enc" and can be reset by a hardware reset. If "system position trimming must take place" is displayed, either the motor data of the encoder must be read out or a system position trimming must be done.

Encoder 1 read/write (Ec.38)

Enc.1 encoder r/w

read data		bit0 1	0 not active active (reset after reading)
store data	bit1	0 1	not active [1] active (reset after reading)
Motor data	bit2	0 1	not automated [2] automated
Data group	bit3	0 1	System and application data [3] System data

(1) Storing is supervisor-password protected

(2) Servo power controller with Endat/Hiperface encoder do not have a factory default download list of the motor data.

(3) cs.19 and ec.3 belong to the application data

Dependent on bit 2 the once-only reading-out of the motor data from a Hiperface or a Endat encoder can be automated through:

- the factory configuration of the F5-S inverter (In.24 via supervisior password to 199), so the motor data are read out with the first power on with encoder.

-Acknowledgement of the encoder interface change (E.HYPC) via ec.0.

-Loading the system default value fr.1 = -3 or -4, the motor data are read out only at F5-M/ S

If reading out is not possible error message „E.ENCC" is displayed, and can only be reset by writing on ec.0 or via Bit 0 or 1 of ec.38. The inverter must be parameterized then, afterwards a system trimming at free rotating motor must take place.

Encoder 1 over transmission (Ec.39)

This parameter must be activated for synchronous motors with indirect mounted encoder (e.g. via toothed belt). The gear ratio amounts to a multiple of the pole-pair number.

Act. abs. pos el. (Ec.40)

Displays the actual absolute el. position (2^16 = 360°).This parameter is used for the system position trimming on a preset system position

Mode disp. multiturn (Ec.41)

mode channel 1	bit	0	0	full 32 bit range
			1	only multiturn range
mode channel 2	bit	1	0	full 32 bit range
			1	only multiturn range

Description also see ec.33/34

6

6.10.8 Used Parameters

Parameter		Addr.				min	max		default	[?]	Notes
Ec.0	encoder 1 interface	1000	x	–	x	-127	127	1	GBK	-	GBK=encoder Id
Ec.1	encoder 1 (inc/r)	1001	x	–	–	1	16383	1	GBK	-	GBK=encoder Id
Ec.2	Absolute position 1	1002	yes	–	–	0	65535	1	0	-	only F5-S
Ec.3	time 1 for speed calc.	1003	x	–	–	0	9	1	3	-	-
Ec.4	gear 1 numerator	1004	x	–	–	-10000	10000	1	1000	-	-
Ec.5	gear 1 determinator	1005	x	–	–	1	10000	1	1000	-	-
Ec.6	enc.1 rotation	1006	x	–	–	0	23	1	0	-	-
Ec.7	enc.1 trigger	1007	x	–	–	0	13	1	GBK	-	GBK=encoder Id
Ec.10	encoder 2 interface	100A	x	–	x	-127	127	1	GBK	-	GBK=encoder Id
Ec.11	encoder 2 (inc/r)	100B	x	–	–	1	16383	1	GBK	-	GBK=encoder Id
Ec.12	Absolute position 2	100C	yes	–	–	0	65535	1	0	-	only F5-S
Ec.13	time 2 for speed calc.	100D	x	–	–	0	9	1	3	-	-
Ec.14	gear 2 numerator	100E	x	–	–	-10000	10000	1	1000	-	-
Ec.15	gear 2 determinator	100F	x	–	–	1	10000	1	1000	-	-
Ec.16	enc.2 rotation	1010	x	–	–	0	23	1	0	-	-
Ec.17	enc.2 trigger	1011	x	–	–	0	13	1	2	-	GBK=encoder Id
Ec.20	enc.2 operating mode	1014	x	–	–	0	1	1	GBK	-	-
Ec.21	SSI multiturn resolution	1015	x	–	–	0	13	12	1	-	-
Ec.22	SSI clock frq. sel.	1016	x	–	–	0	1	0	1	-	-
Ec.23	SSI data code	1017	x	–	–	0	1	1	1	-	-
Ec.25	nominal tacho speed	1019	x	–	–	1	16000	1500	1	rpm	-
Ec.27	operation mode output	101B	x	–	x	0	47	1	0	-	-
Ec.29	Position Encoder 1 direct	101D	–	–	–	-2^{31}	$2^{31}-1$	1	0	Inc	-
Ec.30	Position Encoder 2 direct	101E	–	–	–	-2^{31}	$2^{31}-1$	1	0	Inc	-
Ec.31	Absolute position channel 1	101F	–	–	–	0	255	1	0	-	-
Ec.32	Absolute position channel 2	1020	–	–	–	0	255	1	0	-	-
Ec.33	System offset channel 1	1021	yes	–	yes	-2^{31}	$2^{31}-1$	1	0	Inc	only F5-M/S
Ec.34	System offset channel 2	1022	yes	–	yes	-2^{31}	$2^{31}-1$	1	0	Inc	only F5-M/S
Ec.36	encoder 1 typ	1024	–	–	–	0	255	1	0	-	-
Ec.37	encoder 1 state	1025	–	–	–	0	255	1	0	-	-
Ec.38	encoder 1 r/w	1026	–	–	–	0	2	1	0	-	-
Ec.39	encoder 1 over transmission	1027	–	–	–	0	1	1	0	-	-
Ec.40	Absolute actual position	1028	–	–	–	0	65535	1	0	-	only F5-M/S
Ec.41	Mode disp. multiturn	1029	–	–	yes	0	3	1	0	-	only F5-M/S

6.11 SSM

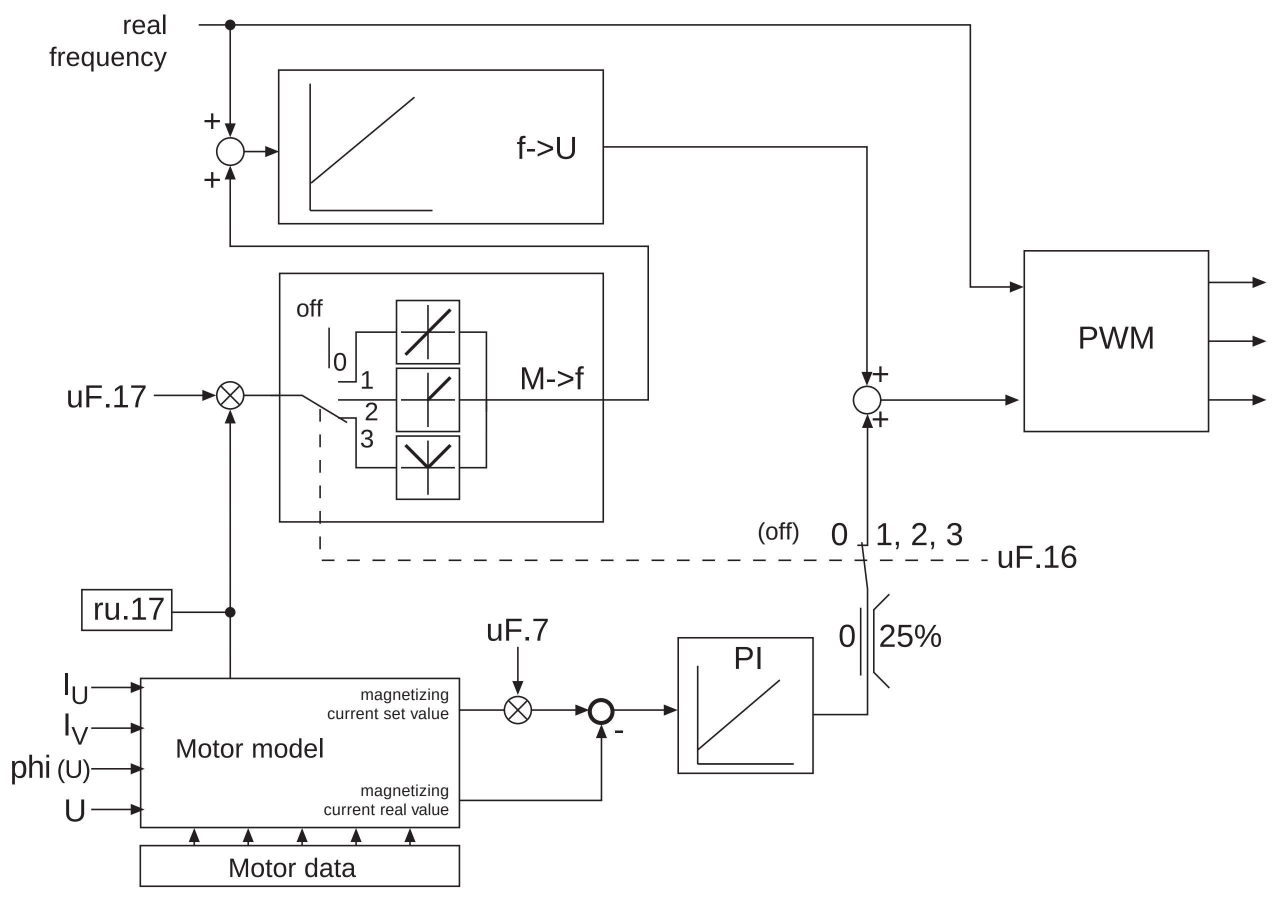
The SMM-function (sensorless motor management) includes the torque and slip compensation. Precondition for a good control characteristic is the input of the motor data in the dr-parameters (see Chapter 6.6).

6.11.1 Torque Compensation

Torque compensation adapts the voltage at variable load torques in such a way that the magnetizing current setpoint is kept constant. With it a higher maximum torque is achieved at small output frequencies compared to uncompensated operation.
With uF.16 and uF.17 the torque compensation is activated and configured. The magnetizing current setpoint and actual value are calculated in the motor model. With uF.7 the magnetizing current setpoint can be adjusted to the application.

Attention! Through overcompensation increased motor currents can occur particularly with small frequencies.

6.11.1Torque compensation



Motordata The motor data is entered in the parameters dr.0...dr.6 as described in Chapter 6.6.

Energy saving factor (uF.7) In the case of activated torque compensation this parameter is used for the optimization of the magnetizing current setpoint to the application. If a drive operates for a long time in the partial-load range the motor heating and the energy consumption can be reduced by decreasing this factor.
The energy saving function is switched off at activated torque compensation.

Torque compensation/ configuration (uF.16)

Parameter uF.16 defines the basic controller structure.

Dec.	Meaning
0	Torque compensation off
1	Torque compensation acts motoric and generatoric
2	Torque compensation works only in the motoric operation; resulting in a smoother run in the generatoric operation.
3	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.

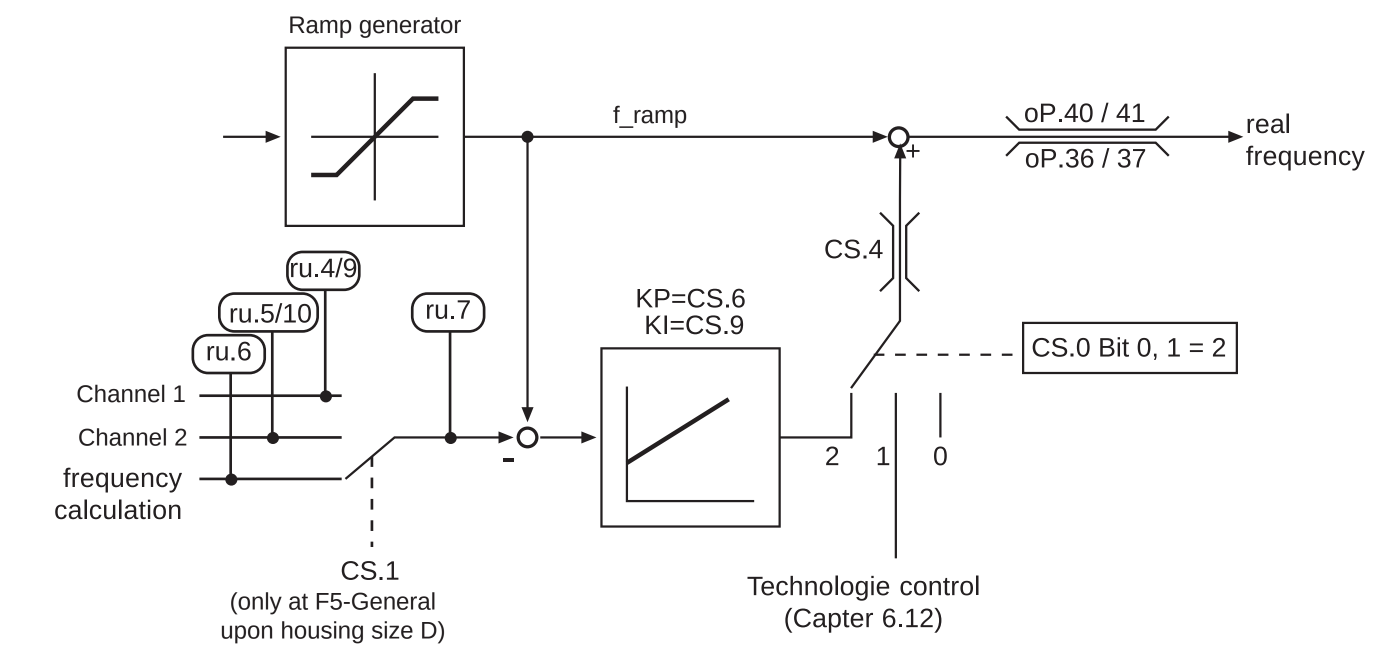
Torque compensation / amplification (uF.17)

With uF.17 the amplification is adjusted within the range of 0.00...2.50.

6.11.2 Speed Control

The integrated speed controller is used at cS.0 = „2“ for the slip compensation. Slip compensation compensates the speed changes caused through load changes by increasing/decreasing the output frequency (ru.3). With that a higher speed stability is achieved.
If one determines during operation that the drive constantly overcompensates, it can be balanced by a slight increase of the rated speed.

6.11.2 Drehzahlregler



Configuration speed controller (cS.0)

Bit	Value	Description
0,1	0 1 2 3	Speed controller off Process control via technologie controller Slip compensation reserved
2	0	No function
3	0 8	Change of direction of rotation via the controller not possible Change of direction of rotation via the controller possible
4	0 16	No controller intervention at f_setting = 0Hz Controller intervention at f_setting = 0Hz
5	0 32	No slip limiting Slip is limited to max. rated slip x dr.9

Actual value source (cS.1)
- not at B-Control -

The parameter cS.1 determines the actual value source for the speed controller. Following selections are available:

Value	Actual value source
0	Actual value from encoder interface channel 1
1	Actual value from encoder interface channel 2
2	Actual value is calculated internally

Frequency limit Speed controller (cS.4)

The frequency limit defines the maximum controller intervention within the range of 0...200 Hz (dep. on ud.2).

KP-Drehzahl (cS.6)

KP-speed defines the proportional component of the speed controller within the range of 0...32767.

KI-Drehzahl (cS.9)

KI-speed defines the integral component of the speed controller within the range of 0...32767.

6.11.3 Used Parameters

Parameter	Addr.				min	max		default	[?]	Notes
uF 7 Energy saving factor	0507	X	X	–	0,0	130,0	0,1	70,0	%	–
uF16 Autoboost configuration	0510	X	X	–	0	3	1	0	–	–
uF17 Autoboost gain	0511	X	X	–	0,00	2,50	0,01	1,25	–	–
cS 0 Speed control configuration	0F00	X	X	–	0	63	1	0	–	–
cS 1 Actual source	0F01	X	X	–	0	2	1	2	–	not at B housing
cS 4 Speed control frequncy limit	0F04	X	X	–	0	200	0,0125	25	Hz	dep. on ud.2
cS 6 KP-speed	0F06	X	X	–	0	32767	1	50	–	–
cS.9 KI-speed	0F09	X	X	–	0	32767	1	500	–	–

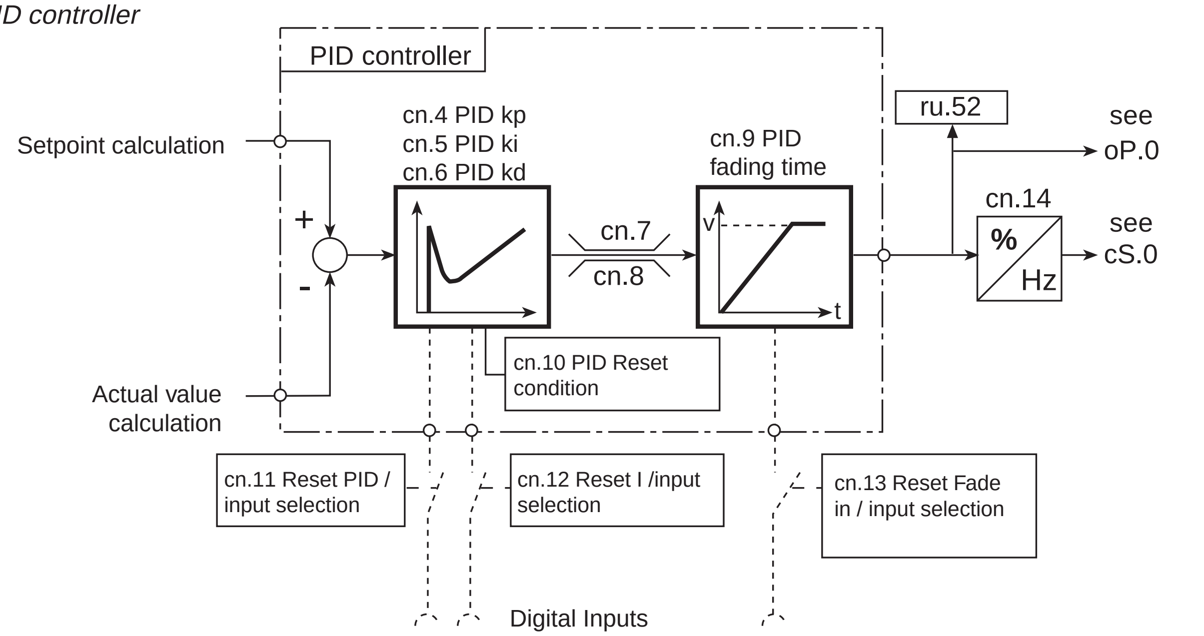
6.12 Technology Control

The KEB COMBIVERT is equipped with an universally programmable technology controller, with it pressure, temperature or dancing position controls can be set up.

6.12.1 The PID Controller

The technology controller consists of a set / actual value comparator, that puts the system deviation on a PID controller. With cn.4, 5 and 6 the P-, I- and D-component is adjusted. The parameter cn.7 and cn.8 limit the maximum manipulated variable of the controller. With the PID-controller fade-in time (cn.9) the controller amplification can be driven up gently from 0...100%. Parameter cn.14 adjusts the frequency reach through in Hz/% (only F5-G/B). With parameters cn.11, 12 and 13 the PID controller, the I controller and/or the controller fade-in can be reset. With cn.10 a PID reset condition can be adjusted.

Fig. 6.12.1 PID controller



PID controller KP (cn.4) Defines the proportional amplification factor in the range of 0,00...250,00.

PID controller KI (cn.5) Defines the integral amplification factor in the range of 0,000...30,000.

PID controller KD (cn.6) Defines the differential amplification factor in the range of 0,000...250,00.

PID positive limit (cn.7)
PID negative limit (cn.8) The max. positive manipulated variable is determined with cn.7 in the range of -400,0...400,0 %, the max. negative manipulated variable is determined with cn.8 in the range of -400,0...400,0 %.

PID fade-in time (cn.9)

With it the control action during the start can be increased linear or decreased linear at the reset of the fade-in. The time refers of 100% of the controller output value. If one input is programmed for „Reset fade-in (cn.13)" the fade-in is counted down at active input and counted up at inactive input.

Value range: -0,01; 0,00...300 s Resolution: 0,01 s

With the setting „-0,01" the fade-in is calculated according to following formula:

Fade-in factor = $f_{setting}$ (ru.2) / max. setpoint value (oP.10/11)

The function is only active, if the technology controller is used as process controller (cs.0 Bit 0...2 = 1). With the adjustment as setpoint controller the fade-in time is = 0.

PID Reset condition (cn.10)

With cn.10 it is possible to preset the reset conditions for the PID-Controller. Thus **simple** speed regulations can be realized for both directions of rotation.

cn.10	Function
0	PID controller is not reset
1	PID controller = 0 (is continuously reset)
2	PID controller is reset in case of modulation off

For speed regulations adjust value „2“, with that the I-component of the controller is reset at LS or nOP. The value „1“ serves mainly for the start-up, to reset the controller manually.

Reset by way of digital inputs (cn.11...13)

The whole controller, the I-component as well as the controller fade-in can be reset via a digital input. When resetting the masking the fade-in time is valid. In accordance with the table below the decimal value of the appropriate inputs must be entered in the following parameters:

cn.11 PID reset / input selection
cn.12 I reset / input selection
cn.13 Fade in reset / input selection

Bit -No.	Decimal value	Input	Terminal
0	1	ST (prog. input „control release/reset“)	X2A.16
1	2	RST (prog. input „reset“)	X2A.17
2	4	F (prog. input „forward“)	X2A.14
3	8	R (prog. input „reverse“)	X2A.15
4	16	I1 (prog. input 1)	X2A.10
5	32	I2 prog. input 2)	X2A.11
6	64	I3 (prog. input 3)	X2A.12
7	128	I4 (prog. input 4)	X2A.13
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% (cn.14)

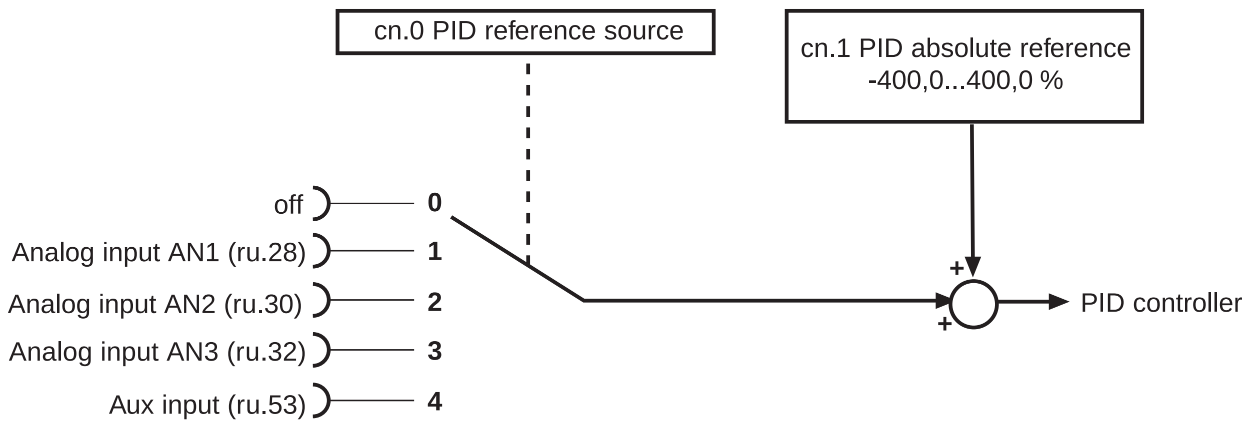
(only F5-G/B)

This block converts the percental controller output value into a frequency. The adjustment of cn.14 determines which frequency is output at 100 % controller output value. A frequency from -400,0...400,0 Hz (dep.on ud.2) can be adjusted. At cS.0 Bit 0...1 = 1 the output value added with the ramp output frequency (ru.2) forms the output frequency (ru.3).

6.12.2 PID Setpoint Value

This section describes the PID-controller setpoint value. PID setpoint value is composed of the absolute reference value (cn.1) and an additional setpoint source which is adjustable with cn.0. The two values are added and transferred to the PID controller setpoint input.

Fig. 6.12.2 PID controller set value



PID controller absolute reference (cn.1)

With cn.1 the set value of the PID controller is preset percentually in the range of -400,0...400,0%. The parameter is set-programmable.

PID reference source (cn.0)

Parameter cn.0 specifies the input which supplies the additional setpoint value. One can choose between following possibilities:

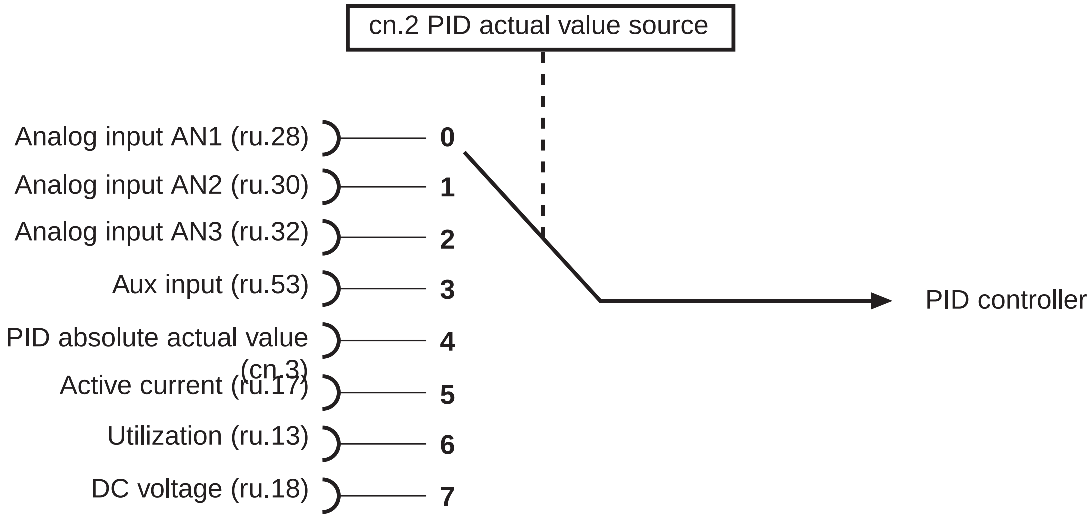
cn. 0	PID reference source
0	off (default)
1	Analog input AN1 (ru.28)
2	Analog input AN2 (ru.30)
3	Analog input AN3 (ru.32)
4	Aux input (ru.53)

If one of the analog channels is adjusted, the signals can be individually adapted to the requirements with the analog amplifier, as described in chapter 6.2.

6.12.3 PID Actual Value

This section describes the PID controller actual value. The actual value input is adjusted with the PID reference source (cn.2).

Fig. 6.12.3 PID Actual Value



PID actual value source(cn.2)

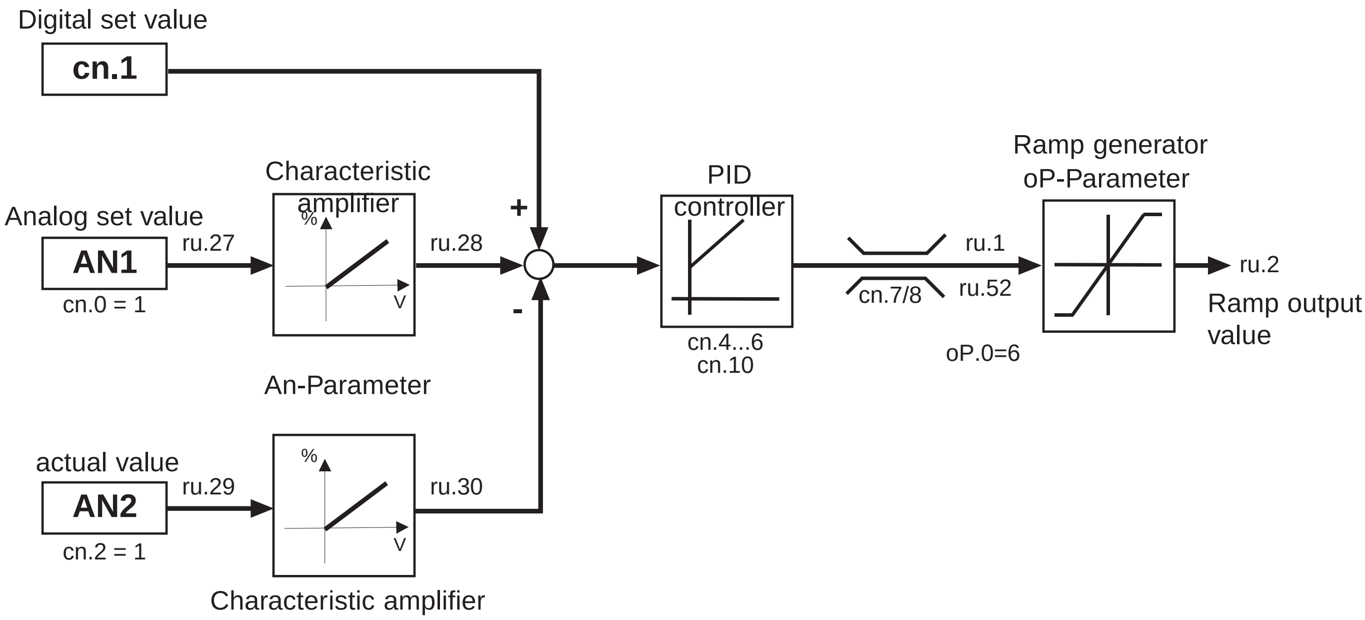
The PID actual value source (cn.2) determines from where the PID controller receives the actual value signal. Following signals are available:

cn.2	Signal	Function
0	AN1	Signal of the analog input 1 (see chapter 6.2)
1	AN2	Signal of the analog input 2 (see chapter 6.2) - reserved at B-control -
2	AN3	Signal of the analog input 3 (see chapter 6.2) - reserved at B-control -
3	AUX	Signal of the Aux input (see chapter 6.2)
4	cn.3	PID absolute actual value is preset with cn.3 in the range of -400,0...400,0 %
5	Active current	The active current -200...200 % displayed in parameter ru.17 is used as actual value signal (100 % = I_{rated})
6	Utilization	The utilization 0...255 % displayed in parameter ru.13 is used as actual value signal (100 % = 100 %)
7	DC link voltage	The DC-voltage 0...1000 V displayed in parameter ru.18 is used as actual value signal (1000 V = 100 %).

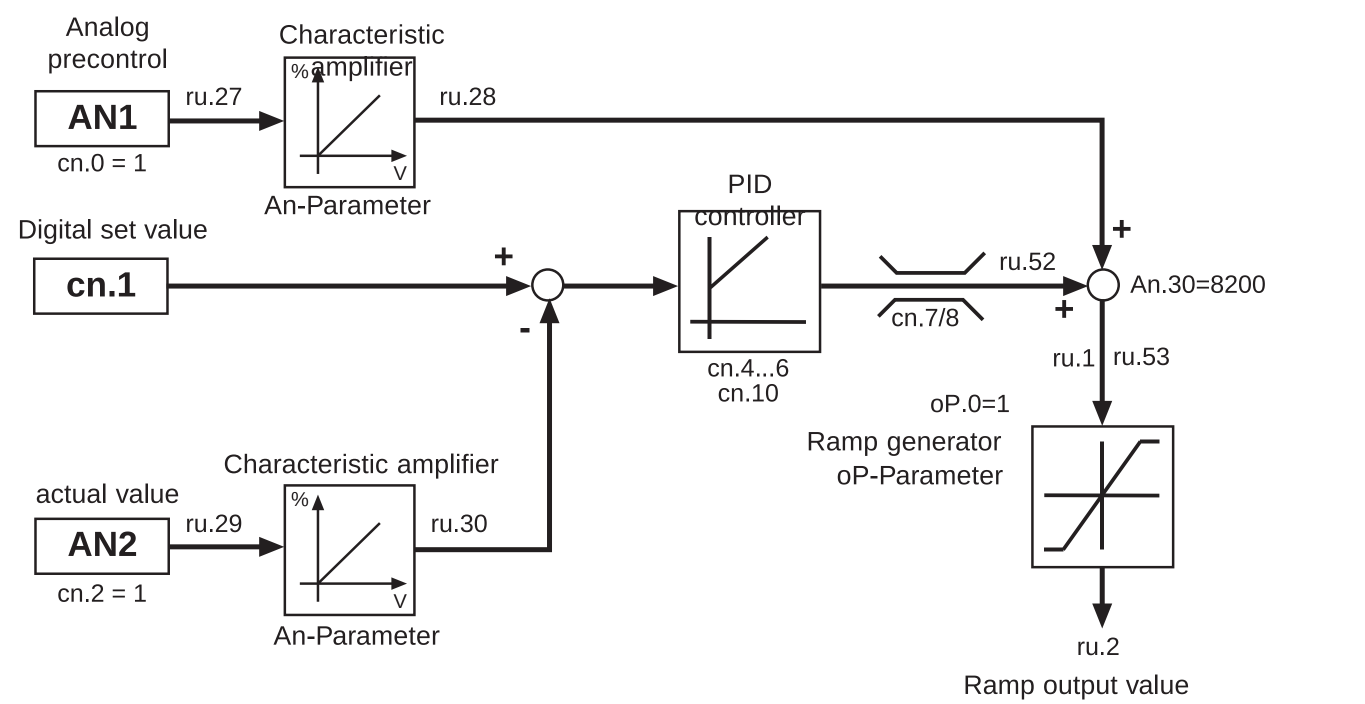
6.12.4 Sample Applications

The following part describes some sample applications of the PID controller.

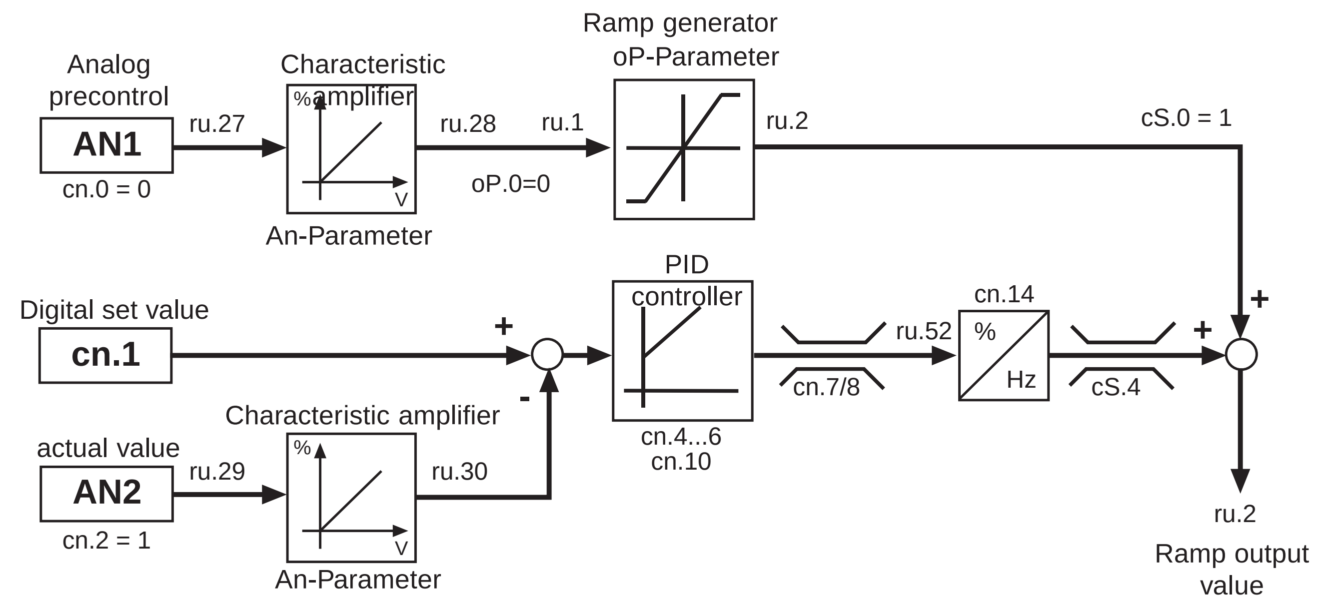
PID controller without precontrol (e.g. for pressure, temperature, level control)



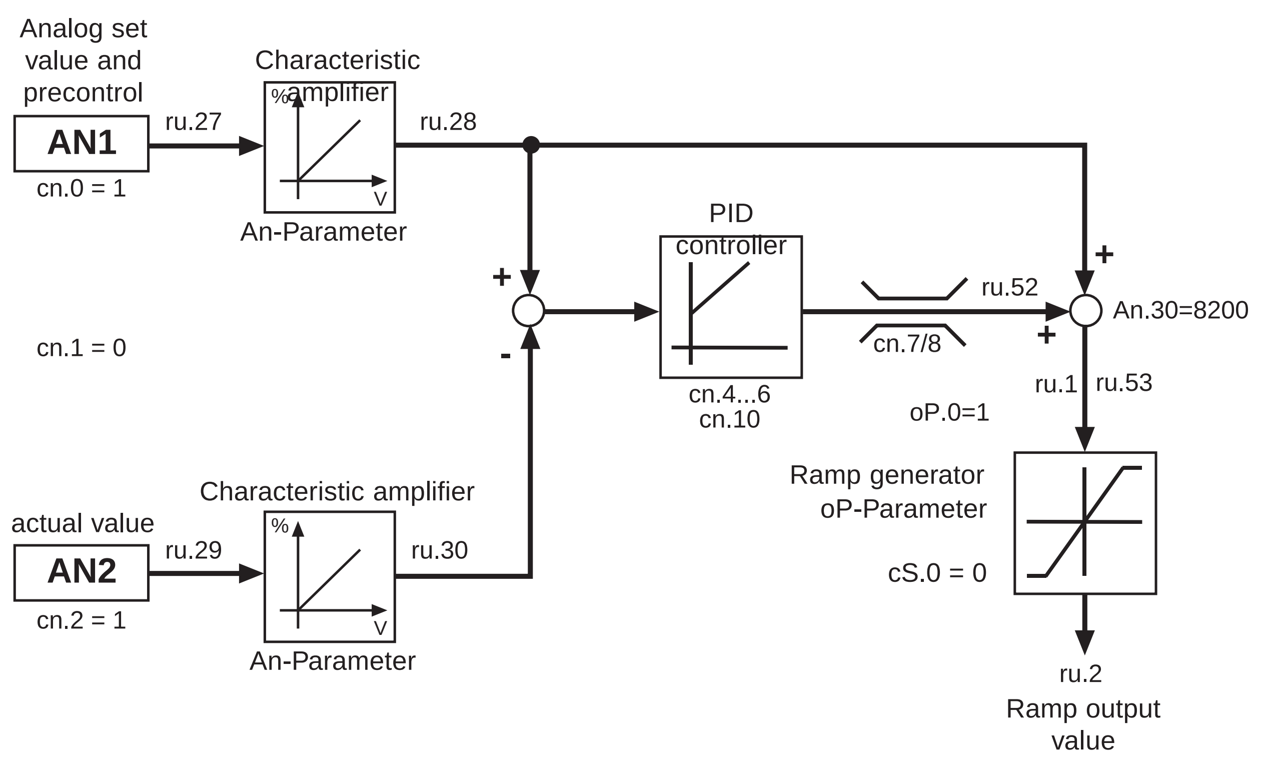
PID controller with precontrol (Variant 1)



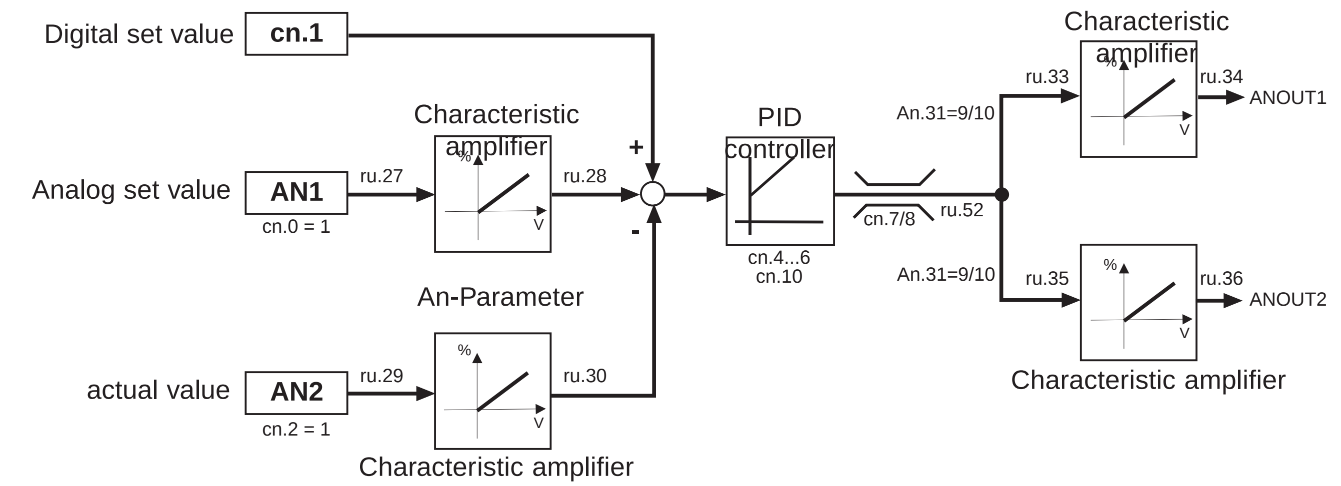
PID controller with precontrol (Variant 2; dancing position control with precontrol - only for F5-G/B)



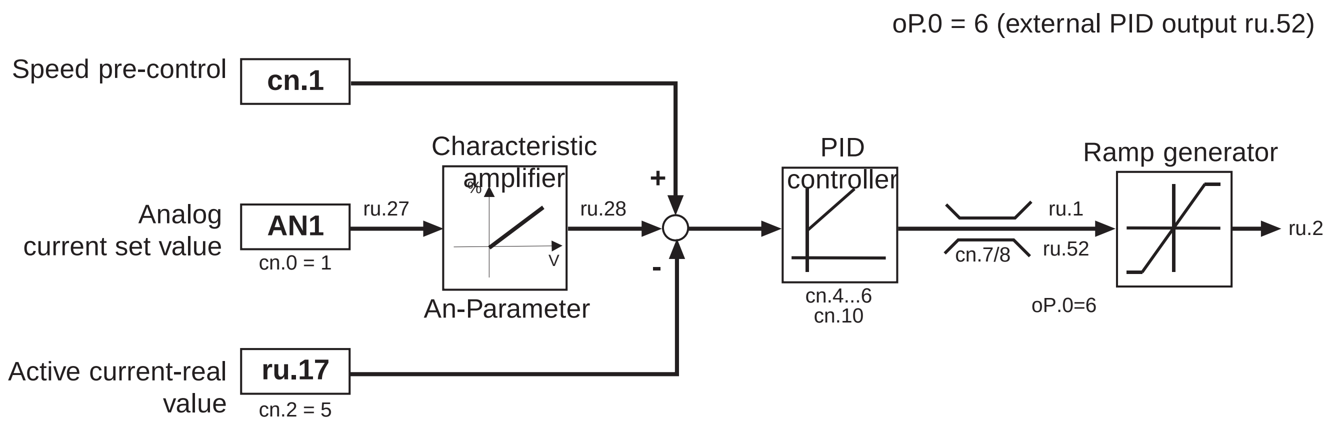
PID controller with precontrol (Variant 3; e.g. for speed regulation with tacho generator - only for F5-G/B)



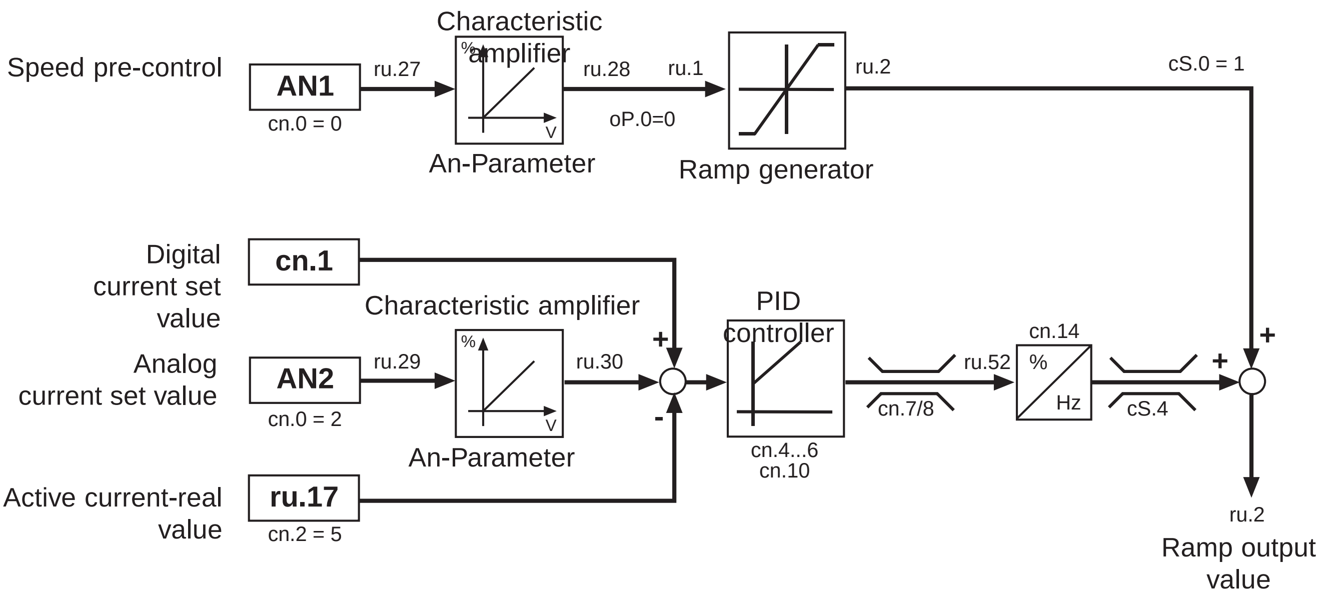
PID controller on the analog output



PID controller as active current- (torque-) regulation without precontrol



PID controller as active current- (torque-) regulation with precontrol



6.12.5 Used Parameters

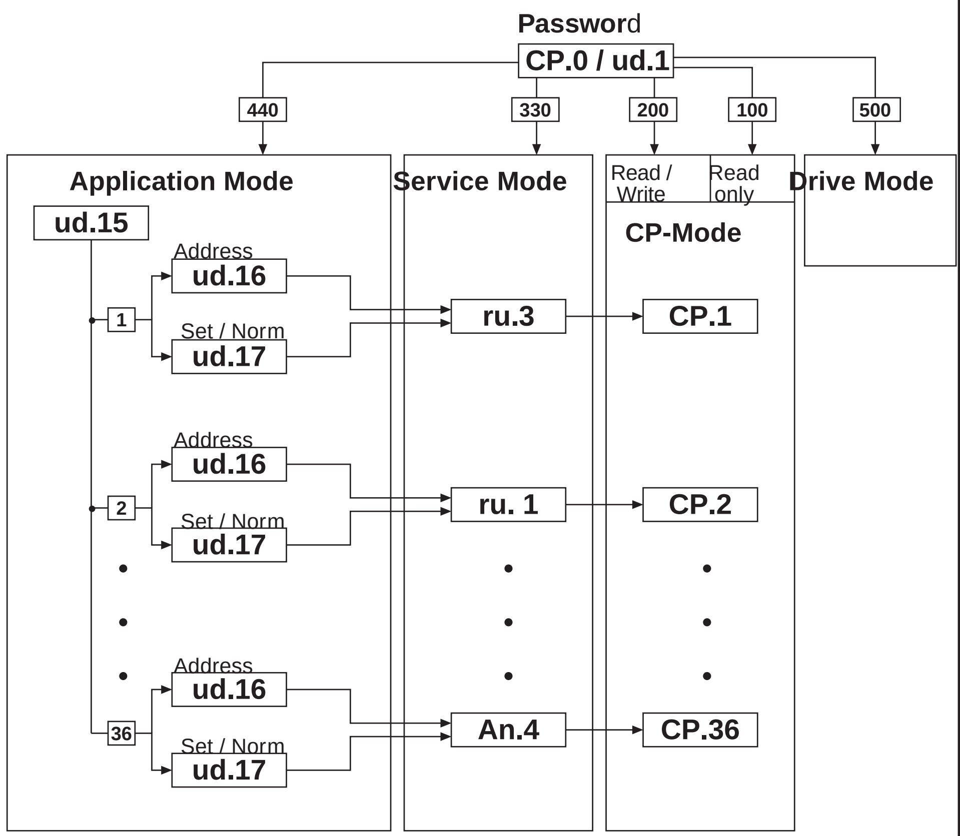
Parameter		Parameter Addr.	✎		↵	min	max		default	[?]	Notes
cn 0	PID reference source	0700	x	x	–	0	4	1	0	–	–
cn 1	PID abs. reference	0701	x	x	–	-400,0	400,0	0,1	0,0	%	–
cn 2	PID act. value src.	0702	x	x	–	0	7	1	0	–	–
cn 3	PID abs. act. value	0703	x	–	–	-400,0	400,0	0,1	0,0	%	–
cn 4	PID kp	0704	x	x	–	0,00	250,00	0,01	0,00	–	–
cn 5	PID ki	0705	x	x	–	0,000	30,000	0,001	0,000	–	–
cn 6	PID kd	0706	x	x	–	0,00	250,00	0,01	0,00	–	–
cn 7	PID pos. limit	0707	x	x	–	-400,0	400,0	0,1	400,0	%	–
cn 8	PID neg. limit	0708	x	x	–	-400,0	400,0	0,1	-400,0	%	–
cn 9	PID fading time	0709	x	x	–	-0,01	300,00	0,01	0,00	s	-0,01 freq. dependent
cn10	PID reset condition	070 A	x	x	–	0	2	1	0	–	–
cn11	PID reset inp. sel.	070B	x	–	x	0	4095	1	0	–	–
cn12	I reset inp. sel.	070C	x	–	x	0	4095	1	0	–	–
cn13	fade in reset inp. sel.	070D	x	–	x	0	4095	1	0	–	–
cn14	PID out freq at 100%	070E	x	x	–	-400,0	400,0	0,0125	0	Hz	dependent on ud.2
ru13	actual utilization	020D	–	–	–	0	255	1	0	%	–
ru17	active current	0211	–	–	–	-3276,7	3276,7	0,1	0	A	–
ru18	actual DC voltage	0212	–	–	–	0	1000	1	0	V	–
ru28	AN1 post amplifier disp.	021C	–	–	–	-400,0	400,0	0,1	0	%	–
ru30	AN2 post amplifier disp.	021E	–	–	–	-400,0	400,0	0,1	0	%	–
ru53	AUX display	0235	–	–	–	-400,0	400,0	0,1	0	%	–

6.13 CP-Parameter Definition

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, the possibility exists to create the one user surface with the CP-parameters. For that purpose 37 parameters (CP.0...CP.36) are available, 36 of them (CP.1...CP.36) are free for assignment.

6.13.1 Survey

Fig. 6.13.1 Definition structure



With ud.15 the CP-parameter that is to be edited is determined. With ud.16 and ud.17 the CP-parameter is defined through its address and the respective set. Depending on the adjusted password (CP.0 or ud.1)

- the adjusted parameter is directly displayed in the Service Mode
- the adjusted parameter is displayed as CP-parameter in the CP-Mode

Parameter CP.0 is not programmable and always contains the password input. If the inverter is in the Application Mode or Service Mode ud.1 is used for the password input.

The parameters ud.15...17 as well as Fr.1 are not permitted as CP-parameter and are acknowledged as invalid parameter address. When entering an invalid parameter address the parameter is set to „oFF“ (-1). The appropriate CP-parameter is not displayed at this setting.

6.13.2 Assignment of CP-Parameters

CP selector (ud.15)

With ud.15 the CP-parameter to be programmed is adjusted in the range of 1...36. CP.0 is not adjustable.

CP address (ud.16)

ud.16 determines the parameter address (see chapter 5) of the parameter to be displayed:

ud.16	CP-address
-1:	Parameter not used
0...32767:	Parameter address

Invalid or not exist parameter addresses are ignored with „Data invalid".

CP set norm (ud.17)

ud.17 determines the set, the addressing and the standardization 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 determines 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 as otherwise an error message is triggered in the cp mode.

Bit									
7	6	5	4	3	2	1	0	Wert	Satz
0	0	0	0	0	0	0	0	0	kein
0	0	0	0	0	0	0	1	1	0
0	0	0	0	0	0	1	0	2	1
0	0	0	0	0	0	1	1	3	0+1
...								...	...
1	1	1	1	1	1	1	1	255	Alle

-> Data invalid, if Bit 8 and 9 = 0

Determination of set addressing mode

Bit 8 and 9 determine the set addressing:

Bit			
8	9	Value	Function
0	0	0	direct set-addressing; the sets determined by Bit 0...7 are valid
0	1	256	current set; the current set is displayed / edited
1	0	512	indirect set addressing, the parameter set determined with the set pointer Fr.9 is displayed / edited
1	1	768	reserved

Display standardization

Bit 10...12 determine how the defined parameter value is displayed. Up to seven different user standardizations (see further on in this chapter) can be determined with the parameters ud.18...21.

Bit				
12	11	10	Value	Function
0	0	0	0	Use standard standardization of the parameter
0	0	1	1024	Display standardization of the parameters ud.18...21 from set 1
0	1	0	2048	Display standardization of the parameters ud.18...21 from set 2
	...		...	
1	1	1	7168	Display standardization of the parameters ud.18...21 from set 7

6.13.3 Example

As an example a user menu with the following features shall be programmed:

1. Display of current actual frequency (ru.3) in the respective set
2. Adjustment of a fixed frequency / fixed value (oP.21) in set 2
3. Adjustment of a fixed frequency / fixed value (oP.21) in set 3
4. Acceleration and deceleration time (oP.28/oP.30) for set 2 and 3
5. Energy saving factor (uF.7) shall be displayed in set 0 with display standardization 4

1.)	ud.15 = 1	; CP.1
	ud.16 = 0203h	; Parameter address for ru.3
	ud.17 = 256	; Display in the active set
2.)	ud.15 = 2	; CP.2
	ud.16 = 0315h	; Parameter address for oP.21
	ud.17 = 4	; Setting in set 2
3.)	ud.15 = 3	; CP.3
	ud.16 = 0315h	; Parameter address for oP.21
	ud.17 = 8	; Setting in set 3
4.)	ud.15 = 4	; CP.4
	ud.16 = 031Ch	; Parameter address for oP.28
	ud.17 = 12	; Setting in set 2 and 3
	ud.15 = 5	; CP.5
	ud.16 = 031Eh	; Parameter address for oP.30
	ud.17 = 12	; Setting in set 2 and 3
5.)	ud.15 = 6	; CP.6
	ud.16 = 0507h	; Parameter address for uF.7
	ud.17 = 4097	; Setting in set 0 and display standardization 4
6.)	ud.15 = 7	; CP.7
	ud.16 = -1: off	; CP.7 not displayed
	ud.17 = xxx	; ud.17 no function

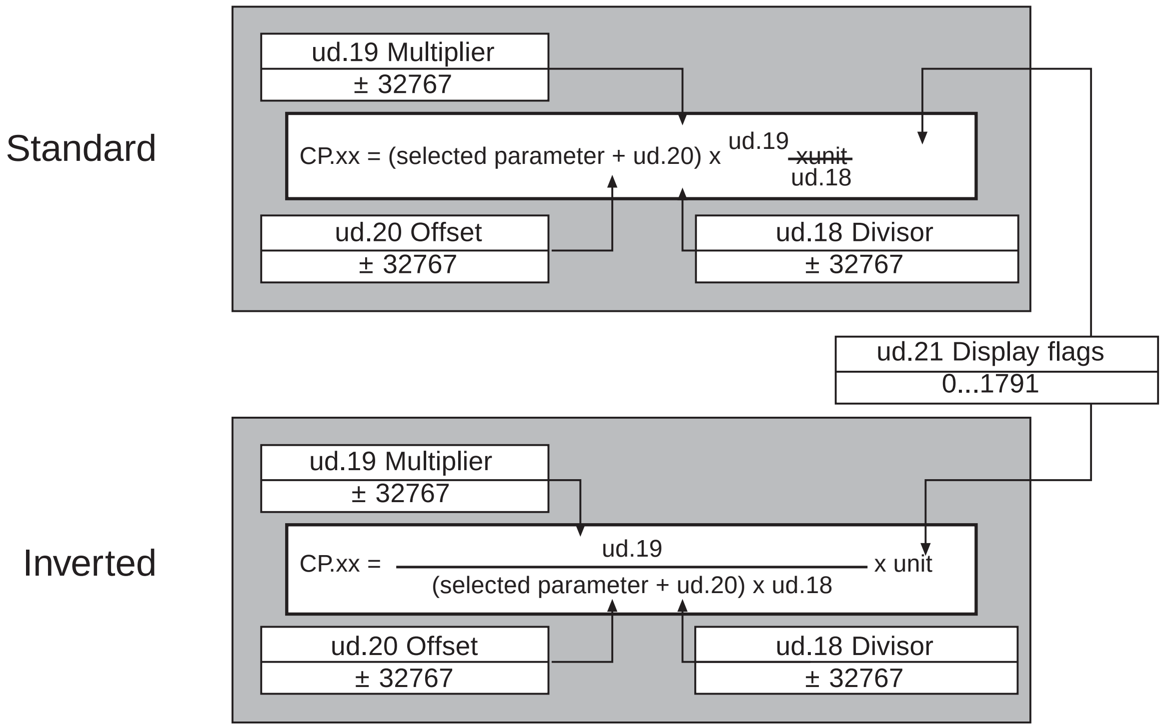
Adjust all other parameter sets to „off“, so that no indication occurs.

The acceptance of the values takes place only after Power-On-Reset of the operator.

6.13.4 Display standardization

The KEB COMBIVERT gives the user the possibility to define his own standardizations (e.g. km/h or bottles/min) in the CP-Mode. The parameters ud.18...20 are used for conversion, ud.21 for specifying the method of calculation, the decimal places as well as the units indicated in KEB COMBIVIS.

6.13.4 Definition of own standardization



! The unstandardized value or the standardized value/resolution is always used for the „selected parameter" !

ud.18 Display standardization Divisor

Adjusts the divisor in the range of ±32767 (default 1). The parameter is set-programmable (not at B-control).

ud.19 Display standardization Multiplier

Adjusts the multiplier in the range of ±32767 (default 1). The parameter is set-programmable (not at B-control).

ud.20 Display standardization Offset

Adjusts the offset in the range of ±32767 (default 0). The parameter is set-programmable (not at B-control).

ud.21 Display standardization Mode

With ud.21 the calculation mode, the decimal places as well as the units indicated in KEB COMBIVIS are adjusted. The parameter is bit-coded and set-programmable (not at B-control). It is adjustable in the range of 0...1791.

Bit 12...15	Bit 11...8	Bit 7...6	Bit 5...0	ud.21
-	-	-	see table 1	unit
-	-	see table 2	-	Calculation mode
-	see table 3	-	-	Representation
free	-	-	-	-

Table 1 Unit (Bit 0...5)

Value	Unit	Value	Unit	Value	Unit	Value	Unit
0	none	16	km/h	32	K	48	lbin
1	mm	17	rpm	33	mW	49	in/s
2	cm	18	Hz	34	W	50	ft/s
3	M	19	kHz	35	kW	51	ft/min
4	km	20	mV	36	inc	52	ft/s²
5	g	21	V	37	%	53	ft/s³
6	kg	22	kV	38	KWh	54	MPH
7	us	23	mW	39	mH	55	KP
8	ms	24	W	40	-	56	psi
9	s	25	kW	41	-	57	°F
10	h	26	VA	42	in	58	-
11	Nm	27	kVA	43	ft	59	-
12	kNm	28	mA	44	yd	60	-
13	m/s	29	A	45	oz	61	-
14	m/s²	30	kA	46	lb	62	-
15	m/s³	31	°C	47	lbft	63	-

Table 2 Calculation mode (Bit 6...7)

Value	Function
0	$(\text{selected parameter} + ud.20)\ x^{ud.19} = \frac{CP.xx}{ud.18}$
64	$\frac{ud.19}{(\text{selected parameter} + ud.20) \times ud.18} = CP.xx$
-	free

The unstandardized value is always used for the „selected parameter“!
unstandardized value = standardized 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
-	free

Example

The actual frequency shall be displayed in CP.1 in rpm. Display standardization from set 4.

ud.15 = 1	; CP.1
ud.16 = 0203h	; Actual frequency ru.3
ud.17 = 4352	; Display in current set, display standardization from set 4
Set 4 ud.18 = 80 Set 4 ud.19 = 60	; Conversion from 1/80 Hz into rpm without pole pair number
Set 4 ud.20 = 0	; no Offset
Set 4 ud.21 = 17	; Unit rpm; direct calculation mode; no decimal places

6.13.5 Variable Standardization

Target of these parameters is to allocate a set of parameter addresses to the control. By this way arbitrary inverter parameters with self-specified standardizations are addressed.

Configuration

A solution of this is to create a parameter group with fixed display characteristics, resolution 1, no decimal places, multiplicator = 1, divisor = 1. Then these parameters can be used for the setting of values in custom-specific standardization. These parameters can be registered in the Configfile and they are also available via COMBIVIS. If you need an additional custom-specific visualization in COMBIVIS, these parameters can be defined as CP parameter, like all the others too. However it is impossible with this procedure to design the start address of the parameter block variable since the parameter addresses are already indicated in the Configfile. The name of the parameter group is programmable parameters.

Required Parameters

The following configuration parameters must be available for one programmable parameter.
The variable display standardization cannot be supported by means of memory requirements in this version. The version like F5-C is valid:

· Target address
· Characteristics

The following settings can be made in the characteristics:

bit 0-7: Target/source set with direct addressing
bit 8-9: Mode of set-addressing:
- 0: Target/source set of bit 0-7
- 1: Target/source set = current set
- 2: Target/source set = fr.9
- 3: Accept target/source setting from PP-Para telegram

The configuration parameters are inserted in the Ud.group and indirect addressed like the configuration parameters of the CP parameters over a selector.

UD.22: PP selector Value range: 0..47
UD.23: PP target address Value range: -1(off)..7FFFH, only available and permitted addresses are accepted
UD.24: PP properties Value range: 1 ... 1023

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: ‘Data invalid‘
generally write protection: ‘Parameter write protected‘
write protection when modulation is switched on: ‘Operation not possible‘
write protection in active set: ‘Set invalid‘
Password: ‘Password invalid‘ is only displayed at parameters with supervisor-password
· ‘Data invalid‘ is always displayed if no source parameter is defined.

Invalid target/source parameters

Some parameters cannot be adjusted as target/source parameter in ud.23. There are all parameters, which are not permissible as CP parameter (characteristics 2 bits 15 = 1) or process date (characteristics 1 bit 28 = 1), as well as the prog. parameters itself. Explanation:

- all sy parameters exception sy.02, 06, 07, 32, 41-44, 50-53
- uf.12-14
- all ud parameters exception ud.01, 09
- fr.01
- in.20,21,31-33
- ec.00,10,36-38
- aa.00-13, 26-29, 34-41
- pp.00-47

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 applies also if the prog. parameter is switched off (ud.23 = -1).
A prog. parameter is additionally invalid as process write date, in case the target parameter is write protected (generally, when the modulation is switched on, in active set).
The set definition of the process date is always valid as set source for process data (e.g. sy.17 for process read date 1). The adjustment in ud.24 is without meaning.

Prog. parameters as scope data

The prog. parameters can be used as scope data. If the selected prog. parameter is switched off (ud.23 = -1) the scope date is switched off and the adjusted address in the corresponding sy-parameter is negated, in order to mark this scope date switched off.
Since the prog. parameters have the type LONG they cannot be assigned on Scope channel 3 and 4, without Combivis leaves the fast scope mode.
The set definition of the process date is always valid as set source for process data (e.g. sy.34 for scope date 1). The adjustment in ud.24 is without meaning.

6.13.6 Used Parameters

Param.	Addr.	R/W	PROG.	ENTER	min	max	Step	default	
ud.1	0801h	4	-	4	0	9999	1	440	Application
ud.15	080Fh	4	-	4	1	36	1	1	-
ud.16	0810h	4	-	4	-1 (off)	32767 (7FFFh)	515 (0203h)	div.	dep. on ud.15
ud.17	0811h	4	-	4	0	8191	1	1	-
ud.18	0812h	4	4	4	-32767	32767	1	1	not at B-control
ud.19	0813h	4	4	4	-32767	32767	1	1	not at B-control
ud.20	0814h	4	4	4	-32767	32767	1	0	not at B-control
ud.21	0815h	4	4	4	0	1791	1	0	not at B-control

7. Start-up

7.1 Preparatory Measures

The following chapter is intended for everybody who has no experience with the KEB frequency inverters. It shall allow a correct entering into this field. But because of the complex application possibilities we must restrict ourselves to explaining the start-up of standard applications.

7.1.1 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.

7.1.2 Installation and connection

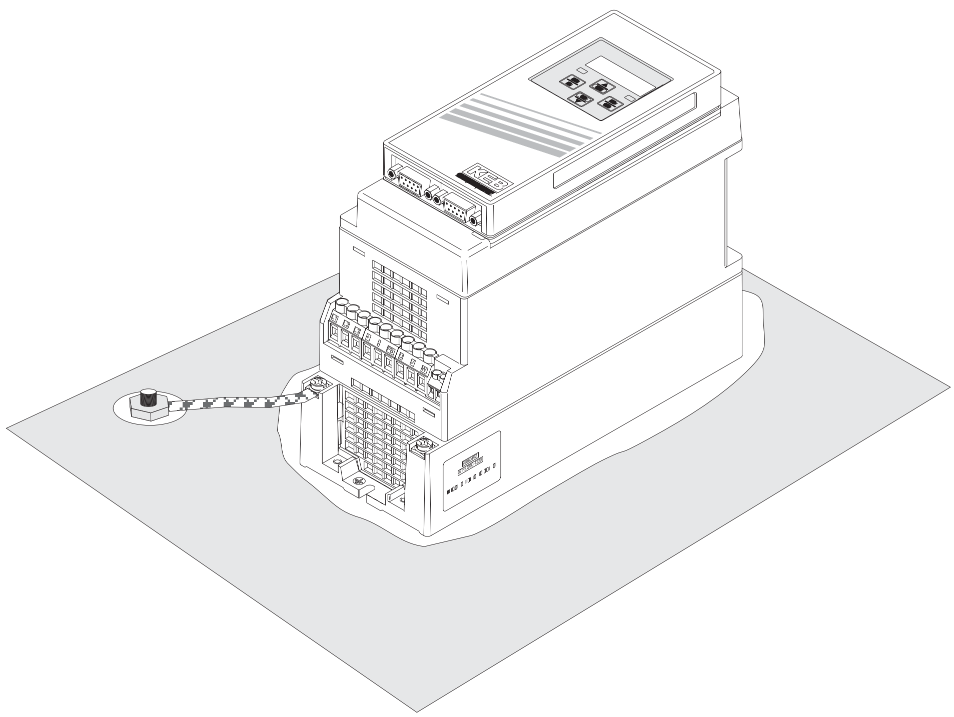
The EMC-conform installation of the inverter is described in the Instruction Manual Part 1. Installation and connection instructions are found in the Instruction Manual Part 2.

☑ The mounting surface of the inverter must be bright.

☑ If necessary, use contact lacquer as protection against corrosion.

☑ Connect the earthing strip to central point in the control cabinet

Fig. 7.1.2 Installation and connection



7.1.3 Checklist prior to Start-up

Before switching on the inverter go through the following checklist.

☑ Is the inverter firmly bolted 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.

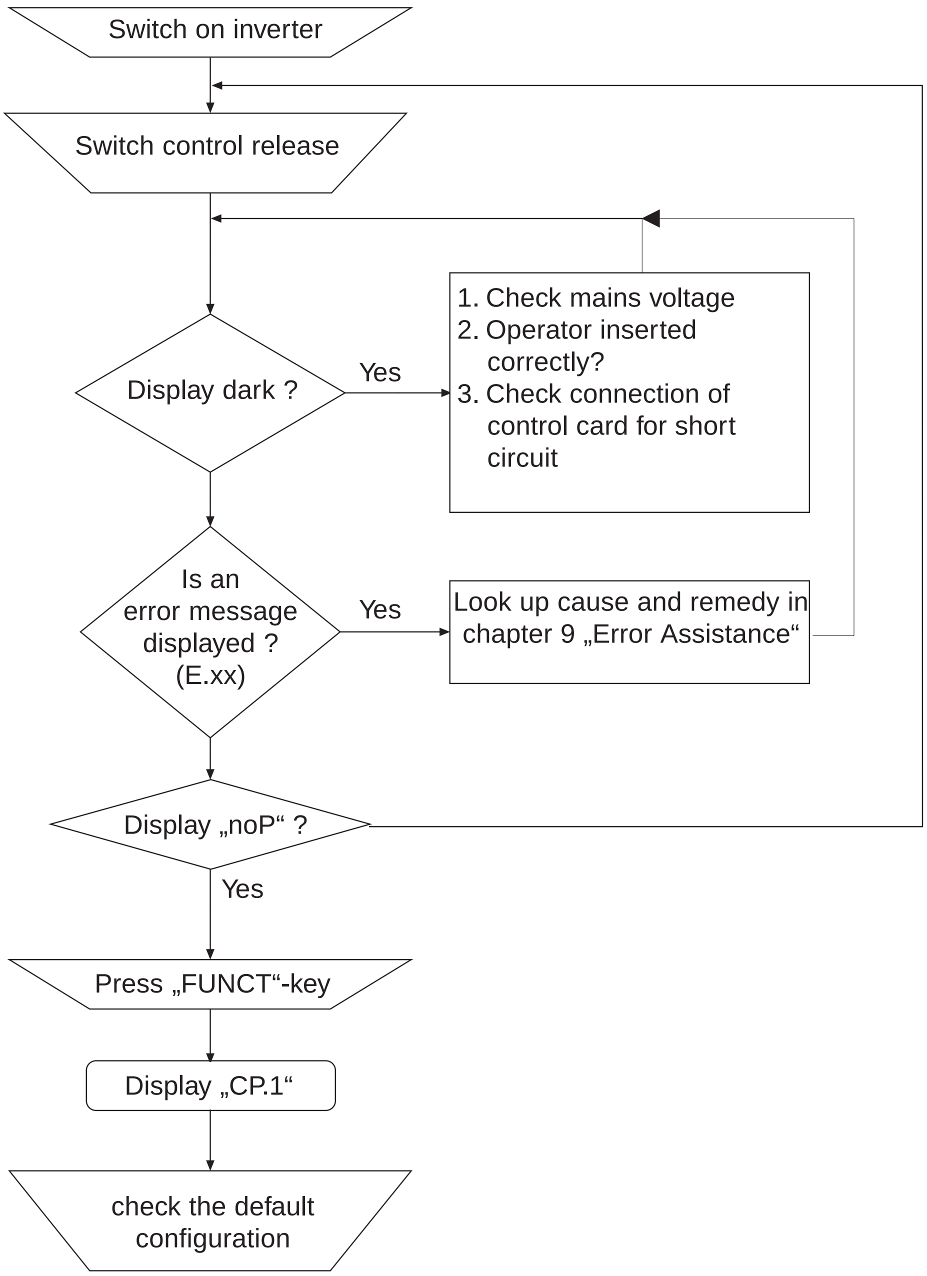
7.2 Initial Start-up

After all preparatory measures have been carried out the KEB COMBIVERT F5 can be switched on.

7.2.1 Switching on of KEB COMBIVERT

The sequence of the switch-on procedure as shown below refers to supplied units with factory setting. Because of the multitude of programs we cannot take into consideration customer-specific adjustments.

Picture 7.2.1 Swtich on of KEB COMBIVERT



7.2.2 Basic Settings in the CP-Mode

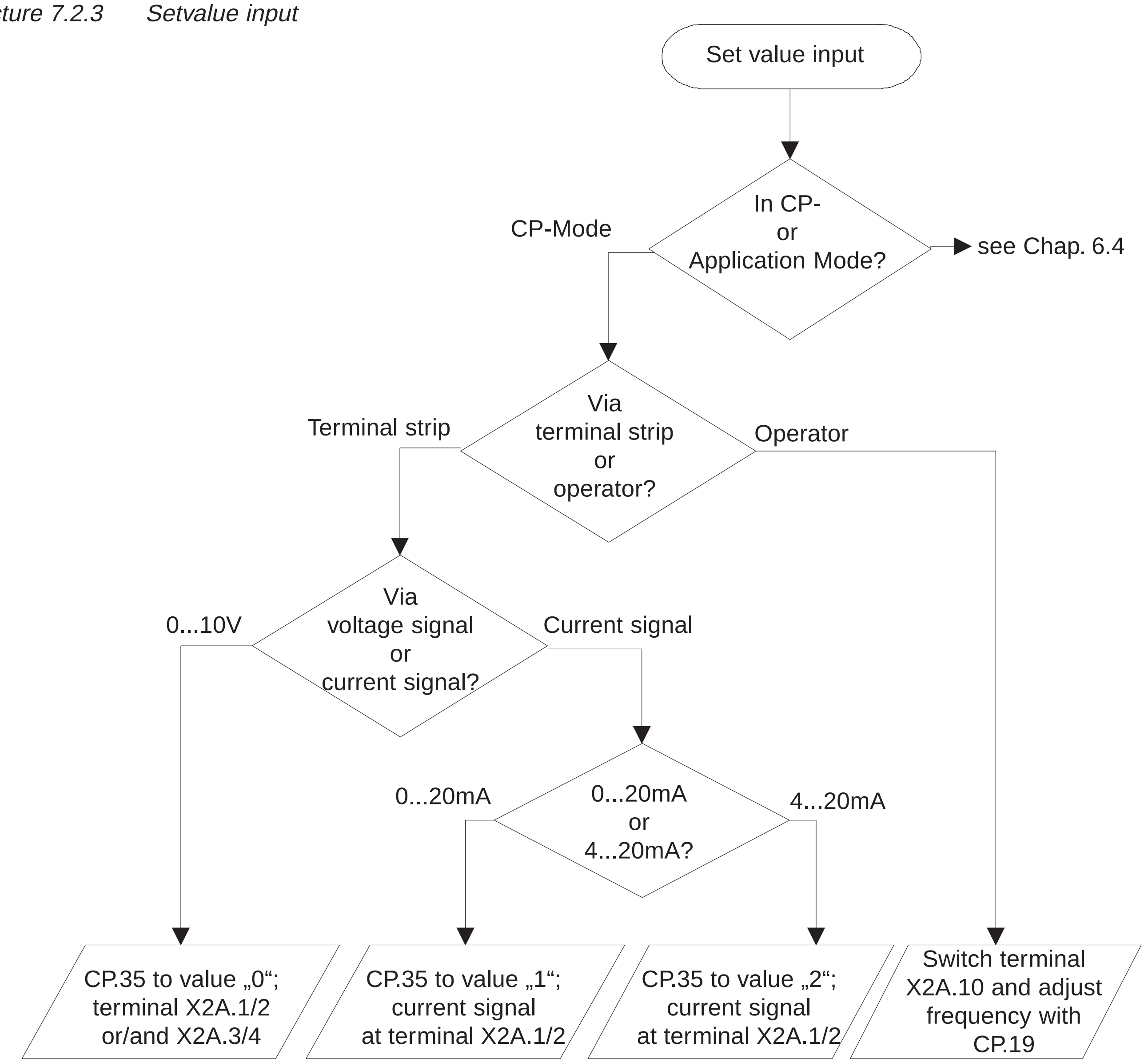
After switch-on with factory setting the inverter is in the CP-Mode. The preadjusted values can be used for 90 % of all applications at the initial start-up. However, the following parameters should be checked and, if necessary, adjusted.

- ☑ Corner frequency CP.16
- ☑ Minimum and maximum frequency CP.10/CP.11
- ☑ Acceleration and decelerationtimes CP.12/CP.13
- ☑ Boost CP.15
- ☑ Activation of the Motor PTC detection, if a PTC is attached

7.2.3 Set value selection

After the basic settings have been made, it must now be determined how the set value input is done.

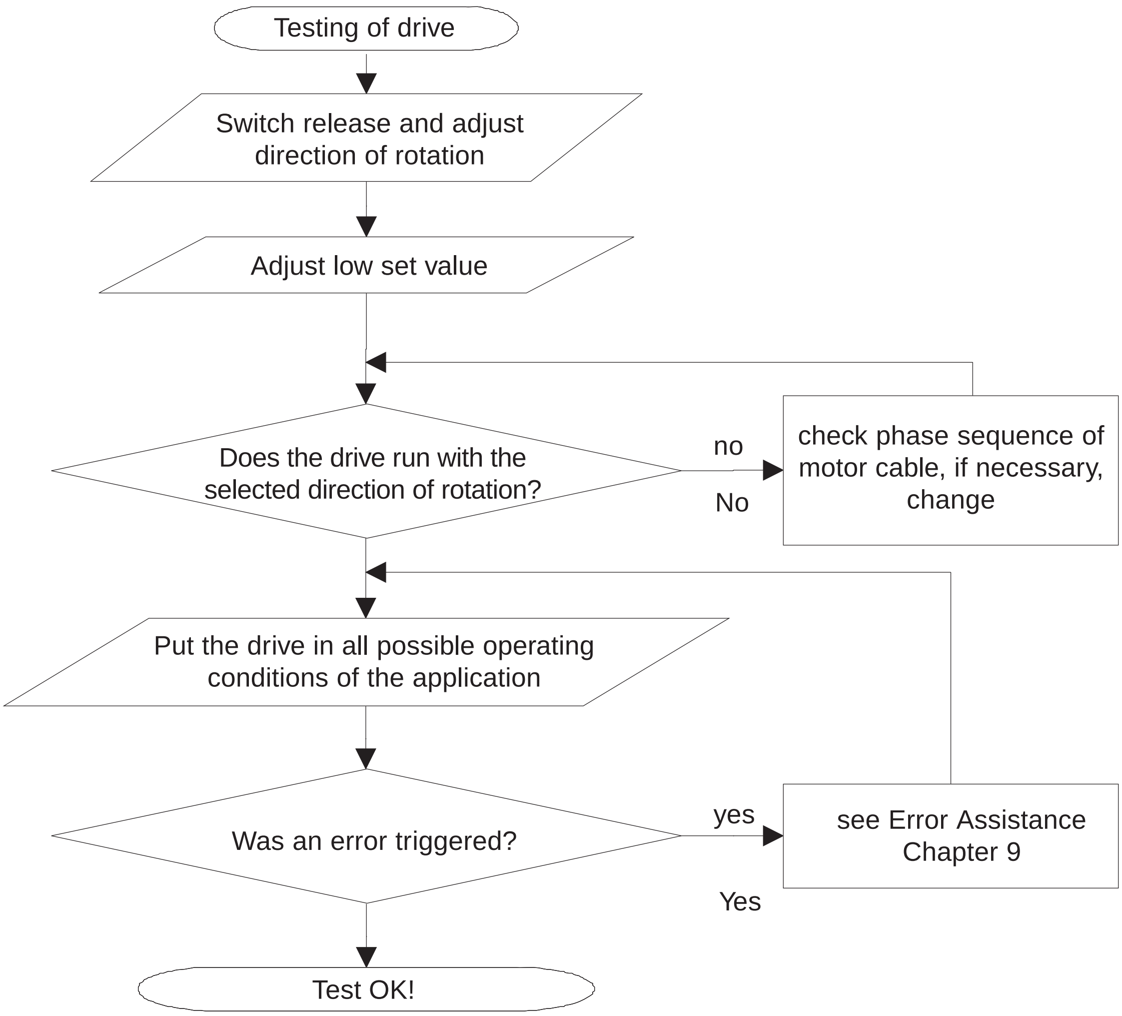
Picture 7.2.3 Setvalue input



7.2.4 Testing of Drive

For the drive to always allow a save controlling through the inverter, carry out the following test under the most adverse operating conditions.

Picture 7.2.4 Testing of drive



8. Special Operations

8.1 Temperature Control

This function serves only as temperature control for watercooled inverters. The water cooling system can be switched on with a pneumatic or solenoid valve.To avoid pressure surges, the valves for a temperature control must be inserted before the cooling circuit. All usual valves can be used. Depending on the used valve the switching electronics must be provided by the customer. The control occurs via the analog outputs 3 and 4 and the flags, which are assigned to the digital outputs. Two functions must be programmed, because the temperature ranges of the inverter and the motor are different. **Attention! Do not use relay outputl**

8.1.1 Parameter Description

Function (An.41, An.47)

The respective functions are adjusted with these parameters (temperature control of the power controller or the motor).

Period (An.46, An.52)

The period determines the cycle time in which the output is switched. The period can be adjusted in a range from 1,0...240,0 s.

Offset X (An.44, An.50)

The heat sink temperature which shall be controlled is entered with Offset. The temperature is in a range from 30 °C...50°C for inverters (heat sink temperature/ see power unit data) and in a range from 40°C ...80°C for motors. The adjustment occurs in percentual values (1% = 1°C).

Gain (An.43, An.49)

The gain determines the max.temperature. The adjustment occurs via a factor and is calculated as follows.

Max. temperature [°C] = An.44 + (100% / An.43)

Example

Adjustments for the Controller

An.41 = 12 :	Power stage temperature
An.44 = 30 %	Beginning of the temperature control
An.43 = 5,00	Gain for the max. temperature, see formula above
An.46 = 20 s	Period (cycle time)
do.06 = 42 :	ANOUT3 PWM, switching condition 6
do.22 = 64 :	Selection for flag 6
do.33 = 64 :	Selection and assignment of the output terminal

The switching period T_{an} of the output is calculated by the following formula if the heat sink temperature is within the adjusted temperature range.

$$T_{an} = \frac{\text{(Max. temp.-setpoint temp.)+(heat sink temp.-setpoint temp.)}}{\text{max. temp.-min.temp.}} \cdot \text{Period}$$

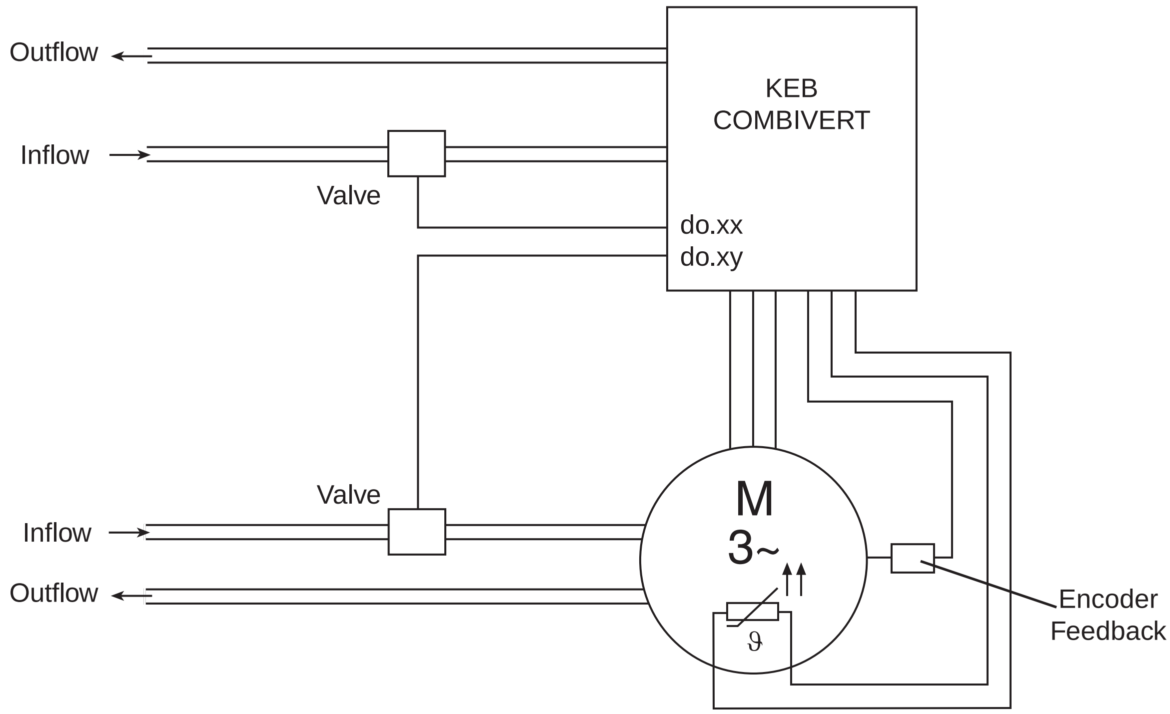
8.1.2 Possibilities for a Temperature Control

There are two possibilities for a temperature control:

a.) with temperature monitoring in the motor
b.) without temperature monitoring in the motor

a.) Temperature Control with Temperature Monitoring in the Motor

In this case inverter and motor possess independent cooling circuits. Two programmable outputs of the control card are required for a control of the valve. (see the following fig.).



b.) Temperature Control without Temperature Monitoring in the Motor

In this case the motor is without temperature monitoring. The motor can be permanently supplied with coolant or the motor can be integrated in the cooling circuit of the inverter.

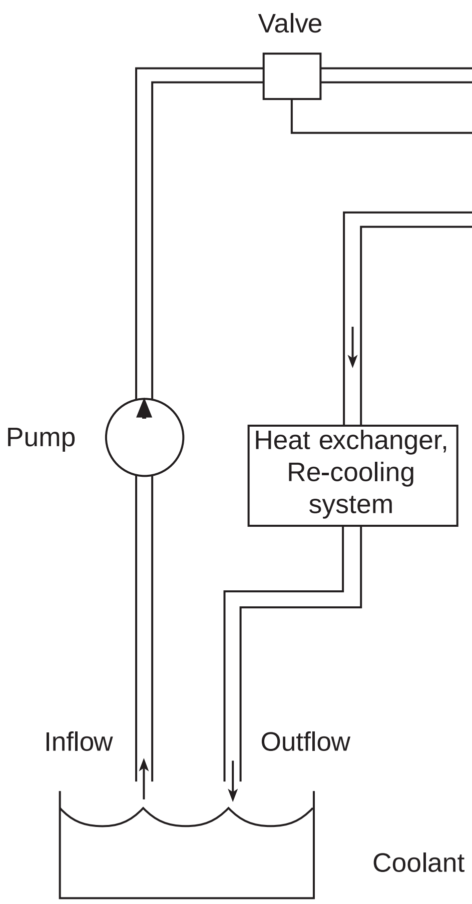
8.1.3 Connection to the Cooling System

The connection to the coolant must be done with flexible pressure-proof tubes and it must be secured with clips. (note flow direction and check tightness!) The connection to the cooling system is done via 1/2 inch secrewed glands . (Whitworth-pipe thread of DIN ISO 228-1).

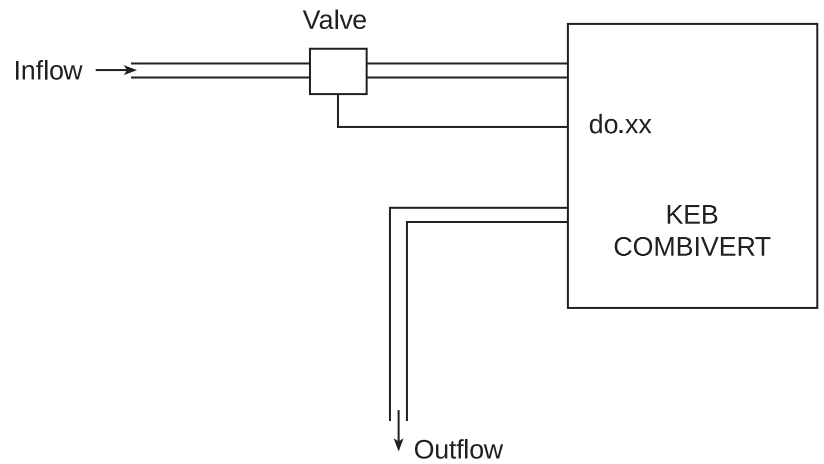
The connection to the cooling system can occur as closed or opened cooling circuit. It is dependent on the local circumstances and it is preset by the mechanical engineer.

closed cooling circuit

In case of a closed cooling circuit the outflow coolant is cooled down by a heat exchanger or by a re-cooling system and refeed back into the cooling cicuit.



open cooling circuit In this case new coolant is constant given in and directly given out.



8.1.4 Inverter Protection Function „Overheat“

Dependent on the power unit and overload capacity the inverter Off-temperatures are 60 ° C, 73 ° C or 90 ° C. To ensure a safe operation the coolant output temperature must be 10 K under "Overheat"- function.

8.1.5 Information about Water Cooling

In continuous operation water-cooled inverters are operated with lower temperature than air-cooled inverters.This has positive effects on the lifetime of the components like fan and DC link capacitors. Also the temperature dependent switching losses are positively effected.

Materials

The machined aluminium heat sinks are sealed with sealing rings and by bonding, dismountable (screwed) and they have a surface protection in the channels (anodized). As standard the heat sinks are maintenance-free!

Cooling Water Quality

There are no special requirements for the coolant.The VGB-cooling water instructions must be observed for a safety operation. The coolant must be free of acid, abrasive materials and pressure surges and it shall not be aggressive to the material. Measures against pollution and calcination must be done externally, if neccessary with a filter.

The main impurities and most usual procedures for eliminating them are:

Pollution of the water	Process
Mechanical impurities	Filtration of water via - sieving filter - sand filter - cartridge filter - precoated filter
Excessive hardness	Softening of the water by ion exchange
Moderate content of mechanical impurities and hardness formers	Injection of stabilisers or dispersants into the water
Moderate content of chemical impurities	Injection of passivators and/or inhibitors into the water
Biological impurities myxobacteria and algae	Injection of biocides into the water

Temperature and Operating Pressure

The temperature shall be max. 40°C. Select a long cycle time in An.46 or An.52 to avoid moisture condensation (see chapter 8.1.1). During transport or storage below freezing point, the water cycle should be drained completely using compressed air. The max. operating pressure of the cooling system shall not exceed 6 bar (special versions with higher pressures are available).

8.1.6 Operation Example

Selection of a COMBIVIS parameter list:

Adjustments of the Temperature Closed-Loop Control

An.41	ANOUT 3 Function	12 : Power stage temperature (ru.38)
An.44	ANOUT 3 Offset	30 %
An.43	ANOUT 3 Gain	5,00
An.46	ANOUT 3 Period	20 s
do.06	Switching Condition SB 6	42 : ANOUT3 PWM
do.22	Selection of SB for Flag 6	64 : SB6
do.33	Selection of Flag for O1	64 : M6

Adjustments of the Motor-Temperature Closed-Loop Control

An.47	ANOUT 4 Function	13 : Motor Temperature (ru.46)
An.50	ANOUT 4 Offset	40 %
An.49	ANOUT 4 Gain	2,50
An.52	ANOUT 4 Period	20 s
do.07	Switching Condition SB 7	43 : ANOUT4 PWM
do.23	Selection SB for Flag 7	128 : SB7
do.34	Selection of Flag for O2	128 : M7

do.00	Switching Condition SB 0	3: Ready for Operation
do.16	Selection of SB for Flag 0	1: SB0
do.35	Selection of Flag for O2	1: M0

Pre-Warning Adjustments

do.01	Selection of SB 1	7: Pre-Warning Overload
do.02	Selection of SB 2	8: Pre-Warning Power Stage Overheat
do.03	Selection of SB 3	9: Pre-Warning Motor Overheat
do.04	Selection of SB 4	11: Warning internal Overheat
do.05	Selection of SB 5	0: alway switched-off
do.17	Selcetion of SB for Flag 1	62: SB1+SB2+SB3+SB4+SB5
do.28	Inverted Flag for R2	2: M1
do.36	Selection of Flag for R2	2: M1

For future informations please contact KEB.

9. Error Assistance

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.

9.1 Troubleshooting

9.1.1 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.

9.1.2 Error Messages and their Cause

At KEB COMBIVERT **error messages** are always represented with an „E.“ and the appropriate error in the display. Error messages cause the immediate deactivation of the modulation. Restart possible only after reset.
Malfunction are represented with an „A.“ and the appropriate message. Reactions to malfunctions can vary.
Status messages have no addition. The status message shows the current operating status of the inverter (e.g. forward constant run, standstill etc.).
In the following the display and their cause are described.

Display	COMBIVIS **Status Messages**	Value	Meaning
bbL	base block	76	Power modules for motor de-excitation locked
bon	close brake	85	Brake control, brake engaged (see chapter 6.9)
boFF	open brake	86	Brake control, brake released (see chapter 6.9)
Cdd	calculate drive	82	Measurement of the motor stator resistance
dcb	DC brake	75	Motor is decelerated by a DC-voltage at the output.
dLS	low speed / DC brake	77	Modulation is switched off after DC-braking (see chapter 6.9 „DC-Braking“).
FAcc	forward acceleration	64	Acceleration with the adjusted ramps in clockwise direction of rotation.
Fcon	forward constant	66	Acceleration / deceleration phase is completed and it is driven with constant speed / frequency in clockwise direction of rotation.
FdEc	forward deceleration	65	It is stopped with the adjusted ramp times in clockwise direction of rotation.
HCL	hardware current limit	80	The message is output if the output current reaches the hardware current limit.

Display	COMBIVIS	Value	Meaning
IdAtA	invalid Data	-	The parameter address adjusted for this parameter value is invalid.
LAS	LA stop	72	This message is displayed if during acceleration the load is limited to the adjusted load level.
LdS	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.
LS	low speed	70	No direction of rotation pre-set, modulation is off.
nO_PU	power unit not ready	13	Power circuit not ready or not identified by the control.
noP	no operation	0	Control release (terminal ST) is not switched.
PA	positioning active	122	This message is displayed during a positioning process.
PLS	low speed / power off	84	No modulation after Power-Off
PnA	position not reachable	123	The specified position cannot be reached within the pre-set ramps. The abort of the positioning can be programmed.
POFF	power off function	78	Depending on the programming of the function (see chapter 6.9 „Power-off Function“) the inverter restarts automatically upon system recovery or after a reset.
POSI	positioning	83	Positioning function active (F5-G).
rAcc	reverse acceleration	67	Acceleration with the adjusted ramp times in anti-clockwise direction of rotation.
rcon	reverse constant	69	The acceleration / deceleration phase is completed and it is driven with constant speed / frequency in anti-clockwise direction of rotation.
rdEc	reverse deceleration	68	It is stopped with the adjusted ramp times in anti-clockwise direction of rotation.
rFP	ready for positioning	121	The drive signals that it is ready to start the positioning process.
SLL	stall	71	This message is displayed if during constant operation the load is limited to the adjusted current limit.
SrA	search for ref. active	81	Search for reference point approach active.
SSF	speed search	74	Speed search function active, that means that the inverter attempts to synchronize onto a running down motor.
StOP	quick stop	79	The message is output if as response to a warning signal the quick-stop function becomes active.
	Error Messages		
E. br	ERROR brake	56	Error: This error can occur in the case of switched on brake control (see Chapter 6.9.5), if • the load is below the minimum load level (Pn.43) at start up or the absence of an engine phase was detected. • the load is too high and the hardware current limit is reached
E.buS	ERROR bus	18	Error: Adjusted monitoring time (Watchdog) of communication between operator and PC / operator and inverter has been exceeded.
E.Cdd	ERROR calc. drive data	60	Error: During the automatic motor stator resistance measurement.
E.co1	ERROR counter overrun 1	54	Counter overflow encoder channel 1

Display	COMBIVIS	Value	Meaning
E.co2	ERROR counter overrun 2	55	Counter overflow encoder channel 2
E.dOH	ERROR drive overheat	9	Error: Overtemperature of motor PTC. Error can only be reset at E.ndOH, if PTC is again low-resistance. Causes: • resistance at the terminals T1/T2 >1650 Ohm • motor overloaded • line breakage to the temperature sensor
E.dri	ERROR driver relay	51	Error: Driver relay. Relay for driver voltage on power circuit has not picked up even though control release was given.
E.EEP	ERROR EEPROM defective t	21	After reset the operation is again possible (without storage in the EEPROM)
E. EF	ERROR external fault	31	Error: External error. Is triggered, if a digital input is being programmed as external error input and trips.
E.EnC1	Error! Encoder 1	32	Cable breakage of encoder at encoder interface 1 Encoder temperature is too high Speed is too high Encoder signals are out of specification Encoder has an internal error
E.EnC2	Error! Encoder 2	34	Cable breakage of encoder at encoder interface 2 Encoder temperature is too high Speed is too high Encoder signals are out of specification Encoder has an internal error
E.EnCC	Error! Encoder change	35	Operation of a synchronous motor with intelligent interface: • Encoder is not connected during the start • Encoder was changed The error can be reset by writing on ec.0.
E.Hyb	ERROR hybrid	52	Invalid encoder interface identifier
E.HybC	ERROR hybrid changed	59	Error: Encoder interface identifier has changed, it must be confirmed over ec.0 or ec.10.
E.iEd	ERROR input error detect	53	Error at PNP/NPN switching or input failure.
E.InI	ERROR initialisation MFC	57	MFC not booted.
E.LSF	ERROR load shunt fault	15	Error: 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
E.ndOH	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.
E.nOH	no E. over heat pow.mod.	36	Temperature of the heat sink is again in the permissible operating range. The error can be reset now.
E.nOHI	no ERROR overheat int.	7	No longer overheating in the interior E.OHI, interior temperature has fallen by at least 3°C

Display	COMBIVIS	Value	Meaning
E.nOL	no ERROR overload	17	No more overload, OL-counter has reached 0%; after the error E. OL a cooling phase must elapse. This message appears upon completion of the cooling phase. The error can be reset. The inverter must remain switched on during the cooling phase.
E.nOL2	no ERROR overload 2	20	The cooling time has elapsed. The error can be reset.
E. OC	ERROR overcurrent	4	Error: Overcurrent Occurs, if the specified peak current is exceeded. Causes: • acceleration ramps too short • the load is too big at turned off acceleration stop and turned off constant current limit • short-circuit at the output • ground fault • deceleration ramp too short • motor cable too long • EMC • DC brake at high ratings active (see 6.9.3)
E. OH	ERROR overheat pow.mod.	8	Error: Overtemperature of power module. Error can only be reset at E.nOH. Causes: • insufficient air flow at the heat sink (soiled) • ambient temperature too high • ventilator clogged
E.OH2	ERROR motor protection	30	Electronic motor protective relay has tripped.
E.OHI	ERROR overheat internal	6	Error: Overheating in the interior: error can only be reset at E.nOHI, if the interior temperature has dropped by at least 3°C
E. OL	ERROR overload (Ixt)	16	Error: Overload error can only be reset at E.nOL, if OL-counter reaches 0% again. Occurs, if an excessive load is applied longer than for the permissible time (see technical data). Causes: • poor control adjustment (overshooting) • mechanical fault or overload in the application • inverter not correctly dimensioned • motor wrongly wired • encoder damaged
E.OL2	ERROR overload 2	19	Occurs if the standstill constant current is exceeded (see technical data and overload characteristics). The error can only be reset if the cooling time has elapsed and E.nOL2 is displayed.
E. OP	Error! Overvoltage	1	Voltage in the DC-link circuit too high. Occurs if the DC-link circuit voltage exceeds the permissible value. Causes: • poor controller adjustment (overshooting) • input voltage too high • interference voltages at the input • deceleration ramp too short • braking resistor defective or too small
E.OS	ERROR over speed	58	Real speed is bigger than the max. Output speed.
E.PFC	ERROR Power factor control	33	Error in the power factor control

Display	COMBIVIS	Value	Meaning
E.PrF	ERROR prot. rot. for.	46	The drive has driven onto the right limit switch. Programmed response “Error, restart after reset” (see chapter 6.7 “Response to errors or warning messages”).
E.Prr	ERROR prot. rot. rev.	47	The drive has driven onto the left limit switch. Programmed response “Error, restart after reset” (see chapter 6.7 “Response to errors or warning messages”).
E. Pu	ERROR power unit	12	Error: General power circuit fault
E.Puci	ERROR pow. unit code inv.	49	Error: During the initialization the power circuit could not be recognized or was identified as invalid.
E.Puch	ERROR power unit changed	50	Error: Power circuit identification was changed; with a valid power circuit this error can be reset by writing to SY.3. If the value displayed in SY.3 is written, only the power-circuit dependent parameters are reinitialized. If any other value is written, then the default set is loaded. On some systems after writing Sy.3 a Power-On-Reset is necessary.
E.PUCO	ERROR power unit commun.	22	Error: Parameter value could not be written to the power circuit. Acknowledgement from PC <> OK
E.PUIN	ERROR power unit invalid	14	Error: Software version for power circuit and control card are different. Error cannot be reset (only at F5-G B-housing)
E.SbuS	ERROR bus synchron	23	Sychronization over sercos-bus not possible. Programmed response “Error, restart after reset” (see chapter 6.7 “Response to errors or warning messages”).
E.SEt	ERROR set	39	It has been attempted to select a locked parameter set. Programmed response “Error, restart after reset” (see chapter 6.7 “Response to errors or warning messages”).
E.SLF	ERROR! Software limit switch forward	44	The target position lies outside of the limit defined with the right software limit switch.Programmed response “Error, restart after reset” (see chapter 6.7 “Response to errors or warning messages”).
E.SLr	ERROR software limit switch reverse	45	The target position lies outside of the limit defined with the left software limit switch. Programmed response “Error, restart after reset” (see chapter 6.7 “Response to errors or warning messages”).
E. UP	ERROR underpotential	2	Error: Undervoltage (DC-link circuit). Occurs, if DC-link voltage falls below the permissible value. Causes: • input voltage too low or instable • inverter rating too small • voltage losses through wrong cabling • the supply voltage through generator / transformer breaks down at very short ramps • At F5-G housing B E.UP is also displayed if no communication takes place between power circuit and control card. • Jump factor (Pn.56) too small (see 6.9.20) • if a digital input was programmed as external error input with error message E.UP (Pn.65).
E.UPh	ERROR Phase failure	3	One phase of the input voltage is missing (ripple-detection)
	Warning Messages		

Display	COMBIVIS	Value	Meaning
A.buS	ABN.STOP bus	93	Warning: Watchdog for communication between operator/ control card or operator/PC has responded. The response to this warning can be programmed (see chapter 6.7 “Response to errors and warning messages”).
A.dOH	ABN.STOP drive over heat	96	The motor temperature has exceeded an adjustable warning level. The switch off time is started. The response to this warning can be programmed (see chapter 6.7 “Response to errors or warning messages”). This warning can be generated only with a special power circuit.
A. EF	ABN.STOP external fault	90	This warning is triggered via an external input. The response to this warning can be programmed (see chapter 6.7 “Response to errors or warning messages”).
A.ndOH	no A. drive overheat	91	The motor temperature is again below the adjusted warning level. The switch off time is stopped.
A.nOH	no A. overheat pow.mod.	88	The heat sink temperature is again below the adjusted warning level.
A.nOHI	no A.STOP overheat int.	92	The temperature in the interior of the inverter is again below the warning threshold.
A.nOL	no ABN.STOP overload	98	Warning: no more overload, OL counter has reached 0 %.
A.nOL2	no ABN.STOP overload 2	101	The cooling time after “Warning! Overload during standstill” has elapsed. The warning message can be reset.
A. OH	A.STOP overheat pow.mod	89	A level can be defined, when it is exceeded this warning is output. A response to this warning can be programmed (see chapter 6.7 “Response to errors or warning messages”).
A.OH2	ABN.STOP motor protect.	97	Warning: electronic motor protective relay has tripped. The response to this warning can be programmed (see chapter 6.7 “Response to error or warning messages”).
A.OHI	ABN.STOP overheat int.	87	The temperature in the interior of the inverter lies above the permissible level. The switch off time was started. The programmed response to this warning message is executed (see chapter 6.7 “Response to errors or warning messages”).
A. OL	ABN.STOP overload	99	A level between 0 and 100 % of the load counter can be adjusted, when it is exceeded this warning is output. The response to this warning can be programmed (see chapter 6.7 “Response to errors or warning messages”).
A.OL2	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 (see chapter 6.7 “Response to errors and warning messages”). The warning message can only be reset after the cooling time has elapsed and A.nOL2 is displayed.
A.PrF	ABN.STOP prot. rot. for.	94	The drive is driven onto the right limit switch. The response to this warning can be programmed (see chapter 6.7 “Response to errors and warning messages”).
A.Prr	ABN.STOP prot. rot. rev.	95	The drive is driven onto the left limit switch. The response to this warning can be programmed (see chapter 6.7 “Response to errors and warning messages”).

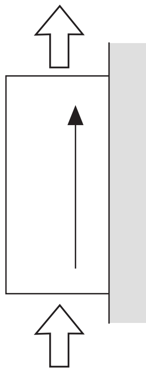
Display	COMBIVIS	Value	Meaning
A.SbuS	ABN.Bus synchron	103	Synchronization over sercos-bus not possible. The response to this warning can be programmed (see chapter 6.7 “Response to errors and warning messages”).
A.SEt	ABN.STOP set	102	Warning: set selection: It has been attempted to select a locked parameter set. The response to this warning can be programmed (see chapter 6.7 “Response to errors or warning messages”).
A.SLF	ABN.Software limit switch forward	104	The target position lies outside of the limit defined with the right software limit switch. The response to this warning can be programmed (see chapter 6.7 “Response to errors or warning messages”).
A.SLr	ABN.Software limit switch reverse	105	The target position lies outside of the limit defined with the left software limit switch. The response to this warning can be programmed (see chapter 6.7 “Response to errors or warning messages”).

10. Project design

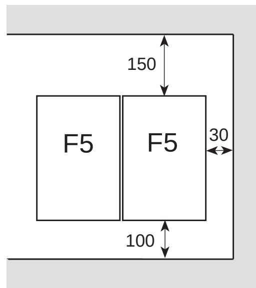
The following chapter shall assist you in the planning stage of applications.

10.1 General Designs

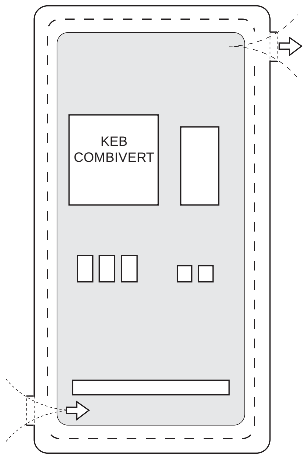
10.1.1 Control Cabinet Design Calculation

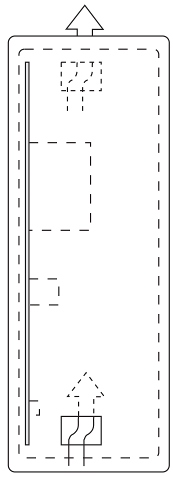


Direction of cooling fins



Minimum distances





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Control cabinet surface

Calculation of control cabinet surface:

$$A = \frac{P_V}{DT \cdot K} \; [m^2]$$

Air flow rate with fan cooling:

$$V = \frac{3{,}1 \cdot P_V}{DT} \; [m^3/h]$$

A	=	Control cabinet surface	[m^2]
DT	=	temperature differential (standard value = 20 K)	[K]
K	=	coefficient of heat transmission (standard value = $5 \frac{W}{m^2 \cdot K}$)	[$\frac{W}{m^2 \cdot K}$]
P_V	=	power loss (see technical data)	
V	=	air flow rate of fan	

For more details please refer to the catalogs of the control cabinet manufacturers.

10.1.2 Design of Braking Resistors

The KEB COMBIVERT fitted with an external braking resistor or an external braking option is suitable for a limited 4-quadrant operation. The braking energy, refeed into the DC-bus at generatoric operation, is dissipated over the braking transistor to the braking resistor.
The braking resistor heats up during the braking process. If it is installed in a control cabinet sufficient cooling of the control cabinet interior and sufficient distance to the KEB COMBIVERT must be observed.

Different braking resistors are available for the KEB COMBIVERT. Please refer to the next page for the corresponding formula and restrictions (valid range).

1. Preset desired braking time.

2. Calculate braking time without braking resistor (t_{Bmin}).

3. If the desired braking time shall be smaller than the calculated time, it is necessary to use a braking resistor. ($t_B < t_{Bmin}$)

4. Calculate braking torque (M_B). Take the load torque into account at the calculation.

5. Calculate peak braking power (P_B). The peak braking power must always be calculated for the worst case (n_{max} to standstill).

6. Selection of braking resistor:
   a) $P_R \geq P_B$
   b) P_N is to be selected according to the cycle time(ED).
   The braking resistors may be used only for the listed unit sizes. The maximum cyclic duration of a braking resistor shall not be exceeded.

6 % ED =	maximum braking time	8 s
25 % ED =	maximum braking time	30 s
40 % ED =	maximum braking time	48 s

   For a longer cyclic duration time special designed braking resistors are necessary. The continuous output of the braking transistor must be taken into consideration.

7. Check, whether the desired braking time is attained with the braking resistor (t_{Bmin}).

   Restriction: Under consideration of the rating of the braking resistor and the brake power of the motor, the braking torque may not exceed 1,5times of the rating torque of the motor (see formula).
   When utilizing the maximum possible braking torque the frequency inverter must be dimensioned for the higher current.

Braking time DEC

The braking time ***DEC*** is adjusted at the frequency inverter. If it is chosen too small the KEB COMBIVERT switches off automatically and the error message ***OP*** or ***OC*** appears. The approximate braking time can be determined according to following formula.

Formula

1. Braking time without braking resistor

$$t_{Bmin} = \frac{(J_M + J_L) \bullet (n_1 - n_2)}{9{,}55 \bullet (K \bullet M_N + M_L)}$$

Valid range: $n_1 > n_N$

(Field weakening range)

2. Braking torque (necessary)

$$M_B = \frac{(J_M + J_L) \bullet (n_1 - n_2)}{9{,}55 \bullet t_B} - M_L$$

Condition: $M_B \leq 1.5 \bullet M_N$

$f \leq 70$ Hz

3. Peak braking power

$$P_B = \frac{M_B \bullet n_1}{9{,}55}$$

Condition: $P_B \leq P_R$

4. Braking time with braking resistor

$$t_{Bmin}{*} = \frac{(J_M + J_L) \bullet (n_1 - n_2)}{9{,}55 \bullet \left(K \bullet M_N + M_L + \frac{P_R \bullet 9{,}55}{(n_1 - n_2)}\right)}$$

Valid range: $n_1 > n_N$

Condition: $\frac{P_R \bullet 9{,}55}{(n_1 - n_2)} \leq M_N \bullet (1{,}5 - K)$

$f \leq 70$ Hz

$P_B \leq P_R$

K = 0,25 for motors upto 1,5 kW
0,20 for motors 2,2 upto 4 kW
0,15 for motors 5,5 upto 11 kW
0,08 for motors 15 upto 45 kW
0,05 for motors > 45 kW

J_M	=	mass moment of inertia motor	[kgm²]
J_L	=	mass moment of inertia load	[kgm²]
n_1	=	motor speed prior to deceleration	[rpm]
n_2	=	motor speed after deceleration (standstill = 0 rpm)	[rpm]
n_N	=	rated motor speed	[rpm]
M_N	=	rated motor torque	[Nm]
M_B	=	braking torque (necessary)	[Nm]
M_L	=	load torque	[Nm]
t_B	=	braking torque (necessary)	[s]
t_{Bmin}	=	minimum braking time	[s]
t_Z	=	cycle time	[s]
P_B	=	peak braking power	[W]
P_R	=	peak power of braking resistor	[W]

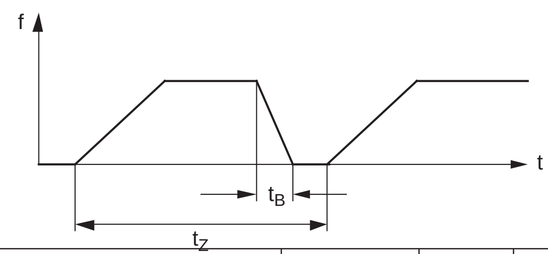
Cyclic duration factor (cdf)

Cyclic duration factor for cycle time $t_Z \leq 120$ s

$$ED = \frac{t_B}{t_Z} \bullet 100\ \%$$

Cyclic duration factor for cycle time $t_Z > 120$ s

$$ED = \frac{t_B}{120\ s} \bullet 100\ \%$$



10.1.3 Cables and fuses

By means of this section you can check whether you can still optimize your machine with regard to the material usage. The specifications are derived for the DIN VDE 0298 Part 4. The values apply approximately and only for the intended operation. In marginal cases it must be always proceed according to the standard described obove. The following table shows the current capability of 3 and/or 5 core PVC cables (i.e. 2 and/or 3 loaded cores) in dependence with the ambient temperature. The current is to be laid out to the input current of the frequency inverter.

Querschnitt der Zuleitung		Strom in [A] bei			
Standard	Alternativ	30°C	40°C	45°C	50°C
0,5 mm²	-	7	6	6	5
0,75 mm²	-	12	10	10	9
1 mm²	-	15	13	13	11
1,5 mm²	-	18	16	15	13
2,5 mm²	-	26	23	22	18
4 mm²	2 x 1,5 mm²	34	30	29	24
6 mm²	2 x 2,5 mm²	44	38	37	31
10 mm²	2 x 4 mm²	61	53	51	43
16 mm²	2 x 6 mm²	82	71	69	58
25 mm²	2 x 10 mm²	108	94	91	77
35 mm²	2 x 16 mm²	135	117	113	96
50 mm²	2 x 16 mm²	168	146	141	119
70 mm²	2 x 25 mm²	207	180	174	147
95 mm²	2 x 35 mm²	250	218	210	178
120 mm²	2 x 50 mm²	292	254	245	207
150 mm²	2 x 50 mm²	330	287	277	234
185 mm²	2 x 70 mm²	394	343	331	280
240 mm²	2 x 95 mm²	450	392	378	320
300 mm²	2 x 95 mm²	507	441	426	360
400 mm²	2 x 150 mm²	661	575	555	469
500 mm²	2 x 185 mm²	774	673	650	550

The use of special cables or the way of laying the cables allows even higher currents (see DIN VDE 0298 Part 4). The motor cable must correspond to the cross-section of the mains cable.
If in case of long lines (>30m) still maximum torque is required at the motor shaft, the cable should be dimensioned for the next larger cross-section in order to reduce line resistances.

Mains fuses are to be designed for the rated input current of the inverter. The current/ time-characteristic of the fuse must be slow-acting in order to avoid premature tripping when utilizing the power reserves of the inverter.

11. Networks

The KEB COMBIVERT F5 can be easily integrated into different networks. For that purpose the inverter is fitted with an operator that is appropriate for the respective bus system. Following hardware components are available:

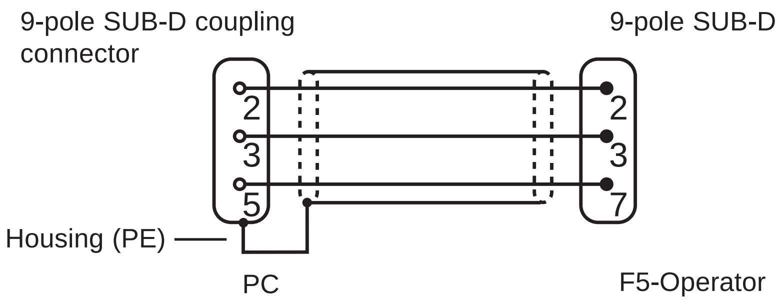
11.1 Network Components

11.1.1 Available Hardware

- **RS232-Cable PC/Operator** **Part No.: 00.58.025-001D**
  for operation with interface operator
- **HSP5-Adaptor PC/Control board** **Part No.: 00.F5.0C0-0001**
  for operation without operator; RS232 => TTL
- **F5 Interface-Operator** **Part No.: 00.F5.060-2000**
  serial networks in RS232 or RS485-standard
- **F5 Profibus-DP-Operator** **Part No.: 00.F5.060-3000**
- **F5 InterBus-Operator** **Part No.: 00.F5.060-4000**
- **InterBus-Remote bus interface connection** **Part No.: 00.B0.0BK-K001**
  (in connection with Interface-Operator)
- **F5 CanOpen-Operator** **Part No.: 00.F5.060-5000**
- **F5 Sercos-Operator** **Part No.: 00.F5.060-6000**

11.1.2 RS232-Cable PC / Operator 00.58.025-001D

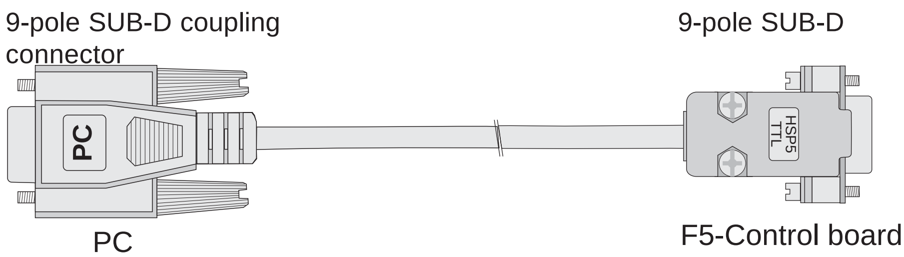
The cable of 3m length is used for the direct RS232-connection between PC (9-pole SUB-D-connector) and operator.



! The RS232-cable is suitable exclusively for the communication between PC and Operator. If the cable is plugged in directly onto the control board, it can lead to the desctruction of the interface of the PC.

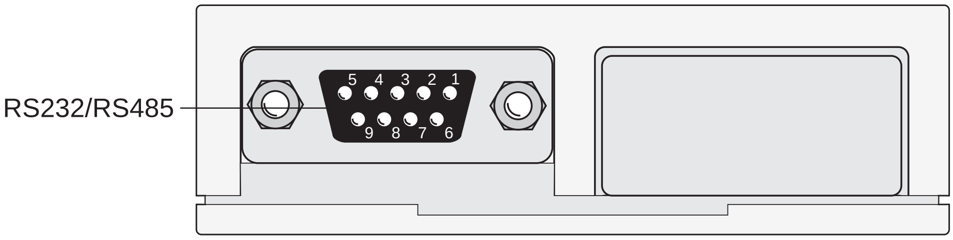
11.1.3 HSP5-Cable / Control Board 00.F5.0C0-0001

The HSP5-cable is used for the direct connection between PC and control board. The necessary conversion to TTL-level occurs in the cable.



11.1.4 Interface Operator F5 00.F5.060-2000

A potential-separated RS232/RS484 interface is integrated in the interface operator (00.F5.060-2000).The telegram structure is compatible to protocol DIN 66019 and ANSI X3.28 as well as to protocol expansion DIN 66019 II.



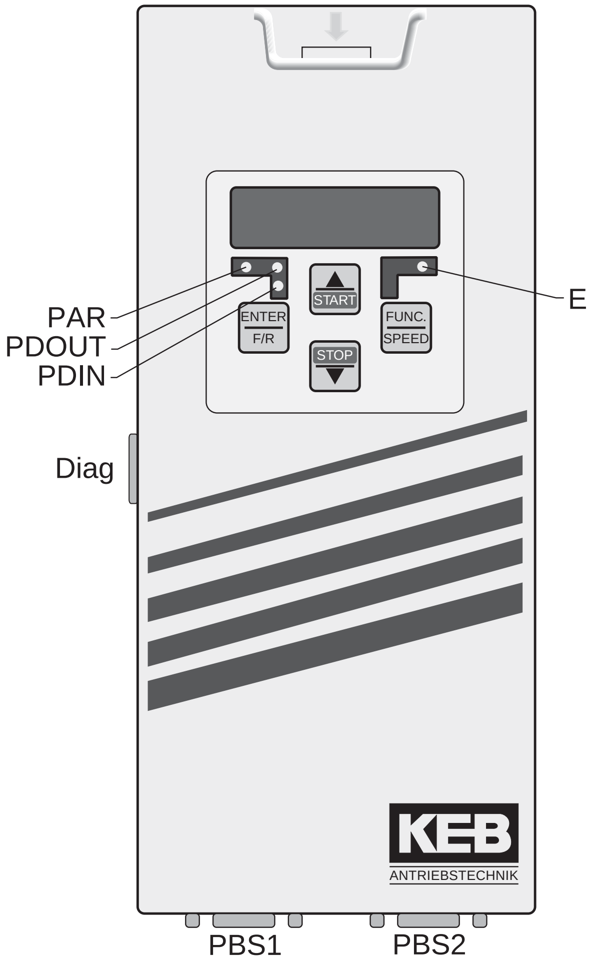
PIN	Signal	Meaning
1	–	Reserved
2	TxD	Transmission signal/RS232
3	RxD	Receive signal/RS232
4	RxD-A (+)	Receive signal A/RS485
5	RxD-B (-)	Receive signal B/RS485
6	VP	Supply voltage -Plus +5V (Imax=10mA)
7	GND	Data reference potential; earth for VP
8	TxD-A (+)	Transmission signal A/RS485
9	TxD-B (-)	Transmission signal B/RS485

11.1.5 Profibus-DP Operator F5 00.F5.060-3000

The PROFIBUS-DP-interface module realizes a passive user (Slave). This means that the PROFIBUS-DP-interface module only transmits, if it receives an enquiry for that from the master.

The PROFIBUS-DP-protocol defines different operating conditions, that must be executed first, before the actual user data can be exchanged. The responsible DP-master must first parameterize and then configure his slaves. If these two functions are successfully completed, the cyclic exchange of user data begins.

Fig. 11.1.5 Profibus-DP Operator

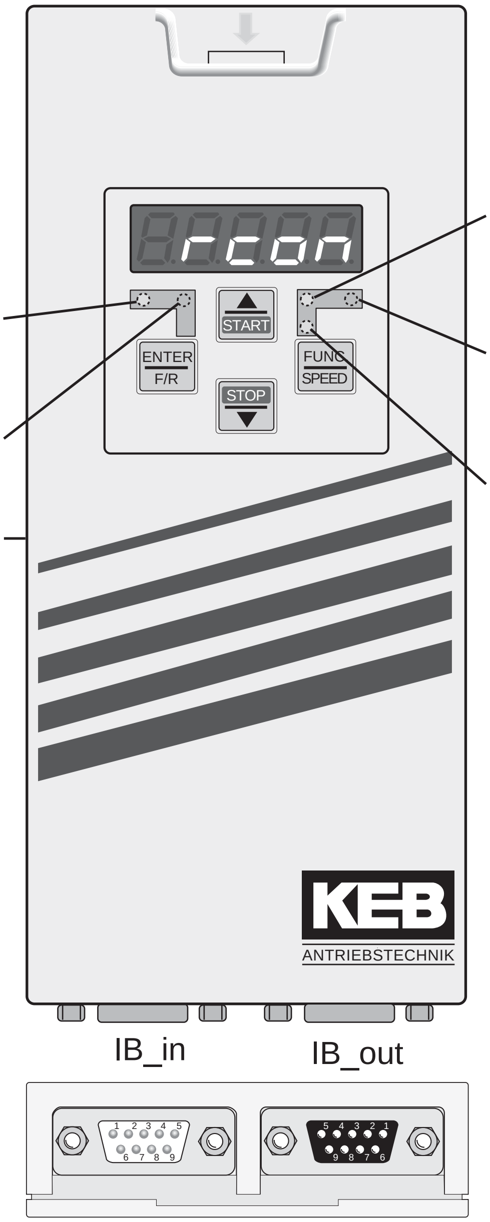


PAR (green):	Parameterizing channel active
PDOUT (green):	PDOUT-data are written to the FI control.
PDIN (green):	PDIN-data are read by the FI control.
E (red): on ==>	Inverter ready for operation
blinking ==>	Inverter failure
off ==>	No supply voltage
Diag:	Diagnostic interface to the PC
PBS1:	PROFIBUS-DP interface (socket connector)
PBS2:	PROFIBUS-DP interface (pin-connector)

11.1.6 InterBus Operator F5 00.F5.060-4000

The InterBus operator F5 is a slip-on operator with interbus 2-wire remote bus connection for KEB COMBIVERT F5. The voltage supply occurs via the inverter, for an independent supply it can also be fed in externally over the control terminal strip of the inverter. Over the PCP channel 0, 1, 2 or 3 interbus register words can be configured for the process data channel. Parallel to the field bus operation the operation via the integrated display/keyboard as well as a further serial interface for diagnosis/parameterization (COMBIVIS) is possible.

Fig. 11.1.6 InterBus Operator



COM (green)
It lights in the case of communication via InterBus PCP or diagnostic interface

RD (red)
On: the remote bus interface (IB_out) was turned off by the host

Diag
Diagnostic interface to the PC
The diagnostic interface is connected to the PC via an adaptor and a HS5P cable. By way of the PC-software COMBIVIS one has now normal access to all inverter parameters. The internal operator parameters like Interbus process data length and occupation can be read and adjusted or parameterized through download. Alternatively a monitoring of the InterBus PCP as well as the process data channels can be carried out with the PC-software HSP5-monitor.

Separately available accessory:
HSP5 cable between PC and adaptor
(Part No: 00.F5.0C0-0001)
Adaptor D-Sub9/Western
(Part No: 00.F5.0C0-0002)

BA (green)
On:Interbus runs
Blinking: Interbus was stopped by the host
Off: Remote bus cable not available or defective/host not in operation or defective

E (red)
On: Ready for operation
Blinking: Inverter failure
Off: No supply voltage

RC (green)
On: Remote bus ready for operation
Off: Remote bus cable not available or defective/host not in operation or defective

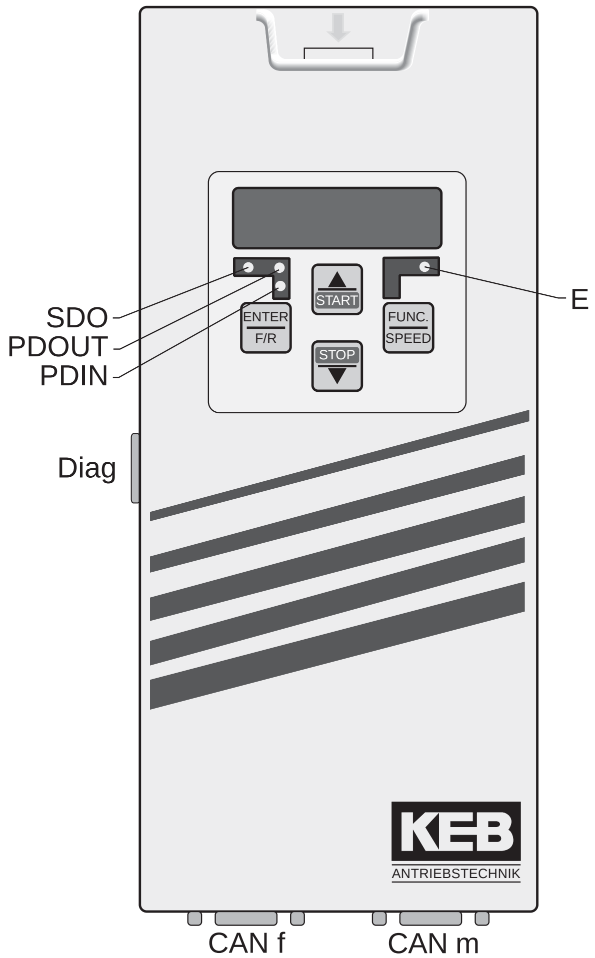
IB_in
Remote bus input
(D-Sub 9-connector)

IB_out
Remote bus output
(D-Sub 9 socket)

11.1.7 CanOpen Operator F5 00.F5.060-5000

CAN is a Multi-Master-System**.** This means every node has access to the BUS and can send telegrams. In order to prevent problems when two nodes simultaneously access the BUS, the CAN-BUS has an arbitration phase which determines who may continue to send his telegram. When there is a conflict in accessing BUS the user with the lowest telegram number (identifier) has priority. This user then can completely send his telegram without repeating the first part. All other nodes go into receiving status and stop sending their telegram. Thus it is determined that lower telegram numbers have automatically priority. The available telegram numbers in the CAN version 2.0A are limited to 2032 identifiers (0...2031).

Fig. 11.1.7 CanOpen Operator

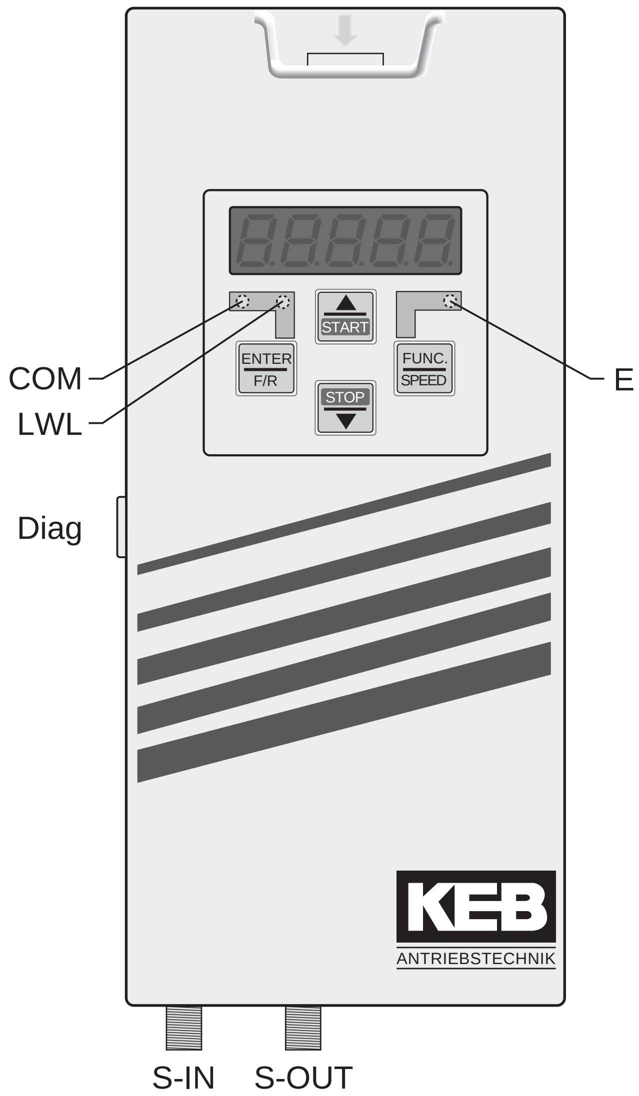


SDO (green):	SDO Communication active
PDOUT (green):	PDOUT data are written to the FI control.
PDIN (green):	PDIN data are read by the FI control.
E (red):on =>	Inverter ready for operation
blinking =>	Inverter in error
off =>	No supply voltage
Diag:	Diagnostic interface to the PC
CAN f:	CAN interface (socket-connector)
CAN m:	CAN interface (pin-connector)

11.1.8 Sercos Operator 00.F5.060-6000

The herein described unit is a plugable operator with SERCOS-interface for the frequency inverter or servo KEB COMBIVERT F5. As far as possible the hard and software were developed taking the DIN/EN 61491 into consideration. The voltage supply occurs via the inverter, for an independent supply it can also be fed in externally over the control terminal strip of the inverter. The SERCOS interface is designed as optical fibre ring for plastic (POF) or fibre glas cable (HCS) with F-SMA plugs. The SERCOS-service channel as well as cyclic data transfer are available. Parallel to SERCOS operation the operation via integrated display/keyboard and also an additional serial interface for diagnosis / parameterization (KEB COMBIVIS) is possible (depending on the operation mode it may be disabled). SERCOS operation parameters like slave address, transmitting power etc. can be adjusted via the keyboard.

Fig. 11.1.8 Sercos Operator



COM (green)
Lights up when access via the SERCOS service channel

LWL (red)
Full brightness*:* no SERCOS input signal (LWL disconnected, previous device switched off)
Low brightness: receive distortion of the SERCOS input signal (transmitting power of the previous device too high or too low, incorrect baud rate)

E (red)
on*:* Inverter/Servo ready for operation
b*linking:* Inverter/Servo in error
off*:* No supply voltage

Diag
Diagnostic interface to the PC

S-IN
SERCOS input interface

S-OUT
SERCOS output interface

11.2. Bus Parameters

11.2.1 Adjustment of Inverter Address (Sy.6)

The address under which the inverter is addressed by „COMBIVIS“ or another control is adjusted via Sy.6. 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. The description of the DIN 66019II protocol (C0.F5.01I-K001) contains further information to this. While loading the default parameters there is no reset of Sy.6.

11.2.2 Baud Rate ext. Bus (Sy.7)

Following values for the baud rate of the serial interface are possible:

Parameter value	Baud rate
0	1200 Baud
1	2400 Baud
2	4800 Baud
3 (default)	9600 Baud
4	19200 Baud
5	38400 Baud
6	55500 Baud

If the value for the baud rate is changed via the serial interface, it can be changed again only by the keyboard or after adapting the baud rate of the master, as no communication is possible with different baud rates of master and slave.
Should problems occur at the data transmission choose a transfer rate of maximal 38400 baud.

11.2.3 Baud Rate int. Bus (Sy.11)

With the internal baud rate the transmission rate is defined between operator and inverter. Following values are possible (dependent of the inverter):

Value	Baud rate	Value	Baud rate	Value	Baud rate
3	9,6 kBaud	6	55,5 kBaud	9	115,2 kBaud
4	19,2 kBaud	7	57,6 kBaud	10	125 kBaud
5	38,4 kBaud	8	100 kBaud	11	250 kBaud

11.2.4 Watchdog-Time (Pn.6)

For a continual check it is possible to trigger an error message of the inverter after completion of an adjustable time (0,01...10 s) during which no telegram is received. The function can be deactivated by adjusting the value „off“.

11.2.5 Response to E.bus (Pn.5)

This parameter determines the response to a Watchdog error. Depending on the selected setting a message E.buS or A.buS is output (further information in chapter 6.7.6).

11

11.2.6 HSP5 Watchdog Time (Sy.9)

The HSP5 Watchdog function monitores the communication of the HSP5 interface (control card - operator; or control card - PC). After expiration of an adjustable time (0,01...10 s) without incoming telegrams, the response adjusted in Pn.5 is triggered. The value „off“ deactivates the function.

11.2.7 Automatic Storing (ud.5)

(only for F5-B/C)

In case of factory setting the KEB COMBIVERT stores all parameter changes immediately non-volatile. Most of the bus operations when new values are cyclically preset still not require this function. To avoid a premature tire of the internal memory, the automatic storing should be switched off with ud.5 = “off“. After each switching on, ud.5 is adjusted to „on“ and must be switched off via bus.

11.2.8 Control and Status Word

The control word is used for the status control of the inverter via bus. With the status word the current state of the inverter is read out.

Control word low Sy.50

The status word low is bit-coded and structured as follows.

Bit	Function	Description
0	Control release	0 = control release not enabled; 1= control release given (this bit is only effective, if di.1 Bit 0 is set. Then the AND-connection with di.2 Bit 0 and the terminal strip ST) is valid; in addition control release must set at terminal ST (hardware)
1	Reset	Triggers reset when changing from 0 => 1
2	**Run / Stop**	0 = setpoint rotation Stop; 1 = setpoint rotation Run (source of setpoint direction op.1 = 8 or 9)
3	**For / Rev**	0 = setpoint rotation forward; 1 = setpoint rotation reverse (source of rotation op.1 = 8 or 9)
4-6	Current set	Source of set selection fr.2 = 5
7	free	
8	fast stop	0 = fast stop inactive; 1 = fast stop activated (OR-operation with further sources for fast stop)
9	Ref. Start	1 = starts the reference point drive
10	Posi Start	1 = starts the positioning
11	reserved	
12-13	Mode	1 = synchronous control; 2 = positioning; 3 = contour control
14-15	reserved	

Control word high Sy.41

The control word high is bit-coded and structured as follows.

Bit	Function	Description
16	I1	Or-operation with di.2 Bit 4
17	I2	Or-operation with di.2 Bit 5
18	I3	Or-operation with di.2 Bit 6
19	I4	Or-operation with di.2 Bit 7
20	IA	Or-operation with di.2 Bit 8
21	IB	Or-operation with di.2 Bit 9
22	IC	Or-operation with di.2 Bit 10
23	ID	Or-operation with di.2 Bit 11
24	O1	Or-operation with ru.25 Bit 0
25	O2	Or-operation with ru.25 Bit 1
26	R1	Or-operation with ru.25 Bit 2
27	R2	Or-operation with ru.25 Bit 3
28 ... 31	free	

Control word long Sy.43

The control word long (32 Bit) consists of Sy.50 and Sy.41.

Status word low Sy.51 With the status word the current state of the inverter is read out.

Bit	Function	Description
0	Control release	0 = control release not enabled; 1=control release given (AND-operated with di.1 bit 0)
1	Error	0=no error; 1=an error occurred
2	Run / Stop	0=actual rotation Stop; 1=actual rotation Run
3	For / Rev	0=actual rotation forward; 1=actual rotation reverse
4-6	Current set	display of the actual parameter set
7	Actual value = Setpoint value	0 = actual value <> setpoint value 1 = actual value = setpoint value
8	Fast stop	0 = not active; 1 = fast stop active
9	Synchronization	1 = Sercos - Bus synchronization reached
10	Ref.mode	1= reference point drive completed
11	Position reached	1 = position reached
12-13	Mode	1 = synchronous control; 2 = positioning; 3 = contour control
14	reserved	
15	Internal Limiting	0 = no limiting active 1 = setpoint value, process controller, foc-controller or vvc-speed controller limited

Status word high Sy.42 The status word high is bit-coded and structured as follows.

Bit	Function	Description
16	I1	Status ru.22 Bit 4
17	I2	Status ru.22 Bit 5
18	I3	Status ru.22 Bit 6
19	I4	Status ru.22 Bit 7
20	IA	Status ru.22 Bit 8
21	IB	Status ru.22 Bit 9
22	IC	Status ru.22 Bit 10
23	ID	Status ru.22 Bit 11
24	O1	Status ru.25 Bit 0
25	O2	Status ru.25 Bit 1
26	R1	Status ru.25 Bit 2
27	R2	Status ru.25 Bit 3
28	OA	Status ru.25 Bit 4
29	OB	Status ru.25 Bit 5
30	OC	Status ru.25 Bit 6
31	OD	Status ru.25 Bit 7

11.2.9 Speed Setting via Bus

Status word long Sy.44 The control word long (32 Bit) consists of Sy.51 and Sy.42.

Setpoint speed value (Sy.52) Preadjustment of the setpoint speed in the range of ±16000 rpm. The source of direction of rotation is determined via oP.1, just as with the other absolute setpoint sources. The setpoint source oP.0 must be adjusted to „5“ via Sy.52 for setpoint setting.

Actual speed value (Sy.53) Via this parameter the current actual speed can be read out in rpm. The direction of rotation is signalled by the sign.

11.2.10 Used Parameters

Param.	Addr.	R/W	PROG.	ENTER	min	max	Step	default	
Pn.5	0405h	4	-	-	0	6	1	6	-
Pn.6	0406h	4	-	-	0,00 s	10,00 s	0,01 s	0,00 s	0,00 = off
SY.6	0006h	4	-	4	0	239	1	1	-
SY.7	0007h	4	-	4	0	6	1	3	-
SY.9	0009h	4	-	-	0.00 s	10.00 s	0.01 s	0.00 s	0.00 = off
Sy.11	000Bh	4	-	4	3	11	1	5	-
SY.41	0029h	4	-	4	0	65536	1	0	-
SY.42	002Ah	-	-	-	0	65536	1	0	-
SY.43	002Bh	4	-	4	-2^{31}	2^{31-1}	1	0	-
SY.44	002Ch	-	-	-	-2^{31}	2^{31-1}	1	0	-
SY.50	0032h	4	-	4	0	65536	1	0	-
SY.51	0033h	-	-	-	0	65536	1	0	-
SY.52	0034h	4	-	-	-16000 rpm	16000 rpm	1 rpm	0 rpm	-
SY.53	0035h	4	-	-	-16000 rpm	16000 rpm	1 rpm	0 rpm	-
ud. 5	0805h	-	-	-	0	1	1	1	-

12. Annex

12.1 Search and Find

12.1.1 Index

12.1.2 KEB- Worldwide

A
H
SK
KEB Antriebstechnik Austria GmbH
Ritzstraße 8
A-4614 Marchtrenk
fon: +43 7243 53586-0
fax: +43 7243 53586-21
mail: info@keb.at
net: www.keb.at

AUS Australien Industrial Machinery
Services A.I.M.S PTY Ltd.
28 West side drive
AUS-Laverton north 3026 Victoria
fon: +61 3 9314 3218
fax: +61 3 9314 3329
mail: terryobrien@aimservices.com.au
net: www.aimservices.com.au

B KEB Antriebstechnik
Vertriebsbüro Belgien
Herenveld 2
B-9500 Geraadsbergen
fon: +32 54437860
fax: +32 54437898
mail: vb.belgien@keb.de

BOL Ergovial Ltda.
AV. Banzer Km 6, 5
BOL-Santa Cruz
fon: +591 3 443349
fax: +591 3 426841
mail: santivanez@cotas.com.bo
net: www.ergovial.com.bo

BR Brastronic Comercico e Servicos Ltda
Rua Nazaré Rezek Farah, 25
BR-CEP 04367-050 Sao Paulo
SP Brasil
fon: +55 11 55653533
fax: +55 11 55633101
mail: brastronic@brastronic.com.br
net: www.brastronic.com.br

CH Stamm Industrieprodukte AG
Witzbergstraße 24
CH-8330 Pfäffikon / ZH
fon: +41 43 2886060
fax: +41 43 2886080
mail: info@stammweb.ch
net: www.stammweb.ch

CHN KEB China Karl E. Brinkmann GmbH
Shanghai Representative Office
(Xinmao Building, Caohejing
Development Zone)
No. 99 Tianzhou Road
(No. 9 building, Room 708)
CHN-200233 Shanghai, PR. China
fon: +86 21 54503230-3232
+86 21 54450115
fax: +86 21 62350015
mail: info@keb.cn
net: www.keb.cn

CHN KEB China Karl E. Brinkmann GmbH
Beijing Representative Office
No. 36 Xiaoyun Road
Chaoyang District
CHN-10027 Beijing, PR. China
fon: +86 10 84475815 + 819
fax: +86 10 84475868
mail: hotline@keb.cn
net: www.keb.cn

CZ KEB Antriebstechnik Austria GmbH
Organizacni slozka
Kostelini 32/1226
CZ-370 04 Ceske Budejovice
fon: +420 38 7699111
fax: +420 38 7699119

DK REGAL A/S
Industrievej 4
DK-4000 Roskilde
fon: +45 4677 7000
fax: +45 4675762
mail: regal@regal.dk
net: www.regal.dk

E KEB España
c/Mitjer,Nave 8-Pol. Ind. „LA MASIA“
E-08798 Sant Cugat Sesgarriugues
fon: +34 618 324 766
mail: vb.espana@keb.de

E ELION S.A.
Farell 9
E-08014 Barcelona
fon: +34 93 2982000
fax: +34 93 4314133
mail: elion@elion.es
net: www.elion.es

ET Tarek El Sehelly
P.O.Box 83
ET-Mehalla El Kobra
fon: +20 402243839
fax: +20 402235753
mail: t_sehelly@hotmail.com

F Société Francaise KEB
Z.I. de la Croix St. Nicolas
14, rue Gustave Eiffel
F-94510 LA QUEUE EN BRIE
fon: +33 1 49620101
fax: +33 1 45767495
mail: info@keb.fr
net: www.keb.fr

GB KEB (UK) Ltd.
6 Chieftain Business Park
Morris Close
Park Farm, Wellingborough
GB-Northants, NN8 6 XF
fon: +44 1933 402220
fax: +44 1933 400724
mail: info@keb-uk.co.uk
net: www.keb-uk.co.uk

GR ELMO L.T.D.
Power Transmission & Engineering
18, Athinon
GR-18540 Piraeus
fon: +30 2 10 4120150
fax: +30 2 10 4176319+9618
mail: elmoltd@ath.forthnet.gr
net: www.elmo-gr.com

I KEB Italia S.r.l.
Via Newton, 2
I-20019 Settimo Milanese (Milano)
fon: +39 02 33500782
+39 02 33500814
fax: +39 02 33500790
mail: kebitalia@keb.it
net: www.keb.it

IL OMEGA Engineering Ltd.
P.O. Box 13825
IL-42138 Netanya
fon: +972 9 7673240
fax: +972 9 7673398
mail: info@omegae.co.il
net: www.omegae.co.il

IND Peass Automation Ltd.
C-1/B, 305-G.I.D.C.
Kabilpore
IND-Navsari 396424
fon: +91 2637 309566
fax: +91 2637 238340
mail: info@peassautomatio.com
net: www.peassautomatio.com

J KEB - YAMAKYU Ltd.
15-16, 2-Chome
Takanawa Minato-ku
J-Tokyo 108-0074
fon: +81 33 445-8515
fax: +81 33 445-8215
mail: ky-sales@d4.dion.ne.jp

J KEB - YAMAKYU Ltd.
711, Fukudayama, Fukuda
J-Shinjo-Shi, Yamagata 996-0053
fon: +81 233 29-2800
fax: +81 233 29-2802
mail: ky-sales@d4.dion.ne.jp

KZ INTEGRATOR Ltd.
Shagabutdinova str. 135 - 2
KZ-480012 Almaty Kazakhstan
fon: +7 333 2465291
fax: +7 3272 928747

LV Energy Line
Ropozu 130/138 - 2
Lativa, LV–1006 Riga
fon: +371 9441105
fax: +371 7113597

MA ASTRONIC s.a.r.l.
Résidence EL FADLE GH1
Immeuble 3 N° 29
MA-AIN SEBAA Casablanca
fon: +212 2266 1408 + 1413
fax: +212 2266 1418
mail: astronic@iam.net.ma

www.regal.dk

MAL BSC Automation
(M) Sdn Bhd
12A, Jalan 7, 108 C
Taman Sungai Besi
MY-57100 Kuala Lumpur
fon: +60 379809591
fax: +60 379817442
mail: bsc-my@tm.net.my

NL KEB Nederland
Leidsevaart 126
NL–2013 HD Haarlem
fon: +31 23 5320049
fax: +31 23 5322260
mobil: +31 653964667
mail: vb.nederland@keb.de

NL Marsman Elektronica
En Aandrijvingen BV
Zeearend 16
NL-7609 PT Almelo
fon: +31 546 812121
fax: +31 546 810655
mail: info@marsman-almelo.nl
net: www.marsman-almelo.nl

NZ Renold New Zealand Limited
P.O. Box 19460
NZ-Avondale Auckland
fon: +64 9 8285018
fax: +64 9 8285019
mail: aksales@renold.co.nz
net: www.renold.co.nz

NZ Vectek Electronics Ltd.
21 Carnegie Road, Onekawa
NZ-Napier
fon: +64 6 8431400
fax: +64 6 8430398
mail: info@vectek.co.nz
net: www.vectek.co.nz

P KEB Portugal
Avenida da Igreja -
PavilãoA n.º 261 Mouquim
P-4770 - 360 MOUQUIM V.N.F.
fon: +351 252 371 318 + 19
fax: +351 252 371 320
mail: keb.portugal@netc.pt

PA Associated Textile Consultants (ATC)
Private LTD
219, The Forum, G-20, Block-9
Khayaban-e-Jami, Clifton
PK-75600, Parkistan
fon: +92 21 582124-1...-6
fax: +92 21 5821559 5821247
mail: ATC.Karachi@atcpak.com

PL KEB Polska
ul. BudapesztaD ´ska 3/16
PL-80-288 GdaD ´sk
fon: +48 58 524 0518
fax: +48 58 524 0519
mail: vb.polska@keb.de

RCH EMET LTDA.
Madrid #1386
RCH-Santiago, Chile
fon: +56 2 5510630
fax: +56 2 5510627
mail: info@emet.cl
net: www.emet.cl

RI siehe Malaysia

ROC KEB Taiwan Ltd.
No. 8, Lane 89, Sec. 3
Taichung Kang Rd.
R.O.C.-Taichung City, Taiwan
fon: +886 4 23506488
fax: +886 4 23501403
mail: info@keb.com.tw

ROM ADF Industries srl
Bucarest Sec. 3, Str. Baraj Bicaz
Nr.2–4, M25 Ap 110
PO 74661
ROM-Bucarest
fon: +40 21 3411200
fax: +40 21 3403224
mail: floria@adf.ro
net: www.adf.ro

RSA P E C S Pneumatic Electric
Control Systems (PTY) Ltd.
P.O. Box 47396
8, Balance Road, Stamford Hill 4001
RSA-Durban / Greyville 4023
fon: +27 31 3033701
fax: +27 31 3127421
mail: pecs@mweb.co.za
net:
www.pecspowertransmission.co.za

RUS Servotechnics
Vyborgskaya 22 of 52
RUS-125130 Moskow / Russia
fon: +7 095 797-8856
fax: +7 095 450-0043
mail: info@servotech.ru

S REVA - drivteknik AB
Slussgatan 13
S-21130 Malmö
fon: +46 4077110
fax: +46 4079994
mail: info@revadrivteknik.se
net: www.revadrivteknik.se

S KEB Sverige
Box 265 (Bergavägen 19)
S-4393 Hälsö
fon: +46 31 96 1520
fax: +46 31 96 1124
mobil: +46 733856400
mail: thomas.crona@keb.de

SGP THE ONE TRANSMISSION Pte Ltd.
64 Sungei Kadut Loop
729493 Singapore
SGP-Singapore
fon: +65 6561 1215
fax: +65 6561 1071
mail: one.trans@pacific.net.sg

THA INNOTECH Solution Co. Ltd.
25/120 Soi. Nawamin 165
(Amornwiwat)
Nawamin Rd., Bungkum,
Klongkum
THA- Bangkok 10230 Bangkok
fon: +66 2 9664927
fax: +66 2 9664928
mail: info@innotech.co.th
net: www.anet.net.th

TN H 2 M
13, Rue El Moutanabi
TN-2037, El Menzah 7
fon: +216 71 427677
fax: +216 71 427688
mail: h2m.tech@planet.tn

TR TEPEKS Elektronik Sanayi Ve
Ticaret Ltd. Sirketj
Harman Cad. Ali Kaya Sok. No. 4
POLAT Plaza B. Blok Kat 5
TR-80640 Levent, Istanbul
fon: +90 212 3252530
fax.: +90 212 3252535
mail: tepeks@tepeks.com
net: www.tepeks.com

UA MARKET-K
of. 2, 62 B, Vishnevetskogo Str.
UA–257002 Cherkassy
fon: +380 472 540617
fax: +380 472 540614
mail: market-k@market-
k.cherkassy.ua

USA KEBCO Inc.
1335 Mendota Heights Road
USA-Mendota Heights, MN 55120
fon: +1 651 4546162
fax: +1 651 4546198
mail: info@kebco.com
net: www.kebco.com

UZ Mechatronika-TES
Str. Mukana berk, 17
UZ-700070 Tashkent
fon: +998 712 556617
fax: +998 712 555726
mail: mtes@online.ru

2/2004

12.1.3 Domestic Representations

teilweise Sachsen und Thüringen
KEB Antriebstechnik GmbH & Co. KG
Wildbacher Straße 5
08289 Schneeberg
Tel.: (0 37 72) 67-0
Fax: (0 37 72) 6 72 81
E-mail: info@keb-combidrive.de

Brandenburg Mecklenburg-Vorp. Sachsen-Anhalt teilweise Sachsen und Thüringen
Schumer Ingenieurgesellschaft mbH
Gottschallstraße 11
04157 Leipzig
Tel.: (03 41) 9 12 95 11
Fax: (03 41) 9 12 95 39
E-mail: info@schumer.de
Internet: www.schumer.de

Hamburg Schleswig-Holstein Bremen teilweise Niedersachsen
KEB Antriebstechnik
Vertrieb Nord
Knüll 9a
21698 Bargstedt
Tel.: (0 41 64) 62 33
Fax: (0 41 64) 62 55
E-mail: vb.nord@keb.de
Internet: www.keb.de

NRW Ost teilweise Niedersachsen
KEB-Antriebstechnik
Vertrieb West
Gartenstraße 18
33775 Versmold
Tel.: (0 54 23) 94 72-0
Fax: (0 54 23) 94 72-20
E-mail: vb.west@keb.de
Internet: www.keb.de

NRW West
Ing. Büro für rationelle Antriebe
Horst Thomalla GmbH
Vorsterstraße 448
41169 Mönchengladbach
Tel.: (0 21 61) 55 62 62
Fax: (0 21 61) 55 78 68
E-mail: horst.thomalla.gmbh@t-online.de

Hessen teilweise Rheinland-Pfalz
KEB Antriebstechnik
Vertrieb Süd-West
Diesterwegstraße 8 B
35745 Herborn
Tel.: (0 27 72) 92 42-0
Fax: (0 27 72) 92 42-28
E-mail: vb.suedwest@keb.de
Internet: www.keb.de

Baden-Württ. Saarland teilweise Rheinland-Pfalz
Laipple / Brinkmann GmbH
Ziegelhau 13
73099 Adelberg
Tel.: (0 71 66) 9 10 01-0
Fax: (0 71 66) 9 10 01-26
E-mail: info@laipple-keb.de
Internet: laipple-keb.de

Bayern Süd
KEB - SÜD
Zentrale Heilbronn
Villmatstr. 35
74076 Heilbronn
Tel.: (0 71 31) 79 793 - 00
Fax: (0 71 31) 79 793 - 10
E-mail: keb.sued@keb.de
Internet: www.keb.de

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 Antriebstechnik GmbH & Co. KG
Wildbacher Str. 5 • **D**–08289 Schneeberg
fon: +49 3772 67-0 • fax: +49 3772 67-281
mail: info@keb-combidrive.de

KEB Antriebstechnik Austria GmbH
Ritzstraße 8 • **A**-4614 Marchtrenk
fon: +43 7243 53586-0 • fax: +43 7243 53586-21
Kostelni 32/1226 • **CZ**-370 04 Ceské Budejovice
fon: +420 38 7319223 • fax: +420 38 7330697
net: www. keb.at • mail: info@keb.at

KEB Antriebstechnik
Herenveld 2 • **B**-9500 Geraadsbergen
fon: +32 5443 7860 • fax: +32 5443 7898
mail: vb.belgien@keb.de

KEB CHINA Karl E. Brinkmann GmH
Shanghai Representative Office
(Xinmao Building, Caohejing Development Zone)
No. 99 Tianzhou Road (No.9 building, Room 708)
CHN-200233 Shanghai, PR. China
fon: +86 21 54503230-3232 • fax: +86 21 54450115
net: www.keb.cn • mail: info@keb.cn

KEB CHINA Karl E. Brinkmann GmH
Beijing Representative Office
No. 36 Xiaoyun Road • Chaoyang District
CHN-10027 Beijing, PR. China
fon: +86 10 84475815 + 819 • fax: +86 10 84475868
net: www.keb.cn • mail: hotline@keb.cn

Société Française KEB
Z.I. de la Croix St. Nicolas • 14, rue Gustave Eiffel
F-94510 LA QUEUE EN BRIE
fon: +33 1 49620101 • fax: +33 1 45767495
net: www.keb.fr • mail: info@keb.fr

KEB (UK) Ltd.
6 Chieftain Buisiness Park, Morris Close
Park Farm, Wellingborough **GB**-Northants, NN8 6 XF
fon: +44 1933 402220 • fax: +44 1933 400724
net: www.keb-uk.co.uk • mail: info@keb-uk.co.uk

KEB Italia S.r.l.
Via Newton, 2 • **I**-20019 Settimo Milanese (Milano)
fon: +39 02 33500782 • fax: +39 02 33500790
net: www.keb.it • mail: kebitalia@keb.it

KEB - YAMAKYU Ltd.
15–16, 2–Chome, Takanawa Minato-ku
J–Tokyo 108-0074
fon: +81 33 445-8515 • fax: +81 33 445-8215
mail: ky-sales@f4.dion.ne.jp

KEB - YAMAKYU Ltd.
711, Fukudayama, Fukuda
J–Shinjo-Shi, Yamagata 996 - 0053
fon: +81 233 29-2800 • fax: +81 233 29-2802
mail: ky-sales@f4.dion.ne.jp

KEB Nederland
Leidsevaart 126 • **NL**–2013 HD Haarlem
fon: +31 23 5320049 • fax: +31 23 5322260
mail: vb.nederland@keb.de

KEB Portugal
Avenida da Igreja – Pavilão A n. º 261 Mouquim
P-4770 - 360 MOUQUIM V.N.F.
fon: +351 252 371318 + 19 • fax: +351 252 371320
mail: keb.portugal@netc.pt

KEB Taiwan Ltd.
No.8, Lane 89, Sec.3; Taichung Kang Rd.
R.O.C.-Taichung City / Taiwan
fon: +886 4 23506488 • fax: +886 4 23501403
mail: kebtaiwan@seed.net.tw

KEB Sverige
Box 265 (Bergavägen 19)
S-4393 Hälsö
fon: +46 31 961520 • fax: +46 31 961124
mail: thomas.crona@keb.de

KEBCO Inc.
1335 Mendota Heights Road
USA-Mendota Heights, MN 55120
fon: +1 651 4546162 • fax: +1 651 4546198
net: www.kebco.com • mail: info@kebco.com