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REFUdrive 500 RD51
Drive control devices
VFC (voltage-frequency-control)

Operating Instructions

REFUdrive 500

DOK-RD500*-RD51*******-IB01-EN-P

Rexroth
Indramat

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Operating Instructions

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Purpose of Documentation
This documentation explains the frequency converters of the drive series REFU*drive 500* RD51. It provides information...
- for planning the mechanical control cabinet construction.
- for planning the electrical control cabinet construction.
- for commissioning the drive controls.
- for basic parameterization of the drive controls.
- to fault messages and notes to cause and remedy

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0 Safety

0.1 Safety information and instructions in the technical documentation for REFUdrive500

The safety information and instructions provided in this section are valid for all documents, electronic documents, or other publications associated with the REFU*drive 500* drive converter series subsequently known as "Technical Documentation REFU*drive 500*". Please observe the safety- and application information for drive converters in the Manual provided, "Safety information and EC Certificates".

0.2 Definition of the terminology used

Qualified personnel

In the sense of the REFU*drive 500* technical documentation and the warning information on the products themselves, are electrical specialists or personnel with electrical training in accordance with EN 600204 Part 1, 3.55 or 3.30. They are knowledgeable about the installation, mounting, connecting-up, commissioning and operation of the product, and have the appropriate qualifications for their job.

WARNING

Warning

For the purpose of the REFU*drive 500* documentation and the warning information on the products themselves, warning means that death, severe personal injury or significant property damage can result if proper precautions are not taken.

CAUTION

Caution

For the purpose of the REFU*drive 500* Technical Documentation and the warning information on the products themselves, caution indicates that minor personal injury or material damage can result if proper precautions are not taken.

Caution - Components which can be destroyed by electrostatic discharge (EGB)

For the purpose of the REFU*drive 500* technical documentation and the warning information on the products themselves, indicate boards and modules which can be destroyed by electrostatic discharge. Please observe the measures specified below.

Note:

For the purpose of the REFU*drive 500* Technical Documentation, "Note" indicates information about the product or the respective part of the Instruction Manual that is essential to highlight.

0.3 Definition of the symbols used

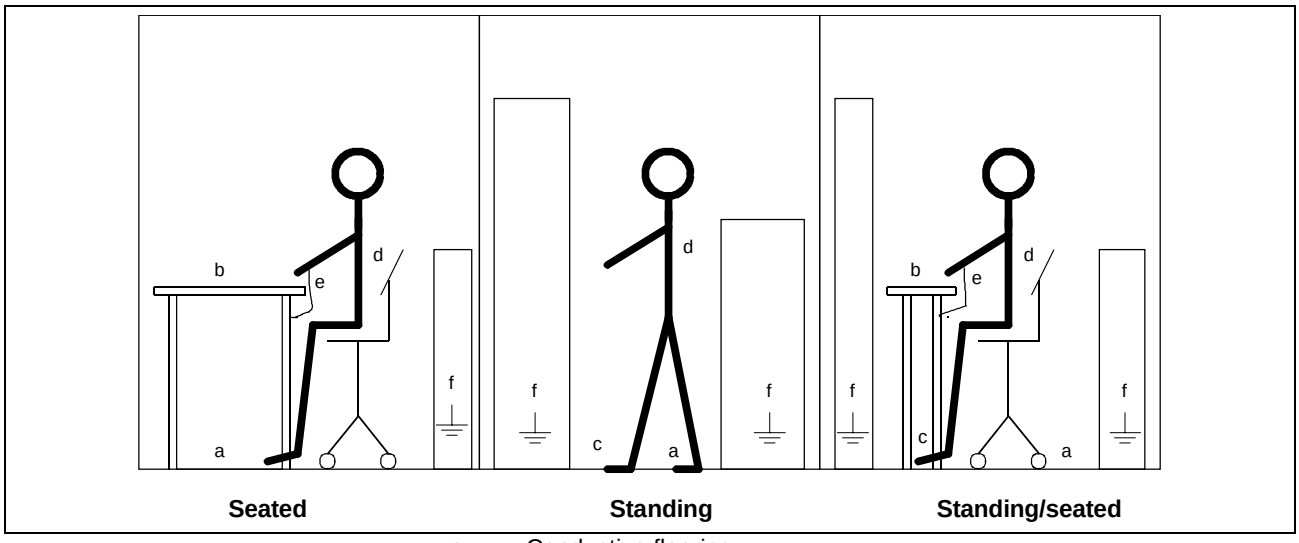
Symbol	Significance and application
	Caution! General potential source of danger. Used in conjunction with the terms "Warning" and "Caution".
	Caution! Danger due to electric current. Used in conjunction with the terms "Warning" and "Caution".
	Caution! Components which can be destroyed by electrostatic discharge This is used in conjunction with the term Caution - ESD‘.
	Important Information! Used in conjunction with the term "Note"

0.4 Precautionary measures when handling components which can be destroyed by electrostatic discharge (ESD)

The units contain electrostatically sensitive devices that can easily be destroyed if they are incorrectly handled. However, if your work does involve the handling of such devices, please observe the following information:

- Electronic modules should not be touched unless work has to be carried-out on them.
- If it is essential for you to touch and handle an electronics module, make sure that your body is electrostatically discharged beforehand .
- Modules may not be allowed to come into contact with electrically insulating materials -such as plastic foil, insulated table tops or clothing made of synthetic fibers-.
- Modules may only be placed on electrically conducting surfaces.
- When carrying-out soldering work on the modules, the soldering iron tip must be grounded.
- Modules and electronic components must always be packed in electrically conducting containers (e.g. such as metalized plastic boxes or metal canisters) before being stored or shipped.
- If packing containers are used which are not conductive, modules and boards must first be wrapped in a conducting material. Examples of such materials including electrically conducting foam rubber or household aluminum foil.

The necessary ESD protective measures are illustrated in the diagram below:



a: Conductive flooring
b: ESD table
c: ESD shoes/footwear
d: ESD overall
e: ESD bracelet/chain
f: Grounding connection of the cabinets

Fig. 0-1: ESD protective measures

1 Description

1.1 The REFU*drive 500* drive converters

REFU*drive 500* is a state-of-the-art three-phase drive system for various types of synchronous- and induction motors which can be universally used. The drive converters can be flexibly adapted to the particular drive task as a result of the modular hardware and software design.

The system includes various versions of AC drive converters (with/without braking chopper, line contactor etc.) inverters for DC rectification as well as rectifier- and regenerative feedback converters. The modules can either be used individually or combined in groups, completely connected-up in cabinets.

The power sections are designed for rear cooling. This allows forced air cooling to be implemented outside the cabinet for higher degrees of protection (where the heat sink extends through the rear panel or heat transfer plates). Versions are also available with liquid cooling, with integrated or external heat exchanger.

Handling

Special importance was placed on simple handling:

- simple commissioning via Quick-Setup
- prompted start-up using the operator panel with graphics display
- highest level of user-friendliness using a PC with the high performance REFUwin software package

Electromagnetic compatibility

The AC drive converters have integrated radio interference suppression filters and line reactors to reduce the harmonics fed back into the line supply. **REFU***drive 500* completely fulfills the EMC Directive in reference to the noise immunity and noise emission according to the EMC Product Standard for electric drives EN 61800-3, EN 55011 Class A (IEC 1800-3). REFU*drive 500* units are in conformance with noise immunity specifications according to EN 50082-2.

Technical features

- AC or DC power supply
- Either forced air cooling, heat transfer plates or liquid cooling
- Removable 4-line graphic display with copy function
- Various interfaces for operating observing, and parameterizing (“download” parameterization) the drive system:
  - Profibus DP
  - Interbus S
  - CAN-Bus, also with fiber-optic cable
  - RS 232 / RS 485
- Peer-to-peer coupling with fiber-optic cable for fast communications between several drives
- Expanded, freely combinable technological functions:
  - PID, PI controller, AND, OR, XOR, RS flip-flop, D latch and Sample & Hold module
  - Mathematical function elements
  - Timers, counters, comparators, ramp-function generators
- Double overload for 0.5 sec

- High-performance software tool: REF*Uwin*

1.2 Rating plate

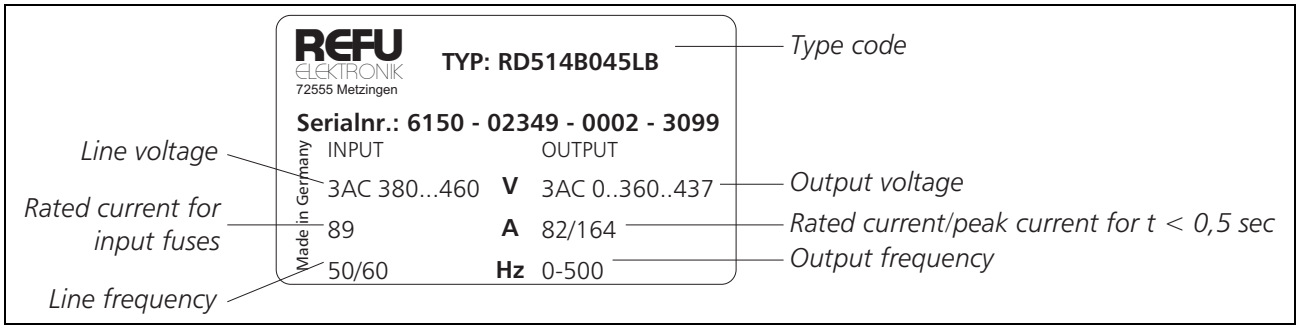


Fig. 1-1: Rating plate

1.3 Technical Data

Technical Data for pulse frequency f_p = 4 kHz

RD51			1.5	3.0	4.0	5.5	7.5	011	015	018	022	030	037
Motor output [1]		[kW]	1.5	3.0	4.0	5.5	7.5	11	15	18.5	22	30	37
Line supply voltage 3 AC 400 V (±15%)													
Output frequency		[Hz]	0 -250 Hz										
Rated current		[A]	4.0	7.5	10	13	18	25	30	35	43	56	68
Peak current for	t=60 s	[A]	5.2	9.8	13	17	23	33	39	46	55	73	88
	t=1 s	[A]	6.8	13	17	22	31	43	51	60	72	95	116
	t=0.5 s	[A]	8.0	15	20	26	36	50	60	70	85	112	136
Rated output S_N		[kVA]	2.6	4.9	6.6	8.6	12	16	20	23	28	37	45
Peak output for t=60s		[kVA]	3.4	6.5	8.6	11	15	22	26	30	36	48	58
Line supply voltage 3 AC 460 V (±15%)													
Output frequency		[Hz]	0 -250 Hz										
Rated current		[A]	3.5	6.5	9	12	16	21	27	31	38	49	60
Peak current for	t=60 s	[A]	5.2	9.8	13	17	23	33	39	46	55	73	88
	t=1 s	[A]	6.8	13	17	22	31	43	51	60	72	95	116
	t=0.5 s	[A]	8.0	15	20	26	36	50	60	70	85	112	136
Rated output S_N		[kVA]	2.6	4.9	6.6	8.6	12	16	20	23	28	37	45
Peak output for t=60s		[kVA]	3.4	6.5	8.6	11	15	22	26	30	36	48	58
Line supply voltage 3 AC 500 V (+10% / -15%)													
Output frequency		[Hz]	0 - 250 Hz										
Rated current		[A]	3	6	8	10	14	20	24	28	34	45	54
Peak current for	t=60 s	[A]	3.9	7.8	10	13	18	26	31	36	44	59	70
	t=1 s	[A]	5.1	10	14	17	24	34	41	48	58	77	92
	t=0.5 s	[A]	6.0	12	16	20	28	40	48	56	68	90	108
Rated output S_N		[kVA]	2.5	4.9	6.6	8.2	12	16	20	23	28	37	44
Peak output for t=60s		[kVA]	3.2	6.4	8.2	11	15	21	26	30	36	49	58
Ambient conditions, radio interference suppression level, noise immunity													
Environmental class			3K3 according to DIN IEC 721-3-3 (ambient temperature 0-40 °C)										
Cooling airflow requirement		[m³/s]	0.02	0.02	0.02	0.03	0.03	0.05	0.05	0.05	0.1	0.1	0.2
Radio interference suppression level/ noise immunity			A 1 according to EN 55011 / EN 61800-3										
Mechanical design													
Size classes			A	A	A	A	A	B	B	B	C	C	C
Degree of protection			IP 20 according to EN 60529					IP 20 acc. to EN 60529 (without terminal connections)					
Weight of the drive converter for cooling type													
Forced ventilation		[kg]	15	15	15	15	15	18	18	18	33	33	33
Liquid cooling		[kg]	10	10	10	10	10	12	12	12	25	25	25
Heat conducting plate		[kg]	10	10	10	10	10	12	12	12	--	--	--
Brake resistor													
Continuous braking power [2]		[kW]	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.4	0.4	0.4

[1] Maximum permissible motor output referred to a 4-pole standard induction motor.

[2] When the braking resistors are mounted in the air flow.

Technical Data for pulse frequency f_p = 4 kHz

RD51			045	055	075	090	110	132	160	200	315	400
Motor output [3]		[kW]	45	55	75	90	110	132	160	200	315	400
Line supply voltage 3 AC 400 V (±15%)												
Output frequency		[Hz]	0 - 250						0 - 150			
Rated current		[A]	82	99	135	165	195	230	290	350	540	680
Peak current for	t=60 s	[A]	107	129	176	215	253	299	377	455	702	884
	t=1 s	[A]	139	168	230	281	331	391	493	595	918	1156
	t=0.5 s	[A]	164	198	270	330	390	-	-	-	-	-
Rated output S_N		[kVA]	54	65	89	109	128	151	191	230	355	448
Peak output for t=60s		[kVA]	70	85	116	142	167	197	248	299	462	582
Line supply voltage 3 AC 460 V (±15%)												
Output frequency		[Hz]	0 - 250						0 - 150			
Rated current		[A]	72	86	120	139	178	200	252	305	470	591
Peak current for	t=60 s	[A]	107	129	176	215	254	299	377	455	702	884
	t=1 s	[A]	139	168	230	281	332	391	493	595	918	1156
	t=0.5 s	[A]	164	198	270	330	390	-	-	-	-	-
Rated output S_N		[kVA]	54	65	89	109	128	151	191	230	355	448
Peak output for t=60s		[kVA]	70	85	116	142	167	197	248	299	462	582
Line supply voltage 3 AC 500 V (+10% / -15%)												
Output frequency		[Hz]	0 - 250						0 - 150			
Rated current		[A]	66	80	108	130	160	190	240	280	432	550
Peak current for	t=60 s	[A]	86	104	140	169	208	247	312	364	562	715
	t=1 s	[A]	112	136	184	221	272	323	408	476	734	935
	t=0.5 s	[A]	132	160	216	260	320	--	--	--	--	--
Rated output S_N		[kVA]	54	66	89	107	132	156	197	230	355	452
Peak output for t=60s		[kVA]	71	86	115	139	171	203	257	299	462	588
Ambient conditions, radio interference suppression level, noise immunity												
Environmental class			3K3 according to DIN IEC 721-3-3 (ambient temperature 0-40 °C)									
Cooling airflow requirement		[m³/s]	0.2	0.4	0.4	0.6	0.4	0.4	0.4	0.6	0.8	1.2
Radio interference suppression level/ noise immunity			A 1 according to EN 55011 / EN 61800-3									
Mechanical design												
Size classes			C	D	D	E	E	G	G	G	H	H
Degree of protection			IP 20 according to EN 60529 (without terminal connections)									
Weight of the drive converter for cooling type												
Forced ventilation		[kg]	33	50	50	80	80	--	--	--	--	--
Liquid cooling		[kg]	25	37	37	60	60	180	180	180	358	358
Heat conducting plate		[kg]	--	--	--	--	--	--	--	--	--	--
Brake resistor												
Continuous braking power [4]		[kW]	0.4	0.6	0.6	0.8	1.2	2	2	2.5	4	5

[3] Maximum permissible motor output referred to a 4-pole standard induction motor.

[4] When the braking resistors are mounted in the air flow.

Technical Data for pulse frequency f_p = 8 kHz

RD51			1.5	3.0	4.0	5.5	7.5	011	015	018	022	030	037
Motor output [5]		[kW]	1.1	2.2	3.0	4.0	5.5	7.5	11	15	18.5	22	30
Line supply voltage 3 AC 400 V (±15%)													
Output frequency		[Hz]	0 - 500										
Rated current		[A]	3.0	5.8	7.5	10	13	18	25	30	35	43	56
Peak current for	t=60 s	[A]	3.9	7.5	9.8	13	17	23	33	39	46	55	73
	t=1 s	[A]	51	9.9	13	17	22	31	43	51	60	72	95
	t=0.5 s	[A]	6.0	12	15	20	26	36	50	60	70	85	112
Rated output S_N		[kVA]	2.0	3.8	4.9	6.6	8.6	12	16	20	23	28	37
Peak output for t=60s		[kVA]	2.6	4.9	6.5	8.6	11	15	22	26	30	36	48
Line supply voltage 3 AC 460 V (±15%)													
Output frequency		[Hz]	0 - 500										
Rated current		[A]	2.6	5.0	6.5	8.7	12	16	21	27	31	38	49
Peak current for	t=60 s	[A]	3.9	7.5	9.8	13	17	23	33	39	46	55	73
	t=1 s	[A]	51	9.9	13	17	22	31	43	51	60	72	95
	t=0.5 s	[A]	6.0	12	15	20	26	36	50	60	70	85	112
Rated output S_N		[kVA]	2.0	3.8	4.9	6.6	8.6	12	16	20	23	28	37
Peak output for t=60s		[kVA]	2.6	4.9	6.5	8.6	11	15	22	26	30	36	48
Line supply voltage 3 AC 500 V (+10% / -15%)													
Output frequency		[Hz]	0 - 500										
Rated current		[A]	2.4	4.5	6	8	10	14	20	24	28	34	45
Peak current for	t=60 s	[A]	3.1	5.9	7.8	10	13	18	26	31	36	44	59
	t=1 s	[A]	4.1	7.7	10	14	17	24	34	41	48	58	77
	t=0.5 s	[A]	4.8	9.0	12	16	20	28	40	48	56	68	90
Rated output S_N		[kVA]	2.0	3.7	4.9	6.6	8.2	12	16	20	23	28	37
Peak output for t=60s		[kVA]	2.6	4.9	6.4	8.2	11	15	21	26	30	36	49
Ambient conditions, radio interference suppression level, noise immunity													
Environmental class			3K3 according to DIN IEC 721-3-3 (ambient temperature 0-40 °C)										
Cooling airflow requirement		[m³/s]	0.02	0.02	0.02	0.03	0.03	0.04	0.05	0.05	0.1	0.1	0.2
Radio interference suppression level/ noise immunity			A 1 according to EN 55011 / EN 61800-3										
Mechanical design													
Size classes			A	A	A	A	A	B	B	B	C	C	C
Degree of protection			IP 20 according to EN 60529					IP 20 acc. to EN 60529 (without terminal connections)					
Weight of the drive converter for cooling type													
Forced ventilation		[kg]	15	15	15	15	15	18	18	18	33	33	33
Liquid cooling		[kg]	10	10	10	10	10	12	12	12	25	25	25
Heat conducting plate		[kg]	10	10	10	10	10	12	12	12	--	--	--
Brake resistor													
Continuous braking power [6]		[kW]	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.4	0.4	0.4

[5] Maximum permissible motor output referred to a 4-pole standard induction motor.

[6] When the braking resistors are mounted in the air flow.

Technical Data for pulse frequency f_p = 8 kHz (* for 110 kW f_p = 6 kHz)

RD51			045	055	075	090	110*	132	160	200	315	400
Motor output [7]		[kW]	37	45	55	75	90	110	132	160	250	315
Line supply voltage 3 AC 400 V (±15%)												
Output frequency		[Hz]	0 - 500						0 - 250			
Rated current		[A]	68	82	99	135	165	195	230	280	400	540
Peak current for	t=60 s	[A]	88	107	129	176	215	254	299	364	520	702
	t=1 s	[A]	116	139	168	230	280	332	391	476	680	918
	t=0.5 s	[A]	136	164	198	270	330	--	--	--	--	--
Rated output S_N		[kVA]	45	54	65	89	109	128	151	184	263	355
Peak output for t=60s		[kVA]	58	70	85	116	142	166	197	240	342	462
Line supply voltage 3 AC 460 V (±15%)												
Output frequency		[Hz]	0 - 500						0 - 250			
Rated current		[A]	60	72	86	118	132	170	200	243	348	470
Peak current for	t=60 s	[A]	88	107	129	176	215	254	299	364	520	702
	t=1 s	[A]	116	139	168	230	280	332	391	476	680	918
	t=0.5 s	[A]	136	164	198	270	330	--	--	--	--	--
Rated output S_N		[kVA]	45	54	65	89	109	128	151	184	263	355
Peak output for t=60s		[kVA]	58	70	85	116	142	166	197	240	342	462
Line supply voltage 3 AC 500 V (+10% / -15%)												
Output frequency		[Hz]	0 - 500						0 - 250			
Rated current		[A]	55	66	80	108	130	160	190	240	345	432
Peak current for	t=60 s	[A]	72	86	104	140	169	208	247	312	449	562
	t=1 s	[A]	94	112	136	184	221	272	323	408	587	734
	t=0.5 s	[A]	110	132	160	216	260	--	--	--	--	--
Rated output S_N		[kVA]	45	54	66	89	107	132	156	197	284	355
Peak output for t=60s		[kVA]	59	71	86	115	139	171	203	257	369	462
Ambient conditions, radio interference suppression level, noise immunity												
Environmental class			3K3 according to DIN IEC 721-3-3 (ambient temperature 0-40 °C)									
Cooling airflow requirement		[m³/s]	0.2	0.4	0.4	0.6	0.4	0.4	0.4	0.6	0.8	1.2
Radio interference suppression level/ noise immunity			A 1 according to EN 55011 / EN 61800-3									
Mechanical design												
Size classes			C	D	D	E	E	G	G	G	H	H
Degree of protection			IP 20 according to EN 60529 (without terminal connections)									
Weight of the drive converter for cooling type												
Forced ventilation		[kg]	33	50	50	80	80	--	--	--	--	--
Liquid cooling		[kg]	25	37	37	60	60	180	180	180	358	358
Heat conducting plate		[kg]	--	--	--	--	--	--	--	--	--	--
Brake resistor												
Continuous braking power [8]		[kW]	0.4	0.6	0.6	0.8	1,2	2	2	2.5	4	5

[7] Maximum permissible motor output referred to a 4-pole standard induction motor.

[8] When the braking resistors are mounted in the air flow.

Technical Data for pulse frequency f_p = 10 and 12 kHz

RD51		1.5	3.0	4.0	5.5	7.5	011	015	018	022	030	037
Data for pulse frequency f_p = 10 kHz												
Rated current for 3-ph. 400 V AC (±15%)	[A]	2.6	4.9	6.5	8.5	11.5	15.5	21.5	26	32.5	39	48
Rated current for 3-ph. 460 V AC (±15%)	[A]	2.2	4.2	5.6	7.3	10.3	13.5	18.5	23	28.5	34.5	42
Data for pulse frequency f_p = 12 kHz												
Rated current for 3-ph. 400 V AC (±15%)	[A]	2.2	4	5.5	7	10	13	18	22	30	35	40
Rated current for 3-ph. 460 V AC (±15%)	[A]	1.9	3.5	4.8	6	8.7	11	15.5	19	26	30.5	35

RD51		045	055	075	090	110	132	160	200	315	400
Data for pulse frequency f_p = 10 kHz											
Rated current for 3-ph. 400 V AC (±15%)	[A]	60	75	89.5	108	108	168	200	245	355	468
Rated current for 3-ph. 460 V AC (±15%)	[A]	53	65.5	78	94	94	146	174	213	309	407
Data for pulse frequency f_p = 12 kHz											
Rated current for 3-ph. 400 V AC (±15%)	[A]	52	68	80	80	80	140	170	210	310	395
Rated current for 3-ph. 460 V AC (±15%)	[A]	45.5	59	69.5	69,5	69,5	122	148	183	270	344

1.4 Circuit principle

Electronic section

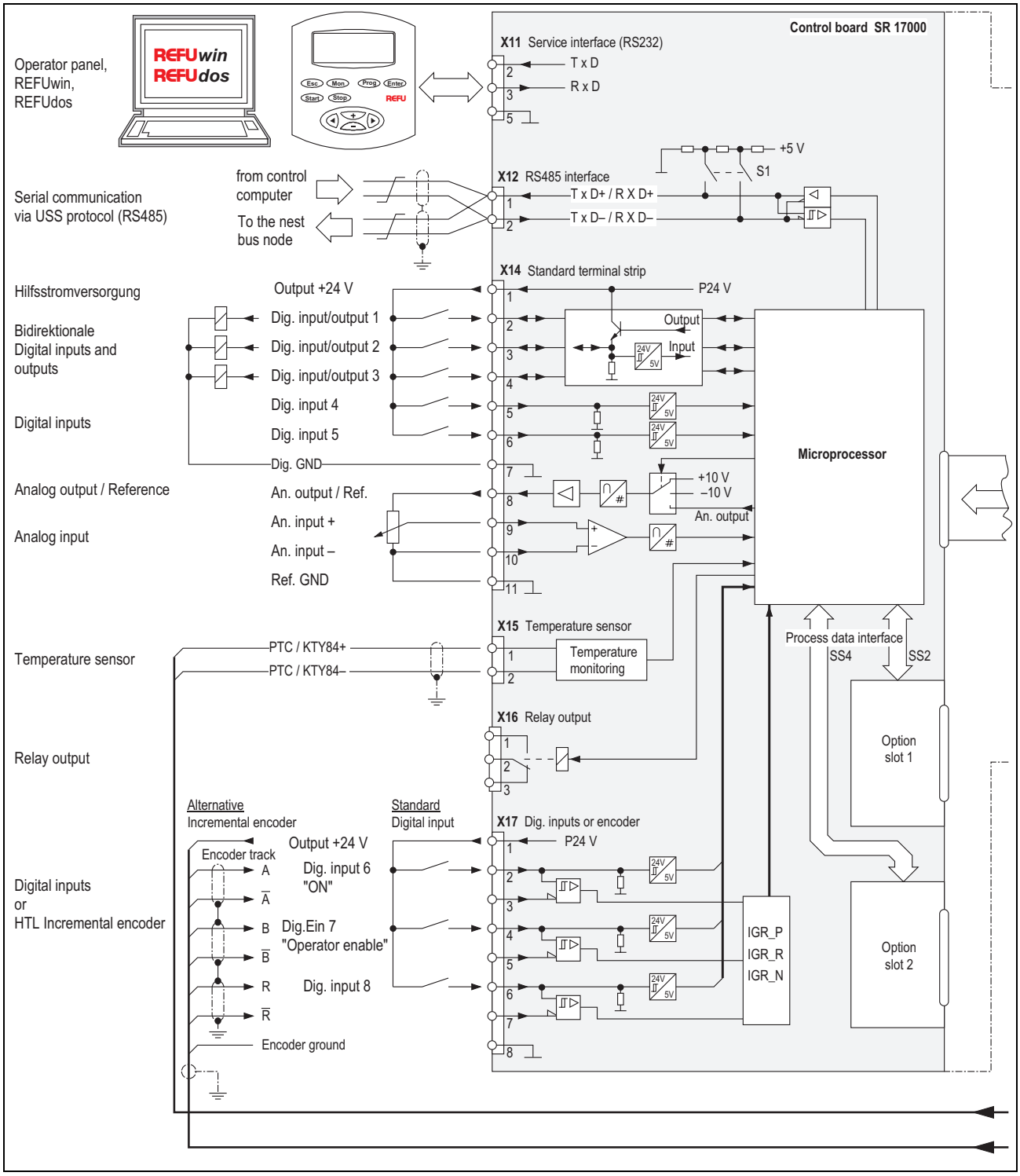


Fig. 1-2: Circuit principle of converter electronic section

Converter power section

Forced air cooling

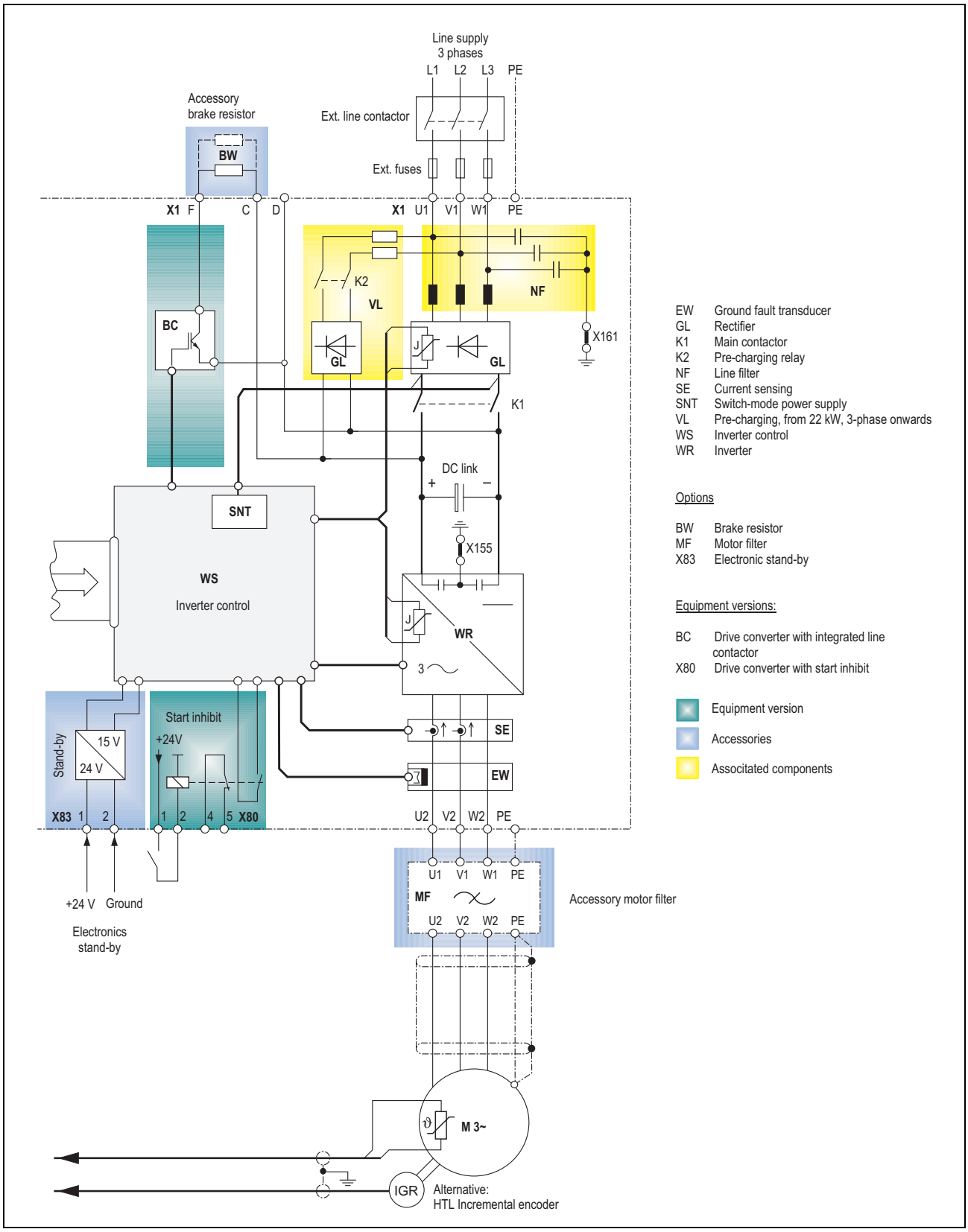


Fig. 1-3: Circuit principle of converter power section

Liquid cooling

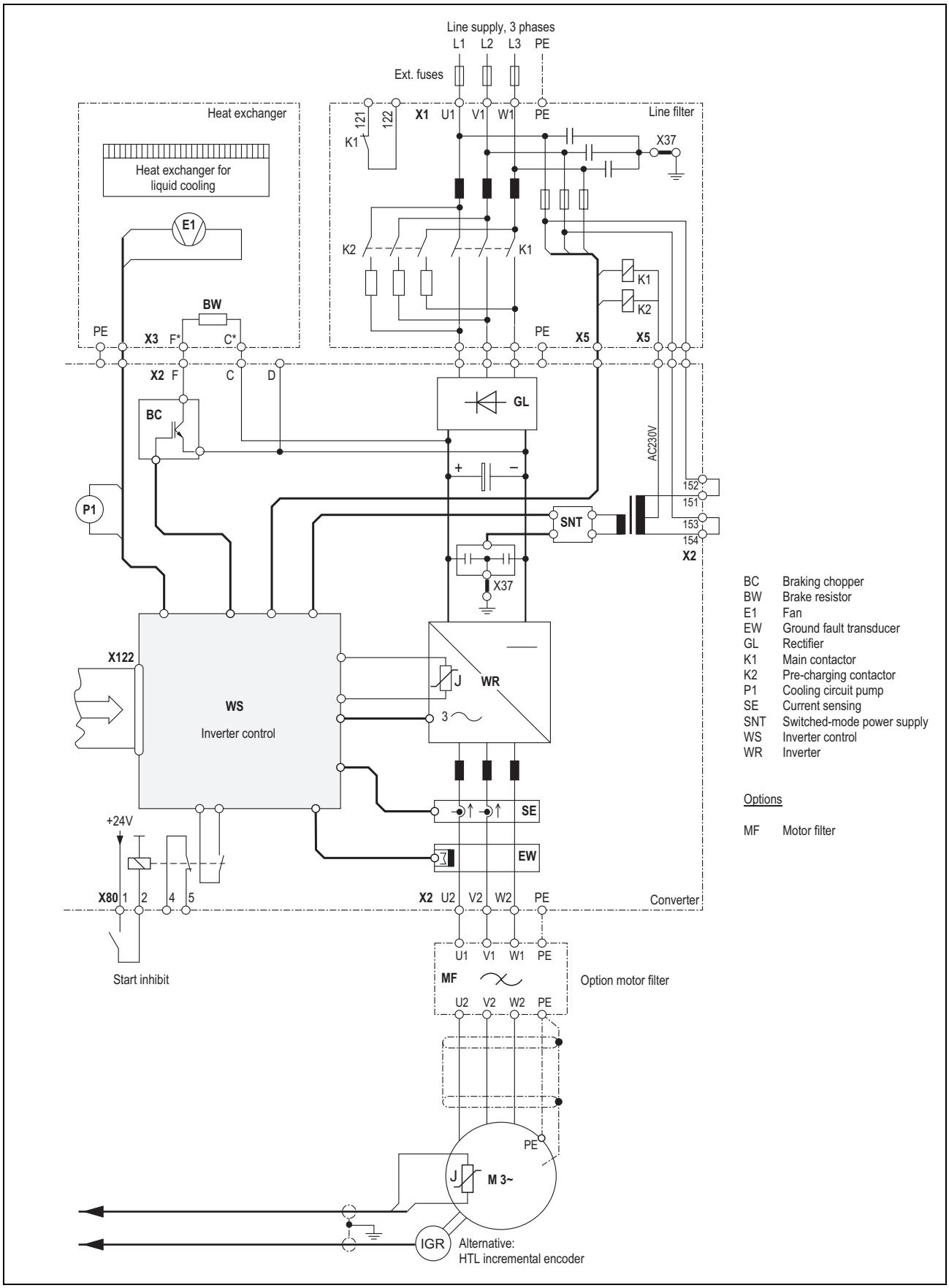


Fig. 1-4: Circuit principle of liquid cooled converter

1.5 Type code

In Preparation!

Abb. 1-5: Type code

2 Mechanically installation

2.1 Storage and installation location

Storage

The units must be stored in clean, dry rooms. The storage temperature must be between -25° C (-13° F) and +70° C (+158° F). Temperature fluctuations exceeding 20 K per hour are not permissible.

Note: AC drive converters and rectifier units include aluminum-Elko DC link capacitors. They can be stored for a maximum of 2 years in a no-voltage condition, for a storage temperature of 40 °C. If they are stored for longer than two years, these DC link capacitors must be re-formed before the unit is commissioned.

Minimum requirements regarding the installation location

- The rooms in which the drive converters are to be installed should be dust-free. Dust-laden air must be filtered (3K3 according to DIN IEC 721-3-3).
- The ambient temperature must be within the range 0...40° C (23° F ... 104 ° F).
- The relative air humidity may not exceed 90 %; moisture condensation is not permissible.
- The fan airflow may not be restricted. The minimum clearances for the air intake and air discharge may not be restricted using additional mounted components.
- The air drawn in may not contain any aggressive or electrically conductive gases which could have a negative impact on the functioning of the equipment.
- The unit dissipates heat and increases the temperature of the ambient air. Thus, sufficient clearance must be maintained to heat-sensitive equipment.

Installation altitudes exceeding 1000 meter above sea level:

For installation altitudes exceeding 1000 meters above sea level, the drive converter or inverter must be de-rated corresponding to the adjacent diagram.

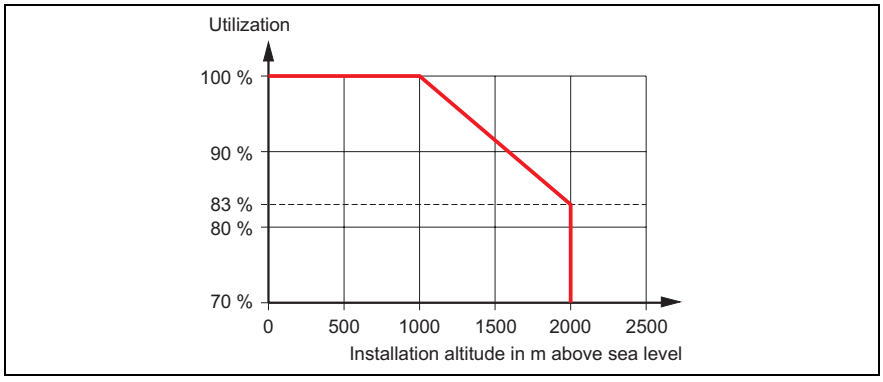


Fig. 2-1: Derating as a function of the installation altitude

2.2 Mounting units sizes A to E

- The REFU*drive 500* drive converters, sizes A to E are modular, and are designed for mounting in cabinets.
- The units have a modular dimension of 22.5 mm (0.88 inch). When using mounting rails with threaded holes in this grid pattern, several units can be mounted next to each other without having to maintain any intermediate space (also refer to the mounting example).
- The units must be mounted vertically on a mounting surface.
- A minimum 100 mm (3.9 inch) clearance must be maintained above and below the units to guarantee unrestricting cooling airflow.
- For cabinet mounting, the cooling air requirements of the mounted units (refer to the Technical Data Section 1) must be calculated and the cabinet cooling appropriately dimensioned.
- The required mounting screws are specified in the drilling templates of the dimensioned drawings.

Mounting example

Four inverters, sizes A, B, C and D are shown mounted next to one another in the diagram below.

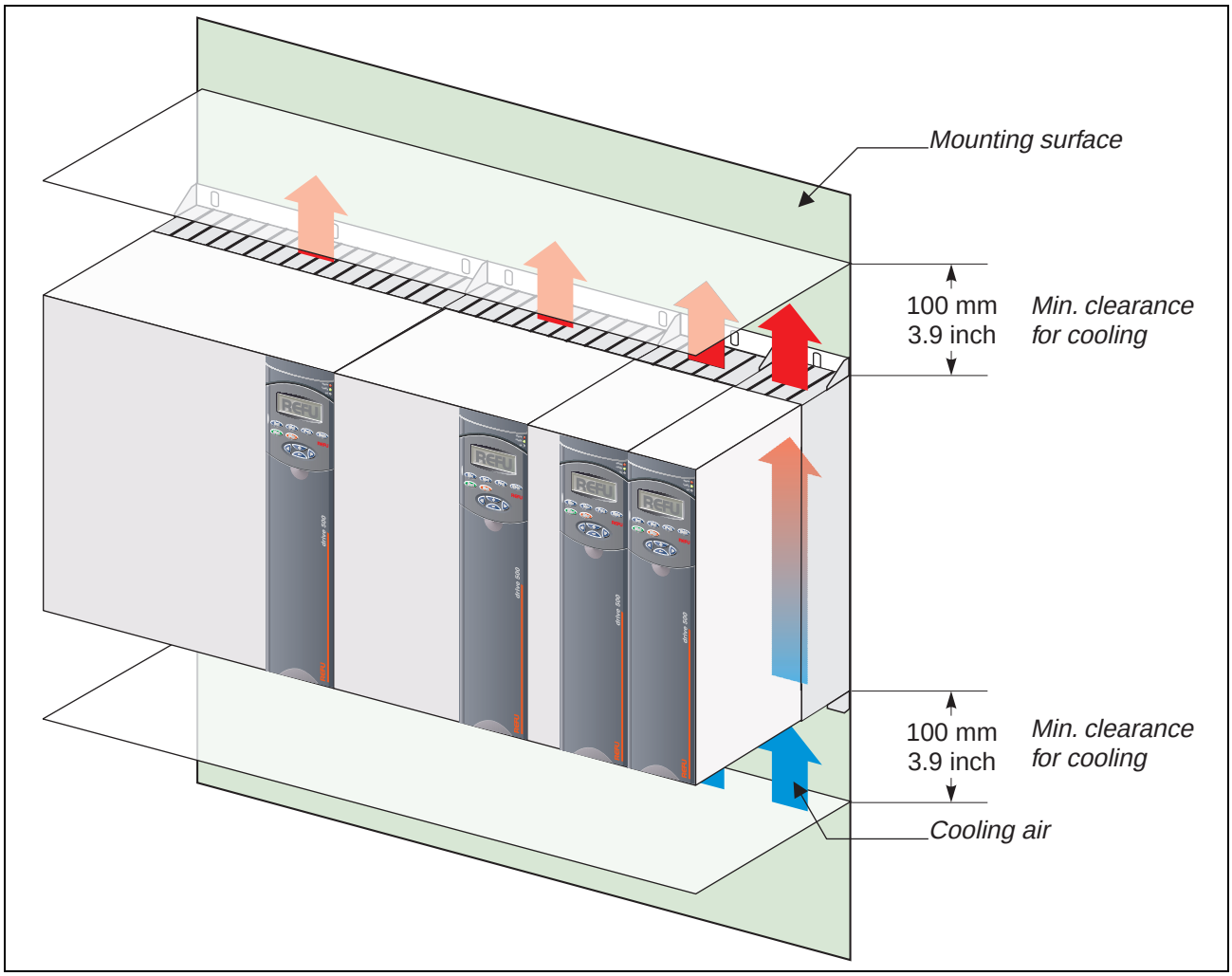


Abb. 2-2: Mounting example inverters

Dimension drawings front view, sizes A to E

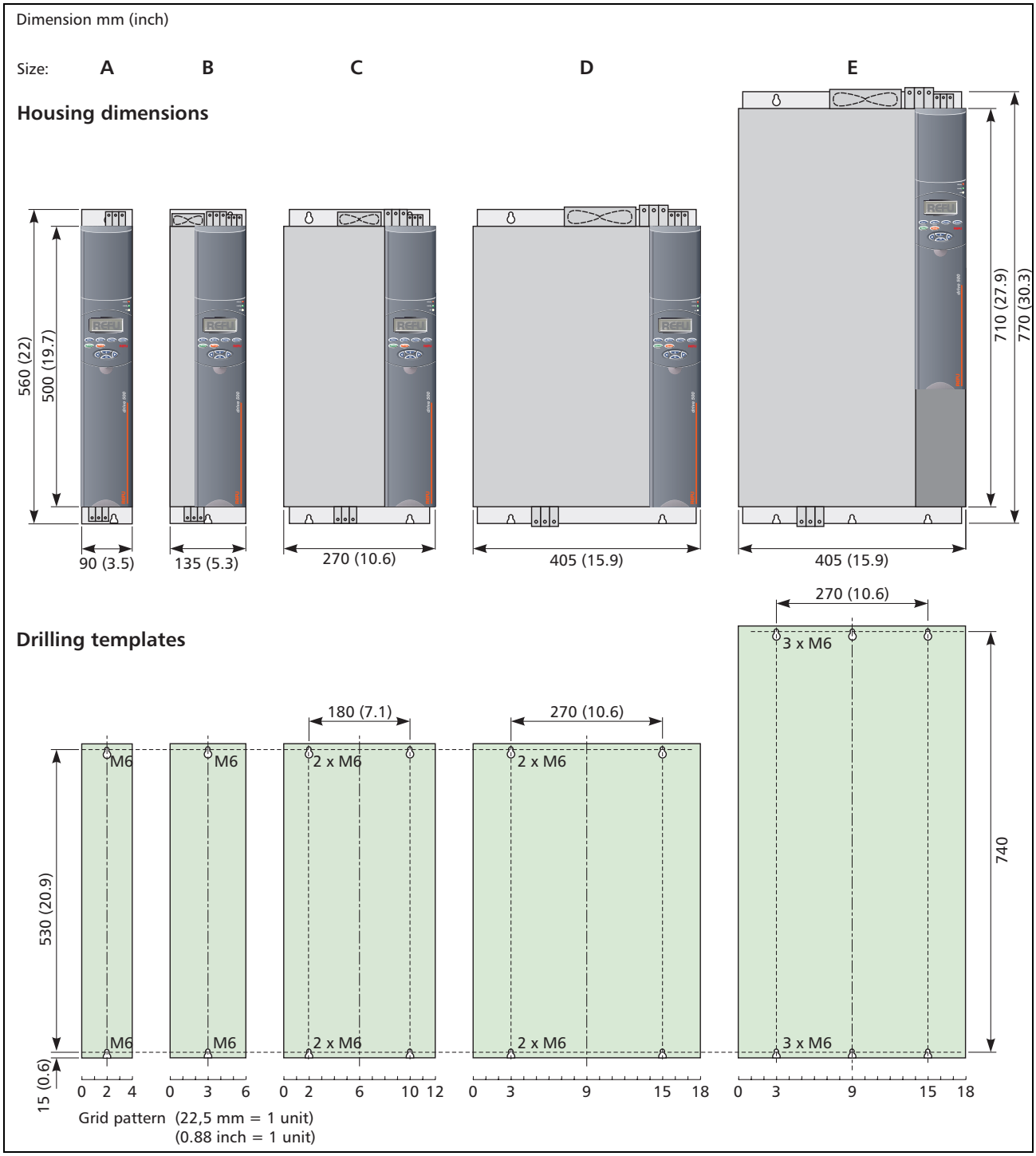


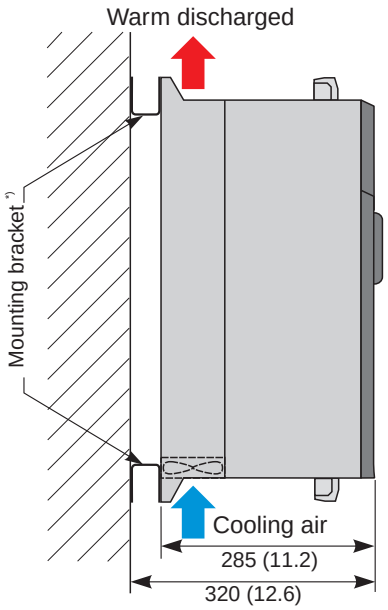
Abb. 2-3: Dimension drawings size class A to E

Dimension drawing side view, sizes A to E

For drive converters with forced air cooling, sizes A and B up to E have different depths. Clearance brackets are available for size A which equalizes the different depth when they are combined with converters from other classes; refer to the drawing below.

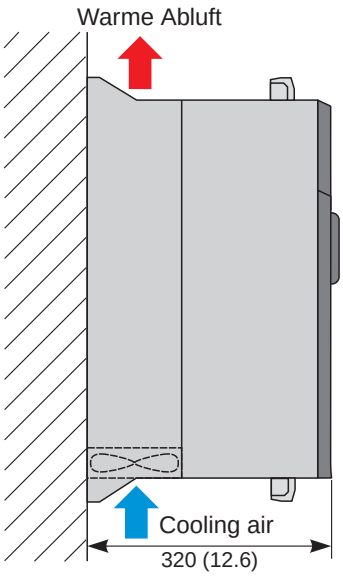
Dimension mm (inch)

Forced ventilation size A

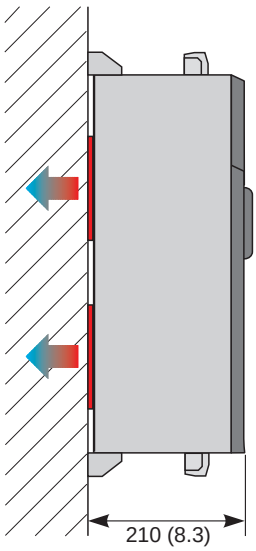


*) The clearance must be additionally ordered when required (option Z depth adaption for class A).

Forcierte Luftkühlung Grössenklasse B bis E



Heat discharge plate sizes A and B



Liquid cooling sizes A to E

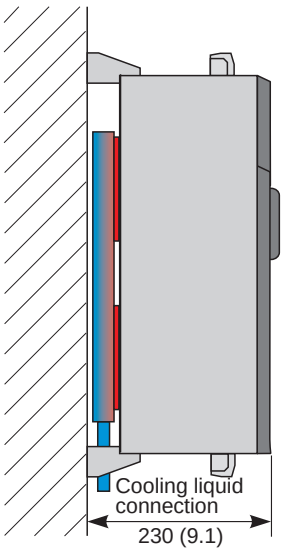


Abb. 2-4: Dimension drawing side view, size class A to E with different cooling types

2.3 Mounting liquid-cooled converters, sizes G and H with integrated heat exchanger

The converters, sizes G and H consist of the line filter, converter and heat exchanger. The drive converter and heat exchanger are mounted on a common mounting plate and connected up. For weight reasons, the line filter has its own mounting panel.

- The units must be mounted vertically on a flat mounting surface.
- A minimum of 200 mm clearance must be maintained above the units to ensure that the warm air discharge is not restricted.
- For cabinet mounting, the cooling airflow requirements of the mounted units (refer to the Technical Data, Section 1) must be calculated and the cabinet cooling appropriately dimensioned.
- The required mounting bolts are specified in the drilling templates of the dimension drawings.
- To mount the equipment using a crane or hoisting device, two devices are supplied with the equipment. These are introduced at both sides at the top of the mounting panel, and secured using a screw (refer to the dimension drawings).
- First mount the line filter and above it the mounting panel with converter and heat exchanger. The two mounting panels must be mounted directly underneath one another without any intermediate clearance, as shown in the dimension drawing to ensure correct cooling air routing. The busbars to connect the line filter and drive converter are supplied.

Dimension drawing with integrated heat exchanger, size G

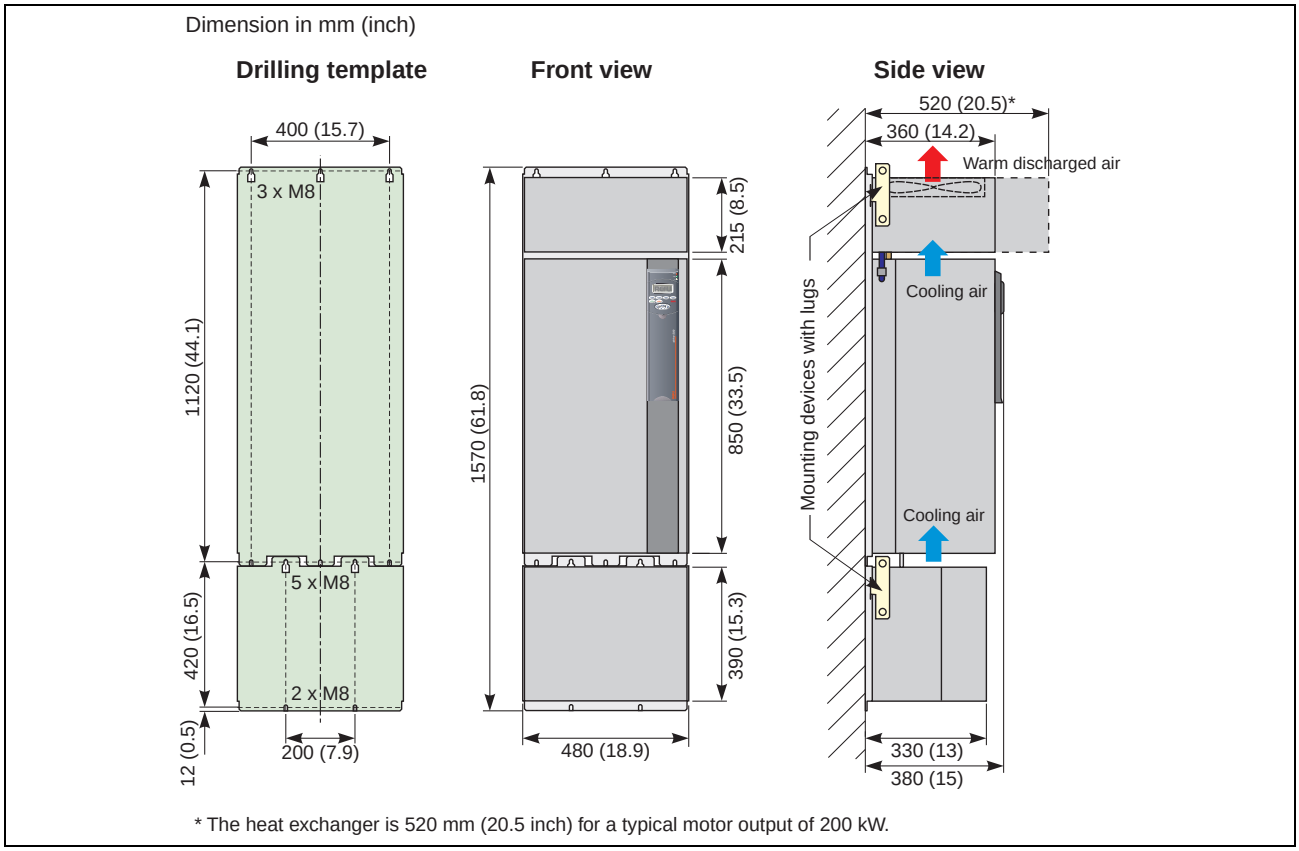


Abb. 2-5: Dimension drawing converter size class G

Dimension drawing with heat exchanger, size H

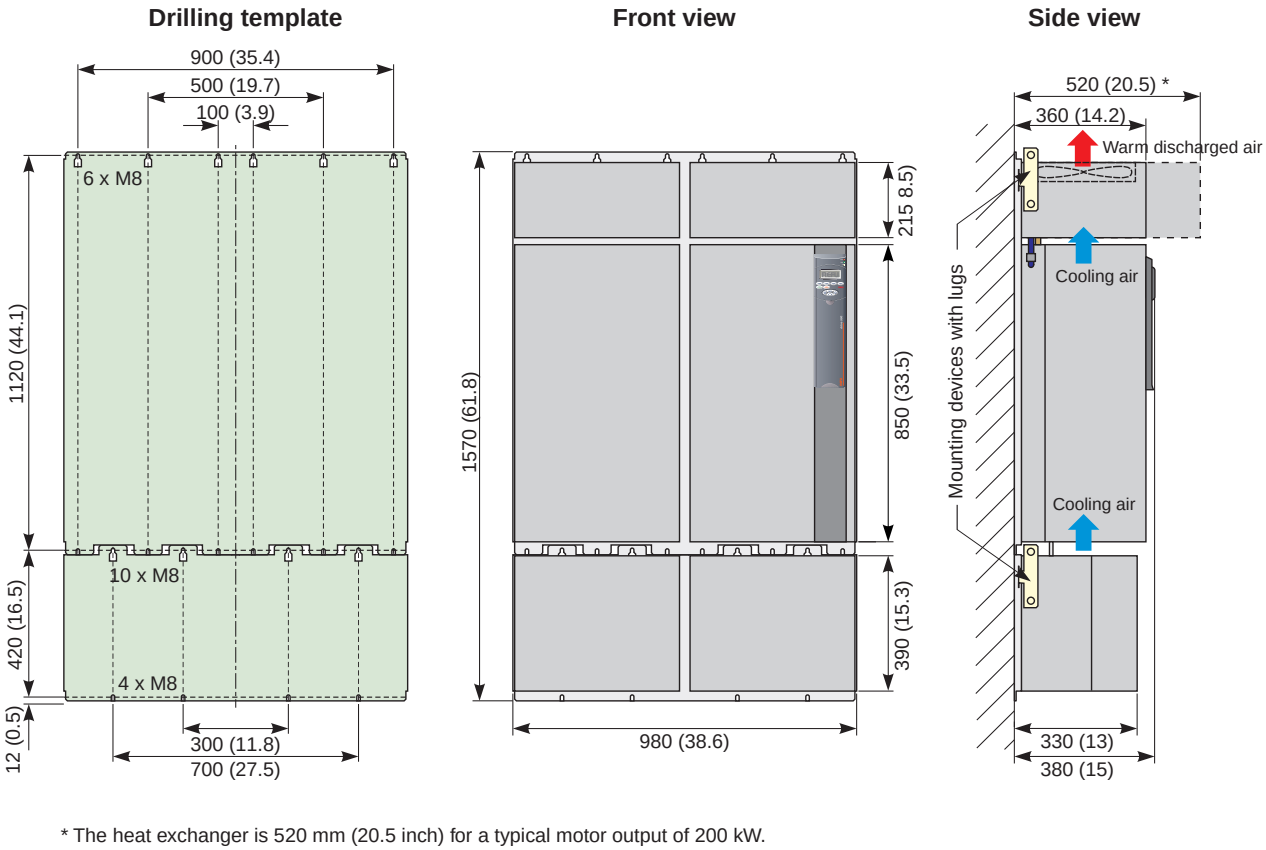


Abb. 2-6: Dimension drawing converter size class H

2.4 Mounting liquid-cooled converters, sizes G and H with external heat exchanger

Units, sizes G and H comprise line filter, converter and heat exchanger. Converter, line filter and heat exchanger are each mounted on their own mounting panel. If the heat exchanger is externally mounted, the drive converter is no longer cooled by the air flow from the heat exchanger. Thus, additional fans are provided on the drive converter. For 200 kW and 400 kW units, the internal power supply is not adequate for these additional fans. An external control transformer is supplied for the fan power supply.

- The units must be mounted on a flat mounting surface.
- A minimum clearance of 200 mm must be maintained above the units to guarantee that the hot air can be freely discharged.
- When the units are mounted in cabinets, the cooling airflow must be calculated (refer to technical data, Section 1), and the cabinet cooling must be appropriately dimensioned.
- The required mounting screws are specified in the drilling templates of the dimension drawings.
- Two elements are supplied to help mount the units. These are introduced at both sides at the top of the mounting panel and secured using a bolt (refer to the dimension drawings).

- First mount the line filter, and then above it the mounting panel with drive converter and heat exchanger. In order that the cooling air can freely flow, the two mounting panels must be mounted below one another as illustrated in the dimension drawing. The busbars to connect the line filter and drive converter are supplied.
- The control transformer to connect the fan in the drive converter must be mounted at a suitable position in the cabinet.
- Mount the external heat exchanger at the required location. Connect the cooling water circuit of the drive converter to the heat exchanger via cooling hoses; refer under 2.5 "Working on the cooling-medium circuit" for additional information. Depending on the particular requirements, the cooler hoses must be ordered together with the drive converter. Refer to the Technical Lists 2000 for additional information on the cooler hoses, hose clamps, couplings, angular connections, etc.

Dimension drawing of the drive converter and line filter without heat exchanger, size G

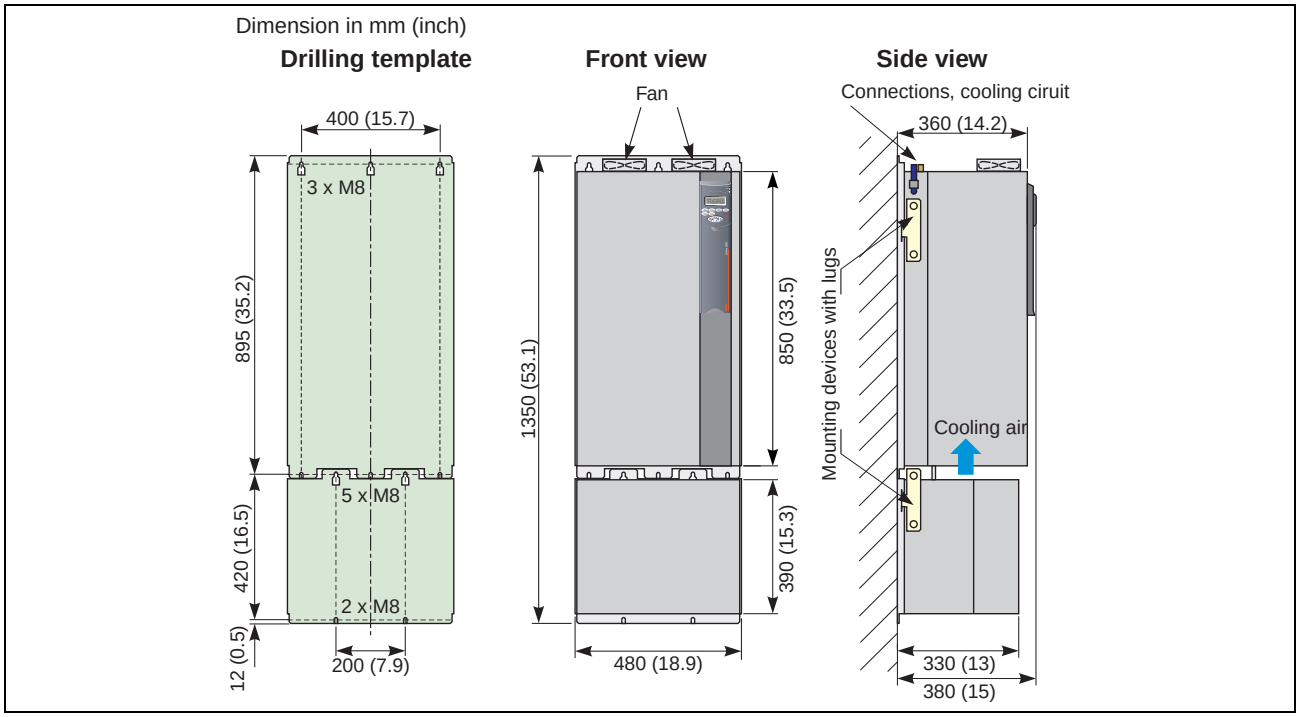


Abb. 2-7: Dimension drawing converter size class G without heat exchanger

Dimension drawing of the drive converter and filter without heatexchanger, size H

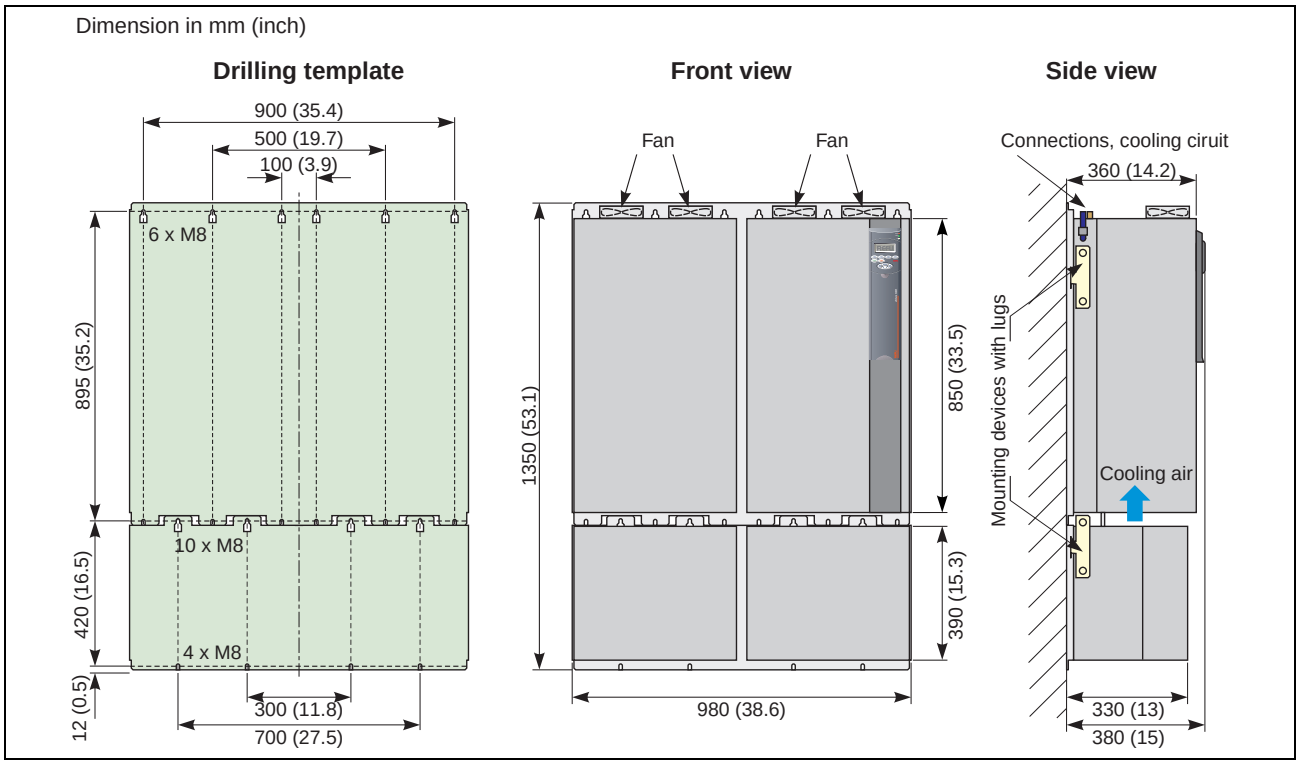


Abb. 2-8: Dimension drawing converter size class H without heat exchanger

Dimension drawing of the external heat exchanger for cabinet mounting

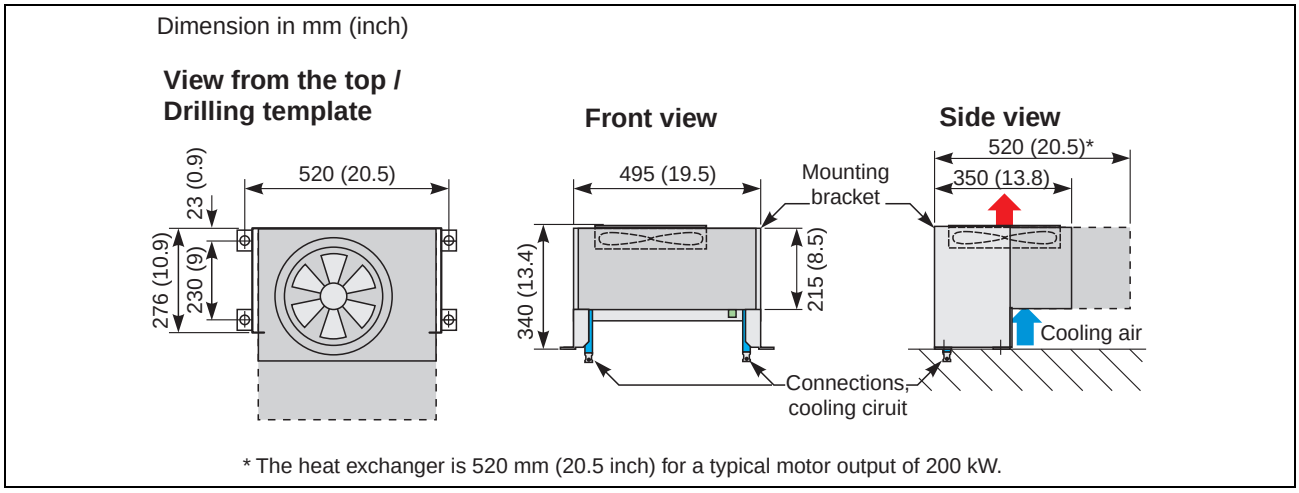


Abb. 2-9: Heat exchanger for cabinet mounting

Dimension drawings of the external heat exchanger for wall mounting

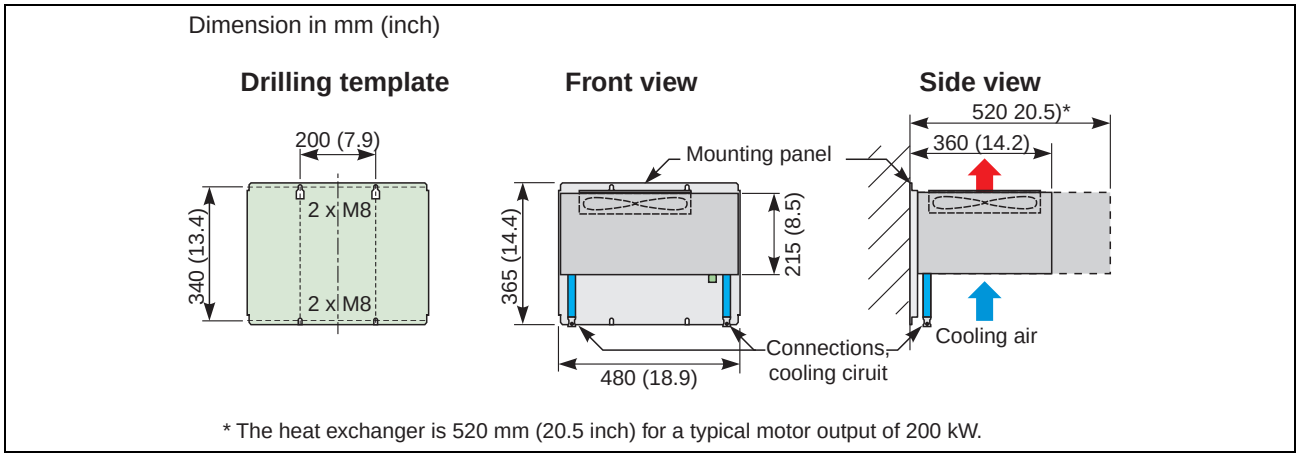


Abb. 2-10: Heat exchanger for wall mounting

2.5 Working on the cooling-medium circuit

Both versions of the liquid-cooled units with integrated- and external heat exchanger are supplied, filled. The cooling liquid comprises tap water (from the public supply) and anti-freeze, **type Antifrogen N (Clariant)** mixed in the ratio 1.5:1 (REFU Order No.: 0015343). This guarantees frost protection up to –30° C.

CAUTION

Anti-freeze agents is poisonous!

⇒ If accidentally swallowed, immediately contact a doctor and show him/her the packing or label on the anti-freeze container.

Mounting extension hoses for external heat exchangers

For units with external exchanger, all of the parts which are required to extend the hoses are supplied according to the customer information when ordered (hoses, connectors, couplings, hose clamps, cooler liquid

etc.). Customers must assembly the extension hoses themselves, as described below:

1. Shorten the heat exchanger hose to the required length.
2. Attach the connector with hose sleeve at one end using a hose clamp.
3. Using a funnel, fill the hose with the cooling medium provided. Connector and couplings have self-closing valves.
4. Attach the coupling with hose envelope at the other end of the heat exchanger hose using the hose clip.

Connect the drive converter to the heat exchanger using the heat exchanger hoses which have been filled with cooling medium. The valves of the connectors and couplings are self-closing which means that no liquid leaks-out when the heat exchanger hoses are connected or withdrawn. In order to vent the cooling system, the drive converter should be powered-up several minutes, so that the pump circulates the water in the cooling circuit. Smaller air bubbles in the cooling medium, which form when the extension hoses are connected-up, collect in the equalization chamber. After the air has been vented, check that the cooling liquid level is at the center of the equalization chamber. If this is not the case, cooling liquid must be added to the equalization chamber. The sheet steel cover of the heat exchanger must be removed to do this.

If the heat exchanger was connected up as described above, then it is no longer necessary to add liquid in the equalization chamber.

Servicing the cooling medium circuit

The cooling medium circuit is an enclosed cooling system and has neither to be serviced nor checked. If the "unit overtemperature" fault occurs in operation then the level of the cooling liquid should be checked to ensure that it is still at the center of the equalization chamber.

WARNING

If other anti-freeze agents are mixed, this can result in deposits which could accumulate and destroy the cooling system!

⇒ Do not mix the cooling medium with other anti-freeze agents!

⇒ If other anti-freeze agents are mixed, this can result in deposits which could accumulate and destroy the cooling system!

3 Electrical installation

3.1 EMC-compatible drive design

The following 10 rules are the basics for designing drive systems which are EMC-compatible. You'll find details in the Instruction Manuals supplied with the equipment.

You can obtain a detailed description "EMC-compatible drive design" from Indramat Refu, or from the Internet under http://www.refu.com.

Rules 1 to 7 are generally valid. Rules 8 to 10 are especially important to limit noise emission.

Rule 1 All metal parts of the cabinet should be connected with one another through the longest possible surface so that the best electrical connection is established. (Not paint on paint!) If required, use serrated washers which cut through the paint surface. The cabinet door should be connected to the cabinet using the shortest possible grounding straps.

Rule 2 Signal-, line supply-, motor- and power cables should be routed away from another (this eliminates mutual interference!). The minimum clearance is: 20 cm. Barriers should be provided between power- and signal cables. These barriers should be grounded at several locations.

Rule 3 Contactors, relays, solenoid valves, electromechanical operating hours counters etc. in the cabinet must be provided with noise suppression devices, e.g. using RC elements, diodes, varistors. These devices must be connected directly at the coil.

Rule 4 Unscreened cables of the same circuit (feeder and return cables) should be twisted with the smallest possible distance between them. Cores which are not used must be grounded at both ends.

Rule 5 Generally, noise which is coupled-in can be reduced by routing cables as close as possible to grounded sheet steel panels. For this reason, cables and wires should not be routed freely in the cabinet, but as close as possible to the cabinet itself and the mounting panels. This is also true for reserve cables.

Rule 6 Incremental encoders must be connected using a shielded cable. The shield must be connected at the incremental encoder and at the AC drive converter through the largest possible surface area. The shield may not be interrupted, e.g. using intermediate terminals.

Rule 7 The screens of signal cables must be connected to ground at both ends through the largest possible surface area to establish a good electrical connection (transmitter and receiver). If the potential bonding between the screen connections is poor, to reduce the screen current, an additional potential bonding conductor with a cross section of at least 10 mm² should be connected in parallel with the screen. The screen can be connected to ground (=cabinet housing) at several locations. This is also true outside the cabinet. Foil screens are not recommended. Braided screens provide a better screening (factor of 5). If the potential bonding is poor, analog signal cables may only be connected at one end to the drive converter in order to prevent low-frequency noise being injected into the screen (50 Hz).

Rule 8 Always locate a radio interference suppression filter close to the noise source. The filter should be connected through the largest possible surface area with the cabinet housing, mounting panel etc. The best solution is a bare metal mounting panel (e.g. manufactured from stainless steel, galvanized steel), as the complete mounting surface can be used to establish good electrical contact.

The incoming and outgoing cables of the radio interference suppression filter should be separated.

Rule 9 All variable-speed motors should be connected using screened cables, whereby the screen is connected at both ends to the housings through the largest possible surface area to minimize the inductance. The motor cables should also be screened outside the cabinet, or at least screened using barriers. Suitable motor cables, e.g. Siemens PROTOFLEX-EMV-CY (4x1.5 mm^2... 4x120 mm^2) with copper screen.

Steel-screened cables are not suitable.

To connect the screen at the motor, a suitable PG gland with screen connection can be used (e.g. „SKINDICHT SHV/SRE/E“ from the Lapp Company, Stuttgart). It should be ensured that the connection between the motor terminal box and the motor housing has a low impedance. Otherwise, use an additional grounding strap between them.

Never use plastic motor terminal boxes!

Rule 10 The screen between the motor and AC drive converter may not be interrupted by installing components such as output reactors, sinusoidal filters, motor filters, fuses, contactors. The components must be mounted on mounting panels which also simultaneously serve as screen connection for the incoming and outgoing motor cables. If required, metal barriers may be required to screen the components.

3.2 Warning notes and informations

DANGER

High electrical voltage! Danger to life, severe electrical shock and severe bodily injury!

⇒ REFUdrive 500 drive converters are operated at high voltages. Work on the equipment may only be carried-out when the equipment is in a no-voltage condition!

⇒ Only qualified personnel may carry out work on the equipment!

⇒ Death, severe bodily injury and significant material damage could result if this warning information is not observed.

⇒ The drive converter can still be at hazardous voltage levels up to 5 minutes after the equipment has been disconnected, due to the DC link capacitors. Thus, work may only start on the drive converters or the DC link terminals after an appropriate delay time has expired.

⇒ Even when the motor is at a standstill, the power- and control terminals could still be under volt-age.

⇒ If the DC link voltage is centrally supplied, it should be ensured that the inverter is safely isolated from the DC link voltage!

⇒ When working on a unit which has been opened, it should be observed that live components are exposed.

⇒ The user is responsible in ensuring that all of the drive converters are mounted and connected according to the recognized technical regulations in the country of installation as well as any other regionally valid regulations. Cable dimensions, fusing/protection, grounding, shutdown, isolation and overcurrent protection must be especially taken into account.

CAUTION

Observe the supply voltage!

⇒ The REFU*drive 500* units are designed and manufactured for various line supply voltages! Thus, line supply voltages are not specified in the drawings and tables for the terminal strips.

⇒ When connecting-up the equipment, please observe the line supply voltage specified on the rating plate and in the Technical Data.

Information regarding protective grounding

As a result of the equipment discharge currents (>3.5mA) through the protective conductor (PE), according to DIN VDE0160, the cross-section of the protective conductor to the cabinet must be at least 10mm^2 Cu, or a second protective conductor must be connected in parallel. (VDE 0160, Section 6.5.2). The equipment discharge currents can be up to 100 mA.

For higher ratings, the minimum cross-section of the protective conductor must have the appropriate relationship to the cross-section of the phase conductor. Refer to DIN 57100 Part 540 / VDE 0100 Part 540 Table 2. The line-side circuit of the drive converter corresponds to circuit 7 (DIN VDE 0160-5.5.3.4.2 Fig. 8).

In this case, it is not permissible to use e.l.c.b.'s as protective device.

3.3 Conductor cross-section

The conductor cross-sections refer to the rated drive converter current.

The associated protective conductor cross-section must be a minimum of 10 mm^2 (if cables have cable cross-sections > 10 mm^2, the protective conductor must have the same cross-section).

For line supply cables (feeder cables), the following assumptions are made:

- The cross-sections are valid for one phase for multi-core cables and was defined in accordance with VDE0298.
- Up to 35 mm^2, individual cores in the cable duct.
- Above 50 mm^2, free routing in the cabinet without coming into contact with other cables or equipment (as an alternative, busbars are recommended).

For motor feeder cables, the following assumptions are made:

- The cross-sections are valid for shielded four-conductor cables, and were defined according to VDE0298.
- Up to 35 mm^2, routing in cable ducts without cable clumping
- From 50 mm^2, free, routing in the cabinet without coming into contact with other cables or equipment.

Equipment output for 400/480 V	Supply connection				Motor connection	
	Recommended min. cross-section		Cable cross-section range 1)	Maximum fusing Type gL	Recommended min. cross-section	Cable cross-section range 1)
	converters 2)	inverters 3)				
[kW]	[mm^2]	[mm^2]	[mm^2]	[A]	[mm^2]	[mm^2]
1,5	2,5	2,5	0,2 - 4	5	2,5	0,5 - 10
3,0	2,5	2,5	0,2 - 4	10	2,5	0,5 - 10
4,0	2,5	2,5	0,2 - 4	16	2,5	0,5 - 10
5,5	2,5	4	0,2 - 4	16	2,5	0,5 - 10
7,5	4	4	0,2 - 4	20	4	0,5 - 10
11	10	10	0,5 - 25	35	6	0,5 - 16
15	10	16	6 - 25	35	10	0,5 - 16
18,5	16	16	6 - 25	50	10	0,5 - 16
22	16	25	16 - 50	50	16	25 - 50
30	25	35	16 - 50	63	25	25 - 50
37	35	35	25 - 50	80	35	25 - 50
45	50	50	25 - 50	100	50	25 - 50
55	50	50	35 - 95	125	50	35 - 95
75	50	95	35 - 95	160	50	35 – 95
90	95	95	35 - 95	250	50	35 - 95
110	95	2 x 50	50 - 110	250	70	50 - 110
132	95	2 x 50	50 - 110	250	95	50 - 110
160	2 x 50	2 x 70	50 - 110	315	2 x 50	50 - 110

200	2 x 70	3 x 70	70 - 185	400	2 x 70	70 - 185
315	3 x 70	4 x 95	Bolzenanschluss M16	630	3 x 70	Bolzenan-schluss M16
400	4 x 95	4 x 95	Bolzenanschluss M16	1000	3 x 95	Bolzenan-schluss M16

1): As a result of the terminal size
2): Frequency converters; feeder cables at U1, V1, W1
3): Inverters; feeder cables at C, D

Fig. 3-1: Cable cross section for mains- and motor connection

3.4 Power terminals RD51, size class A - E

Terminal layout diagram, size class A

Note: The P24V electronics standby power supply (terminal X83) is only installed if this was specified when ordering. It may only be retrofitted by our service department.

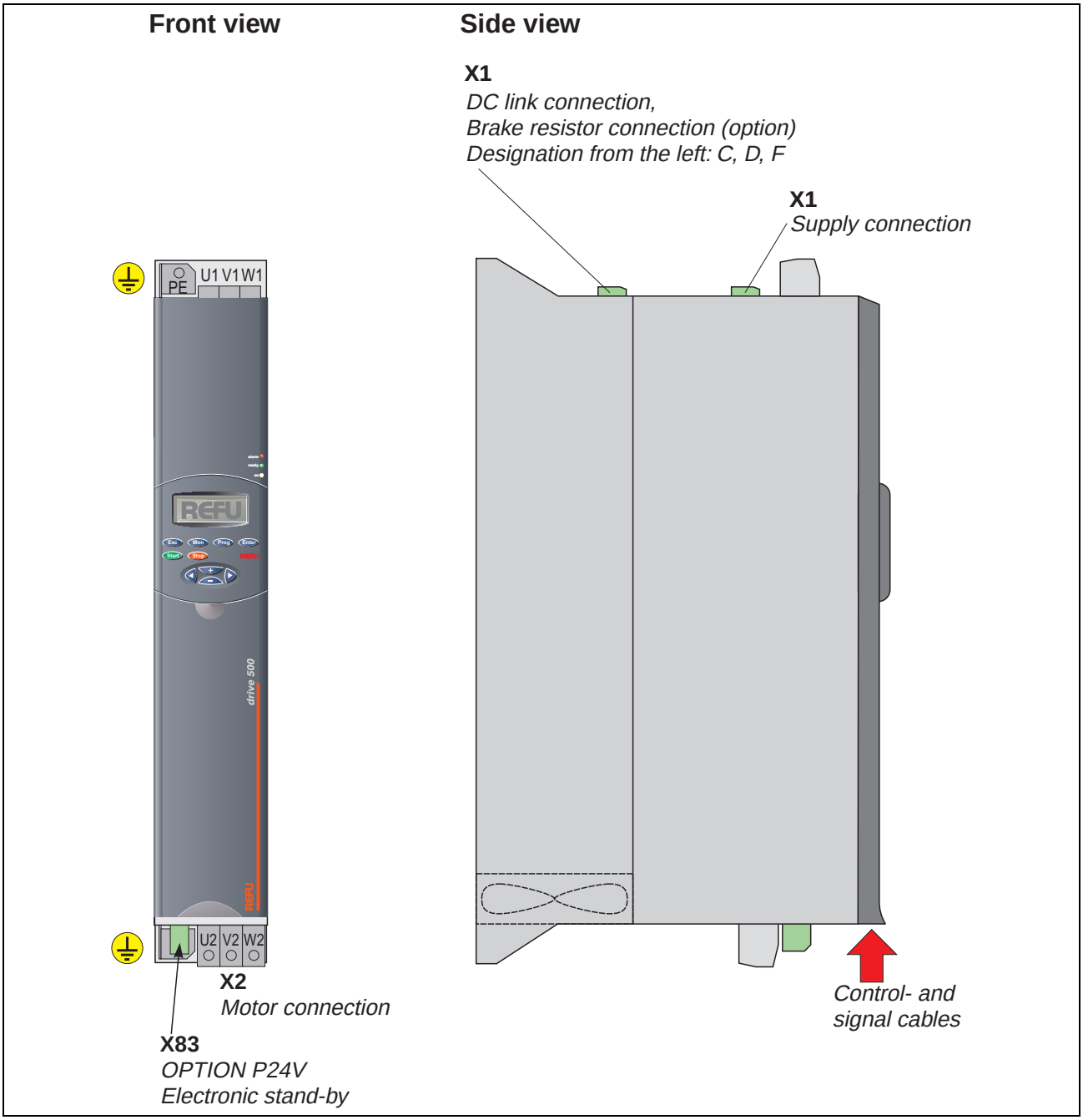


Abb. 3-2: Terminal layout diagram size A

Terminal layout diagram, sizes B - E

A drive converter, size C (270 mm wide) is illustrated in the terminal layout diagram. The terminal position is the same for narrower or wider units. Line supply-, DC- and brake resistor connections are always at the top and the motor connections at the bottom in the housing.

Note: The P24V electronics standby power supply (terminal X83) is only installed if this was specified when ordering. It may only be retrofitted by our service department.

Abb. 3-3: Terminal layout diagram size B - E

Description of the power terminals, size class A to E

Terminal	Comment
X1	**Line-, DC link-, brake resistor connection**
PE	Protective conductor connection; sheet steel lug on the housing with captive nut, for sizes A and B = M5, for sizes C to E = M6
L1 / U1	Supply connection, 3 phases L1, L2, L3 Permissible line supply voltage, refer to the rating plate on the upper section of the equipment.
L2 / V1	
L3 / W1	
C	DC link connection L+
D	DC link connection L-
F	OPTION: An external brake resistor can be connected between C and F

X2	Motor terminal
U2	Motor connection U, V, W
V2	
W2	
PE	Protective conductor connection, motor and screen connection for the motor cable; Sheet steel lug with captive nut on the housing, for sizes A and B = M5, for sizes C and D = M6

X83	OPTION P24V stand-by supply for the electronic (the terminal is only mounted for equipment with the integrated OPTION)
1	+24 V uncontrolled (18 V ... 30 V), power drain approx. 40 W
2	Ground

3.5 Power terminals RD51, sizes G and H

After they have been mounted, only the electrical connections have to be established between the line filter and drive converter:

- Bolt-on the busbars provided, between the main contactor of the line filter and the drive converter.
- Insert the cable assembly with connector (coming from the line filter) into terminal strip X5 on the drive converter.

Terminal layout diagram, size G

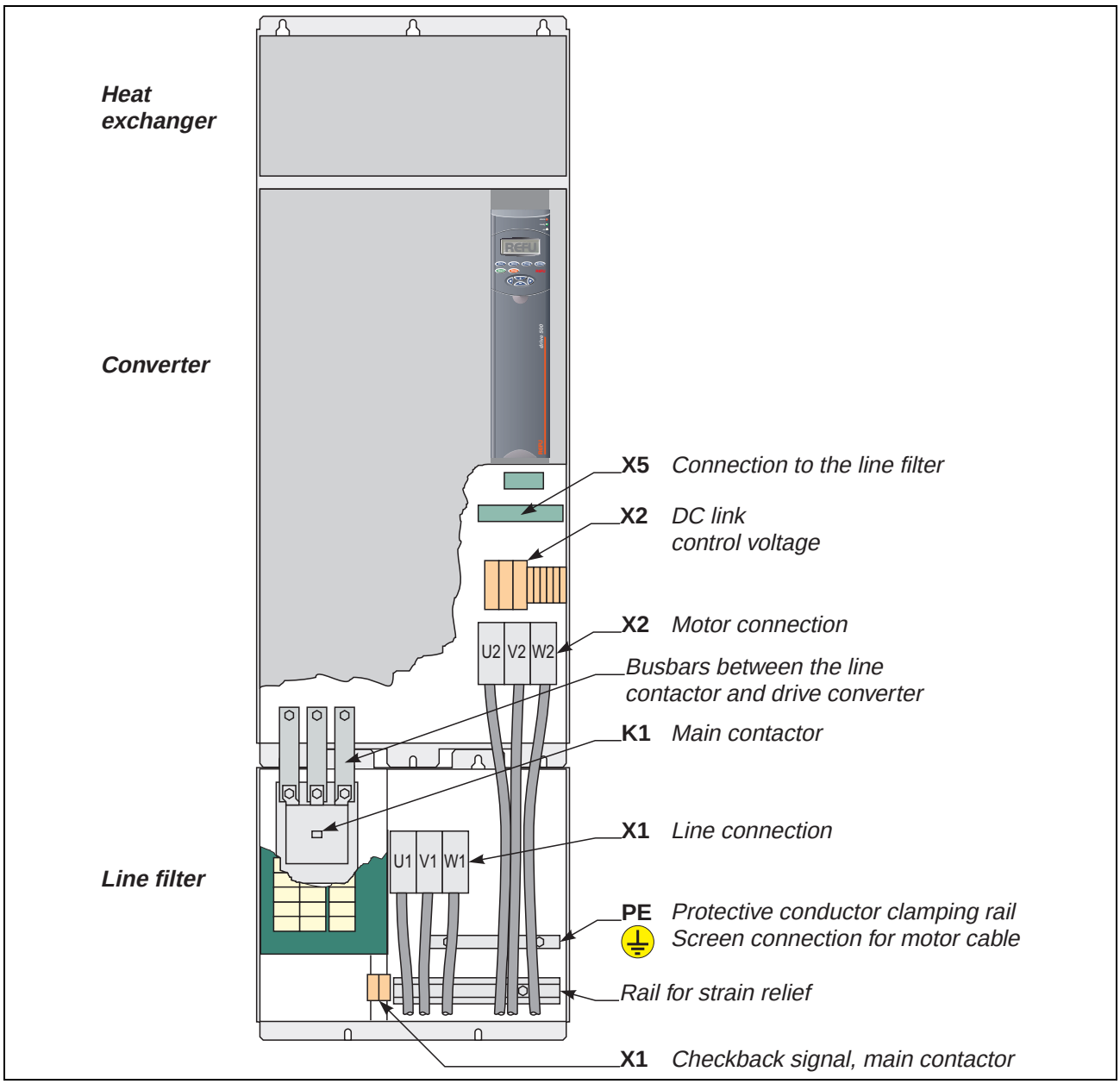


Abb. 3-4: Terminal layout diagram size class G

Terminal layout diagram, size H

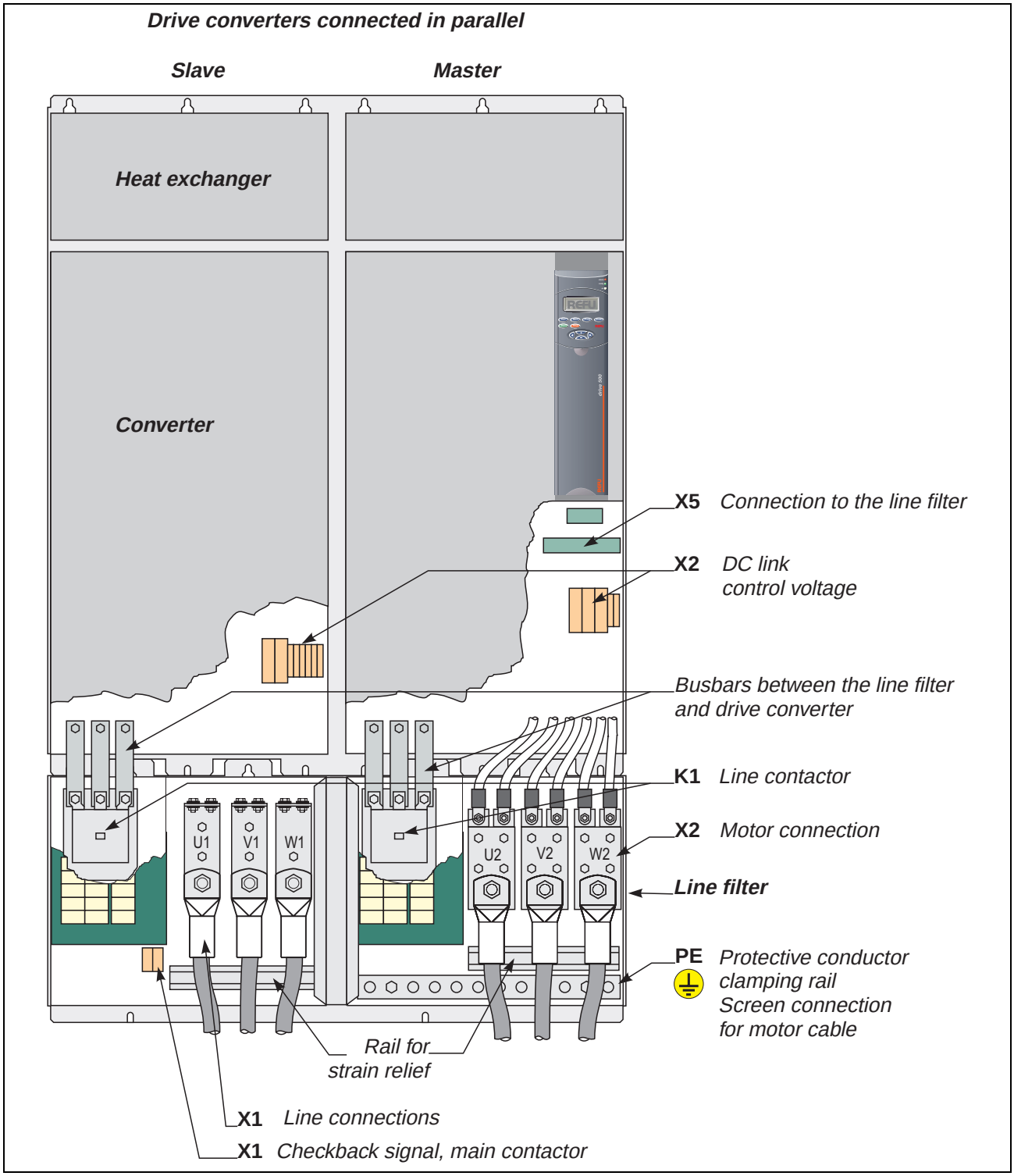


Abb. 3-5: Terminal layout diagram size class H

Description of the power terminals, sizes G and H

Terminal	Comment	
X1	**Supply connection**	
PE	Protective conductor connection; for size G = terminal rail with cable terminal for size H = terminal rail with M16 studs	
U1	Supply connection, 3 phases L1, L2, L3 Permissible line supply voltage, refer to the rating plate	
V1		
W1		
121	Checkback signal contact (NC contact) from the main contactor	
122		
X2	**Motor connection, DC link, line supply isolation**	
C	DC link terminal L+	
D	DC link terminal L-	
F	Internal brake resistor in the heat exchanger is connected between C and F	
1 (L/P)	Heat exchanger fan connection	
2 (0V AC)		
U2	Motor connection U, V, W for size G = cable terminal for size H = M16 studs	
V2		
W2		
151	**Function**: Isolating from the line supply In operation, terminals 151 - 152 and 153 - 154 must remain closed; when they are opened, the unit is isolated from the line supply. If isolation from the line supply is required, both terminals must be opened, in order to avoid erroneous function when a ground occurs. When the terminals are opened, the **auxiliary circuits are in a no-voltage condition,** and the open-loop and closed-loop control **does not** function.	
152		
153		
154		
155	**Function**: Isolating from the line supply In operation, terminals 155 - 156 and 157 - 158 must remain closed; when they are opened, the unit is isolated from the line supply. If isolation from the line supply is required, both terminals must be opened, in order to avoid erroneous function when a ground occurs. When the terminals are opened, the **auxiliary circuits are in a no-voltage condition,** and the open-loop and closed-loop control **does not** function.	
156		
157		
158		
X5	**Control voltages for the line supply filter**	
1	Control voltage supply, 3 x AC	The customer must establish the connection from the line filter to the drive converter after mounting. Insert the cable assembly with connector (coming from the line filter) into X5.
3		
5		
7	Control for pre-charging- and main contactor with checkback signal (NO contact) for the main contactor.	
9		
11		

3.6 Connection diagrams

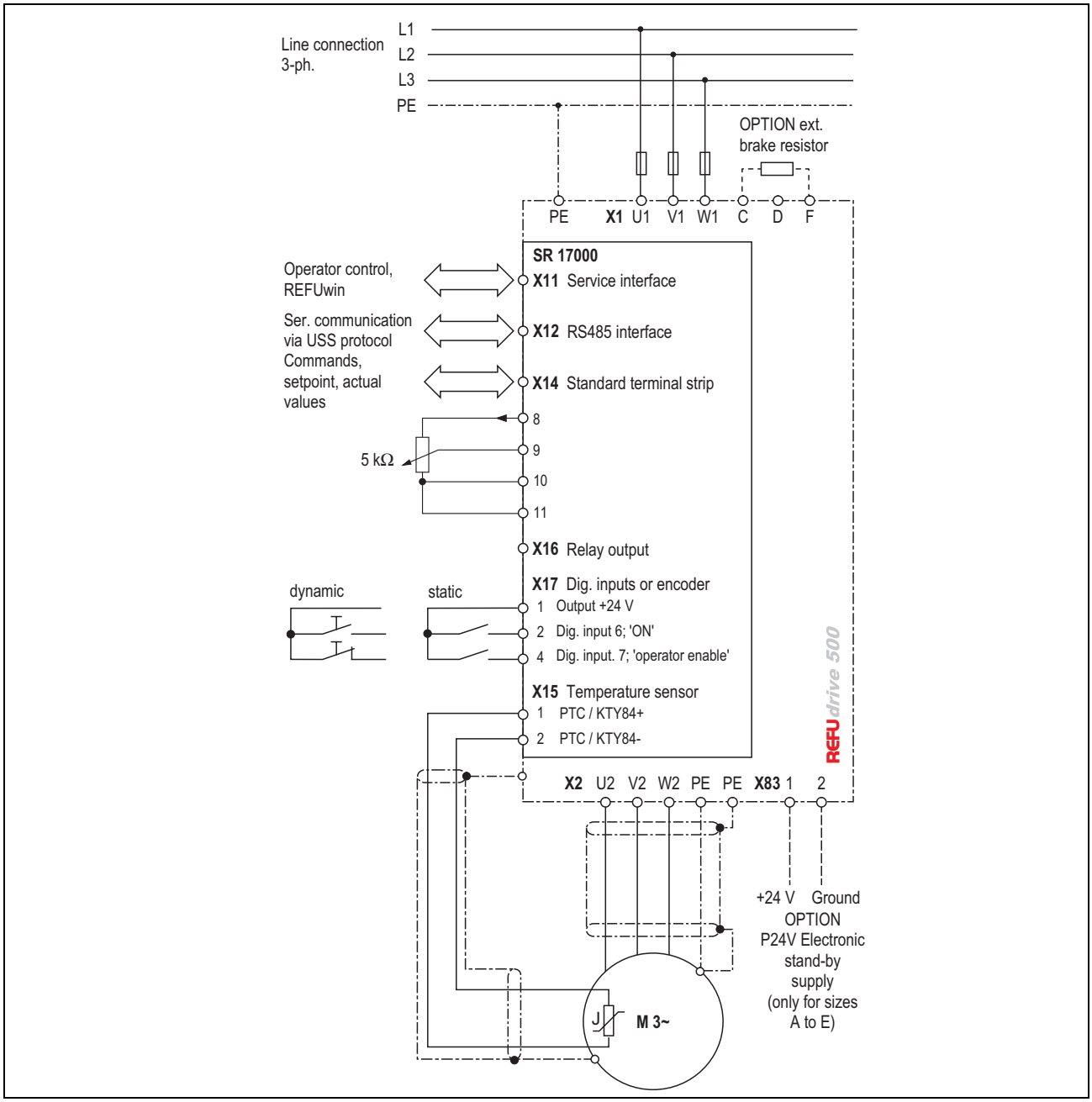


Abb. 3-6: Connection diagram for frequency converter

3.7 Control terminals

Terminal layout diagram SR17000

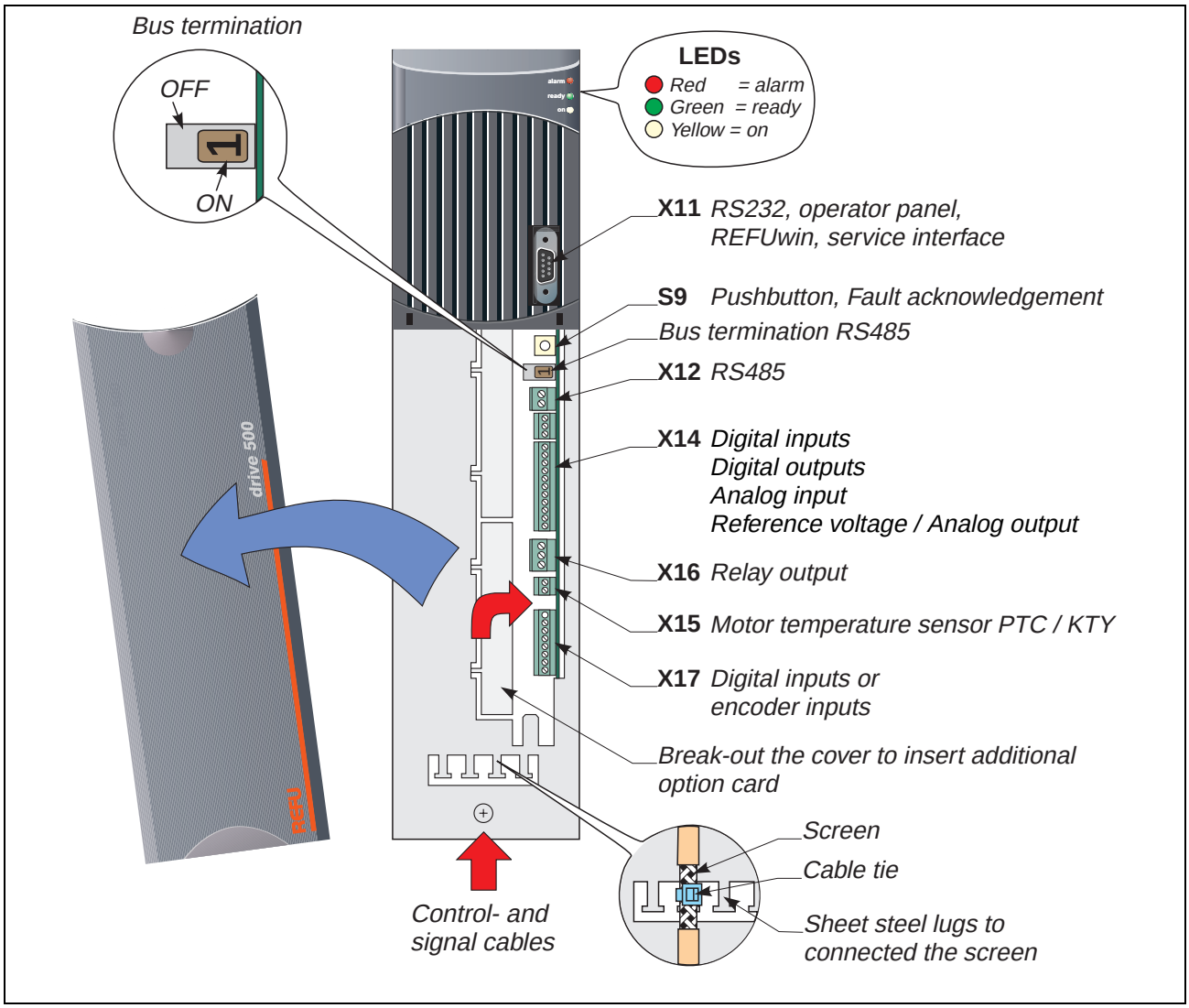


Abb. 3-7: Control terminals on the control board SR17000

Description of the control terminals

Terminal	Designation	Comment
X11	**Service interface**	
3	R x D	RS232 service interface; • to insert the operator panel • to connect a PC with the REFU*win* HMI
2	T x D	
5	Ground	
X12	**RS485 interface**	
1	R x D+ / T x D+	RS485 interface; communications with the USS protocol
2	R x D- / T x D-	

Terminal	Designation	Comment	
X14	**Standard terminal strip**		
1	P24V output	Load capability, max. 50 mA	
2	Dig. input 1 Dig. output 1	Digital inputs without electrical isolation: Input current for 24 V: 8.6 mA H signal: +13 V ... +33 V L signal: –3 V ... +5V or open-circuit terminal Digital outputs H signal: +21 V, max. 20 mA L signal: 0 V	Optional input / output; function can be selected with P0875
3	Dig. input 2 Dig. output 2		Optional input / output; function can be selected with P0876
4	Dig. input 3 Dig. output 3		Optional input/ output; function can be selected with P0877
5	Dig. input 4		Function can be selected with P0878
6	Dig. input 5		Function can be selected with P0879
7	Digital Ground	Reference ground +24 V (X14.1)	
8	±10 V reference Analog output	Optional function, can be switched-over with P0890: • reference voltage +10 V • reference voltage –10 V • analog output 0 ... ±10 V	
9	Analog input+	Differential input, can be optionally set: • ±10 V; A/D converter ±9 Bit; resolution 20 mV, R_e = 40 k□ • 0 ... 20 mA; A/D converter 10 Bit; resolution 0,02 mA, R_e = 150 □ • 4 ... 20 mA; A/D converter 10 Bit; resolution 0,02 mA, R_e = 150 □	
10	Analog input -		
11	Analog Ground	Reference ground, reference voltage / analog output (X14.8)	
X15	**Motor temperature sensor**		
1	PTC / KTY+	Motor temperature sensor connection (PTC or KTY84). Observe the polarity when connecting a KTY84!	
2	PTC / KTY -		
X16	**Relay output**		
1	NO contact	Relay output Load capability: 250 V AC, 7 A 30 V DC, 7 A	
2	Common contact		
3	NC contact		
X17	**Digital inputs / speed encoder**		
1	P24V output	I_{maxIGR} = 250 mA – (No. of digital outputs ∗ 11,4 mA) When connecting the terminal strip expansion option Term. 17037: I_{maxIGR} = 150 mA – (No. of digital outputs ∗ 11,4 mA)	
2	Dig. input 6 encoder track A+	Selectable function: digital input / encoder (IGR) The standard function of the terminals is digital input; the technical data are the same as for digital inputs 1 to 5. In the factory setting, • digital input 6 has the "**On**" function • digital input 7, has the "**operating enable**" function • the function of digital input 8 can be selected using P0880. Optional speed encoder connection: Incremental encoder with 24 V power supply, two signal tracks, zero signal track and complementary tracks.	
3	encoder track A-		
4	Dig. input 7 encoder track B+		
5	encoder track B-		
6	Dig. input 8 encoder track R+		
7	encoder track R-		
8	Ground P24V (GND)	Reference ground for +24 V (X17.1)	

Fig. 3-8: Description of the control terminals on the control board SR17000

Incremental encoder connection

Terminal strip X17 has a double function. When supplied, the terminals are used as digital inputs. A connection for an HTL incremental encoder can be selected using parameter P0130 (encoder selection).

Note to Engineering/configuring instructions

The maximum cable length between the encoder and evaluation electronics depends on the encoder

Observe the limiting frequency of the evaluation electronics as well as the encoder.

Signal characteristics when rotating clockwise, viewing the A end of the motor shaft

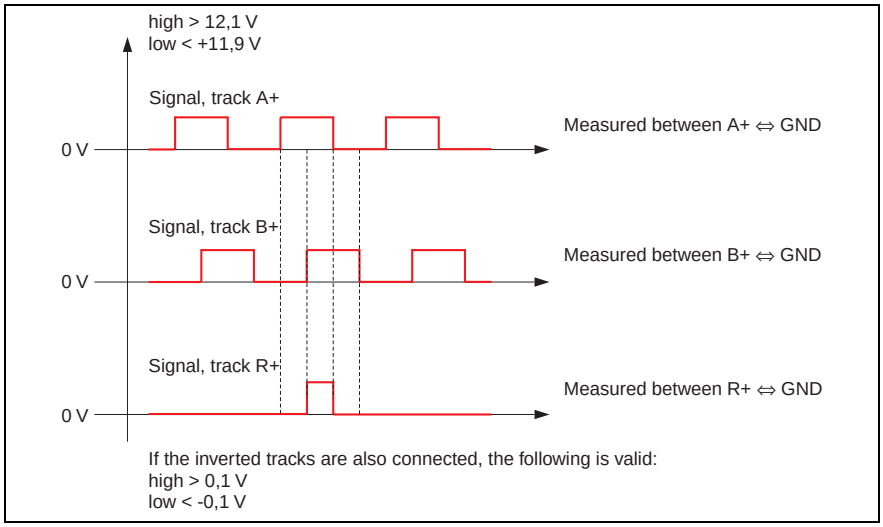


Fig. 3-9: Incremental encoder, signals

Parameterization

The incremental encoder is parameterized in the "Free parameterization".

Parameter No.:	Name	Description /explanation Selectable options	Factory setting Min ... Max values	Password
0130	**Encoder select X17**		**No encoder**	**2**
		Selecting the incremental encoder: 0 = no encoder 1 =incremental 2 track 2 =increment.1 track, right 3 =Increment. 1 track, left	0 ... 3	
0132	**Encoder resolution**		**1024**	**2**
		Selecting the incremental encoder pulse number	1 ... 8192	
0135	**Encoder normalize**		**internal**	**2**
		Incremental encoder normalization: 0 = internal 1 =external	0 / 1	
0136	**Pole pair numb. ext.**		**2**	**2**
			1 ... 32	
0137	**Freq.normalize. ext.**		**50.0 Hz**	**2**
			5.0 ... 1500.0 Hz	
0138	**Encoder meas. time**		**D1800**	**2**
			1 ... 2044 (D-Par)	

Fig. 3-10: Parameterization of the incremental encoder

Connection schematic, incremental encoder evaluation HTL signal level

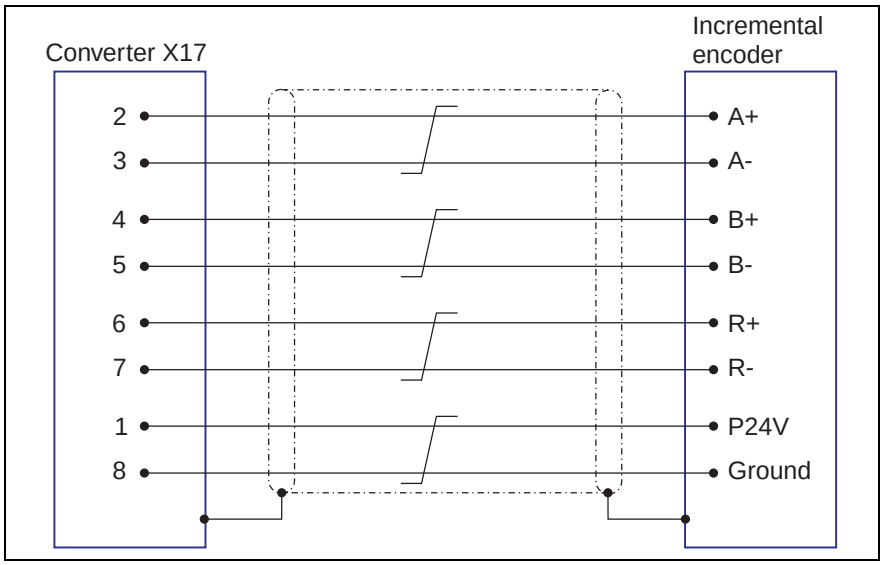


Fig. 3-11: Incremental encoder, connection diagram

Technical data

Supply voltage V_B (DC) 24 V

Max. output current I_{maxIGR} = 250 mA – (number of digital outputs ∗ 11.4 mA)
When connecting a terminal strip expansion, terminal 17037:
I_{maxIGR} = 150 mA – (number of digital outputs ∗ 11.4 mA)

Limiting frequency 150 kHz, when using the inverted tracks 300 kHz

Service interface RS232 (X11)

This interface is used to connect the operator panel or a PC with REFU-win. To connect the devices, a pre-assembled standard extension cable can be obtained from REFU (Order No. 0013456, length 5 m).

Fig. 3-12: Connection possibilities service interface

Connecting the operator panel

The operator panel can either be inserted directly at connector X11 or using the above mentioned cable.

Connecting a PC

The cable to connect a PC must have the following configuration:

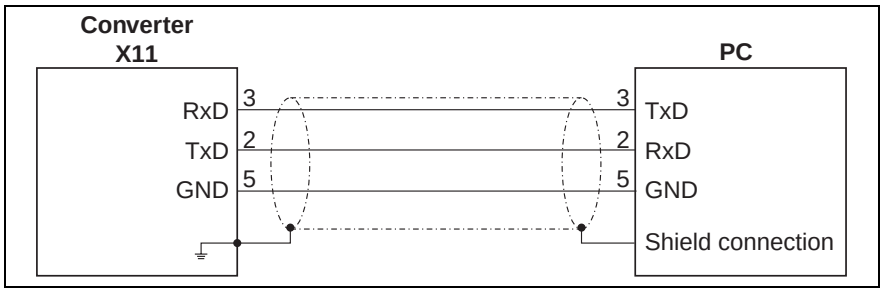


Fig. 3-13: Connecting cable to the PC

Alternatively, the operator panel cable can be used.

The following settings must be observed:

Baud rate	can be set using P 0499: 1200, 2400, 4800, **9600** (factory setting), 19200, 38400, 57600, 76800 baud
Data bits	8
Parity	Even
Stop bits	1
Protocol	USS protocol, 4/6 words

Standard interfaces RS485 (X12)

The RS485 interface supports the USS protocol, which is used to control the drive converter via a PLC. The USS protocol (Universal Serial Interface Protocol) defines an access technique according to the master-slave principle for communications via a serial bus. You can obtain a detailed description of the USS protocol from REFU, or from the Internet under http://www.refu.com.

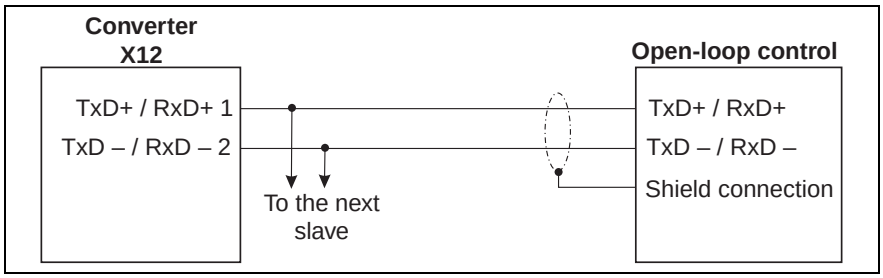


Fig. 3-14: Connecting the standard interface

When using this interface, it should be observed, that each bus node (station) should have the same interface configuration.

Exception: "SS1 slave address", in this case, each bus node (station) has its own address.

The interface **parameterization** is provided in this Instruction Manual in Section 5.4.5 Serial Communications.

Bus termination

The last node of a bus system must terminate the bus to protect the system against the effects of noise and disturbances. The bus terminating resistor is switched-in using a switch on the control board (refer to Section 3.7.1 Terminal layout diagram SR 17000).

4 Operator control and parameterization

4.1 Operating possibilities

he operator panel (option), the REFUwin PC and several interfaces are available to operate, visualize and parameterize REFUdrive 500 drive converters.

The serial RS232 and RS485 interfaces are standard on the control card. In addition, there are the optional interface cards Profibus DP, CAN bus, Interbus S, Peer-to-peer coupling and SynchroLink.

Fig. 4-1: Operator panel with graphic display (option)

4.2 Using the operator panel

Operating using the operator panel

The start/stop button and the plus/minus button (for the motorized potentiometer function) are active when the equipment is supplied (standard values of the basic parameterization are set).

Button	Function	Conditiones
Start	Starts the drive	The on/off command must be set to "Terminal, static + operator panel" or "Operator panel, dynamic"; refer to Section 5.4.1 Equipment control/setpoints.
Stop	Stops the drive	
+	Increase motorized potentiometer setpoint	The setpoint must be set to "Motorized potentiometer" and the on/off logic to "Terminal, static + operator panel" or "Operator panel, dynamic"; refer to Section 5.4.1 Equipment control/setpoints.
−	Decrease motorized potentiometer setpoint	
+	Changeover between STANDARD- and TEST mode.	Password level 2 must be entered, the inverter must be inhibited (refer to 4.2.2 Operating display).

Fig. 4-2: Key functions when operating

Standard- and test mode (local / remote)

The two operating modes are used for setting-up or for service for a drive (test mode) and for the normal mode. The on/off commands and the setpoint input can be separately set for each mode. For example, the normal mode can be set-up for terminal operation (P0870 = static terminal), and the test mode for operator control using the control panel (P0871 = Panel, static).

Monitoring using the operator panel (monitor)

Button	Menu level
Esc	Return to the previous menu item
Mon	Change into the monitor.
Prog	Change into the parameterization.
Enter	Accept the selected menu item.
+	To the previous menu item.
–	To the next menu item.

Fig. 4-3: Key functions when monitoring

Parameterizing using the operator panel

The basic parameterization is described in detail in Section 5.

Button	Menu level	Parameterization level
Esc	Return the previous menu item	Reject the changed value.
Mon	Change into the monitor.	
Prog	Change into the param-eterization.	The value is temporarily accepted. All of the values are only accepted after the “Enter“ button has been pressed.
Enter	Accept the selected menu item.	Accepts the changed value.
+	To the previous menu item.	Increases the value.
–	To the next menu item.	Reduces the value.
▶	Jumps to the end of the list.	Cursor is positioned to the right.
◀	Jumps to the beginning of the list.	Cursor is positioned to the left.

Fig. 4-4: Key function when parameterizing

Fast parameterization using various key combinations

Taste	Response
◀	The first selection text for text parameters is directly selected.
+ + –	When these keys are pressed at the same time: – all of the parameter numbers are set to 0 (numerical list). – the complete parameter value is set to 0 (for numerical parameters). – the text selection is continued in steps of 10 (practical, e.g. for parameter P0875 with almost 100 selection texts). – sets the standard value.
▶	The last selection text for text parameters is directly selected.
◀ + ▶	When these keys are pressed at the same time, the active value is set to the factory setting.

Taste	Response
Mon + Prog	When these keys are pressed at the same time, changes from the mon- or prog range into the temporary actual value display. By pressing the ESC again, the display goes back to the selected menu. In order that the operator can differentiate between the normal operating display and the temporary actual value display, the temporary actual value display has a flashing frame.

Fig. 4-5: Key combinations

Error messages when parameterizing

Error message	Cause	Solution
Parameter not accessible in the basic parameterization.	Incorrect parameter number has been entered in the numerical list.	Only pre-defined parameters are available in the basic parameterization. Only enter parameter numbers from the tables, Section 5.
Please select basic parameterization.	Selected parameter is not accessible in the free parameterization.	Changeover into the basic parameterization. **Caution! This can cause data to be lost.**
Parameter inhibited.	Unit is operational.	Inhibit the inverter and then change the parameter.
Data conflict (general)	Several parameter settings are dependent on one another. If a parameter value is changed and confirmed with Enter, data conflict can occur.	
Data conflict e.g. P0182 with P0183	The V/Hz characteristic frequencies are not correct. The frequencies must have a minimum 1 Hz clearance between them.	Temporarily accept the value of the first parameter change with Prog, after the second parameter change, confirm that both values are saved using Enter.
Data conflict e.g. P0870 static<==>dynamic	Changing from static- into dynamic on/off command or vice/versa. Static/dynamic operation for the test/standard operating modes cannot be selected mixed.	Temporarily accept the value of the first parameter change with Prog, after the second parameter change, confirm that both values are saved using Enter.

Fig. 4-6: Error messages when parameterizing

Copy function

A copy function is integrated into the operator panel. This allows a parameter set to be saved in the operator panel and to be quickly transferred to another unit. Only those parameters are saved, which are accessible using the selected password level. (Refer to the equipment setting, parameters 0732 and 0733).

Note: After the drive has been successfully commissioned and optimized, the parameter set can be saved in the operator panel. This means that when the AC drive is replaced, it can be quickly re-commissioned.

Fault acknowledgment

After a fault/error occurs, “fault” is indicated in the operating display with the fault cause and the number of operating hours. The fault can be acknowledged using the Esc button on the operator panel after the fault cause has been removed.

4.3 Monitoring

Monitor stucture

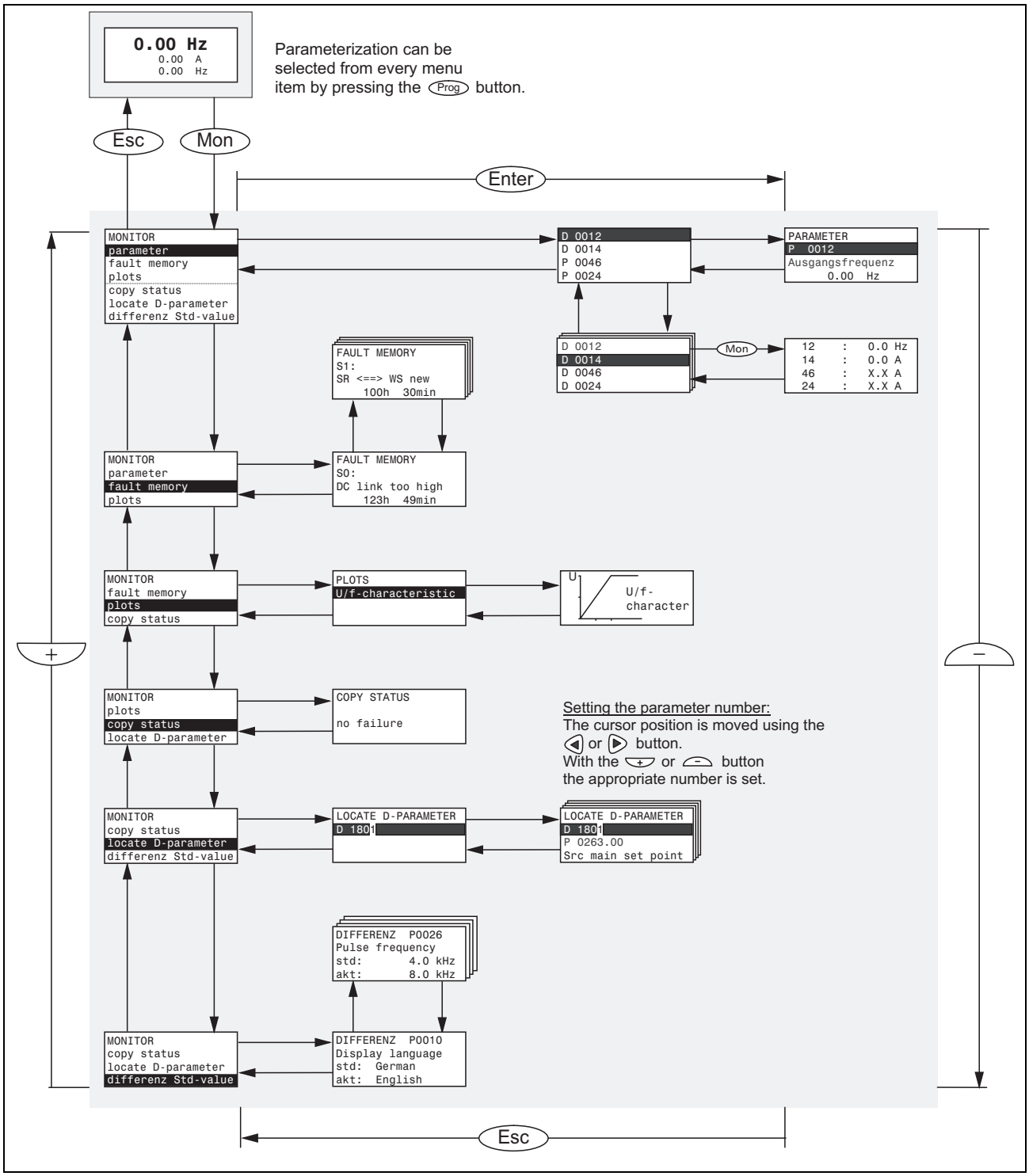


Fig. 4-7: Structure of the monitor programm

Monitor functions

Parameter Four selected parameters can be simultaneously displayed. The parameter monitor can be helpful at start-up, e.g. for the setpoint generation. The actual values of the setpoint change at various points in the setpoint cascade. In this case use the D parameters[1)] in the function diagrams.

Fault memory The last 10 faults are saved in the fault memory. The last fault in the memory is S0 and the oldest is S9. A new fault is always saved in memory location S0. All of the older faults are shifted upwards in the memory by one position. This means that the fault at memory location S9 is lost.

Plots The existing V/f characteristic is graphically shown in this menu.

Copy status Errors and irregularities which occur when copying a data set from the operator panel into the drive converter, are displayed in the menu. The copy status is lost when the drive converter is electrically shutdown.

Locate D-parameter With the search “D parameter”, a list of the variables, parameter sources is displayed, in which the selected D parameter is interconnected. You can scroll through the list using the Enter key. If the selected D parameter is not linked with a “variable, parameter source”, the following is displayed: “Is not linked”. Refer to the function diagrams with legend for a more detailed explanation.

Operating display

From ten displayed values, three can be selected to be displayed in the operating display; refer to P0037.0x in the equipment setting, Section 5.4.4.

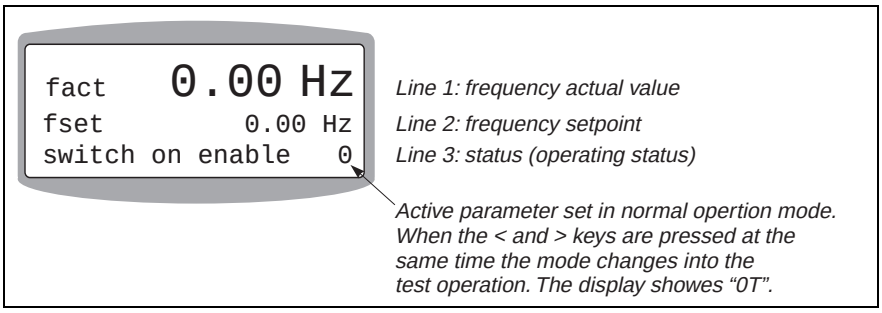


Fig. 4-8: Operating display

Alarm display

If a critical operating status occurs, the alarm message and the operating display are alternately displayed until the critical status has been resolved.

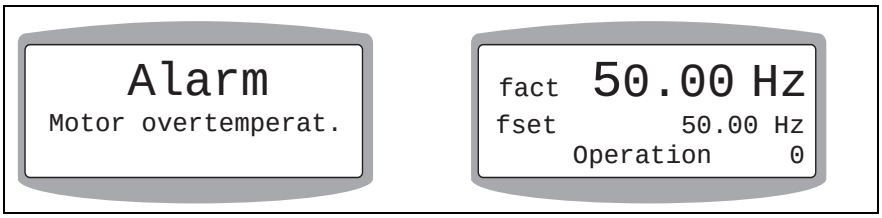
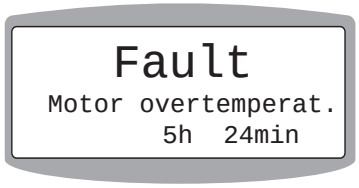


Fig. 4-9: Alarm display

[1)] The terms “D parameter” and “Variable, parameter source” are explained in the legend for the function diagrams, refer to “Function diagram and parameter list.

Fault display

If an operating status occurs, which initiates a fault/error, the operating display is replaced by a fault display.



Line 1: fault message
Line 2: fault cause
Line 3: fault time (operating hours)

Fig. 4-10:Fault display

LED display

LED display		Significance	
○ ○ ○	All LEDs dark	Operating status:	Power-on inhibit Not ready to power-up, alarm present!
●	Green LED bright	Operating status:	Ready to power-up
● ●	Green and yellow LEDs bright	Operating status:	Ready
●	Yellow LED bright	Operating status:	Run
●	Red LED bright	Operating status:	Fault

Fig. 4-11: LED display

5 Basic parameterization

5.1 Parameterizing

There are two possibilities of parameterizing the REFUdrive 500 equipment series:

1. Basic parameterization: In this case, the operator can use menu-prompted, pre-defined functions for simple and fast start-up. This is extremely versatile, for example, control- and setpoint sources can be configured, status messages, analog values can be called-up and important basic functions can be parameterized. When supplied, the basic parameterization is selected. Only the basic parameterization is described in this section.
2. Free parameterization: In this case, the full functional scope of the units can be utilized. Logic gates, comparators, a technology controller, several multi-function blocks and many more functions are available. The description of the free parameterization is provided in the “function charts and parameter lists” manual.

Structure of the basic parameterization

The basic parameterization, comprises three main menus:

Quick Setup Selected parameters for fast start-up (motor adaptation, accelerating/decelerating time....)

Prompted parameterization Menu-prompted individual adaptation of the drive converter

Numerical list Adaptation possibilities can be directly selected

The main menu of the basic parameterization is displayed by pressing the Prog button. The main menu is sub-divided into additional levels. The structure of the various menu levels is shown in the following diagram.

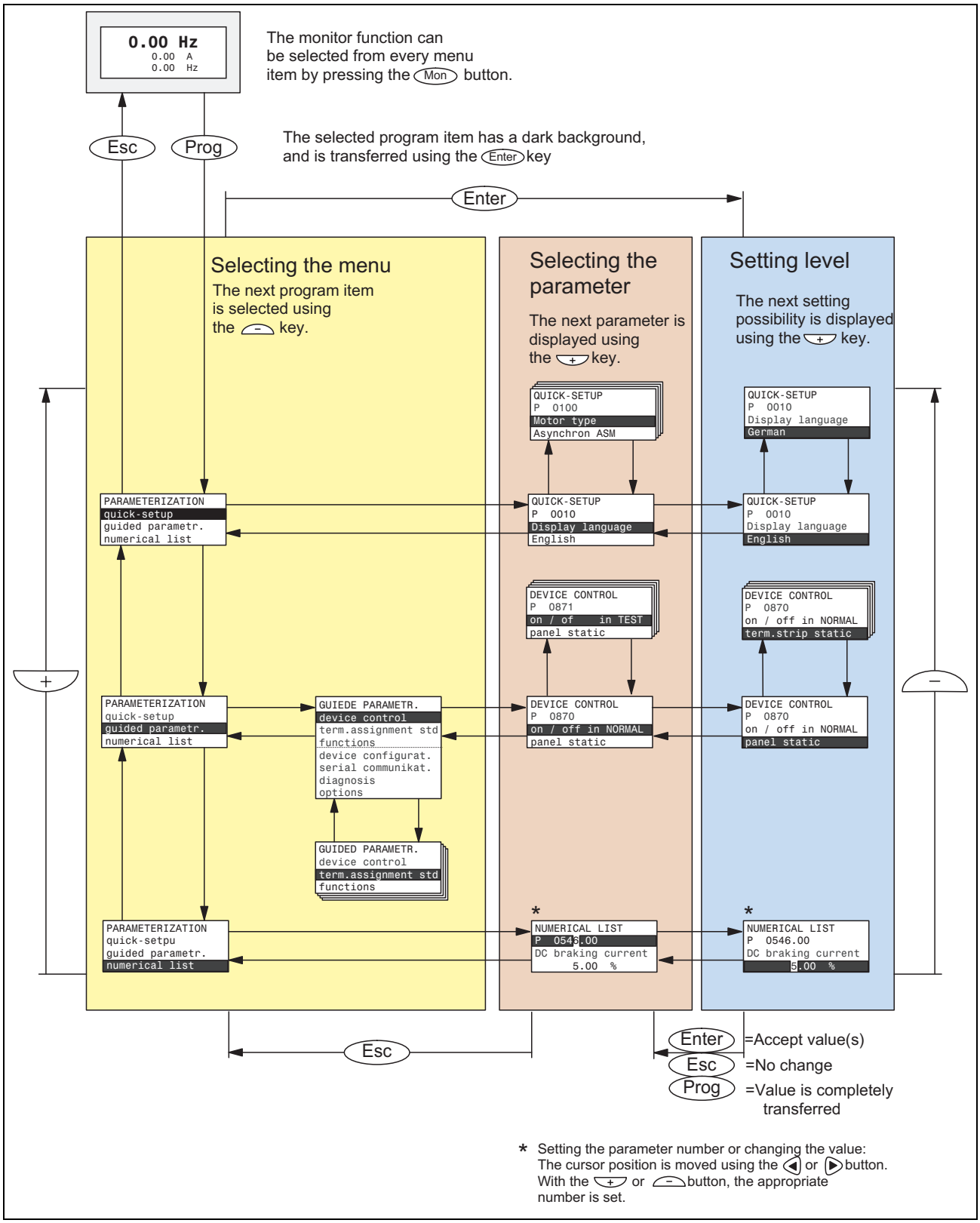


Fig. 5-1: Structure of basic parameterization

Overview

Refer to Fig. 5-2: Menu overview

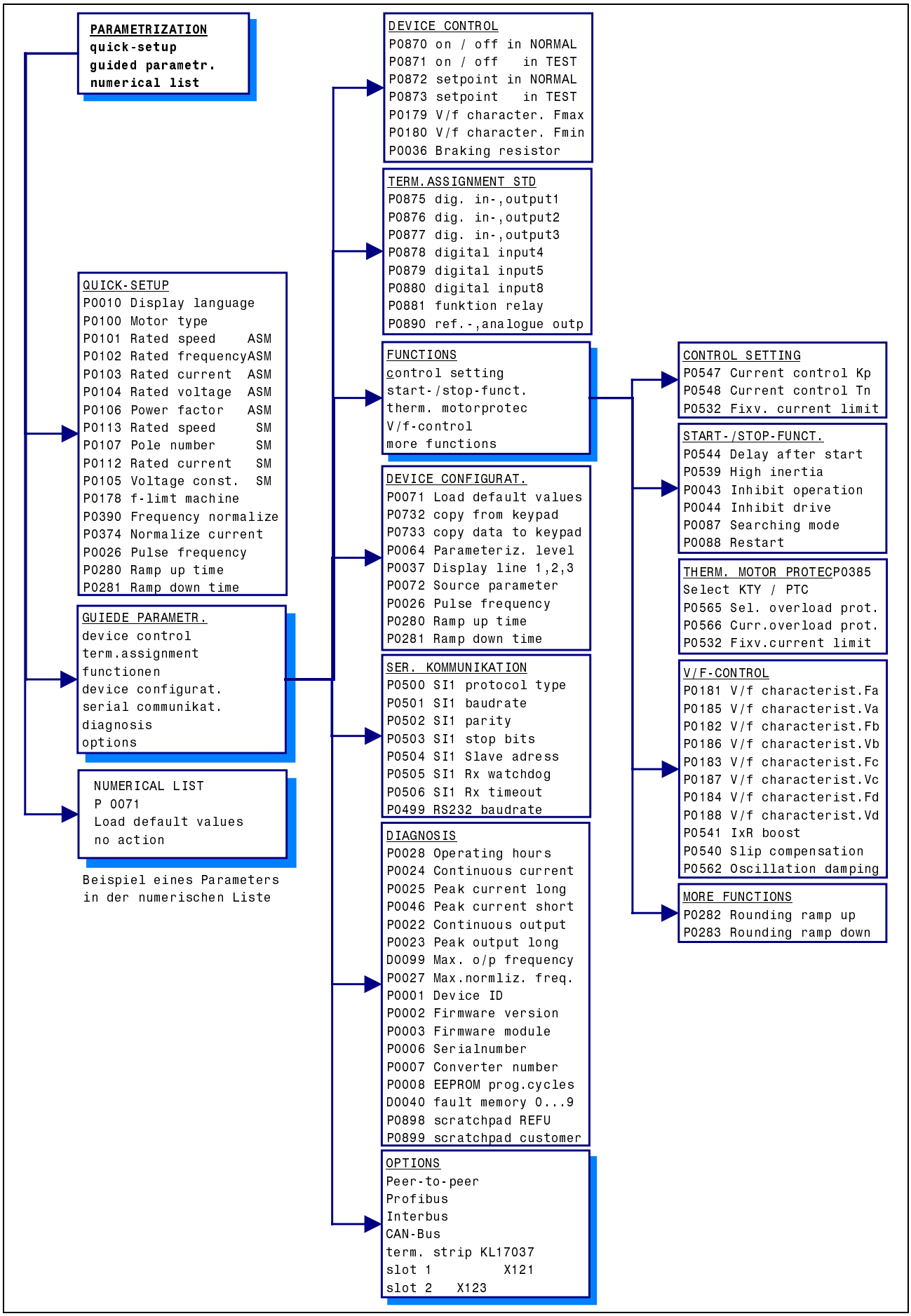


Fig. 5-2: Menu overview

5.2 Password level

The parameters are located at various access levels. A password is required to change parameters. If several parameters are changed in the parameterization, the password must only be entered for the first. The required password level is shown in the parameter table.

Password 0 No password required.

Password 1 Esc, Mon, Prog and confirm with Enter.

Password 2 Esc, Mon, Prog, + and confirm with Enter.

All of the parameters of the lower password level are also accessible with the selected password.

5.3 Quick-Setup

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Password
0010	**Display language**		**English**	**0**
		Selects the display language: 0 = German 1 = English	0 / 1	
0100.00	**Motor type**		**Asychron ASM**	**2**
		Selects the motor type: 0 = Induction motor, IM 1 = Synchronous, SM	0 / 1	
0101.00	**Rated speed ASM**		**1)**	**2**
		Rated speed from the motor rating plate. 2)	100 ... 95000 RPM	
0102.00	**Rated frequency ASM**		**1)**	**2**
		Rated frequency from the motor rating plate. [2)]	10.0 Hz... P0099	
0103.00	**Rated current ASM**		**1)**	**2**
		Rated current from the motor rating plate. 2)	1.00 A... P0033	
0104.00	**Rated voltage ASM**		**1)**	**2**
		Rated voltage from the motor rating plate. 2)	10 ... 600 V	
0106.00	**Power factor ASM**		**1)**	**2**
		cos-phi from the motor rating plate. 2)	0.50 ... 0.98	
0112.00	**Rated current SM**		**1)**	**2**
		Rated current from the motor rating plate. [3)]	1.00 A... P0033	
0113.00	**Rated speed SM**		**1)**	**2**
		Rated speed from the motor rating plate. 3)	100 ... 95000 RPM	
0105.00	**Voltage const. SM**		**1)**	**2**
		Voltage constant from the motor rating plate. 3)	0.01 ... 50.00 V/Hz	
0107.00	**Pole number SM**		**1)**	**2**
		Pole number from the motor rating plate. 3)	1 ... 64	
0178.00	**f-limit machine**		**50.00 Hz**	**2**
		Maximum permissible system frequency (centrifugal force protection).	0.0 Hz ...P0027	

[1)] The motor data of a typical motor are set as the factory setting for every drive converter output class.

[2)] This menu item is only displayed, if an induction motor was selected as the motor type!

[3)] This menu item is only displayed, if an synchronous motor was selected as the motor type!

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Pass-word
		The maximum output frequency is limited, as a function of the pulse frequency, to the value of P0027. When changing the motor rating plate data, P0178 is set to the rated motor frequency plus 5%.		
0390.00	**Frequency normalize**		**50.00 Hz**	**2**
		Reference value for the frequency setpoints and actual values. This parameter is set to 50 Hz in the factory . In order to operate the motor with 50 Hz, a setpoint of 100% must be entered.	15.0 Hz ... P0027	
0374.00	**Normalize current**		**P0024**	**2**
		Reference value for current setpoints and actual values. This parameter is set to the drive current (P0024) in the factory.	0.5 ... 6553.5	
0026.00	**Pulse frequency**		**4.0 kHz**	**2**
		Drive converter pulse frequency.	1.0 / 2.0 / 4.0 / 6.0 / 8.0 / 10.0 12.0 kHz	
0280.XX	**Ramp up time**	**Refer to Fig. 5-3: Ramp-up / ramp-down diagram**	**5.000 s**	**1**
		Ramp-function generator ramp-up time. The entered time is valid for a setpoint change from 0 % to 100 %. **XX** = In parameters P0875, P0876; P0877; P0878, P0879 or P0880 (Function: setpoint memory Bits 20 ... 23) the index is selected, in which a value can be saved	0.000 ... 3200.000 s	
0281.XX	**Ramp down time**	**Refer to Fig. 5-3: Ramp-up / ramp-down diagram**	**5.000 s**	**1**
		Ramp-function generator ramp down time. The entered time is valid for a setpoint change, normalized for 100%. **XX** = In parameters P0875, P0876; P0877; P0878, P0879 or P0880 (Function: setpoint memory Bits 20 ... 23) the index is selected, in which a value can be saved.	0.000 ... 3200.000 s	

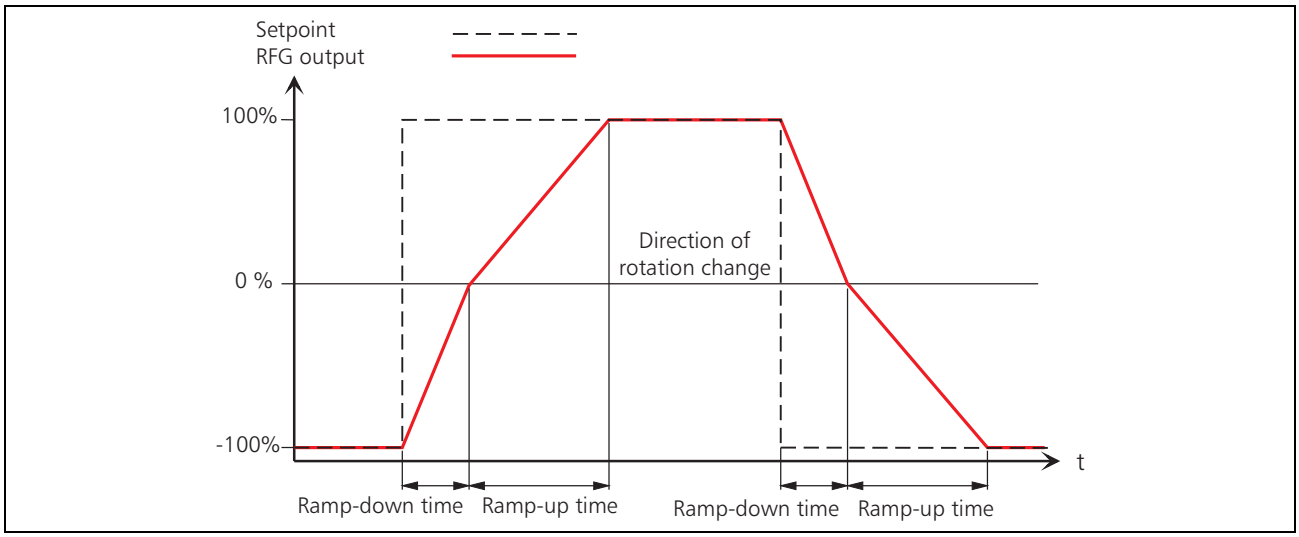


Fig. 5-3: Ramp-up / ramp-down diagram

5.4 Guided parameterization

Device control / setpoints

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Password
0870	**on / off in NORMAL**		**panel static**	**1**
		Enters on/off in NORMAL operation. 0 = term.strip static (static = switch function) 1 = term.stst.+panel (term.=terminal) 2 = term.stat.+PC (PC with REFUwin via service interface) 3 = term.stat.+bus SI1 (SI = serial interface) 4 = term.stat.+bus SI2 (if available) 5 = term.stat.+bus SI4 (if available) 6 = term.dyn. OFF always (dyn.=dynamic) 7 = panel dyn. OFF always 8 = term.strip dynamic (dynamic = pushbutton function) 9 = panel dynamic 10 = panel static	0...10	
0871	**on / off in TEST**		**panel static**	**1**
		Enters on/off in the TEST mode. As for parameter 0870.	0...10	
0872	**setpoint in NORMAL**		**motor potentiometer**	**1**
		Entering a setpoint in NORMAL operation 0 = motor potentiometer 1 = fix setpoint 2 = analog inp 0..±10V 3 = analog inp 0..+20mA 4 = analog inp. 4..+20mA 5 = opt. an.inp 0..±10V (Opt. = optional) 6 = opt. an.inp 0..+20mA 7 = opt. an.inp 4..+20mA 8 = PC (PC with REFUwin via service interface) 9 = bus SI1 10 = bus SI2 11 = bus SI4 12 = analog inp 2..+10V	0...12	
0873	**setpoint in TEST**		**motor potentiometer**	**1**
		Enters the setpoint in the TEST mode as for parameter 0872.	0...12	
0196	**Motorpot. mode**	**Supplementary parameter for “motorized potentiometer”.**	**start f-set expon.**	**1**
		For **Start f-set**, the last selected setpoint of the motorized potentiometer which is selected after the off command, is approached. For **Start f-min**, the actual value f-min (P0180.XX) is approached. In addition, the rate-of-change of the motorized potentiometer can be set using the parameter: **linear** = uniform change according to the selected step width **expon.** = The rate-of-change increases the longer that the button remains pressed 0 = start f-set, linear 1 = start f-min, linear 2 = start f-set, exponential 3 = start f-min, exponential	0 ... 3	
0195	**Mot.pot. step value**	**Supplementary parameters for “motorized potentiometer”.**	**0.01**	**1**
		The rate-of-change of the motorized potentiometer is selected using the step width.	0.01 ... 10.00 Hz	

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Pass-word
0265.XX	**Fixvalue main s/p**	**Supplementary parameter for “fixed setpoint”.**	**5.00 %**	**1**
		Parameter P0390 is the limit for frequency setpoints and actual values. P0390 is set to 50 Hz in the factory . In order to operate the motor with 50 Hz, a setpoint of 100% must be entered. XX = In parameters P0875, P0876; P0877;P0878, P0879 or P0880 (Function: setpoint memory Bits 20 ... 23) the index is selected, in which a value can be saved.	-199.99 ... 199.99 %	
0297.00	**Analog input window**	**Supplementary parameter for “analog input”.**	**0.50 %**	**1**
		The analog setpoint smoothing is specified in a window width in %. e.g. window width = 1 %. An actual setpoint change is only transferred, if a change exceeding 0.99% of the possible end value is identified at the analog input.	0.00 ... 20.00 %	
0200.00	**Analog input 1 norm.**	**Supplementary parameter for “analog input”.**	**100 %**	**2**
		The analog input normalization refers to the frequency normalization P0390.	-199.99 ... 199.99 %	
0202.00	**Analog input 1 offs.**	**Supplementary parameter for “analog input”.**	**0.00 %**	**2**
		Analog input offset	-199.99 ... 199.99 %	
0203.00	**Analog input 1 sign**	**Supplementary parameter for “analog input”.**	**direct**	**2**
		Analog input signal 0 = direct 1 = absolute value 2 = inverted 3 = abs. value inverted	0 ... 3	
0204.00	**Analog input 1 filtr.**	**Supplementary parameter for “analog input”.**	**2 ms**	**2**
		Analog input, filter time to smooth the analog signal.	0 ... 10000 ms	
0564.XX	**Reaction on I < 4mA**	**Supplementary parameter for “analog input” 4...+20 mA“.**	**warning**	**2**
		Response for „I < 4 mA“ 0 = no reaction 1 = warning 2 = fault XX = 00 for STANDARD mode XX = 01 for TEST mode	0 ... 2	
0179.XX	**V/f character. Fmax**		**100.00 %**	**2**
		XX = In the parameters P0875, P0876; P0877; P0878; P0879 or P0880 (Function: setpoint memory bits 20 ... 23) the index is selected, in which a value can be saved.	P0180 ... 199.99 %	
0180.XX	**V/f character. Fmin**		**0.00 %**	**2**
		XX = In the parameters P0875, P0876; P0877; P0878; P0879 or P0880 (Function: setpoint memory bits 20 ... 23) the index is selected, in which a value can be saved.	0.00 % ... P0179	
0036	**Braking resistor**		**REFU standard**	**1**
		Selects the connected brake resistor at power terminals C and F. 0 = REFU standard 1 = disabled 2 = no protection 3 = external programable **Note**: REFU*reduc* drive converters supports no braking resistor! Parameter 0036 must be set to 1 = disabled!	0 ... 3	
0623.00	**Ext. BR: Resistance**	**Supplementary parameters for brake resistor (P0036) „external programmable“**	**199.9 W**	**2**
		This value should be taken from the rating plate of the brake resistor.	0.1 ... 199.9 W	
0624.00	**Ext. BR: Rated power**	**Supplementary parameters for brake resistor (P0036) „external programmable“**	**1.0 kW**	**2**
		This value should be taken from the rating plate of the brake resistor.	0.1 ... 199.9 kW	

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Pass-word
0625.00	Ext. BR: Heatup time.	Supplementary parameters for brake resistor (P0036) „external programmable“	1.0 sec	2
		This value should be taken from the rating plate of the brake resistor.	1.0 ...655.4 sec	

Standard terminal assignment

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Pass-word
0875	dig. in-, output 1		I no function	1
		Combined digital I/O 0 = I no function (I=input) : 2 = I no alarm ext. (alarm) 3 = I no fault ext. (fault) 4 = I fault reset 5 = I fmin-select 6 = I direct. rotat. (direction of rotation change) 7 = I no volt.disc. (power disconnect) 8 = I no fast stop (fast stop) 9 = I RFG parking (RFG = ramp-function generator) 10 = I RFG up stop 11 = I motp. faster (motp.=motorized potentiometer) 12 = I motp. slower : 21 = I TEST/STANDARD (toggles between TEST and STANDARD modes, simultaneously disables the changeover from the operator panel.) 22 = I setp.mem bit 0 (weighting 20: Changes over the f-set-, f-min, f-max max. memory and the ramp-function generator) 23 = I setp.mem bit 1 (weighting 21: Changes over the f-set-, f-min, f-max memory and the ramp-function generator) 24 = I setp.mem bit 2 (weighting 22: Changes over the f-set-, f-min, f-max memory and the ramp-function generator) 25 = I setp.mem bit 3 (weighting 23: Changes over the f-set-, f-min, f-max memory and the ramp-function generator) : 32 = IN no alarm ext. (IN = input which is only active in the „STANDARD“ mode) 33 = IN no fault ext. 34 = IN fault reset 35 = IN fmin select 36 = IN direct. rotat. 37 = IN no volt. disc. 38 = IN no fast stop 39 = IN RFG parking 40 = IN RFG up stop 41 = IN motp. faster 42 = IN motp. slower : 52 = IT not alarm. ext. (IT = input which is only active in the „TEST“ mode) 53 = IT not fault ext. 54 = IT fault reset 55 = IT fmin select 56 = IT direct. rotat. 57 = IT no volt. disc. 58 = IT no fast stop 59 = IT RFG parking 60 = IT RFG up stop 61 = IT motp. faster	0...93	

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Pass-word
		62 = IT motp. slower : 70 = O no function 71 = O ready to switch on (O=output) 72 = O ST ready swotch on (ST=status) 73 = O ready for operating 74 = O ST ready for operating 75 = O operating 76 = O not fault 77 = O switch on inhibit 78 = O not alarm 79 = O motor rotating 1 (on & ((t <x.x sec) or (i>x.xx %))) 80 = O motor rotating 2 (on & (fist > fmin) & (i > x.xx %)) 81 = O direction right 82 = O current limitting 83 = O not mot. alarmtemp. 84 = O not mot.overtemp. (Fault: motor temperature) 85 = O RFG up 86 = O RFG down 87 = O RFG reached 88 = O setpoint reached 89 = O setpoint in tolerance 90 = O fmin limiting 91 = O fmax limiting 92 = O selection TEST 93 = O ctrl. main contact		
0756	**time timer**	**Supplementary parameter for “A motor rotating 1“.**	**1.0 sec**	**1**
		Timer for timer element	0.0 ... 650.0 sec	
0435.00	**Fix value Dxxxx**	**Supplementary parameter for “A motor rotating 1“.**	**0.00 %**	**1**
		Current threshold (100% = IratedMotor)	-199.99 ... 199.99 %	
0757	**hysteresis x:xs**	**Supplementary paramete for “A motor rotating 1“.**	**1.00 %**	**1**
		Hysteresis for current	0.00 ... 100.00 %	
0759.00	**hysteresis x:xs**	**Supplementary parameter for “A motor rotating 2“.**	**1.00 %**	**1**
		Hysteresis for frequency	0.00 ... 100.00 %	
0759.01	**hysteresis x:xs**	**Supplementary parameter for “A motor rotating 2“.**	**1.00 %**	**1**
		Hysteresis for current	0.00 ... 100.00 %	
0435.01	**Fixvalue for Dxxxx**	**Supplementary parameter for “motor rotating 2“.**	**0.00 %**	**1**
		Current threshold (100% = IratedMotor)	-199.99 ... 199.99 %	
0760	**fixvalue xs input**	**Supplementary parameter for „setpoint reached“ and „setpoint in tolerance“.**	**2.00 %**	**1**
		Tolerance value for frequency	0.10 ... 100.00 %	
0761	**hysteresis x:xs**	**Supplementary parameter for „setpoint reached“ and „setpoint in tolerance“.**	**1.00 %**	**1**
		Hysteresis for frequency	0.00 ... 90.00 %	
0762	**time timer**	**Supplementary parameter for „setpoint in tolerance“.**	**1.0 sec**	**2**
		Time value for timer element	0.0 ... 650.0 sec	
0876	**dig. in-, output2**		**I no function**	**1**
		As for parameter 0875	0...93	
0877	**dig. in-, output3**		**I no function**	**1**
		As for parameter 0875	0...93	
0878	**digital input4**		**I no function**	**1**
		As for parameter 0875, from value 0 to 69.	0...62	
0879	**digital input5**		**I no function**	**1**
		As for parameter 0875, from value 0 to 69.	0...62	
0880	**digital input8**		**I no function**	**1**
		As for parameter 0875, from value 0 to 69.	0...62	

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Pass-word
0881	function relay		O not fault	1
		As for parameter 0875, from value 70 to 93.	70...93	
0890	ref.-analogue outp		+10V reference outp.	1
		Reference-, analog voltage 0 = +10V reference output 1 = -10V reference output. 2 = fact outp. frequency 3 = Iact outp. current (apparent current) 4 = Isq (active current) 5 = Uact outp. voltage 6 = Pact outp. power 7 = Pactiv	0...7	
0221.00	PT1 filt.timeconst.	Supplementary parameter for „analog output“.	0 ms	1
		To smooth any value which is connected at the analog output.	0 ... 10000 ms	
0559	Pactual PT1 time	Supplementary parameter for „analog output“.	50 ms	1
		Only to smooth the P active value.	0 ... 10000 ms	
0560	Ptrue PT1 time	Supplementary parameter for „analog output“.	50 ms	1
		Only to smooth the P true value.	0 ... 10000 ms	
0411	Output-block 1 sign	Supplementary parameter for „analog output“.	direct	1
		Defines how a signal is transferred. 0 = direct 1 = absolute value 2 = inverted 3 = abs.value inverted	0...3	
0413	Output-block 1 norm	Supplementary parameter for „analog output“.	100.00 %	1
		Analog output normalization 10 V corresponds to the value set here.	6.26 ... 200.00 %	
0561	Output-block	Supplementary parameter for „analog output“.	0.. ±100 %	2
		0 = 0..±100 % 1 = + 20..+100 %	0 / 1	
0412	Output-block 1 offs	Supplementary parameter for „analog output“.	0.00 %	1
		Offset	-100.00 ... 100.00 %	

Functions

- Controller setting
- Start/stop function
- Thermal motor protection
- V/Hz open-loop control

Controller setting

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Pass-word
0547.00	Current control Kp		0.10	1
		Gain factor for the current controller.	0.01 ... 128.00	
0548.00	Current control Tn		10 ms	1
		Integral action time for the current controller.	0 ... 5000 ms	
0532.00	Fixv. current limit		100.00 %	1
		Current limiting input 100% corresponds to the contents of parameter P0374 (Factory setting: continuous output current of the drive converter).	0.00 ... 199.99 %	

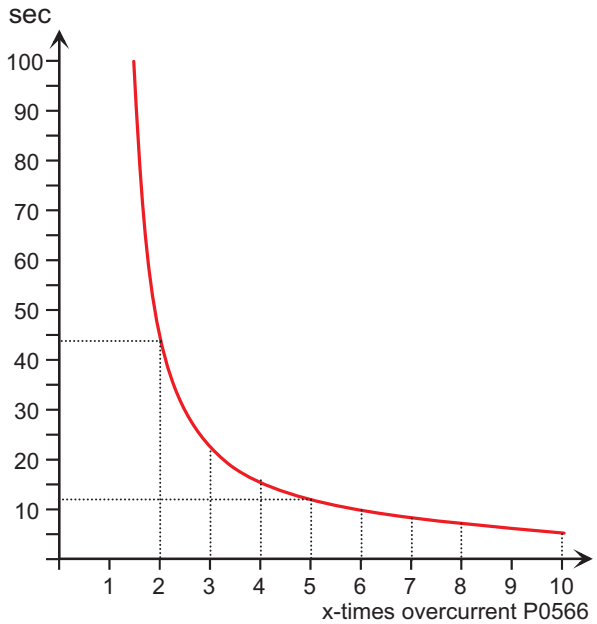
Start/stop functions

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Pass-word
0544.00	**Delay after start**		**0.3 sec**	**1**
		After the start, fa (P0181) is entered for the waiting time, and after this, the system runs-up to the selected setpoint.	0.0 ... 100.0 sec	
0539	**High inertia start**		**no**	**2**
		For the first run-up after start, twice the value of the current limiting is enabled. 0 = no 1 = yes	0 / 1	
0043	**Inhibit operation**		**inverter off**	**2**
		0 = brake mode 1 = inverter off	0 / 1	
0044	**Inhibit drive**		**inverter off**	**2**
		0 = brake mode 1 = inverter off	0 / 1	
0546	**DC braking current**	Supplementary parameter for „brake mode“ from P0043 and P0044:	**5.00 %**	**1**
		100% corresponds to the contents of parameter P0374 (factory setting: Continuous output current of the unit).	1.00 ... 100.00 %	
0545	**DC braking time**	Supplementary parameter for „brake mode“ from P0043 and P0044:	**0.0 sec**	**1**
			0.0 ... 100.0 sec	
0087	**Searching mode**		**no**	**2**
		0 = no: The drive starts after the on command normally, without a search run. 1 = after on: The drive starts after the on command with the last direction of rotation, and searches for the motor which is coasting down, from f max towards 0 Hz. If the motor frequency is found, or at f = 0 Hz, the actual setpoint is approached via the ramp-function generator. 2 = after on ±: The drive starts after the on command with the last direction of rotation which was used and searches for the motor which is coasting down, from f-max to 0 Hz. If the motor frequency is found, the actual setpoint is approached via the ramp-function generator.If the motor has not been found at f = 0 Hz, then a search is made with the other direction of rotation, from f-max to 0 Hz. If the motor frequency is found, or at f = 0 Hz, the actual setpoint is approached via the ramp-function generator.	0 ... 2	
0088	**Restart**		**no**	**2**
		Restart after power failure: 0 = no: Drive only starts when the line supply returns, after the rising edge of the command has been identified. 1 = yes: Drive starts automatically if, when the line supply returns, the on command is present at the drive converter.	0 / 1	

Thermal motor protection

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Pass-word
0385	**Select KTY / PTC**		**PTC**	**2**
		Selecting thermistor protection. 0 = without 1 = KTY 2 = PTC	0 ... 2	
0386	**KTY Alarm**	**Supplementary parameter for KTY in P0385**	**135 °C**	**1**
		Enter the motor temperature for alarm.	30 ... 180 °C	

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Pass-word
0387	**KTY Fault**	**Supplementary parameter for PTC in P0385**	**155 °C**	**1**
		Enter the motor temperature for fault.	30 ... 195 °C	
0388	**PTC Evaluation**	**Supplementary parameter for PTC in P0385**	**Fault**	**2**
		The following options can be selected when the selected PTC switching value (P389) is reached: 0 = Alarm (alarm, motor temperature) 1 = Fault (fault, motor temperature)	0 / 1	
0389	**PTC Switch value**	**Supplementary parameter for PTC in P0385**	**4000 Ω**	**1**
		Enter the resistance switching threshold to initiate the response set using P388 (PTC evaluation).	1000 .. 4500 W	
0565	**Sel. overload prot.**		**no reation**	**2**
		The overload protection function is implemented corresponding to the SIEMENS overload relay 3UB1, setting class 10. The following options can be selected for the response of the IxT overload protective function: 0 = no reaction 1 = warning 2 = fault	0 ... 2	
0566.00	**Curr.overload prot.**	**Refer to Fig. 5-4:**	**0.5 A**	**1**
		Current threshold for the Ixt overload protection function. When the Ixt threshold is reached, the response, set with P565 is initiated. Emulation of the thermal overload trip When the motor rating plate data is changed, P0566 is set to the rated motor current.	0.5 ... 6553.5 A	
0532.00	**Fixva. current limit**		**100.00 %**	**1**
		Current limiting input 100% corresponds to the contents of parameter P0374 (factory setting: continuous drive converter output current).	0.00 ... 199.99 %	



x-times overcurrent P0566	1,05	1,15	3	4	5	6	7	8	10
Release time	2 h	20min	22,5 s	15,4 s	12 s	9,8 s	8,4 s	7,3 s	5,8 s

Fig. 5-4: Emulation terminal overload trip

V/Hz open-loop control

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Pass-word
0181.00	V/f characteristic Fa	Refer to Fig. 5-5:		2
		The V/Hz characteristic data is calculated from the motor rating plate data which is entered. The values of the characteristics can then be modified and optimized. If the rating plate data is re-entered, the calculation is re-executed, and characterisic data, which was manually entered, is overwritten.. Select the monitor by pressing the button. You can then visualize the V/Hz characteristic in the “Plots” sub-menu.	0.0 Hz ... (P0182-1 Hz)	
0185.00	V/f characteristic Va		1) 0 V ... 3000 V	2
0182.00	V/f characteristic Fb		1) (P0181+1 Hz) ... (P0183-1 Hz)	2
0186.00	V/f characteristic Vb		1) 0 V ... 3000 V	2
0183.00	V/f characteristic Fc		1) (P0182+1 Hz) ... (P0184-1 Hz)	2
0187.00	V/f characteristic Vc		1) 0 V ... 3000 V	2
0184.00	V/f characteristic Fd		1) (P0183+1 Hz) ... 6000 Hz	2
0188.00	V/f characteristic Vd		1) 0 V ... 3000 V	2
0541.00	I x R boost		0.00 %	1
		Factors for I x R compensation. IxR compensation is disabled when 0.00% is entered. The I x R compensation can be used to correct the voltage drop, which is obtained across the ohmic component of the stator winding proportional to the apparent current (I-act).	0.00 ... 20.00 %	
0540.00	Slip compensation		0.00 %	1
		Enter the factors for slip compensation. Slip compensation is disabled when 0.00% is entered. For induction motors, the speed loss, which is obtained and which is approximately proportional to the instantaneous torque, can be corrected using the slip compensation.	0.00 ... 199.99 %	
0562.00	Oscillation damping		0	2
		A factor can be entered here for machines which have a tendency to oscillate. The oscillation damping function counteracts this tendency. Oscillation damping is disabled when a factor of 0 is entered.	-127 ... 127	

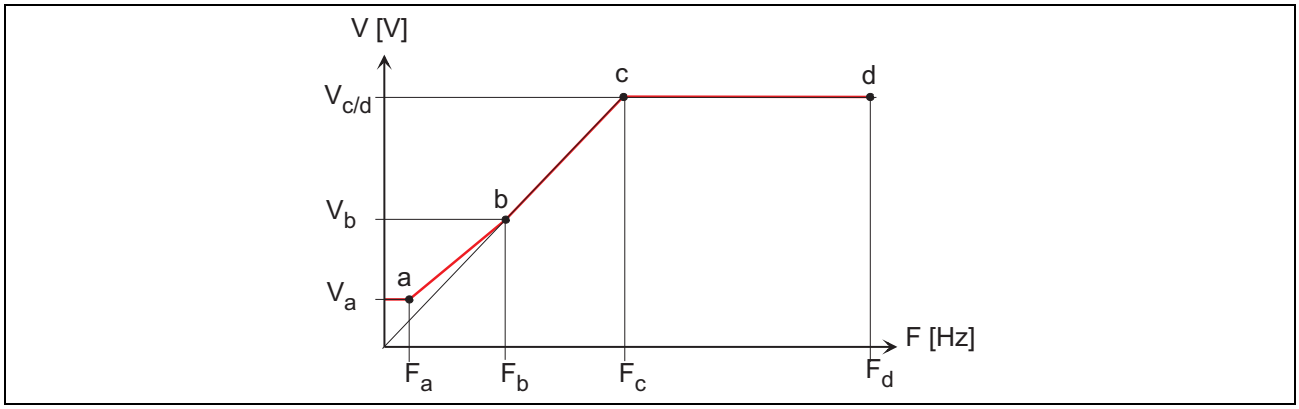


Fig. 5-5: Diagram V/HZ characteristic

[1)] The drive converter calculates the V/HZ characteristic data from the rating plate data of the motor wich you entered.

More functions

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Pass-word
0282.00	Rounding ramp up	Refer to Fig. 5-6: Ramp-up / ramp-down characteristic with rounding	0.000 s	1
		UP rounding-off times for the ramp-function generator. This is used to limit torque surges when accelerating; generally, no more than 1/10 of the ramp time is entered.	0.000 ... 800.00 s	
0283.00	Rounding ramp down	Refer to Fig. 5-6: Ramp-up / ramp-down characteristic with rounding	0.000 s	1
		DOWN rounding-off times for the ramp-function generator.	0.000 ... 800.00 s	

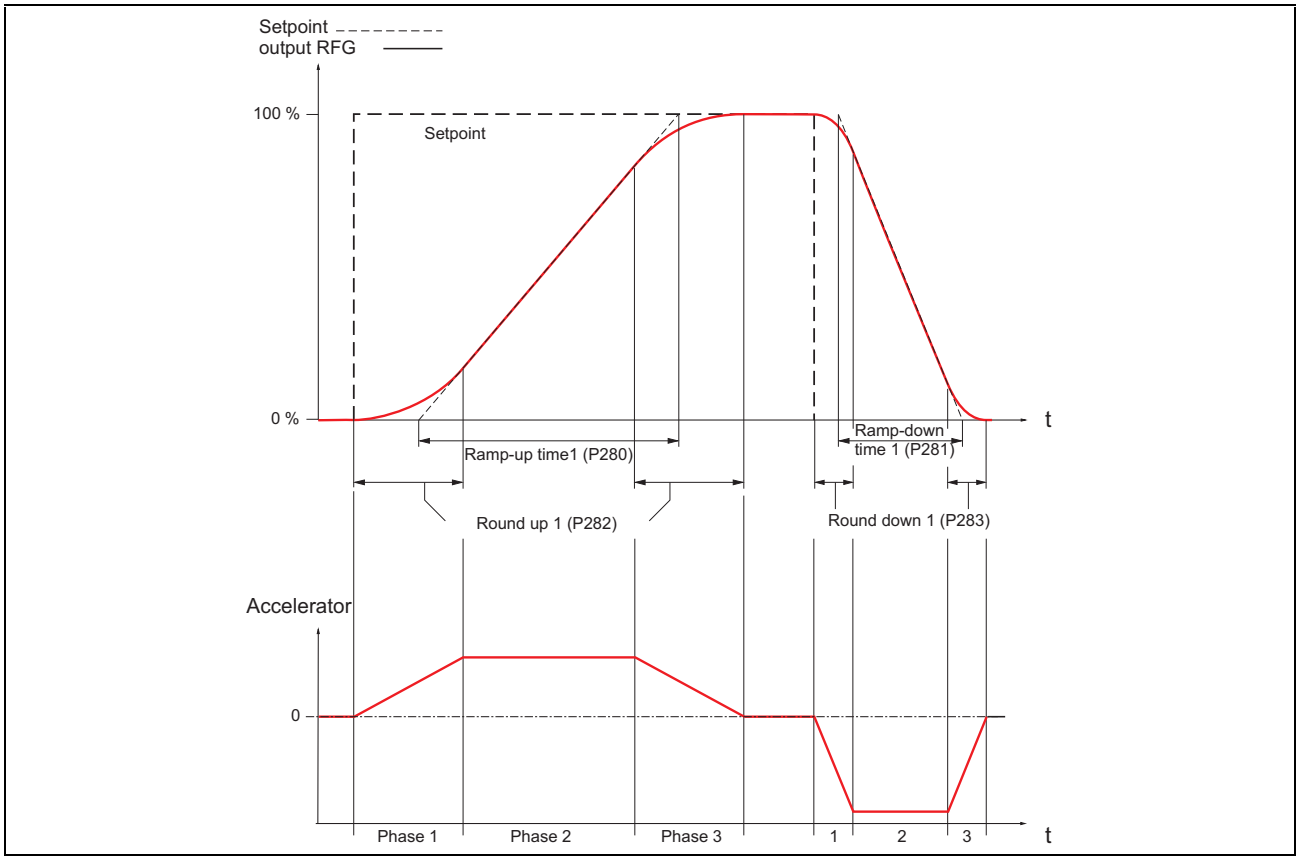


Fig. 5-6: Ramp-up / ramp-down characteristic with rounding

Drive converter settings

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Pass-word
0071	Load default values		no action	0
		0 = no action 1 = basic standard value (The parameter values up to the selected password level are set to the factory settings) 2 = free standard values (refer to the Manual: Function charts and parameter lists).	0 ... 2	
0732	copy from keypad	Caution: Only the parameters are copied, which are enabled by the selected password.	no	
		The data set, saved in the operator panel, is copied into the drive converter. 0 = no 1 = yes 2 = identification (the name of the data set saved can be viewed here)	0 ... 2	

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Pass-word
0733	**copy data to keypad**		**no**	**0**
		The complete drive converter data set is copied into the operator panel. 0 = no 1 = yes After the data transfer, a data set name can be entered. You can scroll through the ASCII code using the + or - keys (if you press the + and - key simultaneously, then you scroll directly to the beginning of the following ranges: A, a, O and blank). You can move the cursor to the right or left using the < or > key.	0 / 1	
0064	**Parameteriz. level**		**pasic parametriza-tion**	**2**
		0 = **basic parametrization**: The operator has access to the pre-defined parameters of the basic parameterization. This is either menu-prompted or via the numerical list. 1 = **free parametrization**: The operator can access all of the parameters of the free parameterization. **Caution:** When changing the parameterizing modes, data may be lost! Please read Section 1.4 “Working with the basic parameterization and the free parameterization” in the Man-ual, Function charts and parameter list.	0 / 1	
0037.00	**Display line 1,2,3**		**f actual**	**0**
		Selecting the operating display for line 1. 0 = status (status signal from the drive converter) 1 = n actual (electrical) 2 = I active 3 = I actual (actual apparent current) 4 = U actual 5 = DC-link 6 = f actual 7 = f set 8 = P actual (actual apparent power) 9 = P active (actual active power which the motor draws)	0 ... 9	
0037.01	**Display line 1,2,3**		**f set**	**0**
		Selects the operating display for line 2. As for parameter 0037.00.	0 ... 9	
0037.02	**Display line 1,2,3**		**status**	**0**
		Selects the operating display for line 3. As for parameter 0037.00.	0 ... 9	
0072	**Source parameter**		**keypad, PC (RS232)**	**2**
		Specifies from which source, parameters can be set. 0 = operator panel, PC (RS232) 1 = Bus SS1 2 = Bus SS2 3 = Bus SS4 4 = Buses SS1, SS2, SS4	0 ... 4	
0026	**Pulse frequency**		**4 kHz**	**2**
		Drive converter pulse frequency	1.0 ... 12.0 kHz	

Serial communications

Sub-menu to set standard RS485 interface.

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Pass-word
0500	**SI1 protocol type**		**USS 4/6 words**	**2**
		The serial interface 1 (SS1) is an RS485 interface (connec-tion X12). 0 = no protocol 1 = USS 4/2 words 2 = USS 4/6 words 3 = USS 0/2 words	0 ... 5	

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Pass-word
		4 = USS 0/6 words 5 = USS 4/0 words		
0501	**SI1 baudrate**		**9600 Baud**	**2**
		0 = 1200 baud 1 = 2400 baud 2 = 4800 baud 3 = 9600 baud 4 = 19200 baud 5 = 38400 baud 6 = 76800 baud	0 ... 6	
0502	**SI1 parity**		**even**	**2**
		0 = no parity 1 = odd 2 = even	0 ... 2	
0503	**SI1 stop bits**		**1**	**2**
		Either 1 or 2 stop bits can be set.	1 ... 2	
0504	**SI1 slave address**		**0**	**2**
		The drive converter address can be set between 0 and 31 for the RS485 bus. Caution: There must be no two identical addresses on the bus (each station/node must have its own unique address!	0 ... 31	
0505	**SI1 Rx watchdog**		**fault**	**2**
		0 = no reaction 1 = warning 2 = fault	0 ... 2	
0506	**SI1 Rx timeout**		**0.1 s**	**2**
		Monitoring time for the standard SS1. If the interface does not receive an error-free protocol within this time, then the response, selected in P0505 is initiated.	0.1 ... 60.0 s	
0499	**RS232 baud rate X11**		**9600 Baud**	**2**
		0 = 1200 baud 1 = 2400 baud 2 = 4800 baud 3 = 9600 baud 4 = 19200 baud 5 = 38400 baud 6 = 57600 baud 7 = 76800 baud	0 ... 7	

Diagnostica / drive converter data

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Pass-word
0028	**Operating hours**		**0 h**	**-**
		Operating hours when the inverter is enabled.	0 ... 2147483647 h	
0024	**Continuous current**	Drive converter data corresponding to the drive converter output class		**0**
0025	**Peak current long**			
0046	**Peak current short**			
0022	**Continuous ouput**			
0023	**Peak output long**			
0099	**Max. o/p frequency**			
0027	**Max.normaliz. freq.**			
0001	**Device ID**	Firmware data	**501**	**0**
0002	**Firmware version**		**e.g. 2**	
0003	**Firmware module**		**e.g. 2**	
0006	**Serial number**		**e.g. 3**	
0007	**Convter number**		**e.g. 1**	
0008	**EEPROM prog. cycles**		**1**	**-**
		Displays the EEPROM programming cycles	-1 ... 100000	

Parameter No.:	Name	Description / Explanation selectable options	Factory setting min ... max values	Pass-word
0040.0X	fault memory		Not fault	0
		X = 0 ... 9 (the last 10 faults)	0 ... 47	
0898	scratchpad REFU		0.000	2
		Save any number	0.000 ... 2147483.647	
0899	scratchpad customer		0.000	2
		Save any number	0.000 ... 2147483.647	

Optiones

These are only displayed if the actual option is available. The parameters are described into the associated option description.

5.5 Numerical list

All of the basic parameterization parameters can be directly selected in the numerical list using the parameter number (refer to the structure of the basic parameterization).

6 Start-up

6.1 Steps to prepare for commissioning

The power terminals should be connected-up, as specified in Section 3.4, and the control terminals, as specified in Section 3.7 .

Check whether the star/delta jumpes have been correctly connected at the motor terminal board.

Observe the “Hazardous voltage warning information” in Section 3.2!

It should also be ensured, that signal-, line supply- and motor feeder cables have been separately routed with a minimum clearance between them. The setpoint cables must be shielded. Please refer to Section 3.1 “EMC-correct design of drives”.

Before first commissioning the electrical system, the qualified electrician or engineer should first check whether the equipment corresponds, both electrically and mechanically to the safety requirements

(5 Paragraph 1 No. 1 VBG 4), specified by

- - the accident prevention regulations, and
- - the general electrical regulations.

Check whether a rotating motor could cause human injury or material damage!

The power- and control voltages can be powered-up after all of the control-, setpoint and power supply cables have been connected. The operator panel displays ”Switch-on enable” message after approx. 10 sec

6.2 Procedure when first commissioning

The factory setting is always assumed regarding the parameterization in this “commissioning” section.

The following diagram guides you through the simplest start-up via the Quick Setup and starting the drive with the factory settings.

The second route represents, as example, several settings per “Prompted parameterization”. Please refer to Section 5 in this Instruction Manual for all other possibilities of parameterizing the drive.

The factory settings of the parameterization are also provided in Section 5 in the tables.

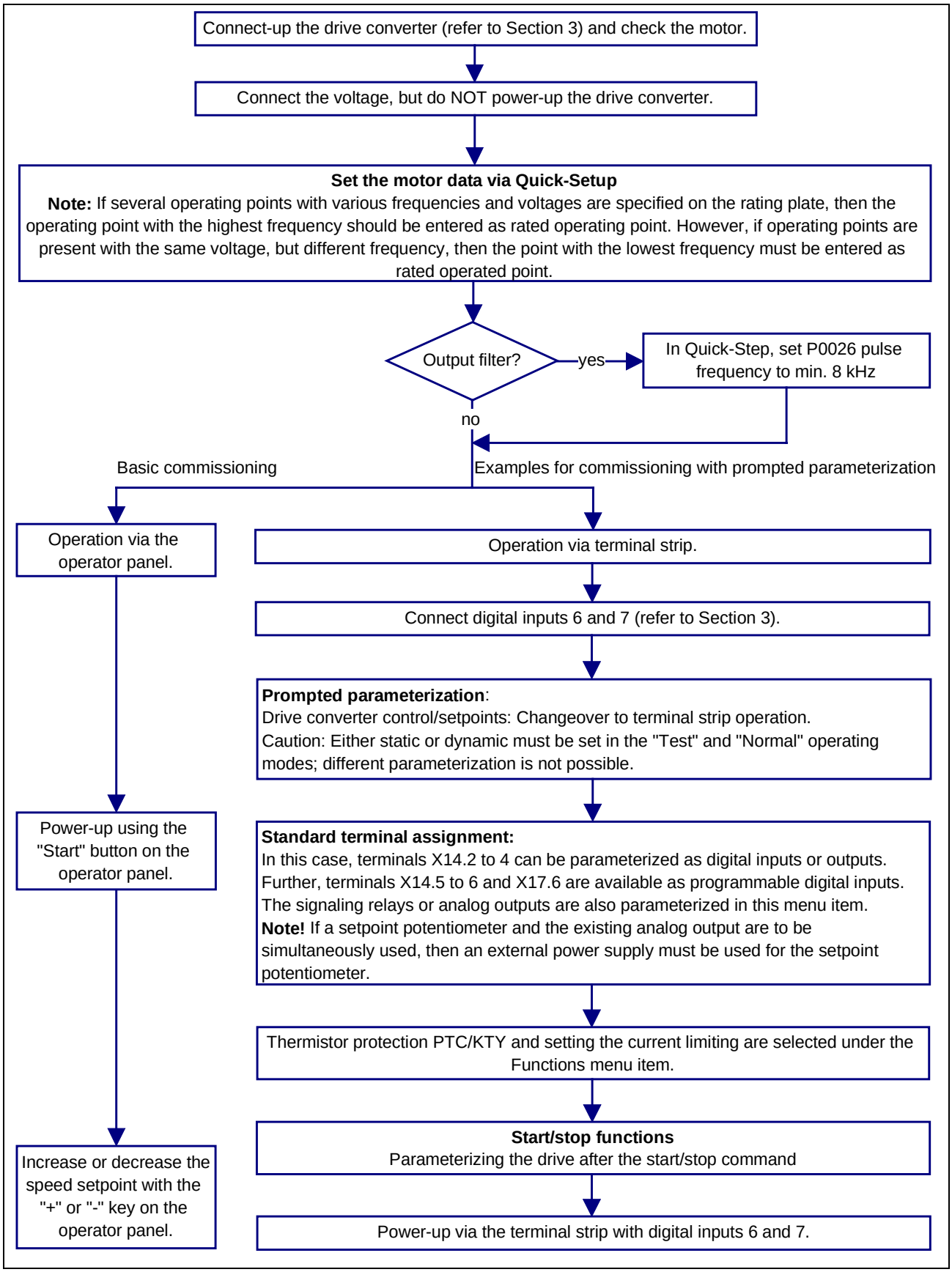


Fig. 6-1: Commissioning flow charter

6.3 Motor optimization / motor evaluation

Motor running under no-load conditions

In the steady-state condition, the drive converter current should be approx. 1/3 of the rated motor current.

If a significant deviation is identified, then the motor data, which was entered in Quick-Setup, can be checked to ensure that it is correct, and the mechanical load can be checked to ensure that it moves freely.

Running-up/accelerating under load

If the run-up /accelerating current is too high when the load is coupled, an additional voltage boost can be selected using parameter P0185 Ua. This means, that the point Ua on the characteristic is increased which reduces the accelerating current, and increases the available starting torque.

Procedure

Increase the point Ua on the characteristic step-by-step, until the starting current has reached the lowest value. The motor current starts to increase again, if the voltage boost is too high.

We also recommend, that when the drive is accelerating, and in steady-state operation, the current limiting does not intervene. When required, the current limit should be increased in parameter P0532, so that the full motor dynamic performance can be utilized, and the motor can be prevented from stalling.

Other measures to reduce the starting current include extending the “Accelerating ramp“ (P0280) or selecting the “Heavy-duty starting“ function (P0539) with a parameterized “delay time after start“ (P0544).

6.4 General information

- You can quickly commission several converters using the copy function (refer to Section 4.1.3, Parameterizing with the operator panel “Copy function“).
- If you wish to reset all of the parmeters to the factory setting, e.g. due to incorrect programming, then you can use the function “Load parameter set” with parameter P0071.
- Fault acknowledgment: There are three ways to acknowledge a fault.
  - Using the “Esc” button on the operator panel
  - Pressing “RESET” button S9 on the control card (the cover must be removed).
  - Controlling/energizing a configured digital input with the “Fault acknowledgement“ function.
- Comment: If a fault develops during operation, and a fault acknowledgment is then made, the “Switch-on inhibit” message is displayed. This means that the drive converter has gone into a fault condition. A “Stop” command must be entered in order to enter the “ready to power-on” status.

7 Troubleshooting

7.1 Self test - error messages

After the initialization routine, the system executes a self test. The individual components of the microcomputer system are tested, e.g. the EEPROM, and the data from the power control board is read-in.

7.2 Alarms

If an alarm is output, the alarm message is displayed, alternating with the programmed operating display. The alarm bit can be output at a digital input. If the drive converter should be prevented from powering-up, the alarm bit must be interlocked in the free parameterization.

7.3 Faults

During operation, permanently-programmed and parameterizable limit values are continuously monitored. In order to protect the power module against damage, when a limit value is exceeded, the drive converter is always powered-down and the appropriate fault message is displayed.

For REFU*drive 500* drive converters with three-phase supply, when a fault occurs, the main contactor is de-energized, and the power module goes into a no-voltage condition. The appropriate fault message is displayed.

The fault is displayed using the red LED "alarm" on the front panel of the drive.

Fault messages are saved in the fault memory so that they are not lost when the power fails. The fault memory is called-up in the monitor (operator control, refer to Section 4). The last faults are saved in the fault memory. The last fault is S0 in the memory location, the oldest, in S9. A new fault is always saved in memory location S0. All of the older faults in the memory are shifted one position upwards. This means the fault at memory location S9 is lost.

Fault acknowledgment

After a fault trip, the drive converter cannot be powered-up again until the fault has been acknowledged. The fault cannot be acknowledged as long as the fault still exists. If the cause of the fault has been removed, the fault can be acknowledged after a timer has expired (P0093, factory setting 1 sec.).

There are several ways of acknowledging a fault message:

- Pressing the Esc -button on the operator panel.
- Pressing the button S9 "Fault acknowledgment" on the control card.
- Using a digital input: Connect an H signal at the digital input, interconnect non-inverted D parameters of the selected digital inputs to P0050.07.
- Via the serial RS485 interface; transfer control word with bit 7 set to "high".

7.4 List of the alarm- and fault messages

No.	Messages	Warning	Fault
1	External	x	x
3	DC link voltage too high		x
4	DC link voltage too low	x	x
7	Device overtemperature	x	x
8	Brake resistor		x
9	Main contactor		x
10	Pre-charging		x
11	New EEPROM		x
13	Power section		x
14	Inverter		x
15	Power supply		x
17	Overspeed	x	x
18	Ground fault		x
19	EEPROM data	x	x
21	Internal WS comm.		x
22	NTC power section		x
24	SI1 timeout	x	x
25	SI2 function	x	x
26	SI2 timeout	x	x
27	Analog input 1: I < 4 mA	x	x
28	Motor oertemperature	x	x
30	SR-Release		x
31	BW overload	x	x
32	Overcurrent		x
34	Safety OFF	x	x
35	Motor, overload	x	x
39	start protection On		x
40	Switched power supply		x
41	SR <==> WS new		x
44	SI4 function	x	x
45	SI4 timeout	x	x
47	start protection On	x	

Fig. 7-1: Fault messages

7.5 Alarm- and fault messages - cause and remedy/comments

No.	Designation	Message
	Cause	Remedy / Comment
1	**External**	**Alarm / fault**
	If a digital input has been assigned the "no external fault" function, and there is no 24 V signal at the digital input, then the drive converter shuts down with the "External" fault (this is the version which is immune to wire breakage – i.e. fail-safe).	Define the cause of the signal loss in the plant/system and remove.
3	**DC link voltage too high**	**Fault**
	The motor regenerates into the DC link. Limit value: $U_{DC\ link\ max}$ (P0095) was exceeded. The ramp down time has been set too short.	If the fault occurs when braking, set the ramp-function generator down ramp slower (P0280). Brake resistor (if option W is used) using an ohmmeter, use a higher-rating external brake resistor. Check whether the brake resistor is selected (P0036).
4	**DC link voltage too low**	**Alarm / fault**
	During operation, the DC link voltage falls below limit value $V_{DC\ link\ min}$ (P0094). • Line supply dips or power failure. • Main contactor interrupted. • Defective line rectifier.	Check the line supply voltage using an oscilloscope.
7	**Device overtemperature**	**Alarm / fault**
	The measured heatsink temperature of the power section or the rectifier is too high. An alarm is displayed if the heatsink temperature is greater than 65 °C. The drive converter is shutdown if the temperature exceeds 70 °C. The temperature difference between the alarm and the fault trip can be changed in parameter P0086. The actual heatsink temperatures can be displayed using the monitor (power section = D1870 and rectifier = D2029). • Ambient temperature > 40 °C • Defective fan • Air filter blocked • NTC (temperature sensor) defective • Incorrectly set fan control	Example of an incorrectly set fan control in P0034: The function is set to "Automatic" and the threshold in P0035 is set too high. Reduce the threshold
8	**Brake resistor**	**Fault**
	• When the brake resistor is controlled, there is no checkback signal. • The switching transistor or the brake resistor is defective.	• Check the brake resistor switching transistor between terminals F and D using a multimeter. If the brake resistor switching transistor is OK, the measurement results must be as follows from F to D: Blocking voltage from D to F: Diode let-through voltage
9	**Main contactor**	**Fault**
	Main contactor does not pull-in during operation, or a checkback signal is not received from it.	• Check the control voltage for the main contactor. • Check the auxiliary contact for the checkback signal.

No.	Designation	Message
	Cause	**Remedy / Comment**
10	**Pre-charging**	**Fault**
	After the drive unit has been powered-up, the DC link voltage charging over time is monitored. If illegal deviations occur, pre-charging is stopped. • Short-circuit between terminals C and D (DC link voltage) or C-PE or D-PE. • Only with the optional W brake resistor: Short-circuit between F and C. • Only for option V, electronics standby: The "ON" command was connected, while the standby supply is active, but there is no line supply voltage.	Check the following, • whether the line supply voltage is available • whether there is a short-circuit between terminals C and D or C-PE and D-PE. **Comment:** After the "pre-charging" fault has been acknowledged, it is only permissible to power-on again after 30 seconds. This protects the pre-charging resistors against overheating.
11	**New EEPROM**	**Fault**
	The processor control did not recognized the bit pattern, factory-loaded in the EEPROM	Please contact customer service
13	**Power section**	**Fault**
	Power section fault, which cannot be described in any detail.	Please contact customer service.
14	**Inverter**	**Fault**
	This fault is initiated when the overcurrent threshold is exceeded; it protects the power section transistors. **Causes outside the drive converter:** • Defective motor; stalled (blocked) motor or a motor which cannot move freely; defective motor cable • Setpoint step which is too fast	• Disconnect the motor cable, enable the inverter. If the fault no longer occurs, then the cause is the motor. Replace the motor • Measuring with REFUwin "Oscilloscope function“: Parameter D1981“f-act from normalization“.
	Parameterization: • The incorrect motor data were parameterized. • Only for option S sinusoidal filter: The pulse frequency (P0026) is set to less than 8 kHz; thus, the sinusoidal filter can oscillate and conduct high currents. **With the drive converter:** • Defective power section transistor.	• Check the motor data in the Quick-setup. • Set the pulse frequency in Quick-setup (P0026) to 8 kHz or greater.
	Troubleshooting: In many cases, a defective power transistor in the inverter can be simply found using a conventional multimeter. Proceed as follows: 1. Disconnect and isolate the drive converter from the line supply. 2. Disconnect the motor. 3. Measuring the diode let-through voltage between the output terminals and the DC link terminals, using the multimeter. If the inverter is intact: from U2 to C: Diode let-through voltage from C to U2: Blocking voltage from U2 to D: Blocking voltage from D to U2: Diode let-through voltage from V2 to C: Diode let-through voltage from C to V2: Blocking voltage from V2 to D: Blocking voltage from D to V2: Diode let-through voltage from W2 to C: Diode let-through voltage from C to W2: Blocking voltage from W2 to D: Blocking voltage from D to W2: Diode let-through voltage	

No.	Designation	Message
	Cause	**Remedy / Comment**
	When the power transistors are inhibited, they are in a high-ohmic state in both directions. The multimeter indicates the diode let-through voltage if the free-wheeling diode, connected in parallel, is measured in the let-through direction.	
15	**Power supply**	**Fault**
	The switched-mode power section voltages lie outside the limit values: Limit value for +15 V = +13.5 V - 15 V = - 13.5 V	The switched-mode power section is defective or the load is too high as a result of a defective module (also refer to the comment on Fault 40, switched-mode power supply).
17	**Overspeed**	**Alarm / Fault**
	The actual speed exceeds the speed limit of parameter "f-limit motor".	• Check P0178 (f-limit motor) to ensure that it has been correctly set. It is possible that an excessive slip compensation was selected (P0540). • Check the P0390 (frequency normalization) to ensure that it has been correctly set; if required, change. • In P0449 (response for overspeed), either alarm or fault can be selected.
18	**Ground fault**	**Fault**
	Ground fault at the inverter output terminals (U2, V2, W2) or excessive capacitance to ground due to long motor cables.	
19	**EEPROM data**	**Alarm / Fault**
	Parameterization: • The control card was replaced and, after initialization, detects a new power section, which, for example, cannot supply the parameterized current. This means, that one or several parameters lie outside the tolerance range. When the fault is acknowledged, the associated parameters are reset to the standard drive converter values. **In the drive converter:** • This fault can occur, if the power fails during operation. In this case, the power section could send incorrect data to the control card.	• Using P0061.XX, the appropriate parameter numbers can be viewed, and with P0062.XX, the erroneous parameter values. • The fault can be removed by special acknowledgment using P0060 (password level 3 [Esc], [Mon], [Prog] and [+]). Finally, it must be checked whether the modified parameters fit the particular application. When parameterization is exited, the values are transferred into the EEPROM. • The fault may be able to be removed by powering-up and powering-down the line supply voltage or the standby supply. If this is not successful, then please call customer service.
21	**Internal WS comm.**	**Fault**
	Communications between the process PC board and the power section is faulted. If the fault occurs after power-up during the self-test, it cannot be acknowledged.	Check the plug connection between the PC boards or replace the modules.
22	**NTC power section**	**Fault**
	Wire broken/interrupted to the NTC on the heatsink in the power section or rectifier; NTC defective; excessive resistance or the contactor has no contact.	Check the plug connection; replace the connector, cable or NTC.
24	**SI1 timeout**	**Alarm / Fault**
	The control computer does not send data within the parameterized response time (P0506).	Check the plug connection SS1 (RS485), extend the response time (P0506), select another response type (P0505).
25	**SI2 function**	**Alarm / Fault**
	Only for option interface cards at option slot 1. The drive converter detects a physical fault on the interface cable from the higher-level control computer. Erroneous data transfer along the fieldbus.	Check that the PPO type (protocol type), baud rate, parity, stop bit and slave address are correct. If a bus error occurs in the form of an alarm or fault, then the alarm or the fault or both messages can be suppressed using parameter P0509; this means that

No.	Designation	Message
	Cause	Remedy / Comment
		the system can continue to operate!
		Only for the CAN bus option: The protocols sent on the CAN bus interface are monitored. If a bus error occurs more than 127x, an alarm is output. If a bus error occurs more than 255x, a fault is signaled. The alarm or fault, or both messages can be masked in parameter P0509; this means that the system can continue to operate. **Only for the Profibus option:** Either "no action" and "fault" when receiving clear data can be selected in parameter P0524. Caution: In this case, P0509 should be set to the "all active" function! i.e. Clear Data is sent from the control computer, if there is an invalid protocol or a bus error. **Only for Interbus S option:** The response type can be set in parameter P0518 and the monitoring time when a bus error occurs, in P0519. Index 0 = process data, index 1 = PKW range.
26	**SI2 timeout**	**Alarm / Fault**
	Only for option interface cards at option slot 1. • Within the parameterized response time (P0527), the higher-level control computer does not send any data.	• Check plug connection SS2 • Extend response time (P0527), select another response type (P0526).
27	**Analog input 1: I < 4 mA**	**Alarm / Fault**
	Cause external to the drive converter: • Short-circuit or interrupted cable on the setpoint line to the analog input or to the option analog inputs (only for the mode 4-20 mA or 2-10 V). **Cause due to the parameterization:** • Erroneous response type • Incorrect operating mode	• Check the setpoint line. • Check the response type in P0564.0X or P0752.0X. • Check the operating mode in P0201.0x or P0735.0X.
28	**Motor overtemperature**	**Alarm / Fault**
	The drive converter detects an excessive resistance at terminals X15.1 and 2. • The motor temperature is too high, temperature sensor defective, sensor cable defective. • Erroneous parameterization.	• Replace the sensor or sensor cable. • Check the temperature evaluation parameters (P0385 – P0389) are correct. When the KTY84 has been selected, the actual motor temperature °C, or for PTC selection, the actual ohmic value can be displayed with D1872 or D1871 respectively.
30	**SR-Release?**	**Fault**
	The control card and the firmware (Flash EPROM) do not match.	Please contact your customer service
31	**BW overload**	**Alarm / Fault**
	For the parameterized brake resistor, the drive converter computes a temperature image. If the brake resistor is controlled, the drive converter calculates the assigned temperature. If a threshold is exceeded, the drive converter signals brake resistor overload. **Cause external to the drive converter:**	

No.	Designation	Message
	Cause	**Remedy / Comment**
	Only for the option W brake resistor: • The brake resistor which is being used has an excessive ohmic value. • A brake resistor has not been connected. • The connected brake resistor is too low for the energy which is fed-back into the DC link when braking. **Cause in the parameterization:** • The down-ramp was set too fast. • Incorrect brake resistor selected. • Only for an external programmable braking resistor: The values for the resistance, continuous output and/or thermal time constant incorrectly parameterized	• Check the break resistor. • Check the down-ramp in P0280.0X. • In P0038 check whether the correct brake resistor was selected. Information regarding REFU Standard: Every drive converter output class is assigned a specific brake resistor. • Check the values in P0623 to P0625. Maintain the max. braking duration and the required no-load times to the next braking operation. The load diagram in the instructions for the brake resistor option can be used to calculate the braking- and no-load times.
32	**Overcurrent**	**Fault**
	Current limiting is active for a time which is longer than that parameterized.	Check the setting of P0574! The time duration of the uninterrupted current limiting (D1678 = 1) can be set between 1 second and 100 seconds in 11 steps, using P0574. If current limiting is interrupted before the parameterized time has expired (D1678 = 0), the time counter is reset to 0 and then restarts at the next current limiting. if P0574 has been set to 0 (= continuous), then the "overcurrent" fault is output.
34	**Safety OFF (NAMUR)**	**Alarm / Fault**
	The "safety shutdown" fault message has been introduced, so that drive converter fulfills the NAMUR standard (NAMUR is a standard committee for instrumentation and control in the chemical industry). It is only activated when P0057 is set to 1. The fault or alarm is selected using P0571. The fault is initiated using an external control signal, which is connected to the digital input of the drive converter. The D parameter of the digital input is interconnected in P0050.1. The external control signal is used to positively disconnect the drive from the line supply (1 = operation; 0 = disconnected from the line supply).	
35	**Motor overload**	**Alarm / Fault**
	The electronic overload relay has responded (refer to the function diagram "modulation, measured value sensing" or in the Instruction Manual, Section 5 of the basis programming "Thermal motor protection").	Check P0566 "Overload protection threshold" to ensure that it has been correctly set. The type of response of the electronic overload relay can be set using P0565: disabled / alarm / fault.
39	**Start protection On**	**Fault**
	This message only occurs when the start inhibit option is being used. Sizes A to E: Contacts X80.1 and 2 were opened during operation, or an on command was output with	

No.	Designation	Message
	Cause	**Remedy / Comment**
	the terminal open. Sizes G and H: Contacts X80.170 and 171 were opened during operation, or an on command was issued with the terminals open-circuit.	
40	**Switched power supply**	**Fault**
	The switched-mode power supply for the electronic supply does not output a checkback signal.	Replace the defective switched-mode power supply. Depending on the drive converter version, the switched-mode power section is on the PC board: LT (power section), WS (inverter control) or SV (power supply).
41	**SR <==> WS new**	
	If the control card is replaced in another drive converter with a higher or lower output- or drive converter index, this entry is made in the fault memory (the drive converter does not go into a fault condition!). A fault is issued if the parameters lie outside the limit values (refer to Fault 19).	
44	**SI4 function**	**Alarm / Fault**
	Only for option interface cards at option slot 2. The drive converter detects a physical fault on the interface cable from the higher-level control computer. Erroneous data transfer along the fieldbus	Check that the PPO type (protocol type), baud rate, parity, stop bit and slave address are correct. If a bus error occurs in the form of an alarm or fault, then the alarm or the fault or both messages can be suppressed using parameter P0745; this means that the system can continue to operate! **Only for the CAN bus option:** The protocols sent on the CAN bus interface are monitored. If a bus error occurs more than 127x, an alarm is output. If a bus error occurs more than 255x, a fault is signaled. The alarm or fault, or both messages can be masked in parameter P0745; this means that the system can continue to operate. **Only for the Profibus option:** Either "no action" and "fault" when receiving clear data can be selected in parameter P0524. Caution: In this case, P0745 should be set to the "all active" function! i.e. Clear Data is sent from the control computer, if there is an invalid protocol or a bus error. **Only for Interbus S option:** The response type can be set in parameter P0518 and the monitoring time when a bus error occurs, in P0519. Index 0 = process data, index 1 = PKW range.
45	**SI4 timeout**	**Alarm / Fault**
	Only for option interface cards at option slot 2. • Within the parameterized response time, the higher-level control computer does not send any data.	• Check plug connection SS4 • Extend response time (P0747), select another response type (P0746).
47	**Start protection On (active)**	**Alarm**
	Only for the start inhibit option: Start inhibit was activated, while the drive converter was not in the operational status.	

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