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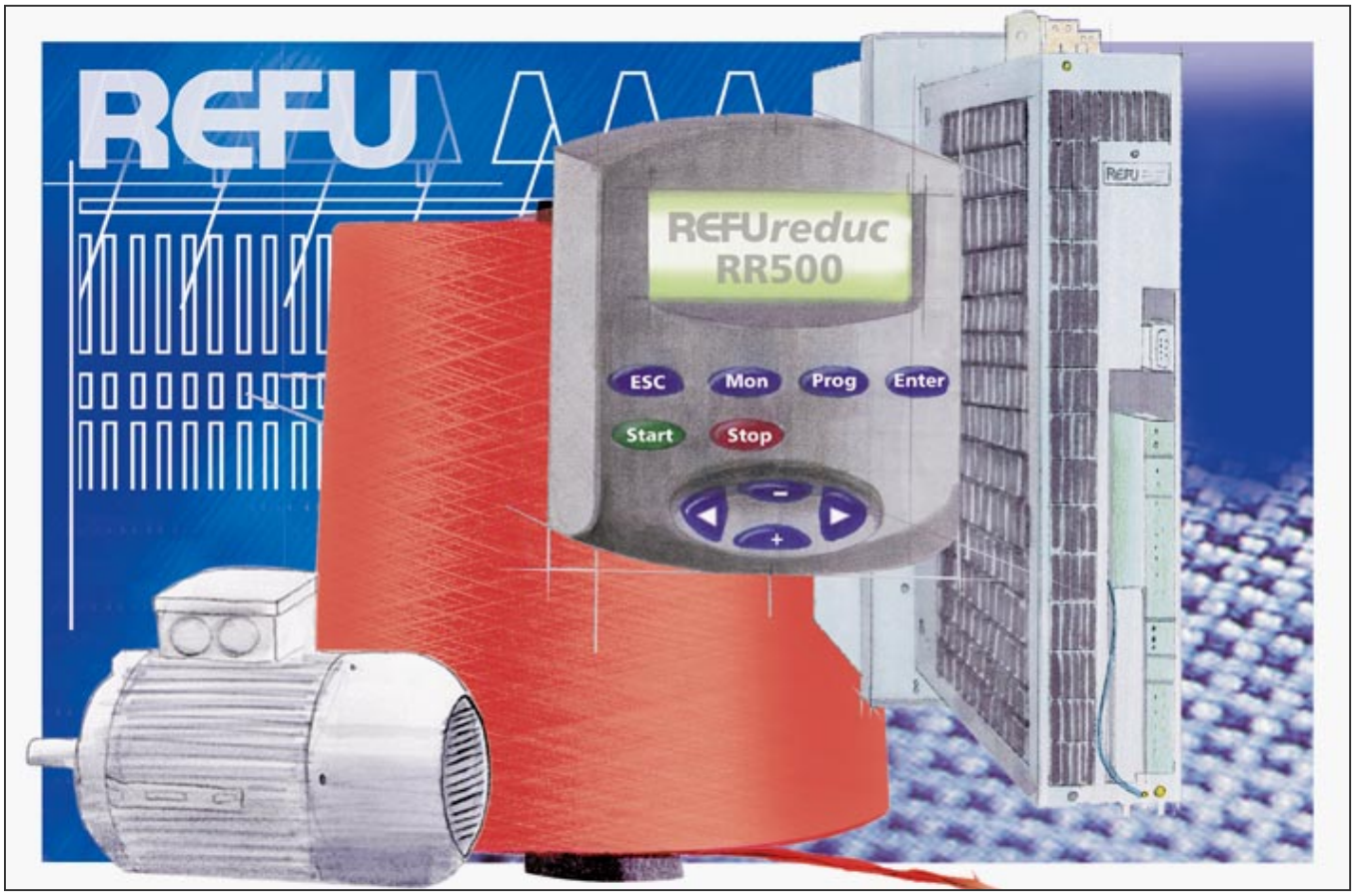

REFUreduc RR51
VFC (voltage-frequency-control)
Drive controls for textile engineering

Operating Instructions

REFU*drive 500*

DOK-RD500*-RR51*******-IB01-EN-P

Rexroth
Indramat

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Type of Documentation
Operating Instructions

Document Typecode
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Purpose of Documentation
This documentation explains the frequency converters and inverters of the drive series REFU*reduc* RR51. 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

Record of Revisions

Description	Release Date	Notes
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List of contents

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

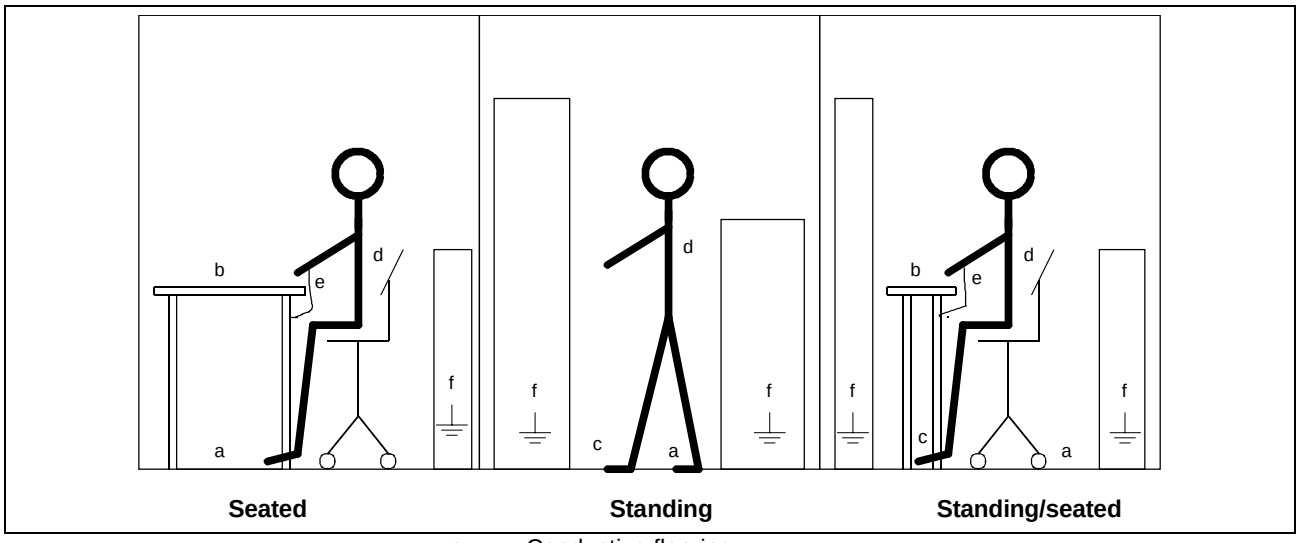
Symbol	Significance and application
	Caution! General potential source of danger. Used in conjunction with the terms "Warning" and "Caution".
	Caution! Danger due to electric current. Used in conjunction with the terms "Warning" and "Caution".
	Caution! Components which can be destroyed by electrostatic 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:

- automatic motor adaptation using parameter identification routines
- 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

1.2 REFU*reduc*

REF*Ureduc* is a member of the REF*Udrive 500* series. Functionality, flexibility, and the performance characteristics have been taken from the larger series line. However, we have focused on the specific requirements of textile engineering, which have been consistently integrated into the product line:

- Optimally designed for the textile industry, with space-saving NEMA 12 construction to avoid heat build-up in your machines
- Textile-suitable heat sink
- Flexible components for solutions with several motors
- VFC (voltage-frequency-control) can be used up to high-quality, dynamic servo drive systems
- Operator panel – if required – is optionally available either as plug-in or as (NEMA 12) membrane display and keypad
- No line filter or input throttle – offered as a group solution for machines

Technical features

- AC or DC power supply
- Either forced air cooling, heat transfer plates or integrated cooling circuits
- Removable 4-line graphic display with copy function
- Various interfaces for operating observing, and parameterizing (“download” parameterization) the drive system:

  - Profibus DP, Interbus S, CANopen
  - Peer-to-peer coupling with fiber-optic cables
  - SynchroLink for fast communication 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
- Additional signal processor (32-bit floating point) for high-dynamic applications and servo applications:
  - Torque rise time of 0.3 ms
  - Current cycle times of 0.1 ms
- Double overload for 0.5 sec
- High-performance software tool: REF*Uwin*

Fig. 1-1: Device of the REFU*reduc* series

1.3 Rating plate

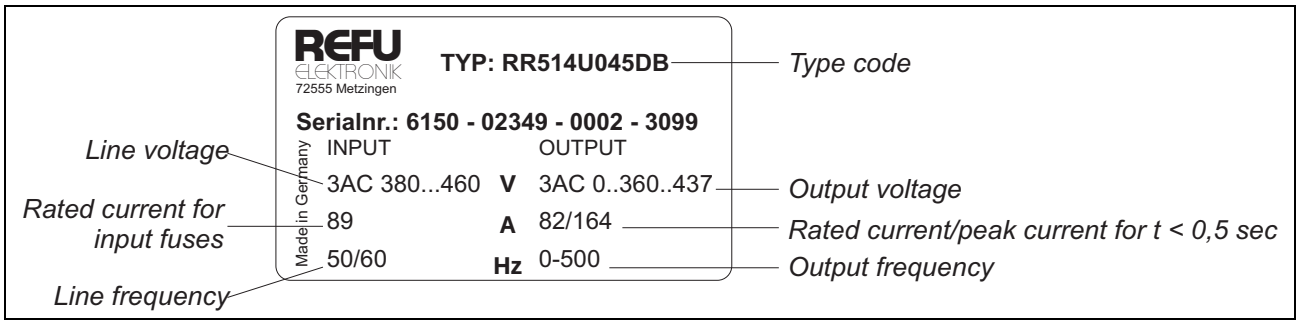


Fig. 1-2: Rating plate

1.4 Technical Data

Technical Data for pulse frequency f_p = 4 kHz

RR51			001	003	004	005	007	011	015
Motor output [1]		[kW]	1,5	3,0	4,0	5,5	7,5	11	15
Line supply voltage: Converter 3-ph. 400 V AC (±15%) / Inverter 560 V DC (±15%)									
Output frequency		[Hz]	0 -250 Hz						
Rated current		[A]	4,0	7,5	10	13	18	25	30
Peak current for	t=60 s	[A]	5,2	9,8	13	17	23	33	39
	t=1 s	[A]	6,8	13	17	22	31	43	51
	t=0,5 s	[A]	8,0	15	20	26	36	50	60
Rated output S_N		[kVA]	2,6	4,9	6,6	8,6	12	16	20
Peak output for	t=60s	[kVA]	3,4	6,5	8,6	11	15	22	26
Line supply voltage: Converter 3-ph. 460 V AC (±15%) / Inverter 650 V DC (±15%)									
Output frequency		[Hz]	0 -250 Hz						
Rated current		[A]	3,5	6,5	9	12	16	21	27
Peak current for	t=60 s	[A]	5,2	9,8	13	17	23	33	39
	t=1 s	[A]	6,8	13	17	22	31	43	51
	t=0,5 s	[A]	8,0	15	20	26	36	50	60
Rated output S_N		[kVA]	2,6	4,9	6,6	8,6	12	16	20
Peak output for	t=60s	[kVA]	3,4	6,5	8,6	11	15	22	26
Line supply voltage: Converter 3-ph. 500 V AC (±10%) / Inverter 710 V DC (±10%)									
Output frequency		[Hz]	0 - 250 Hz						
Rated current		[A]	3	6	8	10	14	20	24
Peak current for	t=60 s	[A]	3,9	7,8	10	13	18	26	31
	t=1 s	[A]	5,1	10	14	17	24	34	41
	t=0,5 s	[A]	6,0	12	16	20	28	40	48
Rated output S_N		[kVA]	2,5	4,9	6,6	8,2	12	16	20
Peak output for	t=60s	[kVA]	3,2	6,4	8,2	11	15	21	26
Ambient conditions, losses, radio interference suppression level, noise immunity									
Environmental class			3K3 according to DIN IEC 721-3-3 (ambient temperature 0-40 °C)						
Losses at rated output		[W]	45	90	120	165	225	330	450
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
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
Liquid cooling		[kg]	10	10	10	10	10	12	12
Heat conducting plate		[kg]	10	10	10	10	10	12	12

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

Technical Data for pulse frequency f_p = 4 kHz

RR51			018	022	030	037	045	055	075
Motor output [2]		[kW]	18,5	22	30	37	45	55	75
Line supply voltage: Converter 3-ph. 400 V AC (±15%) / Inverter 560 V DC (±15%)									
Output frequency		[Hz]	0 -250 Hz						
Rated current		[A]	35	43	56	68	82	99	135
Peak current for	t=60 s	[A]	46	55	73	88	107	129	176
	t=1 s	[A]	60	72	95	116	139	168	230
	t=0,5 s	[A]	70	85	112	136	164	198	270
Rated output S_N		[kVA]	23	28	37	45	54	65	89
Peak output for	t=60s	[kVA]	30	36	48	58	70	85	116
Line supply voltage: Converter 3-ph. 460 V AC (±15%) / Inverter 650 V DC (±15%)									
Output frequency		[Hz]	0 -250 Hz						
Rated current		[A]	3,5	6,5	9	12	72	86	120
Peak current for	t=60 s	[A]	5,2	9,8	13	17	107	129	176
	t=1 s	[A]	6,8	13	17	22	139	168	230
	t=0,5 s	[A]	8,0	15	20	26	164	198	270
Rated output S_N		[kVA]	2,6	4,9	6,6	8,6	54	65	89
Peak output for	t=60s	[kVA]	3,4	6,5	8,6	11	70	85	116
Line supply voltage: Converter 3-ph. 500 V AC (±10%) / Inverter 710 V DC (±10%)									
Output frequency		[Hz]	0 - 250 Hz						
Rated current		[A]	31	38	49	60	66	80	108
Peak current for	t=60 s	[A]	46	55	73	88	86	104	140
	t=1 s	[A]	60	72	95	116	112	136	184
	t=0,5 s	[A]	70	85	112	136	132	160	216
Rated output S_N		[kVA]	23	28	37	45	54	66	89
Peak output for	t=60s	[kVA]	30	36	48	58	71	86	115
Ambient conditions, losses, radio interference suppression level, noise immunity									
Environmental class			3K3 according to DIN IEC 721-3-3 (ambient temperature 0-40 °C)						
Losses at rated output		[kW]	0,56	0,66	0,90	1,11	1,35	1,65	2,25
Radio interference suppression level / noise immunity			A 1 according to EN 55011 / EN 61800-3						
Mechanical design									
Size classes			B	C	C	C	C	D	D
Degree of protection			IP 20 according to EN 60529 (without terminal connections)						
Weight of the drive converter for cooling type									
Forced ventilation		[kg]	18	33	33	33	33	50	50
Liquid cooling		[kg]	12	25	25	25	25	37	37
Heat conducting plate		[kg]	12	--	--	--	--	--	--

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

Technical Data for pulse frequency f_p = 8 kHz

RR51			001	003	004	005	007	011	015
Motor output [3]		[kW]	1,1	2,2	3,0	4,0	5,5	7,5	11
Line supply voltage: Converter 3-ph. 400 V AC (±15%) / Inverter 560 V DC (±15%)									
Output frequency		[Hz]	0 -500 Hz						
Rated current		[A]	3,0	5,8	7,5	10	13	18	25
Peak current for	t=60 s	[A]	3,9	7,5	9,8	13	17	23	33
	t=1 s	[A]	51	9,9	13	17	22	31	43
	t=0,5 s	[A]	6,0	12	15	20	26	36	50
Rated output S_N		[kVA]	2,0	3,8	4,9	6,6	8,6	12	16
Peak output for	t=60s	[kVA]	2,6	4,9	6,5	8,6	11	15	22
Line supply voltage: Converter 3-ph. 460 V AC (±15%) / Inverter 650 V DC (±15%)									
Output frequency		[Hz]	0 -500 Hz						
Rated current		[A]	2,6	5,0	6,5	8,7	12	16	21
Peak current for	t=60 s	[A]	3,9	7,5	9,8	13	17	23	33
	t=1 s	[A]	51	9,9	13	17	22	31	43
	t=0,5 s	[A]	6,0	12	15	20	26	36	50
Rated output S_N		[kVA]	2,0	3,8	4,9	6,6	8,6	12	16
Peak output for	t=60s	[kVA]	2,6	4,9	6,5	8,6	11	15	22
Line supply voltage: Converter 3-ph. 500 V AC (±10%) / Inverter 710 V DC (±10%)									
Output frequency		[Hz]	0 - 500 Hz						
Rated current		[A]	2,4	4,5	6	8	10	14	20
Peak current for	t=60 s	[A]	3,1	5,9	7,8	10	13	18	26
	t=1 s	[A]	4,1	7,7	10	14	17	24	34
	t=0,5 s	[A]	4,8	9,0	12	16	20	28	40
Rated output S_N		[kVA]	2,0	3,7	4,9	6,6	8,2	12	16
Peak output for	t=60s	[kVA]	2,6	4,9	6,4	8,2	11	15	21
Ambient conditions, losses, radio interference suppression level, noise immunity									
Environmental class			3K3 according to DIN IEC 721-3-3 (ambient temperature 0-40 °C)						
Losses at rated output		[W]	45	90	120	165	225	330	450
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
Degree of protection			IP 20 acording 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
Liquid cooling		[kg]	10	10	10	10	10	12	12
Heat conducting plate		[kg]	10	10	10	10	10	12	12

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

Technical Data for pulse frequency f_p = 8 kHz

RR51			018	022	030	037	045	055	075
Motor output [4]		[kW]	15	18,5	22	30	37	45	55
Line supply voltage: Converter 3-ph. 400 V AC (±15%) / Inverter 560 V DC (±15%)									
Output frequency		[Hz]	0 -500 Hz						
Rated current		[A]	30	35	43	56	68	82	99
Peak current for	t=60 s	[A]	39	46	55	73	88	107	129
	t=1 s	[A]	51	60	72	95	116	139	168
	t=0,5 s	[A]	60	70	85	112	136	164	198
Rated output S_N		[kVA]	20	23	28	37	45	54	65
Peak output for	t=60s	[kVA]	26	30	36	48	58	70	85
Line supply voltage: Converter 3-ph. 460 V AC (±15%) / Inverter 650 V DC (±15%)									
Output frequency		[Hz]	0 -500 Hz						
Rated current		[A]	27	31	38	49	60	72	86
Peak current for	t=60 s	[A]	39	46	55	73	88	107	129
	t=1 s	[A]	51	60	72	95	116	139	168
	t=0,5 s	[A]	60	70	85	112	136	164	198
Rated output S_N		[kVA]	20	23	28	37	45	54	65
Peak output for	t=60s	[kVA]	26	30	36	48	58	70	85
Line supply voltage: Converter 3-ph. 500 V AC (±10%) / Inverter 710 V DC (±10%)									
Output frequency		[Hz]	0 - 500 Hz						
Rated current		[A]	24	28	34	45	55	66	80
Peak current for	t=60 s	[A]	31	36	44	59	72	86	104
	t=1 s	[A]	41	48	58	77	94	112	136
	t=0,5 s	[A]	48	56	68	90	110	132	160
Rated output S_N		[kVA]	20	23	28	37	45	54	66
Peak output for	t=60s	[kVA]	26	30	36	49	59	71	86
Ambient conditions, losses, radio interference suppression level, noise immunity									
Environmental class			3K3 according to DIN IEC 721-3-3 (ambient temperature 0-40 °C)						
Losses at rated output		[kW]	0,56	0,66	0,90	1,11	1,35	1,65	2,25
Radio interference suppression level / noise immunity			A 1 according to EN 55011 / EN 61800-3						
Mechanical design									
Size classes			B	C	C	C	C	D	D
Degree of protection			IP 20 according to EN 60529 (without terminal connections)						
Weight of the drive converter for cooling type									
Forced ventilation		[kg]	18	33	33	33	33	50	50
Liquid cooling		[kg]	12	25	25	25	25	37	37
Heat conducting plate		[kg]	12	--	--	--	--	--	--

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

Technical Data for pulse frequency f_p = 10 and 12 kHz

RR51	001	003	004	005	007	011	015
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
Rated current for 3-ph. 460 V AC (±15%) [A]	2,2	4,2	5,6	7,3	10,3	13,5	18,5
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
Rated current for 3-ph. 460 V AC (±15%) [A]	1,9	3,5	4,8	6	8,7	11	15,5

RR51	018	022	030	037	045	055	075
Data for pulse frequency f_p = 10 kHz							
Rated current for 3-ph. 400 V AC (±15%) [A]	26	32,5	39	48	60	75	89,5
Rated current for 3-ph. 460 V AC (±15%) [A]	23	28,5	34,5	42	53	65,5	78
Data for pulse frequency f_p = 12 kHz							
Rated current for 3-ph. 400 V AC (±15%) [A]	22	30	35	40	52	68	80
Rated current for 3-ph. 460 V AC (±15%) [A]	19	26	30,5	35	45,5	59	69,5

Power losses

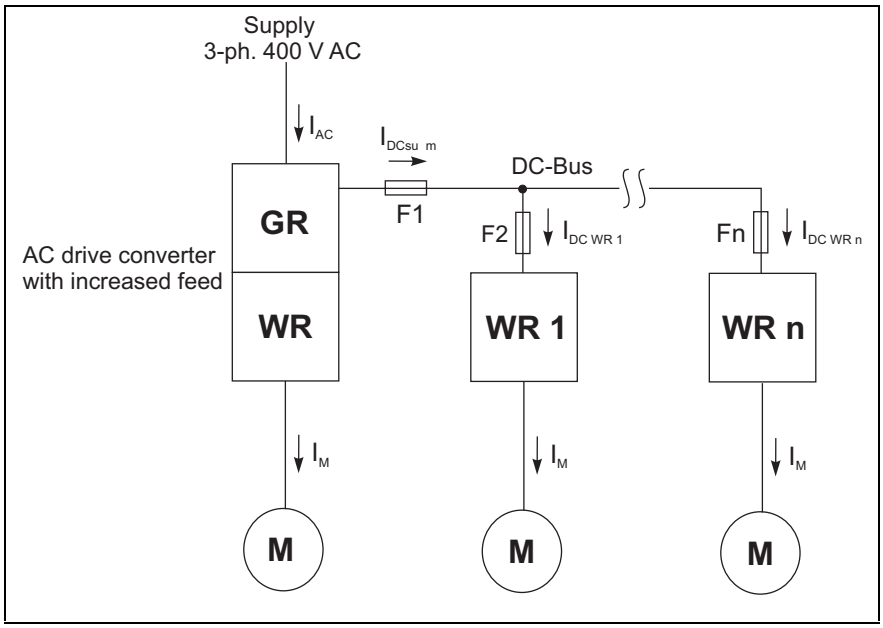
The power loss in the unit at rated output is 3 %, refer to the previous tables, "losses at rated output". The total power loss is sub-divided into 15% convection and an output-independent component of 60 W which is dissipated via the unit housing, and 85% which must be dissipated at the rear to the cooling system via the heat transfer plate.

Power loss via the heat transfer plate 85 % of the total power loss

Power loss through the housing 15 % of the total power loss + 60 W from the control electronics

1.5 DC supply with AC converters

For AC converters with higher rating feed, the rectifier has a higher rating than the inverter. The power difference is available at terminals C and D as feed power for the DC bus. The DC link output must be fused in the AC converter. The DC link cross-section and its fusing (cable protection) is dependent on the sum of the inverter currents, and therefore must be determined on a project-for-project basis. The maximum values for the DC link fuses can be taken from the table below. The sum of the powers of all the inverters connected to the DC bus, may not exceed the rectification power of the AC converter. If the DC bus is a busbar, from which the individual connecting cables to the inverters are connected, with a lower cross-section, then these connecting cables, depending on the cross-section, must be individually fused to provide cable protection



GR: Rectifier
WR: Inverter
M: Motor
F1: Fusing at the AC drive converter
F2-Fn: Fuses for the feeder cables

Fig. 1-3: Circuit principle, AC converter with increased feed power

AC drive converter with increased feed 1)	**Code**	**011**	**015**	**018**	**022**	**030**	**045**	**055**
Rated motor output f_p = 4kHz	[kW]	11	15	18.5	22	30	45	55
Rectifier power	[kW]	26.5	26.5	26.5	75	75	75	75
DC link power for the DC bus	[kW]	15.5	11.5	8.5	53	43	30	20
Max. possible DC-bus fuses	[A]	Not necessary	Not necessary	Not necessary	125 2)	125 2)	50 3)	50 3)
Size class		B	B	B	D 2)	D 2)	D	D

1): The motor output is valid as code
2): External fuse holder
3): Internal fuse

Fig.. 1-4: Dimensioning multi-motor drives with DC bus

Note: The rated current, the peak currents, the rated- and peak power at the various supply voltages and pulse frequencies should be taken from the tables with the drive converter technical data.

1.6 Circuit principle

Electronic section

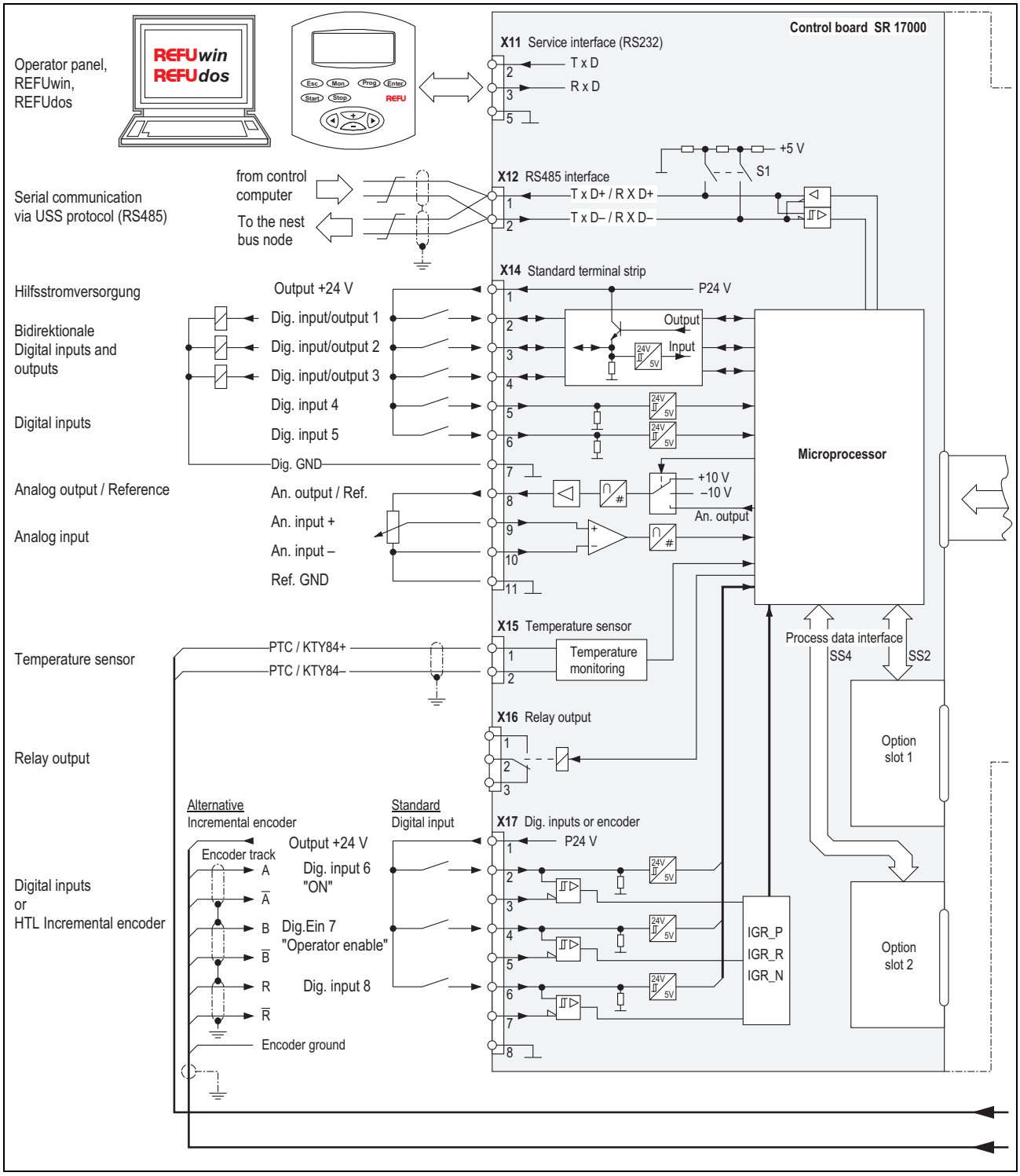


Fig. 1-5: Circuit principle of converter electronic section

Converter power section

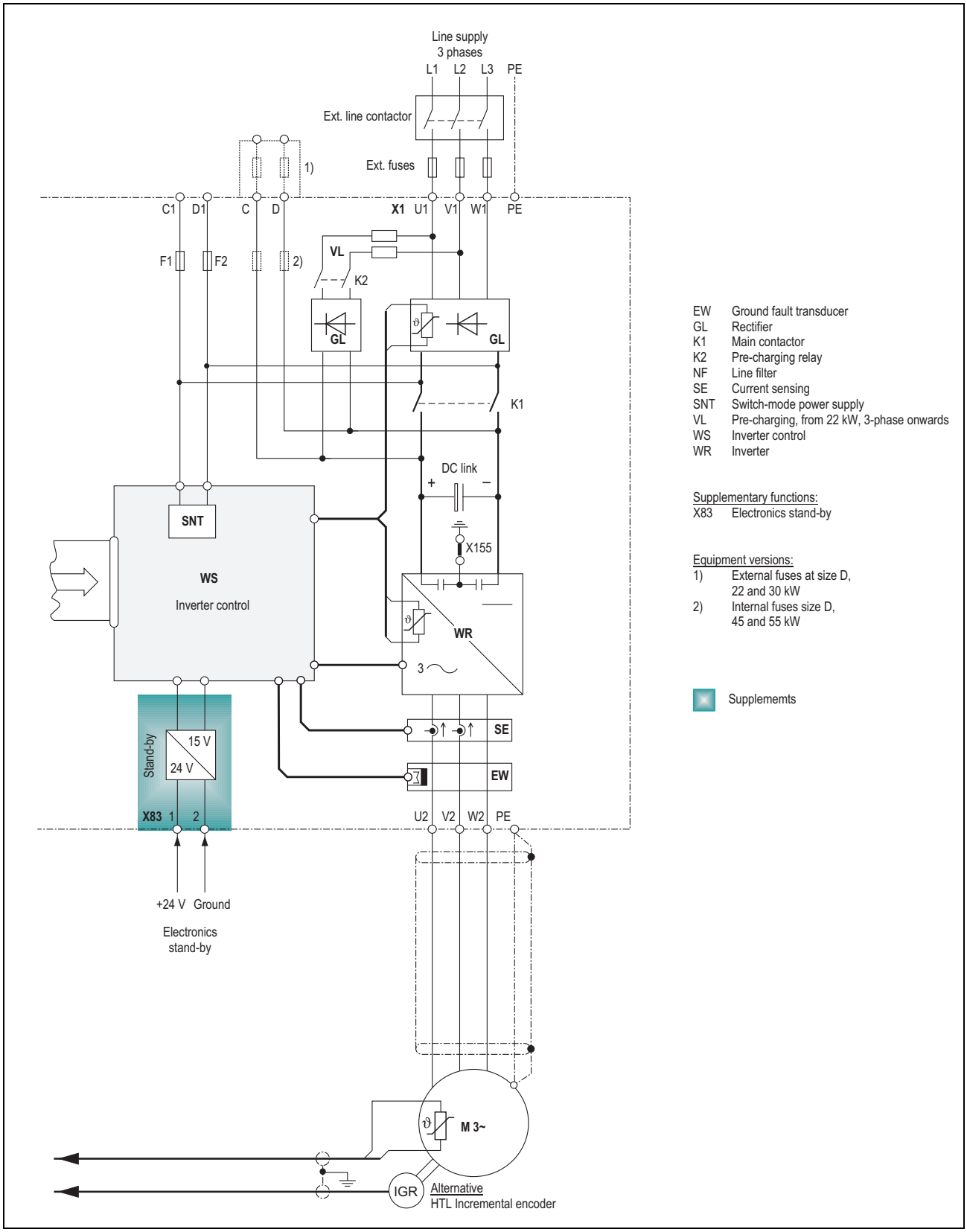


Fig. 1-6: Circuit principle of converter power section

Inverter power section

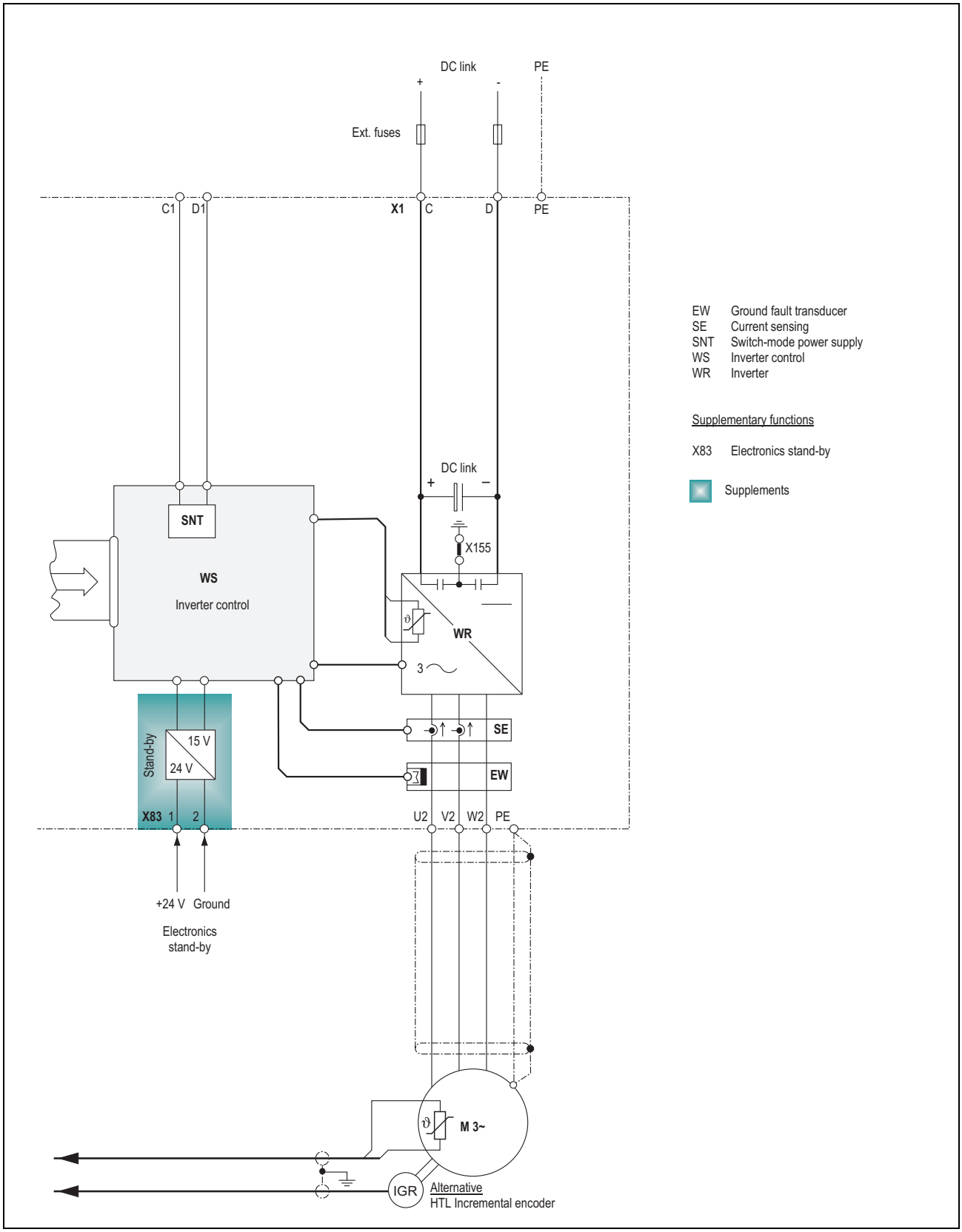


Fig. 1-7: Circuit principle of inverter power section

1.7 Type code

In preparation

Abb. 1-8: 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...45° C (23° F ... 113 ° F), optionally 0...55° C.
- The relative air humidity may not exceed 90 %; moisture condensation is not permissible.
- It should be ensured that the ventilation is adequate. 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.

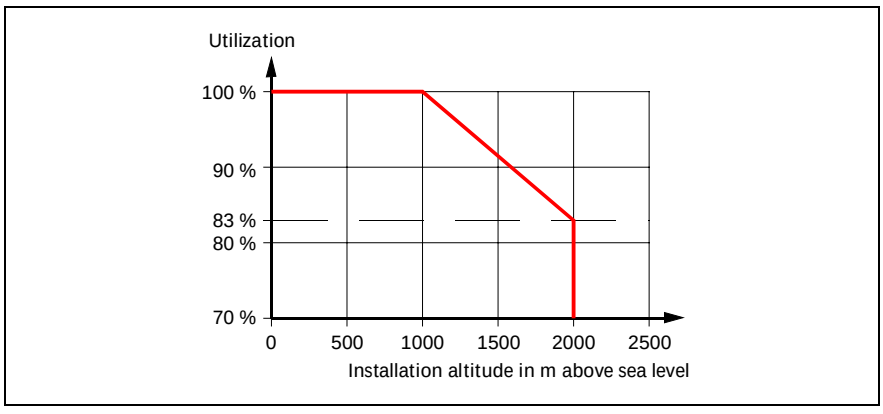


Fig. 2-1: Derating as a function of the installation altitude

2.2 Mounting units sizes A to D

- The REFU*drive 500* drive converters, sizes A to D are modular, and are designed for mounting in cabinets.
- For cabinet mounting, the cooling air requirements of the mounted units must be calculated and the cabinet cooling appropriately dimensioned. The power loss of the units is sub-divided into 15 % + 60 W (from the electronics) dissipated from the unit, and 85 % which is dissipated at the rear of the unit through the heat transfer plate. If the power loss is dissipated to the external environments via the heat transfer plate, or using liquid cooling, the cabinet cooling only has to be dimensioned to dissipate the remaining power loss.
- The units are mounted by flanging the heat transfer plate of the units on heatsinks. As a result of the holding assembly, the minimum clearance when mounting units in-line is 20 mm.

Application-related engineering

For projects involving the REFU*reduc* drive series, a complete quotation is always specifically generated for the particular drive application. The application-related engineering is offered as service and includes the following items:

- Dimensioning the drive systems
- Software and firmware
- Hardware
- Mounted and integrated components
- Cooling systems

In addition to general technical documentation, project-specific documentation is always supplied:

- System description
- Circuit diagrams of the total project
- Mounting and installation diagrams
- Dimension drawings

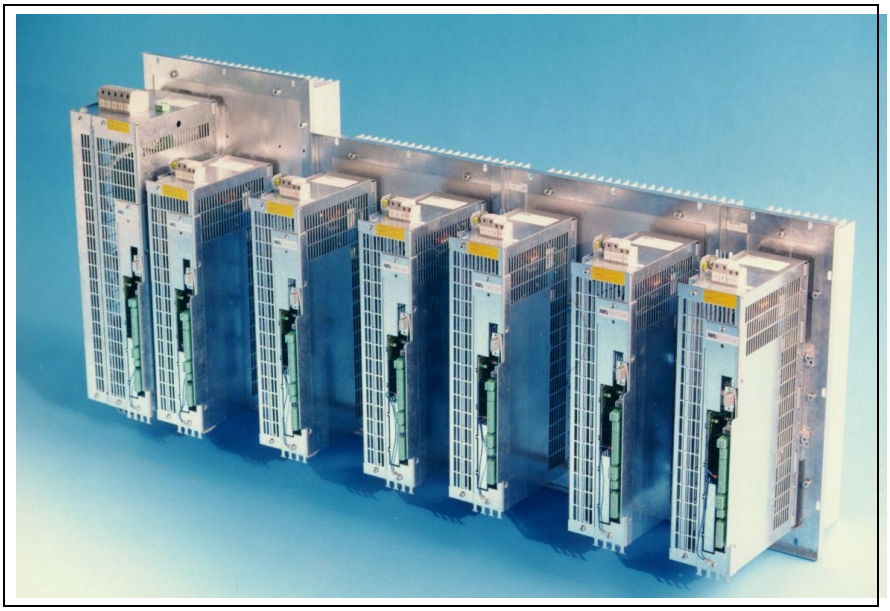


Fig. 2-2: Project with units from the REFU*reduc* series: Multi-motor drive with degree of protection IP 54 (NEMA 12) through connection mounting with textile heatsinks and mounting frames

Project example

Fig. 2-3: Project example; AC drive converter with higher rating feed (rectifier) and inverter

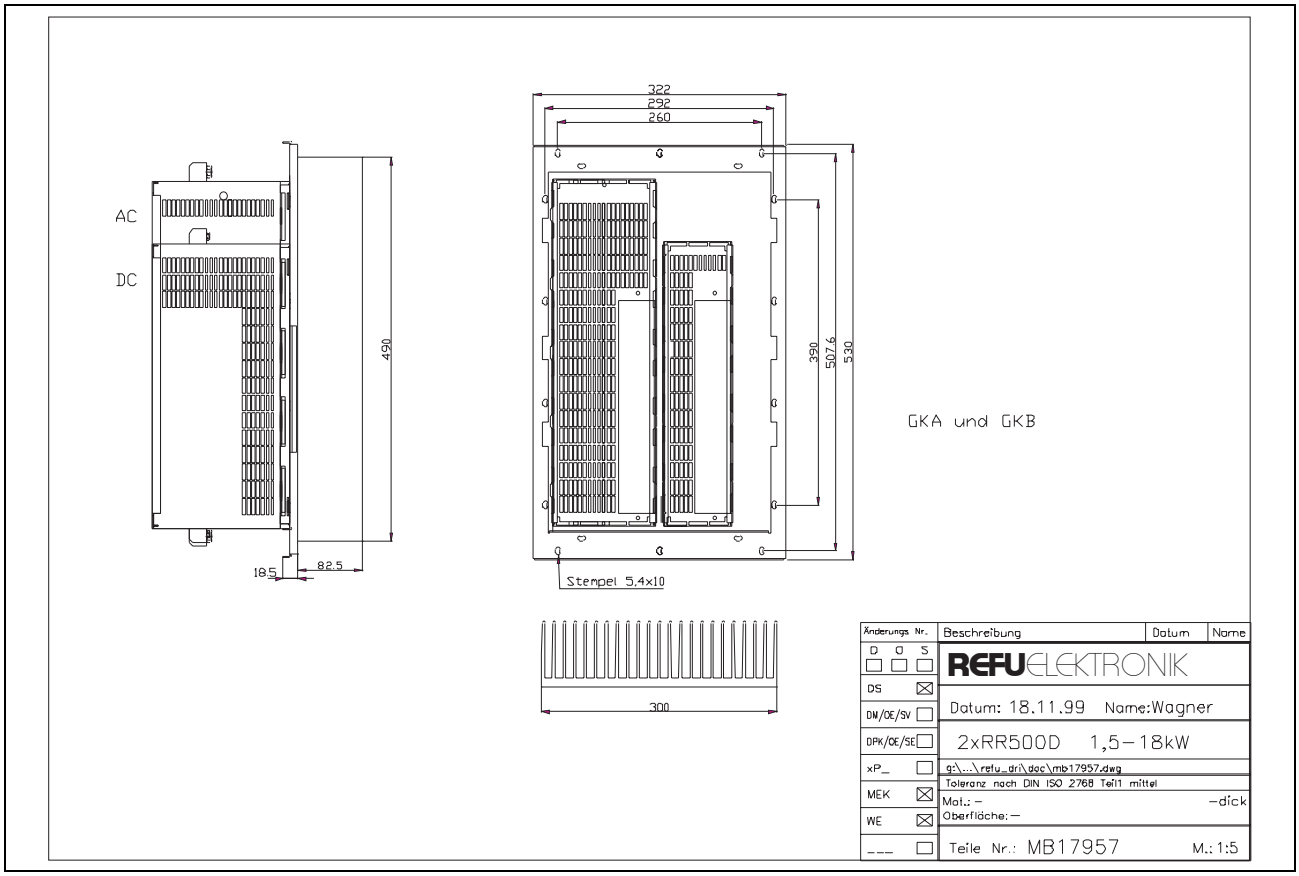


Fig. 2-4: Project documentation; Dimension drawing with overall dimensions and mounting holes

Dimension drawings

Note:

In the dimension sheets shown below, only the housing dimensions of each size class are specified without the cooling system. Every REFU*reduc* series unit with cooling system which is shipped has the project-related dimension drawings with the complete dimensions including the cooling system and mounting holes.

Drive inverter

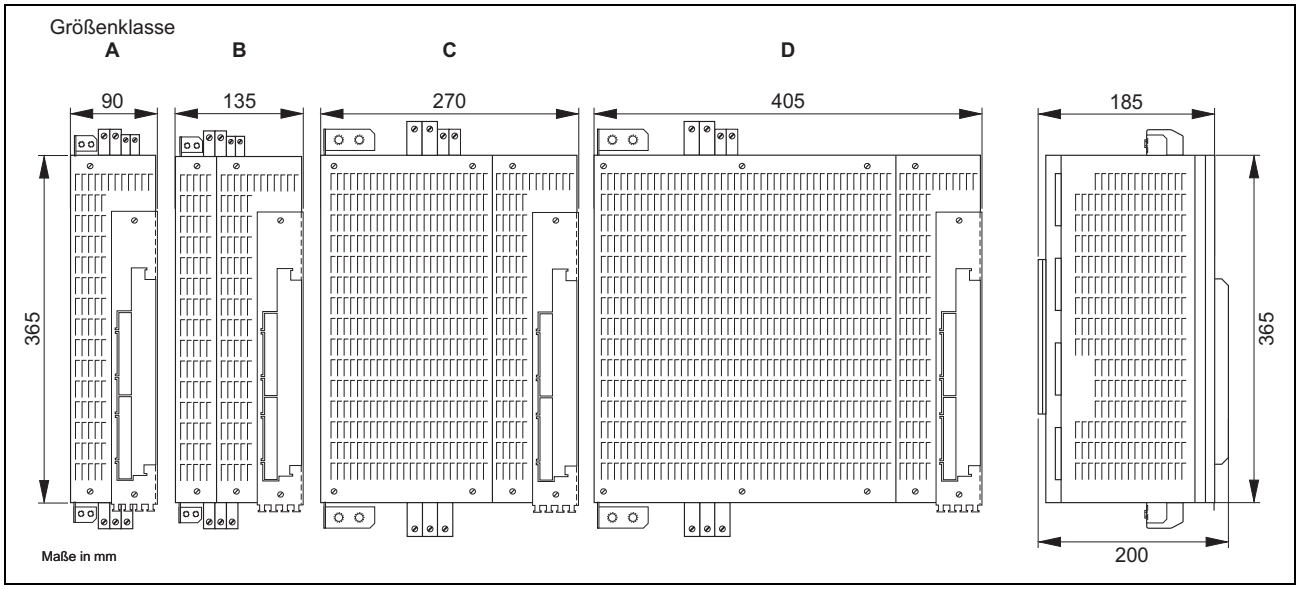


Fig. 2-5: Dimension drawing, inverter without cooler

AC drive converter (size A – D) and AC drive converter with increased feed (size B and D)

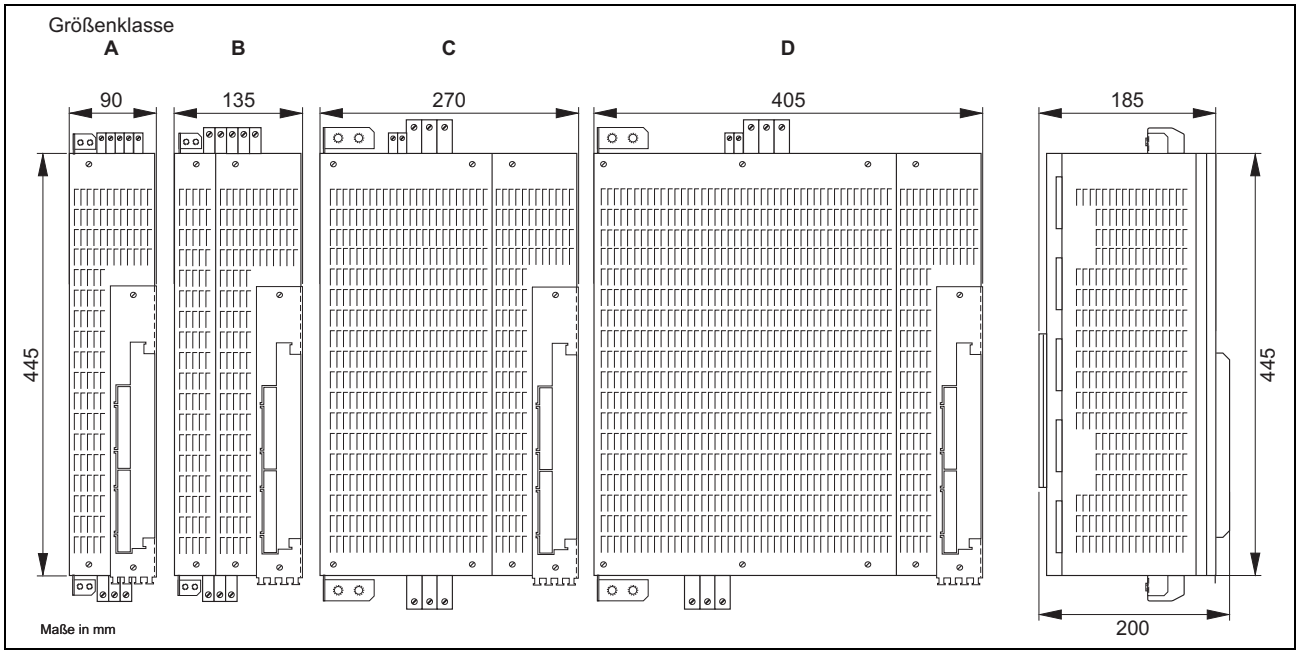


Fig. 2-6: Dimension drawing, converter without cooler

AC drive converters with higher rating rectifier (size D) and external fuse load disconnector

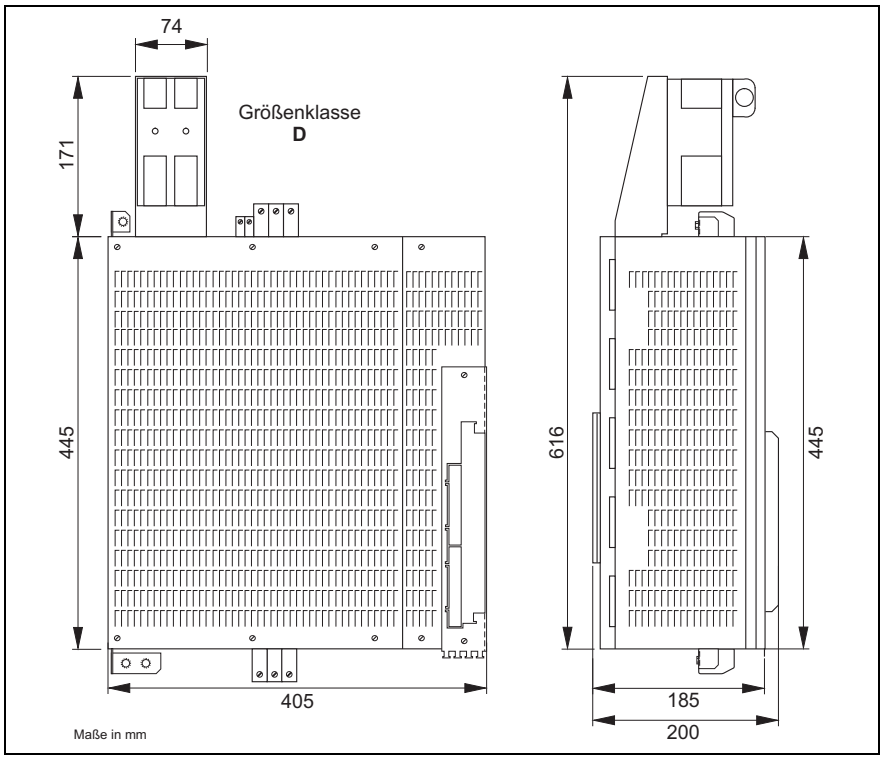


Fig. 2-7: Dimension drawing AC drive converter with higher output rectifier (size D) with external fuse load disconnector without cooler

2.3 Cooling systems

The power sections of AC drive converters and inverters from the *REFUreduc* series are designed for rear cooling. With the heat conduction plate and push-through mounting with special textile heatsinks, forced air cooling can also be implemented outside the cabinet for higher degrees of protection. Versions are also available with liquid cooling with external heat exchangers.

Size class	Heat transition plate	Push-through cooler	Liquid cooling
A and B	yes	yes	yes
C and D	no	yes	yes

Fig. 2-8: Cooling systems for the REFU*reduc*

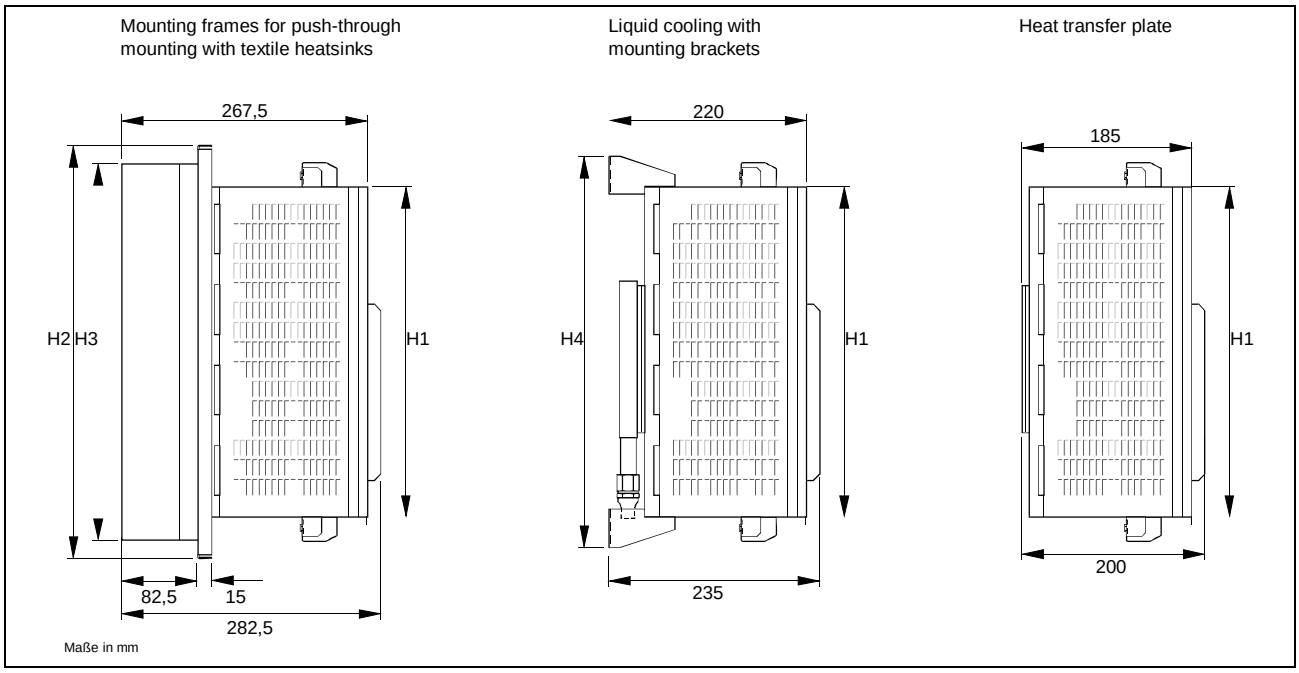


Fig. 2-9: Dimension drawing cooling systems

High	Inverter	Converter
H1	365	445
H2	410	490
H3	450	530
H4	425	505

Fig. 2-10: Height specifications for Fig. 2-9: Dimension drawing cooling systems

Heat transfer plate

Units with heat transfer plate can be directly mounted on a heatsink, or for units with small outputs, on the rear panel of a cabinet or machine housing. The required brackets and mounting rails to flange-mount the heat transfer plate are supplied. In order to calculate the power loss at the heat transfer plate, refer to the Technical data. Heat transfer paste is not required for the heat transfer from the heat transfer plate to the heatsink.

CAUTION

Incorrectly applied heat transfer paste has a negative impact on the heat transfer capability!

The heat transfer plate has been dimensioned so that no heat transfer paste is required. Heat transfer foil can be used without any problems.

Mounting frames for push-through mounting with textile heatsinks

Special textile heatsinks have been used for this cooling system. They have extremely smooth ribs and an optimum cooling rib distance. This means that no fibers or other particles from the cooling air stick to the ribs. This means that cooling air filters are not required. The heatsinks can be easily cleaned.

An air flow of 6 to 10 m/sec is expected for forced cooling with textile heatsinks.

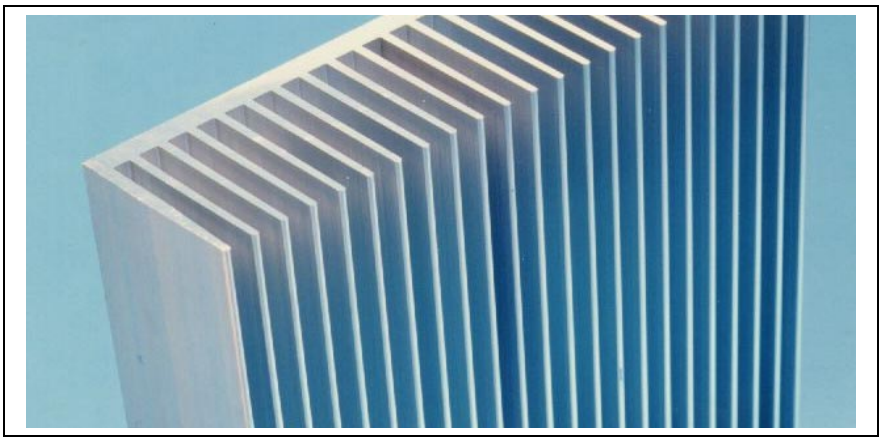


Fig. 2-11: Special textile heatsink

The push-through mounting is especially suitable for cabinets with degree of protection IP54. As a result of the special unit and cabinet mechanical design, the power loss to be dissipated in the cabinet is only 15 %. 85 % of the power loss is directly dissipated through the external heatsink. The textile heatsinks allow cooling with non-filtered ambient air.

For multi-motor drives, the units with heat transfer plate can be mounted on a common heatsink in-line with several other units. The width of the heatsink depends on the size and number of the units and the required heat dissipation. The units with textile heatsinks and mounting frames are always configured on a customer-for-customer basis and supplied as coupled units, refer to Fig. 2-2: . Every REFU*reduc* series unit with cooling system which is shipped has the project-related dimension drawings with the complete dimensions including the cooling system and mounting holes.

Liquid cooling

REFU*reduc* units with liquid cooling are supplied with special mounting brackets. When customers request it, heatsinks for several drive units can be configured and also alternative mounting methods, e.g. where the heatsink is directly bolted to the mounting surface.

REFU*reduc* units with liquid cooling can be integrated in an existing cooling system, e.g. for motors. A dedicated cooling system with heat exchangers can also be configured. It is possible to connect several units in series. The cooling system must be engineered with reference to the flow rates, power loss and connected units and heat exchangers. The liquid discharge temperature at the last drive unit of the cooling system should not be above 50°C. The heatsinks of Indramat Refu are adapted to the power loss of the units so that at rated output, the cooling liquid, depending on the output class of the unit, temperature rises between 3°C and 5°C. An external circulating pump is required to circulate the cooling water. A number of frequency converters can be connected to an Indramat Refu heat exchanger until the sum of all of the individual losses reaches the cooling power of the heat exchanger.

Heat exchanger for liquid cooling systems

Heat exchangers for mounting on the cabinet roof assembly and at the panel are available with two different ratings.

Mounting type	Order code	Size	Cooling power (kW)
Cabinet	LE12305.5	A	4
Cabinet	LE12405.5	B	5
Panel	LE12366.5	C	4
Panel	LE12466.5	D	5

Fig. 2-12: Heat exchanger for liquid cooling systems

Heat exchanger for cabinet mounting

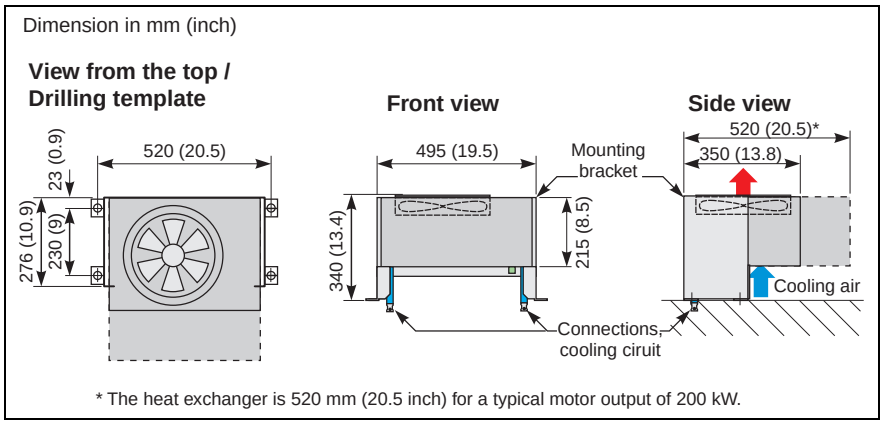


Fig. 2-13: Dimension drawing heat exchanger for cabinet mounting, size class A and B

Heat exchanger for wall mounting

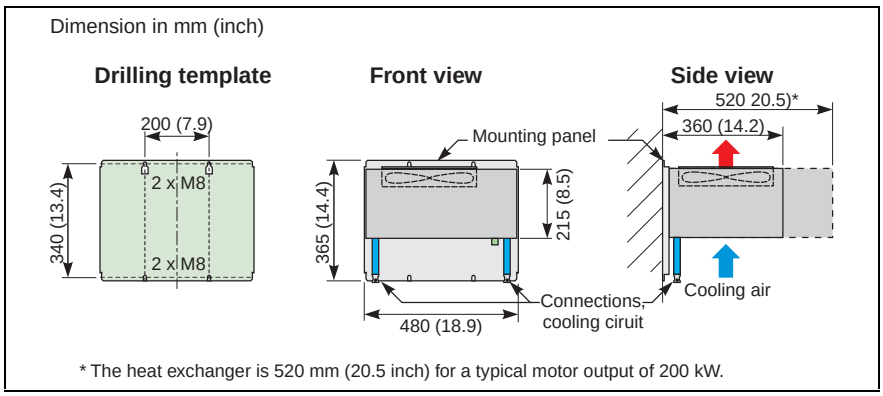


Fig. 2-14: Dimension drawing heat exchanger for wall mounting, size class C and D

Recommended cooling medium for liquid cooling systems

Liquid cooling systems produced by Indramat Refu are filled with a cooling medium comprising tap water and anti-freeze , type Antifrogen N (Clariant) in a ratio of 1.5 : 1. This guarantees corrosion protection and antifreeze protection down to –30° C.

For liquid cooling systems, which customers manufacture themselves using accessories from Indramat Refu (heat exchangers, heatsinks, hoses, connecting elements), a cooling agent must be used with the

same composition as specified above. The anti-freeze is available from Indramat Refu under Order No.: 0015343.

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.

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!

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 / DC link 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.

Frequency converters without DC link and inverters

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

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-, DC bus- and motor connection

Frequency converters to feed a DC bus

Equipment output for 400/480/500 V	Supply connection		
	Recommended min. cross-section	Cable cross-section range 1)	Maximum fusing Type gL
[kW]	[mm^2]	[mm^2]	[A]
11	16	10 - 16	63
15	16	10 - 16	63
18,5	16	10 - 16	63
22	70	35 - 95	160
30	70	35 - 95	160
45	70	35 - 95	160
55	70	35 - 95	160

1): As a result of the terminal size

Fig. 3-2: Cable cross-sections for mains connection, frequency converter with DC bus

3.4 Power terminals RR51, size class A-D

Only a drive converter of one size 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.

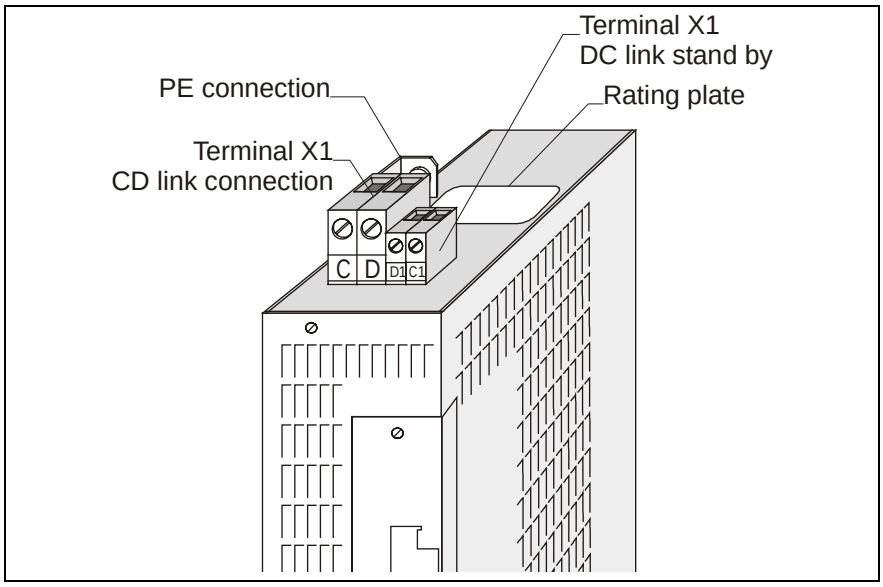
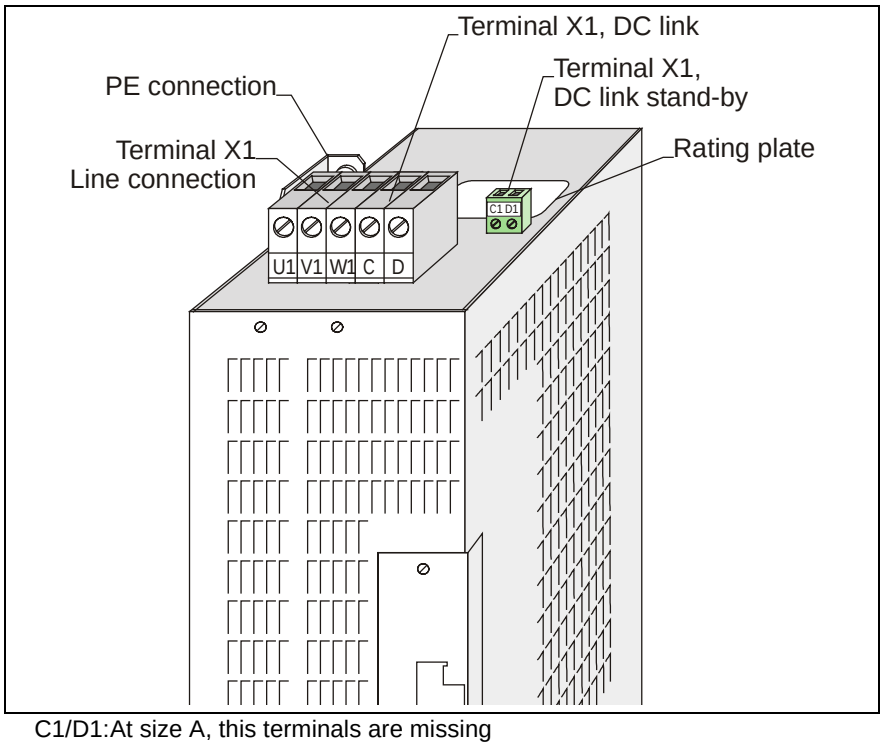


Fig. 3-3: Top side of inverters, size A



C1/D1:At size A, this terminals are missing

Fig. 3-4: Top side of frequency converters, size B

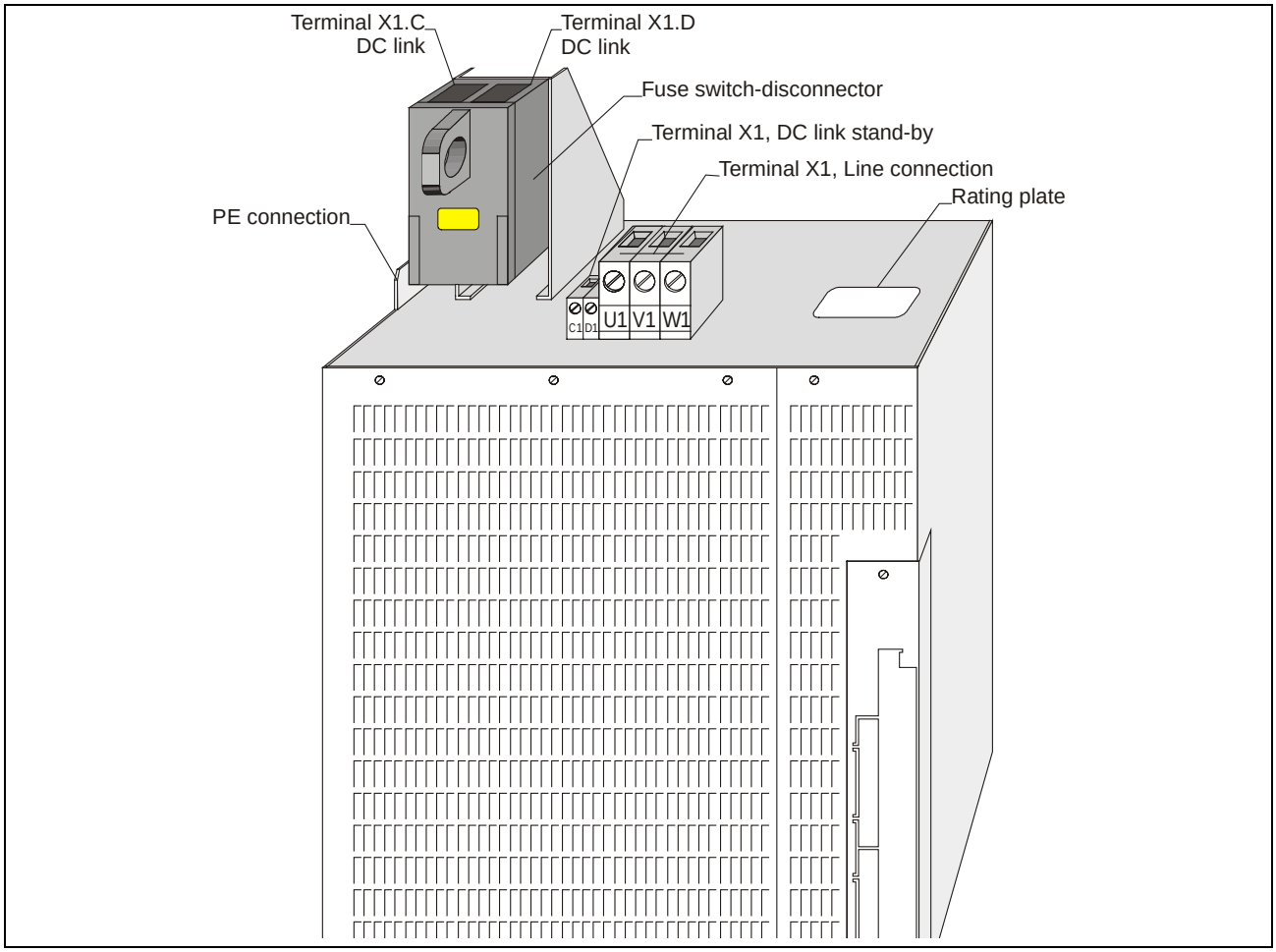


Fig. 3-5: Top side of frequency converters, size D, with external fuse switch-disconnector

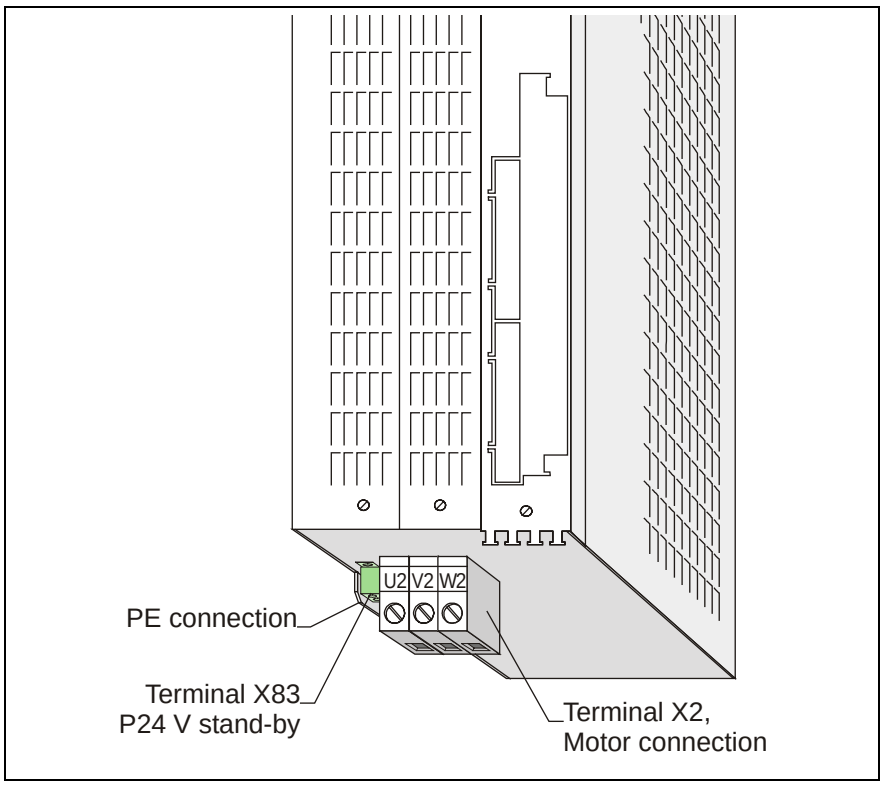


Fig. 3-6: Bottom side, size B

Description of the power terminals

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 Connection diagrams

Frequency converter

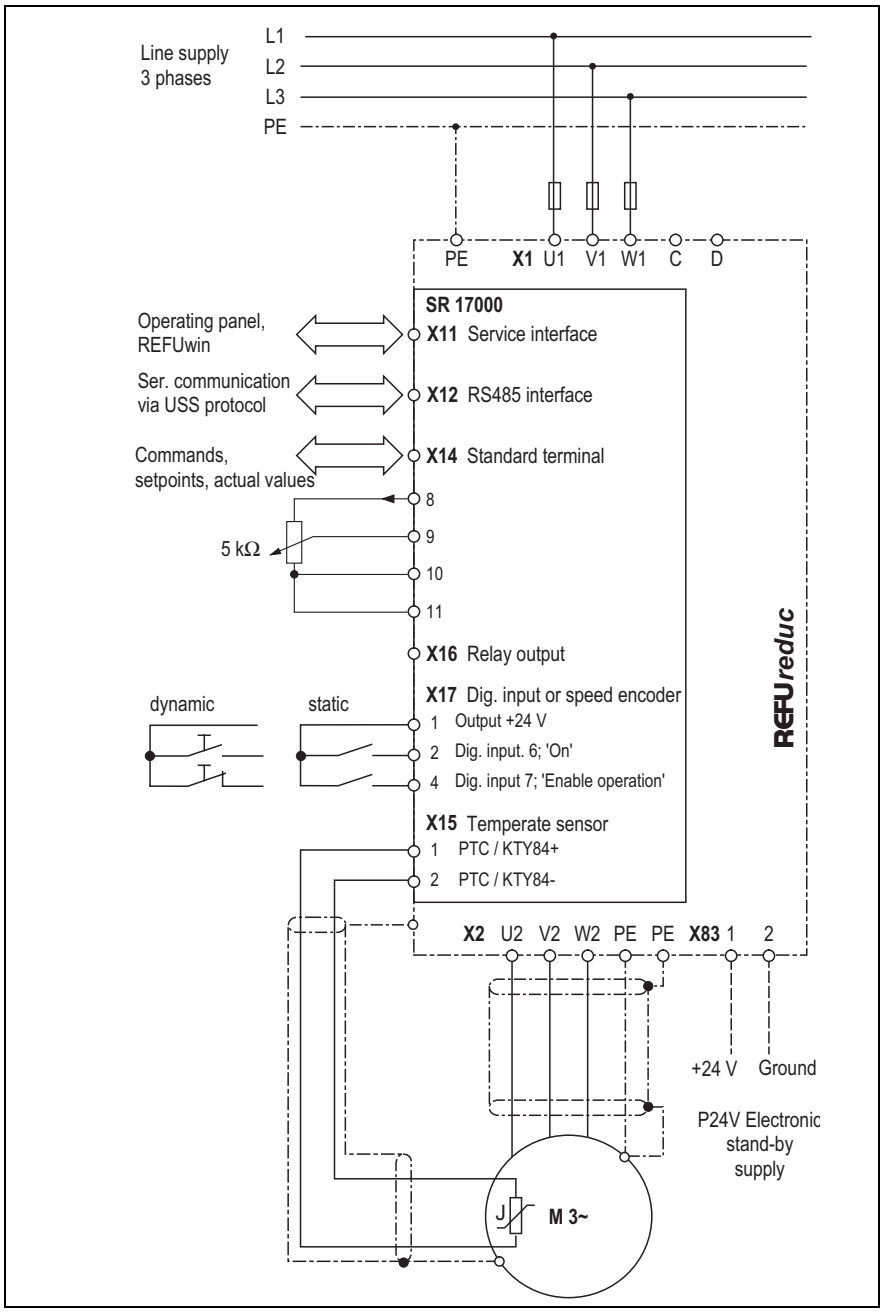


Fig. 3-7: Connection diagram for frequency converter

Frequency converter with DC bus and inverters

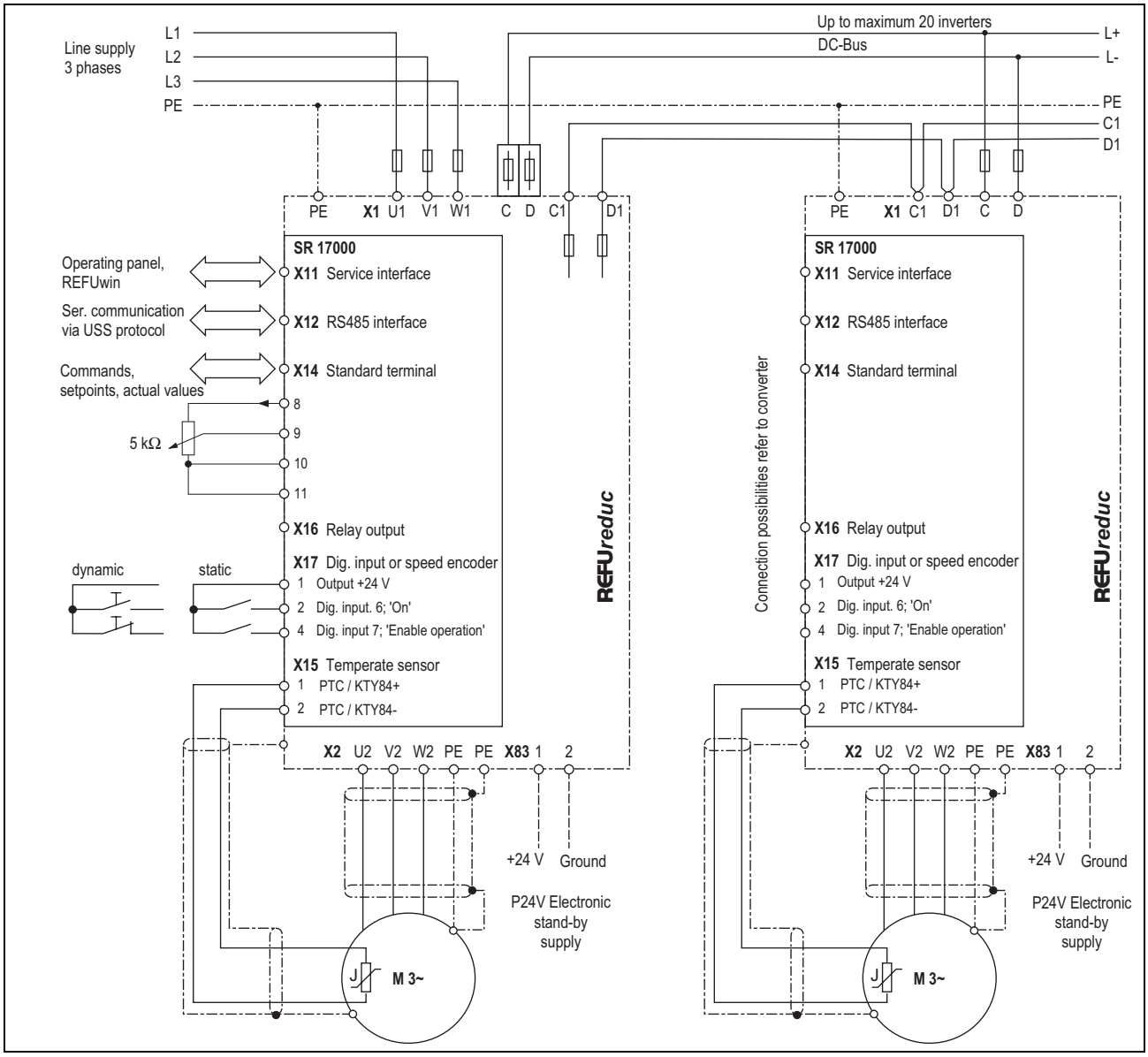


Fig. 3-8: Connection diagram for frequency converter with DC bus and inverters

3.6 Control terminals

Terminal layout diagram SR17000

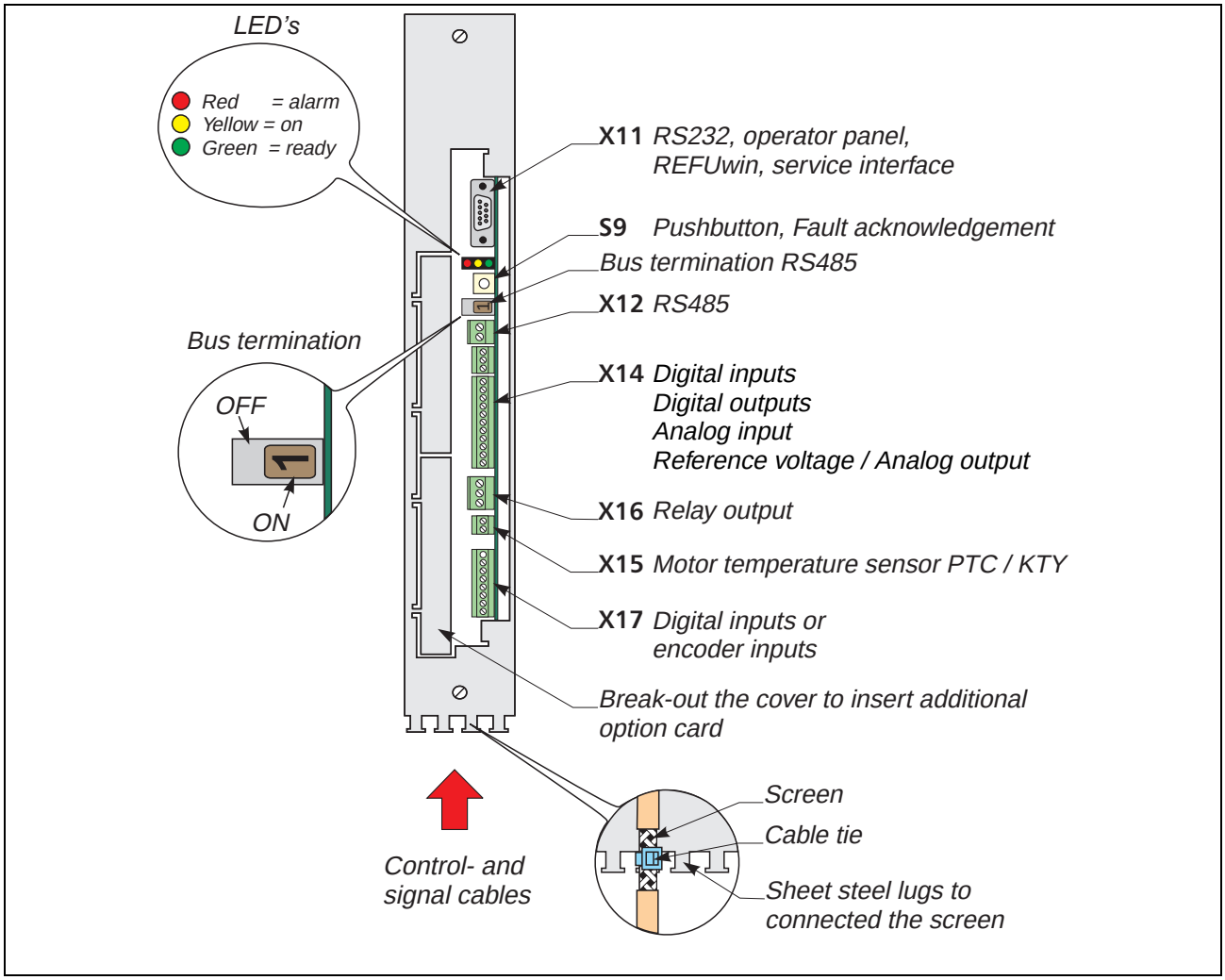


Fig. 3-9: Control terminals on the control board SR17000

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	Analog input -	• ±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 □	
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. 3-10: 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

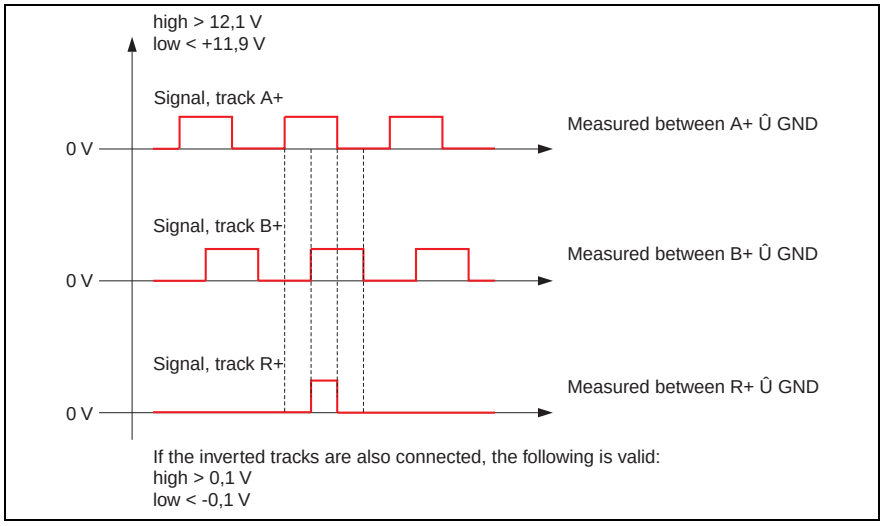


Fig. 3-11: Incremental encoder, signals

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. 3-12: Parameterization of the incremental encoder

Connection schematic, incremental encoder evaluation HTL signal level

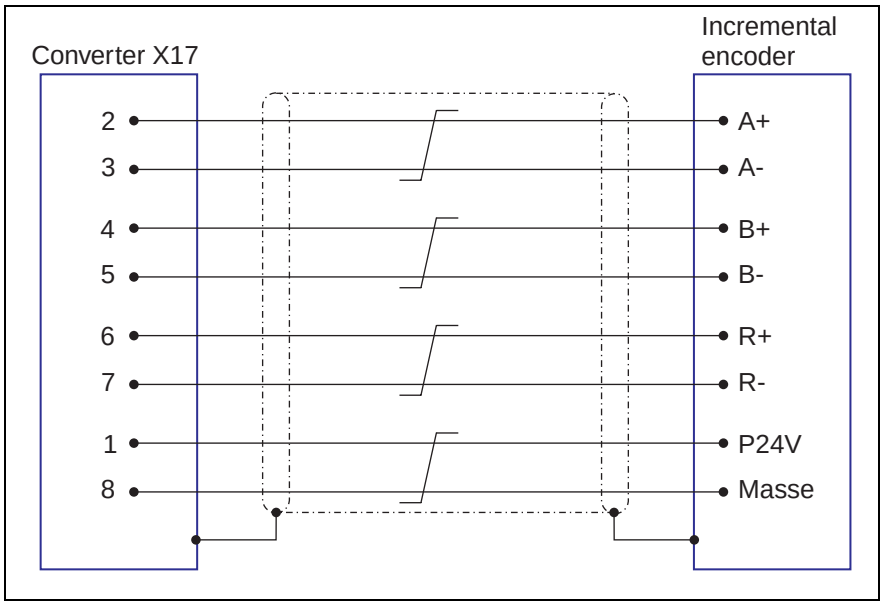


Fig. 3-13: Incremental encoder, connection diagram

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).

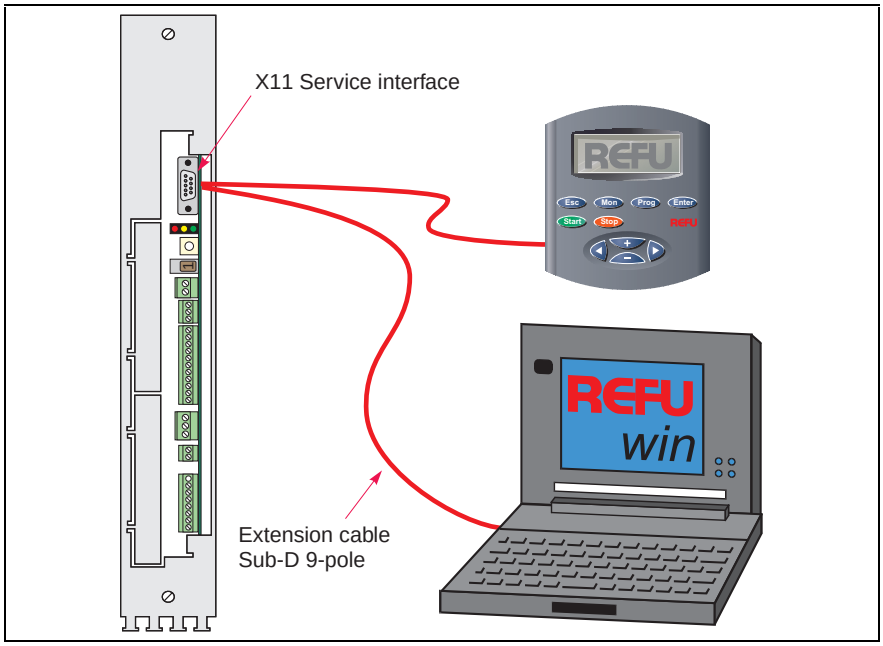


Fig. 3-14: Connection possibilities service interface

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:

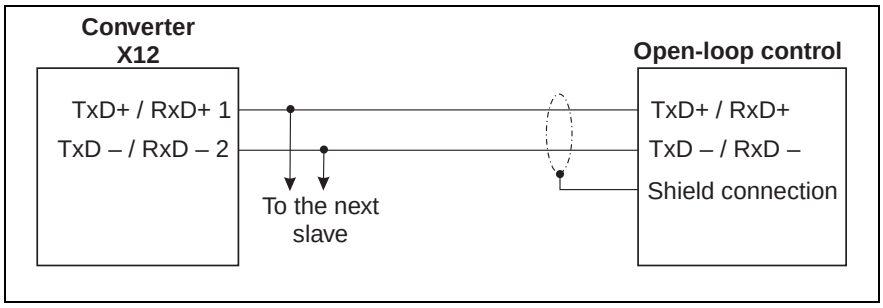


Fig. 3-15: Connecting cable to the PC

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.

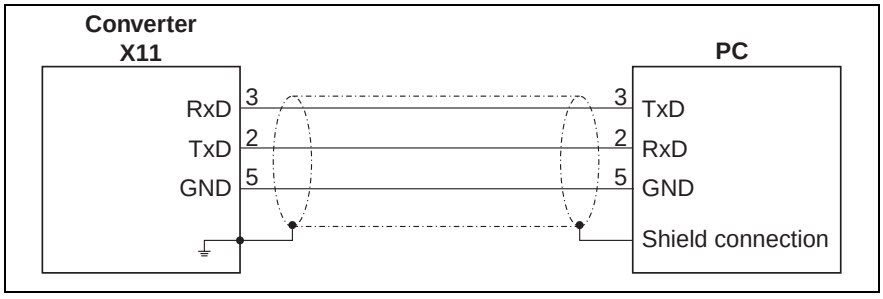


Fig. 3-16: Connecting the standard interface

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

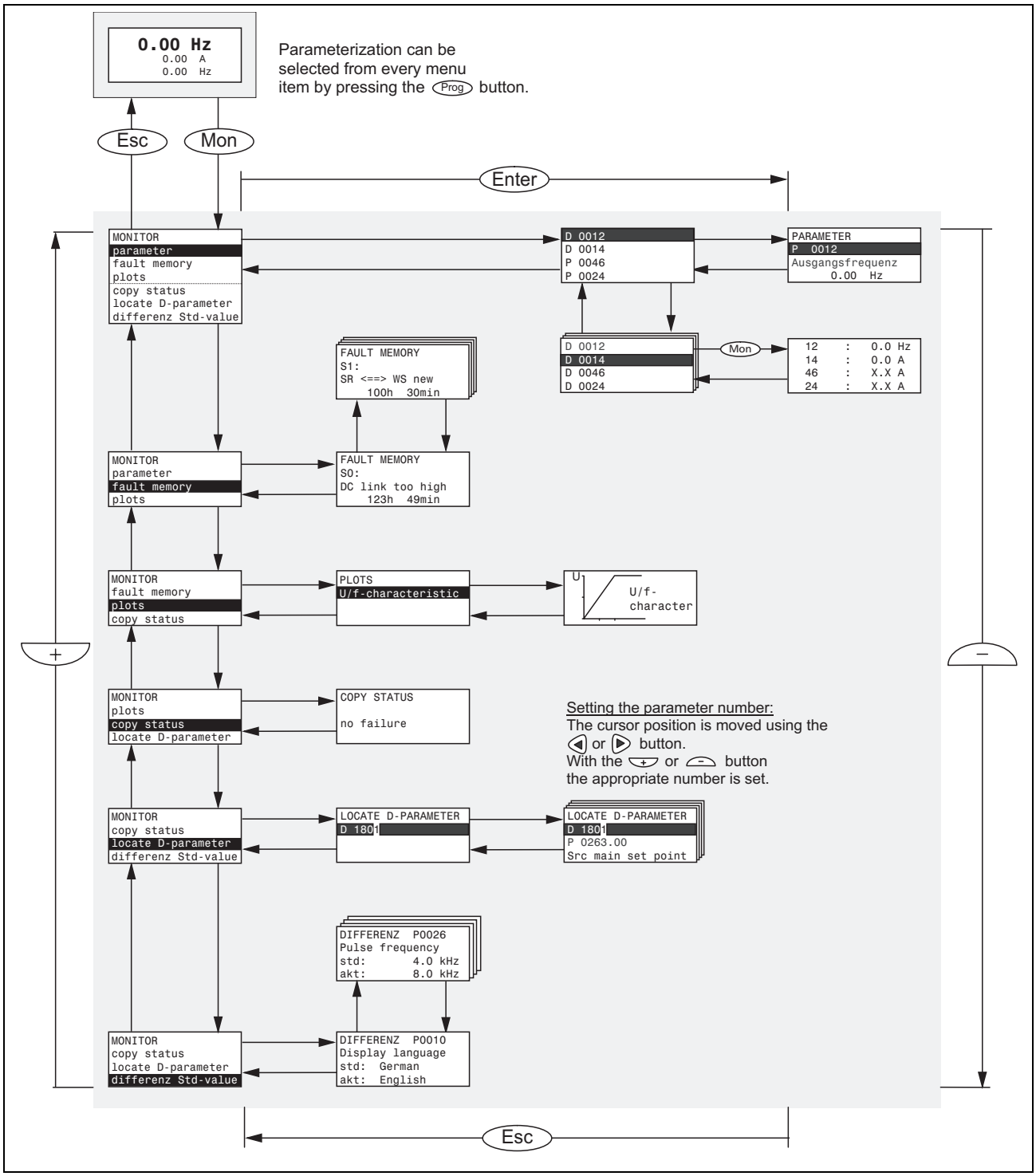


Fig. 4-7: Structure of the monitor programm

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.

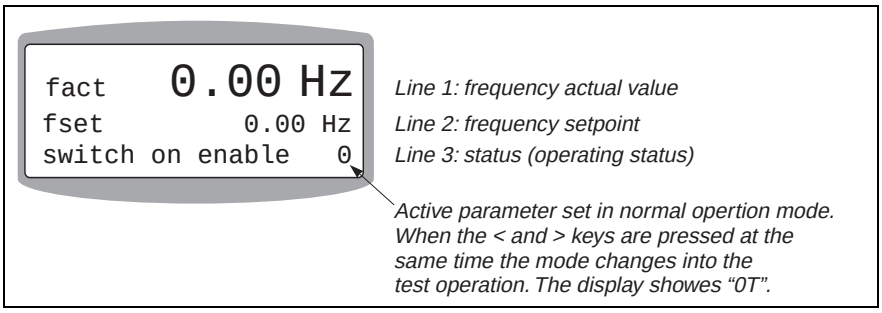


Fig. 4-8: Operating display

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.

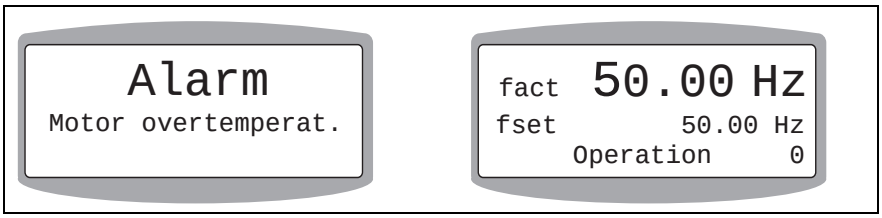
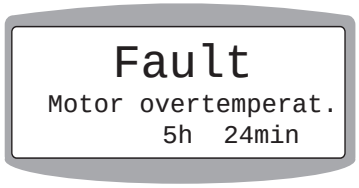


Fig. 4-9: Alarm display

[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.

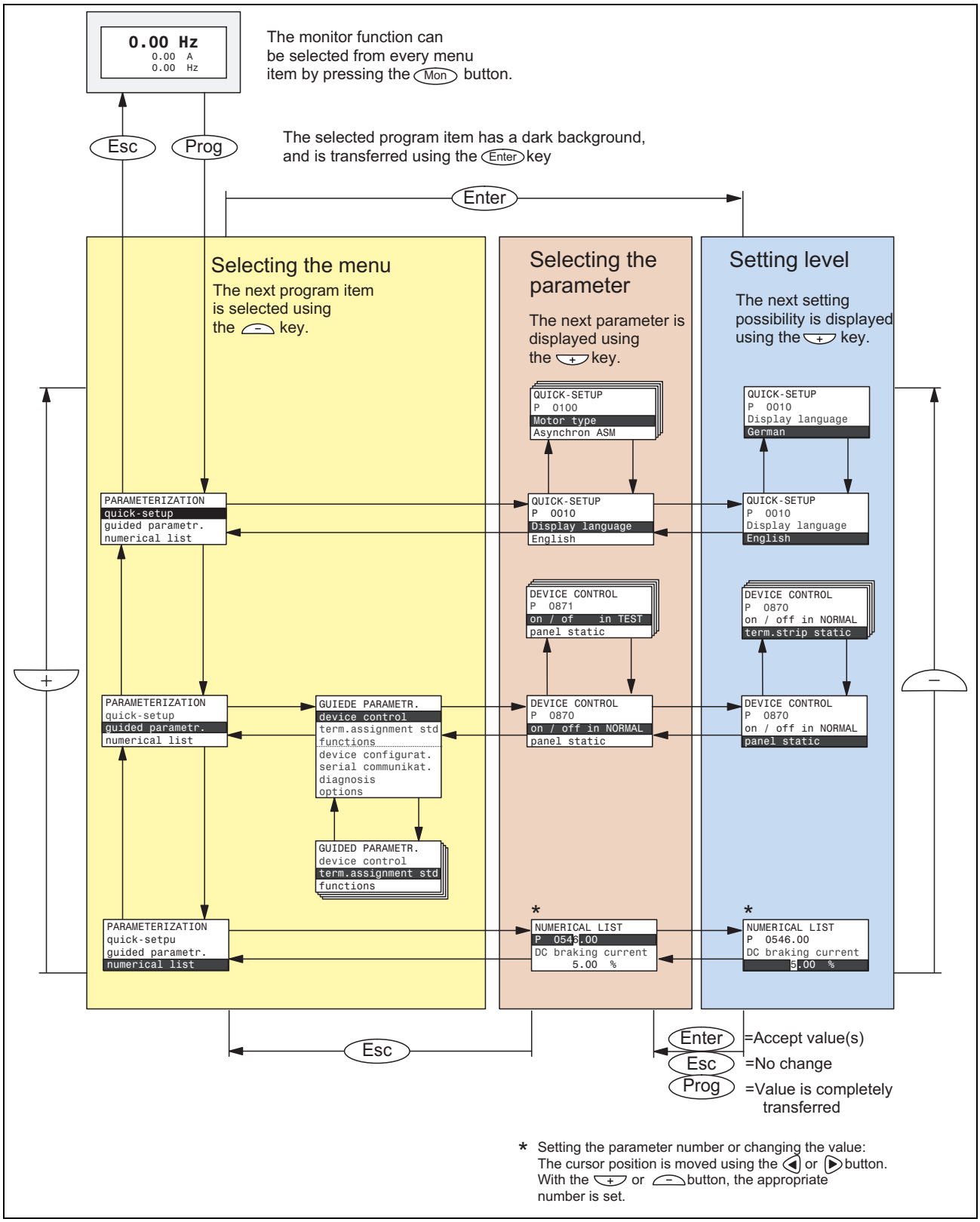


Fig. 5-1: Structure of basic parameterization

Overview

Refer to Fig. 5-2: Menu overview

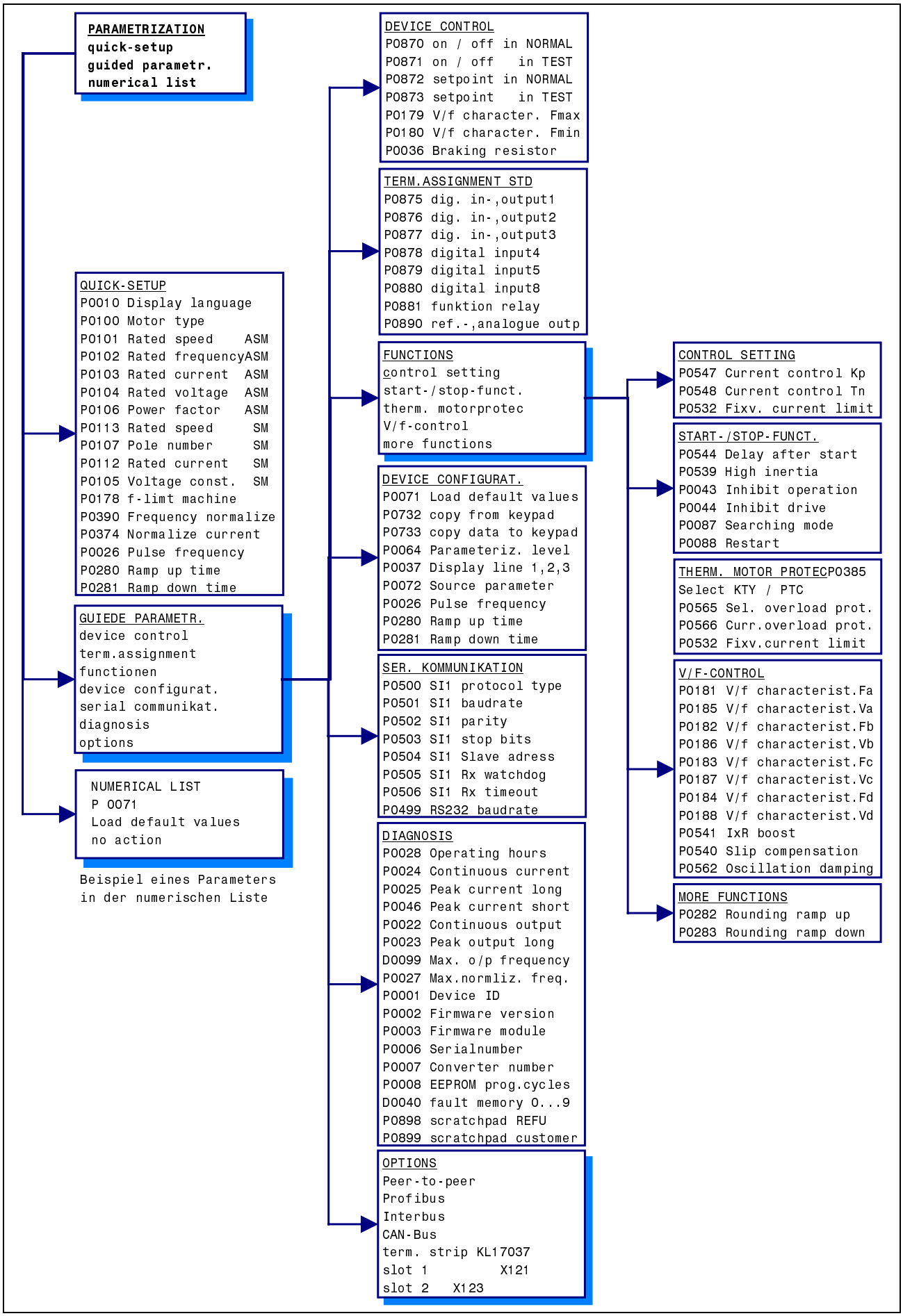


Fig. 5-2: Menu overview

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	

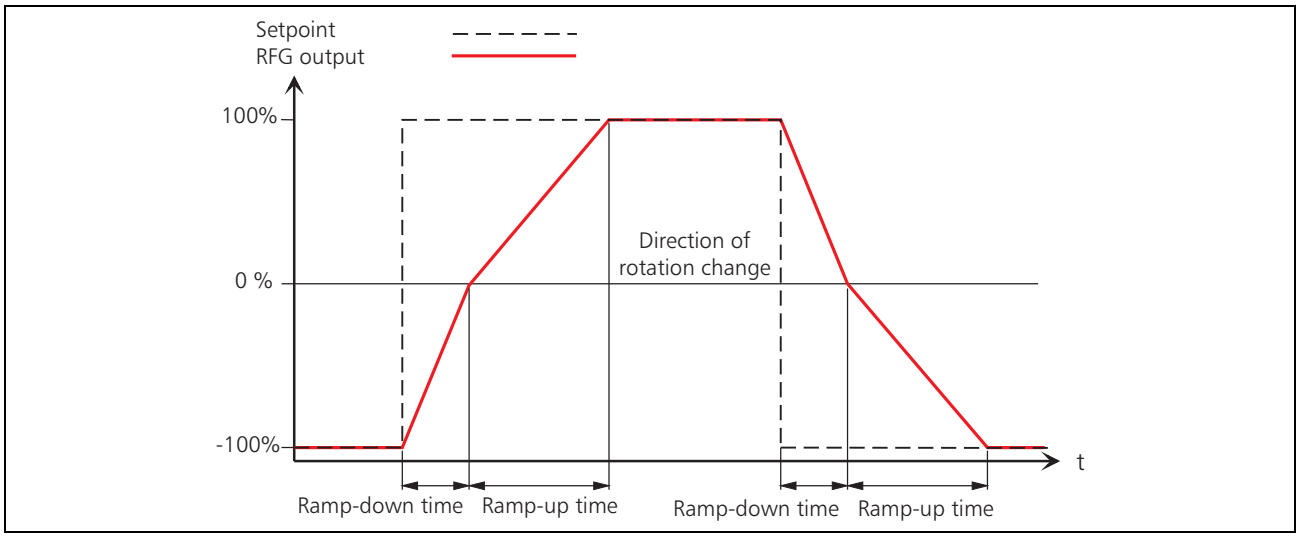


Fig. 5-3: Ramp-up / ramp-down diagram

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 %	

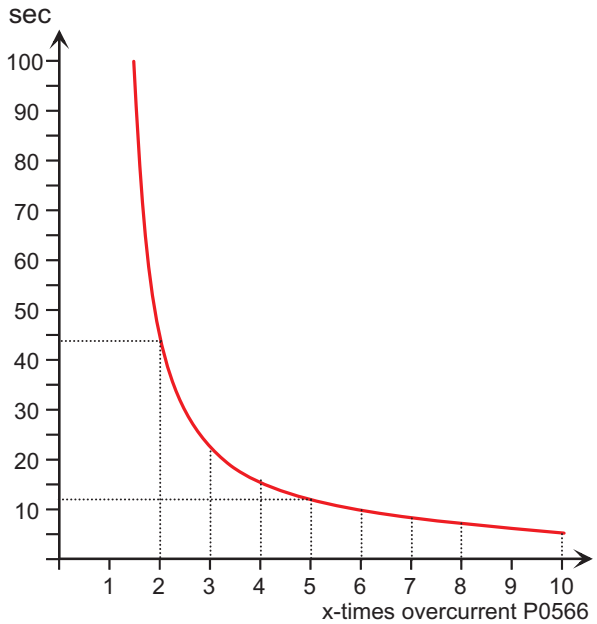
Start/stop functions

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	

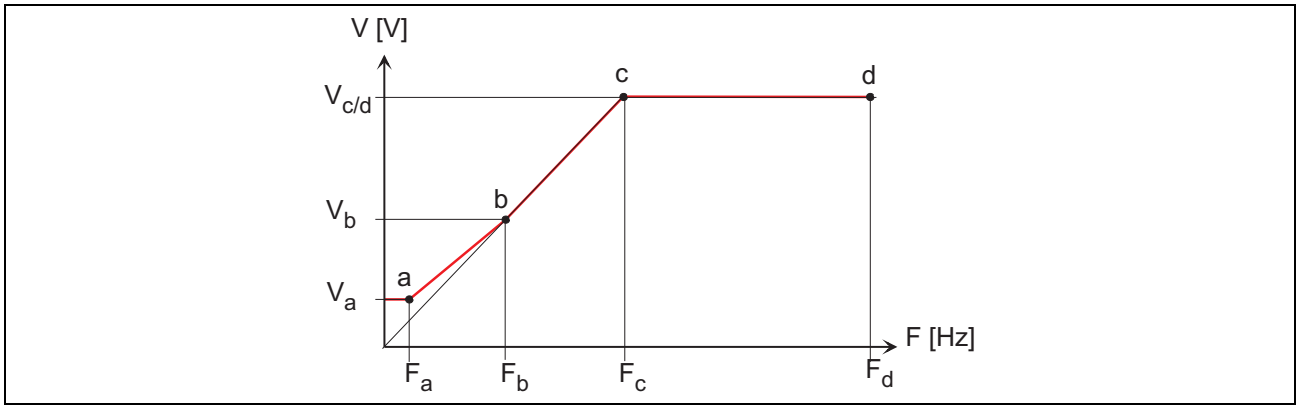


Fig. 5-5: Diagram V/HZ characteristic

[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	

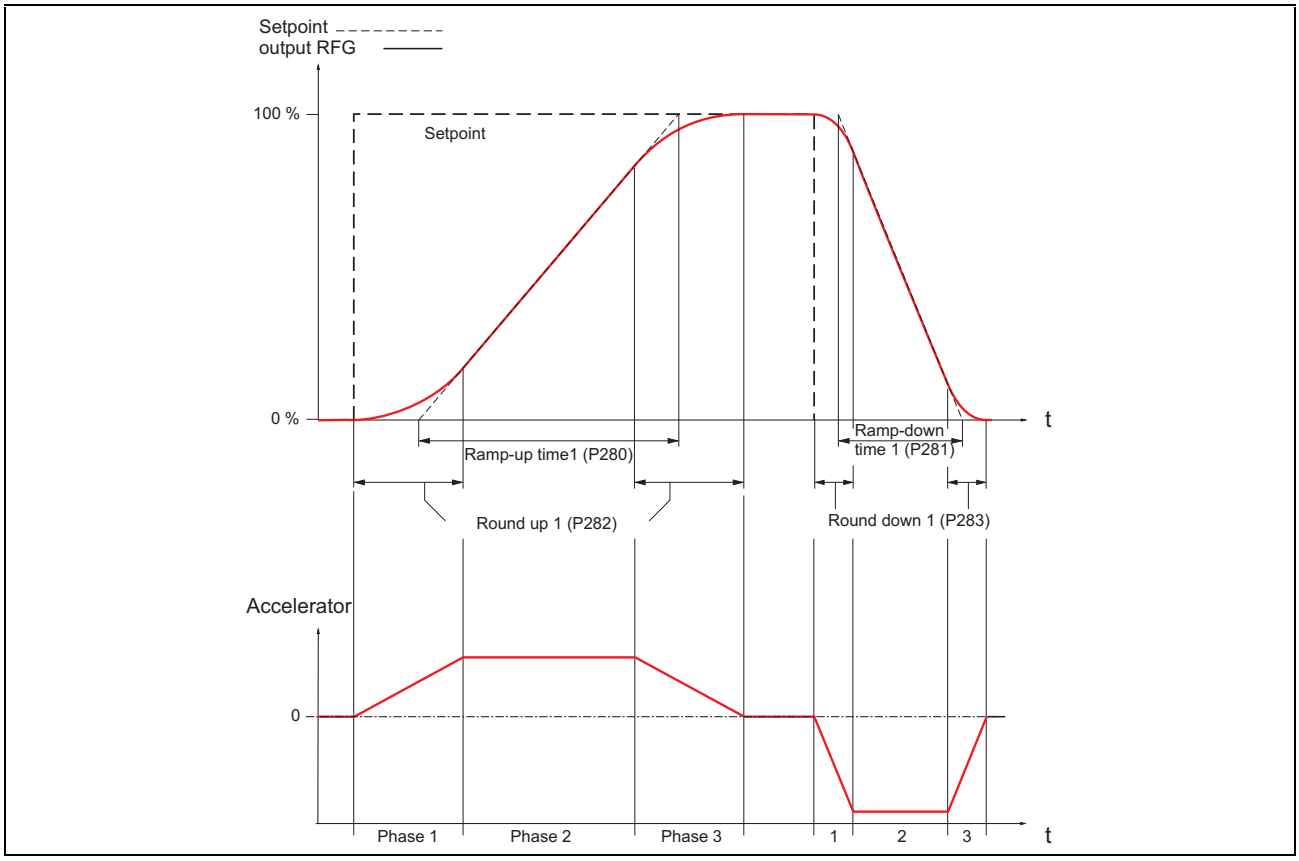


Fig. 5-6: Ramp-up / ramp-down characteristic with rounding

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.

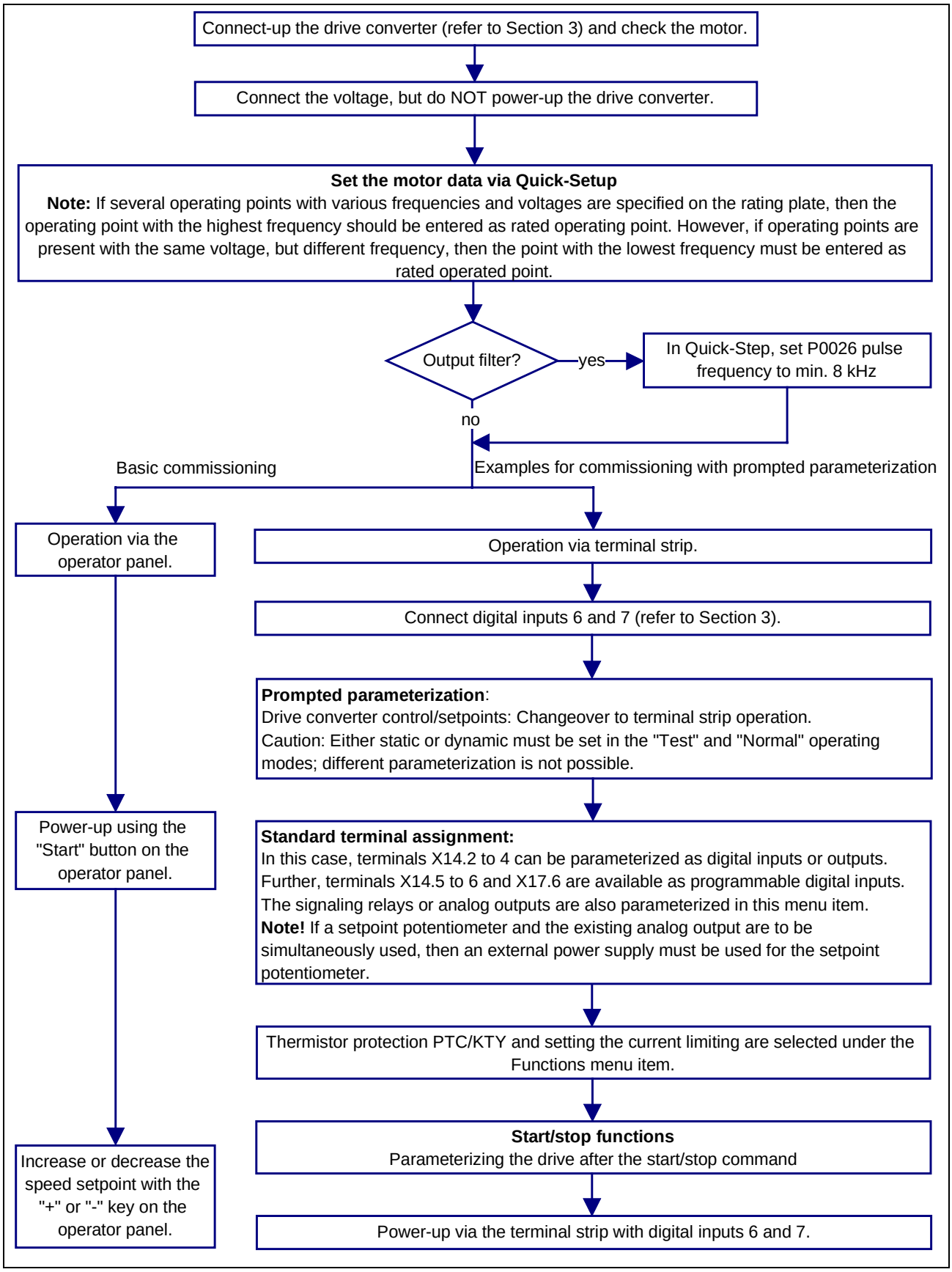


Fig. 6-1: Commissioning flow charter

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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Kundendienst - Service

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Gesch.ber. Rexroth Indramat
Hägelingasse 3
A - 1140 Wien

Telefon: +43 (0)1/9852540-400
Telefax: +43 (0)1/9852540-93

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Mannesmann Rexroth G.m.b.H.
Gesch.ber. Rexroth Indramat
Industriepark 18
A - 4061 Pasching

Telefon: +43 (0)7221/605-0
Telefax: +43 (0)7221/605-21

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Telefax: +32 (0)2/5830731

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Telefon: +45 (0)87/11 90 60
Telefax: +45 (0)87/11 90 61

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Hviezdoslavova 5
CS - 627 00 Brno

Telefon: +420 (0)5/48 126 358
Telefax: +420 (0)5/48 126 112

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Mannesmann Rexroth Ltd.
Rexroth Indramat Division
Broadway Lane, South Cerney
GB - Cirencester, Glos GL7 5UH

Telefon: +44 (0)1285/863000
Telefax: +44 (0)1285/863030

Finland ☒ SALES ☐ Service

Rexroth Mecman Oy
Rexroth Indramat division
Ansatie 6
SF-017 40 Vantaa

Telefon: +358 (0)9/84 91-11
Telefax: +358 (0)9/84 91-13 60

France ☒ SALES ☒ Service

Mannesmann Rexroth S.A.
Division Rexroth Indramat
Parc des Barbanniers
4, Place du Village
F-92632 Gennevilliers Cedex

Telefon: +33 (0)141 47 54 30
Telefax: +33 (0)147 94 69 41
Hotline: +33 (0)6 08 33 43 28

France ☒ SALES ☐ Service

Mannesmann Rexroth S.A.
Division Rexroth Indramat
270, Avenue de Lardenne
F - 31100 Toulouse

Telefon: +33 (0)5 61 49 95 19
Telefax: +33 (0)5 61 31 00 41

France ☒ SALES ☐ Service

Mannesmann Rexroth S.A.
Division Rexroth Indramat
91, Bd. Irène Joliot-Curie
F - 69634 Vénissieux – Cedex

Telefon: +33 (0)4 78 78 53 65
Telefax: +33 (0)4 78 78 53 62

Italy ☒ SALES ☒ Service

Mannesmann Rexroth S.p.A.
Divisione Rexroth Indramat
Via G. Di Vittoria, 1
I - 20063 Cernusco S/N.MI

Telefon: +39 02/92 36 52 70
Telefax: +39 02/92 36 55 12

Italy ☒ SALES ☒ Service

Mannesmann Rexroth S.p.A.
Divisione Rexroth Indramat
Via Borgomanero, 11
I - 10145 Torino

Telefon: +39 011/7 50 38 11
Telefax: +39 011/7 71 01 90

Italy ☒ SALES ☐ Service

Mannesmann Rexroth S.p.A.
Divisione Rexroth Indramat
Via del Progresso, 16 (Zona Ind.)
I - 35020 Padova

Telefon: +39 049/8 70 13 70
Telefax: +39 049/8 70 13 77

Italy ☐ SALES ☒ Service

Mannesmann Rexroth S.p.A.
Divisione Rexroth Indramat
Via Mascia, 1
I - 80053 Castellamare di Stabia NA

Telefon: +39 081/8 71 57 00
Telefax: +39 081/8 71 68 86

Italy ☒ SALES ☐ Service

Mannesmann Rexroth S.p.A.
Divisione Rexroth Indramat
Viale Oriani, 38/A
I - 40137 Bologna

Telefon: +39 051/34 14 14
Telefax: +39 051/34 14 22

Netherlands ☒ SALES ☐ Service

Hydraudyne Hydrauliek B.V.
Kruisbroeksestraat 1
(P.O. Box 32)
NL - 5281 RV Boxtel

Telefon: +31 (0)411/65 19 51
Telefax: +31 (0)411/65 14 83
e-mail: indramat@hydraudyne.nl

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Rußland

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Divisiòn Rexroth Indramat
Centro Industrial Santiga
Obradors s/n
E-08130 Santa Perpetua de Mogoda
Barcelona

Telefon: +34 937 47 94 00
Telefax: +34 937 47 94 01

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Goimendi S.A.
División Rexroth Indramat
Jolastokieta (Herrera)
Apartado 11 37
E - 20017 San Sebastian

Telefon: +34 9 43/40 01 63
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Telefon: +46 (0)8/727 92 00
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Otoki 21
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TR - 34630 Sefaköy Istanbul

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Telefax: +90 212/599 34 07

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Gewerbestraße 3
CH - 8500 Frauenfeld

Telefon: +41 (0)52/720 21 00
Telefax: +41 (0)52/720 21 11

Switzerland ☒ SALES -West- ☐ Service

Mannesmann Rexroth Suisse SA
Département Rexroth Indramat
Rue du village 1
CH - 1020 Renens

Telefon: +41 (0)21/632 84 20
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