Self-cooling, Motor-independent
Frequency Inverter

PumpDrive 2

Installation/Operating Manual

Legal information/Copyright

Installation/Operating Manual PumpDrive 2

Original operating manual

Contents

Glossary

Braking resistor

Takes up the braking power produced during generator operation.

Hydraulic blockage

Undesirable operating situation in which the pump cannot supply fluid due to a closed inlet or outlet.

IE1

Efficiency class to IEC 60034-30: 1 = Standard Efficiency (IE = International Efficiency)

IE2

Efficiency class to IEC 60034-30: 2 = High Efficiency (IE = International Efficiency)

IE3

Efficiency class to IEC 60034-30: 3 = Premium Efficiency (IE = International Efficiency)

IE4

Efficiency class to IEC TS 60034-30-2:2016 = Super Premium Efficiency (IE = International Efficiency)

IE5

Efficiency class to IEC TS 60034-30-2:2016 = Ultra Premium Efficiency (IE = International Efficiency)

KSB device bus

Proprietary CAN bus that is used in dual and multiple pump configurations for facilitating communication among the frequency inverters. The KSB device bus cannot be used for external communication or for communication with the KSB local bus (PumpDrive 1).

Mat. No.

This identification number is composed of an 8-digit numerical code that uniquely identifies a product entered in SAP.

Pump

Machine without drive, additional components or accessories

Pump set

Complete pump set consisting of pump, drive, additional components and accessories

RCD

Abbreviation for "residual current device"

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1 General

1.1 Principles

This operating manual is valid for the type series and variants indicated on the front cover.

The operating manual describes the proper and safe use of this equipment in all phases of operation.

The name plate indicates the type series, the main operating data and the serial number. The serial number uniquely describes the product and is used as identification in all further business processes.

In the event of damage, immediately contact your nearest KSB service facility to maintain the right to claim under warranty.

1.2 Target group

This operating manual is aimed at the target group of trained and qualified specialist technical personnel.

1.3 Other applicable documents

Table 1: Overview of other applicable documents

Document	Contents
Operating manual	Description of the proper and safe use of the pump in all phases of operation
Wiring diagram	Description of the electrical connections
Supplementary operating manual[1)]	Description of the proper and safe use of supplementary product components

For accessories and/or integrated machinery components, observe the relevant manufacturer's product literature.

1.4 Symbols

Table 2: Symbols used in this manual

Symbol	Description
✓	Conditions which need to be fulfilled before proceeding with the step-by-step instructions
▷	Safety instructions
⇨	Result of an action
⇨	Cross-references
1. 2.	Step-by-step instructions
	Note Recommendations and important information on how to handle the product

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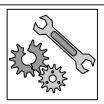
1 Optional

1.5 Key to safety symbols/markings

Table 3: Definition of safety symbols/markings

Symbol	Description
DANGER	**DANGER** This signal word indicates a high-risk hazard which, if not avoided, will result in death or serious injury.
WARNING	**WARNING** This signal word indicates a medium-risk hazard which, if not avoided, could result in death or serious injury.
CAUTION	**CAUTION** This signal word indicates a hazard which, if not avoided, could result in damage to the machine and its functions.
	**General hazard** In conjunction with one of the signal words this symbol indicates a hazard which will or could result in death or serious injury.
	**Electrical hazard** In conjunction with one of the signal words this symbol indicates a hazard involving electrical voltage and identifies information about protection against electrical voltage.
	**Machine damage** In conjunction with the signal word CAUTION this symbol indicates a hazard for the machine and its functions.

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2 Safety

DANGER

All the information contained in this section refers to hazardous situations.

In addition to the present general safety information the action-related safety information given in the other sections must be observed.

2.1 General

- This operating manual contains general installation, operating and maintenance instructions that must be observed to ensure safe operation of the system and prevent personal injury and damage to property.
- Comply with all the safety instructions given in the individual sections of this operating manual.
- The operating manual must be read and understood by the responsible specialist personnel/operators prior to installation and commissioning.
- The contents of this operating manual must be available to the specialist personnel at the site at all times.
- Information and markings attached directly to the product must always be complied with and kept in a perfectly legible condition at all times. This applies to, for example:
  - Markings for connections
  - Name plate
- The operator is responsible for ensuring compliance with all local regulations not taken into account.

2.2 Intended use

- This product must only be operated within the limit values stated in the technical product literature for the mains voltage, mains frequency, ambient temperature, motor rating, fluid handled, flow rate, speed, density, pressure, temperature and in compliance with any other instructions provided in the operating manual or other applicable documents.
- The product must not be used in potentially explosive atmospheres.

2.3 Personnel qualification and training

- All personnel involved must be fully qualified to install, operate, maintain and inspect the product this manual refers to.
- The responsibilities, competence and supervision of all personnel involved in transport, installation, operation, maintenance and inspection must be clearly defined by the operator.
- Deficits in knowledge must be rectified by means of training and instruction provided by sufficiently trained specialist personnel. If required, the operator can commission the manufacturer/supplier to train the personnel.
- Training on the product must always be supervised by specialist technical personnel.

2.4 Consequences and risks caused by non-compliance with this operating manual

- Non-compliance with this operating manual will lead to forfeiture of warranty cover and of any and all rights to claims for damages.
- Non-compliance can, for example, have the following consequences:
  - Hazards to persons due to electrical, thermal, mechanical and chemical effects and explosions
  - Failure of important product functions
  - Failure of prescribed maintenance and servicing practices

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2.5 Safety awareness

In addition to the safety information contained in this operating manual and the intended use, the following safety regulations shall be complied with:

- Accident prevention, health regulations and safety regulations
- Explosion protection regulations
- Safety regulations for handling hazardous substances
- Applicable standards, directives and legislation (e.g. EN 50110-1)

2.6 Safety information for the user/operator

- Fit protective equipment (e.g. contact guards) supplied by the operator for hot, cold or moving parts, and check that the equipment functions properly.
- Do not remove any protective equipment (e.g. contact guards) during operation.
- Provide the personnel with protective equipment and make sure it is used.
- Eliminate all electrical hazards. (In this respect refer to the applicable national safety regulations and/or regulations issued by the local energy supply companies.)

2.7 Safety information for maintenance, inspection and installation

- Modifications or alterations of the pump (set) are only permitted with the manufacturer's prior consent.
- Use only original spare parts or parts/components authorised by the manufacturer. The use of other parts/components can invalidate any liability of the manufacturer for resulting damage.
- The operator ensures that maintenance, inspection and installation are performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.
- Any work on the product shall only be performed when it has been disconnected from the power supply (de-energised).
- Carry out work on the product during standstill only.
- As soon as the work has been completed, re-install and re-activate any safety-relevant devices and protective devices. Before returning the product to service, observe all instructions on commissioning.

2.8 Unauthorised modes of operation

Never operate the product outside the limits stated in the data sheet and in this manual.

The warranty relating to the operating reliability and safety of the product supplied is only valid if the product is used in accordance with its intended use.

2.9 Software changes

The software has been specially created for this product and thoroughly tested. Making changes or additions to the software or parts of the software is prohibited. This does not, however, apply to software updates supplied by KSB.

2.10 Electromagnetic compatibility (EMC)

2.10.1 Interference emission requirements

The EN 61800-3 EMC product standard is relevant for electric variable speed drives/ control systems. It specifies all pertinent requirements and refers to the relevant generic standards for complying with the EMC Directive.

Frequency inverters are commonly used by operators as a part of a system, plant or machine assembly. It should be noted that the operator bears all responsibility for the final EMC properties of the equipment, plant or installation.

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A prerequisite or requirement for complying with the relevant standards or the limit values and inspection/test levels referenced by them is that all information and descriptions regarding EMC-compliant installation be observed and followed.
(⇨ Section 5.5, Page 26)

In accordance with the EMC product standard, the EMC requirements to be met depend on the purpose or intended use of the frequency inverter. Four categories are defined in the EMC product standard:

Table 4: Categories of intended use

Category	Definition	Limits to EN 55011
C1	Frequency inverters with a supply voltage under 1000 V installed in the first environment (residential and office areas).	Class B
C2	Frequency inverters with a supply voltage under 1000 V installed in the first environment (residential and office areas) that are neither ready to be plugged in/connected nor are mobile and must be installed and commissioned by specialist personnel.	Class A, Group 1
C3	Frequency inverters with a supply voltage under 1000 V installed in the second environment (industrial environments).	Class A, Group 2
C4	Frequency inverters with a supply voltage over 1000 V and a nominal current over 400 A installed in the second environment (industrial environments) or that are envisaged for use in complex systems.	No borderline/ boundary[2)]

The following limit values and inspection/test levels must be complied with if the generic standard on interference emissions applies:

Table 5: Classification of installation environment

Environment	Generic standard	Limits to EN 55011
First environment (residential and office areas)	EN/IEC 61000-6-3 for private, business and commercial environments	Class B
Second environment (industrial environments)	EN/IEC 61000-6-4 for industrial environments	Class A, Group 1

The frequency inverter meets the following requirements:

Table 6: EMC properties of the frequency inverter

Power [kW]	Cable length [m]	Category to EN 61800-3	Limits to EN 55011
≤ 11	≤ 5	C1	Class B
> 11	≤ 50	C2	Class A, Group 1

The EN 61800-3 standard requires that the following warning be provided for drive systems that do not comply with category C1 specifications:
This product can produce high-frequency interference emissions that may necessitate targeted interference suppression measures in a residential or office environment.

2.10.2 Line harmonics requirements

The product is a device for professional applications as defined by EN 61000-3-2. The following generic standards apply when establishing a connection to the public power grid:

- EN 61000-3-2
  for symmetric, three-phase devices (professional devices with a total power of up to 1 kW)
- EN 61000-3-12
  for devices with a phase current of between 16 A and 75 A and professional devices from 1 kW up to a phase current of 16 A.

2 An EMC plan must be devised.

2.10.3 Interference immunity requirements

In general, the interference immunity requirements for a frequency inverter hinge on the specific environment in which the inverter is installed.

The requirements for industrial environments are therefore higher than those for residential and office environments.

The frequency inverter is designed such that the immunity requirements for industrial environments and, thus, the lower-level requirements for residential and office environments, are met and fulfilled.

The following relevant generic standards are used for the interference immunity test:

- EN 61000-4-2: Electromagnetic compatibility (EMC)
  - Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test
- EN 61000-4-3: Electromagnetic compatibility (EMC)
  - Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test
- EN 61000-4-4: Electromagnetic compatibility (EMC)
  - Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test
- EN 61000-4-5: Electromagnetic compatibility (EMC)
  - Part 4-5: Testing and measurement techniques – Surge immunity test
- EN 61000-4-6: Electromagnetic compatibility (EMC)
  - Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields

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3 Transport/Storage/Disposal

3.1 Checking the condition upon delivery

1. On transfer of goods, check each packaging unit for damage.
2. In the event of in-transit damage, assess the exact damage, document it and notify KSB or the supplying dealer and the insurer about the damage in writing immediately.

3.2 Transport

DANGER

The pump (set) could slip out of the suspension arrangement

Danger to life from falling parts!

- Always transport the pump (set) in the specified position.
- Never attach the suspension arrangement to the free shaft end or the motor eyebolt.
- Observe the information about weights, centre of gravity and fastening points.
- Observe the applicable local accident prevention regulations.
- Use suitable, permitted lifting accessories, e.g. self-tightening lifting tongs.

To transport the pump/pump set suspend it from the lifting tackle as shown.

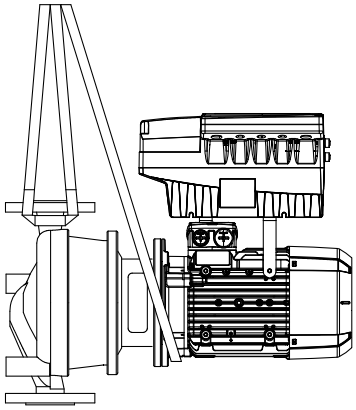

Fig. 1: Transporting a close-coupled pump set

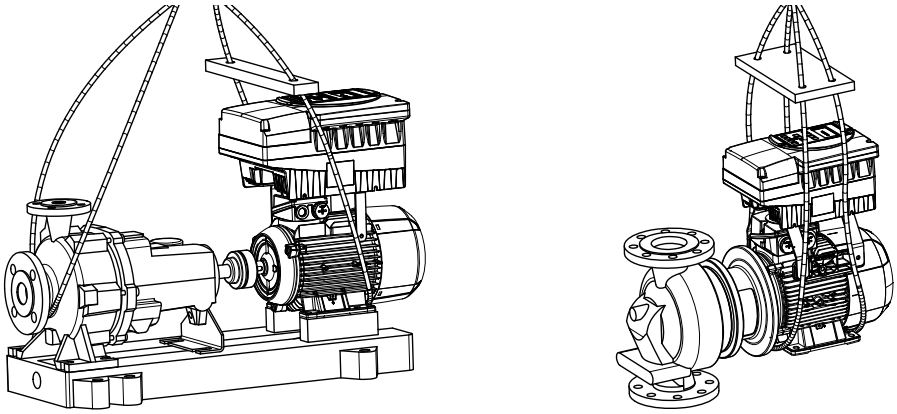

Fig. 2: Transporting a horizontal pump set

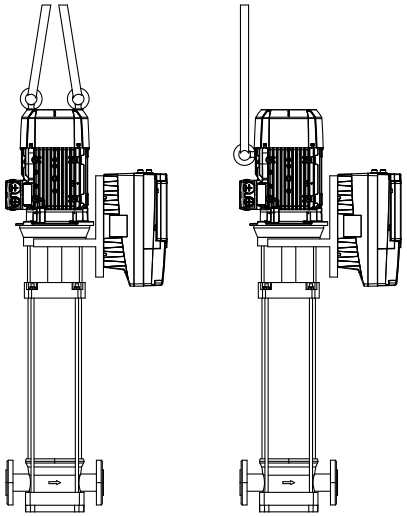

Fig. 3: Transporting a vertical pump set

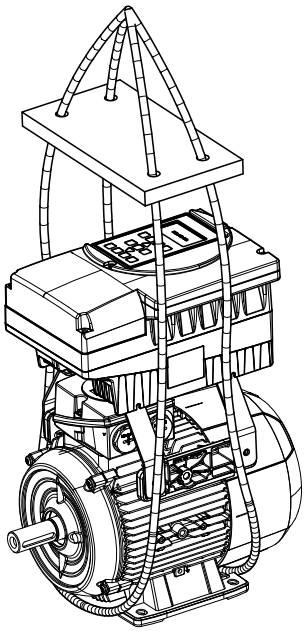

Fig. 4: Transporting the motor with frequency inverter

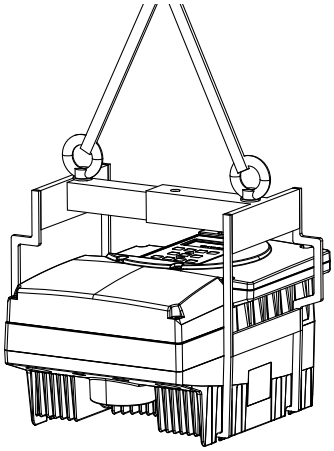

Fig. 5: Transporting the frequency inverter with lifting gear

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3.3 Storage

If the ambient conditions for storage are met, the function of the control unit is safeguarded even after a prolonged period of storage.

CAUTION

Damage during storage due to humidity, dirt or vermin

Corrosion/contamination of the control unit!

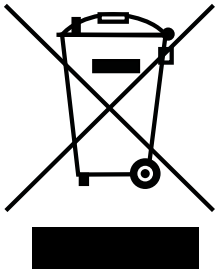
▷ For outdoor storage cover the (packed or unpacked) control unit and accessories with water-proof material.

Table 7: Ambient conditions for storage

Ambient condition	Value
Relative humidity	85 % max. (non-condensing)
Ambient temperature	-10 °C to + 70 °C

- Store the control unit in dry, vibration-free conditions and, if possible, in its original packaging.
- Store the control unit in a dry room where the level of atmospheric humidity is as constant as possible.
- Prevent excessive fluctuations in atmospheric humidity (see table on ambient conditions for storage).

3.4 Disposal/recycling



Electrical or electronic equipment marked with the adjacent symbol must not be disposed of in household waste at the end of its service life.

Contact your local waste disposal partner for returns.

If the used electrical or electronic equipment contains personal data, the operator is responsible for deleting it before the equipment is returned.

The product is classified as special waste due to several installed components:

1. Dismantle the product.
2. Separate materials
   e.g.:
   - Aluminium
   - Plastic cover (recyclable plastic)
   - Line chokes with copper windings
   - Copper lines for internal wiring
3. Dispose of materials in accordance with local regulations or in another controlled manner.
   PCBs, power electronics, capacitors and electronic components are all special waste.

4 Description

4.1 General description

Modular self-cooling frequency inverter that enables continuously variable speed control of asynchronous and synchronous reluctance motors by means of analog standard signals, a field bus or the control panel. As PumpDrive is self-cooling, it can be mounted on a motor, on the wall or in a control cabinet. Up to six pumps can be controlled without needing an additional controller.

4.2 Product information as per Regulation No. 1907/2006 (REACH)

For information as per chemicals Regulation (EC) No. 1907/2006 (REACH), see http://www.ksb.com/reach.

4.3 Designation

Table 8: Designation example

Position																											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
P	D	R	V	2	I	-	0	1	1	K	0	0	M	_	K	S	U	P	B	E	5	P	2	_	O	O	O	O	O

Table 9: Designation key

Position	Code	Description	MyFlow Drive	PumpDrive 2 Eco	PumpDrive 2
1-5	Product generation				
	PDRV2	PumpDrive 2	✘	✘	✘
6	Design				
	E	PumpDrive 2 Eco	-	✘	-
	I	MyFlow Drive	✘	-	-
	-	PumpDrive 2	-	-	✘
7	Product certifications				
	-	CE	✘[3)]	✘	-
	R	UR and CE	✘[4)]	-	✘
	L	UL and CE	-	-	✘[5)]
8-13	Power				
	A	000K37 = 0,37 kW	-	✘	✘
		000K55 = 0,55 kW	✘	✘	✘
		000K75 = 0,75 kW	✘	✘	✘
		001K10 = 1,1 kW	✘	✘	✘
		001K50 = 1,5 kW	✘	✘	✘
	B	002K20 = 2,2 kW	✘	✘	✘
		003K00 = 3 kW	✘	✘	✘
		004K00 = 4 kW	✘	✘	✘
	C	005K50 = 5,5 kW	✘	✘	✘
		007K50 = 7,5 kW	✘	✘	✘
		011K00 = 11 kW	✘	✘	✘
	D	015K00 = 15 kW	✘	-	✘

3 Available only for sizes ≤ 11 kW
4 Available only for sizes 15 kW to 45 kW
5 Available on request only

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Position	Code	Description	MyFlow Drive	PumpDrive 2 Eco	PumpDrive 2
8-13	D	018K50 = 18,5 kW	✗	-	✗
		022K00 = 22 kW	✗	-	✗
		030K00 = 30 kW	✗	-	✗
	E	037K00 = 37 kW	✗	-	✗
		045K00 = 45 kW	✗	-	✗
		055K00 = 55 kW	-	-	✗
14	Mounting option				
	M	Motor mounting	✗	✗	✗
	W	Wall mounting	-	✗	✗
	C	Cabinet mounting	-	✗	✗
16	Motor manufacturer				
	K	KSB	✗	✗	✗
	S	Siemens	-	✗	✗
	C	Cantoni	-	✗	✗
	W	Wonder	-	✗	✗
17-20	Motor type				
	1LE1	Siemens 1LE1/ KSB 1PC3	-	✗	✗
	1LA7	Siemens 1LA7/ KSB 1LA7	-	✗	✗
	1LA9	Siemens 1LA9/ KSB 1LA9	-	✗	✗
	1LG6	Siemens 1LG6/ KSB 1LG6	-	✗	✗
	SUPB	KSB SuPremE B	✗	✗	✗
	DMC	KSB(DM) Cantoni	-	✗	✗
	DMW	KSB(DM) Wonder	-	✗	✗
21-22	Efficiency class				
	E1	IE1	-	✗	✗
	E2	IE2	-	✗	✗
	E3	IE3	-	✗	✗
	E4	IE4	✗	✗	✗
	E5	IE5	✗	✗	✗
23-24	Number of motor poles				
	P2	2 poles	✗	✗	✗
	P4	4 poles	✗	✗	✗
	P6	6 poles	-	✗	✗
26	M12 module				
	O	None	✗	✗	✗
	M	M12 module	-	✗	✗
27	Field bus module				
	O	None	✗	✗	✗
	L	LON	-	-	✗
	P	Profibus DP	-	-	✗
	M	Modbus RTU	✗[6)]	✗	✗
	B	BACnet MS / TP	-	✗	✗
	N	Profinet	-	✗	✗

6 Consult the manufacturer.

Position	Code	Description	MyFlow Drive	PumpDrive 2 Eco	PumpDrive 2
28	Optional component 1				
	O	None	✗	✗	✗
	I	I/O extension board	-	-	✗
29	Optional component 2				
	O	None	✗	✗	✗
	R	Bluetooth module	-	✗	✗
30	Optional component 3				
	O	None	✗	✗	✗
	M	Master switch	-	-	✗

4.4 Name plate

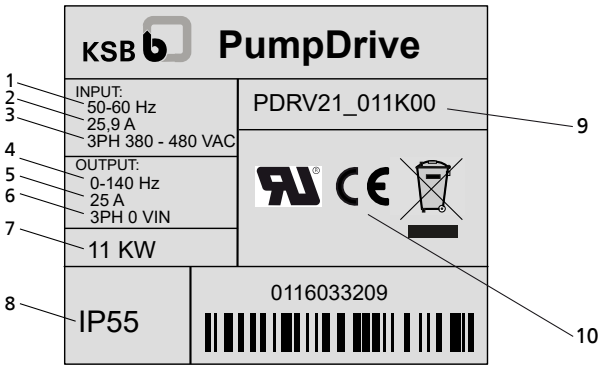

Fig. 6: Name plate 1, frequency inverter (example)

1	Mains input frequency	2	Mains input current
3	Mains voltage	4	Output frequency
5	Nominal output current	6	Output voltage
7	Nominal power	8	Enclosure
9	Type series, size	10	Product certification

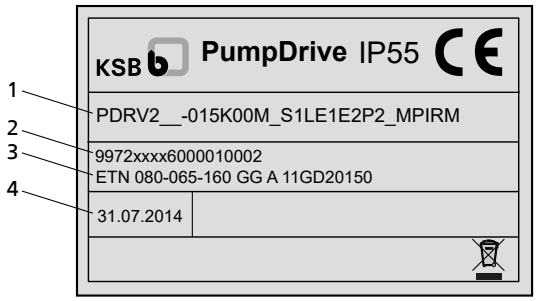

Fig. 7: Name plate 2, frequency inverter (example)

1	PumpDrive type code	2	KSB order number
3	Pump designation	4	Date of manufacture

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4.5 Power range and sizes

Table 10: Power range[7] for 2-pole (3000 rpm), 4-pole (1500 rpm) and 6-pole (1000 rpm) asynchronous motors and KSB SuPremE

Size	Nominal electrical power	Nominal output current	Mains input current
	[kW]	[A]	[A]
A	0,37	1,3	1,5
	0,55	1,8	2
	0,75	2,5	2,7
	1,10	3,5	3,7
	1,50	4,9	5,2
B	2,2	6	6,3
	3,0	8	8,4
	4,0	10	10,4
C	5,5	14	14,6
	7,5	18	18,7
	11	25	25,9
D	15	34,5	35,7
	18,5	44	45,4
	22	51	52,4
	30	68	69,7
E	37	84	85,9
	45	101	103,1
	55	120	122,4

4.6 Technical data

Table 11: Technical data of frequency inverter

Characteristic	Value
Mains supply	
Mains voltage[8]	3 ~ 380 V alternating current -10 % to 480 V alternating current +10 %[9]
Voltage difference between the three phases	±2 % of the supply voltage
Mains frequency	50 - 60 Hz ± 2 %
Mains types	TN-S, TN-CS, TN-C, TT and IT mains (to IEC/EN 60364)
Output data	
Frequency inverter output frequency	0 - 100[10] Hz for asynchronous motors 0 - 175 Hz for KSB SuPremE
PWM carrier frequency	Range: 2 - 8 kHz (Factory setting: 4 kHz)
Phase rate of rise dv/dt[11]	5000 V/µs maximum, depending on the size of the frequency inverter
Peak voltages	$2 \times 1{,}41 \times V_{eff}$ Electric cables with a high current-carrying capacity can cause the voltage to increase up to double the value.
Frequency inverter data	

7 The power ranges specified apply in full to all mounting options.
8 If the mains voltage is low, the nominal torque of the motor will be lower.
9 Optional master switch up to 400 V AC +10 %
10 Depending on the maximum motor speed
11 The phase rate of rise (dv/dt) depends on the line capacity.

Characteristic	Value
Efficiency	98 % - 95 %[12)]
Noise emissions	Sound pressure level of pump used + 2.5 dB[13)]
Environment	
Enclosure	IP55 (to EN 60529)
In-service ambient temperature	-10 °C to +50 °C
In-storage ambient temperature	-10 °C to +70 °C
Relative humidity	Operation: 5 % to 85 % (non-condensing) Storage: 5 % to 95 % Transport: 95 % max.
Installation altitude	< 1000 m above MSL, or 1 % power derating per additional 100 m
Vibration resistance	16.7 m/s^2 max. (to EN 60068-2-64)
Fluid temperature[14)]	-90 °C to +140 °C
EMC	
Frequency inverter ≤ 11 kW	EN 61800-3 C1/EN 55011 Class B/cable length ≤ 5 m
Frequency inverter ≥ 15 kW	EN 61800-3 C2/EN 55011 Class A, Group 1/cable length ≤ 50 m
Mains feedback	Integrated line chokes
Inputs and outputs	
Internal power supply unit	24 V ± 10 %
Maximum load	600 mA DC max., short-circuit and overload-proof
Residual ripple	< 1 %
Analog inputs	
Number of parameterisable analog inputs	2 (configurable for current or voltage input)
Input type	Differential
Maximum voltage (with reference to GND)	± 10 V
Current input	0/4 - 20 mA
Input impedance	500 Ω
Accuracy	1 % of full-scale value
Signal delay	< 10 ms
Resolution	12 bit
Voltage input	0/2 - 10 V
Input impedance	Approx. 40 kΩ
Accuracy	1 % of full-scale value
Signal delay	< 10 ms
Resolution	12 bit
Reverse polarity protection	Positive and negative polarity reversal possible
Analog outputs	
Number of parameterisable analog outputs	1 (toggling 4 output values)
Current output	4-20 mA
Maximum external working resistance	850 Ω
Output	PNP transistor
Accuracy	2 % of full-scale value

12 The efficiency at the nominal point of the frequency inverter varies between 98 percent for high power outputs and 95 percent for low outputs, depending on the inverter's nominal power.

13 The values are for orientation purposes only. The value refers to the nominal duty point (50 Hz) only. Also refer to the pump's noise characteristics. They, too, are documented for nominal duty operation. Other values may occur during variable speed operation.

14 Provided the specified ambient temperature limits are complied with.

Characteristic	Value
Signal delay	< 10 ms
Reverse polarity protection	Provided
Short-circuit protection and overload protection	Provided
Digital inputs	
Number of digital inputs	6 in total, 5 of which can be parameterised
ON level	15 - 30 V
OFF level	0 - 3 V
Input impedance	Approx. 2 kΩ
Electrical isolation	Provided, isolation voltage: 500 V AC
Delay	< 10 ms
Reverse polarity protection	Provided
Relay outputs	
Number of parameterisable relay outputs	2× change-over contact
Maximum contact rating	AC: Max. 250 V AC/0.25 A DC: Max. 30 V DC/2 A

PWM carrier frequency

Power derating for increased carrier frequency

Sizes A, B and C (at PWM carrier frequency > 4 kHz):

$I_{Nominal\ motor\ current\ (PWM)} = I_{Nominal\ motor\ current} \times (1 - [f_{PWM} - 4\ kHz] \times 2.5\ \%)$

Table 12: Technical data of I/O extension board

Characteristic		Value
Analog inputs		
Number of parameterisable analog inputs		1
Input type		Differential
Maximum voltage (with reference to GND)		+ 10 V
Current input		0/4 – 20 mA
	Input impedance	500 Ω
	Accuracy	1 % of full-scale value
	Signal delay	< 10 ms
	Resolution	11 bit
Voltage input		0/2 - 10 V
	Input impedance	Approx. 40 kOhm
	Accuracy	1 % of full-scale value
	Signal delay	< 10 ms
	Resolution	11 bit + 1 bit sign
Reverse polarity protection		Provided
Analog outputs (current output or voltage output)		
Number of parameterisable analog outputs		1 (toggling 4 output values)
Current output		4 – 20 mA
	Maximum external working resistance	850 Ω
	Output	PNP transistor
	Accuracy	2 % of full-scale value
	Signal delay	< 10 ms
	Reverse polarity protection	Provided
	Short-circuit protection and overload protection	Provided
Voltage output		2 – 10 V
	Maximum output current	25 mA

Characteristic		Value
	Output	NPN transistor
	Accuracy	2 % of full-scale value
	Signal delay	< 10 ms
	Reverse polarity protection	Provided
	Short-circuit protection and overload protection	Provided
Digital inputs		
Number of digital inputs		3 (all parameterisable)
ON level		15-30 V
OFF level		0 - 3 V
Input impedance		Approx. 2 kOhm
Electrical isolation		Provided, isolation voltage: 500 V AC
Delay		< 10 ms
Reverse polarity protection		Provided
Digital outputs		
Number of digital outputs		2
Output		PNP transistor
ON level		24 V ±10 %
OFF level		< 2 V
Output current		Max. 40 mA
Differential current		< 100 µA
Reverse polarity protection		Provided
Short-circuit protection and overload protection		Provided
Relay outputs		
Number of parameterisable relay outputs		1× changeover contact 5x normally open contact
Changeover contact, maximum contact rating		AC: Max. 250 V AC/0.25 A DC: Max. 30 V DC/3 A
Normally open contact contact, maximum contact rating		AC: Max. 250 V AC/0.25 A DC: Max. 30 V DC/1 A Suitable for switching operations of contactors with a maximum start-up current of 10 A.

4.7 Dimensions and weights

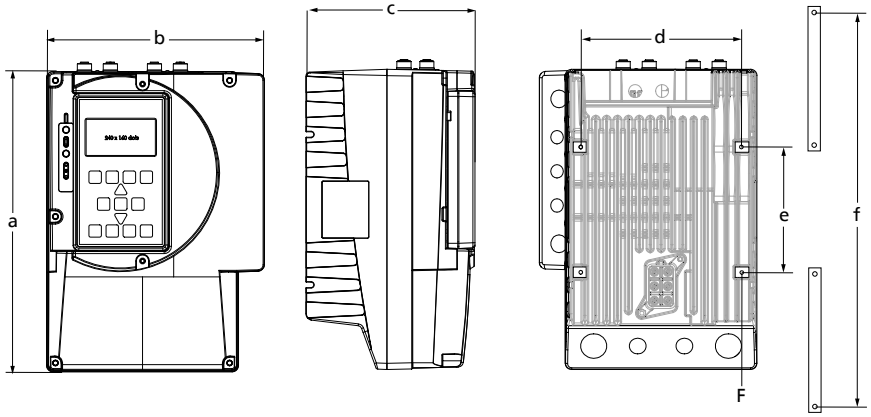

Fig. 8: PumpDrive 2 dimensions

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Table 13: Dimensions and weights

Housing type	P_N	Motor-mounted model					Wall-mounted/ cabinet-mounted model[15]					Fastening screws/bolts	[kg][16]
		a	b	c	d	e	a	b	c	d	f	F	
	[kW]	[mm]										-	
A	0,37	260	190	166	140	141	343	190	166	140	333	M4 × 10	5
A	0,55	260	190	166	140	141	343	190	166	140	333	M4 × 10	5
A	0,75	260	190	166	140	141	343	190	166	140	333	M4 × 10	5
A	1,10	260	190	166	140	141	343	190	166	140	333	M4 × 10	5
A	1,50	260	190	166	140	141	343	190	166	140	333	M4 × 10	5
B	2,20	290	211	166	155	121	328	211	166	155	318	M4 × 10	6,5
B	3,00	290	211	166	155	121	328	211	166	155	318	M4 × 10	6,5
B	4,00	290	211	166	155	121	328	211	166	155	318	M4 × 10	6,5
C	5,50	330	280	210	219	205	401	280	210	219	387	M6 × 12	12,6
C	7,50	330	280	210	219	205	401	280	210	219	387	M6 × 12	12,6
C	11,00	330	280	210	219	205	401	280	210	219	387	M6 × 12	12,6
D	15,00	460	350	290	280	309	582	350	290	280	565	M8 × 14	27,6
D	18,50	460	350	290	280	309	582	350	290	280	565	M8 × 14	36
D	22,00	460	350	290	280	309	582	350	290	280	565	M8 × 14	36
D	30,00	460	350	290	280	309	582	350	290	280	565	M8 × 14	36
E	37,00	700	455	340	375	475	819	455	340	375	800	M8 × 14	57,6
E	45,00	700	455	340	375	475	819	455	340	375	800	M8 × 14	60
E	55,00	700	455	340	375	475	819	455	340	375	800	M8 × 14	60

4.8 Mounting options

The frequency inverter is identical in design and configuration for all 3 mounting options. PumpDrive 2 can be motor-mounted for the entire power range from 0.37 kW to 55 kW.

Motor mounting: The frequency inverter is mounted to the motor with an adapter or to the pump for the Movitec configuration. Adapters for subsequent conversion to the motor mounting configuration for existing pump systems are available as accessories.

Wall / control cabinet mounting: Installation kits for subsequent conversion to the wall / control cabinet mounting configuration for existing pump systems are available as accessories.

15 The dimensions provided refer to the frequency inverter including the wall-mounting brackets.

16 Without motor adapter

5 Installation at Site

5.1 Safety regulations

DANGER

Incorrect installation

Danger to life!

- ▷ Install the frequency inverter in a flood-proof location.
- ▷ Never use the frequency inverter in potentially explosive atmospheres.

5.2 Checks to be carried out prior to installation

Place of installation

The standard configuration is supplied in IP55 enclosure and may only be used in environments for which its enclosure provides adequate protection.

The place of installation must meet the following requirements:

- Well-ventilated
- No direct sunlight
- Protected from weather
- Sufficient clearance for ventilation and dismantling
- Flood-proof
- Protected against water collecting on the frequency inverter.

Ambient conditions

- **Operating temperature:** -10 °C to +50 °C
  The service life of the frequency inverter is reduced if an average temperature of +35 °C/24 h is exceeded or if the inverter is operated at temperatures below 0 °C or above +40 °C.

The frequency inverter switches off automatically if excessively high or low temperatures occur.

NOTE

Contact the manufacturer if the product is to be used under conditions other than those stated above.

5.3 Mounting the frequency inverter

Depending on the selected mounting option, an adapter or installation kit is required.

5.3.1 Motor mounting

The frequency inverter for the motor-mounted model is supplied, together with the pump, already mounted to the motor via an adapter.
Adapters for subsequent conversion to the motor mounting configuration for existing pump systems are available from KSB.

5.3.2 Wall/control cabinet mounting

The wall-mounted model is supplied with the installation kit required for wall mounting as standard. Installation kits for subsequent conversion to the wall mounting configuration for existing pump systems are available from KSB.

The frequency inverter should rest flush against the wall so that the air flow of the fans is directed through the heat sink.

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Make sure to prevent exhaust air produced by other equipment from entering the device's air intake in order to ensure adequate cooling of the device. The following minimum distances must be observed:

Table 14: Minimum distances for control cabinet mounting

Minimum distance from other devices	Distance [mm]
Top and bottom	100
Side	20

The power dissipated in the form of heat when the frequency inverter is operated at nominal duty values varies between 2 percent for high power outputs and 5 percent for low outputs, depending on the frequency inverter's nominal power.

5.4 Outdoor installation of the frequency inverter

For installing the frequency inverter outdoors, fit a suitable protective cover to prevent condensation at the electronic equipment and exposure to excessive sunlight. The protective cover must be designed to protect the frequency inverter from rain and prevent water from collecting on the housing of the frequency inverter.

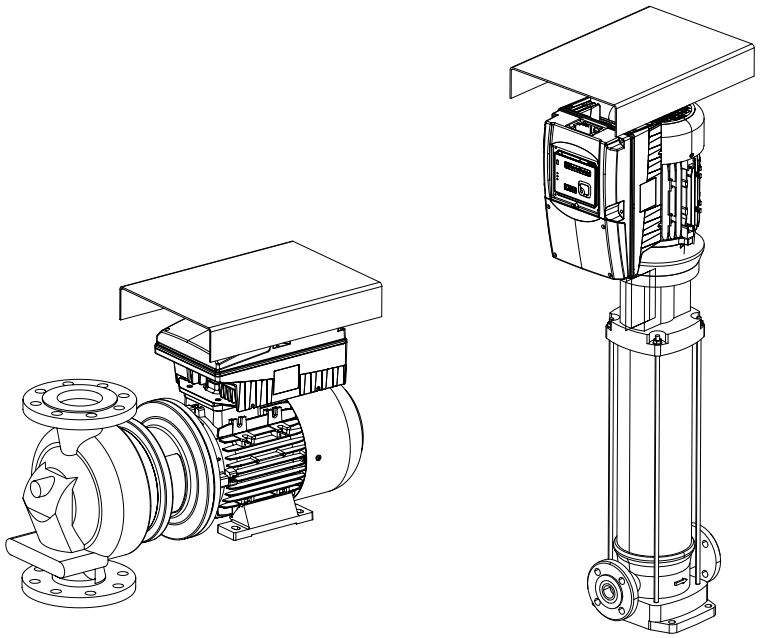

Fig. 9: Pump set with protective roof

Motor mounting option

For horizontally installed motors, mount the frequency inverter to the motor in a horizontal position.

For vertically installed motors, mount the frequency inverter to the motor in a vertical position.

Wall mounting option

For wall mounting, mount the frequency inverter to the wall in a vertical position.

5.5 Electrical Connection

5.5.1 Safety regulations

DANGER

Incorrect electrical installation

Risk of fatal injury due to electric shock!

- Always have the electrical connections installed by specialist personnel.
- Observe the technical specifications of the local and national energy supply companies.

DANGER

Unintentional start-up

Risk of fatal injury due to electric shock!

- Disconnect the frequency inverter from the mains before carrying out any maintenance and installation work.
- Prevent the frequency inverter from being re-started unintentionally when carrying out any maintenance and installation work.

DANGER

Contact with live components

Risk of fatal injury due to electric shock!

- Any work on the product shall only be performed when it has been disconnected from the power supply (de-energised).
- Never remove the centre housing part from the heat sink.
- Mind the capacitor discharge time.
  After switching off the frequency inverter, wait 10 minutes until dangerous voltages have discharged.

WARNING

Direct connection between power supply and motor connection (bypass)

Damage to the frequency inverter!

- Never establish a direct connection between the power supply and motor connection (bypass) of the frequency inverter.

WARNING

Simultaneous connection of several motors to the frequency inverter output

Damage to the frequency inverter!

Fire hazard!

- Never simultaneously connect several motors to the frequency inverter output.

CAUTION

Improper dielectric test

Damage to the frequency inverter!

- Never carry out dielectric tests on frequency inverter components.
- Only carry out dielectric tests on the motor, motor power cable, or power cable after having disconnected the frequency inverter connections.

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NOTE

Depending on the combination of settings, the frequency inverter could conceivably restart automatically after acknowledgement/reset or when the cause of the malfunction or fault has been eliminated.

The frequency inverter is equipped with electronic safety devices, which in case of a disturbance or malfunction switch off the motor, causing it to stop.

Use only the available cable gland holes (if necessary, in combination with double cable glands) for establishing the cable connections. Any additional drilling could generate metal chips and damage the equipment.

5.5.2 Information for planning the system

5.5.2.1 Power cables

Selecting the power/connection cables

The type of power/connection cable you choose depends on various factors such as, for example, the type of connection, the ambient conditions and the type of system.

Power/connection cables must be used in accordance with their intended use, and the manufacturer specifications regarding nominal voltage, current, operating temperature and thermal effects must be observed.

Power/connection cables must not be routed across or near hot surfaces unless they have been designed for this kind of application.

When they are used in mobile system components, flexible or highly flexible power/connection cables must be employed.

The cables used for connections to permanently installed devices should be as short as possible and be properly connected to these devices.

Always use different earth bus bars for the control cable and power cable.

Power cable

Unshielded cables can be used as power cables.

The power cables must be designed with a cross-section suitable for the nominal mains current.

If a mains contactor is used in the power cable (before the frequency inverter), this must be configured for an AC1 duty rating; the rated current values of the frequency inverters used are added and the result is increased by 15 %.

Motor connection cable

Shielded cables must be used as motor connection cables.

Control cable

Shielded cables must be used as control cables.

NOTE

Lines of type J-Y (ST) Y are not suitable for use as control cables.

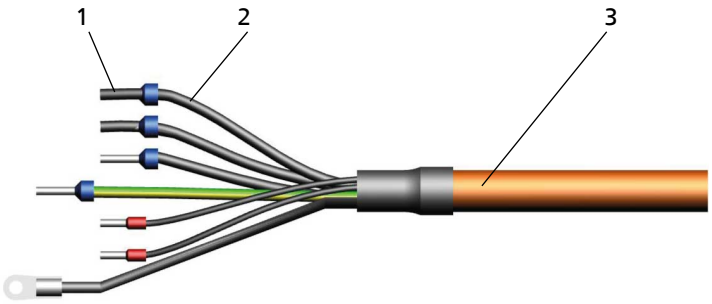

Fig. 10: Structure of electric cable

1	Wire end sleeve
2	Core
3	Cable

Table 15: Cable cross-sections of control terminals

Control terminal	Core cross-section			Cable diameter[17]
	Rigid cores	Flexible cores	Flexible cores with wire end sleeves	
	[mm²]			[mm]
Terminal strip A, B, C	0,2 - 1,5	0,2 - 1,0	0,25 - 0,75	**M12**: 3,5 - 7,0 **M16**: 5,0 - 10,0

Table 16: Power/connection cable properties

Size		Power	Cable gland for				Mains input current[18]	Maximum core cross-section	Cable cross-section KSB motor power cable
			Mains power cable	Sensor cable	Motor power cable	PTC thermistor			
		[kW]					[A]	[mm²]	
A	.. 000K37 ..	0,37	M20	M16	M20	M16	1,5	2,5	2,5
	.. 000K55 ..	0,55					2		
	.. 000K75 ..	0,75					2,7		
	..001K10..	1,1					3,7		
	.. 001K50 ..	1,5					5,2		
B	.. 002K20 ..	2,2	M25	M16	M25	M16	6,3	2,5	
	.. 003K00 ..	3					8,4		
	.. 004K00 ..	4					10,4		
C	..005K500..	5,5	M32	M16	M32	M16	14,6	16	4
	..007K500..	7,5					18,7		
	..011K000..	11					25,9		6
D	..15K000..	15	M40	M32	M40	M20	35,7	50	10
	..18K500..	18,5					45,4		16
	..22K00..	22					52,4		16
	..30K00..	30					69,7		25
E	..37K00..	37	M63	M32	M63	M20	85,9	95	35
	..45K00..	45					103,1		50
	..55K00..	55					122,4		70

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17 Impairment of protection provided by enclosure when cable diameters other than those specified are used.
18 Observe the information on the use of line chokes provided in the Accessories and Optional Equipment section.

Length of motor power cable

If the frequency inverter is not mounted on the motor to be controlled, longer motor power cables may be required. The stray capacitance of the connection cables may result in high-frequency discharge currents flowing to ground. The sum of the discharge currents and motor current may exceed the output-side rated current of the frequency inverter. This will activate the frequency inverter's protection equipment and the motor will be stopped. The following motor power cables are recommended depending on the power range:

Table 17: Length of motor power cable

Power range	Cable length	Stray capacitance
	Max.	
[kW]	[m]	[nF]
≤ 11 (Class B)	5	≤ 5
≥ 15 (Class A, Group 1)	50	≤ 5

Output filters

Dv/dt output filters can be used in conjunction with an asynchronous motor and a KSB SuPremE motor. Sine filters can only be used in conjunction with an asynchronous motor. If the length or stray capacitance of the power cable exceed the values indicated, we recommend installing a suitable output filter between the frequency inverter and the motor to be controlled. These filters reduce the voltage ramp-up time of the frequency inverter output voltages and limit their peaks.

5.5.2.2 Electrical protection devices

Cable protection

We recommend installing a miniature circuit breaker or suitable fuses for protecting the power cable of the frequency inverter with consideration of the input-side rated currents as per the following table. The protection must be able to withstand an overload current of 1.5 times the input-side rated current for 60 seconds. The fuse can be of type gG (IEC 60269) or a UL-equivalent with a response time below 0.5 seconds.

If voltage fluctuations are expected in the power supply, we recommend protecting the frequency inverter with fast acting fuses of type gR (IEC 60269) or UL-class JFHR2/ JFHR8. The maximum permissible values for the clearing integral i^2t [A^2s] indicated in the following table must be observed. The values for the clearing integral i^2t can vary strongly at the same rated power, depending on the manufacturer. For any deviating values, make sure they are smaller than or equal to the maximum permissible value indicated in the table.

Table 18: Technical data of the overcurrent protective device

Size		Variant for		Power	Rated current Irms	Rated voltage		Rated breaking capacity	Clearing integral Total i^2t @ AC 660 V Ipeak	
						IEC 60269-4	UL 248-13			
		400 V / 3~	230 V / 1~	[kW]	[A]	[V AC]		[kA]	[A^2s]	[A]
A	.. 000K37 ..	✘	-	0,37	20	690	700	200	168	600
	.. 000K55 ..	✘	-	0,55	20	690	700	200	168	600
		-	✘		5,5	500	-	180	6	16
	.. 000K75 ..	✘	-	0,75	20	690	700	200	168	600
	..001K10..	✘	-	1,1	20	690	700	200	168	600
		-	✘		8	500	-	180	8	16
	.. 001K50 ..	✘	-	1,5	20	690	700	200	168	600
B	.. 002K20 ..	✘	-	2,2	20	690	700	200	168	600
	.. 003K00 ..	✘	-	3	20	690	700	200	168	600
	.. 004K00 ..	✘	-	4	20	690	700	200	168	600
C	..005K500..	✘	-	5,5	50	690	700	200	945	1500

Size		Variant for		Power	Rated current Irms	Rated voltage		Rated breaking capacity	Clearing integral Total i^2t @ AC 660 V Ipeak	
						IEC 60269-4	UL 248-13			
		400 V / 3~	230 V / 1~	[kW]	[A]	[V AC]		[kA]	[A^2s]	[A]
C	..007K500..	✘	-	7,5	50	690	700	200	945	1500
	..011K000..	✘	-	11	50	690	700	200	945	1500
D	..15K000..	✘	-	15	100	690	700	200	6319	2600
	..18K500..	✘	-	18,5	100	690	700	200	6319	2600
	..22K00..	✘	-	22	100	690	700	200	6319	2600
	..30K00..	✘	-	30	100	690	700	200	6319	2600
E	..37K00..	✘	-	37	160	690	700	200	5775	2100
	..45K00..	✘	-	45	160	690	700	200	5775	2100
	..55K00..	✘	-	55	160	690	700	200	5775	2100

Motor protection switch

Separate motor protection is not required because the frequency inverter has its own safety devices (e.g. electronic overcurrent trip). Available motor protection switches must be rated for 1.4 times the nominal motor current.

Residual current device

If fixed connections and appropriate supplementary earthing are used (to DIN VDE 0160), RCDs are not mandatory for frequency inverters.

If residual current devices (RCDs) are used, three-phase frequency inverters must in accordance with DIN VDE 0160 be connected via universal AC/DC sensitive residual current devices (RCDs), as potential direct-current components may cause standard AC sensitive RCDs to either fail to respond or respond erroneously.

Table 19: Residual current device to be selected

Size	Rated current [mA]
A, B and C	150
D and E	300

If you are using a long shielded cable for the mains connection / motor connection, the residual-current monitoring device may be triggered by the discharge current that flows to earth (triggered by the carrier frequency). Remedies: Replace the RCD (residual current device) or lower the response limit.

Compensation systems

If the frequency inverter is operated on power supply networks with compensation systems, these systems must be designed by the manufacturer for operation in conjunction with a frequency inverter.

5.5.2.3 Information on electromagnetic compatibility

Electromagnetic interference from other electrical devices can affect the frequency inverter. The frequency inverter itself can also produce interference.

The interference emitted by the frequency inverter can generally be conducted through the motor connection cables. The following measures are proposed for interference suppression:

- Shielded motor connection cables must be used for cable lengths > 70 cm and for frequency inverters with low power ratings.
- If shielded power cables cannot be used, use metal cable ducts made from a single piece with a minimum coverage of 80 %.

Installation at site/ Environment

Install the frequency inverter in a metal cabinet for more effective shielding.

When installing the power components in the control cabinet, make sure they are not too close to other devices (control devices and monitoring devices).

Maintain a minimum distance of 0.3 metres between the cabling and power components as well as other cabling in the control cabinet.

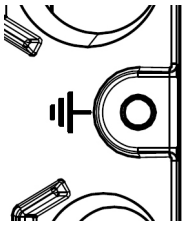
Connecting electric cables

Always use different earth bus bars for the control cable and power cable.

The shield on the power cable must consist of a single piece. It must be earthed at both ends on the appropriate earth terminal or on the earth bus bar (do not connect it to the earth bus bar in the control cabinet).

The shielded electric cable ensures that the high-frequency current flows through the shielding. Otherwise the high-frequency current would flow as a discharge current from the motor housing to earth or between the individual electric cables.

Connect the shield for the control cable to the designated connection points in the control cable terminal compartment (connection on frequency inverter side only). The shield also serves as protection against radiated emission.



In applications with long shielded motor cables, additional reactive resistors or output filters must be provided to compensate the capacitive stray current to earth and reduce the rate of voltage rise on the motor. These measures help reduce radio frequency interference further. Using just ferrite rings or reactive resistors does not ensure compliance with the limit values defined in the EMC directive.

Fig. 11: Connecting a shield

NOTE

If you are using shielded cables that are longer than 10 m, check the stray capacitance to ensure that the diffusion between the phases or to earth is not excessive, which could cause the frequency inverter to stop.

Routing electric cables

Route all connection cables in separate cable ducts.

When routing the control cable observe a minimum distance of 0.3 metres between the control cable and the power cables / motor power cables.

If crossing of control cable and power cable / motor power cable cannot be avoided, cross them at 90 degrees to each other.

5.5.2.4 Earth connection

The frequency inverter must be properly earthed.

To ensure greater interference immunity, a wide contact face is required for the different earth connections.

In the case of cabinet mounting, use two separate copper earth bus bars (mains power connection / motor connection and control connection bar) with a suitable size and cross-section for earthing the frequency inverter. All the earth connections are connected to these.

The bars are connected to the earthing system at one point only.

The control cabinet is earthed via the mains earthing system.

5.5.2.5 Line chokes

The line input currents indicated are for orientation only; they refer to operation at nominal rating. These currents may vary depending on the actual line impedance. In low-impedance mains, higher currents may occur.
To limit the line input current, external line chokes can be used alongside the line chokes already integrated (in the power range up to and including 55 kW). Line chokes also reduce mains feedback and improve the power factor. The scope of DIN EN 61000-3-2 must be heeded.

Appropriate line chokes are available from KSB. (⇨ Section 11.2.8, Page 239)

5.5.2.6 Output filter

The maximum cable lengths must be maintained in order to meet RFI suppression requirements to EN 55011. Output filters are required if the maximum cable lengths are exceeded.

Technical data available on request. (⇨ Section 11.2.8, Page 239)

5.5.3 Electrical connection

5.5.3.1 Removing the housing cover

⚠ DANGER

Contact with live components

Risk of fatal injury due to electric shock!

- ▹ Any work on the product shall only be performed when it has been disconnected from the power supply (de-energised).
- ▹ Never remove the centre housing part from the heat sink.
- ▹ Mind the capacitor discharge time.
  After switching off the frequency inverter, wait 10 minutes until dangerous voltages have discharged.

The housing cover consists of a C-shaped housing cover panel. The terminals of the power cables and motor power cables are fitted with an additional protective cover as a contact guard.

C-shaped housing cover

Fig. 12: C-shaped housing cover

1. Remove the cross-recessed head screws on the C-shaped cover.
2. Remove the C-shaped cover.

Protective cover

Fig. 13: Prying open the protective cover

1. **Sizes A, B and C:** The protective cover for connecting the power cables and motor power cables is push-fit. Before connecting the power cables and motor power cables, carefully pry open the protective cover using a wide screwdriver.
   Sizes D and E: Undo the screws at the protective cover.

Fig. 14: Removing the protective cover

2. Remove the protective cover.

5.5.3.2 Overview of terminal strips

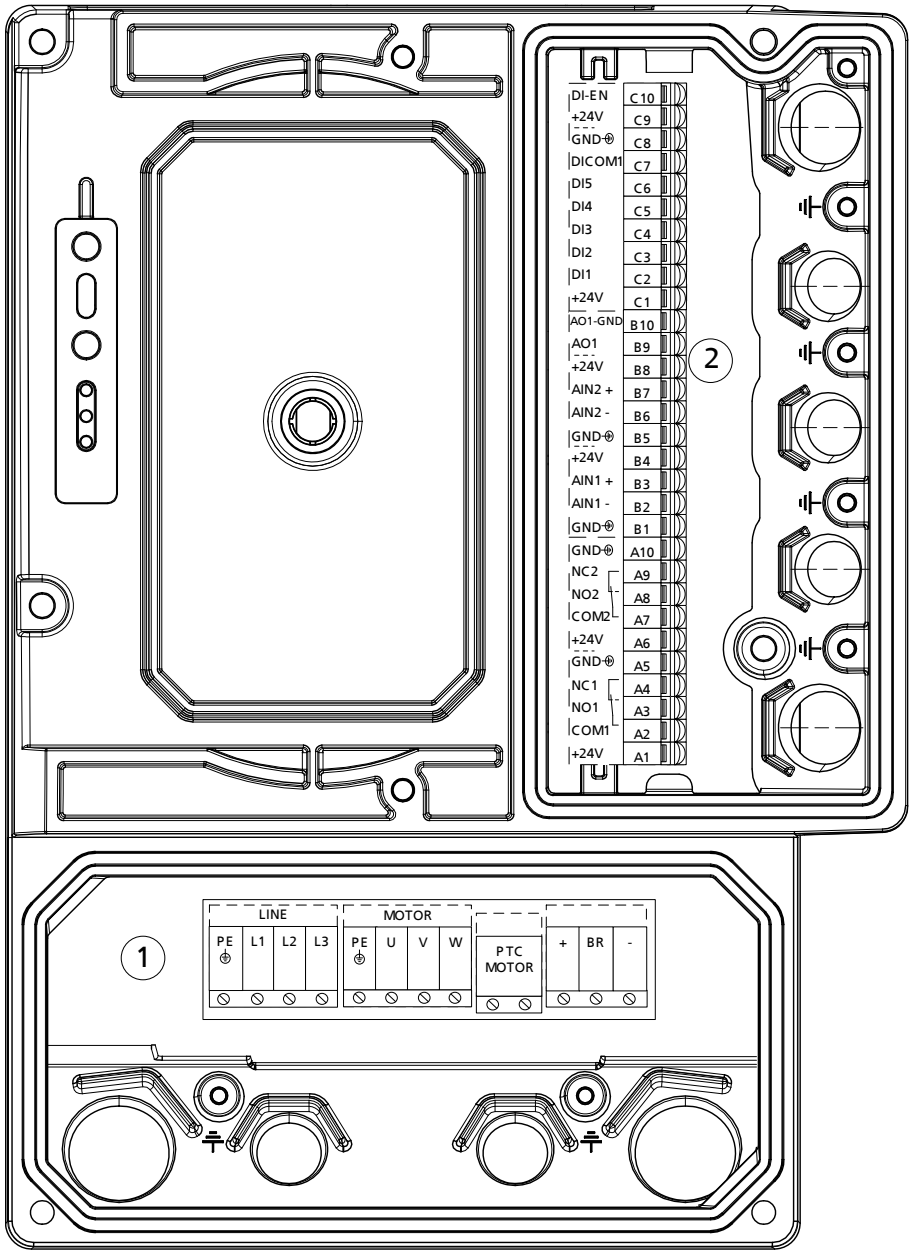


Fig. 15: Overview of terminal strips

1	Mains and motor connection	2	Control cables

5.5.3.3 Connection to mains power supply and motor

DANGER

Touching or removing the terminals and connectors of the braking resistor

Risk of fatal injury due to electric shock!

- ▷ Never open or touch the terminals and connectors of the braking resistor as long as the frequency inverter is energised.

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CAUTION

Incorrect electrical installation

Damage to the frequency inverter!

- ▷ Never fit a contactor (in the motor connection cable) between the motor and the frequency inverter.

1. Route the power cable for the mains power supply and/or the motor connection cable through the cable glands and connect the cable(s) to the specified terminals.
2. Connect the line for a PTC connection/PTC thermistor to the PTC terminal strip (3).

Connecting motor monitoring devices (PTC thermistor)

If no PTC connection is available on the motor side, parameter *3-2-3-1* (PTC Analysis) must be deactivated.

NOTE

IP55 enclosure protection as specified in the technical data is only provided if the cover has been fitted properly.

NOTE

In the event of a short circuit in the winding (short circuit between phase and PTC), a fuse trips and prevents carryover of low voltages to the extra-low voltage level. In the case of a fault or malfunction, this fuse can only be replaced by KSB service personnel.

Size A

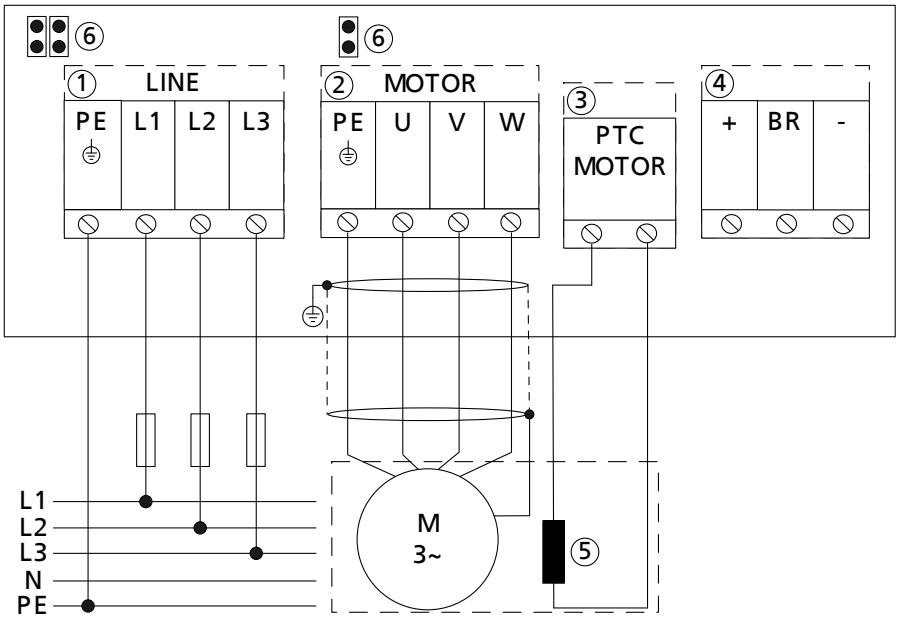

Fig. 16: Establishing the mains power supply and motor connections, size A, 400 V/3~ variant

①	Mains connection	②	Motor connection
③	PTC connection	④	Braking resistor
⑤	Motor PTC	⑥	Jumper for IT mains

Size B

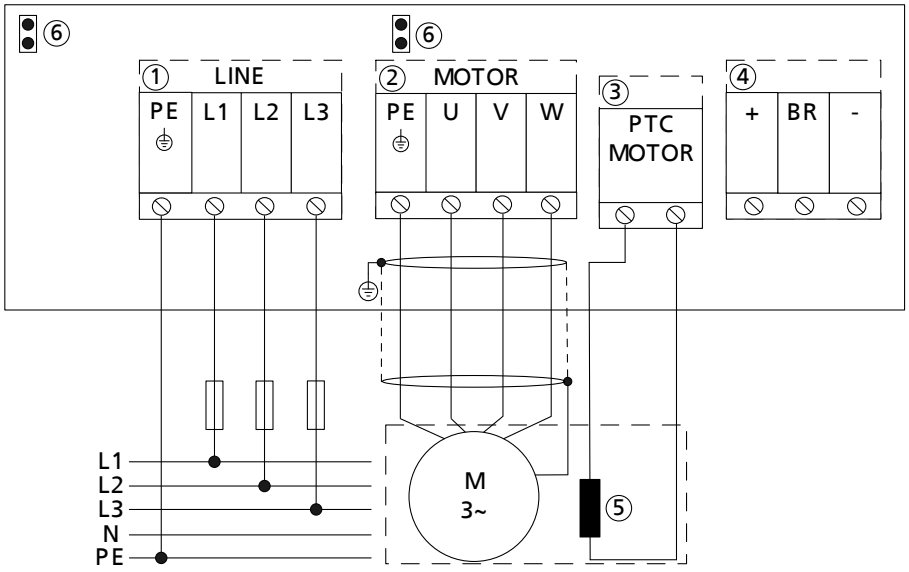

Fig. 17: Establishing the mains power supply and motor connections, size B

①	Mains connection	②	Motor connection
③	PTC connection	④	Braking resistor
⑤	Motor PTC	⑥	Jumper for IT mains

Size C

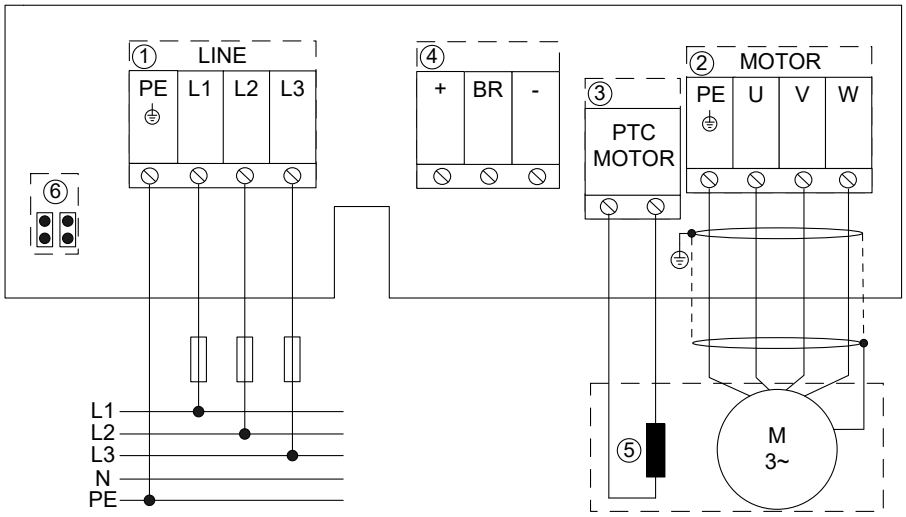

Fig. 18: Establishing the mains power supply and motor connections, size C

①	Mains connection	②	Motor connection
③	PTC connection	④	Braking resistor
⑤	Motor PTC	⑥	Jumper for IT mains

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Size D

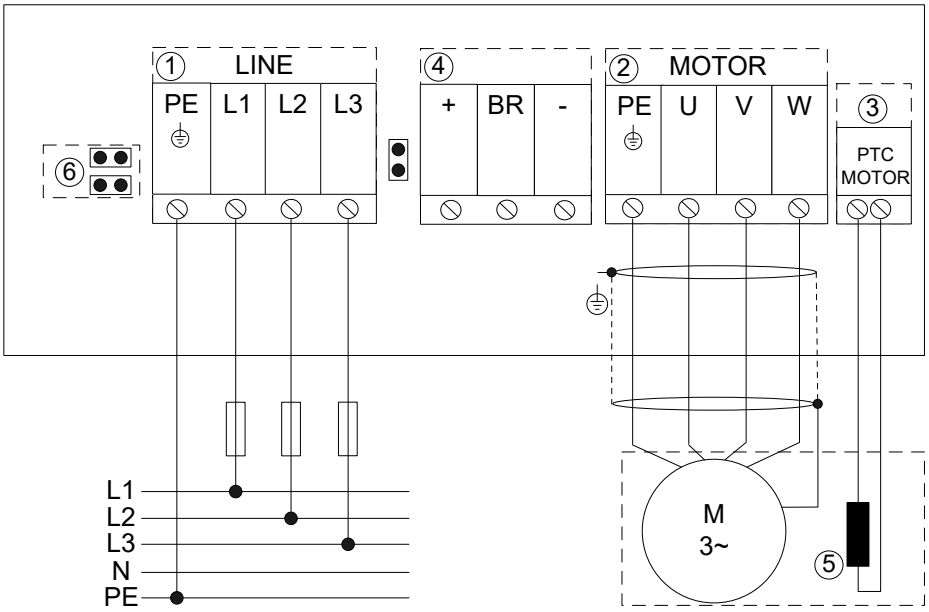

Fig. 19: Connection to mains power supply and motor, size D

①	Mains connection	②	Motor connection
③	PTC connection	④	Braking resistor
⑤	PTC thermistor of motor	⑥	Jumper for IT mains

Size E

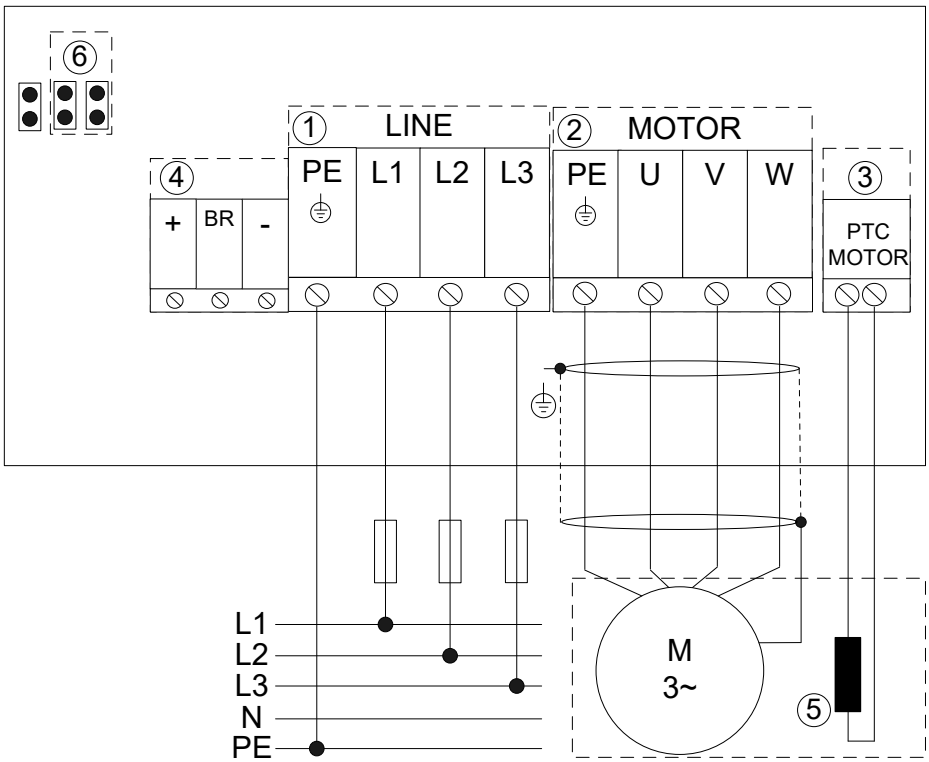

Fig. 20: Connection to mains power supply and motor, size E

①	Mains connection	②	Motor connection
③	PTC connection	④	Braking resistor
⑤	PTC thermistor of motor	⑥	Jumper for IT mains

IT mains

DANGER

Contact with live components

Risk of fatal injury due to electric shock!

- Any work on the product shall only be performed when it has been disconnected from the power supply (de-energised).
- Never remove the centre housing part from the heat sink.
- Mind the capacitor discharge time.
  After switching off the frequency inverter, wait 10 minutes until dangerous voltages have discharged.

Jumper in IT mains

If the frequency inverter is to be used in an IT mains, the relevant IT mains jumpers must be removed.

5.5.3.3.1 Connecting the power supply when the master switch is installed

If the optional master switch is in the OFF position, the frequency inverter and the motor are disconnected from the mains.

DANGER

Opening the protective cover with the master switch in the OFF position

Risk of fatal injury due to electric shock!

- ▹ Disconnect the frequency inverter from the mains before carrying out any maintenance and installation work.
- ▹ Prevent the frequency inverter from being re-started unintentionally when carrying out any maintenance and installation work.

✓ The master switch has been installed in the protective cover.

1. Guide the power cable through the cable gland.

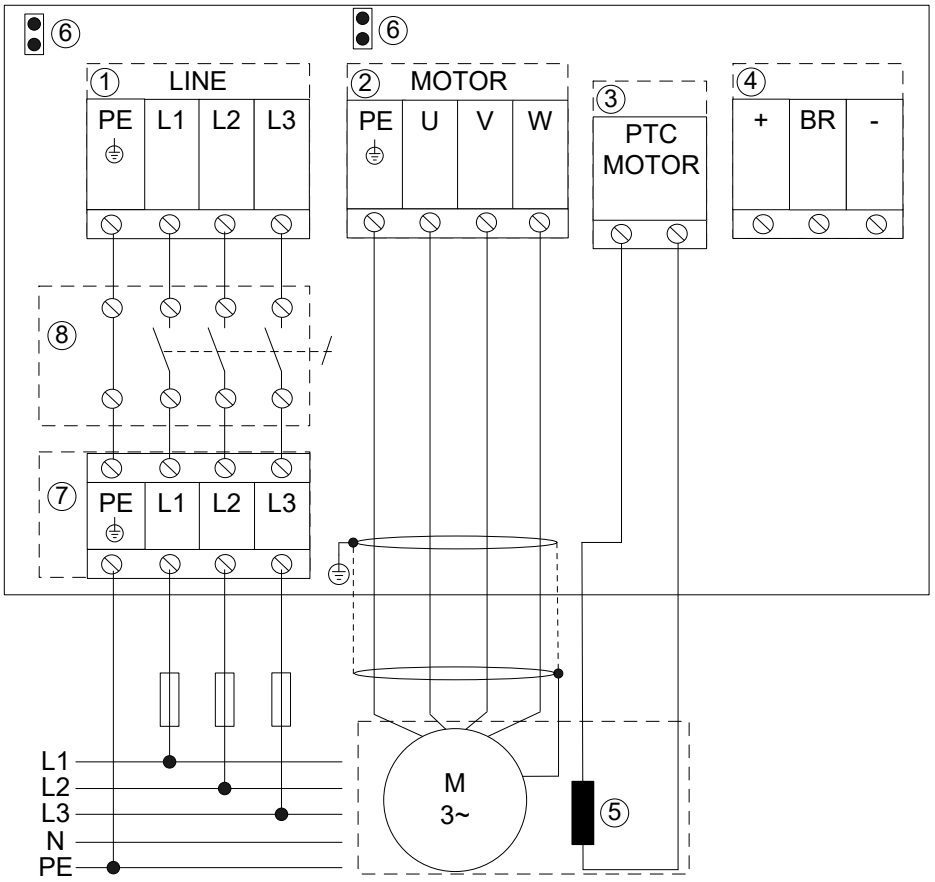

Fig. 21: Example of power supply connection and motor connection to designated terminals, size B

①	Mains connection	②	Motor connection
③	PTC connection	④	Braking resistor
⑤	Motor PTC	⑥	Jumper for IT mains
⑦	Power supply connection terminal for master switch version	⑧	Master switch

2. **Sizes A, B and C**: Connect the power cable and the motor connection cable to the designated terminals on the inside of the protective cover.
   Sizes D and E: Connect the power cable and motor connection cable directly to the master switch.

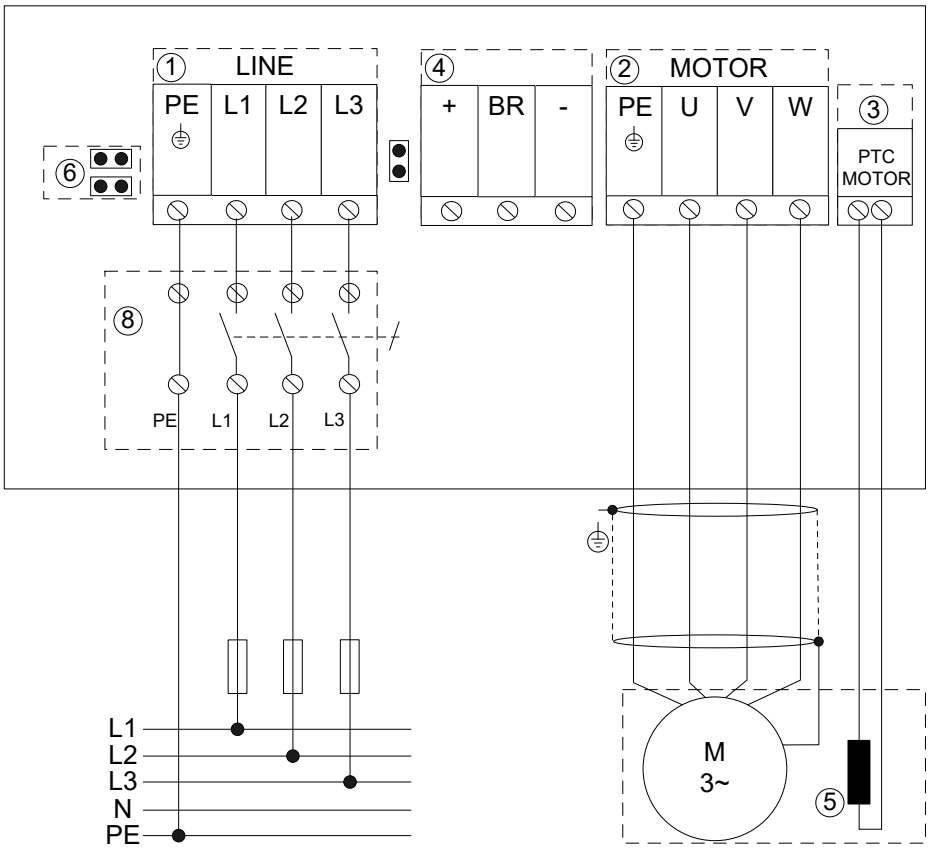

Fig. 22: Example of power supply connection and motor connection to designated terminals, size D

①	Mains connection	②	Motor connection
③	PTC connection	④	Braking resistor
⑤	Motor PTC	⑥	Jumper for IT mains
		⑧	Master switch

5.5.3.3.2 Directly connecting the motor cable without motor connector (for sizes A and B only)

DANGER

Improper electrical connection

Risk of fatal injury due to electric shock!

- Never simultaneously use the motor connector with a motor cable that is directly connected to the motor terminals.
- Never touch terminals and plug-type connections of the motor connector.

When directly connecting a motor cable to the designated motor terminals (U, V, W), the motor connector fitted at the factory must first be removed.

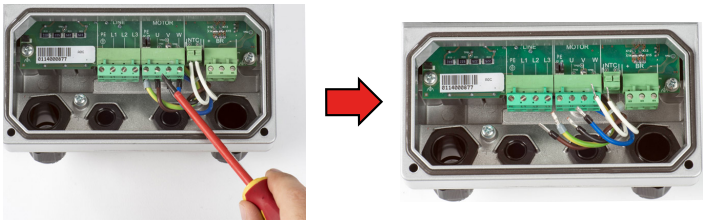

Fig. 23: Disconnecting the cores of the motor connector

1. Disconnect the cores of the motor connector at terminals U, V and W.

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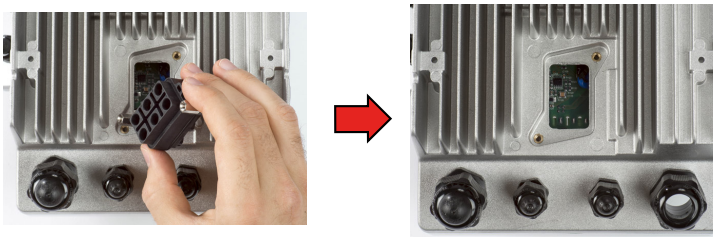


Fig. 24: Removing the motor connector

2. Remove the motor connector from the heat sink.

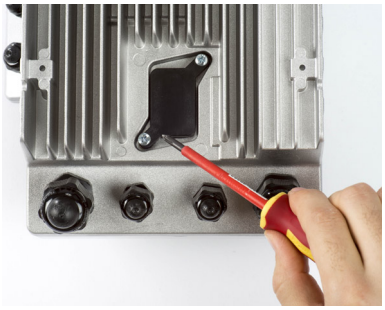
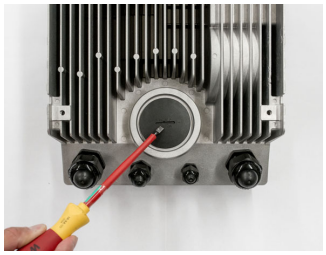


Fig. 25: Inserting and fastening cover

3. Close the opening in the heat sink using the kit accompanying the frequency inverter (comprising a cover, gasket and bolts/screws).

	NOTE
	IP55 enclosure protection as specified in the technical data is only provided if the cover has been fitted properly.

5.5.3.3.3 Retrofitting a frequency inverter for a KSB SuPremE B2 motor (for sizes C, D and E only)



The heat sink is closed with a screw plug. The following steps must be carried out for retrofitting on a KSB SuPremE B2 motor.

1. Remove the screw plug.

Fig. 26: Screw plug

2. Remove the nut from the screw plug inside the frequency inverter.

Fig. 27: Removing the screw plug

	NOTE
	The IP55 enclosure as specified in the technical data is only provided if the O-ring has been fitted properly.

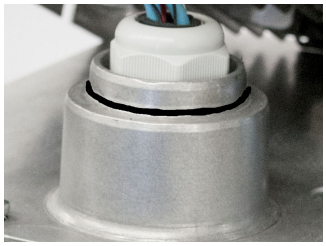


Fig. 28: Inserting the O-ring

3. Place the O-ring onto the adapter.

DANGER

Pinching of power cable and motor power cable

Danger of death from electric shock!

- Never damage the insulation of the power cable and motor power cable when inserting them into the opening of the frequency inverter.

Fig. 29: Inserting the motor cables

4. Place the frequency inverter onto the motor adapter of the KSB SuPremE B2 motor and insert the motor cables of the KSB SuPremE B2 motor into the opening of the frequency inverter.
5. Connect the motor cables as described. (⇨ Section 5.5.3.3, Page 34)

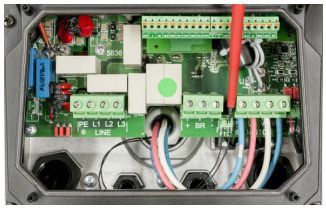


Fig. 30: Connecting the motor cables

6. Connect the PTC cables that are supplied as standard with the KSB SuPremE B2 motor.
7. Close the frequency inverter with the protective cover and the housing cover.

5.5.3.3.4 Installing the line choke and output filter

Fig. 31: Installing line choke and output filters

	Transformer		Dv/dt output filters (suitable for asynchronous motor and KSB SuPremE motor) or Sine filter (only suitable for asynchronous motor)
	Line choke	M	Motor

Line choke

The line input currents may vary depending on the actual line impedance. In low-impedance mains, higher currents may occur. To limit the line input current, external line chokes can be used alongside the line chokes already integrated in the frequency inverter (in the power range up to and including 55 kW).

Output filters

Dv/dt output filters can be used in conjunction with an asynchronous motor and a KSB SuPremE motor. Sine filters can only be used in conjunction with an asynchronous motor. If the length or stray capacitance of the power cable exceed the values indicated, we recommend installing a suitable output filter between the frequency inverter and the motor to be controlled. These filters reduce the voltage ramp-up time of the frequency inverter output voltages and limit their peaks.

1. Install a line choke in series (in the power cable) upstream of the frequency inverter.
2. Install an output filter in series in the motor connection cable downstream of the frequency inverter.

5.5.3.4 Establishing an earth connection

The frequency inverter must be earthed.

Observe the following when establishing the earth connection:

- Ensure that the cable lengths are as short as possible.
- Use different earth bus bars for the control and power/motor connection cables.
- The earth bus bar of the control cable must not be affected by currents from the power/motor connection cables since this could be a source of interference.

Connect the following to the earth bus bar of the power/motor connection cable:

- Motor earthing connections
- Housing of the frequency inverter
- Shielding of the power/motor connection cable

Connect the following to the earth bus bar of the control cable:

- Shielding of the analog control connections
- Shielding of the sensor cables
- Shielding of the field bus connection cable

Installing multiple frequency inverters

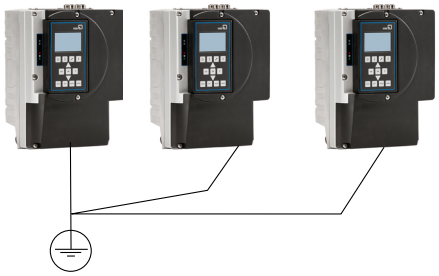


Fig. 32: Establishing an earth connection

If you are installing more than one frequency inverter, the star configuration is recommended.

5.5.3.5 Installing and connecting the M12 module

The M12 module can be used to connect multiple frequency inverters to implement dual pump configurations or multiple pump configurations. The M12 module also allows PumpMeter to be connected to the frequency inverter via Modbus.

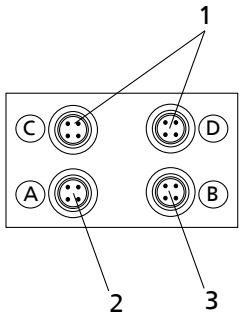


Fig. 33: M12 module

1	Connection for dual pump configuration/multiple pump configuration (KSB device bus)	C - D
2	Connection for PumpMeter (Modbus)	A
3	Connector for the cross-link bus cable (Modbus)	B

- Can be retrofitted
- Internal T-connector (bus looped through); uninterruptible even in the event of a frequency inverter power failure
- Connector for self-assembly (⇨ Section 11.2, Page 230)
- Pre-configured cables (⇨ Section 11.2, Page 230)

The M12 slot module can be fitted in an available slot of the frequency inverter.

Blind cover

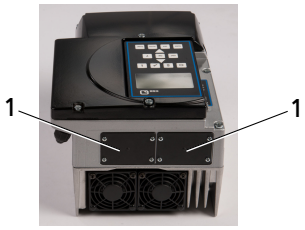


Fig. 34: Blind cover

1	Blind cover

1. Unscrew the cross recessed head screws in the blind cover.
2. Remove the blind cover.

M12 module

1. Carefully insert the M12 module in the open slot. The M12 module is guided on rails until it engages in the contact.

Fig. 35: Inserting the M12 module

Fig. 36: Securing the M12 module

2. Secure the M12 module using the 4 cross recessed head screws. IP55 enclosure protection is not provided until the screws have been tightened.

CAUTION

Incorrect assembly

Impairment of protection provided by the enclosure (protection may be compromised)!

- ▷ Cover unused M12 sockets of the M12 module with a cap (included in the scope of supply).

Connecting dual pump configurations and multiple pump configurations

Designing dual and multiple pump configurations via a cable pre-configured especially for this connection (see Accessories)

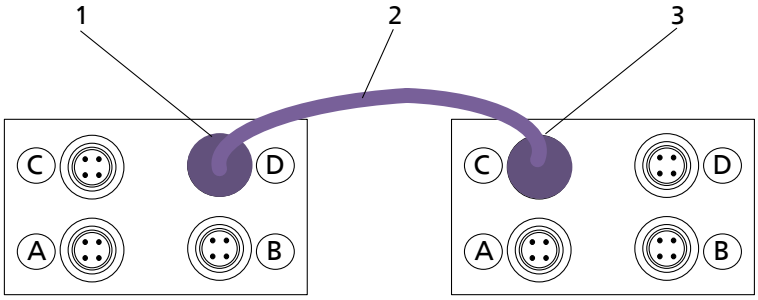


Fig. 37: Connecting M12 modules in dual and multiple pump configurations

1	Connection for dual/multiple pump configuration, PumpDrive No. 1
2	Pre-configured bus cable for dual and multiple pump configuration (colour: light purple, connector: angled, connector: angled)
3	Connection for dual/multiple pump configuration, PumpDrive No. 2

NOTE

Terminating resistors (refer to KSB accessories) that can be connected to the unassigned M12 connector (C or D) at the M12 module are required for the bus terminator.

Connecting PumpMeter in single-pump configurations

Use a pre-configured cable (see PumpDrive 2 (⇨ Section 11.2, Page 230)).

NOTE

Connect PumpMeter (Modbus) to the M12 module, input A.

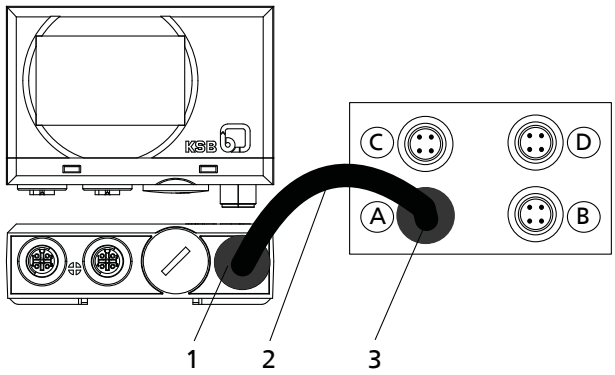


Fig. 38: Connecting PumpMeter to the M12 module in single-pump configurations

1	PumpMeter: Modbus connection
2	Pre-configured bus cable for connecting PumpMeter to M12 module (colour: black, socket: straight, connector: angled)
3	M12 module: Connection for PumpMeter (Modbus)

Connecting PumpMeter in dual and multiple pump configurations

Pre-configured cross-link cables can be used to switch the PumpMeter Modbus signal from frequency inverter to frequency inverter. (⇨ Section 11.2, Page 230)

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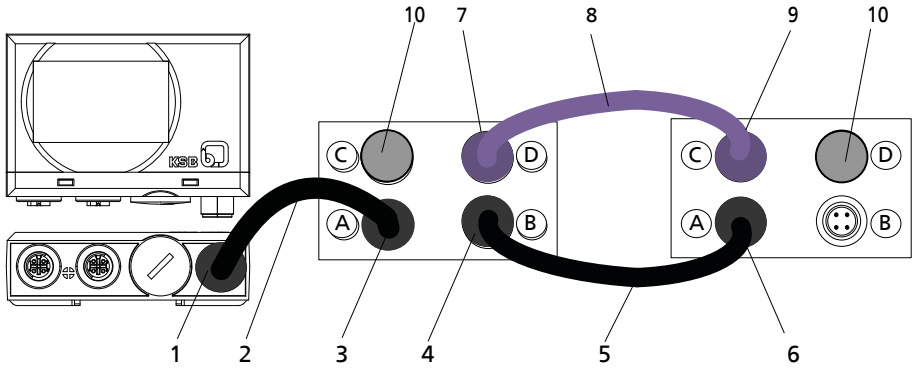

Fig. 39: Connecting PumpMeter in dual and multiple pump configurations

1	PumpMeter: Modbus connection
2	Pre-configured bus cable for connecting PumpMeter to M12 module (colour: black, socket: straight, connector: angled)
3	M12 module, socket A: Connection for PumpMeter (Modbus)
4	M12 module, socket B: Connection for cross-link bus cable (Modbus)
5	Pre-configured cross-link bus cable for redundant connection of PumpMeter (colour: black, connector: angled; connector: angled)
6	M12 module, socket A: Connection for cross-link bus cable (Modbus)
7	Connection for dual/multiple pump configuration, frequency inverter No. 1
8	Pre-configured bus cable for dual and multiple pump configuration (colour: light purple, connector: angled, connector: angled)
9	Connection for dual/multiple pump configuration, frequency inverter No. 2
10	Terminating resistor

Pin assignment

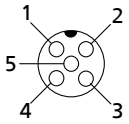

Fig. 40: M12 module standard assignment for M12 socket as viewed looking at the mating face

Table 20: Pin assignment, M12 module, input A/B

Pin	Conductor colour coding	M12 socket A assignment parameterised for PumpMeter Modbus	M12 socket B assignment parameterised for PumpMeter Modbus	M12 socket A and B assignment parameterised as analog input
1	Brown	24 V output (supply to PumpMeter)	24 V output (supply to PumpMeter)	24 V output (supply to PumpMeter)
2	Blue	0 V	0 V	0 V
3	White	D-	D+	Input (4 - 20 mA)
4	Grey	D+	D-	-
5	-	-	-	Vent opening

Table 21: Pin assignment, M12 module, input C/D

Pin	Conductor colour coding	M12 socket C and D assignment
1	-	Shielding
2	Red	-
3	Black	CAN GND
4	White	CAN H

Pin	Conductor colour coding	M12 socket C and D assignment
5	Blue	CAN L
Thread	-	Shielding

5.5.3.6 Installing and connecting the field bus module

The field bus modules are available as plug-in modules in the following variants:

- Modbus RTU module
- Profibus DP module
- LON module
- BACnet MS/TP module
- Profinet Module

The field bus modules have the following properties:

- Can be retrofitted
- Internal T-connector (bus looped through); uninterruptible even in the event of a frequency inverter power failure
- Connector for self-assembly (⇨ Section 11.2, Page 230)

Installing the field bus module

The field bus module can be fitted in an available slot of the frequency inverter.

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Blind cover

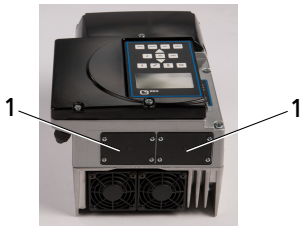

Fig. 41: Blind cover

1	Blind cover

1. Unscrew the cross recessed head screws in the blind cover.
2. Remove the blind cover.

Field bus module

1. Carefully insert the field bus module into the open slot. The plug-in module is guided on rails until it engages in the contact.

Fig. 42: Inserting the field bus module

Fig. 43: Securing the M12 module

2. Secure the field bus module using the 4 cross recessed head screws. IP55 enclosure protection is not provided until the screws have been tightened.

CAUTION

Incorrect assembly

Impairment of protection provided by the enclosure (protection may be compromised)!

- ▷ Cover unused M12 sockets of the M12 module with a cap (included in the scope of supply).

Connecting the field bus module

Observe the following when connecting the field bus module:

- Before the bus connection is established among the nodes, potential equalisation must have been implemented and checked.
- To ensure high-frequency shielding, use suitable, shielded cables for the respective field bus and install them in accordance with EMC requirements.
- A minimum distance of 0.3 metres is recommended between such cables and other electric conductors.
- Do not use the bus cable to make any further connections in addition to the field bus module (for example, 230 V alert and 24 V start).

CAUTION

Incorrect installation

Damage to the field bus module!

▷ Never supply the field bus module with voltage using the M12 connector or the M12 socket.

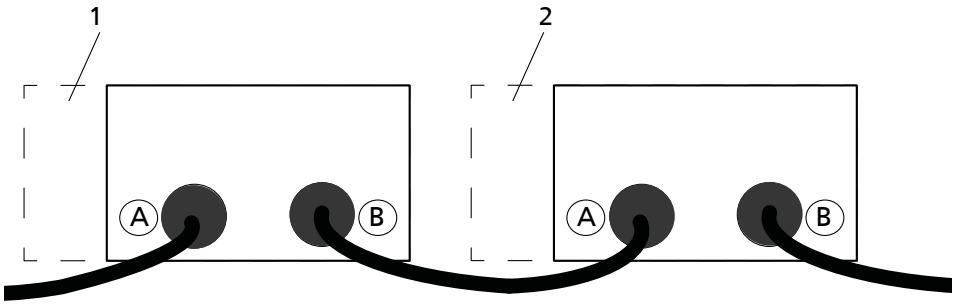

Fig. 44: Connecting the field bus module

Table 22: Connecting the field bus module

Item	Design	M12 connector
1	Frequency inverter 1	M12 connector A: Coming M12 socket B: Going
2	Frequency inverter 2	M12 connector A: Coming M12 socket B: Going

Field bus control must be activated in the frequency inverter when using the field bus module (⇨ Section 7.12, Page 149) .

NOTE

The frequency inverter is reset when a field bus module is replaced or retrofitted. Menu 3-12 for setting the parameters of the field bus module is then enabled.

5.5.3.7 Installing and connecting the I/O extension board

Additional inputs and outputs are made available by the I/O extension board:

- 1 analog input/PT1000
- 1 analog output
- 3 digital inputs
- 2 digital outputs
- 1 changeover contact relay
- 5 NO contact relays

The I/O extension board can be pre-installed at the factory or retrofitted as an accessory.

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Installing the I/O extension board

Fig. 45: C-shaped housing cover

1. Remove C-shaped housing cover. (⇨ Section 5.5.3.1, Page 32)

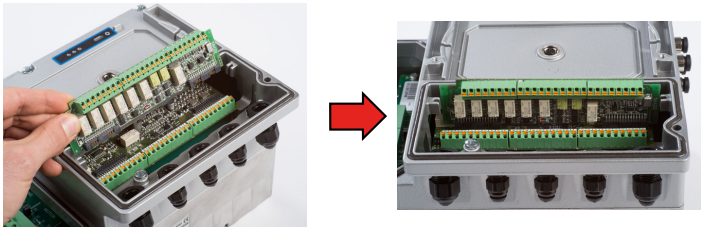

Fig. 46: Installing the I/O extension board

2. Connect the I/O extension board to the control PCB via the guide rails on the housing.
3. Connect the control cables (⇨ Section 5.5.3.9, Page 52) .
4. Reconnect the C-shaped housing cover.

5.5.3.8 Installing the Bluetooth module

The Bluetooth module is required for communication with the app. The Bluetooth module can be pre-installed at the factory or retrofitted as an accessory.

Fig. 47: C-shaped housing cover

1. Remove C-shaped housing cover. (⇨ Section 5.5.3.1, Page 32)

Fig. 48: Open graphical control panel

2. Remove graphical control panel and loosen 4 screws on back of panel.

Fig. 49: Installing the Bluetooth module

Fig. 50: Securing the Bluetooth module

3. Use the screws provided to screw the Bluetooth module onto 2 graphical control panel domes and connect the accompanying power cable to the power supply.
4. Close graphical control panel using 4 screws.
5. Position the graphical control panel and screw on the C-shaped housing cover.

⇨ Once the Bluetooth module is installed, it is displayed on the graphical control panel with an icon. (⇨ Section 6.1.1, Page 59)

5.5.3.9 Connecting the control cable

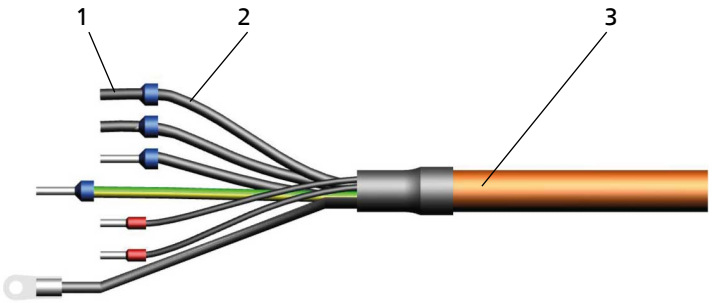

Fig. 51: Structure of electric cable

1	Wire end sleeve
2	Core
3	Cable

Table 23: Cable cross-sections of control terminals

Control terminal	Core cross-section			Cable diameter[19)]
	Rigid cores	Flexible cores	Flexible cores with wire end sleeves	
	[mm²]			[mm]
Terminal strip A, B, C	0,2 - 1,5	0,2 - 1,0	0,25 - 0,75	**M12**: 3,5 - 7,0 **M16**: 5,0 - 10,0

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19 Impairment of protection provided by enclosure when cable diameters other than those specified are used.

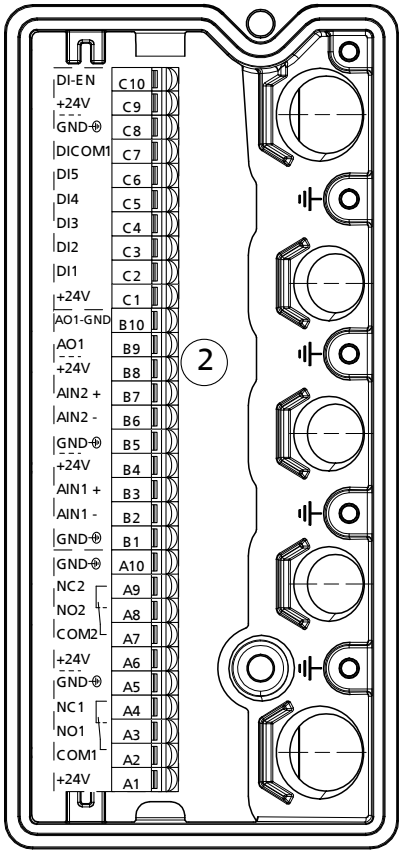
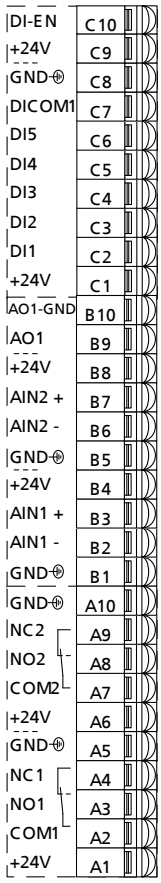


Fig. 52: Control terminals

Table 24: Control terminal assignment

Terminal strip	Terminal	Signal	Description
	C10	DI-EN	Digital enable input
	C9	+24 V	+24 V DC voltage source
	C8	GND	Ground
	C7	DICOM1	Ground for digital inputs
	C6	DI5	Digital input 5
	C5	DI4	Digital input 4
	C4	DI3	Digital input 3
	C3	DI2	Digital input 2
	C2	DI1	Digital input 1
	C1	+24 V	+24 V DC voltage source
	B10	AO1-GND	Ground for AN-OUT
	B9	AO1	Analog current output
	B8	+24 V	+24 V DC voltage source
	B7	AIN2 +	Differential analog input HI
	B6	AIN2 -	Differential analog input LO
	B5	GND	Ground
	B4	+24 V	+24 V DC voltage source
	B3	AIN1 +	Differential analog input HI
	B2	AIN1 -	Differential analog input LO
	B1	GND	Ground
	A10	GND	Ground
	A9	NC2	Relay, NC contact, "NC" No. 2
	A8	NO2	Relay, NO contact, "NO" No. 2
	A7	COM2	Relay, reference "COM" No. 2
	A6	+24 V	+24 V DC voltage source
	A5	GND	Ground
	A4	NC1	Relay, NC contact, "NC" No. 1
	A3	NO1	Relay, NO contact, "NO" No. 1
	A2	COM1	Relay, reference "COM" No. 1
	A1	+24 V	+24 V DC voltage source

Digital inputs

- The frequency inverter is equipped with 6 digital inputs.
- Digital input DI-EN is permanently programmed and is used to enable the hardware.
- The functions of digital inputs DI1 to DI5 can be parameterised as required.

The digital inputs are electrically isolated. The DICOM1 reference ground for the digital inputs is thus also electrically isolated. If the internal 24 V source is used, the internal GND must also be connected to the electrically isolated DICOM1 ground of the digital inputs. A wire jumper can be used between GND and DICOM1 for this purpose.

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	**CAUTION** **Differences in potential** Damage to the frequency inverter! ▷ Never connect an external +24 V DC voltage source to a digital input.

Analog outputs

- The frequency inverter is equipped with an analog output whose output value can be parameterised via the control panel.
- Analog signals to a higher-level control station must be electrically isolated when they are transmitted, for example by using isolating amplifiers.

Relay outputs

- The function of the two volt-free relays (NO/NC) can be parameterised via the control panel.

Analog inputs

- Analog signals from a higher-level control station must be electrically isolated when they are transmitted to the frequency inverter, for example by using isolating amplifiers.
- If the sensor signal from a higher-level control system or a PLC is transmitted to the frequency inverter, the reference signal (e.g. sensor GND) should also be carried in the same line. The sensor and reference signals can then be optimally connected to the differential inputs of the frequency inverter.
- If an external voltage or current source is used for the analog inputs, the ground of the setpoint or sensor sources is applied to terminal B1 or B5.
- The +24 V DC voltage source (terminal B4 or B8) serves as a power supply for the sensors connected to the analog inputs.
- The two differential analog inputs are connected as follows:
  - The sensor signal is connected to AIN1+ (terminal B3) or AIN2+ (terminal B7).
  - The reference signal (0 V of sensor) is connected to AIN1- (terminal B2) or AIN2- (terminal B6).

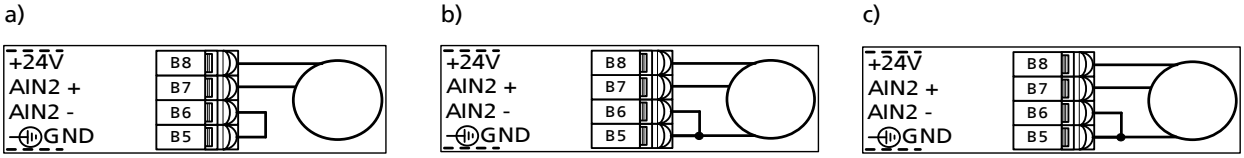
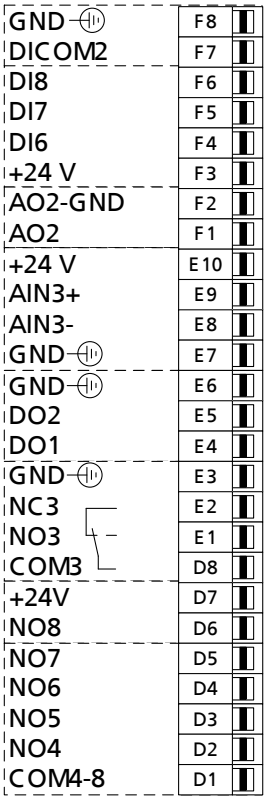


Fig. 53: Connecting sensors to the differential analog input

a)	Current sensor Output signal: 0/4 - 20 mA 2-wire
b)	Current sensor Output signal: 0/4 - 20 mA 3-wire
c)	Voltage sensor Output signal: 0/2 - 10 V 3-wire

Table 25: Control terminal assignment, I/O extension board

Terminal strip	Terminal	Signal	Description
	F8	GND	Ground
	F7	DICOM2	Ground for digital inputs
	F6	DI8	Digital input 8
	F5	DI7	Digital input 7
	F4	DI6	Digital input 6
	F3	+24 V	+24 V DC voltage source
	F2	AO2-GND	Ground for AN-OUT
	F1	AO2	Analog current/voltage output
	E10	+24 V	+24 V DC voltage source
	E9	AIN3+	Differential analog input HI
	E8	AIN3-	Differential analog input LO
	E7	GND	Ground
	E6	GND	Ground
	E5	DO2	Digital output 2
	E4	DO1	Digital output 1
	E3	GND	Ground
	E2	NC3	Relay, NC contact, "NC" No. 3
	E1	NO3	Relay, NO contact, "NO" No. 3
	D8	COM3	Relay, reference "COM" No. 3
	D7	+24 V	+24 V DC voltage source
	D6	NO8	Relay, NO contact, "NO" No. 8
	D5	NO7	Relay, NO contact, "NO" No. 7
	D4	NO6	Relay, NO contact, "NO" No. 6
	D3	NO5	Relay, NO contact, "NO" No. 5
	D2	NO4	Relay, NO contact, "NO" No. 4
	D1	COM4-8	Relay, reference "COM" No. 4-8

Digital inputs

- Three (3) digital inputs are available on the I/O extension board.
- The functions of digital inputs DI6 to DI8 can be parameterised as required.

The digital inputs are electrically isolated. The DICOM1 reference ground for the digital inputs is thus also electrically isolated. If the internal 24 V source is used, the internal GND must also be connected to the electrically isolated DICOM2 ground of the digital inputs. A wire jumper can be used between GND and DICOM2 for this purpose.

	**CAUTION** **Differences in potential** Damage to the frequency inverter! ▷ Never connect an external +24 V DC voltage source to a digital input.

Analog outputs

- The I/O extension board is equipped with an analog output whose output variable can be parameterised via the control panel.
- Analog signals to a higher-level control station must be electrically isolated when they are transmitted, for example by using isolating amplifiers.

Relay outputs

- The I/O extension board has one volt-free (NO/NC) relay and five volt-free (NO) relays.
- The function of the relays can be parameterised via the control panel.

Analog inputs

- Analog signals from a higher-level control station must be electrically isolated when they are transmitted to the frequency inverter, for example by using isolating amplifiers.
- If an external voltage or current source is used for the analog inputs, the ground of the setpoint or sensor sources is applied to terminal E7.
- The +24 V DC voltage source (terminal E10) serves as a power supply for the sensors connected to the analog inputs.
- The two differential analog inputs are connected as follows:
  - The sensor signal is connected to AIN3+ (terminal E9).
  - The reference signal (0 V of sensor) is connected to AIN3- (terminal E8).

5.5.3.10 Connecting the control panel

	**CAUTION** **Electrostatic charging** Damage to the electronics! ▷ Personnel must ensure that they are free of electrostatic charges before the control panel is opened (in the event that the wireless module is retrofitted).

Mounting the graphical control panel to the frequency inverter

The graphical control panel is connected via an M12 plug-type connector and affixed using a C-shaped cover.

1. Undo the screws on the C-shaped housing cover. Remove the graphical control panel.
2. Position the graphical control panel and screw on the C-shaped housing cover.

Changing the installation position of the control panel

Table 26: Possible installation positions for the control panel

Standard	Rotated 180°
	

The graphical control panel can be rotated 180 degrees if required. The pin assignment of the M12 connector accommodates both installation positions.

Mounting the graphical control panel separately from the frequency inverter

CAUTION

Incorrect pin assignment

Damage to the frequency inverter and/or control panel!

▹ Assign pins as described in the operating manual.

The control panel can also be mounted separately from the frequency inverter, such as on a wall. (⇨ Section 11.2.4, Page 232) . When connecting the M12 connection cable between the control panel and frequency inverter, ensure that the correct connection (pin assignment) is made. The connector is not protected against reverse polarity.

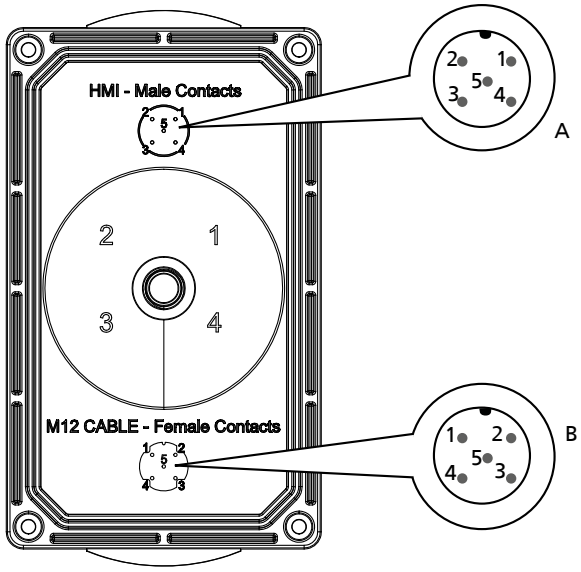


Fig. 54: Pin assignment for M12 connection cable and control panel

Conductor colour coding to EN 50044			
1	Brown	2	White
3	Blue	4	Black
5	Grey		
A	Standard assignment for device connectors/cable connectors (as viewed looking at the mating face)		
B	Standard assignment for device socket/cable socket (as viewed looking at the mating face)		

NOTE

If the control panel is removed during operation and at the same time, the power supply to the DI EN is severed at the internal 24 V supply line, the frequency inverter is deactivated.

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6 Operation

6.1 Graphical control panel

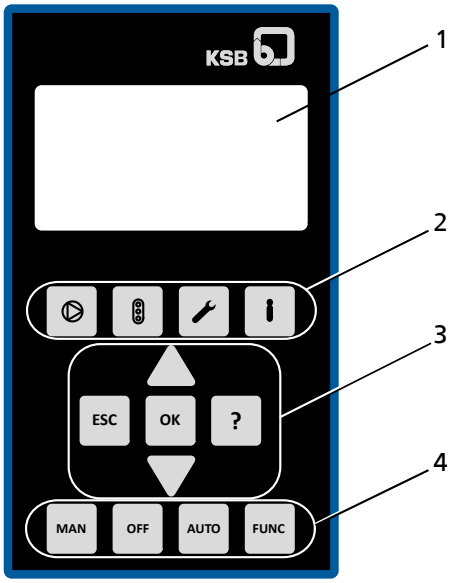

Fig. 55: Graphical control panel

Table 27: Description of graphical control panel

Position	Description	Function
1	Graphical display	Displays information on frequency inverter operation
2	Menu keys	Accessing the elements of the first menu level (Operation, Diagnosis, Settings and Information)
3	Navigation keys	Navigation and parameter setting
4	Operating keys	Toggling operating modes

6.1.1 Graphical display

The main screen breaks down into 6 areas.

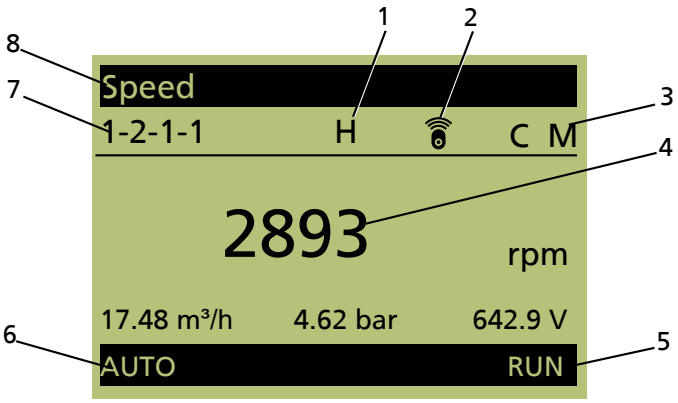

Fig. 56: Main screen (example)

1	Motor standstill heater is switched on
2	The wireless icon illuminates when the Bluetooth module is inserted. The wireless icon flashes when communication takes place.
3	Display of the master and login level
4	Display of up to four (4) operating values: One operating value is displayed in large format. Three (3) operating values are displayed in small format. The operating values scroll through cyclically.

5	Display of operating status
6	Display of the current operating mode
7	Parameter number of the operating value displayed in the centre
8	Name of the operating value displayed in the centre

Table 28: Assignment of keys

Key	Function
	Operation menu key
	Diagnosis menu key
	Settings menu key
	Information menu key
	Arrow keys: ▪ Move up/down in the menu options. ▪ Increase/decrease the value displayed when you are entering numerals. (When an arrow key is pressed and held down, the response repeats in ever shorter intervals.)
ESC	**Escape key:** ▪ Delete/reset entry (the entry is not saved). ▪ Move up one menu level.
OK	**OK key:** ▪ Confirm settings. ▪ Confirm menu selection. ▪ Move to the next digit when entering numerals. ▪ Message display: Acknowledge alert. ▪ Measured value display: Go to Favourites menu.
?	**Help key:** ▪ Displays a help text for each selected menu option.
MAN	MAN operating key: ▪ Starts the frequency inverter in manual operating mode.
OFF	OFF operating key: ▪ Stops the frequency inverter.
AUTO	AUTO operating key: ▪ Switches to automatic operating mode.
FUNC	FUNC operating key: ▪ Parameterisable function key

Manual mode via control panel

NOTE

After a power failure, the frequency inverter reverts to the OFF operating mode. Manual mode must be restarted.

Table 29: Assignment of keys for manual mode

Key	Function
MAN	MAN operating key: ▪ When switching the operating mode from AUTO to MAN, the current operating speed is used as control value (Manual) *1-3-4* and is displayed accordingly. The control point *3-6-2* must be set to Local. ▪ When switching the operating mode from OFF to MAN, the frequency inverter operates at minimum speed. The control point *3-6-2* must be set to Local. ▪ If the control value (Manual) *1-3-4* is defined via an analog input, the analog input speed is accepted. (⇨ Section 7.2, Page 69)
▲ ▼	**Arrow keys:** ▪ Pressing the arrow keys changes and immediately accepts the control value (Manual) *1-3-4*. Making a change using the arrow key has a direct effect even when not confirmed with OK. The speed can only be changed between the set minimum speed and the maximum speed.
ESC OK	**ESC/OK key:** ▪ Press the OK or ESC key to go from digit to digit. Press the ESC key to go back. Changes are rejected. Pressing the OK key for the right-hand digit takes you back to the main screen.

6.1.2 Menu keys

The menu keys allow you to directly access the first menu level (Operation 1-x-x-x, Diagnosis 2-x-x-x, Settings 3-x-x-x, and Information 4-x-x-x).

The parameter numbers contain the navigation path, which helps you find a particular parameter quickly and easily. The first digit of the parameter number indicates the first menu level, which is called up directly via the four menu keys.

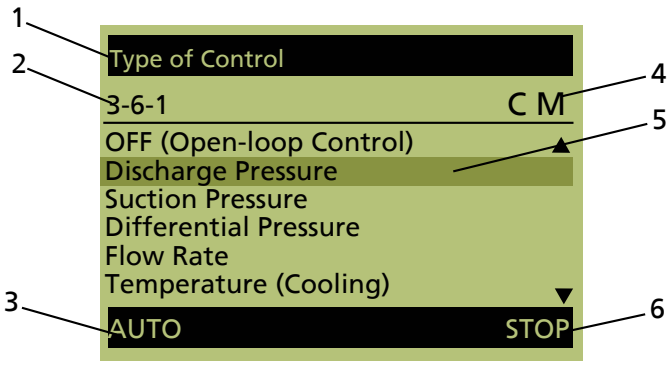

Fig. 57: Menu display

1	Name of current menu/parameter
2	Parameter number of parameter selected in selection list
3	Display of the current operating mode
4	Display of the master and login level
5	Parameter/submenu selection list
6	Display of operating status

6.1.2.1 Menu: Operation

The Operation section contains all information required for operating the machine and the process. This includes:

- Login to device with password
- Operating and measured values for motor, frequency inverter, pump and system
- Setpoints and control values
- Energy meter and operating hours

6.1.2.1.1 Access levels

Three access levels have been defined to prevent unintentional or unauthorised access to frequency inverter parameters:

Table 30: Access levels

Access level	Description
Standard (No Login)	Access without password entry.
Customer	Access level for the expert user with access to all parameters required for commissioning
Customer service	Access level for service personnel.

If a parameter's access level is not explicitly specified, the parameter is always assigned the customer access level.

Table 31: Access level parameters

Parameter	Description	Possible settings	Factory setting
1-1-1	Customer Login *Log in as customer*	0000...9999	0000
1-1-2	Service Login *Log in for access to special parameters for KSB Service*	0000...9999	-
1-1-4	Logout *Log out of all access levels*	Run	-

NOTE

If no keys are pressed for ten minutes, the system will automatically return to the standard access level.

The password can be changed after entering the factory default password.

Table 32: Parameters for changing passwords

Parameter	Description	Possible settings	Factory setting
1-1-5	Customer Access ID *Changing the customer access ID*	0000...9999	-
1-1-6	Service Access ID *Changing the service access ID*	0000...9999	-

6.1.2.1.2 Operating values for input and output signals

The status of the digital inputs/relay outputs is displayed via the Digital Inputs (*1-2-4-6*) and Digital Outputs (*1-2-4-7*) parameters.

Table 33: Example of status of digital inputs (1-2-4-6). 24 V is applied to digital input 1: System Start

	Optional IO card			Standard				
Digital input	DI8	DI7	DI6	DI5	DI4	DI3	DI2	DI1
Bit pattern on display	0	0	0	0	0	0	0	I

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Table 34: Example of status of digital outputs (1-2-4-7). The following is reported via relay output 1: General fault message (configurable)

	Optional IO card								Standard	
Digital output	R8	R7	R6	R5	R4	R3	DO2	D01	R2	R1
Bit pattern on display	0	0	0	0	0	0	0	0	0	I

6.1.2.2 Menu: Diagnosis

In the Diagnosis section, the user is provided with information about faults and warning messages that pertain to the pump set or process. The frequency inverter can be in fault (standstill) or warning (operational) status. The user can also find previous messages in the history.

Messages

All monitoring and protective functions trigger warnings or alerts. These are signalled via the amber or red LED of the LED traffic light function.

A corresponding message is output on the control panel display. If more than one message is output, the last one is displayed. Alerts have priority over warnings.

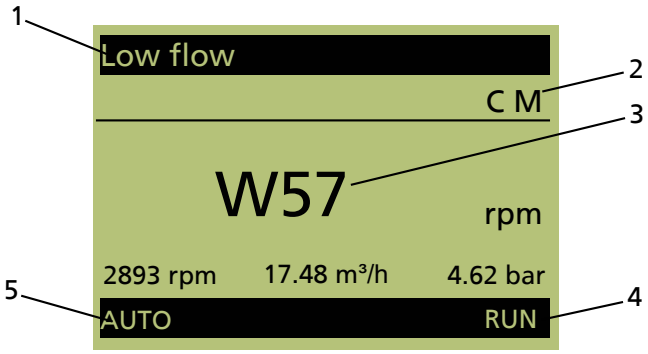

Fig. 58: Message display

1	Name of the message displayed in the centre
2	Display of the master and login level
3	Display of the message: The most recently received message is displayed in large format on the main screen. Three operating values are displayed in small format.
4	Display of operating status
5	Displays the current operating mode

Pending messages If a message has occurred and been acknowledged but has not gone, this message will be listed in the Pending Messages menu. All current messages can be displayed in the Diagnosis menu under Pending Messages (*2-1*). Active warnings and alerts can also be connected to the relay outputs.

Message history Only messages that have come, been acknowledged, and gone are listed in the message history. The message history can be viewed by selecting the Message History parameter *2-2*. The last 100 messages are listed here. You can use the arrow keys and the OK key to select an entry from the list.

Acknowledging and resetting messages

NOTE

Depending on the combination of settings, the frequency inverter could conceivably restart automatically after acknowledgement/reset or when the cause of the malfunction or fault has been eliminated.

Acknowledgement Messages can be acknowledged once the cause has been rectified. Messages can be acknowledged individually in the Diagnosis menu. A message can also be acknowledged via a digital input. Digital input 2 is defaulted for this purpose.

Overview of warnings and alerts (⇨ Section 10, Page 222)

Messages can be acknowledged as follows:

Table 35: Acknowledgement types for messages

Property of message	Type of acknowledgement
Self-acknowledging	Message is automatically acknowledged if condition for message no longer applies.
Automatic acknowledgement (configurable)	Users can choose between automatic acknowledgement and manual acknowledgement.
Partially automatic acknowledgement	Alerts that are partially acknowledged automatically carry out automatic acknowledgement in increasingly large intervals after the alert condition no longer applies. If the alert occurs repeatedly within a specific time window, automatic acknowledgement is suspended. As soon as the alarm condition of a pending alert no longer exists, the time interval is started. When this interval expires, automatic acknowledgement takes place. If the alert occurs again within 30 seconds after the time interval has started, the interval is extended by one increment. Should this not be the case, the previous (shorter) time interval is reverted to and corresponding action is taken again in 30 seconds. The time intervals are 1 second, 5 seconds, 20 seconds, and endless (i.e. manual acknowledgement is required). When the 20-second interval is extended, automatic acknowledgement no longer takes place.
No automatic acknowledgement	Must be acknowledged manually.

Time stamp If a message is not acknowledged and its condition comes and goes several times in this time window, the first occurrence of the message is always used for the Message Come time stamp. The Message Condition Gone time stamp, however, always shows the last time the message condition was no longer active.

6.1.2.3 Menu: Settings

General settings can be made or the settings for the process optimised in the Settings section.

6.1.2.3.1 Setting the display language

The display ships from the factory with support for 4 languages (language package). A language package can be changed using the KSB ServiceTool:

Table 36: Parameters for display language

Parameter	Description	Possible settings	Factory setting
3-1-1	Language *Configurable display language*	Depending on the language package: ▪ English, German, French, Italian ▪ English, French, Dutch, Danish ▪ English, Spanish, Portuguese, Turkish ▪ English, Norwegian, Swedish, Finnish ▪ English, Estonian, Latvian, Lithuanian ▪ English, Polish, Hungarian, Czech ▪ English, Slovenian, Slovakian, Croatian ▪ English, Russian, Romanian, Serbian	English, German, French, Italian

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6.1.2.3.2 Setting the control panel

Table 37: Parameters for setting the control panel

Parameter	Description	Possible settings	Factory setting
3-1-2-1	Operating Values on Main Screen *Display of current operating values on the main screen*	Main screen selection list	-
3-1-2-2	Control Keys Require Login *Direct access to the MAN, OFF, AUTO and FUNC operating keys can be disabled via this parameter.*	▪ OFF ▪ ON	OFF
3-1-2-3	Function Key Assignment *Assigning a freely selectable function to the FUNC key*	▪ No Function ▪ System Start / Stop ▪ Setpoint Changeover (Controller) ▪ Control Value Changeover (Actuator) ▪ Immediate Pump Changeover ▪ Immediate Functional Check Run ▪ Language ▪ Remote / Local Control Point	Language
3-1-2-4	Display Contrast *Configurable contrast for the display*	0...100	50
3-1-2-5	Display Backlight *Configuring the display backlight*	▪ OFF ▪ ON ▪ Automatic	Automatic
3-1-2-6	Display Backlight Duration *Duration of display backlight on period in automatic mode*	0 - 600	30

Operating Values on Main Screen

Up to 4 operating values are simultaneously displayed on the main screen. An operating value is displayed in large format with the associated parameter name, parameter number and unit. Three (3) operating values are displayed in smaller format with the associated unit. The arrow keys can be used to cycle through the operating values. Each operating value passes through all display areas. Up to 10 operating values can be selected from the predefined list for the display. The sequence of the selection list determines the sequence of the operating values on the main screen. If more than 4 parameters are selected, the hidden parameters are also cycled through in the background.

Selecting operating values for the main screen

1. Open parameter *3-1-2-1* in the Settings menu.
2. Using the arrow keys, select the operating value to be displayed from the list.
3. Press OK key.
4. Select additional, required operating values from the list and confirm by pressing the OK key.

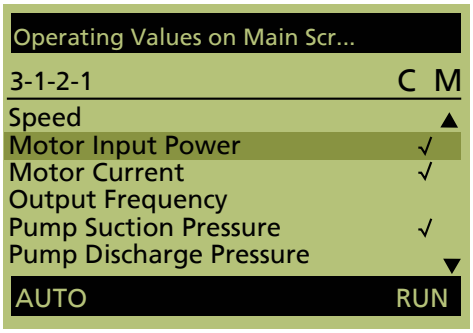

Fig. 59: Selecting multiple parameters from the selection list

Locking operating keys The operating keys of the control panel can be locked via the *3-1-2-2* parameter to prevent unauthorised operation or unauthorised acknowledgement of alerts.

Function key assignment The FUNC operating key can be preassigned a function from a selection list.

NOTE

When the FUNC operating key is used in the System Start / Stop role, the system must be restarted via the **FUNC** operating key every time the voltage is reset.

Favourites menu Press the OK key on the main screen to call up the favourites menu, where you can select various parameters and quickly adapt their configuration settings.

6.1.2.4 Menu: Information

All direct information about the frequency inverter is provided in the Information section. Important details regarding the firmware version are listed here.

6.1.3 Service interface and LED traffic light function

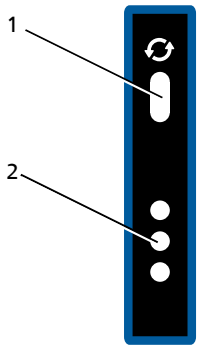

Fig. 60: Service interface and traffic light LEDs

Item	Description	Function
1	Service interface	Optical interface
2	LED traffic light function	The traffic light function provides information about the system's operating status.

Service interface The service interface allows a PC/notebook to be connected via a special cable (USB – optical).

The following action can be taken:

- Configuring and parameterising the frequency inverter with the service software
- Software update
- Saving and documenting set parameters

LED traffic light function The LED traffic light function provides information about the current operating status of the frequency inverter.

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Table 38: LED description

LED	Description
Red	One or more than one alert is active
Amber	One or more than one warning is active
Green	Steady light: Trouble-free operation

7 Commissioning/Shutdown

Ensure that the following requirements are met prior to commissioning:

- The pump has been vented and primed with the fluid to be handled.
- Flow through the pump is in the design direction specified in order to avoid generator operation of the frequency inverter.
- A sudden start-up of the motor or pump set does not result in personal injury or damage to machinery.
- No capacitive loads, for example for reactive current compensation, are connected to the outputs of the device.
- The mains voltage is in the range approved for the frequency inverter.
- The frequency inverter has been properly connected to the power supply (⇨ Section 5.5, Page 26) .
- All enable and start commands that can start the frequency inverter are deactivated (refer to digital inputs, DI-EN Digital Enable Input and DI1 System Start).
- No voltage is applied to the power supply module of the frequency inverter.
- The frequency inverter and/or the pump set must not be loaded above the permissible nominal power.
- The flow rate estimation function activated at the factory is required for many pump-related functions such as starting and stopping pumps. It is therefore recommended that the flow rate estimation function be left on.

7.1 Commissioning wizard

The commissioning wizard guides you through the most important commissioning parameters such as the motor parameters and parameters for basic applications including open-loop control mode, discharge pressure control, and differential pressure control.

After the frequency inverter has been switched on for the first time, the commissioning staff sets the language to be used on the control panel.

The system then prompts the operator to start the commissioning wizard. The commissioning wizard guides the operator through the following settings:

- Setting of date and time
- Entry of motor data
- Selection of the application:
  - Open-loop control mode
  - Discharge pressure control
  - Differential pressure control

The individual parameters can then be set for the individual applications. Press the OK key to confirm the entry and the ESC key to cancel it.

Commissioning wizard

The commissioning wizard can be restarted by the Commissioning Wizard parameter *(3-1-5)*. In a first step, the default factory settings are reloaded. All the relevant application parameters must be configured again using the commissioning wizard.

Multiple pump configuration

After a pump system is started for the first time, a detection routine is started to determine whether the system is a multiple pump system. For specific parameters such as "Role in Multiple Pump System", the relevant data must be entered separately at each frequency inverter in the system. The commissioning wizard is therefore called up at every frequency inverter when the system is started for the first time.

If a multiple pump system is identified, the user is prompted to specify the corresponding parameters after having entered the motor data.

If the commissioning wizard is later started again via parameter *3-1-5*, it is only run at the frequency inverter where the start was initiated.

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7.2 Control point concept

Possible control points are:

- Control panel
- Digital inputs / analog inputs
- Field buses
- Wireless remote control
- KSB ServiceTool

These control points are grouped into three categories:

- Based on one-off event: control unit, radio remote control, KSB ServiceTool
- Based on cyclic events: field buses
- Based on permanent/continuous state: digital inputs / analog inputs

The following control functions can be realised via a control point:

- System Start / Stop
- Setpoint in closed-loop control mode, also alternative setpoint
- Control value in open-loop control mode, also alternative control value
- Control value in manual mode
- Toggling individual frequency inverters between Manual, OFF and Automatic
- Toggling between normal and alternative setpoint/control value

The Control Point parameter *(3-6-2)* only distinguishes between field bus and local operation (control panel, radio remote control or ServiceTool).

Digital and analog inputs

Digital and analog inputs are treated in a special manner:
A digital or analog input can be configured for each of the control functions mentioned. Digital and analog inputs have the highest priority. For this type of control, all other control points (e.g. control panel) are disabled, even if the control function is configured for a field bus. When the control point is changed, the values last set remain intact until they are also changed.

Specifications for digital and analog inputs are defined at the active master control device (= master). Exceptions are fixed speeds, as well as the Digital Potentiometer Manual and OFF parameter options, which only apply to the respective control function.

7.3 Setting motor parameters

The motor parameters are typically preset at the factory. The factory default motor parameters must be compared with the data provided on the motor name plate and adjusted, if required.

NOTE

Motor parameters cannot be changed while the motor is in operation.

NOTE

If the motor parameters are changed, the Automatic Motor Adaptation function must be subsequently called up in conjunction with the vector control method (Motor Control Method parameter *3-3-1*).

Table 39: Motor parameters

Parameter	Description	Possible settings	Factory setting
3-2-1-1	Nominal Motor Power *Nominal power of motor as per name plate*	0,00…110,00 kW	Dependent on size
3-2-1-2	Nominal Motor Voltage *Nominal voltage of motor as per name plate*	230 - 460 V	Dependent on size

Parameter	Description	Possible settings	Factory setting
3-2-1-3	Nominal Motor Frequency *Nominal frequency of motor as per name plate*	0,0…200,0 Hz	Motor-specific
3-2-1-4	Nominal Motor Current *Nominal current of motor as per name plate*	0,00…150,00 A	Dependent on size
3-2-1-5	Nominal Motor Speed *Nominal speed of motor as per name plate*	0…4200 rpm	Motor-specific
3-2-1-6	Nominal Cos Phi Value *Cos phi of motor at nominal power*	0,00…1,00	Motor-specific
3-2-2-1	Minimum Motor Speed *Minimum Motor Speed*	0…4200 rpm	Motor-specific
3-2-2-2	Maximum Motor Speed *Maximum Motor Speed*	0…4200 rpm	Motor-specific
3-2-3-1	PTC Analysis *Motor temperature monitoring*	▪ OFF ▪ ON	Motor-specific
3-2-3-2	Thermal Motor Protection Behaviour *Behaviour for detection of excessive motor temperature*	▪ Non-self-acknowledging ▪ Self-acknowledging	Non-self-acknowledging
3-2-4-1	Motor Direction of Rotation *Setting the direction of rotation of the motor with respect to the motor shaft*	▪ Clockwise ▪ Anti-clockwise	Dependent on pump

7.4 Motor control method

The frequency inverter gives you a choice of several motor control methods:

- Vector control method for the KSB SuPremE motor
- Vector control method for the asynchronous motor
- V/f control method for the asynchronous motor

The V/f control method can be selected for basic applications. For more complex applications, the vector control method can be used, which offers considerably higher speed and torque accuracy than the V/f control method. The motor control method can be set using the Motor Control Method parameter *(3-3-1)*.

Table 40: Parameters for control method

Parameter	Description	Possible settings	Factory setting
3-3-1	Motor Control Method *Selecting the control method*	▪ SuPremE Vector Control ▪ Asynchronous Motor Vector Control ▪ Asynchronous Motor V/f Control	Motor-specific

Vector control method

No additional settings or adjustments are required for vector control methods. The extended motor data required for the vector control method is determined by automatic motor adaptation.

V/f control method

If the V/f control method is selected using the Motor Control Method parameter *(3-3-1)*, it may be necessary to adapt the preset V/f characteristic *(3-3-2)*, depending on the application scenario.

By changing the V/f characteristic in accordance with the pump characteristic, the motor current can be adjusted in line with the required load torque (squared load torque). By default, the frequency inverter is set to a linear V/f characteristic.

By increasing the first voltage data point V_0 (boost voltage), a higher torque can be generated if a higher breakaway torque is required.

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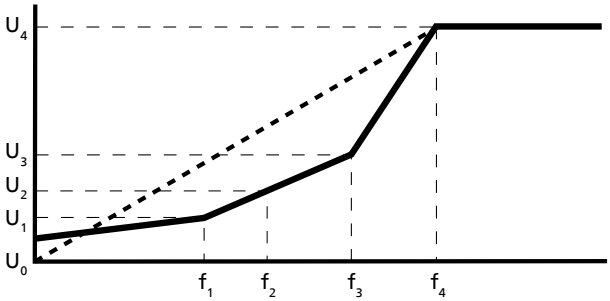

Fig. 61: V/f characteristic

Table 41: Parameters for changing the V/f characteristic

Parameter	Description	Possible settings	Refers to	Factory setting
3-3-2-1	V/f Voltage 0 *Data points for the V/f characteristic*	0,00...15,00 %	*3-2-1-2*	2
3-3-2-2	V/f Voltage 1 *Data points for the V/f characteristic*	0,0...100,00 %	*3-2-1-2*	20
3-3-2-3	V/f Frequency 1 *Data points for the V/f characteristic*	0,0...100,00 %	*3-2-1-3*	20
3-3-2-4	V/f Voltage 2 *Data points for the V/f characteristic*	0,0...100,00 %	*3-2-1-2*	40
3-3-2-5	V/f Frequency 2 *Data points for the V/f characteristic*	0,0...100,00 %	*3-2-1-3*	40
3-3-2-6	V/f Voltage 3 *Data points for the V/f characteristic*	0,0...100,00 %	*3-2-1-2*	80
3-3-2-7	V/f Frequency 3 *Data points for the V/f characteristic*	0,0...100,00 %	*3-2-1-3*	80
3-3-2-8	V/f Voltage 4 *Data points for the V/f characteristic*	0,0...100,00 %	*3-2-1-2*	100
3-3-2-9	V/f Frequency 4 *Data points for the V/f characteristic*	0,0...100,00 %	*3-2-1-3*	100

NOTE

The frequency inverter compensates for motor slip irrespective of the motor control method. The output frequency displayed *(1-2-1-7)* therefore corresponds with the value that is required to actually realise the control variable defined (e.g. 3000 rpm).

7.5 Automatic motor adaptation (AMA) of frequency inverter

Automatic motor adaptation (AMA) is a method that calculates or measures the extended electrical parameters of the motor to ensure optimum motor output and efficiency. Automatic motor adaptation is used in conjunction with the vector control methods.

NOTE

Before starting automatic motor adaptation, ensure that the motor name plate data was parameterised correctly.

NOTE

Automatic motor adaptation can only be started from the Auto Stop state. For this purpose, the frequency inverter must be in automatic mode and the System Start / Stop parameter *(1-3-1)* must be set to Stop.

NOTE

Carry out AMA only when the motor is cold to adapt the frequency inverter.
If standard AMA and extended AMA are used in conjunction with long motor connection cables, measurement errors can occur when identifying the extended motor data. This, in turn, can prevent the motor from being operated in an optimal fashion or prevent it from being operated at all. In such scenarios, it is recommended that you use offline AMA.

Three (3) types of AMA are available to carry out automatic motor adaptation for asynchronous motors:

- **Offline calculation**:
  Using the nominal data of the motor as a basis, the extended motor data required for vector control is calculated.
- **Standard AMA**:
  The extended motor data is determined by taking a measurement with the motor being at a standstill.
- **Extended AMA**:
  The extended motor data is determined by taking a measurement with the motor running at approximately 10 percent of its nominal speed.

The extended AMA option is the most accurate method for determining the extended motor data and ensures very good control of the motor. Offline calculation is the simplest method available and is sufficient for basic applications.

7.5.1 Automatic motor adaptation (AMA) of frequency inverter for KSB SuPremE motors

Automatic motor adaptation for the KSB SuPremE motor is started using the “Start Automatic Motor Adaptation” Parameter (*3-3-4-1*). Depending on the SuPremE variant, *3-3-4-11*after starting AMA, you can select one of the above-mentioned types for automatic motor adaptation.

For the KSB SuPremE variant with magnet all of the three above-mentioned AMA types are available. For the KSB SuPremE variant without magnet only Offline Calculation and Standard AMA are available.

The drive is disabled while AMA is being carried out.

Prior to starting AMA, check the parameter *3-3-4-11*. For motors with magnets this parameter must be set to *With Magnets*.

NOTE

Carrying out standard AMA can take several minutes, depending on the size of the motor.

If the extended motor data cannot be determined using the AMA option, an AMA Fault alert is output. In this scenario, the extended motor data is not saved and AMA must be restarted.

If a different alert is output while AMA is being carried out, the AMA process is interrupted and the AMA Fault alert is output. In this scenario, the extended motor data is not saved and AMA must be restarted.

The following extended motor data (*3-3-4-2* to *3-3-4-10*) is calculated or measured depending on the AMA type selected under “Start Automatic Motor Adaptation” *(3-3-4-1)*:

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Table 42: Parameters for automatic motor adaptation for KSB SuPremE motors

Parameter	Description	Possible settings	Factory setting
3-3-4-1	Start Automatic Motor Adaptation *Function used to start automatic motor adaptation (AMA).* 1. *Offline Calculation: Using the nominal data of the motor as a basis, the extended motor data is calculated.* 2. *Standard AMA: The extended motor data is determined by taking a measurement with the motor being at a standstill.*	▪ Offline Calculation ▪ Standard AMA – Motor at standstill	Offline Calculation
3-3-4-2	Selected Motor *KSB SuPremE motor variant currently selected*	Power range of KSB SuPremE motors	Dependent on motor
Extended motor parameters for KSB SuPremE motors without magnets			
3-3-4-4	RS Stator Phase Resistance *Extended motor data: Stator phase resistance*	0.0 ... 32.000	Dependent on motor
3-3-4-5	Ld 0 inductance, d-axis *Extended motor data: q-axis inductance Iq = 0*	0.0 ... 6553.5	Dependent on motor
3-3-4-6	Id Sat current, d-axis *Extended motor data: d-axis current sat*	0.0 ... 6553.5	Dependent on motor
3-3-4-7	Lq 0 inductance, q-axis *Extended motor data: q-axis inductance Id = 0*	0.0 ... 6553.5	Dependent on motor
3-3-4-8	Iq Sat current, q-axis *Extended motor data: q-axis current sat*	0.0 ... 6553.5	Dependent on motor
3-3-4-9	L Sat inductance, d-q-axis *Extended motor data: d-q-axis inductance sat*	0.0 ... 6553.5	Dependent on motor
3-3-4-10	XCross Saturation Factor *Extended motor data: cross-saturation factor*	0.0 ... 6553.5	Dependent on motor
3-3-4-11	KSB SuPremE variant *KSB SuPremE variant with or without permanent magnets*	▪ With magnets ▪ Without magnets	Dependent on motor
Extended motor parameters for KSB SuPremE motors with magnets			
3-3-4-4	RS Stator Phase Resistance *Extended motor data: Stator phase resistance*	0.0 ... 32.000	Dependent on motor
3-3-4-12	LdPM *Extended motor data: d-axis inductance*	0.0 ... 655.35	Dependent on motor
3-3-4-13	LqPM *Extended motor data: q-axis inductance*	0.0 ... 655.35	Dependent on motor
3-3-4-14	KePM *Extended motor data: effective value of the voltage between two phases depending on the speed*	0.000 ... 65.535	Dependent on motor
3-3-4-15	Istart *Extended motor data: starting current in percent of the nominal current*	20.00 ... 100.00	Dependent on motor

7.5.2 Automatic motor adaptation (AMA) of frequency inverter for asynchronous motors

After starting AMA using the Start Automatic Motor Adaptation parameter *(3-3-3-1)*, you can select one of the above-mentioned types for automatic motor adaptation. The motor is disabled while AMA is being carried out.

NOTE

Carrying out standard AMA can take several minutes, depending on the size of the motor.

If the extended motor data cannot be determined using the AMA option, an AMA Fault alert is output. In this scenario, the extended motor data is not saved and AMA must be restarted.

If a different alert is output while AMA is being carried out, the AMA process is interrupted and the AMA Fault alert is output. In this scenario, the extended motor data is not saved and AMA must be restarted.

The following extended motor data (*3-3-3-2* to *3-3-3-5*) is calculated or measured depending on the AMA type selected under "Start Automatic Motor Adaptation" *(3-3-3-1)*:

Table 43: Parameters for automatic motor adaptation for asynchronous motors

Parameter	Description	Possible settings	Factory setting
3-3-3-1	Start Automatic Motor Adaptation *Function used to start automatic motor adaptation (AMA).* 1. *Offline Calculation: Using the nominal data of the motor as a basis, the extended motor data is calculated.* 2. *Standard AMA: The extended motor data is determined by taking a measurement with the motor being at a standstill.* 3. *Extended AMA: The extended motor data is determined by taking a measurement with the motor running at approximately 10 percent of its nominal speed.*	▪ Extended AMA – Motor Running ▪ Standard AMA – Motor at Standstill ▪ Offline Calculation	-
3-3-3-2	Rs Motor Stator Phase Resistance *Extended motor data:* *Stator phase resistance*	0,0...5000,000	Motor-specific
3-3-3-3	LS – Motor Stator Phase Inductance *Extended motor data: Stator phase inductance*	0,0 … 5000,0	Motor-specific
3-3-3-4	TR – Rotor Time Constant *Extended motor data: Rotor time constant*	0,0 … 5000,0	Motor-specific
3-3-3-5	KM Magnetisation Coefficient of Stator and Rotor *Extended motor data: The magnetisation coefficient describes the magnetic coupling between the stator and rotor of the motor.*	0,0000 … 100,000 0	Motor-specific

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7.6 Entering the setpoint

NOTE

The parameter values and value ranges/units entered are mutually dependent. This is why the first step in parameterising the frequency inverter is always to specify the applicable value range and units (refer to parameter *3-11*). If the value range or unit is subsequently changed, all dependent parameters must be checked for correctness again.

One of the control points (⇨ Section 7.2, Page 69) is used to define the setpoint and control value:

- Setpoint in closed-loop control mode
- Control value in open-loop control mode
- Control value in manual mode

NOTE

When specifying several setpoints/control values, mind the priority of the control points. (⇨ Section 7.2, Page 69)

Table 44: Specifying a setpoint/manual-mode control value via the control panel

Parameter	Description	Possible settings	Refers to	Factory setting
1-3-2	Setpoint (Closed-loop Control) *Configurable setpoint. This parameter is disabled if the setpoint is specified via DIGIN/ANIN. Otherwise, the setpoint source is selected via the Control Point parameter (Local/Field Bus).*	Minimum to maximum limit of measuring range	*3-11*	0,00
1-3-3	Control Value (Open-loop Control) *Configurable control value for speed in open-loop control mode*	Minimum to maximum speed of motor	*3-11*	*3-2-2-1*
1-3-4	Control Value (Manual) *When manual mode is activated, the current operating speed is accepted; otherwise, minimum speed is used. The speed can then be set in manual mode.*	Minimum to maximum speed of motor	*3-11*	*3-2-2-1*

System start

The system start function for starting/stopping the system in automatic mode can be specified via a digital input or the control panel.

NOTE

When using the system start via a digital input, the start option must not be simultaneously specified via the System Start / Stop parameter *(1-3-1)*, as the system start would then remain active via this parameter *(1-3-1)* when the digital input is deactivated.

Table 45: System start parameters

Parameter	Description	Possible settings	Factory setting
1-3-1	System Start / Stop *This function is used to start the system.*	▪ Start ▪ Stop	Stop
3-8-6-1	Digital Input 1 Function *Configurable function of digital input 1*	(⇨ Section 7.10.1, Page 127)	System start

Alternative control value or setpoint

If the control value or setpoint is configured at the control panel or via the analog input, an alternative control value or setpoint can be activated by way of the time or a digital input. Using this function, it is possible to define a different setpoint for the night than for the day (setback operation), for example.

NOTE

If a fixed speed is defined via digital inputs, an alternative specification for the control value/setpoint is not possible.

Table 46: Alternative control value and setpoint parameters

Parameter	Description	Possible settings	Refers to	Factory setting
1-3-9-1	Alternative Setpoint (Closed-loop Control) *Alternative configurable setpoint (can be activated via time, FUNC key or DIGIN; DIGIN has priority). This parameter is disabled if the setpoint is specified via DIGIN/ ANIN. Otherwise, the setpoint source is selected via the Control Point parameter (Local/Field Bus).*	Minimum to maximum limit of measuring range	3-11	0.00
1-3-9-2	Alternative Control Value (Open-loop Control) *Alternative configurable control value for speed in open-loop control mode*	Minimum motor speed up to Maximum motor speed	3-11	500 rpm
1-3-9-3	Start of Alternative Setpoint/ Control Value *Start of toggle from setpoint/control value to alternative setpoint/control value*	00:00…23:59	-	00:00
1-3-9-4	End of Alternative Setpoint/ Control Value *End of toggle from setpoint/control value to alternative setpoint/control value*	00:00…23:59	-	00:00
1-3-9-5	Behaviour Alternative Values *Toggling between time control or direct deactivation/activation of the alternative setpoint.*	▪ Time Control ▪ Setpoint / Control Value ▪ Alternative Setpoint/Control Value	-	Time Control

To switch from the current setpoint or control value to an alternative setpoint or control value via a digital input, the digital input must be set to Alternative Setpoint/ Control Value Active. (⇨ Section 7.10.1, Page 127) .

Toggling between the setpoint/control value and alternative setpoint/control value can take place via the control panel. To this end, set the Behaviour Alternative Values *(1-3-9-5)* parameter to Setpoint/Control Value or Alternative Setpoint/Control Value. This function can also be assigned to the FUNC key. For this purpose, the Behaviour Alternative Values *(1-3-9-5)* parameter must be set to Setpoint/Control Value or Alternative Setpoint/Control Value. This setting will deactivate time-controlled toggling.

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7.7 Pump operation

7.7.1 Single-pump operation

7.7.1.1 Open-loop control mode

Open-loop control mode is selected via the Type of Control parameter*(3-6-1)* for pumps in automatic mode (AUTO key). In open-loop control mode, the pump is operated at the specified speed. This speed is specified using the Control Value (Open-loop Control) parameter *1-3-3* (⇨ Section 7.7.1.1.2, Page 78) or via an analog input (⇨ Section 7.7.1.1.1, Page 77) .

The frequency inverter starts in automatic mode if digital input 1 is supplied with +24 V DC (terminal strip C2/C1) (⇨ Section 7.10.1, Page 127) or the system start is activated via the System Start / Stop parameter *(1-3-1)*.

7.7.1.1.1 Open-loop control mode using external standard signal

NOTE

The parameter values and value ranges/units entered are mutually dependent. This is why the first step in parameterising the frequency inverter is always to specify the applicable value range and units (refer to parameter *3-11*). If the value range or unit is subsequently changed, all dependent parameters must be checked for correctness again.

A control value can be defined in automatic mode using an external standard signal.

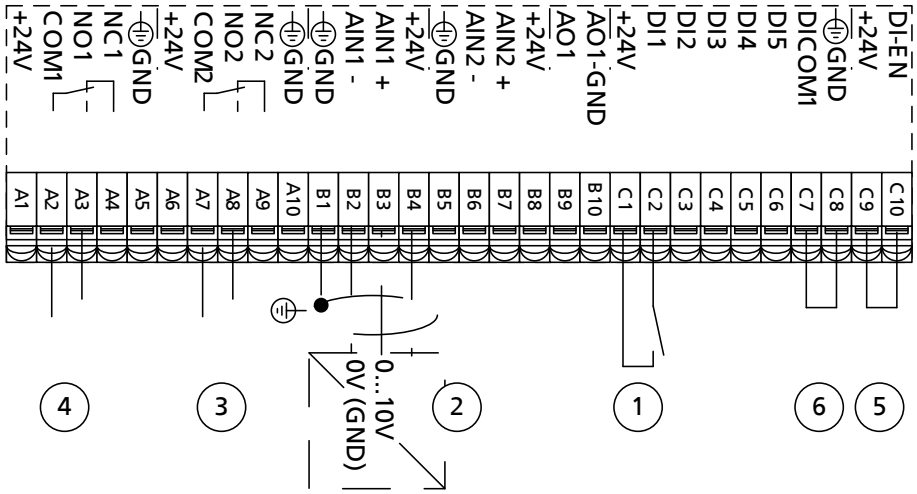

Fig. 62: Terminal wiring diagram, open-loop control mode (dashed line = optional)

1	Start / Stop
2	External setpoint signal (⇨ Section 7.6, Page 75)
3	Signal relay 2 (⇨ Section 7.10.3, Page 135)
4	Signal relay 1 (⇨ Section 7.10.3, Page 135)
5	Digital enable input
6	Ground for digital inputs

Example At analog input 1, a control value of 2000 rpm should be set via a 0 - 10 V voltage signal. 6.66 V then corresponds to a speed of 2000 rpm for a 2-pole motor. The minimum speed set is not undershot. The system start takes place via digital input 1.

Table 47: Example of open-loop control mode using external standard signal

Parameter	Description	Possible settings	Refers to	Factory setting
3-6-1	Type of Control *Selecting the control method. The controller is deactivated when OFF (Open-loop Control) is selected.*	OFF (Open-loop Control)	-	Dependent on pump
3-2-2-1	Minimum Motor Speed	500 rpm	*3-11*	500 rpm
3-2-2-2	Maximum Motor Speed	3000 rpm	*3-11*	2100 rpm
3-8-1-1	Analog Input Signal *Sensor signal at analog input 1*	0…10V	-	OFF
3-8-1-2	Analog Input 1 Function *Internal operating values cannot be used as an actual value source.*	Setpoint/Control Value (Auto)	-	OFF
3-8-1-3	Analog Input 1 Lower Limit	Minimum to maximum limit of measuring range	-	0,00
3-8-1-4	Analog Input 1 Upper Limit	Minimum to maximum limit of measuring range	-	100,00
1-3-1	System Start / Stop *This function is used to start the system.*	Stop	-	Stop

NOTE

The System Start / Stop parameter *(1-3-1)* must be set to Stop if the system start takes place via the digital input.

7.7.1.1.2 Open-loop control mode via control panel

NOTE

The parameter values and value ranges/units entered are mutually dependent. This is why the first step in parameterising the frequency inverter is always to specify the applicable value range and units (refer to parameter *3-11*). If the value range or unit is subsequently changed, all dependent parameters must be checked for correctness again.

The control value for automatic mode can be specified using the control panel. If a control value is simultaneously specified via the analog input, this value has a higher priority (⇨ Section 7.2, Page 69) .

Example A 2-pole motor is to run with a speed of 2000 rpm. To this end, a control value of 2000 rpm must be set via the control panel using the Control Value (Open-loop Control) parameter *(1-3-3)*. The system start is activated by the System Start / Stop *(1-3-1)* parameter. The frequency inverter then starts as soon as it is set to automatic or manual mode and the enable is given via DI-EN.

Table 48: Example of open-loop control mode via control panel

Parameter	Description	Possible settings	Refers to	Factory setting
3-6-1	Type of Control *Selecting the control method. The controller is deactivated when OFF (Open-loop Control) is selected.*	OFF (Open-loop Control)	-	Dependent on pump
3-2-2-1	Minimum Motor Speed	500 rpm	*3-11*	500 rpm
3-2-2-2	Maximum Motor Speed	3000 rpm	*3-11*	2100 rpm

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Parameter	Description	Possible settings	Refers to	Factory setting
1-3-1	System Start / Stop *This function is used to start the system.*	Start	-	Stop
1-3-3	Control Value (Open-loop Control) *Configurable control value for speed in open-loop control mode*	2000 rpm	-	500 rpm

7.7.1.2 Closed-loop control mode

The frequency inverter has a process controller to detect and adjust or compensate for changes in hydraulic processes. Controlled variables such as discharge pressure, differential pressure, flow rate and temperature are recorded and compared with the setpoint specified. Based on the current control deviation, a new control variable is calculated that is implemented as the new speed for the drive.

Overall structure of the process controller

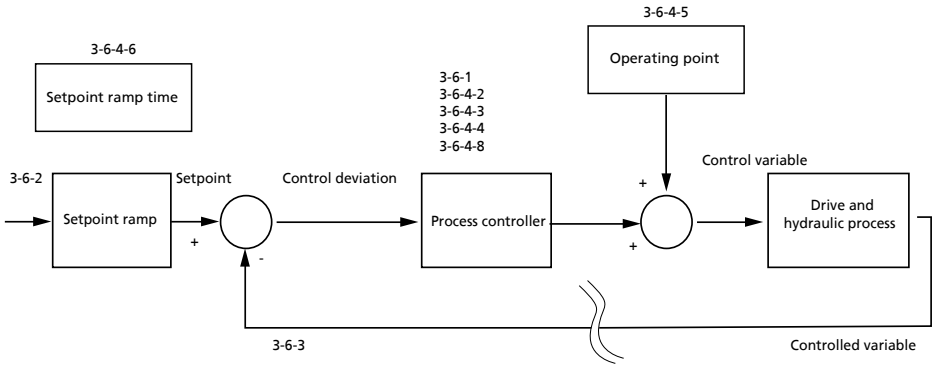

Fig. 63: Overall structure of the process controller

The hydraulic process to be controlled, influenced by the speed of the frequency inverter, represents the controlled system. The measured controlled variable, or in the case of sensorless differential pressure control, the internally calculated controlled variable, is subtracted from the setpoint to form the control deviation. The control deviation is supplied to the actual process controller. The time taken to achieve the setpoint can be prolonged via a setpoint ramp.

Selecting the type of control

To activate the process controller, the type of process to be controlled must be selected via the Type of Control parameter *(3-6-1)*. When OFF (Open-loop Control) is selected, the process controller is deactivated and the frequency inverter runs in open-loop control mode.

Table 49: Selecting the type of control

Parameter	Description	Possible settings	Factory setting
3-6-1	Type of Control *Selecting the control method. The controller is deactivated when OFF (Open-loop Control) is selected.*	▪ OFF (Open-loop Control) ▪ Discharge Pressure ▪ Suction Pressure ▪ Differential Pressure ▪ Differential Pressure (Sensorless) ▪ Flow Rate ▪ Flow Rate (Sensorless) ▪ Temperature (Cooling) ▪ Temperature (Heating) ▪ Suction-side Level ▪ Discharge-side Level	Dependent on pump

The response of the frequency inverter to a positive or negative control deviation is defined by the controller's control direction. For a normal control direction and positive control deviation, the speed is increased; for an inverted control direction and positive control deviation, the speed is decreased. The control direction of the controller is implicitly defined by the type of control selected.

Table 50: Control direction

Type of control	Control direction	Comment
Discharge pressure, differential pressure, differential pressure (sensorless), flow rate, temperature (heating), discharge-side level	Normal	Increase in speed for positive control deviation
Suction pressure, temperature (cooling), suction-side level	Inverted	Decrease in speed for positive control deviation

Setting the setpoint or control value

Parameter *(3-6-2)* is used to define the source of the setpoint for an activated process controller or the source of the control value for a deactivated process controller. When Local is selected, an analog input or the control panel may be used as the source. When Field Bus is selected, the source of the field bus device is used.
(⇨ Section 7.2, Page 69)

Changes in the setpoint are ramped along the setpoint ramp
(⇨ Section 7.8.5, Page 116) .

Setting the actual value

Parameter *(3-6-3)* is used to define the source of the actual value. When Local is selected, an analog input or the control panel may be used as the source. When Field Bus is selected, the source of the field bus device is used. (⇨ Section 7.10.2, Page 131)

Setting the process controller

NOTE

The parameter values and value ranges/units entered are mutually dependent. This is why the first step in parameterising the frequency inverter is always to specify the applicable value range and units (refer to parameter *3-11*). If the value range or unit is subsequently changed, all dependent parameters must be checked for correctness again.

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The PID process controller is set using the following parameters:
Parameter *(3-6-4-2)* defines the proportional constant of the controller. The control deviation is transferred to the control value, amplified by the proportional gain.

To avoid a permanent control deviation, an integrating controller constant is required for many hydraulic processes. For this purpose, parameter *(3-6-4-3)* is used to define the integral time of the integral constant. The control deviation is integrated over time, weighted in relation to the integral time selected and added to the control value. Reducing the integral time leads to faster adjustment or compensation for the control deviation. When an integral time of 0 s is selected, the integral constant is deactivated.

By leveraging the differential constant, the controller can respond to a quick change in the control deviation. Whether a differential constant is necessary is a function of the dynamics of the hydraulic process; for typical centrifugal pump applications, it is not required. When a rate time of 0 s is selected, the differential constant of the process controller is deactivated. The rate time of the differential constant is defined using parameter *(3-6-4-4)*. By increasing the rate time, the response to quick changes in the control deviation is intensified. The Differential Constant Limitation parameter *(3-6-4-8)* is used to define the maximum differential gain, which will help limit the effect of measurement noise on the control value. Decreasing the limitation value restricts the influence of the differential constant at high frequencies, and the influence of measurement noise can be suppressed.

Table 51: Parameters of the PID controller

Parameter	Description	Possible settings	Factory setting
3-6-4-2	Proportional Constant *Setting the proportional constant of the controller*	0,01...100,00	1,00
3-6-4-3	Integral Time (Integral Constant) *Setting the integral constant of the controller*	0,0 to 9999,9 s	0,2 s
3-6-4-4	Rate Time (Differential Constant) *Setting the differential constant of the controller*	0,00... 100,00 s	0,00 s
3-6-4-8	Differential Constant Limitation *The maximum differential gain is limited in order to suppress measurement noise, for example.*	1,00...20,00	3,00

7.7.1.2.1 Closed-loop control mode via control panel

NOTE

The parameter values and value ranges/units entered are mutually dependent. This is why the first step in parameterising the frequency inverter is always to specify the applicable value range and units (refer to parameter *3-11*). If the value range or unit is subsequently changed, all dependent parameters must be checked for correctness again.

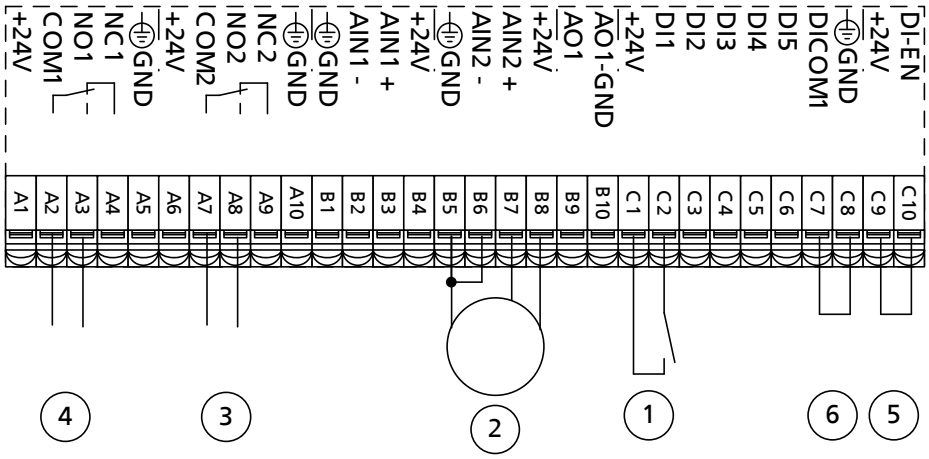

Fig. 64: Terminal wiring diagram, closed-loop control mode (dashed line = optional)

1	Start/ stop 2
2	Feedback value transmitter
3	Signal relay 2 (⇨ Section 7.10.3, Page 135)
4	Signal relay 1 (⇨ Section 7.10.3, Page 135)
5	Digital enable input
6	Ground for digital inputs

Example The frequency inverter is to control the system to achieve a setpoint of 6.7 bar in a differential pressure control process. For this purpose, a differential pressure sensor (4 - 20 mA) with a measuring range of 0 to 10 bar is connected to analog input 2 of the frequency inverter. The setpoint is specified using the control panel. The system start is activated by the System Start / Stop (1-3-1) parameter. The frequency inverter starts as soon as it is set to automatic or manual mode and the enable is given via DI-EN.

Table 52: Example of closed-loop control mode with setpoint specification via the control panel

Parameter	Description	Possible settings	Factory setting
3-6-1	Type of Control *Selecting the control method. The controller is deactivated when OFF (Open-loop Control) is selected.*	Differential Pressure	Dependent on pump
3-11-2-1	Minimum Pressure *Minimum limit of measuring range*	0,00	-1,00 bar
3-11-2-2	Maximum Pressure *Maximum limit of measuring range*	10,0	1000,0 bar
3-11-2-3	Pressure Unit *Configurable unit for pressure 1*	bar	bar
1-3-2	Setpoint (Closed-loop Control) *Configurable setpoint. This parameter is disabled if the setpoint is specified via DIGIN/ANIN. Otherwise, the setpoint source is selected via the Control Point parameter (Local/Field Bus).*	6,7 bar	0,00 bar
3-8-2-1	Analog Input 2 Signal *Sensor signal at analog input 2*	4 - 20mA	OFF

Parameter	Description	Possible settings	Factory setting
3-8-2-2	Analog Input 2 Function *Function of analog input 2. Internal operating values cannot be used as an actual value source.*	Differential Pressure	OFF
3-8-2-3	Analog Input 2 Lower Limit	0,00	0,00
3-8-2-4	Analog Input 2 Upper Limit	10,00	100,00
1-3-1	System Start / Stop *This function is used to start the system.*	Start	Stop

NOTE

The System Start / Stop parameter *(1-3-1)* must be set to Stop if the system start takes place via the digital input.

7.7.1.2.2 Closed-loop control mode with external setpoint signal

The setpoint can be specified via an external setpoint signal. If a setpoint is simultaneously specified via the control panel, the setpoint specified via the analog input has a higher priority (⇨ Section 7.2, Page 69) .

NOTE

The parameter values and value ranges/units entered are mutually dependent. This is why the first step in parameterising the frequency inverter is always to specify the applicable value range and units (refer to parameter *3-11*). If the value range or unit is subsequently changed, all dependent parameters must be checked for correctness again.

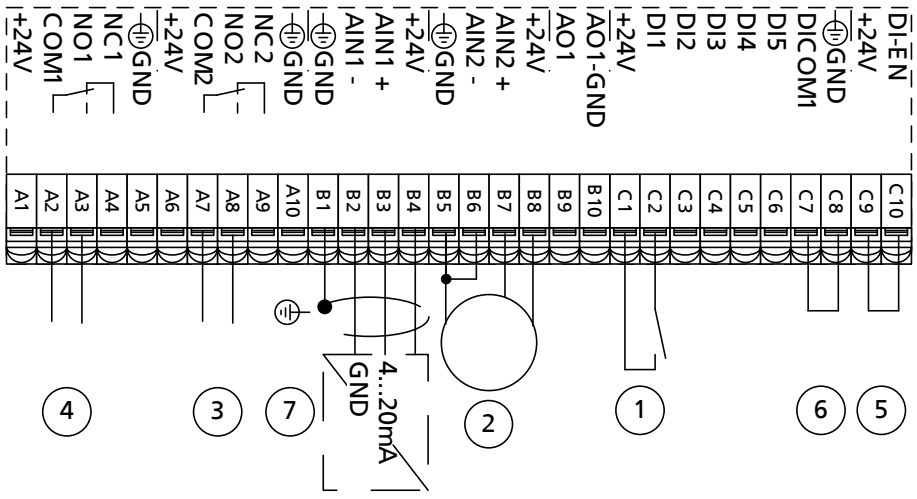

Fig. 65: Terminal wiring diagram, closed-loop control mode (dashed line = optional)

1	Start/ stop 2
2	Feedback value transmitter
3	Signal relay 2 (⇨ Section 7.10.3, Page 135)
4	Signal relay 1 (⇨ Section 7.10.3, Page 135)
5	Digital enable input
6	Ground for digital inputs
7	External setpoint signal

Example The frequency inverter is to control the system to achieve a setpoint of 6.7 bar in a differential pressure control process. For this purpose, a differential pressure sensor (4 - 20 mA) with a measuring range of 0 to 10 bar is connected to analog input 2 of the frequency inverter. The setpoint specification is made as an external setpoint signal (4 - 20 mA) via analog input 1. For the desired setpoint of 6.7 bar, 10.7 mA must be applied at analog input 1. The system start is activated by the System Start / Stop parameter *(1-3-1)*. The frequency inverter starts as soon as it is set to automatic or manual mode and the enable is given via DI-EN.

Table 53: Example of closed-loop control mode with setpoint specification via external setpoint signal

Parameter	Description	Possible settings	Factory setting
3-6-1	Type of Control *Selecting the control method. The controller is deactivated when OFF (Open-loop Control) is selected.*	Differential Pressure	Dependent on pump
3-11-2-1	Minimum Pressure *Minimum limit of measuring range*	0,00	-1,00 bar
3-11-2-2	Maximum Pressure *Maximum limit of measuring range*	10,0	1000,0 bar
3-11-2-3	Pressure Unit *Configurable unit for pressure 1*	bar	bar
3-8-1-1	Analog Input 1 Signal *Sensor signal at analog input 1*	4 - 20 mA	OFF
3-8-1-2	Analog Input 1 Function *Function of analog input 1. Internal operating values cannot be used as an actual value source.*	Setpoint/Control Value (Auto)	OFF
3-8-1-3	Analog Input 1 Lower Limit	0,00	0,00
3-8-1-4	Analog Input 1 Upper Limit	10,00	100,00
3-8-2-1	Analog Input 2 Signal *Sensor signal at analog input 2*	4 - 20 mA	OFF
3-8-2-2	Analog Input 2 Function *Function of analog input 2. Internal operating values cannot be used as an actual value source.*	Differential Pressure	OFF
3-8-2-3	Analog Input 2 Lower Limit	0,00	0,00
3-8-2-4	Analog Input 2 Upper Limit	10,00	100,00
1-3-1	System Start / Stop *This function is used to start the system.*	Start	Stop

NOTE

The System Start / Stop parameter *(1-3-1)* must be set to Stop if the system start takes place via the digital input.

7.7.1.2.3 Sensorless differential pressure control

Sensorless differential pressure control enables control to achieve a constant differential pressure of the pump without the use of pressure sensors in a single-pump configuration. The procedure is based on the characteristic curves of the pump. Steep power curves are conducive to high process accuracy. The process is suitable to a limited extent if sections of the power curve are constant over the flow rate or the pump operates outside the permissible operating range. It is activated by setting the Type of Control parameter *(3-6-1)* to Differential Pressure (Sensorless). Setting the setpoint (⇨ Section 7.6, Page 75) .

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NOTE

To facilitate sensorless differential pressure control, all parameters of the pump characteristic curves (*3-4-1*, *3-4-3-1* to *3-4-3-22*) and the inside pipe diameters at the pressure measuring points (*3-5-2-1* and *3-5-2-2*) must have been entered.

Table 54: Parameters for sensorless differential pressure control

Parameter	Description	Possible settings	Factory setting
3-6-1	Type of Control *Selecting the control method. The controller is deactivated when OFF (Open-loop Control) is selected.*	Differential Pressure (Sensorless)	Dependent on pump

7.7.1.2.4 Sensorless flow rate control

Sensorless flow rate control enables control to achieve a constant flow rate of the pump or multiple pump system without the use of a flow rate sensor. The method is based on the characteristic curves of the pump. Steep power curves are conducive to high process accuracy. It is activated by setting the Type of Control parameter (*3-6-1)* to Flow Rate (Sensorless), with flow rate estimation being active (*3-9-8-1* set to ON). (⇨ Section 7.6, Page 75)

The time response of the control process is influenced not only by the designated control parameters *(3-6-4-2 to 3-6-4-4)*, but significantly by the Attenuation of Flow Rate Estimation parameter *(3-9-8-2)*. The larger and more “sluggish” a hydraulic system is, the higher the value that must be assigned to this parameter. The value should roughly coincide with the system’ response time. The response time of the system refers to the time that lapses after a change in speed until the flow rate exhibits almost no change at all.

NOTE

To facilitate sensorless flow rate control, all parameters of the pump characteristic curves (*3-4-1*, *3-4-3-1* to *3-4-3-22*) and the inside pipe diameters at the pressure measuring points (*3-5-2-1* and *3-5-2-2*) must have been entered.

NOTE

For power curves with sections of the curve being constant over the flow rate (flat characteristic curve), signals must be made available for the suction pressure and discharge pressure of the pump.

Table 55: Parameters for sensorless flow rate estimation

Parameter	Description	Possible settings	Factory setting
3-9-8-1	Flow Rate Estimation	▪ ON ▪ OFF	ON
3-9-8-2	Attenuation of Flow Rate Estimation *Time constant for attenuation of flow rate estimation. Higher values will result in greater attenuation.*	0 … 600 s	5 s
3-6-1	Type of Control *Selecting the control method. The controller is deactivated when OFF (Open-loop Control) is selected.*	▪ OFF (Open-loop Control) ▪ Discharge Pressure ▪ Suction Pressure ▪ Differential Pressure ▪ Differential Pressure (Sensorless) ▪ Flow Rate ▪ Flow Rate (Sensorless) ▪ Temperature (Cooling) ▪ Temperature (Heating) ▪ Suction-side Level ▪ Discharge-side Level	Dependent on pump

7.7.2 Multiple pump configuration

7.7.2.1 Multiple pump configuration in open-loop control mode

Open-loop control mode is selected via the Type of Control parameter *(3-6-1)* for pumps in automatic mode (AUTO key). In open-loop control mode, all running pumps are operated at the specified speed.

The number of running pumps depends on the parameters "Load-dependent Start / Stop" *(3-7-3-8)* and "Maximum Number of Pumps Running" *(3-7-2)*. When Load-dependent Start / Stop is disabled, the number of pumps in operation is defined by the parameter "Maximum Number of Pumps Running" *(3-7-2)* . When Load-dependent Start / Stop is activated, the system behaves in the same way as in a multiple pump configuration in closed-loop control mode.
(⇨ Section 7.7.2.2, Page 87)

The speed is specified using the "Control Value (Open-loop Control)" parameter *1-3-3*. (⇨ Section 7.7.1.1.2, Page 78) or via an analog input (⇨ Section 7.7.1.1.1, Page 77) .

Table 56: Parameters for multiple pump configuration in open-loop control mode

Parameter	Description	Possible settings	Factory setting
3-6-1	Type of Control *Selecting the control method. The controller is deactivated when OFF (Open-loop Control) is selected.*	OFF (Open-loop Control)	OFF (Open-loop Control)
3-7-2	Maximum Number of Pumps Running *Maximum number of pumps running simultaneously in a multiple pump configuration*	0…6	1
3-7-3-8	Load-dependent Start / Stop If an external controller is used, the pumps start and stop as a function of load in open-loop control.	▪ OFF ▪ ON	OFF
1-3-3	Control Value (Open-loop Control) *Configurable control value for speed in open-loop control mode*	Minimum to maximum speed of motor	500

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7.7.2.2 Multiple pump configuration in closed-loop control mode

7.7.2.2.1 Role of the drives in multiple pump configurations

In multiple pump configurations, one of the frequency inverters assumes the function of master control. The master control device starts and stops pumps and manages open-loop and closed-loop control of the multiple pump system. All signals required to control the system must be connected to the master control device. The master control role is assigned to a frequency inverter via the Role in Multiple Pump System parameter *(3-7-1)*.

Several master control devices can be assigned to improve the availability of the multiple pump system. One of them serves as the active master control device, while the others act as redundant devices. The active master control device is identified by an "M" for "master" in the second header of the control panel. In the event that the active master control device fails, its tasks will be assumed by a redundant master control device. To ensure that this takes place, all signals required for open-loop and closed-loop control must also be connected to the redundant master control devices.

NOTE

If the master control device fails and a redundant master control device assumes its tasks, a temporary drop in pressure can occur.

The maximum number of pumps running simultaneously is limited via the Maximum Number of Pumps Running parameter *(3-7-2)*.

Table 57: Multiple pump configuration parameters

Parameter	Description	Possible settings	Factory setting
3-7-1	Role in Multiple Pump System *Selecting the role of the frequency inverter in a multiple pump configuration. The active master control device is responsible for starting and stopping pumps, as well as for open-loop and closed-loop control. All input variables required for open-loop or closed-loop control must be connected to the master control device and all redundant master control devices. The redundant master control device which is to serve as active master control is selected automatically based on a configurable transfer time. Auxiliary control and redundant master control devices receive the control value from the master control device.*	▪ Master Control ▪ Auxiliary Control	Master Control
3-7-2	Maximum Number of Pumps Running *Maximum number of pumps running simultaneously in a multiple pump configuration*	0...6	1

7.7.2.2.2 Starting and stopping

NOTE

System flow rate availability is a prerequisite for starting and stopping pumps. If the flow rate has not been measured, flow rate estimation, parameter *3-9-8-1*, must be enabled.

Pumps are started and stopped in line with current requirements via the switching limits displayed in diagrams 1 and 2. If the current operating point of the multiple pump system shifts such that one of these switching limits is passed, a pump is started or stopped. Switching limits are defined using the parameters listed in the "Start/stop

parameters" table. These switching limits are parameterised for changing over from one to two pumps. Switching limits for starting and stopping additional pumps are calculated automatically and do not need to be defined.

Table 58: Start/stop parameters

Parameter	Description	Possible settings	Refers to	Factory setting
3-7-3-3	Start Speed *A pump is started when the start speed is reached.*	0…140 %	Nominal pump speed	100 %
3-7-3-4	Stop Speed *A pump is stopped when the stop speed is reached (only required for pumps with flat characteristic curves).*	0…90 %	Nominal pump speed	50 %
3-7-3-5	Start Flow Rate *Start flow rate for starting a second pump at nominal speed. Value provided in % of maximum flow rate Q6. Switching limits for starting additional pumps are derived from this value.*	0…100 %	Maximum flow rate	95 %
3-7-3-6	KSB PumpDynamicControl *Shift between energy-efficient (0 %) and dynamic operating mode (100 %)*	0…100 %	-	30 %
3-7-3-1	Min. Time Start *Minimum period of time between two starts*	0.0…600.0s	-	10 s
3-7-3-2	Min. Time Stop *Minimum period of time between two stops*	0.0…600.0s	-	20 s
3-2-2-1	Minimum Motor Speed	0…4000 rpm	-	500 rpm
3-4-3-30	Low Flow Limit Flow Rate in % Q_{opt} *Flow rate for low flow limit at nominal speed*	0…100 %	Best efficiency point Q_{opt}	30 %
3-7-3-7	Time Delay_Trigger Criterion *Period of time for which a start or stop condition (speed and/or flow rate limit) must be continually violated before a pump is started or stopped.*	0.1…600 s	-	5 s

Detailed parameter description

NOTE

Frequency inverters that are parameterised at the factory for the pump set are provided with parameters that have already been optimised for starting and stopping.

The following diagram shows the switching limits of a running pump in a multiple pump system and the associated parameters in the head / flow rate diagram.

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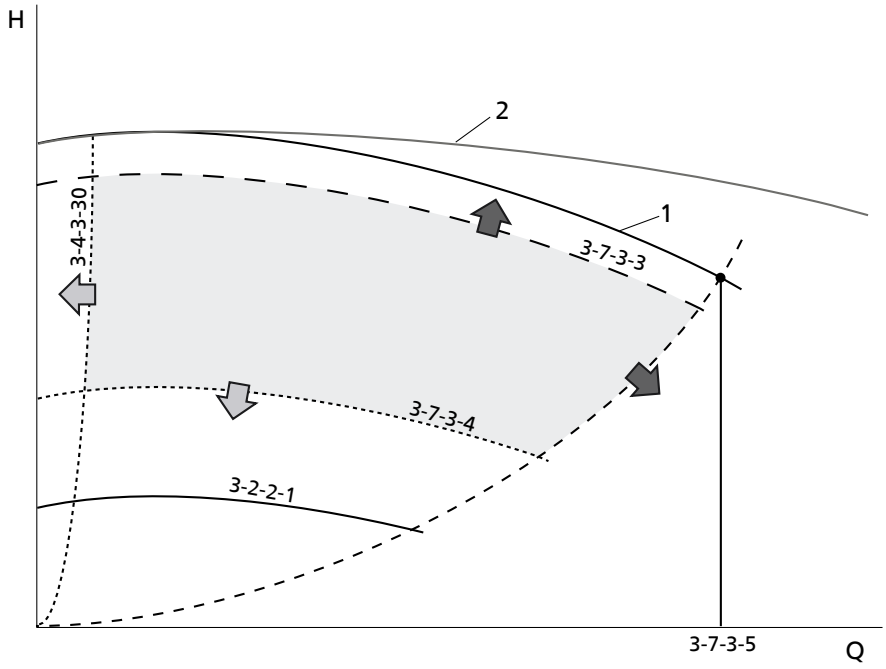

Fig. 66: Switching limits of a running pump in a multiple pump system

1	Characteristic head curve of a running pump
2	Characteristic head curve of two running pumps
.....	Stop limits: Stopping a running pump
- - - - -	Start limits: Starting the first pump
— — —	Start limits: Starting the second pump
Arrows	Effective direction of the switching limits
Coloured area	Operating range of a running pump

Start Speed (3-7-3-3):
If the speed of a pump exceeds this value, an additional pump is started if available. The diagram shows the start speed *(3-7-3-3)* plotted as a curve that limits, or restricts, the operating range of the single pump. Above or to the right of this line, two pumps are running. If the start speed *(3-7-3-3)* is also plotted as a curve, see the "Switching limits of two running pumps in a multiple pump system" diagram, which limits, or restricts, the operating range of two running pumps. Above or to the right of this line, three pumps are running.

Start Flow Rate (3-7-3-5):
The start flow rate defines a point on the characteristic head curve where an additional start limit intersects. It limits the operating range of the single pump. Below or to the right of this line, two pumps are running. The start flow rate optimised for efficiency equates to approximately 95 % of the maximum flow rate (factory setting) for most pumps.

Low Flow Limit (3-4-3-30):
When the low flow limit is reached, a (one) pump is stopped. Even if only one pump is running, it is stopped provided that stand-by mode (sleep mode) is active (⇨ Section 7.8.4.2, Page 110) . If sleep mode is not active, the last pump is not stopped. A warning message is output, however.

Stop Speed (3-7-3-4):
When the stop speed is reached, a (one) pump is stopped. Even if only one pump is running, it is stopped provided that stand-by mode (sleep mode) is active.
(⇨ Section 7.8.4.2, Page 110) If sleep mode is not active, the last pump is not stopped. The minimum speed *(3-2-2-1)* cannot be undershot, however.

The “Switching limits of two running pumps in a multiple pump system” diagram shows the switching limits of two running pumps in a multiple pump system and the associated parameters in the head/flow rate diagram.

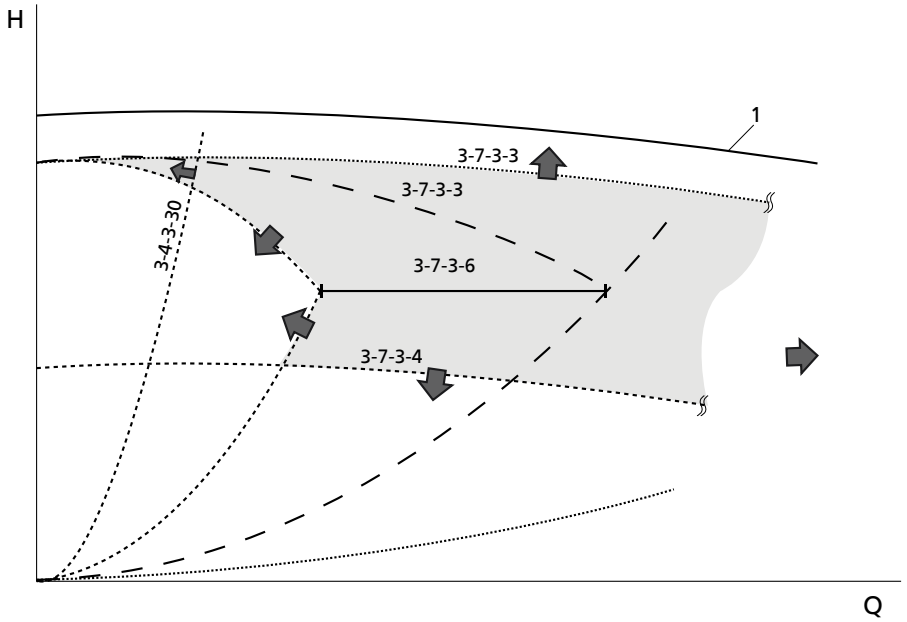

Fig. 67: Switching limits of two running pumps in a multiple pump system

1	Characteristic head curve of a running pump
2	Characteristic head curve of two running pumps
----------	Stop limits: Stopping the second pump
— — —	Start limits: Starting the third pump
Arrows	Effective direction of the switching limits
Coloured area	Operating range of two running pumps

KSB PumpDynamicControl (3-7-3-6):
This parameter determines the position of the stop limits relative to the start limits; see “Switching limits of two running pumps in a multiple pump system” diagram. It greatly impacts the dynamic response and energy efficiency of the system. The parameter can be defined anywhere from 0 % for maximum energy efficiency to 100 % for maximum dynamic response.

Low values mean that only the number of pumps required from a practical energy perspective operate, or run. Fast and extensive changes in demand required may possibly be responded to with a delay as switching operations occur relatively frequently. Values which are set too low, however, can lead to unstable starting and stopping cycles.

High values enable quick response to fast and extensive changes in demand as a relatively large number of pumps run and switching operations do not occur as frequently. High values can also lead to high energy consumption, however. The following procedure is recommended for setting this parameter: Starting with a low value (e.g. 10 %), the parameter is gradually increased until the response time of the multiple pump system suits the application. If this is already the case with the initial value set, decreasing the value may prove even more beneficial.

Minimum Time Between Starts (3-7-3-1):
This parameter defines the minimum period of time that must lapse before a subsequent start is carried out. Setting this parameter can prevent a second pump from being started while a pump that was started just before is still running up to its target speed along the start ramp. The minimum period of time between two starts (3-7-3-1) should therefore be coordinated with the start ramp time (3-3-5-1). An appropriate setting is achieved by selecting roughly the same times.

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Minimum Time Between Stops (3-7-3-2):
This parameter defines the minimum period of time that must lapse before a subsequent stop is carried out. Setting this parameter can prevent a second pump from being stopped while a pump that was stopped just before is still running down along the stop ramp. The minimum period of time between two stops *(3-7-3-2)* should therefore be coordinated with the stop ramp time *(3-3-5-1)*. An appropriate setting is achieved by selecting roughly the same times.

Time Delay_Trigger Criterion (3-7-3-7): This parameter is used to match the sensitivity of starting and stopping to the respective application. This is the period of time for which a start or stop condition must be continually fulfilled before a pump is started or stopped. Reducing the time leads to greater sensitivity. Starting and stopping occur more quickly, and the risk of switching operations triggered by measurement outliers increases. Extending the time leads to reduced sensitivity. Starting and stopping occur more slowly, and the risk of switching operations triggered by measurement outliers decreases.

7.7.2.3 Automatic pump changeover

In multiple pump configurations, an automatic pump changeover for equalising the load placed on the pumps can be activated by configuring parameter *3-7-4-1*. When the Runtime setting has been selected, pumps are changed after the defined runtime *(3-7-4-2)*. When the Runtime with Time of Day setting has been selected, the changeover takes place at the time set *(3-7-4-3)* only if the pump has run for at least the defined runtime. If the pump is stopped, the runtime for this pump is reset.

Table 59: Automatic pump changeover parameters

Parameter	Description	Possible settings	Factory setting
3-7-4-1	Automatic Pump Changeover *If this parameter is enabled, pump changeover will take place after a defined operating time.*	▪ OFF ▪ Runtime ▪ Runtime with Time of Day	OFF
3-7-4-2	Pump Runtime *Runtime of pump up to the next pump changeover. If the pump is stopped, the runtime is reset.*	0…168 h	24 h
3-7-4-3	Pump Changeover Time *Time at which pumps are changed when the runtime is exceeded.*	0:00 - 23:59	0:00

7.8 Application functions

7.8.1 Aligning the frequency inverter with the pump

The characteristic curves of the pump are described by parameters *3-4-3-1* to *3-4-3-22* and apply at the nominal speed of the pump *3-4-1*. The characteristic curves provide the basis for the following functions:

- Flow rate estimation
- Operating point monitoring
- Stand-by mode (sleep mode)
- Sensorless differential pressure control
- Multiple pump configuration

If the frequency inverter is parameterised at the factory, all pump-specific parameters are already specified.

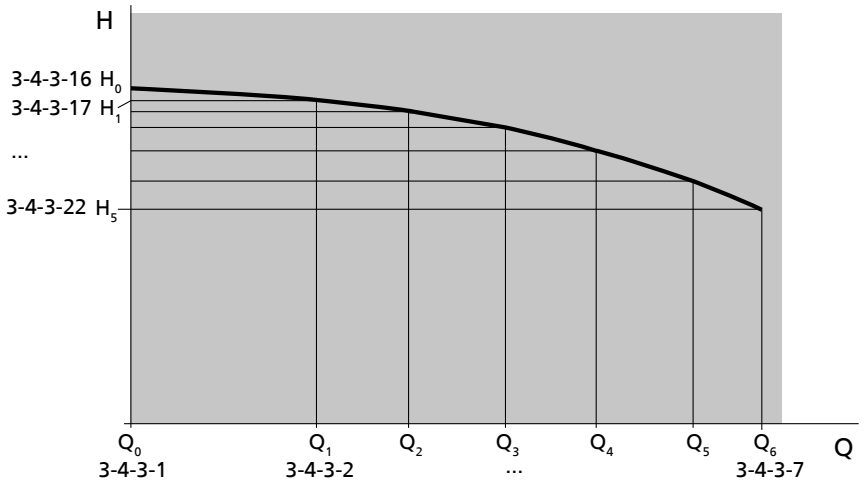

Fig. 68: Characteristic head curve with seven data points and the relevant parameters

Flow rate Q_0, i.e. parameter *(3-4-3-1)*, is always zero. Flow rate Q6 *(3-4-3-7)* describes the end of the characteristic curves and also represents the maximum permissible flow rate of the pump.

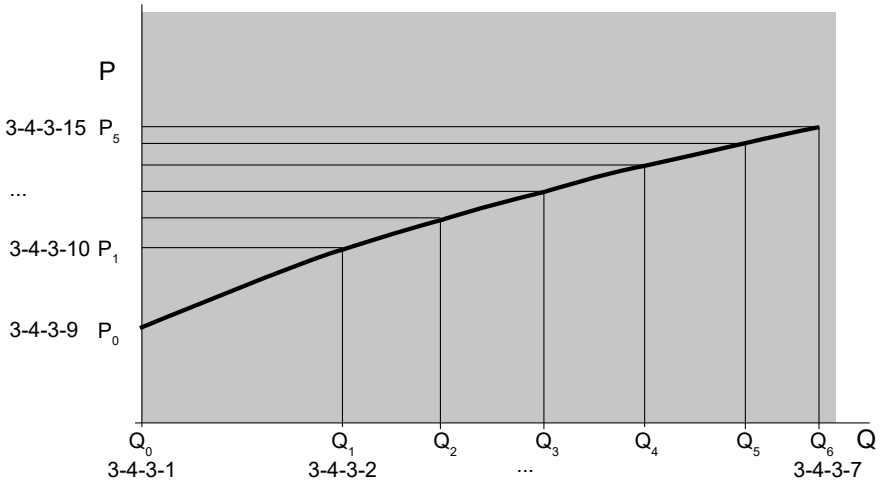

Fig. 69: Power curve with seven data points and the relevant parameters

The same flow rate values are used for the power curves as for the characteristic head curve.

NOTE

The power curve is not converted to account for the density of the fluid handled *(3-5-1)*. A power curve that is consistent with the density of the fluid handled must therefore be entered.

The optimum operating point of the pump at nominal speed is defined via the Flow Rate Q_{opt} parameter *(3-4-3-8)*. The low flow limit of the pump at nominal speed is defined via the Low Flow Limit Flow Rate parameter *(3-4-3-30)*. This is a percentage-based specification that refers to the optimum operating point.

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Table 60: Parameters for matching PumpDrive to the pump

Parameter	Description	Possible settings	Factory setting
3-4-3-1	Flow Rate Q_0	Minimum to maximum limit of value range set	Pump-specific
3-4-3-2	Flow Rate Q_1	Minimum to maximum limit of value range set	Pump-specific
3-4-3-3	Flow Rate Q_2	Minimum to maximum limit of value range set	Pump-specific
3-4-3-4	Flow Rate Q_3	Minimum to maximum limit of value range set	Pump-specific
3-4-3-5	Flow Rate Q_4	Minimum to maximum limit of value range set	Pump-specific
3-4-3-6	Flow Rate Q_5	Minimum to maximum limit of value range set	Pump-specific
3-4-3-7	Flow Rate Q_6	Minimum to maximum limit of value range set	Pump-specific
3-4-3-8	Flow Rate Q_{opt}	Minimum to maximum limit of value range set	Pump-specific
3-4-3-9	Pump Input Power P_0	Minimum to maximum limit of value range set	Pump-specific
3-4-3-10	Pump Input Power P_1	Minimum to maximum limit of value range set	Pump-specific
3-4-3-11	Pump Input Power P_2	Minimum to maximum limit of value range set	Pump-specific
3-4-3-12	Pump Input Power P_3	Minimum to maximum limit of value range set	Pump-specific
3-4-3-13	Pump Input Power P_4	Minimum to maximum limit of value range set	Pump-specific
3-4-3-14	Pump Input Power P_5	Minimum to maximum limit of value range set	Pump-specific
3-4-3-15	Pump Input Power P_6	Minimum to maximum limit of value range set	Pump-specific
3-4-3-16	Head H_0	00,00...1000,00	Pump-specific
3-4-3-17	Head H_1	00,00...1000,00	Pump-specific
3-4-3-18	Head H_2	00,00...1000,00	Pump-specific
3-4-3-19	Head H_3	00,00...1000,00	Pump-specific
3-4-3-20	Head H_4	00,00...1000,00	Pump-specific
3-4-3-21	Head H_5	00,00...1000,00	Pump-specific
3-4-3-22	Head H_6	00,00...1000,00	Pump-specific
3-4-3-23	NPSH_0	00,00...1000,00	Pump-specific
3-4-3-24	NPSH_1	00,00...1000,00	Pump-specific
3-4-3-25	NPSH_2	00,00...1000,00	Pump-specific
3-4-3-26	NPSH_3	00,00...1000,00	Pump-specific
3-4-3-27	NPSH_4	00,00...1000,00	Pump-specific
3-4-3-28	NPSH_5	00,00...1000,00	Pump-specific
3-4-3-29	NPSH_6	00,00...1000,00	Pump-specific
3-4-3-30	Low Flow Limit Flow Rate in % Qopt	0...100	Pump-specific

7.8.2 Protective functions

7.8.2.1 Activating/deactivating thermal motor protection

Thermal overload results in immediate tripping and an alert message is output. Restarting will only be possible after the motor has cooled down sufficiently. The stop threshold value is set at the factory for monitoring with a PTC sensor or a thermal circuit breaker. If other thermocouples are used, the value has to be set by KSB Service.

NOTE

Thermal motor protection cannot be activated/deactivated while the motor is in operation.

Table 61: Thermal motor protection

Parameter	Description	Possible settings	Factory setting
3-2-3-1	PTC Data Analysis *Motor temperature monitoring*	▪ OFF ▪ ON	ON
3-2-3-2	Thermal Motor Protection Behaviour *Behaviour for detection of excessive motor temperature*	▪ Non-self-acknowledging ▪ Self-acknowledging	Non-self-acknowledging

7.8.2.2 Electrical motor protection by overvoltage/undervoltage monitoring

The frequency inverter monitors the mains voltage. If it falls below 380 V -10 % or exceeds 480 V +10 %, this results in tripping and an alert is output. The alert must be acknowledged before the drive can be restarted.

7.8.2.3 Stop due to Overcurrent

NOTE

Should the Overcurrent and Short Circuit faults occur, the frequency inverter is automatically reset (after 2 seconds – 4 seconds – 6 seconds). If the fault still cannot be acknowledged, the frequency inverter switches off for safety reasons, and fault messages A5 (Short circuit)/ A9 (Overcurrent) and A6 (Hardware fault) are output. The combination of these faults indicates to the operator that all components of the system and their electrical connections must be thoroughly checked. The frequency inverter can only be restarted with a voltage reset after the fault present has been rectified.

If the Max. Motor Current in % of Nominal Motor Current (*3-3-7-1*) limit value is exceeded by 5 %, the partially self-acknowledging Overcurrent alert is output that causes the motor to be stopped. The drive remains disabled as long as this event is active. The Motor Disabled status is displayed on the control panel.

7.8.2.4 Dynamic Overload Protection by Speed Limitation

The frequency inverter is equipped with current sensors that record and limit the motor current. When the defined overload limit is reached, the speed is lowered to reduce the power (I^2t control). The frequency inverter then no longer operates in closed-loop control mode but maintains the operative function at a lower speed.

Based on the values set in the I^2t Triggering Characteristic *(3-3-7-5)* and the Max. Motor Current in % of Nominal Motor Current *(3-3-7-1)* parameters, a dynamic time period is calculated during which the motor may be operated at a current higher than the Nominal Motor Current *(3-2-1-4)* until I^2t control takes over. The more the motor exceeds its nominal current, the faster the I^2t control mode is activated.

The first time dynamic overload protection (I^2t counter = 0) is activated and the motor current is at 110 % of the nominal motor current *(3-2-1-4)*, it will take 60 seconds *(3-3-7-5)* for I^2t control to take over as defined in the default factory

settings. If the overload current is below the maximum motor current, the dynamic time period calculated is extended by a corresponding amount. If the motor continues to operate at its nominal current following operation in overload mode, the I^2t control mode remains active. If the current drops to a value below the nominal current of the motor *(3-2-1-4)*, the I^2t counter is reset. This process can take up to 10 minutes, depending on the current at which the motor is currently operating.

As soon as I^2t control is activated, the Dynamic Overload Protection warning is displayed. This warning is self-acknowledging and is reset when I^2t control is deactivated.

When the I^2t stop speed *(3-3-7-6)* is undershot, the partially self-acknowledging Dynamic Overload Protection alert is output and the motor is stopped. The motor is disabled. After the I^2t threshold value is undershot, the motor restarts after a maximum disable time of 10 seconds has lapsed, depending on the size of the motor.

Table 62: Parameters for dynamic overload protection by speed limitation

Parameter	Description	Possible settings	Refers to	Factory setting
3-2-1-4	Nominal Motor Current *Nominal current of motor as per name plate*	0.00 ... 150.00 A	-	Dependent on size
3-3-7-1	Max. Motor Current in % of Nominal Motor Current *Setting the maximum motor current permissible*	0 ... 150 %	3-2-1-4	110 %
3-3-7-5	I^2t Triggering Characteristic *Based on the I^2t triggering characteristic, a period of time is calculated dynamically during which the motor may be operated at a higher current until I^2t control is activated.*	1 .. 60 s	-	60 s
3-3-7-6	I^2t Stop Speed *This speed limit causes a Dynamic Overload Protection alert to be output, at which time the motor is stopped.*	Minimum to maximum speed of motor	-	3-2-2-1
3-3-7-7	I^2t Threshold Value *Current limit value in % of the nominal motor current above which dynamic overload protection is activated.*	100,00 … 125,00 %	-	105,00 %

7.8.2.5 Tripping at phase failure and short circuit

Phase failure and short circuit (phase-phase and phase-earth) lead to direct deactivation (without stop ramp). This protective function does not need to be parameterised.

7.8.2.6 Broken wire detection (live zero)

The control system monitors all analog inputs at which a sensor has already been detected or for which a sensor has been permanently set for broken wire (live zero).

External signals for defining the setpoint and control value specification can also be monitored for broken wires.

A prerequisite are signals with 4 - 20 mA or 2 - 10 V. If the lower voltage or current value is specified to be 0 V or 0 mA, cable integrity monitoring is not carried out for the corresponding analog input. If the value falls below 4 mA or 2 V, a parameterisable response is initiated after a parameterisable time delay.

If the sensor relates to the actual value source and dedicated control is no longer possible due to a lack of redundancy, the No Master Control alert is output (or otherwise, the Failure of Actual Value warning).

A Broken Wire warning is output if no control function is active. The alerts and warnings are self-acknowledging. In the event of an alert (control no longer possible), a configurable response is implemented:

- Stop all pumps
- Configurable speed

Table 63: Broken wire detection (live zero) parameter

Parameter	Description	Possible settings	Factory setting
3-9-1-1	Response to Failure *Frequency inverter response to No Master Control alert*	▪ All Pumps OFF ▪ Fixed speed	Fixed speed
3-9-1-2	Time Delay *Time delay before the message (warning or alert) is triggered. In a redundant system, only a warning is output as the auxiliary master can assume the function. Only if the actual value also fails at the auxiliary master is an alert output, which then triggers the specified response to actual value failure (pump changeover).*	0…10 s	0,5 s
3-9-1-3	Speed During Failure *Fixed speed that is activated when the actual value fails.*	Minimum to maximum speed of motor	3-2-2-1

7.8.2.7 Suppressing a frequency range

In the case of critical system conditions, a frequency range can be suppressed to prevent resonance. An upper and lower speed limit value can be parameterised for this purpose. If the upper and lower limit speeds have the same rpm setting, suppression does not occur.

NOTE

Suppressing a frequency range does not take effect in manual mode.

Suppressing a frequency range in closed-loop control mode

If the closed-loop control value exceeds the lower limit speed or undershoots the upper limit speed, the control system transitions through the resonance range. Before the resonance range is passed again, the closed-loop control value must have left it once. In this way, oscillation is reduced when a controller is set to respond slowly. The effect cannot be avoided altogether, however, if the setpoint is reached within the confines of the resonance range. In the event that several transitions occur in closed-loop control mode, a Resonance Range warning is output. This warning is displayed for 60 seconds after the last transition.

Suppressing a frequency range in open-loop control mode

If the open-loop control value is below the mean value between both limit speeds, the motor remains at the lower limit speed. If the open-loop control value is above the mean value between both limit speeds, the motor remains at the upper limit speed. If the mean value is exceeded or undershot, the control system overcomes the resonance range along the motor protection ramp.

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Table 64: Upper and lower limit speed

Parameter	Description	Possible settings	Factory setting
3-9-12-1	Lower Limit *Lower speed limit for suppressing the resonance range in Hz. If the lower and upper limit frequency are assigned the same values, there is no suppression. This function is not supported in manual mode.*	Minimum to maximum speed of motor	0 rpm
3-9-12-2	Upper Limit *Upper speed limit for suppressing the resonance range in Hz. If the lower and upper limit frequency are assigned the same values, there is no suppression. This function is not supported in manual mode.*	Minimum to maximum speed of motor	0 rpm

7.8.2.8 Dry running protection and protection against hydraulic blockage

If the function is active, dry running of the pump triggers an alert followed by tripping. Hydraulic blockage, i.e. pumping against a closed pipeline, initially leads to a warning and ultimately to an alert followed by tripping.

NOTE

If dry running protection was activated via an external sensor, sensorless dry running detection is inactive.

Protection against dry running and hydraulic blockage is based on a learning procedure that is run through once.

NOTE

The learning procedure can only be run in AUTO / STOPPED operating mode. For this purpose, the system must be stopped via parameter *1-3-1* or via a digital input, and the AUTO key must be pressed. AUTO_____STOPPED appears in the bottommost display row.

Before the learning procedure is started, the valve on the discharge side of the pump must be closed. The procedure is started via the Start Learning Function parameter *(3-9-6-3)*. The frequency inverter now starts the pump set and records the power at different speeds. This procedure lasts approximately half a minute and can be cancelled by pressing the ESC key. As soon as the learning function has completed (as indicated on the display) protection against dry running and hydraulic blockage is active. The valve previously closed can now be opened again.

Dry running protection and protection against hydraulic blockage can be deactivated if the values saved for the learning curve (parameters *3-9-6-4* to *3-9-6-8*) are set to "0".

NOTE

Before the learning function is run, it must be checked whether it is permissible to operate the pump against the closed valve for a short period. This is not the case for KSB pumps of the Sewatec and Sewabloc type series.
After the learning function has run, the frequency inverter reverts to the AUTO operating mode.

NOTE

When the minimum speed is changed, the dry-running learning function must be restarted.

The Hydraulic Blockage Limit parameter *(3-9-6-1)* can be used to adapt the response sensitivity for detecting hydraulic blockages. High values translate into a high response sensitivity.

Warnings and alerts are output with a time delay in relation to the occurrence of the triggering events. The time delays are defined in parameters *(3-9-6-9)* to *(3-9-6-11)*.

Table 65: Parameters for dry running protection and protection against hydraulic blockage

Parameter	Description	Possible settings	Factory setting
3-9-6-1	Hydraulic Blockage Limit	0 - 130 %	101 %
3-9-6-2	Dry Run Time Limit	0 - 130 %	85 %
3-9-6-9	Time Delay Hydraulic Blockage Warning	0 - 600 s	5 s
3-9-6-10	Time Delay Hydraulic Blockage Alert	0 - 600 s	10 s
3-9-6-11	Time Delay Dry Running Alert	0 - 600 s	5 s

7.8.2.9 Operating point monitoring

Operating point monitoring generates warning messages if the pump operates outside the permissible operating range. Excessively low flow rates produce the Low Flow warning. Excessively high flow rates produce the Overload warning. The underlying limits can be matched to the pump via the parameters listed (refer to table on parameters for operating point monitoring). Operating point monitoring is activated together with flow rate estimation via parameter *(3-9-8-1)*.

NOTE

Operating point monitoring will only function properly if the Inside Pipe Diameters at Discharge Pressure Measuring Points (*3-5-2-1* and *3-5-2-2*) parameters have been entered.

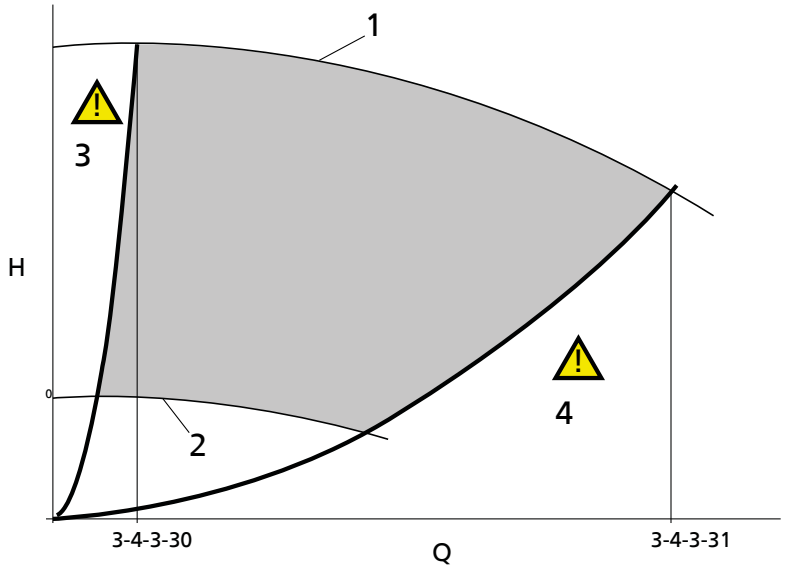

Fig. 70: Head / flow rate diagram

	Permissible operating range		
1	Nominal speed	2	Minimum speed
3	Low flow limit	4	Overload limit

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Table 66: Operating point monitoring parameters

Parameter	Description	Possible settings	Refers to	Factory setting
3-4-3-30	Low Flow Limit Flow Rate in % of Q_{opt} *Flow rate for low flow limit at nominal speed*	0..100 %	*3-4-3-8*	30 %
3-4-3-31	Overload Limit Flow Rate in % of Q_{max} *Flow rate for the overload limit at nominal speed*	0..100 %	*3-4-3-7*	98 %

7.8.2.10 Functional check run

When a pump is stopped for an extended period of time, the pump can be operated cyclically to prevent the pump from seizing up.

NOTE

The functional check run is only performed in automatic mode. The functional check run also remains active if system start has not been activated for the respective pump. The pump will start up.

The speed that is used for the functional check run can be set via the Speed for Functional Check Run parameter *(3-9-2-5)*. The duration of the functional check run *(3-9-2-4)* is extended by ramp times. The functional check run also works for pumps that were stopped by stand-by mode (sleep mode). If a functional check run is in progress, it can be interrupted, or cancelled, at any time by changing to the OFF mode.

Functional check run after idle period

After a configurable idle period has passed *(3-9-2-1)*, a functional check is performed on the pumps in automatic mode. For this purpose, the Automatic Functional Check Run *(3-9-2-1)* parameter must be set to After Idle Period. The Functional Check Run Duration *(3-9-2-4)* parameter is used to specify the duration of the functional check run.

Table 67: Parameters for functional check run after idle period

Parameter	Description	Possible settings	Refers to	Factory setting
3-9-2-1	Automatic Functional Check Run *For a functional check run, a pump is started, run at a configurable frequency for a configurable period of time and then stopped again. During this period, the pump is not available for closed-loop control operation.*	1 = After Idle Period	-	0 = OFF
3-9-2-2	Idle Period before Functional Check Run *A functional check run is performed for a pump if it has not been started for the defined period of time.*	0…168 h	-	24 h
3-9-2-4	Functional Check Run Duration *Runtime of pump during the functional check run at the set speed*	0.0…600.0 s	-	5.0 s
3-9-2-5	Speed for Functional Check Run *Speed for functional check run*	Minimum to maximum speed of motor	3-11	500 rpm

Functional check run after idle period at defined time

The frequency inverter performs a functional check run when a specific time has been reached. If the function is activated, the idle period of the pump must first have passed, at which point the functional check run is delayed until a specific configurable time is reached.

Table 68: Parameters for functional check run after idle period at defined time

Parameter	Description	Possible settings	Refers to	Factory setting
3-9-2-1	Automatic Functional Check Run *For a functional check run, a pump is started, run at a configurable frequency for a configurable period of time and then stopped again. During this period, the pump is not available for closed-loop control operation.*	2 = After Idle Period at Defined Time	-	0 = OFF
3-9-2-2	Idle Period before Functional Check Run *A functional check run is performed for a pump if it has not been started for the defined period of time.*	0…168 h	-	24 h
3-9-2-3	Time for Functional Check Run *When a time has been defined, the functional check run after idle period is delayed until the defined time is reached.*	00:00…23:59	-	00:00
3-9-2-4	Functional Check Run Duration *Runtime of pump during the functional check run at the set speed*	0.0…600.0 s	-	5 s
3-9-2-5	Speed for Functional Check Run *Speed for functional check run*	Minimum to maximum speed of motor	*3-11*	500 rpm

Starting the functional check run via the control panel

The functional check run can be started immediately via the control panel. To do this, activate the Immediate Functional Check Run parameter *(1-3-6)*. This function can also be assigned to the FUNC key.

7.8.2.11 Deragging

If fluids with a high solids content are handled, deposits may form that may in turn impair pump operation or prevent start-up of the pump. The Deragging function serves to prevent deposits from forming in the pump, thus ensuring reliable operation.

To this end, the pump is operated in the opposite direction to its normal direction of rotation at regular intervals in order to clean the hydraulic system. The following functions are available:

- **Deragging after idle period**
  When a set idle period (*3-9-16-2*) has passed, the pumps perform the Deragging function in automatic mode. To do so set the Automatic Deragging parameter *3-9-16-1* to After Idle Period.

  Use parameter *3-9-16-4* to set the Deragging Duration.
- **Deragging after idle period and at a set time**
  The frequency inverter performs the Deragging function at a set time. If this function is activated, deragging is performed after the idle period of the pump has passed and a set time is reached.

NOTE

Prior to using the Deragging function, check whether the pump used is suitable for reverse rotation.
Deragging is only carried out in the AUTO / STOP operating mode.
Deragging also remains active if system start has not been activated for the respective pump. The pump will start up.

For both versions the speed and duration of deragging are set via parameters (*3-9-16-5*) Speed for Deragging and (*3-9-16-4*) Deragging Duration. The deragging duration is extended by the ramp times during start-up. The Deragging function also works for pumps that were stopped by standby mode (sleep mode).

If deragging is in progress, it can be cancelled at any time by changing to the OFF mode.

Table 69: Parameters for deragging after idle period

Parameter	Description	Possible settings	Refers to	Factory setting
3-9-16-1	Automatic Deragging *During deragging a pump is started up in the opposite direction to its normal direction of rotation, run at a configurable frequency for a configurable period of time and then stopped again. During this period, the pump is not available for closed-loop control operation.*	▪ 0 = OFF ▪ 1 = After Idle Period ▪ 2 = After Idle Period at Defined Time	-	0 = OFF
3-9-16-2	Idle Period before Deragging *Deragging is performed for a pump if it has not been started for the set period of time.*	0…168 h	-	24 h
3-9-16-3	Time for Deragging *When a time has been set, deragging after idle period is delayed until the defined time is reached.*	00:00…23:59	-	00:00
3-9-16-4	Deragging Duration *Runtime of pump during deragging run at the set speed*	0.0…600.0 s	-	5.0 s
3-9-16-5	Speed for Deragging *Speed for deragging*	Minimum to maximum speed of motor	3-11	500 rpm

7.8.2.12 Individual monitoring functions

An upper and lower limit value (parameters *3-10-1-1* to *3-10-11-3*) can be defined for the following operating values:

- Power
- Current
- Speed
- Setpoint
- Actual value
- Flow rate
- Suction pressure
- Discharge pressure
- Differential pressure
- Frequency
- Temperature

When these limit values are undershot or overshot, a warning is triggered after a continuous time delay that is defined *(3-10)* has lapsed.

7.8.2.13 Service interval

The maintenance/service interval is set in months. Following an operating period of the pump *(1-4-2-3)* that exceeds the maintenance/service interval, an information message ("Service interval exceeded") is generated.

When the message is acknowledged, it continues to appear in the list of pending messages.

The maintenance/service interval can be reset. The information message is then deleted, and the next service interval starts.

When resetting the counter for the pump runtime *(1-4-2-4)*, the maintenance interval is also automatically reset.

The service interval is deactivated by setting the interval time *(3-9-13-1)* to "0".

Table 70: Service interval

Parameter	Description	Possible settings	Refers to	Factory setting
3-9-13-1	Pump Service Interval *Time interval between notifications for upcoming maintenance service*	0...48 m	-	0
3-9-13-2	Reset Service Interval *The service interval is reset.*	Run	*1-4-2-4*	-

7.8.2.14 Motor bearing service interval

The maintenance/service interval for the motor bearings is set in months. When the set interval *(1-4-2-7)* has elapsed, the information message "Motor Bearing Service Interval" is shown on the display.

When the message is acknowledged, it continues to appear in the list of pending messages. Resetting Motor Bearing Service Interval deletes the information message and starts the next maintenance interval.

The Motor Bearing Service Interval is deactivated by setting the interval time *(3-9-13-3)* to "0".

Table 71: Parameters for the maintenance/service interval for motor bearings

Parameter	Description	Possible settings	Factory setting
3-9-13-3	Motor Bearing Service Interval *Time interval between maintenance of motor bearings*	▪ 0 … 48 m	0
3-9-13-4	Reset Motor Bearing Service Interval *Resetting the service interval for the motor bearings after maintenance has been performed*	▪ Run	-

7.8.3 Flow rate estimation

The flow rate and head estimation is based on the characteristic curves of the pump and the operating data determined by the frequency inverter with regard to pump input power and speed. Flow rate estimation is activated by the Flow Rate Estimation parameter *(3-9-8-1)*. The characteristic curves are entered as described in (⇨ Section 7.8.1, Page 91) . If no pressure sensors are installed close to the pump for improving flow rate estimation accuracy, a monotonically increasing power curve is required.

NOTE

The actual characteristic curves of a pump can differ from the documented ones as a result of manufacturing tolerances. Inaccuracies then arise for flow rate estimation. Higher accuracies can be reached by using the characteristic curves obtained from a pump acceptance test.

Improving accuracy with pressure sensors installed close to the pump

Signals sent from pressure sensors installed close to the pump can be used to improve the accuracy of flow rate and head estimations. They should only be used, however, if the pressure loss between the pump nozzle and pressure measuring point is negligible both on the suction and discharge side (< 1 % of the sensor measuring

range). If this requirement is not met, the Pressure Measuring Point Positions parameter *(3-5-2-4)* must be set to the Distant from Pump value to deactivate the influence of the pressure signals on flow rate estimation. Otherwise, the Close to Pump default setting with activated accuracy improvement function applies. The pressure measuring points must be described by parameters (refer to table on flow rate estimation parameters).

Pressures that are recorded via analog inputs with the Suction Pressure_Internal, Discharge Pressure_Internal or Differential Pressure_Internal function are only used to improve the accuracy of the flow rate and head estimation. They are always regarded as "close to pump" sensors, regardless of the Pressure Measuring Point Positions *(3-5-2-4)* parameter.

Multiple pump systems

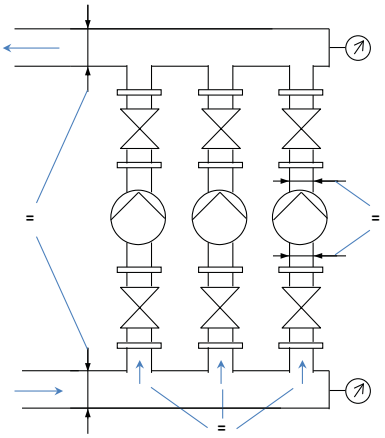

Fig. 71: Conditions for improving accuracy with pressure sensors installed close to the pump in multiple pump systems

The following additional conditions must be fulfilled for multiple pump systems in which pressure measurements are only taken in collecting lines (or headers/ manifolds):

- All of the pumps are identical in design.
- Suction and discharge nozzles of the pumps have the same diameter (in-line pumps).
- Suction and discharge-side collecting lines have the same diameter.
- The total flow rate is largely distributed equally across the individual pumps.

If these requirements are not met, the pressure signals may not be used to improve the accuracy of the flow rate and head calculation. The Pressure Measuring Point Positions parameter *(3-5-2-4)* must be set to the Distant from Pump value.

Table 72: Flow rate estimation parameters

Parameter	Description	Possible settings	Factory setting
3-9-8-1	Flow Rate Estimation *Activation of flow rate estimation*	▪ OFF ▪ ON	ON
3-5-2-1	Inside Pipe Diameter, Suction Pressure Measuring Point *Inside pipe diameter at the suction pressure measuring point*	0...1000 mm	System-specific
3-5-2-2	Pipe Diameter, Discharge Pressure Measuring Point *Inside pipe diameter at the discharge pressure measuring point*	0...1000 mm	System-specific

Parameter	Description	Possible settings	Factory setting
3-5-2-3	Height Difference, Pressure Measuring Points *Difference in height between suction and discharge pressure measuring point*	-10...10 m	System-specific
3-5-2-4	Pressure Measuring Point Positions *The Close to Pump setting must be used if the pressure measurement values for the system can be transferred to the pump.*	▪ Close to Pump ▪ Distant from Pump	Close to Pump

7.8.4 Energy optimisation

7.8.4.1 Pressure/differential pressure control with dynamic pressure setpoint compensation

Dynamic pressure compensation makes it possible to supply a distant consumer with largely constant pressure, irrespective of the flow, when pump-end pressure sensors are used. This is achieved by increasing the pump's pressure setpoint as the flow rate increases in order to compensate for the rising pressure losses in the piping.

Open piping system

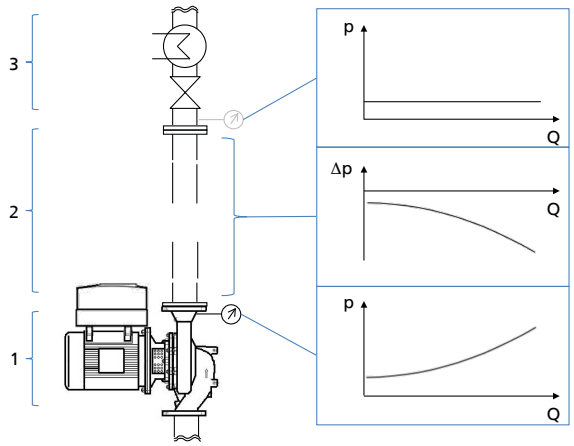

Fig. 72: Pressure control with dynamic pressure compensation in open system

1	Pump set with diagram of flow rate-dependent setpoint
2	Piping with diagram of pressure losses
3	Consumer with diagram of inlet pressure

The discharge pressure of the pump (1) can be used in open piping systems to achieve an almost constant pressure upstream of the consumer (3).

Closed piping system

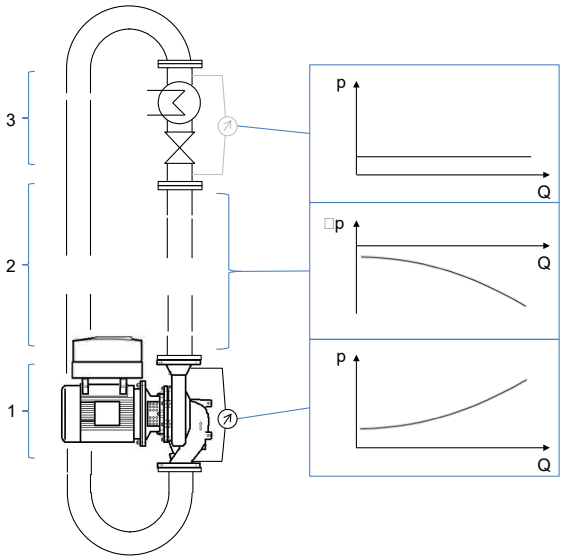

Fig. 73: Differential pressure control with dynamic pressure compensation in closed system

1	Pump set with diagram of flow rate-dependent setpoint
2	Piping with diagram of pressure losses
3	Consumer with differential pressure diagram

The differential pressure of the pump (1) can be used in closed systems to achieve an almost constant differential pressure at the consumer (3).

Two dynamic pressure compensation methods are available: "Dynamic pressure compensation based on flow rate" and "Dynamic pressure compensation based on speed".

NOTE

The parameter values and value ranges/units entered are mutually dependent. This is why the first step in parameterising the frequency inverter is always to specify the applicable value range and units (refer to parameter *3-11*). If the value range or unit is subsequently changed, all dependent parameters must be checked for correctness again.

Based on flow rate

Dynamic pressure compensation is best realised based on the measured or estimated flow rate. To this end, the Dynamic Pressure Compensation Method parameter *(3-9-3-1)* is set to Flow Rate. The following diagram shows the setpoint compensation curve (solid line) as a function of the flow rate and relevant parameters.

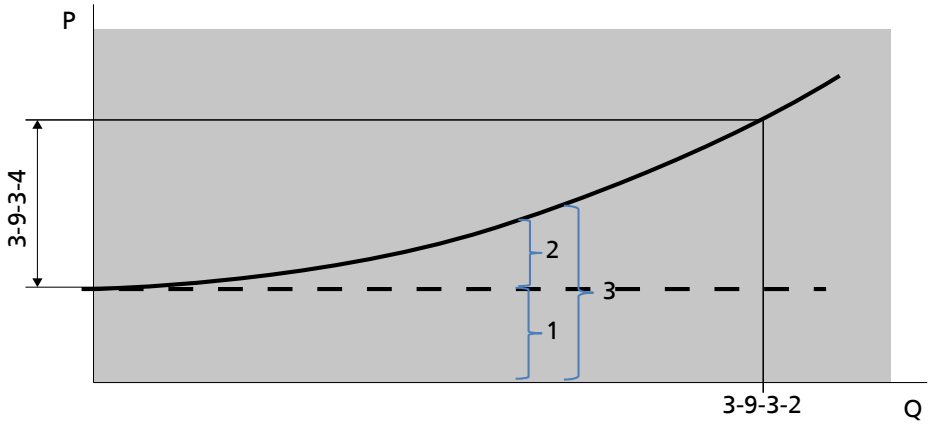

Fig. 74: Setpoint compensation curve for dynamic pressure compensation based on flow rate

1	Flow rate independent setpoint	2	Setpoint Compensation
3	Compensated setpoint		

The compensated setpoint (3) is the sum of the flow rate independent setpoint (1) and setpoint compensation (2). The flow rate independent setpoint (1) is configured as described in (⇨ Section 7.6, Page 75) Setpoint compensation (2) starts at flow rate Q = 0 and reaches the value defined under Setpoint Compensation *(3-9-3-4)* at the Dyn Press Comp Q Data Point *(3-9-3-2)* flow rate. Beyond that, setpoint compensation continues along the parabola shown.

The relatively small pressures in the lower flow rate range may not be sufficient to open installed swing check valves. In order to achieve the pressure required in this range, parameter *(3-9-3-5)* can be used to define a minimum setpoint compensation value. The following diagram shows the influence of minimum setpoint compensation on the setpoint compensation curve.

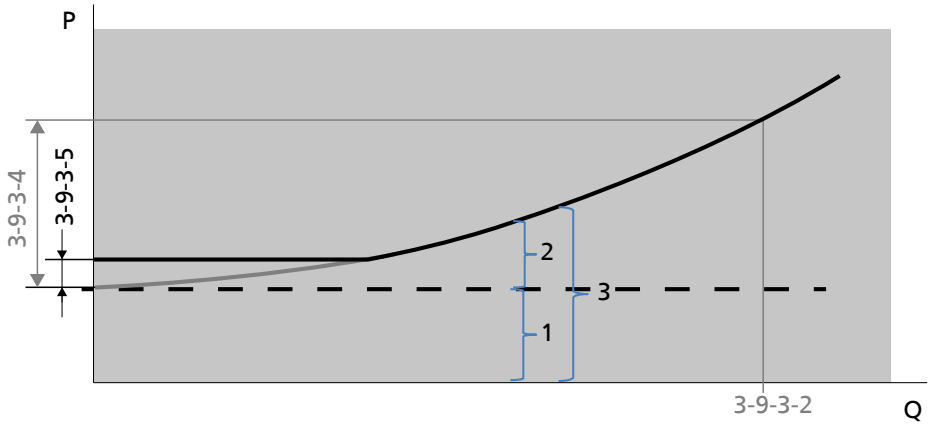

Fig. 75: Setpoint compensation curve for dynamic pressure compensation based on flow rate with minimum setpoint compensation *(3-9-3-5)*

1	Flow rate independent setpoint	2	Setpoint Compensation
3	Compensated setpoint		

Based on speed (for closed hydraulic circuits)

If neither the measured nor estimated flow rate is available, dynamic pressure compensation can be realised based on speed. This is only possible for closed hydraulic circuits and single-pump configurations, however. To this end, the Dynamic Pressure Compensation Method parameter *(3-9-3-1)* is set to Speed.

The following diagram shows the setpoint compensation curve (solid line) as a function of the speed and relevant parameters.

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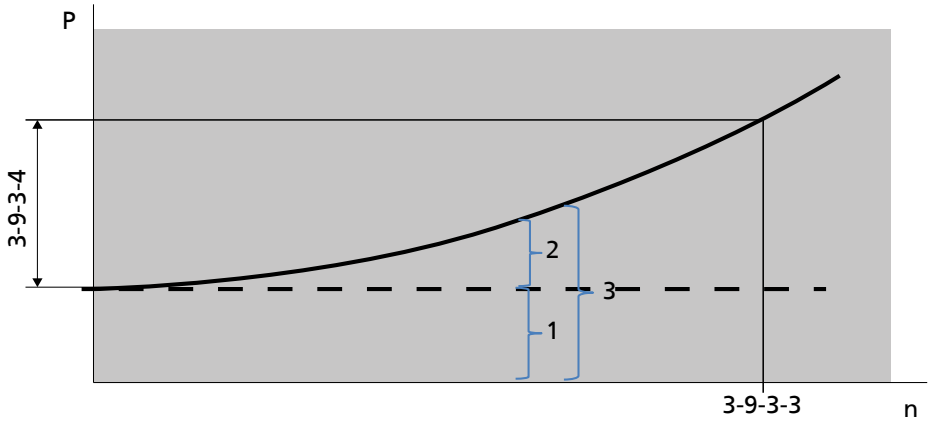

Fig. 76: Setpoint compensation curve for dynamic pressure compensation based on speed

1	Flow rate independent setpoint	2	Setpoint compensation
3	Compensated setpoint		

The compensated setpoint (3) is the sum of the flow rate independent setpoint (1) and setpoint compensation (2). The flow rate independent setpoint (1) is configured as described in (⇨ Section 7.6, Page 75) . Setpoint compensation starts at speed n = 0 and reaches the value defined under Setpoint Compensation *(3-9-3-4)* at the Dyn Press Setpoint Comp n Data Point *(3-9-3-3)* speed. Setpoint compensation continues along the parabola shown. The Minimum Setpoint Compensation parameter *(3-9-3-5)* can be used to define a minimum setpoint compensation value for opening swing check valves.

Table 73: Pressure/differential pressure control parameters with dynamic pressure compensation

Parameter	Description	Possible settings	Factory setting
3-9-3-1	Dynamic Pressure Compensation Method *Selecting the dynamic differential pressure compensation method (DFS). Dynamic pressure compensation based on speed can only be used for systems without a geodetic head (e.g. in closed systems).*	▪ OFF ▪ Speed ▪ Flow Rate	-
3-9-3-2	Dyn Press Comp Q Data Point *The setpoint compensation value is reached at this point. Beyond that, the setpoint is further increased with respect to the specified value.*	Minimum to maximum flow rate	Dependent on the unit set
3-9-3-3	Dyn Press Comp n Data Point *The setpoint compensation value is reached at this point. Beyond that, the setpoint is further increased with respect to the specified value. Data is entered in % in reference to Maximum Motor Speed (3-2-2-2).*	Referring to parameter 3-2-2-2 Maximum Motor Speed	0 %
3-9-3-4	Setpoint Compensation *Configurable setpoint compensation at data point 3-9-3-2 or 3-9-3-3*	Minimum to maximum limit of measuring range	Dependent on the unit set
3-9-3-5	Minimum Setpoint Compensation *Minimum setpoint compensation for opening the swing check valve in the case of low pump flow rates.*	Minimum to maximum limit of measuring range	Dependent on the unit set

Sensorless differential pressure control with dynamic pressure compensation (Sensorless Dyn Press Comp)

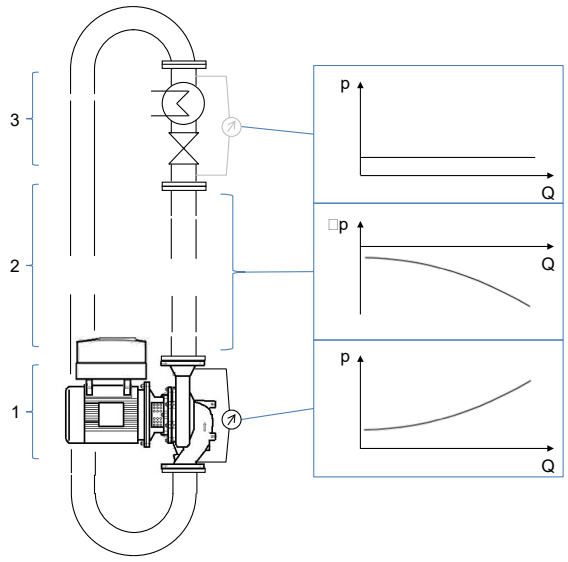

Fig. 77: Differential pressure control with dynamic pressure compensation in closed system

1	Pump set with diagram of flow rate-dependent setpoint
2	Piping with diagram of pressure losses
3	Consumer with differential pressure diagram

In a closed hydraulic system, an almost constant differential pressure can be achieved at the consumer through sensorless dynamic pressure compensation, without the need for pressure sensors. The method is based on the characteristic curves of the pump. Steep power curves are conducive to high process accuracy. The process is suitable to a limited extent if sections of the power curve are constant over the flow rate. It is activated by setting the Type of Control parameter *(3-6-1)* to Differential Pressure (Sensorless) and setting the Dynamic Pressure Compensation Method *(3-9-3-1)* to Flow Rate.

NOTE

Sensorless differential pressure control with dynamic pressure compensation does not work if the Dynamic Pressure Compensation Method (*3-9-3-1*) parameter has been set to Speed.

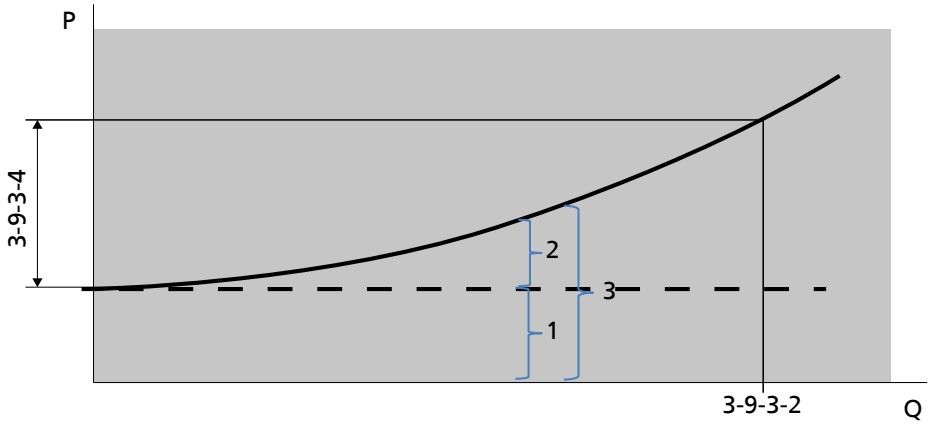

Fig. 78: Setpoint compensation curve for dynamic pressure compensation based on flow rate

1	Flow rate independent setpoint	2	Setpoint Compensation
3	Compensated setpoint		

The diagram shows the setpoint compensation curve (solid line) as a function of the flow rate and relevant parameters. The compensated setpoint (3) is the sum of the flow rate independent setpoint (1) and setpoint compensation (2). The flow rate independent setpoint (1) is configured as described in (⇨ Section 7.6, Page 75) . Setpoint compensation (2) starts at flow rate Q = 0 and achieves the value defined under Setpoint Compensation *(3-9-3-4)* at the Dyn Press Comp Q Data Point *(3-9-3-2)* flow rate. Setpoint compensation also continues along the parabola shown. A minimum pressure increase as for dynamic pressure compensation with pressure sensors is not possible.

NOTE

To facilitate sensorless differential pressure control, all parameters of the pump characteristic curves (*3-4-1*, *3-4-3-1* to 3-4-3-22) must be entered.

Table 74: Parameters for sensorless pressure/differential pressure control with dynamic pressure compensation

Parameter	Description	Possible settings	Factory setting
3-6-1	Type of Control *Selecting the control method. The controller is deactivated when OFF (Open-loop Control) is selected.*	Differential pressure (sensorless)	Dependent on pump
3-9-3-1	Dynamic Pressure Compensation Method *Selecting the dynamic differential pressure compensation method (DFS). Dynamic pressure compensation based on speed can only be used for systems without a geodetic head (e.g. in closed systems).*	Flow Rate	OFF
3-9-3-2	Dyn Press Comp Q Data Point *The setpoint compensation value is reached at this point. Beyond that, the setpoint is further increased with respect to the specified value.*	Minimum to maximum flow rate	0 m^3/h
3-9-3-4	Setpoint compensation *Configurable setpoint compensation at data point 3-9-3-2 or 3-9-3-3*	Minimum to maximum limit of measuring range	0 %

7.8.4.2 Sleep mode

NOTE

In stand-by mode (sleep mode), PumpDrive may start up without any warning if the actual value exceeds the Maximum Control Deviation for Restart *(3-9-4-5)*.

Stand-by mode (sleep mode) can be used for the following control tasks:

- Controlling the discharge pressure or differential pressure (including sensorless control)
- Controlling the temperature for heating
- Controlling the level for filling

NOTE

In pressure control applications, sleep mode requires that the system sensor used for control be fitted downstream of the swing check valve
(⇨ Section 7.11, Page 146) (see Figure: PumpMeter as source of internal measured variable per pump, external pressure sensor as actual value source).

Sleep mode allows the single or multiple pump system to be started and stopped as required. If sleep mode is activated, the frequency inverter stops the pump in the case of low flow rates, i.e. should the low flow limit be continuously undershot (3-4-3-30) or the stop speed be continuously undershot (3-9-8-4). In pressure control applications, an accumulator can be filled during brief operation with an increased setpoint *(3-9-4-2)* prior to stopping. If a drop in pressure and, thus, a flow rate requirement are detected, the pump restarts.

Sleep mode only takes effect in closed-loop control mode. In multiple pump systems, sleep mode only takes effect if just one pump is running. Sleep mode is activated via parameter *(3-9-4-1)*.

Stand-by mode (sleep mode) with setpoint increase

This sleep mode variant is active if a value larger than 0 is selected for the Setpoint Increase parameter *(3-9-4-2)*.

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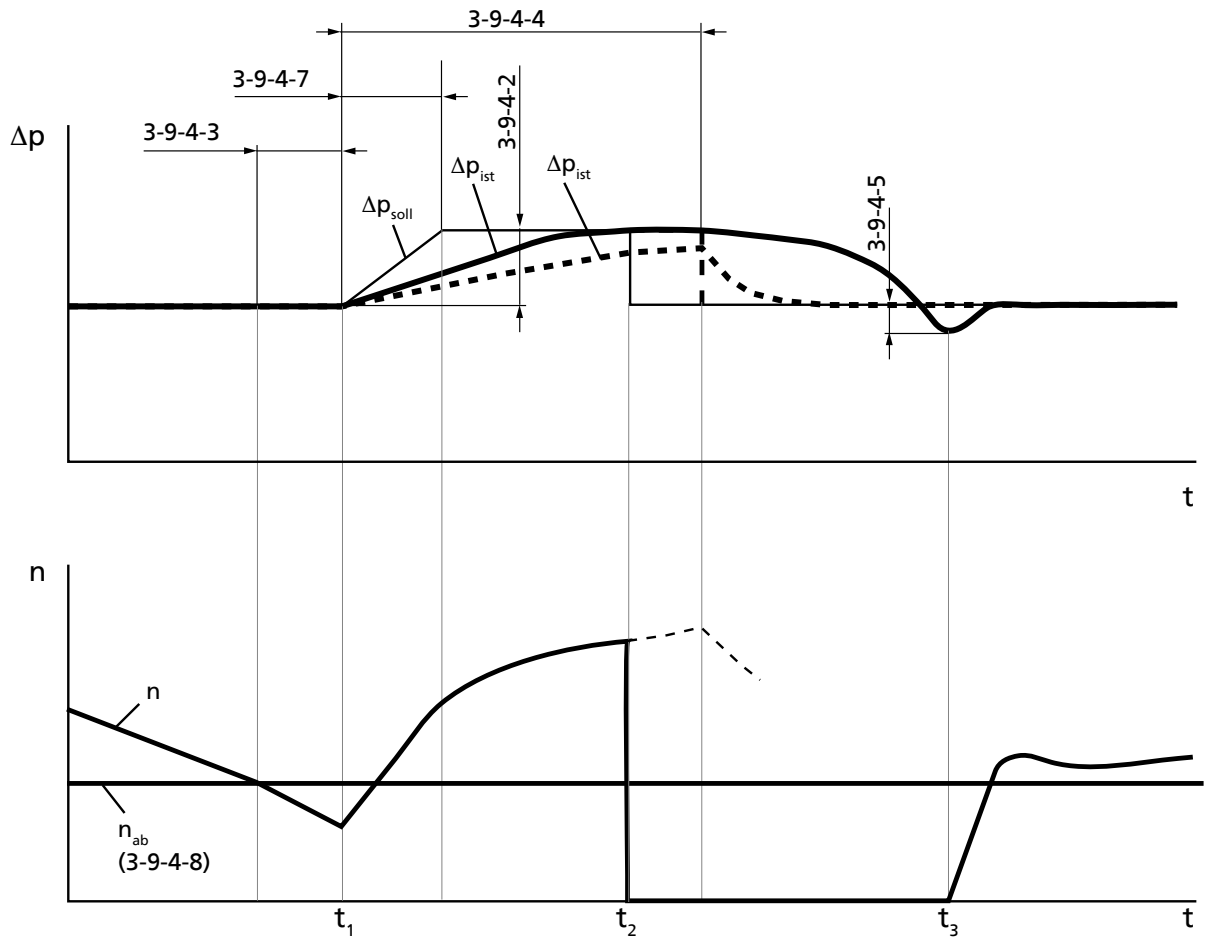

Fig. 79: Sleep mode with setpoint increase (shown here by example after the stop speed has been undershot)

Δp_{actual} ———	Actual value reaches increased setpoint.
Δp_{actual} — — —	Actual value does not reach increased setpoint.

If the low flow limit *(3-4-3-30)* or stop speed *(3-9-4-8)* of the pump is undershot due to minimum withdrawal over the specified period *(3-9-4-3)*, setpoint increase starts (t1). In the process, the setpoint is increased along a ramp until it reaches the target setpoint increase *(3-9-4-2)* and is maintained at a constant level. The ramp time is defined by the Ramp-up Time for Setpoint Increase parameter *(3-9-4-7)*. The total duration of setpoint increase is limited by parameter *3-9-4-4*. Control now targets the increased setpoint. If the increased setpoint is reached within this time, stop is triggered (t2). If the actual value does not reach the increased setpoint within this time, the setpoint is reset and the stop attempt cancelled. The pump then operates for a configurable minimum time *(3-9-4-6)* before another stop attempt can be started.

Restarting

Pressure drops as soon as fluid is withdrawn. If the configurable limit value for the Maximum Control Deviation for Restart *(3-9-4-5)* is achieved, the pump starts up again (t3).

NOTE

In a multiple pump system, starting of an additional pump cancels the stop attempt.

Stand-by mode (sleep mode) without setpoint increase

This sleep mode variant is active if the value 0 is selected for the Setpoint Increase parameter *(3-9-4-2)*.

If the low flow limit *(3-4-3-30)* or stop speed *(3-9-4-8)* of the pump is undershot due to minimum withdrawal over the specified period *(3-9-4-3)*, the pump is stopped.

Pressure drops as soon as fluid is withdrawn. If the configurable limit value for the Maximum Control Deviation for Restart *(3-9-4-5)* is achieved, the pump restarts.

NOTE

The parameter values and value ranges/units entered are mutually dependent. This is why the first step in parameterising the frequency inverter is always to specify the applicable value range and units (refer to parameter *3-11*). If the value range or unit is subsequently changed, all dependent parameters must be checked for correctness again.

Table 75: Parameters for stand-by mode (sleep mode)

Parameter	Description	Possible settings	Refers to	Factory setting
3-9-4-1	Sleep Mode *Sleep mode ON/OFF*	▪ ON ▪ OFF	-	OFF
3-9-4-2	Setpoint Increase *Pressure increase required for tank filling*	Minimum to maximum limit of value range	-	0
3-9-4-3	*Monitoring Period* *Configurable monitoring period until setpoint increase or stop*	0,0…600,0	-	20,0 s
3-9-4-4	Duration of Setpoint Increase *Maximum duration of setpoint increase. Stop is triggered if the setpoint is reached within this window. The duration of the setpoint increase must exceed the time of the ramp defined for the increase.*	0,0…600,0	-	10,0 s
3-9-4-5	Permissible Deviation *Maximum permissible control deviation for restart*	Minimum to maximum limit of value range	-	1 % of the value range of the controlled variable selected
3-9-4-6	Minimum Runtime *Minimum period of time between two stop attempts in sleep mode*	0,0...600,0	-	60,0 s
3-9-4-7	Ramp-up Time for Setpoint Increase *Ramp-up time during which the setpoint is increased*	0,0...1000,0	-	5,0 s
3-9-4-8	Stop Speed *The pump is stopped if the low flow limit or stop speed of the pump is undershot due to minimal withdrawal over period 3-9-4-3.*	Minimum to maximum limit of value range	-	3-2-2-1

Response to Low Flow warning

If low flow is detected in the system, after an internal debounce time has lapsed for operation under low flow or overload conditions, no warning is displayed. The internal debounce time is set by default and can only be changed at Service access level.

Instead, the time delay for hydraulic warnings (*3-4-3-33*) starts after the internal debounce time has lapsed. After this time delay has expired, a Low Flow or Overload warning is generated if the relevant limit flow rate is continually undershot or exceeded.

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The time delay for hydraulic warnings runs in parallel to the monitoring time for stand-by (sleep) mode (*3-9-4-3*). Consequently, in the case of a long pre-set delay period (*3-4-3-33 > 3-9-4-3*) the warning only appears if sleep mode is deactivated or in situations that cannot result in tripping.

7.8.4.3 Energy savings meter

The energy savings meter determines the electrical energy saved by operation on a frequency inverter. To this end, the difference between the current input power of the pump set *(1-2-1-4)* and a reference power is determined and integrated over time. The result of the calculation is displayed as energy saved *(1-4-1-4)* in kilowatt hours. The Energy Savings Meter parameter *(3-9-5-1)* can be used to choose between two calculation methods:

- Method with constant reference power
- Method with variable reference power

Constant reference power

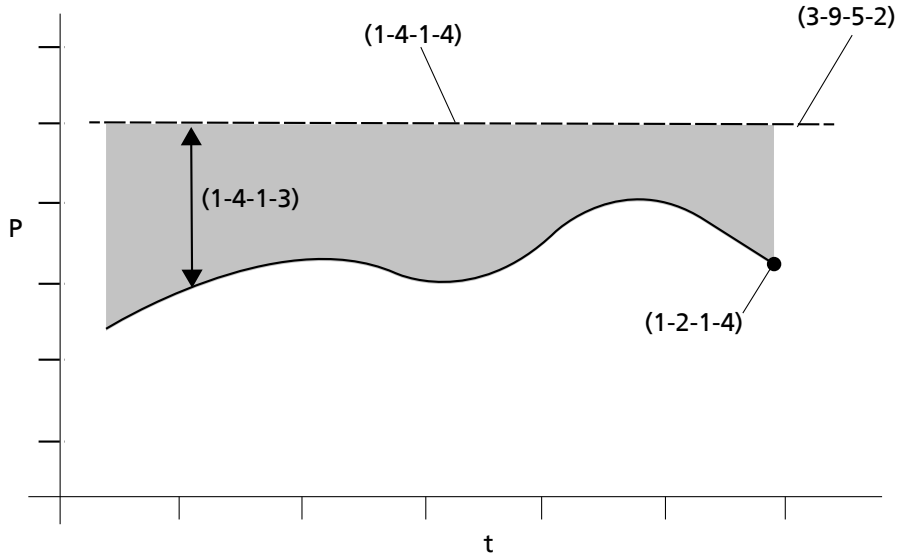

Fig. 80: Energy savings with constant reference power

P	Effective power
t	Time
1-2-1-4	Current input power of frequency inverter
1-4-1-3	Δ P
1-4-1-4	Energy saved
3-9-5-2	Reference power

The method with constant reference power requires specification of the power in kW. This is the average effective power of the running pump set for operation without a frequency inverter. The specification is made using the Fixed Reference Power parameter *(3-9-5-2)*.

Variable reference power

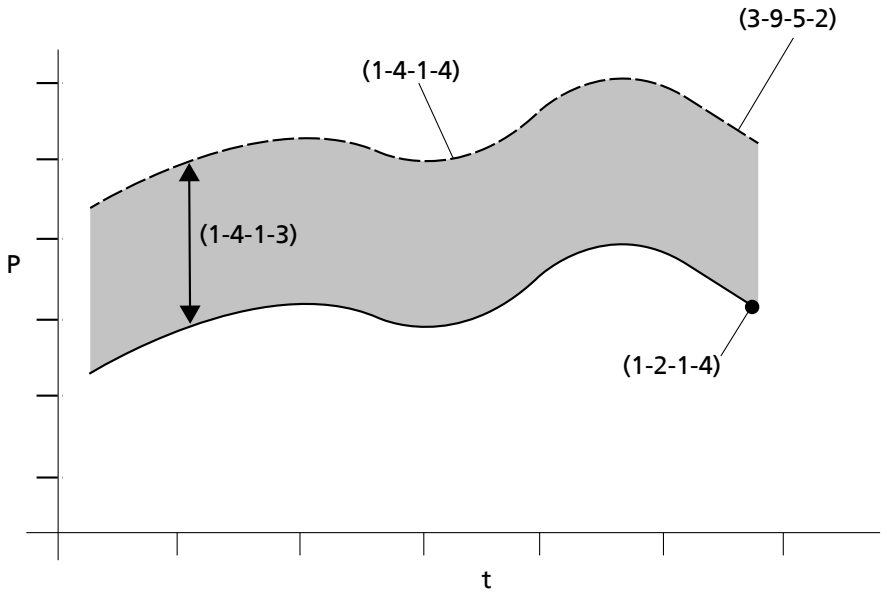

Fig. 81: Energy savings with variable reference power

P	Effective power
t	Time
1-2-1-4	Current input power of frequency inverter
1-4-1-3	Δ P
1-4-1-4	Energy saved
3-9-5-2	Reference power

The method with variable reference power calculates the reference power automatically. The effective power of the pump set that would be required with the current flow rate for fixed speed operation without a frequency inverter is calculated and used as the reference power. For this method, the Flow Rate Estimation parameter *(3-9-8-1)* must be activated.

Both methods take into account the losses directly attributed to the frequency inverter. The energy currently being saved can be displayed via *(1-4-1-3)*. Parameters *1-4-1-6* and *1-4-1-5* output the electricity costs saved and the CO_2 emissions avoided. Adapt parameters *(3-9-5-3)* and *(3-9-5-4)* for this purpose if required. The energy savings meter is reset via the Reset Energy Savings Meter parameter *(1-4-1-7)*.

Table 76: Energy savings meter parameters

Parameter	Description	Possible settings	Refers to	Factory setting
1-4-1-3	Power Saved *Power saved in relation to fixed speed pump*	Display value in kW	3-9-5-1 3-9-5-2	-
1-4-1-4	Energy Saved *Energy saved in relation to fixed speed pump*	Display value in kWh	3-9-5-1 3-9-5-2	-
1-4-1-5	CO_2 Emission Reduction *Reduction in carbon dioxide emissions in comparison with fixed speed pump*	Display value in kg	3-9-5-3	-
1-4-1-6	Costs Saved *Energy cost savings, in national currency, in comparison with fixed speed pump*	Display value in national currency	3-9-5-4	-
1-4-1-7	Reset Energy Savings Meter	Run / ESC	-	-

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Parameter	Description	Possible settings	Refers to	Factory setting
3-9-5-1	Energy Savings Meter *Selection of method for energy savings metering*	▪ OFF ▪ Fixed Reference Power ▪ Variable Reference Power	-	OFF
3-9-5-2	Fixed Reference Power *Configurable reference power of fixed speed pump for energy savings meter*	0 … 110 kWh	-	0 kWh
3-9-5-3	CO2 Emissions per kWh *Carbon dioxide emissions per kWh*	0 … 10000 g/kWh	-	500 g/kWh
3-9-5-4	Electricity Costs per kWh	0,000... 1000,000	-	0,140
3-9-8-1	Flow Rate Estimation *Activation of flow rate estimation*	▪ ON ▪ OFF	-	ON

7.8.4.4 Waste Water Function

7.8.4.4.1 Starting the pump set at maximum speed

This function ensures that a relatively high flow rate is achieved in a short period of time. In this way, solid deposits and gas cushions are transported away at every start-up to prevent clogging or blockage. The function is activated by the Pump Start at Maximum Speed parameter *(3-9-9-7)*. The duration of pump operation at maximum speed is defined by the Duration of Maximum Speed parameter *(3-9-9-8*). After this time lapses, the system switches to closed-loop control mode or open-loop control mode with freely selectable speed.

Table 77: Pump Start at Maximum Speed parameter

Parameter	Description	Possible settings	Factory setting
3-9-9-7	Pump Start at Maximum Speed *Start-up along a ramp up to maximum speed and maintaining maximum speed for the duration of a defined period of time. The function is run or executed at every start to prevent deposits in the pump sump and in the piping.*	▪ ON ▪ OFF	OFF
3-9-9-8	Duration of Maximum Speed *Configurable period of time for which the frequency inverter maintains maximum speed.*	0,0…600,0	180,0

7.8.4.4.2 Monitoring minimum flow velocity and pipe flushing

Monitoring minimum flow velocity

Together with the flushing function, this function makes it possible to prevent disruptive solid deposits from accumulating in piping. When the function is activated, the flow rate measured or estimated is used to compute the flow velocity in the piping, the internal diameter of which is specified by parameter *(3-9-9-6)*. Continued operation below the minimum flow velocity *(3-9-9-2)* triggers a warning and, depending on how parameter *(3-9-9-1)* is set, a pipe flushing routine. The duration of operation below the minimum value is defined by parameter *(3-9-9-3)*. The current flow velocity of the fluid in the system can be displayed at the control panel *(1-2-3-8)*.

Pipe flushing

Closed-loop control mode is required for pipe flushing. Pipe flushing is not possible in open-loop control mode or manual mode. Pipe flushing is triggered manually by activating the Immediate Pipe Flushing parameter *(1-3-7)* at the control panel or by minimum flow velocity monitoring *(3-9-9-1)*. When pipe flushing is triggered, control to achieve a constant pipe flushing flow velocity *(3-9-9-5)* is activated in addition to routine control. Control at the higher speed takes priority so that either the pipe flushing flow velocity is achieved or, if the routine operative control task so requires, exceeded. Pumps operated in a multiple pump configuration are started and stopped as required. Pipe flushing ends after the defined time *(3-9-9-4)*.

This function can also be assigned to the FUNC key.

Table 78: Monitoring minimum flow velocity and pipe flushing

Parameter	Description	Possible settings	Factory setting
1-3-7	Immediate Pipe Flushing *This function allows the pipe flushing function to be started manually once.*	Run	
3-9-9-1	Flow Velocity Monitoring *Activates flow velocity monitoring. Depending on the selection made, a warning is output when the value defined in 3-9-9-2 is undershot, and the pipe flushing function may also be started.*	▪ OFF ▪ Warning ▪ Warning + Pipe Flushing	OFF
3-9-9-2	Minimum Flow Velocity *The minimum flow velocity set here must be undershot for a configurable period of time so that the pipe flushing function starts or a warning is displayed, depending on the configuration.*	0,0…10,0 m/s	2,0
3-9-9-3	Time Delay, Flow Velocity Monitoring *Configurable period of time for which the minimum flow velocity must be continually undershot so that the pipe flushing function starts.*	0…168 h	24
3-9-9-4	Duration of Pipe Flushing *Duration of the pipe flushing cycle during which alternative control is active*	0…120 min	2
3-9-9-5	Pipe Flushing Flow Velocity *Flow velocity value during flushing*	0,0…10,0 m/s	4,0
3-9-9-6	Inside Pipe Diameter of System *Pipe diameter of system*	0…5000 mm	0

7.8.5 Ramps

Start and stop ramps (open-loop control mode/manual mode, closed-loop control mode)

Starting and stopping take place via speed ramps. A distinction is made between a start ramp and a stop ramp. The ramps are defined via parameters *3-3-5-1*, *3-3-5-2* and *3-2-2-2*. In open-loop control mode, the start ramp is left when the control value is reached. In closed-loop control mode, the start ramp is left when the speed defined by the controller is reached. The stop ramp is activated as soon as a stop signal is issued.

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⚠ WARNING

Stop ramp time set exceeded in the case of steep stop ramps in conjunction with pronounced mass inertia. (A "Limited Stop Ramp" warning is output.)

Hazard to operating personnel caused by rotating machine parts!

- ▷ Always keep a safe distance from rotating parts until the machine has come to a complete standstill.

NOTE

In the event of a stop via the DI-EN digital input, the motor is not stopped by the stop ramp, but coasts to a standstill. The amount of time this process takes depends on the mass moment of inertia of the system. The drive remains disabled during coasting. The Motor Disabled status is displayed on the control panel.

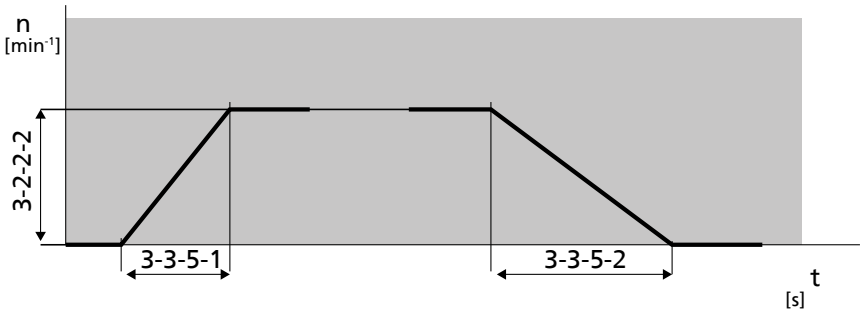

Fig. 82: Start ramp (left) and stop ramp (right)

n	Speed	t	Time

Table 79: Start and stop ramp parameters

Parameter	Description	Possible settings	Factory setting
3-3-5-1	Start Ramp Time *Time defining the start ramp*	1 - 600 s	3 s
3-3-5-2	Stop Ramp Time *Time defining the stop ramp*	1 - 600 s	3 s
3-2-2-2	Maximum Motor Speed	*3-2-2-1…3-11-1-2*	Motor-specific

Operating ramp (open-loop control mode/manual mode)

To avoid spontaneous changes in speed in open-loop control mode/manual mode, operating ramps limit the change velocity of the speed. If a speed change curve is flatter than the operating ramp, no limitation occurs.

Parameters *3-2-2-2* and *3-3-5-3* are used for defining the operating ramp.

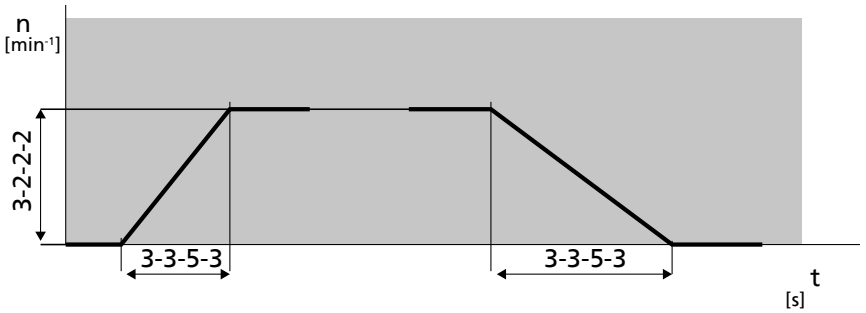

Fig. 83: Operating ramp

n	Speed	t	Time

Table 80: Operating ramp parameters

Parameter	Description	Possible settings	Factory setting
3-3-5-3	Operating Ramp Time *Time defining the ramps for speed changes in open-loop control mode or in manual mode*	1 - 600 s	3 s
3-2-2-2	Maximum Motor Speed	*3-2-2-1…3-11-1-2*[1]	Motor-specific

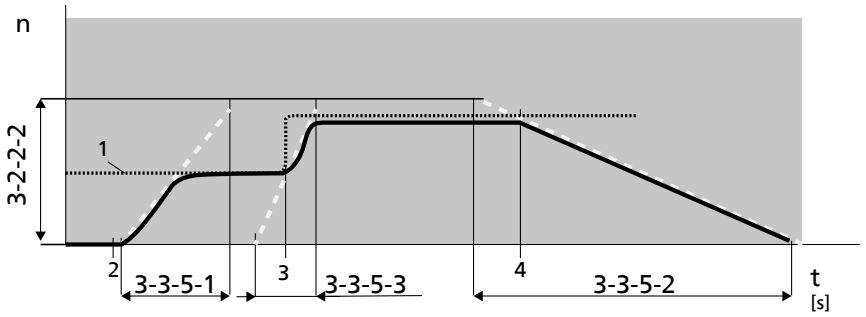

Fig. 84: Example speed curve in open-loop control mode

The illustration shows, by example, a speed curve in open-loop control mode as a solid line. The control value (speed setting) is displayed as a dotted line. The start command takes effect at time 2. The speed increases along the start ramp until the control value (1) is reached and maintained. The control value increases spontaneously at time 3. The speed increases along the operating ramp until the increased control value is reached and maintained. The stop command takes effect at time 4. The speed decreases along the stop ramp until the machine comes to a standstill.

Setpoint ramp (closed-loop control mode)

In closed-loop control mode, setpoint changes are made along the setpoint ramp. This, in turn, avoids spontaneous changes in speed and system oscillations. The inclination of the setpoint ramp is defined by parameter 3-6-4-6 and control range Δx as shown in Figure 4. Control range Δx results from Type of Control 3-6-1 and the settings in the Value Ranges and Units menu 3-11. Two examples:

Example 1 **Control targets constant discharge pressure:**
The Type of Control parameter *(3-6-1)* is set to Discharge Pressure. Accordingly, control range Δx is limited by the Minimum Pressure *(3-11-2-1)* and Maximum Pressure *(3-11-2-2)* parameters.

Example 2 **Control targets constant temperature:**
The Type of Control parameter *(3-6-1)* is set to Temperature (Heating). Accordingly, control range Δx is limited by the Minimum Temperature *(3-11-4-1)* and Maximum Temperature *(3-11-4-2)* parameters.

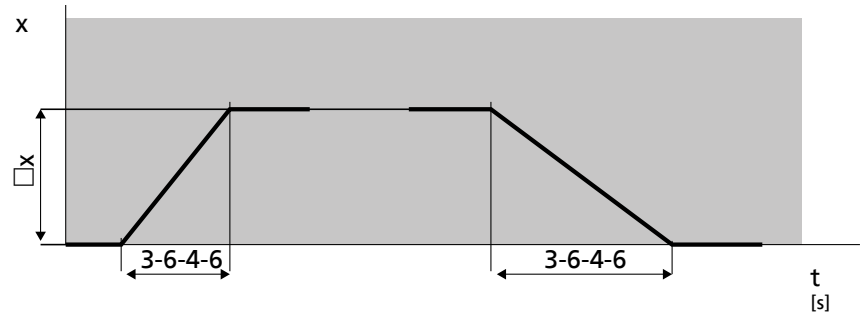

Fig. 85: Setpoint ramp

x	Controlled variable	t	Time
Δx	Control range		

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Table 81: Setpoint ramp parameters

Parameter	Description	Possible settings	Factory setting
3-6-4-6	Setpoint Ramp Time *Time defining the setpoint ramp*	1 - 600 s	3 s

7.8.6 Motor standstill heater

The frequency inverter is equipped with a parameterisable motor standstill heater. When the motor standstill heater is activated, a direct current is applied to the motor windings while the motor is stopped in relation to the cool-down behaviour of the motor winding. This ensures that sufficient heat is generated to prevent condensation from building inside the motor as well as rules out frost damage that can occur when the motors are stopped in a cold ambient environment.

NOTE

The motor standstill heater can only be activated at a standstill and in the OFF or Auto Stop operating modes of the frequency inverter. If the frequency inverter is in the "disabled" status due to e.g. an alert or another function, the standstill heater is not switched on. In addition, to safeguard the operative performance of the motor standstill heater, the PTC monitoring device of the motor must be activated via the frequency inverter using parameter *3-2-3-1*. If the PTC analysis function is deactivated when the motor standstill heater is activated, PTC analysis automatically becomes inactive.

The motor standstill heater can be activated or deactivated via the Motor Standstill Heater parameter *(3-2-5-1)*. The current status of the motor standstill heater is displayed as an information message in the control panel of the frequency inverter. The amount of heating current applied can be changed via the Heating Current parameter *(3-2-5-2)*. This parameter is a service parameter as it should only be changed by qualified staff. The motor standstill heater usually operates with the factory default settings. As soon as the system start procedure has been carried out and the motor starts up, the motor standstill heater is automatically switched off.

Table 82: Motor standstill heater parameters

Parameter	Description	Possible settings	Factory setting
3-2-5-1	Motor Standstill Heater *Heating the motor via the motor windings*	▪ ON ▪ OFF	OFF
3-2-5-2	Heating Current *Heating current in % of nominal motor current*	0,00…50,00	20,00

7.8.7 Pipe filling function

This function is used to avoid surge pressures that can arise when piping is filled at high flow velocities. When this function is activated, piping systems are filled at a low flow velocity and system pressure is slowly established using a configurable gradient before the system automatically switches to closed-loop pressure control after the filling function is completed. The function is suited to filling horizontal, vertical and combined piping.

The function can be activated once to initially fill the piping. It can also be parameterised as a monitoring function and is then always run prior to standard operation as part of the system start-up procedure if the pressure falls below a configurable limit value (e.g. after rectifying leaks).

If activated simultaneously, the pipe filling function has priority over the Pump Start at Maximum Speed function.

NOTE

When the pipe filling function is activated, the function for protecting against hydraulic blockage is deactivated. (⇨ Section 7.8.2.8, Page 97)

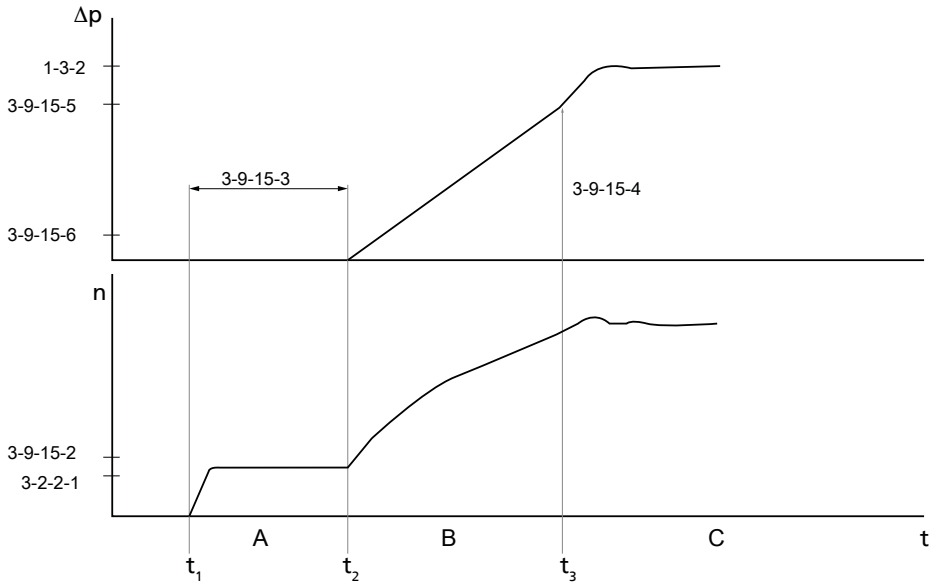

Fig. 86: Pipe filling function time diagram

A	Filling of the horizontal section
B	Filling of the vertical section
C	Pressure control mode

The diagram depicted plots the initial system pressure below the limit value (*3-9-15-6*). At time t_1, the system starts, and when the Start with Pipe Filling Function parameter (*3-9-15-1*) has been pre-selected, the pipe filling function is activated and the horizontal section of the piping system is filled first. To this end, the frequency inverter sets the Start Speed (*3-9-15-2*) for the Duration Initial Speed configured (*3-9-15-3*).

After completion at time t_2, the control system switches to the mode for filling the vertical section. In this phase, the setpoint for the controlled variable selected is increased linearly in accordance with the gradient defined in the Setpoint Increase per Min parameter until the setpoint specified reaches the full-scale value (*3-9-15-5*).

From time t_3, the drive switches to the operating mode selected. The setpoint (*1-3-2*) is now defined and closed-loop control mode is activated, as shown in the diagram. During filling, an information message (I103) indicates that the procedural sequence is active. The message disappears automatically when the pipe filling function has been completed.

If a sensorless control mode is used, the mode for filling the vertical section is only possible to a limited extent. Starting the function only when a limit value (*3-9-15-6*) is undershot is not possible in conjunction with sensorless control modes.

In multiple pump systems, the horizontal section of the piping system is always filled using a single pump.

Pipe filling function in open-loop control mode

In open-loop control mode, the Limit Value Undershot selection option for the Start with Pipe Filling Function parameter (*3-9-15-1*) is disabled. The horizontal section is filled as described for closed-loop control mode. When the vertical section is filled, the pump accelerates along a speed ramp until the full-scale value (*3-9-15-5*) is reached and then adopts the speed set in the Control Value (Open-loop Control) parameter.

Table 83: Pipe filling function parameters

Parameter	Description	Possible settings	Unit	Factory setting
3-9-15-1	Start with Pipe Filling Function *The pipe filling function is initiated at the next system start.*	▪ 0 = OFF ▪ 1 = Once ▪ 2 = Limit Value Undershot	-	0 = OFF
3-9-15-2	Initial Speed *Speed value activated at the beginning of the pipe filling mode*	Minimum to maximum limit of value range set (Parameterisation with the KSB ServiceTool)	rpm	3-2-2-1
3-9-15-3	Duration Initial Speed *Duration of the first phase of the filling process performed at the initial speed*	0…6000	s	60
3-9-15-4	Setpoint Increase per Minute *Increment of the setpoint increase for the second phase of the filling process*	Minimum to maximum limit of value range set (Parameterisation with the KSB ServiceTool)	Dependent on the unit set	2 % of the value range of the control type selected
3-9-15-5	Final Value *Final value of setpoint; when it is reached the second phase of the filling process is stopped.*	Minimum to maximum limit of value range set (Parameterisation with the KSB ServiceTool)	Dependent on the unit set	0
3-9-15-6	Limit Value *When Limit Value Undershot is selected under 3-9-15-1, the system will start the pipe filling function if the actual value falls below the limit value.*	Minimum to maximum limit of value range set (Parameterisation with the KSB ServiceTool)	Dependent on the unit set	0

7.8.8 Functions for pressure booster systems

7.8.8.1 Lack of water

A lack of water in the system can be detected via the frequency inverter by configuring a digital input or via inlet pressure monitoring.

Configuration via a digital input

When configuring a digital input with the Lack of Water function, alert A17 (lack of water) is activated or deactivated in relation to the digital input signal (low/high signal).

If there is a Low signal at the digital input, the frequency inverter generates the lack-of-water alert and stops all pumps operating in Auto mode. The signal is always analysed at the digital input of the active main pump in the system.

The acknowledgement type of the alert can be defined via the Lack of Water Alarm Behaviour parameter (*3-9-11-1*). Possible settings are “Self-acknowledging” and “Non-self-acknowledging”. An active alert can be acknowledged by any pump in the system.

Stopping of the pumps in the system via the lack-of-water alert can be delayed by the Time Delay for Stop parameter (*3-9-11-2*). After the set period of time has lapsed, the pumps are switched off. If the signal changes back to High signal at the digital

input during the delay period, an alert is not output. The lack-of-water alert will be active in the system for at least the period of time defined in the Minimum Alert Duration parameter (*3-9-11-3*).

Inlet pressure monitoring

Monitoring of the system for lack of water can also be done by inlet pressure monitoring by way of measuring the suction pressure. To this end, the Monitoring via Suction Pressure Sensor parameter (*3-9-11-4*) must be set to "On".

The measured values for the suction pressure are recorded via the sensor signal at the analog input. The lack-of-water alert is generated in relation to the Suction Pressure Stop Limit (*3-9-11-5*) and Suction Pressure Start Limit parameters (*3-9-11-6*). If the suction pressure falls below the stop limit, the alert is triggered. If the pumps in the system have been stopped by the lack-of-water alert and the start limit is exceeded, the pumps will be restarted.

The acknowledgement behaviour and timer operation of the alert can be defined as for configuration via a digital input using the Lack of Water Alarm Behaviour (*3-9-11-1*), Time Delay for Stop (*3-9-11-2*) and Minimum Alert Duration (*3-9-11-3*) parameters.

Choose the stop/start limits such that the pumps are not abruptly stopped and started again.

Should the pumps in the system be stopped by the lack-of-water alert, the alert message will remain active for at least the time defined in parameter *3-9-11-3*, even if the measured value signal exceeds the start limit *3-9-11-6* again before this time period has lapsed.

NOTE

If the Suction Pressure_Internal function is set at the analog input, the measured values are not used for monitoring purposes. Therefore, the Suction Pressure function must be set at the analog input. Use the Suction Pressure parameter (*1-2-3-2*) to display the current pressure on the suction side of the system. If recording of the suction pressure measured value is not configured at the analog input, lack-of-water monitoring does not take place.

NOTE

If inlet pressure monitoring (*3-9-11-4*) is activated and a digital input is configured with the lack-of-water function, the digital input has priority. In this scenario, the measured values for the suction pressure at the analog input are not evaluated. The lack-of-water alert is then generated exclusively in relation to the digital input signal.

NOTE

Inlet pressure monitoring can also take place by connecting PumpMeter to the M12 module. In this scenario, set the function of the M12 module input A to PMtr Suction/Discharge Pressure.

Table 84: Lack-of-water function parameters

Parameter	Description	Possible settings	Factory setting
3-9-11-1	Lack-of-water Alarm Behaviour *Function for resetting the lack-of-water alert*	▪ Non-self-acknowledging ▪ Self-acknowledging	Self-acknowledging
3-9-11-2	Time Delay for Stop *After this time delay has expired, the pump is stopped if the stop limit for lack of water is continually undershot.*	0.0…600.0 s	10,0 s

Parameter	Description	Possible settings	Factory setting
3-9-11-3	Minimum Alert Duration *Minimum duration of lack-of-water alert condition. The alert is active for at least this period of time.*	0.0…600.0 s	10,0 s
3-9-11-4	Monitoring via Suction Pressure Sensor *If the suction pressure falls below the stop limit, the lack-of-water alert is triggered.*	▪ OFF ▪ ON	OFF
3-9-11-5	Suction Pressure Stop Limit *If the stop limit for the suction pressure is continually undershot, the pump is stopped.*	-1.00…10.00 bar	1,00 bar
3-9-11-6	Suction Pressure Start Limit *If the pump has been stopped and this start limit is exceeded, the pump is restarted.*	-1.00…10.00 bar	1,50 bar

7.8.8.2 Coasting to a stop

To ensure that operation is gentle on the mechanical seal, you can use the Coast-down function to let the pump coast to a stop. If this function is activated, pulse width modulation (PWM) of the frequency inverter is deactivated and the motor is not braked along the stop ramp, but coasts to standstill from a set speed (*3-3-5-6*).

The amount of time this process takes depends on the moment of inertia of the system. The drive remains disabled during coasting. The Motor Disabled status is displayed on the control panel. This function is activated via the Motor Coasting parameter (*3-3-5-5*).

This parameter has 2 selection options:

- Off
  Function is deactivated; motor is stopped along the stop ramp.
- Fixed Speed
  At shut-down, if the motor coasting speed (*3-3-5-6*) is undershot, pulse width modulation (PWM) of the frequency inverter is deactivated such that the motor coasts to a stop.

Table 85: Coasting parameters

Parameter	Description	Possible settings	Factory setting
3-3-5-5	Motor Coasting *Deactivation of the stop ramp when stopping the motor. The motor coasts to a stop.*	▪ OFF ▪ Fixed Speed	OFF
3-3-5-6	Motor Coasting Speed *Speed from which the frequency inverter will, when decelerating along the stop ramp, let the motor coast to a stop*	0 - max. motor speed *3-2-2-2*	500

7.8.9 Flying start function

NOTE

The Flying Start Function should only be activated in the applications described below. It can only be started by trained specialist personnel (KSB Service). For this reason the following parameters can only be set at Service access level.

The Flying Start Function synchronises the rotating field of the rotating motor with the output signal of the power electronics of the frequency inverter at the time “system start” and / or “enable power electronics” is set at the frequency inverter on the control PCB.

Synchronisation works in both directions of rotation of the motor. This means that it works for a motor rotating in reverse due to, for example, a pump running in reverse, as well as for a pump running in the normal direction of rotation, for instance if slowly coasting to a stop due to a large moment of inertia.

After the rotor position has been determined, the motor follows the set start ramp until the control value and / or setpoint is reached, depending on the selected control mode.

Table 86: Parameters for Flying Start Function

Parameter	Description	Possible settings	Factory setting
3-3-7-8	Flying Start Function *Function used to enable flying start*	▪ OFF ▪ ON	OFF
3-3-7-9	Time, Flying Start Function *Time during which the frequency inverter searches for the synchronous speed*	0.0 … 20.0 s	2,5 s
3-3-7-10	Current, Flying Start Function *Defines the current in the motor, in % of the nominal motor current, to identify the synchronous speed*	10.00…45.00 %	30.00 %

The setting of parameter values depends on the motor type.

For asynchronous motors the time until the rotating field or the synchronous speed is determined is usually between 2 seconds and 4 seconds (*3-3-7-9* Time, Flying Start Function) The current value (3-3-7-10 Current, Flying Start Function) has to be set within the range from 25 % to 40 %.

With a KSB SuPremE motor lower parameter values for time and current can also achieve good results for determining the synchronous speed. The factory settings were generally made for the KSB SuPremE motor; however, they might have to be adjusted depending on the requirements, application and load at the site.

Higher parameter values for the time of the Flying Start Function enable a higher accuracy of recognition, however, they impact on the start-up procedure of the motor.

For the current of the Flying Start Function, too, higher parameter values are favourable for recognition, however, they could lead to alarm messages in the frequency inverter, such as A2 Overvoltage, A5 Short circuit or A9 Overcurrent.

NOTE

In the case that the Flying Start Function (*3-3-7-8*) and the Motor Coasting function (*3-3-5-5*) are activated at the same time, motor coasting or pump coasting will not lead to the power unit of the frequency inverter being disabled. Consequently, the message I101 “Drive disabled” will not be displayed on the graphical control panel. If the “System start” and / or “Enable power electronics” is enabled at the control PCB before the pump has come to a standstill, the motor can start up again after the synchronous speed has been determined by the Flying Start Function.

NOTE

When the Flying Start Function (*3-3-7-8*) is activated, the Disable Time After Critical Alert (*3-3-7-4*) is ignored. If a critical alert is active at the MotorControl during the motor stop ramp, message I101 “Drive disabled” is shown on the graphical control panel and the power unit of the frequency inverter is disabled. When the alert has been acknowledged and the cause of the alert has been eliminated, message I101 is no longer displayed and the drive can be started up again. If this process is carried out prior to the pump coming to a complete standstill, the Flying Start Function takes care of the motor start-up.

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NOTE

When the Flying Start Function (*3-3-7-8*) is activated, the Disable Time After Critical Alert (*3-3-7-4*) is ignored. If the drive is no longer enabled at the digital input "DI-EN", message I101 "Drive disabled" is shown on the graphical control panel and the power unit of the frequency inverter is disabled. If "Enable power electronics" is enabled again via "DI-EN" at the control PCB, message I101 is no longer displayed, and the drive can be started up again. If this process is carried out prior to the pump coming to a complete standstill, the Flying Start Function takes care of the motor start-up.

7.9 Device functions

7.9.1 Factory and user settings

NOTE

If the system has been commissioned/started up before, restoring the factory settings will cause all parameter settings made so far to be deleted if they have not been backed up using the service software or user settings.

Two additional user settings can be saved and loaded in the frequency inverter. The factory settings cannot be overwritten and can be loaded with parameter *(3-1-3-5)*.

NOTE

In a multiple pump configuration, Load Factory Settings *(3-1-3-5)* must be carried out separately on all frequency inverters. It is sufficient to save the settings on just one frequency inverter in the system. This approach must also be adopted when loading and saving user settings.

Table 87: Factory and user settings

Parameter	Description	Possible settings	Factory setting
3-1-3-1	Load User Settings 1	Run	-
3-1-3-2	Load User Settings 2	Run	-
3-1-3-3	Save User Settings 1	Run	-
3-1-3-4	Save User Settings 2	Run	-
3-1-3-5	Load Factory Settings *This function is used to reset the drive or system to the factory settings.*	Run	-

7.9.2 Read out PumpMeter

If the frequency inverter is not parameterised at the factory, all relevant data (motor data, characteristic curves of the pump) can be loaded into the frequency inverter from PumpMeter, provided that PumpMeter is connected via Modbus to input A of the M12 module.

NOTE

When loading data from PumpMeter, the data set at the factory is overwritten. The data in the frequency inverter could be more recent. Reloading the factory data is possible by using the default factory configuration.

Reading out the name plate

In order to read parameters such as pump characteristic curve and motor data from PumpMeter, the Function M12 Module Input A (*3-8-4-1*) parameter must be set to PMtr Suction / Discharge Pressure or PMtr Suction / Discharge Pressure_Internal. The frequency inverter must be in OFF or Auto Stop mode for this.

NOTE

When changing parameter *3-8-4-1* to one of the above-mentioned values (in particular in retrofit applications) a 24 V voltage reset is triggered, which is required for initialisation of the bus connection to PumpMeter.

Only then will it be possible to read out the name plate.

If reading out the name plate is interrupted before data transmission has been completed or if no communication can be established, the PumpMeter Communication warning will be output and none of the parameters already transmitted will be accepted. As motor data can also be changed by the read process, Automatic Motor Adaptation (AMA) needs to be started once again. Once the read process has been completed, the PumpMeter Upload Completed message is output. Motor parameters changed! Run AMA!

NOTE

When PMtr Suction / Discharge Pressure has been selected, parameter *3-8-4-1* needs to be reset to OFF after reading out the name plate, if the analog input is to be used as the source for control.

Table 88: Reading out PumpMeter

Parameter	Description	Possible settings	Factory setting
3-8-4-1	Function M12 Module Input A *Function of M12 module, input A. Internal operating values cannot be used as an actual value source.*	PMtr Suction / Discharge Pressure	OFF
3-13-1	Read Out Name Plate *Transfers the name plate information from PumpMeter to the frequency inverter*	Run	-
3-13-2	Address *Modbus address of PumpMeter device connected*	1...247	247
3-13-3	Baud Rate *Modbus baud rate of PumpMeter device connected*	▪ 9600 ▪ 19200 ▪ 38400 ▪ 115200	38400
3-13-4	System Bus Monitoring Period *Modbus time-out setting*	1...180 s	15

7.9.3 Date and time

The frequency inverter is equipped with a real-time clock. The output format can be selected.

NOTE

Automatic toggling between summer and winter time is not possible.

Table 89: Parameters for setting the date and time

Parameter	Description	Possible settings	Factory setting
1-5-1	System Time *Current time of system*	-	-
1-5-2	System Date *Current date of system*	-	-

Parameter	Description	Possible settings	Factory setting
3-1-4-1	Set Date *Setting the date*	01.01.2000 ... 31.12.2099	-
3-1-4-2	Set Time *Setting the time*	00:00…23:59	-
3-1-4-3	Time Format *Selecting the format for displaying the time*	▪ AM ▪ PM ▪ 24h	-

7.10 Digital and analog inputs/Digital and analog outputs

7.10.1 Digital inputs

The frequency inverter is equipped with six digital inputs.

Digital input DI-EN is assigned a fixed function:
Digital input DI-EN can be used to deactivate the pulse width modulation (PWM) of the frequency inverter. In the event of a stop (DI-EN = Low), the motor is not stopped by the stop ramp, but coasts to a standstill. The amount of time this process takes depends on the mass moment of inertia of the system. The drive remains disabled during coasting. The Motor Disabled status is displayed on the control panel. In the most basic scenario, a +24 V (C9) wire jumper on DI-EN can enable PWM.

NOTE

In the event of a stop via the DI-EN digital input, the motor is not stopped by the stop ramp, but coasts to a standstill. The amount of time this process takes depends on the mass moment of inertia of the system. The drive remains disabled during coasting. The Motor Disabled status is displayed on the control panel.

⚠ WARNING

Rotating machine parts

Risk of injury to operating personnel!

▷ Always keep a safe distance from rotating parts until the machine has come to a complete standstill.

Five of these digital inputs (DI1 to DI5) can be freely parameterised. The following functions can be selected:

- No function
- System start
- Digital potentiometer (faster/slower)
- Toggle control point (local/remote)
- Dry running protection
- Reset alert
- Output control of analog input
- Process an external message (e.g. door open – response: pump off)
- Toggle alternative setpoint/control value
- Toggle OFF/Automatic/Fixed speed/External OFF
- Pump changeover
- Start functional check run
- Start pipe flushing

- Overflow
- Lack of water
- Parameter set changeover

It is not possible for the same digital input to be parameterised differently for the individual frequency inverters used in multiple pump configurations.

Table 90: List of parameters with default assignment of function

Parameter	Description	Possible settings	Factory setting
3-8-6-1	Digital Input 1 Function *Configurable function of digital input 1*	▪ No Function ▪ System Start ▪ Potentiometer Auto - ▪ Potentiometer Auto + ▪ Control Point ▪ Alternative Setpoint/Control Value Active ▪ Potentiometer Manual - ▪ Potentiometer Manual + ▪ Control Digital Bit 0 ▪ Control Digital Bit 1 ▪ Control Digital Bit 2 ▪ Dry Running Protection ▪ Reset Messages ▪ Control AOUT Bit 0 ▪ Control AOUT Bit 1 ▪ External Message ▪ Start Functional Check Run ▪ Start Pump Changeover ▪ Start Pipe Flushing ▪ Overflow ▪ Lack of Water ▪ Parameter Set Changeover	System Start
3-8-6-2	Digital Input 2 Function *Configurable function of digital input 2*		Reset Messages
3-8-6-3	Digital Input 3 Function *Configurable function of digital input 3*		No Function
3-8-6-4	Digital Input 4 Function *Configurable function of digital input 4*		No Function
3-8-6-5	Digital Input 5 Function *Configurable function of digital input 5*		No Function

7.10.1.1 Digital potentiometer

This function can be used to increase or decrease the respective required value (setpoint, control value, manual-mode control value) in conjunction with the operating mode (closed-loop control mode, open-loop control mode, manual mode). Two digital inputs are used for this purpose.

NOTE

In the process, the required value must not be defined via an analog input, as the digital potentiometer will then have no function.

Auto digital potentiometer in closed-loop control mode

To incrementally change the Setpoint (Closed-loop Control) in automatic mode as a function of the digital inputs, select “Potentiometer Auto -” and “Potentiometer Auto +”, respectively. The Setpoint Change Increment parameter *(3-6-6-1)* defines by what value per pulse at the digital input the setpoint for a single-pump and multiple pump system is increased or decreased.

Digital potentiometer Auto in open-loop control mode

To incrementally change the Control Value (Open-loop Control) in automatic mode as a function of the digital inputs, select “Potentiometer Auto -” and “Potentiometer Auto +”, respectively. The Speed Change Increment parameter *(3-6-6-2)* defines by what value per pulse at the digital input the control value for a single-pump and multiple pump system is increased or decreased.

Digital potentiometer in manual mode

To incrementally change the Control Value (Manual) as a function of the digital inputs, select “Potentiometer Manual -” and “Potentiometer Manual +”, respectively. The Speed Change Increment parameter *(3-6-6-2)* defines by what value per pulse at the digital input the control value for a single-pump and multiple pump system is increased or decreased.

NOTE

Requirements for the Digital Potentiometer Manual function must be specified at every control device, not just at the active master control device.

Behaviour depends on the wiring of the digital inputs:

- 00: Inactive;
  Setpoint or control value can be changed via the control panel, for example.
- 01: Up
- 10: Down
- 11: Disabled;
  Setpoint or control value are not changed.

  The Interval parameter *(3-6-6-3)* can be used to set the time value for an automatic change in value for a continuously present signal. After this period of time lapses, the setpoint and/or control value changes continuously.

Table 91: Digital potentiometer parameters

Parameter	Description	Possible settings	Factory setting
3-6-6-1	Setpoint Change Increment *The parameter defines by what value per pulse at the digital input the setpoint is increased or decreased in automatic mode.*	Minimum to maximum limit of value range	0,10
3-6-6-2	Speed Change Increment *The parameter defines by what value per pulse at the digital input the manual-mode control value for a single-pump and multiple pump system is increased or decreased.*	0..1000 rpm	10
3-6-6-3	Interval *Time for automatic change in value for continuously present signal*	0,0…10,0 s	0,5

7.10.1.2 External Message

A local message can be created externally via a digital input.

The Response to External Message parameter (*3-9-14-1*) can be used to determine whether the message is an alert or a warning.

The Behaviour of External Message parameter (*3-9-14-2*) can be used to determine whether the message is self-acknowledging or not.

The external message triggers a routine alert or a routine warning that can also be taken into account in the general fault message via a relay.

Table 92: External message parameters

Parameter	Description	Possible settings	Factory setting
3-9-14-1	Response to External Message *Response to output of external message*	▪ Alert ▪ Warning	Alert
3-9-14-2	Behaviour of External Message *Alarm response of external message*	▪ Non-self-acknowledging ▪ Self-acknowledging	Non-self-acknowledging

7.10.1.3 Fixed-speed operation

This function can be used to change the current speed of the frequency inverter by specifying a fixed speed.

NOTE

Requirements for the Fixed Speed Operation function must be specified at every control device, not just at the active master control device.

Depending on the connection of the digital inputs, up to 3 fixed speeds can be selected. The function of the digital inputs selected is defined via Control Digital Bit 0, Control Digital Bit 1 and Control Digital Bit 2. Behaviour depends on the wiring of the digital inputs.

Table 93: Wiring of digital inputs

	Control Digital Bit 2	Control Digital Bit 1	Control Digital Bit 0
OFF	0	0	0
Automatic	0	0	1
Manual (variable speed)	0	1	0
Fixed Speed 1	0	1	1
Not used	1	0	0
Fixed Speed 2	1	0	1
Not used	1	1	0
Fixed Speed 3	1	1	1

Parameters *3-6-5-1* and *3-6-5-3* are used to define the fixed speed values.

Table 94: Parameters for fixed speed operation via digital inputs

Parameter	Description	Possible settings	Refers to	Factory setting
3-6-5-1	Fixed Speed 1 *Fixed speed selectable via digital inputs*	Minimum to maximum speed of motor	*3-2-2-1* *3-2-2-2*	0
3-6-5-2	Fixed Speed 2 *Fixed speed selectable via digital inputs*	Minimum to maximum speed of motor	*3-2-2-1* *3-2-2-2*	0
3-6-5-3	Fixed Speed 3 *Fixed speed selectable via digital inputs*	Minimum to maximum speed of motor	*3-2-2-1* *3-2-2-2*	0

7.10.1.4 Dry running protection

Dry running can be monitored by an external sensor (e.g. pressure switch) via a digital input. For this purpose, the digital input function must be set to the dry running protection value.

NOTE

If dry running protection was activated via an external sensor, sensorless dry running detection is inactive.

Table 95: Behaviour of the frequency inverter during dry running via digital input

Parameter	Description	Possible settings	Refers to	Factory setting
3-9-7-1	External Dry Running Detection Behaviour *Alarm behaviour of external dry running detection*	▪ Non-self-acknowledging ▪ Self-acknowledging	*3-8-6-1* *3-8-6-2* *3-8-6-3* *3-8-6-4* *3-8-6-5*	Non-self-acknowledging

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7.10.1.5 Starting the functional check run via digital input

NOTE

The functional check run is only performed in automatic mode.

NOTE

When a digital input is assigned the Functional Check Run function, this has the highest priority. In this scenario, an automatic functional check run via the control panel is not possible.

Table 96: Example of starting a functional check run via digital input 3

Parameter	Description	Possible settings	Factory setting
3-8-6-3	Digital Input 3 Function *Configurable function of digital input 3*	Start Functional Check Run	No Function

7.10.1.6 Parameter set changeover

The Parameter Set Changeover function allows you to toggle 2 saved parameter sets (user settings 1 and 2) via the digital input.

This makes it possible to configure emergency operation e.g. in the event that field bus communication fails. After all parameters have been set, the parameter set defined can be saved with parameter (*3-1-3-3*) or (*3-1-3-4*).

Table 97: Saving parameter sets

Parameter	Description	Possible settings	Factory setting
3-1-3-3	Save User Settings 1	-	Run
3-1-3-4	Save User Settings 2	-	Run

Table 98: Example of parameter set changeover via digital input 3

Parameter	Description	Possible settings	Factory setting
3-8-6-3	Digital Input 3 Function *Configurable function of digital input 3*	Parameter set changeover	No Function

After the parameter sets are loaded, the control panel or KSB ServiceTool displays the following information message: *I106 User Settings 1 Loaded* or *I107 User Settings 2 Loaded*..

7.10.2 Analog inputs

Two analog inputs are available. These analog inputs can be used to apply the setpoints of external control systems or actual value signals of pressure sensors to the frequency inverter, for example. To this end, a signal type and function must be selected for the respective analog input. A corresponding upper and lower limit can then be defined to scale the measuring range to the signal selected.

NOTE

The parameter values and value ranges/units entered are mutually dependent. This is why the first step in parameterising the frequency inverter is always to specify the applicable value range and units (refer to parameter *3-11*). If the value range or unit is subsequently changed, all dependent parameters must be checked for correctness again.

For example, if a differential pressure sensor (4 - 20 mA; 0 - 6 bar) is to be connected as an actual value signal, the following settings must be made:

- Signal type "4 - 20 mA"
- "Differential pressure" function
- Analog input lower limit: 0 bar
- Analog input lower limit: 6 bar

It is not possible for the same analog input to be parameterised differently for the individual frequency inverters used in multiple pump configurations.

If signal type 4 - 20 mA or 2 - 10 V is parameterised at an analog input without a live-zero signal present at the device, the frequency inverter outputs the Broken Wire warning. (⇨ Section 7.8.2.6, Page 95)

Table 99: Parameters for analog inputs 1 and 2

Parameter	Description	Possible settings	Factory setting
3-8-1-1	Analog Input 1 Signal *Sensor signal at analog input 1*	▪ OFF ▪ 4…20 mA ▪ 2…10 V ▪ 0…20 mA ▪ 0…10 V	OFF
3-8-1-2	Analog Input 1 Function *Function of analog input 1. Internal operating values cannot be used as an actual value source.*	▪ No Function ▪ Setpoint/Control Value (Auto) ▪ Control Value (Manual) ▪ Suction Pressure ▪ Discharge Pressure ▪ Differential Pressure ▪ Flow Rate ▪ Level ▪ Temperature ▪ Suction Pressure_Internal ▪ Discharge Pressure_Internal ▪ Differential Pressure_Internal ▪ Alternative Setpoint/Control Value (Auto)	OFF
3-8-1-3	Analog Input 1 Lower Limit	Minimum limit of measuring range (dependent on the analog input function selected)	0
3-8-1-4	Analog Input 1 Upper Limit	Maximum limit of measuring range (dependent on the analog input function selected)	0
3-8-1-5	Calibration Analog Input 1	Run	-
3-8-1-6	Calibration Selection	▪ Factory setting ▪ Customer Settings	Factory setting
3-8-2-1	Analog Input 2 Signal *Sensor signal at analog input 2*	▪ OFF ▪ 4…20 mA ▪ 2…10 V ▪ 0…20 mA ▪ 0…10 V	OFF

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Parameter	Description	Possible settings	Factory setting
3-8-2-2	Analog Input 2 Function *Function of analog input 2. Internal operating values cannot be used as an actual value source.*	▪ No Function ▪ Setpoint/Control Value (Auto) ▪ Alternative Setpoint/Control Value (Auto) ▪ Control Value (Manual) ▪ Suction Pressure ▪ Discharge Pressure ▪ Differential Pressure ▪ Flow rate ▪ Level ▪ Temperature ▪ Suction Pressure_Internal ▪ Discharge Pressure_Internal ▪ Differential Pressure_Internal	OFF
3-8-2-3	Analog Input 2 Lower Limit	Minimum limit of measuring range (dependent on the analog input function selected)	0
3-8-2-4	Analog Input 2 Upper Limit	Maximum limit of measuring range (dependent on the analog input function selected)	0
3-8-2-5	Calibration Analog Input 2	Run	-
3-8-2-6	Calibration Selection	▪ Factory setting ▪ Customer Settings	Factory setting

It is also possible to simultaneously read 2 signals via analog input 1 and analog input 2 to query these signals based on the following criteria (setting only possible for analog input 2):

- Difference of the two signal values DIFF (AI1, AI2)
- Minimum of the two signal values MIN (AI1, AI2)
- Maximum of the two signal values MAX (AI1, AI2)
- Mean value of the two signal values AVE (AI1, AI2)

NOTE

If a failure is detected at one of the two analog input signals, the process value corresponds with the remaining signal, which can have undesirable effects on the process.

If the analog input is configured to one of the following settings, the available sensor signals are only used for calculations and not for control purposes.

- Suction Pressure_Internal
- Discharge Pressure_Internal
- Differential Pressure_Internal

For example, analog input 1 uses a pressure sensor in a collecting line as the source for control but at the same time, an additional pressure sensor is available at analog input 2 for taking local measurements at the pump that are not meant to be used as actual values for pump control.

- Suction Pressure_Internal
- Discharge Pressure_Internal
- Differential Pressure_Internal

DIP switches for the analog inputs

To ensure that in the event of failure of the active master control device (Master), the redundant master control device (Aux Master) can take over, sensor signals or external standard signals for setpoints and (open-loop or manual-mode) control values must be redundantly applied to the analog inputs of both frequency inverters. When looping 0/4 - 20 mA current signals, the signal must be converted to a 0/2 - 10 V voltage signal. DIP switches are available for signal conversion that internally activate an electrical resistance of 500 ohms.

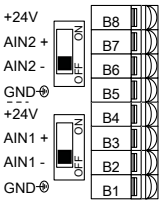

Fig. 87: DIP switches for the analog inputs (factory setting)

Both DIP switches for analog input 1 and analog input 2 are set to OFF by default.

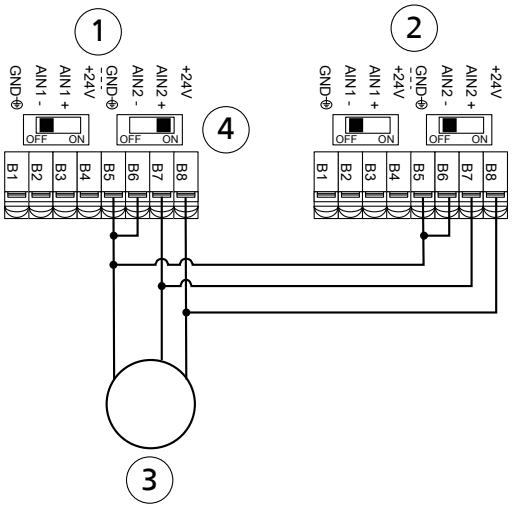

Fig. 88: Example, looping of a 4 - 20 mA signal

1	Active master control device
2	Redundant master control device (AUX master)
3	Feedback value transmitter 4 - 20 mA input
4	DIP switch for analog input 2 of active master control device ON

At all frequency inverters where a 0/4 - 20 mA signal is looped, the 0/4 - 20 mA signal is converted to a 0/2 - 10 V signal if the DIP switch on the active master control device (Master) is set to ON. Correspondingly, set the Analog Input Signal parameters (*3-8-1-1*, *3-8-2-1*, *3-8-3-1*) to 0/2 - 10 V at the analog inputs of every frequency inverter for which the signal was looped.

Calibration of analog input

For calibrating any analog input, connect the analog input to be calibrated to an external power supply. The selection of the power supply depends on the unit set under *3-8-1-1 and / or 3-8-2-1* Analog Input Signal.

Calibration can be started when the value factory setting is selected under *3-8-1-6 and / or 3-8-2-6* Calibration Selection and the function *3-8-1-5 and / or 3-8-2-5* Calibration Analog Input has been performed. After this, a specific signal must be provided by the power supply. The signal required is indicated on the frequency inverter display. (Also observe the unit selected under *3-8-1-1 and / or 3-8-2-1* Signal Analog Input.) Calibration is completed as soon as the signals are provided and the corresponding dialog boxes have been confirmed. The external power supply can then be removed.

7.10.3 Relay outputs

Operating status information can be queried on the two volt-free contacts (changeover contact relays) of the frequency inverter.

Table 100: Parameters for relay 1

Parameter	Description	Possible settings	Factory setting
3-8-9-1	Relay 1 Function *Selectable messages via relay 1*	▪ None ▪ AUTO operating mode ▪ RUN operating status ▪ AUTO/SLEEP operating status ▪ Warning ▪ Alert ▪ Alert or Warning ▪ No alert ▪ Dynamic overload protection ▪ Current too high ▪ Current too low ▪ Frequency too high ▪ Frequency too low ▪ Power too high ▪ Power too low ▪ Actual value = setpoint ▪ Butterfly valve control ▪ Bypass control	Alert
3-8-9-2	Time Delay ON *Period of time during which the event selected must be continually available until the relay is set.*	0,0 – 10,0 s	0,5 s
3-8-9-3	Time Delay OFF Period of time for which the event selected must have gone before the relay is reset	0,0 – 10,0 s	0,5 s

Table 101: Parameters for relay 2

Parameter	Description	Possible settings	Factory setting
3-8-10-1	Relay 2 Function *Selectable messages via relay 2*	▪ None ▪ AUTO operating mode ▪ RUN operating status ▪ AUTO/SLEEP operating status ▪ Warning ▪ Alert ▪ No alert ▪ Alert or Warning ▪ Dynamic overload protection ▪ Current too high ▪ Current too low ▪ Frequency too high ▪ Frequency too low ▪ Power too high Power too low ▪ Actual value = setpoint ▪ Butterfly valve control ▪ Bypass control	RUN operating status
3-8-10-2	Time Delay ON *Period of time during which the event selected must be continually available until the relay is set*	0,0…10,0 s	0,5 s
3-8-10-3	Time Delay OFF *Period of time for which the event selected must have gone before the relay is reset*	0,0 …10,0 s	0,5 s

Actual Value = Setpoint function

NOTE

The parameter values and value ranges/units entered are mutually dependent. This is why the first step in parameterising the frequency inverter is always to specify the applicable value range and units (refer to parameter *3-11*). If the value range or unit is subsequently changed, all dependent parameters must be checked for correctness again.

For the Actual Value = Setpoint function, after the value range and units are defined, the bandwidth must be specified for comparing the actual value and setpoint data. This is done via the Deviation Permitted when Actual Value = Setpoint *(3-6-4-7)* parameter.

Butterfly valve control

The "Butterfly Valve Control" relay function enables a discharge-side butterfly valve to be opened / closed in order to prevent backflow through the pump.

A relay parameterised with the "Butterfly Valve Control" function closes when the start ramp is left and enables a discharge-side butterfly valve to be opened. In open-loop control mode, the start ramp is left when the control value is reached. In closed-loop control mode, the start ramp is left when the speed defined by the controller is reached. The relay opens again when the stop ramp starts and enables the butterfly valve to be closed. The stop ramp is activated as soon as a stop signal is issued. In this way, backflow through the pump is prevented by the timely actuation of a butterfly valve in the system.

Bypass Control

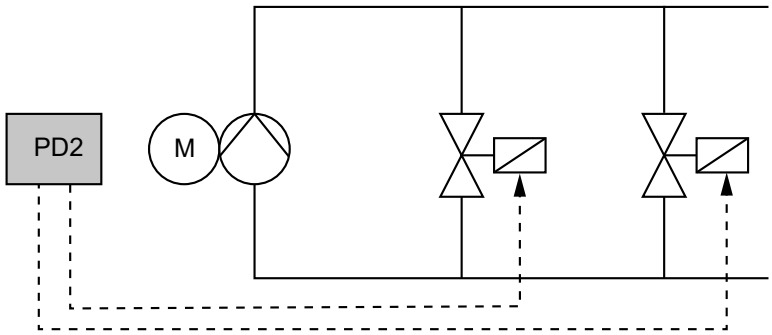

Fig. 89: Circuit diagram Bypass Control

The Bypass Control relay function enables opening / closing of the bypass valves in the system depending on a maximum / minimum limit value of the volume flow rate. If the volume flow rate of the system falls below the minimum limit value, a relay parameterised with the Bypass Control function closes and enables automatic opening of a bypass valve in the system. If the volume flow rate of the system exceeds the maximum limit value, the relay used opens again and the connected bypass valve is closed again.

Table 102: Parameters for the Bypass Control

Parameter	Description	Possible settings	Factory setting
3-10-6-4	Limit Value – Open Bypass *Definition of the lower limit value for the Bypass. If the value is undercut, the relay for the Bypass Control function closes.*	Minimum flow rate – Maximum flow rate	0.0 m^3/h
3-10-6-4	Limit Value – Close Bypass *Definition of the upper limit value for the Bypass. If the value is exceeded, the relay for the Bypass Control function opens.*	Minimum flow rate – Maximum flow rate	9999.9 m^3/h

7.10.4 Analog outputs

By default, the value selected via parameter *3-8-7-1* Assignment 1 Analog Output 1 is output as a 4 - 20 mA signal at the analog output. Output as a 0-10 V signal is also possible.

Four different process values can be assigned to the analog output.

The selection as to which value is output is made via two digital inputs (2 bits = 4 options). For this purpose, set the function of the digital inputs to Control AOUT Bit 0 or Control AOUT Bit 1.

Table 103: Controlling the output values

Assignment at analog output 1	Control AOUT Bit 1	Control AOUT Bit 0
1	0	0
2	0	1
3	1	0
4	1	1

Table 104: Parameters for analog output

Parameter	Description	Possible settings	Factory setting
3-8-7-1	Assignment 1 Analog Output 1 *Selectable assignment 1 of analog output 1*	▪ No Function ▪ Setpoint ▪ Actual Value ▪ Motor Speed ▪ Motor Power ▪ Motor Current ▪ Motor Voltage ▪ Output Frequency ▪ DC Link Voltage ▪ Pump Suction Pressure ▪ Pump Discharge Pressure ▪ Pump Differential Pressure ▪ Pump Flow Rate ▪ Suction Pressure ▪ Discharge Pressure ▪ Differential Pressure ▪ Flow Rate	Motor Speed
3-8-7-2	Assignment 2 Analog Output 1 *Selectable assignment 2 of analog output 1*		Motor Current
3-8-7-3	Assignment 3 Analog Output 1 *Selectable assignment 3 of analog output 1*		Motor Power
3-8-7-4	Assignment 4 Analog Output 1 *Selectable assignment 4 of analog output 1*		DC Link Voltage
3-8-7-5	Calibration Analog Output 1	Run	-
3-8-7-6	Calibration Selection	▪ Factory setting ▪ Customer settings	Factory setting
3-8-7-7	Signal Analog Output 1 *Signal type (signal range) at analog output 1*	▪ 4...20 mA / 2...10 V ▪ 0...20 mA / 0...10 V	4...20 mA / 2...10 V

The scales of the possible output values of the analog output reference the parameters in menu *3-11*, Value Ranges and Units.

Example Pressure Control Parameter *3-8-7-1*, Assignment 1 Analog Output 1 is configured for the setpoint. Parameters *3-8-7-2* to *3-8-7-4* are set to OFF. Scaling is then as follows:

- 4 mA refer to the Minimum Pressure parameter *(3-11-2-1)*
- 20 mA refer to the Maximum Pressure parameter *(3-11-2-2)*

DIP switches Process variables can be output as a 4 - 20 mA/ 0 - 20 mA signal or 2 - 10 V/ 0 - 10 V signal, depending on the position of the DIP switch on the control PCB.

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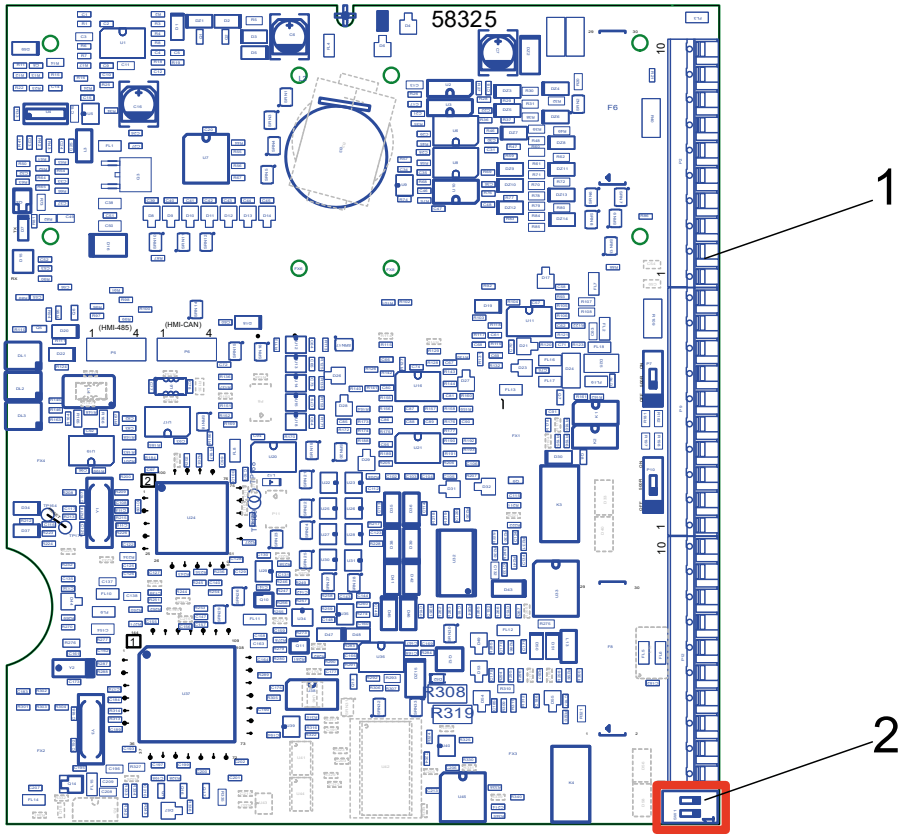
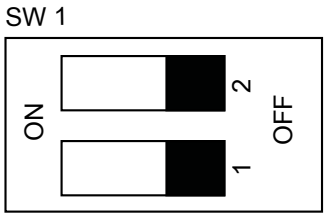


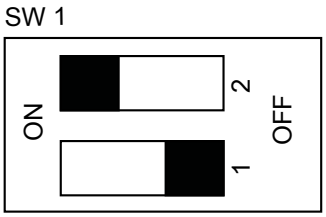
Fig. 90: Position of DIP switches on the control PCB

1	Terminal strip	2	DIP switches, analog output

Key to switch positions of DIP switches



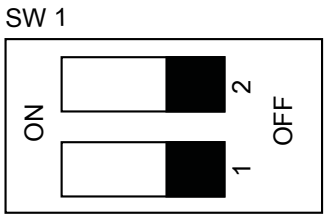
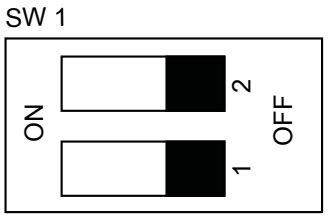
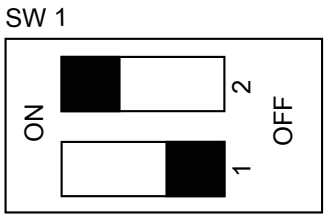
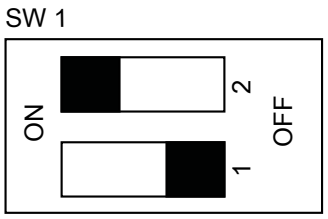
4 - 20 mA/ 0 - 20 mA signal



2 - 10 V/ 0 - 10 V signal

The DIP switch for the analog output is set to OFF by default. The signal range is preset to 4 - 20 mA. The signal range depends on how parameter *3-8-7-7* is configured.

Table 105: Possible combinations and signal ranges

Switch position of DIP switches	Setting of parameter 3-8-7-7, Signal Analog Output 1	Signal range
	4-20 mA / 2-10 V	4-20 mA
	0-20 mA / 0-10 V	0-20 mA
	4-20 mA / 2-10 V	2-10 V
	0-20 mA / 0-10 V	0-10 V

Calibrating the analog output

All analog outputs, including those on the I/O extension board, can be calibrated with the calibration methods Automatic Calibration or Measured Value Input. The method can be selected under parameter *3-8-x-5* Calibration Analog Output.

- Automatic Calibration
  For this calibration type the analog output to calibrated has to be connected to the corresponding analog input (e.g. analog output 1 to analog input 1 or analog output 2 to analog input 2). Calibration can be started by setting parameter *3-8-x-6* Calibration Selection to Factory Setting and selecting the function *3-8-x-5* Calibration Analog Output. Calibration is then carried out automatically. After its completion, the connection to the analog input can be removed.
- Calibration Type Measured Value Input
  This calibration type requires the use of an external multimeter, which has to be connected to the analog output to be calibrated. The multimeter has to be set to voltage or current measurement depending on the unit set under *3-8-x-7* Signal Analog Output. Calibration can be started by setting parameter *3-8-x-6* Calibration Selection to Factory Setting and selecting the function *3-8-x-5* Calibration Analog Output. Two signals will then be available at the

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corresponding analog output. These can be measured with the connected multimeter. The measured values can then be entered in a dialog box on the display. This concludes the calibration. The multimeter can be removed.

7.10.5 Inputs and outputs of the I/O extension board

Digital inputs on the I/O extension board

Digital inputs (DI6 to DI8) can be freely parameterised, like digital inputs DI1 to DI5.

It is not possible for the same digital input to be parameterised differently for the individual frequency inverters used in a multiple pump configuration.

Table 106: List of parameters with default assignment of function

Parameter	Description	Possible settings	Factory setting
3-8-6-6	Digital Input 6 Function *Configurable function of digital input 6*	▪ No Function ▪ System Start ▪ Potentiometer Auto - ▪ Potentiometer Auto + ▪ Control Point ▪ Alternative Setpoint/Control Value Active ▪ Potentiometer Manual - ▪ Potentiometer Manual + ▪ Control Digital Bit 0 ▪ Control Digital Bit 1 ▪ Control Digital Bit 2 ▪ Dry Running Protection ▪ Reset Messages ▪ Control AOUT Bit 0 ▪ Control AOUT Bit 1 ▪ External Message ▪ Start Functional Check Run ▪ Start Pump Changeover ▪ Start Pipe Flushing ▪ Overflow ▪ Lack of Water ▪ Parameter Set Changeover	No Function
3-8-6-7	Digital Input 7 Function *Configurable function of digital input 7*		No Function
3-8-6-8	Digital Input 8 Function *Configurable function of digital input 8*		No Function

Analog inputs on the I/O extension board

The I/O extension board has an additional analog input. A signal type and function must be selected for the analog input. The measuring range is scaled for the signal selected by setting a defined upper and lower limit. (⇨ Section 7.10.2, Page 131)

NOTE

The parameter values and value ranges/units entered are mutually dependent. This is why the first step in parameterising the frequency inverter is always to specify the applicable value range and units *(3-11)*. If the value range or unit is subsequently changed, all dependent parameters must be checked for correctness again.

Table 107: Parameters for analog input 3

Parameter	Description	Possible settings	Factory setting
3-8-3-1	Analog Input 3 Signal *Sensor signal at analog input 3*	▪ OFF ▪ 4…20mA ▪ 2…10V ▪ 0…20mA ▪ 0…10V	OFF
3-8-3-2	Analog Input 3 Function *Function of analog input 3. Internal operating values cannot be used as an actual value source.*	▪ OFF ▪ Setpoint/Control Value (Auto) ▪ Control Value (Manual) ▪ Suction Pressure ▪ Discharge Pressure ▪ Differential Pressure ▪ Flow Rate ▪ Level ▪ Temperature ▪ Suction Pressure_Internal ▪ Discharge Pressure_Internal ▪ Differential Pressure_Internal	OFF
3-8-3-3	Analog Input 3 Lower Limit	Minimum limit of measuring range (dependent on the analog input function selected)	0
3-8-3-4	Analog Input 3 Upper Limit	Maximum limit of measuring range (dependent on the analog input function selected)	0
3-8-3-5	Calibration Analog Input 3	Run	-
3-8-3-6	Calibration Selection	▪ Factory setting ▪ Customer Settings	Factory setting

Relay outputs on the I/O extension board

The I/O extension board has one volt-free (NO/NC) relay and five volt-free (NO) relays. The function of the relays can be parameterised via the control panel.
(⇨ Section 7.10.3, Page 135)

Table 108: Parameters of relays 3 to 8

Parameter	Description	Possible settings	Factory setting
3-8-11-1 *3-8-12-1* *3-8-13-1* *3-8-14-1* *3-8-15-1* *3-8-16-1*	Relay 3 Function Relay 4 Function Relay 5 Function Relay 6 Function Relay 7 Function Relay 8 Function *Selectable messages via relays 3 to 8*	▪ None ▪ AUTO operating mode ▪ RUN operating status ▪ AUTO/SLEEP operating status ▪ Warning ▪ Alert ▪ Alert or Warning ▪ Dynamic overload protection ▪ Current too high ▪ Current too low ▪ Frequency too high ▪ Frequency too low Power too high ▪ Power too low ▪ Actual value = setpoint ▪ Butterfly valve control ▪ Bypass control	None
3-8-11-2 *3-8-12-2* *3-8-13-2* *3-8-14-2* *3-8-15-2* *3-8-16-2*	Time Delay ON *Period of time during which the event selected must be continually available until the relay is set*	0,0 – 10,0 s	0,5 s
3-8-11-3 *3-8-12-3* *3-8-13-3* *3-8-14-3* *3-8-15-3* *3-8-16-3*	Time Delay OFF *Period of time for which the event selected must have gone before the relay is reset*	*0,0 – 10,0 s*	*0,5 s*

Analog inputs on the I/O extension board

By default, the value selected via parameter 3-8-8-1 Assignment 1 Analog Output 2 is output as a 4 - 20 mA signal at the analog output. Four different process values can be assigned to the analog output. The selection as to which value is output is made via two digital inputs on the IO extension board (2 bits = 4 options). For this purpose, set the function of the digital inputs to Control AOUT Bit 0 or Control AOUT Bit 1. (⇨ Section 7.10.4, Page 137)

Table 109: Controlling the output values

Assignment at analog output 1	Control AOUT Bit 1	Control AOUT Bit 0
1	0	0
2	0	1
3	1	0
4	1	1

NOTE

Only the digital inputs on the I/O extension board can be used to initiate the measurement value output sequence for analog output 2.

Table 110: Parameters for analog output

Parameter	Description	Possible settings	Factory setting
3-8-8-1	Assignment 1 Analog Output 2 *Selectable assignment 1 of analog output 2*	▪ No Function ▪ Setpoint ▪ Actual Value ▪ Motor Speed ▪ Motor Power ▪ Motor Current ▪ Motor Voltage ▪ Output Frequency ▪ DC Link Voltage ▪ Pump Suction Pressure ▪ Pump Discharge Pressure ▪ Pump Differential Pressure ▪ Pump Flow Rate ▪ Suction Pressure ▪ Discharge Pressure ▪ Differential Pressure ▪ Flow Rate	OFF
3-8-8-2	Assignment 2 Analog Output 2 *Selectable assignment 2 of analog output 2*		OFF
3-8-8-3	Assignment 3 Analog Output 2 *Selectable assignment 3 of analog output 2*		OFF
3-8-8-4	Assignment 4 Analog Output 2 *Selectable assignment 4 of analog output 2*		OFF
3-8-8-5	Calibration Analog Input 2	Run	-
3-8-8-6	Calibration Selection	▪ Factory setting ▪ Customer settings	Factory setting
3-8-8-7	Signal Analog Output 2 *Signal type (signal range) at analog output 2*	▪ OFF ▪ 4...20 mA ▪ 2...10 V ▪ 0...20 mA ▪ 0...10 V	4...20 mA

Digital outputs on the I/O extension board

There are two programmable digital outputs on the I/O extension board.

Table 111: Digital output parameters

Parameter	Description	Possible settings	Factory setting
3-8-17-1	Digital Output 1 Function *Selectable messages via digital output 1 of the I/O extension board*	▪ None ▪ AUTO operating mode ▪ RUN operating status ▪ AUTO/SLEEP operating status ▪ Warning ▪ Alert ▪ Alert or Warning ▪ No alert ▪ Dynamic overload protection ▪ Current too high Current too low ▪ Frequency too high ▪ Frequency too low ▪ Power too high ▪ Power too low ▪ Actual value = setpoint ▪ Butterfly valve control ▪ Bypass control	OFF
3-8-17-2	Time Delay ON *Period of time during which the event selected must be continually available until the digital output is set*	0,0…600,0 s	0,5 s
3-8-17-3	Time Delay OFF *Period of time for which the event selected must have gone before the digital output is reset*	0,0…600,0 s	0,5 s
3-8-18-1	Digital Output 2 Function *Selectable messages via digital output 1 of the I/O extension board*	▪ None ▪ AUTO operating mode ▪ RUN operating status ▪ AUTO/SLEEP operating status ▪ Warning ▪ Alert ▪ Alert or Warning ▪ No alert ▪ Dynamic overload protection ▪ Current too high ▪ Current too low ▪ Frequency too high ▪ Frequency too low ▪ Power too high ▪ Power too low ▪ Actual value = setpoint ▪ Butterfly valve control ▪ Bypass control	OFF

Parameter	Description	Possible settings	Factory setting
3-8-18-2	Time Delay ON *Period of time during which the event selected must be continually available until the digital output is set*	0,0…600,0 s	0,5 s
3-8-18-3	Time Delay OFF *Period of time for which the event selected must have gone before the digital output is reset*	0,0…600,0 s	0,5 s

7.11 Parameterising the M12 module

Installing an M12 module (⇨ Section 5.5.3.5, Page 43)

If a function is parameterised at an M12 module socket contact (A or B) without such a signal present at the device, the frequency inverter reports one of the following messages:

- Failure of Actual Value warning
- No Master Control alert
- Broken Wire warning

This depends on whether the signal is to be used as an actual value source. (⇨ Section 7.8.2.6, Page 95) It is not possible for the same M12 module socket contact to be parameterised differently for the individual frequency inverters used in multiple pump configurations.

Parameterising the M12 module for PumpMeter as an actual value source (via Modbus)

If PumpMeter is connected to input A of the M12 module via Modbus and used as actual value source for control, the Function M12 Module Input A parameter must be set to PMtr Suction / Discharge Pressure *(3-8-4-1)*.

NOTE

When changing parameter *3-8-4-1* to the above-mentioned value (in particular in retrofit applications) a 24 V voltage reset is triggered, which is required for initialisation of the bus connection to PumpMeter.

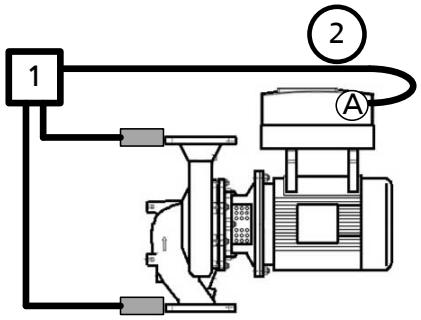

Fig. 91: PumpMeter as actual value source via Modbus

1	PumpMeter as actual value source
2	PumpMeter connection to the M12 module, input A, via Modbus

Table 112: PumpMeter connection via Modbus

Parameter	Description	Possible settings	Factory setting
3-8-4-1	Function M12 Module Input A *Function of M12 module, input A. Internal operating values cannot be used as an actual value source.*	PMtr Suction/Discharge Pressure	OFF

Parameterising the M12 module for PumpMeter as an internal measured variable source (via Modbus)

If PumpMeter is only used as internal measured variable source at input A of the M12 module (via Modbus) and not for control, the Function M12 Module Input A parameter *(3-8-4-1)* must be set to PMtr Suction/Discharge Pressure_Internal.

NOTE

When changing parameter *3-8-4-1* to the above-mentioned value (in particular in retrofit applications) a 24 V voltage reset is triggered, which is required for initialisation of the bus connection to PumpMeter.

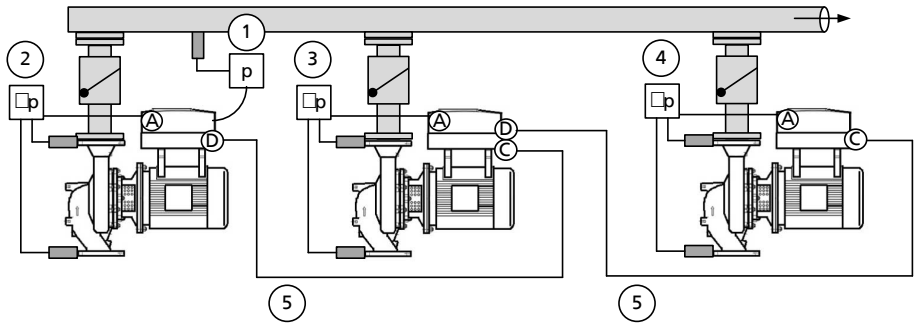

Fig. 92: PumpMeter as internal measured variable source per pump, external pressure sensor as actual value source

1	External pressure sensor as actual value source
2	PumpMeter as internal measured variable source for the master control device
3	PumpMeter as internal measured variable source for auxiliary control device 1
4	PumpMeter as internal measured variable source for auxiliary control device 2
5	Pre-configured cable for multiple pump configuration

Table 113: PumpMeter connection via Modbus

Parameter	Description	Possible settings	Factory setting
3-8-4-1	Function M12 Module Input A *Internal operating values cannot be used as an actual value source.*	PMtr Suction/Discharge Pressure_Internal	OFF

Parameterising the M12 module as an analog input

NOTE

The parameter values and value ranges/units entered are mutually dependent. This is why the first step in parameterising the frequency inverter is always to specify the applicable value range and units (refer to parameter *3-11*). If the value range or unit is subsequently changed, all dependent parameters must be checked for correctness again.

Table 114: Parameters for parameterising the M12 module, input A

Parameter	Description	Possible settings	Factory setting
3-8-4-1	Function M12 Module Input A *Internal operating values cannot be used as an actual value source.*	▪ OFF ▪ Suction Pressure ▪ Discharge Pressure ▪ Suction Pressure_Internal ▪ Discharge Pressure_Internal	OFF
3-8-4-2	Lower Limit M12 Module Input A *Only relevant for analog inputs.*	Minimum to maximum pressure	OFF
3-8-4-3	Upper Limit M12 Module Input A *Only relevant for analog inputs.*	Minimum to maximum pressure	OFF

Table 115: Parameters for parameterising the M12 module, input B

Parameter	Description	Possible settings	Factory setting
3-8-5-1	Function M12 Module Input B *Internal operating values cannot be used as an actual value source.*	▪ OFF ▪ Suction Pressure ▪ Discharge Pressure ▪ Suction Pressure_Internal ▪ Discharge Pressure_Internal	OFF
3-8-5-2	Lower Limit M12 Module Input B *Only relevant for analog inputs.*	Minimum to maximum pressure	OFF
3-8-5-3	Upper Limit M12 Module Input B *Only relevant for analog inputs.*	Minimum to maximum pressure	OFF

If the analog input of the M12 module is used as an actual value source for control, the Function M12 Module Input A *(3-8-4-1)* or B (3-8-5-1) parameters must be set to Suction Pressure or Discharge Pressure.

If the analog input of the M12 module is only used as an internal measured variable and not for control, the Function M12 Module Input A *(3-8-4-1)* or B *(3-8-5-1)* parameters must be set to Suction Pressure_Internal or Discharge Pressure_Internal.

NOTE

Only sensors with 4 - 20 mA signals can be connected to the M12 module.

M12 module for PumpMeter as actual value source (via Modbus) in dual pump configuration

PumpMeter devices to be used for Etaline Z pumps equipped with frequency inverters are provided with a special firmware version at the factory to serve as Modbus master. The two frequency inverters are set to Modbus slave. This is the only configuration enabling redundant operation should a frequency inverter fail. If a frequency inverter is retrofitted, this special firmware must be installed on PumpMeter using the KSB ServiceTool to enable redundant dual pump operation.

NOTE

The operating point display of PumpMeter always refers to operation of one pump only.

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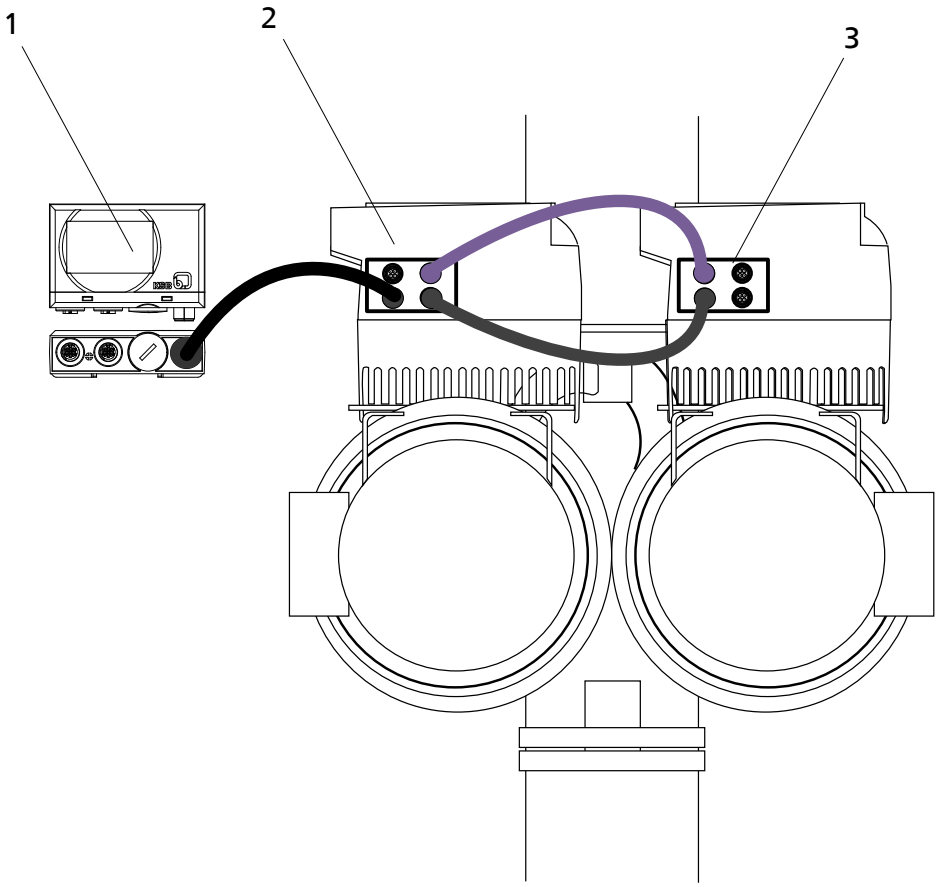

Fig. 93: PumpMeter as Modbus master

1	PumpMeter as Modbus master
2	Frequency inverter No. 1 as Modbus slave
3	Frequency inverter No. 2 as Modbus slave

Table 116: Example of PumpMeter as a Modbus master for an Etaline Z redundant dual pump configuration

Parameter	Description	Possible settings	Factory setting
3-13-5	PumpMeter Master/Slave *If PumpMeter is to be used as a redundant system sensor fitted in the header in a dual or multiple pump configuration as for Etaline Z, the parameter must be set to Master. In all other scenarios, the parameter is set to Slave.*	Master	Slave

7.12 Parameterising the field bus module

Install the field bus module. (⇨ Section 5.5.3.6, Page 48)

Additional technical information is provided in the relevant project planning manuals for the field bus modules.

NOTE

If the field bus is only used for monitoring purposes, the Control Point parameter *3-6-2* is set to Local.

NOTE

The frequency inverter is reset when a field bus module is replaced or retrofitted. Menu 3-12 for setting the parameters of the field bus module is then enabled.

Table 117: Modbus RTU Module parameters

Parameter	Description	Possible settings	Factory setting
3-6-2	Control Point *Toggling the control point from Local to Field Bus. DIGIN/ANIN have the highest priority. The actual value source must be configured separately.*	▪ Local ▪ Field Bus	Local
3-12-2-1	Modbus Slave Address *Modbus slave address of the system*	1 - 247	1
3-12-2-2	Baud Rate *Baud rate of the Modbus slave*	▪ 4800 ▪ 9600 ▪ 19200 ▪ 38400 ▪ 56k ▪ 115k	19200
3-12-2-3	Parity *Parity of the Modbus slave*	▪ Even ▪ Odd ▪ No parity	Even
3-12-2-4	Modbus Address Range of Pump *Configurable address range via which the local parameters of the pump are addressed*	▪ 0x0100 - 0x1FF ▪ 0x0200 - 0x2FF ▪ 0x0300 - 0x3FF ▪ 0x0400 - 0x4FF ▪ 0x0500 - 0x5FF ▪ 0x0600 - 0x6FF	0x0100 - 0x01FF
3-12-2-5	Cycle Time, Setpoint/Control Value *Time delay before the message (warning or alert) is triggered. In a redundant system, only a warning is output as the auxiliary master can assume the function. Only if the setpoint/control value also fails at the auxiliary master is the alert output, which then triggers the specified response to setpoint/control value failure.*	0,0…10,0 s	5,0 s
3-12-2-6	Cycle Time, Actual Value *Time delay before the message (warning or alert) is triggered. In a redundant system, only a warning is output as the auxiliary master can assume the function. Only if the actual value also fails at the auxiliary master is the alert output, which then triggers the specified response to actual value failure.*	0,0…10,0 s	1,0 s

Table 118: Profibus module parameters

Parameter	Description	Possible settings	Factory setting
3-6-2	Control Point *Activating the field bus as control point. Digital inputs and analog inputs have the highest priority. The actual value source must be configured separately.*	▪ Local ▪ Field Bus	Local
3-6-3	Actual Value Source *Selecting the source for the actual value: Activating the field bus as the actual value source. Analog inputs or PumpMeter have the highest priority.*	▪ Local ▪ Field Bus	Local

Parameter	Description	Possible settings	Factory setting
3-12-1-1	Profibus Slave Address *Profibus slave address of the system*	1 - 126	126
3-12-1-2	Pump Number *Unique assignment of the pump in multiple pump configuration*	1 - 6	1
3-12-1-3	Cycle Time, Setpoint/Control Value *Time delay before the message (warning or alert) is triggered. In a redundant system, only a warning is output as the auxiliary master can assume the function. Only if the setpoint/ control value also fails at the auxiliary master is the alert output, which then triggers the specified response to setpoint/control value failure.*	0,0...10,0	5
3-12-1-4	Cycle Time, Actual Value *Time delay before the message (warning or alert) is triggered. In a redundant system, only a warning is output as the auxiliary master can assume the function. Only if the actual value also fails at the auxiliary master is the alert output, which then triggers the specified response to actual value failure.*	0,0...10,0	1

Table 119: LON module parameters

Parameter	Description	Possible settings	Factory setting
3-6-2	Control Point *Activating the field bus as control point. Digital inputs and analog inputs have the highest priority. The actual value source must be configured separately.*	▪ Local ▪ Field Bus	Local
3-6-3	Actual Value Source *Selecting the source for the actual value: Activating the field bus as the actual value source. Analog inputs or PumpMeter have the highest priority.*	▪ Local ▪ Field Bus	Local
3-12-3-1	Send Service Pin Message *Activates the service pin for commissioning the LON module*	Run	-
3-12-3-2	Maximum Transmission Time *The nvoPumpCapacity, nvoEffOpMode, nvoControlMode and nvoPumpStatus variables are updated at the very latest when this time lapses.*	0,0…6553,5	0,0
3-12-3-3	Minimum Transmission Time *Shortest update time for the nvoPumpCapacity, nvoEffOpMode, nvoControlMode and nvoPumpStatus variables. Used for limiting, or restricting, the load on the LON bus.*	0,0…6553,5 (0,0 = No limitation)	0,0
3-12-3-4	Maximum Timeout *After this time lapses, the remote actual values are set to invalid. This affects the nviRemotePress, nviRemoteFlow and nviRemoteTemp variables.*	0,0…6553,5 (0 = No monitoring)	0,0
3-12-3-5	Installation Location *Installation location of the LON subscriber*	Character string: A to Z	

Parameter	Description	Possible settings	Factory setting
3-12-3-6	LON Control Type *Specifies the type of control in LON mode. This type of control is used if nviRemotePress, nviRemoteFlow and nviRemoteTemp do not supply a signal.*	▪ OFF (Open-loop Control) ▪ Discharge Pressure ▪ Suction Pressure ▪ Differential Pressure ▪ Differential Pressure (Sensorless) ▪ Flow rate ▪ Flow Rate (Sensorless) ▪ Temperature (Cooling) ▪ Temperature (Heating) ▪ Suction-side Level ▪ Discharge-side Level	OFF (Open-loop Control)
3-12-3-7	Control Direction, Temperature Control *Specifies the control direction for temperature control. The control direction is used if the actual value is supplied via nviRemoteTemp.*	▪ OFF ▪ ON	OFF
3-12-3-8	LON Dyn Press Comp Method *Determines whether dynamic pressure compensation is used for pressure control via nviRemotePress.*	▪ OFF ▪ Speed ▪ Flow rate	OFF
3-12-3-9	Cycle Time *Setpoint/control value time delay before the message (warning or alert) is triggered. In a redundant system, only a warning is output as the auxiliary master can assume the function. Only if the setpoint/control value also fails at the auxiliary master is the alert output, which then triggers the specified response to setpoint/control value failure.*	0,0 …10,0 s	1,0 s
3-12-3-10	Cycle Time *Actual value time delay before the message (warning or alert) is triggered. In a redundant system, only a warning is output as the auxiliary master can assume the function. Only if the actual value also fails at the auxiliary master is the alert output, which then triggers the specified response to actual value failure.*	0,0 …10,0 s	1,0 s

Table 120: PROFINET module parameters

Parameter	Description	Possible settings	Factory setting
3-6-2	Control Point *Activating the field bus as control point. Digital inputs and analog inputs have the highest priority. The actual value source must be configured separately.*	▪ Local ▪ Field Bus	Local
3-6-3	Actual Value Source *Selecting the source for the actual value: Activating the field bus as the actual value source. Analog inputs or PumpMeter have the highest priority.*	▪ Local ▪ Field Bus	Local

Parameter	Description	Possible settings	Factory setting
3-12-4-1	Profinet Device Name *User-defined device name for identification in the network (a maximum length of 49 characters is recommended). The control panel just allows read-only access to this parameter. The device name is changed in the PROFINET controller.*	User-defined	-
3-12-4-2	Profinet IP Address *Display of the IP address defined in the network. The IP address is changed in the PROFINET controller.*	User-defined	0.0.0.0
3-12-4-3	Cycle Time, Setpoint/Control Value *Time delay, in seconds, before the message (warning or alert) is triggered. In a redundant system, only a warning is output as the auxiliary master can assume the function. Only if the setpoint/control value also fails at the auxiliary master is the alert output, which then triggers the specified response to setpoint/ control value failure.*	0,0...10,0	5,0
3-12-4-4	Cycle Time, Actual Value *Time delay, in seconds, before the message (warning or alert) is triggered. In a redundant system, only a warning is output as the auxiliary master can assume the function. Only if the actual value also fails at the auxiliary master is the alert output, which then triggers the specified response to actual value failure.*	0,0...10,0	1,0

Table 121: Parameters for BACnet MS/TP module

Parameter	Description	Possible settings	Factory setting
3-6-2	Control Point *Activating the field bus as control point. Digital inputs and analog inputs have the highest priority. The actual value source must be configured separately.*	▪ Local ▪ Field Bus	Local
3-6-3	Actual Value Source *Selecting the source for the actual value: Activating the field bus as the actual value source. Analog inputs or PumpMeter have the highest priority.*	▪ Local ▪ Field Bus	Local
3-12-5-1	Device Identification *Device Object Instance Number*	0-4194303	Generated value
3-12-5-2	MS/TP MAC Address *Network address in accordance with MS/TP frame format*	1-254	254
3-12-5-3	Baud Rate *Baud rate of the BACnet slave*	▪ 9600 ▪ 19200 ▪ 38400 ▪ 57600 ▪ 115200	38400

Parameter	Description	Possible settings	Factory setting
3-12-5-4	Pump Number *Unique number of the pump in the multiple pump system* *Only required when a single gateway is used in a multiple pump system. Only required when pump values are to be read by several drives via one gateway.* **NOTE! If pump number 1-2 is not assigned in the multiple pump system, the pump values of the drive in which the gateway is located are automatically displayed at PD2-1-###### and PD2-2-###### .**	▪ 0 = disabled 1 = pump values are displayed at PD2-1-###### 2 = pump values are displayed at PD2-2-######	0
3-12-5-5	Communication Failure Monitoring Time *If the BACnet module is not in the token cycle of the MSTP network for a longer period of time, a broken wire is reported.*	0...60 s	20 s
3-12-5-6	Device Name *Device name for device identification in the network*	Configuration via configuration tool, maximum of 32 characters	KSB PumpDrive
3-12-5-7	Device Description *Device description for device identification in the network*	Configuration via configuration tool, maximum of 32 characters	KSB PumpDrive
3-12-5-8	Installation Location *Installation location of the BACnet subscriber*	Configuration via configuration tool, maximum of 32 characters	KSB PumpDrive

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8 Servicing/Maintenance

8.1 Safety regulations

The operator ensures that maintenance, inspection and installation are performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.

DANGER

Unintentional start-up

Risk of fatal injury due to electric shock!

- Disconnect the frequency inverter from the mains before carrying out any maintenance and installation work.
- Prevent the frequency inverter from being re-started unintentionally when carrying out any maintenance and installation work.

DANGER

Contact with live components

Risk of fatal injury due to electric shock!

- Any work on the product shall only be performed when it has been disconnected from the power supply (de-energised).
- Never remove the centre housing part from the heat sink.
- Mind the capacitor discharge time.
  After switching off the frequency inverter, wait 10 minutes until dangerous voltages have discharged.

NOTE

All maintenance work, service work and installation work can be carried out by KSB Service or authorised workshops. For contact details please refer to the enclosed "Addresses" booklet or visit "www.ksb.com/contact" on the Internet.

8.2 Servicing/Inspection

8.2.1 Supervision of operation

The frequency inverter must run quietly and free from vibrations at all times.

Ensure sufficient cooling for the frequency inverter.

In dirty environments, clean the air vents and housing surface regularly.

8.3 Dismantling

8.3.1 Preparing frequency inverter for dismantling

1. Disconnect the frequency inverter from the power supply.
2. Disconnect the electrical connection at the frequency inverter.
3. Carry out mechanical dismantling.

9 Parameter List

Table 122: Overview of parameters

Parameter	Description	Help text	Possible settings	Unit	Factory setting
1	Operation	-	-	-	-
1-1	Login	-	-	-	-
1-1-1	Customer Login	Log in as customer	0000…9999	-	-
1-1-2	Service Login	Log in for access to special parameters for KSB Service	0000…9999	-	-
1-1-3	Factory Login	Log in for access to special parameters for KSB Production	0000…9999	-	-
1-1-4	Logout	Logout from all access levels	Run	-	-
1-1-5	Customer Access ID	Change to customer access ID	0000…9999	-	-
1-1-6	Service Access ID	Change to customer service ID	0000…9999	-	-
1-2	Operating Values	-	-	-	-
1-2-1	Motor and Frequency Inverter	-	-	-	-
1-2-1-1	Speed	Current speed of motor	-	rpm	-
1-2-1-2	Motor Input Power	Current effective power of motor	-	Dependent on the unit set	-
1-2-1-3	Pump Input Power	Current mechanical power of pump	-	Dependent on the unit set	-
1-2-1-4	Pump Set Input Power	Current effective power of pump set (pump set = frequency inverter + motor + pump)	-	Dependent on the unit set	-
1-2-1-5	Motor Current	Current output current of frequency inverter. Losses and/or discharge currents can cause the actual motor current to differ from the output current of the frequency inverter.	-	A	-
1-2-1-6	Motor Voltage	Current output voltage of frequency inverter. Long motor cables and/or filters can cause the voltage at the motor terminal board to differ from the output voltage of the frequency inverter.	-	V	-
1-2-1-7	Output Frequency	Current output frequency of frequency inverter	-	Hz	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
1-2-1-8	DC Link Voltage	Current DC link voltage of frequency inverter	-	V	-
1-2-1-9	Heat Sink Temperature	Current temperature of frequency inverter heat sink	-	Dependent on the unit set	-
1-2-1-10	PCB Temperature	Current temperature on the I/O board	-	Dependent on the unit set	-
1-2-1-11	Motor Torque	Current motor torque based on the motor speed and mechanical power of the motor	-	Nm	-
1-2-2	Pump	-	-	-	-
1-2-2-1	Pump Suction Pressure	Current pressure on the centrifugal pump's suction side	-	bar	-
1-2-2-2	Pump Discharge Pressure	Current pressure on the centrifugal pump's discharge side	-	bar	-
1-2-2-3	Pump Differential Pressure	Difference between the suction- and discharge-side pump pressure	-	bar	-
1-2-2-4	Pump Flow Rate	Current flow rate of the pump	-	m3/h	-
1-2-3	System	-	-	-	-
1-2-3-1	Actual Value (Closed-loop Control)	Current actual value in closed-loop control mode	-	%	-
1-2-3-2	Suction Pressure	Current pressure on the suction side of the system	-	bar	-
1-2-3-3	Discharge Pressure	Current pressure on the discharge side of the system	-	bar	-
1-2-3-4	Differential Pressure	Difference between the suction- and discharge-side pressure of the system	-	bar	-
1-2-3-5	Flow Rate	Current flow rate of the system	-	m3/h	-
1-2-3-6	Level	Current fill level	-	m3/h	-
1-2-3-7	Temperature	Current temperature at the measuring point	-	°C	-
1-2-3-8	Flow Velocity	Current flow velocity of the fluid in the system	-	m/s	-
1-2-3-9	Head	Estimated head at current speed (derived from N_est. N)	-	m	-
1-2-4	Inputs/Outputs	-	-	-	-
1-2-4-1	Analog Input 1 Value	Current signal value present at analog input 1 of the control PCB	-	mA or V	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
1-2-4-2	Analog Input 2 Value	Current signal value present at analog input 2 of the control PCB	-	mA or V	-
1-2-4-3	Analog Input 3 Value	Current signal value present at analog input 3 of the control PCB	-	mA or V	-
1-2-4-4	M12 Module Input A Value	Current signal value present at analog input A of the M12 module	-	mA	-
1-2-4-5	M12 Module Input B Value	Current signal value present at analog input B of the M12 module	-	mA	-
1-2-4-6	Digital Inputs	Display of the current statuses of the digital inputs	-	-	-
1-2-4-7	Digital Outputs	Display of the current statuses of the digital outputs	-	-	-
1-2-4-8	Analog Output 1 Value	Current signal value output at analog output 1 of the control PCB	-	mA	-
1-2-4-9	Analog Output 2 Value	Current signal value output at analog output 2 of the I/O extension board	-	mA	-
1-3	Open-loop Control	-	-	-	-
1-3-1	System Start / Stop	This function is used to start the system.	▪ Stop ▪ Start	-	Stop
1-3-2	Setpoint (Closed-loop Control)	Configurable setpoint. This parameter is disabled if the setpoint is specified via DIGIN/ANIN. Otherwise, the setpoint source is selected via the Control Point parameter (Local/Field Bus).	Minimum to maximum limit of value range set	Dependent on the controlled variable set	0,00
1-3-3	Control Value (Open-loop Control)	Configurable control value for speed in open-loop control mode	3-2-2-1 … 3-2-2-2	rpm	3-2-2-1
1-3-4	Control Value (Manual)	When manual mode is activated, the current operating speed is accepted; otherwise, minimum speed is used. The speed can then be set in manual mode.	3-2-2-1...3-2-2-2	rpm	3-2-2-1
1-3-5	Immediate Pump Changeover	This function is used to change pumps directly.	Run	-	-
1-3-6	Immediate Functional Check Run	This function is used to perform the functional check run for this pump directly.	Run	-	-
1-3-7	Immediate Pipe Flushing	This function allows the pipe flushing function to be started manually once.	Run	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
1-3-8	Operating Mode	Setting the operating mode	▪ OFF ▪ Manual Mode ▪ Automatic Mode	-	Automatic Mode
1-3-9	Alternative Values	-	-	-	-
1-3-9-1	Alternative Setpoint (Closed-loop Control)	Alternative configurable setpoint (can be activated via time or DIGIN; DIGIN has priority). This parameter is disabled if the setpoint is specified via DIGIN/ ANIN. Otherwise, the setpoint source is selected via the Control Point parameter (Local/Field Bus).	Minimum to maximum limit of value range set	Dependent on the controlled variable set	0,00
1-3-9-2	Alternative Control Value (Open-Loop Control)	Alternative configurable control value for speed in open-loop control mode	3-2-2-1 … 3-2-2-2	rpm	500
1-3-9-3	Start of Alternative Setpoint/Control Value	Start of toggle from setpoint/ control value to alternative setpoint/ control value	00:00…23:59	h	00:00
1-3-9-4	End of Alternative Setpoint/Control Value	End of toggle from setpoint/ control value to alternative setpoint/ control value	00:00…23:59	h	00:00
1-3-9-5	Behaviour Alternative Values	Toggling between time control or direct deactivation/ activation of the alternative setpoint	▪ Time Control ▪ Setpoint/Control Value ▪ Alternative Setpoint/Control Value	-	Time Control
1-3-11	Immediate Deragging	Immediate Deragging	Run	-	-
1-4	Meter	-	-	-	-
1-4-1	Energy	-	-	-	-
1-4-1-1	Energy Meter (kWh)	Current energy consumption of pump set	-	kWh	0
1-4-1-2	Reset Energy Meter	Resetting the pump set's energy (kWh) meter	Run	-	-
1-4-1-3	Power Saved	Power saved in relation to fixed speed pump	-	kW	0,00
1-4-1-4	Energy Saved	Energy saved in relation to fixed speed pump	-	kWh	0
1-4-1-5	CO2 Emission Reduction	Reduction in carbon dioxide emissions in relation to fixed speed pump	-	t	0,0

Parameter	Description	Help text	Possible settings	Unit	Factory setting
1-4-1-6	Costs Saved	Energy cost savings, in national currency, in relation to fixed speed pump	-	-	0,00
1-4-1-7	Reset Energy Savings Meter	Reset energy savings meter	Run	-	-
1-4-2	Operation	-	-	-	-
1-4-2-1	Frequency Inverter Operating Hours	Operating hours of frequency inverter in stand-by (sleep) mode and during operation	-	h	0
1-4-2-2	Reset Frequency Inverter Operating Hours	Resetting operating hours counter of frequency inverter	Run	-	-
1-4-2-3	Pump Operating Hours	Operating hours of pump in active operation	-	h	0
1-4-2-4	Reset Pump Operating Hours	Resetting operating hours counter of pump	Run	-	-
1-4-2-5	Number of Starts	Number of frequency inverter starts on the line side	-	-	0
1-4-2-6	Reset Starts	Function for resetting the start counter	Run	-	-
1-5	Date and Time	-	-	-	-
1-5-1	System Time	Current time of system	00:00 … 23:59	-	Current Time
1-5-2	System Date	Current date of system	01.01.1970 … 31.12.2099	-	Current Date
1-6	Service	-	-	-	-
1-6-1	Time to Service	Remaining period of time until servicing	-	h	0
2	Diagnosis	-	-	-	-
2-1	Pending Messages	All currently active messages are displayed in the order of their priority in the Pending Messages menu item.	-	-	-
2-2	Message History	The last 100 messages are displayed in the message history.	-	-	-
2-3	Clear History	Deletes the list of messages in the history.	Run	-	-
3	Settings	-	-	-	-
3-1	General Settings	-	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-1-1	Language	Configurable display language	▪ English ▪ (Language 2 in the national language) ▪ (Language 3 in the national language) ▪ (Language 4 in the national language)	-	English (other languages as required for country)
3-1-2	Control Panel Configuration	-	-	-	-
3-1-2-1	Operating Values on Main Screen	Display of current operating values on main screen	See selection list	-	-
3-1-2-2	Operating Keys Require Login	Direct access to the MAN, OFF, AUTO and FUNC operating keys can be disabled via this parameter.	▪ OFF ▪ ON	-	OFF
3-1-2-3	Function Key Assignment	Assigning a freely selectable function to the FUNC key	▪ No Function ▪ System Start / Stop ▪ Setpoint Changeover (Closed-loop Control) ▪ Control Value Changeover (Open-loop Control) ▪ Immediate Pump Changeover ▪ Immediate Functional Check Run ▪ Language ▪ Remote/Local Control Point	-	Language
3-1-2-4	Display Contrast	Configurable contrast for display	0…100	%	50
3-1-2-5	Display Backlight	Configuring the display backlight	▪ OFF ▪ ON ▪ Automatic	-	Automatic
3-1-2-6	Display Backlight Duration	Duration of display backlight in automatic mode	0,00 … 600,00	s	30
3-1-3	Parameter Sets	-	-	-	-
3-1-3-1	Load User Settings 1	-	-	-	Run
3-1-3-2	Load User Settings 2	-	-	-	Run
3-1-3-3	Save User Settings 1	-	-	-	Run
3-1-3-4	Save User Settings 2	-	-	-	Run
3-1-3-5	Load Factory Settings	This function is used to reset the drive or system to the factory settings.	-	-	Run

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-1-4	Date and Time	-	-	-	-
3-1-4-1	Set Date	Setting the date	01.01.2000 ... 31.12.2099	-	Current Date
3-1-4-2	Set Time	Setting the time of day	00:00…23:59	-	Current Time
3-1-4-3	Time Format	Selecting the format for displaying the time	▪ AM ▪ PM ▪ 24h	-	24h
3-1-5	Commissioning Wizard	Starting the commissioning wizard	Run	-	-
3-2	Motor	-	-	-	-
3-2-1	Nominal Motor Data	-	-	-	-
3-2-1-1	Nominal Motor Power	Nominal power of motor as per name plate	Minimum to maximum limit of value range set	Dependent on the unit set	Dependent on size/ motor
3-2-1-2	Nominal Motor Voltage	Nominal voltage of motor as per name plate	Minimum to maximum limit of value range set	V	Dependent on size/ motor
3-2-1-3	Nominal Motor Frequency	Nominal frequency of motor as per name plate	Minimum to maximum limit of value range set	Hz	Dependent on size/ motor
3-2-1-4	Nominal Motor Current	Nominal current of motor as per name plate	Minimum to maximum limit of value range set	A	Dependent on size/ motor
3-2-1-5	Nominal Motor Speed	Nominal speed of motor as per name plate	Minimum to maximum limit of value range set	rpm	Dependent on size/ motor
3-2-1-6	Nominal Cos Phi Value	Cos phi of motor at nominal power	0,00 … 1,00	-	Dependent on size/ motor
3-2-2	Motor Speed Limitation	-	-	-	-
3-2-2-1	Minimum Motor Speed	-	3-11-1-1 … 3-2-2-2	rpm	Motor-specific
3-2-2-2	Maximum Motor Speed	-	3-2-2-1 … 3-11-1-2	rpm	Motor-specific
3-2-3	Thermal Motor Protection	-	-	-	-
3-2-3-1	PTC Analysis	Motor temperature monitoring	▪ OFF ▪ ON	-	Motor-specific
3-2-3-2	Thermal Motor Protection Behaviour	Behaviour for detection of excessive motor temperature	▪ Self-acknowledging ▪ Non-self-acknowledging	-	Non-self-acknowledging
3-2-4	Motor Direction of Rotation	Setting the direction of rotation of the motor with respect to the motor shaft	▪ Clockwise ▪ Anti-clockwise	-	Dependent on pump
3-2-5	Motor Standstill Heater	-	-	-	OFF

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-2-5-1	Motor Standstill Heater	Heating the motor via the motor windings	OFF ON	-	-
3-2-5-2	Heating Current	Heating current in % of nominal motor current	0,00…50,00	%	20,0
3-3	Frequency Inverter	-	-	-	-
3-3-1	Motor Control Method	Selecting the control method	▪ Asynchronous Motor V/f Control ▪ Asynchronous Motor Vector Control ▪ SuPremE Vector Control	-	Motor-specific
3-3-2	V/f Control for Asynchronous Motor	-	-	-	-
3-3-2-1	V/f Voltage 0	Data points for the V/f characteristic	0,00 … 15,00	%	2
3-3-2-2	V/f Voltage 1	Data points for the V/f characteristic	0,00 … 100,00	%	20
3-3-2-3	V/f Frequency 1	Data points for the V/f characteristic	0,00 … 100,00	%	20
3-3-2-4	V/f Voltage 2	Data points for the V/f characteristic	0,00 … 100,00	%	40
3-3-2-5	V/f Frequency 2	Data points for the V/f characteristic	0,00 … 100,00	%	40
3-3-2-6	V/f Voltage 3	Data points for the V/f characteristic	0,00 … 100,00	%	80
3-3-2-7	V/f Frequency 3	Data points for the V/f characteristic	0,00 … 100,00	%	80
3-3-2-8	V/f Voltage 4	Data points for the V/f characteristic	0,00 … 100,00	%	100
3-3-2-9	V/f Frequency 4	Data points for the V/f characteristic	0,00 … 100,00	%	100
3-3-3	Vector Control for Asynchronous Motor	-	-	-	-
3-3-3-1	Start Automatic Motor Adaptation	Function used to start automatic motor adaptation (AMA). 1. Offline Calculation: Using the nominal data of the motor as a basis, the extended motor data required for vector control is calculated. 2. Standard AMA: The extended motor data is determined by taking a measurement with the motor being at a standstill. 3. Extended AMA: The extended motor data is determined by taking a measurement with the motor running at approximately 10 % of its nominal speed.	▪ Run ▪ Extended AMA – Motor Running ▪ Standard AMA – Motor at Standstill ▪ Offline Calculation	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-3-3-2	RS Stator Phase Resistance	Extended motor data: Stator phase resistance	0,000 … 5000,000	Ohm	Motor-specific
3-3-3-3	LS Stator Phase Inductance	Extended motor data: Stator phase inductance	0,0 … 5000,0	mH	Motor-specific
3-3-3-4	TR Rotor Time Constant	Extended motor data: Rotor time constant	0,0 … 5000,0	ms	Motor-specific
3-3-3-5	KM Magnetisation Coefficient	Extended motor data: The magnetisation coefficient describes the magnetic coupling between the stator and rotor of the motor.	0,0000 … 100,000 0	-	Motor-specific
3-3-4	Vector Control for SuPremE	-	-	-	-
3-3-4-1	Update Motor Parameters	Function used to start automatic motor adaptation (AMA) for the KSB SuPremE motor. Using the nominal motor data as a basis, the extended motor data is determined which ensures very good control of the KSB SuPremE motor.	Run	-	-
3-3-4-2	Selected Motor	KSB SuPremE motor variant currently selected	-	-	Motor-specific
3-3-4-3	Efficiency Optimisation	Efficiency optimisation	ON / OFF	-	ON
3-3-4-4	RS Stator Phase Resistance	Extended motor data: Stator phase resistance	0.0 ... 32.000	-	Dependent on motor
3-3-4-5	Ld 0 inductances, d-axis	Extended motor data: q-axis inductance Iq = 0	0.0 ... 6553.5	-	Dependent on motor
3-3-4-6	Id Sat current, d-axis	Extended motor data: d-axis current sat	0.0 ... 6553.5	-	Dependent on motor
3-3-4-7	Lq 0 inductance, q-axis	Extended motor data: q-axis inductance Id = 0	0.0 ... 6553.5	-	Dependent on motor
3-3-4-8	Iq Sat current, q-axis	Extended motor data: q-axis current sat	0.0 ... 6553.5	-	Dependent on motor
3-3-4-9	L Sat inductance, d-q-axis	Extended motor data: d-q-axis inductance sat	0.0 ... 6553.5	-	Dependent on motor
3-3-4-10	XCross Saturation Factor	Extended motor data: cross-saturation factor	0.0 ... 6553.5	-	Dependent on motor
3-3-4-12	LdPM Inductance, d-axis	Extended motor data: d-axis inductance motor stator	0.0 ... 655.35	-	Dependent on motor

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-3-4-13	LqPM Inductance, q-axis	Extended motor data: q-axis inductance motor stator	0.0 ... 655.35	-	Dependent on motor
3-3-4-14	KePM	Extended motor data: effective value of the voltage between two phases	0.000 ... 65.535	-	Dependent on motor
3-3-4-15	Istart	Extended motor data: starting current in percent of the nominal current	20.00 ... 100.00	-	Dependent on motor
3-3-5	Ramps	-	-	-	-
3-3-5-1	Start Ramp Time	Period of time defining the start ramp	0,0 … 600,0	s	3,0
3-3-5-2	Stop Ramp Time	Period of time defining the stop ramp	0,0 … 600,0	s	3,0
3-3-5-3	Operating Ramp Time	Time defining the ramps for speed changes in open-loop control mode or in manual mode	0,0 … 600,0	s	3,0
3-3-5-5	Motor Coasting	Deactivation of the stop ramp when stopping the motor. The motor coasts to a stop.	▪ OFF ▪ Fixed Speed	-	OFF
3-3-5-6	Motor Coasting Speed	Speed from which the frequency inverter will, when decelerating along the stop ramp, let the motor coast to a stop.	0 - max. motor speed 3-2-2-2	-	500
3-3-6	PWM	-	-	-	-
3-3-6-1	Switching Frequency	Configurable switching frequency of power inverter in the frequency inverter power output stage	2 … 8	kHz	Dependent on size
3-3-6-2	Random PWM	-	▪ OFF ▪ ON	-	OFF
3-3-7	Additional Frequency Inverter Settings	-	-	-	-
3-3-7-1	Max. Motor Current in % of Nominal Motor Current	Configuring the maximum motor current permissible	0,00 ...150,00	%	110
3-3-7-5	I^2t Triggering Characteristic	Based on the I^2t triggering characteristic, a period of time is calculated dynamically during which the motor may be operated at a higher current until I^2t control is activated.	1 … 60	s	60
3-3-7-6	I^2t Stop Speed	This speed limit causes a Dynamic Overload Protection alert to be output, at which time the motor is stopped.	3-2-2-1 … 3-2-2-2	rpm	3-2-2-1

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-3-7-7	I^2t Threshold Value	Current limit value in % of the nominal motor current above which dynamic overload protection is activated	100.00 - 125.00	%	105
3-3-7-8	Flying start function	Function used to enable flying start	▪ ON ▪ OFF	-	OFF
3-3-8	MotionControl Controller Settings	-	-	-	-
3-3-8-1	Proportional Constant_Current (KpI)	Setting the proportional constant of the MotionControl power controller	0 … 9999	-	Dependent on size
3-3-8-2	Integral Constant_Current (KiI)	Setting the integral constant of the MotionControl power controller	0 … 9999	-	Dependent on size
3-3-8-3	Proportional Constant_Flux (Kpflx)	Setting the proportional constant of the MotionControl flux controller	0 … 9999	-	Dependent on size
3-3-8-4	Integral Constant_Flux (Kiflx)	Setting the integral constant of the MotionControl flux controller	0 … 9999	-	Dependent on size
3-3-8-5	Proportional Constant_Speed (Kpw)	Setting the proportional constant of the MotionControl speed controller	0 … 9999	-	Dependent on size
3-3-8-6	Integral Constant_Speed (Kiw)	Setting the integral constant of the MotionControl speed controller	0 … 9999	-	Dependent on size
3-3-8-7	Differential Constant_Speed (Kdw)	Setting the differential constant of the MotionControl speed controller	0 … 9999	-	Dependent on size
3-4	Pump	-	-	-	-
3-4-1	Pump Nominal Speed	Nominal speed of centrifugal pump	0 … 4200	rpm	Pump-specific
3-4-2	Number of Pump Stages	Number of pump stages. Only relevant for multi-stage pumps (with respect to power curve)	1 … 99	-	Pump-specific
3-4-3	Pump Characteristic Curve	-	-	-	-
3-4-3-1	Flow Rate Q_0	Data point 0 for flow rate at nominal speed	Minimum to maximum limit of value range set	Dependent on the unit set	Pump-specific
3-4-3-2	Flow Rate Q_1	Data point 1 for flow rate at nominal speed	Minimum to maximum limit of value range set	Dependent on the unit set	Pump-specific
3-4-3-3	Flow Rate Q_2	Data point 2 for flow rate at nominal speed	Minimum to maximum limit of value range set	Dependent on the unit set	Pump-specific
3-4-3-4	Flow Rate Q_3	Data point 3 for flow rate at nominal speed	Minimum to maximum limit of value range set	Dependent on the unit set	Pump-specific

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-4-3-5	Flow Rate Q_4	Data point 4 for flow rate at nominal speed	Minimum to maximum limit of value range set	Dependent on the unit set	Pump-specific
3-4-3-6	Flow Rate Q_5	Data point 5 for flow rate at nominal speed	Minimum to maximum limit of value range set	Dependent on the unit set	Pump-specific
3-4-3-7	Flow Rate Q_6	Data point 6 for flow rate at nominal speed	Minimum to maximum limit of value range set	Dependent on the unit set	Pump-specific
3-4-3-8	Flow Rate Q_opt	Flow rate at the pump's best efficiency point (BEP)	Minimum to maximum limit of value range set	Dependent on the unit set	Pump-specific
3-4-3-9	Pump Input Power P_0	Data point 0 for hydraulic performance at nominal speed	Minimum to maximum limit of value range set	Dependent on the unit set	Pump-specific
3-4-3-10	Pump Input Power P_1	Data point 1 for hydraulic performance at nominal speed	Minimum to maximum limit of value range set	Dependent on the unit set	Pump-specific
3-4-3-11	Pump Input Power P_2	Data point 2 for hydraulic performance at nominal speed	Minimum to maximum limit of value range set	Dependent on the unit set	Pump-specific
3-4-3-12	Pump Input Power P_3	Data point 3 for hydraulic performance at nominal speed	Minimum to maximum limit of value range set	Dependent on the unit set	Pump-specific
3-4-3-13	Pump Input Power P_4	Data point 4 for hydraulic performance at nominal speed	Minimum to maximum limit of value range set	Dependent on the unit set	Pump-specific
3-4-3-14	Pump Input Power P_5	Data point 5 for hydraulic performance at nominal speed	Minimum to maximum limit of value range set	Dependent on the unit set	Pump-specific
3-4-3-15	Pump Input Power P_6	Data point 6 for hydraulic performance at nominal speed	Minimum to maximum limit of value range set	Dependent on the unit set	Pump-specific
3-4-3-16	Head H_0	Data point 0 for head at nominal speed	0,00 … 1000,00	m	Pump-specific
3-4-3-17	Head H_1	Data point 1 for head at nominal speed	0,00 … 1000,00	m	Pump-specific
3-4-3-18	Head H_2	Data point 2 for head at nominal speed	0,00 … 1000,00	m	Pump-specific
3-4-3-19	Head H_3	Data point 3 for head at nominal speed	0,00 … 1000,00	m	Pump-specific
3-4-3-20	Head H_4	Data point 4 for head at nominal speed	0,00 … 1000,00	m	Pump-specific
3-4-3-21	Head H_5	Data point 5 for head at nominal speed	0,00 … 1000,00	m	Pump-specific
3-4-3-22	Head H_6	Data point 6 for head at nominal speed	0,00 … 1000,00	m	Pump-specific
3-4-3-23	NPSH_0	Data point 0 for pump NPSH values at nominal speed	0,00 … 1000,00	m	Pump-specific

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-4-3-24	NPSH_1	Data point 1 for pump NPSH values at nominal speed	0,00 … 1000,00	m	Pump-specific
3-4-3-25	NPSH_2	Data point 2 for pump NPSH values at nominal speed	0,00 … 1000,00	m	Pump-specific
3-4-3-26	NPSH_3	Data point 3 for pump NPSH values at nominal speed	0,00 … 1000,00	m	Pump-specific
3-4-3-27	NPSH_4	Data point 4 for pump NPSH values at nominal speed	0,00 … 1000,00	m	Pump-specific
3-4-3-28	NPSH_5	Data point 5 for pump NPSH values at nominal speed	0,00 … 1000,00	m	Pump-specific
3-4-3-29	NPSH_6	Data point 6 for pump NPSH values at nominal speed	0,00 … 1000,00	m	Pump-specific
3-4-3-30	Low Flow Limit Flow Rate in % Qopt	Flow rate for low flow limit at nominal speed	0 … 100	%	30
3-4-3-31	Overload Limit Flow Rate in % Q6 (Qmax)	Flow rate for the overload limit at nominal speed	0 … 100	%	98
3-4-3-33	Time Delay Hydraulic Warnings	After this time delay has expired, a Low Flow or Overload warning is generated if the relevant limit flow rate is continually undershot or exceeded.	0,0...600,0 s	-	300,0 s
3-5	System	-	-	-	Application-specific
3-5-1	Fluid Density	Density of the fluid handled	0 … 10000	kg/m3	1000
3-5-2	Pressure Measuring Points	-	-	-	-
3-5-2-1	Pipe Diameter_Suction Pressure Measuring Point	Inside pipe diameter at the suction pressure measuring point	0 … 1000	mm	System-specific
3-5-2-2	Pipe Diameter_Discharge Pressure Measuring Point	Inside pipe diameter at the discharge pressure measuring point	0 … 1000	mm	System-specific
3-5-2-3	Height Difference_Pressure Measuring Points	Difference in height between suction and discharge pressure measuring point	-10,00 … 10,00	m	System-specific
3-5-2-4	Pressure Measuring Point Positions	The Close to Pump setting must be used if the pressure measurement values for the system can be transferred to the pump.	▪ Close to Pump ▪ Distant from Pump	-	Close to Pump

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-6	Open-loop and Closed-loop Control	-	-	-	-
3-6-1	Type of Control	Selecting the control method. The controller is deactivated when OFF (Open-loop Control) is selected.	▪ OFF (Open-loop Control) ▪ Discharge Pressure ▪ Suction Pressure ▪ Differential Pressure ▪ Differential Pressure (Sensorless) ▪ Flow Rate ▪ Flow Rate (Sensorless) ▪ Temperature (Cooling) ▪ Temperature (Heating) ▪ Suction-side Level ▪ Discharge-side Level	-	Dependent on pump
3-6-2	Control Point	Activating the field bus as control point. Digital inputs and analog inputs have the highest priority. The actual value source must be configured separately.	▪ Local ▪ Field Bus	-	Local
3-6-3	Actual Value Source	Selecting the source for the actual value: Activating the field bus as the actual value source. Analog inputs or PumpMeter have the highest priority.	▪ Local ▪ Field Bus	-	Local
3-6-4	Controller Settings	-	-	-	-
3-6-4-2	Proportional Constant	Setting the proportional constant of the controller	0,01 … 100,00	-	Dependent on size
3-6-4-3	Integral Time (Integral Constant)	Setting the integral constant of the controller	0,1 … 9999,9	s	Dependent on size
3-6-4-4	Rate Time (Differential Constant)	Setting the differential constant of the controller	0,00 … 100,00	s	Dependent on size
3-6-4-6	Setpoint Ramp Time	Time defining the setpoint ramp	0,0 … 600,0	s	3,0
3-6-4-7	Deviation Permitted when Actual Value = Setpoint	Configurable band within which the Actual Value = Setpoint message is active via a digital output.	Minimum to maximum limit of value range set	Dependent on the unit set	-
3-6-4-8	Differential Constant Limitation	The maximum differential gain is limited in order to suppress measurement noise, for example.	1,00 … 20,00	-	3,00

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-6-4-9	ARW Delay	Configuration of the ARW measure, time sampling factor at least 5 * ts	0,0 … 1000,0	s	2,0
3-6-5	Manual Mode	-	-	-	-
3-6-5-1	Fixed Speed 1	Fixed speed selectable via digital inputs	3-2-2-1 … 3-2-2-2	-	0
3-6-5-2	Fixed Speed 2	Fixed speed selectable via digital inputs	3-2-2-1 … 3-2-2-2	-	0
3-6-5-3	Fixed Speed 3	Fixed speed selectable via digital inputs	3-2-2-1 … 3-2-2-2	-	0
3-6-6	Digital Potentiometer	-	-	-	-
3-6-6-1	Setpoint Change Increment	The parameter defines by what value per pulse at the digital input the setpoint is increased or decreased in automatic mode.	Minimum to maximum limit of value range set	Dependent on the unit set	0,10
3-6-6-2	Speed Change Increment	The parameter defines by what value per pulse at the digital input the manual-mode control value for a single-pump and multiple pump system is increased or decreased.	0 … 1000	rpm	10
3-6-6-3	Interval	Time for automatic change in value for continuously present signal	0,0 … 10,0	s	0,5
3-7	Multiple Pump Configuration	-	-	-	-
3-7-1	Role in Multiple Pump System	Selecting the role of the frequency inverter in a multiple pump configuration. The active master control device is responsible for starting and stopping pumps, as well as for open-loop and closed-loop control. All input variables required for open-loop or closed-loop control must be connected to the master control device and all redundant master control devices. The redundant master control device which is to serve as active master control is selected automatically based on a configurable transfer time. Auxiliary control devices and redundant master control devices receive their control value from the master control device.	▪ Master Control ▪ Auxiliary Control	-	Master Control

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-7-2	Maximum Number of Pumps Running	Maximum number of pumps running simultaneously in a multiple pump configuration	1…6	-	1
3-7-3	Start / Stop	-	-	-	-
3-7-3-1	Min. Time Start	Minimum period of time between two starts	0.0…600,0	s	10,0
3-7-3-2	Min. Time Stop	Minimum period of time between two stops	0.0…600,0	s	20,0
3-7-3-3	Start Speed	A pump is started when the start speed is reached.	0…140	%	100
3-7-3-4	Stop Speed	A pump is stopped when the stop speed is reached (required only for pumps with flat characteristic curves).	0…90	%	50
3-7-3-5	Start Flow Rate	Start flow rate for starting a second pump at nominal speed. Value provided in % of maximum flow rate Q6. Switching limits for starting additional pumps are derived from this value.	0…100	%	95
3-7-3-6	KSB PumpDynamicControl	Shift between energy-efficient (0 %) and dynamic operating mode (100 %)	1…100	%	30
3-7-3-7	Time Delay_Trigger Criterion	Period of time for which a start or stop condition (speed and/or flow rate limit) must be continually violated before a pump is started or stopped	0.1…600,0	s	5,0
3-7-3-8	Load-dependent Start / Stop	If an external controller is used, the pumps start and stop as a function of load in open-loop control.			
3-7-4	Automatic Pump Changeover	-	-	-	-
3-7-4-1	Automatic Pump Changeover	If this parameter is enabled, pump changeover will take place after a defined operating time.	▪ OFF ▪ Runtime ▪ Runtime with Time of Day	-	OFF
3-7-4-2	Pump Runtime	Pump runtime up to the next pump changeover. If the pump is stopped, the runtime is reset.	0…168	h	24

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-7-4-3	Pump Changeover Time	Time at which pumps are changed when the runtime is exceeded	00:00…23:59	-	00:00
3-8	Inputs/Outputs	-	-	-	-
3-8-1	Analog Input 1	-	-	-	-
3-8-1-1	Analog Input 1 Signal	Sensor signal at analog input 1	▪ OFF ▪ 4-20 mA ▪ 2-10 V ▪ 0-20 mA ▪ 0-10 V	-	OFF
3-8-1-2	Analog Input 1 Function	Function of analog input 1. Internal operating values cannot be used as an actual value source.	▪ No Function ▪ Setpoint/Control Value (Auto) ▪ Control Value (Manual) ▪ Suction Pressure ▪ Discharge Pressure ▪ Differential Pressure ▪ Flow Rate ▪ Level ▪ Temperature ▪ Suction Pressure_Internal ▪ Discharge Pressure_Internal ▪ Differential Pressure_Internal ▪ Alternative Setpoint/Control Value (Auto)	-	No Function
3-8-1-3	Analog Input 1 Lower Limit	-	Minimum to maximum limit of value range set	Dependent on the unit set	-
3-8-1-4	Analog Input 1 Upper Limit	-	Minimum to maximum limit of value range set	Dependent on the unit set	-
3-8-1-5	Calibration	Calibration function of the analog input. After executing the parameter, 2 calibration points can be set for the analog input.	-	-	-
3-8-1-6	Calibration Selection	-	▪ Factory setting ▪ Customer Settings	-	Factory setting
3-8-2	Analog Input 2	-	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-2-1	Analog Input 2 Signal	Sensor signal at analog input 2	▪ OFF ▪ 4-20 mA ▪ 2-10 V ▪ 0-20 mA ▪ 0-10 V	-	OFF
3-8-2-2	Analog Input 2 Function	Function of analog input 2. Internal operating values cannot be used as an actual value source.	▪ No Function ▪ Setpoint/Control Value (Auto) ▪ Alternative Setpoint/Control Value (Auto) ▪ Control Value (Manual) ▪ Suction Pressure ▪ Discharge Pressure ▪ Differential Pressure ▪ Flow Rate ▪ Level ▪ Temperature ▪ Suction Pressure_Internal ▪ Discharge Pressure_Internal ▪ Differential Pressure_Internal ▪ DIFF (AI1, AI2) ▪ MIN (AI1, AI2) ▪ MAX (AI1, AI2) ▪ AVE (AI1, AI2)	-	No Function
3-8-2-3	Analog Input 2 Lower Limit	-	Minimum to maximum limit of value range set	Dependent on the unit set	-
3-8-2-4	Analog Input 2 Upper Limit	-	Minimum to maximum limit of value range set	Dependent on the unit set	-
3-8-2-5	Calibration	Calibration function of the analog input. After executing the parameter, 2 calibration points can be set for the analog input.	-	-	-
3-8-2-6	Calibration Selection	-	▪ Factory setting ▪ Customer settings	-	Factory setting
3-8-3	Analog Input 3	-	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-3-1	Analog Input 3 Signal	Sensor signal at analog input 3 of the I/O extension board	▪ OFF ▪ 4-20 mA ▪ 2-10 V ▪ 0-20 mA ▪ 0-10 V	-	OFF
3-8-3-2	Analog Input 3 Function	Function of analog input 3 of the I/O extension board. Internal operating values cannot be used as an actual value source.	▪ No Function ▪ Setpoint/Control Value (Auto) ▪ Alternative Setpoint/Control Value (Auto) ▪ Control Value (Manual) ▪ Suction Pressure ▪ Discharge Pressure ▪ Differential Pressure ▪ Flow Rate ▪ Level ▪ Temperature ▪ Suction Pressure_Internal ▪ Discharge Pressure_Internal ▪ Differential Pressure_Internal	-	No Function
3-8-3-3	Analog Input 3 Lower Limit	-	Minimum to maximum limit of value range set	Dependent on the unit set	-
3-8-3-4	Analog Input 3 Upper Limit	-	Minimum to maximum limit of value range set	Dependent on the unit set	-
3-8-3-5	Calibration	Calibration function of the analog input. After executing the parameter, 2 calibration points can be set for the analog input.	-	-	-
3-8-3-6	Calibration Selection	-	▪ Factory setting ▪ Customer Settings	-	Factory setting
3-8-4	M12 Module Input A	-	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-4-1	Function M12 Module Input A	Function of M12 module, input A. Internal operating values cannot be used as an actual value source.	▪ OFF ▪ PMtr Suction/Discharge Pressure ▪ PMtr Suction/Discharge Pressure_Internal Suction Pressure ▪ Discharge Pressure ▪ Suction Pressure_Internal ▪ Discharge Pressure_Internal	-	OFF
3-8-4-2	Lower Limit M12 Module Input A	Only relevant for analog inputs	Minimum to maximum limit of value range set	Dependent on the unit set	-
3-8-4-3	Upper Limit M12 Module Input A	Only relevant for analog inputs	Minimum to maximum limit of value range set	Dependent on the unit set	-
3-8-4-4	Calibration	Calibration function of the M12 module. After executing the parameter, 2 calibration points can be set for the M12 module.	-	-	-
3-8-5	M12 Module Input B	-	-	-	-
3-8-5-1	Function M12 Module Input B	Function of M12 module, input B. Internal operating values cannot be used as an actual value source.	▪ OFF ▪ PMtr Suction/Discharge Pressure ▪ PMtr Suction/Discharge Pressure_Internal ▪ Suction Pressure ▪ Discharge Pressure ▪ Suction Pressure_Internal ▪ Discharge Pressure_Internal	-	OFF
3-8-5-2	Lower Limit M12 Module Input B	Only relevant for analog inputs	Minimum to maximum limit of value range set	Dependent on the unit set	-
3-8-5-3	Upper Limit M12 Module Input B	Only relevant for analog inputs	Minimum to maximum limit of value range set	Dependent on the unit set	-
3-8-5-4	Calibration	Calibration function of the M12 module. After executing the parameter, 2 calibration points can be set for the M12 module.	-	-	-
3-8-6	Digital Inputs	-	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-6-1	Digital Input 1 Function	Configurable function of digital input 1	▪ No Function ▪ System Start ▪ Potentiometer Auto + ▪ Potentiometer Auto - ▪ Control Point ▪ Alternative Setpoint/Control Value Active ▪ Potentiometer Manual + ▪ Potentiometer Manual - ▪ Control Digital Bit 0 ▪ Control Digital Bit 1 ▪ Control Digital Bit 2 ▪ Dry Running Protection ▪ Reset Messages ▪ Control AOUT Bit 0 ▪ Control AOUT Bit 1 ▪ External Message ▪ Start Functional Check Run ▪ Start Pump Changeover ▪ Start Pipe Flushing ▪ Overflow ▪ Lack of Water ▪ Parameter Set Changeover	-	System Start

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-6-2	Digital Input 2 Function	Configurable function of digital input 2	▪ No Function ▪ System Start ▪ Potentiometer Auto + ▪ Potentiometer Auto - ▪ Control Point ▪ Alternative Setpoint/Control Value Active ▪ Potentiometer Manual + ▪ Potentiometer Manual - ▪ Control Digital Bit 0 ▪ Control Digital Bit 1 ▪ Control Digital Bit 2 ▪ Dry Running Protection ▪ Reset Messages ▪ Control AOUT Bit 0 ▪ Control AOUT Bit 1 ▪ External Message ▪ Start Functional Check Run ▪ Start Pump Changeover ▪ Start Pipe Flushing ▪ Overflow ▪ Lack of Water ▪ Parameter Set Changeover	-	Reset Messages

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-6-3	Digital Input 3 Function	Configurable function of digital input 3	▪ No Function ▪ System Start ▪ Potentiometer Auto + ▪ Potentiometer Auto - ▪ Control Point ▪ Alternative Setpoint/Control Value Active ▪ Potentiometer Manual + ▪ Potentiometer Manual - ▪ Control Digital Bit 0 ▪ Control Digital Bit 1 ▪ Control Digital Bit 2 ▪ Dry Running Protection ▪ Reset Messages ▪ Control AOUT Bit 0 ▪ Control AOUT Bit 1 ▪ External Message ▪ Start Functional Check Run ▪ Start Pump Changeover ▪ Start Pipe Flushing ▪ Overflow ▪ Lack of Water ▪ Parameter Set Changeover	-	No Function

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-6-4	Digital Input 4 Function	Configurable function of digital input 4	▪ No Function ▪ System Start ▪ Potentiometer Auto + ▪ Potentiometer Auto - ▪ Control Point ▪ Alternative Setpoint/Control Value Active ▪ Potentiometer Manual + ▪ Potentiometer Manual - ▪ Control Digital Bit 0 ▪ Control Digital Bit 1 ▪ Control Digital Bit 2 ▪ Dry Running Protection ▪ Reset Messages ▪ Control AOUT Bit 0 ▪ Control AOUT Bit 1 ▪ External Message ▪ Start Functional Check Run ▪ Start Pump Changeover ▪ Start Pipe Flushing ▪ Overflow ▪ Lack of Water ▪ Parameter Set Changeover	-	No Function

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-6-5	Digital Input 5 Function	Configurable function of digital input 5	▪ No Function ▪ System Start ▪ Potentiometer Auto + ▪ Potentiometer Auto - ▪ Control Point ▪ Alternative Setpoint/Control Value Active ▪ Potentiometer Manual + ▪ Potentiometer Manual - ▪ Control Digital Bit 0 ▪ Control Digital Bit 1 ▪ Control Digital Bit 2 ▪ Dry Running Protection ▪ Reset Messages ▪ Control AOUT Bit 0 ▪ Control AOUT Bit 1 ▪ External Message ▪ Start Functional Check Run ▪ Start Pump Changeover ▪ Start Pipe Flushing ▪ Overflow ▪ Lack of Water ▪ Parameter Set Changeover	-	No Function

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-6-6	Digital Input 6 Function	Configurable function of digital input 6 of I/O extension board	▪ No Function ▪ System Start ▪ Potentiometer Auto + ▪ Potentiometer Auto - ▪ Control Point ▪ Alternative Setpoint/Control Value Active ▪ Potentiometer Manual + ▪ Potentiometer Manual - ▪ Control Digital Bit 0 ▪ Control Digital Bit 1 ▪ Control Digital Bit 2 ▪ Dry Running Protection ▪ Reset Messages ▪ Control AOUT Bit 0 ▪ Control AOUT Bit 1 ▪ External Message ▪ Start Functional Check Run ▪ Start Pump Changeover ▪ Start Pipe Flushing ▪ Overflow ▪ Lack of Water ▪ Parameter Set Changeover	-	No Function

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-6-7	Digital Input 7 Function	Configurable function of digital input 7 of I/O extension board	▪ No Function ▪ System Start ▪ Potentiometer Auto + ▪ Potentiometer Auto - ▪ Control Point ▪ Alternative Setpoint/Control Value Active ▪ Potentiometer Manual + ▪ Potentiometer Manual - ▪ Control Digital Bit 0 ▪ Control Digital Bit 1 ▪ Control Digital Bit 2 ▪ Dry Running Protection ▪ Reset Messages ▪ Control AOUT Bit 0 ▪ Control AOUT Bit 1 ▪ External Message ▪ Start Functional Check Run ▪ Start Pump Changeover ▪ Start Pipe Flushing ▪ Overflow ▪ Lack of Water ▪ Parameter Set Changeover	-	No Function

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-6-8	Digital Input 8 Function	Configurable function of digital input 8 of I/O extension board	▪ No Function ▪ System Start ▪ Potentiometer Auto + ▪ Potentiometer Auto - ▪ Control Point ▪ Alternative Setpoint/Control Value Active ▪ Potentiometer Manual + ▪ Potentiometer Manual - ▪ Control Digital Bit 0 ▪ Control Digital Bit 1 ▪ Control Digital Bit 2 ▪ Dry Running Protection ▪ Reset Messages ▪ Control AOUT Bit 0 ▪ Control AOUT Bit 1 ▪ External Message ▪ Start Functional Check Run ▪ Start Pump Changeover ▪ Start Pipe Flushing ▪ Overflow ▪ Lack of Water ▪ Parameter Set Changeover	-	No Function
3-8-7	Analog Output 1	-	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-7-1	Assignment 1 Analog Output 1	Selectable assignment 1 of analog output 1	▪ No Function ▪ Setpoint ▪ Actual Value ▪ Motor Speed ▪ Motor Power ▪ Motor Current ▪ Motor Voltage ▪ Output Frequency ▪ DC Link Voltage ▪ Pump Suction Pressure ▪ Pump Discharge Pressure ▪ Pump Differential Pressure ▪ Pump Flow Rate ▪ Suction Pressure ▪ Discharge Pressure ▪ Differential Pressure ▪ Flow Rate	-	Motor Speed

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-7-2	Assignment 2 Analog Output 1	Selectable assignment 2 of analog output 1	▪ No Function ▪ Setpoint ▪ Actual Value ▪ Motor Speed ▪ Motor Power ▪ Motor Current ▪ Motor Voltage ▪ Output Frequency ▪ DC Link Voltage ▪ Pump Suction Pressure ▪ Pump Discharge Pressure ▪ Pump Differential Pressure ▪ Pump Flow Rate ▪ Suction Pressure ▪ Discharge Pressure ▪ Differential Pressure ▪ Flow Rate	-	Motor Current

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-7-3	Assignment 3 Analog Output 1	Selectable assignment 3 of analog output 1	▪ No Function ▪ Setpoint ▪ Actual Value ▪ Motor Speed ▪ Motor Power ▪ Motor Current ▪ Motor Voltage ▪ Output Frequency ▪ DC Link Voltage ▪ Pump Suction Pressure ▪ Pump Discharge Pressure ▪ Pump Differential Pressure ▪ Pump Flow Rate ▪ Suction Pressure ▪ Discharge Pressure ▪ Differential Pressure ▪ Flow Rate	-	Motor Power

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-7-4	Assignment 4 Analog Output 1	Selectable assignment 4 of analog output 1	▪ No Function ▪ Setpoint ▪ Actual Value ▪ Motor Speed ▪ Motor Power ▪ Motor Current ▪ Motor Voltage ▪ Output Frequency ▪ DC Link Voltage ▪ Pump Suction Pressure ▪ Pump Discharge Pressure ▪ Pump Differential Pressure ▪ Pump Flow Rate ▪ Suction Pressure ▪ Discharge Pressure ▪ Differential Pressure ▪ Flow Rate	-	DC Link Voltage
3-8-7-5	Calibration Analog Output 1	Calibration function of the analog output. After executing the parameter, 2 calibration methods can be set for the analog output.	▪ Run	-	-
3-8-7-6	Calibration Selection	-	▪ Factory setting ▪ Customer settings	-	Factory setting
3-8-7-7	Signal Analog Output 1	Signal range at analog output 1	▪ 4...20 mA / 2...10 V ▪ 0...20 mA / 0...10 V	-	4...20 mA / 2...10 V
3-8-8	Analog Output 2	-	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-8-1	Assignment 1 Analog Output 2	Selectable assignment 1 of analog output 2 of I/O extension board	▪ No Function ▪ Setpoint ▪ Actual Value ▪ Motor Speed ▪ Motor Power ▪ Motor Current ▪ Motor Voltage ▪ Output Frequency ▪ DC Link Voltage ▪ Pump Suction Pressure ▪ Pump Discharge Pressure ▪ Pump Differential Pressure ▪ Pump Flow Rate ▪ Suction Pressure ▪ Discharge Pressure ▪ Differential Pressure ▪ Flow Rate	-	Motor Speed

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-8-2	Assignment 2 Analog Output 2	Selectable assignment 2 of analog output 2 of I/O extension board	▪ No Function ▪ Setpoint ▪ Actual Value ▪ Motor Speed ▪ Motor Power ▪ Motor Current ▪ Motor Voltage ▪ Output Frequency ▪ DC Link Voltage ▪ Pump Suction Pressure ▪ Pump Discharge Pressure ▪ Pump Differential Pressure ▪ Pump Flow Rate ▪ Suction Pressure ▪ Discharge Pressure ▪ Differential Pressure ▪ Flow Rate	-	Motor Current

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-8-3	Assignment 3 Analog Output 2	Selectable assignment 3 of analog output 2 of I/O extension board	▪ No Function ▪ Setpoint ▪ Actual Value ▪ Motor Speed ▪ Motor Power ▪ Motor Current ▪ Motor Voltage ▪ Output Frequency ▪ DC Link Voltage ▪ Pump Suction Pressure ▪ Pump Discharge Pressure ▪ Pump Differential Pressure ▪ Pump Flow Rate ▪ Suction Pressure ▪ Discharge Pressure ▪ Differential Pressure ▪ Flow Rate	-	Motor Power

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-8-4	Assignment 4 Analog Output 2	Selectable assignment 4 of analog output 2 of I/O extension board	▪ No Function ▪ Setpoint ▪ Actual Value ▪ Motor Speed ▪ Motor Power ▪ Motor Current ▪ Motor Voltage ▪ Output Frequency ▪ DC Link Voltage ▪ Pump Suction Pressure ▪ Pump Discharge Pressure ▪ Pump Differential Pressure ▪ Pump Flow Rate ▪ Suction Pressure ▪ Discharge Pressure ▪ Differential Pressure ▪ Flow Rate	-	DC Link Voltage
3-8-8-5	Calibration Analog Output 2	Calibration function of the analog output. After executing the parameter, 2 calibration methods can be set for the analog output.	▪ Run	-	-
3-8-8-6	Calibration Selection	-	▪ Factory setting ▪ Customer settings	-	Factory setting
3-8-8-7	Signal Analog Output 2	Signal type at analog output 2	▪ 4...20 mA / 2...10 V 0...20 mA / 0...10 V	-	4...20 mA / 2...10 V
3-8-9	Relay Output 1	-	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-9-1	Relay 1 Function	Selectable messages via relay 1	▪ No Function ▪ AUTO operating mode ▪ RUN operating status ▪ AUTO/SLEEP operating status ▪ Warning ▪ Alert ▪ Alert or Warning ▪ No alert ▪ Dynamic overload protection ▪ Current too high ▪ Current too low ▪ Frequency too high ▪ Frequency too low ▪ Power too high ▪ Power too low ▪ Actual value = setpoint ▪ Butterfly valve control ▪ Bypass control	-	Alert
3-8-9-2	Time Delay ON	Period of time during which the event selected must be continually available until the relay is set	0,0 … 10,0	s	0,5
3-8-9-3	Time Delay OFF	Period of time for which the event selected must have gone before the relay is reset	0,0 … 10,0	s	0,5
3-8-10	Relay Output 2	-	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-10-1	Relay 2 Function	Selectable messages via relay 2	▪ No Function ▪ AUTO operating mode ▪ RUN operating status ▪ AUTO/SLEEP operating status ▪ Warning ▪ Alert ▪ Alert or Warning ▪ No alert ▪ Dynamic overload protection ▪ Current too high ▪ Current too low ▪ Frequency too high ▪ Frequency too low ▪ Power too high ▪ Power too low ▪ Actual value = setpoint ▪ Butterfly valve control ▪ Bypass control	-	RUN operating status
3-8-10-2	Time Delay ON	Period of time during which the event selected must be continually available until the relay is set	0,0 … 10,0	s	0,5
3-8-10-3	Time Delay OFF	Period of time for which the event selected must have gone before the relay is reset	0,0 … 10,0	s	0,5
3-8-11	Relay Output 3	Selectable messages via relay 3 of I/O extension board	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-11-1	Relay 3 Function	Selectable messages via relay 3	▪ No Function ▪ AUTO operating mode ▪ RUN operating status ▪ AUTO/SLEEP operating status ▪ Warning ▪ Alert ▪ Alert or Warning ▪ No alert ▪ Dynamic overload protection ▪ Current too high ▪ Current too low ▪ Frequency too high ▪ Frequency too low ▪ Power too high ▪ Power too low ▪ Actual value = setpoint ▪ Butterfly valve control ▪ Bypass control	-	No Function
3-8-11-2	Time Delay ON	Period of time during which the event selected must be continually available until the relay is set	0,0 … 600,0	s	0,5
3-8-11-3	Time Delay OFF	Period of time for which the event selected must have gone before the relay is reset	0,0 … 600,0	s	0,5
3-8-12	Relay Output 4	-	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-12-1	Relay 4 Function	Selectable messages via relay 4 of I/O extension board	▪ No Function ▪ AUTO operating mode ▪ RUN operating status ▪ AUTO/SLEEP operating status ▪ Warning ▪ Alert ▪ Alert or Warning ▪ No alert ▪ Dynamic overload protection ▪ Current too high ▪ Current too low ▪ Frequency too high ▪ Frequency too low ▪ Power too high ▪ Power too low ▪ Actual value = setpoint ▪ Butterfly valve control ▪ Bypass control	-	No Function
3-8-12-2	Time Delay ON	Period of time during which the event selected must be continually available until the relay is set	0,0 … 600,0	s	0,5
3-8-12-3	Time Delay OFF	Period of time for which the event selected must have gone before the relay is reset	0,0 … 600,0	s	0,5
3-8-13	Relay Output 5	-	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-13-1	Relay 5 Function	Selectable messages via relay 5 of I/O extension board	▪ No Function ▪ AUTO operating mode ▪ RUN operating status ▪ AUTO/SLEEP operating status ▪ Warning ▪ Alert ▪ Alert or Warning ▪ No alert ▪ Dynamic overload protection ▪ Current too high ▪ Current too low ▪ Frequency too high ▪ Frequency too low ▪ Power too high ▪ Power too low ▪ Actual value = setpoint ▪ Butterfly valve control ▪ Bypass control	-	No Function
3-8-13-2	Time Delay ON	Period of time during which the event selected must be continually available until the relay is set	0,0 … 600,0	s	0,5
3-8-13-3	Time Delay OFF	Period of time for which the event selected must have gone before the relay is reset	0,0 … 600,0	s	0,5
3-8-14	Relay Output 6	-	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-14-1	Relay 6 Function	Selectable messages via relay 6 of I/O extension board	▪ No Function ▪ AUTO operating mode ▪ RUN operating status ▪ AUTO/SLEEP operating status ▪ Warning ▪ Alert ▪ Alert or Warning ▪ No alert ▪ Dynamic overload protection ▪ Current too high ▪ Current too low ▪ Frequency too high ▪ Frequency too low ▪ Power too high ▪ Power too low ▪ Actual value = setpoint ▪ Butterfly valve control ▪ Bypass control	-	No Function
3-8-14-2	Time Delay ON	Period of time during which the event selected must be continually available until the relay is set	0,0 … 600,0	s	0,5
3-8-14-3	Time Delay OFF	Period of time for which the event selected must have gone before the relay is reset	0,0 … 600,0	s	0,5
3-8-15	Relay Output 7	-	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-15-1	Relay 7 Function	Selectable messages via relay 7 of I/O extension board	▪ No Function ▪ AUTO operating mode ▪ RUN operating status ▪ AUTO/SLEEP operating status ▪ Warning ▪ Alert ▪ Alert or Warning ▪ No alert ▪ Dynamic overload protection ▪ Current too high ▪ Current too low ▪ Frequency too high ▪ Frequency too low ▪ Power too high ▪ Power too low ▪ Actual value = setpoint ▪ Butterfly valve control ▪ Bypass control	-	No Function
3-8-15-2	Time Delay ON	Period of time during which the event selected must be continually available until the relay is set	0,0 … 600,0	s	0,5
3-8-15-3	Time Delay OFF	Period of time for which the event selected must have gone before the relay is reset	0,0 … 600,0	s	0,5
3-8-16	Relay Output 8	-	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-16-1	Relay 8 Function	Selectable messages via relay 8 of I/O extension board	▪ No Function ▪ AUTO operating mode ▪ RUN operating status ▪ AUTO/SLEEP operating status ▪ Warning ▪ Alert ▪ Alert or Warning ▪ No alert ▪ Dynamic overload protection ▪ Current too high ▪ Current too low ▪ Frequency too high ▪ Frequency too low ▪ Power too high ▪ Power too low ▪ Actual value = setpoint ▪ Butterfly valve control ▪ Bypass control	-	No Function
3-8-16-2	Time Delay ON	Period of time during which the event selected must be continually available until the relay is set	0,0 … 600,0	s	0,5
3-8-16-3	Time Delay OFF	Period of time for which the event selected must have gone before the relay is reset	0,0 … 600,0	s	0,5
3-8-17	Digital Output 1	-	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-17-1	Digital Output 1 Function	Selectable messages via digital output 1 of I/O extension board	▪ No Function ▪ AUTO operating mode ▪ RUN operating status ▪ AUTO/SLEEP operating status ▪ Warning ▪ Alert ▪ Alert or Warning ▪ No alert ▪ Dynamic overload protection ▪ Current too high ▪ Current too low ▪ Frequency too high ▪ Frequency too low ▪ Power too high ▪ Power too low ▪ Actual value = setpoint ▪ Butterfly valve control ▪ Bypass control	-	No functions
3-8-17-2	Time Delay ON	Period of time during which the event selected must be continually available until the digital output is set	0,0 … 600,0	s	0,5
3-8-17-3	Time Delay OFF	Period of time for which the event selected must have gone before the digital output is reset	0,0 … 600,0	s	0,5
3-8-18	Digital Output 2	-	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-8-18-1	Digital Output 2 Function	Selectable messages via digital output 2 of I/O extension board	▪ No Function ▪ AUTO operating mode ▪ RUN operating status ▪ AUTO/SLEEP operating status ▪ Warning ▪ Alert ▪ Alert or Warning ▪ No alert ▪ Dynamic overload protection ▪ Current too high ▪ Current too low ▪ Frequency too high ▪ Frequency too low ▪ Power too high ▪ Power too low ▪ Actual value = setpoint ▪ Butterfly valve control ▪ Bypass control	-	No Function
3-8-18-2	Time Delay ON	Period of time during which the event selected must be continually available until the digital output is set	0,0 … 600,0	s	0,5
3-8-18-3	Time Delay OFF	Period of time for which the event selected must have gone before the digital output is reset	0,0 … 600,0	s	0,5
3-9	Application Functions	-	-	-	-
3-9-1	Broken Wire Detection	-	-	-	-
3-9-1-1	Response to Failure	Frequency inverter response to *No Master Control* alert	▪ All Pumps OFF ▪ Fixed speed	-	Fixed speed

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-9-1-2	Time Delay	Time delay before the message (warning or alert) is triggered. In a redundant system, only a warning is output as the auxiliary master can assume the function. Only if the actual value also fails at the auxiliary master is the alert output, which then triggers the specified response to actual value failure.	0,0 … 10,0	s	0,5
3-9-1-3	Speed During Failure	Fixed speed that is activated when the actual value fails	3-2-2-1 … 3-2-2-2	rpm	3-2-2-1
3-9-2	Functional Check Run	-	-	-	-
3-9-2-1	Automatic Functional Check Run	For a functional check run, a pump is started, run at a configurable frequency for a configurable period of time and then stopped again. During this period, the pump is not available for closed-loop control operation.	▪ OFF ▪ After Idle Period ▪ After Idle Period at Defined Time	-	OFF
3-9-2-2	Idle Period before Functional Check Run	A functional check run is performed for a pump if it has not been started for the defined period of time.	0…168	h	24
3-9-2-3	Time for Functional Check Run	When a time has been defined, the functional check run after idle period is delayed until the defined time is reached.	00:00…23:59	-	00:00
3-9-2-4	Functional Check Run Duration	Runtime of pump during the functional check run at the set speed	0.0 … 600.0	s	5,0
3-9-2-5	Speed for Functional Check Run	Speed for Functional Check Run	3-2-2-1 … 3-2-2-2	rpm	500
3-9-3	Dyn Press Comp	-	-	-	-
3-9-3-1	Dynamic Pressure Compensation Method	Selecting the dynamic differential pressure compensation method (DFS) Dynamic pressure compensation based on speed can only be used for systems without a geodetic head (e.g. in closed systems).	▪ OFF ▪ Speed ▪ Flow Rate	-	OFF
3-9-3-2	Dyn Press Comp Q Data Point	The setpoint compensation value is reached at this point. Beyond that, the setpoint is further increased with respect to the specified value.	Minimum to maximum limit of value range set	Dependent on the unit set	0,0

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-9-3-3	Dyn Press Comp n Data Point	The setpoint compensation value is reached at this point. Beyond that, the setpoint is further increased with respect to the specified value. Data is entered in % referred to Maximum Motor Speed (3.2.2.2).	0,0 … 600,0	%	0,0
3-9-3-4	Setpoint Compensation	Configurable setpoint compensation at data point 3.9.3.2 or 3.9.3.3	Minimum to maximum limit of value range set	Dependent on the unit set	0,0
3-9-3-5	Minimum Setpoint Compensation	Minimum setpoint compensation for opening the swing check valve in the case of low pump flow rates	Minimum to maximum limit of value range set	Dependent on the unit set	0,0
3-9-4	Sleep Mode	-	-	-	-
3-9-4-1	Sleep Mode	Sleep mode ON/OFF	▪ OFF ▪ ON	-	OFF
3-9-4-2	Setpoint Increase	Pressure increase required for tank filling	Minimum to maximum limit of value range set	Dependent on the unit set	-
3-9-4-3	Monitoring Period	Configurable monitoring period until setpoint increase or stop	0,0 … 600,0	s	20,0
3-9-4-4	Duration of Setpoint Increase	Maximum duration of setpoint increase. Stop is triggered if the setpoint is reached within this window. The duration of the setpoint increase must exceed the time of the ramp defined for the increase.	0,0 … 600,0	s	10,0
3-9-4-5	Permissible Deviation	Maximum permissible control deviation for restart	Minimum to maximum limit of value range set	Dependent on the unit set	1 % of the value range of the controlled variable selected
3-9-4-6	Minimum Runtime	Minimum period of time between two stop attempts in sleep mode	0,0 … 600,0	s	60,0
3-9-4-7	Ramp-up Time for Setpoint Increase	Ramp-up time during which the setpoint is increased	0,0 … 1000,0	s	5,0
3-9-4-8	Stop Speed	The pump is stopped if the low flow limit or stop speed of the pump is undershot due to minimal withdrawal over period 3-9-4-3.	3-2-2-1 … 3-2-2-2	rpm	3-2-2-1
3-9-5	Energy Savings Meter	-	-	-	-
3-9-5-1	Energy Savings Meter	Selection of method for energy savings metering	OffFixedReferencePowerVariableReferencePower	-	OFF

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-9-5-2	Fixed Reference Power	Configurable reference power of fixed speed pump for energy savings meter	0,00…110,00	kW	0,00
3-9-5-3	CO2 Emissions per kWh	Carbon dioxide emissions per kWh	0 - 10000	g/kWh	500
3-9-5-4	Electricity Costs per kWh	Electricity price per kWh	0,000…1000,000	-	0,140
3-9-6	Dry Running Detection	-	-	-	-
3-9-6-1	Hydraulic Blockage Limit	Factor for shifting the learning curve. The limit curve for hydraulic blockage is calculated based on the product of the learning curve with the parameter.	0 … 130	%	101
3-9-6-2	Dry Run Time Limit	Factor for shifting the learning curve. The limit curve for dry running is calculated based on the product of the learning curve with the parameter.	0 … 130	%	85
3-9-6-3	Start Learning Function	When the learning function is run, the frequency inverter activates 5 speed points and saves the associated mechanical power values. For this purpose, it must be ensured that discharge-side valves are fully closed.	Run	-	-
3-9-6-4	Mech. Power at n_min	Mechanical power at speed 1 (minimum speed) from learning function for Q = 0 m^3/h	Minimum to maximum limit of value range set	Dependent on the unit set	0,00
3-9-6-5	Mech. Power at n_2	Mechanical power at speed 2 from learning function for Q = 0 m^3/h	Minimum to maximum limit of value range set	Dependent on the unit set	0,00
3-9-6-6	Mech. Power at n_3	Mechanical power at speed 3 from learning function for Q = 0 m^3/h	Minimum to maximum limit of value range set	Dependent on the unit set	0,00
3-9-6-7	Mech. Power at n_4	Mechanical power at speed 4 from learning function for Q = 0 m^3/h	Minimum to maximum limit of value range set	Dependent on the unit set	0,00
3-9-6-8	Mech. Power at n_max	Mechanical power at speed 5 from learning function for Q = 0 m^3/h	Minimum to maximum limit of value range set	Dependent on the unit set	0,00
3-9-6-9	Hydraulic Blockage Warning Time Delay	Time delay before the hydraulic blockage warning is triggered	0,0 … 600,0	s	60,00
3-9-6-10	Hydraulic Blockage Alert Time Delay	Time delay before the hydraulic blockage alert is triggered	0,0 … 600,0	s	120,00
3-9-6-11	Dry Running Alert Time Delay	Time delay before the dry running alert is triggered	0,0 … 600,0	s	5,0
3-9-7	External Dry Running Detection	-	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-9-7-1	External Dry Running Detection Behaviour	Alarm behaviour of external dry running detection	▪ Self-acknowledging ▪ Non-self-acknowledging	-	Non-self-acknowledging
3-9-8	Flow Rate Estimation	-	-	-	-
3-9-8-1	Flow Rate Estimation	Activation of flow rate estimation	▪ OFF ▪ ON	-	ON
3-9-8-2	Time Constant for Attenuation of Estimated Flow Rate Values	Time constant for attenuation of estimated flow rate values. The time constant makes it easier to read the display value on the control panel and is required for sensorless flow rate control.	0,0 … 600,0	s	5,0
3-9-9	Waste Water Function	-	-	-	-
3-9-9-1	Flow Velocity Monitoring	Activate flow velocity monitoring. Depending on the selection made, a warning is output when the value defined in 3.9.9.2 is undershot, and the pipe flushing function may also be started.	OffWarningWarning + Pipe flushing	-	OFF
3-9-9-2	Minimum Flow Velocity	The minimum flow velocity set here must be undershot for a configurable period of time so that the pipe flushing function starts or a warning is displayed, depending on the configuration.	0,0…10,0	m/s	2,0
3-9-9-3	Time Delay, Flow Velocity Monitoring	Configurable period of time for which the minimum flow velocity must be continually undershot so that the pipe flushing function starts.	0…168 h 24	h	24
3-9-9-4	Duration of Pipe Flushing	Duration of pipe flushing cycle. Period of time during which alternative control is active	0 …120	min	2
3-9-9-5	Pipe Flushing Flow Velocity	Flow velocity value during flushing	0,0…5,0	m/s	4,0
3-9-9-6	Inside Pipe Diameter of System	Pipe diameter of system	0…5000	mm	0

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-9-9-7	Pump Start at Maximum Speed	Start-up along a ramp up to maximum speed and maintaining maximum speed for the duration of a defined period of time. The function is run or executed at every start to prevent deposits in the pump sump and in the piping.	OFF / ON	-	OFF
3-9-9-8	Duration of Maximum Speed	Configurable period of time for which the frequency inverter maintains maximum speed	0,0…600,0	s	180,0
3-9-11	Lack-of-water Function	-	-	-	-
3-9-11-1	Lack-of-water Alarm Behaviour	Function for resetting the lack-of-water alert	Non-self-acknowledging	-	Self-acknowledging
3-9-11-2	Time Delay for Stop	After this time delay has expired, the pump is stopped if the stop limit for lack of water is continually undershot.	0,0...600,0	s	10,0
3-9-11-3	Minimum Alert Duration	Minimum duration of lack-of-water alert condition. The alert is active for at least this period of time.	0,0...600,0	s	10,0
3-9-11-4	Monitoring via Suction Pressure Sensor	If the suction pressure falls below the stop limit, the lack-of-water alert is triggered.	▪ OFF ▪ ON	-	OFF
3-9-11-5	Suction Pressure Stop Limit	If the stop limit for the suction pressure is continually undershot, the pump is stopped.	-1,00...10,00	bar	1,0
3-9-11-6	Suction Pressure Start Limit	If the pump has been stopped and this start limit is exceeded, the pump is restarted.	-1,00...10,00	bar	1,5
3-9-12	Resonance Range	-	-	-	-
3-9-12-1	Lower Limit	Lower speed limit for suppressing the resonance range. If the lower and upper limit frequency are assigned the same values, there is no suppression. This function is not supported in manual mode.	3-2-2-1 … 3-2-2-2	rpm	3-2-2-1

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-9-12-2	Upper Limit	Upper speed limit for suppressing the resonance range. If the lower and upper limit frequency are assigned the same values, there is no suppression. This function is not supported in manual mode.	3-2-2-1 … 3-2-2-2	rpm	3-2-2-1
3-9-13	Service Interval	-	-	-	-
3-9-13-1	Interval Time	Time interval between notifications for upcoming maintenance service	0 … 48	Months	0
3-9-13-2	Reset Service Interval	Resetting the service interval	Run	-	-
3-9-13-3	Motor Bearings Service Interval	Time interval between notifications for upcoming maintenance service	0 ... 48	Months	0
3-9-13-4	Reset Motor Bearing Service Interval	Resetting the service interval for the motor bearings after maintenance has been performed	Run	-	-
3-9-14	External Message	-	-	-	-
3-9-14-1	Response to External Message	Response to output of external message	▪ Alert ▪ Warning	-	Alert
3-9-14-2	Behaviour of External Message	Alarm behaviour of external message	▪ Self-acknowledging ▪ Non-self-acknowledging	-	Non-self-acknowledging
3-9-15-1	Start with Pipe Filling Function	The pipe filling function is initiated at the next system start.	▪ 0 = OFF ▪ 1 = Once ▪ 2 = Limit value undershoot	-	0 = OFF
3-9-15-2	Initial Speed	Speed value activated at the beginning of the pipe filling mode	Minimum to maximum limit of value range set	rpm	3-2-2-1
3-9-15-3	Duration Initial Speed	Duration of the first phase of the filling process performed at the initial speed	0...6000	s	60
3-9-15-4	Setpoint Increase per Min	Increment of the setpoint increase for the second phase of the filling process	Minimum to maximum limit of value range set	Dependent on the unit set	2 % of the value range of the control type selected
3-9-15-5	Final Value	Final value of setpoint; when it is reached the second phase of the filling process is stopped.	Minimum to maximum limit of value range set	Dependent on the unit set	0

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-9-15-6	Limit Value	When 3.9.15.1 Limit Value Undershot is selected the system will start the pipe filling function if the actual value falls below the limit value.	Minimum to maximum limit of value range set	Dependent on the unit set	0
3-9-16-1	Automatic Deragging During deragging a pump is started up in the opposite direction to its normal direction of rotation, run at a configurable frequency for a configurable period of time and then stopped again. During this period, the pump is not available for closed-loop control operation.	▪ 0 = OFF ▪ 1 = After Idle Period ▪ 2 = After Idle Period at Defined Time	-	0 = OFF	0
3-9-16-2	Idle Period before Deragging Deragging is performed for a pump if it has not been started for the set period of time.	0…168 h	-	24 h	0
3-9-16-3	Time for Deragging When a time has been defined, deragging after idle period is delayed until the defined time is reached.	00:00…23:59	-	00:00	0
3-9-16-4	Deragging Duration Runtime of pump during deragging at the set speed	0.0…600.0 s	-	5.0 s	0
3-9-16-5	Speed for Deragging	0 rpm to maximum speed of the motor	0 1rpm to 3-2-2-2	rpm	0
3-10	Monitoring Functions	-	-	-	-
3-10-1	Power	-	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-10-1-1	Lower Limit	Defining the lower limit value for warning. When the lower limit value is undershot, a warning is triggered after the time delay has lapsed.	3-11-6-1 … 3-10-1-2	Dependent on the unit set	0,00
3-10-1-2	Upper Limit	Defining the upper limit value for warning. When the upper limit value is exceeded, a warning is triggered after the time delay has lapsed.	3-10-1-1 … 3-11-6-2	Dependent on the unit set	500,00
3-10-1-3	Time Delay	Period of time for which the limit value must be continually violated before a warning is triggered	0,0 … 600,0	s	3,0
3-10-2	Current	-	-	-	-
3-10-2-1	Lower Limit	Defining the lower limit value for warning. When the lower limit value is undershot, a warning is triggered after the time delay has lapsed.	3-11-7-1 … 3-10-2-2	A	0,00
3-10-2-2	Upper Limit	Defining the upper limit value for warning. When the upper limit value is exceeded, a warning is triggered after the time delay has lapsed.	3-10-2-1 … 3-11-7-2	A	150,00
3-10-2-3	Time Delay	Period of time for which the limit value must be continually violated before a warning is triggered	0,0 … 600,0	s	3,0
3-10-3	Speed	-	-	-	-
3-10-3-1	Lower Limit	Defining the lower limit value for warning. When the lower limit value is undershot, a warning is triggered after the time delay has lapsed.	3-11-1-1 … 3-10-3-2	rpm	3-2-2-1
3-10-3-2	Upper Limit	Defining the upper limit value for warning. When the upper limit value is exceeded, a warning is triggered after the time delay has lapsed.	3-10-3-1 … 3-11-1-2	rpm	3-11-1-2
3-10-3-3	Time Delay	Period of time for which the limit value must be continually violated before a warning is triggered	0,0 … 600,0	s	3,0
3-10-4	Setpoint	-	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-10-4-1	Lower Limit	Defining the lower limit value for warning. When the lower limit value is undershot, a warning is triggered after the time delay has lapsed.	Minimum limit of value range set up to 3-10-4-2	Dependent on the unit set	
3-10-4-2	Upper Limit	Defining the upper limit value for warning. When the upper limit value is exceeded, a warning is triggered after the time delay has lapsed.	3-10-4-1 up to maximum limit of value range set	Dependent on the unit set	-
3-10-4-3	Time Delay	Period of time for which the limit value must be continually violated before a warning is triggered	0,0 … 600,0	s	3,0
3-10-5	Actual Value	-	-	-	-
3-10-5-1	Lower Limit	Defining the lower limit value for warning. When the lower limit value is undershot, a warning is triggered after the time delay has lapsed.	Minimum limit of value range set up to 3-10-5-2	Dependent on the unit set	-
3-10-5-2	Upper Limit	Defining the upper limit value for warning. When the upper limit value is exceeded, a warning is triggered after the time delay has lapsed.	3-10-5-1 up to maximum limit of value range set	Dependent on the unit set	-
3-10-5-3	Time Delay	Period of time for which the limit value must be continually violated before a warning is triggered	0,0 … 600,0	s	3,0
3-10-6	Flow Rate	-	-	-	-
3-10-6-1	Lower Limit	Defining the lower limit value for warning. When the lower limit value is undershot, a warning is triggered after the time delay has lapsed.	3-11-3-1 … 3-10-6-2	Dependent on the unit set	Application-specific
3-10-6-2	Upper Limit	Defining the upper limit value for warning. When the upper limit value is exceeded, a warning is triggered after the time delay has lapsed.	3-10-6-1 … 3-11-3-2	Dependent on the unit set	Application-specific
3-10-6-3	Time Delay	Period of time for which the limit value must be continually violated before a warning is triggered	0,0 … 600,0	s	3,0
3-10-6-4	Limit Value – Open Bypass	Defines the lower limit value for the bypass. If the value is undercut, the relay for the Bypass Control function closes.	3-11-3-1 ... 3-11-3-2	m3/h	0,0

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-10-6-5	Limit Value – Close Bypass	Defines the upper limit value for the bypass. If the value is exceeded, the relay for the Bypass Control function closes.	3-11-3-1 ... 3-11-3-2	m3/h	9999,9
3-10-7	Suction Pressure				
3-10-7-1	Lower Limit	Defining the lower limit value for warning. When the lower limit value is undershot, a warning is triggered after the time delay has lapsed.	3-11-2-1 … 3-10-7-2	Dependent on the unit set	-
3-10-7-2	Upper Limit	Defining the upper limit value for warning. When the upper limit value is exceeded, a warning is triggered after the time delay has lapsed.	3-10-7-1 … 3-11-2-2	Dependent on the unit set	-
3-10-7-3	Time Delay	Period of time for which the limit value must be continually violated before a warning is triggered	0,0 … 600,0	s	-
3-10-8	Discharge Pressure	-	-	-	-
3-10-8-1	Lower Limit	Defining the lower limit value for warning. When the lower limit value is undershot, a warning is triggered after the time delay has lapsed.	3-11-2-1 … 3-10-8-2	Dependent on the unit set	-
3-10-8-2	Upper Limit	Defining the upper limit value for warning. When the upper limit value is exceeded, a warning is triggered after the time delay has lapsed.	3-10-8-1 … 3-11-2-2	Dependent on the unit set	-
3-10-8-3	Time Delay	Period of time for which the limit value must be continually violated before a warning is triggered	0,0 … 600,0	s	3,0
3-10-9	Differential Pressure	-	-	-	-
3-10-9-1	Lower Limit	Defining the lower limit value for warning. When the lower limit value is undershot, a warning is triggered after the time delay has lapsed.	3-11-2-1 … 3-10-9-2	Dependent on the unit set	-
3-10-9-2	Upper Limit	Defining the upper limit value for warning. When the upper limit value is exceeded, a warning is triggered after the time delay has lapsed.	3-10-9-1 … 3-11-2-2	Dependent on the unit set	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-10-9-3	Time Delay	Period of time for which the limit value must be continually violated before a warning is triggered	0,0 … 600,0	s	3,0
3-10-10	Frequency	-	-	-	-
3-10-10-1	Lower Limit	Defining the lower limit value for warning. When the lower limit value is undershot, a warning is triggered after the time delay has lapsed.	3-11-8-1 … 3-10-10-2	Hz	0,00
3-10-10-2	Upper Limit	Defining the upper limit value for warning. When the upper limit value is exceeded, a warning is triggered after the time delay has lapsed.	3-10-10-1 … 3-11-8-2	Hz	70,00
3-10-10-3	Time Delay	Period of time for which the limit value must be continually violated before a warning is triggered	0,0 … 600,0	s	3,0
3-10-11	Temperature	-	-	-	
3-10-11-1	Lower Limit	Defining the lower limit value for warning. When the lower limit value is undershot, a warning is triggered after the time delay has lapsed.	3-11-4-1 … 3-10-11-2	Dependent on the unit set	-
3-10-11-2	Upper Limit	Defining the upper limit value for warning. When the upper limit value is exceeded, a warning is triggered after the time delay has lapsed.	3-10-11-1 … 3-11-4-2	Dependent on the unit set	-
3-10-11-3	Time Delay	Period of time for which the limit value must be continually violated before a warning is triggered	0,0 … 600,0	s	3,0
3-11	Value Ranges and Units	-	-	-	-
3-11-1	Speed	-	-	-	-
3-11-1-1	Minimum Speed	Minimum limit of measuring range	0 … 4200	rpm	0
3-11-1-2	Maximum Speed	Maximum limit of measuring range	0 … 4200	rpm	Motor-specific
3-11-2	Pressure	-	-	-	-
3-11-2-1	Minimum Pressure	Minimum limit of measuring range	-1,00 … 3-11-2-2	-	-1,00
3-11-2-2	Maximum Pressure	Maximum limit of measuring range	3-11-2-1 … 999,99	-	999,99
3-11-2-3	Pressure Unit	Configurable unit for pressure	▪ bar ▪ psi ▪ kPa	-	Application-specific

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-11-3	Flow Rate	-	-	-	-
3-11-3-1	Minimum Flow Rate	Minimum limit of measuring range	0,00 … 3-11-3-2	-	0,00
3-11-3-2	Maximum Flow Rate	Maximum limit of measuring range	3-11-3-1 … 9999,9	-	9999,9
3-11-3-3	Flow Rate Unit	Configurable unit for flow rate	▪ m3/h ▪ l/min ▪ gal/min	-	Application-specific
3-11-4	Temperature	-	-	-	-
3-11-4-1	Minimum Temperature	Minimum limit of measuring range	-200,0 … 3-11-4-2	-	-200,0
3-11-4-2	Maximum Temperature	Maximum limit of measuring range	3-11-4-1 … 350,0	-	350,0
3-11-4-3	Temperature Unit	Configurable unit for temperature	▪ °C ▪ F ▪ K	-	Application-specific
3-11-5	Level	-	-	-	-
3-11-5-1	Minimum Level	Minimum limit of measuring range	0,00 … 3-11-5-2	-	0,00
3-11-5-2	Maximum Level	Maximum limit of measuring range	3-11-5-1 … 100,00	-	100,00
3-11-5-3	Level Unit	Configurable unit for level	▪ m ▪ ft ▪ mm	-	Application-specific
3-11-6	Power	-	-	-	-
3-11-6-1	Minimum Power	Minimum limit of measuring range	0,00 … 3-11-6-2	-	0,00
3-11-6-2	Maximum Power	Maximum limit of measuring range	3-11-6-1 … 110,00	-	110,00
3-11-6-3	Power Unit	Configurable unit for power	▪ kW ▪ W ▪ HP	-	Application-specific
3-11-7	Current	-	-	-	-
3-11-7-1	Minimum Current	Minimum limit of measuring range	0,00 … 3-11-7-2	A	0,00
3-11-7-2	Maximum Current	Maximum limit of measuring range	3-11-7-1 … 150,00	A	150,00
3-11-8	Frequency	-	-	-	-
3-11-8-1	Minimum Frequency	Minimum limit of measuring range	0,0 … 3-11-8-2	Hz	0,0
3-11-8-2	Maximum Frequency	Maximum limit of measuring range	3-11-8-1 … 200,0	Hz	200,0
3-11-9	Voltage	-	-	-	-
3-11-9-1	Minimum Voltage	Minimum limit of measuring range	0 … 3-11-9-2	V	0
3-11-9-2	Maximum Voltage	Maximum limit of measuring range	3-11-9-1 … 1000	V	1000

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-12	Field Bus	-	-	-	-
3-12-1	Profibus	-	-	-	-
3-12-1-1	Profibus Slave Address	Profibus slave address of the system	1 … 126	-	126
3-12-1-2	Pump Number	Unique assignment of the pump in multiple pump configuration	1 … 6	-	1
3-12-1-3	Cycle Time, Setpoint/ Control Value	Time delay before the message (warning or alert) is triggered. In a redundant system, only a warning is output as the auxiliary master can assume the function. Only if the setpoint/control value also fails at the auxiliary master is the alert output, which then triggers the specified response to setpoint/control value failure.	0.0…10.0	s	5
3-12-1-4	Cycle Time, Actual Value	Time delay before the message (warning or alert) is triggered. In a redundant system, only a warning is output as the auxiliary master can assume the function. Only if the actual value also fails at the auxiliary master is the alert output, which then triggers the specified response to actual value failure.	0.0…10.0	s	1
3-12-2	Modbus	-	-	-	-
3-12-2-1	Modbus Slave Address	Modbus slave address of the system	1…247	-	1
3-12-2-2	Baud Rate	Baud rate of the Modbus slave	▪ 4800 ▪ 9600 ▪ 19200 ▪ 38400 ▪ 57600 ▪ 115200	-	19200
3-12-2-3	Parity	Parity of the Modbus slave	▪ Even ▪ Odd ▪ No parity	-	Even

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-12-2-4	Modbus Address Range of Pump	Configurable address range via which the local parameters of the pump are addressed	▪ 0x1000 - 0x1FF ▪ 0x2000 - 0x2FF ▪ 0x3000 - 0x3FF ▪ 0x4000 - 0x4FF ▪ 0x5000 - 0x5FF ▪ 0x6000 - 0x6FF	-	0x1000 - 0x1FF
3-12-2-5	Cycle Time, Setpoint/ Control Value	Time delay before the message (warning or alert) is triggered. In a redundant system, only a warning is output as the auxiliary master can assume the function. Only if the setpoint/ control value also fails at the auxiliary master is the alert output, which then triggers the specified response to setpoint/ control value failure.	0,0…10,0	s	5,0
3-12-2-6	Cycle Time, Actual Value	Time delay before the message (warning or alert) is triggered. In a redundant system, only a warning is output as the auxiliary master can assume the function. Only if the actual value also fails at the auxiliary master is the alert output, which then triggers the specified response to actual value failure.	0,0…10,0	s	1,0
3-12-3	LON	-	-	-	-
3-12-3-1	Activate Service Pin	Activates the service pin for commissioning the LON module	Run	-	-
3-12-3-2	Maximum Transmission Time	The nvoPumpCapacity, nvoEffOpMode, nvoControlMode and nvoPumpStatus variables are updated at the very latest when this time lapses.	0,0 … 6553,5	s	0,0
3-12-3-3	Minimum Transmission Time	Shortest update time for the nvoPumpCapacity, nvoEffOpMode, nvoControlMode and nvoPumpStatus variables. Used for limiting, or restricting, the load on the LON bus. 0,0 = No limitation	0,0 … 6553,5	s	0,0

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-12-3-4	Maximum Timeout	After this period of time lapses, the remote actual values are set to invalid. This applies to the nviRemotePress, nviRemoteFlow and nviRemoteTemp variables. 0 = No monitoring	0,0 … 6553,5	s	0,0
3-12-3-5	Installation Location	Installation location of the LON subscriber	-	-	-
3-12-3-6	LON Control Type	Specifies the type of control in LON mode. This type of control is used if nviRemotePress, nviRemoteFlow and nviRemoteTemp do not supply a signal.	▪ OFF (Open-loop Control) ▪ Discharge Pressure ▪ Suction Pressure ▪ Differential Pressure ▪ Differential Pressure (Sensorless) ▪ Flow rate ▪ Flow Rate (Sensorless) ▪ Temperature (Cooling) Temperature (Heating) ▪ Suction-side Level ▪ Discharge-side Level	-	OFF
3-12-3-7	Control Direction, Temperature Control	Specifies the control direction for temperature control. The control direction is used if the actual value is supplied via nviRemoteTemp.	▪ OFF ▪ ON	-	OFF
3-12-3-8	LON Dyn Press Comp Method	Determines whether dynamic pressure compensation is used for pressure control via nviRemotePress.	▪ OFF ▪ Speed ▪ Flow rate	-	OFF
3-12-4	Profinet	-	-	-	-
3-12-4-1	Profinet Device Name	Host name of the PROFINET IO device	Character string: A to Z	-	-
3-12-4-2	Profinet IP Address	IP address of the PROFINET IO device	Character string: A to Z	-	0-0-0-0

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-12-4-3	Cycle Time, Setpoint/ Control Value	Time delay before the message (warning or alert) is triggered. In a redundant system, only a warning is output as the auxiliary master can assume the function. Only if the setpoint/control value also fails at the auxiliary master is the alert output, which then triggers the specified response to setpoint/control value failure.	0.0…10.0	s	5
3-12-4-4	Cycle Time, Actual Value	Time delay before the message (warning or alert) is triggered. In a redundant system, only a warning is output as the auxiliary master can assume the function. Only if the actual value also fails at the auxiliary master is the alert output, which then triggers the specified response to actual value failure.	0.0…10.0	s	1
3-12-5	BACnet MS/TP	-	-	-	-
3-12-5-1	Device Identification	Unique number for identifying the device in the network.	0…4194303	-	0
3-12-5-2	MS/TP MAC Address	Network address in accordance with MS/TP frame format	1..254	-	254
3-12-5-3	Baud Rate	Baud rate of the BACnet slave	▪ 9600 ▪ 19200 ▪ 38400 ▪ 57600 ▪ 115200	-	38400
3-12-5-4	Pump Number	Unique number of the pump in the multiple pump system	1..2	-	1
3-12-5-5	Communication Failure Monitoring Time	If no valid data packets are received within this time frame, a broken wire message is output.	0 … 60	s	20
3-12-5-6	Device Name	Device name identifying the device within the network	Character string: A to Z	-	KSB PumpDrive
3-12-5-7	Device Description	Device description identifying the device within the network	Character string: A to Z	-	KSB PumpDrive

Parameter	Description	Help text	Possible settings	Unit	Factory setting
3-12-5-8	Installation Location	Installation location of the BACnet subscriber	Character string: A to Z	-	KSB PumpDrive
3-13	PumpMeter	-	-	-	-
3-13-1	Read Out Name Plate	Transfers the name plate information from PumpMeter to PumpDrive	Run	-	-
3-13-2	Address	Modbus address of PumpMeter device connected	1 … 247	-	247
3-13-3	Baud Rate	Modbus baud rate of PumpMeter device connected	▪ 9600 ▪ 19200 ▪ 38400 ▪ 115200	-	38400
3-13-4	Monitoring Period	System bus, Modbus time-out setting	1 … 180	s	15
3-13-5	PumpMeter Master/Slave	If PumpMeter is to be used as a redundant system sensor fitted in the header in dual/multiple pump configurations or on Etaline Z pump sets, the parameter must be set to Master. In all other scenarios, the parameter is set to Slave.	▪ Slave ▪ Master	-	Slave
4	Information	-	-	-	-
4-1	Frequency Inverter	-	-	-	-
4-1-1	Device ID	User-defined device name for identifying the drive. The control panel just allows read-only access to this parameter. The device name can only be changed via the ServiceTool/APP.	-	-	-
4-1-2	Serial Number	Serial number of the frequency inverter	-	-	-
4-1-3	Software Version	Software version of frequency inverter	-	-	-
4-1-4	Software Revision	Revision of frequency inverter software	-	-	-
4-1-5	Device Type	Device type of the frequency inverter	-	-	-
4-1-6	Frequency Inverter Power Class	Setting the power class of the frequency inverter	-	-	Dependent on size
4-1-7	MotionControl Software Version	Software version of integrated MotionControl	-	-	-
4-1-8	MotionControl Software Revision	Revision of integrated MotionControl software	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
4-2	Control Panel	-	-	-	-
4-2-1	Control Panel Serial Number	Serial number of the control panel	-	-	-
4-2-2	Control Panel Software Version	Software version of the control panel	-	-	-
4-2-3	Control Panel Software Revision	Revision of control panel software	-	-	-
4-3	KSB Order	-	-	-	-
4-3-1	Order Number	Order number	-	-	-
4-4	PumpMeter	-	-	-	-
4-4-1	PumpMeter Serial Number	Serial number of PumpMeter	-	-	-
4-4-2	PumpMeter Software Version	Software version of PumpMeter	-	-	-
4-4-3	PumpMeter Software Revision	Revision of PumpMeter software	-	-	-
4-5	Profibus Module	-	-	-	-
4-5-1	Profibus Module Serial Number	Serial number of the Profibus module	-	-	-
4-5-2	Profibus Module Software Version	Software version of the Profibus module	-	-	-
4-5-3	Profibus Module Software Revision	Revision of Profibus module software	-	-	-
4-6	LON Module	-	-	-	-
4-6-1	LON Module Serial Number	Serial number of the LON module	-	-	-
4-6-2	LON Module Software Version	Software version of the LON module	-	-	-
4-6-3	LON Module Software Revision	Software revision of the LON module	-	-	-
4-6-4	Neuron ID	Neuron ID of LON module	-	-	-
4-8	Modbus Module	-	-	-	-
4-8-1	Modbus Module Serial Number	Serial number of the Modbus module	-	-	-

Parameter	Description	Help text	Possible settings	Unit	Factory setting
4-8-2	Modbus Module Software Version	Software version of the Modbus module	-	-	-
4-8-3	Modbus Module Software Revision	Software revision of the Modbus module	-	-	-

9.1 Selection lists

Table 123: Main screen selection list

Parameter	Description
1-2-1-1	Speed
1-2-1-2	Motor Input Power
1-2-1-3	Pump Input Power
1-2-1-4	Pump Set Input Power
1-2-1-5	Motor Current
1-2-1-6	Motor Voltage
1-2-1-7	Output Frequency
1-2-1-8	DC Link Voltage
1-2-1-9	Heat Sink Temperature
1-2-1-10	PCB Temperature
1-2-1-11	Motor Torque
1-2-2-1	Pump Suction Pressure
1-2-2-2	Pump Discharge Pressure
1-2-2-3	Pump Differential Pressure
1-2-2-4	Pump Flow Rate
1-2-3-1	Actual Value (Closed-loop Control)
1-2-3-2	System Suction Pressure
1-2-3-3	System Discharge Pressure
1-2-3-4	System Differential Pressure
1-2-3-5	System Flow Rate
1-2-3-6	System Level
1-2-3-7	System Temperature
1-4-1-1	Energy Meter (kWh)
1-4-2-1	Frequency Inverter Operating Hours

After having logged in to the graphical control panel of the frequency inverter at Customer access level, users are presented with the following options in the favourites menu:

Table 124: Favourites menu selection list

Parameter	Description
1-1-1	Customer Login
1-3-1	System Start / Stop
1-3-2	Setpoint (Closed-loop Control)
1-3-3	Control Value (Open-loop Control)
1-3-4	Control Value (Manual)
1-3-5	Immediate Pump Changeover
1-3-6	Immediate Functional Check Run
1-3-7	Immediate Pipe Flushing
3-1-1	Language
3-6-1	Type of Control
3-6-2	Control Point
3-6-3	Actual Value Source
1-2-3-5	Flow Rate
1-2-2-4	Pump Flow Rate

10 Trouble-shooting

DANGER

Unintentional start-up

Risk of fatal injury due to electric shock!

- ▷ Disconnect the frequency inverter from the mains before carrying out any maintenance and installation work.
- ▷ Prevent the frequency inverter from being re-started unintentionally when carrying out any maintenance and installation work.

DANGER

Contact with live components

Risk of fatal injury due to electric shock!

- ▷ Any work on the product shall only be performed when it has been disconnected from the power supply (de-energised).
- ▷ Never remove the centre housing part from the heat sink.
- ▷ Mind the capacitor discharge time.
  After switching off the frequency inverter, wait 10 minutes until dangerous voltages have discharged.

NOTE

Depending on the combination of settings, the frequency inverter could conceivably restart automatically after acknowledgement/reset or when the cause of the malfunction or fault has been eliminated.

The operator ensures that trouble-shooting is performed by authorised, qualified specialist personnel who are thoroughly familiar with the operating manual.

Reset the frequency inverter to the default factory settings before engaging in any fault rectification measures.

10.1 Faults/malfunctions: Trouble-shooting

WARNING

Improper work to remedy faults

Risk of injury!

- ▷ For any work performed to remedy faults, observe the relevant information given in this operating manual and/or in the product literature provided by the accessories manufacturer.

If problems occur that are not described in the following table, consultation with the KSB service is required.

A Mains fuse rating too small for the nominal mains current.
B Motor does not start.
C Motor running unevenly.
D Max. speed not reached.
E Motor running at maximum speed only.
F Motor running at minimum speed only.
G No/faulty 24 V supply.
H Wrong direction of rotation of the motor.
I Fault message/protective tripping.

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Table 125: Trouble-shooting

A	B	C	D	E	F	G	H	I	Possible cause	Remedy
-	✗	-	-	-	-	✗	-	-	No voltage applied	Check the mains voltage. Check the mains fuses.
-	✗	-	-	-	-	-	-	-	No enable	Check enable via DIGIN-EN and system start.
✗	-	-	-	-	-	-	-	-	Mains fuse rating too low for frequency inverter input current	Check configuration/selection of mains fuse.
-	-	-	✗	-	-	-	-	-	No setpoint signal or setpoint set too low / drive overloaded and in i^2t control mode	Check setpoint signal and operating point.
-	-	-	-	✗	-	-	-	-	Process-related persistent control deviation (actual value smaller than setpoint) / no actual value (e.g. due to broken wire)	Check setpoint/actual value signal; check operating point; check controller setting.
-	✗	- -	-	-	-	-	-	✗	Permissible voltage range undershot/exceeded	Check mains voltage; supply frequency inverter with required voltage.
-	-	-	-	-	-	-	✗	-	Wrong direction of rotation setting.	Change the direction of rotation.
-	-	✗	✗	-	-	-	-	✗	Frequency inverter overloaded	Reduce the power input by lowering the speed; check the motor/pump for blockages.
-	✗	-	-	-	-	-	-	✗	Short circuit in control cable/ pump blocked	Check/replace control cable connections. Remove the pump blockage manually.
-	-	✗	✗	-	-	-	-	✗	Temperature of power electronics or motor winding too high	▪ Reduce the ambient temperature by improving ventilation. ▪ Improve cooling by cleaning the cooling fins. ▪ Ensure that the intake opening for the fans is not blocked. ▪ Ensure that the fans are working properly. ▪ Reduce the power input by changing the operating point (system-specific). ▪ Check the permissible load and, if necessary, use external cooling.
-	-	-	-	-	-	✗	-	✗	24 V voltage supply overloaded	Disconnect frequency inverter from the power supply and eliminate the cause of the overload.
-	-	-	-	-	-	-	-	✗	Dry running of pump	Check the hydraulic system and rectify the fault on the frequency inverter.
-	-	-	✗	-	✗	-	-	✗	Sensor signal error (e.g. broken wire)	Check sensor and sensor cable.
-	✗	✗	-	-	-	-	-	✗	Phase failure (drive)	Check motor connection and motor winding.

10.2 Alerts

Table 126: Alerts

Message number	Message	Description	Behaviour
A1	Thermal motor protection	PTC thermistor has tripped.	Self-acknowledging (configurable)
A2	Overvoltage	Impermissible overvoltage (mains)	Partially self-acknowledging
A3	Undervoltage	Impermissible undervoltage (mains)	Partially self-acknowledging
A4	Phase failure, drive end	Phase failure at the drive	Non-self-acknowledging
A5	Short circuit	Motor short-circuited (defective motor winding)	Partially self-acknowledging

Message number	Message	Description	Behaviour
A6	Hardware error	Hardware defective	Non-self-acknowledging
A7	Heat sink temperature high	Power electronics overtemperature	Non-self-acknowledging
A8	PCB temperature high	Control electronics overtemperature	Non-self-acknowledging
A9	Overcurrent	Impermissible overcurrent	Partially self-acknowledging
A10	Braking resistor	Internal overcurrent (for example, if the ramp is too steep)	Non-self-acknowledging
A11	Dynamic overload protection	Impermissible overcurrent	Partially self-acknowledging
A12	Firmware update required	Firmware update required	Non-self-acknowledging
A13	Dry running	Dry running of pump	Non-self-acknowledging
A14	Dry running (external)	Dry running of pump	Self-acknowledging (configurable)
A15	Hydraulic blockage	Pumping against closed piping	Non-self-acknowledging
A16	No master control	Failure of actual value sensor / Broken wire / Local / No redundancy	Self-acknowledging
A17	Lack of water	Lack of water	Self-acknowledging (configurable)
A18	No matching motor data available	The extended KSB SuPremE motor data could not be determined.	Self-acknowledging
A19	No motor data available	The motor data is not set.	Self-acknowledging
A20	AMA fault	The extended motor data could not be determined.	Self-acknowledging
A98	HMI hardware test not passed	Control panel defective	Non-self-acknowledging
A99	IO hardware test not passed	Control electronics or M12 module defective	Non-self-acknowledging

Table 127: Alerts

Alert	Possible causes	Remedy[20)21)]
Short circuit	Motor short-circuited (defective motor winding)	Check motor winding, perform dielectric test. Check motor for blockage.
	Power supply connected incorrectly	Check the cabling; connect the mains power supply to L1, L2, L3, PE.
	Parallel operation of motors	Impermissible operating range
	Motor terminal board wired incorrectly (delta/star)	Wire motor terminal board correctly.
	Motor power cable short circuit	Check motor power cable.
	Sensor cable shielding connected incorrectly	Connect sensor cable shielding to PE on one end only.
	24 V DC cabling short circuit	Check cabling.
Thermal motor protection	PTC thermistor connected incorrectly	Check PTC sensor connection.
	Incorrect motor data set	Match motor data settings to motor used.
	Wrong direction of rotation of the pump	Adjust the direction of rotation of the motor via the phase sequence.
	Hydraulic overload	Reduce the hydraulic load.
	Pump blocked mechanically/runs sluggishly	Check pump.

20 Disconnect the frequency inverter from the power supply to rectify faults on current-carrying components. Observe the safety information!

21 Restore the frequency inverter's default settings.

Alert	Possible causes	Remedy[20)21)]
Thermal motor protection	Motor terminal board wired incorrectly (delta/star)	Wire motor terminal board correctly.
	Frequency inverter power < motor power and/or output current < motor current	Wrong device ordered, mount larger frequency inverter.
	Carrier frequency of frequency inverter set too high	Set carrier frequency to permissible range.
	Fluctuating DC link voltage when pump is not running	Check mains voltage quality.
	Fluctuating DC link voltage when pump operates at nominal values	Check mains voltage quality.
	Incorrect motor current measurement	Measure current using suitable snap-on ammeter and compare with the information displayed on the control panel. **NOTE!** Approx. 10 % tolerance is permissible.
	Pump runs in reverse when motor is not supplied with current.	Check swing check valve.
	Motor voltage output is too low at nominal load, < 380 V at nominal load	Check line input voltage; enter motor current at 380 V mains voltage; fit larger-sized motor.
Heat sink temperature high / PCB temperature high	Ambient temperature of frequency inverter > 50 °C	Impermissible operating range; mind power derating.
	Dirt in external fans	Clean fans.
	Heat sink/cooling fins dirty	Clean heat sink/cooling fins.
	Carrier frequency of frequency inverter set too high	Set carrier frequency to permissible range.
	Frequency inverter power < motor power and/or output current < motor current	Wrong device ordered, mount larger frequency inverter.
	Frequency inverter mounted incorrectly	External fans must point upwards; on the wall-mounted model, the back of the heat sink must be closed.
Undervoltage	Line input voltage too low	Check the mains voltage.
	Fluctuating DC link voltage when pump is not running	Check mains voltage quality.
	Mains fuse has tripped	Fit new mains fuse.
	Brief interruption of mains voltage	Check the mains voltage.
Overvoltage	Line input voltage too high	Check the mains voltage.
	Fluctuating DC link voltage when pump is not running	Check mains voltage quality.
	Ramp times too short	Select longer ramp times.
	Pump runs in reverse when motor is not supplied with current.	Check swing check valve.
Overcurrent/ dynamic overload protection	Mains power supply connected incorrectly	Connect mains power supply to L1, L2, L3, PE.
	Motor terminal board wired incorrectly (delta/star)	Wire motor terminal board correctly.
	Incorrect motor data set *(3-3-2)*	Match motor data settings to motor used.
	Parallel operation of motors	This mode of operation is not permissible.
	Sensor cable shielding connected incorrectly	Connect sensor cable shielding to PE on one end only.
	Frequency inverter power < motor power and/or output current < motor current	Wrong device ordered, mount larger frequency inverter.
	Ramp times too short	Select longer ramp times.
	Wrong direction of rotation of the pump	Adjust the direction of rotation of the motor via the phase sequence.

Alert	Possible causes	Remedy[20)21)]
Overcurrent/ dynamic overload protection	Pump blocked mechanically/runs sluggishly	Check pump.
	Carrier frequency of frequency inverter set too high	Set carrier frequency to permissible range.
	Incorrect motor current measurement	Measure current using suitable snap-on ammeter and compare with the information displayed on the control panel. Please note: Approx. 10 % tolerance is permissible.
	Pump runs in reverse when motor is not supplied with current.	Check swing check valve.
No master control	KSB device bus wired incorrectly (interruption, short circuit)	Re-wire properly.
	Sensor connected incorrectly (actual value failure)	Connect sensor correctly.
	No main pump recognised in system	Define role in multiple pump system.
Braking resistor	Stop ramp time too short	Increase ramp time.
	Pump runs in reverse when motor is not supplied with current.	Check swing check valve.
	Generator operation of pump	Impermissible operating range
Dry running / dry running (external)	Dry running of pump	Check piping. Check the pump valves.
Hydraulic blockage	Piping clogged	Check piping. Check the pump valves.

10.3 Warnings

Table 128: Warnings

Message number	Message	Description	Behaviour
A30 / W30	External message	External message present	Self-acknowledging (configurable)
W50	Dynamic overload protection	Impermissible overcurrent	Self-acknowledging
W51	Overvoltage	Overvoltage	Self-acknowledging
W52	Undervoltage	Undervoltage	Self-acknowledging
W53	Resonance range	Resonance range	Self-acknowledging
W54	Broken wire	Broken wire	Self-acknowledging
W55	Actual value failure	Failure of actual value	Self-acknowledging
W56	Hydraulic blockage	Pumping against closed piping	Self-acknowledging
W57	Low flow	Low flow	Self-acknowledging
W58	Hydraulic overload	Hydraulic overload	Self-acknowledging
W59	Heat sink temperature high	Power electronics overtemperature	Self-acknowledging
W60	PCB temperature high	Control electronics overtemperature	Self-acknowledging
W61	Current high	Motor current high	Self-acknowledging
W62	Current low	Motor current low	Self-acknowledging
W63	Speed monitoring	Limit value violation, speed	Self-acknowledging
W64	Setpoint monitoring	Limit value violation, setpoint	Self-acknowledging
W65	Actual value monitoring	Limit value violation, actual value	Self-acknowledging
W66	Flow rate monitoring	Limit value violation, flow rate	Self-acknowledging
W67	Suction pressure monitoring	Limit value violation, suction pressure	Self-acknowledging

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Message number	Message	Description	Behaviour
W68	Discharge pressure monitoring	Limit value violation, discharge pressure	Self-acknowledging
W69	Differential pressure monitoring	Limit value violation, differential pressure	Self-acknowledging
W70	Temperature monitoring	Limit value violation, temperature	Self-acknowledging
W71	Frequency high	Frequency high	Self-acknowledging
W72	Frequency low	Frequency low	Self-acknowledging
W73	Power high	Power high	Self-acknowledging
W74	Power low	Power low	Self-acknowledging
W75	Limited stop ramp	Set stop ramp time exceeded	Self-acknowledging
W76	24 V overload	Internal 24 V power supply unit overloaded	Self-acknowledging
W77	PumpMeter communication	Incorrect PumpMeter communication	Self-acknowledging
W80	Low flow velocity	Lower limit for flow velocity undershot	Self-acknowledging
W81	Field bus communication	Defective field bus module	Self-acknowledging
W83	Overflow	Overflow trip via external signal	Non-self-acknowledging
W84	Setpoint/control value failure	Failure of setpoint/control value via external signal	Self-acknowledging
W99	General settings loaded	General settings loaded	Self-acknowledging

Table 129: Warnings

Warning	Possible causes	Remedy
Dynamic overload protection	Incorrect motor data set	Match motor data to motor used.
	Wrong direction of rotation of the pump	Adjust the direction of rotation of the motor via the phase sequence
	Hydraulic overload	Reduce the hydraulic load.
	Pump blocked mechanically/runs sluggishly	Check pump.
	Motor terminal board wired incorrectly (delta/star)	Wire motor terminal board correctly.
	Frequency inverter power < motor power and/or output current < motor current	Wrong device ordered, mount larger frequency inverter.
	Frequency inverter carrier frequency set too high	Set carrier frequency to permissible range.
	Ambient temperature of frequency inverter > 50 °C	Impermissible operating range; mind power derating.
	Fluctuating DC link voltage when pump is not running	Check mains voltage quality.
	Incorrect motor current measurement	Measure current using suitable snap-on ammeter and compare with the information displayed on the control panel. **NOTE!** Approx. 10 % tolerance is permissible.
	Pump runs in reverse when motor is not supplied with current	Check swing check valve.
	Motor voltage output is too low at nominal load, < 380 V at nominal load	Check line input voltage; enter motor current at 380 V mains voltage; fit larger-sized motor.
Broken wire	Cable integrity monitoring	Replace defective sensor with new one.
Low flow/overload	The driven pump is operated under low flow/overload conditions.	Impermissible operating range; operate the pump within the permissible range.
24 V overload	24 V DC voltage supply overload	Reduce current draw on 24 V DC supply; compare the number of electrical connections with the maximum permissible current load of the 24 V DC supply.

Warning	Possible causes	Remedy
24 V overload	Short circuit of consumers connected to 24 V DC voltage supply	Disconnect defective 24 V DC consumers.
	Control terminal wiring errors (DigIn, AnIn)	Re-wire properly.

10.4 Information messages

Table 130: Information messages

Message number	Message	Description	Behaviour
I100	Pump maintenance/ service interval	Maintenance/service interval set for pump expired	Self-acknowledging
I101	Drive disabled	▪ The motor is disabled while AMA is being carried out. ▪ If the Overcurrent alert is output that causes the drive to be stopped, the drive remains disabled as long as this event is active. ▪ In the event of a stop via the DI-EN digital input, the drive is not stopped via the stop ramp, but coasts to standstill. The amount of time this process takes depends on the mass moment of inertia of the system. The drive remains disabled during coasting.	Self-acknowledging
I102	Pipe flushing mode active	Performing the pipe flushing function	Self-acknowledging
I103	Pipe filling mode active	After the system has been started, the pipe filling function is carried out.	Self-acknowledging
I104	Maintenance interval, motor bearings	Maintenance/service interval set for motor bearings expired	Self-acknowledging
I105	Factory-set defaults loaded	Factory-set defaults are being loaded	Self-acknowledging
I106	User settings 1 loaded	User settings 1 were loaded	Non-self-acknowledging
I107	User settings 2 loaded	User settings 2 were loaded	Non-self-acknowledging

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11 Purchase Order Specifications

11.1 Ordering spare parts

Always quote the following data when ordering replacement or spare parts:

- Order number
- Order item number
- Consecutive number
- Type series
- Size
- Material variant
- Seal code
- Year of construction

Refer to the name plate for all data.

Also specify the following data:

- Part number and description
- Quantity of spare parts
- Shipping address
- Mode of dispatch (freight, mail, express freight, air freight)

11.2 Accessories

11.2.1 Service software

Table 131: Accessories: Service software (PumpDrive 2/PumpDrive 2 Eco)

	Description	Design	Mat. No.	[kg]
	USB parameterisation cable, optical For frequency inverter parameterisation with Automation service software Pre-configured with optical connection for frequency inverter and USB connection for laptop/ PC	Length 1 m	01538436	0,2
	Service dongle For authorisation The service software can also be used without a dongle. However, the parameters used for customer service will be locked in this case. The dongle can only be used after it has been enabled by KSB in accordance with the instructions included.	-	47121256	0,1

11.2.2 Control panels

Table 132: Accessories: PumpDrive 2 control panels

	Description	Design	Mat. No.	[kg]
	Wall mounting brackets accessories set For mounting the graphical control panel of the frequency inverter 4 brackets and screws	Wall mounting/ mounting on a pipe	01522974	0,3
	Connection cable for graphical control panel For connecting the graphical control panel separately from the frequency inverter Colour: black, straight connector, angled socket	Length 3 m	01522975	0,3
		Length 5 m	01566211	0,3
		Length 10 m	01566212	0,6
		Length 20 m	01566213	1

11.2.3 Motor mounting adapters

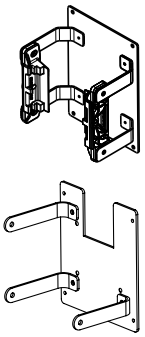
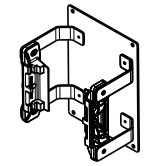
An adapter is required to mount the frequency inverter to the motor. Select the adapter based on the motor size and the type of construction used.

KSB SuPremE type A (sizes 180 to 225): No motor mounting adapters can be retrofitted for PumpDrive 2 and PumpDrive 2 Eco. The preferred mounting option is wall mounting.

KSB SuPremE type B1 (size 180 to 225): Adapters for PumpDrive 2/ PumpDrive 2 Eco for motor mounting upon the customer's request or if a replacement is needed (replacement of PumpDrive 1 with PumpDrive 2) can be retrofitted.

KSB SuPremE type B2: Use for new installations with PumpDrive 2 and PumpDrive 2 Eco.

Table 133: Accessories: Motor mounting adapter (PumpDrive 2 / PumpDrive 2 Eco)

	Description	Design			Mat. No.	[kg]
		Frequency inverter size	P [kW]	Motor		
	Motor adapter kit For mounting frequency inverter to KSB motor/ Siemens standardised motor, type 1LE1/ 1PC3, 2-pole/ 4-pole/ 6-pole, IE2/ IE3 With power cable	A	0,37 - 1,5	BG80	01496568	3
		A	0,37 - 1,5	BG90	01496569	3
		B	2,2 - 4	BG90	01496570	3
		B	2,2 - 4	BG100	01496571	3
		B	2,2 - 4	BG112	01496572	3,8
		C	5,5 - 11	BG132	01496573	3,8
		C	5,5 - 11	BG160	01496574	3,8
		D	15 - 30	BG160	01496575	5,2
		D	18,5/22	BG180 M, L	01496576	8
		D	30	BG200 L	01496577	10
		D	15 - 30	BG225	01654738	11
		E	37	BG200 L	01496578	14,2
		E	37/45	BG225 S, M	01496579	11
		E	37 - 55	BG250 M	01496580	14
		E	37 - 55	BG280 S, M	01500521	16
-	Motor adapter kit For mounting frequency inverter to KSB motor/ Siemens standardised motor, type 1LA7/ 1LA9/ 1LG6 (retrofit), 2-pole/ 4-pole With power cable	A	0,37 - 1,5	1LA7 BG71M V1	01506318	3
		A	0,37 - 1,5	1LA9 BG80 V1	01506320	3
		A	0,37 - 1,5	1LA7 BG80 V1	01506320	3
		A	0,37 - 1,5	1LA9 BG90 V1	01506322	3
		A	0,37 - 1,5	1LA9 BG90 B3	01606776	3
		B	2,2 - 4	1LA9 BG90 B3	01506323	3
		B	2,2 - 4	1LA9 BG90 V1	01606892	3
		B	2,2 - 4	1LA9 BG100 B3	01506324	3
		B	2,2 - 4	1LA9 BG100 V15	01606893	3
		B	2,2 - 4	1LA7 BG112 B3/V15 1LA9 BG112 B3/V15	01506325	3,8
		C	5,5 - 11	1LA9 BG132 B3/V15	01506326	3,8
		C	5,5 - 11	1LA9 BG160 B3/V15	01506328	3,8
		D	15 - 30	1LA9 BG160 B3/V15	01506329	5,2
		D	15 - 30	1LA9 BG180 B3/V15	01506331	8
		D	15 - 30	1LA9 BG200 B3/V15	01506332	10
		E	37 - 55	1LA9 BG200 B3	01506333	10
		E	37 - 55	1LG6 BG225S B3	01506334	11
		E	37 - 55	1LG6 BG225M B3	01650429	11
	Motor adapter kit For mounting frequency inverter to KSB SuPremE A/ SuPremE B1 motor, 2-pole/ 4-pole With power cable	A	0,55/0,75/1,1	BG80 M	01666670	3
		A	1,1/1,5	BG90 S	01666671	3,5
		A	1,5	BG90 L	01677488	3,7
		B	2,2	BG90 L	01666672	3,7
		B	2,2/3	BG100 L	01666673	4
		B	4	BG112 M	01666674	4,1
		C	5,5/7,5	BG132 S, M	01666675	4,2
		C	11	BG160 M	01666677	3,8
		D	15	BG160 M	01675995	3,8
		D	15/18,5	BG160 L	01677489	5,2

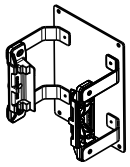
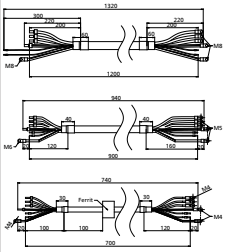
	Description	Design			Mat. No.	[kg]
		Frequency inverter size	P [kW]	Motor		
	Motor adapter kit For mounting frequency inverter to KSB SuPremE B1 motor, 2-pole/ 4-pole With power cable	D	18,5/22	BG180 M, L	01496576	8
		D	30	BG200 L	01496577	10
		E	37	BG200 L	01496578	14,2
		E	37/45	BG225 S, M	01496579	11

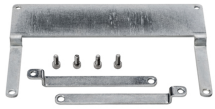
Table 134: Accessories: Power/connection cable (PumpDrive 2)

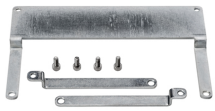
	Description	Design	Mat. No.	[kg]
	Cable connector, shielded	≤ 4 kW: 4 × 2,5² + PTC...XM	01538433	0,9
	Blanking plate including screws to replace removed motor connector	-	01595759	0,1
	Motor power cable, shielded For connecting the PTC sensor, halogen-free, price per unit	≤ 4 kW: 4 × 2,5 mm² + PTC Length 0.7 m	47117500	0,3
		5,5 - 7,5 kW: 4 x 4 mm² + PTC Length 0.9 m	01437169	0,3
		11 kW: 4 × 6 mm² + PTC Length 0.9 m	01637009	0,3
		15 kW: 4 × 10 mm² + PTC Length 0.9 m	47117506	0,8
		18,5 - 22 kW: 4 × 16 mm² + PTC Length 1.15 m	01466746	1
		30 kW: 4 × 25 mm² + PTC Length 1.2 m	47117509	1,7
		37 kW: 4 × 35 mm² + PTC Length 1.4 m	01641614	2
		45 kW: 4 × 50 mm² + PTC Length 1.5 m	01641615	2,4
		55 kW: 4 × 70 mm² + PTC Length 1.6 m	01641616	3,3

11.2.4 Wall/ cabinet mounting adapters

An adapter is required for the wall / cabinet-mounted frequency inverter. An adapter is included in the KSB scope of supply as standard.

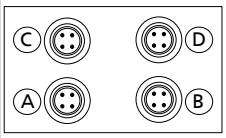
Table 135: Accessories: Wall/ cabinet mounting adapters (PumpDrive 2/ PumpDrive 2 Eco)

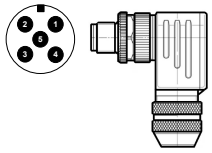
	Description	Mat. No.	[kg]
	Adapter kit, frequency inverter, size A	01496581	0,2
	Adapter kit, frequency inverter, size B	01579783	0,3
	Adapter kit, frequency inverter, size C	01496582	0,5
	Adapter kit, frequency inverter, size D	01629744	3

	Description	Mat. No.	[kg]
	Adapter kit, frequency inverter, size E	01629745	10
	Adapter kit, frequency inverter, size E with larger distance from the wall	01671121	10

11.2.5 M12 module

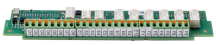
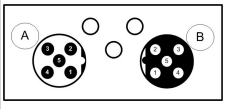
Table 136: Accessories: M12 module (PumpDrive 2/ PumpDrive 2 Eco)

	Description	Design	Mat. No.	[kg]
	M12 module accessory kit For multiple pump configuration with up to 6 pumps For connecting PumpMeter via Modbus	-	01496566	0,3
	Blind cover For closing an open slot	-	01496567	0,1
	M12 protective cap for M12 module	-	01125084	0,05
	Bus cable, pre-configured, shielded For dual pump / multiple pump configuration For looping the KSB device bus (CAN) from frequency inverter to frequency inverter via the M12 module Colour: purple; M12 connector, angled; M12 connector, angled A-coded, 5 poles	Length 1 m	01533747	0,1
		Length 2 m	01533748	0,2
		Length 3 m	01533749	0,3
		Length 5 m	01651182	0,3
		Length 10 m	01651183	0,6
		Length 20 m	01651184	1,2
	Terminating resistors CAN for bus termination of multiple pump configuration Two M12 connectors with integrated CAN terminating resistor	-	01522993	0,3
	PumpMeter cross-link bus cable, pre-configured, shielded For redundantly connecting PumpMeter via Modbus For looping the PumpMeter Modbus from frequency inverter to frequency inverter via the M12 module For analog sensors 4 - 20 mA Colour: black; M12 connector, angled; M12 connector, angled A-coded, 5 poles	Length 1 m	01533769	0,1
		Length 2 m	01533770	0,2
		Length 3 m	01533771	0,2
		Length 5 m	01533772	0,3
		Length 10 m	01533773	0,6
		Length 20 m	01533774	1,2

	Description	Design	Mat. No.	[kg]
	M12 bus cable, PumpMeter, pre-configured, shielded For connecting PumpMeter to M12 module via Modbus Colour: black; M12 socket, straight; M12 connector, angled A-coded, 5 poles	Length 1 m	01533775	0,2
		Length 2 m	01533776	0,2
		Length 3 m	01533777	0,3
		Length 5 m	01533778	0,3
		Length 10 m	01670718	0,445
		Length 20 m	01670719	1,2
	M12 connector for M12 module, for self-assembly For multiple pump configuration For connecting PumpMeter via Modbus Not suitable for direct connection of a PumpMeter sensor (no vent pin 5) Angled connector, A-coded, 5-pole Screw terminal connection with shield ring, shieldable, Connection cross-section: Max. 0.75 mm² (max. AWG 20) Cable passage: 4 - 6 / 5 - 8 / 6 - 8 / 6.5 - 8.5 [mm] Enclosure IP67	-	01523004	0,1

11.2.6 Optional components

Table 137: Optional modules for retrofitting (PumpDrive 2)

	Description	Design	Mat. No.	[kg]
	Master switch retrofit kit[22)] Master switch, adapted C cover, protective cover for the master switch, wire harness Voltage 400 V	Size A 0,37 - 1,5 kW	01500522	1,4
		Size B 2,2 - 4 kW	01500523	1,7
		Size C 5,5 - 11 kW	01500524	2,8
		Size D 15 - 30 kW	01500525	5,5
		Size E 37 - 55 kW	01500526	14,5
	I/O extension board Additional inputs and outputs: 1 analog input, 1 analog output, 3 digital inputs, 2 digital outputs, 1 changeover contact relay, 5 NO contact relays	Sizes A, B, C, D, E	01537900	0,2
 	Modbus RTU field bus module For connecting the frequency inverter to Modbus networks Monitoring, open-loop control, closed-loop control of frequency inverter in single-pump configuration and multiple pump configuration with Modbus module only Field bus cable connection looped through from 1 x M12 connector, B-coded, 5-pole, to 1 x M12 socket, B-coded, 5-pole	Sizes A, B, C, D, E	01551016	0,3

22 Optional master switch up to 400 V AC +10 %

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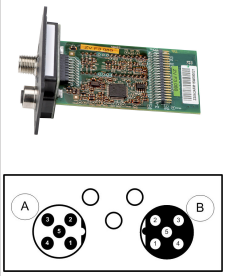
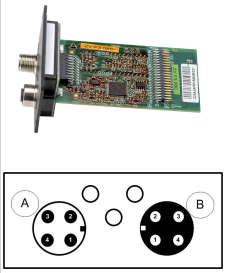
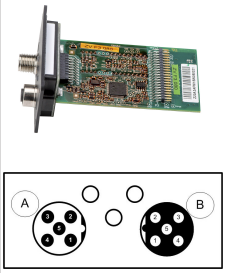
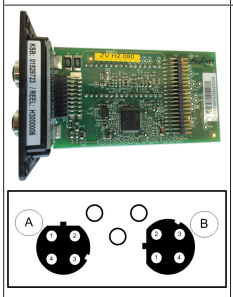
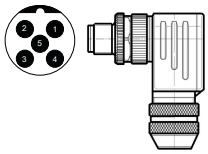
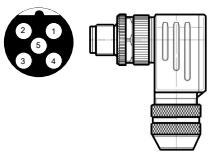
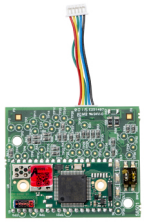
	Description	Design	Mat. No.	[kg]
	BACnet MS/TP module field bus module For connecting the frequency inverter to BACnet network Monitoring, open-loop control, closed-loop control of frequency inverter in single-pump and multiple-pump configuration with BACnet module only	Sizes A, B, C, D, E	01551014	0,3
	LON field bus module For connecting the frequency inverter to LON network Monitoring, open-loop control, closed-loop control of each frequency inverter in single-pump configuration and multiple pump configuration only with one LON module each Field bus cable connection looped through from 1 x M12 connector, A-coded, 4-pole, to 1 x M12 socket, A-coded, 4-pole	Sizes A, B, C, D, E	01551015	0,3
	Profibus field bus module For connecting the frequency inverter to Profibus networks Monitoring, open-loop control, closed-loop control of each frequency inverter in single-pump configuration and multiple pump configuration only with one Profibus module each Field bus cable connection looped through from 1 x M12 connector, B-coded, 5-pole, to 1 x M12 socket, B-coded, 5-pole	Sizes A, B, C, D, E	01551037	0,3
	Profinet module field bus module For connecting the frequency inverter to Profinet network Monitoring, open-loop control, closed-loop control of each frequency inverter in single-pump configuration and multiple pump configuration only with one Profinet module each	Sizes A, B, C, D, E	01551038	0,3
	M12 connector for self-assembly For Modbus , BACnet and Profibus Angled connector, B-coded, 5 poles, screw terminal connection, with shield ring, shieldable Connection cross-section: Max. 0.75 mm² (max. AWG 20) Cable passage: 4 - 6 / 5 - 8 / 6 - 8 / 6.5 - 8.5 [mm] Enclosure: IP67	-	01651264	0,1
	M12 socket for self-assembly For Modbus , BACnet and Profibus Angled socket, B-coded, 5 poles, screw terminal connection, with shield ring, shieldable Connection cross-section: Max. 0.75 mm² (max. AWG 20) Cable passage: 4 - 6 / 5 - 8 / 6 - 8 / 6.5 - 8.5 [mm] Enclosure: IP67	-	01651298	0,1

	Description	Design	Mat. No.	[kg]
	Bus cable CAN, BACnet and Modbus Cut to length for self-assembly, shielded, twisted pair, cable 2 × 2 × 0.22 mm²	Length 1 m	01111184	0,2
		Length 5 m	01304511	0,4
		Length 10 m	01304512	0,7
		Length 20 m	01304513	1,4
	M12 terminating resistor for Profibus, Modbus and BACnet B-coded, connector The terminating resistor is designed to plug into the free M12 socket on the Profibus module / Modbus module.	-	01125102	0,1
	Bluetooth module, retrofittable For communication with a smartphone/tablet (Android or iOS) Installation in the control panel of the frequency inverter Bluetooth 2.0, range approx. 10 m, compatible from Apple iOS 8 and Android 8.0 Free download of KSB FlowManager app from the App Store and the Google Play Store		01496565	0,1
	External Bluetooth gateway for communication with a smartphone/tablet (Android or iOS) or notebook For plugging onto the service interface of the frequency inverter Bluetooth 2.0, range approx. 10 m, compatible from Apple iOS 8 and Android 8.0 Free download of KSB FlowManager app from the App Store and the Google Play Store	-	01800770	0,1
-	Set of cable sealing elements PDRV2 EMV A-B-C-D-E EMC cable gland kit for PumpDrive 2 For using PumpDrive 2 in electrical plants of the automotive industry in accordance with electromagnetic compatibility requirements, EMC-ILA	-	01711794	0,12

11.2.7 Sensor system

Table 138: Accessories: Pressure measurement (PumpDrive 2 / PumpDrive 2 Eco)

	Description	Design	Mat. No.	[kg]
	PumpMeter Intelligent pressure transmitter for pumps with on-site display of measured values and operating data, parameterised at the factory in line with pump-specific requirements, selection via KSB EasySelect	Pump-specific	-	0,1
	Differential pressure transducer With two copper-spiralled pipe sections measuring 75 cm in length for connection to the discharge nozzle / suction nozzle, complete with retaining plate, spiralled pipe section and adapter, output 4 - 20 mA, 3-wire power supply, supply voltage 18 - 30 V DC, 2.5 m connection cable Ambient temperature -10 to +50 °C Temperature of measured medium -10 to +80 °C	0 - 1 bar, RC3/8	01111180	0,3
		0 - 2 bar, RC3/8	01109558	0,3
		0 - 4 bar, RC3/8	01109560	0,3
		0 - 6 bar, RC3/8	01109562	0,3
		0 - 10 bar, RC3/8	01109585	0,3
		0 - 1 bar, RC1/2	01111303	0,3
		0 - 2 bar, RC1/2	01111305	0,3
		0 - 4 bar, RC1/2	01111306	0,3
		0 - 6 bar, RC1/2	01111307	0,3
		0 - 10 bar, RC1/2	01111308	0,3
		0 - 1 bar, RC 1/4	01558789	0,3
		0 - 2 bar, RC 1/4	01558790	0,3
		0 - 4 bar, RC 1/4	01558791	0,3
		0 - 6 bar, RC 1/4	01558792	0,3
		0 - 10 bar, RC 1/4	01558793	0,3
	A-10 pressure transducer For general applications, for liquid and gaseous fluids 0 to +80 °C, measuring accuracy smaller than or equal to 1 %, 2.5 % max. (at 80 °C), G1/4B process connection with Cu joint ring, IP67, 2-wire output 4 - 20 mA	0 - 2 bar	01152023	0,07
		0 - 5 bar	01152024	0,07
		0 - 10 bar	01210880	0,4
		0 - 16 bar	01073808	0,128
		0 - 20 bar	01152025	0,07
		0 - 50 bar	01152026	0,07
	S-20 pressure transducer For general applications in industry, mechanical engineering, hydraulics, pneumatics, pneumatics, for liquid and gaseous fluids -30 to +100 °C, parts in contact with the measured medium made of CrNi steel (no gaskets), mechanical shock load capacity up to 100 g (IEC 60068-2-27), vibration load capacity at resonance up to 20 g (IEC 60068-2-6), measuring accuracy < 0.5 % of measuring range, G1/2B EN837 connection, IP65 enclosure, 2-wire output 4 - 20 mA, maximum line cross-section of 1.5 mm², outer line diameter of 6 to 8 mm, electrical connection via angular connector to DIN 175301-803 A	0 - 1.0 bar	01147224	0,12
		0 - 1.6 bar	01147225	0,12
		0 - 2.5 bar	01147226	0,12
		0 - 4.0 bar	01147267	0,12
		0 - 6.0 bar	01147268	0,12
		0 - 10.0 bar	01147269	0,12
		0 - 16.0 bar	01084305	0,159
		0 - 25.0 bar	01084306	0,2
		0 - 40.0 bar	01087244	0,2
		-1 - 1.5 bar	01150958	0,6
		-1 - 5.0 bar	01087507	0,2
		-1 - 15.0 bar	01084308	0,2
		-1 - 24.0 bar	01084309	0,2

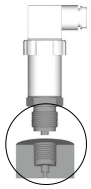
	Description	Design	Mat. No.	[kg]
	S-11 pressure transducer For applications in the hygiene, food and beverage industries, for liquid, gaseous, viscous and contaminated fluids, Temperature of measured medium -30 to 100 °C; on request with integrated cooling section for temperatures of the measured medium of up to +150 °C, parts in contact with the measured medium made from CrNi steel (no gaskets); on request: Hastelloy C4 (2.4610) variant available for aggressive media, mechanical shock load capacity up to 1000 g (IEC 60068-2-27), vibration load capacity at resonance up to 20 g (IEC 60068-2-6), measuring accuracy < 0.5 % of measuring range, G1/2B EN837 connection, flush diaphragm, NBR O-ring, IP65 enclosure, 2-wire output 4 - 20 mA, maximum line cross-section of 1.5 mm², outer line diameter of 6 to 8 mm, auxiliary energy supply, UB: 10 < UB ≤ 30 V DC (14 to 30 for output 0 - 10 V), electrical connection via angular connector to DIN 175301-803 A	0 - 1.0 bar	01147270	0,24
		0 - 1.6 bar	01147271	0,24
		0 - 2.5 bar	01147272	0,24
		0 - 4.0 bar	01147273	0,24
		0 - 6.0 bar	01147274	0,24
		0 - 10.0 bar	01147275	0,24
		0 - 16.0 bar	01084310	0,24
		0 - 25.0 bar	01084311	0,24
		0 - 40.0 bar	01087246	0,24
		-1 - 1.5 bar	01087506	0,24
		-1 - 5.0 bar	01084307	0,24
	Weld-in socket for S-20 / S-11 pressure transducers G1/2B process connection, internal thread	-	01149296	0,2

Table 139: Accessories: Temperature measurement (PumpDrive 2 / PumpDrive 2 Eco)

	Description	Mat. No.	[kg]
	Resistance thermometer Pre-configured for temperatures of the measured medium of 0 - 150 °C, TR10-C sensor well, T24.10 transmitter and TW35-4 thermowell for measured medium temperatures of -200 °C to 600 °C, sensor tolerance: Class B to DIN EN 60751, 2-wire output 4 - 20 mA, measuring range with Pt100 element 1 x 3-wire, supply voltage: 10 - 36 V DC, G1/2B process connection made from CrNi steel 1.4571, total length with stem: 255 mm, thermometer installation length: 110 mm, connecting head type BSZ, aluminium, IP65 enclosure	01149295	0,8

Table 140: Accessories: Flow measurement (PumpDrive 2 / PumpDrive 2 Eco)

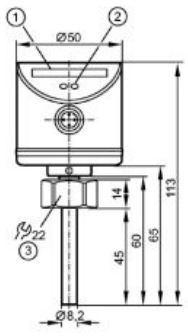
	Description	Mat. No.	[kg]
	Flow sensor 3 … 300 cm/s for filter loss compensation control, cost-effective flow control, measuring range 3 - 300 cm/s, process connection with internal thread, output 4 - 20 mA, Effector 300 transmitter	01150960	0,3
	Plug connector with cable for Effector 300 transmitter Cable socket M12/angled/4-core/5 m/PUR, compatible with cable drag chains, free of halogen and silicone	01473177	0,2

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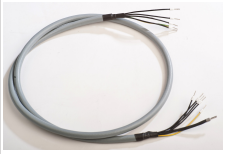
Table 141: Accessories: Connection cable (PumpDrive 2 / PumpDrive 2 Eco)

	Description	Mat. No.	[kg]
	Connection cable for sensors Cable 2 × 2 × 0.5 mm², shielded, for connecting sensors to frequency inverter, price per metre	01083890	0,1
	Connection cable for redundant sensor connection 5-core cable, halogen-free, type Ölflex 110CH, length approx. 1 m, pre-configured, for forwarding a sensor signal to a second frequency inverter for redundant operation (e.g. DPM)	01131430	0,3

11.2.8 Control cabinet installation

Table 142: Accessories: Potential separator (PumpDrive 2 / PumpDrive 2 Eco)

	Description	Design	Mat. No.	[kg]
	Potential separator For volt-free signal transmission between the frequency inverter and external control systems. Differences in potential can damage analog and digital inputs.	Top hat rail mounting, external supply voltage 24 V DC, IP40 housing, IP20 terminals, 22.5 × 82 × 118.2 mm (W × H × D)	01085905	1,2
		Top hat rail mounting, external supply voltage 230 V AC, IP40 housing, IP20 terminals, 22.5 × 82 × 118.2 mm (W × H × D)	01086963	1,2

Table 143: Accessories: Mains filter (PumpDrive 2)

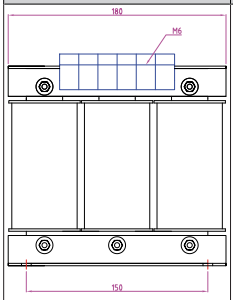
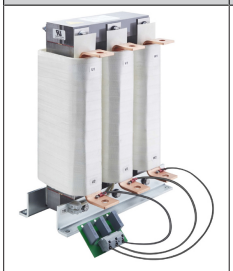
	Description	Design	Mat. No.	[kg]
	Line choke for frequency inverter for preventing mains feedback IP00 enclosure Protection of frequency inverter from peak voltages	0,37 - 1,5 kW	01665518	3,6
		2,2 - 4 kW	01093105	3,6
		5,5 - 11 kW	01093106	8,3
		15 - 18,5 kW	01093107	9,17
		22 - 37 kW	01093108	9,17
		45 - 55 kW	01665519	14

Table 144: Accessories: Output filter, 400 V / 3~ variant (PumpDrive 2 / PumpDrive 2 Eco)

	Description	P_N Frequency inverter [kW]	Design	Asynchronous motor -	KSB SuPremE 1500 [rpm]	KSB SuPremE 3000 [rpm]	Mat. No.	[kg]
	Output filters dv/dt for motor power cables up to 160 m, IP00 enclosure Line chokes for reducing electromagnetic interference emissions Reduction of peak currents in long motor power cables	0,37 - 3,00	FN 5060-12-84	✗	✗	✗	01686772	1
		4,00 - 5,50	FN 5060-24-84	✗	✗	✗	01686773	1,6
		7,50	FN 5060-30-99	✗	✗	✗	01686774	5,85
		11,00	FN 5060-45-99	✗	✗	✗	01686775	6,4
		15,00	FN 5060-45-99	✗	✗	-	01686775	6,4
		15,00	FN 5060-60-99	-	-	✗	01686776	7

	Description	P_N Frequency inverter	Design	Asynchronous motor	KSB SuPremE 1500	KSB SuPremE 3000	Mat. No.	[kg]
		[kW]		-	[rpm]			
	Output filters dv/dt for motor power cables up to 160 m, IP00 enclosure Line chokes for reducing electromagnetic interference emissions Reduction of peak currents in long motor power cables	18,50	FN 5060-60-99	✘	✘	-	01686776	7
		18,50	FN 5060-70-99	-	-	✘	01686857	8,52
		22,00	FN 5060-60-99	✘	✘	-	01686776	7
		22,00	FN 5060-90-99	-	-	✘	01686858	10,5
		30,00	FN 5060-90-99	✘	✘	-	01686858	10,5
		30,00	FN 5060-110-99	-	-	✘	01686859	11,35
		37,00	FN 5060-90-99	✘	✘	-	01686858	10,5
		37,00	FN 5060-150-99	-	-	✘	01686860	14,47
		45,00	FN 5060-110-99	✘	✘	-	01686859	11,35
		45,00	FN 5060-150-99	-	-	✘	01686860	14,47
		55,00	FN 5060-150-99	✘	-	-	01686860	14,47

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12 Commissioning Report

Report number: .....

Purchaser

Order number .....

Customer .....

Installation location .....

Contact .....

Product

Pump type .....

Pump works number 1. ..... 2. .....
3. ..... 4. .....
5. ..... 6. .....

Motor data ..... [kW] ..... [A] ..... [V] ..... [cos phi] ..... [rpm]

Type code 1. ..... 2. .....
3. ..... 4. .....
5. ..... 6. .....

Serial number 1. ..... 2. .....

(Name plate), frequency inverter 3. ..... 4. .....

5. ..... 6. .....

Operating mode

Manual mode — Application: Pressure/differential pressure/flow rate/temperature

Open-loop control mode — Setpoint ..... [Source] ..... [Unit] ..... [Value]

Closed-loop control mode — Sensor .....[sensor full-scale value]

Multiple pump configuration — Number of frequency inverters ..... [Quantity] Number of HMIs..... [Quantity]

Master control device — Number of master control devices ..... [Quantity]

Bus connection — Field bus type ..... Number of modules ..... [Quantity]

Comments

.....
.....
.....
.....

.....	.....
KSB Customer Service/name	Client/name
.....	.....
Place, date, signature	Place, date, signature

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13 EU Declaration of Conformity

Manufacturer:

KSB SE & Co. KGaA
Johann-Klein-Straße 9
67227 Frankenthal (Germany)

The manufacturer herewith declares that **the product**:

PumpDrive 2, PumpDrive 2 Eco, MyFlow Drive

Serial number range: 0117000000 to 0123000000

- is in conformity with the provisions of the following directives / regulations as amended from time to time:
  - 2014/30/EU: Electromagnetic Compatibility (EMC)
  - 2014/35/EU: Electrical Equipment Designed for Use within Specific Voltage Limits (Low Voltage)
  - Electrical components: 2011/65/EU Restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

The manufacturer also declares that

- the following harmonised international standards have been applied:
  - EN 55011
  - EN 61000-3-11, EN 61000-3-12
  - EN 61000-6-1, EN 61000-6-2 > **11 kW**, EN 61000-6-3 ≤ **11 kW**, EN 61000-6-4
  - EN 61800-3, EN 61800-5-1
  - EN 50581

The EU Declaration of Conformity was issued in/on:

Frankenthal, 1 February 2020

Jochen Schaab

Head of Product Development Pump Systems and Drives

KSB SE & Co. KGaA
Johann-Klein-Straße 9

67227 Frankenthal

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