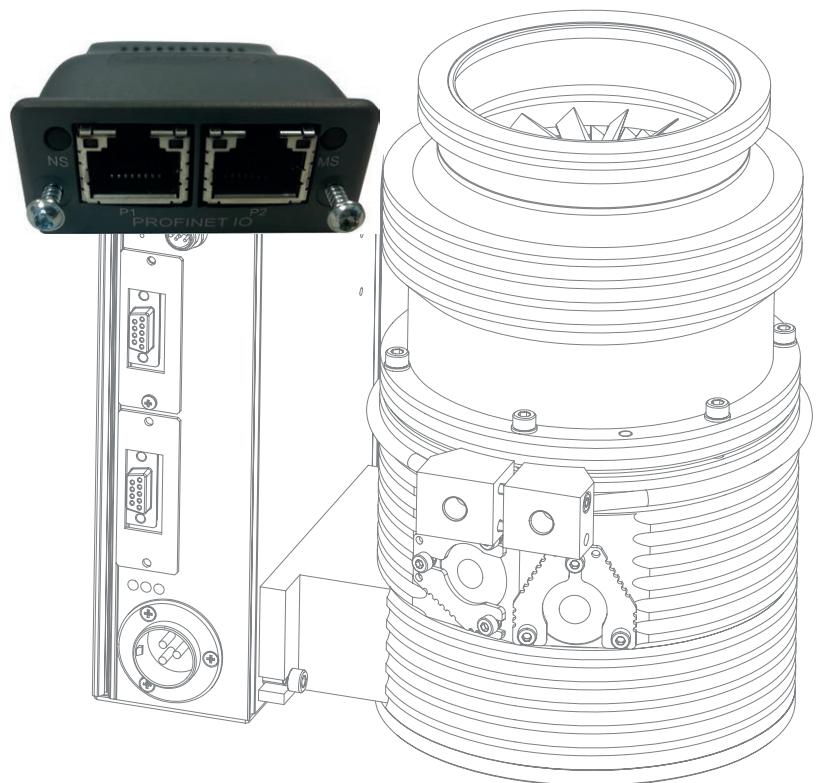


Profinet Interface for MAG.DRIVE S / iS

Operating Instructions 300806903_002_C1



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Original installation and operating instructions.

Obligation to Provide Information

Before installing and commissioning, carefully read these Operating Instructions and follow the information so as to ensure optimum and safe working right from the start.

The Leybold **frequency converters MAG.DRIVE S and iS with Profinet interface** have been designed for safe and efficient operation when used properly and in accordance with these Operating Instructions. It is the responsibility of the user to carefully read and strictly observe all safety precautions described in this section and throughout the Operating Instructions. The MAG.DRIVE **must only be operated in the proper condition and under the conditions described in the Operating Instructions**. It must be operated and maintained by trained personnel only. Consult local, state, and national agencies regarding specific requirements and regulations. Address any further safety, operation and/or maintenance questions to our nearest office.

“Trained personnel” for the operation of this pump are

- skilled workers with knowledge in the fields of mechanics, electrical engineering and vacuum technology, and
- personnel specially trained for the operation of vacuum pumps.

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE is used to notify users of installation, operation, programming or maintenance information that is important, but not hazard related.

We reserve the right to alter the design or any data given in these Operating Instructions. The illustrations are not binding.

Retain the Operating Instructions for further use.

NOTICE



DANGER



WARNING



CAUTION



NOTICE



Description

1 Description

1.1 Profinet Environment

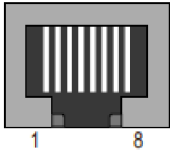
In a Profinet environment, a difference is made between master and slave units. Here the master units control all traffic. They transmit data to the related slaves and request data from these. It is possible to run one or several masters in a system.

The MAG.DRIVE S / iS is a slave unit, thus responds to requests from the master, and supplies data exclusively after having received a request to do so from the master.

1.2 Ethernet Interface (RJ45 connector)

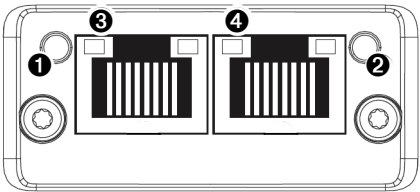
The Profinet option shows two RJ45 connectors each serving as input or output. This facilitates connecting several devices in series. Only use industrial approved Profinet cables to ensure for stable communications.

The Ethernet interface operate at 100 Mbit, full duplex, as required by PROFINET specifications.

Pin no.	Signal	Description	Connector
1	TD+		
2	TD-		
3	RD+		
6	RD-		
4, 5, 7, 8		connected to chassis ground over serial RC circuit	
Housing		Cable shield	

1.3 Profinet Status-LEDs

LED	Item
1	Network status
2	Module status
3	Link / Activity (Port 1)
4	Link / Activity (Port 2)



Test sequences are performed on the Network and Module status LEDs during start-up.

Description

Network Status LED

LED State	Description	Comments
Off	offline	- no power - no connection with IO controller
Green	online (RUN)	- connection with IO controller established - IO controller in RUN state
Green (1 flash)	online (STOP)	- connection with IO controller established - IO controller in STOP state or IO data bad - IRT synchronization not finished
Green (blinking)	blink	- used by engineering tools to identify the node on the network
Red	fatal event	- major internal error (this indication is combined with a red Module Status LED)
Red (1 flash)	station name error	- station name not set
Red (2 flashes)	IP address error	- IP address not set
Red (3 flashes)	configuration error	- expected ID differs from real identification

Module Status LED

LED State	Description	Comments
Off	not initialized	- no power - module in SETUP or NW_INIT state
Green	normal operation	- module has shifted from the NW_INIT state
Green (1 flash)	diagnostics event	- diagnostic event(s) present
Red	exception error	- device in EXCEPTION state
	fatal event	- major internal error (this indication is combined with a red Network Status LED)
Alternating Red / Green	Firmware update	- Do Not power off the module! Turning off the module during this phase could cause permanent damage.

Link / Activity LED

LED State	Description	Comments
Off	no link	- no link, no communication present
Green	link	- Ethernet link established, no communication present
Green (flickering)	activity	- Ethernet link established, communication present

2 GSDML file

The master configuration software receives all necessary information about a Profinet device via its corresponding GSDML file.

Visit www.leybold.com/ → Downloads → [Download Software](#),
to download the latest GSDML file.

Documented in the GSDML (GSD Markup Language) file are all relevant information of the corresponding device used. The file format has been defined in the standards so that proprietary project tools from different manufacturers can be used.

Configuration

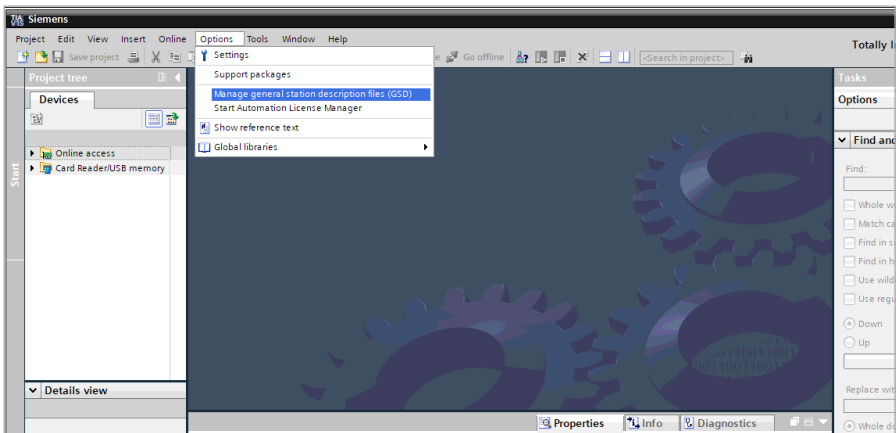
3 Configuration via the Siemens TIA Portal

As an example, the system's configuration is described by using the TIA Portal tools. Configurations using other tools should be similar.

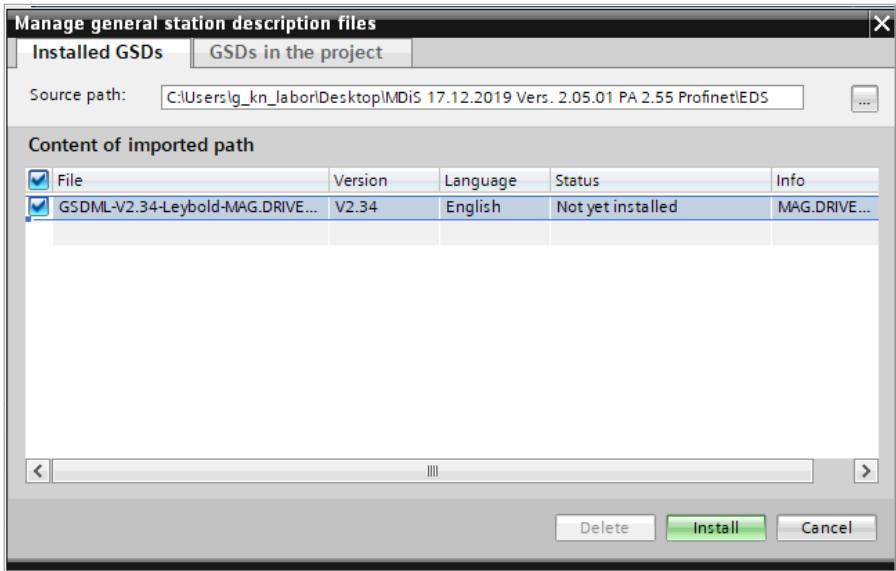
3.1 Installing the GSDML file

First of all, the GSDML file must be loaded into the configuration software.

From the **Options** menu select **Manage general station description files (GSD)**.



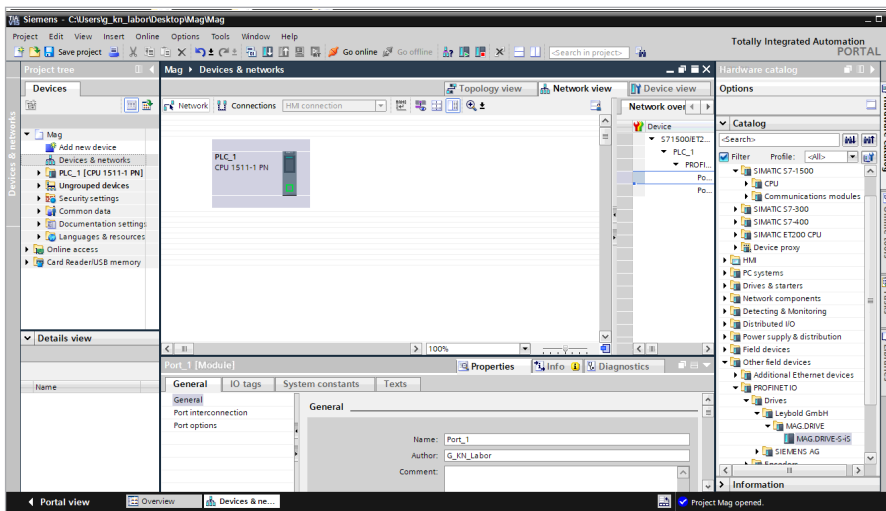
Then select the GSDML file's source directory, and load the file.



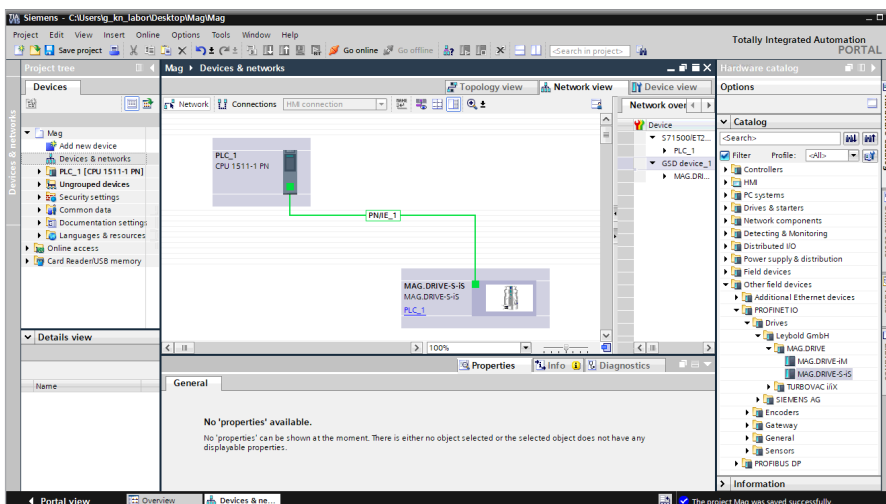
The device will then be listed and available in the hardware catalogue.

3.2 Adding the Device

From the hardware catalogue select the **MAG.DRIVE-S-IS** entry, to add the device to the system.



Then connect the device to the control.



Configuration

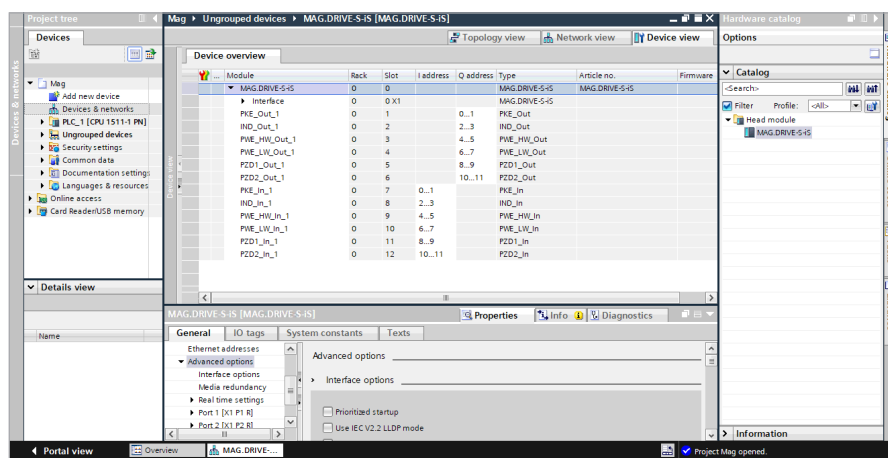
3.3 Creating the Slave Configuration

The configuration of the modules is done automatically.

There is only one permissible configuration:

3.3.1 PP01

Byte no.	Abbreviation	Description	Input	Output
0-1	PKE	Parameter number and type of access	PKE_In	PKE_Out
2-3	IND	Parameter index	IND_In	IND_Out
4-7	PWE	Parameter value	PWE_HW_In + PWE_LW_In	PWE_HW_Out + PWE_LW_Out
8-9	PZD1: ZSW STW	Status and control bits	PZD1_In	PZD1_Out
10-11	PZD2: HIW HSW	Current rotor frequency	PZD2_In	PZD2_Out



4 Description of PKE, IND, Control and Status Bits

4.1 PKE: Parameter Number and Type of Access

The parameter number is sent when accessing the frequency converter and also in the response of the frequency converter.

The receiver is provided with information on the parameter value PWE: size, field value or individual value, read or write.

The parameters and error messages are listed in Sections 5 and 6.

Type of Parameter Access to the Frequency Converter (Query Designator)					Type of Parameter Response from the Frequency Converter (Reply Designator)				
Bit no.					Bit no.				
15	14	13	12		15	14	13	12	
0	0	0	0	no access	0	0	0	0	no response
0	0	0	1	parameter value requested	0	0	0	1	16 bit value is sent
					0	0	1	0	32 bit value is sent
0	0	1	0	write a 16 bit value	0	0	0	1	16 bit value is sent
0	0	1	1	write a 32 bit value	0	0	1	0	32 bit value is sent
0	1	1	0	field value requested*	0	1	0	0	16 bit field value is sent
					0	1	0	1	32 bit field value is sent
0	1	1	1	write a 16 bit field value*	0	1	0	0	16 bit field value is sent
1	0	0	0	write a 32 bit field value*	0	1	0	1	32 bit field value is sent
1	0	0	1	number of field elements of a field requested	0	1	1	0	number of field elements of a field is sent
					Further responses				
					0	1	1	1	the frequency converter can not run the command
					1	0	0	0	during a write access: no permission to write

Depending on the query designator, only certain reply designators are possible. If the reply designator has the value 7 (query cannot be run), then in parameter value (PWE) an error number is provided.

Parameter Index IND

* The desired element of the index parameter is provided in IND.

Fault detection	Description
0	impermissible parameter number
1	parameter cannot be changed
2	min./max. restriction
3	wrong index value
4	no array
5	wrong data type
6	setting is not allowed
7	element was not changed
101	order unknown
104	password level too low

4.2 Status and Control Bits (Status and Control Word)

The status and control bits are only temporarily available, i.e. after interrupting the power supply the bits revert to the default status.

4.3 Control Word (PZD1, STW) = 16 Control Bits

(is sent to the pump for each access)

PZD1 Bit	Command	Remarks
0	*System Start/Stop	Value = 1: pump drive start Value = 0: pump drive stop (start impossible if Bit 7 = 1; means Reset active)
1 – 5	unassigned	
6	*Enable main set point in PZD2	Value = 1: the value of PZD2 will be used as speed set point. Value = 0: the set point value of PZD2 will be ignored.
7	*Failure reset Reset impossible, if Bit 0 = 1; Start active	Changing from 0 to 1 clears all pending failures, if the causes are away. To avoid a continuously reset, only the transient from 0 to 1 may work as reset signal.
8	*Activate Standby function	Value = 1: Activate the standby function: if the main value in PZD 2 is deactivated, the drive reference value of the drive speed must be the same value as parameter 150. Value = 0: Deactivate the standby function: if the main value in PZD 2 is deactivated, the drive reference value of the drive speed must be the same value as parameter 24. This bit corresponds to the alternative standby activation of parameter 151.
9	unassigned	
10	*Enable Process Data (Bit 0, 6, 7, 8, 13, 14)	Value = 0: pump drive control by digital I/O signal, all bits in PZD1 will be ignored. Value = 1: System control by this interface. The digital I/O signal will be ignored.
11	**Purge gas On/Off	Value = 1: Purge gas valve open Value = 0: Purge gas valve closed
12	**Venting On/Off	Value = 1: Venting valve open Value = 0: Venting valve closed
13 – 14	unassigned	
15	**Venting On/Off	Value = 1: Status of the venting valve depends on pump operating status Value = 0: Venting valve closed

* In order to activate the control function, bit 10 must be set. Control via other methods is then disabled.

** For future applications

*** Parameter 134 must be set to 21, to activate the function.

PKE, IND, Bits

4.4 Status Word (PZD1, ZSW) = 16 Status Bits

(is sent with each response from the frequency converter)

PZD1		
Bit	Interpretation	Description
0	Ready to run	Bit 0 will be set after initialization of the system, if there is no failure pending.
1	unassigned	Value set to 0.
2	Operation enabled	Bit 2 will be set if no failure condition is present, rotor is lifted and drive is active.
3	Failure condition	Bit 3 will be set if any failure condition is pending und the pump drive is deactivated. The pump is not ready for start.
4	Acceleration	Bit 4 will be set to 1, if the drive increases or tries to increase the speed of the pump (actual speed << speed reference value).
5	Deceleration	Bit 5 will be set to 1, if the drive decreases or tries to decrease the speed of the pump (actual speed >> actual speed reference value; also active during run out).
6	Switch on lock	Value inverse to Bit 2 of PZD1.
7	Warning temperature	Temperature warning condition: one or more temperature limits are above the warning limits.
8	unassigned	Value set to 0.
9	Parameter channel enabled	If set, the parameter channel is ready for operation; normally always = 1.
10	Normal Operation reached	Bit 10 is set if the normal operation condition of the pump is true: „actual pump speed” ≥ „speed reference” * P25.
11	Pump is rotating	Bit 11 is set if rotor rotates, $f > 3\text{Hz}$.
12	Failure Counter	Bit 12 is set if the alarm level of internal counters have reached the set points, so that the system may not be operated any longer.
13	Warning overload	Bit 13 is set, if load condition leads to one or more of the overload conditions; definition is still open.
14	unassigned	Value set to 0.
15	Process channel enabled	Bit 15 is set to 1 if Bit 10 of PZD1 is set, recognized and the pump is controlled by this interface.

Parameter List

5 Parameter List

It is possible to change certain parameters depending on the specific requirements and save these permanently. For this refer to the Annex, example 4.

r = readable, w = writeable

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
1	Pump unit identifier	100	201	201		r	u16	201 = MAG.DRIVE S;
2	Software version xxx.yy.zz	8010000	2147483647	8015500		r	i32	xxx.yy: Version, zz: Correction index
3	Actual frequency	0	1200	0	rps	r	u16	Actual value of the rotor frequency.
4	Actual intermediate	0	1000	480	0.1 V	r	u16	Actual intermediate circuit voltage of the circuit voltage converter.
5	Actual current	0	100	0	0.1 A	r	u16	Actual motor current
6	Actual electrical power	0	5000	0	0.1 W	r	u16	Actual drive input power.
7	Actual motor temperatur	0	150	0	°C	r	u16	Actual value of the motor temperature.
8	Save data command	-2147483648	2147483647	0		r/w	i32	A write command with any value saves temporary data into nonvolatile memory.
11	Actual converter temperatur	0	100	0	°C	r	u16	Actual heat sink temperature of the converter.
16	Motor temperature	5	250	110	°C	r	u16	Exceeding the motor temperature warning threshold warning threshold °C results in a warning.
17	Nominal motor current	0	200	45	0.1 A	r	u16	Maximum permissible motor current
18	Maximum frequency	0	1200	980	Hz	r	u16	Highest permissible frequency
19	Minimum frequency	0	1200	230	Hz	r	u16	Lowest permissible frequency
20	Critical frequency	0	1200	200	Hz	r	u16	When the pump is accelerating this frequency must be reached within the maximum passing time (P183). After run-up: Switch-off threshold because of overload.
21	Motor overload limit	0	200	45	0.1 A	r	u16	Max. current level during normal operation; Higher current value leads to „overload“ and stops the pump if the durance exceeds a certain time.

Parameter List

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
23	Pump type	200	300	200		r	u16	Code no. of the connected turbo pump: 230 = MAG 300/400 260 = MAG 600/700
24	Setpoint frequency	600	1200	980	Hz	r/w	u16	Setpoint of the rotor frequency
25	Normal operation	35	99	90	%	r/w	u16	Setpoint of the frequency dependent normal operation level
32	Max. run-up time	0	3600	420	s	r/w	u16	Max. permissible time during which the pump must attain the normal operation threshold (P24*P25) with the start signal present.
36	Start delay time	0	3600	0	s	r/w	u16	Delays the start of the pump to allow leadtime for the fore vacuum pump for example.
38	Start cycle counter	0	65535	0		r	u16	Counts all run-ups of the pump from stand-still.
50	Pump catalog no.	0	2147483647	0		r	i32	Last 9 digits of the pump's catalog number.
52	Pump serial no.	0	2147483647	0		r	i32	Last 9 digits of the pump's serial number.
54	Date of manufacturing	0	2147483647	0		r	i32	Manufacturing date of the pump [DDMMYY].
56	Date of last service	0	2147483647	0		r	i32	Last service date of the pump [DDMMYY].
60	Last service operating hours	0	2147483647	0	0.01 h	r	i32	Number of operating hours at the last service event.
62	Date of last repair	0	2147483647	0		r	i32	Last repair date of the pump [DDMMYY].
66	Last repair operation hours	0	2147483647	0	0.01 h	r	i32	Number of operating hours at the last repair event.
86	Number of repairs	0	65535	0		r	u16	Number of all repairs
105	Counted magn. bearing touch downs	0	65535	0		r	u16	Actual number of recognized magnetic bearing touch downs
106	Accumulated time of MB touch downs	0	2147483647	0	0.01 s	r	i32	Actual total amount of time during recognized bearing touch downs
109	Max. no. of touch downs	0	65535	1000		r	u16	Maximum number of touch downs until warning or error indication.

Parameter List

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
110	Max. amount of touch down time	0	2147483647	360000	0.01 s	r	i32	Max. amount of touch down time until warning or error indication
125	Bearing temperature	0	150	0	°C	r	u16	Actual value of the bearing temperature
126	Bearing temperature warning threshold	5	250	85	°C	r	u16	Warning level of the bearing temperature
131	Bearing temperature error threshold	10	250	90	°C	r	u16	Error level of the bearing temperature
133	Motor temperature error threshold	10	250	115	°C	r	u16	Error level of the motor temperature
134	Option 24 volts behavior	0	21	19		r/w	u16	Selects the behavior of the 24 volt auxiliary supply (fan, valve etc.) 0: always deactive 1: failure 2: no failure 3: warning 4: no warning 5: at speed 6: not at speed 7: motor rotates 8: motor does not rotate 9: reference speed reached 10: warning supply voltage low 11: warning supply voltage high 12: warning motor temperature high 13: warning converter temp. power stage 14: warning converter temp. air inside 15: warning pump bearing temperature 16: warning pump speed too high 17: warning pump motor overload 18: serial interface controlled 19: always active 20: option brake operation 21: vent valve option

Parameter List

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
139	Current reduction factor	30	100	100	%	r/w	u16	Is used for the reduction of the maximum consumption current, e.g. for adaption of low performance power supplies. Note: values < 100 reduce the pump performance and increase the run-up time.
140	Intermediate circuit current	0	100	0	0.1 A	r	u16	Actual average intermediate circuit current of the converter.
143	Actual motor voltage	-1000	1000	0	0.1 V	r	i16	Actual motor rms coil voltage
144	Run-up cycles warning threshold	0	65535	27000		r	u16	Warning level of start cycle numbers
145	Run-up cycles error threshold	0	65535	30000		r	u16	Error level of start cycle numbers
146	Stand-by cycle counter	0	65535	0		r	u16	Counts all run-ups from stand-by up to normal speed.
147	Run-up cycle counter	0	65535	0		r	u16	Number of all start-up events from stand-still and stand-by up to normal speed.
150	Stand-by frequency	0	1200	250		r/w	u16	Stand-by operation frequency setpoint
154	Pump op. hours warning threshold	0	2147483647	9000000	0.01 h	r	i32	Pump operating hours warning level
155	Pump op. hours error threshold	0	2147483647	10000000	0.01 h	r	i32	Pump operating hours alarm level
157	Pump op. hours blocked-start threshold	0	2147483647	9500000	0.01 h	r	i32	Start-up is blocked, if this number of operation hours is reached.
171	Error code memory	0	1000	0		r	u16	Indexed parameter for storing the most recent 40 error codes. The individual error memory entries are accessed via this parameter with additional index number. The last error code is accessed with index 0 and the oldest with index 39. See Section 6 for the error codes. Max. Index = 39
174	Error rotor frequency	0	1200	0		r	u16	Actual speed, when error occurred. Access analogously as for parameter 171 (error code memory)

Parameter List

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
176	Error operating hours	0	2147483647	0		r	i32	Pump operating hours, when error occurred. Access analogously as for parameter 171 (error code memory)
181	Profibus control watchdog	0	200	200	0.1 s	r/w	u16	0.0 = no supervision of cyclic control messages xx.x = watchdog triggers xx.x sec. after missing of control messages and stops the pump with an error message.
182	RS 232/485 control watchdog	0	200	0	0.1 s	r/w	u16	0.0 = no supervision of cyclic control messages xx.x = watchdog triggers xx.x sec. after missing of control messages and stops the pump with an error message.
183	Max. passing time	0	1200	360	s	r	u16	Maximum permissible time amount from start to minimum speed.
184	Converter operating hours	0	65535	0	h	r	u16	Counts the operating hours of the converter during active pump operation.
220	Peak orbit level 1	0	65535	0	1/2 ¹⁴	r	u16	Actual peak value of the level 1 radial bearing amplitude.
221	Peak orbit level 2	0	65535	0	1/2 ¹⁴	r	u16	Actual peak value of the level 2 radial bearing amplitude.
222	Peak amplitude Z	0	65535	0	1/2 ¹⁴	r	u16	Actual peak value of the Z bearing amplitude.
227	Warning bits 1	0	65535	0		r	u16	Active warnings described bit per bit. See Section 7 for meaning.
228	Warning bits 2	0	65535	0		r	u16	Active warnings described bit per bit. See Section 7 for meaning.
230	Warning bits 3	0	65535	0		r	u16	Active warnings described bit per bit. See Section 7 for meaning.
232	Warning bits 4	0	65535	0		r	u16	Detailed MAG bearing conditions
243	Time delay SEMI F47	0	9999	5	s	r/w	u16	Adjustable time which in the case of an input voltage breakdown is bridged without an error message. For the entire duration, the converter will indicate a normal operation. Auxiliary parameter for fulfilling SEMI F47 requirements.
254	RS485 address set	0	31	0		r/w	u8	Address setup of passive serial interfaces as RS232, RS485 etc. in the Control Slot

Parameter List

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
260	Current upper limit of vent valve	0	1000	0	0.1 A	r	u16	
261	Current lower limit of vent valve	0	1000	0	0.1 A	r	u16	
262	Frequency lower limit of vent valve	0	1000	100	Hz	r	u16	
263	No. of touch downs at generator operation	0	65535	0		r	u16	
264	Max. no. of touch downs at generator operation	0	65535	0		r	u16	
265	Frequency lower limit at generator operation	0	1000	200	Hz	r	u16	
266	No. of touch downs at full shut down (PK)	0	65535	0		r	u16	
267	No. of touch downs at full shut down (converter)	0	65535	0		r	u16	
268	Max. no. of touch downs at full shut down	0	65535	0		r	u16	
312	Catalog no. of converter	0	255	0	:CHAR	r	u16	Catalog no. of converter, max. Index = 10
315	Serial no. of converter	0	255	0	:CHAR	r	u16	Serial no. of converter, max. Index = 10
343	Acceleration current	0	200	45	0.1 A	r	u16	Motor current setpoint during acceleration
344	Cable length	0	65535	0	m	r	u16	Length of pump cable
350	Catalog number of pump	0	127	0	:CHAR	r	u16	Catalogue number of the pump. One ASCII char per index, max. Index = 18
390	Actual cooler temperature	0	150	0	°C	r	u16	Actual value of the converter power stage cooling device temperature.
398	Pump volume	0	65535	300	l/s	r	u16	Pumping speed of the pump
399	Pump type	0	65407	0	:CHAR	r	u16	Pump description; ASCII sequence, max. Index = 18

Parameter List

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
801	Magnetic bearing current	-32768	32767	0	0.01 A	r	i16	Actual magnetic bearing current 1a, 2a, 1b, 2b, Z, max. Index = 4
815	Mag. bearing current 1a	-32768	32767	0	mA	r	i16	Actual magnetic bearing current 1a of high vacuum side
816	Mag. bearing current 2a	-32768	32767	0	mA	r	i16	Actual magnetic bearing current 2a of foreline side
817	Mag. bearing current 1b	-32768	32767	0	mA	r	i16	Actual magnetic bearing current 1b of high vacuum side
818	Mag. bearing current 2b	-32768	32767	0	mA	r	i16	Actual magnetic bearing current 2b of foreline side
819	Mag. bearing current Z	-32768	32767	0	mA	r	i16	Actual magnetic bearing current of Z axle
872	Mag. bearing current 1c	-32768	32767	0	mA	r	i16	Actual magnetic bearing current 1c of high vacuum side
873	Mag. bearing current 2c	-32768	32767	0	mA	r	i16	Actual magnetic bearing current 2c of foreline side
918	Set parameter bus address	0	65535	126		r/w	u16	Set parameter bus address
923	Active bus address	0	65535	126		r	u16	Effective bus address
924	Type of bus Address	0	1	0		r/w	u16	Choice of parameter bus address (value=1) or network bus address (value=0).

Error Memory

6 Error Memory

Parameter 171 contains in the case of an error the corresponding error code. For the respective error, the corresponding rotor frequency and the corresponding number of operating hours at that point of time the error has occurred is saved under the parameters 174 and 176 at the same index number. Listed in the following are the possible error codes and their causes.

Error code	Designation	Description	Possible cause	Remedy
2	Pump Motor Temperature is too high	The motor temperature has exceeded the error threshold.	The cooling water flow is too low or the cooling water temperature is too high.	Cooling system needs to be improved
			The converter is overloaded due to too high gas load.	The gas load needs to be reduced.
			Frequent acceleration and deceleration of the pump.	Allow converter to cool down between the cycles.
3	Supply Voltage Failure	The supply voltage is out of the specified voltage range.	Usage of a wrong power supply unit	Replace the power supply by a more powerful one.
			Misaligned output voltage	The output voltage of the power supply should be adjusted.
			Voltage drop across the supply cable	Adjust the output voltage of the power supply, increase the copper area of the cable, use a shorter DC cable.
4	Converter Temperature Failure	The temperature sensor inside of the converter reads too high temperature value.	The cooling water flow is too low or the cooling water temperature is too high.	Cooling system needs to be improved
			The converter is overloaded due to too high gas load.	Reduce the gas flow.
			Frequent acceleration and deceleration of the pump.	Allow converter to cool down between the cycles.
6	Overload Failure	Rotational speed dropped below the shutdown frequency threshold (140 Hz).	Backing pressure too high during operation.	Reduce backing pressure.
			Too high gas flow during operation	Reduce process gas flow.
			High vacuum pressure too high.	Check the chamber pressure during operation.
7	Accel. Time	The pump does not reach the normal operation frequency during the adjusted maximum acceleration time.	Backing pressure or gas load is too high during start-up.	Reduce backing pressure and / or gas flow.
			Parameter „Accel. Time“ is not set correctly.	Set parameter „Accel. Time“
9	Bearing Temperature too high	The temperature sensor inside the pump reads a higher temperature value than the failure threshold.	Missing cooling device (water or air).	Apply a air or water cooling device according to specifications.
			Cooling water flow too low or cooling water temperature too high.	Check cooling water tubes for deposits.
			Air temperature too high	Cooling system needs to be improved
			Air cooling device blocked by dust	The gas load needs to be reduced.
			Frequent acceleration and deceleration of the pump.	Allow pump to cool down between the cycles.

Error Memory

Error code	Designation	Description	Possible cause	Remedy
12	Radial Bearing Unbalance Failure at the Upper Magnetic Bearing	The radial magnetic bearing near the high vacuum flange takes a too large orbit.	Resonance effects between different pumps could increase the unbalance amplitude of a certain pump.	Setup the pumps to a slightly different rotation frequency or isolate the pumps from dynamic influence.
13	Radial Bearing Unbalance Failure at the Lower Magnetic Bearing	The radial magnetic bearing near the high vacuum flange takes a too large orbit.	Deposition of material from the pumped media at the turbo rotor could cause unbalance. Due to aggressive media, abrasion at the turbo rotor could cause unbalance.	Check the pumped media for suitability with this pump design.
14	Axial Bearing Unbalance Failure	The radial magnetic bearing near the high vacuum flange takes a too high oscillation amplitudes.	Resonance effects between different pumps could increase the unbalance amplitude of a certain pump. The environmental vibration might be too heavy	Setup the pumps to a slightly different rotation frequency or isolate the pumps from dynamic influence. Reduce the vibration which might affect the pump
16	Overload Duration Failure	The rotational speed has dropped below normal operation frequency and stays there for longer than the maximum „Acceleration Time“.	Backing pressure or processgas flow too high during operation. Parameters „Accel. Time“ or „Normal Operation“ are not set correctly.	Check backing pressure and process gas flow Check parameter „Normal Operation“ and parameter „Acceleration Time“ for correct setting.
17	Pump Motor Current Failure		On START command: DRIVE cable not connected or connectors damaged. DRIVE cable interrupted during operation of the MAG.	Check cables and connectors, straighten pins if required. Reconnect or replace DRIVE cable
19	Starting Time exceeded	The frequency has not reached the minimum frequency during the startup time frame.	Backing pressure too high during start-up. Rotor blocked.	Reduce backing pressure Check if the rotor rotates freely.
26	Bearing Temperature Sensor Defective		Temperature sensor defective, connection shorted or interrupted	Check for correct pump cable connection.
28	Motor Temperature Sensor Defective			
31	Highload Duration Failure	The actual motor current exceeds the maximum working level for more than twice the acceleration duration.	Backing pressure or processgas flow too high during operation.	Check backing pressure and process gas flow
39	Magnetic Bearing Startup Failure	The magnetic bearing system is not able to lift the rotor properly.	Shock venting occurred Too high amplitude or force of mechanical shocks or vibration from the mounting rack. Resonance effects between different pumps could increase the unbalance amplitude of a certain pump.	Refer to the pump manual for correct venting of the pump. Reduce the vibration or shocks influence which might affect the pump Setup the pumps to a slightly different rotation frequency or isolate the pumps from dynamic influence.
43	Overspeed	The actual frequency exceeds the setpoint frequency.	The frequency setpoint has been set during operation with serial interface e.g. RS232.	Provide for correct speed setting.

Error Memory

Error code	Designation	Description	Possible cause	Remedy
63	Internal Parameter Failure		<p>There is a parameter mismatch occurred during the startup initialisation of the pump or while parameters are stored permanently.</p> <p>The pump was disconnected during storing of important system data.</p>	<p>Stop the pump, wait for stillstand, remove the supply voltage temporarily and start the system once more.</p> <p>When using any serial interface with any appropriate tool, initiate a permanent storage procedure manually. Set parameter 8, see example 4.</p>
65	Cyclic Pump Communication Failed	Failure of the internal data communication of the converter	The continuous pump communication failed.	<p>Check the pump connectors and cable.</p> <p>Stop the pump, wait for stillstand, remove the supply voltage temporarily and start the system once more.</p>
67	Internal Overload		Internal drive overload	Stop the pump, wait for stillstand, remove the supply voltage temporarily and start the system once more.
71	First Time Initialisation Failure		First initialisation of pump parameters failed.	Stop the pump, wait for stillstand, remove the supply voltage temporarily and start the system once more.
73	Operating Cycles	The registered number of start and standby cycles exceeds the permissible alarm limit during system start. The system can no longer be started.	<p>Intensive utilisation of the standby mode or a high number of starting processes.</p> <p>(By default setup this alarm is disabled and only a warning occurs)</p>	Have the pump serviced.
74	Operating Hours	The number of operating hours of the pump has reached the preset alarm limit during system start. The system can no longer be started.	<p>The number of operating hours of the system has reached the level necessary for servicing.</p> <p>(By default setup this alarm is disabled and only a warning occurs.)</p>	Have the pump serviced.
75	Pump Initialisation Failure	There is a parameter mismatch occurred during the startup initialisation of the pump.	<p>Defective pump cable</p> <p>Failure in pump or converter</p>	<p>Check cables and connectors for damages. Reconnect or replace the pump cable</p> <p>Stop the pump, wait for stillstand, remove the supply voltage temporarily and start the system once more.</p>

Error Memory

Error code	Designation	Description	Possible cause	Remedy
77	Number of Bearing Touch Downs Failure	The registered number of auxiliary bearing touches exceeds the permissible alarm limit.	Shock venting occurred	Refer to the pump manual for correct venting of the pump.
78	Bearing Touch Down Time Failure	The registered cumulated time of auxiliary bearing touches exceeds the permissible alarm limit.	Too high amplitude or force of mechanical shocks or vibration from the mounting rack. Resonance effects between different pumps could increase the unbalance amplitude of a certain pump.	Reduce the vibration or shocks influence which might affect the pump. Setup the pumps to a slightly different rotation frequency or isolate the pumps from dynamic influence.
79	Internal Communication Failure	Failure of the internal data communication of the converter	A failure of the converter internal data or parameter handling occurred, inconsistent data were found.	Stop the pump, wait for stillstand, remove the supply voltage temporarily and start the system once more.
80	Invalid Interface Module Combination	Configuration of the interface modul slot is inconsistent.	An invalid combination of interface module is in use. The X1 module (24 Volt SPS) interface can only be used in the control slot. Only one active interface module like Profibus, DeviceNet, Ethernet/IP etc. can be used in one converter unit.	Place the X1 module (24 Volt SPS) interface in the control slot. Use only one active interface module like Profibus, DeviceNet, Ethernet/IP etc. in one converter unit.
81	RS232/RS485 Communication Interruption Failure	Cyclic communication fail for a longer period than in P182 defined.	The RS232 / RS485 supervision mechanism detects missing communication. By default setup the supervision is disabled.	Switch off either the communication supervision, or make sure the cyclic telegram exchange fits to the selected time out value of the watchdog.
82	Fieldbus Communication Interruption Failure	Cyclic communication fail for a longer period than in P925 defined.	The fieldbus (Profibus, DeviceNet etc.) supervision mechanism detects missing communication. By default setup the watchdog is set to about 2 seconds.	Switch off either the communication supervision, or make sure the cyclic telegram exchange fits to the selected time out value of the watchdog. For the default setup the telegram exchange should run faster than 1 telegram per second.
90	Pump Speed Adjustment Failure	Frequency setpoint is above the maximum frequency in parameter 45	The selected pump speed is higher than the nominal speed.	Make sure only a permitted speed value is sent to the pump controller.

Error Memory

Error code	Designation	Description	Possible cause	Remedy
91	Pump Cable Length Failure	Failure by detecting the cable length	The detected cable length is not supported.	Check the installation for usage of correct cable.
92	External Pump Controller and Cable Length of „0 m“ Failure	External converter MAG.DRIVE S couldn't be driven without cable. The detected cable length „0m“ is a failure.	External pump controller with zero meter cable is not correct.	Stop the pump, wait for stillstand, remove the supply voltage temporarily and start the system once more.
93	Cable Parameter Faulty		Failure during cable detection	
201	Controller Hardware Failure	Failure in the controlling computer of the converter	External parasitic coupling or failure in the converter electronics.	Stop the pump, wait for stillstand, remove the supply voltage temporarily and start the system once more.
203	Failure during self-test	Failure in the parameter table allocation		
204	RAM array insufficient for scope functionality	Failure in the controlling computer of the converter		
206	Pump Parameter Failure	Failure during identification and initiation of the pump or the converter	There is inconsistent pump data	Stop the pump, wait for stillstand, remove the supply voltage temporarily and start the system once more.
209	Pump Initialisation Failure	Failure during identification and initiation of the pump or the converter	There is inconsistent pump data after a power on sequence.	Wait for stillstand of the pump, remove the supply voltage temporarily and start the system once more.
213	Supply Voltage Too High	The drive circuitry was deactivated due to an overvoltage detected.	Usage of a wrong power supply unit. Misaligned output voltage.	A wrong power supply unit is in use. The output voltage of the power supply should be adjusted.

Theoretically there are further error codes. Should these be displayed, please contact Leybold.

In the case of malfunctions also note the troubleshooting information provided in the Operating Instructions for the pump.

7 Warnings

Possibly present current warning conditions can be read through the parameters 227, 228, 230, 232 and 233.

If a warning condition is fulfilled, then the corresponding bit is set. If several warning conditions are fulfilled, then their weights are added. When converting this decimal value to a binary value, then the individual bits can be assigned to the warning messages.

Example: imbalance affecting the X-axis, imbalance affecting the Y-axis

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
3072 →	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0

P227 Bit	Designation	Possible cause	Remedy
0	Pump Motor Temperature too high	The cooling water flow is too low or the cooling water temperature is too high.	Cooling system needs to be improved
1	Converter Housing Temperature too high	The converter is overloaded due to too high gas load.	The gas load needs to be reduced.
2	Bearing Temperature too high	Frequent acceleration and deceleration of the pump.	Allow converter to cool down between the cycles.
3-5	–		
6	Overspeed	The frequency setpoint has been set during operation with serial interface e.g. RS232.	Provide for correct speed setting.
7-9	–		
10	MAG Unbalance at the Upper Bearing	Deposition of material from the pumped media at the turbo rotor Due to aggressive media, abrasion at the turbo rotor.	Check the pumped media for suitability with this pump design
11	MAG Unbalance at the Lower Bearing	Deposition of material from the pumped media at the turbo rotor Due to aggressive media, abrasion at the turbo rotor.	Check the pumped media for suitability with this pump design
12	MAG Oscillation at the Axial Bearing	The environmental vibration might be too heavy.	Reduce vibration which might affect the pump.
13-15	–		

P228 Bit	Designation	Possible cause	Remedy
0-10	–		
11	Magnetic Bearing has not lifted	There was a fatal error before, which is not resettable.	When the pump is stillstanding, disconnect the pump from the power supply and reconnect it. If this behaviour is repeated by the pump, then contact the Leybold service department
12	MAG Bearing Overload (Level 1)	The environmental vibration might be too heavy.	Reduce vibration which might affect the pump.
13	Converter Power Stage Temperature too high	The cooling water flow is too low or the cooling water temperature is too high. The converter is overloaded due to too high gas load. Frequent acceleration and deceleration of the pump.	Cooling system needs to be improved. The gas load needs to be reduced. Allow converter to cool down between the cycles.
14, 15	–		

Warnings

P230 Bit	Designation	Possible cause	Remedy
0-3	–		
4	MAG Bearing Overload (Level 2)	The environmental vibration might be too heavy.	Reduce vibration which might affect the pump.
5	Max. Number of Pump Runup Cycles are reached	The recommended max. number of start cycles of the pump are reached.	Arrange a service date at Leybold for this pump.
6	Max. Number of Pump Operation Hours are reached	The recommended max. number of operating hours of the pump are reached.	Arrange a service date at Leybold for this pump.
7	–		
8	High load	Backing pressure too high during operation. Too high amount of gas flow during operation	Reduce backing pressure or process gas flow. Check the chamber pressure during operation.
9	MAG Bearing Overload Z-Axis	The magnetic bearing current no.4 is too high. The environmental vibration might be too heavy	Reduce vibration which might affect the pump.
10	–		
11	Overload	Backing pressure too high during operation. Too high amount of gas flow during operation Parameter „Normal Operation“ is not set correctly.	Reduce backing pressure or process gas flow. Check the chamber pressure during operation. Check the „normal operation“ level adjustment.
12	MAG Radial Bearing Displacement	The environmental vibration might be too heavy.	Reduce vibration which might affect the pump.
13	–		
14	Supply Voltage too high or too low	Usage of a wrong power supply unit. Misaligned output voltage. Too high load. Voltage drop across the supply cable.	Use correct power supply. Adjust the output voltage of the power supply. Replace the power supply by a more powerful one. Increase the copper area of the cable
15	Motor Start Locked	There was a fatal error before, which is not resetable.	When the pump is stillstanding, disconnect the pump from the power supply and reconnect it. If this behaviour is repeated by the pump, then contact the Leybold service department.

P232 Bit	Designation	Possible cause	Remedy
0	MAG Bearing Overload 0	The magnetic bearing current for the individual axes is too high.	Reduce vibration which might affect the pump.
1	MAG Bearing Overload 1		
2	MAG Bearing Overload 2		
3	MAG Bearing Overload 3		
4	MAG Bearing Overload 4 Z-Axis	The environmental vibration might be too heavy.	
5	MAG Bearing Overload 5		
6	MAG Bearing Overload 6		
7	–		
8	MAG Upper Radial Bearing Displacement X1	The magnetic bearing close to the high vacuum flange has been shifted radially.	Reduce vibration which might affect the pump.
9	MAG Upper Radial Bearing Displacement Y1	The environmental vibration might be too heavy.	
10	MAG Lower Radial Bearing Displacement X2	The magnetic bearing close to the forevacuum flange has been shifted radially.	
11	MAG Lower Radial Bearing Displacement Y2	The environmental vibration might be too heavy.	
12	MAG Axial Bearing Displacement Z	The magnetic bearing has been shifted axially. The environmental vibration might be too heavy.	
13	High Number of Auxiliary Bearing Impacts	The environmental vibration might be too heavy or too many shocks or impacts interfered the pump	
14	High Amount of Cumulated Bearing Touch Down Time	Too many full or partial auxiliary bearing run downs affected the pump.	Reduce vibration which might affect the pump. Avoid shocks or impacts at the pump.
15	High No. of Touch Down Bearing Run Downs	The number of partial or full touchdowns into the touchdown bearings is too high. The environmental vibration might be too heavy or too many shocks or impacts interfered the pump Too many full or partial auxiliary bearing run downs affected the pump.	Avoid stopping the pump by switching off the mains power. Avoid disconnecting the pump cable, when the pump is still running“

Warnings

P233 Bit	Designation	Possible cause	Remedy
0	Flange temperature above warning limit.	<p>The Cooling water flow is too low or the cooling water temperature is too high.</p> <p>The Converter is overloaded due to too high gas load.</p> <p>Frequent acceleration and deceleration of the pump.</p>	<p>The cooling system needs to be improved.</p> <p>The gas load needs to be reduced.</p> <p>Allow converter to cool down between the cycles.</p>
1	Temperature power stage bearing electronic	<p>Ambiant temperature to high.</p> <p>The Cooling water flow is too low or the cooling water temperature is too high.</p> <p>Too high amplitude or force of mechanical shocks or vibration fto the system.</p>	<p>Improve cooling conditions</p> <p>Reduce the vibration or shocks influence which might affect the pump</p>
2	Shake warning	The pump has been operated for such a long duration (default 4000 hours) that it shaking and cleaning are needed to remove dust deposited inside.	See pump Operating Instructions.
3-15	–		

8 Device Behaviour at Start-up and IOPS = bad

All IO data are zeroed, when the device is switched on. The device is stopped.

In case of network interruptions or PLC mode changes from RUN to STOP, the last data received from the controller are used.

A watchdog can be configured via parameter 181, which in case of a network interruption safely shuts down the pump after a preset time with an error message.

Telegram examples

Detailed in the following table is the complete structure of the telegram as described in detail on the preceding pages.

Abr.		Description	Dez	Value Hex	Bin	Bit	Byte	Word	Bit	Bin	Value Hex	Dez	Description		Abr.	
PKE	Query designator					7	0		15					Reply designator	PKE	
						6			14							
	Res.					5			13					Res.		
						4			12							
						3			11							
						2			10							
						1			9							
						0			8							
						7	1	0	7							
						6			6							
						5			5							
						4			4							
						3			3							
						2			2							
						1			1							
						0			0							
IND	Parameter Index					7	2		15					Parameter Index	IND	
						6			14							
						5			13							
						4			12							
						3			11							
						2			10							
						1			9							
						0			8							
-	Reserved					7	3		15					Reserved	-	
						6			14							
						5			13							
						4			12							
						3			11							
						2			10							
						1			9							
						0			8							
PWE	Parameter value					7	4		15					Parameter value	PWE	
						6			14							
						5			13							
						4			12							
						3	5		11							
						2			10							
						1			9							
						0			8							
						7	2		7							
						6			6							
						5			5							
						4			4							
						3	5		3							
						2			2							
						1			1							
						0			0							
						7	6		15							
						6			14							
						5			13							
						4			12							
						3	6		11							
						2			10							
						1			9							
						0			8							
						7	3		7							
						6			6							
						5			5							
						4			4							
						3	7		3							
						2			2							
						1			1							
						0			0							
PZD1	Control word	-				7	8		15				Remote active	Status word	PZD1	
		-				6			14				-			
		-				5			13				Warning overload			
		-				4			12				Failure counter			
		-				3	9		11				Pump is rotating			
		Activate remote				2			10				Normal operation			
		-				1			9				Parameter accepted			
		Standby speed				0			8				-			
		Error reset				7	4		7				Warning temperature			
		-				6			6				Switch-on lock			
		-				5			5				Deceleration			
		-				4			4				Acceleration			
		-				3	9		3				Error active			
		-				2			2				Operation enabled			
		-				1			1				-			
		Start/Stop				0			0				Ready to start			
PZD2	Setpoint rotor speed					7	10		15					Actual rotor speed	PZD2	
						6			14							
						5			13							
						4			12							
						3	11		11							
						2			10							
						1			9							
						0			8							
						7	5		7							
						6			6							
						5			5							
						4			4							
						3	11		3							
						2			2							
						1			1							
						0			0							

Abr.		Description	Value Dez Hex	Bin	Bit	Byte	Word	Value Bin Hex	Dez	Description		Abr.
①	PZD1	Control word	4	4	8	4	15	8E	142	Remote active	③	PZD1
										-		
										-		
										Warning overload		
										Failure counter		
										Pump is rotating		
										Normal operation		
										Parameter accepted		
										-		
										Warning temperature		
										Switch-on lock		
										Deceleration		
										Acceleration		
										Error active		
										Operation enabled		
										-		
										Ready to start		
PZD2	Setpoint rotor speed		0	0	10	5	15	3	800		②	PZD2

It is possible to simultaneously drive the pump and perform parameter operations but we consider these operations separately in the following for the sake of clarity.

Example 1: Starting the pump

The pump was started (PZD1 Bit 0, 10) ① and runs at 800 Hz ② during normal operation ③.

Abr.		Description	Value Dez Hex	Bin	Bit	Byte	Word	Value Bin Hex	Dez	Description		Abr.
①	PZD1	Control word	4	4	8	4	15	8E	142	Remote active	④	PZD1
										-		
										-		
										Warning overload		
										Failure counter		
										Pump is rotating		
										Normal operation		
										Parameter accepted		
										-		
										Warning temperature		
										Switch-on lock		
										Deceleration		
										Acceleration		
										Error active		
										Operation enabled		
										-		
										Ready to start		
②	PZD2	Setpoint rotor speed	700	2	10	5	15	2	700		③	PZD2

Example 2: Setpoint active

The pump is operated with the setpoint active (PZD1 Bit 10,6,0) ①. The frequency is defined in PZD 2 rotor frequency setpoint ②. The pump runs at 700 Hz ③ during normal operation ④.

Example 3:

Read parameter 150

The parameter 150 ①, standby frequency, is read ②.

The requested parameter ③ is sent ④. The standby frequency is 250 Hz ⑤.

Abr.		Description	Value				Byte	Word	Value				Description		Abr.		
			Dez	Hex	Bin	Bit			Dez	Hex	Bin	Bit					
②	Query designator		1	10	0	7	0	0	15	0	0	1	Reply designator	④			
			0	0	6	14			0	0							
	PKE	Parameter number	150	96	4	12			1	Parameter number	PKE						
					0	3			11				0		13	0	
					0	2			10				0		9	0	
					0	1			9				0		8	0	
					0	0			8				0		7	1	
					0	7			7				1		6	0	
					0	6			6				0		5	0	
					0	5			5				0		4	1	
					0	4			4				1		3	0	
					0	3			3				0		2	1	
①	IND	Parameter Index	0	0	2	15	0	IND	Parameter Index	IND							
					0	6	14					0	0				
	Reserved	Reserved	0	0	0	5	13	0	Reserved	Reserved							
					0	4	12	0				0					
					0	3	11	0				9	0				
					0	2	10	0				8	0				
					0	1	9	0				7	0				
					0	0	8	0				6	0				
					0	7	7	0				5	0				
					0	6	6	0				4	0				
					0	5	5	0				3	0				
					0	4	4	0				2	0				
PWE	Parameter value	0	0	4	15	0	250	Parameter value	PWE	⑤							
				0	6	14					0	0					
	PKE	Parameter value	0	0	0	5		13	0		PKE	PKE					
					0	4		12	0					0			
					0	3		11	0					9	0		
					0	2		10	0					8	0		
					0	1		9	0					7	0		
					0	0		8	0					6	0		
					0	7		7	0					5	0		
					0	6		6	0					4	0		
					0	5		5	0					3	0		
					0	4		4	0					2	0		
PWE	Parameter value	0	0	6	15	0	FA	Parameter value									
				0	6	14					0	0					
	IND	Parameter Index	0	0	0	5		13	0		IND	IND					
					0	4		12	0					0			
					0	3		11	0					9	0		
					0	2		10	0					8	0		
					0	1		9	0					7	1		
					0	0		8	0					6	1		
					0	7		7	1					5	1		
					0	6		6	1					4	1		
					0	5		5	1					3	1		
					0	4		4	1					2	0		

Abr.		Description	Value				Word	Value				Description	Abr.			
			Dez	Hex	Bin	Bit		Dez	Hex	Bin	Bit					
①	PKE	Query designator												⑤		
		Res.													Reply designator	
	Parameter number													Parameter number	PKE	④
IND	Parameter Index													Parameter Index	IND	
.	Reserved													Reserved	.	
PWE	Parameter value													Parameter value	PWE	⑥

Example 4:

Write parameter 150

The parameter 150 ① is set ③ to 500 Hz ②.

Writing of the parameter ④ is confirmed by sending ⑤ the new value ⑥.

Caution

The saving process takes a few seconds. It is indicated by a running light on the front LEDs. During the saving process the power supply must not be interrupted.

So that this value is maintained even after having switched off the power, it will have to be saved permanently by writing the parameter 8 to 1.

Example 5:

Reading the error code

The next to last (index number 1)

① error code (parameter 171) ②

is read ③.

The requested error code ④ is sent ⑤. It contains the error message 39, general magnetic bearing fault ⑥.

Abr.	Description	Value				Word	Value				Description	Abr.
		Dez	Hex	Bin	Bit		Dez	Hex	Bin	Bit		
③	Query designator											⑤
	Res.	0	60	0	0	15	0	0	0			
②	Parameter number											④
	Res.	0	171	0	0	14	0	1	0			
①	Parameter Index											IND
	Res.	0	1	0	0	13	0	0	0			
	Reserved											Reserved
	Res.	0	0	0	0	12	0	0	0			
PWE	Parameter value											Parameter value
	Res.	0	0	0	0	11	0	0	0			
												PWE
	Res.	0	0	0	0	10	0	0	0			

Abr.	Description	Value				Word	Description	Abr.
		Dez	Hex	Bin	Bit			
②	Query designator	6	60	0 7	0	15	5	④
				1 6	1	14		
	Res.	0	60	1 5	1	13	0	③
				0 4	0	12		
	PKE	176	B0	0 3	0	11	176	PKE
				0 2	0	10		
				0 1	0	9		
				0 0	0	8		
				1 7	1	7		
				0 6	0	6		
				1 5	1	5		
				1 4	1	4		
				0 3	0	3		
				0 2	0	2		
				0 1	0	1		
				0 0	0	0		
				0 7	0	15		
				0 6	0	14		
				0 5	0	13		
①	Parameter Index	1	1	0 4	2	12	1	③
				0 3	2	11		
	IND	1	1	0 2	1	10	1	IND
				0 1	1	9		
				1 0	1	8		
				0 7	0	7		
				0 6	0	6		
				0 5	0	5		
				0 4	3	4		
				0 3	3	3		
				0 2	0	2		
				0 1	0	1		
				0 0	0	0		
				0 7	0	15		
				0 6	0	14		
				0 5	0	13		
				0 4	0	12		
	Reserved	0	0	0 3	3	11	0	
				0 2	0	10		
	PWE	0	0	0 1	0	9	2792	⑤
				0 0	0	8		
				0 7	0	7		
				0 6	0	6		
				0 5	0	5		
				0 4	0	4		
				0 3	0	3		
				0 2	0	2		
				0 1	0	1		
				0 0	0	0		
				0 7	0	15		
				0 6	0	14		
				0 5	0	13		
				0 4	0	12		
				0 3	0	11		
	Parameter value	0	0	0 2	0	10	0A	
				0 1	0	9		
	PWE	0	0	0 0	0	8	E8	
				0 7	3	7		
				0 6	6	6		
				0 5	5	5		
				0 4	4	4		
				0 3	3	3		
				0 2	2	2		
				0 1	1	1		
				0 0	0	0		
				0 7	0	15		
				0 6	0	14		
				0 5	0	13		
				0 4	0	12		
				0 3	0	11		
				0 2	0	10		

Example 6: Reading out the number of pump operating hours in the event of a malfunction

The number of pump operating hours related to the preceding example (parameter 176) ① is read ②.

The requested parameter ③ is sent ④. It contains the number of pump operating hours at the point of time the error 27,92 h ⑤ has occurred.



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