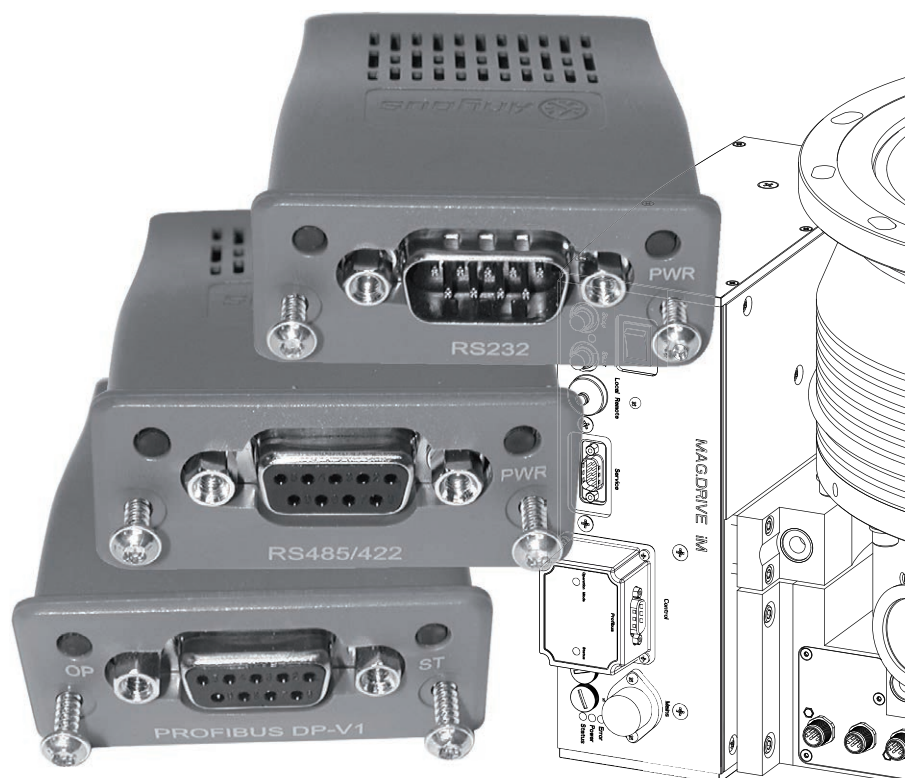


# Serial Interfaces for MAG integra

RS 232, RS 485, Profibus

Operating Instructions 300336926\_002\_C0



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Original installation and operating instructions.

# Safety Information

## 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 iM with serial 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.

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.

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## NOTICE



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## DANGER



---

## WARNING



---

## CAUTION



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## NOTICE



# Description RS 232, RS 485



Fig. 1.1 Interface modules

## 1 Description

### 1.1 Description of the RS 232 and RS 485 Interfaces

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

In the case of word data (16 or 32 bits long) the high byte is transferred first (Motorola standard).

#### LED PWR (Power)

State	Indication
Off	no power
Green	power on

# Description RS 232, RS 485

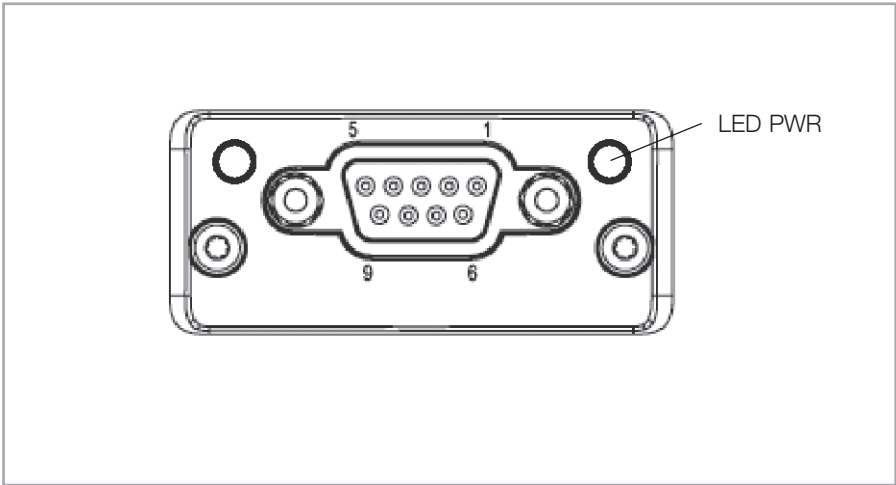
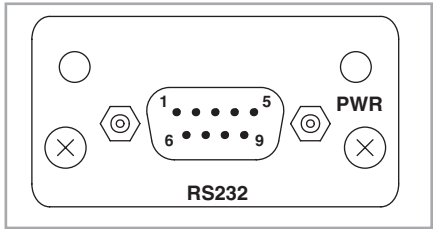


Fig. 1.2 Front

## Technical Data RS 232

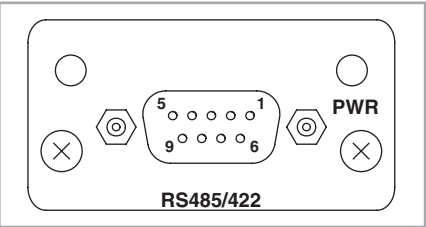
The module is designed as a DTE (Data Terminal Equipment, i.e. in order to connect the module another DTE such as a computer, a crossover cable must be used (0-Modem)

Pin	Signal	Description
1	–	
1	–	
2	RxD	RS 232 level receive data input
3	TxD	RS 232 level transmit data output
4	–	
5	GND	Signal ground
6	–	
7	RTS	Request to send
8/9	–	
Housing	Shield	Cable shield



Max. cable length	10 m
Baud rate	19200 Baud
Address range	–
Voltage level	see standards
Interface connection	Sub-D 9-way socket (male)

# Description RS 232, RS 485



## Technical Data RS 485 / 422

Pin	RS 422 Mode	RS 485 Mode
1	+ 5 V termination power (isolated)	+ 5 V termination power (isolated)
2/3	–	–
4	Mode select: Connect to GND (Pin 5) for RS 422	Mode select: NC for RS 485
5	GND Isolated signal ground	GND Isolated signal ground
6	RxD inverted (Internally terminated (100 Ω) Receive data line	–
7	RxD (Internally terminated (100 Ω) Receive data line	–
8	TxD inverted Transmit data line	RxD/TxD inverted Bidirectional data line
9	TxD Transmit data line	RxD/TxD Bidirectional data line
Housing	Cable shield	Cable shield

Max. cable length 100 m

Baud rate  
19200 Baud

Address range 0 bis 31

Default address 0

Voltage level see standards

Interface connection Sub-D 9-way socket (female)



Fig. 1.3 Profibus module

## 1.2 Description of the Profibus Interface

In a Profibus DP system, 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 iS is a slave unit and thus responds to requests from the master, and supplies data exclusively after having received a request to do so from the master.

For more information on the Profibus system:  
"The New Rapid Way to Profibus DP",  
Manfred Popp, Profibus Nutzerorganisation e.V.  
Haid-und-Neu-Str. 7  
D-76131 Karlsruhe, Germany  
P/N 4.072  
[www.profibus.com](http://www.profibus.com)

At both ends of the bus a terminating resistor is required. Such a terminator must be incorporated in an external plug. The connections for this plug are provided through the interface connector. For this also see the standards.

### Standards

Profibus DP V0 corresponding to IEC 61158-2 and IEC 61784 Type 3

Profibus DP V1 corresponding to IEC61158-8 (not supported)

### Protocol

In accordance with Profidrive profile

In the case of word data (16 or 32 bit word length) , the high bit is transmitted first (Motorola standard).

# Description Profibus

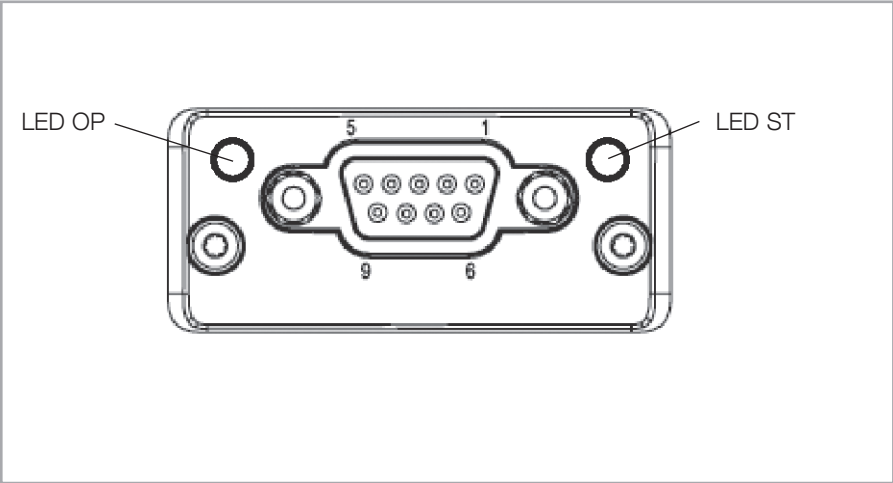


Fig. 1.4 Front

### LED OP (Operation Mode)

State	Indication
Off	Not online, no power
Green	online, data exchange
Flashing green	online, clear
Flashing red (1 flash)	Parametrization error
Flashing red (2 flashes)	Profibus configuration error

### LED ST (Status)

State	Indication	Comment
Aus Off	keine Spannung, nicht initialisiert no power or not initialised	Anybus-Zustand = Anybus state = SETUP or NW_INIT
Green	Initialised	Anybus module has left the NW_INIT state
Flashing green	Initialised, diagnostic event(s) present	Extended diagnostic bit is set
Red	Exception error	Anybus state = EXCEPTION



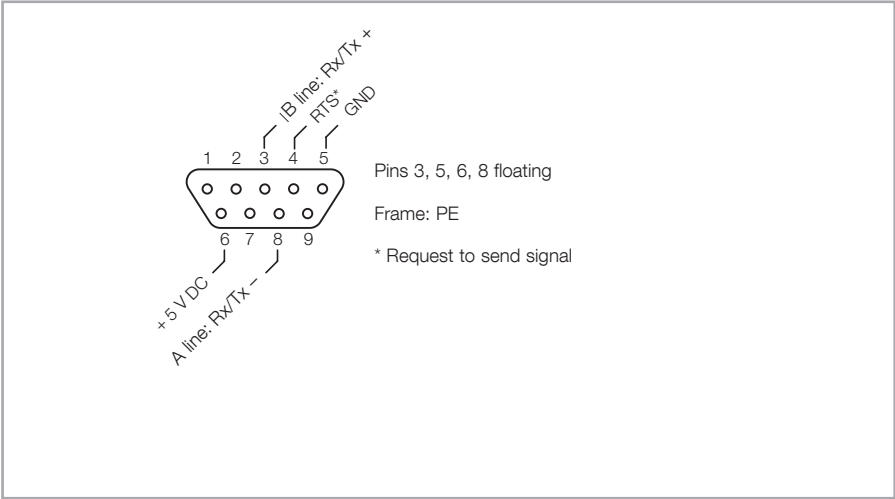


Fig. 1.5 Pin assignment for the socket

**Transmission rates and cable lengths**  
(see also the standards)

Transmission rate (kBit/s)	max. segment length (m)
9.6 –93.75	1200
187.5	1000
500	400
1500	200
3000 - 12000	100

The baud rate is set automatically. The following baud rates are supported:

9.6 k Baud	19.2 k Baud	4.45 k Baud	
93.75 k Baud	187.5 k Baud	500 k Baud	
1.5 M Baud	3 M Baud	6 M Baud	12 M Baud

Address range	0 to 125
Voltage level	see standards
Interface connection	Sub-D 9-way socket (female))

## 2 Start-up

### Connection

---

**NOTICE**

Before making any connections, switch the pump off and wait until it turns no longer. Then deenergise the frequency converter.

### RS 232, RS 485

Connect the interface connector on the front of the frequency converter.

### Address Setup RS 485

The saving process takes a few seconds. It is indicated by a running light on the front LEDs.

---

**NOTICE**

During the saving process the power supply must not be interrupted.

Parameterisation through the serial service interface (typically RS 232).

For this, set parameter 254 to the desired address.

Permanently save the setting, by setting parameter 8 to 1.

Then switch the pump off (Caution: shut down the pump; wait for it to stop), switch off the supply voltage and switch on again.

## Profibus

Connect the Profibus to the Profibus interface connector on the front of the frequency converter (Control). Both bus ends must be terminated. This must be done externally using a special plug. The connections required for this are provided in the interface connector.

Line type	Profibus standard line
P/N (Siemens)	6XV1830-0EH10
Default Bus address:	126

## Address Setup for Profibus

Profibus DP provides for a maximum of 126 possible addresses whereby the addresses 1 to 125 are defined.

Address 126 is typically used for configuration settings and does not represent a valid address for cyclic data traffic. Addresses 01 and 02 are reserved for the Profibus master.

The address for the MAG Integra can be set up in three different ways. Here the address for the turbomolecular pump should be in the range of 03hex to 7Ehex (7Ehex = 126dec).

- Setting through the Profibus service
- Setting through hardware address switches
- Setting through USS parameters

### 1. Address setting through the Profibus bus service:

When the slave has the bus address 126 (this being the default for parameter 918 and the default for the address switch setting) then the bus address can be changed through the standard Profibus bus service SAP 0x37 (Set\_Slave\_Add). The changed address setting is saved without further measures in the interface module. A saving process as detailed in Section 3 below is not necessary. The value of parameter 924 is not relevant. Decisive here is the value 126 for the parameter 918 respectively the default setting (126) of the address switches.

### 2. Address setting through the hardware address switches:

Upon delivery of the instrumentation both address switches have been set to bus address 126.

Both switches are hex coded. For setting the address 126 the corresponding setting 7E i.e. (set switch x10 to 7 and switch x1 to E) must be made.

So that the address setting through the address switches remains effective after powering up, parameter 924 must be set to 2. This is also the default for this parameter upon delivery of the versions which provide a Profibus.

If in the course of first-time commissioning the setting shall be provided through the address switches, then it will suffice to set up the desired address. After powering up, the desired bus address will then be effective.

### 3. Address setting through the parameter 918 via the service interface (RS 232):

Here the address setting is saved to the pump's memory and not to the interface module. The value for the bus address is defined through parameter 918. The default upon delivery for this parameter is 126.

If the address setting shall be defined through the value of parameter 918, then first the value for parameter 924 must be set to 1, and thereafter the desired value for the bus address must be written to parameter 918. Finally this setting needs to be saved permanently in the pump's memory.

This should only be done with the pump at standstill. By setting parameter 8 to 1, save the setting permanently. The saving process takes a few seconds. It is apparent through a running light on the front LEDs. During the saving process, the power supply must not be interrupted.

With the pump at standstill disconnect the system from the mains power side and then switch it on again. After a reinitialisation, the changed bus address will then be available.

The change to parameter 918 is effected only in connection with the reinitialisation after switching on the mains power once more.

# Telegram RS 232, RS 485

## 3 Description of the Telegram

### 3.1 Telegram for RS 232 and RS 485

#### Structure of the complete data string in accordance with USS protocol specification

Byte NO.	Abbreviation	Description	Read access to frequency converter	Write access to frequency converter	Response from the frequency converter
0	STX	Start byte	2		
1	LGE	Length of the payload data block in bytes (bytes 3 to 22) + 2: 22	22		
2	ADR	Frequency converter address	RS232: 0 RS485: 0...31		
3-4	PKE	Parameter number and type of access	Value (s. 4.1)		
5	-	Reserved	0		
6	IND	Parameter index	Value (s. 4.1)		
7-10	PWE	Parameter value	0	Value	Value
11-12	PZD1 STW, ZSW	Status and control bits	Value (see 4.3 / 4.4)		
13-14	PZD2, HSW HIW, (MSW)	Current stator frequency (= P3)	0	0	Value (Hz)
15-16	PZD3, HSW HIW, (LSW)	Current frequency converter temperature (= P11)	0	0	Value (°C)
17-18	PZD4	Current motor current (= P5)	0	0	Value (0.1 A)
19-20	-	Reserved	0	0	0
21-22	PZD6	Current intermediate circuit voltage (=P4)	0	0	Value (0.1 V)
23	BCC	Recursive calculation: Checksum (i = 0) = byte (i = 0) Checksum (i) = checksum (i-1) XOR byte (i); i from 1 to 22, i = byte No.	Checksum (i=22)		

Payload data block for  
RS 232 and RS 485

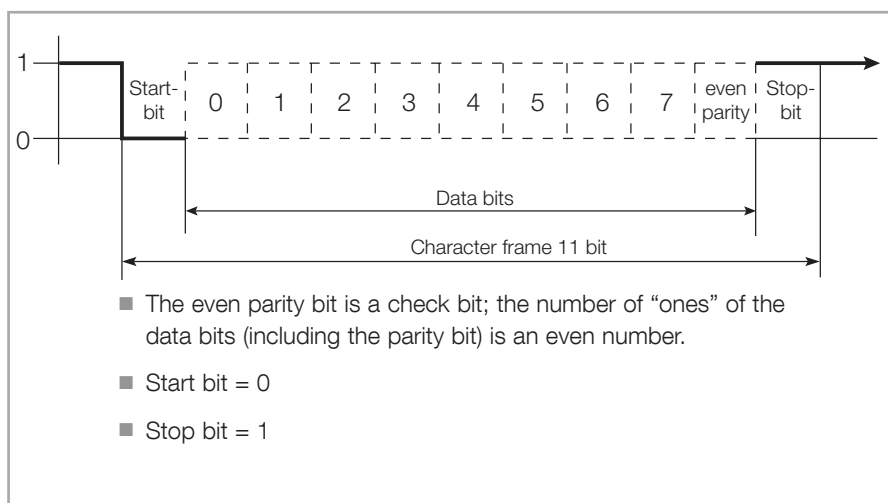


Fig. 3.1 Structure of a data frame for transferring a string byte

# Telegram Profibus

## 3.2 Telegram for Profibus

Two types of protocol (PPO types) have been implemented. In the following only the payload data are described. Data which serve communication purposes (data link layer, layer 2 acc. to OSI, for example, start byte and addressing etc.) are processed automatically in the background by the Profibus.

### PPO Type 1

Length of the payload data block: 6 words = 12 bytes

Designator = 0xF3, 0xF1

Byte No.	Abbreviation	Description	Read access to frequency converter	Write access to frequency converter	Response from the frequency converter
0-1	PKE	Parameter number and type of access	Value (s. 4.1)		
2	IND	Parameter index	Value (s. 4.1)		
3	–	reserved	0		
4-7	PWE	Parameter value	0	Value	Value
8-9	PZD1: ZSW STW	Status and control bits	Value (s. 4.3/4.4)		
10-11	PZD2: HIW HSW	Current rotor frequency (= P3)	0	0	Value (Hz)

### PPO Type 6

Length of the payload data block: 1 word = 2 byte identifier = 0x00, 0xF0

Byte No.	Abbreviation	Description	Read access to frequency converter	Write access to frequency converter	Response from the frequency converter
0-1	PZD1: ZSW STW	Status and control bits	Value (s. 4.3/4.4)		

### GSD File

Documented in the GSD file are the parameters of the Profibus DP interface. The file format has been defined in the standard so that project tools from different manufacturers can be used. The current GSD file can be downloaded from the Leybold homepage or is available upon request.

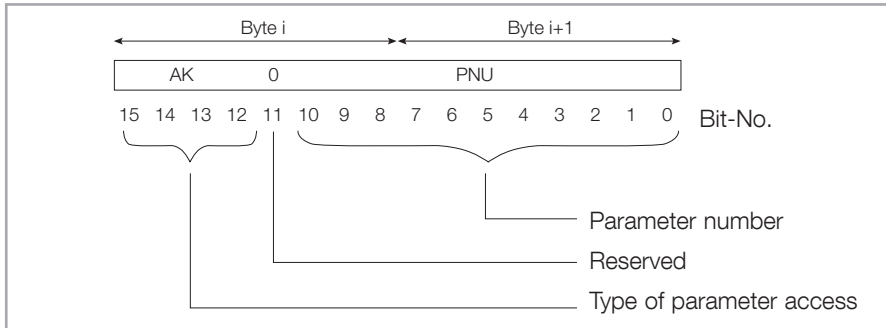


Fig. 4.1 Structure of the parameter section

## 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 number					Bit number				
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
					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.

# PKE, IND, Bits

Fault detection	Description
0	impermissible parameter number
1	parameter cannot be changed
2	min./max. restriction
18	all other errors

## 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	Remark
0	*System Start/Stop	Value = 1 pump drive start Value = 0 pump drive stop (Start impossible if Bit 7 = 1; means Reset active)
1	Request to run shaking process	Value = 0 Do not shake Value = 1 Shake A detected change from 0 to 1 initiates the request. This function has been implemented only for some MAG models. Before using this function please consult Leybold first.
2 to 5	No function	
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	No function	
10	*Enable Process Data ( Bit 0,6,7,8, 11, 12 )	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 to 15	No function	

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

\*\* The purge gas supply must be switched on for venting to function

# PKE, IND, Bits

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

(Is sent together with each response from the frequency converter)

PZD1 Bit	Interpretation	Note
0	Ready to run	Bit 0 will be set after initialization of the system, if there is no failure pending.
1	Shaking status	Value = 0 Currently no shaking is in progress. Value = 1 Currently shaking is in progress. The duration of an active shaking process amounts to approximately 2 seconds. After shaking has been completed, the bit is reset to 0 again. In order to allow more time for a possible evaluation, the bit is reset after approximately 5 seconds irrespectively of the real shaking duration. This function has been implemented only for some MAG models.
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	No function	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	Collective warning	Bit 14 is set, if a warning is existent
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

## 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.

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
1	Pump unit identifier	100	300	211		r	u16	211=MAG.DRIVE M/iM; (Vers. 101, 22. Oct. 2010, R.Nawroth)
2	Software version xxx.yy.zz	8010000	8015500	2147483647		r	i32	xxx.yy: Version, zz: Correction index
3	Actual frequency	0	650	0	rps	r	u16	Actual value of the rotor frequency.
4	Actual intermediate circuit voltage	0	1000		0,1 V	r	u16	Actual intermediate circuit voltage of the converter.
5	Actual current	0	100	0	0,1 A	r	u16	Actual motor current
7	Actual motor temperatur	0	150	0	°C	r	u16	Actual value of the motor temperature.
8	Save data command	-1	100000	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 warning threshold	5	250	80	°C	r	u16	Exceeding the motor temperature warning threshold results in a warning.
17	Nominal motor current	0	200	18	0,1 A	r	u16	Maximum permissible motor current
18	Maximum frequency	0	650		Hz	r	u16	Highest permissible frequency
19	Minimum frequency	0	650	230	Hz	r	u16	Lowest permissible frequency
20	Critical frequency	0	650	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 acceds a certain time.
23	Pump type	200	400	200		r	u16	Code no. of the connected turbo pump: 330=MAG 1300 360=MAG 1600 390=MAG 2000
24	Setpoint frequency	0	650		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 (P24xP25) 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.
44	Pump operating hours	0		0	0,01 h	r	i32	Counter of total operating hours of the pump. 2147483647
45	Maximum type frequency	0	1200	980	Hz	r	i16	Maximum type depending pump frequency. Highest usable frequency of this pump type.

# Parameter list

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
50	Pump catalog no.	0		0 2147483647		r	i32	Last 9 digits of the pump's catalog number.
52	Pump serial no.	0		0 2147483647		r	i32	Last 9 digits of the pump's serial number.
54	Date of manufacturing	0		0 2147483647		r	i32	Manufacturing date of the pump [DDMMYY].
56	Date of last service	0		0 2147483647		r	i32	Last service date of the pump [DDMMYY].
60	Last service operating hours	0		0 2147483647	0,01 h	r	i32	Number of operating hours at the last service event.
62	Date of last repair	0		0 2147483647		r	i32	Last repair date of the pump [DDMMYY].
66	Last repair operation hours	0		0 2147483647	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 ring touch downs	0		0 2147483647	0,01 s	r	i32	Actual total amount of time during recognized bearing touch downs.
109	Max. no. of touch downs of MB touch downs	0	65535	1000		r	u16	Maximum number of touch downs until warning or error indication.
110	Max. amount of touch down time	0		360000 2147483647	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	80	°C	r	u16	Warning level of the bearing temperature.
131	Bearing temperature error threshold	10	250	85	°C	r	u16	Error level of the bearing temperature.
133	Motor temperature error threshold	10	250	90	°C	r	u16	Error level of the motor temperature.
143	Actual motor voltage	-4000	4000	0	0,1 V	r	i16	Actual motor rms coil voltage.
144	Run-up cycles warning threshold	0		27000 65535		r	u16	Warning level of start cycle numbers.
145	Run-up cycles error threshold	0		30000 65535		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.

# Parameter list

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
150	Stand-by frequency	0	650	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 according section of the manual for the error codes. (Field value 0 ... 39)
174	Error rotor frequency	0	650	0		r	u16	Actual speed, when error occurred. Access analogously as for parameter 171. (Field value 0 ... 39)
176	Error operating hours	0	2147483647	0		r	i32	Pump operating hours, when error occurred. Access analogously as for parameter 171. (Field value 0 ... 39)
181	Fieldbus 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	USS 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.

# Parameter list

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
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 according section of the manual for meaning. 0=Pump Motor Temperature Too high 1=Converter Housing Temperature Too High 2=Bearing Temperature Too High 3=n/a 4=n/a 5=n/a 6=Over speed 7=n/a 8=n/a 9=n/a 10=MAG Unbalance at the Upper Bearing 11=MAG Unbalance at the Lower Bearing 12=MAG Oscillation at the Axial Bearing 13=n/a 14=n/a 15=n/a
228	Warning bits 2	0	65535	0		r	u16	Active warnings described bit per bit. See according section of the manual for meaning. 0=n/a 1=n/a 2=n/a 3=n/a 4=n/a 5=n/a 6=n/a 7=n/a 8=n/a 9=n/a 10=n/a 11=Magnetic Bearing has not Lifted 12=MAG Bearing Overload (Level 1) 13=Converter Power Stage Temperature Too High 14=n/a 15=n/a
230	Warning bits 3	0	65535	0		r	u16	Active warnings described bit per bit. See according section of the manual for meaning. 0=n/a 1=n/a 2=n/a 3=n/a 4=MAG Bearing Overload (Level 2) 5=Max. Number of Pump Runup Cycles are reached 6=Max. Number of Pump Operation Hours are reached 7=n/a 8=High load 9=MAG Bearing Overload Z-Axis 10=n/a

# Parameter list

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
								11=Overload 12=MAG Radial Bearing Displacement 13=n/a 14=Supply Voltage Too High or Too Low 15=Motor Start Locked
232	Warning bits 4	0	65535	0	:BIN	r	u16	Detailed MAG bearing conditions 0=MAG Bearing Overload 0 1=MAG Bearing Overload 1 2=MAG Bearing Overload 2 3=MAG Bearing Overload 3 4=MAG Bearing Overload 4 Z-Axis 5=MAG Bearing Overload 5 6=MAG Bearing Overload 6 7=n/a 8=MAG Upper Radial Bearing Displacement X1 9=MAG Upper Radial Bearing Displacement Y1 10=MAG Lower Radial Bearing Displacement X2 11=MAG Lower Bearing Radial Displacement Y2 12=MAG Axial Bearing Displacement Z 13=High Number of Auxiliary Bearing Impacts 14=High Amount of Cumulated Bearing Touch Down Time 15=High No. of Touch Down Bearing Run Downs
233	Warning bits 5	0	65535	0		r	u16	Active warnings described bit per bit. See according section of the manual for meaning. 0=Warning Flange Temperature 1=Warning Temperature power stage bearing electronic 2=Warning Shaking required 3=n/a 4=n/a 5=n/a 6=n/a 7=n/a 8=n/a 9=n/a 10=n/a 11=n/a 12=n/a 13=n/a 14=n/a 15=n/a
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
257	Current process data instance for EtherNet IP, DeviceNet and EtherCat	**	**	257(0): 100 257(1): 101	-	r/w	u16	Array (0,1) Index 0: EtherNet = Input Assembly Instance DeviceNet = Input Assembly Instance EtherCat = TxPDO mapping Index 1: EtherNet = Output Assembly Instance DeviceNet = Output Assembly Instance EtherCat = RxPDO mapping  ** Range of values depends on the type of bus system installed. Further details see Operating Instructions for the respective bus adapters.
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	650	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	
303	Actual operating status	0	65535	0		r	i32	Active status described bit per bit.. 0=Normal operation 1=Ready for switch on 2=Speed is increasing 3=Speed is dropping 4=Generator operation 5=Stand-by 6=n/a 7=n/a
312	Catalog no. of converter	0	255	0		r	u16	Catalog no. of converter (Field value 0 ... 10)
315	Serial no. of converter	0	255	0		r	u16	Serial no. of converter (Field value 0 ... 10)
343	Acceleration current	0	200	18		r	u16	Motor current setpoint during acceleration
346	START/STOP buttons interlock	0	1	0		r/w	u16	0=START/STOP buttons unlocked 1=START/STOP buttons interlocked
350	Catalog number of pump	0	127	0		r	u16	Catalogue number of the pump. One ASCII char per index. (Field value 0 ... 18)
354	Dataset of pump	0	127	0		r	u16	Dataset revision no. of the Pump Code memory (Field value 0 ... 28)
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		r	u16	Pump description; ASCII sequence (Field value 0 ... 18)



# Parameter list

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
749	Shaking routine status	0	255	-	-	R	U8	Bit encoded
								This function has been implemented only for some MAG models. Before using this function please consult Leybold first.
								0    0 = shaking time monitoring not active 1    1 = shaking time monitoring is active
								1    0 = current rotational speed > 5 Hz 1    1 = current rotational speed < 5 Hz
								2    Limit current shaking process  0 = currently the shaking process was run already twice. The number of possible shaking runs is only increased to the value of 2 when restarting the pump again and after the pump has attained its nominal speed.  Bit not set means: remaining number of shaking runs = 0  1 = shaking limit (2 runs) has currently not yet been made use of  Bit set means: remaining number of shaking runs = 1 or 2.
								3    0 = installation orientation not correct for active shaking. 1    1 = installation orientation is correct for active shaking.
								4    0 = rotor has not lifted 1    1 = rotor is suspended
								5    0 = no shake warning is pending 1    1 = shake warning is pending (operating hours time span until shake warning has been reached)
								6    0 = conditions for shaking (bit 0 to 4 = 1) are <b>not</b> fulfilled 1    1 = conditions and for shaking (bit 0 to 4 = 1) are fulfilled
								7-15 Not used

# Parameter list

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
750	Shake warning operating hours	0		-	0.01h	r	I32	When the number of hours reaches the limit (parameter 751) and when the warning has been enabled (parameter 756), a warning is initiated.
		2147483647						
751	Shake warning threshold	0	65535	4000	h	r	U16	Number of operating hours after which a shake warning is initiated provided the function (parameter 756) has been enabled.
752	Number of shake runs	0	65535	-	-	r	U16	Number of shaking runs performed so far
754	Shake runs operating hours	0		-	0.01h	r	I32	Indexed parameter with the 10 most recent points in time (operating hours) of shaking runs (field parameter 0-9) (for internal Leybold purposes)
		2147483647						
755	Index (0-9) of the shaking routine	0	65535	-	-	r	U16	Index pointer for parameter 754. (for internal Leybold purposes).
756	Shake warning	0	256	1	-	r	U16	0 = warning disabled 1 = warning enabled
757	Request shake run	0	256	0	-	w	U16	0 = no action selected 1 = initiate shaking 2 = reset operating hours counter for shake warning 3 = reset status message after erroneous shaking start  This function has been implemented only for some MAG models. Before using this function please consult Leybold first.
758	Installation orientation detection	-32768			mA	r	U16	Current limit of the axial bearing for detecting the installation orientation of the pump
		32767						

# Parameter list

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
759	Baud rate setpoint Device Net	0	4	0	-	r/w	u16	Default value for the baud rate for Device Net Interface. Permissible values 0 = 125 kBaud 1 = 250 kBaud 2 = 500 kBaud 3 = not permissible 4 = for enabling the setting from the bus side
760	Setpoint for the MAC ID for Device Net Interface	0	64	63	-	r/w	u16	Default for the address setting for Device Net Interface. 0-63 valid address for MAC ID 64 = for enabling the address setting from the bus side
764	Current mains side	0	65535		0,001 A	r	u16	Current mains side
767	Version communication profile	0	999		0,01	r	u16	Version communication profile
772	Additional index for data version PK Data Set	0	99	0		r	u16	
774	DC Voltage on Valve Outputs	0	65535		0,1 V	r	u16	
775	Error Code memory Safety System	0	31			r	u16	(Field value 0 ... 7)
776	Error Code memory Safety System	0	31			r	u16	(Field value 0 ... 7)
777	Error Code memory Safety System	0	65535			r	u16	(Field value 0 ... 7)
778	Installed motortype	0	1			r	u16	0=Beta Stand 1=Series Stand
779	Maximum braking current	-500	0	85	0,01 A	r	i16	Maximum motor current during braking
780	Alarm temperature power stage bearing electronic	0	65535	85	°C	r	u16	
781	Warnign temperature power stage bearing electronic	0	65535	80	°C	r	u16	Warning temperature power stage bearing board (heat sink bearing board)
782	Maximum overload time	0	65535	420	s	r	u16	Maximum allowed time in overload condition
783	Maximum highload time	0	65535	420	s	r	u16	Maximum allowed time in highload condition
786	Alarm temperature converter ( heat sink power stage )	5	100		°C	r	u16	Alarm level heat sink temperature converter (heat sink power stage)
787	Alarm temperature converter (air temperature inside)	5	100		°C	r	u16	Alarm temperature converter (air temperature inside)
796	Revision control board	0	256			r	u16	Revision control board 1054.023.x
797	Variant control board	0	256			r	u16	Variant control board 1054.023.x
798	Revision transfer board	0	256			r	u16	Revision transfer board 1054.083.x
799	Revision power board	0	256			r	u16	Revision power board 1054.013.x

# 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 (Field value 0 ... 4)
804	Supply voltage	0	65535	0	0,1 V	r	u16	Actual supply voltage at the AC connector.
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
824	Preselect Output X200	0	199	7		r/w	u16	Selects the behavior of the 24 volt PK auxiliary X200 0=OFF: always deactive 1=ERR: failure 2=/ERR: no failure 3=WARN: warning 4=/WARN: no warning 5=NRF: at speed 6=/NRF: not at speed 7=ROT: motor rotates (as of rotation speed 10-20 Hz) 8=/ROT: motor does not rotate (as of rotation speed 20-10 Hz) 9=REF: reference speed reached 10=WUV: warning supply voltage low 11=WOV: warning supply voltage high 12=WOTM: warning motor temperature high 13=WOTI: warning converter temp. power stage 14=WOTD: warning converter temp. air inside 15=WOTB: warning pump bearing temperature 16=WLS: warning pump speed too high 17=WIT: warning pump motor overload 18=BUS: serial interface controlled 19=ON: always active 20=DE: RS485 transmit/receive control 21=VALVE: vent valve option 22=Purge Valve OFF 23=Purge Valve ON 24=Venting Valve OFF 25=Venting Valve ON 26=Cooling Valve OFF 27=Cooling Valve ON

# Parameter list

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
825	Preselect Output X201	0	199	24		r/w	u16	<p>Selects the behavior of the 24 volt PK auxiliary X201</p> <p>0=OFF: always deactive</p> <p>1=ERR: failure</p> <p>2=/ERR: no failure</p> <p>3=WARN: warning</p> <p>4=/WARN: no warning</p> <p>5=NRF: at speed</p> <p>6=/NRF: not at speed</p> <p>7=ROT: motor rotates</p> <p>(as of rotation speed 10-20 Hz)</p> <p>8=/ROT: motor does not rotate</p> <p>(as of rotation speed 20-10 Hz)</p> <p>9=REF: reference speed reached</p> <p>10=WUV: warning supply voltage low</p> <p>11=WOV: warning supply voltage high</p> <p>12=WOTM: warning motor temperature high</p> <p>13=WOTI: warning converter temp. power stage</p> <p>14=WOTD: warning converter temp. air inside</p> <p>15=WOTB: warning pump bearing temperature</p> <p>16=WLS: warning pump speed too high</p> <p>17=WIT: warning pump motor overload</p> <p>18=BUS: serial interface controlled</p> <p>19=ON: always active</p> <p>20=DE: RS485 transmit/receive control</p> <p>21=VALVE: vent valve option</p> <p>22=Purge Valve OFF</p> <p>23=Purge Valve ON</p> <p>24=Venting Valve OFF</p> <p>25=Venting Valve ON</p> <p>26=Cooling Valve OFF</p> <p>27=Cooling Valve ON</p>

# Parameter list

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
826	Preselect Output X202	0	199	23	:ORD	r/w	u16	<p>Selects the behavior of the 24 volt PK auxiliary X202</p> <p>0=OFF: always deactive</p> <p>1=ERR: failure</p> <p>2=/ERR: no failure</p> <p>3=WARN: warning</p> <p>4=/WARN: no warning</p> <p>5=NRF: at speed</p> <p>6=/NRF: not at speed</p> <p>7=ROT: motor rotates</p> <p>(as of rotation speed 10-20 Hz)</p> <p>8=/ROT: motor does not rotate</p> <p>(as of rotation speed 20-10 Hz)</p> <p>9=REF: reference speed reached</p> <p>10=WUV: warning supply voltage low</p> <p>11=WOV: warning supply voltage high</p> <p>12=WOTM: warning motor temperature high</p> <p>13=WOTI: warning converter temp. power stage</p> <p>14=WOTD: warning converter temp. air inside</p> <p>15=WOTB: warning pump bearing temperature</p> <p>16=WLS: warning pump speed too high</p> <p>17=WIT: warning pump motor overload</p> <p>18=BUS: serial interface controlled</p> <p>19=ON: always active</p> <p>20=DE: RS485 transmit/receive control</p> <p>21=VALVE: vent valve option</p> <p>22=Purge Valve OFF</p> <p>23=Purge Valve ON</p> <p>24=Venting Valve OFF</p> <p>25=Venting Valve ON</p> <p>26=Cooling Valve OFF</p> <p>27=Cooling Valve ON</p>

# Parameter list

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
827	Master select Output X200	0	2	0		r/w	u16	Temporary Master Select 24V PK Output X200 0=Auswahl entsprechend P824 1=ON 2=OFF
828	Master select Output X201	0	2	0		r/w	u16	Temporary Master Select 24V PK Output X201 0=Auswahl entsprechend P825 1=ON 2=OFF
829	Master select Output X202	0	2	0		r/w	u16	Temporary Master Select 24V PK Output X202 0=Auswahl entsprechend P826 1=ON 2=OFF
833	Temperature power stage bearing board	0	150	0	°C	r	u16	Actual temperature power stage bearing board.
848	Profile adapter version	0	65535			r	u16	Version of the Profibus/US\$ Profile Adapter. (Field value 0 ... 9)
834	Flange temperature	0	150	0	°C	r	u16	Actual temperature of the basic flange.
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.
880	Flange temperature warning threshold	10	250	37	°C	r	u16	Warning level of the flange temperature.
881	Flange temperature error threshold	10	250	40	°C	r	u16	Error level of the flange temperature.
882	Warning temperature converter (heat sink power stage)	5	100	80	°C	r	u16	Warning level heat sink temperature converter.
883	Warning temperature converter (air temperature inside)	5	100	80	°C	r	u16	Warning temperature converter (air temperature inside)
918	Parameter default for the bus address for Profibus	0	65535	126		r/w	u16	Parameter for setting the bus address. 1 to 126 are permissible addresses for the Profibus.
923	Active bus address	0*	65535*	*		r	u16	Effective bus address * Range of values depends on the type of bus system installed
924	Source for the bus address default	0	2	2		r/w	u16	0 = setting the value via the bus side 1 = setting through parameter 918 2 = setting the corresponding value through the address switches on the unit. The above setting applies when using the Profibus interface. For other bus adapters the information given in the respective manual applies.

# 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	Motor temperature error	The motor temperature has exceeded the error threshold.	Forevacuum pressure too high, gas flow too high, defective fan, Water cooling switched off.	Check ultimate pressure of the forevacuum pump and if required install a larger forevacuum pump. Seal off leak, check process. Replace fan. Switch water cooling on.
3	Supply voltage failure	Intermediate circuit voltage is too low or maximum generator operating mode duration exceeded.	Mains supply voltage is too low. Mains voltage has failed.	Check voltage at the mains feed point. Remedy mains power failure.
4	Converter temperature failure	Overtemperature at the power output stage or inside the frequency converter.	Ambient temperature too high. Inadequate cooling owing to cooling water which is too warm.	Do not exceed the maximum ambient temperature of 45 °C. Improve cooling, comply with specified cooling water temperature and cooling water quantity.
5	Overload failure	Rotational speed has dropped below the minimum speed.	Forevacuum pressure is too high. Gas flow is too high.	Check ultimate of the forevacuum pump and if required install a larger forevacuum pump. Seal off leak, check process.
6	Run-up failure	Pump has not attained its normal operating frequency after the maximum run-up time has elapsed.	Forevacuum pressure is too high. Gas flow is too high.	Check ultimate pressure of the forevacuum pump and if required install a larger forevacuum pump. Seal off leak, check process.
7	Run-up time failure	Maximum permissible bearing temperature was exceeded.	Forevacuum pressure is too high. Gas flow is too high.	Check ultimate pressure of the forevacuum pump and if required install a larger forevacuum pump. Seal off leak. Check process.
9	Bearing temperature failure	Maximum permissible bearing temperature was exceeded.	Forevacuum pressure is too high. Gas flow is too high. Water cooling switched off. Water cooling disabled or cooling water throughput or cooling water temperature inadequate.	Check ultimate pressure of the forevacuum pump and if required install a larger forevacuum pump. Seal off leak. Replace fan. Ensure sufficient water cooling.
12	Orbit monitoring, level XY1	Deflection of the rotor at the radial magnetic bearing on the high vacuum side is too high.	Mechanical impacts, possibly through maintenance work. Cross influences of vibrations between several pumps. Vibration influences through external exciting. Balancing condition of the rotor insufficient due to deposits or wear.	Remove external influences. Should the error still occur inform Leybold Service; have the pump replaced.



# Error memory

Error code	Designation	Description	Possible cause	Remedy
13	Orbit monitoring, level XY2	Deflection of the rotor at the radial magnetic bearing on the forevacuum side is too high.	Mechanical impacts, possibly through maintenance work. Cross influences of vibrations between several pumps. Vibration influences through external exciting. Balancing condition of the rotor insufficient due to deposits or wear.	Remove external influences. Should the error still occur inform Leybold Service; have the pump replaced.
14	Axial orbit monitoring	Deflection of the rotor at the axial bearing is too high.	Venting gas flow is too high, mechanical impacts, possibly through maintenance work. Cross influences of vibrations between several pumps. Vibration influences through external exciting.	Remove external influences. Should the error still occur inform Leybold Service; have the pump replaced.
16	Overload duration failure	After having attained its normal operating frequency the pump was operated for a longer period of time below its normal operating frequency.	Forevacuum pressure too high. Gas flow too high.	Check ultimate pressure of the forevacuum pump and if required install a larger forevacuum pump. Seal off leak. Check process.
17	Motor current failure	Motor current below setpoint current.	With start command being present: frequency converter not properly connected to the pump or damaged connector between pump and frequency converter. Internal fault within the frequency converter.	Inform Leybold Service; have connectors and if required the cable checked. Have the converter replaced.
19	Passthrough time failure	The pump did not attain its minimum speed within the maximum passthrough time.	Forevacuum pressure too high when starting the system. Seized rotor.	Reduce forevacuum pressure. Check to ensure that the rotor rotates freely.
26	Bearing temperature sensor failure	Bearing temperature sensor is defective.	Component is defective, sensor short-circuit or interruption.	Inform Leybold Service. If required have converter respectively pump replaced.
28	Motor temperature sensor failure	Motor temperature sensor is defective.	Component is defective, sensor short-circuit or interruption.	Inform Leybold Service. If required have converter respectively pump replaced.
31	High load duration failure	Motor current has exceeded the warning threshold too long (time span defined through parameter "Overload time 2").	Forevacuum pressure is too high. Gas flow is too high.	Check ultimate pressure of the forevacuum pump and if required install a larger forevacuum pump. Seal off leak. Check process conditions.
39	Magnetic bearing start-up failure	Magnetic bearing is not able to lift the rotor properly.	Pump was shock vented. Excessively high vibrations or mechanical impacts from the system. Vibration influences between several pumps.	Refer to the pump manual for correct venting of the pump. Avoid vibrations or mechanical impacts.
43	Overspeed failure	The actual frequency exceeds the setpoint frequency.	Setpoint frequency was changed during operation via a serial interface, RS 232, for example.	Provide for correct speed setting.

# Error memory

Error code	Designation	Description	Possible cause	Remedy
63	Internal parameter failure		There is a parameter mismatch which occurred during start-up or while saving the parameters. The pump was disconnected from its power supply while storing important system data was in progress.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
65	Internal communication failure	Failure of internal data communication with the frequency converter.	Cyclic pump communication has failed.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON.
66	Magnetic bearing current too high	Overloading of one or several magnetic bearing power output stages.	Excessively high vibrations or mechanical impacts from the system.	Reduce the level of vibrations or mechanical impacts.
67	Internal overload		Internal drive overload.	Stop the pump. Wait for standstill. Switch mains power OFF and ON again and restart the system.
71	First time initialisation failure of the parameter list.	Interface parameter/table mapping error.	First time initialisation of the pump parameters has failed.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON.
73	First time initialisation failure of the parameter list.	The registered number of start and standby cycles exceeds the maximum permissible number for safe operation.	Very high number of starts respectively much use of the standby function.	Have the pump serviced.
74	Number of operating hours exceeded.	The number of operating hours of the pump exceeds the maximum permissible number of hours for safe operation.	The number of operating hours of the system has reached the level necessary for servicing.	Have the pump serviced.
75	Failure during the initialisation of the pump data.	Failure during identification and initialisation of the pump.	Failure in frequency converter or in the pump.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
77	Too many touchdown bearing contacts were detected.	The registered number of touchdown bearing contacts exceeds the permissible alarm limit.	Due to external or internal influences of the pump the turbo rotor makes contact with the emergency bearings (touchdown bearings): mechanical impacts, possibly due to maintenance work. Vibration influences between several pumps. Vibration influences due to external exciting. Balancing condition of the rotor inadequate due to deposits or wear. Magnetic suspension is defective. Full or partial shutdown of the pump without magnetic bearing support due to mains power failure or failure in the frequency converter.	Have the pump serviced. If required check frequency converter and the connections. Check installation orientation of the pump and if required correct it. Avoid external influences (vibrations, impacts etc.). Review electric power supply and control concept.

# Error memory

Error code	Designation	Description	Possible cause	Remedy
78	Bearing contact time too long was detected.	The registered total duration of all touchdown bearing contacts exceeds the permissible alarm limit.	Due to external or internal influences of the pump the turbo rotor makes contact with the emergency bearings (touchdown bearings): mechanical impacts, possibly due to maintenance work. Vibration influences between several pumps. Vibration influences due to external exciting. Balancing condition of the rotor inadequate due to deposits or wear. Magnetic suspension is defective. Full or partial shutdown of the pump without magnetic bearing support due to mains power failure or failure in the frequency converter.	Have the pump serviced. If required check frequency converter and the connections. Check installation orientation of the pump and if required correct it. Avoid external influences (vibrations, impacts etc.). Review electric power supply and control concept.
79	Internal communication failure.	Failure of the internal data communication of the frequency converter.	Failure in the frequency converter.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
80	Invalid interface module combination.	Configuration of the interface module slots is inconsistent.	Two active Fieldbus modules were inserted, the X1 24 V PLC module has been inserted into the "Service" slot.	Correct installation of the interface modules: use control interface slot (CONTROL) with Fieldbus module (Profibus), RS 485, RS 232 or X1. Equip the service slot with a RS 232, a RS 485 or an USB module only.
81	Watchdog for monitoring of USS communication has responded.	Cyclic communication has failed for a longer period of time than defined through P 182.	Cable running to the controller was removed. Controller has interrupted communication. Interface module is defective.	Reinsert cable. Check controller. Inform Leybold Service.
82	Watchdog for monitoring Fieldbus communication has responded.	Cyclic communication has failed for a longer period of time than defined through P 925.	Cable running to the controller was removed. Controller has interrupted communication. Fieldbus interface is defective.	Reinsert cable. Check controller. Inform Leybold Service; have frequency converter replaced.
90	Setpoint speed setting higher than permissible.	Frequency setpoint is higher than the maximum value defined through parameter 45.	Incorrect setpoint entry or parameterisation of the pump is in error.	Correct setpoint entry or run a software respectively parameter update.

# Error memory

Error code	Designation	Description	Possible cause	Remedy
200	Pump identification temperature failure	Temperature in the pump identification is too high.	Forevacuum pressure is too high. Gas flow is too high. Water cooling switched off.	Check ultimate pressure of the forevacuum pump and if required install a larger forevacuum pump. Seal off leak. Check process. Water cooling disabled or cooling water throughput or cooling water temperature inadequate.
201	Unidentifiable failure on control board	Failure affecting the control computer of the frequency converter.	External interference or hardware failure affecting the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
203	Failure during self test	Failure affecting the parameter table mapping.	External interference or hardware failure affecting the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
204	RAM area insufficient for scope functionality	Failure in the control computer of the frequency converter.	External interference or hardware failure affecting the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
206	Pump parameter failure	Failure during identification and initialisation of the pump or the frequency converter.	Failure in the frequency converter, in the pump respectively in the pump's cables.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
209	Pump initialisation failure	Failure during identification and initialisation of the pump or the frequency converter.	Failure in the frequency converter, in the pump respectively in the pump's cables.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
210	Non-cyclic data transfer to pump identification interrupted (parameter transfer)	Communication malfunction with data memory of pump identification.	Temporary EMC interference. Defective hardware.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
213	Intermediate circuit overvoltage	The power supply voltage is too high.	The frequency converter has detected an intermediate circuit voltage which is too high.	Check power supply on the mains power side.

# Error memory

Error code	Designation	Description	Possible cause	Remedy
913	Temperature Power Stage Bearing electronic	The temperature has exceeded the error threshold.	The Cooling water flow is too low or the cooling water temperature is too high. Ambient temperature too high. Too high amplitude or force of mechanical shocks or vibration to the system.	Check cooling conditions  Check ambient conditions  Reduce the vibration or shocks influence which might affect the pump
914	Initialisation of parameter 893 was not yet run	Movement range in yM saved in the pump's memory needs to be updated.	When shifting the values this failure should no longer be able to occur.	
915	Intermediate circuit voltage is too low	Intermediate circuit voltage has dropped below the necessary value.	Unstable mains power supply. Equipment failure.	Check the mains power supply
916	Sensor alignment Channel Z	Automatic sensor alignment for channel Z resulted for parameter SGAIN and/or SOFFS values outside the range which can be typically tolerated.	Parameter changes in the pump's memory.	System needs to be recalibrated and aligned by Leybold.
917	Sensor alignment channel Y2	Automatic sensor alignment for channel Y2 resulted for parameter SGAIN and/or SOFFS in values outside the range which can be typically tolerated.	Parameter changes in the pump's memory.	System needs to be recalibrated and aligned by Leybold.
918	Sensor alignment Channel X2	Automatic sensor alignment for channel X2 resulted for parameter SGAIN and/or SOFFS in values outside the range which can be typically tolerated.	Parameter changes in the pump's memory.	System needs to be recalibrated and aligned by Leybold.
919	Sensor alignment Channel Y1	Automatic sensor alignment for channel Y1 resulted for parameter SGAIN and/or SOFFS in values outside the range which can be typically tolerated.	Parameter changes in the pump's memory.	System needs to be recalibrated and aligned by Leybold.
920	Sensor alignment Channel X1	Automatic sensor alignment for channel X1 resulted for parameter SGAIN and/or SOFFS in values outside the range which can be typically tolerated.	Parameter changes in the pump's memory.	System needs to be recalibrated and aligned by Leybold.
921	Current controller initialisation	Initialisation failure affecting the current controllers.		Re-initialisation attempt by the system by restarting.
922	Initialisation MM module	Initialisation failure of different controller modules.		Re-initialisation attempt by the system by restarting.
923	Initialisation position task 2	Initialisation failure of software module position task 2.		Re-initialisation attempt by the system by restarting.

# Error memory

Error code	Designation	Description	Possible cause	Remedy
924	Initialisation position task 1	Initialisation failure of software module position task 1.		Re-initialisation attempt by the system by restarting.
925	Software not capable of running on the target system	Software is not capable of running on this control board.	Uploading of an incorrect software version.	Load correct software version.
926	Floating point error has occurred	The floating point unit has signalled a failure, error code in debug variable, error code floating point, message after software reset.		Re-initialisation attempt by the system by restarting.
927	System stack overflow	Not enough unoccupied memory in the system stack, message after software reset.		Re-initialisation attempt by the system by restarting.
928	User stack overflow	Not enough unoccupied memory any more.		Re-initialisation attempt by the system by restarting.
929	System stack overflow	System stack overflow, message after software reset.		Re-initialisation attempt by the system by restarting.
930	System stack underflow	System stack underflow, message after software reset.		Re-initialisation attempt by the system by restarting.
931	Word access failure	Illegal word access, message after software reset.		Re-initialisation attempt by the system by restarting.
932	Undefined operation code for protected commands	Programme was detected as incorrect and cannot be run.	Temporary problem or inadmissible changes in the flash/RAM memory.	After the system has arrived at standstill, disconnect it from the power supply to re-initialise the software.
933	Memory access error	Access to the system memory has been found to be in error.	Temporary problem or inadmissible changes in the flash/RAM memory.	After the system has arrived at standstill, disconnect it from the power supply to re-initialise the software.
934	Undefined operation code	Programme code was detected as being in error and cannot be run.	Temporary problem or inadmissible changes in the flash/RAM memory.	After the system has arrived at standstill, disconnect it from the power supply to re-initialise the software.
935	External failure affecting the safety processors	At least one of the safety processors has detected a failure.	For further analysis the status words and control words of the processors need to be read out.	System locks the power output stage of the drive unit. Wait for the system to arrive at standstill and try to enable the system by switching the mains power off and on again.
936	The current offset and gain values deviate from the initial data.			
937	The Soffset values are outside of the defined range (initialisation).			
938	Cable parameters soffs, sgain and xgain are at their factory defaults.			
939	Cancellation during calculation of the checksum across the range of the static parameters in the pump identification.			
940	Cancellation during the calculation of the checksum across the range of the static parameters in the frequency converter.			

# Error memory

Error code	Designation	Description	Possible cause	Remedy
941	Incompatible compiling of the profile adapter version.	Interface parameter table mapping error.	Failure during software update.	If required repeat the software update, respectively check combination of software and profile adapter file.
949	Checksum error during initialisation of the equipment settings.	Failure while operating or identifying and initialising the pump.	Failure in the frequency converter, in the pump respectively in the pump's cable.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
950	Checksum error during initialisation of the autosave parameters	Failure while operating or identifying and initialising the pump.	Failure in the frequency converter, in the pump respectively in the pump's cable.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
951	Error while writing a string parameter to the fixed parameter memory.	Failure while operating or identifying and initialising the pump.	Failure in the frequency converter, in the pump respectively in the pump's cable.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
952	Failure during reading of the permanent parameter memory during the start-up phase.	Failure during operation or while identifying and initialising the pump.	Malfunction in the frequency converter, in the pump respectively in the pump's cable.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
953	Failure while writing to the fixed parameter memory.	Failure during operation or while identifying and initialising the pump.	Malfunction in the frequency converter, in the pump respectively in the pump's cable.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
955	Watchdog for monitoring the communication via Lustbus has responded.	Failure affecting the internal data communication of the frequency converter.	Malfunction in the frequency converter.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
956	Profile adapter: no opcode	Failure affecting the internal data communication of the frequency converter.	Malfunction in the frequency converter.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
957	Profile adapter: invalid opcode	Profile adapter: invalid opcode	Malfunction in the frequency converter.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
958	Profile adapter: failure during reading of parameters.	Failure affecting the internal data communication of the frequency converter.	Malfunction in the frequency converter.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.



# Error memory

Error code	Designation	Description	Possible cause	Remedy
959	Profile adapter: failure during writing of parameters	Failure affecting the internal data communication of the frequency converter.	Malfunction in the frequency converter.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
979	General failure during floating point calculation	Failure affecting the control computer of the frequency converter.	External interference or hardware fault of the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
980	Not enough memory for module parameters	Failure affecting the control computer of the frequency converter.	External interference or hardware fault of the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
982	Failure during initialisation of the generator mode.	Internal frequency converter failure.	External interference or hardware fault of the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
983	Failure during initialisation of the speed controller.	Internal frequency converter failure.	External interference or hardware fault of the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
984	Failure during initialisation of rotational speed calculation.	Internal frequency converter failure.	External interference or hardware fault of the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
985	Failure during initialisation of the current controller.	Internal frequency converter failure.	External interference or hardware fault of the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
986	Failure during initialisation of the controller.	Internal frequency converter failure.	External interference or hardware fault of the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
987	Internal failure of the state machine controller.	Internal frequency converter failure.	External interference or hardware fault of the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
988	Failure during initialisation of the motor protection module.	Internal frequency converter failure.	External interference or hardware fault of the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
989	Internal failure affecting the number formats.	Internal frequency converter failure.	External interference or hardware fault of the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.



# Error memory

Error code	Designation	Description	Possible cause	Remedy
990	Failure during internal parameter access via KP 200. A parameter could not be read or written.	Internal frequency converter failure.	External interference or hardware fault of the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
991	Failure during initialisation of a parameter with its saved setting.	Internal frequency converter failure.	External interference or hardware fault in the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
992	User stack has exceeded the maximum size.	Internal frequency converter failure.	External interference or hardware fault in the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
994	Runtime error during checking of the assisting parameter	Internal frequency converter failure.	External interference or hardware fault in the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
995	An exception was initiated.	Internal frequency converter failure.	External interference or hardware fault in the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
996	Non-identifiable parameter access level.	Internal frequency converter failure.	External interference or hardware fault in the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
997	Runtime error during enabling of an assisting parameter.	Internal frequency converter failure.	External interference or hardware fault in the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.

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.

# Warnings

## 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	–		

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	–		

# Warnings

P230 Bit	Designation	Possible cause	Remedy
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	–		

P232 Bit	Designation	Possible cause	Remedy
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.	Reduce vibration which might affect the pump. Avoid shocks or impacts at the pump. Avoid stopping the pump by switching off the mains power. Avoid disconnecting the pump cable, when the pump is still running“
13	High Number of Auxiliary Bearing Impacts	The environmental vibration might be too heavy or to 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.	
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 to many shocks or impacts interfered the pump Too many full or partial auxiliary bearing run downs affected the pump.	
P233 Bit	Designation	Possible cause	Remedy
0	Flange temperature above warning limit.	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.	The cooling system needs to be improved. The gas load needs to be reduced. Allow converter to cool down between the cycles.
1	Temperature power stage bearing electronic	Ambiant temperature to high. The Cooling water flow is too low or the cooling water temperature is too high. Too high amplitude or force of mechanical shocks or vibration fto the system.	Improve cooling conditions Reduce the vibration or shocks influence which might affect the pump
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	–		

# Example for telegrams

## Annex: Profibus strings

Detailed in the following table is the complete structure of the Profibus payload data block as described in detail on the preceding pages.

Abr.		Description	Value				Word				Description		Abr.
			Dez	Hex	Bin	Bit	Byte	Word	Bit	Bin	Hex	Dez	
PKE	Query designator					7	0		15				Reply designator
						6			14				
						5			13				
						4			12				
	Res.					3	0		11				Res.
						2			10				
						1			9				
						0			8				
						7			7				
						6			6				
						5			5				
						4			4				
						3			3				
						2			2				
						1			1				
						0			0				
IND	Parameter index					7	2		15				Parameter index
						6			14				
						5			13				
						4			12				
						3			11				
						2			10				
						1			9				
						0			8				
						7			7				
						6			6				
						5			5				
						4			4				
-	Reserved					3	3		3				Reserved
						2			2				
						1			1				
						0			0				
						7			7				
						6			6				
						5			5				
						4			4				
						3			3				
						2			2				
						1			1				
						0			0				
PWE	Parameter value					7	4		15				Parameter value
						6			14				
						5			13				
						4			12				
						3			11				
						2			10				
						1			9				
						0			8				
						7			7				
						6			6				
						5			5				
						4			4				
						3			3				
						2			2				
						1			1				
						0			0				
						7			7				
						6			6				
						5			5				
						4			4				
						3			3				
						2			2				
						1			1				
						0			0				
						7			7				
						6			6				
						5			5				
						4			4				
						3			3				
						2			2				
						1			1				
						0			0				
						7			7				
						6			6				
						5			5				
						4			4				
						3			3				
						2			2				
						1			1				
						0			0				
						7			7				
						6			6				
						5			5				
						4			4				
						3			3				
						2			2				
						1			1				
						0			0				
PZD1	Control word	-				7	8		15				Status word
		-				6			14				
		-				5			13				
		-				4			12				
		-				3			11				
		-				2			10				
		Activate remote				1			9				
		-				0			8				
		Standby speed				7			7				
		Error reset				6			6				
		Enable setpoint				5			5				
		-				4			4				
		-				3			3				
		-				2			2				
		-				1			1				
		-				0			0				
		Start/Stop				7			7				
						6			6				
						5			5				
						4			4				
						3			3				
PZD2	Setpoint rotor speed					2	11		2				Actual rotor speed
						1			1				
						0			0				
						7			7				
						6			6				
						5			5				
						4			4				
						3			3				
						2			2				
						1			1				
						0			0				
						7			7				
						6			6				
						5			5				
						4			4				
						3			3				
						2			2				
						1			1				
						0			0				
						7			7				
						6			6				
						5			5				
						4			4				
						3			3				
						2			2				
						1			1				
						0			0				

# Profibus strings

Order		Description	Data				Byte	Word	Data				Description		Order
			Dec	Hex	Bin	Bit			Bit	Bin	Hex	Dec			
①	PZD1	Control Word	4	4	8	4	8	4	8	8E	142	142	PZD1	③	PZD1
②	PZD2	Setpoint rotor speed	0	0	10	5	11	5	20	800	800	800	PZD2	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).

Order		Description	Data				Byte	Word	Data				Description		Order	
			Dec	Hex	Bin	Bit			Bit	Bin	Hex	Dec				
①	PZD1	Control Word	-			0	7		15	1			Disable alarm	Status Word	④	PZD1
			-			0	6		14	0			-			
			-			0	5		13	0			Warning overload			
			-			0	4		12	0			Disable monitor			
			-			0	3		11	1			PLC in rotation			
			Rotate reset			1	2		10	1			Coordinate operation			
			-			0	1		9	1			Parameter accepted			
			Standby speed			0	0		8	0			-			
			Error reset			0	7		7	0			Warning temperature			
			Enable setpoint			1	6		6	0			Switch-on PLC			
			-			0	5		5	0			Deceleration			
			-			0	4		4	0			Acceleration			
			-			0	3		3	0			Error alarm			
			-			0	2		2	1			Operation enabled			
			-			0	1		1	0			-			
			Start/Stop			1	0		0	1			Ready to start			
			②	PZD2	Setpoint rotor speed				0	7		15	0			
						0	6		14	0						
						0	5		13	0						
						0	4		12	0						
						0	3		11	0						
						0	2		10	0						
						1	1		9	1						
						0	0		8	0						
						1	7		7	1						
						0	6		6	0						
						1	5		5	1						
						1	4		4	1						
						1	3		3	1						
						1	2		2	1						
						0	1		1	0						
						0	0		0	0						

## 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).

# Profibus strings

**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).

Adr.		Description	Data				Data	Description		Adr.
			Dec	Hex	Bin	Bit				
1	PKE	Ready descriptor	1	0	0	7	15	0	4	Ready descriptor
		Res.	0	10	1	4	12	1		
	Parameter number		150	96	0	0	8	0		Parameter number
					0	3	11	0		
					0	2	10	0		
					0	1	9	0		
					0	0	8	0		
					1	7	7	1		
					0	6	6	0		
					0	5	5	0		
2	IND	Parameter Index	0	0	0	4	12	0		Parameter Index
					0	3	11	0		
	Reserved				0	2	10	0		Reserved
					0	1	9	0		
					0	0	8	0		
					0	7	7	0		
					0	6	6	0		
					0	5	5	0		
					0	4	4	0		
					0	3	3	0		
5	PWE	Parameter value	0	0	0	4	12	0	5	Parameter value
						3	11	0		
						2	10	0		
						1	9	0		
						0	8	0		
						7	7	0		
						6	6	0		
						5	5	0		
						4	4	0		
						3	3	0		
			0	0	0	5	13	0		
						4	12	0		
						3	11	0		
						2	10	0		
						1	9	0		
						0	8	0		
						7	7	1		
						6	6	1		
						5	5	1		
						4	4	1		
			0	0	0	6	14	0		
						5	13	0		
						4	12	0		
						3	11	0		
						2	10	0		
						1	9	0		
						0	8	0		
						7	7	1		
						6	6	1		
						5	5	1		
			0	0	0	7	15	0		
						6	14	0		
						5	13	0		
						4	12	0		
						3	11	0		
						2	10	0		
						1	9	0		
						0	8	0		
						7	7	1		
						6	6	1		



## Profibus strings

Def.		Description	Def.		Description	Def.		
①	PKE	Primary descriptor	150	20	0	2	PKE	
		Res.		0	3	0		Res.
		0		4	0			
		0		5	0			
		0		6	0			
		0		7	0			
		0		8	0			
		0		9	0			
		0		10	0			
		0		11	0			
		0		12	0			
		0		13	1			
		0		14	0			
		0		15	0			
		0		16	0			
		②		PWE	Primary descriptor	500		20
Res.	0		3		0		Res.	
0	4		0					
0	5		0					
0	6		0					
0	7		0					
0	8		0					
0	9		0					
0	10		0					
0	11		0					
0	12		0					
0	13		0					
0	14		0					
0	15		0					
0	16		0					
③	IND		Primary descriptor		0		20	0
		Res.	0	3		0	Res.	
		0	4	0				
		0	5	0				
		0	6	0				
		0	7	0				
		0	8	0				
		0	9	0				
		0	10	0				
		0	11	0				
		0	12	0				
		0	13	0				
		0	14	0				
		0	15	0				
		0	16	0				
		④	PKE	Primary descriptor		150	20	0
Res.	0			3	0		Res.	
0	4			0				
0	5			0				
0	6			0				
0	7			0				
0	8			0				
0	9			0				
0	10			0				
0	11			0				
0	12			0				
0	13			0				
0	14			0				
0	15			0				
0	16			0				
⑤	IND			Primary descriptor	0		20	0
		Res.	0	3		0	Res.	
		0	4	0				
		0	5	0				
		0	6	0				
		0	7	0				
		0	8	0				
		0	9	0				
		0	10	0				
		0	11	0				
		0	12	0				
		0	13	0				
		0	14	0				
		0	15	0				
		0	16	0				
		⑥	PWE	Primary descriptor		500	20	0
Res.	0			3	0		Res.	
0	4			0				
0	5			0				
0	6			0				
0	7			0				
0	8			0				
0	9			0				
0	10			0				
0	11			0				
0	12			0				
0	13			0				
0	14			0				
0	15			0				
0	16			0				

### Example 4:

### Write parameter 150

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

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.

# Profibus strings

**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 mes-  
sage 39, general magnetic bear-  
ing fault (6).

Adr.		Description	Dez	Hex	Bin	Bit	Byte	Word	Bit	Bin	Hex	Dez	Description		Adr.
③	PKE	Library descriptor	6		0	7	0	0	15	0		4		Library descriptor	⑤
		Res.	0	60	1	6			14	1	40				
②	PKE	Parameter number	171	AB	0	1	1	0	13	0		171		Parameter number	PKE
					0	4			12	0					
①	IND	Parameter Index	1	1	0	3	2	1	11	0	1	1		Parameter Index	IND
					0	2			10	0					
	Reserved		0	0	0	1	3	1	9	0	0	0		Reserved	
					0	0			8	1					
	PWE	Parameter number	0	0	0	7	4	2	7	0		39		Parameter number	PWE
					0	6			14	0					
					0	5	5	3	13	0		0			⑥
					0	4			12	0					
					0	3	6	2	11	0	0	0			
					0	2			10	0					
					0	1	7	3	9	0	0	27			
					0	0			8	0					
					0	7			7	0					
					0	6			6	0					
					0	5			5	0					
					0	4			4	0					
					0	3			3	0					
					0	2			2	0					
					0	1			1	0					
					0	0			0	0					
					0	7			15	0					
					0	6			14	0					
					0	5			13	0					
					0	4			12	0					
					0	3			11	0	0				
					0	2			10	0					
					0	1			9	0	0				
					0	0			8	0					
					0	7			7	0					
					0	6			6	0					
					0	5			5	0					
					0	4			4	0					
					0	3			3	0					
					0	2			2	0					
					0	1			1	0					
					0	0			0	0					
					0	7			15	0					
					0	6			14	0					
					0	5			13	0					
					0	4			12	0					
					0	3			11	0	0				
					0	2			10	0					
					0	1			9	0	0				
					0	0			8	0					
					0	7			7	0					
					0	6			6	0					
					0	5			5	1					
					0	4			4	0					
					0	3			3	0					
					0	2			2	1					
					0	1			1	1					
					0	0			0	1					
					0	7			15	0					
					0	6			14	0					
					0	5			13	0					
					0	4			12	0					
					0	3			11	0	0				
					0	2			10	0					
					0	1			9	0	0				
					0	0			8	0					
					0	7			7	0					
					0	6			6	0					
					0	5			5	1					
					0	4			4	0					
					0	3			3	0					
					0	2			2	1					
					0	1			1	1					
					0	0			0	1					
					0	7			15	0					
					0	6			14	0					
					0	5			13	0					
					0	4			12	0					
					0	3			11	0	0				
					0	2			10	0					
					0	1			9	0	0				
					0	0			8	0					
					0	7			7	0					
					0	6			6	0					
					0	5			5	1					
					0	4			4	0					
					0	3			3	0					
					0	2			2	1					
					0	1			1	1					
					0	0			0	1					
					0	7			15	0					
					0	6			14	0					
					0	5			13	0					
					0	4			12	0					
					0	3			11	0	0				
					0	2			10	0					
					0	1			9	0	0				
					0	0			8	0					
					0	7			7	0					
					0	6			6	0					
					0	5			5	1					
					0	4			4	0					
					0	3			3	0					
					0	2			2	1					
					0	1			1	1					
					0	0			0	1					
					0	7			15	0					
					0	6			14	0					
					0	5			13	0					
					0	4			12	0					
					0	3			11	0	0				
					0	2			10	0					
					0	1			9	0	0				
					0	0			8	0					
					0	7			7	0					
					0	6			6	0					
					0	5			5	1					
					0	4			4	0					
					0	3			3	0					
					0	2			2	1					
					0	1			1	1					
					0	0			0	1					

Adr.	Description	Data				Word	Data				Description	Adr.
		Dez	Hex	Bin	Bit		Dez	Hex	Bin	Bit		
②	Library descriptor											④
	Res.	0	60	0 0 0 0 0 0 0 0	0							
①	PKE	176	B0	0 0 0 0 0 0 0 0	1	0	176	B0	0 0 0 0 0 0 0 0	5	PKE	③
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
①	IND	1	1	0 0 0 0 0 0 0 0	2	1	1	1	0 0 0 0 0 0 0 0	1	IND	③
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
①	Reserved	0	0	0 0 0 0 0 0 0 0	3	0	0	0	0 0 0 0 0 0 0 0	0	Reserved	③
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
①	PWE	0	0	0 0 0 0 0 0 0 0	4	0	0	0	0 0 0 0 0 0 0 0	0	PWE	⑤
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
①	PWE	0	0	0 0 0 0 0 0 0 0	5	0	0	0	0 0 0 0 0 0 0 0	0	PWE	⑤
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			
				0 0 0 0 0 0 0 0					0 0 0 0 0 0 0 0			

**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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