

Serial Interfaces for TURBOVAC i/iX

RS 232, RS 485, Profibus, Profinet, USB

Operating Instructions 300450826_002_C2



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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 **TURBOVAC i/iX 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 device must only be operated in the proper condition and under the conditions described in the Operating Instructions. It must be operated and maintained by trained personnel only. Consult local, state, and national agencies regarding specific requirements and regulations. Address any further safety, operation and/or maintenance questions to our nearest office.

“Trained personnel” for the operation of this pump are

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

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

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

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

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

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

Retain the Operating Instructions for further use.

NOTICE



DANGER



WARNING



CAUTION



NOTICE



Description RS 232, RS 485



Fig. 1.1 Interface modules for the Anybus plug-in

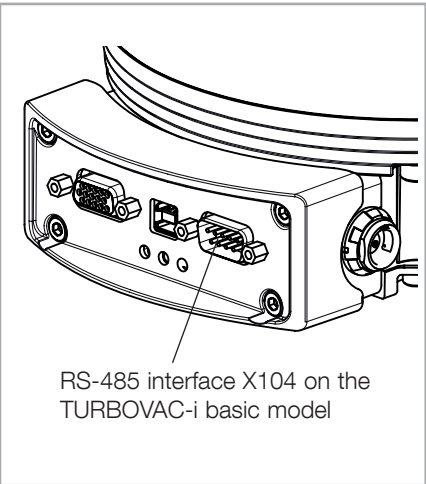


Fig.1.2 TURBOVAC i

1 Description

1.1 Description of the RS 232 and RS 485 Interfaces

The TURBOVAC 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

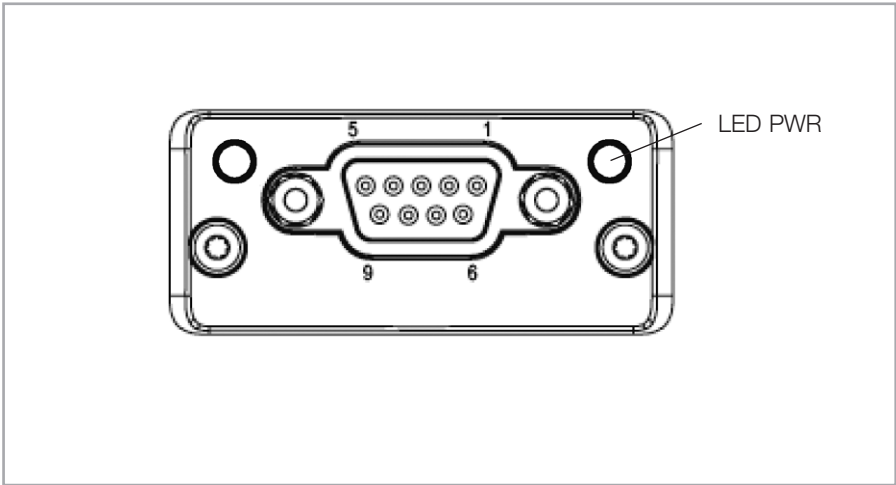
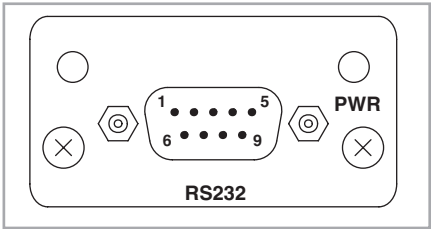


Fig.1.3 Front

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	–	
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



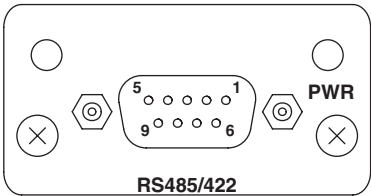
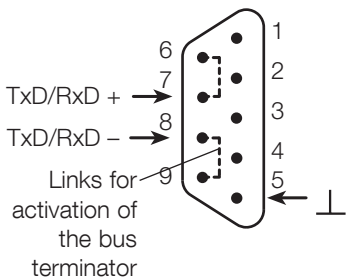
Max. cable length	10 m
Baud rate	19200 Baud
	Data bits: 8
	Stop bits: 1
	Parity: even
	Flow control: none
Address range	–
Voltage level	see standards
Interface connection	Sub-D 9-way socket (male)

Description RS 232, RS 485

Two types of RS-485 interface which differ slightly are used on the TURBOVAC i/iX. However, their programming is identical

- Combined RS 485/422 interface for the optional plug-in interface X120 on the TURBOVAC i /iX.
- Standard RS 485 interface on the TURBOVAC-i basic models.

Pin	Standard RS 485 on the TURBOVAC-i basic models	Optional interface RS-422 mode	Optional interface RS-485 mode
-----	--	--------------------------------	--------------------------------



Pin	male	female	female
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	GND Isolated signal ground
6	–	RxD inverted (Internally terminated (100 Ω) Receive data line	–
7	TxD/RxD +	RxD (Internally terminated (100 Ω) Receive data line	–
8	TxD/RxD -	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	Cable shield

Description RS 232, RS 485

Technical Data RS 485

Max. cable length	100 m (in the case of long cable runs observe bus master termination)
Baud rate	19200 Baud fixed Data bits: 8 Stop bits: 1 Parity: even Flow control: none
Address range	0 to 31 (Parameter 37)
Default address	0
Voltage level:	see standards transmitter: 1,5 ... 5 V receiver: > 0,3 V logic «1»: transmitter: - 1,5 ... - 5 V receiver: ≤ - 0,3 V
Standards	ISO 8482, EIA 485
Protocol	acc. to VDI/VDE 3689
Response delay	10 ms
Type of cable	2 wire twisted pair

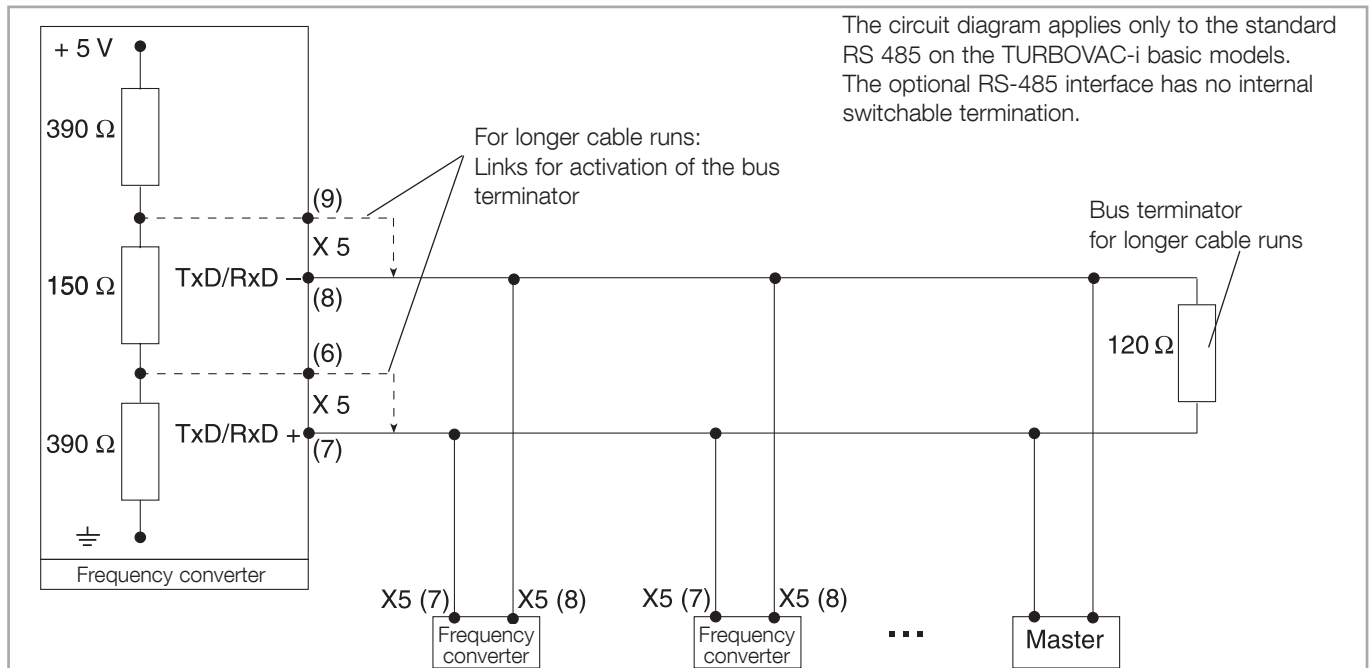


Fig. 1.4 Connection of the RS 485 bus

Description Profibus



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 TURBOVAC 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

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).

Device-ID: 0x0E96
GSD file: LEY_0E96.GSD

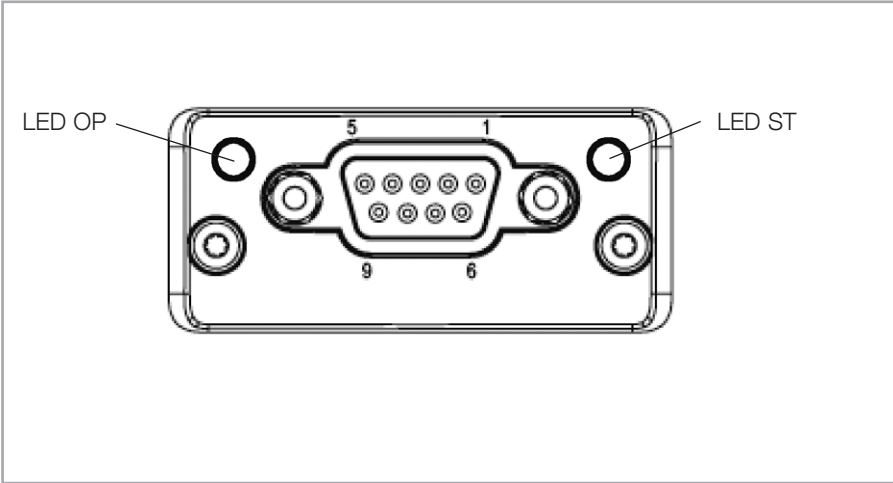


Fig.1.6 Front

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
Off	no power or not initialised	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

Description Profibus

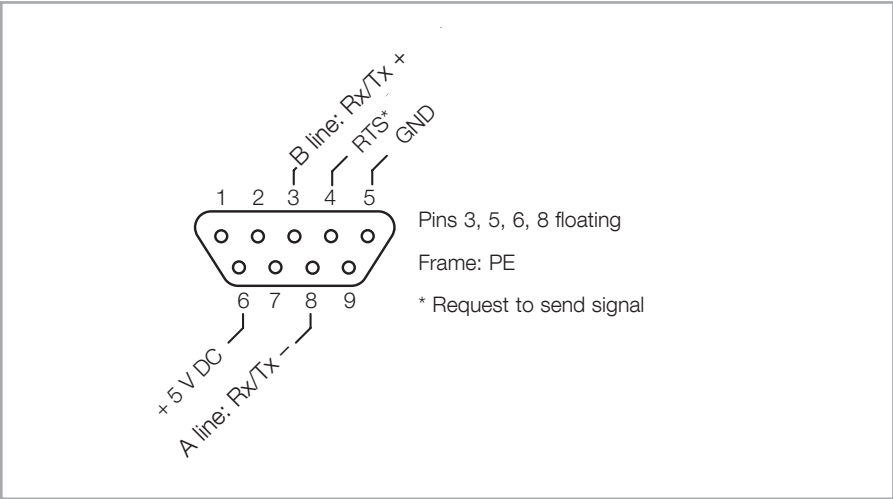


Fig. 1.7 Pin assignment for the socket

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))



Fig.1.8 Profinet Module

1.3 Description of the Profinet Interface

Profinet Environment

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

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

Ethernet Interface (RJ45 connector)

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

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

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

Profinet Status-LEDs

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

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

Description Profinet

Network Status LED

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

Module Status LED

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

Link / Activity LED

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

GSDML file

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

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

1.4 Description of the USB Interface

USB device class	0A _h CDC-Data (COM port emulation)
Serial protocol via the COM port	acc. to VDI/VDE 3689
Transmission rate	19200 baud fixed
Address range	0 (fixed)
Max. cable length	5 m
Interface connection	USB B

Visit www.leybold.com/ → Downloads → [Download Software](#),
to download drivers for Windows.

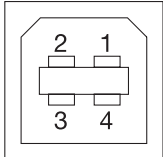
	Pin	Name	Color	Description
	1	VCC	red	+ 5 V
2	D-	white	Data -	
3	D+	green	Data +	
4	GND	black	Ground	

Fig. 1.8 Pin assignment for the socket at the frequency converter for USB interface

2 Start-up

Connection

NOTICE



Before making any connections, switch the pump off and wait until it turns no longer (LEDs are off). Interfaces and connections may only be plugged in and removed in the deenergised state.

2.1 RS 232, RS 485

Connect the interface connector.

Address Setup RS 485

The saving process takes approx. 30 secs.

NOTICE



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

Parameterisation through the serial service interface (typically USB).

For this, set parameter 37 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.

While saving is in progress, no parameters can be read or written. However, PZDs are still transferred.

2.2 Profibus

Connect the Profibus to the Profibus interface connector (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 TURBOVAC can be set up in two 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 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) 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 2 below is not necessary. The value of parameter 924 is not relevant. Decisive here is the value 126 for the parameter 918.

2. Address setting through the parameter 918 via the service interface (USB):

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 approx. 30 seconds. 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.

2.3 Profinet

2.3.1 Network Configuration

Before the module can be used on the network, some basic network settings must be configured.

IP address

The IP address is used to identify each node on the TCP/IP network. Therefore, each node on the network must have a unique IP address. IP addresses are written as four decimal integers (0-255) separated by periods, where each integer represents the binary value of one byte in the IP address. This is called dotted-decimal notation.

Example:

Address 10000000 00001010 00000010 00011110 is written as 128.10.2.30

Subnet Mask

The subnet mask is a 32-bit binary pattern, where a set bit allocates a bit for network/subnet ID, and a cleared bit allocates a bit for the host ID. Like the IP address, the subnet mask is commonly written in dotted-decimal notation.

Example:

To make the IP address 128.10.2.30 belong to subnet 128.10.2, the subnet mask shall be set to 255.255.255.0. Subnet Mask: 11111111 11111111 11111111 00000000 (255.255.255.0)

Special case IP addresses

The following IP addresses are reserved and should not be used:

0.x.x.x - IP address where the first byte is zero

127.x.x.x - IP address where the first byte is 127

127.x.x.0 - IP address where the last byte is zero

x.x.x.255 - IP address where the last byte is 255

2.3.1a Configuring the IP settings

The module offers several ways to set the IP settings (IP address, Subnet mask & Gateway address):

- DHCP
a DHCP server sets the address as user predefined or automatically
- HICP
the HMS Anybus IP Config program allows an easy adjustment of the IP settings

If DHCP is enabled, the module will attempt to retrieve the following information via DHCP:

- IP address
- Subnet mask
- Gateway address

The module supports DHCP Reboot, i.e. it will ask the DHCP server for the previous used IP address. If that address is free to use, it will be assigned to the module. If not, the module will be assigned a new IP address.

Host IP Configuration Protocol (HICP)

HICP is an acronym for 'Host IP Configuration Protocol', and is used by the Windows-based application program 'AnyBus IPconfig' that is able to detect HMS modules on the network and configures their IP settings. Since the protocol is based on broadcast messages, it is possible to detect and configure modules that are outside of the host's subnet.

The Anybus IPconfig tool is used to set up or change the Ethernet configuration on an HMS Ethernet 10/100 Mbit module. Start with opening the program and press SCAN. All HMS Ethernet nodes will then be listed. To change a configuration, just perform a double click on the desired node. All settings will then be available.

For more information and downloading of the latest version of the AnyBus IPconfig program look at the HMS homepage: "www.anybus.com".

2.3.1b Web Server

The embedded web server of the TURBOVAC i/iX provides an easy access to some important information about the pump and can be used with the common internet browsers like MS Internet Explorer, Firefox etc..

For some sites you need to log in with the following data:

User:	customer
Password:	customing

The following information can be retrieved via the internet browser:

Identity

- IP configuration
- Catalog no. of pump
- Serial no. of pump
- Software revisions

State

- Controlling the pump
- Actual state of the pump
- Actual speed, temperature, voltage and current information

Config

- Configuration of the digital and analog outputs

Service

- Operating cycles and operating hours
- Actual temperatures of converter and pump
- Warning and failure Information

Start-up

2.3.2 Configuration via the Siemens TIA Portal

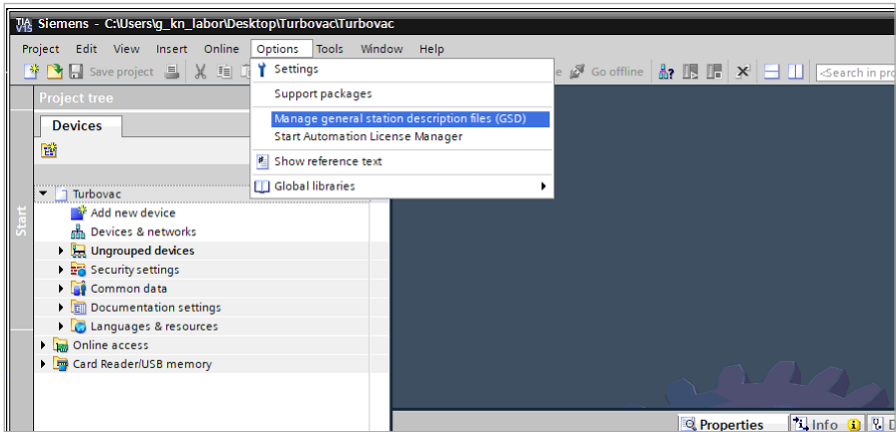
As an example, the system's configuration is described by using the TIA Portal tools. Configurations using other tools should be similar.

Installing the GSDML file

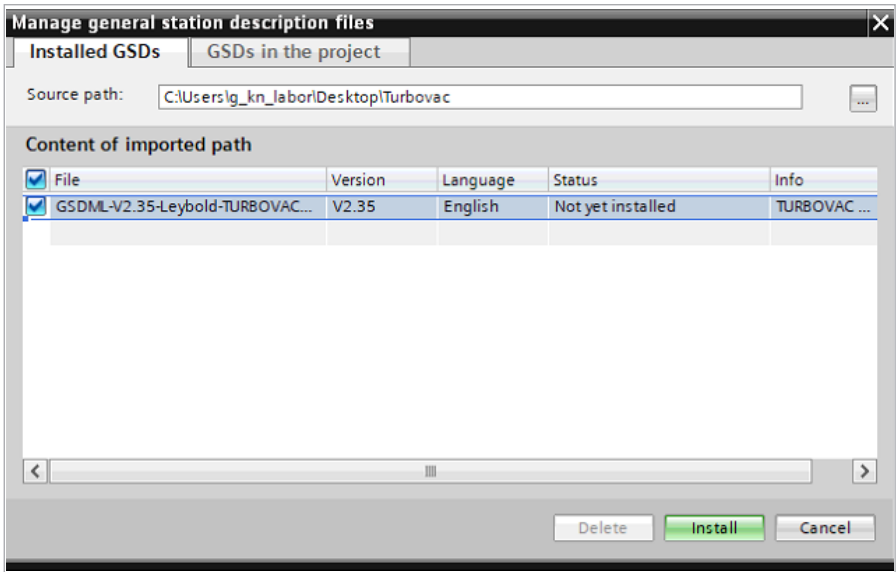
Documented in the GSDML (GSD Markup Language) file are all relevant information of the corresponding device used. The file format has been defined in the standards so that proprietary project tools from different manufacturers can be used.

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

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



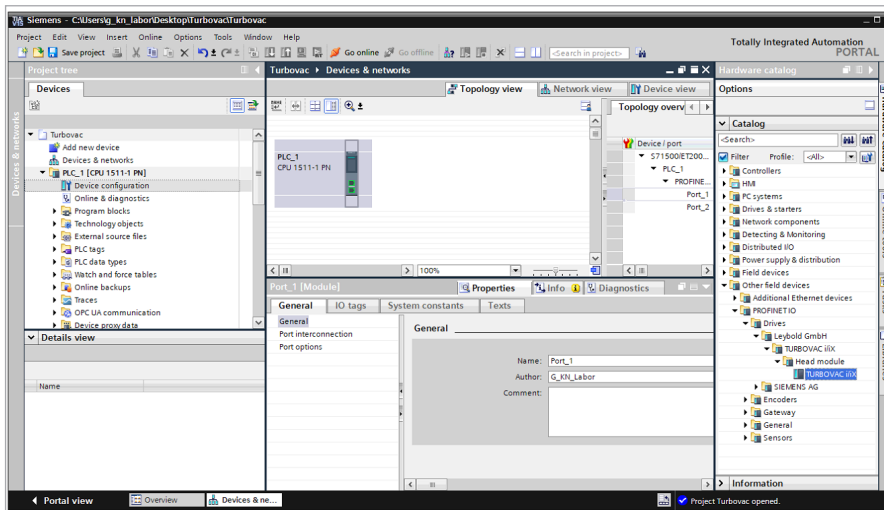
Then select the GSDML file's source directory, and load the file.



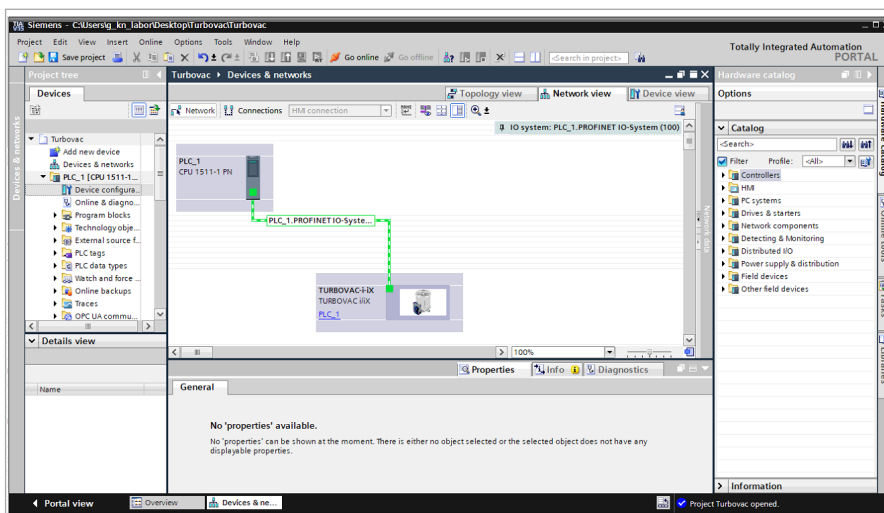
The device will then be listed and available in the hardware catalogue.

Adding the Device

From the hardware catalogue select the **TURBOVAC i/iX** entry, to add the device to the system.



Then connect the device to the control.



Start-up

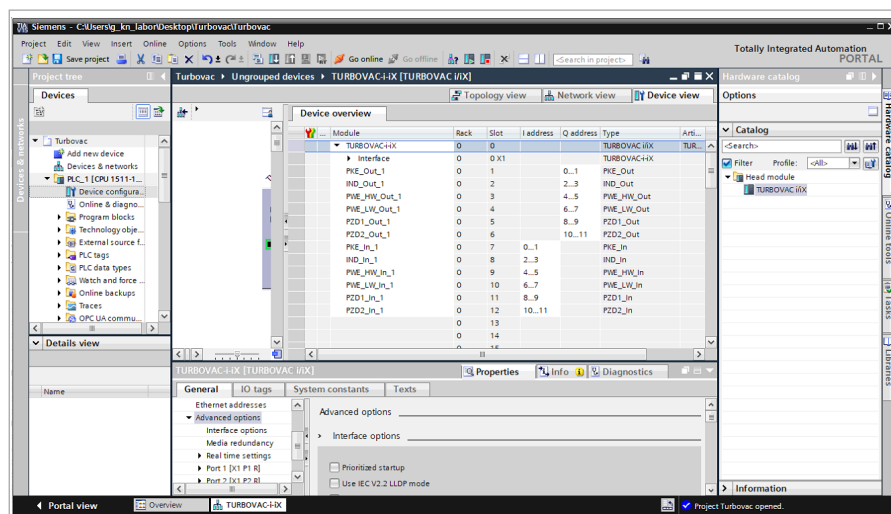
Creating the Slave Configuration

The configuration of the modules is done automatically.

There is only one permissible configuration:

PPO1

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



Device Behaviour at Start-up and IOPS = bad

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

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

A watchdog can be configured via parameter 182, which in case of a network interruption after a preset time safely shuts down the pump with an error message.

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)	Frequency target / Current stator frequency (= P3)	Value (Hz)	Value (Hz)	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	PZD5	Current bearing temperature (= P125)	0	0	Value (°C)
21-22	PZD6	Current intermediate circuit voltage (=P4)	0	0	Value (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

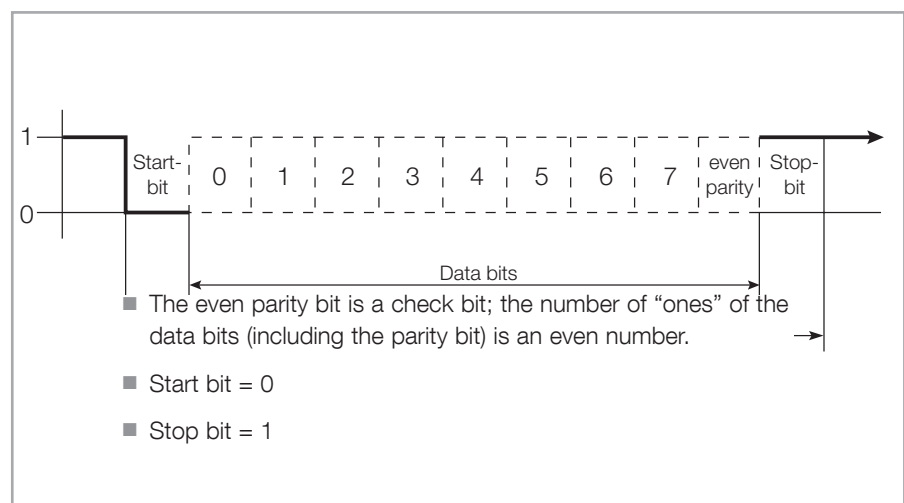


Fig. 3.1 Structure of a data frame for transferring a string byte

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	Frequency target / Current stator frequency (= P3)	Value (Hz)	Value (Hz)	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.

PKE, IND, Bits

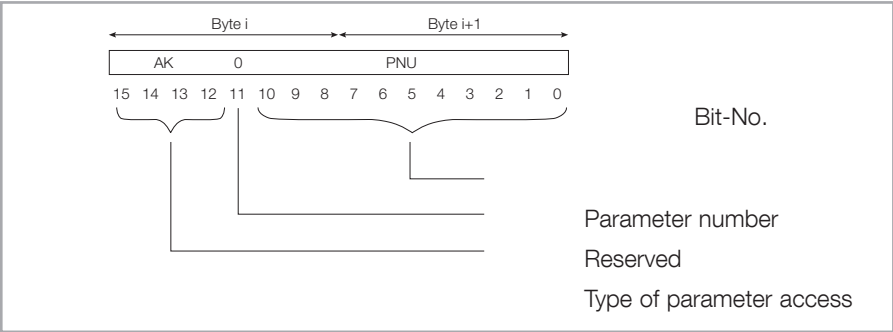


Fig. 4.1 Structure of the parameter section

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.

Fault detection	Description
0	impermissible parameter number
1	parameter cannot be changed
2	lower or upper threshold exceeded
3	faulty index
5	wrong data type
101	internal communication error
102	no access due to a longer lasting storage process

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.

See also the example telegrams given in the Annex.

4.3 USS Control Word

Bit	Description
0	Start/Stop
1	Not assigned
2	Not assigned
3	Not assigned
4	Not assigned
5	24 VDC output X201
6	Enable main setpoint PZD2 PZD2 = speed setpoint
7	Reset error (all components) Resetting impossible when Bit 0 = 1; Start is active
8	Enable standby function
9	Not assigned
10	Enable process data (Bit 0, 5, 6, 7, 8, 13, 14, 15 only true with Bit 10 activated)
11	Error operation relay X1
12	Normal operation relay X1
13	Warning relay X1
14	24 VDC output X202 (function present on the TURBOVAC iX only)
15	24 VDC output X203 (function present on the TURBOVAC iX only)

Note: To directly switch the outputs X201, X202, X203 via Bits 5, 14, 15, the function code 18 (field bus-controlled) must be set for the respective output (Parameter 134, Index 1, 2, 3).

4.4 USS Status Word

Bit	Description
0	Ready for operation
1	No function
2	Operation enabled
3	Error condition (all components)
4	Accelerating
5	Decelerating
6	Switch-on lock
7	Temperature warning
8	No function
9	Parameter channel enabled
10	Normal operation detained
11	Pump is turning
12	No function
13	Overload warning
14	Collective warning
15	Process channel enabled

Parameter List

5 Parameter List

It is possible to change certain parameters depending on the specific requirements and save these permanently.

r = readable, w = writable

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
1	Converter type	0	65535	*1		r	U16	180=TURBOVAC 350/450 i 181=TURBOVAC 350/450 i with optional interface 182=TURBOVAC 350/450 iX 190=TURBOVAC 90/250 i 191=TURBOVAC 90/250 i with optional interface 192=TURBOVAC 90/250 iX
2	Software version communication elec.	0	65535	*1		r	U16	xx.yy: version, zz: correction index
3	Actual frequency	0	65535	*2	Hz	r	U16	Actual rotor frequency
4	Actual intermediate circuit voltage	0	1500	*2	0,1 V	r	U16	Actual intermediate circuit voltage of the converter
5	Actual current	0	150	*2	0,1 A	r	U16	Actual motor current
6	Actual electrical power	0	65535	*2	0,1 W	r	U16	Actual drive input power
7	Actual motor temperature	-10	150	*2	°C	r	I16	Actual value of the motor temperature.
8	Save data command	0	65535	0		r/w	I16	A write command with any value saves temporary data into nonvolatile memory.
11	Actual converter temperature	-10	100	*2	°C	r	I16	Actual heat sink temperature of the converter.
16	Motor temperature warning threshold	0	150	80	°C	r	I16	Exceeding the motor temperature warning threshold results in a warning.
17	Nominal motor current	3	120	*1	0,1 A	r	U16	Maximum permissible motor current
18	Maximum frequency	500	2000	*1	Hz	r	U16	Highest permissible frequency
19	Minimum frequency	P20	2000	*1	Hz	r	U16	Lowest permissible frequency
20	Critical frequency	0	2000	*1	Hz	r	U16	When the pump is accelerating this frequency must be reached within the maximum passing time (P183). After the run-up: switch-off limit in case of overload.
21	Motor overload limit	1	100	100	%	r	U16	After attaining normal operation and when this threshold is exceeded a „high load error“ will occur after a certain period of time has elapsed.
23	Pump type/ Rotor type	0	255	*1		r	U16	0=TURBOVAC i/iX CL 1=TURBOVAC i/iX WR 2=TURBOVAC i/iX MI

Parameter List

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
24	Setpoint frequency	P19	P18	*1	Hz	r/w	U16	Setpoint of the rotor frequency
25	Frequency dependent normal operation	35	99	90	%	r/w	U16	Setpoint of the frequency dependent normal operation level
26 ^{*3}	Lower temperature switching threshold	0	65535	25	°C	r/w	U16	Defines the lower temperature switching threshold for the function output.
26 ^{*4}	Lower temperature switching threshold	0	65535	25	°C	r/w	U16 [0..2]	Defines the lower temperature switching threshold for the function output. X201: Index 0 / X202: Index 1 / X203: Index 2
27 ^{*3}	Upper current switching threshold	0	65535	40	0,1 A	r/w	U16	Defines the upper current switching threshold for the function output.
27 ^{*4}	Upper current switching threshold	0	65535	40	0,1 A	r/w	U16 [0..2]	Defines the upper current switching threshold for the function output. X201: Index 0 / X202: Index 1 / X203: Index 2
28 ^{*3}	Upper frequency switching threshold	0	65535	999	Hz	r/w	U16	Defines the upper frequency switching threshold for the function output
28 ^{*4}	Upper frequency switching threshold	0	65535	999	Hz	r/w	U16 [0..2]	Defines the upper frequency switching threshold for the function output X201: Index 0 / X202: Index 1 / X203: Index 2
29	Relay function selection on X1	0	8	0		r/w	U16 [0..2]	If required, special functions can be assigned to the normal operation and the error relay. Field 0 specifies the function for normal operation relay: 0=Frequency dependent (=ZSW bit 10) 2=Fieldbus controlled (=STW bit 12) 3=Trigger current bearing temperature (P122) 4=Venting function (P247/P248) 5=Pump at standstill (=ZSW bit 11) 6=Start command is present 7=Ready for switch on (=ZSW bit 0) Field 1 specifies the function for the error relay: 0=Energised when an error is present 1=Deenergised when an error is present 2=Fieldbus controlled Field 2 specifies the function for the warning relay: 0=Energised when an warning is present 1=Deenergised when an warning is present 2=Fieldbus controlled
30 ^{*3}	Analog output function	0	5	0		r/w	U16	Defines what function the analog-out of the I/O interface should have. 0=No function 1=Pump temperature 2=Motor current 3=Frequency 4=Input voltage

Parameter List

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
30 ¹⁴	Analog output function	0	5	0		r/w	U16	Defines what function the analog-out of the I/O interface should have. 0=No function 1=Pump temperature 2=Motor current 3=Frequency 4=Input voltage 5=Value Gauge (only Turbovac iX)
31 ¹³	Limits for analog output	-32768	32767	10000	0,1	r/w	I16 [0..2]	Index 0: Reserved Index 1: Value corresponding to 10 V at the analog output Index 2: Value corresponding to 0 V at the analog output
32	Max. run-up time	30	20000	30	s	r/w	U16	Max. permissible time during which the pump must attain the normal operation threshold (P24*P25) with the start signal present.
36	Start delay time	0	255	0	0,1 min	r/w	U16	Delays the start of the pump to allow leadtime for the fore vacuum pump for example. Only active when pump is at standstill.
37	RS485 address	0	31	0		r/w	U16	Parameterizable RS485 address. A change of this parameter setting will only be effective after the power supply has been switched off and on. Bus address does not apply to the USB interface.
38	Number of start commands	0	65535	*2		r	U16	Counts all run-ups of the pump from stand-still.
40	Error counter total	0	65535	*2		r	U16	Counts the total number of all errors.
41	Error counter overload	0	65535	*2		r	U16	Counts the total number of all overload errors.
43	Error counter mains supply	0	65535	*2		r	U16	Counts the total number of all mains failure events, occurred while the drive was active.
82	Friction value	0	65535	*2	s	r	U16	Friction value
119	Bearing run-in function	0	8	0		r/w	U16 [0..1]	The bearing run-In function will be initiated with setting index 0 to 1, 2, 4 or 8. With the next start command the pump will start a run-in procedure beginning with the selected phase. While run-in procedure the progress can be read out from index 1. 0=Bearing run-in function deactivated 1=Phase 1 2=Phase 2 4=Phase 3 8=Phase 4
122 ¹³	Switching thres. bearing temp. relay out	0	65535	40	°C	r/w	U16	Temperature at which the relay contact shall be switched on when P29[0]=3. When P125 > P122 the relay is energised.

Parameter List

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
122	⁴ Switching thres. bearing temp. relay out	0	65535	40	°C	r/w	U16 [0..2]	Temperature at which the relay contact shall be switched on when P29[0]=3 or P134 = 24 or 30. When P125 > P122 the relay is energised. X201: Index 0 / X202: Index 1 / X203: Index 2
125	Actual bearing temperature	-10	150	0	°C	r	I16	Calculated temperature of the bearing.
126	Bearing temperature warning threshold	-10	150	60	°C	r	I16	Exceeding the bearing temperature warning threshold results in a warning
128	Motor temperature lower warning thres.	-10	150	5	°C	r	I16	Falling below the motor temperature lower warning threshold results in a warning
131	Motor temperature lower error threshold	-10	150	0	°C	r	I16	Falling below the motor temperature lower error threshold causes the pump to be switched off.
132	Bearing temperature error threshold	-10	150	65	°C	r	I16	Exceeding the bearing temperature error threshold causes the pump to be switched off.
133	Motor temperature error threshold	-10	150	100	°C	r	I16	Exceeding the motor temperature error threshold causes the pump to be switched off.
134	³ Output function	0	41	26		r/w	I16	Selects the behavior of the 24 volt output X201 0=Always off 1=Failure 2=No failure 3=Warning 4=No warning 5=Normal operation 6=Not at normal operation 7=Pump rotates 8=Pump does not rotate 18=Fieldbus controlled 19=Always on 24=Bearing temperature dependent 25=Power outage venting 26=Start command active (Default) 27=Ready to start 28=Fan 1 29=Fan 2 30=Fan 3 31=Purge valve 1 32=Purge valve 2 33=Purge valve 3 34=Fore vacuum pump 1 35=Fore vacuum pump 2 36=Vent valve 1 37=Acceleration 38=Deceleration 40=VentValve (normally closed) 41=Power outage venting & vent valve (normally open)

Parameter List

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
134	^{*4} Output function	0	41	7		r/w	I16 [0..2]	<p>Selects the behavior of the 24 volt output X201 (Index 0) / X202 (Index 1) / X203 (Index 2)</p> <p>0=Always off 1=Failure 2= No failure 3=Warning 4=No warning 5=Normal operation 6=Not at normal operation 7=Pump rotates 8=Pump stand still 18=Fieldbus controlled 19=Always on 23=Current dependent 24=Bearing temperature dependent 25=Power outage venting 26=Start command active 27=Ready 28=Fan 1 29=Fan 2 30=Fan 3 31=Purge valve 1 32=Purge valve 2 33=Purge valve 3 34=Fore vacuum pump 1 35=Fore vacuum pump 2 36=Vent valve 1 37=Acceleration 38=Deceleration 39=Pressure dependent 40=VentValve (normally closed) 41= Power outage venting & vent valve (normally open)</p>
140	Intermediate circuit current	0	150	0	0,1 A	r	I16	Mean value measurement of the intermediate circuit current. Corresponds to the current consumption of the frequency converter.
150	Stand-by frequency	0	1000	*1	Hz	r	U16	Stand-by operation frequency setpoint
171	Error code memory	0	65535	*2		r	U16 [0..253]	<p>Indexed parameter for storing the most recent 254 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 253.</p> <p>Refer to Section 6 for error codes details.</p>
174	Rotor frequency at error	0	65535	*2	Hz	r	U16 [0..253]	Access analogously as for parameter 171.

Parameter List

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
176	Operating hours at error	0	2.147E+09	*2	0,01 h	r	I32 [0..253]	Access analogously as for parameter 171.
179	Fallback control word	0	65535	0		r/w	U16	<p>Behaviour in case bit 10 in the control word of the bus adapter is cancelled or when interrupting the communication between converter and bus adapter (see also P182). Here it is assumed that the respective bus adapters perform a cyclic communication on the USS side, so that the respective converter electronics is capable of detecting a communication interruption.</p> <p>The bits in parameter 179 represent an equivalent to the control word in the USS protocol. The actions linked to these bits are run provided bit 10 in the control word (USS protocol for bus adapter) is cancelled or if there are interruptions in the communication between converter and bus adapter.</p> <p>Here bit 10 is of special significance: Bit 10=0 The control rights are returned to the next lower priority level. All other bits are not relevant. Bit 10=1 The control rights remain unchanged. The actions linked to the other bits are run.</p>
180	USS response delay time	0	20	10	ms	r/w	U16	Pause time between received and transmitted USS protocol string of the frequency converter's serial interface RS232 and RS485. We recommend not to change the default setting (10ms).
182	USS control watchdog	0	65535	100	0,1 s	r/w	U16	<p>Defines the time characteristic when cancelling bit 10 in the control word of the USS protocol or when an interruption in the communication between bus adapter and converter electronics is detected. Handling when cancelling bit 10 or when there is an interruption on the communication side of the USS bus adapter is the same.</p> <p>Value 0.0: Indefinite time delay. In this way a change of the control right is inhibited. Values 0.1 ..6553.5: A change in the control right corresponding to the setting of parameter 179 is only effected after the time span defined through parameter 182 has elapsed.</p>
183	Max. passing time	60	19000	1800	s	r	U16	Max. permissible time during which the pump must - with the start signal present - have passed through the critical speed range between 60 Hz and P20.
184	Converter operating hours	0	2.147E+09	0	0,01 h	r	I32	Counts the operating hours of the converter during active pump operation.

Parameter List

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
185	Max. DC converter current	0	10000	9000	0,001 A	r/w	U16	Maximum DC Converter Current
198	Max. system power	0	2400	2400	0,1 W	r/w	U16	Maximum system power
227	Warning bits 1	0	65535	0		r	U16	Active warnings described bit per bit. Bit00=Pump temperature 1 too high Bit01=Pump temperature 2 too high Bit02=Pump temperature 3 too high Bit03=Ambient temperature too low Bit04=n/a Bit05=n/a Bit06=Overspeed warning Bit07=Pump temperature 4 too high Bit08=n/a Bit09=n/a Bit10=n/a Bit11=Overload warning Bit12=Pump temperature 5 too high Bit13=Pump temperature 6 too high Bit14=Power supply voltage warning
247	Vent on frequency	0	P18	999	Hz	r/w	U16	Frequency at which the venting valve shall be switched on in the event of a mains power failure. Power failure venting can be enabled through P134.
248	Vent off frequency	0	P18	5	Hz	r/w	U16	Frequency at which the venting valve shall be switched off in the event of a mains power failure. Power failure venting can be enabled through P134.
249	Generator mode	0	1	0		r/w	U16	0=No feedback into the DC supply 1=Feedback into the DC supply Notice: take note of the maximum generator power of 160 W as otherwise the electronics may suffer damage.
297 ¹⁵	Module identification Anybus	0	2.147E+09	*1		r	U32	ID of the inserted bus module 5=Profibus 37=DeviceNet 133=Ethernet/IP 135=EtherCAT 65537=RS232 65539=USB 65541=Bluetooth 65546=RS485 -1=No module found
312	Catalog no. of converter	0	127	*1		r	U16 [0..17]	Catalogue number of the converter. One ASCII char per index.

Parameter List

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
313	Product name	0	127	*1		r	U16 [0..17]	Product name. One ASCII char per index.
314	Configuration text	0	127	0		r/w	U16 [0..26]	Configuration text. One ASCII char per index.
315	Serial no. of convert- er	0	127	*1		r	U16 [0..17]	Serial number of the converter. One ASCII char per index.
316	Hardware version converter	0	127	*1		r	U16 [0..17]	Hardware version of the converter. One ASCII char per index.
349	Parameter set of pump	0	127	*1		r	U16 [0..17]	Document no. of the pump's parameter set
350	Catalog no. of pump	0	127	*1		r	U16 [0..17]	Catalogue number of the pump. One ASCII char per index.
355	Serial no. of pump	0	127	*1		r	U16 [0..17]	Serial number of the pump. One ASCII char per index.
395	Serial no. of com. elec.	0	127	*1		r	U16 [0..17]	Serial number of the front end. One ASCII char per index.
396	Hardware version of com. elec.	0	127	*1		r	U16 [0..17]	Hardware version of the front end. One ASCII char per index.
601	^{*4} Device type gauge	0	65535	*2		r	U16	0=None 1=CTR 2=TTR9x 3=TTR100 4=PTR90 5=PTR2xx 6=ITR 7=DI200 8=DI2000 9=Measuring device 10=BPG 11=DU200 12=DU2000
602	^{*4} Sub type gauge	0	65535	*2		r/w	U16	Sub type of CTR gauge 0=No CTR 1=0.1 Torr 2=1 Torr 3=10 Torr 4=100 Torr 5=1000 Torr 6=20 Torr
603	^{*4} Device name gauge	0	65535	0		r/w	U16 [0..30]	Device name gauge

Parameter List

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
604 ^{*4}	Status word gauge	0	4.295E+09	0		r	U32	Bit00=Power supply ok Bit01=Status Bit02=Degas on Bit03=Error Bit04=Overrange Bit05=Underrange Bit12=Maintenance required Bit14=Warning
606 ^{*4}	Command word gauge	0	4.295E+09	0		r/w	U32	Bit01=Degas
609 ^{*4}	Gas type correction factor available	0	65535	0		r	U16	Bit encoded information which type of gas can be selected. Bit00=Air, N2, CO, O2 Bit01=CO2 Bit02=He Bit03=Ne Bit04=Ar Bit05=Kr Bit06=Xe Bit07=H2 Bit10=Custom
610 ^{*4}	Gas type correction factor	1,401E-42	3,403E+41	*2		r	R32	Actual gas correction factor
611 ^{*4}	Customer specific gas correction factor	1,401E-42	3,403E+41	1		r/w	R32	Value for customer specific gas type correction factor, active at P620=10.
612 ^{*4}	Degas function available	0	65535	0		r	U16	0=Degas not available 1=Degas available
615 ^{*4}	Filtering time	0	3	3		r/w	U16	Size of the ring memory for averaging the pressure value 0=1 1=50 2=100 3=200
616 ^{*4}	Gauge pressure value in mbar	1,401E-42	3,403E+41	*2	mbar	r	R32	Pressure value gauge mbar
617 ^{*4}	Gauge pressure value in torr	1,401E-42	3,403E+41	*2	Torr	r	R32	Pressure value gauge torr
618 ^{*4}	Gauge pressure value in Pa	1,401E-42	3,403E+41	*2	Pa	r	R32	Pressure value gauge pa
619 ^{*4}	Gauge measurement voltage	1,401E-42	3,403E+41	*2	V	r	R32	Current voltage value of the gauge head measurement signal

Parameter List

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
620	^{*4} Gas type	0	65535	0		r/w	U16	Gas correction factor 0=Air, N2, CO, O2 1=CO2 2=He 3=Ne 4=Ar 5=Kr 6=Xe 7=H2 10=Custom
623	^{*4} System warning bits	0	65535	*2		r	U16	Active warnings described bit per bit. Bit00=Converter housing temperature too high Bit01=Intermediate circuit voltage not in valid range
624	^{*4} Gauge warning bits	0	65535	0		r	U16	Active warnings described bit per bit. Bit00=2nd stage not started
625	^{*4} Pump start function	0	65535	0		r/w	U16	0=Pump starts on start command 1=Pump starts pressure dependent
630	^{*4} Device main type output	0	65535	0		r/w	U16 [0..2]	0=System 1=Pump 2=Gauge 3=Valve 4=Special 5=Vacuum chamber 6=Arrow 7=Line
631	^{*4} Device type output	0	65535	0		r/w	U16 [0..2]	
634	^{*3} Status word output	0	4.295E+09	0		r	U32	Pump: Bit03 = Error Bit10 = Normal operation : = 10 Bit14 = Warning : = 14 Special: Bit03 = Error Bit10 = Setpoint reached Bit14 = Warning Valve: Bit03 = Error Bit10 = Valve in position Bit14 = Warning

Parameter List

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
634 ^{*4}	Status word output	0	4.295E+09	0		r	U32 [0..2]	X201 (Index 0) / X202 (Index 1) / X203 (Index 2) Pump: Bit03 = Error Bit10 = Normal operation : = 10 Bit14 = Warning : = 14 Special: Bit03 = Error Bit10 = Setpoint reached Bit14 = Warning Valve: Bit03 = Error Bit10 = Valve in position Bit14 = Warning
636 ^{*3}	Command word output	0	4.295E+09	2		r/w	U32	Pump: Bit00 = Start Bit07 = Reset Bit10 = Control right Special: Bit00 = Operate Bit07 = Reset Bit10 = Control right Valve: Bit00 = Open Bit07 = Reset Bit10 = Control right
636 ^{*4}	Command word output	0	4.295E+09	2		r/w	U32 [0..2]	X201: Index 0 / X202: Index 1 / X203: Index 2 Pump: Bit00 = Start Bit07 = Reset Bit10 = Control right Special: Bit00 = Operate Bit07 = Reset Bit10 = Control right Valve: Bit00 = Open Bit07 = Reset Bit10 = Control right
643 ^{*3}	Accessory output switch-on delay	1,401E-42	3,403E+41	0	ms	r/w	R32	X201: Index 0 / X202: Index 1 / X203: Index 2
643 ^{*4}	Accessory output switch-on delay	1,401E-42	3,403E+41	0	ms	r/w	R32 [0..2]	X201: Index 0 / X202: Index 1 / X203: Index 2

Parameter List

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
644 ^{*3}	Accessory output switch-off delay	1.401E-42	3.403E+41	0	ms	r/w	R32	X201: Index 0 / X202: Index 1 / X203: Index 2
644 ^{*4}	Accessory output switch-off delay	1.401E-42	3.403E+41	0	ms	r/w	R32 [0..2]	X201: Index 0 / X202: Index 1 / X203: Index 2
647 ^{*3}	Lower frequency switching threshold	0	65535	5	Hz	r/w	U16	X201: Index 0 / X202: Index 1 / X203: Index 2
647 ^{*4}	Lower frequency switching threshold	0	65535	5	Hz	r/w	U16 [0..2]	X201: Index 0 / X202: Index 1 / X203: Index 2
648 ^{*4}	Upper pressure switching threshold	1.401E-42	3.403E+41	0	mbar	r/w	R32 [0..2]	X201: Index 0 / X202: Index 1 / X203: Index 2
649 ^{*4}	Lower pressure switching threshold	1.401E-42	3.403E+41	0	mbar	r/w	R32 [0..2]	X201: Index 0 / X202: Index 1 / X203: Index 2
652 ^{*3}	Lower current switching threshold	0	65535	15	0,1 A	r/w	U16	X201: Index 0 / X202: Index 1 / X203: Index 2
652 ^{*4}	Lower current switching threshold	0	65535	15	0,1 A	r/w	U16 [0..2]	X201: Index 0 / X202: Index 1 / X203: Index 2
656	Device name output 1	0	65535	0		r/w	U16 [0..30]	Name for X201
657 ^{*4}	Device name output 2	0	65535	0		r/w	U16 [0..30]	Name for X202
658 ^{*4}	Device name output 3	0	65535	0		r/w	U16 [0..30]	Name for X203
670 ^{*4}	Communication electronics temperature	0	65535	*2	°C	r	U16	Actual temperature of the communication electronic
671 ^{*4}	Com. elec. temp. warn. thres.	0	65535	75	°C	r	U16	Exceeding the communication electronic temperature warning threshold results in a warning.
672 ^{*4}	Com. elec. temp. err. thres.	0	65535	80	°C	r	U16	Exceeding the communication electronic temperature error threshold causes the pump to be switched off.
673 ^{*4}	Software version com. elec.	0	65535	*2		r	U16	xx.yy: version, zz: correction index
678 ^{*4}	Equipment error code	0	65535	*2		r	U16 [0..253]	Equipment error: number code indicates the error source. 1=System 101=Pump 201=Gauge
679 ^{*4}	Electronics op. hours at error	0	4.295E+09	*2	0,01 h	r	I32 [0..253]	Electronics operating time upon error occurrence
682	Electronics operating hours	0	4.295E+09	*2	0,01 h	r	I32	Operation hour Electronic

Parameter List

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
686 ^{*4}	Threshold for pressure dep. pump start	1.401E-42	3.403E+41	0	mbar	r/w	R32	Pressure threshold for function Pump start controlled by pressure
690 ^{*4}	Limits for analog output	1.401E-42	3.403E+41	0		r/w	R32 [0..2]	Index 0: Reserved Index 1: Value corresponding to 10 V at the analog output Index 2: Value corresponding to 0 V at the analog output
918 ^{*5}	Set parameter bus address	0	126	0		r/w	U16	Set parameter bus address
923 ^{*5}	Active bus address	0	126	*2		r	U16	Active bus address
924 ^{*5}	Type of bus address	0	1	1		r/w	U16	Source of Profibus address 0=Bus 1=Parameter
925 ^{*5}	Profibus device ID	0	65535	0		r/w	U16	Setting of Profibus device ID 3734=0x0E96 Device ID TVi 241=0x00F1 Device ID TD400 TD300
1025	Reset to factory default	0	65535	0		r/w	U16	A write command with any value Initializes the parameters to its factory defaults.
1050 ^{*5}	IP Address	0	255	0		r/w	U16 [0..3]	IP address of the device for web server and FTP
1051 ^{*5}	Subnet mask	0	255	0		r/w	U16 [0..3]	Subnet mask of the device for web server and FTP
1052 ^{*5}	DHCP	0	1	1		r/w	U16 [0..3]	0=Off 1=On
1054 ^{*5}	Web server	0	1	1		r/w	U16	0=Web server deactivated 1=Web server activated
1100	Drive electronics software version	0	65535	*2		r	U16	xx.yy: version, zz: correction index
1101	Converter temperature warning threshold	0	90	75	°C	r	I16	Exceeding the converter temperature warning threshold results in a warning
1102	Converter temperature error threshold	0	90	80	°C	r	I16	Exceeding the converter temperature error threshold causes the pump to be switched off.
1100	Drive electronics software version	0	65535	*2		r	U16	xx.yy: version, zz: correction index
1101	Converter temperature warning threshold	0	90	75	°C	r	I16	Exceeding the converter temperature warning threshold results in a warning
1102	Converter temperature error threshold	0	90	80	°C	r	I16	Exceeding the converter temperature error threshold causes the pump to be switched off.

Parameter List

No.	Designation	Min.	Max.	Default	Unit	r/w	Format	Description
1326 ^{*6}	Pump start/stop cycles remaining	0	65535	0		r	U16	This is number of start/stop cycles to the next impeller change / pump rebuild.
1327 ^{*6}	Pump run time	0	2147483647	0	s	r	I32	Time for which the pump has been running. This is time since last impeller change / pump rebuild.
1328 ^{*6}	Pump run time remaining	0	2147483647	0	s	r	I32	Time to the next impeller change / pump rebuild.
1329 ^{*6}	Pump run time since bearing replacement	0	2147483647	0	s	r	I32	Time since last bearing change.
1330 ^{*6}	Pump run time to bearing replacement	0	2147483647	0	s	r	I32	Time to the next bearing change due to activity.
1331 ^{*6}	Electronics ambient temperature	-32768	32767	0	°C	r	I16	
1332 ^{*6}	Product life in seconds	0	2147483647	3.15E+08	s	r	I32	Time between impeller change / pump rebuild.
1333 ^{*6}	Product life in cycles	0	2147483647	20000		r	I32	Number of cycles between impeller change / pump rebuild.
1334 ^{*6}	Major service Interval	0	2147483647	1.26E+08	s	r	I32	Time between bearing changes.
1335 ^{*6}	Elapsed seconds initialisation	0	2147483647	0	s	r/w	I32	When a new value is written to this register it is used to reset the internal elapsed seconds counter. The elapsed seconds counter is a parameter in the monitor values group. Zero time indicates the start of the year 2000 (UTC).

Notes:

*1 = specific values for each pump

*2 = measuring value

*3 = available for the TURBOVAC i only

*4 = available for the TURBOVAC iX only

*5 = w/ bus interface

*6 = available for the TURBOVAC 850/950 i(X) only

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.

Only for TURBOVAC iX: also under the same index number under parameter 678 the error source and under parameter 679 the corresponding number of operating hours of the electronics is saved.

Listed in the following are the possible error codes and their causes.

Error code	Designation	Possible cause	Remedy
1	Overspeed warning. The actual frequency exceeds the setpoint by over 10 Hz.	Frequency converter defective	Contact Leybold Service.
2	Pass through time error. The pump has not reached the minimum speed after the maximum run-up time has elapsed.	Forevacuum pressure too high Gas flow too high Rotor blocked	Check the ultimate pressure of the backing pump and install a bigger backing pump if required. Seal leak, check process Check if the rotor turns freely. Contact Leybold Service if the rotor is damaged or blocked.
3	Bearing temperature too high. The maximum permissible bearing temperature was exceeded.	Forevacuum pressure too high Gas flow too high Fan defective Water cooling switched off	Check the ultimate pressure of the backing pump and install a bigger backing pump if required. Seal leak, check process Replace fan Switch on water cooling
4	Short circuit error. Shortcut in motor coil or converter electronics	Hardware defective	Reset error, try to restart. If this is not possible inform Leybold Service or send in the pump.
5	Converter temperature error. Overtemperature at the power output stage or within the frequency converter	Ambient temperature too high Poor cooling	Ensure max. ambient temperature of 45°C Improve cooling
6	Run-up time error. The pump has not reached the normal operating frequency after the maximum run-up time.	Forevacuum pressure too high Gas flow too high	Check the ultimate pressure of the backing pump and install a bigger backing pump if required. Seal leak, check process
7	Motor temperature error. The motor temperature has exceeded the error threshold.	Forevacuum pressure too high Gas flow too high Fan defective Water cooling switched off	Check the ultimate pressure of the backing pump and install a bigger backing pump if required. Seal leak, check process Replace fan Switch on water cooling
61	Bearing temperature warning. The warning threshold of the bearing temperature has been exceeded.	Forevacuum pressure too high Gas flow too high Fan defective Water cooling switched off	Check the ultimate pressure of the backing pump and install a bigger backing pump if required. Seal leak, check process Replace fan Switch on water cooling
83	Motor undertemperature warning. The minimum permissible motor temperature is not attained.	Ambient temperature too low Pump cooling too high	Ensure min. ambient temperature of 5°C Reduce water cooling

Error Memory

Error code	Designation	Possible cause	Remedy
84	Motor temperature warning. The motor temperature has exceeded the warning threshold.	Forevacuum pressure too high Gas flow too high Fan defective Water cooling switched off	Check the ultimate pressure of the backing pump and install a bigger backing pump if required. Seal leak, check process Replace fan Switch on water cooling
85	Converter overtemperature warning. The converter temperature has exceeded the warning threshold.	Forevacuum pressure too high Gas flow too high Fan defective Water cooling switched off	Check the ultimate pressure of the backing pump and install a bigger backing pump if required. Seal leak, check process Replace fan Switch on water cooling
86	Pump temperature 6 warning. The pump temperature 6 has exceeded the warning threshold.	Forevacuum pressure too high Gas flow too high Fan defective Water cooling switched off	Check the ultimate pressure of the backing pump and install a bigger backing pump if required. Seal leak, check process Replace fan Switch on water cooling
87	Pump temperature 6 failure. The pump temperature 6 has exceeded the failure threshold.	Forevacuum pressure too high Gas flow too high Fan defective Water cooling switched off	Check the ultimate pressure of the backing pump and install a bigger backing pump if required. Seal leak, check process Replace fan Switch on water cooling
94	Pump temperature 4 warning. The pump temperature 4 has exceeded the warning threshold.	Forevacuum pressure too high Gas flow too high Fan defective Water cooling switched off	Check the ultimate pressure of the backing pump and install a bigger backing pump if required. Seal leak, check process Replace fan Switch on water cooling
95	Pump temperature 4 failure. The pump temperature 4 has exceeded the failure threshold.	Forevacuum pressure too high Gas flow too high Fan defective Water cooling switched off	Check the ultimate pressure of the backing pump and install a bigger backing pump if required. Seal leak, check process Replace fan Switch on water cooling
96	Pump temperature 5 warning. The pump temperature 5 has exceeded the warning threshold.	Forevacuum pressure too high Gas flow too high Fan defective Water cooling switched off	Check the ultimate pressure of the backing pump and install a bigger backing pump if required. Seal leak, check process Replace fan Switch on water cooling
97	Pump temperature 5 failure. The pump temperature 5 has exceeded the failure threshold.	Forevacuum pressure too high Gas flow too high Fan defective Water cooling switched off	Check the ultimate pressure of the backing pump and install a bigger backing pump if required. Seal leak, check process Replace fan Switch on water cooling

Error Memory

Error code	Designation	Possible cause	Remedy
101	Overload warning. The pump speed has dropped under the normal operation threshold	Forevacuum pressure too high Gas flow too high	Check the ultimate pressure of the backing pump and install a bigger backing pump if required. Seal leak, check process
103	Supply voltage warning. Intermediate circuit voltage too low or maximum time for generator operation was exceeded.	DC supply voltage below 24V resp. 48V Mains voltage has failed	Check the voltage at the power supply and if required set up correctly Remedy the cause for the mains power failure
106	Overload Failure . The pump speed has dropped under the minimum speed	Forevacuum pressure too high Gas flow too high	Check the ultimate pressure of the backing pump and install a bigger backing pump if required. Seal leak, check process
111	Motor undertemperature error. The minimum permissible motor temperature is not attained.	Ambient temperature too low Pump cooling too high	Ensure min. ambient temperature of 5°C Reduce water cooling
116	Permanent overload error. The speed of the pump has dropped below the normal operation threshold and has stayed there for a longer period of time.	Forevacuum pressure too high Gas flow too high	Check the ultimate pressure of the backing pump and install a bigger backing pump if required. Seal leak, check process
117	Motor current error. Motor current below nominal current, switchover from open loop controlled to closed loop controlled operation was not successful.	Cable fault Faulty connector	Contact Leybold Service
143	Overspeed failure. The actual frequency exceeds the setpoint frequency more than 10%.	Frequency converter defective	Contact Leybold Service
213	Supply voltage error 1. The drive circuitry was deactivated due to an over-voltage detected.	Usage of a wrong power supply unit. Misaligned output voltage	Check the voltage at the power supply and if required set up correctly
221	Checksum error 1. Checksum error during initialisation of the pump	Failure in the frequency converter Power reset during save procedure	Switch power supply off and on Restore factory settings (see parameter 1025)
225	Bearing run-in active. Bearing run-in procedure is active or passed		Wait for end of bearing break-in or disable bearing break-in function and restart the pump
227	Frequency converter collective error. Error in frequency converter	Hardware defective	Reset error, try to restart. If this is not possible inform Leybold Service or send in the pump.
228	Frequency converter collective error. Error in frequency converter	Hardware defective	Reset error, try to restart. If this is not possible inform Leybold Service or send in the pump.
229	Frequency converter collective error. Error in frequency converter	Hardware defective	Reset error, try to restart. If this is not possible inform Leybold Service or send in the pump.
230	Frequency converter collective error. Error in frequency converter	Hardware defective	Reset error, try to restart. If this is not possible inform Leybold Service or send in the pump.

Error Memory

Error code	Designation	Possible cause	Remedy
231	Supply voltage error 1. The drive circuitry was deactivated due to an over-voltage detected.	Usage of a wrong power supply unit. Misaligned output voltage	Check the voltage at the power supply and if required set up correctly.
232	Supply voltage error 1. The drive circuitry was deactivated due to an under-voltage detected.	Usage of a wrong power supply unit. Misaligned output voltage	Check the voltage at the power supply and if required set up correctly.
233	Supply voltage error 1. The drive circuitry was deactivated due to an over-voltage detected.	Usage of a wrong power supply unit. Misaligned output voltage	Check the voltage at the power supply and if required set up correctly.
234	Supply voltage error 1. The drive circuitry was deactivated due to an under-voltage detected.	Usage of a wrong power supply unit. Misaligned output voltage	Check the voltage at the power supply and if required set up correctly.
235	Frequency converter collective error. Error in frequency converter	Hardware defective	Reset error, try to restart. If this is not possible inform Leybold Service or send in the pump.
236	Startup- failure. Failure during startup procedure	Pump is mechanical blocked. High Gasload.	Check if the rotor rotates freely. Reduce gasload
237	Frequency converter collective error. Error in frequency converter	Hardware defective	Reset error, try to restart. If this is not possible inform Leybold Service or send in the pump.
238	Frequency converter collective error. Error in frequency converter	Hardware defective	Reset error, try to restart. If this is not possible inform Leybold Service or send in the pump.
239	Frequency converter collective error. Error in frequency converter	Hardware defective	Reset error, try to restart. If this is not possible inform Leybold Service or send in the pump.
240	Checksum error 2. Failure while operating or initialising the pump.	Failure in the frequency converter Power reset during save procedure	Switch power supply off and on Restore factory settings (see parameter 1025)
241	Supply voltage is not 24V. The permissible supply voltage of 24V was exceeded or undershot.	Usage of a wrong power supply unit. Misaligned output voltage	Check the voltage at the power supply and if required set up correctly
242	Supply voltage is not 48V. The permissible supply voltage of 48V was exceeded or undershot.	Usage of a wrong power supply unit. Misaligned output voltage	Check the voltage at the power supply and if required set up correctly
252	Hardware plausibility error. Frequency converter and communication electronics are not from same pump.	Front end and frequency converter were interchanged.	Establish the correct hardware configuration. Reset error, try to restart. If this is not possible inform Leybold Service or send in the pump.

Error Memory

Error code	Designation	Possible cause	Remedy
600	Second gauge stage not started. Although the working pressure was reached, the 2nd stage of a combined gauge did not start.	Gauge or cable defective.	Check gauge head and connection, if required replace the gauge head.
601	Gauge lost. Contact lost to a previously connected gauge.	The gauge was removed.	Reconnect the gauge.
602	No power supply at gauge. No measurement signal from the gauge.	Gauge does not get voltage. Cable defective.	Check cable.
603	No voltage at gauge output. Return signal from the gauge head output voltage is missing.	Internal power supply of the communication electronics defective.	Contact Leybold Service.
608	Filament break. The filament of the gauge is broken.	Wear	Repair or exchange gauge.
609	Pirani error. The measuring unit of the gauge is defective.	Wear	Repair or exchange gauge.
610	Communication electronics temperature warning. The interior temperature of the communication electronics has exceeded the warning limit.	Forevacuum pressure too high Gas flow too high Fan defective Water cooling switched off	Check the ultimate pressure of the backing pump and install a bigger backing pump if required. Seal leak, check process Replace fan Switch on water cooling
611	Communication electronics temperature failure. The interior temperature of the communication electronics has exceeded the error limit.	Forevacuum pressure too high Gas flow too high Fan defective Water cooling switched off	Check the ultimate pressure of the backing pump and install a bigger backing pump if required. Seal leak, check process Replace fan Switch on water cooling
612	Intermediate circuit voltage warning. The intermediate circuit voltage is too high or too low.	Wrong power supply voltage	Check the voltage of the power supply and adjust it if necessary.
612	Intermediate circuit voltage warning. The intermediate circuit voltage is too high or too low.	Wrong power supply voltage	Check the voltage of the power supply and adjust it if necessary.
700 – 704	Frequency converter collective error. Error with frequency converter	Hardware defective	Reset error, try to restart. If this is not possible, inform Leybold Service, or send in the pump.
705	RTC battery low / expired	The RTC battery is missing or has a low voltage	Contact Leybold Service.
706 – 707	Frequency converter collective error. Error with frequency converter	Hardware defective	Reset error, try to restart. If this is not possible, inform Leybold Service, or send in the pump.

Warnings

7 Warning Codes for Parameter 227

P227 Bit	Designation	Possible cause	Remedy
0	Pump temperature 1 has passed the warning threshold.	Forevacuum pressure too high.	Check the ultimate pressure of the backing pump and install a bigger backing pump if required.
1	Pump temperature 2 has passed the warning threshold.	Gas flow too high.	Seal leak, check process.
2	Pump temperature 3 has passed the warning threshold.	Fan defective.	Replace fan.
		Water cooling switched off.	Switch on water cooling.
3	The minimum permissible ambient temperature is not reached.	Ambient temperature too low.	Ensure min. ambient temperature of 5 °C.
		Pump cooling too high.	Reduce water cooling.
4, 5	Warning with frequency converter	Hardware defective	Contact Leybold Service.
6	The actual value exceeds the set-point by more than 10 Hz.	Frequency converter defective	Contact Leybold Service.
7	Pump temperature 4 has passed the warning threshold.	Forevacuum pressure too high.	Check the ultimate pressure of the backing pump and install a bigger backing pump if required.
		Gas flow too high.	Seal leak, check process.
		Fan defective.	Replace fan.
		Water cooling switched off.	Switch on water cooling.
8 - 10	not used		
11	The pump speed has dropped under the normal operation threshold.	Forevacuum pressure too high.	Check the ultimate pressure of the backing pump and install a bigger backing pump if required.
		Gas flow too high.	Seal leak, check process.
			Replace fan.
			Switch on water cooling.
12	Pump temperature 5 has passed the warning threshold.	Forevacuum pressure too high.	Check the ultimate pressure of the backing pump and install a bigger backing pump if required.
13	Pump temperature 6 has passed the warning threshold.	Gas flow too high.	Seal leak, check process.
		Fan defective.	Replace fan.
		Water cooling switched off.	Switch on water cooling.
14	Supply voltage failure during active operation of the pump.	Intermediate circuit voltage too low.	Check DC power supply voltage.
		Mains voltage failure.	Check mains voltage.

8 Operation of the Accessory Connections

Through the accessory connections (M8 plug) accessories can be electrically powered and driven. The switching behaviour (operation) of the accessory connections can be set up through parameters.

The functions for the accessory connections and the parameters must only be changed while the pump is at standstill as otherwise the connected accessories may only function incorrectly.

8.1 Configurations upon Delivery

The accessory connections have been preconfigured in the factory and are therefore immediately ready for operation upon connecting the accessory equipment.

Accessory Connection X201: Air Cooling Function

The output switches as soon as the pump is turning. Status word Bit 11 is set ("pump is turning").

Accessory Connection X202 (for TURBOVAC iX only):

Function: Relay Box for Backing Pump

The output switches as soon as the pump is started.

Control word Bit 00 is set ("start command").

Through parameter 643[1] and parameter 644[1] a switch-on and a switch-off delay time in ms can be set up for each. The default for the switch-on and switch-off delay time is 0 ms.

Accessory Connection X203 (for TURBOVAC iX only):

Function: Venting Valves

The output switches when the start signal control word Bit 00 is not set and the frequency drops below the upper limit.

When the frequency drops below the lower limit, the output is reset.

Switching of the output can be prevented by setting Bit 14 in the control word.

The limits can be changed through parameter 28 [2] (upper limit) and parameter 647 [2] (lower limit). The default settings are 999 Hz (upper limit) and 5 Hz (lower limit).

Accessory Connections

8.2 Function Codes of the Accessory Connections

The function of the accessory connections can be changed through

- parameter 134 for accessory connection X201 on the TURBOVAC i
- parameter 134 [0] for the accessory connection X201 on the TURBOVAC iX
- parameter 134 [1] for the accessory connection X202 on the TURBOVAC iX
- parameter 134 [2] for the accessory connection X203 on the TURBOVAC iX

by writing a certain value (called function code in the following) in to the respective parameter.

Through further parameters the limit values of the respective function can be changed.

When in a function code the output is enabled or disabled through a bit in the control word, the following bit is assigned to the respective output. Bit 10 must be enabled additionally.

Control word Bit 5: Accessory connection X201

Control word Bit 14: Accessory connection X202 (available on the TURBOVAC iX only)

Control word Bit 15: Accessory connection X203 (available on the TURBOVAC iX only)

Accessory Connections

Function code	Function	Bit controlled function	Status controlled function with switch-on and switch-off delay	Function with limit values
0	Always off			
1	Error	■		
2	No error	■		
3	Warning	■		
4	No warning	■		
5	Pump in normal operation	■		
6	Pump not in normal operation	■		
7	Pump is turning	■		
8	Pump at standstill		■	
18	Fieldbus controlled		■	
19	Always on			
23	Motor current dependent			■
24	Trigger current bearing temperature			■
25	Power failure venting			■
26	Pump has start command	■		
27	Pump is ready for switching on		■	
28	Fan 1 ("pump is turning") (default X201)	■		
29	Fan 2 ("frequency dependent")			■
30	Fan 3 ("bearing temperature dependent")			■
31	Purge gas valve 1 ("normally open")		■	
32	Purge gas valve 2 "normally closed")		■	
33	Purge gas valve 3 ("start command")		■	
34	Relay box for backing pump ("start command") (default X202)		■	
35	Relay box for backing pump 2 ("current dependent")			■
36	Venting valve ("frequency dependent") (default X203)			■
37	Acceleration of the pump	■		
38	Delay of the pump	■		
39	Pressure dependent			■
40	Venting function			■
41	Combination of power failure venting and frequency dependent venting			■

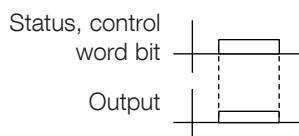
Accessory Connections

8.2.1 Status Controlled Functions

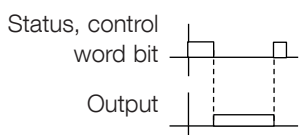
The output is set when a corresponding bit in the USS status or control word has been set.

Function code	Function	
0	Always off	The output is always disabled
1	Error	The output is set when Bit 3 in the USS status word is set (active error)
2	No error	The output is set when Bit 3 in the USS status word is not set (no active error)
3	Warning	The output is set when Bit 14 in the USS status word is set (collective warning)
4	No warning	The output is set when Bit 14 in the USS status word is not set (no collective warning)
5	Pump in normal operation	The output is set when Bit 10 in the USS status word is set (normal operation reached)
6	Pump not in normal operation	The output is set when Bit 10 in the USS status word is not set (no normal operation reached)
7	Pump is turning	The output is set when Bit 11 in the USS status word is set (pump is turning).
19	Always on	The output is always enabled
26	Pump has start command	The output is set when Bit 0 in the USS status word is set (start command)
28	Fan 1 ("pump is turning") (default X201)	The output is set when Bit 11 in the USS status word is set (pump is turning)
37	Acceleration of the pump	The output is set when Bit 4 in the USS status word is set (acceleration)
38	Delay of the pump	The output is set when Bit 5 in the USS status word is set (deceleration/delay)

State diagram for function code 0, 1, 3, 5, 6, 19, 26, 28, 37, 38



State diagram for function code 2, 4



Accessory Connections

8.2.2 Functions with Switch-on and Switch-off Delay

The output is set when a corresponding bit in the USS status or control word has been set.

Additionally a switch-on and switch-off delay time in milliseconds can be set up by writing a value into a parameter.

The parameter relates to the output and is the same parameter for every function which offers a switch-on and switch-off delay!

Parameter number and index	0	1	2
Switch-on delay time for the accessory connection P643	Connection X201	Connection X202	Connection X203
Switch-off delay time for the accessory connection P644			

When changing the function code for an accessory connection, the value in the parameter remains unchanged!

The parameter must (if necessary) is set by the user to 0! This does not happen automatically when changing a function code!

In the case of functions which do not take into account any delay times this does not matter since the value is not effective.

We urgently recommend that you consult Leybold when making changes to the pump settings. Unsuitable settings or incorrect combinations of settings may damage the pump or reduce its service life and will void any warranty claims.

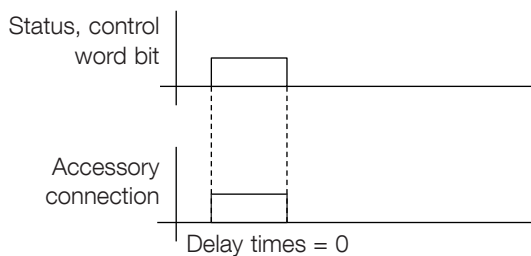
NOTICE



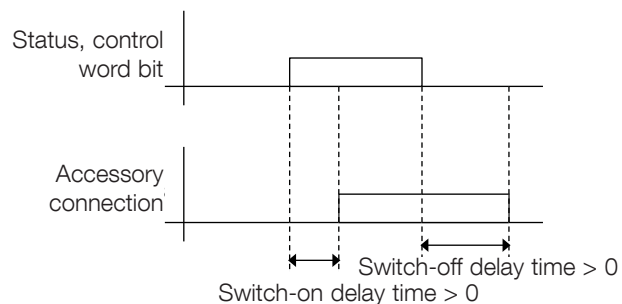
Accessory Connections

Function code	Function	The output is set when ...
18	Fieldbus controlled	the corresponding bit for the accessory output in the USS control word has been set (cf. Section 8.2)
27	Pump is ready for switching on	Bit 0 in the USS status word is set (pump ready for operation)
31	Purge gas valve 1 ("normally open")	the corresponding bit for the accessory output has been set in the USS control word (Bit 5: X201, Bit 14: X202, Bit 15: X203)
33	Purge gas valve 3 ("start command")	Bit 0 has been set in the USS control word (start command)
34	Relay box for backing pump ("start command") (default X202)	Bit 0 has been set in the USS control word (start command)

State diagram for function code 18, 27, 31, 33, 34

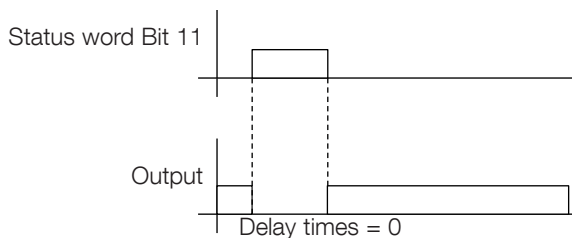


Additionally via Parameters 643 and 644, a switch-on/switch-off delay time can be set up.

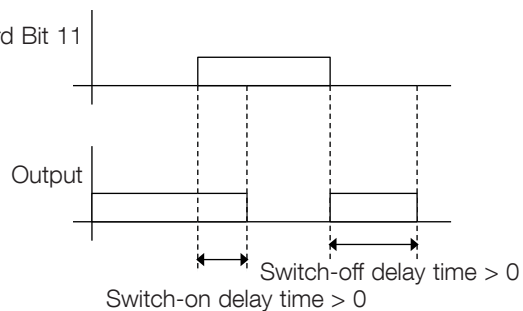


Function code	Function	The output is set when Bit 11 in the USS status word is not set (pump is turning).
8	Pump at standstill	

State diagram for function code 8



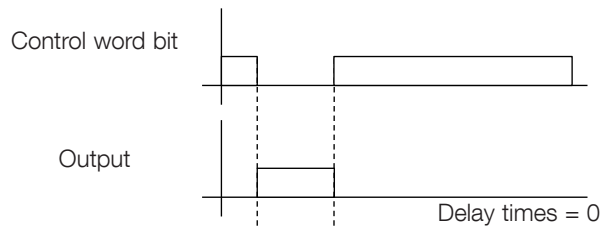
Additionally via Parameters 643 and 644, a switch-on/switch-off delay time can be set up.



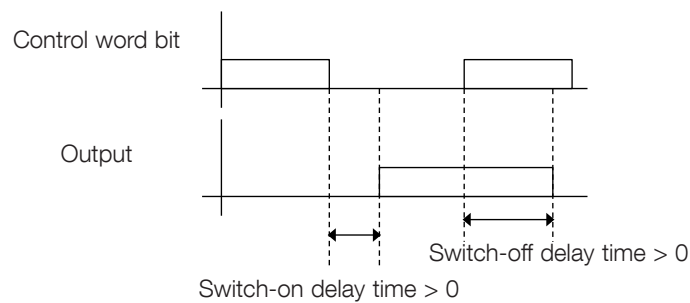
Accessory Connections

Function code	Function	
32	Purge gas valve 2 “normally closed”)	The output is set when the corresponding bit for the accessory output has not been set in the USS control word. (Bit 5: X201, Bit 14: X202, Bit 15: X203)

State diagram for function code 32



Additionally, a switch-on/switch-off delay time can be set up.
The delay time is entered in milliseconds.

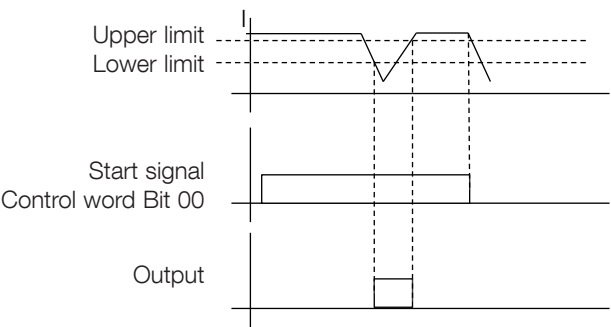


Accessory Connections

8.2.3 Functions with Limit Values

Function code	Function	
23	Motor current dependent	<p>The output is set when the current drops below the lower limit and in the USS status word Bit 00 has been set (start command).</p> <p>When the current exceeds the upper limit, the output is reset again.</p> <p>Parameter 27 [0 ... 2]: upper limit for accessory connection (unit 0.1 A)</p> <p>Parameter 652 [0 ... 2]: lower limit for accessory connection (unit 0.1 A)</p>

State diagram for function code 23



Note: The specification [0 ... 2] refers to the respective 24VDC-output, and represents the parameter array:

Parameter ... [0]: value for function output X201

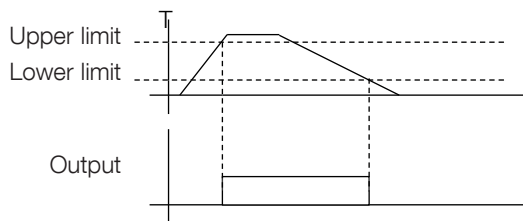
Parameter ... [1]: value for function output X202

Parameter ... [2]: value for function output X203

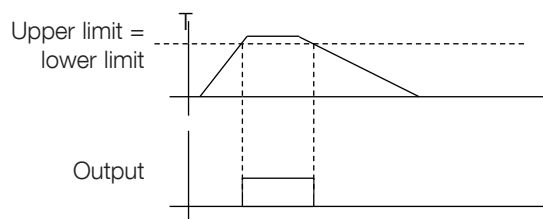
Accessory Connections

Function code	Function	
24	Current bearing temperature trigger	<p>The output is set when the bearing temperature exceeds the upper limit.</p> <p>When the bearing temperature drops below the lower limit, the output is reset again.</p> <p>Parameter 122 [0 ... 2]: upper limit for accessory connection (unit °C).</p> <p>Parameter 26 [0 ... 2]: lower limit for accessory connection (unit °C).</p> <p>The default settings are listed in the parameter list.</p>
29	Fan 2 ("frequency dependent")	<p>The output is set when the frequency exceeds the upper limit.</p> <p>When the frequency drops below the lower limit, the output is reset again.</p> <p>Parameter 28 [0 ... 2]: upper limit for accessory connection (unit Hz).</p> <p>Parameter 647 [0 ... 2]: lower limit for accessory connection (unit Hz).</p> <p>The default settings are listed in the parameter list.</p>
30	Fan 3 ("bearing temperature dependent")	<p>The output is set when the bearing temperature exceeds the upper limit.</p> <p>When the bearing temperature drops below the lower limit, the output is reset again.</p> <p>Parameter 122 [0 ... 2]: upper limit for accessory connection (unit °C).</p> <p>Parameter 26 [0 ... 2]: lower limit for accessory connection (unit °C).</p> <p>The default settings are listed in the parameter list.</p>
39	Pressure dependent	<p>The output is set when the pressure exceeds the upper limit.</p> <p>When the pressure drops below the lower limit, the output is reset again.</p> <p>Parameter 648 [0 ... 2]: upper limit for accessory connection (unit mbar).</p> <p>Parameter 649 [0 ... 2]: lower limit for accessory connection (unit mbar).</p> <p>The default settings are listed in the parameter list.</p>

State diagram for function code 24, 29, 30, 39



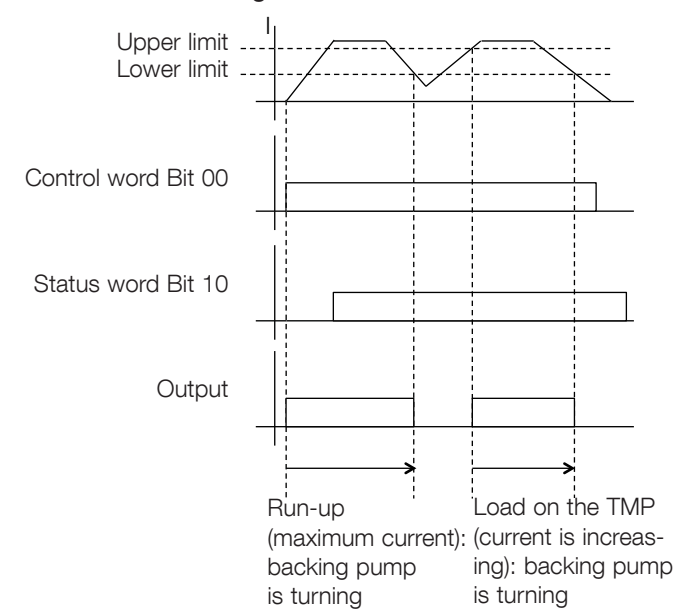
When upper limit = lower limit is set up then the output switches as soon as the limit is exceeded and it switches off again when the value drops below the limit.



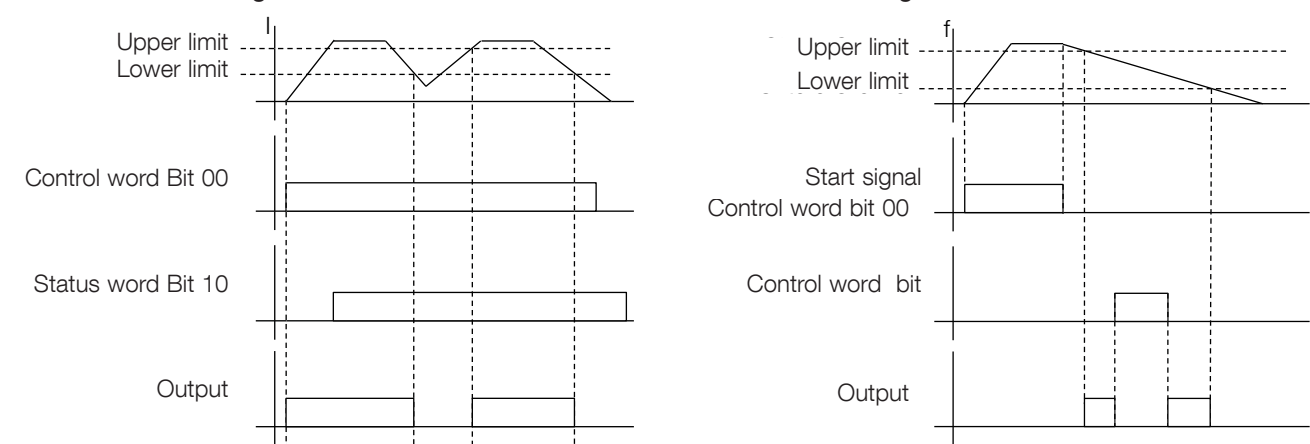
Accessory Connections

Function code	Function
35	<div>Relay box for backing pump 2 ("current dependent")</div> <div><div>1. When the pump runs up to nominal speed, the output is set until the current drops below the lower limit.</div><div>2. The output is set when control word Bit 00 is set (start command), status word Bit 10 is set (pump in normal operation) the current exceeds the upper limit</div><div>When the current drops below the lower limit, the output is reset again.</div><div>3. When the start signal is revoked, the output is reset..</div><div>Parameter 27 [0 ... 2]: upper limit for accessory connection (unit 0.1 A).</div><div>Parameter 652 [0 ... 2]: lower limit for accessory connection (unit 0.1 A).</div><div>The default settings are listed in the parameter list.</div></div>
36	<div>Venting valve ("frequency dependent") (default X203)</div> <div><div>The output is set when the control word Bit 00 (start command) is not set and the frequency drops below the upper limit.</div><div>When the frequency drops below the lower limit, the output is reset again.</div><div>Switching of the output can be prevented by setting the corresponding bit in the USS control word for the accessory output. (Bit 5: X201, Bit 14: X202, Bit 15: X203)</div><div>Parameter 28 [0 ... 2]: upper limit for accessory connection (unit Hz).</div><div>Parameter 647 [0 ... 2]: lower limit for accessory connection (unit Hz).</div><div>The default settings are listed in the parameter list.</div></div>

State diagram for function code 35



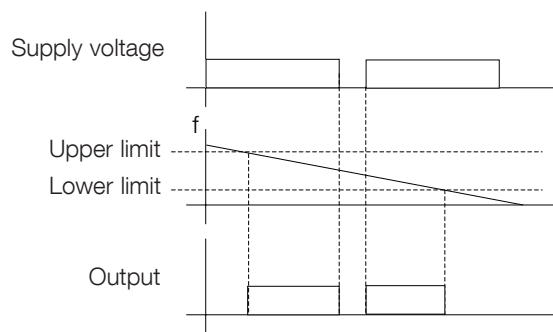
State diagram for function code 36



Accessory Connections

Function code	Function	
25	Power failure venting	<p>The output is reset when the supply power fails and the frequency drops below the upper limit.</p> <p>When the frequency drops below the lower limit, the output is set again.</p> <p>Parameter 247: upper limit for accessory connection (unit Hz).</p> <p>Parameter 248: lower limit for accessory connection (unit Hz).</p> <p>The default settings are listed in the parameter list.</p>

State diagram for function code 25



Note: with iX the values set for all three function outputs X201 / X202 / X203 are valid.

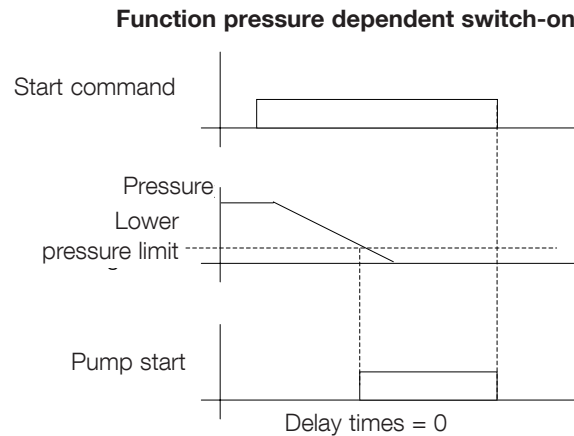
Accessory Connections

Function code	Function	
40	Venting function	<p>By default, the output is disabled.</p> <p>The output is enabled, as long as a STOP command is present with the pump turning.</p> <p>Switching of the output can be prevented by setting the corresponding bit in the USS control word for the accessory output.</p> <p>(Bit 5: X201, Bit 14: X202, Bit 15: X203)</p>
41	Combination of power failure venting and frequency dependent venting	<p>By default, the output is enabled.</p> <p>Power failure venting:</p> <p>The output is disabled, when the supply power fails with the frequency dropping below the upper limit. When the frequency drops below the lower limit, the output is enabled again.</p> <p>Parameter 247: upper limit for accessory connection (unit Hz) Parameter 248: lower limit for accessory connection (unit Hz)</p> <p>The default settings are listed in the parameter list.</p> <p>Frequency dependent venting:</p> <p>The output will be disabled, when a STOP command is present with the frequency dropping below the upper limit.. When the frequency drops below the lower limit, the output is enabled again.</p> <p>Parameter 28 [0 ... 2]: upper limit for accessory connection (unit Hz) Parameter 647 [0 ... 2]: lower limit for accessory connection (unit Hz)</p> <p>The default settings are listed in the parameter list.</p>

8.2.4 Function for Pressure Dependent Switching on of the Pump

Through parameter 625 the function can be enabled. P625 = 0 – disabled. P625 = 1 – enabled. The pressure limit can be set up through parameter 686.

When the function has been enabled, the pump will respond as shown in the diagram: the pump starts when a start command is present and the pressure has dropped below the limit.



Example for Telegrams

Annex: Profibus strings

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

For the TURBOVAC i
Bit 14 (24 VDC output X202) and
Bit 15 (24 VDC output X203) have
no function in the control word.

Abr.		Description	Dez	Value Hex	Bin	Bit	Byte	Word	Bit	Bin	Value Hex	Dez	Description		Abr.
PKE	Query designator					7	0		15					Reply designator	PKE
					6	14									
					5	13									
					4	12									
	Res.				3	11			10			Res.			
					2	10									
					1	9									
					0	8									
	Parameter number					7	1		7			Parameter number			
						6			6						
						5			5						
						4			4						
						3	3			3					
						2	2								
						1	1								
						0	0								
IND	Parameter Index				7	2		15			Parameter Index				
					6			14							
					5			13							
					4			12							
					3	11			10						
					2	9									
					1	8									
					0										
-	Reserved				6	3		6			Reserved				
					5			5							
					4			4							
					3			3							
					2	2			1						
					1										
					0										
PWE	Parameter value				7	4		15			Parameter value				
					6			14							
					5			13							
					4			12							
					3	11			10						
					2	9									
					1	8									
					0										
					7	2		7							
					6			6							
					5			5							
					4			4							
					3	3			3						
					2	2									
					1	1									
					0										
					7	6		15							
					6			14							
					5			13							
					4			12							
					3	11			10						
					2	9									
					1	8									
					0										
					7	3		7							
					6			6							
					5			5							
					4			4							
					3	3			3						
					2	2									
					1	1									
					0										
PZD1	Control word	24 VDC Output X203			7	8		15			Status word				
		24 VDC Output X202			6			14							
		Warning relay			5			13							
		Normal operation relay			4			12							
		Error relay			3	11			10						
		Activate remote			2	9									
		-			1	8									
		Standby speed			0										
		Error reset			7	9		7							
		Enable setpoint			6			6							
		24 VDC Output X201			5			5							
		-			4			4							
		-			3	3			3						
		-			2	2									
		-			1	1									
		Start/Stop			0										
PZD2	Setpoint rotor speed				7	10		15			Actual rotor speed				
					6			14							
					5			13							
					4			12							
					3	11			10						
					2	9									
					1	8									
					0										
					7	5		7							
					6			6							
					5			5							
					4			4							
					3			3				3			
					2			2							
					1			1							
					0										

Example for Telegrams

Abr.		Description	Value Dez Hex Bin	Bit	Byte	Word	Bit	Value Dez Hex Bin	Description		Abr.
①	PZD1	Control word	4	4	8	4	15	142	Status word	PZD1	③
		24 VDC Output X203									
		24 VDC Output X202									
		Warning relay									
		Normal operation relay									
		Error relay									
		Activate remote									
		-									
		Standby speed									
		Error reset									
		Enable setpoint									
		24 VDC Output X201									
		-									
		-									
		-									
		Start/Stop									
②	PZD2	Setpoint rotor speed	0	0	10	5	15	1000	Actual rotor speed	PZD2	②

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 1000 Hz (2) during normal operation (3).

Abr.		Description	Value Dez Hex Bin	Bit	Byte	Word	Bit	Value Dez Hex Bin	Description		Abr.
①	PZD1	Control word	4	4	8	4	15	142	Status word	PZD1	④
		24 VDC Output X203									
		24 VDC Output X202									
		Warning relay									
		Normal operation relay									
		Error relay									
		Activate remote									
		-									
		Standby speed									
		Error reset									
		Enable setpoint									
		24 VDC Output X201									
		-									
		-									
		-									
		Start/Stop									
②	PZD2	Setpoint rotor speed	700	2	10	5	15	700	Actual rotor speed	PZD2	③

Example 2: Setpoint active

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

Example for Telegrams

Example 3:

Read parameter 150

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

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

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

Example for Telegrams

	Abr.	Description	Value				Byte	Word	Value				Description	Abr.
			Dec	Hex	Bin	Bit			Dec	Hex	Bin	Bit		
③	PKE	Query designator	2		00000000	7	0	0	2		00000000	7	PKE	⑤
		Res.	0	20	00000000	6			0	20	00000000	6		
①	PKE	Parameter number	150	96	01001010	1	1	0	150	96	01001010	1	PKE	⑥
		Res.	0		00000000	0			0		00000000	0		
	IND	Parameter Index	0	0	00000000	2	2	1	0	0	00000000	2	IND	
		Res.	0	0	00000000	1			0	0	00000000	1		
	.	Reserved	0	0	00000000	3	3	0	0	0	00000000	3	.	
		Res.	0	0	00000000	0			0	0	00000000	0		
②	PWE	Parameter value	500	F4	00111100	7	7	3	500	F4	00111100	7	PWE	
		Res.	0		00000000	6			0		00000000	6		

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.

Example for Telegrams

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 bea-
ring fault (6).

Abr.		Description	Value				Word	Value				Description	Abr.
			Dez	Hex	Bin	Bit		Bin	Hex	Dez			
③	Query designator		6	60	0 0 0 0 0 0 0 0	0	15	0	40		Reply designator		
					0 0 0 0 0 0 0 0		14	0					
②	PKE	Parameter number	171	AB	0 0 0 0 0 0 0 0	0	13	0	171	AB	Parameter number		
					0 0 0 0 0 0 0 0		11	0					
①	IND	Parameter Index	1	1	0 0 0 0 0 0 0 0	2	10	0	1	1	Parameter Index		
					0 0 0 0 0 0 0 0		9	0					
	Reserved	Reserved	0	0	0 0 0 0 0 0 0 0	3	7	0	0	0	Reserved		
					0 0 0 0 0 0 0 0		6	0					
	PWE	Parameter value	0	0	0 0 0 0 0 0 0 0	4	5	0	0	0	Parameter value		
					0 0 0 0 0 0 0 0		4	0					
			0	0	0 0 0 0 0 0 0 0	5	3	0	0	0			
					0 0 0 0 0 0 0 0		2	0					
			0	0	0 0 0 0 0 0 0 0	6	1	0	0	0			
					0 0 0 0 0 0 0 0		0	0					
			0	0	0 0 0 0 0 0 0 0	7	15	0	7	7			
					0 0 0 0 0 0 0 0		14	0					
			0	0	0 0 0 0 0 0 0 0	3	13	0	0	0			
					0 0 0 0 0 0 0 0		12	0					
			0	0	0 0 0 0 0 0 0 0		11	0	0	0			
					0 0 0 0 0 0 0 0		10	0					
			0	0	0 0 0 0 0 0 0 0		9	0	0	0			
					0 0 0 0 0 0 0 0		8	0					
			0	0	0 0 0 0 0 0 0 0		7	0	0	0			
					0 0 0 0 0 0 0 0		6	0					
			0	0	0 0 0 0 0 0 0 0		5	0	0	0			
					0 0 0 0 0 0 0 0		4	0					
			0	0	0 0 0 0 0 0 0 0		3	0	0	0			
					0 0 0 0 0 0 0 0		2	0					
			0	0	0 0 0 0 0 0 0 0		1	0	0	0			
					0 0 0 0 0 0 0 0		0	0					
			0	0	0 0 0 0 0 0 0 0		15	0	7	7			
					0 0 0 0 0 0 0 0		14	0					
			0	0	0 0 0 0 0 0 0 0		13	0	0	0			
					0 0 0 0 0 0 0 0		12	0					
			0	0	0 0 0 0 0 0 0 0		11	0	0	0			
					0 0 0 0 0 0 0 0		10	0					
			0	0	0 0 0 0 0 0 0 0		9	0	0	0			
					0 0 0 0 0 0 0 0		8	0					
			0	0	0 0 0 0 0 0 0 0		7	0	0	0			
					0 0 0 0 0 0 0 0		6	0					
			0	0	0 0 0 0 0 0 0 0		5	0	0	0			
					0 0 0 0 0 0 0 0		4	0					
			0	0	0 0 0 0 0 0 0 0		3	0	0	0			
					0 0 0 0 0 0 0 0		2	0					
			0	0	0 0 0 0 0 0 0 0		1	0	0	0			
					0 0 0 0 0 0 0 0		0	0					
			0	0	0 0 0 0 0 0 0 0		15	0	7	7			
					0 0 0 0 0 0 0 0		14	0					
			0	0	0 0 0 0 0 0 0 0		13	0	0	0			
					0 0 0 0 0 0 0 0		12	0					
			0	0	0 0 0 0 0 0 0 0		11	0	0	0			
					0 0 0 0 0 0 0 0		10	0					
			0	0	0 0 0 0 0 0 0 0		9	0	0	0			
					0 0 0 0 0 0 0 0		8	0					
			0	0	0 0 0 0 0 0 0 0		7	0	0	0			
					0 0 0 0 0 0 0 0		6	0					
			0	0	0 0 0 0 0 0 0 0		5	0	0	0			
					0 0 0 0 0 0 0 0		4	0					
			0	0	0 0 0 0 0 0 0 0		3	0	0	0			
					0 0 0 0 0 0 0 0		2	0					
			0	0	0 0 0 0 0 0 0 0		1	0	0	0			
					0 0 0 0 0 0 0 0		0	0					
			0	0	0 0 0 0 0 0 0 0		15	0	7	7			
					0 0 0 0 0 0 0 0		14	0					
			0	0	0 0 0 0 0 0 0 0		13	0	0	0			
					0 0 0 0 0 0 0 0		12	0					
			0	0	0 0 0 0 0 0 0 0		11	0	0	0			
					0 0 0 0 0 0 0 0		10	0					
			0	0	0 0 0 0 0 0 0 0		9	0	0	0			
					0 0 0 0 0 0 0 0		8	0					
			0	0	0 0 0 0 0 0 0 0		7	0	0	0			
					0 0 0 0 0 0 0 0		6	0					
			0	0	0 0 0 0 0 0 0 0		5	0	0	0			
					0 0 0 0 0 0 0 0		4	0					
			0	0	0 0 0 0 0 0 0 0		3	0	0	0			
					0 0 0 0 0 0 0 0		2	0					
			0	0	0 0 0 0 0 0 0 0		1	0	0	0			
					0 0 0 0 0 0 0 0		0	0					
			0	0	0 0 0 0 0 0 0 0		15	0	7	7			
					0 0 0 0 0 0 0 0		14	0					
			0	0	0 0 0 0 0 0 0 0		13	0	0	0			
					0 0 0 0 0 0 0 0		12	0					
			0	0	0 0 0 0 0 0 0 0		11	0	0	0			
					0 0 0 0 0 0 0 0		10	0					
			0	0	0 0 0 0 0 0 0 0		9	0	0	0			
					0 0 0 0 0 0 0 0		8	0					
			0	0	0 0 0 0 0 0 0 0		7	0	0	0			
					0 0 0 0 0 0 0 0		6	0					
			0	0	0 0 0 0 0 0 0 0		5	0	0	0			
					0 0 0 0 0 0 0 0		4	0					
			0	0	0 0 0 0 0 0 0 0		3	0	0	0			
					0 0 0 0 0 0 0 0		2	0					
			0	0	0 0 0 0 0 0 0 0		1	0	0	0			
					0 0 0 0 0 0 0 0		0	0					
			0	0	0 0 0 0 0 0 0 0		15	0	7	7			
					0 0 0 0 0 0 0 0		14	0					
			0	0	0 0 0 0 0 0 0 0		13	0	0	0			
					0 0 0 0 0 0 0 0		12	0					
			0	0	0 0 0 0 0 0 0 0		11	0	0	0			
					0 0 0 0 0 0 0 0		10	0					
			0	0	0 0 0 0 0 0 0 0		9	0	0	0			
					0 0 0 0 0 0 0 0		8	0					
			0	0	0 0 0 0 0 0 0 0		7	0	0	0			
					0 0 0 0 0 0 0 0		6	0					
			0	0	0 0 0 0 0 0 0 0		5	0	0	0			
					0 0 0 0 0 0 0 0		4	0					
			0	0	0 0 0 0 0 0 0 0		3	0	0	0			
					0 0 0 0 0 0 0 0		2	0					
			0	0	0 0 0 0 0 0 0 0		1	0	0	0			
					0 0 0 0 0 0 0 0		0	0					
			0	0	0 0 0 0 0 0 0 0		15	0	7	7			
					0 0 0 0 0 0 0 0		14	0					
			0	0	0 0 0 0 0 0 0 0		13	0	0	0			
					0 0 0 0 0 0 0 0		12	0					
			0	0	0 0 0 0 0 0 0 0		11	0	0	0			
					0 0 0 0 0 0 0 0		10	0					
			0	0	0 0 0 0 0 0 0 0		9	0	0	0			
					0 0 0 0 0 0 0 0		8	0					
			0	0	0 0 0 0 0 0 0 0		7	0	0	0			
					0 0 0 0 0 0 0 0		6	0					
			0	0	0 0 0 0 0 0 0 0		5	0	0	0			
					0 0 0 0 0 0 0 0		4	0					
			0	0	0 0 0 0 0 0 0 0		3	0	0	0			
					0 0 0 0 0 0 0 0		2	0					
			0	0	0 0 0 0 0 0 0 0		1	0	0	0			
					0 0 0 0 0 0 0 0		0	0					
			0	0	0 0 0 0 0 0 0 0		15	0	7	7			
					0 0 0 0 0 0 0 0		14	0					
			0	0	0 0 0 0 0 0 0 0		13	0	0	0			
					0 0 0 0 0 0 0 0		12	0					
			0	0	0 0 0 0 0 0 0 0		11	0	0	0			
					0 0 0 0 0 0 0 0		10	0					
			0	0	0 0 0 0 0 0 0 0		9	0	0	0			
					0 0 0 0 0 0 0 0		8	0					
			0	0	0 0 0 0 0 0 0 0		7	0	0	0			
					0 0 0 0 0 0 0 0		6	0					
			0	0	0 0 0 0 0 0 0 0		5	0	0	0			
					0 0 0 0 0 0 0 0		4	0					
			0	0	0 0 0 0 0 0 0 0		3	0	0	0			
					0 0 0 0 0 0 0 0		2	0					
			0	0	0 0 0 0 0 0 0 0		1	0	0	0			
					0 0 0 0 0 0 0 0		0	0					
			0	0	0 0 0 0 0 0 0 0		15	0	7	7			
					0 0 0 0 0 0 0 0		14	0					
			0	0	0 0 0 0 0 0 0 0		13	0	0	0			
					0 0 0 0 0 0 0 0		12	0					
			0	0	0 0 0 0 0 0 0 0		11	0	0	0			
					0 0 0 0 0 0 0 0		10	0					
			0	0	0 0 0 0 0 0 0 0		9	0	0	0			
					0 0 0 0 0 0 0 0		8	0					
			0	0	0 0 0 0 0 0 0 0		7	0	0	0			
					0 0 0 0 0 0 0 0		6	0					
			0	0	0 0 0 0 0 0 0 0		5	0	0	0			
					0 0 0 0 0 0 0 0		4	0					
			0	0	0 0 0 0 0 0 0 0		3	0	0	0			
					0 0 0 0 0 0 0 0		2	0					
			0	0	0 0 0 0 0 0 0 0		1	0	0	0			
					0 0 0 0 0 0 0 0		0	0					
			0	0	0 0 0 0 0 0 0 0		15	0	7	7			
					0 0 0 0 0 0 0 0		14	0					
			0	0	0 0 0 0 0 0 0 0		13	0	0	0			
					0 0 0 0 0 0 0 0		12	0					
			0	0	0 0 0 0 0 0 0 0		11	0	0	0			
					0 0 0 0 0 0 0 0		10	0					
			0	0	0 0 0 0 0 0 0 0		9	0	0	0			
					0 0 0 0 0 0 0 0		8	0					
			0	0	0 0 0 0 0 0 0 0		7	0	0	0			
					0 0 0 0 0 0 0 0		6	0					
			0	0	0 0 0 0 0 0 0 0		5	0	0	0			

Example for Telegrams

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