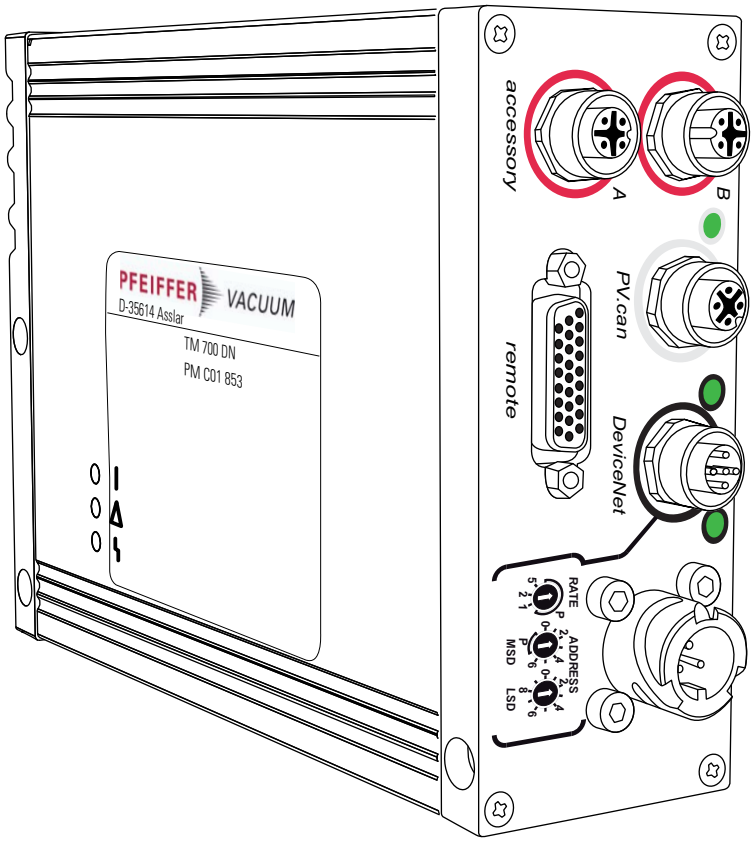
A PASSION FOR PERFECTION

PFEIFFER VACUUM



TM 700 DN

Electronic Drive Unit

Operating Instructions

EN

Translation of the original instructions

PT 0356 BEN/C (1203)

Table of contents

1 About this manual

1.1 Validity

This operating manual is for customers of Pfeiffer Vacuum. It describes the functioning of the designated product and provides the most important information for safe use of the unit. The description follows applicable EU guidelines. All information provided in this operating manual refer to the current state of the product's development. The documentation remains valid as long as the customer does not make any changes to the product.

Up-to-date operating instructions can also be downloaded from www.pfeiffer-vacuum.com.

1.2 Conventions

Safety instructions

The safety instructions in Pfeiffer Vacuum operating instructions are the result of risk evaluations and hazard analyses and are oriented on international certification standards as specified by UL, CSA, ANSI Z-535, SEMI S1, ISO 3864 and DIN 4844. In this document, the following hazard levels and information are considered:

CAUTION
Possible danger Injuries or property damages can occur.

NOTE
Command or note Command to perform an action or information about properties, the disregarding of which may result in damage to the product.

Pictograph definitions

Warning of a displayed source of danger in connection with operation of the unit or equipment.

Command to perform an action or task associated with a source of danger, the disregarding of which may result in serious accidents.

Instructions in the text

➔ Work instruction: here you have to do something.

Abbreviations used

DCU:	Display and control unit
HPU:	Handheld programming unit
TC:	Electronic drive unit for turbopump
TPS:	Mains pack
DI / DO:	Digital input / digital output
AI / AO:	Analog input / analog output
f:	Rotation speed (derivated from frequency in Hz)
[P:000]:	Parameter of the electronic drive unit with number

2 Safety

NOTE

Duty to inform

Each person involved in the installation or operation of the unit must read and observe the safety-related parts of these operating instuctions.

➔ The operator is obligated to make operating personnel aware of dangers originating from the unit or the entire system.

2.1 Safety precautions

WARNING

Danger of unsafe electrical installation

Safe operation after installation is the responsibility of the operator.

➔ Do not independently modify or change the pump and electrical equipment.
➔ Make sure that the system is integrated in an emergency off safety circuit.
➔ Consult Pfeiffer Vacuum for special requirements.

WARNING

Danger of electric shock

In case of defect, the parts connected to the mains supply are under voltage.

➔ Always keep the mains connection freely accessible so you can disconnect it at any time.

- **Power supply:** The turbopump power supply must apply to the requirements of double insulation between mains input voltage and operating voltage according to the regulations of IEC 61010 and IEC 60950. Therefore Pfeiffer Vacuum recommends to use exclusively original-power packs and -accessories. Only in this case Pfeiffer Vacuum is able to guarantee the compliance of the European and North American guidelines.
- Observe all safety and accident prevention regulations.
- A safe connection to the protective earthing conductor (PE) is recommended (protection class III).
- Regularly check the proper observance off all safety measures.
- Before carrying out any work disconnect the unit and all associated installations safely from the mains.
- Do not loosen any plug connection during operations.
- The unit has been accredited with protection class IP 54. Take necessary measures when installing into ambient conditions, which afford other protection classes.
- Keep leads and cables well away from hot surfaces (> 70 °C).
- Only separate the pump and the electronic drive unit from each other after disconnecting the supply voltage and the complete standstill of the pump.

2.2 Proper use

NOTE

CE conformity

The manufacturer's declaration of conformity becomes invalid if the operator modifies the original product or installs additional components.

➔ Following installation into a plant and before commissioning, the operator must check the entire system for compliance with the valid EU directives and reassess it accordingly.

- The electronic drive unit TM 700 DN operates designated Pfeiffer Vacuum turbopumps and their accessories in a DeviceNet bus system.

2.3 Improper use

Improper use will cause all claims for liability and warranties to be forfeited. Improper use is deemed to be all use for purposes deviating from those mentioned above, especially:

- The use of accessories or spare parts, which are not named in this manual.
- The operation of the devices in potentially radioactive areas.

NOTE

Closure seal

The product is sealed at the factory. Damaging or removal of a closure seal leads to the loss of liability and warranty entitlements.

➔ Do not open the product within its warranty period!

➔ For process-related shorter maintenance intervals please contact the Pfeiffer Vacuum Service.

3 Product description

3.1 Product identification

This product has been tested to the requirements of CAN/CSA-C22.2 No. 61010-1, second edition, including Amendment 1, or a later version of the same standard incorporating the same level of testing requirements.

For information about other certifications, if applicable, please see the signet on the product or:

- www.tuvdotcom.com
- TUVdotCOM-ID 0000021320

Product features

The electronic drive unit TM 700 DN is an integrated component of the turbopump. It's purpose is to drive, monitor and control the entire pump.

Characteristics	TM 700 DN
Connection voltage TC	48 V DC ± 5 %
Connection panel	DeviceNet
Turbopump HiPace	300 M, 700 M, 800 M

To correctly identify the product when communicating with Pfeiffer Vacuum, always have the information from the rating plate available.

Scope of delivery

- CD-ROM for DeviceNet connection with EDS files

3.2 Range of application

Pfeiffer Vacuum electronic drive units TM 700 DN must be installed and operated in the following ambient conditions.

Installation location	weather protected (indoors)
Protection category	IP 54
Protection class	III
Temperature	+5 °C to +40 °C (up to +35 °C with air cooling)
Relative humidity	max. 80 %, at T ≤ 31 °C, up to max. 50% at T ≤ 40 °C
Atmospheric pressure	75 kPa - 106 kPa
Installation altitude	2000 m max.
Degree of pollution	2
Overvoltage category	II

3.3 Function

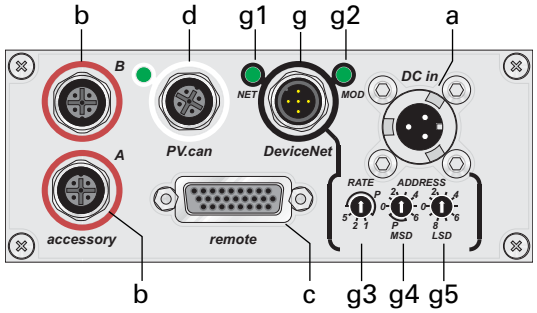
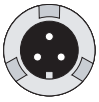
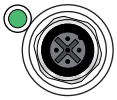
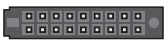


Fig. 1: DeviceNet panel for the TM 700 DN

a	Mains connection "*DC in*"	g1	DeviceNet status LED
b	Connection "*accessory A+B*"	g2	Device status LED
c	Connection "*remote*"	g3	DeviceNet baudrate switch
d	Service connection "*PV.can*"	g4	DeviceNet address selection switch MSD
g	Connection "*DeviceNet*"	g5	DeviceNet address selection switch LSD

3.4 General connection description

	***DC in***[1] Casing plug with bayonet locking for the voltage supply between Pfeiffer Vacuum mains packs and the electronic drive unit TC.
	***Accessory*** M12 socket with screw coupling for the connection of Pfeiffer Vacuum accessories. The use of a Y-connector enables double assignment of one connection.
	***PV.can***[2] M12 casing socket with screw coupling and LED for Pfeiffer Vacuum Service purposes.
	***remote*** High Density D-sub 26 pole female socket for the connection of a remote control.
	***DeviceNet*** M12 plug (sealed micro) with screw coupling and LEDs for the connection of a DeviceNet bus system.
	Casing socket on the rear side of the electronic drive unit for the connection to the turbopump.

1. "DC in" and "accessory" are already described in the operating instructions of the turbopump.
2. The connection "PV.can" serves to service purposes exclusively.

4 Connections diagram

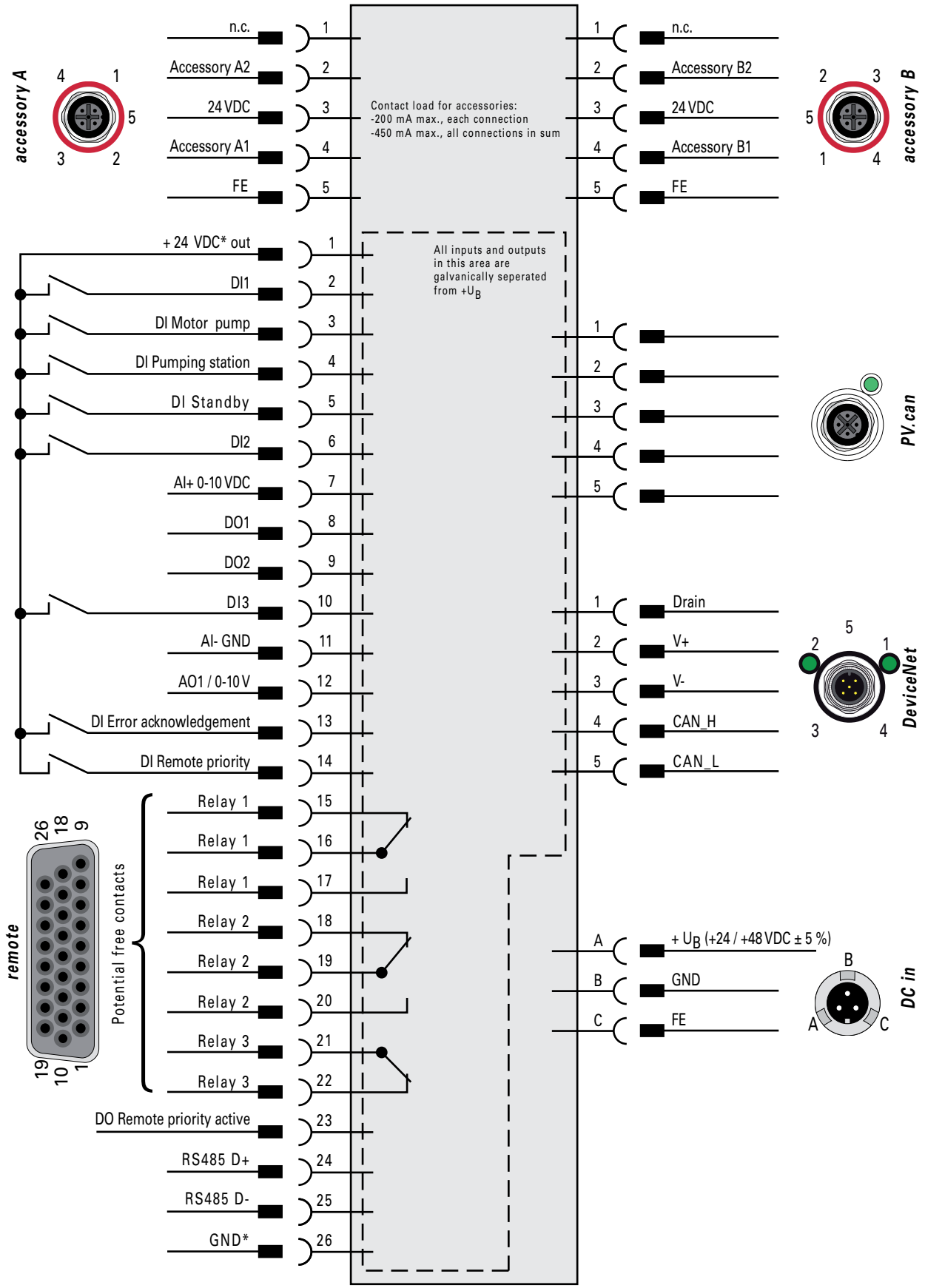
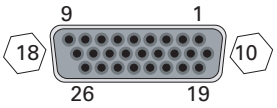


Fig. 2: Connections diagram and assignment of the TM 700 DN

5 Connection "*remote*"



Remote control options are provided via the 26-pole D-Sub connector with the designation ”*remote*“ on the electronic drive unit.

➔ Shielded connectors and cables must be used.

The following information display the factory setting. Configuration is possible using the Pfeiffer Vacuum parameter set.

5.1 Pin assignment

Pin	Function	Designation factory settings
1	+24 V DC output (V+)	Reference voltage for all digital in- and outputs
2	DI1	Enable venting; open: no; V+: yes
3	DI Motor pump	Drive motor; open: off; V+: on
4	DI Pumping station	Open: off; V+: on and error acknowledgement
5	DI Standby	Standby rotation speed; open: off; V+: on
6	DI2	Heating; open: off; V+: on
7	AI+ Rotation speed setting mode	Set value in rotation speed setting mode; 2-10 V DC = 20-100% of the nominal rotation speed
8	DO1	Rotation speed switch point attained; GND:no; V+: yes (I_{max} = 50 mA/24 V)
9	DO2	GND: error; V+: no error (I_{max} = 50 mA/24 V)
10	DI3	Sealing gas; open: off; V+: on
11	AI- Rotation speed setting mode GND	Set value in rotation speed setting mode; GND
12	AO1	Actual rotation speed; 0-10 V DC is equivalent to 0-100%; R_L > 10 kΩ
13	DI Error acknowledgement	Error acknowledgement: V+ pulse (min 500 ms)
14	DI Remote priority	Control via interface "remote"; open: off V+: set and priority over other digital inputs
15	Relais 1	Connection to Pin 16 if relay 1 is inactive
16	Relais 1	Rotation speed switchpoint attained; relay contact 1 (U_{max} = 50 V DC; I_{max} = 1 A)
17	Relais 1	Connection to Pin 16 if relay 1 is active
18	Relais 2	Connection to Pin 19 if relay 2 is inactive
19	Relais 2	No error; relay contact 2 (U_{max} = 50 V DC; I_{max} = 1 A)
20	Relais 2	Connection to Pin 19 if relay 2 is active
21	Relais 3	Connection to Pin 22 if relay 3 is inactive
22	Relais 3	Warning; relay contact 3 (U_{max} = 50 V DC; I_{max} = 1 A)
23	DO Remote priority	GND: off; V+: remote priority active
24	RS-485 D+	according to specifications and Pfeiffer Vacuum protocol
25	RS-485 D-	according to specifications and Pfeiffer Vacuum protocol
26	Ground (GND)	Reference ground for all digital inputs and all outputs

5.2 Operation via "*remote*" connection

CAUTION

Increased wear and damage due to incorrect operation

Active magnetic bearings require a constant power supply. The motor acts as a generator and supplies the drive electronics in the event of a power failure. Below a speed of approx. 6500 rpm, the kinetic energy of the rotor will no longer be sufficient to supply the magnetic bearings. The drive electronics will switch off completely. The rotor will run down audibly in the safety bearings.

➔ Do not switch off the pump by disconnecting the mains power supply.

+24 V DC* Output / Pin 1

Inputs 2 - 6 and the connections to Pins 10, 13, 14 are activated by connecting them with +24 V DC to Pin 1 (active high). They can also be activated via an external PLC. The functions are deactivated by "PLC high level" and by "PLC low level".

- PLC high level: +13 V to +33 V
- PLC low level: -33 V to +7 V
- Ri: 7 kΩ
- I_{max} < 210 mA (with RS-485, if existing)

Inputs

The digital inputs at connection "*remote*" are used to connect various functions of the electronic drive unit. Functions are assigned to the inputs DI1 - DI2 ex factory. These can be configured via interface RS-485 and the Pfeiffer Vacuum parameter set.

DI1 (Enable venting) / Pin 2

V+ : Venting is enabled (venting according to venting mode)

open: Venting locked (no venting is performed)

DI Motor pump / Pin 3

After Pin 4 (pumping station) is activated and the electronic drive unit successfully completes the self-test, the turbopump is placed into operation. During operation, the turbopump can be switched off and on again, while the pumping station remains switched on. The turbopump is not vented thereby.

V+ : Turbopump motor on

open: Turbopump motor off

DI Pumping station / Pin 4

Connected pumping station components (e.g. backing pump, venting valve, air cooling unit) are triggered and, with Pin 3 (motor) simultaneously activated, the turbopump is placed in operation. Any ongoing error messages are reset when their cause has been eliminated.

V+ : Malfunction acknowledgement and pumping station on

open: Pumping station off

DI Standby / Pin 5

In standby mode, the turbopump operates at a specified rotor speed < nominal rotation speed. Factory setting and recommended operation are 66.7 % of the nominal rotation speed.

V+ : Standby activated

open: Standby off, operation at nominal rotation speed

DI2 (Heating) / Pin 6

V+ : Heating on

open: Heating off

DI3 (Sealing gas) / Pin 10

V+ : Sealing gas valve open

open: Sealing gas valve closed

DI Error acknowledgement / Pin 13

V+ : Reset ongoing error messages when cause has been eliminated with a pulse of min. 500 ms duration.

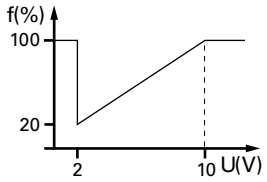
open: Inactive

DI Remote priority / Pin 14

V+ : The connection "*remote*" has operation priority over all other digital inputs.

open: Remote priority inactive

AI Rotation speed setting mode / Pin 7 and Pin 11



The analog input at the TM 700 DN defines the set rotation speed of the turbopump. An input signal of 2 - 10 V between AI+ (Pin 7) and AI- (Pin 11) corresponds to a rotation speed within the range of 20 - 100% of the nominal rotation speed. If the input is open or signals fall below 2 V, the pump is accelerated up to nominal rotation speed.

Outputs

The digital outputs at the connection "*remote*" can be loaded with a maximum of 24 V / 50 mA per output. All outputs listed below are configurable by the Pfeiffer Vacuum parameter set via interface RS-485 (description related to factory settings).

DO1 (Rotation speed switch point attained) / Pin 8

Active high after the rotation speed switch point is attained. Rotation speed switch point 1 is factory-set to 80% of the nominal rotation speed. It can, for example, be used for a "pump operational" message.

DO2 (No errors) / Pin 9

When the supply voltage has been established, digital output DO2 permanently outputs 24 V DC which means "no errors". Active low in case of error (collective error message).

DO Remote priority active / Pin 23

Active high: The connection "*remote*" takes priority over any other connected control panels (e.g. RS-485). With active low, the connection "*remote*" is ignored.

AO1 Analog output 0-10 V DC / Pin 12

A rotation-speed-proportional voltage (0-10 V DC equals 0 - 100 % x $f_{Nominal}$) can be picked up via the analog output (load R ≥ 10 kΩ). Additional functions (optionally current/power) can be assigned to the analog output via DCU, HPU or PC.

Relay contacts (invertible)

Relay 1 / Pin 15, Pin 16 and Pin 17

The contact between Pin 16 and Pin 15 is closed when the rotation speed switch point is underrun; relay 1 is inactive. The contact between Pin 16 and Pin 17 is closed when the rotation speed switch point is attained; relay 1 is active.

Relay 2 / Pin 18, Pin 19 and Pin 20

The contact between Pin 19 and Pin 18 is closed when a malfunction is present; relay 2 is inactive. The contact between Pin 19 and Pin 20 is closed when operation is malfunction free; relay 2 is active.

Relay 3 / Pin 21 and Pin 22

The contact between Pin 21 and Pin 22 is closed when no warning messages are active; relay 3 is inactive. The contact between Pin 21 and Pin 22 is open when a warning message is present; relay 3 is active.

RS-485

One Pfeiffer Vacuum display and control panel (DCU **or** HPU) **or** an external PC can be connected respectively to the electronic drive unit via Pin 24 and Pin 25 of the connection "*remote*" on the electronic drive unit.

CAUTION

Danger of electric shock

The insulation measures of the bus system are designed only for use with safety extra-low voltage.

➔ Connect only suitable devices to the bus system.

- The group address of the electronic drive unit is 964.
- All units connected to the bus must have differing RS-485 device addresses **[P:797]**.

➔ Establish the connections according to the specification of the interface RS-485.

➔ Connect all units with RS-485 D+ and RS-485 D- to the bus.

Designation	Value
Serial interface	RS-485
Baud rate	9600 bauds
Data word length	8 bits
Parity	none (no parity)
Start bits	1
Stop bits	1..2

Connecting Pfeiffer Vacuum display and control units or PC

➔ The connection of respectively one external operating unit is possible on the interface RS-485.

➔ A USB interface (PC) can be connected via the USB/RS-485-converter.

6 Connection "*DeviceNet*"

6.1 Connections

The turbopump can be connected to a DeviceNet bus system using the connector (5 - pin, sealed micro) labelled "DeviceNet" on the electronic drive unit. A supply voltage (V+, V-) is required to supply this connection in addition to the supply voltage for the electronic drive unit. The interface is galvanically safe and is isolated from the maximum supply voltage for the electronic drive unit.

Pin	Assignment
1	Drain
2	V+, 24 V DC referred to V-
3	V-
4	CAN_H
5	CAN_L

➔ Perform DeviceNet wiring in accordance with the applicable specifications.

➔ Supply the DeviceNet connection with voltage.

6.2 Configuring the connection

To start DeviceNet communication, the TM 700 DN must be configured using the enclosed EDS files.

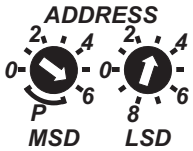
➔ Select desired device address

➔ Select desired baud rate

➔ Fit rubber plugs at the address selector switches evenly and as deep as possible to achieve the stated protection class.

Device address

The DeviceNet device address is set manually using the "***ADDRESS***" selector switches or via DeviceNet.



Position	Meaning
00 to 63	Device address (decimal) – MSD = multiples of 10 (0x-6x) – LSD = units (x0-x9)
P	Address via DeviceNet

Setting the address manually

➔ Set the selector switches to the desired value.

– Once the setting has been made, the device accesses the bus using the new address.

Setting the address via DeviceNet

➔ Switch off the pump/electronic drive unit

➔ Set the selector switches to "P".

– When switched on, the system uses the last valid valid address ("63" upon delivery).

– The address is programmable via DeviceNet object 3.1.1. *(see p. 16, chap. 6.5)*.

Baud rate

The DeviceNet baud rate is set manually using the "RATE" selector switches or via DeviceNet.

Position	Meaning
1	125 kBit/s
2	250 kBit/s
5	500 kBit/s
P	Baud rate via DeviceNet

Setting the baud rate manually

➔ Set the selector switches to the desired value.
  – The change takes effect the next time the system is switched on.

Setting the baud rate via DeviceNet

➔ Switch off the pump/electronic drive unit
➔ Set the selector switches to "P".
  – When switched on, the system uses the last valid baud rate (500 kBit/s upon delivery).
  – The baud rate is programmable via DeviceNet object 3.1.2. *(see p. 16, chap. 6.5)*.

6.3 Configuring the data exchange

Depending on the program used to set up DeviceNet communication, you can carry out the following steps:

➔ Import EDS file (see scope of delivery)

Device-specific data:

➔ Specify the format of the cyclical input/output data
  – Specify the cyclically alternating process data using objects "Poll I/O input data (4.0.100)" and "Poll I/O output data (4.0.101)"
  – The format can be changed only if the poll I/O connection is inactive.
➔ Specify system behaviour following termination of the cyclical DeviceNet communication.
  – Use object "Idle Action (9.1.7)" to specify which action is to be carried out if there is a failure of the cyclical exchange of process data (poll I/O connection).
➔ Specify the remote priority.
  – Use object "Permission locked (101.0.17)" to specify whether the electronic drive unit is to be controlled exclusively via DeviceNet or whether other interfaces (e.g. RS485) are also permitted.
  – This does not restrict write access via other interfaces.
➔ Perform pump configuration.
  – To set a configuration that differs from the delivery state, use the EDS file to adjust individual objects (e.g. accessory configuration).

Master-specific data:

➔ Set up the device in the master scanlist.
➔ Set the format of the cyclical input/output data

Explicit data exchange (explicit connection)

This connection can be used to access the individual DeviceNet objects *(see p. 16, chap. 6.5)*. As a rule, this is done using a dedicated configuration program and the EDS file. This is also used to specify which data is sent during the cyclical data exchange.

Cyclical data exchange (poll I/O connection)

For the cyclical data exchange, multiple DeviceNet objects are combined to form *assemblies (4.x.3.)*. One *assembly* is selected for each direction (input/output data). The following *assemblies* are available for selection:

Input data (produced data, pump --> PLC)

1: pump status (default)
2: pump status, speed
100: pump status, speed, current
101: pump status, speed, current, temperature

Assembly ... Byte				Denotation
1	2	100	101	
0	0	0	0	(BYTE) Exception Status (48.1.12) – Bit 0: Common alarm – Bit 1: Device-specific alarm – Bit 2: Manufacturer-specific alarm Details for Bit 0-2 s. Exception Detail Alarm (48.1.13) – Bit 4: Common warning – Bit 5: Device-specific warning – Bit 6: Manufacturer-specific warning Details for Bit 4-6 s. Exception Detail Warning (48.1.14)
1	1	1	1	(BYTE) Speed Status (42.1.39) – Bit 0: Pump is on, rotation speed > 0 – Bit 1: Motor is off – Bit 2: Standby rotation speed attained – Bit 4: Stopped – Bit 5: Accelerates – Bit 6: Set rotation speed attained – Bit 7: Decelerates
2	2	2	2	(BOOL) Pump On Status (8.1.3) – 0: Pump is off – 1: Pump is on, rotation speed > 0
-	3-4	3-4	3-4	(INT) Pump Speed (42.1.7) – Actual rotation speed in rpm/4 (e.g. value 15000 equates to 60000 rpm)
-	-	5-6	5-6	(INT) IMC Current (42.1.102) – Intermediate circuit current in 100 mA (e.g. value 42 equates to 4.2 A)
-	-	-	7-8	(INT) Bearing Temperature (49.3.6) – Bearing temperature in °C/10 (e.g. value 210 equates to 21.0 °C)
-	-	-	9-10	(INT) Pump Temperature (49.101.6) – Bottom part temperature in °C/10 (e.g. value 210 equates to 21.0 °C)

Output data (consumed data, PLC --> pump)

5: pump control (default)
6: pump/speed control
7: pump/speed control, set speed
103: pump/speed control, set speed, vent valve cfg.

Assembly ... Byte				Denotation
5	6	7	103	
0	0	0	0	(BOOL) Pump On (9.1.3) – 0: Pumping station off – 1: Pumping station on
-	1	1	1	(BYTE) Speed Control (42.1.38) – Bit 0: Pumping station on – Bit 1: Motor off – Bit 2: Standby on
-	-	2-3	2-3	(INT) Speed Target (42.1.8) – Set rotation speed in rpm/4 (e.g. value 15000 writing for 60000 rpm)
-	-	-	4-5	(WORD) Vent Valve Configuration (7.1.4) – 0: No venting – 1: Direct venting – 2: Delayed venting

6.4 LED operation

NET

Status	Meaning	Action
Off	Device not on bus	⇨ Supply operating voltage ⇨ Wait for address test (approx. 2 s)
Green flashing	On bus, no master allocated	⇨ Create connection with master
Green illuminated	On bus, master allocated	
Red flashing	Connection to master expired	⇨ Test connection to master
Red illuminated	Bus error or duplicate device address allocated	⇨ Check bus ⇨ Check device address ⇨ Check baud rate

MOD

Status	Meaning	Action
Off	No voltage supply	⇨ Supply operating voltage
Green illuminated	Device ready for operation	
Red flashing	Device error	⇨ Resolve error

6.5 DeviceNet objects

Identity

Path	Name	Data type	Service	Comment
1.0.1	Revision	UINT	get	
1.0.2	Max Instance	UINT	get	
1.0.3	Number of Instances	UINT	get	
Instance 1				
1.1.0	(Instance)	USINT	res, gaa	
1.1.1	Vendor ID	UINT	get	527 (Pfeiffer Vacuum)
1.1.2	Device Type	UINT	get	33 (Turbomolecular Vacuum Pump Device)
1.1.3	Product Code	UINT	get	5377
1.1.4	Revision	STRUCT of	get	
	Major Revision	USINT		
	Minor Revision	USINT		
1.1.5	Status	WORD	get	
1.1.6	Serial Number	UDINT	get	
1.1.7	Product Name	SHORT_STRING	get	TM 700 DN
1.1.100	Status Code	SHORT_STRING	get	

Message Router

This object provides no attributes and services.

DeviceNet

Path	Name	Data type	Service	Comment
3.0.1	Revision	UINT	get	
Instance 1				
3.1.0	(Instance)		all, re	
3.1.1	MAC ID	USINT	get, (set)	set only at switch setting "P"
3.1.2	Baud Rate	USINT	get, (set)	set only at switch setting "P"
3.1.5	Allocation Information	STRUCT of	get	
	Allocation Choice Byte	BYTE		
	Master's MAC ID	USINT		
3.1.6	MAC ID Switch Changed	BOOL	get	
3.1.7	Baud Rate Switch Changed	BOOL	get	
3.1.8	MAC ID Switch Value	USINT	get	
3.1.9	Baud rate Switch Value	USINT	get	

Assembly

Path	Name	Data type	Service	Comment
4.0.1	Revision	UINT	get	
4.0.3	Number of Instances	UINT	get	
4.0.100	Poll I/O Input Data	USINT	get, (set)	Assembly instance for input data (pump->master) of Poll I/O connection, set only if connection not active
4.0.101	Poll I/O Output Data	USINT	get, (set)	Assembly instance for output data (master->pump) of Poll I/O connection, set only if connection not active
Instance 1 (default input): pump status				
4.1.3	Data	ARRAY of	get	
	Exception Status	BYTE		48.1.12
	Speed Status	BYTE		42.1.39
	Pump on Status	BYTE		8.1.3
Instance 2 (input): pump status, speed				
4.2.3	Data	ARRAY of	get	
	Exception Status	BYTE		48.1.12
	Speed Status	BYTE		42.1.39
	Pump on Status	BYTE		8.1.3
	Pump Speed	2 x BYTE (INT)		42.1.7
Instance 5 (default output): pump control				
4.5.3	Data	ARRAY of	get, set	
	Pump On	BYTE		9.1.3
Instance 6 (output): pump control				
4.6.3	Data	ARRAY of	get, set	
	Pump on	BYTE		9.1.3
	Speed control	BYTE		42.1.38
Instance 7 (output): pump/speed control, set speed				
4.7.3	Data	ARRAY of	get, set	
	Pump On	BYTE		9.1.3
	Speed Control	BYTE		42.1.38
	Speed Target	2 x BYTE (INT)		42.1.8
Instance 100 (input): pump status, speed, current				
4.100.3	Data	ARRAY of	get	
	Exception Status	BYTE		48.1.12
	Speed Status	BYTE		42.1.39
	Pump on Status	BYTE		8.1.3
	Pump Speed	2 x BYTE (INT)		42.1.7
	IMC Current	2 x BYTE (INT)		42.1.102
Instance 101 (input): pump status, speed, current, temperatures				
4.101.3	Data	ARRAY of	get	
	Exception Status	BYTE		48.1.12
	Speed Status	BYTE		42.1.39
	Pump on Status	BYTE		8.1.3
	Pump Speed	2 x BYTE (INT)		42.1.7
	IMC Current	2 x BYTE (INT)		42.1.102
	Bearing Temperature	2 x BYTE (INT)		49.3.6
	Pump Temperature	2 x BYTE (INT)		49.101.6
Instance 103 (output): pump/speed control, set speed, vent valve cfg				
4.103.3	Data	ARRAY of	get, set	
	Pump On	BYTE		9.1.3
	Speed Control	BYTE		42.1.38
	Speed Target	BYTE		42.1.8
	Vent Valve Cfg. (1)	BYTE		7.1.4 (1)

Instance 103 (output): pump/speed control, set speed, vent valve cfg				
	Vent Valve Cfg. (2)	BYTE		7.1.4 (2)

Connection

Path	Name	Data type	Service	Comment
5.0.1	Revision	UINT	get	
Instance 1: Explicit connection				
5.1.1	State	USINT	get	
5.1.2	Instance Type	USINT	get	
5.1.3	Transport Class Trigger	BYTE	get	
5.1.4	DeviceNet Produced Connection ID	UINT	get	
5.1.5	DeviceNet Consumed Connection ID	UINT	get	
5.1.6	DeviceNet Initial Comm Characteristics	BYTE	get	
5.1.7	Produce Connection Size	UINT	get	
5.1.8	Consumed Connection Size	UINT	get	
5.1.9	Expected Package Rate	UINT	get, set	
5.1.12	Watchdog Timeout Action	UINT	get, set	
5.1.13	Produced Connection Path Length	USINT	get	
5.1.14	Produced Connection Path	UINT	get	
5.1.15	Consumed Connection Path Length	Packed EPATH	get	
5.1.16	Consumed Connection Path	UINT	get	
5.1.17	Production Inhibit Time	Packed EPATH	get	
5.1.18	Connection Timeout Multiplier	USINT	get	
Instance 2: Poll I/O connection				
5.2.1	State	USINT	get	
5.2.2	Instance Type	USINT	get	
5.2.3	Transport Class Trigger	BYTE	get	
5.2.4	DeviceNet Produced Connection ID	UINT	get	
5.2.5	DeviceNet Consumed Connection ID	UINT	get	
5.2.6	DeviceNet Initial Comm Characteristics	BYTE	get	
5.2.7	Produce Connection Size	UINT	get	
5.2.8	Consumed Connection Size	UINT	get	
5.2.9	Expected Package Rate	UINT	get, set	
5.2.12	Watchdog Timeout Action	UINT	get	
5.2.13	Produced Connection Path Length	USINT	get	
5.2.14	Produced Connection Path	UINT	get	
5.2.15	Consumed Connection Path Length	Packed EPATH	get	
5.2.16	Consumed Connection Path	UINT	get	
5.2.17	Production Inhibit Time	Packed EPATH	get, set	
5.2.18	Connection Timeout Multiplier	USINT	get	

Register

Path	Name	Data type	Service	Comment
7.0.1	Revision	UINT	get	
7.0.2	Max Instance	UINT	get	
7.0.3	Number of Instances	UINT	get	
Instance 1				
7.1.1	Bad Flag	BOOL	get	0
7.1.2	Direction	BOOL	get	1
7.1.3	Size	UINT	get	16
7.1.4	Data	ARRAY of	get, set	
		BITS		– 0: No venting – 1: Direct venting – 2: Delayed venting
		BITS		0
7.1.100	Venting Frequency	USINT	get, set	40-98 %
7.3.101	Venting Time	UINT	get, set	6-3600 s

Discrete Input Point

Path	Name	Data type	Service	Comment
8.0.1	Revision	UINT	get	
8.0.2	Max Instance	UINT	get	
8.0.3	Number of Instances	UINT	get	
Instance 1				
8.1.3	Value	BOOL	get	– 0: Pump off – 1: Pump on and f > 0
8.1.7	Off-On Cycles	UDINT	get	

Discrete Output Point

Path	Name	Data type	Service	Comment
9.0.1	Revision	UINT	get	
9.0.2	Max Instance	UINT	get	
9.0.3	Number of Instances	UINT	get	
Instance 1: Pump On/Off				
9.1.3	Value	BOOL	get, set	– 0: Pumping station off – 1: Pumping station on
9.1.5	Fault Action	BOOL	get, set	– 0: Pumping station off – 1: Hold last state
9.1.6	Fault Action	BOOL	get, set	0
9.1.7	Idle Action	BOOL	get, set	– 0: Pumping station off – 1: Hold last state
9.1.8	Idle Action	BOOL	get, set	0
Instance 2: TMS/Heating				
9.2.3	Value	BOOL	get, set	– 0: TMS/Heating off – 1: TMS/Heating released
9.2.5	Fault Action	BOOL	get, set	– 0: TMS/Heating off – 1: Hold last state
9.2.6	Fault Action	BOOL	get, set	0
9.2.7	Idle Action	BOOL	get, set	– 0: TMS/Heating off – 1: Hold last state
9.2.8	Idle Action	BOOL	get, set	0
Instance 3: Sealing gas				
9.3.3	Value	BOOL	get, set	– 0: Sealing gas off – 1: Sealing gas on
9.3.5	Fault Action	BOOL	get, set	– 0: Sealing gas off – 1: Hold last state
9.3.6	Fault Action	BOOL	get, set	0
9.3.7	Idle Action	BOOL	get, set	– 0: Sealing gas off – 1: Hold last state
9.3.8	Idle Action	BOOL	get, set	0

Instance 100: Brake				
9.100.3	Value	BOOL	get, set	– 0: Brake off – 1: Brake released
9.100.5	Fault Action	BOOL	get, set	– 0: Brake off – 1: Hold last state
9.100.6	Fault Action	BOOL	get, set	0
9.100.7	Idle Action	BOOL	get, set	– 0: Brake off – 1: Hold last state
9.100.8	Idle Action	BOOL	get, set	0

AC/DC Drive

Path	Name	Data type	Service	Comment
42.0.1	Revision	UINT	get	
42.0.2	Max Instance	UINT	get	
42.0.3	Number of Instances	UINT	get	

Instance 1				
42.1.3	At Reference	BOOL	get	– 0: Set rotation speed not attained – 1: Set rotation speed attained
42.1.4	Net Ref	BOOL	get	1
42.1.6	Drive Mode	USINT	get, set	2
42.1.7	Speed Actual	INT	get	Current rotation speed (rpm/2 $^{\text{speed Scale}}$) e.g. 15000 read => 60000 rpm
42.1.8	Speed Ref	INT	get, set	Set rotation speed (rpm/2 $^{\text{speed Scale}}$) e.g. 7500 write for 30000 rpm
42.1.15	Power Actual	INT	get	Current power (W)
42.1.16	Input Voltage	INT	get	Input voltage (V/2 $^{\text{voltage Scale}}$) e.g. 192 read => 24 V
42.1.18	Accel Time	UINT	get, set	Run-up time (ms/2 $^{\text{time Scale}}$) e.g. 2813 read => 6 min
42.1.22	Speed Scale	SINT	get, set	-2
42.1.27	Voltage Scale	SINT	get, set	3
42.1.28	Time Scale	SINT	get, set	-7
42.1.38	Speed Control	BYTE	get, set	– Bit 0: Pumping station on – Bit 1: Motor off – Bit 2: Standby on
42.1.39	Speed Status	BYTE	get	– Bit 0: Pump on and f > 0 – Bit 1: Motor is off – Bit 2: Standby rotation speed attained – Bit 4: stopped – Bit 5: accelerates – Bit 6: Set rotation speed attained – Bit 7: decelerates
42.1.41	Max Rated Speed	INT	get	Nominal rotation speed (rpm/2 $^{\text{Max Rated Speed Scale}}$)
42.1.42	Max Rated Speed Scale	SINT	get, set	-2
42.1.43	Speed Standby	INT	get, set	Standby rotation speed (rpm/2 $^{\text{Speed Scale}}$)
42.1.46	Drive On Hours	DINT	get	Operating hours drive (h)
42.1.100	Gas Mode	USINT	get, set	– 0: Heavy gases – 1: light gases – 2: Helium
42.1.101	Max Power	USINT	get, set	%
42.1.102	IMC Current	INT	get	Intermediate circuit current (100 mA) e.g. 123 read => 12.3 A
42.1.103	Max Rated Speed Confirmation	INT	get, set	Nominal rotation speed (rpm/2 $^{\text{Max Rated Speed Scale}}$)
42.1.104	Imbalance	INT	get	Rotor imbalance in %
42.1.105	Bearing Wear	INT	get	Safety bearing stress in %

S-Device Supervisor

Path	Name	Data type	Service	Comment
48.0.1	Revision	UINT	get	
48.0.2	Max Instance	UINT	get	
48.0.3	Number of Instances	UINT	get	
Instance 1				
48.1.0	(Instance)		res, sta, abo, rec, per	
48.1.3	Device Type	SHORT_STRING	get	
48.1.4	SEMI Standard Revision Level	SHORT_STRING	get	
48.1.5	Manufacturer's Name	SHORT_STRING	get	
48.1.6	Manufacturer's Model Number	SHORT_STRING	get	
48.1.7	Software Revision Level	SHORT_STRING	get	
48.1.8	Hardware Revision Level	SHORT_STRING	get	
48.1.11	Device Status	USINT	get	– 1: Self Testing – 2: Idle – 3: Self-Test Exception – 4: Executing – 5: Abort – 6: Critical Fault
48.1.12	Exception Status	BYTE	get	*(see p. 14, chap. 6.3)*
48.1.13	Exception Detail Alarm	STRUCT of	get	
	Common Exception Detail Size	USINT		2
	Common Exception Detail 0	BYTE		see below
	Common Exception Detail 1	BYTE		see below
	Device Exception Detail	USINT		2
	Device Exception 0	BYTE		see below
	Device Exception 1	BYTE		see below
	Manufacturer Exception Detail Size	USINT		2
	Manufacturer Exception Detail 0	BYTE		see below
	Manufacturer Exception Detail 1	BYTE		see below
48.1.14	Exception Detail Warning	STRUCT of	get	
	Common Exception Detail Size	USINT		2
	Common Exception Detail 0	BYTE		see below
	Common Exception Detail 1	BYTE		see below
	Device Exception Detail	USINT		2
	Device Exception 0	BYTE		see below
	Device Exception 1	BYTE		see below
	Manufacturer Exception Detail Size	USINT		2
	Manufacturer Exception Detail 0	BYTE		see below
	Manufacturer Exception Detail 1	BYTE		see below
48.1.15	Alarm Enable	BOOL	get, set	
48.1.16	Warning Enable	BOOL	get, set	
48.1.23	Run Hours	UDINT	get	Pump operating hours (h)

For Exception Detail Alarm and Exception Detail Warning applies:

Bit	Common Ex. Detail 0	Common Ex. Detail 1	Device Ex. Detail 0	Device Ex. Detail 1
0	internal diagnostic	Excess supply	Drive unit	Motor excess temperature
1	Microcontroller	reserved	TMS	Pump excess temperature
2	EPROM	Output voltage supply	Voltage supply	Bearing excess temperature
3	EEPROM	Input voltage supply	Excess rotation speed	Electronic drive unit excess temperature
4	RAM	Maintenance	Overload	Connection
5	reserved	Contact manufacturer	Run-up time	Bearing
6	internal real time	Reset	Run-up time	Interlock
7	reserved	reserved	Vibration	reserved

Manufacturer Exception Detail equates to the current message for alarm respective warning in the data type UINT.

S-Analog Sensor

Path	Name	Data type	Service	Comment
49.0.1	Revision	UINT	get	
49.0.2	Max Instance	UINT	get	
49.0.3	Number of Instances	UINT	get	
Instance 1: Motor temperature				
49.1.5	Reading Valid	BOOL	get	0: invalid, 1: valid
49.1.6	Value	INT	get	Motor temperature (°C/10)
49.1.7	Status	BYTE	get	see below
Instance 3: Bearing temperature				
49.3.5	Reading Valid	BOOL	get	0: invalid, 1: valid
49.3.6	Value	INT	get	Bearing temperature (°C/10)
49.3.7	Status	BYTE	get	see below
Instance 4: Electronic temperature				
49.4.5	Reading Valid	BOOL	get	0: invalid, 1: valid
49.4.6	Value	INT	get	Electronic temperature (°C/10)
49.4.7	Status	BYTE	get	see below
Instance 100: Power stage temperature				
49.100.5	Reading Valid	BOOL	get	0: invalid, 1: valid
49.100.6	Value	INT	get	Power stage temp. (°C/10)
49.100.7	Status	BYTE	get	see below
Instance 101: Bottom part temperature				
49.101.5	Reading Valid	BOOL	get	0: invalid, 1: valid
49.101.6	Value	INT	get	Bottom part temperature (°C/10)
49.101.7	Status	BYTE	get	see below

For all "Status" (49.x.7) applies:

Bit	Meaning
0	Excess temperature (alarm)
2	High temperature (warning)

Interfaces

Path	Name	Data Type	Service	Comment
101.0.1	Revision	UINT	get	
101.0.2	Max Instance	UINT	get	
101.0.3	Number of Instances	UINT	get	
101.0.16	Current Permission	BYTE	get, set	
101.0.17	Permission Locked	BOOL	get, set	– 0: other interfaces approved to operation – 1: operation exclusively via DeviceNet

Instance 2: RS485				
101.2.19	Address	USINT	get, set	1-255: RS485 address
Instance 4: Remote				
101.4.17	Configuration	USINT	get, set	{0;4} *(see p. 30, chap. 7.3)*
Instance 6: DI1				
101.6.17	Configuration	USINT	get, set	0-5*(see p. 30, chap. 7.3)*
Instance 7: DI2				
101.7.17	Configuration	USINT	get, set	0-5*(see p. 30, chap. 7.3)*
Instance 8: DI3				
101.8.17	Configuration	USINT	get, set	0-5*(see p. 30, chap. 7.3)*
Instance 9: AI				
101.9.17	Configuration	USINT	get, set	0-1 *(see p. 30, chap. 7.3)*
Instance 10: DO1				
101.10.17	Configuration	USINT	get, set	0-15 *(see p. 30, chap. 7.3)*
Instance 11: DO2				
101.11.17	Configuration	USINT	get, set	0-15 *(see p. 30, chap. 7.3)*
Instance 12: AO1				
101.12.17	Configuration	USINT	get, set	0-5 *(see p. 30, chap. 7.3)*
Instance 13: Relay 1				
101.13.17	Configuration	USINT	get, set	0-15 *(see p. 30, chap. 7.3)*
Instance 14: Relay 2				
101.14.17	Configuration	USINT	get, set	0-15 *(see p. 30, chap. 7.3)*
Instance 15: Relay 3				
101.15.17	Configuration	USINT	get, set	0-15 *(see p. 30, chap. 7.3)*
Instance 16: Accessory A1				
101.16.17	Configuration	USINT	get, set	0-10*(see p. 30, chap. 7.3)*
Instance 17: Accessory B1				
101.17.17	Configuration	USINT	get, set	0-10*(see p. 30, chap. 7.3)*
Instance 18: Accessory A2				
101.18.17	Configuration	USINT	get, set	0-10*(see p. 30, chap. 7.3)*
Instance 19: Accessory B2				
101.19.17	Configuration	USINT	get, set	0-10*(see p. 30, chap. 7.3)*

Process Components

Path	Name	Data type	Service	Comment
102.0.1	Revision	UINT	get	
102.0.2	Max Instance	UINT	get	
102.0.3	Number of Instances	UINT	get	
Instance 1: Backing pump				
102.1.17	Configuration	USINT	get, set	0-2 *(see p. 31, chap. 7.4)*
102.1.21	Switch-Off Threshold	UINT	get, set	0-1000 W
102.1.22	Switch-On Threshold	UINT	get, set	0-1000 W
Instance 7: Rotation speed switch point				
102.7.17	Configuration	USINT	get, set	0-1 *(see p. 31, chap. 7.4)*
102.7.18	Status	BOOL	get	– 0: Rotation speed switch point not attained – 1: Rotation speed switch point attained
102.7.21	Switchpoint 1	UINT	get, set	50-97 % *(see p. 31, chap. 7.4)*
102.7.22	Switchpoint 2	UINT	get, set	5-97 % *(see p. 31, chap. 7.4)*

Data types

Data type	Byte	Description	Example
BOOL	1	Binary value (0/1)	00h: 0, 01h:1
BYTE	1	8 single bits	00h, FFh
DINT	4	signed integer	12345678h: 89h, 56h, 34h, 12h
INT	2	signed integer	1234h: 34h, 12h
Packed EPATH	6		1.2.3: 20h, 01h, 24h, 02h, 30h, 03h
SHORT_STRING		character string with antecedent length byte	"Bilbo": 05h, 42h, 69h, 6Ch, 62h, 6Fh
SINT	1	signed integer	-42: D6h
UINT	2	unsigned integer	2468h: 68h, 24h
UDINT	4	unsigned integer	10203040h: 40h, 30h, 20h, 10h
USINT	1	unsigned integer	101: 65h
WORD	2	16 single bits	55AAh: AAh, 55h

Services

Service	DeviceNet-Service	Code
abo	abort	4Bh
all	allocate_master/slave_connection_set	4Bh
gaa	get_attributes_all	01h
get	get_attribute_single	0Eh
per	perform_diagnostics	4Eh
rec	recover	4Ch
rel	release_master/slave_connection_set	4Ch
res	reset	05h
set	set_attribute_single	10h
sta	start	06h

7 The Pfeiffer Vacuum parameter set

7.1 General

All function-relevant variables of a turbopump are anchored in the electronic drive unit as parameters. Each parameter has a three-digit number and a designation. Parameters can be used via Pfeiffer Vacuum display and control units or via RS-485 with the Pfeiffer Vacuum protocol.

NOTE

Additional parameters in the control unit

For the control of connected external components (e.g. vacuum measurement devices) there are additional parameters fixed in the respective Pfeiffer Vacuum display and control unit.

➔ Please consider the respective operating instructions.

Conventions

Parameters are displayed in square brackets as a three-digit number in bold font. The designation may also be stated if necessary.

Example: **[P:312] Software version**

7.2 Parameter overview

Annotation

#	Three figure number of the parameter
Display	Notification of the parameter in a Pfeiffer Vacuum display and control unit
Designation	Short description of the parameter
Functions	Functional description of the parameter
Data type	Type of formatting of the parameter for the use within the Pfeiffer Vacuum protocol
Access method	R: read access; W: write access
Unit	Physical unit of the described characteristic
min / max	permissible limits for value input
default	factory settings (partially specific of the pump type)
🖫	Parameter can be stored non volatile in the electronic drive unit and may be reused after resetting of the mains supply.

Operation with DCU

NOTE

Parameter set and Pfeiffer Vacuum display and control unit

Pfeiffer Vacuum display and control units DCU show the basic parameter set by default. Furthermore the DCU contains parameters, which are not positioned in the electronic drive unit.

➔ Parameter **[P:794]** = 1 (Display of all available parameters).

#	Display	Designation	Functions	Data type	Access	Unit	min	max	default	🖫
340	Pressure	Active pressure value		7	R	mbar	1E-10	1E3		
350	Ctr Name	Type of display and control unit		4	R					
351	Ctr Software	Software of display and control unit		4	R					
738	Gaugetype	Type of pressure gauge		4	RW					
794	Param set	Parameterset	0 = basic parameter set 1 = extended parameter set	7	RW		0	1	0	
795	Servicelin	Insert service line		7	RW				795	

Control commands

#	Display	Designation	Functions	Data type	Access	Unit	min	max	default	
001	Heating	Heating	0 = off 1 = on	0	RW		0	1	0	x
002	Standby	Standby	0 = off 1 = on	0	RW		0	1	0	x
004	RUTimeCtrl	Run-up time control	0 = off 1 = on	0	RW		0	1	1	x
009	ErrorAckn	Error acknowledgement	1 = Error acknowledgement	0	W		1	1		
010	PumpgStatn	Pumping station	0 = off 1 = on and error acknowledgement	0	RW		0	1	0	x
012	EnableVent	Enable venting	0 = no 1 = yes	0	RW		0	1	0	x
013	Brake	Brake	0 = off 1 = on	0	RW		0	1	1	x
017	CfgSpdSwPt	Configuration rotation speed switch point	0 = Rotation speed switch point 1 1 = Rotation speed switch point 1&2	7	RW		0	1	0	x
019	Cfg DO2	Configuration output DO2	0 = Rot. speed switch point attained 1 = No error 2 = Error 3 = Warning 4 = Error and/or warning 5 = Set speed attained 6 = Pump on 7 = Pump accelerates 8 = Pump decelerates 9 = always 0 10 = always 1 11 = Remote priority active 12 = Heating 13 = Backing pump 14 = Sealing gas 15 = Pumping station 16 = Pump rotates 17 = Pump does not rotate	7	RW		0	17	1	x
023	MotorPump	Motor pump	0 = off 1 = on	0	RW		0	1	1	x
024	Cfg DO1	Configuration output DO1	0 = Rot. speed switch point attained 1 = No error 2 = Error 3 = Warning 4 = Error and/or warning 5 = Set speed attained 6 = Pump on 7 = Pump accelerates 8 = Pump decelerates 9 = always 0 10 = always 1 11 = Remote priority active 12 = Heating 13 = Backing pump 14 = Sealing gas 15 = Pumping station 16 = Pump rotates 17 = Pump does not rotate	7	RW		0	17	0	x
025	OpMode BKP	Operation mode backing pump	0 = Continous operating 1 = Intermittend mode 2 = Delayed switch-on	7	RW		0	2	0	x
026	SpdSetMode	Rotation speed setting mode	0 = off 1 = on	7	RW		0	1	0	x
027	GasMode	Gas mode	0 = Heavy gases 1 = Light gases 2 = Helium	7	RW		0	2	0	x
028	Cfg Remote	Configuration remote	0 = Standard 4 = Relais inverted	7	RW		0	4	0	x
030	VentMode	Venting mode	0 = Delayed venting 1 = No venting 2 = Direct venting	7	RW		0	2	2	x
035	Cfg Acc A1	Configuration accessory connection A1	0 = Fan (continous operation) 1 = Venting valve, normally closed 2 = Heating 3 = Backing pump 4 = Fan (temperature controlled) 5 = Sealing gas 6 = always 0 7 = always 1 8 = Power failure venting unit	7	RW		0	8	0	x

#	Display	Designation	Functions	Data type	Access	Unit	min	max	default	🖫
036	Cfg Acc B1	Configuration accessory connection B1	0 = Fan (continous operation) 1 = Venting valve, normally closed 2 = Heating 3 = Backing pump 4 = Fan (temperature controlled) 5 = Sealing gas 6 = always 0 7 = always 1 8 = Power failure venting unit	7	RW		0	8	1	x
037	Cfg Acc A2	Configuration accessory connection A2	0 = Fan (continous operation) 1 = Venting valve, normally closed 2 = Heating 3 = Backing pump 4 = Fan (temperature controlled) 5 = Sealing gas 6 = always 0 7 = always 1 8 = Power failure venting unit	7	RW		0	8	3	x
038	Cfg Acc B2	Configuration accessory connection B2	0 = Fan (continous operation) 1 = Venting valve, normally closed 2 = Heating 3 = Backing pump 4 = Fan (temperature controlled) 5 = Sealing gas 6 = always 0 7 = always 1 8 = Power failure venting unit	7	RW		0	8	2	x
045	Cfg Rel R1	Configuration Relay 1	0 = Rot. speed switch point attained 1 = No error 2 = Error 3 = Warning 4 = Error and/or warning 5 = Set speed attained 6 = Pump on 7 = Pump accelerates 8 = Pump decelerates 9 = always 0 10 = always 1 11 = Remote priority active 12 = Heating 13 = Backing pump 14 = Sealing gas 15 = Pumping station 16 = Pump rotates 17 = Pump does not rotate	7	RW		0	17	0	x
046	Cfg Rel R2	Configuration Relay 2	0 = Rot. speed switch point attained 1 = No error 2 = Error 3 = Warning 4 = Error and/or warning 5 = Set speed attained 6 = Pump on 7 = Pump accelerates 8 = Pump decelerates 9 = always 0 10 = always 1 11 = Remote priority active 12 = Heating 13 = Backing pump 14 = Sealing gas 15 = Pumping station 16 = Pump rotates 17 = Pump does not rotate	7	RW		0	17	1	x

#	Display	Designation	Functions	Data type	Access	Unit	min	max	default	🖫
047	Cfg Rel R3	Configuration Relay 3	0 = Rot. speed switch point attained 1 = No error 2 = Error 3 = Warning 4 = Error and/or warning 5 = Set speed attained 6 = Pump on 7 = Pump accelerates 8 = Pump decelerates 9 = always 0 10 = always 1 11 = Remote priority active 12 = Heating 13 = Backing pump 14 = Sealing gas 15 = Pumping station 16 = Pump rotates 17 = Pump does not rotate	7	RW		0	17	3	x
050	SealingGas	Sealing gas	0 = off 1 = on	0	RW		0	1	0	x
055	Cfg AO1	Configuration output AO1	0 = Actual rotation speed 1 = Power 2 = Current 3 = always 0 V 4 = always 10 V 5 = follows AI1	7	RW		0	5	0	x
057	Cfg AI1	Configuration input AI1	0 = Disconnected 1 = Set value rot. speed setting mode	7	RW		0	1	0	x
060	CtrlViaInt	Control via interface	1 = Remote 2 = RS-485 4 = PV.can 8 = Field bus 16 = E74 255 = Unlock interface selection	7	RW		1	255	2	x
061	IntSelLckd	Interface selection locked	0 = off 1 = on	0	RW		0	1	0	x
062	Cfg DI1	Configuration input DI1	0 = Deactivated 1 = Enable venting 2 = Heating 3 = Sealing gas 4 = Run-up time control 5 = Rotation speed setting mode Setting ≠**[P:063/064]**	7	RW		0	5	1	x
063	Cfg DI2	Configuration input DI2	0 = Deactivated 1 = Enable venting 2 = Heating 3 = Sealing gas 4 = Run-up time control 5 = Rotation speed setting mode Setting ≠**[P:062/064]**	7	RW		0	5	2	x
064	Cfg DI3	Konfiguration input DI3	0 = Deactivated 1 = Enable venting 2 = Heating 3 = Sealing gas 4 = Run-up time control 5 = Rotation speed setting mode Setting ≠**[P:062/063]**	7	RW		0	5	3	x

Status requests

#	Display	Designation	Functions	Data type	Access	Unit	min	max	default	🖫
300	RemotePrio	Remote priority	0 = no 1 = yes	0	R		0	1		
302	SpdSwPtAtt	Rotation speed switch point attained	0 = no 1 = yes	0	R		0	1		
303	Error code	Error code		4	R					
304	OvTempElec	Excess temperature electronic drive unit	0 = no 1 = yes	0	R		0	1		
305	OvTempPump	Excess temperature pump	0 = no 1 = yes	0	R		0	1		
306	SetSpdAtt	Set rotation speed attained	0 = no 1 = yes	0	R		0	1		

#	Display	Designation	Functions	Data type	Access	Unit	min	max	default	🖫
307	PumpAccel	Pump accelerates	0 = no 1 = yes	0	R		0	1		
308	SetRotSpd	Set rotation speed (Hz)		1	R	Hz	0	999999		
309	ActualSpd	Active rotation speed (Hz)		1	R	Hz	0	999999		
310	DrvCurrent	Drive current		2	R	A	0	9999.99		
311	OpHrsPump	Operating hours pump		1	R	h	0	65535		x
312	Fw version	Firmware version electronic drive unit		4	R					
313	DrvVoltage	Drive voltage		2	R	V	0	9999.99		
314	OpHrsElec	Operating hours electronic drive unit		1	R	h	0	65535		x
315	Nominal Spd	Nominal rotation speed (Hz)		1	R	Hz	0	999999		
316	DrvPower	Drive power		1	R	W	0	999999		
319	PumpCylces	Pump cycles		1	R		0	65535		x
324	TempPwrStg	Temperature power stage		1	R	°C	0	999999		
326	TempElec	Temperature electronic		1	R	°C	0	999999		
329	BearngWear	Wear conditions safety bearings		1	R	%	0	150		
330	TempPmpBot	Temperature pump bottom part		1	R	°C	0	999999		
336	AccelDecel	Acceleration / Deceleration		1	R	rpm/s	0	999999		
342	TempBearng	Temperature bearing		1	R	°C	0	999999		
346	TempMotor	Temperature motor		1	R	°C	0	999999		
349	ElecName	Name of electronic drive unit		4	R					
354	HW Version	Hardware version electronic drive unit		4	R					
358	RotorImbal	Rotor out-of-balance		1	R	%	0	150		
360	ErrHist1	Error code history, pos. 1		4	R					x
361	ErrHist2	Error code history, pos. 2		4	R					x
362	ErrHist3	Error code history, pos. 3		4	R					x
363	ErrHist4	Error code history, pos. 4		4	R					x
364	ErrHist5	Error code history, pos. 5		4	R					x
365	ErrHist6	Error code history, pos. 6		4	R					x
366	ErrHist7	Error code history, pos. 7		4	R					x
367	ErrHist8	Error code history, pos. 8		4	R					x
368	ErrHist9	Error code history, pos. 9		4	R					x
369	ErrHist10	Error code history, pos. 10		4	R					x
397	SetRotSpd	Set rotation speed (rpm)		1	R	rpm	0	999999		
398	ActualSpd	Actual rotation speed (rpm)		1	R	rpm	0	999999		
399	NominalSpd	Nominal rotation speed (rpm)		1	R	rpm	0	999999		

Set value settings

#	Display	Designation	Functions	Data type	Access method	Unit	min	max	default	🖫
700	RUTimeSVal	Set value run-up time		1	RW	min	1	120	8	x
701	SpdSwPt1	Rotation speed switch point 1		1	RW	%	50	97	80	x
707	SpdSVal	Set value in rot. speed setting mode		2	RW	%	20	100	65	x
708	PwrSVal	Set value power consumption		7	RW	%	10	100	100[1]	x
710	Swoff BKP	Switching off threshold backing pump in intermittend mode		1	RW	W	0	1000	0	x
711	SwOn BKP	Switching on threshold backing pump in intermittend mode		1	RW	W	0	1000	0	x
717	StdbySVal	Set value rotation speed at standby		2	RW	%	20	100	66.7	x
719	SpdSwPt2	Rotation speed switch point 2		1	RW	%	5	97	20	x
720	VentSpd	Venting rot. speed at delayed venting		7	RW	%	40	98	50	x
721	VentTime	Venting time at delayed venting		1	RW	s	6	3600	3600	x
777	NomSpdConf	Nominal rotation speed confirmation		1	RW	Hz	0	1500	0	x
797	RS485Adr	RS-485 device address		1	RW		1	255	1	x

1. depending on the pump type

7.3 Configuring the connections

The electronic drive unit is pre-configured in the factory. Thereby the turbopump is immediately operational with the necessary functions. The connections of the electronic drive unit can be configured to suit individual requirements using the parameter set.

Accessory connection

➔ Configuration via parameters **[P:035]**, **[P:036]**, **[P:037]** or **[P:038]**.

Option	Description
0 = Fan (continous operation)	Control via parameter Pumping station
1 = Venting valve, normally closed	Control via parameter Enable venting, when using a venting valve which is normally closed.
2 = Heating	Control via parameters Heating and Rotation speed switchpont attained
3 = Backing pump	Control via parameters Pumping station and operation mode backing pump
4 = Fan (temperature controlled)	Control via parameter Pumping station and temperature thresholds
5 = Sealing gas	Control via parameters Pumping station and Sealing gas
6 = always 0	GND for the control of an external device
7 = always 1	+24 V DC for the control of an external device
8 = Power failure venting unit	Control via parameter Enable venting, when using a power failure venting unit.
9 = TMS heating unit*	TMS switching box control
10 = TMS cooling unit*	TMS control of cooling water supply

* Only when using pumps with Temperature Management System TMS

Digital inputs on "*remote*"

➔ Configuration via parameters **[P:062]**, **[P:063]** or **[P:064]**.

Option	Description
0 = deactivated	Connection deactivated
1 = Enable venting	Control is equal to parameter [P:012]
2 = Heating	Control is equal to parameter [P:001]
3 = Sealing gas	Control is equal to parameter [P:050]
4 = Run-up time control	Control is equal to parameter [P:004]
5 = Rotation speed setting mode	Control is equal to parameter [P:026]

Digital outputs and relays on "*remote*"

➔ Configuration via parameters **[P:019]** and **[P:024]**, respectively **[P:045]**, **[P:046]**, **[P:047]** and **[P:028]**.

- In the description "active" means:
  - For all digital outputs: V+ active high
  - For all relays: Contact switch-over according to configuration of **[P:028]**

Option	Description
0 = Rotation speed switchpoint attained	active, if switchpoint attained
1 = No error	active, if failure-free operation
2 = Error	active, if error message is active
3 = Warning	active, if warning message is active
4 = Error and / or warning	active, if error and / or warning is active
5 = Set rotation speed attained	active, if set rotation speed is attained
6 = Pump on	active, if Pumping station and Motor is on; No Error
7 = Pump accelerates	active, if Pumping station is on; Actual rotation speed < Set rotation speed
8 = Pump decelerates	active, if Pumping station is on; Actual rotation speed > Set rotation speed Pumping station is off; Rotation speed > 3 Hz
9 = always 0	GND for the control of an external device
10 = always 1	+24 V DC for the control of an external device
11 = Remote priority active	active, if Remote priority is active

Option	Description
12 = Heating	Control is equal to parameter [P:001]
13 = Backing pump	Control is equal to parameter [P:010] and [P:025]
14 = Sealing gas	Control is equal to parameter [P:050]
15 = Pumping station	Control is equal to parameter [P:010]
16 = Pump rotates	active, if rotation speed > 1 Hz
17 = Pump does not rotate	active, if rotation speed < 2 Hz
18 = TMS engaged*	active, if TMS set temperature is engaged

* Only when using pumps with Temperature Management System TMS

Analog output on "*remote*"

➔ Configuration via parameter **[P:055]**.

Option	Description
0 = Rotation speed	Rotation speed signal; 0 - 10 V DC = 0 - 100 % x $f_{Nominal}$
1 = Power	Power signal; 0 - 10 V DC = 0 - 100 % x P_{max}
2 = Current	Current signal; 0 - 10 V DC = 0 - 100 % x I_{max}
3 = always 0 V	always GND
4 = always 10 V	output of continously 10 V DC
5 = follows AI1	follows the analogue input 1

Analog input on "*remote*"

➔ Configuration via parameter **[P:057]**.

Option	Description
0 = Switched off	Connection is deactivated
1 = Set value in rotation speed setting mode	Rotation speed setting mode via pin 7 (0 - 10 V) and pin 11 (GND)

Control via interface

➔ Configuration via parameters **[P:060]** and **[P:061]**.

Option [P:060]	Description
1 = remote	Operation via connection "*remote*"
2 = RS-485	Operation via connection "*RS-485*"
4 = PV.can	For service purposes only
8 = Field bus	Operation via field bus
16 = E74	Operation via connection "*E74*"

Option [P:061]	Description
0 = off	Interface selection via [P:060]
1 = on	Interface selection locked

7.4 Operation with the Pfeiffer Vacuum parameter set

Factory settings

The electronic drive unit is pre-programmed in the factory. This guarantees proper, reliable turbopump operation without the need for additional configuration.

Checking the adjustments

➔ Before operating with parameters, check set values and control commands for their suitability for the pumping process.

➔ Remove the remote plug from electronic drive unit if required.

Gas type dependent operations

Friction causes the rotor to heat up severely under gas load and high rotation speed. To avoid overheating, the electronic drive unit has implemented power-rotation speed-characteristics, whereby the pump can be operated at every rotation speed with the maximum allowable gas load without danger of damage. The maximum power consumption depends on the gas type. Three characteristics are available in order to completely exhaust the pump's capacity for each gas type.

CAUTION

Danger of the pump being destroyed

Pumping of gases with a higher molecular mass in the wrong gas mode can lead to destruction of the pump.

➔ Ensure the gas mode is correctly set.

➔ Contact Pfeiffer Vacuum before using gases with a greater molecular mass (> 80).

- Gas mode "0" for gases with the molecular mass >39, e.g. Ar.
- Gas mode "1" for gases with the molecular mass ≤ 39.
- Gas mode "2" for helium.
- Power characteristics according to the technical data of the turbopump.

➔ Check and set-up the gas mode via **[P:027]**.

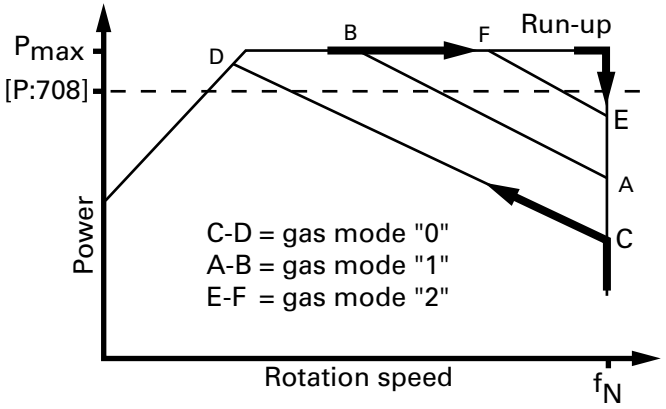


Fig. 3: Principle of power characteristics lines for gas type dependent operations, e.g. gas mode = 0

The turbopump runs up with maximum power consumption. When the nominal and/or set rotation speed is reached, the pump automatically switches over to the chosen power characteristic of the selected gas mode. Increasing gas load is initially compensated by a rise in power consumption in order to keep the rotation speed constant. Increasing gas friction, however, causes the turbopump to heat up more severely. When the gastype-dependent maximum power is exceeded, the rotation speed of the turbopump is reduced until an equilibrium between permissible power and gas friction is attained.

➔ To avoid rotation speed fluctuations, Pfeiffer Vacuum recommends setting a somewhat lower frequency in rotation speed setting mode.

Set value power consumption

➔ Adjust the parameter **[P:708]** to the desired value in %.

If adjusting the set value power consumption below 100 % the run-up time prolongs. To avoid error messages, the parameter **[P:700] RUTimeSVal** should be adjusted accordingly.

Run-up time

The run-up of the turbopump is time-monitored ex factory. There are various causes of prolonged run-up times, e.g.:

- Too high gas loads
- Leakage in the system
- The set value run-up time is too low

➔ Eliminate any external and application-related causes.

➔ Adjust the run-up time via parameter **[P:700]**.

Adjusting the rotation speed switchpoint

The rotation speed switch point can be used for the message "Pump operational for the process". Overrunning or underrunning the active rotation speed switch point activates or deactivates a signal at the pre-configured output on the electronic drive unit and at the status parameter **[P:302]**.

Rotation speed switchpoint 1

➔ Adjust the parameter **[P:701]** to the desired value in %.

➔ Parameter **[P:017]** = 0

Signal output and status parameter **[P:302]** are based on the set value for rotation speed switch point 1 **[P:701]**.

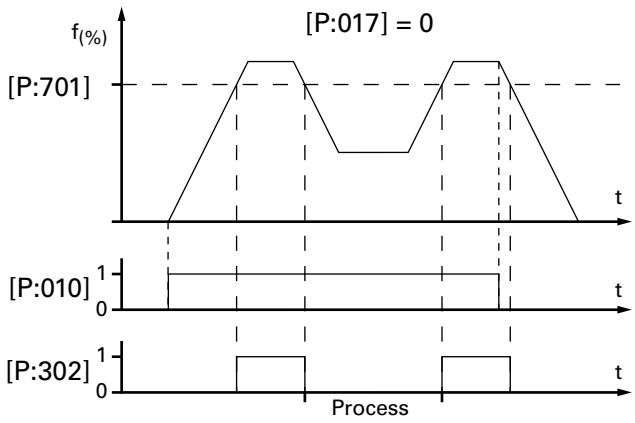


Fig. 4: Example for the configuration rotation speed switch point 1 active

Rotation speed switchpoint 1 & 2

➔ Adjust the parameter **[P:701]** to the desired value in %.

➔ Adjust the parameter **[P:719]** to the desired value in %.

➔ Parameter **[P:017]** = 1

When the pumping station **[P:010]** is switched on, the rotation speed switch point 1 is the signal generator. When the pumping station is switched off, signal output and status query are based on the rotation speed switch point 2. The signal output is governed by the hysteresis between the two switch points.

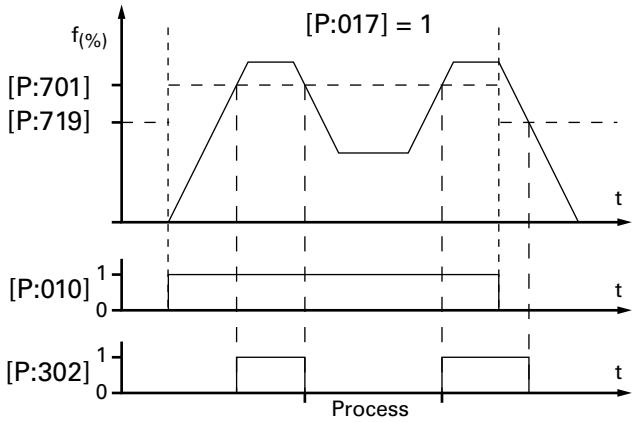


Fig. 5: Example for the configuration rotation speed switch point 1+2 active; [P:701] > [P:719]

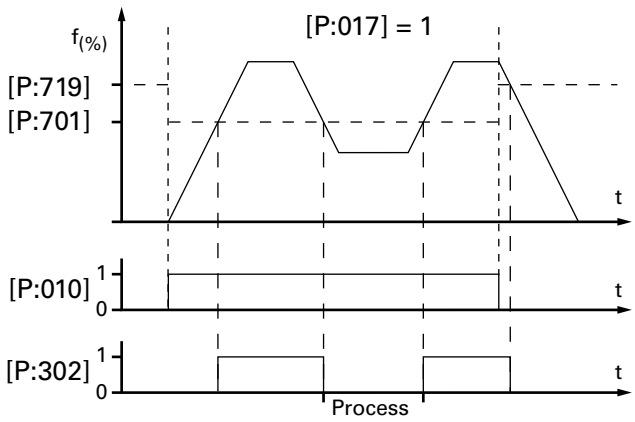


Fig. 6: Example for the configuration rotation speed switch points 1+2 active; [P:701] < [P:719]

Rotation speed setting mode

The rotation speed setting mode reduces the rotation speed and hence the throughput of the turbopump. The pumping speed of the turbopump changes proportional to rotation speed. Standby mode is ineffective during rotation speed setting mode. The set rotation speed is adjusted by the set value in rotation speed setting mode **[P:707]**. The rotation speed switch point varies with the set rotation speed. Underrunning or overrunning the set value in rotation speed setting mode activates and deactivates the status signal **[P:306] SetSpdAtt** respectively.

➔ Adjust the parameter **[P:707]** to the desired value in %.
➔ Parameter **[P:026]** = 1
➔ Read the parameters **[P:308]/[P:397]**.

Standby

Pfeiffer Vacuum recommends standby mode for the turbopump during process and production stops. When standby mode is active, the electronic drive unit reduces the rotation speed of the turbopump. Standby mode is ineffective during rotation speed setting mode. The factory setting for the set value in standby mode is 66.7 % of the nominal rotation speed. Underrunning or overrunning the set speed in standby mode activates or deactivates the status signal **[P:306] SetSpdAtt**.

➔ Adjust the parameter **[P:717]** to the desired value in %.
➔ Parameter **[P:026]** = 0
➔ Parameter **[P:002]** = 1
➔ Read the parameters **[P:308]/[P:397]**.

Rotation speed set value

The typical nominal rotation speed of a turbopump is factory-set in the electronic drive unit. If the electronic drive unit is replaced or a different pump type is used, the reference set value of the nominal rotation speed must be confirmed. This procedure is part of a redundant safety system for avoiding excess rotation speeds.

HiPace	Nominal rotation speed confirmation [P:777]
300	1000 Hz
400 / 700 / 800	820 Hz

➔ Adjust the parameter **[P:777]** according to the pump type.

Once the nominal rotation speed is attained, the pump will run idle unless additional gas loads are entered. Depending on process or application requirements, the nominal rotation speed can be reduced in rotation speed setting mode or standby mode.

Operation mode backing pump

Operation of a connected backing pump via the electronic drive unit depends on the backing pump type.

Operation mode [P:025]	recommended backing pump
"0" continous operation	all kinds of backing pumps
"1" Intermittend operation	diaphragm pumps only
"2" Delayed switching on	all kinds of backing pumps

➔ Adjust the parameter **[P:025]** to the desired value.

Continous operation

With "pumping station on", the electronic drive unit sends a signal to the configured accessory connection to switch on the backing pump. This signal can also be used for controlling a fore-vacuum safety valve.

Intermittend operation (diaphragm pumps only)

Intermittend operation can extend the life expectancy of the membrane of a connected diaphragm pump. Either a diaphragm pump with built-in semiconductor relay or an interconnected relay box with semiconductor relay is required for intermittend operation. The backing pump is switched on and off in dependence of the turbopump's power consumption. A relation to the supplied fore-vacuum pressure is derived from the power consumption. The switching off and switching on thresholds for the backing pump are adjustable. Fluctuations in the power consumption of idling turbopumps and type-dependent varying fore-vacuum pressures of the backing pumps require the switching thresholds to be set separately for the intermittend mode.

Pfeiffer Vacuum recommends the intermittend mode between 5 and 10 mbar. A pressure gauge and a dosing valve are required to set the switching thresholds.

➔ Switch on the vacuum system via the function "pumping station" and await the run-up.
➔ Generate a fore-vacuum pressure of 10 mbar by gas inlet via dosing valve.
➔ Read and note the parameter **[P:316]**.
➔ Adjust the switch on threshold backing pump via parameter **[P:711]** to the determined drive power for a fore-vacuum pressure of 10 mbar.
➔ Reduce the fore-vacuum pressure to 5 mbar.
➔ Read and note the parameter **[P:316]**.
➔ Adjust the switch off threshold backing pump via parameter **[P:710]** to the determined drive power for a fore-vacuum pressure of 5 mbar.

Electrical brake

The turbopump is equipped with an electric brake. It supports rapid deceleration of the rotor until standstill.

➔ **Recommendation**: To reduce rotor slow-down time, always shut down turbopumps with magnetic bearings using the electric brake.
➔ Parameter **[P:013]** = 1

Operation with accessories

Depending on the configuration, various accessories can be connected to the turbopump and controlled via parameter of the electronic drive unit.

Heating

➔ Switch on or off the heating via parameter **[P:001]**.

The activation of a connected casing heating depends on rotation speed switch point 1 (factory setting: 80 % x $f_{Nominal}$).

Fan

Two options in the connection configuration enable continuous or temperature controlled operation of a connected air cooling unit *(see p. 30, chap. 7.3)*. Threshold values are type-specific and are anchored in the electronic drive unit.

Sealing gas valve

➔ Switch on or off a sealing gas valve which is connected to a pre-configured output via parameter **[P:050]**.

Vent modes

The turbopump can be vented only after the function "pumping station" has been switched off. Signals are sent to configured outputs with a fixed delay of 6 s. There are three options for operation with a venting valve connected.

➔ Enable venting via parameter **[P:012]**.

➔ Select the venting mode via parameter **[P:030]**.

Delayed venting

Start and venting time after "pumping station off" are configurable and depend on the rotation speed of the turbopump.

➔ Parameter **[P:030]** = 0

➔ Adjust the venting rotation speed in % of the nominal rotation speed via parameter **[P:720]**.

➔ Adjust the venting time in s via parameter **[P:721]**.

If the venting rotation speed is underrun, the venting valve will open for the set venting time. In the event of a power failure, venting will occur if the set venting rotation speed is underrun. In this case, the venting period depends on the residual energy delivered by the moving rotor. When power is restored, the venting process is interrupted.

No venting

No venting is performed during this operation mode.

➔ Parameter **[P:030]** = 1

Direct venting

Start and venting time are not configurable. Venting starts with a delay of 6 s after "pumping station off". When the function "pumping station" is switched on renewed, the venting valve closes automatically. In the event of a power failure, venting will occur if an anchored type-specific rotation speed is underrun. When power is restored, the venting process is interrupted.

➔ Parameter **[P:030]** = 2

Safety bearing stress

The level of stress on the safety bearings is linked to the severity of the disruptive influences on the running rotor. The stress on the safety bearings is expressed as a percentage of the maximum possible stress due to the drive electronics and can be viewed via the RS-485 interface using the Pfeiffer Vacuum display and control unit or PC.

➔ Display the current safety bearing stress in % via parameter **[P:329]**.

- Display of a correspondent warning message at 75 % total stress.
- Display of a correspondent error message at 100 % total stress.
  - Operation of the pump is no longer possible.
  - Please contact Pfeiffer Vacuum Service.

Balance

The magnetic bearing sensorics permanently monitor the current rotor balance. The balance is expressed as a percentage of the maximum possible rotor imbalance due to the drive electronics and can be viewed via the RS-485 interface using the Pfeiffer Vacuum display and control unit or PC.

➔ Display the current rotor balance in % via parameter **[P:329]**.

- Display of a correspondent warning message at 75 % of the admissible unbalance.
- Display of a correspondent error message at 100 % of the admissible unbalance.

– Operation of the pump is no longer possible.
– Please contact Pfeiffer Vacuum Service.

Monitoring the thermal load

If threshold values are overrun, output signals from temperature sensors allow the pump to be brought to a safe condition. Depending on pump type, temperature threshold values for warnings and error messages are saved fixed in the electronic drive unit . For information purposes, various status queries are prepared in the parameter set.

7.5 Switching on/off the pump

Switching on

The function "pumping station" comprises turbopump operation with control of all connected accessories (e.g. backing pump).

➔ Switch on the supply voltage with switch S1 on the power supply.
➔ Parameter **[P:023]** = 1
➔ Parameter **[P:010]** = 1

Ongoing (and removed) error messages are reset. After a successfully completed self-test, the electronic drive unit sets the turbopump motor and all connected accessories into operation depending on their configuration.

When the pumping station is activated, the motor of the turbopump can be switched off and on via the function **[P:023]**.

Switching off

➔ Parameter **[P:010]** = 0

The electronic drive unit switches off the turbopump and activates preset accessory options (e.g. venting, backing pump).

➔ Wait for the complete standstill of the pump.
➔ Cut off the supply voltage with switch S1 on the power supply.

8 Pfeiffer Vacuum Protocol for "RS-485"

8.1 Telegram frame

The telegram frame of the Pfeiffer Vacuum protocol contains only ASCII code characters [32; 127], the exception being the end character of the message C_R. Basically, a master 💻 (e.g. a PC) sends a telegram, which is answered by a slave ○ (e.g. electronic drive unit or transmitter).

a2	a1	a0	*	0	n2	n1	n0	l1	l0	dn	...	d0	c2	c1	c0	C_R

a2 - a0	Unit address for slave ○ – Individual address of the unit ["001";"255"] – Group address "9xx" for all identical units (no response) – global address "000" for all units on the bus (no response)
*	Action *(see p. 38, chap. 8.2)*
n2 - n0	Pfeiffer Vacuum parameter numbers
l1 - l0	Data length dn ... d0
dn - d0	Data in data type concerned *(see p. 39, chap. 8.3)*
c2 - c0	Checksum (sum of ASCII values of cells a2 to d0) modulo 256
C_R	carriage return (ASCII 13)

8.2 Telegrams

Data request 💻⇨○?

a2	a1	a0	0	0	n2	n1	n0	0	2	=	?	c2	c1	c0	C_R

Control command 💻⇨○!

a2	a1	a0	1	0	n2	n1	n0	l1	l0	dn	...	d0	c2	c1	c0	C_R

Data response / control command understood ○⇨💻✓

a2	a1	a0	1	0	n2	n1	n0	l1	l0	dn	...	d0	c2	c1	c0	C_R

Error message ○⇨💻×

a2	a1	a0	1	0	n2	n1	n0	0	6	N	O	_	D	E	F	c2	c1	c0	C_R
										_	R	A	N	G	E				
										_	L	O	G	I	C				

"NO_DEF"	The parameter n2 - n0 does not exist
"_RANGE"	Data dn - d0 are outside the permitted range
"_LOGIC"	Logic access violation

Example 1

Data request

Actual rotation speed (parameter **[P:309]**, device address slave: "123")

💻⇨○?	1	2	3	0	0	3	0	9	0	2	=	?	1	1	2	C_R
ASCII	49	50	51	48	48	51	48	57	48	50	61	63	49	49	50	13

Data request: 633 Hz

Actual rotation speed (parameter **[P:309]**, device address slave: "123")

○⇨💻✓	1	2	3	1	0	3	0	9	0	6	0	0	0	6	3	3	0	3	7	C_R
ASCII	49	50	51	49	48	51	48	57	48	54	48	48	48	54	51	51	48	51	55	13

Example 2

Control command

Switch on pumping station (parameter **[P:010]**, device address slave: "042")

💻⇨○!	0	4	2	1	0	0	1	0	0	6	1	1	1	1	1	1	0	2	0	C_R
ASCII	48	52	50	49	48	48	49	48	48	54	49	49	49	49	49	49	48	50	48	13

Control command understood

Switch on pumping station (parameter **[P:010]**, device address slave: "042")

💻⇨○!	0	4	2	1	0	0	1	0	0	6	1	1	1	1	1	1	0	2	0	C_R
ASCII	48	52	50	49	48	48	49	48	48	54	49	49	49	49	49	49	48	50	48	13

8.3 Applied data types

Data type	Description	Size l1 - l0	Example
0	False / true	06	000000 / 111111
1	Positive integer number	06	000000 to 999999
2	Positive fixed comma number	06	001571 equal to 15,71
4	Symbol chain	06	TC_400
7	Positive integer number	03	000 to 999
11	Symbol chain	16	BrezelBier&Wurst

9 Malfunctions

9.1 General

Turbopump and electronic drive unit malfunctions always result in a warning or error message. In both cases, the electronic drive unit outputs an error code. Operating messages are generally displayed via the LEDs on the electronic drive unit. If an error occurs, the turbopump and connected devices will be switched off. The selected venting mode will be triggered after the preset delay.

WARNING

Automatic start-up after power failure or malfunction acknowledgement

The function "pumping station" of the electronic drive unit remains active after power failure or errors that lead to shut down the pump or the system. The turbopump runs up automatically after power ist restoresd or malfunction acknowledgement.

➔ Switch off the function "pumping station" if necessary.

➔ Provide safety measures against interference in the high vacuum flange while the turbopump is running.

9.2 Operating mode display via LED

LEDs in the front panel of the electronic drive unit show basic operating conditions of the turbopump. A differentiated malfunction and warning display is possible only for operation with DCU or HPU.

LED	Symbol	Steady OFF	Flashing (1/12 s active)	Blinking (1/2 s active)	Steady ON
Green		insufficient power supply	Pumping station "OFF" Rotation speed ≤ 1Hz	Pumping station "OFF" Rotation speed > 1 Hz	Pumping station "ON"
Yellow		no warning			Warning
Red		no malfunction			Malfunction

9.3 Error codes

Error code	Problem	Possible cause	Remedy
Err001	Excess rotation speed		⇨ Contact Pfeiffer Vacuum Service ⇨ Reset at rotation speed f = 0 only
Err002	Overvoltage	– Wrong mains pack used	⇨ Check type of mains pack ⇨ Check mains pack voltage
Err006	Run-up time error	– Run-up time too short – Gas flow in the vacuum chamber caused by leakage or open valves – Rotation speed switchpoint is underrun after run-up time is expired	⇨ Adjust run-up time to process ⇨ Check the vacuum chamber for leaks or closed valves ⇨ Adjust rotation speed switch point
Err008	Connection electronic drive unit - pump faulty	– Connection to the pump is faulty	⇨ Check the connection ⇨ Reset at rotation speed f = 0 only
Err010	Internal device fault		⇨ Contact Pfeiffer Vacuum Service ⇨ Reset at rotation speed f = 0 only
Err021	Electronic drive unit does not recognize pump		⇨ Contact Pfeiffer Vacuum Service ⇨ Reset at rotation speed f = 0 only
Err041	Excess current motor		⇨ Contact Pfeiffer Vacuum Service
Err043	Internal configuration fault		⇨ Contact Pfeiffer Vacuum Service
Err044	Excess temperature electronic	– Cooling deficient	⇨ Optimize cooling ⇨ Check the ambient conditions
Err045	Excess temperature motor	– Cooling deficient	⇨ Optimize cooling ⇨ Check the ambient conditions

Error code	Problem	Possible cause	Remedy
Err046	Internal initialization fault		⇨ Contact Pfeiffer Vacuum Service
Err073	Overload axial bearing		⇨ Contact Pfeiffer Vacuum Service
Err074	Overload radial bearing		⇨ Contact Pfeiffer Vacuum Service
Err089	Rotor out of target area, stabilization impossible	– Crushes and vibrations	⇨ Check the ambient conditions
Err091	Internal device fault		⇨ Contact Pfeiffer Vacuum Service
Err092	Unknown connection panel		⇨ Contact Pfeiffer Vacuum Service
Err093	Temperature analysis motor faulty		⇨ Contact Pfeiffer Vacuum Service
Err094	Temperature analysis electronic faulty		⇨ Contact Pfeiffer Vacuum Service
Err098	Internal communication fault		⇨ Contact Pfeiffer Vacuum Service
Err107	Collective fault power stage		⇨ Contact Pfeiffer Vacuum Service ⇨ Reset at rotation speed f = 0 only
Err108	Rotation speed measurement faulty		⇨ Contact Pfeiffer Vacuum Service ⇨ Reset at rotation speed f = 0 only
Err109	Firmware not confirmed		⇨ Contact Pfeiffer Vacuum Service
Err114	Temperature analysis power stage faulty		⇨ Contact Pfeiffer Vacuum Service
Err117	Excess temperature pump bottom part	– Cooling deficient	⇨ Optimize cooling ⇨ Check the ambient conditions
Err118	Excess temperature power stage	– Cooling deficient	⇨ Optimize cooling ⇨ Check the ambient conditions
Err119	Excess temperature bearing	– Cooling deficient	⇨ Optimize cooling ⇨ Check the ambient conditions
Err777	Nominal rotation speed not confirmed	– Nominal rotation speed not confirmed after replacement of the electronic drive unit	⇨ Confirm the nominal rotation speed via **[P:777]** ⇨ Reset at rotation speed f = 0 only
Err800	Excess current position sensors		⇨ Contact Pfeiffer Vacuum Service
Err802	Calibration of position sensors faulty		⇨ New calibration by mains "ON/OFF" ⇨ Contact Pfeiffer Vacuum Service
Err810	Data set missing in the pump		⇨ Contact Pfeiffer Vacuum Service
Err815	Excess current magnetic bearing output stage		⇨ Contact Pfeiffer Vacuum Service
Err890	Safety bearing stress > 100 %		⇨ Contact Pfeiffer Vacuum Service
Err891	Rotor unbalance > 100 %		⇨ Contact Pfeiffer Vacuum Service
Wrn007	Low voltage / mains power failure	– Mains failure	⇨ Check mains supply
Wrn018	Remote priority conflict	– Pumping station is switched on via **[P:010]**, whereas the E74-input "start/stop" is off (opened)	⇨ Switch on the pumping station via E74 ⇨ Switch off **[P:010]**
Wrn045	High temperature motor	– Cooling deficient	⇨ Optimize cooling ⇨ Check the ambient conditions
Wrn076	High temperature electronic	– Cooling deficient	⇨ Optimize cooling ⇨ Check the ambient conditions
Wrn089	Rotor out of target area, stabilization was possible	– Crushes and vibrations	⇨ Check the ambient conditions
Wrn097	Pump information invalid	– Pump data faulty	⇨ Reset for default values
Wrn098	Pump information incomplete	– Connection to the pump is faulty	⇨ Contact Pfeiffer Vacuum Service
Wrn100	Rotation speed raised to minimum value	– Permissible adjustments for the rotation speed setting mode or standby are incorrect	⇨ Check **[P:707]** or **[P:717]** ⇨ Find the valid rotation speed range in the technical data of the turbopump
Wrn115	Temperature analysis pump bottm part faulty		⇨ Contact Pfeiffer Vacuum Service
Wrn116	Temperature analysis bearing faulty		⇨ Contact Pfeiffer Vacuum Service
Wrn117	High temperature pump bottom part	– Cooling deficient	⇨ Optimize cooling ⇨ Check the ambient conditions
Wrn118	High temperature power stage	– Cooling deficient	⇨ Optimize cooling ⇨ Check the ambient conditions
Wrn119	High temperature bearing	– Cooling deficient	⇨ Optimize cooling ⇨ Check the ambient conditions
Wrn168	High deceleration	– Rate of pressure rise too high; Venting rate to high	⇨ Check and optimize the venting rate (pump specific)
Wrn801	Brake electronics defective		⇨ Contact Pfeiffer Vacuum Service
Wrn806	Brake resistor defective		⇨ Contact Pfeiffer Vacuum Service
Wrn807	Calibration position sensors required	– Recommended by status evaluation	⇨ Automatic calibration at rotation speed f=0
Wrn890	Safety bearing stress > 75 %		⇨ Contact Pfeiffer Vacuum Service
Wrn891	Rotor unbalance > 75 %		⇨ Contact Pfeiffer Vacuum Service

Declaration of conformity

according to the EC directive:

- **Electromagnetic Compatibility 2004/108/EC**
- **Low Voltage 2006/95/EEC**

We hereby certify, that the product specified below is in accordance with the provision of EU Electromagnetic Compatibility Directive **2004/108/EEC** and EU Low Voltage Directive **2006/95/EEC**.

TM 700 DN

Guidelines, harmonised standards and national standards and specifications which have been applied:

DIN EN 61000-3-2 : 2008
DIN EN 61000-3-3 : 2006
DIN EN 61010-1 : 2002
DIN EN 61326-1 : 2006
DIN EN 62061 : 2005
Semi F47-0200
Semi S2-0706

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CE/2011

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