



# OPERATING INSTRUCTIONS



Translation of the original instructions

## ETHERCAT® GATEWAY

Communication protocol - Turbo pumps

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# 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 refers 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](http://www.pfeiffer-vacuum.com).

### Applicable documents

Operating instructions	Part number
ATH 2804-3204 M/MT Operating instructions	121608
ATH 1603-2303 M Operating instructions	118414
ATH 500 M/MT Operating instructions	114436

## 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 S2, ISO 3864 and DIN 4844. In this document, the following hazard levels and information are considered:

<b>DANGER</b>
<b>Imminent danger</b> Indicates an imminent hazardous situation that will result in death or serious injury.
<b>WARNING</b>
<b>Possibly imminent danger</b> Indicates an imminent hazardous situation that can result in death or serious injury.
<b>CAUTION</b>
<b>Possibly imminent danger</b> Indicates an imminent hazardous situation that can result in minor or moderate injury.
<b>NOTICE</b>
<b>Command or note</b> Command to perform an action or information about properties, the disregarding of which may result in damage to the product.

## Pictographs



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



Important information about the product or this document

## Instructions in the text

➔ Work instruction: here you have to do something.

## EtherCAT®

EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

## 2 Safety

### 2.1 Safety precautions

The potential risks and safety precautions of EtherCAT® gateway use (integrated on turbomolecular pump) are described in **Security** chapter of the pump operating instructions. **Read the safety instructions (mandatory!) of the turbomolecular pump operating instructions.**



#### Obligation to inform

Any person responsible for installing, using or maintaining the product must first read the security instructions in this operating manual and comply with them.

→ It is the operating customer's responsibility to protect all operators against the dangers associated with the product, with the media pumped and with the entire installation.



#### WARNING

#### Risk of electromagnetic disturbance

The product's EMC behavior is guaranteed only if the relevant EMC standards are followed during installation.

→ Use shielded cables and connections for the interfaces in interference-prone environments.

- Only qualified personnel trained in safety rules (EMC, electrical safety, chemical pollution) may carry out the installation and maintenance described in this manual. Our service centers can provide the necessary training.
- Do not loosen any plug connection during operations.
- Keep leads and cables well away from hot surfaces ( $> 70\text{ °C}$ ).

### 2.2 Proper use



#### NOTICE

#### EC conformity

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

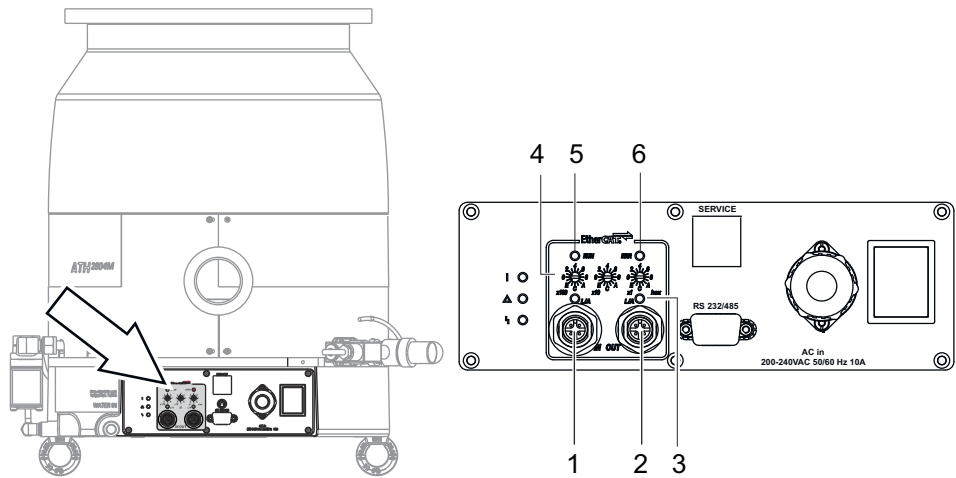
→ Following installation into a plant and before commissioning, the operator must check the entire system for compliance with the valid EU directives and reassess it accordingly.

- The product may be used in an industrial environment.

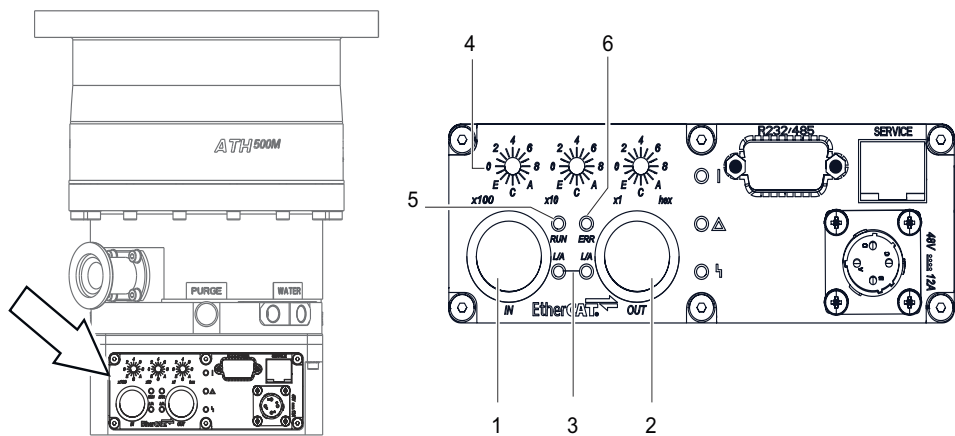
### 3 Product description

#### 3.1 Function

ATH 2804 M front panel





ATH 500 M front panel



- 1 EtherCAT IN connection
- 2 EtherCAT OUT connection
- 3 L/A LED (see 5.3)

- 4 Pump address (see 5.2)
- 5 RUN LED (see 5.3)
- 6 ERR LED (see 5.3)

#### General connection description

	<b>EtherCAT IN</b> M12 socket (D coded) with threaded coupling and L/A-LED for connecting an incoming EtherCAT cable.
	<b>EtherCAT OUT</b> M12 socket (D coded) with threaded coupling and L/A-LED for connecting an EtherCAT cable to the next device.

## 4 Connection diagram

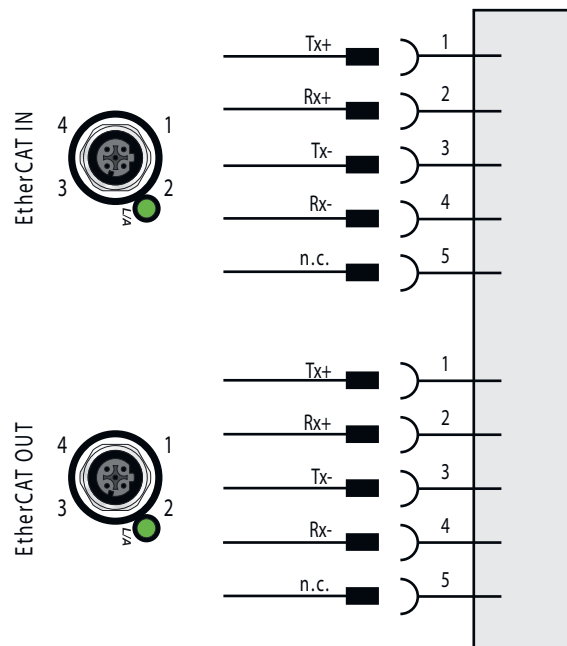


Fig. 1: Connection drawing

# 5 Connection "EtherCAT"

## 5.1 Connections

The pump can be connected to an EtherCAT bus system using the connectors IN/OUT (5-pin, M12, D coded).



Pin	Assignment
1	Tx+
2	Rx+
3	Tx-
4	Rx-

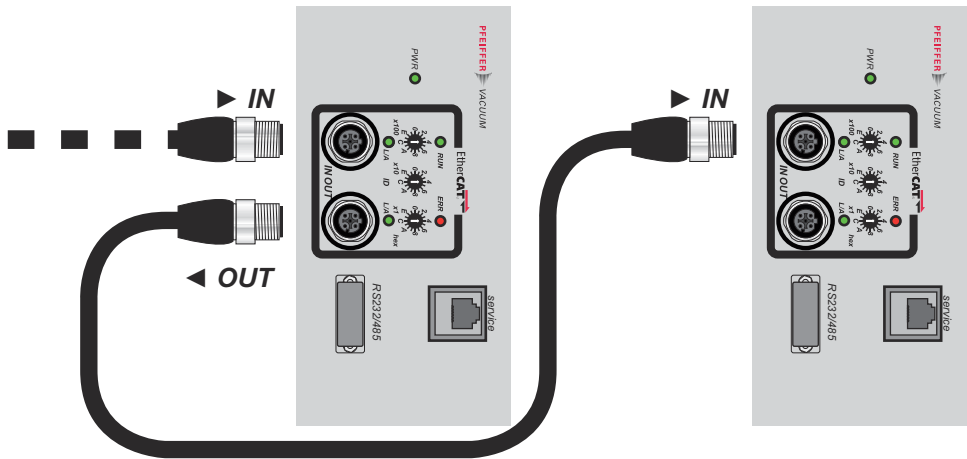


Fig. 2: EtherCAT cable connection

- Observe the EtherCAT specification.
- Insert the incoming cable from the tool into **EtherCATIN**.
- Connect the bus connection to other devices to **EtherCATOUT**.

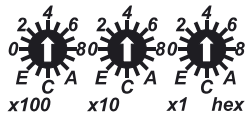
**The use of Ethernet switches and hubs is not supported.**

### Integration

- Use the xml ESI file (delivered by the service center).



## 5.2 Device identification



EtherCAT devices are addressed using their position in the bus. There is no need to make conventional address settings.

- ID switch (hexadecimal) for selection of device identification.
- Set device ID to 0 (0 x 100, 0 x 10, 0 x 1)
- Note the configured position in the bus.

### Explicit device identification

Preferred method as no additional configuration programs are required.

- Select this identification in the device integration.
- Set the device ID to the configured value.
  - Hexadecimal 001h - FFFh corresponds to decimal 1 - 4095.
  - This value applies after a "reset".
- When replacing a device, use the ID of the older device.

### Station alias

A suitable configuration program must be used as a prerequisite.

- Select this identification in the device integration.
- Assign "Station alias" to the device online.
  - This value applies after a "reset".
- Repeat this process when replacing a device.

## 5.3 LED operation

Display	L/A (green) Connection	RUN (green) EtherCAT status	ERR (red) EtherCAT error
Off 	No connection	"INIT": – Initialization, no process or service data	No errors
Rapid flashing 	-	"SAFE OPERATIONAL": – Process input data (TURBO PUMP -> control) valid – Output data (control -> TURBO PUMP) status is safe	Spontaneous status change
2 x rapid flashing 	-	-	Connection lost
Flashing 	-	"PRE_OPERATIONAL": – Service data only, no process data	Invalid configuration
Permanently on 	Connection to next device, no activity	"OPERATIONAL": – Process input and output data is valid	Bootstrap
Flickering 	Connection active	"BOOTSTRAP"	Bootling error

## 5.4 Process data

### Process output data

- Process output data are defined as follows:

Default RxPDO (control -> TURBO PUMP, "output"), CoE 1600h.1-4 (1 byte)

Byte.Bit	CoE <sup>1</sup>	Meaning
0.0	7000.01 Pump Run/Stop	0: Stop, 1: Run
0.1	7000.02 Fault acknowledgement	0->1 : Fault acknowledgement

Byte.Bit	CoE <sup>1</sup>	Meaning
0.2	7000.03 Stand-by speed	0: Normal speed, 1: Stand-by speed
0.3-7.	-	Reserved

<sup>1</sup>. Hexadecimal, see "Service data" chapter

### Process input data

- Process input data are defined as follows:

Default TxPDO (TURBO PUMP -> control, "input"), CoE 1A00h.1-11 (7 byte)

Byte.Bit	CoE <sup>1</sup>	Meaning
0.0	6000.01 Rotation speed > 60 min <sup>-1</sup>	0: no, 1: yes
0.1	6000.02 Normal speed	0: no, 1: yes
0.2	6000.03 Acceleration	0: no, 1: yes
0.3	6000.04 Deceleration	0: no, 1: yes
0.4	6000.05 Remote/Local	0: Remote (EtherCAT), 1: Local (HHR)
0.5	6000.07 Stand-by speed	0: no, 1: yes
0.6	6000h.09h Alarm	0: no, 1: yes
0.7	6000h.0Ah Warning	0: no, 1: yes
1.-2.	6000h.11h Speed	0.1% of nominal rotation speed
3.-4.	6000h.12h Current	0.1 A
5.-6.	6000h.13h Pump Temperature	°C

<sup>1</sup>. Hexadecimal, see "Service data" chapter

**Process data can also be compiled from CoE objects as an alternative.**

- ➔ To do this, set "PRE-OPERATIONAL" status each time.
- ➔ Describe object 1601h.0 or 1A01h.0 with 0.
- ➔ Describe object 1601h.1-n or 1A01h.1-n with corresponding CoE indices.
  - Only objects labeled with "P" can be used.
  - Assign sub-index 1-n on a sequential basis only and without gaps
  - The data must yield a total number of bytes (use "pad bits" if needed) and start with whole bytes (exception BOOL).
  - Max. 12 objects per PDO
- ➔ Describe object 1601h.0 or 1A01h.0 with the number n of objects to be used.
- ➔ Change object 1C12h.1 to 1601h or 1C13h.1 to 1A01h.
- ➔ In the process data, select the corresponding PDO assignment 1601h or 1A01h.

Fig. 3: Example for output data (incl. 4 padding bits)

Fig. 4: Example for input data (incl. 5 padding bits)

## 5.5 Service data

### Data types

Type	Description
BOOL	Binary value (yes/no)
BYTE()	Single byte number

Type	Description
STRING()	Character string
USINT	Positive integer, 8 bit
UINT	Positive integer, 16 bit
UDINT	Positive integer, 32 bit
ULINT	Positive integer, 64 bit
SINT	Integer, 8 bit
INT	Integer, 16 bit
DINT	Integer, 32 bit
REAL	Floating point number, single precision

The following CoE objects are available for access to individual data objects (e.g. for configuration):

#### Administrative data (information about the device, communication)

Idx <sup>1</sup>	sldx	Name	Type	Access <sup>2</sup>	Description
1000	-	Device Type	UDINT	RO	
1008	-	Manufacturer Device Name	STRING()	RO	
1009	-	Manufacturer Hardware Version	STRING()	RO	
100A	-	Manufacturer Software Version	STRING()	RO	
1018		Identity Object			
	01	Vendor ID	UDINT	RO	
	02	Product Code	UDINT	RO	
	03	Revision Number	UDINT	RO	
	04	Serial number	UDINT	RO	
10F8	-	Timestamp Object	ULINT	RO	
1600	01-04	Default RxPDO Mapping (1-4)	UDINT	RO	See process data
1601	00	User RxPDO Mapping	USINT	RW	See process data
	x		UDINT	RW	
1A00	01-0B	Default TxPDO Mapping (1-11)	UDINT	RO	See process data
1A01	00	User TxPDO Mapping	USINT	RW	See process data
	x		UDINT	RW	
1C00	01-04	Sync Manager Communication Type	USINT	RO	
1C12	00	Sync Manager 2 PDO Assignment	USINT	RW	See process data
	01		UINT	RW	
1C13	00	Sync Manager 3 PDO Assignment	USINT	RW	See process data
	01		UINT	RW	
F000		Semiconductor Device Profile			
	01	Index Distance	UINT	RO	
	02	Maximum Number of Modules	UINT	RO	
F010		Module Profile Lists			
	01		UDINT	RO	
F9F0	-	Manufacturer Serial Number	STRING	RO	
F9F1	01	CDP Functional Generation Number (1)	UDINT	RO	
F9F2	01	SDP Functional Generation Number	UDINT	RO	
F9F3	-	Vendor Name	STRING()	RO	
F9F4	01	Semiconductor SDP Device Name (1)	STRING()	RO	
F9F8	-	FW Update Funct. Gen. Number (1)	UDINT	RO	

1. Idx = Index, sldx = Sub-index, hexadecimal

2. RO = Read only, RW = Read/write, P = Suitable for process data

#### Input data (TURBO PUMP -> control)

Idx <sup>1</sup>	sldx	Name	Type	Access <sup>2</sup>	Description
2000		In Identity/Status			
	01	Manufacturer	STRING()	RO	
	02	Elc.Device Name	STRING()	RO	
	03	Elc. Serial Number	STRING()	RO	
	05	Firmware Version	STRING()	RO	
	08	Status Code	UINT	RO P	0: No error 1-999: Error 1-999 1001-1999: Warning 1-999

Idx <sup>1</sup>	sldx	Name	Type	Access <sup>2</sup>	Description
	0A	Elc. Operating Hours	UDINT	RO P	h
	82	Pmp. Device Name	STRING()	RO	
	8A	Pmp. Operating Hours	UDINT	RO P	h
2001		In Operation			
	81	Speed Status	USINT	RO P	0: Stopped (< 60 min <sup>-1</sup> ) 1: Accelerating 2: At speed 3: Decelerating
	82	Actual Speed (rel.)	SINT	RO P	%
	83	Actual Speed (abs.)	DINT	RO P	min <sup>-1</sup>
	88	Ready for Process	BOOL	RO P	Rotation speed switchpoint attained (0: no, 1: yes)
2002		In Pump Power/Temperature			
	08	Elc. Temperature	INT	RO P	°C
	11	Voltage	INT	RO P	0.1 V
	12	Current	INT	RO P	0.1 A
	13	Power	INT	RO P	W
	88	Pmp. Temperature	INT	RO P	°C
6000		Turbo Status and Sensor Value			
	01	Rotation	BOOL	RO P	Pump is rotating > 60 min <sup>-1</sup> (0: no, 1: yes)
	02	Normal	BOOL	RO P	Normal operation from rotation speed switchpoint (0: no, 1: yes)
	03	Acceleration	BOOL	RO P	Pump is accelerating (0: no, 1: yes)
	04	Deceleration	BOOL	RO P	Pump is decelerating (0: no, 1: yes)
	05	Remote/Local	BOOL	RO P	Control via EtherCAT (0: yes, 1: no)
	06	Motor off	BOOL	RO P	0: Motor on, 1: Motor off
	07	Turbo Low Speed	BOOL	RO P	Standby (0: off, 1: on)
	09	Alarm	BOOL	RO P	0: no 1: yes
	0A	Warning	BOOL	RO P	0: no 1: yes
	11	Turbo Speed	INT	RO P	0.1% of nominal rotation speed
	12	Turbo Current	INT	RO P	0.1 A
	13	Turbo Pump Temperature	INT	RO P	°C
F380	-	Active Exception Status	USINT	RO P	BIT 0/1: Warning Bit 2/3: Errors Bit 4-7: Reserved
F381	01	Active Device Warning Details	UDINT	RO P	Bit 0: Loss of voltage Bit 1: Pump excess temperature Bit 2: Overspeed Bit 3: Pump excess current Bit 4: Drive excess temperature Bit 5: Drive excess current Bit 6: Drive excess voltage Bit 7: Drive Bit 8: Controller Bit 9: Unable to start Bit 10: Run-up time Bit 11: Braking time Bit 12: Bearing Bit 13: Bearing sensor Bit 14: Heating excess temperature Bit 15: Heating sensor Bit 16: Heating Bit 17: Valve Bit 18: Other Bit 19-31: Reserved
F383	01	Active Device Error Details (1)	UDINT	RO P	See F381.01
F390	-	Latched Exceptions	USINT	RO P	See F380
F391	01	Latched Device Warning Details (1)	UDINT	RO P	See F381.01

Idx <sup>1</sup>	sldx	Name	Type	Access <sup>2</sup>	Description
F393	01	Latched Device Error Details (1)	UDINT	RO P	See F381.01
F6F0	01	Input Latch Local Timestamp (1)	UDINT	RO	
F9F5	01	Output Identifier (1)	USINT	RW P	
F9F6	-	Time since power on	UDINT	RO P	s
F9F7	-	Total Time Powered	UDINT	RO P	s

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#### Output data (control -> TURBO PUMP)

Idx <sup>1</sup>	sldx	Name	Type	Access <sup>2</sup>	Description
3005		Accessories Control			
	01	Enable heating	BOOL	RW P	0: no, 1: yes
	11	Enable venting	BOOL	RW P	0: no, 1: yes
	21	Enable purge	BOOL	RW P	0: no, 1: yes
	31	Pump braking	BOOL	RW P	0: braking up to 10000 mn <sup>-1</sup> 1: braking up to stop
7000		Pump Control			
	01	Pump Run/Stop	BOOL	RW P	0: stop, 1: run
	02	Defect acknowledgement	BOOL	RW P	0->1: Defect acknowledgement
	03	Stand-by speed	BOOL	RW P	0: Normal speed, 1: Stand-by speed
	04	Motor Run/Stop	BOOL	RW P	0: stop, 1: run

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2. RO = Read only, RW = Read/write, P = Suitable for process data

#### Configuration data (control -> TURBO PUMP)

Idx <sup>1</sup>	sldx	Name	Type	Access <sup>2</sup>	Description
4001		Cfg Pump Operation			
	87	Speed Switchpoint 1	USINT	RW P	% of nominal rotation speed
4005		Cfg Component Operation			
	02	Htg. Set Point	INT	RW P	°C
8001		Turbo Parameter Setting			
	01	Turbo Safe State	UINT	RW P	For INIT, PREOP, SAFEOP and interruption of communication 0: Maintain status 1: 7000.01-04-> 0 (pump off) 2: To normal operation
	02	Low Speed Setpoint	UINT	RW P	0.1% of nominal rotation speed
	03	Normal Speed Setpoint	UINT	RW P	0.1% of nominal rotation speed
F3A1	01	Device Warning Mask (1)	UDINT	RW P	Format, see F381.01, events are placed in F381.01 if bit 1 is set accordingly here
F3A3	01	Device Error Mask (1)	UDINT	RW P	Format, see F381.01, events are placed in F383.01 if bit 1 is set accordingly here

1. Idx = Index, sldx = Sub-index, hexadecimal

2. RO = Read only, RW = Read/write, P = Suitable for process data

## VACUUM SOLUTIONS FROM A SINGLE SOURCE

Pfeiffer Vacuum stands for innovative and custom vacuum solutions worldwide, technological perfection, competent advice and reliable service.

## COMPLETE RANGE OF PRODUCTS

From a single component to complex systems:

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