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# TCM 1601

Magnetlagerelektronik Magnetic Bearing Controller





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# 1. Safety Precautions

- Read and follow all the instructions in this manual. ☞ Inform yourself regarding:
- Hazards which can be caused by the unit, - Hazards which can arise in your system,
- Comply with all safety and accident prevention regulations.
- Check regularly that all safety requirements are being complied with.
- rake account of the ambient conditions when installing the TCM 1601. The protection type is IP20. The unit is protected against the ingress of foreign bodies  $\geq \emptyset$  12 mm. Because water protection is not provided the unit must be fitted into a suitable housing (please see Section 3. Installation).
- re Do not carry out any unauthorised conversions or modifications on the unit.
- Reither disconnect the cable on the TCM during operations nor in the event of a malfunction.
- restoration of The pump re-starts automatically after restoration of power after a mains power failure.
- reason and the cable insulation is not damaged.
- INF Do not open the housing cover when the unit is connected to the mains nor during pumping operation.
- Take account of the prescribed voltage when connecting the cable to the various plugs.
- reason and the cable lines are correctly positioned so that no damage can occur. Do not lay cable over sharp edges or hot surfaces.
- real The unit must only be operated within the prescribed voltage range (see Section 3.4.).
- real The unit must not be used as a table unit without a surface.
- Ise only mains switches with earthing conductors (PE; Protection class 1).
- Protect the unit against thermal overloading.
- re Neither disconnect the connector plug on the unit nor on the turbopump during operations and nor before the pump is completely at rest.
- IF When returning the unit to us please note the shipping instructions (please see Section 9).

Corrections reserved!

## **Pictogram Definitions**



Danger of an electric shock.



Danger of personal injury. BEWARE



Danger of damage to the unit or system.



# 2. Understanding The TCM 1601

# 2.1. For Your Orientation

#### Symbols Used

The following symbols are used throughout in the illustrations:

High vacuum flange

♥ Fore-vacuum flange

• Venting connection

• Cooling water connection

Electric connection

• Air cooling

#### **Position Numbers**

Identical accessory parts have the same position numbers in all illustrations.

#### **Operating instruction In The Text**

Here, you have to do something.

#### **Text Definition (Example)**

 [P:701] =
 Parameter number, choosable

 **«Param. Set»** =
 Parameter description

 SPC =
 Stored Program Control

## 2.2. Product Description

The Magnetic Bearing Controller TCM 1601 serves to drive and monitor PFEIFFER turbomolecular pumps.

The following components are included on delivery:

- TCM 1601.
- Mating plugs for X16

The Magnetic Bearing Controller TCM 1601 contains the following functional units:

- Electronic drive monitoring and controlling.
- Monitoring and controlling for the magnetic bearing.
- LC display with information on the operations status of the pump.
- Parameter selection and adjustment
- Power failure electronics
- Serial Interface RS 485
- Remote control
- potentialfree contacts K1, K2
- external connection for battery box TBB 001

Battery box TBB 001 serves as a supply source for the magnetic bearing in emergency power operations up to the reduction of the rotation speed to 0 Hz (see 12. Accessories).

## **Connection Options:**

The following connection options are available on the TCM 1601:

- Remote control (X16).
- Pumping Station Control Unit TCS 180 (X41)
- Host computer via Serial Interface RS 485 (X17)
- Heating, turbopump housing (X6).
- Air cooling for turbopump (X6).
- Operations monitoring, TMP (X20).
- Temperature Management System TMS 001 (X6)
- Battery box TBB 001 (X29).

The unit has been tested and cleared by the appropriate authorities in accordance with EN 61010/VDE0411 "Safety Ordinance For Electrical Units".

#### **Pumping Station Control Unit TCS 180**

With the Pumping Station Control Unit TCS 180 components can be operated as follows:

- Backing pump (Intermittent operations in respect of the diaphragm pumps).
- Fore-Vacuum Safety Valve (TVV 001) to prevent venting via the backing pump.
- High vacuum valve.
- High vacuum gauge head.

## Proper Use:

- The Magnetic Bearing Controller TCM 1601 may only be used to drive and monitor PFEIFFER magnetic bearing turbomolecular pumps.
- The operations unit TCM- turbopump may only be operated together with a backing pump.
- Instructions concerning installation, start-up, operating and maintenance must be observed.

## Improper Use:

Improper is:

- Uses not covered above, and, in particular,
- Connection to pumps and units which is not permitted in their operating instructions.
- Connection to units which contain touchable and voltage carrying parts.

Improper use will cause any rights regarding liability and guarantees to be forfeited.

# 2.3. Description Of The Front Panel



All operating and display elements are located on the front panel.

- 1 LCD display
- 2 Status display
- 3 Push-button "Malfunction Acknowledgment"
- 4 Push-button parameter selection "backwards"
- 5 Push-button parameter selection "forwards"
- 6 Push-button "Pumping Station ON/OFF"
- 7 Red illuminating diode for the error status
- 8 green illuminating diode for the operations status

# 2.4. Description Of The Rear Panel



On the rear panel are plug connections for the various connections, mains switch and fuses.

- 9 Mains Switch S1
- 10 Fuses F1,F2 (10 AF)
- 11 Mains connection X4 (90-132/190-265 V~)
- 12 Connection socket, pump X5
- 13 Connection socket, Remote X16
- 14 Connection socket, pumping stat. control TCS 180 (X41)
- 15 Potential free contacts X20 (relay controls)
- 16 Serial Interface RS 485 / X17
- 17 Connection socket Battery box X29

# 2.5. General Description Of The Unit

The Magnetic Bearing Electronic Unit TCM 1601 contains a number of monitoring and control options for your vacuum pump and for the pumping process. It can be operated via the keypad, serial interface or remote control.



The LC display enables the representation of various operating conditions. The influence on the vacuum components and their operational behaviour is controlled via parameters; this means via specific numeric combinations to which are assigned functions. The parameters which can be selected are explained in the parameter lists in Sections 5.2. and 5.3.

#### Parameters sets

The parameters can be called up from three different parameter sets (please also refer to the explanation in Section 5.1.).

- Basic parameter set
- Extended parameter set
- Operational orientated parameter set

#### Parameter groups

The parameters are classified in three groups.

- Setting commands
- Status requests
- Set values

Works settings can be retained or you have the option to enter your own settings under setting commands and set value specifications. Please follow the procedure outlined in Section 6, "Operations" when undertaking pre-setting or when modifying operational modes.

Please refer to Section 6.14. for operations via remote control. Serial interface operations are described in Section 6.16.

# 3. Installation

# 3.1. Preparations For Installation



Unauthorised modifications or alterations to the magnetic bearing controller unit are not allowed. The unit must be fitted in a housing taking account of the ambient conditions (see Section 10, "Technical Data").

Please refer to section 11 for the electrical connections diagram.

➡ Disconnect mains power before installation work.

# 3.2. Connections Diagram



Take account of the following ambient conditions when installing the TCM 1601.

Installation location: Protected against the weather.

The following is applicable for open buildings and operations rooms which are not fully air conditioned:

Temperature:+5°C - +40°C.Relative humidity:5 - 85%, non-condensing.Air pressure:86 kPa - 106 kPa

# 3.3. Fitting The Unit Into A Rack

To fit into a 19" rack housing, the unit should be inserted into a 19", 3HE frame in accordance with the specifications and secured.

The ambient temperature in the rack casing should not exceed 40°C.

The unit may only be fitted into racks which comply with the prescribed safety protection regulations.

## **Cooling/Air Circulation**

The Magnetic Bearing Control Unit TCM 1601 generates dissipation power of 200W. Adequate air circulation must be provided around the unit to conduct away this power.

# 3.4. Mains Power Connection

- The unit has been designated protection class 1 and must therefore always be connected with the earthed conductor (PE).
- Mains connection must be made in accordance with the local regulations.



Danger of an electrical shock.

The mains voltage on X4.2 can be in the range 90-132/190 - 265 V. Mains voltage commutation for the TCM 1601 is not necessary.

- ➡ Plug mains cable into X4.
- ➡ Install mains connection.
- ➡ If a Pumping Station Control Unit TCS 180 is in use, make the mains connection via the TCS (see chapter 3.7. and the connections diagram PM 041 892 -S, chapter 11.).



Where large turbomolecular pumps are involved, the drive power can be limited in the 100V range (please see the operating instructions for the pump).

# *3.5. Connecting The Pump And The Venting Valve*



Voltages of up to 50 V<sub>eff</sub>. can be present on the open connection of a running down pump.

There is a danger of an electric shock by touching the contacts.

- Connect the turbomolecular pump with connecting cable (52) to X5/TCM 1601.
- ➡ Lock the bayonet catch (51, 53) on the pump after plugging in.
- Connect the cable splice X1 of the TCM connecting cable to the venting valve (54) and lock it with a screw.

Only PFEIFFER connecting cable should be used for connecting the pump.





Only disconnect the plug connector to the magnetic bearing controller once the pump is completely at rest and the unit has been disconnected from the mains power supply.

# 3.6. Connecting The Casing Heating Or Air Cooling Units To The Turbopump

## **Casing heating**

- Fit the casing heating unit in accordance with the operating instructions.
- ➡ Connect the relay box control lead to X6.
- ➡ Connect the casing heating unit to mains power.

#### **Air Cooling**

- Fit the air cooling unit in accordance with the operating instructions.
- ➡ Connect the relay box control lead to X6.
- ➡ Connect the air cooling unit heating to mains power.

# 3.7. Connecting The Pumping Station Control Unit TCS 180 (optional)

- Connect the Pumping Station Control Unit TCS 180 in accordance with connections diagram section 3.2.
- → Use the mains cable from the TCM 1601 for the TCS 180 mains connection.
- ➡ Connect cable connection X4.1/TCS 180 with X4/TCM 1601.
- Connect cable connection X41.1/TCS 180 with X41/TCM 1601.

No other units may be connected to X4/TCM 1601.

Further notes regarding the connection of Pumping Station Control Unit can be found in the operating instructions for the TCS 180 (PM 800 384 BN).



Only disconnect the plug connector to the Pumping Station Control Unit TCS 180 once the pump is completely at rest and the unit has been disconnected from the mains power supply.

# 3.8. Connecting The Temperature Management System (TMS)

The connections for heating and sensors are centrally accessible in the TMS connecting box. The installation is described in the installation instruction PM 800 570 BN.



When the TMS is in operation additional housing heating of the turbomolecular pump is not possible.

When the TMS is in operation the pump must be water cooled.

# 3.9. Connecting The Remote Control Unit

The TCM 1601 or the complete pumping station can be remote controlled via plug X16. Before connecting the remote control, the remote mode should be selected (please refer to Section 6.14.).

Connect the remote control in accordance with the required functions to mating plug X16 (cable) as per the connections diagram PM 041 892 -S (see Section 11).

#### Pin Arrangement X16

Pin	Description	Function	Тур
X16.1	+15 V	_	-
X16.2	UF	frequency proportional	voltage
		analog voltage	output
		(0 - 10V DC)	
X16.3 <sup>1</sup> )	PWM <sup>2)</sup> Turbo-	set value for turbopump	PWM-Input:
	rotation speed	in the range of	basic frequency
		20 - 100% of the max.	100 Hz (± 20%)
		turbo rotation speed	pulse-duty factor:
			25 - 75%
X16.4	-	-	-
X16.5	-	-	-
X16.6 <sup>3)</sup>	Heating "ON"	TMS "ON" or housing	digital Input
		heating "ON" pre-	(statical signal)
		selected	
X16.7	Remote Priority	switch on Remote Priority	digital Input
	"UN"	(Keyboard and	(statical signal)
		function)	
X16.8	_	-	_
x16.9 <sup>3</sup> )	Standby "ON"	Turbo rotation speed	digital Input
	oluniz, en	reduce to 66% of the	(statical signal)
		maximum rotation speed	(otut.ou o.g,
X16.10 <sup>3)</sup>	Pumping station	switch on pumping	digital Input
	"0N"	station	(statical signal)
X16.11 <sup>3)</sup>	Turbopump	Preselect turbo drive	digital Input
	"ON"	"ON"(drive current	(statical signal)
	0.1	is switched on, if	(otution orginal),
		pumping station is	
		switched on).	
X16.12	-	-	_
X16.13 <sup>3)</sup>	Reset "ON"	delete of an error-	digital Input
		message	(pulse)
X16.14 <sup>3)</sup>	Release pump	pump venting released	digital Input
	venting	after pre-selected vent	(statical signal)
		mode)	
X16.15	OV	reference ground for all in	
		and outputs of plug X16	

<sup>1)</sup> Connection by setup of the PWM; compatibel to Stored Program Control (SPC).

Function can be aktivated by a signal level from a SPC (see chapter 6.10).

2) PWM = puls-width modulation

<sup>3)</sup> SPC compatibel or connect the PIN with PIN X16.1.

# 3.10. Connecting The Potential Free Contacts

The switching contacts K1 and K2 on X20 are available. They can be used for external monitoring of the turbomolecular pump. Connection is as per Connections Diagram PM 041 892-S. The contacts can be loaded as written in sect. 10.1. "Technical Data".

#### Pin Arrangement X20

Pin	Description	Function	
X20.1	К1	Closer	
X20.2	-	-	X20
X20.3	К1	Closer	
X20.4	K2	Closer	
X20.5	-	-	
X20.6	-	-	
X20.7	-	-	18
X20.8	K2	Closer	

# Switch Contact K1 Functions

The functions are set via **«024 : Conf Out1»**. The potential free contact possesses three adjustable functions:

#### Function 0/setting 0: rotation speed switchpoint monitoring

- -> Contact is open, if the turbo rotation speed is less than/the same as the rotation speed switchpoint [P:701].
- -> Contact is closed if the turbo rotation speed is greater than the rotation speed switchpoint.

#### Function 1/setting 1: TMS temperature monitoring

-> K1 is closed as long as TMS temperature is in the tolerance range of ±5K of the selected temperature.

# Function 2/setting 2: Pumping operations and rotation speed switchpoint monitoring

- -> Contact is open if the turbo rotation speed is less/the same as the rotation speed switchpoint [P:701] or the drive has been switched off via «010 : Pump stat.» or «023 : Motor TMP» or via malfunction identification.
- -> Contact is closed if the turbo rotation speed is greater than the rotation speed switchpoint and the pump drive is switched on.

# Switch Contact K2 Functions

The potential-free switch contact K2 posesses three settable functions which are set via **«019 : Conf Out2**».

#### Function 0

➡ Select «019 : Conf Out2» and set to «0».

The contact is open in the following situations: In unit mode "Netz AUS" (power OFF) or In error status (display **"Exxx**")

#### Function 1

➡ Select «019 : Conf Out2» and set to «1».

The contact is open in the following situations: - In unit mode "Netz AUS" (power OFF).

- In error status (display "Exxx") or warning status ("Fxxx").

#### Function 2

Select «019 : Conf Out2» and set to «2».

The contact is open in the following situations:

- In unit mode "Netz AUS" (mains OFF).
- With "Netz EIN" (mains ON) with
  - «023 : Motor TMP» to "OFF" or
  - «010 : Pump stat» to "OFF".

# 3.11. Connecting The Pressure Gauges

Any one of the pressure gauges listed in the above table can be connected to X27/TCS 180. They are recognized automatically by the TCM 1601.

Pressure Gauge	p <sub>min</sub> / mbar	p <sub>max</sub> / mbar
TPR 250 (HVV)	5E-4	1E+3
IKR 250	2E-9	1E-2
PKR 250 (HVV)	5E-9	1E+3
ACR 261 (HVV)	1E-1	1E+3
ACR 262 (HVV)	1E-2	1E+2
ACR 263 (HVV)	1E-3	1E+1

Gauges marked "HVV" are appropriate, in connection with TCS 180, for controlling high vacuum valves (see section 6.11).

# 3.12. Connecting The Serial Interface

The serial interface contact is made with a RJ45 plug (Western plug) via X17 on the rear side of the unit.

# **Physical Connection**

#### **Connection plug arrangement X17**

Description	Value
Serial Interface Type:	RS 485
Baudrate:	9600 baud
data word lenghts:	8 bit
Parity:	no parity
Startbits:	1
Stopbits:	12



PIN	Arrangement
1	not connected
2	+15V output (≤150mA loading capacity)
3	not connected
4	not connected
5	RS 485: D+ (DO / RI)
6	gnd
7	RS 485: D- (DO / RI)
8	not connected

An RS 485 bus can be assembled as in the following example. By means of a standard Western plug connector, cable and cross-over network the signals are looped from one unit to the next. The bus is terminated at both ends (RT and RT\*) and maintained at approx. 200mV via a voltage divider (R1 and R2). The resistance values are dependent on the cable and the application. Typically, the values involved are R1=R2=680 $\Omega$ ; RT=130 $\Omega$ . The +5V supply voltage must be either connected externally or be provided by several units themselves. This must then be connected to one end of the bus with the other end only terminated with RT.

#### Connecting to a fixed bus system:

➡ Connect all units with D+ (pin 5) and D-(pin7) to the bus.

The bus must be connected at both ends with RT.

#### Networking several units:

➡ Continue the loops by means of a T piece.

The bus must be connected at both ends with RT.

All units connected to the bus must have differing serial interface addresses [P: 797].





Only safety low voltages (SELV) may be connected to Serial Interface RS 485 (X17).

Ű

# 3.13. Connections of the RS 232 Interface

The connection of an RS 232 Serial Interface is possible via a Level Converter (see 12, Accessories). The converter is equipped with a 9 pole D-SUB plug connector, an RJ45 Western Plug and a connecting cable.

➡ Connect the level converter to X17/TCM 1601 by an equivalent cable.

# 3.14. Connecting The External Battery Box TBB 001

- ➡ Connect battery box TBB 001 (with battery 2x12V/2.1Ah, lead gel) to plug connection X29/TCM 1601.
- Connect battery box TBB 001 with mains cable to the mains.

# 4. Operating And Display Elements

# 4.1. Operating Elements

.

The four push-buttons on the front panel have the following functions:

<b>Push-Button</b>	Applicatio	n/Example	Explanation
$\bigcirc$		> <b>∳</b> 1;	<b>Reset</b> (malfunction acknowledgement) acknowledges malfunctions (red LED illuminates)
۵		૧૯૩09: Act rotspd ૧૯૩10: TMP I-Mot	Scroll Parameters Backwards scrolls a parameter backwards
	>	மீ <b>50% மீ 49%</b>	Reduce Values (with arrow "——>")
		<b>喙310: TMP I-Mot</b> ₲311: TMP Op hrs	Scroll Parameters Forwards scrolls a parameter forwards
	>	49% 전 50% 전	Increases Values (with arrow ">")
		001: Heating ☞ off	Alters Values (⇔data editing mode) access to a displayed value, if possible (arrow "——>" appears)
simultaneous- ly	>	001: Heating off ✔	<b>Conforms a Value</b> (⇔parameter selecting mode) takes over altered value (arrow "——>" disappears)
0		010: Pump stat. on ⇔ off	<b>Pumping Station ON/OFF</b> switches the pumping station ON or OFF, corresponding to Parameter 010: "Pump stat."

£,

The following should also be noted:

-The data editing mode (arrow "——>" is displayed) is automatically exited under the following conditions, without

taking over the possible altered value:

if no push-button is depressed for approximately 10 seconds.

an error occurs.

# 4.2. Display Elements

# LC Display



The display of the functions is shown via a four line LC display. In normal operations a specific function is assigned to each line:

- Line 1: Number and name of the selected parameter (e.g. «721: Vent time»).
- Line 2: relevant value. In the data editing mode [P:795] an arrow (--->) is displayed left. The value can now be altered.
- Line 3: With two functions,
  - Function 1: Actual messages which refer to operation and control appear (see table "Operating Messages (line 3)" on the next page.

**Function 2**: An optional second parameter in the form «Parameter number»: «Value» is is displayed. The function of this line is set via «**725**: **Servicelin**»: The value «**795**»» allows actual messages to appear.

Error messages/ warning messages overwrite the selected value of the parameter.

- **Line 4**: Arrows which point to the underlying symbols. These restore the unit status.

Symbols "keyboard lock" and "battery box connected".

## **Symbol Definitions**

Symbol	Meaning	Display	Explanation
	Pump	-	No
	accelerates	▼	YES
	Pre-selection	_	OFF
<u> </u>	housing-/ TMS- heating	$\bigtriangledown$	Pre-selection heating ON
		▼	Heating ON
Ô	Standby	_	OFF
		▼	ON
	Unit	-	NO
	remote controlled	▼	YES
$\bigcirc$	Rotation	-	NO
	attained	▼	YES
ł	Excess	-	NO
	temperature	$\mathbf{V}$	Excess temperature TMP
		V	Excess temperature Magnetic Bearing Elektronic
		▼	Excess temperature TMP and Magnetic Bearing Elektronic
0	Final rotation	-	NO
	speed attained	▼	YES
	Keypad lock	A	ON, operation locked via keys
	Battery box		Battery box connected. No statement with regard to the charge level of the battery.

# 4.3. Abbreviated Overview, Operating



## **Selecting Parameters**

→ Selecting parameters with push-button 
(backwards)

or (forwards). Keeping the key depressed enables rapid scrolling.

#### **Setting Parameters**

- ➡ Select Parameter.
- → Depress key-button and simultaneously till an arrow (--->) will appear in the second line from the top.
- → With key-button reduce the value and with key-button increase the value.
- Depress key-button and simultaneously till the arrow (--->) disappears. The set values are now taken over.

## Error acknowledgement

Depress key-button 😧 for a duration of min. 2 seconds.

## Switching ON and OFF the pumping Station

Depress key-button **O**.

# **Operating Examples**

#### Switching on the magnetic bearing controller

➡ Switch on the unit on the rear side with switch S1.

#### Switching on the pumping station

- ➡ Select «794: Param. Set» and set to «1»
- ➡ Check set values [P:7xx] and setting commands [P:0xx]

#### **Casing heating ON/OFF**

- ➡ Select «018: Conf. OUT3» and set to «1».
- ➡ Select «001: Heating» and set to «1».

#### Switching off the turbopump

- → Select «023 : Motor TMP».
- ➡ Select «OFF».

#### Switching off the pumping station

# Illuminated Displays

The red LEDs (error status) and green LEDs (operations status) on the front panel can assume the following conditions:

	Red LED	Green LED
Illuminates:	Collective error message	Mains ON, pumping station ON [P:010]
Flashes short: (1/12s active)	Warning	Mains pack ON, pumping station OFF [P:010]
Blinks: (1/2s active)	Turbopump vibration	Mains power failure

# **Operations Messages (Line 3)**

Independent to the adjustments «795: Servicelin» to «0»

Message	Meaning
** Error Exxx **	Error xxx has occured
* Warning Fxxx *	Warning xxx has occured

Adjustment «795: Servicelin» to «795» (overwrite by error messages/warning messages)

Message	Meaning
data read only !	Attempted access to read only parameter
data not changed	Data editing mode has been quit without taking over altered values
	(e.g. settings are not confirmed before the expiration of a waiting period of approximately 10s).
change confirmed	Altered value entered
type invariable !	Recognized vacuum pressure gauge cannot be altered

# 5. Parameters

# 5.1. General

All function relevant sizes of the magnetic bearing controller are structured in the form of parameters. Each parameter has a number and a clear text designation (e.g. **« 026: OpMode TMP**»). There are three different parameter types:

Type of Parameter	Function
Setting commands	Activating/de-activating a controlling function
Status requests	Parameter status/value request (readable only)
Set values	numerical modifying of a value

The total of the available parameters represents a parameter set.

user the TCM 1601 provides three parameter sets which differ from each other in the number of parameters and their sorting. The respective parameter set can be selected via the parameter **«794: Param. set**».

To adapt this parameter to the individual requirements of the

Parameter set	Notice	Setting «794: Param. set»
Basic parameter set	Only basic function parameters sorted by number	0
Extended parameter set	Complete parameter set sorted by number	1
Parameter set, operational orientated	Complete parameter set sorted according to application criteria	2

# 5.2. Parameter Overview, numerical

-	Display		Name, Description	min	max	fact. set.	RS 485 <sup>1</sup>	Data <u>typ</u> 2)
01	Heating		Pre-selection, heating. 0=OFF; 1=ON	OFF	ON	OFF <sup>3)</sup>	R/W	0
02	Standby		Standby 0=off; 1=on	OFF	ON	OFF <sup>3)</sup>	R/W	0
004	RUTime ctr		Run-up time monitoring, 0=OFF; 1=ON	OFF	ON	ON	R/W	0
208*		Α	Keyboard interlock			-	R/W	0
009*			Error acknowledgement			-	W	0
010	Pump stat		Pumping station ON/OFF	OFF	ON	OFF <sup>3)</sup>	R/W	0
012	Vent enab		Venting enable ON/OFF	OFF	ON	0N <sup>3)</sup>	R/W	0
013	Brake enab		Pre-selection brake 0=off; 1=on	OFF	ON	OFF	R/W	0
018	Conf OUT3		Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function	0	3	0	R/W	7
019	Conf. OUT2		Config. K2 0= open if mains OFF or failure, 1=dto. or warnings 2=open if mains OFF, turbo drive OFF or failure	OFF	ON	OFF	R/W	7
023	Motor TMP		Motor Turbopump ON/OFF	OFF	ON	ON <sup>3)</sup>	R/W	0
024	Conf. OUT1		Config. output K1 0=switchp. attained; 1= TMS temp. attained (±5K) 2=switchpoint attained + turbo drive "ON"	0	1	0	R/W	7
)25	OpMode BkP		Operations mode backing pump, 0=non-stop; 1=intermittent	0	1	0	R/W	7
026	OpMode TMP		Operations mode TMP 0=final rotation speed operations;	-		-21		_
		<del></del>	1=rotation speed setting mode	0	1	03/	R/W	7
027	Gas mode		Gas mode 0=heavy inert gases; 1=other gases	0	1	0	R/W	7
028	Opmode rem		Remote operations mode 0=standard operations, 1=remote priority	0	1	0	R/W	7
030	Vent mode	Ш.	Venting mode 0=automatic venting ; 1=do not vent; 2=venting "ON"	0	2	0	R/W	7
)31	HiFlowCtrl		Monitoring rotor lifting in case of high gas flow; 0="OFF", 1="ON"	0	1	0	R/W	0
Stat	tus request	(on	ly readable)	min	-	fact cat	DC 4051	Data tun <sup>2</sup>
200*			Unit remote controlled via ¥16		IIIdX	-	R 8	
200*	<u> </u>		Botation switch point attained			1	R	0
2021	Error codo		Actual arror and a po Err" Errore" adar Menung"				D D	4
03	Error code		Actual enfor code "no Err, "ErrXXX" oder "WrnXXX"					4
504*	<u>.</u>		Over temperature wagnetic bearing controller			-	н	0
s05*			Over temperature turbopump				н	0
306*	<u> </u>		Set rotation speed attained			-	Н	0
307*	<b>(</b>		I urbopump accelerates			-	К	0
308	Set rotspd		Set rotation speed TMP in Hz	0	1000	-	R	1
309	Act rotspd		Actual rotation speed TMP in Hz	0	1000	-	R	1
310	TMP I-Mot	-	Motor current TMP in A	0.00	10.00		R	2
311	TMP Op hrs	L	Operating hours TMP in h	0	99999	-	R	1
312	Drv Softw		Software version electronic drive unit	V 0.0	V 25.4	-	R	4
313	TMP DClink		Motor voltage TMP in V	0.0	127.5	-	R	2
315	TMP finspd		Final rotation speed TMP in Hz	0	1000	-	R	1
316	TMP power		Motor power TMP in W	0	1000.0		R	1
318		۵	Battery box connected			-	R	0
331	TMS ActTmp		Heating TMS, actual value in <sup>o</sup> C	0	255	-	R	1
333	TMS steady		TMS regulator engaged (± 5K)	YES	NO	-	R	0
334	TMS maxTmn		Maximum TMS temperature occured in °C			-	R	1
335	Heat type		Heating typ 0=convent, heating, 1=TMS, 2=cooling, 255 no heating	0	255	_	R	7
340	Pressure		Actual pressure value in mbar	0	255	-	R	3
349	Dry Name		Unit type electronic drive unit	1E-12	1F3	-	R	4
360	Paet Err1		Error storage Position 1 (last error occuring)	12 12	120	CM1601	R	4
261	Post Err?		Error storage, Position 2				D	4
262	Past Err?		Error storage, Position 2			-		4
202	Past Erra		Error storage, Position 3				R	4
003		uni D	Error storage, Position 4					4
004	Past Errb		Error storage, Position 5				<u>п</u>	4
600	Past Erro		Error storage, Position 6					4
566	Past Err7		Error storage, Position /				н	4
367	Past Err8	Ш,	Error storage, Position 8				К	4
368	Past Err9	L.	Error storage, Position 9			-	R	4
369	Past Err10		Error storage, Position 10				R	4
Set	values (read	lab	e and writable)	-				
ŧ	Display		Name, description	min	max	fact. set.	RS 485	Data typ <sup>2</sup>
00	TMP RUTime		maximum run-up time in mins	1	120	8	R/W	1
/01	Switch pnt		Rotation speed switchpoint in %	50	90	80	R/W	1
03	HVVthrshld		High vacuum pressure switchpoint in mbar	1E-1	5E0	1E-1	R/W	3
704	TMSheatset		TMS heating temperature set value in °C	30	90	40	R/W	1
707	TMProt set		Rotation speed set value in rotation speed setting operations in %	20.0	100.0	50.03)	R/W	2
10	BKP off		P <sub>min</sub> for Interval operations backing pumps [W]	0	1000	0	R/W	1
11	BKP on		Pmax for Interval operations backing pumps [W]	0	1000	0	R/W	1
20	Vent frequ		Venting frequency as a % of the final rotation speed of the TMP	40	80	50	R/W	7
21	Vent time		Venting time in s	6	3600	3600	R/W	1
738	Gaugetype		Vacuum pressure gauge type			-	R/W	4
794	Param. set		Parameter set 0 = basic parameter set;		-			1
			1 = extended parameter set; 2 = operational orientated parameter set	0	2	0	R/W	7
795	Servicelin		Contains the service line 795 = messages; ≠795 = # of the 2. param. set			795	R/W	7
797	Address		Unit address	1	255	1	R/W	1
4 nui 1) R = 2) Se 3) Fu	mber in bold ty Parameter setti = Parameter rea e Interface inst nction can only	pe is ng is idabl ructi be a t sho	a basic parameter set, e.g. <b>"700 TMP RUTime"</b> . saved internal and preserves the value if mains is switched off. e via interface (W = parameter writeable via interface. on "Pfeiffer Protocol to RS 232 and 485" / PM 800 488 BN iffected via remote plug (X16) wn in the LC display but displayed by symbols (line 4) or operable by th	e keys.				

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# 5.3. Parameter overview, operation oriented

Ħ	Display	ivame, Description	min	max	tact. set.	KS 485	Sect
Run	up time and s	witch point					
004	RUTime ctr	Run-up time monitoring ON/OFF	OFF	ON	L ON		l -
700	TMP RUTime	Maximum run-up time in mins	1	120	8	•	6.2.,6
701	Switch pnt	Switchpoint in %	50	90	80	•	6.4.,6
<b>^</b>		1-6					
Gen	eral operating				1		
315	TMP Inspo	The rotation speed IVIP in Hz			1 -		6.2.,0
310	TMP DClink	TMP motor current in A			+		0.2.
313		TMP motor voltage in v					
310	TMP On hrs	Operating hours TMP in h			+-		1-
				1	1		1
Ope	rating adjustn	nent turbopump					
010	Pump stat	Pumping Station ON/OFF	OFF	ON	OFF <sup>3)</sup>	•	-
023	Motor TMP	Motor Turbopump	OFF	ON	ON <sup>3)</sup>	•	6.8.
002	Standby	Standby ON/OFF	OFF	ON	OFF( <sup>3)</sup>	•	6.3.
026	OpMode TMP	Operations mode TMP 0=final rotation speed operations; ; 1=rotation speed setting mode	0	1	0	•	6.9.
027	gas mode	Operations mode 0=heavy nobel gases; 1=other gases	0	1	0	•	6.7.
707	TMProt set	Rotation speed set value in rotaion speed setting operations in %	20.0	100.0	50.03)	•	6.5.,6
308	Set rotspd	Set rotation speed TMP in Hz	0	1000	-	•	-
309	Act rotspd	Actual rotation speed TMP in Hz	0	1000	-	•	-
013	Brake enab	Pre-selection brake 0=off; 1=on	OFF	ON	OFF	•	6.12.
Hea	ting/cooling tu	urbopump					
335	Heat type	Heating typ 0=conventional heating, 1=TMS, 2=cooling	0	255		•	6.6.,6
001	Heating	Pre-selection, heating. 0=OFF; 1=ON	0	1	03/	•	6.4.,6
704	TMSheatset	TMS heating temperature set value in <sup>o</sup> C	30	90	40	•	6.5.
331	TMS ActTmp	TMS- heating actual value in <sup>o</sup> C			-	•	6.5.
333	I MS steady	I MS regulator engaged ON/OFF	UFF	ON			6.5.
534	I IVIS max I mp	Waximum TMS temperature occured in *C		L	+	•	6.7.
Von	t valva aantrol	ling turbonumn					
ven 12	Vent ench		055				1 6 1 4
130		Venting release turbopump UN/UFF	0		0/*)	+	0.14
							0.14.
720	Vent mode	Venting mode U=automatic venting; 1=do not vent; 2=venting Un	40	2	50		65 1
720	Vent frequ	Venting mode d=automatic venting; i=ao not vent; z=venting On Venting frequency as a % of the final rotation speed of the TMP	40	2 80 2600	50	•	6.5.,6
720 721	Vent mode Vent frequ Vent time	Venting mode = deatomatic venting; i=do not vent; 2=venting On Venting frequency as a % of the final rotation speed of the TMP Venting time in seconds	40 6	2 80 3600	50 3600	•	6.5.,6 6.14.
720 721	Vent mode Vent frequ Vent time	Venting mode = deatomatic venting; i=do not vent; 2=venting On Venting frequency as a % of the final rotation speed of the TMP Venting time in seconds	40 6	80 3600	50 3600	•	6.5.,6 6.14.
720 721 721 Pum	Vent mode Vent frequ Vent time ping station v	Venting mode = 0=automatic venting; i=ao not vent; 2=venting On Venting frequency as a % of the final rotation speed of the TMP Venting time in seconds vith TCS	40 6	2 80 3600	50 3600	•	6.5.,6 6.14.
720 721 721 <b>Pum</b> 025	Vent mode Vent frequ Vent time ping station v OpMode BkP BKP off	Venting mode beautomatic venting; 1=do not vent; 2=venting on Venting frequency as a % of the final rotation speed of the TMP Venting time in seconds vith TCS Operations mode backing pump, 0=non-stop operations; 1=intermittent operations	40 6 0	2 80 3600	0(*) 50 3600	•	6.5.,6 6.14. 6.10.
720 721 721 721 721 721 721	Vent mode Vent frequ Vent time ping station v OpMode BkP BKP off BKP on	Venting mode 0=automatic Venting; 1=ab not vent; 2=venting On Venting frequency as a % of the final rotation speed of the TMP Venting time in seconds vith TCS Operations mode backing pump, 0=non-stop operations; 1=intermittent operations P <sub>min</sub> for Interval operations [W] P_min for Interval operations [W]	40 6 0 0	2 80 3600 1 1000	0 50 3600 0 0		6.5.,6 6.14. 6.10. 6.10.
720 721 <b>Pum</b> 025 710 711 738	Vent mode Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetyne	Venting mode 0=automatic Venting; 1=ab not vent; 2=venting On Venting frequency as a % of the final rotation speed of the TMP Venting time in seconds vith TCS Operations mode backing pump, 0=non-stop operations; 1=intermittent operations Pmin for Interval operations [W] Pmax for Interval operations [W] Vacuum pressure gauge type	40 6 0 0 0	2 80 3600 1 1000 1000	0 50 3600 0 0 0 -		6.5.,6 6.14. 6.10. 6.10. 6.10. 6.10
720 721 721 725 710 711 738 703	Vent mode Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVtbrshid	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations [W]         Pmin for Interval operations [W]       Pmax for Interval operations [W]         Vacuum pressure gauge type       High vacuum pressure switchpoint	40 6 0 0 0 1E-1	2 80 3600 1 1000 1000 5E0	0(*) 50 3600 0 0 		6.5.,6 6.14. 6.10. 6.10. 6.10. 6.10. 6.10.
720 721 721 725 710 711 738 703 340	Vent mode Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure	Venting mode 0=automatic venting; 1=ab not vent; 2=venting On Venting frequency as a % of the final rotation speed of the TMP Venting time in seconds vith TCS Operations mode backing pump, 0=non-stop operations; 1=intermittent operations Pmin for Interval operations [W] Pmax for Interval operations [W] Vacuum pressure gauge type High vacuum pressure switchpoint in mbar Actual pressure value in mbar	0 6 0 0 0 1E-1 1E-12	2 80 3600 1 1000 1000 5E0 1E3	0(*) 50 3600 0 0 - 1E-1 -		6.5.,6 6.14. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10.
720 721 721 725 710 711 738 703 340	Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]       Pmax for Interval operations [W]         Vacuum pressure gauge type       High vacuum pressure switchpoint in mbar         Actual pressure value       in mbar	0 6 0 0 0 0 1E-1 1E-12	2 80 3600 1 1000 1000 5E0 1E3	0(-') 50 3600 0 0 - 1E-1 -		6.5.,6 6.14. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10.
720 721 721 725 710 711 738 703 340 Othe	Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]       Pmax for Interval operations [W]         Vacuum pressure gauge type       High vacuum pressure switchpoint in mbar         Actual pressure value       in mbar	0 6 0 0 0 1E-1 1E-12	2 80 3600 1000 5E0 1E3	0(-') 50 3600 0 0 - 1E-1 -	• • • • • • • • •	6.5.,6 6.14. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10.
Pum           720           721           721           725           710           711           738           703           340           Othe           018	Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure Ers Conf OUT3	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations; Pmin for Interval operations [W]         Pmax for Interval operations [W]       Vacuum pressure gauge type         High vacuum pressure switchpoint       in mbar         Actual pressure value       in mbar	0 0 0 0 1E-1 1E-12	2 80 3600 1000 5E0 1E3	0 3600 0 0 0 - 1E-1 -		6.5.,6 6.14. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10.
720       721       721       721       725       710       711       738       703       340       018       019	Vent mode Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure Ers Conf OUT3 Conf. OUT2	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]       Pmax for Interval operations [W]         Vacuum pressure gauge type       High vacuum pressure switchpoint in mbar         Actual pressure value       in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. 42 open if mains OFF or failure. 1=dto. or warnings	0 0 0 0 1E-1 1E-12 0	2 80 3600 1000 5E0 1E3 3	0(-') 50 3600 0 0 - 1E-1 -		6.5.,6 6.14. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10.
D38           720           721           710           711           738           703           340           018           019	Vent mode Vent frequ Vent time ping station v OpMode BkP BKP off BKP off Gaugetype HVVthrshld Pressure Prs Conf OUT3 Conf. OUT2	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations; Pmin for Interval operations [W]         Pmax for Interval operations [W]       Vacuum pressure gauge type         High vacuum pressure switchpoint       in mbar         Actual pressure value       in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. K2 0= open if mains OFF or failure, 1=dto. or warnings         2=open if mains OFF. turbo drive OFF or failure       1=dto. or warnings	0 0 0 0 1E-1 1E-12 0 0	2 80 3600 1000 5E0 1E3 3	0(-') 50 3600 0 0 - 1E-1 - -		6.5.,6 6.14. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 3.10
Pum           025           710           721           025           710           711           738           703           340           018           019           024	Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure ers Conf OUT3 Conf. OUT2 Conf. OUT1	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]       Pmax for Interval operations [W]         Vacuum pressure gauge type       High vacuum pressure switchpoint in mbar         Actual pressure value       in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Config. Comparison of the off of railure, 1=dto. or warnings         2=open if mains OFF, turbo drive OFF or failure       Configuration output K1       0=switchpoint attained: 1= TMS temperature	0 0 0 0 0 1E-1 1E-12 0 0 0 0	2 80 3600 1000 1000 1E3 3 2 1	0() 50 3600 0 0 0  1E-1  0 0 0 0		6.5.,6 6.14. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 3.10.
720 721 <b>Pum</b> 225 710 711 738 703 340 <b>Othe</b> 018 019	Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure ers Conf OUT3 Conf. OUT1	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]       Pmax for Interval operations [W]         Vacuum pressure gauge type       High vacuum pressure switchpoint in mbar         Actual pressure value       in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. K2 0= open if mains OFF or failure, 1=dto. or warnings         2=open if mains OFF, turbo drive OFF or failure;       1=TMS temperature attained (±5K); switchpoint attained + turbo drive "ON"	0         0           0         0           0         0           1E-1         1E-12           0         0           0         0           0         0	2 80 3600 1000 1000 5E0 1E3 3 2 1	0(-') 50 3600 0 0 - 1E-1 - 0 0 0 0 0		6.5.,6 6.14. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 3.10. 3.10.
720 721 <b>Pum</b> 025 710 711 738 703 3340 <b>Othe</b> 018 019 024	Vent frequ Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure ers Conf OUT3 Conf. OUT1 Conf. OUT1	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]       Pmax for Interval operations [W]         Vacuum pressure gauge type       High vacuum pressure switchpoint         High vacuum pressure switchpoint       in mbar         Actual pressure value       in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. K2 0= open if mains OFF or failure, 1=dto. or warnings         2=open if mains OFF, turbo drive OFF or failure;         Configuration output K1 0=switchpoint attained;       1= TMS temperature attained (±5K); switchpoint attained + turbo drive "ON"         Remote Operations mode       0=Standard operations. 1=Latch	0 0 0 0 1E-1 1E-12 0 0 0 0 0 0 0	2 80 3600 1000 1000 5E0 1E3 3 2 1 1	0(-') 50 3600 0 0 - 1E-1 - 0 0 0 0 0 0 0 0 0 0 0 0 0		6.5.,6 6.14. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 3.10. 3.10.
720 721 Pum 025 710 711 738 703 340 018 019 024	Vent frequ Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure Conf OUT3 Conf. OUT2 Conf. OUT1 OpMode rem	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]       Pmax for Interval operations [W]         Vacuum pressure gauge type       High vacuum pressure switchpoint         High vacuum pressure value       in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. K2 0= open if mains OFF or failure, 1=dto. or warnings         2=open if mains OFF, turbo drive OFF or failure         Configuration output K1 0=switchpoint attained; 1= TMS temperature         attained (±5K); switchpoint attained + turbo drive "ON"         Remote Operations mode       0=Standard operations, 1=Latch operations, (1=Latch op	0 0 0 0 1E-1 1E-12 0 0 0 0 0 0	2 80 3600 1 1000 5E0 1E3 3 2 1 1	0(-') 50 3600 0 0 - 1E-1 - 0 0 0 0 0 0 0 0 0 0 0 0 0		6.10. 6.10.0.0.00.00.00.00.00.00.00.00.00.00.00
720 721 721 721 721 721 721 721 721 723 733 703 703 703 703 703 703 703 703 70	Vent mode Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure Prs Conf OUT3 Conf. OUT2 Conf. OUT1 OpMode rem HiFlowCtrl	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations; Pmin for Interval operations [W]         Pmax for Interval operations [W]       Vacuum pressure gauge type         High vacuum pressure gauge type       High vacuum pressure switchpoint in mbar         Actual pressure value       in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. 1=casing heating, 2=TMS, 3=air cooling, 1=no function         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. 1=casing heating, 2=TMS, 3=air cooling, 1=no function         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. 1=casing heating, 2=TMS, 3=air cooling, 1=no function         Config. 1=casing heating, 2=TMS, 1=air cooling, 0=no function         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. 1=casing heating, 2=TMS, 1=air cooling, 0=no function         Config. 1=casing heating, 2=TMS, 1=air cooling, 0=no function         Config. 1=casing heating, 2=TMS, 3=air cooling, 1=no function         Config. 1=casing heating, 2=TMS, 3=air cooling, 1=no function <tr< td=""><td>0 0 0 0 0 1E-1 1E-12 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>2 80 3600 1 1000 1000 5E0 1E3 3 2 1 1 1</td><td>0(-') 50 3600 0 0 - 1E-1 - 1E-1 0 0 0 0 0</td><td></td><td>6.10. 6.10.0.0.00.00.00.00.00.00.00.00.00.00.00</td></tr<>	0 0 0 0 0 1E-1 1E-12 0 0 0 0 0 0 0 0 0 0 0 0 0	2 80 3600 1 1000 1000 5E0 1E3 3 2 1 1 1	0(-') 50 3600 0 0 - 1E-1 - 1E-1 0 0 0 0 0		6.10. 6.10.0.0.00.00.00.00.00.00.00.00.00.00.00
720 721 721 721 721 721 721 721 721 721 721	Vent frequ Vent time Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure Prs Conf OUT3 Conf. OUT2 Conf. OUT1 OpMode rem HiFlowCtrl Error code	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         operations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]         Pmax for Interval operations [W]         Vacuum pressure gauge type         High vacuum pressure switchpoint         Actual pressure value         in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. 1=casing heating, 2=TMS, or failure, 1=dto. or warnings         2=open if mains OFF, or failure, 1=dto. or warnings         2=open if mains OFF, turbo drive OFF or failure         Configuration output K1       0=switchpoint attained; 1= TMS temperature attained (±5K); switchpoint attained + turbo drive "ON"         Remote Operations mode       0=Standard operations, 1=Latch operations-(Remote Priority; Pin X16.7 set to 1)         Monitoring rotor lifting in case of high gas flow; 0="OFF", 1="ON"         Actual error code       _no Err", _#Errxxx" oder ,,Wrmxxx"	0 6 0 0 0 1E-1 1E-12 0 0 0 0 0	2 80 3600 1000 1000 5E0 1E3 3 2 1 1 1	0() 50 3600 0 0 0  1E-1  0 0 0 0 0 0 0  0 0 0 0  0 0  		6.5.,(.) 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7.
720 721 721 721 721 721 721 721 721 723 703 703 703 703 703 703 703 703 703 70	Vent frequ Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure ers Conf OUT3 Conf. OUT3 Conf. OUT1 OpMode rem HiFlowCtrl Error code Drv Softw	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         operations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]         Pmax for Interval operations [W]         Vacuum pressure gauge type         High vacuum pressure switchpoint         Actual pressure value         in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. 2=open if mains OFF or failure, 1=dto. or warnings         2=open if mains OFF, turbo drive OFF or failure         Configuration output K1         0=switchpoint attained; 1=TMS temperature         attained (±5K); switchpoint attained + turbo drive "ON"         Remote Operations mode       0=Standard operations, 1=Latch         operations-(Remote Priority; Pin X16.7 set to 1)         Monitoring rotor lifting in case of high gas flow; 0="OFF", 1="ON"         Actual error code       "no Err", "Errxx" oder "Wrnxxx"         Software version electronic drive unit	0         0           0         0           0         0           1E-1         1           1E-12         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0	2 80 3600 1 1000 1000 5E0 1E3 3 2 1 1 1	0(-') 50 3600 0 0 0  1E-1 - 0 0 0 0 0 0 0 - - - - - - - - - - - - -		6.5.,(6.14. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 3.10. 3.10. 3.10. 3.10. 4.4. 8.0
720 721 721 721 721 721 721 721 721 723 723 703 703 703 703 703 703 703 703 703 70	Vent frequ Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure Prs Conf OUT3 Conf. OUT2 Conf. OUT1 OpMode rem HiFlowCtrl Error code Drv Softw Param. set	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]       Pmax for Interval operations [W]         Vacuum pressure gauge type       High vacuum pressure gauge type         High vacuum pressure switchpoint       in mbar         Actual pressure value       in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. 2=open if mains OFF or failure, 1=dto. or warnings         2=open if mains OFF, turbo drive OFF or failure         Configuration output K1       0=switchpoint attained; 1=TMS temperature         attained (±5K); switchpoint attained + turbo drive "ON"         Remote Operations mode       0=Standard operations, 1=Latch         operations-(Remote Priority; Pin X16.7 set to 1)         Monitoring rotor lifting in case of high gas flow; 0="OFF", 1="ON"         Actual error code       _no Err", "Errxx" oder "Wrnxx"         Software version electronic drive unit         Parameter set       0=basic parameter set; 1=expanded parameter set;	0         0           0         0           0         0           1E-1         1E-12           0         0           0         0           0         0           0         0           0         0           0         0	2 80 3600 1 1000 1000 5E0 1E3 3 2 1 1 1	0(-') 50 3600 0 0 - 1E-1 - 0 0 0 0 0 0 - - - - 0 0 0 0 - - - - - - - - - - - - -		6.5.,( 6.14. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 3.10. 3.10. 3.10. 3.10. 4.4. 8.0
720 721 721 721 721 721 720 721 723 723 723 723 738 703 738 703 703 703 703 703 703 703 703 703 703	Vent mode Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshid Pressure ers Conf OUT3 Conf. OUT2 Conf. OUT1 OpMode rem HiFlowCtrl Error code Drv Softw Param. set	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]       Pmax for Interval operations [W]         Vacuum pressure gauge type       High vacuum pressure switchpoint       in mbar         Actual pressure value       in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config	0 0 0 0 1E-1 1E-1 0 0 0 0 0 0 0 0 0 0 0 0 0	2 80 3600 1 1000 1000 5E0 1E3 3 2 1 1 1 2	0(-') 50 3600 0 0 - 1E-1 - 0 0 0 0 0 0 0 - - 0 0 0 0 0 0 0 0 0 0 0 0 0		6.5.,( 6.14. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 3.10. 3.10. 3.10. 3.10. 4.4. 8.0 6.2.,(
720 721 721 721 721 721 720 721 720 721 721 723 733 733 733 733 733 733 733 733 733	Vent frequ Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure Conf OUT3 Conf. OUT2 Conf. OUT1 OpMode rem HiFlowCtrl Error code Drv Softw Param. set Servicelin	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]       Pmax for Interval operations [W]         Vacuum pressure gauge type       High vacuum pressure switchpoint         High vacuum pressure switchpoint       in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. X2 0= open if mains OFF or failure, 1=dto. or warnings         2=open if mains OFF, turbo drive OFF or failure         Configuration output K1 0=switchpoint attained; 1= TMS temperature attained (±5K); switchpoint attained + turbo drive "ON"         Remote Operations mode       0=Standard operations, 1=Latch operations-(Remote Priority; Pin X16.7 set to 1)         Monitoring rotor lifting in case of high gas flow; 0="OFF", 1="ON"         Actual error code       "no Err", "Errxxx" oder "Wmxxx"         Software version electronic drive unit         Parameter set       0=basic parameter set; 1=expanded parameter set;         2 = operational orientated parameter set	0         0           0         0           0         0           1E-1         1E-12           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0	2 80 3600 1 1000 5E0 1E3 3 2 1 1 1 1 2	0(-') 50 3600 0 0 - 1E-1 - 0 0 0 0 0 0 0 0 0 0 0 0 0		6.5.,( 6.14. 6.10.00. 6.10.00.00.00.00.00.00.00.00.00.00.00.00.
720 721 721 9 025 710 711 738 703 340 711 738 703 340 018 019 024 028 024 0228 024 0228 024 0228 031 303 312 794	Vent mode Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure Prs Conf OUT3 Conf. OUT2 Conf. OUT1 OpMode rem HiFlowCtrl Error code Drv Softw Param. set Servicelin Address	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]       Pmax for Interval operations [W]         Pmax for Interval operations [W]       Vacuum pressure gauge type         High vacuum pressure switchpoint       in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Confi	0 0 0 0 0 1E-1 1E-12 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	2 80 3600 1000 1000 5E0 1E3 3 2 1 1 1 1 2 2 255	0(-7) 50 3600 0 0 - 1E-1 - 0 0 0 0 0 0 0 - - 0 0 0 0 - - - - 0 0 - - - - - - - - - - - - -		6.5.,( 6.14. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 3.10. 5.10.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5
720 721 721 9 025 710 711 738 703 340 018 019 024 028 024 024 024 024 024 024 024 024 024 024	Vent frequ Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure Pressure Pressure Conf OUT3 Conf. OUT3 Conf. OUT1 OpMode rem HiFlowCtrl Error code Drv Softw Param. set Servicelin Address	Venting mode       0=automatic venting; r=ab not vent; 2=venting; On         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds <b>vith TCS</b> Operations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]       Pmax for Interval operations [W]         Vacuum pressure gauge type       High vacuum pressure switchpoint         High vacuum pressure switchpoint       in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Con	0         0           0         0           0         0           1E-1         1           0         0           0         0           0         0           0         0           0         0           0         0           0         0           1         1	2 80 3600 1 1000 1000 5E0 1E3 3 2 1 1 1 1 2 2 55	0(-7) 50 3600 0 0 0 - 1E-1 - 0 0 0 0 0 0 0 0 0 - - 0 0 0 0 - - - 0 0 0 0 - - - - - - - - - - - - -		6.5.,( 6.14. 6.10. 6.00. 6.10.00. 6.10.00.00.00.00.00.00.00.00.00.00.00.00.
720 720 721 <b>Pum</b> 225 710 711 738 703 340 <b>Othe</b> 018 019 024 028 031 303 312 794 795 797 <b>Fabl</b>	Vent frequ Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure Prs Conf OUT3 Conf. OUT2 Conf. OUT1 OpMode rem HiFlowCtrl Error code Drv Softw Param. set Servicelin Address e of failures	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         operations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]         Pmax for Interval operations [W]         Vacuum pressure gauge type         High vacuum pressure switchpoint         Actual pressure value         in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. 2=open if mains OFF or failure, 1=dto. or warnings         2=open if mains OFF, turbo drive OFF or failure         Configuration output K1       0=switchpoint attained; 1=TMS temperature         attained (±5K); switchpoint attained + turbo drive "ON"         Remote Operations mode       0=Standard operations, 1=Latch         operations-(Remote Priority; Pin X16.7 set to 1)         Monitoring rotor lifting in case of high gas flow; 0="OFF", 1="ON"         Actual error code       "no Err", "Errxx" oder "Wrnxxx"         Software version electronic drive unit         Parameter set       0=basic parameter set; 1=expanded parameter set;         2 = operational orientated parameter set         Contains the service line       795=messages; ≠795=# of the second parameter set         <	0         0           0         0           0         0           1E-1         1           0         0           0         0           0         0           0         0           0         0           0         0           0         0           1         1	2 80 3600 1 1000 1000 5E0 1E3 2 1 1 1 2 255	0(-') 50 3600 0 0 - 1E-1 - 0 0 0 0 0 0 0 0 0 - - 0 0 0 0 - - 0 0 0 0 0 0 - - - - 0 0 0 0 - - - - - - - - - - - - -		6.5.,( 6.14. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.13. 6.13. 6.13. 6.2.,( 6.15.
720 720 721 720 721 720 720 720 720 720 720 720 720 700 711 738 703 340 703 340 0018 0018 0018 0019 0024 0024 0024 0024 0024 0024 0025 794 0025 794 0025 794 0025 794 0025 794 0025 794 0025 794 0025 794 0025 795 790 700 700 700 700 700 700 700 700 700	Vent frequ Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure Prs Conf OUT3 Conf. OUT2 Conf. OUT1 OpMode rem HiFlowCtrl Error code Drv Softw Param. set Servicelin Address e of failures Past Err1	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]       Pmax for Interval operations [W]         Vacuum pressure gauge type       High vacuum pressure gauge type         High vacuum pressure switchpoint       in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. 1=configuration output K1         Config. K2 0= open if mains OFF or failure, 1=dto. or warnings       2=open if mains OFF, turbo drive OFF or failure         Configuration output K1       0=switchpoint attained; 1= TMS temperature attained (±5K); switchpoint attained + turbo drive "ON"         Remote Operations mode       0=Standard operations, 1=Latch operations. (Remote Priority; Pin X16.7 set to 1)         Monitoring rotor lifting in case of high gas flow; 0="OFF", 1="ON"         Actual error code       _no Err", _Errxx* der _Wrnxx*         Software version electronic drive unit         Parameter set       0=basic parameter set; 1=expanded parameter set; 2 = operational orientated parameter set; 2 = operational orientated parameter set         Contains the service line       795=messages; ≠795=# of the second parameter set         Unit address       Error storage, Posi	0         0           0         0           0         0           1E-1         1           0         0           0         0           0         0           0         0           0         0           0         0           0         0           1         1	2 80 3600 1 1000 1000 5E0 1E3 3 2 1 1 1 2 255	0(-7)           50           3600           0           -           1E-1           -           0           0           0           0           0           0           0           0           0           0           0           0           0           0           0           0           0           1		6.5.,() 6.10. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7.
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720 720 720 721 <b>Pum</b> 710 711 738 703 340 018 019 024 028 031 024 028 031 312 794 995 797 <b>Fabl</b> 3660 3661 3662	Vent mode Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure Prs Conf OUT3 Conf. OUT2 Conf. OUT1 OpMode rem HiFlowCtrl Error code Drv Softw Param. set Servicelin Address Past Err1 Past Err2 Past Err3	Venting mode       0=automatic venting; r=ab not vent; 2=venting; On         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]       Pmax for Interval operations [W]         Pmax for Interval operations [W]       Vacuum pressure gauge type         High vacuum pressure switchpoint       in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Config. Config. Config. Composition (Config. Composition)         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Config. Composition (Config. Composition)         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Config. Composition (Config. Composition)         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Config. Composition (Composition)         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Composition (Composition)         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Composition (Composition)         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Composition (Composition)         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Composition (Composition)	0 0 0 0 1E-1 1E-12 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	2 80 3600 1 1000 1000 5E0 1E3 3 2 1 1 1 1 2 255	0(-7)           50           3600           0           0           -           1E-1           -           0           0           0           0           0           0           0           0           0           0           0           0           0           0           0           795           1           -           -           -           -           -           -           -           -           -           -           -           -           -           -           -           -           -           -           -		6.5.,() 6.14. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 3.10.10.10.10.10.10.10.10.10.10.10.10.10.
720 720 721 720 721 720 720 721 720 720 721 738 703 340 7711 738 703 340 0018 018 019 024 024 0224 0224 0224 0224 0224 0224	Vent frequ Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure Prs Conf OUT3 Conf. OUT2 Conf. OUT1 OpMode rem HiFlowCtrl Error code Drv Softw Param. set Servicelin Address e of failures Past Err1 Past Err3 Past Err3 Past Err4	Venting mode       0=automatic venting; r=ab not vent; 2=venting; On         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]       Pmax for Interval operations [W]         Vacuum pressure gauge type       High vacuum pressure switchpoint         High vacuum pressure switchpoint       in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Config. Config. Comparison of the of the second parameter set;         2=open if mains OFF, turbo drive OFF or failure, 1=dto. or warnings       2=open if mains OFF, turbo drive OFF or failure         Configuration output K1       0=switchpoint attained; 1= TMS temperature         attained (±5K); switchpoint attained + turbo drive "ON"         Remote Operations mode       0=Standard operations, 1=Latch         operations-(Remote Priority; Pin X16.7 set to 1)         Monitoring rotor lifting in case of high gas flow; 0="OFF", 1="ON"         Actual error code      no Err",Errxx* oder ,Wrmxx*         Software version electronic drive unit       Parameter set       0=basic parameter set;         2 operational orientated parameter set       Contains the service line 795=messages; ≠795=# of the second parameter set;         2 operation 2	0         0           0         0           0         0           1E-1         1           0         0           0         0           0         0           0         0           0         0           0         0           1         1	2 80 3600 1 1000 1000 5E0 1E3 2 1 1 1 2 255	0(-7)           50           3600           0           0           -           1E-1           -           0           0           0           0           0           0           0           0           0           0           0           0           795           1           -		6.5.,() 6.14. 6.10. 7. 6.10. 7. 6.10. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7.
720 720 721 <b>Pum</b> 025 710 711 738 703 340 <b>Othe</b> 018 019 024 024 024 024 024 024 024 024 024 024	Vent frequ Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure Prs Conf OUT3 Conf. OUT2 Conf. OUT1 OpMode rem HiFlowCtrl Error code Drv Softw Param. set Servicelin Address e of failures Past Err1 Past Err2 Past Err4 Past Err5	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]       Pmax for Interval operations [W]         Vacuum pressure gauge type       High vacuum pressure switchpoint         High vacuum pressure switchpoint       in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Corfig. Config. Config. Composition         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Config. Config. Composition         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Config. Config. Composition         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Config. Composition Composition         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Config. Composition Composition         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Composition Signature         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Composition Signature         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Composition Signature         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Composition Si	0         0         0         0         0         1E-1         1E-12         0         0         0         0         0         0         0         0         0         1	2 80 3600 1 1000 5E0 1E3 3 2 1 1 1 2 255	0(-7)           50           3600           0           0              1E-1           -           0           0           0           0           0           0           0           0           0           0           0           0           0              0           795           1              -		6.5.,() 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 7. 7. 7. 7. 7. 7. 7.
720 720 721 720 721 720 720 720 720 720 720 720 720 721 738 703 340 773 703 340 025 703 340 025 703 340 025 703 340 025 703 700 711 738 703 340 0018 0018 0025 703 740 703 740 703 740 703 740 703 740 703 740 700 700 700 701 700 700	Vent frequ Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure Prs Conf OUT3 Conf. OUT2 Conf. OUT2 Conf. OUT1 OpMode rem HiFlowCtrl Error code Drv Softw Param. set Servicelin Address e of failures Past Err1 Past Err3 Past Err3 Past Err5 Past Err6	Venting mode       0=automatic venting; r=ab not vent; 2=venting; on         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]       Pmax for Interval operations [W]         Vacuum pressure gauge type       High vacuum pressure switchpoint         High vacuum pressure switchpoint       in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Config. Config. Config. Composition (Config. Composition)         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Config. Composition (Composition)         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Config. Composition (Composition)         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Config. Composition (Composition)         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Composition (Composition)         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Composition (Composition)         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. Composition (Composition)         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function       Config. 1=Casing heating, 2=TMS, 3=air cooling, 0=no function         Config. 1=casing heati	0         0         0         0         0         1E-1         1E-12         0         0         0         0         0         0         0         0         0         1	2 80 3600 1 1000 5E0 1E3 3 2 1 1 1 2 255	0(-') 50 3600 0 0 - 1E-1 - 1E-1 - 0 0 0 0 0 0 - - 0 795 1 - - - - - - - - - - - - -		6.5.,() 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 7. 7. 7. 7. 7. 7. 7.
720 720 721 720 721 720 720 720 720 720 720 720 720 720 720	Vent frequ Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure ers Conf OUT3 Conf. OUT2 Conf. OUT1 OpMode rem HiFlowCtrl Error code Drv Softw Param. set Servicelin Address e of failures Past Err1 Past Err2 Past Err3 Past Err6 Past Err6 Past Err7	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting frequency       as a % of the final rotation speed of the TMP         Venting time       in seconds         vith TCS       0perations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]       Pmax for Interval operations [W]         Vacuum pressure gauge type       High vacuum pressure switchpoint         High vacuum pressure switchpoint       in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. 2 open if mains OFF or failure, 1=dto. or warnings         2=open if mains OFF, turbo drive OFF or failure         Configuration output K1 0=switchpoint attained; 1= TMS temperature         attained (±5K); switchpoint attained + turbo drive "ON"         Remote Operations mode       0=Standard operations, 1=Latch         operations-(Remote Priority; Pin X16.7 set to 1)         Monitoring rotor lifting in case of high gas flow; 0="OFF", 1="ON"         Actual error code       _no Err", _Errxx" oder ,Wrnxx"         Software version electronic drive unit       Parameter set         Parameter set       0=basic parameter set; 1=expanded parameter set;         2 = operational orientated parameter set       contains the service line	0         0         0         0         0         1E-1         1E-12         0	2 80 3600 1 1000 1000 5E0 1E3 3 2 1 1 1 2 255	0(-7)           50           3600           0           0           -           1E-1           -           0           0           0           0           0           0           0           0           0           0           0           0           0           0           0           795           1           -		6.5.,( 6.14. 6.10. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7.
720 720 720 721 <b>Pum</b> 2025 710 711 738 703 340 <b>Othe</b> 018 019 024 028 031 024 028 031 024 028 031 024 028 031 024 028 031 033 312 794 028 033 312 795 797 <b>Callore</b> 025 5 797 <b>Callor</b> 700 710 711 738 703 702 705 710 710 711 738 703 702 705 710 711 738 703 702 705 710 711 738 703 703 704 710 711 738 703 704 710 711 738 703 704 705 710 711 738 703 704 705 710 711 738 703 704 704 704 704 704 705 704 704 705 704 705 704 704 705 704 704 705 704 707 707 707 707 707 707 707 700 701 707 700 700	Vent frequ Vent frequ Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure Prs Conf OUT3 Conf. OUT2 Conf. OUT1 OpMode rem HiFlowCtrl Error code Drv Softw Param. set Servicelin Address Past Err1 Past Err2 Past Err3 Past Err7 Past Err7 Past Err7 Past Err7 Past Err7 Past Err7 Past Err7 Past Err7	Venting mode       0=automatic venting; r=ab not vent; 2=venting; on         Venting time       in seconds         vith TCS         Operations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]         Pmax for Interval operations [W]         Vacuum pressure gauge type         High vacuum pressure switchpoint         In mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. 2=copen if mains OFF or failure, 1=dto. or warnings         2=open if mains OFF, turbo drive OFF or failure         Config. K2 0= open if mains OFF or failure, 1=dto. or warnings         2=open ational output K1       0=standard operations, 1=Latch         operations-(Remote Priority; Pin	0         0           0         0           0         0           1E-1         1           0         0           0         0           0         0           0         0           0         0           1         1	2 80 3600 1 1000 1000 5E0 1E3 3 2 1 1 1 2 255 	0(-7)         50           3600         3600           0         0           -         1E-1           -         0           0         0           0         0           0         0           0         0           0         0           0         0           -         -           0         -           -         -           -         -           -         -           -         -           -         -           -         -           -         -           -         -           -         -           -         -           -         -           -         -           -         -           -         -		6.5.,() 6.14. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 3.10. 3.10. 3.10. 3.10. 3.10. 3.10. 3.10. 3.10. 3.10. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7.
330           720           720           720           720           720           720           720           720           720           720           720           720           720           720           721           720           721           720           710           710           711           738           703           340           018           019           024           0231           303           312           794           995           797 <b>Tabl</b> 860           361           362           363           364           865           3666           367           368           367           368	Vent frequ Vent time Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure Prs Conf OUT3 Conf. OUT2 Conf. OUT1 OpMode rem HiFlowCtrl Error code Drv Softw Param. set Servicelin Address e of failures Past Err1 Past Err2 Past Err3 Past Err6 Past Err7 Past Err7	Venting mode       0=automatic venting; r=ab not vent; 2=venting; on         Venting time       in seconds         vith TCS         Operations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]         Pmax for Interval operations [W]         Vacuum pressure gauge type         High vacuum pressure switchpoint         In mbar         Actual pressure value         In mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. 2=open if mains OFF or failure, 1=dto. or warnings         2=open if mains OFF, turbo drive OFF or failure         Configuration output K1         0=operations mode       0=Standard operations, 1=Latch         operations-(Remote Priority; Pin X16.7 set to 1)         Monitoring rotor lifting in case of high gas flow; 0="OFF", 1="ON"         Actual error code      no Err",Errxxx" oder ,,,Wrmxxx"         Software version electronic drive unit         Parameter set       0=basic parameter set;         2 = operational orientated parameter set;         2 = operational orientated parameter set         Contains the service line       795=#soft the second parameter set;         2 = operational orientated parameter set         Contains the service line       795=messages; ≠795=	0         0           0         0           1E-1         1           0         0           0         0           0         0           0         0           0         0           0         0           1         1	2 80 3600 1 1000 1000 5E0 1E3 2 1 1 1 2 255 	0(-7)           50           3600           0           0           -           1E-1           -           0           0           0           0           0           0           0           0           0           0           0           0           0		6.5.,( 6.14. 6.10. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7.
330           720           720           720           720           720           720           720           720           720           720           720           720           720           720           721           720           710           738           703           340           0119           024           0231           0303           312           794           031           3603           361           362           363           364           365           3666           3667           3688           3669	Vent frequ Vent time Vent time ping station v OpMode BkP BKP off BKP on Gaugetype HVVthrshld Pressure Prs Conf OUT3 Conf. OUT2 Conf. OUT1 OpMode rem HiFlowCtrl Error code Drv Softw Param. set Servicelin Address e of failures Past Err1 Past Err2 Past Err3 Past Err4 Past Err7 Past Err7	Venting mode       0=automatic venting; 1=ab not vent; 2=venting; 0n         Venting time       in seconds         vith TCS         Operations mode backing pump, 0=non-stop operations; 1=intermittent operations         Pmin for Interval operations [W]         Pmax for Interval operations [W]         Vacuum pressure gauge type         High vacuum pressure switchpoint         Actual pressure value         in mbar         Config. 1=casing heating, 2=TMS, 3=air cooling, 0=no function         Config. 2=open if mains OFF or failure, 1=dto. or warnings         2=open if mains OFF, turbo drive OFF or failure, 1=tots or warnings         2=open if mains OFF, turbo drive OFF or failure         Configuration output K1         0=switchpoint attained; 1=TMS temperature         attained (±5K); switchpoint attained + turbo drive "ON"         Remote Operations mode       0=Standard operations, 1=Latch         operations-(Remote Priority; Pin X16.7 set to 1)         Monitoring rotor lifting in case of high gas flow; 0="OFF", 1="ON"         Actual error code       _no Err", _Errxx" oder _,Wrmxx"         Software version electronic drive unit         Parameter set       0=basic parameter set; 1=expanded parameter set; 2 = operational orientated parameter set         Contains the service line       795=messages; ≠795=# of the second parameter set; 2 = operation	0         0           0         0           0         0           1E-1         1           0         0           0         0           0         0           0         0           0         0           0         0           1         1	2 80 3600 1 1000 5E0 1E3 3 2 1 1 1 2 255	0(-7)           50           3600           0           0              1E-1           -           0           0           0           0           0           0           0           0           0           0           0           0           0              0           795           1              -		6.5.,() 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 6.10. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7.

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# 6. Operations ....

# 6.1. Switching On The Magnetic Bearing Controller

Switch on the unit with switch S1 on the rear side of the unit.

## Self-Testing

The TCM 1601 carries out a self test. This is identifiable on the LC display with **«SELF»**. After the end of the self test the unit is switched on. The duration of the self-test is maximum 10s. If, when switching on mains power, the rotation speed of the turbopump f>0Hz the self-test is performed as soon as the rotation speed of the turbopump f=0Hz is attained.

# 6.2. Switching ON The Pumping Station

#### Please note:

Before switching on the pumping station set value programming and setting commands (please see section 5.) should be checked for their suitability with regard to the selected pumps and the pumping process.

- ➡ Select «794: Param. Set» and set to «1»
- ➡ Check set values [P:7xx] and setting commands [P:0xx]

With backing pumps with high volume flow rates (>16m3/h): -> Select «031 : HiFlowCtrl» and set to «ON».

- -> The start up of the magnetic bearing is delayed against the switching on of the backing pump.
- Switch on the Pumping station with key-button (1), alternative via the remote control or via the serial interface.

While the magnetic bearing is being calibrated the display shows **«calibration**» and on completion the turbopump begins to rotate. During the preselected run up time [P:700], the rotation speed switch point [P:701] must be attained. If an error is identified the LC will display the appropriate error code (please see section 7. "Error Codes And Warnings").

Where backing pumps with high volume flow rates ( $\geq 16m^3/h$ ) are involved the strong gas flow at the beginning in the turbopump can affect the magnetic bearing and can lead to a malfunction. With [P:031] = «ON» this will be checked before the activation of the magnetic bearing. During a possible waiting period **«HighPressDly»** will be displayed in the LC display.

When the key 🐼 is used to acknowledge an error the running up time is re-set to the starting value.

# Normal Operations, Turbopump

Once the final rotation speed [P:315] has been attained, the motor current [P:310] is set to a value which is dependent on the level of gas throughput and fore-vacuum pressure.

## 6.3. Standby ON/OFF

- ➡ Select «002: Standby»
- ➡ Select «OFF» or «ON».

"Standby" operations is the operation of the pump at 66% of its final rotation speed.

Standby is recommended during breaks in operations. The function can be also be selected via the remote control or the serial interface.

# 6.4. Casing Heating ON/OFF

#### Activating the casing heating

- → Select «018: Conf. OUT3» and set to «1».
- ➡ Select «001: Heating» and set to «1».

The casing heating is switched on and off dependent on the rotation speed switchpoint [P:701]. Falling below the rotation speed switchpoint causes the heating to be switched off. The status of the casing heating is visible via the LC display (please see section 4.2.).

The function "casing heating" can be carried out via the serial interface or remote control.

# 6.5. Temperature Management Operations (TMS)



The Temperature Management System (TMS) consists of a controllable heating system which is fitted in the fore-vacuum part of the turbomolecular pump. Heating to a maximum of 90°C prevents the condensation of process gases or by-products in this part of the pump.

To optimise the performance of the pump in gas load operations and to keep the temperature of the pump under control, in TMS operations the rotation speed of the pump is slightly reduced by activating the TMS heating. Specific TMS rotation speeds can be found in the technical data section of the respective pump.

#### Activating the TMS heating

- ➡ Selec t «794: Param. Set» and set to «1».
- → Select «018: Conf. OUT3» and set to «2».
- → Select «704: TMSHeatset» and set the temperature.
- → Selec t«001: Heating» and set to «ON».

In addition to the parameters referred to above, further information/functions which support operations with the TMS are available.

## **Request TMS temperature**

- ➡ Select «331: TMS ActTmp»
- ➡ Read the current temperatur.

#### TMS temperatur attained?

- ➡ Select «333: TMS steady»
- ➡ Read display (yes/no).

## **Function Switch contact K1**

The information **«333 : TMS steady»** (TMS set temperature attained) can, in addition, be assigned to the potential-free switch contact with

«024 : Conf Out1» (please refer to Section 3.10.). It is then available for example for higher level process control.

#### **Please Note:**

By pre-selecting [P:001] «heating» to «1» the following parameters are influenced by a reduction of the final rotation speed:

- [P:315] in final rotation speed operations.
- [P:707] in rotation speed setting operations.
- [P:720] in automatic venting mode.

As a matter of principle the TMS heating is only activated once the rotation speed switchpoint [P:701] is attained.

# 6.6. Air Cooling ON/OFF

### Activating the air cooling:

➡ Select «018 : Conf Out3» and set to «3».

The air cooling is switched on and off contingent on the rotation speed of the pump. Rotation speeds greater than 0 Hz cause the air cooling to be switched on. At 0 Hz the air cooling is switched off.

## 6.7. Gas Type Dependent Operations

To protect the rotors against overheating the maximum power on some turbopumps is limited to the nominal rotation speed. As a general rule however, with lower pre-selected rotation speeds more power is provided. This frequency/power curve is dependent on the type of gas.

#### Select gas mode

- ➡ Select «794 : Param. Set» and set to «1».
- Select «027 : gas mode».
- ➡ Select «0» for heavy inert gas, «1» for other gases.

The rotation speed is reduced on non-attainment of the gas dependent maximum power until the permissible power and gas friction levels are in balance. To avoid rotation speed fluctuations it is recommended in rotation speed setting operations to set a balance frequency or even a slightly lower frequency (please see Section 6.10.).

The values A, B, C and D are stated in the technical data section of the pump operating instructions.



# 6.8. Switching ON/OFF the turbopump

During pumping station operations the turbopump can be switched off and on separately:

- → Select «023 : Motor TMP».
- Select «OFF», or «ON».

# 6.9. Rotation Speed Setting Operations

The rotation speed setting operation is selected if the volume flow rate of the turbopump should be reduced. The pressure ratio of the pump reduces exponentially with the rotation speed.

#### Rotation speed settings in rotation speed setting operations

- → Select «794 : Param. Set» and set to «1».
- ➡ Select «707 : TMProt set».
- ➡ Adjust rotation speed in the range of 20-100%.

#### **Operation mode turbopump**

- → Select «026 : OpMode TMP».
- Select rotation speed setting operations «1».

#### Remark

The electrical brake can be used for faster reduction of the rotation speed (see chapter 6.11.).

The stand-by mode is ineffective in rotation speed setting operations. The rotation speed switchpoint is fixed at 20% of the final rotation speed.

The provision of a pulse width modulated signal (PWM) on X16:3 enables the rotation speed to be set in the range 20%-100% of the nominal rotation speed.

Ground frequency:100 Hz (±20%)Amplitude, maximum:33 VPulse-width repetition rate:25-75%



In the event there is a static or a PWM signal with a frequency from <80 Hz or >120 Hz on X16:3, the pump runs up to its final rotation speed.

The PWM signal can be generated with a PWM box (please refer to Section 12, "Accessories"). Control here is executed with 0-10 VDC.

## 6.10. Operations With The Pumping Station Control Unit TCS 180

The following pumping station components can be controlled with the Pumping Station Control Unit TCS 180:

- Turbopump
- Backing pump (continuous/intermittend operation)
- Fore-vacuum safety valve
- High vacuum valve
- High vacuum pressure gauge

For a description of the function of Pumping Station Control Unit TCS 180 please refer to the Operating Instructions PM 800 384 BN.

## **Pressure Measurement**

With the use of a HV pressure gauge (please see the table in Section 3.11.) the pressure in the vacuum chamber is displayed on the TCM 1601.

Inquiry of the gauge type

- → Select «794: Param set», set to «1».
- → Select «738: gauge type».
- ➡ Read off the gauge type.

Some pressure gauges can be recognised as groups (for example the ACR 261 to 263) and have to be adjusted manual-ly.

## Request pressure set value

- → Select «794: Param set», set to «1».
- ➡ Select «340: Pressure».
- Read off the pressure set value [mbar].

Depending on the pressure gauges which are connected, the following displays can appear:

Display (expl.)	appears on
« mbar»	no pressure gauges connected
«<5E-4mbar»	non-attainment of the measurement range (de
	pendent on the type of gauge in operation)
«>1E3mbar»	measurement range is exceeded (dependent on
	the type of pressure gauge in operation)
«6.3E-9mbar»	valid pressure value
«idfam mbar»	pressure gauge type not yet identified;
	>settype
«TPR250»	pressure gauge type TPR 250 connected
«ACR?»	pressure gauge types ACR 261, ACR 262 or
	ACR 263 connected and not yet selected (in this
	case display is «id fam» [P:340])
«Error!»	pressure gauge malfunction

# High Vacuum Valve Control

Controlling the high vacuum valve via pump rotation speed and HV pressure measurement protects the magnetic bearing pump from sudden rises in pressure and the process charge in the event of a breakdown. The pump rotation speed and an adjustable high vacuum pressure threshold serve as the control parameters.

If operation of the high vacuum valve is released via the TCS 180, the valve can be opened or closed by a switch in the feed line.

The switch must be installed by the customer.

⇒ See also wiring diagram PM 041 892 -S, section 11, connection X13, PIN 1 to the high vacuum valve.

# Adjustment pumping speed and HV pressure treshhold

- ➡ Select «794: Param set», set to «1».
- ➡ Select «701: Switch pnt» «50....90%».
- ➡ Select «703: HVVthrshld»
- ➡ Adjust «1·10<sup>-1</sup>..5·10<sup>0</sup> [mbar]».

#### **Operation high vacuum valve**

The operation of the HV valve in conjunction with the pumping station status and the valve status is described in Operating Instructions PM 800 384 BN for the TCS 180.

# **Operation Backing Pump**

Depending on the selected backing pump and the vacuum application the operations mode "non-stop operations" or "intermittent operations" can be selected. Intermittent operations are used to increase the working life of the diaphragms in diaphragm backing pumps. The backing pump is switched on and off depending on the take-up power of the turbopump.



Rotary vane pumps must not be used for internal operations.

#### Non-stop operations backing pump

- ➡ Select [P:794] «Param set» and set to «1».
- Select [P:025] «OpMode BkP» and set to «0» for nonstop operations.

#### Interval operations backing pump

- ➡ Select [P:794] «Param set» and set to «1».
- Select [P:025] «OpMode BkP» and set to «1» for interval operations.

For intermittent operations involving the backing pump a pumping station control unit TCS 180 should be used. The backing pump is switched on and off in accordance with the power take-up levels of the turbopump.

Differing power take-up levels on an idling turbopump lead to differing pressure switchpoints on various pumps. In addition, on diaphragm pumps there are differing final pressures resulting from the gas ballast equipment. This means that ideal pressure switchpoint setting via the power take-up level is not possible. Nevertheless, the advantage of intermittent operations can still be exploited by setting the pressure switch threshholds individually. In this respect operations between 5 and 10 mbar are recommended.

## Setting the switching threshholds

- → Select [P:340] «Pressure».
- Admit air into the fore-vacuum line with the dosing valve while the pumping station is running until the fore-vacuum pressure increases to 10 mbar.
- → Select [P:316] «TMP power».
- ➡ Read off the take-up power at 10 mbar.
- → Select [P:711] «BKP Pon».
- Save the read-off take-up power as the upper switching threshhold.
- Proceed analogically with the lower switching threshold. Take 5 mbar as the pressure value.
- → Select [P:710] «BKP Poff».
- Save the read-off take-up power as the lower switching threshhold.

# 6.11. Switching Off The Pumping Station

Press key-button O on the front panel. As an alternative, the pumping station is switched off via the remote control or the serial interface.

After switching off, the rotation speed is reduced to 0 Hz and the magnetic bearing is switched off.

# 6.12. Switch On The Electrical Brake

With an electrical brake the pump can be braked rapidly from the rated rotation speed to 0 Hz. Braking from the rated rotation speed to 200 Hz is with constant power. From 200 Hz to 0 Hz braking is via a motor coil short cut.

- ➡ Select «794: Param set», set to «1».
- ➡ Select «013: Brake enab».
- ➡ Select «ON».

## 6.13. Remote Control



The pump re-starts automatically after restoration of power after a mains power failure.

Following functions can be switched on and off via remote control (see also the table on section 3.9.)

- Heating "ON/OFF"
- Standby "ON/OFF"
- Pumping station "ON/OFF"
- Turbopump "ON/OFF"
- Reset
- Venting release "ON/OFF"
- Remote priority "ON/OFF"

# **Operations Modes With The Remote Control**

Basically there are three remote control options with differing priorities of the remote control functions:

#### Standard remote operations

➡ Select «028: OpMode rem» to «0».

The individual functions which are operable via the remote control are activated via "SPC high level"\*. Individual functions activated via the serial interface cannot be altered via the keyboard or the serial interface. Individual functions de-activated via the remote control can be operated via the serial interface or the keyboard.

\*) SPC high level: +13V bis +33V SPC low level: -33V bis +7V Ri: 7kΩ

#### **Remote Control Priority "ON"**

Where certain application situations are involved, for example SPC control, the remote control functions can be assigned prioritized switching.

#### With f=0Hz:

- ➡ Select «028 : OpMode rem» and set to «1».
- ➡ Make a bridge from X16.7 to X16.1.
- -> All set functions are switched off.
- -> The remote control functions can only be set via X16. The keyboard and the serial interface are inactive.
- -> The set values are saved.

#### The functions

- Motor TMP "ON/OFF"
- Heating "ON/OFF"
- Standby "ON/OFF"
- Pumping station "ON/OFF"
- Reset
- Venting release ON/OFF

are activated with "SPC high level" and deactivated with "SPC low level". In the rotation speed setting mode set values are processed exclusively via X16.3.

If X16.7 should be set to "SPC-Low":

-> The values set via the remote control are assumed.

#### **Remote Control Priority "OFF"**

- ➡ Set «028 : OpMode rem» with f=0 Hz to «1»:
- -> All set functions are switched off.
- ➡ Set pin X16.7 to "SPC-Low".
- -> Operations are only possible via the keyboard and the serial interface (remote control is inactive).
- -> Set values are saved.

#### If «028 : OpMode rem» should be re-set to «0»:

-> Values set via the keyboard or the serial interface are assumed and also the values set via the remote control in "SPC High".

#### 6.14. Venting of the pump

Venting is only possible after the pump has been switched off.

Basically there is a delay time of 6 seconds before each venting cycle so as to close any high vacuum valve which may be connected. In a current-less state, the high vacuum valve is closed. In the event of a malfunction venting takes place in accordance with the selected venting mode.

Cyclic venting can proceed in accordance with the operating conditions.

If the self test after switching on the unit fails, the venting valve remains closed.

In the event of a mains power failure, venting does not take place.

#### Venting release

➡ Select «012: Vent enab», set to «ON».

Three venting modes can be selected in the extended parameter set:

- ➡ Select «794: Param set», set to «1».
- ➡ Call «030: Vent mode», select «0», «1» or «2».

#### Venting mode «0»: automatic venting

Automatic venting means that venting begins at a set frequency [P:720] for a set duration [P:721].

- → Select «720: Vent frequ».
- ➡ Adjust venting frequency between «40...80%».
- ➡ Select «721: Vent time».
- ➡ Adjust venting time.

Where the pumping station is "OFF" if the turbopump once attains more than 15% of the final rotation speed and then does not attain the venting frequency, venting will take place for the duration of the set venting time.

After "Mains Power ON", the venting valve is closed.

#### Venting mode «1»: Venting OFF

--> Venting does not take place.

#### Venting mode «2»: Venting ON

--> In case of "Pumping Station OFF" or in case of a failure venting takes place. The venting valve remains open during mains "ON" (S1). It closes by switching on the pumping station.

# 6.15. Serial Interface RS 485 Operations

The group adress of the TCM 1601 is 988. All units connected to the bus must have differing serial interface adresses [P:797]. The connection of an RS 232 (for example a PC) is possible via Level Converter (see accessories, chapter 12.).



The description of the data communication can be found in Operating Instructions PM 800 488 BN.

# 6.16. Emergency Current Operations

If the mains power supply fails during operations the magnetic bearing controller is supplied by the back-up current electronic unit. The mains power supply failure is indicated by a blinking green LED on the front panel and a warning message **«F007**».

If the rotor energy is no longer sufficient to supply the magnetic bearing electronic unit, the rotor is deposited into the safety bearing and is braked as a result of a motor short circuit. Simultaneously all displays on the TCM are deleted.

If mains power is restored before the rotor is deposited the pump is re-accelerated to its nominal rotation speed. If mains power is restored after deposition (but the rotor is still turning) there is a waiting period of f=0Hz (during this time the magnetic bearing controller is inactive). Then the TCM 1601 carries out a self test and the pump starts again.

# 6.17. Emergency Current Operations With Battery Box TBB 001

The battery box TBB 001, connected to X29, takes over the supply for the magnetic bearing controller. Subsequently the motor brake brings the rotor to rest within a short time. On deposition of the rotor the battery box is switched off.

The level of charge in the batteries is checked by the TCM 1601 before each time mains power is switched on and every 2 hours during operations. If, in the event of a mains power failure, the capacity of the batteries is insufficient to supply the magnetic bearing to 0 Hz the warning message **«F006**» (Battery capacity too low) appears in the display.

Batteries are charged with a maximum of 1A with the battery box TBB 001. Empty batteries are fully charged within approximately 2.5 hours.

A replacement of the complete battery box TBB 001 is possible while the turbopump is running. The warning message **«F008**» can be acknowledged after the battery box has been replaced. Subsequently there follows a once only capacity test on the battery box.

# 7. Errors And Warnings

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#	Meaning	arises when	when resettable	Troubleshooting
	«Error Exxx»			
F001	Error Excess rotation sneed TMP	B	Pump at rest	PEEIEEB service
E006	Start-up time error	B	any time	Adjust run up time correctly, open fore vacuuum valve
				Remove the leak, reduce fore vacuum pressure
E014	In the self test recognized heating rate			Change the heating or cooling configuration
	is modified by pulling the plug or malfunction	В	any time	PFEIFFER service
E016	Brake reduction current defective	B/S	Pump at rest	Test magnetic bearing controller, PFEIFFER Service
E017	Non-conformity in the setting of switching			Check setting [P:018]. Check the electrical connections
	output 3 [P:018] and the installed heating system	B/S	any time	to the TMS box/casing heating/air cooling.
E020	Emergency current supply malfunction	B/S	Pump at rest	Test magnetic bearing controller, PFEIFFER Service
E021	Unknown pump connected	B/S	Pump at rest	Test pump and cable, PFEIFFER Service
EU22	Pump cable not connected or resistance	D/C	Dump at reat	Piug in pump cable
E033	+15V malfunction	B/S	Pump at rest	Test magnetic hearing controller PEFIFFER Service
E033	Motor voltage +70V malfunction	B B	Pump at rest	Test magnetic bearing controller, PEEIFEER Service
E040	BAM module defektive	S	not resetable	Test magnetic bearing controller, PFEIFFER Service
E041	ITRIP Motor current too high	B/S	Pump at rest	Test magnetic bearing controller, PFEIFFER Service
E043	Data storage malfunction	B/S	not resetable	Test magnetic bearing controller, PFEIFFER Service
E050	Excess temperature magnetic bearing amplifier	B	any time	Keep to the ambient conditions
				Test magnetic bearing controller, PFEIFFER Service
E051	Vent valve defective or not connected	В	any time	Test the vent valve, PFEIFFER Service
E052	Watchdog TMS320	В	Pump at rest	Test magnetic bearing controller, PFEIFFER Service
E062	Magnetlic bearing X unstabil	В	Pump at rest	Test the pump or call PFEIFFER Service
E063	Magnetlic bearing Y unstabil	В	Pump at rest	Test the pump or call PFEIFFER Service
E064	Radial emergency bearing clearance too small	B	Pump at rest	Test the pump or call PFEIFFER Service
E065	Radial emergency bearing clearance too big	В	Pump at rest	Test the pump or call PFEIFFER Service
E066	Lower axial bearing clearance too small	B	Pump at rest	Test the cooling, reduce the gas load, PFEIFFER Service
E067	Lower axial bearing clearance too big	B	Pump at rest	Test the pump or call PFEIFFER Service
E068	Upper axial bearing clearance too small	В	Pump at rest	Test the pump or call PFEIFFER Service
E069	Opper axial bearing clearance too big	В	Pump at rest	Test the pump or call PFEIFFER Service
E070	Axial bearing current teo low	B	Pump at rest	Test the pumper call PECIFER Service
E072	Axial bearing current too high		Pump at rest	Test the pumper call PECIEEEP Service
E074	Badial bearing current X different	B	Pump at rest	Test the number call PEFIFFER Service
E075	Radial bearing current Y different	B	Pump at rest	Test the pumper call PEEIFER Service
E078	Axial bearing amplifier defective	B	Pump at rest	Test magnetic bearing controller. PFEIFFER Service
E079	Radial bearing amplifier X defective	В	Pump at rest	Test magnetic bearing controller, PFEIFFER Service
E080	Radial bearing amplifier Y defective	В	Pump at rest	Test magnetic bearing controller, PFEIFFER Service
E082	Pump cable disconnected	В	Pump at rest	Test cable connection, change the cable, if necess.
E086	Sensor voltage X malfunctioning	В	Pump at rest	Test the pump and TCM or call PFEIFFER Service
E087	Sensor voltage Y malfunctioning	В	Pump at rest	Test the pump and TCM or call PFEIFFER Service
E088	Sensor voltage, axial bearing, malfunctioning	В	Pump at rest	Test the pump and TCM or call PFEIFFER Service
E089	Rotor vibrations	B	any time	Reduce vibrations or call PFEIFFER Service
E100	Pressure gauge defective	B/S	Pump at rest	Test the gauge, the cable and the TCM
E101	High vacuum valve bridges not connected	B/S	any time	Put on the bridge plug, test the TCS
E102	High vacuum valve in undefined position	В	any time	Test the end switch, test the TCS
E103	High vacuum valve does not close	B	any time	Test the backing pump test the TCS
E104	TCS disconnected	B/S B	any time	Put on the plug, test the TCS
E 105			any une	Fut on the plug, test the 105
	«Warning Fxxx»			
F001	TMS warm-up time elapsed	В	any time	Test heating cartridges, test the TMS system, PFEIFFER Service
F002	TMS limit temperature attained	В	any time	Test the cooling, test the ambient temperature, PFEIFFER Service
F005	The battery test fuse is defective	B/S	any time	Insert a new fuse in the TBB 001.
F006	Batterie capacity too low	В	any time	Check battery, load battery, PFEIFFER Service
F007	Emergency power operation	В		See sect6.17. "Emergency Power Operations"
F008	TBB 001 defective	B/S	any time	PFEIFFER Service
F010	Non conformity setting switch output 3 [P:018]	B/S	anytimo	Check settings [P:018]. Check electrical connections to

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# 8. What To Do In Case Of Breakdowns?

#### **Check The Fuses**

In case of defects:

Remove F1 and F2 using a screwdriver and check fuses. Replace if defective. The fuse values are printed on the reverse side of the fuse.

#### **Identifying Error Messages**

Error messages on the LC display can be identified with the help of the error table (Section 7) and in some cases eliminated.

# 9. Maintenance, Service

The unit requires no maintenance. A damp cloth can be used to wipe away any dirt which has collected on the front panel. Ensure that the unit is first disconnected from the mains power supply.

#### **Do Make Use Of Our Service Facilities**

In the event that repairs are necessary a number of options are available to you to ensure any system down time is kept to a minimum:

- Have the unit repaired on the spot by PFEIFFER Service Engineers;
- Return the unit to the manufacturer for repairs;
- Replace with a new value unit.

Local PFEIFFER representatives can provide full details.

During operations, the last ten errors and warnings are saved in parameter [P:303] **«Error Code»**.

If an error cannot be remedied:

- ➡ Inform PFEIFFER-Service.
- ➡ Describe the error and mention respective error message.

When carrying out their own repairs customers must bear in mind that dangerous voltage levels are present. When carrying out own repairs or maintenance work on the units which are in contact with hazardous substances it is important to comply with all relevant safety regulations.

#### Please note:

Units returned to us for repair or maintenance are covered by our general conditions of sale and supply.

#### **Contact addresses and telephone hotline:**

Please refer to the back cover of this manual for contact addresses and telephone hotline numbers.

# 10. Technical Data 📟

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# 10.1. Data List, Magnetic Bearing Controller TCM 1601

AC 90 - 132 190 - 265 8 800 50 50
190 - 265 8 800
N 800
N 800
50 60
00-00
DC 70
DC 7,9
DC 4,3
att 180
5 - 40
5-85
a 86-106
IP 20
1
DC SELV <sup>1)</sup>
0,5
10
n 8-120
50-90
50
60-90
RS 485
20-100
8

# 10.2. Dimensions





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11. Connections Diagram

# 12. Accessories ....

Description	Size	Number	Operating Instructions	Order Quantity/ Comments
Pumping Station Control Unit TCS 180	100 - 240 V; 50/60 Hz	PM C01 655	PM 800 384 BN	
Mains cable				
- Schuko		P4564 309 ZA		
- US-version	115 V	P4564 309 ZE		
- US-version	208 V	P4564 309 ZF		
Pump cable	3 m	PM 051 003 -T		
Level converter RS 485/RS 232		PM 051 054 -X	PM 800 549 BN	
Battery box TBB 001		PM K 01 712	PM 800 517 BN	
PWM box		PM 051 028 -U		

# 13. Supplementary Informations

The operating of PFEIFFER magnetic bearing turbomolecular pumps is described in these operating instructions. These operating instructions are an integral part of the complete operating instruction manual for your modular turbopump system. The delivery consignment contains further operating manuals according to the configuration of your components (please see the table). We make every effort to ensure that you have all the information on our products which is necessary but if you feel you need any further advice, please get in touch with your local Pfeiffer representatives or call us on the hotline shown on the back cover of this manual.

The respective documents are also available in PDF format.

The following operating manuals are available for the pump program:

Product	Definition	Operating Manual Number
Magnetic bearing Turbomolecular Pump	Definition of the turbopump	dependent on the type of pump*
Casing heating, turbopump	Description of the casing heating	PM 800 542 BE
Water cooling, turbopump	Description of the water cooling recycling unit	PM 800 369 BE
Temperature Management System TMS	Description of the TMS installation	PM 800 570 BE
Pfeiffer protocol RS 232/RS 485	Description of the serial interface protocol	PM 800 488 BE
Level Converter RS 232/RS 485	Description of the pumping control via the RS 232	PM 800 549 BE
Venting valve TVF 005	Description of the venting valve	PM 800 507 BE
Pumping station control unit TCS 180	Description of the pumping station control unit	PM 800 384 BE
* The number is available from PFEIFFER Service.		



# CE

# Konformitätserklärung Declaration of Conformity

im Sinne folgender EU-Richtlinien: pursuant to the following EU directives:

- Elektromagnetische Verträglichkeit/Electromagnetic Compatibility 89/336/EWG
- Niederspannung/Low Voltage 73/23/EWG

Hiermit erklären wir, daß das unten aufgeführte Produkt den Bestimmungen der EU-Richtlinie über elektromagnetische Verträglichkeit 89/336/EWG und der EU-Niederspannungsrichtlinie 73/23/EWG entspricht.

We hereby certify that the product specified below is in accordance with the provision of EU Electromagentic Compatibility Directive 89/336/EEC and EU Low Voltage Directive 73/23/EEC.

Produkt/Product:

Magnetlagerelektronik TCM 1601 Magnetic Bearing Controller TCM 1601

Angewendete Richtlinien, harmonisierte Normen und angewendete, nationale Normen:

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

EN 61010, EN 55011, EN 50081-1, EN 50082-2, IEC 801 1-4, VDE 0843-6

Unterschrift/Signature:

(W. Dondorf) Geschäftsführer Managing Director

Pfeiffer-Vacuum GmbH Emmeliusstrasse 33 35614 Asslar Germany

(Konf.II/2000

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