GA05142_0902

TURBOVAC
TW 300
TW 300 H

Wide-Range Turbomolecular Pump with Integrated or External Frequency Converter

Operating Instructions

Contents

Figures

The references to the diagrams, e.g. (2/10), consist of the figure number and the item number, in that order.

Warning

Identifies working and operating procedures which must be strictly observed to prevent hazards to persons.

Caution

Indicates working and operating procedures which must be strictly observed to prevent damage to or destruction of the appliance.

We reserve the right to alter the design or any data given in these operating instructions.
The illustrations are approximations.

Safety information

Failure to observe the following precautions could result in serious personal injury:

Warning

The turbomolecular pump must only be operated in the proper condition and under the conditions described in the Operating Instructions.

Mechanical hazards

Warning

Never expose any parts of the body to the vacuum.

The high-vacuum flange must be solidly mounted to the vacuum chamber. If the mounting is not sturdy enough, pump blockage could cause the pump to break loose; internal pump components could be thrown in all directions. Never operate the pump (in bench testing, for example) without proper flanging to the vacuum chamber.

Under vacuum conditions the pump may take up to one hour to run down, when venting to atmospheric pressure it may take up to one minute. During the time the pump is running down, the green LED at the frequency converter will flash, indicating that the rotor has not yet arrived at standstill.

When shutting down by **switching off the power supply voltage**, there will be only enough power for the LEDs down to a speed of the pump of approximately 200 Hz. Thus the pump may still turn without a LED being on. For this reason, when switching off without venting, wait for approximately 15 minutes after the LEDs have turned off until the pump has arrived at standstill.

After a mains power failure the pump can run up automatically once more.

Electrical hazards

Warning

Mains voltage may be present at the power failure airing valve, the purge gas valve or the venting valve.

The pump may be operated only with a suitable frequency converter and suitable connector cables.
Route all cables so as to protect them from damage.
Do not expose the pump, the frequency converter or the connections to water.

The frequency converter must only be connected to power supplies which meet the requirements for functional extra low voltage with positive isolation in accordance with IEC 364 (VDE 0100, Part 410, or local regulations) (SELV).

When the connector cable is attached, the outputs at the frequency converter are not free of voltage.

Thermal hazards

Warning

During operation the pump can become so hot that there is a danger of burns (up to approx. 80 °C, 176 °F).
Provide protection against contact with the hot components.

Hazards caused by materials and substances

Warning

The forevacuum line must be tight. Hazardous gases can escape at leaks or the gases being pumped can react with air or humidity.

If the pump has previously handled hazardous gases, implement the proper precautionary measures before opening the intake or exhaust connection.

If necessary, use gloves, a respirator and/or protective clothing and work under an exhaust hood.

Failure to observe the following precautions could result in damage to the pump:

Caution

The pumps are **not suitable** for pumping aggressive or corrosive media or those which contain dust.

Install a micropore filter when pumping media which contains dust.

Observe the information on media compatibility at the beginning of these operating instructions.

Caution

Never touch the rotor. Touching the rotor may cause injury and damage the rotor bearing.

Caution

If foreign objects could pass from the vacuum chamber into the pump, install a wire mesh splinter guard. Foreign objects which enter the pump through the intake would cause serious damage to the rotor. Damage resulting from foreign objects in the rotor section are excluded from guarantee coverage.

Caution

Ensure that the pump is sufficiently isolated against resonances (vibrations) generated by the forevacuum pump.

Caution

Unplug any connectors only when the mains voltage is switched off and the pump does no longer turn (the green LED is off). Separating the connections while the mains power is still applied or while the pump is still turning may destroy the TURBO.DRIVE 300.

Caution

Ensure correct polarity when connecting the frequency converter.

Caution

Exposure of the pump to accelerating forces must be avoided or reduced to such an extent that the rotor unit will not be excited by vibrations. In the case of critical applications you must consult our Applications Dept. first.

Caution

Avoid the influences of shock and vibration when the pump is running.

Caution

The rotor bearings must be changed after 1,500 starts or 10,000 operating hours.

Caution

Pumps with integrated frequency converter need to be shipped to the Leybold Service with the frequency converter.

Caution

The pump must only be opened by such persons who have been authorised by Leybold to do so.

1 Description

Use and media compatibility

The TURBOVAC TW 300 and TW 300 H are turbomolecular pumps with integrated or external frequency converter. They are designed to evacuate vacuum chambers down to pressure levels in the high vacuum range.

They are suitable for pumping air and clean gases. A forevacuum pump is required for their operation.

The pumps have been manufactured according to the state-of-the-art and approved safety regulations. Even so in the case of improper installation or when improperly used there can be risks or damage may be caused.

The TW 300 has been designed for high gas throughputs, the TW 300 H for high gas compression in the case of lighter gases.

These pumps are **not** suitable for

- pumping liquids or gases containing dust or particulates
- pumping corrosive, explosive or reactive gasses
- operation without a forevacuum pump.

If reactive gases in low concentrations must be pumped please consult with Leybold.

During operation the pressure inside the pump is so low that there is no danger of ignition (at pressures below about 100 mbar). A hazardous condition will be created if flammable mixtures enter the hot pump at pressures above 100 mbar. During operation the pump can reach temperatures as high as 110°C (230 °F). Ignition sparks could occur in case of damage to the pump and these could ignite explosive mixtures.

All seals are prone to leaks. In case a seal fails, there is the risk that hazardous gases may escape. Introduce the appropriate safety measures depending on the media being pumped in each case.

We would be glad to consult with you as regards the media which can safely be handled with this unit.

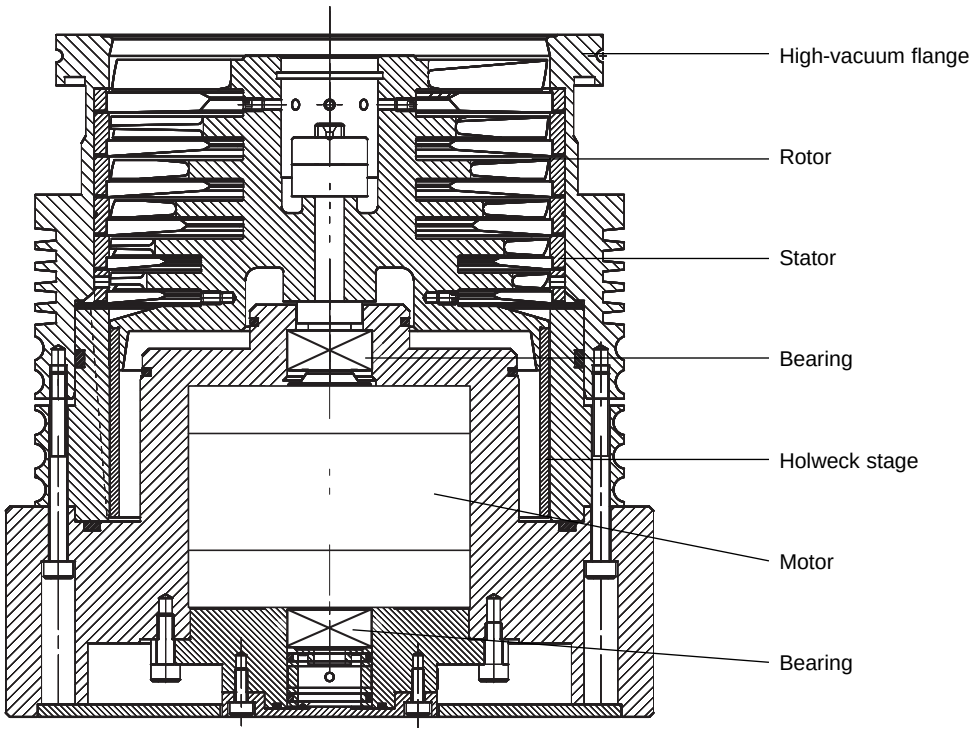


Fig. 1 Section through a TURBOVAC TW 300

1.1 Design

The pumps comprise essentially the pump housing, a multi-stage rotor with the stator group, and the drive. The design of a TURBOVAC TW 300 is depicted in Fig. 1.

The rotor consists of a turbomolecular pump stage and a Holweck stage. The Holweck pumping stage increases the permissible forevacuum pressure level markedly when compared with the classical turbomolecular pump.

The rotor shaft runs in two ceramic ball bearings, lubricated with grease.

The pump is driven by a split-cage DC motor. In this motor the rotor and stator windings are separated by a vacuum-tight can. Consequently the rotor runs inside the vacuum while the stator is outside the vacuum. This eliminates any need of vacuum feedthroughs.

Standard pumps rely on convection cooling, but require depending on the load, like increased gas throughput, high ambient temperatures, additional air or water cooling.

The pump has DN 16 KF connectors for forevacuum, and venting/purge gas.

The pump is driven by an electronic frequency converter TURBO.DRIVE 300. All functions like, for example, speed control, pump sensing or temperature monitoring are monitored by the TURBO.DRIVE 300. This unit is powered by an external power supply.

1.2 Standard equipment

The pumps are shipped sealed in a PE bag with a desiccant to absorb moisture.The maximum useful life of the desiccant is one year.

The flanges for forevacuum, venting, and purge gas are blank-flanged with centering ring with FPM sealing ring and a clamping yoke.

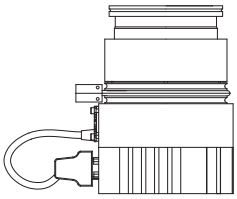
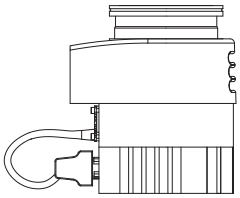
The high-vacuum connection elements are not part of the standard equipment.

A suitable DC coupling for the power supply is included: In the case of pumps with integrated frequency converter it is supplied with the pump; in the case of pumps with a separate frequency converter it is supplied with the frequency converter.

PE = Polyethylene
FPM = Fluororubber, resistant to temperatures up to 150°C (302 °F)

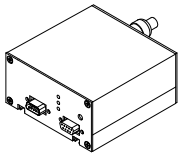
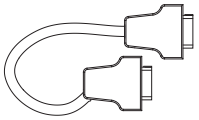
1.3 Ordering data

1.3.1 Pumps

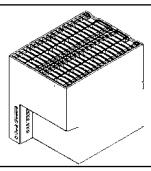
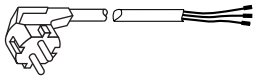
TURBOVAC TW 300		
DN 100 ISO-K, no forced cooling, without frequency converter, without splinter guard	800170V2101	
DN 100 ISO-K, air cooling, without frequency converter, without splinter guard	800011V0003	
DN 100 ISO-K, air cooling, with TURBO.DRIVE 300 with RS 485, without splinter guard	800170V2105	
DN 100 ISO-K, water cooling, with TURBO.DRIVE 300 with RS 232/422, with splinter guard	800170V2106	
DN 100 CF, water cooling, with TURBO.DRIVE 300 with RS 232/422, without splinter guard	800170V2103	
DN 160 ISO-K, water cooling, with TURBO.DRIVE 300 with RS 485, without splinter guard	800170V2108	
TURBOVAC TW 300 H		
DN 100 ISO-K, air cooling, with TURBO.DRIVE 300 with RS 485, without splinter guard	800170V2107	
DN 100 CF, air cooling, with TURBO.DRIVE 300 with RS 485, without splinter guard	800170V2102	
DN 100 CF, air cooling, with TURBO.DRIVE 300 with RS 232/422, without splinter guard	800170V2104	

1.3.2 Frequency converter and accessories for the frequency converter

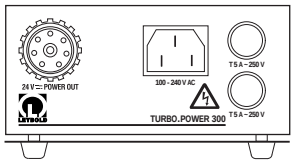
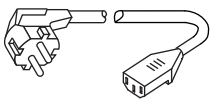
Frequency converter

Frequency converter Basic unit with RS 232/422 interface with RS 485 interface	 800072V0001 800072V0003	
Connecting cable pump - frequency converter 1.0 m long 2.5 m long 3.0 m long 5.0 m long	 152 47 864 49 864 40 864 50	

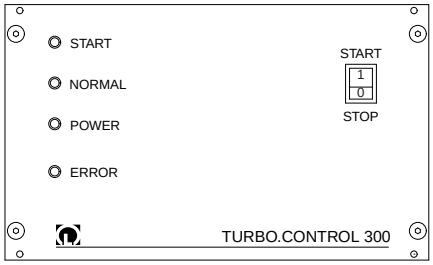
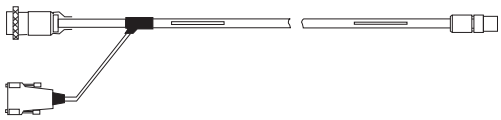
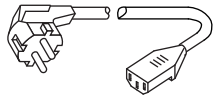
OEM power supply (with screw terminals)

SITOP 24 V / 10 A • supplies the TURBO.DRIVE 300 with 24 V DC	152 50	
24 V DC cable **(TURBO.DRIVE 300 – OEM power supply)** 3 m 5 m 10 m 20 m	 200 12 732 200 12 733 200 12 734 200 12 735	
Mains cable for power supply, 2 m long with EURO plug / conductor ferrules with US plug 5-15P / conductor ferrules	 800102V0001 800102V1001	

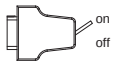
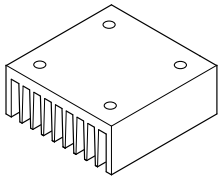
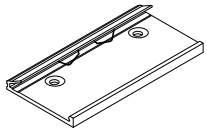
Power supply unit - plug and play

TURBO.POWER 300 • supplies the TURBO.DRIVE 300 with 24 V DC • plug & play cables • desktop unit or rack mountable	800100V0002	
24V DC Power cable **(TURBO.DRIVE 300 – TURBO.POWER 300)** 1 m 3 m 5 m 10 m 20 m	 800094V0100 800094V0300 800094V0500 800094V1000 800094V2000	
Mains cable for TURBO.POWER 300, 3 m long with EURO plug / IEC mains plug with US plug 6-15P / IEC mains plug	 800102V0002 800102V1002	

Power supply and control unit

TURBO.CONTROL 300 • supplies the TURBO.DRIVE 300 with 24 V DC • plug & play cables • desktop unit or rack mountable • with power switch • with start/stop switch for the turbomolecular pump • remote control • status LEDs and status relays	800100V0001	
24V DC Control cable **(TURBO.DRIVE 300 – TURBO.CONTROL 300)** 1 m 3 m 5 m 10 m 20 m	 800091V0100 800091V0300 800091V0500 800091V1000 800091V2000	
Mains cable for TURBO.CONTROL 300, 3 m long with EURO plug / IEC mains plug with US plug 6-15P / IEC mains plug	 800102V0002 800102V1002	

Mechanical accessories

Plug for connector REMOTE with integrated **ON/OFF switch** for the pump (Sub-D plug, 9 way)	152 48	
Heat sink for frequency converter	800110V0001	
Top hat rail adaptor (mounting aid for TURBO.DRIVE 300 and TURBO.POWER 300)	800110V0003	

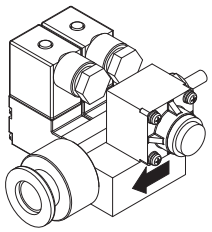
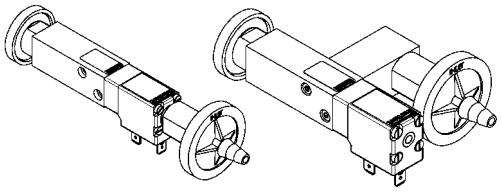
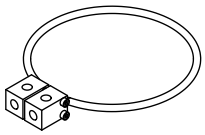
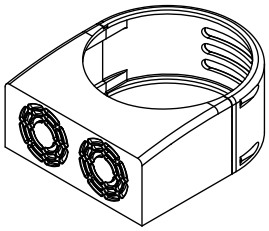
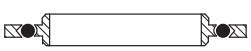
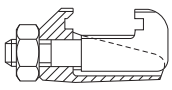
Mounting the frequency converter to the pump

Heat sink	200 11 628
Adaptor cable	200 12 703
4 screws M4x12	201 03 204
2 screws M4x25	201 03 209
(see Section 2.6)	

Accessories for serial interfaces

Display PDA* (display unit for parameters, requires the software "Turbo.Drive Panel") data cable and adaptor	upon request	
Required "**Turbo.Drive Panel**" software for the display PDA with operating system OS 4.0 to 4.x, 3.5" floppy	800110V0104	
PC software "**Turbo.Drive Server**" for Windows 95 and higher, CD-ROM* • Soft panel • Display, change, save and compare parameter lists • Integration of customer's software • Record parameter data	800110V0102	
Adaptor RS232/RS485 for 220 V/Euro plug	800110V0101	
GSD file for Profibus DP	upon request	
***** Can be used in connection with the following interfaces: - For frequency converters with RS232 interface. - For frequency converters with RS485 interface, a RS232/RS485 adaptor is required.		

1.3.3 Accessories for the pump

Splinter guard coarse, DN 100 ISO-K Splinter guard fine, DN 100 ISO-K	800132V0101 800132V0102	
Purge gas and venting valve 24 V DC	800120V0001	
Venting valve 24 V DC Power failure airing valve 24 V DC	800120V0011 800120V0021	
Water cooling unit with G 1/8" connection incl. 2 hose nipples G 1/8" outer Ø 10 mm for water hose, 4 sealing rings, 2 blind plugs (see Section 2.4)	800135V0002	
Air cooling (for fitting to pumps without forced cooling) (see Section 2.4)	800000249	
Flange heater DN 100 CF (only for pumps with CF flange) 230 V 110 V	 854 27 854 28	
Centering ring (Al) with O-ring (FPM) DN 100 ISO-K DN 160 ISO-K	 268 42 268 43	
Clamps (Set of 4 pieces) Galvanized steel, clamping range 19 to 27 mm Galvanized steel clamping range 25 to 35 mm Stainless steel, clamping range 19 to 27 mm	 267 01 267 02 887 99	
Copper gasket rings for CF flange (Set of 10 pieces)	839 45	
Set of hex. screws with nuts, screws and washers for CF flange	839 04	

1.4 Technical data

1.4.1 TURBOVAC

	TW 300	TW 300	TW 300 H	TW 300 H
High-vacuum connection	DN 100 ISO-K DN 160 ISO-K	DN 100 CF	DN 100 ISO-K	DN 100 CF
Pumping speed at 10^{-5}/10^{-3} mbar				
N_2	240/240 l·s^{-1}	240/240 l·s^{-1}	240/240 l·s^{-1}	240/240 l·s^{-1}
Ar	230/230 l·s^{-1}	230/230 l·s^{-1}	240/240 l·s^{-1}	240/240 l·s^{-1}
H_2	140/125 l·s^{-1}	140/125 l·s^{-1}	160/140 l·s^{-1}	160/140 l·s^{-1}
He	230/220 l·s^{-1}	230/220 l·s^{-1}	240/230 l·s^{-1}	240/230 l·s^{-1}
Ultimate pressure				
with two-stage, oil-sealed rotary vane pump	< 2·10^{-8} mbar	< 2·10^{-10} mbar	< 1·10^{-8} mbar	< 1·10^{-10} mbar
with ECODRY M 15	–	< 8·10^{-10} mbar	–	< 2·10^{-10} mbar
with diaphragm pump	–	< 4·10^{-9} mbar	–	< 1·10^{-9} mbar
Max. permissible forevacuum pressure N_2				
water-cooled		< 5 mbar		
air-cooled		<1 mbar		
(Measurements in progress for releasing higher pressures)				
Weight (with/without frequency converter), approx.		6.8 / 6.0 kg		
Recommended forevacuum pumps				
• TRIVAC		D 2.5 E		
• ECODRY		M 15		
• Diaphragm pump DIVAC		2.5 VT		
• (at purge gas operation) TRIVAC		D 8 B		
Operating speed		60 000 rpm		
Run-up time		ca. 4 min		
Forevacuum connection		DN 16 KF		
Venting connection		DN 16 KF		
Type of protection		IP 20		
Noise level		< 49 dB(A)		
Ambient temperature				
during operation, water-cooled pump		+ 15 - + 35 °C		
during operation, air-cooled pump		+ 15 - + 30 °C		
storage		– 15 - + 70°C		
Max. rel. air humidity		95% (non-condensing)		
Purge gas flow		12 sccm / 0.2 mbar·l·s^{-1}		
Purge gas		Nitrogen, Argon or similar		
Option pump with water cooling				
Cooling water connections (Adapter on request)		G 1/8“		
Cooling water data		see Section 2.4		

TW 300	a_1	a_2	h	h_1
DN 100 ISO-K	130	171	217	243
DN 160 ISO-K	180	202	221	247,5
DN 100 CF	151,5	–	219,4	–

TW 300 H	a_1	a_2	h	h_1
DN 100 ISO-K	130	171	225	251
DN 100 CF	151,5	–	227,4	–

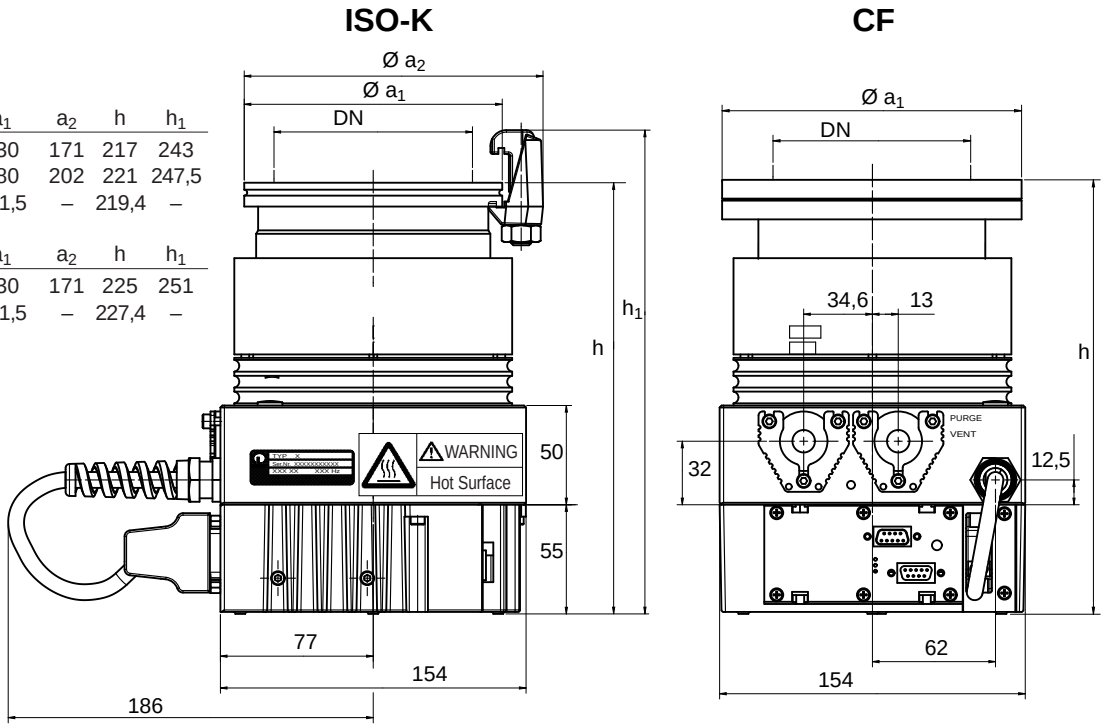


Fig. 2 Dimensional drawing for the TW 300 / TW 300 H with mounted frequency converter; dimensions in mm

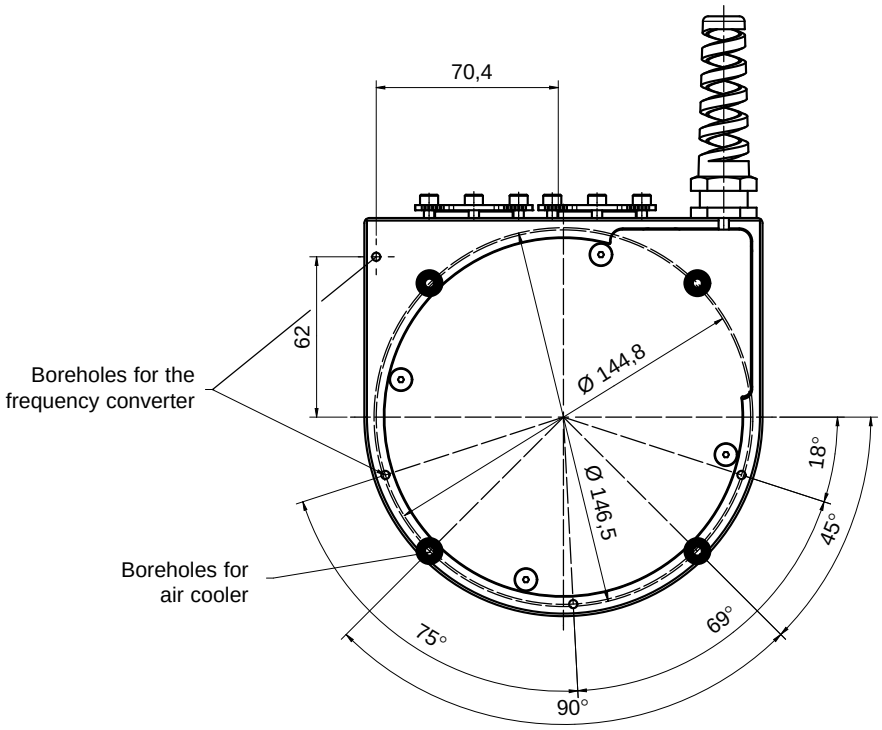


Fig. 3 Bottom side of the TW 300 / TW 300 H; dimensions in mm

1.4.2 TURBO.DRIVE 300

Supply voltage	24 V ⎓ (21 ... 29 V)
Residual ripple	< 3 %
Output	
Voltage	0 - 24 V 3~
Power	160 W
Frequency	0 - 1500 Hz
Nominal voltage	24 V⎓
Max. power consumption	190 W
Max. peak current, input side	8 A DC
Required power output from the power supply	≥ 200 W
Max. length of the DC cable (shielded)	
at 3 x 1.5 mm^2	5 m
at 3 x 2.5 mm^2	20 m
Relay output rating	42 V, 0.5 A
Ambient temperature	
during operation	5 - 45 °C
storage	- 15 - + 70 °C
Relative air humidity	5 to 85 % non condensing
Overvoltage category	II
Contamination grade	2
Temp. of the cooling surface	5 - 55 °C
Only Part No. 800072V0004	5 - 50 °C
Power consumption	≤ 20 W
Type of protection	IP 20
Weight, approx.	0.7 kg

1.4.3 Power supply SITOP 24 V / 10 A

AC input voltage	120/230 V, 50/60 Hz
Tolerance	93 - 132 V 187 - 264 V
Recommended circuit breaker (characteristic C)	16 A
Power consumption	270 W
DC output voltage	24 V ± 1%
DC output current	0 - 10 A
Weight, approx.	1 kg
Mounting	DIN rail
Screw-type terminals	0.5 - 2.5 mm^2 22 - 12 AWG
Ambient temperature	
during operation	0 - 60 °C
storage	-25 - + 85 °C
Cooling	air convection
Type of protection	IP 20
Safety to EN60950	SELV
RI suppression to EN 55022	limit curve B
Noise immunity to EN 50082-2	incl. Table A4
UL508 FILE	E143289

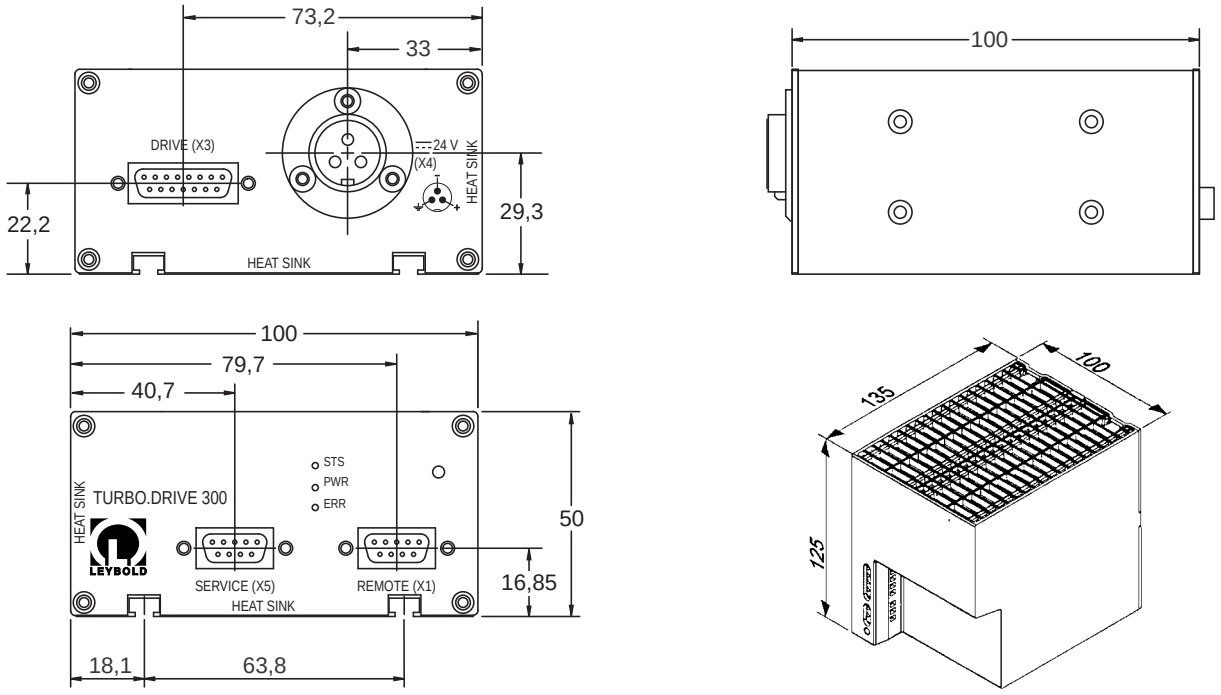


Fig. 4 Dimensional drawing for the frequency converter and the OEM power supply unit, dimensions in mm

2 Connections

Caution

The pumps are **not suitable** for pumping aggressive or corrosive media or those which contain dust.

Install a micropore filter when pumping media which contains dust.
Observe the information on media compatibility at the beginning of these operating instructions.

Do not open the packaging until immediately before installation.

Do not remove the covers and blind flanges on the pump until just before attachment to the equipment to ensure that assembly is carried out under the cleanest possible conditions.

Caution

Never touch the rotor. Touching the rotor may cause injury and damage the rotor bearing.

Warning

During operation the pump can become so hot that there is a danger of burns (up to approx. 80 °C, 176 °F).
Provide protection against contact with the hot components.

2.1 Operating environment

Do not expose the pump or the frequency converter to dripping or spraying water

The pump must not be installed within a magnetic field.

The maximum heat load from the system via the high-vacuum flange is 15 W.

Places of installation up to 1000 m above sea level (3300 ft) are possible without restrictions. At altitudes over 1000 m heat dissipation by the ambient air is impaired. Please consult us.

The frequency converter must not be operated in explosive gas atmospheres.

2.2 Attach the pump to the vacuum chamber

Warning

The high-vacuum flange must be solidly mounted to the vacuum chamber. If the mounting is not sturdy enough, pump blockage could cause the pump to break loose; internal pump components could be thrown in all directions. Never operate the pump (in bench testing, for example) without proper flanging to the vacuum chamber.

If the pump should suddenly seize, an ensuing deceleration torque of momentary up to 200 Nm will have to be absorbed by the system. To accomplish this, a minimum of 4 clamping bolts are required for securing an ISO-K type high-vacuum flange.

The clamping bolts must be torqued down to 20 Nm (15 ft-lb).

In most applications the pump is flanged to the high-vacuum flange at the apparatus. No support is required.

Attach the pump **horizontally or vertically**. Other mounting orientations are not allowed.

If several pumps are to be mounted to a system, you must consult our Applications Dept. in order to prevent that the pumps will be excited by vibrations by each other.

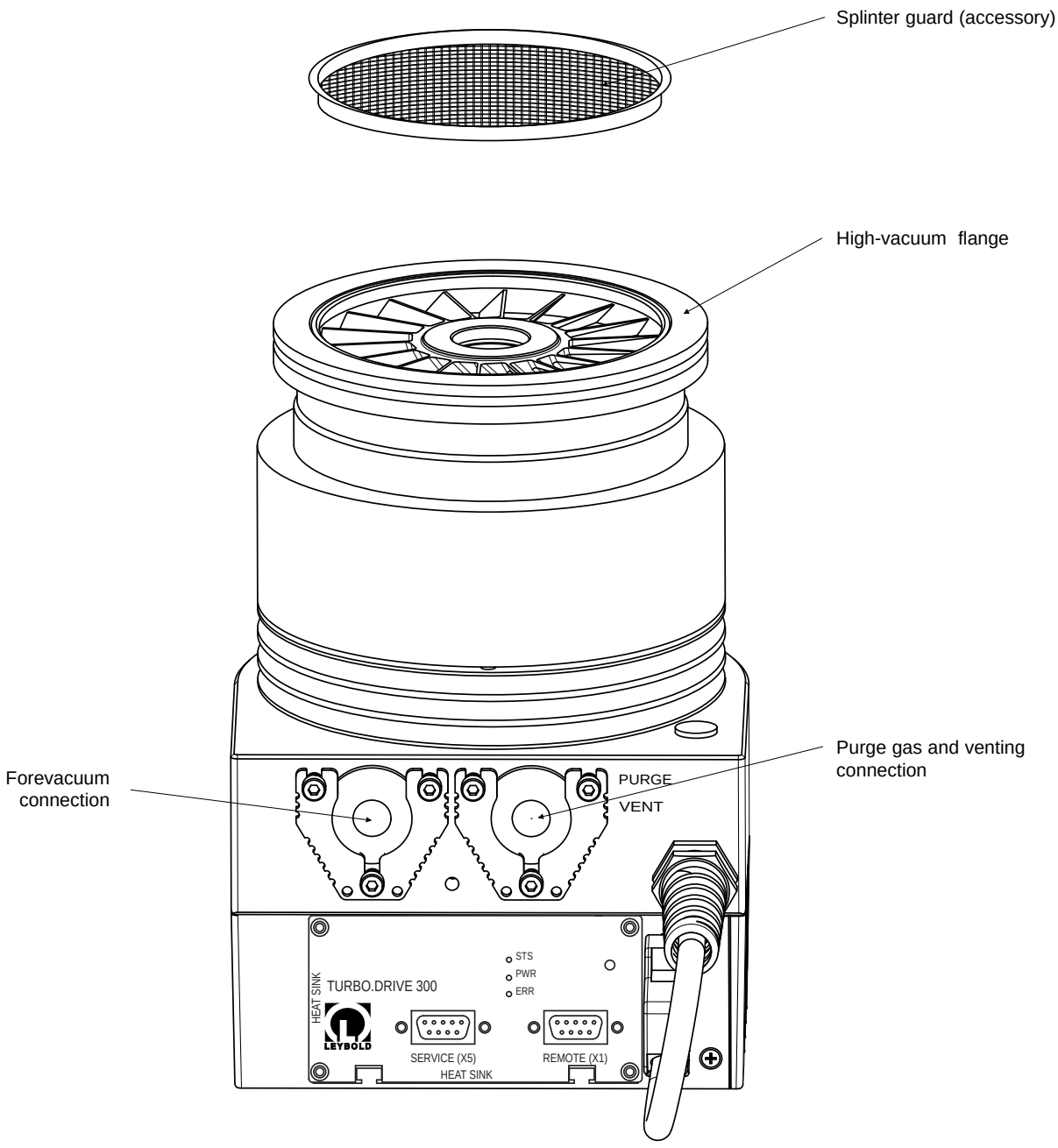


Fig. 5 Connection elements

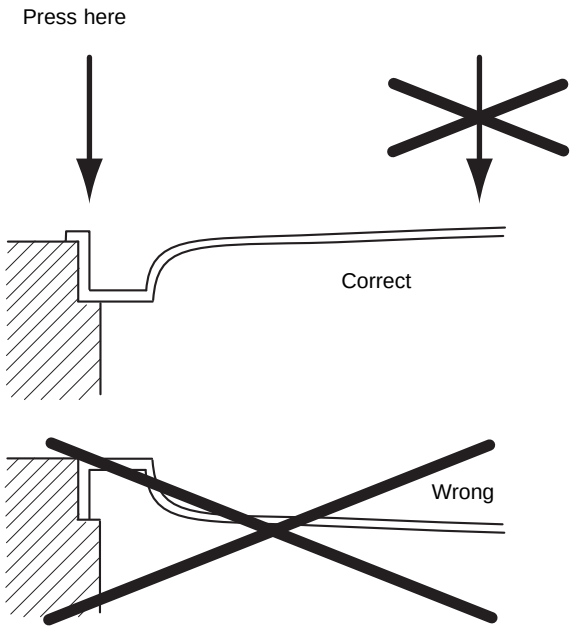


Fig. 6 Installing the splinter guard

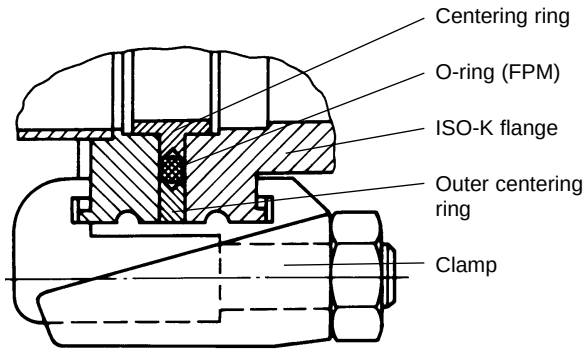


Fig. 7 Using type ISO-K flanges

Caution

If foreign objects could pass from the vacuum chamber into the pump, install a wire mesh splinter guard. Foreign objects which enter the pump through the intake would cause serious damage to the rotor. Damage resulting from foreign objects in the rotor section are excluded from guarantee coverage.

Insert the splinter guard so that the surface curvature is at the top and apply some pressure lightly at the rim so that the splinter guard engages. The splinter guard **must not touch the rotor**.

If dust could pass from the vacuum chamber into the pump, then a micropore filter must be installed between the vacuum chamber and the pump.

The pump is precision balanced and is generally operated without a resonance damper. To decouple extremely sensitive equipment and to prevent transfer of external vibrations to the pump a special resonance damper is available for mounting at the high-vacuum flange.

Detach the shipping flange from the high-vacuum flange and remove the desiccant. Pay attention to scrupulous cleanliness when making the connection.

Design with ISO-K clamp flange

Lay the O-ring on the centering ring.

The O-ring must be positioned so as to be smooth and flat; it must not be twisted. Then position the outer ring.

A collar flange with circlip and the appropriate gasket may be used to connect the pump.

A collar flange is required when using ultra-vacuum sealing gaskets.

The order numbers for the flange components are given in the Leybold Catalog.

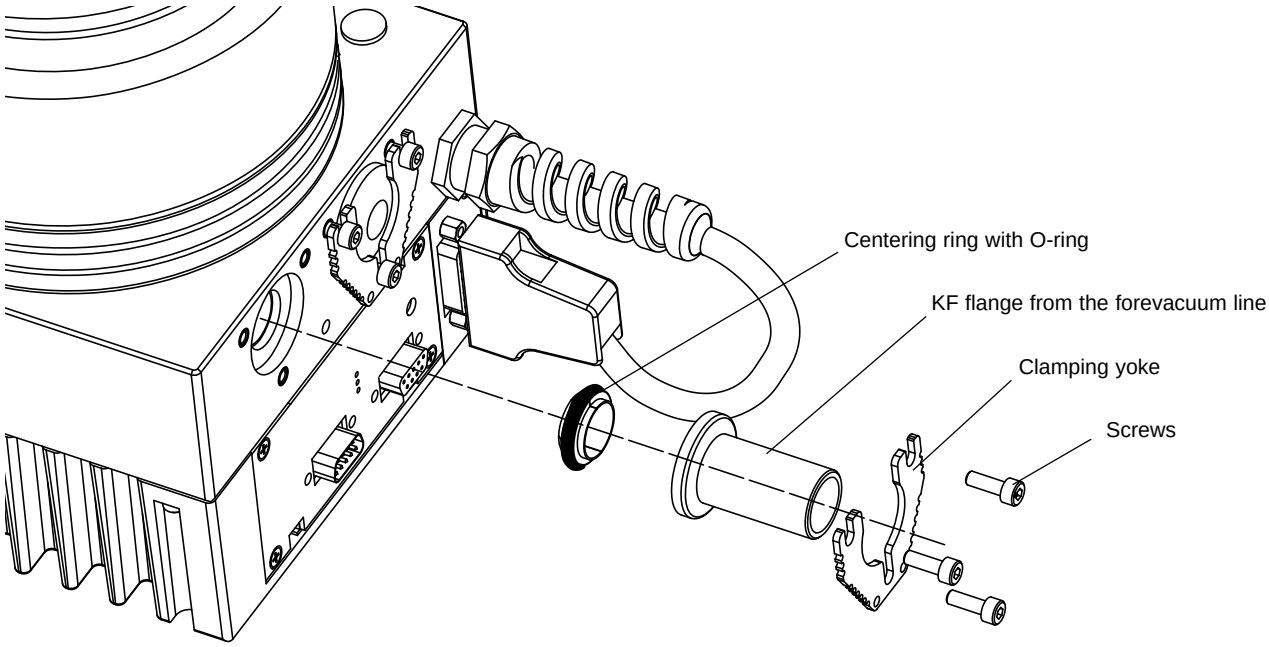


Fig. 8 Connecting the forevacuum line

2.3 Forevacuum connection

As forevacuum pump we recommend using the dry compressing ECODRY M15 piston pump, a diaphragm pump or a TRIVAC two-stage rotary vane vacuum pump.

Connect the clean forevacuum line; see Fig. 8. The connecting flanges must be clean an undamaged. The cross section of this line must be so wide that safe operation of the pump can be ensured.

Remove the three screws and the clamping yoke. Remove the shipping flange.

Slide the KF flange from the forevacuum line onto the centering ring, slide the clamping yoke over the flange, insert and tighten the three screws.

Warning

The forevacuum line must be tight. Hazardous gases can escape at leaks or the gases being pumped can react with air or humidity.

Figure 14 is a schematic diagram of a pump system incorporating a turbomolecular pump and a TRIVAC forevacuum pump with an anti-suckback valve.

A separate safety valve is provided for oil-sealed forevacuum pumps without an anti-suckback valve. The safety valve prevents oil flowing back from the forevacuum pump into the turbomolecular pump when the system is not running.

To ensure that the forevacuum space at the turbomolecular pump is kept largely free of oil vapors during operation, as well, we recommend installing an adsorption trap in the forevacuum line. An adsorption trap is not required when using a dry compressing forevacuum pump like the ECODRY, for example.

Provide a roughing line to achieve the shortest cycle times.

Caution

Ensure that the pump is sufficiently isolated against resonances (vibrations) generated by the forevacuum pump.

2.4 Connect the cooling

Cooling of the TW 300 depends on the required pumping power and the ambient temperature; see Fig. 9. When the pump is insufficiently cooled it will shut down.

High gas throughputs, cyclic operation or high ambient temperatures will necessitate air or water cooling.

Air or water cooling (Part Nos. see Section1.3.3) can be mounted to the pump.

Mounting the air cooling (optional)

Warning

Separate the unit from the mains power supply.

See Fig. 9.

Pull out the plug cautiously and pull the connector, which is fitted in or under the plug, a few centimeters out; use tweezers if required.

Caution

The pump must not be opened, no seals must be broken.

Unscrew the 4 screws and separate the air cooler.

Connect the pump connector and the air cooler connector and push them into the pump.

Mount the air cooler to the pump. Take care that the cable is in the relief of the air cooler.

Air cooling

The air cooling facility has two powerful fans capable of passing a large quantity of air past the pumps' casing, see Fig. 11. When installing air cooled pumps within a system ensure that sufficient quantities of fresh air are freely available. The air cooling facility is powered via the pump.

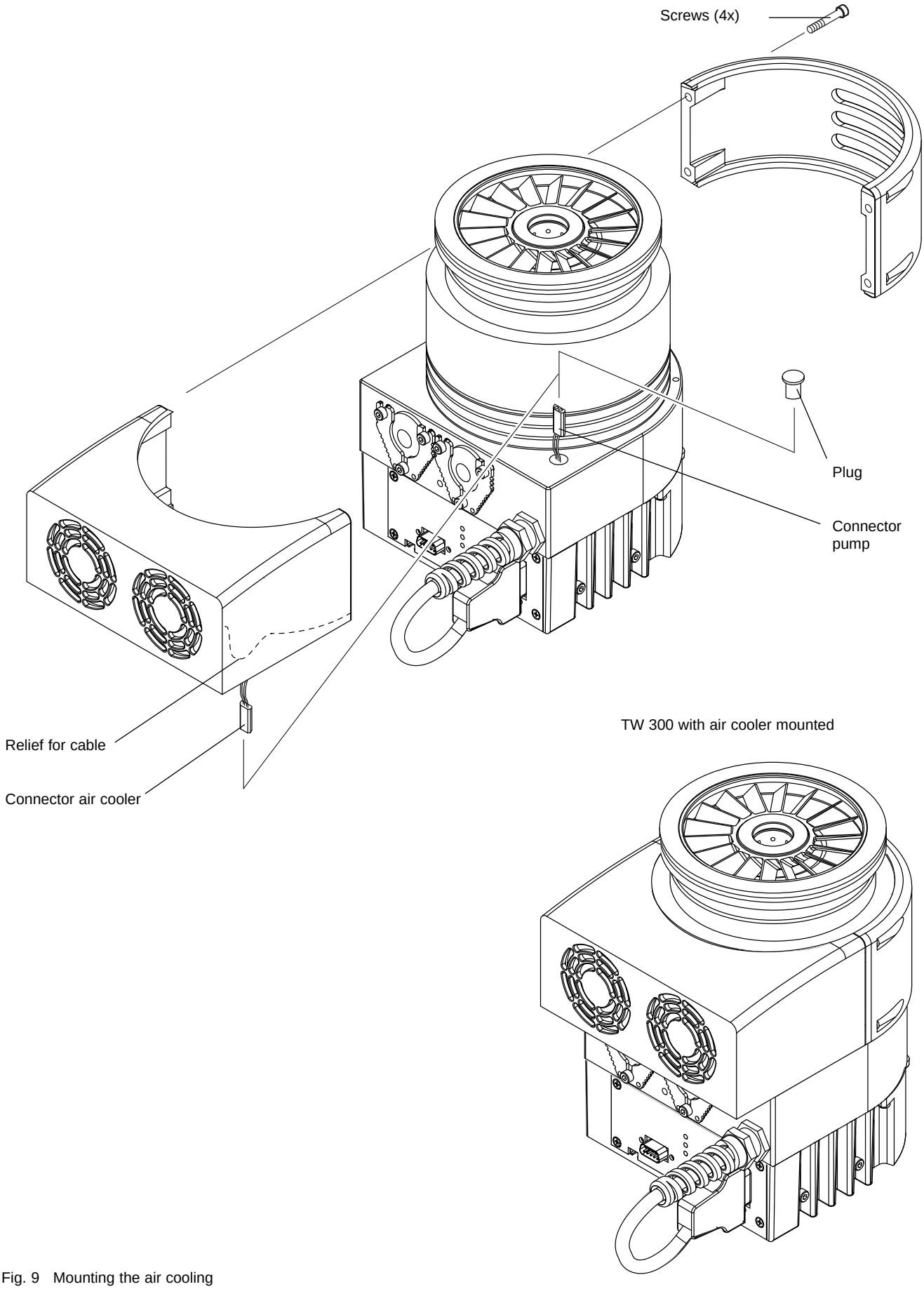


Fig. 9 Mounting the air cooling

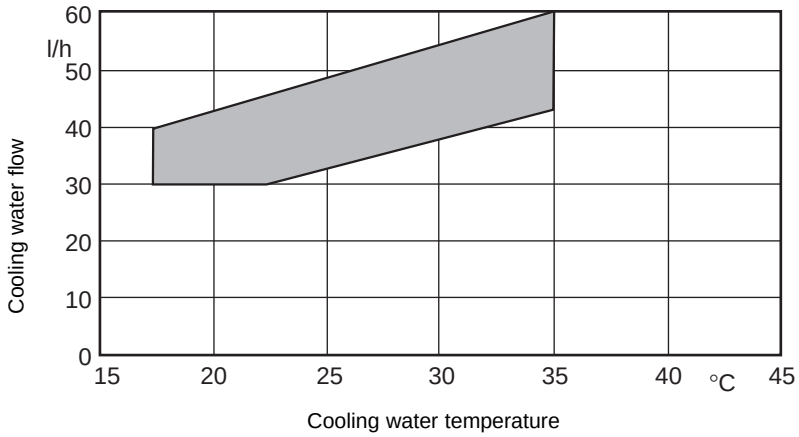


Fig. 10 Cooling water requirements

Mounting the water cooling (optional)

Unscrew 2 screws and bend the cooling coil cautiously a little bit open. Mount it to the pump and fix the 2 screws.

Cooling water specifications

Feed temperature	20 - 35 °C
Feed pressure	3 to 7 bar absolute
Cooling water requirement	See Fig. 10
Appearance	colourless, clear, free of oils and greases
Sediments	< 250 mg/l
Particle size	< 150 µm
pH value	7 to 8.5
Overall hardness (total alkaline earths)	max. 20 ° German hardness scale (= 3.57 mmol/l)

Further information on request.

Connecting the cooling water

Screw on the cooling water lines.

The cooling water may be connected radially or axially to the connecting piece of the cooling coil; see Fig. 12. Blank off the unused G 1/8” threads using the screw-in stoppers and gaskets supplied.

Adjust the cooling water temperature so that the formation of condensate is avoided.

When switching the cooling water supply on and off by means of an electrically actuated valve, connect the valve so that it will be switched on and off together with the pump.

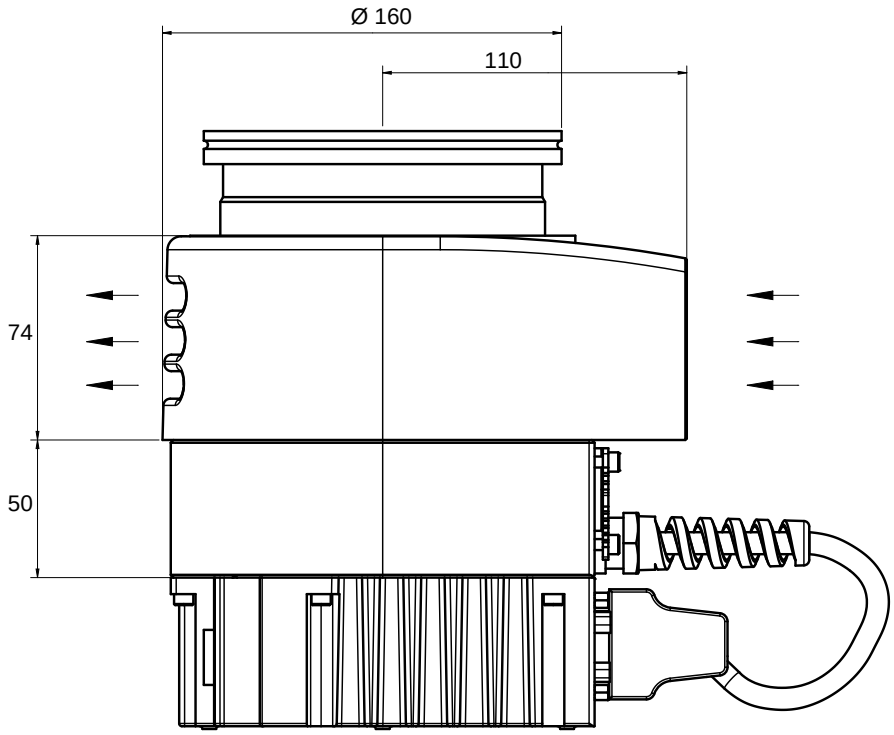
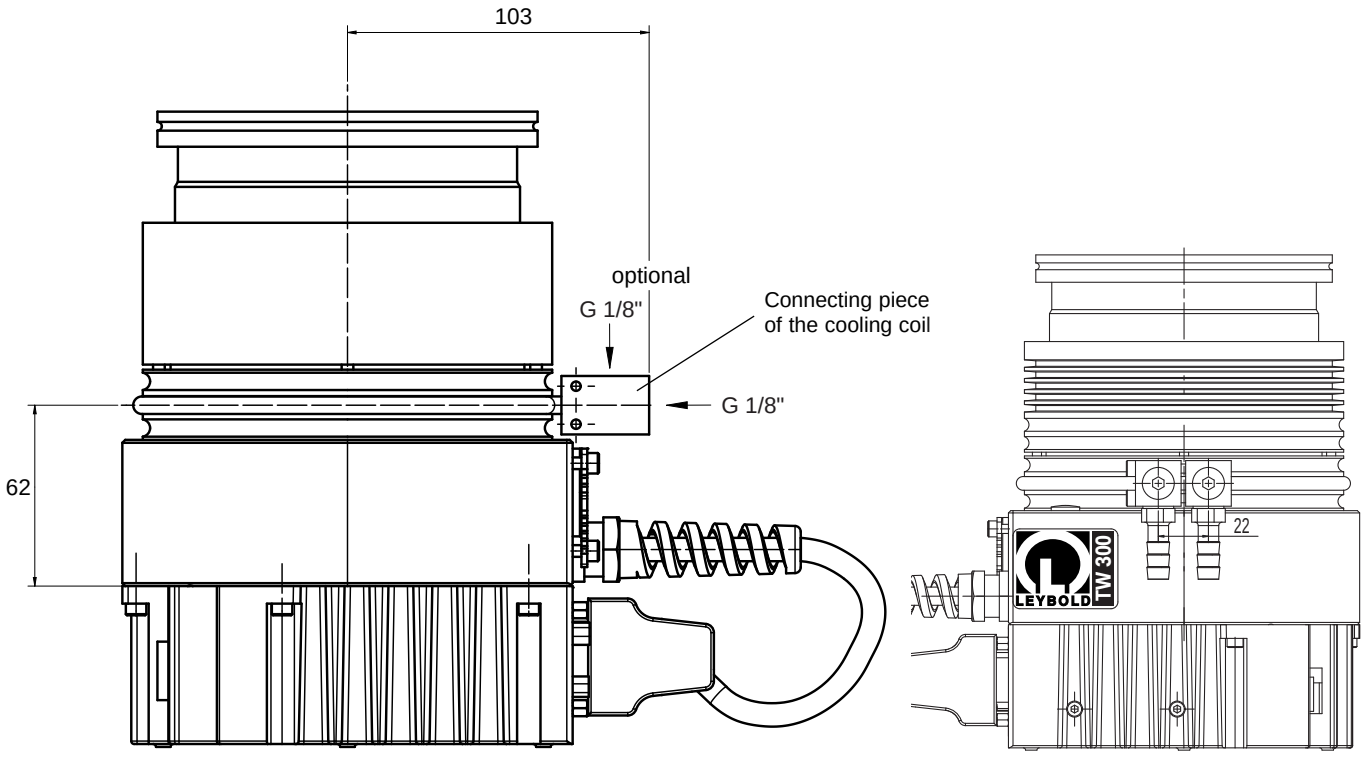


Fig. 11 Optional air cooling



Part No. 800170V2106
with hose nipples Ø 10 mm

Fig. 12 Optional water cooling

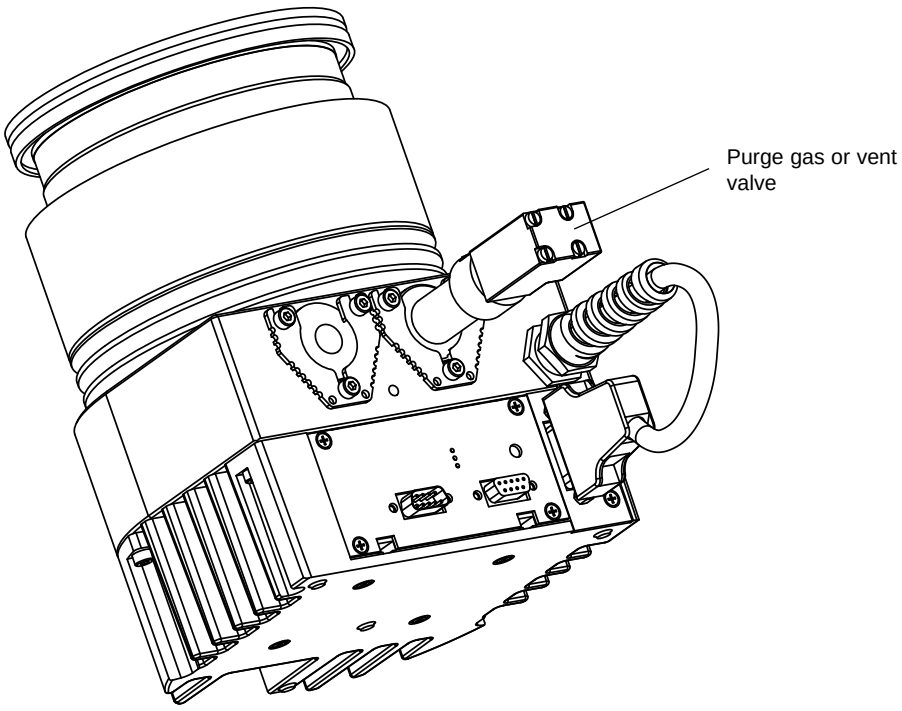


Fig. 13 Purge gas or vent valve flanged to a TURBOVAC TW 300

2.5 Connect the purge gas and venting valve

The pumps have a DN 16 KF flange as venting port.

A power failure airing valve or a purge gas and venting valve can be connected to this flange.

Warning

Mains voltage may be present at the power failure airing valve, the purge gas valve or the venting valve.

The power failure airing valve or venting valve vents the pump and the forevacuum line when the pump is switched off and thus keeps oil vapor from diffusing back from the forevacuum line.

A choke nozzle in the vent port ensures that the pump is not vented too fast.

When pumping **abrasive** media, connect a purge gas and venting valve, so as to protect the bearings against light contamination.

Please contact Leybold for assistance in making the decision as to which media can be pumped with or without purge gas.

In processes which require purge gas the pump will have to be vented, when it is switched off, through the purge gas valve.

Suited are all gases,

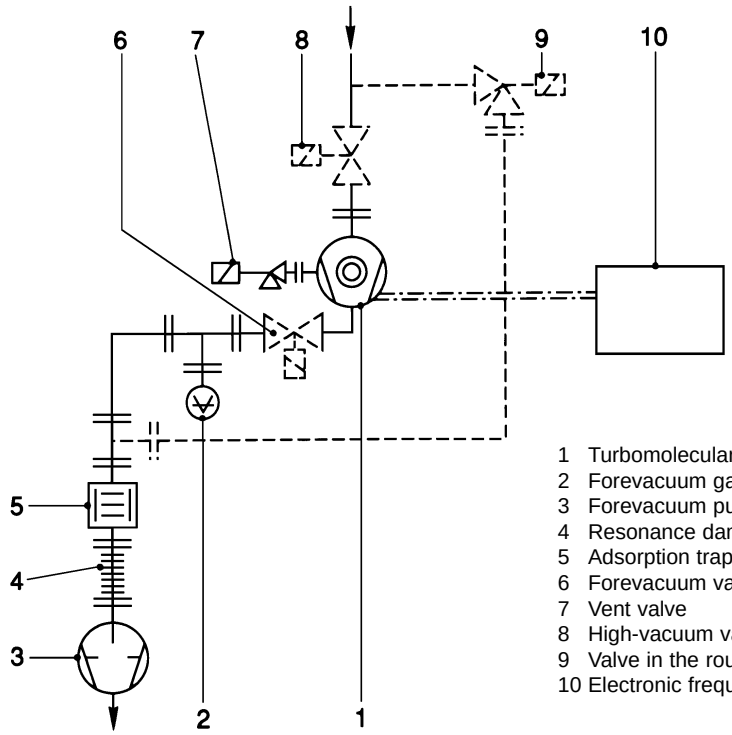
- which will not cause corrosion or pitting in aluminium and steel and
- which in connection with process deposits in the pump will not cause corrosion or sticking.

For venting and as the purge gas we recommend inert gases like nitrogen or argon. The temperature of these gases should be between 5 °C and 80 °C , max. relative humidity should not exceed 10 ppm.

In individual cases and after consultation also dry, filtered, oil-free air or filtered ambient air may be used (filter mesh < 1µm).

Change the filters after some time, at least annually.

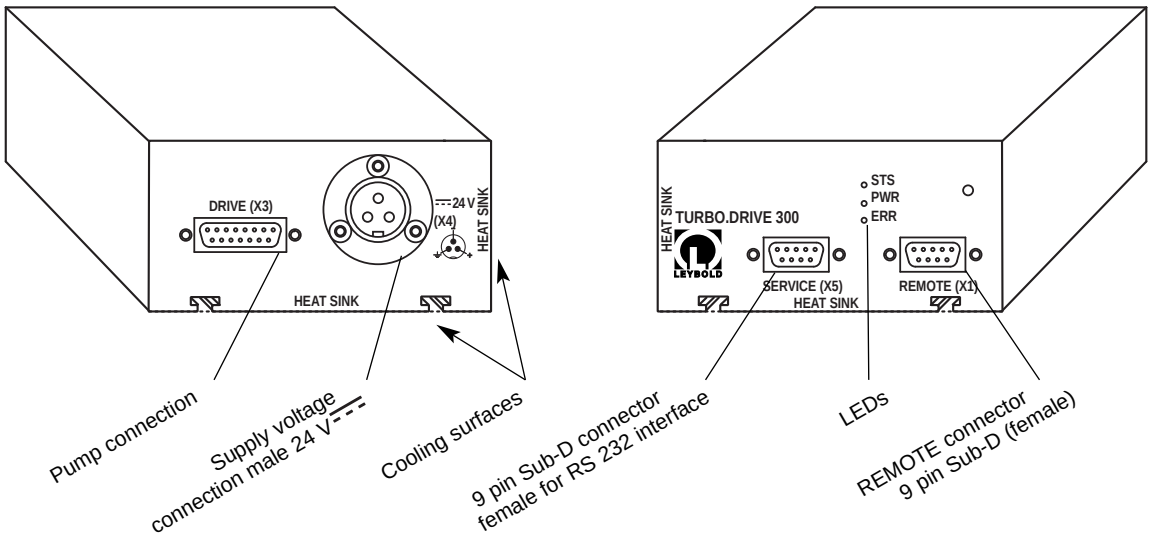
Different venting methods are described in Chapter 3.3.



1 Turbomolecular pump
2 Forevacuum gauge port
3 Forevacuum pump
4 Resonance damper
5 Adsorption trap
6 Forevacuum valve
7 Vent valve
8 High-vacuum valve
9 Valve in the roughing pump line
10 Electronic frequency converter

— — — — Roughing line; recommend to achieve the shortest possible cycle times

Fig.14 Schematic of a turbomolecular pump system



Green LED STS

off:	Pump at standstill (< 3 Hz)
flashes slowly 1/s:	Start command is present (about 10 s after start)
flashes fast 3/s:	Run up or running down
on:	Normal operation

Yellow LED PWR

off:	No supply voltage
flashes:	Supply voltage too low or too high
on:	Supply voltage is present

Red LED ERR

off:	No error, no warning
flashes:	Warning is present, pump can be operated possibly with some restrictions
on:	Fault is present, pump stopped or can not be operated

Fig. 15 TURBO.DRIVE 300, front and rear panel

2.6 Electrical connection

The TURBO.DRIVE 300 frequency converter needed to operate the TURBOVAC TW 300 / TW 300 H has either been integrated in the pump or is a separate unit. For connection examples see Fig. 19.

Warning

The pump may be operated only with a suitable frequency converter and suitable connector cables.
Route all cables so as to protect them from damage.
Do not expose the pump, the frequency converter or the connections to water.

Disconnect and connect the cable connections only while the pump is turning no longer (green status LED off) and with the mains power switched off (yellow power LED off). Otherwise there is the risk of damaging the TURBO. DRIVE 300.

2.6.1 Connecting pump and frequency converter

Only required in the case of a separate frequency converter.

Connect the pump to the frequency converter using a suitable connecting cable (15 way Sub-D plug X3). Connect the Sub-D-plugs with the hexagon threaded bolts UNC 4/40x6 which are provided with the cable.

Make sure that the frequency converter is adequately cooled; for this see Section 2.6.3 and also Fig. 18.

The frequency converter can optionally be mounted to the pump, see Section 2.6.5.

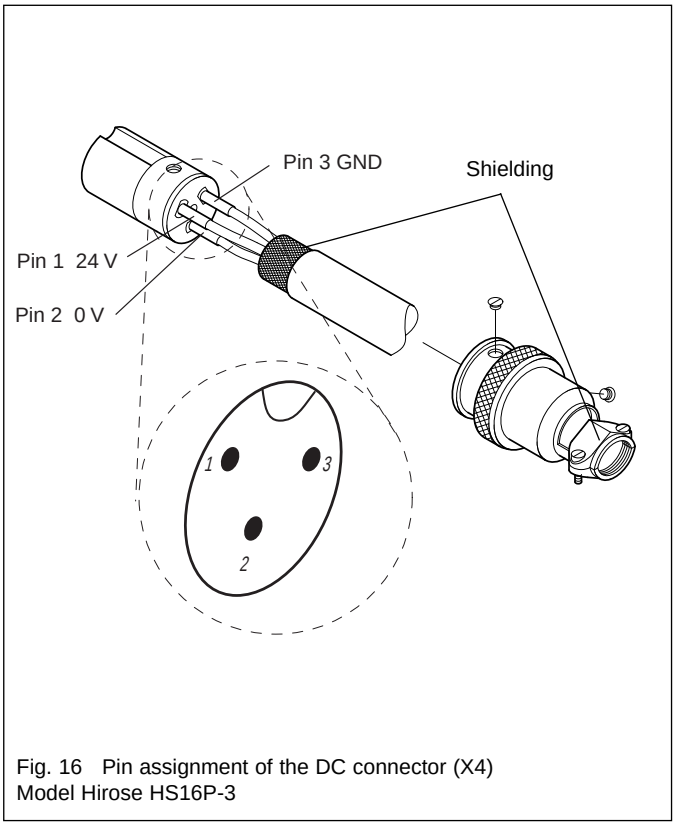


Fig. 16 Pin assignment of the DC connector (X4)
Model Hirose HS16P-3

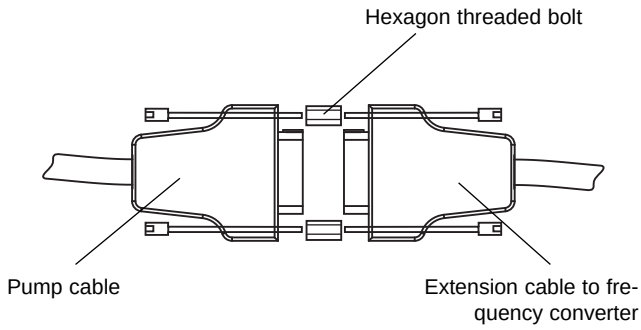


Fig. 17 Connect the extension cable

2.6.2 Connecting the power supply

Warning

The frequency converter must only be connected to power supplies which meet the requirements for functional extra low voltage with positive isolation in accordance with IEC 364 (VDE 0100, Part 410, or local regulations) (SELV).

The power supply must meet the requirements given in Section 1.4.3. Peak currents in the kHz range may be present on the DC side. The power supply should have a current limiter or be of the current regulated type.

Connect the frequency converter to the 24 V DC power supply or to the TURBO.CONTROL 300 or to the TURBO.POWER 300 via the 24 V DC cable.

Caution

Ensure correct polarity.
Pin 1 + 24 V ⎓
Pin 2 0 V
Pin 3 GND

The frequency converter is equipped with an internal 8 AT (slow blow) fuse. It can only be replaced by Leybold staff.

Connect the power supply to the mains.

Emergency shut down: By shutting down the power supply voltage. Please note the information on shutting down and emergency shut down provided in Section "3.2 Shutting down”

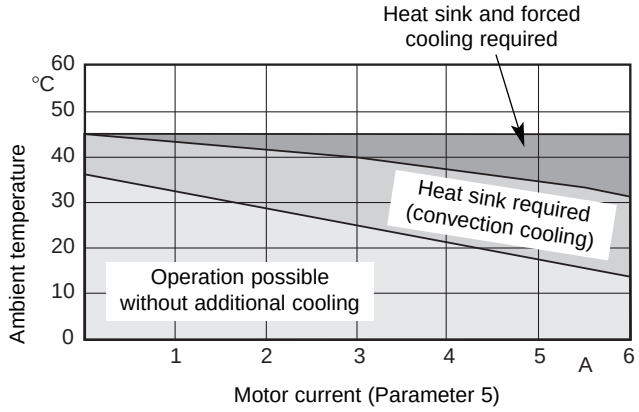


Fig. 18 Cooling requirements for the TURBO.DRIVE 300 when fitted separately

2.6.3 Mounting the frequency converter

The frequency converter may be affixed with the aid of the enclosed M4 sliding nuts. The bottom side of the frequency converter must be cooled sufficiently.

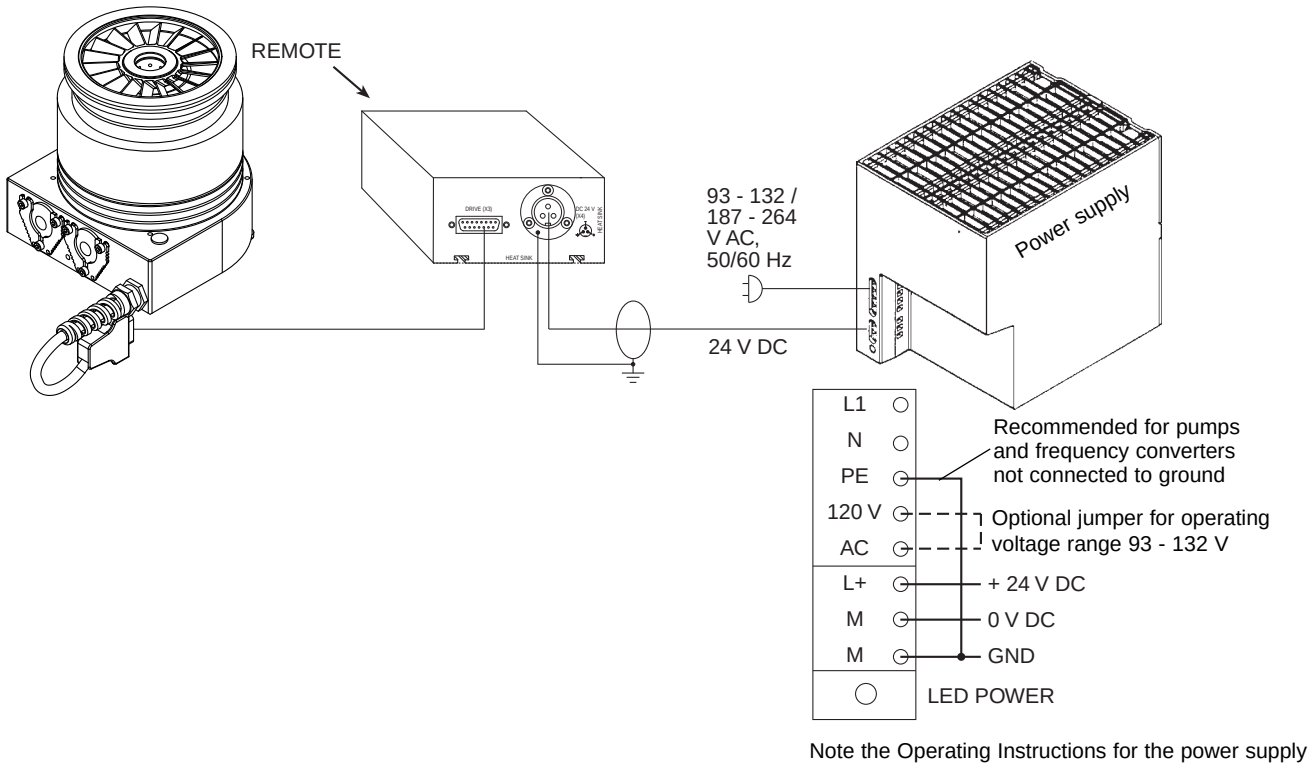
Ensure an adequate supply and discharge of cooling air.

For special requirements please contact Leybold.

Warning

During operation the frequency converter may attain temperatures up to 75 °C. We recommend that the unit be installed so that it can not be touched inadvertently.

Owing to the small quantity of combustible material and the proven safety of the instrument by testing in accordance with EN 61010, the risk through fire and burning can almost completely be excluded.



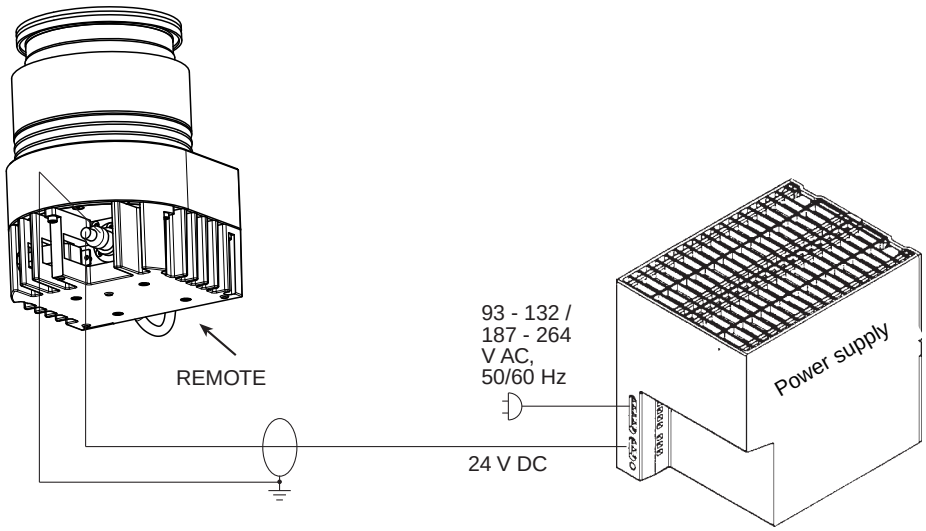


Fig. 19 Connecting the power supply;
top at the separate frequency converter
bottom at the integrated frequency converter

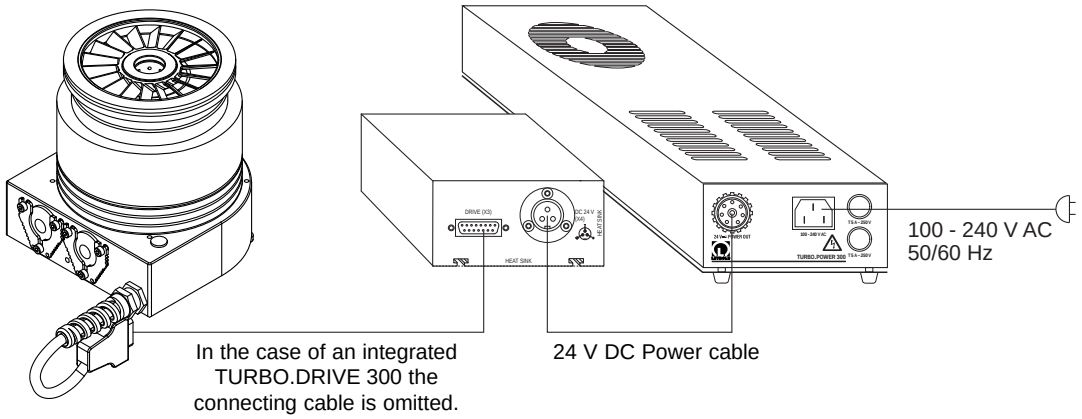


Fig. 20 Connecting the pump and the TURBO.POWER 300

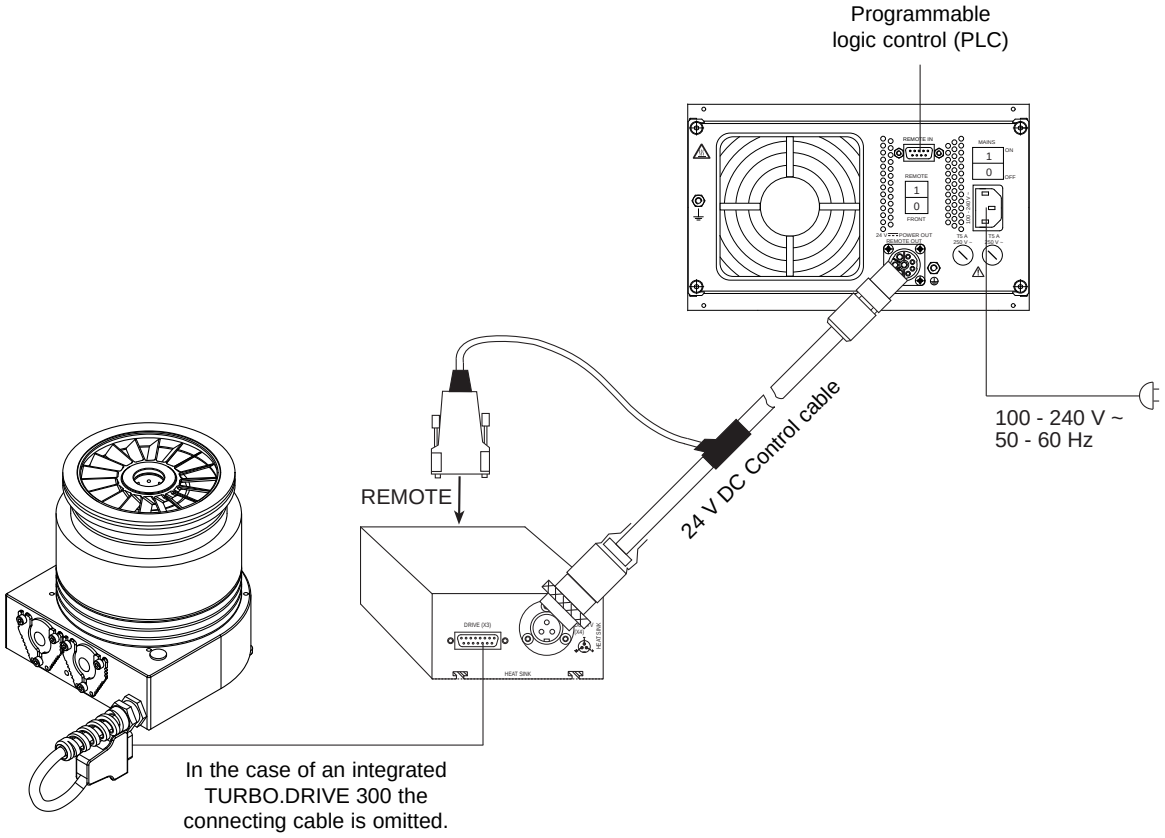
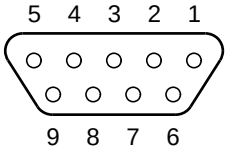


Fig. 21 Connecting the pump and the TURBO.CONTROL 300

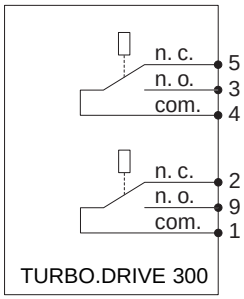
2.6.4 Relay status

Input data / status				Output data					Operating mode
Start/ stop signal	Pump rotating	Normal frequency ≥ 90% of setpoint frequency	Error is present	Motor drive	Relay NORMAL OPERATION	Relay ERROR	LED STATUS	LED ERROR	Other modes are not possible; they indicate a failure affecting the TURBO.DRIVE 300.
Stop	no	no	no	off	passive	passive	off	off	Pump not operating
Stop	yes	no	no	off	passive	passive	flashes	off	Pump is decelerating
Stop	yes	yes	no	off	passive	passive	flashes	off	Just after stop; pump was in the normal operating mode before that
Start	no	no	no	on	passive	passive	off	off	Just after start
Start	yes	no	no	on	passive	passive	flashes	off	Pump is accelerating
Start	yes	yes	no	on	active	passive	green	off	Pump is in the normal operating mode
Stop	no	no	yes	off	passive	active	off	red	Error is present; pump is at standstill
Stop	yes	no	yes	off	passive	active	flashes	red	Error is present; pump is decelerating
Stop	yes	yes	yes	off	passive	active	flashes	red	Error has just occurred
Start	no	no	yes	off	passive	active	off	red	Error is present; pump is at standstill
Start	yes	no	yes	off	passive	active	flashes	red	Error is present; pump is decelerating
Start	yes	yes	yes	off	passive	active	flashes	red	Error has just occurred

Pin assignment of the connector



Relay functions

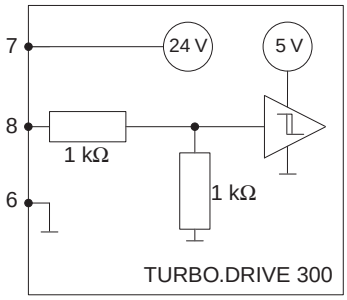


Relay - Normal operation
- While deceleration, acceleration, Stop: 4 connected to 5 (as shown; passive)
- During normal operation ($f > 0{,}9 \cdot f_{nom.}$): 4 connected to 3 (active)

Relay - Error
- No error: 1 connected to 2 (as shown; passive)
- Error is present: 1 connected to 9 (active)

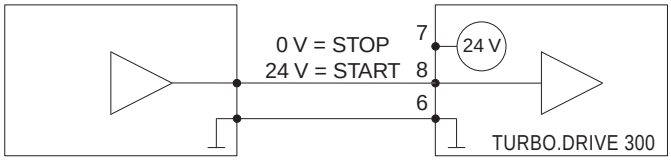
Relay output rating: 42 V, 0.5 A

Pin assignment for the Start/Stop input



Switching threshold for the Start/Stop control input:
Low level: < 5 V
High level: > 15 V

Start/Stop operation
Example 1: Operation via a PLC



Example 2: Operation via contacts

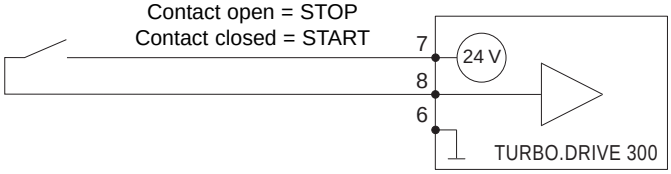


Fig. 22 Pin assignment of the REMOTE (X1) connector

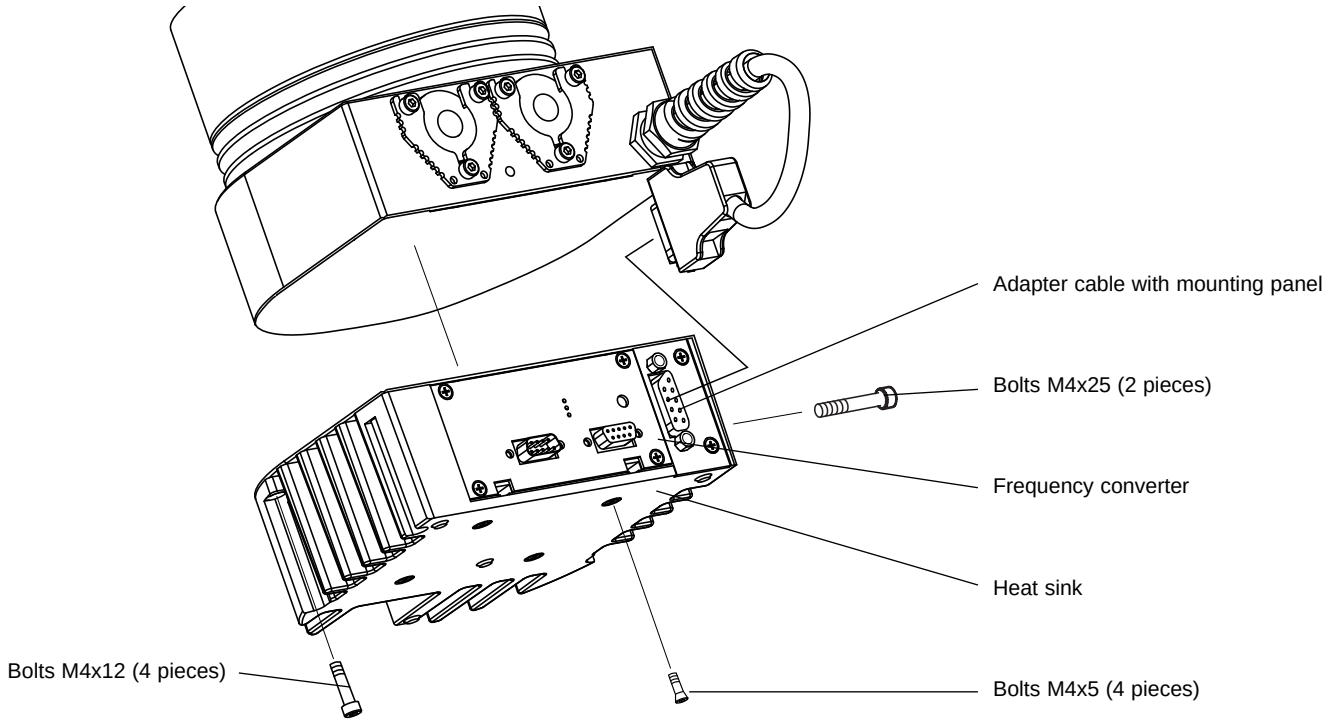


Fig. 23 Optional installation of the frequency converter to the pump

2.6.5 Installing the frequency converter (Optional)

The frequency converter may be retrofitted to the pump. The part numbers for the necessary installation components are provided on Chapter 1.3.2.

Insert the plug of the adapter cable at the rear into the socket market DRIVE on the frequency converter. Push the frequency converter from the front into the heat sink and affix it from below using the bolts M4x5. At this point do not yet firmly tighten the bolts.

Affix the mounting panel with two cross-head bolts.

Affix the heat sink with the bolts M4x12 to the pump.

Screw in 2 bolts M4x25 from the side. These bolts serve the purpose of forcing the heat sink against the left-hand side of the frequency converter which is used as a cooling surface.

Now tighten the bolts M4x5.

Insert the plug from the pump.

2.7 Interface description

The frequency converter may be equipped with either of the following interfaces (optional):

- RS 232/RS 422(485)
- RS 485
- Profibus DP

The TURBO.DRIVE 300 is configured through the parameters according to the parameter list. Pxxx denotes parameter value xxx.

The PC software "TURBO.DRIVE Server" and a display PDA with the software “TURBO.DRIVE Panel” allow convenient access by the user to the parameters of the frequency converter.

For further information on the interfaces refer to Operating Instructions GA 05.281 “Serial Interfaces”.

Profibus DP

The Profibus DP used has been defined in the standards EN 50170, DIN 19245-1, -3, VDI/VDE 3689.

For more information on the Profibus system:

"The Rapid Way to Profibus",
Manfred Popp, Profibus Nutzerorganisation e.V., Germany
P/N 4.072

Upon request we shall be pleased to provide detailed information on the hardware and the protocol used for the data.

Applications which can be implemented with the aid of the serial interface:

Application	**Benefits to the customer**	**How to do it**
Networking of several pumps and other equipment	Savings relating to the costs for signalling cables	With Field Bus systems like Profibus
Automation	Savings related to repetitive manual work	For example by a control computer
Avoidance of warnings and warnings before overload operation and early detection of a failing pump	• Precise planning for maintenance • Improved reliability of sensitive production processes in a vacuum	Monitoring of: • Motor current P5 • Ball bearing temperature P125 or P127 • Motor temperature P7 • Frequency converter temperature P11
Standby operation	• Extending the service life for the ball bearings • Cutting energy consumption	Reducing the rotor’s frequency through P24
Troubleshooting	Quick analysis of problems	Reading of error memories P171, P174 and P176: error code, speed, operating hours for error
Slow pressure control by changing the pumping speed	Dispensing with a flow controller	Changing the rotor frequency through parameter 24
Reducing the maximum motor current	Cost savings through smaller power supply units if peak loads can be reduced	With P139, motor current reduction factor
Starting the pump with a delay if a several consumers are connected to the same PSU	Cost savings through smaller power supply units if peak loads can be reduced	With P36, delay
Frequency converter as a simple pressure gauge, since motor current is dependent on the vacuum conditions	Dispensing with pressure gauges	Monitor motor current P5; second function for “Normal Operation” relay: relay switches as soon as the motor current threshold is tripped Adjust second function: P29 Set motor current threshold: P27
Lowering the normal operation threshold	Normal operating mode is attained faster, processes can be started faster	Reduce frequency threshold through P25

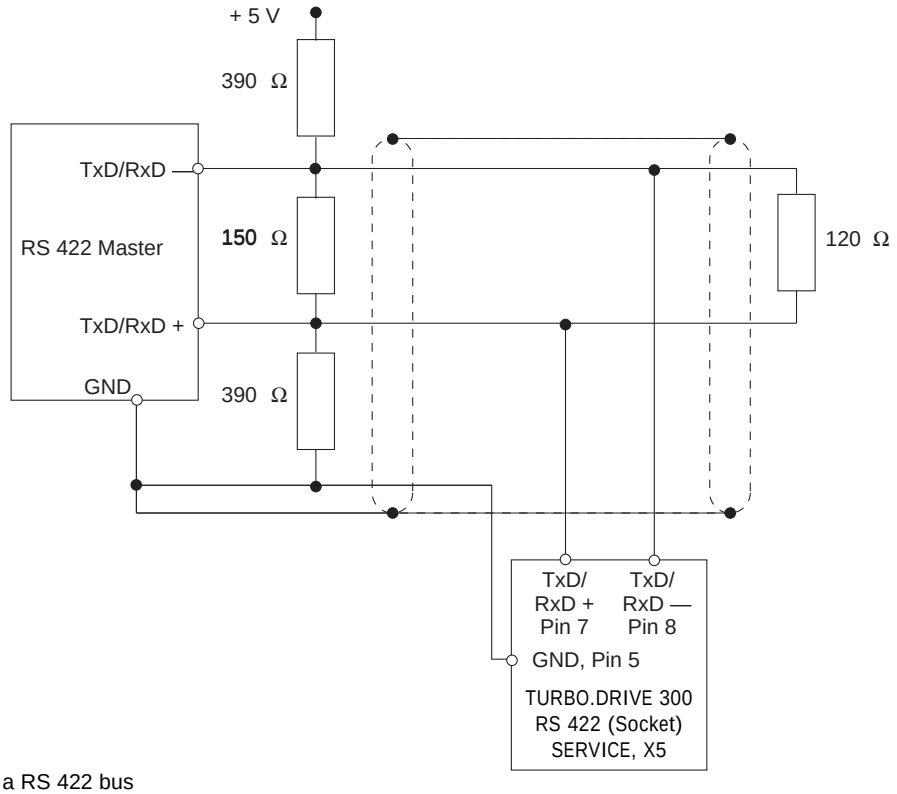


Fig. 24 Structure of a RS 422 bus

2.7.1 RS 232/RS 422(485) interface (SERVICE X5)

Standards	DIN 66020
Protocol	acc. to VDI/VDE 3689
Transmission rate	19200 baud
Response delay	default setting 10 ms (parameter 180)
Address range	
RS 232	non-addressable
RS 485, Address 0 ... 3	connection coded
RS 485, Address 0 ... 31	via parameter 37
Max. cable length	
RS 232	5 m
RS 422 (485)	100 m
Interface connector	9 way Sub-D type, socket on the instrument (female) thread UNC4-40

Alternatively RS 232 **or** RS 422(485) operation

Note: If on the controlling side an RS 232 interface in accordance with the PC standard with a 9-pin Sub-D male connector is present, then a straight through cable as shown in Fig. 26 may be used.

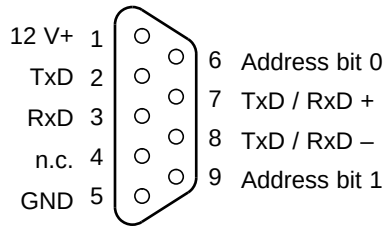


Fig. 25 Pin assignment for the socket at the frequency converter (female) SERVICE X5

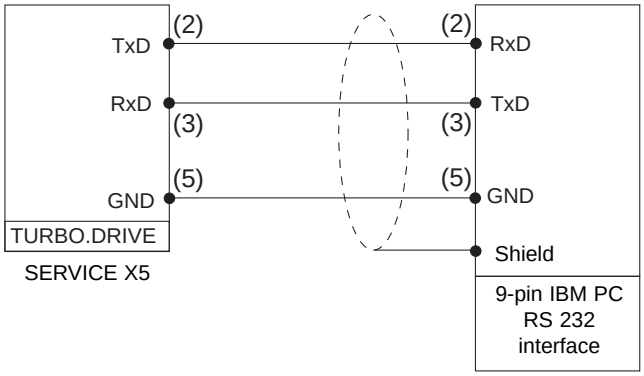


Fig. 26 Providing a RS 232 connection

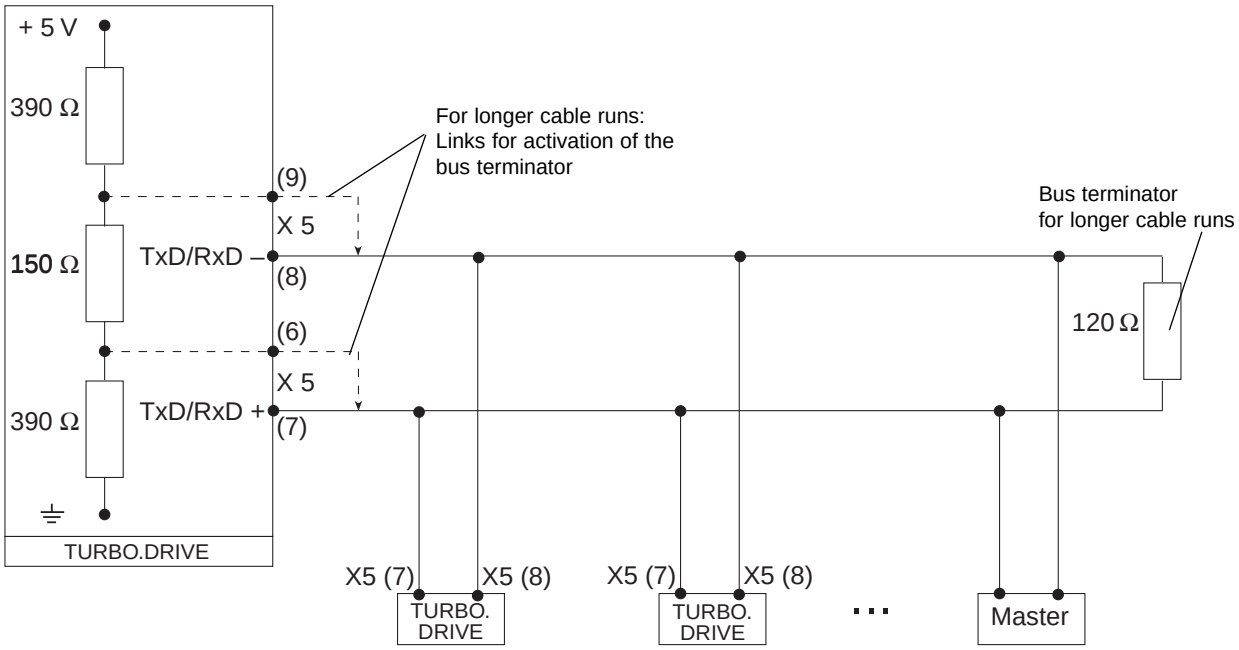


Fig. 27 Connection of the RS 485 bus

2.7.2 RS 485 interface

Standards	ISO 8482, EIA 485
Protocol	acc. to VDI/VDE 3689
Transmission rate	19200 baud fixed
Response delay	default setting 10 ms (parameter 180)
Address range	0 ... 15
Max. cable length	50 m (with bus termination)
Type of cable	2 wire twisted pair (twisted pair cable)
Differential voltage levels (see also “Standards”)	logic "0": transmitter: 1.5 ... 5 V receiver: > 0.3 V
	logic "1": transmitter: - 1,5 ... - 5 V receiver: ≤ - 0,3 V
Interface connector	9 way Sub-D type, socket on the instrument (female) thread UNC4-40

Note: After having changed the bus address through the rotary switch, the frequency converter must be switched off (yellow power LED off) and then on again so as to enable the new address setting.

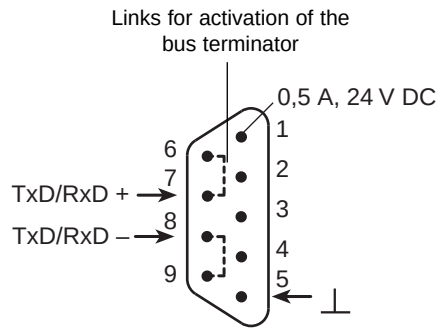


Fig. 28 Pin assignment for the socket at the frequency converter for RS 485 interface (male)

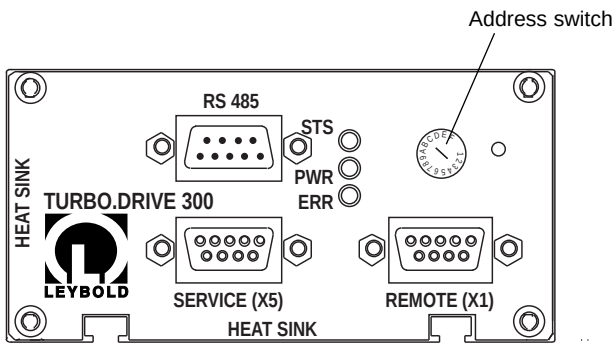


Fig. 29 TURBO.DRIVE 300 with RS 485 interface

2.7.3 Parameter list

No.	Designation	Range	Unit	Default	Format	r/w	Description
0	Dummy parameter	-	-	-	U16		No function
1	Type of frequency converter	132 / 134	-	-	U16	r	TURBO.DRIVE 300 = 132
2	Software version	xx.yy.zz	-	1.12.02	U16	r	xx.yy: version, zz: correction index
3	Actual rotor frequency	0...1300	Hz	-	U16	r	The max. frequency depends on the pump type.
4	Actual converter supply voltage	18...32	V	-	U16	r	Nominal value for TURBO.DRIVE 300: 24V
5	Setpoint for the motor current	0... 60	0.1A	-	U16	r	
7	Actual motor-temperature	-20...150	°C	-	S16	r	Measured coil temperature for the motor
8	Permanently save the changed parameter data in the EEPROM	-	-	-	U16	w	A write command will cause the data to be saved. The parameter value itself is not processed and saved. After a reset or switching on the supply voltage with a different pump connected or without a pump, all parameters will be reset to their defaults.
11	Actual converter temperature	-20...150	°C	-	S16	r	Measured internal converter temperature
12	Operating mode for	0...2	-	0	U16	r/w	P12 = 0 (default): via REMOTE (X1); P12 = 1: via serial interface P12 = 2: Start: REMOTE (X1) at Start **and** serial interface sends Start signal Stop: REMOTE (X1) at Stop **or** serial interface sends Stop signal
16	Motor temperature warning threshold	30...150	°C	95	U16	r	Exceeding the motor temperature warning threshold results in a warning
17	Max. value setting for motor current	5 ... 75	0,1 A	60	U16	r/w	Maximum permissible motor current
18	Nominal pump frequency	750...1200	Hz	1000	U16	r	Highest permissible frequency
19	Minimum setpoint frequency for the pump	P20 ... P18	Hz	525	U16	r/w	Lowest permissible frequency
20	Minimum frequency level	0 ... P19	Hz	500	U16	r r	When the pump is accelerating this frequency must be reached within the maximum passing time (P183). After the end of acceleration: Switch-off threshold because of overload; see error 106
23	Pump type	0...4	-	4	U16	r	4 = TW 300 / TW 300 H
24	Setpoint frequency	P19 ... P18	Hz	1000	U16	r/w	Adjustable between P19 to P18
25	Frequency dependent normal operation level	35..99	%	90	U16	r/w	If P29 = 0: Defines the normal operation level. Normal operation if P3 ≥ P24 x P25
27	Motor current dependent normal operation level	5...75	0,1 A	20	U16	r/w	If P29 = 1: Defines the normal operation level. Normal operation if P5 ≤ P27

No.	Designation	Range	Unit	Default	Format	r/w	Description
29	Selection of the relay functions	0 ... 4	-	0	U16	r/w	The normal operation and error relays can be set to special functions if required.
	P29 = 0 means:	the **normal operation relay** is active when the normal operation frequency is exceeded (P3 ≥ P24 * P25) the **error relay** is active in case of an error {TDS/L compatible}					
	P29 = 1 means:	the **normal operation relay** is active when the current falls below the normal operation threshold (P5 ≤ P27) the **error relay** is active in case of an error {TDS/L compatible}					
	P29 = 2 means:	the **normal operation relay** controls e.g. a venting valve, activated via the field bus interface (Bit 12 in the control word of the data transfer protocol) the **error relay** controls e.g. a purge gas valve, activated via the field bus interface (Bit 11 in the control word of the data transfer protocol) (makes only sense at interface operation}					
	P29 = 3 means:	the **normal operation relay** is active when the normal operation frequency is exceeded (P3 ≥ P24 * P25) the **error relay** is active when **no** error exists {T1600 compatible}					
	P29 = 4 means:	the **normal operation relay** is active when the current drops below the normal operation threshold (P5 ≤ P27) the **error relay** is active when **no** error exists					
32	Maximum run up time	P183...2000	s	720	U16	r/w	Max. permissible time during which the pump must attain the normal operation threshold (P24 x P25) with the start signal present
36	Start delay time	0...255	0.1 min.	0	U16	r/w	Pause time after the Start command until the pump's drive is started
37	RS485 address	0 ... 31	-	0	U16	r/w	Parameterizable RS485 address; a change of this parameter setting will only be effective • after the power supply has been switched off and on and • if the addresses 1, 2 and 3 are **not connection coded** via SERVICE (X5)
38	Start counter	0 ... 65535	-	-	U16	r	Counts the total number of pump starts
40	Error counter	0 ... 65535	-	-	U16	r	Counts the total number of errors
90	Error mode	1/2	-	2	U16	r/w	Selection of the error code table which is saved in P171 2 = standard setting 1 = compatible to T1600
125	Current bearing temp.	-20...150	°C	-	S16	r	Measured bearing temperature (identical to P127)
127	Current bearing temp.	-20...150	°C	-	S16	r	Measured bearing temperature (identical to P125)
128	Bearing temperature warning threshold	30...150	°C	60	U16	r	Exceeding the bearing temperature warning threshold results in a warning

r = readable, w = writable

No.	Designation	Range	Unit	Default	Format	r/w	Description
132	Bearing temperature shutdown level	30...150	°C	67	U16	r	Max. permissible bearing temperature; P125 > P132 causes the pump to be switched off
133	Motor temperature shutdown level	30...150	°C	100	U16	r	Max. permissible motor temperature; P7 > P133 causes the pump to be switched off
139	Current reduction factor	30...100	%	100	U16	r/w	Is used for the reduction of the maximum current drawn by the frequency converter, e.g. for adaption of low performance power supplies (Note: values < 100 reduce the pump performance and increase the run-up time) A change in the current reduction factor will only become effective after writing any value to parameter 8 and when switching after this the supply voltage off and on.
171	Error code memory for the last 40 error events	0...39	-	0	Array 0..39 U16	r	Sequential permanent memory; the individual error codes are accessed via parameter 171 with additional index no. in the parameter order identifier of the interface protocol. The last error code which has occurred is saved at the memory location with the index 0, the oldest is at index 39. See 2 pages further for the error codes.
174	Rotor frequency at the time of error	0...1300	Hz	-	U16	r	Sequential permanent memory of the last 40 rotor frequency values, which have been saved at the time of an error. The individual error codes are accessed via parameter 174 with additional index no. in the parameter order identifier of the interface protocol. The last error code which has occurred is saved at the memory location with the index 0, the oldest is at index 39.
176	Error operating hours memory for the last 40 error events	0...19 years	0.01 h	-	Array 0..39 U32	r	Analogous to P171 (error code memory)
180	Response delay time	2...19	msec	10	U16	r/w	Pause time between received and transmitted interface protocol string of the frequency converter's serial interface RS 232 and RS 422(485). We recommend not to change the default setting (10 ms)
183	Max. passing time	10...2000	s	500	U16	r	Max. permissible time during which the pump must - with the start signal present - have passed through the critical speed range between 60 Hz and P20
184	Converter operating hours counter	0...19 Years	0,01h	-	U32	r	Totals the operating hours for the converter when the pump's drive is active

No.	Designation	Range	Unit	Default	Format	r/w	Description
199	Converter date of manufacture	01.01.00 ... 31.12.99	-	-	U32	r	
227	Warnings bits 1	0 ... 65535	-	-	U16	r	Active warnings described bit per bit; for the meaning see Section 4.5
303	Pump status word	-	-	-	U16	r	Meaning of the bits: Bit 0 = 1 Normal operation Bit 1 = 1 Ready for switch on Bit 2 = 1 Speed is increasing Bit 3 = 1 Speed is dropping Bit 4 = 1 Generator operation Bit 5 = 1 Stand-by In case of an error P303 has the value of 0 (not ready to be switched on)
312	Cat. No. code	0 ... 2^{31}-1	-	-	U32	r	Abbreviated description of the Cat. No. of the pump Examples: 800072V1003 = 721003 830070V0101 = 300700101
315	Serial No. code	1 ... 2^{31}-1	-	-	U32	r	The 9 least significant bits of the original serial No.
316	Hardware identifier	0...100	-	-	U16	r	Hardware version index of the converter

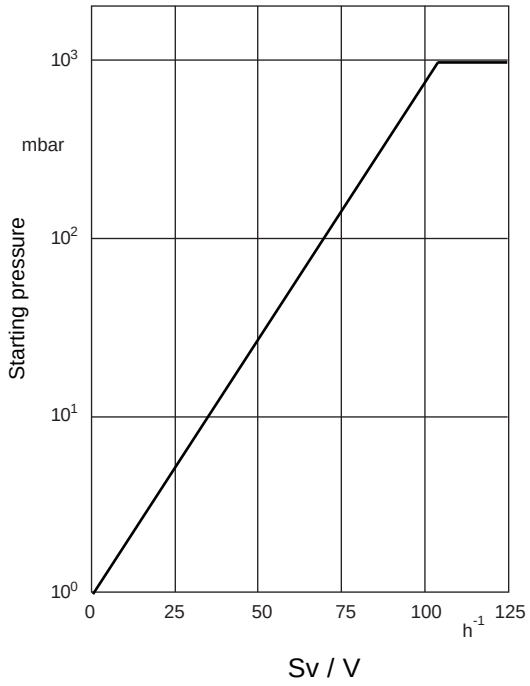
2.7.4 Warning codes for parameter 227

Bit	Bit 15 **binary value** Bit 0 ← MSB ... LSB →	Hexadecimal value	Decimal value	Designation	Condition / description of the warning
0	0000 0000 0000 0001	0001	1	Motor temperature warning	P7 > P16
1	0000 0000 0000 0010	0002	2	Converter temperature warning	P11 > 70 °C
2	0000 0000 0000 0100	0004	4	Bearing temperature warning	P125 > P126 or P127 > P128
3	0000 0000 0000 1000	0008	8	Bearing temperature warning	P127 > P128 or P125 > P126
4	0000 0000 0001 0000	0010	16	not used	-
5	0000 0000 0010 0000	0020	32	not used	-
6	0000 0000 0100 0000	0040	64	Overspeed warning	P3 > (P24 + 10 Hz)
7	0000 0000 1000 0000	0080	128	not used	-
8	0000 0001 0000 0000	0100	256	High load warning	P5 > (P17 * P21) effective P32 seconds after the start and if P21 < 100%
9	0000 0010 0000 0000	0200	512	not used	-
10	0000 0100 0000 0000	0400	1024	Bearing change required	P125 > P131 or P127 > P132
11	0000 1000 0000 0000	0800	2048	Overload warning	P3 < P25 * P24
12	0001 0000 0000 0000	1000	4096	not used	-
13	0010 0000 0000 0000	2000	8192	not used	-
14	0100 0000 0000 0000	4000	16384	Power supply warning	P4 > P805 or P4 < P806
15	1000 0000 0000 0000	8000	32768	not used	-

2.7.5 Error codes for parameter P171

Code	Type of error	Condition / Description of the error	Pump switched off
0	No error	–	no
1	Overspeed error	Nominal speed of the pump (P 18) has been exceeded by over 10%	no
2	Pass through time error	Max. time for passing through the critical frequencies of 60 Hz to P20 has been exceeded: 60 Hz < P3 < P20 after P183 has elapsed with the start signal present	yes
3	Bearing temperature error	Maximum bearing temperature has been exceeded: P125 > P132 or P127 > P132	yes
4	Short circuit error	Short circuit in the pump's motor or the connecting cable	yes
5	Converter temperature error	Maximum temperature for the converter has been exceeded: P11 > 85°C	yes
6	Run up time error	Max. time after which the pump must enter its normal operation mode has been exceeded: P3 < P24 x P25 after P32 has elapsed with the start signal present	yes
7	Motor temperature error	Maximum motor temperature has been exceeded: P7 > P133	yes
8	Pump error	Pump could not be identified or no pump is connected.	yes
60	Short circuit error	Short circuit in the pump's motor	yes
61	Bearing temperature warning	Bearing temperature warning threshold has been exceeded: P125 > P126 or P127 > P128	no
62	Bearing temperature warning	Bearing temperature warning threshold has been exceeded: P127 > P126 or P125 > P128	no
101	Overload warning	The frequency has dropped below the normal operation frequency by high load: P3 < P25 * 24 (after normal operation has been reached)	no
103	Power supply error	No power supply during active operation of the pump	no
106	Overload error	Upper critical limit frequency has been exceeded by overload (P3 < P20 after P32 from start after run-up)	yes
116	Permanent overload error	Max. overload time has been exceeded: P3 < P25* P24 for longer than P32	yes
117	Motor current error	No motor current or motor current too low (I_{set} > 1 A and P5 < 0,2 A)	yes
118	Motor connection error	Error in the motor connection cable	yes
125	High load warning	Max. permissible permanent current has been exceeded: P5 > P17 * P21 for longer than P32 from start after run-up	no
126	Bearing temperature sensor error	Error at the bearing temperature sensor (Resistance not in the plausible range; –20 °C < T < 150 °C)	yes
127	Bearing temperature sensor error	Error at the bearing temperature sensor (Resistance not in the plausible range; –20 °C < T < 150 °C)	yes
128	Motor temperature sensor error	Error at the motor temperature sensor (Resistance not in the plausible range; –20 °C < T < 150 °C)	yes
131	Permanent high load error	Max. high load time has been exceeded: P5 > P17 * P21 for longer than 2 * P32	yes
143	Overspeed error	Pumping speed has been exceeded by more than 15 % (P3 > P18 x 1,15)	yes
144	Profibus address error	Wrong Profibus address set (must be 0 ... 126)	yes
145	Profibus error	Error during cyclic exchange of data over the Profibus, the watchdog timer has responded	yes
201	CPU error	Error in the micro computer	yes
202	PLL-synchronisation warning	Error in the pump's speed synchronisation wiring	no

Code	Type of error	Condition / Description of the error	Pump switched off
203	Parameter value error	Parameter value internally not valid; data error	yes
205	Data plausibility error	Internal data error (open loop)	yes
207	Motor blocked error	Rotor blocked	yes
208	PLL error	PLL synchronisation error	yes
212	Shut down	Emergency off	
213	Overvoltage error	Power supply voltage too high (UZK > 80 V)	yes
214	Undervoltage error	Power supply voltage too low (level depends on pump)	yes
216	Memory test error	Error in external memory	yes
217	Pump identification resistor error	Wrong or missing pump identification resistor	yes
222	Hardware test error		yes
223 - 226	Logical unit error	Error in the programmed logigal unit	yes
227	Pump model can not be operated	No set of parameters defined for the recognized pump model	yes



Sv = Pumping speed of the forevacuum pump ($m^3 \cdot h^{-1}$)
V = Volume of the vacuum chamber (m^3)

Fig. 30 Determining the starting pressure of a turbomolecular pump when evacuating large volumes

3 Operation

Warning

The turbomolecular pump must only be operated in the proper condition and under the conditions described in the Operating Instructions.

Caution

Exposure of the pump to accelerating forces must be avoided or reduced to such an extent that the rotor unit will not be excited by vibrations. In the case of critical applications you must consult our Applications Dept. first.

The direction of rotation for the pump has been checked by Leybold. For this reason a further check by the user is **not required** and must, for safety reasons, **not** be done on the opened system.

3.1 Switching on

Switch on the 24 V DC power supply. The yellow LED at the frequency converter lights up.

The maximum starting pressure for the turbomolecular pump can be read from the graph in Figure 30.

Switch on the turbomolecular pump at the frequency converter

- via pins 7 and 8 of the socket REMOTE (X1) (For example via a remote control or with the aid of the plug with integrated ON/OFF switch: see Section 1.3 Ordering data).
- by a start command via the interface; see Section 2.7.
- For the power supply units offered or recommended by Leybold: If the contacts 7 and 8 at the REMOTE (X1) connector are closed the pump starts automatically when the DC voltage is switched on (provided parameter 12 is set to 0).

The turbomolecular pump runs up. The green LED flashes. When the pump reaches normal operation the green LED lights up permanently.

Caution

Avoid the influences of shock and vibration when the pump is running.

Warning

During operation the pump can become so hot that there is a danger of burns (up to approx. 80°C, 176 °F).

Warning

After a mains power failure the pump can run up automatically once more.

Caution

The rotor bearings must be changed after 1,500 starts or 10,000 operating hours; see Section 4.

3.2 Shutting down

Switch off the pump at the frequency converter.

- via contacts 7 and 8 of the socket REMOTE (X1), if parameter 12 = 0.
- apply a stop command via the interface, if parameter 12 = 1 or 2.
- for the power supply units offered or recommended by Leybold switch off the DC voltage.

After switching off, the green status LED will flash until the rotor of the turbomolecular pump is at standstill. This may take several minutes.

With the DC power supply off, the turbomolecular pump will act as a generator supplying the frequency converter with energy as indicated by the yellow power LED. At speeds approximately below 200 Hz, there will not be enough power any more for the LEDs, i.e. the pump may still turn with out any of the LEDs being on.

Switch off the forevacuum pump.

When using oil-sealed forevacuum pumps, vent the turbomolecular pump before it comes to a stop; refer to Section 3.3.

When using TRIVAC pumps the built-in anti-suckback valve will close automatically, shutting off the forevacuum line. In forevacuum pumps without a vacuum retention valve, close the valve in the forevacuum line.

When the system is not operating, ensure that neither ambient air nor cleaning media can enter the pump.

If a failure occurs the turbomolecular pump will be shut down automatically. The red LED at the frequency converter lights up.

Warning

Under vacuum conditions the pump may take up to one hour to run down, when venting to atmospheric pressure it may take up to one minute. During the time the pump is running down, the green LED at the frequency converter will flash, indicating that the rotor has not yet arrived at standstill.

When shutting down by **switching off the power supply voltage**, there will be only enough power for the LEDs down to a speed of the pump of approximately 200 Hz. Thus the pump may still turn without a LED being on. For this reason, when switching off without venting, wait for approximately 15 minutes after the LEDs have turned off until the pump has arrived at standstill.

Warning

Unplug any connectors only when the mains voltage is switched off **and** the pump does no longer turn (the green LED is off).

Emergency shut down

In the case of an emergency shut down, the pump is switched off as described above. The rotor of the turbomolecular pump may be stopped faster by venting the pump.

3.3 Venting

As to suitable gases, see Chapter 2.5.

Venting Methods

There are three different methods of venting the turbomolecular pump.

In the case processes requiring a purge gas, the pump must be vented via the **purge gas and venting valve** when shutting the pump down.

When additionally venting the vacuum chamber, the venting function of the purge gas and venting valve must be opened before opening the chamber valve. This will ensure the presence of a higher pressure in the area of the ball bearings compared to the remaining vacuum area. This will prevent particles, dust or aggressive gases from being forced through the bearings into the not yet vented motor chamber of the pump.

Cautious venting of the pump is possible from the **high vacuum side**, since here the bearing forces will be

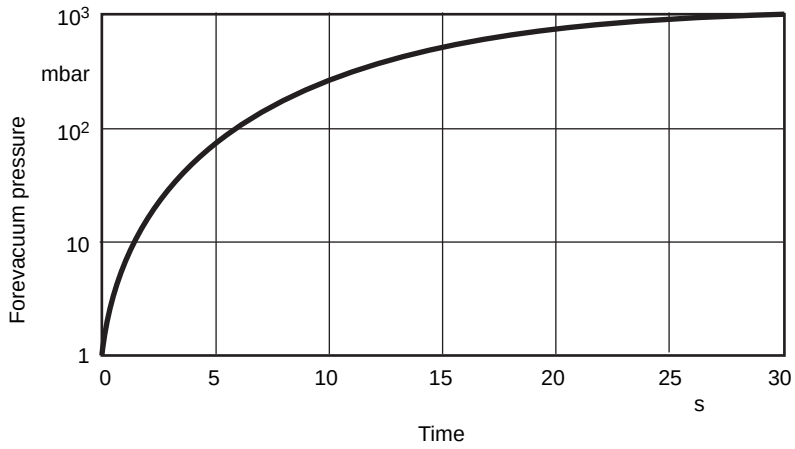


Fig. 31 Maximum rise in pressure

lowest. When doing so, no free jet of gas must be allowed to form on the rotor so as to avoid exposing the rotor to additional forces.

When venting the pump through its **foreline connection**, neither oil nor particles may be entrained in the gas flow from the forevacuum side into the pump.

Speed of the Pressure Rise

All turbomolecular pumps may be vented at full speed. However, the pressure must not increase faster than specified through the pressure rise curve.

The pump must be vented significantly slower when there is the risk of particles entering into the pump from the process. During venting, the flow must be of the laminar type in both the vacuum chamber and the turbomolecular pump.

The speed of the pressure rise during venting of the running pump will greatly influence the load on the rotor/stator pack and the bearings. The slower the pump is vented, the longer the service life of the bearings will be.

The pump must not be vented to pressures above atmospheric pressure.

3.4 Bakeout

For TURBOVACs with CF flange

If pressures in the range of 10^{-8} mbar or below are to be developed, the vacuum chamber and the components installed therein will have to be baked out. In addition, the TURBOVAC can be baked out using the flange heater provided for this purpose.

Protect the rotor against intensive, direct heat radiation. When baking out at the forevacuum side – at a sorption trap, for example – ensure that the components attached direct are not heated to more than 100 °C (212 °F).

The forevacuum pump must be in operation so as to eliminate the vapors liberated at the sorption trap.

3.5 Removing the pump from the system

Shut down the pump and vent as described in Sections 3.2 and 3.3.

Warning

If the pump has previously handled hazardous gases, implement the proper precautionary measures before opening the intake or exhaust connection.

If necessary, use gloves, a respirator and/or protective clothing and work under an exhaust hood.

Disconnect the pump only when it has come to a full stop. The green LED at the frequency converter must have gone out.

When shutting down by switching off the power supply voltage, wait for approximately 15 minutes after the LEDs have turned off until the pump has arrived at standstill.

Then switch the mains power off and wait until the yellow power LED is off. Then only disconnect any cable connections.

The pumps may be contaminated with process gases. These gases may be toxic and hazardous to health. In addition, deposits with similarly dangerous properties may have formed. Many of these gases and deposits form acids when they come into contact with humid air. This will result in serious corrosion damage to the pump.

To avoid health hazards and corrosion damage when the pumps are detached from the system, fasten a container of desiccant under the transport cover of the high-vacuum connection and then close the pump immediately at all flange connections. Store the pump, with a desiccant, in an air-tight PE bag.

Corrosion damage due to faulty packing will nullify the guarantee.

Pack the pump so that it cannot be damaged during shipping and storage. Pay particular attention to protection for the flanges and the electrical plug.

Observe the instructions in Section 4.2 if you forward the pump to Leybold.

Caution

Pumps with integrated frequency converter need to be shipped to the LEYBOLD Service with the frequency converter.

4 Maintenance

A standard bearing change must be carried forward after 10,000 operating hours or 1,500 starts at the latest.

Moreover, we are recommending an exchange of the rotor unit after 45,000 operating hours at the latest.

Such maintenance work can only be done by the LEYBOLD Service. If required contact the LEYBOLD service center nearest to your location. You can find the address on our internet page www.leyboldvac.de.

At high pump loads - for example during cyclic operation, at high gas throughputs or at high ambient temperatures - the aforementioned maintenance work should be carried forward.

When using purge gas valves

Depending on the degree of contamination of the purge gas used the filter will clog and will have to be exchanged (our experience indicates that this will become necessary after 1 to 6 months).

When using an adsorption trap

Regenerate or renew the adsorption agent regularly; refer to the operating instructions provided with the trap.

Caution

The pump must only be opened by such persons who have been authorised by Leybold to do so.

4.1 Cleaning

If required clean the turbomolecular pump with a dry cloth.

4.2 Service by LEYBOLD

Whenever you send a pump to Leybold, indicate whether the pump is contaminated or is free of substances which could pose a health hazard. If it is contaminated, specify exactly which substances are involved. You must use the form we have prepared for this purpose; we will forward the form on request.

A copy of the form is printed at the end of these operating instructions: „Declaration of contamination of vacuum equipment and components“. Another suitable form is available from the Leybold homepage:
http://www.leyboldvac.de under the headline “customer service”.

Attach the form to the pump or enclose it with the pump.

This statement detailing the contamination is required to satisfy legal requirements and for the protection of our employees.

Pumps which are not accompanied by a contamination statement will be returned to the sender.

5 Troubleshooting

Warning

When the connector cable is attached, the outputs at the frequency converter are not free of voltage.

Before you start searching for the source of the problem, you should carry out a few simple checks:

Are the connections in good working order?

- Mains connection,
- 24 V DC cable to the frequency converter,
- Connector cable between the frequency converter and the pump

Is the forevacuum pressure sufficient?

After having removed the cause for the error reset the error message at the TURBO.DRIVE 300.

- In case of errors with error codes 1 to 7 by applying a STOP signal via the socket REMOTE (X1) or a reset sequence via the serial interface or by switching the mains power off.
- In case of error code 8 by switching the mains power off.

The error codes can only be read if a serial interface is present.

The following table has been provided as a guide when determining the causes of errors.

To remove possible faults, staff having different qualifications is required:

- **Operator** of the system
- Qualified **maintenance staff** of the system operator or qualified staff from the vendor erecting the system
- Staff from **Leybold-Service**

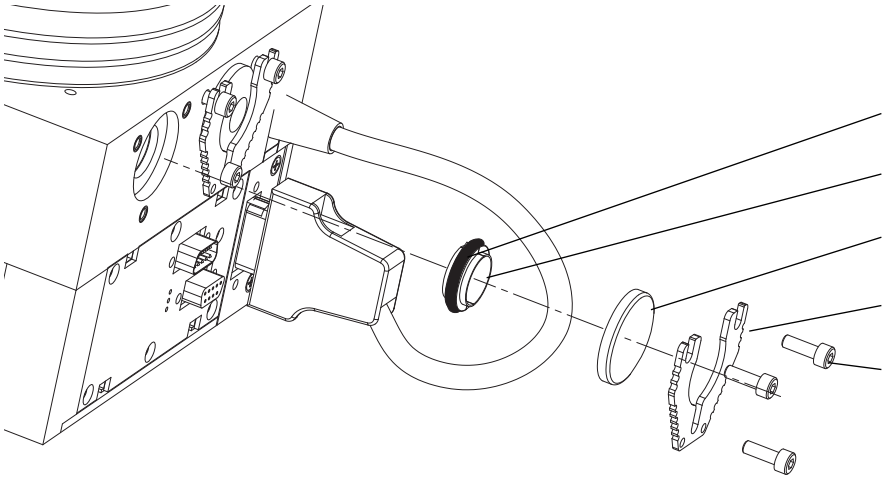
In some cases also a combination of the above will be needed, for example, check by the operator, rectification of the fault by maintenance staff.

Malfunction	Possible cause	Corrective action	Responsible
Red ERROR LED is on: Error code1: Overspeed error	EMC influence	Check connecting cable, insert it properly Switch the power supply voltage off and then on again	Operator/ maintenance staff Operator
	TURBO.DRIVE 300 faulty	Replace frequency converter.	Maintenance staff/ Leybold service
Red ERROR LED is on: Error code 2 + 6: pass through timer error and run up time error	Forevacuum or high-vacuum pressure too high.	Check the forevacuum pump and use a different forevacuum pump if necessary.	Operator/ maintenance staff
	Gas volume too great.	Seal leak; install a higher-capacity vacuum pump if necessary.	Maintenance staff
• Pump runs up too slowly • Pump looses its speed	Power supply overloaded	Reduce the number of consumers or use a stronger power supply or switch on the consumers one after the other.	Operator/ maintenance staff
	Bearing defective.	Repair the pump.	Leybold service
Red ERROR LED is on: Error code 3 + 7: bearing temperature error and motor temperature error	Forevacuum pressure too high.	Check the forevacuum pump and use a different forevacuum pump if necessary.	Operator/ maintenance staff
	Gas volume too great or leak in the system.	Seal leak; install a higher-capacity vacuum pump if necessary.	Maintenance staff
	Fan defective.	Replace the fan.	Leybold service
	Ambient temperature too high.	Feed cooler air to the pump or install water cooling.	Maintenance staff
	Bearing defective.	Repair the pump.	Leybold service

Malfunction	Possible cause	Corrective action	Responsible
Red ERROR LED is on: Error code 4: Short circuit error	Short circuit in the pump's motor	Repair the pump.	Leybold service
	Short circuit in the connecting cable	Check to see if the connecting cable is undamaged, exchange it if required.	Operator/ maintenance staff
Red ERROR LED is on: Error code 5: converter temperature error	TURBO.DRIVE integrated in the pump: Inadequate cooling of the pump; operation at too high loads	See error code 3 + 7.	–
	Separate TURBO.DRIVE: Ambient temperatures too high Inadequate cooling of the TURBO.DRIVE	Improve the cooling situation: Install a fan. Ensure better thermal linking to the cooling surface and ensure a lower temperature at the cooling surfaces. Avoid exposure to the heat generated by other equipment.	Maintenance staff Maintenance staff Maintenance staff
	Operation at too high loads	See error code 3 + 7.	–
Red ERROR LED is on: Error code 8: pump error TURBO.DRIVE 300 can not detect the type of connected pump.	Pump not connected to TURBO.DRIVE	Check connecting cable.	Operator
	Wrong connector cable pump - frequency converter.	Use standard cable; see Section 1.3.	Maintenance staff
	Power supply builds up the DC too slowly.	Use power supply recommended by Leybold.	Maintenance staff
	Power supply overloaded.	Reduce the number of consumers when switching on or use a stronger power supply.	Operator/ maintenance staff
Yellow power LED is not on.	No DC power	Check cables and power supply.	Operator/ maintenance staff
	DC power miswired.	Ensure correct polarity of the DC cable.	Maintenance staff
	Frequency converter defective.	Replace frequency converter. The following may damage the frequency converter: • Disconnection of the DC cable while the pump was still rotating • Non-compliance with the note related to connecting several pump to a single power supply.	Maintenance staff/ Leybold service
Red LED flashes.	Warning message. See Section "Warning codes" for the possible reasons of the warning.	The pump can continue to run, possibly with reduced load. The warning "bearing change required" (occurs after the bearing temperature had reached the switch-off threshold and then the pump has cooled down again) can only be reset by separating the frequency converter from the mains power supply and the pump. In this case possibly other settings are set to the default values. We recommend to let the bearings change.	Operator/ maintenance staff
Yellow LED flashes.	Warning message: Supply voltage too low or too high.	The pump can continue to run. Check the reason for wrong voltage and eliminate the fault.	Operator/ maintenance staff

Malfunction	Possible cause	Corrective action	Responsible
Turbomolecular pump does not start, ERROR LED does not light.	Operation mode set wrongly, e. g. with TURBO.DRIVE Panel or Server.	Change parameter 12.	Operator/ Maintenance staff
	Interface protocol error	Use USS protocol.	Operator/ Maintenance staff
	No communication via the serial interface.	Connect bus as shown in Section 2.7.	Maintenance staff
	REMOTE connector (X1) connected wrongly.	Connect as shown in Fig. 22.	Maintenance staff
	REMOTE and SERVICE connectors mixed up.	Connect correctly.	Maintenance staff
	Wrong Profibus address set.	Set address between 0 and 126.	Operator/ Maintenance staff
Turbomolecular pump produces loud running noises and vibrations.	Rotor out of balance.	Balance the rotor.	Leybold service
	Bearing defective.	Replace the bearing.	Leybold service
Turbomolecular pump does not reach ultimate pressure.	Measurement instrument defective.	Inspect the measurement sensor.	Operator/ Maintenance staff
	Measurement sensors soiled.	Clean or replace the sensors.	Maintenance staff
	Leaks at the equipment, lines or the pump.	Check for leaks.	Maintenance staff
	Pump soiled.	Clean the pump.	Leybold service
	Forevacuum pump provides insufficient pumping speed or ultimate pressure which is too high.	Check the ultimate pressure of the forevacuum pump and install a higher-capacity vacuum pump if necessary.	Operator/ maintenance staff
	Frequency parameters programmed wrongly.	Check parameters.	Operator/ Maintenance staff

6 Spare parts



	Part no.
O ring 18 x 5, FPM	239 70 176
Centering ring DN 16 KF	231 94 205
Blind flange DN 16 KF	361 20 205
Clamping yoke DN 16	200 18 372
Screw M4 x 10	200 18 489

Fig. 32 Spare parts

EEC Manufacturer's Declaration

in the sense of EEC Directive on Machinery 89/392/EWG, Annex IIb

We - LEYBOLD Vacuum GmbH - herewith declare that operation of the incomplete machine defined below, is not permissible until it has been determined that the machine into which this incomplete machine is to be installed, meets the regulations of the EEC Directive on Machinery.

At the same time we herewith certify conformity with EEC Directive on Low-Voltages 73/23/EWG.

When using the appropriate Leybold accessories, e.g. connector lines, valves, or fans, the protection level prescribed in the EMC Guidelines will be attained.

Designation: Turbomolecular pump

Model: TW 300, TW 300 H

Catalog numbers: 80001xVxxxx

„x": Variable 0 to 9

Applied harmonized standards:

• EN 292 Part 1 & 2	Nov. 1991
• EN 1012 Part 2	1996
• EN 60 204	1993
• EN 61 010-1	1993

Applied national standards and technical specifications:

• DIN 31 001	Nov. 1984
• DIN ISO 1940	Dec. 1993

Cologne, Oct. 31, 2000

Dr. Reinelt, Business Area Manager
Turbomolecular pumps

Cologne, Oct. 31, 2000

Dr. Beyer, Design Department Manager
Turbomolecular pumps

EC Declaration by the Manufacturer

as defined by Machinery Directive 98/37 EEC, Appendix II B

Document No:	0963.0EH.0
Month, Year:	November, 2002
Manufacturer:	Company
	Lust Antriebstechnik GmbH
Address:	Gewerbestraße 5 - 9
	D - 35633 Lahnau (Germany)
	Tel.: 06441 / 966-0
Product:	**TURBO.DRIVE 300**
Typ:	**TD300: 800072Vxxxx**

The product described is intended exclusively to be installed in another machine or in an installation in the sense of the Machinery Directive.
Commissioning is prohibited until such time as conformity of the end product with Directive 89/392/EEC is established.

The standards relevant to Directive 89/338/EEC (EMC) which have been used in type testing the product described are:
EN 61326: 2001- 02
EN 61326/A1: 1998- 04
In order to comply with EMC legislation the installation instructions described in the product documentation must be observed.

Manufacturer:	Company
	Lust Antriebstechnik GmbH
Place, Date:	Lahnau, November, 07.2002

Legally Binding signature:

K.-H. Lust Managing Director

This declaration does not imply any assured characteristics.
The installation directions and safety instructions in the product documentation must be observed.

Semiconductor Equipment and Materials International

The system TURBOVAC TW 300 H / TURBO.DRIVE S, turbomolecular pump with integrated frequency converter, has been tested successfully by the TÜV Rheinland Product Safety GmbH according to the requirements of

SEMI S2-0200

Report No. E2110757.02

The system TURBOVAC TW 300 H / TURBO.DRIVE 300, turbomolecular pump with integrated frequency converter, has been tested successfully by the TÜV Rheinland of North America according to the requirements of **NRTL**. Relevant standard: UL 61010 A-1: 2002 R4.02

NRTL Report No. USA-JK 30380455001

Certificate No. US 72030360 01

Index

LEYBOLD

VDMA

Declaration of Contamination of Vacuum Equipment and Components

The repair and/or service of vacuum equipment and components will only be carried out if a correctly completed declaration has been submitted. Non-completion will result in delay. The manufacturer could refuse to accept any equipment without a declaration.

This declaration can only be completed and signed by authorized and qualified staff.

1. Description of Vacuum Equipment and Components

- Equipment type/model: _____
- Code No.: _____
- Serial No.: _____
- Invoice No.: _____
- Delivery date: _____

2. Reason for Return

_____
_____
_____
_____
_____
_____

3. Condition of the Vacuum Equipment and Components

- Has the equipment been used?
  yes ❒ no ❒
- What type of pump oil/liquid was used? _____
- Is the equipment free from potentially harmful substances?
  yes ❒ (go to Section 5)
  no ❒ (go to Section 4)

4. Process related Contamination of Vacuum Equipment and Components:

- toxic	yes ❒	no ❒
- corrosive	yes ❒	no ❒
- explosive*)	yes ❒	no ❒
- biological hazard*)	yes ❒	no ❒
- radioactive*)	yes ❒	no ❒
- other harmful substances	yes ❒	no ❒

*) Vacuum equipment and components which have been contaminated by biological explosive or radioactive substances, will not accepted without written evidence of decontamination!

Please list all substances, gases and by-products which may have come into contact with the equipment:

Trade name Product name Manufacturer	Chemical name (or Symbol)	Dangerous material class	Measures if spillage	First aid in case of human contact
1.				
2.				
3.				
4.				
5.				

5. Legally Binding Declaration

I hereby declare that the information supplied on this form is complete and accurate. The despatch of the contaminated vacuum equipment and components will be in accordance with the appropriate regulations covering Packaging, Transportation and Labelling of Dangerous Substances.

Name of organisation or company: _____

Address: _____ Post code: _____

Tel.: _____

Fax: _____ Telex: _____

Name: _____

Job title: _____

Date: _____ Company stamp:

Legally binding signature: _____

 Order No.: 2121

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