Vacuum Solutions | Application Support | Service

LEYBOLD VACUUM

GA 05.137/9.02

TURBOVAC TW 250 S
TURBO.DRIVE S

Turbomolecular Pump
and Frequency Converter

Cat. No. 113 52, 114 37, 114 42,
800070V0001 /0003 /0006

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.

1 Description

The TURBOVAC TW 250 S is a turbomolecular pump designed to evacuate vacuum chambers down to pressure levels in the high vacuum range. It is suitable for pumping air and clean gases. The TURBO.DRIVE S frequency converter and a forevacuum pump are required for its operation.

These pumps are **not** suitable for

- pumping liquids or gases containing dust or particulates
- pumping corrosive 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.

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

Warning

Never expose any parts of the body to the vacuum.

1.1 Design

The pumps comprise essentially the pump housing, a multi-stage rotor with the stator group, and the drive.

The first section of the rotor is a turbomolecular pump rotor while the second tile represents a Holweck stage. The Holweck pumping stage increases the permissible forevacuum pressure level markedly when compared with the classic 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.

A circuit board and a fan are installed in the pump. The circuit board is equipped with a temperature sensor and a resistor code.

Water cooling is available as optional equipment; this is bolted to the housing of the pump.

The intake flange is fitted with a wire mesh splinter guard to protect the pump against mechanical damage caused by foreign objects.

KF type components can be connected directly to the forevacuum flange using a clamping yoke.

The pumps exhibit a threaded hole, used as the connection point for venting. This port is sealed at the factory with a screw and gasket ring.

The TURBOVAC TW 250 S has an additional purge gas device. The purge gas is also connected at the venting port.

The TURBO.DRIVE S frequency converter takes care of power supply and pump control.

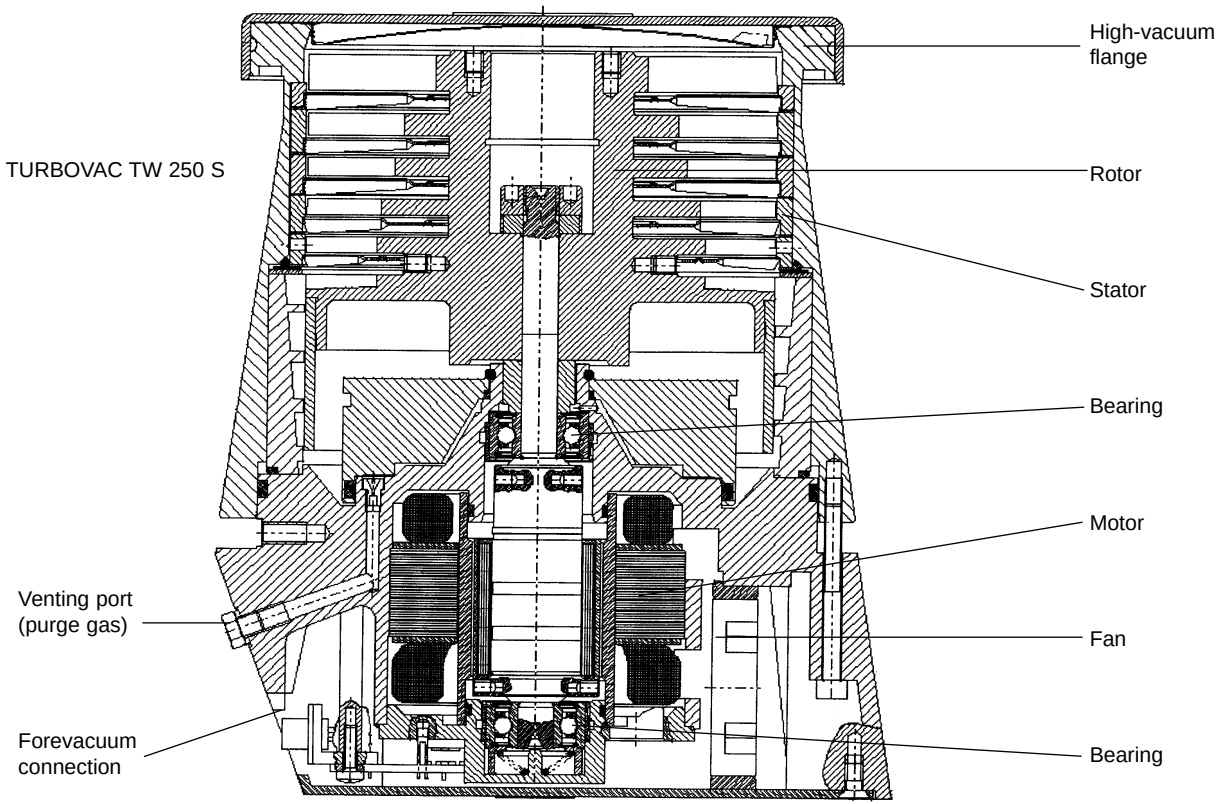


Fig. 1 Section through the pump

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 are equipped with blank covers for shipping.

The high-vacuum connection elements are **not** part of the standard equipment. For the forevacuum connection a centering ring with FPM sealing ring, and a clamping yoke is delivered.

A DC coupling is included with the frequency converter.

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

1.3 Ordering data

TURBOVAC TW 250 S	***Cat. No.***
for operation with TURBO.DRIVE S with DN 100 ISO-K high-vacuum flange with coarse splinter guard	113 52
with TURBO.DRIVE S with Profibus mounted under the pump with DN 100 ISO-K high-vacuum flange with water cooling with coarse splinter guard	114 37
with TURBO.DRIVE S with RS 485 interface mounted under the pump with DN 100 ISO-K high-vacuum flange with fine splinter guard with mounted venting valve	114 42
Water cooling with G 1/8“ connector	200 06 255
Adapter G 1/8“ — 1/4“ Swagelok	200 12 686
Splinter guard, coarse	200 18 692
Splinter guard, fine	200 18 340

Venting valves

Power failure airing valve, 220/240 V AC	280 71
Power failure airing valve, 24 V AC	280 85
Venting valve, 220/240 V AC	280 70
Venting valve, 110/120 V AC	280 72
Venting valve, 24 V AC	280 73
Venting valve, 24 V DC	280 74
Mounting kit for power failure airing valve or venting valve	863 20
Purge gas and venting valve, 220/240 V AC	855 49
Purge gas and venting valve, 110/120 V AC	855 48

TURBO.DRIVE S for operation with TW 250 S

without RS 485 interface	800070V0001
with RS 485 interface	800070V0003
with RS 485 interface, with heat sink	800070V0006

Power Supply

SITOP Power 10	152 50
other power supplies	on request

Connector cable pump – frequency converter
(TD Pump cable)

1.0 m long	152 47
2.5 m long	864 49
3.0 m long	864 40
5.0 m long	864 50
Plug for REMOTE connector with integrated ***ON/OFF switch*** for the pump	152 48

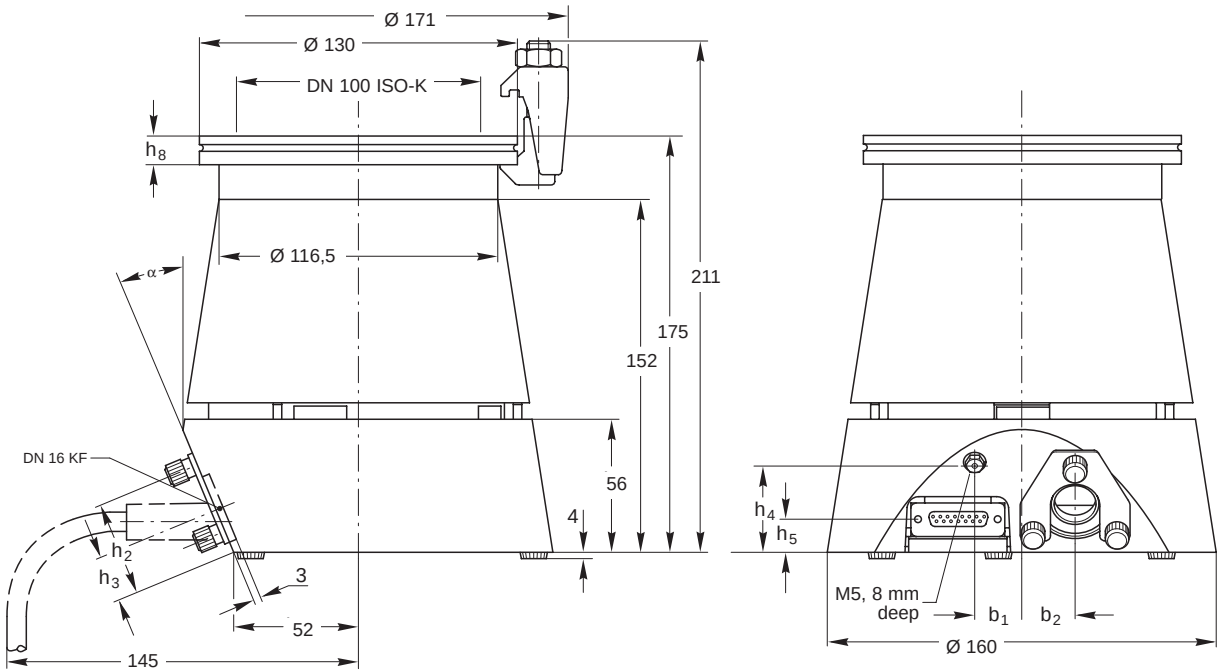
1.4 Technical data

TURBOVAC	***TW 250 S***
High-vacuum connection	DN 100 ISO-K
Pumping speed for N_2	230 $l \cdot s^{-1}$
Ultimate pressure	
with two-stage, oil-sealed rotary vane pump	< 10^{-9} mbar
with piston pump	< 10^{-8} mbar
with diaphragm pump achieving ultimate pressure < 5 mbar	< 10^{-7} mbar
Max. permissible forevacuum pressure	3 mbar
Recommended forevacuum pumps	
• TRIVAC	D 2.5 E
• ECODRY	M 15
• Diaphragm pump with ultimate pressure < 5 mbar and pumping speed at 5 mbar	on request > 2 $m^3 \cdot h^{-1}$
• (at purge gas operation) TRIVAC	D 8 B
Operating speed	51 600 r.p.m.
Run-up time, approx.	3 min
Forevacuum connection	DN 16 KF
Venting port	threads M 5
Weight, approx.	5 kg
Noise level	< 55 dB(A)
Type of protection	IP 20
Option pump with water cooling	
Cooling water connections	G 1/8“
Cooling water data	see Section 2.4

TURBO.DRIVE	***S***
Supply voltage	24 V DC ± 5%
Residual ripple	< 2%
Max. power consumption	125 W
Max. permanent current	5 A
Max. current	6.5 A
Max. length of the DC cable (shielded)	
at 3 x 1.5 mm^2	5 m
at 3 x 2.5 mm^2	10 m
Load capability, relay output	48 V, 0,5 A

Ambient temperature	
during operation	10 - 45 °C
storage	-15 - + 70 °C
Temp. of the heat transmission surface	10 - 55 °C
Stray power	≤ 20 W
Relative air humidity acc. to DIN EN 60721	Class F
Type of protection	IP 20
Weight, approx.	0,7 kg
RS 485 Interface	19 200 Baud
Address	0 - 15
Parity	even
Response delay time	2 - 19 ms
Default	10 ms

Power supply	***SITOP Power 10***
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



b_1	b_2	α	h_2	h_3	h_4	h_5	h_8
20	22	22°	40	20	37	14	12

Fig. 2a Dimensional drawing for the pump, dimensions in mm

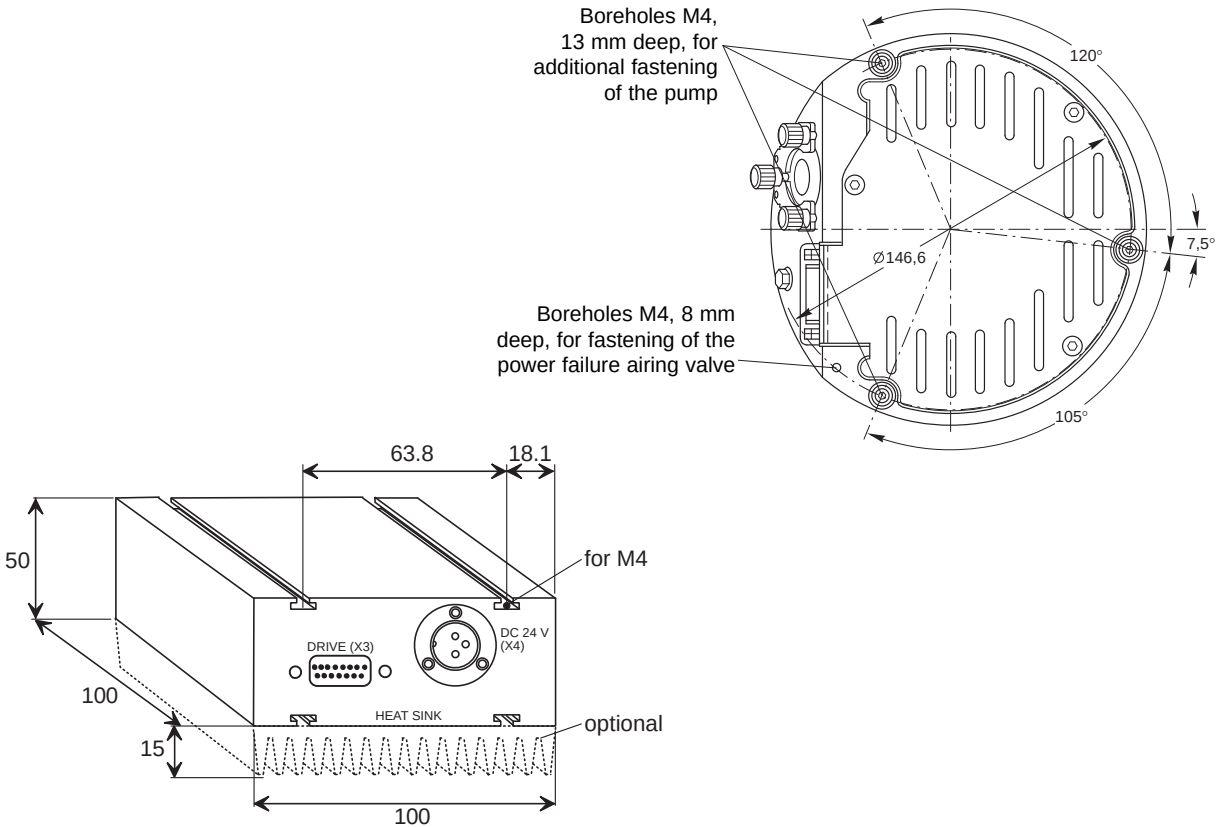
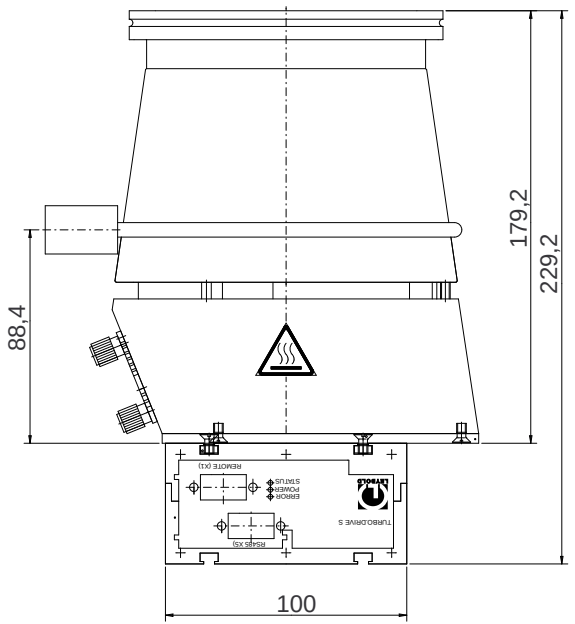
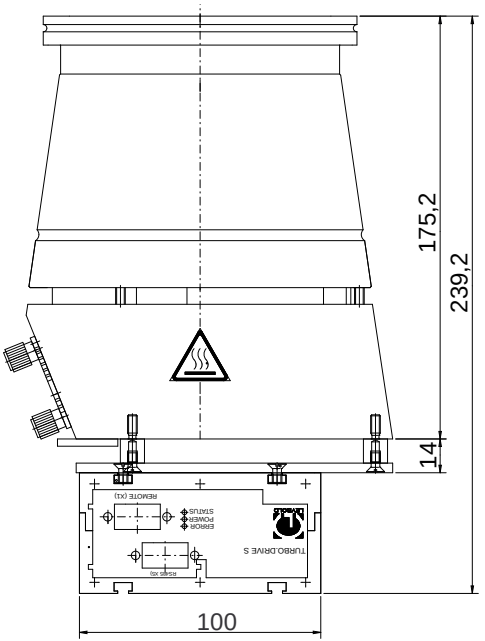


Fig. 2b Dimensional drawing for the frequency converter and bottom of the pump, dimensions in mm



Pump with water cooling



Frequency converter mounted with distance sleeves

Fig. 2c Dimensional drawing for the pump with mounted frequency converter; dimensions in mm

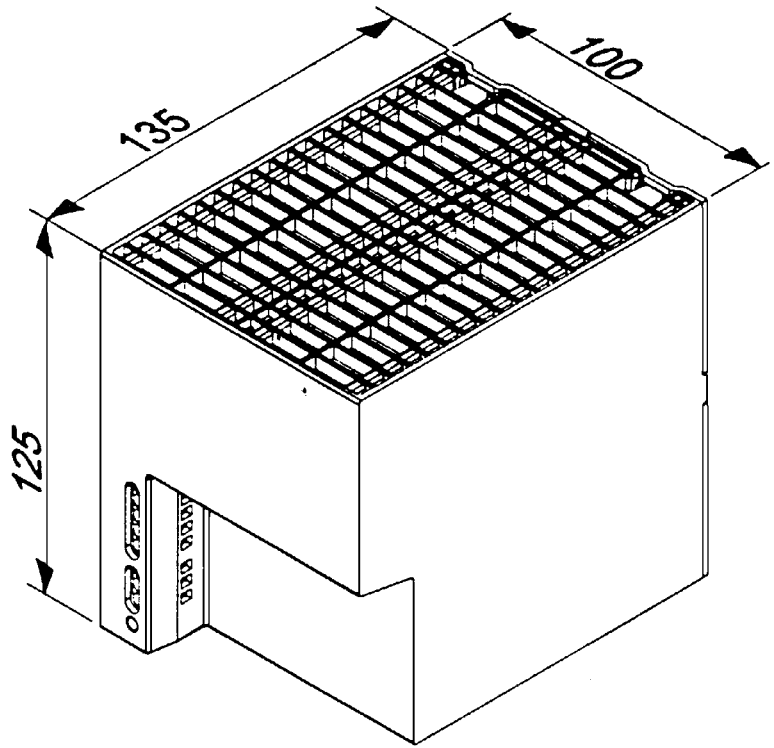


Fig. 2d Dimensional drawing for the SITOP Power 10 power supply; dimensions in mm

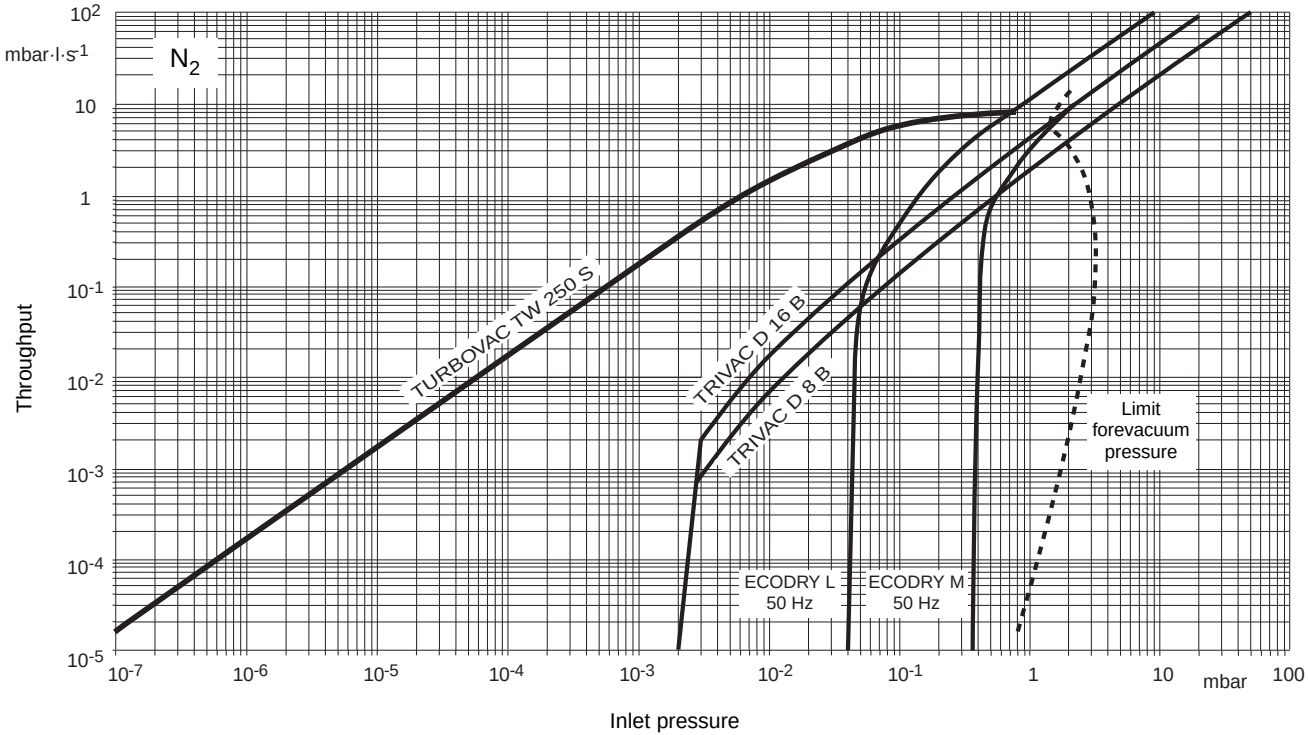


Fig. 3 Operation diagram for nitrogen

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 contain 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 blank flanges on the pump until just before attachment to the equipment to ensure that assembly is carried out under the cleanest possible conditions.

The noise level when the pump is running is below 70 dB(A). No acoustic insulation is required.

Warning

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

2.1 Operating environment

When using the air cooling alone, the maximum permissible ambient temperature is 40°C (104 °F). Do not expose the pump or the frequency converter to dripping or spraying water.

Places of installation up to 1000 m above sea level (3300 ft) are possible without restrictions. For higher places of installation, please ask Leybold.

If the pump is used within a magnetic field, the magnetic induction at the surface of the pump housing may not exceed:
B = 5 mT if impinging radially and
B = 15 mT if impinging axially.

Install shielding equipment as appropriate if these values are exceeded.

The standard version is resistant to radiation up to 10^3 Gy.

1 mT (milli-Telsa) = 10 G (Gauss)
1 Gy (Gray) = 100 rad

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 up to 470 Nm will have to be absorbed by the system. To accomplish this, 4 clamping bolts are required when securing an ISO-K type high-vacuum flange.

Clamping bolts made of steel must be torqued down to 35 Nm (26 ft-lb), those made of stainless steel to 50 Nm (37 ft-lb).

In most applications the pump is flanged to the high-vacuum flange at the apparatus. The pump can be mounted and operated in any desired attitude.

No support is required. If nonetheless an additional fastening is requested you can use the 3 boreholes in the pump's bottom. A rubber foot must be removed from one of the boreholes.

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.

Legend for Fig. 4

1 High-vacuum connector flange
2 Wire mesh splinter guard
3 Forevacuum connection
4 Venting port (purge gas)
5 Connection for frequency converter

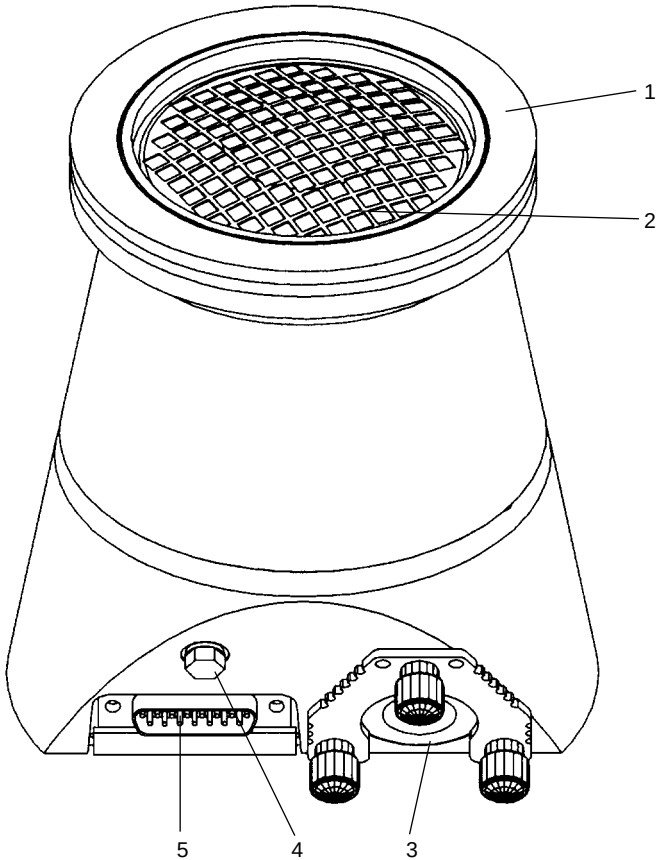


Fig. 4 Connection elements

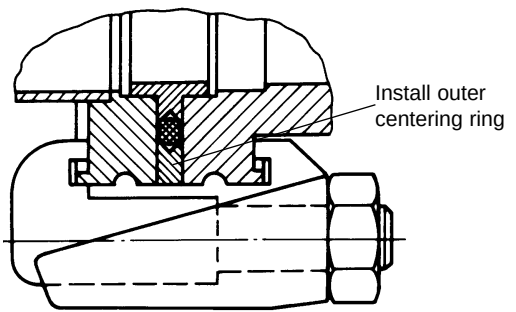


Fig. 5 Using type ISO-K flanges

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.

Splinter protection

A wire mesh splinter guard screen is installed in the high-vacuum flange to protect the pump.

The pump shall be run only with this guard in place since 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.

2.3 Forevacuum connection

The high vacuum pressure level which can be achieved is a function of the volume of gas flow Q to be pumped and the forevacuum pressure; see Figure 3.

We recommend using dry-running diaphragm vacuum pumps or piston pumps ECODRY M or the one-stage or two-stage TRIVAC rotary vane pump for this purpose.

Connect the forevacuum line; refer to Figure 6.

To do so, remove the three screws and the clamping yoke. Remove the shipping plug.

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 down by hand.

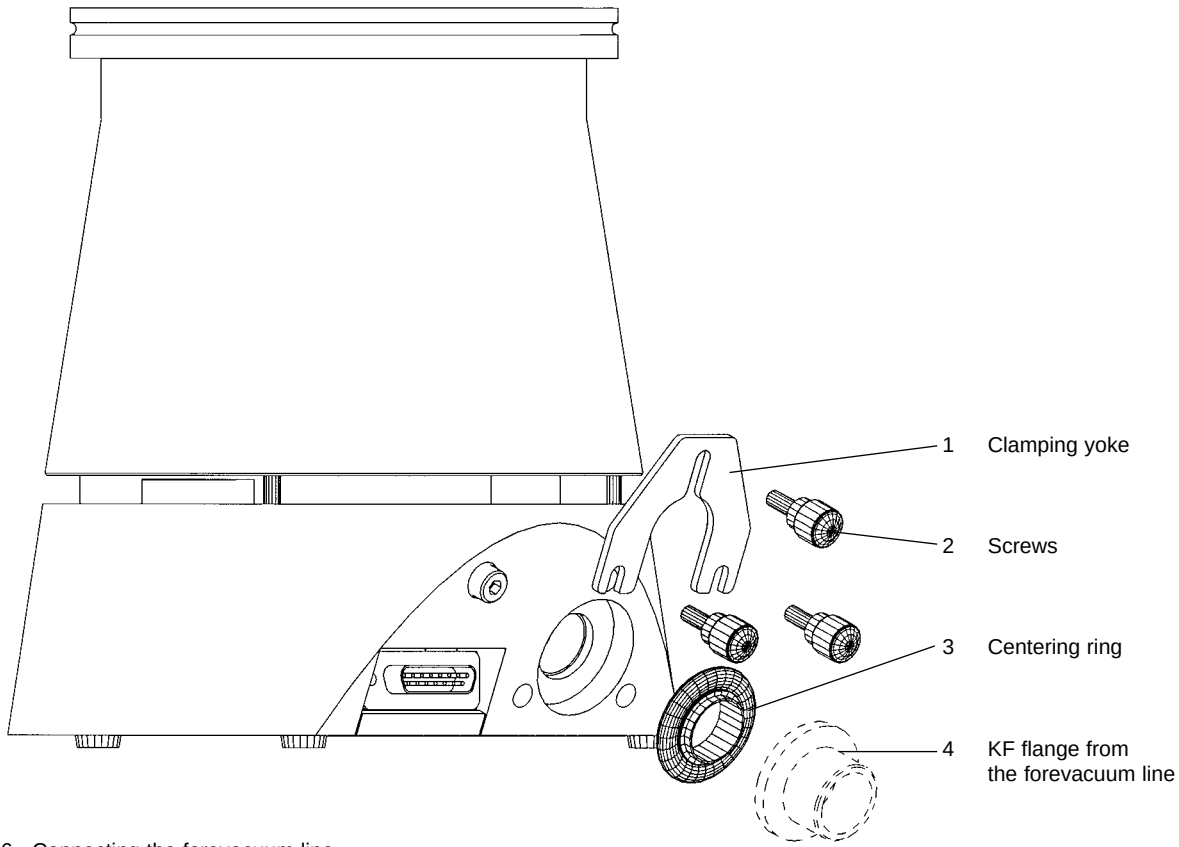


Fig. 6 Connecting the forevacuum line

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 11 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 must be 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. Alternatively purge the forevacuum line with inert gas. In this case the pressure in the forevacuum line must be over 10^{-2} mbar.

Provide a roughing line to achieve the shortest cycle times.

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

2.4 Connect the cooling

2.4.1 Air cooling

The pump is equipped with an internal fan which is fed by the DC supply of the frequency converter. When installing the pump into a housing, ensure that the flow of cooling air is not restricted.

Refer to Figure 9 for the cooling requirements for the TURBO.DRIVE S.

2.4.2 Water cooling

Cooling water specifications

Feed temperature	20 - 40 °C
Feed pressure	3 to 7 bar absolute
Cooling water requirement	See Fig. 7
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.

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.

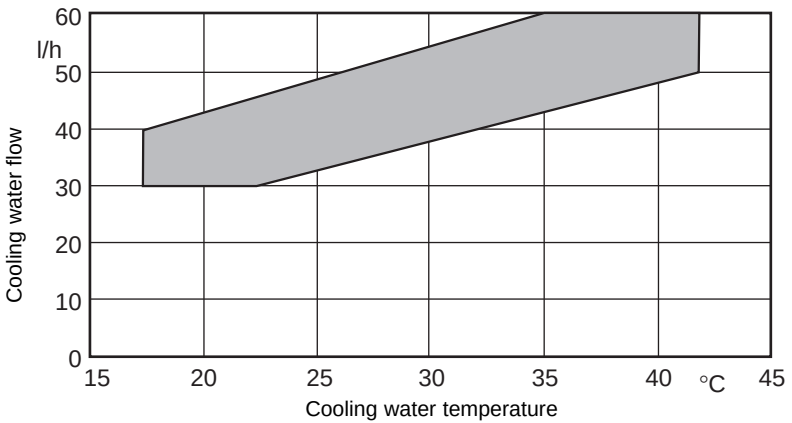


Fig. 7 Cooling water requirements

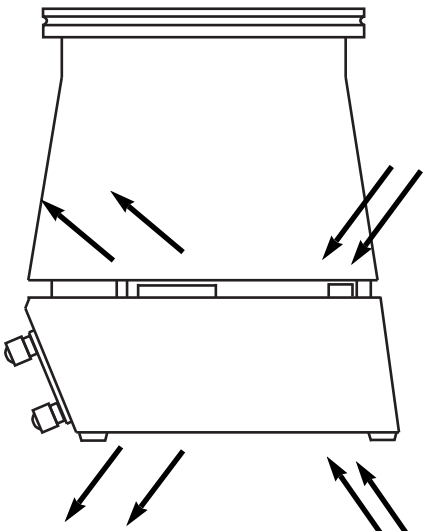


Fig. 8 Cooling air flow pattern

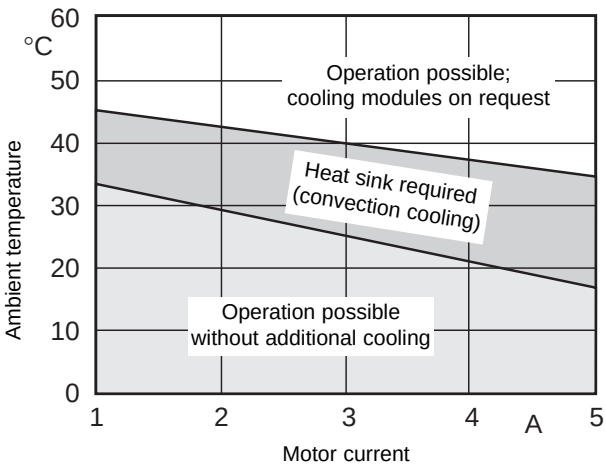


Fig.9 Cooling requirements for the TURBO.DRIVE S

2.5 Connect the purge gas and airing valve

The pumps have a threaded port (Fig. 4 / Item 4) which serves as the vent connection; it is sealed with a screw and gasket during shipment.

This port is provided for connecting a power failure airing valve or a venting valve.

For the connection of the power failure airing valve or venting valve we recommend the mounting kit; see Fig. 10.

Warning

Mains voltage may be present at the power failure airing 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 airing valve.

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.

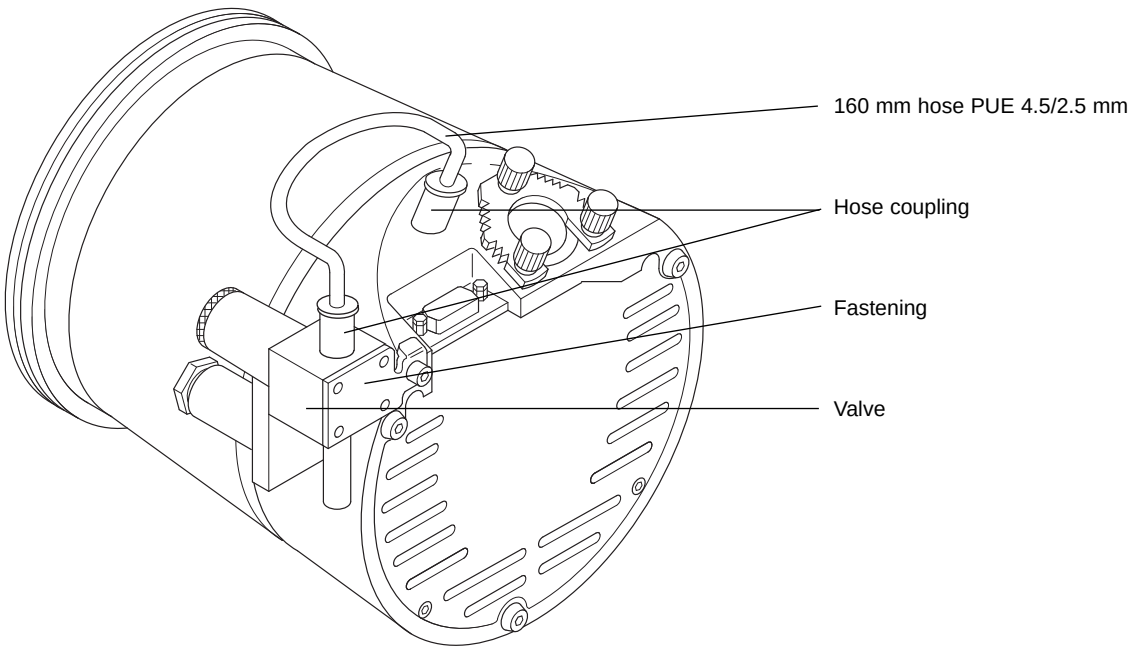
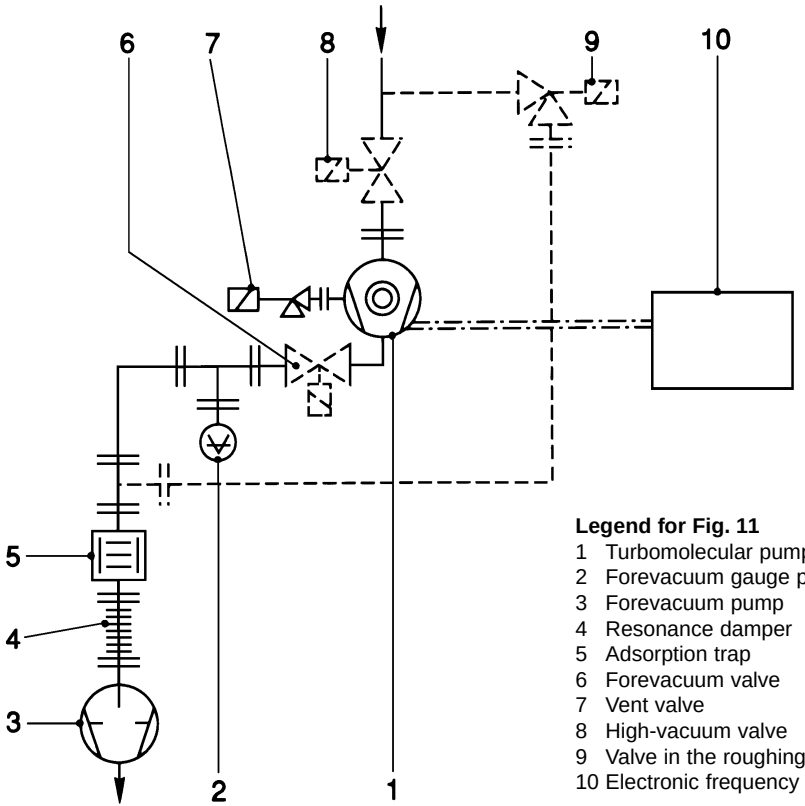


Fig. 10 Pump with power failure airing valve and mounting kit



Legend for Fig. 11

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; recommended to achieve the shortest possible cycle times

Fig. 11 Schematic of a turbomolecular pump system

2.6 Connect the frequency converter

Use the cable to connect the frequency converter and the pump.

Warning

The frequency converter must only be connected to power supplies which meet the requirements for functional extra-low voltages 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. Peak currents in the kHz range may be present on the DC side. The power supply should have a current limiter or control.

Connect the frequency converter to the 24 V DC power supply. The DC coupling for the power supply cable is included in the standard specification.

Caution

Ensure correct polarity.

Connect the power supply to the mains.

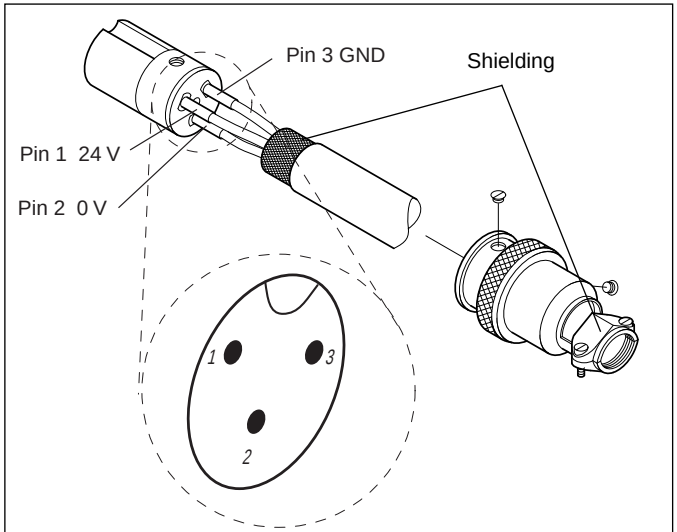


Fig. 12 Pin assignment of the DC connector (X4)
Model Hirose HS16P-3

Warning

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

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

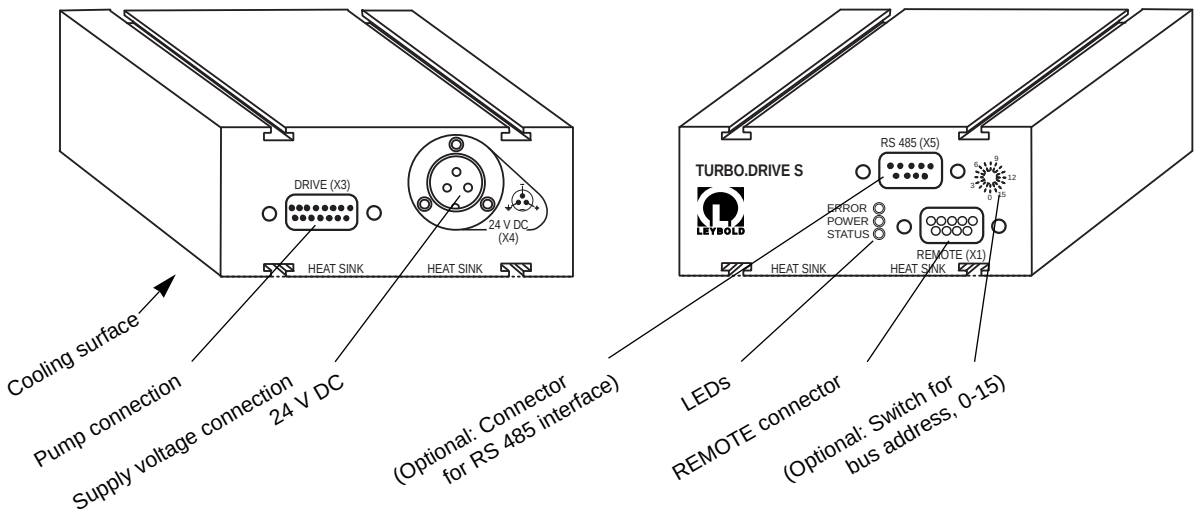
The frequency converter can be mounted into a rack. The bottom side of the frequency converter must be cooled sufficiently.

If the frequency converter is mounted without the optional heat sink ensure sufficient cooling by other means.

The cooling surface of the frequency converter must not warm up to more than 55 °C (113 °F). When mounting the frequency converter on existing cooling surfaces ensure good thermal contact between the surfaces.

For special requirements please contact Leybold.

The frequency converter has an internal SMD fuse T 7 A. It can only be changed by the Leybold Service.



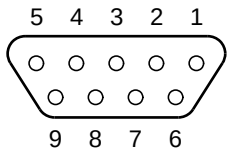
red LED: Failure

yellow LED: Voltage applied

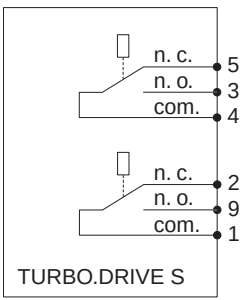
green LED
flashes: Run-up or Run-down
lights up: Normal operation

Fig. 13 TURBO.DRIVE S

Pin assignment of the connector



Relay operation



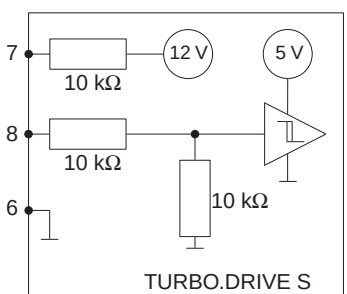
Relay - Normal operation

- 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

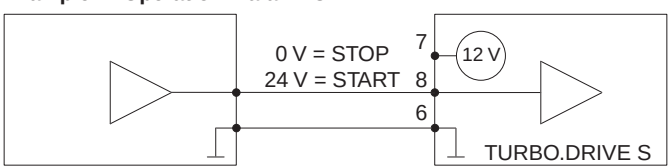
- No error: 1 connected to 2 (as shown; passive)
- Error is present: 1 connected to 9 (active)

Pin assignment for the Start/Stop input



Switching threshold for the Start/Stop control input:
Low level: < 3 V
High level: > 7 V

Start/Stop operation
Example 1: Operation via a PLC



Example 2: Operation via contacts

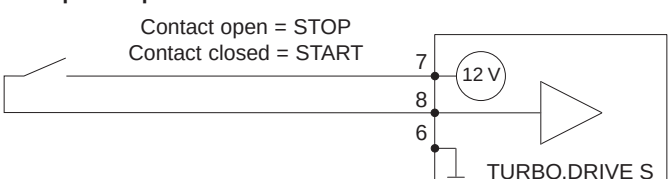


Fig. 14 Pin assignment of the REMOTE (X1) connector

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 (see Fig. 14)	Relay ERROR (see Fig. 14)	LED STATUS (green)	LED ERROR (red)	
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

Other modes are not possible; they indicate a failure affecting the TURBO.DRIVE S.

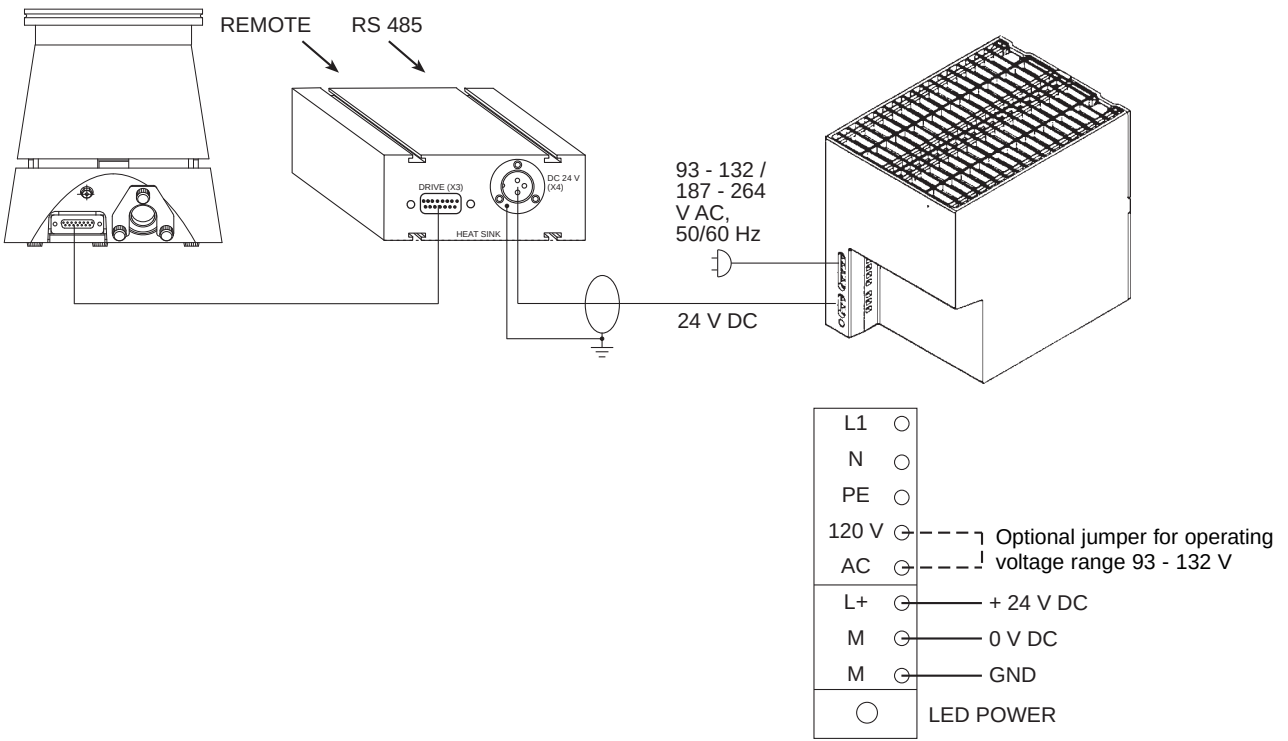


Fig. 15 Connection of the power supply and the TURBO.DRIVE S

2.7 Interface description

The frequency converter has a serial interface RS 485. It is operated with a USS compatible protocol. The frequency converter can be set to addresses 0 to 15. Addresses over 15 are not supported.

For more detailed information concerning the USS protocol please contact Leybold.

The RS 485 bus should be connected as shown in Fig. 17.

The TURBO.DRIVE S will be configurated by the parameters shown in the parameter list.

For further information on the interfaces (incl. the optional Profibus) refer to Operating Instructions GA 05.281 “Serial Interfaces”.

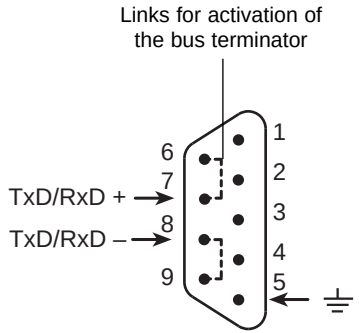


Fig. 16 Pin assignment of the interface connector „RS 485“

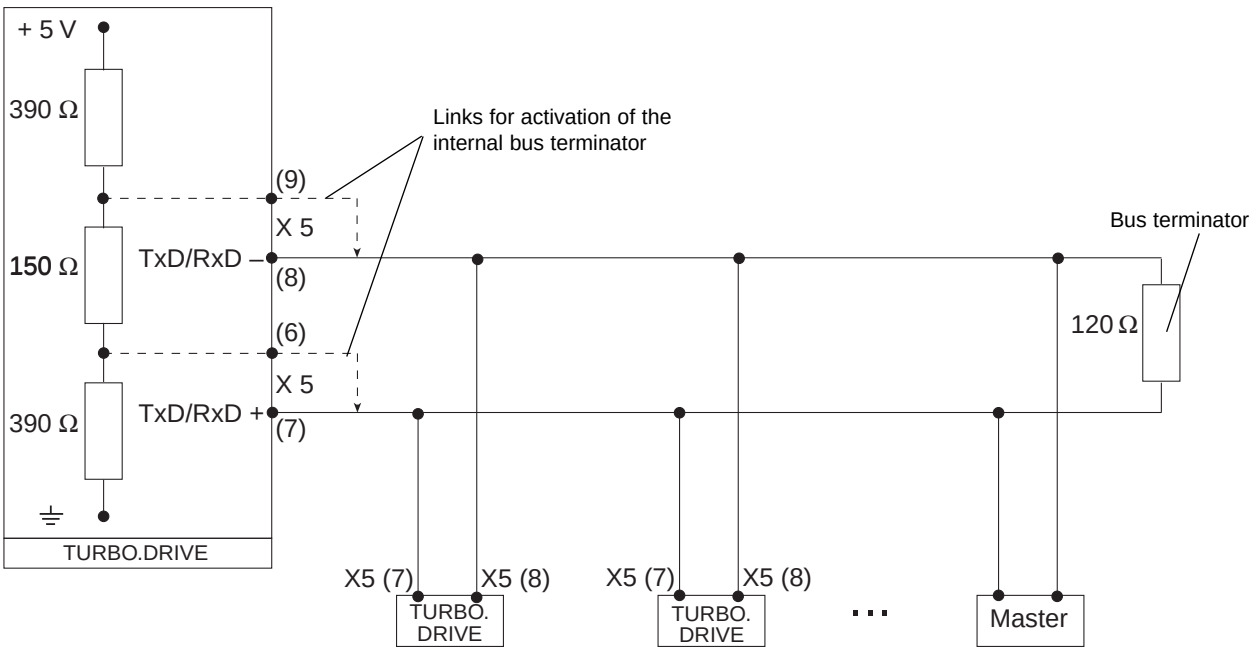


Fig. 17 Connection of the RS 485 bus

Parameter list

No.	Designation	Range	Unit	Default	Format	r/w	Description
0	Dummy parameter	-	-	-	U16		No function
1	Type of frequency converter	130 / 131	-	130	U16	r	TURBO.DRIVE S = 130
2	Software version	2.x.x	-	-	U16	r	
3	Actual rotor frequency	0...1300	Hz	-	U16	r	The max. frequency depends on the pump type.
4	Actual converter supply voltage	18...30	V	-	U16	r	Nominal value for TURBO.DRIVE S: 24V
5	Setpoint for the motor current	0... 60	0.1A	-	U16	r	
7	Actual motor-temperature	0...150	°C	-	U16	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.
11	Actual converter temperature	0...150	°C	-	U16	r	Measured internal converter temperature
12	Operating mode for Start/Stop	0...2	-	0	U16	r/w	P12 = 0 (default): via REMOTE (X1); see Fig. 14 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

No.	Designation	Range	Unit	Default	Format	r/w	Description
17	Max value setting for motor current	5 ... 75	0,1 A	45	U16	r/w	Maximum permissible motor current
18	Nominal pump frequency	750...1200	Hz	860	U16	r	Highest permissible frequency
19	Minimum setpoint frequency for the pump	375..600	Hz	450	U16	r	Lowest permissible frequency
20	Minimum frequency level	375..600	Hz	450	U16	r r	When the pump is accelerating this frequency must be reached within the maximum passing time (P183).
23	Pump type	0...4	-	2	U16	r	2 = TW 250S, T 180
24	Setpoint frequency	P19 ... P18	Hz	860	U16	r/w	Adjustable between P19 to P18
25	Frequency dependent normal operation level	0..100	%	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
29	Selection of the normal operation function	0 / 1	-	0	U16	r/w	Normal operation relay function: 0 = frequency dependent (see P25) 1 = current dependent (see P27)

No.	Designation	Range	Unit	Default	Format	r/w	Description
32	Maximum run up time	30...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
125	Current bearing temp.	0...150	°C	-	U16	r	Measured bearing temperature (identical to P127)
127	Current bearing temp.	0...150	°C	-	U16	r	Measured bearing temperature (identical to P125)
132	Bearing temperature shutdown level	30...150	°C	80	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
171	Error code memory for the last 8 error events Error codes see error table	0...8		0	Array 0..7 U16	r	Sequential permanent memory; the last error code which has occurred is saved at the memory location with the index 0, the oldest is at index 7
176	Error operating hours memory for the last 8 error events	0...19 years	0.01 h	-	Array 0..7 U32	r	Analogous to P171 (error code memory)

No.	Designation	Range	Unit	Default	Format	r/w	Description
180	Response delay time	2...19	msec	10	U16	r/w	Pause time between received and transmitted USS protocol string of the frequency converter's serial interface RS 232 and RS 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
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 In case of an error P303 has the value of 0 (not ready to be switched on)
312	Cat. No. code	0 ... 65535	-	-	U16	r	800070V0002 = 7002 800070V0003 = 7003 etc.
315	Serial No. code	1 ... 231-1	-	-	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

Error codes for parameter P171

Code	Type of error	Description of the error
0	No error	–
1	Overspeed error	Nominal speed of the pump (P 18) has been exceeded by over 10%
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
3	Bearing temperature error	Maximum bearing temperature has been exceeded: P125 > P132; P127 > P132
4	Short circuit error	Short circuit in the pump's motor or the connecting cable
5	Converter temperature error	Maximum temperature for the converter has been exceeded: P11 > 75°C
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
7	Motor temperature error	Maximum motor temperature has been exceeded: P7 > P133
8	Pump error	Pump could not be identified or no pump is connected.

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.

3.1 Switching on

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

The starting pressure for the turbomolecular pump can be read from the graph in Figure 18.

Switch on the turbomolecular pump at the frequency converter

- by connecting pins 7 and 8 of the REMOTE (X1) connector (e.g. via remote control or via the plug with integrated ON/OFF switch) or
- by a start command via the RS 485 interface.

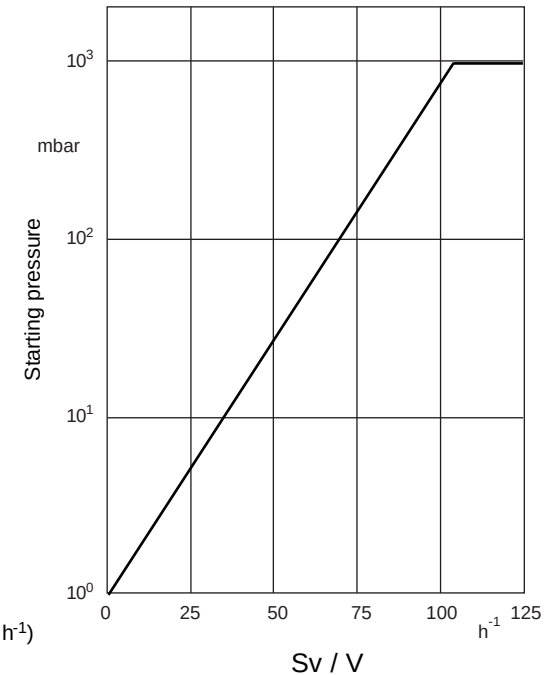
If the contacts 7 and 8 at the REMOTE (X1) connector are closed the pump starts automatically when the DC voltage is switched on (provided that parameter 12 is set to 0).

The turbomolecular pump runs up. The green LED at the frequency converter flashes. When the pump reaches normal operation the green LED lights up permanently. Refer to the working diagram in Fig. 15.

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).



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

Fig. 18 Determining the starting pressure of a turbomolecular pump when evacuating large volumes

3.2 Shutting down

Switch off the pump at the frequency converter. Disconnect contacts 7 and 8 at the REMOTE (X1) connector or apply a stop command via the RS 485 interface or switch off the DC voltage.

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.

Warning

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

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.

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 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.

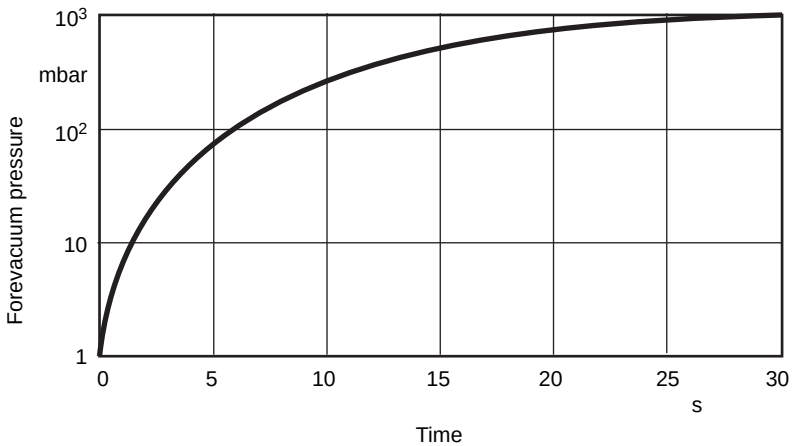


Fig. 19 Rise in pressure

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 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.

The pumps may have been 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 serous corrosion damage to the pump.

To avoid health hazards and corrosion damage when the pumps are detached from the system, lay a container of desiccant on the splinter guard and then close the pump immediately at all flange connections and the venting port. 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.

4 Maintenance

We recommend a standard bearing change after 20,000 operating hours 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 (at the latest after 15,000 and 40,000 hours respectively).

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.

4.1 Cleaning

If required clean the turbomolecular pump of dust 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“.

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:

Is the turbomolecular pump connected to the electrical power supply?

Are the connections in good working order?

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

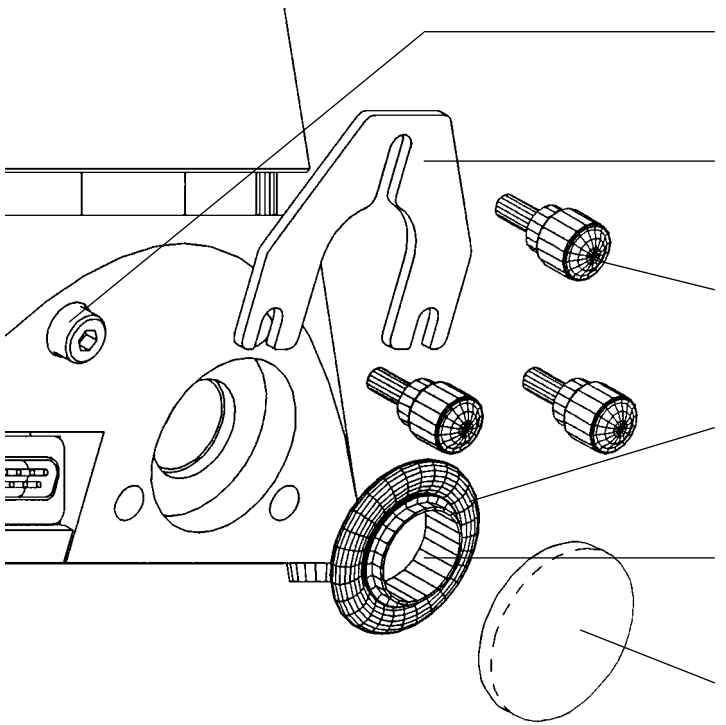
Is the forevacuum pressure sufficient?

Malfunction	Possible cause	Corrective action
Turbomolecular pump does not start.	**Fault in the DC supply**	
	Plug or cable not properly attached, loose or defective.	Attach the cable and cord correctly; replace if necessary.
	DC cable too long.	Increase the cross section of the DC cable or use shorter DC cable.
	DC connection with wrong polarity.	Connect DC connection correctly.
	Control error	
	REMOTE operation not set.	Change parameter 12.
	Interface protocol faulty.	Use USS protocol.
	No RS 485 communication.	Connect bus as shown in Section 2.7.
	Connector line	
	Wrong connector cable pump - frequency converter.	Use standard cable (TD pump cable); see Section 1.3) (ConeNect doesn't work)
	Plug or connector line not properly attached, loose or defective.	Attach the cable and cord correctly; replace if necessary.
	Equipment failure	
	Output of the power supply insufficient.	Use suitable power supply.
	Short circuit in the TURBO.DRIVE S due to pulling of cables during deceleration of the pump.	Change fuse (may be done only by a Leybold service technician).
	Pump has seized.	Replace the pump.

Malfunction	Possible cause	Corrective action
Turbomolecular pump produces loud running noises and vibrations.	Rotor out of balance.	Have the rotor balanced (may be done only by a Leybold service technician).
	Bearing defective.	Have the bearing replaced (may be done only by a Leybold service technician).
Turbomolecular pump does not reach ultimate pressure.	Measurement instrument defective.	Inspect the measurement sensor.
	Measurement sensors soiled.	Clean or replace the sensors.
	Leaks at the equipment, lines or the pump.	Check for leaks.
	Pump soiled.	Have the pump cleaned (may be done only by a Leybold service technician).
	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.
	Frequency parameters programmed wrongly.	Check parameters.

Malfunction	Possible cause	Corrective action
The speed of the turbo-molecular pump drops.	Cooling for pump and/or frequency converter insufficient.	Provide sufficient cooling; refer to Section 2.4.
	Power supply or cables don't work properly.	Connect power supply correctly or replace it. If the voltage drops too much on the DC cable the DC output voltage of the power supply may be increased; see Operating Instructions for the power supply.
	Control signals with interference.	Use shielded control cables. Observe the bus termination. Observe the „control word" function.
	Gas flow too high or leak in the system.	Seal any leaks, check the process, install a higher-capacity vacuum pump if necessary.
Turbomolecular pump runs too hot.	Forevacuum pressure too high.	Check the forevacuum pump and use a different forevacuum pump if necessary.
	Gas volume too great or leak in the system.	Seal leak; install a higher-capacity vacuum pump if necessary.
	Fan defective.	Replace the fan (may be done only by a Leybold service technician).
	Ambient temperature too high.	Feed cooler air to the pump or install water cooling.
	Bearing defective.	Have the pump repaired (may be done only by a Leybold service technician).
Frequency converter runs too hot.	Ambient temperature too high; see Section 2.4.	Feed cooler air to the frequency converter or mount a heat sink.
	Bad thermal coupling.	Mount a heat sink or improve thermal coupling.

6 Spare Parts



Designation	Order No.
Blind plug with gasket, M5	200 23 006
Clamping yoke DN 16	200 18 372
Screw M4 x 10	200 18 489
O ring 18 x 5, FPM	239 70 176
Centering ring DN 16 KF	231 94 205
Blank flange DN 16 KF	361 20 205

Fig. 20 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, and when powering the pump with the specified Leybold frequency converters, the protection level prescribed in the EMC Guidelines will be attained.

Designation: Turbomolecular pump

Model: TW 250 S

Catalogue number: 113 52, 114 37, 114 42

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	April 1983
• DIN ISO 1940	Dec. 1993

Cologne, March 13, 2002

Dr. Götz, Business Area Manager
Turbomolecular pumps

Cologne, March 13, 2002

Adamietz, Design Department Manager
Turbomolecular pumps

Declaration of Conformity

as per EG Low-Voltage Guidelines 73/23/EWG,
Attachment lll B

Product: TURBO.DRIVE S

RIR-TDS2-NSR

2000-12-07

We herewith declare sole responsibility for the product

1. Product: Inverter

2. Manufacturer: Indramat Refu GmbH
Uracher Straße 91
72555 Metzingen / Germany

3. Type: TURBO.DRIVE S, Cat. No.: 800070Vxxxx

4. including the following options: RS 232 interface, RS 485 interface, integrated Profibus DP, built on heat sink

5. from date of manufacture: 2000-12-01

6. Applicable standard: EN 61010 Part 1: Safety requirements for electrical equipment for measurement, control and laboratory use., 03/94

EN 60204 Part 1: Safety of machinery - Electrical equipment of machines, 06/93

including the required accessories, as agreeing with EG guidelines 72/23/EWG, and 93/68/EWG.

Explanation

This product is a component intended for further assembly. Due to the features resulting therefrom, the product cannot initially meet requirements made of finished products, machines or plants. It must thus be used for mounting/assembly only.

An evaluation of electrical and mechanical safety, environmental conditions (e.g., extrinsic objects and/or humidity) must be performed after mounting/assembly in the finished product.

The EMC characteristics of this product can change in a mounted/assembled state. An EMC check must thus be made for the finished product (final unit, machine or plant) by the manufacturer of the finished unit, machine or plant.

Metzingen, 2000-12-07

We reserve the right to make changes in the conformity declaration. Presently applicable edition can be obtained upon request.

Michael Kimmich
Head of Quality Management

Stephan Scholze
Head of Development

Indramat Refu GmbH
Uracher Straße 91 • D-72555 Metzingen
Phone +49 (0) 71 23 / 9 69-0 • Fax +49 (0) 71 23 / 9 69-120

Declaration of Conformity

as defined by the EMC guideline 89/336/EWG
with revisions 91/263/EWG and 93/68/EWG

Product: TURBO.DRIVE S

RIR-TDS2-EMV

2000-12-07

We herewith declare sole responsibility for the product

1. Product:	Inverter
2. Manufacturer:	Indramat Refu GmbH
	Uracher Straße 91
	72555 Metzingen / Germany
3. Type:	TURBO.DRIVE S, Cat. No.: 800070Vxxxx

4. including the following options: RS 232 interface, RS 485 interface, integrated Profibus DP, built on heat sink

5. from date of manufacture: 2000-12-01

6. Applied standards: EN 50081 Part 2: Electromagnetic compatibility (EMC) / Generic emission standard

EN 50082 Part 2: Electromagnetic compatibility (EMC) / Generic immunity standard 06/93

meet the requirements outlined in the EG requirements on 89/336/EWG (EMC guideline) with revisions 91/263/EWG and 93/68/EWG.

Explanation

Maintaining the EMC guideline assumes an EMC adapted installation of component within the plant or machine.

Test were run using a typical construction in a test assembly that conforms with the standards. The legal requirements made of resistance to interference and resistance to emission of interference limit values and standards are outlined in the above-referenced documentation.

This Indramat Refu product is intended for installation into an end product. The test results are not applicable to every installed state in every end product. This declaration does not therefore guarantee the EMC characteristics of the end product.

Metzingen, 2000-12-07

We reserve the right to make changes in the conformity declaration. Presently applicable edition can be obtained upon request.

Michael Kimmich
Head of Quality Management

Stephan Scholze
Head of Development

Indramat Refu GmbH
Uracher Straße 91 • D-72555 Metzingen
Phone +49 (0) 71 23 / 9 69-0 • Fax +49 (0) 71 23 / 9 69-120

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

NRTL
LISTED

The system TURBOVAC TW 250 S / TURBO.DRIVE S, turbomolecular pump with frequency converter, has been tested by the TÜV Rheinland of North America according to the requirements of

- **NRTL**
  (applied standards UL 3101-1/10.93)

It is in compliance to the tested standards.

NRTL Report No. E 9972082 E 01

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