Leybold

TURBOVAC 90/250/350/450 i/i(X)

Turbomolecular pumps with integrated frequency converter (and control unit)

Operating instructions 300554863_002_C4

Part No.

810010V1000 to 819999V9999

820050V1000 to 829999V9999

830050V1000 to 839999V9999

Copyright notice

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Associated publications

Publication title	Publication number	Link
Serial Interfaces for TURBOVAC i/i(X)	300450826	*https://4vac.io/320s6k*
TURBOVAC i/i(X) EtherCAT Interface	300687441	*https://4vac.io/64t1ds*

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We accept no liability for loss of profit, loss of market or any other indirect or consequential loss whatsoever.

Product warranty and limit of liability are dealt with in our standard terms and conditions of sale or negotiated contract under which this document is supplied.

You must use this product as described in this manual. Read the manual before you install, operate, or maintain the product.

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1 Safety and compliance

For safe operation from the start, read these instructions carefully before you install or commission the equipment and keep them safe for future use. Read all the safety instructions in this section and the rest of this manual carefully and make sure that you obey these instructions.

The instruction manual is an important safety document that we often deliver digitally. It is your responsibility to keep the instruction manual available and visible while working with the equipment. Please download the digital version of the instruction manual for use on your device or print it if a device will not be available.

1.1 Definition of Warnings and Cautions

Important safety information is highlighted as warning and caution instructions which are defined as follows. Different symbols are used according to the type of hazard.

WARNING:

If you do not obey a warning, there is a risk of injury or death.

CAUTION:

If you do not obey a caution, there is a risk of minor injury, damage to equipment, related equipment or process.

NOTICE:

Information about properties or instructions for an action which, if ignored, will cause damage to the equipment.

We reserve the right to change the design and the stated data. The illustrations are not binding.

1.2 Trained personnel

For the operation of this equipment “trained personnel” are:

- skilled workers with knowledge in the fields of mechanics, electrical engineering, pollution abatement and vacuum technology and
- personnel specially trained for the operation of vacuum pumps

1.3 Safety symbols

The safety symbols on the products show the areas where care and attention is necessary.

The safety symbols that we use on the product or in the product documentation have the following meanings:

	**Warning/Caution** Risk of injury and/or damage to equipment. An appropriate safety instruction must be followed or a potential hazard exists.
	**Warning - Dangerous voltage** Risk of injury. Identifies possible sources of hazardous electrical shock.
	**Warning - Hot surfaces** Risk of injury. Identifies a surface capable of inflicting burns through contact.
	**Warning - Risk of explosion** Risk of injury or damage to equipment. Identifies a situation that could result in an explosion.
	**Warning - Toxic material** Risk of injury or damage to the environment. Identifies a source of toxic gases, liquid or material.

2 Important safety information

2.1 Mechanical hazards

WARNING: VACUUM HAZARD

Risk of injury. Avoid exposing any part of the human body to the vacuum.

WARNING: ROTATING PARTS

Risk of injury. Avoid exposing any part of the human body to the rotating parts.

WARNING: UNSUITABLE ATTACHMENTS

Risk of injury. Do not use unsuitable attachments for the pumps or attachments that can be torn off. When using clamped flange connections at the housing or with components above the housing, there is a risk of sudden twistingof the entire pump.

WARNING: EXPLOSION HAZARD

Risk of injury. The pressure in the pump must not exceed 1.4 bar(absolute).

1. The pump is intended for generating a vacuum only. If there is a risk of overpressure within the system and the pump, then the pump must be protected with an overpressure safety valve, for example.
2. Vent the pump only up to atmospheric pressure.
3. When using the pump with a purge gas valve, protect the purge gas supply such that in the event of a malfunction no overpressure can occur within the system.
4. The pump must be firmly 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.
5. Do not operate the pump (in bench testing, for example) without proper flanging to the vacuum chamber. Refer to *Attach the pump to the vacuum chamber* on page 44.
6. Due to high speed and temperature, the service life of the rotor is limited. If the rotor is changed too late, it may be damaged. Thus in the flange mounts, high forces and torque conditions can occur. We recommend an exchange of the rotor unit after 80000 operating hours at the latest.
7. Turbomolecular pumps as described in the following operation manual contain a high portion of kinetic energy due to their high rotational speed in combination with the specific rotor mass. In case of a malfunction of the system, for example, rotor/stator contact or even a rotor crash, the rotational energy is released.

8. To avoid the risk of injury or damage to the equipment, follow the installation instructions as given in this manual.

2.2 Electrical hazards

WARNING: DANGEROUS VOLTAGE

Risk of injury. Lethal voltages are present at the mains connections. Before starting any maintenance or service work, de-energise (lockout/tagout) the product first. Obey the safety instructions given below when you work on the equipment.

1. The electrical connection must only be provided by a trained person. Please observe the national regulations in the country of use like EN 50110-1 for Europe, for example.
2. The pump must only be connected to power supplies which meet the requirements for functional extra-low voltages with positive isolation in accordance with IEC 60364-4-41 (or local regulations) (PELV). All interfaces must only be operated with PELV-fed components and devices.
3. Only unplug connectors when the mains voltage is switched off and the pump is no longer turning.
4. Unauthorised device conversion and modifications are prohibited for safety reasons.
5. The outputs at the frequency converter are not free of voltage.
6. Lay connecting lines so that they cannot be damaged. Protect the lines against humidity and contact with water. Avoid any heat stress on the line due to unfavourable laying conditions.
7. Suitably support the connecting lines so that the pumps are not exposed to any major mechanical stress.
8. Do not expose the pump and the connections to dripping water. Note the information on the IP type of protection.
9. When storing the pump in a humid atmosphere, these can suffer corrosion. Corrosion gives rise to conductive deposits which in turn can cause short-circuits and reduce the insulation levels of electrical components.
10. Transport the pump only in its original packaging so as to avoid any mechanical damage which in turn may reduce air gaps and creepage distances.
11. When applying external voltages above 42 V to the connection terminals, observe the applicable VDE safety regulations.
12. Make the electrical connections only after pump and accessories (for example, air cooler) have been installed mechanically.
13. The slot for the Anybus interface must be blanked off during operation of the pump: either through a blank panel or by inserting an optional Anybus module.

2.3 Thermal hazards

WARNING: HOT SURFACE

Risk of burn. During the operation of the pump certain areas can get hot (65 °C maximum). Protect hot parts against being touched. Handle the equipment only after venting and cooling down.

Important safety information

2.4 Hazards caused by materials and substances

WARNING: HAZARDOUS MATERIALS

Risk of injury. Contaminated parts can be detrimental to health and environment. Before beginning with any work, find out whether any parts are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts. Obey the safety instructions given below when you work on the equipment.

1. The pump is not suitable for pumping reactive or corrosive media. The rotor may get damaged due to process gases. Thus in the flange mounts, high forces and torque conditions can occur. The mounting screws for the pump may be torn off. When using clamped flange connections at the housing or with components above the housing, sudden twisting of the entire pump can be experienced.
2. When pumping dusty media, use a dust filter. The pollution degree II applies to the inside surface of the pump.
3. If low concentration corrosive or reactive gases are being pumped, then operate the pump with purge gas.
4. Consult with us for which types of pumps are required for specific processes and applications.
5. The forevacuum line must be tight. Hazardous gases can escape at leaks or the gases being pumped can react with air or humidity. Do a leak check after you install the pump and after every service on the vacuum system. Upon delivery, the pump has an integral leak rate of $< 1 \times 10^{-8}$ mbar·l/s. Do a leak check regularly, when pumping toxic gases.
6. If the pump has previously handled hazardous gases, implement the proper precautionary measures before opening the intake or exhaust connection. Before opening the pump, purge it for a longer period with an inert gas. If necessary, use gloves, a respirator and/or protective clothing and work under an exhaust hood. Firmly seal off the pump. When shipping the contaminated pump for servicing, also state the type of hazard.
7. The cooling water from the return is not of drinking water quality and should not be used for this purpose. After operating the pump, the cooling water lines may suffer from microbiological contamination. Take appropriate safety precautions.

2.5 Ignition hazards

WARNING: IGNITION HAZARD

Risk of injury. Sparks could occur in case of damage to the pump, this can ignite the explosive mixtures. Check the pump at regular intervals for damage.

During operation, the pressure inside the turbomolecular pump is so low that there is no risk of ignition (at pressures less than 100 mbar). A hazardous condition will be created if flammable mixtures enter the hot pump at pressures more than 100 mbar. During operation, the pump can reach temperatures as high as 140 °C internally, and at parts of the outside surfaces 65 °C. Also, note the safety information provided by the gas supplier.

2.6 Dangers in connection with safety-related measures and precautions

The frequency converter is not equipped with its own emergency shutdown switch. Such a facility needs to be provided from the side of the system.

2.7 Risk of damaging the pump

1. Do not touch the rotor, it cause injury and damage the rotor bearing.
2. Foreign objects which enter the pump through the intake would cause serious damage to the rotor. To avoid damage install an inlet screen. Damages caused during operation without the inlet screen are excluded from warranty.
3. The contact surfaces of the pump housing, vacuum system and centring ring must be dry and free of grease so as to ensure sufficient stability in case the rotor seizes.
4. Connect a purge gas or venting valve to the correct flange. Interchanging the venting and purge gas flange can cause shock venting of the pump.
5. The interface connectors have UNC 4-40 threads. Do not use connectors with M3 treads.
6. Only connect and disconnect the cable connections between the pump and power supply when the pump is not turning (green status LED off) and with the mains power switched off (yellow power LED off). Otherwise there is the risk of damaging the frequency converter.
7. Exposure of the pump to accelerating forces must be avoided or reduced to such an extent that the rotor will not be excited by vibrations. In the case of critical applications you must consult our applications department first.

3 Description

The TURBOVAC 90 i(X), 250 i(X), 350 i(X) and 450 i(X) are turbomolecular pumps designed to evacuate vacuum chambers down to pressure levels in the high vacuum and ultra-high vacuum range.

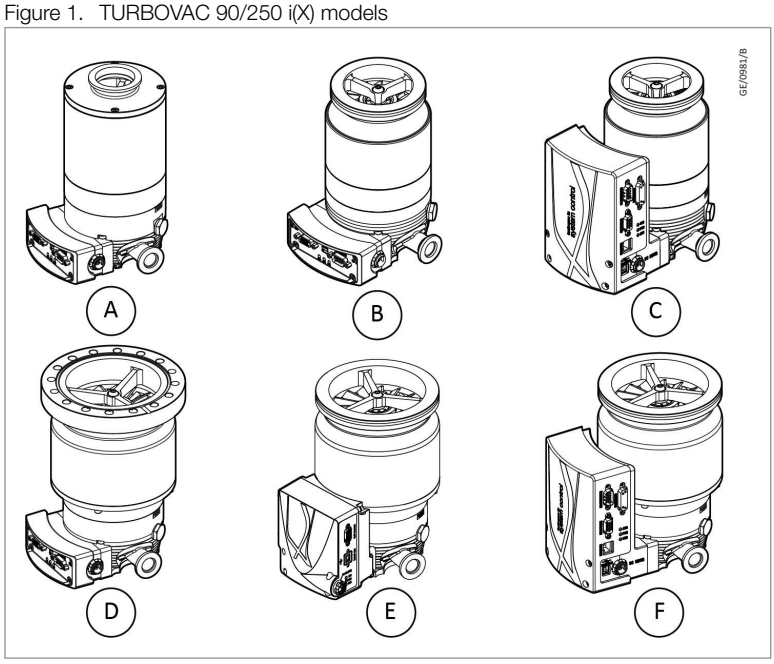
They are suitable for pumping air and clean gases. A forevacuum pump and a power supply are required for their operation.

The TURBOVAC allows controlling of the pump through both standard and optional interfaces and setting up of some pump functions according to specific requirements.

Refer to Serial Interfaces for TURBOVAC i/i(X) (Publication number - 300450826) for a detailed description of the interfaces RS 232, RS 485, Profibus and USB of the TURBOVAC.

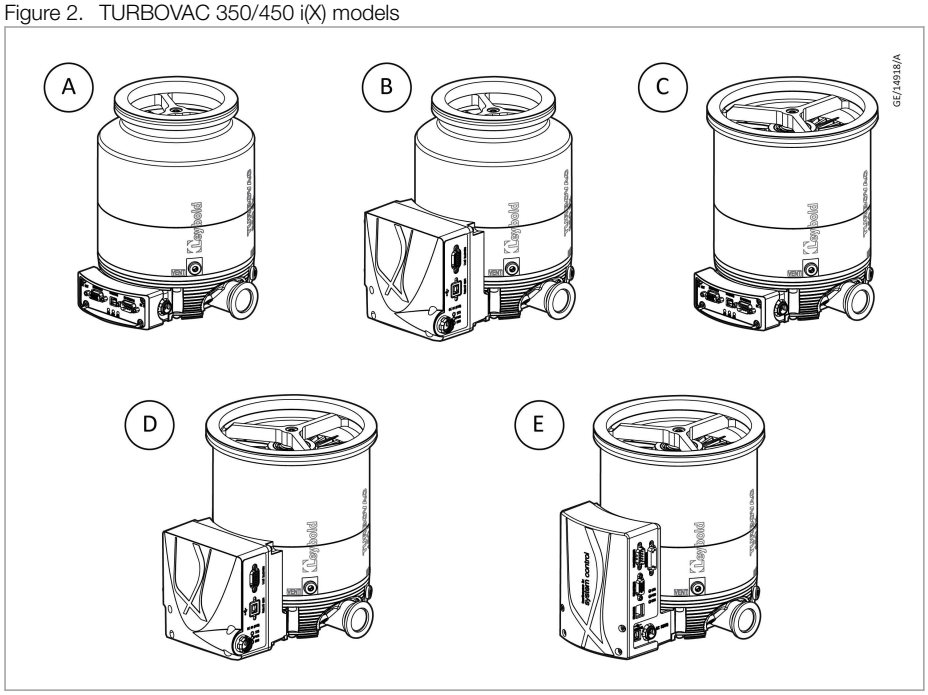
Refer to TURBOVAC i/i(X) EtherCAT Interface (Publication number - 300687441) for a detailed information on the EtherCAT Interface.

Figure 1. TURBOVAC 90/250 i(X) models



A. TURBOVAC 90 i with KF flange
B. TURBOVAC 90 i
C. TURBOVAC 90 i(X)
D. TURBOVAC 250 i with CF flange
E. TURBOVAC 250 i with optional interface
F. TURBOVAC 250 i(X)

Figure 2. TURBOVAC 350/450 i(X) models



A. TURBOVAC 350 i

B. TURBOVAC 350 i with optional interface

C. TURBOVAC 450 i

D. TURBOVAC 450 i with optional interface

E. TURBOVAC 450 i(X)

3.1 Design

The TURBOVAC i(X) models are wide-range turbomolecular pumps equipped with an additional Holweck stage.

With the built-in frequency converter as the electronic drive the TURBOVAC i(X) forms one single unit. The electronic drive governs the pump's speed and serves as a monitor for all functions of the pump. The TURBOVAC i(X) is equipped with an integrated vacuum system controller for connection and operation of various accessory components.

At the high vacuum side the bearing is of a non-wearing permanent magnetic bearing type, at the forevacuum side a lifetime lubricated oil-free ceramic ball bearing is used.

Water cooling or an air cooling fan is available as an optional equipment.

The intake flange should be fitted with a wire mesh inlet screen to protect the pump against mechanical damage caused by foreign objects.

The pumps are equipped with a venting and a purge gas facility. The connections are blanked off by default with G1/8" closure screws.

Venting and purge gas valves, or a venting screw, or a pressure regulator can be connected directly to the pump.

3.2 Standard equipment

Turbomolecular pump with the integrated electronic drive unit and integrated vacuum system control unit for TURBOVAC i(X).

High and fore-vacuum flanges are protective-capped.

Flange mounting elements, the DC In plug and the inlet screen are not enclosed, but are available as accessories, refer to *Accessories* on page 85.

Only TURBOVAC i(X)

The PC software LEYASSIST can be used for the configuration of the pump and accessories and for data logging. The tool is available for download free of charge on our website:

www.leybold.com > Media > Downloads > Download Software > PC-Software for Turbomolecular pumps (*https://www.leybold.com/en/media/downloads/download-software/pc-software-for-turbomolecular-pumps/*).

3.3 Conforming utilisation

The turbomolecular pump is intended for generating a vacuum. It is suited for non-corrosive processes only.

The turbomolecular pump must be bolted to a rigid vacuum system and connected to a suitable backing pump.

Operate the turbomolecular pump in a closed rooms.

Accessories which have not been specified by us should only be used after approval by us.

3.3.1 Non-conforming utilisation

WARNING: NON-CONFORMING UTILISATION OF PUMP

Risk of injury and damage to equipment. Any non-conforming utilisation of pump, frequency converter and accessories can result in severe injury or death and cause damage to components.

Non-conforming utilisations for both pump and frequency converter are:

- Pumping of gases and vapour for which the materials of the pump are unsuitable.
- Operation in connection with processes in which GaAs (gallium arsenide) is being pumped.
- Pumping gas mixtures with an oxygen content of > 21%.
- Pumping corrosive gases and dust containing gases without reverting to purge gas operation.
- Pumping condensable vapour without controlling the temperature of the pump. Upon compression within the pump, these vapours can condense or form deposits.
- Pumping dust and solids without the use of suitable screens and filters.
- Operation at a high forevacuum pressure.
- Operation at high gas loads.
- Utilisation of both pump and frequency converter in explosion hazard areas.
- Non-compliance with the specified maintenance and servicing intervals.
- Operation of the pump and drive electronics in environments which require protection type of IP 40 or higher and where the installation site is more than 4000 m above sea level.
- The maximum permissible pressure in the pump and the system must not exceed 1.4 bar (absolute).

- Operation with an inadequately mounted pump.
- Operation without having flanged the pump to the system or without having connected it to a suitable backing pump.
- Operation with additional heat sources involving thermal radiation, thermal conduction through the high vacuum or the forevacuum flange, strong magnetic fields or very hot process gases, for example. In environments with water cooling operation, CF flanges may be baked-out up to 100 °C.
- Use in systems in which impact stress and vibrations or periodically occurring forces affect pump, frequency converter and cables.
- Operation on the moving system or system components (locks, for example).
- Operation at vibration absorbers and vacuum components (gate valves, valves) which are not capable of sustaining the specified deceleration torque at which the pump rotor seizes.
- Stepping on the pump, add-on parts, drive electronics, flanges and cables to climb onto the system. Fitting of add-on parts to the forevacuum flange which causes an inadmissible high load.
- Removing, covering or obstructing warning notices.
- Standstill or storing of the pump without suitable sealing-off and drying.
- Storing in a humid atmosphere which can cause corrosion.
- Conversions, manipulations and maintenance work by personnel not authorised by us.

4 Technical data

4.1 Operating environment

Table 1. Operating environment

Parameter	Value
Permissible ambient temperature	5 to 45 °C*
Installation altitude	up to 4000 m†

** Depending on the ambient temperature, the gas throughput and the type of gas, forced air cooling or water cooling may be necessary. No dripping or spraying of water, no explosive gas atmospheres.*

† At altitudes more than 2000 m heat dissipation by the ambient air is impaired.

4.2 General technical data

Table 2. General technical data

Parameter	90 i	90 i(X)	250 i(X)	350 i(X)	450 i(X)	Unit
High-vacuum connection	40 ISO-KF	63 ISO-K 63 CF	100 ISO-K 100 CF	100 ISO-K 100 CF	160 ISO-K 160 CF	DN
Forevacuum connection	16 KF	16 KF	16 KF	25 KF	25 KF	DN
Pumping speed*						
N_2	38	90	225	290	430	$l \cdot s^{-1}$
Ar	36	83	210	260	400	
He	39	90	250	360	440	
H_2	31	78	210	350	420	
Gas throughput*						
N_2	10	10	6	4.5	4.5	$mbar \cdot l \cdot s^{-1}$
Ar	3	3	3	2.0	2.0	
He	11	11	6	8.0	8.0	
H_2	11	11	>10	8.0	8.0	
Compression ratio*						
N_2	1×10^{11}	1×10^{11}	1×10^{11}	1×10^{11}	1×10^{11}	
Ar	1×10^{11}	1×10^{11}	1×10^{11}	1×10^{11}	1×10^{11}	
He	1×10^{8}	1×10^{8}	1×10^{8}	1×10^{8}	1×10^{8}	
H_2	5×10^{7}	5×10^{7}	2×10^{7}	5×10^{6}	5×10^{6}	
Ultimate pressure with 2-stage oil-sealed rotary vane pump ISO-K / CF	$< 8 \times 10^{-8}$ / $< 5 \times 10^{-10}$					mbar
Maximum permissible forevacuum pressure for N_2	14			10		mbar

Technical data

Parameter	90 i	90 i(X)	250 i(X)	350 i(X)	450 i(X)	Unit
Operating speed	72000			60000		min^{-1}
Speed adaptation	62 to 100%			50 to 100 %		
Run-up time, approximate	2			5.5		min
Maximum power consumption	240					W
Power consumption at ultimate pressure, approximate	9.5		10	15		W
Type of protection	IP40					
Ambient temperature						
during operation	+5 to +45†					°C
storage	-15 to +70					
Cooling standard	Convection†					
Cooling optional	Air or water†					
Cooling water connection	plug connection for 6x1 hose / alternatively G 1/8" screw-in thread					
Cooling water consumption	30 to 60			50 to 100		l/h
Permissible cooling water pressure (bar(g): bar (gauge) is overpressure, i.e. atmospheric pressure = 0 bar(g))	3 - 6					bar(g)
Permissible cooling water temperature	15 to 35					°C
Weight ISO-K / CF						
TURBOVAC i	3.1 / 4.8		4.0 / 6.6	7.5 / 11.5	7.7 / 12.5	kg
TURBOVAC i(X)	3.6 / 5.3		4.5 / 7.1	8.0 / 12.0	8.2 / 13.0	
Recommended forevacuum pumps						
TRIVAC	D 2.5 E / D 4 B		D 2.5 E / D 4 B	D 4 B		
SCROLLVAC	SC 5		SC 5 D / SC 15 D	SC 5/15 D		

Parameter	90 i	90 i(X)	250 i(X)	350 i(X)	450 i(X)	Unit
DIVAC	1.4 HV 3		3.8 HV 3	3.8 HV 3		
Noise level						
with convection cooling	< 41			< 44		dB(A)
with radial air cooler	< 44			< 47		
with axial air cooler	< 49			< 49		
Maximum bake-out temperature of the CF version, water cooled	100					°C
Maximum relative air humidity	approximately 85% (non condensing)					
Purge gas flow	0.4					$mbar \cdot l \cdot s^{-1}$
	24					sccm
Purge gas connection	G 1/8"					
Venting connection	G 1/8"					

** Contact us when using Argon or other "heavy" gases as process gas.*

† Depending on the ambient temperature, the gas throughput and the type of gas, forced air cooling or water cooling may be necessary.

4.3 Pumping speed curve

Figure 3. Pumping speed curve for the TURBOVAC 90 i(X)

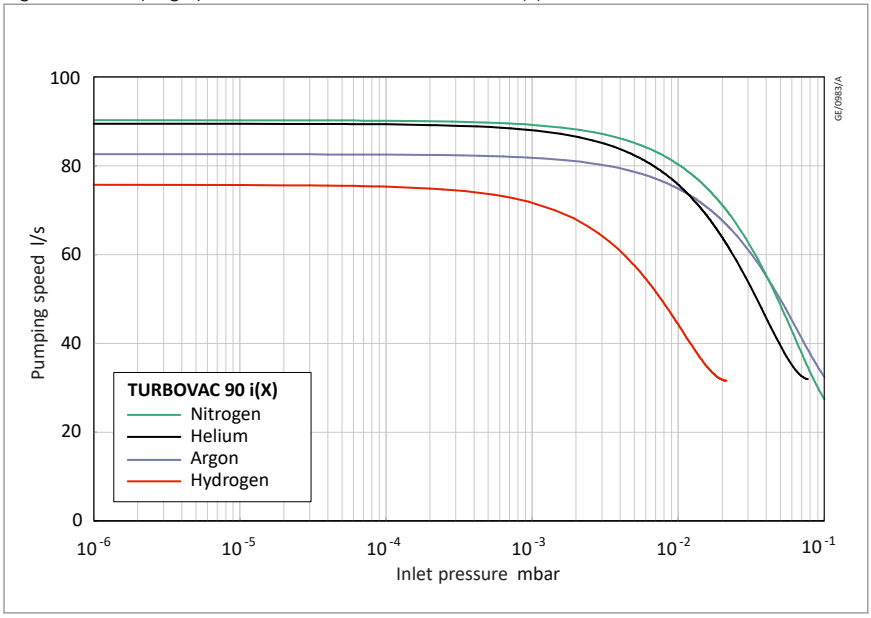


Figure 4. Pumping speed curve for the TURBOVAC 250 i(X)

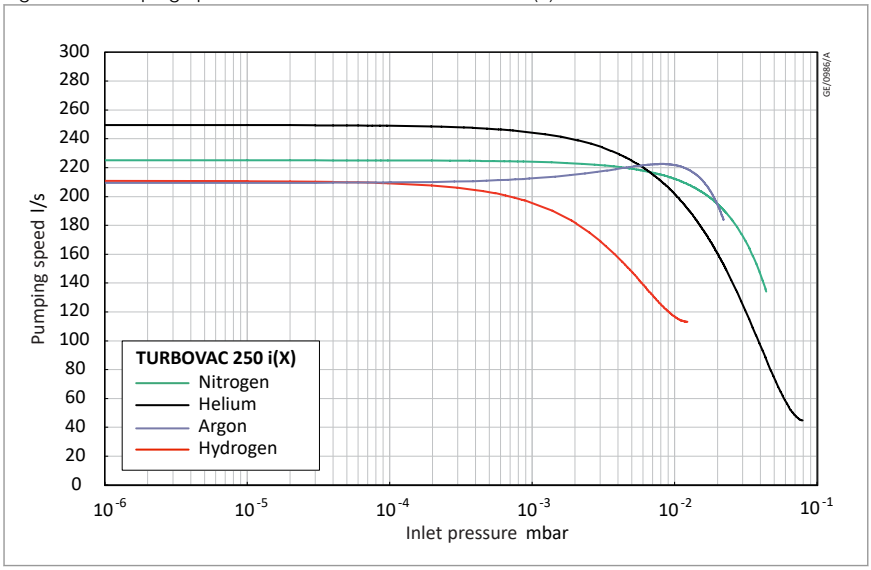


Figure 5. Pumping speed curve for the TURBOVAC 350 i(X)

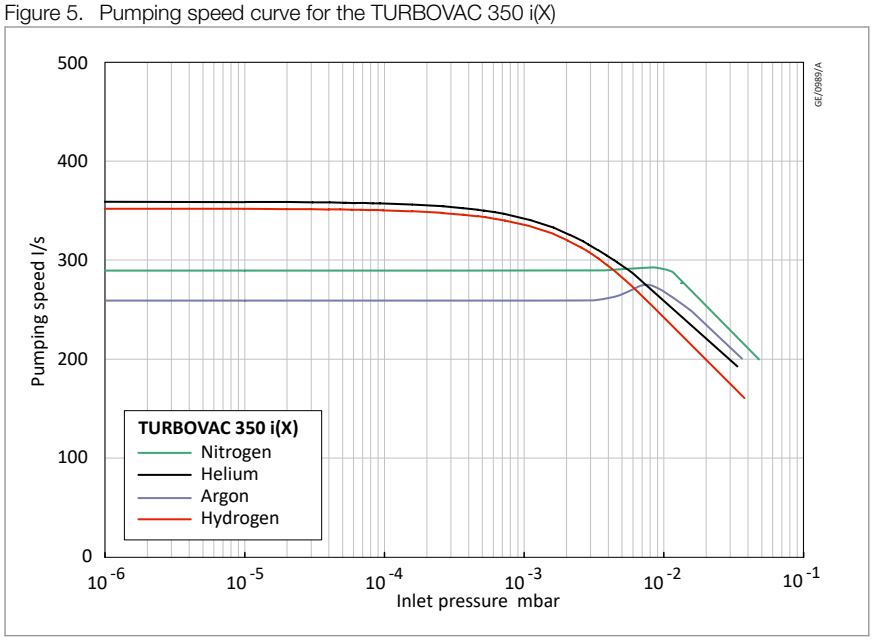
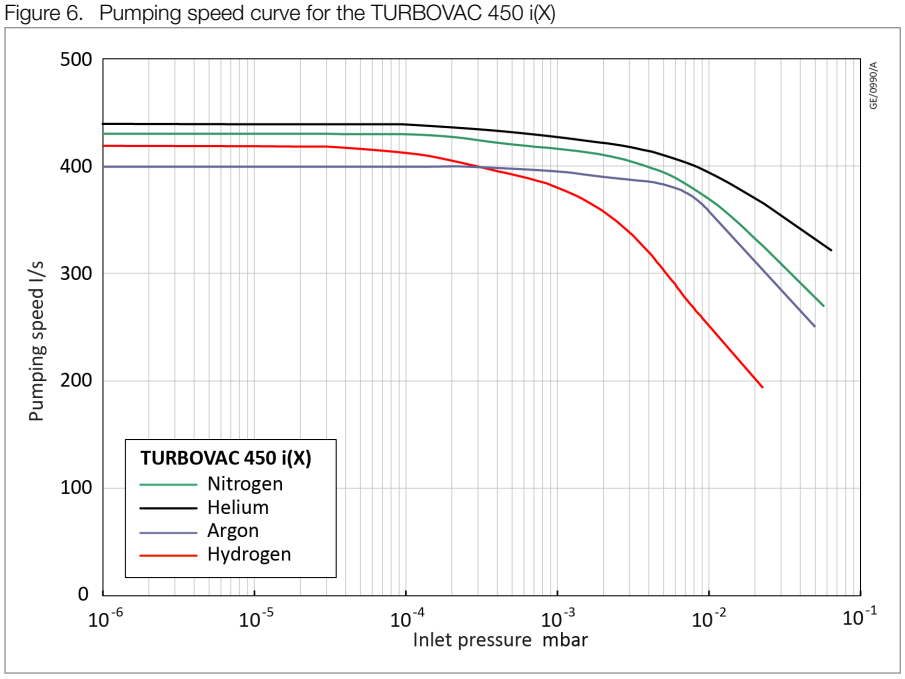


Figure 6. Pumping speed curve for the TURBOVAC 450 i(X)



4.4 Operation diagram

How to read the operating diagram:

With deploying a SCROLLVAC SC 5 D backing pump, gas flows may be transported permanently with maximum throughput quantities of:

- 0.2 mbar·l/s (with convection cooling)
- 0.7 mbar·l/s (with air cooling at 40 °C) and
- approximately 2 mbar·l/s (with cooling water at 35 °C)

These values are a result of the intersection between the limitations of the individual cooling variant and the pumping speed of the backing

pump. Maximum permanent gas flows are not only a turbomolecular pump characteristic but are also dependent on the installed backing pump.

Figure 7. Operation diagram for nitrogen for the TURBOVAC 90 i(X) 48 V

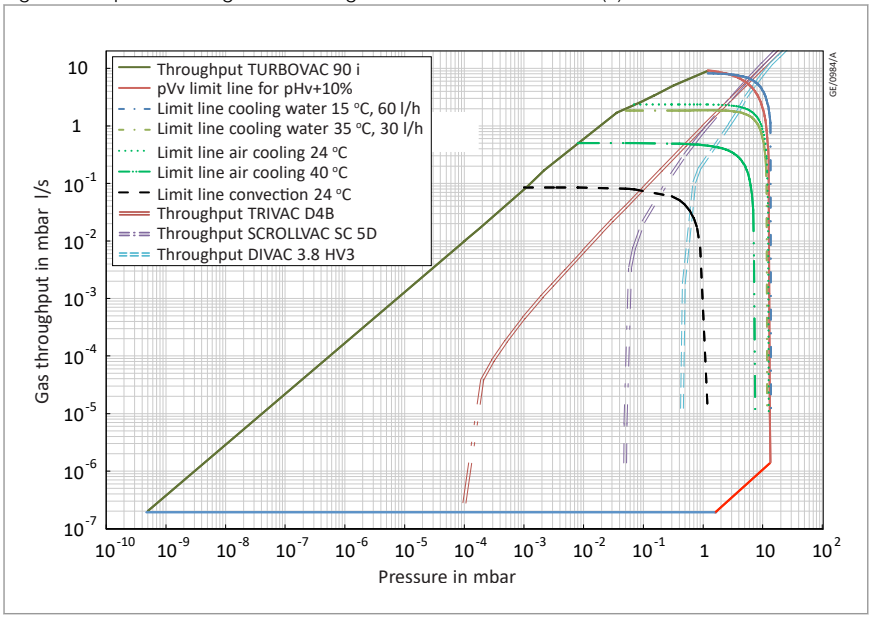


Figure 8. Operation diagram for nitrogen for the TURBOVAC 90 i(X) 24 V

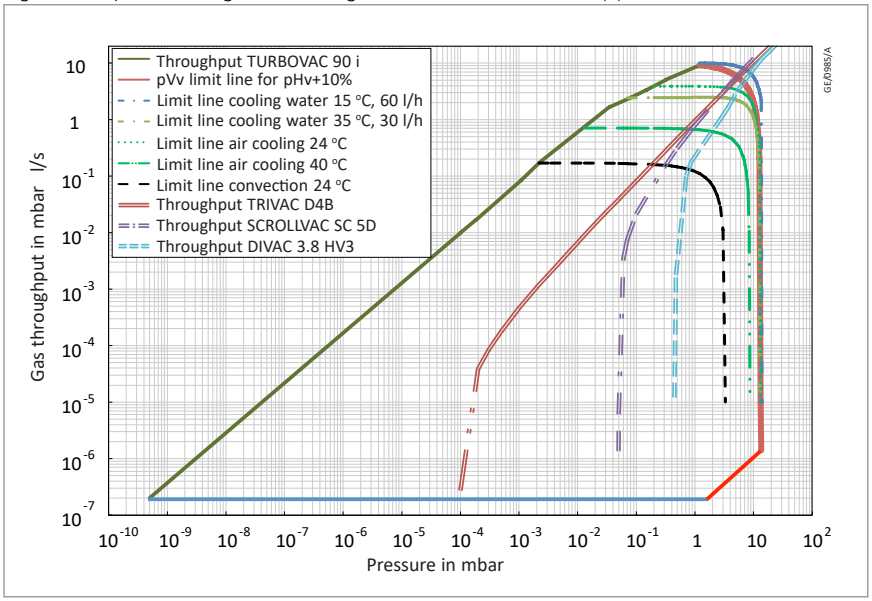


Figure 9. Operation diagram for nitrogen for the TURBOVAC 250 i(X) 48 V

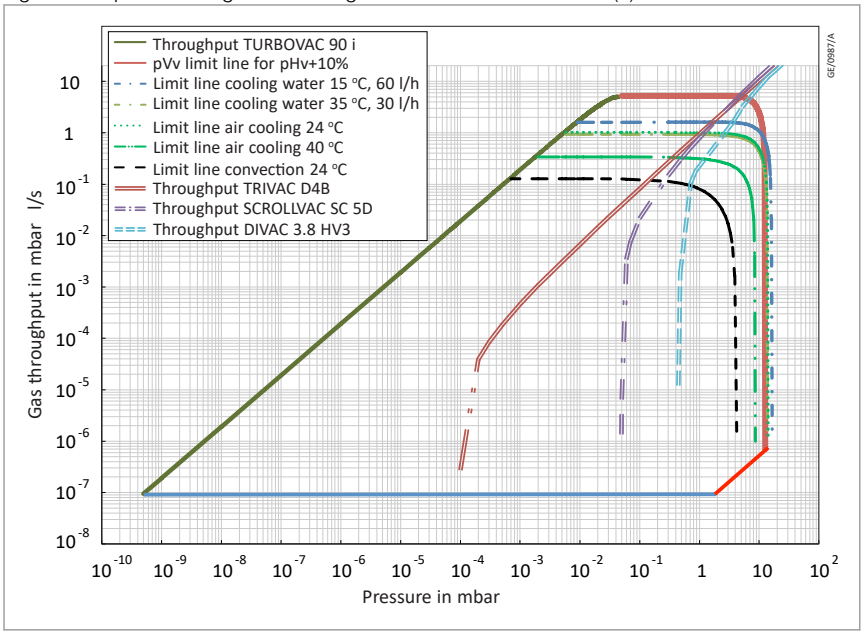
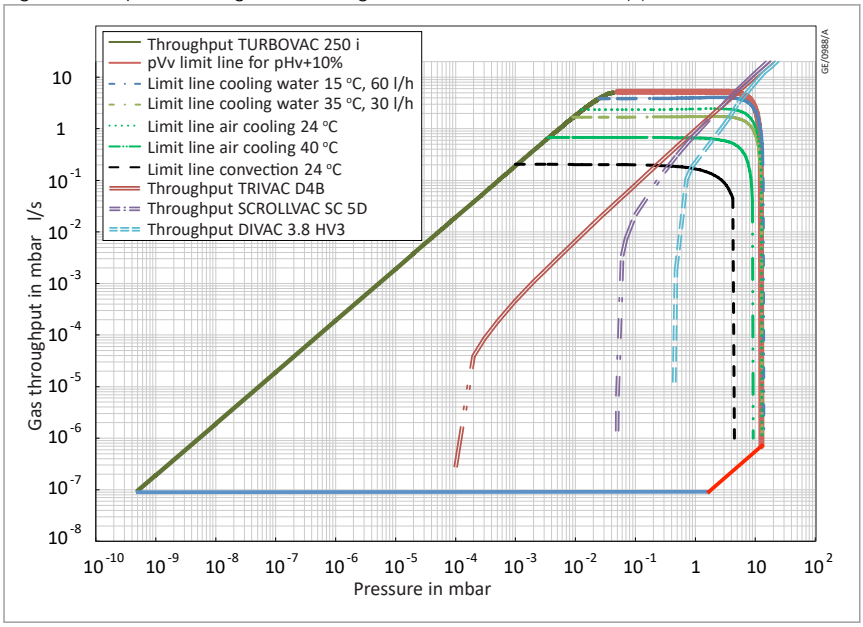


Figure 10. Operation diagram for nitrogen for the TURBOVAC 250 i(X) 24 V



4.5 Technical data for the integrated drive electronics

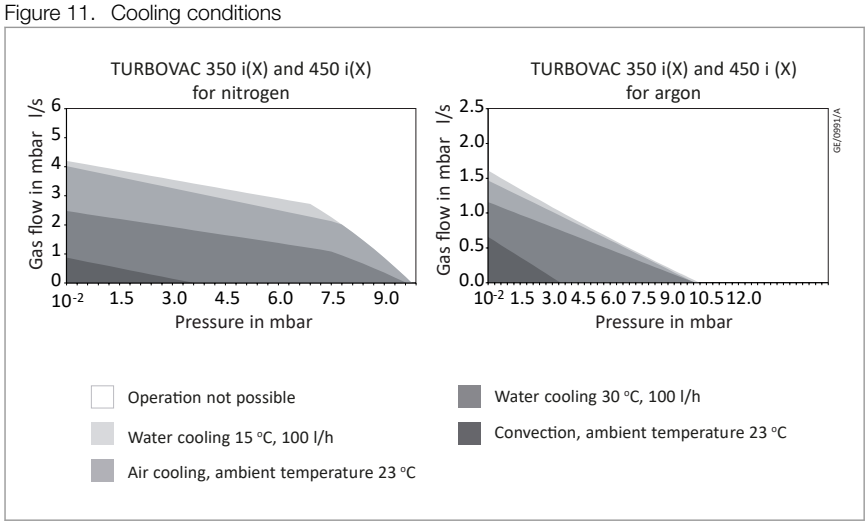
Table 3 Technical data for the integrated drive electronics

Parameter	TURBOVAC i	TURBOVAC i(X)
	Drive electronics	Drive electronics and vacuum system control unit
Supply voltage	24/48 V d.c. ± 10 %	24/48 V d.c. ± 10 %
Maximum current consumption	10 A at 24 V d.c.	10 A at 24 V d.c.
Maximum power consumption	240 W	240 W
Interfaces	Refer to *Ordering data* on page 87	

Technical data

Parameter	TURBOVAC i	TURBOVAC i(X)
	Drive electronics	Drive electronics and vacuum system control unit
Residual ripple	< 3%	< 3%
Maximum length of the d.c. cable (for variants with removable front end)	0.5 m	-
Maximum contact rating of the relays	48 V, 0.5 A 24 V, 1.0 A	48 V, 0.5 A 24 V, 1.0 A
Overvoltage category	II	II
Contamination grade	2	2
Accessory connections	1 pc. M8 connector, 24 V d.c.	1 pc. M8 connector, 24 V d.c.
Maximum load rating for the 24 V d.c. outputs (powering accessories, for example, cooling unit or valves)	24 V, maximum 18 W	24 V, 12 W
Vacuum gauge head connection	-	15 pin Sub-D

Figure 11. Cooling conditions



Contact us for information on pumps or applications which are not listed here.

- pumps with a CF flange
- in the case of special applications

For the TURBOVAC 90 i(X) and 250 i(X) refer to *Operation diagram* on page 23.

5 Transportation

WARNING: SUSPENDED LOAD

Risk of injury. Do not stand below the pump while connecting or removing the turbomolecular pump.

Transportation

The devices are delivered in safe transport packaging. Check whether the packaging has been damaged during transport. If that is the case, check the equipment immediately and notify the freight forwarder and us if necessary.

Keep transport packaging for any further transportation and storage of the pump. Be careful not to damage the sockets and connections during transport.

Unpack

The turbomolecular pump is shipped in a sealed PE bag with desiccant. You must open the PE bag only when the pump is ready for installation. Do not remove the covers and blanking flanges until you are ready to make the connections, to make sure that the turbomolecular pump is installed under the cleanest possible conditions.

Lifting

The larger pumps (TV850 iR / TV 950 iR / TV1350 iR / TV1450 iR) are equipped with four M8 holes for eye-bolts for lifting and moving. Remove the pump from the packaging using lifting equipment connected to the two eye-bolts provided, guiding it with one hand.

CAUTION: FALLING PARTS

Risk of injury from falling parts. Mistakes made during transport can cause the pump to fall down. Transport the pump only in its transport packaging or using the eye-bolts provided for this purpose.

6 Installation

6.1 Dimension drawings

The dimensions given are in mm (inch).

Figure 12. TURBOVAC 90 i with water cooling

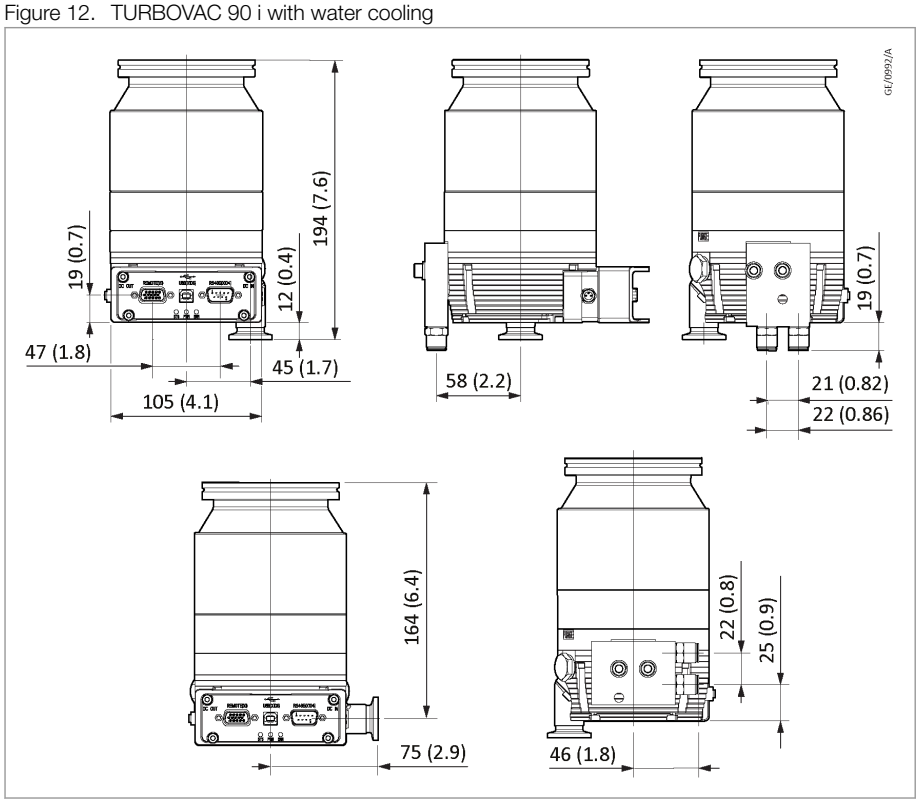


Figure 13. TURBOVAC 90 i with axial air cooling

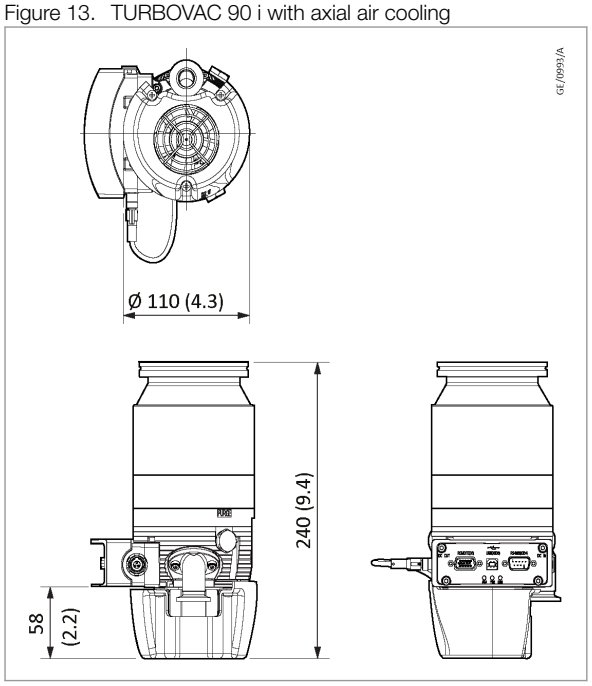


Figure 14. TURBOVAC 90 i with radial air cooling

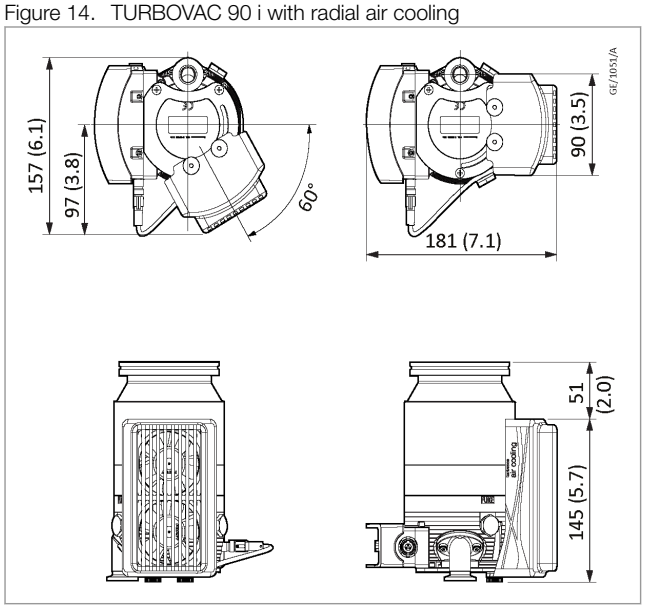
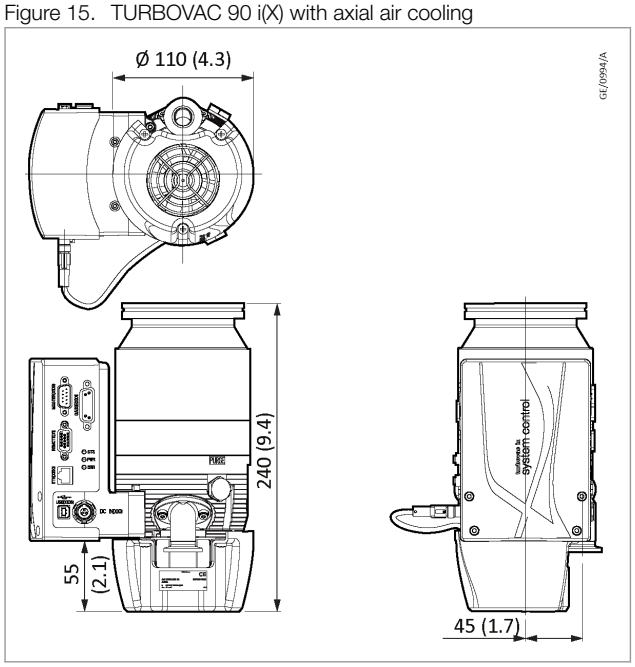
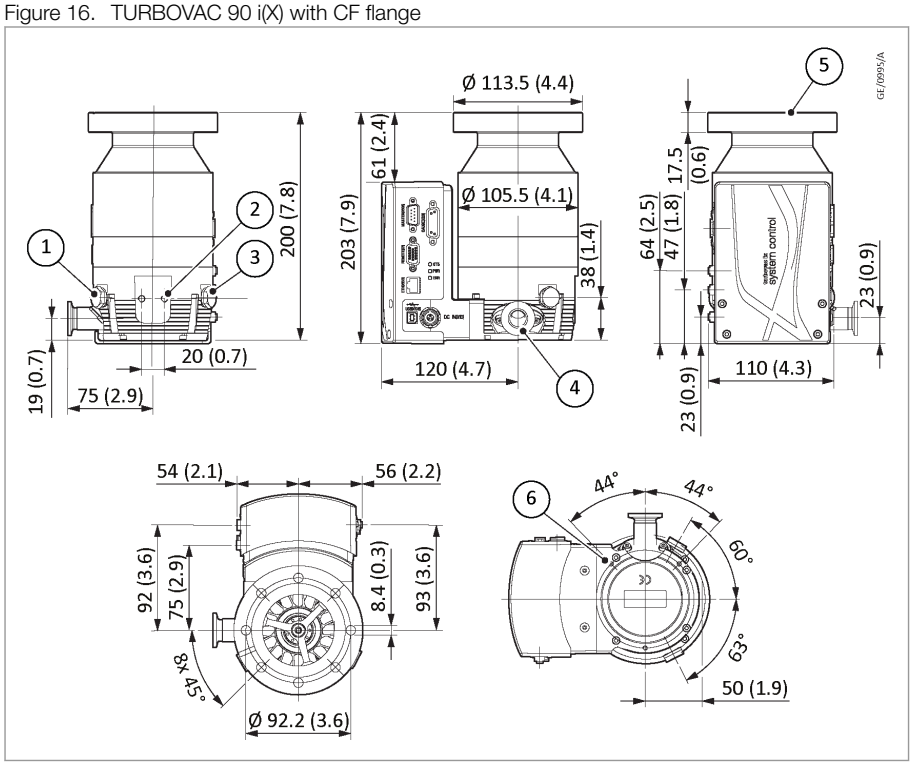


Figure 15. TURBOVAC 90 i(X) with axial air cooling



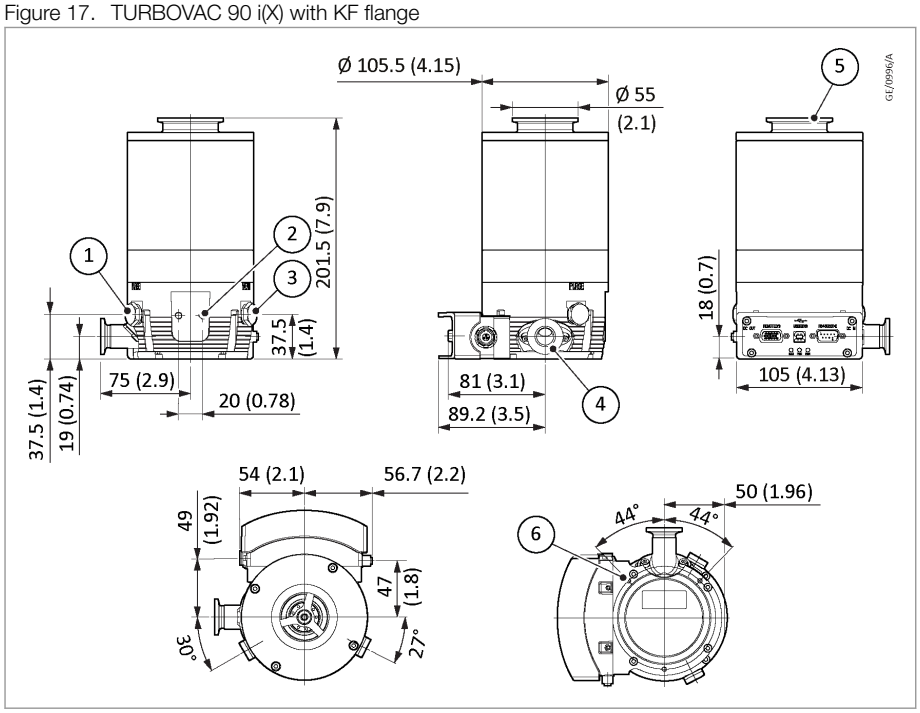
Installation

Figure 16. TURBOVAC 90 i(X) with CF flange



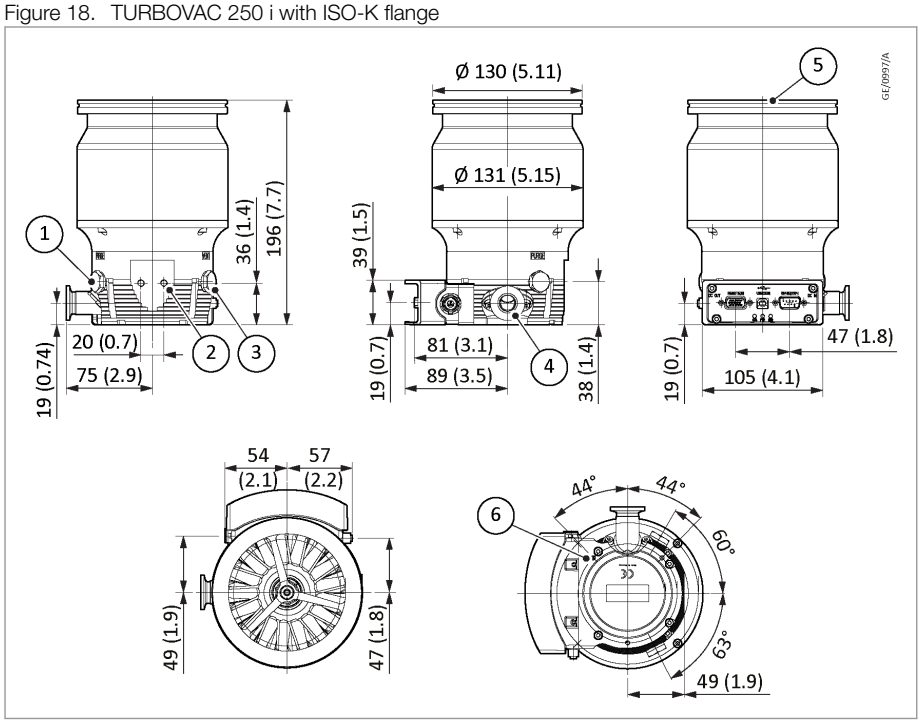
1. *Purge G1/8"*
2. *M6-10 × 2*
3. *Vent G1/8"*
4. *DN 16 KF*
5. *DN 63 CF*
6. *M4-8 × 3*

Figure 17. TURBOVAC 90 i(X) with KF flange



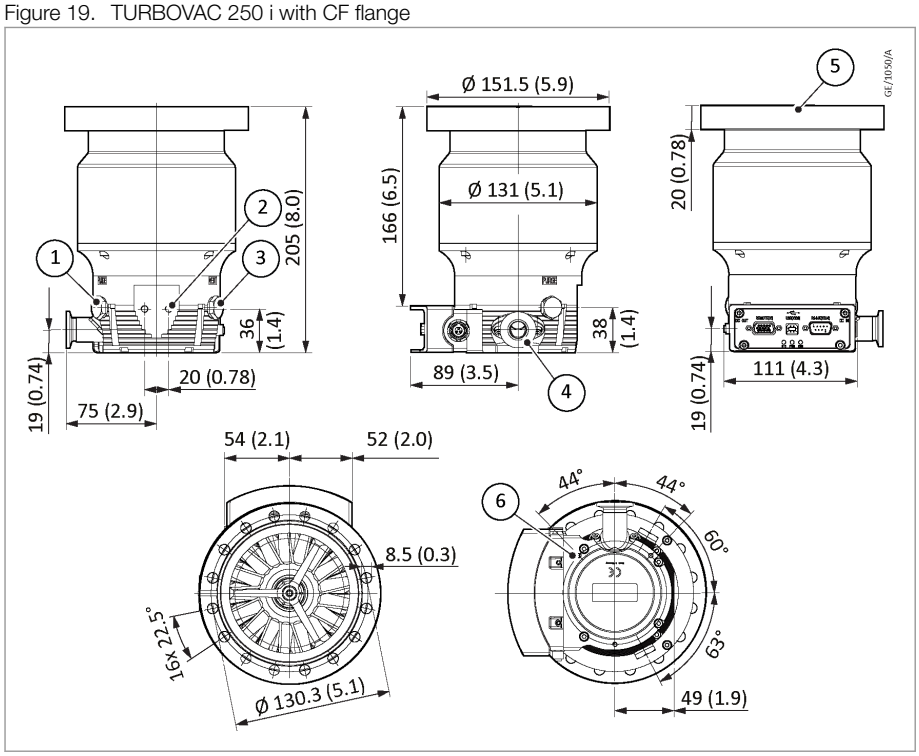
1. *Purge G1/8"*
2. *M6-10 × 2*
3. *Vent G1/8"*
4. *DN 16 KF*
5. *DN 40 KF*
6. *M4-8 × 3, ø 86*

Figure 18. TURBOVAC 250 i with ISO-K flange



1. *Purge G1/8"*
2. *M6-10 × 2*
3. *Vent G1/8"*
4. *DN 16 KF*
5. *DN 100 ISO-K*
6. *M4-8 × 3*

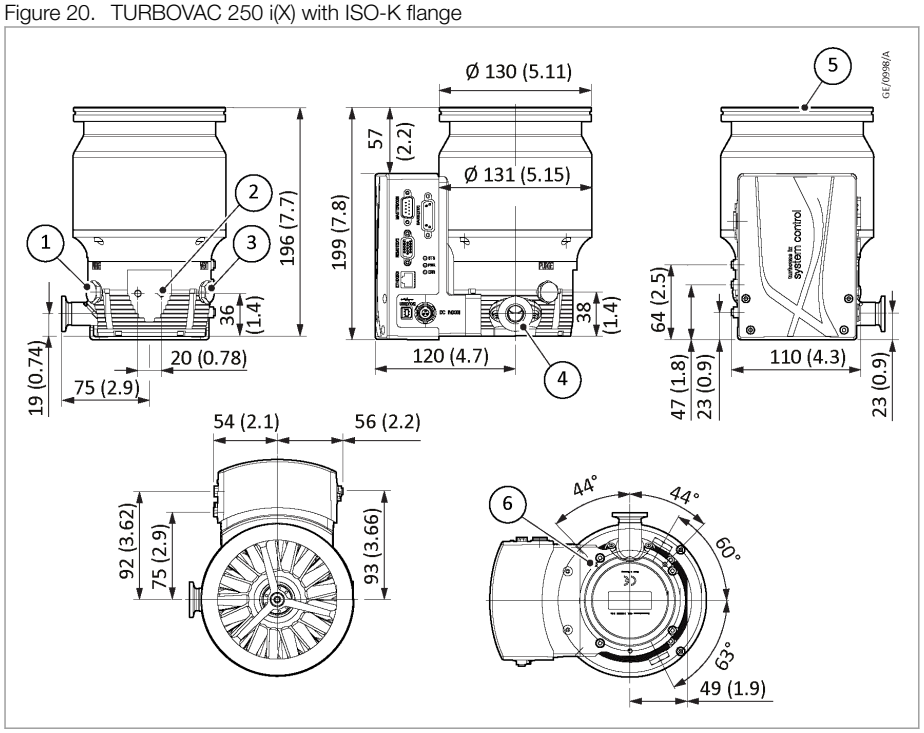
Figure 19. TURBOVAC 250 i with CF flange



1. *Purge G1/8"*
2. *M6-10 × 2*
3. *Vent G1/8"*
4. *DN 16 KF*
5. *DN 100 CF*
6. *M4-8 × 3*

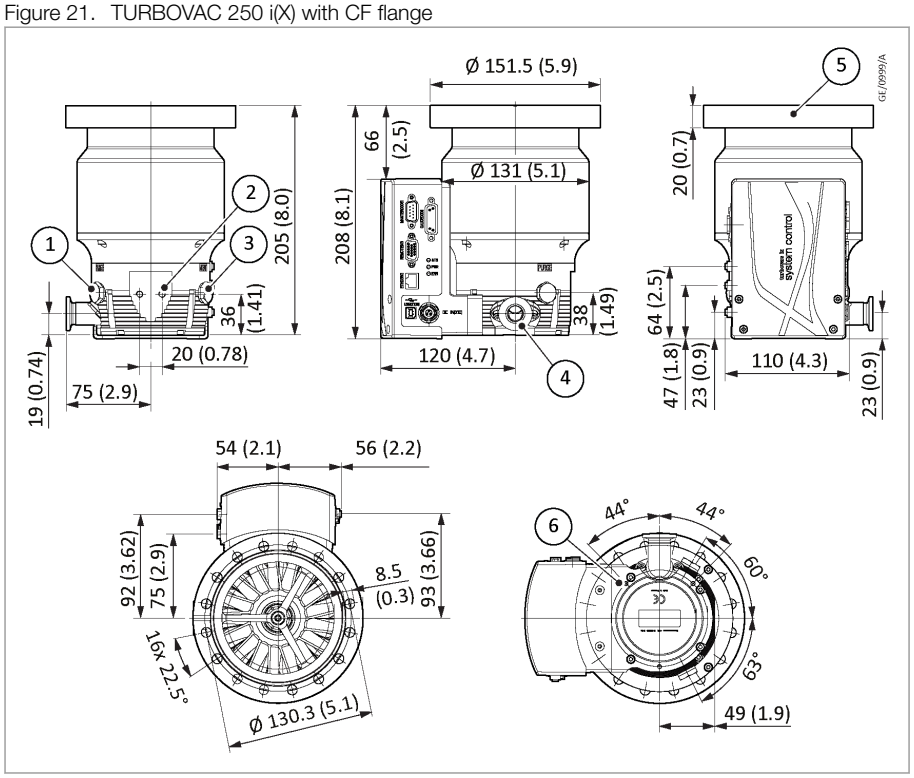
Installation

Figure 20. TURBOVAC 250 i(X) with ISO-K flange



1. *Purge G1/8"*
2. *M6-10 × 2*
3. *Vent G1/8"*
4. *DN 16 KF*
5. *DN 100 ISO-K*
6. *M4-8 × 3*

Figure 21. TURBOVAC 250 i(X) with CF flange



1. *Purge G1/8"*
2. *M6-10 × 2*
3. *Vent G1/8"*
4. *DN 16 KF*
5. *DN 100 CF*
6. *M4-8 × 3*

Figure 22. TURBOVAC 250 i with axial air cooling

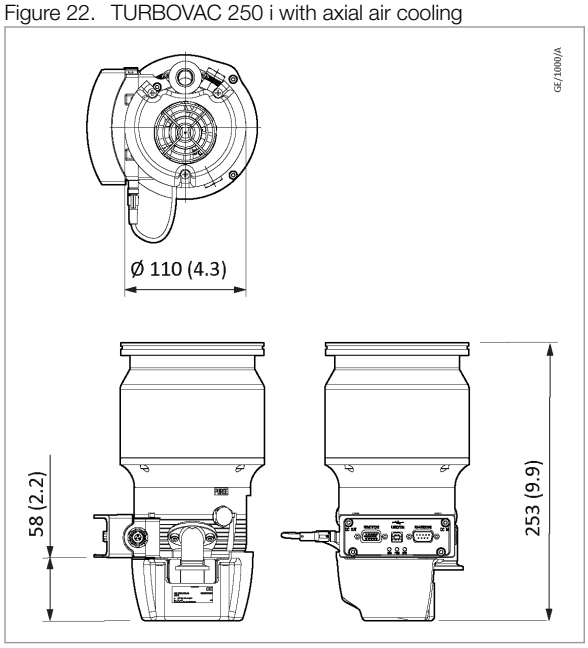
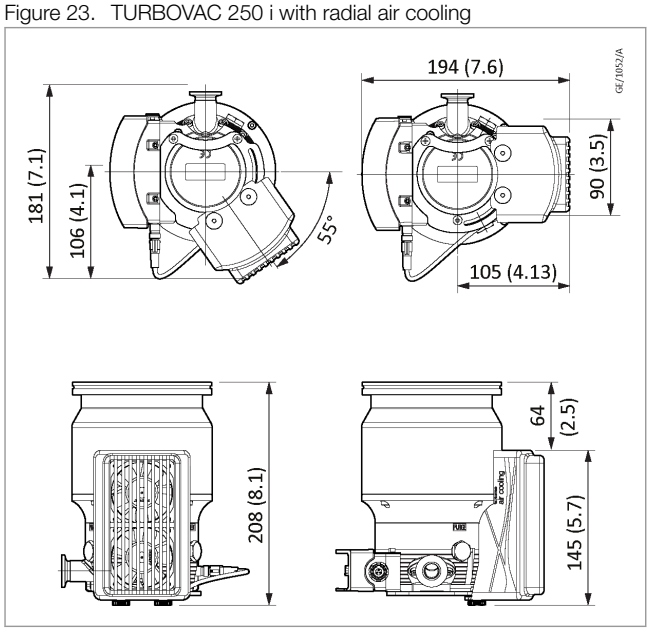
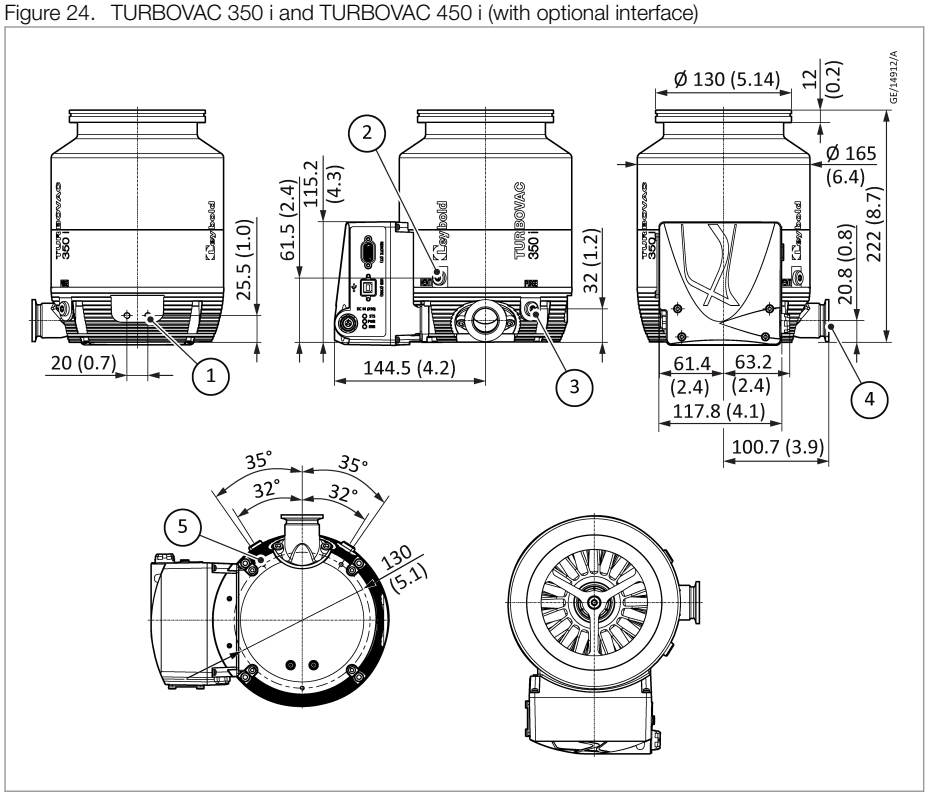


Figure 23. TURBOVAC 250 i with radial air cooling



Installation

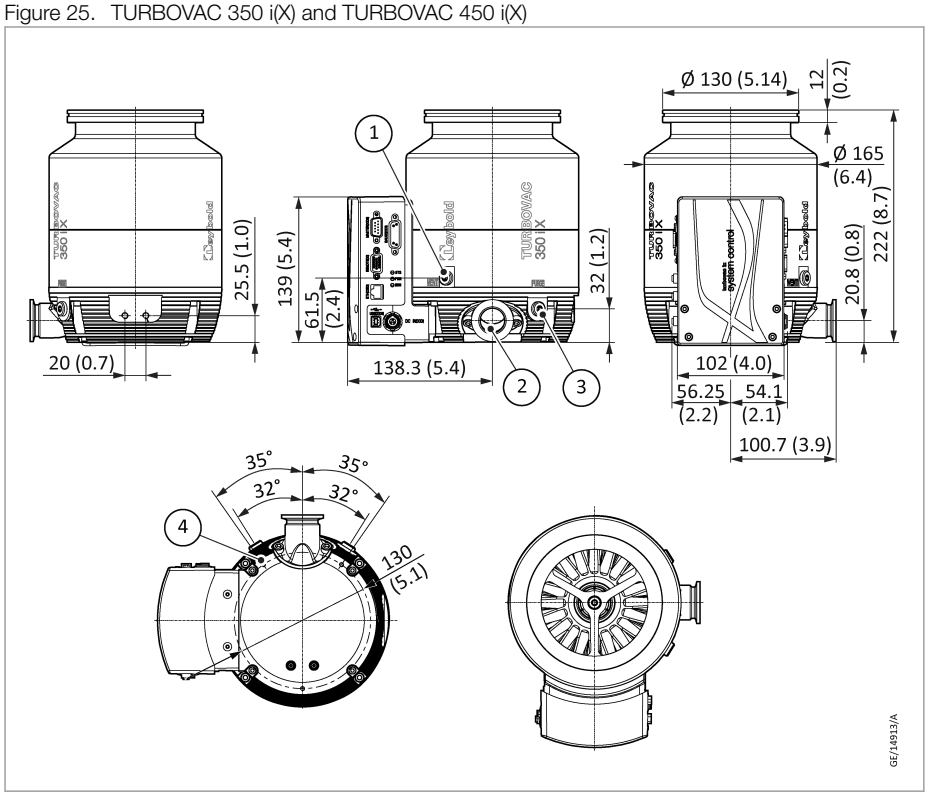
Figure 24. TURBOVAC 350 i and TURBOVAC 450 i (with optional interface)



1. *M6-10 × 2*
2. *Vent (G1/8")*
3. *DN 25 KF*
4. *Purge (G1/8")*
5. *M4-8 × 3, ø130*

Flange	Height (H)	HV/FV distance
TURBOVAC 350 i		
DN 100 ISO-K	222 mm (8.74 inch)	201 mm (7.91 inch)
DN 100 CF	235 mm (9.25 inch)	214 mm (8.43 inch)
TURBOVAC 450 i		
DN 160 ISO-K	214 mm (8.43 inch)	193 mm (7.60 inch)
DN 160 CF	222 mm (8.74 inch)	201 mm (7.91 inch)

Figure 25. TURBOVAC 350 i(X) and TURBOVAC 450 i(X)

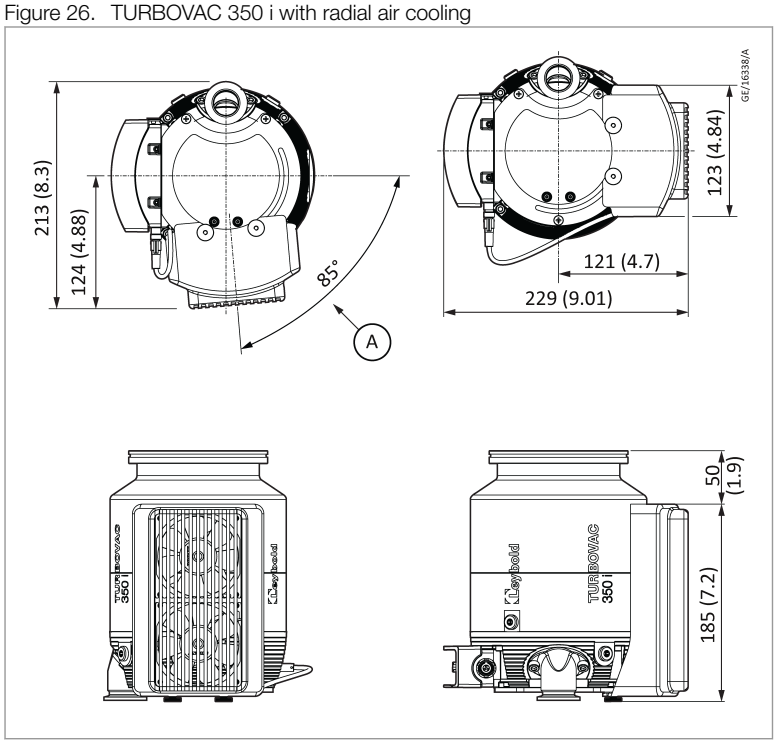


1. Vent (G1/8")
2. Purge (G1/8")
3. DN 25 KF
4. M4-8 × 3, ø130

Flange	Height (H)
TURBOVAC 350 i(X)	
DN 100 ISO-K	235 mm (9.25 inch)
DN 100 CF	248 mm (9.76 inch)
TURBOVAC 450 i(X)	
DN 160 ISO-K	219 mm (8.62 inch)
DN 160 CF	225 mm (8.85 inch)

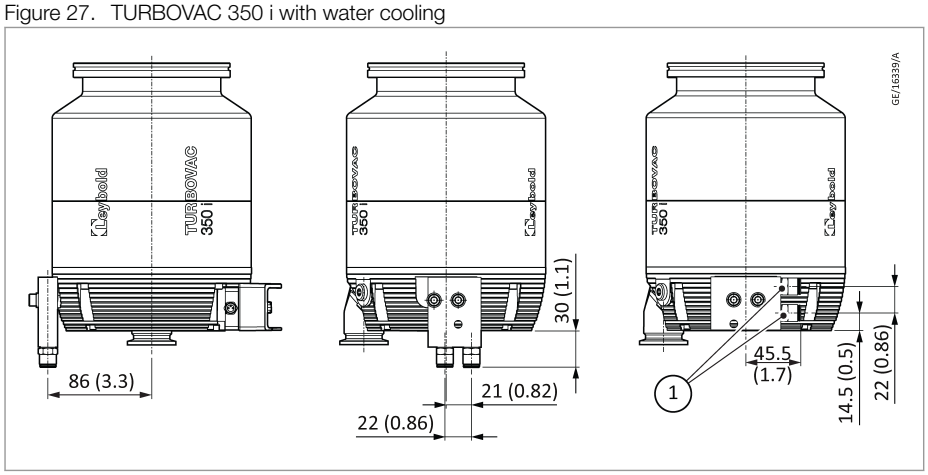
Installation

Figure 26. TURBOVAC 350 i with radial air cooling



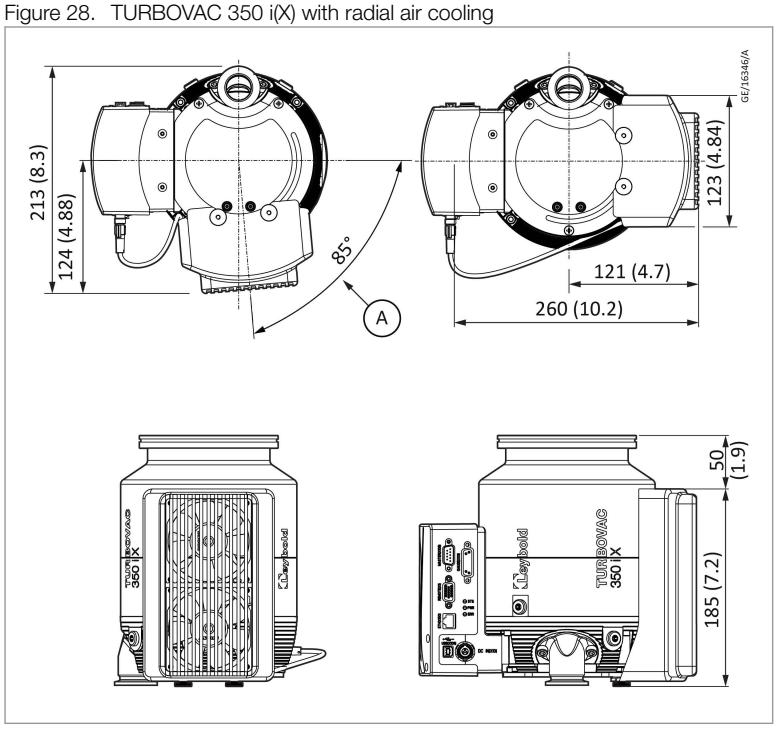
A. Adjustable range for air cooler

Figure 27. TURBOVAC 350 i with water cooling



1. Plug connection for 6×1 hose G1/8" without plug connection

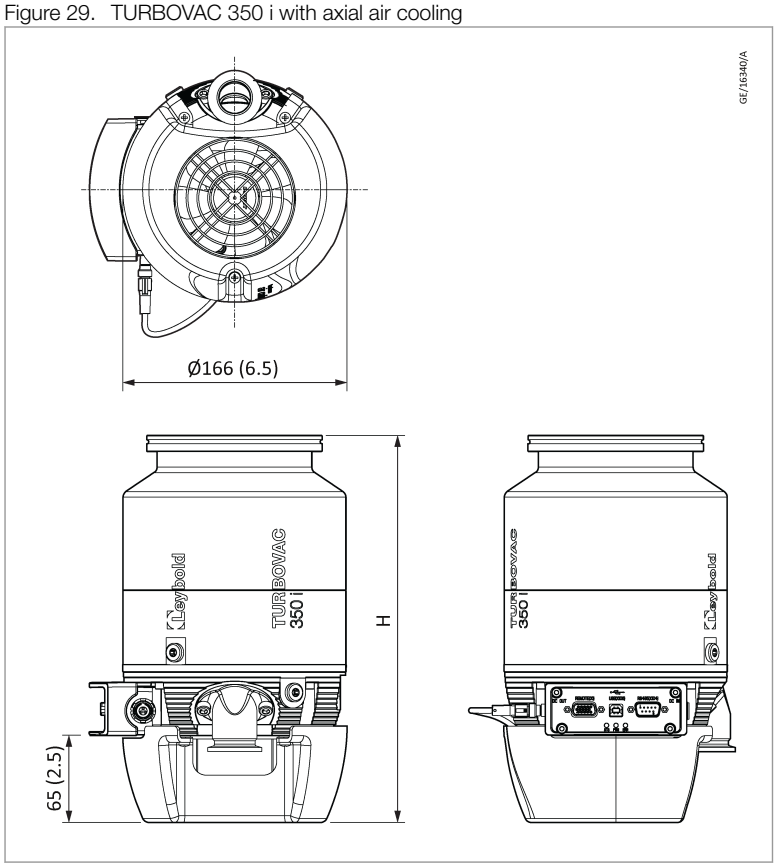
Figure 28. TURBOVAC 350 i(X) with radial air cooling



A. Adjustable range for air cooler

Installation

Figure 29. TURBOVAC 350 i with axial air cooling



Flange	Height (H)
DN 100 ISO-K	296 mm (11.65 inch)
DN 100 CF	319 mm (12.55 inch)
DN 160 ISO-K	280 mm (11.02 inch)
DN 160 CF	286 mm (11.25 inch)

Figure 30. TURBOVAC 350 i with forevacuum flange to the bottom

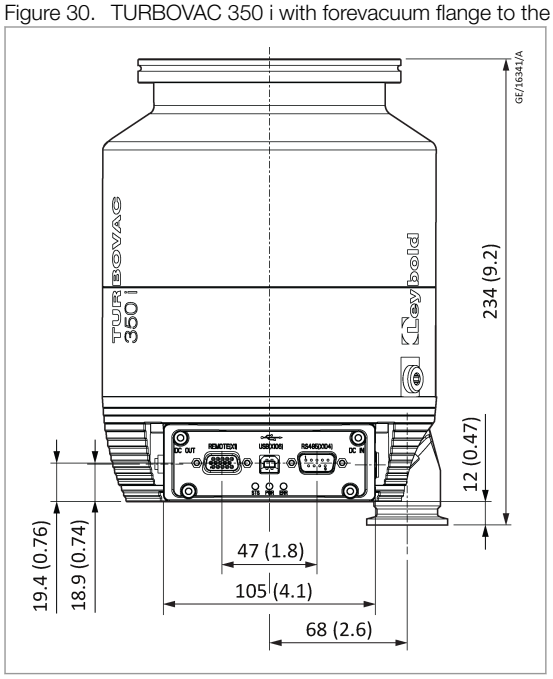


Figure 31. TURBOVAC 350 i with lateral forevacuum flange

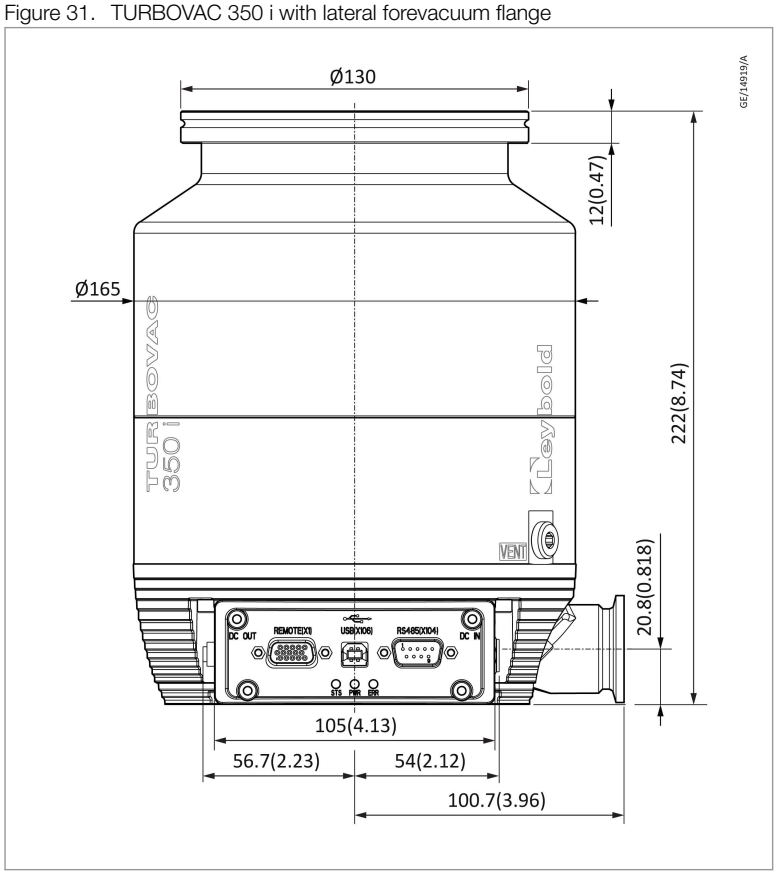
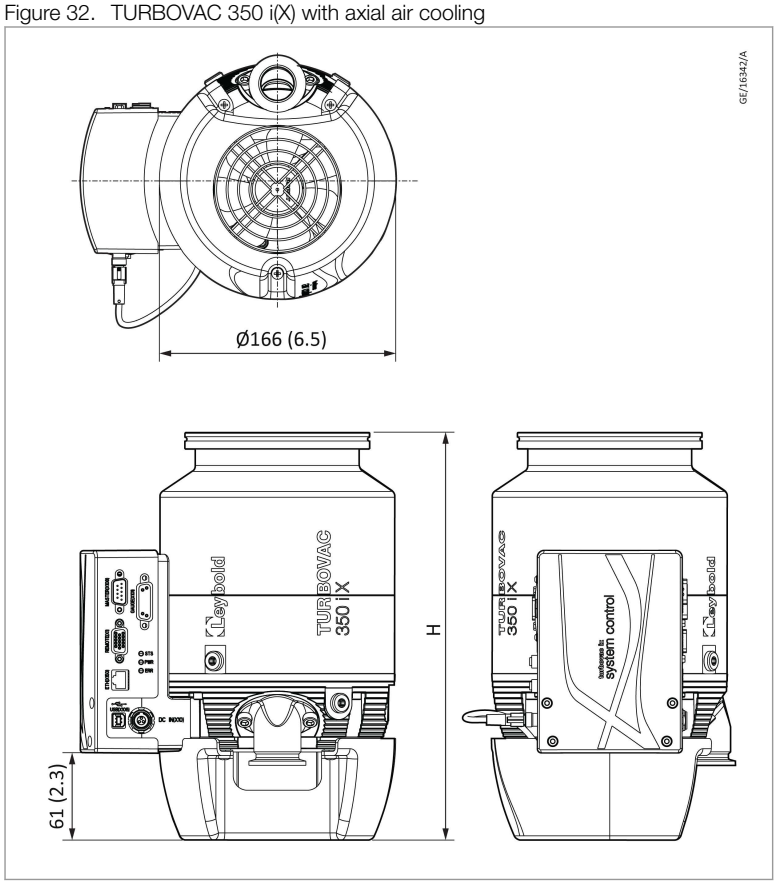


Figure 32. TURBOVAC 350 i(X) with axial air cooling



Flange	Height (H)
DN 100 ISO-K	296 mm (11.65 inch)
DN 100 CF	319 mm (12.55 inch)
DN 160 ISO-K	280 mm (11.02 inch)
DN 160 CF	286 mm (11.25 inch)

6.2 Fitting accessories

See also *Accessories* on page 85.

Various accessory components can be connected to the TURBOVAC i(X):

- Water cooling or air cooling, refer to *Connect the cooling* on page 53
- Purge gas valve, venting valve or power failure venting valve, refer to *Connect a power failure venting valve or a venting valve* on page 58 and *Purge gas connection* on page 59.
- Relay box for switching a forevacuum pump.

The accessory connections are pre-configured in the factory and are therefore ready for immediate operation when connecting the pre-configured accessory equipment.

Configurations may be modified through the interfaces, refer to *Interfaces* on page 69.

The TURBO.CONTROL i serves to control and monitor a TURBOVAC i/i(X) turbomolecular pump.

Only for TURBOVAC i

Secondary devices are directly energised and activated through the accessory connection X201 (M8 plug), by means of a Y-cable 2 accessories can be connected at the same time. In this case, both devices are energised in parallel and switched between active and inactive at the same time.
The factory-set accessories's interface features a plug-and-play mode, and is instantly ready for operation with the connected device (energised with pump switched on).

Only for TURBOVAC i(X)

Additional accessory components can be connected to the TURBOVAC i(X):

- Pressure gauge
- Further 24 V d.c. operated equipment which may be driven depending on the pump status.

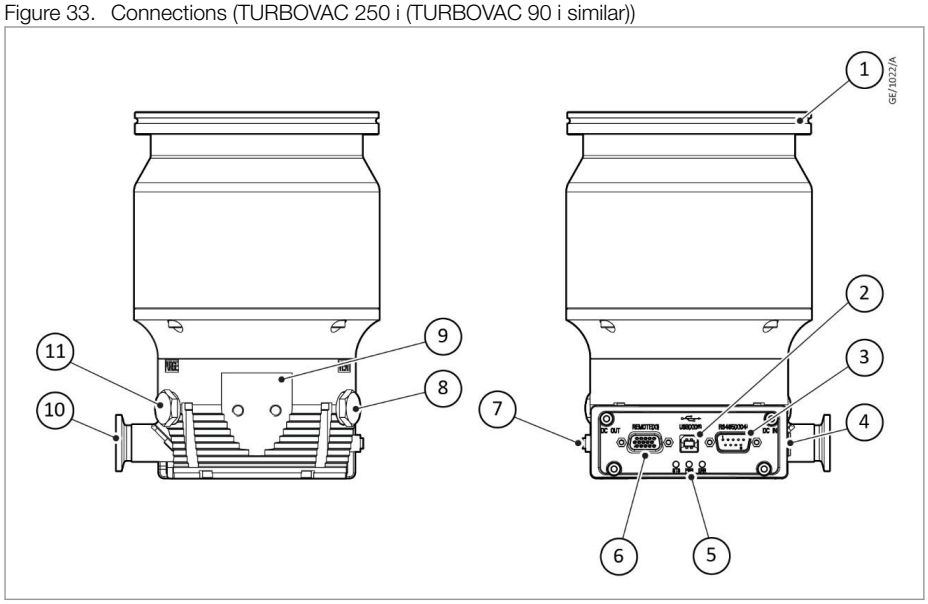
The accessory components can be electrically powered and driven through three accessory connections. Refer to *Table: TURBOVAC i(X) configuration as delivered from the factory*.

Table 4. TURBOVAC i(X) configuration as delivered from the factory

Accessory connection	Pre-configured equipment	Reaction
X201	Air cooling	Air cooling unit is running when the TURBOVAC is running.
X202	Relay box for forevacuum pump	Forevacuum pump is running when the TURBOVAC has received the start command.
X203	Venting valve	The venting valve opens when the start command is revoked and the frequency drops below 999 Hz. At 5 Hz the valve is closed again (no power failure venting).

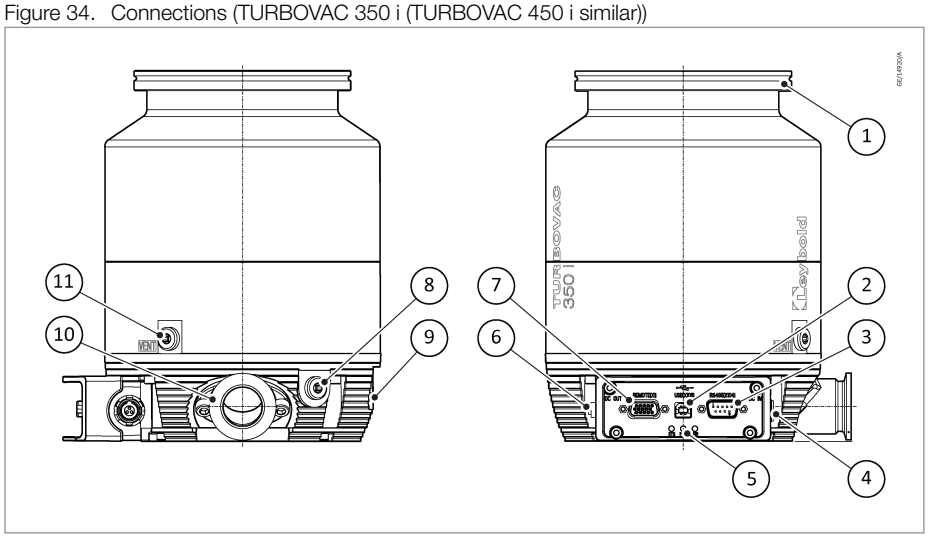
Installation

Figure 33. Connections (TURBOVAC 250 i (TURBOVAC 90 i similar))



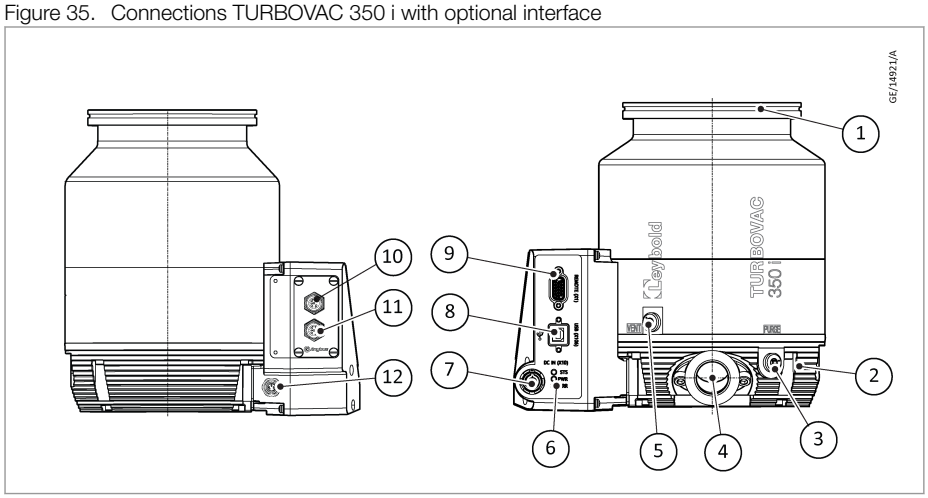
1. *High vacuum flange*
2. *USB interface X106*
3. *RS 485 interface X104*
4. *DC input d.c. IN X10*
5. *LEDs*
6. *Remote interface X1*
7. *Accessory connection d.c. out (M8) X201*
8. *Venting connection G1/8"*
9. *Mounting surface for water cooling*
10. *Forevacuum connection*
11. *Purge gas connection G1/8"*

Figure 34. Connections (TURBOVAC 350 i (TURBOVAC 450 i similar))



1. *High vacuum flange*
2. *USB interface X106*
3. *RS 485 interface X104*
4. *DC input DC IN X10*
5. *LEDs*
6. *Accessory connection d.c. out (M8) X201*
7. *Remote interface X1*
8. *Purge gas connection G1/8"*
9. *Mounting surface for water cooling*
10. *Forevacuum connection*
11. *Venting connection G1/8"*

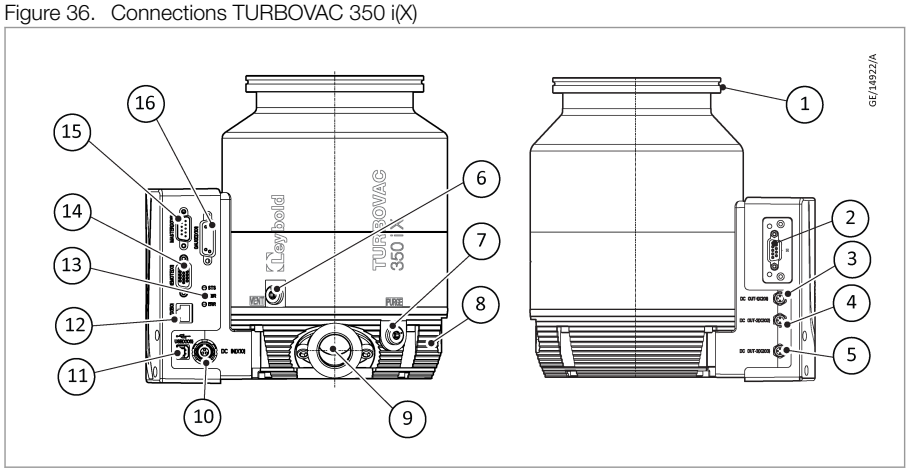
Figure 35. Connections TURBOVAC 350 i with optional interface



Similar for TURBOVAC 90 i, 250 i and 450 i.

1. *High-vacuum flange*
2. *Mounting surface for water cooling*
3. *Purge gas connection G1/8"*
4. *Forevacuum connection*
5. *Venting connection G1/8"*
6. *LEDs*
7. *DC input DC IN X10*
8. *USB interface X106*
9. *REMOTE interface X1*
10. *Anybus port 2 (OUT for EtherCAT)*
11. *Anybus port 1 (IN for EtherCAT)*
12. *Accessory connection d.c. out (M8) X201*

Figure 36. Connections TURBOVAC 350 i(X)



Similar for TURBOVAC 90 i(X), 250 i(X) and 450 i(X).

1. *High-vacuum flange*
2. *Anybus interface X120*
3. *Accessory connection X201*
4. *Accessory connection X202*
5. *Accessory connection X203*
6. *Venting connection G1/8"*
7. *Purge gas connection G1/8"*
8. *Mounting surface for water cooling*
9. *Forevacuum connection*
10. *d.c. IN X10*
11. *USB interface X106*
12. *Ethernet interface (not usable for customers)*
13. *LEDs*
14. *Remote interface X1*
15. *RS-485 master (not usable for customers)*
16. *Gauge X101*

6.3 Attach the pump to the vacuum chamber

WARNING: ROTOR DAMAGE

Risk of injury and damage to equipment. Do not touch the rotor, it can cause injury and damage the rotor bearing.

WARNING: EXPLOSIVE MATERIALS

Risk of injury. The high vacuum flange must be firmly mounted to the vacuum chamber. Observe safety information given in *Mechanical hazards* on page 10.

WARNING: HOT SURFACE

Risk of injury. During the operation, the pump can get so hot that there is the risk of suffering burns (up to approximately 65 °C). Protect the hot parts against being touched.

CAUTION: PUMP ROTATION

Risk of damage to equipment. Even the correct KF connector for the high-vacuum flange is not strong enough to keep the pump completely from rotating a little bit if it should suddenly seize. Rotation of the pump can cause leaks in the forevacuum line. Secure the pump additionally to prevent rotation in case it should suddenly seize.

Remove the transport seal from the intake flange and remove the desiccant.

Pay attention to maximum cleanliness when you make connections.

In the case of a sudden rotor vane rupture or rotor-stator contact which may occur in practise (caused, for example, by solid objects from the process chamber entering the pump through the high vacuum flange), the torques need to be absorbed by the system is given in *Table: Torque when the rotor seizes*.

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

When using flange connecting elements in accordance with DIN 28404, ISO 1609 (ISO-K flange connection) or ISO 3669 (CF flange connection), which fit positively to the pump flange, check the maximum load capacity of the connecting element. Not all flange components can withstand the forces that occur in a crash.

If the strength of the component is not sufficient, there is the possibility of providing an additional safeguard through the three threaded holes in the base of the pump.

The flange material to which the pump is bolted must have a minimum strength specification of 150 N/mm^2 at operating temperature.

Operation with vibration absorber

To decouple extremely sensitive equipment and to prevent the transfer of external vibrations to the pump a special resonance damper is available for mounting at the high vacuum flange.

In this case, mount the turbomolecular pump separately. A vibration absorber cannot reliably sustain the high deceleration torque in case of a rotor seizure.

If additional mounting is not possible, then the pump must be protected by a suitable shield during operation.

On the cooling surface, it is possible to connect a vibration sensor: thread M6, 10 mm deep.

If several turbomolecular pumps are attached to the vacuum chamber of the same system, there is the risk of interference (vibration interference between the pumps). If such a risk exists, contact our application support.

The standard mounting arrangement for the pump is adequate to make sure protection from the earthquake. If required mount the system to the floor or the walls.

Install a splinter guard or an inlet screen

To protect the turbomolecular pump against foreign material from the vacuum vessel we recommend to mount a centring ring with a fine or coarse inlet screen at the high vacuum flange, though this will reduce the pumping speed at the chamber flange.

Reduction of the pumping speed in %	H_2	He	N_2	Ar
Fine inlet screen DN 63	10	13	23	23
Coarse inlet screen DN 63	2	3	5	5
Fine inlet screen DN 100	5	7	24	24
Coarse inlet screen DN 100	2	2	10	8
Fine inlet screen DN 160	6	9	20	23
Coarse inlet screen DN 160	1	2	6	7

Note:
Damages caused during operation without the inlet screen are excluded from warranty.

Flange mounting for KF flanges

Refer to *Figure: DN 40 KF flange connection with clamping collar for ultra sealing rings*.

Mount the TURBOVAC 90 i with DN 40 KF flange using an ultra sealing ring and a clamping collar for ultra sealing rings. Refer to *Accessories* on page 85. Mount the turbomolecular pump and tighten the three bolts of the clamping collar step-by-step.

The contact surfaces of pump housing, vacuum system and centring ring must be dry and free of grease to make sure adequate strength in case the rotor is seize.

Apply a suitable lubricant to the inner clamping surfaces of the clamping ring elements, for example LITHELEN (LVO 810) vacuum grease.

Only the clamping collar for the ultra sealing rings as depicted in the figure may be used. A standard clamping collar is not capable of exerting the necessary force and the rotor should suddenly seize, the pump may heavily twist.

Even the correct KF connector for the high-vacuum flange is not strong enough to keep the pump completely from rotating a little bit if it should

suddenly seize. Rotation of the pump can cause leaks in the forevacuum line. Secure the pump additionally to prevent rotation in case it should suddenly seize.

Flange mounting for ISO-K flanges

Refer to:

Figure: Mounting high vacuum flange ISO-K (ISO-K flange at ISO-K flange)

Figure: Mounting high vacuum flange ISO-K (ISO-K flange at ISO-F flange with collar flange)

Figure: Mounting high vacuum flange ISO-K (ISO-K flange at ISO-F flange with claws).

When flanging on the high vacuum connecting flange, place the O-ring on the centring ring. The O-ring must remain in place, smooth and untwisted. Thereafter put the outer ring (support ring) in place.

Mount the turbomolecular pump and tighten the bolts crosswise step-by-step.

When using an ultra sealing ring, always use an outer support ring. The information on the number of bolts and clamps also applies to the ultra sealing rings.

Required for the installation:

- Mounting kit (accessories)
- Coarse or fine inlet screens (accessories, optional).

Flange mounting for CF flanges

Refer to:

Figure: Mounting the CF high vacuum flange (CF flange connection with clearance hole)

Figure: Mounting the CF high vacuum flange (CF flange connection with blind hole thread).

Before fitting, check to make sure that the sealing edge is undamaged. Do not touch the copper gasket and the sealing edge with your bare hands.

The contact surfaces of the pump housing, vacuum system and centring ring must be dry and free of grease to make sure adequate strength in case the rotor should seize.

Mount the turbomolecular pump and tighten the bolts step-by-step.

When the pump is to be baked out, the threads of the bolts should have been lubricated with a high temperature lubricant.

Owing to the deformation of the copper gasket, the fastening torque of all bolts must be checked once more after you complete the installation work.

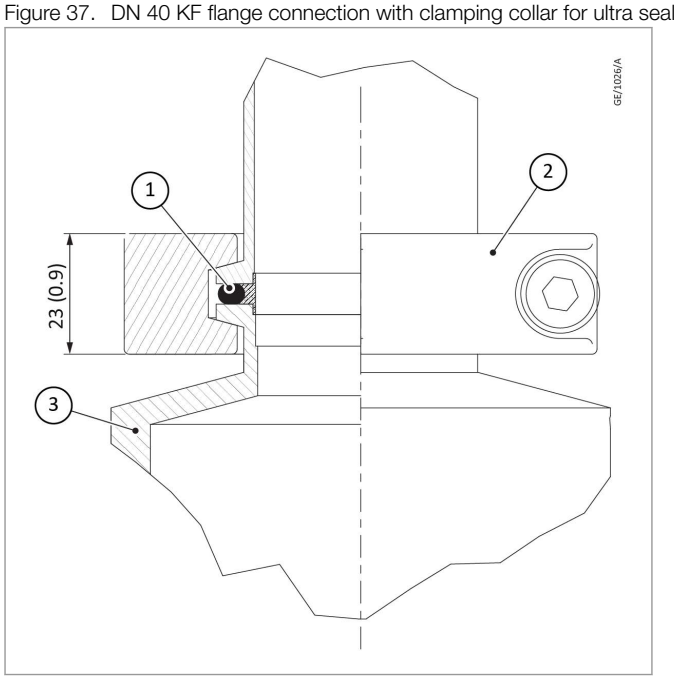
Required for the installation:

- Mounting kit (accessories)
- Coarse or fine inlet screens (accessories, optional).

Table 5. Torque when the rotor seizes

Model	Maximum value
TURBOVAC 90 i(X)	250 Nm
TURBOVAC 250 i(X)	850 Nm
TURBOVAC 350 i(X), 450 i(X)	1000 Nm

Figure 37. DN 40 KF flange connection with clamping collar for ultra sealing rings



1. *Centering ring with O-ring*
2. *Clamping collar for ultra sealing rings with three fastening bolts M8x35*
3. *Pump housing with KF flange*

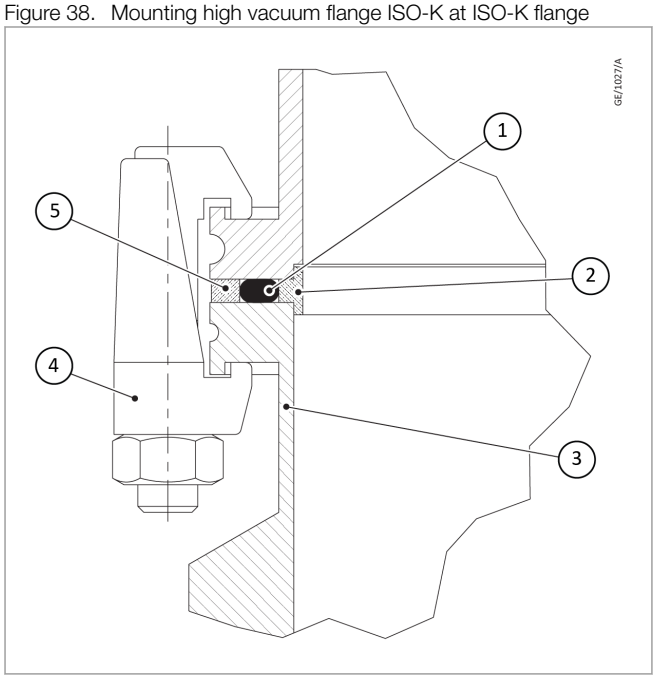
Note:

Fastening torque 10 Nm.

The fastening torque applies to lubricated threads.

Installation

Figure 38. Mounting high vacuum flange ISO-K at ISO-K flange



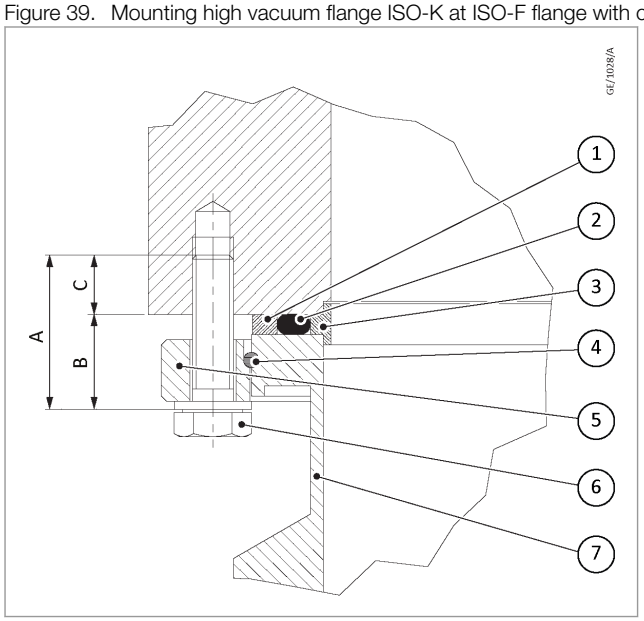
1. *O-ring*
2. *Centering ring*
3. *Pump housing with ISO-K flange*
4. *Clamp*
5. *Outer ring*

Flange	DN 63 ISO-K	DN 100 ISO-K	DN 160 ISO-K
Number of clamps	M10 × 4	M10 × 6	M10 × 6
Minimum clamp strength, yield strength	> 450 N/mm^2		
Fastening torque	20 - 23 Nm		

Note:

The fastening torque levels apply to lubricated threads.

Figure 39. Mounting high vacuum flange ISO-K at ISO-F flange with collar flange

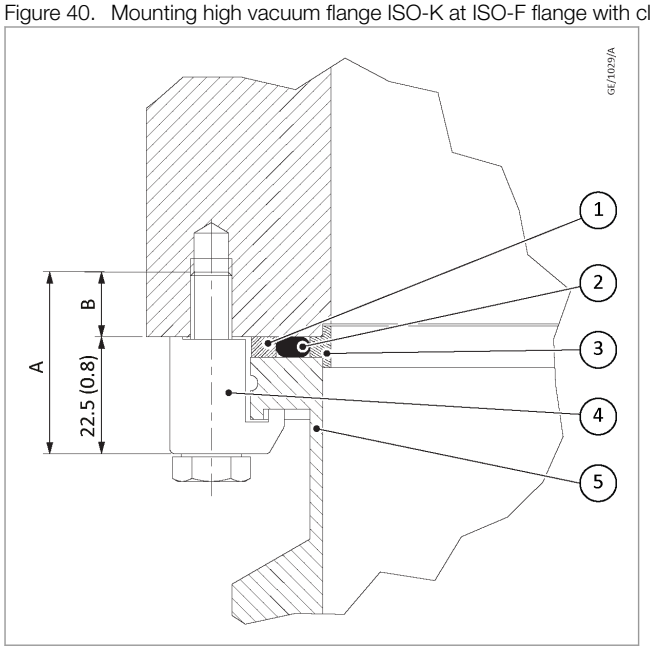


1. *Outer ring*
2. *O-ring*
3. *Centering ring*
4. *Retaining ring*
5. *Collar flange*
6. *Bolt with washer*
7. *Pump housing with ISO-K flange*

Flange	**DN 63 ISO-K**	**DN 100 ISO-K**	**DN 160 ISO-K**
Number of bolts	M8 × 4	M8 × 8	M10 × 8
Minimum bolt strength, yield strength	> 450 N/mm^2	> 600 N/mm^2	> 600 N/mm^2
Minimum screw in depth (C)			
for steel	12 mm	12 mm	13 mm
for aluminium	16 mm	12 mm	18 mm
Variable dimension (B)	18.5 mm	18.5 mm	23 mm
Recommended bolts – ISO 4014			
for steel flanges	M8×30	M8×30	M10×40
for aluminium flanges	M8×35	M8×30	M10×45
Bolt quality stainless steel bolts	8.8 or A2(A4)-70	8.8 or A2(A4)-80	8.8 or A2(A4)-80
Fastening torque	15-17 Nm	20-23 Nm	35-40 Nm

Installation

Figure 40. Mounting high vacuum flange ISO-K at ISO-F flange with claws



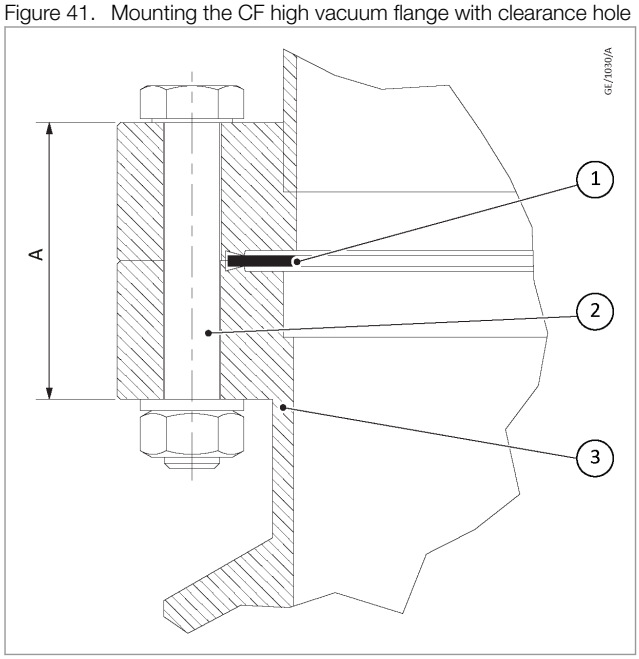
1. *Outer ring*
2. *O-ring*
3. *Centering ring*
4. *Claw with bolt*
5. *Pump housing with ISO-K flange*

Flange	DN 63 ISO-K	DN 100 ISO-K	DN 160 ISO-K
Number of bolts	M8 × 4	M8 × 8	M10 × 8
Minimum bolt strength, yield strength	> 450 N/mm^2	> 600 N/mm^2	> 600 N/mm^2
Minimum screw in depth (B)			
for steel	12 mm	12 mm	13 mm
for aluminium	16 mm	12 mm	18 mm
Recommended bolts – ISO 4014			
for steel flanges	M8×35	M8×35	M10×35
for aluminium flanges	M8×40	M8×35	M10×40
Bolt quality stainless steel bolts	8.8 or A2(A4)-70	8.8 or A2(A4)-80	8.8 or A2(A4)-80
Fastening torque	15-17 Nm	20-23 Nm	35-40 Nm

Note:

The fastening torque levels apply to lubricated threads.

Figure 41. Mounting the CF high vacuum flange with clearance hole



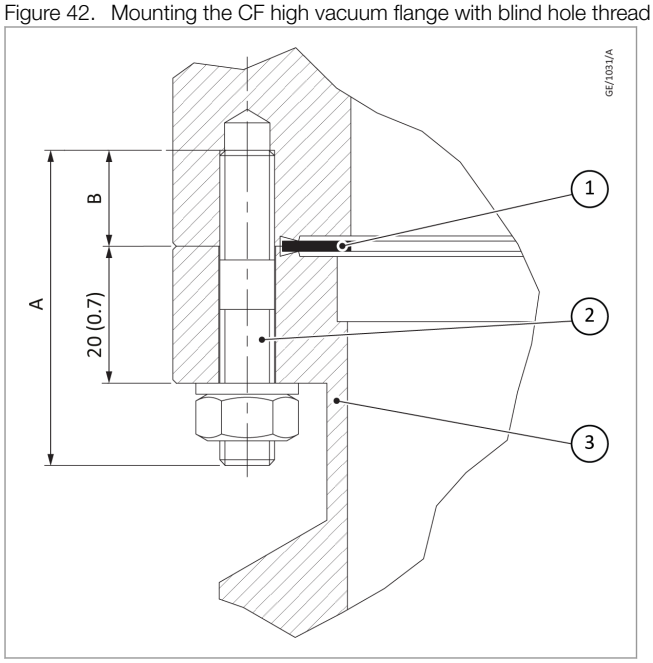
1. *Copper gasket*
2. *Bolt with washer and nut*
3. *Pump housing with CF flange*

Flange	DN 63 CF	DN 100 CF	DN 160 CF
Number of bolts	M8 × 8	M8 × 16	M8 × 20
Minimum bolt strength, yield strength	> 450 N/mm^2		
Recommended bolts – ISO 4014 (A)	M8×45 35	M8×50 40	M8×55 44
Bolt quality stainless steel bolts	8.8 or A2(A4)-70		
Fastening torque	15-17 Nm		

Note:

The fastening torque levels apply to lubricated threads.

Figure 42. Mounting the CF high vacuum flange with blind hole thread



1. *Copper gasket*
2. *Stud bolt with washer and nut*
3. *Pump housing with CF flange*

Flange	DN 63 CF	DN 100 CF	DN 160 CF
Number of bolts	M8 × 8	M8 × 16	M8 × 20
Minimum bolt strength, yield strength	> 450 N/mm^2		
Minimum screw-in depth for steel	12 mm	12 mm ≤ B < 16 mm	
Recommended bolts for steel flanges – DIN 835 (A)	M8×30 45		
Bolt quality stainless steel bolts	8.8 or A2(A4)-70		
Fastening torque	15-17 Nm		

6.4 Forevacuum connection

WARNING: TOXIC MATERIAL

Risk of injury. The forevacuum line must be tight. Hazardous gases can escape at leaks or the gases being pumped can react with air or humidity. Observe safety information given in *Hazards caused by materials and substances* on page 12.

The forevacuum flange may be detached, turned by 180°, and refit, refer to *Dimension drawings* on page 28. Tightening torque for the screws is:

Model	Tightening torque
TURBOVAC 90 i(X), 250 i(X)	3 ± 0.5 Nm
TURBOVAC (T) 350 i(X), (T) 450 i(X)	5 ± 0.5 Nm

Connect the clean forevacuum line with the small flange connectors or the hose couplings, and take care not to constrict the forevacuum flange's diameter.

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

No forces from the piping system may be allowed to affect the turbomolecular pump. Support the piping correspondingly or decouple through flexible joints.

Connect the forevacuum pump through the relay box

Refer to *Figure: Connect the forevacuum pump through the relay box*.

- Only for TURBOVAC i

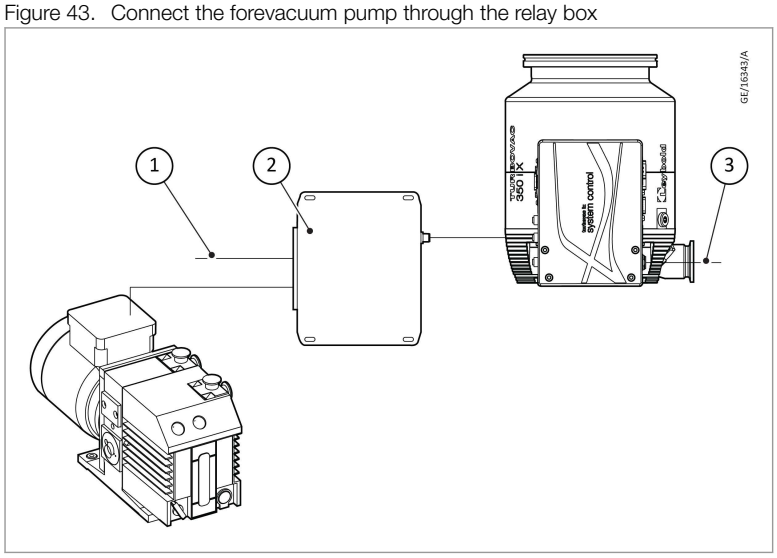
  The forevacuum pump can be energised at the accessories connection of the TURBOVAC through the relay box.
- Only for TURBOVAC i(X)

  A forevacuum pump may be electrically connected through the relay box to accessory connection X202 on the TURBOVAC i(X).

  The relay box switches the forevacuum pump on when a start command is present for the turbomolecular pump, and the relay box switches the forevacuum pump off when the start command is revoked.

  Through parameter 643[1] the switch-on delay time and through parameter 644[1] a shutdown delay time in seconds can be set up (the default for both parameters is 0).

Figure 43. Connect the forevacuum pump through the relay box



1. Main voltage *2. Relay box*
3. 24/48 V d.c.

6.5 Connect the cooling

Refer to *Figure: Mounting air coolers (TURBOVAC 350 i(X) (other models similar))*.

Cooling of the pump depends on the required pumping power and the ambient temperature. 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.

For the operations diagram for the TURBOVAC 90 i or 250 i, refer to *Operation diagram* on page 23.

For the operations diagram for the TURBOVAC 350/450 i(X), refer to *Figure: Cooling conditions*.

6.5.1 Air cooling

When installing air cooled pumps within a system, make sure that sufficient quantities of fresh air are freely available. The air cooling facility is powered through the pump.

Use the 3 bolts which are included in the delivery to attach the air cooling unit at the bores provided on TURBOVAC, refer to the respective dimensional drawings. Plug in the control cable of the air cooler into the accessories connection (X201 for the TURBOVAC i(X)) and screw tightly. The accessory connection is pre-configured so that the air cooler will always be running when the pump is running. To change this setting, refer to *Interfaces* on page 69.

The radial air cooler may be adjusted and turned after loosening the two knurled nuts, refer to the air cooler operating instructions.

6.5.2 Water cooling

Refer to *Figure: Cooling water block*.

Attach the cooling water block to the TURBOVAC with two M6 screws, tightening torque is 8-10 Nm. Depending on the requirements, the supply or the drainage may be arranged radially or axially, refer to *Dimension drawings* on page 28. Connect the cooling water hoses.

The hose connections may be unscrewed and removed, to make use of the integrated G1/8" threads.

Adjust the cooling water temperature to avoid condensation. With pump downtimes, the cooling water has to be turned off.

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

6.5.3 Water quality

For trouble-free operation, the cooling water must not contain any oils, greases and suspended solids. Obey the limit values given in *Table: Water quality*.

If there is a risk of frost, you may use a water-glycol mixture of up to 30%.

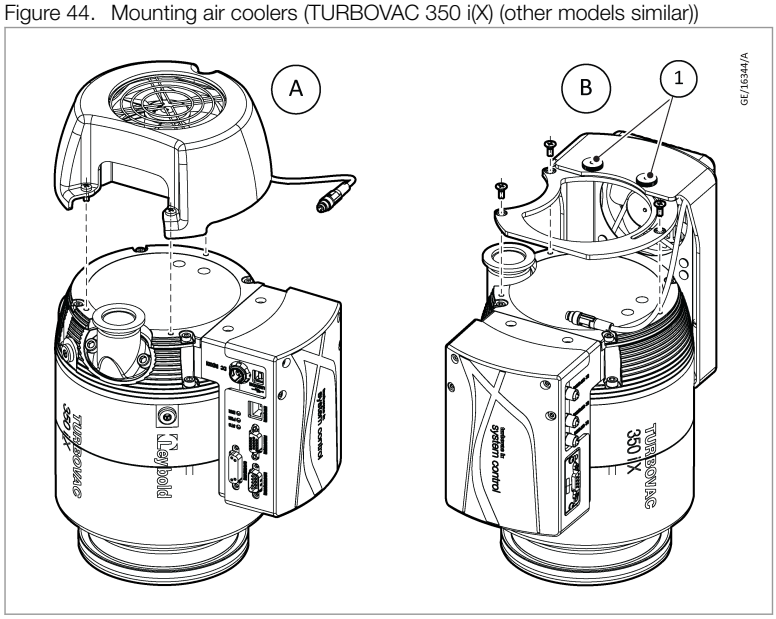
DS water (softened or fully desalinated water) can be used for cooling the pump if the pH value corresponds to the range indicated below.

Table 6. Water quality

Parameter	Value
Appearance	Clear, free of oils and greases
Suspended matter	< 250 mg/l
Particle size	< 150 µm
Electrical conductivity	< 700 µS/cm
pH value	7.0 to 9.0
Total hardness (total alkaline earths)	< 8 °dH
Aggressive carbon dioxide	None, not detectable

Parameter	Value
Chloride	< 100 mg/l
Sulphates	< 150 mg/l
Nitrate	≤ 50 mg/l
Iron	< 0.2 mg/l
Manganese	< 0.1 mg/l
Ammonium	< 1.0 mg/l
Free chlorine	< 0.2 mg/l
8 °dH (degrees German hardness) 10 °e (degrees English hardness) 14 °f (degrees French hardness)	1.4 mmol/l

Figure 44. Mounting air coolers (TURBOVAC 350 i(X) (other models similar))



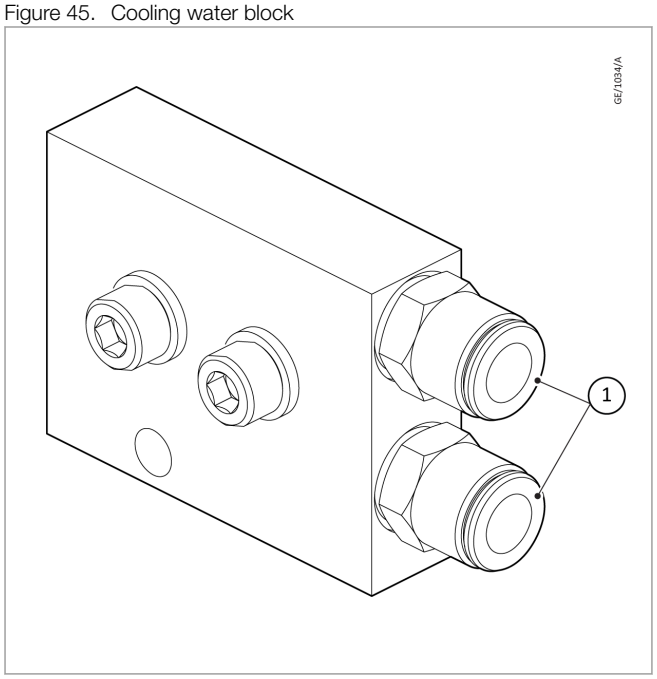
A. Axial air cooler

B. Radial air cooler

1. Knurled nuts

Installation

Figure 45. Cooling water block



1. Hose connection for 6x1 hose

Figure 46. Cooling water requirements

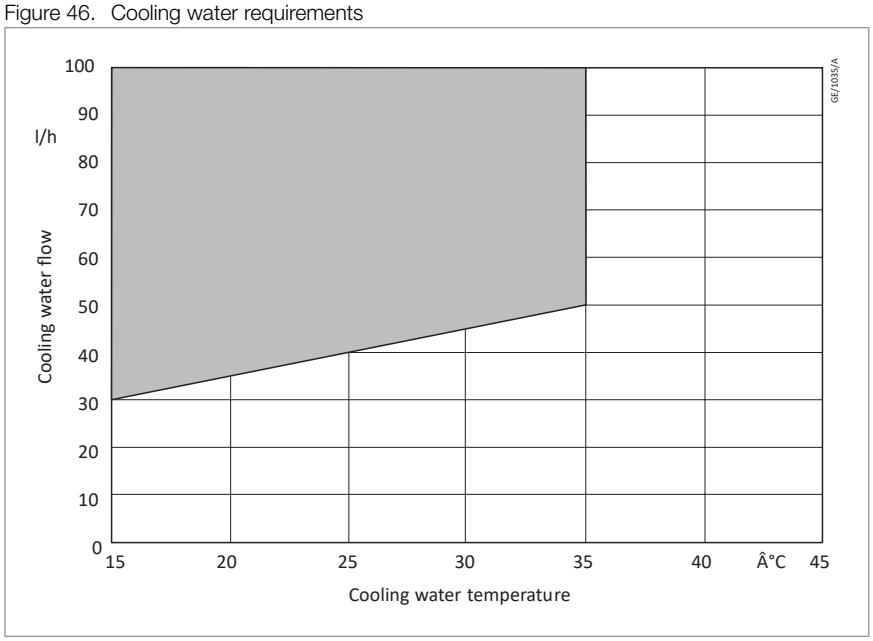
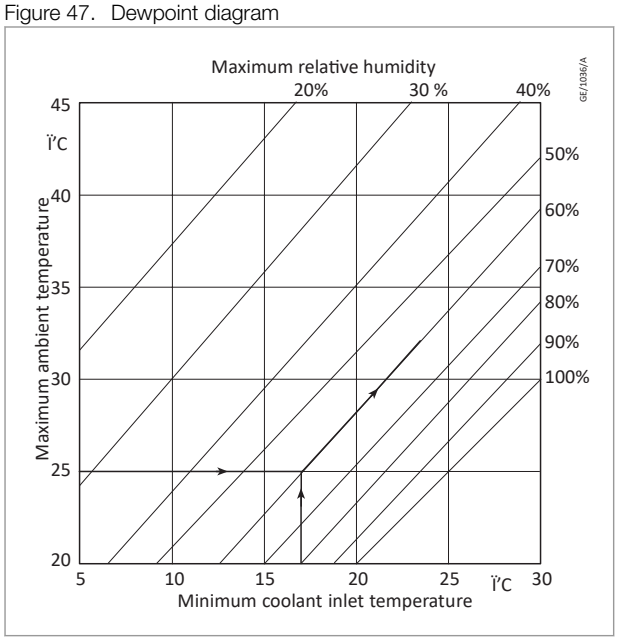


Figure 47. Dewpoint diagram



Minimum coolant inlet temperature at which condensation does not yet occur, as a function of maximum room temperature and maximum relative humidity.

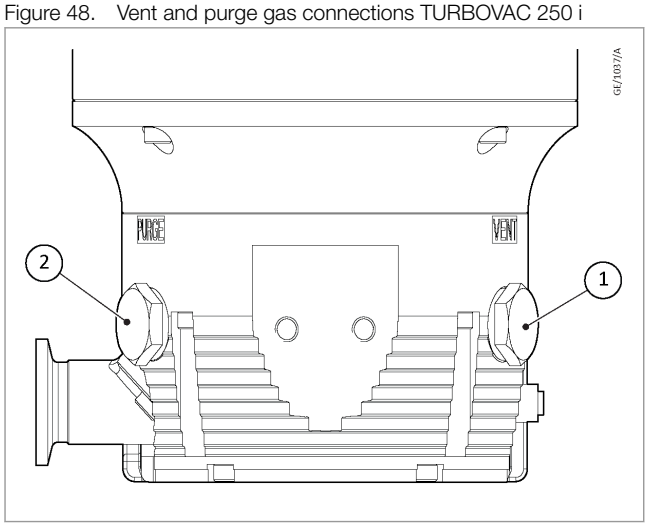
Example:

Maximum ambient temperature 25 °C

Minimum coolant inlet temperature 17 °C

Maximum relative humidity 60%

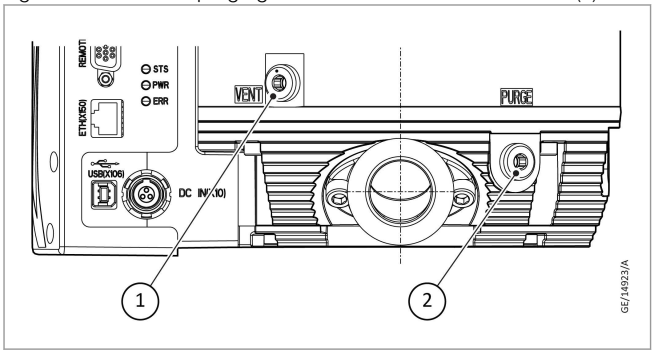
Figure 48. Vent and purge gas connections TURBOVAC 250 i



Similar for TURBOVAC 90 i(X) and 250 i(X).

1. *Vent (venting connection G1/8")*
2. *Purge (purge gas connection G1/8")*

Figure 49. Vent and purge gas connections TURBOVAC 350 i(X)



Similar for TURBOVAC 350 i and 450 i(X).

1. *Vent (venting connection G1/8")*
2. *Purge (purge gas connection G1/8")*

6.6 Connect a power failure venting valve or a venting valve

WARNING: EXPLOSIVE MATERIALS

Risk of injury and damage to equipment. The pressure in the pump must not exceed 1400 mbar (0.4 bar overpressure). Observe safety information given in *Mechanical hazards* on page 10.

The power failure venting valve (normally open) or venting valve (normally closed) vents the pump and the forevacuum line when the pump is switched off and thus keeps oil vapour from diffusing back from the forevacuum line. A choke nozzle in the vent port makes sure that the pump is not vented too fast.

The maximum permissible pressure in the pump must not exceed 1.4 bar (absolute).

1. Unscrew and remove the locking screw and the gasket from the venting connection of the TURBOVAC.
2. Screw in the venting valve and the gasket into the venting connection. To protect the threads, the maximum fastening torque is 5 Nm.
3. If applicable connect the venting gas supply at the valve's inlet (G1/8").

Note:
Connect a purge gas or venting valve to the correct flange. Interchanging the venting and purge gas flange can cause shock venting of the pump.

Only for TURBOVAC i

Plug in the corresponding control cable into the accessories connection.

For the electronic drive unit change the venting valve settings to venting operation (through the interfaces).

Only for TURBOVAC i(X)

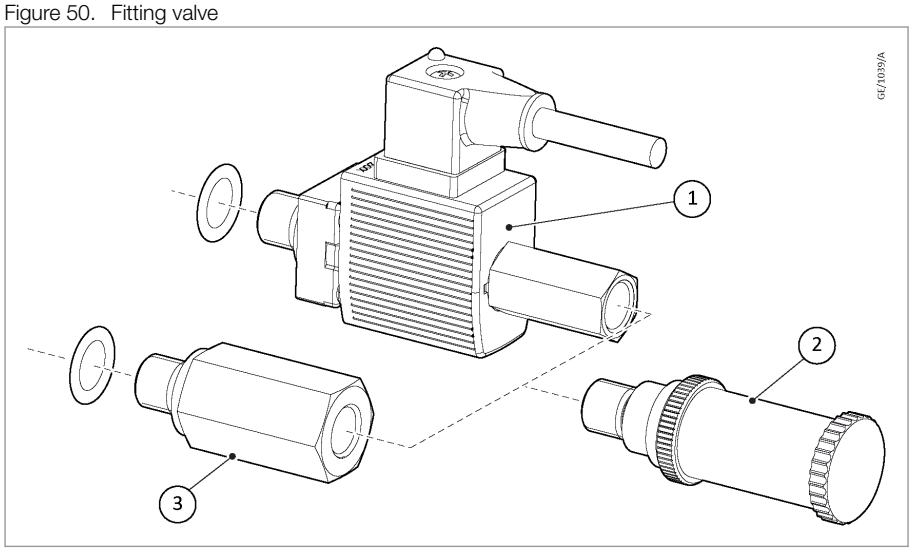
Refer to *Figure: Fitting valve*.

Plug in the corresponding control cable into the accessories connection X203. Accessory connection X203 is pre-configured so that the venting valve opens when the start command is revoked and the frequency drops below 999 Hz. At 5 Hz this valve is closed again. This is no power failure venting. The limits can be changed through parameter 28[2] (upper

switching threshold) and parameter 647[2] (lower switching threshold). For this refer to *Interfaces* on page 69.

Connect a power failure venting valve electrically separate or connect it to X201, X202 or X203 and change the function for the accessory connection. For this refer to *Interfaces* on page 69.

Figure 50. Fitting valve



1. *Valve*
2. *Air filter*
3. *Purge gas throttle G1/8"*

Parameter	Part number
Valve	800120V0012, 800120V0013, 800120V0022
Air filter	800110V0022
Purge gas throttle G1/8"	800120V0014

6.7 Purge gas connection

WARNING: EXPLOSIVE MATERIALS

Risk of injury and damage to equipment. The pressure in the pump must not exceed 1400 mbar (0.4 bar overpressure). Observe safety information given in *Mechanical hazards* on page 10.

Contact us for help to decide which gases need or do not need to be pumped with purge gas.

Refer to *Media compatibility/purge gas* on page 69 for suited gases.

Consider the additional purge gas flow when selecting a suitable backing pump.

We recommend a purge gas flow of 0.4 mbar·l/s (24 sccm) with nitrogen.

The purge gas is fed through an activated valve or a manually operated throttle.

Purge gas connection with purge gas valve

1. Unscrew and remove the locking screw and the gasket from the purge gas connection of the TURBOVAC.
2. Screw in the purge gas valve and the gasket into the thread.

3. Connect the purge gas supply at the valve's inlet (G1/8").
4. Connect the purge gas valve electrically separate or connect it to an accessory connection and thereafter change the function for the accessory connection. For this refer to *Interfaces* on page 69.

Purge gas connection with purge gas throttle

1. Unscrew and remove the locking screw and the gasket from the purge gas connection of the pump.
2. Then screw in the throttle and the gasket into the thread.

6.8 Connect a flange heater

Only 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.

With the aid of the relay box, the heating jacket can be driven directly through the turbopump. For this, connect the heating jacket to the relay box and insert the connection cable of the relay box at the accessory connection (X201 for the TURBOVAC i(X)) and screw it down.

The accessory connection has been pre-configured so that the heating jacket will heat as long as the turbomolecular pump is running. To change this setting, refer to *Interfaces* on page 69.

Alternatively, the heating jacket may be connected through the corresponding mains power cable to the power supply.

Information on baking out is also given in *Bakeout* on page 75.

6.9 Connect a vacuum gauge head (only for TURBOVAC i(X))

One of the listed vacuum gauge heads may be connected to connection X101.

Connect the vacuum gauge head only after you switch off the pump first.

The type of connected vacuum gauge head is detected automatically.

The measured value can be read out in millibar, Torr and Pascal through parameter as real value.

- P616: measured value in millibar
- P617: measured value in Torr
- P618: measured value in Pascal

Parameters (like filter time, CTR vacuum gauge head subtype, gas type correction factor) may be set up for the respective vacuum gauge head. For this refer to *Interfaces* on page 69.

Table 7. Connect a vacuum gauge head (only for TURBOVAC i(X))

Vacuum gauge head	Connection cable	Pressure range
TTR 101, TTR 101 S2, TTR 101 N, TTR 101 N(S2)	Type F	$5x10^{-4}$…1500 mbar
ITR 200 S, ITR 200 SL, ITR 200 SP, ITR 200 SD	Type C	$5x10^{-10}$…1000 mbar

Vacuum gauge head	Connection cable	Pressure range
CTR 100/101, CTR 100 N, CTR 101 N	Type C	$1x10^{-1}$…1000 torr to $1x10^{-5}$…0.1 torr
TTR 91, TTR 91 S, TTR 96 S, TTR 91 N, TTR 91 N(S), TTR 96 N(S)	Type F	$5x10^{-4}$…1000 mbar
PTR 90, PTR 90 N	Type F	$5x10^{-9}$…1000 mbar
ITR 90, ITR 90 P	Type C	$5x10^{-10}$…1000 mbar

6.10 Electrical connection

WARNING: DANGEROUS VOLTAGE

Risk of injury. Unplug any connectors only when the mains voltage is switched off and the pump does no longer turn.

Observe safety information given in *Electrical hazards* on page 11.

Note:

Make sure that you have correct polarity.
Pin 1 24/48 V
Pin 2 PE
Pin 3 0 V
When pulling the d.c. IN connector first retract the retaining sleeve (Refer to Figure: Power supply connector d.c. IN (X10)).

Refer to *Figure: TURBOVAC i(X) with power supply*.

The pump can be operated with 24 V or 48 V d.c. power supply. Take note of the performance data specified in *Technical data for the integrated drive electronics* on page 25.

LEDs

- Green LED (Status)
  - off: Pump at standstill (< 3 Hz)
  - flashes slowly 1/s: Start command is present (about 10 s after start)
  - flashes fast 3/s: Running up
  - flashes slowly 0.5/s: Running down
  - on: Normal operation
- Yellow LED (Power)
  - off: No supply voltage
  - flashes 1/s: Supply voltage too low or too high
  - flashes 3/s: Running down and pump speed < 100 Hz
  - on: Supply voltage is present
- Red LED (Error)
  - off: No error, no warning
  - flashes: Warning is present, pump can be operated possibly with some restrictions or run-in procedure is running
  - on: Fault is present, pump stopped or can not be operated
- LED running light (green-yellow-red)

  Pump is in a state in which it cannot be controlled.

  Possible reasons:

- Initialisation shortly after switching on the supply voltage
- Memory procedure in progress (power supply must not be interrupted)
- Reset of factory setting is ongoing
- Firmware update is ongoing.

The electronics are protected by an internal fuse. The fuse cannot be replaced by the customer.

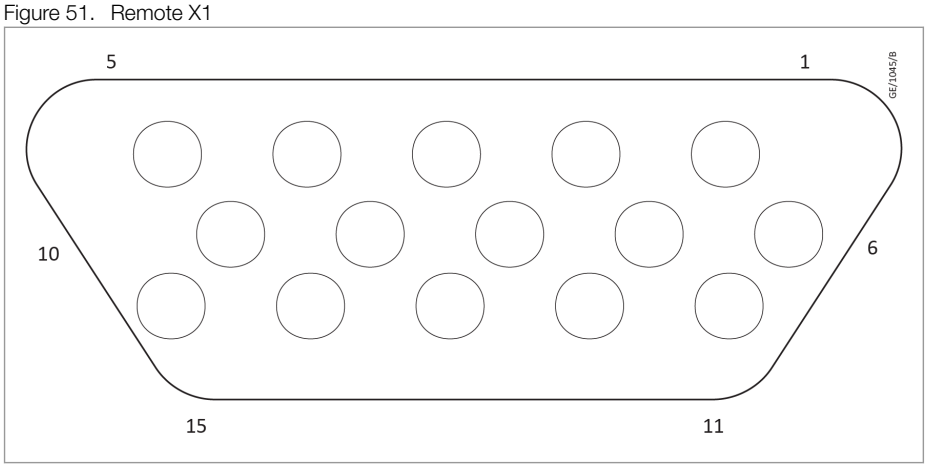
The cable protection and voltage drop and the minimum supply voltage must be adhered to when wiring.

When operating more than one pump with a single power supply, fuse each pump separately due to the line protection.

Emergency shut down: By shutting down the power supply voltage. Note the information on shutting down and emergency shut down provided in *Shut down* on page 73.

6.10.1 REMOTE interface X1

Figure 51. Remote X1

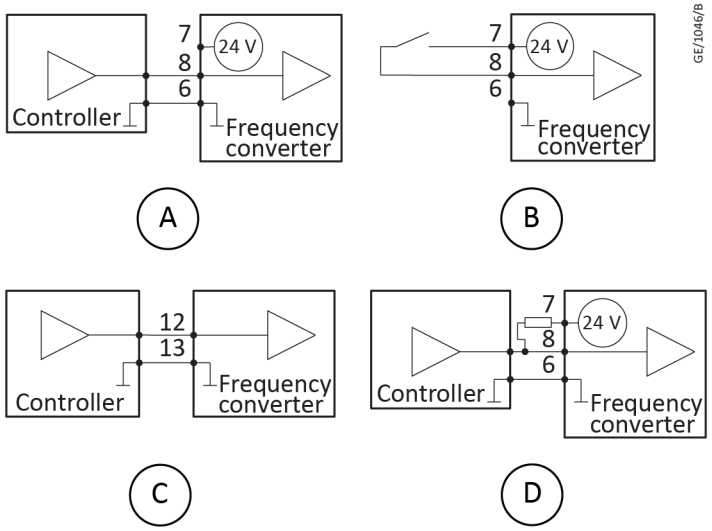


Pin	Name	Description
1	Error relay	(COM)
2	Error relay	(NC)
3	Normal operation relay	(NO)
4	Normal operation relay	(COM)
5	Normal operation relay	(NC)
6	Signal GND	-
7	High level output	24 V, 100 mA, Tolerance according to device supply voltage
8	Start input (High) Reset input (Low)	High > 10 V ± 0.5 V Low < 7.5 V ± 0.5 V
9	Error relay	(NO)

Pin	Name	Description
10	Standby input	High > 10 V ± 0.5 V Low < 7.5 V ± 0.5 V
11	Cooling/Venting valve input (Low)	High > 10 V ± 0.5 V Low < 7.5 V ± 0.5 V
12	Analog output (Default: Frequency)	0 - 10 V, 2 mA
13	Analog GND	-
14	Warning relay	(NC)
15	Warning relay	(COM)
Shield	Connected with the pump housing	-

Note:

Maintain pin 6 Signal GND and pin 13 Analogue GND separate so as to avoid equalisation currents.



A. With controller (Start/Stop input)

B. Without controller (Start/Stop input)

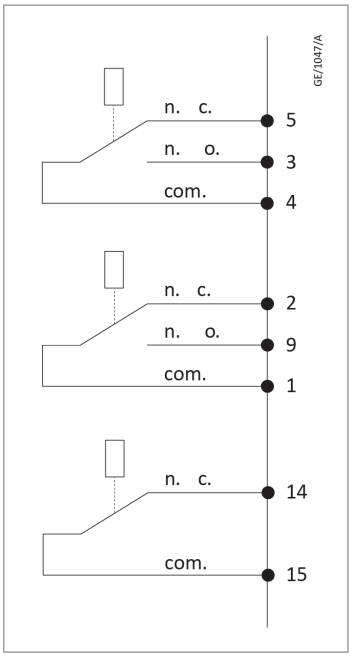
C. Analog output

D. With open collector (Start/Stop input) resistor 10k Ohm

With controller (A)	without controller (B)
0 V = STOP/Fehlerrese	Contact open = STOP/Error reset
24 V = START	Contact closed = START
Pin 10	Pin 10
▪ 0 V = no Standby operation	▪ Contact open: no Standby operation
▪ 24 V = Standby operation	▪ Contact closed: Standby operation
Pin 11	Pin 11
▪ 0 V = no function	▪ Contact open: no function
▪ 24 V = Cooling or valve is activated	▪ Contact closed: Cooling or valve is activated

Installation

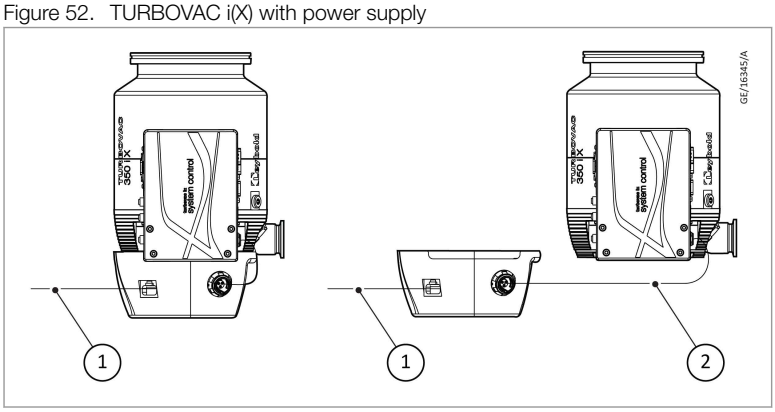
Relay



Refer to *Table: Technical data for the integrated drive electronics*.

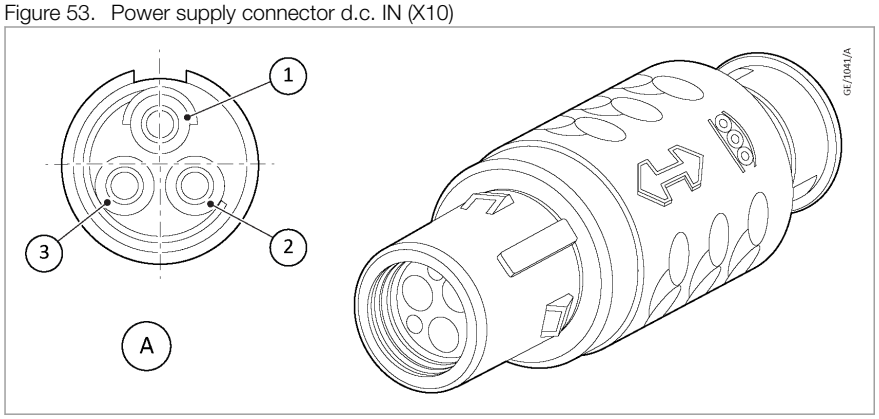
Normal operation relay	
4 and 5 connected (normal position)	Run-down, run-up, stop
4 and 3 connected	Normal operation
Error relay	
1 and 2 connected (normal position)	No error
1 and 9 connected	Error
Warning relay	
14 and 15 connected (normal position)	No warning
14 and 15 open	Warning

Figure 52. TURBOVAC i(X) with power supply



1. *Mains 85-264 V a.c.*
2. *Cable TURBOVAC i/i(X) - TURBO.POWER integra maximum 5 m long*

Figure 53. Power supply connector d.c. IN (X10)



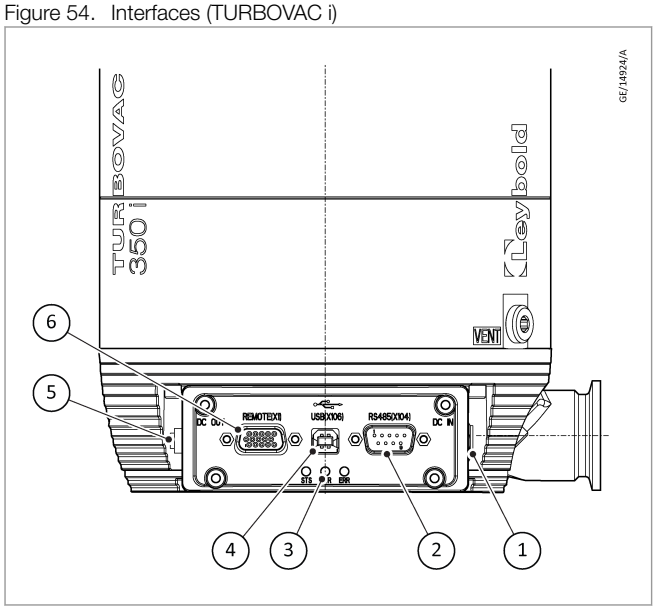
A. View soldering side

1. +24 V / 48 V
2. 0 V
3. PE

Table 8 Relay status

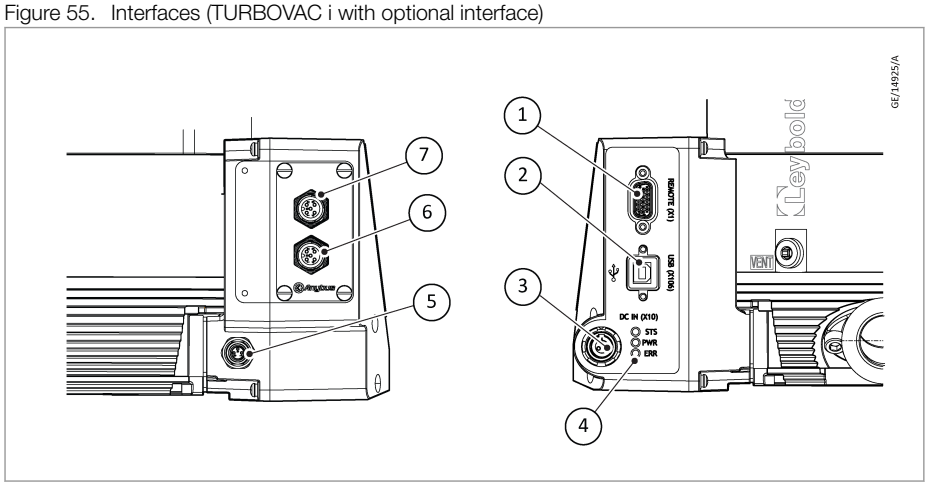
Input data / status			Output data						Operating mode
Start/ stop signal	Pump rotating	Normal frequency ≥ 90% of set-point frequency	Error is present	Motor drive	Relay NORMAL OPERATION	Relay ERROR	LED STATUS (green)	LED ERROR (red)	Other modes are not possible, they indicate a failure affecting the frequency converter.
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, the pump was in the normal operating mode before stopping
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

Figure 54. Interfaces (TURBOVAC i)



1. *DC input DC IN X10*
2. *RS 485 interface X104*
3. *LEDs*
4. *USB interface X106*
5. *Accessory connection 24 V d.c. out X201*
6. *Remote interface X1*

Figure 55. Interfaces (TURBOVAC i with optional interface)



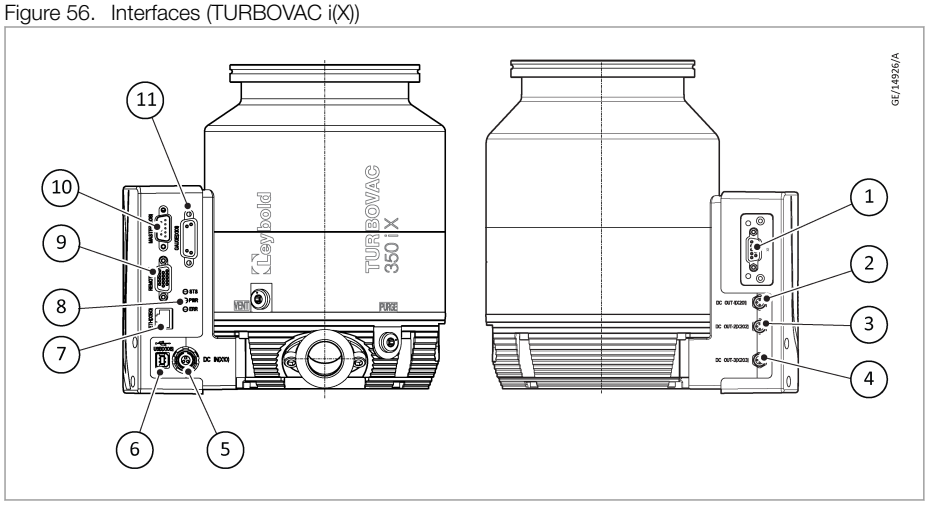
1. *Remote interface X1*
2. *USB X106*
3. *DC input DC IN X10*
4. *LEDs*
5. *Accessory connection d.c. out (M8) X201*
6. *Anybus port 1 (IN for EtherCAT)*
7. *Anybus port 2 (OUT for EtherCAT)*

Note:

For Anybus modules refer to Table: Accessories.

Installation

Figure 56. Interfaces (TURBOVAC i(X))



1. *Anybus interface X120*
2. *Accessory connection X201*
3. *Accessory connection X202*
4. *Accessory connection X203*
5. *DC IN X10*
6. *USB interface X106*
7. *Ethernet interface (not usable for customers)*
8. *LEDs*
9. *Remote interface X1*
10. *RS-485 master (not usable for customers)*
11. *Gauge X101*

Note:

For Anybus modules refer to Table: Accessories.

7 Operation

7.1 Media compatibility/purge gas

- The TURBOVAC integra is suitable for pumping air and clean gases.
- If reactive gases in low concentrations must be pumped, operate the pump with purge gas.
- Contact us for the media which can safely be handled with this unit.
- Install a micropore filter when pumping media which contains dust.
- Suited for venting or purging are all gases,
    - which will not cause corrosion or pitting in aluminium and steel
    - 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, maximum relative humidity should not exceed 10 ppm.
- The gas must be clean.
- 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 annually.

7.2 Interfaces

The TURBOVAC i(X) is always equipped with the following interfaces for customers:

- USB (COM port) (X106)
- REMOTE (X1)

Some models are equipped with an Anybus interface which may be equipped with different interfaces (for example like a RS 485).

The control hierarchy is as follows: Anybus interface → USB → REMOTE (X1). See also parameter 179.

The frequency converter is configured through the parameters according to the parameter list. Pxxx denotes parameter value xxx.

The PC software LEYASSIST allows convenient access by the user to the parameters of the frequency converter.

Refer to Serial Interfaces for TURBOVAC i/i(X) (Publication number - 300450826) for a detailed description of the interfaces RS 232, RS 485, Profibus and USB of the TURBOVAC.

Table 9 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
Automation	Savings related to repetitive manual work	For example by a control computer
Avoiding 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 ▪ Motor temperature P7 ▪ Frequency converter temperature P11.
Standby operation	▪ Cutting process gas consumption ▪ Cutting energy consumption	Reducing the rotor's frequency through P
Troubleshooting	A quick analysis of problems	Reading of error memories P171, P174 and P176: error code, speed, operating hours for error Read out warning messages through P227.
Slow pressure control by changing the pumping speed	Dispensing with a flow controller	Changing the rotor frequency through parameter 24
Starting the pump with a delay if several consumers are connected to the same PSU	Cost savings through smaller power supply units if peak loads can be reduced	With P36, delay
Lowering the normal operation threshold	Normal operating mode is attained faster, processes can be started faster	Reduce frequency threshold through P25.
Only for TURBOVAC i(X): Switch the fan depending on temperature or frequency	Saving electricity, reduce noise, optimise the pump temperature for the process	Configure accessory connection (X201, for example) correspondingly, for example, enter function code 30 in parameter 134[0] and set up the temperature limits in parameter 122[0] and 26[0].
Only for TURBOVAC i(X): Individually adapt venting and purge gas (active venting, an adaptation of the delay time etc.)	Save gas, process speed-up	Correspondingly configure the function code for an accessory connection (X203, for example).
Control cooling water flow	Avoid condensation during cooling water operation	Connect cooling water valve at the accessory connection (X201, for example).

Application	Benefits to the customer	How to do it
Enable generator operation (power backup mode)	The power produced by the pump when running in the generator mode may be used for other electrical consumers and the pump is also decelerated faster.	With P249 This function is only changed after de-energising the pump and then restarting it.
Only for TURBOVAC i(X): Changing the function of the accessory outputs	Different applications for connected accessories	Configure the accessory connection, refer to *Interfaces* on page 69.

7.3 Switch on

If the pumps have been stored for more than 6 months, refer to *Operation after a longer storage period* on page 75.

Switch on the power supply. All LEDs come on one after the other (sequential light), drive electronics (and vacuum system controller) are running up (for approximately 35 seconds).

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

Switch on the turbomolecular pump

- Through pins 7 and 8 of the socket REMOTE (X1) (for example through a remote control or with the aid of the plug with integrated ON/OFF switch).
- By a start command through the interface.

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

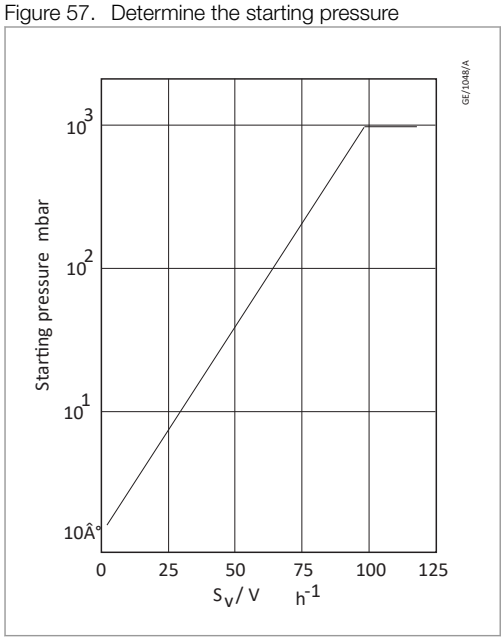
Avoid the influences of shock and vibration when the pump is running.

After a mains power failure the pump can run up automatically once more if a start command is present.

Note:

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 application department first.

Figure 57. Determine the starting pressure



For determining the starting pressure of a turbomolecular pump when evacuating large volumes

S_V = Pumping speed of the forevacuum pump ($m^3 \cdot h^{-1}$)

V = Volume of the vacuum chamber (m^3)

Example:

Pumping speed of the forevacuum pump, S_V = 3 $m^3 \cdot h^{-1}$,

Volume of the vacuum chamber, V = 60 l = 0.06 m^3

S_V / V = 50 h^{-1}

Starting pressure approximately 30 mbar.

7.4 Shut down

CAUTION: ELECTRICITY HAZARD

Risk of injury. Unplug any connectors only when the mains voltage is switched off and the pump does no longer turn.

Switch off the pump.

- Through contacts 7 and 8 of the socket REMOTE (X1)
- Apply a stop command through the interface
- For the power supply units offered or recommended by us, switch off the d.c. 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 d.c. power supply off, the turbomolecular pump will act as a generator supplying the frequency converter and the control unit with the connected devices with energy as indicated by the yellow power LED. When the generator mode is enabled, the turbomolecular pump supplies power back in to the d.c. power grid.

Switch off the forevacuum pump.

Vent

When using oil-sealed forevacuum pumps, vent the turbomolecular pump before it comes to a stop, refer to *Venting* on page 74.

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, make sure that ambient air or cleaning media cannot enter the pump.

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

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.

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 will flash, indicating that the rotor has not yet arrived at standstill.

When shutting down by switching off the power supply voltage, there will only be enough power for the LEDs to flash down to a speed of approximately 200Hz. 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.

7.5 Venting

Refer to *Media compatibility/purge gas* on page 69 for suited gases.

Venting methods

There are three different methods of venting the turbomolecular pump and can be vented through the venting connection (VENT),

- With a venting valve
- A power failure venting valve
- A venting screw

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 to avoid exposing the rotor to additional forces.

When venting the pump through its foreline connection, oil or particles should not be entrained in the gas flow from the forevacuum side into the pump.

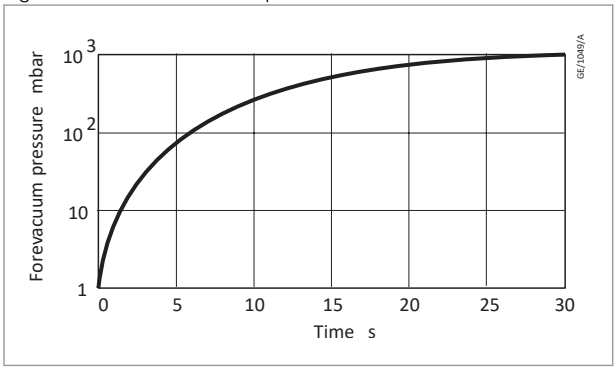
Speed of the pressure rise

All turbomolecular pumps may be vented at full speed. However, the pressure must not increase faster than specified through the pressure rise curve, refer to *Figure: Maximum rise in pressure*.

The pump must be vented significantly slower when there is the risk of particles entering 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 pump must not be vented to pressures above atmospheric pressure.

Figure 58. Maximum rise in pressure



7.6 Bakeout

Only for TURBOVACs with CF flange, refer to *Connect a flange heater* on page 60.

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 adsorption trap, for example - ensure that the components attached directly are not heated to more than 100 °C (212 °F).

Operate the pump with water cooling when baking out.

7.7 Operation after a longer storage period

Note:

For pumps that have been stored for more than 6 months, a ball bearing run-in procedure for smooth ball bearing running must be carried out when putting into operation again. The procedure differs according to the firmware version of the pump, refer to the following sections.

To do this, set parameter P119 [0] to the value 1 using a serial interface and save the parameter change with parameter P8. Then start the pump.

This process takes approximately 4.3 hours, the red LED will flash during this time. The TURBOVAC may be operated only with low gas throughput during this time.

Valid up to firmware parameter P2: R02.07.02

At the end, the pump decelerates to a standstill and before the restart, the parameter P119 [0] must be set to the value 0 and stored with a write command to parameter P8.

Valid up to firmware parameter P2: R02.09.01

At the end, the pump accelerates to the nominal speed and parameter P119 [0] is written to 0 by the electronics.

For pumps that have been stored for more than 3 years, we recommend a preventive exchange of the ball bearings, refer to bearing replacement from *Maintenance* on page 77.

7.8 Remove the pump from the system

WARNING: HAZARDOUS GASES

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

Observe safety information given in *Hazards caused by materials and substances* on page 12.

CAUTION: TOXIC MATERIAL

Risk of pump damage. 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.

1. Shut down the pump and vent as described in *Shut down* on page 73 and *Venting* on page 74.
2. Disconnect the pump only when it has completely stopped. The green LED must have gone out.
3. During run down the pump may still turn without a LED being on, observe the information on emergency shut down given in *Shut down* on page 73.
4. Switch the mains power off and wait until the yellow power LED is off.
5. Disconnect any cable connections.

To avoid health hazards and corrosion 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 airtight PE bag.

Corrosion due to faulty packing will nullify the guarantee.

Pack the pump such 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 Return the equipment or components for service if you forward the pump to us.

8 Maintenance

Rotor change

We recommend an exchange of the rotor unit after 80000 operating hours at the latest.

Such maintenance work can only be done by us. If required contact our service centre nearest to your location. You can find the address on our internet page *www.leybold.com*.

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

Observe safety information given in *Mechanical hazards* on page 10.

Bearing maintenance

The bearing must be replaced when it reaches its service life. This is typically after 17500 - 35000 operating hours.

At high pump loads - for example during cyclic operation, at high gas throughputs or at high temperatures, the maintenance work should be done within the service life range. Contact us for recommendations.

The ceramic ball bearings can be exchanged, if necessary, by our customer service, our nearest service centre or by the customer: contact us for this.

If you wish to exchange the bearings yourself, you will need our tool kit and spare ball bearings. Immediately after exchanging the bearings, let them run in, refer to *Operation after a longer storage period* on page 75.

Purge gas filter

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).

Adsorption trap

When an adsorption trap is used, regenerate or renew the adsorption agent regularly, refer to the operating instructions provided with the trap.

8.1 Cleaning

If required clean the turbomolecular pump of dust with a dry cloth.

Cleaning the frequency converter internally

The converter essentially requires no servicing since it contains no components which could be adjusted.

Depending on the installation particulars and the ambient conditions, the converter may collect grime (dust, moisture) on the inside. Such contamination can lead to malfunctions, overheating or short circuits and will have to be avoided to the maximum extent possible. Our service department can clean the converter.

Maintenance

8.2 Leybold Service

Whenever you send us equipment, indicate whether the equipment 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.

The form Declaration of Contamination for Compressors, Vacuum Pumps and Components is available on *www.leybold.com-> Downloads -> Download Documents*.

Attach the form to each pump. This statement detailing the type of contamination is required to satisfy legal requirements and for the protection of our employees.

We will return to the sender any equipment which is not accompanied by a contamination statement.

9 Fault finding

CAUTION: ELECTRICITY HAZARD

Risk of injury. 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
- 24/48 V d.c. cable to the frequency converter.

Observe the polarity.

Is the forevacuum pressure sufficient?

After having removed the cause for the error reset the error message: By applying a STOP signal through the socket REMOTE (X1), or by a reset sequence through the serial interface or by switching the mains power off.

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

The *Table: Fault finding* has been provided as a guide when determining the causes of errors.

Table 10. Fault finding

Condition	Shut down
Yellow power LED is not on on page 79	-
Red LED flashes on page 80	No
Red LED is on on page 80	Yes
Turbomolecular pump does not start, ERROR LED does not light on page 80	Yes
Turbomolecular pump produces loud running noises and vibrations on page 81	No
Pump overload, pump cannot keep up its speed on page 81	Yes
When the speed drops below 900 Hz the red LED flashes. When this continues for more than 12 minutes* the pump shuts down* on page 81	Yes
Turbomolecular pump does not reach ultimate pressure on page 81	No
Running pump can not be stopped through X1 on page 82	No
Connected accessories do not operate as intended on page 82	No

Fault	Yellow power LED is not on
Cause	**No d.c. power**
Remedy	Check cables and power supply.

Fault finding

Cause	**The d.c. power miswired**
Remedy	Ensure correct polarity of the d.c. cable.
Cause	**Frequency converter defective**
Remedy	Have the pump repaired. The following may damage the frequency converter: - Disconnection of the d.c. cable while the pump was still rotating - Non-compliance with the note related to connecting several pump to a single power supply.

Fault	Red LED flashes
Cause	**Warning message**
Remedy	The pump can continue to run, as long as operation limits are only exceeded for a short time. In case of longer time, send pump and frequency converter to our service.

Fault	Red LED is on
Cause	**Forevacuum or high-vacuum pressure too high.**
Remedy	Check the forevacuum pump and use a different forevacuum pump if necessary.
Cause	**Gas volume too high.**
Remedy	Seal leak: Install a higher-capacity vacuum pump if necessary.
Cause	**Bearing defective.**
Remedy	Repair the pump.
Cause	**Ambient temperature too high.**
Remedy	Install additional water cooling or reduce throughput.
Cause	**Frequency converter faulty.**
Remedy	Replace frequency converter.
Cause	**EMC influence.**
Remedy	Switch the power supply voltage off and then on again.

Fault	Turbomolecular pump does not start, ERROR LED does not light
Cause	**Interface protocol error**
Remedy	Use USS protocol.
Cause	**No communication through the serial interface**
Remedy	Connect bus as shown in the interface instructions.
Cause	**REMOTE connector (X1) connected wrongly**
Remedy	Observe *REMOTE interface X1* on page 62.

Fault	Turbomolecular pump produces loud running noises and vibrations
Cause	**Rotor out of balance**
Remedy	Balance the rotor. Refer to *Maintenance* on page 77.
Cause	**Bearing defective**
Remedy	Replace the bearing. Refer to *Maintenance* on page 77.

Fault	Pump overload, pump cannot keep up its speed
Cause	**Forevacuum pressure too high**
Remedy	Check the ultimate pressure of the backing pump and install a bigger backing pump if required.
Cause	**Gas flow too high**
Remedy	Seal leak, check process.

Fault	When the speed drops below 900 Hz* the red LED flashes. When this continues for more than 12 minutes* the pump shuts down
Cause	**Fan defective**
Remedy	Replace the fan.
Cause	**Water cooling switched off**
Remedy	Switch on water cooling.

** Default values for normal operation threshold (P25) and maximum run-up time (P32), can be changed through serial interface.*

Fault	Turbomolecular pump does not reach ultimate pressure
Cause	**Measuring instrument defective**
Remedy	Inspect the measurement sensor.
Cause	**Measurement sensors soiled**
Remedy	Clean or replace the sensors.
Cause	**Leaks at the equipment, lines or the pump**
Remedy	Check for leaks.
Cause	**Pump soiled**
Remedy	Clean the pump.
Cause	**Forevacuum pump provides insufficient pumping speed or ultimate pressure which is too high**
Remedy	Check the ultimate pressure of the forevacuum pump and install a higher-capacity vacuum pump if necessary.
Cause	**Frequency parameters programmed wrongly**
Remedy	Check parameters.

Fault finding

Fault	Running pump can not be stopped through X1
Cause	**Pump has been started through the serial interface, the interface controls the pump**
Remedy	Disconnect the d.c. supply or connect serial interface and stop through bus.

Fault	Connected accessories do not operate as intended
Cause	**Accessories incorrectly connected or wrong function code has been set up or function code dependent parameters have not been properly set up.**
Remedy	Check the settings for the function codes and the corresponding parameters or check to ensure that the accessories have been connected to the correct accessory connection.

10 Storage

To store the devices, place them in a sealable PE bag containing a drying agent and use the supplied transport packaging. Do not store the pump and accessories in a moist atmosphere to prevent it from corrosion. Take note of details in *Remove the pump from the system* on page 76.

For pumps that have been stored for more than 6 months, a ball bearing run-in procedure must be carried out before operation, refer to *Operation after a longer storage period* on page 75.

For pumps that have been stored for more than 3 years, we recommend a preventive exchange of the ball bearings, refer to bearing maintenance from *Maintenance* on page 77.

11 Disposal

WARNING: CONTAMINATED PARTS

Risk of injury. Contaminated parts can be detrimental to health and the environment. Before beginning with any work, find out whether any parts are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

Waste disposal

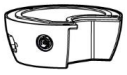
The equipment may have been contaminated by the process or by environmental influences. In this case, the equipment must be decontaminated in accordance with the relevant regulations. We offer this service at fixed prices.

Separate clean components according to their materials, and dispose of these accordingly. We offer this service. Further details are available on request.

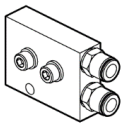
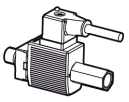
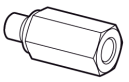
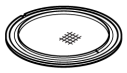
When sending us any equipment, observe the regulations given in Return the equipment or components for service.

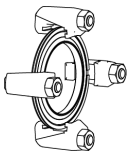
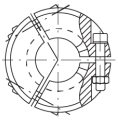
12 Accessories

Table 11 Accessories

Accessory	Part number	Graphic
TURBO.CONTROL i	800100V0004	
Power supply TURBO.POWER integra incl. 0.3 m cable	800100V0003	
Cable TURBOVAC i/i(X) - TURBO.POWER integra, 1 m	800096V0100	
Cable TURBOVAC i/i(X) - TURBO.POWER integra, 3 m	800096V0300	
Cable TURBOVAC i/i(X) - TURBO.POWER integra, 5 m	800096V0500	
Mains cable for power supplies, 3 m long		
EC plug	800102V0002	
UK plug	800102V0003	
US plug	800102V1002	
24/48 V d.c. in plug TURBOVAC	800090V0000	
TURBOVAC i d.c. cable with bare wire ends, 1 m	800095V0100	
TURBOVAC i d.c. cable with bare wire ends, 3 m	800095V0300	
TURBOVAC i d.c. cable with bare wire ends, 5 m	800095V0500	
Accessory cable TURBOVAC i, M8-M8, 2 m	800110V0016	
Y cable TURBOVAC i, M8	800110V0020	
Start stop switch for TMP	800110V0021	
USB cable 2.0 Type A/B, 1.8 m	800110V0108	
Relay box for forevacuum pump, 1-phase, 10 A incl. 2 m M8-M8 cable	800110V0030	
LEYASSIST software for TMPs	Refer to *Standard equipment* on page 15 for download link	
Air cooling radial		
TURBOVAC 90 i(X)	800136V0007	
TURBOVAC 250 i(X)	800136V0009	
TURBOVAC 350-450 i(X)	800136V0005	
Air cooling axial		
TURBOVAC 90 i(X) and 250 i(X)	800136V0008	
TURBOVAC 350-450 i(X)	800136V0006	

Accessories

Accessory	Part number	Graphic
Water cooling TURBOVAC i(X), hose 6x1, G 1/8"	800135V0005	
Water cooling TURBOVAC i(X), hose 1/4"	800135V0006	
Venting valve, 24 V d.c. G 1/8"	800120V0012	
Power failure venting valve 24 V d.c. G 1/8"	800120V0022	
Purge gas valve, 24 V d.c. G 1/8", 24 sccm	800120V0013	
Purge gas throttle 24 sccm	800120V0014	
Air filter for TMP, G 1/8"	800110V0022	
Air drier TURBOVAC	auf Anfrage	
Flange heater DN 63 CF, 230 V	800137V0003	
Flange heater DN 63 CF, 115 V	800137V0004	
Flange heater DN 100 CF, 230 V	800137V0005	
Flange heater DN 100 CF, 115 V	800137V0006	
Flange heater DN 160 CF, 230 V	800137V0007	
Flange heater DN 160 CF, 115 V	800137V0008	
Vibration absorber DN 100 ISO-K*	800131V1100	
Centring ring with coarse inlet screen DN 63 ISO-K	800133V0011	
Centring ring with splinter guard DN 63 ISO-K	800133V0012	
Centring ring with coarse inlet screen DN 100 ISO-K	800133V0021	
Centring ring with splinter guard DN 100 ISO-K	800133V0022	
Centring ring with coarse inlet screen DN 160 ISO-K	800133V0031	
Centring ring with splinter guard DN 160 ISO-K	800133V0032	
Coarse inlet screen DN 63 CF (3.2 mm)	800132V0011	
Splinter guard DN 63 CF (0.8 mm)	800132V0012	
Coarse inlet screen DN 100 CF (3.2 mm)	800132V0021	
Splinter guard DN 100 CF (0.8 mm)	800132V0022	
Coarse inlet screen DN 160 CF (3.2 mm)	800132V0031	
Splinter guard DN 160 CF (0.8 mm)	800132V0032	

Accessory	Part number	Graphic
Mounting kit TURBOVAC		
DN 63 ISO-K	800134V0010	
DN 63 CF	800134V0011	
DN 100 ISO-K	800134V0020	
DN 100 CF	800134V0021	
DN 100 ISO-K to ISO-F	800134V0025	
DN 160 ISO-K	800134V0030	
DN 160 CF	800134V0031	
DN 160 ISO-K to ISO-F	800134V0035	
Required for TURBOVAC 90 i with HV flange DN 40 KF:		
Ultra sealing ring, DN 32/40 KF Al, (3 pieces)	88377	
Clamping collar DN 32/40 KF Al	88278	
Vacuum grease LITHELEN (LVO 810), Tube 50 g	L 810 05	
Anybus RS232 Module	410300V0902	
Anybus RS485 Module	410300V0903	
Anybus Profibus M40 Module	410300V0904	
Anybus Profinet IRT Module	410300V0905	
Anybus Ethernet IP Module	410300V0906	
Anybus EtherCAT Module	410300V0907	

** Part number for other flanges: on request.*

12.1 Ordering data

Accessories

High-vacuum flange	90i	90i(X)	250i	250i(X)	350i	350i(X)	450i	450i(X)
40 KF	810011V2000	810011V3000						
40 KF	810011V1000							
63 CF	810041V2000	810041V3000						
63 CF	810041V1000	810041V3300						
63 ISO-K	810031V2000	810031V3000						
63 ISO-K	810031V1000	810031V3300						
100 CF			820061V2000	820061V3000	830061V2000	830061V3000		
100 CF			820061V1000	820061V3300	830061V1000	830061V3300		
100 ISO-K			820051V2000	820051V3000	830051V2000	830051V3000		
100 ISO-K			820051V1000	820051V3300	830051V1000	830051V3300		
160 CF							830081V2000	830081V3000
160 CF							830081V1000	830081V3300
160 ISO-K							830071V2000	830071V3000
160 ISO-K							830071V1000	830071V3300

Refer to Figure: Interfaces (TURBOVAC i) for I/O interfaces of XXXXXXV1000 variants.

Refer to Figure: Interfaces (TURBOVAC i with optional interface) for I/O interfaces of XXXXXXV2000 variants.

Refer to Figure: Interfaces (TURBOVAC i(X)) for I/O interfaces of XXXXXXV3000 variants.

Note:
For operational interfaces refer to Anybus module in Table: Accessories.

P20010481A

EU Declaration of Conformity

Leybold GmbH
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Germany

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The product specified and listed below

- Turbomolecular Pumps with Integrated Frequency Converter

Type Designation	*Part Numbers*	*Description*
For Pumps with max. 3 inlets: *TURBOVAC a1 a2 a3 i* *TURBOVAC a1 a2 a3 iX* *TURBOVAC a1 a2 a3 iC* *a1 = 30 to 450* *a2, a3= 1 to 300 (Indices a2 and a3 optional)*	*8xxxxxVxxxx* *8xxxxxVxxxx/8xxxxxVxxxxC* *x= 0 to 9*	*a1* = *Pumping speed (first Inlet)* *a2* = *Pumping speed (second Inlet)* *a3* = *Pumping speed (third Inlet)* *i* = *Communication electronic Frontend or Frontend Anybus* *iX* = *Communication electronic Extension box* *iC / C* = *Cartridge - Housing for Customer Application* *m* = *Customer-Variants Multi-Inlet*
For Pumps with>3 inlets: *TURBOVAC numeral m i* *TURBOVAC numeral m iC* *numeral = quad, penta, hexa, hepta, octa, nona, deca (according to the number of inlets)* *m = 1 to 99*		

Is in conformity with the relevant requirements of European CE legislation:

2006/42/EC	Machinery directive *Note: The safety objectives of the Low Voltage Directive 2014/35/EU were complied with in accordance with Annex 1 No. 1.5.1 of this directive.*
2014/30/EU	Electromagnetic compatibility (EMC) directive Class B Emissions, Industrial Immunity
2011/65/EU	Restriction of certain hazardous substances (RoHS) directive as amended by Delegated Directive (EU) 2015/863

Based on the relevant requirements of harmonised standards:

EN 1012-2:1996 +A1:2009	Compressors and vacuum pumps. Safety requirements. Vacuum pumps
EN 61010-1:2010	Safety requirements for electrical equipment for measurement, control and laboratory use. General requirements
EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements

This declaration, based on the requirements of the listed Directives and EN ISO/IEC 17050-1, covers all product serial numbers from this date on: *2021-11-17*

You must retain the signed legal declaration for future reference

This declaration becomes invalid if modifications are made to the product without prior agreement.

Ian Keech – VP Engineering, Scientific Vacuum Division
Burgess Hill

Axel Guddas – General Manager
Product Company Cologne

P20010481A

Declaration of Conformity

Leybold GmbH
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This declaration of conformity is issued under the sole responsibility of the manufacturer.

- Turbomolecular Pumps with Integrated Frequency Converter

Type Designation	*Part Numbers*	*Description*
For Pumps with max. 3 inlets: *TURBOVAC a1 a2 a3 i* *TURBOVAC a1 a2 a3 iX* *TURBOVAC a1 a2 a3 iC* *a1 = 30 to 450* *a2, a3= 1 to 300 (Indices a2 and a3 optional)*	*8xxxxxVxxxx* *8xxxxxVxxxx/8xxxxxVxxxxC* *x= 0 to 9*	*a1 = Pumping speed (first Inlet)* *a2 = Pumping speed (second Inlet)* *a3 = Pumping speed (third Inlet)* *i = Communication electronic Frontend or Frontend Anybus* *iX = Communication electronic Extension box* *iC / C = Cartridge - Housing for Customer Application* *m = Customer-Variants Multi-Inlet*
For Pumps with>3 inlets: *TURBOVAC numeral m i* *TURBOVAC numeral m iC* *numeral = quad, penta, hexa, hepta, octa, nona, deca (according to the number of inlets)* *m = 1 to 99*		

The object of the declaration described above is in conformity with relevant statutory requirements:

Supply of Machinery (Safety) Regulations 2008
The objectives of the Electrical Equipment (Safety) Regulations 2016 are governed by Annex 1 1.5.1 of this regulation.

Electromagnetic Compatibility Regulations 2016
Class B Emissions, Industrial Immunity

Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

Relevant designated standards or technical specifications are as follows:

EN 1012-2:1996 +A1:2009	Compressors and vacuum pumps. Safety requirements. Vacuum pumps
EN 61010-1:2010	Safety requirements for electrical equipment for measurement, control and laboratory use. General requirements
EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements

This declaration, based on the requirements of the listed Statutory Instruments and EN ISO/IEC 17050-1, covers all product serial numbers from this date on: 2021-11-17

You must retain the signed legal declaration for future reference
This declaration becomes invalid if modifications are made to the product without prior agreement.

Signed for and on behalf of Leybold GmbH

Ian Keech – VP Engineering, Scientific Vacuum Division Burgess Hill

Axel Guddas – General Manager Product Company Cologne

ADDITIONAL LEGISLATION AND COMPLIANCE INFORMATION

RoHS (EU, UK): Material Exemption Information

This product is compliant with the following Exemptions
Annex III:

- 6(a) **Lead** as an alloying element in steel for machining purposes and in galvanised steel containing up to 0.35 % lead by weight
- 6(b) **Lead** as an alloying element in aluminium containing up to 0.4% by weight
- 6(c) Copper alloy containing up to 4% **lead** by weight

REACH (EU, UK)

This product is a complex article which is not designed for intentional substance release. To the best of our knowledge the materials used comply with the requirements of REACH. The product manual provides information and instruction to ensure the safe storage, use, maintenance and disposal of the product including any substance based requirements.

Article 33.1 Declaration (EU, UK)

This product contains Candidate List Substances of Very High Concern above 0.1%ww by article as clarified under the 2015 European Court of Justice ruling in case C-106/14.

- Lead (Pb)
  This substance is present in certain steel / aluminium / brass components.

Additional Applicable Requirements

The product is in scope for and complies with the requirements of the following:

2012/19/EU	Directive on waste electrical and electronic equipment (WEEE)
Product is certified to CSA-C22.2 No.61010-1-12	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
Product is certified to UL61010-1 3rd Edition	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
cTUVus Certificate No.	CU 72193329

The product is certified by TÜV Rheinland of North America which is a “Nationally Recognized Testing Laboratory” (NRTL) for USA and Canada.

材料成分声明

China Material Content Declaration

	有害物质 Hazardous Substances					
部件名称 Part name 	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr VI)	多溴联苯 Polybrominated biphenyls (PBB)	多溴二苯醚 Polybrominated diphenyl ethers (PBDE)
铸铝及铝合金制品 Aluminium alloys	X	O	O	O	O	O
钢合金制品 Steel alloys	X	O	O	O	O	O
铜管管件 Brass pipe fitting	X	O	O	O	O	O

O: 表示该有害物质在该部件的所有均质材料中的含量低于 GB/T 26572 标准规定的限量要求。
O: Indicates that the hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in GB/T 26572.

X: 表示该有害物质在该部件的至少一种均质材料中的含量超出 GB/T26572 标准规定的限量要求。
X: Indicates that the hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T26572.

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Leybold

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