KYKY
— SINCE 1958 —

The Instruction Manual of KYKY Integrated Magnetically-levitated Turbomolecular Pump

V1.10

KYKY TECHNOLOGY CO., LTD .

About the Instruction Manual

Before installing and using the turbomolecular pump, the installation and operation technicians of the pump should carefully read the Instruction Manual and follow the instructions for avoiding physical injury and equipment damage.

Due to technical improvement of products or manual revision, the contents of the Instruction Manual are subject to change without further notice. For relevant information, please visit the KYKY website www.kyky.com.cn or contact KYKY Company!

Disclaimer

KYKY integrated magnetically-levitated turbomolecular pump is safe, convenient and effective if it is installed and used according to the specifications in this Instruction Manual.

The operators of the integrated magnetically-levitated turbomolecular pump must carefully read and strictly obey the specifications in this Instruction Manual. KYKY doesn't undertake any responsibility for any hurt or loss caused by the user who doesn't carefully read the Instruction Manual or operates the device without following the Instruction Manual.

CONTENT

Chapter 1 Overview

1.1 Scope of the Manual

Thank you for purchasing and using KYKY's integrated magnetically-levitated turbomolecular pump. The product is classified as vacuum acquisition equipment for high vacuum and ultra-high vacuum. This Instruction Manual applies to series models of CXF-200/1401, CXF-250/2301, CXF-320/3001 integrated magnetically-levitated turbomolecular pumps and subsequent improved models. This manual provides guidance for installation, operation and maintenance of KYKY integrated magnetically-levitated turbomolecular pump.

1.2 Characteristics

These series of integrated magnetically-levitated turbomolecular pumps have the following characteristics:

（1） All using active 5-axis magnetically levitated technology, which can achieve installation by any angle.

（2） All using precision ceramic ball to protect bearings with high security and long service life.

（3） Whole pumping units use integral compound turbine with carbon fiber circular column as the drag stage.

（4） Using permanent magnet motor and driving technology, can achieve the function of power generation with low power consumption and high efficiency.

（5） Rotor operation monitoring and automatic balance function, automatic protection against power failure and temperature management system.

（6） The controller has multiple interfaces for external control and communication, can provide users with a variety of centralized control.

（7） High cleanliness, maintenance-free and energy-saving.

（8） Higher backing pressure tolerance.

（9） Corrosion resistance (with corrosion resistant design type).

（10） Low vibration and low noise.

（11） Smaller size and lighter weight.

1.3 Main application

Turbomolecular pump is a mechanical vacuum pump which can obtain high vacuum and ultra-high vacuum. It obtains the required vacuum performance by pumping air through the combination of high-speed rotating multi-stage turbine rotor blade and static turbine blade, and producing high compression ratio for the extracted gas in the molecular flow region. Turbomolecular pumps can only be used for obtaining high and ultra-high vacuum and must be equipped with reasonable backing pump and matching turbomolecular pump controller. Turbomolecular pumps are widely used in: vacuum acquisition of physical surface analyzer; vacuum acquisition of accelerator technology; vacuum acquisition of plasma technology; vacuum acquisition of aerospace environment simulation; vacuum acquisition of electronic and electrical components manufacturing; vacuum acquisition of various surface coating, etc. KYKY integrated magnetically-levitated turbomolecular pump is a compound turbomolecular pump, which is widely used in semiconductor, industrial coating, scientific research, surface analysis and vacuum electronic equipment.

The typical application system diagram of turbomolecular pump is shown in Figure 1.1.

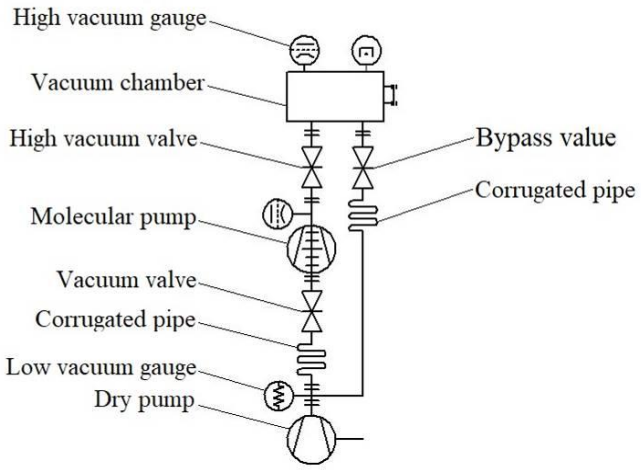


Figure 1.1 Turbomolecular pump applications (vacuum system principle diagram)

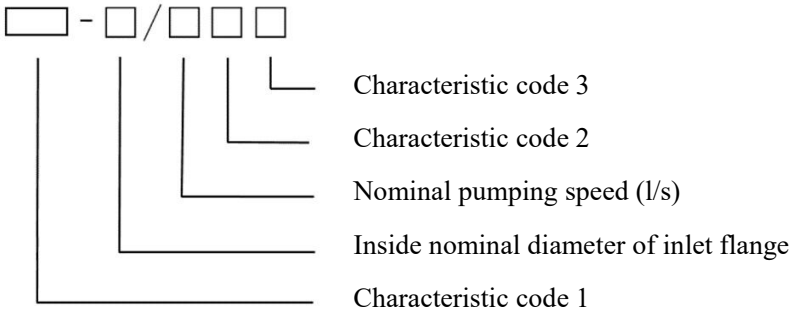
The integrated magnetically-levitated turbomolecular pump for inflammable, explosive, toxic, harmful and corrosive gases and materials needs to be customized. For details, please consult KYKY technical engineers.

If you are not sure whether specific working conditions are suitable for this series of products, please contact KYKY technical engineers.

1.4 Model composition and meaning

The integrated magnetically-levitated turbomolecular pumps listed in this manual are divided into DN200, DN250 and DN320 series. According to the nominal pumping speed, the turbomolecular pumps are divided into 1400L/s, 2300L/s and 3000L/s, totally 3 pumping speed levels. And product models include CXF-200/1401 、 CXF-200/1402 、 CXF-250/2301、CXF 250/2302、CXF-320/3001、CXF-320/3002, etc.

The meaning of product model and code is as follows:



Description:

Characteristic code 1:

"CXF" indicates magnetically-levitated turbomolecular pump (all magnetically-levitated turbomolecular pumps in this manual are compound).

Inside nominal diameter of inlet flange:

Represented by two or three digits. The integrated magnetically-levitated turbomolecular pumps listed in this manual are divided into DN200, DN250 and DN320 series according to inlet flange diameter.

Nominal pumping speed (l/s):

Represented by two digits. The integrated magnetically-levitated turbomolecular pumps listed in this manual can be divided into 1400 l/s, 2300 l/s and 3200 l/s, totally 3 pumping speed levels according to nominal pumping speed.

Characteristic code 2:

Represented by two or three digits. It indicates the product upgrade model.

Characteristic code 3:

"C" indicates corrosion resistant pump; "S" indicates separated type of pump;

"A", "D" and so on indicates improvement of product or performance.

Notes: Various models of integrated magnetically-levitated turbomolecular pump components correspond to unique integrated controller components. Different model of magnetically-levitated turbomolecular pump and its controller cannot be arbitrarily interchangeable. The integrated magnetically-levitated turbomolecular pump and controller described in this manual are a set of products. And customers do not need to purchase or configure controller separately.

See Table 1.1 for controller models corresponding to the various models of integrated magnetically-levitated turbomolecular pumps shown in table 1.1:

Table1.1 Correspondence between turbomolecular pump and controller model

Integrated magnetically-levitated turbomolecular pump	Configured controller model
CXF-200/1401、CXF-200/1402	CXFD-1001
CXF-250/2301、CXF-250/2302	CXFD-1601
CXF-320/3001、CXF-320/3002	CXFD-1601

1.5 Working environment and working conditions

Before installation, it is necessary to confirm normal working environment and working conditions for turbomolecular pump, as shown in Table 1.2.

Table 1.2 Working environment

Installation location	Indoor
Protection category	IP54
Electric shock proof protection grade	Class I
Ambient temperature	5-40℃
Relative humidity	40% ~ 85%
Ambient pressure	0.75×10^5P ~ 1.06×10^5Pa
Installation height (altitude)	⩽1500m
Pollution class	2
Magnetic field	Magnetic field strength of radial and axial on the pump housing can be less than or equal to 3mT(30Gs);
Radiation environment	$\leq10^5$rad
Vacuum environment	Oil free

1.6 Safety Instructions

Safety instructions are divided into three levels: danger, warning and note. Please pay attention to safety instructions when reading this manual. Format and meaning of safety instructions are as follows:

 DANGER	**DANGER** **Danger: means the items which should be paid great attention to and must be obeyed for avoiding physical injury;**
 WARNING	**WARNING** **Warning: means the items which should be paid moderate attention to and must be obeyed for avoiding damaging the pump;**
 CAUTION	**CAUTION** **Caution: means the items which should be paid attention to and must be obeyed for keeping the best performance of the pump.**

Chapter 2 Precautions for Safe Operation

2.1 Safe use under general circumstances

General circumstances means that installation and debugging are completed according to the manual under normal working environments and working conditions. Before installation, operation, maintenance and inspection, you must carefully read this manual and get familiar with safety precautions for correct use.

✧Integrated magnetically-levitated turbomolecular pump can only be used to obtain high (ultra-high) vacuum;

✧Integrated magnetically-levitated turbomolecular pump must work with standard backing vacuum pump and Configured controller.

✧Power supply should meet the requirements of turbomolecular pumps.

✧Make sure that pump and controller should match each other and both should be properly grounded to prevent electric shock; otherwise it may cause product damage, personal injury, electric shock or interference.

✧It is forbidden to operate switches with wet hands. Otherwise, it will cause electric shock.

✧It is forbidden to contact wiring and terminal of turbomolecular pump and controller when they are charged. Otherwise, it may cause product damage or electric shock.

✧Ensure that wires and cables are away from the heat source (surface temperature greater than 70℃); Otherwise, it may reduce the service life of conductors and cables and cause product failure or damage.

✧Before starting the turbomolecular pump, it is necessary to check whether it meets start-up requirements. Otherwise, it may cause product failure or damage.

✧ Turbomolecular Pumps shall not be started when purge intake port is not sealed or fails to be properly connected to purge pipeline. Otherwise, it may cause product pollution, product damage.

✧During the operation of turbomolecular pump, it should not be subject to violent impact or vibration. Otherwise, pump will be crushed and so on.

✧Do not connect and disconnect any plug in normal operation of pump; otherwise, it may cause product damage or electric shock.

✧Turbomolecular pump power supply must be disconnected for more than 2 minutes before it can be checked or connected. Otherwise, it may cause electric shock.

✧Do not expose any part of body to the vacuum environment; otherwise, it may cause personal injury.

✧Turbomolecular pumps should be shut down, power supply is disconnected, and the air pressure in the pump is balanced with the atmosphere before daily maintenance. Otherwise, it may cause product damage, personal injury or electric shock.

✧Regularly check magnetically-levitated turbomolecular pumps to prevent them from running under abnormal vibration; otherwise, it may cause product failure, product damage or personal injury.

✧Turbomolecular pumps and matched controllers must be returned to KYKY for maintenance by professional personnel. Do not modify the connection of pump and controller without permission; otherwise, it may cause product damage, personal injury or electric shock.

✧It is strictly forbidden to dismantle or modify magnetically-levitated turbomolecular pump. Otherwise, it may cause product failure, product damage, and pump crushing and personal injury during use, and KYKY will not be responsible for all the consequences.

2.2 Incorrect Use

The following are the most common improper modes of operation.

✧ Incorrect power supply or operation with driving unit and controller of magnetically-levitated turbomolecular pump；

✧ Incorrect placement/use direction of pump during its transport, installation and operation;

✧ Failing to use anti-corrosion turbomolecular pump to pump corrosive gases;

✧ Improper flow rate of protective gases;

✧ Pumping explosive substance;

✧ Pumping liquid;

✧ Pumping condensed steam;

✧ Magnetically-levitated turbomolecular pump operates under overload;

✧ Magnetically-levitated turbomolecular pump operates for long time under high pressure of backing pressure;

✧ Pump is used in the sealed and heat-insulation environment;

✧ Magnetically-levitated turbomolecular pump is used in strong magnetic field;

✧ Magnetically-levitated turbomolecular pump is used in ionizing radiation environment;

✧ Magnetically-levitated turbomolecular pump is used in potentially explosive environment;

✧ External devices apply impact, vibration or Periodic force on magnetically-levitated turbomolecular pump;

✧ Turbomolecular pump is used for pressurization;

✧ Components and accessories not listed in this manual are used；

✧ Failure to install cooling devices as required by the instructions.

KYKY Company will not take any responsibility for any damage and loss due to improper operation of users.

2.3 Emergency measures under abnormal circumstances

Emergency measure in case of blackout (i.e. power failure): Do not cut off power supply and it is necessary to immediately restore power supply as soon as possible after eliminating the cause of power supply failure. When power supply fails, the motor will convert the mechanical energy of rotor into the energy consumption of magnetic bearing. When the mechanical energy of the rotor is reduced to a certain extent, it will not be enough to maintain the energy consumption of the magnetic bearing and the rotor will drop due to loss of suspension ability, which may damage the pump.

In case of splashing, it is necessary to stop machine to check, eliminate splashing, keep it clean and dry, and insulation of electrical connections is safe and reliable and reliably sealed before starting.

2.4 Other safety warnings


DANGER

DANGER
Prevention of harmful substances Gases pumped by magnetically-levitated turbomolecular pump in the operation may contain toxic or harmful substances, such as corrosive chemical or radioactive substance. Maintenance personnel need to be well protected in the maintenance or re-installation of turbomolecular pump. Otherwise it may cause personnel injury or product damage.


WARNING

WARNING
Prevention of turbomolecular pump from falling **(a) Do not drop down turbomolecular pump to avoid danger when handling turbomolecular pump;** **(b) Handle the inlet flange or bottom of turbomolecular pump with both hands when carrying light turbomolecular pump;** **(c) Handle the turbomolecular pump of more than 20 kg with handling tool and prevent it from falling. Otherwise it may cause personnel injury or product damage.**


CAUTION

CAUTION
Prevention of burns **(a) Be careful in the operation of turbomolecular pump to prevent burns if the turbomolecular pump is heated;** **(b) Ensure that pump and heater have been cooled prior to repair and maintenance of turbomolecular pump.** **(c) The molecular pump will change the braking mode during deceleration. Do not touch the controller housing to prevent scalding**


CAUTION

CAUTION
Prevention of scratches **Prevent body from scratches by sharp edge of turbomolecular pump or control system**


CAUTION

CAUTION
Prevention of injury from accidental noise **Prevent injury to the human hearing system due to the friction and vibration noise from accidental fall of the turbomolecular pump.**

Chapter 3 Product Introduction

3.1 Product Category and Working Principle

The integrated magnetically-levitated turbomolecular pump described in this manual is composed of turbomolecular pump and controller, and the overall structure of turbomolecular pump is shown in Figure 3.1.

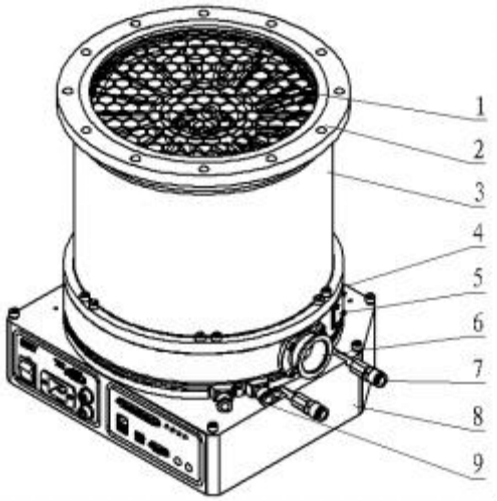


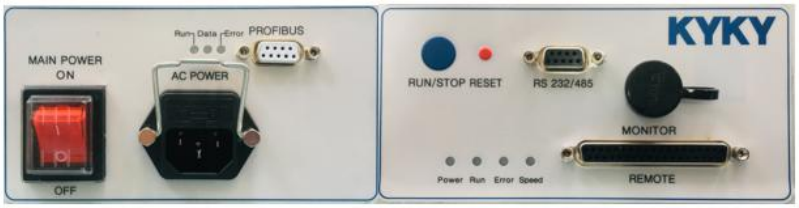
Figure 3.1 Main functional interfaces of turbomolecular pump

1 – Protective net(with steel cable baffle ring) 2 – Inlet port (flange type ISO K, ISO F, ISO CF optional) 3-Pump housing 4-Pump body 5-Purge port(Normal closed, KF 10) 6-outlet port(KF40) 7-cooling-water pipe fittings for controller (connected by Φ10 water pipe) 8-controller 9-Cooling-water pipe fittings for pump (connected by Φ10 water pipe)

Note: Water cooling (standard) is adopted, and both turbomolecular pump and controller need to be connected with cooling water pipes.

CXF-200/1401 and CXF-200/1402 pumps are equipped with controller CXFD-1001 controller; CXF-250/2301, CXF-250/2302, CXF-320/3001 and CXF-320/3002 pumps are equipped with controller CXFD-1601 controller; the ports are shown in Fig. 3.2 (a) and Fig. 3.2 (b) respectively. The panel is divided into left part and right part, with power supply on the left part and communication and operation on the right part.

(a) CXFD-1001



(b) CXFD-1601

Figure 3.2 Controller panel interface

Description for the controller panel interface:

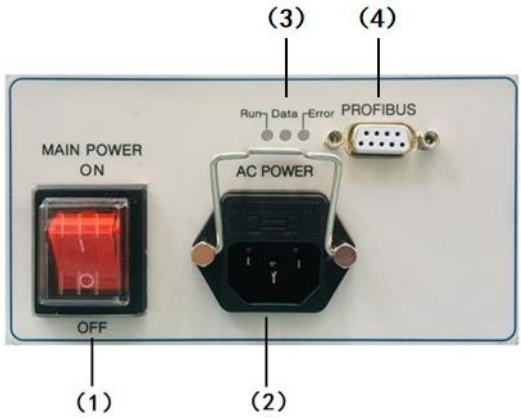


Figure.3.3 Panel Interface on the Left (Pictures for reference only, subject to physical objects)

Table 3.1 Panel interface on the left

Position	Identification	Function	Meaning	Remarks
(1)	【MAIN Power On /OFF】	User key	Power switch	
(2)	【AC POWER】	Power interface	Power supply	
(3)	【INDICATOR LIGHT OF PROFIBUS】	Profibus indicator	【Run】Power supply indication 【Data】	

			Communication indication 【Error】Error indication	
(4)	【PROFIBUS】	User communication interface	DB9 female，providing “Profibus” communication mode	Optional，see7.6 for details

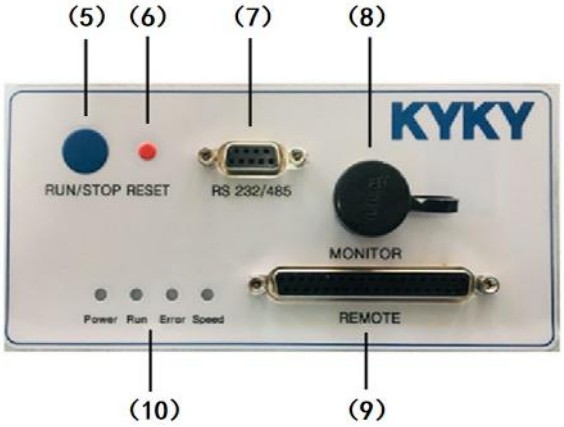


Figure 3.4 Panel interface on the right (pictures for reference only, subject to actual product)

Table 3.2 Panel interface on the right

Position	Identification	Function	Meaning	Remarks
(5)	【RUN/STOP】	User key	Running and Stopping	
(6)	【RESET】	User key	Reset fault	
(7)	【RS232/485】	User communication interface	DB9 female, providing "RS485" communication; (Note 1)	See7.5 for details
(8)	【MONITOR】	Equipment interface	Connect external LCD touch panel	Optional
(9)	【REMOTE】	IO external control interface	DB37 female, providing IO control	See 7.4 for details
(10)	Indicator light	State indicator	【POWER】 【RUN】 【ERROR】 【SPEED】	

3.2 Functions and working principles of major components or functional units

Main components of turbomolecular pump include: protective net, pump housin, turbine, stator, spindle assembly, stator assembly, base and cooling unit. Turbomolecular pump can obtain high and ultra-high vacuum environment required for the closed chamber by pumping via combination of high-speed rotating multi-stage turbine rotor blades and stationary turbine blades, which produces high compression ratio for the pumped gas in the molecular flow region.

Controller components mainly include system power supply, main board, control and display panel and operation software. Controller components are responsible for motion control of turbomolecular pump and external signal communication.

3.3 List of turbomolecular pump Accessories

Optional accessories indicate the accessories purchased additionally by the user in necessary situation during the installation of the magnetically-levitated turbomolecular pump:

Table 3.3 List of turbomolecular pump accessories

Category	Name	Specification	Number	Unit	Function description
Baking component	Turbomolecular pump body heater	CXF-200/1401CV	1	Set	Provide case-heating function to turbomolecular pump, to prevent the pumping gas from being Customized
		CXF-250/2301CV			
		CXF-320/3001CV			
Standard accessories	Protective net and steel cable baffle ring	CXF-200/1401 CXF-200/1402	1	Set	Protection of magnetically-levitated turbomolecular pump inlet port
		CXF-250/2301 CXF-250/2302			
		CXF-320/3001 CXF-320/3002			
	Center bracket and seal ring	DN200 ISO K/F	1	Set	Inlet port ISO K/-F flange seal
		DN250 ISO K/F			

	assembly	DN320 ISO F (customized)			
	CF copper washer	DN 200	1	Piece	DN 200/DN250 inlet port CF flange seal
		DN 250			
	Purge port flange	KF10	1	Piece	Providing interface for feeding protective gases into turbomolecular pump
	Caliper	M10	1	Piece	Connecting fastener between ISO K (customized) and ISO K flange
	Clamp assembly (including blind plate, center support and rubber ring)	KF 10/16/25/40	1	Set	Connection fasteners for turbomolecular pump backing and inflatable interface
	Caliper pad	M8	1	Piece	Connecting fastener between ISO K (customized) and ISO F flange blind hole
	Double-end stud (including flat gasket, spring washer and nut)	M10, M12	1	Piece	Connecting fastener of CF flange

Chapter 4 Technical Parameters, Dimensions and Weight

4.1 Technical Parameters

Table 4.1 Technical parameters list

Item \ Model	CXF-200/1401	CXF-200/1402	CXF-250/2301	CXF-250/2302	CXF-320/3001	CXF-320/3002
Pumping speed (L/s)*1	N_2：1280 A_r：1100 H_e：880 H_2：560	N_2：1400 A_r：1300 H_e：1100 H_2：820	N_2：2150 A_r：1900 H_e：1500 H_2：850	N_2：2360 A_r：2260 H_e：1980 H_2：1250	N_2：2950 A_r：2750 H_e：2300 H_2：1100	N_2：3260 A_r：2900 H_e：2550 H_2：1730
Compression ratio	N_2：$>10^8$ A_r：$>10^8$ H_e：$>10^4$ H_2：$>10^3$	N_2：$>10^8$ A_r：$>10^8$ H_e：$>10^4$ H_2：$>10^3$	N_2：$>10^8$ A_r：$>10^8$ H_e：$>10^4$ H_2：$>10^3$	N_2：$>10^8$ A_r：$>10^8$ H_e：$>10^4$ H_2：$>10^3$	N_2：$>10^8$ A_r：$>10^8$ H_e：$>10^4$ H_2：$>10^3$	N_2：$>10^9$ A_r：$>10^9$ H_e：$>10^4$ H_2：$>10^3$
Ultimate pressure（Pa）	10^{-7}（Rubber seal） 10^{-8}（Metal seal）	10^{-7}（Rubber seal） 10^{-8}（Metal seal）	10^{-7}（Rubber seal） 10^{-8}（Metal seal）	10^{-7}（Rubber seal） 10^{-8}（Metal seal）	10^{-7}（Rubber seal） ----	10^{-7}（Rubber seal） ----
Maximum continuous backing pressure（Pa）	266（2Torr）	266（2Torr）	266（2Torr）	266（2Torr）	266（2Torr）	266（2Torr）
Maximum continuous flow rate *1（sccm）（N_2）	1100	1200	1300	1500	2100	2400
Inlet port flange	DN200 ISO F（standard）	DN200 ISO F（standard）	DN250 ISO F（standard）	DN250 ISO F（standard）	DN320 ISO F（standard）	DN320 ISO F（（standard）
	DN200 ICF(option)	DN200 ICF(option)	DN250 ICF（option）	DN250 ICF（option）	----	----
	DN200 LF (customized)	DN200 LF (customized)	DN250 LF (customized)	DN250 LF (customized)	----	----
Baking temperature of inlet flange（℃）	＜120	＜120	＜120	＜120	＜120	＜120
Outlet port flange	KF40	KF40	KF40	KF40	KF40	KF40
Purge port flange（optional）	KF10	KF10	KF10	KF10	KF10	KF10

Recommended purge gas flow （sccm）	20	20	50	50	50	50
Rated speed（rpm）	30000	33000	27000	30000	21000	24000
Backup rotational speed（rpm）	Approximately 5000	Approximately 5000	Approximately 5000	Approximately 5000	Approximately 5000	Approximately 5000
Starting time（min）	≤6	≤7	≤8	≤9	≤9	≤10
Stopping time （min）	≤8	≤9	≤11	≤12	≤12	≤14
Vibration（μm）	≤0.01	≤0.01	≤0.01	≤0.01	≤0.01	≤0.01
Noise（dB）	＜50	＜50	＜50	＜50	＜50	＜50
Recommended backing-pump（l/s）	≥16	≥16	≥22	≥22	≥30	≥30
Installation position	Free	Free	Free	Free	Free	Free
Water pipe joint	G1/4 female，internal diameter Φ 10 in-line and self-sealing（Connecting outer diameter Φ10 plastic rigid pipe）	G1/4 female，internal diameter Φ 10 in-line and self-sealing（Connecting outer diameter Φ10 plastic rigid pipe）	G1/4 female，internal diameter Φ 10 in-line and self-sealing（Connecting outer diameter Φ10 plastic rigid pipe）	G1/4 female，internal diameter Φ 10 in-line and self-sealing（Connecting outer diameter Φ10 plastic rigid pipe）	G1/4 female，internal diameter Φ 10 in-line and self-sealing（Connecting outer diameter Φ10 plastic rigid pipe）	G1/4 female，internal diameter Φ 10 in-line and self-sealing（Connecting outer diameter Φ10 plastic rigid pipe）
Cooling method	Water cooling	Water cooling	Water cooling	Water cooling	Water cooling	Water cooling
Cooling water flow rate（L/min）	2	2	3	3	3	3
Recommended Cooling water temperature *2（℃）	20±5	20±5	20±5	20±5	20±5	20±5
Cooling water pressure（MPa）	0.15～0.4	0.15～0.4	0.15～0.4	0.15～0.4	0.15～0.4	0.15～0.4
Ambient temperature range （℃）	5～40（40～80% RH）	5～40（40～80% RH）	5～40（40～80% RH）	5～40（40～80% RH）	5～40（40～80% RH）	5～40（40～80% RH）
Storage temperature range（℃）	-25～55	-25～55	-25～55	-25～55	-25～55	-25～55
Maximum allowable magnetic flux density（mT）	Radial：3 Axial：15	Radial：3 Axial：15	Radial：3 Axial：15	Radial：3 Axial：15	Radial：3 Axial：15	Radial：3 Axial：15

Weight（kg）（ISO F）	51	51	60	60	76	76
Power Supply（VAC）	220±10%，50Hz 110±10%，60Hz	220±10%，50Hz 110±10%，60Hz	220±10%，50Hz 110±10%，60Hz	220±10%，50Hz 110±10%，60Hz	220±10%，50Hz 110±10%，60Hz	220±10%，50Hz 110±10%，60Hz
Maximum input power（W）	1000	1000	1500	1500	1500	1500

Notes: 1.The pumping speed of backing pump for vacuum performance test shall meet the recommended value;

2. The temperature of cooling water shall be higher than the condensation temperature of the service environment to prevent condensation.

3. Molecular pump with anti-corrosion function can be customized

4.2 Overall dimension

The overall dimensions of the CXF-200/1401, CXF-200/1402, CXF-250/2301, CXF-250/2302, CXF-320/3001, CXF-320/3002 Magnetically-levitated turbomolecular pump are shown in Figure 4.1. The detailed overall dimensions are shown in Table 4.2.

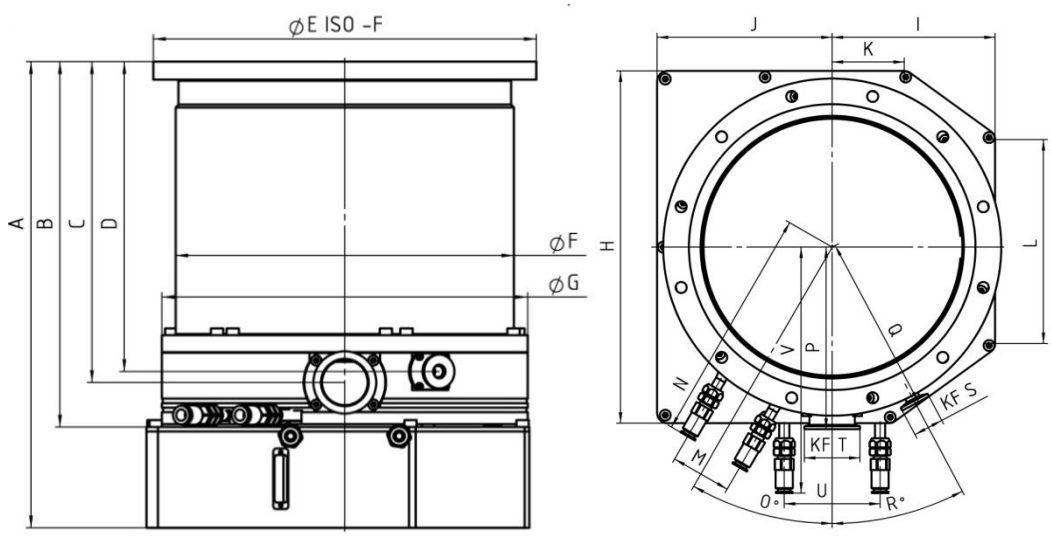


Figure 4.1 Dimensions for CXF-200/1401, CXF-200/1402, CXF-250/2301, CXF-250/2302, CXF-320/3001 and CXF-320/3002

The dimensions of integrated magnetically-levitated turbomolecular pumps are shown in Figure 4.1 and the details are shown in table 4.2.

Table 4.2 Overall dimension parameters of series turbomolecular pumps (Unit: mm, °)

Model	**CXF-200/1401 CXF-200/1402**	**CXF-200/1401 CXF-200/1402**	**CXF-250/2301 CXF-250/2302**	**CXF-250/2301 CXF-250/2302**	**CXF-320/3001 CXF-320/3002**
Inlet flange	ISO F	ICF	ISO F	ICF	ISO F
A	388.5	426	411.5	443	417
B	299.5	335	322.5	354	328
C	259.5	297	283	314.5	288
D	250.5	288	273.5	305	285
E	285	253	335	305	425
F	241	241	296	296	342
G	278	278	320	320	358
H	278	278	337	337	337

I	139	139	153.5	153.5	153.5
J	139	139	168.5	168.5	168.5
K	101	101	84	84	84
L	192	192	198.5	198.5	198.5
M	53	53	52.5	52.5	52.5
N	172	172	191	191	191
O	42°	42°	30°	30°	30°
P	160	160	181	181	189
Q	155	155	176	176	176
R	30°	30°	30°	30°	30°
S	10	10	10	10	10
T	40	40	40	40	40
U	95	95	95	95	95
V	202	202	231	231	231
W	53.5	53.5	66	66	66

Chapter 5 Unpacking Inspection

5.1 Inspection before unpacking

Before unpacking, it is necessary to check the appearance, whether the box is damaged, collided or sprayed with water. If you find any similar traces, please contact our company in time.

Before unpacking, it is necessary to carefully check whether the quantity of the goods received is the same as that of the goods delivered. If you have any questions, please contact our company in time.

5.2 Unpacking inspection and precautions

It is necessary to carefully disassemble and handle the box should be for safety of goods and personnel. Our company will not be responsible for damage of goods and personnel injury caused by disassembly and handling.

After unpacking, it is necessary to carefully check whether goods on the packing list are complete, whether the appearance of goods in the box is intact, and whether the cover plates at the opening of the pump are sealed completely.

Table 5.1 CXF-200/1401, CXF-200/1402, CXF-250/2301, CXF-250/2302, CXF-320/3001 and CXF-320/3002 integrated magnetically-levitated turbomolecular pump packing list

Model	Type of interface	Name	Specification	Number	Unit
CXF-200/1401 CXF-200/1402 CXF-250/2301 CXF-250/2302	ISO K ISO F CF	Instructions		1	Book
		Warranty bill		1	Book
		Certificate		1	Piece
		Power supply cord	3 meters	1	Piece
CXF-320/3001 CXF-320/3002	ISO F	Instructions		1	Book
		Warranty bill		1	Book
		Certificate		1	Piece
		Power supply cord	3 meters	1	Piece
CXF-200/1401 CXF-200/1402 Model	ISO K Caliper (customized)	Centering bracket (aluminum)	LF 200	1	Piece
		Fluorine rubber O-ring	Φ218×5.3 F	1	Piece

		Caliper	M10	8	Piece
		Protective net	For CXF-200/1401	1	Piece
		Snap ring	For CXF-200/1401	1	Piece
	ISO F Bolt	Centering bracket (aluminum)	LF 200	1	Piece
		Fluorine rubber O-ring	Φ218×5.3 F	1	Piece
		Loose flange with steel ring	LF 250	1	Piece
		Stud（stainless steel、with nut）	M10×55	12	Piece
		Double-end stud (stainless steel)	M10×50	12	Piece
		Nut (optional 、 stainless steel)	M10	24	Piece
		Protective net	For CXF-200/1401	1	Piece
		Snap ring	For CXF-200/1401	1	Piece
	CF Blade	Sealing copper ring	CF 200	1	Piece
		Stud（stainless steel、with nut）	M8×65	24	Piece
		Double-end stud (optional, stainless steel)	M8×60	24	Piece
		Nut (optional, stainless steel)	M8	48	Piece
		Protective net	For CXF-200/1401	1	Piece
		Snap ring	For CXF-200/1401	1	Piece
CXF-250/2301 CXF-250/2302 Model	ISO K caliper (customized)	Centering bracket (aluminum)	LF 250	1	Piece
		Fluorine rubber O-ring	Φ265×5.3 F	1	Piece
		Caliper	M10	8	Piece
		Protective net	For CXF-250/2301	1	Piece

		Snap ring	CXF-250/2301	1	Piece
	ISO F bolt	Centering bracket (aluminum)	LF 250	1	Piece
		Fluorine rubber O-ring	Φ265×5.3 F	1	Piece
		Loose flange with steel ring	LF 250	1	Piece
		Stud (stainless steel, with nut)	M10×55	12	Piece
		Double-end stud (optional, stainless steel)	M10×50	12	Piece
		Nut (optional, stainless steel)	M10	24	Piece
		Protective net	CXF-250/2301	1	Piece
		Snap ring	CXF-250/2301	1	Piece
	CF blade	Sealing copper ring	CF 250	1	Piece
		Stud (stainless steel, with nut)	M8×70	32	Piece
		Double-end stud (optional, stainless steel)	M8×65	32	Piece
		Nut (optional, stainless steel)	M10	64	Piece
		Protective net	CXF-250/2301	1	Piece
		Snap ring	CXF-250/2301	1	Piece
CXF-320/3001 CXF-320/3002 model	ISO F bolt	Fluorine rubber O-ring	Φ325×7 F	1	Piece
		Stud (stainless steel, with nut)	M12×65	12	Piece
		Double-end stud (optional, stainless steel)	M12×65	12	Piece
		Nut (optional, stainless steel)	M12	12	Piece
		Protective net	For CXF-320/3001	1	Piece
		Cross grooved spherical cylindrical head screw	M 3×5	6	Piece

Take out the pump from the package and check whether it is broken in transportation. Remove

the plastic cover and protective net on the high vacuum interface of pump, wear clean gloves, toggle turbine rotor to achieve smooth rotation, and lift the turbine rotor up and down (there exists small gap in the axial direction of turbine rotor), no scratch, and stuck, and then restore the protective net and flange cover.

Turbomolecular pump is placed vertically in the packing box. When unpacking, please use ring screw or alternative screw connection to fix the pump entrance flange reliably. As shown in Figure 5.1 (more ropes need to be used) (ring screw specification references table 5.2), the turbomolecular pump should be lifted from the packing box carefully and safely to check whether it is damaged during transportation. Please wear clean gloves, remove the flange cover plate, pressure cylinder or protective net on the high vacuum interface of the pump, turn the turbine rotor (the turbine rotor should be flexible to rotate), pull up and down the turbine rotor (the turbine rotor has a small gap in the axis) without scratch, jam and other abnormal phenomena, and then install the protective net, and flange. The cover plate is re-covered and ready for installation and use.

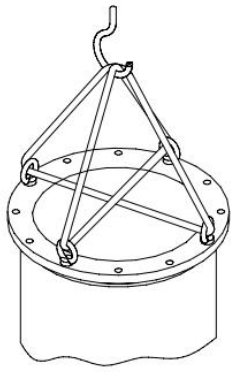


Figure 5.1 Schematic diagram of turbomolecular pump transported by ring screw

Table 5.2 Specifications of ring screws

Specification of Ring Screw	**Applicable Molecular Pump Inlet Flange**
M8	DN200 ISO F，DN200 CF DN250 ISO F，DN250 CF
M10	DN320 ISO F

If you find anything abnormal, you should inform our company in time rather than deal with it by ourselves, otherwise our company will not be responsible for the loss.

When carrying the packing box, the bottom of the packing box must be extracted and handled

lightly. Vibration, shock, knocking, rain, cold and sun exposure are strictly prohibited. The magnetically-levitated turbomolecular pump shall be packed in the package when leaving the factory. During the transporting, it is required to be gently taken or placed, and the strong vibration, pump, impact, rain, coldness and sun exposure are prohibited. Otherwise, the turbomolecular pump may be damaged. Large turbomolecular pumps need to be handled with forklift trucks.

During the moving after opening the package, pay attention to protecting the high vacuum sealing flanges, outlet flanges, pipe joint, controller sockets and easily damaged parts of the magnetically-levitated turbomolecular pump. To prevent air leakage or damage due to collision.

WARNING

WARNING
（1） If any damage which may influence the operational performance of the pump is discovered after opening the package, the user shall contact the manufacturer immediately; Do not handle by yourself; （2）Pay attention to protecting the high vacuum inlet port and outlet port of the pump from scratch which may influence vacuum sealing during the moving. （3）The outlet port, pipe joint, pump foot pad, electric connector interfaces and other projecting parts shall not used as the carrying handle; Only when the pump is placed in front of the installed system, the sealing cap of the pump can be opened; （4）Do not open the plastic flange cover on the high vacuum inlet port and outlet port of the pump for a long time; do not make debris or dust fall into the pump and always keep the pump clean and clear; **（5）** Install the pump in an environment as clean as possible.

Chapter 6 Installation and Commissioning

6.1 Preparation and Technical Requirements before Installation

Please read the manual carefully before installation.

First, confirm that the installation environment meets the requirements in this manual, specifically as shown in Table 1.2.

Identify use environment of turbomolecular pumps. Turbomolecular pump cannot be used to pump liquid, or gas with dust or solid particles. In addition to "N" type corrosion resistant magnetically-levitated turbomolecular pump, any other magnetically-levitated turbomolecular pumps cannot be used for pumping corrosive gases. Inert gas, N2 for example, must be fed for protection when "N" type magnetically-levitated turbomolecular pump is pumping corrosive gases.

Check whether turbomolecular pump matches controller. Confirm that models of turbomolecular pumps are compatible with those of controllers, and turbomolecular pumps can only match controllers specified in this manual.

Before installation, it is necessary to check and confirm:

- Whether the turbomolecular pump has been damaged. Remove the plastic cover and protective net on the high vacuum interface of pump, wear clean gloves, toggle turbine rotor to achieve smooth rotation.
- Ensure that goods on the packing list are complete and fittings (such as clamps and bolts) and tools are complete, and wear clean clothes and take corresponding protective measures (such as anti-skid gloves) according to actual cleanliness requirements.
- Confirm that the vacuum chamber is exposed to atmosphere.
- Confirm the installation location/angle of turbomolecular pump. Pay attention to reserve space for installing the pump backing pipe and power cord/cable.
- Ensure that the protective net is tight and reliable.

After confirming the above, you can install integrated magnetically-levitated turbomolecular pump.

The integrated magnetically-levitated turbomolecular pump described in this manual should be installed in line with national and local standards and safety specifications. Please contact KYKY for

technical assistance before using turbomolecular pump in dangerous media.

And Integrated Magnetically-levitated turbomolecular pump should avoid large vibration and impact as much as possible during use. It is recommended to take the following protective measures:

（1） Vibration reduction structure should be designed into the whole system to avoid mutual influence between different equipment;

（2） Vibration source (such as pneumatic gate value, mechanical vacuum pump, etc.) of turbomolecular pump should be separately protected to reduce and isolate vibration;

（3） Magnetically-levitated turbomolecular pump should stand away from vibration source as much as possible;

（4） Hydraulic or welded bellows with vibration reduction/isolation function should be used for magnetically-levitated turbomolecular pump backing connection.

（5） Try to use small-vibration (especially shock vibration) equipment, such as electric slider damper, try not to use pneumatic gate value.

First, check the tools for handling and installation are all in readiness. Please use ring screw or alternative screw connection to fix the pump entrance flange reliably during transportation. As shown in Figure 5.1 (more ropes need to be used) (ring screw specification references table 5.2), the turbomolecular pump should be lifted from the packing box carefully and safely to check whether it is damaged during transportation.

When the turbomolecular pump is installed horizontally, lifting device or other safe and reliable device should be used to carry and install it by supporting pump body and pump seat, as shown in Figure 6.1. Never support the parts of pump, such as water pipe and water pipe joint, plug, front flange and protective gas joint, because they are easy to cause pump dropping, parts and components damaged.

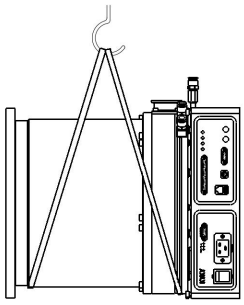


Figure 6.1 Schematic diagram of molecule pump during horizontal installation

When the turbomolecular pump is installed vertically, lifting device or other safe and reliable device should be used to lift and install it by supporting the pump seat, as shown in Figure 6.2. Note that lifting device must be able to bear more than five times the overall weight of the molecular pump, and the lifting process should be stable and reliable. Turbomolecular pumps need to be controlled by the four M12 screw holes (note: four M10 screw holes for CXF-200/1401 pump controller) on the bottom of the turbomolecular pumps controller and reliably fixed on the platform of the lifting device (the platform needs to be larger than the bottom of the pump). Move device, lift and install the turbomolecular pumps carefully and slowly to ensure safety. Never support the parts of the pump, such as water pipe and water pipe joint, plug, front flange and purge port, because they are easy to cause pump dropping and parts damage.

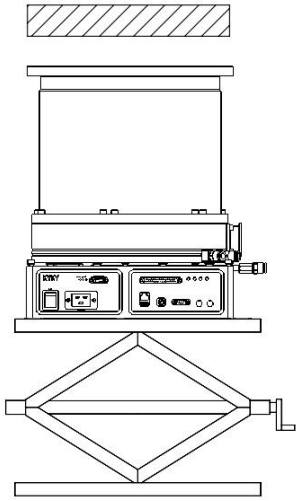


Figure 6.2 Diagram of turbomolecular pump up and down during vertical installation

When the turbomolecular pump is installed upside down, ring screw or alternative screw should be used to connect the pump. Turbomolecular pumps need to be controlled by the four M12 screw holes on the bottom of the turbomolecular pumps controller, as shown in Figure 6.3 (more ropes need to be used), and then the molecular pump should be lifted carefully and safely. The process of moving, hoisting and installing molecular pumps should be carefully and slowly, so as to prevent accidents such as knocking of molecular pumps and ensure the safety of equipment and personnel. Never support the parts of the pump, such as water pipe and water pipe joint, plug, front flange and purge port, because they are easy to cause pump dropping and parts damage.

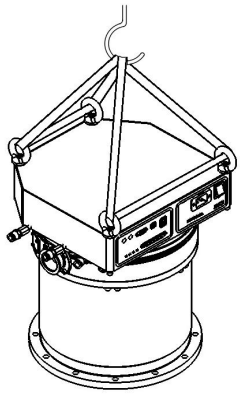


Figure 6.3 Schematic diagram of molecule pump during inverted installation

There is high-speed rotating rotor in the magnetically-levitated turbomolecular. Its extreme instability may cause the pump to shift the flange coupling due to the disturbing torque in the direction of rotation, which may result in physical damage and equipment damage. When the inlet flange bolts are connected, they should meet the installation requirements of "GB / T 6070-2007 Vacuum Technical Flange Size"(reference to ISO 1609:1986), the bolt material should be carbon steel or alloy steel, the bolt performance grade should reaches 12.9 or higher (refer to GB / T3098-2000 and ISO 898:1999). The recommended bolt tightening torque is shown in Table 6.1. It is recommended to use the outrigger structure to support the pump and enhance the safety protection of the pump.

Table 6.1 Recommended bolt tightening torque for flange bolts in pump inlet

Bolt models	Tightening torque (N·m)
M8	14
M10	29
M12	46

The specifications of this manual should be followed to ensure the safety of magnetically-levitated turbomolecular pump and vacuum systems. For installations that do not comply with this specification, please contact KYKY technical engineers.

6.2 Installation procedures, methods and precautions

6.2.1 Installation of protective net

(1) When installing the protective net, remove the pump cover on the magnetically-levitated turbomolecular pump port and the cylinder on the turbine rotor.

(2) Install the protective net.

(3) After installing the protective net, install the flexible steel cable baffle ring in the slot of the pump port to fix the protective net for CXF-200/1401, CXF-200/1402, CXF-250/2301, and CXF-250/2302. For CXF-320/3001, CXF-320/3002 integrated magnetically-levitated turbomolecular pump, it is necessary to fix protective net with six M3x5 screws at the inlet of the pump.

(4) Check the protective net is tight and reliable.

Protective net (standard accessory) at the pump inlet can prevent foreign objects from falling into pump (for objects with a diameter of greater than 5mm) but will reduce the pumping speed (pumping speed is reduced by about 10-20% for nitrogen) of turbomolecular pump after it is fitted. Protective net can neither prevent objects with a diameter of less than 5mm from falling into pump, nor prevent damage of the objects on turbomolecular pump in operation.

6.2.2 Adjusting installation angle of the outlet port flange

Before connecting integrated magnetically-levitated turbomolecular pump with vacuum chamber, it is necessary to consider and adjust the angle of the backing port in advance.

The integrated magnetically-levitated turbomolecular pump in this manual uses a active 5-axis magnetically levitated bearing, and the outlet flange corresponds to a magnetic pole. The outlet flange should be placed vertically or horizontally if the horizontal installation is used (± 2.5°) for the magnetically-levitated turbomolecular pump, which will help reduce the impact of the rotor weight on magnetically-levitated control. Shown in figure 6.4.

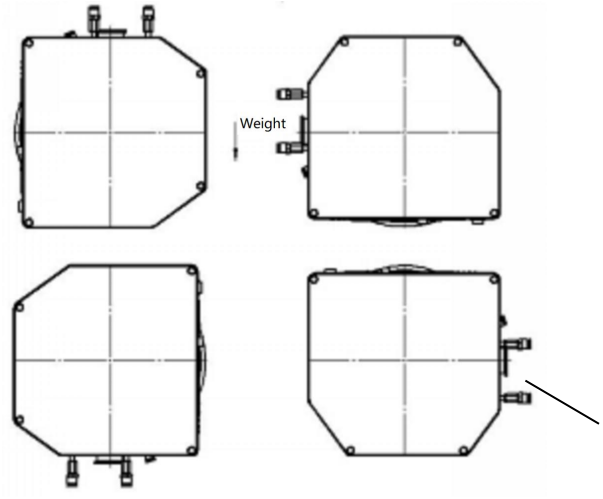


Figure 6.4 Diagram of installation angle of outlet port of integrated magnetically-levitated turbomolecular pump

6.2.3 Vacuum Chamber Connection

The high vacuum interfaces of integrated magnetically-levitated turbomolecular pump are ISO F flange, ISO K flange (i.e. LF flange) and CF flange. ISO K flange is sealed with fluorine rubber. CF flange is sealed with oxygen-free copper. The connection between different flanges is shown below.

Molecular pump is generally mounted on the corresponding interface of vacuum chamber. However, for heavy pump, base supporting structure should balances the weight of the pump completely and prevents welds from cracking; the high vacuum interface of turbomolecular pump should be as close as possible to the vacuum chamber pumped (see figure 6.5).

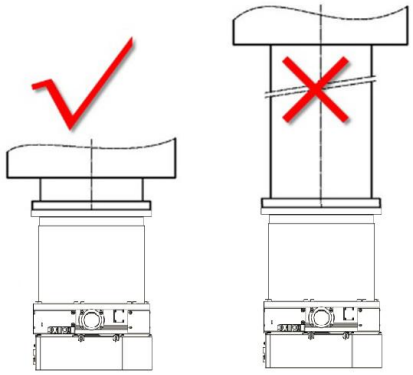


Figure 6.5 Connection diagrams of integrated magnetically-levitated turbomolecular pump and

vacuum chamber

CAUTION

The interface flanges of turbomolecular pump produced by the company completely meet the ISO international standards. See flange specifications in the Technical Parameter List and refer to relevant standards of dimension.

CAUTION

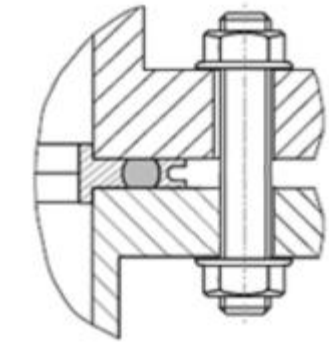
WARNING

(a) The pump can acquire a great deal of kinetic energy through the rotor's high-speed rotation, inappropriate operation or other causes may make the connection between the pump and vacuum chamber become loose or may result in the pump's abnormal damage; therefore, install the pump by using intensity-qualified connections;

(b) Do not separately power on. Turbomolecular pump must be installed in the vacuum system and started after specified conditions of vacuum are met;

(c) When hoisting the pump, make sure the welding seam of hoisting parts are fixed firmly to prevent cracking;

Connection of ISO F flange and ISO F flange



Prior to the flange installation, prepare installation tool, center support, rubber ring, hexagonal bolt and nut, etc. Check the flange sealing surface to ensure that there is no damage;

Use installation tool to install the flange as shown in figure 6.6;

Use corresponding number of bolts to fix the flanges and symmetrically tighten them in turn. It is recommended that

Figure 6.6 Connection of ISO F flange and ISO F flange

bolts should be tightened for three times;

Tighten the nuts symmetrically, orderly and evenly. Refer to Table 6.1 for the final tightening torque.

Tighten bolts again after vacuuming;

Refer to Standard Manual to know the size of bolts for the flanges with different diameters.

Connection of ISO K flange and ISO F flange

ISO K flange is connected to ISO F flange in two ways as follows:

- **Connect standard ISO F flange with loose flange**
- **Connect to chamber blind hole with loose flange**

Prior to the flange installation, prepare installation tool, center support, rubber ring, bolt/stud and nut, etc.

CAUTION

CAUTION
(a) Refer to Standard Manual to know the number of fasteners for flanges with different diameters; (b) **Note that fasteners should be symmetrically tightened in turn and tightened again after vacuuming.**

➢ **Connect standard ISO F flange with loose flange**

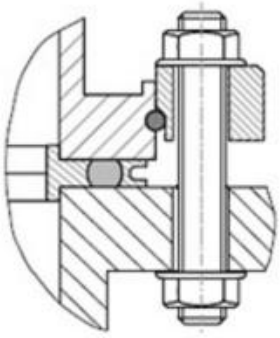


Figure 6.7 Connection of ISO K flange and ISO F flange

（1）Check the flange sealing surface to ensure that there is no damage before installation;

（2）Apply loose flange and retainer onto the turbomolecular pump inlet flange in turn;

（3）Place center support/positioning ring and rubber ring in the turbomolecular pump inlet flange (ISO K flange) along the central line. Center support is not necessarily used in the turbomolecular pump inlet flange

with reserved gasket groove;

（4）Use appropriate number of hexagonal bolts (or stud + nut) to fix turbomolecular pump as shown in figure 6.7.

Tighten the nuts symmetrically, orderly and evenly. Refer to Table 6.1 for the final tightening torque.

Tighten bolts again after vacuuming;

Refer to Standard Manual to know the size of bolts for the flanges with different diameters.

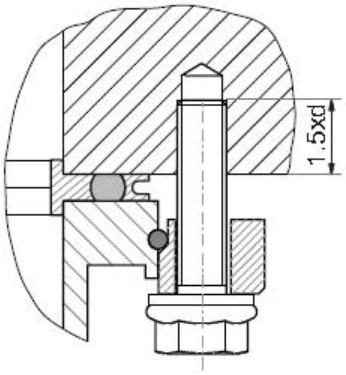


Figure 6.8 Connection of ISO K flange and blind threaded hole

➢ **Connect to chamber blind hole with loose flange**

（1）Check the flange sealing surface to ensure that there is no damage before installation;

（2）Apply loose flange and retainer onto the turbomolecular pump inlet flange in turn;

（3）Place center support/positioning ring and rubber ring in the turbomolecular pump inlet flange (ISO K flange) along the central line. Center support is not necessarily used in the turbomolecular pump inlet flange with reserved gasket groove;

（4） Use appropriate number of hexagonal bolts (or stud + nut) to fix turbomolecular pump as shown in figure 6.8.

Tighten the nuts symmetrically, orderly and evenly. Refer to Table 6.1 for the final tightening torque.

Tighten bolts again after vacuuming;

Refer to Standard Manual to know the size of bolts for the flanges with different diameters.

CF flange connection

ISO CF flange is connected to ISO CF flange in two ways as follows:

- **Connect to CF flange hole with hexagonal bolt**
- **Connect to CF flange blind hole with hexagonal bolt**

Prior to the flange installation, prepare installation tool, metal seal ring, bolt and nut, etc.

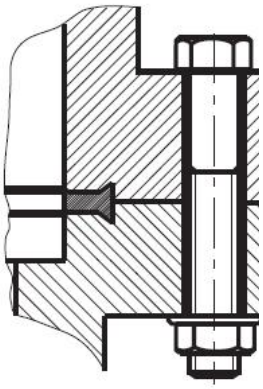


Figure 6.9 ISO CF Flange Connection

➢ **Connect to CF flange hole with hexagonal bolt**

（1）Check whether there is damage on the knife edge;

（2）Install protective net and place seal;

（3）Use corresponding number of hexagonal bolts to connect the flanges;

（4）Symmetrically tighten nuts orderly and evenly until tightening torque reaches the values in the table 6.1.

Tighten bolts again after vacuuming;

Refer to Standard Manual to know the size of bolts for the flanges with different diameters.

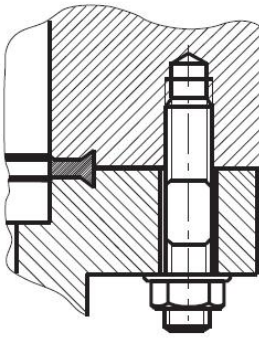


Figure 6.10 CF Flange Connection

➢ **Connect to CF flange blind hole with hexagonal bolt**

（1）Check whether there is damage on the knife edge;

（2）Install protective net and place seal;

（3）Use corresponding number of hexagonal bolts (or double-end stud + nut) to connect the flanges;

（4）Symmetrically tighten nuts orderly and evenly until tightening torque reaches the values in the table 6.1.

Tighten bolts again after vacuuming;

Refer to Standard Manual to know the size of bolts for the flanges with different diameters.

CAUTION

CAUTION
(a)The effective length of bolt or stud screwed into the blind hole should be greater than or equal to 1.5 d. The length of screwed stud should be appropriately extended;

(b) Bolts should be tightened again when flange and part near it are heated and cooled.

6.2.4 Backing Connection

Backing interface is ISO KF quick connection flange (see specifications in Technical Parameter).

As for the connection between turbomolecular pump and backing vacuum pump, metal /hydraulic bellow which can reduce the vibration is suggested.

It is recommended to use the backing vacuum pump with anti-back flow function at shutdown or install closing valve and release valve which are opened or closed simultaneously with the on-off of the backing vacuum pump at the inlet to prevent gas from returning to vacuum chamber when the backing vacuum pump is stopped.

CAUTION

Our standard integrated magnetically-levitated turbomolecular pumps adopt active 5-axis magnetically levitated technology, all using Precision ceramic ball touchdown bearings, are completely oil-free turbomolecular pump, the backing vacuum pump must be oil-free vacuum pump.

6.2.5 Cooling Water Connection

Cooling water interface uses quick plug-in interface, using a fiber reinforced plastic hose with outer diameter of 10mm connecting to water source, regardless of inlet or outlet of the pipe joint. Cooling water needs to be clean, low precipitation, water pressure is about 0.1 ～ 0.2MPa. Water temperature should be about 20℃-25℃, flow≧1l/min. If there is condensate water in the turbomolecular pump, the working temperature of the turbomolecular pump should be lowered appropriately).

The integrated magnetically-levitated turbomolecular pump has two cooling water pipelines. Turbomolecular pump and controller must always be water-cooled (under special circumstances such as heating, water valves are needed to automatically control the temperature of the pump).

WARNING

WARNING
Using high-sediment or corrosive water may result in blocking or corrosion on cooling water channel in the pump.

6.2.6 Connection of Control cable

CXFD integrated controllers are connected with connection board of CXF-200/1401, CXF-200/1402, CXF-250/2301, CXF-250/2302, CXF-320/3001, and CXF-320/3001 integrated magnetically-levitated turbomolecular pumps with 9 M6 screws (which is completed before leaving the factory; when users need to replace the integrated controller, they need to disassemble and install the connection). The connection diagram is shown in Figure 6.11.

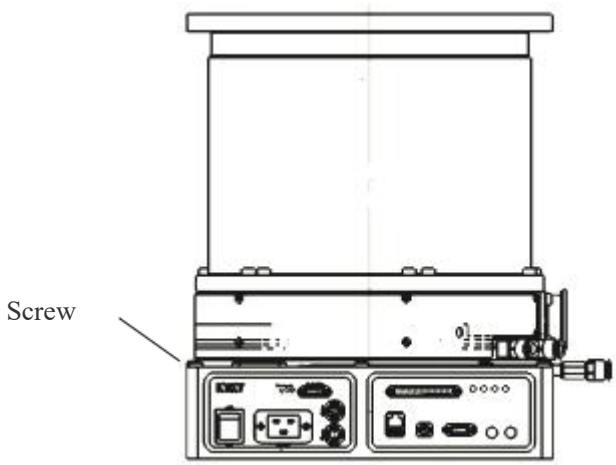


Figure 6.11 Schematic diagram of connecting the integrated controller and turbomolecular pump

There is an electric connector plug in the base of the turbomolecular pump, which is connected with the socket on the controller. In case of replacement of the integrated controller, it is necessary to ensure that the pin is intact when connecting the electric connector, pay attention to the position of slot, pin/pin hole and the direction of connector assembly; when connecting, it is necessary to align the slot properly not to bend the pin; after insertion, and check whether the pin is in place and the controller is fully fitted with the pump connecting plate.

Connect power supply line and signal communication line for the controller. The standard length of power supply cable is 3m. Type and length of other cables (e.g., custom cables) should be specified and ordered separately.

WARNING!

WARNING!
Before power-supply to the integrated magnetically-levitated turbomolecular, please carefully read the Instruction Manual of the corresponding controller.

6.2.7 Connection of protective gases for noncorrosive pump

The connecting device of protective gases is the standard accessory of noncorrosive pump. Please install it according to Figure 6.12 for non-corrosion resistant molecular pumps.

The protective gases interface is ISO-compliant KF10 quick release flange at the side of pump body. The connection is shown in Figure 6.12.

It is recommended to set flow meter and release valve in the pipeline to control the flow of protective gases according to the concentration of pumped corrosive gases.

Protective gases are generally industrial nitrogen or argon.

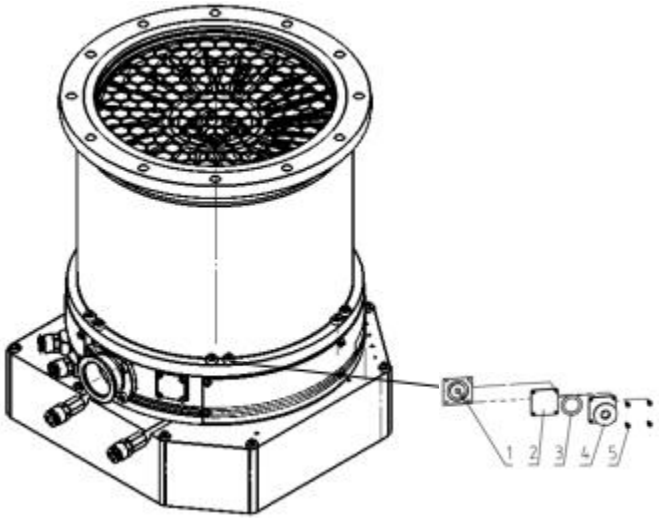


Figure 6.12 Protective gases connections

1-Purge port 2-Blind plate 3-Φ20×3.55 The fluorine sealing ring 4-Purge port flange KF10
5-Four M3×8 Hexagon socket head cap screws

CAUTION

CAUTION
Protective gases should be the gas which does not corrode alloy aluminum and stainless steel and react with pumped gas, such as nitrogen, argon, etc. The gas temperature should be 5-30℃ and gas concentration should be less than or equal to 10ppm. Under special conditions, dried and filtered oil-free air (filter grid density is less than 1um) can also be used.

6.2.8 Air Charging Connection after Shutdown

Corrosion-resistant pump can use protective gases inlet (KF10) for charging after shutdown; as for non-corrosion resistant pump, the user can selective purchase KF10 inflation connector manufactured by the company. The manufacturer of vacuum equipment can install it on the pumped chamber or backing pipeline according to the user's requirements, so as to make the inlets correspond to the valves.

The charge valve is electromagnetic valve. The charging process is described in chapter 7.7.

6.2.9 Heating tape connection

Using heating tape（customized） to heat turbomolecular pump can obtain better ultimate vacuum and prevent the condensation of special gases. The connection of heating tape is shown in Figure 6.13.

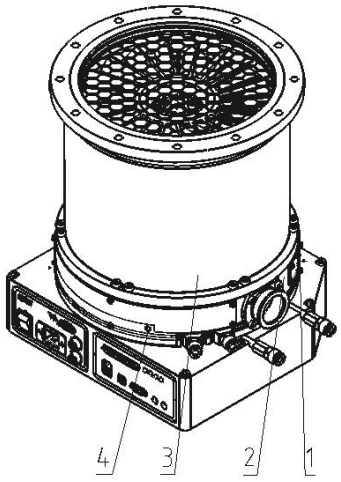


Figure 6.13 Heating tape connection

1-Fixing screw 2-Heating tape 3-Pump housing 4-Heated cable (220VAC power supply)


CAUTION

CAUTION
(a) Generally, it is unnecessary to heat turbomolecular pump through baking when the vacuum pressure P is greater than or equal to 5×10^{-5}Pa; **(b) The baking temperature of pump housing of different turbomolecular pumps is shown in Technical Parameters and Dimensions Chapter.**

Chapter 7 Use and Operation

7.1 Precautions before Use


DANGER

DANGER
When pumping flammable mixed gas, the pressure within the turbomolecular pump system is low (less than 10^{-4}Pa), there is generally no fire hazard. But when the pressure is high (greater than 10^{-4}Pa) and the temperature in the pump is higher than 100℃, sparks would occur on the pump due to damage on it, igniting the combustible mixed gas.


WARNING

WARNING
(a) Turbomolecular pump cannot be used for pumping liquid and gas with dust and solid particles. If the pumped gas contains a small amount of solid dust, multiple layers of filter net must be installed at the pump inlet; (b) Turbomolecular pumps except "N" type pump, cannot be used for pumping corrosive gases; protective gases must be fed into "N" type pump before it is used for pumping corrosive gases;


CAUTION

CAUTION
Some substances (such as boron trichloride, etc.) will condensed into solid in the pump body and generate sediment on the blade. The thick layer settled on the turbine blade will reduce the pumping action of movable blade. Heating the pump may reduce the generation of sediment. In case of such problems, please consult the pump manufacturer.

7.1.1 Starting pressure calculation of turbomolecular pump

Assume that the pumping system is V [m^3] and the pumping speed of backing vacuum pump is Sr [m^3/h].

When Sr/V＞40 [h^{-1}], the turbomolecular pump and the backing vacuum pump can start at the same time, at this time the turbomolecular pump is equivalent to a resistance valve.

When Sr/V≤40 [h^{-1}], the pumping volume is relatively large, then firstly the backing vacuum pump should be started, until the system pressure P≤5Pa, the turbomolecular pump can be started.

7.1.2 Pre-start cooling system

When using water cooling, the cooling water should be connected (water pressure and water temperature should meet the requirements, otherwise affecting the water cooling effect).

7.1.3 Pre-pass protective gas

Determine the flow of protective gases according to the concentration of pumped corrosive gases, generally as 20~50sccm. But the flow should be appropriately increased when pumping highly corrosive gases.

7.2 Operating procedures, methods and notes in starting and running process

7.2.1 Start-up

The turbomolecular pumps mentioned in this manual are all integrated magnetically-levitated turbomolecular pumps. The rotors of turbomolecular pumps shall be checked when they are used for the first time or reused after long-term idle (generally more than 3 months). The operation steps are as follows:

Check operation is as below：

(1) Wear clean gloves;

(2) Remove the plastic cover and protective net on the high vacuum interface of pump;

(3) Toggle turbine rotor to achieve smooth rotation;

(4) Lift the turbine rotor up and down (there exists small gap in the axial direction of turbine rotor), no scratch, and stuck;

(5) Then restore the protective net and flange cover.

Start and stop of the turbomolecular pump can be controlled by system external control/upper computer, as well as portable touch panel or start-stop key on the control panel of the turbomolecular pump, and also can be controlled through I/O external control and serial port communication.

Portable touch panel operation and start-stop method:

(1) Definition of local control mode: it refers to start-stop mode of touch panel or panel. Only under the premise that "local control mode" is enabled, can the turbomolecular pump be started and stopped by touch panel or panel. If the system is in other mode, the "start-stop" button of touch panel and panel is invalid.

(2) It is necessary to disable "external control mode" to set up "local control mode", which can be found in communication control section.

(3) You can enter the settings interface through "System Settings" on the touch panel, click "+" and "-" buttons on "Running Mode Settings" page to get the control mode you need to set under "Preset Control Mode", find "Local Control Mode", click the "Settings" button, and "Local Control Mode" will appear under "Current Control Mode", which means successful setup.

(4) Problems: Click on the "Settings" button, and "Local Control Mode" cannot appear under "Current Control Mode". It is because the system is currently in the "external control mode" and you should disable the "external control mode" through the external control interface before "setting".

（a）System monitoring page （b）System setting page

Figure 7.1 System monitoring page of the system settings interface

Start and stop operation method on molecular pump control panel:

Startup operation: first, the controller is powered on with 220V AC and the POWER indicator is on. Please wait for 10 seconds and then press RUN/STOP for starting the pump, and the RUNNING indicator is on (green). About one minute later, the SPEED indicator (yellow and green) starts to flash, and the pump speed is accelerating. As the pump speed increasing, the light will flash faster. Finally, when the rated speed is reached, the SPEED indicator (yellow and green) is always on.

Shutdown operation: first, press the RUN/STOP button to stop the molecular pump, the RUN indicator goes out, and the SPEED indicator (Orange) starts to flash, and the pump speed starts to slow down, As the pump speed decreasing, the light flashing slower. Then, when the pump speed reaches to zero, the SPEED indicator goes out. Finally, after waiting for one minute, turn off the power and the POWER indicator goes out.

About control the startup and shutdown of molecular pump through I/O external control and serial port communication, please refer to chapter 7.4 and 7.5 respectively.

7.2.2 Baking

In general, the rationally-designed vacuum system is not necessarily baked to obtain the vacuum of more than 10^{-4}Pa; the vacuum of 10^{-5}Pa can be obtained by simply baking the parts of vacuum system other than pump; but for obtaining ultra-high vacuum, all parts of vacuum system including turbomolecular pump need to be fully baked at the same time; and the ionization vacuum gauge must

be fully degassed to ensure the accuracy of measurement data.

In the areas with greater humidity, baking is also required for the vacuum system and the turbomolecular pump sometimes in order to obtain the vacuum of 10^{-4}Pa.

Baking should be carried out when the turbomolecular pump is in operation. Refer to the technical parameters list for baking temperature. The baking time shall be determined according to the contamination level of the system and pump and the expected ultimate pressure.

DANGER!
The temperatures of heater and pump housing are very high during baking, any direct contact by any part of body can cause injuries.

WARNING!
Baking temperature should be controlled strictly. If the temperature is too high, turbine vane in the turbomolecular pump can be deformed and damaged.

7.2.3 Start time

The normal start-up time for turbomolecular pump should be less than or close to the start-up time listed in the technical parameter list. The user should pay attention to abnormities and stop the pump timely if any abnormity appears during operation, and notify experienced technical staff to check the cause of abnormity.

7.3 Panel keys and status indicators

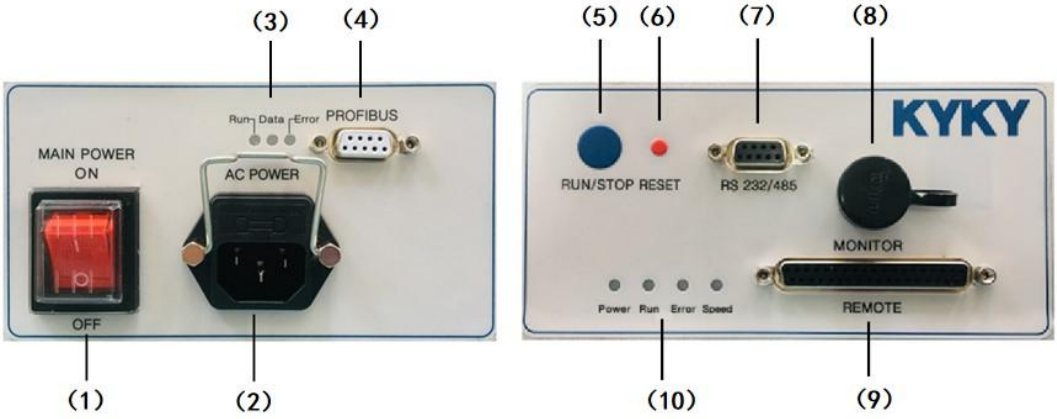


Figure 7.2 Controller panel diagram

表 7.1 Description for panel keys and status indicators of turbomolecular pump

Name	Action	Graphic position	Indicator	Meaning	Remarks
Switch On	Switch to ON position 	Figure 7.2 (1)	Power switch red light on	Equipment is electrified	Switch back to off for power off
Startup Stop	Touch the RUN/STOP button 	Figure 7.2 (5)	RUN indicator: Light (green) Speed indicator: flashing with pump speed increasing (green)	Acceleration Process	
	Touch the RUN/STOP button again 		RUN indicator: Out Speed indicator: flashing with pump speed decreasing (orange)	Deceleration Process	
Reset	Touch RESET 	Figure 7.2 (6)	Error indicator: the fault state can be reset under some conditions, while the red / yellow light is	Clear errors	

			off		

Note 1: If it is necessary to restart after shutdown, it can be restart at least 20 seconds after shutdown. The integrated magnetically-levitated turbomolecular pump controller has only one mechanical button, i.e., power switch.

7.4 I/O external control operation

The "remote" external control interface can realize the signal input and signal output functions between the controller and the outside (see figure 7.2(9)), using the D-sub37 pin connector (see Figure 7.3) with female connector and the screw M2.6.

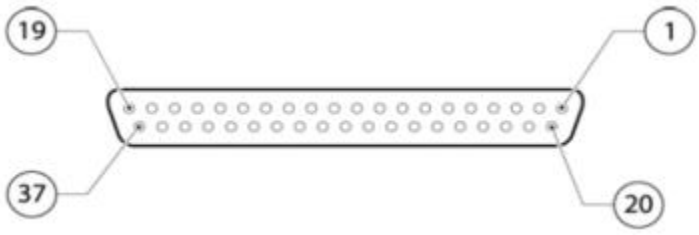


Figure 7.3 I/O external control connector (DB37 pin)

Note:1. the product accessories do not include the male socket of d-sub37 pin connector which needs to be configured by the customer;

2.It is strongly recommended to use the connecting cable with shielding layer, and the shielding layers at both ends of the cable should be respectively connected to the ground.

7.4.1 Input control description for external control interfaces

Two types of external control input signals can be chosen: contact signal input or voltage signal input. When using contact signal input, refer to the descriptions in table 7.2 and figure 7.4. When using voltage signal input, refer to the descriptions in table 7.3 and figure 7.5.

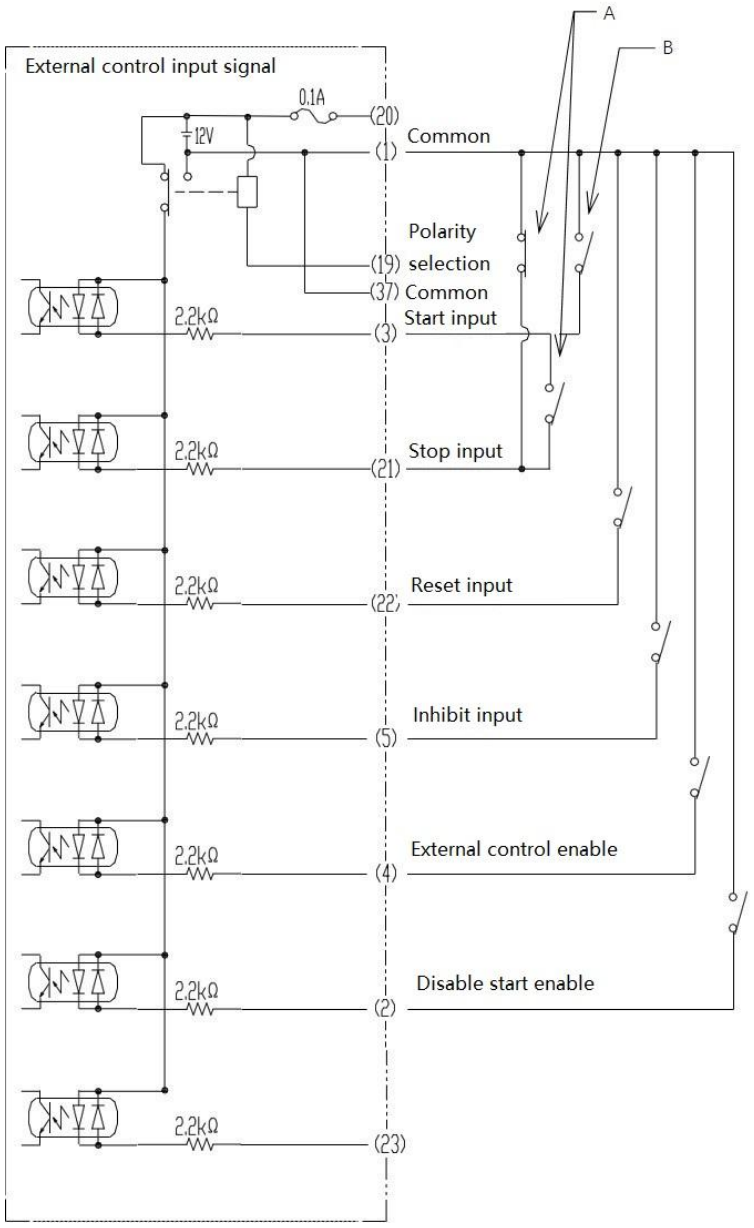
The external control input signal is only valid when the external control mode is enabled. The external control mode can be set through the serial communication, the enable pin of the external control interface or the setting mode of the external touch panel.

Table 7.2 External control input signal pins (contact input)

Pin No.	**Definition**	Introduction of the pins
1, 37	Common pin	Common pin (isolated from the enclosure)
19,37	For choosing the input signal type	When using the contact input, disconnect the circuits between pin 19 and pin 37
1,3,21	Start/stop signal	Pins for inputting the Start/stop signal. The following two methods are available: A. Shot the circuits between pin 1 and pin 21, and then short the circuits between pin 3 and pin 21 for at least 0.3 seconds to start the molecular pump. If the power of molecular pump has just turned on, it needs to short for at least 10 seconds.

		Disconnect pin 1 and pin 21 to stop the molecular pump. B.Short the circuits between pin 1 and pin 3 to start the molecular pump. Disconnect pin 1 and pin 3 to stop the molecular pump.
1,22	Reset signal	When the error is clear, shot the circuits between pin 1 and pin 22 at least 0.3 seconds to reset (the error light is out).
1,5	Inhibit for start signal	When shot the circuits between pin 1 and pin 5, it's inhibited to start the molecular pump. If the pump is running, shot the circuits between pin 1 and pin 5 to stop the molecular pump. This function needs to short the circuits between pin 1 and pin 2 first to enable.
1,4	External control enable signal	When shot the circuits between pin 1 and pin 4, the control mode of molecular pump will be set as external mode automatically. Meanwhile, the external input signal is valid, serial control is inhibited, but the series communication is normal.
1,2	Start enable signal	When shot the circuits between pin 1 and pin 2, the starting inhibit signal input is enabled.

Note: The external control input signal is only valid when the external control mode is enabled.



A，B indicate the two methods of table 7.2

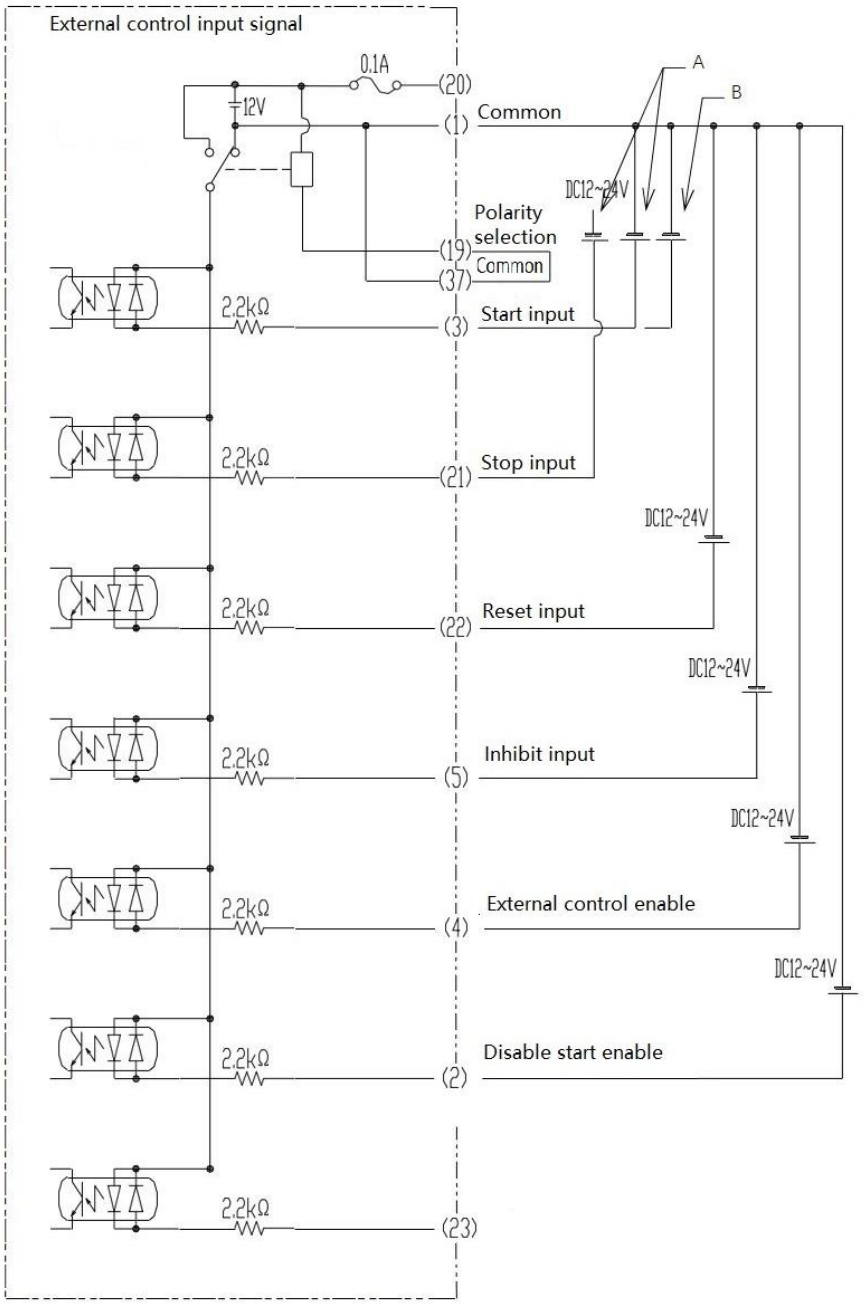
Figure 7.4 External control input signal pins (contact input)

Table 7.3 External control input signal pins (voltage input)

Pin No.	**Definition**	Introduction of the pins
1, 37	Common pin	Common pin (isolated from the enclosure) When voltage signals is connected, common pin connects the negative pole of power supply

19,37	For choosing the input signal	When using the voltage input, open the circuits between pin 19 and pin 37
1,3,21	Start/stop signal	Pins for inputting the Start/stop signal. The following two methods are available: C.First connect pin 1 and pin 21 to the 12~24V DC, and then connect pin 1 and pin 3 to the 12~24V DC for at least 0.3 seconds to start the molecular pump. If the power of molecular pump has just turned on, it needs to connect continuously for at least 10 seconds. Disconnect pin 1 and pin 21 to stop the molecular pump. D. Connect pin 1 and pin 3 to the 12~24V DC to start the molecular pump. Disconnect pin 1 and pin 3 to stop the molecular pump.
1,22	Reset signal	When the error is clear, connect pin 1 and pin 22 to the 12~24V DC at least 0.3 seconds to reset (the error light is out).
1,5	Inhibit for start signal	When pin 1 and pin 5 is connected to the 12~24V DC, it's inhibited to start the molecular pump. If the pump is running, connect pin 1 and pin 5 to the 12~24V DC to stop the molecular pump. This function needs to connect pin 1 and pin 2 to the 12~24V DC first to enable.
1,4	External control enable signal	When pin 1 and pin 4 is connected to the 12~24V DC, the control mode of molecular pump will be set as external mode automatically. Meanwhile, the external input signal is valid, serial control is inhibited, but the series communication is normal.
1,2	Start enable signal	When pin 1 and pin 2 is connected to the 12~24V DC, the starting inhibit signal input is enabled.

Note: The external control input signal is only valid when the external control mode is enabled.



A，B indicate the two methods of table 7.3

Figure 7.5 External control input signal pins (voltage input)

7.4.2 Output control description for external control interfaces

The external control output pins realizes status output through the on and off of relays

(CR1~CR8).

Whether in external control mode or serial port control mode, the external control output pin is valid.

Table 7.4 External control output signal pins

Pin No.	Definition	Pump operation
9,28	Power status output	Normally open, closed after rotor balancing normally, disconnected after power failure
10, 29	Accelerated state output	Normally open pin, closed at acceleration
13, 32	Speed-down state output	Normally open pin, closed at deceleration(breaking)
11, 30	On-speed output	Normally open pin, closed at rated speed
12, 30		Normally closed pin, disconnected at rated speed
14, 33	Fault state output	Normally open pin, closed in case of failure
15, 33		Normally closed pin, disconnected in case of failure
24, 6	Warning state output	Normally open pin, closed in case of warning (overload)
25, 6		Normally closed pin, disconnected in case of warning (overload)
34,31	External control enable	Normally open, closed after setting the external control mode
7,26	Running status output	Normally open, closed while the speed is available

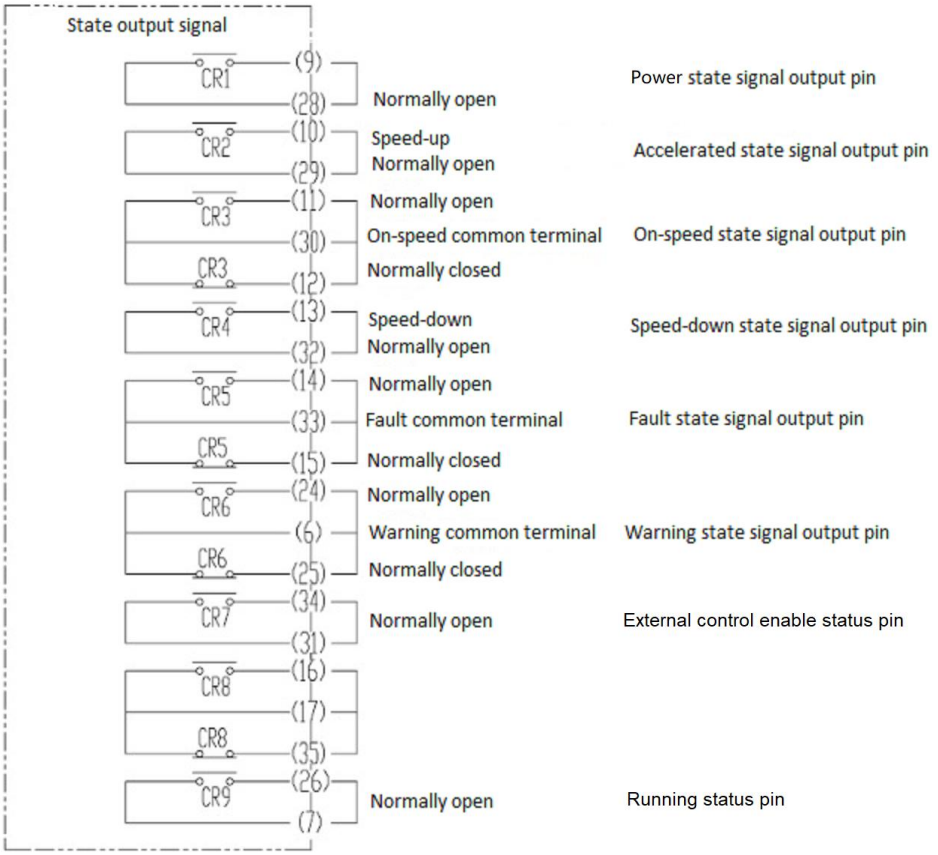


Figure 7.5 Status output signal pins

The following table shows the rated operating value of relay contacts (CR1-CR8) in Figure 7.6.

Table 7.5 Rated operating value of relay contacts

Item	**Resistance Load（COS Ø=1）**
Rated load	30V ,0.5A
Rated current	0.5A
Maximum switching power	DC：15W
Minimum working load	10mV DC, 1μA

7.5 RS232/RS485 Communication

The RS232/485 communication of CXF series controller adopts Modbus communication protocol, which is a serial and asynchronous communication protocol. This protocol has defined a message structure which the driver controllers can recognize and use, no matter which network is adopted for message transmission.

7.5.1 Modbus Communication Protocol for CXF Series Driver Controllers

Transmission mode

RTU mode

Characters which are sent are represented in hexadecimal digits. For example, when characters 31H need to be sent, they are directly put 31H in a data packet.

Note: At present, the Modbus communication protocol for CXF series driver controllers only provides the RTU mode.

Baud rate

Setting range: 2400, 4800, 9600, 19200, 38400, 57600, 115200.

Frame structure

Table 7.6 Frame structure description (RTU Mode)

Bit	Function
1	Start bit (low level)
8	Data bit
0/1	Parity check bit (This bit does not exist when there is no check bit, and one bit is occupied when there is the check bit.)
1/2	Stop bit (One bit is occupied when the check is operated, and two bits are occupied when the check is not operated.)

Note: By default, the parity check is not operated and one stop bits are occupied.

Error detection

- **RTU mode**

CRC-16 (cyclic redundancy error check)

The CRC-16 error check program is shown as below: a packet (only the data bit is involved here, not including the start bit, stop bit or the optional parity check bit) is deemed as one continuous binary, its most significant bit (MSB) is sent preferentially. Packet is multiplied by 2^{16} (16 bits left), and then divided by $2^{16}+2^{15}+2^{2}+1.2^{16}+2^{15}+2^{2}+1$ can be expressed as binary digit 11000000000000101. The integer-quotient bit is neglected, and the 16-digit remainder is added to the packet (the MSB is sent first), forming two CRC check bytes. All the 1s in the remainder are initialized for avoiding the case that all the 0s are received as one packet. The message which contains CRC byte after the above treatment, if there isn't error, is divided with the polynomial (X↑16+X↑15+X↑2+1) in the receiving equipment, which will produce one zero remainder (receiving equipment checks this CRC byte, and compares it with the sent CRC). All the operations are modulo with 2 (no-carry).

The equipment which is accustomed to sending data in string will send the rightmost bit (LSB-least significant bit) of a character preferentially. Under the condition of producing CRC, the first bit to be sent should be the most significant bit (MSB) of the dividend. Since it doesn't carry during operations, for convenient operation, the MSB is set at the rightmost bit when the CRC is calculated. The order of the bits of the produced polynomial must be reversed to keep consistent. The MSB of the MSB of the polynomial is neglected, because it only affects the quotient instead of the remainder.

The steps for producing the CRC-16 check bytes are shown as below:

① Load one 16-bit register. All the digit bits are 1s.

② An "exclusive or" operation is operated for the high bytes of the 16-bit register and the start 8-bit bytes. The operation result is stored in this 16-bit register.

③ This 16-bit register is moved by one bit to the right.

④ If the digit bit (the mark bit) moved to the right is 1, an "exclusive or" operation is operated for the produced polynomial 1010000000000001 and this register;

If the digit bit moved to the right is 0, then return to step ③.

⑤ Repeat steps ③ and ④ until 8 bits are moved.

⑥ An "exclusive or" operation is operated for the other 8 bits and this 16-bit register.

⑦ Repeat steps ③-⑥ until all the bytes of the packet operate "exclusive or" operations with

the 16-digit register, and are moved for 8 times.

⑧ Theses contents of this 16-bit register, 2-byte CRC error check, are added to the most significant bit of the packet.

7.5.2 Instruction Type and Format

1. Two command types of function codes of common functional domain are shown as below.

Table 7.7 Command type of function codes of common functional domain

Command Type	Name	Description
03	Read the content of the holding register	Get the current value in one or more registers, up to 12 numbers.
06	Preset the single register	Load the specific value into the holding register

2. Data packet format:

Table 7.8 RTU Mode Packet Format

Start	Address domain	Functional domain	Data domain	CRC Check		End
⩾3.5bits	Turbomolecular pump controller address	Function code	N data	CRC Low Byte	CRC High Byte	⩾3.5bits

3. Communication address and command meaning

This part describes the communication contents, and is used to control the running of the turbomolecular pump driver controller, the status of the turbomolecular pump driver controller, and the setting of relevant parameters.

(1)Communication parameter setting.

a. Communication baud rate setting: on the basis of normal communication, the next communication baud rate can be set by data command.

Note: If there is no modification, the default baud rate is 9600. Once the baud rate is modified, it shall be written into the controller memory and remained unchanged till the next modification.

b. Controller ID setting: Equipment ID can be set by serial data command.

Note: If there is no modification, the default ID is 16. When multiple turbomolecular pumps are working at the same time, the upper computer can distinguish different pumps by controller ID. Once the controller ID number is modified, it shall be written into the controller memory and remained unchanged till the next modification.

c. Controller mode settings: pump control modes include I/O external control mode, RS232/485 serial mode, Profibus mode and display control mode. The starting and stopping control mode of the pump can be set through series communications or LCD touch panel, and the corresponding control mode should be set when starting and stopping the pump.

(2)Representation rules with different kinds of parameters as addresses

Parameter addresses represented in this section and the values stored at these addresses are all for hexadecimal. For example, 1000 represents hexadecimal digits 4096.)

a. Running status parameters

Parameter Address	Parameter Description (Read Only)
1000-1003	Output frequency, Reserved, Output current and Output motor state
1004-1007	Fault message 1, Fault message 2, Fault message 3, Fault message 4
1008-100B	Motor temperature, Pump temperature, Heating temperature and Set speed
100C-100D	Software version
100E-100F	AMB software version
1010	Driver software version
1011	Controller temperature
1012	Heating target temperature
1013	Reserved
1014-1015	Balancing center of X AMB
1016-1017	Balancing center of Y AMB
1018-1019	Balancing center of A AMB
101A-101B	Balancing center of B AMB
101C-101D	Balancing center of Z AMB

101E-101F	accumulated running time (hours)
1020-1021	accumulated running time (minutes)

b. Control command

Parameter Address	Parameter Description (Write Only)
2000	Contents and meaning of the command 0004: Stop the computer freely 0008: Start (directionless) 000C: Reset (clear errors)

c. Setup Command

Parameter Address	Parameter Description (Write Only)
3000	Contents and meaning of the command 0001:2400 bps 0002:4800 bps 0003:9600 bps (Default baud rate) 0004:19200 bps 0005:38400 bps 0006:57600 bps 0007:115200 bps Not supported in PROFIBUS mode
3010	Equipment address (default: 0010, maximum 00F7)
3020	0001:I/O external control mode 0002: RS232/485 serial port mode 0003: Profibus mode 0004: Local mode

d. Abnormal read and write parameter responses

Command	Function Area Code	Data Area

Description		
Slave computer parameter response	The most significant bit of the function area code changes to 1	Contents and meaning of the command 0001: Invalid function code 0002: Invalid data address 0003: Invalid data 0004: Slave computer fault

e. The reply command of the read and write parameters are shown as follows.

Example 1: Read the output frequency, output voltage, output current, and controller status of No. 16 turbomolecular pump driver controller.

The host computer makes a request as follows:

Address	**Function Code**	**High Bit Address of the First Register**	**Low Bit Address of the First Register**	**High Bit of the Quantity of Registers**	**Low Bit of the Quantity of Registers**	**CRC Low Byte**	**CRC High Byte**
10	03	10	00	00	04	43	88
—— ——		Communication parameter address 1000H		Read data length		—— ——	

Response when the slave computer works normally:

Address	**Function Code**	**Byte Number**	**Data High Byte**	**Data Low Byte**	**Data High Byte**	**Data Low Byte**	**Data High Byte**	**Data Low Byte**	**Data High Byte**	**Data Low Byte**	**CRC Low Byte**	**CRC High Byte**
10	03	08	11	94	03	13	00	BE	01	01	F5	66
—— ——			Output Frequency		Reserved		Output Current		Running state		—— ——	

The output frequency of No. 16 controller is 450.0 Hz, the output current is 1.9 A, and the controller status is running.

Note: for detailed algorithm of status data, see the additional description in chapter 7.5.3.

Example 2: Read the fault information of No. 16 turbomolecular pump

The host computer makes a request as follows:

Address	**Function Code**	**High Bit Address of the First Register**	**Low Bit Address of the First Register**	**High Bit of the Quantity of Registers**	**Low Bit of the Quantity of Registers**	**CRC Low Byte**	**CRC High Byte**
10	03	10	04	00	04	02	49
—— ——		Communication parameter address 1000H		Read data length		—— ——	

Response when the slave computer works normally:

Address	**Function Code**	**Byte Number**	**Data High Byte**	**Data Low Byte**	**Data High Byte**	**Data Low Byte**	**Data High Byte**	**Data Low Byte**	**Data High Byte**	**Data Low Byte**	**CRC Low Byte**	**CRC High Byte**
10	03	08	00	01	00	00	00	00	00	01	14	EB
—— ——			Fault code 1		Fault code 2		Fault code 3		Fault code 4		—— ——	

Note: for detailed meaning of fault code, see the additional description in chapter 7.5.3.

Example 3: Read the turbomolecular pump temperature of No. 16 molecular pump.

The host computer makes a request as follows:

Address	**Function Code**	**High Byte of the First Register**	**Low Byte of the First Register**	**High Byte of the Write Parameter Status**	**Low Byte of the Write Parameter Status**	**CRC Low Byte**	**CRC High Byte**
10	06	20	00	00	08	80	8D

—— ——	Communication parameter address 1008H	Read data length	—— ——

Response when the slave computer works normally:

Address	**Function Code**	**Bytes**	**High Byte of the Register**	**Low Byte of the Register**	**High Byte of the Register**	**Low Byte of the Register**	**High Byte of the Register**	**Low Byte of the Register**	**High Byte of the Register**	**Low Byte of the Register**	**CRC Low Byte**	**CRC High Byte**
10	03	08	00	18	00	18	00	17	00	00	CD	EC
—— ——			Motor temperature		Pump temperature		Heating temperature		System setting		—— ——	

For the 16 turbomolecular pump, he motor temperature is 24℃, the pump temperature is 24℃, and the heating temperature is 23℃.

Example 4: Communication for the drive controller of No.16 turbomolecular pump to run (RS232/485 control mode must be set to run, stop and reset turbomolecular pump, otherwise it is invalid.)

The host computer makes a request as follows:

Address	**Function Code**	**High Byte of the Register**	**Low Byte of the Register**	**High Byte of the Write Parameter Status**	**Low Byte of the Write Parameter Status**	**CRC Low Byte**	**CRC High Byte**
10	06	20	00	00	08	80	8D
—— ——		Communication parameter address 2000H		Read data length		—— ——	

Response when the slave computer works normally:

Address	**Function Code**	**High Byte of the**	**Low Byte of the**	**High Byte of the Write Parameter**	**Low Byte of the Write Parameter**	**CRC Low**	**CRC High**

		Register	Register	Status	Status	Byte	Byte
10	06	20	00	00	08	80	8D
—— ——		Normal Response				—— ——	

Example 5: Communication for the drive controller of No.16 turbomolecular pump to stop (RS232/485 control mode must be set to run, stop and reset turbomolecular pump, otherwise it is invalid.)

The host computer makes a request as follows:

Address	**Function Code**	**High Byte of the Register**	**Low Byte of the Register**	**High Byte of the Write Parameter Status**	**Low Byte of the Write Parameter Status**	**CRC Low Byte**	**CRC High Byte**
10	06	20	00	00	04	80	88
—— ——		Communication parameter address 2000H		Stop		—— ——	

Response when the slave computer works normally:

Address	**Function Code**	**High Byte of the Register**	**Low Byte of the Register**	**High Byte of the Write Parameter Status**	**Low Byte of the Write Parameter Status**	**CRC Low Byte**	**CRC High Byte**
10	06	20	00	00	04	80	88
—— ——		**Normal Response**				—— ——	

Example 6: Communication for the drive controller of No.16 turbomolecular pump to reset (RS23/485 control mode must be set to run, stop and reset turbomolecular pump, otherwise it is invalid.)

The host computer makes a request as follows:

Address	Function Code	High Byte of the Register	Low Byte of the Register	High Byte of the Write Parameter Status	Low Byte of the Write Parameter Status	CRC Low Byte	CRC High Byte
10	06	20	00	00	0C	81	4E
—— ——		Communication parameter address 2000H		Reset		—— ——	

Response when the slave computer works normally:

Address	Function Code	High Byte of the Register	Low Byte of the Register	High Byte of the Write Parameter Status	Low Byte of the Write Parameter Status	CRC Low Byte	CRC High Byte
10	06	20	00	00	0C	81	4E
—— ——		Normal Response				—— ——	

Example 7: Set the communication baud rate for No.16 turbomolecular pump.

The host computer makes a request as follows:

Address	Function Code	High Byte of the Register	Low Byte of the Register	High Byte of the Write Parameter Status	Low Byte of the Write Parameter Status	CRC Low Byte	CRC High Byte
10	06	30	00	00	04	84	48
—— ——		Communication parameter address 3000H		baud rate parameter		—— ——	

Response when the slave computer works normally:

Address	Function Code	High Byte of the Register	Low Byte of the Register	High Byte of the Write Parameter Status	Low Byte of the Write Parameter Status	CRC Low Byte	CRC High Byte
10	06	30	00	00	04	84	48
—— ——		Normal Response				—— ——	

Baud rate is set to 19200, which will take effect for the next communication.

Example 8: Change the equipment ID 16 of the 16 turbomolecular pump to 20

The host computer makes a request as follows:

Address	Function Code	High Byte of the Register	Low Byte of the Register	High Byte of the Write Parameter Status	Low Byte of the Write Parameter Status	CRC Low Byte	CRC High Byte
10	06	30	10	00	14	84	41
—— ——		Communication parameter address 3010H		Equipment ID		—— ——	

Response when the slave computer works normally:

Address	Function Code	High Byte of the Register	Low Byte of the Register	High Byte of the Write Parameter Status	Low Byte of the Write Parameter Status	CRC Low Byte	CRC High Byte
14	06	30	10	00	14	85	C5
Equipment ID	——	Normal response				—— ——	

Example 9: Set the control mode of No.16 turbomolecular pump

The host computer makes a request as follows:

Address	Function Code	High Byte of the Register	Low Byte of the Register	High Byte of the Write Parameter Status	Low Byte of the Write Parameter Status	CRC Low Byte	CRC High Byte
10	06	30	20	00	02	05	80
—— ——		Communication parameter address 3020H		RS232/485 communication mode		—— ——	

Response when the slave computer works normally:

Address	Function Code	High Byte of the Register	Low Byte of the Register	High Byte of the Write Parameter Status	Low Byte of the Write Parameter Status	CRC Low Byte	CRC High Byte
10	06	30	20	00	02	05	80
—— ——		Normal response				—— ——	

The control mode is RS232/485.

Example 10: Illegal function code while setting the control mode of No.16 turbomolecular pump

The host computer makes a request as follows:

Address	Function Code	High Byte of the Register	Low Byte of the Register	High Byte of the Write Parameter Status	Low Byte of the Write Parameter Status	CRC Low Byte	CRC High Byte
10	07	30	20	00	02	38	40
—— ——		Communication parameter address 3020H		RS232/485 communication mode		—— ——	

Response when the slave computer works normally:

Address	Function Code	Abnormal code	CRC Low Byte	CRC High Byte
10	87	01	D2	35

Because the written function code only supports 06H, and the 07H function code is not supplied, the 07H function code in this communication is abnormal. The highest byte 1 of 07H is changed to 87H in the slave response, and the abnormal code is 01H, which indicating an illegal function code.

Example 11: Illegal data address while setting the control mode of No.16 turbomolecular pump

The host computer makes a request as follows:

Address	Function Code	High Byte of the Register	Low Byte of the Register	High Byte of the Write Parameter Status	Low Byte of the Write Parameter Status	CRC Low Byte	CRC High Byte
10	06	30	40	00	02	05	9E
—— ——		Communication parameter address 3040H		RS232/485 communication mode		—— ——	

Response when the slave computer works normally:

Address	Function Code	Abnormal code	CRC Low Byte	CRC High Byte
10	86	02	93	A4

Because the data address do not support 3040H, the data address in this communication is abnormal. The highest byte 1 is changed to 86H in the slave response, and the abnormal code is read to 01H, which indicating an illegal function code.

Example 12: Illegal data while setting the control mode of No.16 turbomolecular pump

The host computer makes a request as follows:

Address	Function Code	High Byte of the Register	Low Byte of the Register	High Byte of the Write Parameter Status	Low Byte of the Write Parameter Status	CRC Low Byte	CRC High Byte
10	06	30	20	00	05	44	42
—— ——		Communication parameter address 3020H		RS232/485 communication mode		—— ——	

Response when the slave computer works normally:

Address	Function Code	Abnormal code	CRC Low Byte	CRC High Byte
10	86	03	52	64

Because the data only supports 0001H-0004H, and the 0005H function code is not supplied, the data in this communication is abnormal. The highest byte 1 is changed to 86H in the slave response, and the abnormal code is read to 03H, which indicating an illegal function code.

7.5.3 Additional notes

(1)Description of data in the communication process:

Parameter value of the frequency = actual value × 10

Parameter value of the current = actual value × 100

Explanation: The parameter values are values sent in the data packet. The actual values are the actual values of the parameters in the turbomolecular pump driver controller. The upper computer divides corresponding proportional coefficients of parameters to get the actual values of the corresponding parameters of the controller and refer to the above formulas for proportional coefficients.

Note: When commands are sent to the turbomolecular pump driver controller, decimal points of the data in the data packet are neglected. The values of all the data cannot be greater than 65535. Otherwise, the data will overflow.

(2)Description of controller status:

	7	6	5	4	3	2	1	0
High byte				Running status	Control mode 00:local 01:I/O 10:RS232/485 11:Profibus		Heating temperature reached	1 Levitating normally
Low byte	Warring	Fault	Brake	Target Speed reached	Accelerating	Power supply	Second speed	1 Running

(3)Description of fault code:

Fault code 1

	7	6	5	4	3	2	1	0
High byte						Hall fault from Motor board	Communication failure from Motor board	System overload
Low byte	AMB fault	System power down	Motor watchdog reset	Motor overheating	Motor stalled	Motor overcurrent	accelerating failure with open loop	Motor wiring failure

Fault code 2

	7	6	5	4	3	2	1	0

High byte						System information 4	System information 3	Rated speed decreasing
Low byte	Acceleration too low	Acceleration timeout	System information 2	System information 1	Pump temperature over	AMB communication failure	AMB imbalance	AMB Hall fault

Fault code 3

	7	6	5	4	3	2	1	0
High byte								
Low byte			Z offset under voltage	AB offset under voltage	XY offset under voltage	Z offset over voltage	AB offset over voltage	XY offset over voltage

Fault code 4

	7	6	5	4	3	2	1	0
High byte					System information 5	AMB watchdog reset	Z AMB imbalance	B AMB imbalance
Low byte	A AMB imbalance	Y AMB imbalance	X AMB imbalance	Z AMB Levitating	B AMB Levitating	A AMB Levitating	Y AMB Levitating	X AMB Levitating

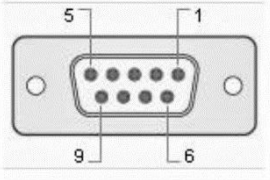
				failed	failed	failed	failed	failed

7.5.4 Connections of Physical Interfaces

7.5.4.1 Interface Specification

RS232 and RS485 communication can be achieved through panel DB9 interface (position (9) in Figure 7.2). Pins are defined as follows:

Table 7.9 Definition of the RS 232/485communication pin

DB9 female	Pin	Definition	Description
	1	----	----
	2	232TXD	Sending data
	3	232RXD	Receiving data
	4	----	----
	5	GND	Signal ground
	6	----	----
	7	485B/-	Negative
	8	485A/+	Positive
	9	----	----

Note: (1) Pin 2, pin 3 and pin 5 are used for RS232 communication, and pin 7 and pin 8 are used for RS485 communication.

(2) Pay attention to distinguish it from the Profibus communication interface on the panel to avoid wrong connection.

7.5.4.2 On-Site Bus Structure

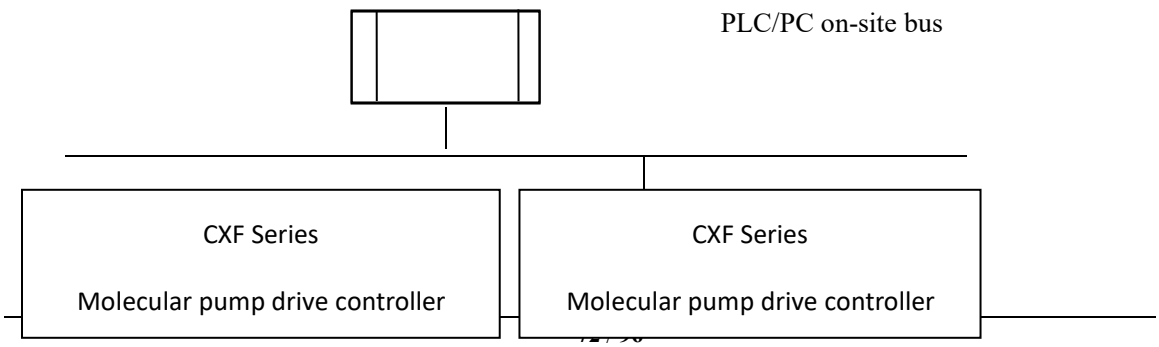


Figure 7.7 On-site bus connection diagram

The turbomolecular pump driver controller adopts the RS-485 half-duplex communication mode. The RS-485 bus should adopt a hand-in-hand structure instead of a star structure or bifurcation structure. The star structure or bifurcation structure will produce reflection signals, which may affect the RS-485 communication. As for the arrangement of cables, shielded twisted pairs must be used. The cables should be away from strong current as much as possible, and cannot be parallel to or bound with the power cable.

It should be noted that, for half-duplex connections, only one turbomolecular pump driver controller can communicate with the upper computer at one moment. If two or several turbomolecular pump driver controller upload data simultaneously, then it may cause bus competition, which will not only cause communication failure, and but also produce high current by some components.

7.5.4.3 RS485 grounding and Terminal

Terminals in the RS-485 network should adopt a 120-Ω terminal resistor to weaken signal reflection. But the intermediate network shall not use terminal resistors.

Any point in the RS-485 network shall not be directly connected to the ground. All the equipment in the network should be connected to the ground with their own grounding terminals. It should be noted that, under any condition, the grounding cables are not allowed to form a closed loop.

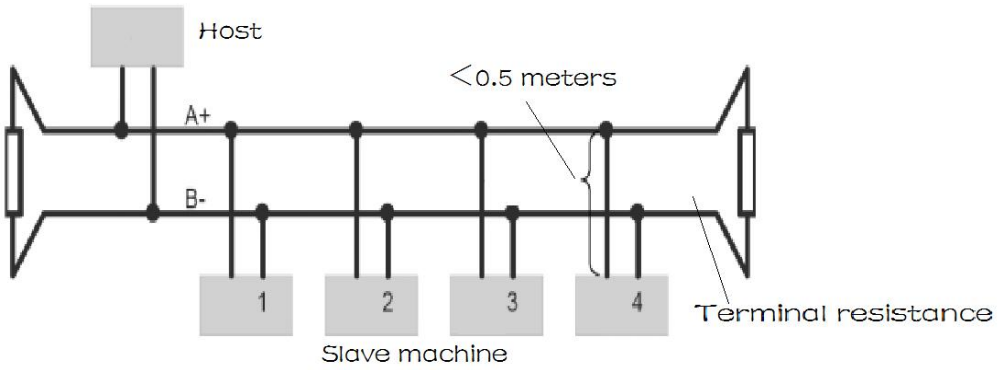


Figure 7.8 System Connection Diagram

When the cables are connected, the driving capacity of the computer/PLC and the distance between the computer/PLC and the turbomolecular pump driver controller must be considered. A

repeater should be installed if the driving capacity is inadequate.

7.5.4.4 RS232 Wiring

RS232 is a one-to-one communication mode. One upper computer can only communicate with one molecular pump, and the communication distance is not more than 15m. RS232 communication can be realized by connecting pin 2, pin 3 and pin 5 to the corresponding RS232 ports of the upper computer according to the pins definition in table 7.10. It is recommended to use shielded twisted-pair wiring.

7.6 PROFIBUS communication

PROFIBUS-DP is used in the application of factory automation. The central controller could control many sensors and actuators, and obtain the status of each module by using standard or selected diagnostic functions.

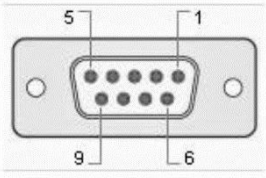
7.6.1 Definition of PROFIBUS Pins

This device is a PROFIBUS-DP/V0 slave station, which conforms to the national standard GB/T 20540-2006(refer to IEC 61158 TYPE 3).

Baud rate is self-adaptive, and the maximum baud rate is 1.5Mbps.

The interface adopts standard 9-pin D-type socket (hole), and it is recommended that users use standard PROFIBUS plug and standard PROFIBUS cable to connect.

Definition of the PROFIBUS Pins:

DB9 female	Pin	Definition	Description
	1	GND	Shielded ground
	2	----	----
	3	B+	Connect to signal B+
	4	----	----
	5	DGND	Connected to power ground of the signal
	6	VP	Connected to power positive electrode of the signal
	7	----	----
	8	A+	Connect to signal A+
	9	----	----

Note: Pay attention to distinguish it from the Profibus communication interface on the panel to avoid wrong connection.

7.6.2 Instruction Type and Format

The slave address setting mode, instruction type and format are consistent with RS232/485. See the specific description in chapter 7.5.2 for details.

Address range of slave station: 2 ~ 125.

Please contact the manufacturer to obtain the GSD file for the Profibus of CXF series controller.

7.6.3 BUS Structure

When each site of bus structure is connected to the network through plug and bus, terminal resistance shall be set at the site of physical network segment terminal to prevent surge and ensure communication quality. Each standard PROFIBUS plug has a built-in terminal resistance, which can be switched on and off when necessary. When the terminal resistance is set to "on", it indicates the end of a physical network segment, so the signal of the network segment connected behind the outgoing port "out" will also be interrupted. Therefore, the plugs on the two terminal stations of each physical network segment need to connect the bus to the incoming port "in" and set the terminal resistance to "on", while the stations in the middle of the network segment need to connect the bus to the incoming port "in" and the outgoing port "out" in turn, and meanwhile set the terminal resistance to "off". The specific connection method is shown in the following figure:

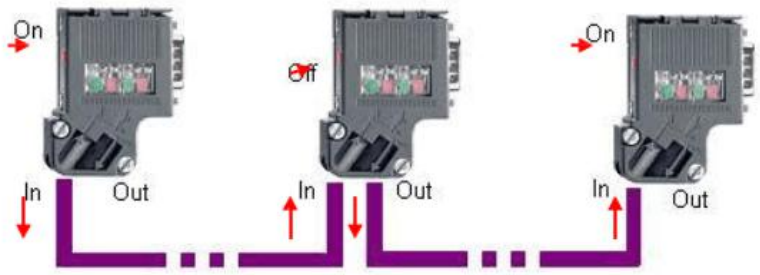


Figure 7.9 System Connection Diagram

When the Profibus cable is wired in the plug, the shielding layer must be stripped off and pressed on the metal part in the plug, which is connected to the metal part outside the D-sub plug to ensure shielding very well.

For more PROFIBUS installation specifications, please refer to relevant PROFIBUS technical standards.


CAUTION

CAUTION
Note：The installation and cabling must be operated after the turbomolecular pump driver controller is powered off.

7.7 Operation procedures, methods and precautions for shutdown

Start and stop of the turbomolecular pump can be controlled by system external control/upper computer, as well as portable touch panel or start-stop button on the control panel of the turbomolecular pump. Refer to chapter 7.2.1 for the operation of portable touch panel.

Never cut off power supply during shutdown, and the power supply can not be cut off until the molecular pump speed drops to 0Hz. When the "speed" indicator on the molecular pump controller panel changes from flashing to off, it indicates that the molecular pump speed reduction has been completed, but at this time, the rotor still has a low speed, and the power supply should be cut off after 1 minute.

WARNING

WARNING
Do not cut off the power supply during shutdown to avoid damage to the molecular pump.

DANGER

DANGER
During shutdown, the molecular pump brake will generate a lot of heat, and the temperature of the controller shell will rise. Avoid touching the controller housing to prevent scalding.

After the molecular pump completely stops and the power supply is turned off, some devices in the controller need to fully release electric energy. So must wait 20 seconds for turning on the controller power again.

If it is necessary to supply protective gas, it is necessary to maintain continuous supply of protective gas during the shutdown of the molecular pump to protect the internal components of the molecular pump.

If the chamber needs introducing protective gas to achieve balance the pressure of inside chamber and the atmosphere, the gas can be introduced only when the molecular pump is stopped and the speed is displayed as 0Hz.

7.8 Using the Pump in Special Environment

7.8.1 Vibration Isolation

If the vacuum system has serious vibration, please adopt the vibration isolator to reduce the damage of pump caused by vibration.

7.8.2 Heat Insulation

If there is a thermal radiation source in the pumped system, it is necessary to set a heat shielded plate at the inlet of the molecular pump to prevent the thermal radiation from affecting the molecular pump rotor and reduce the damage caused by the thermal radiation to the integrated magnetic levitation molecular pump.

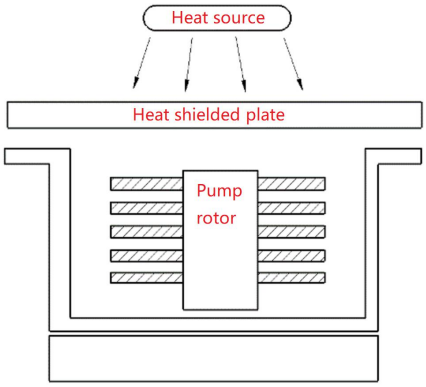


Figure 7.10 Installation diagram of heat shield plate in thermal radiation environment

7.8.3 High magnetic field shielding

When the integrated magnetically-levitated turbomolecular pump works in the high magnetic fields, the rotating rotor will generate eddy current and become hot, and may impair the strength of aluminum material. Therefore, the magnetic field strength at the radial and axial direction of the pump shall not exceed 3mT(30Gs). Please shield the magnetic field with permeability magnetic material if the pump works in the environment with magnetic field strength over 3mT.

7.8.4 Electromagnetic interference

The integrated magnetically-levitated turbomolecular pump and controller will generate electromagnetic field in the environment when working, but the electromagnetic strength meets the international standard. In special applications (such as medical equipment, etc.), please contact the manufacturer.

7.8.5 High radioactivity limit

The performance of most materials will be changed in the environment of high radioactivity, especially for the

organic materials (such as seal ring) and the semi-conductor components. In order to prevent the accidental damage, the radioactive intensity in the working environment of the pump shall be lower than 10^5rad.


DANGER

DANGER
It is prohibited to carry out installation, maintenance and repair of magnetically-levitated turbomolecular pump in power-on state. The power must be cut off after shutdown safely.


WARNING

WARNING
(a) The pump shall be disassembled by the professionally trained technicians, and it is prohibited to disassemble the pump without authorization. **(b) The magnetically-levitated turbomolecular pump has received precise dynamic balancing machine calibration, any operation such as loosening the bolt or adding gasket may cause serious dynamic imbalance. Under such condition, please return the pump to the manufacturer for calibration.**

Chapter 8 Fault Analysis

See Table 8.1 for reasons, investigation and measures for typical fault sites.

DANGER
For the pump which has been used for pumping corrosive gases, please list out the type of the pumping gas before returning it to the manufacturer, and fill the *Product Warranty* (attached in the Instruction Manual) for guaranteeing the safety of the repair technicians. Otherwise, KYKY reserves the right to refuse the repair service.

Table 8.1 Typical fault

Fault	Possible cause	Solution
Start failure	(1)Molecular pump has not received signal for start the pump; Molecular pump is damaged;	（1）For the fault of controller, please refer to the instructions of controller; （2）If the connection cable is inactive, check the cable with electric meter; For other reasons, please consult the manufacturer.
Start timeout or slow down or running stop after start	（1）Vacuum system leakage （2）Abnormal backing pressure （3）Touchdown bearings damage （4）Controller failure	（1）Check whether there is system leakage and stop leakage; （2）Check whether the backing vacuum pump works properly or whether there is leakage of backing pipe and seal; （3） If touchdown bearings and spindle got damaged, send the machine back to the manufacturer; （4）Refer to Controller Manual.
Large vibration and noise when pump runs	（1）Equipment resonance （2）Dynamic balance destruction （3）Rotor instability and damage	（1）Change the mounting position or connection dimension of pump, fix movable parts or add vibration-reduction pads; （2）Send the machine back to the manufacturer; （3） Send the machine back to the manufacturer.
Low Vacuum	（1）Backing pressure high （2）The system leaking （3）Large gas output of	（1）Check whether the backing vacuum pump works properly or whether there is leakage of backing pipe and seal; （2）Leakage detection, leakage stop;

	gauge （4） Abnormal rotation speed of pump （5） Unreasonable system （6） System pollution	（3） If the gauge has high air flow, degas from the cathode of gauge or bake the housing of the gauge for 2 hours under 200℃; （4） The Pump does not reach rated speed （5） The pumping speed of backing vacuum pump is not large enough or system piping is too thin; （6） Vacuum chamber, piping and vacuum pump are contaminated. The system should be cleaned.
Other error		If there is any other troubles or in need of technical support, please contact the manufacturer.

Chapter 9 Maintenance and Repair

9.1 Maintenance Period and Content

Maintenance item	Maintenance method	Maintenance period	Remarks
Vibration and noise	Utilizing body senses or special vibration tester to determine vibration and noise of turbomolecular pump in operation. In case of any abnormality, immediately stop to find the cause or contact the manufacturer;	Once per month Start each time	
Current and voltage	Utilizing display status of controller panel or upper computer to check whether there is abnormal operating voltage, current and magnetically-levitated location of turbomolecular pump. In case of any abnormality, immediately stop to find the cause or contact the manufacturer	Once per week Start each time	
▲ Internal cleaning	Except the air leakage of the vacuum system or the vacuum chamber is polluted seriously, if the vacuum performance of the pump is not recovered after baking the pump for a long time, then it should be confirmed that the pump is polluted, and the pump must be cleaned.	Depending on the conditions during use	Return to factory
▲ Replacement of touchdown bearings	Before delivery all qualified magnetically-levitated turbomolecular pumps need conduct a dynamic balance test with a special instrument, the touchdown bearings and the spindle need to be replaced due to falling damage for the instability of the rotor, after the replacement the dynamic balance test needs to repeated, it can only be done by KYKY or the designated repair center Of KYKY.	Depending on the conditions during use	Return to factory

9.2 Maintenance during long-term outage

When the turbomolecular pump is out of service for a long time, it should be filled with dry inert protective gases, such as nitrogen and argon, to protect parts and electronic equipment in the pump, and then seal inlet, exhaust port and inflatable port of the pump, seal the turbomolecular pump and controller as a whole, keep them dry and put them in stock. Refer to 10.2 for storage environment conditions.

The molecular pumps listed in this manual are integrated magnetically-levitated turbomolecular pumps. When they are re-used after they have been stored for a long time (usually more than 3 months), the rotor of the molecule pump should be inspected. For steps, please refer to 7.2.1.

9.3 Disassemble the pump from the vacuum system

When the integrated magnetically-levitated turbomolecular pump is fault and need to be removed from the system, please:

Make sure the pump is in the shutdown state, internal and external air pressure reaches balance, then cut off the power and disassemble connecting cables;

If the pump is used for pumping corrosive gases, confirm that the corrosive gases has been completely removed from the vacuum chamber, pump body and backing pipes, the sediment in the pump is also harmful to human body, the technician for disassembling the pump should wear the respirator and gloves if needed. After removing the pump, please remove the sediment as soon as possible to avoid producing volatile substance or corrosive acid and alkali by the sediment reacts with the damp air;

After removing the pump, it should be packed with closed plastic bag as soon as possible.

If it is necessary to return them to the factory for maintenance, you only need to return corresponding parts and accessories. For replacement, you need to return all the items in the original packing list, including turbomolecular pumps (including controllers) and all accessories and certificates of qualification.

Chapter 10 Transportation and Storage

10.1 Transportation

The integrated magnetically-levitated turbomolecular pump shall be packed in the package when leaving the factory. During the transporting, it is required to be gently taken or placed, and the strong vibration, pump, impact, rain, coldness and sun exposure are prohibited.

When carrying the packing box, the bottom of the packing box must be extracted and handled lightly. Vibration, shock, knocking, rain, cold and sun exposure are strictly prohibited. The magnetically-levitated turbomolecular pump shall be packed in the package when leaving the factory. During the transporting, it is required to be gently taken or placed, and the strong vibration, pump, impact, rain, coldness and sun exposure are prohibited. 。 Otherwise, the turbomolecular pump may be damaged. Large turbomolecular pumps need to be handled with forklift trucks.

During the moving after opening the package, pay attention to protecting the high vacuum sealing flanges, outlet flanges, pipe joint, controller sockets and easily damaged other parts of the magnetically-levitated turbomolecular pump. To prevent air leakage or damage due to collision.

10.2 Storage

The integrated magnetically-levitated turbomolecular pump and controller shall be stored in the dry ventilated room without the corrosive gases and oil gas. They shall be prevented from the rain, coldness and sun exposure before opening. The ambient temperature for storage is -20～+55˚C; and the relative humidity shall not exceed 95%.

Chapter 11 Environmental Protection and Others


WARNING

WARNING
Products and components (including metals, electronic elements, cleaning fluid, etc.) may cause pollution to environment. Please carry out scrap disposal according to local laws and specifications.

After-sales Service

The turbomolecular pump manufactured by our company may enjoy 1-year warranty service with the warranty card since the purchasing date.

The repair fee is free of charge during the warranty period, half fee will be charged for replacing the accessories generally, free of charge if it is less than half a year.

The pump should not enjoy warranty service for one of the following reasons:

The product is disassembled by the user without authorization;

The damage is caused by incorrect storage or use (such as pump, vibration impact**, etc.);**

Damages caused by other reasons of the user.

Product Warranty

Product Name: KYKY_____ integrated magnetically-levitated turbomolecular pump

Product Code:_____

Date of production：_____ ___

User:_____

Date	Repair Contents	Repaired By

……Cut …… Seal Here ……

Please fill into the detailed information as follow and post it to our company

Product Name: _____ Contact Person: _____

Product Model: _____ Phone Number: _____

Product Code: _____ Postal Code: _____

Date of Purchasing: _____

Company Address:

Company Name:

Address: No.13, Bei er tiao, Zhong guan cun, Hai dian District, Beijing, P.R. China

Zip Code：100190

Tel：+86-10-62520080

Fax：+86-10-58043695

E-mail： international@kyky.com.cn

Website：www.kyky.com.cn