The Instruction Manual of KYKY Integrated Magnetic Levitation Turbo Molecular Pump

V1.04

CXF-200/1401 Integrated Magnetic Levitation Turbo Molecular Pump
CXF-250/2301 Integrated Magnetic Levitation Turbo Molecular Pump
CXF-320/3001 Integrated Magnetic Levitation Turbo Molecular Pump

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About the Instruction Manual

Before installing and using the turbo molecular 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 turbo molecular 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 turbo molecular 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.

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Chapter 1 Overview

1.1 Scope of the Manual

Thank you for purchasing and using KYKY's integrated magnetic levitation molecular pump. This product belongs to high vacuum and ultra-high vacuum obtaining equipment. This manual is suitable for KYKY CXF-200/1401, CXF-250/2301, CXF-320/3001 three types of integrated magnetic levitation molecular pumps and their subsequent improvements. Provide guidance for its installation, operation, maintenance and maintenance.

1.2 Characteristics

These series of integrated magnetically-levitated turbo molecular 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 customers 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

Turbo molecular 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. Turbo molecular pumps can only be used for obtaining high and

ultra-high vacuum and must be equipped with reasonable backing pump and matching turbo molecular pump controller. Turbo molecular 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 turbo molecular pump is a compound turbo molecular pump, which is widely used in semiconductor, industrial coating, scientific research, surface analysis and vacuum electronic equipment.

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

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

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

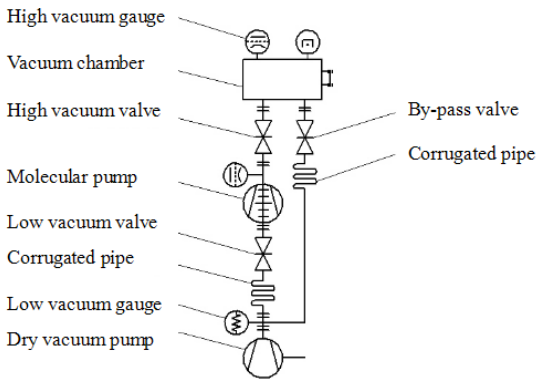
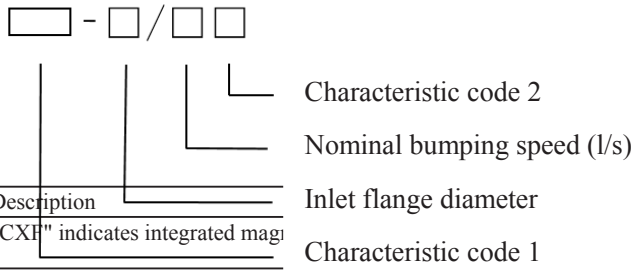


Figure 1.1 Turbo molecular pump application system

1.4 Product model and meaning

The integrated magnetic levitation molecular pumps listed in this manual are divided into three types: DN200, DN250 and DN320 according to their different calibers; according to the nominal pumping speed, they are divided into three types: 1400 l/s, 2300 l/s, and 3000 l/s. There are three in total. Three types of molecular pumps, the models are: CXF-200/1401, CXF-250/2301, CXF-320/3001.

Product model and meaning are as follows:



Code	Description
Characteristic code 1	"CXF" indicates integrated magı
Inlet flange diameter	The integrated magnetically-levitated turbo molecular pumps listed in this manual are divided into DN200, DN250 and DN320 series according to Inlet flange diameter.
Nominal pumping speed (L/s)	The integrated magnetic levitation molecular pump listed in this manual is divided into three types according to the nominal pumping speed: 1400 l/s, 2300 l/s, and 3000 l/s.
Characteristic code 2	"N" means corrosion-resistant pump; Letters such as "B", "C"..., etc., indicate the industry application or performance improvement of the product.

Caution: Various models of integrated magnetically-levitated turbo molecular pump components correspond to unique integrated controller components. Different model of magnetically-levitated turbo molecular pump and its controller can not be arbitrarily interchangeable. The integrated magnetically-levitated turbo molecular 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 turbo molecular pumps:

Table1.1 Correspondence between pump and controller model

Integrated magnetically-levitated turbo molecular pump	Configured controller model
CXF-200/1401	CXFD-1001
CXF-250/2301	CXFD-1601
CXF-320/3001	CXFD-1601

1.5 Working environment and working conditions

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

Installation location	Indoor
Protection category	IP54
Electric shock proof protection grade	Class I
Ambient temperature	5-40 ℃
Relative humidity	≤85%
Ambient pressure	0.75-1.06×10^5Pa
Installation height (altitude)	≤3000m
Pollution class	2
Magnetic field	Magnetic field strength of radial and axial on the pump case can be less than or equal to 3mT(30Gs);
Radiation environment	≤105rad
Vacuum environment	Oil free

1.6 Safety Instructions

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

DANGER!

DANGER!
Danger: means the items which should be paid close attention to and must be obeyed for avoiding physical injury.

WARNING!

WARNING!
Warning: means the items which should be paid attention to and must be obeyed for avoiding damaging the pump.

CAUTION!

CAUTION!
Caution means the items which should be paid close 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

In general, under 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 turbo molecular pump can only be used to obtain high (ultrahigh) vacuum;

◇ Integrated magnetically-levitated turbo molecular pump must work with standard backing vacuum pump.

◇ Power supply should meet the requirements of turbo molecular 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 turbo molecular 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 turbo molecular pump, it is necessary to check whether it meets start-up requirements. Otherwise, it may cause product failure or damage.

◇ Turbo molecular 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 or electric shock.

◇ During the operation of turbo molecular 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.

◇ Turbo molecular 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.

◇ Turbo molecular 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 turbo molecular pumps to prevent them from running under abnormal vibration; Otherwise, it may cause product failure, product damage or personal injury.

◇ Turbo molecular pumps and 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 turbo molecular pump. Otherwise, it may cause product failure, product damage, 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 turbo molecular pump;

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

◇ Failing to use anti-corrosion turbo molecular pump to pump corrosive gases;

◇ Improper flow rate of protective gases;

◇ Pumping explosive substance;

◇ Pumping liquid;

◇ Pumping condensed steam;

◇ Magnetically-levitated turbo molecular pump operates under overload;

◇ Magnetically-levitated turbo molecular pump operates for long time under high pressure of backing pressure;

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

◇ Magnetically-levitated turbo molecular pump is used in strong magnetic field;

◇ Magnetically-levitated turbo molecular pump is used in ionizing radiation environment;

◇ Magnetically-levitated turbo molecular pump is used in potentially explosive environment;

◇ External devices apply impact, vibration or forces periodically on magnetically-levitated turbo molecular pump;

◇ Turbo molecular 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 treatment in case of blackout (i.e. power failure): Do not cut off power supply and it is necessary to immediately restore power supply. 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 turbo molecular pump in the operation may contain toxic and harmful substances, such as corrosive chemical or radioactive substance. Maintenance personnel need to be well protected in the maintenance or reinstallation of turbo molecular pump.

WARNING!

WARNING
Prevention of turbo molecular pump from falling a.Do not drop down turbo molecular pump to avoid danger when handling turbo molecular pump; b.Handle the inlet flange or bottom of turbo molecular pump with both hands when carrying light turbo molecular pump; c.Handle the turbo molecular pump of more than 20 kg with handling tool and prevent it from falling.

WARNING!

CAUTION!
Prevention of burns a. Be careful in the operation of turbo molecular pump to prevent burns if the turbo molecular pump is heated; b. Ensure that pump and heater have been cooled prior to repair and maintenance of turbo molecular pump.

CAUTION!

CAUTION!
Prevention of injury from accidental noise Prevent body from scratches by sharp edge of turbo molecular 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 turbo molecular pump.

Chapter 3 Product Introduction

3.1 Product Category and Working Principle

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

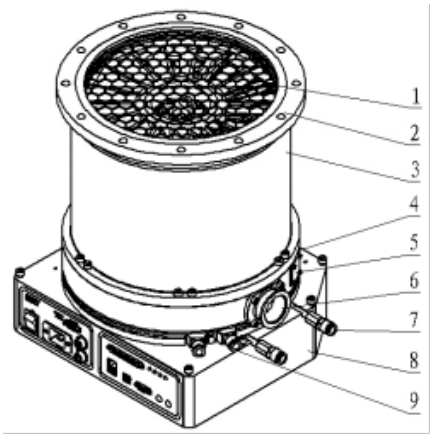


Figure 3.1 Main functional interfaces of turbo molecular pump

1 – Protective net 2 – Inlet port (flange type ISO K, ISO F, ISO CF optional) 3-Pump case 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 turbo molecular pump and controller need to be connected with cooling water pipes.

Controller CXFD-1001 is suitable for the pump CXF-1401; controller CXFD-1601 is suitable for the pump CXF2301 and CXF3001.Controller panel of CXFD-1001 and CXFD-1601 is shown in Figure 3.2(a) and Figure 3.2(b). 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) Controller panel of CXFD-1001

(a) Controller panel of CXFD-1601

Figure 3.2 Controller panel interface

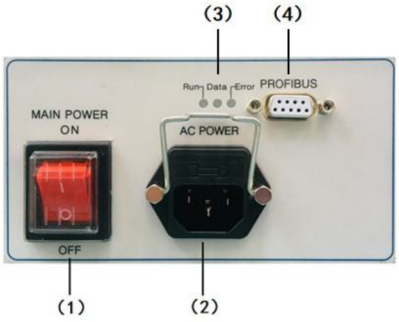


Figure.3.3 Panel Interface on the Left

Position	Identification	Function	Meaning	Remarks
(1)	【MAIN POWER ON/OFF】	Power Switch	220V Power supply Switch	
(2)	【AC POWER】	Power Interface	Interface of 220V Power supply	
(3)	【PROFIBUS LIGHT】	Profibus indicator	1.Run is power indication; 2.Data is communication indication; 3.Data is error indication;	
(4)	【PROFIBUS】	Profibus Interface	Interface of Profibus	Optional, See section 7.6

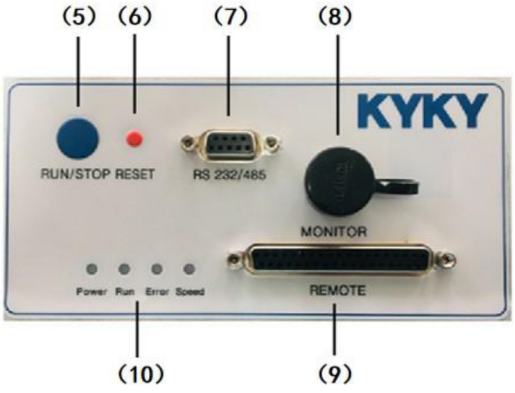


Figure 3.4 Panel interface on the right

Table 3.2 Panel interface on the right

Position	Identification	Function	Meaning	Remarks
(5)	【RUN/STOP】	User keys	Running and Stopping	
(6)	【RESET】	User keys	Reset fault	
(7)	【RS232/485】	User communication interface	DB9 female port, providing two communication modes: RS232/RS485	See section 7.5
(8)	【MONITOR】	Equipment interface	Connect an external touch screen	Optional
(9)	【REMOTE】	IO external control interface	DB37 female, providing IO control	See section 7.4
(10)	【POWER】	Equipment indicator	Indication of power	
	【RUN】		Indication of run	
	【ERROR】		Indication of error	
	【SPEED】		Indication of speed	

3.2 Functions and working principles of major components or functional units

Main components of turbo molecular pump include: protective net, pump case, turbine, stator, spindle assembly, stator assembly, base and cooling unit. Turbo molecular 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 turbo molecular pump and external signal communication.

3.3 List of turbo molecular pump Accessories

Optional accessories refer to the accessories that need to be purchased separately by the user when using the integrated magnetic levitation molecular pump.

Table 3.3 Optional accessories list

Category	Name	Specification	Number	Unit	
Baking component	Turbo molecular pump body heater	CXF1401 CXF2301	1	Set	Provide the heating function of the molecular pump body to prevent the condensation of the pumped gas (customization required)
Standard accessories		CXF1401 CXF2301 CXF3000	1	Set	Protection of magnetically-levitated turbo molecular pump inlet
		DN200 ISO K/F DN250 ISO K/F DN320 ISO F	1	Set	Gas inlet ISO K/-F flange seal
	CF copper washer	DN 200	1	Piece	DN 200/DN250 gas inlet CF flange seal
		DN 250			
	Purge port flange	KF10	1	Piece	Providing interface for feeding protective gases into turbo molecular pump
	Caliper	M10	1	Piece	Connecting fastener between ISO K and ISO K flange
	Clamp assembly (including blind plate, center support and rubber ring)	KF 10/16/25/40	1	Set	Connection fasteners for turbo molecular pump backing and inflatable interface
	Caliper pad	M8	1	Piece	Connecting fastener between ISO K 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 and Dimensions

4.1 Technical Parameters

Product technical parameters are shown in Table 4.1.

Table 4.1 Technical parameters list

Model	CXF-200/1401	CXF-250/2301	CXF-320/3001
Pumping speed (L/s)	1400	2300	3000
Compression ratio	N2：10^7	N2：10^7	N2：10^8
Ultimate pressure	≦2×10^{-6}	≦2×10^{-7}	≦5×10^{-7}
Recommended starting pressure (Pa)	<5	<5	<5
Maximum continuous backing pressure(Pa)	300	300	300
Maximum continuous flow rate(SCCM)	1200	1000	800
Outlet port flange	KF40	KF40	KF40
Inlet port flange	DN200 ISO F	DN250 ISO F	DN320 ISO F
	DN200 CF(Optional)	DN250 CF（Optional）	----
Purge port flange	KF10	KF10	KF10
Rated speed(rpm)	30000	27000	21000
Starting time (min)	6	8	12
Down time (min)	16	25	26
Vibration value (μm)	≤0.05	≤0.05	≤0.05
Recommended backing vacuum pump(L/s)	15	15	15
Pipe joint	Inner diameter of Φ10 in-line and self-sealing	Inner diameter of Φ10 in-line and self-sealing	Inner diameter of Φ10 in-line and self-sealing
Installation angle	Vertical, horizontal, and inverted	Vertical, horizontal, and inverted	Vertical, horizontal, and inverted
Cooling method	Water cooling	Water cooling	Water cooling
Cooling water temperature(˚C)	20	20	20

Cooling water flow rate(L/min)	1	1	1
Cooling water pressure(M Pa)	0.15	0.15	0.15
Pump body heating temperature range(˚C)	60～75	60～75	60～75
Ambient temperature(˚C)	5～40	5～40	5～40
Weight (kg)（ISO-F）	51.2	60.3	76.5
Power Supply（V AC）	220(±10%)	220(±10%)	220(±10%)
Power supply frequency (Hz)	50/60	50/60	50/60

Note: 1. Weight items include protective net, cylinder, pump cover, excluding external accessories, such as cable, central bracket in packing list, bolt, sealing copper ring, etc.

2. Input power for distribution reference only.

4.2 Dimension

The dimensions of the CXF-1401/2301/3001 Integrated magnetically-levitated turbo molecular pump are shown in Figure 4.1. The detailed dimensions are shown in Table 4.2.

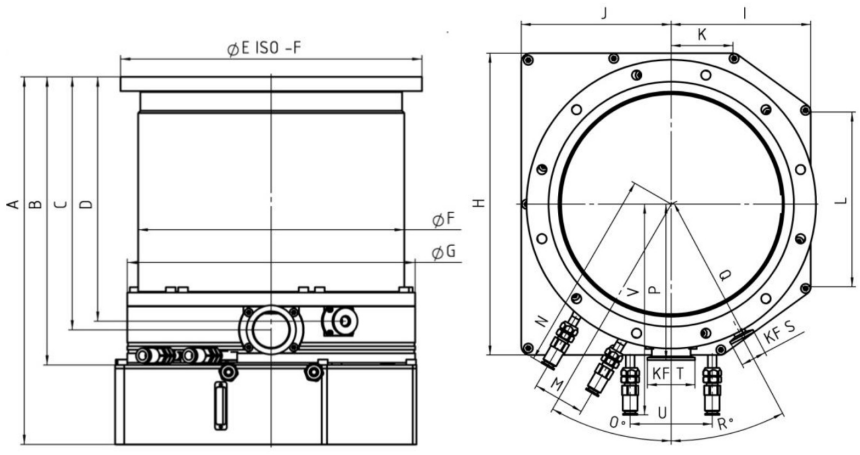


Figure 4.1 Dimensions for CXF-1401/2301/3001

Table 4.2 Dimension parameters of CXF-1401/2301/3001 (Unit: mm, °)

Model	CXF-200/1401	CXF-200/1401	CXF-250/2301	CXF-250/2301	CXF-320/3001
Inlet port flange	ISO F	ISO CF	ISO F	ISO CF	ISO F
A	388.5	426	411.5	443	417
B	299.5	437	322.5	354	328
C	259.5	297	283	314.7	288
D	250.5	288	273.3	305	285
E	285	285	335	335	425
F	241	241	296	296	342
G	278	278	320	320	358
H	278	337	337	337	337
I	139	168.5	168.5	168.5	168.5
J	139	153.5	153.5	153.5	153.5
K	101	84	84	84	84
L	192	198.6	198.6	198.6	198.6
M	53	52.5	52.5	52.5	52.5
N	172	191	191	191	191
O	42°	30°	30°	30°	30°
P	159.7	181	181	181	189
Q	155.1	176	176	176	176
R	30°	30°	30°	30°	30°
S	10	10	10	10	10
T	40	40	40	40	40

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-1401/2301/3001 integrated magnetically-levitated turbo molecular pump packing list

Model	Type of interface	Name	Specification	Number	Unit
CXF-1401\ CXF-2301	ISO K Caliper/ ISO F Bolt/ ISO CF Blade	Manual		1	
		Warranty		1	
		Certificate of conformity		1	
		power cable	3 meters	1	
CXF-3001	ISO F Bolt	Manual			
		Warranty			
		Certificate of conformity			
			3 meters		

Model	Type of interface	Name	Specification	Number	Unit
CXF-1401Model	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
		Protection net	For CXF 1401	1	Piece
		Snap ring	For CXF 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
		Bolt(stainless steel, with nuts)	M10×55	12	Piece
		Double-end stud (optional, stainless steel)	M10×50	12	Piece
		Nut (optional, stainless steel)	M10	12	Piece
		Protection net	For CXF 1401	1	Piece
		Snap ring	For CXF 1401	1	Piece
	ISO CF Blade	Sealing copper ring	CF 200	1	Piece
		Double-end stud (stainless steel)	M8×45	12	Piece
		Nut (stainless steel)	M8	12	Piece
		Protection net	For CXF 1401	1	Piece
		Snap ring	For CXF 1401	1	Piece
CXF-2301Model	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
		Protection net	For CXF 1401	1	Piece
		Snap ring	For CXF 1401	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
		Bolt(stainless steel, with nuts)	M10×55	12	Piece
		Double-end stud (optional, stainless steel)	M10×50	12	Piece
		Nut (optional, stainless steel)	M10	12	Piece
		Protection net	For CXF 2301	1	Piece
		Snap ring	For CXF 2301	1	Piece

Model	Type of interface	Name	Specification	Number	Unit
CXF-2301Model	ISO CF blade	Sealing copper ring	CF 250	1	Piece
		Double-end stud (stainless steel)	M8×45	12	Piece
		Nut (stainless steel)	M8	12	Piece
		Protection net	For CXF 2301	1	Piece
		Snap ring	For CXF 2301	1	Piece
CXF-3001model	ISO F bolt	Centering bracket (aluminum)	LF 320	1	Piece
		Fluorine rubber O-ring	Φ325×7 F	1	Piece
		Bolt(stainless steel, with nuts)	M12×65	12	Piece
		Double-end stud (optional, stainless steel)	M12×60	12	Piece
		Nut (optional, stainless steel)	M12	12	Piece
		Protection net	For CXF 3001	1	Piece
		Cross grooved spherical cylindrical head screw	M3×5	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.

Turbo molecular 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 turbo molecular 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.

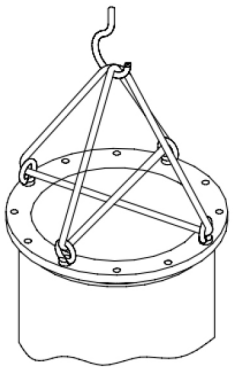


Figure 5.1 Schematic diagram of turbo molecular pump transported by ring screw

Table 5.2 Specifications of ring screws

Specification of Ring Screw	Applicable Molecular Pump Entrance 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 turbo molecular 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, bump, impact, rain, coldness and sun exposure are prohibited. Otherwise, the turbo molecular pump may be damaged. Large turbo molecular 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 turbo molecular pump. To prevent air leakage or damage due to collision.

WARNING!

WARNING!

a.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;

b.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.

c.The outlet port, pipe joint, pump foot pad, electric connector interfaces and other projecting parts shall not use as the carrying handle;

d. Only when the pump is placed in front of the installed system, can the sealing cap of the pump be opened;

e. 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;

f.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 turbo molecular pumps. Turbo molecular pump cannot be used to pump liquid, or gas with dust or solid particles. In addition to "N" type corrosion resistant magnetically-levitated turbo molecular pump, any other magnetically-levitated turbo molecular pumps cannot be used for pumping corrosive gases. Inert gas, N2 for example, must be fed for protection when "N" type magnetically-levitated turbo molecular pump is pumping corrosive gases.

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

Before installation, it is necessary to check and confirm:

□ Whether the turbo molecular 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 turbo molecular pump. Pay attention to reserve space for installing the pump backing pipe and power cord/cable.

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

The integrated magnetically-levitated turbo molecular 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 turbo molecular pump in dangerous media.

And Integrated Magnetically-levitated turbo molecular 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 turbo molecular pump should be separately protected to reduce and isolate vibration;

(3) Magnetically-levitated turbo molecular 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 turbo molecular 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 turbo molecular pump should be lifted from the packing box carefully and safely to check whether it is damaged during transportation.

When the turbo molecular 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.

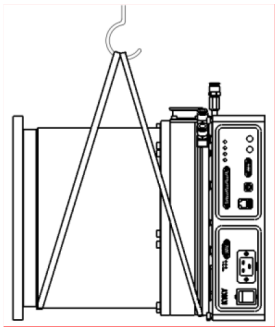


Figure 6.1 Schematic diagram of molecule pump during horizontal installation

When the turbo molecular 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. CXF-2301/CXF3001 Turbo molecular pumps need to be controlled by the four M12 screw holes (CXF-1401 Turbo molecular pumps need to be controlled by the four M10 screw holes)on the bottom of the turbo molecular 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 turbo molecular 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.

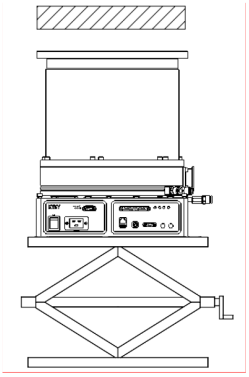


Figure 6.2 Diagram of turbo molecular pump up and down during vertical installation

When the turbo molecular pump is installed upside down, ring screw or alternative screw should be used to connect the pump. CXF-2301/CXF3001 turbo molecular pumps need to be controlled by the four M12 screw holes on the bottom of the turbo molecular pumps controller(CXF-1401 turbo molecular pumps need to be controlled by the four M10 screw holes on the bottom of the turbo molecular 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.

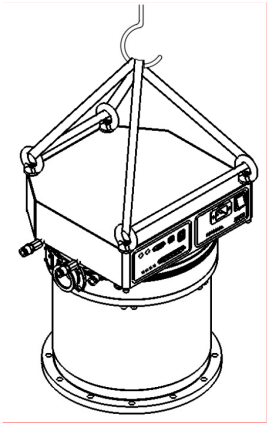


Figure 6.3 Schematic diagram of molecule pump during inverted installation

There is high-speed rotating rotor in the magnetically-levitated turbo molecular. 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 Vacuum Technical Flange Size", 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). 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 turbo molecular 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 turbo molecular 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-250/2301. For CXF-320/3001 integrated magnetically-levitated turbo molecular pump, it is necessary to fix protective net with six M3x5 screws at the inlet of the pump.

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 turbo molecular 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 turbo molecular pump in operation.

6.2.2 Installation angle of the outlet port flange

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

The integrated magnetically-levitated turbo molecular 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 turbo molecular pump, which will help reduce the impact of the rotor weight on magnetically-levitated control. Shown in Figure 6.4.

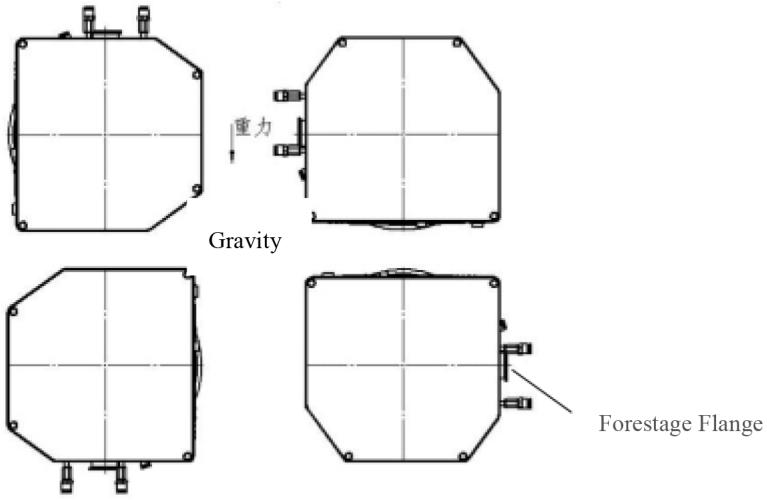


Figure 6.4 Diagram of installation angle of backing port of integrated magnetically-levitated turbo molecular pump

6.2.3 Vacuum Chamber Connection

The interface forms of the high vacuum end of the integrated magnetic levitation molecular pump described in this manual are ISO F flange, CF flange and ISO K flange (that is LF flange, which needs to be customized). The CF flange adopts oxygen-free copper metal seal, ISO K method The flange is sealed with a fluorine rubber ring, and 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 support should be fixed to support the pump and prevent welds from cracking; the high vacuum interface of turbo molecular pump should be as close as possible to the vacuum chamber pumped (see Figure 6.5).

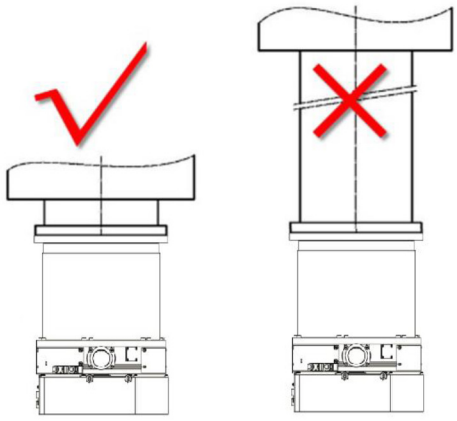


Figure 6.5 Connection diagrams of integrated magnetically-levitated turbo molecular pump and vacuum chamber

CAUTION!

CAUTION!

The interface flanges of turbo molecular 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!

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.

WARNING!

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, do install the pump by using intensity-qualified connections;

b.Do not separately power on. Turbo molecular 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

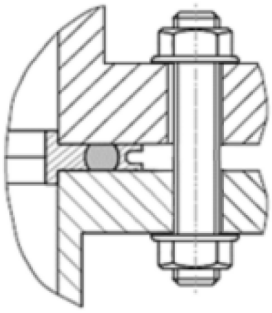


Figure 6.6 ISO F flange and ISO F flange connection

a.Before installing the flange, prepare installation tools, center brackets, rubber rings, hexagonal bolts and nuts, etc., and check the flange sealing surface to ensure that there is no damage;

b. As shown in Figure 6.6, use the installation tool to install the flange;

c. Fix the flange with the corresponding number of bolts and tighten them symmetrically. It is recommended to tighten the bolts in three steps;

d.Reinforce and tighten after vacuuming;

e.See the standard manual for the bolt specifications and quantity of different diameter flanges.

Connection of ISO F flange and ISO K flange

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

(1) ISO K flange is connected to standard ISO F flange through loose flange

(2) ISO F flange is connected to blind hole of the vacuum chamber

Before installing the flange, prepare installation tools, center brackets, rubber rings, hexagonal bolts/ double-ended studs and nuts, etc.

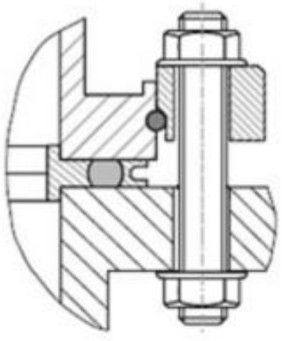


Figure 6.7 ISO F and ISO K flange connection

◇**ISO K flange is connected to standard ISO F flange through loose flange**

a.Check the flange sealing surface before installation to ensure that there is no damage;

b.Put the loose flange and the retaining ring on the ISO K flange in turn;

c.Place the center bracket/locating ring and apron into the molecular pump inlet flange (ISO F flange). The molecular pump inlet flange is preset with apron groove and does not use the center bracket;

d. As shown in Figure 6.7, use the corresponding number of hexagonal bolts and nuts to fix the molecular pump.

e. Tighten the nuts symmetrically and evenly one by one, and the final tightening torque refers to Table 6.1.

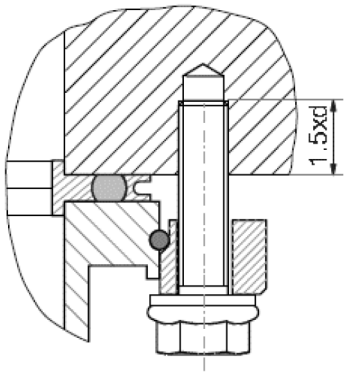


Figure 6.8 ISO F flange is connected to blind hole of the vacuum chamber

◇Connected by hexagon bolts and CF flange through holes

a. Check whether the knife edge is damaged by bumps;

b. Install protective nets and place seals;

c.As shown in Figure 6.9, use the corresponding number of hexagon bolts and nuts to connect the flanges;

d.Tighten the nuts symmetrically and evenly in sequence, and refer to Table 6.1 for the final tightening torque.

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.

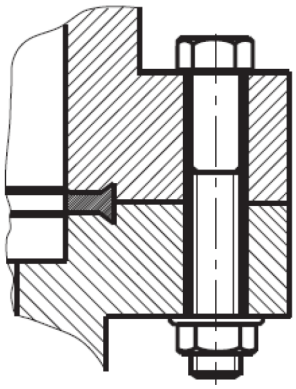


Figure 6.9 ISO CF Flange Connection

◇ISO K flange is connected to standard ISO F flange through loose flange

a.Check the flange sealing surface before installation to ensure that there is no damage;

b.Put the loose flange and the retaining ring on the ISO K flange in turn;

c.Place the center bracket/locating ring and apron into the molecular pump inlet flange (ISO F flange). The molecular pump inlet flange is preset with apron groove and does not use the center bracket;

d. As shown in Figure 6.7, use the corresponding number of hexagonal bolts and nuts to fix the molecular pump.

e. Tighten the nuts symmetrically and evenly one by one, and the final tightening torque refers to Table 6.1.

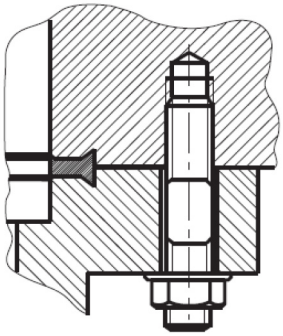


Figure 6.10 CF flange and CF flange blind hole connection

◇**Connected by hexagon bolts and blind holes of CF flange**

a.Check whether there is any collision loss on the knife edge;

b.Install protective nets and place seals;

c.As shown in Figure 6.10, use the corresponding number of hexagonal bolts (or studs) and nuts to connect the flange;

d.Tighten the nuts symmetrically and evenly in sequence, and refer to Table 6.1 for the final tightening torque.

CAUTION!

CAUTION!

a.The effective length of bolt or stud screwed into the blind hole should be greater than or equal to 1.5d. 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 turbo molecular 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 inflation 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!

CAUTION!

The standard integrated magnetic levitation molecular pumps produced by KYKY are completely oil-free molecular pumps, and the fore-stage pump must use an 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 turbo molecular pump, the working temperature of the turbo molecular pump should be lowered appropriately).

The integrated magnetically-levitated turbo molecular pump has two cooling water pipelines. Turbo molecular 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 Controller

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

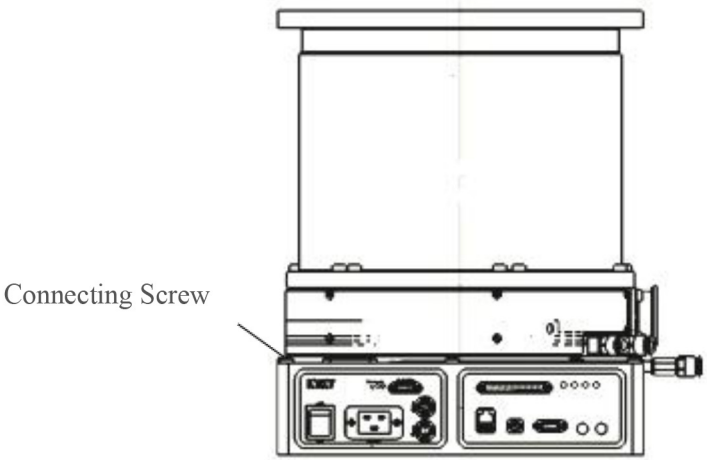


Figure 6.11 Schematic diagram of connecting the integrated controller and turbo molecular pump

There is an electric connector plug in the base of the turbo molecular 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. When placing the controller, it is necessary to tidy up cables and not to break them.

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 supplying power to the integrated magnetic levitation molecular pump, please read the instructions for the integrated magnetic levitation molecular pump controller in this manual.

6.2.7 Connection of protective gases in 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.

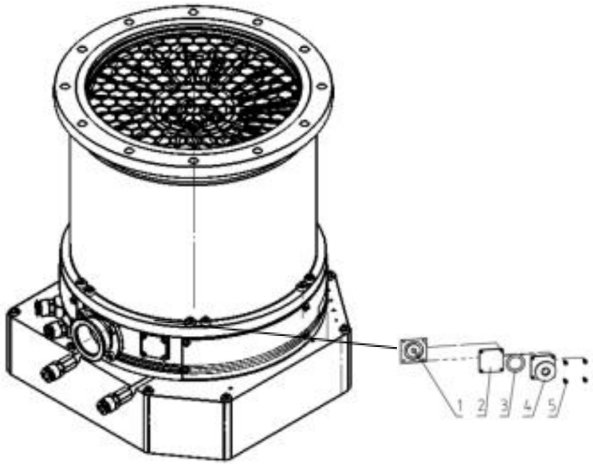


Figure 6.12 Protective gases connections

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 Shutdown chapter 7.7.

6.2.9 Heating tape connection

Use the heating belt to heat the molecular pump (need to be customized) to prevent special gas from condensing and depositing. Please refer to the product technical parameters for heating temperature range. The connection method of the heating belt is shown in Figure 6.13.

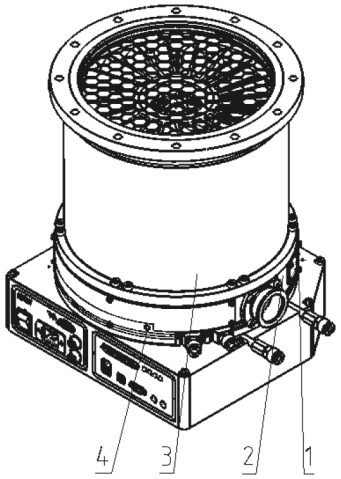


Figure 6.13 Heating tape connection

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

CAUTION!

CAUTION!
a.Generally, it is unnecessary to heat the turbo molecular pump case through baking when the vacuum pressure P is greater than or equal to 5×10-5Pa; b.The baking temperature of pump case of different turbo molecular pumps is shown in Technical Parameters and Dimensions Chapter.

Chapter 7 Use

7.1 Precautions before Use

DANGER!

DANGER!

When pumping flammable mixed gas, the pressure within the turbo molecular pump system is low (less than 10-4Pa), there is generally no fire hazard. But when the pressure is high (greater than 10-4Pa) 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.Turbo molecular 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. No turbo molecular pumps except "N" type pump, can 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 be condensed 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 Calculation of starting pressure of turbo molecular pump

Assume that the pumped system is V [m3] and the pumping speed of backing vacuum pump is Sr [m3/h].

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

When Sr/V≤40 [h-1], the pumped volume is relatively large, and the fore pump should be started first, and then the molecular pump should be started when the system pressure P≤5Pa.

7.1.2 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 Protective gases supply

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 strong corrosive gases.

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

7.2.1 Start-up

Pumps listed in this manual are integrated magnetically-levitated type, after the initial use or long-term placement (generally refers to more than 3 months), the check operation is needed.

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) and then restore the protective net and flange cover.

Start and stop of the turbo molecular pump can be controlled by system external control/upper computer, as well as portable touch screen or start-stop button on the control panel of the turbo molecular pump.

Portable touch screen operation and start-stop method:

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

(2) To set the "local control mode", the "external control mode" needs to be prohibited. Please refer to the

I/O control section for the prohibition method.

(3) You can enter the settings interface through "System Settings" on the touch screen, 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 Touch screen function page

Controller panel operation and start-stop method:

(1) Start: The controller is connected to 220V AC, the power indicator is on. Wait 10 seconds, press the RUN/STOP button to start the molecular pump, the Run indicator light is on (green). About 1 minute later, the Speed indicator light (yellow-green) starts to flash and the molecular pump starts to accelerate. As the speed increases, the flashing becomes faster. When the rated speed is reached, the Speed indicator (yellow-green) is always on.

(2) Stop: Press the RUN/STOP button to stop the molecular pump, the Run indicator light goes out, the Speed indicator light (orange) starts to flash and the molecular pump starts to slow down. As the speed decreases, the flashing slows. When the speed of the molecular pump drops to zero, the Speed indicator light goes out; after waiting for 1 minute, turn off the power and the POWER indicator light goes out.

(3) As for start and stop operations of the molecular pump by I/O external control and serial communication control, please refer to chapters 7.4 and 7.5 respectively.

7.2.2 Baking

Under normal circumstances, the rationally-designed vacuum system is not necessarily baked to

obtain the vacuum of more than 10-4Pa; the vacuum of 10-5Pa 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 turbo molecular 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. When baking the pump casing, please contact KYKY

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

Baking should be carried out when the turbo molecular 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!

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

WARNING!

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

7.2.3 Acceleration Time

The normal start-up time for turbo molecular 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 buttons and status indication

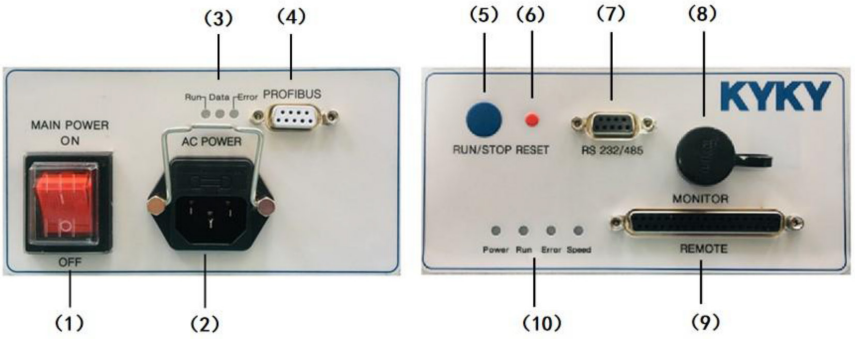


Figure 7.2 Controller panel diagram

Name	Action	Graphic position	Indicator	Meaning	Remarks
Power Switch	Switch to ON position 	Figure 7.2 (1)	Red light of Power switch is on	Pump is electrified	Power is off when switch to OFF position
	Switch to OFF position 	Figure 7.2 (1)	Red light of Power switch is off	Pump is not electrified	Note 1
RUN\ STOP Button	Touch the RUN/ STOP button 	Figure 7.2 (5)	Indicator RUN: Light (green) Indicator speed: flicker with speed (yellow-green)	Speed-up operation	
	Touch the RUN/ STOP button 	Figure 7.2 (5)	Indicator RUN: Light off Indicator speed: flicker with speed (orange-yellow)	Speed-down operation	
Reset	Touch RESET 	Figure 7.2 (6)	Indicator error: Lighting status can be reset, red/yellow light off	Clear errors	

Note 1: If it is necessary to start it again after shutdown, it can be started again at least 20 seconds after shutdown.

7.4 I/O external control operation

The "REMOTE" external control interface is for the signal input and output of the pump controller (see Figure 7.2 position (9)), the interface uses a D-Sub 37-pin connector (see Figure 7.3), the female seat, and the connection screw is M2.6.

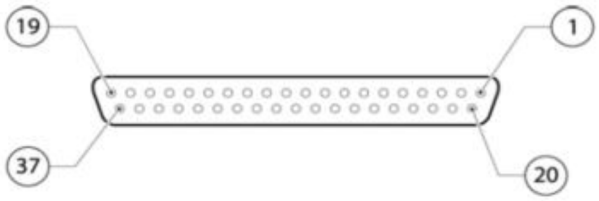


Figure 7.3 I/O External Control Terminal (DB37 pin female)

Note: The meal seat of the D-Sub 37-pin connector is not included in the product accessories, and the customers need to buy it by themselves; It is recommended to use shielded connection cables, and the shielding layers at both ends of the cable are connected to the earth respectively.

7.4.1 Input control for external control interfaces

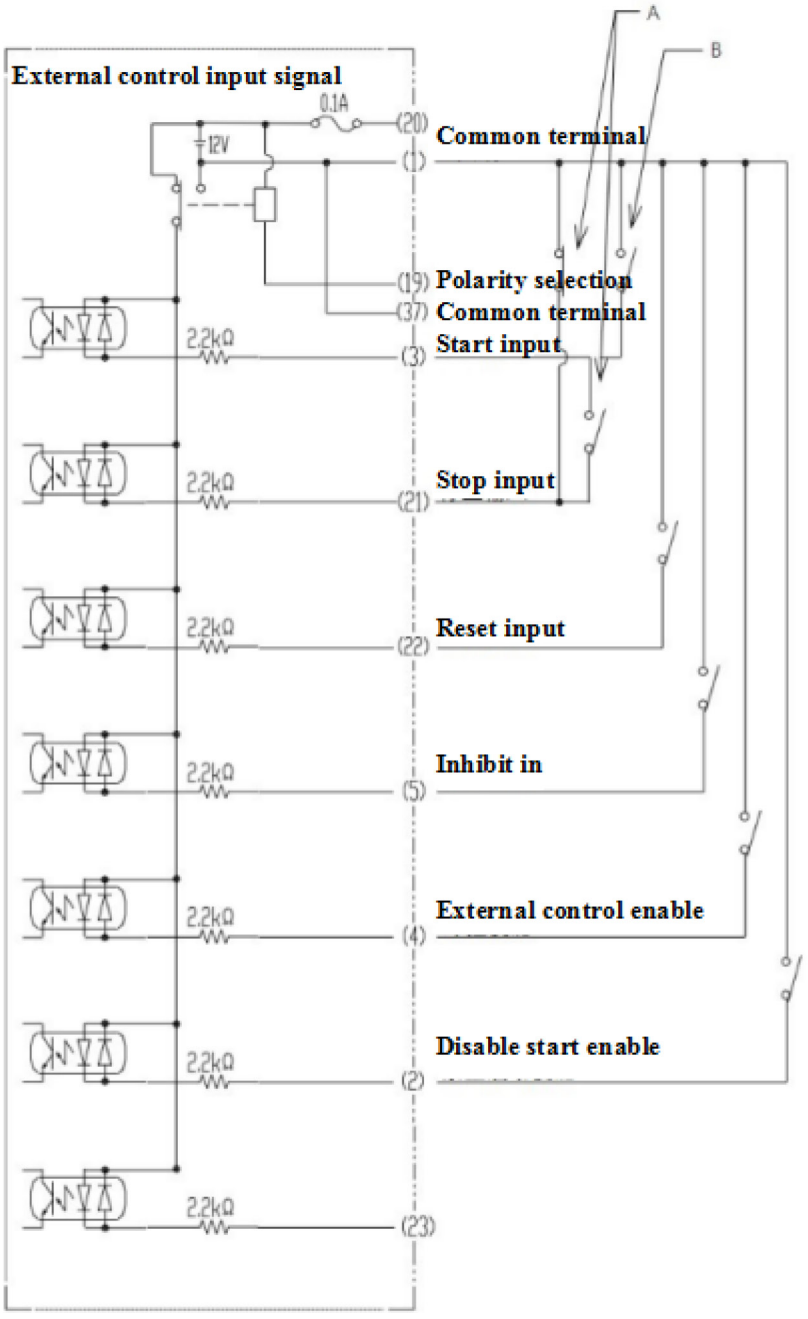
The external control input signal can choose contact signal input or voltage signal input. When using contact signal input, refer to the description in Table 7.2 and Figure 7.4; when using voltage signal input, refer to the description in Table 7.3 and Figure 7.5;

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

Table 7.2 Contact input control signal pin description

Pin No.	Definition	Pin description
1, 37	Common terminal	Common terminal (isolated from the chassis)
19,37	Input signal type selection	When using the contact input signal, disconnect the 19-pin and 37-pin;
1,3,21	Start/Stop	
1,22	Reset	Two start and stop methods: A. Short-circuit pins 1 and 21, then short-circuit pins 3 and 21 for at least 0.3 seconds to start the molecular pump, if the molecular pump has just been powered on, it needs to be short-circuited for at least 10 seconds; Disconnect pin 1 and pin 21 to stop the molecular pump; B. Short-circuit pin 1 and pin 3 to start the molecular pump; Disconnect pin 1 and pin 3 to stop the molecular pump
1,5	Prohibit start	When pins 1 and 5 are closed, the molecular pump is prohibited from starting. If the molecular pump is running, closing pins 1 and 5 will stop the molecular pump; Need to short-circuit pin 1 and pin 2 to make this function effective;
1,4	External control enable	When pin 1 and pin 4 are shorted, the control mode of the molecular pump is automatically set to external control mode. At this time, the external control input signal is valid and the control signal input from the serial port will be invalid, but the communication function of the serial port is normal.
1,2	Disable start enable	When pin 1 and pin 2 are short-circuited, the prohibit start signal is valid;

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



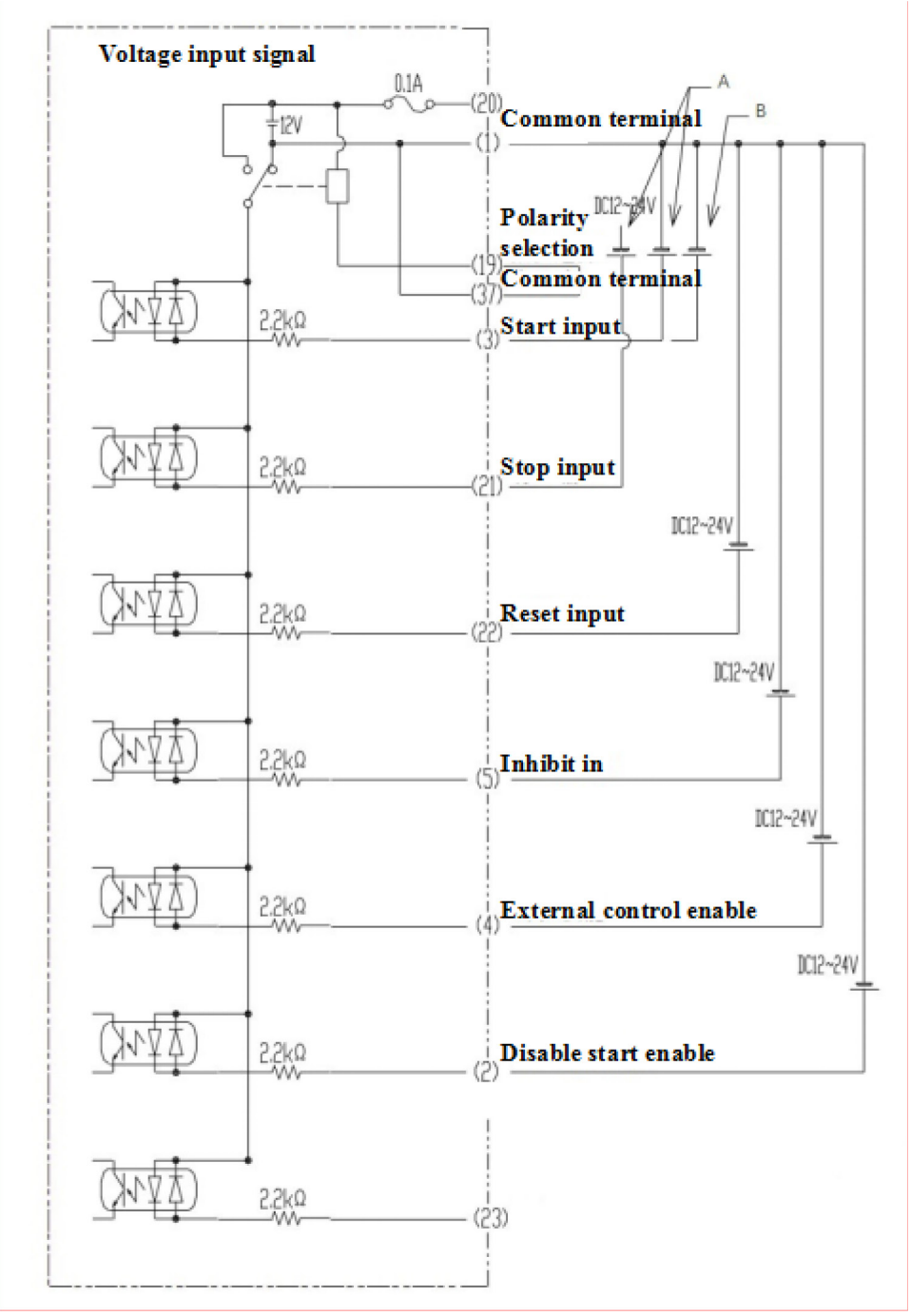
(A and B are the two start and stop methods in Table 7.2)

Figure 7.4 External control contact input pin diagram

Table 7.3 Voltage input control signal pin description

Pin No.	Definition	Pin description
1, 37	Common terminal	Common terminal (isolated from the chassis) When the voltage signal is connected, the common terminal is connected to the negative pole of the power supply;
19,37	Input signal type selection	When using voltage input signal, connect the 19-pin and 37-pin;
1,3,21	Start/Stop	Two start and stop methods: A. First connect pins 1 and 21 to the 12V-24V DC power supply, then connect pins 3 and 1 to the 12V-24V DC power supply for at least 0.3 seconds to start the molecular pump. If the molecular pump has just been powered on, it needs to continue Power supply for at least 10 seconds; Disconnect the DC power supply of pin 1 and pin 21 to stop the molecular pump; B. Connect pin 1 and pin 3 to the 12V-24V DC power supply to start the molecular pump; Disconnect the DC power supply of pin 1 and pin 3 to stop the molecular pump;
1,22	Reset	After troubleshooting, connect pin 1 and pin 22 to the 12V-24V DC power supply for at least 0.3 seconds to reset the fault signal (the fault light goes out)
1,5	Prohibit start	When pins 1 and 5 are connected to 12V-24V DC power supply, the molecular pump is prohibited from starting. If the molecular pump is running, connecting pins 1 and 5 to the DC power supply will stop the molecular pump; Need to connect pin 1 and pin 2 to 12V-24V DC power supply to make this function effective;
1,4	External control enable	When pin 1 and pin 4 are connected to 12V-24V DC power supply, the control mode of the molecular pump is automatically set to external control mode. At this time, the external control input signal is valid, and the serial input control signal will be invalid, but the serial communication function is normal;
1,2	Disable start enable	When pin 1 and pin 2 are connected to 12V-24V DC power supply, the start prohibition signal is valid;

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



(A and B are the two start and stop methods in Table 7.3)

Figure 7.5 External control voltage input pin

7.4.2 Output state of external control interface

The external control status output pin realizes the status output by turning on and off the relay (CR1~CR8). Whether it is external control mode or serial control mode, the external control output status pin is valid.

Table 7.4 Introduction of External control output signal pins

Pin No.	Definition	Operation notice
9,28	Power state output	Normally open pin, closed after floating normally, open after power failure;
10,29	Acceleration status output	Normally open pin, closed when accelerating
13,32	Speed reduction (brake) status output	Normally open pin, closed when speed reduction (brake)
11,30	On-speed output	Normally open pin, closed at speed
12,30		Normally closed pin, disconnected at 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 output	Normally open pin, closed when using external control mode

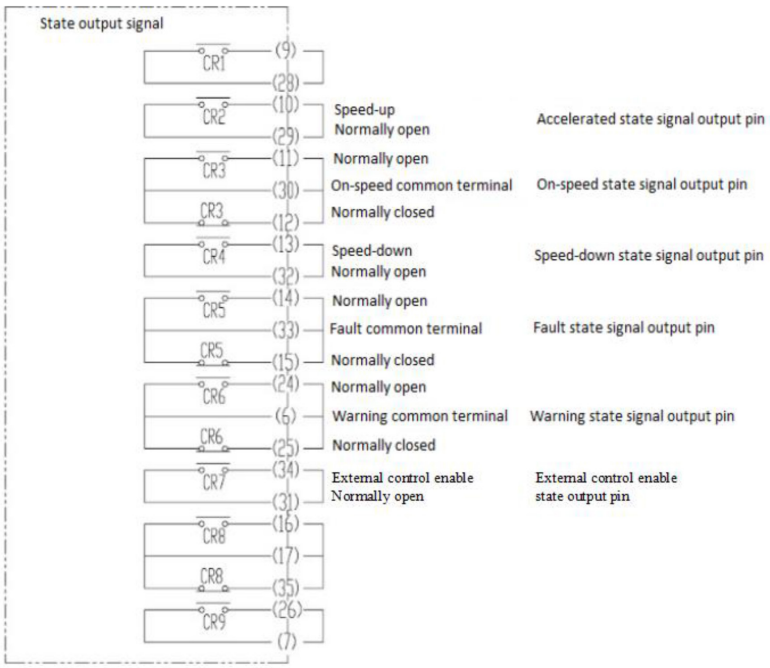


Figure 7.6 External control state output pin

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

Table 7.5 Rated working value of relay contact

Rated load	30V，0.5A
Rated current	0.5A
Maximum switching power	15W
Minimum load	10mV DC， 10μA

7.5 RS485 Communication

CXF series controller RS232/485 communication adopts Modbus communication protocol, Modbus is a serial and asynchronous communication protocol. This protocol defines a message structure that the drive controller can recognize and use, regardless of what kind of network they are transmitted through.

The Modbus does not require any dedicate interface, and the typical physical interface is RS485.

For the detailed information about Modbus, you can check related books or ask our company.

7.5.1 Modbus Communication Protocol for CXF 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 in a data packet.

Note: At present, the Modbus communication protocol for CXF 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 two 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 216 (16 bits left), and then divided by 216+215+22+1. 216+215+22+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 (216+215+22+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 Command 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 content of holding register	Get the current value in one or more registers, no more than 12
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
≥3.5 bytes	Turbo molecular pump controller address	Function code	N data	CRC Low Byte	CRC High Byte	≥3.5 bytes

3. Communication address and command meaning

This part is the content of communication, used to control the operation of molecular pump drive controller, molecular pump drive controller status and related parameter settings.

(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: Controller ID can be set by serial data command.

Note: If there is no modification, the default ID is 16. When multiple turbo molecular pumps are working at the same time, the upper computer can distinguish different pumps by inquiring 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 port mode, Profibus mode and local control mode. The start and stop control mode of the molecular pump can be set through serial communication or touch screen. When the molecular pump is started and stopped, it must be set

to the corresponding control mode.

(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	Output frequency, output voltage, output current and output motor state
1004	Fault Message
1008	Motor temperature, pump temperature, heating temperature, system setting

b. Control command

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

c. Setup Command

Parameter Address	Parameter Description (Write Only)
3000	Contents and meaning of the command 0001:2400 0002:4800 0003:9600 (Default baud rate) 0004:19200 0005:38400 0006:57600 0007:115200
3010	Device address (default: 0010, the highest is 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 Description	Function Area Code	Data Area
Slave parameter response	The highest bit of the functional area code changes to 1	Contents and meaning of the command 0001: Invalid function code 0002: Invalid data address 0003: Invalid data 0004: Slave device failure

e. Example of reply command for reading and writing function parameters

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

The host 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

Response when the slave 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 Output Voltage Output Current Running

The output frequency of No. 16 controller is 450.0 Hz, the output voltage is 78.7 V, the output current is 1.9 A, and the controller status is running.

Note: For detailed algorithm of status data, please refer to section 7.5.3 Additional description.

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

The host 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 1004H

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 algorithm of status data, please refer to section 7.5.3 Additional description

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

The host 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	03	10	08	00	04	C2	4A

Communication parameter address 1004H

Response when the slave 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	18	00	18	00	17	00	00	CD	EC

Motor temp. Pump temp. Heating temp. System Setting

The motor temperature of No. 16 molecular pump is 24℃, the pump temperature is 24℃, and the heating temperature is 23℃.

Example 4: No. 16 molecular pump run (when using RS232/485 to start, stop, and reset the molecular pump, it must be set to the RS232/485 control mode to be effective, otherwise it is invalid)

The host 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 Running

Response when the slave works normally:

Normal Response

Example 5: No.16 turbo molecular pump stop (when using RS232/485 to start, stop, and reset the molecular pump, it must be set to the RS232/485 control mode to be effective, otherwise it is invalid)

The host 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 Running

Response when the slave 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: No.16 turbo molecular pump reset (when using RS232/485 to start, stop, and reset the molecular pump, it must be set to the RS232/485 control mode to be effective, otherwise it is invalid)

The host 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 Running

Response when the slave 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 of No. 16 molecular pump.

The host 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 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 next communication.

Example 8:NO.16 turbo molecular pump equipment ID is changed to 20

The host 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 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 molecular pump

The host 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 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

Equipment ID Normal response

The control mode is RS232/485.

Example 10: Setting the function code of No. 16 molecular pump control mode is illegal

The host 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 works normally:

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

Because the write function code only supports 06H, and the 07H function code is not open, the 07H function code in this communication is abnormal. The highest position 1 of 07H is changed to 87H in the response from the machine, and the abnormal code is 01H, indicating an illegal function code.

Example 11: Setting the data address of No. 16 molecular pump control mode is illegal

The host 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 works normally:

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

Since the data address is not open to 3040H, the data address is an illegal address. When the slave responds, the highest position of the function code is 1 and becomes 86H. The abnormal code is written into 02H, indicating an illegal data address.

Example 12: Illegal setting of No. 16 molecular pump control mode data

The host 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 works normally:

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

Because the data bits are only open 0001H-0004H, and not 0005H, it is illegal data. When the slave responds, it will reply to the highest position of the function code and become 86H. The abnormal code is written into 03H, indicating illegal data.

7.5.3 Additional notes

(1) Data description during communication:

Parameter value of the frequency = actual value × 10

Parameter value of the voltage = actual value × 10

Parameter value of the current = actual value × 100

Description: The parameter value is the value sent by the data packet. The actual value is the value of this parameter in the molecular pump drive controller. After receiving the parameter value, the upper computer divides by the corresponding proportional coefficient to obtain the actual value of the corresponding parameter of the controller. The proportional coefficient refers to the above formula.

Note: When sending commands to the molecular pump drive controller, the data in the data packet does not consider the decimal point. The value of all data cannot be greater than 65535, otherwise the data will overflow.

(2) Controller status description:

When the state is 0100, it indicates that the pump is in standby state;

When the status is 0000, it indicates that the suspension is abnormal;

When the status is 0101, it indicates that the pump is started;

(3) Fault code description:

Fault code1

Low byte	0	Motor connection failure
	1	Open loop acceleration failed
	2	Motor overcurrent
	3	Motor drop speed
	4	Motor overheated
	5	Motor watchdog reset
	6	System power down
	7	Magnetic bearing failure
High byte	8	System overload
	9	Motor communication failure
	10	Motor Hall failure

Fault code2

Low byte	0	Motor connection failure
	1	Open loop acceleration failed
	2	Motor overcurrent
	3	Motor drop speed
	4	Motor overheated
	5	Motor watchdog reset
	6	System power down
	7	Magnetic bearing failure
High byte	8	System overload
	9	Motor communication failure
	10	Motor Hall failure

Fault code3

Low byte	0	XY Bias overvoltage
	1	AB Bias overvoltage
	2	Z Bias overvoltage
	3	XY Bias undervoltage
	4	AB Bias undervoltage
	5	Z Bias undervoltage

Fault code4

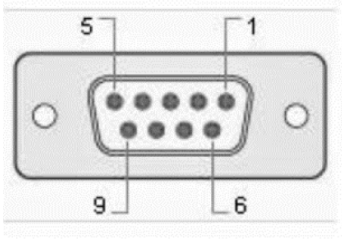
Low byte	0	No float in X direction
	1	No float in Y direction
	2	No float in A direction
	3	No float in B direction
	4	No float in Z direction
	5	Suspension fault in X direction
	6	Suspension fault in Y direction
	7	Suspension fault in A direction
High byte	8	Suspension fault in B direction
	9	Suspension fault in Z direction
	10	Magnetic bearing watchdog reset
	11	System Information 5

7.5.4 Connections of Physical Interfaces

7.5.4.1 Interface Specification

RS485 and RS232 communication can be realized through the panel DB9 interface (position (9) in Figure 7.2), the DB9 pin definition is in Table7.9:

Table7.9 RS232/485 communication port pin definition

DB9 Female	Pin	Definition	Description
	1	----	----
	2	232TXD	Data sender
	3	232RXD	
		Data receiver	
	4	----	----
	5	GND	Signal ground
	6	----	----
	7	485B/-	Negative end
	8	485A/+	Positive end
	9	----	----

Note: RS232 communication uses pin 2, 3 and 5; RS485 communication uses pin 7 and 8.

When using, pay attention to distinguish it from the PROFIBUS communication interface on the panel to avoid wrong connection.

7.5.4.2 RS485 Bus Structure

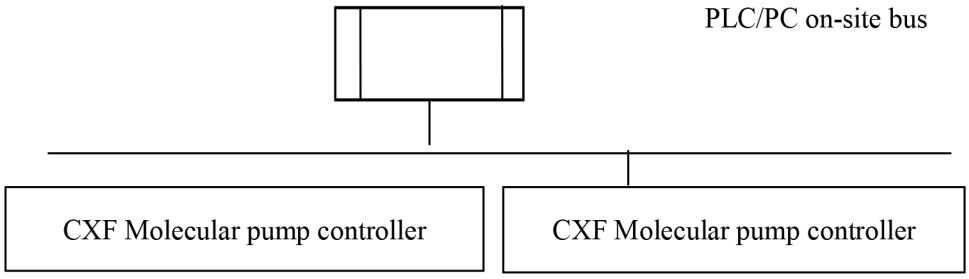


Figure 7.7 On-site bus connection diagram

The molecular pump controller adopts RS485 half-duplex communication. The 485 bus should adopt a hand-in-hand structure instead of a star structure or a bifurcation structure. The star structure or the bifurcation structure will produce the reflected signal, thus affecting the 485 communication. The wiring must use shielded twisted pair, try to stay away from strong electricity, not parallel to the power line, and not to be tied together.

It should be noted that only one molecular pump controller can communicate with the host computer at the same time in a half-duplex connection. If two or more molecular pump controllers upload data at the same time, bus competition will occur. Not only will it cause communication failure, it may also cause some components to generate large currents.

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 equipments 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.

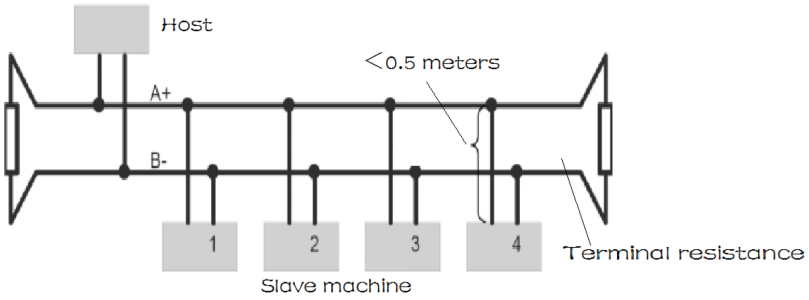


Figure 7.8 System Connection Diagram

When the cables are connected, the driving capacity of the computer/PLC and the distance between the computer/PLC and the turbo molecular 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. An upper computer can only communicate with one molecular pump, and the communication distance does not exceed 15m. Connect pins 2, 3 and 5 to the upper computer according to the pin definitions in Table 7.10 Corresponding 232 port can realize 232 communication, the communication cable is recommended to use shielded twisted pair.

7.6 PROFIBUS Communication

PROFIBUS-DP is used in the application of factory automation. The central controller can control many sensors and actuators. It can also use standard or optional diagnostic functions to know the status of each module。

7.6.1 PROFIBUS interface definition

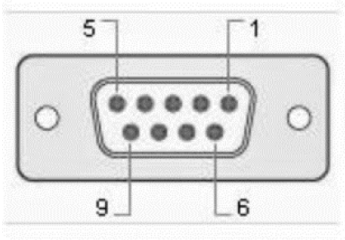
This device is a PROFIBUS-DP/V0 slave station, conforming to the standard GB/T 20540-2006.

The baud rate is adaptive, and the maximum baud rate is 1.5Mbps.

The interface uses a standard 9-pin D-type socket (hole). It is recommended that users use standard PROFIBUS plugs and standard PROFIBUS cables for connection.

PROFIBUS socket pin definition：

Table7.10 PROFIBUS communication socket pin definition

DB9 Female	Pin	Definition	Description
	1	GND	Shield ground
		232TXD	Data sender
	2	----	----
	3	B+	
		Signal B+	----
	4	----	----
	5	DGND	Signal ground
	6	VP	Signal power +
	7	----	----
	8	A-	Signal A-
	9	----	----

Note: When using, pay attention to distinguish it from the RS232/485 communication interface on the panel to avoid wrong connection.

7.6.2 Command type and format

The slave address setting mode and command type and format are consistent with RS232/485. For details, please refer to the specific instructions in Chapter 7.5.2.

Slave address range: 2～125.

Please contact KYKY for the GSD file used for CXF series controller.

7.6.3 PROFIBUS bus structure

When each station is connected to the network through plug connection and bus, the station at the end of the physical network segment should be equipped with a terminating resistor to prevent surges and ensure communication quality. Each standard PROFIBUS plug has a built-in terminal resistance, which can be connected (On) and cut (Off) when needed. 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 inlet "In" and set the terminal resistance to "On". The stations located in the middle of the network segment need to connect the bus in turn. Connect to the inlet "In" and outlet "Out", and set the terminal resistance to "Off". The specific connection method is shown in the figure below:

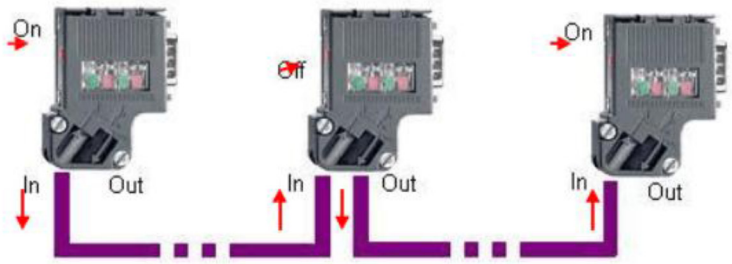


Figure7.9 PROFIBUS-DP bus structure diagram

When wiring the PROFIBUS cable inside the plug, peel off the shielding layer and press it on the metal part inside the plug, which should be connected to the metal part outside the D-Sub plug.

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

CAUTION!

CAUTION!
The installation and cabling must be operated after the turbo molecular pump driver controller is powered off.

7.7 Operation procedures, methods and precautions for shutdown

Each time the molecular pump is started, in addition to controlling the start and stop of the molecular pump through the external control/host computer of the system, the start and stop of the molecular pump can be realized through the portable touch screen or the start/stop buttons on the molecular pump control panel. For the operation of the portable touch screen, please refer to section 7.2.1.

Do not cut off the power supply during the shutdown process, until the molecular pump speed drops to 0Hz, the power can be cut off. When the "Speed" indicator on the molecular pump controller panel changes from flashing to off, it means that the molecular pump has been slowed down. Because the rotor still has a low speed please wait for 1 minute before turning off the power.

WARNING!

WARNING!
Never cut off power supply during the shutdown, so as not to damage turbo molecular pump.

DANGER!

DANGER!
The molecular pump brake will generate a lot of heat during the shutdown process, and the temperature of the controller housing will rise. Avoid contact with the controller housing to prevent burns.

When the molecular pump stops completely, the controller power can be turned off. After turning off the power, some devices need to fully discharge. If you need to restart it, you need to wait 20 seconds before turning on the controller power again.

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

If the chamber needs to be ventilated to achieve equilibrium with the atmosphere, it is necessary to start the gas flow when the molecular pump stops until the rotation speed shows 0Hz.

7.8 Requirements for use in special environments

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 Radiation

If there is thermal radiation source in the pumped system, the heat shield plate should be set at the inlet of the turbo molecular pump to prevent the heat radiation from affecting the rotor of the turbo molecular pump as shown in the figure below, so as to reduce the damage of the integrated magnetic levitation molecular pump caused by the heat radiation.

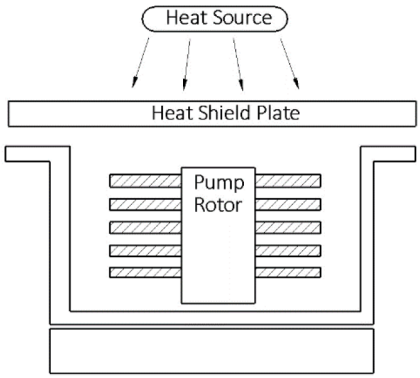


Figure 7.10 Installation diagram of heat shield plate to prevent the heat radiation

7.8.3 High magnetic field shielding

When the integrated magnetically-levitated turbo molecular 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 turbo molecular 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 KYKY.

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 turbo molecular 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 turbo molecular pump has received precise dynamic balancing machine calibration, any operation such as loosening the bolt or adding gasket may cause serious dynamic unbalance. Under such condition, please return the pump to KYKY for calibration.

Chapter 8 Fault Analysis and Solution

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

DANGER!

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 Causes of failures and troubleshooting measures

Fault	Possible cause	Solution
Start failure	(1) Molecular pump has not received signal for start; (2) 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; (3) For other reasons, please consult the manufacturer.
Start timeout or slow down or running stop after start	(1) Vacuum system leakage; (2) Abnormal pressure of 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) Large backing pressure; (2) The system is leaking: (3)Large gas output of gauge; ●Abnormal rotation speed of pump; ●Unreasonable system ●System pollution;	(1) Check whether the backing vacuum pump works properly or whether there is leakage of backing pipe and seal; (2) Leakage detection, leakage stop; (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℃; ●The Pump does not reach rated speed; ●The pumping speed of backing vacuum pump is not large enough or system pipeline is too thin; ●Vacuum chamber, pipeline and vacuum pump are contaminated. The system should be cleaned.
Other error		If there is any other trouble or in need of technical support, please contact the manufacturer.

WARNING!

WARNING!
Products and components (including metals, electronic components, cleaning fluids, etc.) may cause environmental pollution. Please dispose of scrap in accordance with local laws and regulations.

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 turbo molecular 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 host computer to check whether there is abnormal operating voltage, current and magnetically-levitated location of turbo molecular pump. In case of any abnormality, immediately stop to find the cause or contact the manufacturer;	Once per week Start each time	
▲Internal cleaning	If the leakage of the vacuum system or the serious pollution of the vacuum chamber is excluded, and the vacuum performance of the pump cannot be restored after baking for a long time, it is basically confirmed that the pump has been contaminated, and the pump must be cleaned.	Depending on the conditions during use	Return to the manufacturer
▲Replacement of touchdown bearings	Before delivery all qualified magnetically-levitated turbo molecular 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 the manufacturer

9.2 Maintenance during long-term outage

When the turbo molecular 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 turbo molecular pump and controller as a whole, keep them dry and put them in stock. Please refer to section 10.2 for storage environmental conditions.

The molecule pumps listed in this manual are integrated magnetically-levitated turbo molecular 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 section 7.2.1.

9.3 Disassembly procedures and precautions

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

(1) 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;

(2) If the pump is used for exhausting 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 gas mask 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;

(3) After the pump is unloaded, immediately seal the package and seal with a clean plastic bag. The storage requirements refer to the maintenance, maintenance and storage conditions in this manual when it is out of use for a long time.

(4) If you need to return to the factory for maintenance, you only need to return the corresponding parts and accessories. For exchange, you need to return all the items in the original packing list, including the molecular pump (including its controller) and all its accessories, certificates, etc.

Chapter 10 Transportation and Storage

10.1 Transportation

The integrated magnetically-levitated turbo molecular 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, bump, impact, rain, coldness and sun exposure are prohibited.

When transporting with a packing box, the bottom of the packing box must be taken out and handled with care. Strong vibration, impact, bumps, rain, severe cold and exposure are strictly prohibited. Otherwise, the molecular pump may be damaged. For larger molecular pumps, forklifts are needed for handling.

When transporting after unpacking, pay attention to protect the easily damaged parts of the pump, such as the high vacuum flange port, front flange port, water nozzle, controller interface, etc., to prevent water leakage, air leakage or damage after impact.

10.2 Storage

The integrated magnetic levitation molecular pump and controller should be stored in a dry, ventilated, corrosive gas, and oil-free house before opening the box to prevent vibration, rain, moisture, severe cold, sun exposure and oil and gas pollution. Storage temperature: -20℃～+55℃; Relative humidity does not exceed 95%.

Chapter 11 Environmental Protection and Others

WARNING!

WARNING!
Products and components (including metals, electronic elements, cleaning fluid, etc.) may cause environmental pollution. Please dispose of scrap in accordance with local laws and regulations.

After-sales Service

Any purchase of products produced by our company can be guaranteed for one year with the warranty certificate from the date of purchase.

Non-local users can extend the warranty period for one month. During the warranty period, no repair fee will be charged. If you need to replace parts, generally half of the fee will be charged, and no more than half a year can be free.

Any one of the following conditions will not be guaranteed:

1. The user disassembles the product privately or modifies and processes its parts.

2. Improper transportation, handling, disassembly, storage or improper use by the user.

3. Damage caused by other reasons by the user.

Product Warranty

Product Name: _____

Product Code: _____

Date of manufacture：_____

User: _____

Date	Repair Contents	Maintenance Engineer

…Cut …… Seal Here …

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

Product Name:_____ Contact Person: _____

Product Code: _____ Phone Number: _____

Date of Purchasing: _____ Postal Code: _____

Company Address:_____

Company Name: _____