ULVAC

INSTRUCTION MANUAL

TURBO MOLECULAR PUMP

Model

UTM300B

Before using this product, be sure to read this operation manual. Keep this manual with care to use at any time.

ULVAC, Inc.
Components Division
http://www.ulvac.co.jp/

Introduction

Thank you for choosing the Turbo Molecular Pump.
Please read the instruction manual carefully before using turbo molecular pump, and save the instruction manual for future reference.

Copyrights and Disclaimers

Precautions for Safe Operation

The instruction manual's nomenclature for warnings and precautions complies with the following safety warning symbols.

WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in serious injuly or possibly death.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor to moderate injuly or equipment damage.
NOTICE	Emphasizes additional information that is provided to ensure the proper use of this product.

WARNING

Turbo molecular pump repair and/or power supply repair can be very hazardous. Only trained technicians who are authorized by ULVAC may do service of products.

WARNING

Neither overhaul nor modify the pump proper and the controller without admission. Doing so would impair safety of the pump proper.

WARNING

Decisions on system compatibility should be made by the system designer or the person deciding the specifications after conducting tests as necessary. The responsibility for guaranteeing the expected performance and safety of the system lies with the person who decides system compatibility.

WARNING

Do not operate the turbo molecular pump until safety is confirmed.

・ The rotor assembly of the turbo molecular pump rotates at high speed. Large rapid shutdown torque should be generated when abnormality occurs in the pump by any chance. Incidental accident will cause the pump to drop out and to make a catastrophe if the pump is fixed by insufficient method.
・ Fix the pump to host equipment according to 5.1.2.2. The method to fix the pump is different depending on the pump model and the size of inlet flange of the pump.
・ Host equipment should be fixed to the floor so as not to move. Host equipment should be designed to have enough margins in strength, in preparation for an emergency accident.

WARNING

Ensure that no oil mist or hazardous substances are present in process line as safe ducting procedure when turbo molecular pump is installed to host equipment.

WARNING

Do not remove or do maintenance the turbo molecular pump, before safety has been confirmed.

・ Please take an adequate safety precaution based on the result of risk assessment of explosion, fire, corrosion, and toxicity, etc. that depends on process gasses.
・ Please execute the maintenance task of the turbo molecular pump after shutting power off by following proper procedure and confirming that the rotor has stopped completely

WARNING

After having operated the turbo molecular pump for evacuation of corrosive gas, keep the pump internal as vacuumed even after shutdown. Inflow of water content in the air to the pump internal would cause rapid erosion trouble of the pump internals.

CAUTION

Avoid to install the pump at the following places.
(1) Place where the pump is inevitably exposed to significant vibration and impact.
(2) Unstable place.
(3) Place where the pump is inevitably exposed to magnetic field and radioactive ray.
The pump proper is a precision machine. Be careful not to apply abnormal vibration, shock / impact to it during transportation. This pump is not an explosion-proof product. This pump is not intended to be used in a potentially explosive atmosphere. Do not use flammable gas and explosive gas.

CAUTION

The standard power input voltage is 24 VDC ± 5 %. Connection to the incorrect input voltage can cause damage to the equipment.

CAUTION

The following "CAUTIONS" are to prevent operation anomalies.

○ Operating Precautions

(1) Do not interrupt the electrical power operating the turbo molecular pump while the turbo molecular pump is in operation.
(2) Protect the pump from any and all types of impact during operation. Impacts can also be transmitted via the flange, so be careful of impacts near the pump as well.
(3) Do not operate any equipment (i.e. drill motor, welding machine, etc.) that produces electro-magnetic pollution, noise, etc., in the immediate proximity of an operating turbo molecular pumping system.
(4) This turbo molecular pump is not approved for use in applications exhausting process gas containing gallium (Ga, e.g., triethyl gallium, etc.) except for the pumps corresponded to use of gallium.
(5) Plasmas may cause the pump rotor to discharge electrically thus damaging the electrical components.
(6) When using the variable speed function to change the pump rotation rate, use a rotation rate that does not cause resonance with other devices installed at the site.
(7) Be careful to prevent a rapid pressure rise or air rush during operation.
(8) Avoid repeating acceleration and deceleration in short term. Doing so can result in high pump temperature.

NOTICE

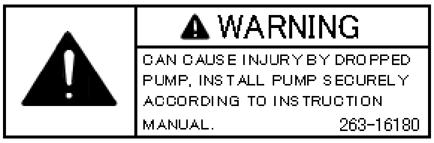
Before touching the pump internals and the vacuum chamber, put a pair of nylon gloves without fail. Avoid direct touch with them. Internal contamination of the vacuum chamber or the pump would cause deterioration of adequate vacuuming performance.

When using a hydraulic rotary pump with vibration of wide amplitude, as a backing vacuum pump, undertake proper anti-vibration measure. (As a guideline, control the vibration to 0.1G/50 Hz max at the outlet connection port of the turbo molecular pump.)

This pump is a precision pump. To protect the pump from torsion due to external piping load, use a bellows joint or a flexible tube to either the pump inlet or outlet, without fail.

○ Explanation of label

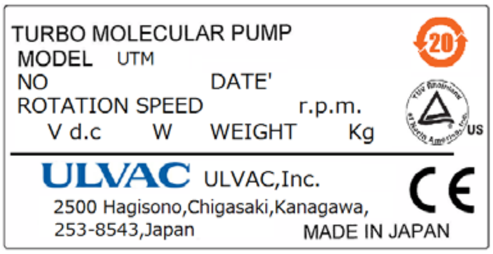
(1) HOT SURFACE Label
Risk of burn. Keep off from touching surface of the pump as it is heated.



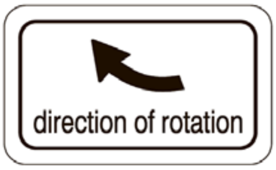
(2) Pump Securement Label
If the pump is not secured properly, it could become detached and cause injury or damage to surrounding equipment. Be sure to secure the pump according to 5.1.2 "Installation of the Pump".

(3) Do Not Remove Label
Do not remove cover, or else it may cause somechanges inside and it is failed.

(4) SECURITY seal
This label certificates that the product was made or maintenanced by ULVAC or by ULVAC authorized facility. In case "this label is removed" or "there is a mark showing once this label has been removed", ULVAC warranty shall not be applied to the product.

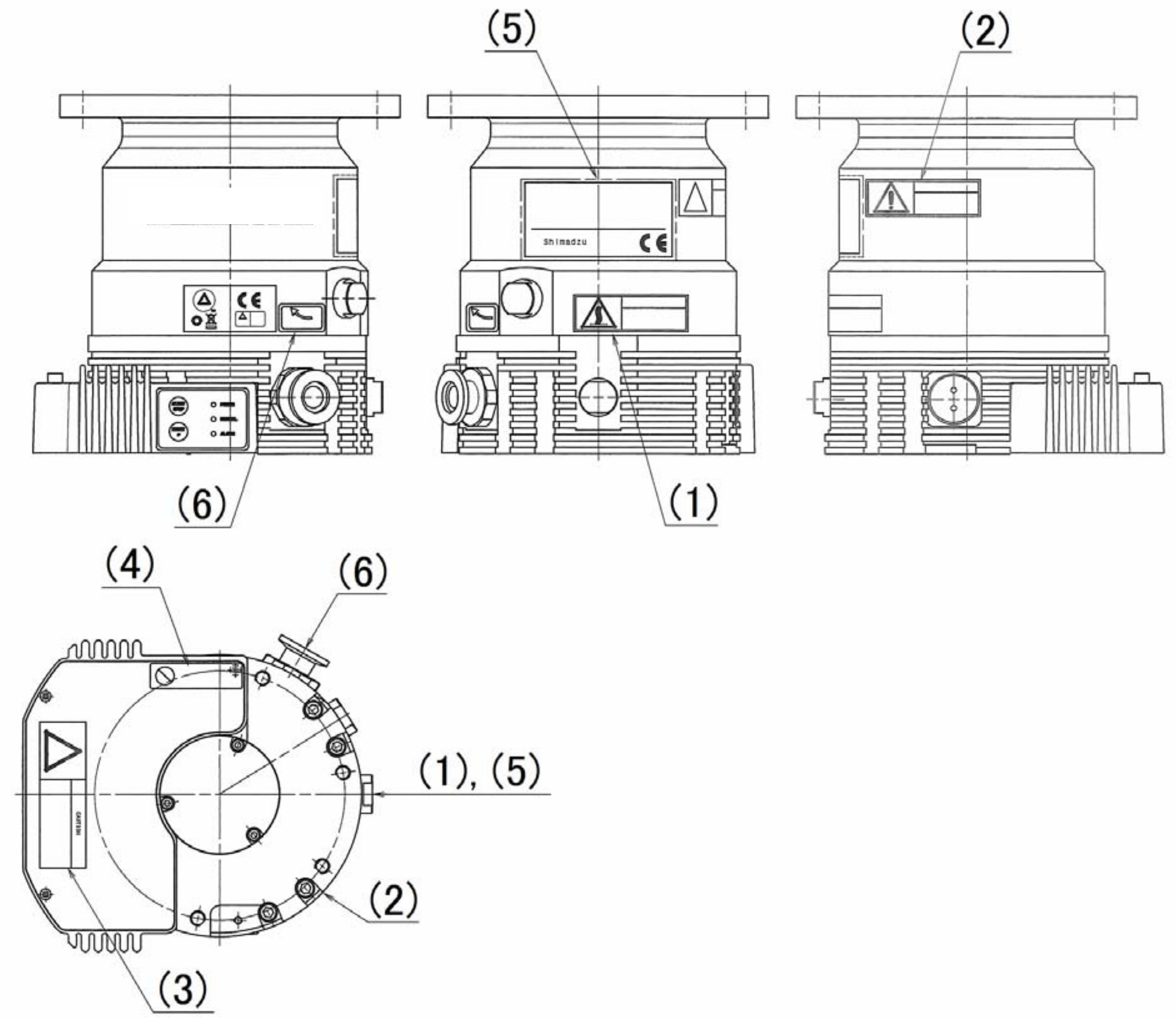


(5) Name plate



(6) Direction of rotation Label
The direction of rotation of rotor inside the pump.

○ **Location of label**



○ Warranty Clauses

This product was shipped after strict company inspection. However, in case any failure occurs under ULVAC's responsibility, such as defect in manufacturing and damage during transportation, buyer shall inform ULVAC, Inc. or the local ULVAC representatives. ULVAC will repair or exchange it at free of charge.

○ Warrantable Items

(1) Turbo molecular pump UTM300B

○ Warranty period

(1) Domestic business in Japan: one year after shipping date from ULVAC.
(2) Direct export transaction: one year after date of B/L

○ Warrantee scope

(1) Scope and exclusion of warranty
The scope of warranty is limited to the Pump only. ULVAC will repair this pump free of charge for a period of twelve (12) months from the date of delivery in case it failed due to defects in design or manufacturing during pumping down of air or nitrogen gas.
Troubles caused by the following are excluded from warranty.

- Troubles that occurred during pumping a gas other than air and nitrogen gas.
- Troubles caused by consumable parts.
- Troubles caused by different power supply from voltage and frequency specified when ordering.
- Because of acts of God or force majored such as earthquake, fire, flood, war, etc.
- Because of operating conditions not given in this instruction manual
- Because of modification, disassembly and repair not authorized by ULVAC
- Used under special environment (strong electromagnetic field, radiation, high temperature, high humidity, flammable gas ambience, corrosive gas ambience, dust, etc)
- Because of noise
- Loss or damage attributed to secondary troubles and indemnification against infringement on right
- In case ULVAC concluded that troubles occurred because of condition which does not meet use condition of this product.

○ Response procedure

(1) Domestic business in Japan:
ULVAC sends a replacement or Buyer returns the defective items to ULVAC, Inc. or to the local ULVAC representatives for repair. If field service is required, Buyer shall ask ULVAC, Inc. or the local ULVAC representatives.

(2) Direct export transaction:
ULVAC sends a replacement or Buyer return the defective items to ULVAC, Inc. or to the local ULVAC representatives for repair. Return charge shall be paid by Buyer.

○ Others

(1) In case, special agreement or memorandum for specifications is made individually, it comes in first.
(2) Buyer shall inform ULVAC when this product is exported out of Japan. In the meantime, Buyer shall take necessary procedures according to Foreign Exchange and Foreign Trade Law.
(3) As for the question and consultation, Buyer shall check the model and serial number and ask the local representative or ULVAC, Inc.
http://www.ulvac.co.jp/eng/support/index.html
(4) The contents of this document is subject to change without notice in future.

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Appendix A COMMUNICATIONS

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1

OUTLINE AND DESCRIPTIONS

1.1 Outline

The turbo molecular pump is a vacuum pump. The turbo molecular pump is used with a backing vacuum pump to create a high vacuum in a vacuum chamber.
This pump is not suitable for pumping aggressive or corrosive gases.

Typical Applications ; Semiconductor equipments,
Industrial equipments,
R&D applications,
The other ultra high vacuum applications.

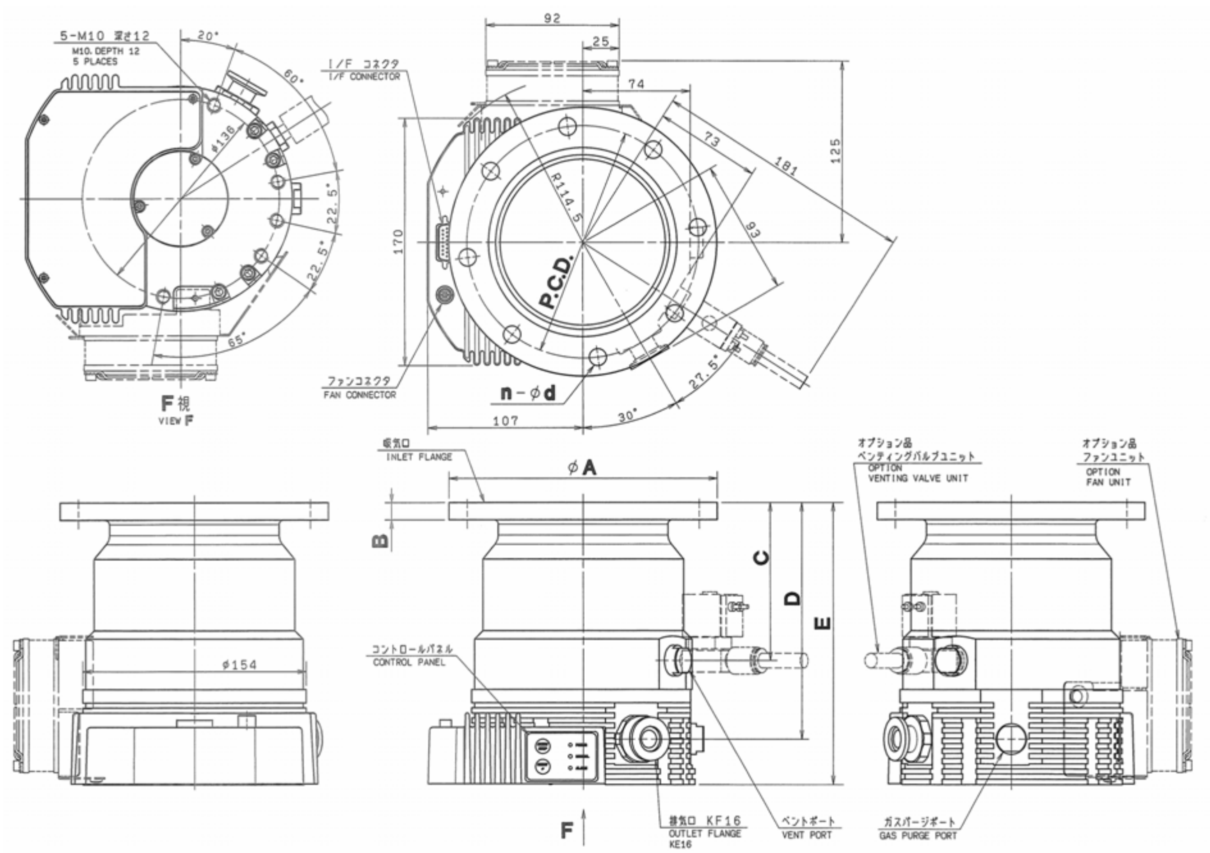
The turbo molecular pump (one standard set) consists of the following items.

・ Pump 1

・ Standard Accessories 1 Set

1.2 Descriptions

1.2.1 Outside drawing



Model	Inlet flange	φA	B	C	D	E	P.C.D	n-φd
UTM300B-AC	ICF152	φ152.4	19.5	122	186	207	φ130.3	16-φ8.5
UTM300B-AV	VG100	φ185	12	110	164	195	φ160	8-φ12
UTM300B-AK	ISO100-K	φ130	12	110	164	195	—	—

Fig1-1 Outside drawing

1.2.2 Standard Accessories

	Part name	Qty	Notes
1	Instruction manual	1	This manual
2	Protection net	1	Only VG and ICF ※ In ISO flange, protection net is built in the gasket.
3	Gasket (inlet flange)	1	ICF152 : Copper gasket VG100 : O-ring ISO100-K : Centering (with protection net)
4	Dust cap	1	For inlet flange, outlet flange and connector

1.2.3 Option Accessories

	Part name	Qty	Notes
1	Cooling fan	1	24 VDC
2	Venting valve	1	24 VDC, normally closed
3	Gas purge adaptor	1	KF10
4	Baking heater,100 V	1	100 VAC, 200 W (Power supply (100 VAC) is required separately)
5	Baking heater,230 V	1	230 VAC, 200 W (Power supply (230 VAC) is required separately)
6	Interface connector	1	D-sub 15 pin female with connector food
7	Interface cable 1 MT	1	24 VDC input, RS-485, relay outputs
8	Interface cable 2 MT		
9	Interface cable 3 MT		
10	Interface cable 5 MT		
11	Power supply, 24 VDC, 300 W 1 MT	1	Input voltage : 100-240 VAC with a 100 VAC plug for use in Japan and North America
12	Power supply, 24 VDC, 300 W 3 MT		
13	Power supply, 24 VDC, 300 W 5 MT		
14	Power supply, 24 VDC, 300 W 1 MT	1	Input voltage : 100-240 VAC with a 230 VAC plug for use in Europe
15	Power supply, 24 VDC, 300 W 3 MT		
16	Power supply, 24 VDC, 300 W 5 MT		
17	Communication cable, 1 MT	1	USB-RS485 converter and RS485 communication cable
18	Communication cable, 3 MT		
19	Communication cable, 5 MT		

2

IDENTIFICATION AND FUNCTION

2. 1　Pump Main Unit

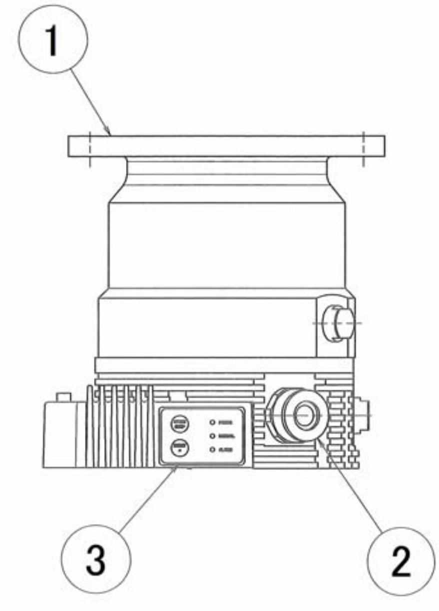


Fig. 2-1　Pump Main Unit

①INLET FLANGE…………………	Inlet flange, joint the turbo molecular pump, VG100, ICF152, ISO100-K
②OUTLET FLANGE………………	Outlet flange, connect a backing vacuum pump or its related pipe connection, KF16.
③LOCAL CONTROL PANEL…	Refer to Section 2.2 "Local Control Panel".

2. 2 Local Control Panel

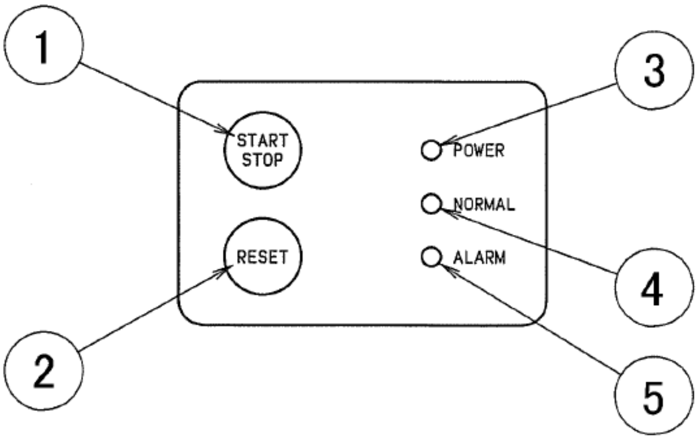


Fig. 2-2 Switch and LED

①START/STOP button…………	Push to acceleration or deceleration during LOCAL mode.
②RESET button…………………	When occur ALARM or WARNING, after remedying the cause of the ALARM, an abnormal state is released by pushing button. By maintained push (about 2 seconds), REMOTE MODE and LOCAL MODE are changed.
③ POWER lamp…………………	This lamp lights or blinks while power on. lights : REMOTE mode blinks : LOCAL mode
④ NORMAL lamp………………	Operation indicator lamp indicating that the pump's rotor rotating normally. lights : During normal rotation (over 80 % of rated speed) blinks : Rotor rotating (under 80 % of rated speed or idle rotation) (Note 1)
⑤ ALARM lamp…………………	Alarm / Warning lamp (orange). lights : ALARM occurs blinks : WARNING occurs

(Note 1) There are two types of blink pattern
blink quickly (approx. 2 Hz) : accelerating
blink slowly (approx. 1 Hz) : idle rotation

2.2.1 Oparational Status

This instruction manual defines the operational status of a turbo molecular pump, as shown in the following table.

Description	Operational status
[STOP]	Rotor of the turbo molecular pump stops. (Motor drive OFF)
[ACC]	Rotor of the turbo molecular pump accelerates. (Motor drive ON)
[IDLE] / [Free run]	Rotor of the turbo molecular pump is rotating. (Motor drive OFF)
[NORMAL]	Rotational speed of the rotor of the turbo molecular pump is over 80 % of rated speed. (Note 1) (Motor drive ON)
[ALARM]	Malfunction is occurring on the turbo molecular pump or the controller. If [ALARM] occur, the pump does not continue operation but shifts to protected operation.
[WARNING]	Malfunction is occurring on the turbo molecular pump or the controller. If [WARNING] occur, the pump continues operation.

(Note 1) The rotational speed setting which shifts to NORMAL state is able to change from 25 % to 97 % of rated speed by RS-485 communication. Refer to Section A3 "SERIAL COMMUNICATIONS PROTOCOL" and Table A-7 "Table of Settings" for detail.

2.2.2 Operation Modes

This instruction manual defines the operation mode of a turbo molecular pump, as shown in the following table. Refer to Section 6.1 "Overview" for detail.

Mode	Start/Stop procedure
[LOCAL]	The pump can be started or stopped by holding down the START/STOP button on local control panel.
[REMOTE]	The pump can be started or stopped via the START/STOP signal on interface connector.
[RS-485]	The pump can be started or stopped via RS-485 communications.

2. 3 Interface Connector

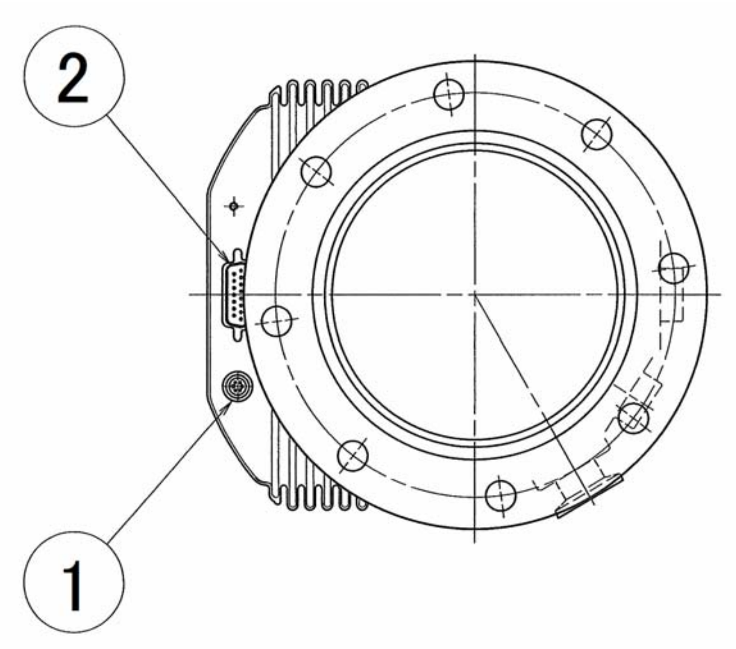


Fig. 2-3 Interface Connector

①Cooling fan connector…………… Connector for cooling fan
②Interface connector……………… Connector for power supply, RS-485, digital input / output, analog output.
(Refer to Section 6.7 "Interface Connector")

2. 4　Optional Accessories

2.4.1 Venting Valve

2.4.1.1 General Description

To maintain the cleanliness of your vacuum system, we recommend that you vent the pump (or vacuum system) whenever you switch the turbo molecular pump off. Otherwise, oil mist on the backing vacuum side spread to the turbo molecular pump or vacuum system. The venting valve operates simultaneously with the turbo molecular pump. The venting valve opens 10 seconds (Note 1) after the STOP signal is input to turbo molecular pump. The venting valve closes when a power failure occurs.

(Note 1) The time can be changed within the range of 0 to 30 seconds via RS-485 communication. Default setting of the delay time is 10 seconds.

2.4.1.2 Installation of Venting valve

Fig. 2-4 shows how the venting valve (P/N : 263-18796) is fitted to the pump.
Please connect nitrogen gas piping if necessary. In this case, you need to dismount the filter of the venting valve. Connecting port of the valve is Rc1/8. The nitrogen gas pressure should be 20 ± 10 kPaG.

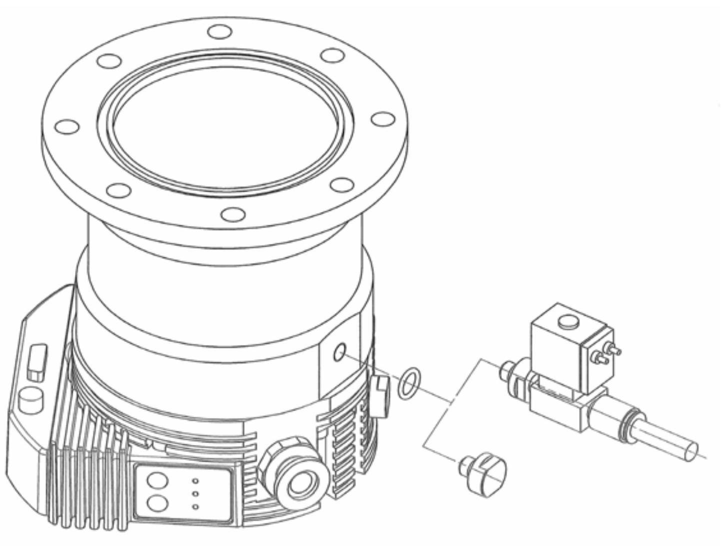


Fig. 2-4　Installation of the venting valve

2.4.1.3 Delay Venting Mode

If "Delay venting mode" is selected by RY1 operation setting, venting valve operation is as follows.

【Example of the operation of venting valve (when the delay time is 10 seconds (Note 1))】

① STOP signal is input to the controller, and TMP decelerates.

↓ …10 seconds (Note 1) after input STOP signal to controller.

② Venting valve is opened.

↓ …Venting valve continues to open until the rotor of TMP stops.

③ Venting valve is closed when the rotor of TMP stops.

(Note 1) The delay time can be changed within the range of 0 to 30 seconds via RS-485 communication. Default setting of the delay time is 10 seconds.

2.4.2 Cooling Fan

Fig. 2-5 shows how the cooling fan (P/N : 263-44455) is fitted to the pump.

CAUTION

Do not shut off the ventilation, or else pump and controller get heated and it is failed.
In order to secure sufficient air flow passage, the domain of less than 50 mm of front side of the cooling fan should leave space.

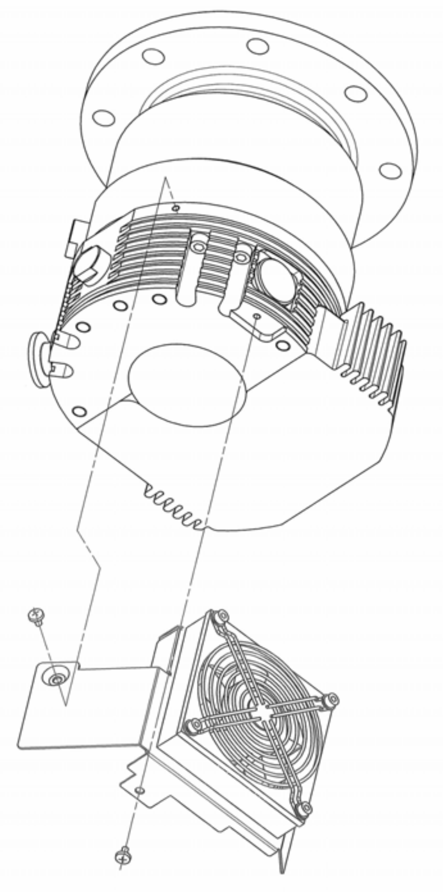


Fig. 2-5　Installation of the cooling fan

3

CONSTRUCTION AND PRINCIPLE

3. 1 Pump Construction

Fig. 3-1 is a sectional drawing of a turbo molecular pump. The built-in high frequency motor (1) is accelerated to the specified revolutions (speed) by the high frequency power supply unit. Rotor blades (3) are fitted onto the drive shaft (2) and the stator blades (4) are arranged in between the rotor blades. A positioning spacer (5) is inserted between the stator blades. The configurations and profiles of the stator blades and rotor blades are designed for high efficiencies in various applications. The upper stages of the rotor blade and stator blade configurations are ideally designed for high gas throughput. The compression ratio of the stator blades and rotor blades becomes higher as the gas molecules converge into the lower stage configurations. The profiles of the stator blades and rotor blades are matched for the desired function.

The shaft (2) is held with the permanent magnet (7) and the ball bearing (6).

A touch-down bearing (8) is used at the top of the casing for safety protection of rotor.

Protective net (11) protects that a foreign object comes in from inlet flange.

3. 2 Principle of Turbo Molecular Pumping

The principle of turbo molecular pumping assumes gas molecules collide with a surface plane (the blade of the pump rotor) moving in a radial span of very high speed in a space with an enlarged mean free gas path (generally a vacuum area of less pressure than 0.1 Pa). Assuming no heat is exchanged between the gas molecule and the pump rotor blade, the speed of the pump rotor blade is added to the speed of the gas molecule, converting the gas molecule's non-oriented thermal motion to a motion with direction. Thus the gas molecule has received an impulse in a desired flow direction.

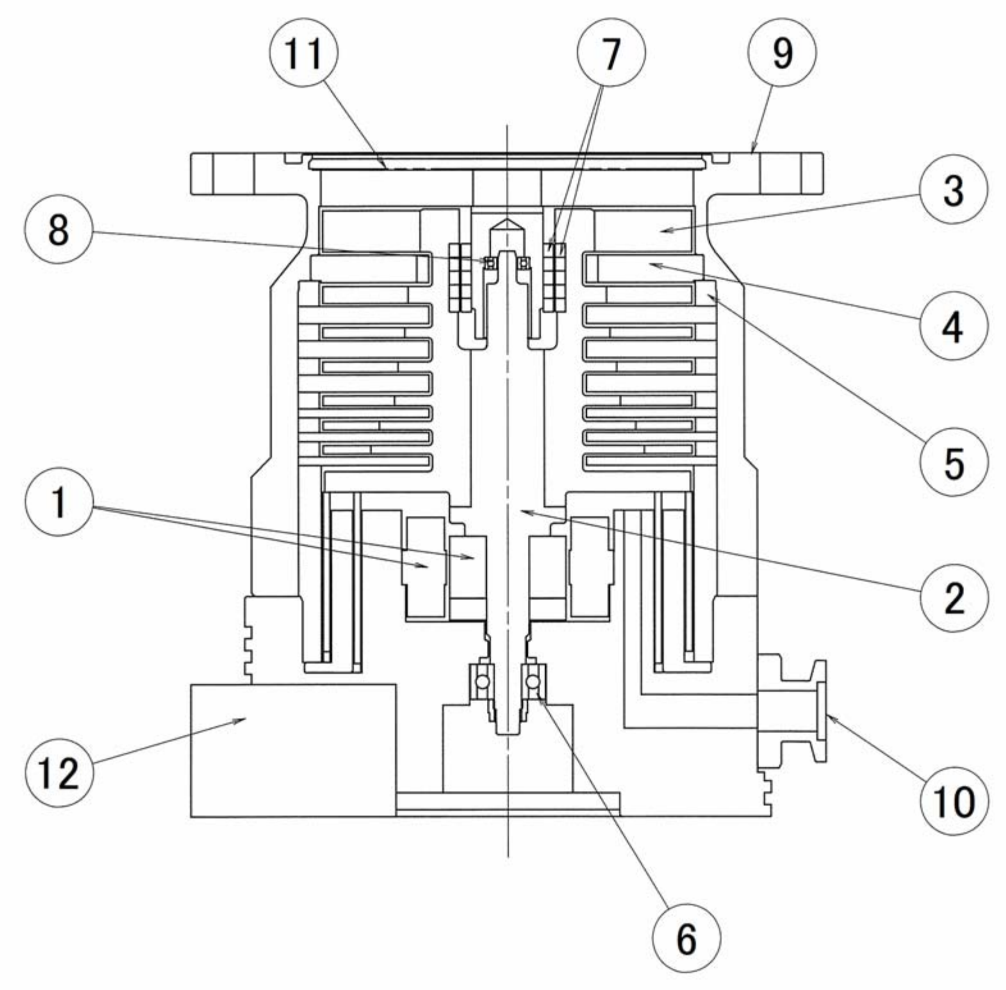


Fig. 3-1 Pump Sectional Drawing

(1) Motor
(2) Drive shaft
(3) Rotor blade
(4) Stator blade
(5) Spacer
(6) Ball bearing
(7) Permanent magnet
(8) Touch-down bearing
(9) Inlet flange
(10) Outlet flange
(11) Protective net
(12) Controller

3. 3 Control system

The controller (Fig. 3-1 (12)) includes the high frequency three phase pulsed power system. This system rotates the rotor inside the pump at a rated rotational speed.

Since it controls the turbo molecular pump externally, by remote control, the control system includes RS-485 serial interface ports, in addition to input/output ports for contact signals. The RS-485 ports allows monitoring the operating status and loading history data._

4

SPECIFICATIONS

4.1 Specification

4.1.1 Pump Main Unit

Turbo molecular pump model		UTM300B	
Cooling method		Convection	Forced air by cooling fan
Ultimate pressure	After baking	(Note 1)	10^{-8} Pa order (Note 2)
	Non-baking	10^{-6} Pa order	10^{-6} Pa order
Pumping speed (Note 3)	N_2	280 L/s	280 L/s
	He	270 L/s	270 L/s
	H_2	220 L/s	220 L/s
Compression ratio	N_2	$>1\times10^9$	
	He	7×10^6	
	H_2	1×10^5	
Critical backing pressure		1500 Pa	
Maximum allowable inlet pressure (Note 4) (Note 5)	N_2	0.06 Pa (ambient : 25 degrees C.) Refer to Section 4.2	0.7 Pa (ambient : 25 degrees C.) Refer to Section 4.2
Maximum allowable outlet pressure (Note 4) (Note 6)	N_2	100 Pa (ambient : 25 degrees C.) Refer to Section 4.3	1000 Pa (ambient : 25 degrees C.) Refer to Section 4.3
Maximum allowable flow rate		Refer to Section 4.4	Refer to Section 4.4
Mass	VG,ISO	6 kg	6.3 kg
	ICF	9 kg	9.3 kg
Bearing type		Permanent magnetic bearing and ceramic ball bearing	
Inlet flange		VG100,ICF152,ISO100-K	
Outlet flange		KF16	
Rated speed		60000 rpm	
Start-up time (> 80 %)		3.5 mimutes (Note 7)	
Allowable gas (Note 8)		N_2,He, H_2,Ar	
Mounting position		In any desired direction	
Noise (by ULVAC's method) (Note 9)		50 dB(A) or less	
Admissible ambient magnetic field	Radial direction	3 mT	
	Axial direction	15 mT	

(Note 1) Only pumps with ICF flange and with cooling fan can be baked.
(Note 2) When backed by two-stage oil-sealed rotary pump.
(Note 3) Without a protective net. Pumping speed for N_2 is 260 L/s with a protective net.

(Note 4) It is inconsistent with maximum continuous inlet pressure and maximum continuous backing pressure.
(Note 5) Maximum inlet pressure in which the pump can be operated continuously when gas flows Into the inlet port.
(Note 6) Maximum backing pressure in which the pump can be operated continuously when inlet pressure is ultimate pressure. Adopt a backing pump whose ultimate pressure lower backing pressure of the turbo molecular pump above mentioned considering conductance of fore-line pipes.
(Note 7) Input voltage : 24.0 VDC, backing pressure : less than 5 Pa.
(Note 8) Do not use reactive gasses, corrosive gasses or gas including gallium. Consult with ULVAC about other kind of gasses.
(Note 9) It is the measure of the ISO flange.

4.1.2 Power Supply Unit

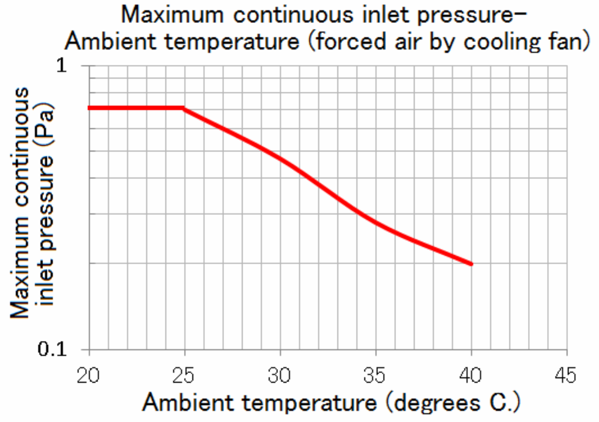
Communication	Contact	REMOTE (D-sub 15 pin male, Screw lock size #4-40UNC) (cf.Section 6.7 "Interface Connector") ・ Digital input : 4 ・ Digital output : 4 (including 2 relay outputs) ・ Analog output : 1 (rotational speed / motor current / motor temperature etc.)
	Serial	RS-485 (D-sub 15 pin male, common with REMOTE) (cf.Section 6.8 "RS-485 Communication Specifications")
Display, Switch	LED	POWER, NORMAL, ALARM
	Switch	START/STOP, RESET
Speed variation		Speed is variable between 25 % and 100 % of the reted speed. (set as 0.1 %)
Alarm detection	Alarms	Pump temperature, Pump startup error, Overload, Overspin for motor, Low voltage (Power failure), Power supply malfunction (Over temperature inside power supply, Failure of drive circuit), etc.
	Warnings	Power supply malfunction (Over temperature inside power supply)
Protective functions	Alarms	ALARM LED illuminates and motor drive stops.
	Warnings	ALARM LED blinks and the pump operation continues.
Input electric power	Voltage	24 VDC ± 5 %
	Maximum power	180 W

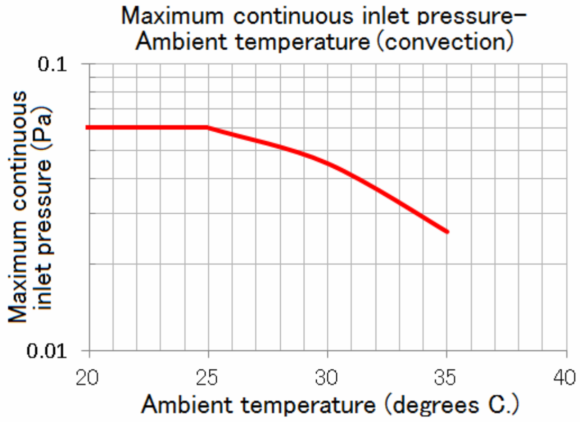
4. 2 Maximum inlet pressure

Condition				Maximum continuous inlet pressure (Note 1) (Note 2)
Backing pump	Gas type	Cooling method	Ambient temperature	
120 L/min	N_2	Natural convection	5 to 25 degrees C.	0.06 Pa
			30 degrees C.	0.045 Pa
			35 degrees C.	0.026 Pa
		Forced air	5 ~ 25 degrees C.	0.7 Pa
			30 degrees C.	0.47 Pa
			35 degrees C.	0.28 Pa
			40 degrees C.	0.2 Pa

(Note 1) It is inconsistent with maximum continuous inlet pressure and maximum continuous backing pressure.

(Note 2) Maximum inlet pressure in which the pump can be operated continuously when gas flows into the inlet port.



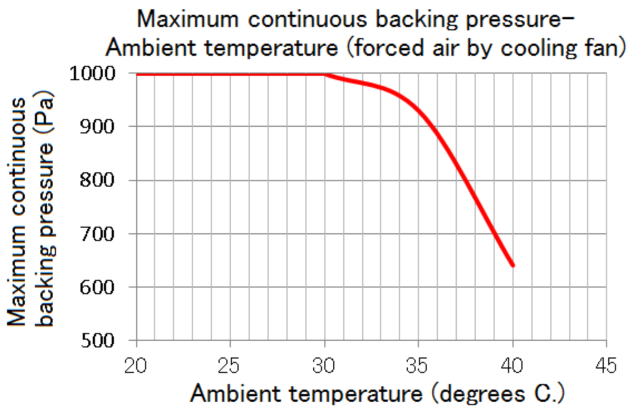


4. 3 Maximum continuous backing pressure

Condition			Maximum continuous backing pressure (Note 1) (Note 2)
Gas type	Cooling method	Ambient temperature	
N_2	Natural convection	5 to 35 degrees C.	100 Pa
	Forced air	5 ~ 30 degrees C.	1000 Pa
		35 degrees C.	930 Pa
		40 degrees C.	640 Pa

(Note 1) It is inconsistent with maximum continuous inlet pressure and maximum continuous backing pressure.

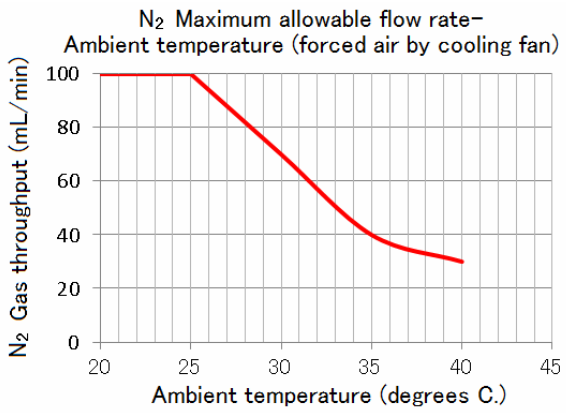
(Note 2) Maximum backing pressure in which the pump can be operated continuously when inlet pressure is ultimate pressure.
Adopt a backing pump whose ultimate pressure allows lower backing pressure of the turbo molecular pump above mentioned considering conductance of fore-line pipes.

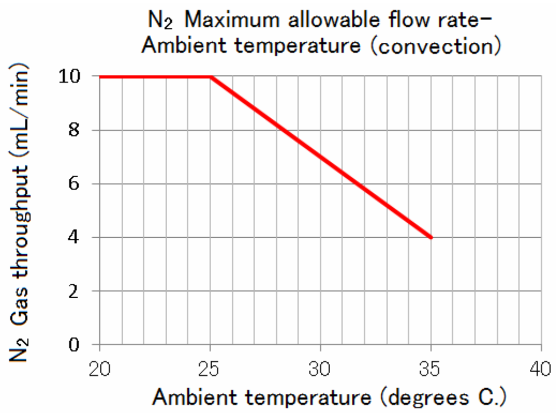


4. 4 Maximum allowable flow rate

Condition					Maximum allowable flow rate (Note 2)
Backing pump	Ambient temperature	Gas type (Note 1)	Cooling method	Gas purge	
120 L/min	5 ~ 25 degrees C.	N_2	Natural convection	No	10 mL/min
			Forced air	No	100 mL/min
		Ar	Forced air	No	30 mL/min
				Yes (Note 3)	40 mL/min

(Note 1) Consult your ULVAC representative before using gasses except shown in above table.
(Note 2) mL/min : volume flow rate at 0 degrees C., 1atm. (Compatible with SCCM.)
(Note 3) Recommended gas purge condition : N_2 gas, 25 mL/min.





4．5 Environmental Conditions

Installation conditions (Refer to UL/EN 61010-1 standard)		Use : Indoor, Altitude max : 2000 m, Overvoltage category I, Pollution degree 2 IP classification 40
Temperature (above dew point)	Operation	5 to 35 degrees C. (natural convection)
		5 to 40 degrees C. (forced air)
	Storage	-25 to 65 degrees C.
Relative humidity		40 to 80 %RH

4．6 Standards Fulfilled

Safety	EN 61010-1: 2010 UL 61010-1: 2012 EN 1012-2: 1996 +A1: 2009
EMC	EN 61326-1: 2006 Class A

5

INSTALLATION

5. 1 Installation

5.1.1 Pump Mounting Direction

This turbo molecular pump can be installed in vertical, horizontal, inverted, or oblique position. (Refer to Fig. 5-1)

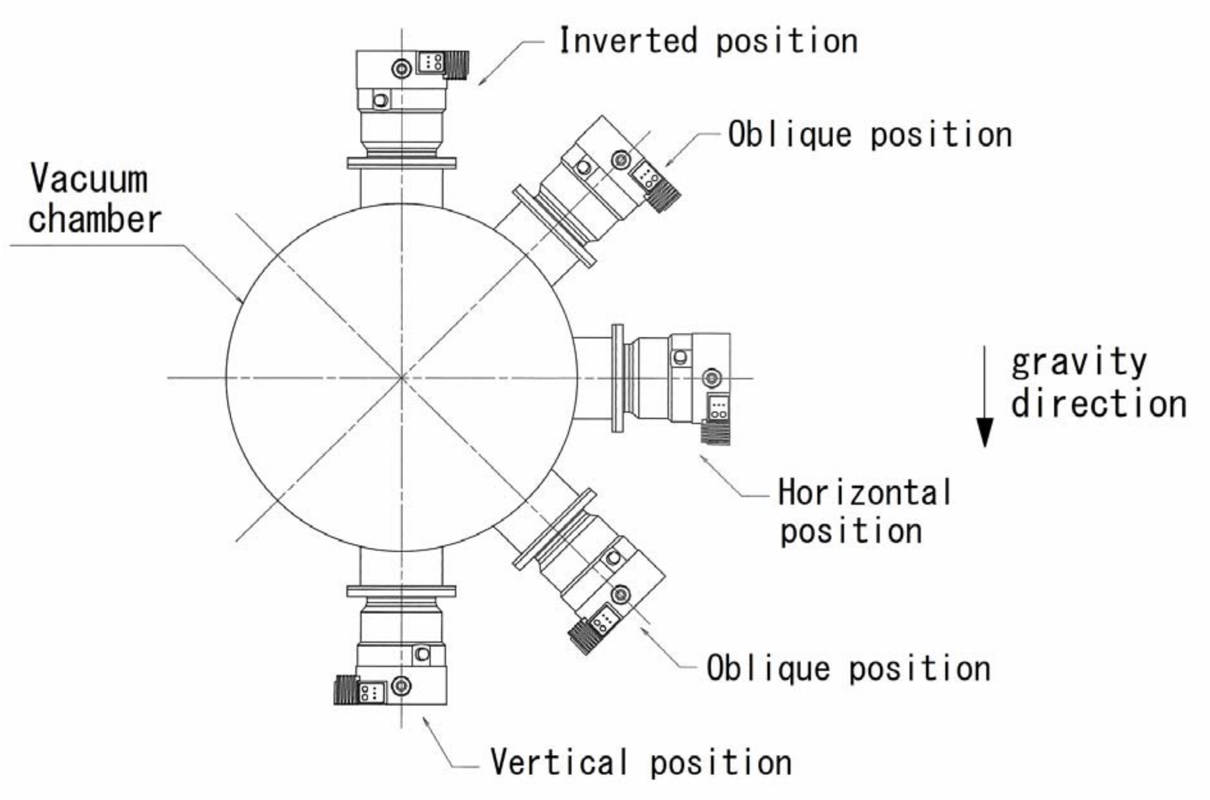


Fig. 5-1　Mounting Direction of the Turbo Molecular Pump

5.1.2 Installation of the Pump

WARNING

To ensure safety, do not operate the pump.

・ The rotor assembly of the turbo molecular pump rotates at high speed. Large rapid shutdown torque should be generated when abnormality occurs in the pump by any chance. Incidental accident will cause the pump to drop out and to make a catastrophe if the pump is fixed by insufficient method.

・ Fix the pump to host equipment according to 5.1.2.2. The method to fix the pump is different depending on the pump model and the size of inlet flange of the pump.

・ Host equipment should be fixed to the floor so as not to move. Host equipment should be designed to have enough margins in strength, in preparation for an emergency accident.

CAUTION

Avoid to install the pump at the following places.
(1) Place where the pump is inevitably exposed to significant vibration and impact.
(2) Unstable place.
(3) Place where the pump is inevitably exposed to magnetic field and radioactive ray.

The pump proper is a precision machine. Be careful not to apply abnormal vibration, shock / impact to it during transportation. This pump is not an explosion-proof product. This pump is not intended to be used in a potentially explosive atmosphere. Do not use flammable gas and explosive gas.

NOTICE

Before touching the pump internals and the vacuum chamber, put a pair of nylon gloves without fail. Avoid direct touch with them. Internal contamination of the vacuum chamber or the pump would cause deterioration of adequate vacuuming performance.

When using a hydraulic rotary pump with vibration of wide amplitude, as a backing vacuum pump, undertake proper anti-vibration measure. (As a guideline, control the vibration to 0.1G/50 Hz max at the outlet connection port of the turbo molecular pump.)

This pump is a precision pump. To protect the pump from torsion due to external piping load, use a bellows joint or a flexible tube to either the pump inlet or outlet, without fail.

5.1.2.1 Instruction and Lifting Method

This puroduct lift the pump in the manner shown in Fig. 5-2.

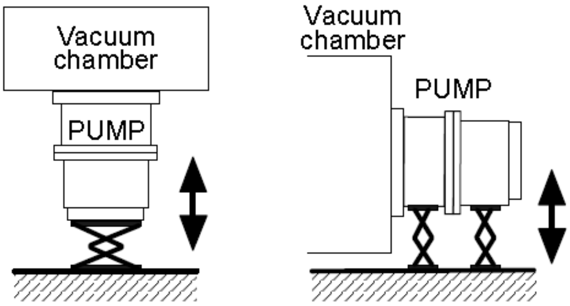
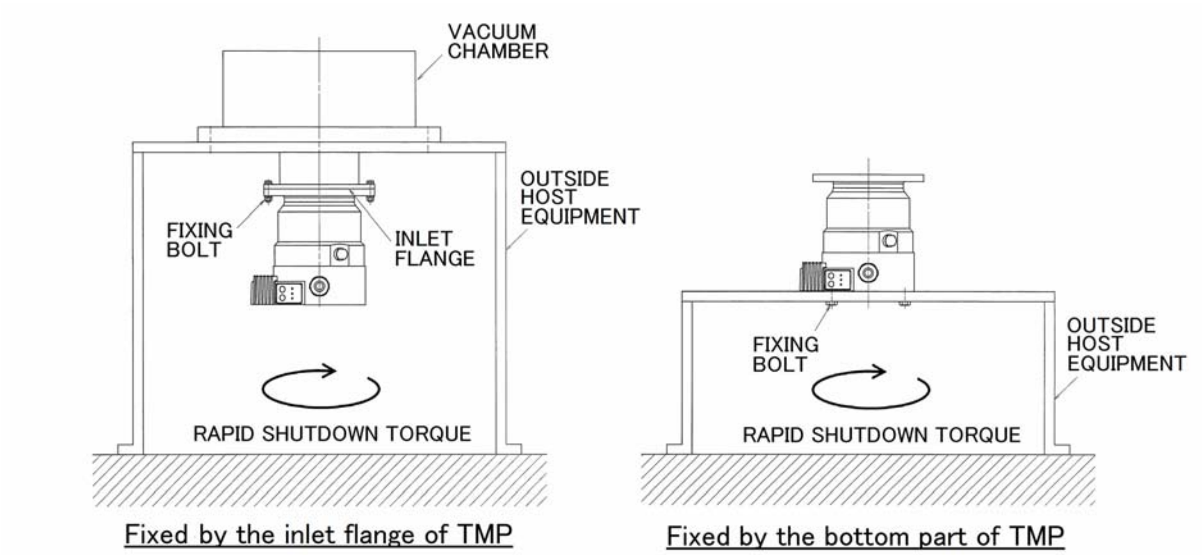


Fig. 5-2　Lifting Method

5.1.2.2 Installation

Refer to Fig. 5-3 for the method to fix the turbo molecular pump to host equipment.
When you fix the pump, use the bolts regulated grade, size, number and tightening torque (Refer to Table 5-1 and Table 5-2). And use all the bolt-holes of the inlet flange of the pump.
Refer to Fig. 5-4 about usage of the bolt.
The sets of half-screw bolt and nut should be used to fix the inlet flange of the pump. Make installation with the cylindrical part of the bolt (not screw part) fit in the mating section of flanges.
When you connect piping or valve between the chamber and the pump, please fix the same method as the inlet flange.



Description	Rapid shutdown torque (Note)
UTM300B	5400 N・m

(Note) Rapid shutdown torque is the typical value measured by the ULVAC's test condition.
The torque to transmit to host equipment might be different according to the rigidity of host equipment. Host equipment should be designed to have enough margins in strength.

Fig. 5-3 Installation of Turbo Molecular Pump

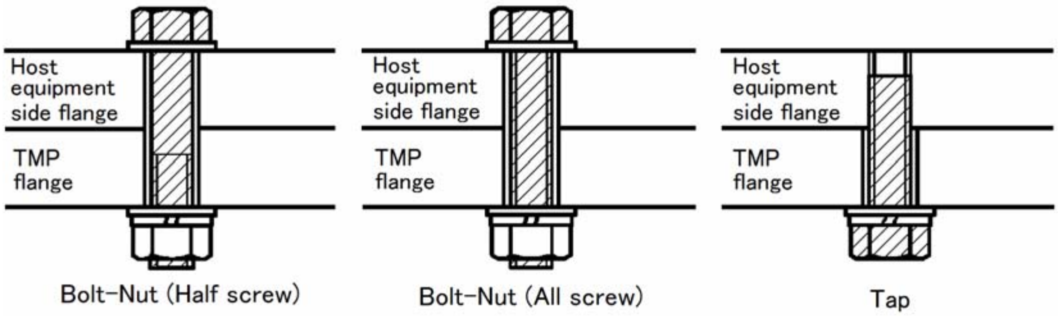


Fig. 5-4 How to use of the bolt

Table 5-1 The recommended fixing bolt

■ **By the inlet flange**

Bolt-Nut (Half screw· All screw)· Tap

Fixing method	By the inlet flange		
Inlet flange	VG100	ICF152	ISO100-K (Note 1)
Bolt size, Quantity	M10, 8 PC	M8, 16 PC	Clamp, 4 PC
Material	Stainless steel		Carbon steel
Grade	A2-70 (JIS B 1054 / ISO-3506)		8.8 (JIS B 1051 / ISO 898-1)
Washer	Plain washer and spring lock washer		

(Note 1) The main pump body may rotate if abnormality occurs in the pump in the event of accident.

■ **By the bottom part**

Fixing method	Bottom part of the pump
Bolt size, Quantity	M10, 5 PC
Material	SCM435（JIS G 4053 / ISO-683）
Grade	12.9（JIS B 1051 / ISO-683）
Washer	Plain washer and spring lock washer

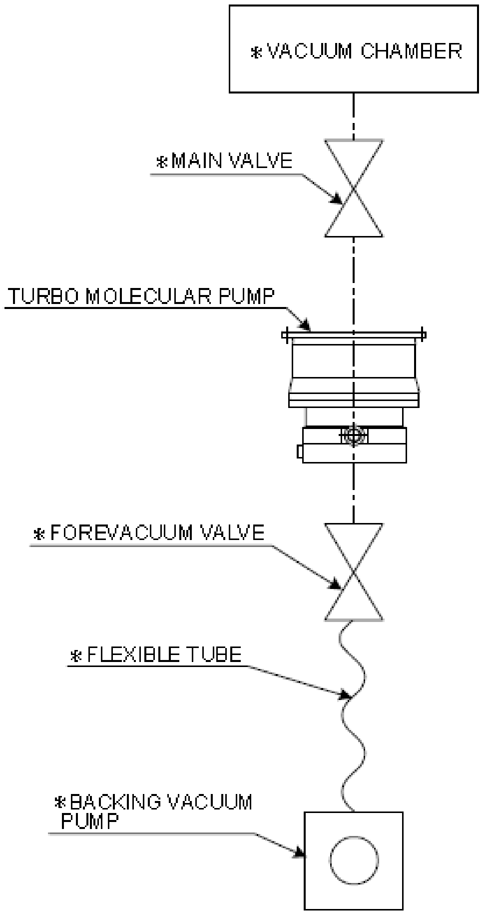
Table 5-2 Tightening torque of the fixing bolt

Size of bolt	Tightening torque [N•m]
M8	4.7 to 7.6
M10	9.4 to 15

5.1.3 Example of piping connection

5.1.3.1 Connection of exhaust line

Connect a backing vacuum pump or its related pipe connection flange to the outlet flange of the pump. (Refer to Fig. 5-5)



* marks are not attached to this turbo molecular pump set.

Fig. 5-5 Example of Exhaust Line

After complete piping connection, check for perfect airtightness by helium leak test.

5. 2 Connection of electrical supply

CAUTION

This product requires a separate power supply (not included). The power supply should be adequately protected against a hazardous live condition.

The power input voltage of this product is 24 VDC ± 5 %. Do not exceed the maximum supply voltage. Excessive supply voltage will cause damage to the control electronics.

5.2.1 Connection of electrical supply

(1) Turn off the separate power supply.
(2) Connect power cable to Inteface connector (Pin No.1, 5, 7, 15. Refer to Table 5-3 and Fig. 5-6).
(3) You must use a shielded wire and the shield wire should be connected the connector case.

Table 5-3 Pin assignment of interface connector

Pin No.	Input/ Output	Name	Designation factory settings
1,5	Input	+ 24 VDC in	Voltage supply for the TMP controller (Note 1)
2	Input	START / STOP	To connect this pin to GND : Start pump To open this pin : Stop pump
3	Input	DI1	To connect this pin to GND : RY1 ON To open this pin : RY1 OFF
4	Input	DI2	To connect this pin to GND : RY2 ON To open this pin : RY2 OFF
6	Input	Low Speed Reset	To connect this pin to GND : Low Speed ON To open this pin : Low Speed OFF To connect this pin to GND for 500 ms to 2000 ms : Reset Alarm
8	Input	DO1	OPEN : Not NORMAL, CLOSE : NORMAL (Note 2)
9	output	DO2	OPEN : No ALARM, CLOSE : ALARM (Note 2)
10	output	RY1 (Relay output)	Venting valve can be connected. (Note 2) (Note 3) This output can be loaded with maximum 24 V / 500 mA.
11	output	RY2 (Relay output)	This output can be loaded with maximum 24 V / 500 mA. (Note 2)
12	output	Analog output	Actual rotation speed : 0-10 VDC is equivalent to 0-100 % of rated speed. (Note 2)
13	output	RS485 (+)	D+
14	—	RS485 (-)	D-
7,15	—	GND	Ground (Note 1)

(Note 1) Connect all 4 pins for 24 VDC line and GND line.
(Note 2) The functions can be change via RS-485 communication.
(Note 3) Venting valve need to be normally closed. If you use a normally open valve, you have to change the function via RS-485 communication.
(Note 4) Don’t connect any pins other than specified above.
(Note 5) It takes 6 seconds until it comes to show that this signal is correct, after input POWER.

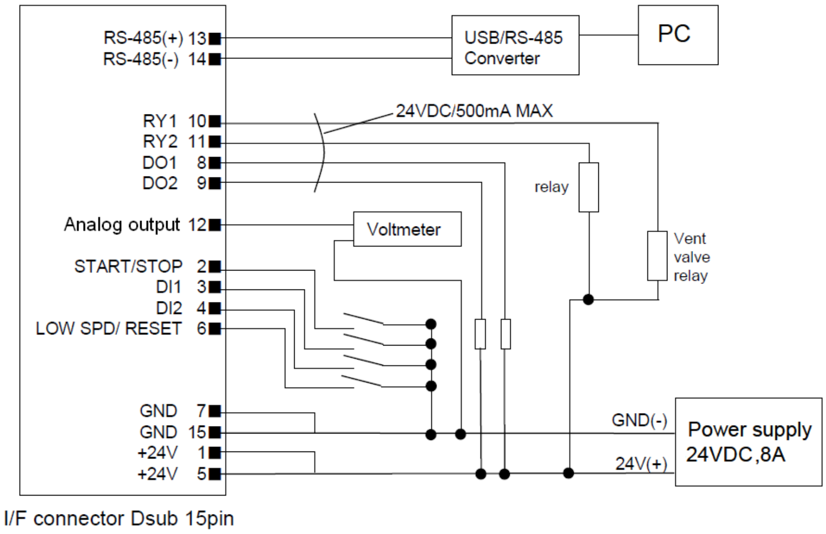


Fig. 5-6 Connection of I/F connector

5.2.2 Connection I/F connector with Interface Cable (Option)

The connection of Interface cable (P/N : 263-44408) is shown in Fig. 5-7.

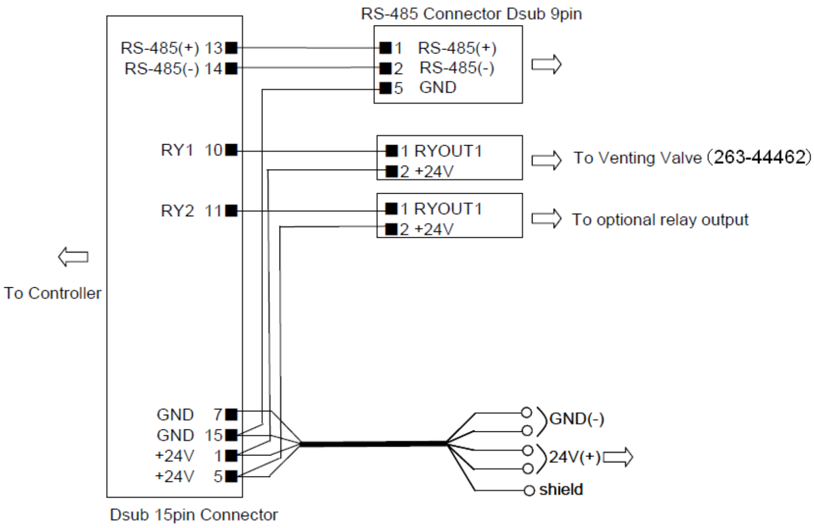


Fig. 5-7 Interface Cable (P/N : 263-44408) diagram

5. 3 Interlock for Vacuum System

(1) When using, as a backing vacuum pump, a vacuum pump with no check mechanism (backstream flow prevention) such as dry vacuum pump, etc., install a forevacuum valve between the turbo molecular pump and the backing vacuum pump to prevent rapid inverse flow of exhausted gas. And close the forevacuum valve before the backing vacuum pump stops. (Refer to Fig. 5-5)
(2) If "ALARM" signal is emitted or ALARM lamp lights, shut down the backing vacuum pump or close the forevacuum valve immediately. Furthermore, when main valve is installed between the turbo molecular pump and the vacuum chamber, close this valve, too.

5. 4 Notes on transportation

This product is precision equipment. Do not give any strong impact or continuous vibration in transportation, otherwise the product could be damaged. In transportation, please use a means of transportation which have vibration-proof function (an air suspension truck, for example). Especially when passing by rough road, we recommend that the product is transported keeping the packing condition when it ships from ULVAC.

When the product is put on the high temperature / humidity environment for a long time, it causes the breakdown of the product due to corrosion of mechanical parts or performance loss of electrical parts. Please transport or store the product under an appropriate environment

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6

OPERATION

6.1 Overview

CAUTION

Do not turn off the power during pump operation.

6.1.1 Introduction : Operation Modes

When the power is input, the pump starts self-diagnosis.
When the result is normal, operation is enabled. When an abnormal condition is detected, the ALARM lamp lights up in orange.

The pump can be started/stopped in a number of different ways ; using a switch, contact signal, or communication.
However, the pump cannot be started/stopped using two or more of these ways at the same time.
Determination of which start/stop instruction to be followed depends on the operation mode selected.

There are three operation modes as listed below.
(1) LOCAL mode where switches on the control panel are used for control
(2) REMOTE mode where logic interface signals are used for control
(3) RS-485 mode where RS-485 communication is used for control

The pump starts in the REMOTE mode described in (2) when the power is turned on including when recovering from a power failure.
Switch to an operation mode prior to starting/stopping the operation.
Transit between operation modes is shown in Fig. 6-1. The state of the POWER lamp is different between the LOCAL and other modes, as shown in Table 6-1.
Hold down the RESET button to transit between the LOCAL and REMOTE modes.
To transit to a communication mode, send an online request via the corresponding communication media.

Table 6-1 LOCAL and REMOTE Modes

mode	lamp state	Start/Stop procedure
LOCAL	POWER lamp flashes.	The pump can be started or stopped by holding down the START/STOP button.
REMOTE RS-485	POWER lamp lights up.	The pump can be started or stopped via a contact input, or RS-485 communication. When using RS-485 communication, the pump can be started or stopped by sending an online request command via the corresponding communication specification. To return from a RS-485 mode to the REMOTE mode, send an offline request command via the corresponding communication specification.

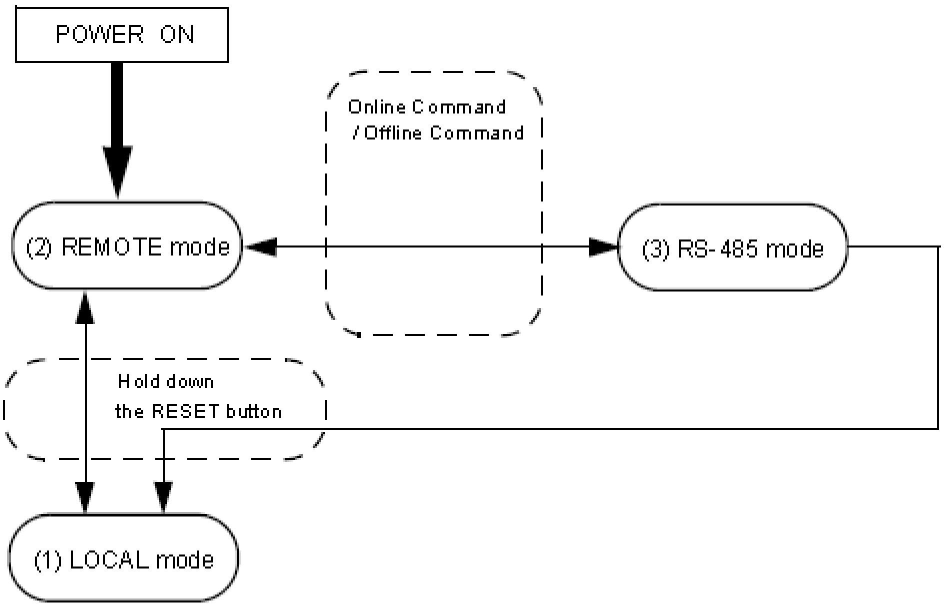


Fig. 6-1 Operation Mode Transition Diagram

6.2 Startup Preparation

6.2.1 Start-up Preparation Sequence in LOCAL Mode

(1) Please input the power and check if the POWER lamp (Fig. 2-2 (3)) lights.
Maintained push the RESET button (Fig. 2-2 (2)) to change from REMOTE mode to LOCAL mode. The POWER lamp blinks when becoming a LOCAL mode.
(2) Evacuate the turbo molecular pump by using a backing vacuum pump.
(3) Start-up preparation is complete if the pressure in the turbo molecular pump reduces below 1000 Pa.

6.2.2 Start-up Preparation Sequence in logic interface

(1) Please input the power and check if the POWER lamp (Fig. 2-2 (3)) lights.
(2) Evacuate the turbo molecular pump by using a backing vacuum pump.
(3) Start-up preparation is complete if the pressure in the turbo molecular pump reduces below 1000 Pa.

6.2.3 Start-up Preparation Sequence in RS-485 communication

(1) Please input the power and check if the POWER lamp (Fig. 2-2 (3)) lights. And check that the fan is operating.
(2) Online command is demanded from RS-485 communication and confirm the mode was switched to the communication means mode.
(3) Evacuate the turbo molecular pump by using a backing vacuum pump.
(4) Start-up preparation is complete if the pressure in the turbo molecular pump reduces below 1000 Pa.

6.3 Start-up

6.3.1 Start-up Sequence in LOCAL Mode

(1) Start-up begins when the 6.2.1 "Start-up Preparation Sequence in LOCAL Mode" is complete.
(2) Maintained push the START/STOP button (Fig. 2-2 (1)).
(3) Pump acceleration starts. The NORMAL lamp (Fig. 2-2 (4)) blinks quickly.
(4) When the rotational speed reaches 80 % rated value, the NORMAL lamp lights.

Pump start-up is complete.

6.3.2 Start-up Sequence in logic interface

(1) Start-up begins when the 6.2.2 "Start-up Preparation Sequence in logic interface" is complete.
(2) "START" signal (Refer to Table 6-6) is input from the Interface connector.
(3) The pump starts to accelerate.
(4) When the rotational speed reaches 80 % rated value, the Interface connector "NORMAL" signal (Refer to Table 6-6) turns on.

Pump start-up is complete.

6.3.3 Start-up Sequence in RS-485 communication

(1) Start-up begins when the 6.2.3 "Start-up Preparation Sequence in RS-485 communication" is complete.
(2) "START" command is input via RS-485 communication.
(3) The pump acceleration starts. Status is changed from "STOP" to "ACCELERATION".
(4) When the rotational speed reaches 80 % rated value, status is changed from "ACCELERATION" to "NORMAL".

Pump start-up is complete.

6.4 Shutting Down

CAUTION

When reducing internal pressure of the turbo molecular pump up to around the atmospheric pressure by use of inert gas, etc., adjust the pressure reducing valve so that the internal pressure of the same pump does not exceed 20 kPa GAUGE.

For shut-down of the turbo molecular pump, follow the sequence below.

6.4.1 Preparations Prior to Shutting Down Operation

(1) Check that process gas inflow is in complete stop. When main valve is provided between the turbo molecular pump and vacuum chamber, close the valve, too.
(2) When purge gas is being fed into the turbo molecular pump, stop the gas feed, too.
(3) When forevacuum valve is provided between the turbo molecular pump and backing vacuum pump, close the valve, too.

6.4.2 Shutting Down Sequence in LOCAL Mode

(1) Maintained push the START/STOP button (Fig. 2-2 (1)) and check that the NORMAL lamp (Fig. 2-2 (4)) blinks slowly.
(2) Wait until the NORMAL lamp goes out.
(3) Shut the power off.

6.4.3 Shutting Down Sequence in logic interface

(1) Input the "STOP" signal (Refer to Table 6-6) from the Interface connector.
If stop from "NORMAL" status, "NORMAL" signal is OFF.
(2) Wait until the analog output signal (rotation speed) to 0 V.
(3) Shut the power off.

6.4.4 Shutting Down Sequence in RS-485 communication

(1) Input the "STOP" command via RS-485 communication.
The pump deceleration starts. Status is changed from "NORMAL" or "ACCELERATION" to "IDLE".
(2) Wait until status changes to "STOP" status.
(3) Shut the power off.

Further, in such a case when a hydraulic rotary vacuum pump is used as backing vacuum pump and there is possible reverse flow and diffusion of oil from the backing vacuum pump, return the pump internal pressure to atmospheric pressure using dry nitrogen gas, after complete shut-down of the pump NORMAL lamp goes out, to prevent the turbo molecular pump from being contaminated with oil vapor.
For shutting down the turbo molecular pump in running at high speed with infeed of dry nitrogen gas to the pump, keep the nitrogen gas flow rate at 1500 mL/min maximum.

REFERENCE (shutting down procedure)
In order to avoid contamination of vacuum chamber by vapor of bearing grease, it recommends returning the inside of TMP to atmospheric pressure using a venting valve.

6. 5 Variable Speed Operation

CAUTION

When using the variable speed function to change the pump rotation rate, use a rotation rate that does not cause resonance with other devices installed at the site.

NOTICE

The variable rotation speed function is only available by remote control or RS-485 operation. Rotation speed cannot be varied by local control.

6.5.1 Outline

(1) The rotational speed settings function sets the rotational speed by selecting between the NORMAL speed mode or LOW SPEED mode.
(2) Select the NORMAL mode or LOW SPEED mode by REMOTE operation using the "LOW SPEED" signal input (Refer to Table 6-6).
(3) The NORMAL mode or LOW SPEED mode selection can be made before or after start-up.
(4) Set the low speed value between 25 % and 100 % of the rated speed in 0.1 % increments, using the RS-485 communication.
(5) The low speed value can be set while the pump is rotating in the LOW SPEED mode. The pump then accelerates or coasts to the new set value and maintains the set speed.
(6) The time required for the speed to change is the same as the time for normal acceleration or coasting.
For example, if the low speed value is set to 80 % and the LOW SPEED mode is selected during normal rotation, the time for the speed to drop to 80 % is approximately one-fifth the time required to stop from rated speed.

6.5.2 Operation from Start-up to Low Speed Rotation

This is the procedure until low-speed rotation is achieved when the speed setting is made with the pump stopped.

6.5.2.1 Logic interface Operation

(1) Start-up begins when the 6.2.2 "Start-up Preparation Sequence in logic interface" is complete.
(2) Set rotation to low speed via RS-485 interface. Once it is set, it does not need to be set each time.
(3) Input the "LOW SPEED" signal (Refer to Table 6-6) from the logic interface.
(4) Input the "START" signal from the remote-control connector (Refer to Table 6-6).
(5) The pump starts to accelerate.
(6) When the rotational speed reaches 80 % of low speed value, the "NORMAL" signal turns on.
(7) When the pump speed reaches the set low speed value, acceleration stops and the pump speed is maintained.

※ The same operation occurs if the "LOW SPEED" signal is input after the "START" signal is input but before the pump speed reaches the set low speed value.

6.5.2.2 RS-485 interface Operation

(1) Start-up begins when the 6.2.3 "Start-up Preparation Sequence in RS-485 communication" is complete.
(2) Set rotation to low speed via RS-485 communication.
(3) "LOW SPEED" command is input via RS-485 communication.
(4) "START" command is input via RS-485 communicaton.
(5) The pump acceleration starts. Status is changed from "STOP" to "ACCELERATION". When the rotational speed reaches 80 % rated value, status is changed from "ACCELERATION" to "NORMAL".
(6) When the pump speed reaches the set low speed value, acceleration stops and the pump speed is maintained.

6.5.3 Operation From Rated Speed Rotation to Low Speed Rotation

The following procedure is used to change the rotation speed setting and operate in the low-speed mode when currently operating at the rated speed or accelerating at a speed greater than low speed rotation.

6.5.3.1 Remote Control Startup Procedure

(1) Set rotation to low speed via RS-485 interface.
(2) Input a low-speed signal via the logic interface (Refer to Table 6-6).
(3) This switches the "NORMAL" signal OFF (Refer to Table 6-6) and starts coasting the pump.
(4) Once rotation reaches the low-speed rotation speed, the "NORMAL" signal ON.
(5) The pump stops coasting and maintains it current rotation speed.

※ If the "LOW SPEED" signal is canceled before reaching low-speed rotation, then it will function the same as for normal startup mode.

6.5.3.2 RS-485 interface Operation

(1) Set rotation to low speed via RS-485 communication.
(2) "LOW SPEED" command is input via RS-485 communication.
(3) Status is changed from "NORMAL" to "IDLE", and starts coasting the pump.
(4) Once rotation reaches the low speed rotation speed, status is changed from "IDLE" to "NORMAL". The pump stops coasting and maintains it current rotation speed.

6.5.4 Operation from Low Speed Rotation to Rated Speed Rotation

This is the procedure to select normal speed operation during low speed rotation.

6.5.4.1 REMOTE Operation

(1) Cancel the "LOW SPEED" signal (Refer to Table 6-6) inputted in the remote-control connector.
(2) Pump starts to accelerate. If the set low speed value did not exceed 80 % rated speed, the "NORMAL" signal turns off.
(3) When the rotational speed reaches 80 % rated speed, the "NORMAL" signal turns on.
(4) If the set low speed value exceed 80 % rated speed, logic interface signals remain unchanged and the pump accelerates.
(5) When the rated speed is reached, the pump stops accelerating and the pump speed is maintained.

6.5.4.2 RS-485 interface Operation

(1) "NORMAL SPEED" command is input via RS-485 communication.
(2) Pump starts to accelerate. If the set low speed value did not exceed 80 % rated speed, status is changed from "NORMAL" to "ACCELERATION".
(3) When the rotational speed reaches 80 % rated value, status is changed from "ACCELERATION" to "NORMAL".
(4) If the set low speed value exceed 80 % rated speed, status remain unchanged and the pump accelerates.
(5) When the rated speed is reached, the pump stops accelerating and the pump speed is maintained.

※ If low speed value is set to 100 %, the same operation occurs.

6. 6 Software Operation

NOTICE

Setting data can be loaded and overwritten only via RS-485 communication.

Software functions are indicated in the table below (Refer to Table 6-2).

Table 6-2 Software Operating Functions

Function		Descripition
Status	Operation mode	LOCAL, REMOTE or RS-485.
	Rotational Speed	
	Motor current	
	Run Status	(Note 1)
Operation	START/STOP	Motor ON/OFF
	ALARM reset	Reset operation when alarm occur.
Timer	Run time	
	Maintenance timer	
	Bearing run time	
Setting	Variable Rotation Speed (Low SPEED)	Changes or sets pump rotational speed.
	Relay Outputs	Set actions for Relay outputs.
	RS-485	Set communication environment. Multi drop setting and Network ID setting. Terminator ON/OFF setting.
History	Alarm History	

(Note 1) List of run status.

STATUS	Descripition
NORMAL	Rotating at rated rotation speed
ACCELERATION	Accelerating
IDLE	Coasting
STOP	Stop rotating
E-STOP	Alarm is active (stop rotating)
E-IDLE	Alarm is active (Coasting)

6. 7 Interface Connector

6.7.1 Specification

The controller is provided with remote control connector for connection with remote operation, alarm signals, etc. Please wire connection with reference to Table 6-3, Table 6-4, and Table 6-5.
You must use a shielded wire and the shield wire should be connected the connector case.

Table 6-3 Interface connector circuit

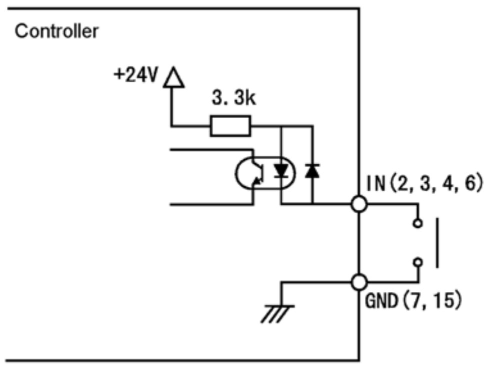
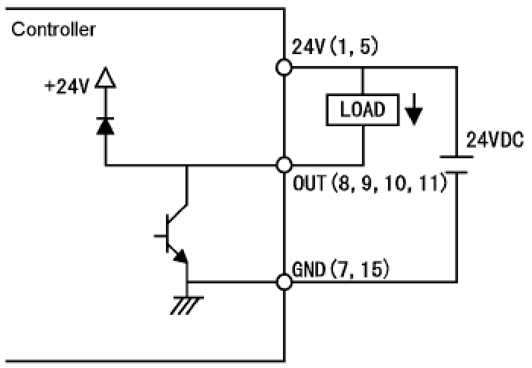
<table>
<tr><th>Input/
Output</th><th>Input</th><th>Output</th></tr>
<tr><td>Wiring connection</td><td>
</td><td>
</td></tr>
<tr><td>Electric capacity</td><td>[Contact]
Voltage…30 VDC,
Current…10 mA or more
[Photo transistor]
Select a photo transistor with a collector-emitter
voltage limit of 30 VDC and an
on-state collector current of 10 mA or more.</td><td>The circuit voltage / current should be less than 24 VDC / 0.5 A in the case of resistance load and inductive load.</td></tr>
</table>

Table 6-4 Acceleration / Deceleration by Interface connector

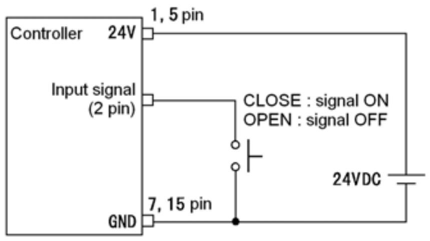
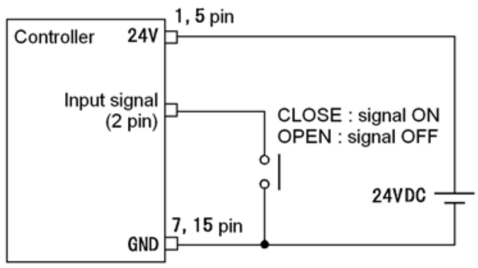
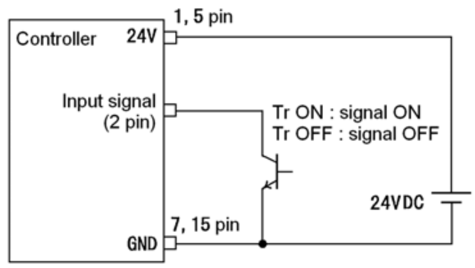
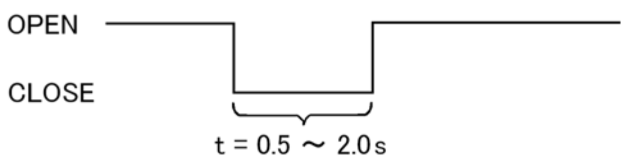
Connection method	By momentary type START/STOP switch	By alternate type switch
Wiring connection		 or 
Control	Pump start by short-circuiting (2) to (7), (15). Pump stop by opening (2) to (7), (15).	Pump start, with the contact close or photo transistor ON ((2) to (7), (15) short-circuit). Pump stop, with the contact open or photo transistor OFF ((2) to (7), (15)) open.)
Electric capacity	Refer to Table 6-3.	
Input rating	Direct forward current 50 mA ; DC reverse voltage 5 V	

Table 6-5 Reset alarm procedure via the Interface connector

Wiring connection	Please wire connection with reference to Table 6-4. The reset input signal is No.6 pin of interface connector.
Input signal	Connect this pin to GND for 500 ms to 2000 ms : Reset alarm  Refer to Section 9 "TROUBLESHOOTING" for detail of ALARM condition.

6.7.2 Pin Assignment

Table 6-6 Pin assignment of interface connector

Pin No.	Input/ Output	Name	Designation factory settings
1,5	Input	+ 24 VDC in	Voltage supply for the TMP controller (Note 1)
2	Input	START / STOP	To connect this pin to GND : Start pump To open this pin : Stop pump
3	Input	DI1	To connect this pin to GND : RY1 ON To open this pin : RY1 OFF
4	Input	DI2	To connect this pin to GND : RY2 ON To open this pin : RY2 OFF
6	Input	Low Speed Reset	To connect this pin to GND : Low Speed ON To open this pin : Low Speed OFF To connect this pin to GND for 500 ms to 2000 ms : Reset Alarm
8	Input	DO1	OPEN : Not NORMAL, CLOSE : NORMAL (Note 2)
9	Output	DO2	OPEN : No ALARM, CLOSE : ALARM (Note 2)
10	Output	RY1 (Relay output)	Venting valve can be connected. (Note 2) (Note 3) This output can be loaded with maximum 24 V / 500 mA.
11	Output	RY2 (Relay output)	This output can be loaded with maximum 24 V / 500 mA. (Note 2)
12	Output	Analog output	Actual rotation speed : 0-10 VDC is equivalent to 0-100 % of rated speed. (Note 2)
13	Output	RS485 (+)	D+
14	―	RS485 (-)	D-
7,15	―	GND	Ground (Note 1)

(Note 1) Connect all 4 pins for 24 VDC line and GND line.
(Note 2) The functions can be change via RS-485 communication.
(Note 3) Venting valve need to be normally closed. If you use a normally open valve, you have to change the function via RS-485 communication.
(Note 4) Don’t connect any pins other than specified above.
(Note 5) It takes 6 seconds until it comes to show that this signal is correct, after input POWER.

6.7.3 Connector

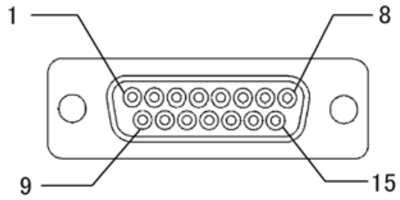


Fig. 6-2 Arrangement of interface connector Pins
(Figure where connector of panel is viewed from the front)

6.7.4 Setting for Interface Connector Operation

Items of the following table can change setting via RS-485 communication.

Name	Table of settings	default settings
RY1 (relay output 1) operation setting	"0000" : RY1 is ON when DI1 is ON "0001" : RY1 is ON when DI1 is OFF "0002" : Always RY1 ON "0003" : Always RY1 OFF "0004" : Delay Venting mode (Refer to Section 6.7.5)	“0004”
RY2 (relay output 2) operation setting	"0000" : RY2 is ON when DI2 is ON "0001" : RY2 is ON when DI2 is ON "0002" : Always RY2 ON "0003" : Always RY2 OFF	“0001”
DO1, DO2 operation setting	"0000" : NORMAL = ON, Not NORMAL = OFF "0001" : ALARM = ON, Not ALARM = OFF "0002" : ALARM = OFF, Not ALARM = ON "0003" : WARNING = ON, Not WARNING = OFF "0004" : WARNING = OFF, Not WARNING = ON "0005" : ACC = ON, Not ACC = OFF "0006" : IDLE = ON, Not IDLE = OFF "0007" : Always ON "0008" : Always OFF	DO1：“0000” DO2：“0001”
Analog output setting (0-10 V)	"0000" : Rotational speed (0 to 100 %) "0001" : Motor current (0 to 15 A) "0002" : Motor temperature (0 to 150 degrees C.) "0003" : Bearing temperature (0 to 150 degrees C.) "0004" : Always 0 V "0005" : Always 10 V	“0000”

6.7.5 Delay Venting Mode

If "Delay venting mode" is selected by RY1 operation setting, venting valve operation is as follows.

【Example of the operation of venting valve (when the delay time is 10 seconds (Note 1))】

① STOP signal is input to the controller, and TMP decelerates.

↓ …10 seconds (Note 1) after input STOP signal to controller.

② Venting valve is opened.

↓ …Venting valve continues to open until the rotor of TMP stops.

③ Venting valve is closed when the rotor of TMP stops.

(Note 1) The delay time can be changed within the range of 0 to 30 seconds via RS-485 communication. Default setting of the delay time is 10 seconds.

6.8 RS-485 Communication Specifications

6.8.1 Transfer Specifications

Interface	RS-485
Synchronous system	Asynchronous
Transmission rate	9600 bps (fixed)
Character configuration	Start bit : 1 Data bits : 8 Parity : None Stop bit : 1
Flow control	None
Number of units connected	Max 32
Connector and Pin assignment	Interface Connector (Refer to Section 6.7) 13 : Receive / Send Data A+ 14 : Receive / Send Data B+

6.8.2 CABLE

(1) Cable connection

Use the connection cable as shown in Fig. 6-3 to connect the turbo molecular pump and computer.

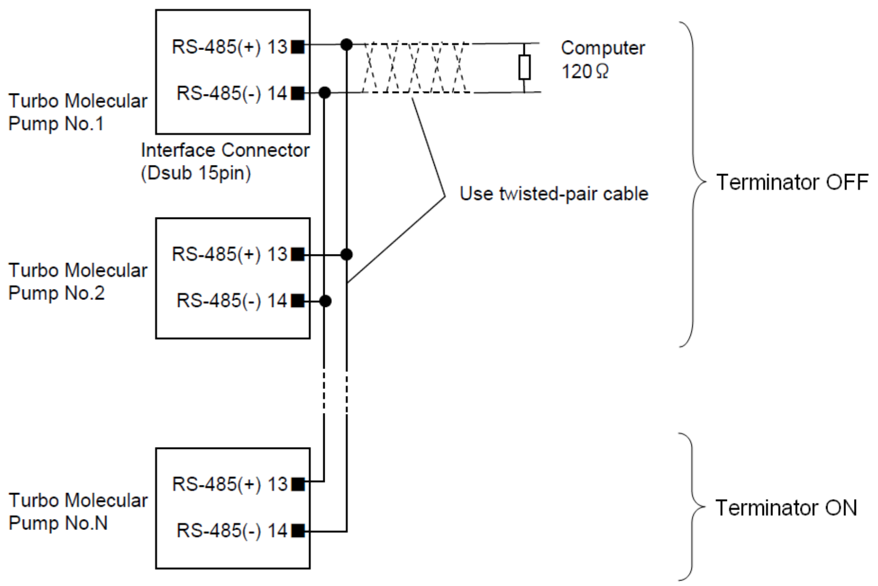


Fig. 6-3 Example of RS-485 cable wiring connections

(2) Cables used
RS-485 is a differential transmission and use twisted-pair cables in combinations as shown in Fig. 6-3.

(3) Connecting the terminator resistor (Terminator)
This product has a terminate resistor (120Ω) inside the controller, and the setting of terminator can be switched ON and OFF. The default setting of terminator is ON.
Terminators are not necessary for multidropped turbo molecular pump with another pump or pump to which the computer connects is connected to both ends (pump 1 through N-1 in Fig. 6-3).
However, connection of the terminator may prevent communications with certain cable lengths and RS-485 device types. Connect the terminator to determine whether it is required.

(4) Cable length
Connection cables can be extended up to 1.2 kilometers, but may be subjects to errors depending on actual operational environment.

NOTICE

Serial interface protocol is compliant RS-485.
Although we have tested in our environment, all communication with apparatus is not guaranteed.

7

GAS PURGE

This product includes a port for purging gasses in optional specification.
It is possible that the pump temperature is increased by the gas load affects the bearing exhange period. When operating in more than 50 % of the allowable flow rate, please use a purge gas in order to suppress the temperature increases.
The proper purge gas flow rate is 25 mL/min.

Fig. 7-1 is an example of gas purge piping diagram. Use a filter 5μ m or less in element size.
Use flow control valve to control the flow rate.

Start gas supply	After starting backing vacuum pump, but before exhausting process gas
Stop gas supply	After thoroughly exhausting process gas, but before shutting off backing vacuum pump
Gas type	Nitrogen, purity 4N (99.99 %) or better
Joint (pump side)	M10 tap with O-ring (P12)

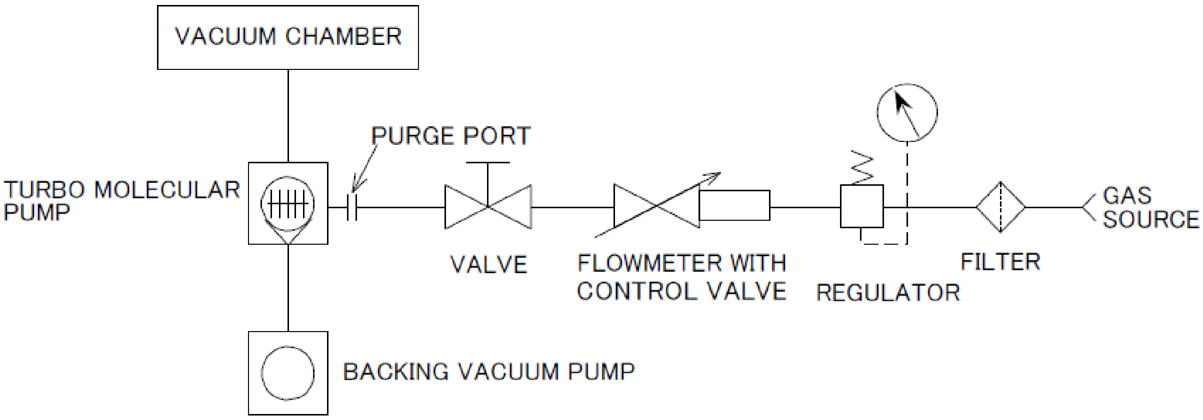


Fig. 7-1　Gas purge method

8

TURBO MOLECULAR PUMP RECONDITION

8．1 Recommended maintenance intervals

It is different for deterioration progress speed of each part changes greatly by pump condition.
Refer to the following list as overhaul. These are not terms of warranty.
Refer to Section 8.5 "Controller Replacement" for Power supply unit.

Process	Recommended maintenance intervals
Non-active gas (Sputtering, Evaporation and so on) and Light load process	3 years

(1) Recommended maintenance intervals for parts
These are not terms of warranty.

	Part name	Recommended maintenance intervals
1	Ball bearing	Refer to Section 8.3
2	Touch down bearing	4 years
3	Rotor	7 years
4	Motor	

(2) Others
When exchanging parts, it has possibility that other parts are exchanged for improving a reliability.

8. 2 Turbo Molecular Pump Decontamination

All expenses incurred with the decontamination of the turbo molecular pump are the responsibility of the customer.

8. 3 Bearing Replacement

The ball bearing (Fig. 3-1 (6)) and the touch-down bearing are the component of this pump that is subjected to friction and wear.
The replacement of (the ball bearing and) the touch-down bearing is done only by ULVAC or an approved service company.
Recommended bearing exchange period depends on mounting direction and gas load.

Table 8-1 Recommended bearing exchange period

Gas load	Mounting direction	Bearing exchange period
No	Vertical (Note 1)	4 years
	Directions other than vertical direction	3.5 years
Yes	Any direction	2 years

(Note 1) Vertical directions is within ±5°.
(Note 2) It is recommended period and is not an exchange period to be guarantee.

8. 4 Check of the rotor blades

Rotor blades of turbo molecular pump are high-speed rotor made of aluminum alloy. It has the possibility that material strength deteriorates, specially when corrosive gas is evacuated. Regular check (Customer is liable for the cost.) by ULVAC or a ULVAC approved/authorized service center is suggested. (Every 1 year is recommended.) ULVAC and/or the service center investigate rotor blades in every overhaul task and check and suggest a rotor replacement to customers if any cracks are found out.

8.5 Controller Replacement

The service life of respective parts (estimated) is indicated below. To ensure safe operation, avoid using parts beyond their expected service life. Doing so may prevent obtaining the maximum performance. Replacement of parts inside controller can not be carried out but will exchange the whole controller.

The replacement of the controller unit is done only by ULVAC or an approved service company.

Table 8-2　Estimated Service Life for Parts

Part name	Estimated service life
Electrolytic capacitor	5 years
Button battery	5 years

8. 6 Turbo Molecular Pump Return Request

Annual overhaul is recommended.
Overhaul, re-manufacturing, refurbishing, or repair of the turbo molecular pump system should always be performed by ULVAC or an approved service company.

The following precautions are required before forwarding the turbo molecular pump to ULVAC or an approved service company for all service related requests.

(1) The turbo molecular pump must be void of all process gases. Turbo molecular pumps that were operated in applications using special gases (doping gas, epitaxial gas, film forming gas, etching gas, etc.), likely have the process by-products, reaction-produced matter, etc. Remove them from the turbo molecular pump by repeated gas purge to the pump and fill the pump with an inert gas. The pump interior must be adequately purged with inert gas before uninstalling from the unit.
(2) The customer is required to submit MSDS (Material Safety Data Sheet) sheets and information of all gases, materials, etc. that have been associated with the turbo molecular pump.
(A copy of this from is printed at the end of this manuals "Certificate of Decontamination ".)

ULVAC will accept and perform service only on turbo molecular pumps that have been properly prepared as stated in (1) and (2) above. ULVAC will advice the customer of any failure precaution/prevention procedures that are appropriate to each individual turbo molecular pump service request.

CAUTION

Please pack it surely so as not to damage it by the impact, the vibration, and the high temperature and humidity environment, etc. from the outside when the pump is returned. Please use the packing materials used when it ships it from our company or the packing materials of quality more than equal to it.

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9

TROUBLESHOOTING

9.1 Vacuum Pressure Rise

A rapid rise of vacuum pressure in the turbo molecular pump causes the internal motor of the turbo molecular pump to start coasting and the ALARM lamp (Fig. 2-2 (5)) lights.
Do not suddenly increase the pressure or let atmospheric air enter the pump during pump operation.

9.2 Abnormal Noise and/or Vibration

Should the turbo molecular pump ever generate abnormal noise and/or vibration, the turbo molecular pump operation is to be stopped immediately.

9.3 Nothing Happens After an Operation is Made

Table 9-1 Nothing Happens After an Operation is Made

	PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION	Section
1	Input the power, but the turbo molecular pump fails to operate.	The GND pin (7, 15) and the 24 VDC pin (1, 5) are not connected to power supply correctly.	Ensure that the GND pin (7, 15) and the 24 VDC pin (1, 5) are connected to power supply correctly.	5.2
		Electrical power outside power supply unit's power range.	Operate within power supply unit's power range.	4.1
2	START/STOP button is pushed but turbo molecular pump does not accelerate.	In REMOTE mode (POWER lamp lights)	By maintained push the RESET button, change to LOCAL mode (POWER lamp blinks)	6.2
		Other causes.	Check the ALARM lamp is not lights. If an alarm is indicated, correct the malfunction and reset alarm.	9.5
3	Remote "START" signal active but the turbo molecular pump does not accelerate.	In LOCAL mode (POWER lamp blinks)	By maintained push the RESET button, change to REMOTE mode (POWER lamp lights)	6.2
		Other problems.	Check the ALARM lamp is not ON. If an alarm is indicated, correct the malfunction and reset.	9.5
4	START/STOP button is pushed but the turbo molecular pump does not coast.	In REMOTE mode (POWER lamp lights)	By maintained push the RESET button, change to LOCAL mode (POWER lamp blinks)	6.2
5	Remote "STOP" signal activated but the turbo molecular pump does not coast.	In LOCAL mode (POWER lamp blinks)	By maintained push the RESET button, change to REMOTE mode (POWER lamp lights)	6.2

9.4 Power Failures

When a power interruption occurs, the motor inside the turbo molecular pump immediately begins regenerative braking. Table 9-2 shows the time until the POWER LED goes out when the power fails at the rated speed. Table 9-3 shows the counter-operations against power supply failure.

Table 9-2 The Time Until the POWER LED Goes Out When the Power Fails at the Rated Speed

Pump model	The time until the POWER LED goes out when the power fails at the rated speed (Note 1)
UTM300B	about 18 minutes

(Note 1) The time is typical for regenerative braking from the rated speed. Actual time will very depending on vacuum conditions inside the pump and the rotational speed when the power fails.

Table 9-3 Counter-Operations Against Power Supply Failure

Interruption time	2 seconds or less		Over 2 seconds	
Interrupt / re-supply	During interruption	After re-supply	During interruption	After re-supply
Motor control	Regenerative braking	Returns to before power-failure running condition	Regenerative braking	Free run
POWER LED	Before-power-failure indication goes on	Before-power-failure indication goes on	Before-power-failure indication goes on	Before-power-failure indication goes on
NORMAL LED	Before-power-failure indication goes on	Before-power-failure indication goes on	Flashes (cycle of 1 second)	Flashes goes on (cycle of 1 second)
ALARM LED	Before-power-failure indication goes on	Before-power-failure indication goes on	Lights up	Lights goes on
DO1 output (8)-(+24 V)	Contact open	Returns to before power-failure	Contact open	Contact open (Note 1)
DO2 output (9)-(+24 V)	Contact open	Returns to before power-failure	Contact open	Contact close (Note 2)
RY1 output (10)-(+24 V)	Contact open	Returns to before power-failure	Contact open	Returns to before power-failure
RY2 output (11)-(+24 V)	Contact open	Returns to before power-failure	Contact open	Returns to before power-failure
Analog output (12)-(GND)	Analog output is possible	Analog output is possible	Analog output is possible	Analog output is possible
RS-485 communication (13)-(14)	Communication is possible	Communication is possible	Communication is possible	Communication is possible

(Note 1) When DO1 is assigned to the NORMAL signal. (This is factory default setting.)
(Note 2) When DO2 is assigned to the ALARM signal. (This is factory default setting.)

9.5 Alarm Detection Capabilities

The fault detection functions shown in Table 9-6 "Table of Alarms" and Table 9-7 "Table of Warnings" are incorporated for protection in the event of a problem with the turbo molecular pump or controller.
When an error is detected, check the ALARM lamp (Fig. 2-2 (5)) and refer to Section 9.5.3 for the appropriate remedy.

9.5.1 Movement in Alarm Detection Capabilities (ALARM)

1. ALARM lamp (Fig. 2-2 (5)) lights.
2. The logic interface "ALARM" signal turn on.
3. The pump start the protective operations shown in Table 9-6 "Table of Alarms".

9.5.2 Movement in Alarm Detection Capabilities (WARNING)

1. ALARM lamp (Fig. 2-2 (5)) flashes.
2. The logic interface "WARNING" signal turn on.
3. Pump operation continues.

9.5.3 Reset Procedure

1. Refer to the Troubleshooting information and eliminate the cause of the problem.
2. Conduct the reset operation.
3. (ALARM) If the problem has been eliminated, the ALARM lamp (Fig. 2-2 (5)) goes out, the "ALARM" logic interface signals turn off after an alarm was given, the pump rotor coasts.
   (WARNING) When the problem is eliminated after a warning occurred, pump operation continues.
4. If the problem was not completely eliminated, the alarm is not cancelled.

Table 9-4 If the ALARM Lamp Lights

	Alarm Code	Alarm Name	Possible Cause	Remedy	Sec-tion
1	15	POWER FAILURE	Power failure	Wait for the power to be restored.	
			Reduction in the power suppluy voltage	Check the 24 VDC power supply.	
2	16	TMP:OVERLOAD	Drop in rotation speed during rotation at rated speed (increased internal pump pressure).	Check that the outlet and inlet pressures are below the specified maximum pressures. Check for leakage. Check that too much purge gas is not flowing. Check that process gas flow rate is not too high.	4.1
3	21	TMP:TEMP/MB CABLE	Increased pump drive motor temperature.	Check that the ambient temperature around the pump is within the specified range. Check that no load in excess of the specified range is continuously applied to the pump. In the case of forced air cooling spcefication, check that the cooling fan is operating. Remove a object obstructing the fan operation.	4.1
	26	TMP:BRG TEMP	Increased pump bearing temperature		
4	43	EI:PARAM ERROR	Stored parameters are not correct.	Turn the power on again after the pump stops. The power supply unit must be repaired if the problem occurs again.	
	44	EI:CPU ERROR	Error in the CPU for inverter control		
5	46 47	MOTOR OVERSPEED EI:R-SPEED ERROR	Rotation detection signal from the motor cannot be detected correctly.	Check that equipment causing noise is not used around the pump and the power supply unit.	5.2
6	23 24	EI:MOTOR OVERCURR EI:INV OVERCURR	Overcurrent supplied to the motor.	Check that the ambient temperature around the pump is within the specified range.	4.1
7	30	EI:CONT.TEMP ERR	Temperature increase in the control system.	Check that the ambient temperature around the pump is within the specified range. In the case of forced air cooling spcefication, check that the cooling fan is operating. Remove a object obstructing the fan operation.	4.1
8	35	EI:INV. OVERVOLT	Increased the 24 VDC power supply.	Check the 24 VDC power supply.	
	36	EI:DC-DC LOW VOLT	Decreased the 24 VDC power supply.		
9	48	EI:ACCEL OVERTIME	Rotation speed does not increase at startup.	Check that the outlet and inlet pressures are not too high. Check for leakage. Check that too much purge gas is not flowing. The time to detect this alarm can be changed via RS-485 communication.	6.2
10	49	TMP:CAN NOT START	Pump does not rotate.	Adhesion of reaction products or damage to the protective bearing is the possible cause. Remove the pump from the unit and check that the rotor blades rotate smoothly at the inlet. An overhaul is required if blades do not rotate smoothly.	

Table 9-5 If the ALARM Lamp Flashes

	Alarm Code	Alarm Name	Possible Cause	Remedy	Sec-tion
1	50	TMP:BRG TEMP WARN	Increased pump bearing temperature.	Check that the ambient temperature around the pump is within the specified range. Check that no load in excess of the specified range is continuously applied to the pump. In the case of forced air cooling specification, check that the cooling fan is operating. Remove a object obstructing the fan operation.	4.1
2	80	EI:CONT.TEMP.WARN	Temperature increase in the control system.	Check that the ambient temperature around the pump is within the specified range. In the case of forced air cooling spcefication, check that the cooling fan is operating. Remove a object obstructing the fan operation.	4.1
3	94	MB:AIR RASH B	Atmospheric penetration	Create a vacuum system not allowing atmospheric penetration by reexamining the operating sequence of the back pump and valves etc.	
4	99	MAINTENANCE TIME	Maintenance call timer reaches its set time.	Implement maintenance works prescribed by the customer, such an overhaul. The alarm can be cancelled by resetting the maintenance call timer after implementing necessary works.	8

Table 9-6 Table of Alarms

Alarm Code	Alarm Name	Possible Cause	Protective Action
15	POWER FAILURE	Power failure or reduction in the power supply voltage.	Free run (motor stop)
16	TMP:OVERLOAD	After accelerating to 80 % of the designated speed or low-speed setting, the speed dropped below 80 % due to overloading etc	
21	TMP:TEMP/MB CABLE	Increased pump drive motor temperature.	
23	EI:MOTOR OVERCURR	Overcurrent ran through the motor.	
26	TMP:BRG TEMP	Increased pump bearing temperature.	
30	EI:CONT. TEMP ERR	Increased temperature inside the control system	
34	EI:INV. OVERCURR	Overcurrent ran through the motor.	
35	EI:INV. OVERVOLT	Increase the 24 VDC power supply.	
36	EI:DC-DC LOW VOLT	Decrease the 24 VDC power supply.	
43	EI:PARAM ERROR	Stored parameters are not correct.	
44	EI:CPU ERROR	Error in the CPU for inverter control	
46	MOTOR OVERSPEED	Pump rotation speed is too high.	
47	EI:R-SPEED ERROR	Pump rotational speed cannot be detected.	
48	EI:ACCEL OVERTIME	Pump does not accelerate to 80 % of the designated speed or low-speed setting within the specified time after start-up.	
49	TMP:CAN NOT START	Pump fails to rotate within 30 seconds after start-up.	

Table 9-7 Table of Warnings

Alarm Code	Alarm Name	Possible Cause	Protective Action
50	TMP:BRG TEMP WARN.	Increased pump bearing temperature	Operation continued.
80	EI:CONT.TEMP.WARN	Increased temperature inside power supply unit.	
94	MB:AIR RASH B	Atmospheric penetration.	
99	MAINTENANCE TIME	Maintenance call timer reaches its set time.	

Appendix A

COMMUNICATIONS

A1 GENERAL SPECIFICATION

The UTM300B controller contaion serial interfaces conforming to and RS-485 specifications. The following functions are available by connecting a computer with communication capacity to these interfaces and creating the appropriate software.
The RS-485 interface permits multi-drop connections, allowing multiple power supplies to be connected to a single computer.
This instruction manual is described about software operation. Refer to instruction manual of turbo molecular pump for hardware specification.

1. Checking current operation mode : The serial interfaces allow the user to check the status of current operation made. In REMOTE mode, the user can change the operation mode to RS-485.
2. Operation : START, STOP and RESET operations are available in the RS-485 operation mode. Also, the speed setting can be made using the set value write function.
3. Checking turbo molecular pump run status : The serial interfaces allow the user to check the current turbo molecular pump's running status (Normal rotation, Accelerating, Coasting, failure occurrence, etc.).
4. Reading parameters : The serial interfaces allow the user to read a variety of turbo molecular pump parameters such as pump rotational speed and motor current which are stored in the control system.
5. Reading history data : The serial interfaces allow the user to read the alarm history data.
6. Reading and writing timer data : The serial interfaces allow the user to read the timer and counter values and to reset the counters.
7. Reading and writing settings data : The serial interfaces allow the user to read and change settings.

A2 PUMP TO COMPUTER CONNECTION

A2.1 Communication Cable Connection

Turn off the power switch and the computer to be connected. Connect the RS-485 signal to the communications port of the computer with a cable, referring to Instruction manual of the pump.

A2.2 RS-485 Multi-drop Settings

The RS-485 interface multi-drop function is used to connect multiple turbo moleculer pump to a single computer.Turn off the multi-drop function if the RS-485 is used instead of RS-232C to extend the communication cable length.

When the multi-drop function is turned on, the network ID portion of the sent character strings (Refer to Section A3) is enabled and the event communication function that notifies the pump status to the connected computer is disabled.

Refer to Section A5 RS-485 Settings for details about the setting method.

A2.3 ON-LINE request

When control the turbo molecular pump via serial communication, need to send ON-LINE request command from customer equipment.

Meanwhile use the serial communication as only monitor the status of the pump, it does not need to send ON-LINE request command.

Refer to Section for detail about ON-LINE request command.

A3 SERIAL COMMUNICATIONS PROTOCOL

Communications software, between the power supply and customer equipment should be design according to the following specifications.

A3.1 Basic Message Structure

A basic transmit and receive message begins with the characters "MJ" and ends with a carriage return code (0dH : xxH means hexadecimal code). (Refer to Table A-1)
The first message to be sent is referred as the COMMAND, while the reply to the command is referred as the ANSWER.

Table A-1 Basic structure of Commands and Answers

Character	Hex. code	Description	Number of bytes
M	4d	Command header characters	2
J	4a		
0	30	Network ID	2
1	31	Multi-drop function OFF : 01 fixed Multi-drop function ON : 01 to 32 RS-485 settings : 99 fixed (Note 1)	
X	xx	Command characters	2
X	xx		
		Sub-command characters Varies depending on commands and answers	X
f	xx	Checksum characters	2
f	xx	(Calculation result by Section A3.6 enters it.)	
CR	0d	Carriage return character	1

(Note 1) When you use commands of RS-485 settings (Refer to Table A-2), Network ID is 99.

A3.2 Character to Character Time-out: 0.1 sec.

Delays between characters, in the answer message, longer that 0.1 sec., shall be considered as a transmission line failure and special considerations should be made to re-send the message.

A3.3 Command to Answer Time-out: 1 sec.

Delays between COMMAND and ANSWER messages, longer that 1 sec., shall be considered as a transmission line failure and special considerations should be made to re-send the message.

The turbo molecular pump re-sends a COMMAND, if it does not receive and ANSWER within a one second period.

A3.4 Command Transmission Specification

A command sent before an answer is sent, will be ignored by the turbo molecular pump, until a reply to the first command is sent. However, this does not apply after a transmission time-out occurs between command and answer. (If processing is performed normally, an answer is returned within 100 msec.)

A3.5 Receiving Sequence

The character string from the turbo molecular pump unit is received after the COMMAND character string is sent. When the carriage return code (0dH) is received, the received character string is checked from the beginning and the portion from the initial command header "MJ" to the carriage return code received last is processed as an answer.
Initialize the receive buffer after the answer character string is acquired from the receive buffer.

The read user memo (described below) may receive the same "MJ" as the command header character string in the answer character string. Therefore, interpret the character string from the first "MJ" appearing in the receive buffer to the carriage return as the answer character string.

A3.6 Using the Checksum Byte

Always calculate the checksum for a received character string and compare it with the checksum byte data to confirm that the character string was received correctly. Conduct error processing such as re-sending the command when a character string is received with an incorrect checksum.

Calculation Example

In the received character string "MJ01LS97$" ($ represents the carriage return code), the check sum code is represented by the last two characters : "97".

The checksum for the received character string is calculated as follows. The result shows that the received character string is correct.

	'M'	'J'	'0'	'1'	'L'	'S'		
Checksum =	4dH +	4aH +	30H +	31H +	4cH +	53H	= 197H	= **97**H

A4 TABLE OF COMMANDS

Table A-2　Table of Commands

Type	Command / answer	Name	Command character string	Sub-command character string	
Operation mode	Command	Operation mode check	LS	None	
		On-line request	LN	None	
		Off-line request	LF	None	
	Answer	Local	LL	None	
		Remote	LR	None	
		RS-485	LD	None	
Operation request	Command	START operation	RT	None	
		STOP operation	RP	None	
		RESET operation	RR	None	
	Answer	Acceleration start	RA	None	
		Free run	RU	None	
		Failure occurred	RF	aa	※1
		Failure elimination	RC	None	
		Operation invalid	RV	None	
Run status	Command	Run status check	CS	None	
	Answer	Stop	NS	aa	※1
		Acceleration	NA	aa	※1
		Normal rotation	NN	aa	※1
		Free run	NF	aa	※1
		Failure-Stop	FS	aa	※1
		Failure-Free run	FF	aa	※1
		Failure-Regenerative braking	FR	aa	※1
	Command	Read alarm list	CF	aa	※4
	Answer	Send alarm list	CA	aabb	※5
		No alarm list	CV	aa	※4
Parameters	Command	Read parameter	PR	aa	※2
	Answer	Send parameter	PA	aabbb	※3
		Invalid parameter number	PV	aa	※2
Timer	Command	Read timer	TR	aa	※6
		Clear timer	TC	aa	
		Write timer	TW	06aaaaa	※7
	Answer	Send timer value	TA	aabbbbbccc...cccddd...ddd	※8
		Invalid timer number	TV	aa	※6

Type	Command / answer	Name	Command character string	Sub-command character string	
History 1	Command	Read alarm history	GA	aa	※9
	Answer	Send alarm history	GB	xxx...xxx	※10
		No history data	GV	aa	※9
History 2	Command	Read alarm history	GJ	Aa	※9
	Answer	Send alarm history	GK	xxx…xxx	※19
		No history data	GV	aa	※9
Settings	Command	Read settings	SR	aa	※11
		Write settings	SW	aabbbb	※12
	Answer	Send settings value	SA	aabbbb	※12
		Invalid setting number	SV	aa	※11
	Command	Read user memo	SU	None	
		Write user memo	SX	xxx…xxx	※13
	Answer	Send user memo	SF	xxx…xxx	※13
	Command	Default setting	SG	None	※17
	Answer	Execute	SH	None	
RS-485 settings	Command	Read setting value	DR	aa	※14
		Write setting value	DW	aabbbb	※15
	Answer	Transmit setting value	DA	aabbbb	※15
		Invalid setting value number	DV	aa	※14
	Command	Default setting	DD	None	※18
	Answer	Execute	DB	None	
Shared answer	Answer	Invalid command	AN	None	

※1 aa : Failure alarm codes (hexadecimal) corresponding to the protection system.
Refer to Table 9-6 "Table of Alarms" and Table 9-7 "Table of Warnings".

※2 aa : Parameter number (decimal). Refer to Table A-4 "Table of Parameters".

※3 aa : Parameter number (decimal). Refer to Table A-4 "Table of Parameters".
bbbb : Parameter value (decimal). Refer to Table A-4 "Table of Parameters".

※4 aa : Alarm list number (decimal)

※5 aa : Alarm list number (decimal)
bb : Alarm code (decimal) stored in the alarm list with the requested number.
Refer to Table 9-6 "Table of Alarms" and Table 9-7 "Table of Warnings".

※6 aa : Timer number (decimal). Refer to Table A-5 "Table of Timer".

※7 06 (fixed) : Timer number (decimal). Refer to Table A-5 "Table of Timer".
aaaaa : Set value (decimal). Refer to Table A-5 "Table of Timer".

※8 aa : Timer number (decimal). Refer to Table A-5 "Table of Timer".
bbbbb : Timer value (decimal). Refer to Table A-5 "Table of Timer".
cccccccccc : Time when the timer updated. (YYMMDDHHMM format. Stored as Greenwich Mean Time)
dddddddddd : Time when the timer reset. (YYMMDDHHMM format. Stored as Greenwich Mean Time)

※9 aa : History number

※10 xxx...xxx : Refer to Table A-6 "Alarm History 1 Data Format".

※11 aa : Settings number (decimal). Refer to Table A-7 "Table of Settings".

*12 aa : Settings number (decimal). Refer to Table A-7 "Table of Settings".
bbbb : Set value (decimal). Refer to Table A-7 "Table of Settings".
*13 xxx...xxx : Any 20-character displayable character string.
*14 aa : Settings number (decimal). Refer to Table A-8 "List of RS-485 Settings".
*15 aa : Settings number (decimal). Refer to Table A-8 "List of RS-485 Settings".
bbbb : Set value (decimal). Refer to Table A-8 "List of RS-485 Settings".
*16 RS-485 Setting.
RS-485 command settings are enabled.
*17 Factory settings.

Function	Default Setting	Refference
Variable rotation speed setting	Rotational speed = NORMAL	Table A-7 No.03
Low rotation speed	Low speed = 100.0%	Table A-7 No.04 or No.08
Warning output setting	WARNING DISPLAY = ON	Table A-7 No.10
RY1 (relay output 1) setting	Delay Venting	Table A-7 No.80
RY2 (relay output 2) setting	DI2	Table A-7 No.81
DO1 setting	NORMAL signal	Table A-7 No.82
DO2 setting	ALARM signal	Table A-7 No.83
Analog output setting	Rotational speed	Table A-7 No.84
Acceleration over time setting	480 [s]	Table A-7 No.85
Power limit setting	100 [%]	Table A-7 No.89
Normal speed setting	80 [%]	Table A-7 No.90
Venting valve operation time setting	10 [s]	Table A-7 No.93

*18 RS-485 Factory Settings.

Function	初期設定	備考
Network ID	NetWork ID = 01	Table A-8 No.01
Multidrop Setting	Multidrop = OFF	Table A-8 No.02
Terminator ON/OFF	Terminator = ON	Table A-8 No.03

*19 xxx...xxx : Refer to Table A-3 "Alarm History 2 Data Format".

Table A-3 Alarm History 2 Data Format

	Item	Number of bytes	Data	Comments
1	History number	2	01 ~ 99	History number designated by the command.
2	Time	10	YYMMDDHHMM	Time when the failure occurred (stored as Greenwich Mean Time) YY : year, MM : month, DD : day, HH : hour, MM : minutes
3	Pump model	4	0000 ~ 9999	The 4-character number which shows a pump model. Format is the same as No.01 in Table A-4.
4	Alarm number	2	00 ~ 99	Alarm number of the failure that occurred. Refer to Table 9-6 "Table of Alarms" and Table 9-7 "Table of Warnings".
5	Run status	2	NS,SA,NN…	Run status when the failure occurred. Data is identical to CS command answer.
6	Rotational speed	4	0000 ~ 0100	Speed when the failure occurred. Format is identical to 09 in Table A-4.
7	Motor current	4	0000 ~ 0100	Motor current in the event of a fault. Format is the same as No.04 in Table A-4.
8	Motor temperature	4	0000 ~ 0150	Motor temperature in the event of a fault. Format is the same as No.52 in Table A-4.
9	Bearing temperature	4	0000 ~ 0150	Bearing temperature in the event of a fault. Format is the same as No.37 in Table A-4.
10	Reserved	4	0000 ~ 9999	This byte is not used forUTM300B
11	Operation time	5	00000 ~ 99999	Operation time in the event of a fault. Format is the same as No.01 in Table A-5.
12	Reserved	5	00000 ~ 99999	This byte is not used forUTM300B
13	Reserved	4	0000 ~ 9999	This byte is not used forUTM300B

Table A-4　Table of Parameters

	Name	Range	Description and format
01	Model identification number	0000 ~ 9999	The pump model connected. Example : UTM300B → "0300"
03	Rotational speed	0000 ~ 5000	Rotational speed / 10 Example : 15000 rpm → "1500"
04	Motor curret	0000 ~ 0100	Motor drive current x 10 Example : 2.3 A → "0023"
09	Rotational speed (%)	0000 ~ 0100	Percentage of rated rotational speed. Example : 80 % → "0080"
10	Rotational speed (%)	0000 ~ 1000	Percentage of rated rotational speed. (x10) Example : 80.3 % → "0803"
11	Rated rotational speed	0000 ~ 5000	Rated rotational speed / 10 Example : 21000 rpm → "2100"
37	Bearing temperature	0000 ~ 0150	Bearing temperature Example : 50 degrees C. → "0050"
52	Motor temperature	0000 ~ 0150	Motor temperature Example : 100 degrees C. → "0100"

Table A-5　Table of Timer

	Name	Range	Description and format
01	Run time	00000 ~ 99999	Integrating timer while the pump is rotating. (Can not be reset. Reset date is invalid) "00000" : 0 hour "99999" : 9999 hours
02	Last maintenance time	00000 ~ 99999	Timer of maintenance call timer. (Can be reset.) The maintenance call timer is a function that outputs warning if internal timer is equal to set-value. Set value of maintenance call is refer to No.06 in this table. "00000" : function is disable "12345" : 12345 hours
06	Maintenance call time	00000 ~ 99999	Set value of maintenance call timer. The maintenance call timer is a function that outputs warning if internal timer is equal to set-value. If use this function, this timer is needed to set. "00000" : function is disable "12345" : 12345 hours
90	Number of start-ups	00000 ~ 99999	Number of start-ups. "00000" : 0 time "00100" : 100 times

Table A-6 Alarm History 1 Data Format

	Item	Number of bytes	Data	Comments
1	History number	2	01 ~ 99	History number designated by the command.
2	Time	10	YYMMDDHHMM	Time when the failure occurred (stored as Greenwich Mean Time) YY : year, MM : month, DD : day, HH : hour, MM : minutes
3	Alarm number	2	00 ~ 99	Alarm number of the failure that occurred. Refer to Table 9-6 "Table of Alarms" and Table 9-7 "Table of Warnings".
4	Run status	2	NS,SA,NN…	Run status when the failure occurred. Data is identical to CS command answer.
5	Rotational speed	4	0000 ~ 0100	Speed when the failure occurred. Format is identical to 09 in Table A-4.
6	Motor current	4	0000 ~ 0150	Motor current in the event of a fault. Format is the same as No.04 in Table A-4.
7	Reserved	6	000000 ~999999	This byte is not used for UTM300B.
8	Reserved	4	0000 ~ 0100	This byte is not used for UTM300B.
9	Reserved	4	0000 ~ 0100	This byte is not used for UTM300B.
10	Reserved	4	0000 ~ 0100	This byte is not used for UTM300B.
11	Reserved	4	0000 ~ 0100	This byte is not used for UTM300B.
12	Reserved	4	0000 ~ 0100	This byte is not used for UTM300B.
13	Reserved	4	0000 ~ 0100	This byte is not used for UTM300B.
14	Reserved	4	0000 ~ 0100	This byte is not used for UTM300B.
15	Operation time	6	000000 ~ 099999	Operation time when a fault occurs. Format is the same as No.01 in Table A-5.

Table A-7 Table of Settings

	Name	Range	Description and format
03	Rotational speed	0000 / 0001	Variable speed operation setting. When set to "LOW SPEED" mode, rated rotational speed is changed to preset rotational speed value which set No.04 or No.08 in this table. "0000" : NORMAL "0001" : LOW SPEED
04	Low speed value	0250 ~ 0100	Values for variable speed operation. In "LOW SPEED" mode, rated rotational speed is set to this value. this value is same as No.08 in this table. "0025" : 25 % "0100" : 100 %
08	Low speed value	0250 ~ 1000	Values for variable speed operation. In "LOW SPEED" mode, rated rotational speed is set to this value. this value is same as No.04 in this table. "0250" : 25.0 % "0999" : 99.9 %
10	Warning output setting	0000 / 0001	Warning output setting. "0001" : ON (When warning occur, output signal is sent via remote-control connector and serial communication) "0000" : OFF (When warning occur, output signal is not sent via remote control connector and serial communication)
80	RY1 (relay output 1) operation setting	0000 ~ 0004	RY1 output setting "0000" : RY1 is ON when DI1 is ON "0001" : RY1 is ON when DI1 is OFF "0002" : Always RY1 ON "0003" : Always RY1 OFF "0004" : Delay Venting mode (Refer to Section 6.7.5)
81	RY2 (relay output 2) operation setting	0000 ~ 0003	RY2 output setting "0000" : RY2 is ON when DI2 is ON "0001" : RY2 is ON when DI2 is OFF "0002" : Always RY2 ON "0003" : Always RY2 OFF
82	DO1 setting	0000 ~ 0008	DO1, DO2 operation setting "0000" : NORMAL = ON, Not NORMAL = OFF "0001" : ALARM = ON, Not ALARM = OFF "0002" : ALARM = OFF, Not ALARM = ON "0003" : WARNING = ON, Not WARNING = OFF "0004" : WARNING = OFF, Not WARNING = ON "0005" : ACC = ON, Not ACC = OFF "0006" : IDLE = ON, Not IDLE = OFF "0007" : Always ON "0008" : Always OFF
83	DO2 setting	0000 ~ 0008	
84	Analog output setting	0000 ~ 0005	Analog output setting (0-10 V) "0000" : Rotational speed (0 to 100 %) "0001" : Motor current (0 to 15 A) "0002" : Motor temperature (0 to 150 degrees C.) "0003" : Bearing temperature (0 to 150 degrees C.) "0004" : Always 0 V "0005" : Always 10 V
85	Acceleration overtime setting	0300 ~ 1800	The time to detect acceleration overtime [s] "0300" : 300 s
89	Power limit setting	0250 ~ 0100	Power limit setting [%] "0100" : 100 % output

	Name	Range	Description and format
90	Normal speed setting	0500 ~ 0970	Normal speed setting [%] "0800" : 80.0 %
93	Venting valve operation time setting	0000 ~ 0030	The time to open venting valve since STOP signal is input to controller. "0030" : Venting valve will open after 30 seconds passes when the controller is input STOP signal.

Table A-8 List of RS-485 Settings

	Name	Range	Description and Configuration
01	Network ID	0001 / 0032	Sets the Network ID "0001" : ID = 01 "0032" : ID = 32
02	Multidrop ON/OFF	0000 / 0001	Sets multidrop ON/OFF setting "0000" : ON "0001" : OFF
03	Terminator ON/OFF	0000 / 0001	Terminator ON/OFF setting "0000" : OFF "0001" : ON

A5 COMMAND DESCRIPTION

A5.1 Operation Mode

Commands	LS	Operation mode check Enables operation mode verification (LOCAL / REMOTE / RS-232C / RS-485) Action : returns an ANSWER showing present operation mode.
	LN	ON-LINE request If the current operation mode is REMOTE, the operation mode is shifted to RS-232C or RS-485. This command is ineffective in other operation modes. Action : returns an ANSWER showing the present operation mode.
	LF	OFF-LINE request If the current operation mode is RS-232C or RS-485, the operation mode is shifted to REMOTE. This command is ineffective in other operation modes. Action : returns an ANSWER showing the present operation mode.
Answers	LL	Operation mode LOCAL This answer is returned when the operation mode is LOCAL. The operation mode can also be shifted to LOCAL mode by the local switch. In this "LOCAL" mode, the operation of the pump is valid only by local switch
	LR	Operation mode REMOTE This answer is returned when the operation mode is REMOTE. This operation mode can also be shifted to REMOTE mode by switching to "REMOTE" mode with a local switch and "OFF-LINE" is demanded from serial communications. In this "REMOTE" mode, the operation of the pump is valid only by signal from remote-control connector.
	LC	Operation mode RS-232C This answer is returned when the operation mode is RS-232C. The operation mode is shifted to RS-232C when the "ON-LINE" request command is sending via RS-232C in the remote operation mode. In this "RS-232C" mode, the operation of the pump is valid only by command via RS-232C.
	LD	Operation mode RS-485 This answer is returned when the operation mode is RS-485. The operation mode is shifted to RS-485 when the "ON-LINE" request command is sending via RS-485 in the remote operation mode. In this "RS-485" mode, the operation of the pump is valid only by command via RS-485.

A5.2 Operation

Commands	RT	START Operation The turbo molecular pump starts accelerating and sends the "Acceleration Start" answer.
	RP	STOP Operation The turbo molecular pump starts coasting and sends the "Coasting" answer.
	RR	RESET Operation This command is effective against failures. This command resets the ALARM. If the cause of the alarm is eliminated after resetting, the “Failure Elimination” answer will be returned.
Answers	RA	Acceleration Start This answer is returned after the acceleration is started on a START operation.
	RB	Deceleration Start This answer is not used for UTM300B.
	RU	Coasting Start This answer is returned after the coasting is started on a STOP operation.
	RC	Failure elimination This answer is returned if the failure cause is removed and send RESET operation command.
	RF	Failure Occurrence This answer is returned if the failure cause is not removed and send RESET operation command. The alarm code of the failure that has not been eliminated is returned as a 2-character sub-command.
	RV	Operation invalid This answer is returned if the operation is invalid (START operation command sent during acceleration) or if the operation mode differs from the port that sent the command (operation mode is RS-485 but operation command was sent from the RS-232C port).

A5.3 Run Status

Commands	CS	Run Status Check This command requests the current status of the turbo molecular pump.
Answers	NS	Stop For a normal status, "00" is returned as the sub-command. If a warning has occurred, the 2-character alarm code is returned as the sub-command.
	NA	Acceleration For a normal status, "00" is returned as the sub-command. If a warning has occurred, the 2-character alarm code is returned as the sub-command.
	NN	Normal rotation For a normal status, "00" is returned as the sub-command. If a warning has occurred, the 2-character alarm code is returned as the sub-command.
	NB	Deceleration For a normal status, "00" is returned as the sub-command. If a warning has occurred, the 2-character alarm code is returned as the sub-command.
	NF	Free run For a normal status, "00" is returned as the sub-command. If a warning has occurred, the 2-character alarm code is returned as the sub-command.
	FS	Failure-Stop This answer is returned when the pump is stopped after a failure occurs. The 2-character alarm code is returned as the sub-command.
	FF	Failure-Free run This answer is returned when the pump is free-running (neither accelerating nor decelerating) after a failure occurs. The 2-character alarm code is returned as the sub-command.
	FR	Failure-Regenerative braking This answer is returned when the pump is regenerative braking after a failure occurs. The 2-character alarm code is returned as the sub-command.
	FB	Failure-Deceleration This answer is returned when the pump is decelerating after a failure occurs. The 2-character alarm code is returned as the sub-command.
Commands	CF	Read alarm list Reads the alarm that occurred for a designated alarm list number. To check all the current failures, the sub-command alarm list number is increased sequentially from 01 until the answer CV is returned.
Answers	CA	Send alarm list Returns the alarm code corresponding to the requested alarm list number. The subcommand returns a 2-character alarm list number and a 2-character alarm code.
	CV	No alarm list This answer is returned if no alarm corresponds to the requested alarm list number. The sub-command returns a 2-character alarm list number.

A5.4 Parameters

Commands	PR	Read paramater Reads the parameter value for a designated parameter number. Sends the 2-character parameter number as the sub-command. Refer to Table A-4 "Table of Parameters" for parameter number.
Answers	PA	Send parameter Returns the parameter value for the designated parameter number. The 2-character parameter number + 4-character parameter value is returned as the sub-command.
	PV	Invalid parameter number This answer is returned if the designated parameter number is invalid. Returns the 2-character parameter number as the sub-command.

A5.5 Timer

Commands	TR	Read timer Reads the timer value for a designated timer number. Sends the 2-character timer number as the sub-command. Refer to Table A-5 "Table of Timer" for timer number.
	TC	Clear timer Clears the timer value for a designated timer number. Sends the 2-character timer number as the sub-command.
	TW	Write timer Overwrites the set value for a maintenance call timer. Sends the 6-character timer value + 5-character set value data as the subcommand.
Answers	TA	Send timer value Returns the timer value for the designated timer number. The 2-character timer number + 5-character timer value is returned as the sub-command.
	TV	Invalid timer number This answer is returned if the designated timer number is invalid. Returns the 2-character timer number as the sub-command.

A5.6 History

Commands	GA	Read alarm history 1 Reads the alarm history for a designated alarm history number. Sends the 2-character alarm history number as the sub-command.
Answers	GB	Send alarm history 1 Returns the alarm history for the designated alarm history number. The 64-character alarm history data is returned as the sub-command in the format shown in Table A-6 "Alarm History 1 Data Format".
	GV	No history data This answer is returned if no alarm history data corresponds to the designated alarm history number. Returns the 2-character alarm history number as the sub-command.
Commands	GJ	Read alarm history 2 Reads the alarm history for a designated alarm history number. Sends the 2-character alarm history number as the sub-command.
Answers	GK	Send alarm history 2 Returns the alarm history for the designated alarm history number. The 54-character alarm history data is returned as the sub-command in the format shown in Table A-3 "Alarm History 2 Data Format".
	GV	No history data This answer is returned if no alarm history data corresponds to the designated alarm history number. Returns the 2-character alarm history number as the sub-command.

A5.7 Settings

Commands	SR	Read settings Reads the set value for a designated settings number. Sends the 2-character settings number as the sub-command. Refer to Table A-7 "Table of Settings" for setting number.
	SW	Write settings Overwrites the set value for a designated settings number.Sends the 2-character settings number + 4-character set value data as the sub-command. Refer to Table A-7 "Table of Settings" for setting number and set value.
Answers	SA	Send settings value Returns the set value for the designated settings number. The 2-character settings number + 4-character set value is returned as the sub-command.
	SV	Invalid setting number This answer is returned if the designated settings number is invalid. Returns the 2-character settings number as the sub-command.
Commands	SU	Read user memo Reads the character string in the user memo.
	SX	Write user memo Overwrites the character string in the user memo. Sends the 20 characters to set in the user memo as the sub-command. If less than 20 characters are set, the remaining characters are filled with spaces. Be sure to always send 20 characters.
Answers	SF	Send user memo Returns as a sub-command the set user memo character string or the 20-character user memo character string overwritten by the SX command.
Commands	SG	Default setting Restore default setting described in Table A-2 *17. This setting is reflected after power supply reclosing.
Answer	SH	Default setting execute After power supply reclosing, turbo molecular pump starts up by default setting.

A5.8 Shared Answer

Answer	AN	Invalid Command Answer returned by the power supply after it receives an invalid command.

A5.9 RS-485 Settings

Commands	DR	Reads RS-485 setting Reads the setting value for the specified setting number. As subcommand, sends 2-character setting number. For setting numbers, refer to Table A-8 "List of RS-485 Settings".
	DW	Writes RS-485 setting Writes the setting value for the specified setting number. As subcommand, sends 2-character setting number and 4-character setting value. For setting numbers and setting values, refer to Table A-8 "List of RS-485 Settings".
Answers	DA	Sends RS-485 setting Returns setting value for specified setting number. As subcommand, sends 2-character setting number and 4-character setting value.
	DV	Invalid RS-485 setting number Answer returned when specified setting number is invalid. As subcommand, sends 2-character setting number.
Commands (Note 1)	DD	Sets RS-485 settings to default factory settings Default setting is described in Table A-2 "Table of Commands" *18. This function change the setting of communication. Therefore, note that there is possibility not to be able to communicate.
Answers (Note 1)	DB	Answer returned when finished restoring RS-485 settings to factory settings.

(Note 1)
a) Communication between customer equipment and turbo molecular pump is needed one-to-one communication when use "RS-485 Multi-drop setting" command.
b) In "RS-485 Multi-drop setting" command, Network ID is fixed "99".

Set up the RS-485 as described below when using a multi-drop connection.

(1) Turn on the Multi-drop Function

Command (from computer to turbo molecular pump)	Answer (from turbo molecular pump to computer)	Description
MJ99DW020000C6$	MJ99DA020000B0$	Multidrop **OFF**
MJ99DW020001C7$	MJ99DA020001B1$	Multidrop **ON**

(2) Setting the Network ID

The network ID is set to designate which turbo molecular pump connected via the multi-drop connection the computer is sending commands to.
The network ID is set as a number between 01 and 32, and must be unique for turbo molecular pump connected to a computer. Refer to Table A-8 "List of RS-485 Settings" for details about the setting method.

Command (from computer to turbo molecular pump)	Answer (from turbo molecular pump to computer)	Description
MJ99DW010001C6$	MJ99DA010001B0$	Network ID = 01
MJ99DW010032CA$	MJ99DA010032B4$	Network ID = 32

A6 RS-485 COMMANDS / ANSWERS (SEND AND RECEIVE Examples)

Table A-9 RS-485 COMMANDS / ANSWERS (SEND AND RECEIVE Examples)

Type	Direction of Data (Note 1)	Character String Sent/Receive (Note 2)	Description	Remarks
Operation Mode	→	MJ01LS97\	Operation Mode Check	
	←	MJ01LL90\	LOCAL	
		MJ01LR96\	REMOTE	
		MJ01LD88\	RS-485	
	→	MJ01LN92\	ON-LINE Request	ON-LINE request from RS-485 communication port
	←	MJ01LC87\	Operation Mode Change	Operation mode changed to RS-485 ON-LINE
		MJ01LD88\	Invalid Request	When in RS-485 mode
		MJ01LL90\	Invalid Request	When in LOCAL mode
	→	MJ01LF8A\	OFF-LINE Request	OFF-LINE request from RS-485 communication port
	←	MJ01LR96\	Operation Mode Change	Operation mode changed to REMOTE
		MJ01LD88\	Invalid Request	When in RS-485 mode
		MJ01LL90\	Invalid Request	When in LOCAL mode
TMP Operation	→	MJ01RT9E\	START Operation	START operation from RS-485 communication port
	←	MJ01RA8B\	Acceleration Start	
		MJ01RVA0\	Ineffective Operation	When START operation is ineffective or operation mode is not RS-485
	→	MJ01RP9A\	STOP Operation	STOP operation from RS-485 communication port
	←	MJ01RU9F\	Coasting Start	
		MJ01RVA0\	Ineffective Operation	When STOP operation is ineffective or operation mode is not RS-485
	→	MJ01RR9C\	RESET Operation	RESET operation from RS-485 communication port
	←	MJ01RF50F5\	Failure Occurrence	When the failure was not eliminated.
		MJ01RC8D\	Failure Eliminated	When the failure was eliminated.
		MJ01RVA0\	Ineffective Operation	When RESET operation is ineffective or operation mode is not RS-485

Type	Direction of Data (Note 1)	Character String Sent/Receive (Note 2)	Description	Remarks
Run Status	→	MJ01CS8E\	Run Status Check	
	←	MJ01NS00F9\	Stop	
		MJ01NA00E7\	Acceleration	
		MJ01NB00E8\	Deceleration	
		MJ01NN00F4\	Normal Rotation	
		MJ01FS1C05\	Failure Stop	
		MJ01FF32E9\	Failure Idle	
		MJ01FR15F6\	Failure Regeneration	Power failure occured
		MJ01FB60E6\	Failure Deceleration	
	→	MJ01CF01E2\	Read Alarm List	Confirm first alarm
	←	MJ01CA011543\	Send Alarm List	Power failure occured
Parameter	→	MJ01PR03FD\	Read Parameter	Parameter 03 (rotational speed)
	←	MJ01PA032700B5\	Send Parameter	Data = 2700 (27000 rpm)
Timer	→	MJ01TR01FF\	Read Timer	Timer 01 (Run time)
	←	MJ01TA01001350304 0515000000000000B 9\	Send Timer	Timer 01 = 135 (135 hours) Last update : 2003/4/5 15:00 Last reset : (invalid)
	→	MJ01TC03F2\	Clear Timer	Clear timer 03 (Number of power failure touch-downs.)
	←	MJ01TA03000000304 0515000304051500C 4\	Send Timer Value	Sets timer number 03 = 0 to date/time cleared. Sets reset date/time to date/ time when clear command was sent.
	→	MJ06TW060500003\	Write Timer Value	Sets timer number 03 to 5000 (time of maintenance call)
	←	MJ01TA06050000304 0515000304051500C C\	Send Timer Value	Sets timer number 06 = 5000 to date/ time updated and reset date/time to date/time when write command was sent.
履歴	→	MJ01GA01E1\	Read Alarm History	History 01
	←	MJ01GB0103040112 0015NN0100001000 02750004000600030 00300050005000200 120098\	Send Alarm History	History : 01 Date & time : 2003/04/01 12:00 Alarm : power failure Status : normal rotation Rotational speed : 100 % Motor current : 1.0 A Reserved bytes : 000275 Reserved bytes : 0004 Reserved bytes : 0006 Reserved bytes : 0003 Reserved bytes : 0005 Reserved bytes : 0005 Reserved bytes : 0002 Runtime : 1200 hours
	→	MJ01GA10E1\	Read Alarm History	History 10
	←	MJ01GV10F6\	No History Data	Less than 10 alarm data

A6 RS-485 COMMANDS / ANSWERS (SEND AND RECEIVE Examples)

Type	Direction of Data (Note 1)	Character String Sent/Receive (Note 2)	Description	Remarks
Setting	→	MJ01SR0300\	Read Settings	Settings number 03
	←	MJ01SA030000AF\	Send Settings Value	Settings number 03 = 0 Rotational speed = NORMAL
	→	MJ01SW030001C6\	Write Settings	Overwrite settings number 03 = 1
	←	MJ01SA030001B0\	Send Settings Value	Settings number 03 = 1 Rotational speed = LOW SPEED
Others	→	MJ01AA7A\	Undefined Command	When undefined command is received
	←	MJ01AN87\	Invalid Command	
	→	MJ01LS20\	Operation Mode Check	When command is correct, but checksum is not.
	←	MJ01AN87\	Invalid Command	

(Note 1) "$" represents a carriage return code (0dH).

(Note 2) → From computer to turbo molecular pump.

← From turbo molecular pump to computer.

A7 RELATION OF LOCAL MODE TO REMOTE MODE OPERATIONS

(1) Input of Local Control panel switch is only effective when POWER lamp is in "LOCAL" mode. (POWER lamp is FLASH.)
(2) When the POWER lamp is in "REMOTE" mode (POWER lamp is ON), "REMOTE" input signal only is effective under initial status.
(3) When the POWER lamp is in "REMOTE" mode (POWER lamp is ON),
The operation mode is shifted to RS-485 ON-LINE in response to ON LINE request of operation mode command from RS-485 communication port, only operation by the operation request command from computer is effective.
(4) RESET button input and "RESET" signals are all-time effective.
(5) When the mode is shifted to "LOCAL" under ON-LINE operation mode, the operation mode is force-shifted to LOCAL.
(6) Commands other than operation commands are all-time effective, and the power supply unit sends back an answer message to computer. In addition, event commands are alltime sent against event occurrence.

A8 TROUBLESHOOTING

A8.1 No Message can Transmit and Receive

(1) Check the connection of RS-485 cable in reference to instruction manual of the pump.
Check the polarity of RS-485 interface, because there is the case that polarity is reverse.
(2) Check the transmission specification of RS-485 at computer side.

A8.2 Sending and Receiving are Done, But Receivable Messages are Invalid

(1) Check the transmission rate of the computer.

A8.3 Characters Get Disordered from Time to Time, Then Resulting in CHECKSUM Error

(1) Remove the cable from equipment as noise source if it runs near it.
(2) When the cable in use is not a shield cable, replace it with the latter cable.
When shield cable is used, be sure to check that it is connected to the frame gland of the connected computer.
Use twisted pair cable when RS-485 is used.
(3) When 10 m or longer cable is used, replace it with another cable as short as possible.

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