

TURBO MOLECULAR PUMP

Model : TMP-V4404LMW

Technical Specification



Industrial Machinery Division

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SHIMADZU TMP-V4404LMW Technical Specification

1. Construction

1.1. Main Unit

Discription	Inlet flange	Outside dimensions	Notes	Part number
TMP-V4404LMW	VG350	263-99264		263-48604

1.2. Gas Purge Adaptor (Option)

In case of using a purge gas, the joint can be selected from followings.

The proper purge gas flow rate is 30 mL/min.

Joint	Part number	Orifice size	Description
KF10 (Clamp / Centering with O-ring)	262-77592-19	φ 0.5 mm	GP ADAPTOR, 0.5 KF10
KF10 (Dust cap)	262-77592-25	φ 0.5 mm	GP ADAPTOR 0.5, KF CAP
UJR 6.35 (Male)	263-14770	φ 0.5 mm	ADAPTOR, 0.5 UJR
SWAGELOK φ 6.35	263-14771	φ 0.5 mm	ADAPTOR, 0.5 SWG
4-VCR (Female)	263-14772	φ 0.5 mm	ADAPTOR, 0.5 VCR

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

Gas feed start	After starting backing vacuum pump; before evacuating of process gas
Gas feed stop	After exhausting process gas sufficiently; before stopping backing vacuum pump
Type of gas	Nitrogen gas (Purity > 99.99 %)

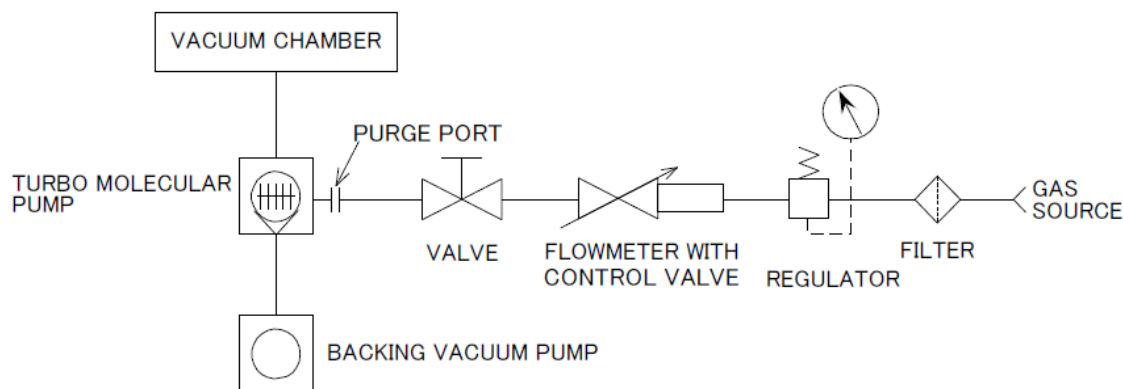


Fig. 1-1 Gas Purge Method

1.3. Power Cable

One of followings. (Not included in Main Unit.)

	Description	Notes	Part number
1	AC CABLE 5,EI	5 MT	263-93532-05
2	AC CABLE 10,EI	10 MT	263-93532-10
3	AC CABLE 15,EI	15 MT	263-93532-15
4	AC CABLE 20,EI	20 MT	263-93532-20

1.4. Remote-control Connector (Option)

	Description	Notes	Part number
1	Connector for remote control	D-sub 25 pin male	070-02844-03 070-02174-12
2	Cable for remote conversion	D-sub 37 pin female (device side) D-sub 25 pin male (power supply side)	263-45087

1.5. Standard Accessories

	Description	Q'ty	Notes	Part number	Status
1	Gasket (inlet flange)	1	VG350 : O-ring gasket	036-13529-97	Attached to the pump
2	Bolt set (inlet flange)	—	VG350 : Not included	—	—
3	Dust cap (outlet flange)	1	KF40	267-93896-03	Attached to the pump
4	Important safety instructions	1	English	263-93297	Inside the box
5	Instruction manual CD-ROM	1	(Note 1)	263-90098	Inside the box

(Note 1) The contents that relates to this product is as follows.

	Description	Document number
1	Instruction manual for TMP-V4404LMW : Japanese	263-92325
1	Instruction manual for TMP-V4404LMW : English	263-93325
2	Exclusive instruction manual for Serial communication (for TMP-Vxx04 series)	263-13476

1.6. Pump Fixing Bolt (Option)

Please select if necessary (Not included in Main Unit).

	Description	Notes	Part number
1	Bolt set (inlet flange)	A2-70, HEX HEAD M12x55W 12PC	267-80062-09

2. Specifications**2.1. TMP-V4404LMW**

Turbo molecular pump		TMP-V4404LMW
Inlet flange		VG350
Outlet flange		KF40
Mass		98 kg
Ultimate pressure (after baking)		10^{-7} Pa order
Maximum allowable flow rate (Note 1)		Refer to Chapter 2.2
Maximum allowable inlet pressure (Note 1)		40 Pa
Maximum allowable outlet pressure (Note 1)		170 Pa
Pumping speed (Note 2) (Note 3)	N ₂	4500 L/s
	Ar	4300 L/s
	H ₂	1800 L/s
Compression ratio	N ₂	1.5×10^7
	He	4.0×10^3
	H ₂	4.4×10^2
Rated speed		24000 rpm
Start-up time		12 minutes or less
Mounting position		In any desired direction (Refer to Chapter 4)
Vibration level (by Shimadzu's method)		0.01 μ m or less (0-peak)
Noise		50 dB(A) or less
Recommended flow rate of purge gas		30 mL/min (Note 4)
Admissible pumping speed of backing vacuum pump in case of gas purge		1500 L/min or more
Display	LED	POWER / STATUS / ROTATION / NET (cf. chapter 7)
Communication	Contact	REMOTE (D-sub 25 pin female, Screw lock size #4-40UNC) Input : START / STOP / RESET / LOW SPEED Output : ROTATION / ACC. / BRAKE / NORMAL / REMOTE / ALARM / WARNING / CONNECTION
	Serial	RS-232C / RS-485 (D-sub 9 pin male, Screw lock size #4-40UNC)
Speed variation		Speed is variable between 75 % and 100 % of the rated speed (set as 0.1 %).
Alarm history		Stores up to latest 99 alarms.
Momentary power failure (Note 5)		If the electrical power is recovered in 1 second or less, then the power supply operation prior to the electrical power failure is continued. No change output signal. Otherwise, the turbo molecular pump rotor is decelerated.
Alarm Detection	Alarm	Pump temperature, Pump start-up error, Overload and Overspin for motor, Failure of magnetic bearing, Controller malfunction (Overtemperature inside control system or failure of drive circuit), Power interruption, Dew condensation, etc.
	Warning	Failure of magnetic bearing, Control system malfunction (Overtemperature inside control system), Dew condensation (Water valve close).

Protection	Alarm	<p>STATUS orange lamp illuminates.</p> <p>Power Interruption Alarm: Decelerated while maintaining levitation using regenerative power. After decelerating to specified low speed, levitation is stopped and rotor is supported by touchdown bearing. When power is restored, the pump can be restarted by resetting.</p> <p>Dew Alarm: The pump is decelerated after dew condensation alarm is detected (Refer to chapter 3(6)).</p> <p>When other alarms occur: Stops operation or decelerates. Magnetic levitation is continued.</p>
	Warning	STATUS orange lamp flashes and pump continues to function (Dew Warning: Water valve is closed).
Input electric Power	Voltage (Note 5)	Single phase 200 to 240 VAC (50 / 60 Hz)
	Maximum power	1.2 kVA
	Insulation withstand voltage	1500 V, 1 minute
	SCCR	200 A
Water (Note 7)	Flow rate Pressure Temperature	<p>3 ~ 4 L/min or more</p> <p>0.2 to 0.4 MPa</p> <p>19 to 30 degrees C. (above dew point)</p>
	Water quality	<p>Non-corrosive industrial water</p> <p>Solid particle size (Max) : 0.025 mm²</p> <p>PH (@25 degrees C.) : 6.5 – 8.2</p> <p>Electrical conductivity (@25 degrees C.) : 100 – 800 μS/cm</p> <p>(Electrical resistivity : 1250 – 10000 Ω cm)</p>
Admissible ambient magnetic field	Radial direction	3 mT
	Axial direction	15 mT

(Note 1) Maximum allowable flow rate, Maximum allowable inlet pressure and Maximum allowable outlet pressure can not be satisfied at same time.

(Note 2) Without a protective net. Pumping speed for N₂ is 4050 L/s with a protective net.

(Note 3) Be sure not to use the non-chemical type pumps to exhaust of corrosive gasses such as chlorine type or fluorine type.

(Note 4) In case of using gas purge option.

mL/min : volume flow rate at 0 degrees C., 1 atm. (Compatible with SCCM.)

(Note 5) The time can be changed to two seconds from one second.

(Note 6) Temporary voltage fluctuation range : ±10 %

Temporary frequency fluctuation range : ±2 Hz

(Note 7) Temperature without dew condensation.

2.2. The maximum allowable flow rate

Gas type (Note 1) (Note 2)	APC valve temperature	Gas purge flow rate (Note 4)	Temperature of cooling water	The maximum allowable flow rate (Note 3) (Note 4)
Argon	45 degrees C.	0 mL/min	25 degrees C.	1450 mL/min
			30 degrees C.	1350 mL/min
Nitrogen			25 degrees C.	2450 mL/min
			30 degrees C.	2250 mL/min

(Note 1) Consult your Shimadzu representative before using gasses except shown in above table.

(Note 2) Be sure not to use the non-chemical type pumps to exhaust of corrosive gasses such as chlorine type or fluorine type.

(Note 3) The maximum allowable flow rate depends on the gas type, the APC valve temperature and the gas purge flow rate.

(Note 4) mL/min : volume flow rate at 0 degrees C., 1 atm. (Compatible with SCCM.)

2.3. Environmental Conditions

Installation conditions (Refer to UL / EN61010-1 standard)		Use : Indoor, Altitude max : 2000 m, Overvoltage category II , Pollution degree 2, IP classification 54
Temperatures	Operation	10 to 40 degrees C.
	Storage	-25 to 70 degrees C.
Relative humidity		40 to 80 %RH

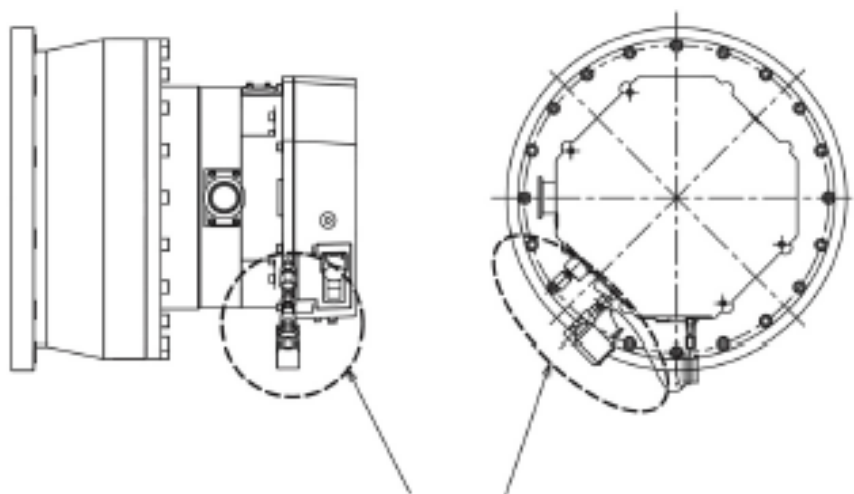
2.4. Standards Fulfilled

Safety	EN 61010-1 UL 61010-1 SEMI S2 EN 1012-2
EMC	EN 61326-1 Class A EN 61000-6-2 SEMI F47 KN 11 KN 61000-6-2

3. Attention in use

3.1. Attention in water cooled specification

- (1) This product is a water cooled model. Always provide a flow of coolant water that meets the indicated specifications.
- (2) Make sure no water is leaking from the coolant lines. Do not spill coolant on the pump.
- (3) Confirm the cable from water valve is surely connected to VALVE connector of External I/F panel.
- (4) Make sure that there is no condensation and not high humidity environment. Do not switch the power supply unit ON with condensation at the location indicated in Fig. 3-1.
- (5) If condensation occurs during operation, condensation warning is detected, and cooling water is bypassed and supply to the pump is stopped. If the dew is not disappeared for a while, dew alarm turns on and decelerate the motor to protect the controller. Please use it at the temperature that the dew condensation is not generated and keep environment humidity low. Even if the power supply unit is OFF, do not flow coolant through it that is below dew point.
- (6) When the power is turned off, cooling water is bypassed and is not supplied to the pump.



Locations to Check for Dew Condensation

Fig.3-1 Locations to Check for Dew Condensation

3.2. Attention in integrated power supply

This turbo molecular pump is integrated power supply.

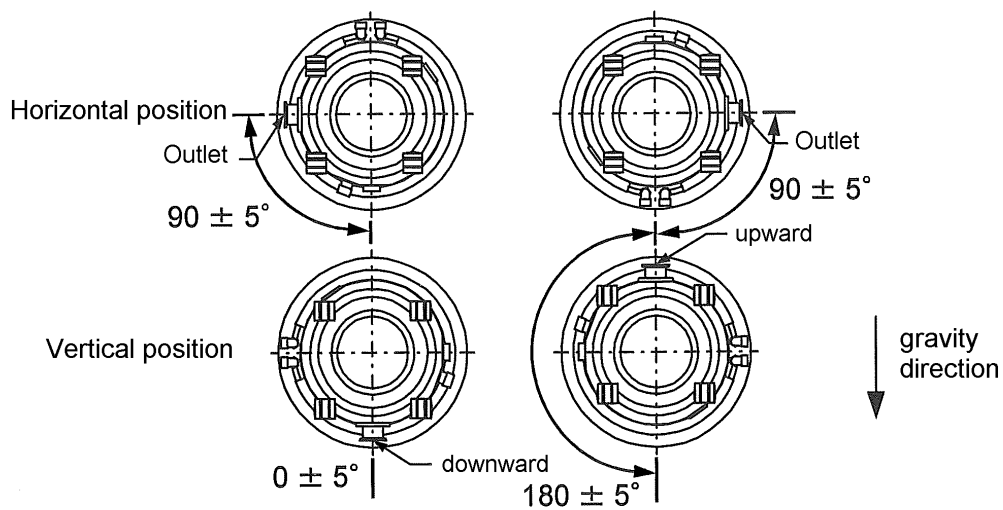
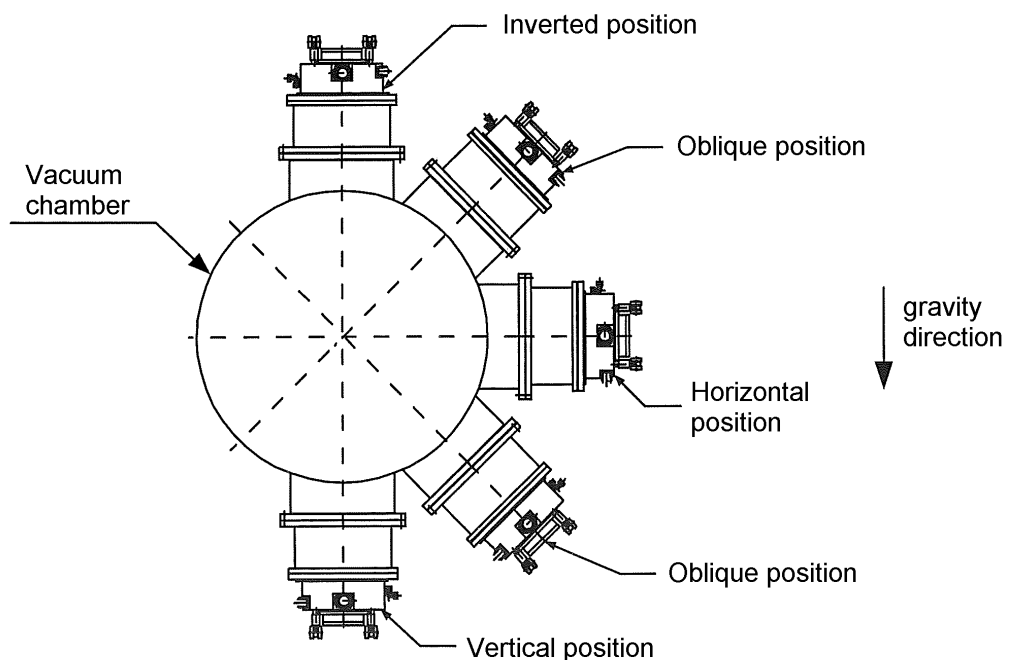
Do not separate the pump and the power supply.

This turbo molecular pump can not be operated in case separate the pump and the power supply.

4. Pump Mounting Direction

This turbo molecular pump can be installed in vertical, horizontal, inverted, or oblique position. The outlet flange of the turbo molecular pump should face horizontally or vertically when installing horizontally and obliquely.

When an installation direction is not appropriate, reliability of operation may deteriorate.



5. Installation of the Pump

WARNING

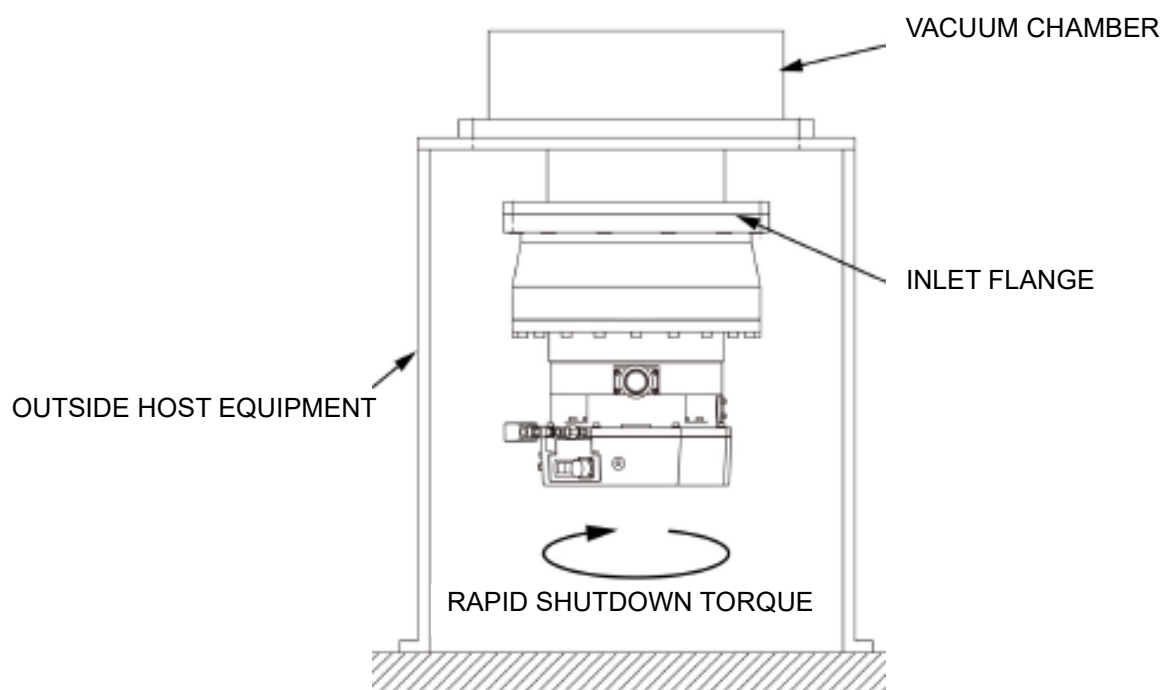
- The rotor assembly of the turbo molecular pump rotates at high speed. Large rapid shutdown torque should be generated when abnormality occurs in the pump by any chance. Incidental accident will cause the pump to drop out and to make a catastrophe if the pump is fixed by insufficient method.
- Fix the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

Please fix the inlet flange of the turbo molecular pump to the flange of vacuum chamber (Refer to Fig. 5-1).

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.

The sets of half-thread bolt and nut should be used to fix the inlet flange of the pump. Make installation with the cylindrical part of the bolt (not thread 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.



Fixed only by the inlet flange of TMP

Description	Rapid shutdown torque (Note)
TMP-V4404LM	70000 N·m

(Note) Rapid shutdown torque is the typical value measured by the Shimadzu'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. 5-1 Installation of the Turbo Molecular Pump

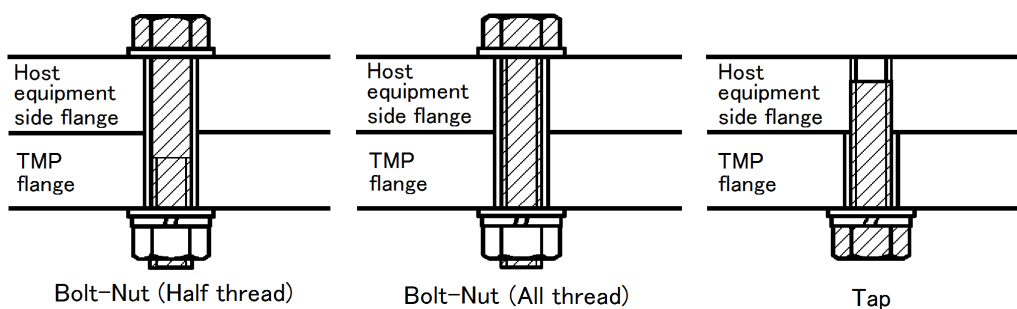


Fig. 5-2 How to use of the bolt

Table 5-1 The recommended fixing bolt

Bolt-Nut (Half thread) · All thread) · Tap

Fixing method	Only by the inlet flange
Inlet flange	VG350
Bolt Size, Quantity	M12, 12 PC
Material	Stainless steel
Grade	A2-70 (JIS B 1054 / ISO-3506)
Washer	Special washer (Note) and spring lock washer

(Note) The special washers are attached to the inlet flange of TMP when shipping.
Do not remove them at the time of TMP installation.
Refer to the following figure for the details of the bolt attaching part.

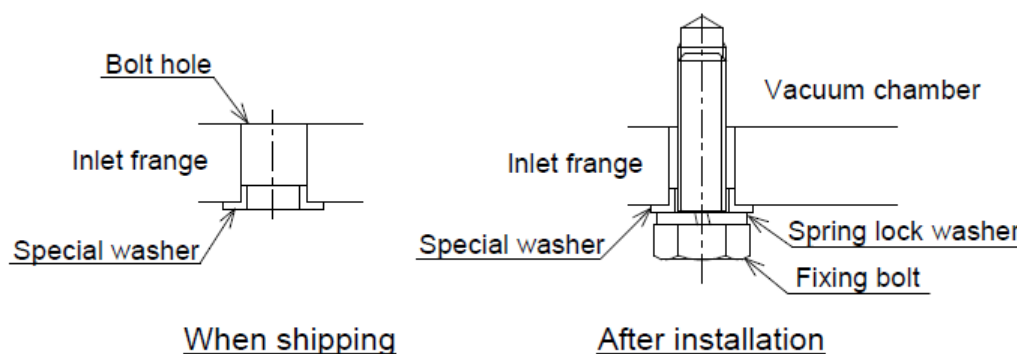


Fig. 5-3 Example of the Fixing Method Using the Special Washer

Table 5-2 Tightening torque of the fixing bolt

Size of bolt	Tightening torque [N·m]
M12	16 to 26

6. Interfaces

- a) Control panel : Refer to Chapter 7.
- b) External I/F panel : Refer to Chapter 8.

7. Control panel

7.1. Description and function of control panel

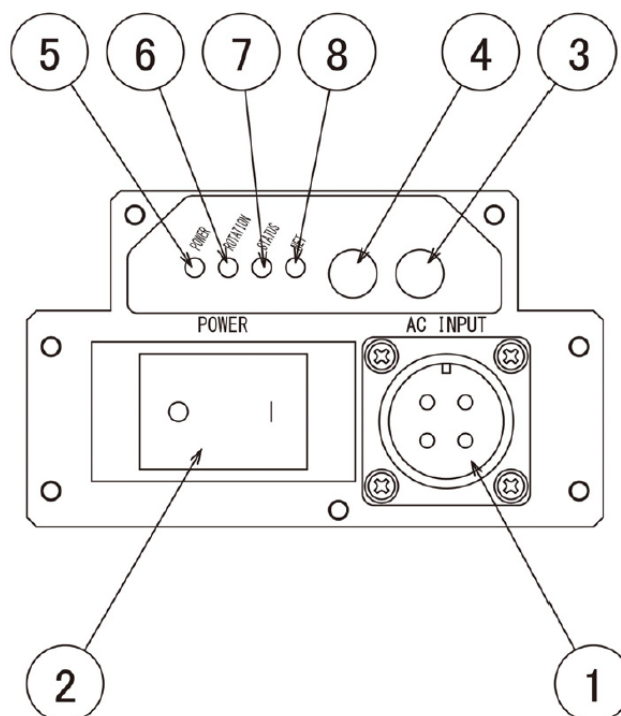


Fig. 7-1 Outline view of control panel

- (1) AC INPUT connectorPower cable receptacle
- (2) POWER SwitchPower switch
- (3) START/STOP buttonPush to acceleration or deceleration.
During LOCAL MODE, control by maintained push.
- (4) RESET button.....When occur ALARM or WARNING, after remedying the cause of the ALARM, an abnormal state is released by pushing button.
By maintained push, REMOTE MODE and LOCAL MODE are changed.
- (5) POWER lampThis lamp lights or blinks while power on (green).
Lights: REMOTE MODE
Blinks: LOCAL MODE
- (6) ROTATION lamp.....Operation indicator lamp indicating that the pump's rotor is running (green).
- (7) STATUS lampOperation indicator lamp indicating that the pump's operation status (green · orange). (Note 1)
green/lights: Rotational speed reaches 80 % rated value.
green/blinks: Accelerating
orange/lights: ALARM occurs
orange/blinks: Warning occurs
- (8) NET lamp.....For option. This lamp is always turned off.

(Note 1) The pattern when both green and orange are lit and blink becomes the following.

- When warning occurred during rating speed.
green/light and orange/blink: green – orange – green – orange – ...
- When warning occurred during acceleration.
green/blink and orange/blink: green – orange – turned off – green – orange – turned off – ...

8. External I/F panel

8.1. Description and function of external I/F Panel

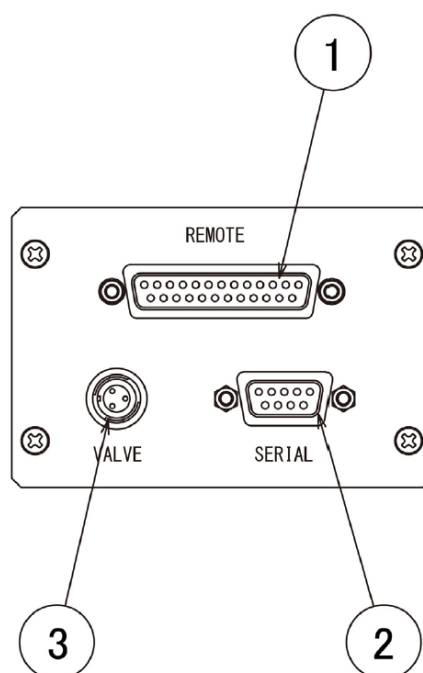


Fig.8-1 Outline view of external I/F panel

- (1) REMOTE connector Connector for remote-control.
Refer to chapter 8.2.
- (2) SERIAL connector Connector for RS-232C and RS-485 communication.
Refer to chapter 8.5.
- (3) VALVE connector..... Water valve connector.
Connection to water valve with cable (provided).
Refer to chapter 3.

(Note) All interfaces are SELV (safety extra-low voltage).

8.2. Remote Control

8.2.1. Specification

This TMP is provided with remote-control connector for connection with remote operation, ALARM signals, etc. (Refer to Fig. 8-2, Fig. 8-3 and Table 8-1).

For connection with this connector, cable with shield is necessary. The shield of the cable should be connect to case.

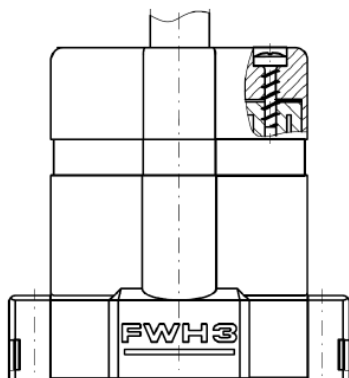


Fig.8-2 Remote Control connector

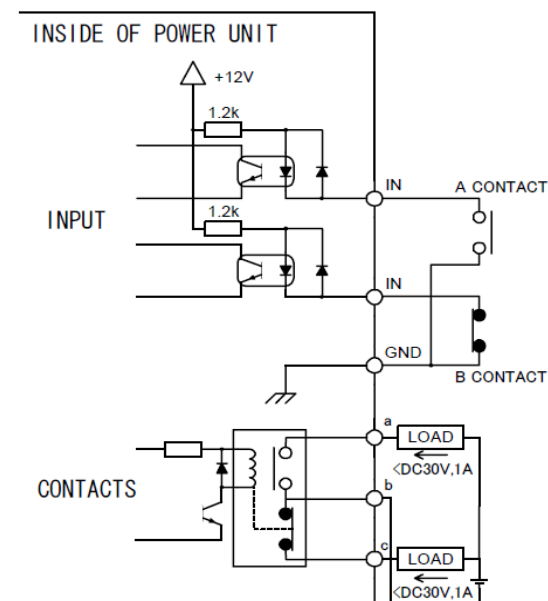


Fig.8-3 Remote-Control Circuit

Table 8-1 START/STOP According to Remote-Control Signals

Connection method	By momentary type START/STOP switch	By alternate type switch
Wiring connection		
Control	Pump start by short-circuiting (1) and (16). Pump stop by opening (2) and (16).	Pump start, with the contact close or photo transistor ON ((2) to (16) short-circuit). Pump stop, with the contact open or photo transistor OFF ((2) to (16) open).
Electric capacity	[Contact] It is connected to +12 V circuit and subject to stable open-close of 5 VDC, 1 mA. Voltage...30 VDC or more, 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	
Input rating	Direct forward current 50 mA ; DC reverse voltage 5 V	

8.3. Pin Assignment

Table 8-2 Remote-Control Signals

	Name	Pin No. (Note 1)	Operation (Note 2)	Electric spec
In- put	START	1	Starting operation on short-circuiting between GND and pin No.1. (Note 3)	Contact Input
	STOP	2	Pump stop by opening GND and pin No.2. (Note 3) (Note 5)	
	RESET (Note 4)	14	Resetting operation on short-circuiting between GND and pin No.14.	
	LOW SPEED	15	Variable speed operation on short-circuiting between GND and pin No.15.	
	GND	16	GND	
Out- put	ROTATION	8 20	During rotation (8)-(20) open → close (make contact)	Contact Output Contact capacity (resistance load) 30 VDC 1 A
	NORMAL	6 18	During rotational speed is more than 80 % rated value (6)-(18) open → close (make contact)	
	ACCELERATION	5 17	During acceleration (5)-(17) open → close (make contact)	
	BRAKE	7 19	During deceleration (7)-(19) open → close (make contact)	
	REMOTE	9 21	Remote-controlled operation is available (Note 5) (9)-(21) open → close (make contact)	
	ALARM	11 23 24	Against ALARM (Note 5) (11)-(24) open → close (make contact) (23)-(24) close → open (break contact)	
	WARNING	12 13 25	Against WARNING (Note 5) (12)-(25) open → close (make contact) (13)-(25) close → open (break contact)	

(Note 1) Don't connect any pins other than specified above.

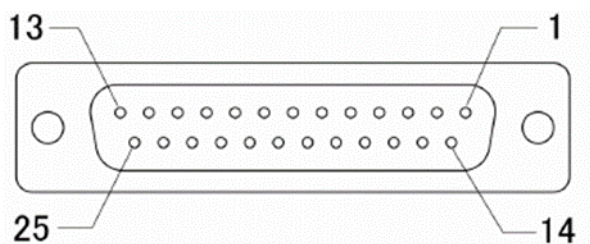
(Note 2) It takes 6 seconds until it comes to show that this signal is correct, after POWER switch is turned on.

(Note 3) "STOP" signal is prior to "START" signal.

(Note 4) One reset signal is received each time when the contact closes. Repeatedly short and open the contact to input multiple reset signals.

(Note 5) It is possible to change movement by remote-control signal settings of serial communication (If set to [SEMI E74], remote control signals will conform to SEMI Standard E74 "Specification for Vacuum Pumps – Turbomolecular Pumps").

8.4. Connector



**Fig. 8-4 Arrangement of Remote-control Connector Pins
(Figure where connector of panel was viewed from the front)**

Connector	D-sub 25 pin female
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8.5. Serial Connector

8.5.1. RS-232C hardware specification

(1) Transmission specifications

Interface	RS-232C
Synchronous system	Asynchronous
Transmission rate	9600 bps (fixed)
Character Configuration	Start bit : 1 Data bits : 8 Parity : None Stop bit : 1
Flow control	None

(2) Connector specifications

Connector	SERIAL Connector (shared with RS-485)
Connector type	D-sub 9 pin male, Screw lock size #4-40UNC
Pin Assignment	2 : RD (Receive data) 3 : SD (Transmit data) 5 : SG (Signal ground) ※ Don't connect other pins except the above-mentioned.

8.5.2. RS-485 hardware specification

(1) Transmission specification

Interface	RS-485 (2-wire, half duplex)
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 pumps in daisy chained line	Maiti-drop function OFF : 1 Maiti-drop function ON : Max. 32 (Note 1)

(Note 1) There may be restrictions depending on cable length or cable type.
Perform appropriate checks in the actual operating environment.

(2) Connector specifications

Connector	SERIAL Connector (shared with RS-232C)
Connector type	D-sub 9 pin male, Screw lock size #4-40UNC
Pin Assignment	4: RXA (Received data +) 7: RXB (Received data -) ※ Don't connect other pins except the above-mentioned.

8.5.3. Software specification

By serial communication, Operation, Status monitor, and Setting is possible

	Description
Operation	START, STOP, ALARM reset, LOW SPEED
Status monitor	Rotation, Normal, Acceleration, Brake, Remote, LOW SPEED, ALARM, WARNING
	Rotational speed, Motor current, Running time, ALARM number Read ALARM history etc.
Setting	Rotational speed at low-speed setting, Power failure detection time etc

8.5.4. Connector

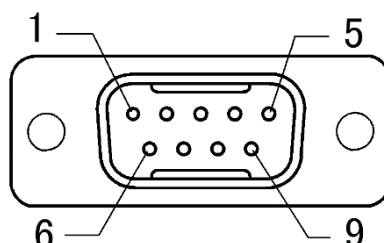


Fig. 8-5 Serial Connector Pin Configuration
(Figure where connector of panel was viewed from the front)

Connector	D-sub 9 pin male
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NOTICE

Serial communication specifications conform to RS-232C and RS-485.
These interfaces were tested on a typical condition, but the normal communication with all equipment are not guaranteed.

9. Warranty

- 9.1.** Warranty period is 12 months on new TMP's from the date of shipment from Shimadzu, or from any of its worldwide sales offices.
- 9.2.** During the warranty period and under normal operation, if the TMP fails to meet its product specification due to defects in material and/or workmanship, Shimadzu will, at its discretion, either repair it or exchange it with a new one for free.
- 9.3.** The warranty covers only TMP's, controllers and accessories sold by Shimadzu.
When rotor break, devices connected to turbo molecular pump may be damaged. Repair and/or replacement charge of devices connected to turbo molecular pump is not covered by warranty whether under warranty or not.
- 9.4.** In-warranty repaired or replacement parts are warranted only for the remaining unexpired portion of the original warranty period applicable to the parts that have been repaired or replaced.
- 9.5.** During the warranty period, Shimadzu will charge for repair or exchange in the following cases :
 - 1) Failure caused by natural disasters or fire.
 - 2) Failure or functional deterioration due to the following :
 - a) Pumping of special gases and materials.
 - b) Dropping of foreign object (solid and liquid) and attachment of reacted object through the TMP's protective net.
 - c) TMP is operated differently than what is prescribed in the instruction manual.
 - d) When Shimadzu determines through failure analysis that the cause of failure was due to abnormal operation or external circumstances. Our engineers judge that the cause of the trouble is an irregular operation.
 - 3) Warranty is voided if the "Security Seal" on the product has been removed, or there is residue or evidence the seal has been tampered with.

10. LIMITATION OF LIABILITY

Except as stated herein, SHIMADZU makes no warranty, expressed or implied (either in fact or by operation of law), statutory or otherwise : And, except as stated herein, SHIMADZU shall have no liability for special or consequential damages of any kind or from any cause arising. Out of the sale, installation, or use of any its products.

11. Turbo Molecular Pump Recondition

It is different for deterioration progress speed of each part changes greatly by pump condition. Refer to the following list as overhaul of each process. These are not terms of warranty.

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.

Non-active gas and Light load process.

	Part name	Recommended maintenance intervals
1	Touch down bearing	3 years
2	Shaft	7 years It has a possibility of under 2 years (Dependent on condition)
3	Rotor	
4	Motor	7 years
5	Magnetic bearing parts	

Power supply unit

	Part name	Recommended maintenance intervals
1	Transformer	10 years
2	Electrolytic capacitor	5 years
3	Button battery	10 years
4	Seal parts for waterproofing	3 years

(2) Recommended maintenance intervals for other parts.

1) It has the possibility that the following part is exchanged, when cleaning TMP.

Part name
55-pin Receptacle

2) Others

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