Instruction Manual

Magnetic Suspended Compound Molecular Pump & Turbo Controller

TG390M/TG420M
TG900M/TG1300M
& TC010M

Read this instruction manual carefully before use and understand each attention item and a warning item well.

This instruction manual keeps importantly being able to be read when it is necessary.

OSAKA VACUUM, LTD.

ND00456-R09

Preface

1. Magnetic Suspended Compound Molecular Pump and Turbo Controller

The magnetic suspended compound molecular pump is the industrial product which the high speed rotating rotor transports (pump downs) air gas molecules from the inlet port to the outlet port. This rotator is suspended by five-axis active type magnetic bearing with no contact. (Hereinafter, the magnetic suspended compound molecular pump is described as “pump” in this manual.)

The turbo controller is the exclusive digital controller for the OSAKA VACUUM magnetic suspended compound molecular pump. The magnetic bearing control unit and the frequency converter to obtain high rotation speed are built in the controller. (Hereinafter, the turbo controller is described as “controller” in this manual.)

2. Symbol Mark and It’s Definition

WARNING and CAUTION marks are used in this manual and these definitions are described as follows.

! WARNING

◇[WARNING] indicates hazards that may result in severe personnel injury or death.

! CAUTION

◇[CAUTION] indicates hazards that may result in minor injury, and may cause the pump, its controller or peripheral unit troubles.

Note

◇[NOTE] describes items related to the system operation and maintenance procedures.

! CAUTION

◇Must conform to the [WARNING] or [CAUTION] described in this manual. And moreover, must conform to the national safety regulations and laws. The [WARNING] or [CAUTION] described in this manual is one which OSAKA VACUUM can presume.

◇OSAKA VACUUM has keep all rights related to the system change for improvement without previous information. Therefore, the system may change partially as compared with the manual description.

Warranty

The warranty on the pump, the controller and the peripherals are specified in the “General Terms of Warranty” published by OSAKA VACUUM, LTD. But the warranty will be avoided if the operations and the maintenance procedures in this manual are not followed.
Note, also, that any special use of the pump and controller without OSAKA VACUUM, LTD.’s agreement will avoid the warranty.

Conformity Standards

The pump and controller of the standard specification of OSAKA VACUUM, LTD. conform to the following directives and standards.

○98/37/EC (Machinery Directive)

EN1012-2:1996 (Compressors and vacuum pumps - Safety requirements)

○73/23/EEC (Low Voltage Directive)

IEC61010-1:1990 +A1:1992 +A2:1995 (Safety requirements for electrical equipment)

EN61010-1:1993 +A2:1995 (Safety requirements for electrical equipment)

IEC61010-1:2001 (Safety requirements for electrical equipment)

EN61010-1:2001 (Safety requirements for electrical equipment)

○89/336/EEC (Electromagnetic Compatibility Directive)

EN50081-2:1993 (Generic Emission Standard - Industrial environment)

EN55011:1998 +A1:1999-Group 1, Class A

(AC Mains Terminal Disturbance Voltage, Radiated Electric Field Strength)

EN61000-6-2:2001 (Generic Standard - Immunity for Industrial environments)

EN61000-4-2:1995 +A1:1998 (ESD)

EN61000-4-3:1996 +A2:2001 (Radiated Susceptibility, Amplitude Modulated)

ENV50204:1995 (Radiated Susceptibility, Pulse Modulated)

EN61000-4-4:1995 +A1:2001 (EFT/Burst)

EN61000-4-5:1995 +A1:2001 (Surge)

EN61000-4-6:1996 (Conductive Susceptibility)

EN61000-4-8:1993 (Power Frequency Magnetic Field)

EN61000-4-11:1994 (Voltage Dip, Interruption)

○SEMI S2-0302 (Safety Guideline for Semiconductor Manufacturing Equipment)

○UL 61010A-1:2002 R4.02 (Electrical Equipment for Laboratory Use)

○CAN/CSA-C22.2 No. 1010.1-92 +A2:97 (Safety Requirement for Laboratory Use)

－Table of Contents－

1. Unpack

1-1. Unpack

Check the following items when unpacking the pump and controller.

☐ Package Damage
Check the package damage. If some damage is found and returning it to us is necessary, call to OSAKA VACUUM.

☐ Composition And Attachment Parts
Check the composition and attachment parts compared with the table 1. If some part is not found, call to OSAKA VACUUM soon. Some composition parts may differ depending on each specification of the pump and controller.

Table 1. Standard Composition And Attachment Parts

Composition Parts Name		Quantity	
		TG390/420M	TG900/1300M
Output Cable / 5 meters (16.4 ft)		1 pc	
Attachment Parts Name		Quantity	
		TG390/420M	TG900/1300M
Pump	Inlet Flange for Shipping	1 pc	
	Outlet Flange for Shipping (with Center Ring)	1 pc (KF25)	1 pc (KF40)
	Plug for Purge Port (with O-Ring)	1 pc	
Controller	Remote Connector	1 set	
	Input Power Cable / 5 meters (16.4 ft)	1 pc	
Instruction Manual (Pump&Controller and Serial Communication)		Each 1 copy	

1-2. Carrying

Weights of the pump and controller are shown in the table 2.

Table 2. Weights of the Pump and Controller

Model	Weight (approx.)
TG390/420M(V/B)＊B	14 kg (31 lb)
TG390/420M(V/B)＊C, TG390/420MC＊＊	17 kg (37 lb)
TG900/1300M(V/B)＊B	34 kg (75 lb)
TG900/1300M(V/B)＊C, TG900/1300MC＊＊	42 kg (93 lb)
TC010M	11 kg (24 lb)

! CAUTION

◇Do not impact on the pump and controller.

◇The pump which weight is more than 18 kg (40 lb) is attached with the mating nuts on the inlet flange. When carrying the pump, shall use a crane to lift the pump. If carrying the pump by hands, lift the pump always by more than two personnel for safety.

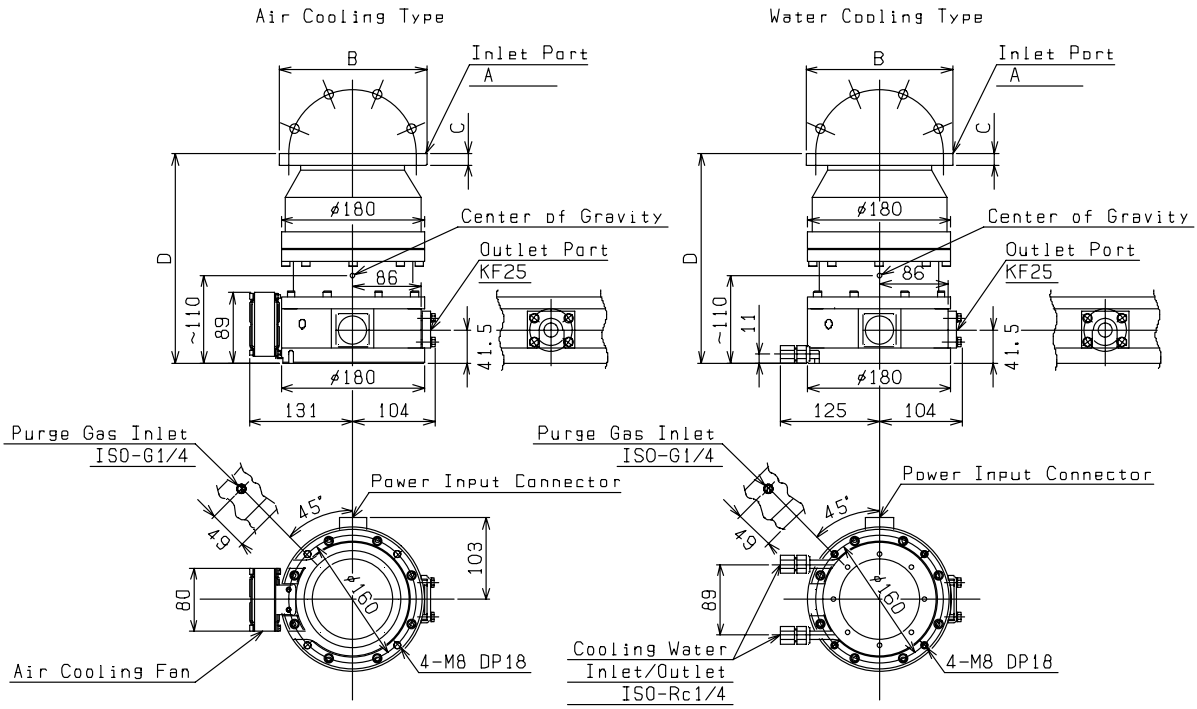
◇If carrying the pump or controller which weight is less than 18 kg (40 lb), hold them securely with both hands.

Note

◇OSAKA VACUUM will recommend that the packing materials of the pump and controller shall be stored for the re-use.

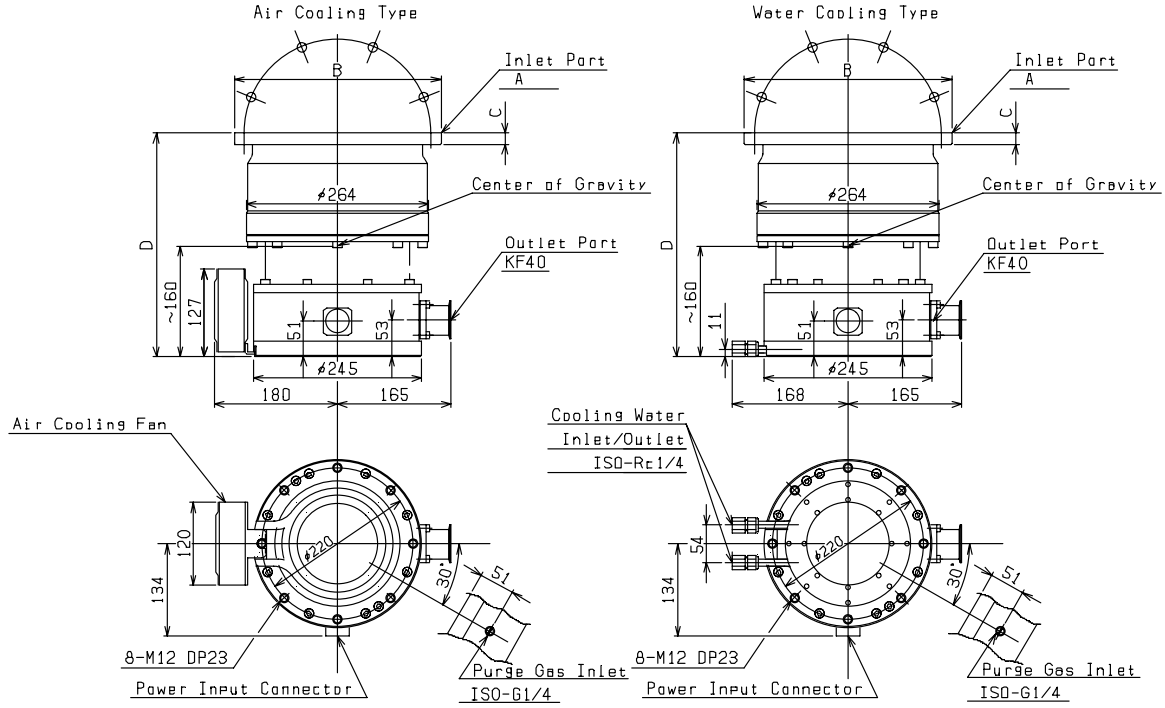
2. Pump Installation

2-1. Pump External View and Part Name



Pump Model	A	B	C	D
TG390MV＊＊	VG100	ϕ185	15	263
TG390MC＊＊	CF100	ϕ152	21	269
TG390MB＊＊	ISO-B100	ϕ165	12	260
TG420MV＊＊	VG150	ϕ235	16	225
TG420MC＊＊	CF160	ϕ203	22	230
TG420MB＊＊	ISO-B160	ϕ225	16	230

Figure 1. Pump External View and Part Name (Model TG390/TG420M)



Pump Model	A	B	C	D
TG900MV＊＊	VG150	φ235	16	376
TG900MC＊＊	CF160	φ203	22	382
TG900MB＊＊	ISO-B160	φ225	16	390
TG1300MV＊＊	VG200	φ300	16	324
TG1300MC＊＊	CF200	φ253	25	385
TG1300MB＊＊	ISO-B200	φ285	16	359

Figure 2. Pump External View and Part Name (Model TG900/TG1300M)

2-2. Nameplate and Hazard Alert Labels

For safety operation, the nameplate and hazard alert labels as shown in table 3 are labeled on the location as shown in figure 3,4. Be sure to check before use.

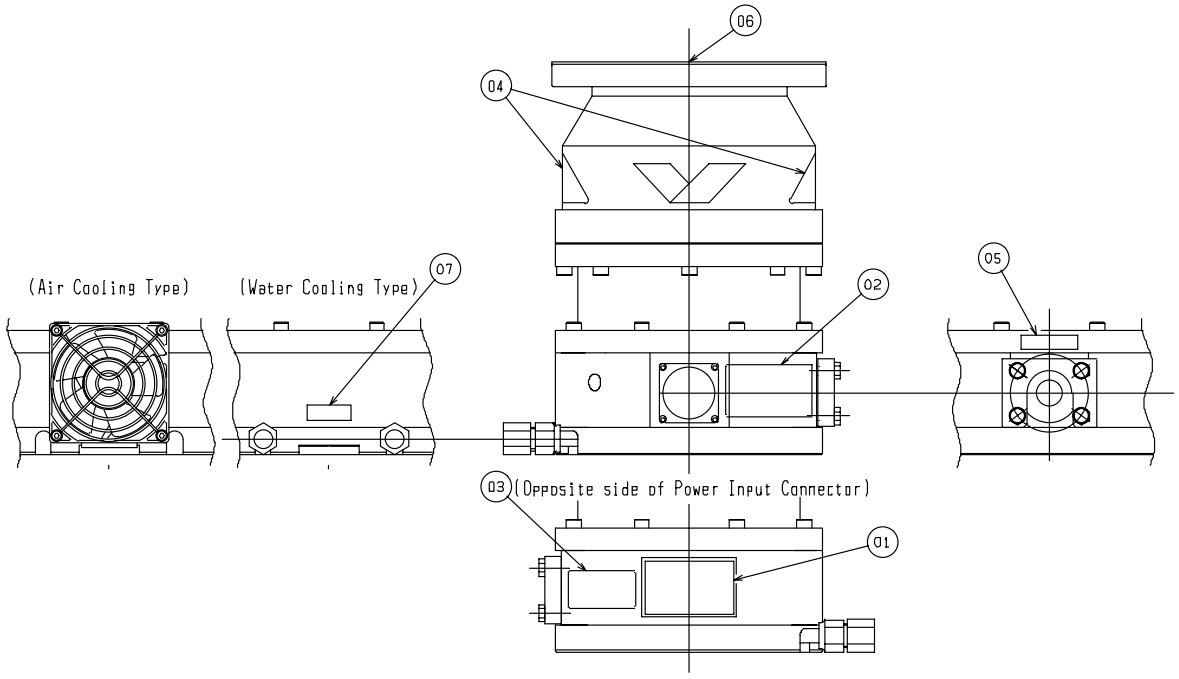


Figure 3. Location of Nameplate and Labels (Model TG390/420M)

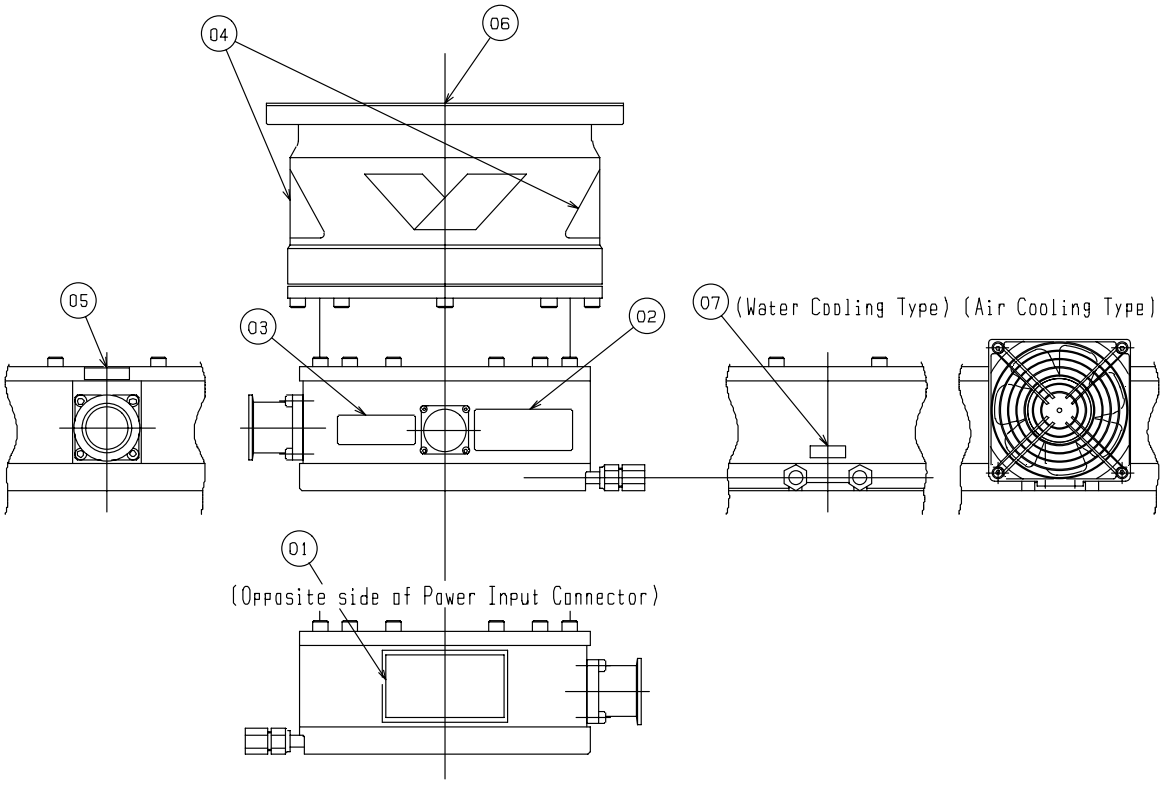


Figure 4. Location of Nameplate and Labels (Model TG900/1300M)

Table 3. Nameplate and Labels

No.	Nameplate and Labels	Intended Meaning
① (Nameplate)	<<MAGNETIC SUSPENDED>> COMPOUND MOLECULAR PUMP MODEL TG1300MVWB SER. NO. 0103 DATE 06. 2002 OSAKA VACUUM, LTD. MADE IN JAPAN	• Model name, serial number and manufacturing date of the pump are printed.
② (Caution Label)	INSTALL the pump securely according to instruction manual ポンプは取扱説明書に従い、確実に固定して下さい。 DO NOT disconnect the cable while the breaker is on. 入力電源通電中にケーブルを抜かないで下さい。	• Install the pump securely to prevent any troubles, according to the instruction manual. (Refer to the section 2-4.) • Do not disconnect the cable, since it may become the cause of pump or controller troubles.
③ (Caution Label)	WEIGHT approx. 42kg(93lb) 質量 約42kg	• The pump weight is printed. Be careful of handling of conveyance etc.
④ (Caution Label)		• The pump surface becomes high temperature during operation. Do not touch the pump surface to prevent severe skin burns.
⑤ (Notice Label)	FORELINE	• Connect to the backing pump.
⑥ (Notice Label)	Keep this lid and use when the pump is removed.	• Keep this lid and use when the pump is removed such as long-term storage or transportation.
⑦ (Notice Label)	WATER	• Connect the cooling water pipe. (only for the water-cooling type pump).

2-3. External Environment of the Pump

Do not use the pump in the following area.

1) High Temperature and High Humidity Area

! CAUTION

◇Ambient temperature of the pump must not exceed over 32℃ (90 ° F) {40℃ (104 ° F) for the water-cooling type pump} during pump operation. If the ambient temperature rises, allowable gas flow rate decrease and it may become the cause of the pump troubles.

2) Strong Magnetic Field and Strong Electrical Field Area

! CAUTION

◇Do not operate the pump in strong magnetic fields. Permissible maximum magnetic fields strength during pump operation is approximately 0.002T (20 gauss). If the pump is operated in strong magnetic fields, the rotor temperature may raise up. It may become the cause of the shorter lifetime or pump troubles.

3) Shock or Vibration Area

! CAUTION

◇Do not impact on the pump and shake the pump during pump operation. Since the shock and vibration may become the cause of the “Displacement” failure of the magnetic bearing.

4) Radiation Area

! CAUTION

◇Do not operate the pump under radiation, since there is a possibility that the parts inside the pump may deteriorate.

2-4. Pump Mounting

The pump is able to mount the vacuum system as vertical, horizontal, reverse or oblique position. Connect the pump to the vacuum system tightly at the inlet flange and/or the bottom plate using the prepared bolt holes for mounting.

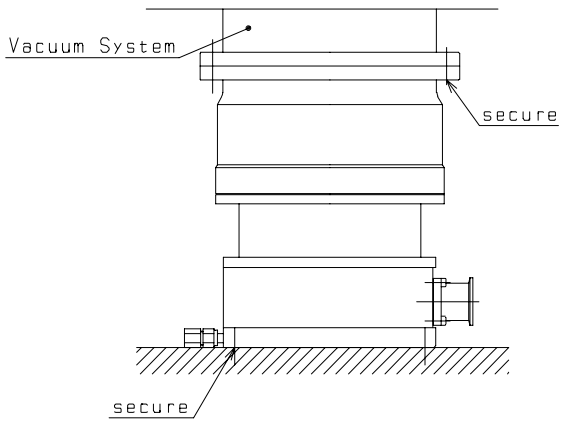


Figure 5. Example of Pump Mounting (Ex. TG1300MVWB)

! WARNING

◇If the pump rotor is damaged during rotation, extremely large torque generates to the pump body. Therefore the pump must be mounted to the vacuum system tightly.

◇The vacuum system and its frame must be designed to be fit for the torque which occurs in rotor destruction as shown in table 4.

Table 4. Maximum Rotation Torque Which Occurs In Rotor Destruction

Pump Model	Rotation Torque [N･m]
TG390/420M	3825
TG900/1300M	26000

◇The fixing bolts for the inlet flange and bottom plate shall be the chromium molybdenum steel bolts and/or stainless steel bolts of property class-70. Specially, the chromium molybdenum steel bolts of property class 12.9 shall be used at the TG900/1300M pump bottom plate. Table 5 and table 6 show the size and number of fixing bolts that be used at the inlet flange and bottom plate. Tighten all bolts equally.

Table 5. Fixing Bolts at the Bottom Plate

Pump Model	Fixing Bolts	P.C.D.
TG390/420M	4×M 8	160
TG900/1300M	8×M12	220

Table 6. Fixing Bolts at the Inlet Flange

Pump Model	Fixing Bolts	P.C.D.
TG390MV＊＊	8×M10	160
TG390MC＊＊	16×M 8	130.2
TG390MB＊＊	8×M 8	145
TG420/900MV＊＊	8×M10	210
TG420/900MC＊＊	20×M 8	181
TG420/900MB＊＊	8×M 8	200
TG1300MV＊＊	8×M12	270
TG1300MC＊＊	24×M 8	231.8
TG1300MB＊＊	12×M10	260

! CAUTION

◇Do not scratch and contaminate the inlet flange surface. And also do not touch to the pump inner surface with bear hands. It may become the cause of pumping characteristics degradation.

◇The protective mesh screen covers the inlet port to prevent any falling materials. Never remove this mesh.

◇Install a cover or a fence to prevent touching to the pump surface, because it becomes high temperature during pump operation.

Note

◇The protective mesh screen can't prevent any falling materials into the pump completely. Therefore the vacuum system shall be designed to prevent any falling materials into the pump.

3. Controller Installation

3-1. Controller External View and Part Name

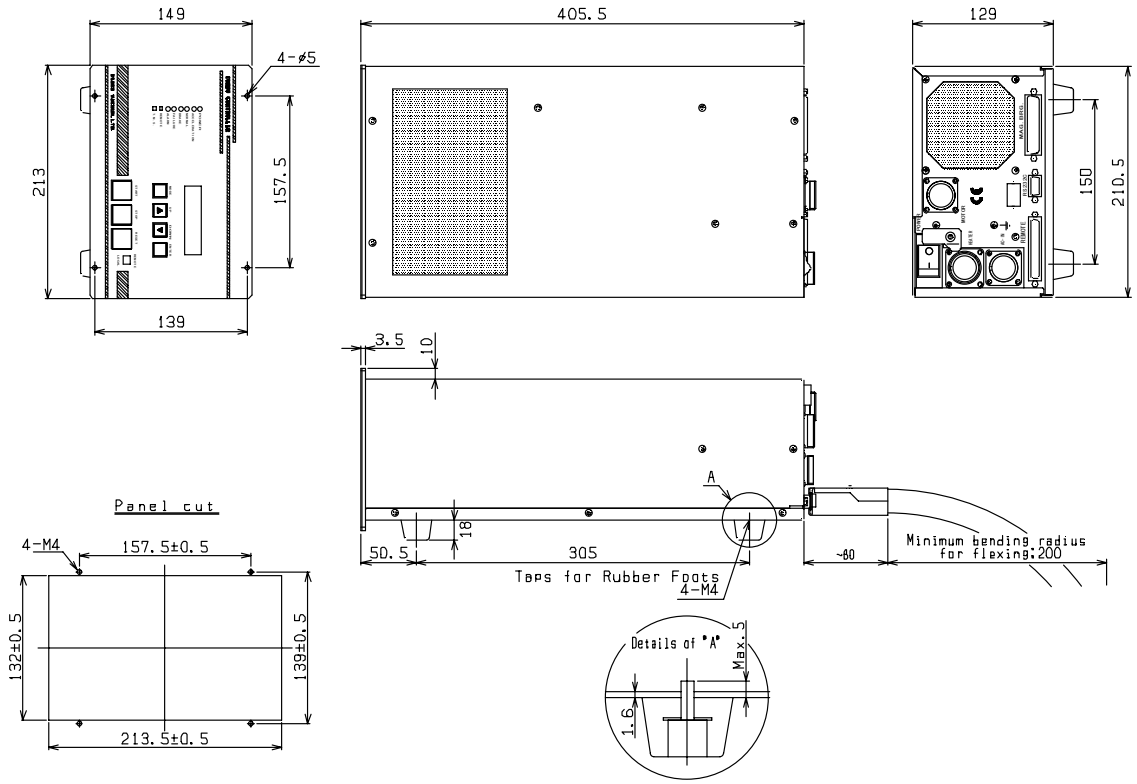
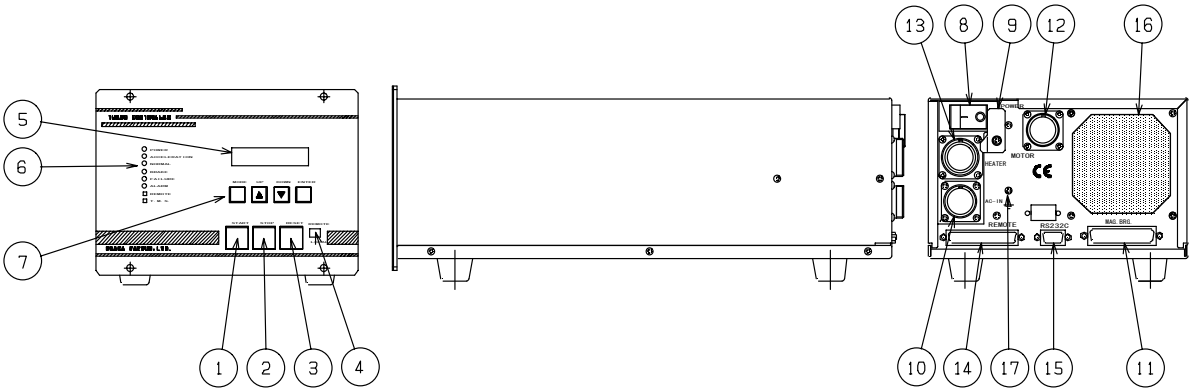


Figure 6. Controller External View



No.	Name	Function
①	[START] switch	In the LOCAL operation, Start the pump by this switch.
②	[STOP] switch	In the LOCAL operation, Stop the pump by this switch.
③	[RESET] switch	In the LOCAL operation, Reset all protective functions by this switch.
④	[LOCAL/REMOTE] switch	Select the LOCAL/REMOTE operation mode by this switch.
⑤	LCD	The setting speed and actual speed are displayed in normal operation. When protective function is activating, the error message is displayed.
⑥	Indicator LED	The operational status of the pump is indicated.
⑦	Function switches ・[MODE] switch ・[UP] switch ・[DOWN] switch ・[ENTER] switch	 ・Change the NORMAL Display to the MENU MODE Display by this switch. ・In the MENU MODE, Select the menu by this switch. ・In the MENU MODE, Select the menu by this switch. ・In the MENU MODE, Confirm the selection and setting number by this switch. When protective function is activating, Reset the protection function by this switch, checking one by one.
⑧	Main Power Breaker	Supply/interrupt the input power to the controller by this breaker.
⑨	Mis-Operation Stopper	Fix the [Main Power Breaker] so that the input power may not be supplied accidentally during the maintenance/check etc.
⑩	[AC-IN] connector	Connect the input power cable (attachment) to this connector.
⑪	[MAG. BRG.] connector	Connect the output cable to this connector.
⑫	[MOTOR] connector	Connect the output cable to this connector.
⑬	[HEATER] connector	Not use.
⑭	[REMOTE] connector	Connect the REMOTE input/output signals.
⑮	Serial Communication connector	Use this connector in the serial communication operation.
⑯	Cooling Fan	Exhaust the heat of the controller inside.
⑰	Functional Earth (Ground) terminal	If necessary, connect the Earth (Ground) to this terminal. (Bolt size is M4.)

Figure 7. Part Name of the Controller

! CAUTION

◇Do not perform an insulation resistance and a withstanding voltage test, since serge absorbers are built in the controller.

3-2. Nameplate and Hazard Alert Labels

For safety operation, the nameplate and hazard alert labels and symbols as shown in table 7 are labeled on the location as shown in the figure 8. Be sure to check before use.

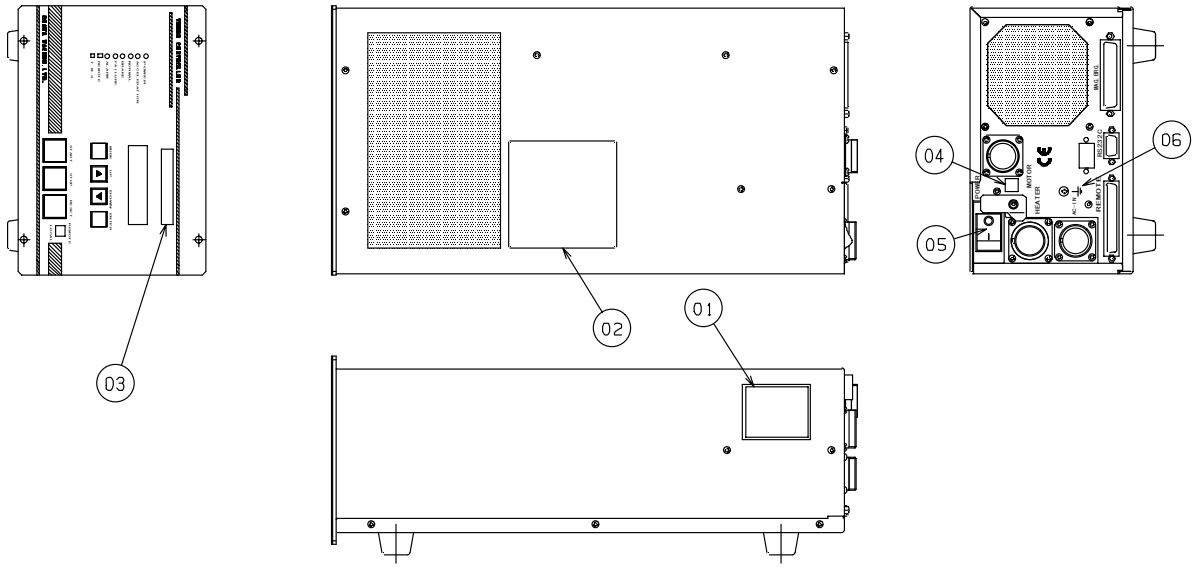


Figure 8. Location of Nameplate and Labels and Symbols

Table 7. Nameplate and Labels and Symbols on the Controller

No.	Nameplate and Labels and Symbols	Intended Meaning
① (Nameplate)	TURBO CONTROLLER Model : TC01OM Ser.No. : V3D02A01 Date : 06.2002 Voltage: AC200/220/240V 50/60Hz Power : 0.7kVA(TG390/420M) : 1.2kVA(TG900/1300M) OSAKA VACUUM,LTD. Made in Japan	• Model name, serial number, manufacturing date, input voltage and maximum power consumption of the controller are printed.
② (Caution Label)	READ instruction manual carefully prior to operation. 運転前に必ず取扱説明書を読んで下さい。 USE only the designated type of cable, connect securely. 必ず指定のケーブルを使用し、確実に接続して下さい。 NEVER touch controller inside while the breaker is on. 入力電源通電中はコントローラ内部に触れないで下さい。 CALIBRATE according to instruction manual, after changing pump,controller and/or different cable in length. ポンプあるいはコントローラを交換またはケーブル長を変更した後には、取扱説明書に従いcalibrationを実施して下さい。	• Shall read this instruction manual carefully prior to operation. • Use the designated type cable and connect it securely. • High voltage areas are present inside controller. Never touch the inside of the controller while the input power is supplied. • Perform the sensor calibration according to the instruction manual, before first use after changing the combination of the pump and controller and/or the cable length. Refer to the section 9. (If the sensor calibration is not performed, the pump performance may not exhibit fully.)
③ (Notice Label)	Factory setting for TG900/1300M	• Applicable pump model is described. Must use the appropriate pump.
④ (Caution Label)		• High voltage
⑤ (Symbols)	 	• This symbol indicates Power OFF. • This symbol indicates Power ON.
⑥ (Symbol)		• This symbol indicates functional Earth (Ground) terminal. If necessary, connect to the Earth (Ground) to this terminal.

3-3. External Environment of the Controller

Do not use the controller in the following area.

1) High temperature and high humidity area.
2) Water dropping area.
3) Explosive or flammable gases existing area.
4) Corrosive or toxic gases existing area.
5) Strong magnetic field or strong electric field area.
6) Vibrating area.
7) Radiation area.

! CAUTION

◇Ambient temperature of the controller must not exceed over 40℃ (104° F).

3-4. Controller Mounting

The controller is able to use as rack mounting and/or stand-alone.

! CAUTION

◇The controller weight is approximately 11kg (24 lb). When mounting the controller to the rack, refer to the Fig.9. Use the rubber stand attachment holes (4-M4 x 5) or other measures to provide support from the bottom. If using the rubber stand attachment holes, the screws must not stick out more than 3.4mm inside. Otherwise, they will interfere with the print-circuit board. It may result in controller damage.

◇Keep the clearance more than 5 centimeter (0.164 ft) to the wall at the side and top plate, keep the clearance more than 30 centimeter (0.984 ft) to the wall at the rear plate for effective ventilation. If these clearances are narrow, the inside temperature of the controller may rise up and it may become the cause of the controller troubles. (Refer to the Fig.9)

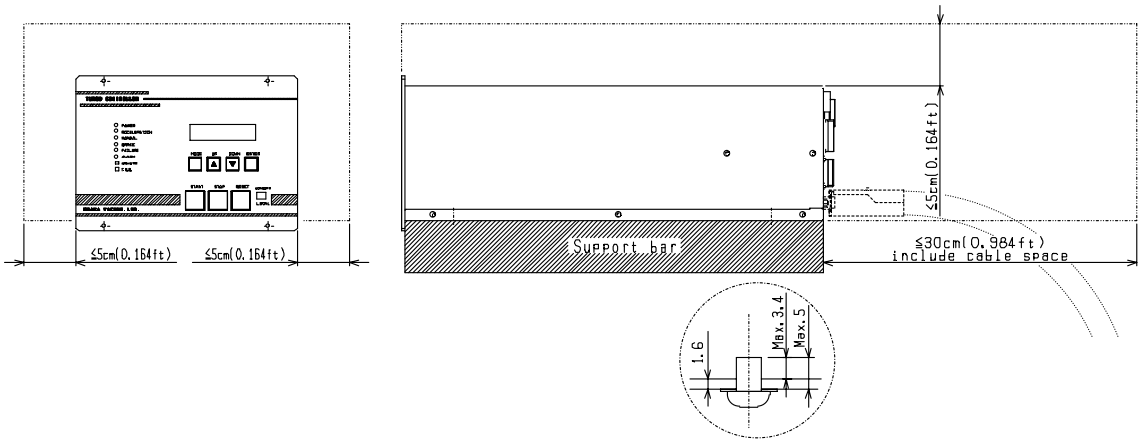


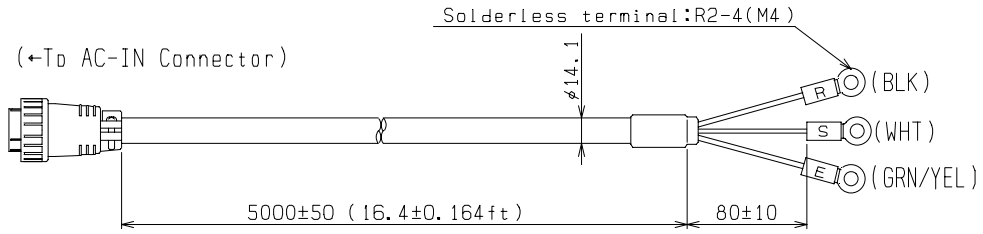
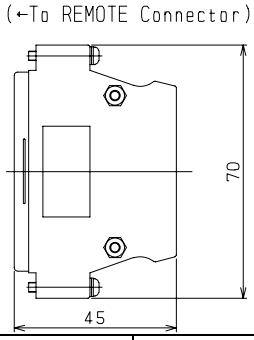
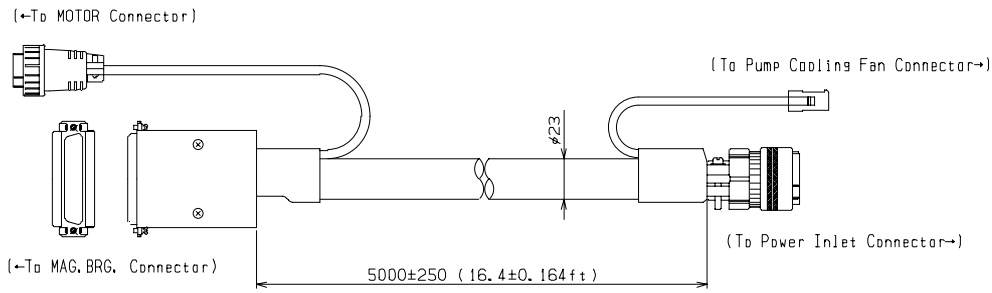
Figure 9. Example of Controller Mounting

Note

◇The LCD on the controller front panel is a upper vision, OSAKA VACUUM will recommend that the controller shall be mounted below an operator's viewpoint.

4. Cable Interconnection

4-1. Cable and Connector External View and Name

<table>
<tr><td rowspan="2">Input Power Cable</td><td>Controller Side</td><td>Power supply Side (Primary)</td></tr>
<tr><td colspan="2"> 
</td></tr>
<tr><td rowspan="2">Remote Connector</td><td>Controller Side</td><td>———</td></tr>
<tr><td colspan="2">Refer to the section 6 [Remote Input and Output Signal] for the cable connection.
Even if the protection signal is not used, the protection signal shall be shorted.
 
</td></tr>
<tr><td rowspan="2">Output Cable</td><td>Controller Side</td><td>Pump Side</td></tr>
<tr><td colspan="2"> 
</td></tr>
</table>

! CAUTION

◇Connect the cables and connector after confirmation that the input power is not supplied.

◇Must use the designated cable.

◇Insert the cable straightly, adjusting the connector pins position. And then lock surely.

◇The cable does not bend excessively.

4-2. Output Cable Interconnection

Connect the output cable to the power input connector and the air-cooling fan (or the terminator, in case of the water-cooling type pump) on the pump. And also connect the output cable to the [MAG. BRG.] and [MOTOR] connector on the controller rear.

4-3. Signal Cable Interconnection

Refer to the section 6 [Remote Input and Output Signals].

4-4. Input Power Cable Interconnection

Connect the input power cable (attachment) to the [AC-IN] connector on the controller rear.

Input power rating is AC 200/220/230/240V, 50/60 Hz, single-phase.

! WARNING

◇The input power cable must be grounded.

! CAUTION

◇An equipment switch or a circuit breaker, which can be used as a disconnecting device, must be incorporated into the controller input power supply circuit. The ampere interruption capacity (A.I.C.) is necessary more than 10,000A.

◇Leakage current (protective conductor current) more than 3.5mA may emerge from the pump and controller. Measurement of the leakage current at final equipment according to the standards that are applied to the final equipment is necessary. When it is excessive, additional earth/grounding connection must be provided from the [Functional Earth (Ground) terminal] on the rear panel of the controller.

5. Vacuum Line Piping

5-1. Inlet Port Piping

○Use the small out gassing piping material such as stainless steel or aluminum alloy.

○Vacuum line pipe diameter and length shall be considered vacuum conductance to obtain efficient pumping characteristic.

○Be clean and dry the pipe inner-surface for minimizing out-gas.

! CAUTION

◇When the pump is mounted to a system, do not remove the protective mesh screen at the inlet port to protect any falling materials from the system.

5-2. Backing Pump

The pumping characteristic of the pump is dependent on the pumping speed of the backing pump. Minimum backing pump capacity is shown in the table 8.

Table 8. Minimum Backing Pump Capacity

Pump Model	Minimum Throughput of Backing Pump
TG390/420M	≧ 160 L/min (5.6 cfm)
TG900/1300M	≧ 250 L/min (8.8 cfm)

! CAUTION

◇If the pumping speed of the backing pump is deteriorated, the pumping speed of the pump is deteriorated too.

5-3. Outlet Port Piping

○Use stainless steel, aluminum alloy or metal flexible tube to connect the backing pump.

○Length and diameter of the vacuum line piping affects the pumping characteristics. Minimize the pipe length and maximize the pipe diameter as much as possible.

○For the outlet port piping, use a flexible tube or bellows to reduce vibration propagation from the backing pump. The pump and the backing pump shall be mounted separately. If the backing pump is mounted on the same frame with the pump, the backing pump shall be fixed with the vibration insulation devices.

Note

◇When rotary vacuum pump is used as the backing pump, a back stream of oil vapor may come from the backing pump and may contaminate the pump inside. The adsorption trap shall be installed before the backing pump.

5-4. Purge Gas Piping

When reactive/corrosive gases or dust are pumped, perform gas purging at the same time.
Connect the purge gas pipe to the gas purge port (refer to the figure 1 and figure 2 of section 2-1).

Nitrogen gas is used generally. Recommended purging gas flow rate shows in the table 9.

Table 9. Recommended Purging Gas Flow Rate

Pump Model	Purging Gas Flow Rate
TG390/420M	18.4 Pa･L/s (10 sccm)
TG900/1300M	36.8 Pa･L/s (20 sccm)

! CAUTION

◇If purging gas flow rate is excess or deficiency, the pump performance may deteriorate.

6. Remote Input and Output Signals

Input and output signals from the [REMOTE] connector on the controller rear panel are shown in figure 10. These signals are all SELV (Safety Extra Low Voltage) circuits that are protected by double insulation or reinforced insulation from the hazardous voltage circuits.

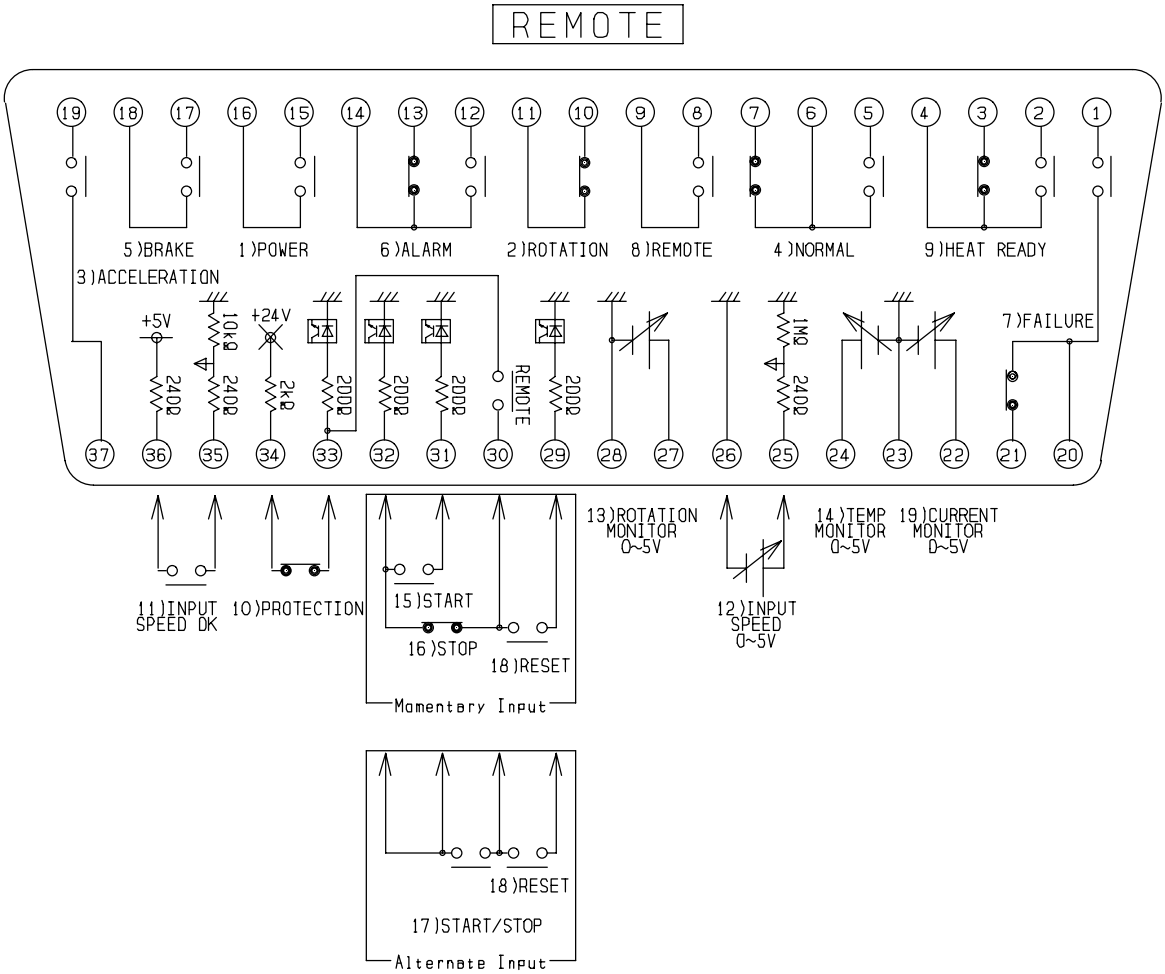


Figure 10. Input and Output Signals from the [REMOTE] connector

! CAUTION

◇Use these signals in only the SELV (Safety Extra Low Voltage, Generally it is less than AC25V or less than DC60V.) circuit that are protected by double insulation or reinforced insulation from the hazardous voltage circuits.

Note

◇6) ALARM signal means only warning, not means failure. So, even if alarm signal occurs, need not to stop the pump immediately. Plan the maintenance of the pump and/or the controller as soon as possible.

6-1. Input Signals

10) PROTECTION: The pump rotation speed is decelerated by protective function, when this signal is opened during pump operation.
START command is not received, when this signal is opened during standby status.

11) INPUT SPEED OK: The controller reads in the “INPUT SPEED” voltage as a commanded rotation speed when this signal is closed more than 0.3sec.

12) INPUT SPEED: Input the voltage corresponding to the rotation speed to be desired.
(DC0～5V⇒100rps～Rated rotation speed)

15) START: The pump rotation speed is accelerated when this signal is closed more than 0.3sec

16) STOP: The pump rotation speed is decelerated when this signal is opened more than 0.3sec.

17) START/STOP: The pump rotation speed is accelerated while this signal is closed.
The pump rotation speed is decelerated while this signal is opened.

18) RESET: All protective functions are canceled when this signal is closed more than 0.3sec.

! CAUTION

◇The "11) INPUT SPEED OK" signal should not short-circuit in a usual state. The signal should be closed only if the pump rotation speed wants to be changed.

Note

◇About 35 seconds from the power on to the standby status which can be operated is necessary.

◇The “10) PROTECTION” signal is always effective irrespective of the [LOCAL/REMOTE] switch setting. This signal is effective to stop the pump urgently such as
- ○When cooling water of the pump is not supplied.
- ○When outlet port pressure of the pump is raised up.

◇About the ”11) INPUT SPEED OK” and “12) INPUT SPEED” signals, even if after the input power interruption, the setting rotation speed is kept. Therefore the last setting rotation speed is effective.

◇The analog input “12) INPUT SPEED” is included with a little offset.

◇The current of each input signal is as follows.

Input Signal	ON (Close)	OFF (Open)
10) PROTECTION	≧4mA	≦0.01mA
11) INPUT SPEED OK	≧1mA	
15) START	≧1mA	
16) STOP	≧2mA	
17) START/STOP	≧2mA	
18) RESET	≧1mA	

6-2. Output Signals

1) POWER: This signal is closed while the input power is supplied.

2) ROTATION: This signal is opened while the pump rotor is rotating.

3) ACCELERATION: This signal is closed while the pump rotation speed is accelerating.

4) NORMAL: The signal between ⑤ and ⑥ is closed, and the signal between ⑦ and ⑥ is opened while the pump rotation speed reaches within designated rotation speed ±10%.

5) BRAKE: This signal is closed while pump rotation speed is decelerating.

6) ALARM: The signal between ⑫ and ⑭ is closed, and the signal between ⑬ and ⑭ is opened while the warning is activating.

7) FAILURE: The signal between ① and ⑳ is closed, and the signal between ㉑ and ⑳ is opened while the protective function is activating.

8) REMOTE: This signal is closed while remote operation is selected.

9) HEAT READY: Not use.

13) ROTATION MONITOR: The controller outputs the DC 5 Volt F.S. corresponding to the pump rotation speed. (DC0～5V⇒100rps～Rated rotation speed)

14) TEMP MONITOR: Not use.

19) CURRENT MONITOR: The controller outputs the DC 5 Volt F.S. corresponding to the build-in motor supply current. (DC0～5V⇒0～10A)

Table 10 shows each output signal rating from 1) to 9).

Table 10. Output Signal Rating

Rated Load (Resistance Load)	DC30V, 2A
Maximum Permissible Power (Resistance Load)	60W / 125VA
Maximum Permissible Voltage	DC220V / AC250V
Maximum Permissible Current	3A
Minimum Load	DC10mV, 10mA

Note

◇6) ALARM signal means only warning, not means failure. So, even if alarm signal occurs, need not to stop the pump immediately. Plan the maintenance of the pump and/or the controller as soon as possible.

◇The analog output signal “13) ROTATION MONITOR” and “19)CURRENT MONITOR” are included with a little offset.

7. Pump Operation

There are three operation methods as follows.

○First method is LOCAL operation mode that is operated by the front switches.

○Second method is REMOTE operation mode that is operated by the remote signals.

○Third method is Serial communication Operation (Refer to the separate volume “Serial Communication Issue”).

Select desired operation mode at the [LOCAL/REMOTE] switch on the front panel.

Note

◇The [LOCAL/REMOTE] switch can be switched over the LOCAL or REMOTE position to select the operation mode during pump operation. Selected operation mode is effective just after setting the [LOCAL/REMOTE] switch.

7-1. Safety Precautions

Confirm the following items before the input power is supplied.

☐ Are the pump and controller mounted properly?

☐ Are the cables and connector connected securely?

! CAUTION

◇The controller shall be use with the designated pump model.

◇Do not disconnect the output cable while the input power is supplied. It may become the cause of the pump and/or controller troubles.

◇Except in case of the emergency stop, Must not interrupt the input power during pump operation.

◇Must not open the inlet and outlet port to atmosphere during pump operation.

◇Perform the sensor calibration, before first use after changing the combination of pump and controller and/or the cable length.

◇Avoid evacuating Gallium/Gallium-based compounds or corrosive gas, otherwise they may cause damage on the pump.

◇In case of evacuating the explosive gas such as hydrogen, make sure that there is not any hazardous/explosive mixture in the pump.

◇The pump needs to be cooled during operation.
○For water-cooling type pump, use the available clean water as the cooling water. Required minimum flow rate of the cooling water should be 1.5 L/min, and cooling water temperature should be between 10℃(50 ゜F) and 35℃(95 ゜F). Water pressure should be below 0.6MPa (5kgf/cm^{2}G, 72.5psiG).
○For air-cooling type pump, check that the cooling fan starts rotation when the input power is supplied.

Note

◇The pump can be started simultaneously with the backing pump. If the “Accel Err” is detected, it needs rough pumping by the backing pump.

◇The pump is able to decelerate its rotation speed during the accelerating. Also, the pump is able to accelerate its rotation speed during the decelerating. However, the pump and controller will be heated up if the start/stop of the pump are repeated frequently. Do not repeat start/stop frequently to prevent the pump and controller troubles.

7-2. LOCAL Operation

1) Power Turn ON

Turn on the [Main Power Breaker] on the controller rear panel.

Note

◇The [Main Power Breaker] is fixed by the [Mis-operation Stopper]. Release the screw and lift up the stopper. Then fasten the screw and fix the stopper.

◇About 35 seconds is necessary until the standby status which can be operated.

◇During the calibration, it is not abnormal although there is sound from the pump.

Status	LED Display	LCD Display	Functions
POWER ON (Just after) ○・・・Light ●・・・Off	● POWER ● ACCELERATION ● NORMAL ● BRAKE ● FAILURE ● ALARM ■ REMOTE ■ T.M.S.	**BOOT PRG v09k_Lic** **PORST Reset**	・Boot program starts ・DSP Initialization ・Cooling fan on the controller rear panel and the pump (only air-cooling type) starts rotation.
		Copying **Ext. Flash ・・・**	・The external memory is read. ・Each A/D, D/A and I/O initialization.
POWER ON (After about 4~35 seconds)	○ POWER ● ACCELERATION ● NORMAL ● BRAKE ● FAILURE ● ALARM ■ REMOTE ■ T.M.S.	**Performing** **Selftest ・・・**	・Self test of the displacement and rotation sensor is performed.
		Calibrating ・・・	・The sensor calibration is performed by setting the Auto Calibration parameter setting. (Refer to the section 9-3.)
		Swapping **User Flash ・・・**	・The user flash memory is accessed.
		Saving **User Flash ・・・**	・The Calibration data is saved.
		Saved Calib **-> Calib Saved**	・The save of the calibration data is completed.
		Lifting UP ・・・	・Lift up the rotor.
		T Rot: 42.10 h **Act Spd: 0Hz**	(Upper) Accumulated operation time (Lower) Actual rotation speed Display for about 2 seconds
		Set Spd: 560Hz **Act Spd: 0Hz**	(Upper) Setting rotation speed (Lower) Actual rotation speed Hereinafter, this display is described as Normal Display. (After about 35 seconds.)

2) Start Up

Press the [START] switch on the controller front panel to start up the pump.

Note

◇The controller does not receive the START command to prevent mis-operation unless pressing the [START] switch 1 second or more.

◇When any switch is not pressed more than 10 minutes, the LCD backlight turns off the light automatically. After pressing some switch ([MODE], [UP/DOWN], or [ENTER]), the LCD backlight lights again.

Status	LED Display	LCD Display	Functions
Accelerating	○ POWER ○ ACCELERATION ● NORMAL ● BRAKE ● FAILURE ● ALARM ■ REMOTE ■ T.M.S.	**Set Spd: 560Hz** **Act Spd: 37Hz**	[ACCELERATION] LED lights and the pump starts rotation. The lower number that indicates the actual rotation speed will increase.
Rated Operating	○ POWER ● ACCELERATION ○ NORMAL ● BRAKE ● FAILURE ● ALARM ■ REMOTE ■ T.M.S.	**Set Spd: 560Hz** **Act Spd: 504Hz**	When the actual rotation speed is reached to 90 % of the designated rotation speed, the [NORMAL] LED lights.

3）Stop

Press the [STOP] switch on the controller front panel to stop the pump.

Status	LED Display	LCD Display	Functions
Decelerating	○ POWER ● ACCELERATION ● NORMAL ○ BRAKE ● FAILURE ● ALARM ■ REMOTE ■ T.M.S.	**Set Spd: 560Hz** **Act Spd: 498Hz**	The [BRAKE] LED lights and the pump start to decelerate. The lower number that indicates the actual rotation speed will decrease.
Stop	○ POWER ● ACCELERATION ● NORMAL ● BRAKE ● FAILURE ● ALARM ■ REMOTE ■ T.M.S.	**Set Spd: 560Hz** **Act Spd: 0Hz**	When the pump rotation is stopped completely, the [BRAKE] LED turns off the light and the pump becomes to the standby status.

4）Power Shut Down

Turn off the [Main Power Breaker] on the controller rear panel.

! CAUTION

◇Do not turn off the [Main Power Breaker] until the pump is stopped completely. Confirm the perfect stop of the pump by one of the following methods.

○The lower number that indicates the actual rotation speed becomes zero, and then the [BRAKE] LED turns off the light.

○The “ROTATION” signal of the [REMOTE] connector is closed.

Status	LED Display	LCD Display	Functions
Power Shut Down	● POWER ● ACCELERATION ● NORMAL ● BRAKE ● FAILURE ● ALARM ■ REMOTE ■ T.M.S.	**Shut Down** 	Levitation control of the pump rotor is cut off and the pump rotor falls on the protective bearings. All LEDs and LCD display turn off the light.

7-3. REMOTE Operation

1) Power Turn ON

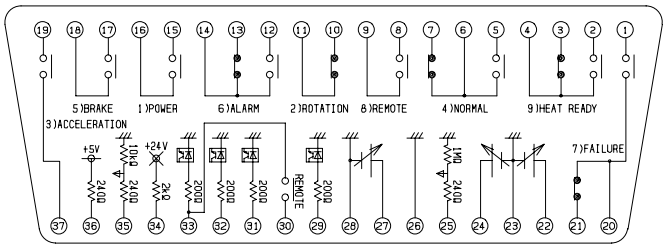
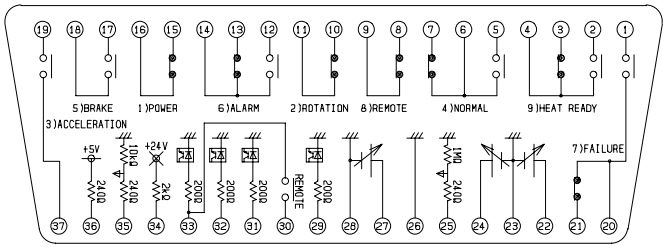
Turn on the [Main Power Breaker] on the controller rear panel.

Note

◇The [Main Power Breaker] is fixed by the [Mis-Operation Stopper]. Release the screw and lift up the stopper. Then fasten the screw and fix the stopper.

◇About 35 seconds is necessary until the standby status which can be operated.

◇During the calibration, it is not abnormal although there is sound from the pump.

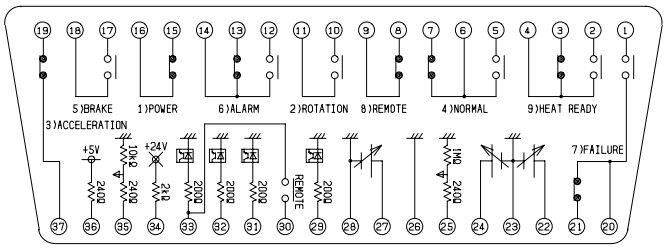
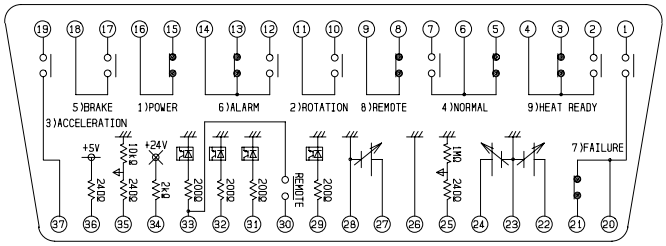
Status	LED Display	REMOTE Output
POWER ON (Just after) ○・・・Light ●・・・Off	● POWER ● ACCELERATION ● NORMAL ● BRAKE ● FAILURE ● ALARM ■ REMOTE ■ T.M.S.	
POWER ON (After about 4~35 seconds)	○ POWER ● ACCELERATION ● NORMAL ● BRAKE ● FAILURE ● ALARM □ REMOTE ■ T.M.S.	

2) Start Up

Input the “START” signal from the [REMOTE] connector by either following method.

○Short-circuit the 15) START signal more than 0.3 seconds.

○Short-circuit the 17) START/STOP signal.

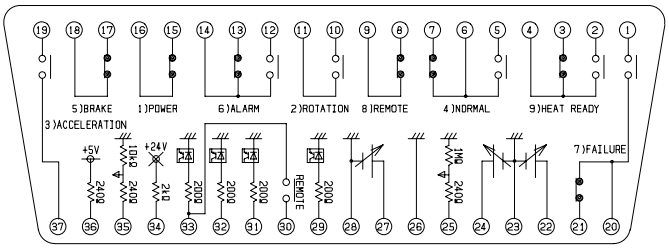
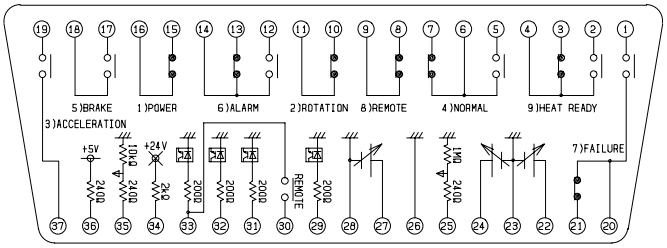
Operation Status	LED Display	REMOTE Output
Accelerating	○ POWER ○ ACCELERATION ● NORMAL ● BRAKE ● FAILURE ● ALARM □ REMOTE ■ T.M.S.	
Rated Operating	○ POWER ● ACCELERATION ○ NORMAL ● BRAKE ● FAILURE ● ALARM □ REMOTE ■ T.M.S.	

3) Stop

Input the “STOP” signal from the [REMOTE] connector by either following method.

○Open the 16) STOP signal more than 0.3 seconds.

○Open the 17) START/STOP signal.

Operation Status	LED Display	REMOTE Output
Decelerating	○ POWER ● ACCELERATION ● NORMAL ○ BRAKE ● FAILURE ● ALARM □ REMOTE ■ T.M.S.	
Stop	○ POWER ● ACCELERATION ● NORMAL ● BRAKE ● FAILURE ● ALARM □ REMOTE ■ T.M.S.	

4）Power Shut Down

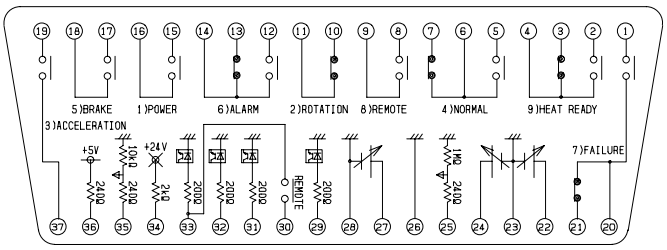
Turn off the [Main Power Breaker] on the controller rear panel.

! CAUTION

◇Do not turn off the [Main Power Breaker] until the pump is stopped completely. Confirm the perfect stop of the pump by one of the following methods.

○The lower number that indicates the actual rotation speed becomes zero, and then the [BRAKE] LED turns off the light.

○The “ROTATION” signal of the [REMOTE] connector is closed.

Operation Status	LED Display	REMOTE Output
Power Shut Down	● POWER ● ACCELERATION ● NORMAL ● BRAKE ● FAILURE ● ALARM ■ REMOTE ■ T.M.S.	

8. Parameter Setting and Its Display

Each parameter (the setting of rotation speed and setting for the sensor auto-calibration etc.) can be set from the controller front panel. And also, operation status can be monitored on the front LCD.

8-1. Display Procedure of the Menu Mode

It is possible to enter the menu mode that sets parameter or monitors operation status by pressing the [MODE] switch from the Normal Display.

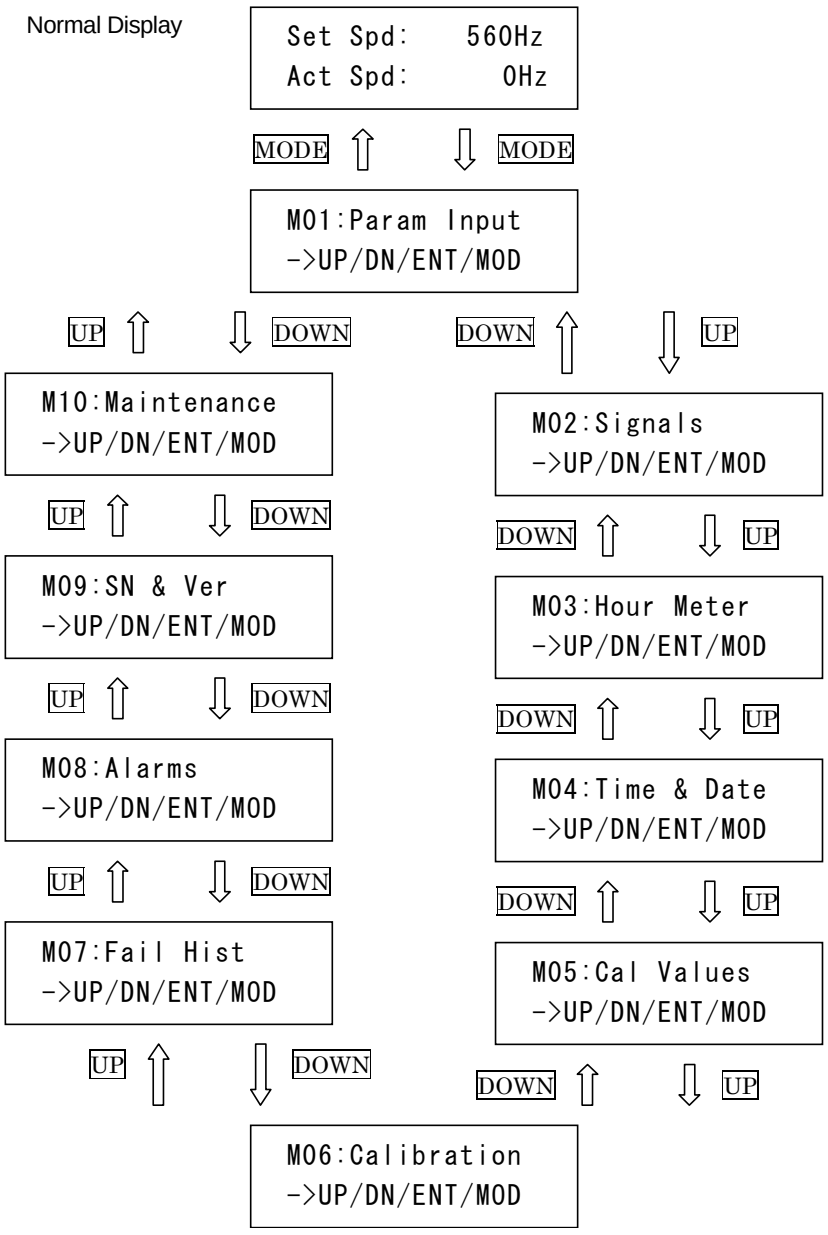


Figure 11. Menu Display

・Press the UP/DOWN switch to change another menu.

・Press the ENTER switch to confirm the menu and to enter to the sub-menu.

・Press the MODE switch to return to the Normal Display.
Sub-Menu →MODE→Menu→MODE→ Normal Display

If there is no input during 5 seconds after the menu selection, the display returns to the Normal Display automatically.

Note

◇When any switch is not pressed more than 10 minutes, LCD backlight turns off the light automatically. After pressing some switch（MODE , UP/DOWN or ENTER）, the LCD backlight lights again.

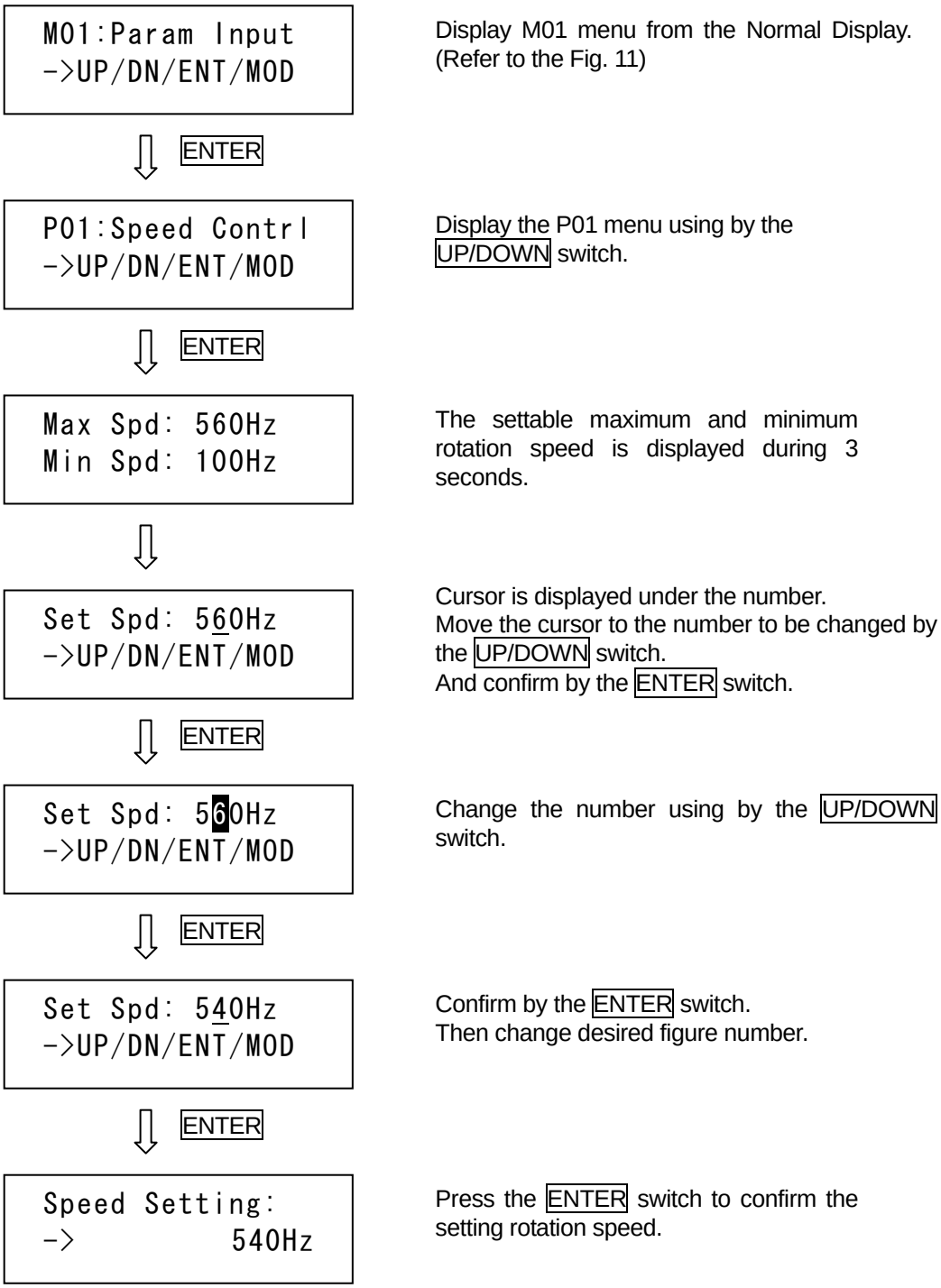
8-2. Menu Meaning

The menu meanings that are displayed on the LCD are shown in the following table.

Menu	Sub-Menu	Meaning
M01: Param Input	P01: Speed Cntrl	Setting of Pump Rotation Speed
	P02: TMS	Not use
	P03: Serial Com	Setting of Serial Communication
	P04: Auto Calib	Setting of Sensor Auto-Calibration (Need Pass Code)
	P05: Unit	Setting of Rotation Speed Unit
M02: Signals	S01: Orbit Level	Monitor of Orbit Level
	S02: Forces	Monitor of Magnetic Bearing Load
	S03: Drive	Monitor of Motor Operation Status
	S04: Temps	Monitor of Temperature
M03: Hour Meter		Display of Hour Meter Pwr: Power Input Time Lev: Rotor Levitating Time Rot: Rotor Rotation Time RateSpd: Number of Times of reaching to “NORMAL”
M04: Time & Date	D01: Actual Time	Display of Current Time
	D02: Time Adjust	Adjust of Time
	D03: Date Adjust	Adjust of Date
M05: Cal Values		Display of Sensor Calibration Values
M06: Calibration		Performing of Sensor Calibration (Manual Operation)
M07: Fail Hist		Display of Failure History
M08: Alarms		Display of Alarm Message
M09: Serial & Ver		Display of Serial Number etc.
M10: Maintenance （Need Pass Code）	I01: Ack Mainten	Cancellation of Operation time Maintenance Call
	I02: Ack TD Ctr	Cancellation of Protective Bearing Maintenance Call
	I03: Clr TD Ctr	Clear Touchdown Counter
	I04: Input TD Ctr	Input of Touchdowns Count

8-2-1. Setting of Rotation Speed (M01: Param Input → P01: Speed Contrl)

This menu sets the pump rotation speed. This setting can be performed even if the pump is operating. Just after setting, the pump rotation speed is accelerated or decelerated to the setting speed.



Display M01 menu from the Normal Display. (Refer to the Fig. 11)

Display the P01 menu using by the UP/DOWN switch.

The settable maximum and minimum rotation speed is displayed during 3 seconds.

Cursor is displayed under the number. Move the cursor to the number to be changed by the UP/DOWN switch. And confirm by the ENTER switch.

Change the number using by the UP/DOWN switch.

Confirm by the ENTER switch. Then change desired figure number.

Press the ENTER switch to confirm the setting rotation speed.

Note

◇Settable maximum rotation speed of the TG900/TG1300M is 560Hz. Settable maximum rotation speed of the TG390/TG420M is 680Hz. And settable minimum rotation speed of both models is 100Hz. If input exceeds settable range, maximum or minimum rotation speed is set automatically.

◇Even if after the input power interruption, the setting rotation speed is kept. Therefore the last setting rotation speed is effective.

◇This menu can not be used while the REMOTE operation is selected.

8-2-2. Setting of Serial Communication Baud rate (M01:Param Input → P03:Serial Com → C02:Baudrate)

This menu sets the baud rate for serial communication.

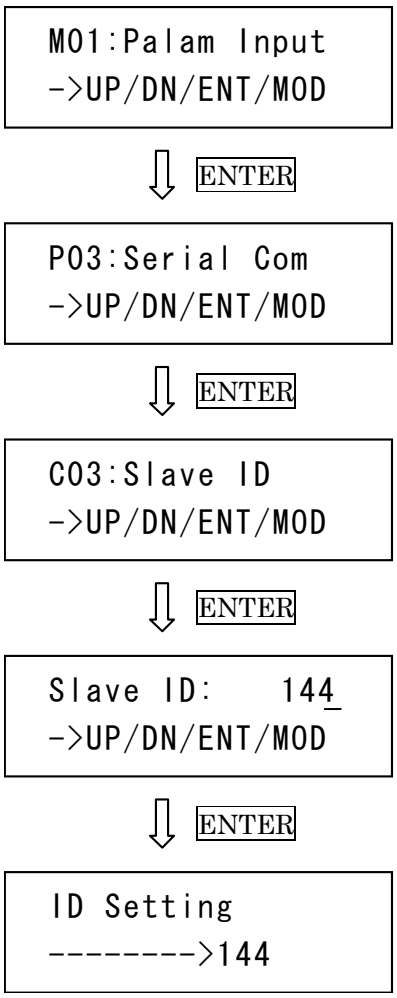
M01:Param Input ->UP/DN/ENT/MOD	Display M01 menu from the Normal Display. (Refer to the Fig. 11)
⇩ ENTER	
P03:Serial Com ->UP/DN/ENT/MOD	Display the P03 menu by the UP/DOWN switch.
⇩ ENTER	
C02:Baudrate ->UP/DN/ENT/MOD	Display the C02 menu by the UP/DOWN switch.
⇩ ENTER	
B01:115.2Kbps ->UP/DN/ENT/MOD	Press the UP/DOWN switch to select the one communication speed among ○B01: 115.2 Kbps ○B02: 57.6 Kbps ○B03: 38.4 Kbps.
⇩ ENTER	
B-Rate Setting --------->115.2Kb	Press the ENTER switch to confirm the communication speed.

Note

◇This parameter is set to “57.6 kbps” in factory shipping.

8-2-3. Setting of Slave ID (M01:Param Input → P03:Serial Com → C03:Slave ID)

This menu sets the Slave ID number of the controller for serial communication.



Display M01 menu from the Normal Display.
(Refer to the Fig. 11)

Display the P03 menu by the UP/DOWN switch.

Display the C03 menu by the UP/DOWN switch.

Cursor is displayed under the number.
Move the cursor to the number to be changed by the UP/DOWN switch.
And confirm by the ENTER switch.

Press the ENTER switch to confirm the Slave ID.

8-2-4. Setting of Sensor Auto-Calibration (M01:Param Input → P04:Auto Calib → A01:Cal ON>OFF)

This menu sets the sensor auto-calibration, which is performed automatically whenever the input power is supplied.

M01:Param Input ->UP/DN/ENT/MOD	Display M01 menu from the Normal Display. (Refer to the Fig. 11)
⇩ ENTER	
P04:Auto Calib ->UP/DN/ENT/MOD	Display the P04 menu by the UP/DOWN switch.
⇩ ENTER	
Pass Code:000_ ->UP/DN/ENT/MOD	Input the pass code by the UP/DOWN switch and the ENTER switch.
⇩ ENTER	
A01:Cal ON>OFF Press ENTER/MODE	Meaning of "ON>OFF" is that current setting status is "ON". Press the ENTER switch to select "OFF". Press the MODE switch to keep "ON" status.
⇩ ENTER	
Auto Calib: --------->OFF	

Note

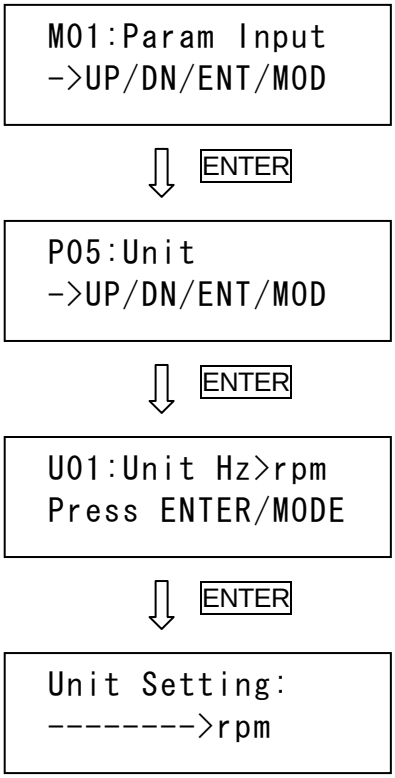
◇This parameter is set to "ON" in factory shipping. Therefore, the sensor calibration will be performed automatically whenever the input power is supplied. It will take about 35 seconds to prepare the magnetic bearing operation whenever the input power is supplied. (If the "Auto Calibration" is set to "OFF", about 13 seconds to prepare the magnetic bearing operation is needed.)

◇OSAKA VACUUM will recommend that the "Auto Calibration" parameter shall be kept "ON" for accurate rotor levitating control.

◇When the input power is supplied during rotation (ex. After short power interruption), the sensor auto-calibration is not performed irrespective of this setting.

8-2-5. Setting of Rotation Speed Unit (Hz⇔rpm)
(M01: Param Input → P05: Unit → U01: Unit Hz > rpm)

This menu sets the unit of the pump rotation speed.



Display M01 menu from the Normal Display. (Refer to the Fig. 11)

Display the P05 menu by the UP/DOWN switch.

Meaning of “Hz>rpm” is that current setting status is “Hz”.
Press the ENTER switch to select “rpm”.
Press the MODE switch to keep “Hz” status.

Note

◇This parameter is set to “Hz” in factory shipping.

8-2-6. Monitor of Orbit Level (M02: Signals → S01: Orbit Level)

This menu monitors the shaft orbit level of the pump rotor while the pump rotor is rotating.

```
M02:Signals
->UP/DN/ENT/MOD
```

Display M02 menu from the Normal Display. (Refer to the Fig. 11)

⇩ ENTER

```
S01:Orbit Level
->UP/DN/ENT/MOD
```

Display the S01 menu by the UP/DOWN switch.

⇩ ENTER

```
Act Spd:    560Hz
Press UP/DN/MODE
```

When rotation speed is over 100 Hz, press the UP/DOWN switch to change display such as “Act spd”, “Orbit 1”, “Orbit 2” in order.

Press the MODE switch to finish this monitor.

⇩ UP

```
Orbit 1:    2%
Press UP/DN/MODE
```

⇩ UP

```
Orbit 2:    3%
Press UP/DN/MODE
```

```
Low Speed
Press UP/DN/ENT
```

When rotation speed is below 100 Hz,
“Low Speed” is displayed.
Press the MODE switch to finish this monitor.

Note

◇”Orbit 1” means the orbit level at the upper radial sensor, and “Orbit 2” means the orbit level at the lower radial sensor. Percentage of the maximum bearing clearance is displayed.

◇“Unbalance_＊＊_Lv1” alarm is detected if this monitor value becomes 30%,
and “Unbalance_＊＊_Lv2” failure will be detected if this monitor value becomes 50%.

8-2-7. Monitor of Magnetic Bearing Load (M02: Signals → S02: Forces)

This menu monitors the load of magnetic bearings.

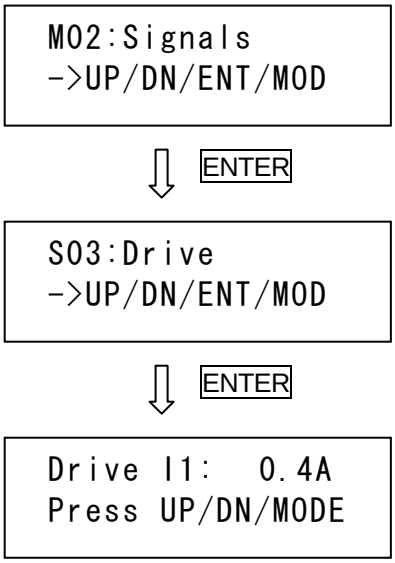
M02:Signals ->UP/DN/ENT/MOD	Display M02 menu from the Normal Display. (Refer to the Fig. 11)
⇩ ENTER	
S02:Forces ->UP/DN/ENT/MOD	Display the S02 menu by the UP/DOWN switch.
⇩ ENTER	
Force X1: 0% Press UP/DN/MODE	Press the UP/DOWN switch to display X1, X2, Y1, Y2 and Z in order. ○X1,Y1: Upper Radial Magnetic Bearing ○X2,Y2: Lower Radial Magnetic Bearing ○Z : Axial Magnetic Bearing Press the MODE switch to finish this monitor.

Note

◇Percentage of the maximum magnetic bearing load is displayed.

8-2-8. Monitor of Motor Current and Inside Voltage of the Controller (M02: Signals → S03: Drive)

This menu monitors the motor current and the inside voltage of the controller.



Display M02 menu from the Normal Display. (Refer to the Fig. 11)

Display the S03 menu by the UP/DOWN switch.

Press the UP/DOWN switch to display I1and UZ in order.
- ○I1 : Motor Current
- ○UZ: Inside Voltage of the Controller

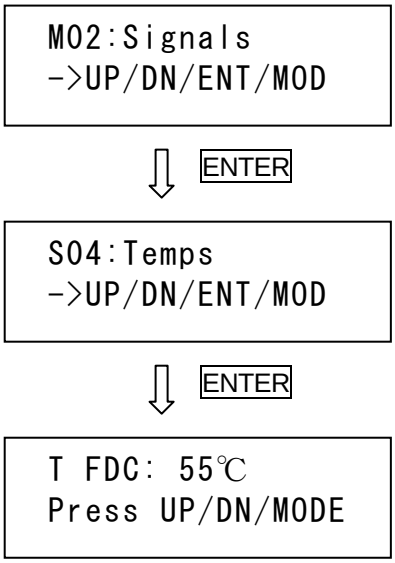
Press the MODE switch to finish this monitor.

Note

◇Both the motor current and the inside voltage of the controller are reference values.

8-2-9. Monitor of Temperature inside Controller (M02: Signals → S04: Temps)

This menu monitors the inside temperature of the controller.



Display M02 menu from the Normal Display.
(Refer to the Fig. 11)

Display the S04 menu by the UP/DOWN switch.

Press the UP/DOWN switch to display “T FDC” and “T Pump” in order.
- ○T FDC : Inside Temperature of the controller
- ○T Pump : Not use

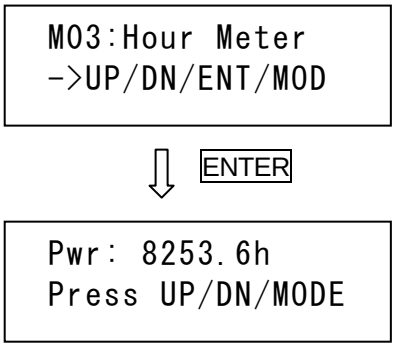
Press the MODE switch to finish this monitor.

Note

◇“T Pump” is not use. “T Pump: Unknown” is displayed.

8-2-10. Display of Operation Time (M03: Hour Meter)

This menu displays the accumulated operation time of the controller.



Display M03 menu from the Normal Display.
(Refer to the Fig. 11)

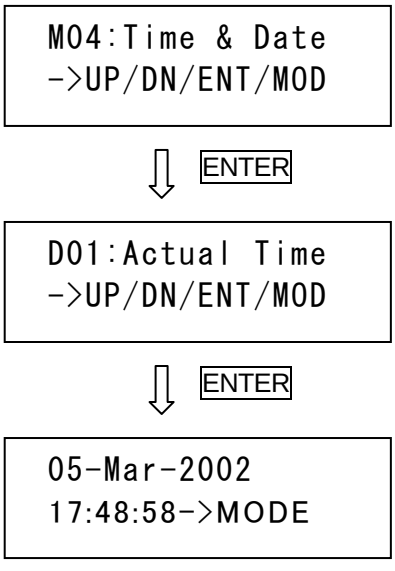
Press the UP/DOWN switch to display
"Pwr", "Lev", "Rot", and "Rate Spd" in order.

- ○Pwr : Power Input Time
- ○Lev : Rotor Levitating Time
- ○Rot : Rotor Rotation Time
- ○Rate Spd: The numbers of times of reaching "NORMAL"

Press the MODE switch to finish this display.

8-2-11. Display of Time and Date (M04: Time & Date → D01: Actual Time)

This menu displays the current time and date that are memorized in the controller.



Display M04 menu from the Normal Display.
(Refer to the Fig. 11)

Display the D01 menu by the UP/DOWN switch.

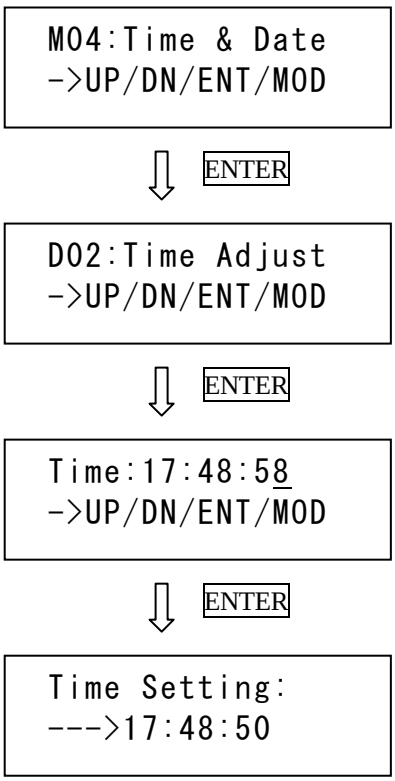
Date and time is displayed.
Press the MODE switch to finish this display.

Note

◇"Time" and "Date" are set to Japanese time in factory shipping.

8-2-12. Time Adjustment (M04: Time & Date → D02: Time Adjust)

This menu adjusts the time that is memorized in the controller.



Display M04 menu from the Normal Display. (Refer to the Fig. 11)

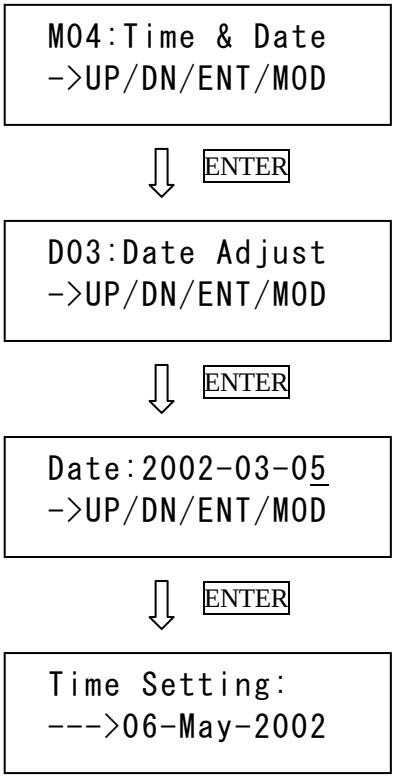
Display the D02 menu by the UP/DOWN switch.

Press the UP/DOWN switch and ENTER switch to input time. (Operation procedure is same as the section 8-2-1.)

Setting time is over.

8-2-13. Date Adjustment (M04: Time & Date → D03: Date Adjust)

This menu adjusts the date that is memorized in the controller.



Display M04 menu from the Normal Display. (Refer to the Fig. 11)

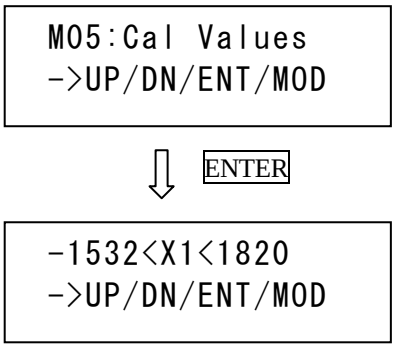
Display the D03 menu by the UP/DOWN switch.

Press the UP/DOWN switch and ENTER switch to input date. (Operation procedure is same as the section 8-2-1.)

Setting date is over.

8-2-14. Display of Calibration Values (M05: Cal Values)

This menu displays the last calibration values.



Display M05 menu from the Normal Display. (Refer to the Fig. 11)

Press the UP/DOWN switch to display "X1", "Y1", "X2", "Y2" and "Z" in order.

Press the MODE switch to finish this display.

8-2-15. Perform of Sensor Calibration (M06: Calibration)

This menu performs the sensor calibration of the magnetic bearing.

M06:Calibration ->UP/DN/ENT/MOD	Display M06 menu from the Normal Display. (Refer to the Fig. 11)
⇩ ENTER	
Calibrate Now? N->MODE/Y->ENTER	Press the ENTER switch to perform the sensor calibration. Press the MODE switch to cancel the sensor calibration.

! CAUTION

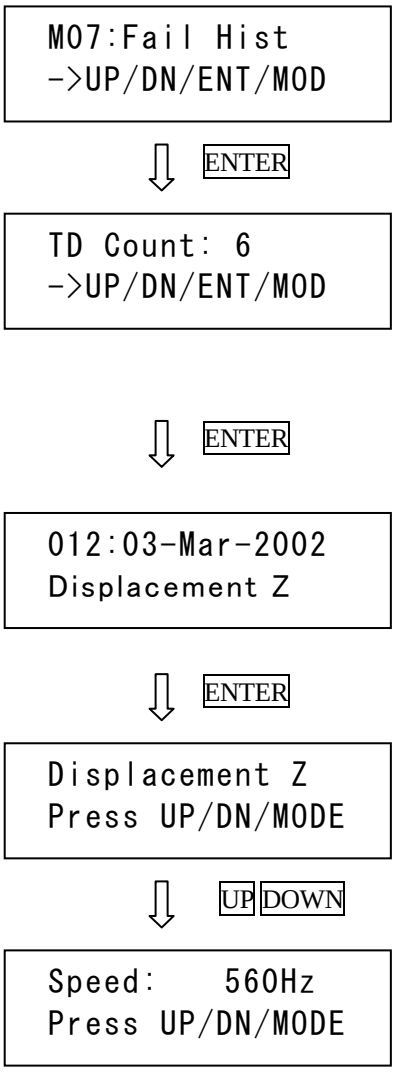
◇Perform the sensor calibration, before first use after changing the combination of pump and controller and/or the cable length. (Refer to the section 9.)

Note

◇The sensor calibration can not be performed during the pump rotor is rotating.

8-2-16. Display of Failure History (M07: Fail Hist)

This menu displays past failure history and its details.



Display M07 menu from the Normal Display.
(Refer to the Fig. 11)

Press the UP/DOWN switch to display "TD Count", "ShDn Count", and "Fail Count" in order.
- ○TD Count : Number of Touchdown Times
- ○ShDn Count : Number of Power Failure Times
- ○Fail Count : Number of Failure Items

Enter to the display of failure history.
Press the UP/DOWN to check the failure history.
A big number means the recent failure.

Press the ENTER switch to check the trouble details.
Press the UP/DOWN switch to select the trouble items.

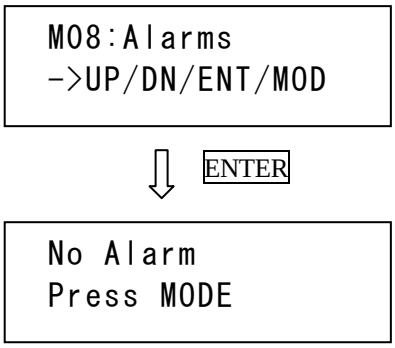
Each value when failure was occurred is displayed.
- ○Speed: Rotation speed
- ○Date: Date
- ○Time: Time
- ○Pwr: Accumulated power in time
- ○Lev: Accumulated levitating time
- ○Rot: Accumulated rotating
- ○T FDC: Inside temperature of the controller
- ○T Pump: Not use
- ○Drive I1: Motor current
- ○Drive UZ: Inside voltage of the controller
- ○Ini: Controller Program Version

Note

◇Maximum 144 failures history can be memorized. If failures exceed more than 145, it erases about 72 of the oldest automatically and it memorizes the last one.

8-2-17. Alarm Message (M08: Alarms)

This menu displays the alarm message.

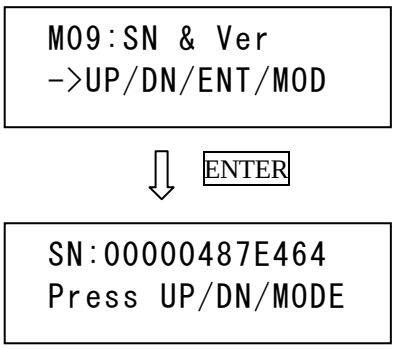


Display M08 menu from the Normal Display. (Refer to the Fig. 11)

This display means the no-alarm status. Refer to the section 10-3 for the alarm details.

8-2-18. Display of Serial Number and Program Number (M09: SN & Ver)

This menu displays DSP serial number and program version number that is build-in the controller.



Display M09 menu from the Normal Display. (Refer to the Fig. 11)

Press the UP/DOWN switch to display "SN", "Project", "Global" and "Template" in order.

- ○SN: Serial Number of DSP
- ○Project: Main Program Version
- ○Global: Sub-Program Version
- ○Template: Control Variable File Version

Press the MODE switch to this display.

8-2-19. Cancellation of Maintenance Call for operation time (M10: Maintenance → I01: Ack Mainten)

This menu cancels the maintenance Call ("Maintenance" alarm) of accumulated operation time.

M10:Maintenance ->UP/DN/ENT/MOD	Display M10 menu from the Normal Display. (Refer to the Fig. 11)
⇩ ENTER	
Pass Code:000_ ->UP/DN/ENT/MOD	Press the UP/DOWN switch and the ENTER switch to input the Pass code.
⇩ ENTER	
I01:Ack Mainten ->UP/DN/ENT/MOD	Press the UP/DOWN switch to display the I01 menu.
⇩ ENTER	
Ack Mainten? Y->ENTER/N->MODE	Press the ENTER switch to clear the "Maintenance" alarm. Press the MODE switch to keep the "Maintenance" alarm.

! CAUTION

◇If the maintenance call ("Maintenance" alarm) is displayed, Order overhaul of the controller to OSAKA VACUUM as soon as possible.

Note

◇Contact OSAKA VACUUM service center shown at the end of this manual about the Pass code.

8-2-20. Cancellation of Maintenance Call for Protective Bearings (M10: Maintenance → I02: Ack TD Ctr)

This menu cancels the maintenance call ("TD_Counter" alarm) of the build-in protective bearings.

M10:Maintenance ->UP/DN/ENT/MOD	Display M10 menu from the Normal Display. (Refer to the Fig. 11)
⇩ ENTER	
Pass Code:000_ ->UP/DN/ENT/MOD	Press the UP/DOWN switch and the ENTER switch to input the Pass code.
⇩ ENTER	
I02:Ack TD Ctr ->UP/DN/ENT/MOD	Press the UP/DOWN switch to display the I02 menu.
⇩ ENTER	
Ack TD Ctr? Y->ENTER/N->MODE	Press the ENTER switch to clear the "TD_Counter" alarm. Press the MODE switch to keep the "TD_Counter" alarm.

! CAUTION

◇If the maintenance call ("TD_Counter" alarm) is displayed, Order overhaul of the pump to OSAKA VACUUM as soon as possible.

Note

◇Contact OSAKA VACUUM service center shown at the end of this manual about the Pass code.

8-2-21. Clearing Touchdown counter (M10: Maintenance → I03: Clr TD Ctr)

This menu clears the touchdown counter that is memorized in the controller.

M10:Maintenance ->UP/DN/ENT/MOD	Display M10 menu from the Normal Display. (Refer to the Fig. 11)
⇩ ENTER	
Pass Code:000_ ->UP/DN/ENT/MOD	Press the UP/DOWN switch and the ENTER switch to input the Pass code.
⇩ ENTER	
I03:Clr TD Ctr ->UP/DN/ENT/MOD	Press the UP/DOWN switch to display the I03 menu.
⇩ ENTER	
Clear TD Ctr? Y->ENTER/N->MODE	Press the ENTER switch to clear the “Touchdown Counter”. Press the MODE switch to keep “Touchdown Counter”.

! CAUTION

◇The touchdown counter shall be cleared only when the protective bearings or the pump was replaced.

Note

◇Contact OSAKA VACUUM service center shown at the end of this manual about the Pass code.

8-2-22. Inputting to Touchdown counter (M10: Maintenance → I04: Inpt TD Ctr)

This menu sets the touchdown counter according to the input value.

M10:Maintenance ->UP/DN/ENT/MOD	Display M10 menu from the Normal Display. (Refer to the Fig. 11)
⇩ ENTER	
Pass Code:000_ ->UP/DN/ENT/MOD	Press the UP/DOWN switch and the ENTER switch to input the Pass code.
⇩ ENTER	
I04:Inpt TD Ctr ->UP/DN/ENT/MOD	Press the UP/DOWN switch to display the I04 menu.
⇩ ENTER	
TD Count: 0_ ->UP/DN/ENT/MOD	Press the UP/DOWN switch and ENTER switch to enter a new touchdown count.
⇩ ENTER	
TD Count: ---> 03	Press the ENTER switch to memorize new count.

! CAUTION

◇Input of the touchdown counter shall be performed only when the pump was replaced.

◇Must input the correct touchdown count, after confirming the touchdown count of the pump which was replaced.

Note

◇Contact OSAKA VACUUM service center shown at the end of this manual about the Pass code.

9. Sensor Calibration

Sensor calibration of the magnetic bearing must be needed for keeping accurate rotor levitating control. Sensor calibration will be performed automatically whenever input power is supplied, because the “Auto Calibration” parameter is set to “ON” in factory shipping. OSAKA VACUUM will recommend that the “Auto Calibration” parameter shall be kept “ON” for accurate rotor levitating control. (Refer to the section 8-2-4, 9-3.)

If the “Auto Calibration” parameter is changed to “OFF”, the sensor calibration must be performed in the following case.

○Before first use after installing the pump and controller.

○Before first use after changing the combination of pump and controller.

○Before first use after changing the cable length.

! CAUTION

◇If the sensor calibration is not performed before first use after changing the combination of pump and controller and/or the cable length, control characteristics of the magnetic bearing may become poor.

◇When the protective bearings have been damaged severely, the sensor calibration may not be performed correctly. If the touchdown count is exceeding the rated value and the maintenance call (“TD_Counter” alarm) is displayed, order overhaul of the pump for OSAKA VACUUM as soon as possible.

There are following three methods for the sensor calibration as following.

1) Method that shall be performed from MENU mode

2) Method that shall be performed manually when the rear [Main Power Breaker] is turned on

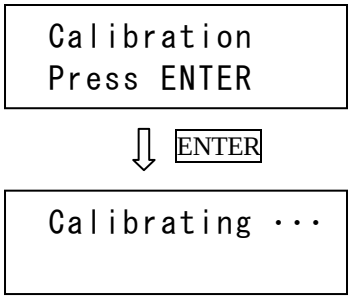
3) Method that shall be performed automatically whenever the input power is supplied

9-1. Sensor Calibration Through MENU Mode

Refer to the section 8-2-15 for this calibration method.

The sensor calibration can be performed only when the pump rotor is stopped. The sensor calibration can not be performed during rotation.

9-2. Manual Sensor Calibration When [Main Power Breaker] is Turned ON



Turn on the [Main Power Breaker], pressing the MODE switch about 10 seconds. Left display may appear.

Press the ENTER switch to perform the sensor calibration. During the calibration, it is not abnormal although there is sound from the pump.

9-3. Automatic Sensor Calibration whenever Input Power is supplied (Auto Calibration)

Sensor calibration can be performed automatically whenever input power is supplied. Refer to the section 8-2-4 for automatic calibration method.

Note

◇The “Auto Calibration” parameter is set to “ON” in factory shipping. Therefore, the sensor calibration will be performed automatically whenever input power is supplied. It will take about 35 seconds to prepare the magnetic bearing operation whenever input power is supplied. (If the “Auto Calibration” is set to “OFF”, about 13 seconds to prepare the magnetic bearing operation is needed.)

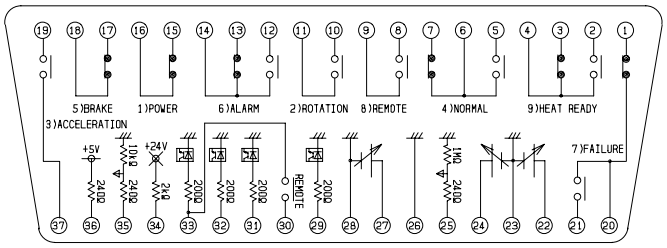
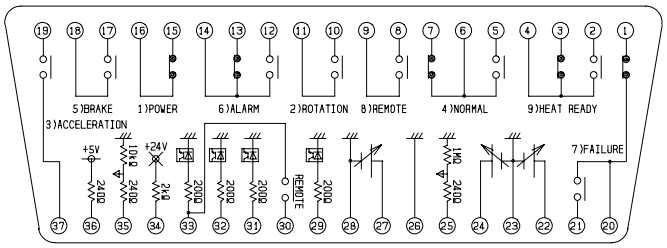
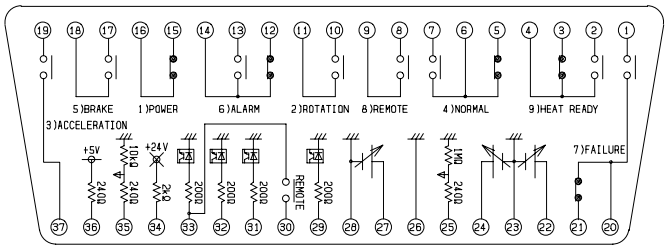
◇OSAKA VACUUM will recommend that the “Auto Calibration” parameter shall be kept “ON” for accurate rotor levitating control.

◇When the input power is supplied during rotation (ex. After short power interruption), the sensor auto-calibration is not performed irrespective of the “Auto Calibration” setting.

10. Protective Functions

This pump and controller have various protective functions. If any troubles occur to the pump and/or the controller during operation, the pump shall be stopped safely. Also the controller can inform the maintenance timing by the maintenance call (alarm display).

The front panel LCD indicates the failure content and the normal display alternately, while the protective function is activating. The outputs from the status indicator LED and the [REMOTE] connector are shown in the following table.

Protective Function	Status Indication LED	REMOTE Output
Failure (Protective action is BRAKE) ○···Light ●···Off	○ POWER ● ACCELERATION ● NORMAL ○ BRAKE ○ FAILURE ● ALARM ■ REMOTE ■ T.M.S.	
Failure (Protective action is FREE-RUN)	○ POWER ● ACCELERATION ● NORMAL ● BRAKE ○ FAILURE ● ALARM ■ REMOTE ■ T.M.S.	
Warning (Protective action is warning indication)	○ POWER ● ACCELERATION ○ NORMAL ● BRAKE ● FAILURE ○ ALARM ■ REMOTE ■ T.M.S.	

When protective function is activated during the pump operation, remedy the failure according to troubleshooting shown in the section 10-1 through 10-3.

! WARNING

◇Never touch the controller inside while the input power is supplied.

! CAUTION

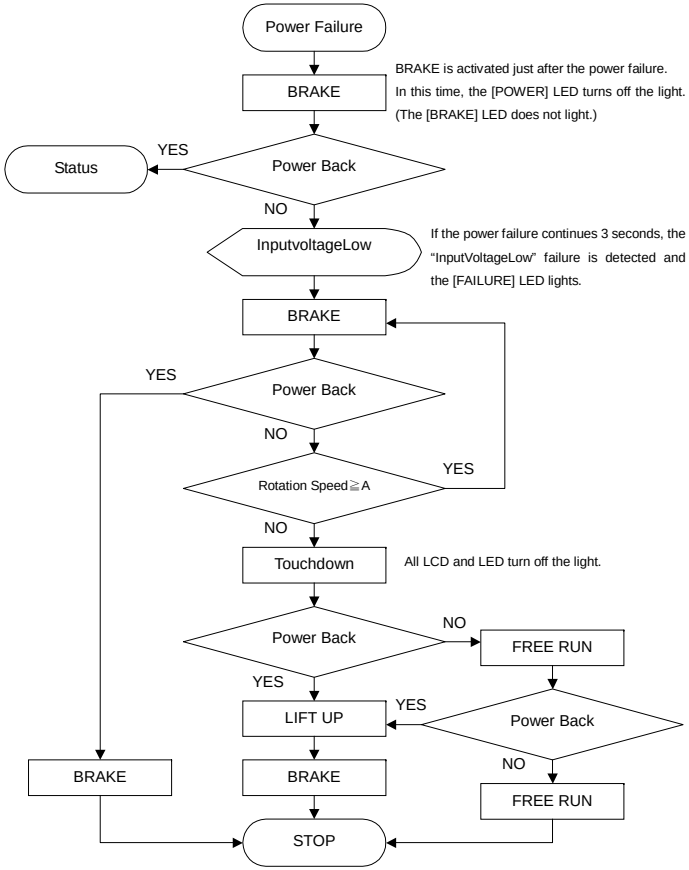
◇When the connector or cable is disconnected for checking and remedying the failure cause, turn off the [Main Power Breaker] after confirmation that the pump is stopped completely. And beware that input power is not supplied by using the [Mis-operation Stopper].

10-1. Error Message When Power is Turned ON

Fault／LCD Display	Protective Action	Supposed Cause	Procedure
Self-Check Error **Self_Check_Err** **Restart AMB**	Can not operating (RESET=Power Re-Input)	・ The connection of the output cable is poor or breakage. ・ The Digital Signal Processor of the controller is faulty.	・ Check the output cable connection. ・ Call to OSAKA VACUUM.
Connection Error of Magnetic Bearing Cable **Cable_Disconnect** **Restart AMB**	Can not operating (RESET=Power Re-Input)	・ The connection of the output cable is poor or breakage.	・ Check the output cable connection.
Matching Error **Matching_Err** **Restart AMB**	Can not operating (RESET=Power Re-Input)	・ The connection of the output cable is poor or breakage. ・ The controller is not match to the pump model. ・ The connection of the model judgment function is breakage. ・ The model judgment function of the controller is faulty.	・ Check the output cable connection. ・ Check the model of pump and controller. ・ Check the pin of the pump power input connector. ・ Call to OSAKA VACUUM.
Displacement Error of Magnetic Bearing **Displacement_X2** **Press ENT/RESET**	Can not floating rotor (RESET=Possible)	・ Calibration is not performed after changing the cable length. ・ The connection of the output cable is poor or breakage. ・ The connection of the displacement sensor is breakage. ・ The power AMP of the controller is faulty.	・ Perform the sensor calibration. ・ Check the output cable connection. ・ Check the pin of the pump power input connector. ・ Call to OSAKA VACUUM.
Overload of Electromagnet **Overload_X1** **Press ENT/RESET**	Can not floating rotor (RESET=Possible)	・ Calibration is not performed after changing the cable length. ・ The connection of the output cable is poor or breakage. ・ The connection of the electromagnet is breakage. ・ The power AMP of the controller is faulty.	・ Perform the sensor calibration. ・ Check the output cable connection. ・ Check the pin of the pump power input connector. ・ Call to OSAKA VACUUM.
Connection Error of Pump Cooling Fan **Fan_Disconnect** **Press ENT/RESET**	Can not floating rotor (RESET=Possible)	・ The pump cooling fan is unplugged. (Air-cooling type) ・ The terminator for fan connector is unplugged. (Water-cooling type)	・ Check the pump cooling fan connection. ・ Check the terminator for fan connector.
Protection Signal Error **ProtectionSignal** **Press ENT/RESET**	Can not floating rotor (RESET=Possible)	・ The protection signal of the [REMOTE] connector is open.	・ Check the protection signal.
Sensor Tuning Error **Sens_Tuning_Err** **Press ENTER**	Can not floating rotor (RESET=Re-Calibration)	・ Calibration values are out of limit. ・ The connection of the displacement sensor is breakage. ・ The reaction byproducts accumulate inside the pump. ・ The protective bearings of the pump have been damaged.	・ Re-perform the sensor calibration. ・ Check the pin of the pump power input connector. ・ Check the reaction byproducts at the outlet port. ・ Call to OSAKA VACUUM.

10-2. Error Message During Pump Operation (1)

Fault／LCD Display	Protective Action
Input Voltage Drops **InputvoltageLow** **Act Spd: 560Hz**	◆If power failure occurs when the pump rotation speed is above A. ○If the power failure continues less than 3 seconds: The “InputvoltageLow” failure is not detected as a momentary power failure. The [POWER] LED turns off the light just after the power failure. When the power is recovered, the [POWER] LED lights again and the pump returns to the operation before the power failure automatically.. ○If the power failure continues more than 3 seconds: The “InputvoltageLow” failure is detected, and both [FAILURE] and [BRAKE] LED light. The BRAKE is activated until the rotation speed decelerates to A. After decelerating the rotation speed until A, the rotor falls on the protective bearings. And the protective action transfers to the FREE-RUN mode from the BRAKE mode. The flow chart is shown in a right figure. **NOTE** ◇Only when the power failure continues more than 3 seconds, the shutdown is counted and the touchdown is not counted. ◆If power failure occurs when the pump rotation speed is below A. ○The rotor falls on the protective bearings just after the power failure. And the all LCD and LED indicators turn off the light. **NOTE** ◇In this case, the touchdown is not counted and only the shutdown is counted. (If the pump rotation speed is below 40rps, the shutdown is not counted too.) | | TG390/420M | TG900/1300M | | A | Approx. 272 rps | Approx. 168 rps |



Note

◇When operating the pump again, re-input the START command after resetting the protective functions.

10-2. Error Message During Pump Operation (2)

Fault／LCD Display	Protective Action	Supposed Cause	Procedure
Protection Signal Error **ProtectionSignal** **Act Spd: 560Hz**	Break (RESET=Possible)	・ The protection signal of the [REMOTE] connector is open.	・ Check the protection signal.
Fan Connection Error **Fan_Disconnect** **Act Spd: 560Hz**	Break (RESET=Possible)	・ The pump cooling fan is unplugged. (Air-cooling type) ・ The terminator for fan connector is unplugged. (Water-cooling type)	・ Check the pump cooling fan connection. ・ Check the terminator for fan connector.
Displacement Error of Magnetic Bearing **Displacement_X2** **Act Spd: 560Hz**	Brake (RESET=Possible)	・ Ambient Vibration ・ The displacement sensor of the pump is faulty. ・ The electromagnet of the pump is faulty. ・ The power AMP of the controller is faulty.	・ Check the ambient vibration. ・ Call to OSAKA VACUUM.
Overload of Electromagnet **Overload_X1** **Act Spd: 560Hz**	Brake (RESET=Possible)	・ The atmosphere inrush occurs. ・ The displacement sensor of the pump is faulty. ・ The electromagnet of the pump is faulty. ・ The power AMP of the controller is faulty.	・ Check the pump load. (pressure/gas flow rate) ・ Call to OSAKA VACUUM.
Over Speed **Over_Speed** **Act Spd: 560Hz**	Brake (RESET=Possible)	・ The inverter of the controller is faulty. ・ The rotation sensor of the pump is faulty.	・ Call to OSAKA VACUUM.
Controller overheat **DSP_Overheat** **Act Spd: 560Hz** **Control_Overheat** **Act Spd: 560Hz**	Brake (RESET=Possible)	・ The ambient temperature of the controller is high. ・ The ventilation space of the controller is narrow. ・ The cooling fun on the controller rear is faulty. ・ Start/stop of the pump is repeated frequently.	・ Check ambient temperature of the controller. ・ Keep the ventilation space. ・ Check the cooling fan. ・ Make longer the repetition interval of start/stop.

Note ◇When operating the pump again, re-input the START command after resetting the protective functions.

10-2. Error Message During Pump Operation (3)

Fault／LCD Display	Protective Action	Supposed Cause	Procedure
Rotation Pulse Error **Pulse_Err** **Act Spd: 487Hz**	Brake (RESET=Impossible)	・ The rotation sensor of the pump is faulty. ・ The rotation detect circuit of the controller is faulty.	・ Call to OSAKA VACUUM.
Unbalance Error **Unbalance_X1_Lv2** **Act Spd: 560Hz**	Brake (RESET= Impossible)	・ The reaction byproducts accumulate on the pump rotor. ・ The pump needs to be overhauled.	・ Order overhaul of the pump to OSAKA VACUUM.
Acceleration Error **Accel_Err** **Act Spd: 75Hz**	Free-Run (RESET= Possible)	・ The pressure rise or overload of the pump. ・ The connection of the [MOTOR] connector is poor.	・ Check the pump load. (pressure/gas flow rate) ・ Check the [MOTOR] connector connection.
Pump Motor Overheat **Motor_Overheat** **Act Spd: 560Hz**	Free-Run (RESET= Possible)	・ The pump cooling is poor. ・ The ambient temperature of the pump is high. ・ The baking temperature of the pump is too high. ・ Start/stop of the pump is repeated frequently.	・ Check the pump cooling fun or cooling water. ・ Check the pump ambient temperature. ・ Check the pump baking temperature. ・ Make longer the repetition interval of start/stop.
Inverter Over Current **Over_Current** **Act Spd: 560Hz**	Free-Run (RESET= Possible)	・ The inverter of the controller is faulty.	・ Call to OSAKA VACUUM.
Inverter Over Voltage **Over_Voltage** **Act Spd: 560Hz**	Free-Run (RESET= Possible)	・ The input voltage is too high. ・ The inverter of the controller is faulty.	・ Check the input voltage. ・ Call to OSAKA VACUUM.
Touchdown Counter Error **CSB** **Act Spd: 560Hz**	Can not operating (RESET= Impossible)	・ The touchdown count becomes 8 times. ・ The protective bearings need to be changed.	・ Order overhaul of the pump to OSAKA VACUUM.

Note ◇When operating the pump again, re-input the START command after resetting the protective functions.

10-3. Alarm List

Alarm／LCD Display	Protective Action	Supposed Cause	Procedure
Unbalance Warning **Unbalance_X1_Lv1** **Act Spd: 560Hz**	Warning Indication (Continuous Operation)	・The reaction byproducts accumulate on the pump rotor. ・The pump needs to be overhauled before long.	・Order overhaul of the pump to OSAKA VACUUM as soon as possible.
Touchdown Counter Warning **TD_Counter** **Act Spd: 560Hz**	Warning Indication (Continuous Operation)	・The touchdown count become to 5 times. ・The touchdown bearings need to be changed before long.	・Order overhaul of the pump to OSAKA VACUUM as soon as possible.
Maintenance Warning **Maintenance_Lv1** **Act Spd: 560Hz**	Warning Indication (Continuous Operation)	・The accumulated power ON time exceeds over 40,000 hours. ・The controller needs to be overhauled before long.	・Order overhaul of the pump and controller to OSAKA VACUUM as soon as possible.
Low Battery Warning **RTC_Battery_Low** **Press ENTER**	Warning Indication (Continuous Operation)	・The capacity of battery for clock back up is declined. ・The controller needs to be overhauled before long.	・Order overhaul of the controller to OSAKA VACUUM as soon as possible.

Note

◇ALARM signal means only warning, not means failure. So, even if alarm signal occurs, need not to stop the pump immediately. Plan the maintenance of the pump and/or the controller as soon as possible.

◇If the “TD_Counter” alarm or “detected, only Maintenance” alarm is the alarm display can be canceled. (Refer to the section 8-2-20 or 8-2-19.)

10-4. Emergency Stop

Install the EMO system on the primary circuit of the controller to interrupt the input power supply in an emergency. After power supply interruption, the “InputvoltageLow” failure shall be detected and the pump shall stop. Refer to the section 10-2 for the operation after power supply interruption.

! CAUTION

◇Design an EMO system so that the atmosphere is not introduced into the pump at the time of the EMO system operation.

◇Perform repair work after the pump stops completely, since the pump may be rotating after the EMO system operates. When the input power supply is not recovered after the interruption, it will take the following time until the pump rotation speed becomes below several rps.

TG900/1300M	TG390/420M
Approx. 60 min.	Approx. 70 min.

11. Maintenance

When the maintenance call (alarm) is displayed on the LCD, maintenance shall be done for the pump and controller without delay. For safety operation, the maintenance shall be done periodically for the pump and controller even if the maintenance call (alarm) indication is not displayed.

Note

◇When maintenance call is ("Maintenance" alarm is displayed or alarm signal occurs, need not to stop the pump immediately. Plan the maintenance of the pump and/or the controller as soon as possible.

! WARNING

◇When maintenance for the pump is performed, residual toxic or flammable gases shall be purged completely. If the gas is left inside the pump, it causes the various accidents when the pump is removed.

Table 11. Pump Capacity

Pump Model	Pump Capacity
TG390/420M	2 L
TG900/1300M	5 L

◇Refer to the [Material Safety Data Sheet] for each toxic or flammable gas handling.

◇Never touch the controller inside while the input power is supplied.

! CAUTION

◇Before maintenance or check for the pump and controller, turn off the [Main Power Breaker] after confirmation that the pump is stopped completely. And beware that the input power is not supplied by using the [Miss-Operation Protective Stopper].

◇If the pump of the vacuum condition is opened to the atmosphere, beware that the surrounding parts are not sucked to the pump inside.

11-1. Protective Bearings

! WARNING

◇The protective bearings are very important parts for supporting the rotor which is rotating at high speed, if the input power goes down or the magnetic bearing is faulty. If the protective bearings have defect, the serious troubles may be caused. Therefore preventive overhaul of the pump shall be done periodically.

Note

◇When the touchdown count becomes 5 times, the controller displays the maintenance call ("TD_Counter" alarm) although it is possible to operate the pump. When the touchdown count becomes 8 times, the controller displays the "CSB" failure, and the pump operation becomes impossible after it.

11-2. Reaction Byproducts

Depending on the condition to use, the reaction byproducts may accumulate inside of the pump. If the accumulation of the reaction byproducts is aggravated, there is fear that the pump operation is impossible. Therefore check periodically according to the use condition.

Confirm the accumulation quantity of reaction byproducts at outlet port of the pump. If the accumulation quantity is much, overhaul the pump.

! CAUTION

◇If leaving alone the pump with which byproducts were accumulated, inside of the pump may be corroded. There is fear that OSAKA VACUUM cannot overhaul the heavily corroded pump.

11-3. Overhaul

The condenser and cooling fan, which are used for the pump and controller, degrade the characteristic in using for a long time. Also, since the exchange of the protective bearings, or the washing of the pump is needed depending on the use condition, OSAKA VACUUM recommends that overhaul of the pump and controller shall be done periodically.

Overhaul of the pump and controller must be always ordered to OSAKA VACUUM.

! WARNING

◇When the overhaul of the pump, that has evacuated toxic gases, reactive gases or flammable gases, is ordered, the customer shall write expressly the names of gas and the matters which should be careful of in the repair requirement sheet that is designated by OSAKA VACUUM.

◇Before the pump is shipped to OSAKA VACUUM, purge the inside of the pump by an inert gas and seal up the pump inlet and outlet port. And then, the customer shall write expressly the names of gas and the matters to the package material.

! CAUTION

◇If the “RTC_Battery_Low” alarm about the battery is displayed, order overhaul of controller to OSAKA VACUUM.

◇When the pump is shipped, use the packing material at the time of OSAKA VACUUM shipping, or the thing more than equivalent. And pack up the pump securely.

◇Because there is fear that the reaction of the reaction byproducts which was accumulated in the pump is promoted when opening a pump to the atmosphere, don't open to the atmosphere as much as possible.

12. Storage and Disposal

12-1. Pump Storage

When the pump is stored for a long time, do the following procedure.

1) Evacuate the inside of the pump in the condition that the inlet port is sealed up.

2) Purge the inside of the pump by an inert gas from the purge port or the outlet port.

3) Seal up the purge port or the outlet port.

4) In case the pump is water-cooling type, blow the water in the cooling water pipe of the pump by compressed air etc.

5) Keep the pump in the condition to be perpendicularly on the horizontal floor.

6) Do not store the pump at the following places.

- ○A place with high temperature and high humidity.
- ○A place with water drops.
- ○A place with explosion gases, flammable gases and dusts.
- ○A place with dust.
- ○A place with strong electric fields or magnetic fields.
- ○A place with vibrations.
- ○A place with radiation.
- ○A place with salt sea breeze.

! CAUTION

◇When the pump is stored over than several months, purge the inside of the pump by a nitrogen gas and seal up the pump inlet and outlet port. And beware that there is no water inside the pump.

12-2. Controller Storage

When the controller and cables are stored for a long time, store on the horizontal floor. Do not store the controller and cables at the following places.

- ○A place with high temperature and high humidity.
- ○A place with direct ray sunlight.
- ○A place with dewfall.
- ○A place with water drops.
- ○A place with explosion gases, flammable gases and dusts.
- ○A place with dust
- ○A place with strong electric fields or magnetic fields.
- ○A place with vibrations.
- ○A place with radiation.
- ○A place with salt sea breeze

12-3. Disposal

When the pump or controller is disposed, the customer should follow the instructions by each self-governing community as the industrial waste.

! WARNING

◇Dispose the pump after treating the gases and byproducts inside of the pump appropriately.

13. Specifications

13-1. Pump Specifications

Model [1]		TG390M series TG420M series	TG900M series TG1300M series
Inlet flange		VG100/CF100/ISO-B100 VG150/CF160/ISO-B160	VG150/CF160/ISO-B160 VG200/CF200/ISO-B200
Outlet flange		KF25	KF40
Volume flow rate [2]	For N_2	340 L/s 400 L/s	900 L/s 1300 L/s
	For H_2	290 L/s 300 L/s	1050 L/s 1200 L/s
Maximum compression ratio	For N_2	1.0×10^8	
	For H_2	4.5×10^3	1.5×10^4
Ultimate pressure [3]		≦ 1.0×10^{-7} Pa (7.5×10^{-10} Torr) [4] / ≦ 1.0×10^{-6} Pa (7.5×10^{-9} Torr) [5]	
Maximum throughput [6]	For N_2	3680 Pa·L/s (2000 sccm)	5520 Pa·L/s (3000 sccm)
	For Ar	1290 Pa·L/s (700sccm)	2760 Pa·L/s (1500 sccm)
Maximum backing pressure		400 Pa (3.0 Torr)	500 Pa (3.8 Torr)
Recommended backing pump		≧ 160 L/min (5.6 cfm)	≧ 250 L/min (8.8 cfm)
Startup time		≦ 3 min.	≦ 5 min.
Shutdown time		≦ 5 min.	≦ 5 min.
Permissible bake-out temperature		≦ 120 ℃ (248 ° F)	
Vibration (0-peak) [7]		≦ 0.01 μm	≦ 0.005 μm
Rated rotational speed		40800 min^{-1}	33600 min^{-1}
Installation position [8]		Any	
Ambient	Temperature	10 - 40 ℃(50 - 104° F) [9] / 10 - 32 ℃(50 - 90° F) [10]	
	Pollution degree	2	
Cooling water	Flow rate	≧ 1.5 L/min	
	Temperature	10 - 35 ℃ (50 - 95 ° F)	
	Pressure	≦ 0.6 MPa (5 kgf/cm^2G, 72.5psiG)	
Gas purge throughput [11]		18.4 Pa·L/s (10 sccm)	36.8 Pa·L/s (20 sccm)
Major materials [12]		Al alloy	
Weight		14 kg (31lb) [13] / 17 kg (37 lb) [14]	34 kg (75 lb) [13] / 42 kg (93 lb) [14]
Capacity		2 L	5 L
Maximum noise level [15]		≦ 70 dBA	
Build-in motor power		220 W	350 W
Applicable controller model		TC010M	
IP Rating		IP10	

1) Pump model is defined as follows.

TG 390 M □ □ □ − □□

- [Special specification] ･･･40: Different cooling system etc.
- [Anticorrosive coating]･･･B: Standard type / C: Chemical type
- [Cooling type]･･･A: Air cooling / W: water cooling
- [Inlet flange]･･･V: JIS B 2290 Annex VG flange / B: ISO 1609 bolted flange / C: JVIS 003 bake able flange
- [Volume flow rate]

2) Without protective screen
3) Pressure attained after 48 hours of bake-out.
4) In case of the pump inlet flange is C.
5) In case of the pump inlet flange is V or B.
6) Maximum throughput when a backing pump with its volume flow rate of 1000 L/min is used and the ambient temperature (air-cooling type) or the cooling water temperature (water-cooling type) is 20-25 °C. In case of TG390M or TG420M, the volume flow rate of the backing pump is 320 L/min
7) Vibration peak at rated rotational speed measured with FFT.

8) Pump must be firmly secured to customer's system. (See the instruction manual for detail.)
9) In case of the pump is water cooling type.
10) In case of the pump is air cooling type.
11) Use an optional gas purge inlet port.
12) Avoid evacuating Ga or Ga-based compounds or corrosive gas, otherwise they may cause damage on the pump.
13) In case of the pump anticorrosive coating is standard type except the inlet flange is C
14) In case of the pump anticorrosive coating is chemical type and the inlet flange is C.
15) Noise at 1m distance

13-2. Controller Specifications

Model		TC010M	
Applicable Pump model		TG390M series TG420M series	TG900M series TG1300M series
Permissible ambient	Temperature	0 - 40 ℃ (50 - 104 ° F)	
	Humidity	35 - 85 %	
	Pollution degree	2	
Input	Phase	Single	
	Voltage	AC 180 - 264 V	
	Frequency	50 / 60 Hz	
	Maximum Power	700 VA	1200 VA
	Over voltage category	Ⅱ	
Circuit Protector capacity		15 A	
Output	Phase	3 phases	
	Voltage [1)]	65 V	80 V
	Current [1)]	0.3 A	0.5 A
	Frequency [1)]	680 Hz	560 Hz
Weight		Approx. 11 kg (24 lb)	
Leakage current		3.5 mA	
IP rating		IP 20	
Protection class		Class Ⅰ	

1) Value of normal operation (no load condition) when the input voltage is AC200V.

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STANDARD WARRANTY CONDITIONS

OSAKA VACUUM, LTD.

Article 1 Warranty

We warrant to users to whom the Product is delivered that the Product conforms with the Delivery Specification (or Product Specification).

THE FOREGOING IS THE ONLY WARRANTY RELATING TO THE PRODUCT AND IN LIEU OF ANY OTHER WARRANTY, ORAL OR WRITTEN AND EXPRESS OR IMPLIED, RELATING TO THE PRODUCT INCLUDING, BUT NOT LIMITED TO, THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NON-INFRINGEMENT OF THIRD PARTY RIGHTS. FURTHER, THE FOREGOING IS THE ONLY WARRANTY RELATING TO ANY DEFECT OF THE PRODUCT.

Article 2 Indemnification

In relation to the Product, in case any breach of the above warranty is found within the warranty period of one year following the delivery (unless otherwise stipulated in writing), and a notice of such defect is given to us within that one-year period, we will, at our election, correct, repair or replace defective parts, or replace the whole Product without charge. The replacement of the whole Product is available only for standard Products, and no replacement may be allowed for any custom-made Products.

We will indemnify the users for direct and actual damages suffered by such users relating to the breach of the warranty except for indemnification or compensation for any indirect or consequential damages, compensation for non-operation (including the compensation for non-operation during correction, repair or replacement) or loss of profit within the contractual amount relating to the Product.

Article 3 Exception

We shall be responsible under the warranty only when the Product is properly installed or fixed, handled, used, stored and appropriately maintained by a user in accordance with the instructions stipulated in the Delivery Specification (or Product Specification), the Instruction Manual of the Product, and/or the related technical documents we provide (“Related Technical Documents”) or any other handling instructions given by us.

Unless otherwise stipulated in writing, we will not be responsible in any of the following cases:

(1) Any failure due to any usage of the Product not described in the Related TechnicalDocuments of the Product, or any other irregular usage of the Product;

(2) Deterioration of the Product due to corrosive gases, organic solvents, radioactive rays, electromagnetic fields etc. or other causes not expected under the Delivery Specification (or Product Specification);

(3) Expendable parts and wearable parts such as lubricant etc.;

(4) Any failure due to repair or reconstruction by any third party (including users);

(5) Repaired Products（the Standard Warranty Conditions for Repaired Products shall apply to the repaired Products);

(6) Minor deviation from the Delivery Specification that does not affect the performance or function of the Product; or

(7) Any failure due to fire, flood, earthquake, lightning strike or any other event of force majeure.

Article 4　Governing Law

Any dispute relating to this document shall be solved in accordance with the laws of Japan.