

OPERATION MANUAL

MAGNETIC SUSPENDED COMPOUND MOLECULAR PUMP

**TG370M/TG373M
TG400M/TG403M
TG710M/TG703M
TG1110M/TG1113M
TG2000M/TG2003M
TG2810M/TG2813M
TG3210M/TG3213M
TG3410M/TG3413M**

**For a safe operation, be sure to read this manual before operating the pump.
This is an important operation manual. Store it safely for a future reference.**

OSAKA VACUUM, LTD.

Important : For a safe pump operation, please be sure to read this manual before any pump operations.
Operations not following the procedures in this manual may result in a failure, or an accident involving injury or electrical shock.

1) Pump Installation

Operate the pump after securing the pump to a frame or onto the floor.
When the pump is used in a system, design the system after reading this manual thoroughly.

2) A Combination of the Pump and a Power Supply.

A proper combination between the pump and a power supply is required.
Select a type of power supply specified on the nameplate at the pump connector.

3) Input Power

Select a input power with a low noise, surge and a good voltage regulation.

4) Grounding

Be sure to connect the earth line "E" of the "INPUT" connector to the ground.

5) Start and Stop

To start or to stop the pump, use the START , STOP buttons on the power supply or the Start / Stop signal fed through the "REMOTE" connector of the power supply.
Do NOT disconnect cables during the pump operation.
When performing a start/stop repeated operation, leave at least 5 seconds of intervals.
Do NOT operate the pump using the input power's ON/OFF.

6) Gas Purge

When pumping reactive or corrosive gases, be sure to perform the gas purge to the pump.

7) Check

When the power supply is to be checked, remove the input power and wait at least for 5 minutes before performing the work.
Do NOT insert your hand(s) or any objects in the pump.

8) Batteries Maintenance

When the pump is not used for a long period of time, charge the batteries in the power supply periodically (every 6 months.)
Replace the batteries at least once per every 2 years.

9) Backing Pump

Be sure to always connect a backing pump to the Magnetic Suspended type Compound Molecular Pump.

10) Pumped Gases

Do NOT pump Gallium and its compounds.
It may damage the pump.

Caution and Warning signs throughout in this manual.

! CAUTION : An important consideration is described in order to operate the pump and the power supply safely.

! WARNING : An important consideration is described in order to avoid any injuries or a risk of electrical shock when operating the pump and the power supply.

Attached Drawings Summary

1. Magnetic Suspended Compound Molecular Pump Outside Drawings(Appearance)
2. Power Supply Outside Drawings
3. Power Supply Main Parts Layout
4. Cable Connection
5. Power Supply I/O Communications

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1. Preface

1-1. Warranty

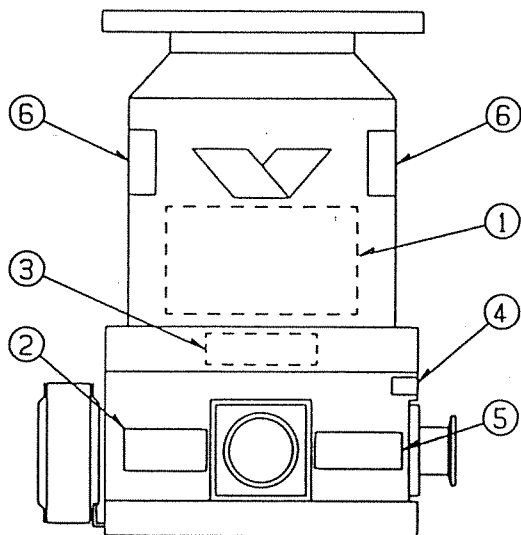
The warranty on the pump, the power supply and the peripherals are specified in the document, "General Terms of Warranty" published by OSAKA VACUUM, LTD., provided that the warranty will be avoided if the operations and the maintenance procedures in this manual are not followed.

Note, also, that any special use of the pump and the power supply without OSAKA VACUUM, LTD's agreement will avoid the warranty.

1-2. The nameplates on the pump and the power supply

A. Pump Nameplate

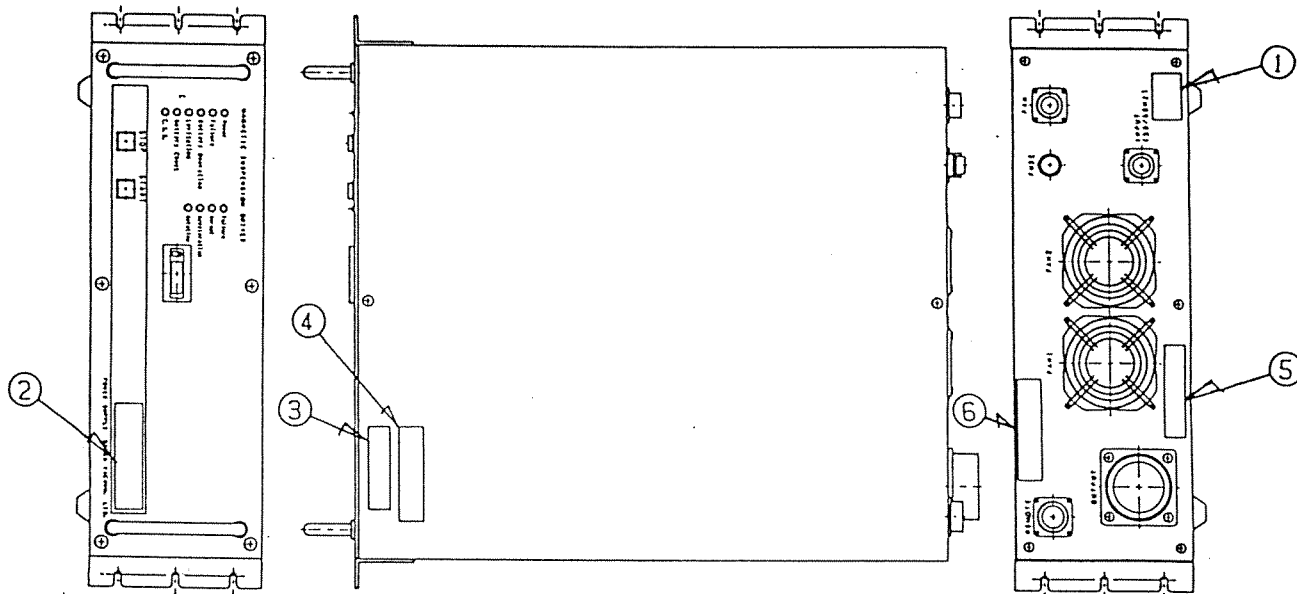
Example: TG370M



- ① Main Plate: Specifies pump type, manufacturing number, manufacturing date.
- ② Power Supply Type Plate: Specifies the type of power supply to be used.
- ③ Caution Plate: Specified the pump weight.
- ④ Caution Plate: "FORELINE"
Be sure to connect to a backing pump.
- ⑤ Caution Plate: "Do not disconnect the cable, while the pump is in operation."
- ⑥ Caution Plate: During operation, the pump is heated up. Do not touch the pump casing.

B. Power Supply Nameplate

Example: TD370



- ① Main Plate Power supply's type, manufacturing number, manufacturing date are specified.
- ② Power Supply Type Plate Use the pump and the power supply in a correct combination.
- ③ Caution Plate Specified the power supply's weight.
- ④ Caution Plate "Never touch the Power Supply inside with power on."
- ⑤ Caution Plate "Do not disconnect the cable, while the pump is in operation."
- ⑥ Caution Plate "Prior to operation, please read the instruction manual carefully."

2. Opening the Crate

Confirm the following items when opening the crate.

A. Any damages to the contents

If any damages are found, notify OSAKA VACUUM, LTD. before use.

B. Attachment parts and spare parts

The standard shipping should include the following attachment and spare parts.

(1) Output cable	1
(2) Fan cable (for air cooling pump)	1
Fan connector (for water cooling pump)	1
(3) Remote connector	1
(4) Input cable	1
(5) Fuse	2
(6) Operation manual	1

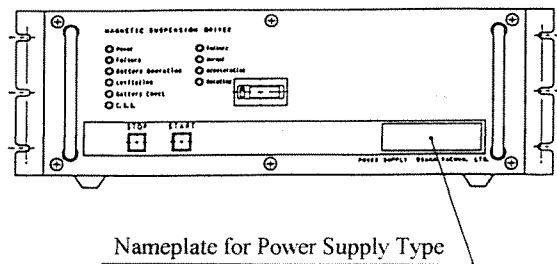
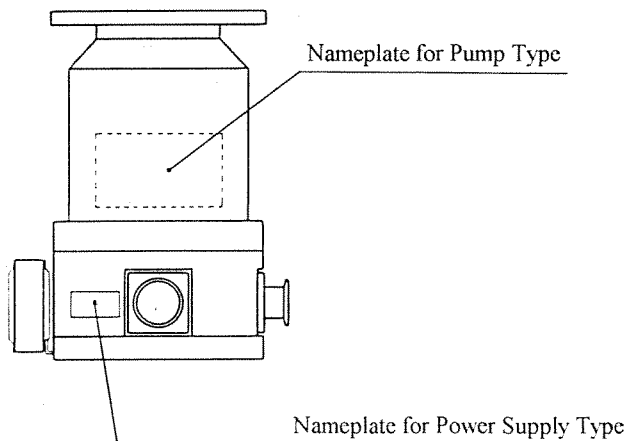
3. Preparation

3-1. Combinations between the pump and the power supply ! CAUTION

Confirm the types for both the pump and the power supply before installation.

The nameplate at the pump connector shows the type of power supply to be used.

Also, the power supply has a nameplate showing the type. Be sure to use the same type.

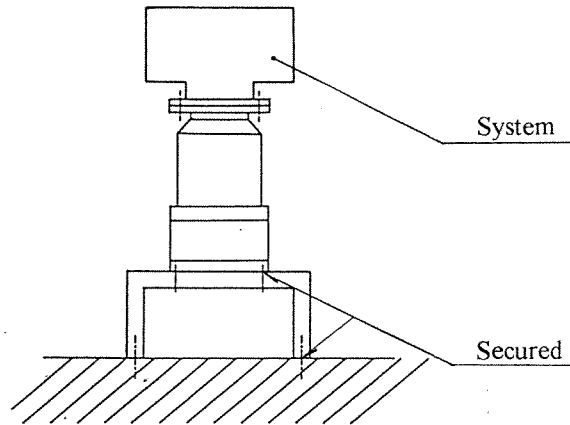


The Combinations between the Pump and the Power Supply are as follow.

Pump Type	Power Supply Type
TG370M/TG373M/TG400M/TG403M	TD370/400
TG710M/TG713M/TG1110M/TG1113M	TD700/1100
TG2000M/TG2003M	TD2000
TG2810M/TG2813M/TG3210M/TG3213M/TG3410M/TG3413M	TD3200

3-2. Pump installation ! CAUTION

Secure the pump not only to the system at the inlet flange but also to the frame utilizing the bolt holes prepared for securing the pump at the bottom. The frame the pump is secured to must be secured to the floor.



! WARNING : If an accident occurred during an pump operation, a damage to the pump rotor will generate a large rotation torque. Since this torque will try to rotate the entire pump, in order to avoid any danger, the pump must be secured to the frame firmly.

When designing the system and the frame and securing it to the floor, refer to the **Table 1.** for rotation torque.

Pump Type	Rotation Torque (N m)
TG370M/TG373M/TG400M/TG403M	306
TG710M/TG713M/TG1110M/TG1113M	1620
TG2000M/TG2003M	5150
TG2810M/TG2813M/TG3210M/TG3213M/TG3410M/TG3413M	8400

Table 1. Rotation torque that can be generated when the pump is damaged.

Table 2. shows the size and the number of securing bolts at the bottom of the pump.

Pump Type	Securing Bolts	P.C.D.
TG370M/TG373M/TG400M/TG403M	4 x M8	160
TG710M/TG713M/TG1110M/TG1113M	4 x M10	220
TG2000M/TG2003M/TG2810M/TG2813M/TG3210M/TG3213M/ TG3410M/TG3413M	4 x M16	250

Table 2. Securing bolts at the bottom of the pump

When securing the pump to the system, use **Table 3.** specified bolts and tighten all the bolts.

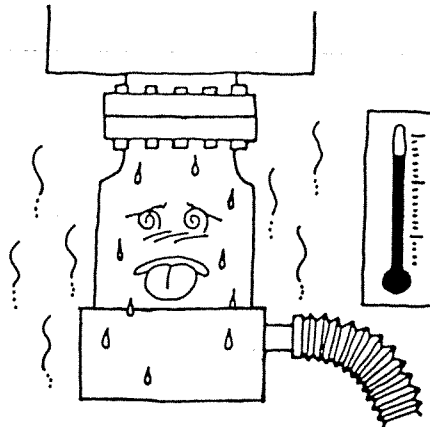
Pump Type	Flange Type	Securing Bolts
TG370M/TG373M	VG	8 x M10
	CF	16 x M8
	B	8 x M8
TG400M/TG403M TG710M/TG713M	VG	8 x M10
	CF	20 x M8
	B	8 x M10
TG1110M/TG1113M	VG	8 x M12
	CF	24 x M8
	B	12 x M10
TG2000M/TG2003M TG2810M/TG2813M	VG	12 x M12
	B	12 x M10
TG3210M/TG3213M	VG	12 x M12
	B	12 x M12
TG3410M/TG3413M	VG	12 x M12

Table 3. The number and the size of the securing bolts for the pump inlet flange.

3-3. External environment of the pump

- 1) Surrounding temperature of the pump
should not exceed 40°C during the pump operation.

! WARNING : During the pump operation the pump will generate heat. If the external temperature exceeds 40°C, it may lead to a failure.



- 2) Magnetic fields

Do NOT operate the pump in strong magnetic fields. During an operation, maximum magnetic fields are 30 Gauss.

! WARNING : If the pump is operated in strong magnetic fields, the rotor temperature will rise and this may lead to a short life of the rotor or to a failure of the pump.

- 3) Do NOT apply any shocks or vibrations from the external to the pump.

3-4. The power supply installation and securing

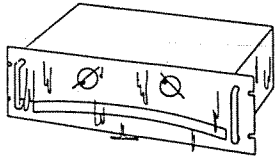
The power supply can be installed either in a rack or onto the floor. If it's installed in a rack, support its weight with either a rail or a plate.

! CAUTION : Weight of the power supply is about 35 kg.

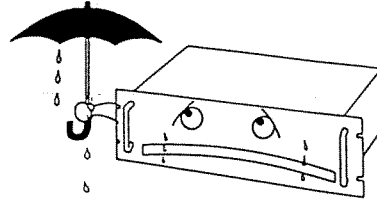
3-5. External environment of the power supply.

Do NOT operate the power supply in the following environment.

1) High temperature, high humidity.



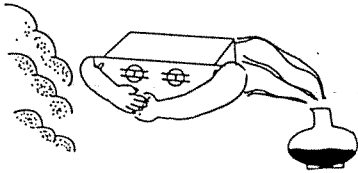
2) Under a water dripping spot.



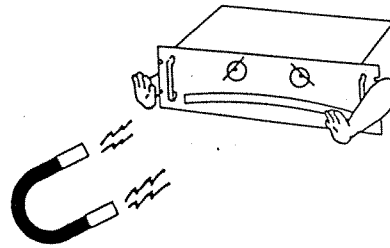
3) A place with explosive or flammable gases.

A place with corrosive or toxic gases.

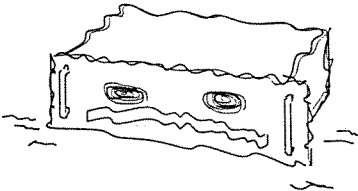
A dusty place.



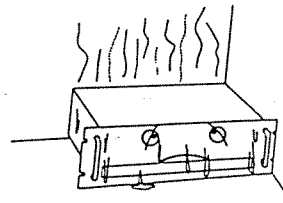
4) A place with strong magnetic or electric fields.



5) A place with vibrations.



6) Do NOT cover the cooling fan at the rear of the power supply.



! WARNING : Leave space to the wall at the rear and the bottom of the power supply for ventilation. Otherwise, the temperature in the power supply may rise and may lead to a failure.

4. Vacuum Piping

4-1. Inlet port piping

- 1) Use a material with a small outgassing rate such as stainless steel and aluminum alloy for the piping.
- 2) Design the piping considering the conductance.
- 3) Minimize the leak rate of the piping and the system. Degrease the pump inner walls in order to minimize the outgassing.
- 4) When the pump is installed to a system, do NOT remove the protective screen at the inlet port in order to prevent any foreign objects falling into the pump.

! WARNING : Even with a protective screen, foreign objects may fall into the pump. When this happens, it could damage the pump.

4-2. Foreline piping

- 1) Use materials for piping such as stainless steel, aluminum, metal flexible tubing, etc. to connect the pump to a backing pump.
- 2) The length and the diameter of the piping will affect the pump performance. Minimize the pipe length and maximize the diameter.

4-3. Settings for the backing pump

1) Depending on the capacity of the backing pump, the performance of the Magnetic Suspended Compound Molecular Pump (hereafter abbreviated as MS type CMP) varies. Refer to **Table 4.** for the backing pump selection. Suggested pump capacities are shown. Use a backing pump that has a capacity in this suggestion or higher.

Pump Type	Suggested Pump Capacity L/min
TG370M/TG373M/TG400M/TG403M	160
TG710M/TG713M/TG1110M/TG1113M	250
TG2000M/TG2003M	500
TG2810M/TG2813M/TG3210M/TG3213M/TG3410M/TG3413M	1500

Table 4. Suggested backing pump capacities

! CAUTION : If the performance of the backing pump deteriorates, the performance of the MS type CMP deteriorates, too.

- 2) Use a flexible tubing or bellows to reduce the vibrations of the backing pump conducted to the MS type CMP. When installing the backing pump, place it either separately from the molecular pump or use some vibration absorption device if installed together in the same frame.

4-4. Purge gas piping

When reactive gases, corrosive gases or dust are pumped, perform a gas purge.

As to the gas purge piping, refer to **Figure 1.**

N₂ is commonly used as a gas purge. Set a flow rate 20 sccm.

! WARNING : Excessive or insufficient purge gas flow rate may lead to a deterioration of the MS type CMP or a failure.

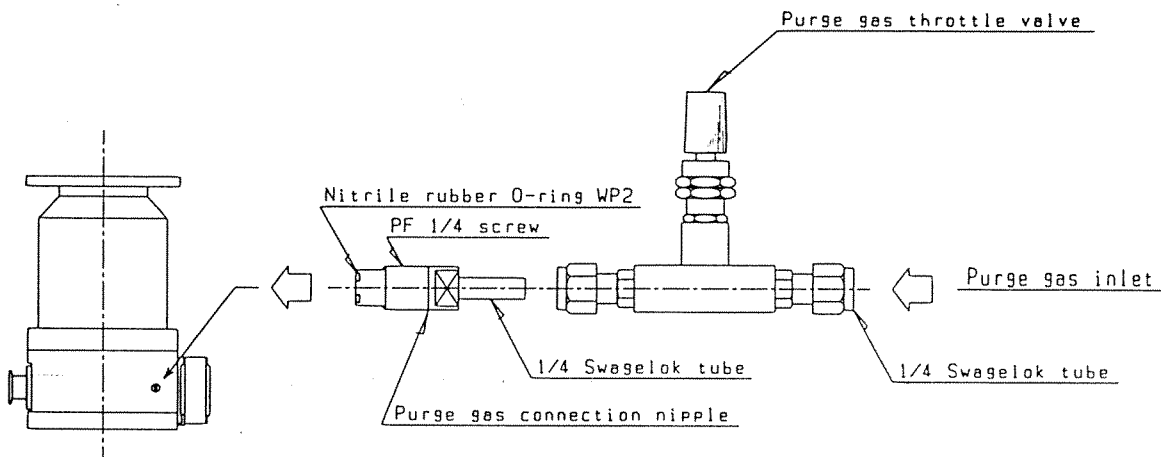


Figure 1. An example of purge gas piping

- For TG370M/TG373M/TG400M/TG403M,

If the chamber pressure of 300 Pa on the system could not be obtained within 5 minutes using only the backing pump, then pump the chamber to 300 Pa first using the backing pump and then startup the molecular pump.

- For TG710M/TG713M/TG1110M/TG1113M/TG2000M/TG2003M/TG2800M/TG2803M/
TG3200M/TG3203M/TG3400M/TG3403M,

If the chamber pressure of 300 Pa on the system could not be obtained within 15 minutes using only the backing pump, then pump the chamber to 300 Pa first using the backing pump and then startup the molecular pump.

2) MS type CMP needs to be cooled during its operation.

- For air cooling Molecular Pumps,

Using the supplied cable, securely connect the cooling fan for the molecular pump and the "FAN" connector at the rear side of the power supply. This will allow the fan to be turned ON when the pump is started.

- For water cooling molecular pumps,

Connect the cooling water line to the cooling water inlet on the molecular pump. Use the best available clean water as the cooling water. Be sure to have an interlock so that if the cooling water supply stops or the flow rate becomes too low, the molecular pump will stop automatically. **The minimum required cooling water is 1.5 L/min and the cooling water temperature range to be 0 ~ 30 °C.**

! CAUTION : Insufficient Cooling of the MS type CMP may result in a failure of the pump.

3) When reactive gases or corrosive gases are pumped, purge the pump with a purge gas.

Flow rate of the purge gas is about 20 NmL/min(20sccm). N₂ is typically used as the purge gas.

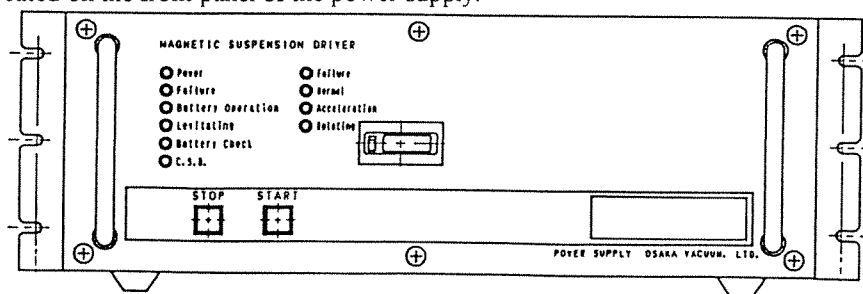
! WARNING : Excessive or insufficient purge gas flow rate may result in a lower pumping performance or a failure of the molecular pump.

4) Confirm the combination between the molecular pump and the power supply.

5) Confirm that the electrical cabling is complete.

6-2. Start and stop of the MS type CMP

START and STOP buttons to startup or to shutdown the MS type CMP, and the LEDs to display the operation status, are located on the front panel of the power supply.



<MAGNETIC SUSPENSION side LEDs>

- **Power**-----Lit when input power (AC200 / 220V) is supplied.

- **Failure**-----Lit when magnetic suspension fails.

- **Battery Operation**-----Lit when the operation is switched to the back-up batteries operation if a power failure occurs during the pump operation.

5. Electrical Connections

The cable connections between the MS type CMP and its power supply are shown in **Figure 2**.

Example: TG370M

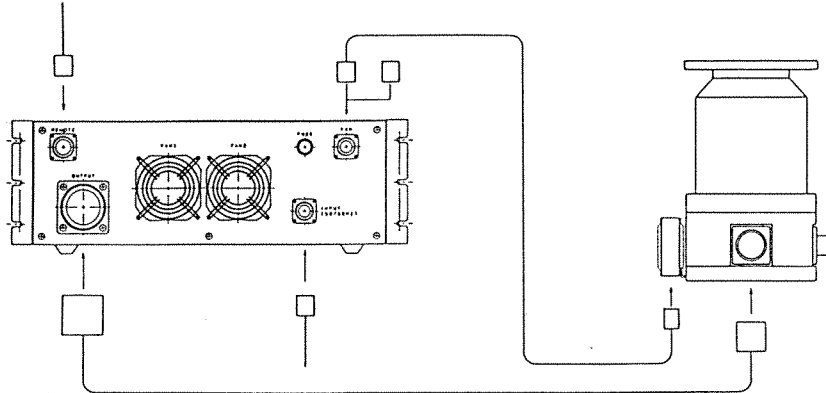


Figure 2. Cable connections between the pump and the power supply

5-1. Output cable connections

Using the output cable (provided in the package), connect the MS type CMP and “OUTPUT” at the rear of the power supply.

5-2. Fan cable connections

If the molecular pump is an air cooling type, using the fan cable (provided in the package), connect the cooling fan of the molecular pump and “FAN” at the rear of the power supply.

If the molecular pump is a water cooling type, insert the fan connector (provided in the package) to “FAN” at the rear of the power supply.

5-3. Input power cable connections

Connect the input power cable (provided in the package) to “INPUT” at the rear of the power supply.

Input power is AC200/220V, 50/60Hz, Single Phase.

! CAUTION : Be sure to connect “Ground” of the input power cable.

! WARNING : When applying a voltage to the power supply, do NOT touch any inner components.

There is a high risk of electrical shock.

! CAUTION : Insert connectors thoroughly and firmly.

5-4. Remote signal connections

MS type CMP can be locally operated via signals from the START and STOP buttons on the front panel of the power supply or remote-controlled via signals from the system.

1) Local operation

The START and STOP buttons on the front panel of the power supply are pressed for the pump start and stop in the local operation.

Even when the local operation is used, the “REMOTE” connector at the rear of the power supply is still used. Feed a protection signal between pins 5-6 of the “REMOTE” connector as necessary.

Protection signal refers to an interlock signal in the following situations.

- When you want to stop the molecular pump because the foreline pressure of the pump became too high.
- When you want to stop the molecular pump because the cooling water supply to the pump is shut off.

This protection signal is fed between pin 5 and pin 6 of “REMOTE” connector such that the logic is normally closed.

When a protection signal is not used, a shortage between pin 5 and pin 6 of the “REMOTE” connector is required. Otherwise, power supply’s “Failure” is lit and the pump cannot be started up.

Initially, at the time of shipping, the pin 5 and 6 are shorted of the “REMOTE” connector.

2) Remote Operation

At the “REMOTE” connector, the following signals are used to communicate with the system.

Refer to **Figure 3.** for wiring.

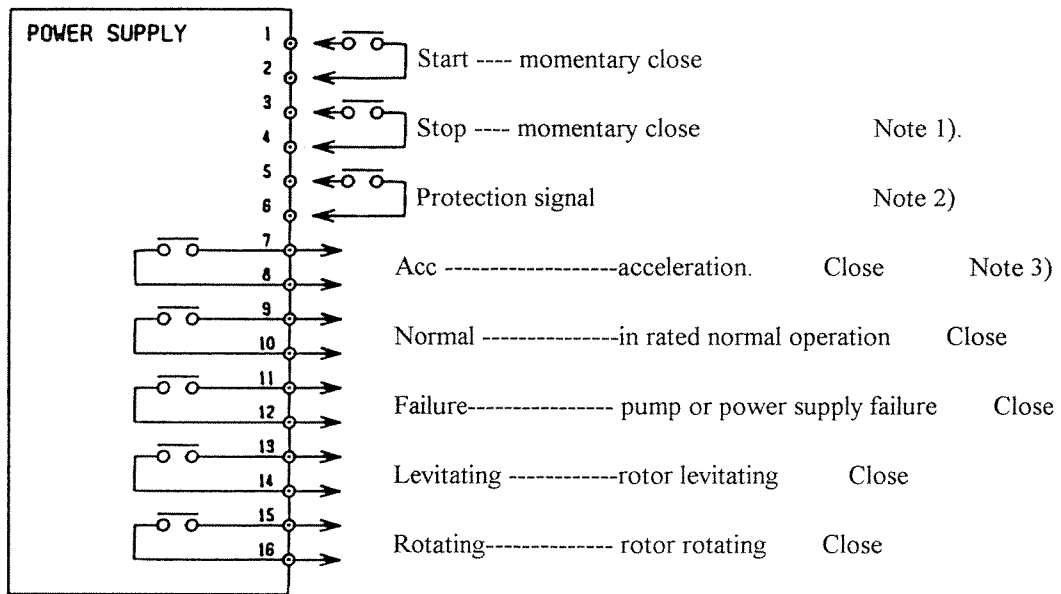


Figure 3. The remote signal communication

Note 1) Use momentary contacts (more than 0.5 sec) for Start and Stop signals.

Note 2) Connect the protection signal lines in the same way as in the local operation. If left open, the power supply’s error will be turned ON and the pump cannot be started.

Note 3) These signals are for the no-voltage contacts. The contacts are rated AC110V/0.2A, DC24V/0.3A.

6. Operation

6-1. Operation precautions

1) MS type CMP can be started together with the backing pump.

If the volume of the chamber the molecular pump’s inlet is connected to is large, however, during the acceleration “Failure” LED may come ON on the power supply and the pump may stop. In this case, follow the next procedure.

- **Levitating**-----Lit when the rotor is levitated.
- **Battery Check**-----Lit when the batteries are charged to a normal voltage.
- **C.S.B.**-----Lit when the touch down bearings needs to be changed. (When rotor touch down count becomes 5.)

<MOTOR DRIVER side LEDs>

- **Failure**-----Lit when the motor or the motor driver fails.
- **Normal**-----Lit when the rotor rotation speed exceeds 80% of the rated rotation speed.
- **Acceleration**-----Lit when the rotor rotation speed is below 80% of the rated rotation speed.
- **Rotating**-----Lit when the rotor is in rotation. (During the acceleration, the rated operation and the brake.)

- **Hour meter**-----Displays accumulated pump operation time. It can be reset to 0 by the reset button of the hour meter.

1) Local Operation

Pump's start and stop operations are performed through the START and STOP buttons on the front panel of the power supply.

During power ON, if the "Battery Check" is not lit, the pump cannot be started. In such case, keep the input power ON and then charge the batteries inside the power supply until the "Battery Check" LED comes ON.

A. Input power ON

Operation Status	Front Panel Display	Functions														
Power ON	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">MAGNETIC SUSPENSION</td> <td style="width: 50%;">DRIVER</td> </tr> <tr> <td><input type="radio"/> Power</td> <td><input checked="" type="radio"/> Failure</td> </tr> <tr> <td><input checked="" type="radio"/> Failure</td> <td><input checked="" type="radio"/> Normal</td> </tr> <tr> <td><input checked="" type="radio"/> Battery Operation</td> <td><input checked="" type="radio"/> Acceleration</td> </tr> <tr> <td><input checked="" type="radio"/> Levitating</td> <td><input checked="" type="radio"/> Rotating</td> </tr> <tr> <td><input type="radio"/> Battery Check</td> <td></td> </tr> <tr> <td><input checked="" type="radio"/> C.S.B.</td> <td></td> </tr> </table>	MAGNETIC SUSPENSION	DRIVER	<input type="radio"/> Power	<input checked="" type="radio"/> Failure	<input checked="" type="radio"/> Failure	<input checked="" type="radio"/> Normal	<input checked="" type="radio"/> Battery Operation	<input checked="" type="radio"/> Acceleration	<input checked="" type="radio"/> Levitating	<input checked="" type="radio"/> Rotating	<input type="radio"/> Battery Check		<input checked="" type="radio"/> C.S.B.		<p>"Power" and "Battery Check" will be lit.</p> <p>The fan in the power supply will be turned on.</p>
MAGNETIC SUSPENSION	DRIVER															
<input type="radio"/> Power	<input checked="" type="radio"/> Failure															
<input checked="" type="radio"/> Failure	<input checked="" type="radio"/> Normal															
<input checked="" type="radio"/> Battery Operation	<input checked="" type="radio"/> Acceleration															
<input checked="" type="radio"/> Levitating	<input checked="" type="radio"/> Rotating															
<input type="radio"/> Battery Check																
<input checked="" type="radio"/> C.S.B.																

B. START : START button pushed

Under Acceleration	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">MAGNETIC SUSPENSION</td> <td style="width: 50%;">DRIVER</td> </tr> <tr> <td><input type="radio"/> Power</td> <td><input checked="" type="radio"/> Failure</td> </tr> <tr> <td><input checked="" type="radio"/> Failure</td> <td><input checked="" type="radio"/> Normal</td> </tr> <tr> <td><input checked="" type="radio"/> Battery Operation</td> <td><input type="radio"/> Acceleration</td> </tr> <tr> <td><input type="radio"/> Levitating</td> <td><input type="radio"/> Rotating</td> </tr> <tr> <td><input type="radio"/> Battery Check</td> <td></td> </tr> <tr> <td><input checked="" type="radio"/> C.S.B.</td> <td></td> </tr> </table>	MAGNETIC SUSPENSION	DRIVER	<input type="radio"/> Power	<input checked="" type="radio"/> Failure	<input checked="" type="radio"/> Failure	<input checked="" type="radio"/> Normal	<input checked="" type="radio"/> Battery Operation	<input type="radio"/> Acceleration	<input type="radio"/> Levitating	<input type="radio"/> Rotating	<input type="radio"/> Battery Check		<input checked="" type="radio"/> C.S.B.		<p>Rotor will be levitated and start acceleration.</p> <p>"Levitating", "Rotating" and "Acceleration" will be lit.</p>
MAGNETIC SUSPENSION	DRIVER															
<input type="radio"/> Power	<input checked="" type="radio"/> Failure															
<input checked="" type="radio"/> Failure	<input checked="" type="radio"/> Normal															
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MAGNETIC SUSPENSION	DRIVER															
<input type="radio"/> Power	<input checked="" type="radio"/> Failure															
<input checked="" type="radio"/> Failure	<input type="radio"/> Normal															
<input checked="" type="radio"/> Battery Operation	<input checked="" type="radio"/> Acceleration															
<input type="radio"/> Levitating	<input type="radio"/> Rotating															
<input type="radio"/> Battery Check																
<input checked="" type="radio"/> C.S.B.																

C. STOP : STOP button pushed

Under Deceleration	<p>MAGNETIC SUSPENSION</p> <p><input type="radio"/> Power</p> <p><input checked="" type="radio"/> Failure</p> <p><input checked="" type="radio"/> Battery Operation</p> <p><input type="radio"/> Levitating</p> <p><input type="radio"/> Battery Check</p> <p><input checked="" type="radio"/> C.S.B.</p>	<p>DRIVER</p> <p><input checked="" type="radio"/> Failure</p> <p><input checked="" type="radio"/> Normal</p> <p><input checked="" type="radio"/> Acceleration</p> <p><input type="radio"/> Rotating</p>	<p>“Normal” and “Acceleration” will be turned off and the pump will start decelerating by the brake.</p>
Stop	<p>MAGNETIC SUSPENSION</p> <p><input type="radio"/> Power</p> <p><input checked="" type="radio"/> Failure</p> <p><input checked="" type="radio"/> Battery Operation</p> <p><input checked="" type="radio"/> Levitating</p> <p><input type="radio"/> Battery Check</p> <p><input checked="" type="radio"/> C.S.B.</p>	<p>DRIVER</p> <p><input checked="" type="radio"/> Failure</p> <p><input checked="" type="radio"/> Normal</p> <p><input checked="" type="radio"/> Acceleration</p> <p><input checked="" type="radio"/> Rotating</p>	<p>When the rotor speed is reduced to a few rps, “Levitating” and “Rotating” will be turned off.</p>
Power OFF	<p>MAGNETIC SUSPENSION</p> <p><input checked="" type="radio"/> Power</p> <p><input checked="" type="radio"/> Failure</p> <p><input checked="" type="radio"/> Battery Operation</p> <p><input checked="" type="radio"/> Levitating</p> <p><input checked="" type="radio"/> Battery Check</p> <p><input checked="" type="radio"/> C.S.B.</p>	<p>DRIVER</p> <p><input checked="" type="radio"/> Failure</p> <p><input checked="" type="radio"/> Normal</p> <p><input checked="" type="radio"/> Acceleration</p> <p><input checked="" type="radio"/> Rotating</p>	<p>All LEDs will be turned off.</p>

Under local operation, output signals from the “REMOTE” connector at the rear of the power supply are still the same as those in remote operation.

! CAUTION : Do NOT remove input power until the rotor of the pump stops completely. (Only “Power” will be lit.)

2) Remote Operation

Start and Stop signals fed to the “REMOTE” connector at the rear side of the power supply are used to start and to stop the molecular pump.

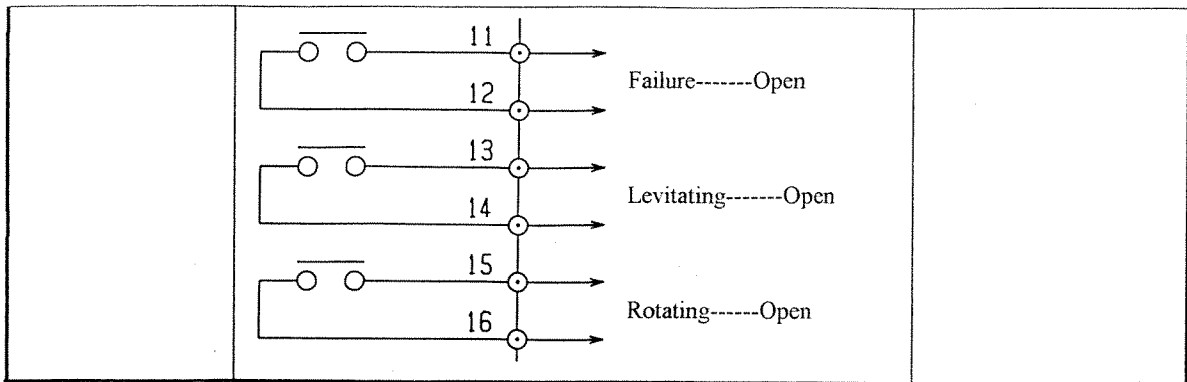
Start of the molecular pump is initiated by momentarily closing the start signal fed between pin 1 - 2 of the “REMOTE” connector at the rear of the power supply.

In remote operation, too, the front panel LEDs will function in the same way as in the local operation.

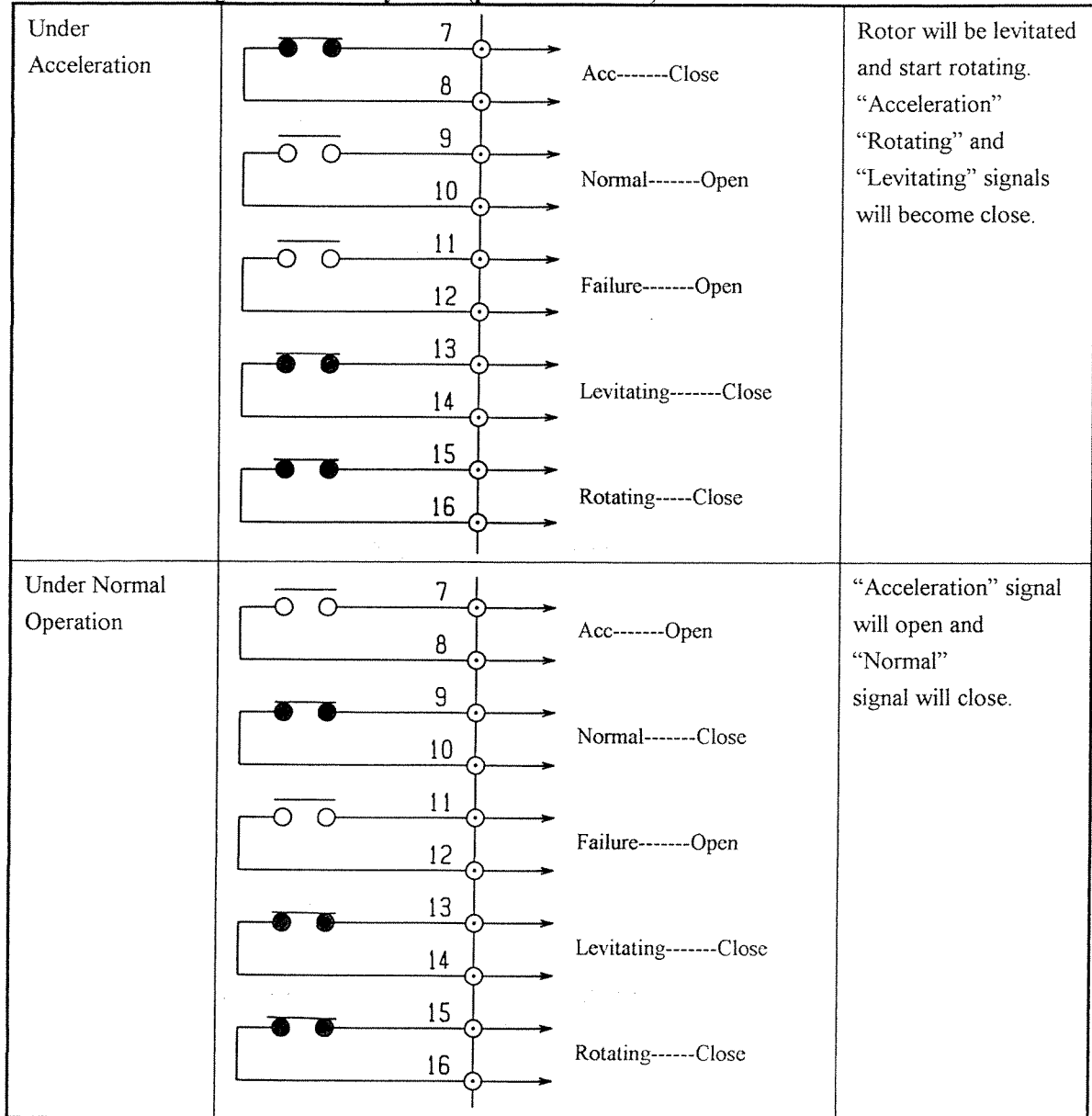
The output signals from the “REMOTE” connector are as follows.

A. Input power ON

Operation Status	Output Signals from “REMOTE” connector	Functions
Power ON		<p>The cooling fan will start rotating.</p> <p>All output signals are currently open.</p>



B. Start : Start signal Momentary Close (pins between 1-2)



Stop of the molecular pump is initiated by momentarily closing the stop signal fed between the pin 3 - 4 of the "REMOTE" connector at the rear of the power supply.

C. Stop : Stop signal Momentary Close (pins between 3-4)

Operation Status	Output Signals from "REMOTE" connector	Functions
Under Deceleration		<p>"Normal" and "Acceleration" signals will be open and deceleration will start with the brake.</p>
Stop		<p>When rotor rotation speed is reduced to a few rps, "Levitating" and "Rotating" signals will open and all signals become open.</p>

! CAUTION : Do NOT remove input power until the rotor of the pump stops completely. (Only "Power" will be lit.)

6-3. Start and stop of the MS type CMP during acceleration/deceleration

The pump can be stopped during acceleration or can be re-accelerated during the stop. However, leave at least 5 seconds between each start and stop operation.

7. Baking

Upon performing a baking of the MS type CMP, mount a baking heater on top of the pump casing as shown in **Figure 4**. Keep the baking temperature below 120°C.

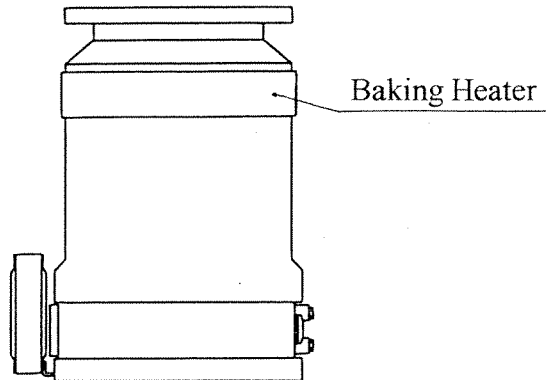


Figure 4. Mounting position of the baking heater.

! WARNING : A wrong mounting position or an excessive baking temperature may result in a pump failure.

8. Protections

8-1. Power failure

If a power failure occurs during the operation of MS type CMP, the power supply will be switched to the back-up batteries in the power supply unit and with the rotor still levitating, the speed will be decreased by the brake. When the power is recovered, the operation will be switched back to the normal power source. The molecular pump, however, will not start automatically.

When a power failure occurs during the operation, the front panel display and the output signals from the “REMOTE” connector at the rear should look like the following:

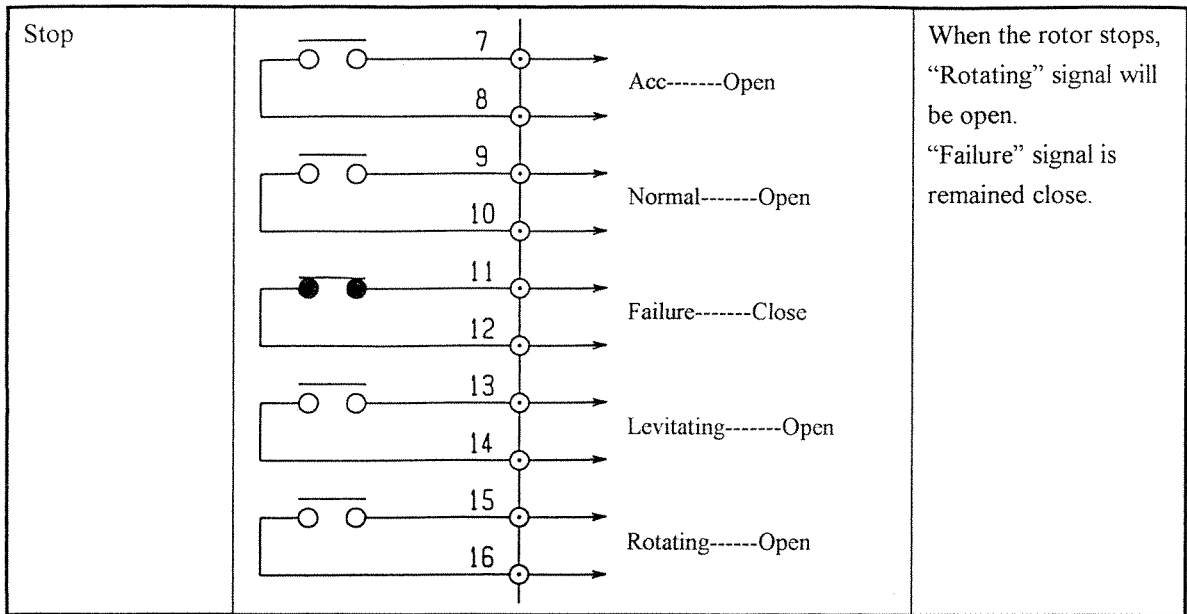
Operation Status	Front Panel Display		Functions
Power Failure	MAGNETIC SUSPENSION <input checked="" type="radio"/> Power <input checked="" type="radio"/> Failure <input type="radio"/> Battery Operation <input type="radio"/> Levitating <input type="radio"/> Battery Check <input checked="" type="radio"/> C.S.B.	DRIVER <input checked="" type="radio"/> Failure <input checked="" type="radio"/> Normal <input checked="" type="radio"/> Acceleration <input type="radio"/> Rotating	“Power” will go off and “Battery Operation” will be turned on. At the same time, “Normal” or “Acceleration” will go off indicating that the brake is now on.
Stop	MAGNETIC SUSPENSION <input checked="" type="radio"/> Power <input checked="" type="radio"/> Failure <input checked="" type="radio"/> Battery Operation <input checked="" type="radio"/> Levitating <input checked="" type="radio"/> Battery Check <input checked="" type="radio"/> C.S.B.	DRIVER <input checked="" type="radio"/> Failure <input checked="" type="radio"/> Normal <input checked="" type="radio"/> Acceleration <input checked="" type="radio"/> Rotating	All LEDs will go off.

Operation Status	Output Signals from "REMOTE" connector	Functions
Power Failure		"Normal" or "Acceleration" will go off indicating that the brake is now on.
Stop		All signals will open.

When the power is recovered, if "Battery Check" is not lit, then keep the power ON. The batteries will be charged and when it's completed, the "Battery Check" will come ON and the pump will become operational to start up.

8-2. Magnetic suspension failure

In the event of a failure on the magnetic suspension or on the magnetic suspension control circuit, or when too much vibration is applied to the CMP in operation, the "Failure" on the MAGNETIC SUSPENSION side will be turned ON and the rotor will touch down to the protection bearings and stop. If this happens 5 times, "C.S.B." on the power supply will be turned ON and the pump can no longer be started. In such case, the protection bearings needs to be replaced. Contact OSAKA VACUUM, LTD for a service.



A magnetic suspension failure (less than 5 times) can be reset by pressing the STOP button on the front panel of the power supply or by momentarily close the STOP signal fed into the "REMOTE" connector at the rear. At the 5th time of magnetic suspension failure, "C.S.B." will be turned ON and it cannot be reset any longer.

8-3. Driver failure

If the motor in the MS type CMP or the motor driver circuit in the power supply has a failure, the DRIVER side "Failure" on the front panel of the power supply will be turned ON and the pump will decelerate.

At this time, the rotor will remain levitated and stop.

When a driver failure occurs, how the display on the front panel of the power supply and the output signals from the "REMOTE" connector at the rear should look like are shown below.

Operation Status	Front Panel Display		Functions
Driver Failure	MAGNETIC SUSPENSION ○ Power ● Failure ● Battery Operation ○ Levitating ○ Battery Check ● C.S.B.	DRIVER ○ Failure ● Normal ● Acceleration ○ Rotating	"Failure" on DRIVER side will be turned ON. The rotor will start decelerating.
Stop	MAGNETIC SUSPENSION ○ Power ● Failure ● Battery Operation ○ Levitating ○ Battery Check ● C.S.B.	DRIVER ○ Failure ● Normal ● Acceleration ● Rotating	"Rotating" will go off indicating that the rotor has stopped. "Levitating" and "Failure" on DRIVER side are remained lit.

When a magnetic suspension failure occurs, how the display on the front panel of the power supply and the output signals from the "REMOTE" connector at the rear should look like are shown below.

Operation Status	Front Panel Display	Functions
Magnetic Suspension Failure	<p>MAGNETIC SUSPENSION DRIVER</p> <p>○ Power ● Failure</p> <p>○ Failure ● Normal</p> <p>● Battery Operation ● Acceleration</p> <p>● Levitating ○ Rotating</p> <p>○ Battery Check</p> <p>● C.S.B.</p>	"Levitating" will go off indicating that the rotor touched down. The rotor will start decelerating by the brake.
Stop	<p>MAGNETIC SUSPENSION DRIVER</p> <p>○ Power ● Failure</p> <p>○ Failure ● Normal</p> <p>● Battery Operation ● Acceleration</p> <p>● Levitating ● Rotating</p> <p>○ Battery Check</p> <p>● C.S.B.</p>	"Rotating" will go off indicating that the rotor has stopped. "Failure" on MAGNETIC SUSPENSION side is remained lit.
When the 5th time of Magnetic Suspension Failure takes place.	<p>MAGNETIC SUSPENSION DRIVER</p> <p>○ Power ● Failure</p> <p>○ Failure ● Normal</p> <p>● Battery Operation ● Acceleration</p> <p>● Levitating ● Rotating</p> <p>○ Battery Check</p> <p>○ C.S.B.</p>	"C.S.B." will be turned ON. "Failure" and "C.S.B." on MAGNETIC SUSPENSION side are remained lit.

Operation Status	Output Signals from "REMOTE" connector	Functions
Magnetic Suspension Failure	<p>7 ○ →</p> <p>8 ○ →</p> <p>9 ○ →</p> <p>10 ○ →</p> <p>11 ● →</p> <p>12 ● →</p> <p>13 ○ →</p> <p>14 ○ →</p> <p>15 ● →</p> <p>16 ● →</p> <p>Acc-----Open</p> <p>Normal-----Open</p> <p>Failure-----Close</p> <p>Levitating-----Open</p> <p>Rotating-----Close</p>	"Failure" signal will be closed indicating that the rotor has touched down. Rotor will start decelerating by the brake.

Operation Status	Output Signals from "REMOTE" connector	Functions
Driver Failure		"Failure" signal will be closed. Rotor will start decelerating.
Stop		When the rotor stops, "Rotating" signal will be opened. "Failure" signal is remained closed.

Reset on the driver failure is done as follow.

First, press the START button on the front panel of the power supply to ON, then press STOP button to ON. Or momentarily close the Start signal (Pin 1 - 2) at the "REMOTE" connector at the rear of the power supply, and then close Stop signal (Pin 3 - 4.)

After the above procedure, if reset cannot be achieved, then the failure still remains. Remove the cause of the failure and then reset again.

9. Troubleshooting

During the operation of the MS type CMP, if the pump stopped due to a failure, follow the procedures described below.

! WARNING : When checking the power supply, wait at least 5 minutes after the input power is removed before performing any work.

Failure	Possible Cause	Countermeasure
“Power” LED does not light.	-Input power has not been set to ON. -Fuse is blown.	-Be sure to set the input power ON. -Replace the fuse(10A) in the fuse box at the rear of the power supply.
“Power” lights up but the pump does not start.	-Input voltage is low. -Batteries have not been charged up	-Set the input voltage to a rated value. (AC200/220V± 10%) -Keep the input power ON until “Battery Check” LED comes ON.
“Acceleration” lights up but “Rotating” does not.	-Rotation sensor or motor driver failure.	-A motor driver circuit in the power supply may be faulty. Contact OSAKA VACUUM, LTD.
When setting input power ON, “Failure” on the DRIVER side lights up.	-The fan connector or the fan cable is not connected. -The cooling fan in the power supply is faulty. -Protection signal is open.	-Connect the fan connector (for water cooling type) or the fan cable (for air cooling type) to the “FAN” connector at the rear of the power supply. -Replace the cooling fan at the rear of the power supply. Contact OSAKA VACUUM, LTD. -Check the signal I/O. Even when the protection signal is not used, insert a connector to “REMOTE” at the rear of the power supply and short between pins 5-6.
When starting up “Failure” on MAGNETIC SUSPENSION side lights up.	-Fuse in the magnetic suspension circuit is blown.	-Check fuses F1. F2. F3 in the power supply. Refer to the attached diagram for fuses locations.
“C.S.B.” is lit.	-Pump has touched down 5 times.	-Protection bearings needs to be replaced. Contact OSAKA VACUUM, LTD.
Pump starts but does not shift from “Acceleration” to	-Acceleration time over.	Check the following: - Whether the pump’s back pressure is sufficiently low.

“ Normal”. Instead “Failure” on DRIVER side lights up.		- Whether the system has not a leak. - Whether excessive amount of gas is not flowing.
When repeating start/stop, “Failure” on DRIVER side comes ON.	-Thermal protector in the pump worked. Or overheat of the heat sink in the power supply.	-Leave more interval between start/stop repetitions.
“Failure” on MAGNETIC SUSPENSION side lights up and the touch down takes place.	-Failure in the magnetic suspension control circuit or in the position sensor.	-Contact OSAKA VACUUM, LTD.

When “Failure” on DRIVER side on the front panel of the power supply comes ON, the cause can be analyzed by checking the diagnostics LEDs located on the motor driver PCB. The cover on the power supply needs to be removed. For the diagnostics LEDs, refer to the attached figure.

This analysis needs to be performed while “Failure” is still ON. Resetting “Failure” or removing the input power will turn off all diagnostic LEDs.

! WARNING : Do NOT touch any parts inside the power supply while the power is ON. There is a high risk of electrical shock.

10. Maintenance

10-1. Batteries

- 1) Batteries charge is done by supplying the input power to the power supply.
- 2) During the power failure the battery operation will take place. After the power recovery, charge the batteries using the method described in the above 1). Charging is complete when “Battery Check” is lit.
- 3) Even when the power supply is not used for a long period of time, charge the batteries periodically. (once every 6 months)
- 4) Replace the batteries with new ones at least every 2 years.

The battery type is as follows:

Japan Storage Battery Co. Ltd. PE6.5-12R 2 batteries

<How to change the batteries>

- a) Set the input power to OFF of the power supply.
- b) Remove 6 screws on the front panel of the power supply and pull out the panel to the front.

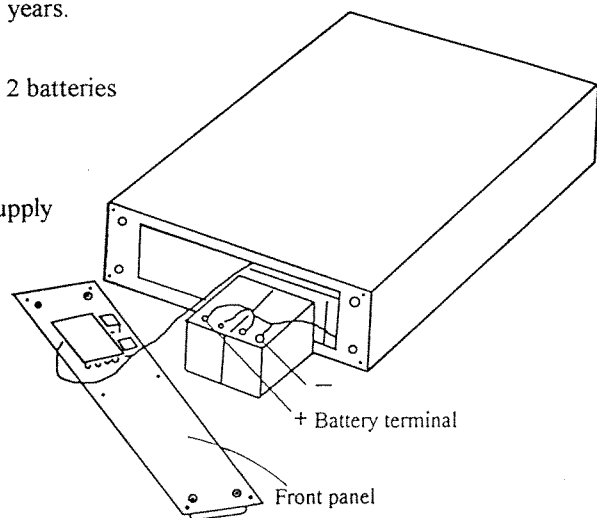
Be cautious about the cables connected to the panel.

- c) Pull out the batteries and remove the cable from the battery terminals.

- d) Connect the cable to the new batteries.

Be sure to connect (+, -) marked terminals correctly.

- e) Insert the batteries into the power supply and attach the front panel.



10-2. Reactive products

If too much reactive products are built up in the pump, the pump may not be able to start or may lead to a further serious failure. Overhaul the pump periodically.

! CAUTION : If the reactive products build-up are left in the pump, the corrosion on the pump will grow and the pump may not be able to be repaired any longer.

10-3. Protection bearings

If a magnetic suspension failure occurs, the rotor will be supported by the protection bearings, decrease its speed and finally stop. When "C.S.B." is lit on the power supply front panel, the protection bearings need to be replaced. In case of using reactive gases or corrosive gases, before "C.S.B." comes ON, overhaul the pump periodically.

! WARNING : If the protection bearings are damaged, it may lead to a serious accident such as rotor blades damage.

10-4. Parts deterioration

The cooling fan of the pump and the power supply deteriorate over the years. A periodical overhaul is recommended.

On the front panel of the power supply, an hour meter is utilized for the purpose of monitoring the pump's operation time as a reference to the overhaul time.

11. Storing the pump and the power supply

When pump is stored for a long period of time, close the inlet, the foreline and the purge gas inlet.

To exchange all reactive or corrosive gases, purge the pump with a gas such as N₂.

Do NOT store the pump and the power supply at the following places.

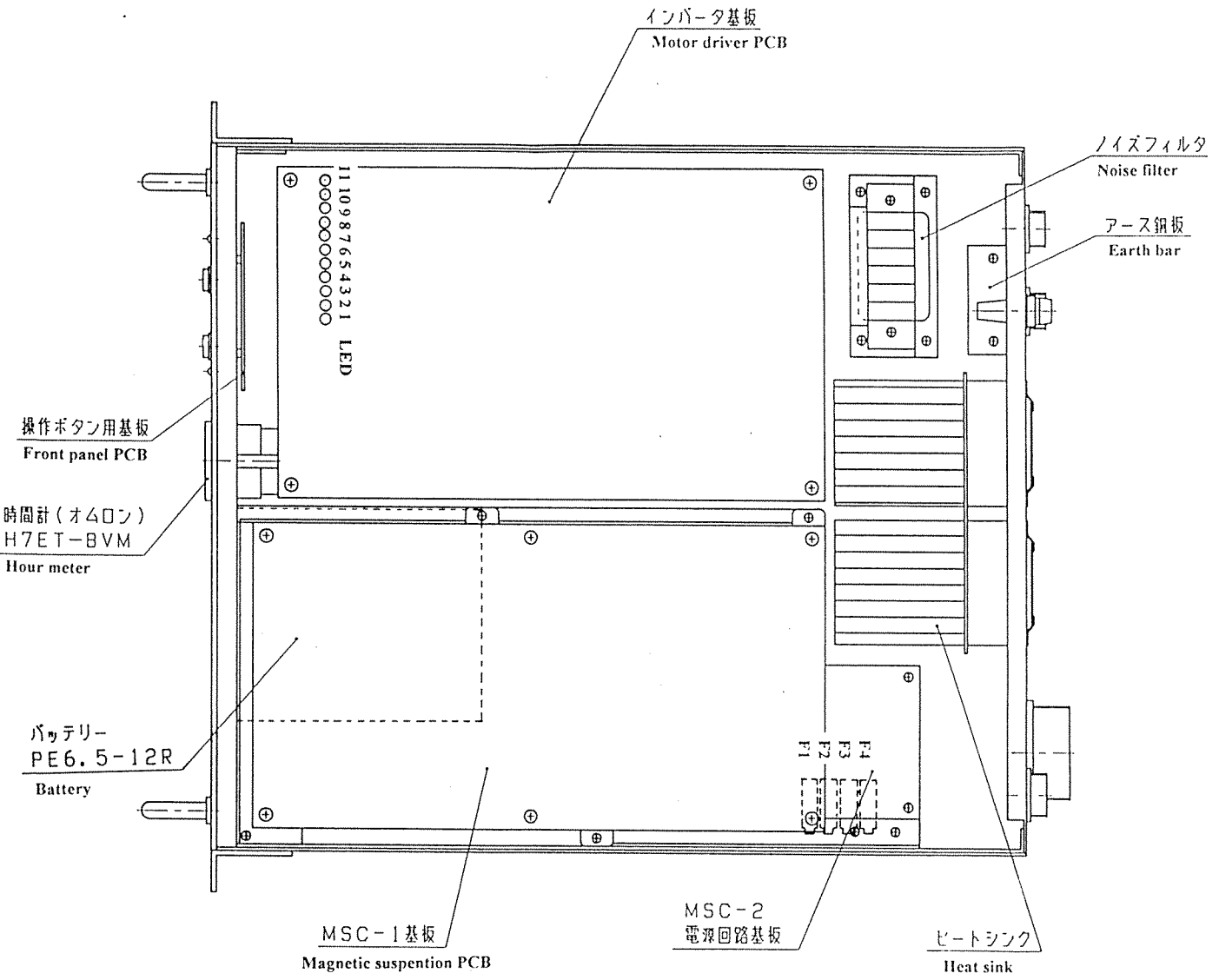
- A place with a high temperature and high humidity
- A place with a reactive or corrosive gases
- A place with a water drops.
- A dusty place
- A place in strong electric fields or magnetic fields
- A radio active place
- A place with vibrations

Pump Model	TG370M	TG400M	TG710M	TG1110M	TG2000M	TG2810M	TG3210M	TG3410M
Specifications	TG373M	TG403M	TG713M	TG1113M	TG2003M	TG2813M	TG3213M	TG3413M
Flange inlet	DN100CF/ DN100ISO-BF	DN160CF/ DN160ISO-BF	DN160CF/ DN160ISO-BF	DN200CF/ DN200ISO-BF	DN250ISO-BF	DN250ISO-BF	DN300ISO-BF	DN350ISO-BF
foreline	DN25KF	DN25KF	DN40KF	DN40KF	DN40KF	DN40KF	DN40KF	DN40KF
Pumping speed N2 L/s	340	430	700	1100	2000	2800	3200	3400
Rotation speed rps	680		560		400	360		
Startup/Shutdown time min.	2/5		6/5		10/12	10/15		
Standard backing pump m3/h	9.6		15		30	90		
Weight kg	18		38		70	120		
Installation	in any position							
Permissible ambient temp. °C	10~40							
Power Supply Model	TD370/400		TD700/1100		TD2000	TD3200		
Input voltage ACV	200/220							
frequency Hz	50/60							
phase	single							
power consumption kVA	max.0.9		max.1.2		max.1.5	max.1.8		
Weight kg	35							
Permissible ambient temp. °C	0~40							

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- LED1:ファン用コネクタ未接続
- LED2:過電流
- LED3:モータ過熱
- LED4:ブレーキ動作中点灯
- LED5:内部冷却ファン故障
- LED6:プロテクション信号オープン
- LED7:入力電圧低下
- LED8:過電圧
- LED9:過速度
- LED10:加速時間オーバ
- LED11:電源正常時点灯

- LED1 : Fan connector not connected
- LED2 : Over current
- LED3 : Motor overheat
- LED4 : Lit during braking
- LED5 : Internal cooling fan defective
- LED6 : Protection signal open
- LED7 : Input voltage lower
- LED8 : Overvoltage
- LED9 : Overspeed
- LED10 : Acceleration overtime
- LED11 : Lit while input power is normal



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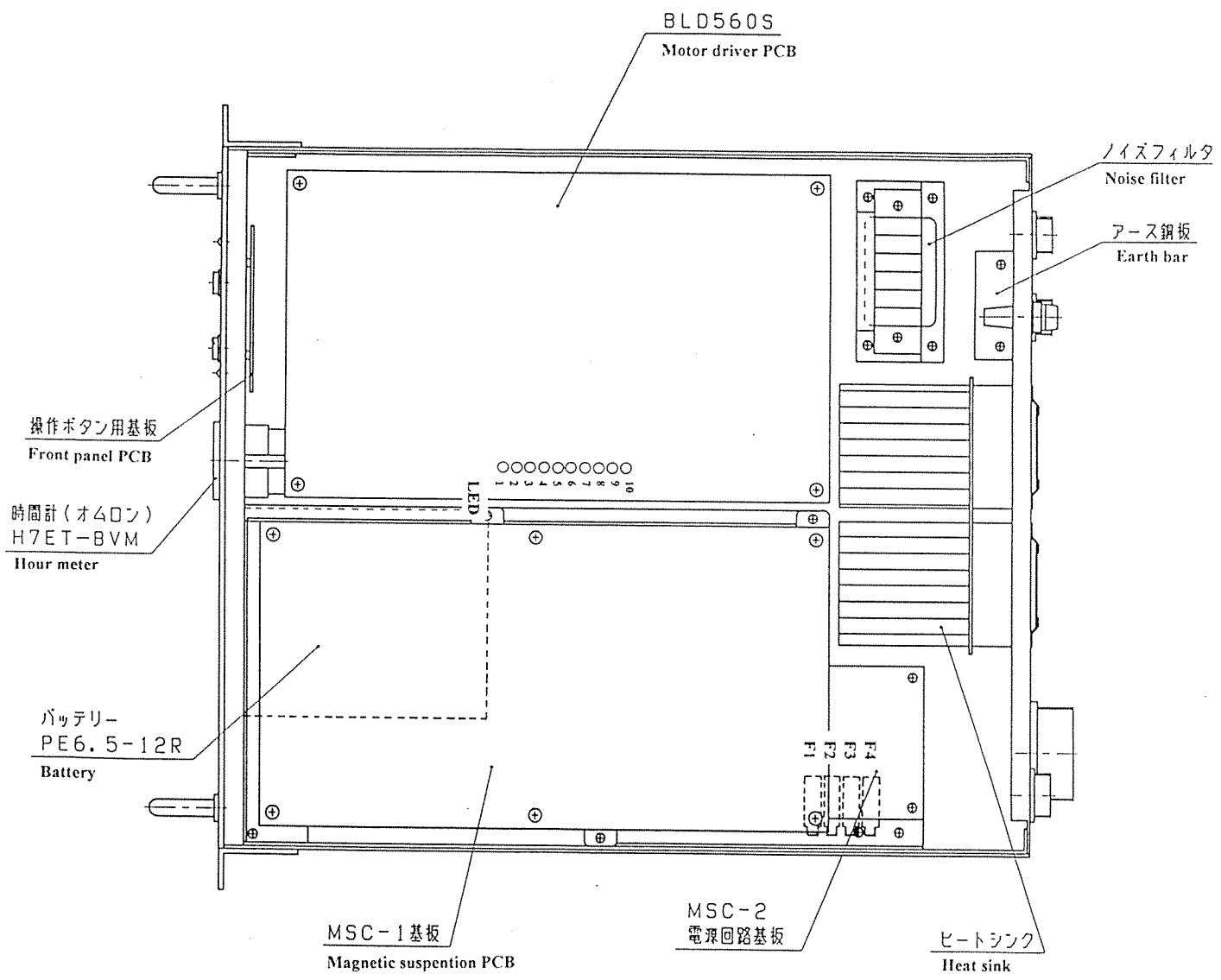
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NO.	DESCRIPTION	MATERIAL	Q'TY	DWG. NO.	REMARKS
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A
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- LED1:入力電圧低下
- LED2:ヒートシンク過熱
- LED3:モータ過熱
- LED4:過電流
- LED5:ファン用コネクタ未接続/
プロテクション信号オープン
- LED6:過速度
- LED7:加速時間オーバ
- LED8:回転検出器異常
- LED9:無負荷運転中点灯
- LED10:インバータ駆動中点灯

- LED1 : Input voltage lower
- LED2 : Heat sink overheat
- LED3 : Motor overheat
- LED4 : Over current
- LED5 : Fan connector not connected /
Protection signal open
- LED6 : Overspeed
- LED7 : Acceleration overtime
- LED8 : Rotation sensor abnormal
- LED9 : Lit during no-load operation
- LED10 : Lit while input power is normal



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DESIGNED	
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TITLE	
Model TD700/1100 Main parts layout	
OSAKA VACUUM, LTD.	
DWG. NO.	3-

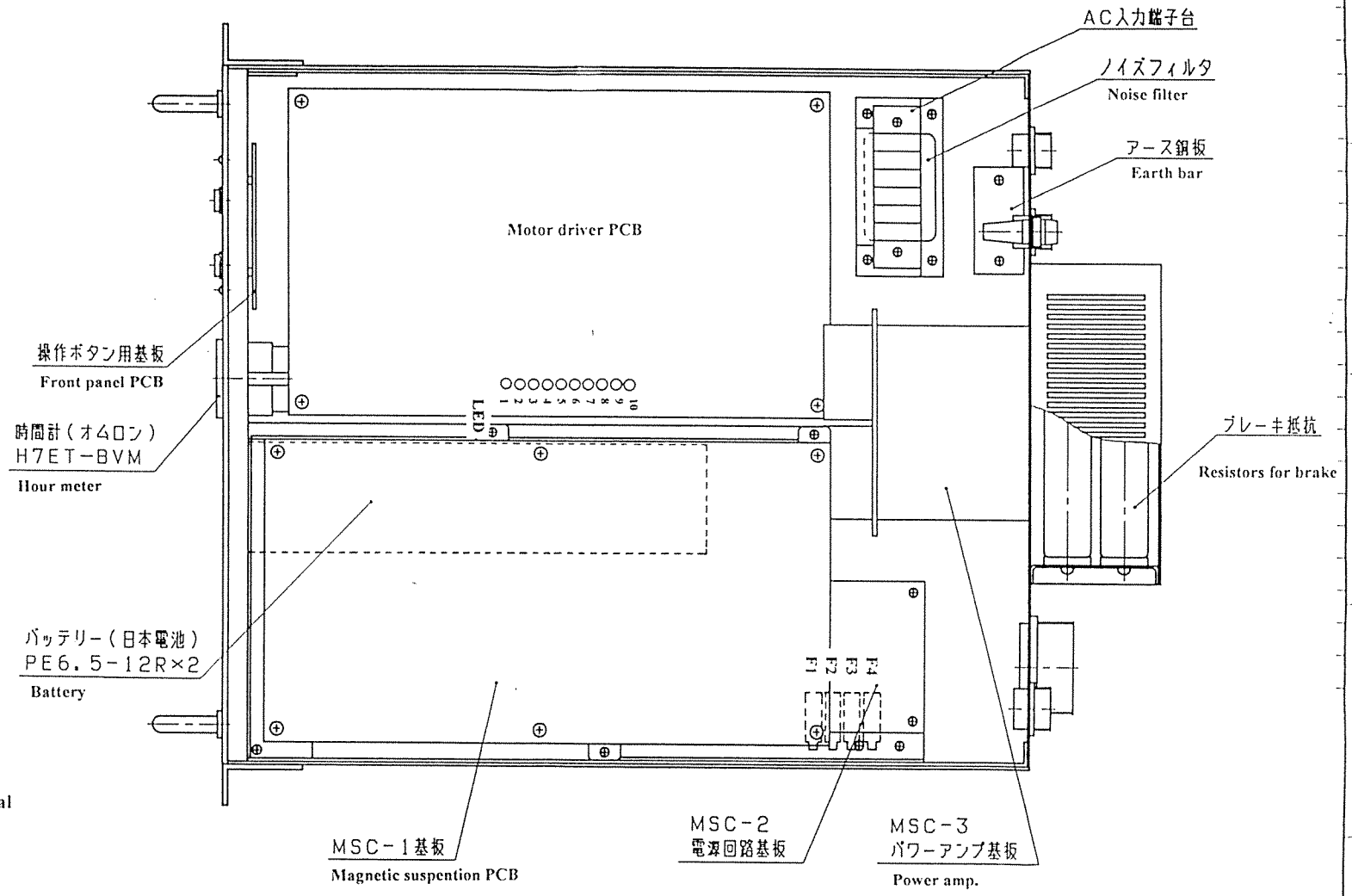
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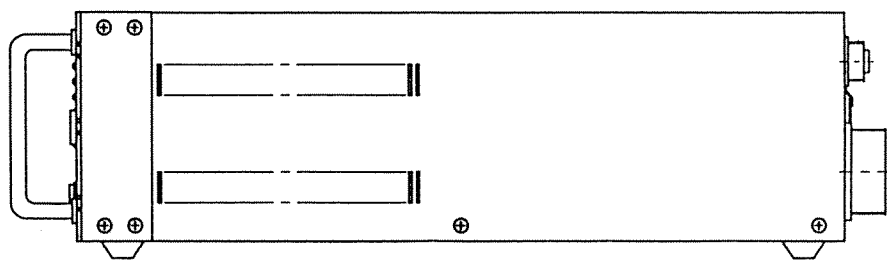
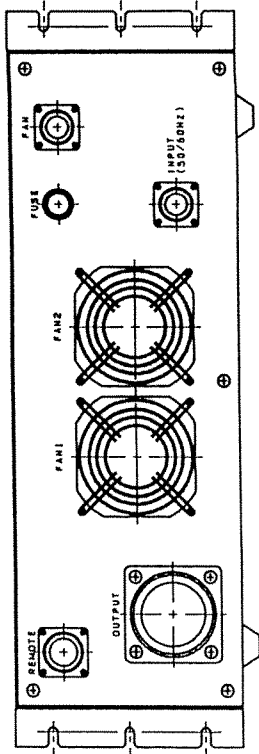
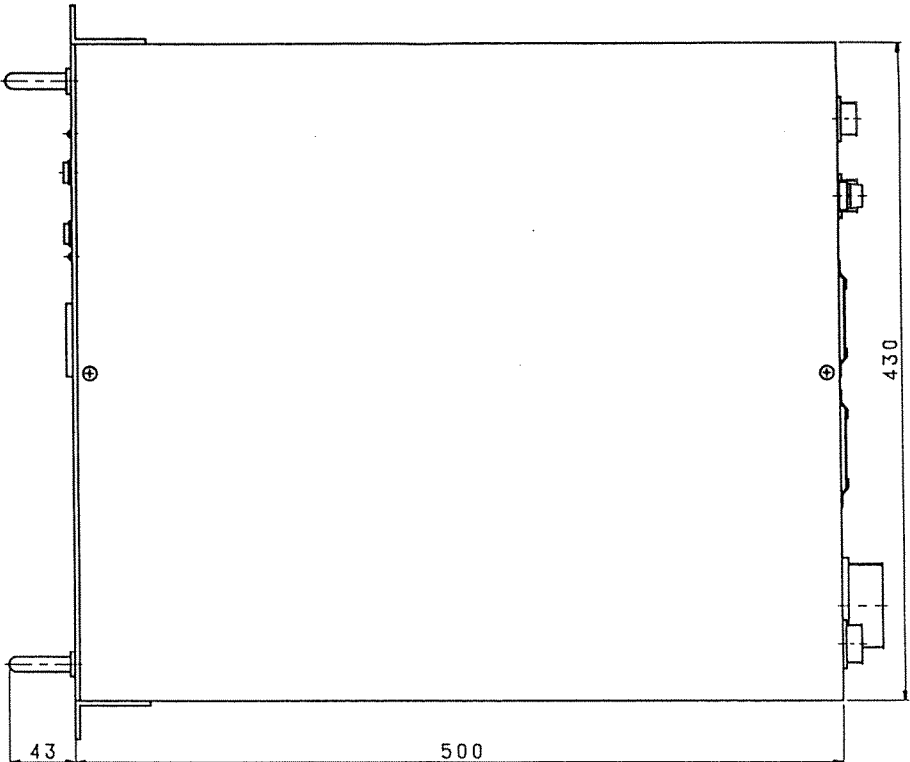
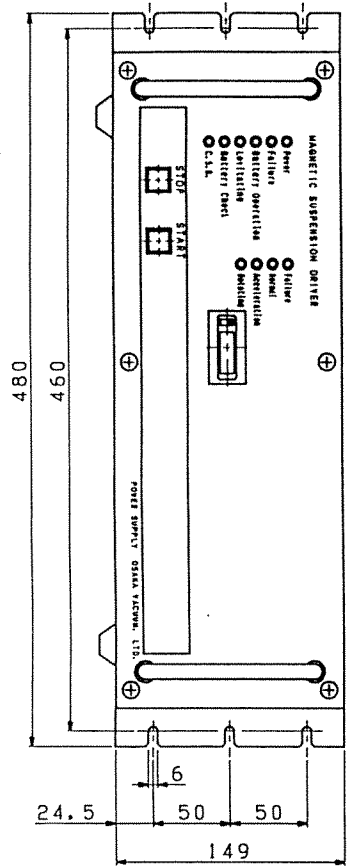
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 - LED3:モータ過熱
 - LED4:過電流
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-
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Protection signal open
 - LED6 : Overspeed
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 - LED8 : Rotation sensor abnormal
 - LED9 : Lit during no-load operation
 - LED10 : Lit while input power is normal




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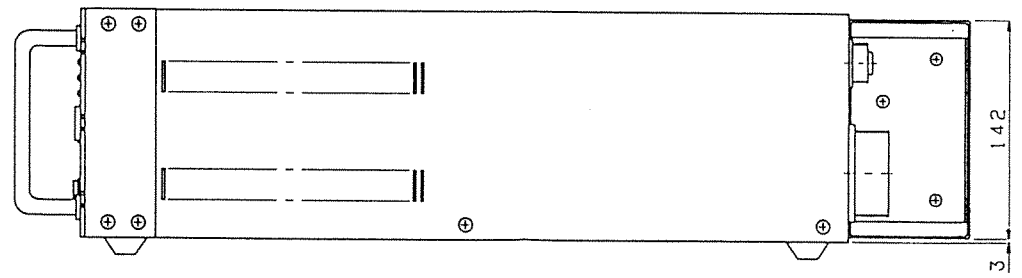
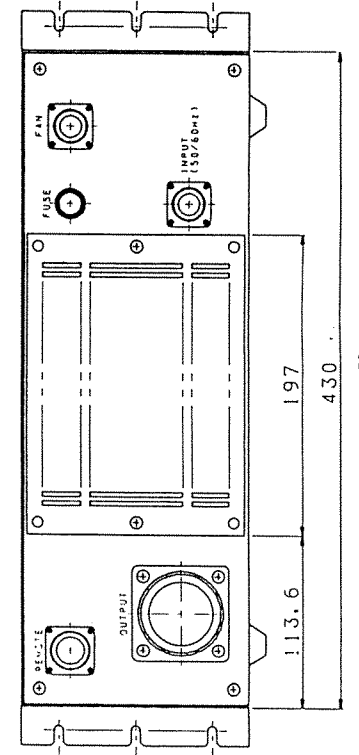
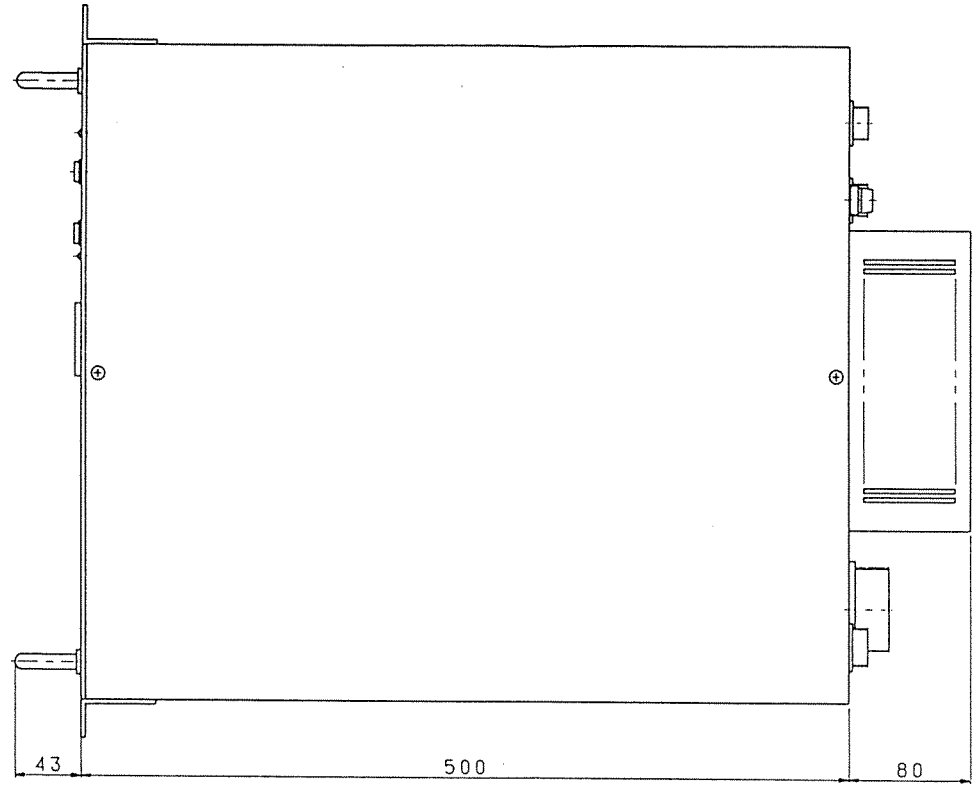
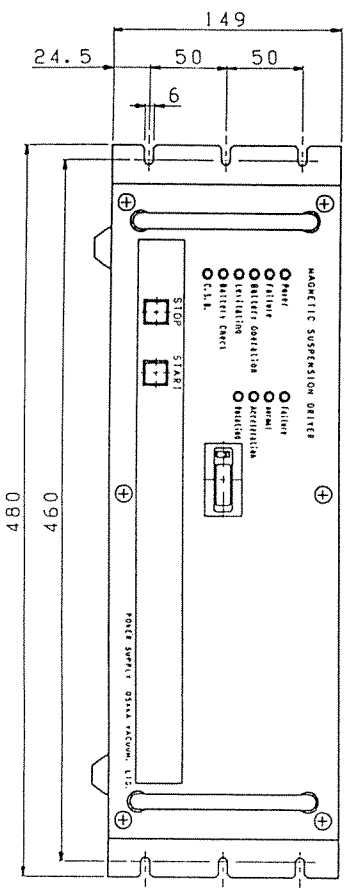


⑤								APPROVED		Model TD370/400 Model TD700/1100 Dimensions
④							CHECKED	<i>A. Park</i>		
③							DESIGNED			
②							DRAWN			
①							NO. OF SET			
REV. NO.	DATE	DESCRIPTION	DRAWN	CHECKED	APP'D	JOB NO.	DATE	SCALE		 OSAKA VACUUM, LTD. DWG. NO. R3-370_1100
							195.10.01			

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NO.	DESCRIPTION	MATERIAL	Q'TY	DWG. NO.	REMARKS
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A
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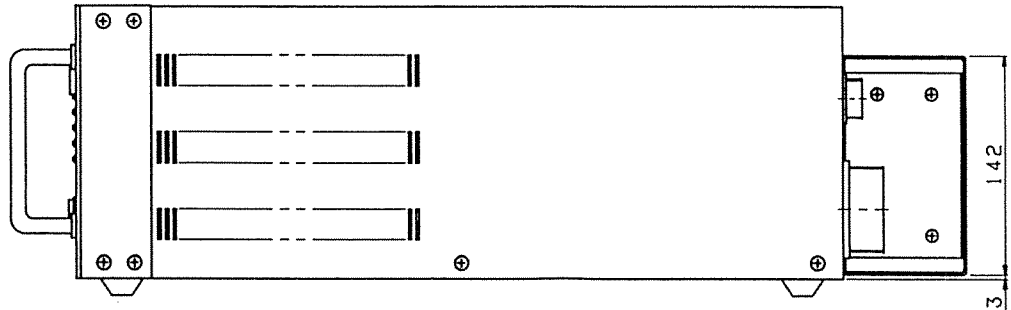
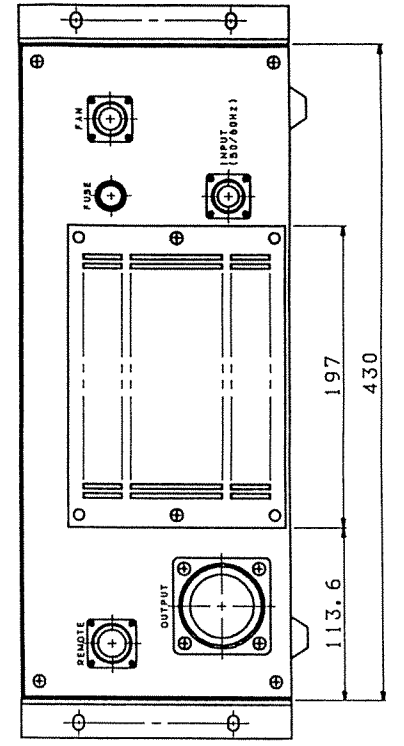
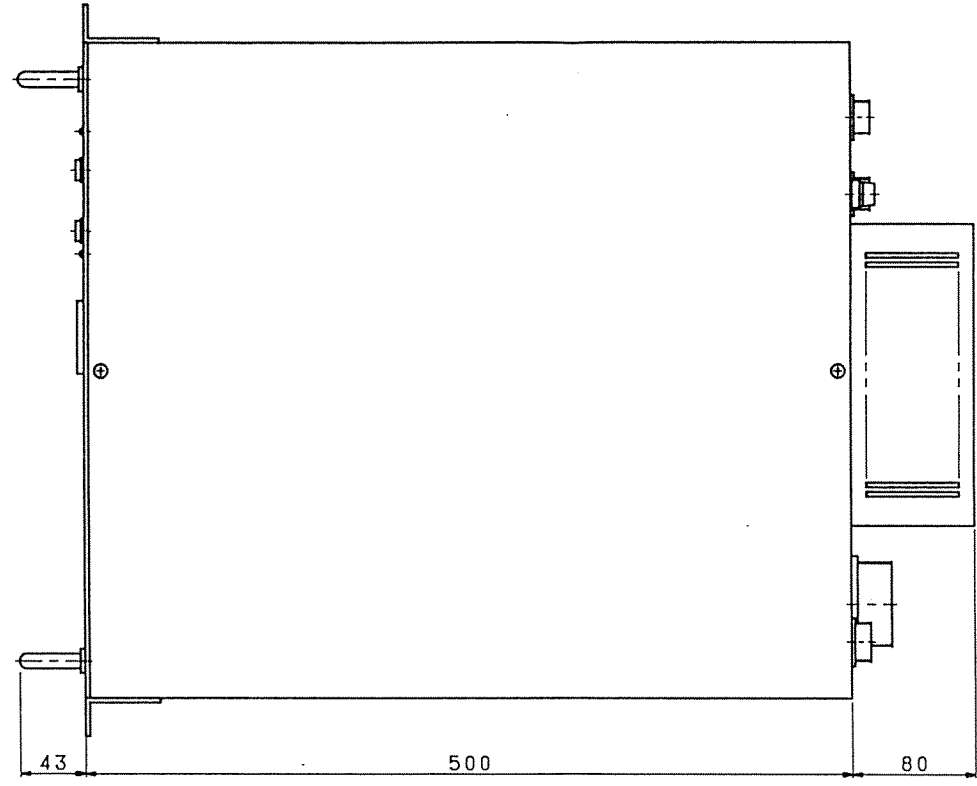
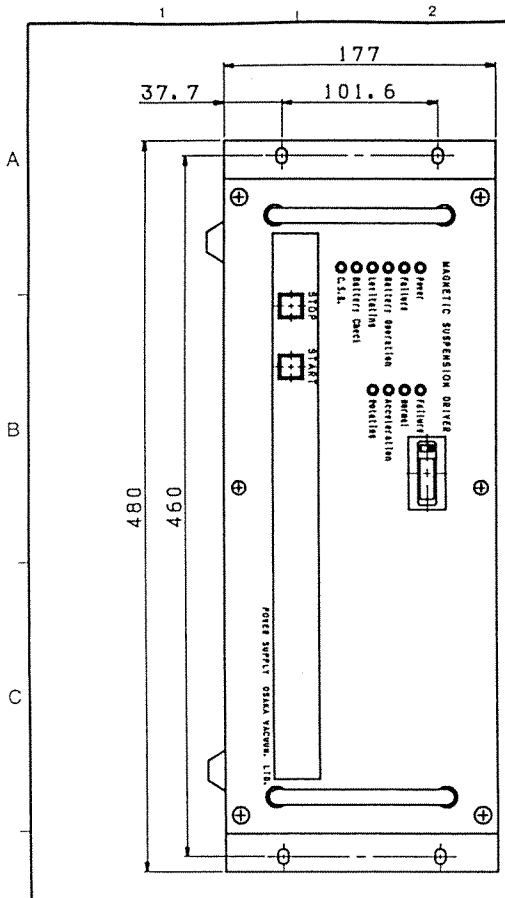
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⑤							

APPROVED	
CHECKED	
DESIGNED	<i>A. Kubota</i>
DRAWN	
NO. OF SET	
SCALE	
DATE	'95.10.01

TITLE	
Model TD2000 Dimensions	
OSAKA VACUUM, LTD.	
DWG. NO.	3-

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AP	ARNO.
CAM	



REV. NO.	DATE	DESCRIPTION	DRAWN	CHECKED	APP'D	JOB NO.	DATE
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4							
3							
2							
1							

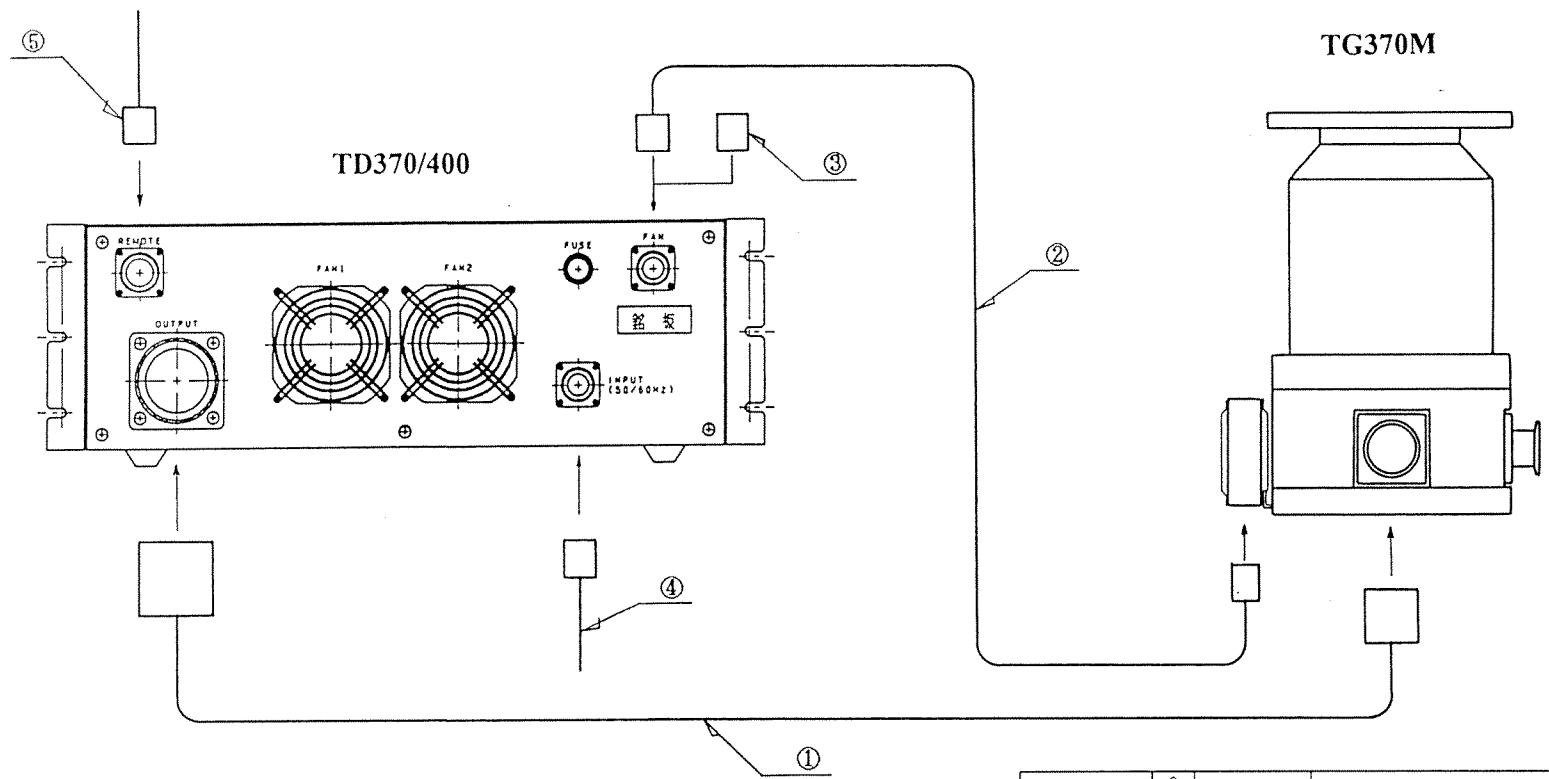
APPROVED	
CHECKED	
DESIGNED	<i>J. Kikuchi</i>
DRAWN	
NO. OF SET	
SCALE	
DATE	'95.10.01

TITLE		Model TD3200 Dimensions	
		OSAKA VACUUM, LTD.	
DWG. NO.	3-	◇	

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NO.	DESCRIPTION	MATERIAL	Q'TY	DWG. NO.	REMARKS
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A
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F



No.	Articles	Reference
1	Output cable	
2	Fan cable	For air-cooling type pump
3	Fan connector	For water-cooling type pump
4	Input cable	Connector: NJC-203-PF Nanaboshi
5	Remote connector	Connector: NJC-2416-PM Nanaboshi

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②						
①						
REV. NO.	DATE	DESCRIPTION	DRAWN	CHECKED	APP'D	
APPROVED		TITLE	Cable Connection Ex. TG370M OSAKA VACUUM, LTD.			
CHECKED						
DESIGNED						
DRAWN						
NO. OF SET						
SCALE						
JOB NO.	DATE					

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Cutes Corporation(Taiwan) : Phone +886-3-452-6161 Fax +886-3-451-1347

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 Technical Documents 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.