

H04462<6>

OPERATION MANUAL

MAGNETIC SUSPENDED COMPOUND MOLECULAR PUMP / CONTROLLER

TG710M / TG713M / TD711/1111-C
TG710EM / TG713EM / TD711/1111-C
TG730M / TG733M / TD711/1111-C
TG730EM / TG733EM / TD711/1111-C
TG1110M / TG1113M / TD711/1111-C
TG1110EM / TG1113EM / TD711/1111-C
TG1130M / TG1133M / TD711/1111-C
TG1130EM / TG1133EM / TD711/1111-C
TG2000M / TG2003M / TD2001-C
TG2810EM / TG2813EM / TD3211-C
TG3210EM / TG3213EM / TD3211-C
TG3410EM / TG3413EM / TD3211-C



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Issue date 05.10.'98

Approved	Checked	Issued
M.Iguchi	M.Sakurai	T.Nakayasu

VIEW OUR INVENTORY

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.

8) Backing Pump

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

9) Pumped Gases

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

10) Disassembly and Modification

DO NOT disassemble and/or modify the pump, power supply and cables. It may result in failures or accidents and fails safety.

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 Drawing
3. Cable Connection
4. Power Supply I/O Communications

1. Preface

1-1. Warranty

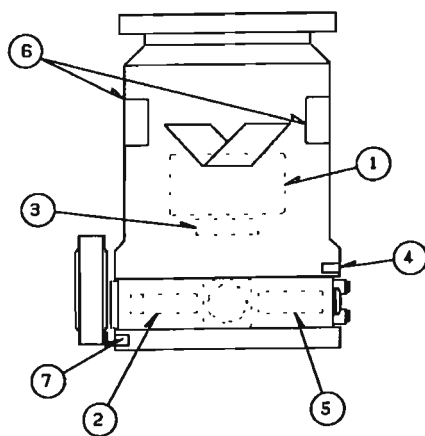
The warranty on the pump, the power supply and the peripherals are specified in the document, "General Terms of Warranty" published by OSAKA VACUUM, LTD., provided that the warranty will be avoided if the operations and the maintenance procedures in this manual are not followed.

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

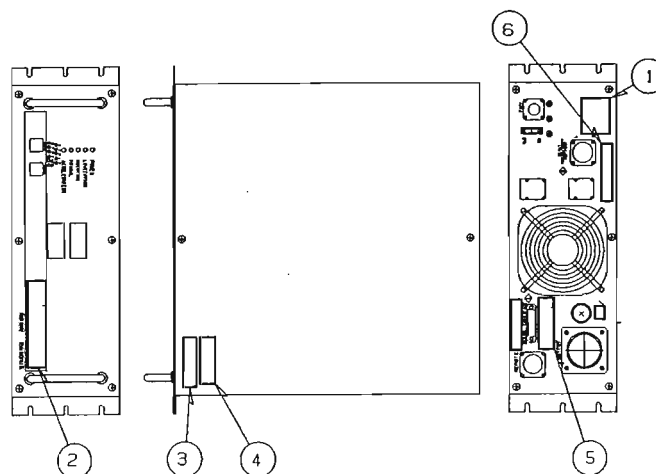
Example: TG730M



- 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.
- ⑦ Caution Plate: "Connect only as stipulated in the instruction manual. This interface is not safe-to-touch and must only be connected through the proper isolation."

B. Power Supply Nameplate

Example: TD711/1111-C



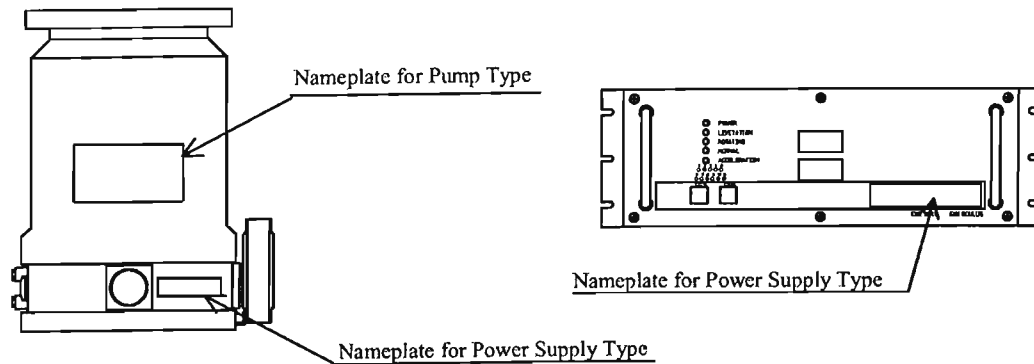
3-2. Combinations between the pump and the power supply

! 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.



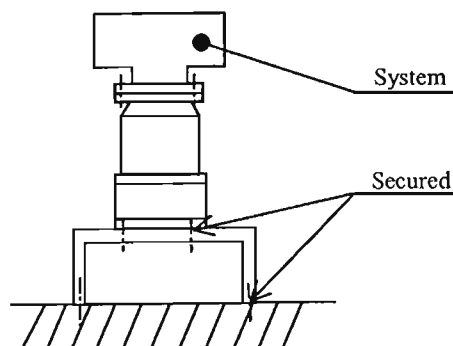
The Combinations between the Pump and the Power Supply are as follow.

Pump Type	Power Supply Type
TG710M/713M/1110M/1113M	-----TD711/1111-C
TG710EM/713EM/1110EM/1113EM	-----TD711/1111-C
TG730M/733M/1130M/1133M	-----TD711/1111-C
TG730EM/733EM/1130EM/1133EM	-----TD711/1111-C
TG2000M/2003M	-----TD2001-C
TG2810EM/2813EM/3210EM/3213EM/3410EM/3413EM	---TD3211-C

3-3. 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.



2) Magnetic fields

DO NOT operate the pump in a strong magnetic fields. During an operation, maximum magnetic fields are $0.003[T](=30[\text{Gauss}])$.

! 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.

3-5. The power supply installation and securing

The power supply can be installed either in a rack. 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 23 kg.
Rack-mount only.

3-6. 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.

4-4. 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 33.8[Pa·L/s](=20[sccm]).

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

(The parts illustrated below are extra options)

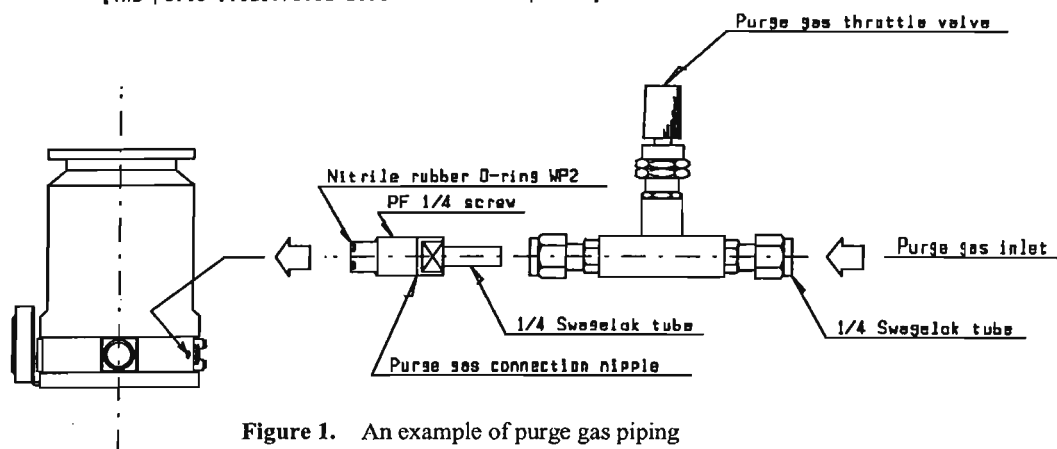


Figure 1. An example of purge gas piping

5. Electrical Connections

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

Example: TG730M&TD711/1111-C

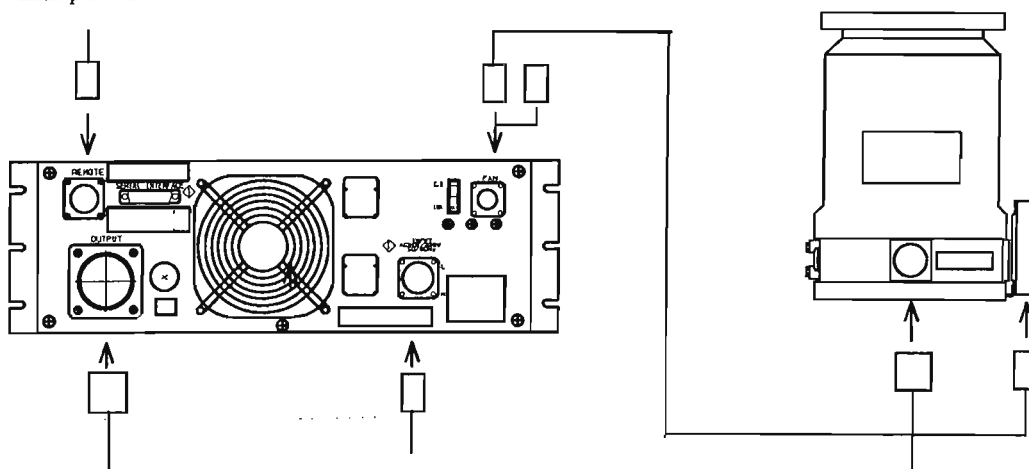


Figure 2. Cable connections between the pump and the power supply

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.

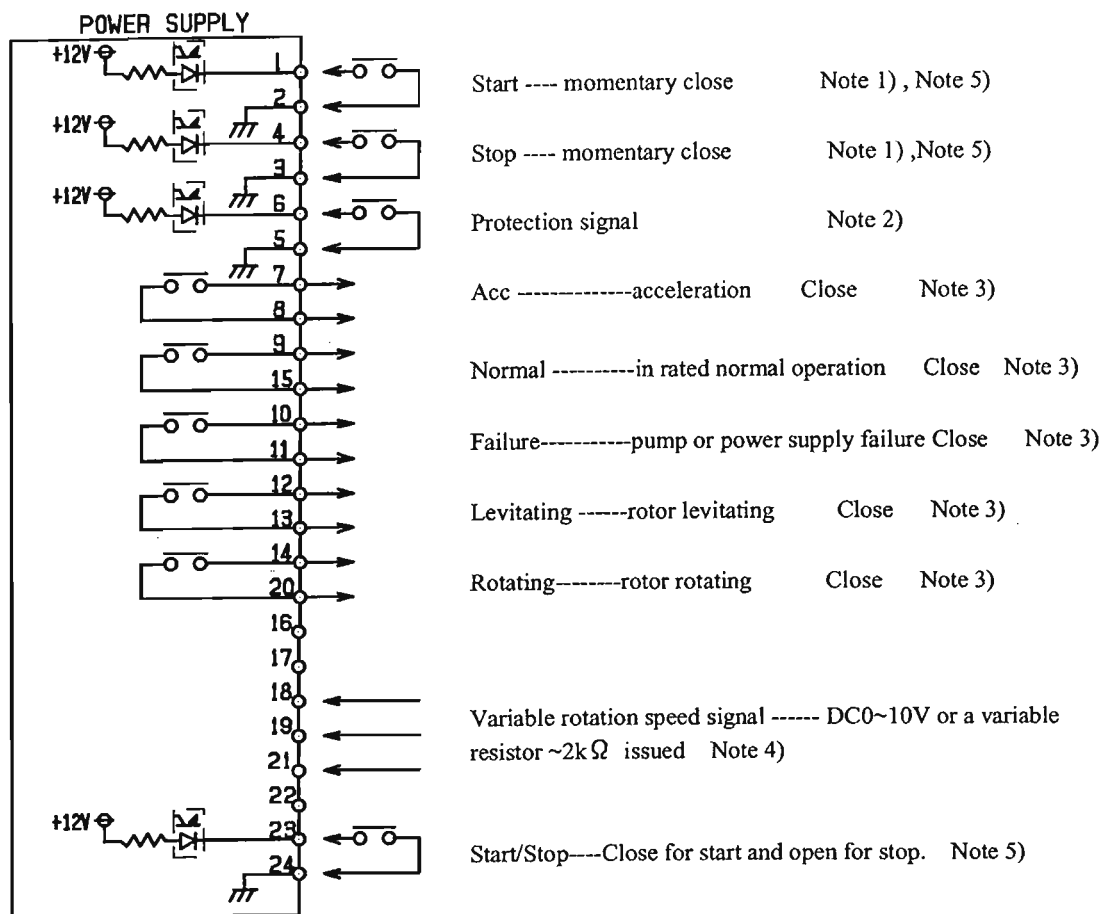


Figure 3. The remote signal communication

- 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.
- Note 4) Refer to section 6-4. on how to use this.
- Note 5) For the remote operation, use either start and stop signals on pins 1-2 and 3-4 or start/stop signals on pins 23-24.
- Note 6) All signal interface connections are low voltage but are not safety isolated from neither the high voltage supply nor motor output connections. (not safety isolation from internal circuit)

5-5. Serial interface

Use a cross-cable for serial interface.

6. Operation

6-1. Operation precautions

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.

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.

1) 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 10 ~ 35 °C.**

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

2) When reactive gases or corrosive gases are pumped, purge the pump with a purge gas. Flow rate of the purge gas is about 33.8[Pa · L/s](=20[sccm]). 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.

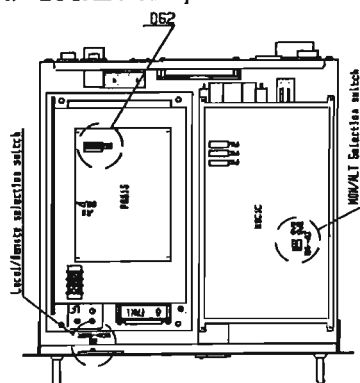
3) Confirm the combination between the molecular pump and the power supply.

4) Make a selection on the Local / Remote switch in the power supply.

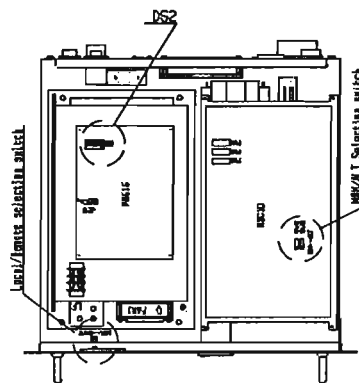
The power supply can be operated via signals from the START and STOP buttons on the front panel or remote controlled via signals from the system.

Prior to operation, set the LOCAL/REMOTE select switch inside of the power supply.

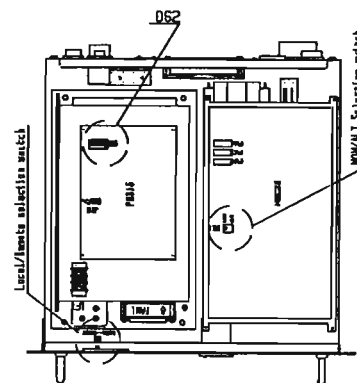
A. LOCAL mode operation



TD711/1111-C



TD2001-C



TD3211-C

A. Input power ON

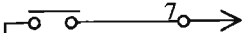
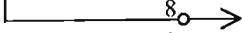
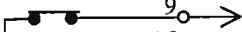
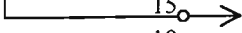
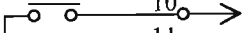


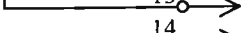
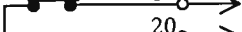

Operation Status	Front Panel Display	Functions
Power ON	<input type="radio"/> POWER <input checked="" type="radio"/> LEVITATING <input checked="" type="radio"/> ROTATING <input checked="" type="radio"/> NORMAL <input checked="" type="radio"/> ACCELERATION <div style="text-align: center;"> 1 2 3 4 5 ● ● ● ● ● 6 7 8 9 10 11 ● ● ● ● ● ● </div>	“Power ” will be lit The fan in the back of power supply will start rotating.

B. START : START button pushed


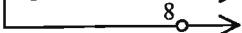


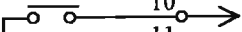
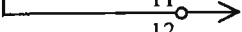


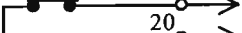
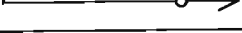
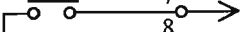
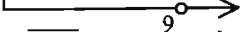

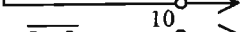




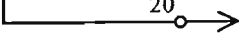

Under Acceleration	<input type="radio"/> POWER <input type="radio"/> LEVITATING <input type="radio"/> ROTATING <input checked="" type="radio"/> NORMAL <input type="radio"/> ACCELERATION <div style="text-align: center;"> 1 2 3 4 5 ● ● ● ● ● 6 7 8 9 10 11 ● ● ● ● ● ● </div>	Rotor will be levitated and start acceleration. “Levitating,” “Rotating” and “Acceleration” will be lit.
Under Normal Operation	<input type="radio"/> POWER <input type="radio"/> LEVITATING <input type="radio"/> ROTATING <input type="radio"/> NORMAL <input checked="" type="radio"/> ACCELERATION <div style="text-align: center;"> 1 2 3 4 5 ● ● ● ● ● 6 7 8 9 10 11 ● ● ● ● ● ● </div>	“Acceleration ” will be turned off and “Normal” will be lit. This shows that the pump is under the rated normal operation

C. STOP : STOP button pushed

Under Deceleration	<input type="radio"/> POWER <input type="radio"/> LEVITATING <input type="radio"/> ROTATING <input checked="" type="radio"/> NORMAL <input checked="" type="radio"/> ACCELERATION <div style="text-align: center;"> 1 2 3 4 5 ● ● ● ● ● 6 7 8 9 10 11 ● ● ● ● ● ● </div>	“Normal” and “Acceleration” will be turned off and the pump will start decelerating by the brake.
Stop	<input type="radio"/> POWER <input checked="" type="radio"/> LEVITATING <input checked="" type="radio"/> ROTATING <input checked="" type="radio"/> NORMAL <input checked="" type="radio"/> ACCELERATION <div style="text-align: center;"> 1 2 3 4 5 ● ● ● ● ● 6 7 8 9 10 11 ● ● ● ● ● ● </div>	When the rotor’s speed is reduced to a few rps, “Levitating” and “Rotating” will be turned off.

Under Normal Operation		7	→	Acc-----Open	“Acceleration” signal will open and “Normal” signal will become close.
		8	→		
		9	→	Normal-----Close	
		15	→		
		10	→	Failure-----Open	
		11	→		
		12	→	Levitating---Close	
		13	→		
		14	→	Rotating----Close	
		20	→		

C. STOP : Stop signal Momentary Close (pins between 3-4) or Start/Stop signal Open (pins Between 23-24)

Under Deceleration		7	→	Acc-----Open	“Normal” and “Acceleration” signals will open and deceleration will start with the brake.
		8	→		
		9	→	Normal-----Open	
		15	→		
		10	→	Failure-----Open	
		11	→		
		12	→	Levitating---Close	
		13	→		
		14	→	Rotating----Close	
		20	→		
Stop		7	→	Acc-----Open	When rotor rotation speed is reduced to a few rps, “Levitating” and “Rotating” signals will open and all signals except “Failure” become open.
		8	→		
		9	→	Normal-----Open	
		15	→		
		10	→	Failure-----Open	
		11	→		
		12	→	Levitating---Open	
		13	→		
		14	→	Rotating----Open	
		20	→		

! CAUTION : When operating in remote operation, use either the Start, Stop signals fed to pins 1-2 and 3-4 of the “Remote” connector, or Start/Stop signals connected to pins 23-24.
Do NOT operate using both.

! CAUTION : Do NOT remove the input power until 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.

For TG2810EM/TG2813EM/TG3210EM/TG3213EM/TG3410EM/TG3413EM

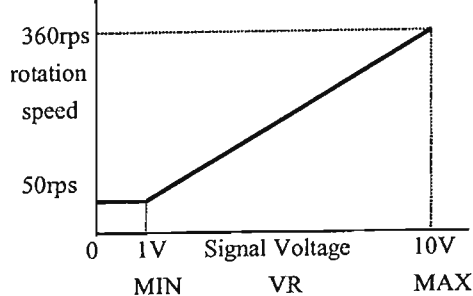


Figure 4. The rotation speed vs. the input signals

! CAUTION : DO NOT repeat altering the rotation speed in a short period of time during the operation. Leave at least 30 minutes between the alterations. Or, the pump may indicate an error and may stop.

6-5. Serial interface

You can perform pump's start and stop operation and confirm the pump's status in detail with serial interface. Set the LOCAL/REMOTE select switch in the power supply to Remote.

Serial interface specifications

CONTENTS			SPECIFICATIONS	
1	System		RS232C *	
2	Format	Command format	(1) Command transfer character with ASCII Code (2) Transfer output with ASCII Code (3) No distinction between capital letter and small letter. (4) Delimiter:CR(0Dh) command [=parameter]CR Output Success: OK Unknown command: UNKNOWN COMMAND XXXXXX Illegal parameter: ILLEGAL PARAMETER XXXXXX	
		Communication format	(1) 8 bit data, Non-parity, 1 stop bit (2) No protocol method (3) No handshake	
3	Switch on the PCB	Transfer rate	1200 / 2400 / 4800 / 9600 (bps)	
		Echo back	Yes / No	
4	Command	Command	Content	Output
		START	Start	
		STOP	Stop	
		RESET	Reset failure	
		ID?	Model	ex. ID=BLD400S
		VERSION?	Version	ex. VER=1.00
		STATUS?	Current condition	STATUS= STANDBY(MS:LEVITATING) STATUS= ACC(MS:VEVITATING)

*RS232C interface but without "safe to touch" status, is not SELV

No.	Setting	FUNCTION																				
		6	DO NOT touch	Always stay OFF																		
		7, 8	Baud rate																			
				<table><tr><td colspan="2">Switch No.</td><td>Bps</td></tr><tr><td>7</td><td>8</td><td></td></tr><tr><td>OFF</td><td>OFF</td><td>1200</td></tr><tr><td>ON</td><td>OFF</td><td>2400</td></tr><tr><td>OFF</td><td>ON</td><td>4800</td></tr><tr><td>ON</td><td>ON</td><td>9600</td></tr></table>	Switch No.		Bps	7	8		OFF	OFF	1200	ON	OFF	2400	OFF	ON	4800	ON	ON	9600
Switch No.		Bps																				
7	8																					
OFF	OFF	1200																				
ON	OFF	2400																				
OFF	ON	4800																				
ON	ON	9600																				

* The switches are set to off before shipping at factory.

The location of DS2 is shown at 6-4 (p20).

This interface doesn't have handshake at all and also doesn't output signal of handshake.

Please short pin 4 - pin 5 and pin 6 - pin 8 - pin 20 if your system has handshake.

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 5. Keep the baking temperature below 120°C.

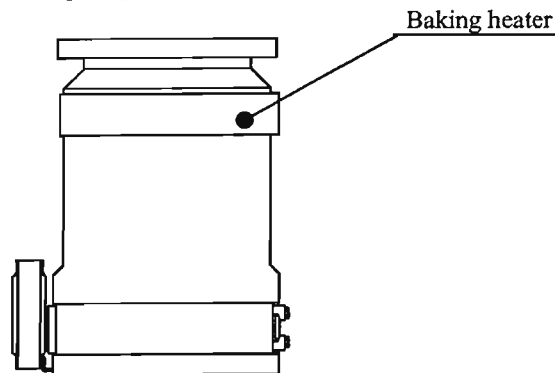


Figure 5. Mounting position of the baking heater.

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

8. Protection Feature

8-1. Power failure

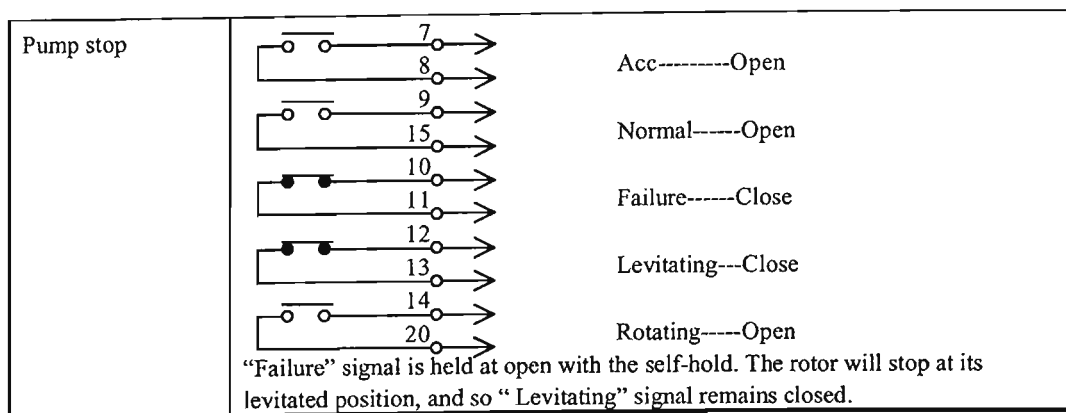
If a power failure occurs during operation of the MS type CMP, the speed of the pump will be reduced with the rotor still levitating. When the rotation speed is reduced to ~30% of its normal rated speed, the rotor will touchdown to the protection bearings. If the power is recovered on the way, the rotor will still continue reducing its speed.

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

The error indications (LED1~11) on the front panel and the output signals from the "REMOTE" connector at the rear panel are shown below.

Front Panel Display	Error	Description
1 2 3 4 5 ○ ● ● ● ● 6 7 8 9 10 11 ● ● ● ● ● ●	Magnetic suspension failure	Lit when an error occurs on the magnetic suspension. Rotor will touchdown to the protection bearings.
1 2 3 4 5 ● ○ ● ● ● ● 6 7 8 9 10 11 ● ● ● ● ● ●	Heat sink over heat	Lit when the heat sink in the power supply is over heated and the thermal protector is triggered.
1 2 3 4 5 ● ● ○ ● ● ● 6 7 8 9 10 11 ● ● ● ● ● ●	Hall sensor failure	Lit when the rotation sensor in the pump is in error.
1 2 3 4 5 ● ● ● ● ○ ● 6 7 8 9 10 11 ● ● ● ● ● ●	Over current	Lit when an excessive current flows in the power supply.
1 2 3 4 5 ● ● ● ● ● ● 6 7 8 9 10 11 ○ ● ● ● ● ●	C.S.B.	Lit when the pump has 5 times of touchdown. The protection bearings need to be replaced.
1 2 3 4 5 ● ● ● ● ● ● 6 7 8 9 10 11 ● ○ ● ● ● ●	Protection signal open	Lit when the signal connected to the pins between 5-6 of the "REMOTE" connector opens.
1 2 3 4 5 ● ● ● ● ● ● 6 7 8 9 10 11 ● ● ○ ● ● ●	Motor over heat	Lit when the motor in the pump is over heated and the thermal protector is triggered.
1 2 3 4 5 ● ● ● ● ● ● 6 7 8 9 10 11 ● ● ● ○ ● ●	Acceleration time over	Lit when "Normal" does not come ON after a set time at the time of startup, or when once "Normal" was ON but the pump went back to "Acceleration" and could not return to "Normal" again after a set time.
1 2 3 4 5 ● ● ● ● ● ● 6 7 8 9 10 11 ● ● ● ● ○ ●	Insufficient input voltage	Lit when the input voltage to the power supply is dropped to a value below the specified voltage. (about 175 V)
1 2 3 4 5 ● ● ● ● ● ● 6 7 8 9 10 11 ● ● ● ● ● ○	Over speed	Lit when the rotor speed exceeds 105% of its rated normal speed.

Of the above specified errors, for the hall sensor failure, the heat sink over heat, the motor over heat and the over current, the speed reduction takes place without the brake function. The error display has a self-hold feature.



8-3. Resetting the error display

For the local operation, reset is performed by pressing the STOP button on the front panel of the power supply. For the remote operation, reset is performed by momentarily closing the Stop signal between pins 3-4 of the "REMOTE" connector at the rear of the power supply, or by opening the Start/Stop signal connected to the pins 23-24 of the "REMOTE" connector.

If the error still cannot be reset after these operations, it indicates that the error condition still remains.

9. Troubleshooting

If the pump stops due to an error, follow the procedures below.

! WARNING : When performing a power supply check, wait at least 5 minutes after removing the input power before the work.

Error LED	Error description	Possible cause	Action
LED1	Magnetic suspension failure	- Magnetic suspension circuit error - Position sensor error	- Contact OSAKA VACUUM, LTD.
LED2	Heat sink over heat	- Repeated pump start/stop - Surrounding temperature of the power supply is high. - The fan at the rear of the power supply is in failure.	- Leave a longer interval - Cool off the surrounding temperature to below 40° C. - Replace the fan.
LED3	Hall sensor failure	- Rotation sensor failure	- Contact OSAKA VACUUM, LTD.
LED4	Not used		
LED5	Over current	- Motor driving circuit failure	- Contact OSAKA VACUUM, LTD.
LED6	C.S.B.	- Pump has 5 times of touchdown.	- Protection bearings need to be replaced. Contact OSAKA VACUUM, LTD.

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

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. 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 a strong electric field or magnetic fields
- A radio active place
- A place with vibrations

STANDARD WARRANTY CONDITIONS

OSAKA VACUUM, LTD.

Article 1 Warranty

In delivery of the product indicated in the Delivery Specifications ("Product"), we warrant that the Product is designed and manufactured in accordance with our regulation, standard or rule etc. with respect to design, purchase, manufacture and quality control under ISO9001 Standard or ISO9002 Standard as well as the specifications in the sales contract, and that there is no defect in design, materials or manufacture of the Product.

Article 2 Indemnification

In relation to the Product, in case any defect in design, materials or manufacture obviously attributable to us is found within the warranty period, one year from the delivery date of the Product (unless otherwise stipulated in written documents), and a notice of such defect is immediately given to us, we will, at our election, correct, repair or replace such defective part, or replace the whole Product without charge. The replacement is available only for standard Products, and no replacement may be allowed for any Custom-made Product.

Article 3 Exception

The warranty and relevant indemnification shall be applied 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 Specifications and the Instruction Manual of the Product and other handling instructions of ours. Unless otherwise stipulated in other written document, the warranty and relevant indemnification shall not be applied to the cases described below;

- (1) Any failure due to any usage of the Product not described in the Delivery Specification and the Instruction Manual of the Product, or any other irregular usage of the Product;
- (2) Deterioration of the Product due to corrosive gases, organic solvent, radioactive rays, electromagnetic field etc.;
- (3) Expendable parts and wearable parts such as lubricant etc.;
- (4) Any failure due to repair or reconstruction by any party other than us;
- (5) Repaired Products (the Standard Warranty Conditions for Repaired Products will apply to the repaired Products);
- (6) An insignificant deviation from the specifications in the sales contract which has no effect on performance or function of the Product;
- (7) Any failure due to fire, flood, earthquake, lightning strike or any other event caused by force majeure.

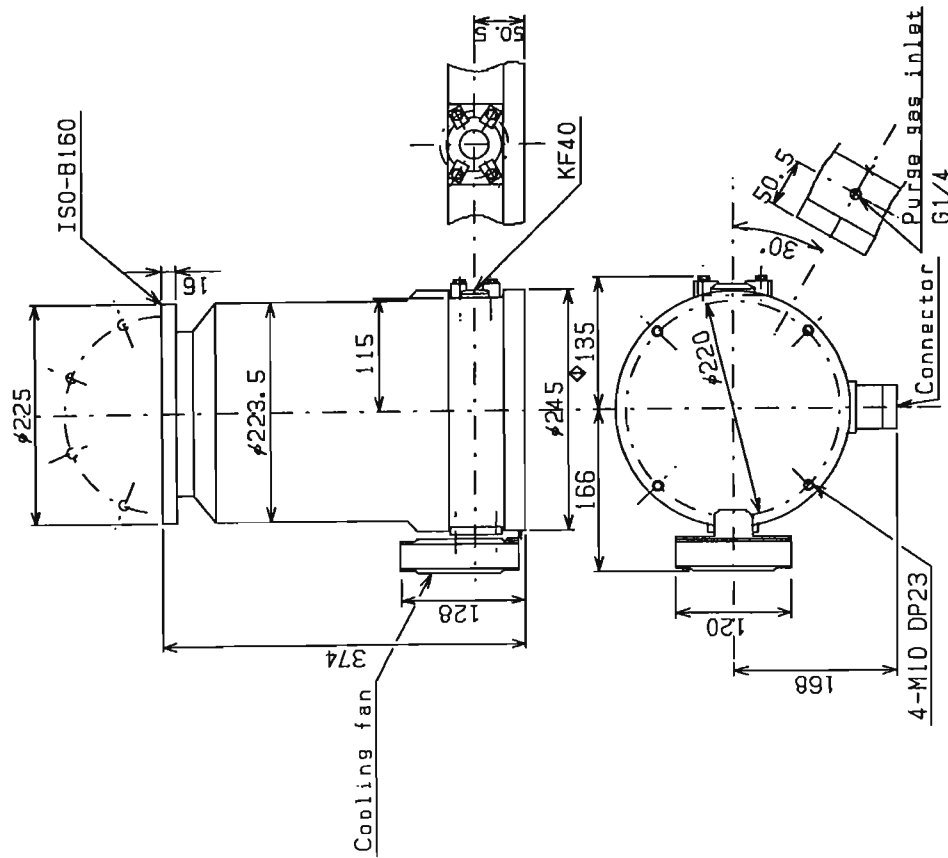
Article 4 Scope of Indemnification

The scope of our indemnification shall be limited to the correction, repair or exchange of defective parts of the Product delivered, or replacement of the whole Product (in case of the standard Product only), and shall not include any compensation for the consequential damage and business losses including the following;

- (1) Cost and expenses accrued in connection with the removal of the failed Product from the equipment in which the Product has been installed; or
- (2) Cost and expenses accrued in connection with installment of the repaired Product or replacement to the equipment.

In addition, the total amount of the indemnification shall be limited to the contract price of the Product. As for "Usage of the Product not described in the Delivery Specification and the Instruction Manual of the Product" stipulated in Article 3 of this Standard Warranty Conditions, such usage shall be included in the scope of indemnification under this Standard Warranty Conditions only when we agree in writing prior to the use of the Product.

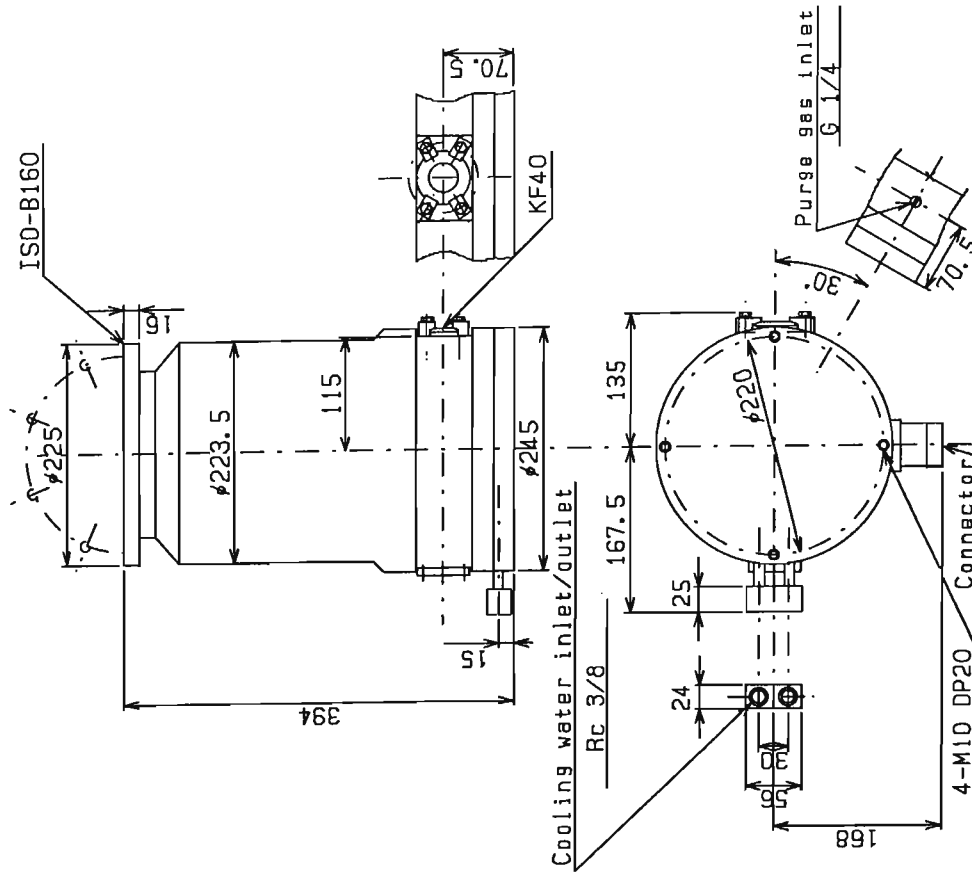
ISO flange, Air-cooling type



Applicable pump

TG710MBA	TG710EMBA	TG730MBA	TG730EMBA
TG713MBA	TG713EMBA	TG733MBA	TG733EMBA

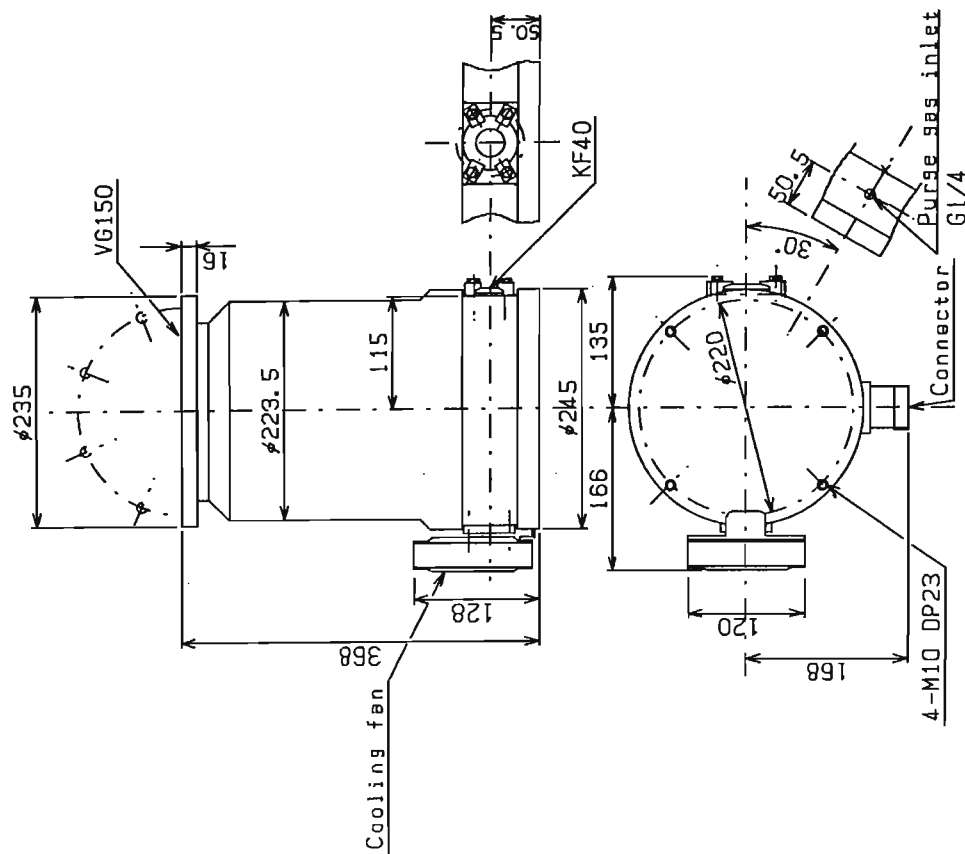
ISO flange, Water-cooling type



Applicable pump

TG710MBW	TG710EMBW	TG730MBW	TG730EMBW
TG713MBW	TG713EMBW	TG733MBW	TG733EMBW

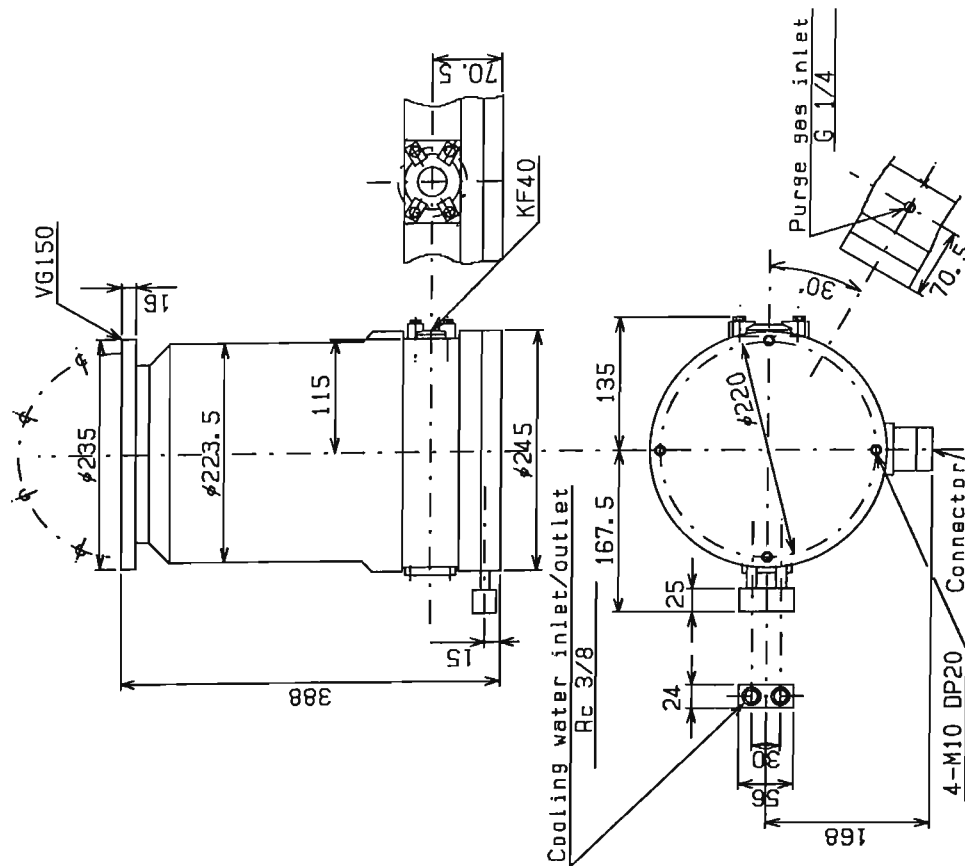
VG flange, Air-cooling type



Applicable pump

TG710MVA	TG710EMVA	TG730MVA	TG730EMVA
TG713MVA	TG713EMVA	TG733MVA	TG733EMVA

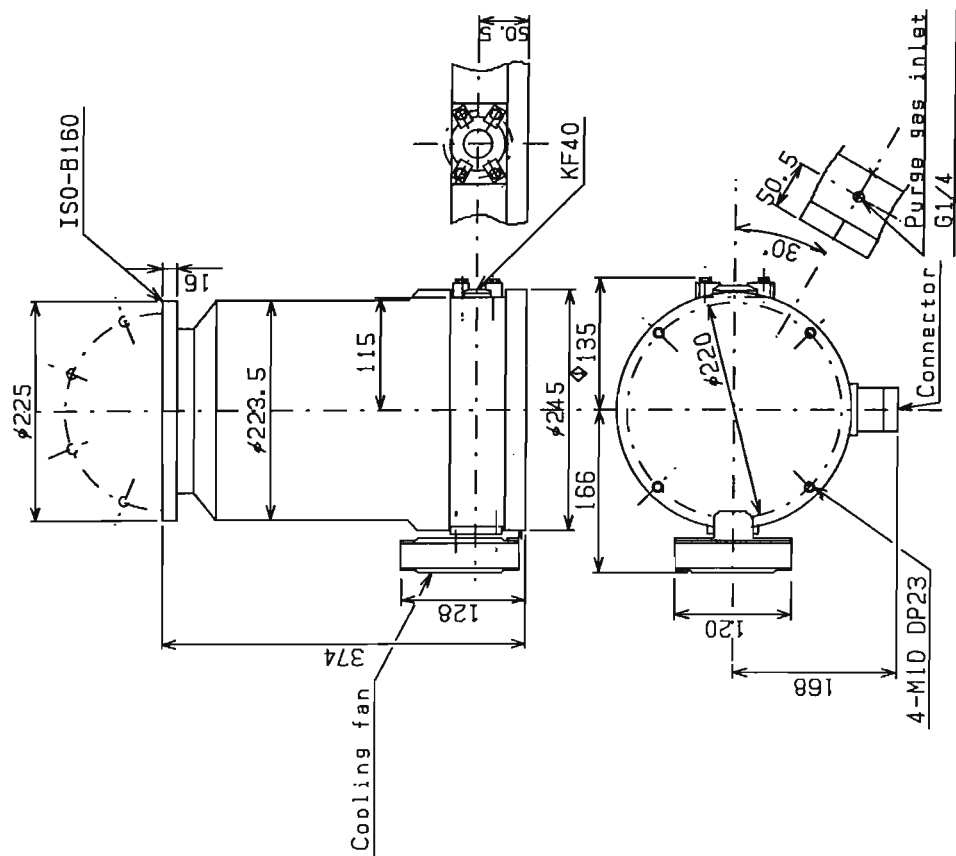
VG flange, Water-cooling type



Applicable pump

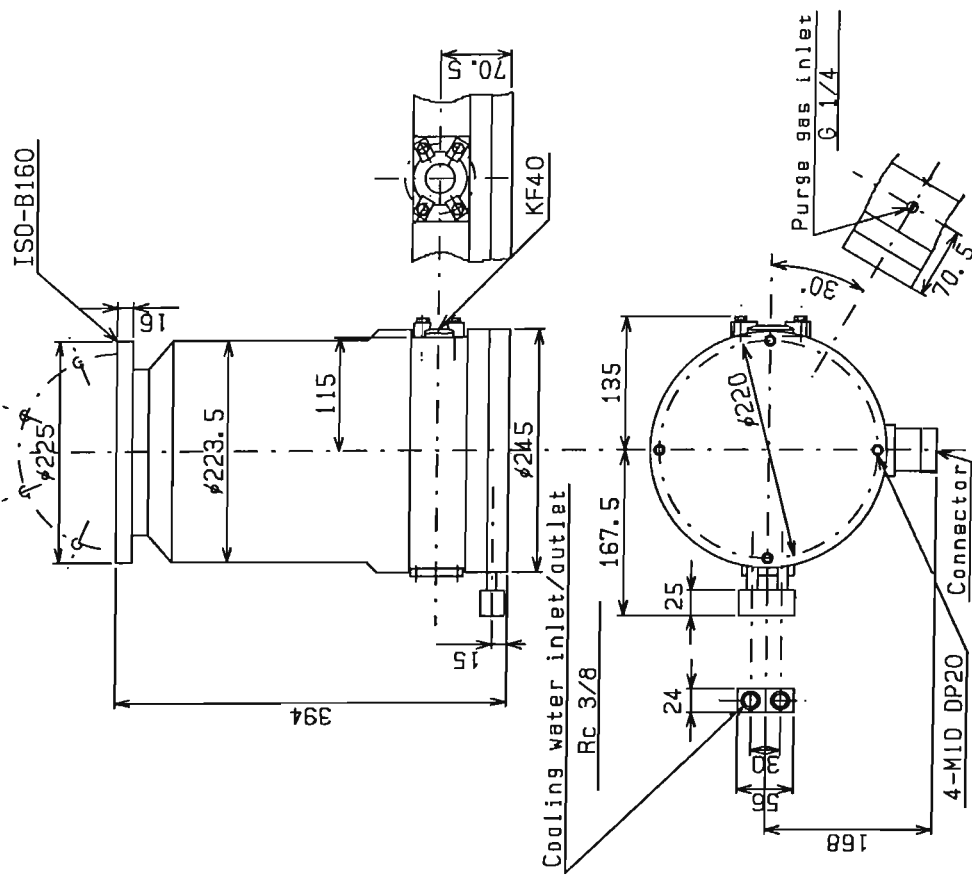
TG710MVW	TG710EMVW	TG730MVW	TG730EMVW
TG713MVW	TG713EMVW	TG733MVW	TG733EMVW

Conflat flange, Water-cooling type



Applicable pump

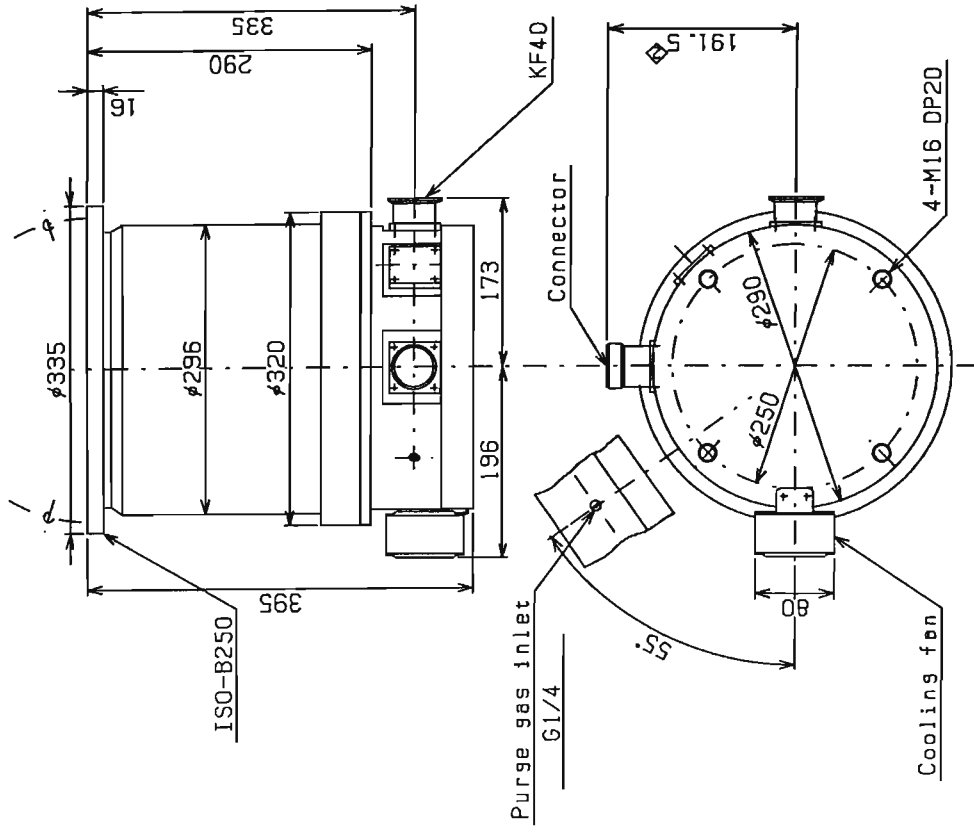
TG1110MCA	TG1110EMCA	TG1130MCA	TG1130EMCA
TG1113MCA	TG1113EMCA	TG1133MCA	TG1133EMCA



Applicable pump

TG1110MCW	TG1110EMCW	TG1130MCW	TG1130EMCW
TG1113MCW	TG1113EMCW	TG1133MCW	TG1133EMCW

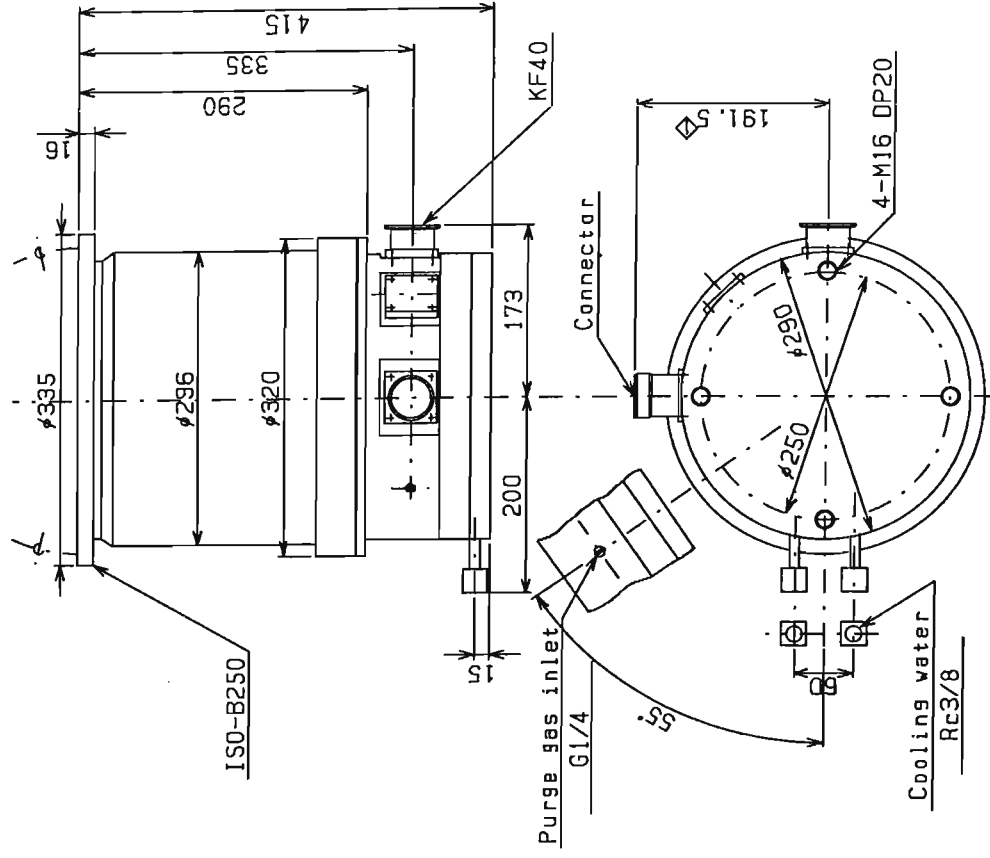
ISO flange, Air-cooling type



Applicable pump

TG2000MBA		
TG2003MBA		

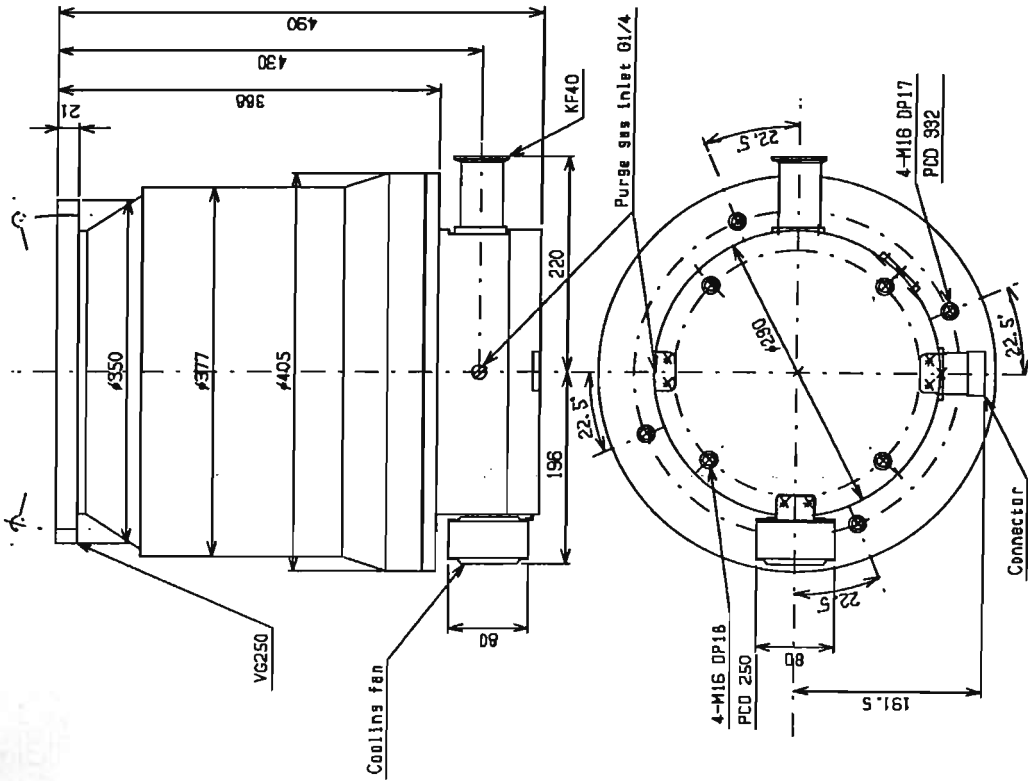
ISO flange, Water-cooling type



Applicable pump

TG2000MBW		
TG2003MBW		

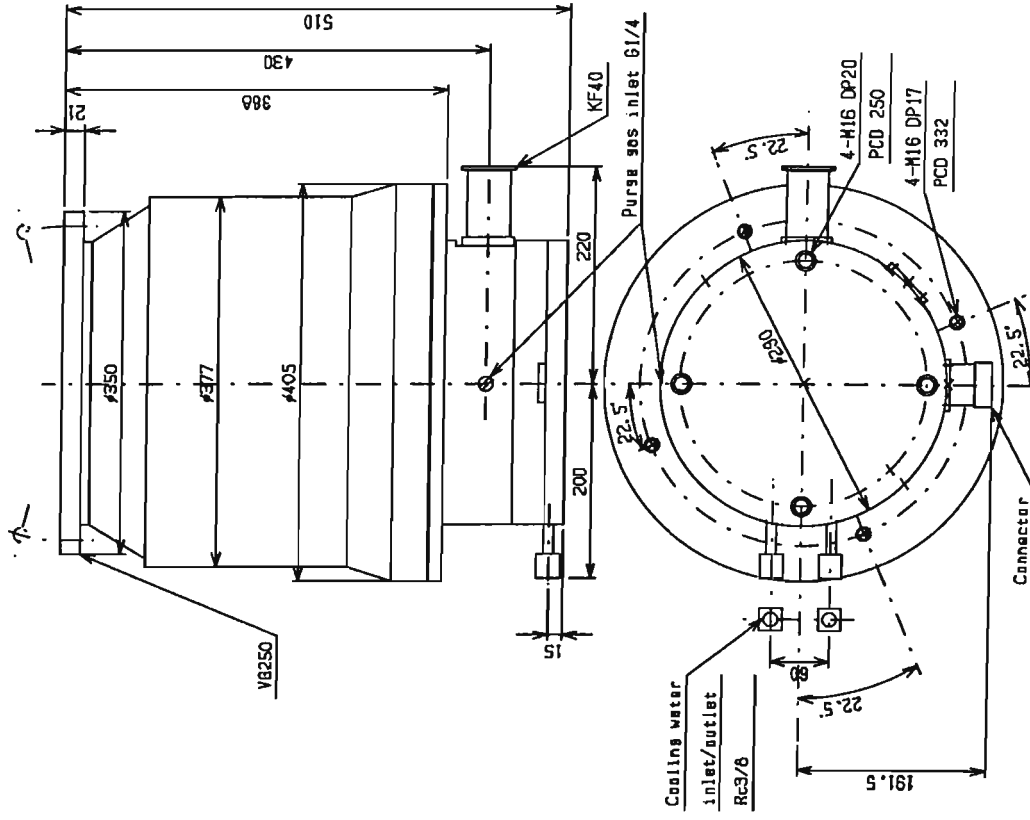
ISO flange, Air-cooling type



Applicable pump

TG2810EMBA		
TG2813EMBA		

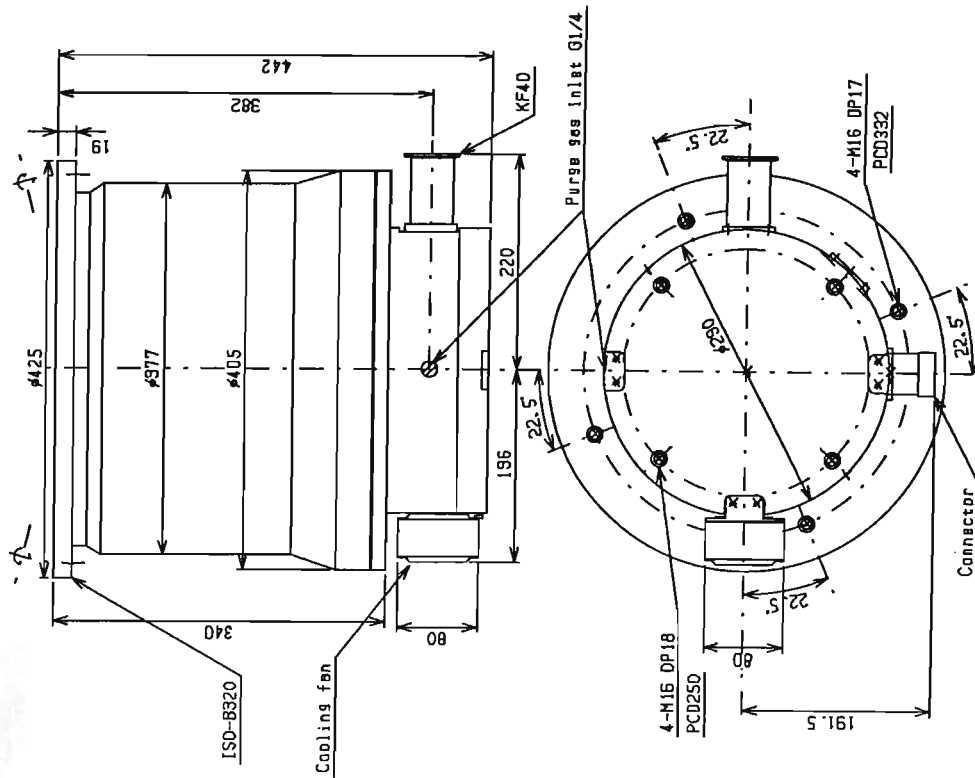
ISO flange, Water-cooling type



Applicable pump

TG2810EMBW		
TG2813EMBW		

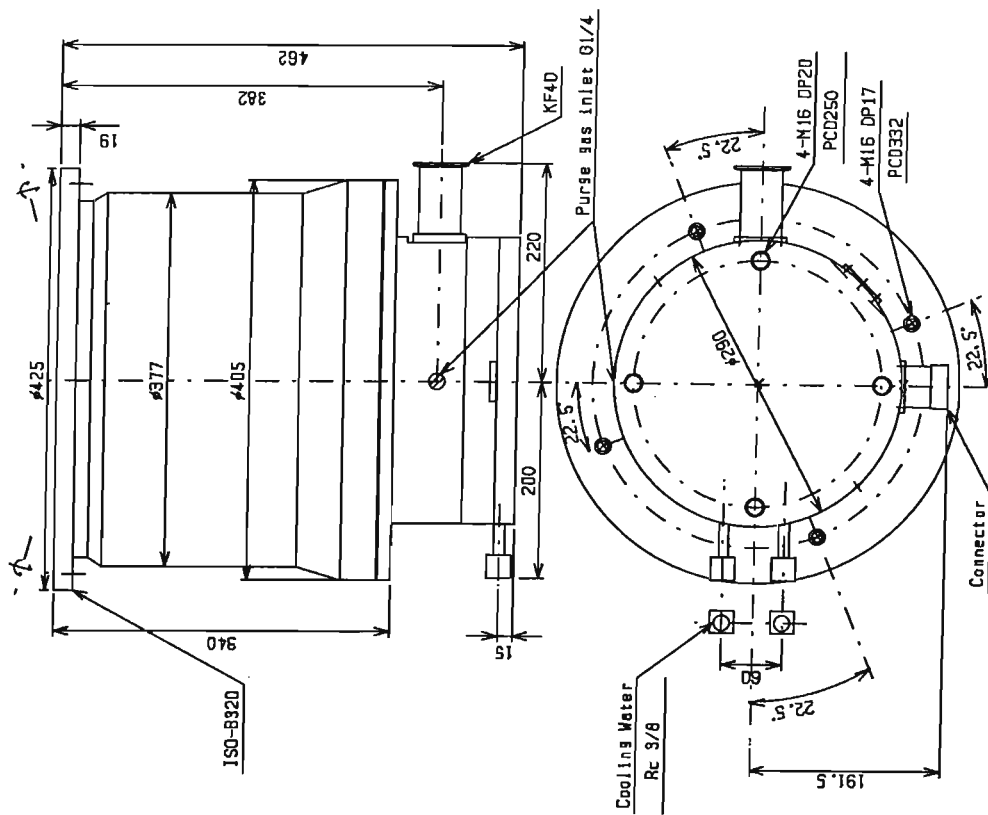
ISO flange, Air-cooling type



Applicable pump

TG3210EMBA		
TG3213EMBA		

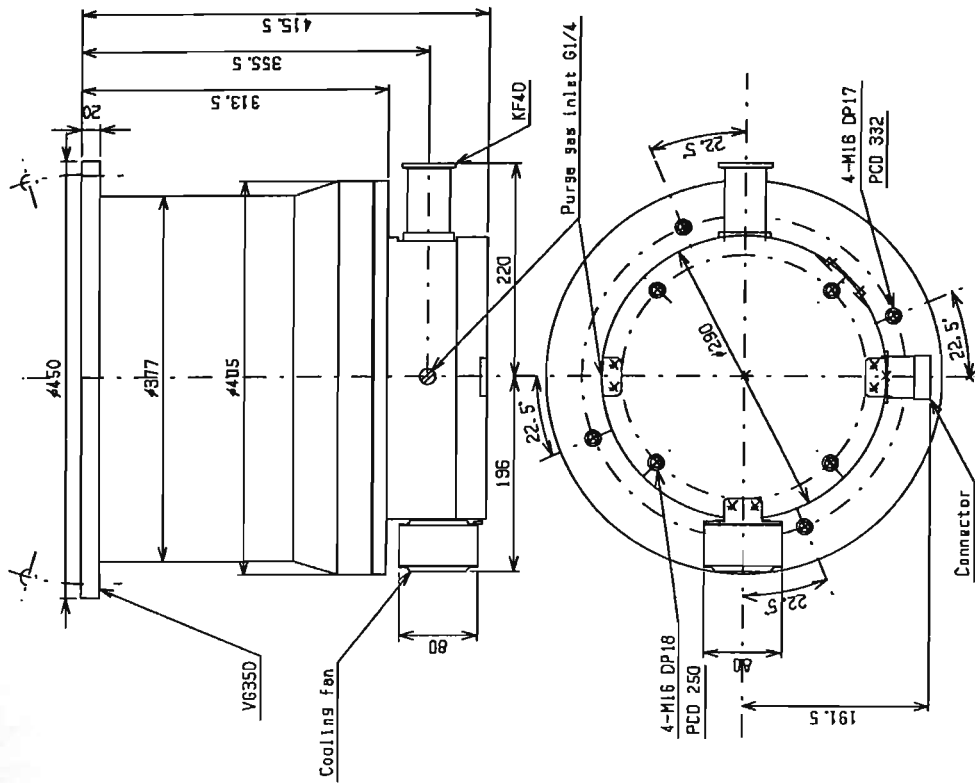
ISO flange, Water-cooling type



Applicable pump

TG3210EMBW		
TG3213EMBW		

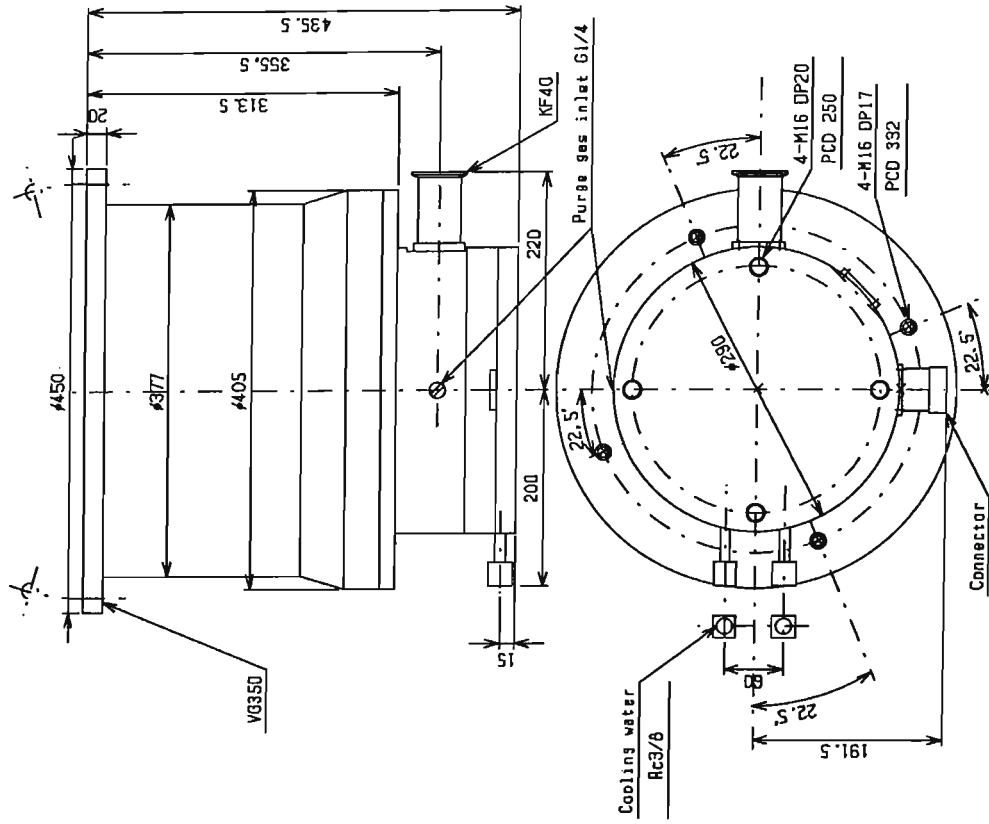
VG flange, Air-cooling type



Applicable pump

TG3410EMVA			
TG3413EMVA			

VG flange, Water-cooling type



Applicable pump

TG3410EMVW			
TG3413EMVW			

