Instruction Manual

STP Series Turbomolecular Pumps
STP-iX455/iXL455 Series
(Second Edition - e)

Read through the Safety Precautions and each section of this Manual carefully before using the STP pump.

Keep this Manual in a place where you can quickly access it at any time.

Jan. 2008

SAFETY PRECAUTIONS

The Safety Precautions in this Manual constitute guidelines to protect operators, the STP pump and its peripheral equipment.
To avoid personal injury and prevent product and/or peripheral equipment damage, observe the Safety Precautions as well as the general safety rules (your country's laws, regulations, safety standards and so on).
If the equipment is used in a manner not specified by Edwards, the protection provided by the equipment may be impaired.

SYMBOLS

The following symbols are used in this manual:

Death or Serious Personal Injury

Failure to follow the guidelines marked with this symbol may result in death or serious personal injury.

Minor Personal Injury, Product and/or Peripheral equipment Damage

Failure to follow the guidelines marked with this symbol may result in minor personal injury, product and/or peripheral equipment damage.

Items you must follow during operation and maintenance.

◇ Symbols as Marked on the Equipment

ATTENTION : refer to this manual.

Edwards Japan Limited (abbreviated to Edwards throughout this manual) cannot perfectly anticipate circumstances of all of hazards or problems.
The scope of anticipation is limited to the precautions included in the 

and 

specified in this manual.

WARNING

◇ The STP pump is provided with a high-speed rotor. Secure the STP pump according to the specified method. Failure to do so may lead to serious personal injury, product and/or peripheral equipment damage if any abnormality/error occurs in the rotor.

◇ The STP pump operates at high temperatures while the baking heater is in operation. NEVER touch the STP pump and its peripheral equipment while the baking heater is in operation.
Operators can burn hands.

◇ Execute the following to prevent an accident caused by the gas.

- Check the properties of the gas to be used, referring to the Material Safety Data Sheet (MSDS) you obtain from the gas supplier. (explosive・combustible・toxic・corrosive, etc) And, keep MSDS and a safety advice of gas supplier.
- Warn of the danger of the gas with the warning label when the use gas is hazardous chemical material.
- Always execute gas purge in the pump with the inert gas, and then exhaust residual gases thoroughly from the STP pump when removing the STP pump from the vacuum equipment.
- Secure safety by wearing personal protective equipment when using the gas which might influence damage health. In addition, take appropriate measure for depending upon the properties of the gas to be used

◇ Exhaust residual gas thoroughly when disposing of the STP pump. If the STP pump is used for any toxic or reactive gas, always clean the STP pump and dispose of it as industrial waste in accordance with guidelines given by the national and/or local government. Residual gas in the STP pump may cause an accident, for certain gases, which may involve serious injury or death.

⚠CAUTION

◇ NEVER use any gas that is not specified as usable in this Manual. The use of such gas may corrode the STP pump and damage it.

◇ Always check the STP pump has stopped, then turn OFF the primary power supply and isolate the electrical energy source (Lockout/Tagout) on the vacuum equipment before proceeding to any of the following operations. Failure to do so may cause the STP pump to rotate accidentally, which may injure operators seriously or result in electric shock.
- Connect or disconnect cables;
- Perform inspections such as deposit and/or the air cooling fan; or
- Perform investigations into probable causes and action/measures taken in the event of occurrence of a problem.

◇ When removing or installing the pump or at maintenance and inspection, follow the precautions below. Failure to do so might hurt your back or cause injuries due to occurrence of an accident such as fall.
- Use a crane or the like when lifting the heavy product of 18 kg or more.
- When lifting by hands for unavoidable reason, two or more people must always conduct it.

◇ When "emergency off" (EMO) circuit is installed in the vacuum equipment, consider the following to stop the STP pump safely when the EMO circuit operates.
- When the EMO circuit operates, atmosphere might be introduced in the STP pump depending upon the backing-pump. Unite the exhaust gas system to prevent atmosphere from being introduced into the STP pump when the EMO circuit operates. (example: shut the valve) When atmosphere is introduced into the STP pump, the touch down bearing may not operate normally.

◇ Connect the cables securely. NEVER bend nor place heavy objects on the cable. Doing so may result in electric shock or product damage.

◇ NEVER remove the splinter shield from the STP pump. Doing so may result in product damage.

◇ DO NOT put foreign objects into the STP pump. Doing so may result in product damage.

◇ Always use the power voltage specified on the nameplates of the STP pump and the external power supply unit. Wire the power cable securely. Incorrect wiring may result in electric shock or product damage.

◇ The wipes used for clean the flange of the pump might become hazardous waste depending upon the solvent (alcohol). Dispose of the contaminated wipes appropriately according to the regulations of each national and/or local government.

◇ NEVER turn OFF the external power supply while the STP pump is rotating. Doing so may result in product damage.

◇ Perform investigations into probable causes and remove them before restarting the STP pump in the event of the occurrence of a problem. The use of the abnormal STP pump may result in product damage.

◇ DO NOT move the STP pump while the STP pump is in operation. Doing so may result in product damage.

INTRODUCTION

Thank you very much for purchasing Edwards' turbomolecular pump.
The turbomolecular pump is designed to be installed in the vacuum equipment to exhaust gases from it.
This manual covers all items necessary to ensure safe installation, operation and maintenance of the following series of the STP-iX455/iXL455 turbomolecular pump:

Model Name	Specification
• STP- iX455	Compact type, Integrated control unit, High-vacuum type
• STP- iX455C	Compact type, Integrated control unit, Corrosion resistant type*1
• STP- iXL455	Compact type, Integrated control unit, Low-vibration type, High-vacuum type
• STP- iXL455C	Compact type, Integrated control unit, Low-vibration type, High-vacuum type, Corrosion resistant type*1

In this manual, the above STP-iX455/iXL455 pump series is collectively referred to as the "STP pump".

APPLIED STANDARDS

The STP pump conforms to the following directives and standards:

◇ Applied Directives
- EC Machinery directive
- EC Low voltage directive
- EC Electromagnetic compatibility directive

◇ Applied Standards
- EN1012-2
- EN61010-1
- EN61326 (class A)
- UL61010-1 (Electrical Equipment for Measurement, Control, and Laboratory Use)

*1 : Corrosion resistant type: STP pump with anti-corrosive treatment (responding to chlorine, fluorine or other system gases)

PRECAUTIONS

1) No part of this manual may be reproduced in any form by any means without prior written permission from Edwards.
2) Edwards pursues a policy of continuing improvement in design and performance of this product. The right is, therefore, reserved to vary specifications and design without notice. Understand that the product you purchased and its contents including specifications described in this manual may differ.

REQUEST

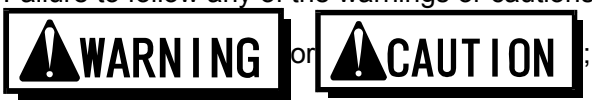
If you find inaccuracies or errors in this manual, advise distributor or the nearest Service office.

LIMITED WARRANTY

This WARRANTY applies to the customer to whom Edwards has delivered this product.

1. WARRANTY PERIOD:
   Edwards warrants this product against defects for a period of two (2) years from the date of delivery or during the period specified in the agreement made by and between the customer and Edwards.

2. ITEM WARRANTED:
   1) This warranty applies only to the product delivered from Edwards to the customer.
   2) If any defect is found during this period, Edwards will, at its option, repair or recondition the product free of charge. The costs for repair or replacement of the product after the warranty period has passed will be at your own charge.

3. DISCLAIMER:
   Edwards makes no warranty with respect to any damage occurred due to any of the following during the warranty period:
   1) Handling, operation or maintenance other than that specified herein;
   2) Failure to follow any of the warnings or cautions enumerated under 

;
   3) Installation, operation or maintenance using parts which are not specified by Edwards;
   4) Maintenance personnel other than those authorized by Edwards or Service office have disassembled, reconditioned, or tampered the product;
   5) Defect resulting from the not-specified use of the product.
   6) When the product is used under special conditions without obtaining the written consent of Edwards (Particular gases, strong magnetic field and the radiation are added to the product.);
   7) Defect resulting from deposit;
   8) Water cooling system defect resulting from water quality used;
   9) Defect resulting from the installation of the product (Exclude the installation by authorized personnel.)
   10) Deterioration in the external because of use (Discoloration, scratches and so forth)
   11) Product damage occurred during transport or other factors not attributable to Edwards;
   12) Product breakage or damage due to natural disasters, fire or other external factors;
   13) Deterioration in the basic performance due to the use of the product beyond limits of the use;
   14) Any direct, incidental or consequential damage resulting from the use of the product;
   15) When continuously operated without overhaul after the WARNING indication from the STP pump;
   16) Overhaul and replacement of maintenance parts;

4. SPARE PARTS:
   - Touch down bearing
     (When exchanging the touch down bearing, contact Service office)
   - Air-cooling unit (optional accessory)

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TABLES

FIGURES

1 Precautions for Safe Operation of the STP Pump

1.1 Usable Gases

Chlorine or fluorine system gases can be used in the only corrosion resistant pumps (type C or other models). When you use gases including alkaline metals, but excluding Li, gases including Ga, Hg, In, or Sn, or HBr, contact Edwards.

WARNING

◇ To prevent an accident, confirm the characteristics of gases to be used, referring to the Material Safety Data Sheet (MSDS) you obtain from the gas supplier. And, keep MSDS and a safety advice of gas supplier.

CAUTION

◇ NEVER use corrosive gases (chlorine, fluorine, or other system gases) in the STP pump without anti-corrosion treatment.
◇ Introduce a dry N_2 gas (purge gas) to protect the inside of the STP pump when using reactive or corrosive gas. The use of reactive or corrosive gas may result in product damage.
◇ DO NOT use any pyrophoric gas.
◇ Cool the STP pump to prevent the STP pump from overheating when pumping gases.

1.2 Maintenance and Inspection Precautions

Perform any maintenance or inspection of the STP pump, following Section 13, "Troubleshooting, Maintenance, and Inspection".

CAUTION

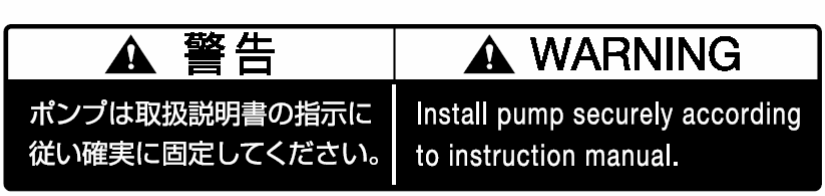
◇ Always turn OFF the primary power, then turn OFF the primary power supply and isolate the electrical energy source (Lockout/Tagout) on the vacuum equipment before performing any maintenance or inspection.
◇ NEVER touch any portions other than those designated when performing maintenance.
Careless touch may cause electric shock and/or a short-circuiting of the internal circuit, resulting in product damage or a problem.

1.3 Labels

The following labels are affixed to the STP pump.
Read the contents of the labels before operation.
For the positions of the labels, see Figure 15.3, "Label Affixing Position for the STP Pump".

1) STP Pump Installation Warning Label

This label describes installation of the STP pump.
Install the STP pump according to the precautions of Section 4, "Installation of the STP Pump".



2) Rotational Direction Instruction Label

This label describes the rotational direction of the STP pump.
The STP pump rotates in this direction.

3) Hot Surface Warning Label

This label instructs operators so as not to touch the hot surface of the STP pump.
The control unit will become high temperature while the STP pump is in operation.
The use of the baking heater (optional accessory) may lead to a considerable rise in temperatures outside the STP pump. This label warns operators so as not to burn hands.

2 Operation Principle of the STP Pump

The STP-iX455/iXL455 series pump is a series of a magnetically-levitated turbomolecular pumps, featuring the following:

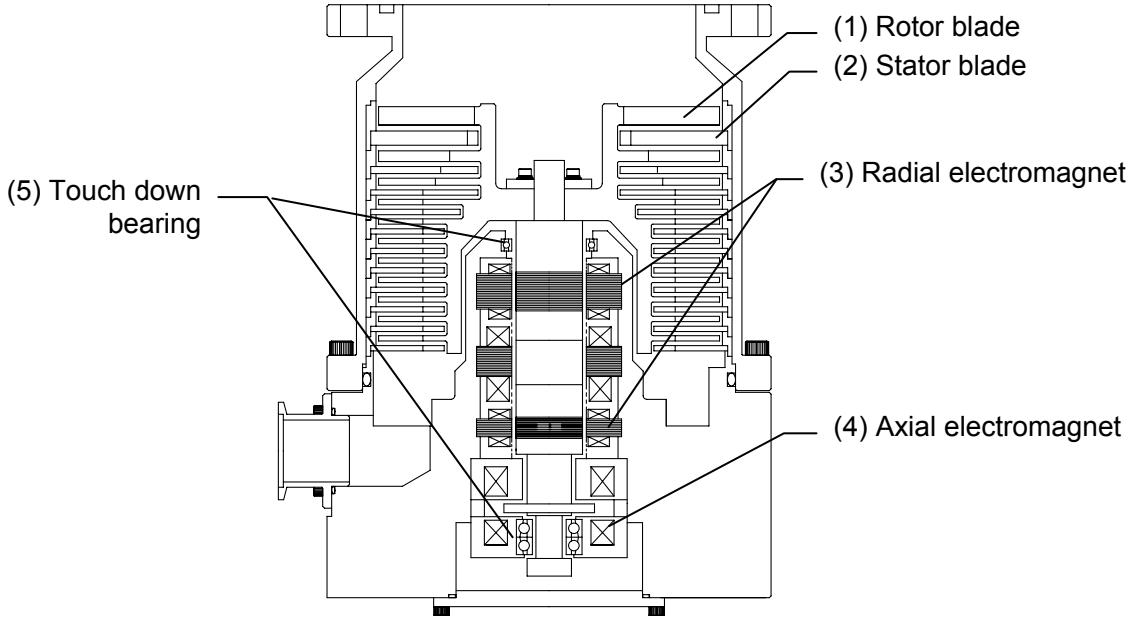
- Oil free
- Compact size (Integrated control unit)
- Low vibration
- High reliability

Figure 2.1 shows the cross sectional view of the STP pump. The STP pump is configured so that rotor blade (1) and stator blade (2) are aligned alternately in the axial direction. The rotor blade (1) is supported by the magnetic bearing without mechanical contact. Therefore, the STP pump requires no lubrication oil, unlike conventional turbomolecular pumps using ball bearings.

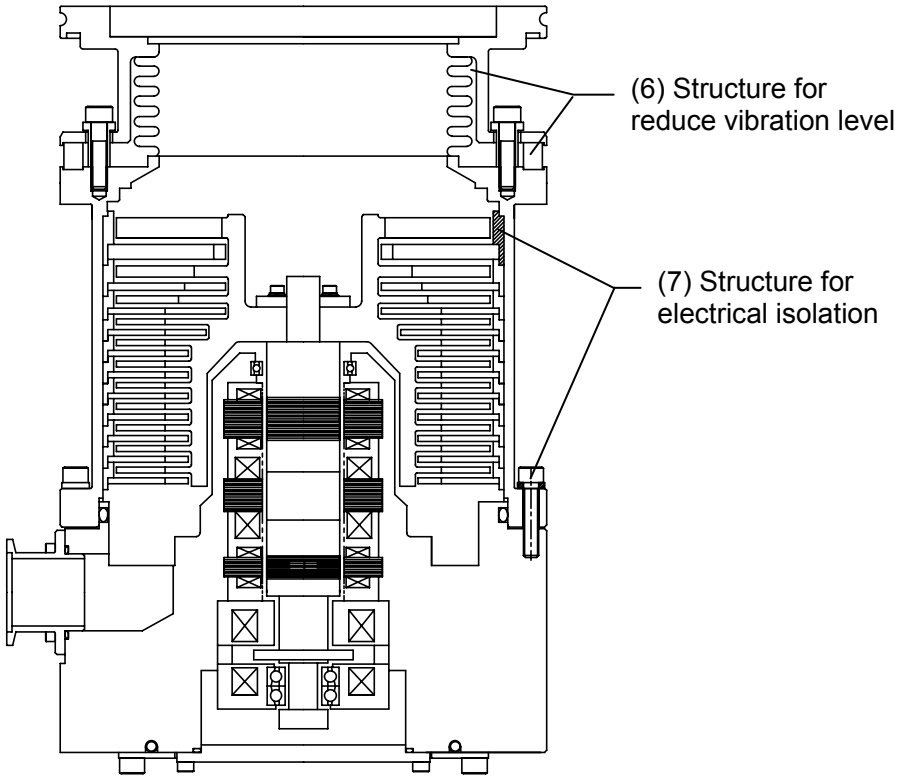
The magnetic bearing consists of 5 pairs of active magnetic bearings. The rotor is supported in the radial direction by 4 pairs of active magnetic bearings that consist of radial electromagnet (3). A pair of axial electromagnets (4) supports the rotor in the axial direction.

Because the rotor is entirely magnetically supported, it rotates with low vibration. Moreover, STP-iXL455 series, with which the structure of low vibration and low noise (6) and (7) are equipped, suppresses vibration and noise more than STP-iX455 series. There is less heat generated from magnetic bearings because there is no friction. Therefore the STP pump requires no cooling. However, the STP pump does require water-cooling or air-cooling during baking and gas pumping.

Taking into consideration an unexpected failure of the magnetic bearings, touch-down bearings (5) coated with solid lubrication have been installed. They do not contact the rotor during normal operation.
The status of the rotor and magnetic bearing is continuously monitored via circuits detecting rotor displacement, rotational speed and pump temperature. If an abnormality/error occurs, the rotor will stop.



a) STP-iX455 Series



b) STP-iXL455 Series

Figure 2.1 Cross Sectional View of the STP Pump

3 Unpacking

3.1 Unpacking the STP Pump

Check the following before unpacking the STP pump.

- Check the package for bruises, breakage, wetness, and other.
  If there is any abnormality/error or it is judged necessary to return the product, contact Edwards or the distributor.
- Check the contents of the package.
  See Section 3.2, "Accessories".

NOTICE

◇ Be careful not to scratch the flange of the STP pump.
Before installing the STP pump, check whether or not there are scratches on the surface.

◇ It is recommended to keep the packaging materials, such as the corrugated fiberboard container and cushioning material for possible reuse.

3.2 Accessories

Table 3.1 Accessories

Item	Q'ty	Remarks
Instruction Manual	1	This manual
Inlet port cover	1	
Outlet port cover	1	
Connector for "X1 DC POWER"	1	• Model: NJC–207–PF (Nanaboshi Electric Mfg.Co,Ltd.) • Cable bushing Model: NJC–20–CB (Nanaboshi Electric Mfg.Co,Ltd.)
Connector for "X2 REMOTE"	1	D-sub25 pin

Table 3.2 Accessories for Corrosion Resistant Pump

The accessories listed below are supplied to the corrosion resistant pump (type C or other models) in addition to the accessories in Table 3.1.

Item	Q'ty	Remarks
Blank flange for purge port	1	KF[*1]10
Clamping ring for purge port	1	KF[*1]10
O-ring washer for purge port	1	KF[*1]10

[*1] : ISO2861–1 (JIS–B–8365)

4 Installation of the STP Pump

4.1 Name and Function of Each Part

4.1.1 Name and Function of the Pump

(1) Inlet Port Flange (ICF[*1], VG[*2], ISO[*3])

- Connected to the vacuum equipment (at the high vacuum side).

(2) Outlet Port Flange (KF[*4]25)

- Connected to the inlet port side of the backing-pump.

(3) Purge Port (KF[*4]10)

- Port for purge gas introduction, and for vent valve attachment.
  This port is only attached on the corrosion resistant pump (type C or other models) or on pumps designed for use with a vent valve.
- Introduces a purge gas in order to protect the inside of the STP pump when pumping reactive or corrosive gases.
- The vent valve when installed reduces the stopping time of the STP pump.
- The STP pump is delivered with a blank flange attached to this port.

(4) Control Unit

- Contains the electronics that control the pump.
  Refer to Section 4.1.2, "Name and Function of the Control Unit" for details.

[*1] : ISO3669 or JVIS–003
[*2] : JIS–B–2290
[*3] : ISO1609
[*4] : ISO2861–1 (JIS–B–8365)

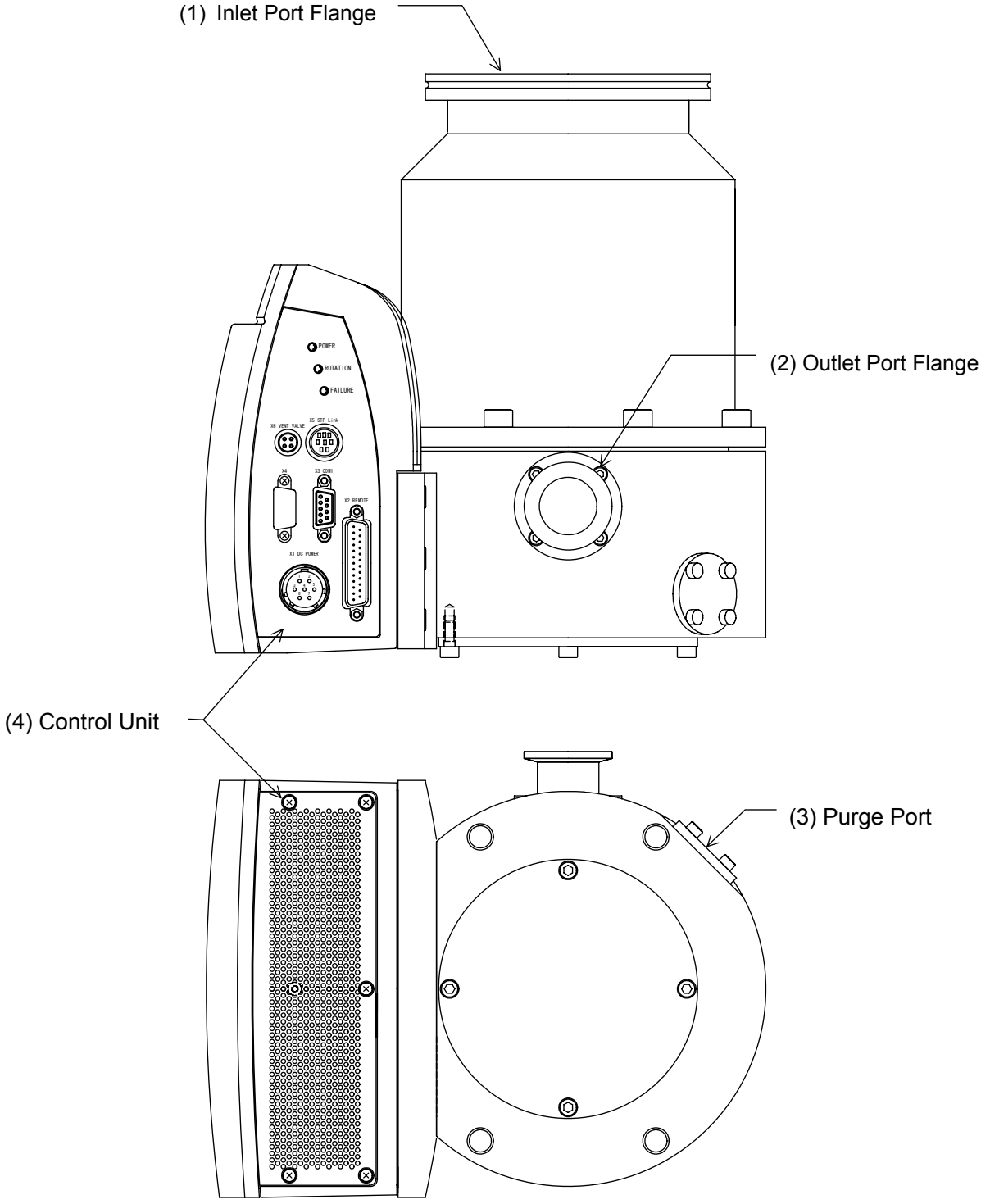


Figure 4.1 Configuration of the STP Pump

4.1.2 Name and Function of the Control Unit

Figure 4.2 shows the front panel and Figure 4.3 shows the rear panel of the control unit.

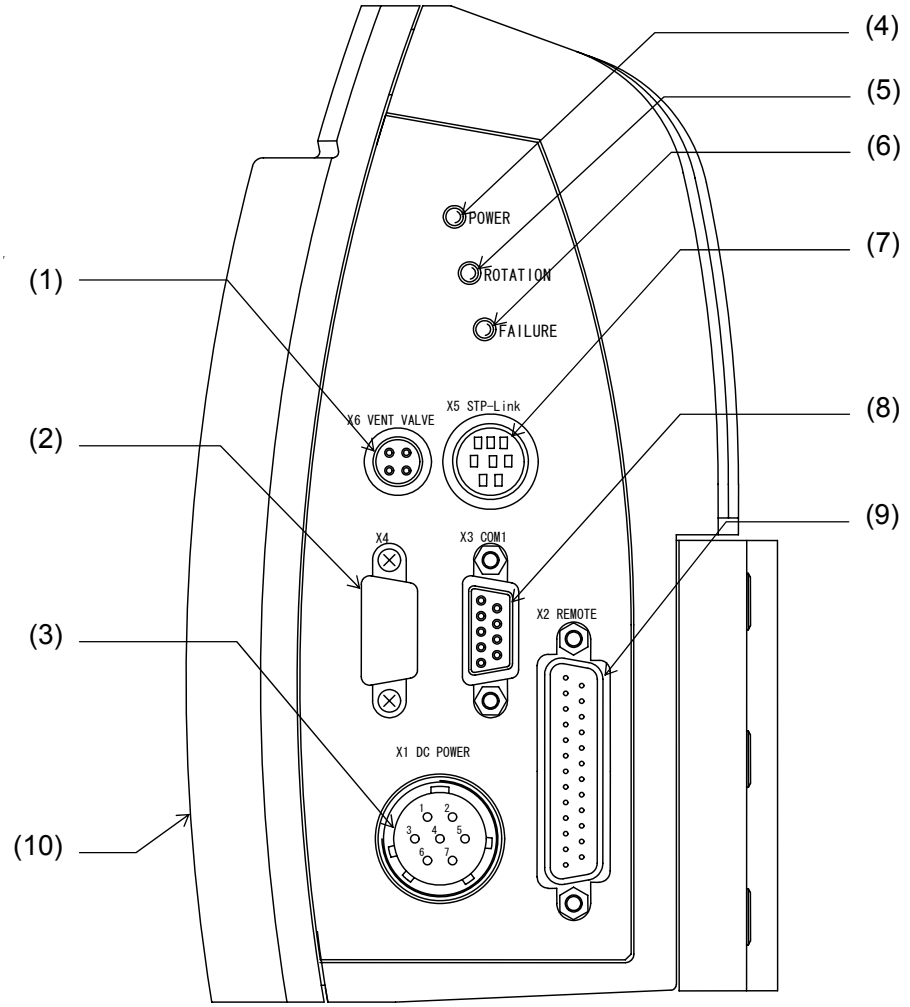


Figure 4.2 Control Unit (Front panel)

(1) "VENT VALVE" connector (X6)

- For the vent valve (optional accessory) attached in the purge port.
- Refer to Section 4.3.7, "Connecting the Vent Valve" or Section 8.1, "Vent Valve Output" for details of the connector X6.

(2) "OPTION PORT" connector (X4: COM4) with cover

- For the network unit (optional accessory).

(3) "DC POWER" connector (X1)

- For power input: 48V DC.
- Includes power supply unit iPS-240 (optional accessory) communication signal.
- Refer to Section 4.5, "Connecting the DC Power Cable".

(4) "POWER" LED (green LED)

- Illuminates when 48V DC is input to the connector X1 (Power ON state).
  Refer to Section 6.7, "LED".

(5) "ROTATION" LED (green/orange LED)

- The rotational speed is indicated by the flashing pattern of the LED (acceleration state: green, deceleration state: orange).
  Refer to Section 6.7, "LED".

(6) "FAILURE" LED (red/orange LED)

- A failure of the STP pump is indicated by the flashing pattern of the red LED. The flashing pattern indicates the failure type.
  Refer to Section 11, "Safety Functions" and Section 13, "Troubleshooting, Maintenance, and Inspection".
- A warning of the STP pump is indicated by flashing of the orange LED. The flashing pattern indicates the warning type.
  Refer to Section 12, "WARNING Function".

(7) "STP-Link" connector (X5: COM2)

- For the communication cable of the STP-Link (optional accessory) or the display unit iDT-001 (optional accessory). These optional accessories can operate the STP pump, confirm the operation state, or change various settings.

(8) "COM1" connector (X3: Dsub9 pin)

- For RS232 and RS485 (common use) serial communication.
- For the user application.
  See Section 9, "Serial Communication Protocol".

(9) "REMOTE" connector (X2: Dsub25 pin)

- For remote input/output signal in the parallel mode setting.
  See Section 6.5, "Pump Operation", Section 7, "Remote Input/Output Signal Connector".

(10) "Radiating fin"

- For dissipating heat caused by the control unit.

⚠WARNING

◇ The operation of the STP pump may lead to a considerable rise in temperatures outside of the control unit. NEVER touch the radiating fin while the STP pump is in operation. Operators can burn hands.

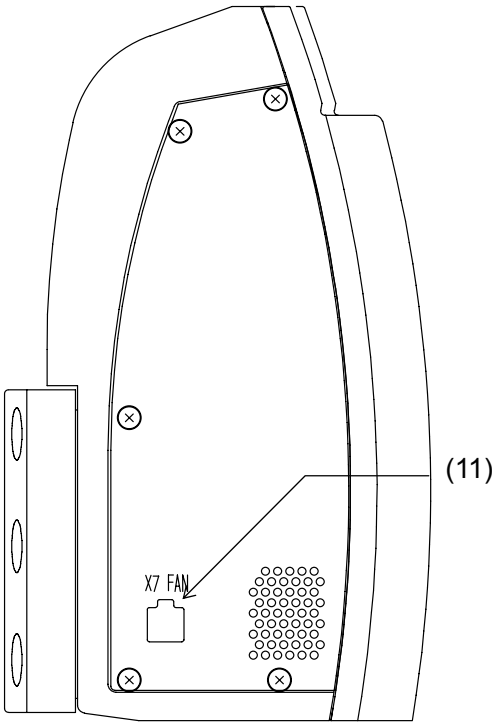


Figure 4.3 Control Unit (Rear panel)

(11) "FAN" connecter (X7)

- Power supply for the air-cooling unit (optional accessory).
  See Section 8.2, "Air-cooling Unit Output, and General-purpose Output" for details of the connector X7.

4.2 Precautions Before Installation

4.2.1 Operating Environment

WARNING

◇ Check the properties of the gas to be used, referring to the Material Safety Data Sheet (MSDS) you obtain from the gas supplier. And, keep MSDS and a safety advice of gas supplier.
Take measures according to MSDS to prevent an accident when using toxic, reactive or combustible gas. Dilute the gas to be used with the inert gas controlled if necessary. And, take measures according to MSDS to prevent an accident caused by exhaust gas.

CAUTION

◇ Chlorine or fluorine system gases can be used only in corrosion resistant pumps (type C or other models). When you use gases including alkaline metals, but excluding Li, gases including Ga, Hg, Sn, or HBr, contact Edwards.
◇ NEVER use corrosive gases (chlorine, fluorine, or other system gases) in the models without anti-corrosion treatment.
◇ If the STP pump is used in an area with radiation, contact Edwards.

Install the STP pump in a place meeting the following requirements:

Table 4.1 Operating Environment

Ambient Temperature	0 to 40 °C
Ambient Relative Humidity	30 to 95 % (no dew condensing)
Environment	● A place free of externally-applied mechanical shock ● A place free of a heat source (Keep clear of the heat source or attach a thermal shield plate) ● A place free of a strong magnetic field (Range: up to 15 mT (150 G) in the axial direction, and up to 3 mT (30 G) in the radial direction with respect to the rotational axis of the STP pump) ● A place free of a strong electric field ● A place free of a source of electric noise ● A place free of radiation ● No discharge of high voltage (more than 500 V) (If more than 500 V is discharged, contact Edwards) ● A place free of exposure to direct sunlight ● A place free of high humidity ● A place free of dust ● A place free of salty air ● A place free of dripping water ● A place free of explosive or flammable gas ● A place free of corrosive gas ● A place free of excessive vibration
STP Pump Installation Equipment Conditions	Install the STP pump securely so that foreign materials will not easily fall into the STP pump (Ex.: Si wafers or samples are positioned above the STP pump) (To prevent foreign materials from falling into the STP pump, design a shield plate with large conductance)

4.2.2 Installation Area

Leave enough space for the following in addition to that for the STP pump:

- Space for maintenance and inspection
- Space for connecting cables
- Space for the radiating fin of the control unit

CAUTION

◇ The minimum bending radius of the iPS-240 connection cable (optional accessory) is 50 mm.[*1]
DO NOT excessively bend the cables and beware of any obstacles when installing the STP pump.
In addition, leave enough space to install other cables without bending them excessively.

4.2.3 Bench

A bench must be prepared by the customer to secure the STP pump. The shape and size of the bench differ depending upon the vacuum equipment. Follow the precautions of the WARNING or NOTICE.

WARNING

◇ The STP pump is provided with a high-speed rotor. Any internal abnormality/error may result in a jump in rotational torque leading to personal injury or peripheral equipment damage.
Design and secure the bench for the STP pump so that it can withstand the maximum torque generated due to the occurrence of an abnormality/error. Refer to Section 4.3.3, "How to Secure the STP Pump" for abnormal torque.

CAUTION

◇ Secure the customer-prepared bench and the vacuum equipment on the floor or peripheral equipment and other equipment in accordance with the customer application. NEVER move them while the STP pump is in operation.

NOTICE

◇ Confirm the dimensions by the external appearance of the STP pump when designing the bench.
The bolt may not be able to be inserted from the lower side of the inlet port according to the shape of the inlet port flange.
When the external appearance of the STP pump is not in the manual, contact Edwards.

[*1] : Confirm the minimum bending radius of a cable when preparing it by the customer.

4.3 How to Install the STP Pump

WARNING

◇ An appropriate enclosure or a barrier which cannot be removed without using a tool should be provided to prevent an operator from accessing the connection cables between the STP pump and its connectors provided.

CAUTION

◇ Use a lifter or the like when installing the STP pump to the vacuum equipment. Failure to do so might hurt your back or cause injuries due to occurrence of an accident such as fall. When lifting by hands for unavoidable reason, two or more people must always conduct it.

Install the STP pump to the vacuum equipment as shown in Figure 4.4.

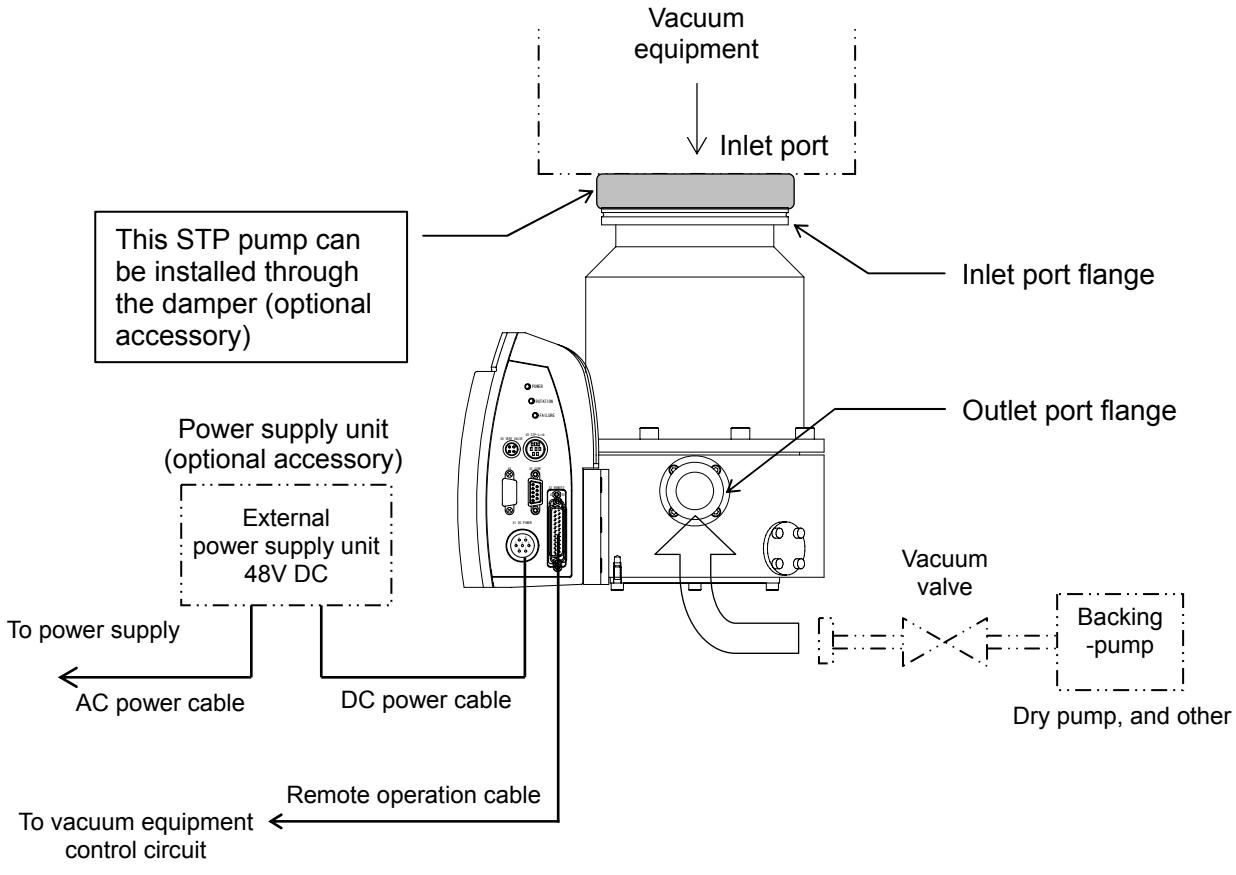


Figure 4.4 Installation of the STP Pump to the Vacuum Equipment

4.3.1 Cleaning the Seal

Inspect the seals of inlet and outlet port flanges for dirt or oil spots before installing the STP pump to the vacuum equipment.
Take the following measures for cleaning the seals:

- Clean off with a pure gas.
- Wipe with proper solvent (such as alcohol).

CAUTION

◇ A splinter shield is attached to the inlet port flange to prevent foreign materials from falling into the STP pump.
Always leave the splinter shield attached during operation.

◇ The wipes used for clean the flange of the pump might become hazardous waste depending upon the solvent (alcohol). Dispose of the contaminated wipes appropriately according to the regulations of each national and/or local government.

NOTICE

◇ The splinter shield cannot perfectly prevent foreign materials from falling into the STP pump.
DO NOT install the STP pump in such a manner that foreign materials can easily fall into it (for example, Si wafers or samples are positioned above the STP pump). If installing the STP pump in such a manner, always attach a shield plate with sufficient conductance above the STP pump to prevent foreign materials from falling into it. Foreign materials falling into the STP pump through the splinter shield may result in product damage.

◇ Be careful not to scratch the flange of the STP pump.
Check whether or not there are scratches on the surface, before installing the STP pump.

4.3.2 STP Pump Installation Positions

The STP pump can be installed vertically, horizontally, upside-down or slanted.

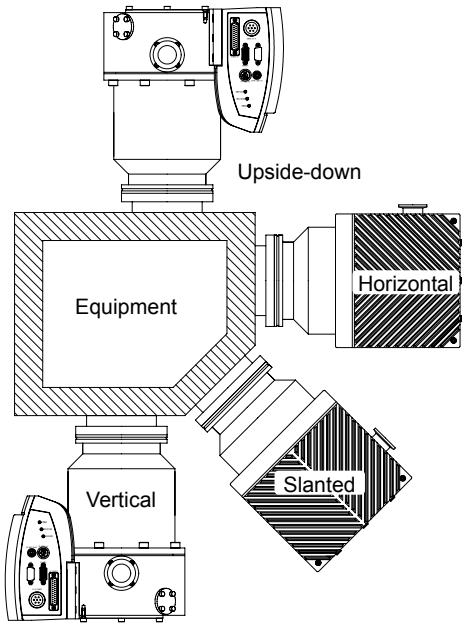


Figure 4.5 STP Pump Installation Positions

When installing the STP pump in a horizontal or slanted position, it is recommended to install the pump so that the direction of the outlet port is on a vertical or horizontal plane in the direction of the gravity to reduce the load on the magnetic bearing and the heat generated by the STP pump. In addition, in order to enhance the effect of radiating fin, install the pump in accordance with the order of precedence shown below:

1. The direction of the outlet port is on a vertical plane in the direction of the gravity (see Figure 4.6 (a-i)).
2. The direction of the outlet port is on a horizontal plane in the direction of the gravity and the control unit is in the upper position (see Figure 4.6 (b-ii)).
3. The direction of the outlet port is on a horizontal plane in the direction of the gravity and the control unit is in the lower position (see Figure 4.6 (b-iii)).

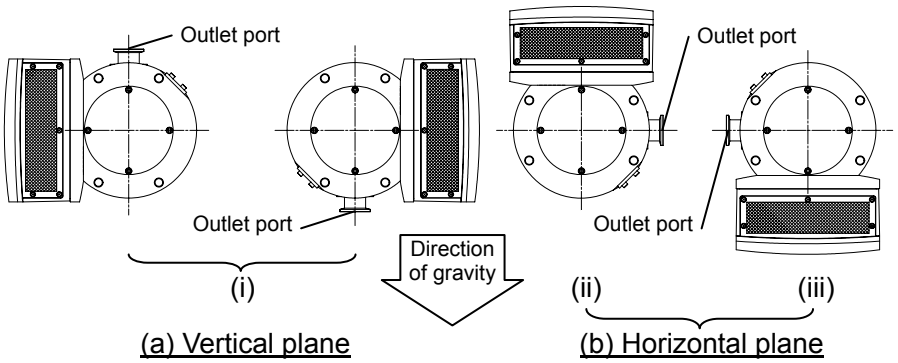


Figure 4.6 Positions of the Outlet Port on the Horizontally or Slanted Installed STP Pump

Installation of the STP-iXL455 series

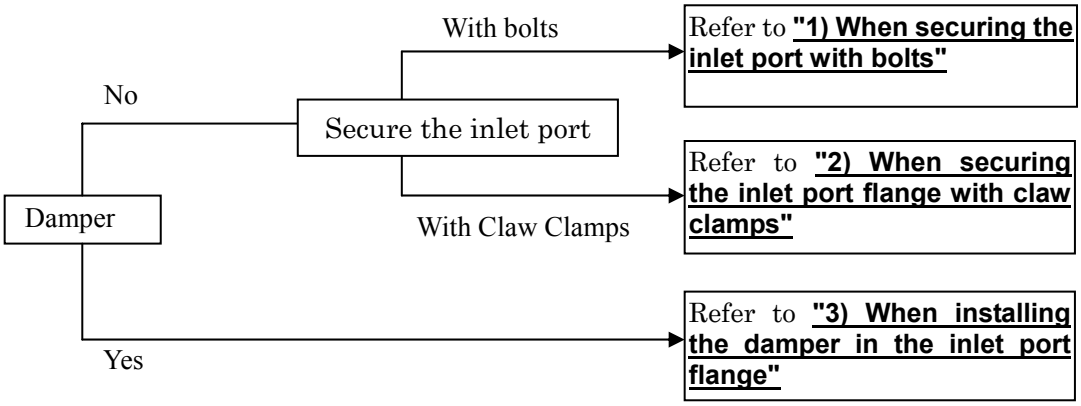
It is recommended to mount the STP-iXL455 series in the vertical position.
The STP pump may be inclined by its own weight in other positions in the case of atmospheric release. To protect a structure for reduce vibration level, install prevention measures for the inclination of the pump.

4.3.3 How to Secure the STP Pump

WARNING

◇ The STP pump is provided with a high-speed rotor. The worst-case failure may result in a jump in rotational torque leading to personal injury or peripheral equipment damage.
The method of securing the STP pump will depend on the installation requirements. Secure the STP pump to the vacuum equipment as follows:

◇ The generated torque during a pump failure is called "Destructive torque". Design and secure the mounting for the STP pump so that it can withstand this destructive torque. Refer to Table 4.3 for destructive torque values.



CAUTION

◇ Refer to Table 4.2 for tightening torque of the bolt.

Table 4.2 Tightening Torque of Bolt

Size of bolt	Tightening torque of bolt (Nm)
M8	12
M10	24
M12	42

NOTICE

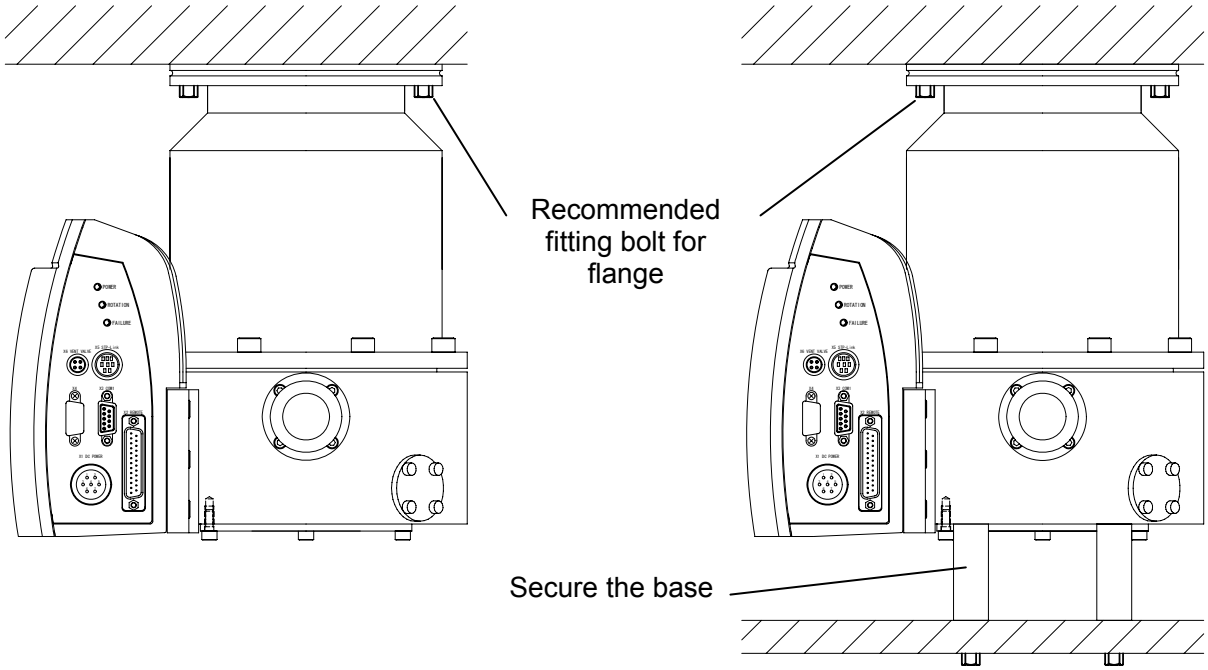
◇ When securing on the pump base side or using any securing method other than that specified in this manual, contact Edwards.

1) When securing the inlet port with bolts

Refer to Table 4.3 for torque in pump abnormality and recommended securing bolts.
Secure the inlet port flange with all of the bolt holes of the size specified in the Inlet Port Flange Standard.
Secure the base with all 4 screw-holes for legs or all 4 legs. Follow "CAUTION" in Section 4.3.4 about legs and bolts for securing the base.

Table 4.3 Destructive Torque and Recommended Securing Bolt for Inlet Port Flange

Model		STP-iX455/iXL455		
Flange type		VG100/VG150	ISO100F/ISO100 ISO160F/ISO160	ICF152/ICF203
Torque in pump abnormality [kNm]		4.1	4.1	4.1
Recommended securing bolt	Shape of bolt	Standard	Standard	Standard
	Steel type*1	Stainless steel	Stainless steel	Stainless steel
	Strength*1	70 or more	70 or more	70 or more



(a) When the base is not secured (b) When the base is secured

Figure 4.7 Example of Securing the STP Pump (When securing the inlet port with bolts)

*1 : Refer to ISO898-1(JIS–B–1051), ISO3506(JIS–B–1054), AMS6419(Aerospace Material Specification).

2) When securing the inlet port flange with claw clamps

Refer to Table 4.3 for destructive torque.
When securing the inlet port flange with only the claw clamp, the vacuum equipment cannot withstand the maximum destructive torque generated by the worst-case failure. To make the vacuum equipment withstand abnormal torque, secure the base with all 4 screw-holes for legs or all 4 legs. Follow "CAUTION" in Section 4.3.4 about legs and bolts for securing the base.
For the claw clamp-type, use the required number of claw clamps as specified in Table 4.4. Position the claw clamps evenly on the circumference.

Table 4.4 Number of Claw Clamps by Size of Flange

Size of Flange	Number of Claw Clamps
ISO160 or less	4 or more
ISO200 to 250	6 or more
ISO320 or more	8 or more

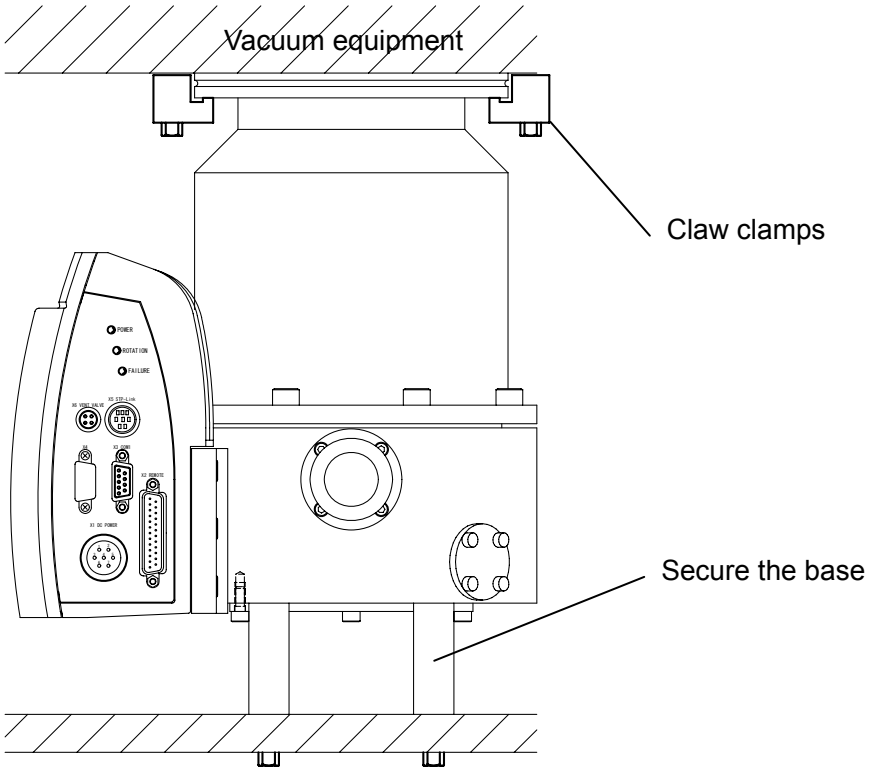


Figure 4.8 Example of Securing the STP Pump
(When securing the inlet port flange with claw clamps)

3) When installing the damper in the inlet port flange

Refer to Table 4.3 for destructive torque.
In case of using a damper, secure the base with all 4 screw-holes for legs or all 4 legs.
Follow "CAUTION" in Section 4.3.4 about legs and bolts for securing the base.
When the base cannot be secured because of the equipment design, install the pump with a torque restraint shown in Figure 4.9.

CAUTION

- ◇ Use a damper only at the vertically upright position.
- ◇ DO NOT remove the bolts and nuts attached to reinforce the damper.

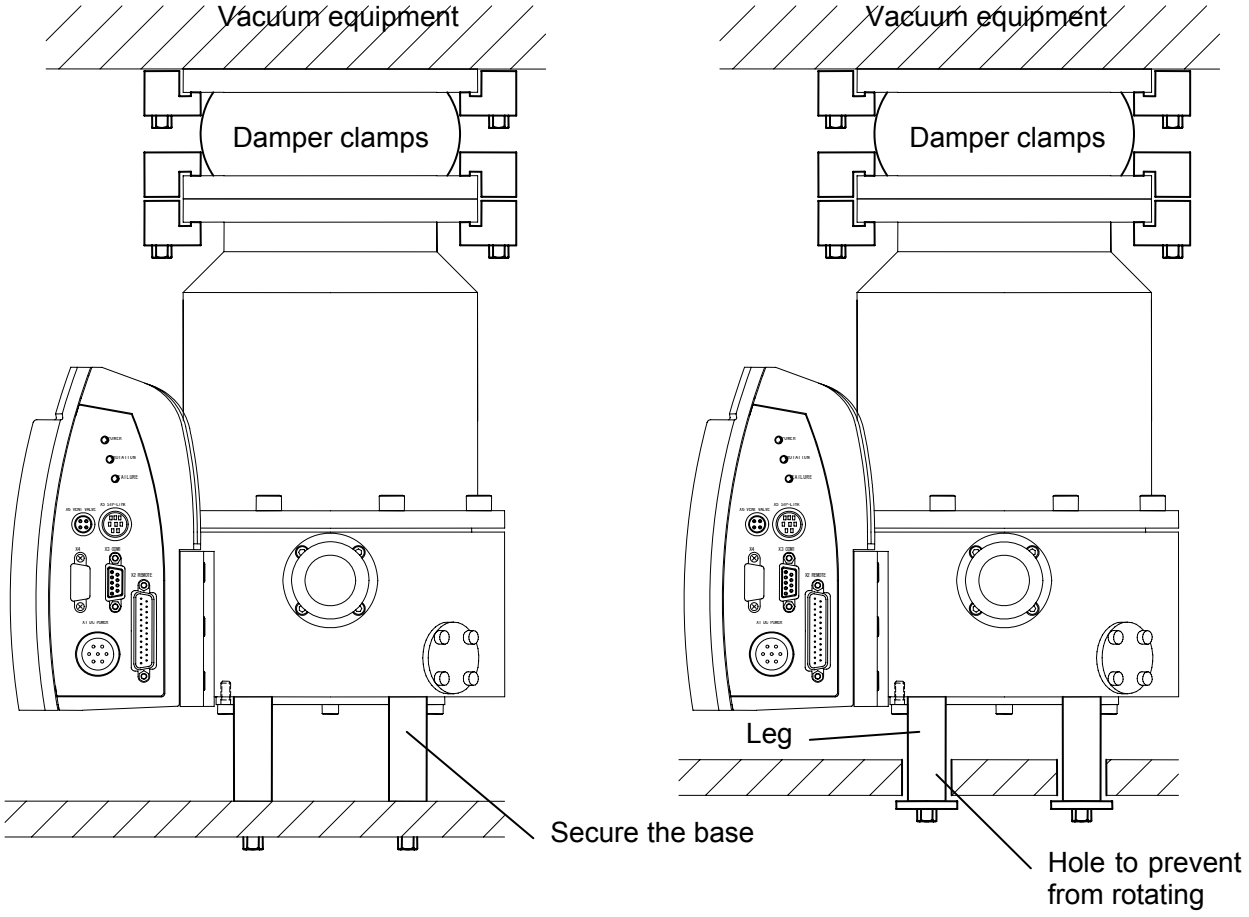


Figure 4.9 Example of Securing the STP Pump
(When installing the damper in the inlet port flange)

4.3.4 Legs for Securing the Base

CAUTION

- ◇ When making legs to secure the base, make the length of legs 35 mm or less. Use a material that has a tensile strength of 600 N/mm^2 or more.
- ◇ When securing the base, use stainless steel securing bolts with a tensile strength class is 70 or more.

The legs for securing the base are not included. Procure the legs at your company.
It is recommended to make legs in the configuration shown in Figure 4.10.
Figure 4.11 shows the position of the screw holes for the legs.

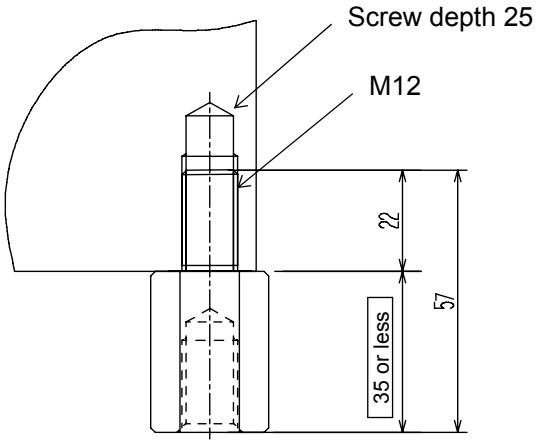


Figure 4.10 Recommended Leg for Securing Base

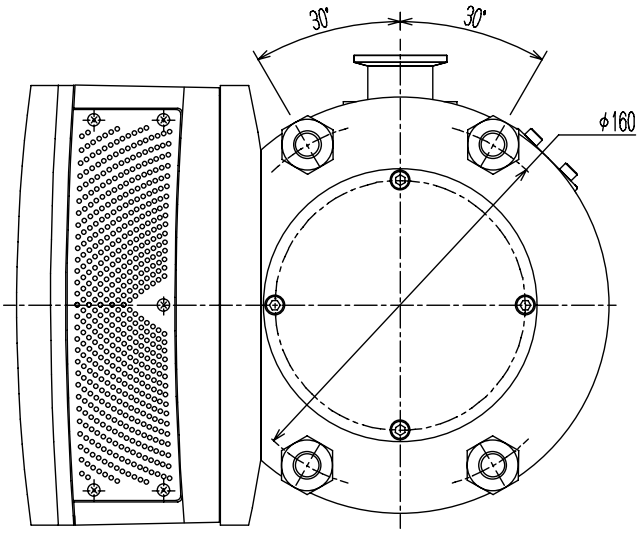


Figure 4.11 Position of the Screw Holes for Legs

4.3.5 Vacuum Piping

CAUTION

◇ DO NOT open the STP pump through the flange to atmospheric air while the STP pump is running.
If atmospheric air flows into the STP pump, it may not function normally.

◇ Depending upon the type of the backing-pump used, atmospheric air may reverse flow into the STP pump when the backing-pump stops.
Attach a vacuum valve to the middle of the piping between the STP pump outlet port flange and the backing-pump, and close the vacuum valve when the backing-pump stops.

In order to let the STP pump bring its performance into full play, follow the precautions below:

1) Be careful not to scratch the flange of the STP pump.
Before installing the STP pump, check whether or not there are scratches on the surface.
2) Use stainless steel or aluminum alloy tubes with a low out gassing loss to connect the vacuum equipment to the STP pump.
3) Take measures for minimizing leakage. It is also necessary to degrease the tubes as regularly as possible to keep the gas loss as low as possible.
4) It is recommended to use a backing-pump of pumping speed 240 L/min or more.
However, the pressure at the inlet and outlet ports varies with the flow rate of gas, capacity of the vacuum equipment, length and material of the piping.
Select a backing-pump in accordance with the capacity and starting method (simultaneous starting, starting after generating roughing vacuum) suitable for the vacuum equipment you use.
5) Connect the STP pump and the backing-pump using stainless steel or aluminum alloy tubing, flexible tubing, vacuum rubber or Teflon tubing, and other.
The following measures can be used to avoid the transmission of the vibration of the backing-pump to the STP pump and the vacuum equipment.
   - DO NOT place the backing-pump on the same floor as the vacuum equipment.
   - Locate the backing-pump on a vibration-proof table.
   Attain 1/3 or less of the rotational speed of the backing-pump, when adjusting the inherent frequency of the backing-pump installed on a vibration-proof table.
   - Attach a weight to the piping from the backing-pump, or secure the piping to a rigid, heavy object free of vibration.
   - Use a tube of high flexibility.
6) Depending upon the type of the backing-pump used, oil vapor may contaminate the inside of the STP pump. Some oil viscosity could cause a malfunction when there is a strong reverse flow of oil.
Take the following measures to ensure the correct flow of oil:
   - Attach a vacuum valve to the middle of the piping between the STP pump outlet port flange and the backing-pump.
   - Attach an absorption trap adjacent to the vacuum valve.

NOTICE

◇ Abnormal noise or excessive vibration failure (Disturbance) caused by rotor incline toward outlet port may be generated when performing roughing vacuum depending upon pumping speed of the backing-pump, chamber capacity, or piping length. When the failure is detected, perform the RESET operation.

Piping at the Inlet Port Flange

Attach the inlet port to the high vacuum side.
Refer to Table 15.1, "Specifications for the STP Pump" for the maximum working pressure (pressure at the inlet port flange applicable continuously).

Piping at the Outlet Port Flange

Attach the outlet port to the inlet port flange of the backing-pump (primary side pump).
Refer to Table 15.1, "Specifications for the STP Pump" for the allowable backing pressure (pressure at the outlet port flange applicable continuously).

NOTICE

◇ To attain the ultimate pressure shown in Table 15.1, "Specifications for the STP Pump", set the pressure at the outlet port flange to 1.3 Pa (10^{-2} Torr) or less.

4.3.6 Connecting the Purge Port (For the corrosion resistant pump)

When pumping reactive or corrosive gases in the corrosion resistant pump (type C or other models), introduce a dry N_2 gas or other inlet gas into the STP pump in order to protect the inside of the STP pump.
As shown in Figure 4.12, introduce a dry N_2 gas through needle valve or similar valve (must be provided by the customer) into the purge port.
For instructions on how to introduce the purge gas, see Section 5.3, "Gas Pumping".

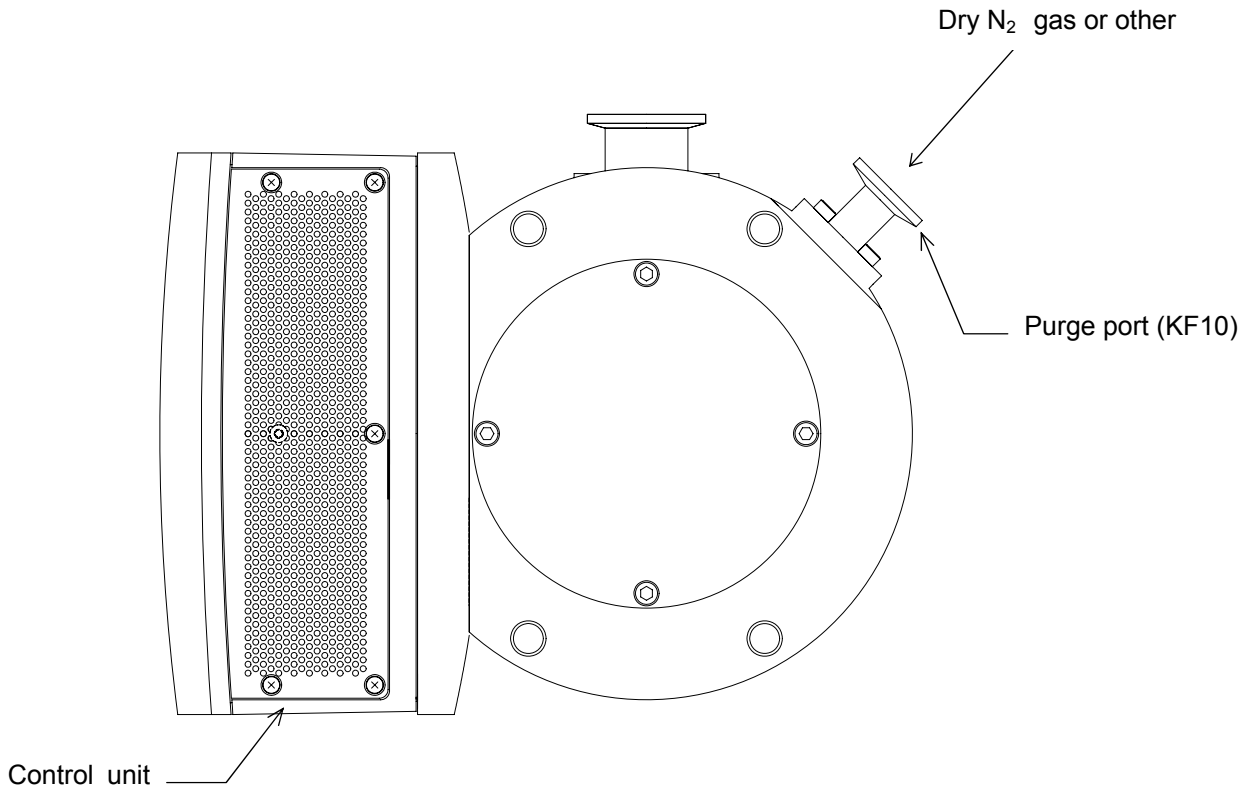


Figure 4.12 Connecting the Purge Port

4.3.7 Connecting the Vent Valve

The vent valve (optional accessory) provides controlled amounts of gas at atmospheric pressure into the pump to shorten the stopping time of the STP pump. Connect the vent valve to the purge port shown in Figure 4.12.
Refer to Section 8.1, "Vent Valve Output" or the Instruction Manual of the vent valve for the operation.

NOTICE

◇ When not using the purge port, close it with the blanking flange (attached on delivery).

4.4 External Power Supply Unit

Use the power supply unit iPS-240 (optional accessory) or procure the DC power supply unit which satisfies following specifications at your company for power supply to the STP pump.

- Rated output voltage +48V DC[*1]
- Rated output current 5A or more

NOTICE

◇ The external power supply unit is not included. Procure it at your company or contact the distributor when purchasing it.

4.5 Connecting the DC Power Cable

Connect between the external power supply unit and the connector X1 with the DC power cable. When using the power supply unit iPS-240 (optional accessory), be sure to use the iPS-240 connection cable for the connection of the iPS-240.
Refer to Figure 4.13, Table 4.5, and Table 4.6 for information on preparing the DC power cable at your company, and then connect the power supply line to the No.1 and 2 pins.

NOTICE

◇ The DC power cable is not included. Procure it at your company.
◇ The iPS-240 connection cable is not included with the power supply unit (optional accessory). Contact the distributor when purchasing it.

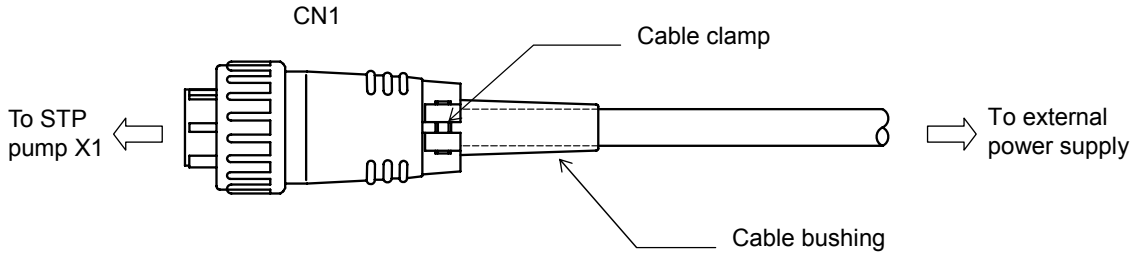


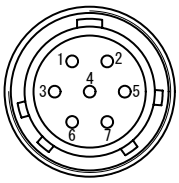
Figure 4.13 DC Power Cable

Table 4.5 Suitable Parts for DC Power Cable

Name	Model number	Remarks
Connector (CN1)	NJC–207–PF (Nanaboshi Electric Mfg.co.,Ltd)	Capable of fastening the cable outside-diameter ϕ 10 to 12.5 mm by the cable clamp
Cable bushing[*2]	NJC–20–CB (Nanaboshi Electric Mfg.co.,Ltd)	Capable of fastening the cable outside-diameter ϕ 7.5 to 9.5 mm
Cable	2-conductor cable, 0.75 to 1.25 mm^2 (AWG19 to 16) (maximum cable outside-diameter is ϕ 12.5 mm)	

[*1] : Use power the range of variation is less than ±5%.
[*2] : The cable bushing is used when the outside-diameter of the cable is ϕ 9.5 mm or less.

Table 4.6 Pin Assignment for Connector X1

Connector X1 pin No	Signal	Remarks	Outline
1	+48 V	For +48 VDC power supply	**X1 DC POWER** 
2	0 VA	For the ground for DC power supply	
3, 4, 5, 6	–	DO NOT connect these pins*1	
7	FG	Frame ground	

CAUTION

◇ Connect the external power supply unit to No.1 and No.2 pins of the connector X1. Failure to do so may result in product damage.

NOTICE

◇ Refer to the iPS-240 Instruction Manual for the operation of the power supply unit (optional accessory).
◇ No. 2 pin (0VA) and No. 7 pin (FG) of the connector X1 are connected internally to the pump body and other metallic components.
◇ The STP pump mounts 7 A fuse in DC power supply input line as overcurrent protection.

*1 : It is equipped for a power supply unit iPS-240 (optional accessory).

4.6 Connecting to Vacuum Equipment

The STP pump and the external power supply unit are considered components when used with the vacuum equipment.
Consider the followings when designing the vacuum equipment.

4.6.1 Connecting to Power

The external power supply unit receives its power from the vacuum equipment electrical distribution system via a circuit breaker. Electrical energy isolation (Lockout/Tagout) is achieved by opening the main disconnect device or circuit breaker of the vacuum equipment, thereby: removing power from the STP pump.
Provide the equipment with the main disconnect or circuit breaker devices rated for at least 10,000 A_{rms} symmetrical amperes interrupting capacity (AIC).

4.6.2 Emergency Off Circuit (EMO Circuit)

Activation of the EMO circuit of the equipment will interrupt electrical power to the STP pump. When the power is shut off, the STP pump will coast down and eventually land on the touch down bearings.
Consider the followings when establishing the EMO circuit.

CAUTION

- ◇ Unite the exhaust gas system to prevent atmosphere from being introduced into the STP pump when the EMO circuit operates (example: shut the valve). When atmosphere is introduced into the STP pump, the touch down bearing may not operate normally.
- ◇ The STP pump rotates for a while after the EMO circuit shuts off the power. Perform a recovery operation after the STP pump has stopped completely.
- ◇ Before performing the operation check of the EMO circuit with regular maintenance, stop the STP pump to prevent damage to the touch down bearing.

NOTICE

- ◇ Procure the main disconnect device and the EMO circuit at your company.
- ◇ Use the main disconnect device which is lockable only in the deenergized position.
- ◇ Locate the main disconnect device and the EMO button in the place where personnel is not be exposed to any hazards during operation.

5 Baking, Cooling the STP Pump and Gas Pumping

5.1 Baking the STP Pump

To attain a less pressure in a shorter time and reduce the exhaust time, bake the vacuum equipment and STP pump.

WARNING

◇ The surfaces of the STP pump and its peripheral equipment will become extremely hot when performing baking. NEVER touch them with bare hands.

CAUTION

◇ When baking the STP pump, always cool it to prevent overheating.
◇ Start baking after cooling is started.
Set the temperature of the baking heater to 120 °C or lower (an optional baking heater is set to 110 °C or lower).
◇ DO NOT pump gases during baking to prevent overheating.

NOTICE

◇ To exhaust the gas discharged from the vacuum equipment and the inner wall of the STP pump, run the STP pump during baking.

5.1.1 Attaching a Baking Heater

1) Install the baking heater (optional accessory) near the inlet port flange in the perimeter of the envelope.
2) Affix the hot surface warning label, which is provided with the baking heater, on the surface of the pump seen well (see Figure 5.1).

CAUTION

◇ Check the rated voltage of the baking heater before use (The range of the available voltage of the backing heater (optional accessory) is display voltage ±10%).
◇ Wind the baking heater around the surface of the STP pump tightly.
If the baking heater is not wound tightly, the loose parts will overheat.
◇ Procure protective parts for the baking heater, such as an earth leakage breaker or fuses when using the baking heater.
◇ DO NOT apply excessive force to the cable for the baking heater.

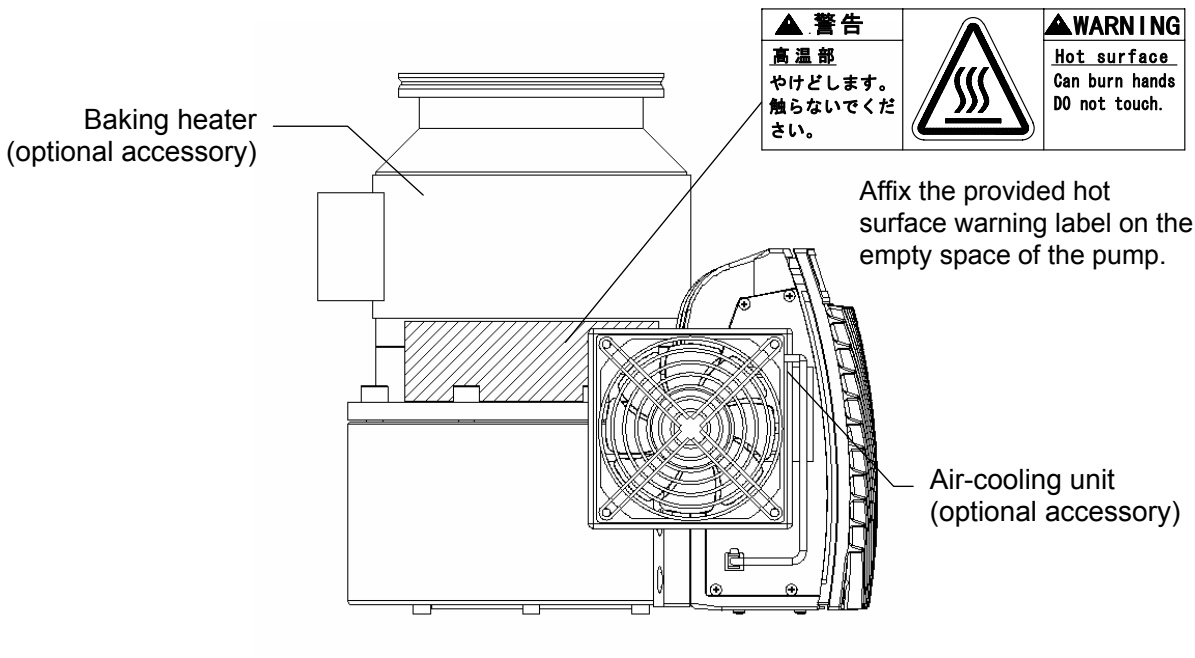


Figure 5.1 Attaching Positions of the Baking Heater and Air-cooling Unit

5.2 Cooling the STP Pump

When performing baking or pumping gases, or when operating the STP pump in area of high humidity or subjected to heat source for unavoidable reason, cool the STP pump. Use an air-cooling unit (optional accessory), when cooling the STP pump.
The air-cooling unit U0-64 cools only control unit. The air-cooling unit U1-64 cools both STP pump and control unit. Select the best method which fits your vacuum equipment.

Air-cooling fan	Cooling area	Condition			
		Baking	Gas pumping*1 (SCCM)		Environment
U0-64	Control unit		N_2	0 to 180	・ Areas of high humidity ・ Areas subjected to heat source
			Ar	0 to 100	
U1-64	Pump and control unit	Yes	N_2	0 to 300	
			Ar	0 to 200	

*1: The values shown in the table are typical; they are not guaranteed.

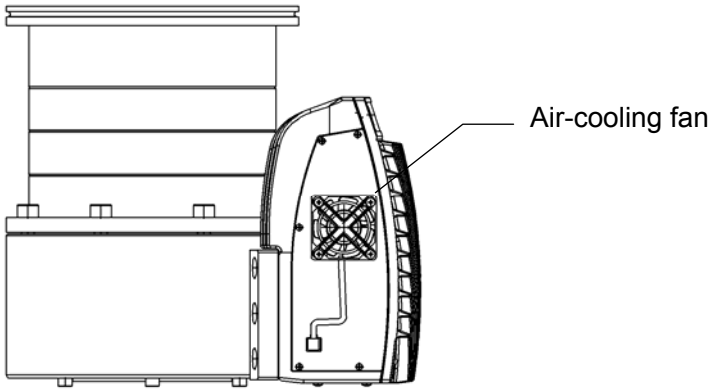


Figure 5.2 Air-cooling Unit U0-64

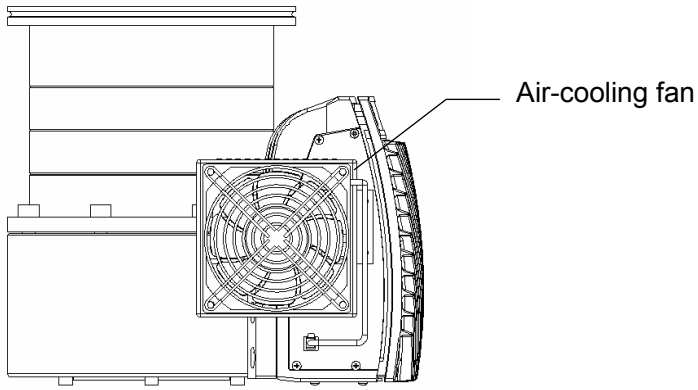


Figure 5.3 Air-cooling Unit U1-64

CAUTION

- ◇ Always turn OFF the primary power, then turn OFF the primary power supply and isolate the electrical energy source (Lockout/Tagout) on the vacuum equipment before performing any maintenance or inspection.
- ◇ When installing the air-cooling fan and bracket, use attached screws or screws equivalent to the attached screws.
- ◇ Make sure the finger guard is installed to the air-cooling fan. Failure to do so may allow fingers or foreign objects come in contact with fan blade, which may injure operators or result in product damage.

NOTICE

- ◇ When the STP pump is in the power ON state or backup operation, the air-cooling unit operates regardless of the status of the STP pump.
- ◇ The air-cooling unit becomes vibration source.

5.3 Air-cooling Unit U0-64

The air-cooling unit U0-64 cools only control unit. When performing baking, cool the STP pump with the air-cooling unit U1-64.

5.3.1 Parts List

Item	Q'ty	Remarks
Air-cooling fan	1	109P0424H702 (Sanyo Denki Co., Ltd) Connector is installed with fan cable
Finger guard	1	109–059 (Sanyo Denki Co., Ltd)
Fixing screw M 3 x 25 (with spring washer)	4	For air-cooling fan and figure guard installation

5.3.2 Installation Procedure

1) When the air-cooling fan U1-64 is attached, remove it before the installation. (see Section5.4, "Air-cooling Unit U1-64")
2) Fix the finger guard and air-cooling fan to the rear panel of the control unit with fixing screws (4 pcs, M3 x 25).
3) Connect the fan cable to "X7 FAN connecter".

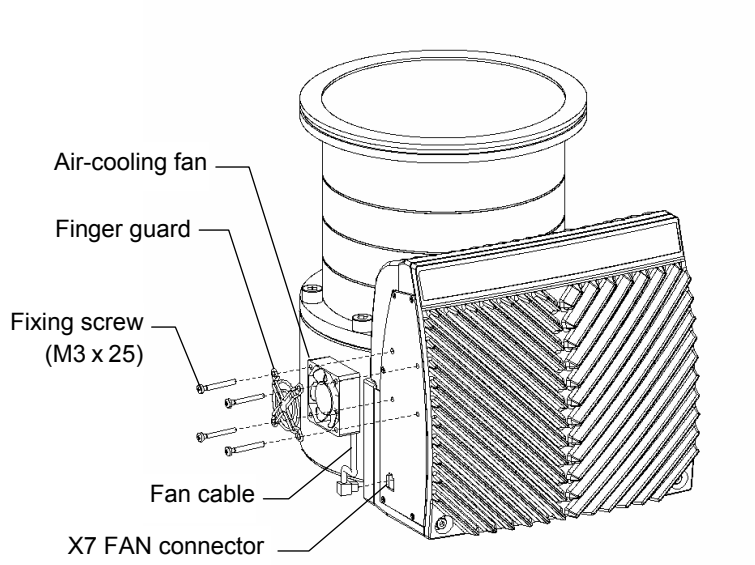


Figure 5.4 Installation Procedure for Air-cooling Unit U0-64

NOTICE

◇ Remove the air-cooling fan from the STP pump by reversing the installation steps.

5.3.3 Maintenance

The expected life of the air-cooling fan U0-64 conforms to fan maker's expected life. It is 80,000 hours (survival rate 90%) in an ambient temperature of 40 °C.
When exchanging, contact Service office.

5.4 Air-cooling Unit U1-64

5.4.1 Parts List

Item	Q'ty	Remarks
Air-cooling fan	1	109P0924H402 (Sanyo Denki Co., Ltd) Connector is installed with fan cable
Finger guard	1	109–099E (Sanyo Denki Co., Ltd)
Bracket U111 for air-cooling fan	1	
Fixing screw M3 x 8 (with spring washer)	4	For bracket U111 installation
Fixing screw M4 x 35 (with spring washer and large diameter plain washer)	4	For air-cooling fan and figure guard installation

5.4.2 Installation Procedure

1) When the air-cooling fan U0-64 is attached, remove it before the installation. (see Section5.3, "Air-cooling Unit U0-64")
2) Attach the bracket U111 to the rear panel of the control unit with fixing screws (4 pcs, M3 x 8), and then remove the sticker from the bracket U111.
3) Attach the fan to the bracket U111 in a way that ▲▲▲ marks to be opposite each other so that the fan cable locates on the radiating fin side of the control unit.
4) Fix the finger guard and air-cooling fan to the bracket U111 with fixing screws (4 pcs, M4 x 35).
5) Remove the sticker from the finger guard and air-cooling fan, and then connect the fan cable to "X7 FAN connecter".

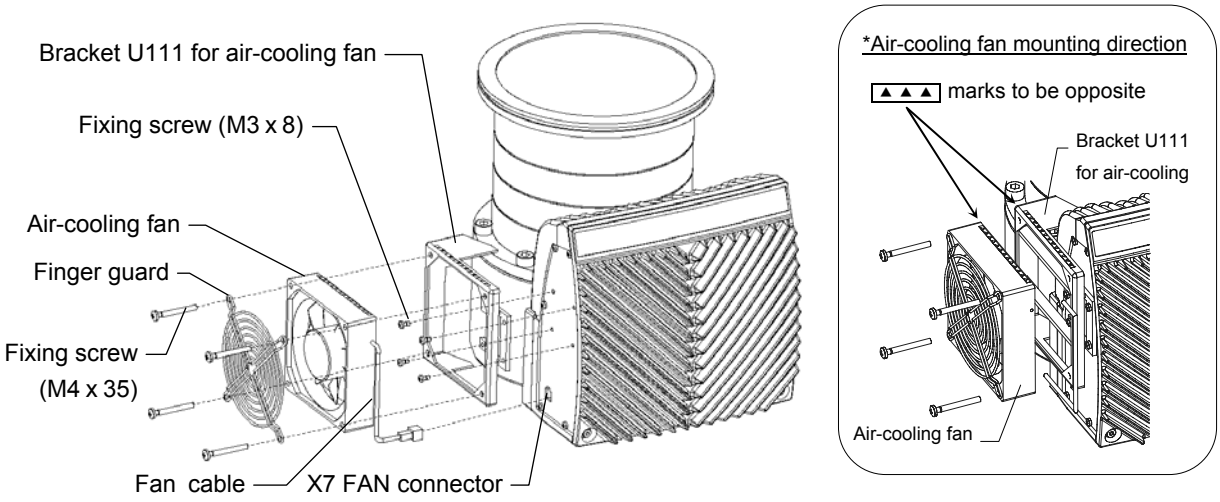


Figure 5.5 Installation Procedure for Air-cooling Unit U1-64

NOTICE

◇ Remove the air-cooling fan from the STP pump by reversing the installation steps.

5.4.3 Maintenance

The expected life of the air-cooling fan U1-64 conforms to fan maker's expected life. It is 80,000 hours (survival rate 90%) in an ambient temperature of 40 °C.
When exchanging, contact Service office.

5.5 Gas Pumping

WARNING

◇ When pumping gases, they may remain in the STP pump.
Introduce a purge gas and then exhaust all gasses.
Residual gases in the STP pump may cause an accident when the STP pump is removed.
Confirm the characteristics of gases to be used, referring to the Material Safety Data Sheet (MSDS) you obtain from the gas supplier.

CAUTION

◇ Chlorine or fluorine system gases can be used in the corrosion resistant pump (type C or other models). When you use gases including alkaline metals, but excluding Li, gases including Ga, Hg, In, or Sn, or HBr, contact Edwards.
◇ NEVER use corrosive gases (chlorine, fluorine, or other system gases) in the STP pump without anti-corrosion treatment.
◇ DO NOT use any pyrophoric gas.
◇ Cool the STP pump to prevent the STP pump from overheating when pumping gases. (see Section 5.2, Cooling the STP Pump)

5.5.1 How to Introduce a Purge Gas (For corrosion resistant pump)

CAUTION

◇ When pumping reactive or corrosive gases, introduce a purge gas to protect the inside of the STP pump. The use of reactive or corrosive gas may result in product damage.

Connect a needle valve or a similar part to the purge port of the corrosion resistant pump (type C or other models), and introduce a dry N_2 gas or other gas to perform a gas purge (see Section 4.3.5, "Connecting the Purge Port (For the corrosion resistant pump)").

NOTICE

◇ The proper amount of the gas purge is approx. 3.4×10^{-2} Pa·m^3/sec (20 SCCM).
◇ The allowable gas pressure ranges from 0.1×10^5 Pa (atmospheric pressure) to 4.9×10^4 Pa (0.5 kgf/cm^2) on the introduction side.
◇ When not using the purge port, always mount the blank flange (attached on delivery).
◇ High-pressure at the inlet port may result in a noise. This is no abnormality/error.

6 How to Start/Stop the STP Pump

- ◇ NEVER connect or disconnect any cables while the power is ON.
- ◇ NEVER stop the power supply to the STP pump while the STP pump is in rotation.
- ◇ DO NOT release the inlet port flange or outlet port flange into the atmosphere while the STP pump is in rotation.

6.1 Before Starting

After completing installation, piping, leakage test of the STP pump, installation of the external power supply unit, and wiring of the power cables, the STP pump is ready for start.

Check the following items before starting:

1) Is the STP pump secured according to the appropriate method?
2) Is the external power supply unit connected correctly to the main power?
3) Are the external power supply unit and STP pump connected with the DC power cable?
4) Is the power voltage properly?
5) Is each connector securely connected?
   Is each terminal and connector securely locked?

6.2 Start Procedures

Start the backing-pump before or simultaneously with start of the STP pump.
Open the vacuum valve located at the outlet port flange side after starting the backing-pump.

- ◇ DO NOT open the vacuum valve without operating the backing-pump.
  Depending upon the type of the backing-pump, doing so may cause a reverse flow of oil, which could contaminate the inside of the STP pump.
- ◇ Avoid frequent start/stop operations as this may cause the STP pump to overheat.

6.3 Stop Procedures

Close the vacuum valve located at the outlet port flange side just before, or after stopping the STP pump. After closing the valve, stop the backing-pump.

CAUTION

◇ DO NOT stop the backing-pump without closing the vacuum valve.
Depending upon the type of the backing-pump, doing so could cause a reverse flow of atmospheric air into the STP pump, which may result in a malfunction.

NOTICE

◇ DO NOT stop the backing-pump without closing the valve.
Depending upon the type of the backing-pump, doing so may cause a reverse flow of oil from the backing-pump, which could contaminate the inside of the STP pump.

6.4 Powering ON

Turn "ON" the external power supply unit. If no error is found, the magnetic bearing functions and the rotor levitates (POWER ON state). The "POWER" LED illuminates in green (Levitation state).

6.5 Pump Operation

6.5.1 Input Operation Port Setting

Set the hardware which operates the STP pump before the operation.
The STP pump is equipped with the parallel port (X2 REMOTE connector), serial port COM1 (X3 COM1 connector), and serial port COM2 (X5 STP-Link connector) as standard hardware for the operation.
Serial port COM3 is available when connecting the power supply unit iPS-240 (optional accessory). The STP-Link (optional accessory) and the display unit iDT-001 (optional accessory) can operate the STP pump via COM2 and COM3.

When setting the input operation port to the parallel port, refer to Section 7, "Remote Input/Output Signal Connector". When setting to a serial port, refer to Section 9, "Serial Communication Protocol" for information and methods.

The method of operation with the parallel port (X2 REMOTE connector) is shown below. Following it after reading through Section 7, "Remote Input/Output Signal Connector".
When operating the STP pump via serial communication, refer to Section 9, "Serial Communication protocol".
When operating the STP pump via the STP-Link (optional accessory) or the display unit iDT-001 (optional accessory), refer to each Instruction Manual.

NOTICE

- ◇ The display unit (optional accessory) can operate the STP pump with flat panel switches, monitor the pump operation state, and set various settings. Contact the distributor when purchasing it.
- ◇ The STP-Link (optional accessory) is a Windows application for operating the STP pump, monitoring the pump operation state, or setting various settings on the PC. Contact the distributor when purchasing it.

6.5.2 Starting/Stopping the STP Pump

There are two methods for the starting/stopping operation with the parallel port. Use one of them.

Table 6.1 Starting/Stopping the STP Pump (X2 REMOTE)

Method	Starting the pump	Stopping the pump
1	1) Short the circuit between (1)–(14). 2) Short the circuit between (2)–(14) for 0.3 seconds or more. However, when inputting this signal simultaneously with switching "ON" the external power supply, short the circuit between (2)–(14) for 10 seconds or more.	Open the circuit between (1)–(14).
2	Short the circuit between (1)–(2). In this case, (14) is not used.	Open the circuit between (1)–(2).

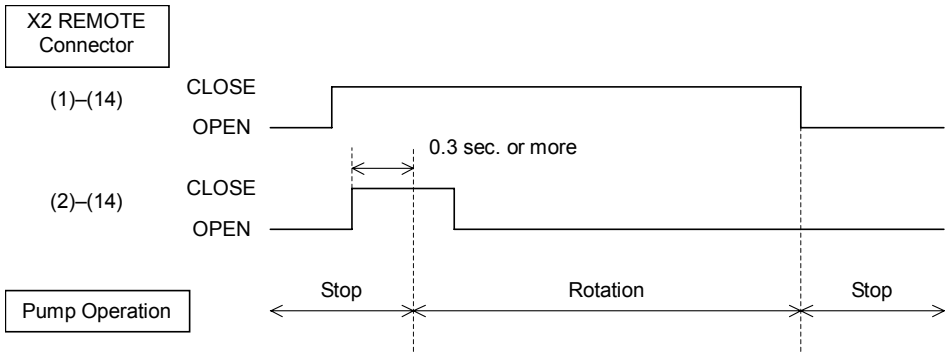


Figure 6.1 Pump Operation (Method 1)

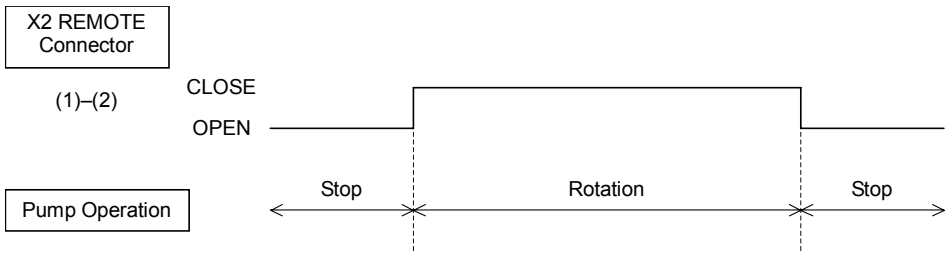


Figure 6.2 Pump Operation (Method 2)

6.5.3 Starting the STP Pump after Stopping

Perform the start operation shown in Section 6.5.2, "Starting/Stopping the STP Pump". The STP pump can be reaccelerated even while it is stopping.

6.5.4 Starting the STP Pump after a Safety Function Operates

A safety function operates when an abnormality/error occurs in the STP pump or peripheral equipment. To restart the STP pump, remove the cause of the abnormality/error after the "ROTATION" LED extinguishes, and perform the operation shown in Table 6.2. The "FAILURE" LED extinguishes and the safety function is released (RESET operation). Then, restart the STP pump.
For the safety functions and troubleshooting, see Section 11, "Safety Functions", and Section 13, "Troubleshooting, Maintenance, and Inspections".

Table 6.2 Reset Operation (X2 REMOTE)

Method	Reset Operation
1	Short the circuit between (1)–(15) for 0.3 seconds or more.

6.6 Powering OFF

Turn "OFF" the external power supply unit when the "ROTATION" LED is OFF.
The magnetic bearing stops, the rotor lands, and the "POWER" LED extinguishes (POWER OFF state).

6.7 LED

Three LEDs indicate the pump's operational state.

Table 6.3 LED Indications for Each State

LED	Power on state (Levitation State)	Acceleration state	Deceleration state	Warning/ Failure state
POWER (green)	Steady green	Steady green	Steady green	Steady green (OFF only at power failure)
ROTATION (green/orange)	Extinguishes	Green 2,000 rpm or less : 1 flash 2,000 to 20,000 rpm : 2 flashes 20,000 to 40,000 rpm: 3 flashes 40,000 to 49,500 rpm: Continuous flash 49,500 to 55,000 rpm: Steady (see Figure 6.3)	Orange	See left
FAILURE (orange/red)	• Warning state: Flashing orange (The flashing pattern of the LED indicates the type of warning. See Section 12, "WARNING Function") • Failure state: Flashing or steady red (The flashing pattern of the LED indicates the type of failure. See Section 11, "Safety Functions" and Section 13, "Troubleshooting, Maintenance, and Inspection")			

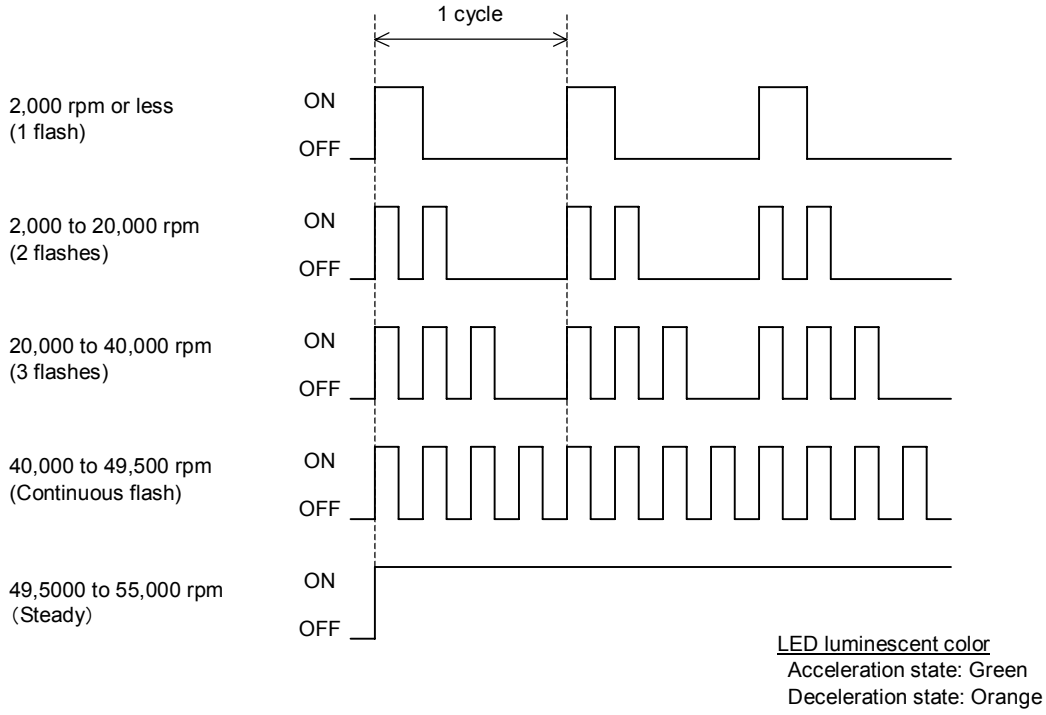


Figure 6.3 "ROTATION" LED Indication

7 Remote Input/Output Signal Connector

The remote input/output signal connector "X2 REMOTE" is used for input/output remote signals of the parallel mode.
This connector is of D-Sub[*1] type (25 pins, socket type).
The screw for connector is M2.6.

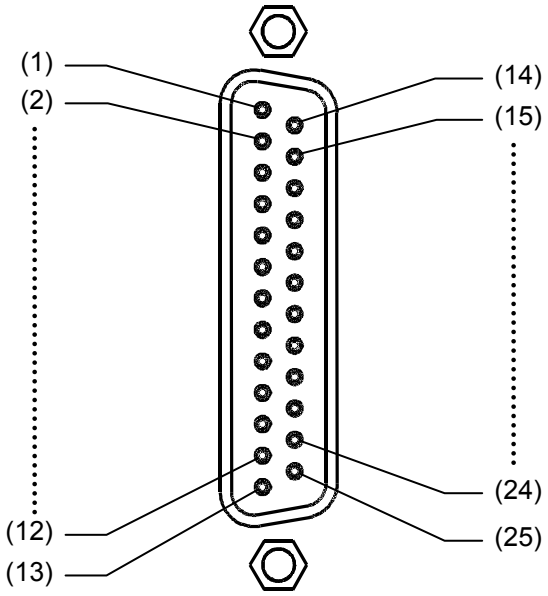


Figure 7.1 X2 REMOTE Pin Arrangement

NOTICE

- ◇ The connector (pin type) for remote connection is included. Procure control equipment at your company.
- ◇ It is recommended to use the remote cable of the shield type grounding both ends.

[*1] : D-Subminiature connector (Conforms to MIL–C–24308)

7.1 Input Signal Pins

The input pin signed assignments are given in Table 7.1, and Figure 7.2.
The input signal pins function only when the input operation port is set to the parallel port, expect pins for inputting the rotation INHIBIT signal and the rotation INHIBIT enable signal.
Two abbreviations are used in Table 7.1:

COM: Common Pin IN: Input Pin

Table 7.1 X2 REMOTE Input Signal Pins (1/2)

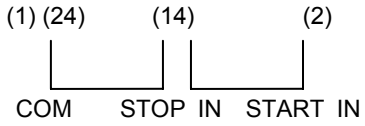
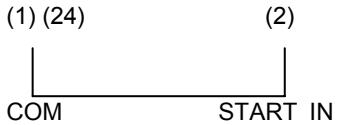
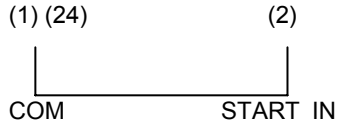
Pin	Description
	Pins for inputting the START signal. The following two methods are available: 1) Short the circuits between (1)–(14). Then, short the circuits between (2)–(14) for 0.3 seconds or more. However, when inputting this START signal simultaneously with switching "ON" the external power supply, continue to short these pins for 10 seconds or more.
	2) Short the circuits between (1)–(2). In this case, (14) is not used.
	Pins for inputting the STOP signal. 1) When 1) above is used to start the STP pump, open the circuits between (1)–(14) to stop the STP pump.
	2) When 2) above is used to start the STP pump, open the circuits between (1)–(2) to stop the STP pump.
	Pins for inputting the RESET signal. When a safety function operates, remove the cause of the abnormality/error after confirming the STP pump has stopped. When the cause of the abnormality/error is removed, short the circuits between (1)–(15) for 0.3 seconds or more to reset the failure signal (The "FAILURE" LED extinguishes).
	Pins for inputting the rotation INHIBIT signal. The input pins are valid even when input operation port is set to serial port. When the pins (1)–(3) are opened, the STP pump does not rotate despite the presence of a start signal. When these pins are opened while the pump is operating, the pump will stop (see Section 7.1.2). When using this function, short the circuits between (24)–(25) of the rotation INHIBIT enable signal.

Table 7.1 X2 REMOTE Input Signal Pins (2/2)

Pin	Description
	Pins for inputting the input operation port select signal. When the pins between (24)–(13) are short-circuited, the input operation port will be set to the parallel port automatically, and the input operation via the serial port is disabled. When the pins between (24)–(13) are opened, a parallel port or any of four serial ports from COM1 to COM4 can be selected in the input operation port (see Section 7.1.1).
	Pins for inputting the rotation INHIBIT enable signal. The input pins are valid even when input operation port is set to serial port. When the pins between (24)–(25) are short-circuited, the rotation INHIBIT signal input is enabled.
	Pins for inputting the vent valve enable signal. When the pins between (24)–(12) are short-circuited, the vent valve connected to the connector X6 is controlled according to the setting value during the deceleration state. Refer to Section 8.1, "Vent Valve Output" for the vent valve setting.

◇ COM is assigned on (1) pin and (24) pins. Both pins are connectable.

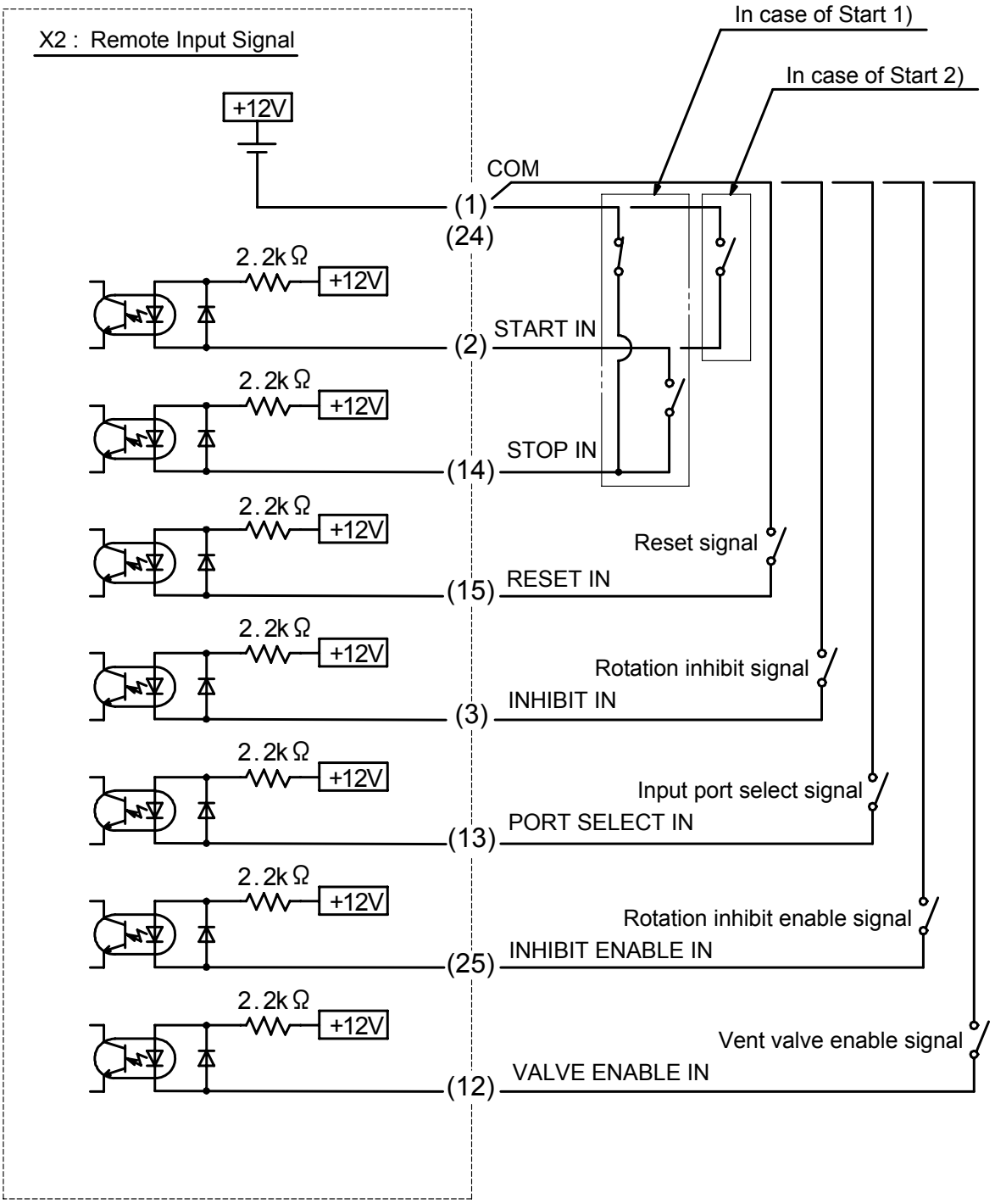


Figure 7.2 X2 REMOTE Input Signal Pins

NOTICE

- ◇ COM pins (1, 24 pin) are isolated from the frame ground.
- ◇ The input current of remote input signal is approx. 5 mA. Make sure the minimum applicable load of the relay contact when the remote operation with the relay.
- ◇ It is recommended to use a remote cable with shield type, and connect both terminals to the ground.

7.1.1 Input Operation Port Setting

Set the input operation port to the parallel port when operating the STP pump via the connector X2. The input operation port can be changed by "PORT SELECT IN" signal of the connector X2 and "Remote Operation Mode" setting. When "PORT SELECT IN" signal is closed, the input operation port will set to the parallel port automatically regardless of the Remote Operation Mode setting. When the "PORT SELECT IN" signal is opened, any input operation ports are selectable in the Remote Operation Mode (see Table 7.2). The default setting of the Remote Operation Mode is "I/O Remote" (parallel port). It can be set via serial communication, the STP-Link (optional accessory), or the display unit iDT-001 (optional accessory).

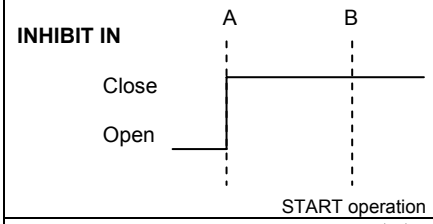
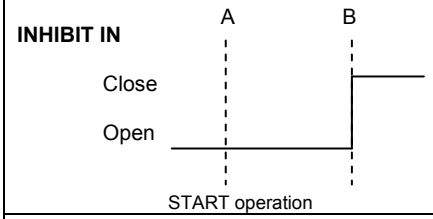
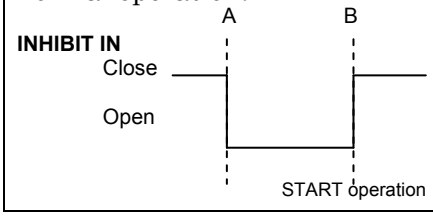
Table 7.2 Input Operation Port Setting

"X2 REMOTE" PORT SELECT IN (24)–(13)	Input operation port	
	Remote Operation Mode setting is "I/O Remote"	Remote Operation Mode setting is COM1 to COM4
Close	Parallel port	Parallel port
Open	Parallel port	Serial port (COM1 to COM4)

7.1.2 Rotation INHIBIT Signal

When using rotation INHIBIT signal, short-circuit the "INHIBIT ENABLE IN" signal. Relations between rotation INHIBIT signal input and pump operation state are shown in Table 7.3.

Table 7.3 Rotation INHIBIT Signal Input

Signal input	Pump operation
After short-circuit of rotation INHIBIT input signal (A), the START operation is performed (B). 	• The pump accelerates when the START operation is performed (B).
After the START operation (A), the rotation INHIBIT input signal is short-circuited (B). 	• The pump does not accelerate when the START operation is performed (A). • The pump accelerates when the rotation INHIBIT signal is short-circuited (B).
The rotation INHIBIT input signal is opened (A) during acceleration or normal operation. 	• The pump decelerates and stops when the rotation INHIBIT input signal is opened (A). • After the operation (A), the pump continues deceleration and stops even by short-circuiting the rotation INHIBIT input signal (B). However, when the START signal is input, the pump will accelerate.

7.2 Output Signal Pins

The output pin signed assignments are given in Table 7.4 and Figure 7.3.
The pins function when the input operation port is either in parallel port setting or serial port setting.
Three abbreviations are used in Table 7.4:

N.O OUT : Normal Open Output Pin
N.C OUT : Normal Close Output Pin
COM : Common Pin

Table 7.4 X2 REMOTE Output Signal Pins

Pin	Description
(4) POWER N.O OUT (16)	Pins for outputting the POWER ON state signal. These pins are closed when magnetic bearing functions and the rotor levitates. This output is opened at a power failure.
(5) ACCELERATION N.O OUT (17)	Pins for outputting the ACCELERATION state signal. These pins are closed when the STP pump is in acceleration.
NORMAL (18) N.O OUT COM (6) (19) N.C OUT	Pins for outputting the NORMAL OPERATION state signal. When the STP pump is in rated operation, the pins between (18)–(6) are closed, and the pins between (19)–(6) are opened.
(7) BRAKE N.O OUT (20)	Pins for outputting the BRAKE state signal. These pins are closed when the STP pump is in brake.
FAILURE (8) N.O OUT COM (21) (9) N.C OUT	Pins for outputting the FAILURE signal. When an abnormality/error is detected, the pins between (8)–(21) are closed, and the pins between (9)–(21) are opened.
(10) WARNING N.O OUT (22)	Pins for outputting the WARNING signal. These pins are closed when the STP pump is WARNING state. Refer to Section12, "WARNING Function" for the warning.
(11) I/O ENABLE N.O OUT (23)	Pins for outputting the parallel port select state signal. When the input operation port is set to the parallel port (I/O REMOTE), the pins between (11)–(23) are closed.

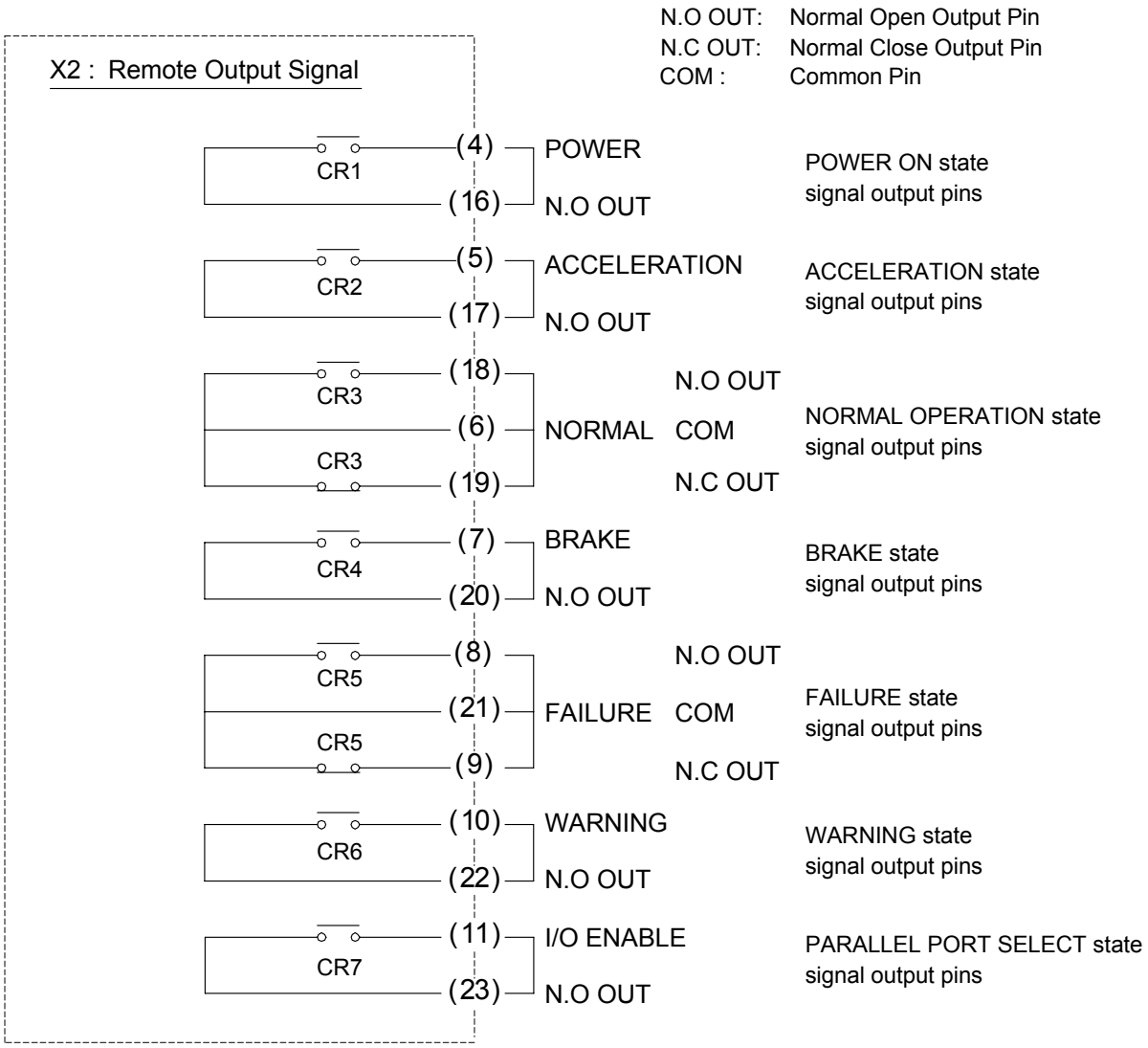


Figure 7.3 X2 REMOTE Output Signal Pins

Table 7.5 shows the rated contacts for relays CR1 to CR7 in Figure 7.3.

Table 7.5 Rated Contacts for Relays CR1 to CR7

	Resistance Load (COS ϕ =1)
Rated Load	125 V AC, 0.3 A 30 V DC, 1 A
Rated Current	1 A
Maximum Contact Point Current	1 A
Maximum Open/Close Capacity	AC: 37.5 VA DC: 30 W
Minimum Applicable Load	10 mV DC, 10 μA

8 Vent Valve Output, Air-cooling Unit Output, and General-purpose Output

8.1 Vent Valve Output

Connect the vent valve to the "X6 VENT VALVE" connector for ON/OFF control. The vent valve is an optional accessory. Contact the distributor when purchasing it.

When using the vent valve, set the vent valve function to ENABLE.
The setting method differs according to the input operation port.

- Parallel port ：Short-circuit the vent valve enable signal of the "X2 REMOTE" connector (see Section 7, "Remote Input/Output Signal Connector").
- Serial port ：Set the vent valve setting to "ENABLE".
  (see Section 9, "Serial Communication Protocol" in this Instruction Manual, or the Instruction Manual of the STP-Link (optional accessory) or the display unit iDT-001 (optional accessory))

When the vent valve function is enabled, the valve is controlled according to the setting values during deceleration state. There are two settings, the vent valve starting speed and vent valve running time, which can be set by customer.

Table 8.1 Vent Valve Operation Setting

Item	Default	Setting range
Vent Valve Starting Speed (at rate to rotational speed)	50 %	10 to 80 % (1 % step)
Vent Valve Running Time	60 sec.	5 to 600 sec. (5 sec. step)

The vent valve settings can be set via the serial communication, the STP-Link (optional accessory) or the display unit iDT-001 (optional accessory).
Refer to Section 9, "Serial Communication Protocol" or the Instruction Manuals of each optional accessory for the setting methods.

NOTICE

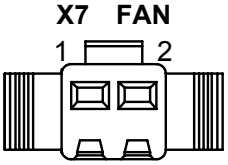
◇ See the Instruction Manual of the vent valve for details.

8.2 Air-cooling Unit Output, and General-purpose Output

8.2.1 Connector X7

The "X7 FAN" connector is used to provide power to the air-cooling unit to cool the STP pump. The air-cooling unit is an optional accessory. Contact the distributor when purchasing it.
It can also be used as a general-purpose power supply (24 V DC, 0.2 A max.).
The "X7 FAN" connector provides 24 V DC in the power ON state or backup operation during a power failure.

Table 8.2 Pin Assignment for Connector X7

Connector X7 pin assignment	Function	Outline
1	24 V DC±2 V/0.2 A	
2	0 V	

CAUTION

◇ When connecting/disconnecting cables, always turn OFF the external power supply. Failure to do so may result in electric shock or product damage.

NOTICE

◇ See Section 5.2, "Cooling the STP Pump" for details.

8.2.2 Using as a General-purpose Power Supply

Connect the equipment to the connector X7 using the parts listed in Table 8.3.
The rated current of the connector X7 is 0.2 A. An output may be interrupted when the current more than 0.2 A is passed.

Table 8.3 Suitable Parts for Connector X7

Parts	Parts number	Remarks
Connector	SMR–02V–B (J.S.T. Mfg. Co., Ltd.)	
Contact	SYM–001T–P0.6 (J.S.T. Mfg. Co., Ltd.)	• Applicable wire: 0.08 to 0.33 mm^2 (AWG#28 to 22) • Wire covering outside diameter: 1.2 to 1.8 mm

9 Serial Communication Protocol

9.1 Serial Communication

The STP-iX455/iXL455 series is provided with compliant serial RS232/RS485 interface. Prepare the user application according to this protocol procedure. Operation instructions and information, such as the running state and setting values of the STP pump can be set by the software.
The STP pump equips the serial ports for connecting the user application, STP-link (optional accessory), or the display unit iDT-001 (optional accessory) (see Figure 9.1).
A serial port located the STP pump is called a serial interface module (hereafter referred to as SIM). The equipment, which can communicate with the STP pump via RS232/RS485, is called a PC.

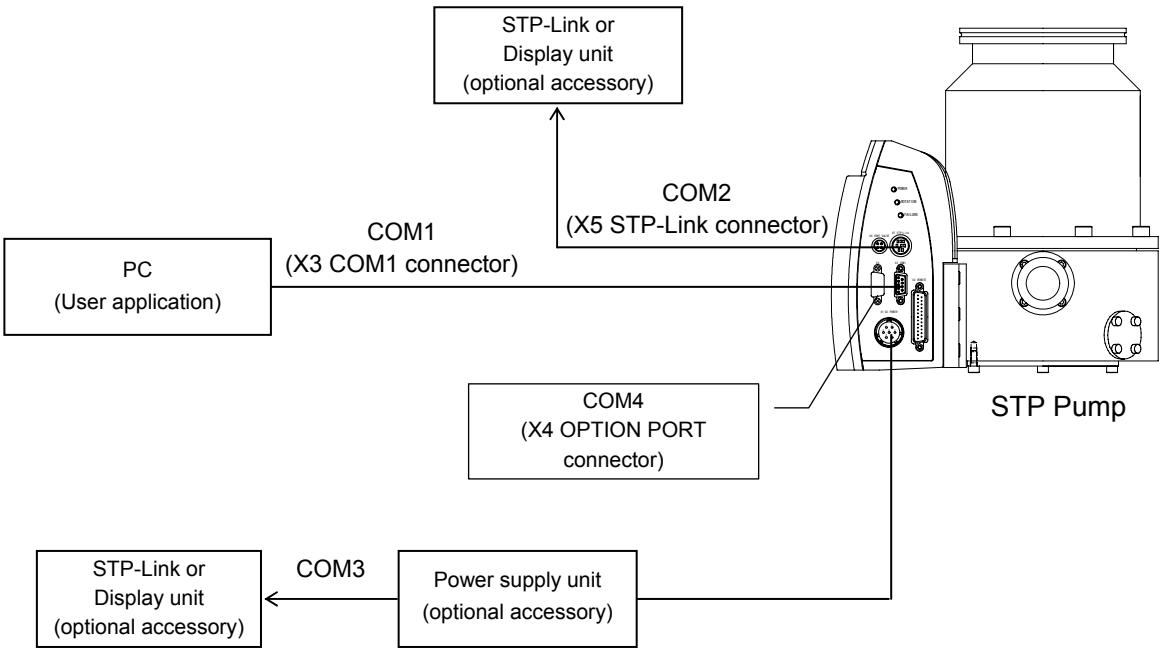


Figure 9.1 Serial Port

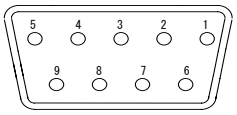
9.2 Connection and Setting Up

9.2.1 Serial Port

(1) Serial Port COM1 (X3 COM1 connector)

The serial port COM1 is available for the serial communication via RS232 or RS485. When using a user application, connect it to this port.
Connect the connector X3 (a D-Sub9 pin, socket type) to the PC according to Figure 9.1. Connect only TxD/RxD/GND in the RS232 and D+/D– in the RS485.
Pin No.1, 4, 6, and 9 of the connector X3 are reserved as optional use. Do not connect to these optional pins.

Table 9.1 Pin Assignment for Connector X3

	Connector X3	Signal	Pin Assignment (D-Sub9 pin, socket type)
For RS232	2	TxD	
	3	RxD	
	5	GND	
For RS485	7	D–	
	8	D+	
Reserved	1, 4, 6, 9	–	

NOTICE

- ◇ The screw for the connector X3 is M2.6.
- ◇ The RS232 and RS485 share the connector X3. The default setting is RS232. When using the RS485, change the communication parameter setting via STP-Link (optional accessory) or the display unit (optional accessory) (Refer to Section 9.2.3).
- ◇ The length of the communication cable should be less than 15 m when using RS232.
- ◇ See Section 9.2.2 when using RS485.
- ◇ It is recommended to use a communication cable with shield type, and connect both terminals to the ground.

(2) Serial Port COM2 (X5 STP-Link connector)

The STP-Link (optional accessory) or the display unit iDT-001 (optional accessory) can be connected to the serial port COM2.

(3) Serial Port COM3 (Power Supply Unit)

Serial port COM3 is available when connecting the power supply unit iPS-240 (optional accessory) to the STP pump. The STP-Link (optional accessory) or the display unit iDT-001 (optional accessory) can be connected to the serial port COM3.

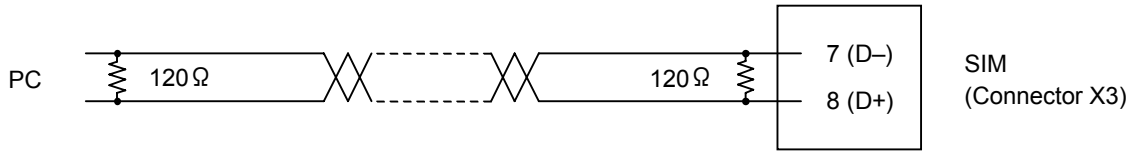
(4) Serial Port COM4 (X4 OPTION PORT Connector)

Serial port COM4 is available when connecting the network unit (optional accessory) to the STP pump.

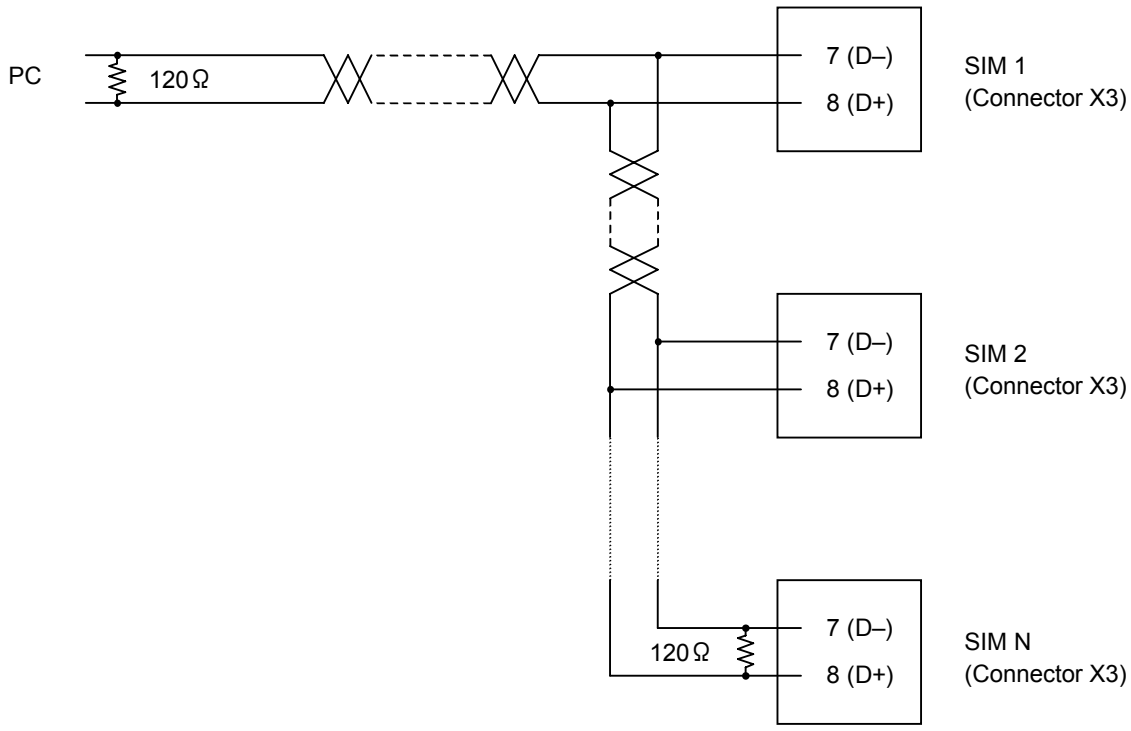
9.2.2 Connecting the RS485

Make sure the followings when using the serial port COM1 with RS485.

- A connection condition is 1 on 1 (single point connection) or 1 on N (multi-point connection).
  A maximum number of 32 SIMs are connectable in the multi-point connection.
- Use twisted-pair wire in communication cable. The extended communication cables should be 1.2 km or less.
- Connect the terminator to the communication devises at both ends of the transmission line. The terminator (120 Ω, 0.25 W) is required for connection (the STP pump dose not have terminator setting function) .



a) RS485 Single Point Connection



b) RS485 Multi-point Connection

Figure 9.2 RS485 Connections

NOTICE

◇ It is recommended to use a communication cable (twisted-pair wire) with shield type, and connect both terminals to the ground.

9.2.3 Communication Parameter Setting

The set value of the serial port COM1 at the factory setting is shown in Table 9.2. To set communication parameters, use the STP-Link (optional accessory) or the display unit iDT-001 (optional accessory).

Table 9.2 Communication Parameters

Communication Parameter	Factory Setting	Setting Range
Baud Rate	9,600 bps	110 to 56,000 bps
Bit Length	8 bit	7, 8
Stop Bit	1 bit	1, 2
Parity	None	None, Even, Odd
Driver Type	RS232	RS232, RS485 Single, RS485 Multi
RS485ID*1	1	1 to 127

*1: It is used in RS485 Multi.

9.2.4 Input Operation Port Setting

Set the input operation port to the serial port when operating the STP pump via the serial port in accordance with the following procedures.

(1) Open the "PORT SELECT IN" signal between (24)–(13) of the "X2 REMOTE" connector.
If the pins are closed, the input operation port will be set to the parallel port automatically, and the input operation via the serial port is disabled (refer to Section 7, "Remote Input/Output Signal Connector" for the details of the "X2 REMOTE" connector).

(2) Set the parameter of the "Remote Operation Mode" to the serial port which operates STP pump, following Section 9.4.15. The parameter value of the factory setting is "I/O REMOTE" (parallel port). The "Remote Operation Mode" can also be changed via the STP-Link (optional accessory) or the display unit iDT-001 (optional accessory).

Table 9.3 Remote Operation Mode

	Parameter	Remark
Parallel port	I/O Remote	X2 REMOTE connector
Serial port	COM1	X1 COM1 connector
	COM2	X5 STP-Link connector
	COM3	Power supply unit (optional accessory)
	COM4	X4 OPTION PORT connector (optional accessory)

NOTICE

◇ Any commands other than STP pump operation are effective in every port regardless of the input operation port setting.

9.2.5 Serial Communication Timeout Setting

If the signal to the input operation port of the STP pump is interrupted for a certain period during acceleration or normal operation, the STP pump detects a failure and stops.
The time setting of the failure detection is user definable. When setting the value to 0, the function is disabled. This value will be common to all serial ports, and the factory setting is 1 min.
The setting value can be changed via serial communication (see Section 9.4.15), the STP-Link (optional accessory), or the display unit iDT-001 (optional accessory).
Design the user application so that the PC can communicate with the STP pump at fixed regular intervals within the setting time, except when the function is disabled (the value is 0).

Table 9.4 Serial Communication Time Out Setting

	Default	Setting Range	Remark
Serial communication time out setting	1 min.	0 to 500 min. (1 min. step)	The function is disabled when the value is set to 0.

NOTICE

◇ When the communication time out is disabled, the STP pump may not stop when the serial communication does not function normally due to a breakage of the communication cable. In this case, interrupt the power supply for 2 seconds or more to stop the STP pump by power failure detection. Supply the power to the STP pump immediately after power failure detection.

9.3 Protocol Specifications

9.3.1 General Description

The STP serial communication protocol enables the SIM to receive the communication command transmitted from the PC and sends a response following the communication command. Each communication command from the PC transmits a text message (ASCII text) assigned to each function. Communication commands include control commands (STP pump operation commands, etc.) and query commands (read-out of STP pump operation mode, etc.).
Table 9.5 shows ASCII characters being used in the transmission control, error control and handshake in the application layer. Note that the transmission frame form differs depending upon the RS232/RS485 single point connection and RS485 multi-point connection (see Section 9.3.8, "Transmission Frame in the RS485 Multi-point Connection").

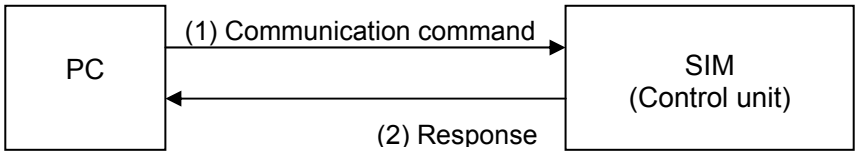


Table 9.5 Transmission Control Characters

	ASCII character	HEX code	Function
Transmission layer	Stx	02	Transmission block start character
	Etx	03	Transmission frame end character
	Etb	17	Transmission block end character
	Ack	06	Acknowledgment response
	Nak	15	Non-acknowledgment response
	@	40	Network frame ID character
Application layer	#	23	Acknowledgment response
	!	21	Non-acknowledgment response

9.3.2 Standard Transmission Frame (in the RS232/RS485 Single Point Connection)

The transmission frame used in the RS232/RS485 single point connection has a single block or multiple transmission blocks. The transmission block consists of a start control character, data block No. (3 digits), a message (up to 255 characters), an end control character, and a checksum (LRC). The following table shows the transmission frame where the message transmission character string is C_n.

Transmission frame when a message is below 255 characters (n<=255):

	1	2	3	4	5		5+n	5+n+1	5+n+2
ASCII	Stx	0	0	1	C_1		C_n	Etx	LRC

"Stx" and "Etx" are used as a start and an end character of the transmission frame, respectively.

Transmission frame when a message exceeds 255 characters (n = 255, m<=255, k = the number of transmission blocks):

First Block		1	2	3	4	5		5+n	5+n+1	5+n+2
	ASCII	Stx	0	0	1	$C1_1$		$C1_n$	Etb	LRC
Second Block		1	2	3	4	5		5+n	5+n+1	5+n+2
	ASCII	Stx	0	0	2	$C2_1$		$C2_n$	Etb	LRC
•••										
Final Block		1	2	3	4	5		5+m	5+m+1	5+m+2
	ASCII	Stx	k			Ck_1		Ck_m	Etx	LRC

"Stx" is used as a start character of each transmission block; "Etb" is used as an end character of the transmission block with a message of 255 characters; "Etx" is used as an end character of the final transmission block (the end character of the transmission frame).

9.3.3 Control Command (in the RS232/RS485 Single Point Connection)

A control command is used when transmitting a pump operation commands and a setting change commands to the SIM. The first character of the control command in the RS232/RS485 single point connection is "Bsp" (a space character, HEX code "20"), and succeeding characters are ASCII characters corresponding to the respective function code and parameter.

Bsp	CHR	C_1	C_2					C_n

CHR: Function code character, C1 to Cn: Parameter

Parameter (from C_1 to C_n) serves as 16 bits signed hexadecimal value coded ASCII text. When a message (a space character, a function code, and parameter) exceeds 255 characters, input "Bsp" and CHR only to the top transmission block (the first transmission block of the transmission frame). It is not necessary to input them to the 2nd and succeeding transmission blocks.
The SIM returns the acknowledgment response character "#" when the control command is processed normally. If not, the SIM returns the non-acknowledgment response character "!" and 3 characters of the non-acknowledgment code are added to "!".

Transmission frame when data is transmitted to one block (a message is less than 256 characters):
Designate the control command on the PC.

←Less than 256 chr.→

PC→SIM	Stx	0	0	1	Bsp	CHR	C_1		C_n	Etx	LRC
SIM→PC											Ack or Nak

Always assign less than 254 characters (n< 254) to the parameter so that the message is less than 256 characters.

Then, the preceding SIM->PC character is "Ack", the instructed control command is executed and the SIM returns the following response.

PC→SIM							Ack or Nak
SIM→PC	Stx	0	0	1	# or !	Etx	LRC

The PC transmits "Ack" or "Nak"; then transmits the next command if necessary.

Transmission frame when data is transmitted to two blocks (message is more than 256 characters and less than 512 characters):

Designate the control command (the 1st block) on the PC.

PC→SIM	Stx	0	0	1	Bsp	CHR	C_1		C_{253}	Etb	LRC
SIM→PC											Ack or Nak

Next, the preceding SIM->PC character is "Ack", the PC continues instructing the control command (the 2nd block).

PC→SIM	Stx	0	0	2	C_{254}		C_n	Etx	LRC	
SIM→PC										Ack or Nak

Always assign less than 510 characters (n< 510) to the parameter so that the message is less than 512 characters.

Then, the preceding SIM->PC character is "Ack", the instructed control command is executed and the SIM returns the following response.

PC→SIM								Ack or Nak
SIM→PC	Stx	0	0	1	# or !	Etx	LRC	

The PC transmits "Ack" or "Nak"; then transmits the next command if necessary.

9.3.4 Query Command (in the RS232/RS485 Single Point Connection)

A query command is used to read the pump operation state and setting values. The first character of the query command in the RS232/RS485 single point connection is "?" (HEX code "3F"), and succeeding characters are ASCII characters corresponding to the respective function code and parameter.

?	CHR	C_1	C_2			C_n

CHR: Function code character, C_1 to C_n: Parameter

Parameter (from C_1 to C_n) serves as 16 bits signed hexadecimal value coded ASCII text. When a message (a space character, a function code, and parameter) exceeds 255 characters, input "?" and CHR only to the top transmission block (the first transmission block of the transmission frame). It is not necessary to input them to the 2nd and succeeding transmission blocks.

The SIM returns the acknowledgment response character "#" when the query command is processed normally. If not, the SIM returns the non-acknowledgment response character "!" and 3 characters of the non-acknowledgment code are added to "!".

Transmission frame when data is transmitted at one block and returned at two blocks:
Designate a query command on the PC.

←Less than 256 chr.→

PC→SIM	Stx	0	0	1	?	CHR	C_1		C_n	Etx	LRC
SIM→PC											Ack or Nak

Always assign less than 254 characters (n< 254) to the parameter so that the message is less than 256 characters.

Next, the preceding SIM->PC character is "Ack", the instructed query command is executed and the SIM returns the following response (1st block).

PC→SIM											Ack or Nak
SIM→PC	Stx	0	0	1	Bsp	CHR	C_1		C_{253}	Etb	LRC

Then, "Ack" is sent by the SIM->PC character in reaction to the response (1st block) from the SIM, the SIM returns the following response (2nd block).

PC→SIM									Ack or Nak
SIM→PC	Stx	0	0	2	C_{254}		C_n	Etx	LRC

The PC transmits "Ack" or "Nak"; then transmits the next command if necessary.

9.3.5 Transmission Data Format

Data value is always 16 bits signed hexadecimal value coded ASCII text.
Example: 12090 on a decimal basis equals to 2F3A on a hexadecimal basis.

9.3.6 Frame Control (Checksum)

The transmission frame is controlled by the odd number parity check.
First initialize LRC as FF_{hex}. Next calculate LRC by EXCLUSIVE-OR (XOR) of all the frame bytes containing "Stx", "Etb", "Etx" and LRC, and transmit the result as LRC.

Examples: Character string for calculation before calculating LRC

ASCII	Stx	0	0	1	#	Etx	LRC
HEX	02	30	30	31	23	03	FF

Calculation of LRC
02_{hex} XOR 30_{hex} XOR 30_{hex} XOR 31_{hex} XOR 23_{hex} XOR 03_{hex} XOR FF_{hex} = EC_{hex}

Character string for transmission after calculating LRC

ASCII	Stx	0	0	1	#	Etx	LRC
HEX	02	30	30	31	23	03	EC

9.3.7 Error Control

- Transmit the transmission frame repeatedly from the PC when the SIM transmits "Nak" (parity check error). When the SIM receives "Nak" from the PC, the transmission frame is transmitted again. This operation is repeated up to 5 times.
- The SIM transmits "Ack" or "Nak" to the PC after the completion of communication command reception. When the PC cannot receive "Ack" or "NaK" after 2 second, retransmit the transmission frame from the PC.

When these communication statuses occur repeatedly, display to an error message or start the error routine on the PC.

9.3.8 Transmission Frame in the RS485 Multi-point Connection

To identify a network frame and ensure the compatibility with a standard transmission frame, add a network frame ID character " @ " and a title of 3 characters of network frame No. to the transmission frame in the RS485 multi-point connection.
Network frame No. is specified by any 16 bits signed hexadecimal value coded ASCII text (alphabets are in capitals) of 1 to 127 to identify the SIM.

Examples: Network frame ID character and No. in the multi-point connection

ASCII	@	0	1
HEX	40	30	31

Network frame No. "1"

ASCII	@	6	4
HEX	40	36	34

Network frame No. "100"

ASCII	@	7	F
HEX	40	37	46

Network frame No. "127"

The transmission frame has a single block or multiple transmission blocks. Each transmission block consists of a network frame ID character, a network frame No., a start control character, data block No. (3 digits), a message (up to 255 characters), an end control character, and a checksum (LRC). The following shows the transmission frame when the message transmission character string is C_n.

Transmission frame when a message is below 255 characters (n<=255):

	1	2	3	4	5	6	7	8		8+n	8+n+1	8+n+2
ASCII	@	F_1	F_2	Stx	0	0	1	C_1		C_n	Etx	LRC

"@" is used as a network frame ID character.
"Stx" and "Etx" are used as a start and an end character of the transmission frame respectively.

Transmission frame when a message exceeds 255 characters (n = 255, m<=255, k = the number of transmission blocks):

First Block		1	2	3	4	5	6	7	8	8+n	8+n+1	8+n+2
	ASCII	@	F_1	F_2	Stx	0	0	1	$C1_1$	$C1_n$	Etb	LRC
Second Block		1	2	3	4	5	6	7	8	8+n	8+n+1	8+n+2
	ASCII	@	F_1	F_2	Stx	0	0	2	$C2_1$	$C2_n$	Etb	LRC
•••												
Final Block		1	2	3	4	5	6	7	8	8+m	8+m+1	8+m+2
	ASCII	@	F_1	F_2	Stx	k			Ck_1	Ck_m	Etx	LRC

"@" is used as a network frame ID character.
"Stx" is a start character of each transmission block, and "Etb" is an end character of the transmission block of a message of 255 characters.
"Etx" is used as an end character of the final transmission block (end character of the transmission frame).

9.3.9 Control Command in the RS485 Multi-point Connection

The control command to be used when a pump operation instruction or a setting change instruction is transmitted to the SIM is arranged in the order specified below: The top is "Bsp" (space character, HEX code"20") and ASCII characters corresponding to the respective function code and parameter follow.

Bsp	CHR	C_1	C_2		C_n

CHR: Function code character, C_1 to C_n: Parameter

Parameter (from C_1 to C_n) serves as 16 bits signed hexadecimal value coded ASCII text. When a message (a space character, a function code, and parameter) exceeds 255 characters, input "Bsp" and CHR only to the top transmission block (the first transmission block of the transmission frame). It is not necessary to input them to the 2nd and succeeding transmission blocks.
The SIM returns the acknowledgment response character "#" when the control command is processed normally. If not, the SIM returns the non-acknowledgment response character "!" and 3 characters of the non-acknowledgment code are added to "!".

Transmission frame when data is transmitted to one block (a message is less than 256 characters):
Designate the control command on the PC.

←Less than 256 chr.→

PC→SIM	@	F_1	F_2	Stx	0	0	1	Bsp	CHR	C_1		C_n	Etx	LRC	
SIM→PC														Ack or Nak	F_1 F_2

Always assign less than 254 characters (n< 254) to the parameter so that the message is less than 256 characters.

Next, the preceding SIM->PC character is "Ack", the instructed control command is executed and the SIM returns the following response.

PC→SIM										Ack or Nak	F_1 F_2
SIM→PC	@	F_1	F_2	Stx	0	0	1	# or !	Etx	LRC	

The PC transmits "Ack" or "Nak"; then transmits the next command if necessary.

Transmission frame when data is transmitted to two blocks (message is more than 256 characters and less than 512 characters):

Designate the control command (the 1st block) on the PC.

PC→SIM	@	F_1	F_2	Stx	0	0	1	Bsp	CHR	C_1		C_{253}	Etb	LRC
SIM→PC													Ack or Nak	F_1 F_2

Next, the preceding SIM->PC character is "Ack", the PC continues instructing the control command (the 2nd block).

PC→SIM	@	F_1	F_2	Stx	0	0	2	C_{254}		C_n	Etx	LRC	
SIM→PC												Ack or Nak	F_1 F_2

Next, the preceding SIM->PC character is "Ack", the PC continues instructing the control command (the 2nd block).

Then, the preceding SIM->PC character is "Ack", the instructed control command is executed and the SIM returns the following response.

PC→SIM										Ack or Nak	F_1 F_2
SIM→PC	@	F_1	F_2	Stx	0	0	1	# or !	Etx	LRC	

The PC transmits "Ack" or "Nak"; then transmits the next command if necessary.

9.3.10 Query Command in the RS485 Multi-point Connection

The query command to be used when a pump operation instruction or a setting change instruction is transmitted from the SIM is arranged in the order specified below. The top is "?" (HEX code "3F") and ASCII characters corresponding to the respective function code and parameter follow:

?	CHR	C_1	C_2					C_n

CHR: Function code character, C_1 to C_n: Parameter

Parameter (from C_1 to C_n) serves as 16 bits signed hexadecimal value coded ASCII text. When a message (a space character, a function code, and parameter) exceeds 255 characters, input "?" and CHR only to the top transmission block (the first transmission block of the transmission frame). It is not necessary to input them to the 2nd and succeeding transmission blocks.

The SIM returns the acknowledgment response character "#" when the query command is processed normally. If not, the SIM returns the non-acknowledgment response character "!" and 3 characters of the non-acknowledgment code are added to "!".

Transmission frame when data is transmitted from one block and returned to two block

Designate a query command on the PC.

←Less than 256 chr.→

PC→SIM	@	F_1	F_2	Stx	0	0	1	?	CHR	C_1		C_n	Etx	LRC
SIM→PC													Ack or Nak	F_1 F_2

Always assign less than 254 characters (n< 254) to the parameter so that the message is less than 256 characters.

Next, the preceding SIM->PC character is "Ack", the instructed query command is executed and the SIM returns the following response (1st block).

PC→SIM													Ack or Nak	F_1 F_2
SIM→PC	@	F_1	F_2	Stx	0	0	1	Bsp	CHR	C_1		C_{253}	Etb	LRC

Then, "Ack" is sent by the SIM->PC character in reaction to the response (1st block) from the SIM, the SIM returns the following response (2nd block).

PC→SIM													Ack or Nak	F_1 F_2
SIM→PC	@	F_1	F_2	Stx	0	0	2	C_{254}		C_n	Etx	LRC		

The PC transmits "Ack" or "Nak"; then transmits the next command if necessary.

9.3.11 Broadcasting Command in the RS485 Multi-point Connection

START or STOP of pump operation command allows to be concurrently instructed to all the multi-connected SIMs. Always assign 0 (HEX code "30", "30") to network frame No. Note that there is no response from the respective SIM.

PC→SIM	@	0	0	Stx	0	0	1	Bsp	E	Parameter 1	Etx	LRC	
SIM→PC													No response

Parameter	Item	Data Format	Remark
1	Pump operation commands	8-bits hexadecimal coded ASCII	See Table 9.6

Table 9.6 Pump Operation Commands

Pump operation command	Value
START	1
STOP	2

9.4 Command Specifications

9.4.1 Command List

Table 9.7 Command List

Function code		Command/Query Name	Function
?	D	ReadMeas	Reads the current measured rotational speed
Bsp	E	Command	Sends commands START, STOP, RESET [*1]
?	F	ReadFailMess	Reads the errors being detected
?	M	ReadModFonct	Reads the pump operation mode and the errors being detected
?	V	ReadVersion	Reads the software version of the control unit
?	c	ReadCounters	Reads serial number, hour counter and start counter
?	e	ReadMotorTemp	Reads the measured motor temperature
?	g	ReadEvents	Reads the error record
Bsp	h	SetSpeedSetPoint	Changes the speed set point
?	h	ReadSpeedSetPoint	Reads the speed set point
?	m	ReadModFonctWithWarning	Reads the pump operation mode, the errors and the warnings being detected
?	[	ReadMeasValue	Reads the motor temperature, motor current, measured rotational speed, and control unit temperature
?	=	ReadOptionFunc	Reads each setting value of items [*2]
Bsp	=	SetOptionFunc	Changes each setting value of items [*2]
?	{	ReadCondition	Reads pump model and damage point [*2]
?	}	ReadEventsWithTime	Reads the error record with detection time [*2]

[*1] : These commands are valid only when being sent to the serial port which is set as the input operation port.

[*2] : It is applied to the STP pump manufactured in August, 2006 and later. Contact Edwards about the STP pump manufactured before then.

9.4.2 ReadMeas

Function:

Reads the measured rotational speed.

Transmission Frame:

PC→SIM	Stx	0	0	1	?	D	Etx	LRC
SIM→PC								Ack

PC→SIM										Ack
SIM→PC	Stx	0	0	1	Bsp	D	Parameter 1 to 2	Etx	LRC	

Parameter	Item	Data format	Remarks
1	[System reservation]	56-bits hexadecimal coded ASCII	
2	Measured rotational speed (Unit: Hz)	16-bits hexadecimal coded ASCII	

Example:

Measured rotational speed: 0395_{hex} = 917 Hz = 55,020 rpm

Parameter	1													2			
ASCII	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	0	3	9	5
HEX														30	33	39	35

*1: System reservation

9.4.3 Command

Function:

Sends the pump operation commands START, STOP and RESET.
These commands are valid only when being sent to the serial port which is set as the input operation port. Refer to Section 9.2.4, "Input Operation Port Setting" and Section 9.4.15, "SetOptionFunc" for the setting method of the input operation port.

Transmission Frame:

PC→SIM	Stx	0	0	1	Bsp	E	Parameter 1	Etx	LRC
SIM→PC									Ack

PC→SIM							Ack
SIM→PC	Stx	0	0	1	#	Etx	LRC

Parameter	Item	Data format	Remark
1	Pump operation command	8-bits hexadecimal coded ASCII	See Table 9.8

Table 9.8 Pump Operation Commands

Pump operation command	Value
START	1
STOP	2
RESET	4

Example:

Pump operation command: RESET operation = 4 = 04_{hex}

Parameter	1	
ASCII	0	4
HEX	30	34

9.4.4 ReadFailMess

Function:

Reads the errors being detected.
This data is the same data as that of "ReadModFonct" parameter 2 to 81 or "ReadModFonctWithWarning" parameter 3 to 82.

Transmission Frame:

PC→SIM	Stx	0	0	1	?	F	Etx	LRC
SIM→PC								Ack

PC→SIM										Ack
SIM→PC	Stx	0	0	1	Bsp	F	Parameter 1 to 80 *1		Etx	LRC

Parameter	Item	Data format	Remarks
1	The number of error	8-bits hexadecimal coded ASCII	Up to 79 errors *1
2 ~ 80 *1	Error 1	8-bits hexadecimal coded ASCII	*2
	…	…	
	Error 79 *1	8-bits hexadecimal coded ASCII	

*1: The maximum number of errors may differ depending upon the software version of STP pump. It is recommended that an application is designed as variable-length data.

*2: Value corresponding to the error is transmitted (see Table 9.9).
The recent error has the largest parameter number. When the number of errors being detected is under the maximum number, the value of parameter that is larger than the number of errors being detected is set to 0.

Example:

The number of error :02_{hex} = 2 errors
Error 1 :$0D_{hex}$ = 13 = Disturbance Xh
Error 2 :$0F_{hex}$ = 15 = Disturbance Xb
Error 3 to 79 :00_{hex} = No error detected

Parameter	1		2		3		4		5		6		7		8		9		10	
ASCII	0	2	0	D	0	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEX	30	32	30	44	30	46	30	30	30	30	30	30	30	30	30	30	30	30	30	30

Parameter	11		12		13					68		69		70	
ASCII	0	0	0	0	0	0		[Omitted]		0	0	0	0	0	0
HEX	30	30	30	30	30	30				30	30	30	30	30	30

Parameter	71		72		73		74		75		76		77		78		79		80	
ASCII	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEX	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30

Table 9.9 Error Values

Error	Value
Ram Error	0
[System reservation]	1
[System reservation]	2
[System reservation]	3
[System reservation]	4
Power Failure	5
[System reservation]	6
Overspeed 1	7
DRV Overvoltage	8
[System reservation]	9
CNT Overheat	10
DRV Overcurrent	11
DRV Overload	12
Disturbance X_H	13
Disturbance Y_H	14
Disturbance X_B	15
Disturbance Y_B	16
Disturbance Z	17
MOTOR Overheat	18
[System reservation]	19
CNT Overheat	20
[System reservation]	21
[System reservation]	22
[System reservation]	23
DRV Com. Failure	24
WARNING: Damage Limit	25 *1
[System reservation]	26
[System reservation]	27
Speed Pulse Lost	28
Overspeed 2	29
Overspeed 3	30
M_Temp Lost	31
[System reservation]	32
AMB Com. Failure	33
[System reservation]	34
[System reservation]	35
[System reservation]	36
[System reservation]	37
[System reservation]	38
[System reservation]	39

Error	Value
[System reservation]	40
[System reservation]	41
[System reservation]	42
WARNING: Imbalance X_H	43 *1
WARNING: Imbalance X_B	44 *1
WARNING: Imbalance Z	45 *1
[System reservation]	46
[System reservation]	47
[System reservation]	48
[System reservation]	49
[System reservation]	50
[System reservation]	51
[System reservation]	52
[System reservation]	53
[System reservation]	54
[System reservation]	55
[System reservation]	56
AMB Overcurrent	57
[System reservation]	58
Acc Malfunction	59
[System reservation]	60
Record Failure	61
[System reservation]	62
[System reservation]	63
[System reservation]	64
[System reservation]	65
[System reservation]	66
[System reservation]	67
[System reservation]	68
[System reservation]	69
[System reservation]	70
[System reservation]	71
Aberrant Brake	72
Aberrant Accel	73
[System reservation]	74
[System reservation]	75
[System reservation]	76
[System reservation]	77
Serial Com. Fail	78

*1: WARNING message. It is not a state of failure (Refer to Section 12, "WARNING Function" for details). The STP pump will continue to operate after the warning is detected. It is recommended that an application be designed with this in consideration.

9.4.5 ReadModFonct

Function:

Reads the pump operation mode and the errors being detected.
The data of errors being detected reads the same data as that of "ReadFailMess".

Transmission Frame:

PC→SIM	Stx	0	0	1	?	M	Etx	LRC
SIM→PC								Ack

PC→SIM									Ack
SIM→PC	Stx	0	0	1	Bsp	M	Parameter 1 to 81 *1	Etx	LRC

Parameter	Item	Data format	Remarks
1	Pump operation mode	8-bits hexadecimal coded ASCII	See Table 9.10
2	The number of error	8-bits hexadecimal coded ASCII	Up to 79 errors *1
3 ~ 81 *1	Error 1	8-bits hexadecimal coded ASCII	*2
	…	…	
	Error 79 *1	8-bits hexadecimal coded ASCII	

*1: The maximum number of errors may differ depending upon the software version of STP pump. It is recommended that an application is designed as variable-length data.

*2: Value corresponding to the error is transmitted (see Table 9.9).
The recent error has the largest parameter number. When the number of errors being detected is under the maximum number, the value of parameter that is larger than the number of errors being detected is set to 0.

Table 9.10 Pump Operation Mode

Pump operation mode	Value
Levitation	1
No Levitation	2
Acceleration	3
Normal	4
Deceleration (Brake)	5
Autotest	6
[System reservation]	7
[System reservation]	8
[System reservation]	9
[System reservation]	10
[System reservation]	11

Example:

Pump operation mode : 01_{hex} = 1 = Levitation
The number of error : 02_{hex} = 2 errors
Error 1 : $0D_{hex}$ = 13 = Disturbance Xh
Error 2 : $0F_{hex}$ = 15 = Disturbance Xb
Error 3 to 79 : 00_{hex} = No error detected

Parameter	1		2		3		4		5		6		7		8		9		10	
ASCII	0	1	0	2	0	D	0	F	0	0	0	0	0	0	0	0	0	0	0	0
HEX	30	31	30	32	30	44	30	46	30	30	30	30	30	30	30	30	30	30	30	30

Parameter	11		12		13				68		69		70	
ASCII	0	0	0	0	0	0	[Omitted]		0	0	0	0	0	0
HEX	30	30	30	30	30	30			30	30	30	30	30	30

Parameter	71		72		73		74		75		76		77		78		79		80	
ASCII	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEX	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30

Parameter	81	
ASCII	0	0
HEX	30	30

9.4.6 ReadVersion

Function:

Read the software version.

Transmission Frame:

PC→SIM	Stx	0	0	1	?	V	Etx	LRC
SIM→PC								Ack

PC→SIM										Ack
SIM→PC	Stx	0	0	1	Bsp	V	Parameter 1 to 24		Etx	LRC

Parameter	Item	Data format	Remarks
1 to 16	Control unit software version	8-bits hexadecimal coded ASCII	
17 to 20	Motor driver software version	4-bits ASCII character	Ver.1.2 = 0120
21 to 24	AMB software version (Digital control loop)	4-bits ASCII character	Ver.3.4 = 0340 *1
	(Analog control loop)	4-bits ASCII character	FFFF fixed *1

*1: STP-iX455/iXL455 series use a digital control loop.

Example:

Control unit software version : $36345F4120312E302020202020202020_{hex}$ = 64_A 1.0

Motor driver software version : 0120_{hex} = 1.2

AMB software version : 0340_{hex} = 3.4

Parameter	1		2		3		4		5		6		7		8	
	"6"		"4"		"_"		"A"		" "		"1"		"."		"0"	
ASCII	3	6	3	4	5	F	4	1	2	0	3	1	2	E	3	0
HEX	33	36	33	34	35	46	34	31	32	30	33	31	32	45	33	30

Parameter	9		10		11		12		13		14		15		16	
	" "		" "		" "		" "		" "		" "		" "		" "	
ASCII	2	0	2	0	2	0	2	0	2	0	2	0	2	0	2	0
HEX	32	30	32	30	32	30	32	30	32	30	32	30	32	30	32	30

Parameter	17	18	19	20	21	22	23	24
ASCII	0	1	2	0	0	3	4	0
HEX	30	31	32	30	30	33	34	30

9.4.7 ReadCounters

Function:

Reads serial number, hour counter and start counter.

Transmission Frame:

PC→SIM	Stx	0	0	1	?	c	Etx	LRC
SIM→PC								Ack

PC→SIM										Ack
SIM→PC	Stx	0	0	1	Bsp	c	Parameter 1 to 23		Etx	LRC

Parameter	Item	Data format	Remarks
1 to 10	Control unit serial number	4-bits ASCII character	
11 to 20	Pump serial number	4-bits ASCII character	
21	Pump hour counter (Unit: minute)	32-bits hexadecimal coded ASCII	
22	Control unit hour counter (Unit: minute)	32-bits hexadecimal coded ASCII	
23	Start counter	32-bits hexadecimal coded ASCII	

Example:

Control unit serial number : 12345
Pump serial number : 6789A
Pump hour counter : $0000003C_{hex}$ = 60 minutes = 1 hour
Control unit hour counter : $0000028C_{hex}$ = 652 minutes = 10 hours 52 minutes
Start counter : 00000064_{hex} = 100 times

Parameter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ASCII	1	2	3	4	5						6	7	8	9	A					
HEX	31	32	33	34	35	20	20	20	20	20	36	37	38	39	41	20	20	20	20	20

Parameter	21								22							
ASCII	0	0	0	0	0	0	3	C	0	0	0	0	0	2	8	C
HEX	30	30	30	30	30	30	33	43	30	30	30	30	30	32	38	43

Parameter	23							
ASCII	0	0	0	0	0	0	6	4
HEX	30	30	30	30	30	30	36	34

9.4.8 ReadMotorTemp

Function:

Reads the measured motor temperature.

Transmission Frame:

PC→SIM	Stx	0	0	1	?	e	Etx	LRC
SIM→PC								Ack

PC→SIM									Ack
SIM→PC	Stx	0	0	1	Bsp	e	Parameter 1	Etx	LRC

Parameter	Item	Data format	Remark
1	Motor temperature (Unit: °C)	16-bits hexadecimal coded ASCII	

Example:

Motor temperature: 0014_{hex} = 20 °C

Parameter	1			
ASCII	0	0	1	4
HEX	30	30	31	34

9.4.9 ReadEvents

Function:

Reads the "Error Record".
It has the recent 10 errors that have been detected.

Transmission Frame:

PC→SIM	Stx	0	0	1	?	g	Etx	LRC
SIM→PC								Ack

PC→SIM									Ack
SIM→PC	Stx	0	0	1	Bsp	g	Parameter 1 to 11	Etx	LRC

Parameter	Item	Data format	Remarks
1	The number of "Error Record"	8-bits hexadecimal coded ASCII	Up to 10 errors
2 to 11	Error Record 1 to Error Record 10	8-bits hexadecimal coded ASCII	*1

*1: Value corresponding to the error is transmitted (see Table 9.9).
The recent error has the smallest parameter number. When the number of errors being detected is under the maximum number, the value of parameter that is larger than the number of errors has been detected is set to 0.

Example:

When 3 errors have been detected in the past;

The number of "Error Record"	: 03_{hex} = 3 errors
Error Record 1	: $0F_{hex}$ = 15 = Disturbance Xb
Error Record 2	: $0D_{hex}$ = 13 = Disturbance Xh
Error Record 3	: 12_{hex} = 18 = MOTOR Overheat
Error Record 4 to 10	: 00_{hex} = No error recorded

Parameter	1	
ASCII	0	3
HEX	30	33

Parameter	2		3		4		5		6		7		8		9		10		11	
ASCII	0	F	0	D	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEX	30	46	30	44	31	32	30	30	30	30	30	30	30	30	30	30	30	30	30	30

9.4.10 SetSpeedSetPoint

Function:

Changes the "Speed Set Point" value.
This value can be changed the range from 45,000 to 55,020 rpm.
The threshold value of the illumination pattern of the "ROTATION" LED is fixed.
It is not changed even if the setting value of the rotational speed is changed.

Transmission Frame:

PC→SIM	Stx	0	0	1	Bsp	h	Paramert 1	Etx	LRC
SIM→PC									Ack

PC→SIM							Ack
SIM→PC	Stx	0	0	1	#	Etx	LRC

Parameter	Items	Data format	Remark
1	Speed Set Point (Unit: Hz)	16-bits hexadecimal coded ASCII	*1

*1: When the value set to the parameter is larger than the upper limit, it is automatically set to the upper limit.
When the value set to the parameter is smaller than the lower limit, it is automatically set to the lower limit.

Example:

Speed Set Point: 54,000 rpm = 900 Hz = 0384_{hex}

Parameter	1			
ASCII	0	3	8	4
HEX	30	33	38	34

9.4.11 ReadSpeedSetPoint

Function:

Reads the "Speed Set Point" value.
This value is the same as "ReadSetPoint" parameter 1 (Speed Set Point).

Transmission Frame:

PC→SIM	Stx	0	0	1	?	h	Etx	LRC
SIM→PC								Ack

PC→SIM									Ack
SIM→PC	Stx	0	0	1	Bsp	h	Parameter 1	Etx	LRC

Parameter	Item	Data format	Remark
1	Speed Set Point (Unit: Hz)	16-bits hexadecimal coded ASCII	

Example:

Speed Set Point: 0320_{hex} = 800 Hz = 48,000 rpm

Parameter	1			
ASCII	0	3	2	0
HEX	30	33	32	30

9.4.12 ReadModFonctWithWarning

Function:

Reads the pump operation mode, errors and warnings being detected.
The data of errors being detected data is the same data as that of "ReadFailMess".

Transmission Frame:

PC→SIM	Stx	0	0	1	?	m	Etx	LRC
SIM→PC								Ack

PC→SIM									Ack
SIM→PC	Stx	0	0	1	Bsp	m	Parameter 1 to 82 *1	Etx	LRC

Parameter	Item	Data format	Remarks
1	Pump operation mode	8-bits hexadecimal coded ASCII	See Table 9.10
2	WARNING being detected	16-bits hexadecimal coded ASCII	See Table 9.11
3	The number of errors detected	8-bits hexadecimal coded ASCII	Up to 79 errors *1
4 to 82 *1	Error 1	8-bits hexadecimal coded ASCII	*2
	…	…	
	Error 79 *1	8-bits hexadecimal coded ASCII	

*1: The maximum number of errors may differ depending upon the software version of STP pump. It is recommended that an application is designed as variable-length data.

*2: Value corresponding to the error is transmitted (see Table 9.9).
The recent error has the largest parameter number. When the number of errors being detected is under the maximum number, the value of parameter that is larger than the number of errors being detected is set to 0.

Table 9.11 Warning Value Bit Assign

Bit	Warning message	16-bits hex value
0	[System reservation]	0001
1	[System reservation]	0002
2	WARNING: Damage Limit	0004
3	WARNING: Imbalance X_H	0008
4	WARNING: Imbalance X_B	0010
5	WARNING: Imbalance Z	0020
6	WARNING: Pump Run Time Over	0040
7	[System reservation]	0080
8	[System reservation]	0100
9	[System reservation]	0200
10	[System reservation]	0400
11	[System reservation]	0800
12	[System reservation]	1000
13	[System reservation]	2000
14	[System reservation]	4000
15	[System reservation]	8000

Example:

Pump operation mode : 01_{hex} = 1 = Levitation
WARNING being detected : $000C_{hex}$ = 0004_{hex} OR 0008_{hex} = 2 warnings of "WARNING: Damage Limit", "WARNING: Imbalance X_H"
The number of error : 02_{hex} = 2 errors
Error 1 : $0D_{hex}$ = 13 = Disturbance Xh
Error 2 : $0F_{hex}$ = 15 = Disturbance Xb
Error 3 to 79 : 00_{hex} = No error detected

Parameter	1		2			
ASCII	0	1	0	0	0	C
HEX	30	31	30	30	30	43

Parameter	3		4		5		6		7		8		9		10		11		12	
ASCII	0	2	0	D	0	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEX	30	32	30	44	30	46	30	30	30	30	30	30	30	30	30	30	30	30	30	30

Parameter	13		14		15				70		71		72	
ASCII	0	0	0	0	0	0		[Omitted]	0	0	0	0	0	0
HEX	30	30	30	30	30	30			30	30	30	30	30	30

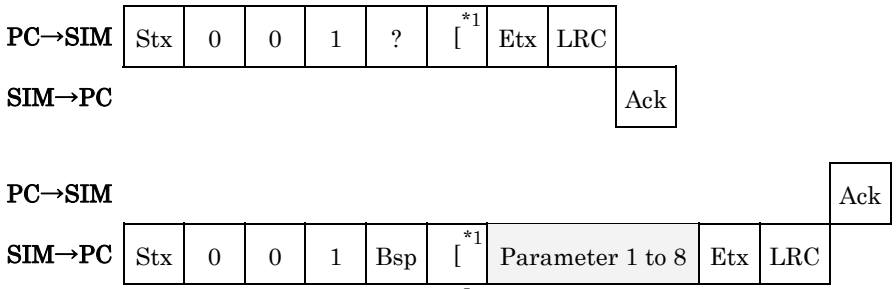
Parameter	73		74		75		76		77		78		79		80		81		82	
ASCII	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEX	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30

9.4.13 ReadMeasValue

Function:

Reads the motor temperature, motor current, measured rotational speed, and control unit temperature.
The motor temperature value is the same temperature as "ReadMotorTemp".
The measured rotational speed value is the same as "ReadMeas" parameter 2 (Measured rotational speed).

Transmission Frame:



*1: The HEX code of ASCII character ' [' is "5B".

Parameter	Item	Data format	Remarks
1	[System reservation]	136-bits hexadecimal coded ASCII	
2	Motor temperature (Unit: °C)	16-bits hexadecimal coded ASCII	
3	[System reservation]	8-bits hexadecimal coded ASCII	
4	Motor current (Unit: 0.1 A)	8-bits hexadecimal coded ASCII	
5	[System reservation]	24-bits hexadecimal coded ASCII	
6	Measured rotational speed (Unit: Hz)	16-bits hexadecimal coded ASCII	
7	[System reservation]	48-bits hexadecimal coded ASCII	
8	Control unit temperature (Unit: °C)	16-bits hexadecimal coded ASCII	

Example:

2. Motor temperature : 0014_{hex} = 20 °C
4. Motor current : 19_{hex} = 2.0 A
6. Measured rotational speed : 0395_{hex} = 917 Hz = 55,020 rpm
8. Control unit temperature : 0032_{hex} = 50 °C

Parameter	1																	
ASCII	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1
HEX																		

Parameter	1															
ASCII	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1
HEX																

Parameter	2				3		4		5						6			
ASCII	0	0	1	4	*1	*1	1	9	*1	*1	*1	*1	*1	*1	0	3	9	5
HEX	30	30	31	34			31	39							30	33	39	35

Parameter	7												8			
ASCII	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	0	0	3	2
HEX													30	30	33	32

*1: System reservation

9.4.14 ReadOptionFunc

Function:

Reads the setting value of the remote operation mode, vent valve, warning function, and serial communication time out.

Transmission Frame:

PC→SIM	Stx	0	0	1	?	=*1	Etx	LRC
SIM→PC								Ack

PC→SIM										Ack
SIM→PC	Stx	0	0	1	Bsp	=*1	Parameter 1 to 13	Etx	LRC	

*1: The HEX code of ASCII character ' = ' is "3D".

Parameter	Item	Data format	Remarks
1	Remote operation mode setting	8-bits hexadecimal coded ASCII	
2	[System reservation]	16-bits hexadecimal coded ASCII	
3	Vent valve Enable/Disable setting	8-bits hexadecimal coded ASCII	
4	Vent valve starting speed setting (Unit:%)	8-bits hexadecimal coded ASCII	
5	Vent valve running time setting (Unit:sec.)	16-bits hexadecimal coded ASCII	
6	[System reservation]	16-bits hexadecimal coded ASCII	
7	Damage Limit Warning Enable/Disable setting	8-bits hexadecimal coded ASCII	
8	Pump Runtime Over Warning Enable/Disable setting	8-bits hexadecimal coded ASCII	
9	Pump Runtime Over Warning Hours setting (x 100 hours)	32-bits hexadecimal coded ASCII	
10	Imbalance Warning Enable/Disable setting	8-bits hexadecimal coded ASCII	
11	[System reservation]	40-bits hexadecimal coded ASCII	
12	Serial communication time out setting (Unit:sec.)	16-bits hexadecimal coded ASCII	60 sec. step
13	[System reservation]	88-bits hexadecimal coded ASCII	

Table 9.12 Parameter Setting Value

Parameter	Item	Setting range
1	Remote operation mode setting	I/O REMOTE (X2): 01_{hex} COM1 (X3): 02_{hex} COM2 (X5 STP-Link): 05_{hex} COM3 (Power supply unit): 06_{hex} COM4 (Communication unit): 07_{hex}
3	Vent valve Enable/Disable setting	ENABLE: 00_{hex} DISABLE: FF_{hex}
4	Vent valve starting speed setting	10 to 80% ($0A_{hex}$ to 50_{hex})
5	Vent valve running time setting	5 to 600sec. (0005_{hex} to 0258_{hex})
7	Damage Limit Warning Enable/Disable setting	ENABLE: 00_{hex} DISABLE: FF_{hex}
8	Pump Runtime Over Warning Enable/Disable setting	ENABLE: 00_{hex} DISABLE: FF_{hex}
9	Pump Runtime Over Warning Hours setting	0 to 300,000×100 hours (00000000_{hex} to $000493E0_{hex}$)
10	Imbalance Warning Enable/Disable setting	ENABLE: 00_{hex} DISABLE: FF_{hex}
12	Serial communication time out setting	0 to 30,000 sec. (0000_{hex} to 7530_{hex}) Round down to the 60 seconds Set to 0 to disable function

Example:

1.	Remote operation mode	: 01_{hex} = I/O REMOTE
3.	Vent valve function	: FF_{hex} = DISABLE
4.	Vent valve starting speed	: 32_{hex} = 50 %
5.	Vent valve running time	: $003C_{hex}$ = 60 sec.
7.	Damage Limit Warning	: 00_{hex} = ENABLE
8.	Pump Runtime Over Warning	: FF_{hex} = DISABLE
9.	Pump Runtime Over Warning Hours	: $000186A0_{hex}$=100,000 (x 100 hours)
10.	Imbalance Warning	: 00_{hex} = ENABLE
12.	Serial communication time out	: $003C_{hex}$ = 60 sec.

Parameter	1		2				3		4		5				6				7	
ASCII	0	1	*1	*1	*1	*1	F	F	3	2	0	0	3	C	*1	*1	*1	*1	0	0
HEX	30	31					46	46	33	32	30	30	33	43					30	30

Parameter	8		9								10	
ASCII	F	F	0	0	0	1	8	6	A	0	0	0
HEX	46	46	30	30	30	31	38	36	41	30	30	30

Parameter	11										12				13					
ASCII	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	0	0	3	C	*1	*1	*1	*1	*1	*1
HEX											30	30	33	43						

Parameter	13															
ASCII	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1
HEX																

*1: System reservation

9.4.15 SetOptionFunc

Function:

Changes the setting value of the remote operation mode, vent valve, warning function, and serial communication time out.

Transmission Frame:

PC→SIM	Stx	0	0	1	Bsp	=*1	Parameter 1 to 13		Etx	LRC
SIM→PC										Ack

PC→SIM							Ack
SIM→PC	Stx	0	0	1	#	Etx	LRC

*1: The HEX code of ASCII character ' = ' is "3D".

Parameter	Item	Data format	Remarks
1	Remote operation mode setting	8-bits hexadecimal coded ASCII	Default 01_{hex} (I/O REMOTE)
2	[System reservation]	16-bits hexadecimal coded ASCII	*1
3	Vent valve Enable/Disable setting	8-bits hexadecimal coded ASCII	Default FF_{hex} (DISABLE)
4	Vent valve starting speed setting (Unit:%)	8-bits hexadecimal coded ASCII	Default 32_{hex} (50 %)
5	Vent valve running time setting (Unit:sec.)	16-bits hexadecimal coded ASCII	Default $003C_{hex}$ (60 sec.)
6	[System reservation]	16-bits hexadecimal coded ASCII	*1
7	Damage Limit Warning Enable/Disable setting	8-bits hexadecimal coded ASCII	Default 00_{hex} (ENABLE)
8	Pump Runtime Over Warning Enable/Disable setting	8-bits hexadecimal coded ASCII	Default FF_{hex} (DISABLE)
9	Pump Runtime Over Warning Hours setting (x 100 hours)	32-bits hexadecimal coded ASCII	Default 00000000_{hex}
10	Imbalance Warning Enable/Disable setting	8-bits hexadecimal coded ASCII	Default 00_{hex} (ENABLE)
11	[System reservation]	40-bits hexadecimal coded ASCII	*1
12	Serial communication time out setting (Unit: sec.)	16-bits hexadecimal coded ASCII	Default $003C_{hex}$ (60 sec.)
13	[System reservation]	88-bits hexadecimal coded ASCII	*1

*1: Send the parameter value F_{hex}.

Refer to Table 9.12, "Parameter Setting Value" for each parameter setting value.

Example:

1.	Remote operation mode	: 01_{hex} = I/O REMOTE
3.	Vent valve function	: FF_{hex} = DISABLE
4.	Vent valve starting speed	: 32_{hex} = 50 %
5.	Vent valve running time	: $003C_{hex}$ = 60 sec.
7.	Damage Limit Warning	: 00_{hex} = ENABLE
8.	Pump Runtime Over Warning	: FF_{hex} = DISABLE
9.	Pump Runtime Over Warning Hours	: $000186A0_{hex}$=100,000 (x 100 hours)
10.	Imbalance Warning	: 00_{hex} = ENABLE
12.	Serial communication time out	: $003C_{hex}$ = 60 sec.

Parameter	1		2				3		4		5				6				7	
ASCII	0	1	F	F	F	F	F	F	3	2	0	0	3	C	F	F	F	F	0	0
HEX	30	31	46	46	46	46	46	46	33	32	30	30	33	43	46	46	46	46	30	30

Parameter	8		9								10	
ASCII	F	F	0	0	0	1	8	6	A	0	0	0
HEX	46	46	30	30	30	31	38	36	41	30	30	30

Parameter	11										12				13					
ASCII	F	F	F	F	F	F	F	F	F	F	0	0	3	C	F	F	F	F	F	F
HEX	46	46	46	46	46	46	46	46	46	46	30	30	33	43	46	46	46	46	46	46

Parameter	13															
ASCII	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
HEX	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46

9.4.16 ReadCondition

Function:

Reads the pump model and damage point.

Transmission Frame:

PC→SIM	Stx	0	0	1	?	{ *1	Etx	LRC	
SIM→PC									Ack

PC→SIM										Ack
SIM→PC	Stx	0	0	1	Bsp	{ *1	Parameter 1 to 4	Etx	LRC	

*1: The HEX code of ASCII character '{' is "7D".

Parameter	Item	Data format	Remarks
1	Pump model	160-bits hexadecimal coded ASCII	
2	[System reservation]	32-bits hexadecimal coded ASCII	
3	Damage point	16-bits hexadecimal coded ASCII	
4	[System reservation]	64-bits hexadecimal coded ASCII	

Example:

1. Pump model : 5354702D6958343535202020202020202020202020$_{hex}$
   = STP-iX455
3. Damage point : 32$_{hex}$ = 50

Parameter	1																			
	"S"		"T"		"P"		"–"		"i"		"X"		"4"		"5"		"5"		" "	
ASCII	5	3	5	4	7	0	2	D	6	9	5	8	3	4	3	5	3	5	2	0
HEX	35	33	35	34	37	30	32	44	36	39	35	38	33	34	33	35	33	35	32	30

Parameter	1																			
	" "		" "		" "		" "		" "		" "		" "		" "		" "		" "	
ASCII	2	0	2	0	2	0	2	0	2	0	2	0	2	0	2	0	2	0	2	0
HEX	32	30	32	30	32	30	32	30	32	30	32	30	32	30	32	30	32	30	32	30

Parameter	2								3				4							
ASCII	*1	*1	*1	*1	*1	*1	*1	*1	0	0	3	2	*1	*1	*1	*1	*1	*1	*1	*1
HEX									30	30	33	32								

Parameter	4							
ASCII	*1	*1	*1	*1	*1	*1	*1	*1
HEX								

*1:System reservation

9.4.17 ReadEventsWithTime

Function:

Reads the "Error Record" with detection time.

Transmission Frame:

PC→SIM	Stx	0	0	1	?	}*1	Etx	LRC	
SIM→PC									Ack

PC→SIM										Ack
SIM→PC	Stx	0	0	1	Bsp	}*1	Parameter 1 ~ 15	Etb	LRC	

PC→SIM								Ack
SIM→PC	Stx	0	0	2	Parameter 15 ~ 22	Etx	LRC	

*1: The HEX code of ASCII character '}' is "7B".

Parameter	Item	Data format	Remarks
1	The number of "Error Record"	8-bits hexadecimal coded ASCII	
2	The maximum number of "Error Record"	8-bits hexadecimal coded ASCII	Up to 20 for STP-iX455/iXL455
3 to 22	Error Record 1 to Error Record 20	80-bits hexadecimal coded ASCII (See "Error Record Format")	*1

*1: The recent error has the smallest parameter number.

Error Record Format:

Time information of error history has two formats that depend on the pump model.

- Total running time of the STP pump and control unit
- Real time data by a built-in clock

Time information is identified with a time flag.

The STP-iX455/iXL455 series has a format of a time flag = 0.

In case of time flag = 0

Parameter	Item	Data format	Remarks
a	Error Code	8-bits hexadecimal coded ASCII	*1
b	Time flag	8-bits hexadecimal coded ASCII	
c	Pump running time	32-bits hexadecimal coded ASCII	Unit: minute
d	Ctrl running time	32-bits hexadecimal coded ASCII	Unit: minute

*1: Value corresponding to the error is transmitted (see Table 9.9).
When the number of errors being detected is under the maximum number, the value of parameter that is larger than the number of errors being detected is set to FF_{hex}.

Example: In case of Disturbance X_H detection at
Pump running time = 5,000 minutes, Ctrl running time = 6,000 minutes

Parameter	a		b		c								d							
ASCII	0	D	0	0	0	0	0	0	1	3	8	8	0	0	0	0	1	7	7	0
HEX	30	44	30	30	30	30	30	30	31	33	38	38	30	30	30	30	31	37	37	30

In case of time flag = 1

Parameter	Item	Data format	Remarks
a	Error Code	8-bits hexadecimal coded ASCII	*1
b	Time flag	8-bits hexadecimal coded ASCII	
c	Error detection time (Format : yymmddhhnn) yy: The last two digits of the year mm: Month dd: Day hh: Hour (24-hour display) nn: Minute	40-bits hexadecimal coded ASCII	*2
d	[System reservation]	24-bits hexadecimal coded ASCII	

*1: Value corresponding to the error is transmitted (see Table 9.9).
When the number of errors being detected is under the maximum number, the value of parameter that is larger than the number of errors being detected is set to FF_{hex}.
*2: Each value of time is transmitted as a character string.

Example: In case of Disturbance X_H detection at July 15, 2006 12: 34

Parameter	A		b		c										d					
ASCII	0	D	0	1	0	6	0	7	1	5	1	2	3	4	*3	*3	*3	*3	*3	*3
HEX	30	44	30	31	30	36	30	37	31	35	31	32	33	34						

*3: System reservation

Example:

When 3 errors have been detected in the past;
The number of "Error Record" : 03_{hex} = 3 errors
The maximum number of "Error Record" : 14_{hex} = 20 errors
Error Record 1 : Error Code $0F_{hex}$ = 15 = Disturbance Xb
Time flag 00_{hex} = Detection time is accumulation running time
Pump running time $0002BF20_{hex}$ = 180,000 min = 3,000 hrs
Ctrl running time $0002D690_{hex}$ = 186,000 min = 3,100 hrs
Error Record 2 : Error Code $0D_{hex}$ = 13 = Disturbance Xh
Time flag 00_{hex} = Detection time is accumulation running time
Pump running time 00007530_{hex} = 30,000 min = 500 hrs
Ctrl running time $000080E8_{hex}$ = 33,000 min = 550 hrs
Error Record 3 : Error Code 12_{hex} = 18 = MOTOR Overheat
Time flag 00_{hex} = Detection time is accumulation running time
Pump running time $000005A0_{hex}$ = 1,440 min = 24 hrs
Ctrl running time $000005DC_{hex}$ = 1,500 min = 25 hrs
Error Record 4 to 10 : No error recorded

Parameter	1		2	
ASCII	0	3	1	4
HEX	30	33	31	34

Parameter	3a		3b		3c								3d							
ASCII	0	F	0	0	0	0	0	2	B	F	2	0	0	0	0	2	D	6	9	0
HEX	30	46	30	30	30	30	30	32	42	46	32	30	30	30	30	32	44	36	39	30

Parameter	4a		4b		4c								4d							
ASCII	0	D	0	0	0	0	0	0	7	5	3	0	0	0	0	0	8	0	E	8
HEX	30	44	30	30	30	30	30	30	37	35	33	30	30	30	30	30	38	30	45	38

Parameter	5a		5b		5c								5d							
ASCII	0	F	0	0	0	0	0	0	0	5	A	0	0	0	0	0	0	5	D	C
HEX	30	46	30	30	30	30	30	30	30	35	41	30	30	30	30	30	30	35	44	43

Parameter	6a		6b		6c								6d							
ASCII	F	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEX	46	46	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30

Parameter	7a		7b				21d							
ASCII	F	F	0	0	[Omitted]		0	0	0	0	0	0	0	0
HEX	46	46	30	30			30	30	30	30	30	30	30	30

Parameter	22a		22b		22c								22d							
ASCII	F	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HEX	46	46	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30

10 STP-Link and Display Unit

The STP-Link (optional accessory) and the display unit iDT-001 (optional accessory) are available with the STP pump.

10.1 STP-Link

The "STP-Link" is a Windows application for operating the STP pump, confirming the pump status or setting various settings. Table 10.1 shows the principal functions. See the Instruction Manual of the "STP-Link" for the detailed specification and operating method.

Table 10.1 Functions of STP-Link

Item	Functions
Operating function	Start, stop and failure reset operation of STP pump
Confirmation function	Operational state of STP pump
	Software version
	Serial No.
	STP pump model
	Operation hours
	Number of starts
	Bearing damage integrated value
	Error history
Option setting function	Remote operation mode setting
	Rotational speed setting
	Vent valve setting
	Warning function setting

10.2 Display Unit

The "display unit" operates the STP pump, confirms the pump status or resets various settings. The display unit iDT-001 is equipped with an LCD and flat panel switches. The display unit iDT-001 can be used with fixing to the front panel of the power supply unit iPS-240, or connecting the STP-Link connector.
See the Instruction Manual of the "Display unit iDT-001" for the detailed specification and operating methods.

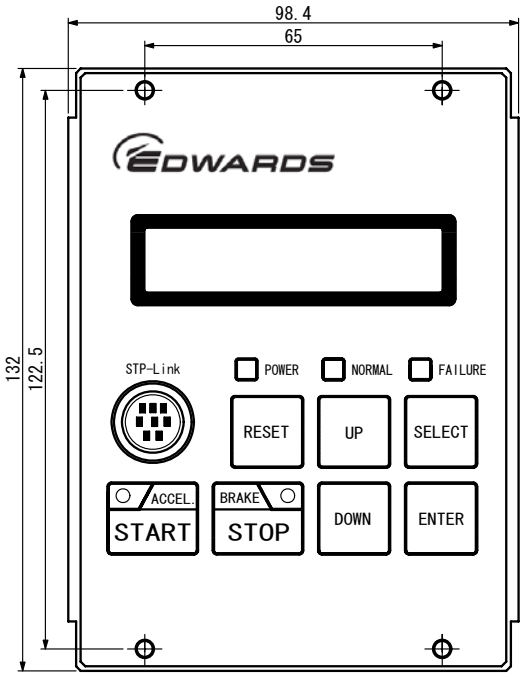


Figure 10.1 Display Unit iDT-001

11 Safety Functions

11.1 Power Failure

11.1.1 Operation at a Power Failure

When the power voltage of the external power supply unit drops less than 43 V DC due to a power failure or other, the normal operation of the magnetic bearing is maintained using the regenerative energy of the rotating rotor (backup operation during a power failure).

1) When the rotational speed is approx. 20,000 rpm or more at a power failure:
   - The STP pump detects any power failure of 2 seconds or more and decelerates.

     At this time, the "POWER" LED extinguishes and the "FAILURE" LED (red) illuminates. Also, POWER OUT pins (4)–(16) is opened, and a failure signal is output from FAILURE OUT pins (8)–(21) and (9)–(21) of the "X2 REMOTE" connector.
     When the rotational speed goes down to approx. 20,000 rpm, the rotor lands on the touch down bearing and stops. All lamps extinguish.
   - The STP pump does not detect a power failure of less than 2 seconds and the STP pump will continue to rotate.
2) When the rotational speed is less than approx. 20,000 rpm at a power failure:
   - The STP pump does not detect the power failure. The rotor lands on the touch down bearing and stops.

Table 11.1 shows the states of LED output and the "X2 REMOTE" output signals at a power failure.

Table 11.1 States of Lamps and X2 REMOTE Output Signals at Power Failure

Rotational speed	Duration of power failure	LED output		X2 REMOTE output signal		
		POWER LED	FAILURE LED	POWER N.O OUT	FAILURE N.O OUT	FAILURE N.C OUT
20,000 rpm or more	Approx. 2 sec. or longer	Extinguish	Illuminate	Open	Close	Open
	Shorter than approx. 2 sec.	Continues as before				
Less than 20,000 rpm		Extinguish	Extinguish	Open	Open	Close

11.1.2 Operation after a Power Recovery

- The STP pump continues decelerating, and power failure detection is reset automatically.

  At this time, the "POWER" LED illuminates and the "FAILURE" LED extinguishes. Also, POWER OUT pins (4)–(16) is closed, and a failure signal is reset between FAILURE OUT pins (8)–(21) and (9)–(21) of the "X2 REMOTE" connector.

- When the START signal is input after a power recovery, the STP pump reaccelerates even while it is in BRAKE state.
  However, the control unit may detect excessive vibration when power is recovered after the rotor lands on the touch down bearing (see Section 11.3). In this case, the STP pump once stops and cannot reaccelerate until the RESET operation completed (see Section 6.5.4).

◇ Re-supply power to the STP pump as soon as possible after a power recovery.

11.2 Abnormal State of Magnetic Bearing (Disturbance)

When the magnetic bearing does not function normally due to disconnection of connectors or any abnormality/error of the STP pump, the rotor lands on the touch down bearing and stops.
The "FAILURE" LED (red) illuminates, and a failure signal is output from the "X2 REMOTE" connector.

11.3 Excessive Vibration (Disturbance)

When serious vibration or mechanical shock causes the rotor to come in contact with the touch down bearing (due to external vibration/impact, intrusion of atmosphere or foreign matter into the STP pump or rotor imbalance), and the state lasts for a certain period of time, the STP pump decelerates and stops.
The "FAILURE" LED (red) flashes, and a failure signal is output from the "X2 REMOTE" connector.

◇ When the rotor contacts the touch down bearing, contact noise and rotational noise of the touch down bearing are generated from the STP pump.

11.4 Motor Driver Overload (DRV Overload)

When the STP pump does not attain the rated speed within approx. 15 minutes after starting or when the ACCELERATION state remains unchanged during operation for approx. 15 minutes, the STP pump decelerates and stops.
The "FAILURE" LED (red) flashes, and a failure signal is output from the "X2 REMOTE" connector.

11.5 Overheating inside the STP Pump (MOTOR Overheat)

When the temperature of the motor inside the STP pump exceeds 110 °C due to an overload, the STP pump decelerates and stops.
The "FAILURE" LED (red) flashes, and a failure signal is output from the "X2 REMOTE" connector.

11.6 Overheating inside the Control Unit (CNT Overheat)

When the temperature inside the control unit exceeds 80 °C due to a ventilation malfunction, external heat source, failure of an air-cooling unit (optional accessory), or other event, the STP pump decelerates and stops.
The "FAILURE" LED (red) flashes, and a failure signal is output from the "X2 REMOTE" connector.

11.7 Overspeed

When the rotational speed of the STP pump exceeds 58,500 rpm due to a failure in the motor driver, the STP pump decelerates and stops.
The "FAILURE" LED (red) illuminates, and a failure signal is output from the "X2 REMOTE" connector.

◇ The flashing pattern of the "FAILURE" LED (red) indicates the type of failure. Refer to Section 13, "Troubleshooting, Maintenance, and Inspection" for details.

12 WARNING Function

12.1 WARNING Function

The STP pump is provided with a WARNING function when an overhaul is needed following a self-test as shown in Table 12.1.
The type of warning is indicated by flashing pattern of the "FAILURE" LED (orange). When two or more warnings are detected simultaneously, a high-priority warning is indicated. Also, the warning signal is output from the "X2 REMOTE" connector.
The serial communication, the STP-Link (optional accessory), or the display unit iDT-001 (optional accessory) can confirm the error message, and change the settings. Refer to Section 9, "Serial Communication Protocol" or each Instruction Manual of the optional accessories for details.

Table 12.1 WARNING Function

No	Warning	"FAILURE" LED Indication	Priority
1	Damage Limit (Touch down bearing warning function)	3 flashes in orange	High
2	Pump Run Time Over (Pump runtime warning function)	2 flashes in orange	⇕
3	Imbalance (Excessive imbalance warning function)	1 flash in orange	Low

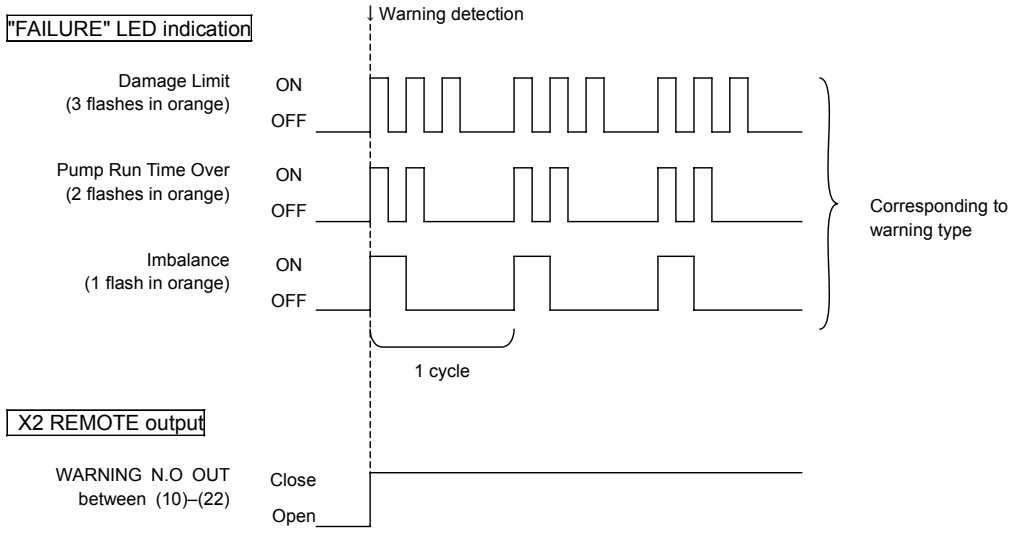


Figure 12.1 WARNING Output

NOTICE

- ◇ The WARNING detection cannot be reset by the "RESET" operation. See Section 12.3, "WARNING Function Setting" for the releasing the WARNING detection.
- ◇ The STP pump can operate even when the WARNING is detected. Overhaul the STP pump when WARNING detection is indicated.

12.2 Contents of WARNING Function

12.2.1 Damage Limit

Impact of the STP pump rotor onto the touch-down bearing, such as by an unexpected in-rush of air from outside or in the event of power failure, can damage the touch-down bearings. The STP pump monitors these impacts and assigns damage points to the event of "Disturbance" or "Power Failure". When the accumulated damage point attains 120 points, the "Damage Limit" is detected.
The damage point increases with the rotational speed up to 15 point for each "Disturbance", and 1 point for each touch-down at "Power Failure".
The accumulated damage points can be confirmed via serial communication, the STP-Link (optional accessory) or the display unit iDT-001 (optional accessory).

12.2.2 Pump Run Time Over

There is a run-time counter that tracks the total running hours of the pump. When the run-time counter attains the setting value, the "Pump Run Time Over" is detected. When deposit accumulates inside the STP pump, this function can be used to consider the time of the overhaul.
The setting value is user-definable.
Confirmation of the total running hours of the pump and change of the setting value can be performed via serial communication, the STP-Link (optional accessory) or the display unit iDT-001 (optional accessory).

12.2.3 Imbalance

The STP pump continuously monitors its rotor balance. The "Imbalance" is detected when imbalance of the synchronized rotor with the rotational speed exceeds the setting value. When the deposit accumulates in the STP pump, with the increase of the STP pump operation hours, the rotor balance is lost and the imbalance increases gradually. An increase in the amount of deposit may lead to a malfunction of the STP pump. Perform the overhaul ahead usual case.
The setting value of the imbalance is fixed, and the user cannot set it.

12.3 WARNING Function Setting

The WARNING functions can be set to Enable or Disable. Set to "ENABLE" when using the WARNING function. Set to "DISABLE" to release each WARNING function after the WARNING is detected.
A setting value of the "Pump Run Time Over" is adjustable. The WARNING detection can be released by setting the value larger than pump running hours after "Pump Run Time Over" is detected.

See Table 12.2 for the default setting. The setting can be changed via serial communication, the STP-Link (optional accessory) or the display unit iDT-001 (optional accessory).

Table 12.2 Default Setting of WARNING Function

WARNING function	Default setting		Remarks
	Enable/Disable	Setting value	
Damage Limit	ENABLE		
Pump Run Time Over	DISABLE	0 hour	Variable range: 0 to 30 million hours (100 hour step). When the setting value is 0, the WARNING function is invalid.
Imbalance	ENABLE		

NOTICE

◇ Refer to Section 9, "Serial Communication Protocol", or the Instruction Manuals of the STP-Link and display unit for the setting methods.

13 Troubleshooting, Maintenance, and Inspection

The STP pump is provided with safety functions for various abnormities/errors.
A safety function operates when an abnormality/error occurs. The "FAILURE" LED illuminates or flashes. Also, the failure signal is output from the "X2 REMOTE" connector.
If an abnormality/error is found when using the STP pump, confirm the pump use and installation accordance with the following procedures.
If you cannot trace the cause of the error or if the STP pump does not function normally after troubleshooting, fill in the necessary information in the "Return Declaration" form and fax it to the Service office.

13.1 Troubleshooting Immediately after Failure Occurs

13.1.1 After Power Failure

Re-supply power to the STP pump as soon as possible after a power recovery.

13.1.2 After Other Abnormality/Error

1) After confirming the "ROTATION" LED has extinguished and the STP pump has stopped, remove the probable cause of the abnormality.
   When the "FAILURE" LED illuminates or flashes, follow the recommended actions given in Table 13.2, "Error List".
2) Perform the RESET operation to extinguish the "FAILURE" LED.
3) Perform the START operation. Check if the STP pump operates correctly.

- ◇ Before disconnecting cables from the STP pump to perform troubleshooting, confirm that the STP pump has stopped. Turn OFF the external power supply unit and isolate the electrical energy source (Lockout/Tagout) on the vacuum equipment, then disconnect the cables.
- ◇ If the RESET operation does not extinguish the "FAILURE" LED, confirm that the STP pump has stopped, turn OFF the external power supply unit, then turn ON the external power supply unit again.

13.2 Troubleshooting

13.2.1 Indication of "FAILURE" LED

The flashing pattern of the "FAILURE" LED (red) differs depending on the type of abnormality/error. When two or more failures are detected simultaneously, a high-priority failure is indicated. Also, the failure signal is output from the "X2 REMOTE" connector.
If an abnormality/error is found, take measures in accordance with Table 13.2.

Table 13.1 Priority of Failure Signal

No	Failure	"FAILURE" LED indication	Priority
1	Power Failure Overspeed, and other	Steady red	High
2	MOTOR Overheat CNT Overheat	3 flashes in red	⇕
3	DRV Overload	2 flashes in red	
4	Disturbance	1 flash in red	Low

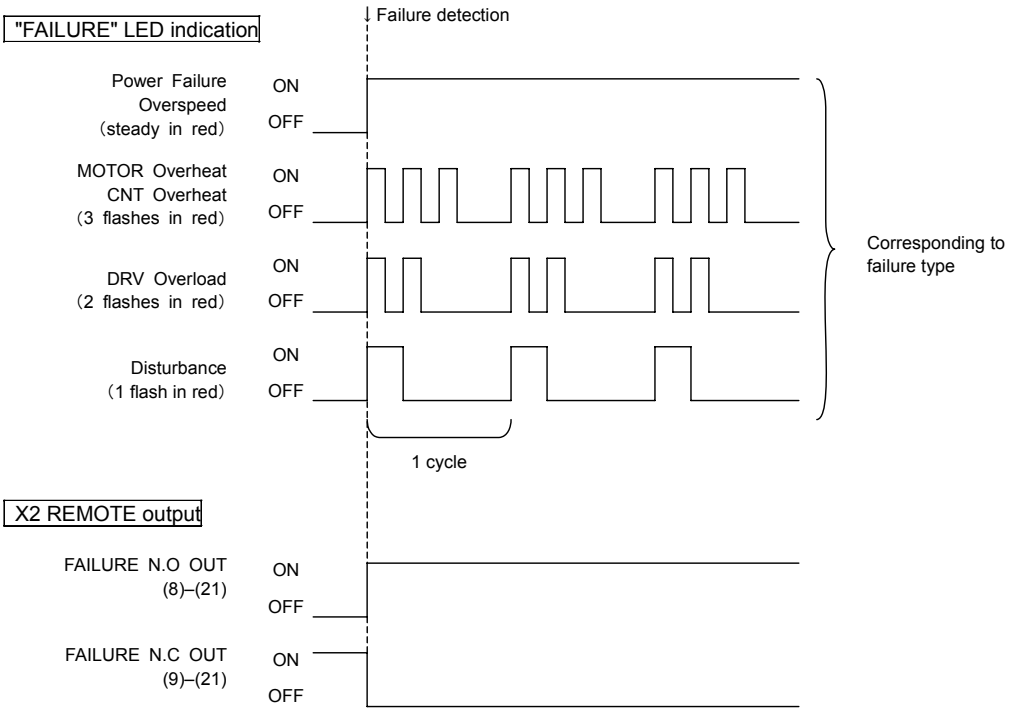


Figure 13.1 Failure Output

NOTICE

◇ The STP-Link (optional accessory) and the display unit (optional accessory) display an error as a message. Also, the errors being detected can be read via serial communication.

Table 13.2 Error List

"FAILURE" LED	(Error message)	Pump operation	Occurrence condition	Probable causes	Countermeasures	Referred Section
1 flash in red	Disturbance X_H Disturbance Y_H Disturbance X_B Disturbance Y_B Disturbance Z	Decelerate and stop	Excessive imbalance	Excessive vibration applied externally to the STP pump:		
				1) External vibration/impact.	1) Remove external vibration so as not to transmit it to the STP pump.	4.3.4
				2) Atmospheric air flows into the STP pump.	2) Check the vacuum piping.	4.3.4
				3) Foreign materials fall into the STP pump.	3) Install the STP pump in a way that no foreign materials fall into the STP pump.	4.3.1
				4) Sudden pressure change at start of roughing vacuum by backing-pump.	4) Perform roughing vacuum through bypass root.	
				Abnormal magnetic bearing: 1) Control circuit error. 2) Disconnection of the internal wiring.	Contact Service office.	
2 flashes in red	DRV Overload	Decelerate and stop	Acceleration state continues for approx. 15 minutes	1) High pressure at the inlet port.	1) Use the maximum working pressure or less.	15.1
				2) High pressure at the outlet port.	2) Use the allowable backing pressure or less.	15.1
				3) Leakage of the piping system.	3) Check the vacuum piping system for leakage.	4.3.4
				4) Failure of the backing-pump.	4) Check the backing-pump for its capacity and START state. (use a backing-pump with the recommended capacity or more)	15.1
3 flashes in red	MOTOR Overheat	Decelerate and stop	Overheating inside the STP pump	1) Overheating during baking.	1) Set the temperature of the baking heater to 120 °C or less.	5.1
				2) Insufficient cooling.	2) At the time of baking or gas pumping, always cool the STP pump.	5.2
				3) Leakage of the vacuum piping system.	3) Check the piping system for leakage.	4.3.4
				4) Repetitive start/stop operations.	4) Repetitious start/stop operations may cause the STP pump to overheat.	6.2
				5) Failure of the air-cooling unit (optional accessory)	5) Replace the air-cooling unit	5.2

"FAILURE" LED	(Error message)	Pump operation	Occurrence condition	Probable causes	Countermeasures	Referred Section
3 flashes in red	CNT Overheat	Decelerate and stop	Overheating inside the control unit	1) High ambient temperature. 2) Insufficient cooling of the control unit 3) Failure of the air-cooling unit (optional accessory)	1) Set the ambient temperature to 40 °C or less. 2) Remove obstacle from the ventilation port. 3) Replace the air-cooling unit	4.2.1 4.2.1 5.2
Steady red	Aberrant Accel	Decelerate and stop	Rotational speed increases in brake or Levitation state	Atmospheric air flows the STP pump.	Check the vacuum piping system for leakage. Check the exhaust sequence.	6.1
	Aberrant Brake	Decelerate and stop	The rotation does not stop after 15 min. into brake state	Failure of the control unit.	Contact Service office.	
	Acc Malfunction	Decelerate and stop	Does not accelerate 1,500 rpm or more	Failure of the control unit.	Contact Service office.	
	AMB Com. Failure	Decelerate and stop	Communication failure with magnetic bearing control board	Failure of the control unit.	Contact Service office.	
	AMP Overcurrent	Touch down *1	Excessive magnetic bearing electric current	Failure of the control unit.	Contact Service office.	
	DRV Com. Failure	Decelerate and stop	Communication failure with motor control board	Failure of the control unit.	Contact Service office.	
	DRV Overcurrent	Free run *2	Motor driver over current	1) Short-circuit or ground fault in the motor winding. 2) Failure of the control unit.	Contact Service office.	
	DRV Overvoltage	Free run *2	Motor driver over voltage	Failure of the control unit.	Contact Service office.	

*1 : The magnetic bearing output stops and the rotor is descended on the touch down bearing

*2 : The driver output stops and the rotor continue rotating by inertia.
It may take several hours to stop. To stop the STP pump quickly, close the vacuum valve at the outlet port flange and introduce gas from the purge port into the STP pump.

"FAILURE" LED	(Error message)	Pump operation	Occurrence condition	Probable causes	Countermeasures	Referred Section
Steady red	M_Temp Lost	Decelerate and stop	Abnormal motor temperature detection	Disconnection of the motor temperature sensor.	Contact Service office.	
	Overspeed 1, 2, 3	Decelerate and stop	Rotaional speed exceeds rated speed	Failure of the control unit.	Contact Service office.	
	Power Failure	Decelerate and stop	Insufficient power supply	1) Power failure. 2) Incorrect connection of the power cable. 3) Failure of the power cable. 4) Failure of the external power supply. 5) Abnormal AC main power voltage on the vacuum equipment.	1) Check whether or not a power failure has occurred. 2) Connect the power cable correctly. 3) Replace the power cable. 4) Set the voltage to 48 V DC. 5) Check the AC main power voltage.	11.1 4.4 4.4 4.4 4.5
	Ram Error	Decelerate and stop	Failure of RAM check in MPU	Failure of the control unit.	Contact Service office.	
	Record Failure	Decelerate and stop	Failure of record in memory	Failure of the control unit.	Contact Service office.	
	Serial Com. Fail	Decelerate and stop	Communication failure of the input operation port during acceleration and normal operation	1) Insufficient user application setting. 2) Disconnection or break of the communication cable. 3) Failure of the control unit.	1) Send a communication command periodically at intervals of less than setting value. 2) Check the communication cable. 3) Contact Service office.	9.2.5
	Speed Pulse Lost	Decelerate and stop	Abnormal rotatinal speed detection	Failure of the control unit.	Contact Service office.	

13.2.2 No Indication of the "FAILURE" LED

Table 13.3 Troubleshooting with No Indication of the "FAILURE" LED

Symptom	Probable cause	Countermeasures	Referred Section
The "POWER" LED does not illuminate after powering ON the external power supply unit.	Incorrect connection of power cable.	Connect the power cable correctly.	4.4
	Abnormal power voltage.	Set the input voltage to 48V DC.	4.4
	Power failure.	Check whether or not a power failure has occurred.	11.1
The "ROTATION" LED does not flash after performing the start operation.	Failure of the "Input Operation Port" setting.	Set the input operation port correctly.	7.1 6.5
	Rotation INHIBIT signal input pins (X2 REMOTE (1)–(3)) are opened.	When not using this function, short the circuits between (1)–(3), or open the circuits between (24)–(25) of the "X2 REMOTE" connector.	7.1
Rotation INHIBIT signal does not function correctly.	Rotation INHIBIT enable signal input pins are opened.	Short the circuits between (24)–(25) of the "X2 REMOTE" connector.	7.1
Insufficient ultimate pressure.	Failure of the backing-pump.	Check the capacity and starting state (use a backing-pump having more capacity that we specified).	4.3.4 15.1
	Leakage of the piping system.	Check the piping system for leakage.	4.3.4
	Residual molecules.	If the main composition is H_2 or H_2O, perform baking; if it is other gases, clean the inside of the vacuum equipment (If gases remain inside the STP pump, contact Service office when it is needed to be cleaned).	5.1
Abnormal noise is generated while the pump is rotating	External vibration or impact	Remove external vibration so as not to transmit it to the STP pump. **NOTICE** ◇ When external vibration or impact causes the rotor to come in contact with the touch down bearing, contact noise is generated from the STP pump. Although the rotational noise of the touch down bearing may last approx. 10 to 20 seconds, this is not an indication of abnormality.	4.2.1

13.3 Maintenance and Inspection

WARNING

◇ When performing maintenance and inspections of the STP pump, exhaust gases inside the STP pump thoroughly.
Residual gases may cause an accident when removing the STP pump.
Confirm the characteristics of gas to be used, referring to the Material Safety Data Sheet (MSDS) you obtain from the gas supplier.
Wear personal protective equipment if necessary.

CAUTION

◇ Stop the STP pump, then turn OFF the primary power and isolate the electrical energy source (Lockout/Tagout) on the vacuum equipment. Ensure the "POWER" LED on the front panel of the STP pump extinguished before performing maintenance and inspections of the STP pump.
Failure to do so may result in the inadvertent rotation of the STP pump, which may result in an accident.

◇ DO NOT touch any place other those specified when performing maintenance or inspecting the pump and NEVER open any panel because it could cause shock, malfunction, or short circuit.

◇ Power OFF peripheral equipments such as a baking heater before performing maintenance and inspections.

◇ The wipes used for clean and decontamination might become hazardous waste depending upon the solvent. Dispose of the contaminated wipes appropriately according to the regulations of each national and/or local government.

◇ Only Service office will replace the maintenance parts, and will execute repair and overhaul. Contact Service office.

13.3.1 Cleaning and Decontamination

The method of cleaning and decontamination of the STP pump is shown below.

Table 13.4 Cleaning and Decontamination

Area		Cleaning and Decontamination
STP pump	Exterior	• Wipe with proper solvent (such as alcohol). • When the label of the STP pump has been damaged, contact Service office.
	Interior	The decontamination (overhaul) in the STP pump is executed in Service office. When overhaul is needed, contact Service office.
Control unit	Exterior	• Clean the outside of the control unit with a dry wipe as needed. • When dust has accumulated in the ventilation port, wipe off or vacuum it with the cleaner. In this case, dust must not enter in the control unit. • Clean off with a pure gas when dust has accumulated in the connector. • When the label of the control unit has been damaged, contact Service office.
	Interior	The decontamination (overhaul) in the control unit is executed in Service office. When overhaul is needed, contact Service office.

13.3.2 Inspecting the Deposit

Leaving the STP pump without removing the deposit may cause the STP pump to be corroded beyond repair.

Deposit may have accumulated inside the STP pump depending upon the type of the vacuum equipment installed in the STP pump. An increase in the amount of deposit may lead to a malfunction of the STP pump.
Therefore, perform regular maintenance (once every three to six months as a target).

Inspect the inside of the outlet port flange for adhesion of deposit while watching the outlet port flange. If deposit has accumulated to some extent, an overhaul (cleaning) is required. Contact Service office.
Note that the costs of troubleshooting problems resulting from deposit will be at your own charge even during the warranty period.

If a problem resulting from deposit occurs inside the STP pump, hermetically seal inlet port, outlet port, or purge port, immediately return them to Service office.
For the transport method, see Section13.3.4, "Transport for Repair or Overhaul".

◇ Contact with atmospheric air may cause a reaction of the deposit. DO NOT open the STP pump to atmospheric air as much as possible.

13.3.3 Overhaul

The air-cooling fan used in the STP pump and its peripheral equipment will deteriorate after long-term use. Deterioration or abrasion of the internal parts of the STP pump will cause a failure. The recommended maintenance intervals for different process applications are tabulated below:

Table 13.5 Recommended Overhaul Period

Process		Period	Remarks
Etching*1	Metal etch process (deposition)	1 year	Processes resulting in large amount of deposits in the pump will require more frequent service.
	Other etch processes	2 years	Processes resulting in accumulation of deposits in the pump will require more frequent service.
	It is recommended to change the pump rotor after 5 years due to accumulated wear of the protective plating material		
Other semiconductor process		2 years	Processes resulting in accumulation of deposits in the pump will require more frequent service.
Clean applications (Only vacuum pumping)		5 years	
Other use		(2 years)	Dependent on application, contact Edwards.

*1: "Etching" includes semiconductor etching and LCD etching.

The costs of replacing parts that need to be replaced because of deterioration or abrasion will be at your own charge.
When overhaul of the STP pump is needed, contact Service office.

13.3.4 Transport for Repair or Overhaul

WARNING

- ◇ When returning the STP pump which has used any kind of gases to Service office, fill the type of gas and handling precautions in the "Return Declaration" form and fax it to Service office.
  Confirm the characteristics of gas to be used, referring to the Material Safety Data Sheet (MSDS) you obtain from the gas supplier.
- ◇ Follow the instruction of "Return Procedure" to prevent an accident during the transportation, repair or overhaul.

CAUTION

- ◇ When returning the STP pump to Service office, be sure to pack it well to prevent external damage.
  If "Return Procedure" has not been satisfied, Edwards will not be responsible for any troubles.

i) Always contact Service office before returning the STP pump for repairs, overhaul, or other purposes. To avoid any accident by gases or corrosion inside the STP pump, particularly when corrosive, reactive or flammable gases have been used, ii) Vacuum and hermetically seal the STP pump before transport. iii) Specify the type of gases used and handling precautions in the "Return Declaration" form and return the STP pump to Service office.
When returning the STP pump to Service office, use the original packing to prevent external damage. If you do not have the original packing, use similar or superior packaging material.

"Return Procedure" and "Return Declaration" are in the end of the Instruction Manual. When additional sheet is needed, contact Service office.

NOTICE

- ◇ The costs of cleaning and overhaul of the STP pump will be at your own charge.
- ◇ When returning the STP pump to Service office, fill in the necessary items in the "Return Declaration" and fax it to Service office.

14 Storage and Disposal

14.1 Storage of the STP Pump

When the STP pump is left unused over a long period (more than a few months), follow the precautions below:

1) Close the inlet port of the STP pump and vacuum it using a backing-pump.
2) Introduce dry N_2 gas or dry air from the outlet port or the purge port.
3) Close the outlet port and purge port.
4) If the STP pump is water cooled, introduce compressed air from one side of the cooling water port so that no water remains in the STP pump.
5) Store the STP pump in a vertical position.
6) DO NOT store the STP pump in the following places:
   - Place of high humidity.
     (If it must be stored in a place of high humidity, insulate it from the outside and use a dehumidifying agent.)
   - Place of high temperatures (more than +55°C) and low temperatures (less than –25°C).
   - Place where there are corrosive gases.
   - Place subjected to dripping water.
   - Place with a lot of dust.
   - Place with insufficient ventilation.
   - Place subjected to strong magnetic or electric fields.
   - Place subjected to radiation.
   - Place subjected to direct sunlight.
   - Place subjected to mist.
   - Place with electric noise.
   - Place with vibration.

14.2 Disposal

Dispose of the STP pump as **industrial waste** according to the guidelines given by each national and/or local government.

◇ When disposing of the STP pump, exhaust gases inside the STP pump thoroughly.
Residual gases may result in an accident when disposing of the STP pump.
If the STP pump has been used with reactive or corrosive gasses, always clean thoroughly before disposing of it to avoid any injury.
Confirm the characteristics of gas to be used, referring to the Material Safety Data Sheet (MSDS) you obtain from the gas supplier.

◇ Edwards is not responsible for problems during or after disposal.

15 Specifications and Accessories

15.1 Specifications for the STP Pump

Table 15.1 Specifications for the STP Pump (1/2)

Item				Specifications			
				STP-iX455		STP-iXL455	
Flange size	Inlet port flange			ICF152/ VG100/ ISO100	ICF203/ VG150/ ISO160	ISO100	ISO160
	Outlet port flange			KF25	KF25	KF25	KF25
Pumping speed	N_2		L/s	300	450	300	380
	H_2		L/s	300	460	300	380
Compression ratio	N_2			$>10^8$			
	H_2			1×10^4			
Ultimate pressure Pa (Torr)	Without anti-corrosive treatment		ICF	10^{-8} (10^{-10})			
			VG/ISO	6.5×10^{-6} (5×10^{-8})			
	Corrosion resistant type		ICF	10^{-7} (10^{-9})			
			VG/ISO	6.5×10^{-6} (5×10^{-8})			
Maximum working pressure (Natural air)			Pa (Torr)	1.3×10^{-1} (1×10^{-3})			
Allowable backing pressure (Natural air)			Pa (Torr)	67 (0.5)			
Rated speed			rpm	55,000			
Rated speed variable range			rpm	45,000 to 55,000			
Starting time			min	≦6			
Stopping time			min	≦8			
Vibration			Mm (0–P)	< 0.01 (55,000 rpm)		< 0.001 (55,000 rpm)	
Noise			dB	< 50 (55,000 rpm)			
Leakage magnetic flux	Axial direction		mGauss	≦100			
	Radial direction		mGauss	≦100			
Baking temperature			°C	< 120			
Bearing				5 axis free-controlled magnetic bearing			
Lubricating oil				Not necessary			
Installation position				Free			
Cooling method				Natural air cooling (Air cooling: At baking and gas pumping)			
Backing pump			L/min	240			
Ambient temperature range			°C	0 to 40			
Storage temperature range			°C	–25 to 55			
Mass[*1]			kg	16			

The values shown in the table are typical; they are not guaranteed.

[*1] : Except the optional accessory.

Table 15.1 Specifications for the STP Pump (2/2)

Item		Specifications	
Input voltage	VDC	48 ⎓	
Input current	A	Max. 5	
Motor driving system		Three phase DC brushless motor driver	
Output voltage under normal operation	Hz	750 to 917	
Panel indication lamp		POWER	(green LED)
		ROTATION	(green/orange LED)
		FAILURE	(red/orange LED)
Input/Output terminal		X1 DC POWER	(7 pin circular connector)
		X2 REMOTE	(25 pin Dsub connector)
		X3 COM1(RS232/485)	(9 pin Dsub connector)
		X5 STP-Link (COM2)	(8 pin Mini-DIN connector)
		X6 VENT VALVE	(4 pin circular connector)
		X7 FAN	(2 pin rectangular connector)

15.2 Accessories

Table 15.2 Accessories

Items	Q'ty	Remark
Instruction manual	1	This manual
Inlet port cover	1	
Outlet port cover	1	
Connector for "X1 DC POWER"	1	• Model: NJC–207–PF (Nanaboshi Electric Mfg.co.,Ltd) • Cable bushing Model: NJC–20–CB (Nanaboshi Electric Mfg.co.,Ltd)
Connector for "X2 REMOTE"	1	Dsub25 pin

Table 15.3 Optional Accessories

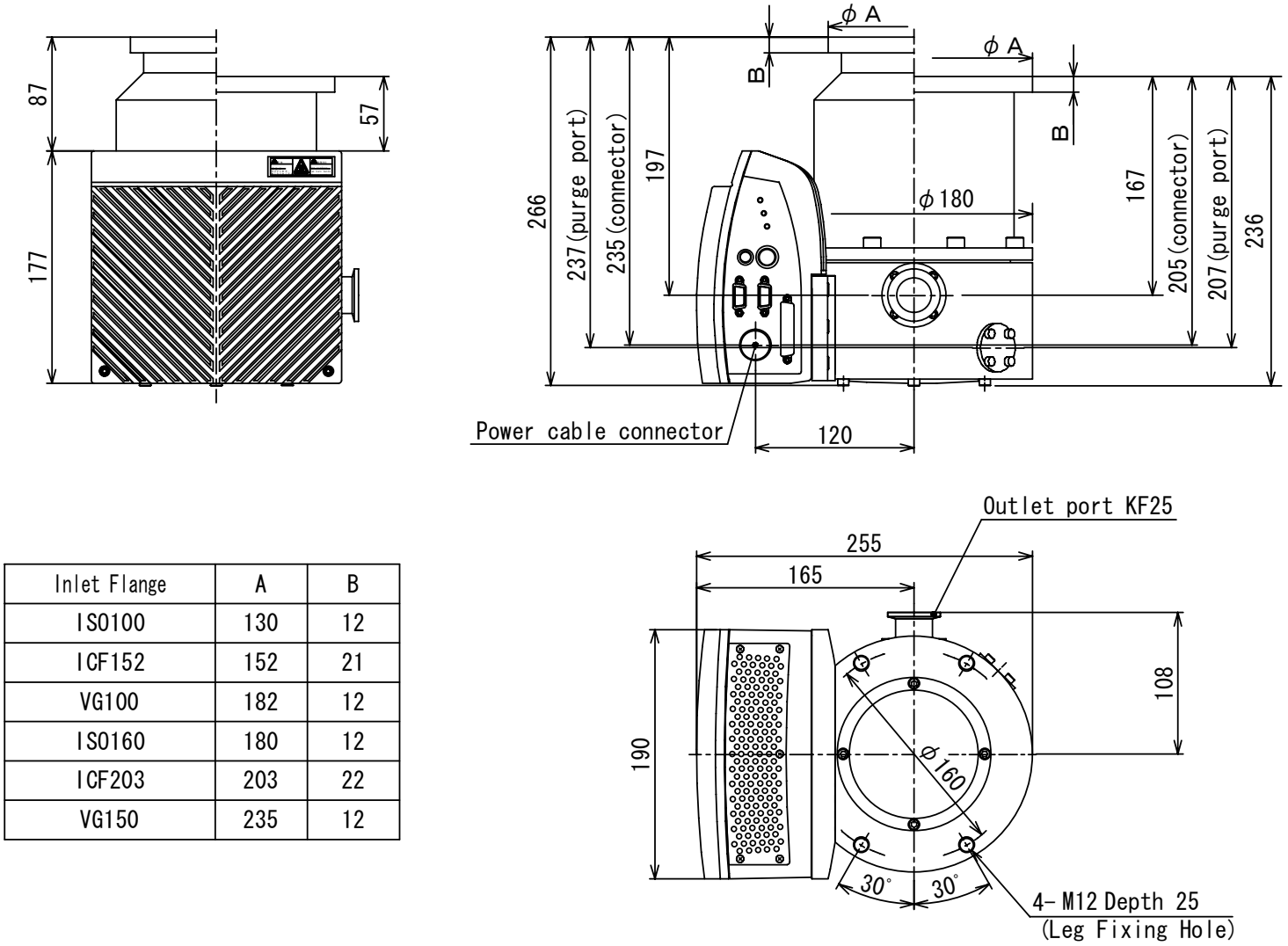
Item	Application purpose	Remarks
Power supply unit (iPS-240)	DC power supply unit for the STP pump	48V DC, 5A
AC power cable	Power supply AC cable for the power supply unit	• Standard cable length is 3m • With one-side crimp-type terminal
iPS-240 connection cable	Connection cable between power supply unit and STP pump	• Standard cable length is 5m • With both-side connectors
Display unit (iDT-001)	Unit for operating or monitoring the STP pump, or setting various settings.	• Attachable to the front panel of the power supply unit (Connection harness is included) • Dedicated communication cable is included (3m)
STP-Link	Windows application for operating or monitoring the STP pump, or setting various settings.	• Dedicated communication cable is included (3m)
Air-cooling unit (U0-64)	Fan for cooling the control unit	
Air-cooling unit (U1-64)	Fan for cooling the STP pump and control unit	
Baking heater	For baking	
Vent valve	Purge port ON/OFF control	

15.3 Maintenance Parts

Table 15.4 Maintenance Parts

Item	Q'ty	Remarks
Touch down bearing	2	Touch down bearing should be replaced in the Service office.
Air-cooling unit	1	Optional accessory (U0-64 or U1-64)

The possession periods of maintenance parts is for at least 7 years after the products is discontinued.



Inlet Flange	A	B
ISO100	130	12
ICF152	152	21
VG100	182	12
ISO160	180	12
ICF203	203	22
VG150	235	12

Figure 15.1　External Appearance of the STP Pump (STP-iX455 series)

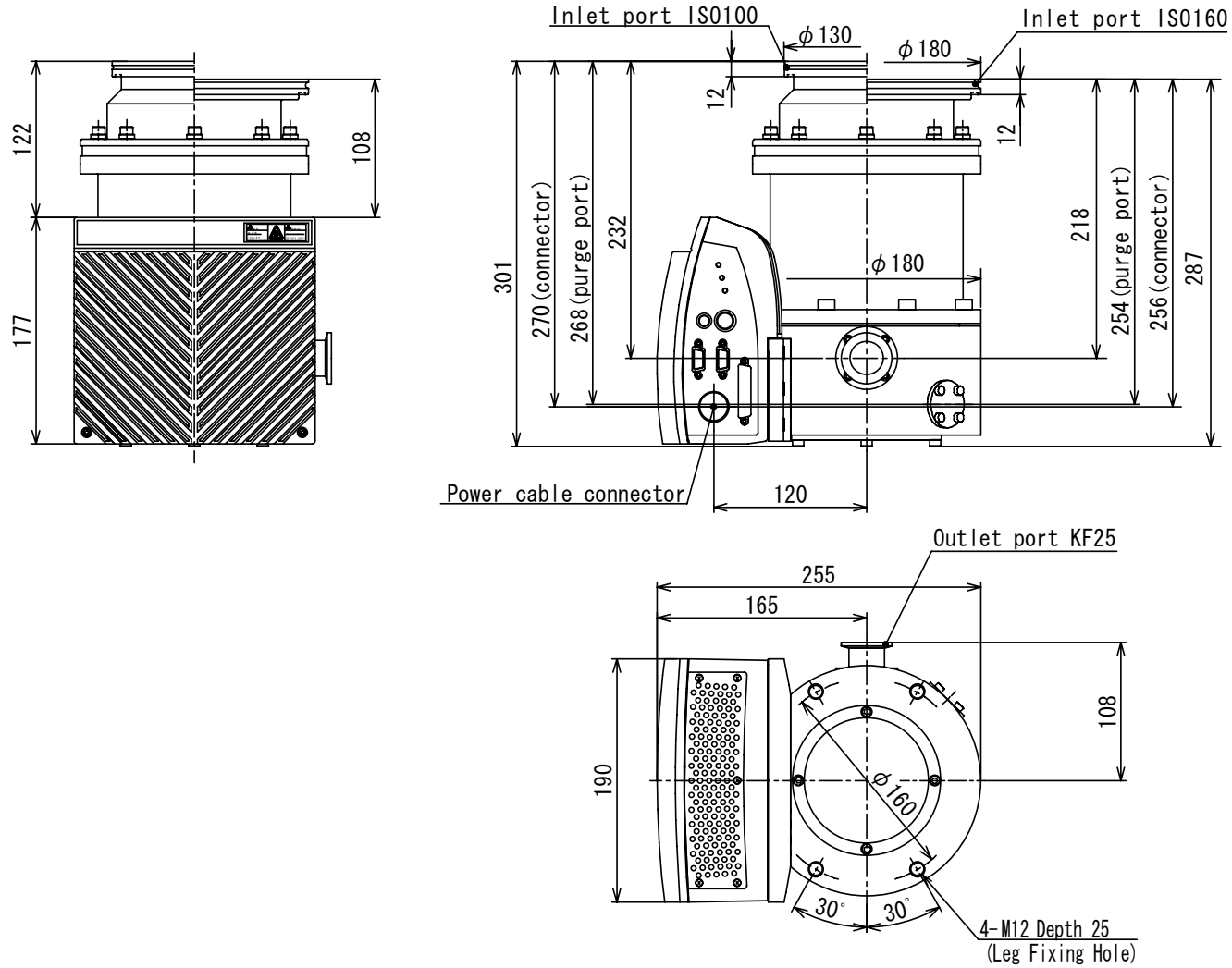


Figure 15.2　External Appearance of the STP Pump (STP-iXL455 series)

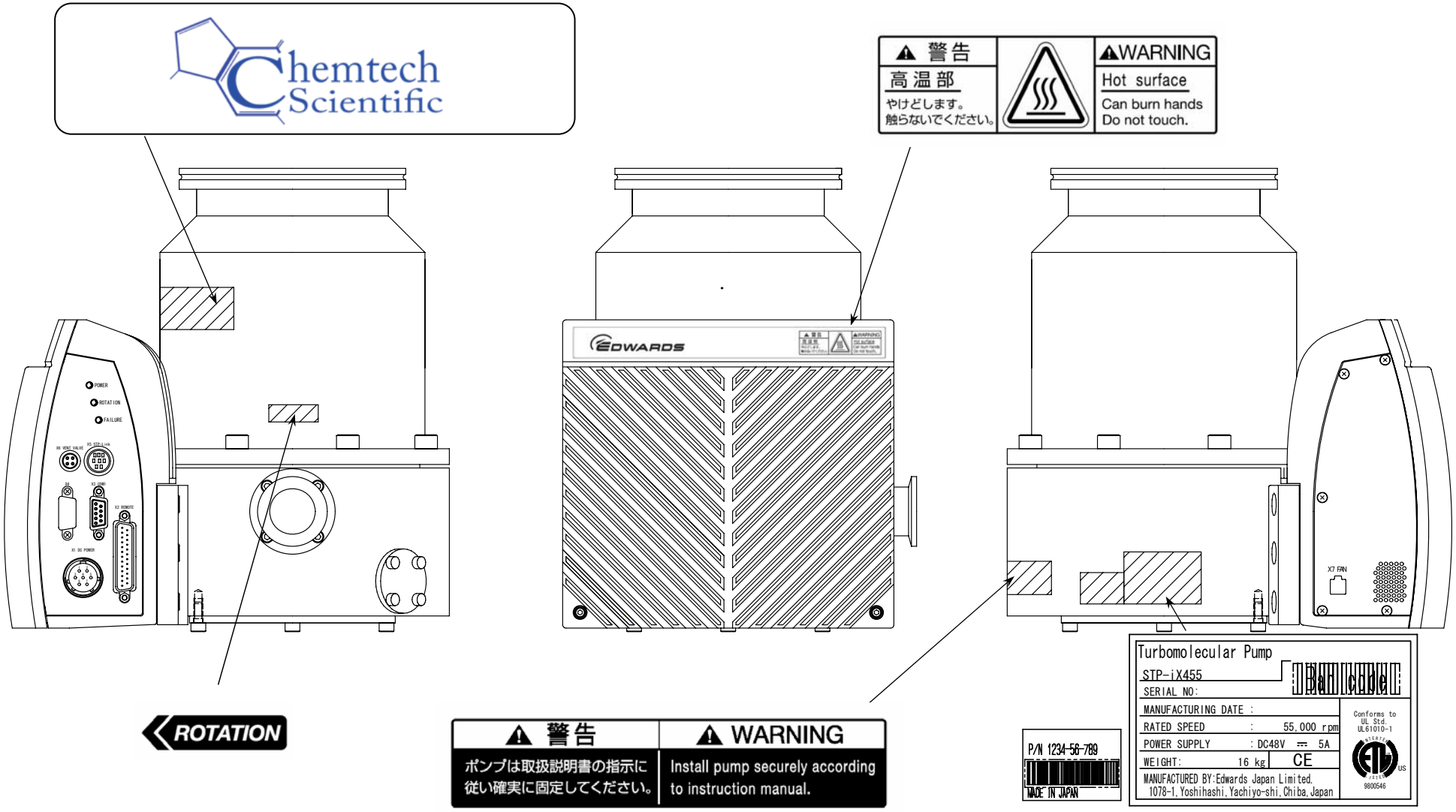


Figure 15.3　Label Affixing Positions for the STP Pump

UNIT CONVERSION TABLE

Length

m	cm	mm	inch
1	100	1.00×10^{3}	39.4
0.01	1	10.0	0.394
1×10^{-3}	0.10	1	39.4×10^{-3}
25.4×10^{-3}	2.54	25.4	1

Mass

g	kg	lb.
1	1.00×10^{-3}	2.20×10^{-3}
1×10^{3}	1	2.20
454	0.454	1

Pressure

Pa	Torr	kgf/cm^2
1	7.50×10^{-3}	1.02×10^{-5}
133	1	1.36×10^{-3}
9.81×10^{4}	736	1

For more information, contact the nearest Service Office.

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