

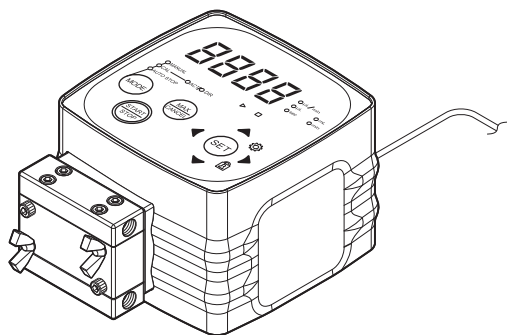
Smoothflow Pump

Q Series

OPERATION MANUAL

Please read this OPERATION MANUAL carefully before use.

Operating the pump incorrectly in disregard of these instructions may lead to death, injury and/or cause property damage.



Calibrate the pump to ensure the correct flow rate.



Page **28**

Applicable Model

Q/QI-5-□-ULP

- TACMINA accepts no liability whatsoever for any damage caused by malfunction of this product and other damage caused by use of this product.
- If the pump you bought conforms to special specifications not described in this manual, use the pump according to the details of the separate meetings, drawings, and approval documents.
- If the pump is used in a manner not specified by the manufacturer, the protection provided by the pump may be impaired.
- Additional information on this product and manuals in other languages may be found on our website.

Smoothflow Pumps enable accurate

1 Installation

Pages 12 and 13



2 Piping

Pages 14 to 18



3 Electrical wiring

Pages 19 to 22



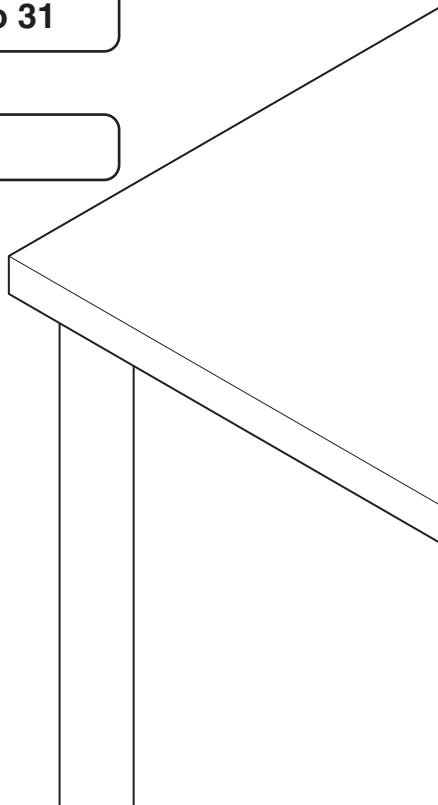
4 Calibration

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5 Starting operation

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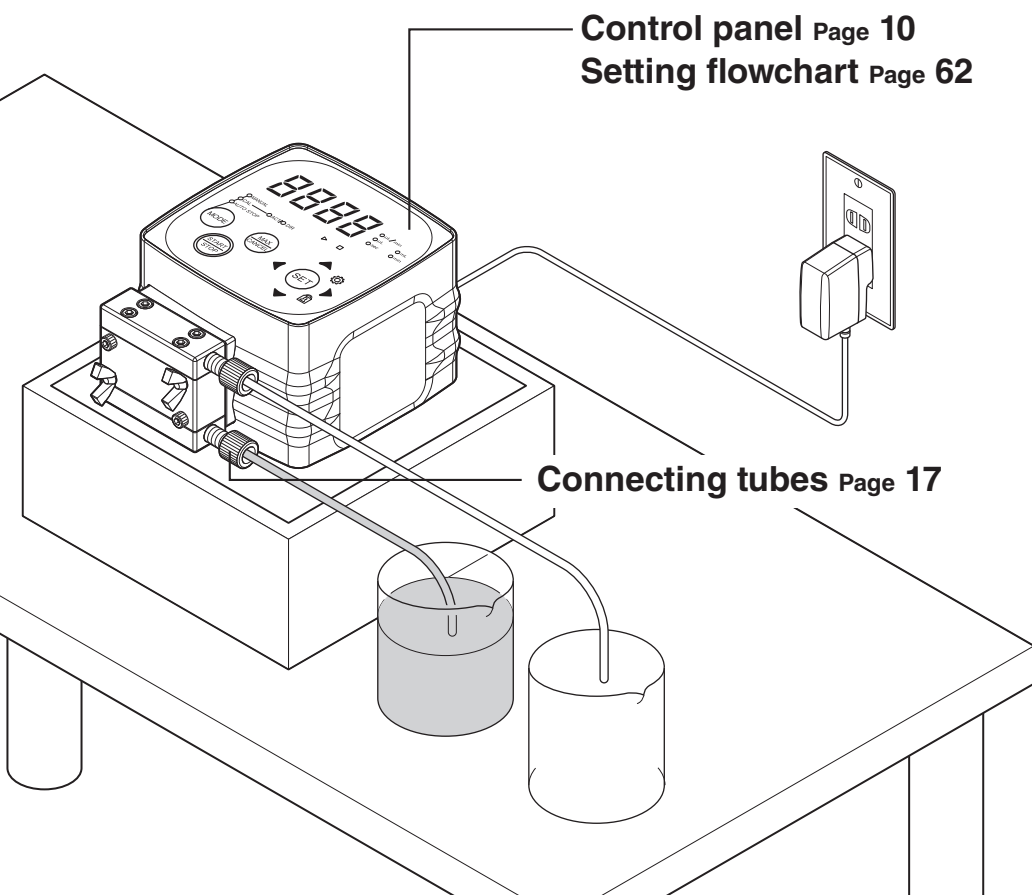


injection and simple control.

- If you have any problems with the pump



Troubleshooting Page 53



How to operate the pump safely

In order to ensure that the pump will be operated correctly and safely, this operation manual contains some guidelines for the user in the form of important safety precautions and considerations that, depending on their seriousness, are categorized as set forth below. Be absolutely sure to heed these precautions and considerations.



WARNING

- This is used to indicate a condition or action that may result in death or serious injury if the instructions given are ignored and the operations are performed incorrectly.



CAUTION

- This is used to indicate a condition or action that may result in injury and/or damage to personal property if the instructions given are ignored and the operations are performed incorrectly.

IMPORTANT

- This is used to indicate a condition or action that must be established or carried out in order to maintain the performance and service life of the equipment.

NOTE

- This is used to indicate supplementary information.

Conditions of use



WARNING

- Do not use this pump in explosion-proof areas or in explosive or combustible atmospheres.



CAUTION

- This pump can only be used to transfer liquids. Do not use this pump for any other applications. Otherwise there is a risk of accident or malfunction.
- This pump cannot be used to inject liquids containing slurry.
- Do not use this pump in a wet location.*¹

*¹ The term wet location refers to a location where water or some other conductive liquid may exist and to a location where it is easy for the human body impedance to decrease due to wet contact between the human body and the machine or between the human body and the surrounding environment.

- Do not use the pump outside the following usage ranges. Doing so may cause malfunctions.

Ambient temperature/humidity	0 to 40°C ^{*2} /85%RH or less
Pollution degree	2
Altitude	1000 m or less
Transfer liquid temperature	0 to 40°C (no freezing)
Transfer liquid viscosity	50 mPa·s or less
Maximum discharge pressure	3.0 MPa

^{*2} -10 to 50°C during transport and storage.

Transportation, installation, and piping



WARNING

- Do not use this pump in explosion-proof areas or in explosive or combustible atmospheres.
- Install the pump in a location that cannot be accessed by anyone but control personnel.



CAUTION

- Take preventative measures such as a chemical drainage ditch that is capable of handling the flow of the transfer liquid. Implement the measures so that the fluid level does not rise up to the surface where the pump is installed.
- Do not subject the pump to strong impacts.
- Keep the product level while transporting it. If the product is tilted by 10° or more, it may fall over.
- If this pump has been dropped or damaged, consult your vendor or a TACMINA representative. Using a dropped or damaged pump may result in accidents and/or malfunctions.
- Installation work must be performed by individuals who have received the required training.
- Do not install the pump in humid or dusty locations. Doing so may cause electric shock or malfunctions.
- This pump has an IP65 or equivalent construction^{*1}, but install it in a location where it is not exposed to direct sunlight, wind, or rain and where there is no chance of the pump being submerged in water. Failing to follow this instruction may damage the pump or shorten its service life. If you will install the pump outdoors, we recommend installing a cover over the pump.^{*2}

^{*1} Evaluated by an organization not related to UL.

^{*2} UL-listed models (ULP types) are all rated for indoor-use only.

- When a shut-off valve is located on the discharge-side piping and when there is a risk of blockage, be sure to install a relief valve on the piping immediately on the discharge side of this pump.
- If there is a chance of the fluid solidifying or freezing due to reasons such as using water-diluted solutions in areas where the temperature is low, install a heating apparatus or heat insulation. The fluid solidifying or freezing may lead to damage to the pump or surrounding equipment.
- The water used for the shipment tests may remain in the liquid-end section of the pump. If the pump will transfer chemicals that harden or give off gas when they react with water, be absolutely sure to drain the water and dry off the liquid-end section prior to use.
- The discharge volume cannot be adjusted by operating valves on the discharge piping.
- The pump head and the joints are not designed to support the piping. Ensure that the pump and pipe joints will not be subjected to any excessive force that might be exerted by, for instance, the weight of the piping or the shifting of the pipe joints out of position.
- Generally speaking, the pressure resistance of hoses and tubes decreases when they reach high temperatures. If you will use commercially available hoses and tubes, be sure to use items that not only are resistant to chemicals but that also conform to the temperature and pressure under which they will be used. Failing to do so may cause hose or tube damage, which will cause chemicals to spray out.
- The hose and tube durability varies greatly depending on factors such as the chemical used, temperature, pressure, and ultra-violet rays. Inspect the parts and replace any that have deteriorated.

Electrical wiring



WARNING

- Do not use this pump in explosion-proof areas or in explosive or combustible atmospheres.
- The wiring must be done by a qualified electrician or somebody with electrical knowledge.
- Do not operate the pump with wet hands. Doing so may result in electric shocks.
- Take steps to ensure that the power will not be turned on during the course of work. Hang a sign on the power switch indicating that work is in progress.
- Do not disassemble the pump body.
- When connecting the pump to another electronic device using a signal cable, such as when controlling the pump from an external device or when controlling another electronic device using the output signal from the pump, check the specifications of both the pump and the other device to ensure the connection is correct.
- To prevent electric shock, fire, etc., use a device insulated from the high-voltage section when connecting the signal cable, and do not apply a voltage higher than the signal rate to the pump.

Operation & maintenance



WARNING

- Install the pump in a location that cannot be accessed by anyone but control personnel.
- Do not operate the pump with wet hands. Doing so may result in electric shocks.
- Take steps to ensure that the power will not be turned on during the course of work. Hang a sign on the power switch indicating that work is in progress.
- When there is a problem (such as when smoke appears or there is a burning smell), shut down the pump immediately, and then contact your vendor or a TACMINA representative. Otherwise, there is a risk of fire, electric shock, malfunction, or accident.
- Check if the valves are open before operating the pump. If you have forgotten to open a valve or foreign objects are blocking the piping on the discharge side of the pump, an excessive pressure rise that will exceed the pump's specification ranges may occur, liquid may spray out, or piping may be damaged, which is dangerous.
- Do not disassemble the pump body.
- Before disassembling the liquid-end section, be sure to unplug the power cord and check that no voltage is being applied to the pump. Hang a sign on the power switch indicating that work is in progress so as to prevent the power from being turned on again during the course of work.
- When working on the liquid-end section of the pump, wear protective gear suited to the chemical concerned (such as rubber gloves, a mask, protective goggles and work overalls that are resistant to chemical).
- Before maintaining or repairing the pump, be sure to release the discharge-side pressure, drain the chemicals from the liquid-end section, and wash the pump with deionized water.



CAUTION

- Set the relief valve pressure to a value that is 120% or less of the pump's normal operation pressure.
- Before starting operation, secure the piping in place and check that the connections have been tightened.

Other precautions



CAUTION

- Do not modify or alter the pump.
- The materials of the parts used in this pump are indicated in the provided diagrams and similar documents. When disposing of the pump, do so after first giving careful consideration to the appropriate disposal method for each material according to the laws and regulations in the area where the pump will be disposed of. Alternatively, contract the disposal of the pump to a dedicated waste disposal company.

Checking the product

After unpacking the pump, check the following.

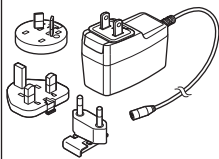
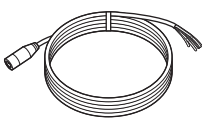
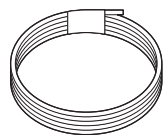
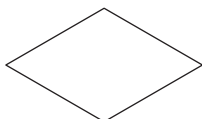
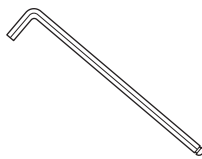
- (1) Is the pump the one that was ordered?
- (2) Do the details on the pump's nameplate match what was ordered?
- (3) Are all the accessories included?

Check the included accessories against the list of accessories shown below.

- (4) Has the pump sustained any damage from vibration or impact during transit?
- (5) Have any of the screws come loose or fallen out?

Every care is taken by TACMINA in the shipment of its pumps, but if you come across anything untoward, please contact your vendor or a TACMINA representative.

■ Accessories

AC adapter set	Syringe set (with tube attached)	Signal cable (QI only)	Tube ($\varnothing 1/16'' \times \varnothing 1/8''$)
 x1	 x1	 1.5 m	 2 m
Joint assembly • Ferrule • Nut	Nonslip sheet	Allen wrench (2.5 mm)	OPERATION MANUAL
 x2	 x1	 x1	 x1

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Introduction

Installation

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Maintenance

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Specifications

Others

Introduction

This diaphragm pump is capable of accurately feeding a constant amount of liquid in a constant amount of time.

Discharge-side pulsation is nearly nonexistent, which enables a stable and continuous transfer of fluids.

Structure

When facing the pump, the model nameplate is on the left side.

Smoothflow Pump

Serial No. : 19C00001

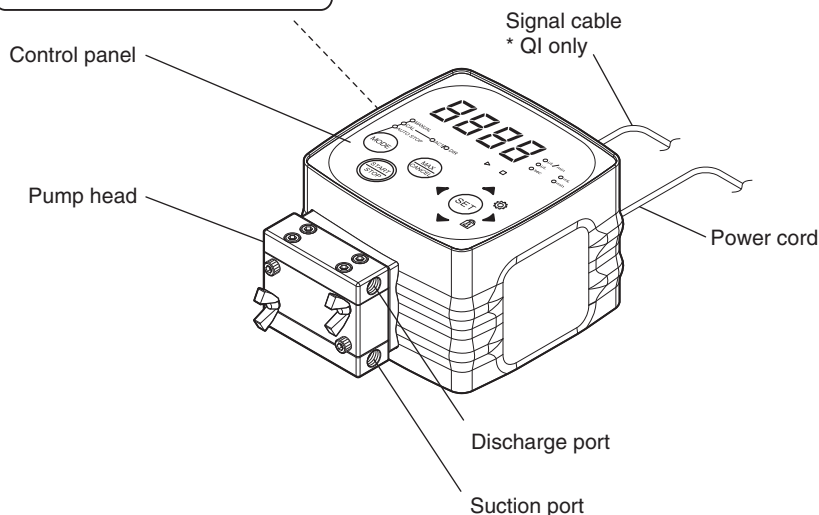
Model : QI-5-6R-ULP-ES

Max.Capacity : 5000 μ L/min

Max.Pressure : 3.0 MPa

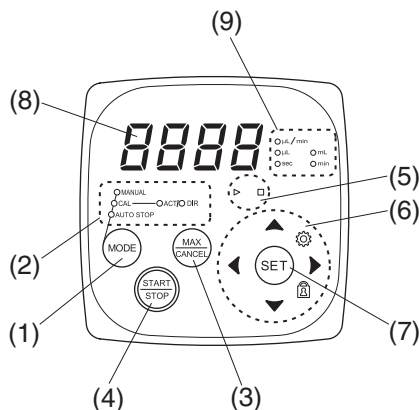
TACMINA CORPORATION

2-2-14 Awajimachi, Chuo-ku, Osaka 541-0047 Japan



Control panel

Q (standard type)



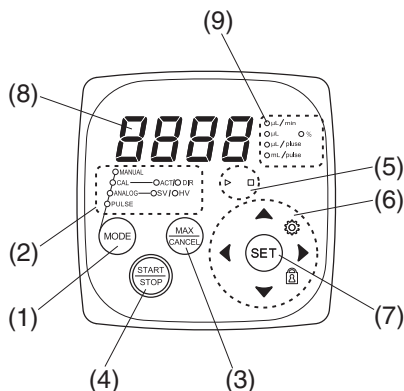
Indications in this manual

- □ : Off
 ● ► ■ : Lit
 ☼ : Flashing

No.	Name	Function
(1)	"MODE" key	Use this key to switch the mode. The pump switches to a different mode each time you press this key.
(2)	Mode indicator lamp	Displays the current mode. "MANUAL": Manual operation mode "CAL" : Calibration mode "AUTO STOP" : Auto-stop operation mode
(3)	"MAX/CANCEL" key	While this key is pressed, the pump operates at the maximum flow rate. When you are setting the amount to inject or the parameters, use this key to cancel settings. Use this key to clear errors.
(4)	"START/STOP" key	Use this key to start/stop the pump.
(5)	Operation status indicator lamp	Displays the pump's operation status. ■ : Pump stopped ► : Pump operating
(6)	Arrow keys	Use these keys to perform operations such as changing the flow rate.
(7)	"SET" key	Use this key to perform operations such as changing the flow rate and calibrating the pump.
(8)	Display	Displays the flow rate and setting values.
(9)	Unit indicator lamp	The unit for the displayed value lights.

Control panel

QI (I/O signal control type)



Indications in this manual

○	▷	□	: Off
●	▶	■	: Lit
⋈			: Flashing

No.	Name	Function
(1)	"MODE" key	Use this key to switch the mode. The pump switches to a different mode each time you press this key.
(2)	Mode indicator lamp	Displays the current mode. "MANUAL": Manual operation mode "CAL": Calibration mode "ANALOG": Analog-input proportional operation mode "PULSE": Pulse-input proportional operation mode
(3)	"MAX/CANCEL" key	While this key is pressed, the pump operates at the maximum flow rate. When you are setting the amount to inject or the parameters, use this key to cancel settings. Use this key to clear errors.
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(7)	"SET" key	Use this key to perform operations such as changing the flow rate and calibrating the pump.
(8)	Display	Displays the flow rate and setting values.
(9)	Unit indicator lamp	The unit for the displayed value lights.

Installation



WARNING

- Do not use this pump in explosion-proof areas or in explosive or combustible atmospheres.
- Install the pump in a location that cannot be accessed by anyone but control personnel.

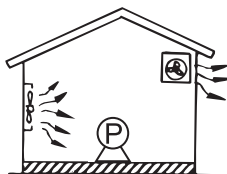
Installation location

- Whenever possible, avoid installing the pump in a location that will shorten its service life.

If you will install the pump outdoors, we recommend installing a cover over the pump.

Locations that will shorten the service life of the pump

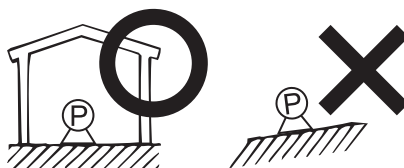
- Locations subject to direct sunlight
 - Locations where corrosive gases are generated
 - Locations exposed to wind or rain
 - Poorly ventilated locations
 - High humidity or dusty locations
- Install the pump in a location that has good ventilation in the summer and where the transfer liquid will not freeze in the winter.



- Provide adequate space around the pump to facilitate maintenance and inspections.



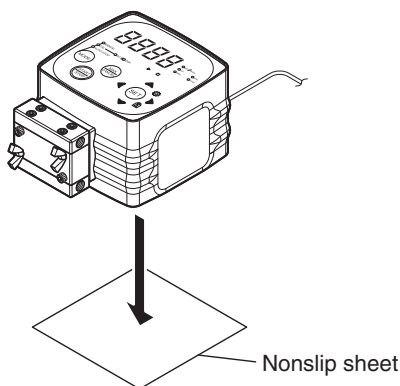
- Place the pump on a level location and secure it so that it will not vibrate. Installing the pump at an angle may result in discharge problems or in the inability of the pump to discharge.



Installation

When not fixing the pump onto the pump stand

Install the pump on top of the nonslip sheet.

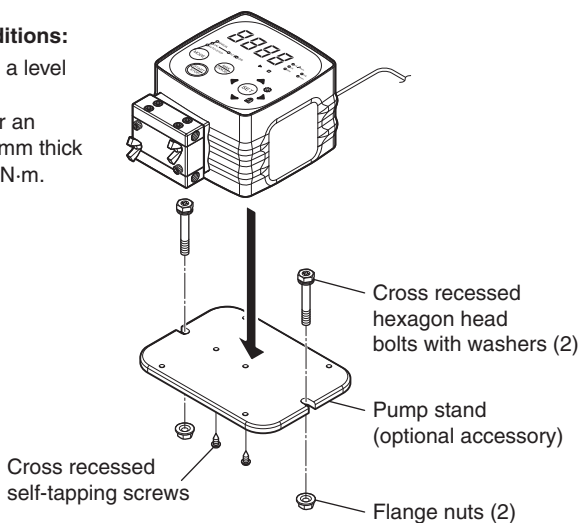


When fixing the pump onto the pump stand

- (1) Use the cross recessed self-tapping screw to fix the pump onto the pump stand (optional accessory).
- (2) Use the cross recessed hexagon head bolts with washers and the flange nuts to install the pump stand.

* Pump stand installation conditions:

- Install the stand horizontally in a level location.
- Fix the pump to a SUS plate or an equally strong plate at least 2 mm thick with a tightening torque of 0.4 N·m.



Piping

Requests during piping

● Pump head joints



CAUTION

- The pump head and the joints are not designed to support the piping. Ensure that the pump and pipe joints will not be subjected to any excessive force that might be exerted by, for instance, the weight of the piping or the shifting of the pipe joints out of position.

● Piping size and length

- Excessively long piping on the suction or discharge side may result in increased pressure loss, which may cause the pressure to exceed the pump's allowable pressure, may cause an excessive amount of liquid to be discharged, or may generate suction/discharge defects.
- When extending the piping, the pressure loss might exceed the pump's maximum discharge pressure, so thicker piping will be required.

See the following table to select the ideal piping sizes.

● Upper limits on piping length

The upper limit on the piping length varies depending on the tube diameter and the set flow rate of the pump.

Tube inner diameter	During 5000 µL/min operation		During 2500 µL/min operation		During 500 µL/min operation	
	Suction side	Discharge side	Suction side	Discharge side	Suction side	Discharge side
ø1 mm	0.5 m	30 m	1.5 m	30 m	10 m	30 m
ø1/16" *1	1.0 m	30 m	2.0 m	30 m	10 m	30 m

*1 Included tube

* These values correspond to situations where the piping is level. The upper limits are smaller if there are height differences between different parts of the piping.

* These values correspond to situations where clean water is transferred. The upper limits are smaller if the liquid has a high viscosity.

* If piping that is longer than the lengths given in the above table is required, contact TACMINA.

* If the liquid continues to flow within the piping even after the pump is stopped and an excessive amount of liquid is discharged, use a valve such as an anti-siphon check valve or a back pressure valve to apply back pressure.

Piping

●Pulsation in the suction-side piping

This pump suppresses pulsation on the discharge side, but pulsation occurs on the suction side.*1

*1) Pulsation

This pump's suction side generates unique pulsation. This pulsation has sine curve characteristics, and the instantaneous flow rate is approximately 2 times the average flow rate. For example, this means that an instantaneous flow rate of 10000 $\mu\text{L}/\text{min}$ is indicated for a 5000 $\mu\text{L}/\text{min}$ model.

For this reason, when selecting piping, the piping differs from that used on a continuous flow pump, such as a centrifugal pump, in that a value of the operating flow rate ($\mu\text{L}/\text{min}$) times 2 must be used.

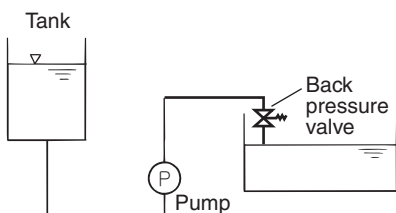
●Preventing the insertion of foreign objects

Foreign objects such as debris and aggregates inside the pipes entering into the pump head may result in discharge problems. Implement countermeasures such as installing filters (optional accessories).

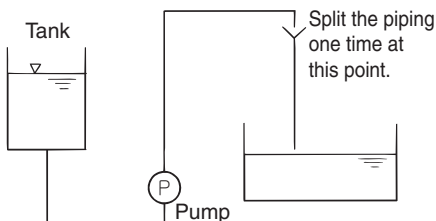
●When injecting fluid below the level of the liquid in the tank

When the end of the discharge-side piping is lower than the level of the liquid in the tank, siphoning will cause the liquid to flow down naturally. To prevent this, install a back pressure valve. If you cannot install a back pressure valve, split off the piping at a location near the injection point and higher than the liquid level in the tank.

Example 1:



Example 2:



●Other



CAUTION

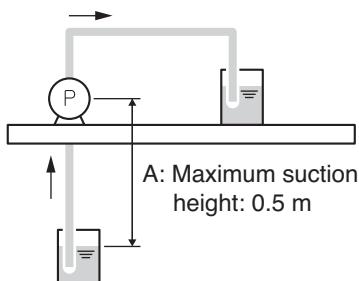
- If there is a chance of the fluid solidifying or freezing due to reasons such as using water-diluted solutions in areas where the temperature is low, install a heating apparatus or heat insulation. The fluid solidifying or freezing may lead to damage to the pump or surrounding equipment.

Piping

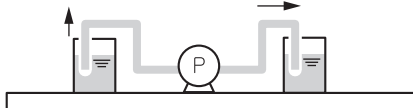
Recommended piping example

- To ensure safety, we recommend that you install the pump at a position that is equal to (level piping) or higher than (upwards suction piping) the level of the liquid in the tank on the suction side.
- The maximum suction height (A in the following figure) may vary depending on the properties of the liquid.
- When the pump is installed at a position lower than the level of the liquid in the tank on the suction side or when the tip of the discharge-side piping is lower than the level of the liquid in the tank on the suction side, siphoning may cause the liquid to flow down even when the pump is stopped. In this situation, use a commercially available back pressure valve, check valve, or a similar instrument to apply back pressure.
- Exercise caution when removing the tubes (such as when performing maintenance) as the remaining liquid in the pump may spray out.
- Pulsations occur on the suction side. Exercise caution to ensure that the tubes remain inside the containers.

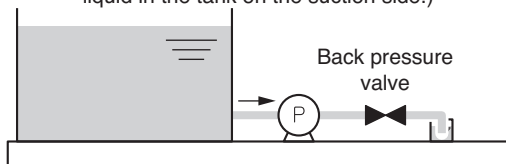
Upwards suction piping
(The pump is higher than the level of the liquid in the tank on the suction side.)



Level piping
(The pump is at the same height as the level of the liquid in the tanks on the suction and discharge sides.)



Pressure booster piping
(The pump is lower than the level of the liquid in the tank on the suction side.)



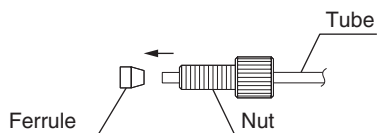
Piping

Connecting tubes

Cut the included tube into segments with the required lengths, and then connect these to the suction side and the discharge side of the pump.

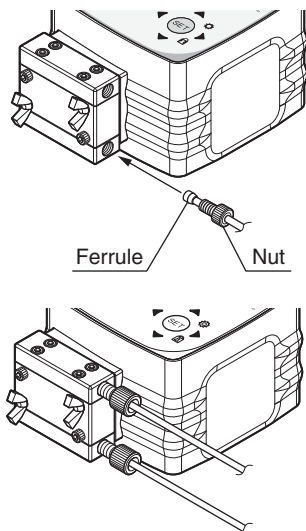
(1) Set a nut and ferrule on the tube.

Position the tapered end of the ferrule toward the nut.



(2) Attach the nut to the pump head.

Tighten the nut by hand. Do not use a tool.



* Do not tighten the cap nut excessively. Doing so may lead to tube deformation or damage.

* It is easy for the stress relaxation phenomenon to occur in the resin joint, and liquid may leak from the threaded part. Retighten the nut to eliminate leakage. If retightening no longer stops leakage, replace the ferrule and the tube.

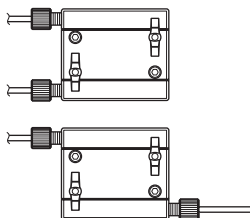
* When replacing the tube with a new one, replace the ferrule with a new one as well.

NOTE

You can change the connection direction of the tube.

For details, see "Disassembling the pump head" on page 46 and "Assembling the pump head" on page 50.

Connection variation example (Front view of the pump head)



Piping

●When using a tube other than that included with the accessories

- Use a tube with good external accuracy.
- Cut the tube at a right angle so that the opening maintains a perfect circle, and then check that the outer surface is not damaged.
- Flexible tubes such as those made from vinyl chloride, polyethylene, or urethane are not appropriate for use with the joints included in the accessories. When using tubes like these, attach an insert or a similar device (contact the tube's manufacturer) in order to change the tube to one that can be supported by the joints.
- A tube with an outside diameter of 1/16" is available for purchase as an optional accessory.

Joints

●When using a joint other than that included with the accessories

- Use a 1/4-28UNF joint.
- Use a joint that can be connected to a port with a flat end.
- A joint for tubes with an outside diameter of 1/16" is available for purchase as an optional accessory.

IMPORTANT

- The upper limit of the operating pressure of this pump is 3 MPa. However, the pressure inside the pipe may exceed 6 MPa when the discharge-side piping is blocked. When selecting piping materials, take the pressure resistance into consideration.

Electrical wiring



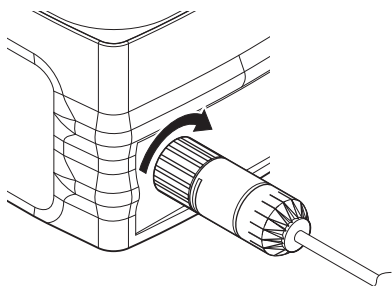
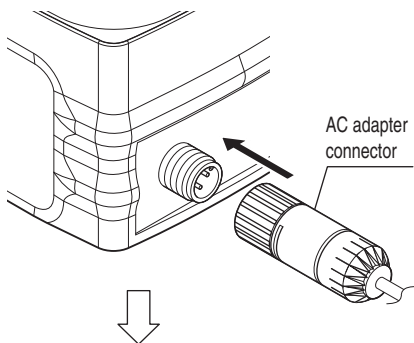
WARNING

- Do not use this pump in explosion-proof areas or in explosive or combustible atmospheres.
- The wiring must be done by a qualified electrician or somebody with electrical knowledge.
- Do not operate the pump with wet hands. Doing so may result in electric shocks.
- Take steps to ensure that the power will not be turned on during the course of work. Hang a sign on the power switch indicating that work is in progress.
- Do not disassemble the pump body.
- When connecting the pump to another electronic device using a signal cable, such as when controlling the pump from an external device or when controlling another electronic device using the output signal from the pump, check the specifications of both the pump and the other device to ensure the connection is correct.
- To prevent electric shock, fire, etc., use a device insulated from the high-voltage section when connecting the signal cable, and do not apply a voltage higher than the signal rate to the pump.

Electrical wiring

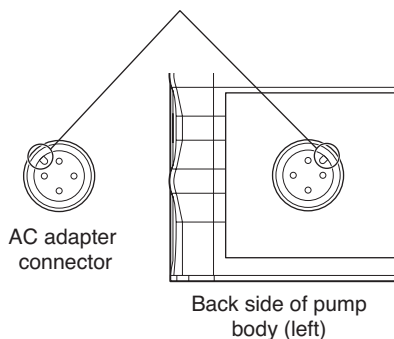
Connecting the power supply

- (1) Connect the AC adapter cord to the pump body.



When inserting the cord, align the positions of the connector pins.

Align these parts to insert.

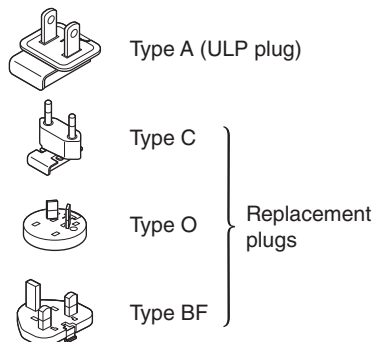


- (2) Plug the AC adapter into a power outlet.

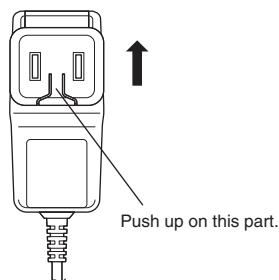
Replacing the plug

A replacement plug is included with the AC adapter. Replace the plug as necessary according to the shape of the power outlet.

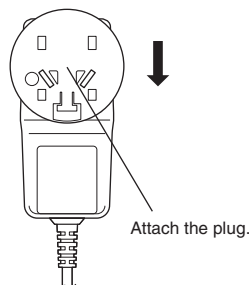
* Only the Type A plug is UL compliant.



- (1) Hold the plug lightly and push up.



- (2) Attach the replacement plug in the reverse order.



Electrical wiring

Connecting the signal cable (QI only)

The signal cable is an eight-core wire. Connect to the necessary devices through a terminal block or a similar apparatus.

The roles of the wires are shown below.

Wire color	Signal	Role
White	DI1 (+)	Digital input 1
Brown	DI2 (+)	Digital input 2
Green	INCOM (-)	Digital input common
Yellow	DO1 (+)	Digital output 1
Gray	DO2 (+)	Digital output 2
Pink	OUTCOM (-)	Digital output common
Blue	AI+	Analog input +
Red	AI-	Analog input -

●About digital input

a) When applying a no-voltage contact signal

Apply a no-voltage contact pulse from a device such as a pulse-transmitting flow meter to INCOM (green) and DI1 (white) or DI2 (brown).

In this situation, the signal has no polarity.

Use a pulse signal with low chattering. This is not suitable for general-purpose control relay contacts.

b) When applying an open collector (drain) signal

The current orientation is determined by the characteristics of the elements of open collectors, open drains, and other semiconductor contacts. Connect the collector (drain) to DI1 (white) or DI2 (brown) and the emitter (source) to INCOM (green).

●About analog input

Connect the signal cable (4 to 20 mADC) so that AI+ (blue) is positive and AI- (red) is negative.

●About signal specifications

See "I/O signal specifications" on page 59.

NOTE

- You can use "Parameter settings" (page 44) to change the assignments of digital inputs 1 and 2 and digital outputs 1 and 2.

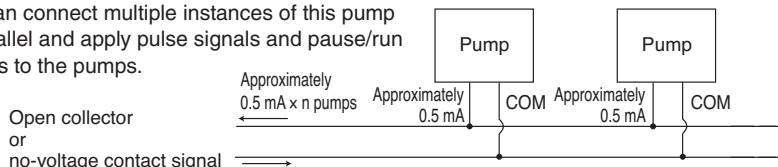
Electrical wiring

Signal cable distribution (QI only)

■When not using a signal distributor

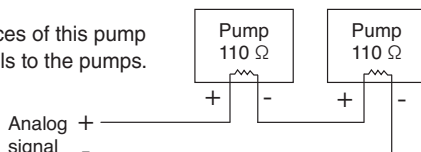
●Digital signal

You can connect multiple instances of this pump in parallel and apply pulse signals and pause/run signals to the pumps.



●Analog signal

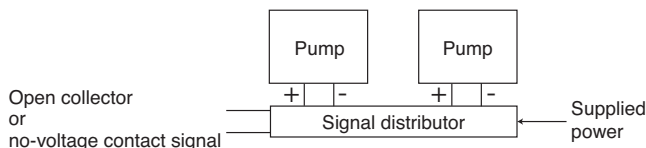
You can connect multiple instances of this pump in series and apply analog signals to the pumps.



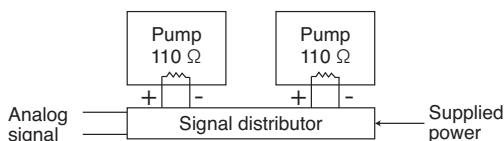
* If you remove a pump during maintenance or similar operations or if a pump is malfunctioning, the analog signal will be interrupted, and the other pumps will stop. If you want to ensure that these other pumps continue operating even in these situations, install a signal distributor.

■When using a signal distributor

●Digital signal



●Analog signal



■Digital signal input precautions

If you are using an open collector for the input, ensure that the leak current is small and the residual voltage is 1 V or less. If you are using an SSR, we recommend that you use the OMRON G3TA-IDZR02S.

■Digital signal output precautions

If you are using an SSR or a similar device to receive pulse output and alarm output, exercise caution regarding the current capacity.

We recommend that you use the OMRON G3F-203SN for the SSR.

Operation



WARNING

- Install the pump in a location that cannot be accessed by anyone but control personnel.
- Do not operate the pump with wet hands. Doing so may result in electric shocks.
- Take steps to ensure that the power will not be turned on during the course of work. Hang a sign on the power switch indicating that work is in progress.
- When there is a problem (such as when smoke appears or there is a burning smell), shut down the pump immediately, and then contact your vendor or a TACMINA representative. Failing to follow this instruction may result in fire, electric shocks, malfunctions, or accidents.
- Check if the valves are open before operating the pump. If you have forgotten to open a valve or foreign objects are blocking the piping on the discharge side of the pump, an excessive pressure rise that will exceed the pump's specification ranges may occur, liquid may spray out, or piping may be damaged, which is dangerous.

Before the first operation

- Check that the usage conditions are suited to the pump. (See "Conditions of use" on page 4.)
- Flush the piping with a safe liquid such as water and check that there are no leaks or blockages. Wash out or flush the piping so that no foreign material, such as cutting debris from the piping construction, remains in the piping.

Operation

Before operation

For safety, check the following items before operation.

Check location	Details of check/action to perform	Remarks
Pump head joints	Check for looseness. If the joints are loose, retighten them.	When first operating the pump after maintenance, retighten in the same manner.
Chemical tank	Check if the chemical amount is sufficient. If the amount is not sufficient, fill the tank.	
Piping	Check for piping disconnections and damage. Reconnect any disconnections and repair any damage.	
Valves (suction side and discharge side)	Check that the valves are open. If a valve is closed, open it.	Closed valves can cause dangerous situations in which the pressure rises excessively, liquid gushes out, or the pipes are damaged.
Power supply	Check that the pump is correctly connected to the specified power supply.	Failure to follow this instruction may lead to circuit damage or the motor burning out.

During operation

For safety, check the following items during operation.

Check location	Details of check/action to perform	Remarks
Pump head	Check for liquid leakage. If liquid leakage is discovered, stop the pump and inspect the bolts for uneven tightening or looseness while retightening any loose connections.	Also see "Liquid is leaking from the pump head." in the troubleshooting. (Page 56)
Joints	Check for liquid leakage. If liquid leakage is discovered, stop the pump and retighten any loose connections.	Also see "Liquid is leaking from the joints." in the troubleshooting. (Page 55)
Discharge-side pressure	Check if the pressure on the discharge side has increased abnormally. The increased pressure may be due to a clogged pipe or a blocked valve. Inspect the piping.	
Drive component/pump	Check for heat being produced and unusual noises.	

When stopping operation for a long period of time

When stopping pump operation for a long period of time or when resuming operation after a prolonged shutdown, perform the following work.

To stop

- (1) Clean the inside of the pump head.
Run the pump for 30 minutes with clean water or a cleaning solution.
- (2) Remove the clean water or cleaning solution.
- (3) Stop the pump, and then completely turn off the power.
- (4) Put a cover on the pump.
Protect the pump from dust accumulation and corrosive environments.

To resume

- (1) Check inside the tank for sediment deposits and for problems such as the liquid turning cloudy.
If the quality of the liquid has deteriorated, first wash the inside of the tank, and then replace the entire volume of liquid with clean liquid.

Turning the power on/off

Plug the AC adapter into a power outlet.

The pump turns on automatically.

Also, immediately after the power turns on, the pump will be stopped, regardless of the operating state that was in use when the pump was last turned off.



You can also change the operation as shown below by following the instructions under "Parameter settings" (page 42). Mainly use this function when the pump is used as an embedded component in a device.

- When the main power supply turns on, return the pump to the operating state that was in use when the main power supply was last turned off.
(Parameter P1-2)

Suctioning liquid/Air release

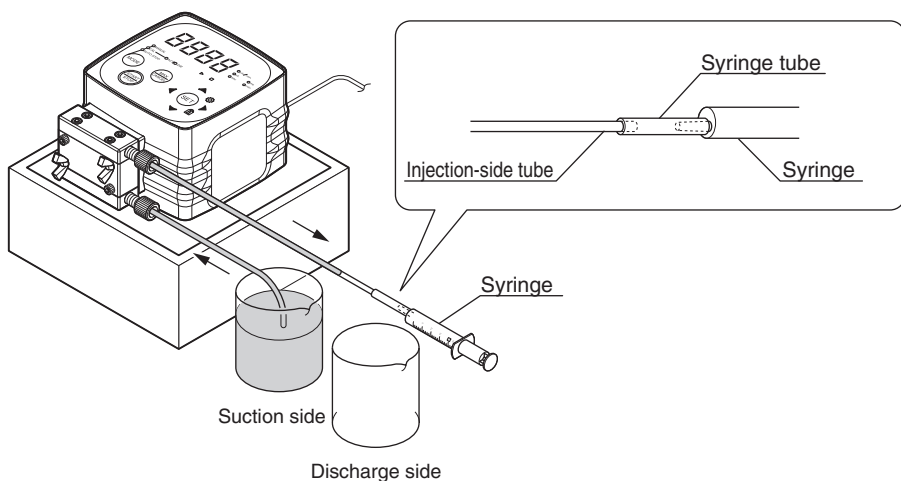
Using the syringe to suction the liquid

The pump cannot suction liquid with an empty pump head, so you have to use the syringe to suction liquid before starting operation.

(1) Stop the pump.

(2) Insert the syringe into the tip of the discharge-side piping, and then suction the liquid to the pump.

When the pump head is full of liquid, remove the syringe, and then operate the pump.



MAX operation

You can force the pump to operate at the maximum flow rate.

The air inside the piping or pump head may be released by increasing the flow velocity.

(1) During pump operation, press the "MAX/CANCEL" key.

While this key is pressed, the pump operates at the maximum flow rate.

The maximum flow rate is shown on the display.



NOTE

- If the air is not released by MAX operation, use the syringe to suction the liquid.

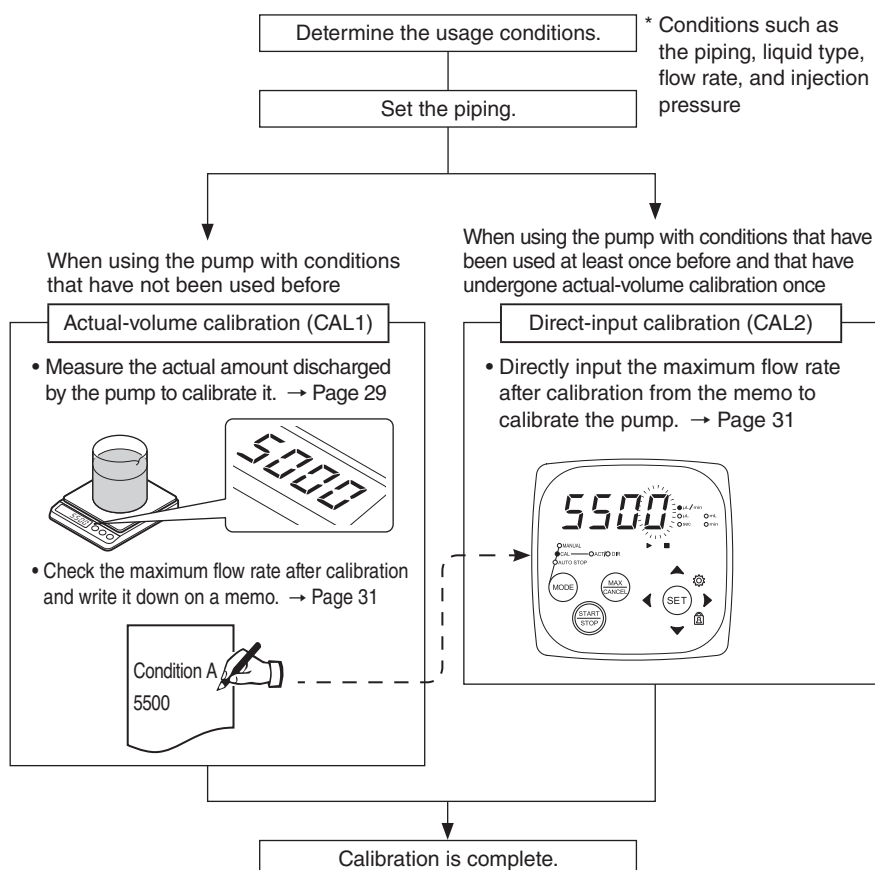
Calibration

You can set an accurate flow rate by measuring the amount of liquid that is discharged under the actual usage conditions and calibrating the pump.

Perform calibration in the following situations.

- The first time that you use the pump
- When the usage conditions change (changes to the liquid, piping, or injection pressure)
- When the pump has not been used for a long period of time
- When the set flow rate and the actual discharge amount do not match

Calibration flowchart



Calibration

Measuring the actual amount discharged and calibrating (CAL1)

(1) Set the piping.

The amount discharged will vary depending on the pressure within the piping. Perform calibration as close to the status with the actual piping as possible.

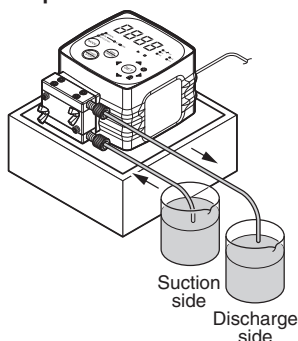
(2) Use the syringe to suction the liquid.

See page 27.

(3) Press the "MODE" key until the "MANUAL" lamp lights.



(4) Press the "START/STOP" key to operate the pump and fill the pump head and piping with the liquid.

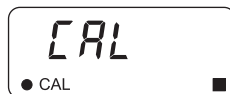


●Before proceeding to the next step

- Circulate the liquid within the pump for a fixed amount of time, and then start the calibration after the pressure within the piping has stabilized.
- Check that liquid containing no air is discharged from the tip of the tube on the discharge side.
- Note that the tube being in contact with the suction-side container or suctioning air will affect the amount of liquid that is transferred and will prevent accurate calibration.

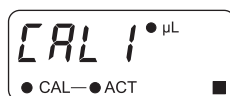
(5) Press the "MODE" key until the "CAL" lamp lights.

This switches the pump to calibration mode.



(6) Press the "SET" key until the "ACT" lamp lights.

"CAL1" is shown on the display.



(7) Press the "SET" key.

The flow rate setting value is displayed.



(8) Press the "SET" key once more.



Calibration

- (9) Change the value to the desired flow rate with the arrow keys.

◀ ▶ : Select the digit.

▲ ▼ : Increase/decrease the value.

Settable range: 1 to (Maximum flow rate)

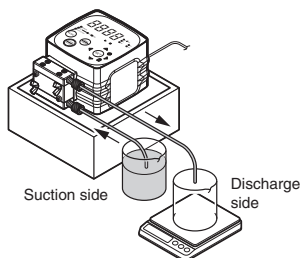
* You can obtain a more accurate calibration result by performing calibration with the flow rate that you actually use.



- (10) Press the "SET" key to confirm the flow rate.



- (11) Prepare a container at the outlet of the discharge-side piping, place it on the electronic balance, and then set the balance to zero.



- (12) Press the "START/STOP" key to start operation.

During operation, the accumulated discharge volume is counted and displayed.

To increase the accuracy, let the pump operate for a few minutes.

(2 minutes or more or 5000 µL or more is recommended.)

The longer you let the pump operate, the more accurate the calibration results you will obtain.

* Up to 9000 µL can be measured.



- (13) After a few minutes of operation, press the "START/STOP" key to stop operation.

The accumulated discharge volume flashes.

* If you stop the pump within 30 seconds of starting operation, the error message "E-09" will be displayed.

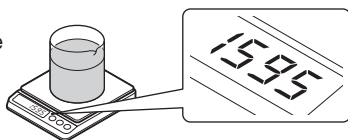
Press the "MAX/CANCEL" key to clear the error, and then perform the procedure again from step (5).



- (14) Check the measured value on the electronic balance, and then use the arrow keys to enter the value.

◀ ▶ : Select the digit.

▲ ▼ : Increase/decrease the value.



- (15) Press the "SET" key to finish calibration.



Calibration

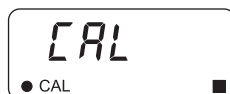
Checking the maximum flow rate after calibration

The pump's maximum flow rate setting is changed by the calibration.

We recommend that you check the maximum flow rate after calibration and make a record of it, such as in a notebook.

You can use "Direct-input calibration" (page 31) to easily calibrate the pump to the same conditions from the second and later times that you need to perform calibration.

- (1) Press the "MODE" key until the "CAL" lamp lights.



- (2) Press the "MAX/CANCEL" key.

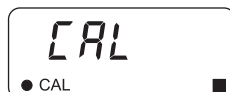
The maximum flow rate after calibration is displayed.



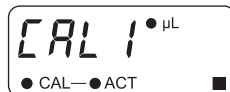
Using a value to perform calibration (CAL2: Direct-input calibration)

To use the pump under the same conditions that you obtained through actual-volume calibration from the second and later times, you can easily perform calibration by directly entering the maximum flow rate after calibration, which you recorded (in a notebook, for example) in advance.

- (1) Press the "MODE" key until the "CAL" lamp lights.

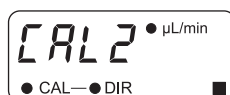


- (2) Press the "SET" key.



- (3) Press the $\blacktriangle$ or $\blacktriangledown$ arrow key until the "DIR" lamp lights.

"CAL2" is shown on the display.



- (4) Press the "SET" key.



- (5) Use the arrow keys to enter the maximum flow rate after calibration.

$\blacktriangleleft$ $\blacktriangleright$: Select the digit. $\blacktriangle$ $\blacktriangledown$: Increase/decrease the value.



- (6) Press the "SET" key to finish calibration.



IMPORTANT

- Direct-input calibration (CAL2) is a simple calibration method. If you require higher accuracy, perform actual-volume calibration (CAL1).

Manual operation

Set an arbitrary flow rate and operate the pump.

- (1) Press the "MODE" key until the "MANUAL" lamp lights.

The pump switches to manual operation mode.



- (2) Press the "SET" key.



- (3) Use the arrow keys to enter the flow rate.

◀ ▶ : Select the digit.

▲ ▼ : Increase/decrease the value.

* At this point, the flow rate has not yet been changed.



- (4) Press the "SET" key to confirm the flow rate.



- (5) Press the "START/STOP" key to start operation.

During operation, you can:

- Change the flow rate (described below).
- Temporarily run the pump at the maximum flow rate. ("Air release" on page 27)



- (6) Press the "START/STOP" key to stop operation.



Changing the flow rate during operation

Even during pump operation, you can use steps (2) to (4) shown above to change the flow rate.



Auto-stop operation (Q only)

If you set the flow rate and the timing with which to stop (the operation time or the accumulated discharge volume), the pump will stop automatically.

- (1) Press the "MODE" key until the "AUTO STOP" lamp lights.

The pump switches to auto-stop operation mode.



- (2) Press the "SET" key.



- (3) Use the arrow keys to set the flow rate ($\mu\text{L}/\text{min}$).

◀ ▶ : Select the digit.

▲ ▼ : Increase/decrease the value.



- (4) Press the "SET" key.



- (5) Use the arrow keys to set the timing with which to stop the pump.

◀ ▶ : Select the digit.

▲ ▼ : Increase/decrease the value.

Settable range: 1 to 9999 (μL or mL)

1 to 9999 (sec or min)

* In the factory default configuration, this is set to operation time with a unit of minutes.

You can change this unit to one of those shown below by using [P7-1] explained in "Parameter settings" (page 42).

- Accumulated discharge volume (μL or mL)
- Operation time (sec or min)



- (6) Press the "SET" key to finish configuring the settings.



- (7) Press the "START/STOP" key to start operation.

The pump will stop automatically with the timing that you have set.



Analog-input proportional operation (QI only)

You can have the pump automatically change the flow rate according to an externally applied analog signal (4 to 20 mADC).

Setting examples

Use the combination of the "target value, SV," and the "maximum flow rate, HV," to set the control range of the flow rate.

■Meaning of terms

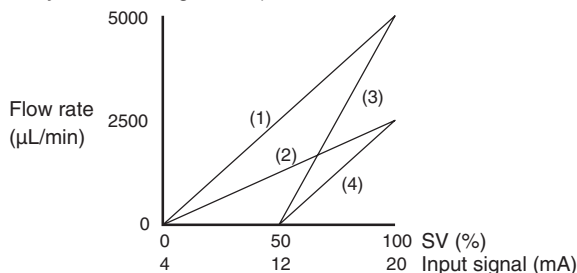
Target value, SV (%): The point where the line crosses the X axis on the proportion graph

Maximum flow rate, HV ($\mu\text{L}/\text{min}$): The flow rate at 100% (20 mA)*¹ input

*¹ This is the flow rate with an input of 4 mA when using negative polarity (20 to 4).

■Example 1: Input proportional operation with positive polarity (4 to 20 mADC)

If [P5-1] is set to [0] in the "Parameter settings" (page 43), and the input signal (mA) is mapped to the X axis and the flow rate ($\mu\text{L}/\text{min}$) is mapped to the Y axis, the result is a proportion graph in which the lines rise to the right as shown in the following figure. (This is the setting in the factory default configuration.)

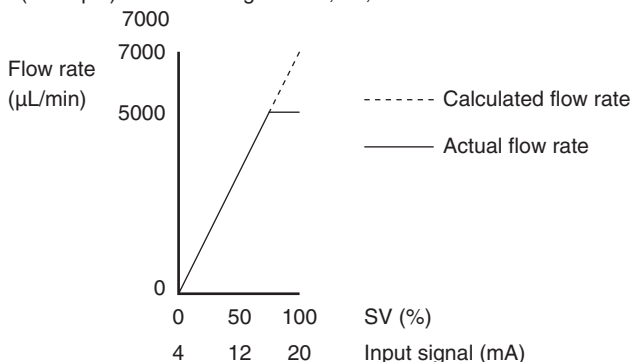


Parameter	Setting value	
P5-1	0 (4-20)	
	SV (%)	HV ($\mu\text{L}/\text{min}$)
(1)	0	5000
(2)	0	2500
(3)	50	5000
(4)	50	2500

* You can set the maximum flow rate, HV, to a value that exceeds the pump's capability, but the actual flow rate will not exceed the maximum flow rate of the pump.

(You can use this in situations such as when you want to perform full range flow rate control with input changes from 0 to 50%.)

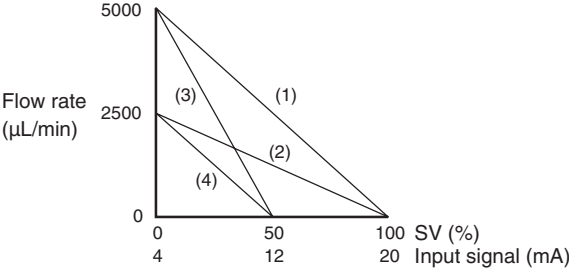
(Example) When the target value, SV, is set to 0 and the maximum flow rate, HV, is set to



Analog-input proportional operation (QI only)

■Example 2: Input proportional operation with negative polarity (4 to 20 mADC)

If [P5-1] is set to [1] in the "Parameter settings" (page 43), the result is a proportion graph in which the lines fall to the right (negative proportion) as shown in the following figure.



Parameter	Setting value	
P5-1	1 (20-4)	
	SV (%)	HV (μL/min)
(1)	100	5000
(2)	100	2500
(3)	50	5000
(4)	50	2500

Analog-input proportional operation (QI only)

Operating procedure

NOTE

- For details on the settings, see "Setting examples" (page 34).

- (1) Press the "MODE" key until the "ANALOG" lamp lights.

The pump switches to analog-input proportional operation mode.



- (2) Press the "SET" key.

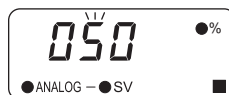


- (3) Use the arrow keys to set the target value, SV.

◀ ▶ : Select the digit.

▲ ▼ : Increase/decrease the value.

Settable range: 0 to 100 (%)



- (4) Press the "SET" key.



- (5) Use the arrow keys to set the maximum flow rate, HV.

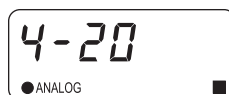
◀ ▶ : Select the digit.

▲ ▼ : Increase/decrease the value.

Settable range: 1 to 9999 (μL/min)



- (6) Press the "SET" key to finish configuring the settings.



- (7) Press the "START/STOP" key to start operation.

The liquid is transferred at a flow rate that matches the applied signal.

* If error code "E-05" is displayed, the signal has not been applied correctly. Check the wiring.



- (8) Press the "START/STOP" key to stop operation.



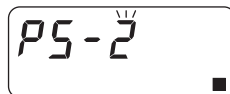
Analog-input proportional operation (QI only)

Calibrating analog inputs

When the accuracy of analog inputs is considered important, perform calibration of the analog inputs.

- (1) Follow the procedure in "Parameter settings" on page 42 to display parameter [P5-2].

Perform calibration at 4 mA.



- (2) Press the "SET" key.



- (3) Input a DC 4 mA analog signal from an external device.

- (4) Use the ▲ or ▼ arrow key to set the value to 400.



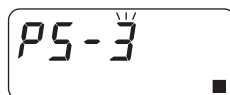
- (5) Press the "SET" key.

Calibration at 4 mA is complete.



- (6) Press the arrow keys to display parameter [P5-3].

Perform calibration at 20 mA.



- (7) Press the "SET" key.



- (8) Input a DC 20 mA analog signal from an external device.

- (9) Use the ▲ or ▼ arrow key to set the value to 2000.



- (10) Press the "SET" key.

Calibration at 20 mA is complete.



- (11) Press the "MODE" key to return to manual operation mode.



NOTE

- If any analog input value exceeds ± 1 mA during analog input calibration, the error code "E-05" (analog input error) is displayed.

Pulse-input proportional operation (QI only)

You can have the pump operate automatically according to an externally applied pulse signal.

Setting examples

You can use the combination of the "discharge volume per pulse" and the "flow rate" to configure a variety of settings.

■Meaning of terms

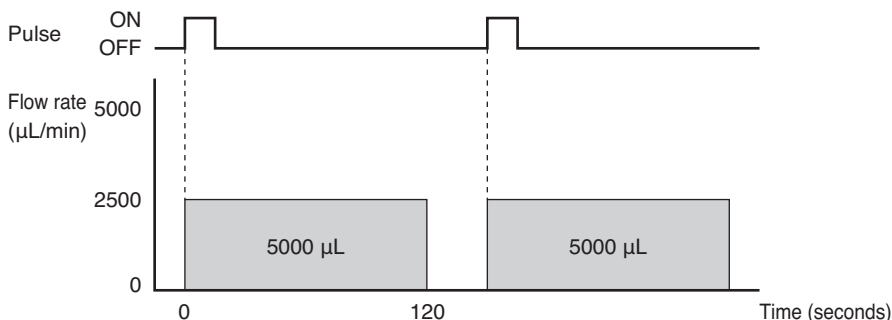
Discharge volume per pulse: The volume of liquid discharged by the pump in response to a single pulse signal

Flow rate: The flow rate when discharging the volume of liquid per pulse (the discharge speed)

■Example 1

Setting item	Setting value
Discharge volume per pulse	5000 μL
Flow rate	2500 $\mu\text{L}/\text{min}$

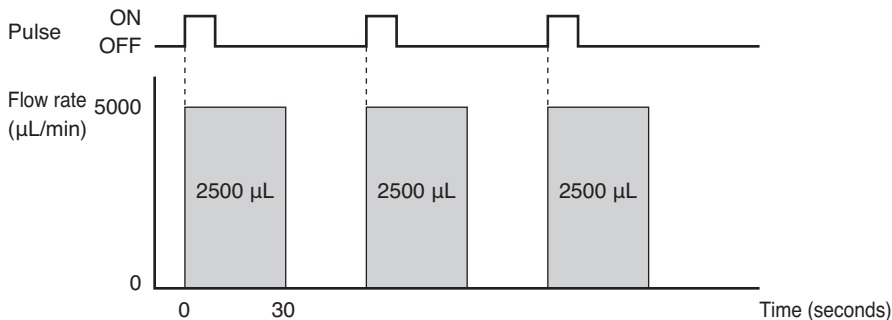
* 5000 μL of chemicals are discharged at a flow rate (discharge speed) of 2500 $\mu\text{L}/\text{min}$ for each pulse signal.
(The operation time for one pulse is 2 minutes [120 seconds].)



■Example 2

Setting item	Setting value
Discharge volume per pulse	2500 μL
Flow rate	5000 $\mu\text{L}/\text{min}$

* 2500 μL of chemicals are discharged at a flow rate (discharge speed) of 5000 $\mu\text{L}/\text{min}$ for each pulse signal.
(The operation time for one pulse is 0.5 minutes [30 seconds].)



Pulse-input proportional operation (QI only)

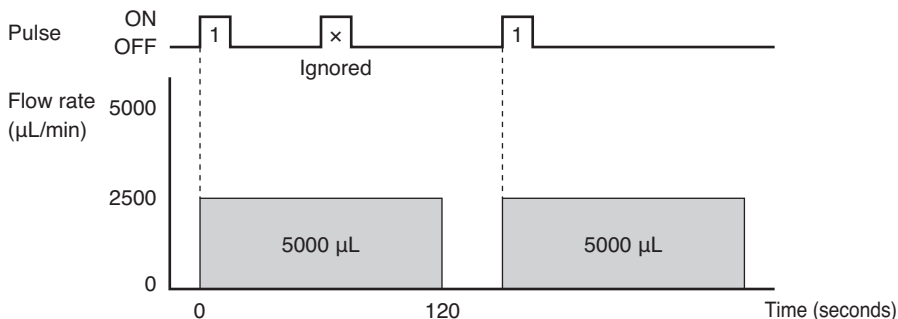
Behavior when a pulse signal is applied during pump operation

■Example 1

If [P6-2] is set to [1] in "Parameter settings" (page 43), pulse signals applied during pump operation will be ignored. (This is the setting in the factory default configuration.)

Setting item	Setting value
Discharge volume per pulse	5000 μL
Flow rate	2500 $\mu\text{L}/\text{min}$

Parameter	Setting value
P6-2	1

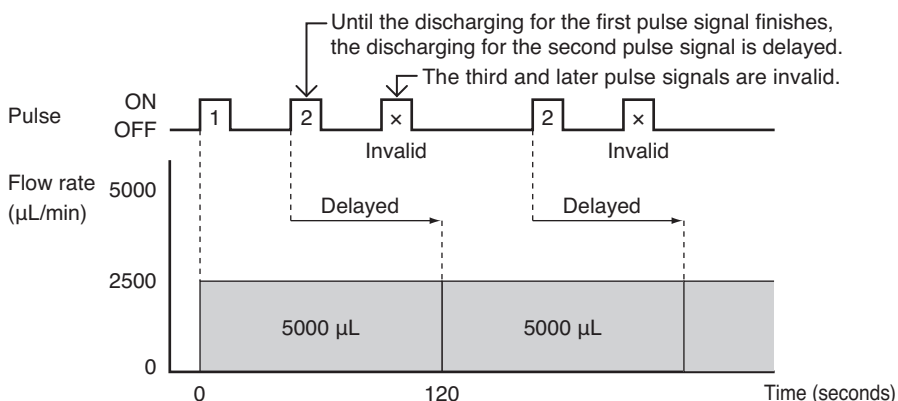


■Example 2

You can delay the pump from discharging liquid for the set number of pulse signals by setting [P6-2] to [2] or higher in "Parameter settings" (page 43).

Setting item	Setting value
Discharge volume per pulse	5000 μL
Flow rate	2500 $\mu\text{L}/\text{min}$

Parameter	Setting value
P6-2	2



* You can output an alarm signal when a pulse signal that exceeds the upper limit of the number of pulse signals to delay is applied by setting [P4-3] to [1] in "Parameter settings" (page 43).

Pulse-input proportional operation (QI only)

Operating procedure

NOTE

- For details on the settings, see "Setting examples" (page 38).

- (1) Press the "MODE" key until the "PULSE" lamp lights.

The pump switches to pulse-input proportional operation mode.



- (2) Press the "SET" key.



- (3) Use the arrow keys to set the discharge volume per pulse.

◀ ▶ : Select the digit.

▲ ▼ : Increase/decrease the value.

Settable range: 1 to 9999 (μL/pulse, mL/pulse)

* In the factory default configuration, the setting is μL/pulse.

You can change this to mL/pulse in "Parameter settings" (page 43).



- (4) Press the "SET" key.



- (5) Use the arrow keys to set the flow rate.

◀ ▶ : Select the digit.

▲ ▼ : Increase/decrease the value.

Settable range: 1 to maximum flow rate (μL/min)



- (6) Press the "SET" key to finish configuring the settings.



- (7) Press the "START/STOP" key to start operation.

The pump operates according to the pulse signal.



- (8) Press the "START/STOP" key to stop operation.



Key lock

This function disables the key operations that are used to perform tasks such as changing the mode and changing settings.

You can use this to prevent misuse and tampering.

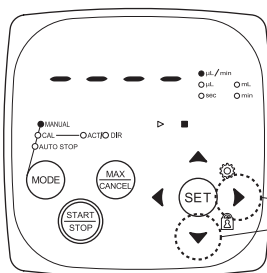
● Even when the key lock is enabled, the following operations are possible.

- Starting/stopping the pump
- Operating the pump at the maximum flow rate

(1) With the pump stopped, press the ▼ and ► arrow keys at the same time for 1 second or more.

This enables the key lock.

With the key lock enabled, if you press one of the disabled keys, "- - -" is displayed.



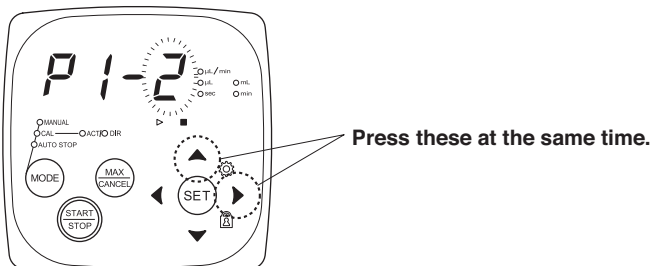
(2) Once more, press the ▼ and ► arrow keys at the same time for 1 second or more.

This disables the key lock.

Parameter settings

You can configure the settings related to pump operation.

- (1) With the pump stopped in manual operation mode, press the ▲ and ► arrow keys at the same time for 1 second or more.



- (2) Use the arrow keys to display the number of the parameter that you want to change.
- ◀ ▶ : Select the parameter digit.
 - ▲ ▼ : Increase/decrease the parameter number.
- (3) After you have displayed the number of the parameter that you want to change, press the "SET" key.
- (4) Use the ▲ or ▼ arrow key to change the setting value.
- (5) Press the "SET" key.
- (6) Press the "MODE" key to return to the previous screen.

Parameter list (Q: standard type)

	Parameter	Function	Setting value *Default values are shown in bold.
Basic settings	P1-2	Pump operation status when the main power supply turns on	0: Stopped 1: Maintained
Auto-stop	P7-1	Auto-stop operation unit setting	0: sec 1: min 2: μL 3: mL
Initialization	P8-1	Initialization (resets the pump to the factory default configuration)	0: Do not initialize 1: Initialize

Parameter settings

Parameter list (QI: I/O signal control type)

	Parameter	Function	Setting value *Default values are shown in bold.
Basic settings	P1-2	Pump operation status when the main power supply turns on	0: Stopped 1: Maintained
Input	P2-1	Digital input 1 assignment *1 (See page 44.)	0: None 1: Pulse 2: – 3: Pause/Run 4: Level 5: MAX operation
	P2-2	Digital input 2 assignment *1 (See page 44.)	0: None 1: Pulse 2: – 3: Pause/Run 4: Level 5: MAX operation
	P2-3	Operation when a pause/run signal is applied	0: Pause 1: Run
Output	P3-1	Digital output 1 assignment (See page 44.)	0: None 1: Unit pulse 2: – 3: Alarm 4: Operation signal
	P3-2	Digital output 2 assignment (See page 44.)	0: None 1: Unit pulse 2: – 3: Alarm 4: Operation signal
	P3-3	Pulse output unit amount	0: 1 μL *2 1: 10 μL 2: 100 μL 3: 1000 μL
Alarm	P4-1	Level error	0: Disable 1: Enable
	P4-2	Analog input error	1: Enable (This cannot be changed.)
	P4-3	Pulse overflow error	0: Disable 1: Enable
Analog input	P5-1	Analog input type	0: 4-20 1: 20-4
	P5-2	Analog input calibration (4 mA)	See page 37.
	P5-3	Analog input calibration (20 mA)	See page 37.
Digital input	P6-1	Input filter (Assigned to both DI1 and DI2.)	5 to 40 (milliseconds)
	P6-2	Number of pulses to delay	1 to 30 (pulses)
	P6-3	Pulse input setting unit	0: $\mu\text{L}/\text{pulse}$ 1: mL/pulse
	P6-4	Digital input 1 check	0: Open 1: Closed
	P6-5	Digital input 2 check	0: Open 1: Closed
Initialization	P8-1	Initialization (resets the pump to the factory default configuration)	0: Do not initialize 1: Initialize

*1 You cannot select the same setting value for [P2-1] and [P2-2].

*2 If you set the pulse output unit amount to 1 μL , use the pump with a flow rate of 10% or less of the maximum flow rate after calibration. If you use the pump with a flow rate more than 10% of the maximum flow rate, no unit pulse will be output.

Parameter settings

Digital input/output assignments (QI only)

● Digital input 1 (parameter P2-1)/ digital input 2 (parameter P2-2)

Setting value	Assignment	Explanation
1	Pulse	This is used in pulse-input proportional operation (page 38).
3	Pause/Run	The pump will pause or run only while the external signal is applied. * You can use parameter [P2-3] to set whether the pump pauses or runs while the signal is applied. * When a pause signal is applied during pulse-input proportional operation, all the pending pulses will be canceled.
4	Level	This is linked to the level switch and is used to detect the amount of liquid remaining in the tank.
5	MAX operation	This is used in place of the "MAX/CANCEL" key. The pump will be operated with the maximum flow rate only while the external signal is applied.

● Digital output 1 (parameter P3-1)/ digital output 2 (parameter P3-2)

Setting value	Assignment	Explanation
1	Unit pulse	Each time that a fixed unit is discharged,*1 a pulse signal (50 msec) is output. You can set the unit amount with parameter [P3-3]. (The setting is 10 μ L in the factory default configuration.)
3	Alarm	A signal is continuously output when a level error, analog input error, or pulse overflow error occurs. * For details on the alarms, see page 57. * For level errors and pulse overflow, you can use parameters [P4-1] and [P4-3], respectively, to enable or disable the alarm output. The alarm output is always enabled for analog input errors.
4	Operation signal	This signal is continuously output during pump operation (while the motor is operating).

*1 This operation is based on the calculated value. The calculated value may vary from the amount that is actually discharged.

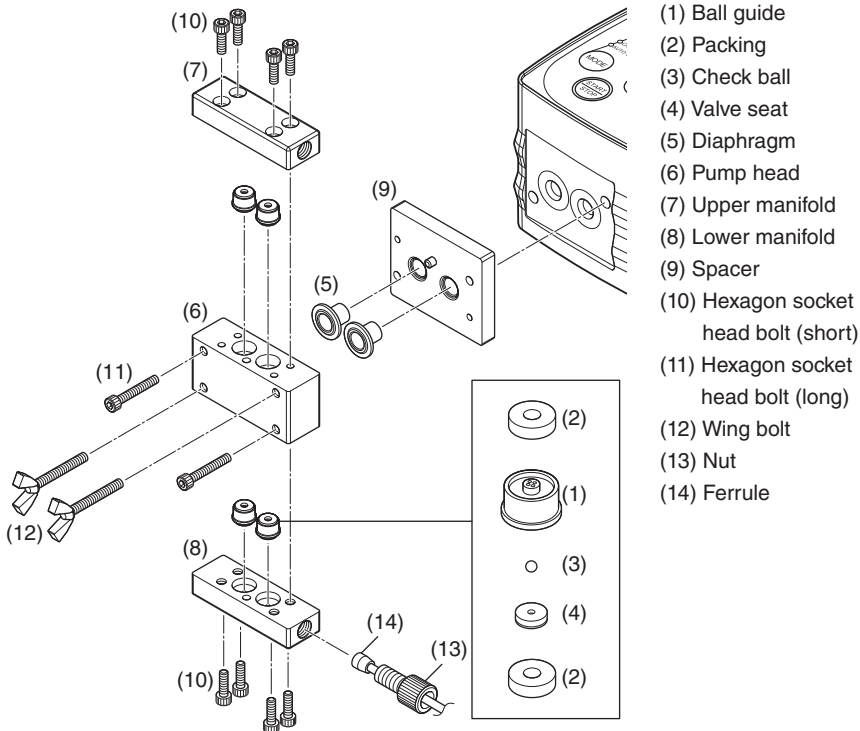
Disassembling the liquid-end section



WARNING

- Do not operate the pump with wet hands. Doing so may result in electric shocks.
- Before disassembling the liquid-end section, be sure to turn off the power and check that no voltage is being applied to the pump. Do not disassemble this section after simply using the key to stop the pump. Hang a sign on the power switch indicating that work is in progress so as to prevent the power from being turned on again during the course of work.
- When working on the liquid-end section of the pump, be sure to wear protective gear (such as rubber gloves, a mask, protective goggles, and work clothes that are resistant to chemicals) suited to the chemical concerned.
- Before maintaining or repairing the pump, be sure to release the discharge-side pressure, drain the chemicals from the liquid-end section, and wash the pump with deionized water.

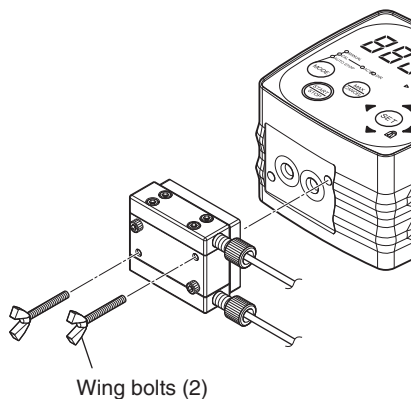
Detailed figure of the liquid-end section



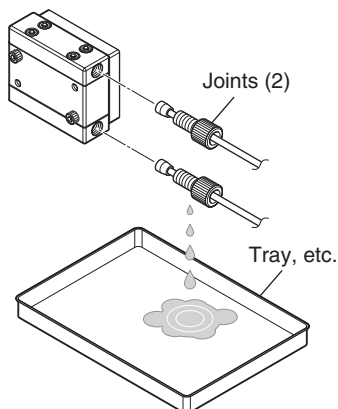
Disassembling the liquid-end section

Disassembling the pump head

- (1) Remove the wing bolts to remove the liquid-end section.

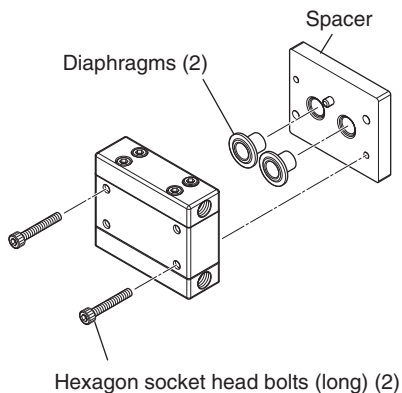


- (2) Remove the joints.

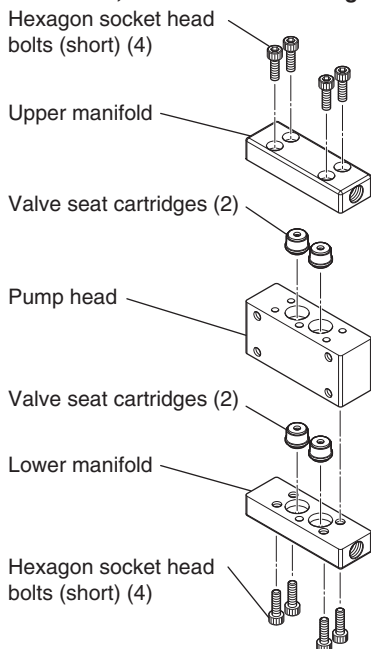


* Liquid will drip from the joint connection. Collect the liquid in a tray, etc.

- (3) Remove the hexagon socket head bolts (long) and disassemble the pump head, diaphragms, and spacer.



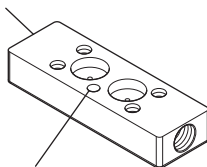
- (4) Remove the hexagon socket head bolts fastened to the top and bottom of the liquid-end section, and disassemble the pump head, manifolds, and valve seat cartridges.



Disassembling the liquid-end section

* You can distinguish between the upper manifold and the lower manifold by the number of holes on the surface to which the valve seat cartridges are installed.

Lower manifold



Only the lower manifold has a hole here.

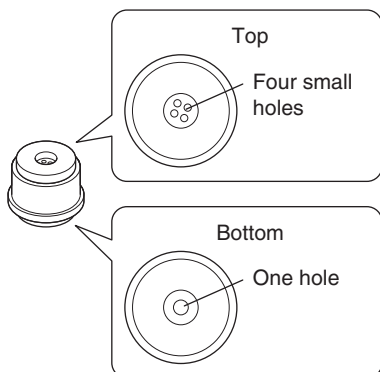
Disassembling the liquid-end section

Disassembling the valve seat cartridge

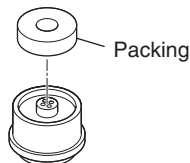
IMPORTANT

- There are very small parts inside the valve seat cartridge. When disassembling the cartridge, perform the work carefully on a tray so as not to lose any parts.
- The valve seat and check ball ensure good accuracy in pairs. Always use the parts in pairs as varying the parts may cause decreased performance.

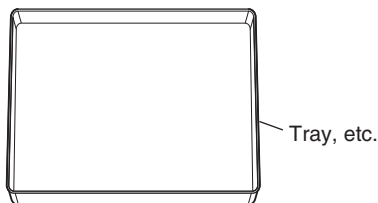
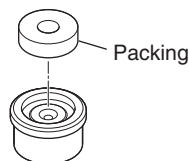
* There are four small holes in the center of the top of the valve seat cartridge and one hole in the center of the bottom of the valve seat cartridge. Small parts such as the valve seat and check ball are located in the side with one hole.



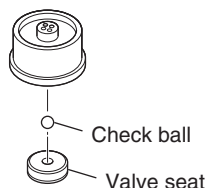
- (1) Remove the packing on the side with four small holes in the center.



- (2) Turn the other side of the ball guide upward and remove the packing carefully so that the contents do not come out.



- (3) Turn the ball guide upside down and remove the valve seat and check ball.



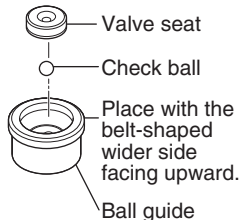
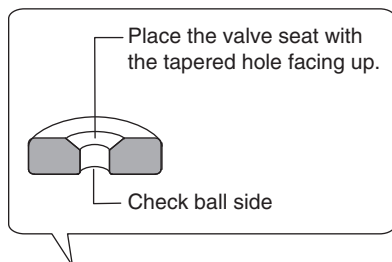
* If the valve seat or check ball does not come out, tap the bottom of the ball guide on a tray.

Assembling the liquid-end section

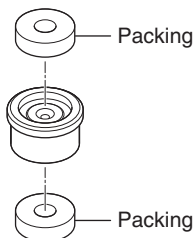
Assembling the valve seat cartridge

- (1) Insert the check ball into the ball guide, and then place the valve seat on top.

Be careful of the installation directions of the ball guide and the valve seat.



- (2) Attach the packings to the top and bottom of the ball guide.



- (3) Turn the ball guide upside down.



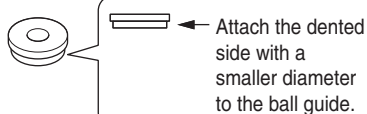
IMPORTANT

The packing for the valve seat cartridge will be deformed when used. Be sure to attach it in the original position after disassembling the cartridge.

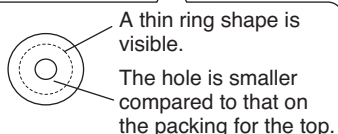
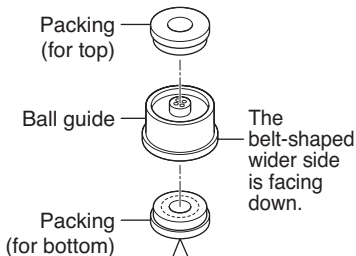
* There is no distinction between the front/back or top/bottom for a new packing.

<Distinguishing between packings>

Once a packing is used, the sides become uneven. The side with a smaller diameter will be attached to the ball guide.



The difference between the packings for the top and bottom of the ball guide is small, but the hole in the center of the packing for the bottom (check ball/valve seat side) is slightly smaller and there is a thin ring shape around the hole.



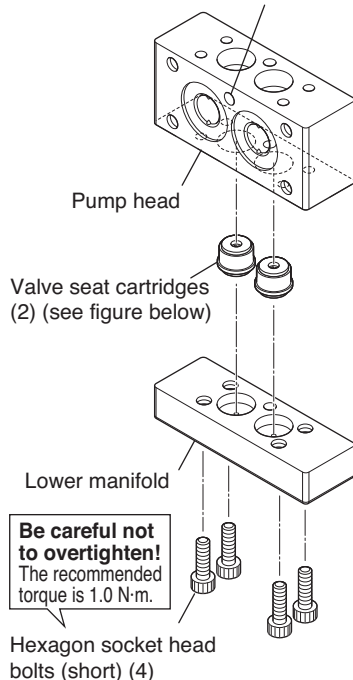
Assembling the liquid-end section

Assembling the pump head

(1) Insert the valve seat cartridges into the lower manifold in the correct direction.

(2) Place the pump head on top of the valve seat cartridges in the correct direction, and fix it in place with the hexagon socket head bolts (short) from below.

This hole should be at the top.

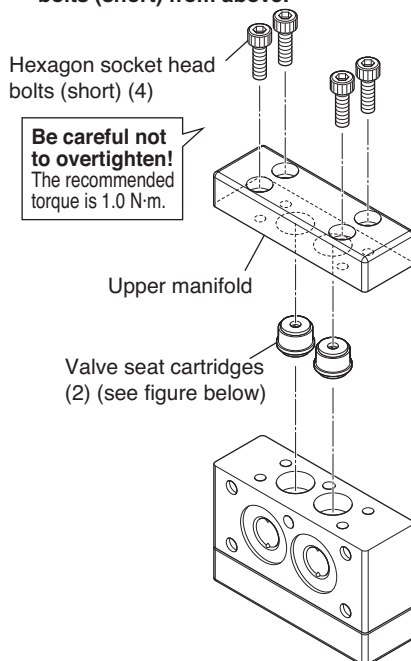


Install the valve seat cartridges with the belt-shaped wider side facing down.



(3) Insert the valve seat cartridges into the pump head in the correct direction.

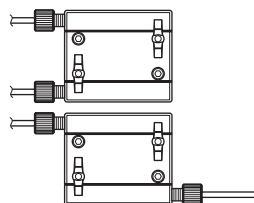
(4) Place the upper manifold on top of the valve seat cartridges, and fix it in place with the hexagon socket head bolts (short) from above.



NOTE

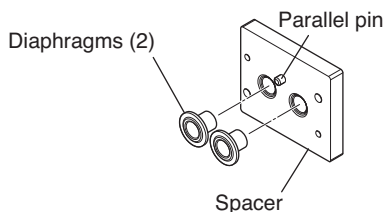
The manifolds can be installed in either direction (left or right). Install them in the direction that makes it easy to handle the tubes.

Connection variation example (Front view of the pump head)

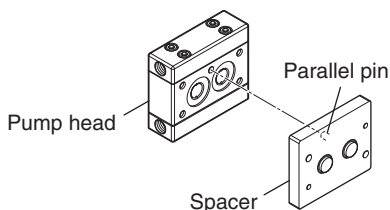


Assembling the liquid-end section

- (5) Insert the diaphragms into the spacer on the side with the parallel pin.

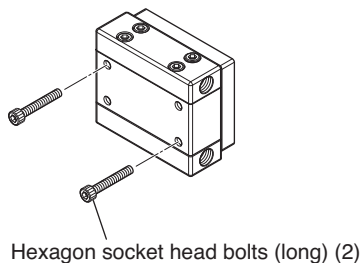


- (6) Align the position of the parallel pin and attach the spacer to the pump head.



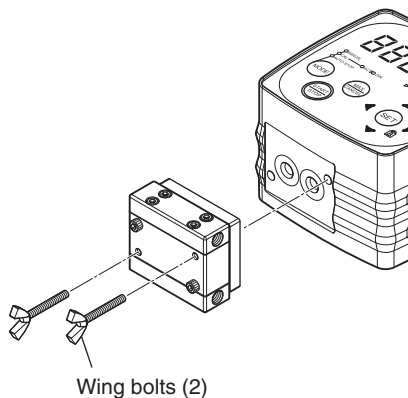
- (7) Insert two hexagon socket head bolts (long) into the holes on the upper left and lower right, and fix the pump head in place.

* Cross recessed self-tapping screw tightening torque = 1.0 N·m

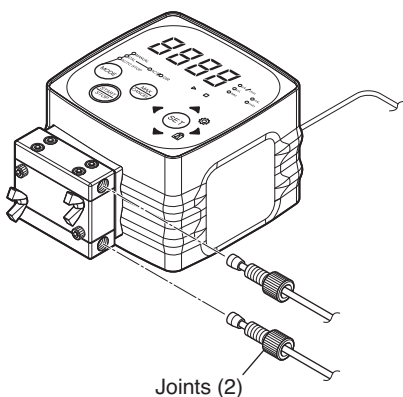


- (8) Turn the spacer side of the liquid-end section toward the pump body and attach the spacer to the body, and then fix it in place with the wing bolts.

Tighten the wing bolts by hand. Do not use a tool.



- (9) Attach the joints.



Correcting motor step-out

If the pressure on the discharge side of the pump increases abnormally due to clogging of the tubes, valve shutoff, or some other reasons, motor step-out (idle-like status) will occur in order to prevent damage to the pump and tubes.

When motor step-out occurs, the pump will not discharge liquid. Perform the following procedure to rectify the situation.

IMPORTANT

- The upper limit of the operating pressure of this pump is 3 MPa. However, the pressure inside the pipe may exceed 6 MPa when the discharge-side piping is blocked. Perform the work carefully to prevent liquid from spraying out.

(1) Stop the pump.

(2) Eliminate the cause of abnormal pressure.

If a valve is closed on the discharge side, open it.

If piping is clogged, clean it.

(3) Disassemble the pump head and check for abnormalities in the liquid-end section.

See “Disassembling the liquid-end section” on pages 45 to 48.

Remove any foreign material that has adhered to any parts inside the pump head.

(4) Reassemble the pump head and attach it.

See “Assembling the liquid-end section” on pages 49 to 51.

(5) Operate the pump and verify that rated volume of discharge is correct.

Troubleshooting

Common to all models

Details	Cause	Remedy
The pump does not turn on. (The control panel does not light.)	The power supply or voltage is not correct.	Check the power supply voltage.
	The power cord is broken.	Contact your vendor or TACMINA.
	The power supply is not connected.	Check the power supply connection.
	The breaker has tripped.	Investigate why the breaker has tripped, and then reset it.
The power turns on, but the pump does not operate.	The motor is malfunctioning.	Contact your vendor or TACMINA.
	The AC adapter is malfunctioning.	Contact your vendor or TACMINA.

Troubleshooting

Details	Cause	Remedy
The pump operates, but the discharge volume is low or the liquid is not discharged or suctioned.	Calibration has not been performed correctly.	Perform calibration. (Performing calibration for a long time will improve the calibration accuracy.) * This pump has a reproducibility of $\pm 10\%$ (R.S.).
	Some condition has changed after calibration was performed.	Perform calibration again.
	Liquid viscosity is too high.	• Decrease the viscosity. • Increase the size of the suction-side piping to enable pressure booster piping.
	The amount of liquid in the tank on the suction side is low.	Fill the tank with liquid, and then release the air.
	A clog is present in the piping or valves.	Clean the piping and valves.
	The foot valve or the strainer is clogged.	Clean the foot valve, strainer, and tank.
	Cavitation is occurring within the suction-side piping or pump head.	Make the suction-side piping larger or shorter.
	The suction height exceeds the specification range.	Set the suction height to a value within the specification range.
	Air has entered into the pump head.	• Release the air. • Eliminate the cause of the air entering into the pump head. → (See the "Air enters into the pump" item.)
	Debris has affixed to the inside of the pump head, or the pump head is deformed.	• Clean the pump head or replace it.
	The installation direction of the valve seat is incorrect.	Install the valve seat correctly.
	The diaphragm has deteriorated or is damaged.	Replace the diaphragm.
	Liquid is leaking from the discharge-side piping.	Inspect the piping and retighten it.
	Relief valve activated.	Adjust the pressure setting.
	The discharge pressure is too high.	Decrease the pressure.
	Motor step-out (a state similar to idling) has occurred due to an abnormal pressure.	See "Correcting motor step-out" on page 52.

Troubleshooting

Details	Cause	Remedy
The discharge volume is too large.	Calibration has not been performed correctly.	Perform calibration. (Performing calibration for a long time will improve the calibration accuracy.) * This pump has a reproducibility of $\pm 10\%$ (R.S.).
	Some condition has changed after calibration was performed.	Perform calibration again.
	Overfeeding is occurring.	• Check whether the piping diameter and length is appropriate. • Use a valve such as a back pressure valve to apply back pressure. • Clean the back pressure valve.
	A negative pressure is occurring at the injection point.	• Use a valve such as a back pressure valve to apply back pressure. • Clean the back pressure valve.
	The push pressure is too high.	Set the discharge-side pressure to a value higher than the push pressure.
The liquid does not stop.	Siphoning is occurring.	Review the piping, install a vent pipe, or install a back pressure valve.
	Air remains in the piping or the damper effect is occurring.	Release the air in the piping.
Large pulsation occurs.	Debris has affixed to the valve seats, or they are deformed.	Clean or replace the valve seats.
Air enters into the pump.	Gas is being produced due to the nature of the liquid.	Eliminate the causes of gas production.
	The joints or seals are loose.	Retighten the joints or seals.
	The amount of liquid in the tank on the suction side is low.	Fill the tank with liquid, and then release the air.
Liquid is leaking from the joints.	The joints are not tightened sufficiently.	Retighten the joints.
	The discharge-side pipe is clogged with dirt or other foreign material, which has caused the pressure to increase.	Clean inside the pipe.
	Tubes have deteriorated.	Replace the tubes.

Troubleshooting

Details	Cause	Remedy
Liquid is leaking from the pump head.	The bolts are loose.	Retighten the bolts.
	The bolts have been tightened unevenly.	Tighten the bolts evenly.
	The discharge-side pipe is clogged with dirt or other foreign material, which has caused the pressure to increase.	Clean the pipe.
	The diaphragm is damaged.	Replace the diaphragm.
	The packing is misaligned or has deteriorated.	Attach the packing correctly or replace it.
The keys cannot be operated.	The key lock has been enabled.	Release the key lock.

QI only

Details	Cause	Remedy
Control by way of digital input cannot be performed correctly.	The signal cable connections are incorrect.	Check the signal cable, and then connect it correctly.
	Noise is present on the signal cable.	- Remove the signal cable and the power cable. - Use a shielded cable for the signal cable.
	The signal cable is broken.	Replace the signal cable.
	The signal specifications are different.	Replace the device with one that matches the signal specifications.
	The pulse signal is chattering.	Replace the device with one that does not chatter.
	There is residual voltage of 1 V or more remaining in the open collector when used.	Use a device with a residual voltage of 1 V or less.
Control by way of analog input cannot be performed correctly.	A current less than 20 mA is flowing due to insufficient driving power in the analog signal.	Check the signal source's maximum drive resistance.
Control of external device using digital output cannot be performed correctly.	A general mechanical contact relay is used.	Use the SSR (see page 22) recommended by TACMINA.
All displays are flashing (pump does not operate).	The stop input is applied. (The run input is not applied.)	Check for errors in the input signal. Check for contact with unintended signal cables, and insulate the cables.

Error codes

If an error code appears on the display, use the error code list shown below to check the details of the error, and then implement the required remedy.

●Error code list

Code	Details	Cause	Remedy
E-02	Level error	The amount of liquid in the tank is incorrect. * This error is displayed when digital input 1 or digital input 2 is set to level input and the signal is ON.	Check the tank's liquid level and implement the required corrective measures.
E-04	Pulse overflow	During pulse-input proportional operation, the number of pulse signals applied has exceeded the set number of pulses to delay.	• Review the setting for the number of pulses to delay. (Parameter P6-2) • Check the device that is the source of the input.
E-05	Analog input error	During analog-input proportional operation or analog input calibration, a signal outside of the prescribed range has been applied or no signal has been applied.	Check the wiring.
E-09	Calibration error	You stopped the pump within 30 seconds of starting operation.	Let the pump operate for 30 seconds or more.
		The entered value is outside the range over which calibration is possible. (This could be a measurement or entry mistake.)	Check the cause of the error, and then perform calibration again.

Model code

Q I - 5 - 6R - ULP - E S
 (1) (2) (3) (4) (5) (6) (7)

(1) Series name

Q Series

(2) Control method

Blank: Standard type

I: I/O signal control type

(3) Model (Flow rate standard)

5: 5 mL/min

(4) Liquid-end section materials

	Pump head	Diaphragm	Check ball	Valve seat	Packing	Ball guide
6R	SUS316L	PTFE/CR	Ruby	Sapphire	PTFE	SUS316L
KR	PEEK	PTFE/CR	Ruby	Sapphire	PTFE	PEEK

(5) Power cord

ULP: Type A/C/O/BF * Only the Type A plug is UL compliant.

(6) Language

E: English

Blank: Japanese

(7) General specifications

S: Standard

X: Special order

* You cannot freely combine the aspects of the model code.

* An X at the end of a model code indicates a made-to-order product. For the detailed specifications, see the diagrams, approval documents, or similar materials.

Specifications

Item		Q/QI
Model		5
Maximum flow rate	μL/min	5000
	L/h	0.3
	US G/h	0.07
Flow rate control range		Variable from 5 to the maximum flow rate (in 1 μL/min steps)
Maximum discharge pressure	MPa	3.0
	bar	30
	psi	435
Stroke length	mm	0.35
Transferable viscosity	mPa·s	50 or less
Transfer liquid temperature	°C	0 to 40 (no freezing)
Connection diameter		ø1/16" × ø1/8"
Environmental resistance		Corresponds to IP65 (dust proofing and waterproofing) *1
Weight	kg	6R: 0.92, KR: 0.74
Sound pressure level		Less than 70 dB

*1 Evaluated by an organization not related to UL (UL-listed models are all rated for indoor-use only).

●AC adapter supply

Power supply		Single phase, 100 to 240 VAC, 47-63 Hz
Max. input current	A	0.7

●I/O signal specifications (QI only)

Signal		QI
Analog	Input	1 port 4 to 20 mA DC Input resistance: Approximately 110 Ω
Digital	Input	2 ports No-voltage contact or open collector (NPN) *1 Maximum pulse count: 6000 pulses/min Minimum pulse width: 5 msec (ON time) Assigned to one of the following: Pulse, pause/run, level, or MAX operation
	Output	2 ports Open collector output 25 VDC, 10 mA or less Assigned to one of the following: Unit pulse, alarm, or operation signal

*1 Make sure the residual voltage of the open collector does not exceed 1 V.

* Digital signals use sync logic (NPN). Please use a converter when connecting to a source logic (PNP) device.
(Example of recommended equipment: DEK-TR/INV-2964319 manufactured by Phoenix Contact GmbH & Co. KG)

Consumables list

The recommended replacement cycles are for cases where the pump is operated under constant conditions (room temperature and clean water). These cycles change according to individual site conditions, so use the recommended replacement cycles as a guide for replacing consumables. Neglecting to replace consumables may cause defective discharge (injection) or malfunction.

IMPORTANT

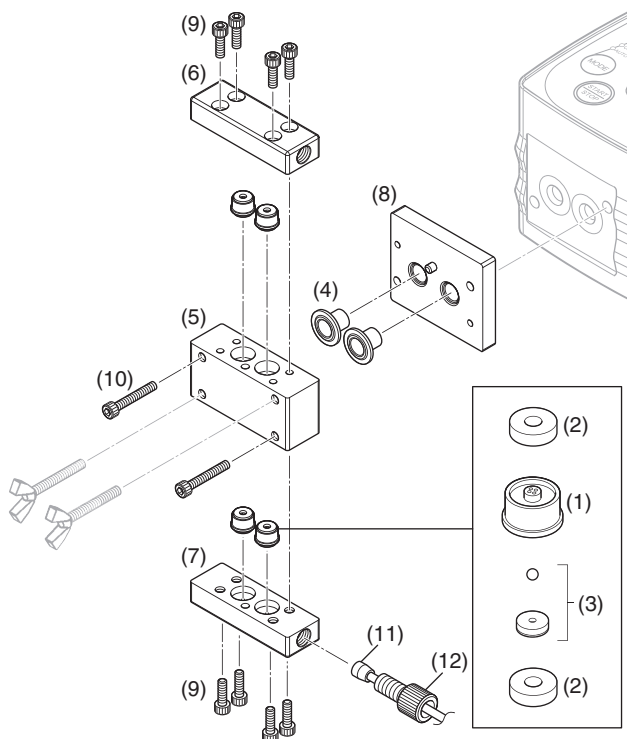
- Replace consumables after 4,000 hours of operation or 1 year of use, whichever is first.
- The hose and tube durability varies greatly depending on factors such as the chemical used, temperature, pressure, and ultra-violet rays. Inspect the parts and replace any that have deteriorated. Even during the warranty period of this product, you will be charged for replacement parts.

Part name	Quantity	Recommended replacement interval
Diaphragm	2	4,000 hours or 1 year
Valve seat assembly	4	
Packing	8	

Consumables list

Information on consumable/spare part sets

Parts for the liquid-end section are sold in sets as shown in the table below.



Contents	Sales unit	Pump head set	Valve seat cartridge set	Valve seat assembly	Packing set	Joint assembly	Ferrule set
(1) Ball guide		4	1				
(2) Packing		8	2		2		
(3) Valve seat assembly (valve seat/check ball)		4	1	1			
(4) Diaphragm		2					
(5) Pump head		1					
(6) Upper manifold		1					
(7) Lower manifold		1					
(8) Spacer		1					
(9) Hexagon socket head bolt (short)		8					
(10) Hexagon socket head bolt (long)		2					
(11) Ferrule						2	10
(12) Nut						2	

(As of October 2020)

Setting flowchart

Mode switching

●Q (standard type)



Manual operation mode
(Page 32)



Calibration mode
(Page 28)



Auto-stop operation mode
(page 33)

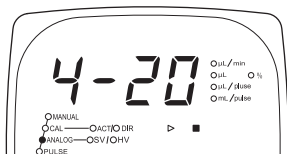
●QI (I/O signal control type)



Manual operation mode
(Page 32)



Calibration mode
(Page 28)



Analog-input proportional
operation mode (page 34)

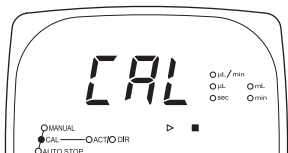


Pulse-input proportional
operation mode (page 38)

Setting flowchart

Calibration mode

When stopped



(MODE)

Mode switching
(Page 62)

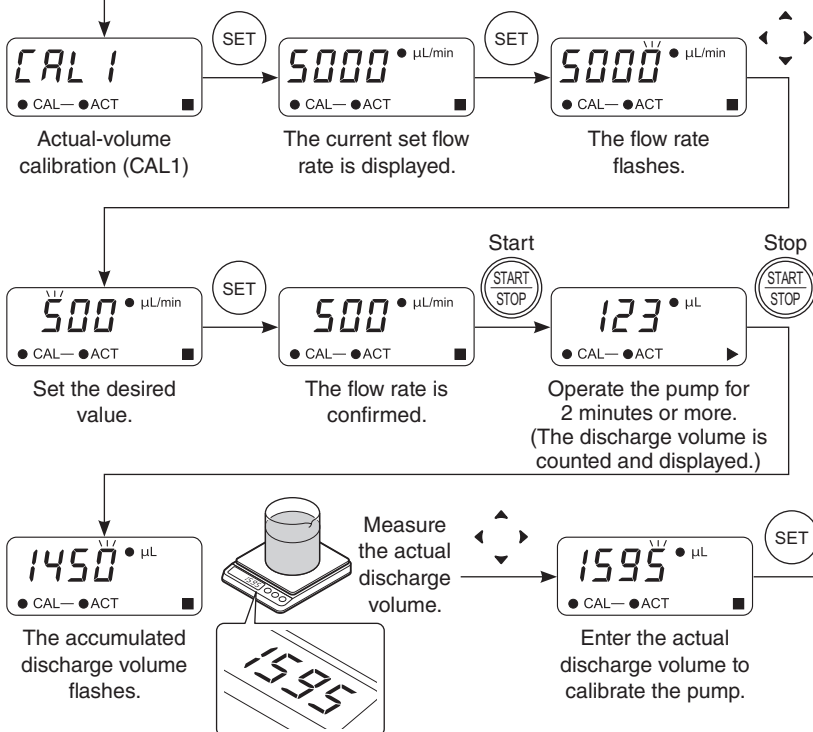
(MAX
CANCEL)

Only when the key is pressed

(SET)

(SET)

Actual-volume calibration (CAL1) ⇒ For details, see page 29.



Setting flowchart

Displaying the maximum flow rate after calibration ⇒ For details, see page 31.

5500 • $\mu\text{L}/\text{min}$
● CAL ■

The maximum flow rate after calibration is displayed.

Condition A
5500

Write down this value.

When using the pump again under the same condition

Direct-input calibration (CAL2) ⇒ For details, see page 31.

CAL 1

● CAL — ● ACT ■

Actual-volume calibration (CAL1)

CAL 2

● CAL — ● DIR ■

Select direct-input calibration (CAL2).

SET

5000 • $\mu\text{L}/\text{min}$
● CAL — ● DIR ■

The current maximum flow rate flashes.

5500 • $\mu\text{L}/\text{min}$
● CAL — ● DIR ■

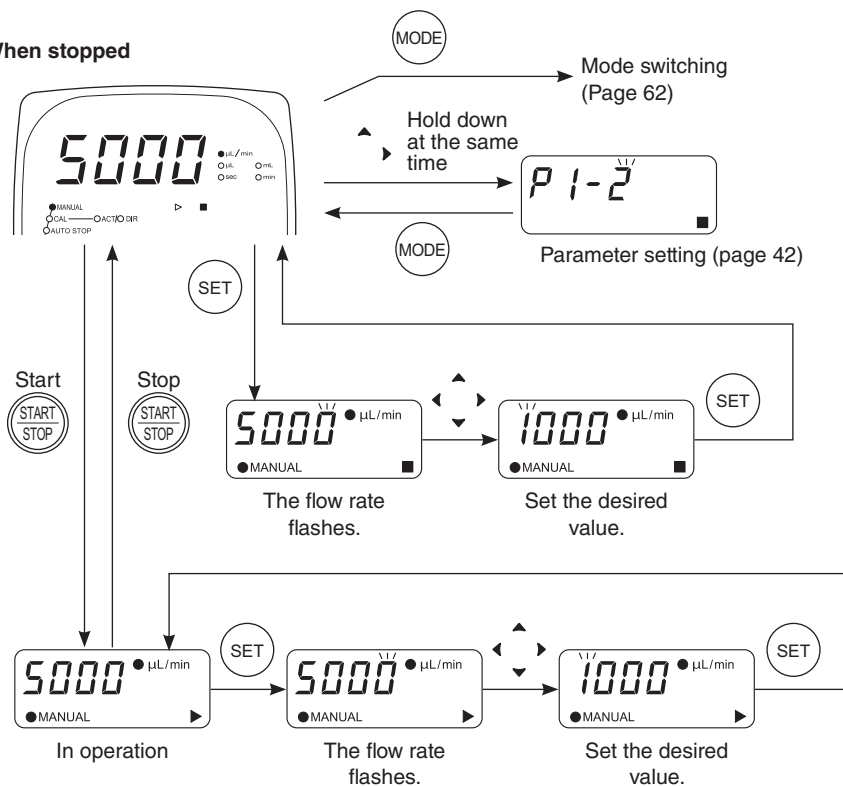
Enter the maximum flow rate after calibration.

SET

Setting flowchart

Manual operation mode

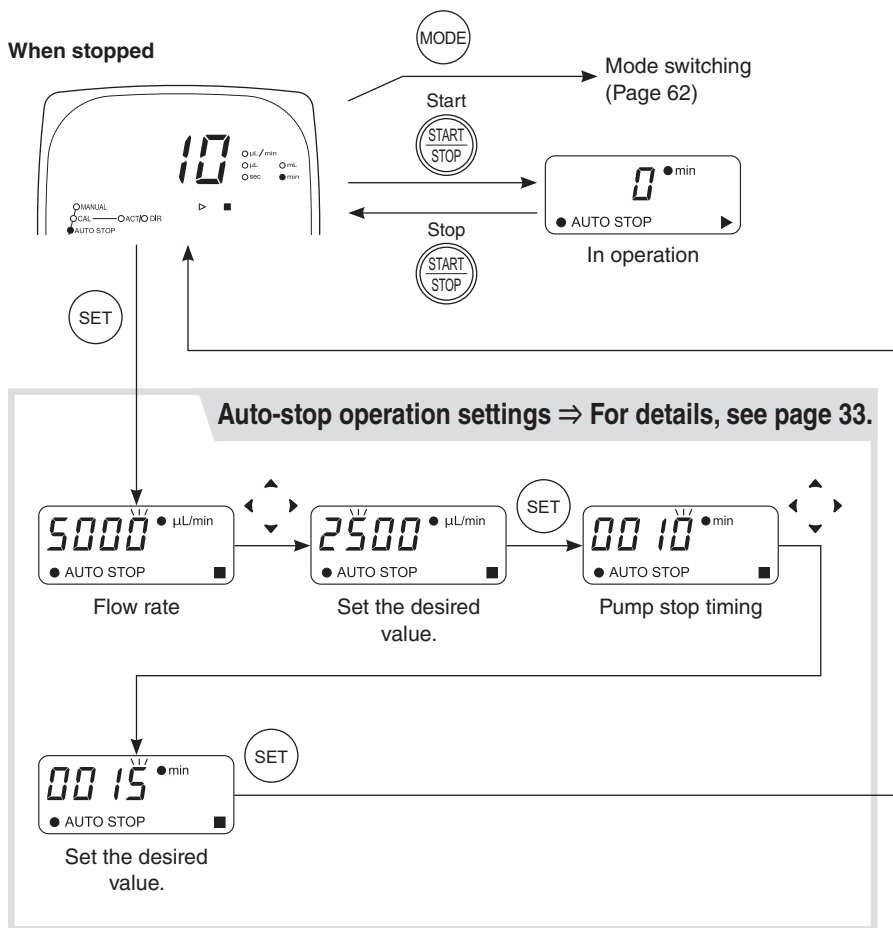
When stopped



Setting flowchart

Auto-stop operation mode

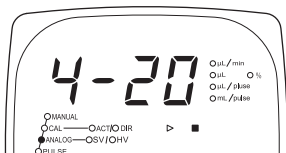
When stopped



Setting flowchart

Analog-input proportional operation mode

When stopped



MODE

Mode switching
(Page 62)

Start

START
STOP

2500 • μL/min
● ANALOG

Stop

START
STOP

In operation

SET

Analog input signal control settings ⇒ For details, see page 34.

000 • %
● ANALOG — ● SV

Target value, SV

050 • %
● ANALOG — ● SV

Set the desired
value.

5000 • μL/min
● ANALOG — ● HV

Maximum flow rate,
HV

2500 • μL/min
● ANALOG — ● HV

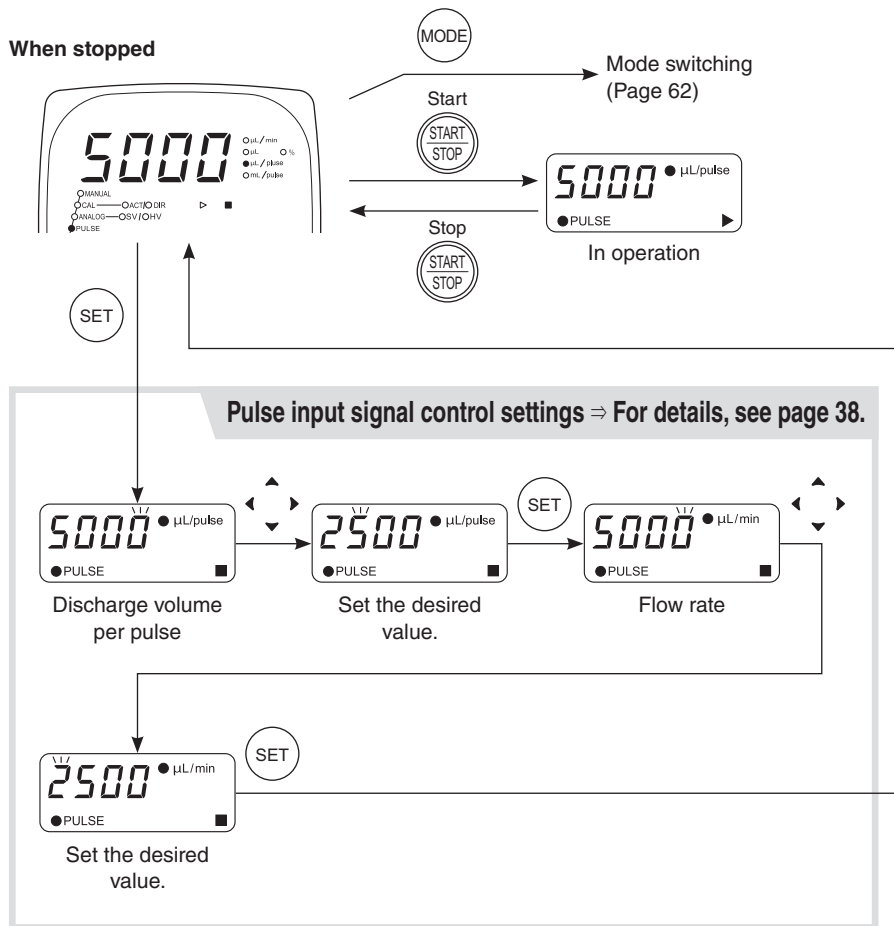
Set the desired
value.

SET

Setting flowchart

Pulse-input proportional operation mode

When stopped



After-sales services

If any aspects of the terms and conditions of the after-sales service applying to the repairs to be provided during the warranty period and other such matters are not clear, consult your vender or a TACMINA representative.

Warranty

- (1) The warranty period shall be one year from the date of dispatch from TACMINA's factory.
- (2) If, during the warranty period, the product sustains malfunctions or damages as a result of design, manufacturing, or material defect, or if the product does not meet its specifications, TACMINA will arrange for repairs, provide replacement components, or replace the product, at TACMINA's discretion, at no charge to the customer. However, this warranty only covers direct damage to the product. Any consequential losses or damages, including, but not limited to, profit losses and any secondary damages, caused by malfunctions, breakage, or impaired performance of this product shall not be covered by this warranty. The limitation of TACMINA's liability shall not exceed the sales value of the defective product.
- (3) If a malfunction or damage is found, notice shall be given to distributor or TACMINA with documents that prove the malfunction or damage is caused by improper design, manufacturing failure or material defect within 14 days after awareness of such malfunction or damage. If the distributor or TACMINA does not receive such notice within aforementioned period, even though the warranty period is still in effect, TACMINA shall not be liable for any malfunction and damage. Please note that TACMINA may request to give further information or to return the product for investigation. If the cause is attributable to TACMINA's action, the shipping fees, cost of investigation and checks performed by TACMINA shall be borne by TACMINA.
- (4) Even in the warranty period, the cost of repairs in the following conditions shall be paid to the distributor or TACMINA.
 - 1) Damages and deterioration of consumables.
 - 2) Damages or malfunctions of the warranted product caused by carelessness in handling or incorrect use.
 - 3) Damages or malfunctions of the warranted product caused by the failure to perform maintenance such as periodic inspections and repairs and replacements of consumables.
 - 4) Damages or malfunctions of the warranted product caused by falls or impacts.
 - 5) Damages or malfunctions of the warranted product resulting from the use of parts other than the ones supplied by TACMINA.
 - 6) Damages or malfunctions of the warranted product resulting from product repairs or remodeling undertaken by individuals other than TACMINA employees or personnel of businesses authorized by TACMINA.

After-sales services

- 7) Damages or malfunctions of the warranted product resulting from fires, natural disasters, geological calamities, and force majeure.
 - 8) Damages or malfunctions of the warranted product resulting from loose bolts or nuts or from defective hose connections.
 - 9) Discoloration, deterioration, damages, or malfunctions of the warranted product resulting from ultraviolet rays, corrosive gases, or flooding.
 - 10) Damages or malfunctions of the warranted product resulting from corrosion, swelling, or melting caused by the adhesion or chemical effect of the used liquid.
 - 11) Damages or malfunctions of the warranted product resulting from damages to products other than those made by TACMINA.
 - 12) Damages or malfunctions of the warranted product resulting from usage outside of the range of the usage conditions listed in the operation manual.
- (5) The judgment of damages, malfunctions, and impaired performance as well as the judgment of whether the cause is the design of the product and product defects shall be performed by TACMINA's technical department.

Repairs

■ Before requesting repairs

Please read this operation manual carefully and inspect the product again.

■ Who to request repairs from

Ask your vendor to take care of the repairs. If you are not sure of who your vendor is, contact TACMINA.

■ Precautions when sending the product for repairs

Be sure to observe the following items to protect worker safety and to protect the environment:

- If any chemicals have affixed to the product, wash it clean.
- Attach the safety data sheet (SDS) to the product.
- If a "maintenance data" page is present at the end of the operation manual, fill in this page and attach it to the product.
- * The product may not be repaired if the necessary materials are not attached.
- * Even when the necessary materials are attached, TACMINA may send the product back if it is determined that repairing the product will constitute risks or dangers.

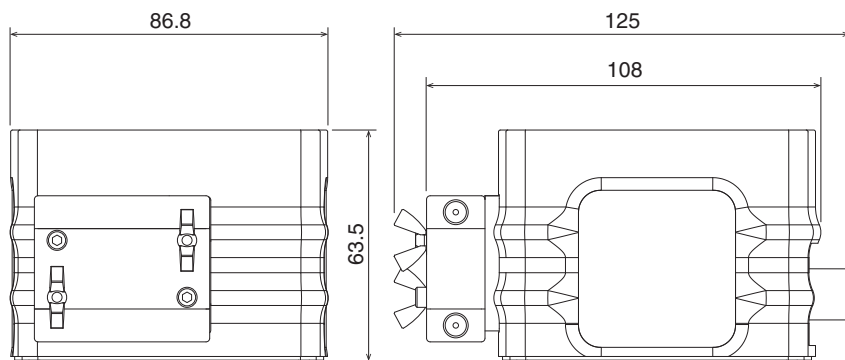
■ Minimum retention period for consumables

TACMINA will continue to supply consumables for its pumps for a period of eight (8) years after the manufacture of the pumps has been discontinued.

External Dimensions

* The example given here is of the standard model. For information on the separate models, see the diagrams.

Unit: mm



EU DECLARATION OF CONFORMITY

(Directive 2006/42/EC, 2014/35/EU, 2014/30/EU, 2011/65/EU - Annex II A)

Manufacturer : TACMINA CORPORATION

Address : 2-2-14, Awajimachi, Chuo-ku, Osaka, 541-0047, Japan

Herewith declares that

Product : Pulseless Motor-Driven Diaphragm Metering Pump

Model (Type) : Q Series (See Appendix 2-4)

- is in conformity with the provisions of Machinery Directive 2006/42/EC,
- is in conformity with the provisions of Low Voltage Directive 2014/35/EU,
- is in conformity with the provisions of EMC Directive 2014/30/EU.
- and, is in conformity with the provisions of Restriction of the use of certain hazardous substances Directive 2011/65/EU.

And furthermore declares that

- the following (parts / clauses of) harmonized standards have been applied :

Machinery Directive

EN809, EN12100

Low Voltage Directive

EN61010-1, EN60529

EMC Directive

EN55011, EN61000-3-2/3, EN61000-6-2, EN61000-4-2/3/4/5/6/8/11

RoHS Directive

IEC 63000:2018

Date: 27. Oct. 2025

Tadashi Kukitome

Name : Tadashi Kukitome

Position : Head of Development Center

TACMINA CORPORATION

Product designs and specifications are subject to change without notice for product improvement.

TACMINA CORPORATION

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