IWAKI
Electromagnetic Metering Pump

EH-F series (Asia version)

Instruction Manual

⚠Read this manual before use of product

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Thank you for selecting the IWAKI electromagnetic metering pump EH-F.
Read through this manual carefully for correct use. This manual should be kept on hand by end users for quick reference.
As regards the pump which is in special specification, the handling of the pump should be in accordance with specific dimensions or authorized instructions.

Contents

Contact us or your nearest dealer for further information.

1 Safety instruction

For the Safe and
Correct Handling of the Pump

- "Safety Instruction" section deals with important details about the handling of the product. Before the use of the pump, read this section carefully for the prevention of personnel injury or loss.
- Observe the instructions accompanied with "WARNING" or "CAUTION" in this manual. These instructions are very important for protecting pump users from dangerous situations.
- The symbols on this instruction manual have the following meanings:

WARNING	**Nonobservance or misapplication of the contents of the "Warning" section could lead to a serious accident which may result in death.**
CAUTION	**Nonobservance or misapplication of the contents of the "Caution" section could lead to the personal injury to users or serious damage to the product.**

Types of Symbols

Indicates that "Warning" or "Caution" must be exercised. Inside this triangle, a concrete and practical image provided as a warning or caution message is depicted.

Indicates a prohibited action or procedure. Inside or near this circle, a concrete and practical image of the activity to be avoided is depicted.

Indicates an important action or procedure which must be performed or carried out without fail. Failure to follow the instructions herein can lead to malfunction or damage to the pump.

⚠WARNING

- Qualified operators only
  This product must be operated by users with a full understanding of the pumps. Person who has not leaned about the pumps should not operate this product.
- Turn off the power supply
  Dismantlement/assembly without turning off the power supply may cause an electrical shock. Before engaging on any maintenance and inspection work, be sure to turn the power supply switches off to stop the pump and the related devices.
- Wear protectors
  Getting wet with or coming in contact with the hazardous chemical liquid such as acid and alkaline solution could lead to a serious injury. Wear protective clothing such as a protective mask, gloves and goggles according to the handled liquid during the work.
- Terminate operation
  Upon becoming aware of any dangerous signs or abnormal condition during operation, terminate the operation immediately and start it from the beginning again.
- For specified application only
  The use of a pump in any application other than those clearly specified may result in the injury or the damage to the pump. Use the pump in accordance with the pump specifications.
- Do not operate pump with the wet hands
  Avoid operating pump with the wet hands.
- No modification
  Do not modify the pump. Otherwise, a serious accident may result. We are not responsible for any accidents or losses caused from any modifications to the pump without the first obtaining permission or instructions from Iwaki.
- Humid place prohibited
  This product is not water-proof construction. If the pump is used at a highly humid place or the place where liquid can splash the pump, electrical shock or short-circuit may happen.
- Do not step on tank
  Stepping on tank, the tank may fall down and cause personal injury or a loss. Never step on tank.


Prohibited


Electrical Shock


Wear protective gear


Prohibited


No wet hand


No Remodeling


Do not wet or dampen


Prohibited

⚠CAUTION

- Earthing
  Provide an earthing to reduce the risk of electric shock. The use of this product without earthing may result in electrical shock.
- Do not touch pump during the operation
  Temperature of the pump surface during the operation is high. Do not touch pump with the bare hands.
- Specified power only
  Do not apply the voltage which is not specified on the nameplate to the product. Otherwise damage or fire may result. Only the specified power source must be used.
- Pay attention to dry running
  Do not run pump dry more than 30 minutes, otherwise the screws of the pump head may loosen. This results in liquid leakage. Secure the working condition for the prevention of dry running.
- Do not wet or dampen
  If the electric parts or the wiring get wet by the unintentional liquid spillage, a fire or an electrical shock may occur and the controller breaks. Install the system in a place free from liquid spillage or leakage. Do not engage in wiring work with the wet hand.


Grounding


Caution


Prohibited


Caution


Do not wet or dampen

- Do not operate pump with valves close

  Liquid spillage or the rupture of pump head/piping may occur due to an abnormal pressure rise. Do not run the pump with valves close.

- Pay attention to the reciprocating motion of diaphragm

  Do not put any objects in bracket hole during the pump operation. Diaphragm reciprocates inside the bracket. The contact with the object can cause malfunction.

- Do not cover the pump body with cloth

  The temperature inside the pump body rises when the pump body is covered. This could lead to a fire. Secure ventilation.

- Prevention against freezing

  Pump head may suffer damage due to freezing at below zero. Be sure to remove the liquid from the pump body and piping after the use of pump.

- Ventilation

  Poisoning may result in the operation handling the toxic or odorous liquid. Ventilate the operating site sufficiently.

- Prevention of the spill-out accident

  Protective measures should be taken against any accidental spill-out as a result of unexpected damage to the pump or the related piping.

- Damaged pump

  Never operate the damaged pumps. The damaged pumps may cause leakage or electrical shock.

- Handling of power cable

  Use of the defective or damaged power cable may result in a fire or electrical shock. Do not scratch, modify or tug the power cable.

- Install an earth leakage breaker (option)

  The operation of this product without using an earth leakage breaker may cause an electrical shock. Purchase an optional leakage breaker and install it in the system.

- Frequent ON-OFF operation should be made via the STOP function with the signals to the STOP terminal. In case the ON-OFF operation without STOP function, the maximum number of the ON-OFF must be 6 per an hour.

- Follow the instruction manual

  Replace the consumable parts by following the descriptions in the instruction manual. Do not disassemble the pump beyond the extent shown on the instruction manual.

- Limited operating site and storage

  Do not install or store the pump in the following places where.....

  * Flammable gas or material is used or stored.
  * The ambient temperature is extremely high (40 dig.C or higher) or extremely low (0 dig.C or lower).
  * The pump is exposed to the direct sunlight.

- Disposal of used pump

  The used or damaged pumps should be disposed of in accordance with the relevant local laws and regulations. (Consult a licensed industrial waste products disposing company.)

- Loose fixation of mounting bolts can lead to liquid leakage.

  Be sure to tighten all the hex. sock. bolts (Number of bolts is 6 or 8) before an initial operation. Periodically check all the bolts tight and re-tight as necessary.

  Tightening torque is 2.55N•m. Have the bolts tight gradually and diagonally.

2 Product outline

1. Unpacking and inspection

For the purpose of confirming that the product delivered corresponds with your order after unpacking, check whether-

- The model, flow rate, discharge pressure and rated voltage on nameplate is as you ordered.
- All the accessories are in place. Refer to page 52 "Accessories".
- There is no transit damage and no loose bolt/nut.
- Regarding union connection and flange connection types, union sockets and flange units are packed apart from pump body.

Note: We ship the products with the greatest care but if you find any defects, contact us or your nearest dealer.

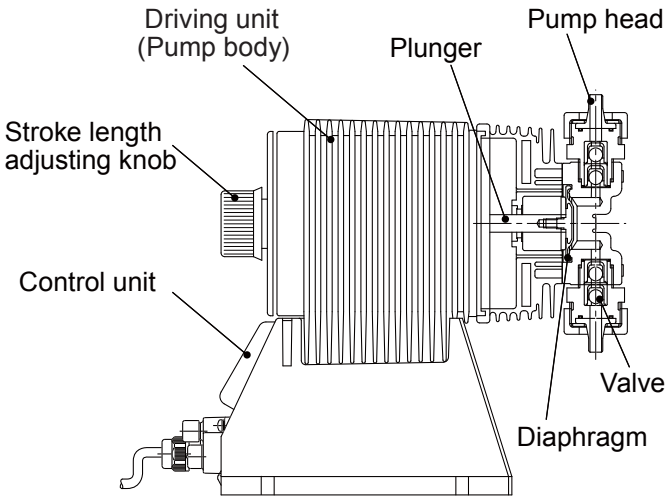
Iwaki Metering Pump

Model / Modell			
Capacity	mℓ/min	Max.Pressure	
Max.Fördermenge	ℓ/h	Max.Förderdruck	MPa
Stroke Rate	spm	Voltage ~ V	Hz
Hub Frequenz	H/min	Power Consumption	W
Current	A	Thermally Protected / Überhitzungsschutz	
MFG.No. / Ser.Nr.			

IWAKI CO.,LTD. TOKYO JAPAN 1P423843

2. Principle of operation

IWAKI electromagnetic metering pump EH-F model is the diaphragm type metering pump of which diaphragm is directly driven by the electromagnet force and consists of a pump head, a driving unit and a control unit. Reciprocating movement is made by the force of spring and the electromagnet generated by the pulse current coming from control unit. The reciprocating movement is transferred to the diaphragm which is connected to a plunger to make volumetric change in pump chamber. Pumping effect is obtained by the volumetric change and by the effect of valves which are placed in a pump head.



3. Model identification

1. Pump

EH - F 55 VC C1 - 10A - □□
① ② ③ ④ ⑤ ⑥ ⑦

① Series code

② Driving unit code (Average power consumption)

F: 100 W

③ Diaphragm effective diameter

35 : 35 mm **45 :** 45 mm **55 :** 55 mm **70 :** 70 mm

④ Wet end material

Part / Code	Pump head	Valve	O ring Valve seat	Gasket	Diaphragm	Handled liquid
VC	PVC	Ceramic	FKM	PTFE	PTFE + EPDM (Non wet end)	Acid solution
V6		SUS316	EPDM			Alkaline solution
PC	GFRPP	Ceramic	FKM			Acid solution

Material code PVC : Polyvinyl chloride PTFE : Poytetrafluro ethylene (Teflon)
FKM : Fluor rubber (Acid resistant Viton) GFRPP : Glass fibber reinforced polypropylene
EPDM : Ethylene propylene rubber

Note: Regarding handled liquid, acid and alkaline solution is transferred depending on wet end material.

⑤ Connection hose diameter code

Code	Connection hose dia.
C1	∅ 10 × ∅ 16
C3	∅ 15 × ∅ 22
C10	JIS 10K 15A
C10T	JIS 10K 15A (Horizontal suction port type)
C13	VP16

⑥ Supply voltage code

Code	Supply voltage	Allowable voltage range	Frequency
10A	AC115 V (with a crimp contact)	AC103 V - AC126 V	50-60 Hz
20A	AC230 V (with a crimp contact)	AC207 V - AC253 V	

⑦ Special specification code

01 - 99: Special specification

2. Controller

EHC - F 10A - □□
① ② ③ ④

① **Controller unit type for EH-F:** EHC Controller

② **EH pump driving unit code**

Code	Average power consumption
F	100W

③ **Supply voltage code**

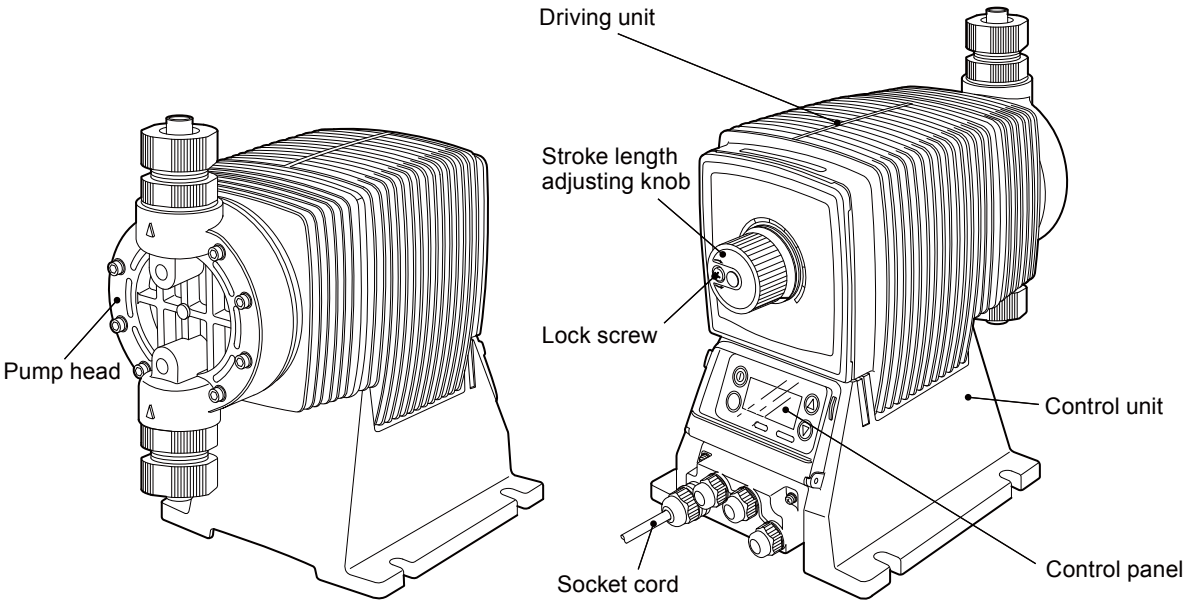
Code	Supply voltage	Allowable voltage range	Frequency
10A	AC115 V	AC90 V - AC110 V	50-60 Hz
20A	AC230 V	AC180 V - AC242 V	

④ **Special specification code**

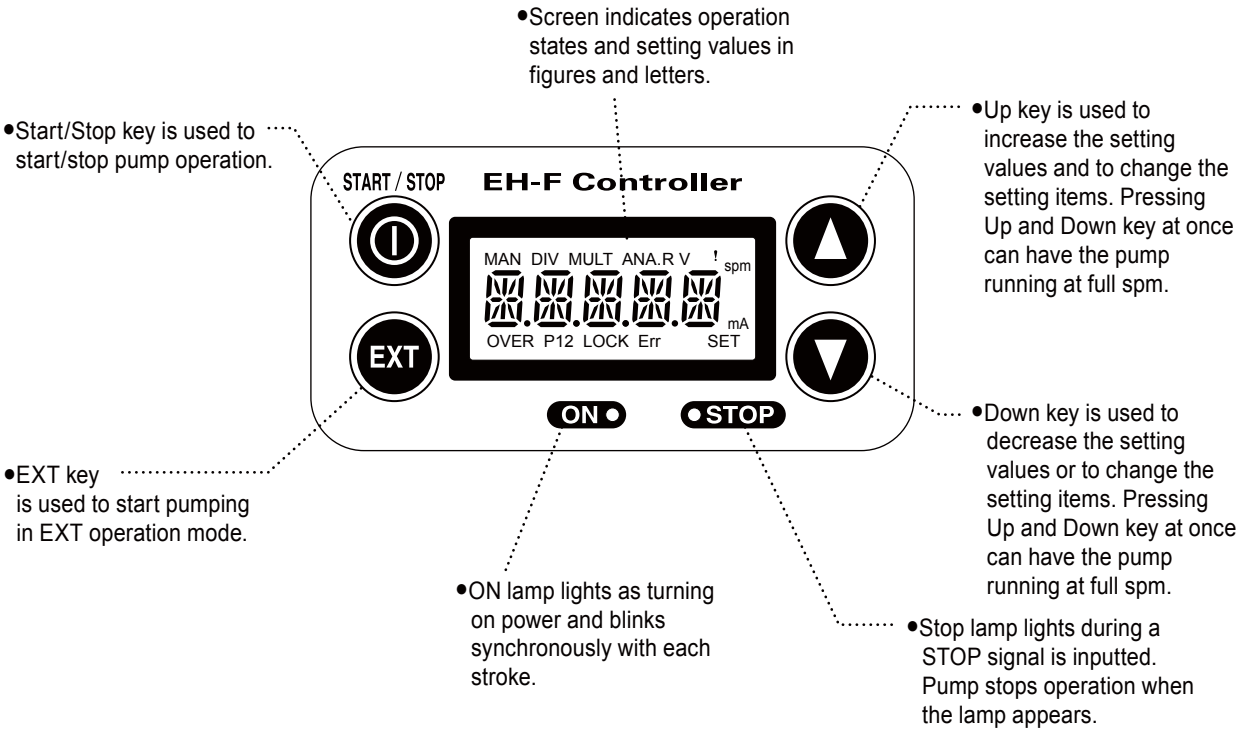
01~99: Special specification

4. Parts name

1. Pump parts



2. Control unit



5. Specification

1. Pump specification

50/60Hz

Models		Max. discharge capacity ml/min	Max. discharge pressure MPa	Stroke speed variable range spm	Stroke length variable range mm(%)	Average power consumption W	Mass kg
EH-F	35	500	1.0	1 - 240	0.9 - 2.25 (40 - 100)	100	16
	45	750	0.7				
	55	1200	0.45				
	70	2000	0.3				

Note 1. Performance is obtained by pumping clean water at ambient temp. at a rated voltage.

2. Discharge capacity is the value at max. discharge pressure (100% stroke length, 100% stroke rate). When discharge pressure is low, pump discharges liquid much more than the discharge capacity shown above.

3. Permissible ambient temperature : 0 ~ 40 deg. C

4. Permissible liquid temperature : VC, V6 0 ~ 40 deg. C PC 0~60 deg.C

5. Permissible voltage fluctuation : Within ±10% of the rated voltage

6. Ask us or our distributor for special cases such as transferring slurry liquid.

2. Control unit specification

Operation mode	MAN (Manual operation)			1 - 240 spm
	EXT	DIV (Pulse dividing)		/1 - 9999
		MULT (Pulse multiply)		×1 - 9999
		ANA. R (Analog rigid)		4-20, 0-20, 20-4, 20-0 mA
		ANA. V (Analog variable)		2 points in a range of 0.0-20.0 mA 0 - 240 spm
		EXT mode consists of the above 4 modes		
Display	LCD	14 seg, 5 digits, spm, Operational states and Settings		
	LED	ON	Green	Lights as turning power on. Blinks synchronous with each stroke.
		STOP	Red	Lights during STOP signal input.
Operation	4 keys	START/STOP, EXT, UP, DOWN		
Control function		STOP		STOP signal input stops pump operation.
		Self priming		Pump operates at full speed when both Up and Down keys are depressed together.
		Key lock		Lock and release key pads.
		Buffer memory		ON/OFF setting is changeable. (Initial setting is OFF.)
Input		Pulse		No-voltage contact Maximum 100 Hz Note 1
		Current		Range of DC0 - 20 mA (Input resistance 200 Ω)
		STOP		No-voltage contact Note. 2
Output		spm synchronous output		Photo MOS Relay AC/DC 24 V 0.1 A

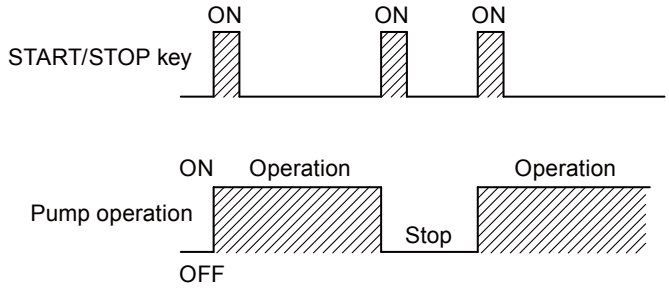
Note 1: The maximum input pulse frequency is 100 Hz, however; the maximum frequency is variable depending on the setting of anti-chattering. On-time of pulse requires 5 ms or more when ST 05 is selected.

Note 2: Max. charged voltage to a contact is 5 V and 1.9 mA. If a type device such as relay is used, the minimum applicable load should be 1 mA or below.

6. Operational function

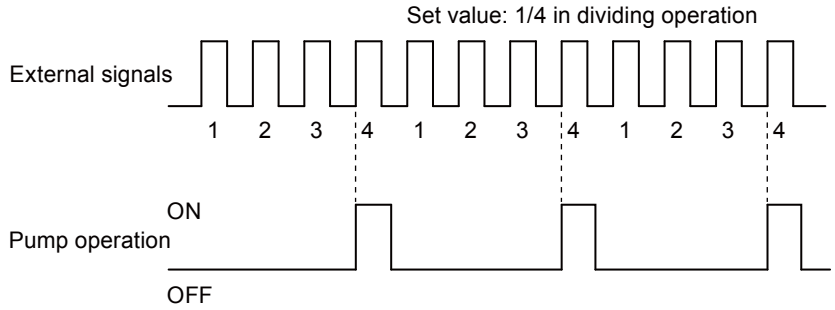
1. Manual operation

▲ and ▼ keys are used to set the number of strokes between 1 and 240 spm. The pump starts/stops operation by pushing START/ STOP key. The number of strokes is adjustable in the both pump states of running and stop.



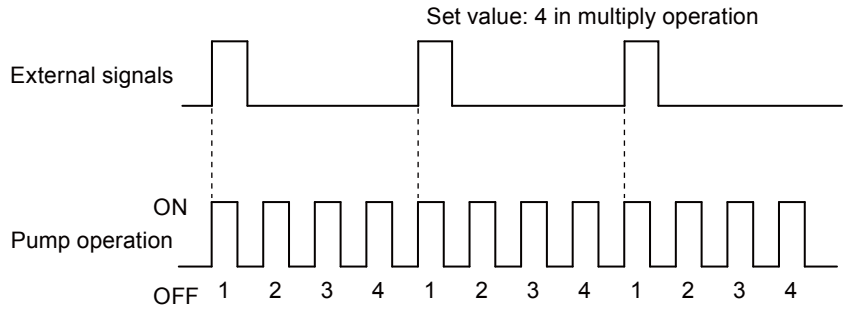
2. Pulse dividing operation

In this mode, pump runs in the dividing operation for external pulse signals. Dividing ratio is variable within the setting range between "9999 : 1" and "1 : 1". The upper limit of the number of strokes in the pulse dividing operation is equivalent to the maximum number of strokes in manual operation. When the input signals over the upper limit stroke speed is incoming, the residual signals can be stored up to 65535.



3. Pulse multiply operation

In this mode, pump runs in the multiply operation between 1 and 9999 times for an external pulse signal and stops automatically. The number of strokes in the pulse multiply operation is equivalent to the number of strokes in manual operation. The incoming pulse signals during the multiply operation motions are cancelled and are stored up to 65535.

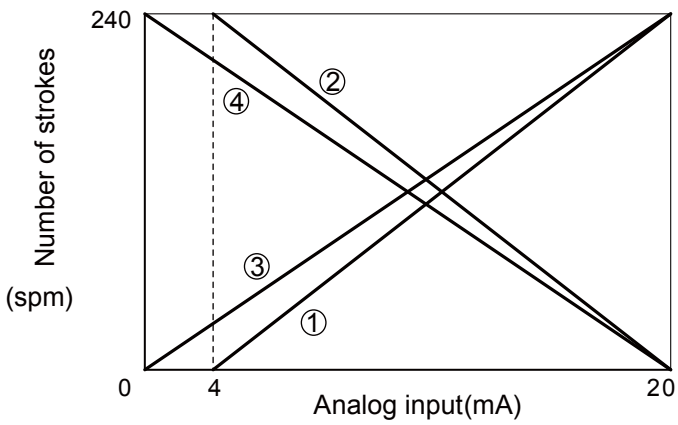


4. Analog control operation

- ANA. R(analogue rigid) mode

  Pump operates within the range of 0-240 spm in proportion to the external signals between 0-20 mA. 4 (4-20, 20-4, 0-20, 20-0) patterns are provided and the pump operates within 0-240 spm in proportion to the external signals in each pattern.

  In the 4-20 or 20-4 pattern, a breaking detective function becomes active automatically. The function stops the pumping operation below 4 mA. And an error indication, "DISCN" blinks on the display of control unit. When this function is active, check wiring. This function can be released with START/STOP key.



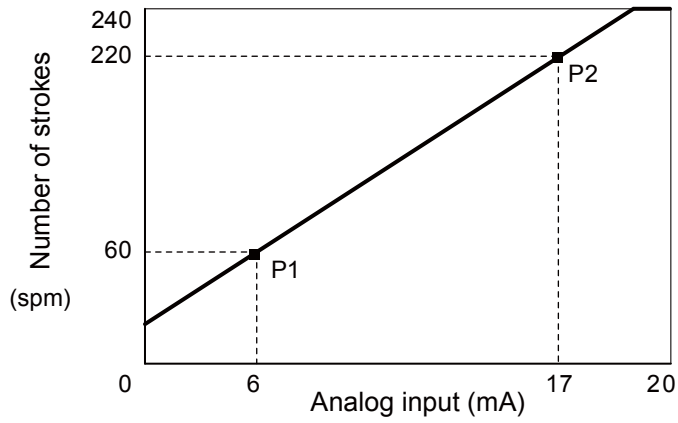
Conditions

The left graph is in the following patterns.

① 4 - 20
② 20 - 4
③ 0 - 20
④ 20 - 0

- ANA. V(analogue variable) mode

  Pump operates within the range of 0-240 spm in proportion to the external signals between 0-20 mA. Setting 2 points can draw a straight line. Depending on the position of the 2 points, 0 spm may not come at 0 mA in some cases. When the stroke speed could become over 240 spm at some mA due to the setting, pump speed is limited to 240 spm.



Conditions

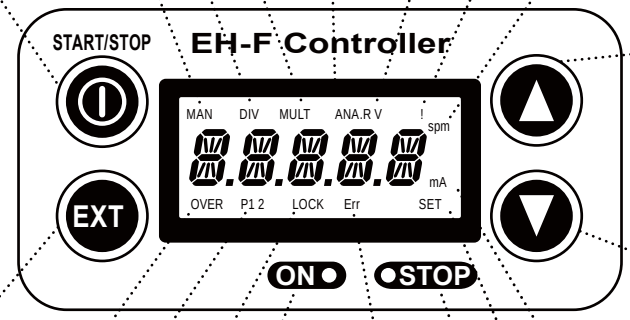
The left graph is in the following setting.

P 1 = 6 mA, 60 spm

P 2 = 17 mA, 220 spm

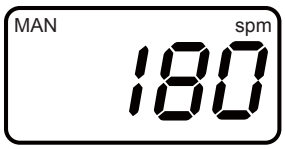
7. Control display instruction

1. Control unit

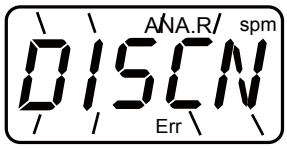
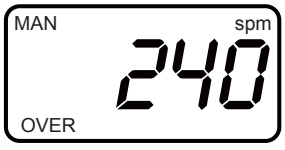


- Pulse multiply indication(MULT) shows pump is in pulse multiply operation or pulse multiply ratio is being set.
- Pulse dividing indication (DIV) shows pump is in pulse dividing operation or pulse dividing ratio is being set.
- Manual operation indication (MAN) shows pump is in manual operation.
- START/STOP key is used to start/stop pump operation.This key is also used to confirm each set value in set modes and used to move to wait mode.
- EXT key is used to start pump operation in EXT operation modes.
- Over indication lights when incoming signals are surplus to 240 spm in EXT operation.
- P1 and P2 indications appear when 2 points(P1, P2) are set in ANA. V(analog variable) mode for analog control operation.
- Lock indication appears when keys are locked.
- Display shows operational state and set values in figures and letters.
- ON lamp appears as turning on power and blinks synchronously with each stroke.
- Error indication appears when an error occurs.
- Analog control operation indication (ANA. R, ANA. V) ANA. R indicates pump is in analog rigid operation or setting mode, ANA. V indicates that pump is in analog variable operation or setting mode.
- ! indication shows pump is running for self-priming at maximum stroke speed, and calls user's attention.
- Stroke speed indication appears when display shows stroke speed.
- Up key is used to increase the setting value and to change the setting items. Pressing Up and Down key at once can have the pump running at full spm.
- Down key is used to decrease the setting values and to change the setting items. Pressing Up and Down key at once can have the pump running at full spm.
- mA indication appears when setting amperage in EXT setting mode for analog control operation.
- SET indcation appears in user mode and EXT setting mode.
- Stop indication appears during STOP signals input. Pump stops when the indication lights.

2. Typical indications

Indications	Show...
	Pump is operating in the manual operation mode. The display shows the set spm.
	Pump is operating in the analog control mode(ANA.V) of the EXT operation. Display indicates 168 spm.
	The stroke speed is being set while pump is operating in the multiply operation(MULT).
	Pump is being stopped via STOP input while operating in the dividing operation(DIV).

3. Warning indications

Indications	shows....
	Key lock All the key operation can be ineffective in order to prevent any person other than user from operating the pump. This function can be active by pressing START/STOP key for 5 seconds in any pump states and "LOCK" indication appears. Key lock function can be released by pressing START/STOP key for 5 seconds when "LOCK" indication appears on the display.
	The left indication appears when input signal is below 4 mA with the 4-20 or 20-4 pattern in ANA. R (Analog rigid) mode. In this state, pump is under suspension. By pushing START/STOP key once, this error is released and the mode moves to waiting mode. Check wiring and signals.
	"OVER" indication appears when incoming signals are surplus to 240 spm in EXT operation.

3 Installation

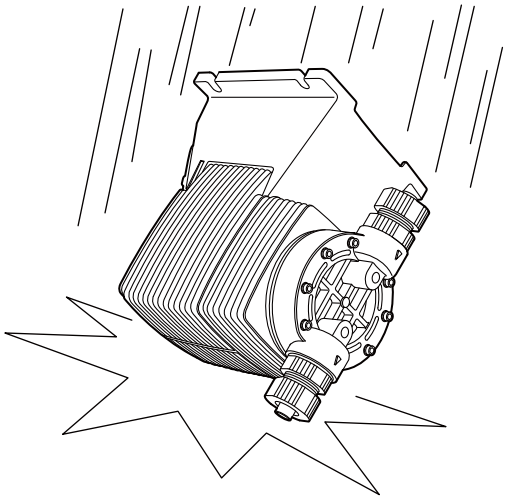
1. Before installation

⚠ WARNING

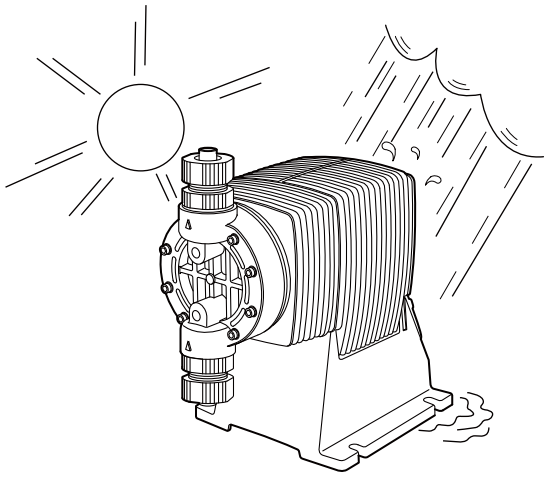
- Working without disconnecting the power supply may cause an electrical shock. Before engaging upon any working procedures involving the pump, be sure to turn the power supply switches off to stop the pump and the related devices.
- Upon becoming aware of a dangerous sign or an abnormal condition while engaging on the installation, terminate the work immediately and start it from the beginning again.

⚠ CAUTION

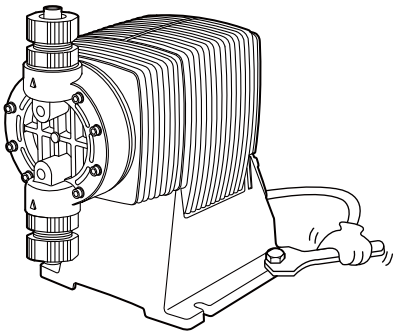
- Do not operate the pump on the voltage which is not specified on the nameplate. Failure to do so may result in damage or a fire. Be sure to earth the pump.
- Do not place any dangerous materials or flammable objects near the pump for the sake of safety.



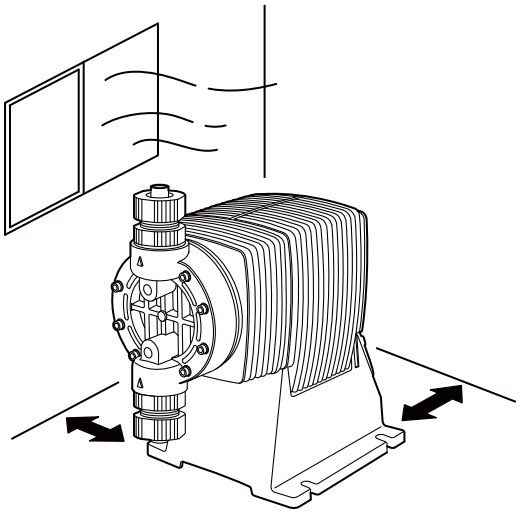
1. Dropping the pump or subjecting it to a strong impact may result in the faulty performance. Handle the pump with care. Do not use the damaged pump for the prevention of the electrical leak or shock.



2. When installing pump, avoid the places where the pump is exposed to the direct sunlight, the ambient temperature is above 40 dig.C, or the relative humidity is above 85%. Though the pump has a simple waterproof and dust-proof structure, it is recommended to protect the pump with a cover when installing it outdoor.



3. Select a level floor and use the four M6 bolts to firmly anchor the pump so as not to allow any vibration. If the pump is inclined, the discharge amount may decrease considerably.



4. Pump should be installed in a well-ventilated place in summer, and free from freezing in winter.

5. Select the installation site convenient for the future maintenance and inspection.

6. Place the pump as close to the suction tank as possible, realizing a flooded suction system (It is recommended the pump should be located lower than the suction-side tank).

7. If the pump is used to feed some liquid that generates air bubbles easily (sodium hypochlorite, hydrazine solution, etc.), the system must be positioned in a cool, dark place away from direct sunlight. If a tank is installed, realize a flooded suction system.

2. Precaution for piping

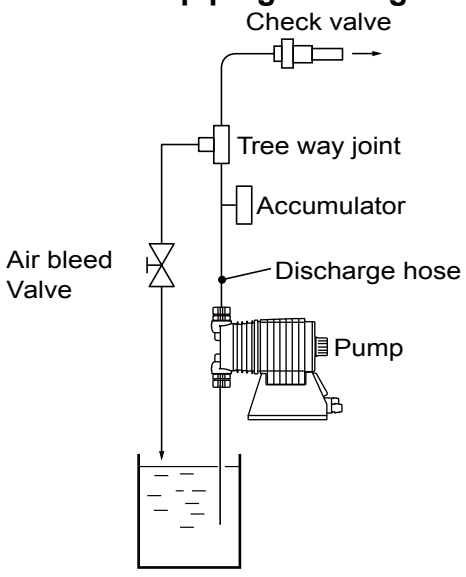
- Piping vibrates due to the pulsation from pump. Piping should be supported in order to prevent the vibration.
- Install an air chamber or an accumulator to reduce the pulsation. Ask us for further information.
- Be careful not to have hose bend when arranging tubing.
- It is recommended to arrange the short piping as much as possible. The longer piping length, the more pressure drops, and can exceed the allowable pressure of pump and can cause the over feed phenomenon.
- It is recommended an automatic air bleed valve or a pressure relief valve should be installed in order to release the pressure of discharge piping for maintenance.
- It is recommended to install a relief valve on the discharge side piping that releases pressure automatically.
- Install a pressure gauge on the discharge side piping in order to measure the pressure inside the piping.
- When installing EH-F pump with the flange connections or the union connections, be sure to have the connections on the discharge side fixation on wall, pillar or the frame of equipment for the prevention of vibration. Make sure that the piping is fixed as well.

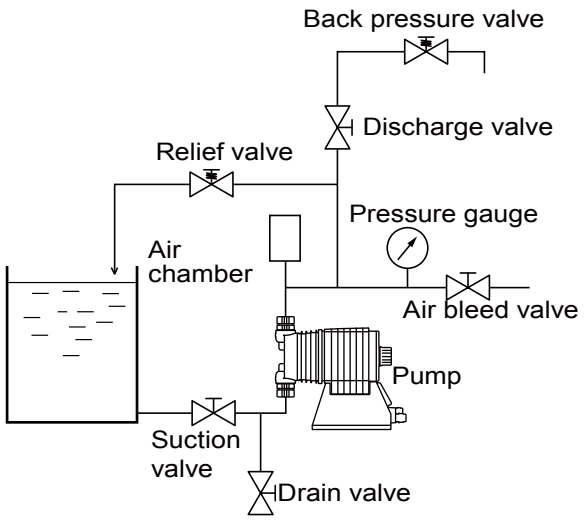
⚠ CAUTION

Incomplete fixation of pump and piping can lead to the damage to these products. Significant vibration often results from the incomplete support for the discharge side connection of pump. In case the direct support for the flange or union connection can not be secured, try to support pump close to the discharge connection as much as possible.

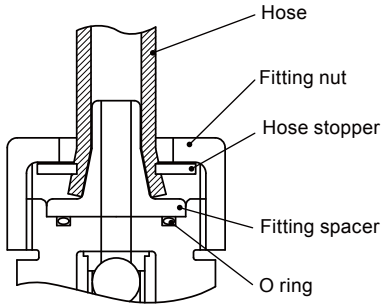
3. Piping

1. Recommended piping drawings





Arrange piping to meet the suction and discharge requirement. Especially pay attention to piping arrangement in case of handling the slurry which has settling property.



Place hose stoppers with R surface face to face with fitting spacer.

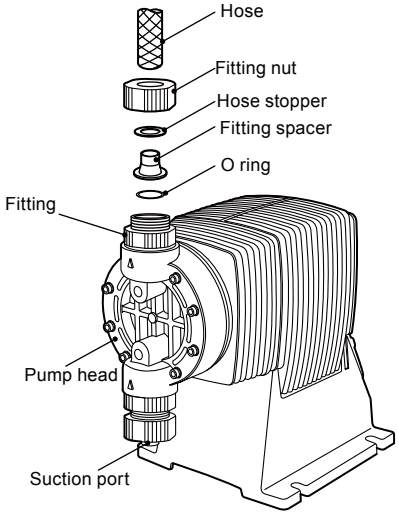
2. Piping arrangement

1. For hose connection, first fit a fitting nut, and then a hose stopper, and a fitting spacer in the last place. If the hose stopper is not fitted properly, leakage may occur and suction amount may decrease.

- The hose end should be secured by a hose stopper. Insert a hose end into a fitting spacer via a fitting nut and a hose stopper. Then squash the hose end between the hose stopper and the fitting spacer. Finally screw the fitting nut in.
- The hose stopper should be placed with its R surface face to face with the fitting spacer. An incomplete hose stopper fixation or a reverse hose stopper placement can lead to leakage or insufficient suction.

⚠ CAUTION

Reverse hose stopper placement can damage hose.



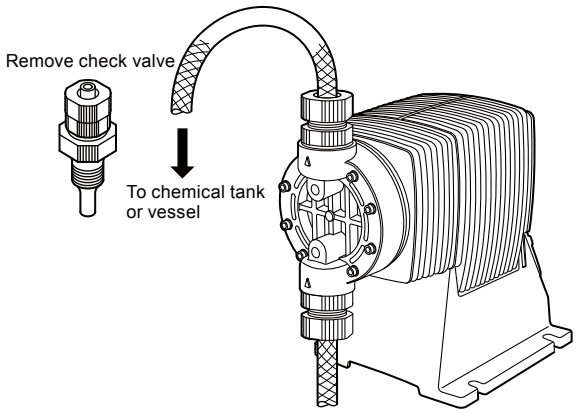
- Fitting nut is made of plastics. The fitting nut may break when it is tightened excessively.
- If attached hose is not long enough, prepare a substitute hose such as chloroethene braided hose and polyethylene hose with a suitable bore to the hose fitting spacer.

⚠ CAUTION

It is very dangerous to attach the different size hose. It may come off.

- Insert the fitting spacer into hose as deep as possible. If the insertion is not enough, hose may come off and leakage may result.
- Be careful not to lose the attached O rings. Leakage or suction failure may result without an O ring.

2. Hose connection tends to loose if liquid or ambient atmosphere is higher than normal temperature. Re-tighten the fitting nut properly after starting operation. Be careful not to tighten the nuts too much.
3. When fitting the hose again after detaching it for maintenance, cut the end of hose off about 10 mm and insert it.



3. Piping for bleeding

Prior to bleeding, disconnect hose and point a hose end at a suction tank or vessel. Remove a check valve if it is attached on the discharge side piping.

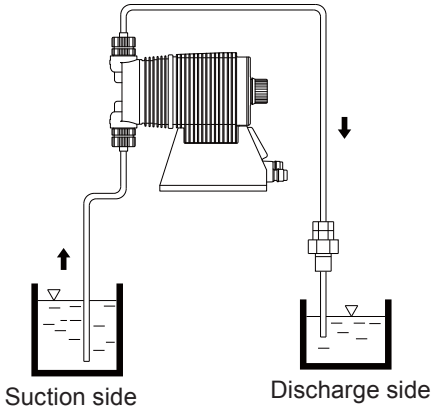


Figure A

4. Check valve

EH-F35, 45 (VC/V6/PC) types are attached with a check valve. Fit the check valve to piping in the following cases.

1. The suction side liquid level is higher than the discharge side liquid level (Fig. A). When injection point is below the liquid level of suction side at atmospheric pressure.

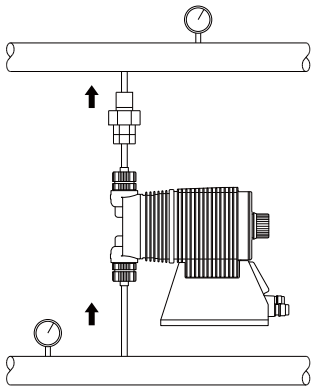


Figure B

2. The suction side pressure is higher than the discharge side pressure (Fig. B).

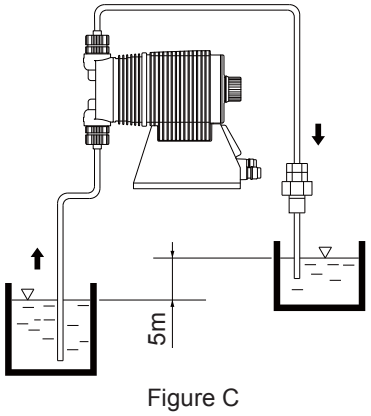
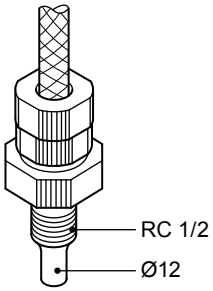


Figure C

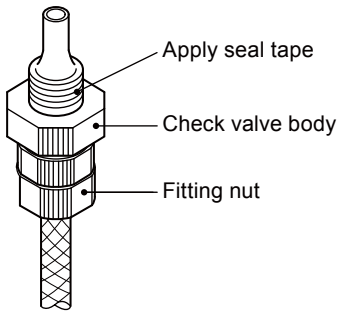
3. The discharge side liquid level is higher than the suction side liquid level but the differential height between both liquid level is 5 m or below (Fig. C).

4. The loading pressure of piping resistance and discharge head to the pump is under 0.13 MPa.

5. Check valve mounting

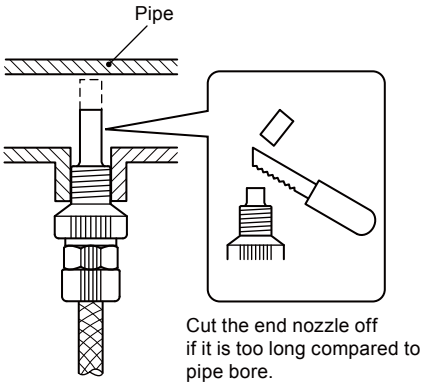


1. Tap the female thread of R1/2 at an injection point. Check valve is provided with the male thread of R1/2. Cut off the unused portion to fit it on a piping.

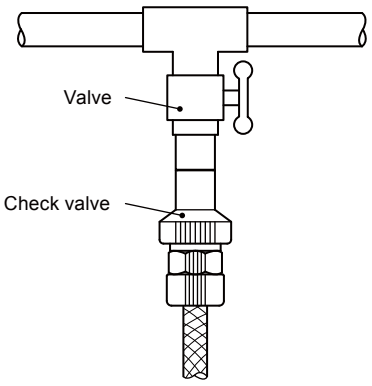


2. Apply seal tape on the threaded portion of the check valve and screw it in the injection point. Pinch the check valve body lightly with a spanner and tighten it for easy mounting.

3. When fitting a hose into a check valve with the check valve on main pipe, tighten the fitting nut, holding the check valve body by hand.



4. Cut the end of check valve(∅ 12) accordingly when mounting it in a small pipe. It is recommended the end of the check valve comes at the centre of pipe bore.



- It is recommended to mount a check valve via a valve for maintenance. Provide R1/2 female thread and screw it in. Valve should be resistant to the chemical liquid in use.

6. Flange connection and union connection

1. Flange units and union sockets are packed apart from pump body. Fit the flange units or the union sockets to pump body before use. Refer to the following figures.
2. Secure the sealing by fitting O rings to each connection.

⚠CAUTION

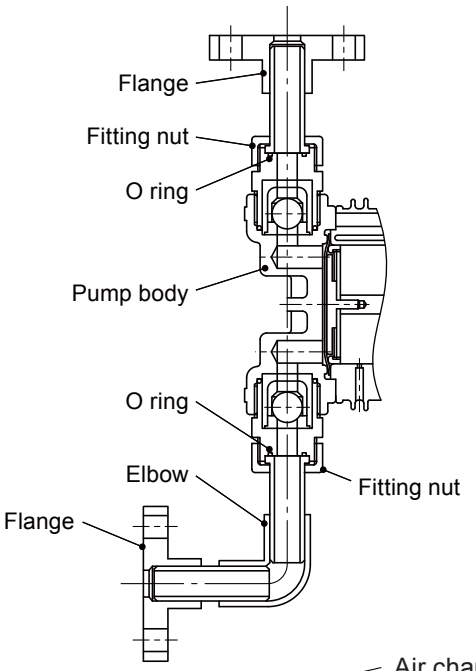
When mounting flange units or union sockets to pump body, be careful not to allow O ring to get out of the groove. Especially pay attention to the O ring on the groove on suction side.

3. Fix the flange units or the union sockets to the pump body by tightening fitting nuts. In this case first tighten the fitting nuts by the hand and then re-tighten it by 90 degrees with a spanner.

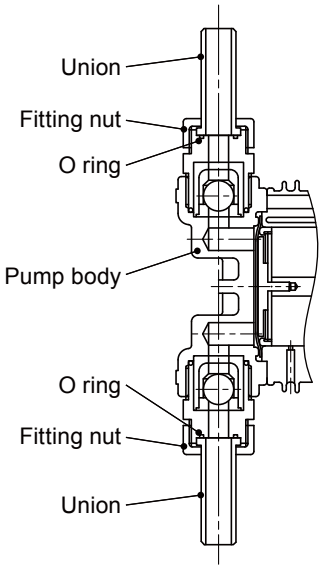
⚠CAUTION

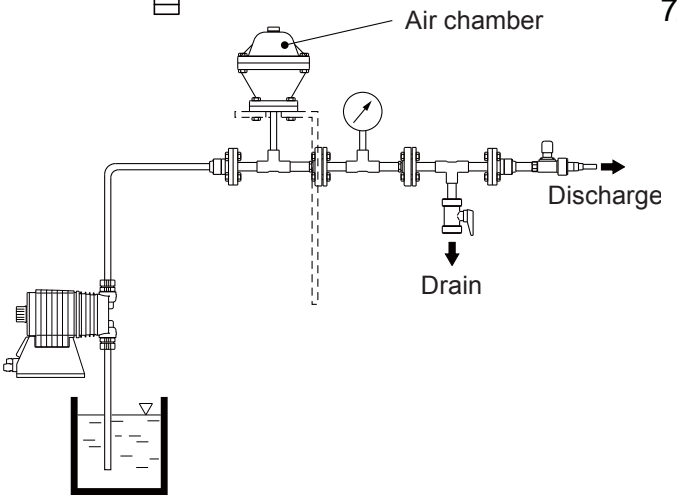
Fitting nut is made of plastics. The fitting nut may break when tightened excessively.

Flange connection type



Union connection type





7. Accumulator and air chamber mounting.

Install an accumulator or an air chamber on piping for the prevention of the vibration from the pulsation of pump discharge hose.

8. Piping (General notes)

1. Keep piping short and less bends. Do not make the projections where air can remains.
2. Support piping to avoid having the pump subject to the piping weight, especially when wet-end material is made of PVC.
3. In case of transferring the slurry which tends to settle, do not make "U" shape on piping. A drain plug is required at the lowest portion of piping as well.
4. In case of transferring the viscous or toxic liquid, or the liquid which tends to settle, provide the piping for cleaning for the purpose of maintenance.
5. In case of transferring the high temperature or low temperature liquid, the telescopic motion of piping from temperature variation should be taken into consideration.
6. Select pipe materials based on a through examination of the corrosive resistance and the estimated pressure applied to piping.
7. Do not allow any adhesive agent to get in pump when connecting PVC-made pipe on the discharge side piping.
8. Clean the inside of piping before installing pump in it.
9. A relief valve is required to protect pump and piping. Install a relief valve on the discharge piping near the pump.

9. Suction piping

1. Regarding suction piping, a flooded suction system should be realized. The bore of suction piping is recommended to be larger than that of pump suction port.
2. Each joint of suction piping needs to be mounted carefully in order to prevent air from coming in. Air influx into piping may cause discharge performance failure and instability.

10. Discharge piping

1. Mount a relief valve on the discharge piping near pump. A discharge valve should be mounted beyond the relief valve.
2. The pressure resistance of discharge piping should be higher than the set pressure of relief valve. Mount each joint carefully.

4. Electrical wiring

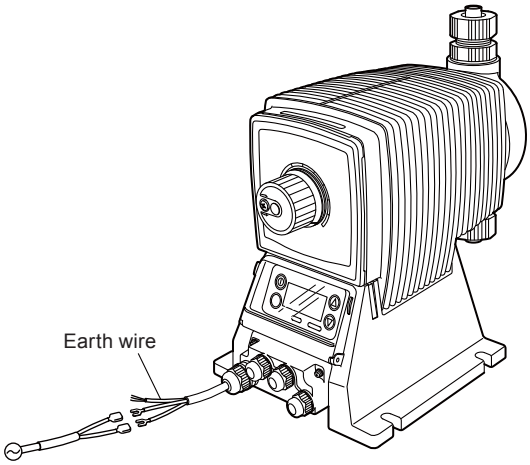
1. Power cord connection and earthing

⚠ WARNING

- Electrical works and the handling of power source must be done by qualified person.
- Do not operate pump with the wet hand.

⚠ CAUTION

- Make sure that power is not turned on while working on wirng.
- Do not dismantle electronic circuit.
- Electronic circuit may be broken. Never apply other voltages than a rated voltage.

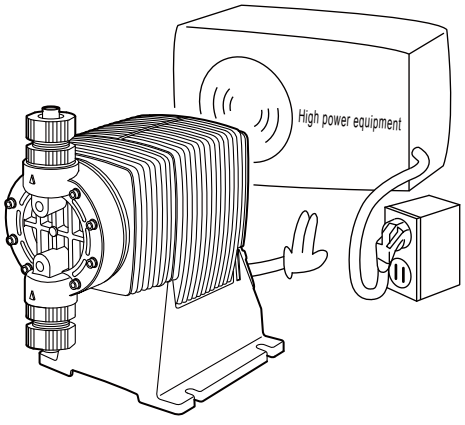


1.Connection to power source

- Before the use of pump, be sure to connect a power cord with crimp contacts.

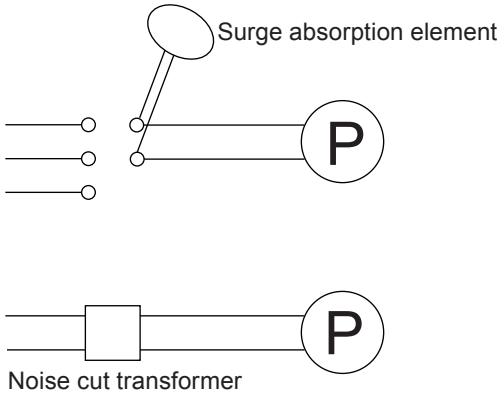
2.Earthing

- Be sure to earth the pump.



⚠ CAUTION

- **Avoid sharing a power source with a high power equipment. This can lead to the failure of the electronic circuit of control unit due to extremely large surge voltage.**
- **The noise from an inverter can cause failure**.



⚠ CAUTION

Electronic circuit of control unit may be failed by extremely large surge voltage. Do not use the pump near to the high power equipment of 200V or more which may generate large surge voltage. If the use of high power equipment is inevitable, take either of the following measures.

a. Install a surge absorption element such as varister with 2000A or more durability on the power point.

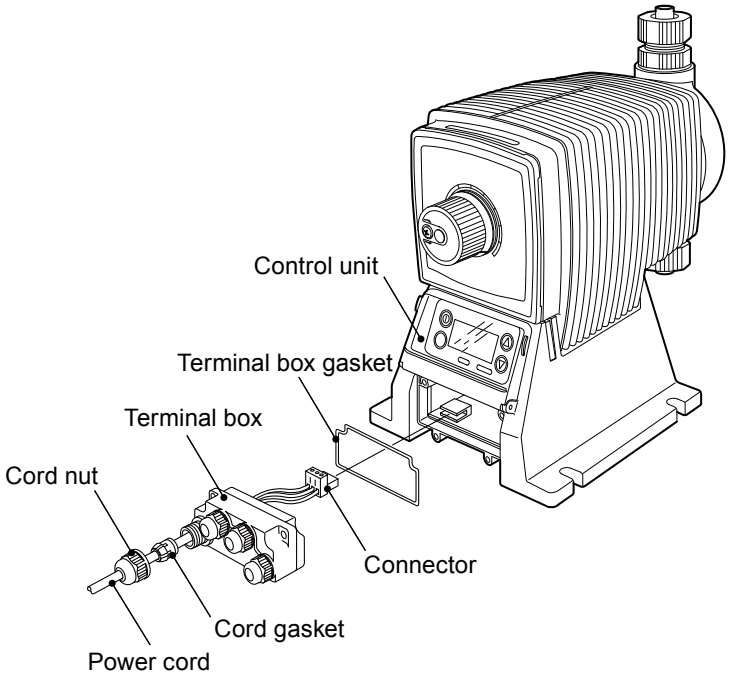
b. Install a noise cut transformer.

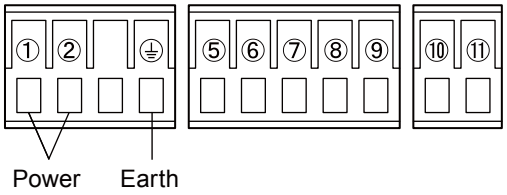
2. Wiring procedure

⚠ CAUTION

- **Only qualified operators/service staff should be in charge of the related electrical arrangement and control of the power source. Failure to observe this instruction may result in injury to person or damage to assets.**
- **Never connect wires while power is turned on, otherwise an electrical shock or a short-circuit of controller may result. Be sure to turn off power before wiring.**
- **Internal circuit is still electrified right after turning off power. Take 1 minute or more to start wiring.**
- **Do not band a power cable either electrical wires or relay output wires.**
- **Earthing wire is equipped with a jumper pin. Keep the jumper pin equipped in use.**
- **Do not combine the EXT or STOP signal line with a power cord or a power cable. Do not combine power source line with the EXT or STOP signal line by a concentric cable (5 wires cable or so).**
  Otherwise noise come about through EXT and STOP wires due to the induction effect from power cable, and it may results in wrong operation or the failure of pump.
- **Regarding frequent ON-OFF operation, it is recommended to stop pump thorough STOP input terminal but not by connecting or disconnecting power source. When connecting and disconnecting power cord can not be avoided, it should be within 6 times an hour.**

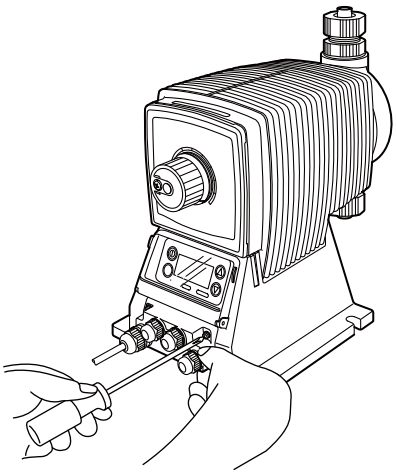
- To change wiring arrangement or add options, wire the terminal box following the next steps.

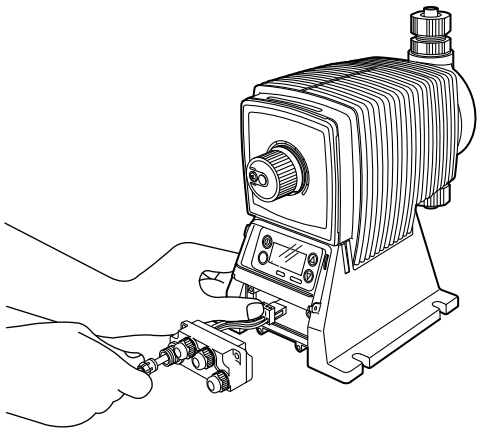


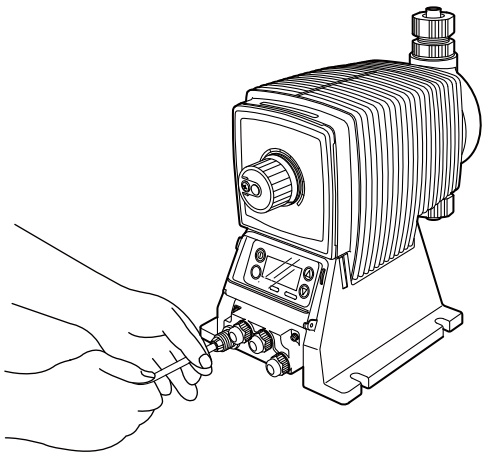


⑤ DC12V output
⑥ ANA(analog) Signal input(+)
⑦ STOP signal input
⑧ Pulse signal input
⑨ COM(−)
⑩ Output
⑪ Output

- Pulse signal input
  Wiring should be connected between ⑧ and ⑨. Pay attention to polarity. ⑧ is + and ⑨ is −.
- Analog signal input
  Wiring should be connected between ⑥ and ⑨. Pay attention to polarity. ⑥ is + and ⑨ is −.
- Stop signal input
  Wiring should be connected between ⑦ and ⑨. Pay attention to polarity. ⑦ is + and ⑨ is −.
- Output
  Wiring should be connected between ⑩ and ⑪. There is no polarity.







3. Connection procedure

1. Remove the terminal box by unscerwing the 4 screws on it.
2. The connector is detachable from the PCB connector. Detach the connector.
3. Remove an unused cord nut, a blind cap and a cord gasket. And insert a cord into a terminal box through a cord nut and a cord gasket in order.
4. Connect the leads to the connector. Strip the end of the leads about 5mm and insert the leads into each terminal. Tighten the screws on the connector to fix the end of leads with a flathead screwdriver by an approximate tightening torque 0.4N·m.
5. Attach the connector to the PCB connector after connecting leads.

⚠CAUTION

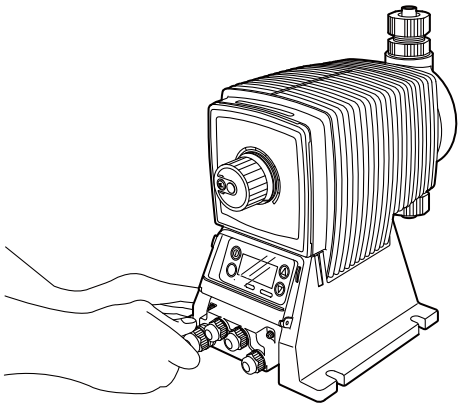
Confirm that the connector is completely attached. Incomplete connection can cause a malfunction.

6. Fix the terminal box to a control unit case with the 4 screws. The tightening torque is 0.5N·m.

⚠CAUTION

Mount the terminal box while checking a terminal box gasket is in place. Incomplete placement can cause a liquid influx.

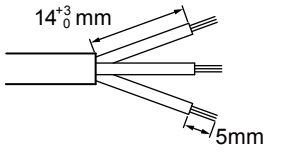
7. Adjust the slackness of cord in the terminal box and fit a cord gasket to into the terminal box.



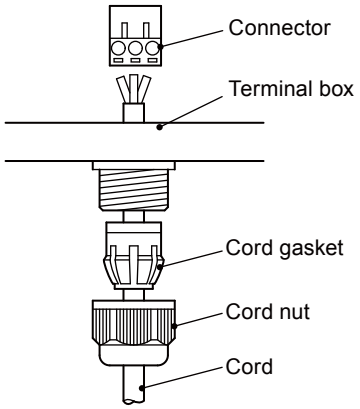
8. Fit and tighten a cord nut in the last place.

- **The outer diameter of the cord should be between 4.6 and 8 mm. An extra measure is required for the prevention of seal performance failure when using any cord beyond the specification range.**

4.Wiring procedure for external signal terminal



EXT cord terminal arrangement



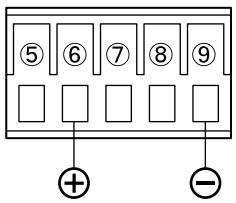
5.Analog signal input

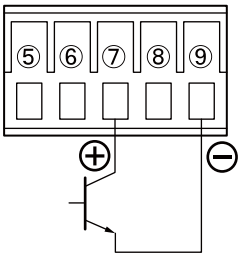
Analog signal input is used for changing the pump stroke speed via the external current signals in pump operation.

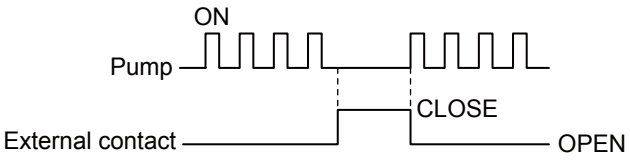
The amperage of input signals can be set optionally between 0 and 20 mA and pump operates in proportion to the input signal between 0 and 240 spm.

Pay attention to a polarity for wiring. ⑥ is +, ⑨ is -. Connect wire between ⑥ and ⑨ of the detachable connector. Strip the end wires about 5mm and insert them into each terminal port. Then tighten the screws on connector with a flathead screw-driver by an approximate tightening torque 0.4N•m.

(Internal resistance 200Ω)







6. STOP function

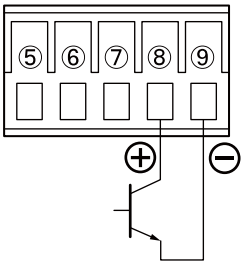
Stop function is the function which can suspend pump operation via a potential free contact signal or an open collector signal. Follow the next steps to use this function.

Terminate wires at ⑦ and ⑨ of the detachable terminal.

Strip the end wires about 5mm and insert them into each terminal port. Then tighten the screws on connector with a flathead screw-driver by an approximate tightening torque 0.4N•m.

- **When using open collector**
  Pay attention to polarity. ⑦ is +, ⑨ is -,
  The maximum applied voltage: 5V
  Amperage: 1.9 mA

- **When using type device such as relay**
  Select some device of which minimum application load is 5mA or below.



7. Pulse input

Pulse input is used to operate pump in a pulse dividing or a pulse multiply operation. The input signals are comes via an external potential free contact or an open collector.

Terminate wires at ⑧ and ⑨ of the detachable terminal. Strip the end wires about 5mm and insert them into each terminal port. Then tighten the screws on connector with a flathead screw-driver by an approximate tightening torque 0.4N•m.

- **When using open collector**
  Pay attention to polarity. ⑧ is +, ⑨ is -.
  The maximum applied voltage: 5V
  Amperage: 1.9 mA

- **When using type device such as relay**
  Select a device of which minimum application load is 5mA or below.

4 Operation

1. Pump Operation

⚠ WARNING

- **Wear protective clothing**
  Wear protective clothing such as a protective mask, safety gloves or so when handling chemical liquid.
- **Do not operate pump with a discharge-side valve completely closed.**
  Operating the pump with the discharge-side valves fully closed may cause the liquid spillage or the extremely high pressure inside the pump or the discharge-side piping/tubing. This could lead to a piping burst. Be sure not to operate pump with the discharge-sides valve closed.

⚠ CAUTION

- A long time dry running (longer than 30 minutes) may cause the pump overheat and it could lead to the deformation of the pump unit consists of a pump head and valve cases or so, or may loosen the pump head fitting and result in liquid leakage.
- If the hex. socket cap bolts on a pump head are loosened, liquid leakage may result.
  Be sure to fasten all the 6 or 8 hex. socket cap bolts tightly before starting the initial pump operation. And periodically check the looseness of the bolts on the pump head and retight the bolts as necessary.
  - **Tightening torque:2.55N•m**
    Tighten all the bolts diagonally, applying equal tightness.
- If electric wiring gets wet due to accidental liquid spillage, fire or electrical shock may occur. Never get it wet. When the electric wiring gets wet, turn off power and wipe the liquid away.
- A frequent ON-OFF operation should be conducted by using STOP function(ON - OFF signals to STOP terminal). In case the STOP function is not available for the ON-OFF operation, the ON - OFF operation by turning on/off power should be limited to six times an hour.

1. Preparation for pump operation

Before pump operation, check that...

- Liquid tank is filled enough. Supply liquid if it is less than the required level.
- There is no liquid leakage or congestion due to breakage.
- Both suction and discharge side valves are opened.
- Pump is connected to the predetermined power source correctly.
- Electrical wiring is correct and there is no possibility of a short circuit or current leakage.

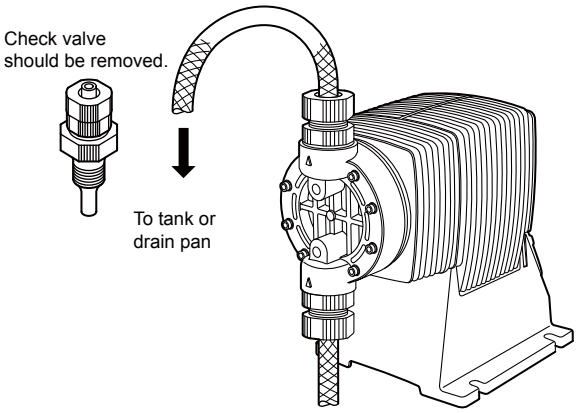
2. Bleeding

Bleeding is a process to eliminate the air inside the suction-side piping. Be sure to carry out an air elimination prior to initiating the pump operation after replacing the liquid inside a tank and after a long period of storage. Air gushes together with chemical liquid when carrying our bleeding. For safety reasons, first turn the end of a bleeding hose to a tank or a container.

⚠ CAUTION

Some liquids may cause skin trouble or affect the quality of mechanical parts. Wipe off chemical liquid immediately when they splash on the hand or mechanical parts.

3. Procedure for bleeding



[1] Extend the tube connected to the discharge-side fitting nut of pump to a chemical tank or a drain pan. Then start pump operation.
- Remove a check valve if it is installed on discharge-side.

[2] Operate the pump for about 10 minutes to eliminate air completely.

[3] When the air in pump head is completely eliminated and liquid is replaced, return the discharge-side tube to the regular tubing position.

[4] Finally, make sure there is no leakage in any section.

4. Discharge capacity adjustment

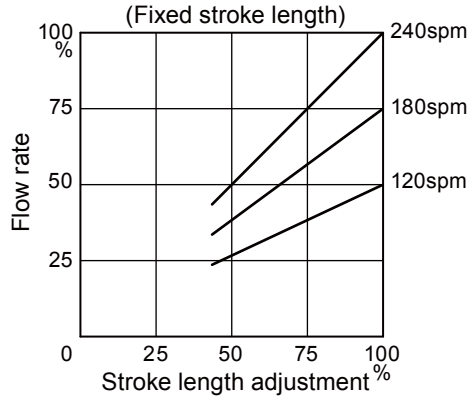
Discharge capacity can be adjusted by both the stroke length adjustment and the stroke rate adjustment but basically adjust it via the stroke rate adjustment. Stroke length adjustment is an auxiliary way to cover the range where the stroke rate adjustment can not reach.
Pay attention to the following for correct procedure.

• Stroke rate adjustment

(1) For some liquids which diffuses gas such as sodium hypochlorite and hydrazine solution, adjust discharge capacity by means of the stroke rate adjustment with the stroke length about 100 %. Gas lock may occur if the stroke length is set to short.

(2) When the back pressure on discharge side is high, adjust discharge capacity by the stroke rate adjustment with the stroke length about 100 %.

(3) In case reaction is greatly influenced depending on the discharge capacity per pump shot in the application of neutralization or titration, adjust discharge capacity by the stroke rate adjustment with the shortened stroke length and reduce the discharge capacity per shot.



1. Discharge capacity adjustment procedure
Appropriate stroke length and stroke rate are decided on the pump operating condition and liquid characteristics. Following ways are recommended for proper calibration.

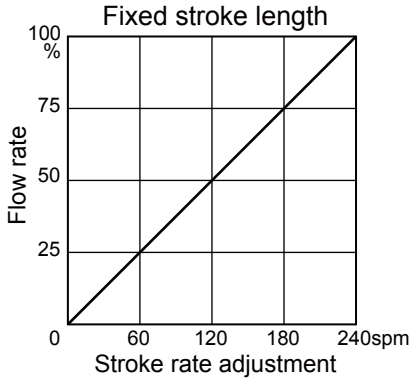
(1) Set stroke length at 100 % and roughly adjust discharge capacity by adjusting stroke rate.

(2) Measure discharge capacity.

(3) If the measured capacity is below the wanted value, increase the stroke rate and measure again the discharge capacity.

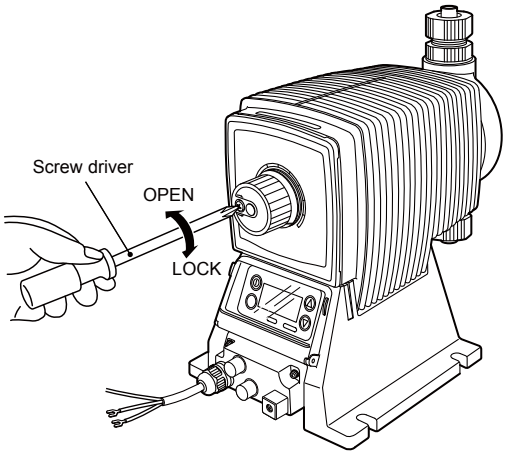
(4) Adjust stroke length for the fine adjustment of discharge capacity.

(5) Determine a discharge capacity at the last and confirm the wanted capacity is discharged.



2. Stroke rate adjustment

Stroke rate is adjusted by the key operations of control unit. Control the plunger stroke rate per minute from 1 to 240 spm via control unit.



3. Stroke length adjustment

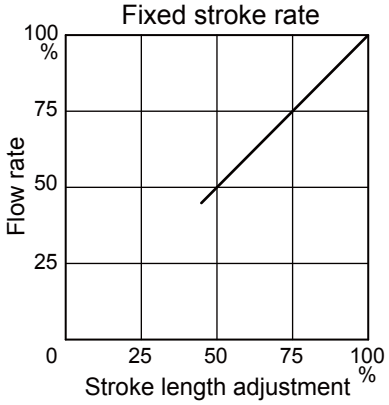
Stroke length adjustment knob is locked with a screw. Loosen the screw before adjustment and lock it afterwards.

⚠ CAUTION

Be sure to tighten the screw on the adjustment knob after an adjustment. The knob may rotate unintentionally due to a loose fixation. This may result in the fluctuation in a discharge rate.

(1) Turn on pump and adjust the discharge capacity by turning the stroke length adjusting knob while pump is running.

(2) The left graph shows the relation between stroke length and discharge capacity. The maximum discharge capacity is shown on the name plate.



• The usage between 40% and 100% is practical.

⚠ CAUTION

Do not turn the stroke length adjusting knob when the pump is not running.

5. Full operation

Put pump in use after bleeding and adjusting discharge capacity.
Pump runs in manual operation or in accordance with the setting of control unit.

6. Manual operation

Starting pump: After turning on power, ON lamp (Green) appears and display shows WAIT mode. For the first time to turn on power, "MAN" lamp appears and pump starts after pushing START/STOP key once.

Stop pump: Push START/STOP key to turn off "MAN" lamp and stop pump. Pump starts and stops every time START/STOP key is pressed.

7. EXT operation

Refer to the next section of "2. Control unit operation".

8. Shout down

- **When pump will not in use for a long time (one month or more).**

  Run pump with clean water about 30 minutes in order to clean the wet-end parts and the inside of piping before storage.

- **When re-starting pump after a long time storage.**

  If pump dose not suck up liquid, clean valve sets and remove the sticking foreign matters. Carry out an air elimination and adjust discharge capacity when air stays inside pump head.
  Refer to page 28 "3. Procedure for bleeding" .

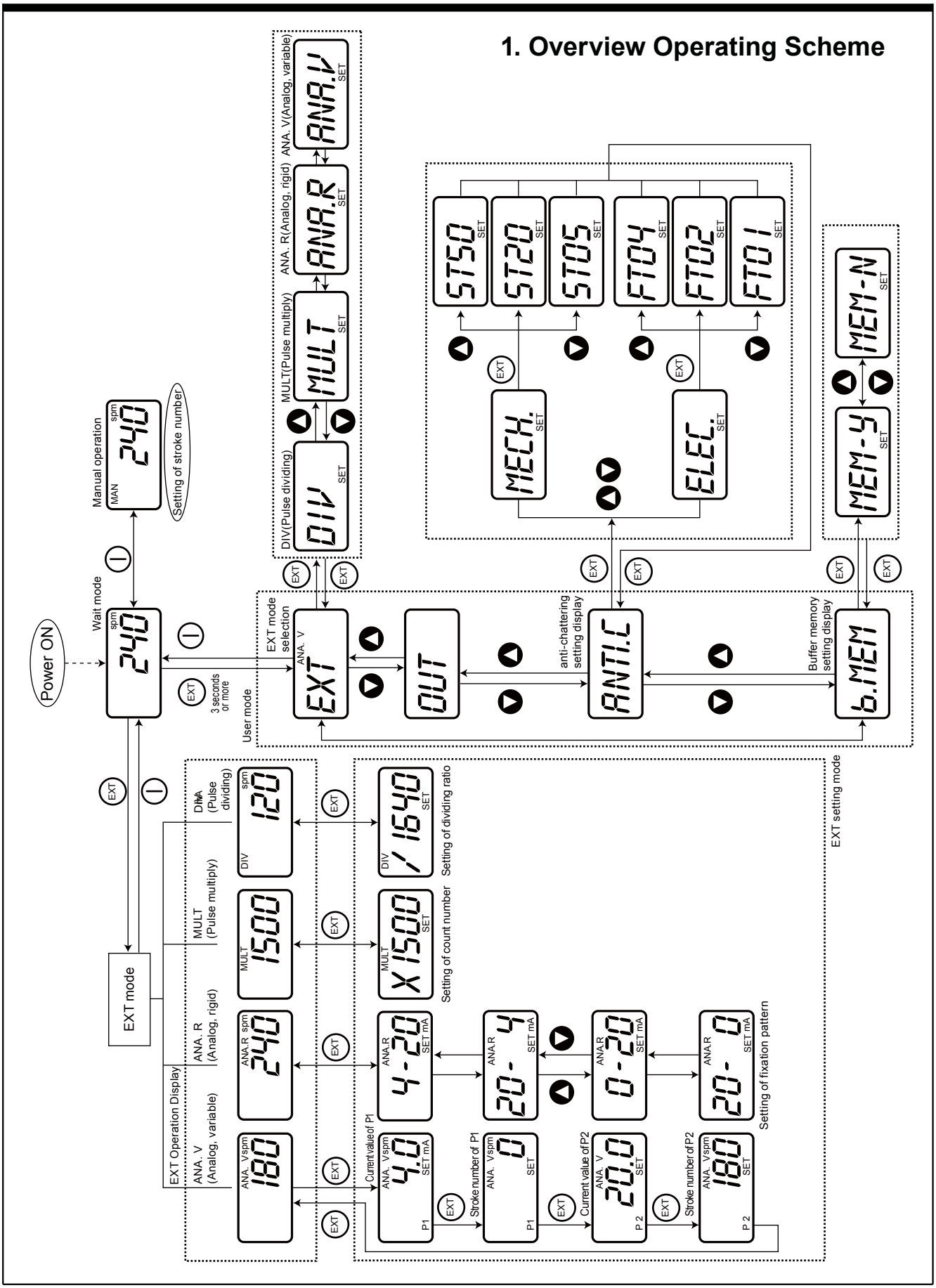
2. Control unit operation

EH-F type pump is controlled by means of setting or changing the setting values of the controller. Control functions are various at each operation mode. Read this section carefully before operation.

Default parameter values

Mode	Parameter	Default value	Setting range	Step
Manual operation	Stroke speed	240	1-240	1
DIV setting	Dividing ratio	／1	/ 1-9999	1
MULT setting	Multiply ratio	×1	×1-9999	1
ANA. R setting		4-20	4-20, 20-4, 0-20, 20-0	-
ANA. V setting	P1 amperage	4.0	0.0-20.0	0.1
	P1 stroke speed	0	0-240	1
	P2 amperage	20.0	0.0-20.0	0.1
	P2 stroke speed	240	0-240	1
User setting	EXT operation	ANA. V	DIV, MULT, ANA. R, ANA. V	-
	Anti-chattering	MECH.	MECH., ELEC.	-
		ST05	ST05, ST20, ST50/FT01, FT02, FT04	-
	Buffer memory	MEM-N	MEM-N, MEM-Y	-

1. Overview Operating Scheme



1. **-----➤ means automatic transfer. WAIT mode is selected when the power is switched on for the first time. On and after the initial power activation, pump restores the previous status right before the power is switched off.**
2. Regarding MANUAL mode, pump starts operation by pushing START/STOP key at WAIT mode. Pushing START/STOP key again, the pump stops and returns to WAIT mode.
3. Regarding EXT operation, pushing EXT key at WAIT mode, the pump moves to EXT mode and starts operation.
   Pushing START/STOP key stops the operation and returns the pump to WAIT mode.
4. The change of each setting of EXT operation is accessible by pushing EXT key at EXT mode. Pushing EXT key after the setting, pump starts in EXT operation according to the changed setting.
5. Pushing EXT key three seconds at WAIT mode, pump moves to USER mode. At USER mode the EXT mode selection and the detailed setting such as the setting of buffer memory or so can be obtained.

For details refer to each section of "2. Pump operation".

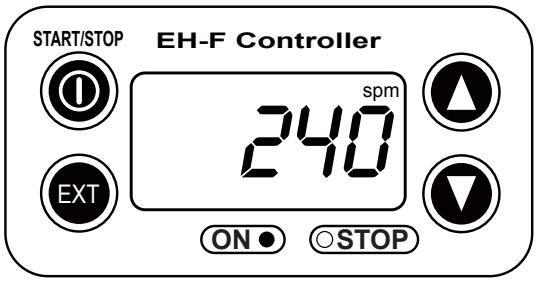
2. Pump operation

1. Operation of controller

Before turning on power, confirm the specified power source on the nameplate.

⚠CAUTION

Connecting any other powers than the one shown on nameplate to pump is strictly prohibited. It could lead to pump trouble or failure.



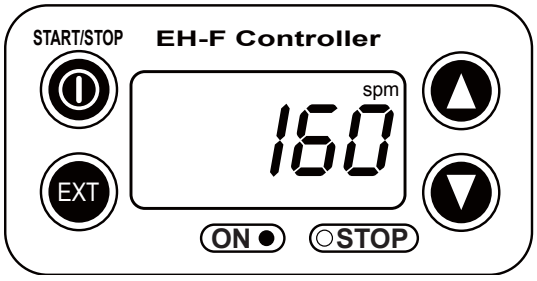
1. Turning on power

Display shows WAIT mode when pump is turned on for the first time. After the initial power activation, the pump restores the previous mode right before the power was turned off last time. If power is turned off at any setting modes, WAIT mode appears at the next power activation.

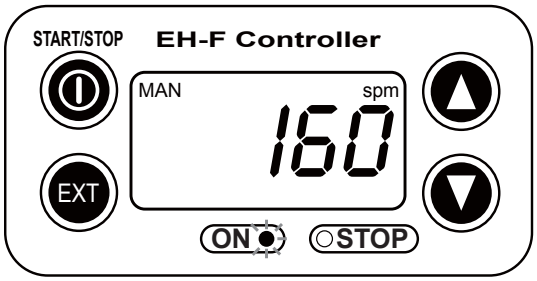
○ Stroke speed setting value is shown on display at WAIT mode. ON lamp lights (Green).

2. Manual operation

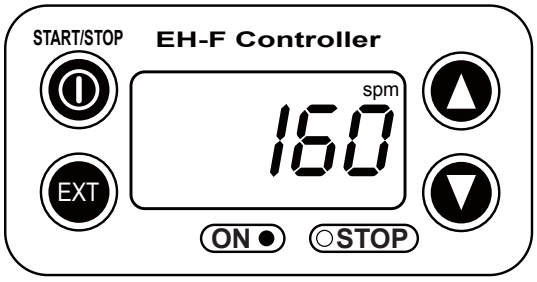
(1) Stroke speed can be adjusted by ▲ and ▼ keys. The figure changes quickly when either ▲ or ▼ key is depressed. The picture below shows the stroke speed is set to 160 spm.



(2) Push START/STOP key once to start the pump operation. "MAN" indication appears and ON lamp blinks synchronously with each stroke.

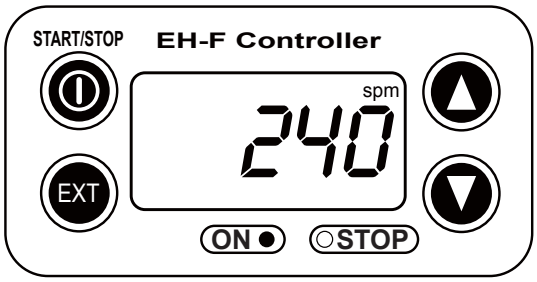


(3) "MAN" indication disappears and ON lamp stops blinking as START/STOP key is pushed again. Pump enters WAIT mode.

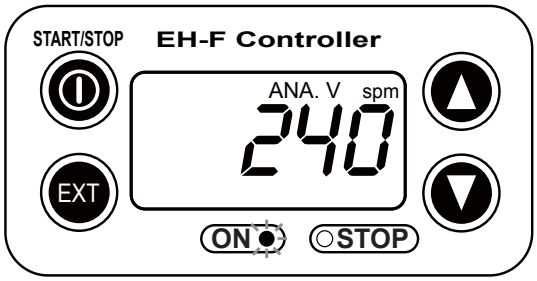


3. EXT operation (ANA. V mode)

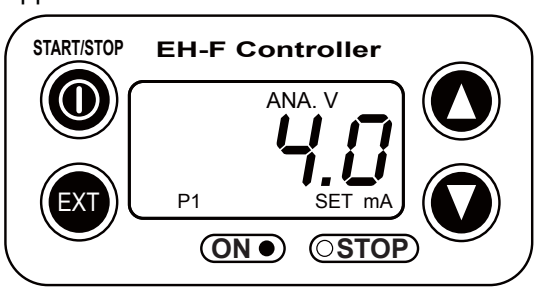
(1) Push START/STOP key to move to WAIT mode if pump is in another mode. Go to next step if pump is in WAIT mode.



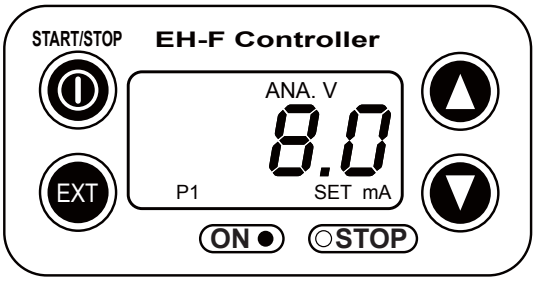
(2) ANA.V indication appears and pump enters an EXT mode as EXT key is pushed once. Pump starts operation in accordance with current signals and various settings. ON lamp blinks at each pumping during operation. Pump is controlled via the EXT mode which was selected at USER mode. The initial setting of EXT mode is ANA. V mode. Select a preferable EXT mode in USER mode. The picture below shows ANA. V mode. (The spm on the display changes according to input signals.)



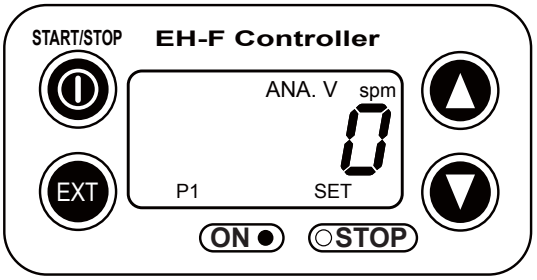
(3) Push EXT key once when pump is running in ANA. V mode. Display indicates the setting display of ANA. V mode. "spm" indication disappears, and "P1", "SET" and "mA" indications appear on the screen.



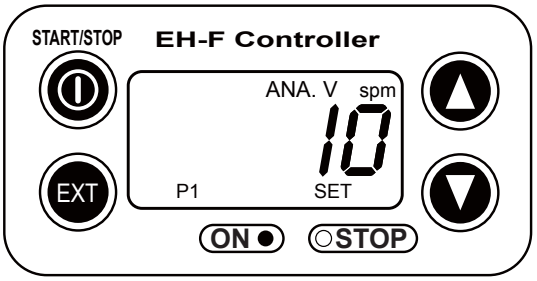
(4) Set the current value at P1. Figure increases or decreases as ▲ or ▼ key is pushed. The picture below shows 8.0 mA is set to point 1.



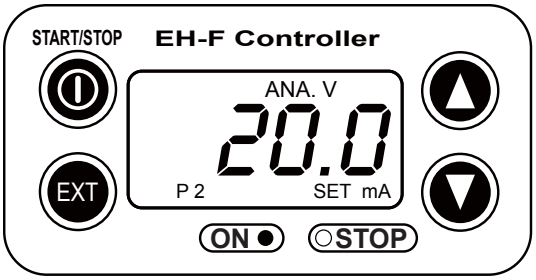
(5) Pushing EXT key once, "spm" appears on the display while "mA" disappears. The picture below shows the number of strokes at "P1".



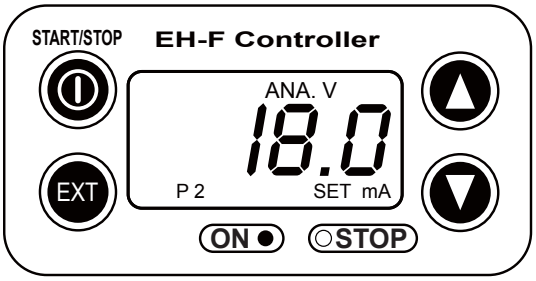
(6) Set the number of strokes at P1. Figure increases/decreases as ▲ / ▼ key is pushed. Picture below shows 10 spm is set for point 1.



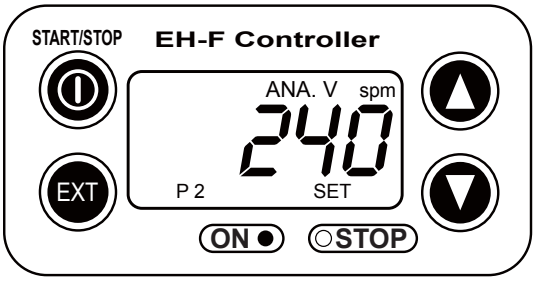
(7) Push EXT key to move to the setting display of the current value at P2. "P1" and "spm" disappear and "P2" and "mA" appears instead.



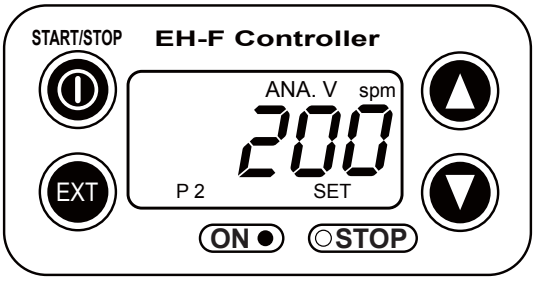
(8) Set the current value of P2 by pushing ▲ and ▼ keys. Picture below shows 18.0 mA is set to point2.



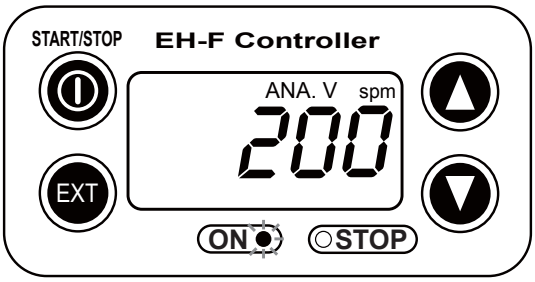
(9) Pushing EXT key once, "spm" appears on the display while "mA" disappears. The picture below shows the number of strokes at "P2".



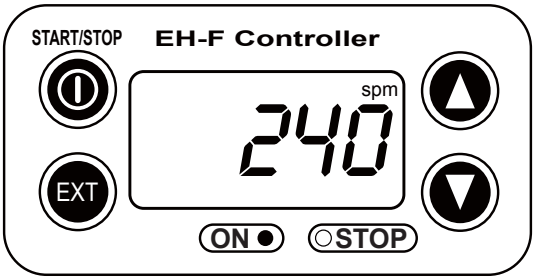
(10) Set the number of strokes at P2 by pushing ▲ and ▼ keys. Picture below shows 200 spm is set to point 2.



(11) Push EXT key to return to EXT mode. Pump starts to run in ANA. V mode on the setting of (4) through (10). ON lamp starts to blink at each pumping.



(12) Pushing START/STOP key, pump enters WAIT mode and pump stops. ON lamp stops blinking and "ANA.V" indication disappears.

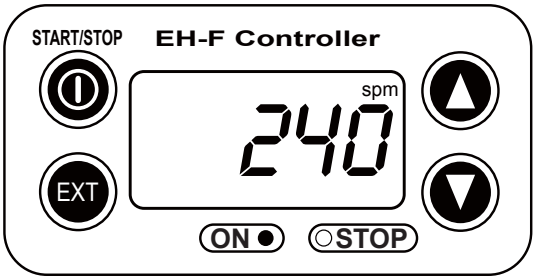


4. EXT operation (DIV mode)

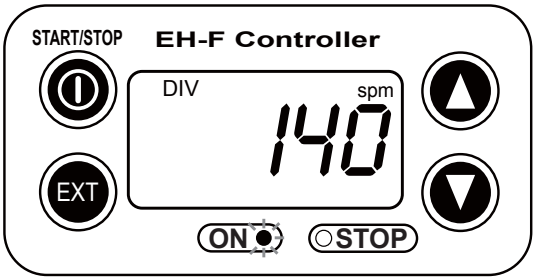
⚠CAUTION

When the setting of the buffer memory is "OFF", keep the number of strokes in the dividing operation 240 spm or below. The input signals to operate the pump over 240 spm can cause an unstable pump operation.
When the setting of the buffer memory is "ON", the pump operates for all the input pulse signals. Pump keeps operating after all the signals are stopped in this case.
Be careful when setting of buffer memory.

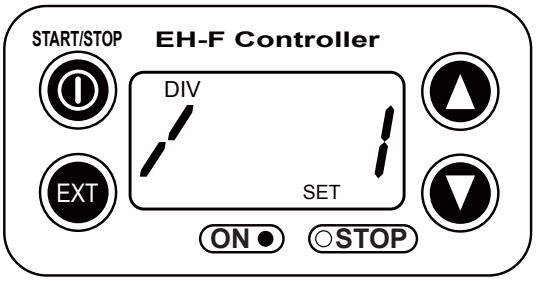
(1) Push START/STOP key to move to WAIT mode if pump is in another mode. Go to next step if pump is in WAIT mode.



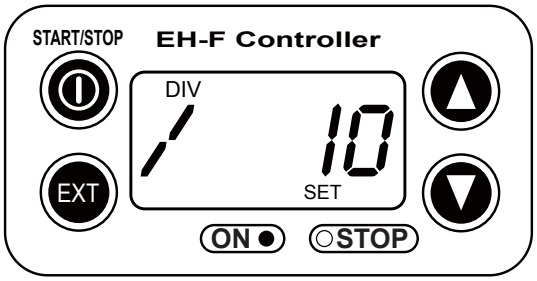
(2) Pushing EXT key, "DIV" appears and pump starts operation in the ratio of input pulse signals : a pumping. ON lamp blinks synchronously at each pumping. The initial setting of EXT selection is ANA. V mode. Change mode to DIV mode via USER mode. Refer to P. 40 for detail information.



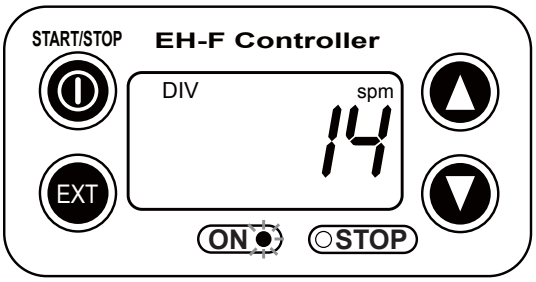
(3) Push EXT key while pump is operating in DIV mode. Pump stop running and "SET" indication appears on the DIV setting display in stead of "spm" indication.



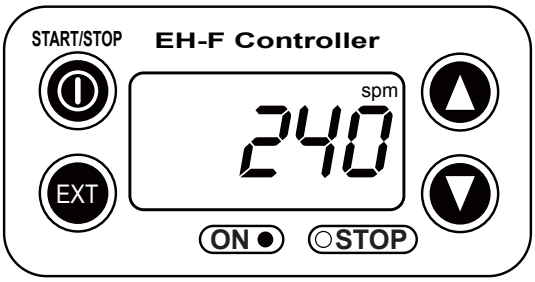
(4) Enter a dividing ratio.
Figure increases/decreases when ▲ / ▼ key is pushed. The picture below shows /10 is set.



(5) Push EXT key to return to EXT operating mode. Pump starts to run on the setting at item (4). ON lamp blinks synchronously at each pumping.



(6) Pushing START/STOP key, pump enters WAIT mode and pump stops.
"DIV" indication disappears and ON lamp stops blinking.

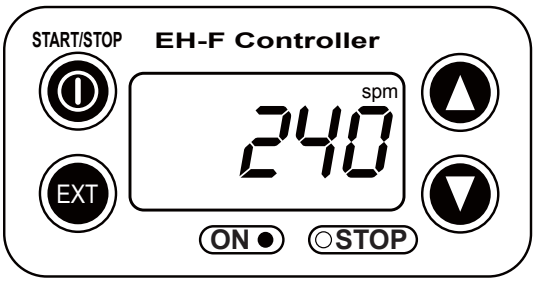


5. EXT operation (MULT mode)

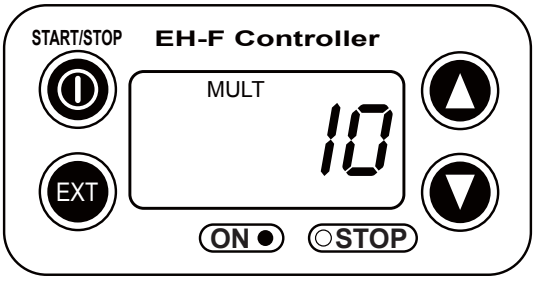
⚠CAUTION

On condition the setting of buffer memory is OFF, do not input any pulse signals during the pumping motions for a input pulse signal in the multiply operation. These input pulse signals are cancelled.
When the setting of buffer memory is "ON", pump operates for all the input pulse signals.

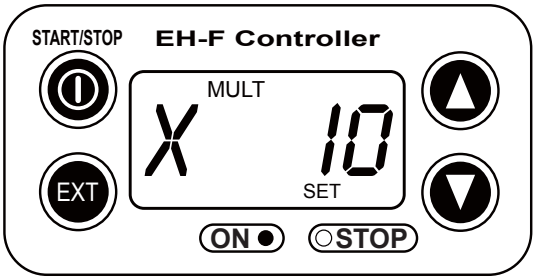
(1) Push START/STOP key to move to WAIT mode if pump is in another mode. Go to next step if pump is in WAIT mode.



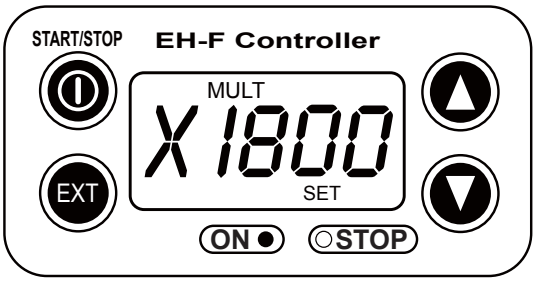
(2) "MULT" indication appears and pump starts running in an EXT operation mode in the ratio of an input pulse signal : pumpings as pressing EXT key. ON lamp blinks at each pumping. Display shows the rest of the number of strokes. In MULT mode the number of strokes is equal to the setting value in manual operation.
The initial setting of the EXT mode selection is ANA. V mode which is the operation in proportion to current. First select MULT mode via USER mode. Refer to P. 40 for detail information.



(3) Pushing EXT key when pump is running in the multiply operation calls the setting display of MULT mode and "SET" indication appears. Pump stops running and ON lamp stop blinking.

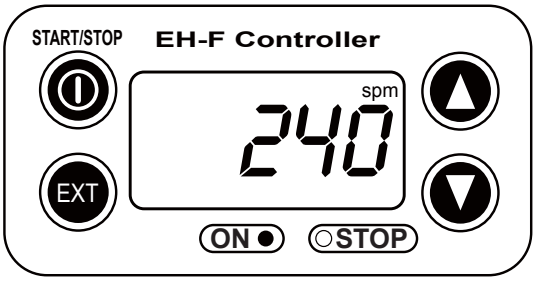


(4) Enter the number of pumpings per input signal. Figure increases/decreases when ▲ / ▼ key is pushed. The picture below shows the pumping number is set to 1800 times per an input signal.

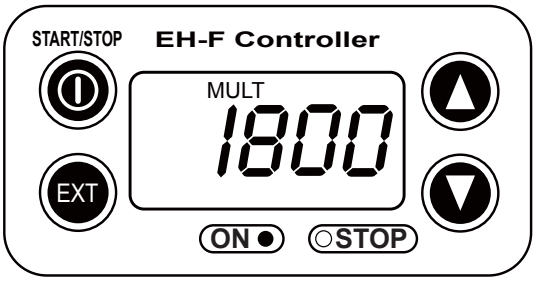


6. EXT operation (ANA. R mode)

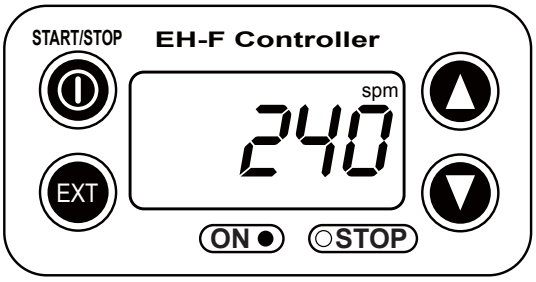
(1) Push START/STOP key to move to WAIT mode if it is in another mode. Go to next step if it is in WAIT mode.



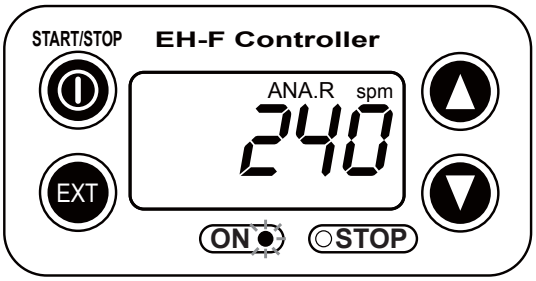
(5) Push EXT key to return to MULT mode.



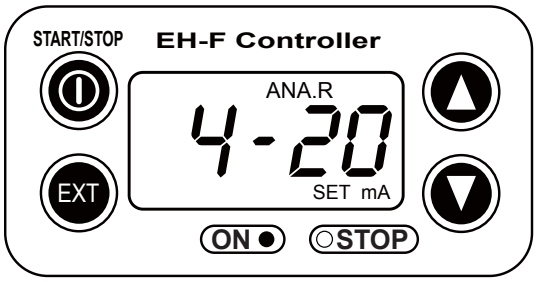
(6) Pushing START/STOP key recalls WAIT mode and pump stops. "spm" indication appears in stead of "MULT" indication.



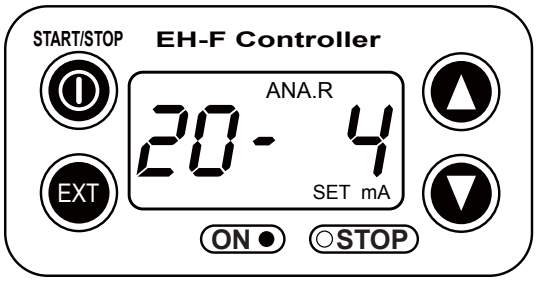
(2) Pushing EXT key, "ANA.R" appears and pump starts running in the ratio of an input pulse signal : pumpings. ON lamp blinks at each pumping. The initial setting of the EXT mode selection is ANA. V mode which is the operation in proportion to current is selected. First select ANA. R mode in USER mode. Refer to P. 40 for more information.



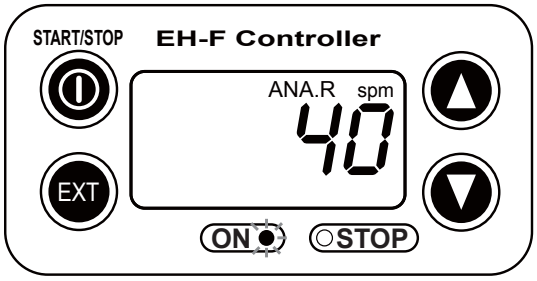
(3) Pushing EXT key when pump is running in the multiply operation calls the setting display of ANA.R mode, and "SET" and "mA" indications appear while "spm" disappears. Pump stops running and ON lamp stops blinking.



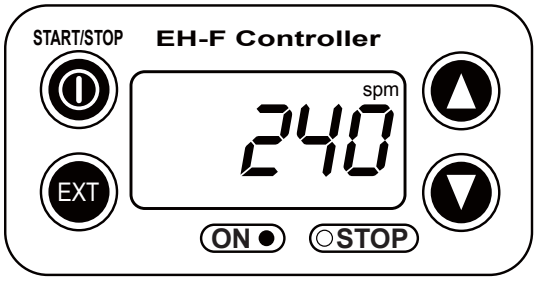
(4) Figure increases/decreases when ▲ / ▼ key is pushed. The picture below is when it is set to 0-240 spm for 20-4 mA.



(5) Push EXT key to return to EXT mode. Pump starts to run on the setting at item (4). ON lamp blinks synchronously at each pumping.



(6) When pushing START/STOP key, pump enters WAIT mode and stops running. ON lamp stops blinking and "ANA.R" disappears.



7. USER setting

The setting of each function is changed in USER mode. Have the pump entering WAIT mode in order to move to USER mode.

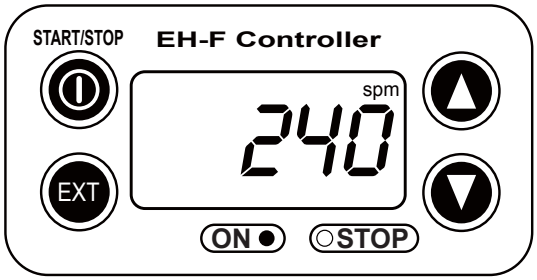
OUT (Output) is synchronous with spm and it can not be changed.

7-1. EXT mode selection

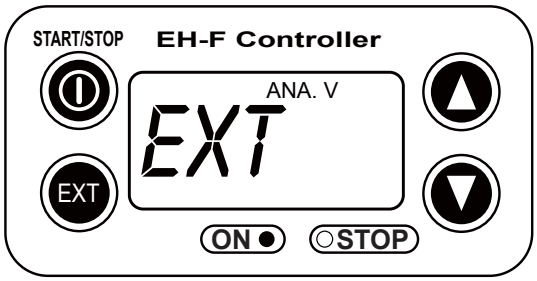
Any one of DIV (pulse dividing), MULT (pulse multiply), ANA.R (analog, rigid) or ANA.V (analog, variable) can be active in EXT mode.

The initial mode when shipped from factory is ANA.V.

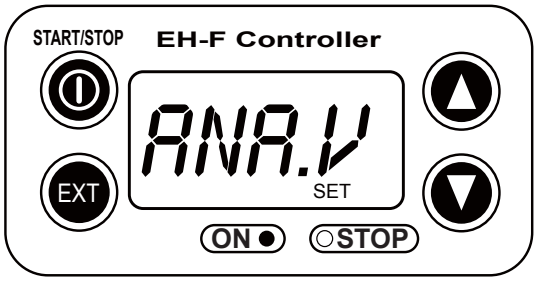
(1) Push START/STOP key to move to WAIT mode if it is in another mode. If it is in WAIT mode, go to next step.



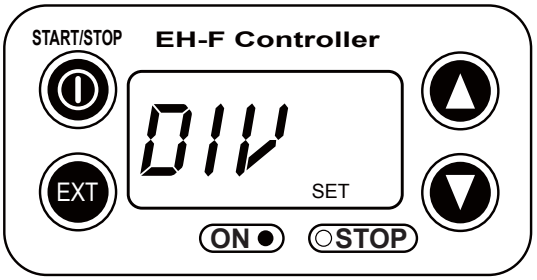
(2) Press EXT key for more than 3 seconds to move to USER mode. The picture below shows pump enters the EXT mode selection.



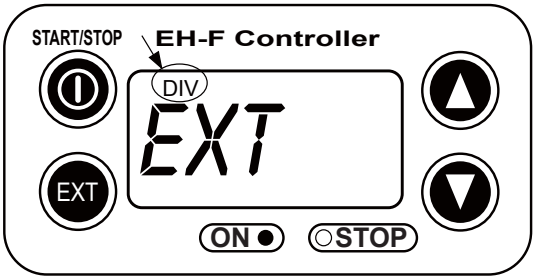
(3) Pushing EXT key, "SET" appears and display shows the mode currently set. Picture below shows ANA. V mode is selected.



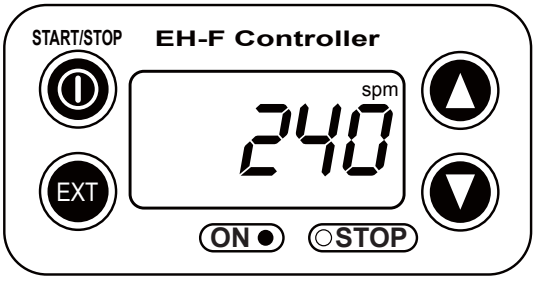
(4) Push ▲ or ▼ key to select a desired EXT mode. The picture below shows DIV mode is selected.



(5) Push EXT key to confirm the desired EXT mode. Pump displays the EXT mode selection. The picture below shows "DIV" appears to indicate DIV mode is selected.



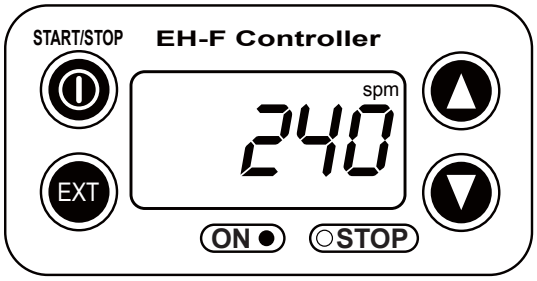
(6) Push START/STOP key to move to WAIT mode. "spm" appears while "DIV" goes out.



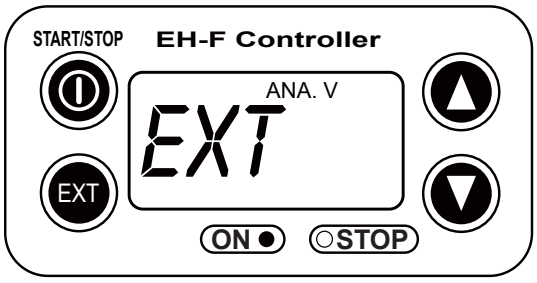
7-2. Setting of anti-chattering

Anti-chattering function is settable against the incoming pulses during the DIV or MULT operation. For the long chattering of mechanical contact such as relay, set a large figure via MECH. For the high speed (high frequency) chattering of the semi-conductor type contact such as transistor, set a small figure via ELEC. ST05 of MECH. is initial setting.

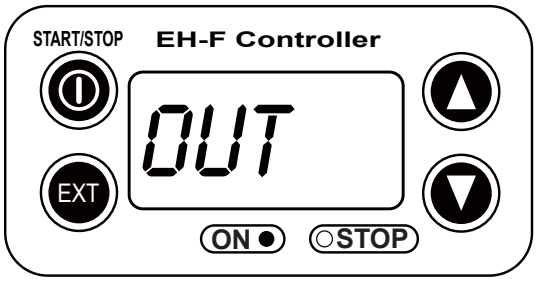
(1) Push START/STOP key to move to WAIT mode if it is in another mode. If it is in WAIT mode, go to next step.



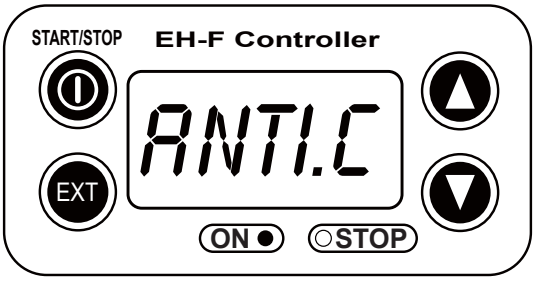
(2) Press EXT key for more than 3 seconds to move to USER mode. The picture below shows pump enters the EXT mode selection.



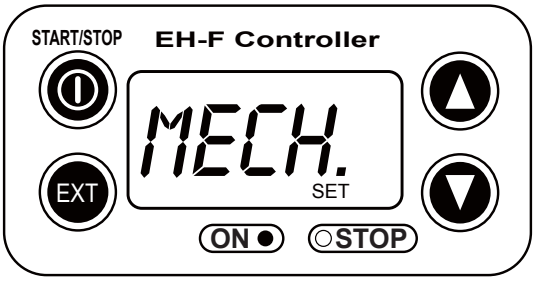
(3) Push ▼ key once.



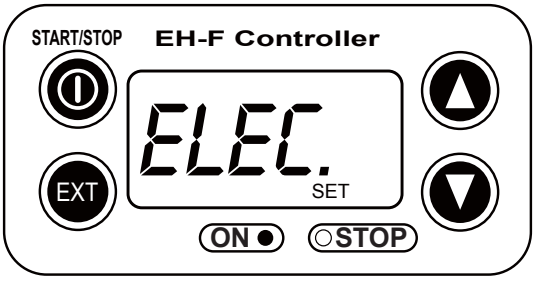
(4) Push ▼ key again to move to the anti-chattering setting display.



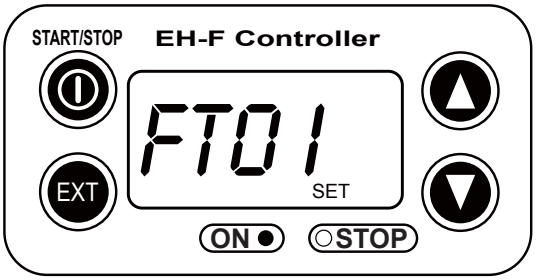
(5) Pushing EXT key, display shows the mode currently set and "SET" appears on it. The picture below shows when MECH. is selected.



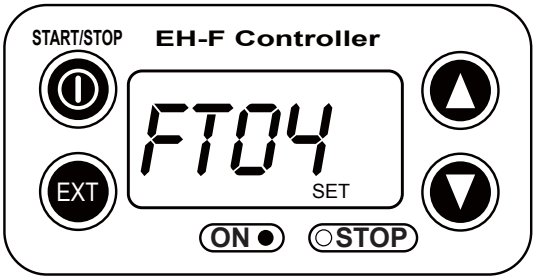
(6) Select MECH. by ▲ or ▼ key for a mechanical contact. And select ELEC. for a semi-conductor contact. The picture below shows ELEC. is selected.



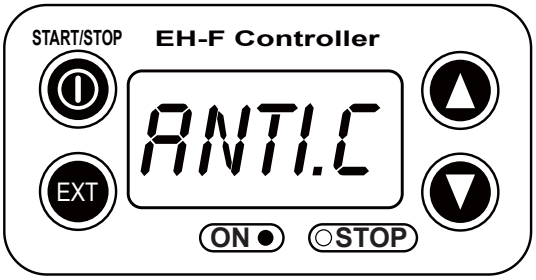
(7) Push EXT key to display the current set state. The picture below shows FT01 is selected.



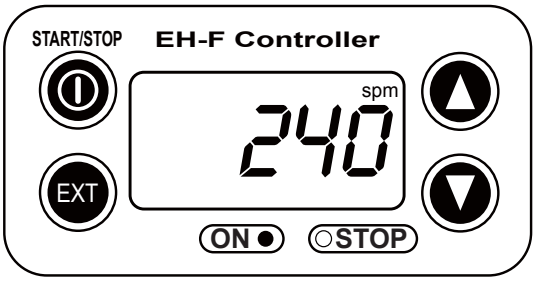
(8) Set a large figure for the long chattering by ▲ or ▼ key, and set a small figure for high speed (high frequency) chattering. The picture below shows FT04 is selected.



(9) Push EXT key to return to the anti-chattering setting display. "SET" indication disappears.



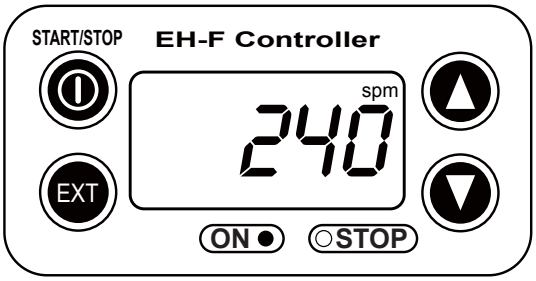
(10) Push START/STOP key to return to wait mode. "spm" indication appears.



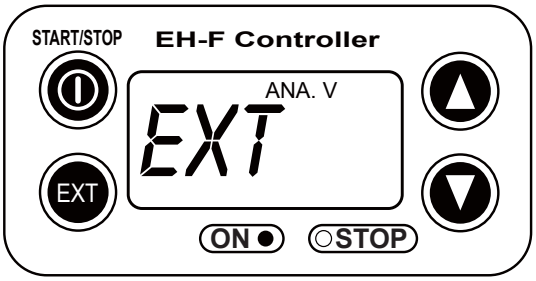
7-3. Setting of buffer memory

In case pump operation can not catch up with the input pulse signals in DIV or MULT operation, excessive pulse signals can be put in memory up to 65,535 pulses. However, the excessive pulses can not be restored if once power is off or mode is changed.

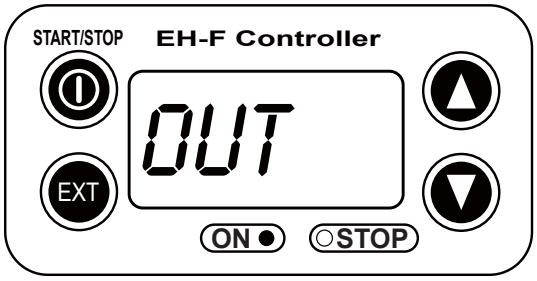
(1) Push START/STOP key to move to WAIT mode if it is in another mode. If it is in WAIT mode, go to next.



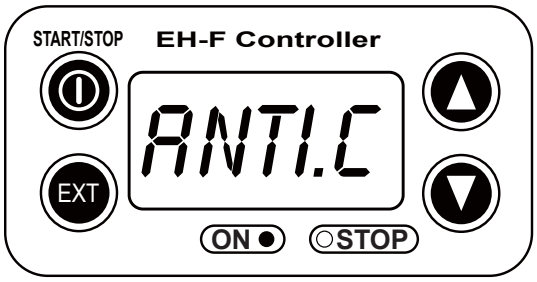
(2) Press EXT key for 3 seconds or more to move to USER mode. The picture below shows the EXT mode selection display.



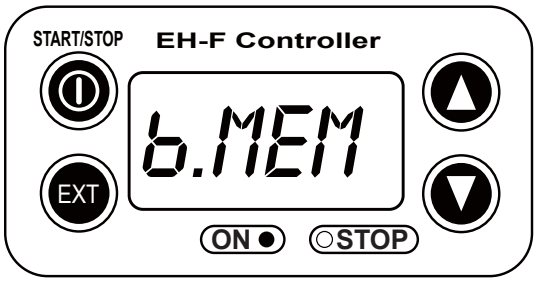
(3) Push ▼ key once.



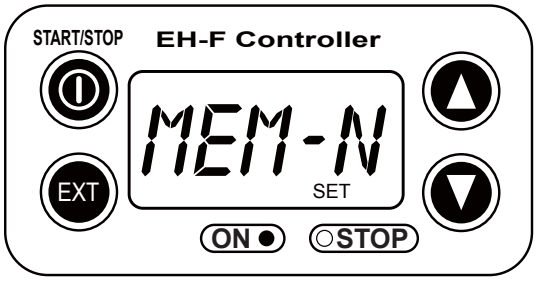
(4) Push ▼ key once again.



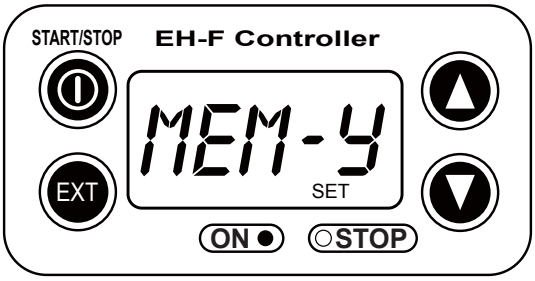
(5) Push ▼ key once again and the buffer memory setting display is shown.



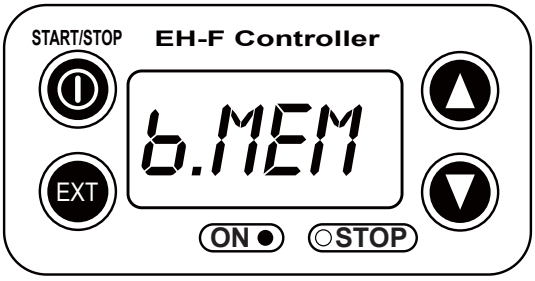
(6) Push EXT key in order to display the current set state. "SET" indication appears. The picture below shows the buffer memory is set to OFF.



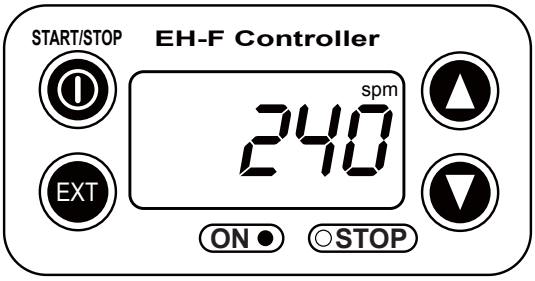
(7) Push ▲ or ▼ key in order to set buffer memory to ON or OFF. Select "MEM-Y" to set it ON. Select "MEM-N" for OFF setting.
The picture below shows when ON is set.



(8) Push EXT key to return to the buffer memory setting display. "SET" indication disappears.

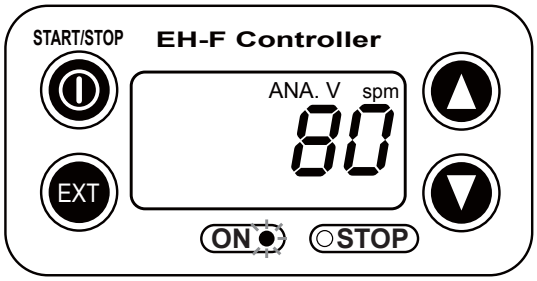


(9) Push START/STOP key to return to WAIT mode. "spm" indication appears.

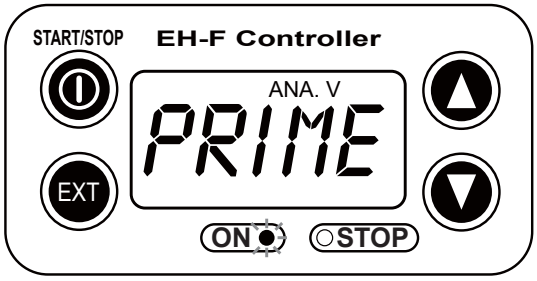


8. Bleeding & self-priming

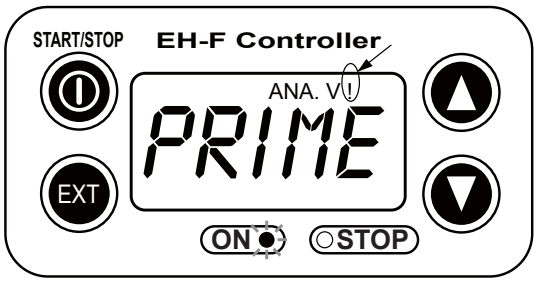
At WAIT mode, Manual operating mode and EXT operating mode, pump operates at max. speed taking priority over any functions when both ▲ and ▼ keys are pushed at once. Pump runs at max. speed only when both keys are depressed. Pump state returns to the previous mode once either ▲ or ▼ key is released. Pressing ▲ and ▼ keys for 10 seconds keeps pump running at maximum speed. In this state this fixation is released when pushing either ▲ or ▼ key once, and pump returns to the previous mode.



(1) When pump is running in ANA.V mode.



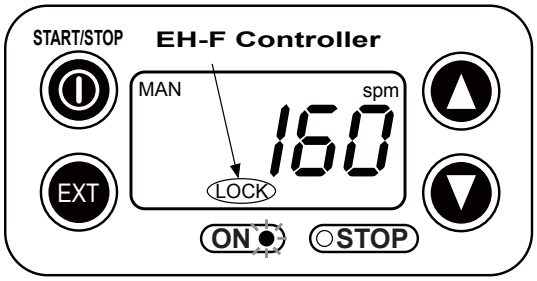
(2) Pump start to run at full speed when ▲ and ▼ keys are pressed at once. Display shows "PRIME". If either ▲ or ▼ key is released, pump returns to the previous mode. In this case pump returns to ANA.V mode.



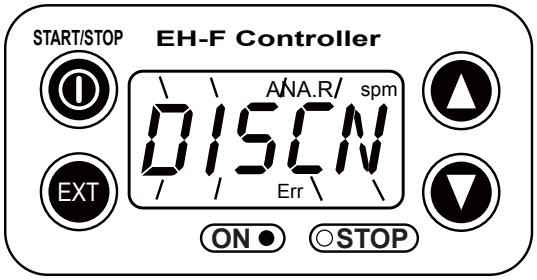
(3) Pressing both ▲ and ▼ keys simultaneously for 10 seconds or more, pump continues to run at full speed even if both keys are released. In this case "!" indication appears.
Push either ▲ or ▼ key to release this state. "!" indication disappears and pump returns to the previous mode. In this case pump returns to ANA.V mode.

9. Key lock

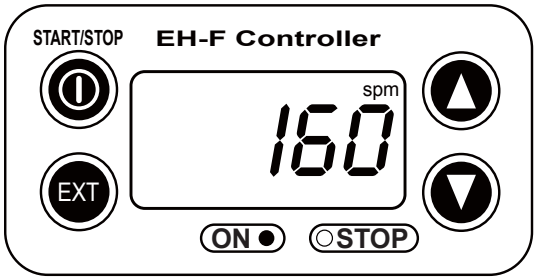
Key lock function is to prevent pump from being operated by some other person than user. If START/STOP key is pressed for five seconds or more when pump is running or stops, all key operations become ineffective with "LOCK" indication on display. This function can be released by pressing START/STOP key for 5 seconds while LOCK lights.



10. Error display and release



(1) In case Input signals fall to 4 mA or below while 4-20 or 20-4 is set to ANA. R mode, pump stops with "DISCN" blinking and "Err" on display.



(2) This error state can be released by pushing START/STOP key and pumps enters wait mode. In this case check the wiring and input signals.

5 Maintenance

⚠ WARNING

- Do not conduct a maintenance work with the wet hands. It can cause an electric shock.
- Before dismantling pump, be sure to turn off power and check the pump is not electrified. Do not start a dismantlement work after stopping the pump by pushing the START/STOP key only. Put up the sign of "Maintenance work is in progress." in order to prevent a pump switch from turning on unintentionally during the work. Release the pressure of discharge piping and drain the liquid from the wet end parts. And then clean the inside of pump head.
- Wear protective clothing such as a protective mask, globes, goggles and chemical-proof wear according to the handled chemical liquid during the work.

1. Trouble shooting

Trouble	Cause	Troubleshooting
Pump dose not start.	● Faulty wiring or disconnection in wiring. ● Voltage is too low. ● Failure in the electronic circuit of control unit.	○ Correct wiring. ○ Inspect power source and provide measurement. ○ Replace the whole unit.
Pump dose not suck liquid. Discharge amount is low.	● Air suction from suction piping. ● Valve gasket is not installed. ● Valve set assembling direction is wrong. ● Pump is air-locked. ● Pump stroke length is too short. ● Suction-side/discharge-side valve is clogged with foreign matter. ● Adhesion of valve onto valve seat.	○ Arrange piping again. ○ Install valve gasket. ○ Reassemble valve set. ○ Carry out air elimination. ○ Drive pump with 100% stroke length to prime liquid. Then reset stroke length. ○ Disassemble, inspect, and clean. ○ Disassemble, inspect, and clean.
Discharge amount fluctuates.	● Suction-side/discharge-side valve is clogged with foreign matters. ● Air is trapped in pump. ● Overfeeding ● Diaphragm is damaged.	○ Disassemble, inspect, and clean. ○ Carry out air elimination. ○ Install a check valve or a back pressure valve. ○ Replace diaphragm.
Liquid leaks	● Fittings are not tightly closed. ● Pump head is not tightened. ● Diaphragm is damaged. ● O ring and valve gasket are not installed. ● O ring is damaged.	○ Tighten fittings. ○ Tighten pump head. ○ Replace diaphragm. ○ Install O ring and valve gasket. ○ Replace O ring.
Key operation is ineffective	● Key is locked.	○ Release key lock.
Pump doesn't run.	● Pump is in waiting mode. ● Signals are not coming for EXT operation. ● Pump is in EXT setting mode. ● Pump is suspended with STOP.	○ Move to operation mode. ○ Check wiring and correct the wrong part. ○ Move to EXT operating mode. ○ Release STOP function.
Abnormal noise	● Suction-side/discharge-side valve is clogged with foreign matters. ● The sound absorption gasket is worn out. ● Bearing is worn out. ● Spring is damaged.	○ Disassemble, inspect, and clean. ○ The end of pump life span. ○ The end of pump life span. ○ The end of pump life span.
Abnormal vibration	● Piping vibrates due to pulsation. ● Bearing is worn out. ● Spring is damaged.	○ Install a accumulator or an air chamber. ○ The end of pump life span. ○ The end of pump life span.
Input pulse can not be read.	● Signals are not coming. ● Anti-chattering setting is not proper.	○ Check wiring and correct the wrong part. ○ Change the setting properly.
Analog signal input can not be read.	● Wrong wiring. ● Signals are over acceptable loaded resistance.	○ Check wiring and correct wrong part. ○ The load resistance is 200Ω. Use some devise which can accept the load resistance.

Trouble	Cause	Troubleshooting
Analog signal input can not be read and "DISCN" indication appears.	● Wrong wiring or disconnection.	○ Check wiring and correct the wrong part. Refer to page 45 for how to release an error indication.
EXT setting can not be stored.	● After EXT setting, START/STOP key is pushed for EXT by mistake.	○ Push EXT key to operate pump in EXT mode.
"PRIME" is kept indicated and other operations are inaccessible.	● Self-priming function is active.	○ Push either ▲ or ▼ key to release the function.

⚠ CAUTION

- **Check periodically whether the bolts fixing pump head are tightened. Tighten them as needed.**
- **The bolts fixing pump head may loosen in operation. Tightening torque: 2.55N•m**

2. Maintenance and inspection

1. Daily inspection

Pay attention to the following points during pump operation. Stop pump immediately upon detecting abnormality and take measures according to the item "Troubleshooting". When wear parts come to the life time, replace them by new ones.

No.	Check Point	Description
1	Does pump lift liquid normally?	• Is liquid normally fed? • Is suction pressure/discharge pressure at normal level? • Has liquid undergone quality change, crystallization, or solidification?
2	Abnormal noise or vibration?	• Abnormal noise or vibration may happen from the abnormal functioning of pump.
3	Is there liquid leakage or air suction at any joints on pump or piping?	• Tighten joint where leakage has occurred. • The excessive air bubbles in the discharged liquid mean air suction has been caused in system. Examine the piping and tighten joint on where leaks.

2. Wear parts

Wear parts should be replaced in proper period for a long period of pump operation. It is recommended that following parts are always ready for the replacement.

VC, V6, PC, P6 types

	Parts				Q'ty	Life span
Pump head	Valve set	EH-F35	EH-F45	EH-F55·70	2 sets	8000 hours
	Diaphragm				1	
	Diaphragm seat				1	
	O ring				Refer to exploded view.	
Check valve	Poppet check valve (With check gasket)				1	4000 hours
	Check valve spring Spacer				1	
Back pressure valve	Diaphragm				1	8000 hours
	O ring				2	

Note: Durability of wear parts depend on the pumped liquid, temperature and pressure.
Time to be replaced mentioned as above is the estimation obtained by continuous pumping of clean water at ambient temperature.

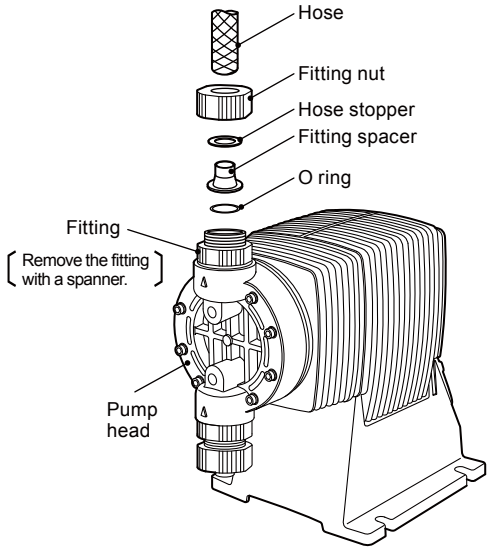
3. Dismantlement and assembly

⚠ WARNING

- Getting wet with or coming in contact with chemicals and toxic liquid is harmful. Wear protective clothing such as a protective mask, globes, goggles and chemical-proof wear during the work.
- Risk of electrical shock. Be sure to turn off power and confirm that pump and devices are not electrified before the work.
- Release the pressure inside pump and a discharge hose by opening an air bleed valve on piping prior to loosening the piping connections or the dismantlement of pump. Dismantlement with the pressure inside pump could lead to liquid spillage.

⚠ CAUTION

- Be careful not to touch residual liquid when dismantling pump. Some liquids are harmful for skin or component parts. Wipe off liquid when the hand or the component parts come in contact with liquid.



1. Valve set replacement

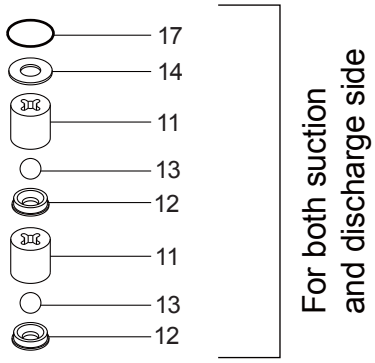
Dismantlement

1. Loosen a fitting nut and remove the hose connected to pump head. Pay attention to the liquid dripping.

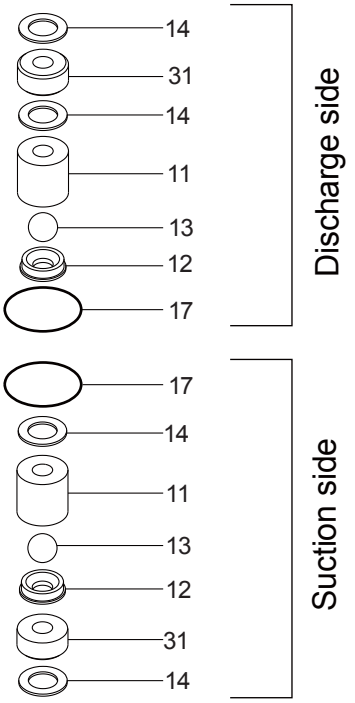
2. Loosen a fitting with a spanner to remove it. Then detach the valve set from pump head.

VC, V6, PC, Type

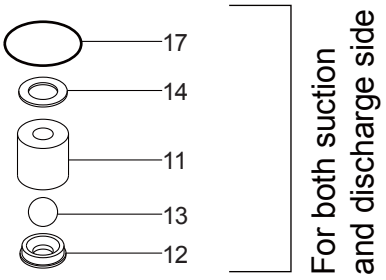
EH-F35



EH-F45



EH-F55·70



Assembly

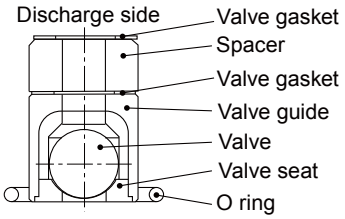
Assembly procedure is in reverse order to disassembly.

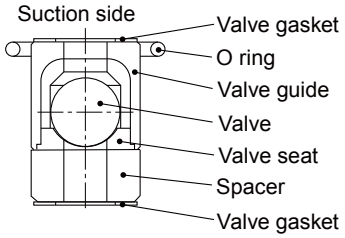
Pay attention to the following when assembling valve set.

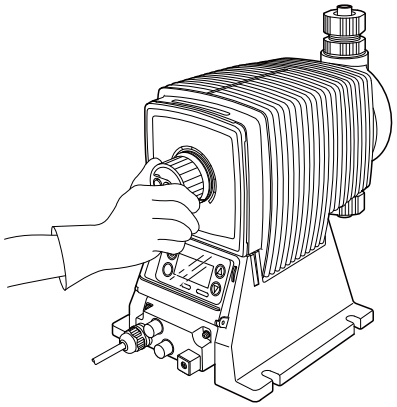
- Disposition/Insertion direction of valve set.
- The wrong disposition/insertion direction of valve set component can lead to leakage and less discharge amount.
- O ring is fitted properly.

1. Discharge side valve set mounting
   Put valve set in pump head and screw a fitting into a pump head by hand and then re-tighten it by 1/4 turns with a spanner.
2. Suction side valve set mounting
   Put valve set in connection port and screw the fitting into pump head by hand and then re-tighten it by 1/4 turns with spanner.

Note: Pay attention to the mounting direction of the spacer fitted to EH-F45(VC, V6, PC).
Make sure the cut portion on the spacer of suction side should be downward, the one of discharge side should be upward.







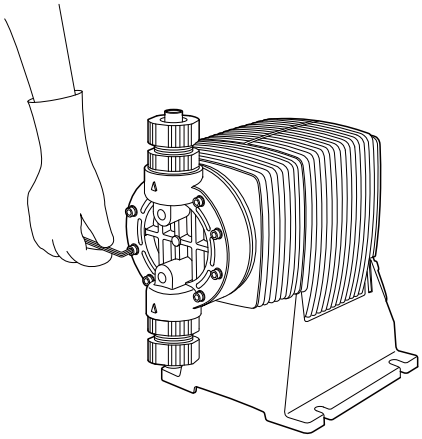
2. Diaphragm replacement

Dismantlement

1. Set stroke length to 0 % by adjusting stroke length adjustment knob.

2. Remove the pump head from the pump body by loosening hex. socket cap bolts.

3. Rotate a diaphragm anti-clockwise to remove it from a plunger pin. The diaphragm is screwed into the plunger pin.



- Pay attention not to lose diaphragm spacer and to apply the correct number of diaphragm spacers. 0 to several pieces of diaphragm spacers are put between retainer and plunger to adjust the position of diaphragm. The number of spacers mounted depends on the pump model. There are the models which do not have spacers.

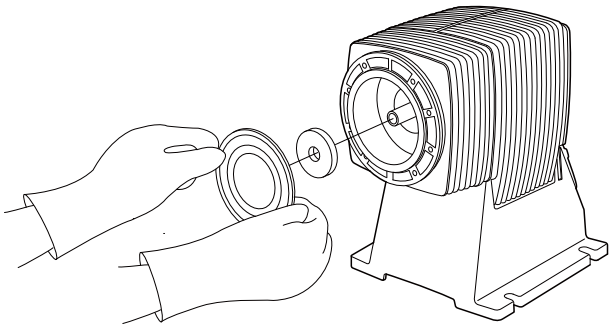
Assembly

Assembly is done in reverse order to disassembly. Follow the steps below.

1. Make sure the stroke length of pump is set to 0% prior to an assembly.

2. Fit a rear diaphragm seat, a back-up retainer (for the F55 and the F70) and a diaphragm spacer into new diaphragm via the threaded pin and screw the diaphragm into the plunger pin.

- Fit the concave side of retainer into the convex side of diaphragm. Pay attention the retainer dose not come off.



3. Set the stroke rate to 100%

- Operate pump to set the stroke length to 100% and stop it.

4. Install a pump head to a pump body by tightening the hex. sock. cap bolts equally. Tightening torque is 2.55N•m.

4. Accessories

1. Connection port bore • Check valve • Back pressure valve

Pump type		Connection port bore	Check valve	Back pressure valve
EH-F35	VC	∅10×∅16 hose	CA-3VCH-C1	–
		JIS10K15A flange	–	BV-1NV-C10
		JIS10K15A elbow union	–	BV-1NV-C10
	V6	∅10×∅16 hose	CA-3VEH-C1	–
		JIS10K15A flange	–	BV-1NE-C10
		JIS10K15A elbow union	–	BV-1NE-C10
	PC	∅10×∅16 hose	CA-3VH-C1	–
EH-F45	VC	∅10×∅16 hose	CA-3VCH-C1	–
		JIS10K15A flange	–	BV-1NV-C10
		JIS10K15A elbow union	–	BV-1NV-C10
	V6	∅10×∅16 hose	CA-3VEH-C1	–
		JIS10K15A flange	–	BV-1NE-C10
		JIS10K15A elbow union	–	BV-1NE-C10
	PC	∅10×∅16 hose	CA-3VH-C1	–
EH-F55	VC	∅10×∅16 hose	–	BV-3NV-C1R
		JIS10K15A flange	–	BV-3NV-C10
		JIS10K15A elbow union	–	BV-3NV-C10
	V6	∅10×∅16 hose	–	BV-3NE-C1R
		JIS10K15A flange	–	BV-3NE-C10
		JIS10K15A elbow union	–	BV-3NE-C10
	PC	∅10×∅16 hose	–	BV-3NPV-C1R
EH-F70	VC	∅15×∅22 hose	–	BV-3NV-C3R
		JIS10K15A flange	–	BV-3NV-C10
		JIS10K15A elbow union	–	BV-3NV-C10
	V6	∅15×∅22 hose	–	BV-3NE-C3R
		JIS10K15A flange	–	BV-3NE-C10
		JIS10K15A elbow union	–	BV-3NE-C10
	PC	∅15×∅22 hose	–	BV-3NPV-C3R

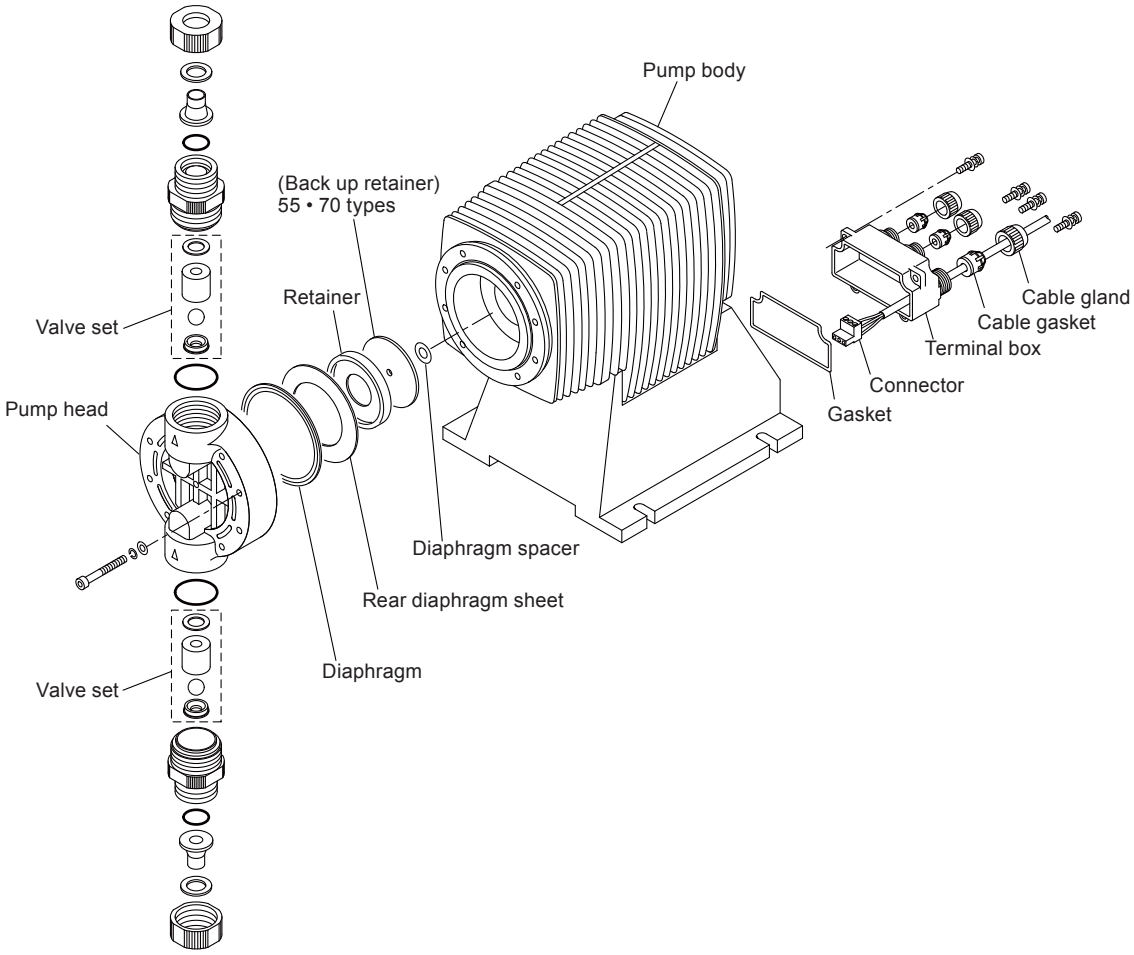
Note1. Check valves and back pressure valves on are standard accessories. The others are options.

2. Regarding the connection of the discharge side of back pressure valve....
R3/8 and R1/2 taper pipe thread is used for BV-□N□□-C□R and JIS 10K15A Flange is used for BV-□N□□-C10.

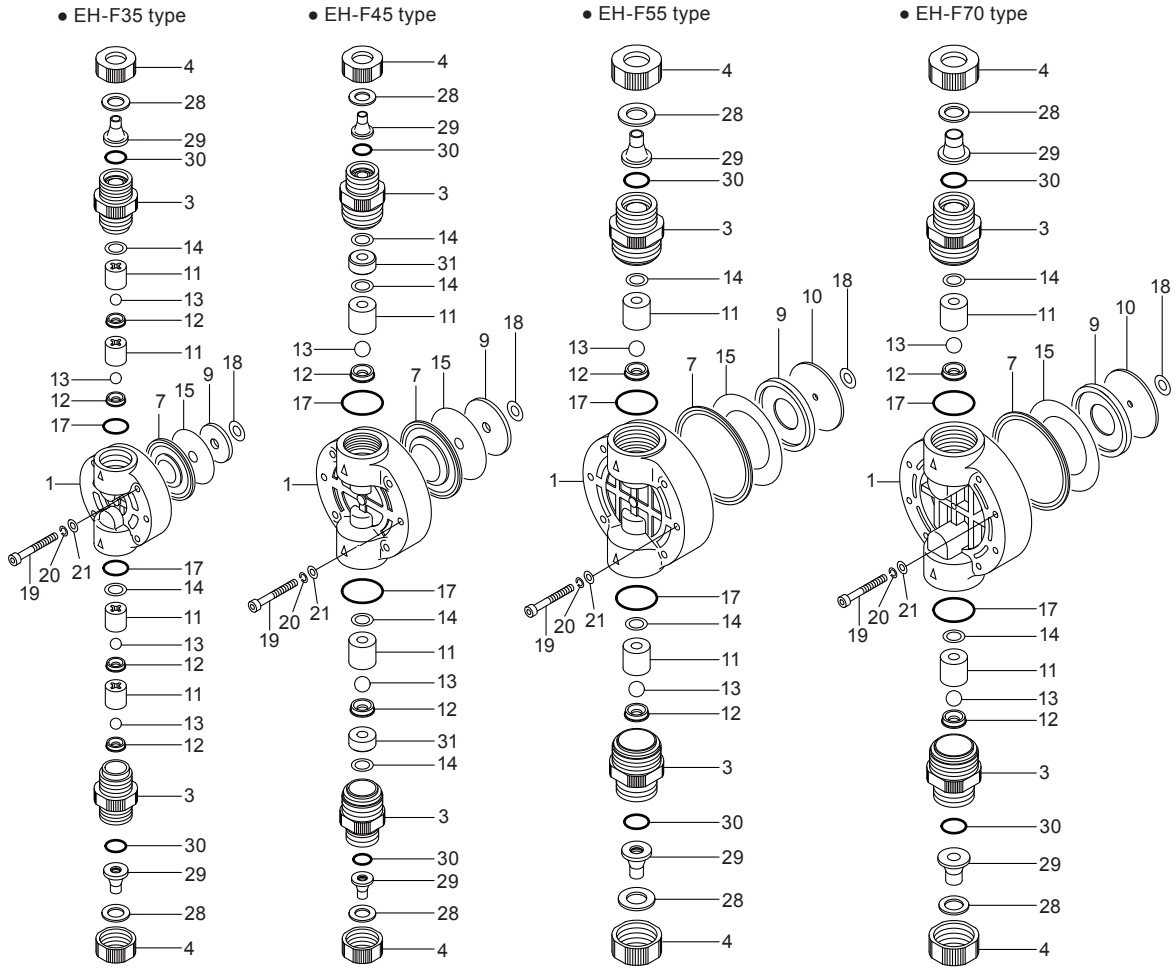
5. Exploded view

1. General view

● The extent of dismantlement is within the following exploded view.



2. Pump head (Hose connection type)

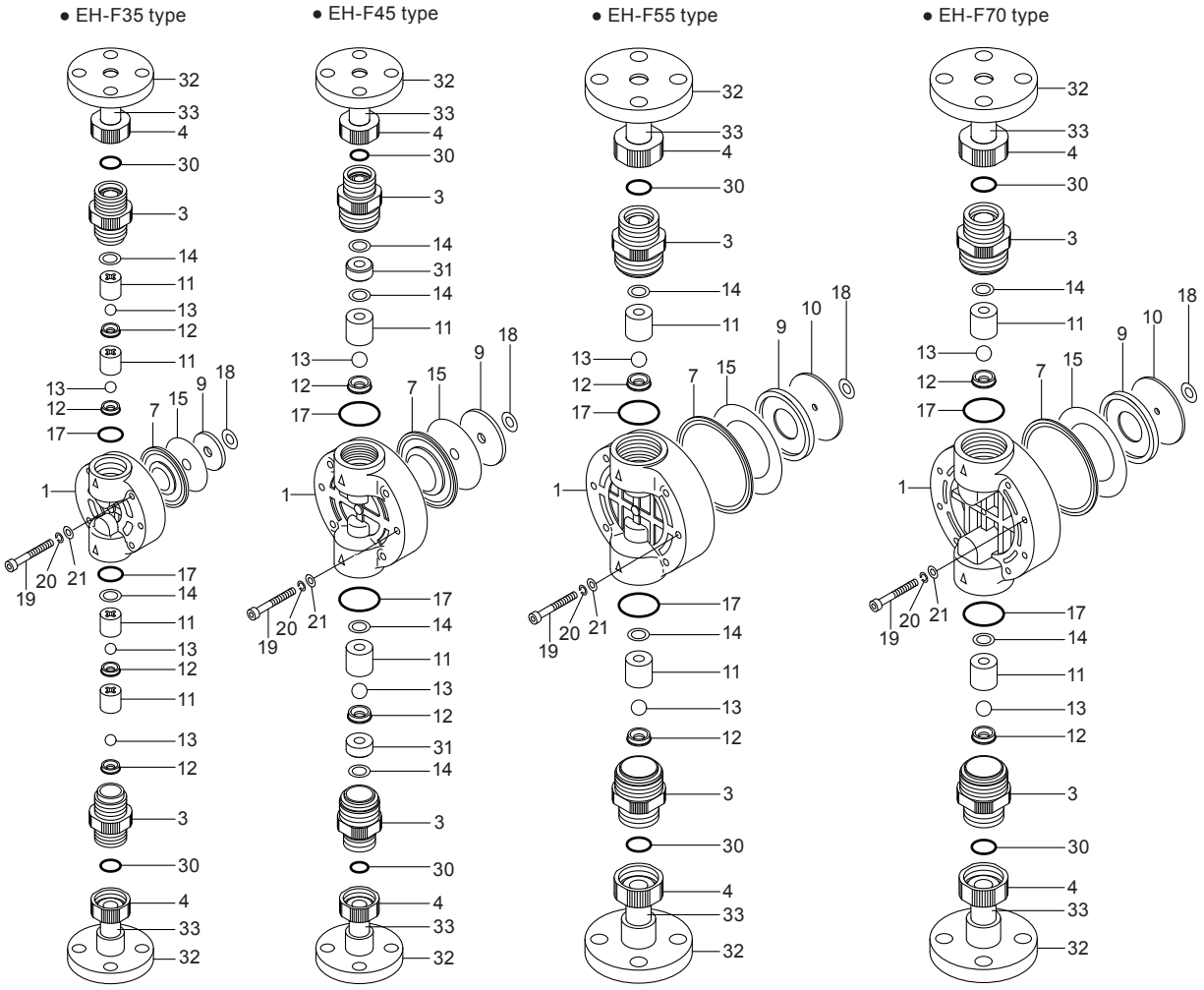


No.	Name	Q'ty
1	Pump head	1
3	Fitting	2
4	Fitting nut	2
7	Diaphragm	1
9	Retainer	1
10	Back up retainer	1 Note1
11	Valve guide	4 (2) Note2
12	Valve seat	4 (2) Note2
13	Valve	4 (2) Note2
14	Valve gasket	2 (4) Note5

No.	Name	Q'ty
15	Rear diaphragm seat	1
17	O ring	2
18	Diaphragm spacer	1 Note3
19	Hex. socket head bolt	6 (8) Note4
20	Spring washer	6 (8) Note4
21	Plain washer	6 (8) Note4
28	Hose stopper	2
29	Fitting spacer	2
30	O ring	2
31	Spacer	2 Note6

Note1: The back up retainer of No.10 is only for EH-F55 • 70 types.
Note2: The figure inside ( ) in the above table is for EH-F45 • 55 • 70 types.
Note3: The number of the diaphragm spacers (No.18) is not constant. None or a few spacers is inserted at each diaphragm.
Note4: The figure inside ( ) in the above table is for EH-F70.
Note5: EH-F35 • 55 • 70 (VC, V6, PC) types require 2 valve gaskets and EH-F45 (VC, V6, PC) types require 4 of them.
Note6: The spacer on No.31 is for EH-F45 type only.

3. Pump head (Flange connection type)

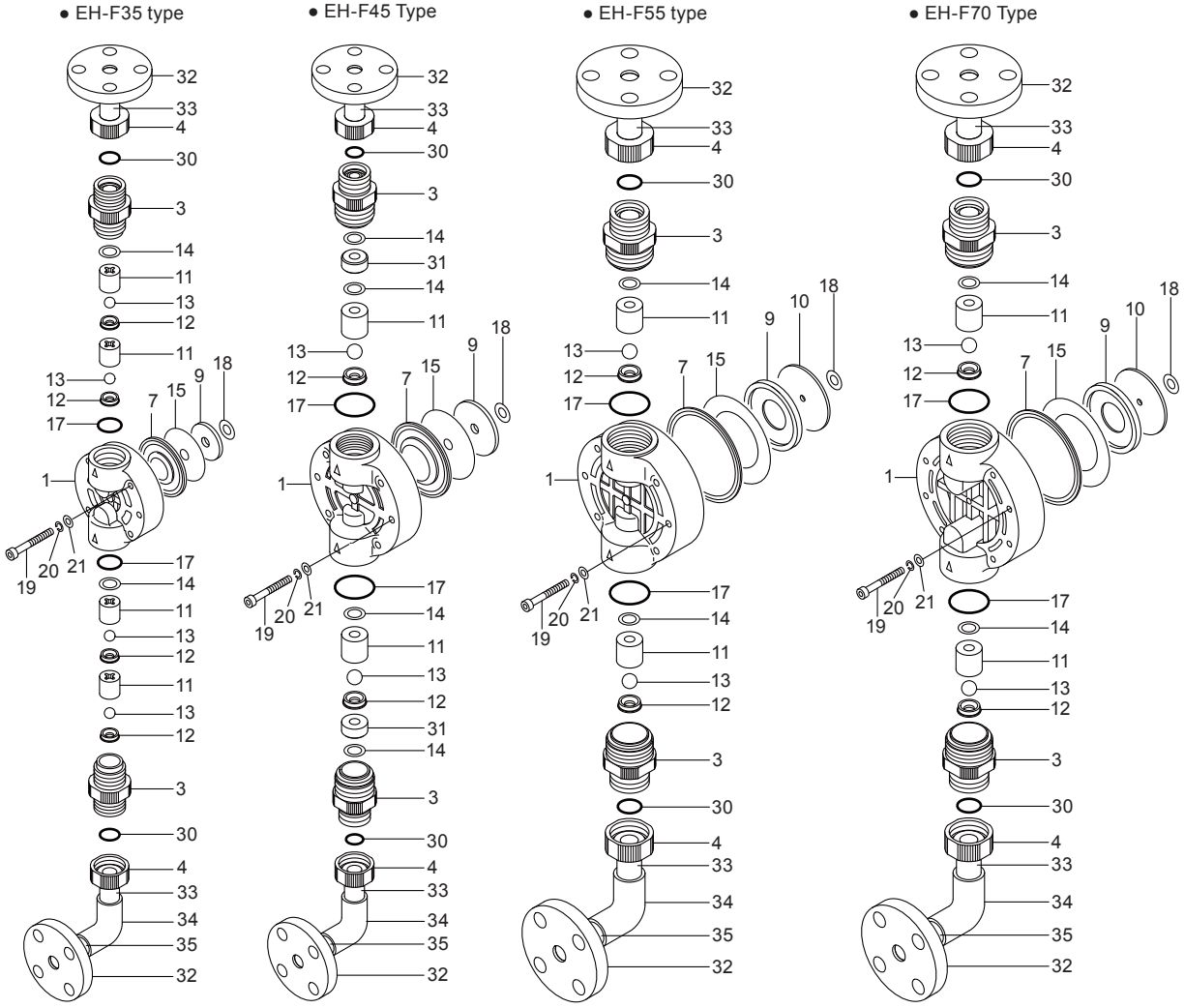


No.	Name	Q'ty
1	Pump head	1
3	Fitting	2
4	Fitting nut	2
7	Diaphragm	1
9	Retainer	1
10	Back up retainer	1 Note1
11	Valve guide	4(2)Note2
12	Valve seat	4(2)Note2
13	Valve	4(2)Note2
14	Valve gasket	2(4)Note5

No.	Name	Q'ty
15	Rear diaphragm seat	1
17	O ring	2
18	Diaphragm spacer	1 Note3
19	Hex. socket cap bolt	6(8)Note4
20	Spring washer	6(8)Note4
21	Plain washer	6(8)Note4
30	O ring	2
31	Spacer	2 Note6
32	Flange	2
33	Union	2

Note1: The back up retainer of No.10 is only for EH-F55 • 70 types.
Note2: The figure inside ( ) in the above table is for EH-F45 • 55 • 70 types.
Note3: The number of the diaphragm spacers (No.18) is not constant. None or a few spacers is inserted at each diaphragm.
Note4: The figure inside ( ) in the above table is for EH-F70.
Note5: EH-F35 • 55 • 70 (VC, V6) types require 2 valve gaskets and EH-F45 (VC, V6) types require 4 of them.
Note6: The spacer on No.31 is for EH-F45 type only.

4. Pump head (Flange connection horizontal suction port type)

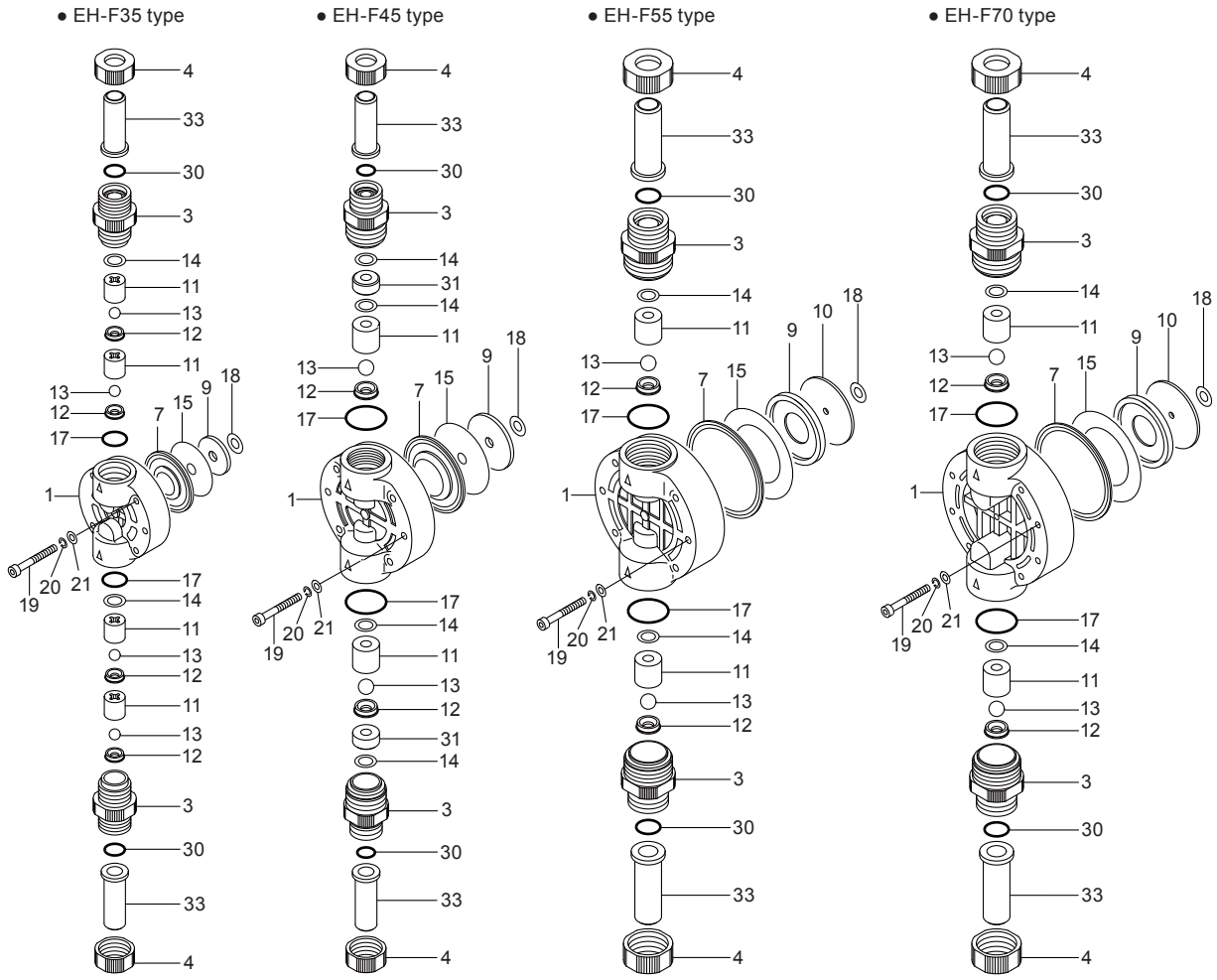


No.	Name	Q'ty
1	Pump head	1
3	Fitting	2
4	Fitting nut	2
7	Diaphragm	1
9	Retainer	1
10	Back up retainer	1 Note1
11	Valve guide	4 (2) Note2
12	Valve seat	4 (2) Note2
13	Valve	4 (2) Note2
14	Valve gasket	2 (4) Note5
15	Rear diaphragm sheet	1

No.	Name	Q'ty
17	O ring	2
18	Diaphragm spacer	1 Note3
19	Hex. socket cap bolt	6 (8) Note4
20	Spring washer	4 (2) Note2
21	Plain washer	4 (2) Note2
30	O ring	2
31	Spacer	2 Note6
32	Flange	2
33	Union	2
34	Elbow	1
35	Pipe	1

Note1: The back up retainer of No.10 is only for EH-F55 • 70 types.
Note2: The figure inside ( ) in the above table is for EH-F45 • 55 • 70 types.
Note3: The number of the diaphragm spacers (No.18) is not constant. None or a few spacers is inserted at each diaphragm.
Note4: The figure inside ( ) in the above table is for EH-F70.
Note5: EH-F35 • 55 • 70 (VC, V6) types require 2 valve gaskets and EH-F45 (VC, V6) types require 4 of them.
Note6: The spacer on No.31 is for EH-F45 type only.

5. Pump head (Union connection type)



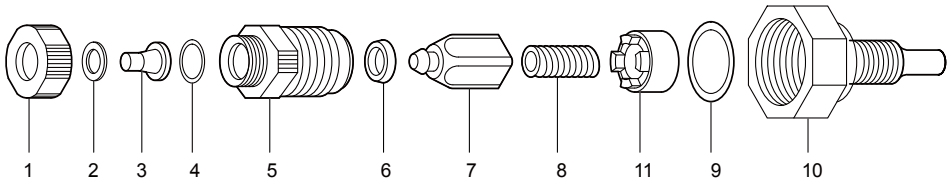
No.	Name	Q'ty
1	Pump head	1
3	Fitting	2
4	Fitting nut	2
7	Diaphragm	1
9	Retainer	1
10	Back up retainer	1 Note1
11	Valve guide	4 (2) Note2
12	Valve seat	4 (2) Note2
13	Valve	4 (2) Note2
14	Valve gasket	2 (4) Note5

No.	Name	Q'ty
15	Rear diaphragm sheet	1
17	O ring	2
18	Diaphragm spacer	1 Note3
19	Hex. socket cap bolt	6 (8) Note4
20	Spring washer	6 (8) Note4
21	Plain washer	6 (8) Note4
30	O ring	2
31	Spacer	2 Note6
33	Union	2

Note1: The back up retainer of No.10 is only for EH-F55 • 70 types.
Note2: The figure inside ( ) in the above table is for EH-F45 • 55 • 70 types.
Note3: The number of the diaphragm spacers (No.18) is not constant. None or a few spacers is inserted at each diaphragm.
Note4: the figure inside ( ) in the above table is for EH-F70.
Note5: EH-F35 • 55 • 70 (VC, V6) types require 2 valve gaskets and EH-F45 (VC, V6) types require 4 of them.
Note6: The spacer on No.31 is for EH-F45 type only.

6.Check valve

- CA-3 type

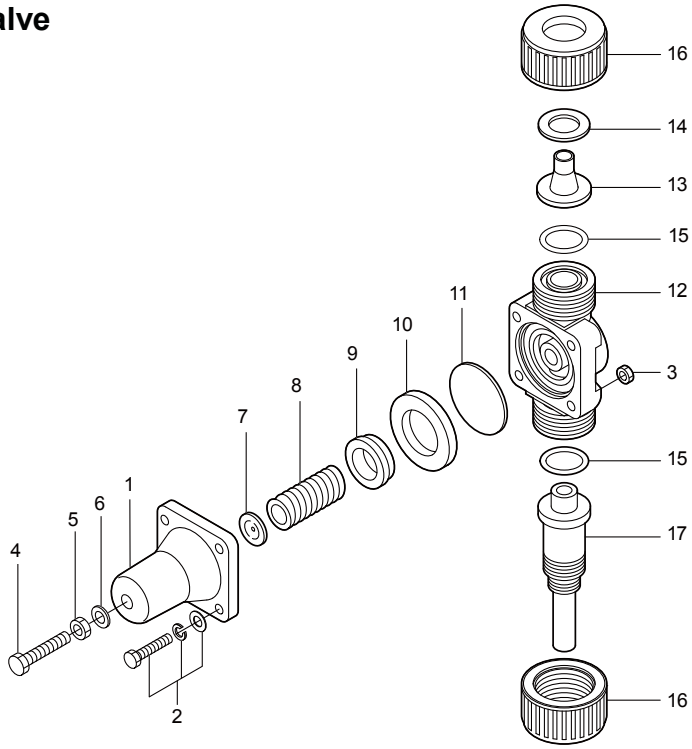


No.	Name	Q'ty
1	Fitting nut	1
2	Hose stopper	1
3	Fitting spacer	1
4	O ring	1
5	Valve case	1
6	Gasket	1

No.	Name	Q'ty
7	Poppet valve	1
8	Spring	1
9	O ring	1
10	Valve fitting	1
11	Spacer	1

7. Back pressure valve

- BV-3N-R type



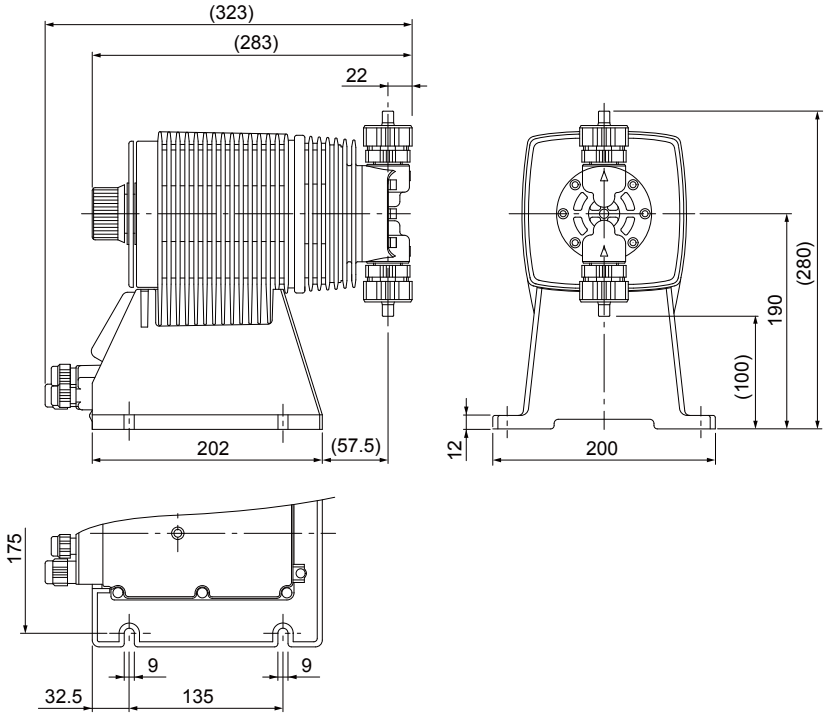
No.	Name	Q'ty
1	Upper case	1
2	Hex.head bolt (with PW, SW)	4
3	Hex. nut	4
4	Adjusting bolt	1
5	Hex.nut	1
6	Plain washer	1
7	Spring seat	1
8	Spring	1
9	Retainer plate	1

No.	Name	Q'ty
10	Stopper	1
11	Diaphragm	1
12	Lower case	1
13	Fitting spacer / Hose port	1
14	Hose stopper / Ferrule	1
15	O ring	2
16	Nut	2
17	Fitting	1

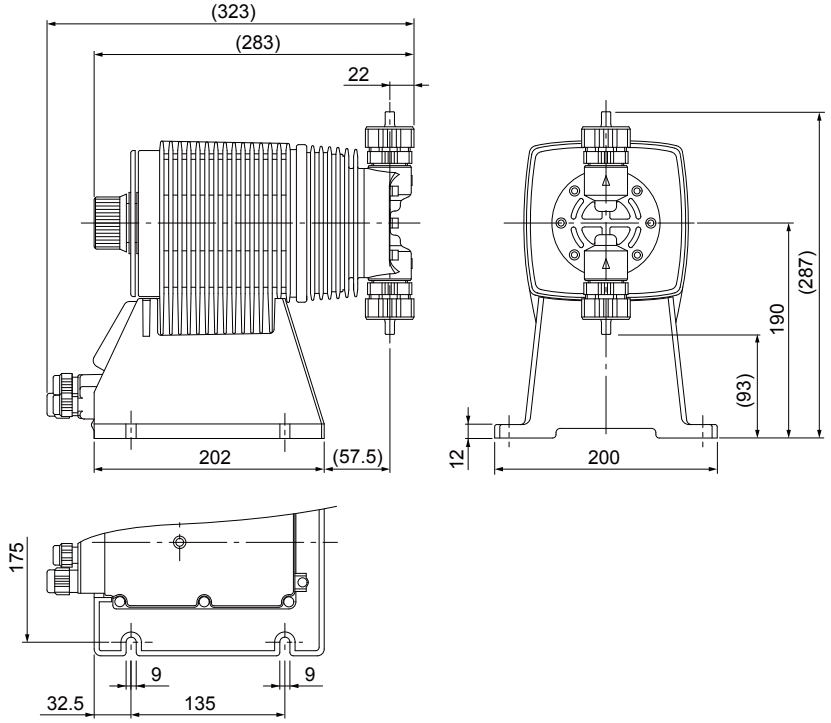
6. Outer dimension

1. Outer dimension (Hose connection type)

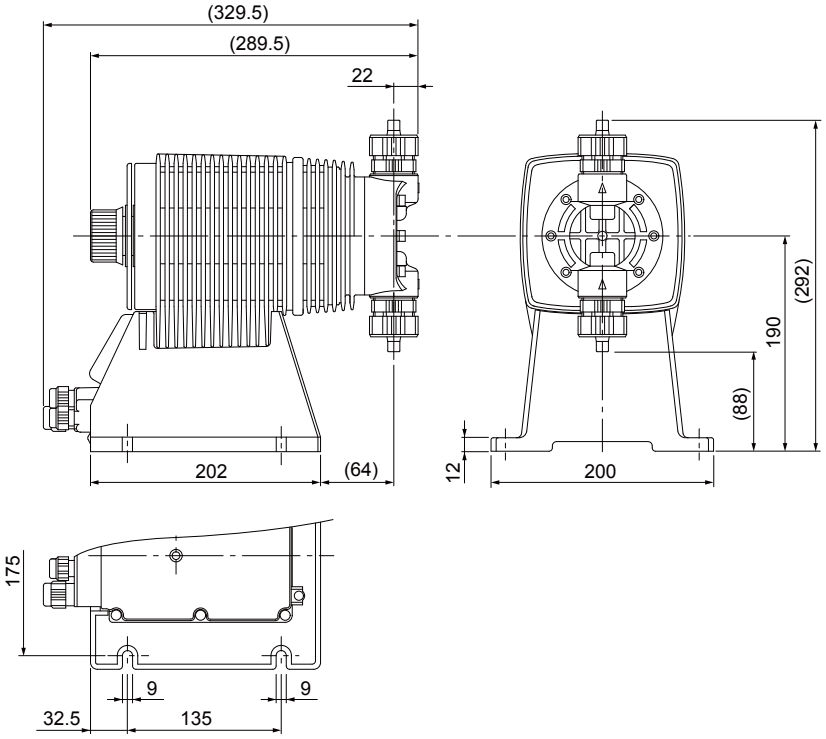
- EH-F35 type



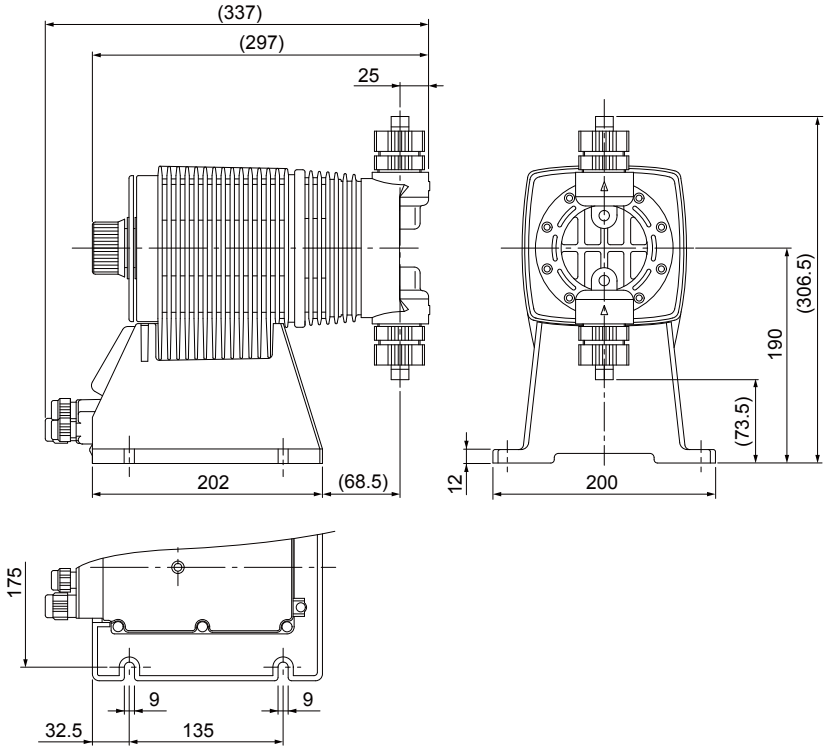
- EH-F45 type



- EH-F55 type

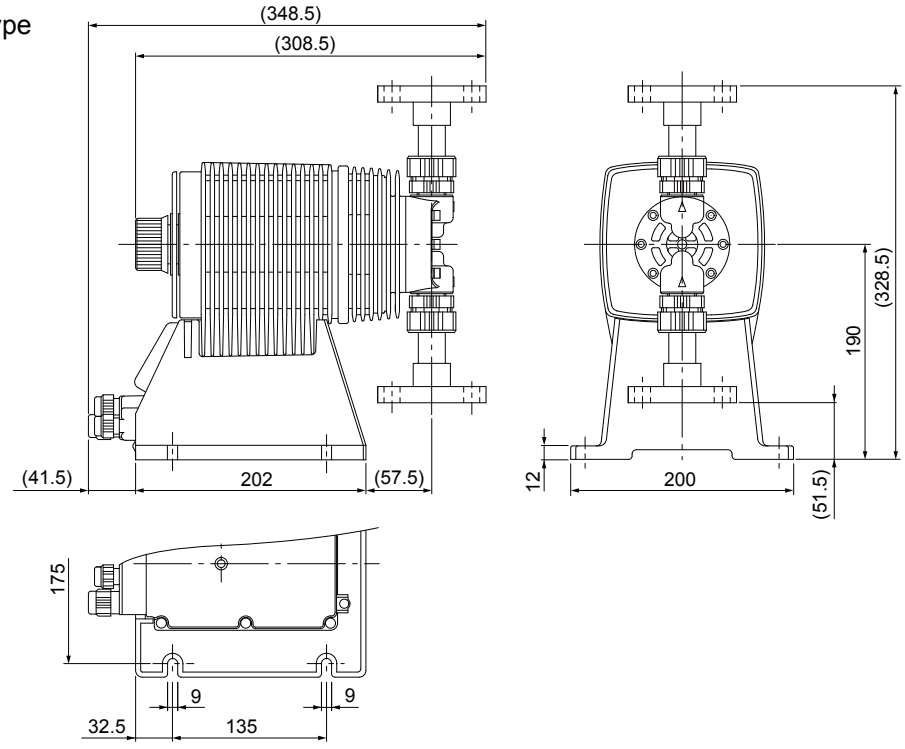


- EH-F70 type

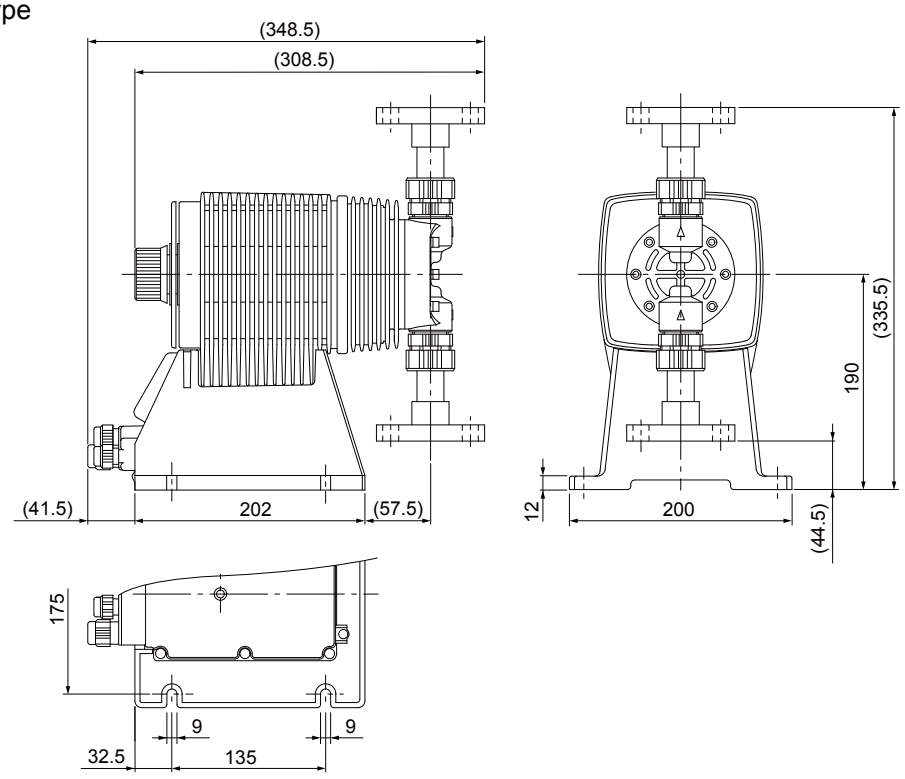


2. Outer dimension (Flange connection type)

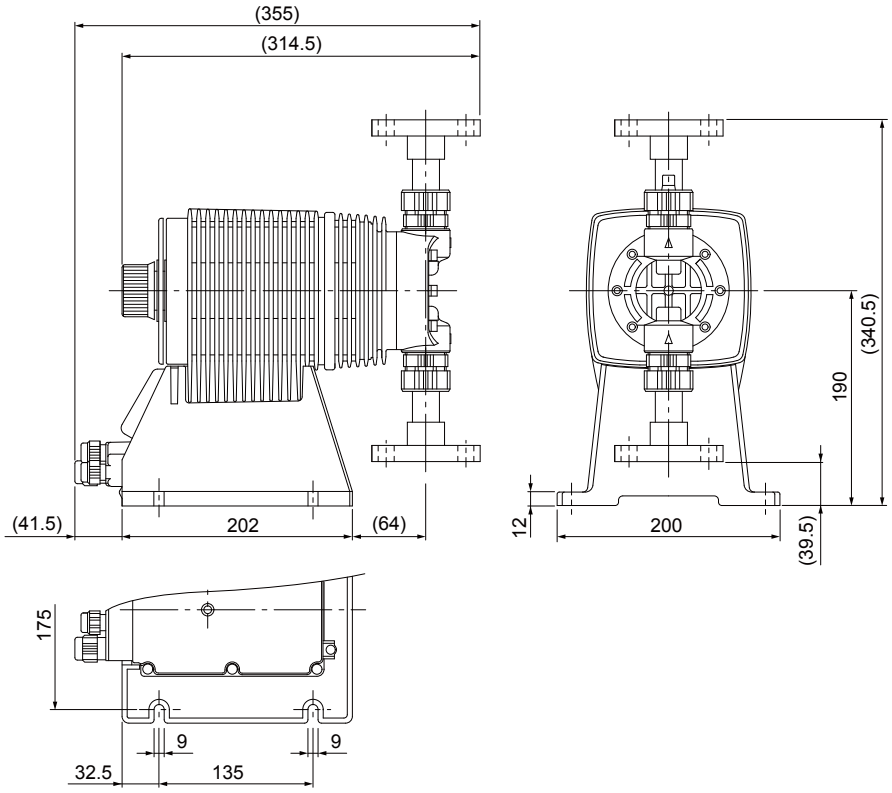
- EH-F35 type



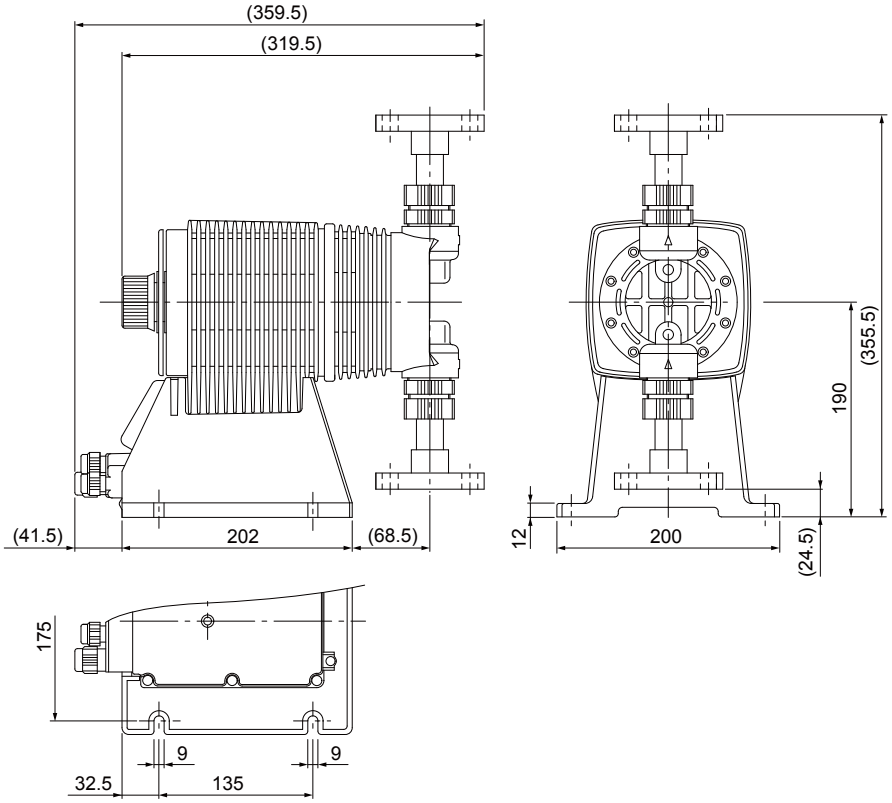
- EH-F45 type



- EH-F55 type

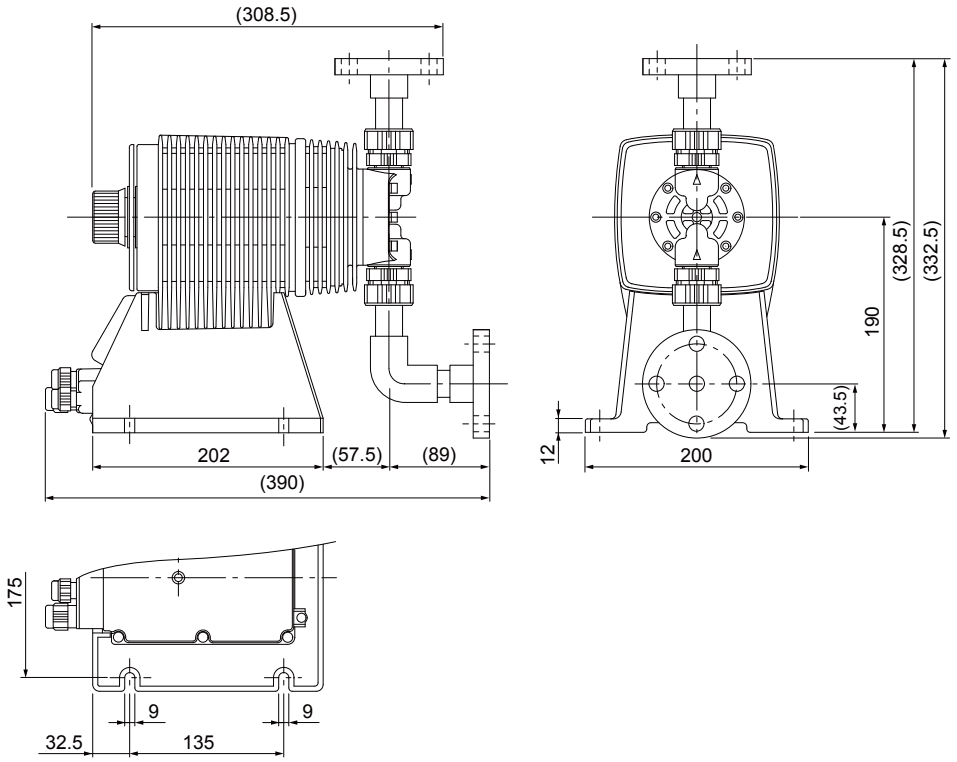


- EH-F70 type

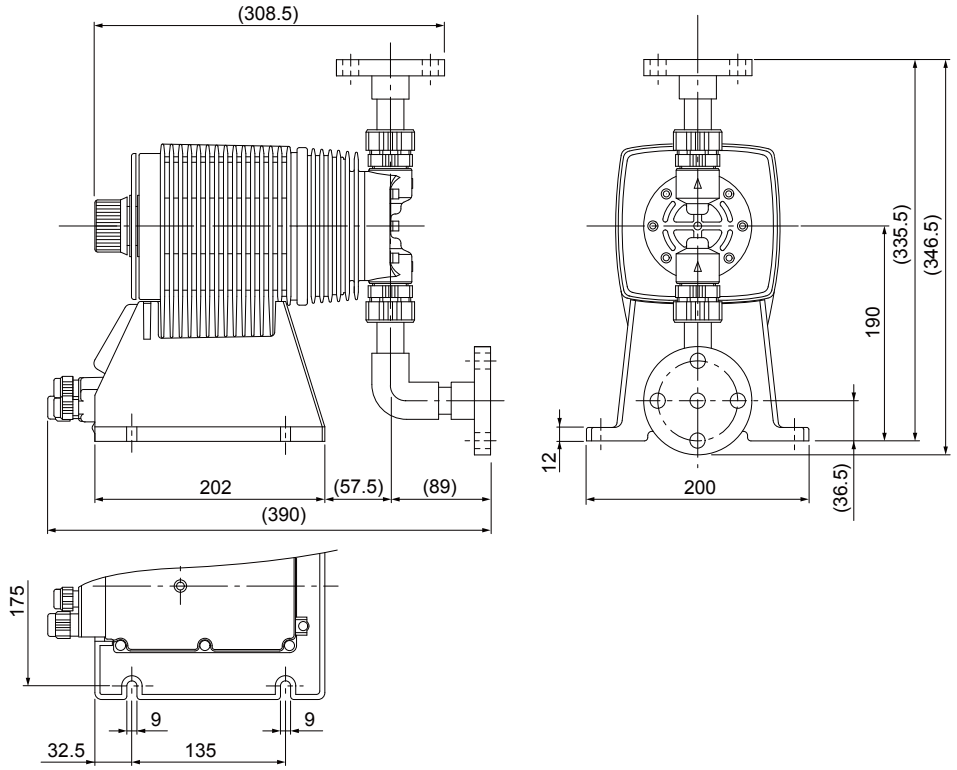


3. Outer dimension (Flange connection horizontal suction port type)

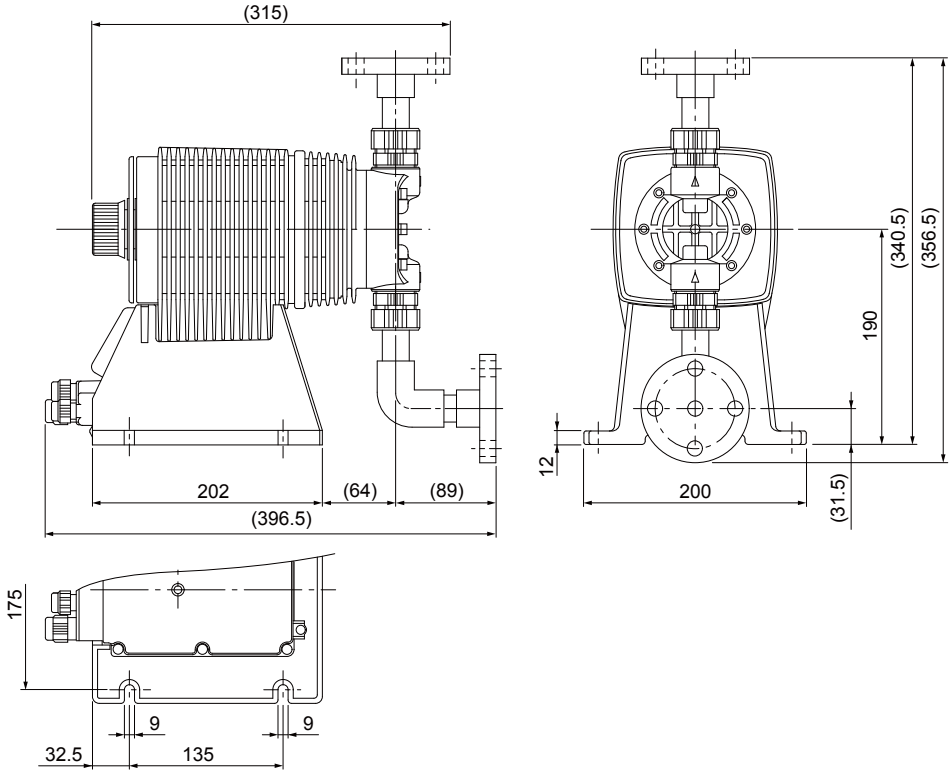
- EH-F35 type



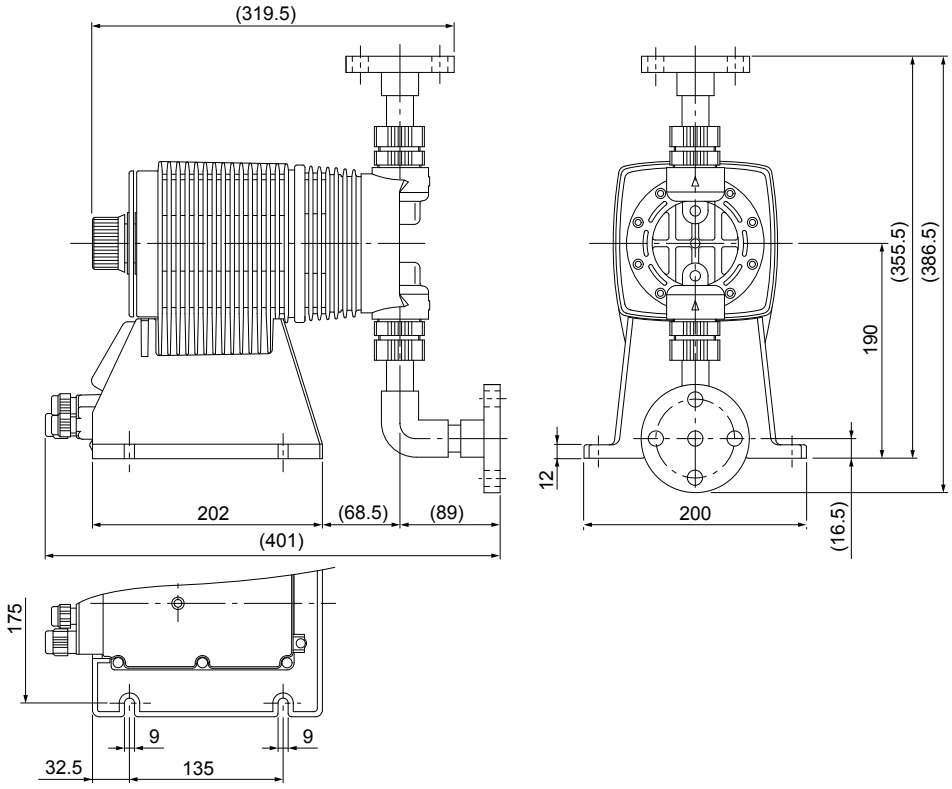
- EH-F45 type



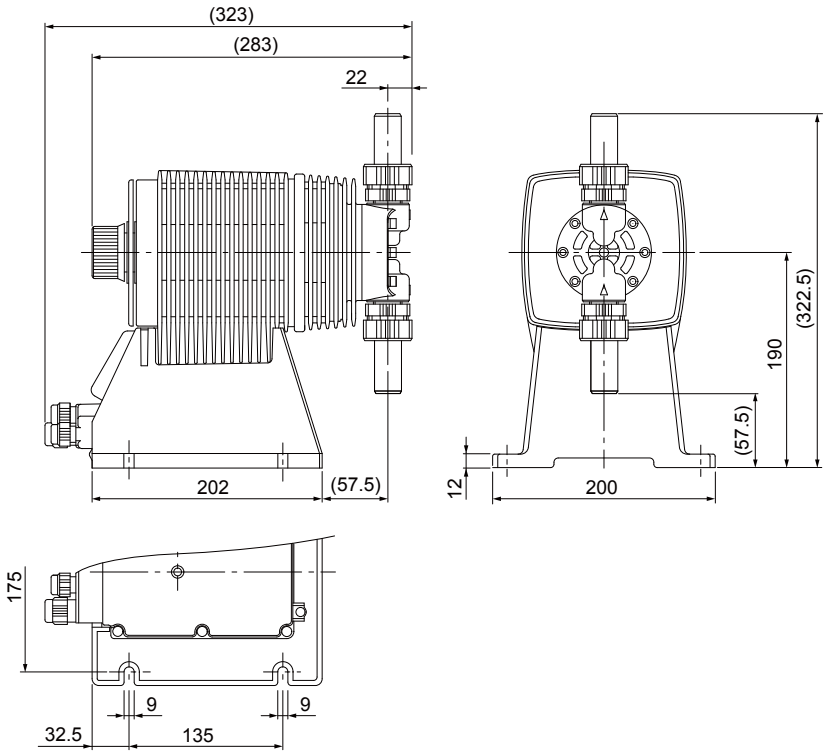
- EH-F55 type



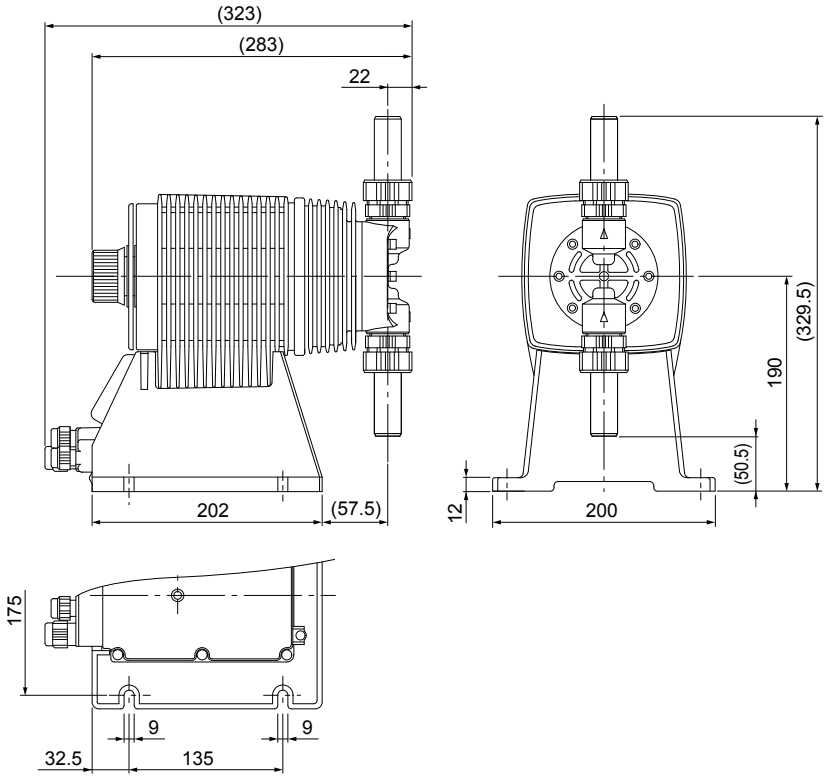
- EH-F70 Type



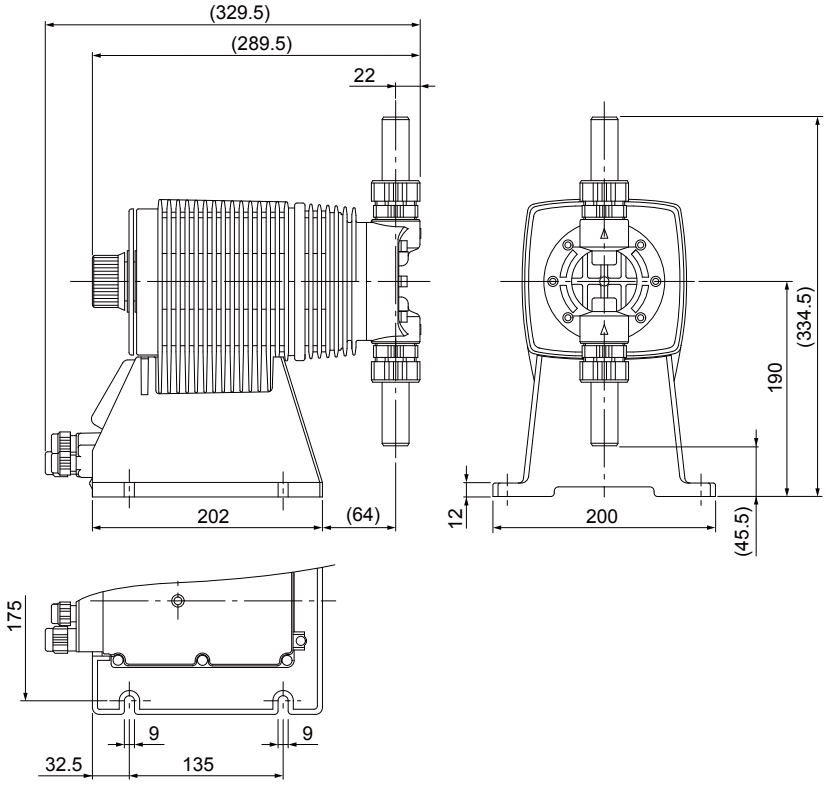
- EH-F35 type



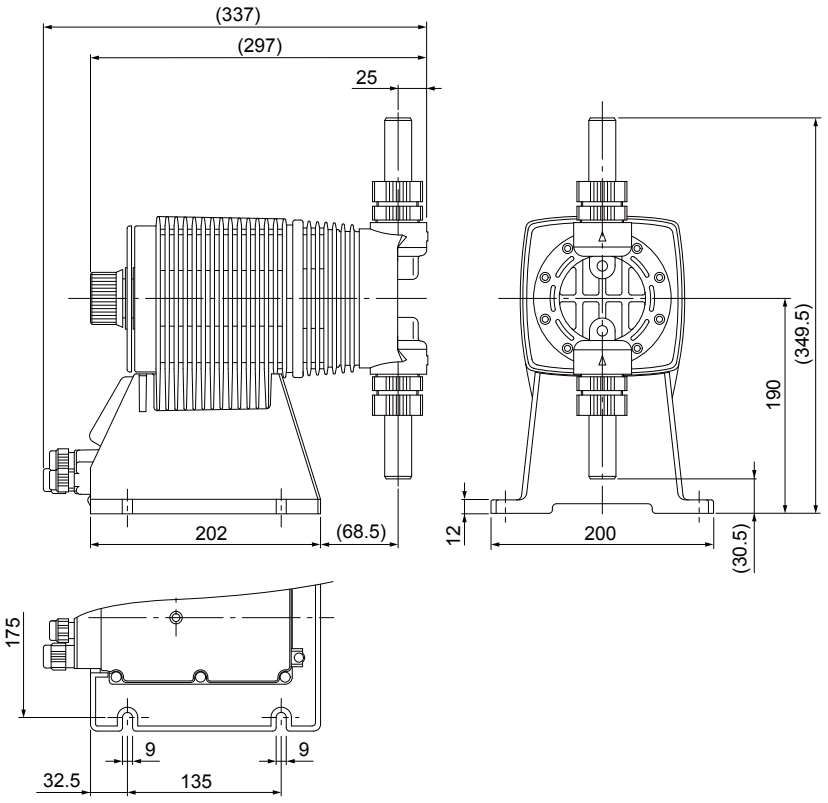
- EH-F45 Type



- EH-F55 type



- EH-F70 Type



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