

Compact solenoid type diaphragm pump, which dispenses stable and repeatable volumes of liquid measuring 5  $\mu$ L or more per shot.

Adjustment of dispense volume is possible.

**Dispense volume:** 

5 to 50  $\mu$ L per shot 50 to 100  $\mu$ L per shot **100 to 200 µL per shot** 

### Stable dispense volume

Repeatability: ±1%\*1,\*2 \*1 ±2% at 5 to 15 μL\*2 \*2 Under SMC's measurement conditions

### Shut-off function

Self-contained system does not need any priming.

SSNC WAR IN E **Body Ported** SSMC THE H (Threaded ports) LSP1 1 Series

PIII-SAI

SSMC MOLIN E

66

**Body Ported** (Tube connection type) LSP1 1 Series

P111-544

Base Mounted LSP1 2 Series

12-54

### Variations

				Disponso volumo	Disponso volumo		
	Connection		per shot Body		Diaphragm, Check valve	Fluid*1	
		Body Ported	M5 thread M6 thread 1/4-28UNF thread Tube connection type	· 5 to 50 μL · 50 to 100 μL	PEEK PP	EPDM FKM	Water DI water (Pure water) Diluent
		Base Mounted		· 100 to 200 μL			Cleaning fluid

\*1 These fluids should not corrode or permeate into the fluid contact materials.

# **LSP** Series



### **Application Examples**





### Specifications

Model		del	LSP111/112	LSP121/122	LSP131/132		
Dispense volume adjustable range*1			5 to 50 μL	50 to 100 μL	100 to 200 μL		
Fluid*4			Water, DI water (Pure water), Diluent, or Cleaning fluid				
Fluid**			(These fluids should not corrode or permeate into the fluid contact materials.)				
	E	Body	PEEK, PP				
material		)iaphragm	EPDM, FKM				
material	C   C	check valve		EPDM, FKM			
Repeatabil	ity*1		±1% (±2% at 5	5 to 15 μL) * Under SMC's measurem	nent conditions		
Dispense pressure*2		e* <sup>2</sup>		10 kPa			
Suction	0	Dry		15 kPa			
pressure*2	2 V	Vet		35 kPa			
Max. operating frequency*3		equency*3	2 Hz (Minimum ON time 200 ms/Minimum OFF time 300 ms)				
Fluid temp	erature		10 to 50°C (No freezing)				
Ambient te	emperat	ure	10 to 50°C (No freezing)				
Mounting of	orientat	ion	Unrestricted*5				
Enclosure			Equivalent to IP40				
	Body	Threaded ports	90 g				
Weight	ported	Tube connection type	85 g				
	Base mounted		85 g				
Rated volta	age		12 VDC, 24 VDC				
Allowable voltage fluctuation			±10% of the rated voltage*6				
Type of coil insulation			Class B				
Lead wire			AWG20 (Outside diameter of insulator: 1.79 mm)				
Power consumption			4 W 9 W 17 W				
Operation noise			60 dB or less *7				

\*1 The values above are at room temperature with clear water at zero pressure. The dispense volume and repeatability will vary depending on the piping conditions (height, diameter, length, etc.), of the INLET and OUTLET sides, fluids, and the ambient and fluid temperatures, etc. For stable dispensing, use the product under stable operating conditions where pressure is not applied to the INLET and OUTLET side as much as possible.

Do not apply excessive torque when rotating the dispensing volume adjusting screw. If the screw is tightened too much, it may lead to product failure or cause the screw to shear. For details on repeatability, refer to page 6 "Design / Selection, 5. Repeatability."

<Variation in SMC measurement conditions> \* Refer to page 7 "Piping, Caution 1." for the installation position of the pump.
Ambient/Fluid temperatures: ±2°C, IN/OUT side piping pressure: ±0.1 kPa or less, Applied voltage: ±0.01 V
The value is measured when the max. dispense volume of clear water at room temperature is adjusted. This value will vary depending on the dispense volume and \*2 fluid conditions

High-speed operation affects the dispense volume and accuracy. The max. operation frequency is decreased by the fluid characteristics (large viscosity) and the piping condition (large piping resistance). When the pump is used continuously for extended periods of time, make the OFF time appropriately longer with the minimum ON time of 200 ms to set the operating frequency to 1 Hz or less. Since the coil temperature may rise due to ambient temperature and energizing time, \*3 so make the OFF time appropriately longer.

Select an appropriate fluid contact material when fluid such as cleaning liquid is used. Also, check the fluid compatibility in advance. Some fluids may have an influence on the dispense volume and repeatability. After mounting is complete, perform appropriate functional inspections. This product is not designed to be explosion proof, so it is not suitable for flammable fluids.

For stable dispension, we recommend that the coil is mounted vertically facing downward or OUTLET side facing upward so that air bubbles are removed easily. Also, dispense liquids by operating the product continuously to remove any air bubbles in the piping and pump chamber. It is recommended to degasify the fluid \*5 before use.

\*6 When response time is prioritized, or dispensing is difficult due to high fluid viscosity or high piping resistance, control the voltage so that there is no fluctuation below the rated voltage

\*7 The value above is under SMC's measurement conditions, and will vary depending on the conditions.

#### Construction



**Component Parts** 

Plate

Body

Buffer

Housing

Solenoid

Cap

O-ring

Check valve

Diaphragm

Return spring

Description

Dispensing volume adjusting screw

Material

PEEK, PP

PEEK, PP

EPDM, FKM

EPDM, FKM

NBR

Stainless steel

PPS

Stainless steel

EPDM

EPDM, FKM

No.

1

2

3

4

5

6

7

8

9

10

11

#### Working Principle

When the pump turns ON (energized), the diaphragm will perform a stroke to the solenoid side. This condition makes the pressure in the pump chamber negative and the check valve on the OUT side is closed. Fluid passed through the suction port then the check valve on the IN side is sucked in the pump chamber.

When the pump turns OFF (de-energized), the diaphragm will perform a stroke to the body side with return force of the return spring. Due to this, the check valve on the IN side is closed, and fluid in the pump chamber is passed through the check valve on the OUT side and is dispensed from the outlet.

Suction and dispensing are repeated with repetitive ON/OFF operation.

#### Dispense Volume Adjustment

The dispense volume per shot can be changed by rotating the dispensing volume adjusting screw. When rotating the dispensing volume adjusting screw clockwise, the dispense volume decreases. When rotating it counterclockwise, the dispense volume increases.

**Step 1** Remove the cap and loosen the lock nut while holding the dispensing volume adjusting screw with a flat blade screwdriver to prevent it from rotating. (Counterclockwise)

- **Step 2** Rotate the dispensing volume adjusting screw to adjust the dispense volume. Refer to the drawing on the right and the table below as reference for the range of the dispensing volume adjusting screw.
  - \* Do not apply excessive torque when rotating the dispensing volume adjusting screw. If the screw is tightened too much, it may lead to product failure or cause the screw to shear. Adjust the dispense volume gradually to avoid breakage of the inner parts due to tightening the adjusting screw too much.
  - \* When the dispensing volume adjusting screw is close to the maximum adjustment level, the noise may be loud. In this case, turn the screw clockwise until the noise is reduced.

	LSP11	LSP12	LSP13	
Upper limit of the adjustment (fully open)	Approx. 3 mm			
Adjustment range (Clockwise)	1.5 turns	2 turns	2.5 turns	

Step 3 Tighten the lock nut while holding the dispensing volume adjusting screw with a flat blade screwdriver to prevent it from rotating. (Clockwise)

∗ Lock nut tightening torque: 0.6 to 0.8 N·m

\* Ensure that the lock nut is secured after adjusting the dispense volume.

#### Counterclockwise Clockwise (Decrease (Increase dispense dispense volume) volume) Lock nut Dispensing volume adjusting screw Maximum adjustment level (Approx. 3 mm) Rubber cap Lock nut Dispensing volume adjusting screw Solenoid

### Dimensions



## Liquid Dispense Pump (Solenoid Type) LSP Series



## **LSP** Series Specific Product Precautions 1

Be sure to read this before handling the products. Refer to the back cover for safety instructions. For temperature control equipment precautions, refer to the "Handling Precautions for SMC Products" and the "Operation Manual" on SMC website: https://www.smcworld.com

#### **Design / Selection**

## **Marning**

- 1. Do not use this product in applications which may adversely affect human life (e.g. medical equipment connected to the human body for drip infusion).
- 2. Confirm the specifications.

Give careful consideration to the operating conditions such as the application, fluid and environment, and use within the operating ranges specified in this catalog.

- 3. Do not apply pressure to the pump. If the pump operates with pressure applied, the repeatability may decrease or liquid may leak to the OUT side when the pump is off.
  - \* Refer to page 7 "Piping, Caution 1." for the installation position of the pump.
- 4. For stable dispensing, please use the product under stable operating conditions (suction height, ambient temperature, fluid temperature). If air bubbles are present in the fluid and the piping material is soft, it may influence on the repeatability of the dispense volume. Install the pump vertically facing downward so that air bubbles in the pump are removed easily. It is recommended to degasify the fluid and use hard material for piping.

When the piping diameter of the fluid outlet is large, repeatability may be influenced by surface tension, so it is recommended to use proper piping diameter with the installation of a nozzle.

#### 5. Repeatability

Measure the amount of clear water which is dispensed 10 times continuously and convert it to one shot of dispensed volume. Repeat this measurement 10 times, and indicate the difference (%) between the average value of 10 sets of data (converted value of one shot) and the maximum and minimum values. These values are calculated based on SMC measurement conditions, so the repeatability accuracy is not guaranteed.

<Variation in SMC measurement conditions> \* Tank liquid level must be lower than the pump and the OUT side tube end must be higher than the tank liquid level. Remove any air bubbles in the piping and pump chamber.

Ambient/Fluid temperatures:  $\pm 2^{\circ}$ C, IN/OUT side piping pressure:  $\pm 0.1$  kPa or less, Applied voltage:  $\pm 0.01$  V

#### 6. Fluid

Be sure to confirm the compatibility between the component material and the fluid. Since the compatibility of the fluid used may vary depending on its type, additives, concentration, temperature, etc., give sufficient consideration when selecting the material.

If the fluid contains foreign matter, it may be caught in the seat or cause wear on the inside of the pump, causing problems.

Install an appropriate filter (strainer) before the pump. As a guide, the appropriate filtration is approximately 50  $\mu m$ 

When transferring a coagulable liquid, take measures to prevent it from coagulating in the pump.

This product is not designed to be explosion proof, so it is not suitable for flammable fluids.

7. Dispense volume will vary depending on the fluid and piping conditions.

After mounting is complete, perform appropriate functional inspections.

## **Warning**

#### 8. Maintenance space

The installation should allow sufficient space for maintenance activities.

#### 9. Ambient environment

Use within the allowable ambient temperature range. Be sure that the liquid or corrosive gas does not touch the external surface of the product.

Specifically, do not expose the solenoid to fluid. This may cause short circuit. When touching the wet solenoid, an electric shock may occur.

#### 10. Countermeasures against static electricity

Take measures to prevent static electricity since some fluids can cause static electricity.

#### 11. Energizing for extended periods of time

If the pump is continuously energized for long periods of time, temperature rise due to heat generation of the coil may result in reduced performance and shorter service life or adversely affect the peripheral device. Therefore, if the pump is energized for long periods, take measures to cool the pump by mounting a fan to keep the surface temperature at 50°C or less. When the pump is mounted into a control panel, take measures to cool the pump and keep the operating temperature within the specified range.

- 12. If the product has not been used for long periods of time, perform a trial run before use. If the product is to remain inactive for long periods of time, remove the fluid from the pump.
- 13. Do not touch the pump directly with hands. The coil can be hot depending on the ambient temperature or energizing time. Install a protective cover over the valve if it can be touched directly with hands.

#### 14. Leakage voltage

Voltages caused by leakage current may lead to pump malfunction.

Leakage voltage: 2% or less of the rated voltage

#### Mounting

## **∧** Warning

- **1. If equipment does not operate properly, stop operation.** After mounting is completed, confirm that it has been done correctly by performing a suitable function test.
- 2. For stable dispensing, mount the coil vertically facing downward so that bubbles in the pump are removed easily.

After releasing air bubbles, mounting orientation is not specified.

- 3. Do not use this product in a location where it will be subject to vibration or impact. The dispense volume may become unstable in the presence of vibration at the pump or piping.
- 4. Do not apply external force to the coil section.
- 5. Install and operate the product only after reading the operation manual carefully and understanding its contents.

## **A** LSP Series Specific Product Precautions 2

Be sure to read this before handling the products. Refer to the back cover for safety instructions. For temperature control equipment precautions, refer to the "Handling Precautions for SMC Products" and the "Operation Manual" on SMC website: https://www.smcworld.com

#### Piping

## Caution

1. Do not apply pressure to the pump. If the pump operates with pressure applied, the repeatability may decrease or liquid may leak to the OUT side when the pump is off. Tank liquid level must be lower than the pump and the OUT side tube end must be higher than the tank liquid level. Remove any air bubbles in the piping and pump chamber.



## 2. Make sure to remove any air bubbles in the piping and pump chamber before use.

#### 3. Preparation before piping

Before piping is connected, it should be thoroughly blown out with air (flushing) or washed to remove chips, cutting oil and other debris from inside the pipe.

## 4. Always tighten threads with the proper tightening torque.

When piping the fitting to the body ported (threaded ports), the installation method and tightening torque value may vary depending on the seal structure (shape) or material of the fitting to be used. Check the methods and precautions recommended by the fitting manufacturer to be used, and be sure to check for leakage. It is customer's responsibility to verify the compatibility of the fitting and operating liquid.

The table below indicates the reference value when KQ2 series is used for water.

	Model	Thread size	Tightening method	Tightening torque [N·m] (Reference)
	LSP1⊡1-⊡A(B)1	ME	After tightening by hand, tighten 1/6 to 1/4 turn with a tightening tool.	0.5 to 0.7
Body ported	LSP1⊡1-⊡C(D)1	NI5		0.3 to 0.35
ports)	LSP1□1-□A(B)2(3)	M6 1/4- 28UNF	After tightening by hand,	0.6 to 0.8
	LSP1□1-□C(D)2(3)		with a tightening tool.	0.4 to 0.45

When mounting the pump, tighten it with the proper tightening torque shown below. For base mounted, tighten the screw surely to the correct torque in the table below after confirming that the O-ring is mounted on the interface properly.

Model			Proper tightening torque [N·m]
Body ported (Tube connection	LSP1□1–□A(B)4 LSP1□2–□A(B)	MO	0.15 to 0.2
mounted, Body mounting	LSP1□1–□C(D)4 LSP1□2–□C(D)	IVIZ	0.1 to 0.15
Body ported	LSP1□1-□A(B)1(2, 3)	M3	0.4 to 0.6
Body mounting	LSP1□1-□C(D)1(2, 3)	IVIO	0.2 to 0.25

5. Mount the pump on the horizontal surface.

Applicable model: All models

6. Remove dust from the pump mounting surface completely.

The surface roughness of the mounting surface should be Rz3.2 or less.

Applicable model: Base mounted

7. When connecting tubing to the tube connection type, please make sure inserting it straight to the end of the tube inlet.

If external force of 10 N or more is applied to tube inlet, the inlet may become damaged, and leakage or breakage could occur.

Select appropriate tubing while referring to the table below.

Model	Tube inside diameter (I.D.)	Tubing outside diameter (O.D.) (after mounting)		
LSP101-004	ø2 or less	ø5.8 or less		

The holding force varies by the tubing material. Be sure to confirm the holding force of each material before operation. After connecting the tubing, please do not apply load such as tensile force, compression, or bending force.

- 8. When the tubing is long or according to the operating conditions, tubing may thrash about, causing damage to the tube inlet of the pump, or the tubing to come off or deteriorate. In this case, secure the tubing to prevent its uncontrolled movement.
- 9. If the removed tubing is to be used again, cut off the section of the tubing which has been gripped by the fitting.

## **A** LSP Series Specific Product Precautions 3

Be sure to read this before handling the products. Refer to the back cover for safety instructions. For temperature control equipment precautions, refer to the "Handling Precautions for SMC Products" and the "Operation Manual" on SMC website: https://www.smcworld.com

Wiring

## **A**Caution

- 1. Use electrical circuits which do not generate chattering in their contacts.
- 2. Use voltage which is within  $\pm 10\%$  of the rated voltage.

However, when response time is prioritized, or dispensing is difficult due to high fluid viscosity or high piping resistance, control the voltage so that there is no fluctuation below the rated voltage.

3. Apply the correct voltage.

Applying incorrect voltage may cause a malfunction or a burned coil.

4. Make sure that no excessive force is applied to the lead wires.

Otherwise, the coil will burn.

5. Electrical polarity does not matter.

#### Fluid Quality

## **A**Warning

When component crystallizes or clots depending on its nature, malfunction will occur due to the diaphragm or check valve sticking. When a crystallized or clotted component is caught between the sealing parts, unstable liquid dispensing will occur. Take measures to clean such component if necessary.

#### **Operating Environment**

## **Warning**

- 1. Do not use in explosive atmospheres.
- 2. Do not use in locations subject to excessive vibration or impact.
- 3. Do not use in locations where radiated heat will be received from nearby heat sources.

Maintenance

## **A**Warning

1. Removing the product

Shut off the fluid supply and release the fluid pressure in the system. Shut off the power supply. Remove the product.

2. Before operating, remove residual chemicals and completely replace it with deionized water, air, etc.

#### 3. Do not disassemble the product.

Products which have been disassembled cannot be guaranteed. If disassembly is necessary, please contact SMC.

### ▲ Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of "**Caution**," "**Warning**" or "**Danger**." They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC)<sup>\*1</sup>, and other safety regulations.

etc

- Caution: Caution indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
- Warning indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.

Danger : Danger indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

### **A** Warning

1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results. The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product. This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

2. Only personnel with appropriate training should operate machinery and equipment.

The product specified here may become unsafe if handled incorrectly. The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

- 3. Do not service or attempt to remove product and machinery/ equipment until safety is confirmed.
  - The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.
  - When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.
  - Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.
- Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.
  - 1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.
  - 2. Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.
  - An application which could have negative effects on people, property, or animals requiring special safety analysis.
  - 4. Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.

- \*1) ISO 4414: Pneumatic fluid power General rules relating to systems. ISO 4413: Hydraulic fluid power – General rules relating to systems. IEC 60204-1: Safety of machinery – Electrical equipment of machines.
  - (Part 1: General requirements) ISO 10218-1: Manipulating industrial robots – Safety.

### **▲**Caution

 The product is provided for use in manufacturing industries. The product herein described is basically provided for peaceful use in manufacturing industries. If considering using the product in other industries, consult SMC beforehand and explanate or a contract if peaceage.

and exchange specifications or a contract if necessary. If anything is unclear, contact your nearest sales branch.

#### Limited warranty and Disclaimer/ Compliance Requirements

The product used is subject to the following "Limited warranty and Disclaimer" and "Compliance Requirements".

Read and accept them before using the product.

#### Limited warranty and Disclaimer

- The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first.\*<sup>2</sup>) Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.
- 2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided. This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.
- Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.
  - \*2) Vacuum pads are excluded from this 1 year warranty.

A vacuum pad is a consumable part, so it is warranted for a year after it is delivered. Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

#### **Compliance Requirements**

- 1. The use of SMC products with production equipment for the manufacture of weapons of mass destruction (WMD) or any other weapon is strictly prohibited.
- 2. The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulations of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.

### 

## SMC products are not intended for use as instruments for legal metrology.

Measurement instruments that SMC manufactures or sells have not been qualified by type approval tests relevant to the metrology (measurement) laws of each country. Therefore, SMC products cannot be used for business or certification ordained by the metrology (measurement) laws of each country.

Safety Instructions Be sure to read the "Handling Precautions for SMC Products" (M-E03-3) and "Operation Manual" before use.

#### UNIT CONVERSIONS

	unit	conversion	result		unit	conversion	result
length	m	x 3.28	psi	pressure	MPa	x 145	psi
	mm	x 0.04	psi		kPa	÷ 6.895	psi
mass	g	x 0.04	°F	temperature	°C	x1.8 then add 32	°F
volume	cm <sup>3</sup>	÷ 16.387	ft-lb	torque	N∙m	x 0.738	ft-lb
	L	x 61.024	lbf	force	Ν	÷ 4.448	lbf
speed	mm/s	÷ 25.4	cfm	flow	L/min	÷ 28.317	cfm

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