Liquid Dispense Pump (Solenoid Type)

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

Adjustment of dispense volume is possible.

Dispense volume:
- 5 to 50 µL per shot
- 50 to 100 µL per shot
- 100 to 200 µL per shot

Stable dispense volume

Repeatability: ±1% *1, *2

*1 ±2% at 5 to 15 µL
*2 Under SMC’s measurement conditions

Shut-off function

Self-contained system does not need any priming.

Variations

<table>
<thead>
<tr>
<th>Connection</th>
<th>Dispense volume per shot</th>
<th>Fluid contact material</th>
<th>Fluid*1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Body</td>
<td>Diaphragm, Check valve</td>
</tr>
<tr>
<td>Body Ported</td>
<td>- 5 to 50 µL</td>
<td>PEEK</td>
<td>EPDM</td>
</tr>
<tr>
<td></td>
<td>- 50 to 100 µL</td>
<td>PP</td>
<td>FKM</td>
</tr>
<tr>
<td></td>
<td>- 100 to 200 µL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base Mounted</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1 These fluids should not corrode or permeate into the fluid contact materials.
Adjustment of dispense volume is possible.
Dispense volume can be changed by adjusting the armature stroke with adjusting screw.
Dispense volume:
- 5 to 50 µL per shot
- 50 to 100 µL per shot
- 100 to 200 µL per shot

Stable dispense volume
Repeatability: ±1%*1, +2
Diaphragm movement is supported by buffer. Stable dispense volume and longer life can be achieved by restricting deformation of the diaphragm.
*1 ±2% at 5 to 15 µL*2
*2 Under SMC’s measurement conditions

Shut-off function
Liquid leakage due to a siphonic phenomenon can be prevented by seating with diaphragm. No need to install an external shut-off valve designed to prevent leakage before and after the pump.

Fluid contact material
- Body
  Can be selected from PEEK or PP
- Diaphragm, Check valve
  Can be selected from EPDM or FKM

Fluid*4
- Water, DI water (Pure water), Diluent, or Cleaning fluid
*4 These fluids should not corrode or permeate into the fluid contact materials.

Self-priming makes priming unnecessary.
Sucks the liquid even if the pump is dry.

Application Examples
Analyzer (for medical/biochemical)  Ink jet printing  Related to semiconductor/solar cell

OUT*3  IN*3
*3 Do not apply positive or vacuum pressure to IN or OUT port.
### How to Order

**Body Ported**
- **LSP1 1-5 A1**

**Base Mounted**
- **LSP1 1-5 A**

#### Port size
1. M5 thread  
2. M6 thread  
3. 1/4-28UNF thread  
4. Tube connection type

#### Dispense volume
1. 5 to 50 µL  
2. 50 to 100 µL  
3. 100 to 200 µL

#### Fluid contact material
- **A**
  - Body: PEEK  
  - Diaphragm: EPDM  
  - Check valve: EPDM  
- **B**
  - Body: PEEK  
  - Diaphragm: FKM  
  - Check valve: FKM  
- **C**
  - Body: PP  
  - Diaphragm: EPDM  
  - Check valve: EPDM  
- **D**
  - Body: PP  
  - Diaphragm: FKM  
  - Check valve: FKM

#### Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>LSP111/112</th>
<th>LSP121/122</th>
<th>LSP131/132</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dispense volume adjustable range</strong>&lt;sup&gt;1&lt;/sup&gt;</td>
<td>5 to 50 µL</td>
<td>50 to 100 µL</td>
<td>100 to 200 µL</td>
</tr>
<tr>
<td><strong>Fluid</strong>&lt;sup&gt;4&lt;/sup&gt;</td>
<td>Water, DI water (Pure water), Diluent, or Cleaning fluid (These fluids should not corrode or permeate into the fluid contact materials.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| **Fluid contact material** | Body: PEEK, PP  
Diaphragm: EPDM, FKM  
Check valve: EPDM, FKM |
| **Repeatability**<sup>1</sup> | ±1% (< ±2% at 5 to 15 µL)  
*Under SMC’s measurement conditions* |
| **Dispense pressure**<sup>2</sup> | 10 kPa |
| **Suction pressure**<sup>2</sup> | Dry: 15 kPa  
Wet: 35 kPa |
| **Max. operating frequency**<sup>3</sup> | 2 Hz (Minimum ON time 200 ms/Minimum OFF time 300 ms) |
| **Fluid temperature** | 10 to 50°C (No freezing) |
| **Ambient temperature** | 10 to 50°C (No freezing) |
| **Mounting orientation** | Unrestricted<sup>5</sup> |
| **Enclosure** | Equivalent to IP40 |
| **Weight** | Body ported: 90 g  
Threaded ports: 85 g  
Tube connection type: 85 g |
| **Rated voltage** | 12 VDC, 24 VDC |
| **Allowable voltage fluctuation** | ±10% of the rated voltage<sup>6</sup> |
| **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<sup>7</sup> |

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<sup>1</sup> 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 7 “Piping, Caution 1.” for the installation position of the pump.

<sup>2</sup> Ambient/Fluid temperatures: ±2°C, IN/OUT side piping pressure: ±0.1 kPa or less, Applied voltage: ±0.01 V

<sup>3</sup> 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 fluid conditions.

<sup>4</sup> The values above are under SMC’s measurement conditions, and will vary depending on the conditions.

<sup>5</sup> 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 operation frequency to 1 Hz or less. Since the coil temperature may rise due to ambient temperature and energizing time, so make the OFF time appropriately longer.

<sup>6</sup> 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.

<sup>7</sup> For stable dispensing, 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 before use.

<sup>8</sup> 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.

<sup>9</sup> The value above is under SMC's measurement conditions, and will vary depending on the conditions.
Construction

**Body Ported (Threaded ports)**

LSP1□1

**Body Ported (Tube connection type)**

LSP1□1

**Base Mounted**

LSP1□2

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**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.

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**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.

**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.

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**Component Parts**

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Plate</td>
<td>PEEK, PP</td>
</tr>
<tr>
<td>2</td>
<td>Body</td>
<td>PEEK, PP</td>
</tr>
<tr>
<td>3</td>
<td>Check valve</td>
<td>EPDM, FKM</td>
</tr>
<tr>
<td>4</td>
<td>Diaphragm</td>
<td>EPDM, FKM</td>
</tr>
<tr>
<td>5</td>
<td>Buffer</td>
<td>NBR</td>
</tr>
<tr>
<td>6</td>
<td>Return spring</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>7</td>
<td>Housing</td>
<td>PPS</td>
</tr>
<tr>
<td>8</td>
<td>Solenoid</td>
<td>—</td>
</tr>
<tr>
<td>9</td>
<td>Dispensing volume adjusting screw</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>10</td>
<td>Cap</td>
<td>—</td>
</tr>
<tr>
<td>11</td>
<td>O-ring</td>
<td>EPDM, FKM</td>
</tr>
</tbody>
</table>

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![Diagram of LSP Series Pump](image-url)
Liquid Dispense Pump (Solenoid Type)  
**LSP Series**

### Dimensions

**Body Ported (Threaded ports)**  
**LSP1□1**

![Diagram of LSP1□1 Body Ported (Threaded ports)](diagram1.png)

- **Vent port** ø0.8
- **OUT port** 
  - M5 x 0.8 depth 5
  - M6 x 1 depth 5, 1/4-28UNF depth 5

![Diagram of Details of thread](diagram2.png)

- **IN port** 
  - M5 x 0.8 depth 5
  - M6 x 1 depth 5, 1/4-28UNF depth 5

- **Mounting hole**
  - M5 x 0.8, M6 x 1, 1/4-28UNF ø1.8

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

![Diagram of LSP1□1 Body Ported (Tube connection type)](diagram3.png)

- **Vent port** ø0.8
- **OUT port**
  - 2 x ø2.3
  - 2 x ø3.6

**Mounting screws**
- M2 x 0.4 Screw length 8 (stainless steel, with spring washer) 3 pcs.
- Mounting screws are shipped together with the product.

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*SMC*
**LSP Series**

**Dimensions**

**Base Mounted LSP1□2**

M2 x 0.4 screw length 8 (stainless steel, with spring washer) 3 pcs.  
Mounting screws are shipped together with the product.

Recommended interface dimensions:

- 2 x Ø0.8, C0.2 or less
- 2 x Ø1.7, Depth 2.5 or more
- 3 x M2 x 0.4
- Effective thread length 3.5 or more
- Surface roughness is Rz3.2 or less

IN port
- 3 x Ø2.2, Mounting hole

OUT port
- with O-ring

**IN port**
- with O-ring

**OUT port**
- with O-ring

**Vent port**
- Ø0.8

**Mounting hole**
- 2 x Ø2, C0.2 or less
- 2 x Ø1.7
- Depth 2.5 or more

**Effective thread length**
- 3.5 or more

**Lead wire length**
- ≈ 300
Warning

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: ±2°C, IN/OUT side piping pressure: ±0.1 kPa or less, Applied voltage: ±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 µm.
   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.
LSP Series
Specific Product Precautions 2

Be sure to read this before handling the products. Refer to the back cover for safety instructions and the “Operation Manual” for handling the products. Please download the Operation Manual via our 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.

<table>
<thead>
<tr>
<th>Model</th>
<th>Thread size</th>
<th>Tightening method</th>
<th>Tightening torque [N·m] (Reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSP1□1-A(B)1</td>
<td>M5</td>
<td>After tightening by hand, tighten 1/8 to 1/4 turn with a tightening tool.</td>
<td>0.5 to 0.7</td>
</tr>
<tr>
<td>LSP1□1-B(C)1</td>
<td>M6</td>
<td>After tightening by hand, tighten 1/8 to 1/4 turn with a tightening tool.</td>
<td>0.3 to 0.35</td>
</tr>
<tr>
<td>LSP1□1-A(B)2(3)</td>
<td>M6</td>
<td>After tightening by hand, tighten 1/8 to 1/4 turn with a tightening tool.</td>
<td>0.6 to 0.8</td>
</tr>
<tr>
<td>LSP1□1-B(C)2(3)</td>
<td>M6</td>
<td>After tightening by hand, tighten 1/8 to 1/4 turn with a tightening tool.</td>
<td>0.4 to 0.45</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Model</th>
<th>Tube inside diameter (I.D.)</th>
<th>Tubing outside diameter (O.D.) (after mounting)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSP1□1-B(D)4</td>
<td>ø2 or less</td>
<td>ø5.8 or less</td>
</tr>
</tbody>
</table>

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.
**LSP Series**

**Specific Product Precautions 3**

Be sure to read this before handling the products. Refer to the back cover for safety instructions and the “Operation Manual” for handling the products. Please download the Operation Manual via our website, https://www.smcworld.com

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### Wiring

⚠️ **Caution**

1. Use electrical circuits which do not generate chattering in their contacts.

2. Use voltage which is within ±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

⚠️ **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

⚠️ **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.
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)\(^1\), and other safety regulations.

### Caution

Caution indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.

### Warning

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.

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### Safety Instructions

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