Important Information:
Please read operating manual carefully before operation.

Warning:
- Use only the line cord shipped with the product and make sure line cord is certified for country of use.
- A pinch hazard may exist between the Pusher Block and End Blocks. Avoid placing fingers between these points while the pump is running.
- Over-push or over-draw the syringe may result in the fluid sprayed. Use appropriate measures to protect operator and equipment. Be careful during operation.
- When the fluid sprays out on the drive unit please shut down the power supply immediately and clean the drive unit, then turn on the power supply.
- If a trouble happens please contact us or our dealer. Don’t repair the equipment by yourself.
- Be careful when inserting or pulling out the connection wire between controller and drive unit to prevent the plug from damaging.

Important Information:
This pump is not for clinical use on human or veterinary patients. It is intended for research use only.

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Important Information:
Be careful when inserting or pulling out the connection wire between controller and drive unit to prevent the plug from damaging.

Important Information:
If the power line or the plug are worn or damaged please pull out the plug.

Important Information:
Please shut down the power supply before connecting the external control equipment.

Note:
This pump is not for clinical use on human or veterinary patients. It is intended for research use only.
General Description

128*64 graphic LCD display the parameters and working states. Membrane keypad and rotary coded switch make the parameters selection and setting easily. The interface is friendly. Suitable for high accuracy and small flow rate liquid transferring.

You can select syringe from a table in memory or enter the syringe diameter directly. After selecting the syringe or entering the syringe diameter, the dispensing volume and flow rates can be entered. Then return to the working interface and press the start/stop key, the pump begins running.

Features

- Syringe identification
- Look up Table
  The pump contains a table of standard syringes arranged by manufacturer and size. Once the syringe is identified in the table the pump automatically enters the appropriate diameter.
- Direct Entry
  If the syringe used is not included in the table of standard syringes, the internal diameter of the syringe barrel can be measured in millimeters and entered directly from the keypad. And four user-defined syringes internal diameter can be stored.
- Infusion flowrates
  Infusion flowrates must be set and can be changed while the pump is running.
- Volume
  A target volume can be entered for infusion, and the pump automatically stops when this volume is reached. The pump displays target dispense volume, linear speed and progress that reads from an initial zero percent to one hundred percent as the dispense proceeds to the target volume. The target volume can be changed as the pump continues to operate.
  When the volume and the flow rates are set, the pump automatically stops when the volume is reached. When the volume setting is “0”, the pump stops manually or when the pump stalls.
- RS485 interface
  Multiple pumps can be controlled in bus structure by a single PC.

Specification Table

<table>
<thead>
<tr>
<th>Specification</th>
<th>LSP01-1A</th>
<th>LSP01-2A</th>
<th>LSP04-1A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. No. of Syringes</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Syringe Size</td>
<td>10μL - 60mL</td>
<td>10μL - 60mL</td>
<td>10μL - 10mL</td>
</tr>
<tr>
<td>Advance per Microstep</td>
<td>0.156μm (1/16step)</td>
<td>0.03125μm (1/16step)</td>
<td>0.156μm (1/16step)</td>
</tr>
<tr>
<td>Infusion Volume Per Microstep</td>
<td>0.0867mL (60mL Syringe)</td>
<td>0.01734μL (60mL Syringe)</td>
<td>0.0257mL (10mL Syringe)</td>
</tr>
<tr>
<td>Max. Linear Rate</td>
<td>65 mm/min</td>
<td>13 mm/min</td>
<td>130 mm/min</td>
</tr>
<tr>
<td>Min. Linear Rate</td>
<td>5 μm/min</td>
<td>1 μm/min</td>
<td>5 μm/min</td>
</tr>
<tr>
<td>Flow Rate</td>
<td>2.779μL/min (60mL BD Syringe)</td>
<td>0.556μL/min (60mL BD Syringe)</td>
<td>2.779μL/min (60mL BD Syringe)</td>
</tr>
<tr>
<td>Dimensions</td>
<td>280×210×140 mm</td>
<td>280×210×140 mm</td>
<td>280×250×140 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>3.6 Kg</td>
<td>3.6 Kg</td>
<td>4.5 Kg</td>
</tr>
</tbody>
</table>

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128*64 graphic LCD display the parameters and working states. Membrane keypad and rotary coded switch make the parameters selection and setting easily. The interface is friendly. Suitable for high accuracy and small flow rate liquid transferring.

You can select syringe from a table in memory or enter the syringe diameter directly. After selecting the syringe or entering the syringe diameter, the dispensing volume and flow rates can be entered. Then return to the working interface and press the start/stop key, the pump begins running.

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  When the volume and the flow rates are set, the pump automatically stops when the volume is reached. When the volume setting is “0”, the pump stops manually or when the pump stalls.
- RS485 interface
  Multiple pumps can be controlled in bus structure by a single PC.
External control interface
Input and output controls are available, such as, run indicator, footswitch or timer control, and valve or relay actuation.

Stall detection
The motor is monitored by an optical encoder to confirm the programmed movement. If the back pressure increases due to jamming or flow restriction then the motor may stall. Stall detection by the encoder results in a pump shutdown. The display will read "Stall!". The Stall message can be cleared with the Return key or Fast Forward / Fast Reverse key.

Power Disruption
When power is returned after a temporary power disruption the pump can be programmed to resume operation or remain stopped. However, if a dispense volume is set then the pump always remains stopped.

Non-volatile memory
All operational settings are stored in non-volatile memory for convenience.

Selection of flow and volume units
Units of volume (µl or ml) and flowrate (µl/ml, µl/hr, mL/min or mL/hr) can be changed if required.

Calibration
The flowrate can be calibrated for more accurate dispense volume.

Operating Instructions

Power Switch
The power switch is located on the right corner of the rear panel.

Syringe loading for LSP01-1A, LSP01-2A

1. a. Press the Drive Nut Knob to release the drive nut from the leadscrew and pull the Pusher Block to the right position.
   b. Use the Fast Forward Key or Fast Reverse Key to move the Pusher Block.

2. Raise and rotate the Spring Clamp and place the syringe barrel in the "V" of the syringe holder. With the syringe in place release the Spring Clamp so that it clamps down on the barrel and holds it securely in place.

3. Press the Drive Nut Knob and slide the Pusher Block until the block pressed firmly against the syringe plunger. Release the Drive Nut Knob to re-engage the drive nut. Use the Fast Forward Key or Fast Reverse Key to move the Pusher Block to make the drive nut engage the leadscrew properly.

Note:
- Move the Pusher Block manually and then release the Drive Nut Knob. The drive nut may engage the leadscrew improperly. Slide the Pusher Block back and forth or use the Fast Forward Key or Fast Reverse Key to make the knob was ejected entirely to ensure the drive nut engage the leadscrew properly.
- Syringe Rest is to prevent the syringe from damaging. It can slide along the guide rod. Make it in the proper position and tighten the screw.
- For some glass syringes, the rounded corners of the syringe barrel flange cause a tendency for the syringe barrel to ride up out of the end block. To give a more secure, flatter surface to clamp against, an O-ring or metal collar can be placed over the barrel and pressed against the flange.
Syringe loading for LSP04-1A

1. Press the Drive Nut Knob to release the drive nut from the leadscrew and pull the Pusher Block to the right position.
2. Use the Fast Forward Key or Fast Reverse Key to move the Pusher Block.

2. Loosen the four Syringe Fixing Knobs. Load and adjust the syringe to the proper position. Tighten the four Syringe Fixing Knobs and press the syringes.
3. Turn the Drive Nut Knob according to the arrow head direction and make the drive nut engage the leadscrew. Then the pump is in the working state.

Note:
- The working mode for LSP04-1A is only infusion. Acceptable syringe (or sample injector) is from 10 µl to 10 ml. Glass syringe is not recommended, but glass sample injector is acceptable.
- Syringe Rest is to prevent the syringe from damaging. It can slide along the guide rod. Make it in the proper position and tighten the screw.

Menu features
- When the pump is turned on, the LCD will display the initializing interface (Interface 1) first and then the language selection interface (Interface 2). Turn the Rotary Encoded Switch (RES) to select the language (Interface 3). Chinese and English can be selected. The selected language is highlighted. If the user doesn’t select the language, the language which selected last time is highlighted. The pump will enter working interface directly after three seconds.
- In the running interface, the first line displays the current target dispense volume when motor stopped or increasing volume when motor running. The second line displays the volume that has been completed in percent. The third line displays current linear speed. The fourth line displays status of pump:
  - ■ indicates stop, ▲ indicates run; EXT indicates external control available; → indicates infusion and flashes when running; 485 indicates RS485 remote control available.
- Pressing Change key repeatedly will always change the display between the running interface and the main menu. The main menu consists of thirteen options, as displayed in interface 4 to 7. Press the Rotary Encoded Switch (RES) to select and change the parameters.

- Flow: xx.xx ml
  - Comp: x.x %
  - Ext: Disable
  - Power up: Run
  - Calibration:

- Vol: xx.xx ml
  - Flow: xx.xx ml/m
  - Time: xx.x min

- RS485: Enable
  - Address: x
  - Baud Rate: xxxx

- Save change?
  - Yes
  - No
  - Cancel

- Interruption!
  - Stop
  - Continue
Keypad functions

- The parameters can be selected and set by membrane keypads and RES. RES Rotary Encoded Switch. Turn the RES for menu selection or parameters setting. Press the RES for confirmation.
- Note: Put the finger in Position 1 (the center of the switch) to press the RES. Put the finger in Position 2 to turn the RES.

  - Clear Used to clear the last entered numerical when setting parameters.
  - Change Used to change the display between the running interface and the main menu.
  - Return Cancel current operation and return to previous menu in multilevel menus. Use this key to clear the alarming prompt message when the pump is blocked.
  - Run/Pause Starts the motor or acts as a pause. When running, press the key the motor stops, an interruption interface (interface 9) will be displayed, using the RES to continue or stop the operation.
  - Fast Reverse In stop state, pressing the key the pump withdraws at the max. speed, when other keys are invalid. Loose the key the pump stops. This feature can be used for loading, purging and reversing out of a stall condition.
  - Fast Forward In stop state, pressing the key the pump infuses at the max. speed, when other keys are invalid. Loose the key the pump stops. This feature can be used for loading, purging and reversing out of a stall condition.

Syringe setting

The pump must be calibrated by identifying the internal diameter of the syringe used. Once entered this data is stored in EEPROM and need be modified only when a different syringe is used.

  - Manufacturer

In running interface, press Change to enter parameters setting interface. Press RES, the first line is highlighted. Press RES again to next interface, press RES to select Manufacturers. Press RES to enter manufacturers list. Turn RES to select syringe manufacturer. Press RES to enter syringe sizes interface. Turn the RES to select the syringe used. Press RES to enter Interface 8. Select Yes to save change and return the previous menu, or select No to return the previous menu without changing, or select Cancel to select the syringe used again.

  - User define

If the syringe used is not listed in the table of standard syringes, then the internal diameter of the syringe barrel must be measured and entered directly. Turn RES to select User Define. Press RES to enter use defined syringes interface. Four inner diameters of syringe barrel can be entered. Press RES to make the numerical value position highlighted. Enter the inner diameter by membrane keypad. Press the RES to save the numerical value then the whole line is highlighted. The value range is from 0.01 to 50.00. Turn the RES to select the syringe used. Press Return to enter Interface 8. Select Yes to save change and return the previous menu, or select No to return the previous menu without changing, or select Cancel to select the syringe used again.

Note: If the syringe or diameter changed the volume, flow rate settings are set to zero. The new parameters need to be reset.
Volume setting

In parameters setting interface, turn and press RES to highlight the volume setting line. Press RES to make the numerical value position highlighted. Enter targeted volume from the membrane keypad. Press RES to set volume unit. Turn RES to scroll through the list and press RES to select the unit required. Possible volume units are µl and ml, i.e. microliter and milliliter. The highlighted display indicates that this parameter can be changed.

Vol: xx.xx ml
Flow: xx.xx ml/m
Time: xxx.x min

Note:
When the volume setting is zero, the LCD will display the flowrate setting and the pump will run until manually stopped or a stall occurs.

Flowrate setting

In parameters setting interface, turn and press RES to highlight the flowrate setting line. Press RES to make the numerical value position highlighted. Enter the flowrate required from the membrane keypad. Possible flowrate units are µl /h, µl/m, ml/h, ml/m. The highlighted display indicates that this parameter can be changed.

Vol: xx.xx ml
Flow: xx.xx µl/h
Time: xx.xx min

Note: If the number entered exceeds the maximum flowrate possible then the pump prompts the maximum feasible flowrate at the Time position. To continue enter a flowrate smaller than the maximum.

Power up

This option is only applicable when no dispense volume is selected. When power returns after an interruption the pump can resume operation (select Run) or remain stopped (select Stop).

Calibration

The flowrate can be calibrated for more accurate dispense volume.
1. In parameters setting interface, press and turn RES to highlight the Calibration line. Press RES to enter calibration interface.
2. Testing time line is highlighted. Press RES to highlight the numerical value position. Turn RES to select the testing time. The testing time is from 0.5 minutes to 60 hours. Press RES to confirm.
3. Press Run/Pause key to start the testing. After testing, turn RES to highlight the testing volume line. Press RES to highlight the numerical value position. Enter the actual volume from the membrane keypad. Press RES to confirm.
4. After calibration, the linear speed of the Pusher Block changes to increase the accuracy of the dispense volume.

Change or review volume and flowrate setting while running

While the pump running, press Change to return to parameters setting interface. Turn RES to review the dispense volume and flowrate setting. If no volume and flowrate change, press Change to return to working interface. If the flowrate changes, the pump immediately changes to the new flowrate. If the dispense volume changes, the volume continues to increase, uninterrupted by the review process, to new target dispense volume when it will stop automatically. If the volume is changed to a volume smaller than the volume already accumulated then the pump will stop as soon as the new, smaller target volume is entered. If the volume is 0, the volume can not be changed while running.

Clear a stall condition

Should a stall occur the pump motor is stopped to prevent damage. To clear the display press Return. To move the stalled mechanism use the Fast Forward or Fast Reverse to move the pusher block. Using the fast forward or fast reverse feature is not only the simplest way to deal with the stall it also reduces potential damage to the cam mechanism which releases the halfnut from the leadscrew.
External control function

External control run/stop control can be enabled or disabled.
1. In parameters setting interface, press and turn RES to highlight the external control line.
2. Press RES to highlight the parameter. Turn RES to select the needed parameter.
   Disable: disable the external control input, that is, the input is invalid.
   TTL: TTL input controls the start and stop of the pump.
   Trigger: falling edge input controls the start and stop of the pump.

RS485 setup

- The RS485 connections are made through terminal connectors, located on the rear panel. A single PC can control up to 30 pumps. When controlled by a PC each pump must be assigned an individual address. When controlled via RS485 the pump will still respond to keypad commands. All RS485 commands settings, similar to keypad settings, are stored in EEPROM. When RS485 is enabled, RS485 interface will display communication address and baud rate. The communication address is from 1 to 30. The default address is 1. The baud rate is 1200 bps, 2400 bps and 9600 bps. The default baud rate is 2400 bps.

- RS485 format: 1 start bit, 8 data bits, 1 even parity, 1 stop. For detailed RS485 commands please see <Longer’s RS485 Protocol for LSP>.

- In parameters setting interface, press and turn RES to highlight the RS485 line. Set RS485 enabled. The LCD displays communication address and baud rate. Turn RES to make the address highlighted. Press RES to highlight the numerical value. Turn RES to set the communication address. Press RES again to confirm and save the setting. Turn RES to highlight the baud rate. Press RES to make the numerical value highlighted. Turn RES to select the baud rate. Press RES again to confirm and save the selection.

External control interface

- Pin definition
  3 COM, ground ref.
  8 Trigger, TTL input, falling edge start/stop pump, e.g. footswitch
  4 Gate, TTL input, change from high to low - starts; when running stays low, change to high - stops e.g. footswitch, timer
  2 Directional output, OC gate output, open infusion, close withdrawal (stays open when stopped)
  7 Run indicator, OC gate output, open running, close stopped

Fuse

The fuses are located in the power entry module on the rear panel. The linecord must be removed first to gain access to the fuse holder. Fuse specification: 5 x 20 mm, 250V— Fast blow, 1 A

Maintenance

Maintenance is required only for the moving mechanical parts, which should be kept clean and lubricated. Occasionally, a small amount of light machine oil should be applied to the guide rods and a small amount of grease or oil to the leadscrew. Solvents of any type should never be used to clean the pump. A mild detergent solution may be used to clean the keypad.

Warranty

The warranty period for this product is one year. If repair or adjustment is necessary within the warranty period, the problem will be corrected at no charge if it is not due to misuse or abuse on your part, as determined by the manufacturer. Repair costs outside the warranty period, or those resulting from product misuse or abuse, may be invoiced to you.
### Standard table of syringe diameters

<table>
<thead>
<tr>
<th>Syringe Specification</th>
<th>Barrel Inner Diameter</th>
<th>Min. Flow Rate</th>
<th>Max. Flow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 μL</td>
<td>0.46 mm</td>
<td>0.001 μL/hr</td>
<td>21.10 μL/min</td>
</tr>
<tr>
<td>25 μL</td>
<td>0.73 mm</td>
<td>0.003 μL/hr</td>
<td>53.15 μL/min</td>
</tr>
<tr>
<td>50 μL</td>
<td>1.03 mm</td>
<td>0.005 μL/hr</td>
<td>105.8 μL/min</td>
</tr>
<tr>
<td>100 μL</td>
<td>1.46 mm</td>
<td>0.009 μL/hr</td>
<td>212.6 μL/min</td>
</tr>
<tr>
<td>250 μL</td>
<td>2.3 mm</td>
<td>0.021 μL/hr</td>
<td>527.6 μL/min</td>
</tr>
<tr>
<td>500 μL</td>
<td>3.26 mm</td>
<td>0.042 μL/hr</td>
<td>1060 μL/min</td>
</tr>
<tr>
<td>1 mL</td>
<td>4.61 mm</td>
<td>0.083 μL/hr</td>
<td>2119 μL/min</td>
</tr>
<tr>
<td>2.5 mL</td>
<td>7.28 mm</td>
<td>0.207 μL/hr</td>
<td>5286 μL/min</td>
</tr>
<tr>
<td>3 mL</td>
<td>8.59 mm</td>
<td>0.288 μL/hr</td>
<td>7360 μL/min</td>
</tr>
<tr>
<td>5 mL</td>
<td>10.3 mm</td>
<td>0.414 μL/hr</td>
<td>634 mL/hr</td>
</tr>
<tr>
<td>10 mL</td>
<td>14.57 mm</td>
<td>0.828 μL/hr</td>
<td>1270 mL/hr</td>
</tr>
<tr>
<td>20 mL</td>
<td>19.05 mm</td>
<td>1.414 μL/hr</td>
<td>2171 mL/hr</td>
</tr>
<tr>
<td>30 mL</td>
<td>21.59 mm</td>
<td>1.817 μL/hr</td>
<td>2789 mL/hr</td>
</tr>
<tr>
<td>50 mL</td>
<td>28.9 mm</td>
<td>3.277 μL/hr</td>
<td>4998 mL/hr</td>
</tr>
<tr>
<td>60 mL</td>
<td>26.6 mm</td>
<td>2.757 μL/hr</td>
<td>4234 mL/hr</td>
</tr>
</tbody>
</table>

- Syringes from different manufacturers can have slightly different limits.
  This is a reference diameter used for calculate the flow rate.

Note:
This pump is not registered with the FDA and is not for clinical use on human beings.
Syringe Pump Operating Manual

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