



INSTRUCTION MANUAL



LIQUID MICROFLOW METER/CONTROLLER

LF/LV SERIES

STEC INC.

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1. INTRODUCTION

Thank you for purchasing this equipment. This instruction manual describes the operation methods and simple maintenance methods. In using the equipment, always handle and service it adequately to patronize the STEC's product as long as possible. If you have any inquiry or trouble with the equipment, consult STEC or our dealer.

The units used in the text are conventional ones. The flow rate values for the mass flow controller (SEC), mass flow meter (SEF), liquid microflow rate controller (LV), and liquid microflow meter (LF) are indicated with flow rate symbols. When converting into the SI units, see the following.

- 1 kgf/cm² = 98.0665 kPa (Gauge pressure)
- 1 Torr(mmHg) = 133.322 Pa (Absolute pressure)
- 1 mmAq = 9.80 Pa
- 1 atmospheric pressure = 1,013 hPa
- 1 atm-cc/sec = 0.1 Pa-m³/s
- 1 CCM = 1 ml/min., 25°C, 1,013 hPa, {1 atm.} calibration
- 1 SCCM = 1 ml/min., 0°C, 1,013 hPa, {1 atm.} calibration
- 1 LM = 1 l/min., 25°C, 1,013 hPa, {1 atm.} calibration
- 1 SLM = 1 l/min., 0°C, 1,013 hPa, {1 atm.} calibration

2. GENERAL DESCRIPTION

The LF series is a world's first thermal mass flow meter for liquid microflow rate measurement, which has employed a cooling system.

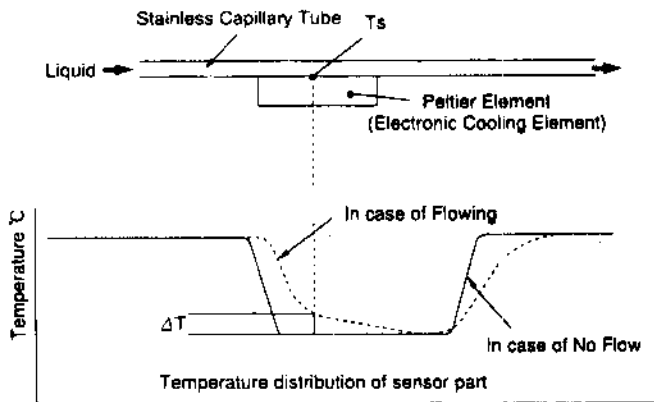
A flow rate sensor consists of an electronic cooling element (Peltier element) in contact with a capillary tube, and multiple temperature detection elements. If the liquid flows, a temperature will increase according to a flow rate. This temperature increase (ΔT) is detected and displayed as a flow rate.

Use of the cooling system enables flow rate measurement of the liquid with a low boiling point and allows you to obtain high stability, free from an effect of redischarge (evaporation) of the dissolved gas.

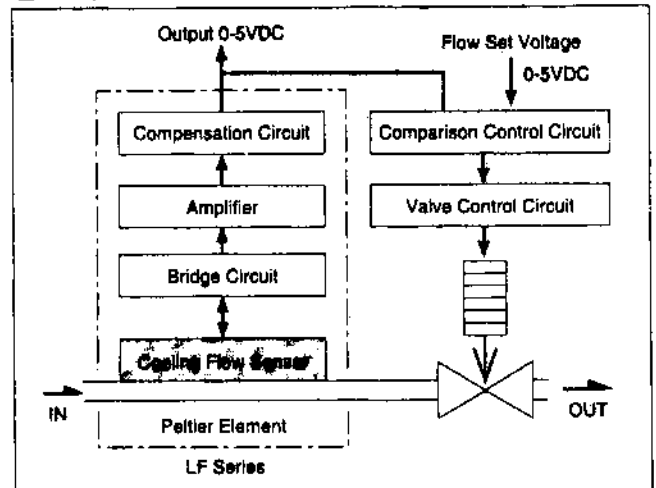
The LV series is a liquid mass flow controller improved over the LF series by adding a control valve to it and incorporating a comparison control circuit in it.

It compares a flow rate setting signal with a flow rate output signal and controls valve opening automatically so that both signals will match. Use of feedback control prevents an effect of disturbance and provides high-accuracy, stable control.

The control valve used is a highly stable piezo valve with no heat generation. It is optimum for flow rate control of the liquid with a low boiling point.



■ Construction of LV Series



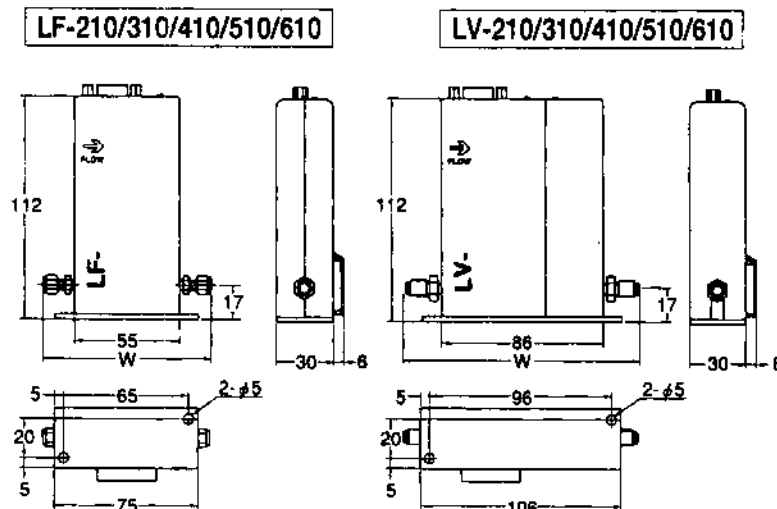
*Note: A shunting system is used for the sensors of the LF-510, LF-610, LV-510, and LV-610.

3. SPECIFICATIONS

	Mass Flow Meter					Mass Flow Controller				
Model Name	LF-210	LF-310	LF-410	LF-510	LF-610	LV-210(MO)	LV-310(MO)	LV-410(MO)	LV-510(MO)	LV-610(MO)
Flow Range (F.S. ml/min)	0.02/0.05/0.1	0.2/0.5	1/2/5	10/20	50/100	0.02/0.05/0.1	0.2/0.5	1/2/5	10/20	50/100
Controllable/Measurable Range	5 - 100% Full Scale (Accuracy Guaranteed)									
*1 Applicable Liquid	Excluding corrosive liquid for Stainless Steel like HCL, HF, etc.									
*2 Viscosity	Max. 100 cP					Max. 10 cP				
*3 Accuracy	± 2% F.S. (Linearity: ± 2% F.S., Repeatability: = 1% F.S.)									
Operating Temperature	5 - 50°C (15 - 35°C Accuracy Guaranteed)									
Operating Pressure	Max. 50 kg / cm ² G					Max. 0.5 - 3.0 kg / cm ² G				
Pressure Resistance	100 kg / cm ² G					9.9 kg / cm ² G				
*4 Pressure Drop	2/5 mmH ₂ O	10/20/50 mmH ₂ O	50 mmH ₂ O			Less than 0.3 kg / cm ² G				
Response (to ±2% F.S.)	3 sec.		2 sec.			3 sec.		2 sec.		
Flow Rate Signal	Output 0 - 5 Vdc					Output 0 - 5 Vdc, Set 0 - 5Vdc				
Leak Integrity	Less than 5 × 10 ⁻¹¹ atm-cc / sec (He)									
Wetted Materials	SS 316L					SS 316L, Teflon (UC treated SS 316L for MO type)				
Sensor Tube	Inner polished SS 316L									
Standard Fittings	1/16" SWL, 1/8" VCR 1/16" Original		1/8" SWL, 1/8" VCR	1/4" SWL, 1/4" VCR	1/16" SWL, 1/8" VCR 1/16" Original			1/8" SWL, 1/8" VCR	1/4" SWL, 1/4" VCR	
Weight	Approx. 450g					Approx. 700g				

- *1 LF/LV is calibrated by liquids with similar cP values, (please specify the name of the liquid to be calibrated). LF/LV can not measure liquids that contain solids. In the event that the liquid is mixed and the concentration is changing, the output may fluctuate even if the flow rate is constant. It is recommended for the LV series that an inlet filter < 0.2 μm (abs) be used.
- *2 If more than 100 cP liquid is to be controlled, please specify to STEC the actual cP rate, and the control valve for the LV will be adjusted specially for this application.
- *3 In order to assure accuracy, the difference between the incoming liquid and the room temperature must be within ± 3°C.
- *4 Pressure drop is defined as the value with 1 cP liquid and full scale flow rate.

4. OUTER DIMENSIONS (Unit: mm)



■ Face-to-face Dimensions W by Joint

	LF Series			LV Series		
	SWL	VCR	Special	SWL	VCR	Special
1/16"	87	-	89	118	-	120
1/8"	99	94	-	130	125	-
1/4"	105	106	-	136	137	-

5. UNPACKING

Upon delivery of the product, unpack it and check for any damages caused during transportation.

6. INSTALLATION

6-1 Operating Environment

Install the equipment in a specified place. Avoid installing it in the following places.

- <1> A place exposed to an abrupt temperature change. (An accuracy assured temperature range is 25 +/- 10 °C.)
- <2> A place exposed to the direct sunshine
- <3> A place exposed to vibrations
- <4> A high-humidity place (Relative humidity of 85 % or more)
- <5> A high-temperature place such as near the heat source(heater, furnace, etc.)

6-2 Precautions for Installation

- <1> Take care not to block air-cooling by a fan(located on the back of the equipment body). When you use multiple units of LF and LV series, arranged side by side, be sure to space them more than 10 mm apart.
- <2> Take care not to directly expose the LF/LV body to the powder dust, dust, etc. When using the equipment in the dusty environment, the lives of the parts such as a fan may be shortened. Inspect them periodically.
- <3> Take care not to splash the liquid over the equipment. If it is splashed over the electrical system(connectors, boards), it could cause a trouble.

7. LIQUID PIPING

7-1 Line Purge

Prior to attaching the LF/LV series, fully purge inside the piping. Line purge with gas may not get you a sufficient effect of purge. It is recommended to purge with the liquid used or cleaning liquid.

7-2 Piping

- <1> Provide adequate piping according to the joint of the LF/LV series.
- <2> When the object liquid may contain particles, etc., attach a filter to the primary side(LF/LV inlet side) as required.
 - LF series ----- Abs. 0.1 mm or less
 - LV series ----- Abs. 0.2 μ m or less
- <3> Run the liquid in the arrow-indicated direction of the LF/LV series. The equipment is not broken if the liquid is run from the non-arrow-indicated direction, but accurate flow rate control is not obtained.
- <4> A mounting posture is free. You may mount as you like.

7-3 Inspection after Piping

After piping is completed, confirm that there is no leak from a joint connection.

8. ELECTRICAL CONNECTION

8-1 Peripheral Devices

A power source-cum-control unit exclusive for the LF/LV series and their special cables are available from STEC. Use of special-purpose devices saves you labor of wiring and assures you of safe operation.

Name	Type	Application/Feature
Power source	PAC-D1	LF special purpose power source-cum-flow rate display unit
Power source	PAC-D2	LV special purpose power source-cum-flow rate display unit
Cable	SC-LV	Special purpose cable, Standard length: 1 m, 2 m, 3 m, 5 m

For the details of the above-mentioned products, see their individual instruction manuals or inquire STEC or our dealer.

8-2 Connecting to the Special Purpose Power Source(PAC-D1/PAC-D2)

- <1> With the special purpose cable SC-LV, connect between the LF/LV series and PAC-D1(2). When this is done, turn off the power switch of the PAC-D1(2).
- <2> Connect an accessory cord to the rear panel of the PAC-D1(2). The PAC-D1(2) operates on 100 V AC. (Frequency: 50/60 Hz, Max. power consumption: 50 VA)
- <3> Seeing the instruction manual for the PAC-D1(2), set the DIP switch and connect output signals.

8-3 Connecting the Connector (When Using Other than the Special Purpose Power Source)

- <1> Any marketed power source is available, if it meets the following specifications.

Supply voltage	+5 V +/- 0.2 V, 500 mA or more
	+15 V +/- 0.5 V, 100 mA or more
Ripple	+5 V, 100 mVp-p or less
	+/-15 V, 60 mVp-p or less
Noise	+5 V, 150 mVp-p or less
	+15 V, 350 mVp-p or less

- <2> Make an electrical connection properly according to the connector table(below).
 - Connector used: D-Subminiature 9-pin contact connector
 - Applicable plug: 17JE-23090-02(D8B) (Made by DDK) or equivalent to D-Sub connector

• Connector table

Pin No.	Signal
1	Valve open/close input *
2	Flow rate output 0 to 5 V DC **
3	Power source +15 V
4	Power source signal COM
5	Power source -15 V
6	Setting input 0 to 5 V DC *
7	N. C ***
8	Power source 0 V (5 V power source COM)
9	Power source +5 V

* Note 1: The pins-1 and -6 are used only for the LV series.

** Note 2: An output impedance for the pin-2 is 0 Ω. Heed matching with the equipment used.

*** Note 3: Connect nothing to the pin-7. (It is used for an internal circuit)

9. FUNCTIONING

9-1 Warming up

After turning on the power, warm up the equipment for about 10 minutes. A flow rate output fluctuates immediately after power-on, but this is not an abnormality. Use the equipment after the output is stabilized.

9-2 Flow Rate Measurement (For the LF Series)

<1> If you start supplying the liquid, the equipment will make flow rate measurement according to an actual flow rate. You will have a full-scale flow rate at a flow rate output voltage of 5.0 V.

<2> An actual flow rate value can be calculated by linear conversion from the flow rate output voltage.

$$\text{Actual flow rate(cc/min.)} = \frac{\text{Flow rate output voltage(V)}}{5.0(\text{V})} \times \text{Full-scale flow rate(cc/min.)}$$

9-3 Flow Rate Control (For LV Series)

<1> If you start supplying the liquid and apply a set voltage, the equipment will control a flow rate according to the set voltage. You will have a full-scale flow rate at the set voltage of 5.0 V.

<2> The set voltage to obtain a required flow rate can be calculated by linear conversion.

$$\text{Set voltage(V)} = \frac{\text{Required flow rate(cc/min.)}}{\text{Full-scale flow rate(cc/min.)}} \times 5.0(\text{V})$$

9-4 Forced Opening/Closing of Valve

An internal control valve can be controlled by inputting a valve open/close signal, regardless of the set voltage. The valve is closed by connecting -15 V to the pin-1 and opened by connecting +15 V to the pin-1. When performing normal flow rate control,

leave the pin-1 opened(no connection).

9-5 Precautions for Operation

- <1> Run the liquid in the arrow-indicated direction of the LF/LV series. The equipment is not broken if the liquid is run from the non-arrow-indicated direction, but accurate flow rate control is not obtained. Do not operate the equipment in such a manner that the liquid will flow backward.
- <2> If a temperature of the liquid controlled greatly differs from an ambient temperature around the LF/LV series, there will be an error between a flow rate output and actual flow rate. Both liquid temperature and ambient temperature should meet an identical condition(within $\pm 3^{\circ}\text{C}$).
- <3> A cooling temperature at the sensor is controlled so that it will be about 10°C lower than the liquid temperature. Be sure to use the equipment in the atmosphere which is 10°C or more higher than a freezing temperature of the liquid. An accuracy assured temperature range is $25 \pm 10^{\circ}\text{C}$.
- <4> Use of uncalibrated liquid causes an error between the flow rate output and actual flow rate.
- <5> Bubbles contained in the liquid causes noise.

10. PRECAUTIONS FOR HANDLING

- 1) Confirm that there is no leak from the piping system, fully purge inside the piping.
- 2) Do not run any liquid through the LF/LV series, which corrodes SUS.
- 3) use the equipment within an operating pressure range. Never apply a pressure exceeding the pressure resistance limit. The pressure resistance limits for the LF and LV series are $100 \text{ kg/cm}^2\text{G}$ and $9.9 \text{ kg/cm}^2\text{G}$, respectively.
- 4) The control valve for the LV series is not of shut-off structure. If perfect shut-off is required, attach a shut-off valve separately.
- 5) Take care not to splash the liquid inside the LF/LV series equipment(board block).
- 6) A voltage of about 150 V DC has been applied to the valve drive block. Do not remove the case with the power turned on. (You may get an electric shock.)
- 7) A withstand voltage of each input terminal(signal system) of the connector is $\pm 15 \text{ V}$ (within a range of supply voltage). Never apply a voltage beyond these limits.
- 8) An LF/LV flow rate output may be transitionally made within a range of $\pm 15 \text{ V}$ (supply voltage). When utilizing the flow rate output, heed a withstand voltage of the input unit. Do not short-circuit or apply a voltage to a flow rate output terminal. (It may be broken.)

11. TROUBLESHOOTING

If the LF/LV series does not operate properly, check the following items on the equipment prior to asking our office for repair.

11-1 Abnormality at Initial Power-on

Symptom: After installing the equipment body, with no liquid running, an output value (displayed value) is abnormal (not zero).

Remedy:

- <1> When using the special purpose power source PAC-D1 and special purpose cable SC-LV
 - a) Check whether the PAC-D1(2) is set correctly.
 - b) Check whether the main body and the power source is properly connected with a cable connector.
- <2> When using other than our special purpose power source and cable
 - a) Seeing 8-3 Connecting the Connector (Page 6), check whether the supply voltage, ripple, noise, and current capacity of the power source used meet the specifications.
 - b) Seeing 8-3 Connecting the Connector (Page 6), check whether the units used (power source, etc.) are properly connected to the LF/LV series.

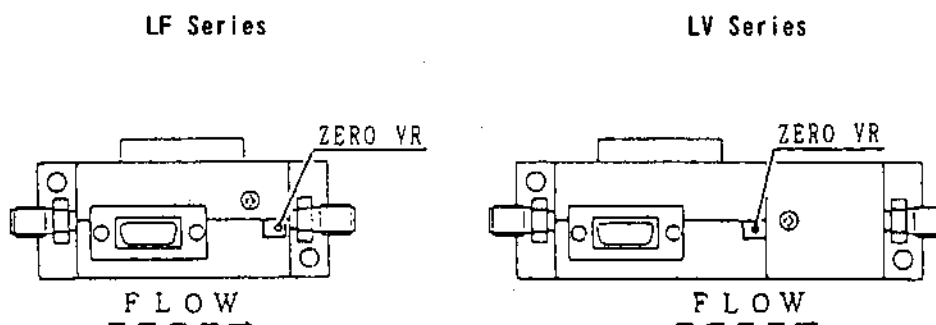
11-2 Abnormal Zero Point

Symptom: After using the equipment, with no liquid running, a zero output is beyond a range of ± 100 mV (full-scale flow rate ± 2 %).

Remedy:

- <1> If there is a heating unit nearby, a zero point may be shifted. Make sure that an environmental temperature is within an accuracy assured range.
- <2> If there is an object near (within 10 mm) the fan (back of the main body), the capabilities of the fan may be deteriorated, changing an output. The object should be separated 10 mm or more from the fan.
- <3> If there is some gas stagnant before and after the LF/LV body, the liquid may be flowing even if it is stopped at the source. The same applies when the piping has a leak.
- <4> To adjust the zero point, remove the upper seal of the main body and turn a trimmer on the internal board. If the zero output is beyond ± 100 mV, contact our office.

Adjustment trimmer position for zero point (TOP VIEW)



11-3 Abnormal Flow Rate Output Value

Symptom: An actual flow rate differs from an LF/LV flow rate output value.

Remedy:

- <1> Check whether the liquid used is identical with the LF/LV calibration liquid. The calibration liquid is indicated on the nameplate attached to the back of the main body.
- <2> Check whether a flow rate is within the full-scale range. (For the LF) We cannot assure a flow rate output beyond the full-scale range.
- <3> If the passage of the LF/LV body is contaminated, the output value will become lower than the actual flow rate. Run the cleaning liquid (alcohol, pure water, etc.) from the inlet of the main body to clean the passage of the main body.
- <4> Confirm the operating environmental condition. (See 11-2 Abnormal Zero Point)
- <5> To make span adjustment, turn a trimmer on the back of the main body (on the internal board on the nameplate side). When you run non-calibration liquid to make adjustment, linearity cannot be assured.

11-4 Faulty Control

Symptom: When controlling a liquid flow rate with the LV, an output value is higher or lower than a set value.

Remedy:

- <1> The output value is higher than the set value.
 - a) If something adheres to the control valve, control may be lost in a low flow rate range. Run the cleaning liquid from the inlet of the main body to clean the passage. The valves for the LV series are of normal opening type. It is recommended to turn off the power and run the cleaning liquid.
 - b) Check a liquid supply pressure. (See 3. SPECIFICATIONS)
If the liquid is supplied at an overpressure, control may be disabled.
- <2> The output value is lower than the set value.
 - a) If something adheres to the control valve, the output value may not reach the set value. Clean the passage of the main body.
 - b) Check a liquid supply pressure.

11-5 Unstable Output Value

Symptom: A flow rate output value is unstable.

Remedy:

- <1> Stop the liquid and check the zero point output value and stability.
- <2> Check stability on the liquid supply side.

12. MAINTENANCE AND INSPECTION

In order to operate the LF/LV series at stable accuracy for a long period of time, check the following items periodically.

Item	Method	Frequency
Zero point output	Stop the liquid and check an output(display)	Occasionally
Span output	Use a measuring cylinder, pipette, or other flow meter to check an output(display).	Occasionally
Min. control flow rate	Set a flow rate of 5 % of the full scale and check an output(display).	Occasionally only for LV
Max. control flow rate	Set a flow rate of 100 % of the full scale and check an output(display).	Occasionally only for LV
Fan capabilities	Turn on the power and check whether the fan is running.	Occasionally

If any abnormality is found by the above-mentioned checks, reconfirm each item in 11. TROUBLESHOOTING and contact STEC or our dealer.

13. PRODUCT WARRANTY

13-1 Warranty Period

A warranty period is one year after purchase of the product. If you have troubles with the product and inform our office of them, we will repair them free from charge.

13-2 Scope of Warranty

The scope of the warranty is limited to this equipment. We will not make compensation for any losses resulting from its troubles.

13-3 Warranty for Replacement Parts

Either 90 days after replacement or the warranty period mentioned in 13-1, whichever is longer

13-4 Exclusions from Warranty

The following cases are excluded from the scope of the warranty even during its effective period.

- 1) Troubles resulting from irresistible forces such as natural disasters.
- 2) Troubles resulting from wrong handling or negligence of precautions required for handling
- 3) When the equipment is used or stored in an inadequate environment
- 4) When the equipment is used beyond a range of the rated specifications
- 5) When the equipment is remodeled or used for other than its intended purpose
- 6) When it is judged that troubles are not attributable to us

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