

Liquid Source Vaporization Control Systems



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As semiconductor devices get faster and levels of integration increase, more detail is required in device construction, and new materials are being introduced into the 300 mm wafer production process to increase production efficiency. As a result of this trend, there is now a larger variety of liquid sources used in the semiconductor manufacturing process, and flow rates have increased as well.

HORIBASTEC is the world leader in this area offering a full line up of liquid source vaporization control systems utilizing different methodologies including baking, direct injection and mixing to guarantee efficient and stable delivery of vapor to the point of use. Auto refill systems complete the lineup offering uninterrupted, safe and reliable delivery of the liquid precursor increasing uptime and reducing operator handling and risk of process contamination.



LF-F/LV-F series

Digital Liquid Mass Flow Meter/Controller

Featuring the world's first sensor with a unique cooling method

- ▶ Offer micro-liter to ultra low flow rate control.
- ▶ Enable precision flow control of low boiling point and high viscosity liquids.
- ▶ Ultra clean.
 - *Please confirm the external dimensions of the last page.
- ▶ RoHS Compliance



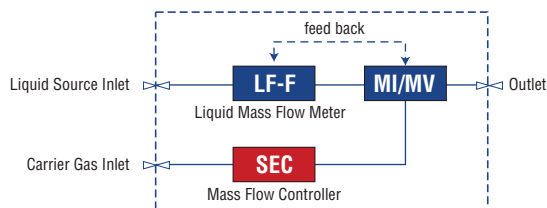
MI/MV series

Mixed injection

Vaporize liquids efficiently using the gas-liquid mixture vaporization method

- ▶ The gas-liquid mixture vaporization method enables stable vaporization of high boiling point liquids.
- ▶ Highly efficient and stable vaporization.
- ▶ Can be used for low temperature, large flow production.
- ▶ Compact vaporization system easily fits into ideal designs.
- ▶ RoHS Compliance

MI/MV series



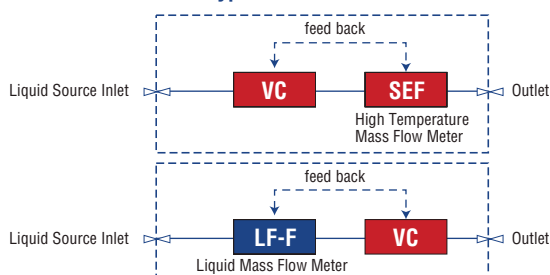
VC series

Direct injection

Compact vaporization system that can be used in different configurations, thanks to its use of non-carrier vaporization

- ▶ Compact size
- ▶ Can be installed in a variety of positions.
- ▶ Best-selling TEOS vaporization system models.
- ▶ It combines SEF or LF, and digital control is possible.
- ▶ No need for a special bubbling tank or vaporization tank.
- ▶ Lineup of DeviceNet™ model.
- ▶ RoHS Compliance

VC series non-carrier type



High temperature mass flow meter SEF-8240

RoHS regulations:

RoHS stands for "Restriction of Hazardous Substances" and is a set of regulations enforced in the EU to limit the use of six hazardous substances (lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBBs) and polybrominated diphenyls (PBDEs)), in electric and electronic components.

LSC series

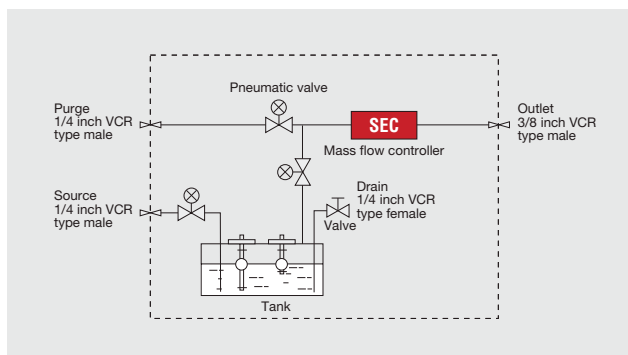
Compact Baking System

Best-selling baking system model

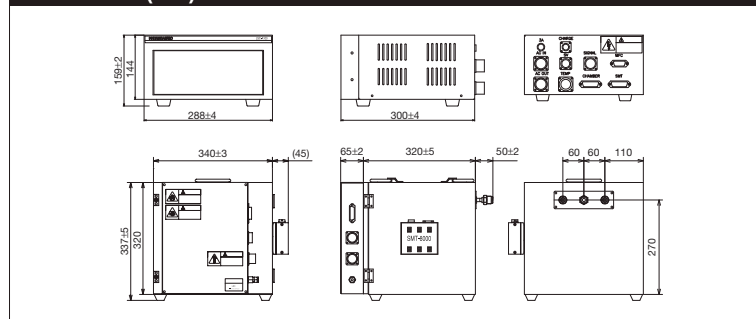
- ▶ Pioneer liquid source vaporization control system that vaporizes liquids including ethyl silicate.
- ▶ Suitable for large flow rate vaporization: Enables vapor generation of stable TEOS at 600SCCM.
- ▶ Easy maintenance from the front of the unit.



Basic flow



Dimensions (mm)



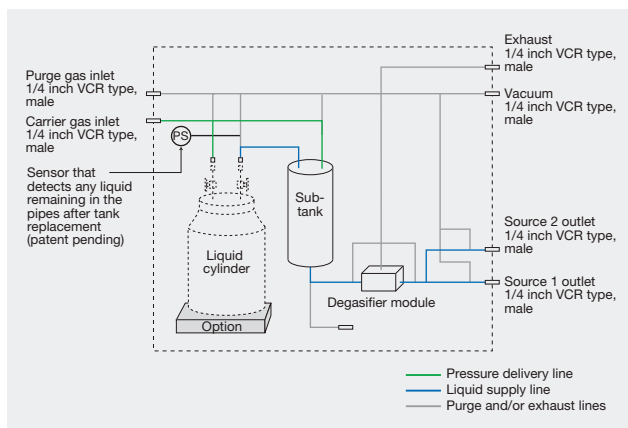
LU series

Liquid Auto Refill System

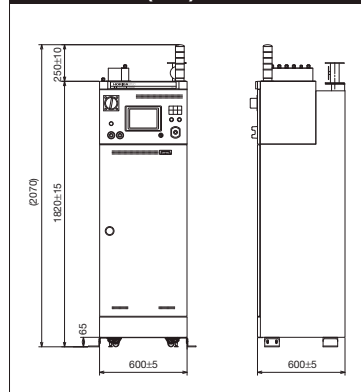
Safe, efficient, and continuous, uniuous supply of liquid sources to vaporization systems

- ▶ Vapor pressure monitoring function (patent pending) that checks the purge efficiency during mother tank replacement comes standard with the unit.
- ▶ Monitoring by the load cell of the remaining amount of material in the mother tank is available as an option.
- ▶ Compact design that allows for easier maintenance.
- ▶ Degasifier module comes standard, and the unit can be used to supply a variety of vaporization systems, including injection and baking type vaporization systems.
- ▶ Safety standards: SEMI S2/S8/S14, CE mark
- ▶ RoHS Compliance

Basic flow



Dimensions (mm)



LF-F/LV-F series

RoHS Compliance

Model	LF-F20M-A	LF-F30M-A	LF-F40M-A	LF-F50M-A	LF-F60M-A	LV-F20(PO/MO)	LV-F30(PO/MO)	LV-F40(PO/MO)	LV-F50(PO/MO)	LV-F60(PO/MO)		
Flow Range (g/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		
Measurement Range	5 to 100% F.S.											
Application Liquid ¹	All liquids except those corrosive to stainless steel (ex. HCl and HF)											
Viscosity ²	MAX. 0.1 Pa·s (100cp)					MAX. 0.01 Pa·s (10cp)						
Accuracy ³	± 1% F.S.											
Linearity	± 0.5% F.S.											
Repeatability	± 0.5% F.S.											
Response speed	Less than 3sec (T98)			≤ 2 second (T98)			≤ 3 second (T98)			≤ 2 second (T98)		
Operating Temperature ⁴	5 to 50°C (Accuracy Guaranteed 15 to 45°C)											
Temperature coefficient	± 0.1%F.S./°C MAX± 1%											
Operating Pressure ⁵	Max. 5MPa (as flow meter) / 50 to 300kPa (with piezo control valve)					0.05 to 0.3 MPa						
Pressure Resistance	10MPa (as flow meter)					1MPa						
Pressure Drop ⁶	MAX. 500Pa					MAX. 30kPa						
Flow Rate Signal	Analog: 0 to 5 VDC Digital: RS485											
Power Supply	+15 V ± 5%, 200 mA					-15 V ± 5%, 200 mA						
Leak Integrity	Less than 5 x 10 ⁻¹² Pa·m ³ /s (He)					PO: Less than 1 x 10 ⁻⁹ Pa·m ³ /s (He) MO: Less than 5 x 10 ⁻¹² Pa·m ³ /s (He)						
Wetted Material	SUS316L, Ni					PO Type: SUS316L, Ni, PTFE, PFA MO Type: SUS316L, Ni						
Standard Fitting	1/16, 8, 4inch compression fitting, 1/18, 4 inch VCR type		1/8, 4 inch compression fitting, VCR type		1/4inch compression fitting, VCR type		1/16, 8, 4inch compression fitting, 1/18, 4 inch VCR type		1/8, 4 inch compression fitting, VCR type 1/4inch compression fitting, VCR type			

¹ With the LF-F/LV-F Series, flow rate calibration is performed using one specified type of liquid. (Please indicate the type of liquid to be used when ordering the device.)
 - Liquids containing solid materials cannot be measured. - Please consult us in advance if you plan to use these devices with liquid mixture for which the mixture ratio may vary.
 - With the LV-F Series, if the liquid to be measured contains particle etc., please install a 0.2µm (Abs) filter on the primary side.
² The LV-F Type can be used with a maximum viscosity of 0.01Pa·s depending on the flow rate range. Please consult us in advance if you plan to use this device with high-viscosity liquids.
³ Specification of accuracy, linearity and repeatability is guaranteed against calibrated liquid based on SEMI E56-1296.
⁴ In order to ensure precise measurement, please maintain incoming liquid temperature to be within 10 deg. C lower or 3 deg. C higher than the ambient temperature.
⁵ Specification of Operating Pressure is the pressure range when liquid viscosity is 0.001Pa·s. ⁶ Maximum pressure loss at full-scale flow of liquids with a viscosity of 0.001 Pa·s at full-scale flow.

MI/MV series

RoHS Compliance

Model	MI-1000	MV-1000
Liquid Material	All liquids except those corrosive to stainless steel(ex. HCl, HF)	
Setting Temperature	Example generated flow rate: TEOS(to 7g/min),IPA(to 3cc/min) Max 140°C	Max. 5.0 CCM conversion (liquid phase conversion) Control Valve: Max 140°C Vaporizer: Max 200°C
Leak Integrity	Control Valve: ≤ 1 x 10 ⁻⁶ Pa·m ³ /s (He) Air Valve Option: ≤ 1 x 10 ⁻⁹ Pa·m ³ /s (He)	Control Valve: ≤ 1 x 10 ⁻⁶ Pa·m ³ /s (He) Vaporizer: ≤ 1 x 10 ⁻⁹ Pa·m ³ /s (He)
Wetted parts	SUS316L,PFA	
Temperature Sensor	Thermocouple K type	Thermocouple K type (Control valve, Vaporizer)
Pressure Resistance	1.0MPa (G)	
Standard Fitting	Liquid Inlet 1/8inch VCR type Male Gas Inlet 1/4inch VCR type Female Gas Outlet 1/4inch VCR type Male	Liquid Inlet 1/8inch VCR type Male Gas Inlet 1/4inch VCR type Female Gas Outlet 1/2inch VCR type Male
Operating Temperature	15 to 50°C	
Option	Pneumatic valve	
Heater	120V(100W) / 208V(100W) / 240V(100W) available	Control Valve: 120V(100W) / 208V(100W) / 240V(100W) available Vaporizer: 120V(100W) / 208V(100W) / 240V(100W) available
Temperature Switch	High limit 2450RC 160°C (ELMWOOD) NC type	Control Valve: High limit 2450RC 160°C (ELMWOOD) NC type Vaporizer: High limit 2450RC 250°C (ELMWOOD) NC type
External leak	≤ 1 x 10 ⁻⁹ Pa·m ³ /s (He)	
Weight (exclude cable)	620 ± 10g (Standard Type) , 700 ± 10g (Air Valve Option Type)	1110 ± 10g (Standard Type) , 1190 ± 10g (Air Valve Option Type)

VC series

RoHS Compliance

Model	VC-1420
Flow rate generated ¹ (during TEOS generation)	Max.5.0 CCM(liquid phase convention)
Liquids supported	TEOS, P(OCH ₃) ₃ , C6F6
Temperature rise	Max. 150°C
Pressure generated	Reduced pressure
External leak integrity	1.0x10 ⁻⁶ Pa·m ³ /s
Internal Leak Integrity	1.0x10 ⁻⁶ Pa·m ³ /s
Wetted material	316L Stainless Steel (polished surface)
Internal heater volume	AC 100V to 120V 70W(35Wx2)
Temperature sensor used	Thermocouple K type (CA)
Pressure Resistance	1.0MPa (G)
Standard Fitting	Liquid inlet: 1/8 inch VCR type male Gas outlet: 1/4 inch VCR type female

RoHS Compliance

Model	SEF-8240D	SEF-8240F
Operating temperature	HM : 100 to 120°C HL : 80 to 100°C MH : 60 to 80°C MM : 35 to 60°C	
Accuracy	± 1% F.S.	
Baking temperature	Max. 150°C (Open at power-off)	
Digital interface	DeviceNet/TM protocol	F-Net protocol / Analog
Leak integrity	Less than 5x10 ⁻¹² Pa·m ³ /sec(1He)	
Power Supply	Conforming to ODVA standards, DC24V 4.0V	+15V±5% 150mA -15V±5% 150mA
Wetted material	316L Stainless Steel (polished surface)	
Heater	AC100 to 120V 50/60Hz 70 to 100VA	
Temperature sensor used	Thermocouple K type (CA)	
Pressure Resistance	1.0MPa (G)	
Standard Fitting	1/4 inch VCR equivalent	

¹ Varies depending on the type of liquid. *CCM is a symbol indicating gas flow rate (mL/min at 25°C, 101.3 kPa).

LSC-A100 series

Model	LSC-A100 series
Flow rate generated	H ₂ O 2SLM, TEOS 600 SCCM (Max.)
Operating pressure	Max. 1.33kPa
Source tank volume	2.7L
Heat regulation method	PID control by the heat regulator
Liquid surface detection method	Floating switch
Internal mass flow controller	SEC-8400 series
Air pressure valve	Bellows type
Materials in liquid connection and gas contact area	SUS316L, PFA
Operating Temperature	20 to 35° C
External input	Air pressure valve open/close, mass flow controller flow rate setting signal (0 to 5 V DC/0 to 100% F.S.), emergency stop signal, auto zero signal (option)
External output	Temperature alarm, liquid level H.H. alarm, liquid level signal (H, M, L), READY signal, mass flow controller flow rate output signal ((0 to 5 V DC/0 to 100% F.S.), thermoregulated bath internal fan stop alarm, valve voltage monitor (option)
Power source	AC 100 V, single phase 50/60 Hz, 1.5 kVA
Other	Auto-recharge system. Can be connected to LU series.

*The flow rate control range varies with the type of liquid. * SCCM and SLM are symbols indicating gas flow rate (mL/min, L/min at 0° C, 101.3 kPa).

LU-A1000 series

RoHS Compliance

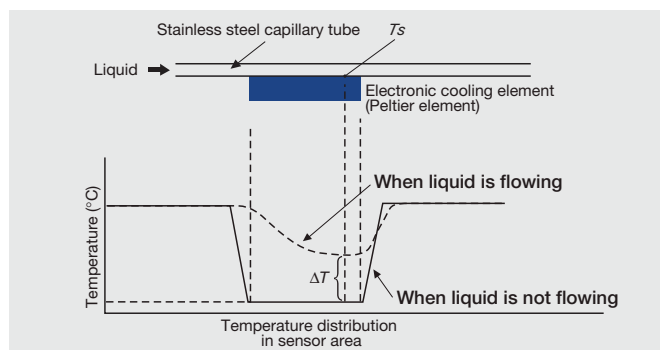
Model	LU-A1000 series
Liquids supported	TEOS, TMOB, TMOP, BTBAS
Supply method	Pressure movement from He gas
Gas supply pressure	For pressure movement: 0.3 to 0.6 MPa (G); For purge: 0.3 to 0.6 MPa (G), OP N ₂ 0.6 to 0.7 MPa (G)
Tank	Maximum 5-gallon container can be attached (outside of production range)
Operation	Automatic supply/stop using external signal from supply system
Operation area display details	Pressure error display; When an alarm is triggered: Display hold function (manual reset); Liquid level display; Sequence, etc.
Gas connection	Refer to basic flow
Power source	AC 100 to 240 V, 50/60 Hz, 300 VA
Electricity connection	AC 100 to 240 V breaker connection, signal receptacle
External dimensions	See external dimensions diagram

* Please make decisions regarding the specifications above after meeting with HORIBA STEC.

Measurement principles

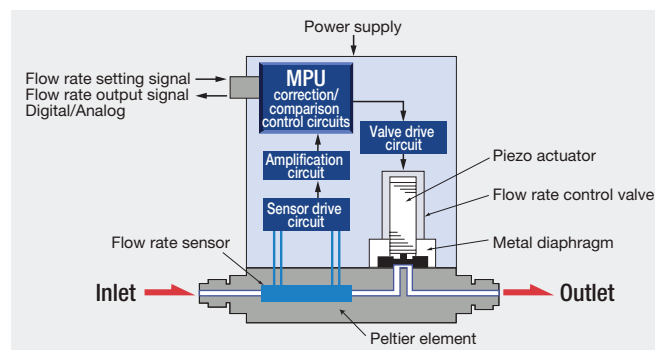
► Cooling measurement method

The flow rate sensor in the LF-F/LV-F series of fine mass flow controllers for liquids consists of an electronic cooling element (Peltier element) that is in contact with a capillary tube, as well as several temperature detection elements. When the liquid is flowing, the sensor detects the temperature rise (ΔT) corresponding to the flow rate and displays it as a flow rate. Unlike methods where heat is added, this cooling method enables flow rate measurement of liquids with low boiling points. It also prevents problems with interference due to the influence of secondary discharge (vaporization) and makes accurate flow rate measurements possible.



► Structure/Operating principle

The LV-F series of mass flow controllers are similar to the LF-F series of mass flow meters, but also have a piezo actuator valve and an internal comparison control circuit. They compare the flow rate setting signal and the flow rate output signal and automatically control the valve aperture so that the two signals will match. Since they use a feedback control system, there are no flow rate variations as a result of external factors, and, therefore, stable, accurate control is possible. The use of a piezo actuator valve, which is both stable and does not generate heat, as the control valve makes these units ideal for flow control of liquids with low boiling points.



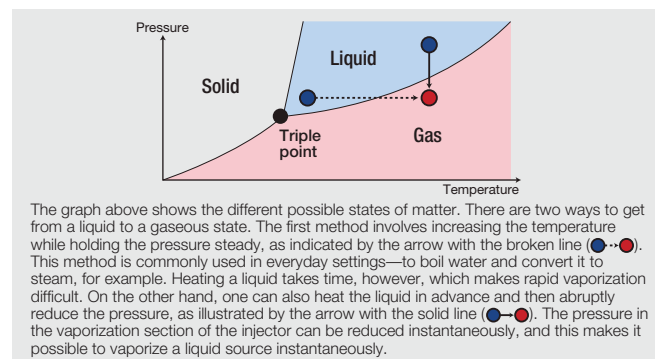
Principle of vaporization

► Injection method

The following list covers the major steps involved in vaporizing a liquid source and supplying it to the process chamber.

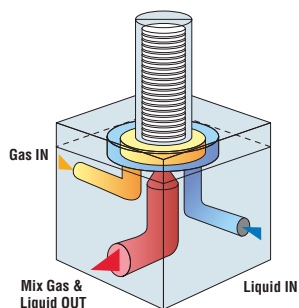
1. The liquid source's flow rate is measured and the amount of liquid is feedback controlled by the valve.
2. The liquid is instantaneously and completely vaporized.
3. The gas is released without being allowed to condense back into its liquid form.

Vaporization systems that use the injection method sequentially carry out steps 1, 2, and 3 listed above. The VC series units measure the liquid flow of the liquid source using a mass flow meter and do not use a carrier gas. The MI/MV series units use a mass flow meter for measurement and feature a mass flow controller that introduces a carrier gas into the unit to vaporize the liquid source.



► Gas and liquid mixture method

This is the vaporization method used in the MI/MV series. Since the pressure on the carrier gas is higher at the front of the nozzle inside the injector, it can be heated efficiently. The liquid source and the heated carrier gas are mixed together in the gas/liquid mixing area in the front of the nozzle, and the pressure is reduced as they pass through the nozzle, vaporizing the mixture. Vaporization efficiency is higher than with traditional vaporization methods. When this method is used, larger flows can be generated, and the generation temperature can be reduced.

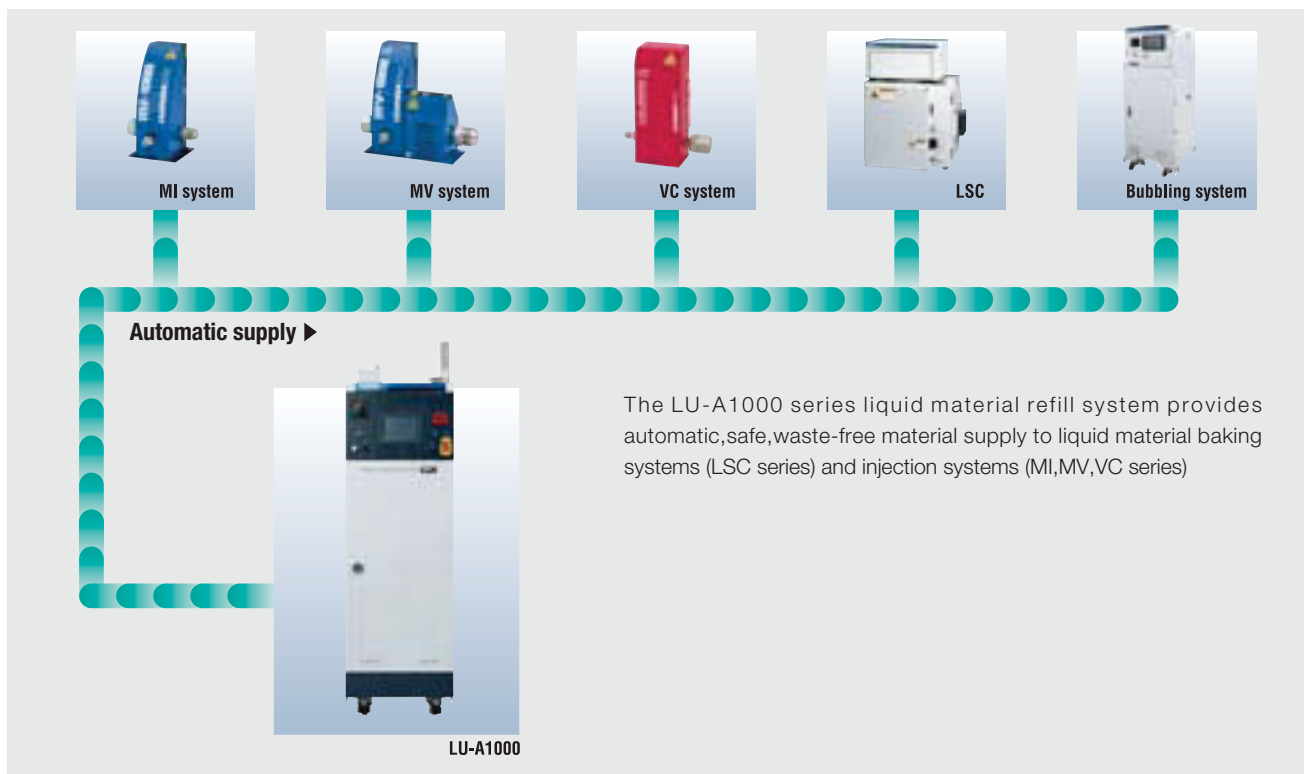


► Optimal vaporization methods for different liquids

In semiconductor devices which continue to require greater integration and detail, a variety of liquid sources are used to accentuate the characteristics of the films created. HORIBA STEC offers vaporization systems that are optimized to make the most of the characteristics of the various liquid sources used in today's cutting-edge processes.

Interlayer dielectric film	Low-k Si	TMCTS DMDMOS OMCTS 4MS HMDSO
Gate insulator	High-k Hf	TEMAH TDEAH
Capacitor Cell	High-k Ta Hf Zr Al Si	TAETO TEMAH TDEAH TEMAZ TMA TDMAS
Barrier layer	Ti TiN	$TiCl_4$ TDMAT TDEAT
Others	BPSG	TEOS TEPO TEB
		H_2O IPA

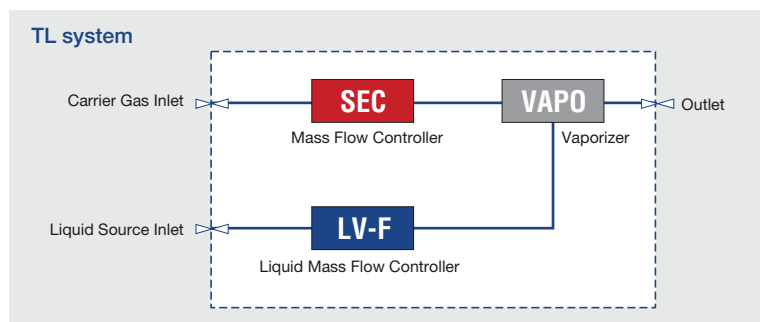
Safe, efficient, and continuous, uniuuous supply of liquid sources to vaporization systems



The LU-A1000 series liquid material refill system provides automatic, safe, waste-free material supply to liquid material baking systems (LSC series) and injection systems (MI, MV, VC series)

HORIBA STEC has amassed a great deal of technical know-how in the precise measurement, control, and vaporization of liquids. We offer equipment for a wide range of fields, so whether you need to deal with liquid chemicals in the semiconductor manufacturing process or add water while developing and producing the latest in fuel cells, HORIBA STEC has the tools for you. HORIBA STEC equipment is suitable not only for vaporization and supply to vacuum chambers, but also for vaporization and supply to atmospheric pressure lines. We offer the ideal vaporization systems for your needs.

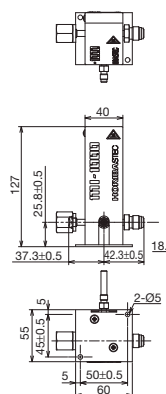
- ▶ An example of a system that can vaporize pure water (H₂O) and supply it to a chamber with greater than atmospheric pressure



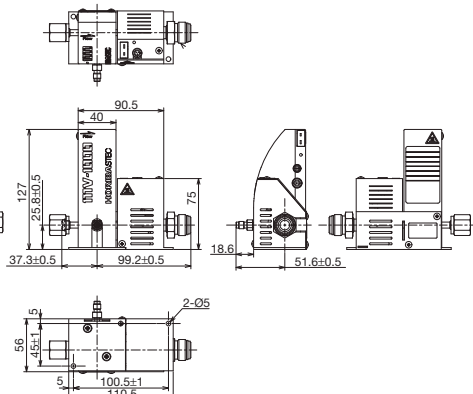
In addition to the TL system, we have recently added LE system models with a new type of vaporizer to our lineup. For details, please contact your sales representative.

External dimensions

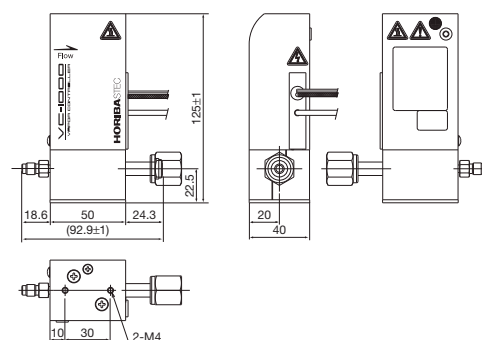
▶ MI-1000



▶ MV-1000

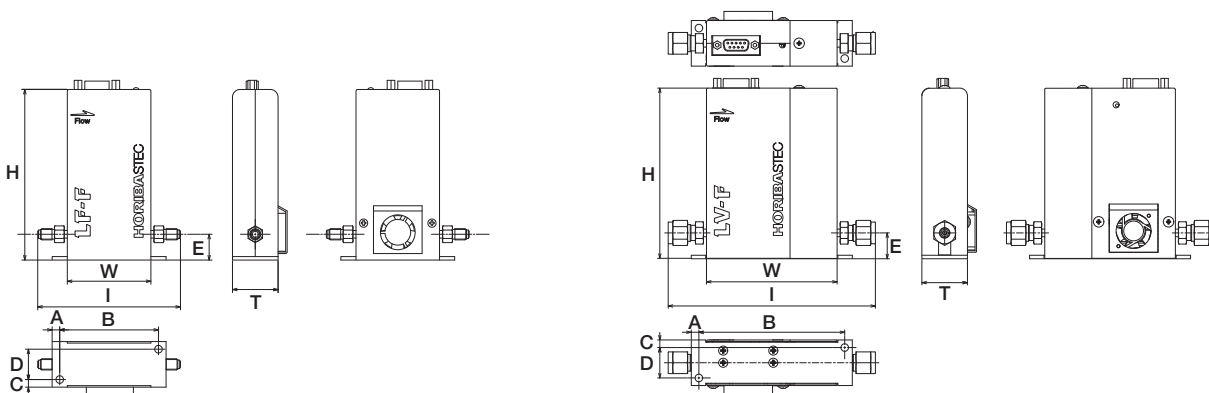


▶ VC series



External dimensions

▶ LF-F/LV-F series



Model	H	T	W	1/4inch VCR	1/4inch Swagelok	1/8inch VCR	1/8inch Swagelok	1/16inch Swagelok	1/16inch Special	A	B	C	D	E
LF-F20M-A	112	30	55	106	105	94	99	87	89	5	65	5	20	17
LF-F30M-A	112	30	55	106	105	94	99	87	89	5	65	5	20	17
LF-F40M-A	112	30	55	106	105	94	99	87	89	5	65	5	20	17
LF-F50M-A	112	30	55	106	105	94	99	87	89	5	65	5	20	17
LF-F60M-A	112	30	55	106	105	94	99	87	89	5	65	5	20	17
LV-F20(PO/MO)	112	30	86	137	136	125	130	118	120	5	96	5	20	17
LV-F30(PO/MO)	112	30	86	137	136	125	130	118	120	5	96	5	20	17
LV-F40(PO/MO)	112	30	86	137	136	125	130	118	120	5	96	5	20	17
LV-F50(PO/MO)	112	30	86	137	136	125	130	118	120	5	96	5	20	17
LV-F60(PO/MO)	112	30	86	137	136	125	130	118	120	5	96	5	20	17

Please request other external dimension drawings from HORIBA STEC.
 * Equivalent joints are sometimes used instead of the ones listed.



Please read the operation manual before using this product to ensure safe and proper handling of the product.

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HORIBASTECH

HORIBA STEC, Co., Ltd.

<http://www.horiba-stec.jp/e>

HEAD OFFICE

11-5, Hokodate-cho, Kamitoba, Minami-ku, Kyoto, 601-8116 Japan
 PHONE: (81)75-693-2314 FAX: (81)75-693-2331

TAIWAN

HORIBA Taiwan, Inc.
 3F, No.18, Lane 676, Zhonghua Rd., Zhubei City,
 Hsinchu County 302, Taiwan (R.O.C.)
 PHONE: (886)3-656-1160 FAX: (886)3-656-8231

Tainan Office

1F, No.117, Chenggong Rd., Shanhua Township,
 Tainan County 741, Taiwan (R.O.C.)
 PHONE: (886)6-583-4592 FAX: (886)6-583-2409

KOREA

HORIBA STEC KOREA, Ltd.
 110, Suntech-City, 513-15, Sangdaewon-Dong, Jungwon-Ku,
 Sungnam-City, Kyungki-Do, 462-725 Korea
 PHONE: (82)31-777-2277 FAX: (82)31-777-2288

CHINA

HORIBA (China) Trading Co., Ltd.
 Unit D, 1F, Building A, Synnex International Park,
 1068 West Tianshan Road, Shanghai, 200335 China
 PHONE: (86)21-6289-6060 FAX: (86)21-6289-5553

Beijing Office

12F, Metropolis Tower, No.2, Haidian Dong 3 Street, Beijing,
 100080, China
 PHONE: (86)10-8567-9966 FAX: (86)10-8567-9066

Shenzhen Office

701 Room, A6th Building, FuTong TianJun Garden,
 Western HePing Road, LongHua Town, BaoAn District, Shenzhen City,
 Guangdong Province 518000, China
 PHONE: (86)755-2967-1203 FAX: (86)755-2967-1192

Shanghai Service Center

Rm.303, No.84, Lane887, Zu-chong-zhi Rd., Zhangjiang Hi-tech Park,
 Shanghai 201203, China
 PHONE: (86)21-5131-7150 FAX: (86)21-5131-7660

PGV-CE23A

SINGAPORE

HORIBA INSTRUMENTS (Singapore) Pte. Ltd.
 10 Ubi Crescent, Lobby B #05-11/12 Ubi techpark Singapore 408564
 PHONE: (65)6-745-8300 FAX: (65)6-745-8155

U.S.A.

HORIBA/STEC Inc.

Santa Clara Office (Technology Center)
 3265 Scott Boulevard Santa Clara, CA 95054
 PHONE: (1)408-730-4772 FAX: (1)408-730-8975

Austin Office

9701 Dessau Rd., Suite 605, Austin, TX 78754
 PHONE: (1)512-836-9560 FAX: (1)512-836-8054

Portland Office

10240 SW Nimbus Ave, Suite L-5, Portland, OR 97223
 PHONE: (1)503-624-9767 FAX: (1)503-968-3236

Reno Office (R&D Center)

605 Spice Island Drive, #5, Sparks, NV 89431
 PHONE: (1)775-358-2332 FAX: (1)775-358-0434

Albany Office

Suite104, 58 Clifton Country Rd, Clifton Park, NY 12065
 PHONE: (1)518-331-1371

U.K.

HORIBA UK Ltd. Northampton Office
 Kyoto Close, Summerhouse Rd., Moulton Park,
 Northampton NN3 6FL England
 PHONE: (44)1604-542-600 FAX: (44)1604-542-696

FRANCE

HORIBA UK Ltd. France Office
 Bat 2 B 2 avenue de Vignate 38610 Gieres
 PHONE: (33)4-76-42-07-58

NETHERLANDS

HORIBA UK Ltd. Netherlands Office
 Zevenheulenweg 85h Berg En Dal 6571 CJ The Netherlands
 PHONE: (31)24-366-0985

GERMANY

HORIBA Europe GmbH
 Zur Wetterwarte 10 Haus 109 01109 Dresden Germany
 PHONE: (49)351-889-6807 FAX: (49)351-889-6808



Printed in Japan