



LIQUI-FLOW™

Including μ -FLOW

Thermal Mass Flow Meters / Controllers for Liquids



› Introduction

Bronkhorst High-Tech B.V., the European market leader in thermal Mass Flow Meters/Controllers and Electronic Pressure Controllers, has many years experience in designing and manufacturing precise and reliable measurement and control devices. With a wide range of instruments, Bronkhorst offers innovative solutions for many different applications in many different markets. The instruments are made to customers' specification, in various styles, suitable for use in laboratory, industrial environment, hazardous areas, semiconductor processing or analytical equipment.

› LIQUI-FLOW™ series L10 / L20

Bronkhorst has been the pioneer in the field of micro to low flow liquid metering instruments based on a thermal measuring principle. The digital LIQUI-FLOW™ Mass Flow Meter was designed to cover the range between 5 and 1000 g/h (Full Scale) in a compact instrument with a fast response. The Flow Meter is basically a stainless steel tube without any moving parts or built-in obstructions. The heater/sensor assembly is arranged around the tube and, by following the anemometric principle: a constant difference in temperature (ΔT) is created and the energy required to maintain the ΔT is dependent of the mass flow rate. Due to the benefits of the unique patented sensor, the fluid will be warmed to a maximum of 5°C, thereby making the L10/L20 series suitable for fluids with low boiling points.

› µ-FLOW series L01, for ultra low flow ranges

For even lower flow rates, Bronkhorst designed the µ-FLOW series thermal liquid flow meters/controllers. These compact instruments can be supplied in ranges from 5...100 mg/h up to 0,1...2 g/h with a pressure rating up to 400 bar. The µ-FLOW L01 mass flow meter is basically a straight sensor tube without any moving parts or built-in obstructions. The heater/sensor assembly utilises the heat transfer principle and is arranged around the tube. Upon flow, the ΔT is sensed by the upstream and downstream temperature sensors and this ΔT is a function of both the flowrate and heat capacity of the liquid to be measured.

› Liquid flow control

Flow control is achieved by integrating a control valve onto the body of the Liquid Flow Meter, or by mounting it as a separate component (in IP65 configuration). This control valve has a purge connection on top of the sleeve that enables easy elimination of air or gas when starting up the system. The electronic control function forms part of the normal circuitry in the liquid flow meter, so the need for an external controller is eliminated.

› Multi-Bus technology

Bronkhorst developed their latest digital instruments according to the 'multi-bus' principle. The basic pc-board on the instrument contains all of the general functions needed for measurement and control. It has analog I/O-signals and also an RS232 connection as a standard feature. In addition there is the possibility of integrating a fieldbus interface.

› General features

- ◆ fast and accurate measuring signal
- ◆ insensitive to mounting position
- ◆ very small internal volume
- ◆ stainless steel sensor
- ◆ suitable for liquids with low boiling points
- ◆ for laboratory and OEM applications

› Digital features

- ◆ Fieldbus interfaces:
 - ◆ DeviceNet™, CANopen®
 - ◆ PROFIBUS DP, Modbus-RTU/ASCII, FLOW-BUS
 - ◆ EtherCAT®, PROFINET, Modbus-TCP, EtherNet/IP, POWERLINK
- ◆ RS232 interface
- ◆ alarm and counter functions

› Fields of application

- ◆ Semiconductor industry
- ◆ HPLC applications
- ◆ Chemical industry
- ◆ Food & Pharmaceutical industry
- ◆ Analytical laboratories



µ-FLOW L01V12 | Ultra Low-Flow Thermal Liquid Mass Flow Controller



LIQUI-FLOW™ L13 | Thermal Liquid Mass Flow Meter

» Technical specifications

Measurement / control system

Accuracy, standard (based on actual calibration)	L01 Series ±2% FS L10/L20 Series ±1% FS
Turndown	L01/L10 Series 1: 20 (5 ... 100%) L20 Series 1: 50 (2 ... 100%)
Reproducibility	±0,2% FS typical H ₂ O
Settling time (controller)	L01 Series 2...4 seconds L10/L20 Series < 2 seconds
Operating temperature	5...50°C
Fluids	liquids with thermal properties similar to H ₂ O
Temperature sensitivity	L01 Series ±0,2% FS/°C L10/L20 Series ±0,1% FS/°C
Attitude sensitivity	negligible
Warm-up time	30 min for optimum accuracy; 10 min. for accuracy ±2% FS

Mechanical parts

Material (wetted parts)	Stainless steel 316L / 320
Process connections	⅜", ½", ¾" or 3 mm, 6 mm OD compression type; ⅜" or ¼" face seal male; other on request (e.g. 10-32 UNF female)
Purge connection (controller)	⅜" OD compression type
Seals	meter L01: all metal L13/L23: Kalrez® (FFKM) controller Kalrez® (FFKM)
Ingress protection (housing)	IP40 or IP65

Electrical properties

Power supply	+15...24 Vdc		
Max. power consumption	Supply	at voltage I/O	at current I/O
	Meter	15 V 100 mA 24 V 65 mA	120 mA 85 mA
	Controller	15 V 285 mA 24 V 250 mA	305 mA 270 mA
Extra for fieldbus (if applicable)	15 V < 75 mA 24 V < 50 mA		
Analog output/command	0...5 (10) Vdc or 0 (4)...20 mA (sourcing output)		
Digital communication	Standard: RS232; Options: DeviceNet™, CANopen®, PROFIBUS DP, Modbus-RTU/ASCII, FLOW-BUS, EtherCAT®, PROFINET, Modbus-TCP, EtherNet/IP, POWERLINK		

Electrical connection IP40 configuration

Analog/RS232	9-pin D-connector (male);	
PROFIBUS DP	bus	9-pin D-connector (female);
	power	9-pin D-connector (male);
DeviceNet™/CANopen®	5-pin M12-connector (male);	
EtherCAT®, PROFINET, Modbus-TCP, EtherNet/IP, POWERLINK	2x RJ45 modular jack (in/out)	
FLOW-BUS/Modbus-RTU/ASCII	RJ45 modular jack	

Electrical connection IP65 configuration (LIQUI-FLOW™ only)

Analog/RS232	8 DIN (male)	
PROFIBUS DP	bus	5-pin M12 (female)
	power	8 DIN (male)
DeviceNet™/CANopen®	5-pin M12 (male)	
EtherCAT®, PROFINET, Modbus-TCP, EtherNet/IP, POWERLINK	bus	2 x 4-pin M12 (female) (in/out);
	power	8 DIN (male)
FLOW-BUS/Modbus-RTU/ASCII	5-pin M12 (male)	

Calibration

References	verified by ISO 17025 calibration laboratory, directly traceable to Dutch and International standards.
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Technical specifications subject to change without notice.

» Models and flow ranges

Liquid Mass Flow Meters; PN400 (pressure rating 400 bar)

Model	min. flow	max. flow
L01	5...100 mg/h	0,1...2 g/h

Liquid Mass Flow Meters; PN100 (pressure rating 100 bar)

Model	min. flow	max. flow
L13 / L13I	0,25...5 g/h	5...100 g/h
L23 / L23I	2...100 g/h	20...1000 g/h

Liquid Mass Flow Controllers; PN100 (pressure rating 100 bar)

Model	min. flow	max. flow
L01V12	5...100 mg/h	0,1...2 g/h
L13V12 / L13I+C2I	0,25...5 g/h	5...100 g/h
L23V12 / L23I+C2I	2...100 g/h	20...1000 g/h

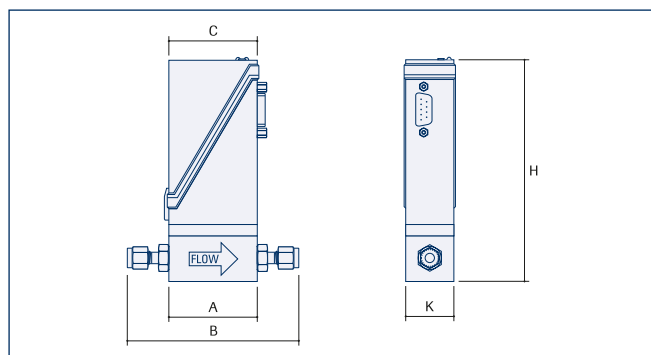
Indicated ranges are based on H₂O.

Higher pressure ratings are available on special request.



LIQUI-FLOW™ L23V12 | Thermal Liquid Mass Flow Controller

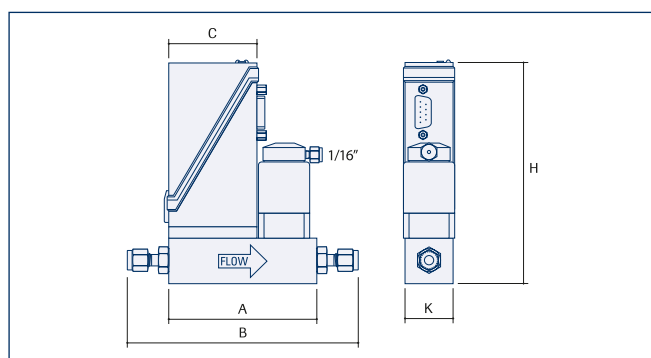
➤ Dimensions and weights



Mass Flow Meter

Model	A	B	C	H	K	Weight (kg)
L01 (1/16" OD)	52	81	47	114	25	0,2
L13 (1/8" OD)	47	98	47	118	25	0,4
L23 (1/4" OD)	47	102	47	121	25	0,4

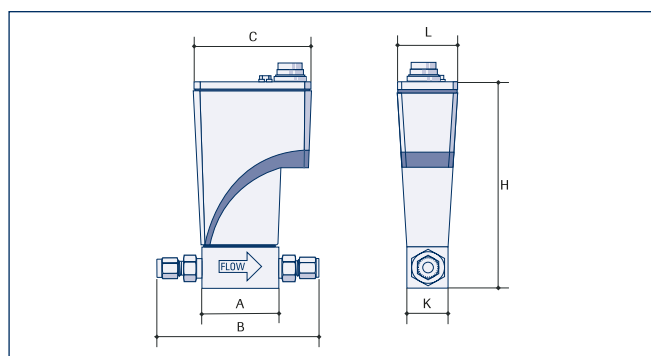
Dimensions in mm



Mass Flow Controller

Model	A	B	C	H	K	Weight (kg)
L01V12 (1/16" OD)	84	111	47	114	25	0,3
L13V12 (1/8" OD)	77	128	47	118	25	0,7
L23V12 (1/4" OD)	77	132	47	121	25	0,7

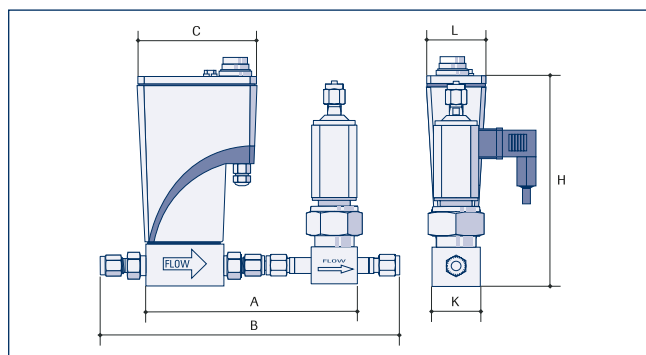
Dimensions in mm



IP65 Mass Flow Meter

Model	A	B	C	H	K	L	Weight (kg)
L13I (1/8" OD)	47	98	74	125	25	36	0,9
L23I (1/4" OD)	47	102	74	128	25	36	0,9

Dimensions in mm



IP65 Mass Flow Controller

Model	A	B	C	H	K	L	Weight (kg)
L13I+C2I (1/8" OD)	127	178	74	125	29	36	1,4
L23I+C2I (1/4" OD)	127	178	74	128	29	36	1,4

Dimensions in mm

➤ Industrial style LIQUI-FLOW™ series

The LIQUI-FLOW™ series L10I/L20I digital Liquid Flow Meters / Controllers for low flow ranges are equipped with a rugged 'industrial style' (IP65) pc-board housing for use in industrial environments. The instruments operate on a thermal, thru-flow measuring principle. The flow meter can be connected to a control valve to form a closed control loop. The standard direct acting valve (model C2I) is normally closed, has a pressure capability of 100 bar (1500 psi) and a purge connection for easy elimination of air or gas.

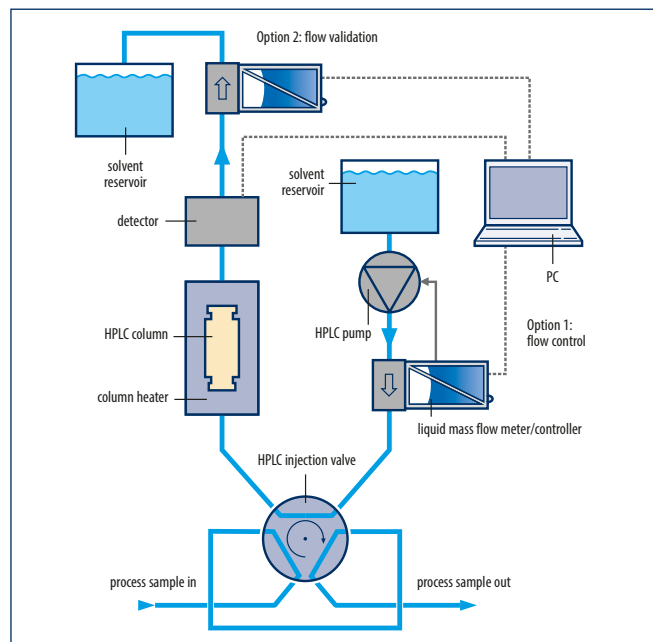


IP65 Mass Flow Meter with close-coupled Control Valve

Application examples

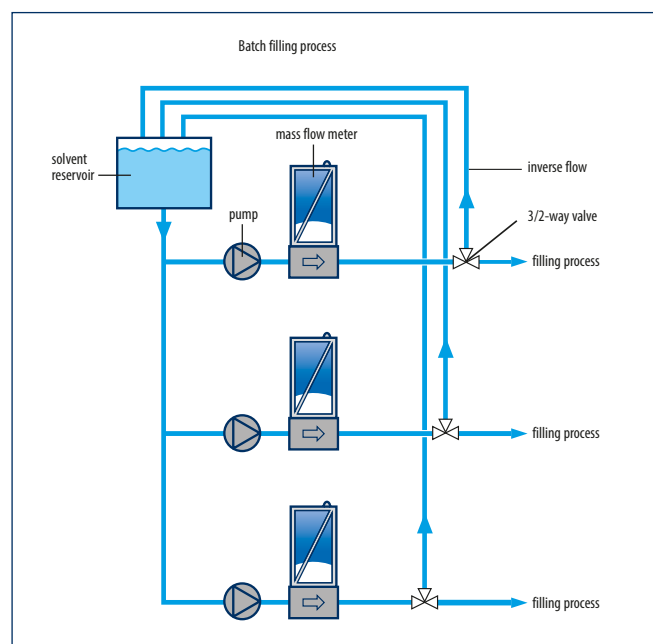
Verifying pumps

LIQUI-FLOW™ and μ -FLOW meters are used in analytical applications in combination with HPLC pumps, verifying the pump performance or even, as shown in this example, close-coupled with a gear pump. Using the integrated PID controller, the setpoint signal continuously adjusts the rotation speed of the pump.



GMP validation in food & pharma filling processes

In food and pharmaceutical applications critical filling processes must be very accurately and, above all, traceably documented. LIQUI-FLOW™ Series L10/L20 are particularly suitable for this task. The main features of these digital instruments are: high precision, fast response, compact design and a very small internal volume.



> Vaporizing

Liquid Delivery with Vapour Control

The CEM-System (Controlled Evaporation and Mixing) is an innovative Liquid Delivery System (LDS) that can be applied for atmospheric or vacuum processes. The vapour generation system consists of a liquid flow controller, an MFC for carrier gas and a temperature controlled mixing and evaporation device.

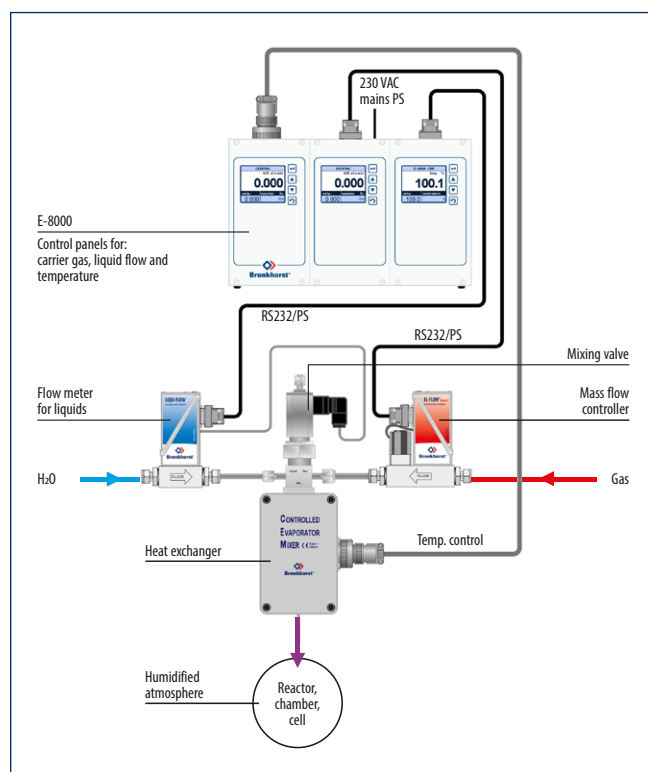
The system is suitable for mixing liquid flows of 0,25-1200 g/h resulting in saturated vapour flows of 50 ml_n/min up to 100 l_n/min. This vaporizer system can replace bubblers. New opportunities created with the CEM-system: mixtures can be evaporated and even solids, dissolved in solvents can be vaporised successfully.

Features

- ◆ Accurately controlled gas/liquid mixture (mass flow)
- ◆ Fast response
- ◆ High reproducibility
- ◆ Handles water, solvents, liquid mixtures
- ◆ Very stable vapour flow
- ◆ Flexible selection of gas/liquid ratio
- ◆ Lower working temperature than conventional system

Vapour delivery applications

- ◆ CVD (Chemical Vapour Deposition), e.g. for hardening, thin film coating or planarization processes
- ◆ Testing/calibration of analyzers with reference gas vapor concentrations
- ◆ Toxic gas effects on protective clothing
- ◆ Analyzers with reference H₂O vapour concentrations
- ◆ Humidification of fuels
- ◆ Anaesthetics



Model number identification

