SLI Liquid Flow Meter

Media Isolated Microfluidic Flow Meter

- Totally Non Invasive
- Digital RS485 Interface
- High Speed Flow Measurement

1 Introduction SLI Flow Meter

The SLI Liquid Flow Meter series enables fast, non-invasive measurements of very low liquid flow in the ml-range. Excellent chemical resistance and bio-compatibility are ensured: The flow path of the SLI Liquid Flow Meters is formed by a simple, straight glass capillary. The Swiss made, non-invasive sensors are based on Sensirion's patented CMOSens® Technology (US Patent 6,813,944 B2). The fourth generation MEMS sensors combine a thermal high precision sensor element with amplification circuits and digital intelligence for linearization and temperature compensation on one single microchip – the products core element.

2 Overview of Key Specifications

Table 1: Specifications of SLI for H_2O (all data for medium H_2O, 20°C, 1 bar_{abs} unless otherwise noted)

Parameter	SLI-0430	SLI-1000	SLI-2000	
Maximum Flow Rate	50	1000	5000	µl/min
Lowest Calibrated Flow (LCF)	2	40	200	µl/min
Accuracy above LCF	5.0	5.0	5.0	% of m.v.[a]
Operating Temperature	+10 … +50			°C
Digital Interface	RS485			
Power Supply DC, VDD	4.5 – 5.5			V
Overpressure Resistance	50	15	5	bar

Table 2: Specifications of SLI for hydrocarbon based liquids (comparable with oil, solvents, fuel, alcohol)
(all data for medium Isopropyl Alcohol, 20°C, 1 bar_{abs} unless otherwise noted)

Parameter	SLI-0430	SLI-1000	SLI-2000	
Maximum Flow Rate (depend on specific liquid type)	0.5	10	80 (120[b])	ml/min
Lowest Calibrated Flow (LCF)	0.025	0.5	4	ml/min
Accuracy above LCF	20	20	20	% of m.v.[a]

3 Output Signals

The flow meter offers a RS485 interface option with bus capability. This interface is embedded in the RS485 Sensor Cable that comes together with the sensor if ordered accordingly.
For the detailed specifications of the RS485 communication interface, refer to the documents for the RS485 Sensor Cable. It is not possible to replace the Sensor Cable with a standard cable.

The SLI Flow Meter can be switched to two different measurement modes by using RS485 commands:

- measurement mode with calibration for bi-directional flow measurement of water
- measurement mode for hydrocarbon based liquids, calibrated for Isopropyl Alcohol (IPA)

[a] Measured value
[b] Extension possible on request

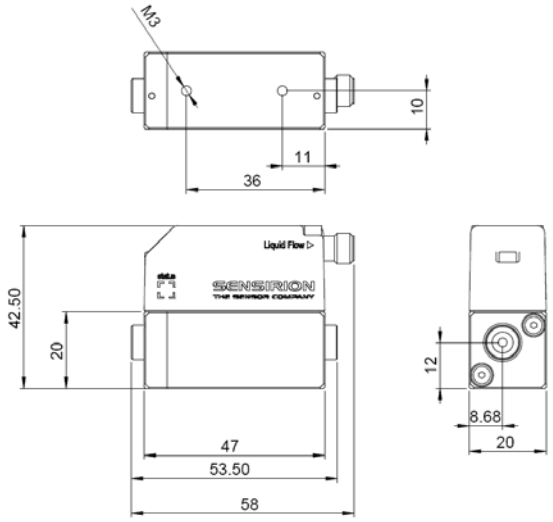
4 Specifications

Table 3: Specifications of SLI Flow Meters (all data for medium H_2O, 20°C, 1 bar_{abs} unless otherwise noted)

Parameter		SLI-0430	SLI-1000	SLI-2000	
Sensing Performance					
Maximum Flow Rate		50	1000	5000	µl/min
Lowest Calibrated Flow (LCF)		2	40	200	µl/min
Digital Resolution at LCF (16 bit)		0.60	12	150	nl/min
Accuracy[a] above LCF		5.0	5.0	5.0	% of m.v.[b]
Accuracy below LCF		0.20	0.15	0.20	% of full scale
Signal Noise, 16 bit Resolution		4.5	4.5	4.5	LSB
- at LCF		0.025	0.25	3.0	µl/min
- at Maximum Flow Rate		0.4	5.0	20	µl/min
Temperature Coefficient		0.13	0.1	0.1	(% m.v.[b]) / °C
Mounting Orientation Sensitivity[c]		<0.4	1.0	1.5	% of full scale
Flow Detection Response Time		< 5 (at 9 bit resolution)			ms
τ_{63} - Response Time		40			ms
Response Time On Power-Up		100 (with RS485 Sensor Cable)			ms
Operating Temperature		+10…+50			°C
Ambient storage temperature		-10…+60			°C
Electrical Specifications					
Digital Interface		RS485 via RS485 Sensor Cable			
Connector Sensor to Cable		4 Pin M8 Male Connector for RS485 Sensor Cable			
Digital Sampling Rate		1 ms at 9 bit, 80 ms at 16 bit			
Power Supply DC, VDD		4.5 – 5.5 (with RS485 cable)			V
Operating Current [d]		100 (with RS485 cable)			mA
Mechanical Specifications					
Fluid Connector Ports (Fittings)		¼-28 flat bottom port for 1/16", 3 mm and 1/8" OD plastic tubing			
Proof Pressure[e]		50	15	5	bar
Burst Pressure		150	40	40	bar
Maximum Pressure Drop[f]		<0.5	0.2	0.06	mbar
Internal Capillary, Inner Diameter		430	1000	1800	um
Wetted Materials	Internal Capillary	Quartz Glass (Fused Silica)	Borosilicate Glass 3.3 (Duran®)		
	Fitting	100% PEEK™ (polyether ether ketone)			
	Additional Sealing	none	FEP (Teflon®)	none	
Total Internal Volume		6.5	< 30	< 90	µl
Protection Class		IP 65			
Total Mass		53 (without cable)			g

[a] Better accuracy available on request
[b] Measured value
[c] Normal position: Horizontal flow channel
[d] Operation with the RS485 Sensor Cable, current during communication
[e] Pressure rating requires suitable fitting material
[f] Pressure drop at max. flow rate H_2O and room temperature

5 Physical Dimensions



6 Ordering Information

For OEM applications the sensor can be purchased in larger quantities without any additional parts.

For laboratory use and technology evaluation, the FlowMeterKit SLI-xxxx can be ordered.
This laboratory-package contains

- Liquid Flow Meter SLI-0430/1000/2000
- Fitting Material for 1/8'' tubing
- PC Software (Viewer & Data Export Tool)
- Data Cable RS485 with USB Adapter
- A/C Adapter (110…230 V, 50..60Hz)

Product	Article No
SLI-0430 (RS485 pigtail incl.)	1-100898-01
SLI-1000 (RS485 pigtail incl.)	1-100899-01
SLI-2000 (RS485 pigtail incl.)	1-100900-01
FlowMeterKit SLI-0430	1-100893-01
FlowMeterKit SLI-1000	1-100879-01
FlowMeterKit SLI-2000	1-100894-01

7 Important Notices

7.1 Warning, personal injury

Do not use this product as safety or emergency stop devices or in any other application where failure of the product could result in personal injury. Do not use this product for applications other than its intended and authorized use. Before installing, handling, using or servicing this product, please consult the data sheet and application notes. Failure to comply with these instructions could result in death or serious injury.

If the Buyer shall purchase or use SENSIRION products for any unintended or unauthorized application, Buyer shall defend, indemnify and hold harmless SENSIRION and its officers, employees, subsidiaries, affiliates and distributors against all claims, costs, damages and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if SENSIRION shall be allegedly negligent with respect to the design or the manufacture of the product.

7.2 ESD Precautions

The inherent design of this component causes it to be sensitive to electrostatic discharge (ESD). To prevent ESD-induced damage and/or degradation, take customary and statutory ESD precautions when handling this product.

7.3 Warranty

SENSIRION warrants solely to the original purchaser of this product for a period of 12 months (one year) from the date of delivery that this product shall be of the quality, material and workmanship defined in SENSIRION's published specifications of the product. Within such period, if proven to be defective, SENSIRION shall repair and/or replace this product, in SENSIRION's discretion, free of charge to the Buyer, provided that:

- notice in writing describing the defects shall be given to SENSIRION within fourteen (14) days after their appearance;
- such defects shall be found, to SENSIRION's reasonable satisfaction, to have arisen from SENSIRION's faulty design, material, or workmanship;
- the defective product shall be returned to SENSIRION's factory at the Buyer's expense; and
- the warranty period for any repaired or replaced product shall be limited to the unexpired portion of the original period.

This warranty does not apply to any equipment which has not been installed and used within the specifications recommended by SENSIRION for the intended and proper use of the equipment. EXCEPT FOR THE WARRANTIES EXPRESSLY SET FORTH HEREIN, SENSIRION MAKES NO WARRANTIES, EITHER EXPRESS OR IMPLIED, WITH RESPECT TO THE PRODUCT. ANY AND ALL WARRANTIES, INCLUDING WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSLY EXCLUDED AND DECLINED.

SENSIRION is only liable for defects of this product arising under the conditions of operation provided for in the data sheet and proper use of the goods. SENSIRION explicitly disclaims all warranties, express or implied, for any period during which the goods are operated or stored not in accordance with the technical specifications.

SENSIRION does not assume any liability arising out of any application or use of any product or circuit and specifically disclaims any and all liability, including without limitation consequential or incidental damages. All operating parameters, including without limitation recommended parameters, must be validated for each customer's applications by customer's technical experts. Recommended parameters can and do vary in different applications.

SENSIRION reserves the right, without further notice, (i) to change the product specifications and/or the information in this document and (ii) to improve reliability, functions and design of this product.

7.4 RoHS and WEEE Statement

The LG16 product family complies with requirements of the following directives:

- EU Directive 2002/96/EC on waste electrical and electronic equipment (WEEE), OJ13.02.2003; esp. its Article 6 (1) with Annex II.
- EU Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS), OJ 13.02.2003; esp. its Article 4.

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