

SLS-1500 Liquid Flow Meter

Compact Flow Meter for Industrial Applications

- Liquid flow rates up to 40 ml/min
- 20 ms response time
- High chemical compatibility
- Modular electrical interface



Product Summary

The SLS-1500 liquid flow meter enables precise, non-invasive measurements of dynamic liquid flow rates up to 40 ml/min bi-directionally. Excellent biocompatibility is ensured by the exclusive use of high-performance stainless steel, PTFE and PEEK for the wetted parts. The flow path of the SLS-1500 liquid flow sensor is formed by an especially thin-walled, straight tube which assures excellent sensitivity.

Interface Options

Digital	Analog
- I2C-Bus	- Voltage output (0-10 V)
- RS485-Bus	- Current Output 4-20 mA (0-20 mA)
- USB Cable	- Additional operation modes

For more information on communication, please refer to page 5 of this document.

Benefits of Sensirion's CMOSens® Technology

- High reliability and long-term stability
- Industry-proven technology with a track record of more than 15 years
- Designed for mass production
- Low signal noise

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1 Sensing Performance

Parameter	SLS-1500	Unit
Full scale flow rate	40	ml/min
Sensor output limit ^a	65	ml/min
Accuracy ^b (whichever error is larger)	5	% of measured value
	0.25	% of full scale
Repeatability ^b (whichever error is larger)	0.5	% of measured value
	0.025	% of full scale
Temperature coefficient (additional error per °C; whichever is larger)	0.25	% measured value / °C
	0.00625	% full scale / °C
Mounting orientation sensitivity ^c	<0.1	% of full scale

Table 1: Performance of SLS-1500 (all data for medium H₂O, 23°C, 1 bar_{abs} unless otherwise noted)

1.1 Specification Charts

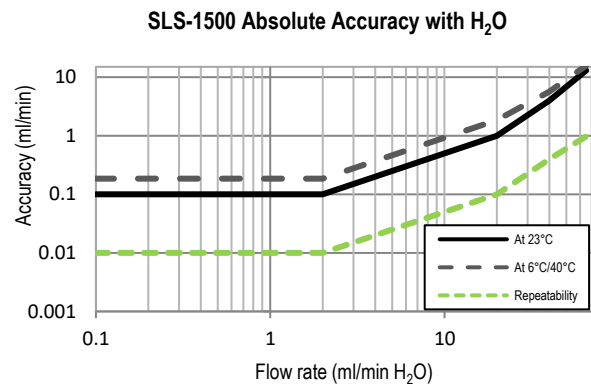
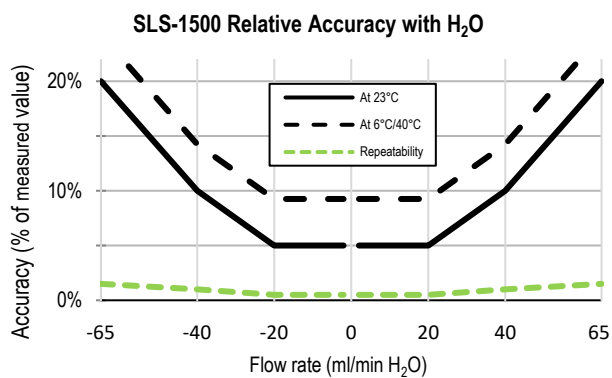


Figure 1: Sensor accuracy and repeatability (% of measured value) across the sensor's flow range

Figure 2: Sensor accuracy and repeatability (ml/min) across the sensor's flow range

^a Flow rate at which the sensor output saturates, see section 1.2 for performance specification between full scale and saturation point.

^b Accuracy respectively repeatability below ±20 ml/min. See the charts in section 1.2 for the accuracy respectively repeatability specifications between ±20 ml/min and full scale.

^c Maximum additional offset when flow channel is vertical.

2 Specifications

The SLS-1500 flow meter shows bidirectional, linear transfer characteristics. The product comes fully calibrated for water.

2.1 Electrical Specifications

This section describes electrical specifications when connecting directly to the sensor's M8 connector for I²C communication. The preferred mode of communication is via the SCC1 interface cables. See the respective SCC1 datasheets for further details.

Parameter	Symbol	Conditions	Min.	Typical	Max.	Units	Comments
Supply voltage DC	VDD		4.0	5.0	6.0	V	
Supply current	IDD	Measurement		5.1		mA	VDD = 5 V

Table 3: DC Characteristics

2.2 Timing Specifications

Parameter	Symbol	Min.	Typical	Max.	Units	Comments
Power-up time	t _{PU}			25	ms	Time to sensor ready
Flow detection response time			20		ms	Response time to flow changes (τ_{63})
I ² C SCL frequency	f _{I2C}		100	400	kHz	
Readout frequency		12.5	200	1000	Hz	Depending on Resolution setting. Sampling time for 9 bit resolution: 1 ms, for 16 bit resolution: < 80 ms.

Table 4: Timing specifications

2.3 Absolute Minimum and Maximum Ratings

Parameter	Rating	Unit
Operating temperature	+5 ... +50	°C
Short term storage temperature ^a	-10 ... +60	°C
Supply voltage	6	V

^aFlow path empty. Short-term storage refers to temporary conditions during e.g. transport.

Table 2: Absolute minimum and maximum ratings

2.4 Electrical Connector and Pinout

The flow meter is equipped with a male connector type M8, 4-pin, threaded lock according to IEC 61076-2-101 (Ed. 1)/ IEC 60947-5-2, and is compatible with Sensirion's SCC1 interface cables.

Pin	
1	SDA (data)
2	GND
3	VDD
4	SCL (clock)

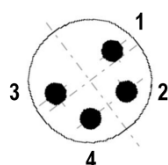


Table 5: Electrical pinout

3 Communication Interface Description

The preferred mode of operation for the SLS-1500 flow meters is via the digital RS485, analog 0-10 V, or analog 4-20 mA SCC1 interface cables.

3.1 Digital Communication via RS485-Bus

The SCC1-RS485 Sensor Cable for flow sensors allows the communication via RS485 interface for use in a demanding industrial automation environment. In addition to the standard commands available in the I²C interface of the sensor, the incorporated microcontroller of the cable provides more complex logic such as a dispense volume totalizer, automatic dispense detection, automatic heater control and data buffer for asynchronous read-out.

For further information please see the SCC1-RS485 Sensor Cable datasheet, available on www.sensirion.com/liquidflow-download.

3.2 Analog 0-10 V Communication

The SCC1-ANALOG Sensor Cable allows simple and quick readout of Sensirion's liquid flow meters by converting the digital flow meter reading to an 0...10 V voltage output. The output scaling of the cable can be configured by the user and the cable additionally features a configurable digital (high/low) output with two different modes of operation (Flow Switch / Volume Counter).

For further information please see the SCC1-ANALOG Sensor Cable datasheet, available on www.sensirion.com/liquidflow-download.

3.3 Analog 4-20 mA (0-20 mA) Communication

The SCC1-CURRENT Sensor Cable converts the sensor's digital signal to a 4...20 mA (0...20 mA) current output. The output scaling and the additional digital (high/low) output of the cable can be configured in the same way as for the SCC1-ANALOG voltage output cable.

For further information please see the SCC1-CURRENT Sensor Cable datasheet, available on www.sensirion.com/liquidflow-download.

3.4 Communication via USB cable

The Sensirion USB Sensor Cable provides an easy to use USB Interface for laboratory and desktop use.

For further information please see the SCC1-USB Sensor Cable datasheet, available on www.sensirion.com/liquidflow-download.

3.5 Digital Communication via I²C Bus

The SLS-1500 liquid flow meters have been designed for use with the SCC1 interface cables. For special applications, direct communication with the flow meter via the standard I²C-interface is possible. The physical interface consists of two bus lines, a data line (SDA) and a clock line (SCL) which need to be connected via pull-up resistors to the bus voltage of the system.

These lines can be used on 3.3 V or 5 V levels with a recommended clock frequency of 100 kHz. For the detailed specifications of this I²C communication, please refer to specific I²C Application Notes from Sensirion.

4 Fluidic Specification and Connection

Parameter	SLS-1500
Wetted materials:	
<ul style="list-style-type: none"> • Internal sensor tube material 	904L high-performance stainless steel
<ul style="list-style-type: none"> • Fitting material 	PEEK
<ul style="list-style-type: none"> • Sealing material 	PTFE
Fluid connector ports (fittings)	1/4-28 flat bottom 1/8" OD tubing (recommended: min 2mm ID)
Pressure drop (at 40 ml/min, H ₂ O, 23°C)	2.15 mbar
Total internal volume	~70 µl

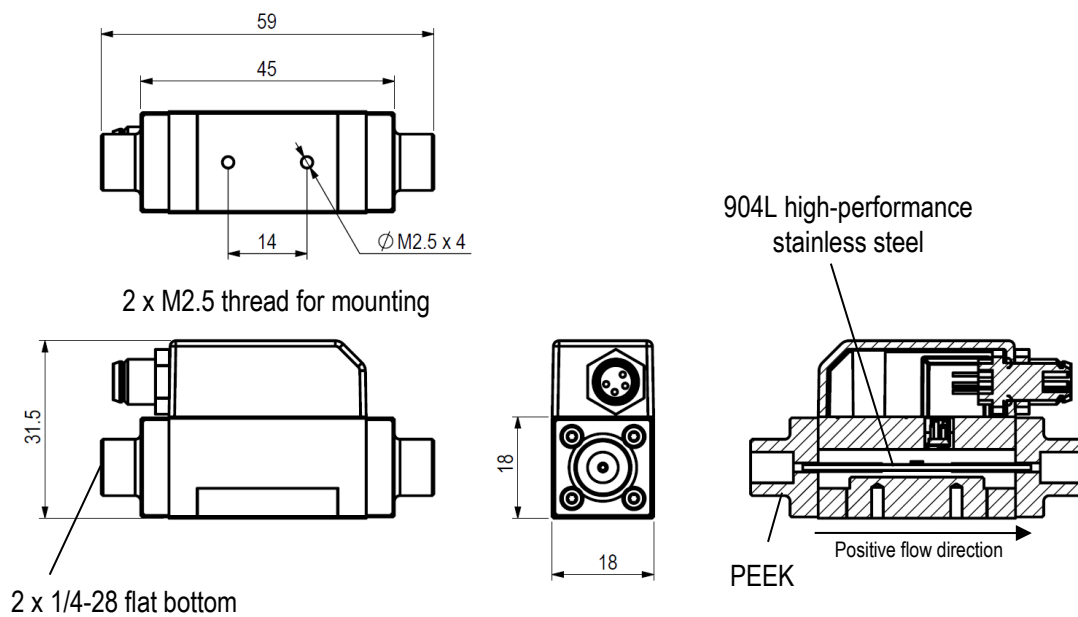
Table 5: Fluidic Specifications

For more information on the fluidic connection please find: "Application Note Sensor Ports and Tubing Connections" in the Download Center on our webpage (www.sensirion.com/liquidflow-download).

5 Mechanical Specifications

Parameter	SLS-1500
Largest dimensions	59 x 31.5 x 18 mm
Total mass	~40 g
Inner diameter sensor tube	1.5 mm
Protection class	IP54
Recommended maximum operating pressure	12 bar
Burst pressure	25 bar

Table 6: Mechanical specifications and pressure rating



All dimensions in mm

6 Ordering Information

Standard shipment includes only the sensor, neither cables nor fluidic connection material. For optimum performance, Sensirion recommends using the SLS-1500 flow meter in combination with the SCC1 interface cables.

For laboratory use and technology evaluation, the Flow Meter Kit SLS-1500 can be ordered.

This laboratory-package contains:

- Liquid Flow Meter SLS-1500
- PC Software (Viewer & Data Export Tool);
- SCC1-USB Sensor Cable with USB connector for plug-and-play connection to a PC
- SCC1-Analog Sensor Cable with 0-10 V voltage output.

Fluidic connection material for 1/4-28 flat bottom ports

Product	Article No
SLS-1500 Liquid Flow Meter	1-101216-01
Flow Meter Kit SLS-1500 ready to use	1-101154-01
Interface Cables:	
SCC1-RS485 Sensor Cable 2m	1-100804-01
SCC1-RS485 Sensor Cable 5m	1-101122-01
SCC1-ANALOG 0-10V Sensor Cable 2m	1-101072-01
SCC1-ANALOG 0-10V Sensor Cable 10m	1-101219-01
SCC1-CURRENT 0-20mA Sensor Cable 5m	1-101667-01
SCC1-USB Sensor Cable 2m	1-101007-01

7 CE, REACH, RoHS, and WEEE

The flow meters of the SLI series comply with requirements of the following directives and regulations:



- The device complies with norm EN 50081-2 (Emission Test Series), EN 50082-2 (Immunity Test Series) and ESD protection when used in combination with the SCC1-RS485, SCC1-ANALOG, or SCC1-CURRENT Sensor Cables.
- EU Directive 1907/2006/EC concerning Registration, Evaluation, Authorization and Restriction of Chemicals (**REACH**)
- EU Directive 2002/65/EC on the restriction of certain hazardous substances in electric and electronic equipment (**RoHS**), OJ01.01.2011
- EU Directive 2002/96/EC on waste electrical and electronic equipment (**WEEE**), OJ13.02.2003; esp. its Article 6 (1) with Annex II.

8 Important Notices

8.1 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.

8.2 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.

8.3 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.

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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.

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9 Headquarters and Subsidiaries

Sensirion AG

Laubisruetistr. 50
CH-8712 Staefa ZH
Switzerland

phone: +41 44 306 40 00

fax: +41 44 306 40 30

info@sensirion.com

www.sensirion.com

Sensirion Taiwan Co. Ltd

phone: +886 3 5506701

info@sensirion.com

www.sensirion.com

Sensirion Inc., USA

phone: +1 312 690 5858

info-us@sensirion.com

www.sensirion.com

Sensirion Japan Co. Ltd.

phone: +81 3 3444 4940

info-jp@sensirion.com

www.sensirion.co.jp

Sensirion Korea Co. Ltd.

phone: +82 31 337 7700~3

info-kr@sensirion.com

www.sensirion.co.kr

Sensirion China Co. Ltd.

phone: +86 755 8252 1501

info-cn@sensirion.com

www.sensirion.com.cn

To find your local representative, please visit www.sensirion.com/distributors