LS32-1500 Liquid Flow Meter

Compact Flow Meter for Low Flow Rates

- Liquid flow rates up to 40 ml/min
- 20 ms response time
- Excellent repeatability
- High chemical compatibility

Product Summary
The LS32-1500 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 LS32-1500 liquid flow sensor is formed by an especially thin-walled, straight tube which assures excellent sensitivity.

Interface Options

Digital
- I2C-Bus

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 10 years
- Designed for mass production
- Low signal noise

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Content

1 Sensing Performance

Parameter	LS32-1500	Unit
Full scale flow rate	40	ml/min
Sensor output limit[a]	65	ml/min
Accuracy[b] (whichever error is larger)	5 0.25	% of measured value % of full scale
Repeatability[b] (whichever error is larger)	0.5 0.025	% of measured value % of full scale
Temperature coefficient (additional error per °C; whichever is larger)	0.25 0.00625	% measured value / °C % full scale / °C
Mounting orientation sensitivity[c]	<0.1	% of full scale

[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.

Table 1: Performance of LS32-1500 (all data for medium H2O, 23°C, 1 bar_{abs} unless otherwise noted)

1.1 Specification Charts

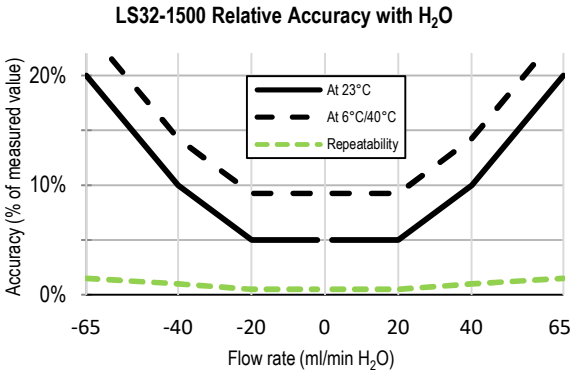


Figure 1: Sensor accuracy and repeatability (% of measured value) across the sensor's flow range

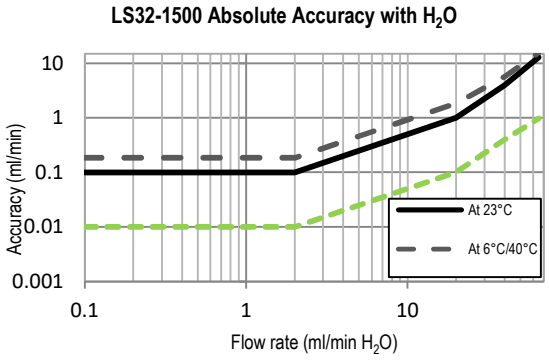


Figure 2: Sensor accuracy and repeatability (ml/min) across the sensor's flow range

2 Specifications

The OEM flow sensor LS32-1500 shows bi-directional, linear transfer characteristics. The product comes fully calibrated for water.

2.1 Electrical Specifications

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})
I²C 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

[a]Flow path empty. Short-term storage refers to temporary conditions during e.g. transport.

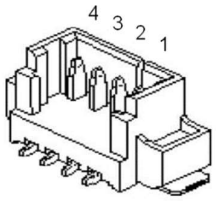
Table 2: Absolute minimum and maximum ratings

2.4 Electrical Connector and Pinout

Connector Type: PCB Header Molex 4 Pin Vertical Art.-No. 0533980471.

Pin	
1	SCL (bi-directional)
2	VDD
3	GND
4	SDA

Table 5: Electrical pinout



3 Communication Interface Description

3.1 Digital Communication via I²C-Bus

Digital communication between a master and the LS32-1500 sensor runs via the standard I²C-interface. 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. By default, the I2C address is set to 64 (hexadecimal: 40, binary: 1000000).

These lines can be used on 3.3V or 5.0V level with a 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	LS32-1500
Wetted materials:	
• Internal sensor tube material	904L high-performance stainless steel
• Fitting material	PEEK
• Sealing material	PTFE
Fluid connector ports (Fittings)	1/4-28 flat bottom 1/8" OD tubing (recommended: min. 2 mm ID)
Pressure drop (at 40 ml/min, H_2O, 23°C)	2.15 mbar
Total internal volume	~70 µl

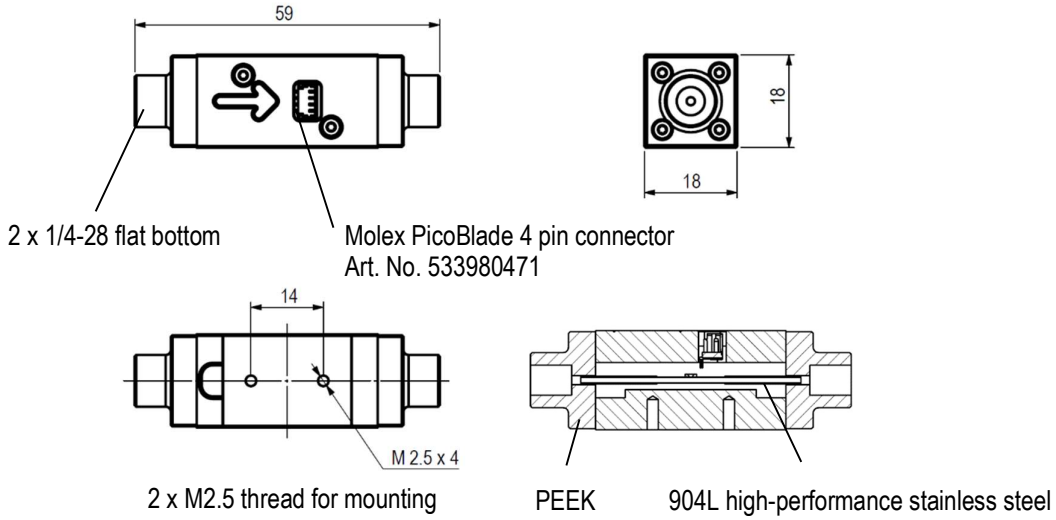
Table 6: Fluidic Specifications

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	LS32-1500
Largest dimensions	59 x 18 x 18 mm
Total mass	~30 g
Inner diameter flow channel	1.5 mm
Maximum recommended operating pressure	12 bar
Burst pressure	25 bar

Table 7: Mechanical specifications and pressure rating



All dimensions in mm

6 Ordering Information

Standard shipment includes only the sensor, neither cables nor fluidic connection material. Preassembled 4-pin Molex to pigtail ribbon cables (Molex 4- pol Type no. 51021-0400, 30 cm) can be ordered optionally.

Product	Article No	MOQ	Packaging Unit
LS32-1500 Liquid Flow Meter	1-101127-01	10	10
Ribbon Cable for LS32 30cm	1-101121-01	10	n/a

Table 8: Ordering information

7 REACH, RoHS, and WEEE

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

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- 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 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.

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