

SLQ-QT500 Liquid Flow Meter

High Purity Flow Meter

- Liquid flow rates up to 120 ml/min
- Dual calibration for IPA and H₂O
- Response time < 50 ms
- Straight flow channel, no moving parts
- For a wide range of viscosities
- Inert wetted materials (PFA, Quartz)



Product Summary

The SLQ-QT500 Liquid Flow Meter enables fast, non-invasive measurements of liquids for demanding high purity applications. Dual calibration (water, H₂O; and isopropyl alcohol, IPA) allows flow monitoring for water-based or hydrocarbon-based liquids. The straight-through wetted flow path has no moving parts and consists entirely of only PFA and Quartz. Its excellent chemical compatibility makes the SLQ-QT500 the first choice for measuring even aggressive chemicals or high-viscosity liquids.

Interface Options

Digital

- I2C-Bus
- RS485-Bus
- USB cable

Analog

- Voltage output (0-10 V)
- Additional operation modes

For more information on communication, please refer to page 3 of this document.

1 Sensing Performance

Table 1: Performance of the SLQ-QT500 (all data for medium IPA, 23°C, unless otherwise noted)

Parameter	SLQ-QT500 (IPA)	SLQ-QT500 (H ₂ O)	Unit
Full scale flow rate	2000 (120)	2000 (120)	μl/s (ml/min)
Flow meter output limit ^a	2500 (150)	2500 (150)	μl/s (ml/min)
Accuracy below full scale ^b (whichever error is larger)	5	5 ^c	% of measured value
	0.125	0.125	% of full scale
Repeatability below full scale (whichever error is larger)	0.5	0.5	% of measured value
	0.0125	0.0125	% of full scale
Temperature coefficient (additional error per °C; whichever is larger)	0.15	0.15	% measured value / °C
	0.00375	0.00375	% full scale / °C
Flow detection response time τ_{63}	<50	<50	ms
Response time on power-up	25	25	ms
Operating temperature	+5...+50	+5...+50	°C
Ambient storage temperature ^d	-10...+60	-10...+60	°C
Operating pressure ^e	12 (175)	12 (175)	bar (psi)
Proof pressure ^e	50 (725)	50 (725)	bar (psi)

^a Flow rate at which the flow meter output saturates; ^b Accuracy with straight inlet tube; ^c Accuracy below ±1000 μl/s. See the charts in section 2 for the accuracy specification between 1000 μl/s and 2500 μl/s; ^d Non-condensing, flow path empty; ^e pressure limited by PFA tubing.

1.1 Calibration Field Information

The SLQ-QT500 Liquid Flow meter holds two calibrations, one for isopropyl alcohol (IPA) and one for water. Each calibration is stored on a separate calibration field (CF):

- Calibration field 0: IPA (factory default)
- Calibration field 2: H₂O

The default calibration field (i.e. the active calibration field at power up) can be permanently changed via I²C or RS485 commands. Alternatively, the default calibration field can be changed using the USB-RS485 Sensor Viewer which is part of the Flow Meter Kit and also available in the download center on the Sensirion liquid flow webpage.

www.sensirion.com/liquidflow-download

The standard calibrations cover the flow range from -2500 $\mu\text{l/s}$ to +2500 $\mu\text{l/s}$. Extended calibration ranges for both IPA and water are available on request.

1.2 Sensor Measurement Configuration

The default measurement configuration of the SLQ-QT500 is optimized for the measurement of short dispensing processes. For measuring continuous flow rates, a different setting for the micro-heater is preferred. The default setting can be permanently changed via I²C or RS485 commands. Alternatively, the default heater setting can be changed using the USB-RS485 Sensor Viewer.

2 Specification Charts

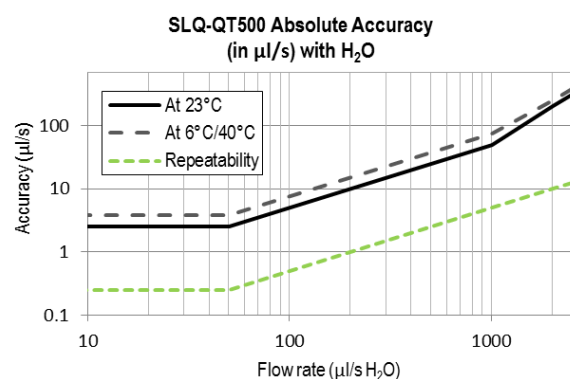
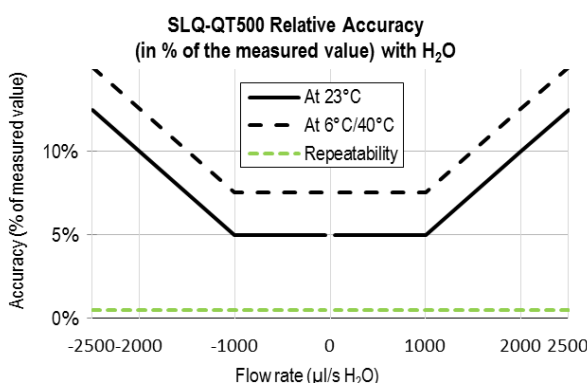
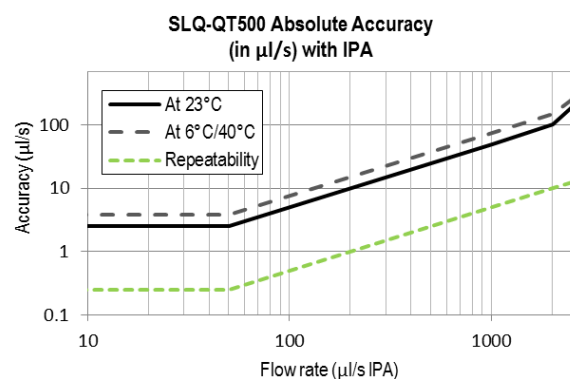
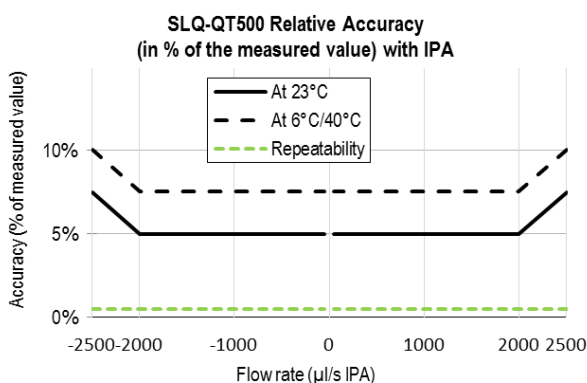


Figure 1: Flow meter accuracy and repeatability across the flow range. Relative error in % of measured value (left column) and absolute error in $\mu\text{l/s}$ (right column) for IPA (top) and H₂O (bottom)

3 Communication with the Liquid Flow Meter

The SLQ-QT500 flow meter shows bidirectional, linear transfer characteristics. The product comes fully calibrated for IPA and water.

Digital sampling time at 16 bit resolution: 74 ms

Digital sampling time at 9 bit resolution: 1 ms

3.1 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.

Table 2: DC characteristics

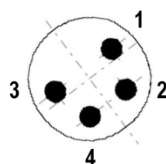
Parameter	Conditions	Min.	Typ.	Max.	Unit
Power supply DC, VDD		3.3	3.5	3.7	V
Operating current			5.1		mA

3.2 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.

Table 3: Electrical pinout

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



3.3 Digital Communication via RS485-Bus

The SCC1-RS485 Sensor Cable for liquid flow meters provides 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 flow meter, 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 readout.

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

3.4 Analog 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 a 0...10 V analog voltage output. Additionally, a digital (high/low) output with two different modes of operation is available (Flow Switch / Volume Counter)

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

3.5 Communication via USB cable

The Sensirion SCC1-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.

3.6 Digital Communication via I²C-Bus

The SLQ-QT500 liquid flow meter has 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 have to be used on 3.3 V level 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 Connection

Table 4: Fluidic specifications and pressure rating

Parameter	SLQ-QT500
Wetted materials:	
<ul style="list-style-type: none"> Internal sensor tube material 	Quartz
<ul style="list-style-type: none"> Connection tube 	PFA
Fluidic connection	PFA tube, 6.35 mm (1/4") OD, 4.35 mm ID
Pressure drop (at 120 ml/min, IPA, 23°C)	< 2 mbar
Total internal volume	5 ml

The flow meter has been robustly engineered to ensure the internal PFA to Quartz interface provides a dependable seal without using any additional adhesives or gasket sealing materials. This tightly integrated design prohibits any disassembly without damaging internal components; never disassemble the flow meter or attempt to replace PFA tubing!

Shortening tubing by cutting to the desired length is possible. Please consider the following basic guidelines.

Important note: Make sure to always leave tubing of sufficient length (depending on the selected type of fitting) before cutting the tube. Cutting the PFA tubing too short will require replacing the flow meter!

Basic guidelines:

- PFA tubing is non-replaceable.
- Use tubing adapters for 6.35 mm (1/4 inch) outer-diameter and 4.35 mm inner-diameter PFA tubing.

- For optimum accuracy, it is recommended to leave the tubing on the inlet at its original length, and to keep it straight. This is most important for low viscosity liquids at high flow rates. See table 5 for more details.
- On the outlet side, the tubing can be cut or bent as needed, without affecting the flow meter's accuracy for flow in the positive direction (normal requirements for handling PFA tubing apply).
- Bending of tubing and mounting orientation has no influence on the repeatability of the flow meter. To maintain the same measurement conditions and benefit from the excellent repeatability of the SLQ-QT500, the position and orientation of the flow meter and its connection tubing should be fixed after installation.
- If the PFA tubing is cut, it must be ensured that sufficient length is left to connect the flow meter to your system.

Table 5: Recommended minimum length of straight inlet tube depending on viscosity and flow rate

		Flow rate (µl/s)		
		1000	1500	2000
Kinematic viscosity (mm ² /s)	1.0 (H ₂ O at 23°C)	6 cm	9 cm	12 cm
	2.5 (IPA at 23°C)	3 cm ^a	4 cm ^a	5 cm
	5.0	2 cm ^a	2 cm ^a	3 cm ^a

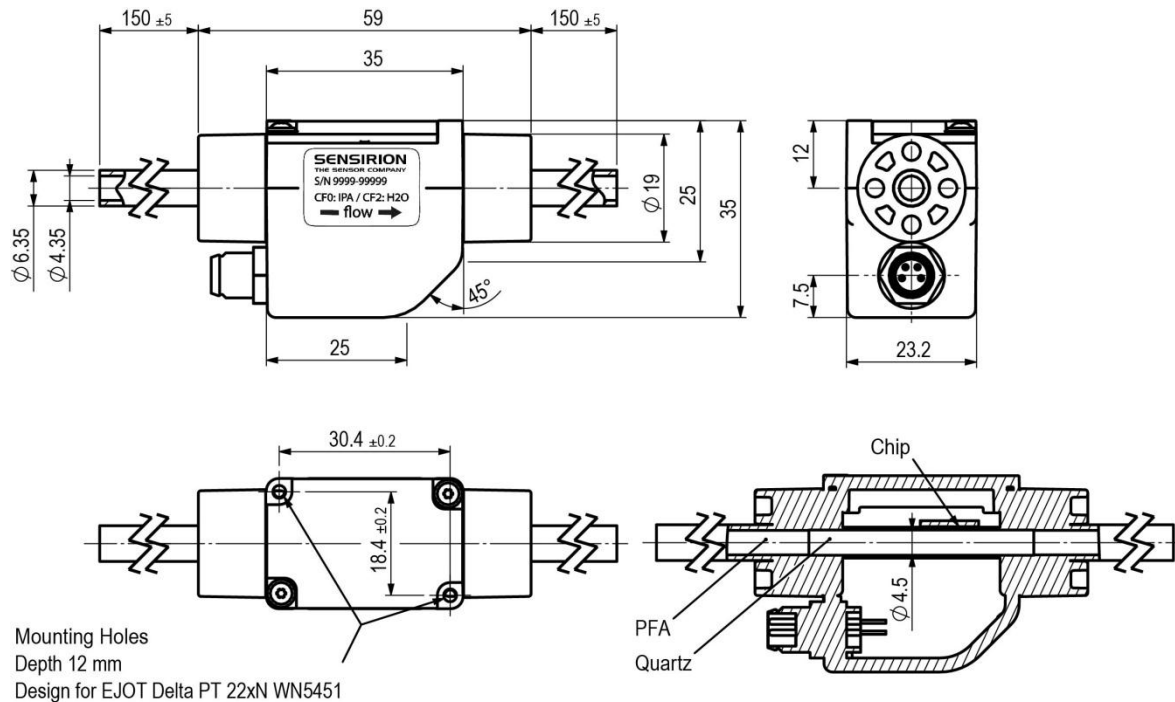
^a **Important!** This table lists the recommended minimum length from a fluidic point of view. A greater length may be required depending on the selected type of fluidic connector.

5 Mechanical Specifications

5.1 Dimensions

Table 6: Mechanical dimensions

Parameter	SLQ-QT500
Flow meter body dimensions	59 x 35 x 23.2 mm
Flow meter overall length	360±10 mm
Total mass	~45 g
Inner diameter sensor tube	4.5 mm
Inner diameter PFA tube	4.35 mm



All dimensions in mm

5.2 Materials

Table 7: Wetted materials

Part	Material	Flammability
Connection tubing 1/4"	PFA	UL-94 V-0
Capillary	Quartz	Not flammable

Table 8: Non-wetted materials

Part	Material	Flammability
Housing	PPS	UL-94 V-0
Screws and electrical connector	Stainless steel	Not flammable
Cables	Copper	Not flammable
	ETFE	UL-94 V-0

5.3 Labels

The SLQ-QT500 has two labels on opposite sides of the housing. Both labels are solvent resistant and contain the following information

- Sensirion product name
- Calibrations on the flow meter: calibration field (CF), type of liquid (H₂O or IPA), full scale flow rate
- Serial number as text and encoded in 2D bar code
- Positive flow direction marked by arrow

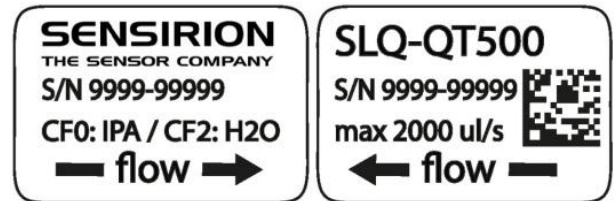


Figure 2: Labels on SLQ-QT500.

6 Cleanliness of flow path

6.1 Particles

The flow path of each SLQ-QT500 flow meter is flushed with ultra-pure water as a final production step before packing. The flow meter is then sealed in PE foil under ISO 5 clean room conditions. The particle count limit for the flushing process is less than

one detected particle per 1 ml of water, and the detection limit for particles is 100 nm in diameter.

Please contact Sensirion for general customer instructions on cleaning and clean handling of the flow meter.

7 Ordering Information

For OEM applications, the flow meter can be purchased in larger quantities without any additional parts. For optimum performance, Sensirion recommends using the SLQ-QT500 flow meter in combination with the SCC1 interface cables.

This laboratory-package contains:

- Liquid Flow Meter SLQ-QT500
- 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.

For laboratory use and technology evaluation, the Flow Meter Kit SLQ-QT500 can be ordered.

Table 9: Ordering information

Product	Article Number
SLQ-QT500 Liquid Flow Meter	1-100963-01
Flow Meter Kit SLQ-QT500	1-101004-01

Interface Cables:

SCC1-RS485 Sensor Cable Pigtail 2m	1-100804-01
SCC1-RS485 Sensor Cable Pigtail 5m	1-101122-01
SCC1-ANALOG Sensor Cable	1-101072-01
SCC1-USB Sensor Cable	1-101007-01

Important Notices

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 (including death). 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 datasheet 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.

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.

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.

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 AG (Germany)
phone: +41 44 927 11 66
info@sensirion.com
www.sensirion.com

Sensirion Inc., USA
phone: +1 805 409 4900
info_us@sensirion.com
www.sensirion.com

Sensirion Japan Co. Ltd.
phone: +81 3 3444 4940
info@sensirion.co.jp
www.sensirion.co.jp

Sensirion Korea Co. Ltd.
phone: +82 31 345 0031 3
info@sensirion.co.kr
www.sensirion.co.kr

Sensirion China Co. Ltd.
phone: +86 755 8252 1501
info@sensirion.com.cn
www.sensirion.com.cn

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

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 datasheet 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.

Copyright © 2001-2014, SENSIRION.

CMOSens® is a trademark of Sensirion

All rights reserved

CE, RoHS, REACH and WEEE Statement

The SLQ-QT500 complies with requirements of the following directives and regulations:



- The device fully 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 or SCC1-ANALOG Sensor Cables.
- EU Directive 1907/2006/EC concerning Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)
- 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 2002/65/EC on the restriction of certain hazardous substances in electric and electronic equipment (RoHS), OJ01.01.2011