

LG16 Liquid Flow Meter Series

Compact Liquid Flow Meter for OEM Applications

- Flow rates up to 10000 $\mu\text{l}/\text{min}$ for water and up to 80 ml/min for hydrocarbons
- Resolution down to sub nl/min
- Media separated, pressures up to 200 bar
- Digital I²C interface



Product Summary

The LG16 Liquid Flow Meter series enables fast, media separated measurements of very low liquid flow rates below 5000 $\mu\text{l}/\text{min}$. This product line is especially suited for OEM volume applications requiring small sized components with high performance at low cost.

Excellent chemical resistance and bio-compatibility are ensured: The flow path of the LG16 Liquid Flow Sensor is formed by a straight-through glass capillary and end fittings. There are no obstructions in the flow path.

For more information on communication, please refer to section 3 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
- Optimized for low cost
- Low signal noise

Content

| | |
|---|----|
| 1 Sensor Performance | 3 |
| 2 Specifications | 6 |
| 3 Sensor Output Signal Description | 7 |
| 4 Communication Interface Description | 8 |
| 5 Fluidic Specification and Connections | 9 |
| 6 Mechanical Specifications | 10 |
| 7 Ordering Information | 11 |
| 8 REACH, RoHS, and WEEE | 12 |
| 9 Important Notices | 13 |
| 10 Headquarters and Subsidiaries | 14 |

1 Sensor Performance

Sensor Performance

| Parameter | LG16-0025D | LG16-0150D | LG16-043xD | LG16-1000D | LG16-2000D | Units |
|---|---------------|---------------|---------------|--------------|-------------------|---|
| H ₂ O full scale flow rate | 1.50 | 7 | 80 | 1000 | 5000 | µl/min |
| H ₂ O sensor output limit ^a | 1.70 | 8 | 120 | 1100 | 5500 ^d | µl/min |
| Accuracy below full scale (whichever error is larger) | 10 0.5 | 5.0 0.3 | 5.0 0.15 | 5.0 0.2 | 5.0 0.2 | % of m.v. ^b % of full scale |
| Repeatability below full scale (whichever error is larger) | <1 0.06 | 0.5 0.05 | 0.5 0.01 | 0.5 0.02 | 0.5 0.02 | % of m.v. % of full scale |
| Temperature coefficient (additional error / °C; whichever is larger) | 0.15 0.007 | 0.09 0.005 | 0.13 0.003 | 0.1 0.004 | 0.1 0.004 | % m.v. / °C % full scale / °C |
| Mounting orientation sensitivity ^c | - | <0.4 | <0.4 | 1.0 | 1.5 | % of full scale |

^aFlow rate at which the sensor output saturates. See section 2 for performance between full scale and saturation point.

^bMeasured value

^cMaximum additional offset when mounted vertically

^dExtended range up to 10500 ul/min, see Specification Charts for details

Table 1: Model specific performance of LG16 (all data for medium H₂O, 23 °C, 1 bar_{abs} unless otherwise noted)

| Parameter | LG16-0150D | LG16-043xD | LG16-1000D | LG16-2000HC-D | Unit |
|---|------------|--------------|-------------|---------------|---|
| IPA full scale flow rate | 70 | 500 | 10'000 | 80 | µl/min |
| | | | | | ml/min |
| IPA sensor output limit ^a | 100 | 600 | 11'000 | 90 | µl/min |
| | | | | | ml/min |
| Accuracy below full scale (whichever error is larger) | 20 0.3 | 20 1 | 20 1 | 10 0.5 | % of m.v. ^b % of full scale |
| Repeatability below full scale (whichever error is larger) | 1 0.01 | 1 0.05 | 1 0.05 | 1.5 0.03 | % of m.v. % of full scale |
| Temperature coefficient (additional error / °C; whichever is larger) | 0.4 | 0.5 0.025 | 0.4 0.02 | 0.35 | % m.v. / °C % full scale / °C |

^aFlow rate at which the sensor output saturates

^bMeasured value

Table 2: Model specific performance of LG16 series (all data for medium IPA, 23 °C, 1 bar_{abs} unless otherwise noted)

1.1 Specification Charts

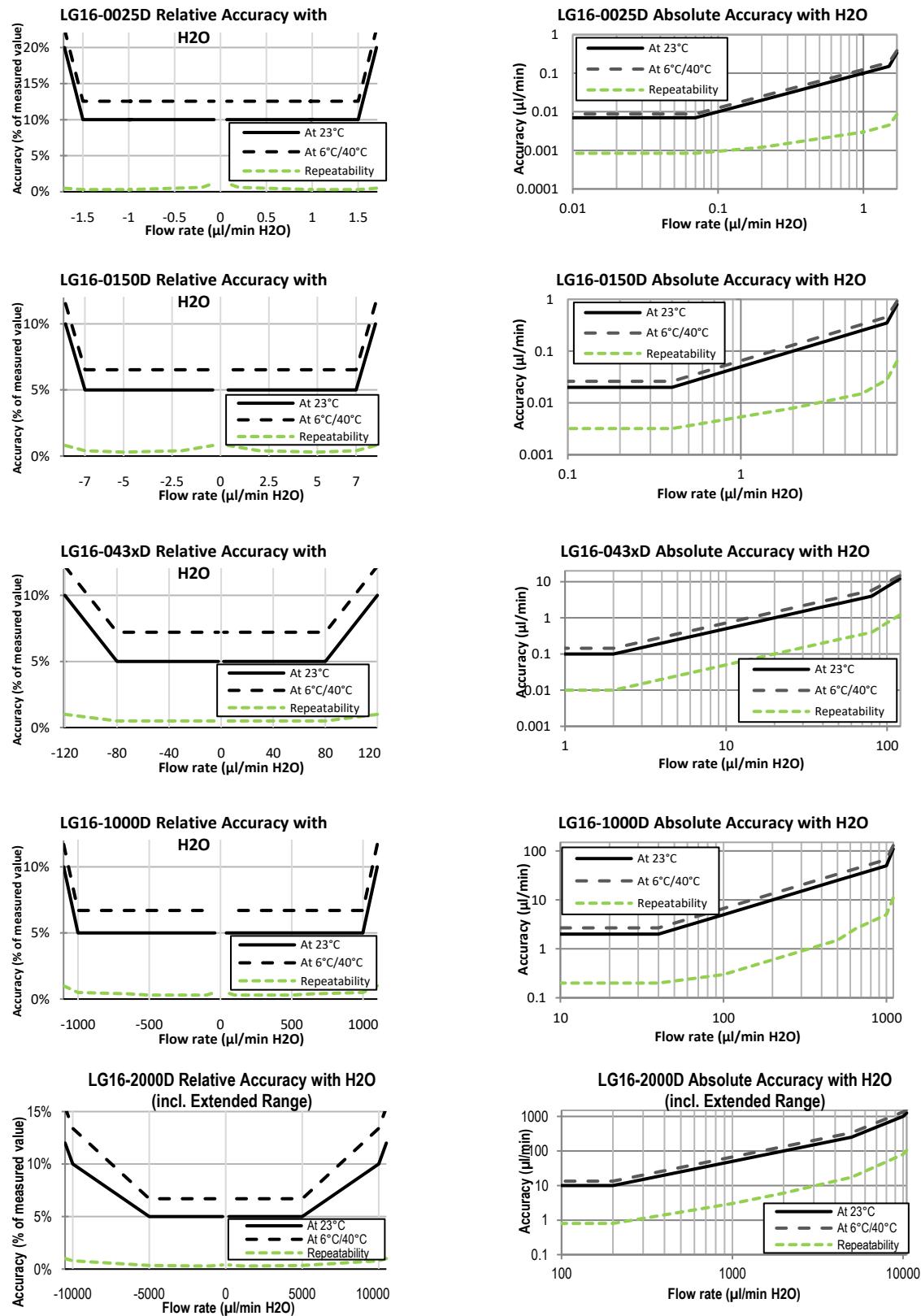


Figure 1: Flow meter accuracy and repeatability across the flow range. Relative error in % of measured value (left column) and absolute error in µl/min (right column) for H₂O.

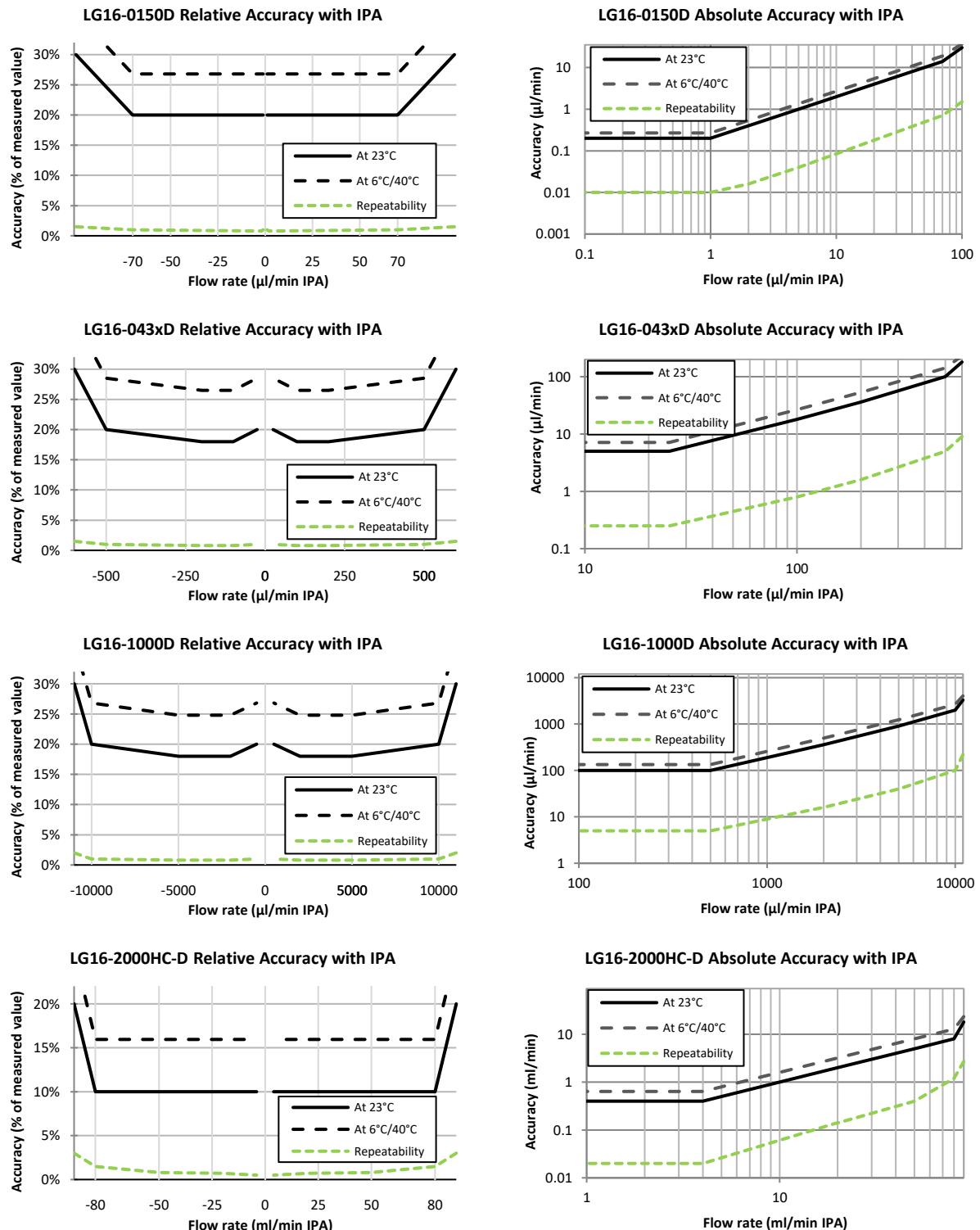


Figure 2: Flow meter accuracy and repeatability across the flow range. Relative error in % of measured value (left column) and absolute error in $\mu\text{l}/\text{min}$ or ml/min (LG16-2000HC-D) (right column) for IPA

2 Specifications

2.1 Electrical Specifications

| Parameter | Symbol | Min. | Typical | Max. | Units | Comments |
|-------------------|--------|------|---------|------|-------|-----------------------------------|
| Supply Voltage DC | VDD | 4.0 | 5.0 | 12.0 | V | Use 9 V max. for best performance |
| Operating current | IDD | | 6.8 | | mA | VDD = 4.0-12.0 V |

Table 3: DC Characteristics

2.2 Timing Specifications

| Parameter | Symbol | Min. | Typical | Max. | Units | Comments |
|--------------------------------|-----------|------|---------|------|-------|--|
| Power-up time | t_{PU} | | | 120 | ms | Time to sensor ready |
| Flow detection response time | | | 40 | | 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: 74 ms. |

Table 4: Timing specifications

2.3 Absolute Minimum and Maximum Ratings

| Parameter | Rating | Unit |
|---|-------------|------|
| Operating temperature | +10 ... +50 | °C |
| Short term storage temperature ^a | -10 ... +60 | °C |
| Maximum supply voltage | 12 | V |

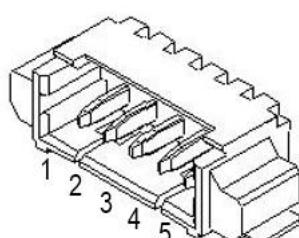
^a Flow path empty. Short term storage refers to temporary conditions during e.g. transport.

Table 5: Absolute minimum and maximum ratings

2.4 Electrical Connector and Pinout

Connector Type: 5-pin Molex PCB Header 53261-0571 (right angle); Mating connector Molex 51021-0500.

| Pin | |
|-----|----------------------|
| 1 | SDA (bi-directional) |
| 2 | SCL |
| 3 | VDD |
| 4 | GND |
| 5 | n/a, leave floating |



3 Sensor Output Signal Description

3.1 Switching between calibration fields

Different calibrations are available in calibration fields (CF) on some versions of the flow meter. The factory default is CF0. If the medium to be measured is different to the factory default calibration field, this has to be changed using the Sensirion Viewer Software or using digital commands via the I²C interface. The H₂O extended range calibration is only available on the LG16-2000D (S/N 1940-00000 and up). To convert the 16 bit signed integer number (two's complement number ranging from -32768...32768) into a physical value, it has to be divided by the respective scale factor (for example: liquid flow in $\mu\text{l}/\text{min}$ = sensor output \div scale factor).

| Sensor | CF0 (default) | Scale Factor | CF1 | Scale Factor | CF2 | Scale Factor |
|---------------|------------------|--|-----|--|--------------------------------|--|
| LG16-0025D | H ₂ O | 19 (nl/min) ⁻¹ | | | | |
| LG16-0150D | H ₂ O | 4 (nl/min) ⁻¹ | IPA | 300 ($\mu\text{l}/\text{min}$) ⁻¹ | | |
| LG16-043xD | H ₂ O | 270 ($\mu\text{l}/\text{min}$) ⁻¹ | IPA | 50 ($\mu\text{l}/\text{min}$) ⁻¹ | | |
| LG16-1000D | H ₂ O | 29 ($\mu\text{l}/\text{min}$) ⁻¹ | IPA | 2 ($\mu\text{l}/\text{min}$) ⁻¹ | | |
| LG16-2000D | H ₂ O | 5 ($\mu\text{l}/\text{min}$) ⁻¹ | | | H ₂ O Ext. Range | 3 ($\mu\text{l}/\text{min}$) ⁻¹ |
| LG16-2000HC-D | IPA | 360 (ml/min) ⁻¹ | | | | |

Table 6: Available calibrations on CF0, CF1 and CF2

4 Communication Interface Description

4.1 Digital Communication via I²C-Bus

Digital communication between a master and the LG16 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.

5 Fluidic Specification and Connections

| Parameter | LG16-0025D | LG16-0150D | LG16-0430D | LG16-0431D | LG16-1000D | LG16-2000(HC-)D | | |
|---|--|------------|------------|--|------------------------|-----------------|--|--|
| Wetted Materials: | | | | | | | | |
| Internal sensor tube material | Quartz Glass (Fused Silica) | | | | Borosilicate Glass 3.3 | | | |
| Fitting material | PEEK | | | | | | | |
| Sealing material | None | | | FEP | | | | |
| Fluid connector ports (Fittings) | UNF 6-40 for 1/32" OD tubing VICI® Nanovolume™ compatible | | | UNF 1/4-28 flat-bottom ports for 1/16" or 1/8" OD plastic tubing ^a | | | | |
| Pressure drop (at full scale flow rate, H ₂ O, 23°C) | 1 bar | 3 mbar | 1 mbar | <1 mbar | <1 mbar | | | |
| Pressure drop (at full scale flow rate, IPA, 23°C) | n.a. | 60 mbar | 7 mbar | 5 mbar | 2 mbar | | | |
| Total internal volume | 1 µl | 1.5 µl | 5 µl | 25 µl | 80 µl | | | |

^a1/8" OD tubing with 2 mm minimum ID is recommended for the LG16-2000(HC-)D.

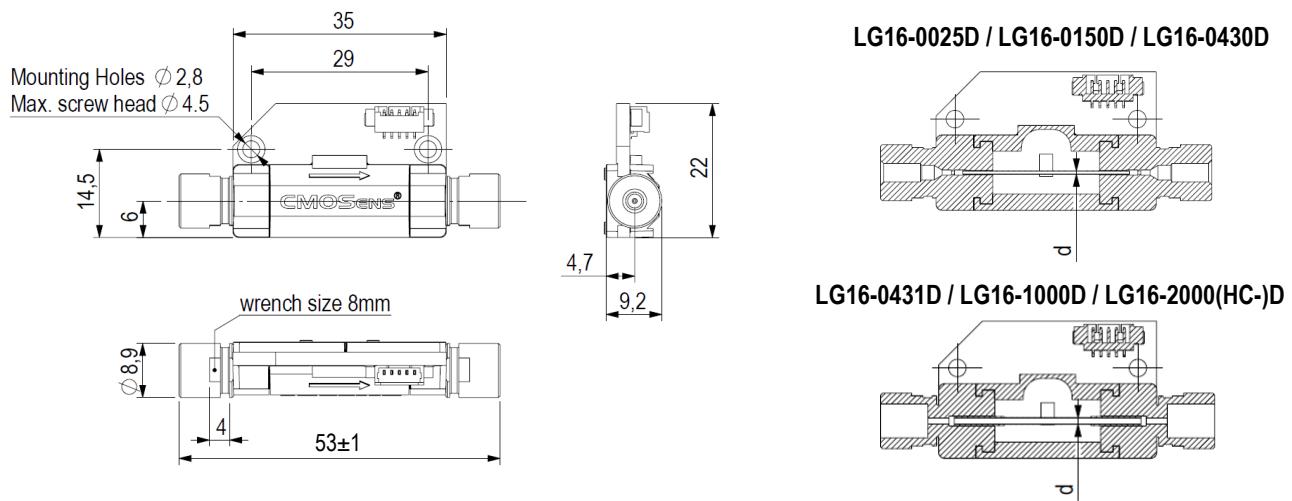
Table 7: Fluidic Specifications and Pressure Rating

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

6 Mechanical Specifications

| Parameter | LG16-0025D | LG16-0150D | LG16-0430D | LG16-0431D | LG16-1000D | LG16-2000(HC-)D |
|--|------------------|-------------------|-------------------|------------|------------|-----------------|
| Largest dimensions | 53 x 22 x 9 mm | | | | | |
| Total mass | 6 g | | | | | |
| Inner diameter d | 25 μm | 150 μm | 430 μm | 1.0 mm | 1.8 mm | |
| Maximum recommended operating pressure | 200 bar | 100 bar | 30 bar | 15 bar | | |
| Burst pressure | 400 bar | 200 bar | 80 bar | 30 bar | | |

Table 8: Mechanical specifications and pressure rating



All dimensions in mm

| Attention Fragile | |
|---|---|
| Mechanical shocks and connecting to the fittings without suitable tools leads to stress on the internal thin walled glass capillary and can cause it to break. | ! |
| <ul style="list-style-type: none"> While tightening the fittings, fix the fluidic ports position with a wrench. Test for leakage after every time new connections are made. | ! |

7 Ordering Information

Standard shipment includes only the sensor, neither cables for electrical connection nor fluidic connection material are included. Preassembled 5-pin Molex to pigtail ribbon cables (Molex 1.25 mm Pitch Receptacle Type 51021-0500 (PicoBlade™ 51021), 30 cm) can be ordered optionally. For evaluation and testing, connectivity kits including cables and fluidic fittings are available.

| Product | Calibration | | Article Number | MOQ | Packaging Unit |
|------------------------------------|-------------|-----|----------------|-----|----------------|
| | H2O | IPA | | | |
| LG16-0025D 1500 nl/min | ● | | 1-100428-01 | 25 | 25 |
| LG16-0150D 7000 nl/min | ● | ● | 1-100410-01 | 25 | 25 |
| LG16-0430D 80 ul/min | ● | ● | 1-100853-02 | 25 | 25 |
| LG16-0431D 80 ul/min, 1/4-28 ports | ● | ● | 3.000.334 | 25 | 25 |
| LG16-1000D 1000 ul/min | ● | ● | 1-100406-01 | 25 | 25 |
| LG16-2000D 5 ml/min (10 ml/min) | ● | | 1-100404-01 | 25 | 25 |
| LG16-2000HC-D 80ml/min IPA | | ● | 1-100840-01 | 25 | 25 |

| | | | | | |
|--|-----|-----|-------------|----|-----|
| Ribbon Cable for LG01/LG16 30cm | n/a | n/a | 1-100482-01 | 25 | n/a |
| LG16/LG01 Connectivity Kit UNF 1/4-28 (for LG16-0431D, -1000D, -2000D, -2000HC-D) | n/a | n/a | 1-100814-01 | 25 | n/a |
| LG16 Connectivity Kit UNF 6-40 coned (for LG16-0150D, -0430D) | n/a | n/a | 1-101691-01 | 25 | n/a |

8 REACH, RoHS, and WEEE

The LG16 series complies with requirements of the following directives and regulations:

- 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.

9 Important Notices

9.1 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.

9.2 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.
See application note "ESD, Latchup and EMC" for more information.

9.3 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.

Copyright® 2020, by SENSIRION.
CMOSens® is a trademark of Sensirion
All rights reserved

10 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 Inc., USA

phone: +1 312 690 5858
info-us@sensirion.com
www.sensirion.com

Sensirion Korea Co. Ltd.

phone: +82 31 337 7700~3
info-kr@sensirion.com
www.sensirion.co.kr

Sensirion Japan Co. Ltd.

phone: +81 3 3444 4940
info-jp@sensirion.com
www.sensirion.co.jp

Sensirion China Co. Ltd.

phone: +86 755 8252 1501
info-cn@sensirion.com
www.sensirion.com.cn

Sensirion Taiwan Co. Ltd

phone: +886 3 5506701
info@sensirion.com
www.sensirion.com

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

Revision History of the LG16 Series Datasheet

| Revision | Date | Changes Chapter | Description |
|----------|-----------|-----------------|---|
| 8 | Jan 2020 | 5 | Product names updated and connectivity kits added, editorial changes |
| 7 | Sept 2019 | All | Introduced LG16-0431D. Extended range for LG16-2000D |
| 6 | Sept 2018 | all | Removal analog LG16 versions. Update: layout. Correction: various small bugfixes. |

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Sensirion:

[LG16-0150D 7000 nl/min](#) [LG16-0430D 80 ul/min](#) [LG16-0431D 80 ul/min 1/4-28 Ports](#) [LG16-1000D 1000 ul/min](#)
[LG16-2000D 5 ml/min \(10 ml/min\)](#) [LG16-2000HC-D 80ml/min IPA](#)