SENSIRION
THE SENSOR COMPANY

# LG16 Liquid Flow Meter Series

## Compact Liquid Flow Meter for OEM Applications

- Liquid flow rates up to 5000 µl/min
- Resolutions down to sub nl/min
- Totally non-invasive, pressures up to 200 bar
- Digital I²C interface or analog out 0-5 V

**Product Summary**

The LG16 Liquid Flow Meter series enables fast, non-invasive measurements of very low liquid flow rates below 5 ml/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-thru glass capillary and end fittings. There are no obstacles in the flow path.

**Interface Options**

**Digital**
- I²C-Bus

**Analog**
- Voltage output (0-5 V)

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

## 1 Sensor Performance

Table 1: Model specific performance of LG16 (all data for medium $H_2O$, 23 °C, 1 $bar_{abs}$ unless otherwise noted)

| Parameter | LG16-0025 | LG16-0150 | LG16-0430 | LG16-1000 | LG16-2000 | Unit |
|---|---|---|---|---|---|---|
| $H_2O$ full scale flow rate[a] | 1.50 | 7 | 80 | 1000 | 5000 | µl/min |
| $H_2O$ sensor output limit[b] for digital version | 1.70 | 8 | 120 | 1100 | 5500 | µl/min |
| Accuracy below full scale (whichever error is larger) | 10<br>0.5 | 5.0<br>0.3 | 5.0<br>0.15 | 5.0<br>0.2 | 5.0<br>0.2 | % of m.v.[c]<br>% of full scale |
| Repeatability below full scale (whichever error is larger) | <1<br>0.06 | 0.5<br>0.05 | 0.5<br>0.01 | 0.5<br>0.02 | 0.5<br>0.02 | % of m.v.<br>% of full scale |
| Temperature coefficient (additional error / °C; whichever is larger) | 0.15<br>0.007 | 0.09<br>0.005 | 0.13<br>0.003 | 0.1<br>0.004 | 0.1<br>0.004 | % m.v. / °C<br>% full scale / °C |
| Mounting orientation sensitivity[d] | - | <0.4 | <0.4 | 1.0 | 1.5 | % of full scale |
| Flow detection response time $\tau_{63}$ | 40 | | | | | ms |
| Response time on power-up | 120 | | | | | ms |
| Operating temperature | +10…+50 | | | | | °C |
| Ambient storage temperature[e] | -10…+60 | | | | | °C |
| Operating pressure | 200 | | 100 | 15 | 15 | bar |
| Burst pressure | 400 | | 200 | 30 | 30 | bar |

[a]Corresponds with 4.8 V in analog version
[b]Flow rate at which the sensor output saturates. See section 2 for performance between full scale and saturation point.
[c]Measured value
[d]Maximum additional offset when mounted vertically
[e]Non-condensing, flow path empty

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

| Parameter | LG16-0150D | LG16-0430D | LG16-1000D | LG16-2000HC-D | Unit |
|---|---|---|---|---|---|
| IPA full scale flow rate | 70 | 500 | 10'000 | | µl/min |
| | | | | 80 | ml/min |
| IPA sensor output limit[a] | 100 | 600 | 11'000 | | µl/min |
| | | | | 90 | ml/min |
| Accuracy below full scale (whichever error is larger) | 20<br>0.3 | 20<br>1 | 20<br>1 | 10<br>0.5 | % of m.v.[b]<br>% of full scale |
| Repeatability below full scale (whichever error is larger) | 1<br>0.01 | 1<br>0.05 | 1<br>0.05 | 1.5<br>0.03 | % of m.v.<br>% of full scale |
| Temperature coefficient (additional error / °C; whichever is larger) | 0.4 | 0.5<br>0.025 | 0.4<br>0.02 | 0.35 | % m.v. / °C<br>% full scale / °C |

[a]Flow rate at which the sensor output saturates
[b]Measured value

## 1.1 Switching between calibration fields

Different calibrations are available in calibration fields (CF) on digital 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 $I^2C$ or RS485 interface.

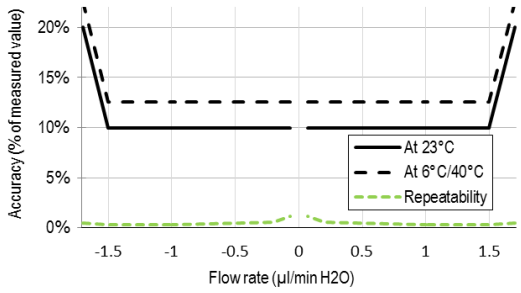
Table 3: Available calibrations on CF0 and CF1

| Sensor | CF0 (default) | CF1 |
|---|---|---|
| LG16-0025D | $H_2O$ | |
| LG16- 0150D | $H_2O$ | IPA |
| LG16-0430D | $H_2O$ | IPA |
| LG16-1000D | $H_2O$ | IPA |
| LG16-2000D | $H_2O$ | |
| LG16-2000-HC-D | IPA | |

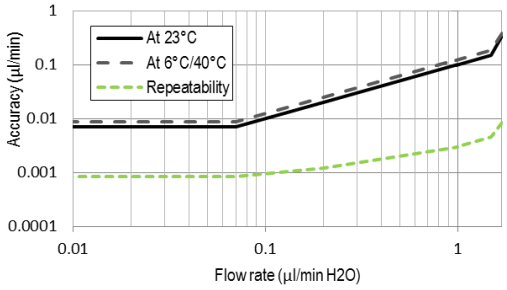
Analog flow meter variants only feature $H_2O$ calibration. For communication with the analog variant see section 3.4.

# 2 Specifications Charts

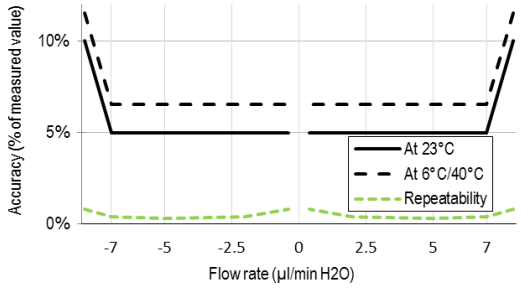
**LG16-0025 Relative Accuracy with $H_2O$**



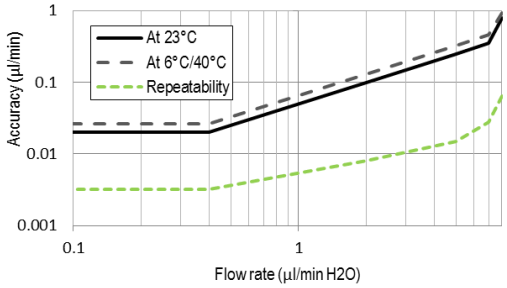

**LG16-0025 Absolute Accuracy with $H_2O$**



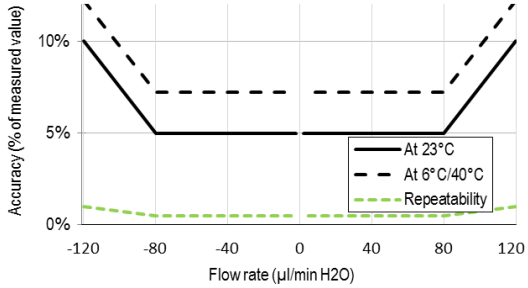

**LG16-0150 Relative Accuracy with $H_2O$**



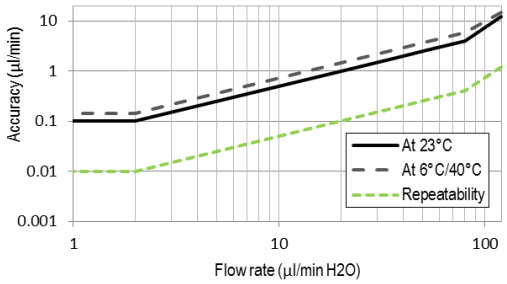

**LG16-0150 Absolute Accuracy with $H_2O$**



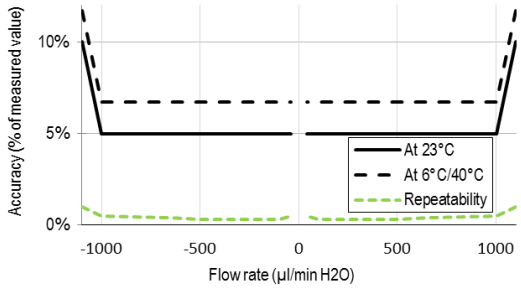

**LG16-0430 Relative Accuracy with $H_2O$**



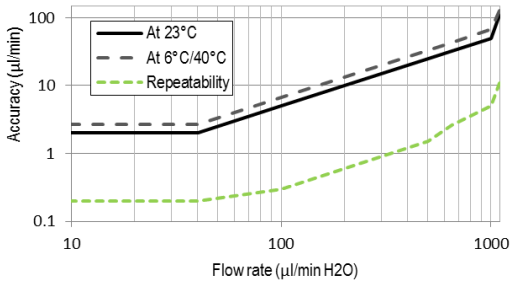

**LG16-0430 Absolute Accuracy with $H_2O$**



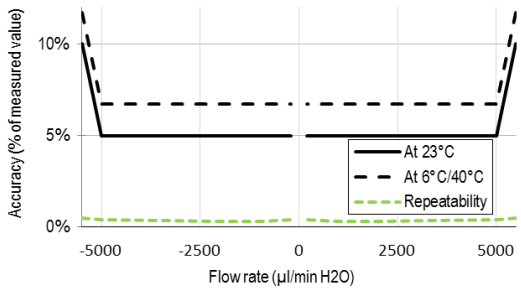

**LG16-1000 Relative Accuracy with $H_2O$**




**LG16-1000 Absolute Accuracy with $H_2O$**




**LG16-2000 Relative Accuracy with $H_2O$**




**LG16-2000 Absolute Accuracy with $H_2O$**

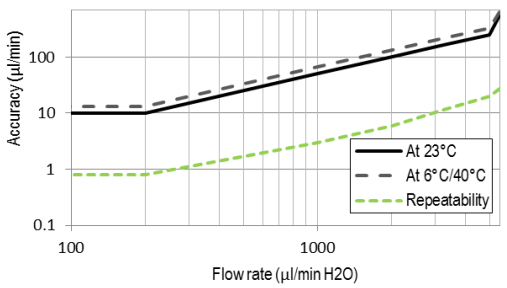


Figure 1: Flow meter accuracy and repeatability across the flow range. Relative error in % of measured value (left column) and absolute error in µl/min (right column) for $H_2O$.

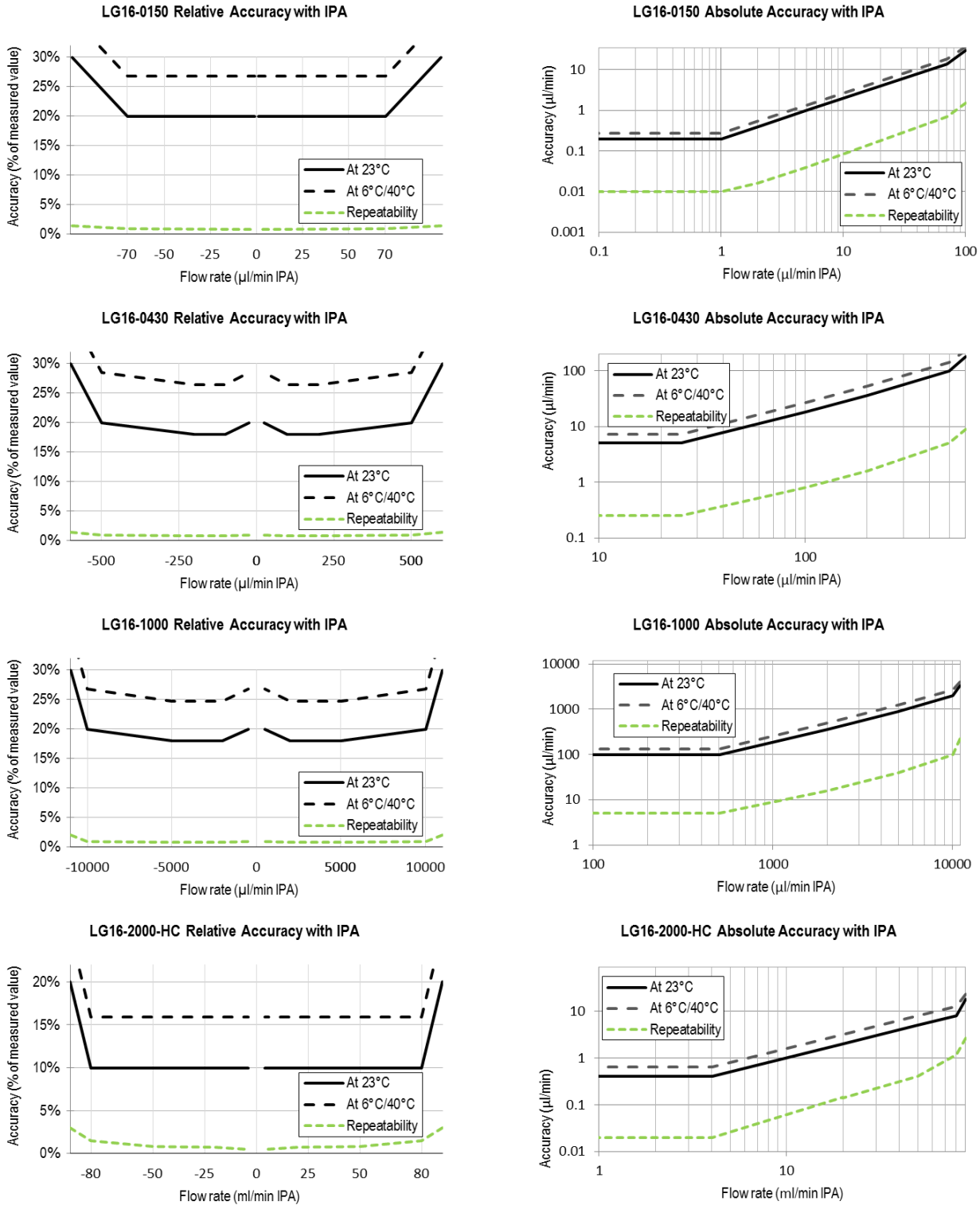



Figure 2: Flow meter accuracy and repeatability across the flow range. Relative error in % of measured value (left column) and absolute error in µl/min or ml/min (LG16-2000-HC) (right column) for IPA.

# 3 Communication with the Sensor

The OEM flow sensor LG16 shows bi-directional, linear transfer characteristics. It can be ordered as analog or digital output version. Please see the following section for more details and the table on page 7 for an overview of the available options.

| | |
|---|---|
| Digital sampling time, 16 bit | 74 ms |
| Digital sampling time, 9 bit | 1 ms |

## 3.1 Electrical Specifications

Table 4: DC Characteristics

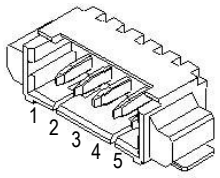
| Parameter | Min. | Typ. | Max. | Units |
|---|---|---|---|---|
| Power Supply DC, VDD | | | | |
| Digital version | 4.0 | 5.0 | 12[a] | V |
| Analog version | 6.0 | 7.0 | 12[a] | V |
| Operating Current, VDD = 4.0-12 V, no load | | 6.8 | | mA |

[a]Use 9 V max. for best performance

## 3.2 Electrical Connector and Sensor Pinout

Connector Type: 5 pin Molex PCB Header 53261-0590 (right angle).

| Pin | |
|---|---|
| 1 | SDA (bi-directional) |
| 2 | SCL |
| 3 | VDD |
| 4 | GND |
| 5 | Analog out |




## 3.3 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.

## 3.4 Analog Communication

The LG16 is available as analog version, with the voltage output representing the current flow rate.

| Analog Out Voltage Range | |
|---|---|
| Negative full scale flow | 0.2 V |
| Zero flow | 2.5 V |
| Positive full scale flow | 4.8 V |
| Minimum load resistance | 10 kΩ |

The analog sensor's output limit is 5V, thus the actual flow rate output limit is lower than the corresponding digital version's output limit (noted in Table 1).

# 4 Fluidic Connection

Table 5: Fluidic Specifications and Pressure Rating

| Parameter | LG16-0025 | LG16-0150 | LG16-0430 | LG16-1000 | LG16-2000 |
|---|---|---|---|---|---|
| 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<br>VICI® Nanovolume™ compatible | | | ¼-28 flat-bottom<br>for 1/16" or 1/8" OD plastic tubing[a] | |
| Pressure drop (at full scale flow rate, $H_2O$, 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 |

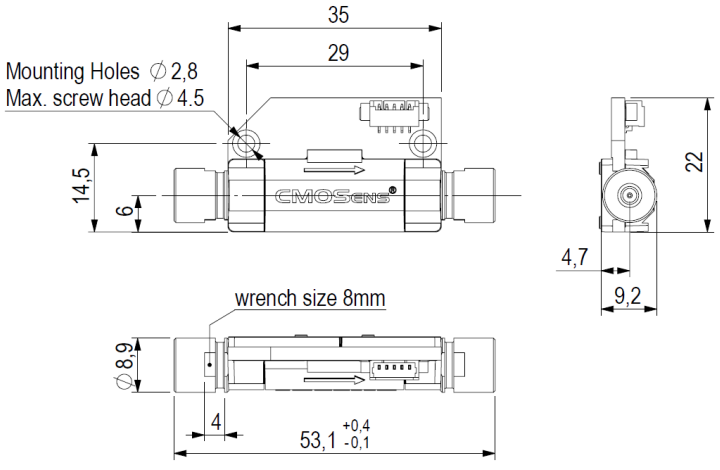
[a]1/8" OD tubing with 2 mm minimum ID is recommended for the LG16-2000.

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).

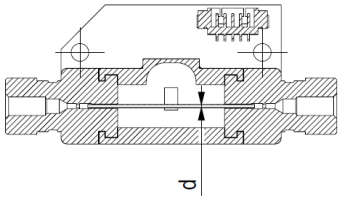
# 5 Mechanical Specifications

Table 6: Mechanical Specifications

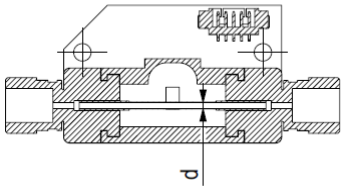
| Parameter | LG16-0025 | LG16-0150 | LG16-0430 | LG16-1000 | LG16-2000 |
|---|---|---|---|---|---|
| Largest dimensions | 53 x 22 x 9 mm | | | | |
| Total mass | 6 g | | | | |
| Inner diameter d | 25 µm | 150 µm | 430 µm | 1.0 mm | 1.8 mm |




**LG16-0025 / LG16-0150 / LG16-0430**




**LG16-1000 / LG16-2000**




**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.<br>• While tightening the fittings, fix the fluidic ports position with a wrench.<br>• Test for leakage after every time new connections are made. | ! |

# 6 Ordering Information

Each model is available with an analog output (ending "A") or with a digital output (ending "D").

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.

| Product | Signal Output | | Calibration | | Article Number | MOQ | Packaging Unit |
|---|---|---|---|---|---|---|---|
| | analog | digital | H2O | IPA | | | |
| LG16-0025A | ● | | ● | | 1-100427-01 | 25 | 25 |
| LG16-0025D | | ● | ● | | 1-100428-01 | 25 | 25 |
| LG16-0150A | ● | | ● | | 1-100409-01 | 25 | 25 |
| LG16-0150D | | ● | ● | ● | 1-100410-01 | 25 | 25 |
| LG16-0430A | ● | | ● | | 1-100852-02 | 25 | 25 |
| LG16-0430D | | ● | ● | ● | 1-100853-02 | 25 | 25 |
| LG16-1000A | ● | | ● | | 1-100405-01 | 25 | 25 |
| LG16-1000D | | ● | ● | ● | 1-100406-01 | 25 | 25 |
| LG16-2000A | ● | | ● | | 1-100403-01 | 25 | 25 |
| LG16-2000D | | ● | ● | | 1-100404-01 | 25 | 25 |
| LG16-2000HC-D | | ● | | ● | 1-100840-01 | 25 | 25 |
| | | | | | | | |
| 5-pin Molex to pigtail ribbon cable, 30 cm | n/a | n/a | n/a | n/a | 1-100482-01 | 25 | n/a |

# 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. 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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**REACH, RoHS and WEEE Statement**

The flow meters of the LG16 Series comply with requirements of the following directives:

- 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

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