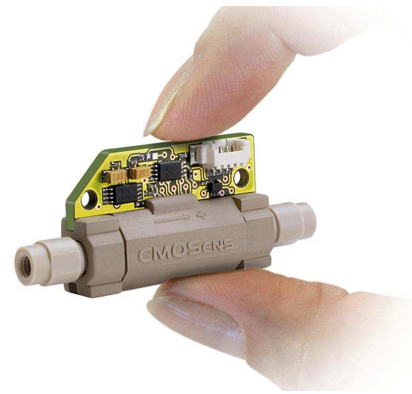


# LG216

## Pressure Resistant Milliliter Flow Sensor

- Maximum flow up to 20 ml/min
- Resolutions in the  $\mu$ l-Range
- Flow path made of glass and PEEK™ only
- Maximum pressure up to 20 bar (290 psi)



### 1 Introduction LG216

The LG216 Liquid Flow Sensor series enables fast, non invasive measurements of low liquid flow rates up to 20 ml/min with medium water<sup>a</sup>. 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 LG216 Liquid Flow Sensors is formed by a simple, straight glass capillary. This Swiss made, non invasive sensors are based on Sensirion's patented CMOSens® Technology (US Patent 6,813,944 B2). The fourth generation MEMS sensors combine a thermal high precision sensor element with amplification circuits and digital intelligence for linearization and temperature compensation on one single microchip – the products core element.

**Attention:** The output signal can be misunderstood below the specified minimum flow rate.

### 2 Sensing Performance

Table 1: Model specific performance of LG216 (all data for medium H<sub>2</sub>O, 20°C, 1 bar<sub>abs</sub> unless otherwise noted)

Parameter	Condition	LG216-0480	LG216-1000 <sup>b</sup>	Units
Maximum Flow Rate		20	80	ml/min
Minimum Flow Rate		1.0	6	ml/min
Digital Resolution (16 bit)	Minimum Flow Rate	0.8	8.0	$\mu$ l/min
Accuracy		5.0	tbd	% of measured value
Temperature Coefficient		0.1	tbd	(% m.v.) / K
Signal Noise, 16 bit digital output		4.5	tbd	LSB
- at Minimum Flow Rate		16	tbd	$\mu$ l/min
- at Maximum Flow Rate		180	tbd	$\mu$ l/min
Signal Noise, analog output, RMS		< 2		mV
Flow Detection Response Time $\tau_{63}$		50		ms
Response Time On Power-Up		120		ms
Digital Sampling Rate, 16 bit		74		ms
Digital Sampling Rate, 9 bit		1		ms
Operating Temperature		+10...+50		°C
Ambient storage temperature		-10...+60 (empty flow channel)		°C

#### Attention: Minimize Temperature Differences

For correct operation of the LG216 flow sensors the temperature difference between liquid medium and ambient air needs to be minimized. This temperature difference must not exceed 3°C.



<sup>a</sup> The sensors of the LG216 series are only suited for use with water or aqueous solution (solutions with high water content). For measuring other liquids please refer to Sensirion's other liquid flow sensors.

<sup>b</sup> Only available for high volume OEM projects.

### 3 Output Signal

The LG216 can be ordered as analog output version (0...5V, LG216-xxxx-A) or as digital output version (LG216-xxxx-D). Digital communication between a master and the LG216 sensor runs via the standard I<sup>2</sup>C-interface. The physical interface consists of two bus lines, a data line (SDA) and a clock line (SCL). 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 I<sup>2</sup>C communication refer to the Sensirion "User Manual I<sup>2</sup>C-Mode SF04".

The LG216 is a uni-directional liquid flow sensor. The product comes fully calibrated for water (see Fig. 1). Below the specified minimum flow rate (with medium H<sub>2</sub>O) the flow signal is not valid and has to be actively ignored by the system as the output can be similar above the specified minimum flow rate (see Fig. 2). To determine if the flow rate is above the lower limit and the signal valid a special check via digital sensor communication is required (request application note) or an additional source of information from the surrounding system is needed.

The maximum output signal of LG216 sensors is generated at zero flow as well as above the specified maximum flow rate. At the specified minimum flow rate the output signal is zero. Between the specified minimum flow rate and the specified maximum flow rate the signal rises linearly to its maximum value.

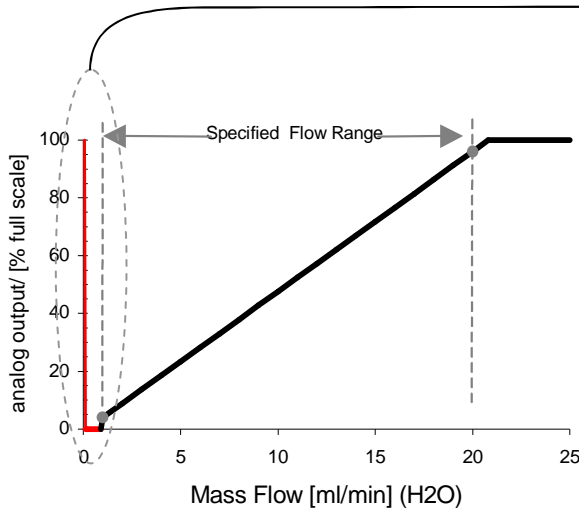


Fig. 1 : Transfer Characteristics, Full Range (example LG216-0480 with water)

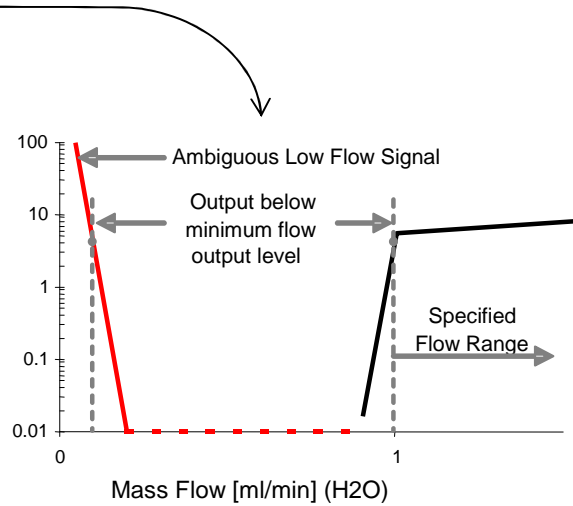


Fig. 2: Transfer Characteristics, Low Range (example LG216-0480 with water)

## 4 Electrical and Mechanical Specifications

### 4.1 Electrical Specifications

Table 2: DC Characteristics.

Parameter	Conditions	Min.	Typ.	Max.	Units
Power Supply DC, VDD	for digital out I <sup>2</sup> C operation	3.5		9 <sup>a</sup>	V
	for analog out operation	5.5		9 <sup>a</sup>	V
Operating Current	V <sub>DD</sub> = 3.5 V, no load		6.8		mA
	V <sub>DD</sub> = 12 V, no load		6.8		mA
Analog Out Voltage Range	Minimum to maximum flow rate (LG216-xxxx-A only)	0.2		4.8	V
Load at Analog Out		10		∞	kΩ

<sup>a</sup> Keep supply voltage below 9V for precision applications; if decreased accuracy is acceptable max. supply voltage is 12V; exceeding 12V will lead to permanent damage of the sensor

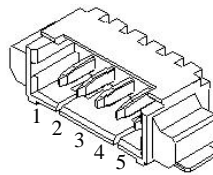
Table 3: I<sup>2</sup>C Output Characteristics (LG216-xxxx-D only).

Parameter	Conditions	Min.	Typ.	Max.	Units
I <sup>2</sup> C Clock Frequency			100		kHz
Max. Output Current	Data line			tbd	μA
Output Voltage Swing	Transmitter output not loaded	tbd		tbd	V
	$I_{out} = 50 \mu A$		tbd		V
Power-Off Output Resistance			tbd		MΩ

#### 4.2 Electrical Connector and 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



#### 4.3 Connection for Analog Operation and for Digital Communication via I<sup>2</sup>C-Bus

Digital communication between LG16-xxxx-D type sensors and an I<sup>2</sup>C master works on both 5V or 3.3V level. The SDA and SCL lines need to be connected via pull-up resistors with the bus voltage of the system. The individual I<sup>2</sup>C address of each sensor on the I<sup>2</sup>C bus can be set with a special interface tool.

#### 4.4 Mechanical Specifications and Pressure Rating

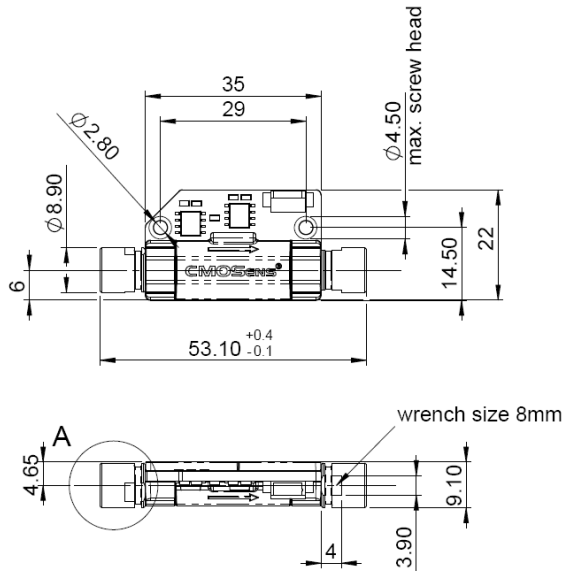
Inside the LG216 flow sensors a highly sensitive microsensor-chip is mounted on the outside of a straight glass capillary and allows to measure the flow through the wall (US Patent 6,813,944 B2) using a thermal principle.

Table 4: Mechanical Specifications and Pressure Rating

Parameter	LG216-0480	LG216-1000
Fluid Connector Standard (Fittings)	1/4-28 for 1/16" or 1/8" OD plastic tubing	
Wetted Materials:		
<ul style="list-style-type: none"> <li>Internal Sensor Capillary Material</li> </ul>	Quartz Glass (Fused Silica)	Borosilicate Glass 3.3 (Duran®)
<ul style="list-style-type: none"> <li>Fitting Material</li> </ul>	100% PEEK™ (polyetheretherketone)	
<ul style="list-style-type: none"> <li>Additional Sealing Material</li> </ul>	None	Teflon®
Overpressure Resistance	20 bar 290 psi	5 bar
Maximum Pressure Drop (at max. flow rate)	0.125 bar	tbd
Internal Sensor Capillary, Inner Diameter	0.48 mm	1 mm
Total Mass	6 g	

<b>Attention Fragile</b>	
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. Test for leakage after every time new connections are made.	<b>!</b>

## 5 Physical Dimensions



## 6 Ordering Information

The LG216 flow sensors can be ordered with analog output (ending "-A") or with digital output ending ("-D").

Product	Article Number
LG216-0480-A	1-100431-01
LG216-0480-D	1-100432-01

## 7 Important Notices

### 7.1 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.

### 7.2 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.

### 7.3 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© 2001-2008, SENSIRION.  
CMOSens® is a trademark of Sensirion  
All rights reserved.  
PEEK™ is a trademark of Victrex PLC  
Teflon® are registered trademarks of DuPont Corporation  
Duran® is a trademark of the SCHOTT-Group

#### 7.4 RoHS and WEEE Statement

The LG16 product family complies with requirements of the following directives:

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 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (**RoHS**), OJ 13.02.2003; esp. its Article 4.



## Headquarter and Sales Office

SENSIRION AG  
Laubisruetistr. 50  
CH-8712 Staefa ZH  
Switzerland  
Phone: +41 44 306 40 00  
Fax: +41 44 306 40 30  
[info@sensirion.com](mailto:info@sensirion.com)  
<http://www.sensirion.com>

SENSIRION Inc.  
Westlake Pl. Ctr. I, suite 204  
2801 Townsgate Road  
Westlake Village, CA 91361  
USA  
Phone: +1 805 409 4900  
Fax: +1 805 435 0467  
[michael.karst@sensirion.com](mailto:michael.karst@sensirion.com)  
<http://www.sensirion.com>

SENSIRION Japan  
Sensirion Japan Co. Ltd.  
Shinagawa Station Bldg. 7F  
4-23-5 Takanawa  
Minato-ku, Tokyo, Japan  
Phone: +81 3-3444-4940  
Fax: +81 3-3444-4939  
[info@sensirion.co.jp](mailto:info@sensirion.co.jp)  
<http://www.sensirion.co.jp>

SENSIRION Korea Co. Ltd.  
#1414, Anyang Construction Tower B/D,  
1112-1, Bisan-dong, Anyang-city,  
Gyeonggi-Province, South Korea  
Phone: +82-31-440-925~27  
Fax: +82-31-440-9927  
[info@sensirion.co.kr](mailto:info@sensirion.co.kr)  
<http://www.sensirion.co.kr>

SENSIRION China Co. Ltd.  
Room 2411, Main Tower  
Jin Zhong Huan Business Building,  
Futian District, Shenzhen, PR China  
Postal Code 518048  
Phone: +86 755 8252 1501  
Fax: +86 755 8252 1580  
[info@sensirion.com.cn](mailto:info@sensirion.com.cn)  
<http://www.sensirion.com.cn>

Find your local representative at: <http://www.sensirion.com/reps>