LPG10 Liquid Flow Sensor (Preliminary Datasheet)

Digital Planar Package Sensor

- Ultra small size
- Excellent repeatability
- Bio-compatible & inert materials
- Calibrated and temperature compensated digital output (I²C)

Product Summary

Unique CMOSens® planar packaging technology enables non-invasive measurement of liquid flow inside a cost-effective planar form factor. The flow channel passes through the planar substrate and is connected to fluidic channels via a manifold. The fluid is only in contact with the glass channel. The digital microsensor chip provides the full signal processing functionality for a fully calibrated, temperature-compensated digital output.

Integration of the LPG10-0150 and LPG10-0500 Liquid Flow Sensors

Due to the dramatically reduced size and downmount fluidic connections, the LPG10 Series allows an outstandingly compact mechanical, fluidic, and electronic integration. To receive support and acceleration on initial testing, please contact Sensirion about existing integration solutions.

1 Sensor Performance

Table 1: Performance of LPG10-0150 and LPG10-0500 models
(all data for medium H₂O, 23 °C, 1 bar abs unless otherwise noted)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>LPG10-0150</th>
<th>LPG10-0500</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full scale flow rate</td>
<td>10</td>
<td>100</td>
<td>µl/min</td>
</tr>
<tr>
<td>Sensor output limit³</td>
<td>15</td>
<td>150</td>
<td>µl/min</td>
</tr>
<tr>
<td>Accuracy below full scale (whichever error is larger)</td>
<td>5</td>
<td>5</td>
<td>% of measured value</td>
</tr>
<tr>
<td></td>
<td>tbd</td>
<td>0.2</td>
<td>% of full scale</td>
</tr>
<tr>
<td>Repeatability error from zero to full scale (whichever error is larger)</td>
<td>1</td>
<td>1</td>
<td>% of measured value</td>
</tr>
<tr>
<td></td>
<td>tbd</td>
<td>0.04</td>
<td>% of full scale</td>
</tr>
<tr>
<td>Temperature coefficient (additional error / °C; whichever is larger)</td>
<td>0.1</td>
<td>0.1</td>
<td>% of measured value / °C</td>
</tr>
<tr>
<td></td>
<td>tbd</td>
<td>0.005</td>
<td>% of full scale / °C</td>
</tr>
<tr>
<td>Flow detection response time τₙ₀</td>
<td>40</td>
<td></td>
<td>ms</td>
</tr>
<tr>
<td>Response time on power-up</td>
<td>120</td>
<td></td>
<td>ms</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>+5 ... +50 (+41 ... +122)</td>
<td>°C (°F)</td>
<td></td>
</tr>
<tr>
<td>Operating humidity</td>
<td>0...95%, non-condensing</td>
<td>% RH</td>
<td></td>
</tr>
<tr>
<td>Storage temperature³</td>
<td>-40 ... +60 (-40 ... +140)</td>
<td>°C (°F)</td>
<td></td>
</tr>
<tr>
<td>Storage humidity</td>
<td>0...95%, non-condensing</td>
<td>% RH</td>
<td></td>
</tr>
<tr>
<td>Recommended maximum operating pressure²</td>
<td>tbd</td>
<td>10 (145)</td>
<td>bar (psi)</td>
</tr>
<tr>
<td>Burst pressure</td>
<td>tbd</td>
<td>20 (290)</td>
<td>bar (psi)</td>
</tr>
</tbody>
</table>

³Flow rate at which the sensor output saturates, see section 2 for performance specifications between full scale and saturation point
²Flow path empty
³Pressures listed are mechanical limits of the glass substrate; Burst pressure of manifold assembly depends on actual manifold seal design.
2 Specifications Chart

![LPG10-500 Relative Accuracy with H₂O](image1)

![LPG10-500 Absolute Accuracy with H₂O](image2)

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

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

3 Communication with the Sensor

The OEM liquid flow sensor models LPG10-0150 and LPG10-0500 show bi-directional, linear transfer characteristics. The product comes fully calibrated for water.

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

3.1 Electrical Specifications

Table 2: DC Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>LPG10-0150 and LPG10-0500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating voltage</td>
<td>3.3–3.6 Vdc</td>
</tr>
<tr>
<td>(Recommended: 3.4–3.5 Vdc)</td>
<td></td>
</tr>
<tr>
<td>Operating current</td>
<td>&lt; 6 mA typical in operation</td>
</tr>
</tbody>
</table>

The electrical connection to the pads can be realized in different ways, e.g. using spring contacts.

3.2 Sample Circuitry

![Sample Circuitry Diagram](image3)

The electrical connection to the pads can be realized in different ways, e.g. using spring contacts.

3.3 Digital Communication via I²C-Bus

Digital communication between a master and the LPG10-0150 or LPG10-0500 liquid flow sensors 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 a 3.3 V 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 Connection

Table 4: Fluidic Specifications and Pressure Rating

<table>
<thead>
<tr>
<th>Parameter</th>
<th>LPG10-0150</th>
<th>LPG10-0500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetted materials:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Internal substrate flow channel material</td>
<td></td>
<td>Borosilicate glass</td>
</tr>
<tr>
<td>Fluidic connection</td>
<td></td>
<td>Downmount</td>
</tr>
<tr>
<td>Pressure drop (at full scale flow rate, H₂O, 23°C)</td>
<td>tbd</td>
<td>0.2 mbar</td>
</tr>
<tr>
<td>Total internal volume</td>
<td>tbd</td>
<td>~3.2 µl</td>
</tr>
</tbody>
</table>

5  Mechanical Specifications

Table 5: Mechanical Specifications (for tolerances please see the drawings below)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>LPG10-0150</th>
<th>LPG10-0500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Largest dimensions</td>
<td>tbd</td>
<td>10 x 10 x 1.75 mm</td>
</tr>
<tr>
<td>Total mass</td>
<td>tbd</td>
<td>0.23 g</td>
</tr>
<tr>
<td>Cross section flow channel</td>
<td>tbd</td>
<td>0.5 mm x 0.4 mm</td>
</tr>
</tbody>
</table>

All dimensions in mm

Note: Example of LPG10-0500. For other versions, layout will be identical, except for the size of the fluidic channel and the fluidic ports.

Attention fragile!

Mechanical shocks and touching of the glass package may lead to stress on the chip and may cause the thin-walled top layer to break.

- Don’t touch the planar glass package on top with your fingers or tools (e.g. tweezers).
- Respect the burst pressure specification.
- Be aware that injecting fluid by hand with a syringe can lead to large pressure peaks.
- Don’t operate the liquid flow sensor when the contact pads have been wetted. Dry first.
6 Ordering Information

Standard shipment includes only the sensor, neither cables nor fluidic connection material.

For easy testing, an Evaluation Kit is available. In this kit, the LPG10-0500 is preassembled in a manifold body featuring ¼-28 flat bottom fluidic fittings and a connector cap with a 4-pin Molex connector for easy electrical connection by using the included cables. Customers who want to design or manufacture their own manifold body for fluidic connection can use the Connectivity Kit which contains the connector cap with a 4-pin Molex connector, O-rings for sealing, and a 30 cm long flat ribbon cable.

Contact Sensirion for more information on the Evaluation or the Connectivity Kit.

<table>
<thead>
<tr>
<th>Product</th>
<th>Article No</th>
<th>MOQ</th>
<th>Packaging Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPG10-0500</td>
<td>1-101119-01</td>
<td>100</td>
<td>20</td>
</tr>
<tr>
<td>Evaluation Kit LPG10-0500</td>
<td>1-101318-01</td>
<td>1</td>
<td>n/a</td>
</tr>
<tr>
<td>Connectivity Kit LPG10 Series</td>
<td>1-101500-01</td>
<td>1</td>
<td>n/a</td>
</tr>
</tbody>
</table>
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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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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REACH, Rohs and WEEE Statement

The LPG10 series complies with requirements of the following directives:

- 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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