

# SLQ-HC60

## Milliliter Flow Meter for Hydrocarbons

- Maximum flows up to 80 ml/min
- Sensitive to lowest flows
- Straight flow path, no moving parts
- Fast response time: < 50 ms
- Optimized for hydrocarbons



### 1 Introduction SLQ-HC60

The SLQ-HC60 Liquid Flow Meter enables fast, non invasive measurements of liquid flow up to 80 ml/min. This product line is especially suited for process monitoring applications in automation technology which require high sensitivity in the milliliter range. It is suited for use with almost all hydrocarbons, as for example, alcohols, oils, gasoline, diesel, etc. and many other chemicals. Excellent chemical resistance is ensured: The flow path of the SLQ-HC60 Liquid Flow Meters is formed by a simple, straight glass capillary. This Swiss made, non invasive flow meter is based on Sensirion's patented CMOSens® Technology (US Patent 6,813,944 B2). An internal fourth generation MEMS sensor chip combines a thermal high precision sensor element with amplification circuits and digital intelligence for linearization and temperature compensation on one single microchip – the product's core element.

### 2 Sensing Performance

In Table 1 the flow sensor's performance for use with Isopropyl Alcohol (IPA) is given. For other hydrocarbons the values will be slightly different as the performance depends on the medium used. Due to the optimized output signal the repeatability is nearly constant over a wide flow range. The repeatability depends on the integration time<sup>a</sup> of the analog signal acquisition. Longer integration time leads to better repeatability of the flow measurement (see table 1). The temperature compensation is optimized for use with IPA and shows very good performance for most hydrocarbons and other media.

Table 1: Model specific performance of SLQ-HC60 for IPA (all data at 20°C, 1 bar<sub>abs</sub> unless otherwise noted)

Parameter	Condition	SLQ-HC60	Units
Maximum Flow Rate	Best Performance	80	ml/min
	Reduced Performance	100	
Repeatability <sup>b</sup> (whichever is greater)	0.2 sec integration time	1.5	% m.v.
		0.2	% F.S.
	2 sec integration time	1	% m.v.
		0.07	% F.S.
Flow Detection Response Time		< 50	ms
Accuracy <sup>c</sup>		10	% m.v.
Response Time On Power-Up		120	ms
Mounting Orientation Sensitivity <sup>d</sup>	For IPA	0.25	ml/min
Operating Temperature	Temperature Compensated	+10...+40	°C
	Functional	+0 ... +55	°C
Ambient storage Temperature	(empty flow channel)	-10...+60	°C

<sup>a</sup> This refers to the time over which the analog acquisition device averages the input signal. Refer to the datasheet of your device.

<sup>b</sup> For medium IPA using 1  $\sigma$  standard deviation of consecutive flow measurements.

<sup>c</sup> With IPA, 2.5-80 ml/min, after conversion of the Vout signal via the exponential relation. See section 3.1

<sup>d</sup> Normal position: Horizontal Flow channel, connector horizontally.

### 3 Output Signal and Media Compatibility

#### 3.1 Output Signal

The SLQ-HC60 flow meter comes with an analog output (0...10V). Depending on the media used, the output will be about 5 Volt at zero flow. For positive flow rates the output signal increases logarithmically<sup>a</sup> with the flow rate for IPA (see figure 1). This signal characteristic has the advantage that the flow meter can be used at various flow rates with a constant relative error and makes measurements for a wide spectrum of liquids possible.

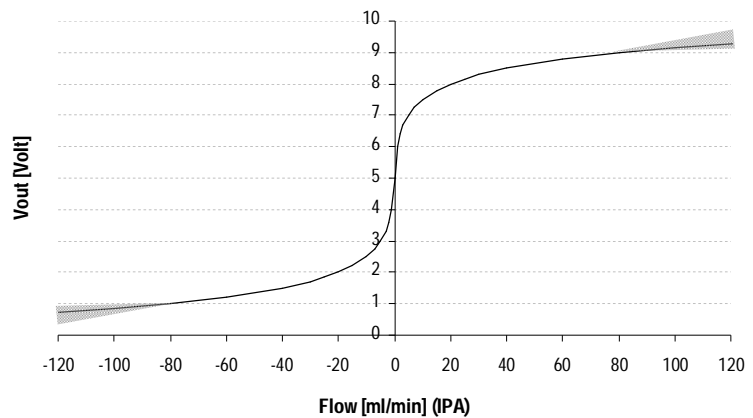


Figure 1: Sensor Signal for IPA

#### 3.2 Signal for Other Media

For other media but IPA the form of the sensor signal will differ slightly as is demonstrated in figure 2. When using the sensor with other media but IPA, ask Sensirion for advice on how to handle the sensor signal to suit your requirements.

Because of the drastically different sensor response the sensor is not suited for use with water or aqueous solutions.

#### 3.3 Maximum Flow Rate for Common Media

Due to the measurement principle, the thermal properties of the medium determine the sensor characteristics and the dynamic range of the device. For most hydrocarbons and most other media this range extends to about 80 ml/min. With reduced performance even rates of 100 ml/min or higher can be reached for some media. For low viscosity (< 1 centipoise) media the dynamic range can be limited by turbulence.

The dynamic ranges for various media are given in Table 2. For other media similar values can be expected.

**Attention:** If unsure about your medium please contact Sensirion for assistance.

Conversion: Signal to Flow (for positive flow rates) <sup>a</sup>
$\text{Flow[ml/min]} = (\text{Exp}[(\text{Vout}-5)/0.729]-1)/3$ $= 1/3 * (e^{(\text{Vout}-5)/0.729}-1)$

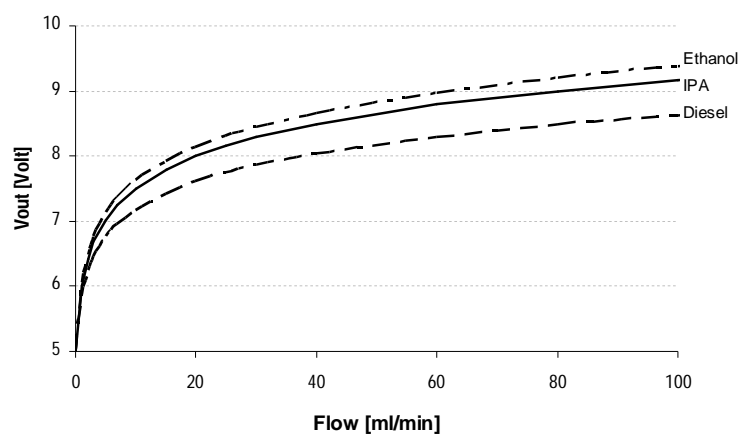


Figure 2: Sensor Signal for Various Media

Table 2: Examples for common media

Medium	Maximum Flow Rate	Units
IPA	80 (100 <sup>b</sup> )	ml/min
Ethanol, Methanol, Gasoline	~50	
Acetone	~ 40	
Diesel, Petroleum, Veg. Oils	80 (100 <sup>b</sup> )	
Silicon Oil, Ether	< 100	

<sup>a</sup> The flow rate for IPA is given by  $\text{Flow[ml/min]} = (\text{Exp}[(\text{Vout}-5)/0.729]-1)/3$  for positive flow rates, i.e. above 5V. For negative flow rates the signal is symmetric:  $\text{Flow[ml/min]} = -(\text{Exp}[(5-\text{Vout})/0.729]-1)/3$ . In Excel or when programming one can use the following formula for the full flow range:  $\text{Flow[ml/min]} = \text{SIGN}(\text{Vout} - 5) * (\text{Exp}[\text{SIGN}(\text{Vout} - 5) * (\text{Vout} - 5) / 0.729] - 1) / 3$  where SIGN is -1 if the argument is negative and +1 if the argument is positive.

<sup>b</sup> At reduced requirements on accuracy (repeatability for other media but IPA) and exchangeability of sensors.