

## 1 Mass Flow Sensor Performance

Table 1: Overview of ASF1400 Gas Sensor Performance<sup>1</sup>

Parameter	Condition	Minimum	Typical	Maximum	Units
<b>Flow Sensor</b>					
Dynamic Range	direct measurement	-400		400	sccm <sup>(2)</sup>
	using proposed bypass tube <sup>(23)</sup>	-100		100	liter/min <sup>(4)</sup>
	customized bypass tube	unlimited		unlimited	
Resolution	400 sccm flow		0.09		sccm
	< 10 sccm flow		0.01		sccm
Lowest Detectable Flow	< 10 sccm flow		0.015 <sup>(4)</sup>		sccm
Pressure Drop	400 sccm, $p_{abs.} = 1$ bar		120		Pa <sup>(5)</sup>
Repeatability			0.0025 % FS <sup>(6)</sup> 0.025 % m.v.		
Accuracy	23 °C	0...5 % of full scale		0.05 % FS <sup>(7)</sup>	
		5...100 % of full scale		1 % m.v. <sup>(7)</sup>	
Offset	23 °C		< 0.005	< 0.02	% FS
Overpressure Resistance <sup>(8)</sup>				2	bar
Response Time <sup>(9)</sup>	depends on resolution setting (see Section 3, Table 2)	142		1280	ms
Operating Temperature		0		70	°C
Ambient Temperature Coefficient	Zero		< 0.005		% FS / °C
	Span		< 0.08		% measured value / °C
Position Sensitivity	$p_{abs}=1$ bar, small nitrogen flow		±0.008		% FS
<b>Temperature Sensor</b>	Measures temperature inside the sensor, but not of the surrounding air <sup>(10)</sup>				
Dynamic Range		0		70	°C
Resolution			0.1		°C
Accuracy		3	2		°C

<sup>1</sup> All data apply for calibration conditions (20 °C, 1013 mbar) unless otherwise noted.

<sup>2</sup> 1 sccm = 1 cm<sup>3</sup>/min at 0 °C and 1013 mbar pressure (1 sccm = 0.001 norm liter)

<sup>3</sup> using bypass tube included in Sensirion's mass flow meter evaluation kit EK-F1

<sup>4</sup> 1 liter/min = 1000 sccm

<sup>5</sup> 1 bar = 100 000 Pa = 0.9869 atm = 401.9 inch H<sub>2</sub>O = 14.5 psi

<sup>6</sup> Error = % of full scale (FS) or % of measured value, whichever is bigger.

<sup>7</sup> Better calibration available for high volume OEM on request. Allow the Sensor to warm up for best results.

<sup>8</sup> For higher overpressure resistance versions please check the EM1 product page.

<sup>9</sup> For faster response times please check out the ASF1430 high speed mass flow meter data sheet

<sup>10</sup> The sensor warms up by about 7 °C (depending on supply voltage and ventilation).

### 1.1 Gas Flow Characteristics

Figure 2 shows the applied gas flow vs. the digital output of the ASF1400.

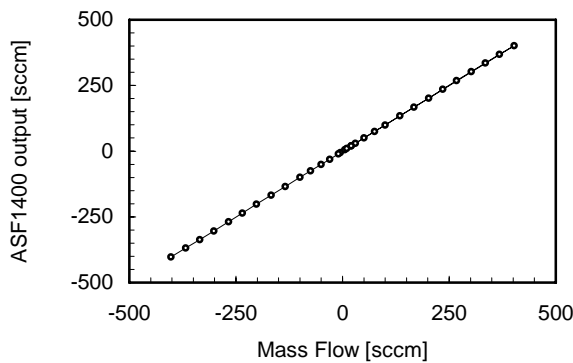


Figure 2: ASF1400 transfer characteristics.

### 1.2 Sensor Principle and Gas Types

The ASF1400 device detects mass gas flow by measuring heat transfer. A heating resistor on a thermally insulated membrane is kept above ambient temperature. In the presence of gas flow, the temperature distribution up- and downstream is disturbed. This asymmetry is then measured. Due to the minimal thermal mass of the membrane, symmetrical arrangement, and accurate temperature measurement, the revolutionary specifications of the ASF1400 devices are achieved.

The above mentioned thermal principle requires information about the gas type to be measured. The ASF1400 is available for air and nitrogen. Other gas types are available on request.

In Figure 3 the repeatability of the ASF1400 devices is compared with the repeatability of a typical Mass Flow Controller (MFC). It emphasizes the superior performance of the ASF1400 device.

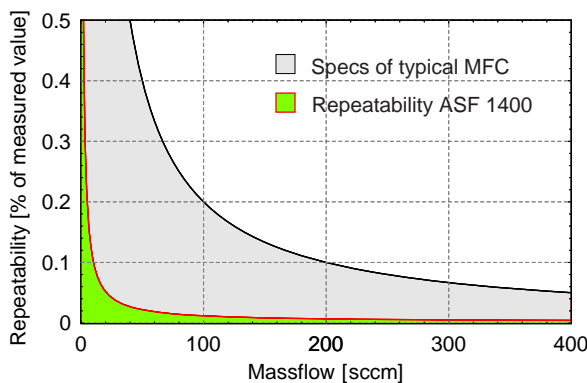


Figure 3: Comparison of the repeatability of the CMOSens® ASF1400 device compared to a typical Mass Flow Controller (MFC).

### 1.3 Gas Flow and Pressure Difference

The ASF1400 is calibrated for mass flow measurements. However, there is a well defined relation between mass flow and pressure drop. This relation is shown in Figure 4. On request the ASF1400 can also be calibrated for the pressure drop at its output (for more details refer to the documentation of the Sensirion Differential Pressure Sensor ASP1400).

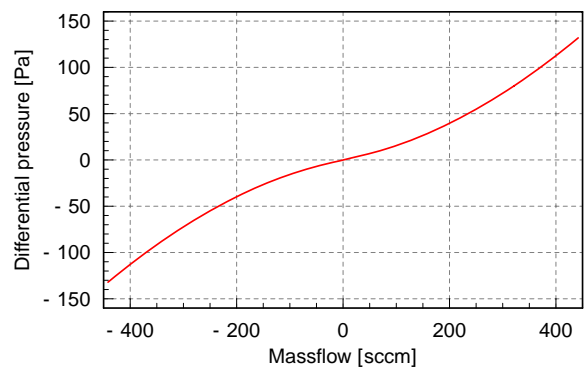


Figure 4: Differential Pressure vs. Mass Flow of ASF1400 Device.

### 1.4 Adjusting the Measurement Range

To adjust the measurement range, the ASF1400 device is used in conjunction with a bypass configuration (see Figure 5). Only a sample of the total flow actually gets directed through the bypass channel and the sensor system. A tube with flow restrictor and all required connection items are included in the Mass Flow Meter Evaluation Kit EK-F1, also available from SENSIRION AG.

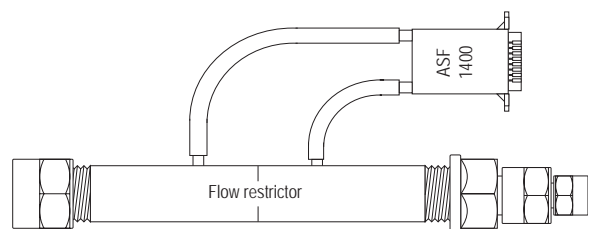


Figure 5: Extending the measurement range of the ASF1400 device using a bypass configuration. Only a sample of the total flow actually gets directed through the bypass channel and the sensor. Shown tube with flow restrictor is included in the EK-F1 evaluation kit.