

## Preliminary Datasheet SFM3300-AW

### Digital Flow Meter for medical applications

- Flow range:  $\pm 250$  slm (bidirectional)
- Small dead space < 10ml
- Cleanable and autoclavable
- Very fast update time (0.5ms)



#### Product Summary

The SFM3300-AW sensor is Sensirion's digital flow meter designed for medical applications. It measures the flow rate of **air, oxygen and other non-aggressive gases** with superb accuracy. The special design of the flow channel results in a **very small dead space**. Combined with its **ability to withstand autoclave procedures** the SFM3300-AW is extremely suited to proximal flow measurements in medical ventilation and other respiratory applications.

The SFM3300-AW has been designed with the use by medical professionals in mind. It features **medical cones** for pneumatic connection to standard breathing circuits

and a mechanical interface for **easy and reliable electrical reconnection**. The sensor element, signal processing and digital calibration are on a single microchip assuring **very fast signal processing time, best-in-class accuracy** and **superior robustness** to rough handling and adverse conditions.

The well-proven and patented **CMOSens® sensor technology** is perfectly suited for high-quality mass production and is the ideal choice for demanding and cost-sensitive OEM applications.

#### Applications

- Proximal Flow measurement
- Expiratory flow measurement
- For Ventilation & Anesthesia
- Respiratory measurements
- Metabolic Measurements

#### OEM options

A variety of custom options can be implemented for high-volume OEM applications (custom flow rates, calibration for other gases, different body form factor, disposable option etc.). Contact us for more information.

#### Sensor chip

The SFM3200 flow meter features a fifth-generation silicon sensor chip SF05. In addition to a thermal mass flow sensor element, the chip contains an amplifier, A/D converter, EEPROM memory, digital signal processing circuitry, and interface. Due to seamless integration of signal acquisition and processing on the single silicon die significant performance and cost benefits are achieved.

## 1.1 Physical specifications <sup>1</sup>

Parameter	Condition	Value		Unit
Flow range		-250 ... +250		slm <sup>2</sup>
		Typ. <sup>3</sup>	Max <sup>4</sup>	
Accuracy <sup>5</sup>	span <100 slm	3	5	% m.v. <sup>6</sup>
	span >100 slm	7	10	% m.v. <sup>6</sup>
	offset	0.1	0.2	slm <sup>2</sup>
Noise Level <sup>5,7</sup>	span <25slm	2.0	2.5	% m.v. <sup>6</sup>
	span >25slm	3	5	% m.v. <sup>6</sup>
	offset	0.1	0.2	slm <sup>2</sup>
Accuracy Shift Due to Temperature Variation <sup>8</sup>	span	0.4	0.5	% m.v./10°C
	offset	0.015	0.02	% m.v./10°C
Resolution (14bit)	span		0.07	% m.v. <sup>6</sup>
	offset		0.034	slm <sup>2</sup>
Pressure drop	@ 60 slm	180 / 0.73	230 / 0.93	Pa / inH <sub>2</sub> O
	@ 100 slm	380 / 1.53	550 / 2.21	Pa / inH <sub>2</sub> O
	@ 200 slm	1400 / 5.62	1900 / 7.63	Pa / inH <sub>2</sub> O

## 1.2 Ambient conditions

Parameter	Condition	Value	Unit
Calibrated Temperature Range	Fluid (Dry gas)	+10 ... +50	°C
Operating Temperature Range	10-95% rel. hum. (non cond.)	+5 ... +50	°C
Storage Temperature	10-95% rel. hum. (non cond.)	-40 ... +70	°C
Operating Pressure Range	absolute	0.54 – 1.1	bar
Burst Overpressure	gauge	0.3	bar

## 1.3 Media compatibility

Parameter	Value
Calibration <sup>9</sup>	Air
Media Compatibility	Air (non-condensing), N <sub>2</sub> , O <sub>2</sub> , other non- aggressive gases
Wetted Materials	Si, Si <sub>3</sub> N <sub>4</sub> , SiO <sub>x</sub> , Gold, Epoxy, PPSU, silicone, stainless steel
RoHS, REACH	RoHS and REACH compliant

<sup>1</sup> Unless otherwise noted, all sensor specifications are valid at 25°C with Vdd = 5V and absolute pressure = 966 mbar and horizontal flow.

<sup>2</sup> slm: mass flow measured in liters per minute at standard conditions (T = 20 °C, p = 1013.25 mbar)

<sup>3</sup> for "Typ" a CpK of 0.67 is targeted (95% of sensors within the Typ limit)

<sup>4</sup> for "Max" no sensor measured outside of this limits will be shipped and a CpK of 1.33 is targeted

<sup>5</sup> Total accuracy/repeatability is a sum of offset and span accuracy/repeatability.

<sup>6</sup> %m.v. = % measured value = % of reading

<sup>7</sup> noise level defined as standard deviation of individual sensor readings, measured at full sampling rate (typ: average of noise level ; max: at least 99.99% of sensors have a noise level below indicated value)

<sup>8</sup> these effects need to be added to the initial values if applicable

<sup>9</sup> Contact Sensirion for information about other gases, wider calibrated temperature ranges and higher storage temperatures.

The sensor can be used with gas mixtures, such as breath gas with up to 10% CO2 and high humidity. Please ask Sensirion for details and error estimates.

## 2. Electrical Specifications

On the PCB a heater resistor and an EEPROM can be added. This enables the user to heat the PCB to avoid condensation or freezing over of the sensing element. The EEPROM can be used to store customer specific data such as hours-in-use, part numbers, etc.

### 2.1 Electrical characteristics

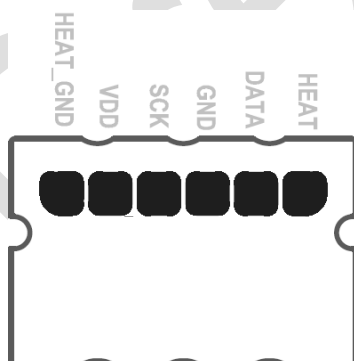
Electrical properties	Condition	Value		Unit
Interface		I <sup>2</sup> C		
Default Sensor Address		64 (h40)		
Update Time	14 bit	0.5		ms
Soft Reset Time		80		ms
Start-up Time <sup>10</sup>	Max.	100		ms
Supply Voltage		5V±5%		V
Communication Level	High	Min. 2.5	Max. VDD	V
	Low	GND	1.1	
Power Consumption <sup>11</sup>		< 50		mW
Electrical Connector		See section 2.2 and 0		
External Heater Power Rating	Max.	0.5		W
External Heater Resistance	Typ.	51		Ω
Output signal resolution <sup>12</sup>		14		bit
Scale Factor Flow	Air, N2	120		1/slm
Offset Flow		32768 (h8000)		

<sup>10</sup> After 4.75V is reached

<sup>11</sup> When the heater resistor on the PCB is not in operation

<sup>12</sup> 16 bit with two least significant bits always zero

### 2.2 Pad layout



### 2.3 Conversion to Physical Values

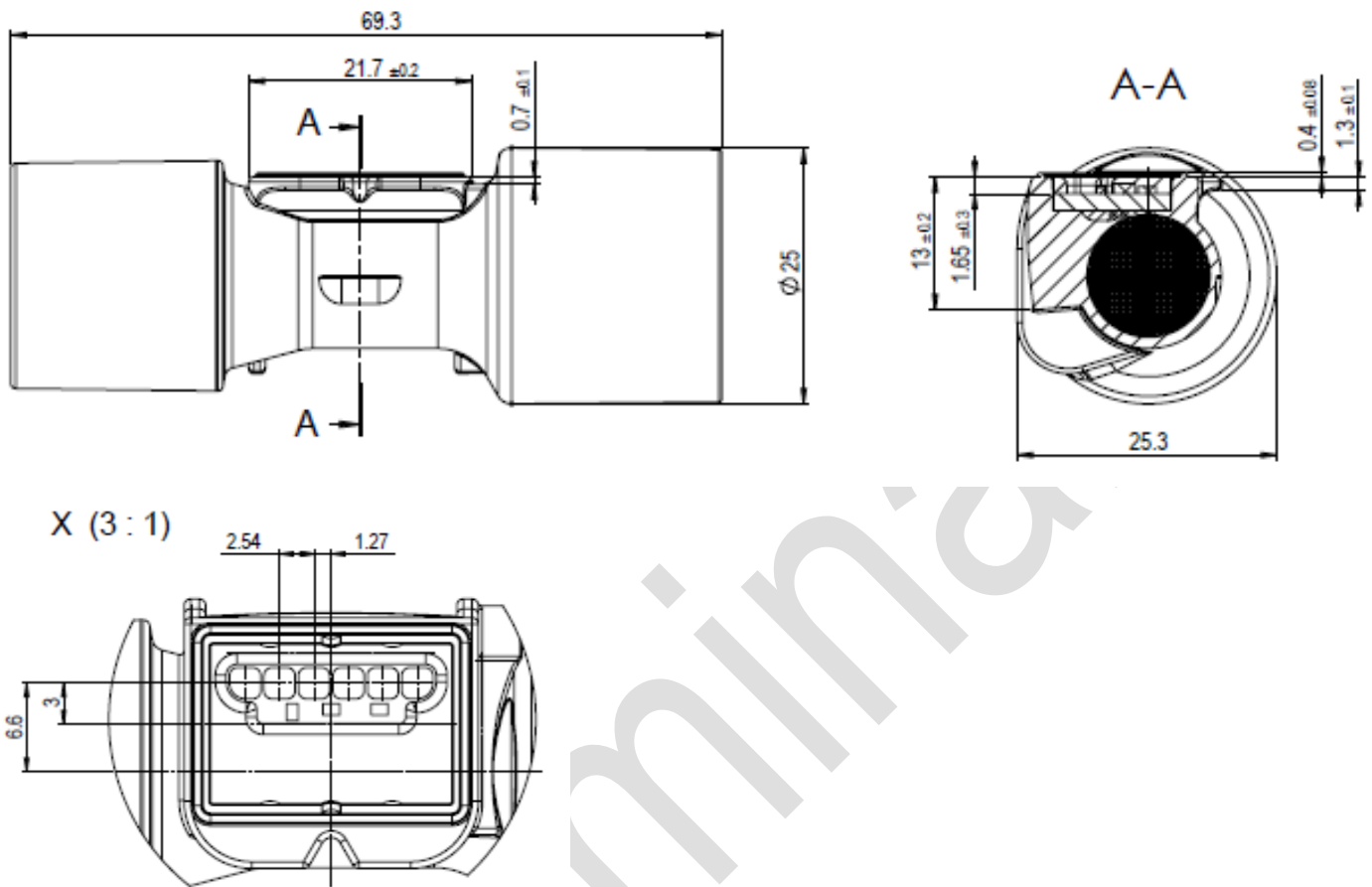
In order to obtain the measured flow in [slm], the measured value needs to be converted using the following formula:

$$flow [slm] = \frac{measured\ value - offset\ flow}{scale\ factor\ flow}$$

Please note that the first measurement performed directly after chip initialization is not valid.

### 3. Mechanical Specifications

All dimensions are in millimeters (mm).



#### 3.1 Mechanical fitting

Fittings of the SFM3300-AW sensor correspond to the international standard ISO5356-1:2004. Details about this type of connection can be found in the description of the standard.

#### 3.2 Mechanical / Electrical Interface

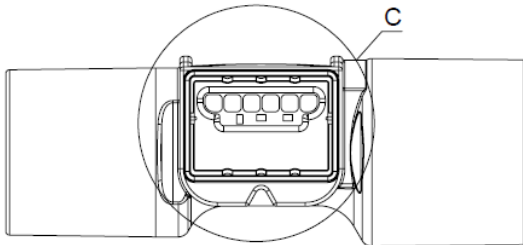
SFM3300-AW has been designed for use in an expiratory environment. Therefore the sensor has been designed for a connector that can be easily connected and disconnected. The connector itself is not provided by Sensirion as a standard product but Sensirion can help with design recommendations.

Dimension	Condition	Value	Unit
Length		69.3	mm
Diameter Flow channel		11.25	mm
Proximal medical cone	Inner	15	mm
Proximal medical socket	Outer	22	mm
Distal medical socket	Inner	22	mm
Distal medical cone	Outer	15	mm
Dead space		<10	ml

## 4. Instructions for Use

### 4.1 Calibration orientation

The sensors are calibrated horizontally as depicted in the following graph:



← Positive flow direction  
(also marked on the sensor body)

Positive flow direction is from the female 22 mm cone to the male 22 mm medical cone, so that inspiratory flows are positive and expiratory flows negative.

### 4.2 Inlet flow conditions

In order to provide good flow conditions, the inner diameter of the connecting tube has to be approximately the same as the inner diameter of the SFM3300-AW main flow channel. The SFM3300-AW is equipped with meshes on the in- and outlets of the flow channel to reduce turbulences and thus improve the stability.

### 4.3 Temperature compensation

The SFM3300-AW sensor features digital temperature compensation. The temperature is measured on the CMOSens® chip by an on-chip temperature sensor. This data is fed to a compensation circuit that is also integrated on the CMOSens® sensor chip. Thus, no external temperature compensation is necessary.

### 4.4 Cleaning (applies only to SFM3300-AW version)

The SFM3300-AW has been designed to withstand medical cleaning procedures. For details of the test and the results contact Sensirion.

Sensirion AG does not guarantee the stability of the flow sensor using arbitrary methods and/or equipment for autoclaving. Validation of the flow sensor stability for a specific type of procedure and/or equipment is the sole responsibility of the customer.

### 4.5 Sensor handling

The SFM3300-AW sensor is designed to be robust and shock resistant. Nevertheless, the accuracy of the high-precision SFM3300-AW can be degraded by rough handling. Sensirion does not guarantee proper operation in case of improper handling.

**Note:** never connect the sensor while connecting part is wet. Especially after cleaning procedure special care is needed to dry the sensor.

Please be aware that SFM3300 has been designed for usage with air and other non-corrosive and toxic gases.

If leak tightness is critical in customer application it remains customer's sole responsibility to leak-test the sensor before usage.

### 4.6 I<sup>2</sup>C Interface and communication

Due to I<sup>2</sup>C interface restrictions, the cable length from the sensor to the microprocessor is recommended to be as short as possible and certainly not above 30 cm. For wires longer than 10 cm it is mandatory to shield the SDA and SCL.

In case data is read from the sensor, the first data byte of the transaction must always be acknowledged by the master.

It must be possible to reset the sensor through a hard reset, i.e. powering off and on the sensor, in case the sensor freezes.

I<sup>2</sup>C Communication details are given in the application note "I<sup>2</sup>C Functional Description for SFM3000".

There is an additional EEPROM on the PCB to allow storage of customer-specific data. Please see all details in the datasheet of the EEPROM. The EEPROM is of type 24LC01BT-I/MC. No additional validation or modification of EEPROM settings has been performed by Sensirion.

## 5. Ordering Information

Use the part names and product numbers shown in the table below when ordering SFM3300-AW sensors. For the latest product information and local distributors, visit [www.sensirion.com](http://www.sensirion.com).

Part name	Product Number
SFM3300-250-AW	1-101052-01

Packaging units: 30 items/tray.  
Every sensor is traceable by a unique Serial Number.

### Revision history

Date	Author	Version	Changes
Aug 2014	AVS	0.1	First preliminary version
Sept 2014	AVS	0.31	adaptation
July 2015	DAT	0.4	Rated D2, filled tbd

## 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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