Preliminary Datasheet SFM3020 series

Analog Mass Flow Meter

Product Summary

SFM3020 is Sensirion's solution on providing high volumes of flow meters for medical ventilators in order to support the global pandemic situation due to the Corona virus outbreak. It relies on a modular approach of assembling approved parts with good availability to Sensirion and a high-volume through-put manufacturing.

The housing geometry is based on the SFM3000 flow meter, hence it remains mechanically compatible to the SFM3000.

A flow range from -10slm to +160slm and one directional flow supports high flow applications while still allowing to detect back flows. To minimize pressure-drop the SFM3020 is equipped with one mesh at the inlet.

Disclaimer: The product is not fully qualified but the risk is deemed low as the processes and materials are already used in other products currently in production.

Benefits of Sensirion's CMOSens® Technology

- Scalability
- High reliability and long-term stability
- Best signal-to-noise ratio
- Industry-proven technology with a track record of more than 15 years
- Designed for mass production
- High process capability

Contents

1. Ordering Information

Use the part names and order number shown in the following table when ordering the SFM3020. For the latest product information and local distributors, visit www.sensirion.com.

Part name	Description	Order number
SFM3020-160-C	-10 to 160slm range, with cap	3.000.401

2. Specifications

2.1. Flow Specification[1]

Parameter	Condition	SFM3020		Units
Measurement range [2]		Air/O2: -10 to 160		slm[3]
		Max.	Typ.	
Accuracy[4,5]	span(0..160slm)	±3%	±2%	m.v.[6]
	span(-10…0slm)	±5%	±3%	m.v.
	zero point	0.15 (max.)	0.05 (typ.)	slm
Repeatability[5]	span	1%		m.v.
	zero point	0.05		slm
Noise Level[5]	span	+1%	0.5%	m.v.
	zero point	0.06		slm
Span shift due to temperature variation		< 0.5% of reading per 10°C		
Flow step response time (τ_{63})		< 5ms		
Calibrated for		Air		
Compensation formula		O2		
Media compatibility		Air, N_2, O_2, non-condensing		
Pressure Drop @60slm @200slm		One mesh version <80 / 0.32 <500 / 2.0		Pa / inH2O

[1] Unless otherwise noted, all sensor specifications are valid at 25°C with VDD = 5 V and absolute pressure = 966 mbar.

[2] For other ranges contact Sensirion

[3] In standard liter per minute at 20°C and 1013 mbar

[4] Output voltage integral non linearity is not included. Note that the effect can add up to ±0.2125slm @ 5V V_{dd} on the flow value.

[5] Span or offset value, whichever is larger

[6] Measured value

2.2. Electrical Specifications

Parameter	Symbol	Condition	Min.	Typ.	Max	Units	Comments
Supply Voltage	V_{DD}			5		V	Recommended: 5V +/- 5%
Power-up/down level	V_{POR}		2.3	2.5	2.7	V	
Supply current	I_{DD}	Measuring			5.5	mA	
Ratiometric analog output							
Output range			10%		90%	V_{DD}	
Resistive load to GND			10 [1]	100		kOhm	
Resistive load to VDD			1000			kOhm	
Capacitive load	C_{load}				100	nF	
Output voltage Integral Non Linearity (INL)					5	mV	
Output voltage noise (RMS)				0.5		mV	

2.3. Timing Specifications

Parameter	Symbol	Min.	Typ.	Max.	Units	Comments
Power-up time	t_{PU}			30	ms	Time to first reliable measurement

2.4. Mechanical Specifications

Parameter	Symbol	Min.	Typ.	Max.	Units	Condition/Comment
Operating pressure range		0.7		1.3	bar	absolute
Allowable overpressure	P_{max}	-0.2		0.2	bar	gauge
Rated burst pressure	P_{burst}			>1	bar	gauge
Weight	W			10	g	

2.5. Materials

Parameter	
Wetted materials	PPE+PS blend, Si, glass (Si_3N_4, SiO_x), gold, FR4, copper alloy, lead-free solder, epoxy, polyurethane, stainless steel (annealed)
REACH, RoHS	REACH and RoHS compliant

[1] For a resistive load to GND less than 100kOhm, a 1nF capacitor to GND on the AOUT is recommended

2.6. Absolute Minimum and Maximum Ratings

Parameter	Rating	Units
Supply Voltage V_{DD}	-0.3 to 5.5	V
Max Voltage on pins (Inputs)	-0.3 to V_{DD}+0.3	V
Input current on any pin	±70	mA
Operating temperature range[1]	0 to +60	°C
Storage temperature range	-20 to +70	°C
Max. humidity for long term exposure	40°C dew point	
ESD HBM (human body model)	2	kV

3. Pin Assignment

The pin assignments of the SFM3020 series can be found in Table 1.The cap of the SFM3020 is compatible with DuraClik™ Wire-to-Board Receptacle Housing, Single Row, 4 Circuits. (Molex product number: 502351-0400).

Pin no.	Name	Description
1	NC	Do not Connect
2	VDD	V_{dd} Supply
3	GND	Connect to ground
4	Aout	Linear analog voltage output

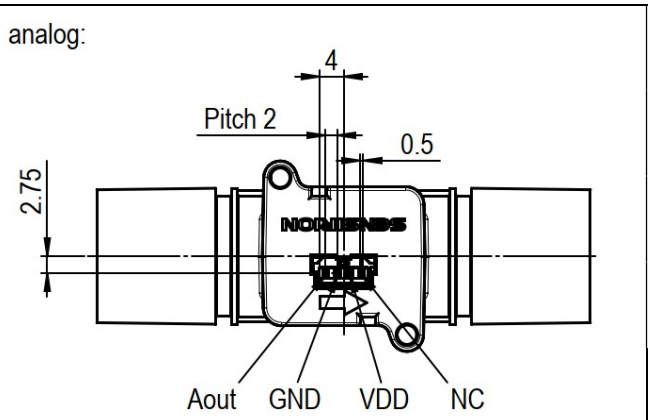
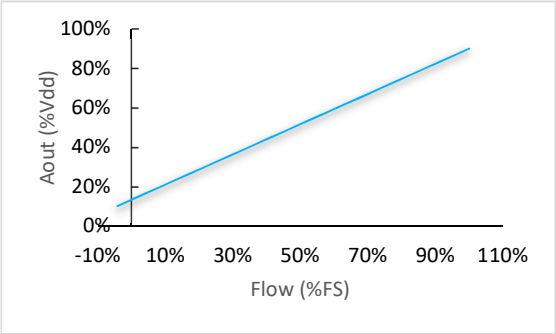


Table 1: *SFM3020 series pin assignment.*

[1] For Air and N_2. Long term exposure to (high concentrations of) O_2 at high temperatures can reduce the product lifetime

3.1. Measurement Mode

Description	Conversion to physical values AOut[V], VDD[V], Standard Liter per Minute (Flow) [slm]	
Analog output is configured as a linear output. The sensor is not fully bi-directional in this configuration: -10% full-scale to 100% full scale. 	160slm	$Flow = 212.5 * (\frac{Aout}{VDD} - 0.1) - 10$

3.2. AOut Pin

The AOut pin gives out an analog linear voltage, representing the flow value in standard liter per minute slm. Please note the resistive and capacitive loads as mentioned in section 2.2.Formulas for converting AOut [V] to flow [slm] can be found in section 3.1

3.3. Correction Formula for Oxygen Flow Measurment

Description of the correction formula for measuring oxygen flow with the SFM3020

Q_{O2}^{SFM} Flow indicated by air calibrated SFM3020 in slm when O2 is flowing through SFM

Q_{O2} Real flow O2 in slm

ΔQ Correction Factor

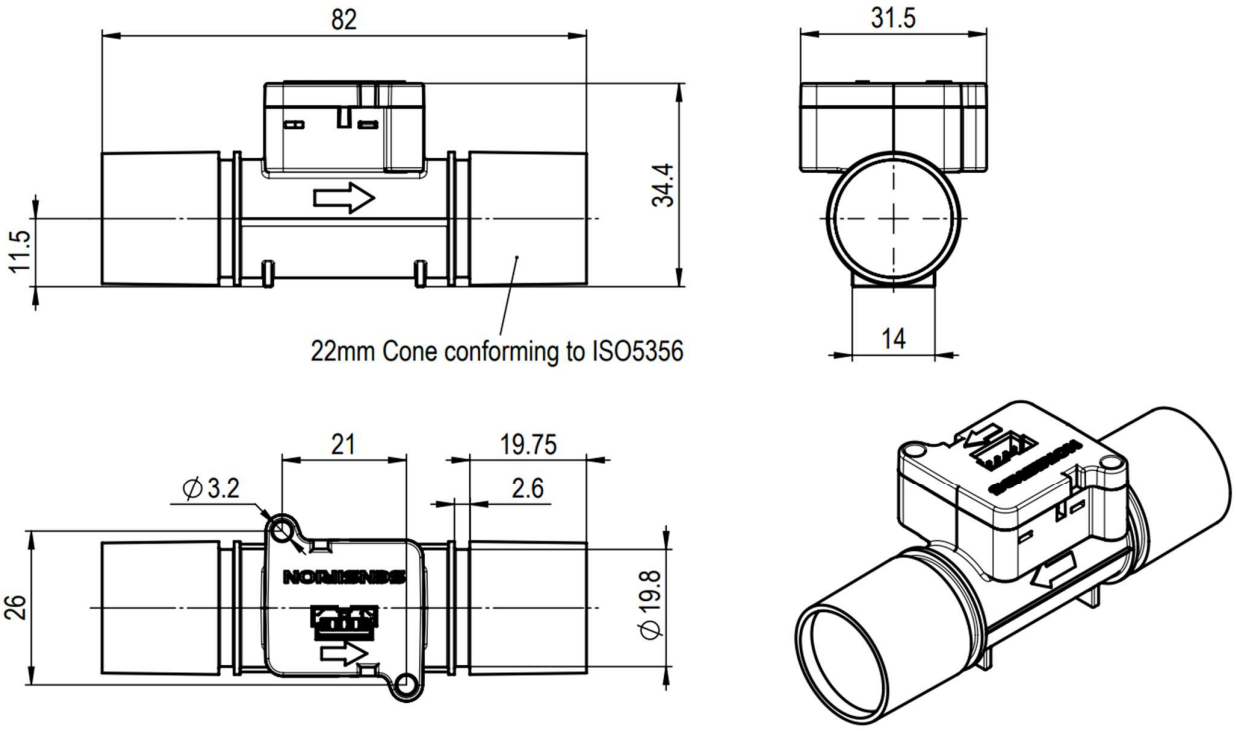
$$Q_{O2} = Q_{O2}^{SFM} - \Delta Q$$

$$\Delta Q = 7 * 10^{-5} \times (Q_{O2}^{SFM})^2 + 0.0144 \times Q_{O2}^{SFM}$$

When a correction for FiO2 other than 100% is needed, the correction ΔQ can be scaled proportional to the FiO2. I.e. The correction formula for arbitrary FiO2 is

$$Q_{O2} = Q_{O2}^{SFM} - \frac{FiO2 - 21\%}{79\%} \times \Delta Q$$

4. Package Outline[1]



4.1. Soldering

Standard wave soldering systems may be used for soldering SFMxxxx sensors. Reflow soldering is not feasible and may damage the sensor. Contact Sensirion for further information.

6 Shipping Package

20 item/tray

5. Revision History

Date	Author	Version	Changes
19.03.2020	JGOE	V0.1	First draft, mostly based on SDP8xx analog and SFM3019
20.03.2020	JGOE	V0.2	Pin Layout updated to analog, Aout curve and equation added
01.04.2020	JGOE	V0.3	O2 Compensation curve, New Picture and drawings
03.04.2020	JGOE	V0.4	Updated Flow Specifications, Corrected Pin Layout

[1] To allow for a further capacity increase within the next months Sensirion recommends to plan an additional 6mm free space over the sensor cover. This will not affect the behavior of the sensor. Please contact Sensirion for further information.

6. 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.

See application note "Handling Instructions" for more information.

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 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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