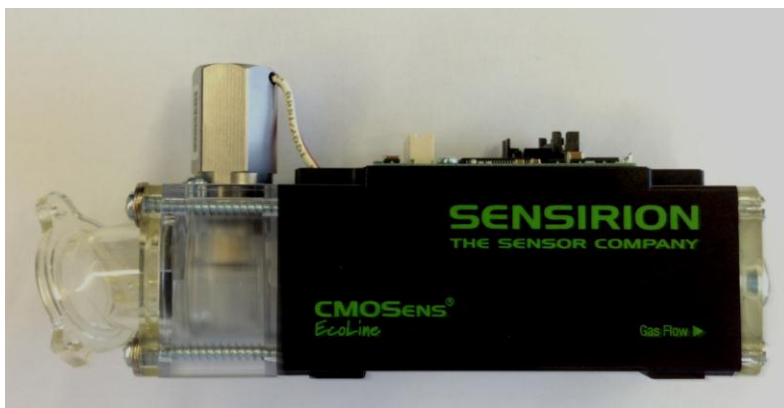


SFC5000-MGE

Ultra-Fast CMOSens[®] Mass Flow Controller for Gases

- High accuracy Mass Flow Controller
 - Ultra fast settling time (<100ms to within 2% of setpoint)
 - CMOSens technology
 - Digitally calibrated & temperature compensated
-



Picture for illustration purpose only

CMOSens[®] SFC5000-MGE Product Summary

The CMOSens[®] SFC5000-MGE mass flow controller enables the very fast and accurate control of gas flows over a very wide range. Its leading performance is based on Sensirion's unsurpassed CMOSens[®] sensor technology which combines a high precision sensor element with the amplification and A/D converter circuit

on one single CMOS chip. The digital calibrated and temperature compensated sensor signal is used in a fast digital controlling circuit to control the valve. This results in a very high accuracy, fast settling time and large dynamic range.

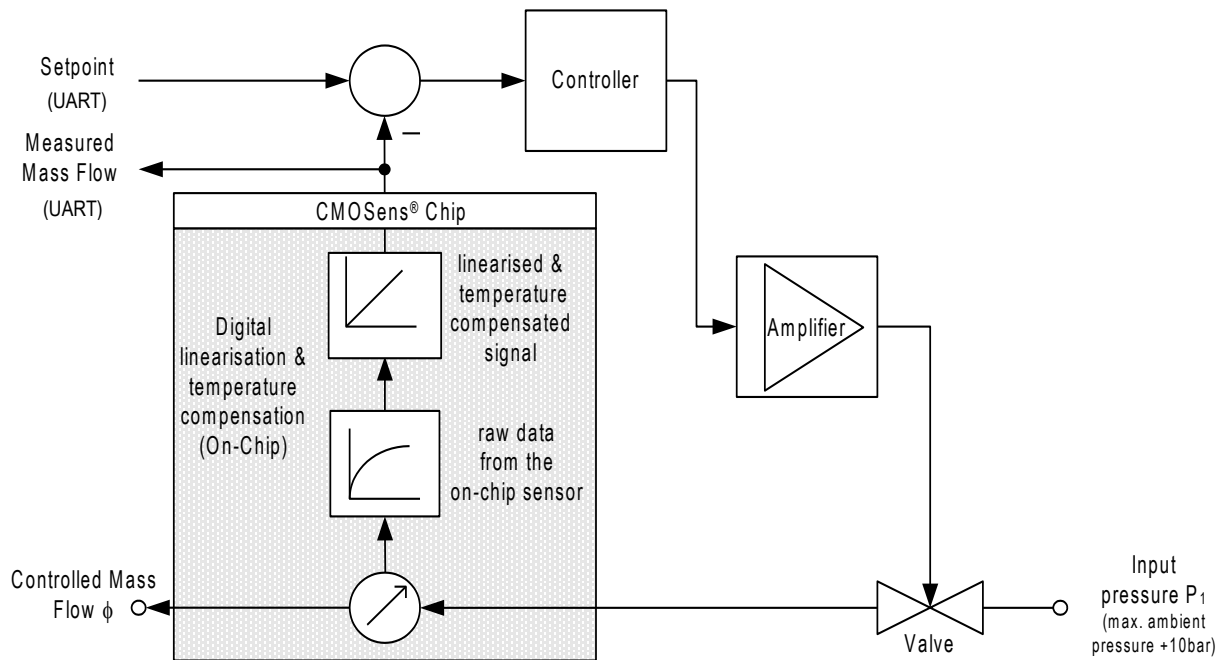


Figure 1: Block Diagram CMOSens® SFC5000-MGE Mass Flow Controller.

Introductory Description

The overall performance of a mass flow controller depends mainly on the mass flow sensor used in it. The heart of the SFC5000-MGE Mass Flow Controller is powered by Sensirion's unsurpassed CMOSens® sensor technology. The SFC5000-MGE Mass Flow Controller therefore provides very high performance and accuracy at very attractive system cost.

A CMOSens® flow sensor comprises the sensing element on a miniaturized membrane and complete signal processing for linearization and temperature compensation on a silicon chip and is manufactured using CMOS standard processes.

Due to the symmetrical arrangement of the two temperature sensors on this membrane, an additional temperature sensor for the temperature compensation data and the high end A/D conversion and amplification on the same chip the unbeatable performance with regard to repeatability and accuracy is achieved.

Since the whole design of the amplification, A/D conversion, digital linearization and temperature compensation are matched to the sensor speed, a fully compensated flow measurement value is delivered every 0.5 milliseconds.

These key advantages of the CMOSens® technology allow very fast and very stable and accurate flow control using conservative and stable control algorithms.

Another advantage of the CMOSens® technology is its resistance to electromagnetic disturbances (EMC). The SFC5000-MGE device controls true mass flow independent of the ambient temperature and pressure changes. You simply connect the gas supply of oxygen to be controlled to the SFC5000-MGE device, set the flow value via the digital interface and get additional feedback via the digital output signal.

1 CMOSens® SFC5000-MGE Mass Flow Controller Performance

Table 1: Overview of CMOSens® SFC5000-MGE Mass Flow Controller Specifications

All data, unless otherwise noted, apply for calibration conditions and refer to the setpoint: 23°C, 2.0 bar overpressure (inlet, 3.0 bar absolute) against atmosphere (outlet, 1.0 bar absolute), horizontal mounting position

Specification	Condition	Value	Unit
Accuracy ¹		±5 % m.v. or 0.1 slm whichever is bigger	
Min. Flow		0.1	slm ²
Max. Flow		120	slm
Flow resolution		0.01	slm
Typical Settling Time ³	10-100% FS	80	ms
Step Rise Time	95% of setpoint	40	ms
Ripple Zone	Ripple around desired signal	+/- 1	%
Controlled Gas		Oxygen	
Operating Temperature (Ambient and Gas)		0 – 50	°C
Temp. Coeff. Zero		0.03	% FS / °C
Temp. Coeff. Span		0.2	% s.p. / °C
Pressure Coefficient		0.2	% s.p.
Input pressure	Over ambient	2.8 - 6	bar
Pressure Drop at Full Flow ⁴	p _{abs.} = 1 bar gas: air	3	bar
Leak Integrity MFC external		< 0.001 (needs to be verified with specific inlet and outlet pieces)	slm
Leak Integrity through closed Valve		< 0.001	slm
Max. Temperature Valve	Ambient T max. 50°C	120	°C
Valve cycles		100 Mio.	

¹ Including Offset, Non-Linearity, Hysteresis

² Upon customer request reference condition for slm is 21.1°C.

³ The maximum time for the flow value of the controller to be in the ripple zone

⁴ 1 bar = 100 000 Pa = 0.9869 atm = 401.9 inch H₂O = 14.5 psi.

1.1 Ambient conditions

Parameter	SFC5000-MGE
Media compatibility	Noncorrosive gases and gas mixtures
Calibrated temperature range ⁵	0 °C to +50 °C
Storage temperature ⁵	-40 °C to +80 °C
Relative humidity (ambient and gas)	0% to 95% (non-condensing)
Ambient pressure	500 – 1200 mbar
Position sensitivity	Use flow horizontally, electronic connector up

2 Working Principle of the CMOSens® Mass Flow Controller

2.1 Calorimetric Principle for Mass Flow Measurement

The CMOSens® SFC5000-MGE measures the mass gas flow using the calorimetric principle of measuring heat transfer. A heating element 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. The whole arrangement is carried out on a silicon chip using CMOS standard processes. Due to the minimal thermal mass of the membrane, symmetrical arrangement, and accurate temperature measurement, the outstanding specifications of the SFC5000-MGE devices are achieved.

2.2 CMOSens® sensor technology

CMOSens® is the base technology for all Sensirion sensor modules and sensor systems. The unification of semiconductor chip and sensor technology serves as a platform for highly integrated system solutions with excellent sensor precision and reliability. With CMOSens®, the on-chip sensor element forms an integrated whole with a high-end amplification and A/D converter circuit. Due to the compact single-chip design, CMOSens® based sensors are very resistant to electromagnetic disturbances (EMC). This is another important technical advantage of this state of the art sensor technology. As a result, CMOSens® based multi sensor modules offer excellent sensor precision, fast response time and a very large dynamic measurement range.

In addition to the flow sensor, the CMOSens® chip also incorporates a temperature sensor which constantly measures the temperature of the chip and due to the small thermal mass also the temperature of the gas. This temperature information is used directly for the temperature compensation.

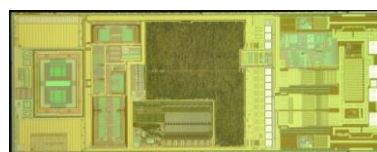


Figure 2: Picture of a CMOSens® chip

2.3 Signal processing

The CMOSens® chip used in the SFC5000-MGE Mass Flow Controller has an EEPROM on chip.

In combination with on-chip intelligence the output signal of the chip can be linearized, temperature compensated and calibrated using the calibration data stored in the EEPROM.

With its internal clock rate of several hundred kHz the CMOSens® chip measures the flow very rapidly and precisely. The generated flow signal is then processed by the on-chip A/D and linearization and temperature compensation is calculated.

The complete layout of the CMOSens® flow chip is strictly designed for best performance of each element and for fast and effective interaction between each other. This ensures optimal signal processing at very high precision and speed.

Based on the high integration on the CMOSens® chip, excellent sensor precision is reached resulting in

high performance of the whole CMOSens® SFC5000-MGE Mass Flow Controller at very attractive system cost.

2.4 Wetted Materials & Compatibility

The packaging method ensures that a minimum number of inert materials only is wetted by the gas which is controlled by the SFC5000-MGE.

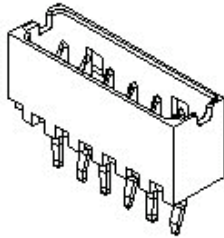
The following Table 2 gives an overview of the materials wetted by the gas.

Table 2: Overview of Wetted Materials

SFC Part	Wetted Material
Body	Polycarbonate
Sensor element	Silicon (Si) Silicon oxide (SiO _x) Silicon nitride (Si ₃ N ₄) Glass Glob Top
Sealing	Viton®
Valve (FAS 2/2 Prop.Ventil 4.5mm)	<p><i>Body material:</i></p> <p>CuZn39Pb3 (brass), DIN 1.4105-1.4305 (Stainless Steel)</p> <p><i>Operational material:</i></p> <p>DIN 1.4105-1.4303-1.4305- 1.4310 (Stainless Steel), DIN 2.4711(Phynox®), 70FPM576+RFN™-8906 DLLF 7090 720120 (FPM)</p> <p><i>Seal material:</i></p> <p>Viton® type A (FPM o'rings)</p>

3 Electrical Specification

3.1 Connector and Pin Layout



Connector type for SFC5000-MGE

Molex – Part-No: 0530140810

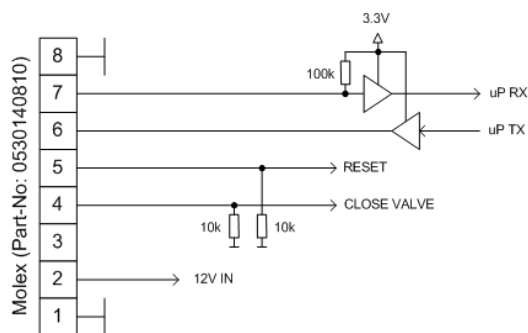


Figure 3: SFC5000-MGE Pin Out

Pin #	Pin Name	Pin Type	Description
1	GND	Power	System Ground
2	12V	Power	MFC Supply (300mA)
3	NC	-	-
4	Close Valve	Input	0V: Normal controller operation 3.3...12V: Force valve to close as long as the pin is high.
5	Reset	Input	0V: Normal controller operation 3.3...12V: Resets the MFC (microcontroller)
6	TXDA	Output (3.3V)	Serial data output of the MFC. This line is high in idle state (pulled up internally by 100kOhm).
7	RXDA	Input (3.3V)	Serial data input of the MFC. This line must be high in idle state (pulled up internally by 100kOhm).
8	GND	Power	Communication Ground (internally connected to System Ground)

Table 3: SFC5000-MGE Pin Description

4 Max. Ratings

4.1 Electrical Specifications

Parameter	Conditions	Min.	Typ.	Max.	Units
Power Supply DC	DC	11.7	12	12.3	V
Operating Current	VDD = 12 V			300	mA

Table 4: Electrical specifications

Physical Dimensions and Mounting Information

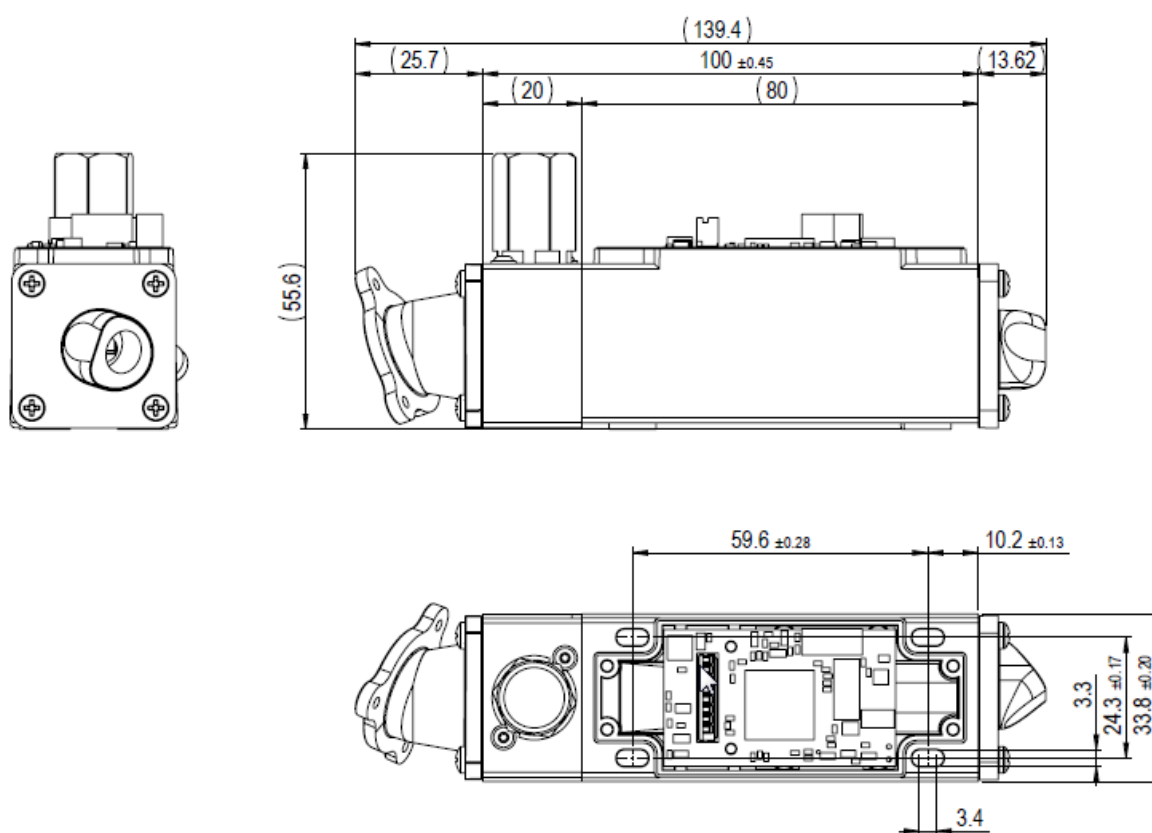


Figure 4: Physical dimensions of SFC5000-MGE. All units are in [mm]. Dimensions of inlet and outlet part are responsibility of the customer.

5 Ordering Information

Product	Article number
SFC5000-MGE	1-100983-01

Minimum packaging: 8 pcs per tray.

6 Revision history

Date	Version	Author	Changes
21 st Feb. 2012	0.1	RDO	Initial Preliminary version
4 th Mar. 2012	0.2	RDO	Included Valve material and flow body material
8 th Jan. 2013	0.3	DAT	Drawing Included; added valve type and updated wetted materials
08 th Feb. 2013	1.0	DAT	Ordering Information added
09 th April 2013	1.1	DAT	Changed figure 1, added revision number

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. 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 data sheet 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.
- SENSIRION is only liable for defects of this product arising under the conditions of operation provided for in the data sheet and proper use of the goods. SENSIRION explicitly disclaims all warranties, express or implied, for any period during which the goods are operated or stored not in accordance with the technical specifications.
- 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.

Copyright© 2001-2008, SENSIRION.

CMOSens® is a trademark of Sensirion

All rights reserved

RoHS and WEEE Statement

- The SFC5000-MGE complies with requirements of the following directives:
- EU Directive 2002/96/EC on waste electrical and electronic equipment (WEEE), OJ13.02.2003; esp. its Article 6 (1) with Annex II.

- EU Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS), OJ 13.02.2003; esp. its Article 4.

Headquarters and Sales Office

Sensirion AG
Laubisruetistrasse 50
CH-8712 Staefa ZH
Switzerland

Phone: + 41 44 306 40 00
Fax: + 41 44 306 40 30
e-mail: info@sensirion.com
Web: www.sensirion.com



Sales Office USA

SENSIRION Inc
Westlake Pl. Ctr. I, suite 204
2801 Townsgate Road
Westlake Village, CA 91361
USA

Phone: +1 805-409 4900
Fax: +1 805-435 0467
e-mail: michael.karst@sensirion.com
Web: www.sensirion.com

Sales Office Korea

Sensirion Korea Co. Ltd.
#1414, Anyang Construction Twr B/D
1112-1, Bisan-dong, Anyang-city
Gyeonggi-Province,
South Korea

Phone: +82 31-440-9925~27
Fax: +82 31-440-9927
e-mail: info@sensirion.co.kr
Web: www.sensirion.co.kr

Sales Office Japan

Sensirion Japan Co. Ltd
Representative Director: Keiichi Hasegawa
Shinagawa Station Bldg. 7F, 4-23-5, Takanawa,
Minato-ku, Tokyo, Japan

Tel : +81 3-3444-4940
Fax: +81 3-3444-4939
e-mail: info@sensirion.co.jp
Web: www.sensirion.co.jp

Sales Office China

SENSIRION China Co. Ltd.
Room 2411, Main Tower
Jin Zhong Huan Business Building,
Futian District, Shenzhen, PR China

Tel: +86 (755) 8252 1591
Fax: +86 (411) 82520100
e-mail: info@sensirion.com.cn
Web: www.sensirion.com.cn