Datasheet – SGM7001, SGM7002, SGM7004, SGM7006

Sensirion CMOSens® G1.6, G2.5, G4 and G6 Gas Flow Meter Modules

- Pressure independent & temperature compensated
- Automatic compensation for gas quality
- Accuracy ±1.5% – 3% m.v.
- Long-term reliability
- Low power consumption
- Zero offset, no drift

Product Summary

The SGM70xx sensors are Sensirion's digital gas flow meter modules designed for residential natural gas smart metering applications. They measure the **standard volume flow of natural gas independent of temperature and pressure.**

Gas meters with SGM70xx as core metrological unit can fulfill international accuracy and reliability standards defined in EN14236. The patented design of the flow channel and the patented pulsed measurement scheme ensure **robust and reliable flow measurements under demanding working conditions and under low power consumption**.

The automatic gas quality compensation mechanism assures **accurate measurements even with varying natural gas composition**.

The standard volume flow ("mass flow") output and I²C digital interface make this sensor highly suitable for **smart gas metering applications**.

The outstanding performance of these sensors is based on Sensirion's patented **CMOSens® Technology**, which combines the sensor element, signal processing and digital calibration on a single microchip.

The well-proven CMOSens® Technology, with several hundred thousand gas flow meters modules in the field, is perfectly suited for high-quality mass production and is an ideal choice for high-volume residential smart gas metering applications.

Applications

- Residential Smart Gas Metering

The sensor chip

The SGM70xx gas flow meter modules feature Sensirion's state-of-the-art CMOSens® flow chip. CMOSens® flow chips are qualified and produced by Sensirion to stringent automotive and medical standards.

The CMOSens® chip not only contains a thermal mass flow sensor element, but also the amplifier, A/D converter, calibration memory, digital signal processing circuitry, and interface. Due to seamless integration of signal acquisition and processing on the single silicon die, significant performance, reliability and cost benefits are achieved.

SGM70xx integration into a gas meter

Sensirion provides the SGM70xx module only. It is the responsibility of the customer to:

- Design and build the gas meter housing
- Ensure correct mounting of SGM70xx module in the gas meter housing
- Implement communication between SGM70xx module and gas meter electronics
- Fine-tune calibration of the gas meter in air only
- Test gas meter in air only

Every SGM70xx sensor is individually pre-calibrated, linearized and temperature compensated with air and a surrogate gas of methane. The automatic gas quality compensation can either be configured for measurements in H-gas or L-gas (configuration for L-gas under development).

The customer needs to fine-adjust meter calibration in air only. No further calibration or testing with natural gas on the customer side is needed. Sensirion provides consulting and support regarding fine-adjustment of calibration.

1. Sensor Performance[1]

Sensor performance is described for fine-adjusted product in template gas meter housing. Please note that a sensor built in customer meter housing can achieve inhere specified performance only after fine-adjustment procedure.

1.1 Specification of Flow Rates

		Unit	SGM7001	SGM7002	SGM7004	SGM7006
Q_{min}		slm [2]	0.267	0.416	0.67	1.0
		scmh [2]	0.016	0.025	0.04	0.06
Q_t		slm [2]	4.17	6.66	10	16.7
		scmh [2]	0.25	0.4	0.6	1
Q_{max}		slm [2]	41.67	66.7	100	167
		scmh [2]	2.5	4.0	6	10
$Q_{saturation}$[3]	neg. saturation	slm [2]	-9	-15	-24	-39
	pos. saturation	slm [2]	53	85	130	255
$Q_{overflow}$[4]			2 Q_{max}			
$Q_{reverse}$[5]			- 0.2 Q_{max}			
SNR[6] @ 0.25 Q_{min} (relevant for min. detectable flow rate)			10			

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[1] Sensirion guarantees specifications of the SGM70xx module only.

[2] slm: standard liter per minute; scmh: standard cubic meter per hour; conditions: T = 15°C and P = 1013 mbar.

[3] $Q_{stauration}$ is defined as minimum / maximum linearized flow output value of the SGM70xx module.

[4] $Q_{overflow}$ is defined as overflow that does not damage the SGM70xx module.

[5] $Q_{reverse}$ = maximum negative flow for which the initial accuracy applies as defined in Table *1.2 Physical specification*.

[6] Signal to noise ratio, $SNR = \frac{Mean\ Signal\ Amplitude}{Std.\ Dev.\ Signal\ Amplitude}$

1.2 Physical specifications

Parameter	Description	Value	Unit
Temperature	Operating Temperature	-25 to 55	°C
	Storage Temperature	-30 to 60	°C
Humidity	Operating humidity of the medium in the gas meter when medium is air (testing purposes)	35 – 75	% RH
	Operating Humidity of the medium in the gas meter when the medium is natural gas	0 – 40	% RH
	Storage Humidity (in Air)	35 – 85	% RH
Initial accuracy[7] (for T = 15°C)	Flow range: $Q_{reverse} \le Q \le -Q_{min}$	+/-10	% m.v.[8]
	Flow range: $-Q_{min} < Q < Q_{min}$	*Not defined*	
	Flow range: $Q_{min} \le Q < 0.1Q_{max}$	+/- 3.0	% m.v.[8]
	Flow range: $0.1Q_{max} \le Q \le Q_{max}$	+/- 1.5	% m.v.[8]
	Flow range: $Q_{max} < Q$	*Not defined*	
Initial pressure drop of SGM70xx module without Meter-Housing	Pressure drop at Q_{max}	<1.5	mbar in air

1.3 Initial accuracy over temperature[7]

For meters with temperature compensation, the European standard EN14236 allows additional +0.5 % m.v. in the temperature range 0° – 30°C. Outside 0° – 30°C, the standard allows additional +0.5 % m.v./10°C. The initial accuracy values over temperature are listed in the table below. Please note that the specified values are valid only after fine-adjustment with assembled meter has been performed.

Flow range			MPE			
			-30°C ≤ T < -20°C	-20°C ≤ T < -10°C	-10°C ≤ T < 0°C	0°C ≤ T ≤ 30°C
	Q	< Q_{min}	*Not defined*	*Not defined*	*Not defined*	*Not defined*
$Q_{min} \le$	Q	< $0.1 \cdot Q_{max}$	±5% m.v. [8]	±4.5% m.v. [8]	±4% m.v. [8]	±3.5% m.v. [8]
$0.1 \cdot Q_{max} \le$	Q	$\le Q_{max}$	±3.5% m.v. [8]	±3% m.v. [8]	±2.5% m.v. [8]	±2% m.v. [8]
$Q_{max} <$	Q		*Not defined*	*Not defined*	*Not defined*	*Not defined*

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[7] One measurement value is specified for an average of at least ten consecutive acquisitions. The value measured with a single acquisition (one single data acquisition) may be outside the specified accuracy range.

[8] In % of measured value (m.v.) = of rate = of reading

Flow range		MPE			
		0°C ≤ T ≤ 30°C	30°C < T ≤ 40°C	40°C < T ≤ 50°C	50°C < T ≤ 60°C
Q	< Q_{min}	*Not defined*	*Not defined*	*Not defined*	*Not defined*
$Q_{min} ≤$ Q	$< 0.1 \cdot Q_{max}$	±3.5% m.v. [8]	±4% m.v. [8]	±4.5% m.v. [8]	±5% m.v. [8]
$0.1 \cdot Q_{max} ≤$ Q	$≤ Q_{max}$	±2% m.v. [8]	±2.5% m.v. [8]	±3% m.v. [8]	±3.5% m.v. [8]
$Q_{max} <$ Q		*Not defined*	*Not defined*	*Not defined*	*Not defined*

1.4 Repeatability

Repeatability at static flow conditions of subsequent measurements[7].

Parameter	Description	Value	Unit
Flow range	$Q < Q_{min}$	*Not defined*	
	$Q_{min} ≤ Q < 0.1Q_{max}$	1	% m.v. [8]
	$0.1Q_{max} ≤ Q ≤ Q_{max}$	0.5	% m.v. [8]
	$Q_{max} < Q$	*Not defined*	

1.5 Temperature compensation

The sensor element features internal temperature compensation for calibrated gases.

1.6 Media compatibility

- Air
- Natural gas (consisting of CO_2, N_2, H_2, CH_4, C_2H_6, C_3H_8, iso-C_4H_{10}, n-C_4H_{10}, iso-C_5H_{12}, n-C_5H_{12}, C_6H_{14})

2. Electrical Specifications
2.1 Operating voltage

Parameter	Description	Value	Unit
Operating voltage	Required voltage supply to fulfil specifications	3.1 – 3.6	Vdc
	Allowed supply voltage	2.7 – 3.6	Vdc
Average current consumption (approx.)[9]	Sensor module SGM70xx	20 – 30	µA

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[9] Exact current consumption depends on the exact electronic host environment.

2.2 Interface

Digital 2-wire interface (standard I2C) with bus clock frequency of 100 kHz (Maximum 400 kHz)

Default I2C address: 64 (binary 1000 000)

2.3 Electromagnetic compatibility (EMC)

To be tested within the final gas meter product.

2.4 Preventions against electrostatic discharge (ESD)

The inherent design of this component causes it to be sensitive to electrostatic discharge (ESD). To prevent ESD-induced damage and/or degradation, take common and statutory ESD precautions when handling this product.
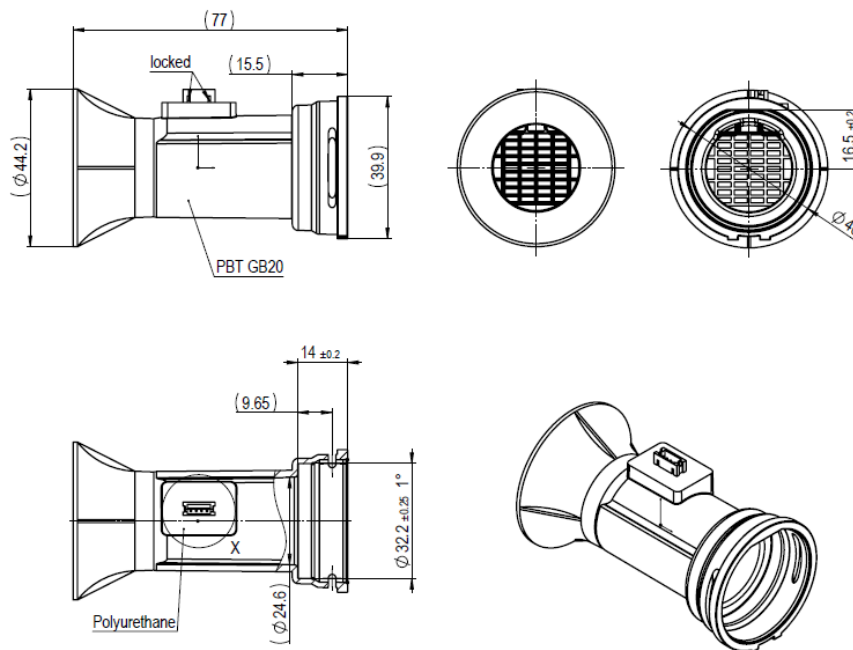
3. Mechanical Specifications

3.1 Mechanical dimensions SGM7001 and SGM7002
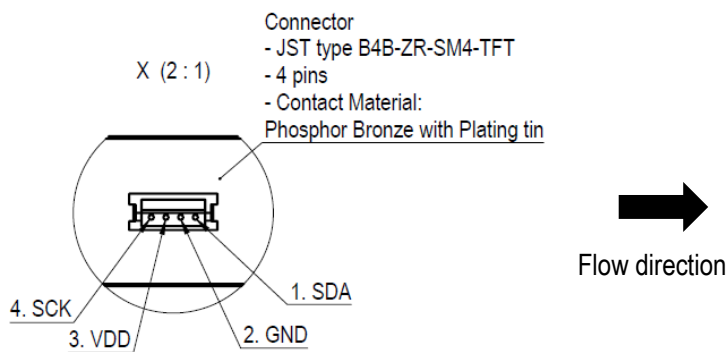
Dimensions are given in mm.
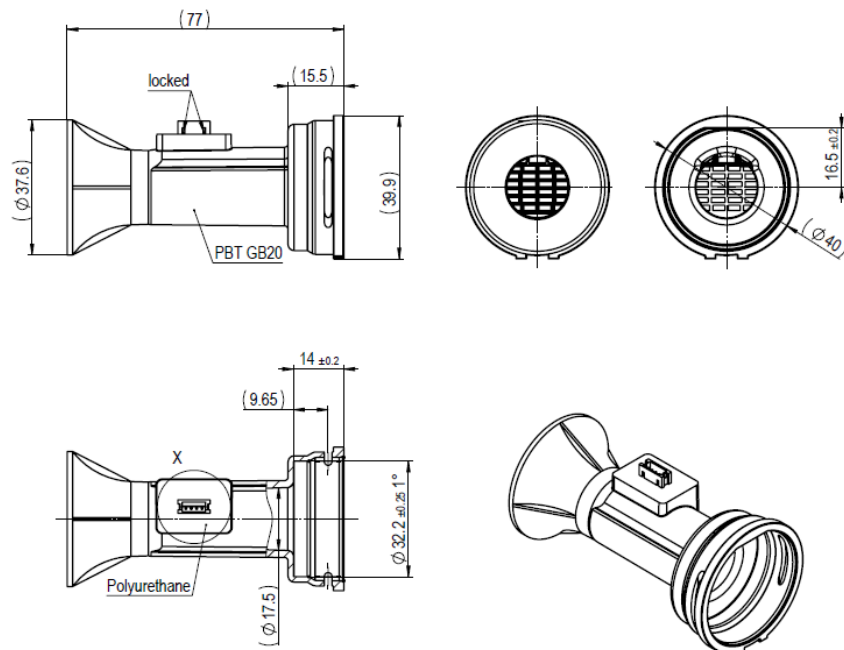
3.2   Mechanical dimensions SGM7004 and SGM7006

Dimensions are given in mm.

3.3   Electrical connector

Connector type: JST-B4B-ZR-SM4-TFT:

X (2 : 1)

Connector
- JST type B4B-ZR-SM4-TFT
- 4 pins
- Contact Material:
Phosphor Bronze with Plating tin

4. SCK
3. VDD
2. GND
1. SDA

Flow direction

3.4   Assembly into gas meter

Sensirion delivers SGM70xx modules only (see the images below only for illustration purposes, design-in is customer's own responsibility). Dimensions are given in mm.

The SGM70xx module is held in place by an O-ring and a metal fixation clip. The O-ring and the fixation clip are not supplied by Sensirion.

Note: the correct function and performance of the SGM70xx module depends on the design and assembly of the gas meter housing. Sensirion AG provides specialized consulting for the integration of SGM70xx into the customer-specific gas meter housing.
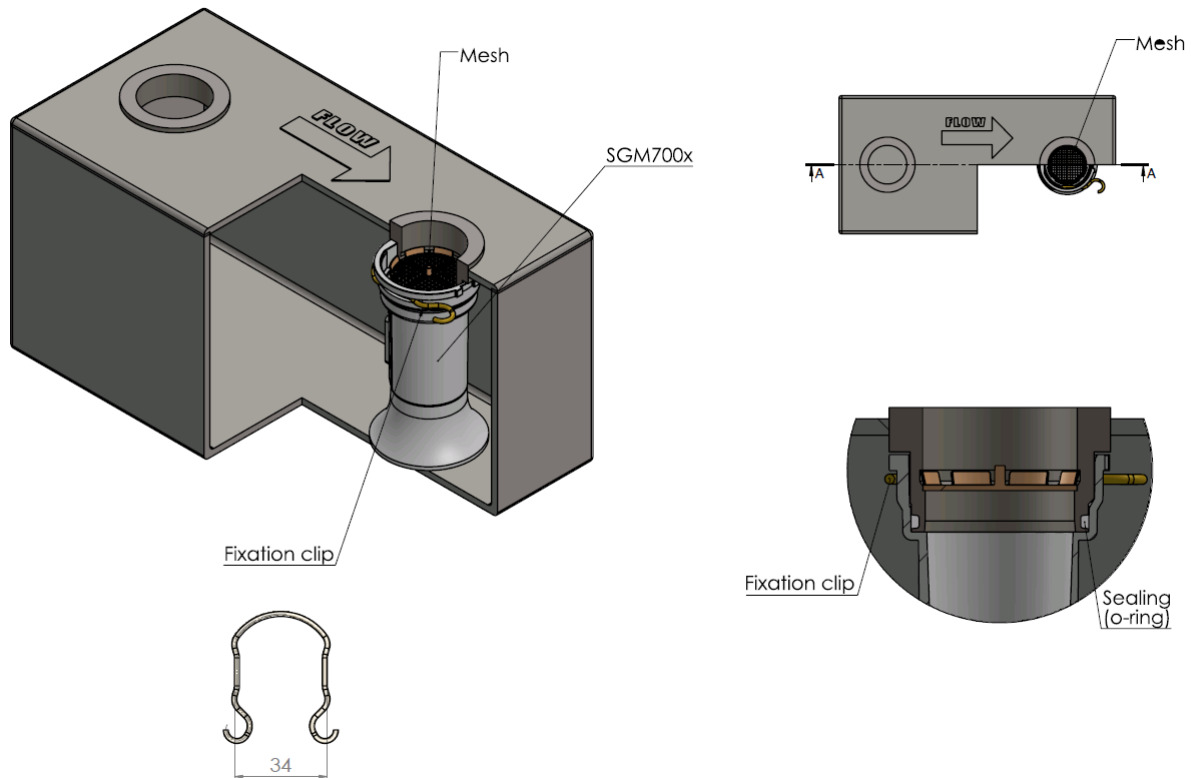
3.4.1   Mounting place

SGM70xx modules are designed to be placed at gas meter outlet.

3.4.2   Mesh at SGM module

Sensirion recommends including a mesh at the outlet (and preferably also at the inlet) of the gas meter to prevent large particles (e.g. screws or nuts) from entering the meter housing.

3.4.3   Mounting restrictions

During or after assembly of the gas meter mechanical stress to SGM70xx module has to be avoided. The mounting has to be in a way that constant gas intake conditions are guaranteed.

3.4.4   Mounting orientation

Recommended vertical, with upwards flow. Connector PINs oriented towards inlet port. Other mounting orientations are possible. For more information please contact Sensirion.

3.5   SGM70xx Housing Material

Plastic: PBT (polybutylene terephthalate)

3.6   Wetted Materials

- SGM70xx housing material (defined in 3.5)
- glass (silicon nitride, silicon oxide)
- silicon
- FR4
- Polyurethane (PUR)
- epoxy
- copper alloy
- Nylon, tin plated phosphor bronze, PBTP

3.7 **Weight**

SGM7001 and SGM7002: less than 25 g.
SGM7004 and SGM7006: less than 30 g.

4. Instructions for Use

In order to ensure proper functioning of SGM70xx within the gas meter, Sensirion AG provides specialized consulting for the integration of SGM70xx into the customer-specific gas meter housing. For further instructions, please contact us directly.

Revision history

Date	Author	Version	Changes
09.10.2015	MOM	1.0	First release of combined datasheet for SGM70xx.

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.

SENSIRION is only liable for defects of this product arising under the conditions of operation provided for in the datasheet 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. No obligation or liability shall arise or grow out of Sensirion's rendering of technical advice, consulting, or advice in connection with the design configurations of the gas meter housing. 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. The design configurations of SGM 700x sensor module in gas meter housings shown in this document are for illustration purposes only. The design-in and design-in configuration of SGM 700x sensor modules into gas meter products is customer's own responsibility.

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.

This datasheet replaces and invalidates all previously released datasheets of SGM7001, SGM7002, SGM7004 and SGM7006.

REACH and RoHS Statement

The SGM70xx sensor complies with requirements of the following directives:

- EU Directive 1907/2006/EC concerning Registration, Evaluation,

Authorization and Restriction of Chemicals (REACH)

- EU Directive 2002/65/EC on the restriction of certain hazardous substances in electric and electronic equipment (RoHS), OJ01.01.2011

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