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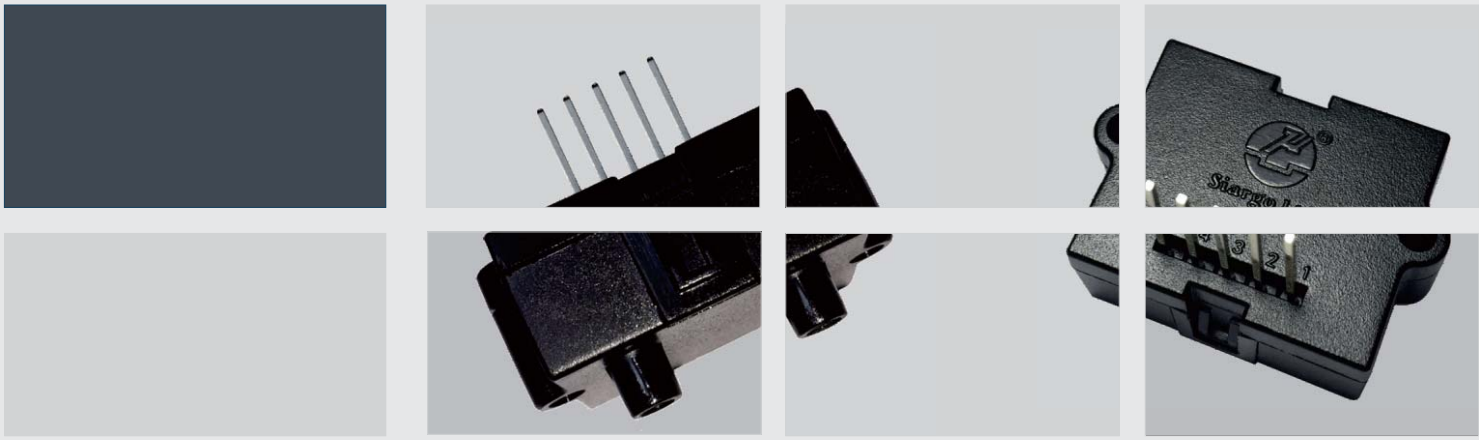

Model FSP1000

SIARGO MEMS FLOW SENSING PRODUCTS

MEMS digital differential pressure sensor

VA.6

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MEMS Digital Differential Pressure Sensor

FSP1000 Series

User Manual

Document No. 07-2019-P1 EN
Issue date: 2019.07
Revision: VA.6

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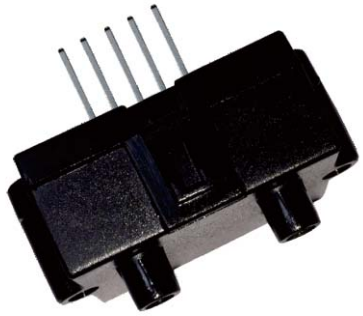
MEMS Digital Differential Pressure Sensor

Model FSP1000

Siargo Ltd.

Features

- Designed for applications in HVAC and CPAP equipment
- High sensitivity at low differential pressure
- Temperature compensated and altitude independent
- Digital and analog linear output with fast response time
- Small form factor and low power consumption



1. Sensor Performance

1.1 Performance Specifications

All data unless otherwise noted apply for measurement conditions: air, 20 °C, 101.325 kPa absolute pressure, in a fixed flow channel of 8mm in diameter.

Pressure range [1]	2~50 or ±(2~50)	2~100 or ±(2~100)	5~250/500 or ±(5~250/500)	Pa
	0.008~0.2 or ±(0.008~0.2)	0.008~0.4 or ±(0.008~0.4)	0.02~1.0/2.0 or ±(0.02~1.0/2.0)	inch H_2O
Power supply	3.0 ~ 3.6 Vdc, 10 mA			
Output	Linear, Analog / I^2C			
Output volatage	0.4 ~ 2.4			Vdc
Output resolution	Analog - 12 bit / I^2C - 14 bit			
Output pin	5 Pin header			
Response time	20			msec
Pneumatic flow resistance	<95 ml/min @500Pa			
Span accuracy [2]	±(2.0+0.8FS)	±(2.0+0.5FS)	±(2.0+0.5FS)	%
Span repeatability	±0.5			%
Span temperature shift	<1.6			% /10°C
Compensated temperature	-5 ~ +65			°C
Offset tolerance	±0.5			Pa
Offset long term stability	0.1			Pa/year
Offset repeatability	±0.1			Pa
Altitude correction	Null, fully compensated			
Storage temperature	-40 ~ +85			°C
Pressure rating	2.0			bar
Humidity	0 ~ 100 (no condensation)			%RH
Warming up time	<500			msec
Vibration	20g; MIL-STD-883E, Method 2002.4.			
Compliance	RoHS and REACH			

Note: 1. Customizable flow range and others are available upon requests.
2. FS means the full scale of one direction.

1.2 Flow Characteristics

The FSP1000 provides a linear analog output. The typical output characteristics of FSP1000-250 illustrated in Figure 1.1. The data are obtained at 3.0 Vdc supply.

Differential pressure	Typical analog output
Pa	mV
-250	400
-200	600
-150	800
-100	1000
-50	1200
0	1400
50	1600
100	1800
150	2000
200	2200
250	2400

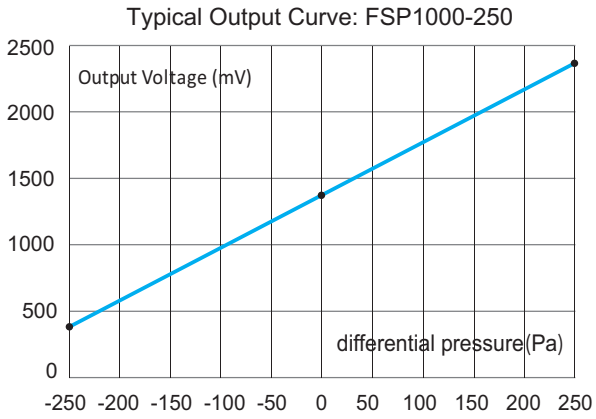
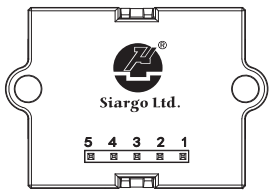


Figure 1.1: The typical analog output curve

2. Electrical Interface

2.1 Pin Definition

The FSP1000 provides a 5-pin electrical interface. The sensor pin configuration is shown in Figure 2.1.



Pin #	Definition
1	SDA (I2C)
2	Analog output (+)
3	Power supply (+)
4	GND, ground (-)
5	SCL (I2C)

Figure 2.1: Pin configuration.

2.2 Pin Description

VCC and **GND**: The FSP1000 requires a power supply of 3.0 ~ 3.6 Vdc. The voltage is internally filtered and regulated to power the circuit. The sensor consumes less than 10 mA normally but the minimum supply current must be larger than 10 mA for stable performance.

Vout: The analog output pin.

SDA and SCL: For I^2C, please contact Siargo for protocol.

2.3 Accessary

An output cable can be chosen to fit the pin out. Part number: SN5-50, this is a 5-pin single row connector (NS-Tech CD H-5) cable at 50 cm long, the opposite end is color-coded wires. The cable definition is shown in Figure 2.2.

Cable Pin #	Color
1	Blue
2	Green
3	Red
4	Black
5	Yellow

Figure 2.2: Cable definition

3. Mechanical Dimensions and Mountings

The FSP1000 provides two mounting holes for easy installation. Be sure to use the sensor by current direction.(P1 is inlet and P2 is outlet of the gases.) The sensor dimensions are shown in Figure 3.1.

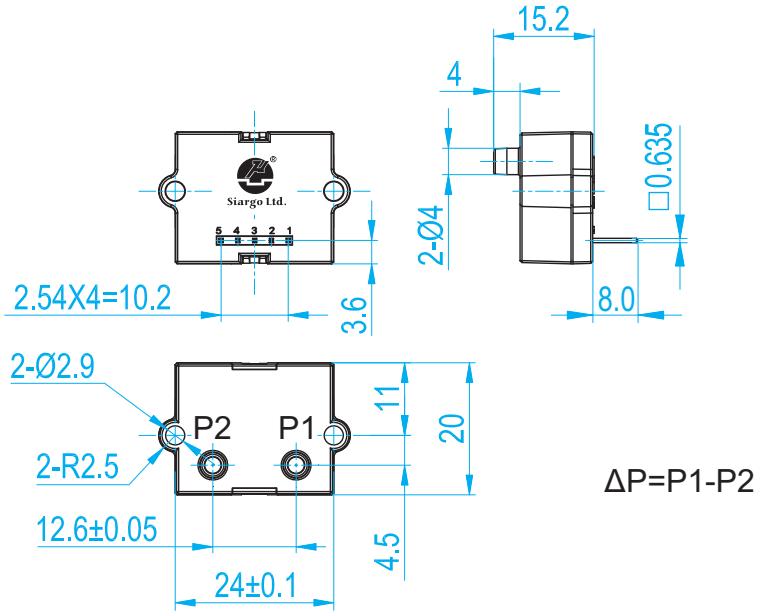


Figure 3.1: Mechanical dimensions.

4. Ordering Guide

4.1 Sensor Selection

The sensor part number is composed of the model number and output format. Refer to the followings for details.

FSP1000 – □ – □ – □

- □ (third): Pressure Direction (U - unidirectional, B - bidirectional)
- □ (second): Output[2] (E - I²C; EV - Analog and I²C)
- □ (first): Differential pressure range (selectable: 50, 100, 250 and 500)

1 Differential pressure range number only, for example, 250 meaning differential pressure range of 250 Pa.
2 The sensor shipped with I²C. Analog output is optional.

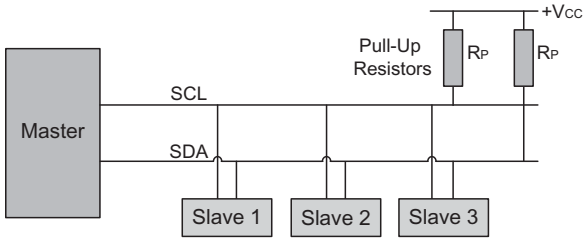
4.2 Order Contact and Customer Support

The sales offices are listed at the end of this document. For small quantities, the order can be placed either through Siargo website: www.siargo.com or the sales office. For large quantities, please contact the sales office or distributors or sales representatives.

Siargo is making every effort to ensure the quality of the products. In case of questions and/or product supports, please contact customer service listed at the end of the document. We will respond your request in a timely fashion and will work with you toward your complete satisfaction.

5. I²C Communication

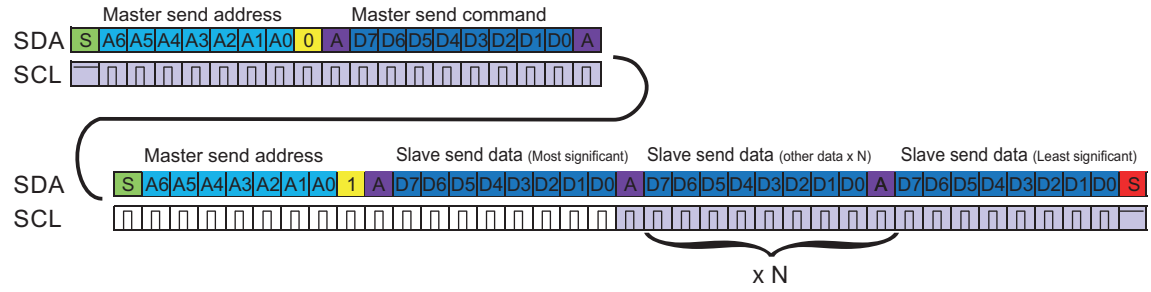
5.1 I²C Connection



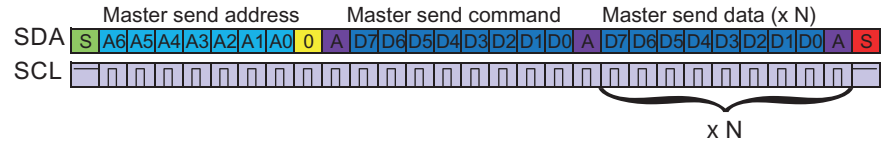
Vcc: 3.0 ~ 5.5 Vdc
Rp: 1.0 ~ 10.0 kΩ
I²C bus clock frequency: 100 kHz

5.2 I²C Read and Write Sequences

I2C Read



I2C Write



Notes

Bit	Name	Description
S	Start bit	Master pulls SDA from high to low while SCL remains high.
S	Stop bit	Master allows SDA to float from low to high while SCL remainshigh.
A	ACK	
1	Read(1Bit)	
0	Write(1Bit)	
A6	Address	7 bits, the 7 Most Significant bits of the first transmitted byte. Default address 1 (0000 001x) .
D7	Data bit	8 bits

5.3 I²C Commands description

Command Byte (Hex)	Length	Command Name	Read / Write	Notes
05H	1	Write the I²C address	W	Bit7 ~ Bit1 can be set *
0BH	1	Write the filter depth	W	Int8, 0~254
1CH	1	Calibration the offset of flow rate	W	1 byte, ensure **NO** flow in the pipe
82H	12	Read the sensor SN	R	ASCII
83H	4	Read the flow rate	R	Int32/1000 Pa
85H	1	Read the I²C address	R	Bit7 ~ Bit1
8BH	1	Read the filter depth	R	Int8, 0~254

* The address is set with Bit7~Bit1. For instance, sensor I²C address 4, write address will be 0x08 (0000 1000) , while read address will be 0x09 (0000 1001).

Important Notices

Wetted Materials and Compatibility

The sensor body is made of polycarbonate. The sensor chip comprises of silicon, silicon nitride and silicon dioxide and the sensor chip surfaces are passivated with silicon nitride and silicon dioxide. The electronic sealing is provided by RTV (room temperature vulcanizing) silicone sealant WR-704 composed of $HOCH_3(SiO)_nCH_3H$.

Cautions for Handling and Installations

The product at the time of shipment is fully inspected for product quality and meets all safety requirements. Additional safety measures during handling and installation should be applied. To prevent ESD (electrostatic discharge) damage and /or degradation, take customary and statutory ESD precautions when handling. Do power the product with the correct polarity, voltage & amperage. All precautions and measures for electrical voltage handling must apply. The product sealing is ensured to work under working pressure of 0.5 MPa and is leakage proof before the shipment. But cautions and further leakage test are important at installation as well since any leakage could cause severe safety issue.

This product contains no user serviceable components. Do not attempt to disassemble, substitute parts or perform unauthorized modifications to the product. Doing so will forfeit the terms of the warranty and cause the liability to any damages thereafter. It should only be serviced by authorized personnel. Upon requests, Siargo will provide necessary technical support and/or training of the personnel.

Cautions for Product Applications

The product is designed for use with general purpose gases such as air and nitrogen. It is advised that the products are best used for non-explosive clean gases. The sensors cannot be used for gas metrology of fluoride or fluoride-containing gases. For updates of the product certification information, please contact the manufacturer. Use for other gases such as extreme corrosive and toxic may cause the product malfunctioning or even severe damages.

Don't expose the product's electronics other than the inner flow channel to any liquids, the unit does not have a water proof electronics. Don't flow gas in conditions that can cause condensing water vapor to be trapped inside the unit during operation as the accuracy could be significantly influenced.

Warranty and Liability

(Effective January 2010)

Siargo warrants the products sold hereunder, properly used and properly installed under normal circumstances and service as described in this user manual, shall be free from faulty materials or workmanship for 180 days for OEM products, and 365 days for non-OEM products from the date of shipment. This warranty period is inclusive of any statutory warranty. Any repair or replacement serviced product shall bear the same terms in this warranty.

Siargo makes no other warranty, express or implied and assumes no liability for any special or incidental damage or charges, including but not limited to any damages or charges due to installation, dismantling, reinstallation or any other consequential or indirect damages of any kind. To the extent permitted by law, the exclusive remedy of the user or purchaser, and the limit of Siargo's liability for any and all losses, injuries or damages concerning the products including claims based on contract, negligence, tort, strictly liability or otherwise shall be the return of products to Siargo, and upon verification of Siargo to prove to be defective, at its sole option, to refund, repair or replacement of the products. No action, regardless of form, may be brought against Siargo more than 365 days after a cause of action has accrued. The products returned under warranty to Siargo shall be at user or purchaser's risk of loss, and will be returned, if at all, at Siargo's risk of loss. Purchasers or users are deemed to have accepted this limitation of warranty and liability, which contains the complete and exclusive limited warranty of Siargo, and it shall not be amended, modified or its terms waived except by Siargo's sole action.

This warranty is subject to the following exclusions:

(1) Products that have been altered, modified or have been subject to unusual physical or electrical circumstances indicated but not limited to those stated in this document or any other actions which cannot be deemed as proper use of the products;

(2) Siargo does not provide any warranty on finished goods manufactured by others. Only the original manufacturer's warranty applies;

(3) Products re-sold to the third parties.

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Appendix: Revision History

Revision A.6 (July 2019):

- Revised the Mechanical Dimensions (*3. Mechanical Dimensions and Mountings*).

Revision A.5 (July 2018):

- Corrected Response time, Span temperature shift and Warming up time. (*1.1 Performance Specifications*).
- Revised the I^2C Sequences and I^2C Commands description (*5.2 I^2C Read and Write Sequences* and *5.3 I^2C Commands description*).

Revision A.4 (September 2017):

- Added the full scales of 50 and 100 Pa. (*1.1 Performance Specifications, 4.1 Sensor Selection*);
- Added the working current. (*1.1 Performance Specifications*).

Revision A.3 (July 2017):

- Added the unidirectional sensors. (*1.1 Performance Specifications, 4.1 Sensor Selection*);
- Added the revision history (*Appendix*).